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भारत सरकार
रेल मंत्रालय
(रेलवे बोर्ड)

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

भारतीय रेल
रेल पथ
नियमावली

INDIAN RAILWAYS
PERMANENT WAY
MANUAL

Second Reprint 2004

INTERNET VERSION - Embodying all advance correction slips upto number 100 dated 21-06-2006

FOREWORD

(to First Edition)

The "Indian Railways Way and Works Manual" incorporating uniform procedure and practices to be followed on Indian Railways was first published in 1954. With the introduction of modernization of track structure, Mechanical maintenance of track and introduction of high speed trains in seventies and thereafter, the provisions in the manual relating to track needed updating. This has now been done by bringing out a separate "Indian Railways Permanent Way Manual". It is hoped that the procedures and practices envisaged in the manual will help the Permanent Way men in maintaining the track to better standards, ensuring safety, economy and efficiency.

New Delhi,
Dated 17th July 1984

T. N. RAMACHANDRAN
Member/Engineering, Railway Board

PREFACE

(to First Edition)

The Indian Railways Way and Works Manual was last published in l967. Since then there have been considerable changes in the Track Standards, Maintenance practices and Track Monitoring. The Track Standards Committee had, *vide* **Item 678** of the **49th** Report, recommended the appointment of an Officer on Special Duty by the Railway Board for revising the Way and Works Manual. The Committee also recommended that the revised manual should be split into three separate parts, for Permanent Way, Bridges and Works.

Pursuant to the above recommendations of the T.S.C., the following three officers worked in succession as Officers on Special Duty and compiled this part of the manual dealing with Permanent Way :

Shri Y.G.Patwardhan	..	Mayl978 - August 1979.
Shri P. O. Thomas	..	August 1979 - January 1981.
Shri K. S. Swaminathan	..	March 1982 onwards.

The Draft Chapters, as compiled, were then scrutinised by a Select Committee consisting of the following Officers :-

Sarvashri		
Y.G.Patwardhan	..	Principal, IRIATT, Pune.
N.Gopalan	..	Director Standards, Civil, RDSO
Y. P. Anand	..	Director, Track, Railway Board.
J.S.Mundrey	..	Chief Track Engineer, N. Railway.
N.S.Raghavan	..	Chief Track Engineer, S. Railway.
Y. V.Aswathnarayana	..	Chief Track Engineer, E. Railway.
N.P.Ghose		

Shri K. S. Swaminathan, Officer on Special Duty and CPDE/South Central Railway acted as Member and Convenor of the Committee.

While revising the Manual, the provisions in the Indian Railway General Rules 1976, Indian Railways Code for the Engineering Department, 1982 *Edition* and the accepted recommendations of the Committee set up for Review of Track Standards for Broad Gauge and Metre Gauge have been taken into account.

The Manual of Instructions on LWR/CWR 1979, the Manual of Instructions on Directed Track Maintenance, and instruction manual on Measured Shovel Packing have been incorporated as Annexures to this Manual. The provisions of SWR Manual have been incorporated in the relevant chapters of the Manual as major portion of the track in the Indian Railways is on SWR track.

In a volume of this type, it is not possible to provide for every contingency that may arise during the course of the working, though every effort has been made to make the instructions comprehensive. The Chief Engineers of Zonal Railways may therefore supplement, where necessary, the practices and procedures contained herein with such further instructions/orders, as would suit local circumstances on their Railway. Such instructions must not of course contravene any of the provision in this manual, the codes of the various departments of the Railways, General Rules, or any of the statutory regulations in force.

The Railway Board will be glad to consider any comments and suggestion from Railway Administrations. Any errors or omissions found in this Edition may be brought to the notice of the Board.

New Delhi,
Dated 17th July 1984

TIRATH PRAKASH
Director, Civil Engineering Railway Board

FOREWORD TO FIRST REPRINT TO IRPWM (1986)

A separate “Indian Railways Permanent Way Manual” incorporating procedure and practices to be followed on Indian Railways after modernisation of the track commenced in the seventies was first published in 1986. It has been decided to reprint the existing IRPWM updating the same by incorporating all the Advance Correction Slips issued so far (i.e. Advance Correction Slip Nos. 1 to 27). It is hoped that this updated manual will help the Permanent Way Men in maintaining the track to prescribed standards.

New Delhi,
June 1999

(V. K. Agnihotri)
Member Engineering
Railway Board

PREFACE TO FIRST REPRINT TO IRPWM (1986)

A Separate “Indian Railways Permanent Way Manual” was published in 1986 pursuant to the recommendations of the 49th Track Standards Committee. With the passage of time, certain changes in Track Standards, maintenance practices, track monitoring, etc. have occurred and Advance Correction Slips have been issued from time to time. It was decided by the Railway Board to reprint the IRPWM incorporating all the Advance Correction Slips No. 1 to 27. Further, as a separate LWR Manual (1996) has already been published, Annexure-M2 of the IRPWM (1986) has been deleted.

Railway Board will be glad to consider any comments and suggestions from the Railway Administrations.

New Delhi,
June 1999

(N. C. Bindlish)
Additional Member Civil Engineering Railway Board

FOREWORD TO SECOND REPRINT TO IRPWM (1986)

"Indian Railways Permanent Way Manual" was published in the year 1986, as per the recommendations of the 49th Track Standards Committee. Thereafter, it was reprinted in the year 1999, incorporating Advance Correction Slip Nos. 1 to 27.

The present manual was issued in English only. It is now being issued in diglot form (Hindi as well as English) for the first time. This reprint incorporates Advance Correction Slips upto No. 93.

A Compact Diskett, containing the full content in PDF form has also been attached to the back cover. This will facilitate the viewing of the manual on a Personal Computer as well as for taking print, if considered necessary.

It is hoped, that this updated manual will help the Permanent Way men, in maintaining the track upto the prescribed standards.



New Delhi
May, 2004

(S.P.S. Jain)
Member Engineering
Railway Board

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CHAPTER I

DUTIES OF PERMANENT WAY OFFICIALS/ MEN

PART 'A'

Duties of Assistant Engineer/Assistant Divisional Engineer

101. General – The Assistant Engineer is generally responsible for the maintenance and safety of all way and works in his charge, for the accuracy, quality and progress of new works and control over all expenditure in relation to budget allotment.

102. Essential Duties of Assistant Engineer– The duties of the Assistant Engineer are detailed in various chapters of the Indian Railways Permanent Way Manual, the Indian Railway Works Manual and the Indian Railway Bridge Manual, the most essential being :

(1) Inspection and maintenance of track and all structures in a satisfactory and safe condition;

(2) Preparation of plans and estimates; execution and measurement of works including track works;

(3) Verification of stores held by stock-holders;

(4) Submission of proposals for inclusion in the track renewal programme, revenue budget and the works programme.

103. Knowledge of Rules and Regulations– He shall observe the rules and procedures laid in the General and Subsidiary Rules, The Indian Railways Permanent Way Manual, The Indian Railway Works Manual, The Indian Railway Bridge Manual, the Engineering Code and other departmental codes and orders and circulars issued from time to time relating to his duties. He shall ensure that all the staff under him are acquainted with the relevant rules and working methods connected with their duties and that they perform their allotted duties.

104. Co-ordination with Officials of other Departments – The Assistant Engineer should co-operate effectively with officers and staff of other departments in matters that warrant co-ordination.

105. Inspection by Higher Officials – (1) When the Assistant Engineer has to accompany a periodical or special inspection such as that of the Territorial Heads of Departments, the Chief Engineer, the General Manager, the Commissioner of Railway Safety or any officer of the Railway Board, he should have with him the undermentioned drawings and registers for reference as required-

(a) Permanent Way diagrams of the section and of station yards.

(b) Index plans and sections.

(c) The bridge inspection register.

(d) Plans and current files of important works recently completed, on hand and proposed.

(e) Progress reports on works, and any other papers and plans that are likely to be required for discussion.

(f) Working time table.

(g) Inspection notes of higher officers and compliance reports.

(2) All Inspection notes should receive prompt attention within a reasonable time.

106. Inspection by Assistant Engineer – The Assistant Engineer shall conduct inspection in his jurisdiction as per the Schedules laid down by the Administration from time to time. He should maintain the records of the results of his inspection and ensure compliance of the instructions within a reasonable time. He should submit to the Divisional Engineer copies of the inspection diagram at the end of every month indicating the inspection carried out during the month.

107. Inspection of Permanent Way – The important inspections to be carried out by the Assistant Engineer are summarised below :

(1) *Trolly Inspection* – The entire Sub-division, should be inspected by trolley once a month, as much inspection as possible being done by push trolley. The entire Sub-division, in case of double and multiple lines shall mean all individual lines. The inspection by trolley should be intensive, which should include checking of attendance of gang, gang work and equipment and examination of gang charts/diary books with reference to the prescribed schedule of track maintenance. During his inspection, he should check the work done by one or two gangs in each P.W.I's jurisdiction and record the results of his inspection.

(2) *Fast Train Inspection* – The entire sub-division should be covered by Engine (foot plate) or by last vehicle (Brake-van or Inspection Carriage) of a fast train once in a month.

(3) *Inspection of Level Crossings* – He should inspect all the manned level crossings once in six months. He should examine the Gatemen's knowledge of rules, check the equipment, track, road approaches and all other safety aspects.

(4) *Checking of curves* – The Assistant Engineer shall check at least one curve in each P. W. I.'s jurisdiction every quarter by verifying its versine and super-elevation.

(5) *Checking of Points and Crossings* – He shall inspect once a year all points and crossings on passenger lines and 10 percent of the points and crossings on other lines.

(6) *Monsoon Patrolling* – When Monsoon Patrolling is introduced he should check the work of Patrolman at night once in a month, either by Train or Push Trolley or Motor Trolly.

(7) *Track on Bridges* – The track on Girder Bridges should be inspected as a part of the annual Bridge inspection, besides normal track inspections.

(8) *Scrutiny of Registers during Inspection* – He should scrutinise the registers maintained by P W I, such as Creep register, Curve register, Points and Crossing register, SEJ and Buffer rail register, Gap Survey register and Section register during his regular trolly inspection, to see whether the schedules of inspection are being adhered to by the Inspectors, and whether the necessary follow up action has been taken.

(9) *Inspections of L W R / C W R Track* – The Assistant Engineer shall inspect the SEJs/Buffer rails provided in the L W R / C W R track once in every six months. He shall check the creep records of L W R / C W R regularly. The duties of the Assistant Engineer with reference to the maintenance of L W R / C W R are detailed in **L W R Manual.**

108. Execution of Works – (1) *General* – The Assistant Engineer should ensure that all works are carried out according to plans and specifications laid down.

Important works should be set out personally by the Assistant Engineer.

Every works should be efficiently organized and so programmed that it progresses speedily and is completed within the time specified. Periodical progress reports on works should be submitted to the Divisional Engineer on prescribed forms.

(2) *Track Renewals* – (a) The Assistant Engineer shall examine the track at the kilometrages where renewals are required before submitting proposals to the Divisional Engineer for inclusion in the Preliminary works programme.

(b) Every sanctioned renewal work should be programmed in detail and labour organized in an efficient manner. Level and centre line pegs given by the Inspector should be test-checked by the Assistant Engineer.

109. Measurement of Ballast – In the Open Line Organisation, the Assistant Engineer may either measure and record the measurements of ballast himself or carry out 100 per cent check on quality and quantity, if the measurements are recorded by Inspectors.

In the case of construction projects, the measurements and classification of Ballast will be done by the Assistant Engineer himself.

110. Action in case of Emergencies – In the case of an accident, including a breach, affecting the running of trains, he should proceed to the site by the quickest available means. On the way, he should ascertain the requirements of materials and men at site and arrange for the same. He should also order for the Accident Relief Equipment as necessary. He should take all possible measures to restore the traffic quickly.

111. Accompanying Track Recording/ Oscillograph Cars – The Assistant Engineer should accompany the Track Recording/ Oscillograph Car runs in his jurisdiction and take down notes regarding the spots needing attention, and issue instructions for rectifying the defects after the run.

112. Control over Expenditure– The Assistant Engineer shall exercise due care in passing requisitions for materials and tools and in the execution of new and maintenance works, ensuring in all cases that the expenditure is within the allotment or provision in the sanctioned estimate.

113. Training of Probationers – The Assistant Engineer should interest himself in all probationers sent to him for training and see that the training is given according to the specified programme. He should periodically examine the notes made by them.

114. Witnessing Payment to Staff– The Assistant Engineer should witness payments to workmen (labour) under one or more Inspector each month. This should be done without warning.

115. Inspection of Office and Stores of Inspectors (a) - The Assistant Engineer shall carry out an inspection of each Inspector's Office and Stores at least once a year.

When checking stores, he should pay particular attention to the imprest and its distribution, Engineering indicators, protection equipment and important items in stores.

(b) The Assistant Engineer shall carry out inspection once in six months of all the small machines including light duty (Chinese type) tampers under the charge of the Inspectors for proper upkeep and good running condition by PWIs.

116. Staff matters – The Assistant Engineer will ensure, that :

(1) strict discipline is maintained within the frame work of the rules;

(2) service and leave records are maintained correctly and up-to-date;

(3) appeals and representations are dealt with promptly;

(4) selection for the various posts like Mates and Keymen are made in time and the posts promptly filled up;

(5) all the Inspectors and other staff working under him receive proper training in maintenance practices, safety and protection rules at the appropriate stage.

117. Relinquishment of charge – (a) Instructions on "Transfer-of-charge" are contained in **Paras 143 & 144** of the Indian Railway Code for the Engineering Department.

The Assistant Engineers handing over/taking over should carry out joint inspections of such works or lengths of track as necessary.

The Assistant Engineer taking over shall test check the balance of ballast, rubble-stone, boulders and bricks in depots and tools and plants as also the along-side collections of ballast. He shall also examine all registers of the sub-division, dockets of rules and orders in vogue and important current files and initial them with the date of inspection

(b) The "Transfer-of-charge" statement should be prepared in triplicate and signed by both the Assistant Engineers and two copies sent to the Divisional Engineer who will forward one copy to the Chief Engineer.

Errors and discrepancies which are noticed should be recorded in the statement and the Divisional Engineer's special attention invited to them.

PART ' B'

DUTIES OF PERMANENT WAY INSPECTORS/ SECTION ENGINEER(P.WAY)

Duties of Permanent Way Inspectors (in overall charge)

118. General Responsibility – The Permanent Way Inspector is generally responsible for :

(1) Maintenance and inspection of track in a satisfactory and safe condition for traffic.

(2) Efficient execution of all works incidental to track maintenance, including track relaying works.

(3) Accountal and periodical verification of stores and tools in his charge.

(4) Maintenance of land boundaries between stations and at unimportant stations as may be specified by the administration.

119. Knowledge of Rules and Regulations– (1) Every Permanent Way Inspector shall have in his possession up-to-date copies of the following codes and manuals with all correction slips up-to-date –

(i) Indian Railways Permanent Way Manual, Bridge Manual and Works Manual.

(ii) Indian Railway General and Subsidiary Rules.

(iii) Indian Railway Track Manual.

(iv) Indian Railway Code for the Engineering Department.

(v) Schedule of Dimensions.

(vi) Circulars issued by the higher authorities.

(2) He shall be well acquainted with the rules, regulations and procedures concerning his work and duties as enjoined in the above codes and manuals. He shall keep himself in touch with the orders and circulars issued by higher authorities from time to time and efficiently act upon them.

(3) He shall ensure that all staff working under him are well acquainted with the relevant rules and working methods and efficiently perform their duties.

120. Co-ordination with Works, Bridge and Staff of other Departments – The Permanent Way Inspector should keep close co-ordination with the Works, Bridge, Signalling and Electrical Staff, when they are required to work jointly.

121. Keeping of Materials – The Permanent Way Inspector shall see to the security of rails, chairs, sleepers and other materials in his charge and ensure that unused materials are stacked properly clear of the line, so as not to interfere with the safe running of trains.

122. Accompanying on Inspections of Higher Officials – (1) When the Permanent Way Inspector accompanies a periodical or special inspection by the higher officials he should have with him the following registers and documents pertaining to his section, other than the codes and manuals mentioned in **para 119 :**

(a) Working Time Table.

(b) Permanent way diagrams of section and yards.

(c) Section register.

(d) Results of track recording / oscillograph runs.

(e) Creep and gap survey register.

(f) Curve register.

(g) Points and crossing register.

(h) SEJ / Buffer rail register.

(j) List of Permanent and Temporary speed restrictions.

(k) List of works and other details.

(l) Inspection notes of higher officials with compliance notes.

(2) The Permanent Way Inspector shall arrange to carry the following measuring devices on these inspections :

(a) Gauge-cum - level.

(b) Flangeway gauge.

(c) Canne-a-boule or wooden mallet.

(d) Fishing cord.

(e) Tape.

(f) Metric scale.

(g) Tapered gauge.

(h) Magnifying glass and mirror.

(j) Versine measuring equipment.

(k) Inspection hammer.

123. Testing of Running Qualities of Track– (1) The Permanent way Inspector shall devote sustained attention to Permanent way as regards safety, smooth running, economy and neatness.

(2) He should travel on the foot plate of the Engine of fast trains at least twice in a month, in the rear brake-van or the last vehicle once in a month and take down notes of bad running kilometrages, and get them rectified.

(3) He should accompany the track recording/ oscillograph car runs over his section, take down the kilometrages which are not running well and take action to rectify the defects.

(4) He should observe the behaviour of track under passing trains to detect inadequate packing during routine inspections.

124. Routine inspection of Track –

(1) *Inspection of Gangs*-(a) The Permanent Way Inspector should inspect the entire section by push trolly at least once in a fortnight or more often as necessary.

(b) In sections where no separate inspection is being carried out by P. W. I. Grade II/ Grade III, the inspection should be carried out by the P. W. I. in-charge every week.

(c) During such inspections the Permanent Way Inspector should –

(i) check the work of gang done earlier and ensure prompt action on items requiring attention;

(ii) arrange to give the programme of work to the gang;

(iii) record details of track maintenance work in gang chart and diaries;

(iv) check the attendance of gang;

(v) instruct men in methods of maintenance.

(d) Once a fortnight, he should examine the small machines including light duty (Chinese type) tampers under his charge and once in a month he should examine the gang tools, particularly gauge-cum-level, and arrange for repair and replacement as necessary.

(e) He should ensure that every man in the gang is aware of safety rules by examining them periodically.

(2) *Level Crossing Inspection* – (a) He should ensure that all the level crossings are opened out once a year to examine the condition of rails, sleepers and fastenings and defects are rectified.

(b) He shall see that the necessary stop boards,whistle boards, and other equipments are provided as laid down.

(c) He shall check the equipment with the Gateman once in a month.

(d) He shall examine their knowledge of safety rules periodically.

(e) He shall arrange to take the census of all level crossings as per the schedules laid down.

(3) *Points and Crossing Inspection* – The Permanent Way Inspector in overall charge and his Assistant should carry out the inspection of points and crossings in passenger running lines once in three months by rotation and on other lines once in six months by rotation.

(4) *Curve Inspection* – The Permanent Way Inspector in overall charge and his Assistant should carry out checks of versines and super-elevation of each curve once in six months by rotation, except for Group A & B routes in B.G. where the check should be conducted once in every four months. They should take action to correct the curves as necessary based on the readings recorded.

(5) *Inspection Diagram* – The Permanent Way Inspector will maintain an inspection diagram of all the inspections carried out during the month as per the schedules in the *pro forma* laid down and submit the same to the Divisional Engineer through Assistant Engineer every month bringing out the reasons for shortfall in adhering to schedules of inspections, if any.

124 A. Revised Schedule Of Inspection Of Track –

The revised schedule of inspection is applicable only when PWI's Section has been provided with concrete sleepers and is under mechanised maintenance:-

(1) Push Trolley Inspection - Once in a month

(2) Foot Plate Inspection - Once in a month

(3) Rear vehicle Inspection	- Not required
(4) Curve Inspection	- Shall be carried out by PWI(not in overall charge) and CPWI/ PWI (in overall charge) once in six months by rotation including for Group A & B routes.
(5) Points & crossings	- As stipulated in **para 124(3).**
(6) Foot Inspection	- Once in a year may be introduced to start with.
(7) OMS/TRC	- PWI(not in overall charge) need accompany only alternate OMS/TRC runs to avoid CPWI/ PWI (in overall charge) & PWI (not in overall charge) both accompanying all the runs.

125. Safety of Track – (1) The Permanent Way Inspector is directly responsible for the safety of the track. He shall be vigilant to locate faults in the Permanent Way and promptly remedy them.

The defects which are beyond his powers to remedy should be immediately brought to the Assistant Engineer's notice by the Permanent Way Inspector and mentioned of the same made in the half-yearly report on the condition of Permanent Way of the section.

(2) Independent of detailed periodical inspections, the Permanent Way Inspector, during his routine inspections, should watch for any signs of weakness in bridges and structures affecting track and promptly report any matter demanding the Assistant Engineer's attention.

(3) Trees in proximity to and liable to foul the track during a storm should be felled.

126. Check on Patrolling – He should arrange for patrolling of track as laid down, by deputing suitably selected men from gangs and arrange to supply them with Patrol books and equipment needed. The Permanent Way Inspector in overall charge will check the night patrolman once a month by train, and by trolly during monsoon as per the schedules laid down by the administration.

127. Execution of Works affecting Track – (1) Before commencing any work the Permanent Way Inspector in overall charge or his Assistant shall ensure that he is in possession of all necessary materials and tools. He shall ensure that Engineering Signals are exhibited at the specified distances according to rules and Flagmen are posted with necessary equipment.

(2) He should programme the works by organising the labour in an efficient manner. He should maintain detailed accounts of materials received and issued to the work. He should exercise frequent checks on quality and quantum of work and submit progress reports on works periodically as may be prescribed.

(3) *Quality of welding and avoidable fractures* - The direct responsibility for quality of AT welding being done in the section shall rest on the PWI incharge of the section. Responsibility for avoidable fractures taking place in the section shall also rest with the PWI incharge of the section, except in cases where the USFD testing was done and found good upto three months before the fractures.

128. Action in case of Emergency – On receipt of intimation of the occurrence of an accident (including breaches) affecting any part of track, restricting free passage of trains, the Permanent Way Inspector should proceed to site by the quickest available means. On the way he should collect information regarding the damage, the men and material requirement at site for restoration and arrange for movement of men and materials and thereafter the restoration.

129. Inspection and maintenance of LWR/ CWR Track – The duties and responsibilities of the Permanent Way Inspector in overall charge is clearly laid down in **Para 9.1.3 of the L W R Manual.**

130. Measurement of Ballast – The Permanent Way Inspector in overall charge will measure the ballast if so directed by the Assistant Engineer and record measurements. He will keep proper records of training out and spreading of ballast in the track.

131. Station Yards – The Permanent Way Inspector shall ensure cleanliness of station yards. Under- growth should be cleared every year, usually in the month of August, before the seed has ripened. At stations where it is proposed to stack engineering or contractor's materials, the stacking area should be carefully selected and clearly demarcated. The materials should be stacked methodically in a tidy manner.

132. Witnessing Payment to Staff – (1) Payment to both Permanent and Temporary staff, working under the Permanent Way Inspector, will be made by the Pay Clerk in the presence of the Permanent Way Inspector. If the Permanent Way Inspector working in the section is not readily available, the Assistant Engineer may depute another Inspector to witness the payment.

(2) The Permanent Way Inspector is responsible for correct identification of the payee and should satisfy himself that the correct amount is paid.

(3) Payments to Permanent Way gangs should, as far as practicable, be made on the beat of each gang during working hours.

(4) The witnessing official should certify to the payment individually or by group, at the same time specifying, both in words and figures at the foot of the muster-sheet, the total amount paid on each date. If any person out of a gang is not present when, the gang is paid on its beat, "Not Paid" should be written immediately against his name. When subsequently payment is made, the place (km.) where payment is made should be entered. Payment made subsequent to the filling in of the certificate should be separately certified on the pay sheet.

133. Other Establishment Matters – (1) The Permanent Way Inspector should ensure that all staff, including Casual labour, are sent for medical examination and are fit for the medical standards, as per the relevant instructions in force, before appointment or promotion. He will also ensure that the staff under him are sent for periodical medical examination as laid down in the relevant rules.

(2) He will arrange to maintain the Service Cards/leave account of all the permanent staff working under him. In the case of casual labour he will arrange to issue the necessary Service Card to them and will maintain the L.T.I. register.

(3) He will ensure that the relevant provisions of the Payment of Wages Act, Workmen's Compensation Act, Hours of Employment Regulations etc., as amended from time to time are followed and complied with.

(4) He will arrange to carry out the other **Establishment works**, such as issue of passes, preparation of pay bills etc., as may be allotted to him by the administration.

(5) He will ensure proper training of the men working under him at the appropriate time.

(6) He will carry out selection of proper Gatemen and Patrolmen from the existing Gangmen and train them in their duties.

(7) He will arrange for the prompt filling up of the vacancies.

134. Correspondence and Records – The Permanent Way Inspector shall keep his correspondence up-to-date and see that the office records, registers and stores ledgers are maintained systematically and posted regularly.

135. Relinquishment of Charge – (1) On relinquishing charge of a section the Permanent Way Inspector shall prepare, in triplicate, the specified "Transfer-of-charge" statement which will briefly contain the following :

(a) Extent of the section.

(b) Establishment (service and leave records).

(c) Works in progress, relaying, scattered renewals and other works incidental to track maintenance.

(d) Kilometrage of banks, cuttings, curves, bridges and structures requiring special attention.

(e) Kilometrages where trouble may be expected during the monsoon.

(f) Certificate of stores-check and correctness of stock.

(g) General notes.

(2) The Permanent Way Inspectors handing over and taking over charge should together trolly over the whole section, inspect all the works in progress, check staff, all tools, plants and materials.

(3) The relieving Inspector will examine all books pertaining to rules and orders in vogue and all registers pertaining to the section to see that they are kept up-to-date and initial them with date.

(4) The statement referred to in **sub-para (1)** should be signed by both the Permanent Way Inspectors and two copies submitted by the relieving Inspector to the Assistant Engineer who will forward one copy to the Divisional Engineer for record.

Errors and discrepancies which are noticed should be recorded in the statement and the Assistant Engineer's special attention invited to them.

Duties of Permanent Way Inspector (not in overall charge)

136. General Responsibilities – The Permanent Way Inspector is generally responsible for :

(a) Inspection and maintenance of track in his jurisdiction (sub-section)in a safe and satisfactory condition for traffic, including execution of all works incidental to track maintenance.

(b) Efficient execution of Special Works, such as Renewals, Directed Track Maintenance, Curve realignment, and deep Screening, as per approved plans and specifications.

(c) He should work in the Permanent Way Inspector's office and assist the Permanent Way Inspector in overall charge as required.

137. Knowledge of Rules and Regulations– Provision of **Para 119** will apply in this case also .

138. Co-ordination with Works, Bridge and Staff of Other Departments – He should keep close co-ordination with the Works, Bridge, Signalling and Electrical staff, when required to work jointly with them.

139. Routine Inspection of Track –

(1) The Permanent Way Inspector should inspect the entire section in his charge by push trolly at least once a week, He should carry out the inspection of gangs as detailed in **Para 124(1) (b) &** (c). He will spend as many days in the week as possible with the gangs. He should cover all the gangs within a month. He should train the Permanent Way Mistry, Mates, Keymen, Gangmen and Gatemen in their duties. He should teach them the maintenance practices.

(2) He will carry out inspection of points and crossings on passenger running lines once in three months and other lines once in six months, by rotation along with the Permanent Way Inspector in overall charge. He will arrange for the rectification of defects noticed during the inspection.

(3) He, along with the Permanent Way Inspector in overall charge, will arrange to check the versine and super-elevation of all the curves once in six months by rotation, except for Group A &B routes where the check should be conducted every four months . He should take action to correct the curves based on the readings.

(4) He will arrange to inspect all the Level crossings in his jurisdiction once in a month and check the equipment. He will examine the Gatemen in rules peoriodically.

139 A. Revised Schedule Of Inspection Of Track-

The revised schedule of inspection is applicable only when PWI's Section has been provided with concrete sleepers and is under mechanised maintenance –

(1) Push Trolley Inspection	-	Once in a fortnight
(2) Foot Plate Inspection	-	Once in a month
(3) Rear vehicle Inspection	-	Not required
(4) Curve Inspection	-	Shall be carried out by PWI (not in overall charge) and CPWI/ PWI (in overall charge) once in six months by rotation including for Group A & B routes.
(5) Points & crossings	-	As stipulated in **para 139 (2).**
(6) Foot Inspection	-	Once in six months may be introduced to start with.
(7) OMS/TRC	-	PWI (not in overall charge) need accompany only alternate OMS/TRC runs to avoid CPWI/ PWI (in overall charge) & PWI (not in overall charge) both accompanying all the runs.

140. Annual Maintenance Works – He will carry out maintenance works such as curve realignment, attention to points and crossings, adjustments of creep, etc, as assigned to him by Permanent Way Inspector in overall charge.

141. Check on Patrolling – He will cover his section once in a fortnight by train and check the night patrolling. He will also check the night patrolling by trollying in the night as per the schedules laid down. During inspections, he will check the patrol books, the knowledge of rules of Patrolmen, their equipment, etc.

142. Execution of works affecting Track – The provision of **Para 127** will apply.

143. Action in case of Emergency – Provision of **Para 128** will apply.

144. Maintenance of LWR/CWR Track – Duties and the responsibilities of P. W. I. in-charge of a sub-section with reference to maintenance of L. W. R. are laid down in **L. W. R. Manual.**

145. Witnessing Payments to Staff – When Permanent Way Inspector not in overall charge is deputed to make payments to staff, he will follow the provisions of **Para 132** of the Manual.

PART 'C'

Duties of Permanent Way Mistries

146. General Responsibilities – They are normally in-charge of items of works which require a higher level of supervision that can be exercised by Gang Mate.They will carry out the following specific works, or such other works pertaining to track maintenance, as may be allotted to them by the Permanent Way Inspector :

(i) Attention to bad spots,

(ii) Directed track maintenance,

(iii) Maintenance LWR track, if he has been issued with a competency certificate(responsibilities have been listed out in **para 9.1.3** of LWR / CWR Manual),

(iv) Isolated renewal of sleepers,

(v) Lubrication of rail joints,

(vi) Lorrying out of material, if issued with competency certificate. They will be responsible for ensuring safety for the works being supervised by them.

147. Knowledge of Rules and Signals – Every Permanent Way Mistry shall have a correct knowledge of hand and detonating signals and shall be conversant with the following rules :

(i) Protecting line in an emergency and during work affecting track.

(ii) Method of fixing and safety range of detonators.

(iii) Action to be taken when train is noticed to have parted .

(iv) "Safety first" rules .

(v) Action to be taken when sabotage is suspected.

(vi) Patrolling in emergencies .

(vii) Rules for working of a trolly and lorry if he is authorised to operate the same .

148. Whenever Permanent Way Mistries are in-charge of gangs /units , they will carry out all the duties and responsibilities assigned to the Mate as laid down in **Part 'D'** of this Chapter.

PART 'D'

Duties of Mates, Keymen and Gangmen - General

149. Knowledge of Rules and Signals – (1) Every Mate, Keyman and Gangman shall have the correct knowledge of hand and detonating signals and shall be conversant with the following rules :

(a) Protecting the line in an emergency and during work affecting the track.

(b) Method of fixing and safety range of detonators.

(c) Action to be taken when a train is noticed to have parted .

(d) "Safety first" rules

(e) Action to be taken where sabotage is suspected, and patrolling in emergencies.

(2) Every Mate and Keyman shall see that the signals, supplied to the Gangs are kept in good order and ready for use and that every man in his Gang has a correct knowledge of all the signals.

150. Safety of the line – Every Mate shall see that his length of line is kept safe for the passage of trains. Kilometrages needing urgent attention shall be picked up without waiting for orders from the Permanent Way Inspectors.

151. Equipment at site of work – (1) Every Mate shall ensure that the following tools and equipments are with him at the site of work :

(a) Level-cum-gauge, square, hemp cord, metre stick, keying and/or spiking hammer, fish-bolt spanner, 2 sets of H.S. flags, 12 detonators, marking chalk and Rail thermometer (2 H. S. lamps in the night)

(b) Sufficient number of shovels or phowrahs, beaters, crow bars, ballast forks or rakes, mortar pans or baskets and wooden mallet.

(2) The Mate shall keep in his charge in the tool box other tools and equipment as may be prescribed.

152. Musters and Gang Charts/Diary Books–

(1) The muster and Gang chart /diary shall be in the possession of each Mate. The Gang chart should be carefully kept in a container provided for the purpose.

(2) The muster should normally be marked by the Mate, checked and initialled by the Permanent Way Inspectors.

(3) The Mate shall see that the prescribed system of track maintenance is adhered to and the tasks allotted, according to verbal instructions or entries made in his Gang chart / diary, and explained to him, are efficiently carried out. If capable of entering details of work done in his Gang diary, the Mate should do so.

153. Observance of sleeper packing during passage of Train – During the passage of the first and last trains in working hours, the Mate and his men should stand on the cess, each about one rail length apart, and observe the effect on the sleepers. Loose sleepers should then be marked and adequately packed. On double line, the Gangs shall invariably stand on the cess side and not in between the tracks.

154. Precautions when view is obstructed–

(1) On double and multiple lines on curves, the view is temporarily obstructed due to a train passing over a track other than that on which the Gangmen are working. It is worsened when trains are crossing each other. The noise of a train passing over one track prevents hearing the noise or whistle of another train approaching the work site.

(2) When working at a place from which an approaching train cannot be seen, at least 600 metres away in the case of B G and 400 metres in the case of M G and N G a Gangman with hand signals should be sent out by the Mate :

(a) On double line in the direction of approaching trains,

(b) On a single line in the direction the view is obstructed (in both directions if view is obstructed on both sides).

It will be the duty of such Flagman to warn the Mate by means of signals when a train is approaching. The Mate will be responsible for warning the Gang in good time to enable them to get clear off the track. It may be deemed expedient, as an additional precaution, to issue portable whistle boards of the type indicated in **Para 815 (2)** to the Mates, who should fix them at least 600 metres on B. G. and 400 metres on M G and N.G, from the work-site, in the direction the view obstructed to less than this distance. In the case of M G high speed routes, the distance may be increased suitably as per the directives of the administration.

155. Tidiness of Section – The Mate shall see that the whole of his Gang length is kept neat and tidy and that all loose materials are collected and brought to stations, gangs quarters or gate lodges.

156. Safe Custody of Tools – The Mate shall be responsible for the safe custody of tools used by him, the Keymen and Gangmen. He should see that Gangmen on work remove their tools clear of the track on the approach of a train. After the day's work the Mate should secure the tools in the toolbox. In no case should Gangmen be permitted to take tools home. Before they break for mid-day meals the Mate should see that the tools are kept away from track.

157. Action when line is unsafe or in the event of Accident – (1) If a Mate or his keyman considers that the line is likely to be rendered unsafe, or that any train is likely to be endangered in consequence of any defect in the permanent way or works, or abnormal rain or flood or any other occurrence, he shall take immediate steps to secure the safety of trains by using the prescribed signals to "Proceed with Caution" or to "Stop" as necessity may require, vide **Para 806,** and shall, as soon as possible, report the circumstances to the nearest Station Master and the Permanent Way Inspector.

(2) In the event of an accident, the Mate, Keymen and Gangmen should lookout for broken fittings of wagons and track components and see that these are not disturbed until they have been seen and recorded by a responsible official.

158. Patrolling during Abnormal Rainfall – During abnormal rainfall, the Mate should organise patrolling on the gang-length, whether or not Patrolmen are on duty. In the event of damage being detected, action should be taken to safeguard traffic by protecting the line in accordance with **Para 812.**

159. Commencing work Affecting Safety of trains – No work, which may involve danger to trains, should be under taken by the Mate except under the personal supervision of the Permanent Way Inspector, or a competent Railway servant authorised by special instructions, unless it is an emergency where the requirements of safety warrant the commencement of the work. In such cases the Mate shall ensure that Engineering Signals are exhibited at the specified distances according to rules and Flagmen are posted with necessary equipment to man them before commencing the work.

160. Weekly Inspection of Gang Length by Mate – The Mate shall inspect the whole Gang length once a week, on which day he will carry out the keyman's work and duties and the Keyman will remain in-charge of the Gang.

161. Preventing Trespass and Theft of P. way Fittings – Every Mate and his men shall endeavour to prevent trespass in Railway limits by persons or cattle on his length of line and report any attempts at encroachment or unauthorised structures when noticed. He along with Gang, should also attempt to prevent theft of P. way fittings and report any attempt to steal, to his Permanent Way Inspector.

162. Relief arrangement in Emergencies – The Mate shall arrange immediate relief for Keymen, Gatemen, Patrolmen and Watchmen when, due to sickness, they are unable to perform their duties.

163. Assistance to P. and T. Staff – Where interruption to the telegraph line has occured through obviously visible causes, the permanent way staff should render all possible assitance. The staff must, for example, remove trees or branches of trees which, after a storm, are seen to foul the wires. Where wires are seen to be broken or entangled, the occurrence should be reported to the nearest Station Master.

164. Assitance in protection of Trains – The Mate and his men should render assitance to Guards and Drivers of the trains for the protection of the trains in the event of an accident between stations, when called upon to do so.

165. Assitance in placing Fog Signals – On requisition from the Station Master, the Mate of a yard gang may depute, if available, two Gangmen for placing of detonators, during time of poor visibility, in the rear of approach signals of the station.

166. Responsibilities of the Mate in L.W.R. Track – The duties and responsibilities of the Mate in LWR sections are detailed in L W R Manual.

Duties of Keyman

167 Selection and training of keyman - The selection of Gangman to perform the duties of a keyman is to be considered as a step in his training as Mate. Keyman trained in laying and maintenance of LWR/CWR on concrete sleeper and possessing valid competency certificates issued by Zonal/ Divisional Training center should only be posted on LWR/CWR section.

168 (1) Keyman's daily inspection - The keyman shall inspect by foot his entire beat once a day, both the tracks and bridges, and return along the opposite rail to that taken on his outward journey in case of single line. On double line, keyman will carry out one round of inspection in morning hours by going along up line and then returning along down line or vice-versa. On the days of Gang holidays and rest, he shall perform the usual duties and get one day's rest in the week as per the roster duties in force. On rest days or during absence or leave or sickness, a senior intelligent gangman should be deputed in place of the regular keyman.

(2) Roster duty hours of keyman - The roster duty hours of keyman for winter months should be so adjusted as to ensure one round of track inspection in early morning to enable detection of any rail or weld fractures that might have occurred during the night or early morning. DEN/Sr.DEN of the section shall decide and notify the exact timings and the period of each section.

169 Equipment of keyman - The keyman shall carry with him on his rounds two red flags, and green flag, ten detonators, a flangeway gauge if required, for unmanned level crossings, a keying and spiking hammer, a fish bolt spanner, and two fish bolts, spare fittings and a rail closure of 30mm size. For the work of greasing of elastic rail clips wherever applicable, keyman shall carry a wire brush, emery paper, a duster and grease.

170 Duties of Keyman -

(1) While walking over his length, he should look for defects, such as loose fish bolts, SEJ fittings in switches and crossings, fittings on girder bridges and open top culverts, broken or burnt sleepers, broken plates or tie bars, attend to them as necessary. If he finds that fittings are consistently working loose even after repeated attention, he should report the matter to the Mate, PWM and Permanent Way Inspector. If the defects are serious, he should at once inform the Mate of the gang protecting the line in the meantime, if necessary, according to rules.

(2) He shall keep a special watch on the rails and welds marked for observation by the USFD team.

(3) If he should notice any condition of danger, such as broken rail, broken weld or wash away of ballast, theft of fittings in large numbers etc., he shall at once protect the line as per rules, take such action as is possible and report the matter to the Mate, the nearest Station Master and Permanent Way Inspector.

(4) At unmanned level crossings, he shall maintain the flange ways between the check and the running rails clear of obstructions.

(5) In track other than with elastic fastenings, the keyman in addition to his normal round of the whole beat and inspection and tightening of loose fittings, should attend one telegraph post (TP) on one line thoroughly on every day. This thorough attention should consist of tightening of each bolt and fittings in these TPs of the beat during that particular day. Missing keys and other missing fittings will be recouped by him. He shall also ensure correct driving of fittings in this stretch.

(6) (a) Where the beat of Keyman consists of PRC sleepers - The Keyman should ensure that, in addition to his normal duty of inspection and tightening of fittings, he should also carry out in a systematic manner from one end, greasing of the ERC and eyes of inserts at the rate of 20 sleepers per day. Greasing shall be done as per the procedure laid down in **para 1411 (5) (b) of IRPWM.**

(b) Where the beat of Keyman consists of PRC as well as other types of sleepers, SE (P. way) should make roster of keyman on monhly basis in the proportion of the beat, so that work mentioned in **para 170(5)** and **170(6)(a)** are completed in respective length. On any particular day however, he will do duties either as **per 170(5) or 170(6)(a)** only.

(7) Keyman with the assistance of one gangman will also carry out rail end examination, lubrication of fish plated joints as per direction of PWI/PWM.

(8) For imposing of caution after stopping the train or otherwise wherever required for safety, Keyman will be provided cyclostyled slips by PWI. Keyman after filling location and speed will hand over the same to Driver or ASM and obtain acknowledgement.

(9) The following are the special duties and responsibilities of the keyman in LWR/CWR territories:-

(i) Periodical (fortnightly) oiling and greasing of SEJ, checking and retightening of fastenings at SEJ and other sleepers, if necessary **(Para 6.2.6 of LWR Manual)**

(ii) Replacement of missing fastenings not requiring lifting or slewing of track as per **Para 6.2.6 (I) of LWR Manual.**

(iii) To ensure that all creep anchors where provided butt against the sleepers and in case of large scale displacement of anchors, he shall report the matter to Mate/PWM/PWI (Subsection)/PWI (incharge).

(iv) To watch for sun kinks, loose or missing fastening which may result in buckling or any damage to LWR/ CWR and SEJ. On noticing any buckling or damage to track, he shall take necessary action to protect the track and report the same immediately to PWI (Sub-section)/ PWI (incharge), Station Master. However, he will continue to perform his Keyman's duties of daily inspection.

(v) To keep a sharp look out in cold mornings, especially during winters to detect any fractures which may occur, in case of rail/weld fracture, he shall take prompt action to protect the track and carry out emergency repairs to permit the restoration of traffic promptly and report to PWI (Subsection)/ PWI(Incharge)/nearest Station Master **(Para 7.2.2 and 7.2.3 LWR Manual).**

(10) The Kayman shall promptly report to Mate/ PWI any encroachment or unauthorised structures as and when they take place in the Railway land in his beat.

(11) After completing inspection of the beat, the Keyman should assist the Mate in the day's work being done.

(12) When materials, such as dynamo-belts, engine tools and personal articles of passengers, are found on line, the Keyman should collect them and arrange for handing them over to the nearest Station Master.

(13) The Keyman will remain incharge of the gang in absence of the Mate once a week. On that day, the Mate is required to carry out the work and duties of Keyman.

(14) Whenever directed he will supervise rail dolly working. However, he must have competency certificate for the same.

171 Keyman's book-

(i) Printed keyman's book should be supplied to every keyman.

(ii) The keyman shall maintain the book upto date wherein all special work done, missing fittings and their recoupment with location and date are to be entered.

(iii) PWI should make a date wise schedule and enclose with the Keyman's book the Kms/ TPs that the Keyman has to attend on each day of the month to complete the task required to be done as per sub **Para 6, 7, 9(i) of Para 170 above.** PWIs and AENs during their inspections should check to ensure that such Kms have really been thoroughly attended to and initial against the entries.

(iv) Special locations to be watched by the keyman should be entered in the book.

(v) The special fittings like joggled fish plates and other material provided in the section which are vital for safety and for restoration of traffic should also be mentioned in the book.

CHAPTER II

THE MAINTENANCE OF PERMANENT WAY

PART 'A'

General Instructions

201. Responsibility of Engineering Officials– The Engineering officials shall devote careful and continous attention towards the efficient upkeep of the permanent way and the achievement of good and smooth running road.

The running qualities of track should be adjudged by riding as frequently as possible on the locomotives or in the rear vehicles of fast trains on the section. Such inspection should be carried out by the Permanent Way Inspectors, the Assistant Engineers, and the Divisional Engineer. Where track geometry is recorded at regular intervals the Divisional Engineer, the Assistant Engineer, and the Permanent Way Inspector should accompany such runs.

The conditions of the track is best judged by track recording cars, oscillograph cars, portable accelerometers, Hallade track recorders, etc. Full use should be made of the records of such runs. Bad spots should immediately be attended to. The Permanent Way Inspector should strive to achieve excellence against each of the parameters recorded by these cars, consistent with the maintainability of the track.

The reports from drivers regarding oscillations or lurching of engines should be promptly investigated and track attended at the kilometerage concerned.

The Assistant Engineers and their Divisional Engineers should maintain records of the results of their inspections either in the form of a notebook or a file and should ensure the compliance of instructions by the inspectors within a reasonable time. These records should be examined by the Headquarters officers during their inspections.

202. Classification of Lines –

(1) Broad Gauge – The B G lines have been classified into seven groups 'A' 'to' E on the basis of the future maximum permissible speeds as under –

Group 'A' – Speeds upto 160 km./hour :

(i) New Delhi to Howrah- Rajdhani Route (via the Grand Chord and Howrah-Burdhwan Chord).
(ii) New Delhi to Bombay Central (Frontier Mail Route).
(iii) New Delhi To Madras Central (Grand Trunk Route).
(iv) Howrah- Nagpur- Bombay V.T.

Group 'B' – Speeds upto 130 k.m./hour:

(i) Allahabad-Katni-Jabalpur- Itarsi- Bhusaval.
(ii) Kalyan - Pune - Daund - Wadi - Secunderabad-Kazipet.
(iii) Kharagpur- Waltair- Vijayawada.
(iv) Wadi-Raichur-Arakkonam-Madras Central.
(v) Howrah-Bandel-Barddhaman.
(vi) Khanna- Barharwa- Farakka Bridge- Malda Town.
(vii) Sitarampur-Madhupur-Kiul-Patna- Mughal Sarai.
(viii) Kiul- Bhagalpur- Sahibganj- Barharwa.
(ix) Delhi- Panipet- Ambala Cantt.- Kalka.
(x) Ambala Cantt.- Ludhiana- Pathankot.
(xi) Ambala Cantt.- Moradabad- Lucknow-Pratapgarh- Mughul Sarai
(xii) Arakkonam- Jolarpettai- Salem- Erode-Coimbatore- Ernakulam.
(xiii) Vadodara- Ahmedabad.
(xiv) Jolarpettai- Bangalore.
(xv) Ahmedabad-Ajmer-Jaipur-Bandikui-Rewari Delhi.
(xvi) Malda Town-Barsoi-New Jalpaiguri.
(xvii) Chennai beach-Dindigul.
(xviii) Bangalore-Dharmavaram-Gooty.
(xix) Ghaziabad-Saharanpur.
(xx) Chennai Beach-Chennai Egmore 3rd line

Annexure 2/1 shows, Group 'A' And 'B' Routes

Group 'C' - Suburban Sections of Mumbai, Delhi, Chennai and Kolkatta as listed below:

(i) CSTM-Kalyan-Kasara
(ii) CSTM-Kalyan-Karjat
(iii) CSTM-Kurla-Panvel
(iv) CSTM-Ravali-Mahim-Andheri
(v) CSTM-Ravali-Kurla
(vi) Churchgate-Mumbai Central-Borivali-Virar
(vii) Chennai Central-Basin Bridge-Veysarpadi-Arakonam
(viii) Chennai Central-Basin Bridge-Washermanpet-Chennai beach-Tambaram
(ix) Chennai Central-Basin Bridge – Korukkupet-Tondiarpet –Tiruvottiyar -Gummidipundi
(x) Chennai Beach-Thirumayilai
(xi) Sealdah-Dumdum-Naihati-Kalyani-Ranaghat-Krishnanagar
(xii) Sealdah-Sonarpur-Baruipur
(xiii) Ballygunj-Budge Budge
(xiv) Howrah-Dankuni-Saktigarh-Bardhaman
(xv) Howrah-Bandel-Saktigarh
(xvi) Seoraphuli-Tarakeshwar
(xvii) Dumdum-Barasat
(xviii) Howrah-Panskura-Kharagpur

Group 'D' Spl.- Sections where the traffic density is very high or likely to grow substantially in future and the sanctioned speed is 100 km/h at present. The following routes will fall under this category:-

(i) Kharagpur-Midnapur-Adra
(ii) Barkakana-Barwadih-Garwa Road
(iii) Tundla-Yamuna Bridge
(iv) Bolangir-Titlagarh
(v) Gudur-Renigunta
(vi) Anara-Chandil-Kandra-Sini
(vii) Anuppur-Shahdol-Katni-Bina
(viii) Ahmedabad-Viramgam
(ix) Nagda-Ujjain-Maksi-Bhopal
(x) Lucknow-Sultanpur-Zaffarabad-Banaras
(xi) Delhi-Ghaziabad-Hapur-Moradabad
(xii) Lucknow-Kanpur
(xiii) Chapra-Hajipur-Barauni
(xiv) Raipur – Titlagarh - Vizianagram
(xv) Guntakal-Tornagallu-Hospet
(xvi) Udhna-Nandurbar-Jalgaon
(xvii) Gomoh-Chandrapura
(xviii) Garva Road-Chopan
(xix) Garva Road-Sone Nagar
(xx) Barauni-Katihar
(xxi) Sambalpur-Talcher-Nergundi
(xxii) Jharsuguda-Bolangir
(xxiii) Barabanki-Gonda-Gorakhpur-Chhapra
(xxiv) Champa-Gewra Road
(xxv) Bilaspur-Anuppur

Group'D' - Sections where the sanctioned speed is 100km./hr. at present.

(i) Salem-Byappanhalli
(ii) Guntur-Donakonda-Guntakal
(iii) Vikarabad-Parli-Parbhani
(iv) Vijayawada-Bhimavaram-Nidadavolu
(v) Secunderabad-Dronachalam
(vi) Jodhpur-Marwar
(vii) Diva-Vasai Road
(viii) Pen-Roha
(ix) Kumedpur-Katihar Jn
(x) Rewari-Hissar
(xi) Kalumna-Nagpur (via Itwari)
(xii) Kota-Ruthiyai
(xiii) Bina-Guna-Ruthiyai

Group'E' Spl. - Sections where traffic density is very high or likely to grow substantially in future and present sanctioned speed is less than 100 km/h, the following routes will fall under this category:

(i) Panskura-Haldia
(ii) Talcher-Rajatgarh-Salegaon-Nergundi
(iii) Cuttack-Paradeep
(iv) Radhakishorepur-Rajathgarh-Barang
(v) Kapilas Road-Salegaon
(vi) Radhakishorepur-Machapur
(vii) Kirandul-Koraput
(viii) Rajakharshwan-Dongaposi-Padapahar Barajamda-Gua
(ix) Bondamunda-Bimlagarh-Barsuan-Kiriburu
(x) Kandra-Gamharria
(xi) Marauda-Dallirajhara
(xii) Urkura-Sarona
(xiii) Bhojudih-Mohuda G-C
(xiv) Chandil-Muri-Bokaro-Rajbera
(xv) Padapahar-Banspani
(xvi) Barajamda-Bolanikhandan
(xvii) Muri-Barkakana
(xviii) Talgoria-Bokaro City
(xix) Andal-Sainthia
(xx) Hatia-Muri
(xxi) Mohuda-Gomoh
(xxii) Koraput - Kottavalasa
(xxiii) Koraput-Singapuram Road
(xxiv) Sambalpur-Angul
(xxv) Anuppur-Bijuri-Boridand
(xxvi) Boridand-Bisrampur
(xxvii) Durg-Marauda
(xxviii) Londa-Vasco
(xxix) Dewas-Maksi
(xxx) Gandhidham-Bhuj
(xxxi) Dornakal-Bhadrachalam Road-Manuguni and Kerapalli-Singereni Collieries
(xxxii) Sanathnagar-Maul Ali (by pass line)

Group'E' - All other Sections and branch lines where the present sanctioned speed shall be less than 100 kmph.

(2) The M.G. lines have been classified into three categories based on the speed potential and traffic density in the section as under -

(a) 'Q' routes.– The 'Q' routes consist of the routes where the maximum permissible speed will be more than 75 km.p.h. The traffic density is generally more than 2.5 G.M.T. the following routes will fall under category 'Q' :-

(i) Delhi-Sarairohilla-Rewari-Ratangarh
(ii) Rewari-Ringus-Phulera
(iii) Ratangarh-Degana
(iv) Ajmer-Ratlam-Khandwa
(v) Jaipur-Phulera-Ajmer
(vi) Bandikui-Agra Fort
(vii) Ahmedabad-Bhavnagar
(viii) Agra-Mathura-Bhojipura-Lalkuan
(ix) Bhojipura-Lucknow
(x) Villupuram-Thanjavur-Tiruchchirappalli.
(xi) Chennai Beach-Villupuram.
(xii) Dindigul-Madurai.

(b) 'R' routes – These routes will have a speed potential of 75 km.p.h. And the traffic density is more than 1.5 G.M.T. 'R' routes are further classified into

three categories as follows depending upon the volume of traffic carried:-

(i) R-1 : when the traffic density is more than 5 G.M.T.
(ii) R-2 : when traffic density is between 2.5 to 5 G.M.T..
(iii) R-3 : when traffic density is between 1.5 to 2.5 G.M.T.

R-1 route:

(i) Gandhidham-Palanpur

R-2 route:

(i) Secunderabad-Mudkhed
(ii) Guntakal-Bellary
(iii) Guntakal-Villupuram
(iv) Tiruchchirappalli-Manamadurai-Virudunagar

R-3 route:

(i) Madurai-Rameswaram
(ii) Virudunagar-Tenkasi
(iii) Dindigul-Pollachi
(iv) Ratangarh-Bikaner

Note : The following two routes also carry a traffic density of more than 5 G.M.T :

(i) Katihar-New Bongai Gaon
(ii) Gauhati-Tinsukia

These have not been included in R1 routes as they are slated for conversion.

(c) 'S' Routes – These will be the routes where the speed potential is less than 75 km.p.h. and the traffic density is less than 1.5 G.M.T.

Annexure 2/2 shows the 'Q' routes.

203. Sytems of Track Maintenance – (1) *System to be adopted*- The track should be maintained either by conventional system of track maintenance or by 3-tier system of track maintenance.

(2) *Details Of Maintenance Works* – (a) In both the systems, track requires to be overhauled periodically with the object of restoring it to best possible condition, consistent with its maintainability. Periodicity of overhauling depends on several factors, such as type of track structure, its age, volume of traffic, rate of track deterioration, maximum permissible speed, system of traction, condition of formation etc. Irrespective of the system of track maintenance adopted, it is obligatory to overhaul specified lengths of gang beat annually. The length of the section to be overhauled shall be such that complete overhauling of track will be accomplished within a specific period (normally 3 to 5 years).

(b) Immediately after cessation of monsoon, the run down lengths should be quickly attended to, to restore the section to good shape. After this is done overhauling/through packing of track should be taken in hand. After completion of one cycle of systematic through maintenance, track should be attended to wherever required.

(c) In any system of maintenance it is necessary to allot certain number of days in a week for 'picking up slacks' to ensure that whole gang length is in safe condition for passage of trains .

204. Annual Programme of Track Maintenance – The annual programme of regular track maintenance and works incidental thereto shall be based on the programme given as shown below, with such variations to suit local conditions, as may be specified by the Chief Engineer. This applies to any system of maintenance

Annual Programme for Regular Track Maintenances

	Period	Work
1.	Post monsoon attention: For about six months after end of monsoon	(a) Attention to run down lengths in the entire gang beat to restore the section to good shape. (b) One cycle of conventional systematic through packing / systematic directed track maintenance from, one end of the gang length to the others including overhauling of nominated sections as detailed in **para 203.2.** (c) Normally 4 to 5 days per week should be allotted for works under item (b) and the remaining days for picking up of slacks, attention to bridge approaches, level crossings and points and crossings over the entire Gang beat. Works such as lubrication of rail joints, joint gap adjustments as required and realignment of curves should be done during this period.

2.	Pre monsoon attention for about 2 months prior to break of monsoon.	Normally 2 to 4 days in a week should be devoted to clearing of side and catch water drains, earthwork repairs to cess, clearing water ways and picking up slacks. In the rest of the days normal systematic maintenance will be carried out.
3.	Attention during monsoon for about four months	Attention to track as required. This will consist primarily of picking up slacks and attention to side and catch water drains and water ways. During abnormally heavy rains, patrolling of the line by gangs should be carried out in addition to regular monsoon patrolling.

Note :- (1) Scattered renewals, creep adjustments and earth work repairs should be done as necessary.

(2) For maintenance schedule on LWR/ CWR, special instructions in the LWR/CWR Manual should in addition be followed.

205. Maintenance Planning – (1) Every Permanent Way Inspector must prepare a perspective maintenance plan of his section one month in advance. The plan should include, apart from normal inspection, inspection of point and crossings, curves and level crossings, realignment of curves, adjustment of creep, deep screening, casual renewal, renewal of points and crossings, welding of joints, destressing of long welded rails etc. so that optimum utilization of time and labour resources is possible. He should also ensure that arrangements are made for adequate materials, tools, labour, man power and necessary caution orders/books, as may be necessary.

(2) For sections nominated for mechanised maintenance, annual plan for deployment of various track machines shall be finalised by CTE(MC)/CTE of the Zonal Railway and he shall arrange to deploy the machines accordingly.

206. Record of Gang Work – (1) Each Mate should be supplied with a gang chart and a gang diary. In the gang chart, details of track maintenance work done over the gang length, on a day-to-day basis shall be recorded by the Permanent Way Inspepctor, according to extant instructions. The work set to the gang should also be indicated in the gang chart by suitable notations. A typical gang chart is enclosed as **Annexure 2/3.** In the gang diary supplied to each gang, weekly programme of work should be entered by the Permanent Way Inspector. At the end of the week, the Inspector should carry out a quantitative and qualitative assessment of the work done during the week after thorough inspection and make suitable observations in the gang diary. Each gang chart/diary should be adequate for recording the work during the complete year. Temporary gangs employed in work allied to track maintenance, should also be supplied with gang diary, wherein the details of the work set and the work carried out will be entered by the Permanent Way Inspector. Details of maintenance work carried out by these gangs should be entered in the gang chart of respective permanent gang.

(2) Gang charts/diaries should be checked by the Assistant Engineers and Divisional Engineers during their inspections. They should record their observation in the gang diary.

(3) On withdrawal of gang chart/diary and supply of fresh ones, the Permanent Way Inspector should carefully analyse the work done and take notes of kilometerages that frequently gave trouble during the previous year, with a view to formulating such special measures as may be necessary. Action may be taken to preserve the gang charts for a period of three years.

(4) Maintenance attention given to the signalled loop lines and turnouts should be recorded on the chart.

(5) Whenever the gang equipments are checked by PWIs, the same should be recorded in gang chart against the date on which such inspection is done. Inspecting officials should initial against the date on the chart and also make suitable entries in gang diary.

(6) Six months after the end of each year, the gang charts will be collected by the PWIs and maintained as record. Thus, for the overlapping period of six months, the gang will have two gang charts with them. A six months record will, therefore, always be available with the gang for reference. Normally, this record should be kept for at least five years. When a particular kilometer or section is under special observation, the record may be maintained for a longer period at the discretion of P.Way officials.

207. Attention To Inspection Notes – Notes on inspections carried out by officers whether on foot, by push or motor trolley, on foot plate of the locomotive or by rear carriage of fast trains, should be sent to the Permanent Way Inspectors concerned for necessary action. The Permanent Way Inspectors should send compliance reports to the concerned officers within reasonable time.

208. Record of Work of Artisans and Other Workmen Employed – Each artisan/workman will be supplied with a diary in which entries will be made by the artisan/workman showing his movement by train and the details of daily work performed by him. The Permanent Way Inspector will scrutinise the work during his inspection and make suitable observations in the artisan's/workman's diary. At the end of the month these diaries will be sent to the Office of the Permanent Way Inspector.

209. Half yearly report on the condition of Permanent Way : (a) The Permanent Way Inspector shall submit half-yearly Reports on the state of track in his charge, to the Divisional Engineer through the Assistant Engineer in the format place at **Annexure-2/19**.

(b) In this Report the Permanent Way Inspector shall make candid statement of the defects in the track, reasons for defects and proposals for rectifying them.

(c) The Assistant Engineer should check the track during his trolley inspections and verify the conditions mentioned by the Permanent Way Inspector, and also study the proposed remedial actions. Remedial actions as necessary should be ordered within his power or referred to the Divisional Engineer for further orders.

(d) The Divisional Engineer should scrutinize the half-yearly reports of the Permanent Way Inspector and the comments forwarded by the Assistant Engineer, and give his orders thereon to the permanent Way Inspector through the Assistant engineer. The Assistant Engineer and Permanent Way Inspector should promptly attend to orders issued by the Divisional Engineer.

(e) Submission of half-year reports does not absolve the Permanent Way Inspector of this basic responsibility of maintaining the track in fit condition for the load and speed sanctioned for the section.

210. Permanent Way Inspector's Section Register – (1) Each Permanent Way Inspector shall maintain a Section register containing all important information including a brief history of the section. Entries shall be brief and categorised under various sections as indicated below :

(a) Administration –
  - (i) Change in Permanent Way Inspectors, Permanent Way Mistries and Clerks.
  - (ii) Change in jurisdiction.

(b) Permanent Way –
  - (i) Formation – Sections giving frequent trouble with brief history and remedial measures adopted, if any.
  - (ii) Track structure, method of maintenance, details of particular locations giving frequent trouble and remedial measures adopted if any.
  - (iii) Details of kilometerages of track laid as short welded panels, long welded rails, continuous welded rails, etc. incidence of buckling, maximum and minimum rail temperatures observed, behaviour of S.E.J. and buffer rails.
  - (iv) Grades – Regrading done, with brief details of lifting or lowering of track.
  - (v) Curves – Realignment and/or transitioning of curves.
  - (vi) Ballast – Kilometerages where there is deficiency of ballast and details of recoupment done. Particulars of deep screening carried out yearwise.
  - (vii) Creep Adjustment – Details of Creep adjustment done and action taken to reduce creep - Details of Gap survey carried out and adjustment done.
  - (viii) Permanent Way renewals – Major renewal carried out as relaying, rerailing and resleepering; large scale renewal of track components at a section should also be shown.
  - (ix) Station yards and sidings – Extension or alteration to sidings, platforms and renewal of points and crossings.
  - (x) Rail failures – Brief particulars of all types of rail failures, including weld failures should be noted in the section register, connecting references to the failure reports.
  - (xi) Rail Testing and Renewals – Records of rail testing by Ultrasonic Testing Method - Brief details of all rails removed with reasons for removal. This will form the basis of justification for through rail renewals/ casual renewals.

(xii) Brief particulars of fish-plate failures with details of fish plates and reasons for failure.

(xiii) Lubrication of rail joints : Particulars of work done with dates each year.

(xiv) Material under trial : Brief particulars - Connect reference to notes in the 'Materials-under-trial' register.

(xv) Track recording : summary of the results of the various track recording runs

(c) Bridges and Floods –

(i) Yearly record of rainfall showing month wise distribution

(ii) Important repairs and renewal to bridges, details of extensive repairs to bridges, dismantling and rebuilding bridges, strengthening of girders, renewal of girders, extension of bridges and through renewal of sleepers, should be shown. Ordinary repairs need not be recorded.

(iii) Damage due to floods : Extent of damage with particulars of rainfall, arrangements made for labour and material, time and labour spent for restoration and approximate cost. Cause of damage and notes of remedial measures

(iv) List of Railway affecting Works with brief history.

(v) List of vulnerable locations, where stationary watchmen are to be posted.

(d) Miscellaneous –

(i) Availability of labour on section for works.

(ii) Encroachment and steps taken to remove them.

(iii) Infringement particulars

(iv) Accidents attributable to Permanent Way with details

(v) List of reference books available in the section.

(vi) Any other important information necessary.

(2) The entries made in the section registers shall be brought up-to-date from time-to-time and these shall be scrutinised in the beginning of every year by the Assistant Engineer.

211. Permanent Way Plans and Diagrams – (1) The Assistant Engineers shall have in their possession complete sets of the following :

(i) The I.R.S. Track manual or I.R.S. type plans, pertaining to track sections and turnouts extent over their jurisdictions.

(ii) Plans and longitudinal sections of the line, to a scale of 50 meters to 1 cm horizontal (1/5,000) and 5 meters to 1 cm vertical (1/500) and Index Plans and sections to a scale of 0.5 km.S to 1 cm horizontal (1/50,000) and 10 meters to 1 cm vertical (1/1,000) showing the physical features, alignment, grades, location of bridges and level crossings.

The longitudional section of the line shall be updated by surveying the longitudinal profile of the line atleast once in five years. The necessary action for elimination of humps, sags and uneveness or providing vertical curves as provided in para 419 of IRPWM be taken if the survey reveals variations in grades. Such an action may also become necessary as a result of track works viz. renwal of rail/ sleepers, lifting/lowring of track, bridge works etc.

(iii) Drawing of bridges, level crossings and protective works and yard layouts over their jurisdiction.

(iv) Working drawings or diagrams pertaining to track and components on their sections, issued from time-to-time.

(v) The Permanent Way track diagram of the railway line showing the type of track and fittings when laid, type of ballast, type of formation with classification of soil (to be carried out as per RDSO's Circular No : GE-P1-May 2003), blanket thickness, type of formation trouble (if any) and indication of how the railway boundary is demarcated. Change points in the track diagram shall be indicated correct to the nearest meter (details as in **Annexure 2/4)**.

(vi) The Permanent Way diagrams of station yards showing complete dimension of running lines, sidings, type of track and turnouts. (Details as per **Annexure 2/5**).

(2) The Permanent Way Inspectors shall have in their possession complete sets of drawings and diagrams mentioned in item (i) and (iv) to (vi) pertaining to their jurisdictions ; he shall have in his possession the land plans pertaining to his jurisdictions covering those between stations and unimportant station yards.

(3) Plans pertaining to their jurisdictions shall be maintained up-to-date by the Assistant Engineer and Permanent Way Inspector.

212. Records of Material Under Trial –

(1) CTEs of Zonal Railways may order limited trials of simple items which do not infringe with existing provisions of standard specification or instructions laid down in Manuals/codes. Before undertaking the trial, complete scheme of trial should be well chalked out including the parameters to be periodically measured/checked, official to measure/ check, periodicity of measurement/checking and proforma in which measurements/ observations to be recorded. CRS shall also be kept informed about such trials.

(2) The Zonal Railways should periodically inform RDSO about such trials to maximize advantage.

(3) Registers - Registers of materials under trial duly indexed shall be maintained by the Assistant Engineer; sufficient number of pages being allotted for each item.

(4) Particulars of entries - Particulars regarding each item should be completed in regard to :

(i) Name of material
(ii) Kilometerage where laid
(iii) Date of laying
(iv) Object of trial
(v) Nature and condition of ballast
(vi) Nature and type of formation
(vii) Track details
(viii) Behavior
(ix) Any other relevant information

In the case of items designed for improved track performance, notes should be made about the extent to which such appliances are producing the desired results, particulars being quoted, whenever possible.

(5) Trial Lengths - Material under trial should, where practicable be laid near Assistant Engineer's headquarters. In the case of sleepers under trial, a special kilometer or kilometer should be utilized for the purpose.

(6) Indication Plates - Materials under trial should be indicated by plates of suitable dimensions fixed on the cess at either end of the trial length, the description and number of item, date laid and kilometerage, being shown thus :

Reconditioned sleepers Nos. 1000, January 1980 Km. 72/0-Km. 72/12

(7) Removal of materials under trial - In every case where sleepers or other materials under trial have to be removed because of relaying or alterations, the Asst. Engineer concerned should report to the divisional Engineer and ask for disposal instructions. When material is removed for any reason, a full note should be made by the Assistant Engineer on its condition after through examination. When materials under trials is removed and re-laid in another Assistant Engineer's length, the previous history of the material shall be copied in the register of the sub-division where it is now laid.

(8) Submission of Assistant Engineer's Register to Divisional Engineer - The 'Materials under trial' register should be submitted by the Assistant Engineer to the Divisional Engineer as often as required. The Divisional Engineer will submit reports on trials carried out to the Chief Engineer, as may be required.

(9) Permanent Way Inspector's Records - The Permanent Way Inspector shall maintain in manuscript form record of all materials under trial on his length with necessary particulars. Notes should be made therein a regular intervals. The Assistant Engineer shall scrutinize the records during his inspections.

(10) The Divisional Engineer should take interest in the trials in progress in his jurisdiction and ensure that the stretch where such material is laid, is maintained to the desired standard.

213. Strength of Gangs – The strength of each maintenance gang shall be decided by the Chief Engineer. A register should be maintained by each Permanent Way Inspector and in the Office of the Divisional Engineer and Assistant Engineers having the sanctioned strengths of gangs, Gatemen, Watchmen, Lookoutmen, Trolleymen and other staff. No deviation from the sanctioned strength of gangs and other staff shall be permitted without the approval of the Chief Engineer.

214. Musters – (1) The attendance of the Permanent Way staff and artisans and others shall be checked by the Inspector under whom the staff are employed according to such instructions as issued by the Administration.

(2) No over-writing in the muster sheet should be permitted. Corrections should be attested and initialled by the Inspector.

(3) Separate musters should be allotted and issued to each batch of workmen such as Gangmen, Gatemen, Trollymen and Artisans. Muster sheet should be kept by the head of each batch and at the site of work for checking attendance by the Inspector concerned. The muster sheet of trollymen and office staff should be kept and maintained in the office concerned.

(4) For each wage period, the muster sheet should be collected and fresh ones issued. Before commencement of a month, the Assistant Engineer should issue requisite number of blank muster sheet forms to each Inspector for the purpose of recording the attendance. Each blank muster sheet before issue, must be initialled on the top by Assistant Engineer, as a token of its authenticity.

(5) The leave availed by each employee should be recorded in the leave register debiting this leave to his account before the musters are dispatched to the Divisional Engineer's office.

(6) The Assistant Engineer should check the musters of all the staff on their sub- division and initial the muster sheet at least once a month during his inspection.

215. Custody Of Gang Tools – For the safe custody of gang tools, boxes should be provided at appropriate locations with proper locking arrangements. They may be provided near gang quarters, gate lodges or in stations. The Gangmate shall ensure that all tools are deposited in the tool box after working hours and kept locked.

Gangmen should not leave any tool unprotected during the course of working or during mid-day-break.

216. Section Limit Boards – (1)Boards at jurisdictional limits should be provided thus:

(a) End of Divisions:

BB DIVN.	BSL DIVN.
D.E.N./BB	D.E.N./BSL
A.E.N./IGP	A.E.N./MMR
P.W.I./IGP	P.W.I./DVL

(b) End of Sub-Divisions:

A.E.N./TNA	A.E.N./KYN
P.W.I./KYN	P.W.I./VSD

(c) End of Sections:

P.W.I./ TNA	PWI/ KYN

(d) End of Gang lengths:

G-3	G-4
1+1+14	1+1+13

(2) If the gang beat ends in a curve the beat should be so adjusted that the entire curve lies in one of the beats. Similarly in case of yards gang beats should be so adjusted that the yard is maintained as far as possible by one gang, exception being in the case of big yards where the yard may have to be maintained by more than one gang.

(3) Suitable boards should also be provided indicating the state and district boundaries.

(4) When a board has to be located at an exact kilometre, it should be fixed by the side of the kilometre post.

(5) The boards which may be of scrap iron or R.C.C. should throughout a division be fixed on the cess on the same side of the line. The letters and figures should be painted black on white background.

217. Kilometre and Gradient Posts – These may preferably be of R.C.C. of suitable dimensions and fixed at right angles to the track on the cess so as to be distinctly visible. The figures, arrows and letters should be painted in black on a white background.

218. Telegraph Pole Numbers – (1) Kilometrages should be indicated on one line of telegraph poles either by painting or providing number plates thereon.

(2) Where single plates are provided, they should be fixed at 45 degrees to the track and face alternatively in the up and down directions. Where one piece angle type plates are provided, they should be fixed so that either face is at 45 degrees to the track. Figures should be painted in black on white background.

(3) In deep-cuttings or tunnels, telegraph pole numbers should be repeated at cess-level.

(4) On double line section where one line is located away from the line along which the telegraph poles are provided and from where the figures on the telegraph poles cannot be easily read, additional rail posts should be provided along the other line which should indicate the corresponding telegraph pole numbers.

(5) On electrified sections the kilometrage is indicated on the structure posts. The responsibility of providing number plates or painting kilometrage on the Electric structure devolves on the Electrical Department.

219. Verification of Land Boundaries: (1) Every Railway Administration is responsible for the demarcation and periodical verification of the boundaries and the maintenance of proper records in connection therewith of all land in the possession of that Railway **(Para 1048 - E).**

(2) The Permanent Way Inspector is responsible for maintaining the railway land boundaries between stations and at unimportant stations. The unimportant stations where the land boundaries are to be maintained by the Permanent Way Inspector should be specified by the administration.

(3) The Permanent Way Inspector is responsible for reporting any encroachment that may occur as soon as they are noticed, to the Assistant Engineer who will on receipt of such report initiate measures to remove the encroachments.

(4) The Permanent Way Inspector shall submit, by the prescribed date every year, a certificate to the Assistant Engineer, copy endorsed to the Divisional Engineer for information, in the following form :

I certify that I have inspected the railway land boundaries on my section during the year ending ... …… and that they are in accordance with the land plans. There have been no encroachments except at the following kilometres that have been reported by me vide reference given against each. I further certify that missing boundary stones at the kilometrages shown below have been replaced.

No Date:

.....
Permanent Way Inspector

(5) During his inspection the Assistant Engineer shall ensure that railway boundaries are demarcated correctly and that there are no encroachments. In cases where he cannot prevail on the parties to remove the encroachments, he must report the facts with particulars to the Divisional Engineer who will take up the matter with the Local Authorities.

220. Trolly Refuges – (1) Trolly refuges in cuttings should be provided as necessary at suitable intervals.

(2) Trolly refuges should be provided on high banks particularly on approaches of important bridges.

(3) On double line these should be staggered, alternate trolly refuges being on up and down sides respectively. The space between the track should be filled with ballast and levelled up to the rail level for easy off-tracking of the trollys opposite to the trolly refuges.

(4) Maximum distance apart of Trolly refuges on bridges will be as under :–

(i) On bridges with main spans of less than 100 metres - 100 metres.

(ii) On bridges with main spans of 100 metres or more - A refuge over each pier.

(iii) On ballasted deck Bridges - 50 metres.

(5) In the case of tunnels, the maximum distance apart of trolly refuges shall not exceed 100 metres.

For easy identification of the location of trolly refuges in tunnels and deep cuttings a distinguishing mark such as a rail post, painted with luminous paint with a mark ‘R’ may be erected by the side of the trolly refuge.

221. Standard Dimensions – (1) *Infringement:* The Permanent Way Inspector should refer any work resulting in infringement of standard dimension to the Assistant Engineer for instructions. Work involving permanent infringement should be referred to the Railway Board for sanction through the Commissioner of Railway Safety.

Permanent way staff shall be on the alert to prevent occurrence of :

(i) 'Slacks' in platform line causing the platform heights to exceed the standard dimension.

(ii) Errors in alignment causing the minimum distance to adjacent structures infringed, for example, platform coping, water columns, overbridges, O.H.E. structures.

(iii) Excessive lifting of the track , causing minimum height to overhead structure to be infringed, for example, underside of overbridge, roofs of tunnels, overhead contact wires.

(2) *Verification and preparation of yearly statements of infringements:* Once a year, the standard dimensions over their sections shall be verified personally by the Permanent Way Inspector according to the profiles shown in the schedule of dimensions and statements of infringements, if any, submitted to the Assistant Engineer by the end of March. The Assistant Engineer after scrutiny should forward these to the Divisional Engineer.

The statement shall briefly indicate against each infringement the reasons for its continuance together with reference to the sanction of Railway Board/ Commissioner of Railway Safety. The Divisional Engineer after scrutinising the yearly returns will issue necessary instructions to the Assistant Engineer. Important items should be referred to the Chief Engineer.

222. Felling of trees obstructing view – Trees and bushes that interfere or tend to interfere with the view from a train or trolly, of signals or level crossings or along the inside of curves, shall be cut. When cut, it should be ensured that they do not foul the track.

When trees and bushes require to be cut in terms of sub-para above, on private lands, action should be taken as laid down in **Section 15 of the Indian Railways Act** reproduced betow :

"15. (1) In either of the following cases, namely:

(a) Where there is danger that a tree standing near a Railway may fall on the railway so as to obstruct traffic, and

(b) When a tree obstructs the view of any fixed signals, the Railway administration may, with the permission of any Magistrate, fell the tree or deal with it in such other manner as will, in the opinion of the Railway administration avert the danger or remove the obstruction, as the case may be.

(2) In case of emergency the power mentioned in sub-section (1) may be exercised by a railway administration without the permission of a Magistrate.

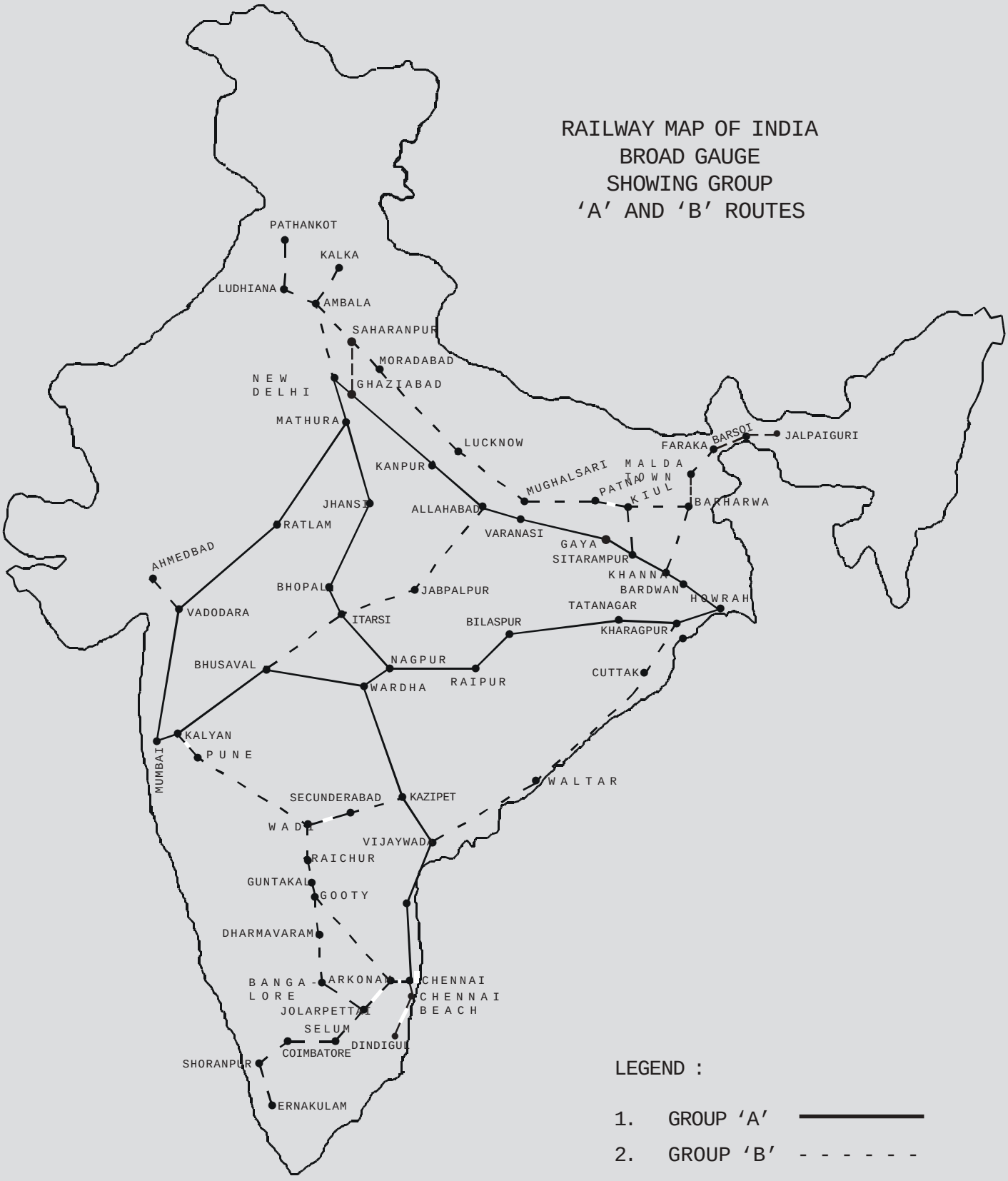
(3) Where a tree felled or otherwise dealt with under sub-section (1) or sub-section (2) was in existence before the railway was constructed or the signal was fixed, any Magistrate may, upon the application of the persons interested in the tree, award to those persons such compensation as he thinks reasonable.

(4) Such an award, subject, where made in a presidency town by any Magistrate other than the Chief Presidency Magistrate, or where made elsewhere by any Magistrate other than the District Magistrate, to revision by the Chief Presidency Magistrate or the District Magistrate, as the case may be, shall be final.

(5) A Civil Court shall not entertain a suit to recover compensation for any tree felled or otherwise dealt with under this section."

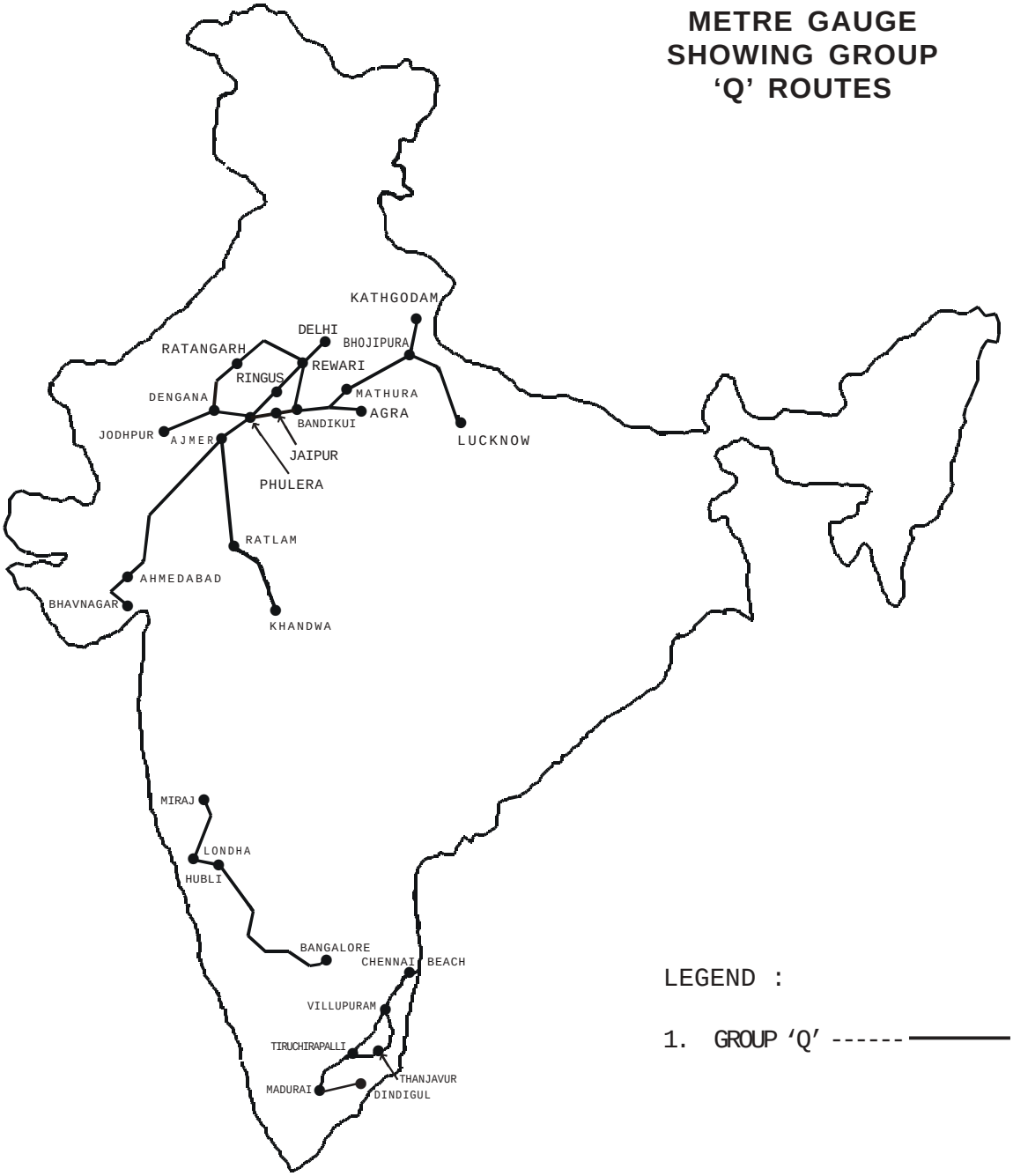
223. Side drains. Catch water drains and Water-ways – The Permanent Way staff shall keep all side drains and catch water drains clear. They should ensure that the outfalls of these drains and the water-ways of all Bridges and Culverts are kept free from obstruction. The spoils from cleaning drains or cuttings should not be deposited at a place from where it is likely to be washed back into the drains.

ANNEXURE - 2/1 PARA 202



ANNEXURE-2/2 PARA 202

RAILWAY MAP OF INDIA METRE GAUGE SHOWING GROUP 'Q' ROUTES



LEGEND :

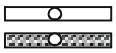
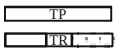
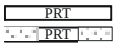
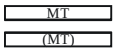
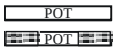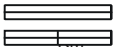
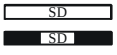
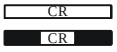
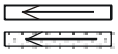
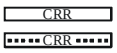
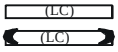
1. GROUP 'Q' ------

ANNEXURE-2/3 PARA 206

GANG CHART

DIVISION_____SUB-DIVN._____PWI_____

SUB SEC._____ SECT BET_____AND_____

1	CHART FOR GANG No	_____	OVERHAULING	WORK SET WORK DONE	
2	KILOMETRE	_____	ORDINARY THROUGH PACKING	WORK SET WORK DONE	
3	MATE (NAME)	_____	PICKING UP SLACKS	WORK SET WORK DONE	
4	GANG STRENGTH	_____	ATTENTION TO PTS. & XING	WORK SET WORK DONE	
5	RAILS	_____	PRETAMPING OPERATION	WORK SET WORK DONE	
6	SLEEPERS	_____	MACHINE TAMPING OPERATION	WORK SET WORK DONE	
7	FASTENINGS	_____	POST TAMPING OPERATION	WORK SET WORK DONE	
8	DEPTH OF BALLAST CUSHION BELOW SLEEPER (mm)	_____ KM	MISC/SQUARING JOINTS KM	WORK SET WORK DONE	
9	DEEP SCREENING	_____	CLEANING SIDE DRAINS	WORK SET WORK DONE	
10	OVER HAULING	_____	ATTENTION TO CESS REPAIRS	WORK SET WORK DONE	
11	DESTRESSING	_____	PULLING BACK CREEP	WORK SET WORK DONE	
12	GAP SURVEY & RECTIFICATION	_____	REALIGNMENT OF CURVES	WORK SET WORK DONE	
13	DETAILS OF CURVES/BRIDGES	_____	CASUAL SLEEPER RENEWAL	WORK SET WORK DONE	
14	L-XING & SEJ	_____	CASUAL RAIL RENEWAL	WORK SET WORK DONE	
			OVERHAULING OF L XING	WORK SET WORK DONE	

ATTENDANCE

M	K	G	TOTAL

KILOMETER →

SIGNALLED LOOP LINES

LOOP No.

T/OUTS ON RUNNING LINES

T/OUT No

PART 'B'

Regular Track Maintenance

224. Through Packing: Conventional Maintenance By Beater Packing :– (1) *General*: Through packing shall consist of the following operations in sequence. The length of track opened out on any one day shall not be more than that can be efficiently tackled before the end of the day:

(a) Opening of the road.
(b) Examination of rails, sleepers and fastenings.
(c) Squaring of sleepers.
(d) Slewing of track to correct alignment.
(e) Gauging.
(f) Packing of sleepers.
(g) Repacking of joint sleepers.
(h) Boxing of ballast section and tidying.

Through packing is best done continuously from one end of a gang length towards the other.

(2) Each of the above operations should be carried out as detailed below :– *(a) Opening of Road*: Ballast should be opened out on either side of the rail seats to the extent shown hereunder to a depth of 50 mm. below the packing surface without disturbing the cores under the sleepers:

(i) Broad Gauge : End of sleepers to 450mm. inside of the rail seat.

(ii) Metre Gauge : End of sleepers to 350mm. inside of the rail seat.

(iii) Narrow Gauge (762mm.) : End of sleepers to 250mm. inside of the rail seat.

In case of cast iron plate or pot sleepers, the opening out should be to the extent of the plates or pots to enable packing being done conveniently.

The ballast should be drawn by powrahs/ shovels outwards and inwards i.e., that portion of the ballast on the outside of the rail should be drawn outwards, the portions between the rails being drawn towards the centre, care however, should be taken to see that the ridge between the rails does not project more than 50mm. above rail level.

(b) *Examination of Rails, Sleepers and Fastenings* – (i) Rails should be examined, the underside for corrosion, the ends for cracks, the head for top and side wear, rail joints for wear on the fishing planes, fish bolts for tightness. If rails on curves wear at an unusually rapid rate, lubrication of the gauge face should be done. Rust and dust must be removed from the corroded rails by using wire brushes; kinks in rails should be removed by jimcrowing.

(ii) Sleepers should be inspected for their condition and soundness particularly at the rail seats. In case of wooden sleepers, plate screws, spikes and fang-bolts should be examined for their firm grip. Sleepers should be checked for split and decay.

In case of cast iron sleepers, the condition and firmness of cotters and keys should be examined. Loose keys should be tightened by providing liners or replaced by appropriate oversized keys. In the case of wear in the rail seat of CST. 9 plates, suitable pad/saddle plates may be provided. Fastenings and fittings should be examined to ensure that they are in good order, appropriately tightened so that they firmly hold the rails. Broken ones should be replaced immediately.

(c) *Squaring of sleepers :*– Gauge variations and kinks inevitably result from sleepers getting out of square.

(i) The spacing of sleepers on the sighting rail should first be checked and correctly chalk-marked. Corresponding marks should then be made on the other rail using the square at every point. The core of sleepers that are out-of-square should then be 'picked' with the pick ends of beaters, the fastenings loosened and the sleepers levered and squared to correct position.

(ii) Squaring should be done by planting the crow bars firmly against the sleeper and pushing it. Under no circumstances should sleepers be hammered. Sleepers that are squared should be regauged immediately, the fastenings tightened and repacked.

(d) *Slewing of track to correct alignment*: - (i)Heavy slewing will only be required during realignment of curves when it will be necessary to loosen the rail, joints and in case of steel sleepers and cast iron sleepers to loosen the fastenings, the packing cores being broken with the pick-ends of beaters. Slewing for normal maintenance will be of a small order and should be done after opening out the road, loosening the cores at ends and drawing out sufficient ballast at the ends of the sleepers.

(ii) Slewing of track shall be directed by the Mate who on straights should sight the rail from a distance of 30 to 60 metres. On curves, he should sight the outer rail. Slewing is best done in the morning unless it is cloudy, as later on, sighting conditions become unfavourable.

When slewing, the crow bars should be planted well into the ballast at an angle not more than 30 degrees from the vertical; otherwise lifting of the track may result.

(e) *Gauging* :– (i) Preservation of gauge is an important part of track maintenance especially through points and crossings. For good riding, the basic requirement is uniform gauge over a continuous stretch of track and such gauge should be allowed to continue so long as it is within the permissible limits of tightness or slackness.

(ii) Gauging should only be done after ensuring that sleepers are truly square. Standard keying hammers shall always be used. Beaters and heavier hammers should not be used, as this causes overdriving of keys and strained lugs on metal sleepers.

(iii) The track gauge should be held firm with one lug against the base rail, and the other end being swivelled over the opposite rails. The tightest position obtained determines the correct point to test the gauge. The gauge should not be forced as that causes considerable wear on the gauge lug.

(iv) The track gauge should be adjusted to correct gauge on the rail opposite to the base rail. The required slackness on sharp curves should be attained by using liners of the requisite thickness against the lug of the gauge in the case of ordinary track iron gauge.

(v) While it is desirable to maintain correct gauge, where due to age and condition of the sleepers, it is not possible to maintain correct gauge, it is good practice to work within the following tolerances of gauge, provided generally uniform gauge can be maintained over long lengths:

	Broad Gauge	
a)	On straight	-6mm to +6mm
b)	On curves with radius 350 m or more	-6mm to +15mm
c)	On curves with radius less than 350 m	upto +20mm

Note : These tolerances are with respect to nominal gauge of 1676 mm.

Metre Gauge

a)	On straight	-3mm to +6mm
b)	On curves with radius 290 m or more	-3mm to +15mm
c)	On curves with radius Less then 290 m	Upto +20mm

Note : These tolerances are with respect to nominal gauge of 1000mm.

Narrow Gauge

a)	On straight	-3mm to +6mm
b)	On curves with radius of more than 175 metres	-3mm to +15mm
c)	On curves with radius less than 175 metres	Upto +20mm

Note : The above tolerance are with respect to nominal gauge of 762mm.

(f) *Packing of sleepers* (i) The aim of packing is to have each sleeper firmly and uniformly packed to ensure that the rails are at their correct relative levels i.e., level on the straight track and to the required cant on curves and that no sleeper has any void between it and its bed.

(ii) Before packing is commenced, it is necessary to ensure that the chairs/bearing plates are firmy fixed to the sleepers and the rails are bearing on the chairs/ bearing plates. In case of rails resting directly on sleepers it should be ensured that there is no gap between the bottom of the rail and top of the sleeper.

(iii) The base rail shall be sighted by the Mate with eye along the lower edge of the head of rail and any dip or low joint lifted correctly. The adjacent sleepers should then be packed and the top checked. After two rail lengths have been attended to, the rail on the other side should be brought to the correct level by checking cross level with the straight edge and spirit level or gauge-cum level at every rail joint and at every fourth sleeper. The next two rail lengths should then be taken up and the process continued.

(iv) No joint or dip should be lifted higher than the proper level in the expectation that it will settle to the correct level. Instead it will settle more under traffic as a result of being high and cause rough running.

(v) Having aligned the track and adjusted the 'top' the Gangmen should be distributed in batches of two for packing all sleepers in a systematic manner, commencing from one end. Four men should deal with every sleeper successively, two at each rail seat. The ballast under the sleeper should be packed by the men standing back-to-back and working their beaters diagonally under the rail seat at the same time to ensure firm packing.

(vi) It is important that men should thoroughly 'break' the cores with the pick-ends and then use the blunt-ends (head-ones), as otherwise, uniform packing will not be achieved and elasticity of the road-bed affected. After packing the rail seat the packing should be continued outwards and inwards to the requisite extent on each side of the rail seat i.e., end of the sleeper to 450 mm. inside on the B.G. and end of sleeper to 350 mm. inside on the M.G. and end of sleepers to 250 mm. inside on the N.G. (762 mm.). The beaters should not be lifted above the chest level, the strokes being kept as nearly horizontal as possible. Care must be taken to avoid forcing under the sleeper any stones so large as to cause uneven bearing and to avoid striking the edges of the sleepers and timbers. All men should aim to work the beater from the same height (chest level) so that the sleepers are uniformly packed. Higher or lower lifting of the beaters results in uneven compactness.

(vii) In case of steel trough and wooden sleepers, packing under the rail seat causes the ballast to work towards the center. Before final dressing is done, it should be ensured that no sleeper is centre-bound by working the pick-ends over the central range. Centre bound sleepers cause vehicles to roll from side to side.

(viii) In the case of CST. 9 sleepers it should be ensured that the end pockets or bowls are filled with ballast and the main packing should be done at corners. The central flat portion of the plate should not be packed hard but only tamped lightly. On pot sleepers the ballast should be punned through the holes provided at the top of the pot and rammed in with crow-bars.

(ix) Care must also be taken while packing to ensure that the work does not result in the sleepers adjoining those being packed, lifted off their bed, thus creating artificial voids under them.

(x) The packing on the inside and outside at every rail seat should, before boxing the track, be checked by the Mate by tapping with a wooden mallet or a canne-a boule. A hollow sound would indicate defective packing which should be attended to again.

(xi) As soon as the packing is completed, slight distortions in alignment and top should be checked and corrected by the Mate, the sleeper disturbed for this purpose being finally repacked.

(g) *Repacking of joint sleepers:* The joint and 'shoulder' sleepers should be repacked, before boxing is done and the cross-levels at joints checked. The rail joint being the weakest portion, firmness of its support is essential.

(h) *Boxing to Ballast section and Tidying* – (i) After completing the preceding operations in sequence, clean ballast should be worked in with ballast forks or rakes. The ballast section should be dressed to the specified dimensions, a template being used for the purpose. Hemp cords 6 mm. dia. of sufficient length should be used for lining the top and bottom edges of the ballast section. Where the quantity of ballast is inadequate, full section of ballast should be provided near the rail seat, the deficiency being reflected along the centre of the track and not under the rails or in the shoulders.

(ii) The cess should then be tidied up. Where earth ridging is existing at the edge of the bank, this should be removed. Cess should be maintained to the correct depth below rail level according to the ballast-section and formation profile. Too high a cess affects drainage; too low a cess results in ballast-spread and wastage.

225. Maintenance By Measured Shovel Packing – Deleted.

226. Track Maintenance by Machines – (1) *General* **-** Mechanical maintenance of track involving use of "on track machines" should be planned, on long continuous lengths.

(2) *Pre-requisites to introduction of mechanical maintenance* – (a) A minimum depth of 150 mm. of clean ballast is recommended for the proper functioning of the tie tampers. Adequate ballast should be available in the shoulders and cribs.

(b) For this purpose, planning and execution of deep screening of ballast where required, as well as running out of ballast, should be done well in advance.

(c) These machines require line occupation and availability of blocks for their working. It is

desirable for these machines to be given a single block of at least 4 hours per day or two separate blocks of 2½ hours each, for better working. It is necessary to have longer blocks, so that the net available time for working on the line is as high as possible. On the double line section, temporary single line working may be introduced whenever possible. Diversion of some trains along alternative routes may also be resorted to, wherever possible. An ideal situation would be to provide for time allowance for working the machines in the working time table. The block time should be interpolated in the master chart for passenger and goods trains that is prepared with every change in time table. It is as much the responsibility of the Operating Department as that of the Engineering Department to ensure provision of adequate time for economical working of machines. For this purpose it is desirable to frame a programme of working the machines in consultation with the Operating Department.

(d) Sanction of the Commissioner of Railway Safety is to be taken before introducing any new type of 'on - track' machine on a section.

(3) *Pre-tamping attention* – To achieve good results the P.W.I. should carry out the following preparatory work before taking up the tamping:

(a) Ballasting where there is shortage of ballast.

(b) Heaping up of ballast in the tamping zone, to ensure effective packing.

(c) Making up of low cess.

(d) Cleaning of pumping joints and providing additional clean ballast, where necessary.

(e) Attending to Hogged joints before tamping.

(f) Tightening of all fittings and fastenings like fish bolts and keys, splitting of cotters, and replacement of worn out fittings.

(g) Renewing broken and damaged sleepers.

(h) Squaring of sleepers and spacing adjustment; regauging to be done as necessary.

(i) Adjusting creep and expansion gap in rails.

(j) Examination of rails for cracks etc.

(k) Realigning of curves which are badly out of alignment.

(l) Clearing of ballast on sleepers to make them visible to the operator.

(m) All obstructions such as signal rods, cables, pipes, level crossing check rails, etc., likely to be damaged by the tampers should be clearly marked and made known to the tamping operator before he starts work. Tight overhead clearance should also be brought to his notice; the beginning and end of transitions should be marked. Super elevation should be marked on every second sleeper so that it can guide the operator for levelling up correctly.

(4) *Attention during Tamping:* – The following points should be observed by the machine operator and the Permanent Way Inspector :

(a) The tamping depth i.e. gap between the top edge of the tamping blade and the bottom edge of the sleeper in closed position of the tamping tool should be adjusted depending on the type of sleepers. This is particularly important in the case of steel trough sleeper because of its shape. Care should be taken to ensure that tamping tools are inserted centrally between the sleepers into the ballast to avoid any damage to the sleepers.

(b) The tamping (squeezing) Pressure should be adjusted according to the track structure, as per the recommendations of the manufacturer.

(c) The number of insertions of tamping tools, per sleeper tamped, varies with the type of sleeper -

(i) CST-9 sleepers and steel trough sleepers require tamping twice before passing on to the next sleeper.

(ii) Wooden Sleepers - Normally one insertion upto 20 mm. Lift and two insertions for lifts above 20 mm may suffice. One additional insertion for joint sleepers will be required.

(iii) Concrete Sleepers-Generally one insertion is adequate. Two insertions may be necessary if the lift is above 30 mm.

(d) While Tamping CST-9 and Steel Trough Sleepers, it should be checked that the keys are properly driven and they are tight.

(e) The shoulders should be compacted along with tamping, where separate provision for shoulder compaction is available.

(f) A run-off ramp of 1 in 1000 should be given before closing the day's work.

(5) *Post Tamping Attention* – The Permanent Way Inspector shall pay attention to the following points :

(a) As some of the rigid fastenings might get loose, tightening of fittings should be done immediately after tamping.

(b) Any broken fitting should be replaced.

(c) It is preferable to check gauge and do gauging, wherever necessary, after tamping.

(d) Proper quality check of work done by tamping machine is important. Immediately after the tamping work, the track should be checked, in respect of cross levels and alignment, and action taken as considered necessary.

(e) The ballast should be dressed neatly and proper consolidation of ballast between the sleepers should be done.

(6) General Notes on Working by Machines.:

(a) As far as possible machines should be worked in pairs in the same block section to make effective use of block.

(b) Where shoulder and crib compacting equipment is available with tie tamping machine, the same should invariably be used.

(c) Only trained and experienced persons should be deputed to man the machines.

(d) While stabling the machine, it should be ensured that all the locking devices are properly secured and the switches are put 'off'.

(e) Before putting the machine into commission all the devices should be checked and made sure that they are in proper working order.

(f) The machine should never be run at a speed higher than that permitted/ sanctioned by the Commissioner of Railway Safety.

(g) While passing trains, on adjacent track(s) on double / multiple lines, it should be ensured that no part of the tamping machine is fouling the other track.

(h) The prescribed schedules of preventive maintenance should be adhered to. Suitable maintenance organisation should be created in the Railways as necessary. Sufficient spares should be arranged. An assessment of requirement of spares, based on the experience should be made.

227. Systematic Overhauling – (1) *Sequence of operations*- Overhauling as described briefly in **para 203 (2)** should consist of the following operations in sequence :–

(a) Shallow screening and making up of ballast.

(b) All items attended to, while doing through packing as detailed in Para 224 (1).

(c) Making up the cess.

(2) Shallow Screening and making up of Ballast –

(a) For good drainage periodical screening of ballast is essential.

(b) In the case of manual maintenance, the crib ballast between sleepers is opened out to a depth of 50 to 75 mm. below the bottom of sleepers, sloping from the centre towards sleeper end. For machine maintained section, the crib ballast in the shoulders should be opened out to a depth of 75 to 100mm. below the bottom of sleepers, sloping from the centre towards sleeper end. The ballast in the shoulders opposite to the crib as well as the sleepers is removed to the full depth. A slope is given at the bottom sloping away from the sleeper end. The ballast is then screened and put back. Care should be taken to see that the packing under the sleepers is not disturbed and the muck removed is not allowed to raise the cess above the correct level.

(c) Two contiguous spaces between sleepers should not be worked at the same time.

(d) Screening should be progressed in alternate panels of one rail length. In no circumstances should several rail lengths of track be stripped of ballast.

(e) Where drains across the track exist, they should be cleaned and filled with boulders or ballast to prevent packing from working out and forming slacks.

(f) After screening, full ballast section should be provided, extra ballast being run out previously for the purpose. Work should be commenced after making sure that the ballast will not be seriously deficient. Deficiency, if any, should be shown in the central portion of sleeper and this also should be made up soon.

(3) *Through packing of track* – The detailed operations are described in Para 224. Through packing may be done either by conventional beater packing, or by using machines.

(4) *Making up of Cess* – Cess when high should be cut alongwith overhauling and when low should be made up. A template should be used for this purpose.

(5) *General* – Overhauling should be completed before the end of March. In the case of L.W.R. territory, the provisions in L.W.R. Manual should be followed.

(6) *Screening in Welded area* – In the case of S.W.R. area screening may be carried out at rail temperatures and conditions as detailed in **Para 509.**

228. 3-tier system of track maintenance :–

(1) 3-tier System of track maintenance shall be adopted on sections nominated for mechanised maintenance. This shall consist of the following 3 tiers of track maintenance:

(i) On-track machines (OMU)
(ii) Mobile Maintenance Units (MMU)
(iii) Sectional Gangs

(2) Large track machines for track maintenance include Tie-tamping machines for plain track and points and crossings, shoulder ballast cleaning machines, ballast cleaning machines, ballast regulating machines and dynamic track stabilizers. These machines shall be used as per the various instructions issued in **Indian Railways Track Machines Manual.** These machines shall be deployed to carry out the following jobs:

(a) Systematic tamping of plain track as well as Points & Crossings;
(b) Intermediate tamping of plain track as well as Points & crossings;
(c) Shoulder ballast cleaning;
(d) Ballast profiling/redistribution;
(e) Track stabilization;
(f) Periodical deep screening.

(3) Mobile Maintenance Units–

(a) The mobile maintenance units (MMU) shall consist of two groups:
(i) MMU-I : One for each PWI's section.
(ii) MMU-II: One for each sub-division

(b) The functions of MMU shall be as below:

MMU-I - (Rail-cum-Road Vehicle based) one with each PWI incharge with a jurisdiction of 40-50 Kms double line or 90-100 Kms single line:

(i) Need based spot tamping;
(ii) In-Situ rail welding
(iii) Casual Renewal and repairs except planned renewals
(iv) Overhauling of Level Xings
(v) Replacement of glued joints
(vi) Rail cutting/drilling and chamfering
(vii) Permanent repairs to fractures
(viii) Creep or gap adjustments involving use of machines
(ix) Destressing of LWR/CWR
(x) Loading/Unloading of materials
(xi) Any other functions assigned.

MMU-II - (Road Vehicle Based) one with each sub division
(i) Reconditioning of Turnouts
(ii) Minor repairs to the equipments of MMU

(c) The MMU shall be equipped with the following equipments. These equipments shall be used according to the working instructions, as and when issued.

List of equipments for MMU-I:

(A) *Communication Equipment*

1. Walkie Talkie	4 sets
2. Portable field telephones	4 sets

(B) *Rail Cutting/Drilling Equipment*

3. Disc Cutter	1
4. Rail Cutting Machine	1
5. Rail Drilling Machine	1
6. Chamfering kit	1

(C) *Rail Welding Equipment*

7. Rail Welding Equipment	2 sets
8. Weld Trimmer	1 set
9. Rail Profile Grinder for welded joints	1 set

(D) *Spot Tamping with Lifting Lining*

10. Off Track Hand Held Tamper with Generators	1 set
11. Lifting Jack-hydraulic/ mechanical	4 sets
12. Lifting-cum-Slewing Device	2 sets

(E) *Destressing Equipment*

13. Rail Tensors- Hydraulic/ mechanical	2 sets
14. Rollers, wooden mallets	1complete set for Destressing 3 Km LWR

(F) *Inspection Gadgets*

15. Inspection Kit	1 No.
16. Gauge cum Level	1 No.
17. Rail Thermometer	1 No.
18. Vernier Calipers	1 No.
19. Micrometer	1 No.

(G) *Material Handling Equipment*

20. Rail Dolly	6 No.
21. Mono Rail Wheel Borrow	2 No.

(H) *Safety and Protection Equipments*

22. Warning System
23. Red Banner Flag
24. Red Hand Signal Flag
25. Green Hand Signals Flag
26. Detonators

(I) Gas Cutting Equipments with Accessories: 1 set.

List of Equipments for MMU-II:

(A) *Points and Crossing Reconditioning Equipment :*

1. Welding Generator	1 set
2. Arc Welding Equipment	1 set
3. Hand Held Rail Grinder	2 sets

(B) *For Minor Repairs to Equipments:*

4. Spanner of sizes	2 sets
5. Turfer	2
6. Files of Sorts	2 sets
7. Bench Drill	2
8. Vice Bench	2
9. Bench Grinder	2

(4) *Sectional Gangs:*

The sectional gangs, under 3-tier system of track maintenance shall perform the following functions:

(a) Patrolling of track:
  (i) Keyman's daily patrol
  (ii) Hot/cold weather patrolling
  (iii) Monsoon Patrolling
(b) Watching vulnerable locations
(c) Attention of emergencies viz. temporary repairs of fractures.
(d) Need-based attention to bridges, turnouts, SEJs and approaches of level crossings.
(e) Greasing of ERCs, lubrication of joints, casual changing of rubber pads and other fittings
(f) Minor cess repairs
(g) Cleaning of drains and boxing of ballast
(h) Attention to loops
(i) Creep and gap adjustment not involving use of machines
(j) Cleaning of crib ballast for effective cross drainage
(k) Pre & post tamping attention
(l) Assistance to MMU & OMU as required
(m) Any other functions assigned.

229. Picking up Slacks – Slacks usually occur on stretches of yielding formation on high banks and cuttings, on approaches of bridges, on badly aligned curves, where ballast is poor in quality or quantity or where drainage is defective. Attention to slacks should be need based, need for the same being determined by inspections and results of track recording. Picking up slacks shall be done where the alignment is kinky or top level is uneven and the track has to be restored to normal condition quickly. The quantum of work turned out by a gang during the day will depend on the extent of slacks. In all cases sighting is done, the defects assessed and marks made on sleepers to be dealt with in chalk. The marked sleepers should then be dealt with as in through packing care being taken to see that the packing of adjacent sleepers does not get disturbed. In case a large percentage of sleepers needs attention in a rail length, the entire rail length should be attended to. The marking of defects shall be as indicated below :

Defects	Symbol	Place of indication
Cross levels	C-2	On the sleeper inside gauge face.
Loose packing	H or P	On the sleeper outside the gauge face
Gauge	O ±	On the sleeper inside the gauge face
Unevenness	→ ←	On the rail web on gauge face side
Alignment	↓ →	On the foot of rail inside the gauge face

It is imperative that when joints are picked up, at least three sleepers on either side of the joints are packed. Picking up slacks may be done, by conventional method or by off-track tampers. In the case of a low joint, the fish plates should be slightly loosened and the joint tapped, so that the rail ends are, rendered free and are capable of being lifted. After the joint is thoroughly packed the fish plates should be tightened again.

230. Observance of Sleepers under passage of traffic – During the passage of the first and last trains within working hours, the Mate and Gangmen at the work site should stand on the cess each about one rail-length apart on either side of the portion of track they are attending to, whether through packing or picking up slacks and observe the movement of sleepers under load.

Immediately after the passing of train, loose sleepers should be marked, packed uniformly and the packing tested. In respect of other trains, the Mate and the Gangmen should observe the sleepers near where they are working and take similar action. Firm and uniform packing is the primary need for good track maintenance.

231. Sample of standard section of track – At or near the commencement of each gang length between stations a sample of three rail lengths of track should be maintained to accord with all standards laid down –

(a) Formation of standard width and level below rail.

(b) Clean ballast of correct size, quantity and cross section.

(c) Correct alignment, level and gauge.

(d) Sleepers and fastenings in good condition.

The object of the sample track is to indicate the standard to which the track should be maintained throughout the gang length.

232. Checking work of Gangs by Permanent Way Inspectors – (1) *Examination of Gang's Work*– The work done by a gang either on the previous day or during the interval when the Permanent Way Inspector is next with the gang should be examined for alignment, surfacing and boxing throughout. The Permanent Way Inspector should inspect rails and sleepers and their fastenings and check cross levels, gauge, squareness of sleepers, packing, joint maintenance, profile of ballast and depths of cess below rail level. The Mate's Muster Sheet should be checked and initialled. Instructions to the Mates should be recorded in the gang diaries.

(2) Examination of tools and equipment - (a) The Permanent Way Inspector should examine every month and replace, when necessary, worn out tools and equipment.

(b) He should check the accuracy of the spirit level/gauge and straight edge every month, the result of this examination being entered in the Mate's diary book.

(c) Each gang should have the following minimum equipment:

(i) Level-cum-gauge.
(ii) One set of hand signal flags, red and green (2 hand signal lamps at night).
(iii) 12 detonators.
(iv) Steel scale 30cm. long.
(v) Straight edge 1 metre long.
(vi) Square.
(vii) Hump chord.
(viii) Keying and spiking hammer.
(ix) Marking chalk.
(x) Rail thermometer.
(xi) Sufficient No. of shovels, Phowrahs, beaters, crow-bars, Ballast-forks or rakes, mortar pans or baskets.
(xii) Wooden mallet or Canne-a-Boule.
(xiii) Feeler gauge.

(3) *Instructions and Tuition* – The permanent Way Inspector should ensure that every man in each gang is aware of the following rules in which the men should be examined periodically and on appointment, promotion or transfer :–

(a) Protecting the lines in an emergency or during work affecting the running of trains.
(b) Method of fixing and safety range of detonators.
(c) Showing of signals with or without hand signal flags during day and with hand signal lamps during night.
(d) Action to be taken when a train is noticed to have parted.
(e) 'Safety first' rules.
(f) Patrolling of the line during heavy rains /storms and hot weather on LWR lengths.The Permanent Way Inspector should instruct the men in the proper use of tools and upkeep of the road. The instructions should not be of a casual nature; they should be demonstrative.

233. Lifting Of Track – (1) Lifting of track will become necessary during regrading and for elimination of minor sags, which develop through improper maintenance or yielding soil, to keep a good top.

(2) Correct level pegs should be fixed at suitable intervals, before lifting is commenced.

(3) Heavy lifting should always be carried out under suitable speed restriction and under the protection of corresponding engineering signals. Lifting should not exceed 75 mm. at a time so as to allow proper consolidation. The easement gradient for the passage of trains should not be steeper than 25 mm. in one rail length of 13 metres. The operation should be repeated until the required level is attained when the track should be finally ballasted, through packed and boxed, the cess being made up to proper level.

(4) Lifting should commence from the down hill end carried out in the direction of rising grade in case of single line. It should proceed in the opposite direction to traffic, in case of double line, care being taken not to exceed the easement grade.

(5) While lifting track under bridges and overhead structures and in tunnels it should be ensured that there is no infringement of standard dimensions.

(6) In case of curves, it is usual to set the inner rail to the correct level and grade and to raise the outer rail to give the required superelevation, care being taken to see that the cant gradient is within the permissible limit.

234. Lowering of Track – (1) Lowering of the track should not be resorted to except where it can not be avoided and if resorted to, it should be done under suitable speed restriction and under the protection of Engineering signals.

(2) When lowering is to be done, trenches should be made across the track at every 30 M. to the final level in order to give a continuous indication, while the work is in progress. The ballast should be removed sufficiently far away from the track to prevent it getting mixed up with excavated material.

(3) The procedure is to clear the spaces between the sleepers, then slightly lift the track, break the packing beneath and level it into the space between sleepers. This material is then removed and the operation repeated until the final level is reached. The road should then be ballasted, through packed and boxed, the cess being cut down to proper level.

(4) Lowering as in the case of lifting, should be restricted to a maximum of 75 mm. at a time and the grade for passage of trains should not exceed 25 mm. in a rail length of 13 M. As opposed to lifting, lowering should be carried out in the direction of the falling grade.

(5) Work of lifting or lowering of track should be carried out in the presence of Permanent Way Inspector.

235. Distance Pieces to Platform Lines – Tracks adjacent to platforms should be provided, with 'distance pieces' made of unserviceable timber fixed at intervals of about 30 M. one end of each such piece butting against the near rail and the other against the face of the platform wall or any other suitable arrangement to obviate the possibility of infringement of the horizontal distance from centre of track to face of platform coping.

236. Fouling Marks – (1) Fouling marks should be distinctly visible and difficult to remove.

(2) These should be fixed at the point at which the spacing between the tracks, begin to reduce to less than the minimum as laid down in the schedule of dimensions.

(3) The fouling marks should consist of a stone /cement concrete block about 1500 mm. in length, 250 mm. wide and 125 mm. thick, with the top edge rounded off and the top surface white-washed or of unserviciable rail pieces embedded in concrete support & painted white. These should be laid level with the top line of the ballast section.

The number of wagons which can be accommodated in a siding or a loop should be marked on each fouling mark.

237. Inspection and Maintenance of Points and Crossings – (1) *Maintenance - General*- (a)Points and crossings should be laid without the 1 in 20 cant.

(b) Where large number of Points and Crossings are being maintained within a specific area such as marshalling yards, large lay-outs of sidings, terminal stations etc., regular cycle of maintenance covering all Points and Crossings should be organised.

(c) Cess should be low enough to permit efficient drainage and adequate depth of ballast cushion should be provided.

(d) Correct spacing of sleepers should be ensured according to the standard lay out drawings.

(e) There should be no junction fish plates at stock rail joints or at the heel of crossings. At least one rail on either side of the Points and Crossings should have the same section as the Points and Crossings assembly rail section.

(f) Use of spherical washers at appropriate places in a Points and Crossings assembly is very important. A spherical washer is used to obtain flush fit of the head of the nut of the bolt with the web of the rail, in the switch and crossing assembly. The use of spherical washer is necessary where the shank of the bolt is not at right angles to the axis of the rail. Spherical washers are used on skew side. In I.R.S. turnouts with straight switches, these should be provided on the left hand side invariably in the switch assembly.

(g) The gauge and cross level measurements shall be done at the nominated stations as indicated in the proforma. The track geometry at the turnout should not be inferior to that applicable to the route. However, gauge just ahead of actual toe of switch shall be as follows:

(i) All BG turnouts of 1:12 BG 60 kg with 10125 mm O.R. curved switches (on wooden, steel or PSC sleepers), 1:12 BG 52 Kg with 10125 mm O.R. curved switches on PSC sleepers and all thick web switches (52 kg/ 60 kg) on wooden/PSC sleepers i.e. all turnouts with switches having switch entry angle $\leq 0^{0}$°20'00" = Nominal gauge.

(ii) All other turnouts excluding those (i) above i.e. turnouts with switches having switch entry angle > 0^{0}°20'00"=Nominal gauge + 6mm.

h) The clearance, at the toe, heel of switch, at check rail and wing rail must be maintained within the tolerances prescribed in the schedule of dimensions.

i) Packing under the sleepers must not be loose/defective especially under the crossing and the switch.

(j) The chairs and fastenings and all other fittings must be properly secured.

(k) The Points and Crossings assembly, should be in good condition and alignment with the rest of the track without kinks.

(l) Adequate creep anchors should be provided to arrest creep. Box anchoring of at least one rail length ahead of stock rail is recommended. Creep posts should be erected at all interlocked facing points opposite the toe of the switch and creep should not be allowed to exceed permissible limits. In case of PSC sleeper layout with elastic fastening, creep anchors need not be provided. In case excessive creep is observed at such layouts, the condition of elastic fastenings may be examined and suitable action be taken.

(m) It is desirable to weld stock and lead joints on the Points and Crossings assembly.

(2) *Maintenance of Switches* –

(a) In case of straight switches, correct amount of bend should be given to the stock rail on the turnout side at the theoretical toe of switch, to avoid bad alignment and kink.

(b) The condition of stock & tongue rails should be carefully examined. Badly worn and damaged stock and tongue rails should be replaced by serviceable ones. A tongue rail may be classified as worn/damaged when -

It is chipped/cracked over small lengths aggregating to 200 mm. within a distance of 1000 mm. from its toe (i) chipped length will be the portion where tongue rail has worn out for a depth of more than 10 mm over a continuous length of 10 mm.

(ii) it has developed knife edged tip (thickness of top edge being less than 2 mm) over a length of more than 100 mm any where upto a distance of 1000 mm from its toe.

(iii) it is badly twisted or bent and does not house properly against the stock rail causing a gap of 5mm or more at the toe, the limit described in the I.R.S.E.M. The tongue rail can, however, be reused after reconditioning of the broken/worn/ damaged tip by welding.

(iv)Tongue rail should be replaced/ reconditioned when vertical/lateral wear exceeds the values laid down. The wear shall be measured at a point with 13 mm head width and at the point where tongue and stock rails are at same level. This location is indicated in table at **Annexure 2/6/1.**

Vertical Wear	– 8mm for 60 kg
	– 5mm for 52 kg and 90R
	– 3mm for 75R and 60R
Lateral Wear	– 8mm for 60 kg
	– 6mm for 52 kg and 90R
	– 5mm for 75 R and 60R

(v) Wear on stock rail shall not exceed the limits laid down in **para -302 of IRPWM.** However, proper housing of tongue rails is to be ensured.

Burred stock rail likely to obstruct the lock bar, should be replaced, if necessary.

(c) Rail Gauge ties, rodding etc., hinder proper packing and ordinary beaters become ineffective. Yard gangs therefore, should use tamping bars at such locations.

(d) To check the housing of the tongue rail and also the throw of the switch, all non - interlocked points should be operated by hand lever and other points from the signal frame, when traffic permits doing so. If the tongue rail is found to be not housing properly against the stock rail, the defect must be rectified by the Permanent Way Staff in case of non-interlocked points and jointly with signal and telecommunication staff, in case of interlocked or partially interlocked points.

(e) Tongue rail should bear evenly on all the slide chairs. This will be ensured when all the sleepers are packed properly.

(f) When the tongue rail is in closed position, it must bear evenly against distance studs or blocks.

(g) All bolts on switches should be kept tight.

(h) Slight wide gauge at the toe of switch over and above the required widening to house the tip of the tongue rail, may be adjusted by providing suitable steel packing between the web of the stock rail and the lug of the slide chair wherever feasible.

(i) Stretcher bars connected to the pull rod shall be maintained jointly by the Permanent Way Staff and the Signaxlling Staff. All other stretcher bars shall be maintained by the Permanent Way Inspector. Stretcher bars insulated for track circuit purposes shall not be interfered with unless signal staff are present.

(j) Wear on switches can be reduced by lubrication of the gauge face of tongue rail.

(k) On wooden sleeper layout assembly, the slide chairs should be fixed to timbers by plate screws; Round spikes should not be used for this purpose.

(3) *Maintenance of Crossings* –

(a) If any damage to the nose of crossing is noticed, its cause must be traced, which may be due to tight gauge or due to excessive clearance at the check rail.

(b) If wing rails or check rails are badly worn laterally, it could be due to wide gauge at the crossing. Gauge can be maintained properly by the provision of a gauge tie plate under the nose of crossing, on layout of wooden sleepers.

(c) In obtuse crossings, the distance between the throat and the nose must be maintained correctly.

(d) In diamond crossings, obtuse crossings should be laid square to each other with respect to the centre line of the acute crossings.

(e) Maximum permissible vertical wear on wing rails or nose of crossing shall be 10mm. However, on Rajdhani/Shatabdi routes, as a good maintenance practice, crossing and the wing rails should be planned for reconditioning/resurfacing by welding on reaching the following wear limits:

Built up/welded crossing - 6mm

CMS crossings - 8mm

Note :

(i) In case of CMS crossings, following dimensions should be deducted (to account for slope in casting of wing rails to 1:20 cant) from the observed wear measurements to find out the actual wear.

for 52 kg section : 2.0mm.

for 60 kg section : 2.5mm.

(ii) In case of welded heat treated crossings, the dimensions to be deducted from the observed wear for finding out actual wear is as shown on the relevant layout drawing.

(f) In the case of steel trough sleepers used in crossings, use of wooden blocks added to the contour of the underside of sleepers, strengthens the support and helps in better maintenance. However, for sleepers strengthened by providing steel ribs on their underside, use of wooden block is not required.

(4) *Maintenance of lead portion and turn in curve*–

(a) The leads and radii of turnout should be correct according to the section of the rail and the angle of crossing used.

(b) Initially, the lead curve correctness should be ensured by measuring offsets from the gauge face of the straight track. During maintenance, stations at 3.0 M intervals should be marked and the versines checked and track attended as necessary.

(c) The versines of turn in curves on loops should be recorded at stations at 3.0 M intervals on 6.0m chord length during the inspection of points and crossings to check the sharpness of the curve and rectified as necessary. The turn-in curve should also be checked for condition of sleepers and fastenings.

(d) The variation in versines on two successive stations in lead curve and turn in curve portions should not be more than 4mm. and versine at each station should also not be beyond ± 3mm. from its designed value

(5) Schedule of Inspections of Points and Crossings –

(a) *Permanent Way Inspector's Inspection* - The Permanent Way Inspector-in-charge of the Section and his Assistant should carryout thorough inspection of points and crossings in passenger running lines once in 3 months and other lines once in six months by rotation.

(b) *Assistant Engineer's Inspection* - The Assistant Engineer should inspect once a year all points and crossings thoroughly on passenger running lines and 10 per cent of the points and crossings on other lines.

(c) *Divisional Engineer's Inspection* - The Divisional Engineer should inspect at his discretion a certain number of points and crossings particularly in running lines and those recommended for renewals.

(d) *Proforma for points and crossings inspection* is appended as **Annexure 2/6.**

(6) *Cleaning and Lubrication of Points* - At all interlocked and partially interlocked stations, the Signal Staff will be responsible for the periodical cleaning and lubrication of slide chairs of all points interlocked with signals or provided with locks. The Permanent Way Inspectors shall be responsible for the cleaning and lubrication of slide chairs of all hand operated points on their sections.

(7) *Alterations of Points* – The position of points and crossings should not be altered nor should any be removed without the written authority of the Divisional Engineer. The sanction of the Commissioner of Railway Safety is necessary in the case of alterations/insertion/removal of points and crossings in existing running lines.

(8) *Gauge and Super-elevation in Turnouts* – (a) It is a good practice to maintain uniform gauge over turn outs.

(b) If gauge of track adjoining the points and crossings is maintained wider/tighter than the gauge on the points and crossings, the guage on the adjoining track must be brought to same gauge as in the points and crossings and run out at the rate of 1 mm in 3 M to the requisite extent.

(c) Super-elevation on turnouts with curve of similar or contrary flexture should be provided in accordance with **Paras 413 and 414.**

(9) *Interlocked Points* – Before interlocking work is taken in hand, the Permanent Way Inspector should :

(a) Bring the rails to correct level and alignment.

(b) Fully pack and ballast the points to be interlocked.

(c) Provide creep indicators if required.

(d) Mark places where the rods and wires have to cross the lines.

(e) To avoid future adjustments of gear, see that the Permanent Way at points, is laid to correct gauge so that switches, fittings and locks may be correctly put together.

(f) Clear formation and bring it to the correct level and section where rods and wires have to be run.

(g) Make the road at level crossings, if any to correct level and section to allow casing pipes for wires to be put in their final position.

(h) Provide and fix special timbers as may be required.

(i) Provide sufficient anchors of an approved type ahead of switches.

(j) Fit gauge ties correctly to all switches.

As interlocked points should be disturbed as little as possible, it is of the utmost importance that these instructions should be rigidly adhered to.

In the case of interlocked points, the Signal Inspector will be responsible for keeping in working order, the interlocking parts and apparatus. As the slewing of the track at points is likely to throw them out of adjustment, such work should not be undertaken except in the presence of the Signal staff.

On the advice of track defects from Signal Inspectors, Permanent Way Inspector should promptly attend to them.

(10) *Date of Laying Points and Crossings* – The month and year of laying a new or second hand points and crossings should be painted in white block letters on the webs of switches about 500mm. from the heel joint and the webs of crossings about 500mm. from the joint connected to the lead rails. When second hand points and crossings are subsequently laid at another site, the dates previously marked should not be obliterated; an indication of the total life will then be available. In the case of reconditioning of switches and crossings the date of reconditioning should also be painted.

Annexure-2/6 PARA 237(5)

PROFORMA FOR INSPECTION OF POINTS AND CROSSINGS

Station _____

Point No. _____

Location _____

Type of rail _____

Date of laying _____

Date of laying reconditioned crossing : _____

1st 2nd 3rd 4th

Date of laying reconditioned switch :

LH : 1st 2nd 3rd 4th
RH: 1st 2nd 3rd 4th

Type of sleeper/assembly _____

Angle of crossing _____

Nominal gauge of turnout _____

Left hand or right hand _____

Laid on straight or on curve of radius _____

Similar/contrary flexure _____

Particulars	Details of Inspection	Action taken with date and sign	Details of Inspection	Action taken with date and sign
1	2	3	4	5
I. General - 1. Condition of sleepers: 2. Condition of ballast and drainage.				

Particulars	Details of Inspection	Action taken with date and Sign.	Details of Inspection	Action taken with date and Sign.
1	2	3	4	5
3. Availability of: a) Ballast in shoulders and cribs. b) Clean ballast cushion				
II. Switch assembly and lead portion				
4. Condition of tongue rails: a) Whether chipped or cracked over 200 mm length within 1000 mm from ATS. LH: RH: b) Whether twisted or bent. LH : RH: (causing gap of 5mm or more at toe) (For joint check with signal staff) c) Whether knife edge LH: RH: d) Vertical wear Right Hand i) At point with 13 mm head width (**as per Annexure 2/6/1)** ii) At point where tongue rail and stock rail level is same (**as per Annexure 2/6/1)** Left Hand i) At point with 13 mm head width **(as per Annexure 2/6/1)**				

Particulars	Details of Insp-ection	Action taken with date And Sign.	Details of Insp-ection	Action taken with date and Sign.
1	2	3	4	5
ii) At point where tongue rail and stock rail level is same **(as per Annexure 2/6/1)** e) Lateral wear - (to be measured at 13 mm to 15 mm below top of stock rail) **(as per Ann.2/6/1)** Right Hand i) At point with 13 mm head width **(as per Annexure 2/6/1)** ii) At point where tongue rail and stock rail level is same **(as per Annexure 2/6/1)** Left Hand i) At point with 13 mm head width **(as per Annexure 2/6/1)** ii) At point where tongue rail and stock rail level is same **(as per Annexure 2/6/1)** Vertical and lateral wear may be measured starting at point 'Q' (13 mm head width) and at a point where the tongue and stock rails are at same level **(as per Annexure 2/6/1)** 5. Condition of stock rail. a) Right hand : i) Vertical wear ii) Lateral wear (to be measured at 13 mm to 15mm below of stock rail) **(as per Annexure 2/6/1)**				

Particulars	Details of Inspection	Action taken with date & Sig.	Details of Inspection	Action taken with date & Sign.
1	2	3	4	5
b) Left hand : i) Vertical wear ii) Lateral wear (to be measured at 13 mm to 15 mm below of stock rail) (as per **Annexure 2/6/1)** 6. Condition of fittings of switches 7. Gauge and cross level in switch and lead portion. a) At 450mm ahead of toe of switch. b) At ATS between the two stock rails: c) At 150 mm behind toe of switch (only gauge) : i) For straight road: ii) For turnout: d) At heel of switch. i) For straight road: ii) For turnout: e) At 3m interval in lead portion **(see note on next page)** Station Set for main line / Set for turnout Gauge: X- : level / Gauge: X- : level 0. ATS Heel / ATS Heel 1. 2. 3. 4.				

Particulars	Details of Insp-ection	Action taken with date & Sign.	Details of Insp-ection	Action taken with date & Sign.
1	2	3	4	5
5. 6. 7. 8. 9. 10 11. 12. **Note:** The gauge and cross level in lead portion should be recorded at the stations where versine measurements are being recorded as per **col. 12(a) or Col.12(b)** 8. Divergence at heel block a) Right hand b) Left hand 9. Throw of switch a) Right hand b) Left hand 10. Creep at toe of switch 11. Packing conditions under the switch assembly. 12. Versine in switch and lead portion. a) Versines of curved stock rail and lead rails upto end of lead curve **(see note on next page):** Station Versines in mm 0. (Heel/ATS)				

Particulars	Details of Insp-ection	Action taken with date & Sign.	Details of Insp-ection	Action taken with date & Sign.
1	2	3	4	5
1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11. 12. b. Versines of curved tongue rail and lead rails upto end of lead curve **(see notes below):** Station Versines in mm 0. (Heel/ATS) 1. 2. 3. 4. 5. 6. 7. 8. 9. 10 11. 12. **Note:** Versines to be recorded at 3 m interval on 6m chord length commencing from heel of switch for straight switch & from ATS for curved switches.				

Particulars	Details of Inspection	Action taken with date & Sign.	Details of Inspection	Action taken with date & Sign.
1	2	3	4	5
13. Housing of stock and tongue rails : LH: RH:				
14. Seating of tongue rails on slide chairs : LH: RH:				
15. Straightness of straight stock rail : (measured on 10m chord)				
16. Straightness of straight tongue rail : (measured on 10m chord)				
17. Distance between gauge faces of stock rails at JOH:				
18. Distance between web to web of tongue rails at respective stretcher bar locations: a) Leading stretcher bar b) Ist following stretcher bar c) IInd following stretcher bar				
19. Gap between top edge of stretcher bar and bottom of rail foot at : a) Leading stretcher bar b) Ist following stretcher bar				

Particulars	Details of Insp-ection	Action taken with date & Sign.	Details of Insp-ection	Action taken with date & Sign.
1	2	3	4	5
c) IInd following stretcher bar				
20. Clearance at JOH: i) When set for main line a) On Open tongue rail side b) On Closed tongue rail side				
ii) When set for turnout side a) On Open tongue rail side b) On Closed tongue rail side				
Note: To be recorded only if spring setting device has been provided at or near JOH.				
III. Crossing Assembly				
21. Condition of crossing a) Sign of propogation of crack (if any) in crossing assembly:				
b) Burring on top surface at nose:				
22. Type of crossing				
23. Wear of crossing A. Built-up/Heat-treated welded crossing (wear to be measured with straight edge at 100 mm from ANC):				
i) On left wing rail: ii) On nose: iii) On right wing rail				
B. CMS crossing (wear to be measured with straight edge):				

Particulars	Details of Inspection	Action taken with date & Sign.	Details of Inspection	Action taken with date & Sign.
1	2	3	4	5
i) On left wing rail: (opposite ANC)				
ii) On nose: (At 100 mm from ANC)				
Actual wear for 52 kg section: measured wear -2.0mm				
Actual wear for 60 kg section measured wear - 2.5 mm				
iii) On right wing rail: (Opposite ANC)				
C. Heat-treated welded crossing				
i) Weld texture on top surface:				
ii) Whether any flow of metal is there in weld portion:				
iii) Any indication of separation of weld metal from parent metal.				
24. Clearance of wing rail opposite nose of crossing and upto 450 mm towards heel end. a) Right b) Left				
25. Gauge and cross level at crossings: a) 1m ahead of ANC i) On straight road ii) On turnout b) 150 mm behind ANC i) On straight road ii) On turnout c) 1m behind ANC i) On straight road ii) On turnout				

Particulars	Details of Inspection	Action taken with date & Sign.	Details of Inspection	Action taken with date & Sign.
1	2	3	4	5
26. Condition of check rail fitting eg.bearing plates, keys, blocks, bolts and elastic fastenings:				
27. Clearance of check rails: a) Opposite ANC: Left: Right: b) At following locations with respect to centre of check rails. i) 500 mm ahead towards toe of crossing: Left: Right: ii) 500 mm behind heel of crossing Left : Right: c) At the flared end towards heel: Left: Right: d) At the flared end towards toe: Left: Right:				
IV Turn in curve: 28. Versines to be measured at 3m interval on 6m chord. (From heel end of crossing to end of turn in curve) Station Versines in mm 0. 1. 2.				

Particulars	Details of Inspection	Action taken with date & Sign.	Details of Inspection	Action taken with date & Sign.
1	2	3	4	5
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
29. Super elevation				
30. Ballast: Availability of : i) 150 mm additional ballast shoulder width on out side of turn in curve. ii) Clean ballast cushion.				
V. General				
31. Any other special feature /defects.				
32. Signature of the inspecting offical with date				

NOTE : (1) Necessary additional entries may be made against relevant columns of switch, crossing and lead assemblies in case of diamond crossing, diamond single slip/double slips.

(2) Locations where the gauge and cross levels are to be checked should be painted on the web of the rail.

Annexure-2/6/1

PARTICULARS OF TONGUE RAILS SHOWING LOCATION AND HEAD THICKNESS AT LEVEL POINT OF STOCK AND TONGUE RAIL

S. No.	Description of switches	Drg. No. of of tongue rails	Location of 13 mm head from ATS mm	Location of JOH from ATS mm	Location of level point of stock & tongue rail from ATS mm	Head thickness of tongue rail at level point mm
1.	6400 mm c/s on w/s BG 52 kg TA-20197	TA-20197/1	464	3005	1503	31.6
2.	6400mm c/s on s/s BG 52kg TA-20836	TA-20197/1	464	3005	1503	31.6
3.	6400mm c/s on PSC BG 52kg RT-4866	RT-4866/2	476.5	3023	1512	31.6
4.	6400mm c/s on PSC BG 60 kg RT-4966	RT-4966/1	476.5	3229	2348	48.25
5.	7135 mm c/s on w/s BG 60 kg RT-3011	RT-3011/1	1046	3900	2836	50.54
6.	7730 mm c/s on w/s BG 52 kg TA-20172	TA-20172/1	814	4669	2335	30.50
7.	7730 mm c/s on s/s BG 52 kg TA-20832	TA-20832/1	814	4669	2335	30.50
8.	10125mm c/s on w/s BG 60 kg RT-2581	RT-2581/1	1682	5840	4247	43.40
9.	10125 mm c/s on PSC BG 60 kg RT-4219	RT-4325/1	1682	5836	4244	43.40
10.	10125mm c/s on PSC BG 52kg RT-4733	RT-4733/1	1682	5540	4029	40.34

Part C
Works Incidental to Regular Track Maintenance

238. Deep Screening of Ballast-

(1) *General* – (a) It is essential that track is well drained for which screening of ballast should be carried out periodically as described in **Para 238(2).** Due to presence of bad formation, ballast attrition, excessive rain fall and dropping of ashes and ore, ballast gets choked up and track drainage is impaired. In such situations, it becomes necessary to screen the entire ballast right up to the formation level /sub-ballast level. Further through screening restores the resiliency and elasticity of the ballast bed, resulting in improved running quality of track. Such screening is called "Deep screening", as distinguished from the shallow screening, which is done, during overhauling.

(b) Deep screening should be carried out in the following situations by providing full ballast cushion :

(1) Prior to complete track renewal.
(2) Prior to through sleeper renewal.
(3) Where the caking of ballast has resulted in unsatisfactory riding.
(4) Before converting existing track, fish plated or SWR into LWR or CWR; or before introduction of machine maintenance, unless the ballast was screened in recent past.
(5) The entire track must be deep screened atleast once in ten years.

(c) The need for intermediate screening between track renewals may be decided by the Chief Engineer depending on the local conditions.

(d) At the time of deep screening, standard ballast section should be provided invariably.

(e) In case of the bad formation, formation treatment should be carried out along with the deep screening.

(f) The work of deep screening should be carried out continuously from one end of the section to the other.

(2) *Procedure for systematic Deep screening (not applicable to LWR Sections)* – (a) *Survey :* Before deep screening of a section is undertaken, it is necessary to survey the section. This will consist of the following operations :

(i) A longitudinal section of the track should be taken indicating the rail levels at every 30 meters, as also at changes of the grades, obligatory points like culverts, bridges, over line structures, tunnels, level crossings, Signal gantries, ash pits, and points and crossings etc.

(ii) In station yards, on run through lines, cross sections at every 50 meters should be taken and plotted including platform levels, rail levels and clearance to underside of overline structures.

(iii) On the basis of longitudinal and cross sections, the final levels will be decided by the Divisional Engineer, keeping in view -

The depth of ballast cushion to be provided;

The relative implications of lifting or lowering of track;

The possibility of eliminating humps, sags, and unevenness in the existing longitudinal section.

It is not necessarily the intention that the original longitudinal section of the line should be restored .

(b) *Preparation of Estimates* – The estimate for the work of deep screening and full ballasting should also include provision of survey mentioned in **sub para 2(a)** of this para.

(c) *Preliminary works.* - (i) Additional ballast required, should be unloaded/spread out opposite to the place where it is required. When ballast is collected along the track, care should be taken to see that the new ballast is not mixed with the unscreened ballast .

(ii) Cess should be brought up to correct level in relation to the final rail level.

(iii) Pegs should be provided at intervals of 30 metres to indicate the final rail levels.

(iv) Slewing of curves should be done in advance.

(v) Sleeper renewal as necessary should be carried out in advance.

(d) Screening operations - General – (i) The work would be done under the supervision of an official not lower in rank than the Permanent Way Inspector Grade III.

(ii) The daily output should be pre-determined, depending on the time allowance, availability of labour, extent of ballasting/screening to be done etc.

(iii) Taking the length to be deep screened daily, planning of speed restriction should be done and necessary notice should be issued to all concerned and speed restriction boards put up.

(iv) It will be desirable to proceed with the work of deep screening in the direction opposite to that of the traffic on double line.

(e) *Detailed procedure* – A day's length will be deep screened as per the procedure detailed below:

Stage I	The ballast should be removed from space 'A' and 'B' on either side of the sleeper '1' down to final formation level and wooden blocks provided to support the rail for passing trains.
Stage II	The ballast is removed from under sleeper '1' down to final formation level/sub-ballast level.
Stage III	The ballast should then be screened and placed back under sleeper '1' which should then be packed.
Stage IV	The wooden blocks from space 'A' should then be removed.
Stage V	The ballast from space 'C' down to formation level should be removed and after screening, be placed in space 'A' upto bottom of sleeper .The balance may be taken outside the track and screened .The rail in space 'C' should be supported with wooden blocks.
Stage VI	The ballast should be removed from under sleeper '2' down to formation level.
Stage VII	Screened ballast should be provided under sleeper '2' and sleeper well packed.
Stage VIII	The ballast from space 'D' down to formation level should be removed and after screening, be placed in space 'B' upto bottom of sleeper; the balance may be taken outside the track and screened. The wooden blocks should be removed from space 'B' and placed to support the rail in space 'D'.
Stage IX	The ballast from under sleeper '3' should be removed and so on till the whole rail length is provided with screened ballast upto level of the bottom of sleepers.
Final Stage	The track should be lifted to provide additional cushion where required. The track should be packed in the final position and then boxed.

Sequence of the operations is shown in the **sketch on next page:**

(f) *The following points may be kept in view while doing the work – (i)* No unscreened length should be left between screened lengths of the track at the same time.

(ii) It should be ensured, that when ballast is being removed from any sleeper, invariably, there are at least four fully supported sleepers between it and the next sleeper worked upon.

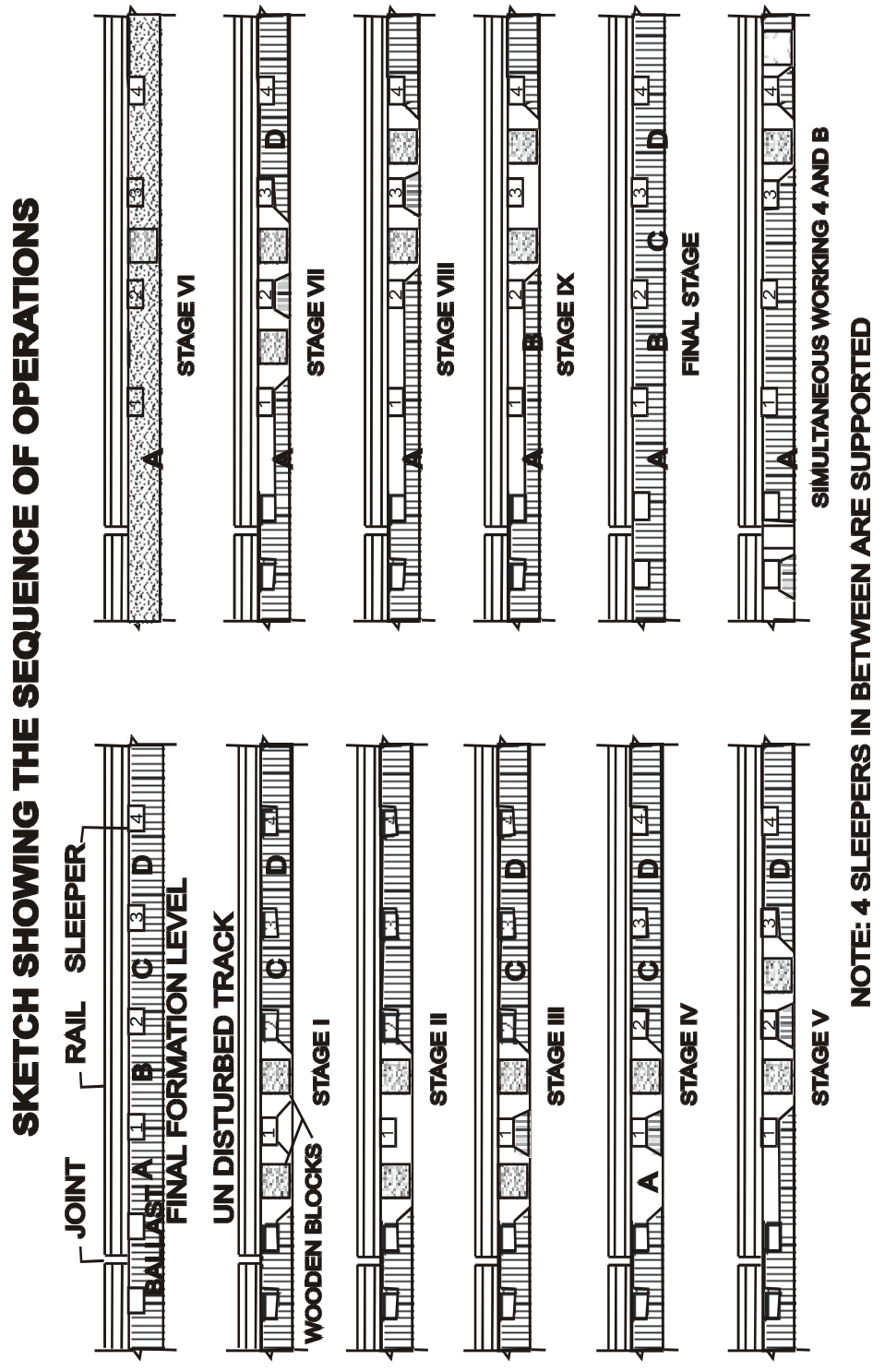
(iii) Lifting should be limited to 50 mm. at a time.

(iv) It should be ensured that packing, cross levels and grade run off are satisfactory before closing the day's work.

(v) The work should be done under a speed restriction of 20 km.p.h.

(vi) The speed should be gradually raised as in **Para (g)** below which will vary depending on the type of maintenance in the section.

(g) *Schedule for working and speed restriction to be observed, in deep screening works.-*


SKETCH SHOWING THE SEQUENCE OF OPERATIONS
JOINT
RAIL
SLEEPER
BALLAST
FINAL FORMATION LEVEL
UN DISTURBED TRACK
WOODEN BLOCKS
STAGE I
STAGE II
STAGE III
STAGE IV
STAGE V
STAGE VI
STAGE VII
STAGE VIII
STAGE IX
FINAL STAGE
SIMULTANEOUS WORKING 4 AND B
NOTE: 4 SLEEPERS IN BETWEEN ARE SUPPORTED

(i) *With Manual Packing* – The details of the work to be carried out in stages on various days, after the starting of the screening operation and the speed restriction recommended to be imposed are shown in **Table 1.** According to the above schedule normal Sectional speed can be resorted on the 21st day.

TABLE I
PROPOSED SCHEDULES FOR DEEP SCREENING (MANUAL PACKING)

Details of Work	Day of Work	Speed restrictions and their length	
		Broad Gauge	Metre Gauge
Deep screening and initial packing … …	1	20 km.p.h.	20 km.p.h.
First through packing … … … … …	2		
Second through packing … … … …	3		
Picking up slacks as required … …	4 5 6 7 8 9	45 km.p.h.	30 km.p.h.
Third through packing … … … …	… 10		
Picking up slacks as required … …	11 12 13 14 15 16 17 18 19	75 km.p.h.	60 km.p.h.
Fourth through packing ..... … …	… 20		
	21 onwards	Normal Sectional speed	Normal sectional speed

(ii) *With Machine Packing* – The details of work to be carried out in stages on various days after the start of the screening operations and the speed restriction recommended to be imposed are indicated in the schematic representation in **Table II.** Accoding to this schedule, normal sectional speed can be resumed on the tenth day.

TABLE II

PROPOSED SCHEDULE FOR DEEP SCREENING (MACHINE PACKING /B.G.)

Details of work	Day of work	Speed restrictions and their lengths
Deep screening with initial packing ….	1	
First machine packing … … …. ..	2	20 km.p.h.
Picking up slacks as required … …	3 4 5	45 km.p.h.
Second machine packing … … …	… … 6	
Picking up slacks as required ….	7 8	
Third machine packing … …. … …	… … 9	75 km.p.h.
	10 onwards	Normal sectional speed

The period mentioned in the schedules shown above is the minimum and can be suitably increased to suit local condition of the track consolidation.

239. Side and Catch water drains and Waterways – (1) For efficient drainage of cuttings, side and catch water drains of suitable type and size should be provided. The bottom of side drains should be at least 30 cm. below the formation level.

(2) Adequate openings to take the full flow of side drains should be provided under level crossings where they exist in or at the end of the cuttings.

(3) In cutting of black cotton soil and similar soils, catch water drain should be provided sufficiently away from the top of the cutting to avoid any danger of a breach occurring between the drain and the cutting itself. The excavated spoil should be used to form a 'bund' between the drain and the top of the cutting.

(4) Ballast walls, where provided in cuttings, should be regularly inspected. The efficient maintenance of ballast walls includes regular cleaning of weep holes, the provision of weep holes where none exist and rebuilding where necessary.

(5) The Permanent Way Staff shall carry out cleaning of side and catch water drains, clearing of obstructions from outfalls and cleaning water-ways of bridges and culverts methodically and complete the work before the monsoon sets in. The spoil from cleaning drains or cuttings should not be deposited at a place from where it is likely to be washed back into the drains.

(6) In the Municipal areas, where the outfall of Railway drains is in the municipal drains, close co-ordination should be maintained with the municipal authorities to ensure free flow from Railway drains.

240. Drainage in Station Yards – (1) The network of cross and longitudinal drains in yards whether earthen or masonry, should be so planned that storm water is led away in least possible time. The system of surface drains of water columns carriage-watering and carriage washing hydrants should be efficiently maintained.

241. Lubrication of Rail Joints – (1) The purpose of lubricating rail joints is not only to facilitate expansion of rails but also to retard wear on the fishing planes of the rail and the fish plate. Reduced wear on the fishing planes is one of the preventives of the low joints.

(2) The lubricant to be used should be specified by the Chief Engineer. A stiff paste of plumbago (Graphite) and kerosene oil, made in the proportion of 3 Kg. of plumbago to 2 Kg. of kerosene oil may be used. Black oil or reclaimed oil may be used for fish bolts and nuts. Alternatives to the above may be used, with the specific approval of Chief Engineer.

(3) All rail joints should normally be lubricated once a year on a programmed basis during the cold weather months after the monsoon, from October to February. Lubrication should not be carried out in extremes of weather both hot and cold. In yards this period may be extended to 2 years with the approval of the Chief Engineer.

(4) Creep in excess of 150 mm. should be adjusted before the work of lubrication of rail joints is undertaken.

(5) The lubrication of rail joints should normally be carried out by gangs working under the direct supervision of at least a qualified Permanent Way Mistry. The work should be carried out under caution orders arranged to be issued daily by the Permanent Way Inspector and under protection of engineering signals, as per **Para 806(2).** In this case the procedure to be followed for lubrication of rail joints will be as follows :

(i) The nuts are unscrewed and the fish bolts and fish-plates are removed.

(ii) The fishing surfaces of the fish-plates and rail are then cleaned with a wire brush.

(iii) The rail ends are inspected for cracks, and the fishing surfaces of rails and fish-plates are checked for wear. A magnifying glass and a mirror should be used for detecting cracks in rail ends and fish-plates.

(iv) The fishing surfaces of the rails and fish-plates are then lubricated.

(v) The fish bolts are then put back in reverse position and tightened using a standard fish bolt spanner, the inner two bolts being tightened first.

(vi) While tightening overstraining of bolts shall be avoided.

(vii) Spare fish-plates and bolts should be available for replacement of cracked ones.

(6) Alternatively, the work of lubrication may be carried out by the Keymen of the gang, assisted by one or more men on such sections as may be specified by the Divisional Engineer. In such cases the Keymen shall exhibit a red signal flag at the site of the work and act as lookout man also. Normally not more than one joint should be opened at a time under this procedure.

In this case the lubrication of rail joints and reversing of fish bolts should be carried out as follows:

(i) The nuts are unscrewed and the fish-plate on the nut-side is then removed leaving the other fish plate and bolts in position.

(ii) The fishing surfaces of the fish-plate and the rails are cleaned with a wire brush. The rails ends are examined for cracks and fishing planes of rails and fish-plates for wear, a mirror and a magnifying glass should be used to detect cracks. Such conditions shall be brought to the notice of Permanent Way Mate/Mistry for necessary action. The fish-plates are lubricated and put back in position.

(iii) The fish bolts are taken out one at a time, and then put back, after oiling.

(iv) The other fish-plate and fishing surface of the rail is treated similarly.

(v) The nuts are replaced and tightened to the extent possible with the standard fish bolt spanner without overstraining the bolts.

(vi) Two joints opposite each other or consecutive joints shall not be opened out at the same time. It should be particularly noted that at no time during the operation there is less than one fish-plate and three fish bolts without nuts connecting the two rails. The men should sit facing the direction of train while doing the work.

(vii) Both fish-plates should be fixed and at least one fish bolt and nut on either side of each joint should be tightened when a train is approaching the site of Work.

(viii) Spare fish-plates and bolts should be carried for renewal of cracked ones.

(7) The Chief Engineer may issue subsidiary instructions as necessary.

(8) The lengths over which the rail joints are lubricated together with dates shall be recorded in the gang chart of the section and in the Permanent Way Inspector's section register. In the month of April, Permanent Way Inspectors should submit to the Assistant Engineers certificates of lubrication of rail joints giving reasons for any exception. Copies of these certificates should be forwarded with the Assistant Engineer's comments to the Divisional Engineer for scrutiny and record.

(9) During all works such as relaying, rail renewals and renewals of turnouts, etc. rail joints should be lubricated. The importance of going over and re-tightening the bolts after the fish-plates have taken a bearing under traffic should be impressed on the staff.

(10) Insulated fish-plates should not be greased.

242. Counteraction and Adjustment of creep – (1) *General.*-Rails have a tendency to move gradually in the direction of the dominant traffic. It is believed to be caused by the ' ironing out ' of yielding track by the moving load, augmented by braking loads, and by the impact of the wheels on the running-on ends of the rails, particularly at times when they are in a state of expansion or contraction. Among the troubles caused by ' creep ' are -

(a) Sleepers getting out of square.

(b) Distortion of gauge.

(c) Loosening of joints.

(d) Shearing and breaking of spikes, bolts and fish-plates.

(e) Buckling in extreme cases.

(2) *Causes for creep in Track* – The following are some of the avoidable causes to which creep is attributed :

(a) Inadequate toe loads of the rail to sleeper fastening and rails not secured properly to sleeper.

(b) Inadequate ballast resistance to the movement of sleepers due to poor or insufficient ballast or other causes.

(c) Inefficient or badly maintained rail joints.

(d) Rails too light for the traffic they carry.

(e) Improper expansion gaps.

(f) Decaying sleepers, uneven spacing of sleepers.

(g) Lack of proper drainage.

(h) Yielding formation resulting in uneven cross levels.

(i) Loose/uneven packing.

(j) Rail seat wear in metal sleeper road.

(3) *Precautions to reduce creep* – (a) For reducing creep, it must be ensured that the rails are held firmly to the sleepers and adequate ballast resistance is available. All spikes, screws and keys should be driven home, the sleepers properly packed and crib and shoulder ballast should be compacted. Rail anchors should be provided wherever necessary.

(b) With steel trough and cast iron plate sleepers and in the case of sleepers where elastic fastenings and other fastenings with adequate toe load are used, no trouble is normally experienced. Careful watch should be kept for a series of jammed joints. Not more than six jammed joints continuously should be permitted in the case of single rails . In case of SWR not more than two consecutive jammed joints should be permitted at rail temperatures lower than "tm" in the case of Zone I and II and "tm-5" in the case of Zone III and IV. On girder bridges adjustment may be necessary at regular intervals. Anti-creep devices should be provided on the approaches of girder bridges for adequate length.

(c) : The PSC sleepers with elastic fastenings are considered as creep resistant and therefore no other creep anchors are required. In case, excessive creep is observed on PSC sleeper road, the condition of elastic fastenings, sleepers and adequacy of ballast resistance should be examined. Action for replacement/renewal of fittings, sleepers and providing adequate ballast resistance etc. should be taken as necessary.

(4) *Creep Register* – Creep registers should be maintained in the pro forma given in **Annexure 2/7**. Entries should be complete as regards kilometerage, section and length of rail, sleeper density, type and number of anchors per rail length used. Periodical readings of creep should be recorded in the prescribed pro forma . Separate page should be allotted for each km. Frequency of recording of creep should be specified by the Divisional Engineer taking into consideration the rate of creep. The Assistant Engineer should test check the register frequently, particularly sections which are prone to creep.

(5) *Creep indication Posts* – Creep indication posts square to the track should be erected on either side of the track on the cess at intervals of about one km. These may be un serviceable rail posts with chisel mark square to the joints . The top of the post should be about 25 mm. above the rail level and the amount of creep one way or the other measured with a fishing cord stretched over the chisel marks.

(6) *Permissible amount of creep* – Creep in excess of 150 mm. shall not be permitted.

(7) *Adjustment of creep* **–** Adjustments of creep should be carried out in the following manner :

(a) Careful measurement of expansion gaps, as existing, should be done and appropriate length which can be dealt with in one operation should be chosen. The total amount of gap in the length should be equal to the standard expansion gap required for the temperature at the time , multiplied by the number of joints in the length.

(b)Work should start at the running-on end of the length, commonly just beyond the points and crossings or level crossings. The work of creep adjustments should be carried out under the protection of Engineering signals by the Permanent Way Inspector as envisaged in **Para 806(2).** Before pulling back is commenced the keys are knocked out and fish-plates removed or eased. Correct expansion liners should be used and the rails should be pulled back with bars. If the fish-plates are removed, the bars can pull against a tommy bar thrust through a bolt hole. Next, the rail is keyed up, the bolts of joints correctly tightened up, and the expansion liner moved to the next joint, whereupon the process is repeated.

(c) It is a good practice to adjust creep before the commencement of summer. It is desirable to pull back the rails during the cool hours of the day.

(d) Mechanical and hydraulic devices are available for adjustment of creep. Such a device can be set with the wide joints behind it and the tight joints ahead of it. Expansion liners are put in all the wide joints, all keys, spikes and fish bolts are loosened.

The adjuster then closes up the rails behind it by pushing, leaving a gap of some centimetres between the rail ends opposite the machine. The corrected rails are then fastened up.

(e) The machine is next attached to the rail ahead of it, keys, spikes and fish bolts loosened for that rail and those beyond it. These rails are then pulled until only the normal expansion gap is left opposite the machine. The operation leaves some of the gaps wide and it is then necessary to fix the machines further ahead in order to close them upto normal by pulling against expansion liners.

(f) When the value of total gap existing is more than the standard expansion gap required for the temperature at the time of adjustment multiplied by the number of joints, it is necessary to provide closure rails. When closure rails are put in, a speed restriction of 30 km/h should be imposed,which should be removed, when closure rail is changed.

(g) During adjustment of creep, the sleeper spacing should be adjusted, if necessary, special attention being given to the joint and shoulder sleeper spacing.

(8) *Provision of Anchors to arrest Creep* -To arrest excessive creep on wooden sleepered road, not provided with anti-creep fastenings, adequate number of anchors of approved design should be provided; no anchors being provided at the joint sleepers. Both rail seats of the sleepers should be anchored on the same side. In addition to sufficient directional anchors being provided, back up anchors may be provided if considered necessary.

(9) *Prevention of creep on metal sleeper road*– Creep on cast iron plate sleepers should be counteracted as follows :

(a) On C.I. plate sleepers all keys should be driven in the direction of traffic on the double line and alternately in the opposite direction on single line.

(b) On steel trough road normally keys are driven as indicated in **S.S.I. sheet 3 of 4 of Indian Railway Standard Track Manual.** However, where heavy creep is experienced on double line, all the four keys may be driven in the direction of the creep (generally in the direction of traffic). On single line keys may be driven in the opposite direction on alternate sleepers.

243. Buckling of Track – (1) *General* - Buckling of track occurs when high compressive forces are created in the rails associated with inadequacy of lateral resistance in the track at the place. A special watch should be kept on the junction of two stretches of track, one liable to creep and the other held against creep, such as when track laid on wooden sleepers with inadequate anchors and scanty ballast or track laid on metal sleepers with loose keys butts against track laid on new sleepers with tight fastenings or track anchored and ballasted as with welded track. As one side of such a junction point is held firmly against creep, the movement of rails due to creep from the other side is resisted resulting in heavy compressive force being exerted which will tend to buckle the track. Jammed rail joints at such junctions are therefore an indication of the track being subjected to undue strain.

(2) *Conditions which Induce Buckling* –

(a) The following conditions create high compressive forces in the rail :

(i) Inadequate expansion gaps,

(ii) Failure to counteract creep in time.

(iii) Non-lubrication of rail joints,

(iv) Failure to remove rail closures from track.

(b) The lateral resistance gets impaired due to inadequacy of ballast and due to carrying out of operations such as deep screening, lifting of track and slewing of track, without adequate precautions.

(3) *Precautions against Buckling* – It should be seen that -

(a) Operations which impair the lateral resistance of track are not carried out when rail temperatures are high.

(b) The greasing of fish-plates is done before the hot weather sets in.

(c) The joint gap survey is done in the case of S.W.R. and adjusted before the hot weather **(See Para 510).** Similarly in case of single rail panel, joint gaps should be adjusted wherever necessary.

(d) Adequate precautions are taken to reduce creep as detailed in **Para 242 (3).**

(e) Overtightening of fish bolts is avoided - but they should be reasonably tight.

(f) Particular attention is also paid to stretches of track, one liable to creep and the other held against creep **(refer para above).** Jammed joints at such junctions call for remedial measures. Extra shoulder ballast should be provided at such places.

(4) *Action on buckling of track* - If a buckling does occur or appears imminent, the track should be protected immediately with hand signal flags and detonators as per the protection rules laid down. The buckled rails shall preferably be cut adequately apart not less than 6.5 metres. The track shall then be slewed to the correct alignment and cut rails of the required length shall be inserted to close the gaps making due provision for welding of joints on both rails. The cut rails shall then be connected by use of special fish plates and screw clamps and the line opened to traffic with speed restriction. It may not be possible to do any more until the temperature drops when the joints must be adjusted. Particular care must be taken to see that the factors which contributed to the buckling i.e. jammed joints, seized fish plates or shortage of ballast receive appropriate attention without delay.

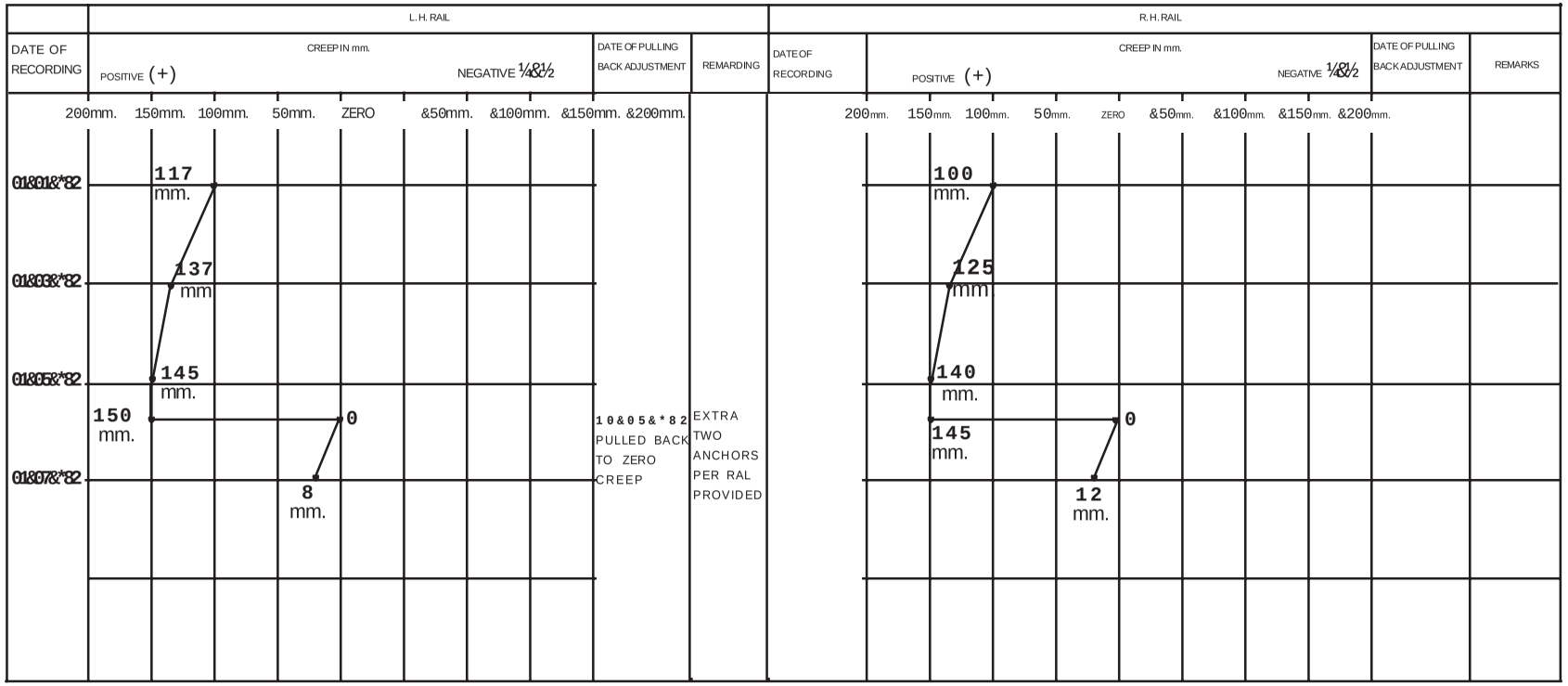
PROFORMA OF CREEP REGISTER

SECTION _____ KIL OMETRE _____

UP DOWN LINE _____ DETAILS OF SLEEPER & FITTINGS _____

PARTICULARS OF RAIL & FITTINEGS _____ ANY SPECILS SPECIAL FEATURE _____

DETAILS OF ANCHORS PROVIDED _____



Part 'D'

Sleepers and Fastenings

244. Laying of Sleepers – (1) *General* - Sleepers shall be laid and maintained square to the rails on straights and radially on curves. Rail joints should be suspended.

(2) Sleeper Spacing –

(a) The sleeper spacing on straights and curves shall be in accordance with approved plans. The sleeper spacing should be marked on the outer rail in case of curved track. Closer spacing should be provided at the joint sleepers of fish-plated joints and between the joint sleeper and shoulder sleeper.

(b) The following standard spacing should be adopted on fish-plated track :

Spacing	Centre to centre spacing (maximum)			
	Wooden Sleepers		Metal Sleepers	
	B.G.	M.G.	B.G.	M.G.
1. Between joint sleepers	30 cm.	25 cm.	38 cm.	33 cm.
2. Between joint sleepers and first shoulder sleeper.	61 cm.	58 cm.	61 cm.	58 cm.
3. Between first shoulder sleeper and second shoulder sleeper.	Spacing to be of a value between 2 and 4.			
4. Between intermediate sleeper...	To be equal and in whole number of cm.			

(c) In the case of LWR on B.G. and M.G. the sleeper spacing shall be maintained at 65cm, as **per para 5.4.2 of L.W.R. Manual.**

(d) In the case of SWR, the sleeper spacing for M+4 and M+7 densities will be as **shown on the next page.**

(e) Where concrete sleepers are required to be laid in unavoidable circumstances as SWR the sleeper spacings should be the same as for wooden sleepers. The joint and first shoulder sleepers in such cases should be wooden.

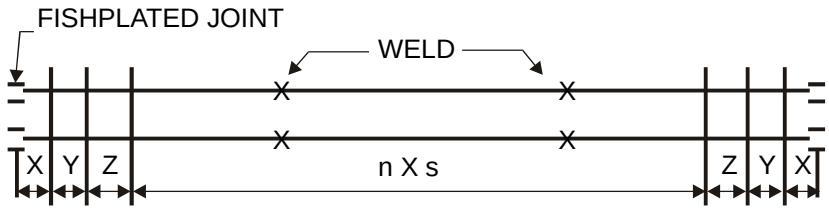
(f) In B.G. where SWR is expected to be converted into LWR within a year or two, 62 Nos. of sleepers shall be used per panel of 3x13m. length as shown **on next page.**

(g) Where SWR is to be converted into LWR soon after its being laid, sleeper spacing as prescribed for LWR in the LWR Manual should be adopted.

(h) The sleeper spacings under welded joints of all types with or without holes in rails shall be the same as the intermediate sleeper spacings.

(3) *Sleeper Density* – The sleeper density is the number of sleepers used per rail length and is described as M+1, M+2 etc., where M is the length of Standard Single rail in metres. In the case of LWR and CWR this is expressed as the number of sleepers per km. of track. The sleeper density is fixed duly taking into consideration the maximum permissible speed and the traffic density of the section.

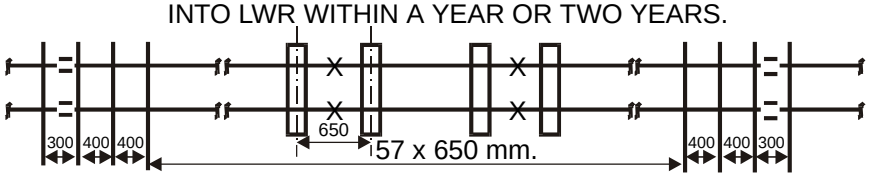
SLEEPER SPACINGS FOR SWRs FOR (M+4) & (M+7) DENSITIES



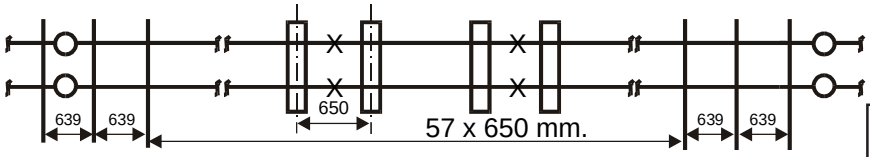
MINIMUM SLEEPER SPACING AT ANY LOCATION EXCEPT AT FISHPLATED JOINT 560 mm

B.G. 3 x13 m RAIL								M.G. 3x12 m RAIL							
Sleeper Density	n	S (mm)	Type of sleeper at FP 300 MT	Type of Weld	X (mm)	Y (mm)	Z (mm)	Sleeper Density	n	S (mm)	Type of sleeper at FP 300 MT	Type of Weld	X (mm)	Y (mm)	Z (mm)
M + 4	46	780	Wooden	F.B./ G.P.	150	643	750	M + 4	43	770	Wooden	F.B./ G.P.	120	600	708
				A.T.	150	645	780					A.T.	120	600	740
			Metal	F.B./ G.P.	190	620	733				Metal	F.B./ G.P.	160	580	688
				A.T.	190	625	760					A.T.	160	600	700
M + 7	55	660	Wooden	F.B./ G.P.	150	573	610	M + 7	52	640	Wooden	F.B./ G.P.	120	603	620
				A.T.	150	595	620					A.T.	120	615	640
			Metal	F.B./ G.P.	190	563	580				Metal	F.B./ G.P.	160	573	610
				A.T.	190	575	600					A.T.	160	595	620

SLEEPER SPACINGS FOR SWR EXPECTED TO BE CONVERTED INTO LWR WITHIN A YEAR OR TWO YEARS.



BEFORE CONVERSION INTO LWR (TOTAL 62 SLEEPERS)



AFTER CONVERSION INTO LWR (TOTAL 60 SLEEPERS)

LEGEND :
O A.T. WELDED JOINT
X WELDED JOINT
= FISH PLATED JOINT

NOTE : FOLLOWING ASSUMPTIONS HAVE BEEN MADE WHILE CALCULATING SLEEPER SPACINGS.

i) SLEEPERS SPACINGS SHOWN ARE FROM CENTRE TO CENTRE OF SLEEPERS.

ii) TOTAL REDUCTION IN LENGTH AT EACH FLASH- BUTT OR GAS-PRESSURE WELDED JOINT 20 mm.

iii) LENGTH OF B.G. FREE RAILS 13000 mm.

(4) Minimum Sleeper Density –

(a) **Broad Gauge** - The minimum sleeper density for all future track renewals (complete track renewals and through sleeper renewals) is recommended and given as below.

	Routes						
Traffic Density in GMT	A	B	C	D-Spl	D	E-Spl	E
More than 20	1660	1660	1660	1660	1660	1660	1660
10-20	1660	1660	1660	1660	1540	1660	1540
Under 10	1660	1540	1540	1540	1540	1540	1540
Loop lines	1340	1340	1340	1340	1340	1340	1340
Pvt. siding	1340	1340	1340	1340	1340	1340	1340

NOTE : Number of sleepers per km.

(i) For routes identified for running 22.1 t axle load wagons, Sleeper density of 1660 nos/km should be

(b) **Metre Gauge** :– In the case of M.G. Track renewals, the sleeper densities are recommended for the various M.G. routes as given on below.

SLEEPER DENSITY FOR MG.

Route	Q	R1	R2	R3	S
Sleeper density	M+7	M+7	M+7	M+4	M+3

Note :- (i) Higher sleeper density may be provided with the approval of the Chief Engineer

(ii) For LWR/CWR minimum sleeper density shall be 1540 sleeper/km.

(iii) In case of SWR, the minimum sleeper density in the case of B.G. and M.G. is fixed as M+4.

(5) *Respacing of sleepers :*

(a) When respacing wooden sleepers dog spikes/rail screws should be loosened, just enough to permit sleepers being shifted.

(b) When respacing cast iron or steel trough sleepers, the keys should be removed and the packing core broken before shifting the sleepers.

245. Wooden Sleepers – (1) *Classification of Wooden Sleepers* - All wooden sleepers shall be classified into two categories viz. 'U' (untreated) and 'T' (treated). Category 'U' (untreated) shall comprise of all sleepers from natural durable species only. The rest shall be classified as 'T' (treated) category.

(2) *Inspection and Renewals*- The average life of wooden sleepers varies with the species of timber. In the interest of both safety and economy, it is essential that wooden sleepers more than 5 years old are thoroughly inspected every year according to the following procedure :

(a) The Permanent Way Inspector should carefully examine the track and bridge sleepers during annual through packing/overhauling. Those requiring renewals during the year should be painted with two white lines (Category I) and sleepers requiring reconditioning with one white line (Category II) at the end. Details of these telegraph-post/O.H.E. mast-wise should then be intimated to the Assistant Engineer. The Permanent Way Inspector will maintain a Sleeper replacement/reconditioning register in the following proforma :

Km.	O.H.E. Mast/ Telegraph Post		No. of sleepers marked		No. of sleepers replaced	No. of sleepers reconditioned and reused
	From	To	Category			
			I	II		

(b) The Assistant Engineer should then test check the requirement given by the Permanent Way Inspector at site and examine about 50 sleepers per Km. particularly at places where the sleepers are more than 5 years old, and where the percentage of deteriorating sleepers is reported to be 20 per cent or more. The requirements together with the Assistant Engineer's observations should then be submitted to the Divisional Engineer.

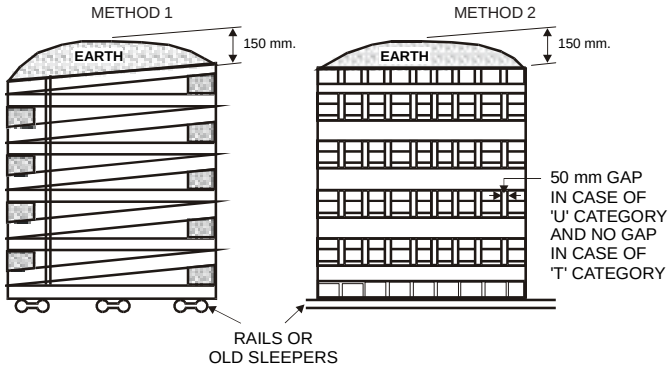
(c) The Divisional Engineer should personally check these sections where abnormal increase in the number of deteriorating sleepers is reported to ensure that serviceable sleepers are not condemned prematurely.

(d) (i) Generally a sleeper is classified as unserviceable if even after reconditioning it cannot perform the essential function of holding the gauge, providing a satisfactory rail seat, permitting sleeper fastenings being maintained in a tight condition, and retaining packing.

(ii) It is advisable to carry out through sleeper renewal, before the percentage of unserviceable sleeper reaches a level, when imposition of speed restriction may become necessary. On branch lines, however, only casual renewals may be resorted to.

(e) While doing casual/scattered renewals, priority should be given in replacing unserviceable joint sleepers and unserviceable consecutive sleepers. Through sleeper renewals should be carried out in continuous stretches and released sleepers after reconditioning should be used for scattered renewals. New sleepers should not be used in sidings. If the percentage of unserviceable sleepers becomes high, speed restrictions may have to be imposed.

(3) *Stacking of Wooden Sleepers* – (i) 'U' category sleepers should be stacked in accordance with one of the methods shown in the sketch below in lots of 100s and covered with at least 150mm. thickness of earth as a protective measure. The ground should be dressed to a flat slope and cleared of grass and undergrowth.



(ii) Treated wooden sleepers, released second hand and scrap wooden sleepers awaiting disposal should be stacked in horizontal layers without any gap, each stack being covered with 150mm. layer of earth.

(iii) A fire zone of about 10m. in width should be left around each group of 25 stacks and kept clear of grass and other combustible materials.

(4*) Preparation of Sleepers* – (a) End Binding - To protect the inner untreated portion of sleepers from being exposed to attack by insects/fungi due to shatter and splitting of sleepers in track, a systematic practice of end binding all new reconditioned sleepers should be adopted. This should be done for 'T' category sleepers in the treatment plants, before treatment and for 'U' category sleepers, in the Divisional Track reconditioning depots. For effective end binding both ends of the sleepers shall be held in a press so as to close all the cracks and splits near the ends and end binding should be done using wire, hoop iron or clips. In reconditioning depots, it may be preferable to deploy end strapping machines for end binding.

(b) *Adzing of Sleepers* – (i) When wooden sleepers are used without bearing plates, the rail seats should be adzed to a slope of 1 to 20, planed for the section of the rail with the correct template. It is desirable to accommodate the rail foot in a recess 3 to 5mm. deep in the adzed portion of the sleeper to restrict the lateral forces being transmitted to the spike and to protect the sleeper from getting spike killed. The operation of adzing and recess cutting should be carried out preferably in the track conditioning depot, where the adzed rail seat may be treated with coal tar/creosote.

(ii) For treated sleepers adzing and recess cutting should be done before treatment.

(iii) Sleepers should not be adzed in the case of points and crossings.

(iv) When bearing plate or chairs are used it should be ensured that the seat is adzed or planed to ensure even bearing and that the two bearing areas are truly in the same horizontal plane.

(c) *Auguring of Sleepers* – (i) Spike holes should be bored right through the sleeper vertically where bearing plates are used and at right angles to the rail seat where the rail rests directly on the sleeper. The size of augur for boring should be as given below :

	Name of some common species	Diameter of Augur in mm.	
		For 20mm dia. plate screws Drg. No. RDSO/ T. 10677 to 10679	For 22mm. dia. rail/ screws Drg. No. RDSO/T. 10673 to 10676
Sleepers having C. S. I. values upto 63 (925)	Chir, Fir, Deodar, Hollock, Hingori.	16	18
Sleepers having C. S. I. values above 63 (925)	Sayal, Nahor, Sal, Jutili, Kindal, Poon, Gurjan, Hollong, Kokko	18	20

(ii) During the process of boring, the tips of augurs should frequently be dipped in oil to facilitate work. When sleepers are being bored outside the track, correct templates should be used. When being bored or rebored while in the track, the auguring should be done correctly with the gauge held in position. The holes after being bored should be given a coating of coal tar or creosote.

(iii) For 'T' category sleepers boring should be done before treatment.

(iv) When extracting dog spikes, the fulcrum on which the crow bar works should be raised so that the spikes can be withdrawn vertically without enlarging the dog spike hole.

(v) Plate/Rail screws should always be screwed by box spanners and not driven by hammers.

(5) *Use of Bearing Plates* :– (a) Bearing plates should be provided invariably on 'T' category sleepers.

(b) They should be compulsorily used in the following locations :

(i) All sleepers on girder bridges.

(ii) All sleepers of turn outs.

(iii) All timbers of ash pits and examination pits.

(iv) All joint sleepers.

(v) On sharp curves of radius less than 600m. on B.G. and M.G.

(c) Bearing plates should receive two coats of black oil prior to their being fixed to the sleepers.

(6) *Screws/Spikes at Rail Seat* – (a) The number of spikes/screws per rail seat should be as given below :–

(i) All joint sleepers, bridge timbers, turn out sleepers and ash pit timbers — Four

(ii) Intermediate sleepers on curves on other than branch lines	Three (Two outside and One inside)
(iii) Intermediate sleepers on curves on branch lines and on straights	Two (One inside and One outside).

(b) Where A.C. bearing plates are used on intermediate sleepers for arresting creep the number of screws/spikes per plate should be four for B.G. and three for M.G.

(c) (i) When two screws/spikes are used, the outer ones should be in line on one side and the inner ones on the other side of the centre line of the sleeper.

(ii) Screws/Dog spikes should be dipped in coal tar before use. If it is necessary to draw and re-drive spikes or to drive spikes in holes other than those freshly bored, such spike holes should first be carefully plugged with tightly fitting tarred wooden plugs and rebored before spikes are driven.

(iii) Additional screws/spikes may be provided at the discretion of Chief Engineer wherever necessary.

(7*) Reconditioning of Wooden Sleepers* – (a) Reconditioning of all released wooden sleepers before their reuse should be carried out in a centralised depot. To arrest deterioration in track, systematic practice of reconditioning 'in-situ', the spike killed sleepers, otherwise in good condition, should be resorted to.

(b) *Procedure for Plugging Spike killed Sleepers 'in-situ'* - Sleepers without bearing plate can be reconditioned without removing the sleepers from track. The sequence of operations should be as under:

(i) The fastenings viz. spikes, screws etc. are removed and the sleeper shall be cleaned of all dust.

(ii) The existing holes should be rebored so as to ensure that the existing holes are adequately scrapped all round.

(iii) The rebored and cleaned spike holes shall be plugged using tapered octogonal plugs of size of slightly bigger than the holes. These plugs are made from scrap hard wood sleepers in a centralized depot.

(iv) Before driving the plugs, the plugs are dipped in a mixture of creosote and coal tar. The plug should be driven right upto the bottom of the holes.

(v) After plugging, a new hole would be bored at some distance in line with the old holes, parallel to the centre line of the track. Then sleeper fastenings are re-inserted in new holes. **(Annexure 2/8).**

(c) Procedure for reconditioning of released wooden sleepers in Permanent Way Depots -

In the case of sleepers with bearing plates, repairs to spike killed holes which would involve removal of the sleeper from the track for the purpose of plugging the existing holes, readzing of the rail seat and boring holes in new position are best carried out in a centralised depot. When reconditioning of sleepers is done in a depot, the following works are also carried out:-

(i) End binding;

(ii) Readzing of rail seat;

(iii) Spraying with coal tar or creosote.

(d) *Conversion of B.G. into M.G./N.G. Sleepers*– Broad Gauge wooden sleepers which are classified as unserviceable and removed from track as such, can be conveniently converted to serviceable Metre Gauge or Narrow Gauge sleepers whenever their condition permits of such conversions.

Another method is to crop the two ends of the damaged/split sleeper, salvage the middle length to use them for making two block sleepers held together by second hand tie bars, with two long bolts holding tie bars in each block.

The aim should be to obtain maximum life out of sleepers before classifying them as unserviceable. With tamping methods of track maintenance and proper ballast cushion associated with proper treatment of sleepers, the service life of sleepers can be enhanced appreciably.

(8) *Dating* – When wooden sleepers are laid, the year of laying should be cut or branded on each sleeper at the centre or one end omitting the first two digits of the century. Thus '83' will indicate that the sleeper was laid in the year '1983'. All dates shall be in one direction, which in the case of double line shall be the direction of traffic and in the case of single line, in the direction of increasing kilometrage.

In the case of 'U' category of sleepers the dating will be done at the time of laying and in the case of 'T' category sleepers, the dating will be done in the treatment plant before treatment.

(9) *Important Points to be borne in mind in a Wooden Sleepered Track* – (a) Intermixing of 'U' category and 'T' category sleepers should be avoided.

(b) No holes should normally be drilled in the treated sleeper in the field, nor adzing/planing done. But if new holes are to be drilled or adzing/planing to be done unavoidably, the holes/surface should be treated with hot creosote.

(c) To avoid damage to the sleeper by beater packing, M.S.P. should be introduced.

(d) 'U' category sleeper shall be laid with sap wood on top and heart wood below. 'T' category sleepers should be laid with heart wood on top and sap wood below.

246. Cast Iron Sleepers – *(1) General* - (a) CST.9 type cast iron sleepers are widely used in Indian Railways. However, these are not recommended for use in high speed routes in B.G..

(b) The usual defects noticed in CST.9 sleepers are detailed below-

(i) Cracks at rail seats or fracture.

(ii) Wear of lug and rail seat so that the sleeper no longer grips the rail firmly and the keys work loose, resulting in creep.

(iii) Tie bars weakened by corrosion, broken or damaged by falling brake gears, wagon parts etc..

(iv)Corrosion of tie bars inside the cast iron plate resulting in removal and adjustment becoming difficult.

(c) Cast Iron Sleepers should be considered for replacement when they are cracked or there is excessive wear at the rail seat making remedial measures ineffective. Such sleepers may be used in unimportant lines or scrapped .

(2) Precautions during maintenance – (i) Imperfect packing is the cause of majority of breakages of cast iron plates or pots . Care should be taken to see that the plate is packed evenly, so that it may not tilt either inward or outward. Tilting would disturb the gauge and will not give proper bearing. Defective plates should not be boxed with ballast unless replaced.

(ii) Cast iron plates tend to corrode in channels through which the tie bars pass. To prevent tie bars from being corroded into a solid mass, periodically alternate tie bars should be drawn out of the sleepers, treated with coal tar between the cotter slots and replaced

The Divisional Engineer will specify the interval at which the above action is to be taken. Action once in 5 to 7 years should suffice.

(iii) When owing to wear the keys on CST. 9 sleepers exceed the limit of key driving, the keys should be used with appropriate size of liners or replaced by oversized keys.

(iv) When driving keys, no hammer which is heavier than the standard keying hammer(1.8 kg.) should be used. Beaters should not be used for driving keys.

(v) While fixing cotters for CST.9 plates, it shall be ensured that the tapered side of the cotter is in contact with the sloped face of the CST.9 plate and the cotters are split sufficiently so that they remain tight.

(vi) When there is wear on the rail seat ,pad plates (saddle plates) of suitable thickness should be tried for arresting the creep.

247. Steel Trough Sleepers – (1) *General* - (a) Steel sleepers are liable to corrode and therefore they should not be used near coastal and other areas, vulnerable to corrosion. They should not be used near ashpits and platform lines where trains stop.

(b) The usual defects noted in the steel sleepers are detailed below –

(i) Rusted and corroded metal

(ii) Cracks at the rail seat or near the lugs.

(iii) Elongation of holes.

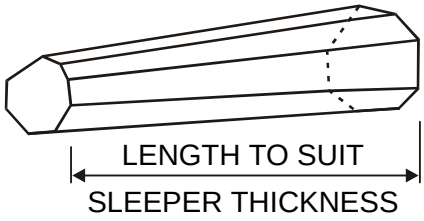
Steel sleepers that are over 20 years old should be inspected in detail for defects every year in the same way as wooden sleepers.

(2) *Precautions during maintenance* – (a)Corroded or damaged sleepers should not be boxed with ballast until replaced.

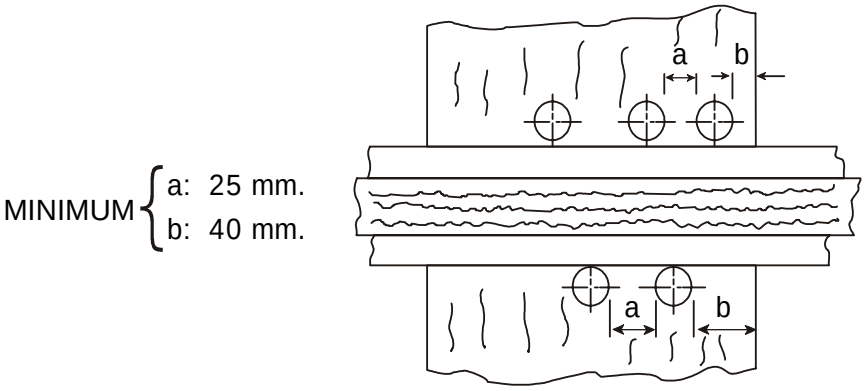
(b)In steel trough sleepers with loose jaws and two way keys, the holes in the sleepers get elongated due to wear. Half-moon tapered washers should be used, to make up for the wear on the holes. Indiscriminate driving of keys should be avoided. Standard keying hammers (1.8kg.) should be used.

(3) *Reconditioning of steel sleepers* – Old steel, trough sleepers having worn out rail seats can be reconditioned by strengthening the rail seats with M. S. pads altering them suitably for use with 'elastic rail clip' fastening. S.T. sleepers worn at rail seats or with elongated holes can also be reconditioned by welding a pad plate and drilling new holes.

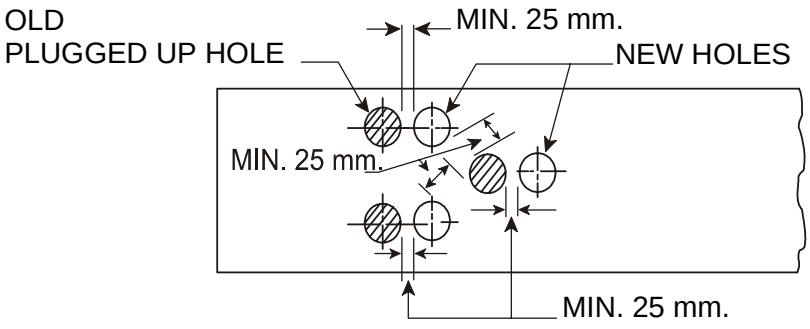
ANNEXURE-2/8 PARA 245 (7)



OCTAGONAL PLUGS



IN SITU PLUGGING AND REBORING OF HOLES



PLUGGING AND REBORING OF WOODEN SLEEPERS AT THE TIME OF RECONDITIONING

RECONDITIONING OF HOLES IN WOODEN SLEEPERS

PART 'E'

Rails and Fastenings

248. Standard Sections of Rails – (1) *General* **–** Rail sections are normally selected to suit the standard of loading and the speeds. The other important factor which must govern the choice of a rail section is the traffic carried so that adequate service life could be obtained.

(2) Recommended Rail Section - (a) Broad Gauge – The following minimum rail sections are recommended based on the speeds obtainable and the traffic condition :

	Routes						
Traffic density in G. M. T.	A	B	C	D Spl.	D	E Spl.	E
More than 20	60 kg	60 kg	60 kg	60 kg	60 kg	60 kg	60 kg
10 - 20	60 kg	60 kg	60 kg	60 kg	52/90	60 kg	52/90
5 - 10	60 kg	52/90	52/90	52/90	52/90	52/90	52/90
Under 5	52/90	52/90	52/90	52/90 or 60 kg (SH)	52/90 or 60 kg (SH)	52/90 or 60 kg (SH)	*52/90 (SH) or 60 kg (SH)
Loop line	52 kg IRS-T-12 second quality rails or 52 kg (SH)						
Pvt Siding	For sidings with operating speed more than 80 kmph and upto 100 kmph			Track structute specified for 'D' route.			
	For sidings with operating speed more than 50 kmph and upto 80 kmph			Track structute specified for 'E' route.			
	Where BOX'N' or 22.1 Tonnne axle wagon ply or operating speeds on sidings exceed 30 and are going uptr 50 kmph.			52 kg IRS-T-12 Second quality rails or 52 kg (SH).			
	For other sidings with operating speed upto 30 kmph			52 kg IRS-T-12 third quality rails also called 'Industrial use rails' or 52 kg (SH).			

Note : 52/90 represents 52 kg/90 UTS rail section.

(i) Existing 90-R rails may be allowed to remain for speeds not exceeding 110 kmph.

(ii) On routes identified for running of 22.1 Tonne axle load wagons, 60-kg rails shall be used on all routes.

(iii) Head hardened rails should be used on (a) Local lines where dedicated EMU stock is running. (b) Ghat section with gradients steeper than 1 in 150 and / or curves sharper than 2 degree, (c) Locations where due to grades, curves, traffic density and type of stock, the rate of wear of rails is such as to necessitate rail renewal, on wear considerations, at a frequency of 10 years or so. (d) Routes where predominantly captive rolling stock is moving in close circuit movement, particularly with heavy mineral traffic. (e) The HH rails should be laid on continuous & long stretches.

(iv) *Second hand 52 kg rails may be used on case-to-case basis, with the prior approval of Railway Board; depending upon quality of released rails available.

(b) *Metre gauge* – The following rail sections are recommended on M .G. routes:-

Route	Rail Section recommended
'Q' and 'R1'	52 Kg (SH)/90 R (New)*
'R2' and 'R3'	52 Kg (SH)/90 R (SH)
'S'	52 Kg (SH)/90 R (SH)/75R (SH)

* 90R (New) to be only used with specific approval of railway Board, in case no suitable 52-Kg (SH) rails are available for use on MG during renewal.

(c) *Narrow gauge (762 mm.*) – Suitable new or second hand rails 50 lbs. and above.

249. Causes of Rail Deterioration – The principal factors causing rail deterioration are detailed below :

(1) *Corrosion and rusting* – Corrosion is caused not so much by the dampness as by acid gases dissolved in the film of moisture which frequently coats the rails. Corrosion is generally heavy in the following locations :

(a) Platform lines where trains make prolonged halts.

(b) Sidings where saline or corrosive goods are dealt with .

(c) Where the rails are affected by the dropping of engine ashes, such as at ash pits.

(d) Near water columns due to insufficient drainage.

(e) Tunnels and damp cuttings.

(f) Areas near the sea coast.

(g) Industrial belts.

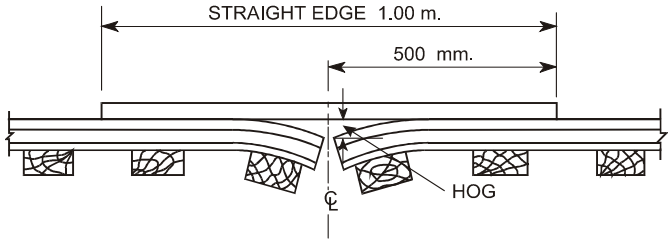
Corrosion is generally noticed on the web and foot of the rail.

(2) Wear on Rail Table – Normally this is of a very small order. The amount of wear increases with heavy traffic density as in suburban section, though not proportionately.

(3) Flattening of rail table **—** This mostly occurs on the inner rail of a curve by high contact stresses combined with horizontal forces. The vertical pressure may be due to heavy axle load, large unsprung mass or under equilibrium speed on canted track. The horizontal forces are associated with slow running on canted track, which condition produces slipping of wheel sets. Spreading of rail table is an indication of overloading on one rail and such tendency can be reduced by providing appropriate cant.

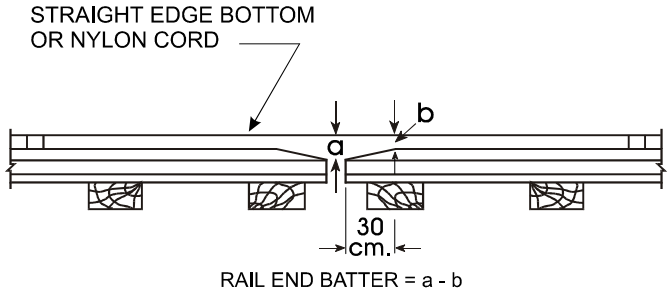
(4) *Wear on Gauge Face* – The outer rail of a curve has to withstand heavy pressure from the wheels which results in the running edge becoming worn or 'side-cut'. Wear on gauge face is specially pronounced in case of suburban sections where multiple unit coaches are provided with laterally unsprung traction motors.

(5) *Hogging of rail end* – A hogged rail is one with its end or ends bent in vertical direction. A hogged rail end in the track is ascertained by unfishing the joints, removing the fastenings and then measuring the extent of hog at the rail end by placing a 1 metre long straight edge over the rail table, centrally over the joint as shown in the sketch below–



HOGGING OF RAIL - METHOD OF MEASUREMENT

(6) *Battering of rail ends* – Rail end batter occurs where the joint gaps are excessive. It is caused by the impact of wheels on end of a rail particularly if the fish-plates do not fit snugly. Rail end batter is measured as the difference in heights of the rail at its end and at a point 30 cm. away from the rail end as shown in the sketch as shown below.



RAIL END BATTER-METHOD OF MEASUREMENT

(7) *Wheel burns* – Wheel slipping occurs usually on adverse gradients or while starting on rising grades when considerable heat is generated and top of the rail is torn off in patches, causing depressions known as wheel burns, from which cracks may develop. This also occurs when train brakes are applied suddenly and wheels lock and slide. Wheel burns cause the wheels to hammer the rails and lead to difficulties in keeping the sleepers packed firmly and fastenings tight. Such rail should be kept under observation and changed, in case repair by welding is not feasible. The incidents of wheel burns is predominant where the mode of traction is electric or diesel-electric.

(8) *Corrugation* – In certain locations, rail table develops ridges and hollows called corrugation and when vehicles pass over these rails, a roaring sound ensues. Such rails are called "roaring rails".

In such locations, excessive vibrations are caused, due to which fastenings and packing tend to get loose, track needing frequent attention at these places.

250. Rail Maintenance to reduce Rail Deterioration – (1) Efficient maintenance of rails results in increased service life of rails. The following precautions/maintenance practices if observed ,will effectively reduce rail deterioration.

(2) *Prevention of corrosion (Anti-corrosive measures)*– (a) Anti-corrosive paintings –

(i) Anti-corrosive painting of rails should be carried out in locations which are prone to corrosion.

(ii) While carrying out renewals in these areas, anti-corrosive treatment should be given before the rails are laid in the track. The rust is removed and scales are loosened by wire brushing/scraping. Thereafter rails are painted with –

One coat of Red oxide zinc chromate primer to **IS:2074.**

Two coats of Bituminous emulsion to IRS-P-30-1996 to a dry film thickness of 350 microns (each coat to a minimum thickness of 175 microns).

(iii) In the case of rails that are already laid in track and subject to corrosion the rails should be given the treatment in the track itself. The rust and scales are first removed by wire brushes and thereafter painted with-

One coat of Red oxide zinc chromate primer to **IS:2074.**

Two coats of Bituminous emulsion to I**RS-P-30-1996** to a dry film thickness of 350 microns (each coat to a minimum thickness of 175 microns).

(b) Rail flanges/web should be kept free of the ashes particularly near the ash pits in watering stations.

(c) Periodical cleaning of rubbish should be got done in goods shed siding lines.

(d) Water column should be avoided on the run through lines as far as possible. Where however water columns are necessary to be retained, proper drainage of water column should be ensured.

(3) *Reducing side wear on rails-(Gauge face of outer rails)* – (a)On sharp curves where the tendency to wear on the outer rail is noticeable, lubricators should be installed or hand lubrication of gauge face should be done, care being taken not to apply the lubricant on the top of the table.

(b) Increased life can be obtained by turning the rails when side wear reaches the permissible limit. At the time of turning, matching of rail ends on the gauge face should be ensured. Spot renewals should not be carried out with new rails particularly, if the heads of the existing rails are worn badly. These should be spot renewed with matching sections of serviceable rails.

(4) *Repairs to wheel burns* – This could be carried out at site by *in situ* welding.

251. Maintenance Of Rail Joints – (1)Special care is needed for maintenance of fish-plated joints to get better rail life as well as improved running.

(2) The efficient maintenance of joint depends on **:**

(a) Efficiency of fastenings.

(b) The efficiency of packing and correct spacing of sleepers.

(c) The provision and maintenance of correct expansion gaps.

(d) The proper lubrication and fishing of the joints.

(e) The correct maintenance of gauge and cross levels and proper packing.

(f) Efficient drainage.

(3) *Defects in rail joints* – Some of the major defects, noticed at the rail joints and the preventive measures suggested to rectify or minimise the deficiencies /defects noticed are detailed below –

(a) *Slack sleepers* – Maintenance of joints by Measured Shovel Packing in case of flat bottomed sleepers improves the condition of the joints. In the case of conventional maintenance by beater packing it should be ensured that the sleepers do not get tilted.

(b) *Loose Fish-Plates* – Fish bolts must be kept tight, but not so tight as to prevent expansion or contraction of rails, by using standard spanners.

(c) *Wear of Fish-Plates and Rails at fishing surfaces* – When wear takes place on the fishing planes of rails and fish-plates, the joint dips down. The wear is generally greatest at the centre of the top of the fish-plates and least at the ends.

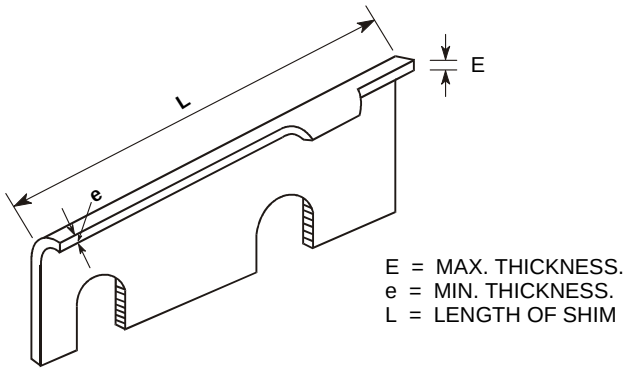
Two types of devices are used for compensating the wear of the fishing planes :

(i) Repressed fish-plates.

(ii) Tapered shims.

(i) *Repressed Fish-Plates* – The repressed fish-plates are those which are hot forged so as to form a bulge in the middle part of the fish-plate conforming to the wear most prevalent.

(ii) *Tapered shims* – Tapered shims are pieces of steel, shaped to fit the usual pattern of wear between the top fishing surfaces. They are made in varying thicknesses, each size being designated by the wear in mm. between the fishing surfaces multiplied by 10. Thickness of shim is varied in steps of 0.5 mm. from 1.5 mm. to 3.8 mm. Length of the shims should be determined on the basis of actual wear pattern of different sections of rails. Shims are tapered in thickness from one to the other to conform to the wear. The sketch shown as below indicates the type of tapered shim, which is commonly used :



SKETCH SHOWING THE TAPERED SHIM IN USE

(d) *Battering of Rail ends* – Battering can be avoided by packing the joint sleepers firmly and by maintaining correct expansion gaps. Battering of rail ends can be repaired by *in situ* welding. It can also be improved by end cropping.

(e) *Hogged Rail Joints* – De-hogging can be done by de-hogging machines. De-hogging of rail ends can be done by Measured Shovel packing. In this method the joint sleepers are normally packed to a specified height above the normal, taking into consideration the dip at the joint and voids below the sleepers, leaving the shoulder sleepers without packing. After allowing traffic for about two days, the shoulder sleepers are packed without lifting them. De-hogging is effected by traffic passing over the joints. Use of repressed fish-plates helps in improving the hogged joints. Hogging can also be eliminated by cropping the rail ends.

(f) *Broken Fish-plates* – Broken or cracked fish-plates must be replaced with new or reconditioned fish-plates.

(g) *Cracked or Broken Rail ends* – The fish bolt and bond holes at rail ends weaken the rails. When maintenance is poor, rail end fractures occur, the fracture almost always starting as a fine crack from the fish bolt or bond holes. During lubrication of rail joints, opportunity should be taken to observe the rail ends carefully for any fine cracks. If cracks are noticed rails should be replaced. Chamfering of bolt holes and bond holes should be done. Ultrasonic testing of rails helps in detecting the cracks which are difficult to detect by visual examination.

(h) *Pumping of Joints* – Immediately after the monsoon, the ballast at such joints should be removed. Sand blanketting should be provided on the top layer of the formation which will prevent upward rise of clay slurry. On top of this blanket clean and adequate ballast should be put. Cross drains should be provided between first and second shoulder sleepers. Geotextiles can also be advantageously used.

(4) *Other important points regarding joint maintenance* – (a) Gap survey should be undertaken periodically and gap adjusted, as detailed in **Para 510.**

(b) Use of wooden sleepers at fish-plated joints, on a metal sleepered road, is desirable.

(c) Ordinary fish-plated track could be converted into three rail panel, wherever all other conditions for SWR are satisfied.

(5) *Chamfering of bolt holes in rails-*

(a) General : (i) Chamfering of bolt holes work hardens the periphery of holes and thereby delays the formation of star cracks. The chamfering of hole takes 5 minutes per hole. Each drilled hole shall be chamfered.

(ii) Existing bolt holes in fracture prone zones should be chamfered if not elongated. In case of elongated holes, the chamfering bit will not be in contact with the full edge of the bolt holes and there will be uneven hardening of the metal resulting in stress concentration in weaker-zones. Therefore, such portion of rail should be removed; holes should be drilled and chamfered.

(b) Equipment for chamfering of bolt holes: Work hardening of bolt holes should be done with chamfering kit of approved make. The chamfering kit consists of the following:

Equipment **(as per Fig.1)**

	Qty.
(i) High tensile bolt M-20	1 No.
(ii) High tensile nut for M-20 bolt	1 No.
(iii) Sets of 2 H.S.S. chamfering bits	1 set
(iv) 19mm sq. drive sockets size 32mm	8 Nos.
(v) Set of 2 packing pieces (sleeves)	1 set
(vi) T-400 torque-wrench with built-in rachet Mechanism 1.25m length	1 No.

(d) Procedure for chamfering of bolt holes: (i) The nut of high tensile steel bolt is removed and one packing piece is inserted in the shank followed by one side of the H.S.S. chamfering bit.

(ii) The high tensile steel bolt is inserted with 2 pieces in the rail hole.

(iii) On the other face of the rail hole, the second half of the HSS chamfering bit is inserted over the shank followed by the second packing piece.

(iv) The nut on the high tensile steel bolt is replaced.

(v) Pre-set torque-wrench on nut at torque value of 52 Kg-m equivalent to an axial force of 12.5 tonnes, is applied. The nut is tightened with the torque wrench. As soon as the preset torque is attained, the torque wrench will automatically trip indicating complete tightening to preset torque value.

(vi) The nut by reversing the torque wrench is unscrewed and HTS bolt is removed. The process is repeated on other rail holes.

(e) Chamfering of each hole should be done under the supervision of Mate/Keyman.

252. Inspection of Rails In Service – (1) *General* – Rails should be inspected for flaws specially, when the rails show signs of fatigue and the rail wear is excessive. The detection of rail flaws is done either by visual examination of the rail or by ultrasonic rail flaw detection.

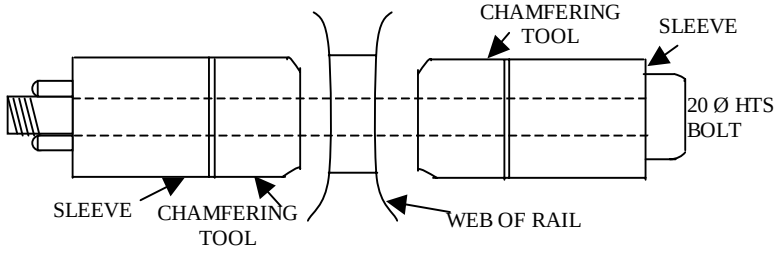


Fig.1

(c) (i) Chamfering of bolt holes in the welded rail panels should be done before despatch in the Flash Butt Welding Plants, if situation so warrants.

(ii) When rails in track are end-cropped, new bolt holes should be chamfered at site.

(iii) Bolt holes in new rails received directly from steel plant should be chamfered before rails are laid in track.

(2) *Visual examination of Rails* – Most of the rail flaws develop at the rail ends. Rail ends should be examined for cracks during the lubrication of rail joints by cleaning the surface of the rail by wire brushes and using a magnifying glass. A small mirror is of assistance in examining the underside of rails. Such an inspection on the important grider bridges and their approaches should be done twice a year.

(3) "Ultrasonic testing of rails is specialized activity and the inspectors carrying out the ultrasonic testing of rails shall be trained by RDSO, in the technique of USFD testing. Each zonal railway shall create adequate number of ex-cadre posts of inspectors to ensure that entire track length in their jurisdiction is ultrasonicaliy tested at the laid down periodicity.

Detailed instructions for ultrasonic testing of rails and welds are contained in the **Manual for Ultrasonic Testing of Rails and Welds, August, 1998,** which along with its correction slips may be referred to as Annexure to this Manual, It is very important that instructions contained therein are carefully studied by the Permanent Way Officials connected with the laying and maintenance of track".

(4) USFD Testing of Service Rails**:-** No rail untested by USFD shall be laid in the track whether for new lines or layouts or renewals or for repair works or even temporarily such as service rails for PQRS work. For repairs and casual renewals, a location-wise imprest of tested rails of various lengths (13m, 9m, 6m) shall be prescribed for each PWI by Sr.DEN/DEN.

253. Action to be taken in the case of Rail fractures/Weld failures – (1) It is of paramount importance that whenever a fracture of a rail/welded joint is noticed, immediate action is taken to restore the track, if necessary with restricted speed, with the least possible delay.

(2) The Mate/Keyman/Gangman, as soon as he notices the rail fracture/weld failure should first protect the track, while the repairs are being carried out. He should also send information to the P.W.I. and the Station Master of the nearest station.

(3) If the fracture is with a gap of less than 30 mm. in the case of fish-plated/SWR track, the fractured portion should be supported on wooden block or by shifting the nearest sleepers on both sides. In the case of LWR the fractured rail should also be clamped.

(4) When the fracture gap is more than 30 mm., a closure of appropriate length should be used with a clamp and further action taken as in **sub-para (3)** above.

(5) In cases where a small portion or piece of rail has come off or in the case of multiple fracture, the rail has to be changed.

(6) In the case of weld failure, joggled fish-plates and clamps should be used.

(7) After doing the emergency repairs the trains may be passed at 20 km.p.h. by a Mate/Keyman, until the Permanent Way Official replaces the rail and restores full speed.

(8) If there is a spate of rail fractures, additional Keyman's patrol should be introduced in the early hours of the morning.

254. Stacking of Rails – In stacking rails, care shall be taken that -

(a) The ground is level;

(b) Free rails are supported at least at four points, evenly in their length; and

(c) Each stack of the rail should be of the same section and class.

255. Handling of Rails – (1) Any carelessness in loading, unloading, handling and laying is liable to cause damage which will not only contribute towards bad running but also result in irrepairable damage to, or incipient failures of rails. During loading and unloading, ramps of un-serviceable rails should be made and the rails slid over them, intermediate supports being given to prevent excessive sagging.

(2) When conveyed in bolster -wagons, the rails should be loaded to obtain equal over hang at each end beyond the bolsters and securely chained.

(3) Carrying rails, on the head or shoulders should be avoided. For handling rails, slings or tongs should be used. When hauled into position, prior to linking or otherwise, rails should be so spread as to rest evenly along their entire length or on supports closely spaced. Flat footed rails should lie on the foot. Those that are found with kinks should be straightened.

(4) When housing rails into metal sleepers or chairs, the sleepers should be properly aligned and levelled. Forced insertion of rails with hammer blows should be avoided.

(5) During yard surveys, curve adjustments and realigning operations, chisel or punch marking of rails should be avoided.

256. Rail Closures – The following instructions regarding use of rail closures should be observed :

1) (a) Permanent closure in running lines should not be less than 5.5 metre in length. However, for locations such as 500 metre length on both side approaches of tunnels, tunnel proper, major and important bridges including bridge proper, deep cuttings and high embankments, the stipulations of **para 1** (b) below shall apply.

(b) Permanent closure in running lines, on locations specified in **para 1 (a) above,** should not be less than 11 metre in length, between two adjoining fish plates.

The closure rails existing in track which are less than 11 metre, should be welded at least at one joint on either side to make the minimum rail length of 11 metre between two adjoining fish plated joints. Till such time this welding is done and the length of at least 11 metre is achieved, speed restriction of 30 kmph shall be imposed.

(2) The use of closures should be limited and reduced to the minimum possible.

(3) Closures should not be located near each other in the same portion of track nor in proximity to-

(a) Junctions of different types of rails and/or sleepers.

(b) Bridges, level crossings, ash pits, and points and crossings

(4) Closures should be obtained by hacksaw cutting and not by gas cutting.

(5) It is better not to use closures opposite to each other but stagger the same.

257. Rail Failures – (1) *Definition of a Rail failure*– A rail is said to have failed if it has fractured in track or it is considered necessary to remove it from track on account of defects other than those due to accidental damages due to buckling, kinking, derailments, abnormal wheel burns etc.

(2) *Action to be taken in case of Rail failures*– When a rail fails in track, action as detailed in **items (i), (ii) and (iii) below** is to be taken -

(i) Entry in the Permanent Way Inspector's section register as detailed in sub para (3) below.

(ii) Preparation of a detailed report of the failure in cases where applicable as laid down in **sub-para (4)** as mentioned below.

(iii) Detailed metallurgical investigation in cases, where applicable, as per **sub-paras (4) & (5)**

(3) *Register of Rail failures* – All the cases of rail failures have to be entered in the section register by the Permanent Way Inspector as laid down in **Para 210.** For this purpose all failures whether in running lines, points and crossing rails etc. and irrespective of type and age of the rails, have to be entered in the section register. This recod is intended to serve as a basic record which should be available in the office of the Permanent Way Inspectors and will serve to furnish data, if required subsequently for any statistical analysis or for framing out proposals for track renewal works. Care should therefore be taken by the Permanent Way Inspectors for filling up all the details as per **Para 210.** The Assistant Engineer concerned shall call for the P. W. I.'s register once every year and initial the same in token of his perusal.

(4*) Reports of Rail failures* – In addition to the record maintained in the section register, as detailed above, a report has to be prepared as per **Annexure 2/10** in all cases of rail failures occurring in track with the exception of the cases noted below -

(a) Rail failures occurring in non running lines.

(b) Non standard and obsolete rails.

(c) Rails removed due to casual renewals on account of accidental damages to the rails such as wheel burns and scabbings, buckling, kinking, derailments, abnormal slipping of loco wheels, excessive wear, loss of section by corrosion, battering, elongation of holes.

(d) Machined rails such as mitred joints, switch expansion joints, switches and crossings.

For this purpose, the Permanent Way Inspector will prepare a 'Rail failure' Report in quadruplicate as per *pro forma* at **Annexure 2/10** and shall forward 3 copies to the Assistant Engineer, who will transmit all the copies with his remarks to the Divisional Engineer, for onward transmission of one copy each to the Chief Engineer and Director (M&C)/RDSO/Lucknow-11. In case of failures requiring metallurgical investigation, the report should be prepared in quaintuplicate, the extra copy being sent to the Chemist and Metallurgist of the Zonal Railway along with the samples as detailed in the **sub-para (6)** below. Efforts should be made by Divisional Engineer so that the report reaches the Director (M&C)/RDSO within a month of the rail failure. The Director (M&C) will arrange to carry out annual numerical analysis of rail failures from the reports received from the Permanent Way Inspectors and the Chemist and Metallurgist and publish reports with suggestions for reducing failures.

Sketches illustrating the fractures will be prepared and submitted with the failure reports on each case, care being taken that the running face of the rail is indicated thereon.

It is particularly essential to record the type of failure in the failure reports against **item No. 5.3 as per R.D.S.O. monograph " Rail Failures - Description, Classification and Reporting".** In most cases, it is possible to determine the cause of the failure by visual examination/ultrasonic detection without the need for metallurgical investigation. However, in cases mentioned in **sub-para (5)** below, it is obligatory to take up full metallurgical examination by the Chemist and Metallurgist of the Railway concerned with a view to ascertaining the exact cause of failure. In such cases the rail failure report should be made out in the prescribed *pro forma* inserting the most probable code of failure against **item No. 5.3** and indicating whether the sample has been sent to the Chemist and Metallurgist for metallurgical investigation.

For the cases of rail failures detected visually, a short piece of rail approximately 2 m. long has to be sent to the Zonal Railway Chemist and Metallurgist by the Permanent Way Inspector direct, along with a copy of the rail failure report only for such cases which come under the category listed below. In other cases, i.e. , those detected by ultrasonic flaw detectors, the rail pieces have to be sent for metallurgical test only from those rails which are removed from track based on the criteria for renewal of rails and falling in the category listed below. The test pieces for metallurgical examination are to be sent only for rail failures which occur within 10 years of primary renewals and for which detailed reports are to be prepared. To sum up, before sending the test pieces to the Chemist and Metallurgist, it should be ensured that -

(i) The rail failure is within 10 years of primary renewals;

(ii) The rails have been removed from track as a result of visual or ultrasonic detection; and

(iii) The failures fall only in categories listed below:

(iv) The rails where rail/weld failure is a prima facie cause of the train accident should be sent to RDSO.

In cases of failures of imported rails occurring within guarantee period, stipulation of **sub para (6)**

(5) Type of rail failures for which metallurgical investigation is required -

(a) 100/200 - Transverse breakage with apparentorigin (sudden breakage)

(b) 1212/2212 - Head, surface, shallow surface defect(line).

(c) 1321/2321 - Web horizontal crack at top fillet radius.

(d) 1322/2322 - Web horizontal crack at bottom fillet radius.

(e) 1323/2323 - Web horizontal crack not at fillet radius.

(f) 238 - Web diagonal cracks not at a hole.

(g) 253 - Foot , vertical, longitudinal crack in foot half-moon break.

(h) 1511/2511 - Foot transverse break at rail seat.

(i) 1512/2512 - Foot transverse break not at rail seat.

(j) 111/211 - Internal flaw in head, transverse breakage.

(k) 112/212 - Internal flaw in head, horizontal crack.

(l) 113/213 - Internal flaw in head, vertical longitudinal split.

(m) 133/233 - Web, vertical longitudinal splitting

(n) 139/239 - Web, lap.

(o) 153/253 - Foot, vertical longitudinal split.

(6) *Failure of imported rails within the Guarantee period* - In all cases of failure of imported rails, occurring within the guarantee period, irrespective of the type of fracture/flaw a 2 m. piece containing the fracture/ flaw detected visually or by ultrasonic flaw detector, should be sent to the Chemist and Metallurgist together with a rail failure report for metallurgical investigation.

(7) *Procedure for sending samples for metallurgical investigation*— In case of fractured rail, both the pieces containing fractured faces should be sent to the Chemist and Metallurgist for investigation. To avoid damage in transit, the fractured faces shall be protected with mineral jelly and suitably covered with hessain cloth. Cracked rails may also be suitably protected at the crack location to avoid damage in transit. Pieces having internal defects may be dispatched as such.

The Chemist and Metallurgist of the Railway will carry out metallurgical investigation, as required, and forward one copy of the report each to the Chief Engineer of the Railway and the Director (M&C)/ R.D.S.O.

In case of failures of imported rails within the guarantee period, attributable to manufacturing defects as revealed my metallurgical investigation, the Chief Engineer should immediately lodge a provisional claim with the manufacturer pending Director (M&C)'s confirmation of the findings submitted by the Chemist and Metallurgist of the Railway. The Director (M&C)/ R.D.S.O. will scrutinise the report submitted by the Chemist and Metallurgist and if he agrees with the findings as submitted, inform the Chief Engineer accordingly. Where the Director (M&C)/ RDSO feels the need for carrying out further investigation before giving his verdict, he will call for the sample from the Chemist and Metallurgist of the Railway and carry out confirmatory tests, as necessary and intimate the findings to the Chief Engineer. On the basis of Director (M&C)'s advice, the Chief Engineer will then finalise the claim with the manufacturer.

In case of failures of rails other than imported, the Director(M&C)/RDSO will call for samples from the Chemist and Metallurgist, for confirmatory test, where necessary. Based on the trend indicated by the numerical analysis of the rail failures for the period under review, the Director(M&C) will bring to the notice of the indigenous manufacturers and D.G.S. & D. any predominance of failures attributable to manufacturing defects, to enable corrective action being taken.

258. Careful usage of Fish-Plates – (1) The hammering of the fish-plates should be strictly forbidden. For removing a fish-plate which has seized to the rails, the fish-plate may be tamped gently, by a hammer by interposing a wooden piece.

(2) Over tightening of fish-plates shall be avoided. Fish bolt spanner of standard length 680 mm to 760 mm on B.G. and 530 mm to 610 mm on M.G. and N.G. (762 mm) shall be used. Alternatively mechanical torque wrenches with predetermined torque should be used. When tightening bolts the two central bolts should be tightened first.

259. Combination Fish-Plates – Rails at joints should butt against each other and fishbolts tightened. A set of four combination fishplates is to be used at joints of two different rail sections. The 4 fishplates are different from each other and are marked I.R., OR., I.L. or O.L. apart from their part numbers. On either side of combination fishplates, full length of rail should be used. Combination rails prepared by welding two rail sections as per standard drawings should, preferably be used in place of combination fish-plates.

260. Fish-plates failures – (a) A fish-plate is said to have failed if it fractures or cracks in service in track for reasons other than service wear and tear, accidents, or excessive wheel grazing noticed on it, and it becomes necessary to remove it from track.

(b) All cases of failure of fish-plates shall be entered by the Permanent Way Inspector in the section register allotting separate pages for the same.

(c) Renewal of worn fish-plates should be considered when condition has reached a stage where remedial measures like use of tapered shims are ineffective.

.....RAILWAY

ANNEXURE-2/10 Para 257 (4)

Pro forma for Reporting Rail Failures

Broken/Cracked/Defective rail removed on .....day of 19.....

1.0 General Information
- 1.1. Division.
- 1.2. Section (name of line or branch).
- 1.3. Between Stations .....and.....
- 1.4. Kilometrage.
- 1.5. Line.
  - 1.5.1. Up/Down/Single.
  - 1.5.2. B.G./M.G./N.G.
- 1.6. Alignment.
  - 1.6.1. Straight/Curve(indicate degree of curvatures).
  - 1.6.2. Inner/Outer in case of curve.

2.0. Charateristics of Traffic and Traction.
- 2.1. Traffic density in G. T. K. M./annum.
- 2.2. Total traffic carried in G. M. T. before failure (for realeased rails, also add previous traffic carried).
- 2.3. Maximum axle load with type of vehicle on section.
- 2.4. Maximum permissible speed.

3.0. Characteristics of Rail.
- 3.1. Rail Section .....kg./m.
- 3.2. Rolled marking .....
- 3.3. Total number of years in service.....
- 3.4. Cast No.

4.0 Characteristics of Track.
- 4.1. If fracture occured at or within 100mm. of weld, indicate date of welding.
- 4.2. Position of fracture.
- 4.3. Type of sleepers and density.
- 4.4. Depth of ballast.

5.0. Particulars of defect or fracture.
- 5.1. Detected–Visually/By flaw detector.
- 5.2. Remarks, if any.....
- 5.3. Classification of failure in code.....

.....	.....	.....
Signature of Permanent Way Inspector	Signature of Asst. Engineer	Signature of Divi. Engineer

PART - 'F'

Ballast and Ballast Depots

261. Type of ballast in use - Stone ballast shall be used on all lines including points and crossings.

262. Size of the Ballast – The gauge of stone ballast shall be as follows:

As per specifications issued from time to time.

263. Ballast Profiles/Sections/Depths of Cushion – (1) *Ballast Profiles/Sections to be adopted* - The following ballast profiles shall be provided for the various groups of track in B.G., M.G., and N.G. :–

	LWR/CWR	other than LWR/CWR
B.G. ..	**Annexure 2/11**	**... Annexure 2/13**
M.G. ..	**Annexure 2/12**	**... Annexure 2/14**
N.G.		**... Annexure 2/15**

In the case of conversion to CWR/LWR in both B.G. and M.G., the ballast profiles should be made up as per the Manual.The approximate quantity of ballast required per metre run of track for each of these standard ballast sections has been worked out and shown in the sketch itself.

(2) *Minimum depths of Ballast Cushion* **–** (a) The recommended minimum depth of the ballast below the bottom of the sleepers at the rail seat should be as under **–**

Groups	Recommended depth
B.G. Group 'A'	300 mm
B.G. Groups 'B' and 'C '	250 mm
B.G. Group 'D'	200 mm
B.G. Group 'E'	150 mm
M.G. 'Q' routes	250mm (300 mm when speed is 100 kmph)
'R1' routes	250 mm
'R2' and 'R3' routes	200 mm
'S' routes	150 mm
Narrow gauge	150 mm

Note:- (i). In case of SWR the recommended depth is 200mm.

(ii) Whenever primary renewals are carried out even on 'E' routes, the minimum depth of ballast of 200mm shall be provided.

(iii) Minimum depth of ballast under the rail seat of the sleepers shall be 150mm except under PRC sleepers where it shall be 250mm.

(iv) Wherever 22.1 t Axle load rolling stock is nominated to run the minimum depth of ballast shall be 350mm.

(b) Increase in ballast cushion to make up the recommended depth will be carried out during complete track renewal, through sleeper renewal or programmed deep screening.

(3) On wooden sleepered road, for a distance of 50 m. outside of stop signals and at every place where steam engines are likely to stop, it is a good practice to cover the central portion of the sleepers with ballast to reduce the risk of fire.

(4) At locations where there is a change in the type of sleepers, special precaution should be taken and six rail lengths on either side of the junction should be fully boxed. Similar action should be taken for bridge and level crossing approaches.

264. Assessment of Ballast Requirements– (1) The requirement of ballast shall be assessed separately for

(a) making good the deficiencies as existing in track,

(b) making good deficiencies arising out of overhauling, through packing and deep screening,

(c) for providing adequate cushions in the case of mechanical tamping,

(d) For providing extra cushion while converting into LWR

(2) The ballast required for maintenance purposes shall be estimated by assessing the quantity approximately if necessary by a survey, over a rail length in every 1 km. Care should be taken that the cores under the sleepers are not disturbed.

(3) In case of deep screening, assessment of ballast required for recoupment and providing standard section should be made by deep screening the ballast section to the full depth in a rail length for two to three sleepers at every $^1/_2$ to 1 km. In this case screening is done under the sleepers as well.

(4) In new line construction, ballast requirements will be assessed as per the profile (to be adopted) given in **para 263 (1)**

(5) The quantities assessed vide **sub-para** in **(2), (3) and (4)** above will be the net quantities of ballast required to recoup the deficiencies or to provide required profile / sections. The above net quantities may be enhanced suitably (say 8%) to arrive at gross quantities of ballast for the purpose of procurement action in case measurements are proposed to be taken in stacks or in wagons at originating station.

265. Collection and Training out of Ballast– The collection of ballast can either be done- (a) by resorting to alongside collection, or (b) by collecting at depots and training them out in ballast trains.

The mode of collection will have to be decided taking into account proximity of quarry, availability of good stone ballast, service roads along side the line for carrying of ballast,availability of ballast trains, the turn round of ballast trains and availability of block for unloading.

266. Depot collection of ballast – (1) *Register of ballast collection and training out* - The Inspector-in-charge of the depot shall maintain a register showing all transactions in respect of stone ballast,moorum and sand ballast. If the depot deals with boulders also, the same should also find a place in a register.

(2*) Loading from the Depot* - At all depots the following instructions should be followed :

(a) The space along the sides of the Railway siding, meant for stacking, should be divided into convenient number of zones and demarcated.

(b) For each depot, a depot diagram shall be maintained, which should indicate the site details of all the measured stacks.

(c) Each stack in each zone should be serially numbered.

(d) The operations of collecting and training out materials should not be carried out at the same time in any one zone.

(e) The ground on which the stacks are made should be selected and levelled.

(f) Where practicable, no stack should be less than one metre in height.

(g) Measurements should be taken of complete stacks. The measured stacks should be identified suitably by lime sprinkling or any other method.

(h)Before training out of Ballast or other material is undertaken on contract, a copy of each of the depot diagram should be kept with the permanent Way Inspector, the Ballast Train Guard and the Contractor, the original being with the Assistant Engineer. As each stack is lifted, this should be recorded on the depot diagram which should always be kept up-to-date. Challans should be prepared after loading the ballast into wagons.

(3) *Quantity trained out* – When settling accounts for training out ballast, checks should be made by comparing the quantities as per stack measurements recorded in the measurement books, with those deduced from wagon measurements as recorded in the ballast train reports, due allowance being given for sinkage as per rules.

Should the wagon measurements differ from the recorded measurements by more than 5 percent, the matter should be investigated immediately and reported to the Divisional Engineer. In special cases direct measurement of ballast in wagons may be resorted to with the approval of the Chief Engineer.

267. Along side Collections (Cess Collections) – In the case of along side collections the Inspector-in-charge should maintain separate register showing the measurement of stacks as well as its disposition(Between km. to km.). The stacks should be serially numbered between the successive posts. Any entry should be made in the register whenever the stacks are removed and ballast put into the track. Record should show the place where the removed ballast has been used with the date of removal.

268. Handing over charge by Assistant Engineer – During transfer of charge of a sub division, the Assistant Engineer taking over, should satisfy himself by test checking some of the stacks at each depot and along the cess to the effect that the quantities of materials shown in the registers are correct. He should certify that this has been done by initialling each entry so checked.

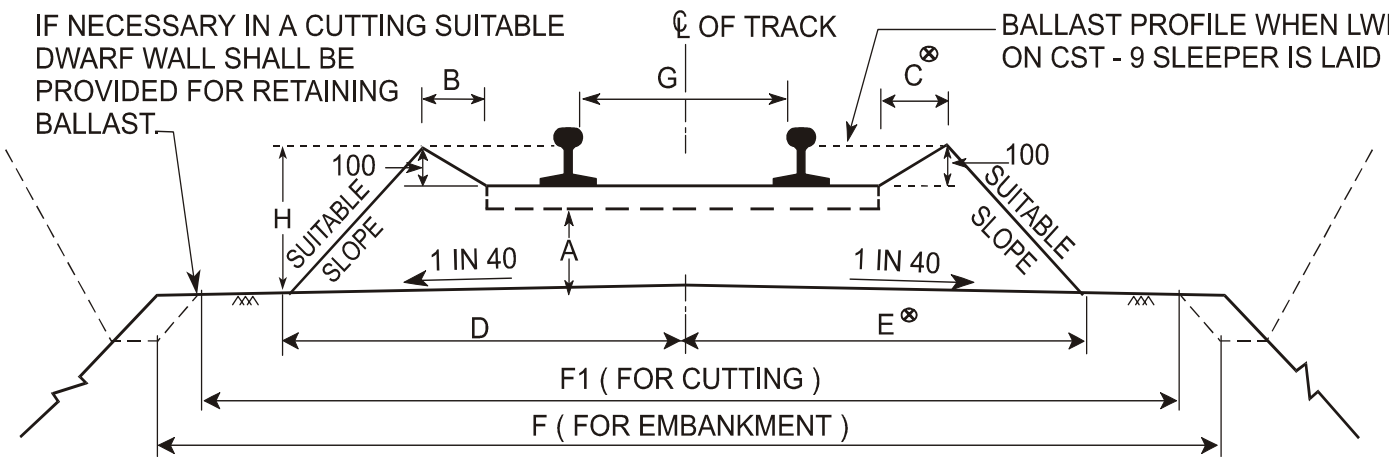
269. Unloading Ballast along the line – When unloading ballast along the line care shall be taken that the heaps at the sides and the centre are clear of prescribed running dimensions.

Ballast shall not be unloaded upon signal wires or point rods. Care should be taken to ensure that no stone is left inadvertently between the stock rail and tongue rail.

270. Surplus Ballast along the line – All surplus ballast left along side the line should be collected and stacked in regular heaps and not left scattered on the slopes to be overgrown by grass and lost.

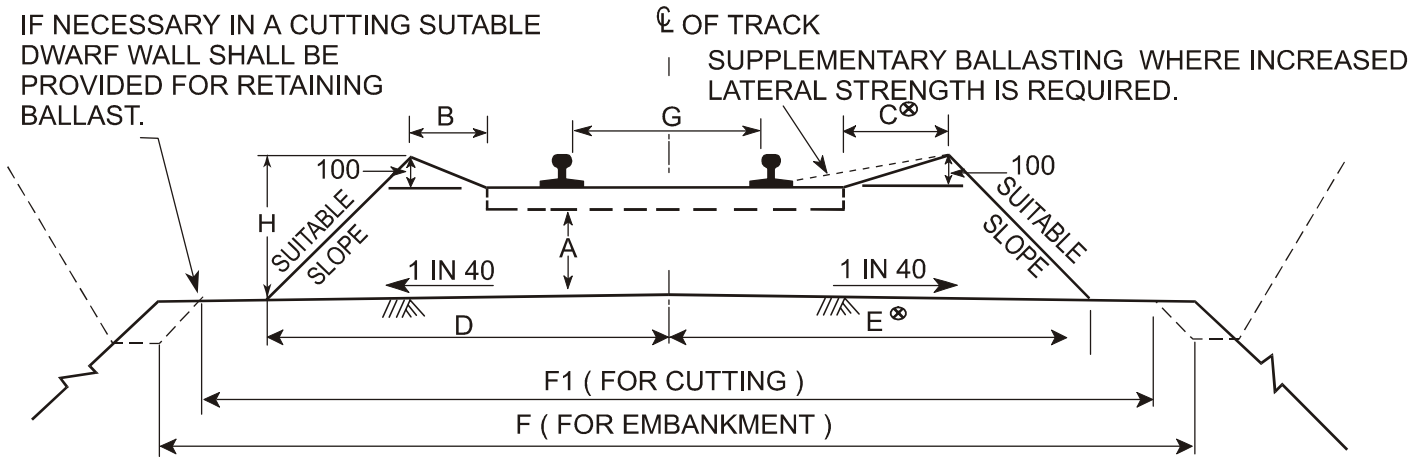
271. Ballasting New Formation – Banks should be preferably compacted in which case ballasting can be done straightaway. If compaction is not done initially, the ballast punctures the formation and ballast pockets are formed which give rise to problems in maintaining correct track geometry. On banks where track has to be laid before proper consolidation, it is desirable to use coarse sand or moorum for packing and boxing. Quarry grit and stone chips can be used if available. Ash, cinder, slag and fine and medium sand should not be used. After consolidation, the road should be opened to the bottom of the sleeper, all surplus material removed, the track raised to final level on stone ballast and packed.

BALLAST PROFILE FOR LWR TRACK (SINGLE LINE B.G.)

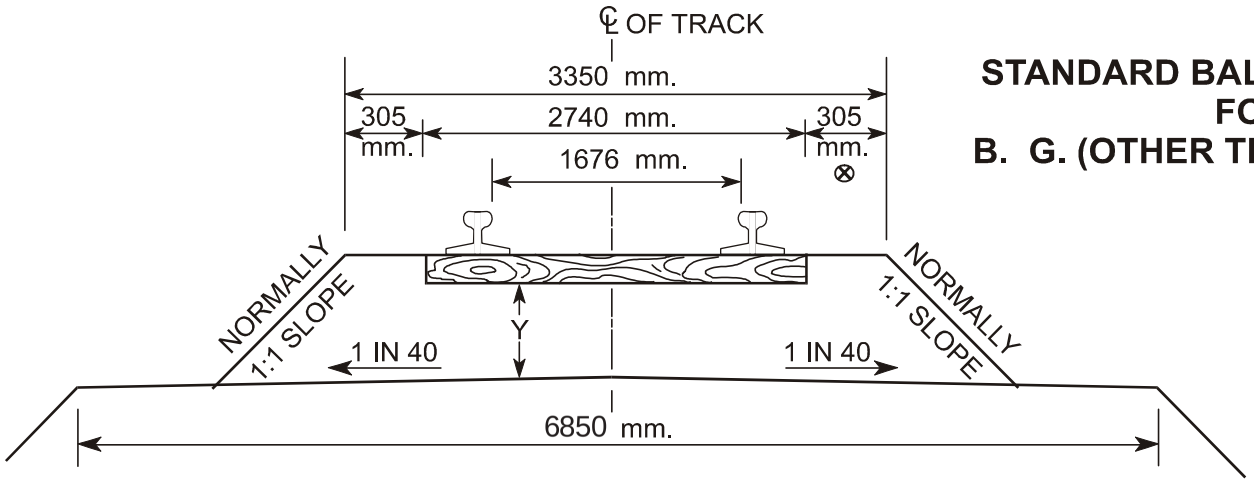


G Gauge	Type of Sleeper	A	B	C*	D	E*	F	F1	H	Quantity of Ballast per meter in		Remarks
										Straight Track	Curved Track	
1676 mm	Wooden	250	350	500	2,270	2,420	6,850	6,250	540	1.682 M^3	1.646 M^3	1. The Minimuim Clean Stone Ballast cushion below the bottom of sleeper i. e., A–250 mm. 2. For routes where increase in speeds are to be more than 130 Km.p.h. A–300 mm. or 200 mm. along with 150 mm. of sub-ballast. 3. Suitable dwarf walls shall be provided in case of cuttings, if necessary for retaining ballast. 4. *On outer side of curves only. 5. Cess may be widened where required depending on local conditions and outside of curves. 6. All dimensions are in mm. 7. ¶ 200 over 150 Sub-Ballast.
	"	300	"	"	"	"	"	"	590	1.782 "	1.853 "	
	"	¶	"	"	"	"	"	"	640	1.982 "	2.060 "	
	Steel Trough	{ 300 ¶	350	500	2,280	2,430	6,850	6,250	550	1.762 M^3	1.827 M^3	
			"	"	"	"	"	"	600	1.962 "	2.035 "	
			"	"	"	"	"	"	650	2.162 "	2.242 "	
	PRC	250	350	500	2,360	2,510	6,850	6,250	630	1.954 M^3	2.032 M^3	
	"	300	"	"	"	"	"	"	680	2.158 "	2.243 "	
	"	¶	"	"	"	"	"	"	730	2.362 "	2.455 "	
	2 Block	250	350	500	2,360	2,510	6,850	6,250	630	2.110 M^3	2.193 M^3	
	"	300	"	"	"	"	"	"	680	2.314 "	2.405 "	
	"	¶	"	"	"	"	"	"	730	2.518 "	2.616 "	

BALLAST PROFILE FOR LWR TRACK (SINGLE LINE M.G.)



G Gauge	Type of Sleeper	A	B	C*	D	E*	F	F1	H	Quantity of Ballast per meter in		Remarks
										Straight Track M^3	Curved Track M^3	
1000 mm.	Wooden " "	250 300 ¶	350 " "	500 " "	1,760 " "	1,930 " "	5,850 " "	5,250 " "	510 560 610	1.179 1.331 1.482	1.284 1.407 1.567	1. The Minimuim Clean Stone Ballast cushion below the bottom of sleeper i. e., A 250 mm. 2. For routes where increase in speeds are to be more than 100 Km.p.h. A30 mm. or 200 mm. along with 150 mm sub-ballast. 3. Suitable dwarf walls shall be provide in case of cuttings, if necessary for retaining ballast. 4. *On outer side of curves only. 5. Cess may be widened where require depending on local conditions and outside of curves. 6. All dimensions are in mm. 7. ¶ 200 over 150 Sub-Ballast.
	Steel Trough	{ 250 300 ¶¶	350 " "	500 " "	1,790 " "	1,940 " "	5,850 " "	5,250 " "	520 570 620	1.290 1.443 1.600	1.353 1.514 1.674	
	CST-9 " "	250 300 ¶	350 " "	500 " "	1,730 " "	1,880 " "	5,850 " "	5,250 " "	510 560 610	1.235 1.385 1.535	1.295 1.453 1.609	
	PRC " "	250 300 ¶	350 " "	500 " "	1,940 " "	2,100 " "	5,850 " "	5,250 " "	590 640 690	. . . . . .	. . . . . .	



STANDARD BALLAST PROFILE FOR B. G. (OTHER THAN LWR/ CWR)

RECOMMENDED DEPTHS OF BALLAST AND BALLAST REQUIREMENTS FISH-PLATED TRACK			
Group	Recommended Depth of Ballast Cushion Y	Quantity of Ballast Required/Metre	
		On Straight and Curves of Radius Flatter than 600 M	Curves of Radius Sharper than 600 M
A	300 mm.	1.588 M^3	1.634 M^3
B & C	250 mm.	1.375 M^3	1.416 M^3
D	200 mm	1.167 M^3	1.202 M^3
E	150 mm.	0.964 M^3	0.996 M^3

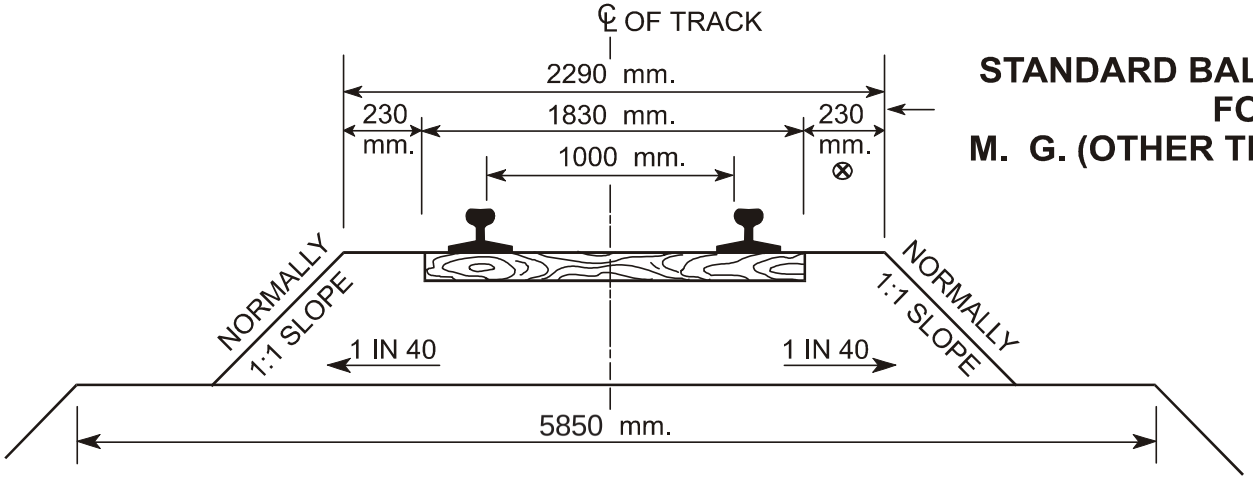
Note :

(1) In the case of ordinary fish-plated track : * To be increased on the outside of curves to 400 mm. in the case of curves sharper than 600 M. radius.

(2) In short welded panel Track * To be increased to 400 mm. on outside of all curves, flatter than 875m radius and to 450mm. In the case of curves sharper than 875m. radius.

(3) *To be increased to 550 mm. on the outside of turn in curves of turn-outs in passenger yards.

(4) In the case of S. W. R. track, the minimum depth of cushion shall be 200 mm.



STANDARD BALLAST PROFILE FOR M. G. (OTHER THAN LWR/ CWR)

RECOMMENDED DEPTHS OF BALLAST AND BALLAST REQUIREMENTS FISH-PLATED TRACK

Routes	Recommended Depth of Ballast Cushion Y	Quantity of Ballast required per Metre on	
		On Straight and Curves of Radius Flatter than 600 M.	Curves of Radius Sharper than 600 M.
Q Routes 100 Km. p. h.	300 mm.	1.070 M^3	1.145 M^3
Q Routes of less than 100 Km. p. h. . .	250 mm.	0.965 M^3	1.033 M^3
R-1 Routes	250 mm.	0.965 M^3	1.033 M^3
R-2 Routes where LWR is contemplated	250 mm.	0.965 M^3	1.033 M^3
R-2 Routes where LWR is not Contemplated.	200 mm.	0.817 M^3	0.905 M^3
R-3 Routes	200 mm.	0.817 M^3	0.905 M^3
S Routes	150 mm.	0.673 M^3	0.725 M^3

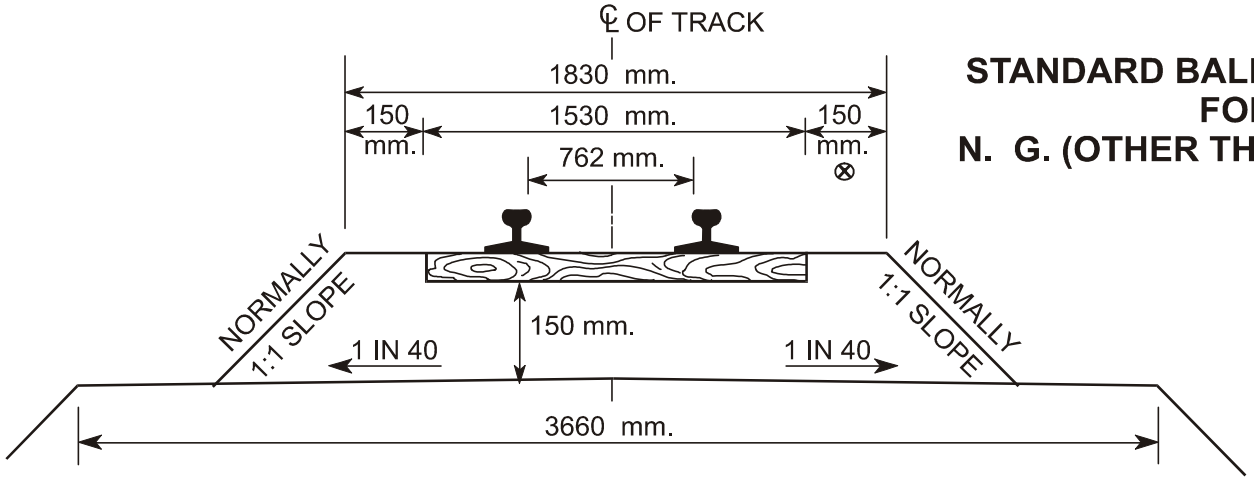
Note :

(1) In the case of fish-plated track : * To be increased on the outside of curves to 400 mm. in the case of curves sharper than 600 M. radius.

(2) In short welded panel : * To be increased to 330 mm. in the case of all curves flatter than 600 M. radius, and to 380 mm. in the case of curves sharper than 600 M. radius.

(3) *To be increased to 550 mm. on the outside of turn in curves of turn-outs in passenger yards.

(4) In the case of S. W. R. track, the minimum depth of cushion shall be 200 mm.



STANDARD BALLAST PROFILE FOR N. G. (OTHER THAN LWR/ CWR)

Recommended Depth of Ballast Cushion	Quantity of Ballast required per Metre of Track	
	On Straight	Curves of Track Sharper than 300 m Radius.
150 mm	0.543 M^3	0.584 M^3

Note :

(1) *To be increased on the outside of curves, to 300 mm. in the case of curves sharper than 300 M. radius.

(2) * To be increase to 450 mm in the case of turn in curves of turn-outs in passenger yards.

PART – 'G'

Track Structure on Bridges

272. Rail and rail joints on Bridges – (1) *Longitudinal Profile of Rails* – In standard plate girders no camber is provided. Open web girders of span 30.5 m. and above are provided with camber. Track on these bridges are laid correctly following the camber of the girder. While retimbering is done it should be ensured that the longitudinal level of rails follows the camber of girders.

(2) *Rail Cant* – On Bridges the rail should be laid with an inward cant of 1 in 20 by continuing the same cant as on the approaches.

(3) *Rail joints over the Bridge* – In the case of small bridge openings less than 6.1 m. rail joints should be avoided. For other spans, the preferred position of the rail joint is at 1/3 the span from either end.

(4) *SWR on Bridges* – SWR may be continued over girder bridges with unballasted decks upto 13.3 m. opening if the length of SWR is symmetrical to the centre line of bridge and upto 6.1 m. opening if the length of SWR is unsymmetrical to the centre line of the bridge. No fish-plated joint should be located on the girder or within six metres from either abutment. In all such cases rail free fastenings, such as rail screws, dog spikes or rail free clips shall be used, so that relative movement between rail and sleepers may take place.

(5) *LWR/CWR on Bridges* – In the case of laying LWR/CWR, provisions of LWR Manual should be followed.

(a) In the case of girder bridges (unballasted deck) LWR can be continued over bridges where overall length is not more than 20 m. In case of bridges where the overall length is between 20 and 43 m., LWR can be continued on B.G., in case the track is laid with 52 kgs. and 90-R rails under certain conditions as laid down in LWR/ Manual.

(b) LWR with rail free fastenings can be provided from pier to pier with S.E.Js. on each pier over the free end in the case of rollers on one side and rockers on other side. Box anchoring for a few sleepers should be done at the fixed end. In case of roller bearings on both sides, the central portion of the welded rails shall be box anchored on a few sleepers.

(c) LWR can be continued over a girder bridge with the provision of S.E.J. at the far end of the approach of the bridge using rail free fastenings over girder bridge. The length of the girder bridge will be restricted as per the table given in LWR Manual.

(6) *Precautions for arresting Creep* – Track on girder bridges with un-ballasted deck is always laid with rail free fastenings in all cases. Track on girder bridges laid with standard single rails and fish-plated joints be isolated from the SWR if existing, on approaches on either side by providing at least two well anchored Standard rail lengths. Similarly the track on the girder bridges not laid with LWR/CWR shall be isolated from LWR/CWR by a minimum length of 36 metres of well anchored SWR on either side.

273. Bridge Timbers – (1) Minimum requirements of depth, length and spacing- Provisions in the Schedule of dimensions, indicating the minimum length of sleeper, minimum depth of sleeper and the maximum clear distance between the sleepers for the three gauges are summarised below (nearest to 5 mm) *:*

Gauge	Clear distance between consecutive sleepers not to exceed	Depth of sleepers (exclusive of notching) not less than	Length of sleepers
B.G.	510 mm	150 mm	Outside to outside of girder flanges plus 305 mm. but not less than 2440 mm.
M.G.	305 mm	125 mm	Outside to outside of girder flanges plus 305 mm. but not less than 1675 mm.
N.G.	125 mm	125 mm	Outside to outside of girder flanges plus 305 mm. but not less than 1525 mm

Note : The details are for timbers directly resting on logitudinal girders.

(2) *Size of Bridge Timber to be used for different Spans(B.G. and M.G.)*

(a) A table showing the minimum thickness of timber for various girder spacings for B.G. and M.G. is given below (applies to sleepers of sal wood or similar timber with a permissible fibre stress of 140 kg./cm^2 for sleeper width of 250 mm. in B.G. and 200 mm in M.G.) :

B.G.		M.G.	
Centre to Centre of Girder	Depth of sleeper excluding notching	Centre to Centre of girder	Depth of sleeper excluding notching
Up to 1,850	150 mm.	Up to 1,250	150 mm.
Up to 2,000	180 mm.	Up to 1,650	200 mm.
Up to 2,300	240 mm.	Up to 2,000	240 mm.

(b) A table showing the size of bridge timber required for the standard spans that are now being adopted is appended below for guidance :–

Spans in Meters	B.G.		M.G.	
	R.D.S.O. Drawing No.	Size of sleeper b x d	R.D.S.O. Drawing No.	Size of sleeper b x d
Up to 12.2	BA-11073	250 x 150mm.	BA-11023	200 x 150 mm.
Up to 18.3	BA-11074	250 x 150 mm.	BA-11024	200 x 200 mm.
Up to 24.4	BA- 11075	250 x 180 mm.	BA-11025	200 x 200 mm.
Up to 30.5	BA -11076	250 x 240 mm.	BA-11026	200 x 240 mm.

(3) *Clear distance between joint sleepers* :– The clear distance between joint sleepers should not exceed 200 mm. both for B.G. and M.G.

(4) *Treatment, end-binding and dating* :–*(a) Treatment*:- Bridge sleepers should initially receive a coating of boiling coal tar before their use. Underside of the sleepers resting on girders should receive two coats. To each litre of coal tar 50 gms. of quick lime should be added. In case, this treatment has not been given in a depot, the **P.W.I**. should paint the sleepers with coal tar before insertion. Retarring of sleepers after insertion may be done once in five to seven years, as found necessary.

(b) *End-Binding* :– To prevent splitting at the ends, the sleeeper ends, after being pressed, should be bound firmly with wire or hoop iron, or clamped. End bolts may be provided only when the sleepers supplied are severely split.

(c) *Dating and Branding* :– The year of laying sleepers should be cut or branded on each sleeper at the centre or at the end omitting the first two digits of the year. All dates shall be in one direction which in the case of double line shall be in the direction of traffic and in the case of single line, in the direction of increasing kilometrage.

(d) *Cambering* :– Provision of **para 272(1)** shall apply. Preferably sleepers of standard thickness should be used. Where pad plates are necessary, it should be ensured that their width shall cover the full sleeper seat and hook bolts shall also pass through the pad plate.

(5) *Use of Packing Plates* :– Packing plates are used to make up for the difference in levels on the top boom of the girder due to cover plates, etc. These plates should be of mild steel, as thick as the cover plates, and of sufficient width to take the hook bolts. In case cover plates exist only for part width of the girder, the sleepers are to be notched to the same shape.

(6) *Preparation of Timber before laying* :– (a)The position of sleepers should be marked on top flange of the girder.

(b)Sleepers are numbered serially on every sleeper span-wise.

(c) For accuracy and increased output it is desirable to prepare a stand by bracing two pieces of R.S.Js. about 600 mm. long. The distance between the centres of flanges of R.S.Js. should be the same as that of the centres of the girders on the bridge.

(d) **Annexure 2/16** describes the details of the method of notching to be carried out in the sleeper. The sleeper should be kept as shown in **Fig. 1** and checked for rocking. Rocking should be eliminated by planing the seats of the sleepers.

(e) The position of sleeper seats should be marked on both faces of the sleepers. The sleeper should now be placed with level(non-rocking) surface on the R.S.J stand. The required depth of sleeper should be marked along with the length of the sleeper seat, as shown in **Fig. 2.**

(f) A notch should be made up to the depth marked as shown in **Fig. 3.**

(g) The notched surface should be tested with a template. The two notched bearing surfaces will be in one plane when the template sits evenly and does not rock, as shown in **Fig. 4.**

(h) The holes for the hook bolts should be drilled from the notched side to ensure full grip of the bolts.

(i) The new cut surface of the sleeper should be coal tarred.

(7) *Laying of Sleepers :*– (a) Creep should be adjusted before taking up the work of re-sleepering. Rails and old sleepers should be removed under line block.

(b) The contact surface of steel work between the sleepers and girders(top of flange under sleeper seat) should be painted after thorough scraping.

(c) Sleepers are then placed in position and with a light mallet the sleeper is hammered sufficiently for the rivet head to mark their position on the notch surface, when pad plates are not provided.

(d) The gauging or grooving is done on these marks to house the rivet heads.

(e) The sleepers should be prepared 3 mm. thicker than required and finally levels adjusted by stretching a string over the rail seats from one end of the girder to the other. A levelling instrument may be used, if necessary, to fix levels. Standard mild steel canted bearing plates with 4 rail screws should be fixed in position after tightening the hook bolts. Care should be taken to ensure that the rails on the bridge are in alignment with the approach track.

(8) *Fixing up of Hook bolts* – (a) there are two types of hook bolts (22 mm.dia) one with straight lip suitable for securing sleepers to plate girders and other with sloping lip for securing sleepers to R.S.Js. In both types the hook is an integral part of the bolt.

A 75x75x6 mm. mild steel square washer is used along with each hook bolt to prevent the nut from cutting into the sleeper.

(b) Two hook bolts are used for each sleeper. These hook bolts must be on the outside of the girder and not on the inside. The diameter of the hole augured should not be more than the diameter of the hook bolt. On the top end of each hook bolt there will be an arrow mark chiselled indicating the direction of the hook of the bolt. The arrow grooved on the top end of the bolt should be perpendicular(square) to the rail and pointed towards it when the hook holds the girder flange. This enables the maintenance staff to see from above and ensure that the lips of the hooks are in proper position.

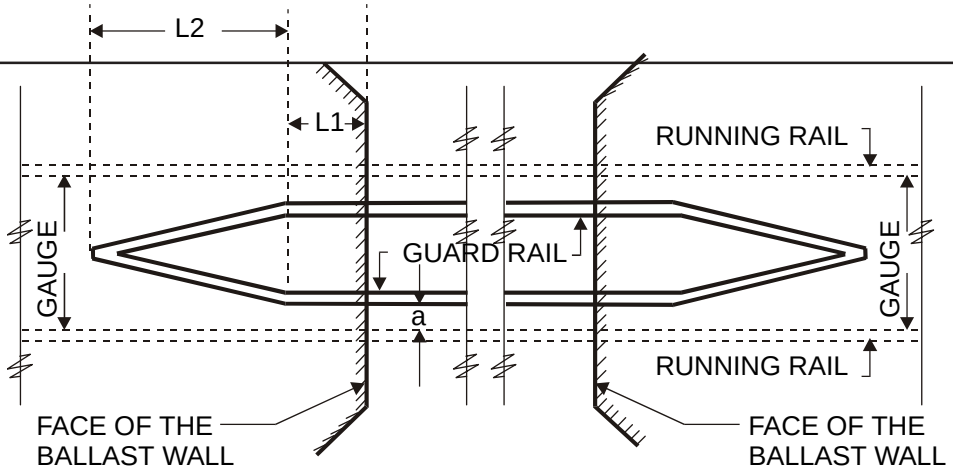
274. Use of Rail Free Fastening in Girder Bridges – Rail free fastenings such as canted mild steel bearing plates with four rail screws may be used on wooden sleepers. No anti-creep bearing plates should be used. If channel sleepers are used, suitably designed canted bearing plates with rubber pads and rail free clip and bolt type of fastening should be used.

275. Provision of Guard Rails on Bridges –

(1) Location- Guard rail should be provided on all girder bridges (including prestressed Concrete girder bridges without deck slab) whether major or minor. Guard rails should also be provided on all major and important ballasted bridges and also on such other minor bridges where derailment may cause serious damages.

On all flat top, arch and prestressed concrete girder bridges with deck slab, where guard rails are not provided the whole width of the bridge between the parapet walls shall be filled with ballast upto the top of sleeper level.

(2) Design of Guard rails – The typical arrangement of a guard rail, with the important dimensions for B.G., M. G.and N.G. are shown in the sketch and table as shown below –



PARTICULARS	SKETCH No .REF.	B.G.	M.G.	N.G.
CLEARANCE BETWEEN GUARD RAIL AND RUNNING RAIL	"a"	250±50 mm	200±25 mm	150±25 mm
LENGTH OF GUARD RAIL OUTSIDE BALLAST WALL AND MAINTAINED TO CLEARANCES MENTIONED IN **ITEM-1**	L1	1825 mm	1825 mm	1825 mm
LENGTH OF GUARD RAILS TO BE BENT SO AS TO BE BROUGHT TOGETHER AT THE MIDDLE OF THE TRACK.	L2	4875 mm	3655 mm	3200 mm

The top table of the guard rail should not be lower than that of the running rail, by more than 25 mm. In the case of bridges on curves with canted track the difference should be measured with reference to a straight line connecting the running tables of inner and outer rails.

(3) *Fixing of Guard rails*- The ends of guard rails should be bent vertically and buried and a block of timber fixed at the end to prevent entanglement of hanging loose couplings. To ensure that guard rails are effective, they should be spiked down systematically to every sleeper with two spikes towards the centre of the track and one spike on the opposite site. Notching of the rail foot for spikes fixing the guard rails should be done on every alternate sleeper. Sleepers should be tied at both ends by MS Flats/tie bars fixed through holding down bolts.

The fixing of guard rail on concrete sleepers shall be done as shown in **drawing No. RDSO/T-4088 to 4097** by proper tightening of rail screws. Provision of MS flats/tie bars for tying PRC sleepers together at ends is not required.

(4) *Splaying of Guard rails*- In the case of through girder bridges on double lines, the guard rails should be splayed on both ends on both lines. In the case of bridges other than through bridges on double lines, the splaying need be done only on the facing direction of the particular line. However, the non-splayed end should be bent downwards after it is stopped at the end of the abutment and wooden block provided.

276. Provision of walkways – Over all girder bridges, footways (walkways) should be provided in the centre of track over sleepers to help the Engineering staff for inspection.

277. Inspection and maintenance of Track on Approaches of Bridges :– (a) For all Bridges- (1) On the bridge approaches, sleepers with arrangement for fixing guard rails should be provided for provision of guard rails as per Para 275 above.

(2) Full complement of track fittings at bridge approaches up to 100 metres should be provided to maintain required track geometry and effort should be made to immediately recoup deficiency noticed, if any.

(3) Rail level of track in approaches of bridges should be maintained, as per provision of IRPWM under respective Para and dips in rail level immediately after abutments should be avoided. The alignment and super elevation in case of curved track should also be maintained as per provisions of IRPWM under respective Para.

(4) Rail joints should be avoided within three metres of a bridge abutment.

(5) In case of LWR track, full ballast section as specified in LWR Manual should be provided up to 100 metres from the abutment.

(6) Switch expansion joints should be provided at the bridge approaches in LWR/CWR track as per provisions of LWR manual.

(b) ***For important and major bridges*** - In addition to **Para (a)** above, following should also be provided.

(1) In case of CST-9 or wooden sleeper track, concrete/steel trough sleepers with elastic fastenings should be provided up to 100m/upto full breathing length wherever LWR is provided in approach of bridge.

(2) On the bridge approaches, for a length of abut 100 metres, width of cess should be 90 cm clear of full ballast section to maintain ballast profile. For maintaining ballast section, suitable ballast retaining arrangement should also be provided.

278. Inspection and Maintenance of Track on Bridge proper – (1) *Condition of track* :– It should be ascertained whether it is central on the rail bearers and the main girders and in good line and level.

Departure from line is caused by incorrect seating of girders, shifting of girders laterally or lengthwise, incorrect seating of sleepers on girders or rails on sleepers, varying gauge or creep.

Departure from level is caused by errors in level of bed blocks or careless sleepering. The adequacy of clearances of running rails over ballast walls or ballast girders at the abutments and condition of timbers and fastening on the run off and skew spans should be inspected.

(2) *Sleepers* - The condition of sleepers and fastenings should be checked. The spacing of sleepers should not exceed the limits laid down in **paras 273(1) and 273(3).** Squareness of sleepers shall be ensured. Sleepers requiring renewals should be marked with paint, and renewals carried out. End bolts should be provided on sleepers which have developed end splits.

(3) *Hook Bolts* – Hook bolts should be checked for their firm grip. Position of arrows on top of the bolts should be at right angles to the rails pointing towards the rail. Hook bolts should be oiled periodically to prevent rusting.

(4) Creep and joint gaps should be checked and rails pulled back wherever necessary. Rail fastenings should be tight. Defective rails should be replaced. Where switch expansion joints are provided on the girder bridge, it should be ensured that free movement of the switch is not hindered.

(5) Guard rails – Adequacy of guard rail arrangements should be checked. Correct distance between the running rail and guard rail should be maintained as per the prescribed dimensions.

(6) Camber packing where provided should be in sound condition.

(7) On girder bridges adequacy of path ways for inspection should be checked.

(8) Sand bins which are provided for putting out fires should be filled with dry and loose sand.

ANNEXTURE-2/16 PARA 273(6)

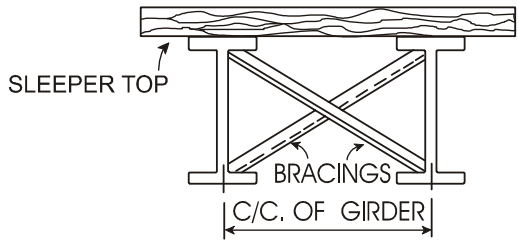


FIG. 1 MAKING RAIL SEATS IN ONE PLANE

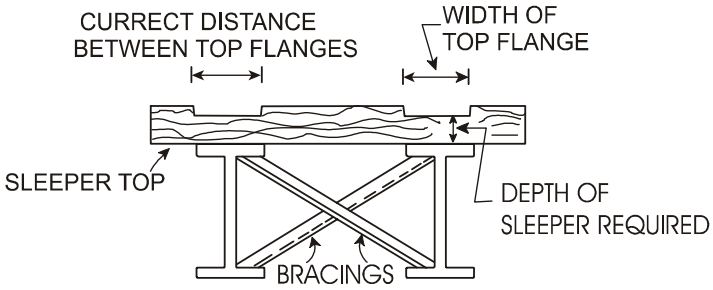


FIG. 2: MAKING OF NOTCHES FOR SEATING ON GIRDER FLANGES

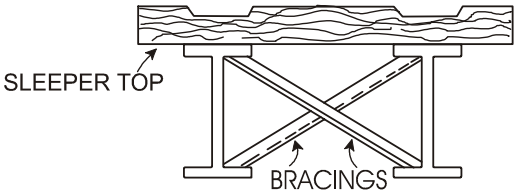


FIG. 3: NOTCHES CUT IN SLEEPER

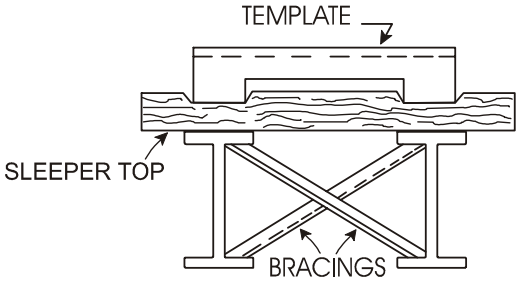


FIG. 4: CHECKING OF NOTCHED SURFACES TO BE IN ONE PLANE

PREPARATION OF BRIDGE TIMBER

PART – 'H'

Maintenance of Track in Track Circuited Area

279. Precautions to be taken while working in Track Circuited Areas –

(1) The Permanent Way Inspector should instruct the staff not to place across or touching two rails in the track, any tool or metal object which may cause short circuiting.

(2) All gauges, levels, trollys and lorries used on the track circuited length should be insulated.

(3) Steel or C.I. pipes used for carrying water/ gas under the track should be run sufficiently below the rails to prevent any short circuiting.

(4) While carrying out track maintenance, care should be taken to see that no damage of track circuit fittings like rail bonding wires, lead wires to rails, boot leg, jumper wires etc., takes place.

(5) Use of steel tapes should be avoided in track circuited section.

(6) Pulling back of rails should be done in track circuited areas in the presence of S&T staff, where signaling connections are involved.

(7) Proper drainage should be ensured so as to avoid flooding of track, during rains, particularly in yards, where watering of coaches is done and in water columns and ash pits. It would be desirable to provide washable concrete aprons on platform lines at originating stations, in track circuited areas.

(8) Ballast must be kept clean throughout the track circuited section and care should be taken to see that the ballast is kept clear of the rails and rail fastenings. The clearance from the foot of the rail should not be less than 50mm. During every packing this point should be taken note of.

280. Insulated joints – (1) Description :– Track circuited sections are 'insulated' electrically from the track on either side by insulated joints. The standard insulated joint in normal use, is made out of ordinary fish-plates duly planed on the fishing planes for accommodating channel type insulation between rails and fish-plates with ferrules/ bushes over the fish bolts and end posts between the rail ends.

Failure of insulated joints results in failure of track circuits. Hence more care has to be exercised in maintenance of insulated joints.

(2) *Laying and Maintenance* :– (a) Insulated joints wherever provided shall be maintained as square joints. Where staggering cannot be avoided, the distance between staggered joints should not exceed the minimum wheel base of the vehicles.

(b) Rail ends of the insulated joints shall be square and true. All rough edges and burrs should be removed from bolt holes. Battered ends must be put right and the gap between the rails should be equal to the thickness of the end post.

(c) Fish bolts at the joints must be kept tight and the sleepers well packed in the vicinity of the joints.

(d) Rail ends shall be kept free from brake dust, dirt sand, rust, other foreign materials etc. All rough edges and burrs at the rail ends must be removed.

(e) The heads of dog spikes/screws should not be allowed to touch the fish-plates.

(f) Keys of anti-creep bearing plates on adjacent sleepers to the insulated joints should not be allowed to touch each other, as they may cause short circuiting.

(g) Particular care should be taken to ensure that the spikes/screws do not protrude below the sleepers.

(h) To avoid crushing of end posts of insulated joints, creep should be effectively arrested. At least one rail length on either side of the insulated joint should be provided with anti-creep devices.

(j) Rail screws should preferably be used in place of dog spikes at insulated joints.

281. Glued insulated joints – (1) *General* - (a) Glued insulated joints have been developed using resin adhesives. These joints consist of web-fitting fish-plates glued to the rails with a high polymer adhesive and bolted with high tensile steel bolts. The insulation is provided by special type of insulating side channels, bushes and end posts made of fiber glass cloth rovings.

(b) In all future works of Track circuiting Glued insulated joints which have better insulation qualities should preferably be provided in place of standard insulated joints.

(c) The instructions for Fabrication, installation and Maintenance of Glued insulated rail joints as given in the **`Manual for Glued Insulated Rail joints, 1998' issued by RDSO,** should be strictly followed.

(2) *Maintenance of Glued Insulated Joints*:

(a) The joint normally does not need any special maintenance other than that required for normal track.

(b) The ballast used in track in the vicinity of glued insulated joints shall be clean to ensure efficient packing and drainage. Care should be taken to see that the ballast is clear of rails and rail fastenings. The clearance from underside of the rail must not be less than 50mm.

(c) As in the case of standard insulated joints, the metal burrs at the end of the rails shall be removed well in time to avoid short circuiting, without damaging end posts.

(d) In the glued joints, normally no relative movement occurs between rails and fish-plates. In case, failure of joints occur by separation of rail, fish-plate surfaces, with consequent relative movement, the damaged glued joint shall be replaced.

(e) It shall be ensured that live cinders which can cause damage to glued insulated joints are removed from the vicinity of joints. At locations prone to such droppings, provision of protective boxes of asbestos or other material of suitable design may be thought of.

PART – 'J'
Maintenance in Electrified Areas

282. General Instructions to staff – (1) *General Knowledge of Engineering Staff*- (a) Every engineering official working in electrical traction area shall be in possession of a copy of rules framed for the purpose of the operation of the Traction Power Distribution system pertaining to Engineering Department and ensure that staff working under him are also acquainted with the rules. He will ensure that rules pertaining to carrying out engineering works are strictly observed.

(b) All electrical equipment, every power line or cable shall be regarded as being 'live' at all times. No work shall be commenced adjacent to any electrical equipment except on authority issued in writing by a competent official of the Electrical Department to the effect that the equipment has been made dead and earthed.

(2) *Defects in a Overhead Equipment:*– Defects or break-downs in the overhead equipment including track and structure bonds noticed by the Engineering staff shall be reported immediately to the Traction Power Controller. When defects in the overhead equipment that are likely to cause damage to pantographs or trains, are noticed and it is not possible to convey information to Station Masters or signalmen to enable them to issue caution orders, the line shall be protected by the staff noticing such defects according to **General Rule 3.62.**

(3) *Traction Bonds* – In electrified areas the return current fully or partially flows through the rail. To ensure a reliable electrical circuit continuity and also to ensure proper earthing in case of leakage of current, various types of traction bonds as described below are provided at suitable places and maintained by the Electrical Traction Department.—

(a) *Longitudinal Rail Bonds* – In the case of D.C. traction system, practically the whole return current flows through the rail. Therefore, two flexible copper bonds offering minimum resistance to the flow of current are provided at each rail joint under the fish-plates. Two solid lugs at the two ends of the copper bonds are inserted in holes drilled at the two rail ends between the fish bolt holes and are pressed by using a bend press to rivet them firmly to the rail. On points and crossings and at junction fish-plates where continuity bonds of the above type can not be provided due to space constraint, continuity of return current path is achieved by using mild steel straps or G.I. wire ropes.

Absence of such bonds may cause unsafe working condition and in extreme cases may damage the rail ends.

(b) *Cross Bonds (D.C.) :*– Cross bonds are provided between adjacent tracks at regular intervals to reduce resistance of the current to the minimum. Such cross bonds are also known as transverse bonds.

(c) *Structure Bonds :*– All structures supporting overhead equipment either in A.C or D.C. track circuited areas are connected to the running rails for ensuring good earthing. Failure of insulator or leakage of current switches off the supply from the sub-station so that men coming in contact with supporting structure etc. do not get electric shock. Removal or tampering of such bonds can, therefore, result in unsafe conditions. Since the structures are grouted in concrete, they are likely to become charged in case such bonds are kept disconnected. Similarly other steel structures such as foot-over bridges, sheds, etc., in the vicinity of O.H.E. lines are also connected to rails through similar structure bonds.

283. Special Instructions To Staff Working In Traction Area -

(1) *Need for Precautions* – Precautions are required to be taken on account of following :—

(a) *Proximity of a Live Conductor* – The risk of direct contact with live O.H.E. is ever present while working in electrified sections such as for painting of steel work of through spans of bridges and platform cover.

(b) *Build up of potential due to return current in rails*. - The return current in the rails may cause a potential difference –

(i) Between rail and the surrounding mass of earth.

(ii) Between two ends of a fractured rail.

(iii) Between the two rails at an insulated joint.

(iv) Between earth and any other metallic mass.

(2) The following precautions should, therefore, be taken while working in traction areas :–

(a) No work shall be done within a distance of two metres from the live parts of the O.H.E. without a 'permit-to-work'.

(b) For work adjacent to overhead equipment the Engineering Inspector shall apply to the proper authority sufficiently in advance for sanctioning the traffic and power block required.

The Traction Power Controller through Traction Foreman will arrange to isolate and earth the section concerned on the date and at the time specified in consultation with the Traffic Controller. He shall then issue 'permit-to-work' to the Engineering Inspector.

On completion of the work the 'Permit-to-work' should be cancelled and Traction Power Controller advised, who will then arrange to remove the earth and restore power supply.

(c) "No part of the tree shall be nearer than 4 mts from the nearest live conductor. Any tree or branches likely to fall on the live conductor should be cut or trimmed periodically to maintain the safety clearances. The responsibility for wholesale cutting of the trees, i.e. cutting of tree trunks, will rest with the Engineering Department. In the electrified territories, however, the cutting of the trees shall be done by the Engineering Department in the presence of authorized TRD staff to ensure safety and satisfactory completion of the work. The day to day trimming of the tree branches, wherever required, to maintain the 4 m safety clearances from OHE shall be done by the authorized TRD staff and Supervisors.

In case of dispute, the decision whether to cut or trim a tree, shall be taken through a joint inspection of Engineering and Electrical officials.

The modalities to be adopted for cutting / trimming of the trees i.e. contractually or departmentally, may be decided by the respective departments based on local conditions. Accountal and disposal of trees cut wholesale will be done by the Engg. Deptt. While the disposal of the trimmed tree branches will be the responsibility of the TRD Department. The expenditure for cutting / trimming of trees to maintain safe clearance for OHE, shall be debited to revenue grant of TRD Department."

(d) No fallen wire or wires shall be touched unless power is switched off and the wire or wires suitably earthed. In case the wires drop at a level crossing, the Gatekeeper shall immediately make arrangements to stop all road traffic.

(e) *Work on Station roofs and Signal Gantries*.- Staff working on station roofs and signal gantries and similar structures adjacent to Live Overhead Equipment shall not use any measuring tapes, tools and materials when there is a possibility of their being dropped or carried by wind on to the live overhead equipment.

(f) *Earth work* – For excavation work adjacent to tracks, the following action is taken :–

(i) In D. C. traction areas, intimation should be given in writing sufficiently in advance to the concerned Traction Distribution Officer to enable him to depute the Traction staff to be present in order to prevent possible damage to the traction underground feeder cables witch are always located near the running lines.

(ii) In A. C. traction areas, intimation should be given to the concerned officers of the Electrical General services and also S.&T. Department, since all the S. & T. and Electrical lines are cabled on account of Electrical Induction.

In all A. C. and D. C. traction areas, cable markers showing location of cables are provided by the Traction Department. In addition, the cables are protected by tiles and bricks, and during excavation if workmen come across such tiles or bricks in an arranged manner, they should at once report the matter to the higher officials. Any further excavation should be carried out only in the presence of the authorised staff of Electrical Traction and or S. & T. Department as the case may be.

(g) *Alteration to Tracks* – The relative alignments of the centreline of the track with respect to the alignment of the contact wire must be maintained within the specified tolerances. This applies to both horizontal and vertical clearances. Slewing or lifting of track must not be done outside the agreed maintenance limits, unless the position of the contact wire is altered at the same time. Adjustment of cant has a magnified effect of the horizontal displacement of the centreline of the track with respect to the alignment of the contact wire.

Horizontal clearances to structures within the limits laid down in the Schedule of Dimensions must be maintained. For Slewing or alterations to track involving adjustment of contact wire (outside the agreed maintenance limits) sufficient notice should be given to the traction staff so that they arrange to adjust the overhead equipment.

(h) *Alterations to Track bonding* :– All bonds removed by the staff of the Engineering Department shall be replaced by the staff of the Engineering Department and all such removals and replacements shall be reported to the Assistant Electrical Engineer, Traction Distribution in-charge, concerned without delay.

(j) *Working of Cranes* :– No crane shall be worked except on the authorised 'permit-to-work'. In every case of working a crane, arrangement should be made for the presence of authorised overhead equipment staff to ensure that all safety precautions are taken.

(k) *Inspection of Tunnels* :– For inspection of roofs and sides of a tunnel, the overhead equipment shall be rendered 'dead'. Special insulated apparatus should be used if sounding the unlined portions to locate loose rock in the roof and sides, is required to be carried out, when the overhead equipment is 'live'.

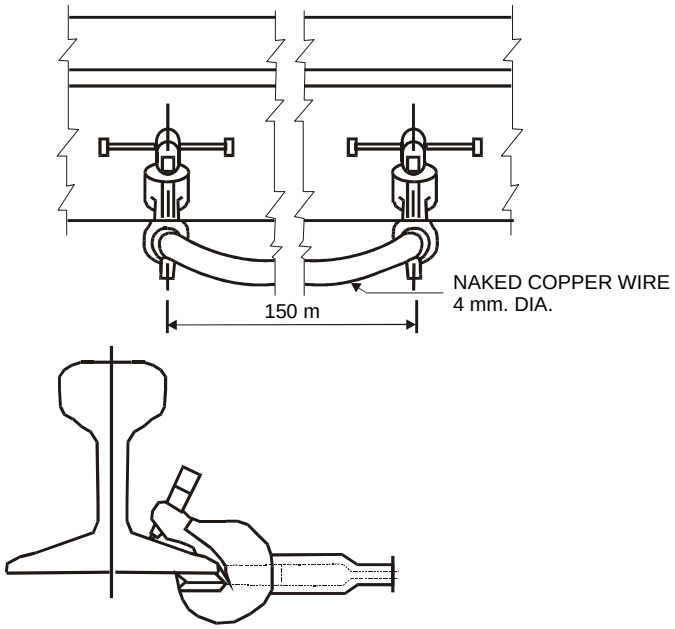
(l) As far as possible closed wagons shall be used for material trains. In case open or hopper wagons are used, loading and unloading of such wagons in electrified tracks shall be done under the supervision of an Engineering Official not below the rank of a Permanent Way Mistry, who shall personally ensure that no tool or any part of body of the workers comes within the 'danger zone' i.e., within 2m. of O.H.E.

(m) Steel tapes or metallic tapes with woven metal reinforcement should not be used in electrified tracks. Linen tapes are safer and, therefore, should be used eventhough they are not accurate.

(n) The top foundation blocks in electrified structures should be kept clear of all materials.

284. Maintaining continuity of track – (1) During maintenance or renewal of track, continuity of the rails serving electrified tracks shall invariably be maintained. For bridging gaps which may be caused during removal of fish-plates or rails, temporary metallic jumpers of approved design shall be provided as under. The necessary jumper will be provided by the Electrical Department on requisition.

(2) In case of rail fracture, the two ends of the fractured rail shall be first temporarily connected by a temporary metallic jumper of approved design **(as shown in the sketch below)**. In all cases of discontinuity of rails, the two parts of the rail shall not be touched with bare hands; Gloves of approved quality shall be used.



TEMPORARY JUMPERING OF RAILS IN CASE OF RAIL FRACTURES

(3) In the case of track renewals temporary connection shall be made as shown in **annexure 2/17.**

(4) In the case of defective or broken rail bond, a temporary connections shall be made as shown in **sub-para [2] above.**

(5) Before fish-plates are loosened or removed temporary connection shall be made in as in **sub-para [3] above.**

285. Catch Sidings – Normally all catch sidings except those which are sanded shall be kept alive. On sanded catch siding, the rails shall be kept clear of sand for a length of 21.5 metres, beyond the section insulators in the overhead lines and the switches controlling the sanded catch sidings shall be kept in the neutral position. If an electric engine or single or multiple unit train runs into the sanded length of a catch siding, it may possibly be insulated from earth except through the buffers or couplings if connected to other vehicles, therefore these sidings shall not be made alive when an electric engine or single or multiple unit train or any vehicle coupled thereto are standing in the sanded tracks until all staff have been moved away from positions where they are likely to make contact between the permanent way formation and any part of the locomotive or single or multiple unit train or coupled vehicles. No person shall attempt to enter, or leave or in any other way make contact between the permanent way formation and the electric engine or single or multiple unit train or any vehicles coupled thereto while the overhead equipment of the sanded length of siding is alive.

286. Additional precautions in A. C. Traction area – The following additional precautions are required to be taken in A. C. traction areas:-

(1) *Build-up of potential due to induction in metallic bodies situated close to O.H.E.* – It is important to note that dangerous voltages may be induced in metallic masses such as fencing posts in the vicinity of traction conductors. To avoid possibility of shock due to such voltages, the metallic structures are bonded together and earthed.

(2) *Unloading of rails* – When unloading rails along tracks, care shall be taken to ensure that rails do not touch each other to form a continuous metallic mass of length greater than 300 metres.

(3) Permanent way staff are advised to keep clear of the tracks and avoid contact with the rails when an electrically hauled train is within 250 m.

287. Fire in electrified areas – The Permanent Way Officials noticing a fire likely to result in loss of life or cause damage to property shall take all possible steps to prevent it from spreading and to extinguish it. In case the fire is on adjacent to any electrified equipment, the Permanent Way Official shall make no attempt to extinguish the fire but shall report the occurrence of fire to the nearest Station Master by most expeditious means.

288. Permanent way Tools – Permanent Way tools (insulated and uninsulated) along with gloves shall be used in manner as approved by the Chief Engineer of the railway.

289. Treatment of persons suffering from Electric shock – When persons receive electric shock, practically in every case they can be revived with prompt application of First-Aid.

Method of Resuscitation.- The method of resuscitation resorted to should be that known as artificial respiration.

Continuity of Treatment – The efforts to restore breathing must be continued regularly and with perseverance, and must not be discontinued until a Doctor has taken charge of the case.

290. Accident to power lines of outside bodies– The Engineering Inspector shall be in possession of the name and address of the officer-in-charge of each power line across Railway land to enable an immediate report of any defect or accident appertaining thereto being made, under advice to the Assistant Engineer/Divisional Engineer.

TEMPORARY CONNECTION DURING RELAYING OPERATION

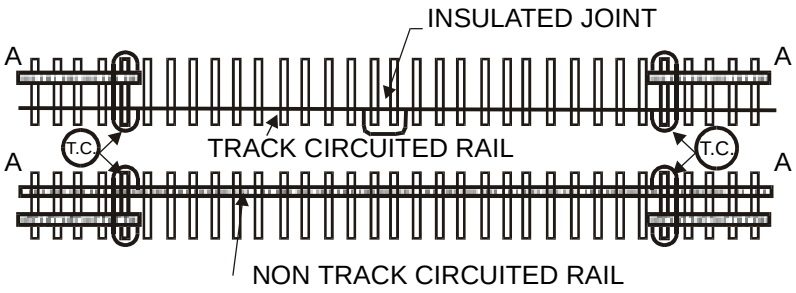
ANNEXTURE-2/17 PARA 284



1) REMOVING OF ONE RAIL
(BOTH THE RAILS INSULATED FOR TRACK CIRCUITING)



2) REMOVING BOTH THE RAILS, SIMULTANEOUSLY
OF ONE LINE
(BOTH THE RAILS INSULATED FOR TRACK CIRCUITING)



3) REMOVING OF ONE RAIL
(ONE RAIL ONLY INSULATED FOR TRACK CIRCUITING)



4) REMOVING BOTH THE RAILS SIMULTANEOUSLY
OF ONE LINE
(ALTERNATIVE TO NO. 2 ABOVE)

TC TEMPORARY CONNECTIONS.

FIGURE - A

NOTE:
IN ADDITION, PROVISION OF INDIAN RAILWAY PERMANENT WAY MANUAL ARE TO BE STRICTLY FOLLOWED IN CONNECTION WITH TRACK CIRCUITED LINES.

PART – 'K'

Treatment of Formation

291. Classification of Formation Requiring Treatment – Formation requiring treatment shall be categorised as under-

(a) *Very bad* - Where either speed restrictions are imposed on this account or number of normal attentions to track in a year is more than 12.

(b) *Bad* - Where the number of normal attentions to track is between 6 to 12 in a year.

292. Nature of Formation Problems – In such stretches, the track levels get disturbed frequently causing problems in track maintenance. These problems are attributable to –

(a) Excessive or uneven settlement of banks.

(b) Slope and the failure of soil leading to slips, heaving beyond the toe, creep or bulging of slopes.

(c) Ballast penetration and mud pumping of poor subgrade material.

(d) Swelling and shrinkage of expansive soils in fills such as black cotton soil.

293. Site Investigations – The following data should be collected for determining the type of treatment to the formation :–

(a) *History of the affected section* –

- Period when constructed;
- Method of construction;
- Date of opening to traffic;
- Subsoil bank settlements;
- Slips if any; and
- Speed restrictions on formation account.

(b) Site details –

- Bank heights;
- Depth of cutting;
- Nature of existing slopes(Turfed or not, with or without berms);
- Drainage conditions;
- Stagnation of water;
- Condition and proximity of borrow pits;
- Signs of movement and bulging in the slopes;
- Ground water level and its position during rains.

(c) *Number of attentions to track* – The particulars of the number of attentions to track should be obtained from gang charts for the last five years, to get an idea about track maintainability. Man-days utilised for maintenance per Km should also be collected vis-à-vis men required for normal maintenance.

(d) *Ballast penetration profiles* – These profiles should be obtained at regular intervals of one telegraph post/O.H.E. mast, to indicate the extent of ballast penetration and condition of ballast (loose, caked, mixed with cinder/sand moorum etc.)

(e) *Exact nature of present troubles* – The exact nature of the present trouble should be identified whether it is due to –

- Bulging of ballast between cribs or at the cess;
- Mud pumping;
- Slope movement;
- Slope failure; etc.

294. Soil investigations and testing – (1) *Soil investigation* – (a) Undisturbed soil samples should generally be collected at every telegraph post/ O.H.E. mast. Undisturbed soil samples in 100mm. sampling tubes should be collected from the following places as necessary :–

(i) From the formation below the depth upto which the ballast has penetrated.

(ii) From inside the bank along the probable circle through which the slip has occurred, where the bank has been found to be structurally unstable.

(iii) From various depths below the ground level at the toe of the bank, where base failures/settlements have occurred.

(iv) From two sections in the slipped portion and one section at the toe adjoining the site where slip has not occurred in the past **(Annexure 2/18).**

(b) Two cross sections of the bank in both the sections should also be taken by means of precise levelling.

(c) In addition to this, disturbed soil samples should also be collected at regular intervals of a telegraph post/O.H.E. mast, to determine the index properties of the formation soil.

(2*) Soil Testing* – Selected undisturbed/ disturbed soil samples should be tested at the soil Mechanics Laboratory, to determine the following properties :–

(a) Index properties viz., grain size analysis and Atterrberg limits(i.e., L.L.,P.L.,S.L.).

(b) Natural moisture content and natural dry density.

(c) Optimum moisture content and optimum dry density.

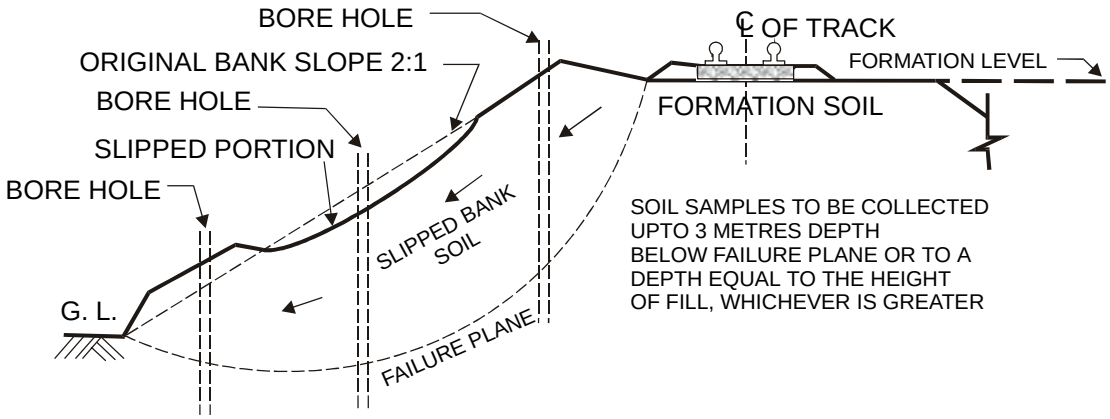
(d) Shear property.

(e) Differential free swell.

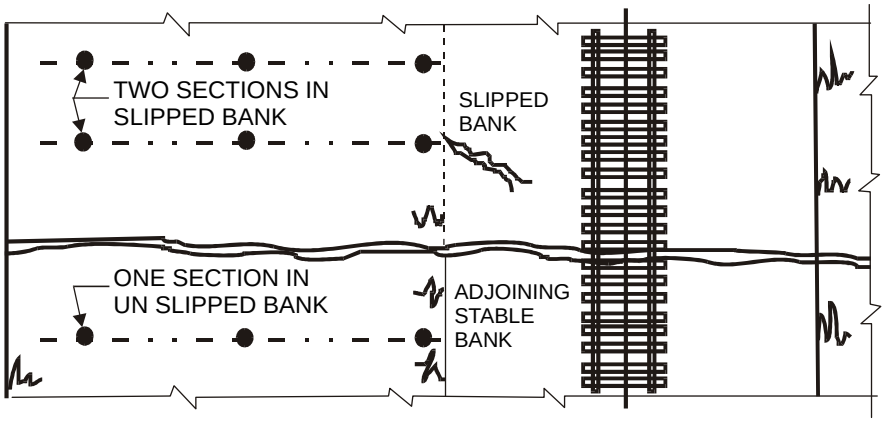
For banks which are structurally weak/ unstable, the shear property of the soil sample is very important and sufficient number of samples must be tested so as to get an accurate idea of the shear strength of the bank soil and soil strata below ground level.

For banks where settlement has occurred, consolidation test should also be carried out.

ANNEXTURE-2/18 PARA 294



CROSS SECTION SHOWING SAMPLING LOCATIONS ON SLIPS OF BANKS



PLAN SHOWING LOCATIONS OF SOIL SAMPLING (NOT TO SCALE)

NOTES:-

1. DEPENDING ON THE TYPE OF FAILURE, BORES ARE TO BE MADE AT THE TOP OF EMBANKMENT, MID SLOPE OF EMBANKMENT AND NEAR TOE AS SHOWN ABOVE.
2. SOIL SAMPLES TO BE COLLECTED UP TO THE DEPTH AS INDICATED ABOVE AT INTERVALS OF 1.5 TO 3 METRES.
3. ONE SET OF BORES ARE REQUIRED FROM ADJOINING STABLE BANK FOR COMPARISON OF SOIL BEHAVIOR.

ANNEXTURE-2/19 PARA 209

HALF-YEARLY PERMANENT WAY REPORT

Report for the half-year ending
31st March }.....regarding the section of track under Permanent Way Inspector
30th September }

Name.....Section.....

Hd.Qrs.....Km.....to Km.....

Item No.	Particulars of item	PWI's remarks			AEN's remarks	DEN's remarks	Details to be entered under column Problem areas by PWI
		Major Important work done in last 6months	Problem areas	Assistance required			
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.	Track						Rails fastenings, sleepers, ballast, formation and drainage
2.	Points and crossings						Details of turnouts requiring frequent attention
3.	Bridges & approaches						Details of bridges having problem of creep, condition of sleepers and fittings
4.	Level crossings						Details of level crossings having road surface and approach road requiring attention, slope of approach road,visibility, overdue overhauling
5.	Fencing and Boundary Post						

ANNEXTURE-2/19 PARA 209 (Contd.)

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
6.	Imprest (Store/Cash)						Complete or not, any delay in supply/ recoupment
7.	Man power						Adequate or not, absence for sickness, seasonal absence, low output due to overage/ higher average age, man days lost due to special features (such as patrolling etc.) vacancies.
8.	Infrastructure						Availability of traffic block, working of materials trains/ballast trains, machines for maintenance and renewal works (their workings and shortfalls in schedule and problems, if any)
9.	Vulnerable locations						
10.	Engineering Material in ARTs						
11.	Small track machines						
12.	Functioning of Reconditioning workshop for turnouts and SEJs						
13.	Periodic Medical Examination/ Refresher of safety category staff						Details of staff overdue for Periodic Medical Examination/Refresher
14.	Encroachment on Rly. Land between stations						
15.	Items to which special attention is directed in the interest of the safety of the travelling public						Reference to be made to previous items and where the supply of stores is involved, requisition numbers should be quoted
16.	Material under trial						Progress and performance

295. Remedial measures suggested – Based on the site investigations and soil testing, the relevant remedial measures should be formulated.

Some of the remedial measures suggested for the formation troubles generally encountered are listed below :

(a) Track level variations due to —	Suggested treatment (any one or in conjunction)
(i) Inadequate drainage due to high cess, dirty ballast	Improve side drainage by lowering the cess and screening of ballast.
(ii) Weakening of soil at formation top on contact with rain water resulting in mud pumping.	(i) Cationic bituminous emulsion below ballast. (ii) Provision of moorum/sand blanket of 20-30 cm. depth below ballast. (iii) Laying of geotextiles.
(iii) Strength failure below ballast causing heaving of cess or between sleepers.	(i) Provision of 30-60 cm. deep blanket below ballast. (ii) Provision of Sub-ballast.
(iv) Seasonal variation in moisture in formation top in expansive soils causing alternate heaving, shrinkage of formation.	(i) Treatment with lime slurry pressure injection. (ii) Moorum blanket 30-45 cm. with moorum lining.
(v) Gradual subsidence of the bank core under live loads due to inadequate initial compaction/ consolidation of embankment.	(i) Cement grouting of ballast pockets if ballast pockets are permeable. (ii) Sand or boulder drains.
(vi) Gradual consolidation of earth below embankment.	(i) Lime piling in sub-soil. (ii) Sand drains in sub-soil.
(vii) Creep of formation soil.	Easing of side slopes.
(vii) Coal ash pockets due to treatment of previous slips.	(i) Sand drains below deepest level of coal ash. (ii) Cement pressure grouting.
(b) Instability of Bank/Cutting slopes due to –	Treatment
(i) Inadequate side slopes causing bank slips after prolonged rains.	Flattening slopes and provision of berms, improvement in drainage.
(ii) Consolidation/settlements of sub-soil causing bank slips.	Provision of sand drains to expedite consolidation.
(iii) Hydro-static pressure built up under live loads in ballast pockets containing water causing bank slips.	(i) Draining out of ballast pockets by sand or boulder drains. (ii) Cement sand pressure grouting of ballast pockets.
(iv) Creep of soil.	Reducing stresses by provision of side berms or flattening the slopes.
(v) Swelling of over consolidated clay side slopes in cuttings causing loss of shear strength and slipping.	Flattening side slopes.
(vi) Erosion of banks	Provision of turfing, mats, etc.

R.D.S.O.'s help, wherever necessary, may be taken for formulating the remedial measures.

CHAPTER III

PERMANENT WAY RENEWALS

301. Classification of Renewals – (1) All track renewals can be classified generally into one of the following categories :

(1)	Complete Track Renewal	(Primary)	abbreviated as	C.T.R.(P)
(2)	Complete Track Renewal	(Secondary)	abbreviated as	C.T.R.(S)
(3)	Through Rail Renewal	(Primary)	abbreviated as	T.R.R.(P)
(4)	Through Rail Renewal	(Secondary)	abbreviated as	T.R.R. (S)
(5)	Through Sleeper Renewal	(Primary)	abbreviated as	T.S.R. (P)
(6)	Through Sleeper Renewal	(Secondary)	abbreviated as	T.S.R. (S)

(7) Casual Renewals.
(8) Through Turn-out renewal (TTR)
(9) Through Fitting renewal (TFR)
(10) Through Weld renewal (TWR)
(11) Through Bridge timber renewal (TBTR)
(12) Scattered renewal

(2) Primary renewals are those where only new materials are used and secondary renewals are those where released serviceable materials are used.

(3) *Scattered Renewal*- In this case, unserviceable rails, sleepers and fastenings are replaced by identical sections of serviceable and nearly the same vintage track components. These are carried out in isolated locations and not more than 10 rails and/or 250 sleepers in a gang beat in a year. Such renewals are a part of normal maintenance operations.

(4) *Casual Renewal*- In this case, unserviceable rails, sleepers and fastenings are replaced by identical sections of serviceable and nearly the same vintage or new track components. These are carried out in isolated locations of continuous but small stretches. Such renewals are not a part of normal maintenance operations and cannot be covered under scattered renewals.

302. Factors Governing Permanent Way Renewal

(1) *Criteria for Rail Renewal* - The following are to be considered in connection with the criteria of rail renewals :-

- Incidence of rail fractures/failures.
- Wear on rails.
- Maintainability of track to prescribed standards.
- Expected service life in terms of Gross million tonnes carried.
- Plan based renewals.

(a) *Incidence of Rail Fractures/Failures* - A spate of rail fractures on a particular sections having 5 withdrawls of rails per 10 km. in a year due to fracture and/or rail flaws detected ultrasonically falling in the category of IMR & REM will have priority while deciding rail renewals. In case the rail failures at fish-plated/welded joints are pre-dominant, end cropping with or without welding could be considered.

(b) *Wear on Rails* – (i) *Limiting Loss of Section*– The limiting loss in rail section, as a criterion for recommending rail renewals shall be as under:

Gauge	Rail Section	Loss in section in percentage
B.G.	52 kg./metre ..	6
	90 R	5
M.G.	75 R	4.2
	60 R	3.25

Rail wear may be determined by actual weighment, taking rail profiles at ends after unfishing joints and taking rail profiles with special profile measuring gadgets.

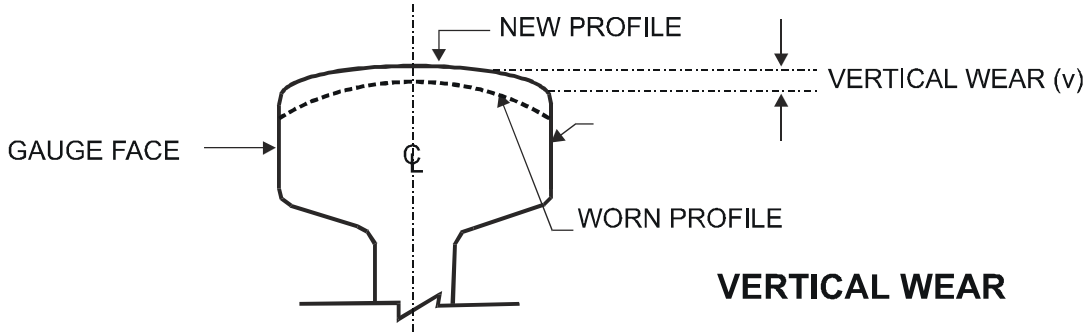
(ii) *Wear due to corrosion* – Corrosion beyond 1.5 mm in the web and foot may be taken as the criterion for wear due to corrosion. Existence of the localised corrosion such as corrosion pits, specially on the underside of the foot, acting as stress raisers from the origin of fatigue cracks and would necessitate renewals.

(iii) *Vertical Wear* – When the reduction of the depth of the rail head reaches a point beyond which there is a risk of wheel flanges grazing the fish-plates, such rails should be renewed. The limits of vertical wear at which renewals are to be planned are given as below.

Vertical wear

Gauge	Rail Section	Vertical Wear
B. G.	60 Kg./ metre ..	13.00 mm.
	52 Kg./ metre ..	8.00 mm.
	90 R	5.00 mm.
M. G.	75 R	4.50 mm.
	60 R	3.00 mm

A typical profile showing the measure of vertical wear of the rail is given below :

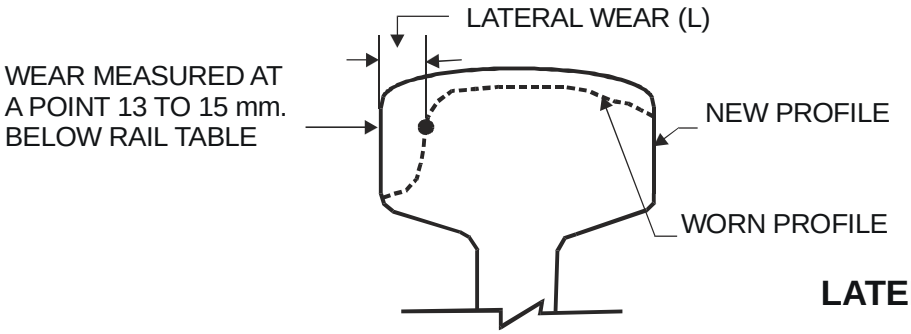


Vertical wear is to be measured at the centre of the rail either by measuring the height of the worn out rail by callipers or by plotting the profile. In the first case, the wear is the difference between the height of the new rail and the height of the worn out rails.

(iv) *Lateral Wear* – Limits of lateral wear from relaying considerations are as under :

Section	Gauge	Category of track	Lateral wear
Curves	B.G. ..	Group 'A' & 'B' Routes ..	8 mm.
		Group 'C' & 'D' Routes ..	10 mm.
	M.G. ..	Group 'Q' & 'R' Routes ..	9 mm.
Straight	B.G. ..	Group 'A' & 'B' Routes ..	6 mm.
		Group 'C' & 'D' Routes ..	8 mm.
	M.G. ..	'Q' Routes	6 mm.
		'R' Routes	8 mm.

A typical profile of the worn rail showing the measurement of lateral wear is shown as below.



LATERAL WEAR

Lateral wear is to be measured at 13 to 15 mm. below the rail top table. Worn rail profile should be recorded and superimposed over new rail profile to find out the lateral wear.

(c) Maintainability of track to prescribed standards –

(i) There may be cases, where renewals may be necessary on the following considerations viz.,

(1) Poor running quality of track in spite of extra maintenance labour engaged for maintaining the same,

(2) Disproportionate cost of maintaining the portion of track in safe condition.

(ii) The condition of rails with regard to hogging/battering,scabbing and wheel burns and other conditions such as excessive corrugation of rail as can be ascertained by visual inspections, which affects the running quality of track, and make the track maintenance difficult and uneconomical, should be taken into account while proposing renewals.

(iii) Renewals of rail due to hogged and battered rails ends should be considered only if other remedies have not been found to be effective.

(d) *Renewals on consideration of service life in terms of total G.M.T. of traffic carried* – The rail shall be planned for through renewal after it has carried the minimum total traffic as shown below –

Gauge	Rail Section	Total G.M.T. carried for T.12 Med. Manganese rails	Total GMT carried for 90 UTS rails
B.G.	60 Kg/ m ..	550	800
	52 Kg/ m ..	350	525
	90 R	250	375
M.G.	75 R	150	-
	60 R	125	-

(e) - The service life in terms of total GMT of traffic carried for considering through rail renewal on the bridge proper and in approaches (upto 100 m on either side) for all the important brides and such of the major bridges where height of bank is in excess of 4.0 m, all tunnels and their approaches (upto 100 m on either side) shall be half of the GMT specified in **para 302 (1) (d)** above.

The released P.way material shall be dealt with in accordance with **para 320 of IRPWM.**

(f) *Plan based Renewals* – Renewals to pre-determined plan with the objective of modernising the track structure on selected routes in the quickest possible time may be planned even if it involves premature renewals.

(2) *Secondary Rail Renewals* – (a) In the case of Secondary Renewals, if the condition of rail is satisfactory, it is a good practice to crop the rail ends and weld them into SWR and use them in lesser important lines. The rails should be ultrasonically tested before use.

(b) Building up of chipped rail ends by welding will also improve the service life.

(c) The rails released from primary relaying and not fit for use in secondary relayings should be used in sidings.

(3) *Criteria for Renewal of Sleepers* – Generally a sleeper is serviceable if it can hold gauge, provide satisfactory rail seat and permit rail fastenings being maintained in tight condition, and retain the packing underneath the sleepers. Such sleepers that are not likely to fulfil the above functions even after reconditioning should be renewed. Where re-sleepering only is justified this should be carried out in continuous stretches, the released serviceable sleepers being utilised for casual renewals elsewhere. The conditions indicative for the need for renewal of sleepers are given in **para 245(2)** in case of wooden sleepers, and in **paras246(1) and 247(1)** in the case of cast iron and steel trough sleepers respectively.

On girder bridges when several sleepers are defective, renewals should be carried out for the full span, the released serviceable sleepers being used for casual renewals on the other spans. Before re-using the sleepers, they should be reconditioned.

303. Planning of Renewals – Renewals may be planned in as long and continuous lengths as practicable, within the available resources with priorities to meet the projected traffic. Short isolated stretches of 10 kms. and less, not due for renewal on condition basis may be programmed along with the adjoining lengths, if these stretches do not confirm to the required standards. Priority in planning renewals should be given to busy and important lines.

Track renewal programmes shall be framed by the Chief Engineer of each Railway taking into consideration the proposals submitted by the Divisional Engineers.

304. Track Renewal Programme –

(1) *Initiation of Proposals* – Track renewal proposals are submitted to the Divisional Engineer by the Assistant Engineer on condition basis and also on the basis of various inspections carried out during the year. The Divisional Engineer shall personally check the details submitted by the Assistant Engineers at site and compile and initiate the track renewal programme indicating the priorities. The justification for track works shall be prepared on the basis of factually correct data and submitted in proforma given at **Annexure 3/1**. It shall include an abstract estimate of the cost of work and detailed narrative justification covering technical and financial aspects. The Divisional Engineer should personally satisfy himself about the reasonableness of the proposal and certify that the justification furnished is factually correct. The Assistant Engineer should keep a close watch on the condition of all track on their sub-divisions so that every length which after careful and judicious examination requires renewal, is included in the proposals, bearing in mind that the programme is prepared a year in advance and as much as two years may elapse before renewals are carried out. The proposals should reach the Chief Engineer's Office by end of March.

(2)*Verification of proposals by the Track Cell in the Chief Engineer's Office* – Important items relating to complete track renewal, through sleeper renewal or through rail renewal shall be test checked by the nominated administrative officer of the Headquarters who will –

(a) Co-ordinate the proposals received from the divisions;

(b) Frame programmes for renewal taking into account the sections planned for renewal;

(c) Decide priority for the works;

(d) Satisfy himself that the renewal is unavoidable in the case of track renewal proposals which are justified primarily on condition basis but are premature as far as quantum of traffic carried (G.M.T.) is concerned and;

(e) Finalise the track renewal programme and submit the same to the Chief Track Engineer/Chief Engineer for his approval. On receipt of Railway Board's sanction to the track renewal programme, arrangements will be made by the Headquarters for supply of track materials to the Divisions and for co-ordinated execution and control over the works.

305. Track Standards for Renewals –

(1) *Rails* – The recommended section of rail to be adopted for track renewals shall be in accordance with **para 248(2).**

(2) *Sleepers and Fastenings* – The recommended types of sleepers and fastenings to be adopted for track renewals should be as given below.

(i) All primary renewals in future shall be carried out with 60-kg PRC sleepers.

(ii) PRC or ST sleepers may be used on loop lines and private sidings.

(iii) ST sleepers used on loop lines and private sidings may be with elastic or rigid fastenings.

(iv) All renewals on Metre Gauge shall be with concrete, steel and CST-9 sleepers (new or second hand).

(3) *Sleeper Density and Sleeper Spacing* – Sleeper density for various groups on Broad Gauge and Metre Gauge will be in accordance with **para 244(4).**

The spacing of sleepers for Broad Gauge and Metre Gauge shall be in accordance with the provisions in para 244(2)

As far as possible in metal sleepered road, wooden sleepers should be provided at joints.

(4) *Ballast Section* – The ballast section to be adopted should confirm to the standards laid down in **para 263.**

306. Planning for posting of staff and other facilities – (1) Special Permanent Way Inspectors with clerical staff at the executive and office levels as provided in the estimates shall be posted in good time. Provision of gazetted staff may be made in the estimate in the case of large scale permanent way renewals according to the yard sticks laid down.

(2) The Permanent Way Inspector in-charge of track renewal will take over the maintenance of suitable lenghts of the section to be relaid a few days in advance of the actual commencement of the work. He will be responsible for its maintenance till the section is handed over to the maintenance Permanent Way Inspector after completion of the work.

(3) Experienced labour shall be recruited for relaying works which should be so programmed that gangs move from one work to the next. Watchman for materials at site and at depots should be appointed. Watchman should be drawn from the permanent gangs and resultant vacancies filled by casual labour.

(4) The Special Permanent Way Inspector shall make all arrangements for the training out of materials, selection of camp sites, housing of labour with requisite amenities such as water supply, drainage etc. A fully equipped First Aid Box should be kept at the site of work. Labour camp should be so located that men are not required to walk a long distance to reach the site of work.

307. Traffic facilities for Renewals – (1) In the case of big relaying works, additional sidings as necessary should be provided at the depots for receipt and dispatch of materials.

(2) Arrangements for special rakes for movement of rails and sleepers should be made by the Divisional Engineer in consultation with the Operating Department. Where necessary, separate power and crew should be arranged. Provision of Engineering time allowance in the working time table should be arranged with the Traffic Department.

(3) Traffic blocks may be necessary depending on the method of relaying adopted. In such cases the Divisional Engineer must give adequate notice to the Operating Department before framing of the time table for the period during which the track renewal work will be carried out. Such information is useful to the Operating Department in framing the time table and making the required time available by regulating certain trains, as necessary. In case of any difficulty, the Divisional Engineer should refer the matter to the Chief Engineer, who will arrange for the required blocks in consultation with the Chief Operating Superintendent. A minimum block of 2 to 3 hours duration is necessary where renewal works are carried out manually. In the case of mechanical relaying, a minimum block of 4 hours is desirable.

(4) When work is being carried out between trains in a location from where the Inspectors-in-charge cannot readily communicate with the Station Master at either side of the block section, a field telephone, on controlled sections may be installed, in order to permit of every suitable interval between trains being utilised.

(5) The Divisional Engineers, in consultation with the Operating Department Officers, should manage to carry out permanent way renewals with the minimum obstruction and detention to traffic.

Whenever possible, the following arrangements should be made in consultation with the Operating Department :

(a) On double line, the traffic of both lines may be worked over the unaffected line under the "Single line-working" regulations.

(b) If there are triple or more lines, two lines may be worked as the up line and the down line respectively, subject to compliance with single line working regulations in respect of the line over which trains run in a direction contrary to the normal usage of that line.

(6) Arrangements should be made for –

(a) Notification by the Operating Department, authorising Engineering Department to undertake the work.

(b) Imposition of blocks and protection by temporary Engineering fixed signals.

(c) Issue of caution orders to Drivers by Station Masters on daily advice of actual kilometrages received from the Inspector-in-charge of the work.

308. Speed Restrictions – The speed restrictions to be imposed during various sequences of work are given in Table I and II which are as shown below :

Table 1
Broad and Metre Gauge - Manual Packing

Day	Sequence of events	Speed in Km. p. h.	
		B.G.	M.G.
1st	Opening, relaying and initial packing	20	20
2nd	1st through packing	20	20
3rd	2nd through packing	20	20
4th to 9th	Picking up of slacks as required	45 (after second through packing)	30 (after second packing)
10th	3rd through packing	45	30
11th to 19th	Picking up of slacks as required	75 (after third through packing)	60 (after third packing)
20th	4th and final through packing	75	60
21st	.....	Normal sectional speed.	Normal sectional speed.

Table II
Broad Gauge - Machine Packing

Day	Sequence of events	Speed in Km. p.h.
1st ..	Opening, relaying and packing	20
2nd ..	1st tamping	20
3rd to 5th	Attention to track as required	45 (after completion of 1st tamping)
6th ..	2nd tamping	45
7th to 8th	Attention to track as required	75 (after completion of 2nd tamping)
9th ..	3rd tamping	.....
10th ..	....	Normal sectional speed.

Note : The work of Track renewals on double line should normally proceed in the direction opposite to Traffic.

309 A. Project report for track renewal works : Systematic and meticulous planning for various items of execution of track works is essential for achieving quality, economy and timely completion of works. For every sanctioned track work e.g. CTR, TSR, TRR, deep screening, bridge timber renewal, etc. a detailed project report should be prepared. The report should inter alia, cover the following aspects:

(i) *Details of Work* - Pink book detail, scope of work, locational details, cost and estimate particulars etc.

(ii) *Existing track structure* - Inventory of existing track structure including the rails, sleepers, fittings, ballast quantity/deficiency in track, type, width of formation and other details should be taken as prescribed in P.Way diagram, details of level crossings, bridges, electrical fittings, curves, height of bank/cuttings, yards, sidings, etc.

(iii) *Classification of track materials* - During inventory of the existing track structure by foot by foot survey, identification, classification and colour making of existing track materials as second hand and scrap would be done as provided in **Para 320 of** IRPWM. The classification should be approved by the competent authority. Action plan for stacking/ storage and disposal of the released materials should be clearly indicated. Inventory of existing track materials would normally be prepared jointly by the PWI of the section and the PWI (Spl) for the renewal.

(iv) *Proposed track structure* - The proposed P.Way diagram of the affected length should be prepared in the same format as done for the existing track structure and incorporated in the project report.

(v) *Existing/proposed gradient profile* - The levels of existing track should be taken at every 20 metres and a gradient diagram prepared. Introduction of vertical curves should be critically examined and the proposed profile of track shown in red line indicating the proposed grades. Lowering of track should be avoided. Precise lift of track at girder bridges should be worked out and a separate scheme developed for lifting of girders on each of the affected bridges. Similarly, the magnitude of lifting at level crossing should be worked out and indicated in the report. Care should be exercised to keep the road surface in one level on level crossings spanning to across multiple tracks. This may require regrading of adjacent lines too.

(vi) *Realignment of curves* - All curves should be measured afresh and slews worked out for realignment wherever necessary, keeping the obligatory points in view.

(vii) *Method of execution* - The work should be executed "bottom upwards" i.e. sequence of execution of works will be in the following order -

Formation ⟶ Ballast ⟶ Sleepers ⟶ Rails

viii) *Formation:*

(a) Repair and widening of cess: The project report should indicate the requirement of and plan for widening of formation in both banks and cuttings wherever necessary. Provision of proper drains in cuttings should also be planned.

(b) Formation treatment: Areas needing formation rehabilitation should be identified and a study for possible solutions and method of execution of the rehabilitation scheme should form part of the project report.

(ix) *Ballast* - The requirement indicating bifurcation of cess supply and depot supply and the source and means of each should be spelt out clearly. Mode of providing ballast cushion i.e. deep screening or raising should be identified along with sketches of cross sections present and proposed. Sleeper renewal would normally not be started unless adequate arrangements for supply of ballast have been made.

(x) *Transportation of P. Way materials* - The mode of transportation for various track components and unloading of rails and sleepers in particular, at the work sites should be indicated in the project report.

(xi) *Welding* -The complete details of welding requirements, the arrangements need to be made for its execution whether departmentally or through contract should be clearly indicated in the report.

(xii) *Renewal of turnouts, bridge timbers, etc* - The project report should cover the complete details of turnouts, bridge timbers, level crossings, etc. where renewal is to be carried out. Whether turnouts are to be laid manually or by mechanized means, should be clearly brought out indicating the arrangements made. The report should also include the mode and agency for overhauling and relaying and making up of road surface at the level crossings.

(xiii) *Use of machines* - The requirement of machines for renewal (if machanised renewal is planned) deep screening (if mechanized deep screening is planned) and tamping/stabilizing and the duration for which the machines are required should be indicated. The machines that would be deployed should be identified and staff nominated. The planning for repair of machines at the works site, supply of fuel and other consumables should be planned. The requirement of additional lines in the existing yards for making base depot and arrangements made for the same should be indicated in the report.

(xiv) *Contracts* - The contracts that are required to be entered into for various activities of works and the activities, which are to be done departmentally, should be spelt out. The planning for deployment of staff/supervisors for execution at various activities should be indicated.

(xv) *Material Planning* - The material requirement should indicate the materials to be arranged by the headquarters and by the Divisions. Against each material, the proper nomenclature and drawing number should be indicated. Rails nos. and sizes (including lead rails, check rails etc.), sleepers (including specials), rails and sleeper fastenings, switches and crossings, level crossing and bridge sleepers and fittings, etc. should be fully covered. The consignee particulars and the destination, the mode of transport should also be indicated.

(xvi) *Manpower Planning* - The requirement of manpower including the officers, supervisors, artisan and other staff should be worked out with minute details. The arrangements made for camping of these officials and mobilization should be reflected in the report.

(xvii) *LWR/CWR plans* - For welding of rails into LWR/CWR, the LWR plan should be got approved by the competent authority in advance. Such plan should form part of the project reports.

(xviii) *Requirement of speed restrictions, traffic blocks and other material train* - Planning for execution of track renewal works should be such that the time loss on account of speed restriction is minimal and is within the permissible limits. The report should indicate requirement of speed restrictions and traffic blocks together with duration. The corridor for blocks is required to be planned in consultation with the Operating Department and accordingly reflected in the report after obtaining the approval of DRM. Arrangements made for various types of wagons for transportation of ballast, sleepers, etc. together with requirement of locomotives should be indicated in the report in consultation with Sr. DOM and with the approval of DRM.

(xix) *Monitoring mechanism* - The list of all activities involved and the time estimation for each activity should be worked out. These activities should be sequenced and co-related in logical manner and network diagram prepared using CPM method. The critical activities should thus be identified. These should form part of the project report.

(xx) The detailed project report covering the various points as mentioned above should be prepared as soon as the approval of Board to include the works in FWP is conveyed to the Railways. These reports should be submitted to headquarters for scrutiny and approval.

309 B. Preliminary Works – (1) Ballast required for making good possible deficiency in cushion due to deep screening should be unloaded on both sides of the track opposite to the place where it is actually required. It should be pulled back on the cess so as not to permit its admixture with un-screened ballast. Where complete track renewal or through sleeper renewal is planned, deep screening of ballast should also be planned and executed. The progress of deep screening should match with the progress of renewals and should precede complete track renewal or through sleeper renewal by a couple of days. In the case of LWR track, the additional requirement of ballast for the extra profile should also be ensured.

(2) Treatment of bad formation should be carried out in advance of the relaying.

(3) Centre line and level pegs made out of scrap tie bars as also the pegs for realignment of curves should be fixed before hand. Where necessary, curves should be realigned and transitioned. Longer transitions should be provided to cater for future increase in speed wherever possible. In case heavy slewing is necessary for providing longer transitions, centre line pegs indicating revised alignments should be fixed and new track laid accordingly. The formation should be suitably widened.

(4) On sections where creep is noticeable, joints should be squared and gaps rectified for short length at the point of commencement.

(5) Where wooden sleepers are used, adzing, auguring, end binding etc. should be done sufficiently in advance of the daily requirements. In the case of CST. 9 sleepers and two block concrete sleepers, tie bars should be given a coat of coal tar before laying. The underside of bearing plates should be treated with black oil before re-use. A few extra bolts, nuts, keys, spikes, rail screws, etc. should be arranged.

(6) As a preliminary measure the Permanent Way Inspector should actually mark out the position of the new rail joints with a tape. The lengths marked out should be the length of the new rail together with one expansion space. On a curve the rail lengths should be set out along each rail, starting from a point on the straight where the sites of the two joints have been set out opposite one another by means of square. The square should be used at each joint on the curve to determine the amount by which the inner rails gaining over the outer rail. As soon as the lead of the inner rail is equal to half the distance between fish bolt holes, a length shall be sawn off the end of the rail equal to the full distance and a new fish bolt hole drilled. The length of cut rails varies according to the degree of each curve, and should be determined before hand; a cut rail will be required after every two or three or four full length rails depending on the curvature.

(7) Sufficient track gauges, gauge-cum-levels, spanners, keying and spiking hammers, augurs, crow bars, tommy bars, claw bars, grip gauges, cotter splitters, beaters, ballast rakes, wire claws, forks, wire brushes, ballast screens, mortar pans screening baskets, shovels, powrahs, rail thermometers, expansion liners, slotted fish-plates, rail closures, combination fish-plates, wooden blocks and wedges and all tools and equipment necessary for efficient execution of work including that for rail cutting and rail drilling and mechanical tampers where used, should be arranged by the Permanent Way Inspector, in advance. Before starting and during the course of work, the track gauges and the gauge-cum-levels should be checked periodically for their accuracy.

(8) Labour should be properly organized and suitably distributed to ensure maximum efficiency.

(9) Before carrying out track renewal work in electrified areas sufficient notice should be given to the Electrical Traction Distribution Department so that they can arrange for adjustment of overhead wires to conform to the new alignment and level. They will also arrange for bonding the new track. In track circuited sections and in yards where change in yard layout is contemplated notice should be given to the Signalling Department for getting assistance in executing joint works. Advance Notice as laid down by the respective railway should be given to the Operating Department of the actual commencement of work by the Permanent Way Inspector, for sending advice to all concerned. The safety of traffic is of paramount consideration.

310. Unloading of Rails, Sleepers and Fastenings – (1) It should be ensured that materials are unloaded fairly opposite to the position where they are to be laid. Care should be taken to avoid unloading of materials in excess of the actual requirement, so as to avoid double handling.

(2) Utmost care should be exercised in unloading rails. Ramps made of unserviceable rails should be used for unloading. Short welded panels as well as rail panels for laying welded rails may be unloaded by “end-off-loading” method, wherever possible.

(3) The unloaded panels should be carefully stacked on a level base, care being taken to prevent formation of kinks. Flat footed rails, as a rule should rest on the foot. Any carelessness in unloading and stacking is liable to cause irreparable damage, resulting in bad running. While carrying rails they should be supported at several places by rail tongs or rail slings. Carrying of rails and heavy articles on the head or shoulder should be avoided. Kinked rails must be jim-crowed and straightened. Punch marks on rails or marking by chisel should be prohibited as these cause incipient failures.

(4) New rails should be unloaded on one side of the track preferably on the cess leaving the other side free for stacking released rails. Care should be taken not to unload rails and C.I. sleepers one over the other, as this practice causes bending of rails and breakage of C.I. sleepers.

(5) New rails and sleepers for the next day’s work should be hauled from the place of unloading to opposite to the place, where they are to be laid.

(6) Material new or old, lying along side the track is always a potential source of danger and efforts should be made to keep the quantity down as low as possible,

311. Methods of carrying out renewal – Complete track renewal is carried out by any one of the following methods :–

(1) With mechanical equipment.

(2) Complete dismantling of old track and relaying with new track(manual).

(3) Piecemeal method in which resleepering and rerailing are carried out separately.

Detailed instructions shall be issued by the Assistant Engineer regarding the method of relaying which depends on the site conditions.

312. Relaying with mechanical equipment– This method should be adopted while carrying out track renewals with concrete sleepers, as the manual handling of concrete sleepers is difficult and may cause damage to the sleepers. It can be used with advantage for carrying out relayings with other types of sleepers also.

The preliminary (preparatory) work prior to relaying at site, the actual relaying process at site and the post relaying operations are described in detail in **Paras 1405 and 1406.**

313. Complete Relaying Method (Manual) –

(1) Preparatory Work before Block Period –

(a) Track should be deep screened one or two days in advance of the relaying as described in **Para 238**. The ballast section should be made up, upto bottom of sleeper to facilitate relaying. The balance quantity of screened ballast should be stacked on the section for use after relaying.

(b) work is carried out under block protection

(c) A speed restriction of 20 Km. p.h. is imposed at the site of work, Temporary fixed Engineering signals are erected at appropriate places.

(d) Fish bolts are oiled and eased one day in advance of the actual block day.

(e) A couple of hours before the actual operation of the block, the outer fish bolts of each joint and fastenings of alternate sleepers are removed.

(2) Work during the Block Period –

(a) Dismantling of old track – Immediately after the commencement of the block, the remaining fish bolts and fastenings are removed. To prevent loss, care should be taken to screw the nuts of released fish bolts on to those bolts immediately after they are removed from fish-plates. The old track is dismantled and released materials are removed on one side of the line opposite to where the new materials have been unloaded, due care being taken, not to disturb the centre line and level pegs. Ballast in the sleeper bed is then levelled.

(b) Linking New Track – (i) New sleepers are spread out to correct spacing with the help of tapes/ spacing rods on which the sleeper spacing is marked. The new rails are then linked over the sleepers,using correct expansion liners, giving correct expansion gaps.

(ii) Only two bolts per joint are put and tightened lightly. The rails are then straightened up and roughly aligned and the sleepers adjusted to the correct spacing as per making on the new rails. They keys and spikes are then fixed to the rails. It is essential that the base rail is aligned first and fixed in position before the other rail is linked to correct gauge.

(iii) Having reached the predetermined length of track in the above manner, rail closures should be inserted to connect the new track with the old track. Combination fish-plates should be used where necessary. The track is then lifted and packed. The traffic block is cleared and the traffic passed at a restricted speed of 20 Km. p. h., after ensuring that all sleepers are supported by initial packing.

(iv) While renewals are being carried out, advantage may be taken of the block period for loading new materials as also for picking up the released materials.

(3) Work during Post Block Period. (a) During this period new track is attended by different packing parties-at suitable intervals.

These parties generally attend to the track in all respects paying special attention to –

(i) Squaring of sleepers

(ii) Tightening of fittings,

(iii) Gauging,

(iv) Splitting of cotters,

(v) Packing the sleepers,

(vi) Correcting cross levels,

(vii) Providing correct superelevation and providing curve boards and pillars for each curve,

(Viii) Aligning and surfacing,

(ix) Boxing and providing full ballast section,

(x) Making up cess to correct depth, and

(xi) Clearing of side drains.

(b) The speed restriction should be relaxed progressively after attending to the track, as per the schedules laid down in **Para 308**. The track will always require attention for some time and additional labour should be provided to help the sectional gangs. Arrangements should be made to train out released materials.

314. Piecemeal method of Relaying (Manual) – (1) General–In this method Through Sleeper Renewals (T.S.R.) is carried out first. Through Rail Renewal (T.R.R.) is carried out after the track gets consolidated by three rounds of through packing and also on account of passage of trains. This method can be carried out when the section of the new rail is the same as the existing rail or where 90-R rails are renewed by 52 kg. rails in B. G.

(2) Preparatory Work before Relaying – (a) The exact position of rail joints after allowing for one expansion gap each is marked accurately with steel tape on the base rail.

(b) Position of new sleepers is then marked on the base rail with white paint and transferred to the opposite rail by means of T-square.

(c) A speed restriction of 20 Km.p.h. is imposed and temporary Engineering restriction boards are fixed at appropriate places.

(3) Work during Block Period – (a) Deep screening is carried out under speed restriction. While carrying out the deep screening work, renewal of sleepers is also carried out simultaneously. The work is a so programmed that at the end of a day's work both deep screening and re-sleepering is completed in a continuous stretch without leaving any gap.

(b) At the end of the day's work, the track is lifted and packed to the final level and suitable ramp should be provided to meet with the levels of the existing track.

(c) After three rounds of through packing, through rail renewal is carried out under suitable short block.

(d) The final round of through packing is undertaken and the speed relaxed to normal in accordance with the time scheduled described in **Para 308.**

Note – If adequate blocks are available for carrying out the work of deep screening, both the deep screening and sleeper renewal works are carried out in a continuous stretch. If, however, the work is carried out under speed restriction, as described above, every fifth sleeper is renewed leaving at least four sleeper space between intact.

(4) Post Relaying Works – During this period, special attention is given to the following items :–

(a) Attending to the alignment, surfacing, gauging, packing cross-levels and tightening of fittings.

(b) Boxing and providing full ballast section.

(c) Making up cess to the required depth.

(d) Providing curve boards over each curve, providing correct super-elevation on curves.

(e) Cleaning of side drains,

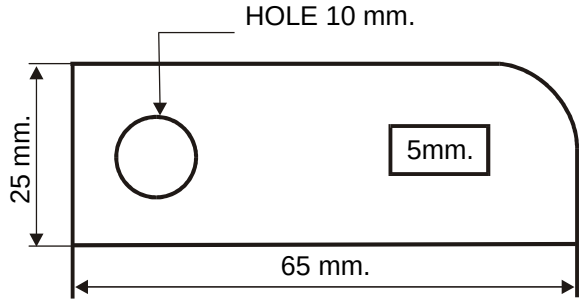
(f) Removal of all released materials and clearing the site.

315. Essential Points to be observed during Linking – (1) Laying of Rails –

(a) Correct expansion gap should be provided according to the temperature at the time of laying, in accordance with the existing instructions as contained in **Para 508** in the case of SWR. In the case of free rails (single rails) the recommended initial laying gap for 12/13 M. rail length for various temperature ranges is as follows :

Rail temperature range	Recommended initial laying gap for 12/13 M. rail length
0 to 10^0 C	10mm
10 to 25^0 C	8mm
25 to 40^0 C	6mm
40 to 55^0 C	4mm
55 to 70^0 C	2mm
Above 70^0 C	Zero

The liners shall be made of steel and so shaped that the wheels of a train can pass over them. Each liner must have stamped on it the corresponding expansion space in millimeters. Details of a suitable pattern is given below.



SKETCH SHOWING A LINER

The expansion liners should be kept in position at the joints for at least six rail lengths at a time and the rails butting against expansion pieces.

(b) Fishing surfaces of rail and fish-plates should be greased before putting the fish-plates in position.

(c) Bent rails shall on no account be put into the road. These should be straightened with a jim crow, before laying.

(d) The rails used at Level Crossings and Station Yards should be given a coat of coal tar before laying.

(e) Rails should be laid with a cant of 1 in 20 towards the centre of the track.

(f) The shortest length of rails to be used in track shall not be less than 5.5 M. except as a temporary measure, when cut pieces can be used, with suitable speed restrictions. Short rails should be laid in yards except where required for approaches of Bridges and Level Crossing.

(g) Rails of the same length should be used in pairs.

(2) *Rail Joints* – (a) Rail joints shall be laid square to track. Provisions of **Paras 424 and 425** will apply while laying track on curves.

(b) Provision of rail joints in Level Crossings and approaches will be governed by provision in **Para 921.**

(c) Provision of rail joints on Bridges and approaches will be governed by provisions in **Paras 272 and 277.**

(3) *Spacing of Sleepers* – **Para 244(2)** lays down the standard spacings to be adopted in the case of fishplated track, SWR and LWR.

(4) *Gauge on Straights and Curves* – The standards laid down for gauge as in **Para 403** may be followed while relaying is carried out.

(5) *Provisions of Creep Posts* – Provision in **Para 242(5)** may be followed.

316. Track Laying standards – (1) Utmost care should be taken during linking to ensure good quality of work, which on no account should be allowed to suffer.

(2) As a good practice, the laying standards of track geometry measured in floating condition **(as shown on the next page)** during primary renewals for Broad Gauge and Metre Gauge should be achieved (Track laid with new materials). The track geometry will be recorded three months after the speed is raised to normal – **(see on page 122)**

317. Renewal of Points and Crossing - (1) It may become necessary to replace points and crossings due to the following reasons :–

(a) Wear on the switches and crossings: The limits of wear have been specified in **Para 237.**

(b) Sleeper renewal when the sleepers are not able to hold the gauge and maintain cross levels.

(c) When the rail section on either side is changed to a higher section in through running lines.

(2) Any modification in the layout of passenger lines should be carried out with the sanction of the Commissioner of Railway Safety.

(3) The following aspects should be considered while relaying points and crossings in station yards:–

(a) When points and crossings are renewed, particular care should be taken to effect improvements in the lay out.

(b) The renewal should as a rule be carried out with standard rail sections, in accordance with the standard drawings and not with obsolescent sections. Non-standard crossing in main line, loops and sidings should be replaced with standard crossings.

(c) All turn-outs negotiated by passenger trains should be 1 in 12 or a flatter turn out; where adequate space is not available, 1 in 8-1/2 turn-outs with curved switches may be used.

(a) Gauge	sleeper to sleeper variation ..	2 mm.
(b) Expansion gap ..	Over average gap worked out by recording 20 successive gaps	± 2mm.
(c) Joints	Low joints not permitted High joints not more than . . Squareness of joints on straight	 ± 2mm ± 10mm
(d) Spacing of sleepers .. .	With respect to theoretical spacing	± 20mm
(e) Cross level	To be recorded on every 4th sleeper.	± 3mm
(f) Alignment	On straight on 10M. Chord..	± 2mm
	On curves of Radius more than 600 M. On 20 M. Chord. Variation over theoretical versines: On curves of Radius less than 600 M. On 20 M. Chord.	5 mm
	Variation over theoretical versines:-.	10 mm
(g) Longitudinal level ..	Variation in longitudinal level with . reference to approved longitudinal sections.	50 mm

(d) 1 in 8-1/2 symmetrical split turn-outs should generally be used for snag dead- ends; special crossings 1 in 8-1/2 for snag dead ends may be used in Broad Gauge.

(e) Track at either end of the turn-out should be adequately anchored. At least one rail length on either side of the turn-out should have the same section of rail as the turn-out.

(f) The following aspects should be considered while relaying points and crossings in station yards:–

Stock rail on turnout side of straight switches or curved switches having switch entry angle of more than 0°20'00'' (all turnouts excluding those mentioned at clause 237-1 (g-i) should be bent at theoretical toe of switch to such an extent that after the switch assembly is laid in track, the guage measured between two stock rails just ahead of actual toe of switch is equal to nominal gauge + 6mm.

(g) Centre line pegs must be fixed for the new assembly, particular care being taken to fix accurately the inter-section point of the turn-out track and the main line track, from which measurements are taken to fix other points.

(h) Joints on the SRJ and lead rail should be welded.

(i) In case of LWR/CWR territory, three normal rail lengths shall be provided between stock rail joint (SRJ) and SEJ as well as between crossing and SEJ. These normal rail lengths shall be provided with elastic rail clips/anchors to arrest creep as laid down in **manual of instructions or LWR 96.**

(j) *Gauge tie Plates* – New gauge tie plates in replacement of the unserviceable ones should be fitted jointly by the Permanent Way Inspector and the Signal Inspector. The Permanent Way Inspector will be responsible for the correct gauging of the switches and the Signal Inspector for the correct fixing of the interlocking apparatus.

(k) *Stretcher Bars* – Standard Stretcher bars should be so fitted that the "throw" of the switch is as specified in the Schedule of Dimensions and the clearance between its top edge and the bottom of the stock rail shall be atleast 1.5 mm, but nor more than 3.0mm. The Permanent Way Inspector shall be responsible for the correct fixing of the leading and the following stretcher bars. These should be fixed with the tongue rails opened to half the throw on both the sides. The signal inspector shall be responsible for the correct fixing of the split stretcher bar blades, wherever these are required to be fixed.

(I) *Switches* – Before stretcher bars are connected, each tongue rail should be examined to see that it lies properly housed against the stock rail for the full length of the planing of the switch without any pressure being applied to keep it in position. If a tongue rail does not fit properly against the stock rail, it should be carefully jim-crowed.

In case of interlocked points close co-ordination should be maintained by the Permanent Way Inspector with the Signal Inspector and in case of electrified sections with the Electrical Inspector and work should be carried out jointly.

(4) *Actual procedure of carrying out renewals*– (a) Before renewing points and crossings, the ballast in the layout should be deep screened. After deep screening the ballast should be laid only upto the bottom of the sleepers and extra quantity of ballast kept ready by the side of the layout for fully ballasting the layout, after renewal. Equipment for rail cutting and rail drilling should be kept ready at site.

(b) Renewals can be carried out by any of the following methods :

(i) *Building up at the site* – In this method all the Permanent Way materials for the turn-out are brought to the site and the turn-out assembled at site in its correct position after dismantling the old turn-out. This method is followed in the case of laying out new yards.

(ii) *Pre-assembling and slewing in at site* – The layout is assembled by the side of the existing layout. The ground on which the turn-out is to be assembled is leveled first. If necessary room is not available, additional space is created by doing extra earth work or by constructing a working platform with the old rails and sleepers. The assembly is usually built on a rail grid, the top surface of which is greased beforehand to facilitate easy slewing. During the block period the existing layout is dismantled and removed and the pre-assembled layout is slewed in its correct position, aligned and packed.

(iii) *Pre-assembling in depots* – In this method the layout is assembled in a central depot on a specially built platform for this purpose. After assembling the layout the corresponding parts should be suitably numbered indicating the matching rail ends of the various components when the layout is split into components. The layout is then dismantled and the component parts kept in proper sequence according to their relative position. The old layout is dismantled and the new layout laid in its position. In this method the workmanship achieved is of a high standard and therefore it should be preferred to other methods.

318. Sleepers in Yards and Running Lines –

(1) *Sleeper Density* –

(a) Passenger loops, other running lines and busy lines in the yards should have a sleeper density of M + 4.

(b) Other yard lines should have a sleeper density of M + 2.

(c) For symmetrical splits where speeds on the main and loop lines will be the same, the sleeper density to be adopted on the loop line shall be the same as that on the main line.

(2) *Types of Sleepers* –

(a) At large stations the use of steel sleepers should be avoided in running lines as far as possible as at these locations, sleepers are prone to corrosion.

(b) On lines proposed to be track circuited, concrete or wooden sleepers should be used.

(c) On other lines, as far as possible, R.C. twin block sleepers should preferably be used. CST. 9 sleepers may be used as an alternative. At least in important stations CST. 9 sleepers may be used in preference to wooden sleepers which are liable to be damaged by fire droppings.

319. Rails In Station Yards – (1) Renewals in Passenger Loops should normally be carried out with new or second hand serviceable rails of the same section as laid between stations, except in terminal yards where all trains stop and loops where speed is to be restricted to 50 Km.p.h. in which case second quality rails of the same section may be used.

(2) While carrying out through rail renewals or complete track renewal in yards, short welded panels of 3 rail length may be used.

(3) LWR may be provided in yards in terms of and subject to conditions laid down in L.W.R. Manual.

320. Classification and use of released material- (1) (a) After a section of track has been renewed, the released material shall be carefully sorted out so that greatest possible use may be made of them. They should then be classified by the Sr.Section Engineer (P.Way). Tools and plant left over should also be classified and action taken on their disposal.

(b) The rails should be graded according to their weight and condition into groups suitable for re-use in running lines, non-running lines and for conversion into posts or structural members for various purposes or for sale as scrap. Where rail-ends are worn or hogged, the feasibility of "Cropping" the ends should be considered if the condition of the rail is otherwise satisfactory.

(c) The sleepers should be sorted into various grades suitable for re-use in the track or as unserviceable material not fit for use in track works. The possibility of converting unserviceable Broad Gauge wooden sleepers to Metre Gauge or Narrow Gauge (762 mm.) should be considered before their classification as scrap. The unserviceable wooden sleepers may be used for temporary road-ways and other sundry purposes.

(d) Fish-plates, fish bolts, keys and dog-spikes should be sorted into those suitable for re-use and the rest as scrap.

(e) If the switches and crossings themselves are too badly worn to be re-used, the small fittings such as stretcher bars, switch anchors, stud-bolts and blocks can generally be used. Crossings should be reconditioned by welding, if the wear is not too severe, as also the switches.

(f) The timbers should be carefully inspected to decide the best use that can be made of them. If they are not too severely worn, the holes can be filled with a suitable compound or plugged and the timbers re-used in less important positions. It often happens that long timber is not decayed throughout its length and it is frequently possible to cut short lengths. If cut lengths so obtained are not long enough for re-use, two such pieces may be spliced and bolted together to form a composite sleeper for use in important sidings, interlaced with through sleepers.

(2) Basis for Classification – For the purpose of classification, Permanent Way materials should be divided into three classes depending upon the section and condition as detailed below –

(a) Class I material is that which is new and of standard section. New items of obsolescent sections which are interchangeable with standard materials and are purchased from time to time to prevent wastage of other serviceable material, should be brought on to the stock account as Class I material. These items should be included in the price lists for the miscellaneous and common items.

No other material of an obsolescent section is to be treated as Class I, even though it may never have been put in the road.

(b) Class II material includes all new material of obsolescent sections other than those included under Class I and all standard and obsolete material released from the road and fit for further use on track.

Class II released rails should be classified and sub-divided as under –

Class II (a) rails fit for use in running lines.

Class II (b) rails fit for use in non-running lines.

(c) Class III materials shall include all materials that has become unserviceable. This is either metal scrap or unserviceable timber. This class will include all rails which are neither Class I nor Class II.

Class III sleepers, wooden or steel should be further sub-divided as follows :–

(i) *Wooden sleepers* – Class III-A not fit for use in track but fit for walling of enclosures or for paving.

Class III-B not fit for use in track but fit for scantling or manufacturing keys or plugs.

Class III-C fit for fire-wood only.

(ii) *Steel sleepers* – Class III-A unserviceable, suitable for reconditioning or conversion to smaller gauge. Class III-B unserviceable scrap.

(d)*Valuation of released material* – The value of Class I, II and III materials should be fixed in consultation with the Financial Adviser and Chief Accounts Officer and shown in the price list for D. I. class materials.

(3) *Accountal of released P.Way materials:*

(1) The quantity of released materials from every work included for track renewal/gauge conversion will be based on yardsticks for loss of weight to be fixed on the basis of data collected during foot by foot survey. If there is more than one work on the same route, near to each other and under similar ground conditions, only one set of yardsticks would suffice.

(2) List of materials likely to be released will be prepared indicating the quantum of such materials separately as second hand (SH) and scrap following the instructions given in **Para 320(2)** above.

(3) While second hand materials will be indicated only in length/nos. in case of scrap materials, the accountal will be as follows:

(i) Rails - in length, then converted to weight.

(ii) Sleepers - Nos. separately as whole and in parts and then converted to weight.

(iii) Fittings & fastenings - by weight.

(4) During foot by foot survey, actual observations will be recorded jointly by PWI and ISA/ Stock Verifier giving the percentage loss of weight over the new component for each and every material likely to be declared as `SCRAP'. This can be done by actual weighment of few representative samples.

(5) The yardsticks will then be approved by the Sr.DEN/DEN personally based on the report duly test checked by AEN or DEN. These will specify the maximum percentage loss of weight for different components under different ground conditions as per format given in the **Annexure-3/2.**

(6) The conversion to weight in case of each of the items for purpose of accountal will then be done by the Section Engineer (P.Way) on the basis of the specified percentage loss of weight over the new components. In case, however, some abnormal variation of weight is observed after the materials have been released and the percentage loss is more than that specified for that category, specific justification will have to be recorded for the same by the Senior Section Engineer (P.Way) and all such cases would have to be certified by DEN/Sr.DEN after actual sample checking at site.

(7) In case however, the actual loss after release is seen to be lower than the yardstick the accountal will be done on the basis of the actual.

(8) After actual releases of materials, the Section Engineer (P.Way) will take the releases on books on the basis of summary sheet as per **Annexure-3/3.**

(9) The sectional AEN will carry out test checks to the extent of 20% of each item and make entries to this effect in the summary sheet. The sectional DEN/Sr.DEN will also carry out random checks to ensure that the category and weight of releases are correct to the maximum possible extent.

(10) The periodical returns for track renewals/ gauge conversions are to be submitted at the laid down periodicity as per rules and the existing procedure for checking should be streamlined to ensure that the returns are looked into detail in the AEN's office in nos. as also their conversion in weight. The returns will be specifically checked with regard to the correctness of input/output materials having been prepared on the basis of instructions given in **para-2 above.**

(11) As an internal check by the department, one of the works accountants in the division with engineering department or with construction department should be made responsible to carry out methodical checks of all MAS accounts of track renewals/gauge conversion works.

(12) In cases where the track work is to be done by contractor, the list of released materials shall be jointly prepared on the basis of a field survey to be conducted by the Sr.Sec. Engineer (P.Way) and contractors representative after the work has been awarded but before the dismantling work is allowed to commence. The contractor shall be bound to hand over the materials according to the said agreed list and should be responsible for any shortages.

321. Marking of Permanent Way Material – All Permanent Way material should be distinguished as follows or as otherwise directed :

(1) Class I - No marks.

(2) (a) For rails-

(i) Class II (a) Second hand rail fit to be relaid in running lines-Ends to be painted with a daub of white.

(ii) Class II (b) Second hand rail fit for use in non-running lines-Ends to be painted with a daub of yellow.

(iii) Unserviceable rails not fit for use – Ends to be painted with a daub of red.

(b) For other track materials like sleepers etc.–

(i) Class II i.e., Second hand fit for use in track works to be painted with a daub of white.

(ii) Unserviceable material not fit for use - Ends to be painted with a daub of red.

It should be ensured by the Assistant Engineer and Permanent Way Inspector that the materials of each class including fittings, are separately stacked for convenience of accounting and despatch and indication plates erected there at.

322. Identification of different qualities of rails in the Field –

(1) *First Quality Rails (T-12)* – **Indian Railways specification IRS – T – 12/96** gives the detailed specification of Flat Bottom Rails 60 kg. and 52 kg. of grade 880 MPa, 1000 MPa and 1080 MPa. 52 kg./m and 60 kg./m rails shall be classified as Class 'A' and Class 'B' rails based on tolerance in End Straightness. The rails shall have rolled on it, the rail section, the Grade of steel, identification marks of the manufacturer, month and last two digits of the year of the manufacture, process of steel making and direction of rolling of rail.

(2) *Second Quality Rails* – These are rails with relaxation in sectional tolerance as provided in Amendment to IRS – T – 12/96 but other wise conforming to **T – 12/96** in all other respects. The identification of such rails will be one hole of 6 mm dia, champhered at both ends, drilled at the center length of the rail and at the middle of the web. These rails shall be used only on loop lines / sidings with speed restriction of 50 kmph. These rails shall be painted with orange colour on both sides of the web for a distance of 1 metre from each end, for easy identification.

(3) *Third Quality Rails* – In addition to above two qualities, third quality rails supplied by Steel Plants are arising, particularly during the inspection of rails while producing first quality rails as per IRS – T – 12 specification. There is no deviation in chemical composition or echanical property in 'Industrial Use' rails from that of IRS-T-12. The deviations exist only in tolerance in surface defects, dimensions and straightness. These can be used in industrial sidings where speeds are limited to 30 km p. h in B. G. and 25 km.p.h. in M.G.

The identification of such rails will be one hole of 12m dia., champhered at both ends, drilled at the center length of the rail and at the middle of the web. a marking "I.U." in 18 mm, size shall be stamped on both end faces of rail. The third quality rail shall be painted with white paint on end face of the flange and on both sides of flange for a distance of 500 mm, from each end for identification.

323. Works to be attended after completion of relaying – (1) *Classification and loading of released materials* – Materials as and when removed during the progress of relaying should be collected and classified and despatched to the destination. No released material should be left lying about at the site of the renewals. A relaying work shall not be considered complete until all released materials are removed from site and necessary credit afforded.

(2) *Temporary strengthening of gangs* – After the relaying is completed it would be necessary to strengthen the regular maintenance gangs temporarily to maintain it to the required standard for the maximum permissible speed on the section.

(3) *Description Boards*–Boards displaying information in regard to track materials laid for special or experimental purposes should be erected at each end of the length over which the trial is being conducted & maintained only for so long as the materials remain under trial.

(4) *Dating of wooden sleepers* – The date of laying should be cut out or branded on each wooden sleeper in accordance with **Para 245(8)**.

(5) *Revision of Permanent Way Diagrams* – As soon as the re-railing /or the re-sleepering work is completed, the Permanent Way diagrams & the station yard diagrams and the index section that embody the detailed particulars of the track in regard to the year of laying, section of rail, type of sleepers, fish plates & fittings should be amended up-to-date in the Divisional Engineer's office and the head-quarters advised. Copies of amended diagrams should be issued by the Divisional Engineer to the Assistant Engineer & Permanent Works inspector concerned for record in their offices.

(6) *Closing of the Accounts* – The account for relaying works should be closed within 3 months of completion of the work & completion report submitted.

ANNEXURE-3/1 PARA 304(1)

JUSTIFICATION FOR COMPLETE TRACK RENEWAL

DIVISION———————— SECTION———————————— FROM Km. ———————— TO Km.————————

1. RAILWAY ————————————-
2. TOTAL SERVICE TRAFFIC CARRIED SO FAR (G. M. T.) ——————————————-
3. PRESENT ANNUAL TRAFFIC DENSITY (G. M. T.) : Single line ——————————————————
4. PRESENT NATURE OF TRAFFIC:- ...(1) AVERAGE NO. OF TRAINS PER DAY——————
   (2) MAXIMUM PERMISSIBLE SPEED ——————————
   (3) HEAVIEST LOCOMOTIVE IN USE: Type.....Axle load.....

(5)PRESENT TRACK STRUCTURE: RAILS —————— SLEEPERS —————— DENSITY ——————-

OBSERVATION

Sl. No	Items	Km. from the beginning of the proposed renewal (excluding loops &sidings in yards)				Designation of the official recording observations
		0-1	1-2	3-4	5-6	
1.	**Rails—**					
	(a)Type					
	(b)Age					
	(c) % wear of rails					
	(d) Corrosion in mm. (also give condition regarding pitting etc.)					
	(e) Rail failures (During last 5 years)					
	(i) Rail ends (Nos.)					
	(ii) Manufacturing (Nos.)					
	(f) Rail ends					
	(i) hogged % / KM.					
	(ii) battered % / KM					
	(g) Scabbed rails % / KM					
	(h) Other defects (Corrugation etc.)					
2.	**Sleepers**					
	(a)Type					
	(b) Age					
	(c) Condition					
	(d) Unserviceable (%)					
3.	**Ballast Cushion (cm.)**					
4.	**Formation**					
	(i) Soil					
	(ii)Condition					
	(iii)Treatment proposed if any					
5.	**Casual Renewals** (during last 3 yrs.)					
	(i) Rails (nos.)					
	(ii) Sleepers (nos.)					

ANNEXURE-3/2 PARA 320(3)(5)

LOSS OF WEIGHT OF RELEASED SCRAP (P.WAY COMPONENTS)

DESCRIPTION OF WORK:
FOOT BY FOOT SURVEY CARRIED OUT BY: _____ **Railway**
_____**Division**

DATE :

S.No.	Description of Material	Weight of New item	Max. % loss of weight on release	Weight of released item	Remarks
(1)	Rails				
(2)	SLEEPERS : (a) Steel (b) CST-9 (c) Wooden				
(3)	FISH PLATE				
(4)	TIE BAR				
(5)	OTHER FITTINGS (a) Bearing Plates (b) ACP (c) ERC (d) Two way key, other fittings				

ANNEXURE-3/3 PARA 320(3)(8)

SUMMARY OF P.WAY MATERIAL TO BE RELEASED.

NAME OF WORK_____

DIVISION_____SECTION_____PWI_____

DEN/SR.DEN_____

PERIOD OF EXECUTION OF WORK FROM (date)_____ to (Date)_____

Km	Category of section	Name of material	List of material to be released				Remarks for abnormality if any	Sign. of PWI	Test check by AEN	Remarks
			Service able or scrap	If scrap						
				No/ Length	Rate (WT.)	WT.				

CHAPTER IV

CURVED TRACK AND REALIGNMENT OF CURVES

PART 'A'
GENERAL

401. Determination of Radius – (1) The radius of a curve is determined by measuring the versine on a chord of known length, from the equation,

$R = \frac{125\ C^2}{V}$ where R = Radius in metres;
C = Chord length in metres; and
V = Versine in millimetres.

(2) Curves can be designated by the radius in metres or by its degree. The angle subtended at the center by a chord of 30.5 metres, is the degree of the curve.

A 1^0 curve is thus of $\frac{360 \times 30.5}{2\pi}$ =1750 metres radius; a 2^0 curve has a radius of $\frac{1750}{2}$ = 875 metres and so on.

Curves shall be described invariably by the radius in metres.

(3) For measuring versines of a curve, 20 metres overlapping chords should normally be used with stations at 10 metres intervals. For checking the radii of turn-out and turn-in curves overlapping curve of 6 metres should be used and the versine measuring stations should be located at every 1.5 metres. (The turn-out curve can also be checked by off-sets from the straight with the versine measuring stations 1.5 metres apart.)

(4) The versine is obtained by stretching a fishing/nylon chord or wire taut between the end of chord length decided upon, and the measuring distance between the cord/wire and gauge face of the rail at the middle point of the chord. Care should be taken that the cord or wire is applied to the side of the head of the rail at the gauge point.

RAIL LEVEL AND THE GAUGE

402. The Reference Rail –

The level of inner rail of any curve is taken as reference level. Superelevation is provided by raising the outer rail. For reverse curves, however, stipulation as laid down in **Para 408(3)** shall apply.

403. Gauge On Curves – The gauge on curve shall be to the following standards : –

(1) On new lines and on lines where complete renewal or through sleeper renewal is carried out, the track should be laid to the following standards –

Radius in metres	Gauge
a) Broad Gague (1676 mm.)	
i) Straight including curves of radius upto 350m. and more	-5mm. to +3mm.
ii) For curves of radius less than 350m.	Upto +10mm.
b) Metre Gague (1000mm.)	
i) On straight including curves with radius 290m. and more	-2mm. to +3mm.
ii) On curves with radius less than 290m.	Upto +10mm.
c) Narrow Gague (762mm.)	
i) Straight including curve with radius upto 400m.	-3mm. to +3mm.
ii) For curves with radius less than 400m. and upto 100m.	Upto +10mm.
iii) Curves with radius less than 100m.	Upto +15mm.

(2) Gauge on the wooden sleepered road however, need not be disturbed, if it is likely to cause spike killing of sleepers. Uniformity of the gauge should be stressed in all cases to get better track riding quality.

(3) These limits are not applicable to curves laid with different gauge widening by railways as trial measure in consultation with RDSO.

Note : For narrow Gauge sections for which special schedules have been prescribed by the Zonal Railways, provisions in those schedules should be observed.

TRANSITIONS, SAFE SPEED AND SUPERELEVATION ON CURVES

404. Definitions – (1) Cant or superelevation is the amount by which one rail is raised above the other rail. It is positive when the outer rail on a curved track is raised above inner rail and is negative when the inner rail on a curved track is raised above the outer rail.

(2) Equilibrium speed is the speed at which the centrifugal force developed during the movement of the vehicle on a curved track is exactly balanced by the cant provided.

(3) *Cant deficiency* – Cant deficiency occurs when a train travels around a curve at a speed higher than the equilibrium speed. It is the difference between the theoretical cant required for such higher speed and actual cant provided.

(4) *Cant excess* – Cant excess occurs when a train travels around a curve at a speed lower than the equilibrium speed. It is the difference between the actual cant and the theoretical cant required for such a lower speed.

(5) *Maximum permissible speed of the curve*– It is the highest speed which may be permitted on a curve taking into consideration the radius of the curvature, actual cant, cant deficiency, cant excess and the length of transition. When the maximum permissible speed on a curve is less than the maximum sectional speed of the section of a line, permanent speed restriction becomes necessary.

(6) Cant gradient and cant deficiency gradient indicate the amount by which cant or deficiency of cant is increased or reduced in a given length of transition e.g., 1 in 1000 means that cant or deficiency of cant of 1mm. is gained or lost in every 1000mm. of transition length.

(7) Rate of change of cant or rate of change of cant deficiency is the rate at which cant or cant deficiency is increased or reduced per second, at the maximum permissible speed of the vehicle passing over the transition curve, e.g., 35 mm. per second means that a vehicle when traveling at a maximum speed permitted will experience a change in cant or deficiency of cant of 35mm. in each second of travel over the transition.

(8) Transition curve is an easement curve, in which the change of radius is progressive throughout its length and is usually provided in a shape of a cubic parabola at each end of the circular curve. It affords a gradual increase of curvature from zero at the tangent point to the specified radius of circular arc and permits a gradual increase of super elevation, so that the full superelevation is attained simultaneously with the curvature of the circular arc.

405. Safe Speed On Curves – (1) *Fully transitioned curves* – The maximum permissible speed for transitioned curves should be determined from the following formulae –

(a) BROAD GAUGE –

$$V = 0.27 \sqrt{R\,(C_a + C_d)}$$

(This is on the assumption that the centre to centre distance between railheads is 1750 mm.)

(b) METRE GAUGE –

$$V = 0.347 \sqrt{R\,(C_a + C_d)}$$

(This is on the assumption that the centre to centre distance between railheads is 1057 mm.)

(c) NARROW GAUGE (762 mm.) –

$V = 3.65\sqrt{(R-6)}$ subject to maximum of 50 km. p. h.

V = speed in km. p. h.

R = radius in metres.

Ca = Actual cant in mm.

Cd = permissible cant deficiency in mm.

Graphs showing (i) maximum permissible speed for transitioned curves of different radii and equilibrium cant are appended in **Annexures 4/1** and **4/2** for B G and M G respectively.

(2) (a) *Non transitioned curves with cant on virtual transition* –

The determination of the maximum permissible speed on curves without transition involves the concept of the virtual transition. The change in the motion of a vehicle from straight to curve conditions takes place over the distance between the bogie centres, commencing on the straight at half the distance before the tangent point and terminating on the curve at the same half distance beyond the tangent point. Normally, the length of virtual transition is taken as 14.6 meter on B G, 13.7 meter on M G and 10.3 meter on N G The cant or superelevation is gained over the virtual transition.

The cant gradient in any case should not be steeper than 1 in 360 (2.8 mm. per metre) on B.G. and 1 in 720 (1.4 mm. per metre) on M. G. and N. G.

Graph showing the safe speeds over the non-transitioned curves in case of virtual transition, both for B. G. and M. G. is appended as **Annexure 4/3.**

(b) *Non-transitioned curves with no cant provided –*

In case of non-transitioned curves where no cant is provided, the safe speed over the curve can be worked out from the graph appended as **Annexure 4/4.**

(3) For curves laid with inadequate length of transition, the safe permissible speed should be worked out on the basis of actual cant/cant deficiency, which can be provided taking into consideration the limiting values of cant/cant deficiency gradient and the rate of change of cant and cant deficiency.

(4) The speed as determined above shall not exceed the maximum permissible speed of the section.

406. Superelevation, Cant deficiency and Cant excess – (1) *Superelevation/cant*

(a)The equilibrium superelevation/cant necessary for any speed is calculated from the formula

$$C = \frac{GV^2}{127R}$$

Where C is cant / superelevation in mm. G is the gauge of track + width of rail head in mm. R is the radius of the curve in metres.

(b) The equilibrium speed for determination of cant to be provided shall be decided by the Chief Engineer, after taking into consideration the maximum speeds which can be actually attained by fast and slow trains, the proximity of permanent speed restriction in the route, junctions, stopping places, gradients which may reduce the speeds of goods trains, without appreciably affecting the speed of fast trains and their relative importance. For this purpose the entire section may be divided into a certain number of sub sections with a nominated equilibrium speed for each sub section, fixed on the basis of speeds which can be actually attained by fast or slow trains over the sub section, so that the need for imposing any speed restrictions for limiting the cant excess for slow trains and cant deficiency for fast trains is avoided. On sections where all trains run at about the same maximum permissible speeds like suburban section, it will be preferable to provide cant for that speed.

(c) The amount of superelevation to be actually provided will be calculated by the formula given in sub-para (a) for the equilibrium speed determined on the basis of sub-para (b) above.

(d) *Maximum cant on curved track shall be as under –*

(1)(i) Broad Gauge – *Group 'A', 'B' and 'C' routes-165 mm.*

Note :– Maximum cant of 185 mm. may be assumed for the purpose of locating all permanent structures etc., by the side of the curves on new constructions and doubling on group 'A' routes having potential for increasing the speed in future. The transition length should also be provided on the basis of 185 mm. cant for the purpose of planning and layout of the curve.

(ii) *Broad gauge* – Group 'D' and 'E' routes-140 mm.

(iii) *Metre Gauge* – 90 mm. (can be increased to 100 mm. with special permission of Chief Engineer)

(iv) *Narrow Gauge* (762 mm.) – 65 mm. (can be increased to 75 mm. with special permission of Chief Engineer)

For Narrow gauge sections for which special schedules are prescribed by the Zonal Railways provisions in these schedules should be observed.

(e) Cant for each curve should be specified and indicated on web of the inside face of the inner rail to the nearest 5 mm.

In every case, the superelevation to be provided should be specified when the line is originally laid and thereafter altered only with the prior approval of the Chief Engineer.

(2) *Cant Deficiency* – Maximum value of cant deficiency –

(a) For speeds in excess of 100 km.p.h. on Groups 'A' and 'B' routes for nominated rolling stocks and routes with permission of the Chief Engineer. ..... 100 mm.

(b) For Broad Gauge routes not covered by above .....75 mm.

(c) Metre Gauge .....50 mm.

(d) Narrow Gauge (762 mm.) .....40 mm.

For Narrow Gauge sections for which special schedules are prescribed by the Zonal Railways, provisions in those schedules should be observed.

(3) Cant Excess-Maximum values of cant excess –

On Broad Gauge cant excess should not be allowed to exceed 75 mm. and on Metre Gauge 65 mm. for all types of rolling stock. The cant excess should be worked out taking into consideration the booked speed of goods trains on a particular section. In the case of a section carrying predominantly goods traffic, the cant excess should be preferably kept low to minimize wear on inner rail.

407. Length Of Transition Curve And Setting Out Transitions –

(1) The desirable length of transition 'L' shall be maximum of the following three values –

(a) $L = 0.008\ C_a \times V_m$

(b) $L = 0.008\ C_d \times V_m$

(c) $L = 0.72\ C_a$

Where : L = the length of transition in metres.

V_m = maximum permissible speed in km.p.h.

C_d = cant deficiency in millimetres.

C_a = actual superelevation on curve in millimetres.

The formula (a) and (b) are based on rate of change of cant and of cant deficiency of 35 mm. per second. The formula (c) is based on the maximum cant gradient of 1 in 720 or 1.4 mm. per metre.

(2) For the purpose of designing future layouts of curve, future higher speeds (such as 160 km./h. for Group 'A' routes and 130 km./h. for Group 'B' routes) may be taken into account for calculating the length of transitions.

(3) In exceptional cases where room is not available for providing sufficiently long transitions in accordance with the above, the length may be reduced to a minimum of 2/3 of the desirable length as worked out on the basis of formula **(a)** and **(b)** above or 0.36 C_a (in metres) whichever is greater. This is based on the assumption that a rate of change of cant/cant deficiency will not exceed 55 mm. per second and the maximum cant gradient will be limited to 2.8 mm. per metre or 1 in 360. This relaxation shall apply to Broad Gauge only. For Narrow Gauge and Metre Gauge sections, cant gradient should not be steeper than 1 in 720. For Metre Gauge the rate of change of cant/cant deficiency should not exceed 35 mm./ second.

(4) At locations where length of transition curve is restricted, and therefore, may be inadequate to permit the same maximum speed as calculated for the circular curve, it will be necessary to select a lower cant and/or a lower cant deficiency which will reduce the maximum speed on the circular curve but will increase the maximum speed on the transition curve. In such cases, the cant should be so selected as to permit the highest speed on the curve as a whole.

An example is illustrated with calculations below –

A curve of 600 metres radius has a limited transition of 40 metres length. Calculation of maximum permissible speed and superelevation is as follows :–

Speed on transition curve = Speed on circular curve.

$$\frac{\text{Rate of change of cant} \times L \times 3.6}{C_a} = 0.27\sqrt{R\,(Ca + Cd)}$$

Best values of speed are obtained when $C_a = C_d$.
(3.6 is a factor used for converting 'M' /Sec. to km./hr.)

Adopting the same units and the maximum value of rate of change of cant of 55 mm. per second for Broad Gauge –

$$\frac{55 \times 40 \times 3.6}{C_a} = 0.27\sqrt{(600 \times 2Ca)}$$

Solving C_a = 89.50 or 90 mm.

Limiting the value of Cd to 75 mm.

Maximum speed ....= $0.27\sqrt{R\,(Ca + Cd)}$

$= 0.27\ \sqrt{600\,(90 + 75)}$

= 84.95 say 85 km.p.h.

$$\text{Cant gradient} = \frac{90}{40000} = \frac{1}{444}$$

which is within the permissible limits.

The rate of change of cant at 85 km.p.h. works out to 53.12 mm. / second which is also within the permissible limits.

(5) *Laying transition* – (a) A transition curve is laid out as a cubic parabola and to accommodate this, the main circular arc is moved inwards by an amount called the "**Shift**".

"Shift" is calculated from the formula :

$$S = 4.2 \frac{L^2}{R}$$

Where S = shift in centimetres.

L & R being in metres.

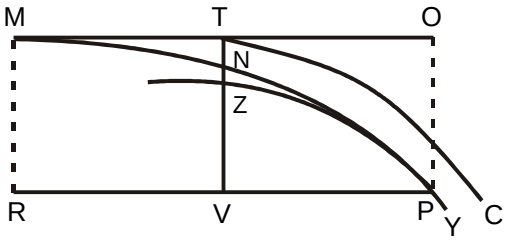
(b) The off-set in centimetres from the straight to any point on the transition curve is calculated from the formula –

$$Y = 16.7 \frac{X^3}{LR}$$

Where Y = off-set from the straight in centimetres.

X = distance from the commencement of the curve in metres, and L & R length of transition and radius of curve respectively in metres.

(c) The arrangement of a transition curve is shown in the figure below –



The original circular curve TC is tangential to the straight at T. The curve is shifted to ZY and TZ is the amount of shift. The transition curve MNP bisects the shift TZ at N. A typical example of working out maximum permissible speed on a curve, calculating the length of transition and detailed calculation of laying the transition are given in **sub-para(6).**

(6) ***Example*** – A 600 metres radius curve is introduced between straight portions of a Broad Gauge Railway line intersecting to form a total deviation of 70 degrees. The speed for determining the equilibrium cant is fixed at 80 km.p.h. and the maximum sectional speed is 110 km.p.h. Calculate the equilibrium cant, the maximum permissible speed, length of transition and the off-set for setting out the transition curve. The maximum permissible cant and cant deficiency are 165 mm. and 100 mm. respectively.

Solution –

$$\text{Equilibrium cant} = \frac{GV^2}{127\,R} = \frac{1750 \times 80^2}{127 \times 600} = 146.98 \text{ mm.}$$

$$\text{Cant for maximum sectional speed} = \frac{1750 \times 110^2}{127 \times 600} = 277.88 \text{ mm.}$$

Cant deficiency for maximum sectional speed = 277.88 — 146.98 = 130.90 mm.

which is more than the permitted cant deficiency of 100 mm. With 100 mm. C_d, actual cant = 277.88 - 100 = 177.88 mm. But actual cant is to be limited to 165 mm.

Cant excess : Cant for a speed of 50 km.p.h. which is the booked speed of a goods train (assumed).

$$= \frac{1750 \times 50^2}{127 \times 600} = 57.41 \text{ mm}$$

∴ Cant excess = 165 — 57.41 = 107.59 mm. which is in excess of 75 mm. permitted value.

Provide actual cant = 57.41+ 75 =132.41, say 130 mm.

Maximum permissible speed $V_m = 0.27 \sqrt{R(C_a+C_d)}$

$= 0.27 \sqrt{600(130+100)}$

= 100.3 or 100 kmph

Length of transition -

(a) $L = 0.008 \times C_a \times V_m = 0.008 \times 130 \times 100 = 104$ M.

(b) $L = 0.008 \times C_d \times V_m = 0.008 \times 100 \times 100 = 80$ M

(c) $L = 0.72\, C_a = 0.72 \times 130 = 93.6$ M.

The maximum value obtained is 104 M.

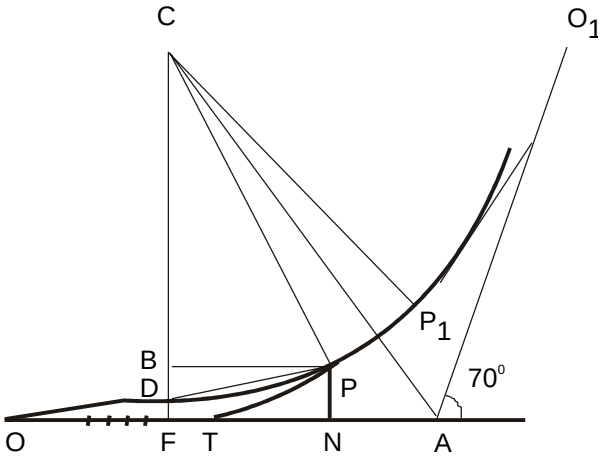
Provide 100 M. length of transition. Cant gradient will be 130 mm. in 100 M. which is equal to 1 in 769. At 100 km.p.h. maximum speed, the rate of change of cant works out to be 36 mm. per second.

$$\text{Shift} = 4.2 \times \frac{L^2}{R}$$ **(see figure on the next page)**

$$= 4.2 \times \frac{100^2}{600} = 70 \text{ cm.}$$

CF = 600 + 0.7 = 600.70 M.

FA = 600.7 tan 35^0 = 420.61 M.



$$OF = \frac{L}{2} = \frac{100}{2} = 50 \text{ M.}$$

OA = 420.61 + 50 = 470.61 M.

The point '0' can be fixed by measuring this distance back from the apex.

The deviation angle for each transition is

$$\tan^{-1}\frac{L}{2R} = \tan^{-1}\frac{100}{1200} = 4.76^0$$

The deviation angle for the circular curve $= 70^0 - (2 \times 4.76) = 60.48^0$

$$\text{Length of circular arc} = \frac{600 \times 60.48 \times \pi}{180} = 633.34 \text{ M.}$$

Off-sets are required at every 20 m. interval on the transition.

$$Y = \frac{16.7 \times X^3}{LR}$$

Y = 0

$$Y1 = \frac{16.7 \times 20^3}{100 \times 600} = 2.22 \text{ cms.}$$

$$Y2 = \frac{16.7 \times 40^3}{100 \times 600} = 17.8 \text{ cms.}$$

$$Y3 = \frac{16.7 \times 60^3}{100 \times 600} = 60.1 \text{ cms.}$$

$$Y4 = \frac{16.7 \times 80^3}{100 \times 600} = 142.5 \text{ cms.}$$

$$Y5 = \frac{16.7 \times 100^3}{100 \times 600} = 278.3 \text{ cms.}$$

(7) When realigning old curves, transition curves on approaches should invariably be provided. It should should be ensured that there is no change of grade over the transition.

(8) Compound curves – In case of a compound curve which is formed by two circular curves of different radii but curving in the same direction, common transition curve may be provided between the circular curves. Assuming that such compound curve is to be traversed at uniform speed, the length of the transition connecting the two circular curves can be obtained from –

(i) $L = 0.008 (C_{a1} - C_{a2}) \times V_m$

(ii) $L = 0.008 (C_{d1} - C_{d2}) \times V_m$ whichever is greater, where C_{a1} and C_{d1} are cant and cant deficiency for curve No.1 in mm. ,C_{a2} and C_{d2} are cant and cant deficiency for curve No.2 in mm., L is length of transition in metres., V_m is the maximum permissible speed in km.p.h.

Cant gradient should be within the permissible limits as stated in **Para 407(1).**

Common transition may be provided when the length of common transition as worked out above is more than the length of virtual transition as specified in **Para 406 (1) (b)**.

(9) *Reverse Curves* – (a) In case of a reverse curve which is formed by two circular curves which curve in opposite directions, common transition curve may be provided between circular curves. The total length of common transition, i.e., from circular curve to circular curve, may be obtained from –

(i) $L = 0.008 (C_{a1} + C_{a2}) \times V_m$

or

(ii) $L = 0.008 (C_{d1} + C_{d2}) \times V_m$ whichever is greater, where C_{a1} and C_{d1} are cant and cant - deficiency of curve No. 1 in mm., C_{a2} and C_{d2} are cant and cant deficiency of curve No. 2 in mm..

L = is the transition in metres.

V_m = maximum permissible speed in km.p.h.

Cant gradient should be within the permissible limits as stated in **Parsa 407 (1).**

(b) For high speeds, in group 'A' and 'B' routes, a straight with a minimum length of 50 M. shall be kept between two transitions of reverse curves. In the case of M. G. high speed routes the distance to be kept will be 30 metres. On groups 'A' and 'B' routes on B. G., straights less than 50 metres between reverse curves and on M. G. high speed routes, straights less than 30 metres should be eliminated by suitably extending the transition lengths. In doing so, it should be ensured that the rate of change of cant and versine along the two transitions so extended is kept the same. Whenever such straights between reverse curves can neither be eliminated nor the straight length increased to over 50 metres in B. G. and 30 metres in M. G. speed in excess of 130 km.p.h. in B. G. and 100 km.p.h. in M.G.should not be permitted.

408. Running out Superelevation – (1) On transitioned curves, cant should be run up or run out on the transition, not on the straight or on the circular curve, increasing or decreasing uniformly throughout its length.

(2) On non-transitioned curves, cant should be run up or run out on the 'virtual transition'.

(3) Longitudinal profile of transition on the reverse curve may be in one of the following two alternatives :

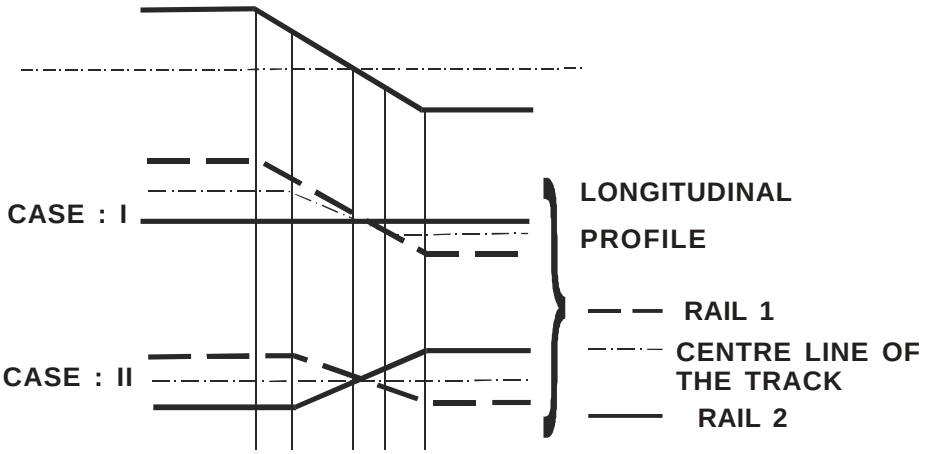
In case no. 2, the level of the centre line of the track is maintained the same throughout, and the cant is provided by raising one rail by half the amount of cant and lowering the other rail by the equal amount. Cant is run out or gained over the length of the transition by raising and lowering both the rails by equal amount symmetrically, with respect to the level of the centre line track.

In case of no.1, the level of the centre of the track gets disturbed whereas in case of No. 2, it is maintained the same throughout.

(4) *Special cases of superelevation run out may be approved by the Chief Engineer.*

409. Indicators/Boards provided in curves– (1) *Curve Board* **–** Each approach of a curve should be provided with a curve board at the tangent point fixed on the outside of the curve. This Board should indicate the radius of the curve, the length of the curve, length of transition in metres and the maximum cant provided on the circular portion of curve in millimetres.

(2) *Rail Posts Indicating Tangent Points* – On the inside of the curve, rail posts should be erected on each approach of the curve, to indicate the positions of the begining and end of transition curves. These rail posts may be painted in red and white colours respectively. In the case of non transitioned



VERSINE OR CANT DIAGRAM

In case no. 1, the level of one of the rails is maintained and the super elevation is run out on the other rail by lowering it over half the transition length and raising it to the required amount of cant over the remaining half portion of the transition.

curve, similar rail post should be erected on the tangent track and on the circular curve over which the cant is run out, indicating the begining and end of the virtual transition.

(3) *Indication of cant on track* – Superelevation or cant should be indicated by painting its value on the inside face of the web of the inner rail of the curve and at every versine station, begining with zero at the commencement of the transition curve. The value of cant should be indicated on the circular curve at its begining and at the end. In the case of long circular curve the cant value should be indicated at intermediate stations at a distant not exceeding 250 metres.

(4) *Cant boards* – Cant boards supplied to the gangs should be graduated in steps of 5 mm. The maximum height of these should be 165 mm. for B. G., 100 mm. for M. G. and 75 mm. for N. G.(762 mm.)

(5) When curves are realigned, the repositioning of the curve boards and posts and repainting of values of superelevation at intermediate points should be done, as required.

410. Speed over Turn-out Curves – (1) Provision in general rules-Relevant Para 4.10 of General Rules,1976 Edition is reproduced below-

(i) The speed of trains over non-interlocked facing points shall not exceeed 15 kilometres per hour in any circumstances and the speed over turn-out and cross overs shall not exceed 15 kilometres per hour, unless otherwise prescribed by approved special instruction, which may permit a higher speed.

(ii) Subject to provision of sub-rules (i) a train may run over interlocked facing points at such speed as may be permitted by the standard of interlocking.

(2) *Turn-outs on running lines with passenger traffic* – Turn-outs in running lines over which passenger trains are received or despatched should be laid with crossing, not sharper than 1 in 12 for straight switch. However, 1 in 8-1/2 turn-out with curved switches may be laid in exceptional circumstances, where due to limitation of room, it is not possible to provide 1 in 12 turn-outs. Sharper crossings may also be used when the turn-out is taken off from outside of a curve, keeping the radius of lead curve within the following limits :–

Gauge	**Minimum radius of lead curve**
Broad Gauge	350 M.
Metre Gauge	220 M.
Narrow Gauge(762 mm.)	165 M.

Where it is not practicable to achieve the radius of curvature of turn in curves as specified above on account of existing track centres for the turn-out taking off from curves, the turn in curves may be allowed upto a minimum radius of 220m for B.G. and 120m for M.G.subject to the following :–

(a) Such turn in curves should be provided either on PSC or steel trough sleepers only, with sleeper spacing same as for the main line.

(b) Full ballast profile should be provided as for track for main line

Emergency cross overs between double or multiple lines which are laid only in the trailing direction may be laid with 1 in 8-1/2 crossings.

In the case of 1 in 8-1/2 turn-outs with straight switches laid on passenger running lines, the speed shall be restricted to 10 km.p.h. However, on 1 in 8-1/2 turn-outs on non passenger running lines, speed of 15 km.p.h. may be permitted.

(3) *Speed over interlocked turnouts* - Speed in excess of 15 kmph may be permitted for straights of interlocked turnouts only under approved special instructions in terms of **GR 4.10.**

In the case of 1 in 8.5, 1 in 12 and flatter turn-outs provided with curved switches, higher speeds as permitted under approved special instructions may be allowed on the turnout side, provided the turn-in curve is of a standard suitable for such higher speeds. While permitting speed beyond 15 kmph, provisions of **Para 410 (4)** may be kept in view.

The permissible speed on turnouts taking off on the inside of the curve should be determined by taking into consideration the resultant radius of lead curve which will be sharper than the lead curve for turnouts taking off from the straight. 1 in 8.5 turnouts should not be laid on inside of curves.

(4) *Upgradation of speeds on Turnouts and Loops to 30 kmph* - (a) *Length of Section* - Upgradation of speeds on turnout should cover a number of contiguous stations at a time so as to derive a perceptible advantage of the higher speed in train operation. The works described below, should cover all the running loops on the stretch of line taken up.

(i) *Turnouts* - Speed, in excess of 15 kmph, should be permitted on turnouts laid with ST or PRC sleepers only. All turnouts on the running loops shall be laid with curved switches, with minimum rail section being 52 Kg. All rail joints on these turnouts should also be welded to the extent possible.

For different type of curved switches permissible speed are as under:-

S. No.	Type of Turnout (BG)	Permissible speed
1.	1 In 8.5 curved switch	15 kmph
2.	1 in 8.5 symmetrical split with curved switches	30 kmph
3.	1 in 12 curved switch	30 kmph

(ii) *Track on running loops* - Speed in excess of 15 kmph, should not be permitted on running loops laid with wooden sleepers. The minimum track structure on the running loops should be 90R rails laid as Short Welded Panels, M+4 density on PRC, ST, CST-9 sleepers and 150 mm ballast cushion. Out of 150 mm total cushion, clean cushion of 75 mm at least should be available. Proper drainage of the area should also be ensured.

(iii) *Turn-in curves* - Speed in excess of 15 kmph, should not be permitted on Turn-in curves laid with wooden sleepers. Turn-in curves should be laid with the same rail section as on the turn-out with PRC, ST or CST-9 sleepers with sleeper spacing being 65 cm centre to center (maximum).

Turn-in curve should conform to **Para 410 (2)** of IRPWM and especially so in respect of curvature of the lead curve.

Extra shoulder ballast of 150 mm should be provided on outside of the turn-in curve.

The frequency of inspection of turn-in curves should be same as that for main line turn-outs.

(b) The following should be ensured, if CST-9 sleepers are used in running loops or turn-in curves :-

(i) There is no crack or fracture at rail seat in two consecutive sleepers.

(ii) There is no excessive wear of lug and rail seat.

(iii) All the fittings, keys, cotters and tie bars are fitted properly. Rail is held firmly with sleepers.

(iv) Tie bars should not be broken or damaged by falling brake gear, wagon parts etc. and they should not have excessive corrosion or elongated holes. The corrosion of tie-bars inside the CST-9 plate should be especially checked as this results in their removal and adjustment becoming difficult.

(c) The following should be ensured, if ST sleepers are used in Turnouts, Turn-in curves or running loops:-

(i) There is no crack or fracture at rail seat in two consecutive sleepers.

(ii) There is no excessive wear of lug, MLJ and rail seat.

(iii) All the fittings are effective and rail is held with sleepers properly.

(iv) The sleepers and fittings do not have excessive corrosion, elongated holes etc.

411. Permissible Speed over curved Main line at Turn-outs – Subject to the permissible run through speed governed by the interlocking standard, speed over the main line will be determined taking into consideration the maximum cant which can be provided on the main line and the permissible amount of cant deficiency. In the case of turn-out of similar flexure, the maximum cant that can be provided, on the main line will be the sum of equlibrium cant for the turn-out and permissible cant excess. In the case of turn-outs of contrary flexure, the maximum cant on the main line (negative superelevation on turn-out) will be the difference between the maximum permissible cant deficiency and cant determined for turn-out from the formula given in Schedule of Dimensions as indicated in **para 413**. The permissible speed on the main line will be worked out by the formula as given in **para 405(1)**

412. No change of superelevation over turn-outs– There should be no change of cant between points 20 metres on B. G.,15 metres on M. G., and 12 metres on N. G. outside the toe of the switch and the nose of the crossing respectively, except in cases where points and crossings have to be taken off from the transitioned portion of a curve. Normally, turn-outs should not be taken off the transitioned portion of a main line curve. However, in exceptional cases, when such a course is unavoidable a specific relaxation may be given by the Chief Engineer of the Railway. In such cases change of cant and/or curvature may be permitted at the rates specified in **para 407** or such lesser rates as may be prescribed.

413. Curves of contrary flexure – On the main line curve from which a curve of contrary flexure takes off, the cant of the main line (which is the negative superelevation on the turn-out) should be calculated from the formula given in the Schedule of Dimension and the permissible speed on the main line determined from the allowable cant deficiency and cant on the main line. The speed so determined shall be subject to limitations governed by the standard of interlocking and the sectional speed.

414. Curves of similar flexure – (1) *Not followed by reverse curves*-On a main line curve from which a curve of similar flexure takes off, not followed immediately by a reverse curve, the turn-out curve shall have the same cant as the main line curve.

(2) *Followed by reverse curves* – A change of cant on the turn-out may be permitted starting behind the crossing and being run out at a rate not steeper than 2.8 mm. per metre and subject to the maximum cant on the main line turn-out being limited to 65 mm. on Broad Gauge, 35 mm. on Metre Gauge and 25 mm. on Narrow Gauge (762 mm.)

The permissible speed on the main line is then determined from the allowable cant-deficiency and subject to limitations governed by the standard of interlocking and the safe speed limit.

415. Curves with cross overs – On curves on double line connected by cross over road, the speed and the cant for both roads are governed by the inner road to which the cross over road is a curve of contrary flexure. On the outer road, it is a curve of similar flexure. The permissible speed and the necessary cant on the inner road shall be calculated in accordance with **para 413.** The same speed and the same cant shall be allowed on the outer road.

The outer track shall be raised so that both roads lie in the same inclined plane in order to avoid change in cross-level on the cross over road. Where this is not possible, both main line and the turn-out should be laid without cant and suitable speed restriction imposed.

416. Curves with diamond crossing – Normally straight diamond crossings should not be provided in curves as these produce kinks in the curve and uniform curvature cannot be obtained. However, where provision of such diamonds cannot be avoided or in case where such diamonds already exists in the track, the approach curves of these diamonds should be laid without cant for a distance of at least 20 metres on either side of the diamond crossings. Cant should be uniformly runout at the rate specified in **para 407** beyond 20 metres. The speed restrictions on the approach curve shall be decided in each case by the Chief Engineer taking into consideration the curvature, cant deficiency and lack of transition but shall in no case be more than 65 km.p.h. in the case of Broad Gauge, 50 km.p.h. in the case of Metre Gauge and 40 km.p.h. in the case of Narrow Gauge (762 mm.) No speed restriction shall, however be imposed on the straight track on which the diamond is located. In the case of diamond crossings on a straight track located in the approach of a curve, a straight length of minimum 50 M. between the curve and the heel of acute crossing of diamond is necessary for permitting unrestricted speed over the diamond, subject to maximum permissible speed over the curve from consi-derations of cant deficiency, transition length etc.

417. Extra clearance on curves – On curves, additional lateral clearances, in excess of the fixed dimensions should be provided as laid down in the Schedule of Dimensions –

(a) between adjacent tracks and

(b) between curved track and fixed structure.

418. Compensation for curvature on gradient– Compensation for curvature should be given in all cases where the existing gradient when added to the curve compensation exceeds the ruling gradient. The compensation to be allowed should ordinarily be $\frac{70}{R}$ percent.(0.04 percent per degree of curvature) for Broad Gauge, $\frac{52.5}{R}$ per cent (0.03 percent per degree of curvature) for Metre Gauge and $\frac{35}{R}$ per cent (0.02 per cent per degree of curvature) for Narrow Gauge(762 mm.) where R is the radius of curvature in metres.

Thus for a ruling gradient of 0.5 per cent or 1 in 200, the gradient for 583 metre radius of curvature on Broad Gauge should be flattened to –

$$0.5 - \frac{70}{583} \text{ or } 0.5 \text{ X } 0.04 = 0.38 \text{ per cent or 1 in 264.}$$

419. Vertical curve :– A vertical curve shall be provided only at the junction of the grade when the algebraic difference between the grades is equal to or more than 4 mm. per metre or 0.4 per cent.

The minimum radius of the vertical curve shall be kept as under –

Broad Gauge		Metre Gauge	
Group	Minimum Radius	Group	Minimum Radius
A	4000 metres	All Routes	2500 metres
B	3000 metres		
C ,D & E	2500 metres		

PART ' B'

Realignment of Curve

420. Running on curves – (1) For smooth and satisfactory running on curves –

(a) there should be no abrupt alteration of curvature and/or superelevation (cant), and

(b) the superelevation should be appropriate to the curvature, at each point.

(2) On Group 'A' and 'B' routes, gauge, versines and superelevation on each curve must be checked once in every four months and on other routes every six months. such checks should also be carried out whenever the running over curves is found to be unsatisfactory. The versines, superelevation and gauge should be recorded by the Permanent Way Inspector in the curve register as per the *pro forma* given as **Annexure 4/5**. Curve registers of groups 'A' and 'B' routes should also be provided with cumulative frequency diagrams for each curve to get a graphic idea about the condition of geometry of curve. The A.E.N shall check at least one curve of each Permanent way Inspector every quarter by taking its versine and superelevation as well as gauge from end to end. The decision to realign should be taken by the Permanent Way Inspector-in-charge or Assistant Engineer. The realignment of curve should be carried out in dry season and not during rainy season except when this is unavoidable.

421 - Criteria for realignment of a curve:

(1) When as a result of inspection by trolley or from the foot plate of locomotive or by carriage or as a result of Track Recording carried out, the running on a curve is found to be unsatisfactory the curve should be realigned.

(2) The running over a curve depends not only on the difference between the actual versine and the designed versine but also on the station-to-station variation of the actual versine values. This is because it is the station to station variation of versine which determines the rate of change of lateral acceleration, on which depends the riding comfort.

Service limit for station to station versine variation for 3 speed group viz. 120 Km/h and above, below 120 Km/h and upto 80 Km/h and below 80 Km/h and upto 50 Km/h, should be considered as tabulated below:

Speed Range	**Limits of station to station Variation (mm)**
120 Kmph and above	10 mm or 25% of the average versine on circular curve whichever is more
Below 120 Kmph and upto 80 Kmph	15 mm or 25% of the average versine on circular curve whichever is more
Below 80 Kmph and upto 50 Kmph	40 mm or 25% of the average versine on circular curve whichever is more

In case exceedence of the above limit is observed during an inspection, local adjustments may be resorted to in cases where the variation of versines between adjacent stations is only at few isolated locations, at the earliest possible. If more than 20% of the stations are having versine variation above the limits prescribed, complete realignment of the curve should be planned within a month.

422. Stringlining operations :– (1) The work of realigning and transitioning curves consist of the following three main operations :–

(a) Survey of the existing curve by measurement of versines.

(b) Determination of the revised alignment and computation of slews, including provision of correct superelevation.

(c) Slewing of the curve to the revised alignment.

(2) *Chord Length* – Chord length of 20 metres should be used for recording versine. The stations should be at 10 metres intervals and versines should be recorded at these stations with overlapping chord of 20 metres.

(3) Versine survey of curve – *Operation No. 1 :*– Versine readings shall be taken along the gauge face of the outer rail.

To ensure inclusion of the point of commencement of the curve, a mark is made on the gauge face of the outer rail at a distance of about three half-chord lengths behind the apparent tangent point and numbered zero. From this point, half-chord distances are measured with steel tape along the gauge face of the outer rail over the whole length of the curve and numbered serially 1, 2, 3, 4 and so on and carried upto about three half-chord lengths beyond the apparent tangent point at the other end. These "stations" should be marked and numbered in white paint on the rail. With a fishing cord or wire stretched out over the full length of the chord, versines are measured to 1 mm. accuracy serially at each station from one end of the curve to the other with the rule held normal to the line and recorded.

Features which restrict slewing of the track either inwards or outwards should be recorded, mentioning the maximum extent inwards and outwards to which slewing is possible (i) in existing circumstances and (ii) if a moderate expenditure be incurred in removing the "restriction". The existing superelevation should also be measured and recorded against each "Station".

For purposes of check, this process should be repeated in the reverse direction with the persons recording and measuring versines interchanging their duties.

The record obtained would be in the following form

Curve from km.....to km.....

Between station.....and station.....

Date of survey.....

Jurisdiction of Assistant Engineer/Permanent Way Inspector…….....

Station at Half-chord intervals	Versine in (mm)	Cant existing	Remarks regarding restrictions to slewing
0	0	Zero	
1	2	5 mm	
2	4	10 mm	
3	4	20 mm	
4	10	25 mm.	
5	11	..	1.6 metres.
6	23	..	G. B. obligatory point
7	30	..	Low or high bank, moorum or rock cutting etc.
etc., etc.			

Where there are two or more lines, track centres at intervals should be recorded. After the versine-survey, the curve alignment shall not be disturbed until the realignment is commenced. This interval should be the least possible.

In the case of reverse curves, the versine survey should be continuous, but transferred to the outer rail at points where the curvature changes sign. It is probable that the exact point will not be definite; it is therefore, desirable to keep the original rail face as the base until the change is certain to enable plus or minus versines to be read from the same rail, it is only necessary to hold the fishing cord or wire 20 mm. clear of the rail edge at each end by using special gadget and substracting 20 mm. from the reading at the centre.

(4) *Determination of revised alignment and computation of slews :–*

Operation No. 2 :–

(a) The basic principles of string lining are as follows :–

(i) The chord length being identical, the sum total of the existing versines should be equal to the sum total of the proposed versines.

(ii) The slew in any direction at a station affects the versines at the adjacent stations by half the amount in the opposite direction, when the track is not disturbed at the adjacent stations.

(iii) The second summation of versine difference represents half the slew at any station.

(iv) At the first and at the last station, the slews should be zero.

(b) Success in obtaining the most suitable alignment depends on the proper selection of versines.

(c) In actual practice the calculations are carried out in the following manner :–

(i) After recording the versines in mm., proposed versines are selected in such a way as to obtain uniform rate of change of versines over the transition curve and uniform versines over the circular portion of the curves.

(ii) The difference between the proposed and the existing versines are worked out for each station, the positive sign being used, if the proposed versine is greater than the existing versine and negative sign if it is less **(Ref.Col. 4 -Table 1,** at the end of this sub- para (4), wherein a solution to a realignment of curve is worked out).

(iii) First and second summations of the differences of proposed and existing versines are then worked out **(Ref. Cols. 5 & 6).**

(iv) The first summation at any station, gives the cumulative versine difference at each station. To begin with this value for station ' 0 ' is the same as the versine difference **(Col. 4).** To obtain the corresponding value for station No. 1 the cumulative versine difference of station '0' **(Col. 5)** is added to the versine difference of station No. 1 **(Col. 4)** diagonally downward as shown by the arrow indication and the resultant value is written against Station No.1(Col. 5) Similarly the cumulative versine difference is calculated at each station till the last station is reached. Since the sum total of the existing and the proposed versines is the same, the figure against the last station will be '0' **(Col. 5).**

(v) The second summation at any station gives the cumulative effect of the figures of first summations upto the previous station. It can be proved theoretically that this represents half the slew required at each station to obtain the proposed versine. To start with, this value for station'0' is taken as zero.To obtain the corresponding value of Station No.1, the second summation value of the station'0'(*i.e.,* the previous station) is added to the first summation value of the same station '0',as shown by horizontal arrow. This value is shown against Station No. 1**(Col. 6).** Similarly the second summation for Station No. 2 is the sum of the figures of the first summation and second summation of Station No.1**(Col.5 and 6).** The second summation is obtained against each station till the last station is reached. The slew at the last station should be zero. Otherwise the track beyond the last station will be affected by the slew at the last station. Normally this figure at the last station will not be zero. To bring this to zero correcting couples are applied.

(vi) *Method of applying correcting couples* - For correcting the half-throws to zero the procedure shall be as follows :–

When the final half-throw is negative, add to the versines having the lower station numbers and substract an equal amount from the versines having the higher station numbers, selecting "station" in pairs such that the sum of the products of the difference of the "station" numbers taken in pairs and the amount added to the versines, equals the numerical amount of the negative half-throw to be cleared.

When the final half -throw is positive, substract from the versines having the lower station numbers and add an equal amount to the versiness having the higher station numbers, selecting the stations in pairs such that the sum of the product of differences of the station numbers in pairs and the amount substracted from the versines, equals the numerical amount of the positive half throw to be cleared.

(vii) For computing slews when realigning and/ or transitioning a complete curve the following procedure should be adopted :–

Calculate the length of transition from **Para 407(1).** This determines the versine gradient on the transition.

Work out versine difference, first and second summations as discussed above at the initial stations with a view to foreseeing and exercising due control over the slews**(col. 4, 5 and 6).** Review the figures of proposed versines **(col 8)** if necessary and continue the process until the transition at the other end on which the specific versine gradient should be observed. In the process it must be ensured that difference of versines**(col. 4)** should sum up to zero.

Apply correcting couples to control the slew at obligatory points and to close the slew at the end to zero. The slews must be limited to the minimum possible.

Determine correct cant to be provided, points of zero and maximum cant and the cant run-off.

Curve realignment can be worked out by graphical method. Mechanical and electronic devices where available may be used to determine the final values of slew, thus avoiding the lengthy process of first and second summation and application of correcting couples.

(viii) *Maximum Slew* – Maximum slew at any station is usually limited by practical considerations. The distance between tracks and adequate clearance to existing structures must be maintained and track must not be slewed too near the edge of the formation. At certain locations like bridges, it may not be possible to slew the curve at all .

(ix) In carrying out the calculations for the realignment of a long curve of more than 50 stations it is best to write down values of about 10 proposed versines at a time and see that the sum is approximately the same as that of the corresponding old versines and then workout the second summation to ensure that slews are minimum. A final adjustment to ensure that the sum of the existing and proposed versines is equal and that the slew at last station is zero can then be made.

A numerical example is given in table 1 on the next page which will illustrate the method of working out the solution for realignment of a curve.

(See Table No. 1)

(5) Slewing the curve to revised alignment :–

Operation No. 3 :– The revised alignment of the curve should be staked out with a steel tape by using the pegs cut from the bars (or wooden stakes with tack marks) which should be fixed on the cess on the inner side of the curve square to the track and at such a distance according to the value of the slews, so that the final alignment of the track is at one gauge distance from the face of the pegs or the tacks on wooden pegs to the outer edges of the inner rail. In narrow cuttings with sharp curves or in tunnels it may not not be possible to measure versines on the pegs driven on the inner cess of the curve due to the face of the cutting fouling the fishing cord. In such cases, the pegs may be driven on the outer cess. Their correctness should be checked by measuring the versines on these pegs and verifying that they correspond with the final versines of the alignment. The curve should then be correctly slewed to the realignment of pegs.

Whether or not permanent pegs should be fixed is left entirely to the discretion of Divisional Engineer. In no case should these be fixed on formation that is not firm or at locations where they are liable to the disturbed or tampered with.

Where it is considered more expedient, the staking of the realigned curve may be done by driving tie-bar pegs of about 750 mm. in length against each station down to rail level along the centre line of the revised alignment and slewing the track to these pegs.

It is important that the slewing is done to 2 mm. accuracy and actual versines again taken to ensure that they accord with the calculated versines of the realigned curve.

Along with slewing of the curve to the revised alignment correct superelevation should be provided at each station to accord with the curvature, particular attention being paid to the run-off on the transition. Repositioning of posts on the cess to indicate zero and maximum superelevation and remarking of cant values on the inside web of the inner rail should be done.

423. Realigning curves on double or multiple lines :– On double or multiple tracks each curve should be stringlined independently. No attempt should be made to realign any curve by slewing it to a uniform centre to centre distance from the realigned curve as –

(a) The existing track centres may not be uniform and relatively small throw on one may entail a much larger (even prohibitively large) throw on the adjacent track

(b) It is nearly impossible to measure the centre to centre distance of curved tracks along the true radial lines and a small error in angular direction of measurement would mean an appreciable error in true radial distance.

(c) The transitions at the entry and exit may be of different lengths which make it impracticable to maintain uniform centres on them even though the degree of the circular curves may be nearly the same.

424. Cuttings of rails on curves :– Rails are usually laid with square joints on curve. On curved track the inner rail joints gradually lead over the outer rail joints. When the inner rail of the curve is ahead of the outer rail by an amount equal to half the pitch of bolt holes, cut rails should be provided to obtain square joints. Cut rail is a rail which is shorter than the standard length of rail by an amount equal to the pitch of the bolt holes. The excess length 'd' by which the inner rail gains over the outer rail is calculated by the formula –

$$d = \frac{LG}{R}$$

where 'd' is the length in mm. by which the inner rail joint is ahead of the outer rail joint over the entire length of the curve, if cut rails are not provided.

L = length of the curve in meters

R= radius of the curve in meters

G= the gauge + width of the rail head in mm.

The number of cut rails for a particular curve is worked out by the formula –

$$N = \frac{d}{\textit{pitch of the bolt holes in mm.}}$$

It must be ensured that rail joints are square at beginning and at the end of the curve.

425. Joints on curves :– Rails joints on curves normally be laid square. On the sharp curves less than 400 meters on the Broad Gauge and 300 meters on the Metre Gauge the rail joints may be staggered, where elbows and kinks are likely to develop if rail joints are laid square.

426. Check rails on curves :– Check rails should be provided on the inside of the inner rail of the curve as stipulated in the schedule of dimensions.

Appropriate clearances should be provided between the check rail and the running rail as stipulated in the schedule of dimensions. Check rails reduce the risk of derailment on the sharp curves.

Location where check rails should be provided shall be decided by the Chief Engineer taking into considration the negotiability of the rolling stock and the curve geometry.

427. Wear on outer rail of curves :– (1) This can be reduced effectively

(a) by lubricating the gauge face of outer rails on the curves.

(b) by maintaining correct curve geometry and superelevation.

(c) Provision of the suitable check rail.

(2) Rail flange lubricators should be provided on curves of radius 600 meters and less on Broad Gauge and of radius 300 meters and less at Meter Gauge to avoid rail face wear, the first lubricator being provided a little ahead of the curve.

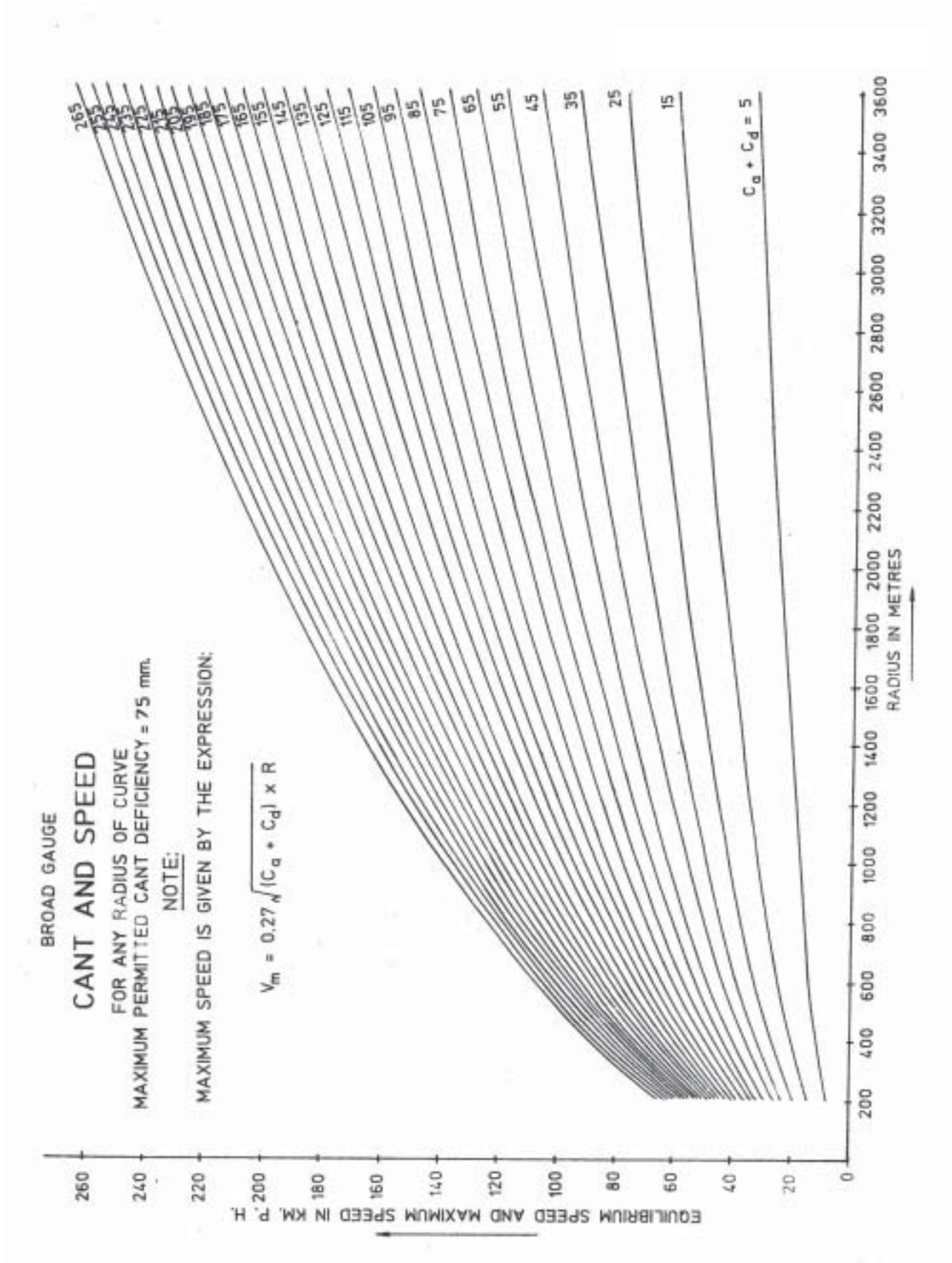
428. Measurement of rail wear on sharp curves:– The wear of rails of curves having radius of 600 M. or less on B. G. and 300 M. or less on M. G. shall be periodically recorded. Railways should prescribe the periodicity of measurement of wear on those sharp curves. The lateral, vertical and total loss of section should be recorded. Proper record of the measurements should also be maintained.

Table 1

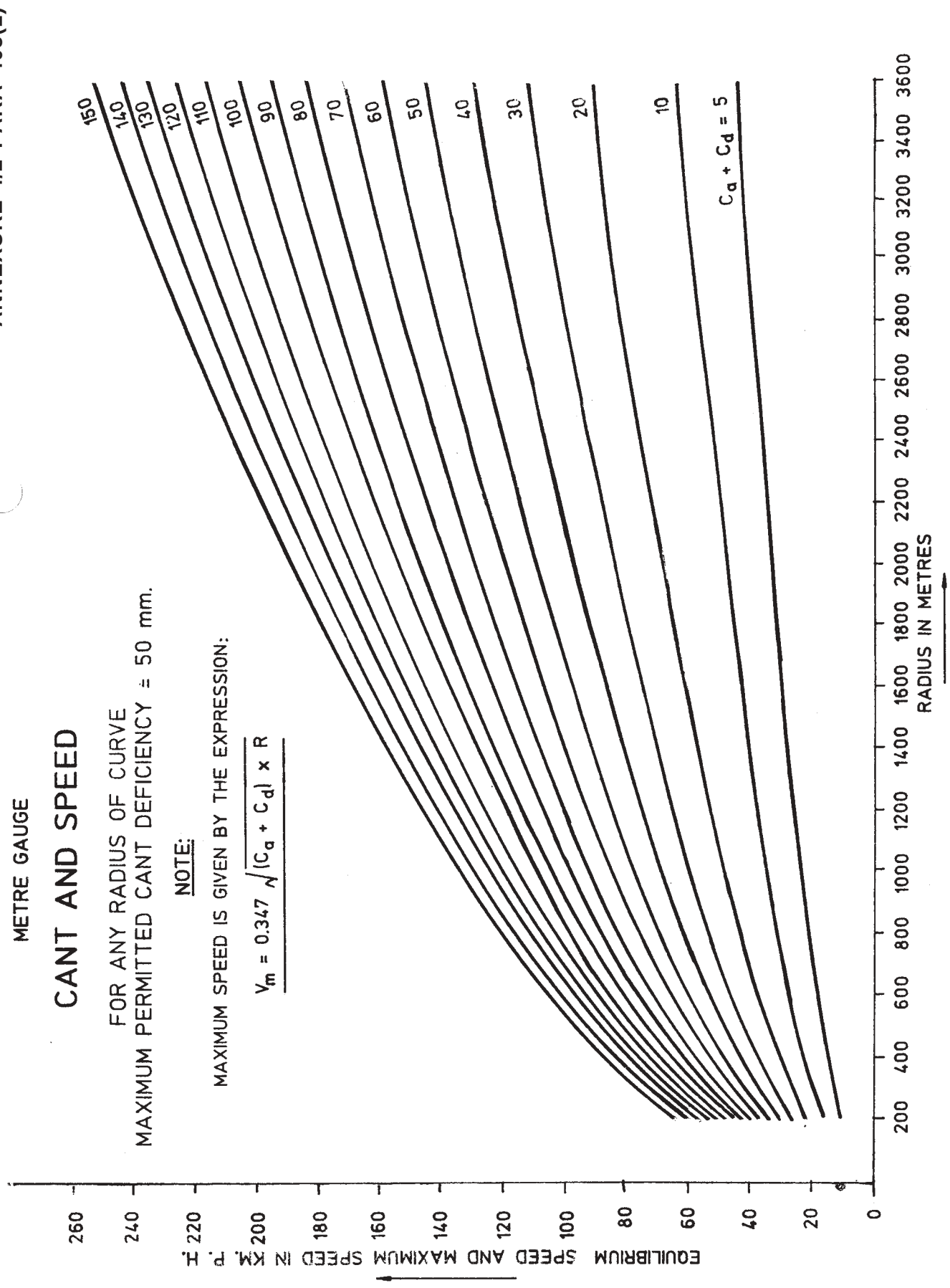
Realignment of curve by stringlining method

Station number.	Existing versines in mm on 20 M chord	Proposed versine in mm.	Versine difference column 3 - column 2	1st summation of versine differnce	2nd summatinon of versine differenece or half throw in mm.	Correcting couple			Resultant half slew col 9 +col.6 in mm	Resultant full slew in mm	Resultant versine in mm col 3 +col 7
						Correcting versine in mm	1st summation of correcting versine	2nd summation of correcting versine			
1	2	3	4	5	6	7	8	9	10	11	12
0	2	2	0	0	0	-1	-1		-0	0	1
1	0	8	+8	+8	0	-1	-2	-1	-1	-2	7
2	14	16	+2	+10	+8	-1	-3	-3	+5	+10	15
3	28	24	-4	+6	+18	-1	-4	-6	+12	+24	23
4	30	32	+2	+8	+24	-1	-5	-10	+14	+28	31
5	36	32	-4	+4	+32	-1	-6	-15	+17	+34	31
6	36	32	-4	0	+36	-1	-7	-21	+15	+30	31
7	24	32	+8	+8	+36	-1	-8	-28	+8	+16	31
8	32	32	0	+8	+44		-8	-36	+8	+16	32
9	28	32	+4	+12	+52		-8	-44	+8	+16	32
10	36	32	-4	+8	+64		-8	-52	+12	+24	32
11	34	32	-2	+6	+72		-8	-60	+12	+24	32
12	32	32	0	+6	+78		-8	-68	+10	+20	32
13	34	32	-2	+4	+84	+1	-7	-76	+8	+16	33
14	36	32	-4	0	+88	+1	-6	-83	+5	+10	33
15	24	32	+8	+8	+88	+1	-5	-89	-1	-2	33
16	24	24	0	+8	+96	+1	-4	-94	+2	+4	25
17	28	16	-12	-4	+104	+1	-3	-98	+6	+12	17
18	0	8	+8	+4	+100	+1	-2	-101	-1	-2	9
19	6	2	-4	0	+104	+1	-1	-103	+1	+2	3
20	0	0	0	0	+104	+1	0	-104	0	0	1

+ Slew inside. – Slew Outside

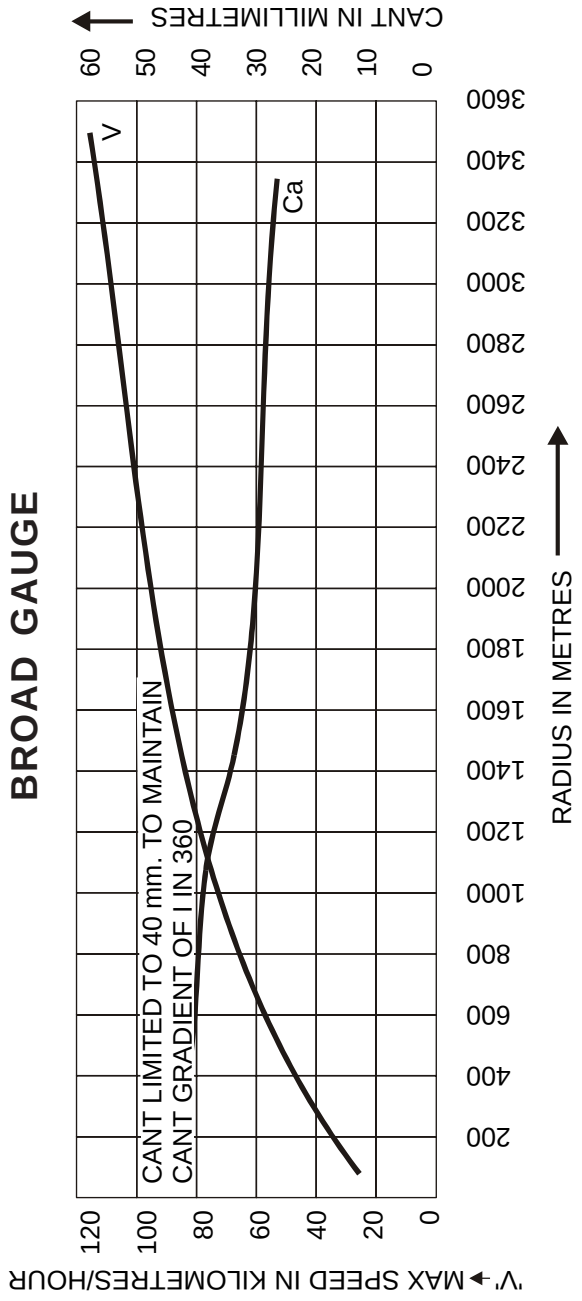

BROAD GAUGE
CANT AND SPEED
FOR ANY RADIUS OF CURVE
MAXIMUM PERMITTED CANT DEFICIENCY = 75 mm.
NOTE:
MAXIMUM SPEED IS GIVEN BY THE EXPRESSION:
$V_m = 0.27\sqrt{(C_a + C_d) \times R}$
EQUILIBRIUM SPEED AND MAXIMUM SPEED IN KM. P. H.
RADIUS IN METRES
$C_a + C_d = 5$
265
255
245
235
225
215
205
195
185
175
165
155
145
135
125
115
105
95
85
75
65
55
45
35
25
15
0
20
40
60
80
100
120
140
160
180
200
220
240
260
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600

ANNEXURE-4/2 PARA 405(1)



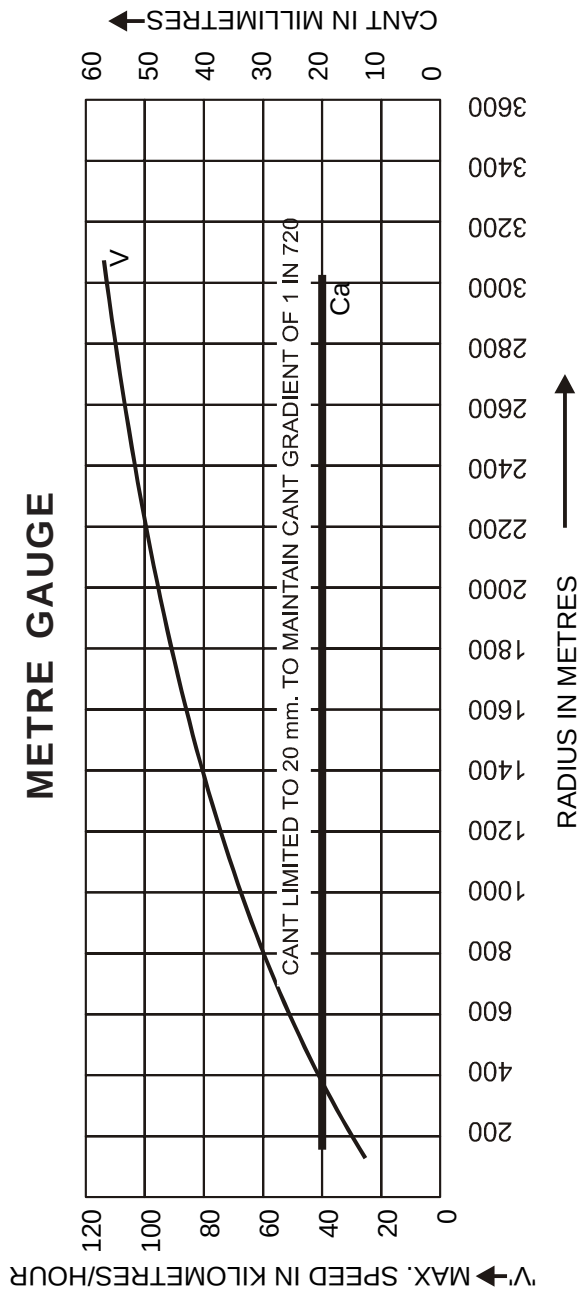
ANNEXURE-4/3 PARA 405(2)

NON TRANSITIONED CURVES WITH CANT
ON VIRTUAL TRANSITION
MAXIMUM SPEED AND CANT FOR ANY RADIUS OF CURVE



ANNEXURE-4/3 PARA 405(2)

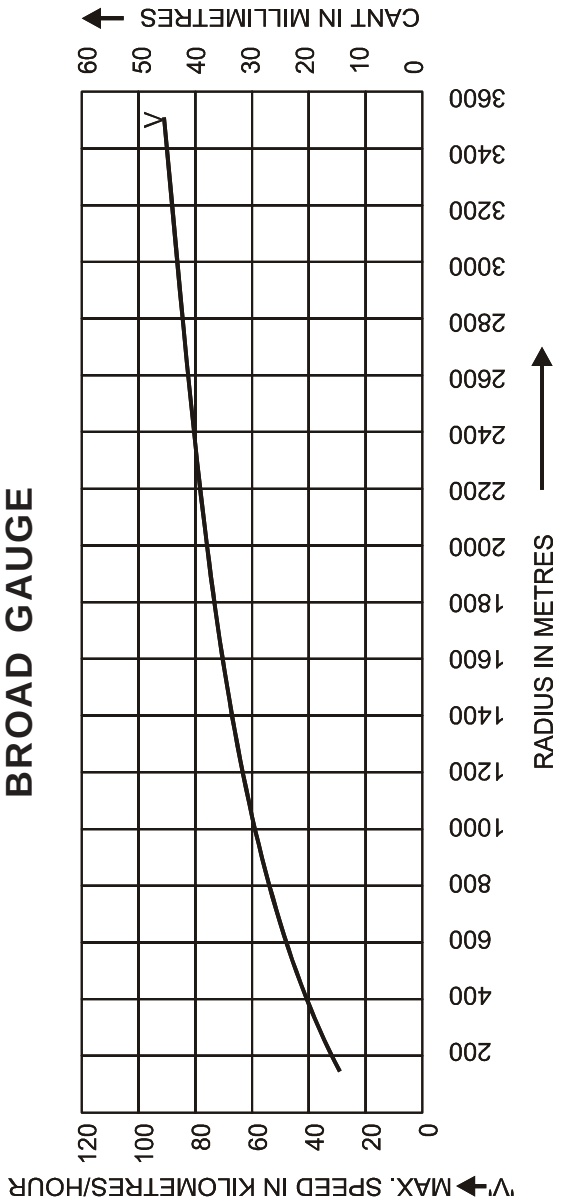
NON TRANSITIONED CURVES WITH CANT ON VIRTUAL TRANSITION MAXIMUM SPEED AND CANT FOR ANY RADIUS OF CURVE



ANNEXURE-4/4 PARA 405(2)

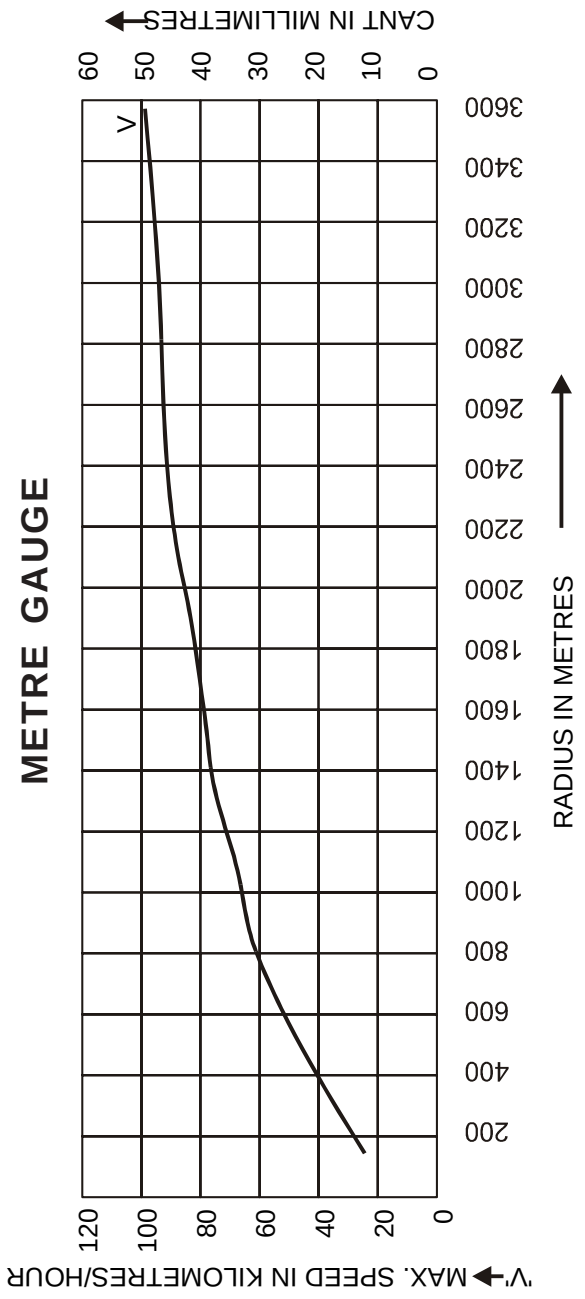
NON TRANSITIONED CURVE WITHOUT CANT
MAXIMUM SPEED FOR ANY RADIUS OF CURVE

BROAD GAUGE



ANNEXURE-4/4 PARA 405(2)

NON TRANSITIONED CURVE WITHOUT CANT
MAXIMUM SPEED FOR ANY RADIUS OF CURVE



ANNEXURE-4/5 PARA 420 (2)

PRO FORMA OF CURVE REGISTER
ABSTRACT OF CURVES

.....RAILWAY .....Section

Sl. No. (1)	Curve No. (2)	Between Stations (3)	Kilometres		R.H.or L.H. (6)	Degree of curve (7)
			From (4)	To (5)		

Radius of curve (8)	S.E. (9)	Length of		Total Length of curve (12)	Whether joints are square or staggered (13)	Whether reference pillars have been provided (14)
		Transition (10)	Circular curve (11)			

ANNEXURE4/5 Para420(2) *...contd.*

PRO FORMA OF CURVE REGISTER
DETAILS OF INSPECTION

.....RAILWAY

Curve No..... Degree of curve.....

From Km. ..... To Km. .... .Section.

Station No. (1)	Prescribed (Ideal) V (2)	SE (3)	G (4)	Date of check (5)	Measurements recorded V (6)	SE (7)	G (8)

Action to be taken (9)	Date of string-lining or local adjustment (10)	Measurements recorded after adjustment with date of check V (11)	SE (12)	G (13)

Note - No. of pages to be allotted for each curve.

CHAPTER V

WELDING OF RAILS : LAYING AND MAINTENANCE OF SHORT WELDED RAILS, LONG WELDED RAILS AND CONTINUOUS WELDED RAILS

PART 'A'
Welding of rails

501. General – The welding of rails is carried out in a depot by the "Flash butt welding process and at site by the "Thermit Welding" process. The length to which the rails can be welded in a depot depends on the transport facilities available.

502. Alumino thermit Welding of rails: -

Alumino Thermit Welding of rails may be carried out in accordance with the detailed procedure laid down in the "Manual for Fusion Welding of Rails by Alumino Thermit Process, September,1996". A thermit weld done in situ shall be joggle fish plated with two clamps till tested as good by USFD.

503. Tolerances allowed in the case of flash butt welds —The tolerances allowed in the case of flash butt welds are the same as allowed in the case of Alumino-thermit welds (para 502). In addition to the tolerances mentioned for thermit weld, the following additional item of tolerance is specified–

Web zone : + 3.0 mm, – 0.0 mm } of parent contour

In the case of old rails welded together the tolerances can not exceed double the above values stipulated for new rails, keeping the tolerances to the minimum.

504.Short pre-heat welding process –(1) *General* – The conventional thermit welding process takes about 60 minutes for welding of a joint. To reduce this time in view of non availability of longer time interval between trains this method with shorter preheating time is used.

The principle of this process is essentially the same as thermit process except that –

(i) Prefabricated mould is used in place of green sand, to reduce the time due to drying of sand.

(ii) Larger gap of 22 to 24 mm. is provided at the rail ends.

(iii) Rail ends are heated only to 600^{o} C against 950^{o}C.

(iv)Preheatin time is reduced to 10 to 12 minutes.

(v) Thermit portion is double the quantity for this process .

(vi) A stronger burner with larger fuel flow is used.

In this case also, the traffic can be allowed only after 30 minutes have elapsed after welding of the joint. The code of practice for welding of rail joints Alumino thermic process issued by R. D. S. O. should be refered for complete details regarding selection of rails for welding, preliminary work prior to welding, the actual details of work of execution of welding, and inspection of welds.

PART B

Short Welded Rails (SWR)

505. Definitions – (1)Short Welded Rail (SWR) is a welded rail which contracts and expands throughout its length.

Note – Normally the length of SWR is 3X 13 M.for Broad gauge and 3X12 M. for Metre gauge.

(2) Rail temperature is the temperature of the rail as recorded by an approved type of rail thermometer at site.

This differs from the ambient temperature which is the temperature of air in shade at that place, as reported by the meterological department.

The Indian Railways have been divided into four rail temperature zones. **Annexure 5/1** is a map showing the four temperature zones and the annual mean rail temperatures at all important places are shown in the map.

(3) Mean annual rail temperature **{tm}** is the average of the maximum and minimum rail temperature recorded during the year. **tm.** will be fixed locally wherever rail temperature records are avilable for a reasonable period of five years. Where rail temperature records are not avilable **tm.** can be read from the rail temperature map **(Annexure 5/1)**

(4) Installation temperature **(ti)** is the average rail temperature during the process of fastening the rails to the sleepers at the time of installation of SWR.

506. Track structure for SWR –

(1) *Formation* – SWR shall be laid generally on stable and efficiently drained formation.

(2) *Rails* – The minimum section of rail shall be 90-R for Broad Gauge and 60-R for Metre Gauge. Only new rails and second hand rails conforming to the standards laid down in relevant cause of the Code of practice for welding of Rail Joints by the Alumino thermit process and the Code of Practice for Flash Butt Welding of rails shall be welded into SWR.

(3) *Sleepers* – The sleepers approved for use with SWR shall be as under –

(a) Wooden sleepers with anti-creep or elastic fastenings.

(b) Cast iron sleepers and steel trough sleepers with key type or elastic fastenings.

Wooden sleepers with mild steel bearing plates and rail free fastenings may preferably be used at all fish plated joints when SWR is laid on metal sleepers. Concrete sleepers should be used in cases where SWR is likely to be converted to LWR/CWR immediately. In such cases the fish-plated joints shall have wooden sleepers at the joints.

(4) *Sleeper Density* – Reference may be made to **Para 244 (4)** of the Manual for the details.

(5) *Ballast :*– Only stone ballast shall be used. The recommended depth of ballast below the bottom of sleepers is as indicated in **Para 263 (2),** the minimum in no case being less than 200 mm. both for Broad Gauge and Metre Gauge. 100 mm. extra width of shoulder ballast over and above the standard ballast section on tangent track shall be provided on outside of curves upto 875 metres radius in Broad Gauge, 600 metres radius in Metre Gauge. In the case of sharper curves, the extra width shall be 150mm. On existing SWR lengths, where this width is not available, this may be provided on a programmed basis. In the case of 60 kg. Rails LWR profile shall be adopted.

507. Condition of laying : (1) *Alignment* - SWR shall not be laid on curves sharper that 500 meters radius in both Broad Gauge and Metre Gauge. However, on PSC Sleepers, SWR may be laid on curves with radius not less than 440 meters.

Existing SWR laid on sharper curves may, however, be allowed to continue if there is no difficulty experienced in maintaining these lengths. Chief Engineer's approval should be taken in such cases.

(2) *Junction with insulated joints and points and crossings* – SWR shall not butt againist insulated joints, heel of crossing and stock rail joints. Two standard length rails (13M./12M.) shall be interposed to isolate the SWR from such locations. These standard length rails shall be anchored effectively to arrest movement in either direction.

(3) *Junction with standard length rails on wooden sleepers* – When SWR track butts against track laid with standard length rail (13M. for Broad Gauge and 12 M. for Metre Gauge) on wooden sleepers, the latter shall be adequately anchored for at least six rail lengths to check the creep of rails. These six rail lengths shall have a sleeper density of M+7. Additional shoulder ballast should also be provided.

(4) Regarding laying of SWR in Level Crossings and Bridges, **Para 921** of Chapter on Level Crossings, **Para 272(4)** of Chapter on Permament Way Maintenance-Track Structure on Bridges may be referred to.

508. Laying of short welded rails (SWR) – The gaps to be provided for SWR at the time of laying shall be in accordance with **Table 1** depending on the installation temperature (**ti**) and the Zone in which the rails are laid –

TABLE 1

Initial laying gaps for SWR for various installation temperatures

For Zones 1 and II

Rail temperature at the time of installation (ti) (in centigrade) –

tm-17.5	tm-12.5	tm-7.5	tm-2.5	tm+2.6	tm+7.6
to	to	to	to	to	to
tm-12.6	tm-7.6	tm-2.6	tm+2.5	tm+7.5	tm+12.5

Initial laying gaps in mm –

12mm	10mm	8mm	6mm	4mm	2mm

For Zones III and IV

Rail temperature at the time of installation (ti) (in centigrade) –

tm-22.5	tm-17.5	tm-12.5	tm-7.5	tm-2.4	tm+2.6
to	to	to	to	to	to
tm-17.6	tm-12.6	tm-7.6	tm-2.5	tm+2.5	tm+7.5

Initial laying gaps in mm –

12mm	10mm	8mm	6mm	4mm	2mm

Note – Values are for three rail panels.

If the laying has to be done outside the temperature range given in table above, or wherever joint gaps could not be provided as per the table, re-adjustment of gap shall be carried out within two days of laying before the track consolidates. Along with the gap adjustment, any respacing of sleepers, if required, must be carried out.

509. Maintenance of short welded rails – Regular maintenance operation –

(1) Regular track maintenance including all operations involving packing, lifting, aligning, local adjustment of curves, screening of ballast other than deep screening, and scattered renewal of sleepers may be carried out without restriction when the rail temperature is below **tm.** +25° C in the case of zone I & II and **tm** + 20° C in the zone III and IV. However on curves of less than 875 metres radius Broad Gauge,and less than 600 meteres radius in Metre Gauge or yielding formation, the above temperature limit shall be restricted to **tm.** +15° C in the case of Zone I and II and **tm.** + 10°C in the case of Zone III and IV.

(2) If the maintenance operations have to be undertaken at temperature higher than that mentioned above in **Para 509 (1),** not more than 30 sleeper spaces in one continuous stretch shall be opened, leaving at least 30 fully boxed sleeper spacer between adjacent lengths which are opened out. Before the end of the days work it shall be ensured that the ballast is boxed up.

(3) As an additional precaution, during summer months, to be specified by the Chief Engineer, for attention to run down track, even if temperature is less the temperature specified in **Para 509 (1)** not more than 30 sleepers in one continuous stretch shall be opened, leaving at least 30 boxed sleeper spaces between adjacent lengths which are opened up. Further, if joint gaps are not available at the time of opening of the track even when rail temperature are less than those specified in clause Para 509 (1). not more than 30 sleepers in one continuous stretch should be opened leaving at least 30 boxed sleeper spaces between adjacent lenghts which are opened up.

(4) *Major lifting, major alignment of track, deep screening and renewal of sleepers in continuous length.* - Each of these operations shall be done under suitable precautions and normally when the rail temperature is below tm. $+15^0$ C in the case of Zones I and II, and tm. $+10^0$ C in the case of Zones III and IV. If it becomes necessary to undertake such works at rail temperature exceeding the above values adequate speed restrictions shall be imposed.

(5) Adequate number of joggled fish-plates with special clamps shall be provided to the gangs for use in emergencies.

(6) In the case of any fracture in the weld or in the rail, the portion of rail with fracture is cut, and removed for a length of not less than 4 M. to carry out the rewelding duly introducing a rail piece of equivalent length, also ensuring that no weld lies closer than 4M. from the fish-plated joint.

(7) Conversion of 10 rail/5 rail panels into shorter panels – It will be desirable to convert the existing 10 rail panels and 5 rail panels into 2-$^1/_2$ rail panels wherever maintenance problems cannot be solved otherwise. Whereever conditions permit, conversion of SWR into LWR may also be considered.

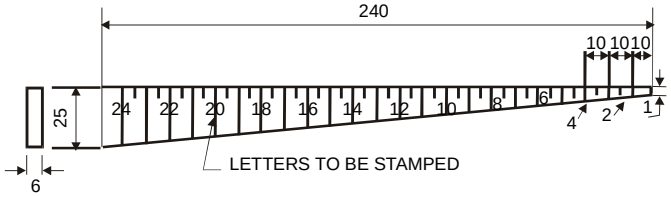
510. Gap survey and adjustment of gap –

(1) *General* - Gap survey and rectification of gaps is to be carried out, in stretches where track develops excessive creep jammed joints, sun kinks, buckling, wide gaps, battered and hogged joints, fractures at joints and bending of bolts etc. In SWR the gap survey and adjustment should normally be done before the end of February once a year (i.e., before onset of Summer).

(2) *Gap Survey* – (a) The gap survey shall be conducted on a clear and sunny day in the cool hours of the day.

(b) The length over which gap survey is to be done should, whereever possible, be divided into suitable sub-sections, each bounded by fixed points such as level crossings, points and crossings etc. The survey should be completed during as short a time as possible, by employing adequate number of parties so that the rail temperature is not likely to vary appreciably.

(c) The joint gaps shall be measured by taper gauge in mm. (shown below) and the readings entered in the pro forma as shown in **Annexure 5/2.**



TAPER GAUGE

(3) Recommended range of value of gaps – The recommended range of value of gaps (in mm.) during service for various ranges of rail temperature is indicated in the table given below :–

TABLE II

For Zones 1 and II

Temperature during gap survey –

tm-12.5	tm-7.5	tm-2.5	tm+2.6	tm+7.6	tm+12.6
to	to	to	to	to	to
tm-7.6	tm-2.6	tm+2.5	tm+7.5	tm+12.5	tm+17.5

Permissible values of gap –

11 to14mm	9 to 13mm	7 to 11mm	5 to 9 mm	3 to 7mm	1 to 5mm

For Zones III and IV

Temperature during gap survey –

tm-17.5	tm-12.5	tm-7.5	tm-2.4	tm+2.6	tm+7.6
to	to	to	to	to	to
tm-12.6	tm-7.6	tm-2.5	tm+2.5	tm+7.5	tm+12.5

Permissible values of gap –

11 to14mm	9 to 13mm	7 to 11mm	5 to 9mm	3 to 7mm	1 to 5mm

Note : – (i) The values given above are for 3 rail panels.

(ii) The gaps given above are to be distinguished from the values given in Para 508 (Table I) which are intended to be provided at the time of initial laying of SWR.

(iii) Gap survey should be carried out when rail temperature is in rising trend only.

(4) *Calculations for adjustment* – The average of the measured gaps is worked out as shown in the pro forma for gap survey **(Annexure 5/2)**. A comparison of the results of the gap measurements recorded and the permissible values of gap (concerned range for gap) given above will lead to one of the following cases :–

Case 1 – Average gap is within the recommended range, but some of the individual gaps fall outside the range.

Case 2 – Average gap falls outside the recommended range.

Case 3 – Average gap as well individual gaps fall within the range.

(5) *Action to be taken* – The action to be taken is as follows :–

Case 1 – Rectification work should be restricted to correcting the individual gaps, which falls outside the recommended range. Rectification should be done by pulling the minimum number of rails. Under no circumstances shall the adjustment be done by cutting a rail or introducing a longer rail.

Case 2 – The joint gaps shall be systematically adjusted from one end to the other end of the sub-section. The rails shall be unfastened over convenient lenghts, the gaps adjusted to the initial laying gaps as per **Para 508** and rails fastened. In this case introduction of a longer or shorter rail will be involved. Efforts should be made to see that only the minimum number of joint sleepers are disturbed.

Case 3 – No action is to be taken.

As far as possible, the day chosen for rectification should be a day on which the rail temperature is not likely to vary much during rectification period.

511. Conversion of SWR into LWR – The following additional precuations should be observed when converting SWR into LWR :–

(1) The anticipated residual life shall be at least 10 years.

(2) The rails shall be tested ultrasonically and all defective rails replaced before conversion into LWR.

(3) Rail ends which are hogged or battered or have a history of cracks in bolt hole region, shall be cropped before conversion into LWR.

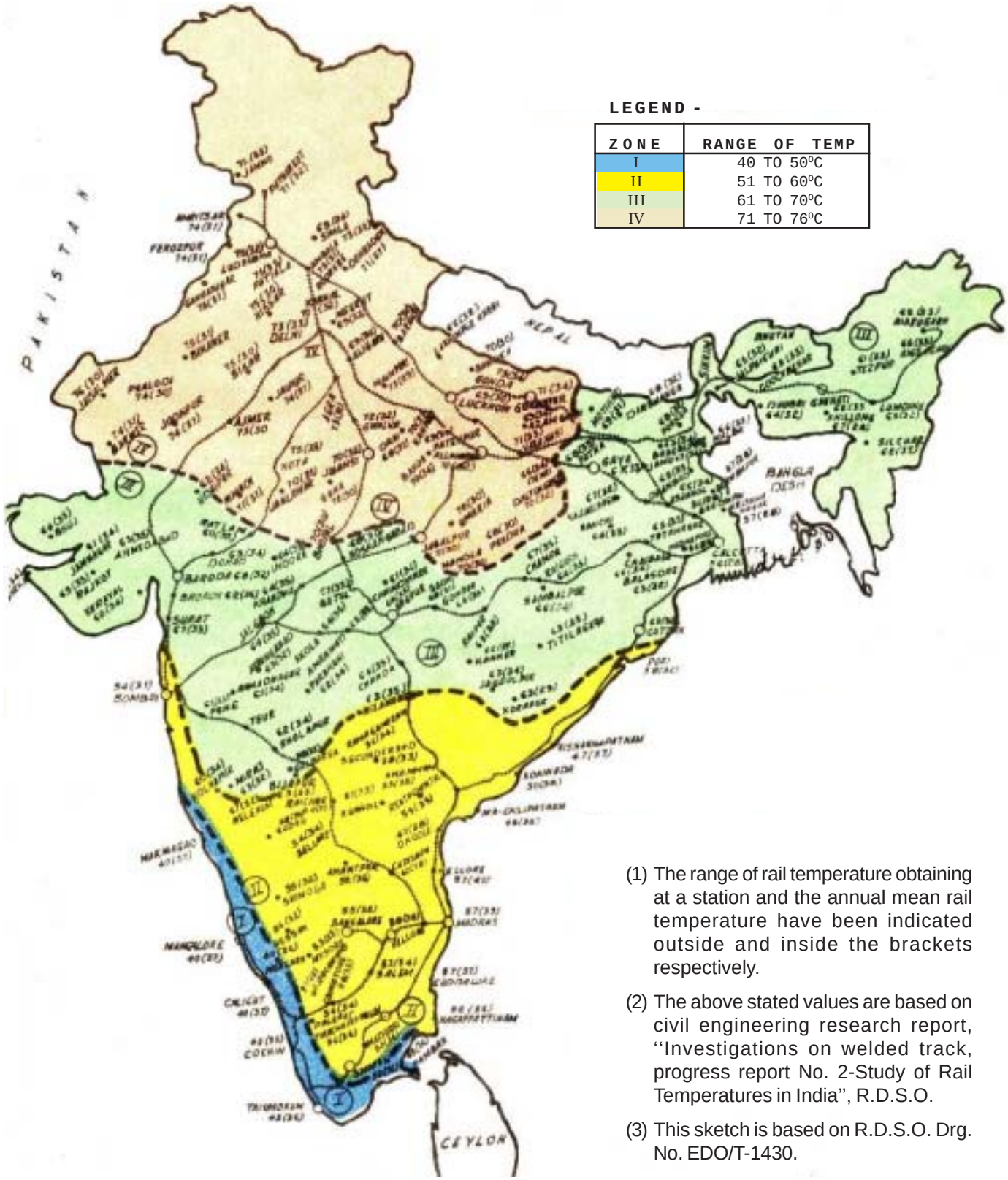
PART 'C'

Long welded rails/Continuous welded rails

512.Referenceto LWR/CWR Manual - Detailed instructions for laying and maintenance of long welded rails/continuous welded rails are contained in the **"Manual of Instructions on long welded rails 1996".** It is very important that instructions contained thereon are carefully studied by all Permanent Way officials connected with the laying and maintenance of long welded rails/ continuous welded rails.

ANNEXURE-5/1 PARA 505

MAP OF INDIA SHOWING RAIL TEMPERATURE ZONES



(1) The range of rail temperature obtaining at a station and the annual mean rail temperature have been indicated outside and inside the brackets respectively.

(2) The above stated values are based on civil engineering research report, ''Investigations on welded track, progress report No. 2-Study of Rail Temperatures in India'', R.D.S.O.

(3) This sketch is based on R.D.S.O. Drg. No. EDO/T-1430.

ANNEXURE 5/2 Para 510 (4)

PROFORMA FOR GAP SURVEY AND RECTIFICATION OF GAPS

Between stations Nawabpalem and Nidadavole/Down Line.
Between Kms. 551/13 - 551/0.
Rails 52 kgs. on S.T. sleeper M + 7 density.
Mean annual rail temperature tm.
tm .= 38°C Zone II.

Survey details
Date : 28th February 1981
Time : 12-00 hrs.

Average rail temperature 45°C (tm+7) during gap survey.

Rail temperature —

At start .. 44°C.

At close .. 46°C.

Recommended range of gap for 45°C. noted at the time of survey as per Table II: 5 to 9 mm.

Adjustment details —
Date: 2nd March 1981. Time: 4-30 hrs. –

Rail temperature —
At start .. 40°C. At close .. 45°C.
Average temperature: 42.5°C.(tm.+4.5°C.)

To be adjusted to the gap as shown in Table I = 4 mm.

Location and descripton of immovable point	Serial No. of points	Gap in mm.		Action taken with P. W. I.'s initials and date	Adjusted gaps in mm.	
		Left	Right		Left	Right
Girder Bridge at km. 551/13 (first Fixed point).	1	15	11	Gaps systematically adjusted from one end to the other end and by providing a longer rail on 2nd March 1981 and gap adjusted to 4 mm.	4	4
	2	14	9		4	4
	3	17	14		4	4
	4	14	15		4	4
	5	10	15	(Sd.)	4	4
	6	15	15	P. W. I.	4	4
	7	17	14		4	4
	8	17	12		4	4
	9	15	10		4	4
	10	14	9		4	4
	11	11	6		4	4
	12	8	10		4	4
	13	11	12		4	4
	14	5	9		4	4
	15	13	12		4	4
	16	8	13		4	4
	17	15	15		4	4
	18	12	14		4	4
	19	14	14		4	4
	20	15	14		4	4
	21	13	16		4	4
	22	14	14		4	4
	23	15	17		4	4
Km. 551/0 Level crossing (Second fixed point).	24	18	20			
	25	19	10		4	4
	26	20	20		4	4
	Total ..	359	340		4	4
	Average	13.8	13.1		104	104
		This falls in case II.				

CHAPTER VI

TRACK RECORDING, ANALYSIS AND MONITORING

601. Introduction – Inspection by foot, trollies, locomotives and rear vehicles enable the Permanent Way staff to carry out assessment of the quality of track. These inspections, though important, are qualitative and enable assessment based on individual experience. Objective assessment of track is done by track recording cars, Oscillograph cars and portable accelerometers.

602. Track Recording by Mechanical / Electronic Equipment – The following track recording equipments are in use in Indian Railways at present :–

(1) Track recording cars.

(2) Hallade track recorder.

(3) Oscillograph car.

(4) Portable accelerometers.

603. Track Recording Car – There are two types of track recording cars currently in use in Indian Railways, one mechanical and the other electronic. With these track recording cars, it is possible to have a continuous record of the track geometry under loaded conditions, by running the cars at nominated intervals.

604. Mechanical Track Recording Car (B.G.)– (1) It has two bogies one of two axles and the other of three axles. The measuring bogie has a base of 3.6 metres, and is three axled with an axle load of 7.0 tons. It gives a continuous record of –

(a) Unevenness - Left rail.

(b) unevenness - Right rail.

(c) Gauge.

(d) Twist.

(e) Curvature/alignment - Left rail.

(f) Curvature/alignment - Right rail.

(g) Speed

(2) The manner of recording of each parameter is indicated below :–

(a) *Unevenness* – The longitudinal unevenness of rails is measured as a deviation in the vertical plane (depression or rise) of the middle axle of the measuring bogie with reference to the average position of the two outer axles. The outer axles are spaced 3.6 metres apart and unevenness is recorded to scale of 1:1 on a base of 3.6 M. for left and right rail separately.

(b) *Gauge* – The changes in gauge are picked up by spring loaded gauge feelers which are in contact with the gauge faces at about 18 mm. below the rail table. The recording is done to a scale of 1:1. The feelers are so made that they can pass over the points and crossings and through check rails at level crossings without difficulty.

(c) *Twist* – Twist is measured as the relative out of planeness of one of the four wheels with respect to the plane formed by the other three wheels, of the outer axles of the measuring bogie. If, a, b, are the movements of the axle boxes of the leading axle and c, d, are the relative movements of the axle boxes of the rear axle then (a+d) - (b+c) gives the twist over a base of 3.6 M. The points from where these movements are picked up from the frame connected to the outer axles are so **located** as to compensate for the frame spacing being wider than the gauge. The twist is also recorded to full scale of 1:1.

(d) *Curvature/Alignment* – Curvature is deduced from the angle between the tangent and a chord of known length at any point of the rail, assumed to be circular. Two spring loaded feelers press against the rails from the tangents. The line joining the centres of the pivots of the two bogies forms the chord. By arrangement of cables attached to these feelers, the differential movement of the feelers with respect to the chord is transmitted to the recording table. The curvature is recorded as versines in mm. on a 7.2 M. chord. This measurement, however, is somewhat vitiated due to transverse play existing between the various parts of the vehicle such as between wheels and rails, between axles and bogie and between bogie and the vehicle. The magnitude of inaccuracy on this account is of a small order and the recording gives general guidance regarding the condition of alignment.

605. Electronic Track Recording Car – (1) *Broad Gauge* – (a) The construction features of this car are the same as those of the mechanical car excepting that the sensing elements of various track parameters transmit impulses electrically. Electrical track recorder gives out the various track parameters in analogue form on a graph paper.

(b) *Details of the items of measurement* - With the indigenously modified electronic track recording cars, it is possible to get a continuous record of alignment of each rail on a 7.2 M. chord in addition to the parameters described in Para 604 (1) above.

(c) *Manner of Recording* – In the electronic car, alignment is measured by versines on a chord length of 3.6 M. The mid-chord processor facilitates the conversion of the versines measured on 3.6 M base to 7.2 M base, electronically. This is according to formula $V = V_1 + 2V_2 + V_3$ where V = Versine on 7.2 M. chord. V_1, V_2, V_3 are the versines on 3.6 M. chord.

(2) *Metre Gauge* - (a) *Construction features* - The Metre Gauge track recording car is equipped with a measuring frame similar to the one provided in B.G. Track recording car. The transmission is electronic and the recording is done on a six channel B.N.L. recorder. The vertical and lateral acceleration are measured by an accelerometer fitted on the floor of the coach.

(b) *Items of measurements* – For Metre Gauge an indigenous track recording car is in use for recording the following parameters :

(i) Gauge.
(ii) Twist.
(iii) Unevenness - Left rail.
(iv) Unevenness - Right rail.
(v) Speed.

(c)(i) *Gauge* – The gauge is recorded at 14 mm. below the rail surface to a scale of 1:1. Feelers are pressed against the rail surfaces by spring loaded arrangement. The relative movements of the feelers are picked up by L.V.D. Ts. (Linear Variable Differential Transducer) and transferred to the recording table electrically.

(ii) *Twist* – It is recorded to a base of 2.74 metres, the distance between the two outer axles of a three axle bogie. The relative movements of the outer wheels with respect to carriage frames is picked up by L.V.D. Ts. In recording the twist some amplification is made to give appreciable record on the chart. A record of 5 mm. on chart is equivalent to 1 mm. / metre.

(iii) Unevenness is recorded over a base of 2.74 M. The relative movements of central axle with respect to the outer axles connected by a longitudinal beam is picked up with the help of suitable L.V.D. Ts.

606. Frequency of Track Recording - Track geometry monitoring of Metre Gauge routes is not to be done by track recording car. The Broad Gauge routes should be mointored by TRC as per the following frequencies (except for the routes where track recording is to be dispensd with):-

i) Routes with existing speeds above 130 kmph	- Once in 2 months
ii) Routes with existing speeds above 110 kmph and upto 130 kmph.	- Once in 3 months
iii) Other Group 'A' and 'B' routes	- Once in 4 months
iv) Group 'C', 'D' and 'D Spl.' routes	- Once in 6 months
v) Group 'E' and 'E Spl.' routes	- Once in 12 months

607. (1) Track categories for various Parameters – *The track charts record* - Imperfections in the form of peaks and the magnitude of the peaks is an indication of the extent of the defect. For each track parameter, track should be classified kilometre-wise based on the number of peaks and their magnitude occurring in that kilometre. The specified values for different categories for various parameters are given on next page –

Parameters	Category	Extent of irregularities
Broad Gauge		
(1) Unevenness (3.6 M. chord)	A	0-6 mm. (inclusive)
	B	6 mm. (exclusive) to 10 mm. (inclusive)
	C	10 mm. (exclusive) to 15 mm. (inclusive)
	D	Above 15 mm.
(2) Twist (3.6 M. base) Note –1 mm./M. = 3.6 mm. on chart	A	0-5.0 mm. on chart (upto and inclusive of 1.39 mm./M)
	B	5-7.5 mm. on chart (1.39 mm./M to 2.08 mm./M. inclusive)
	C	7.5-10.0 mm. on chart (2.08 mm./M to 2.78 mm./M. inclusive)
	D	Above 10.00 mm. on chart (above 2.78 mm./M.)
(3) Gauge	A	Upto and ± 3 mm. (inclusive)
	B	±± 3 mm. to & ± 6 mm. (inclusive)
	C	Above ±± 6 mm.
(4) Alignment (7.2 M. chord)	A	Upto 3 mm. versine (inclusive)
	B	More than 3 mm. and less than 5 mm. versine.
	C	5 mm. versine and above
Metre Gauge		
(1) Unevenness (2.74 M. chord)	A	0 to 3 mm. (inclusive)
	B	3 mm. to 5 mm. (inclusive)
	C	5 mm. to 8 mm. (inclusive)
	D	Above 8 mm.
(2) Twist (2.74 M. base) Note : 1 mm/M = 5 mm. on chart	A	0 to 5 mm (inclusive) on chart upto and 1 mm./M. (inclusive)
	B	5 to 10mm (inclusive) on chart - 1 mm. to 2 mm./M. (inclusive)
	C	10 to 15 mm. (inclusive) on chart 2 mm. to 3 mm./M. (inclusive)
	D	Above 15 mm. on chart (above 3mm./M)
(3) Gauge	A	Upto and ±3 mm. (inclusive)
	B	± 3 mm. to ± 6 mm.
	C	Above ±6 mm.
(4) Alignment (7.2 M. base)	A	0-3 mm. (inclusive)
	B	3-5 mm. (inclusive)
	C	Above 5 mm.

Note : (i) 10 points exceeding the outer limit of an irregularity under each category is allowed in 1 Km. length of track. If more than 10 peaks in one Km. cross the outer limits of 'A' category the kilometer is classified 'B' and so on. Based on the number of peaks and extent of irregularity the track is classified into 'A', 'B', 'C', and 'D' categories separately for each parameter-gauge twist, unevenness and alignment.

(ii) The number of peaks in each kilometer exceeding the outer limit for the 'B' category is indicated as a suffix.

607(2) The following limits of track tolerances are prescribed for the guidance of the Engineering officials on the suitability* of standard of maintenance of track for sanctioned speeds above 100 Km/hr. and upto 140 km/hr on BG track.

(i) *Alignment defects* - (versine measured on a chord of 7.5 metres under floating conditions)

a) *On Straight Track* - 5mm; values upto 10mm could be tolerated at few isolated locations**.

b) *On Curves*- E 5mm over the average versine, Values up to E 7mm could be tolerated at few isolated locations**.

Total change of versine from chord to chord should not exceed 10mm.

(ii) *Cross Level Defects* - No special tolerance limits. As regards cross levels, the track should be maintained, to standards generally superior to that at present available on main line track on which unrestricted speeds upto 100 Km/hr. are permitted.

(iii) *Twist*- (to be measured on a base of 3.5 m)

(a) On straight and curve track, other than on transitions - 2mm/metre except that at isolated locations**, this may go upto 3.5mm/metre.

(b) *On transitions of curves* - Local defects should not exceed 1mm/metres, except that at isolated locations** this may go upto 2.1 mm per metre.

(iv) *Unevenness rail joint depressions (versine measured on a chord of 3.5m)* - 10mm in general and 15mm for isolated locations**.

(v) *Gauge variations* - No special specifications. The maximum limits for tight and slack gauge should be as indicated in Para 224(2) (e).

(*) **Suitability** - Suitability refers to good riding quality for passenger comfort and not from stability point of view.

(**)In above `few isolated locations' has been taken as not exceeding 10 per km.

607(3). The stability of trains against derailment, depends upon several factors such as track geometry, vehicle characteristics & state of their maintenance and speed of the particular vehicle at relevant point of time etc. Rail wheel interaction is thus, a complex phenomenon and therefore, safety tolerances for track alone cannot be prescribed in isolation. With this in view, safety tolerances for maintenance of track, have not been prescribed on Indian Railways. Each derailment case, therefore, needs careful examination of all available evidence, in respect of Track, Rolling Stock, speed and other factors considered relevant, to arrive at the cause.

The provision and tolerances mentioned in Para **607(2)** and elsewhere in this Manual are with a view to maintain track geometry for good riding comfort.

608. Analysis of track recording Car Charts– Prompt analysis of Track Recording Charts should be carried out in the track cell of Chief Engineer's Office. Analysis is done kilometre-wise for each parameter i.e., unevenness, twist, gauge and alignment and is classified into categories A, B, C and D for each parameter. The peaks on the points and crossings need not be counted in the number of peaks for categorisation. However, the quality of maintenance on points and crossings is judged solely on the basis of the peaks recorded. Statements are prepared, giving the results of the analysis of various parameters, P.W.I. - wise and A.E.N. - wise. Typical statements 1 to 9 as prepared for a **Broad Gauge Section** are enclosed as Statements 1 to 9. Similar statements are prepared for Metre Gauge sections with variations as necessary and the corresponding peak values adopted in categorisation.

STATEMENT No. 1
Analysis of Amsler Track Recording (Para 608)
Location-wise Analysis
Unevenness above 10mm.

P.W.I/PDPL.
A.E.N./RDM.

Section: BPQ-KZJ (Down)
Date of run : May 1982

Km.		Unevenness Right Rail			Unevenness Left Rail			
From	To	Peaks			Peaks			
		11 to 15 mm		15 mm and above	11 to 15 mm		15 mm and above	
		No. of peaks	Location and value		No. of peaks	Location and value		
294	295	2	294/7-8 (11 mm.)	...	...	...	...	
			294/11-12 (12 mm.)	...	....	....	....	
295	296	2	295/1-2 (12 mm)	....	2	295/0-1 (12 mm.)	....	
			295/15-296/0 (13 mm)	....	....	295/3-4 (11 mm)	....	And so on.

STATEMENT No.2
Analysis of Amsler Track Recording (Para 608)
Location-wise Analysis
Twist above 10 mm

P.W.I./PDPL
A.E.N./RDM

Section: BPQ—KZJ (Down)
Date of run : May 1982

Km.		Twist (Location and No. of peaks exceeding 10mm with value)
From	To	
294	295	- - - -
295	296	1 295/12-13 (13 mm.)
296	297	1 296/13-14 (11 mm.)
		and so on.

STATEMENT No. 3
Analysis of Amsler Track Recording (Para 608)
Location-wise Analysis—Gauge ± 6mm

P.W.I./PDL
A.E.N./RDM

Section:BPQ—KZJ(Down Line)
Date of run :May 1982

Km.		Gauge Location and No.of peaks exceeding ± 6 mm.
From	To	
294	295	- - - -
295	296	1 295/8-9(+ 9 mm)
296	297	4 296/6-7 (+7 mm), (-7 mm.) 296/13-14 (-8mm.) 296/14-15 (+8mm) and so on.

STATEMENT No.4
Analysis of Amsler Track Recording (Para 608)
Location-wise Analysis

P.W.I./PDPL.
A.E.N./RDM

Section: BPQ—KZJ (Down Line)
Date of run : May 1982

Km.		Unevenness		Twist	Gauge	Remarks
From	To	Left Rail	Right Rail			
294	295	B2	B0	B5	A0	
295	296	B2	B2	A2	A0	
296	297	A0	A0 And so on	B3	A0	

STATEMENT No. 5
A.E.N.-wise Comparative Statement—Category (Para 608)
Section

Section of A.E.N.	Date of Test	Length record-ed	Unevenness %				Twist %				Gauge %		
			A	B	C	D	A	B	C	D	A	B	C
RDM	May 1982	73 Km.	90	10	..	..	56	38	6	..	92	8	..
			And so on										

STATEMENT NO. 6

A.E.N-wise Comparative Statement (Para 608)

No. of peaks—Unevenness

Section of A.E.N.	Date of Test	Kms. Recorded	Down Line				
			Total No. of peaks including Points & Crossings				
			Total No. of peaks in the section			No. of P.&C. recorded	No. of P.&C. which recorded more than 10 mm.
			More than 10 mm.	More than 15 mm.	More than 20 mm.		
RDM ..	May 1982	73 Kms.	78	Nil	Nil	32	32 and so on.

STATEMENT NO. 7

A.E.N-wise Comparative Statement (Para 608)

No. of peaks—Twist

Section of A.E.N.	Date of Test	Kms. Recorded	Down Line				
			Total No. of peaks including Points & Crossings				
			More than 10 mm.	More than 15 mm.	More than 20 mm.	No. of P.&C. recorded	No. of P.&C. which recorded more than 10 mm.
RDM ..	May 1982	73 Kms.	96	22	1	32	32 and so on

STATEMENT NO. 8

A.E.N-wise Comparative Statement (Para 608)

No. of peaks—Gauge

Section of A.E.N.	Date of Test	Kms. Recorded	Down Line					
			No. of peaks + 6 mm. and above	No. per Km.	No. of peaks 6mm. – and above	No. per Km.	No. of peaks ±6mm. and above	No. per Km.
A.E.N./ RDM.	May 1982	73	..	..	..	..	50	0.69 and so on

STATEMENT NO. 9

Abstract of Amsler Results

Section : Ballarshah - Kazipet (Up and Down)

Date of Run : May 1982

Section of A.E. Ns. (Sub- Division)	Unevenness			Twist			Gauge		
	Up No. of peaks 10 mm. and above per km. including P & C	Down No. of peaks 10 mm. and above per km. including P & C	Up and Down No. of peaks 10 mm. and above per km. including P & C	Up No. of peaks 10 mm. and above per km. including P & C	Down No. of peaks 10 mm. and above per km. including P & C	Up and Down No. of peaks 10 mm. and above per km. including P & C	Up No. of peaks ±6 mm. and above per km. including P & C	Down No. of peaks ± 6 mm. and above per km. including P & C	Up and Down No. of peaks ±6 mm. and above per km. including P & C
A.E.N./ RDM.	0.79 (0.92)	1.15 (1.12)	0.97 (1.02) I=4.9%	1.01 (1.22)	1.75 (2.37)	1.38 (1.79) I=22.9%	1.36 (0.75)	1.12 (1.30)	1.24 (1.03) D=20.4%

Note : Figures in brackets pertains to February, 1982.

I - Improvement. % D -Deterioration. %

609. Arrangements for running track recording car – On receipt of track recording car programme from the R.D.S.O., the Zonal Railways should arrange for suitable power and path for the special along with telecommunication arrangement between the track recording car and the locomotive. The Headquarters should advise the Divisions concerned for making necessary arrangements to ensure that the Track Recording Car has an uninterrupted run.

610. Actual running of Track Recording Car – The Divisional Engineer, Assistant Engineer and Permanent Way Inspector of the section and nominated officer/staff of Headquarters office should accompany the Track Recording run. The Track Recording Car results vary appreciably with speed. The Divisional/Headquarters Officers accompanying the special should therefore ensure that the Track Recording Cars are run at the specified recording speed range of the particular car. The recording speed range of a Broad Gauge car is 70 km. p. h. - 80 km. p. h. and a Metre Gauge car 50 km. p. h. - 65 km. p. h. The recording done below these speeds are taken as "Non-recorded". For obtaining comparable results between successive recordings, it is necessary to run the special at uniform speed. The track recording car specials must run on through lines of all stations. Recording should be done during day light hours. Before start of any run it should be ensured that the calibration of the car has been done satisfactorily. The charts should be taken out and sent to Headquarters Office for obtaining copies after the run - samples of charts obtained by (i) Broad Gauge Mechanical track recording car, (ii) Broad Gauge electronic track recording car, and (iii) Meter Gauge electronic track recording car are at **Annexures 6/ 1, 6/2 and 6/3** respectively.

611. Action to be taken on Track Recording Charts – Spots (km.) requiring immediate attention, indicated by large peaks should be noted down by the Assistant Engineer/Permanent Way Inspector accompanying the car and immediate attention should be given to these kms. without loss of time. The charts should be analysed as detailed in Para 608 above and track classified into various categories as detailed in Para 607. A comparison of the records of each section with the previous run should be made and details of locations needing attention sent to the Division for onward transmission to maintenance units. Special attention should be paid by the maintenance units to the places where irregularities are high and where the defects are reappearing in successive recording runs.

612. Brief explanation of recordings – Explanation of the important parameters viz., twist, gauge, alignment and unevenness is given below –

(1)*Twist* – When the recording car follows a straight path where both the rails are in one plane, the track of the twist line follows the datum line. On curves, however, the record will be as shown in sketch below (sketch 'A')



Sketch 'A'

The portions AB and CD indicate the transitions and BC the circular portion. For the circular portion the trace follows the datum line because there is no change of cross levels over the circular portion. The shift of the trace from the datum indicates the cant gradient.

A record as shown below will indicate the following defects (sketch 'B') :-



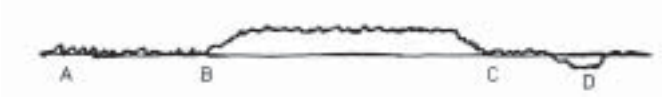
Sketch 'B'

(a) At the entry and exit of transitions there is sudden change indicating shock at entry and exit; smoothening is necessary.

(b) In the case of transitions, particularly AB, cant gradient is not uniform.

(c) Peaks in the circular portion indicate defective cross levels.

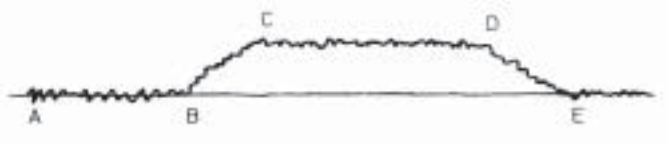
(2) *Gauge* – The trace indicates three conditions viz., correct gauge, tight gauge or slack gauge as shown in Sketch 'C' below –



Sketch 'C'

The shift of the mean above the datum line indicates slack gauge as at BC. If the mean follows the datum, it indicates correct gauge as at AB. The shift of the mean below the datum line indicates tight gauge as at D. Uniform, tight or slack gauge is indicted by parallel shift of the track. In such cases gauge adjustment is not necessary provided the variation is within permissible limits. Isolated peaks indicate the necessity of spot-gauging.

(3) Alignment – The trace on a truly straight portion will follow the datum line as at AB in sketch 'D' below. On a curve the indication will be as at BCDE. The trace shows the versine diagram, BC and DE being the transitions.



Sketch 'D'

If isolated peaks are observed, local adjustment will serve the purpose. If the cant gradient over transition portion is non-uniform and there is wide variation of versines between adjacent chords, such curves call for realignment. By calculating the variation of versines over the mean line of the trace, cumulative frequency can be determined to decide the need for realigning.

(4) *Unevenness* – Unevenness is recorded by variation in the top level of each rail. It is normally noticed at joints either low or high. It is necessary to compare the records of both the rails. A peak on one of the rails only indicates twist which should be verified from the trace of the twist line.

The twist record should also be co-related to the cross-level record. Change in cross-levels over short length will indicate twist.

613. Monitoring of the riding quality of track– While the track recording cars can record the track geometry (i) the Hallade track recorders, (ii) the Oscillograph car, and (iii) the portable accelerometers record vertical and lateral accelerations, on which depends, the riding quality.

614. Hallade track recorder – (1) *General*– The Hallade track recorder is an instrument which produces a graphic record of defects in alignment and surface of the track over which it is carried. The main parts of the instrument are –

(a) a drum rotated at a fixed speed by a clock work mechanism which carries a strip of paper 100 mm. wide covered over a carbon on which the chart is plotted,

(b) four sets of pendulums sensitive to movement in different directions which records the oscillations in those directions of the vehicle and track.

(2) *Hallade Chart* – **Annexure 6/4** shows sample section of the Hallade chart. The top line, marked **Line 1**, is a record of the features of the route, on which telegraph posts, kilometre posts facing and trailing points in station yards, long bridges and tunnels are recorded by the Operator who makes the needle point producing this line move side-ways as the train passes any of the features, so making a small 'tick' in the line. A suitable convention for 'ticks' should be adopted to distinguish the physical features of the section.

Line 2 represents the alignment and is drawn after the test is carried out.

Line 3 represents the fore and aft "rolling" of the vehicle and registers sudden sags or humps and the acceleration of deceleration.

Line 4 represents lateral oscillations of the vehicle. Side to side motion of the vehicle causes the style to oscillate about the "medial line". The amount the style travels from the "medial line" is a comparative measure of the amount the vehicle diverges from its true path. Irregularities in alignment, uneven or incorrect superelevation on curves and uneven cross-levels are indicated.

Line 5 is a record of the vertical disturbance to the coach. Low or high joints, a bad top generally, or "hanging sleepers" are indicated.

(3) *Frequency of testing with Hallade* - On routes where Hallade track recorder is exclusively used for the track monitoring the following frequencies may be adopted :-

On B.G.	On M.G.	On N.G.
On C & D routes 6 months On E routes Every year	On Q routes 4 months On R routes 6 months On S routes Every year	Every year

(4) Testing of track with Hallade –

(a) The Hallade track recorder should be placed on the leading bogie of the trailing vehicle or on the last but one vehicle, but the position of the vehicle must be the same in every run on a particular section.

(b) The Permanent Way Inspector should accompany the Hallade run.

(c) The same vehicle should be there every time preferably.

(d) Proper adjustment of the damping mechanism (critical damping) should be done.

(e) After completing the test, the chart should be completed in the following respects :-

(i) Heading the chart with particulars of date of test, train no., from station ..... to station ....., vehicle no., speed of the paper roll, and details of damping.

(ii) Checking up markings of kilometre posts, telegraph posts (electric masts) and filling in the speed of the train in km. p. h., km. by km.

(iii) Drawing line No. 2 indicating the right hand and left hand curve with the radius of each curve.

(iv) Drawing the medial line on line No. 4.

(v) Scrutinizing and marking track defects on the chart.

Blue prints of the chart should be then taken and 3 copies sent to the Assistant Engineer within a week of the test.

(5) *Interpretation of the Charts* – The charts are then analysed in the track cell of Chief Engineer's Office Kilometre-wise and the actual kilometres where alignment and packing defects have been recorded are listed out and given to the Assistant Engineer and Permanent Way Inspector for attention. The number of defects per km. are also worked out to enable the assessment of the track condition. The interpretation of the various types of typical defects noticed in a track are shown in **Annexure 6/4**. A typical analysis of an Hallade run in a P.W.I.'s/ A.E.N.'s section may be seen in the Statements 1 and 2, shown below.

Result of H.T.R. Test STATEMENT No. 1 (Para 614)

Comparative Statement of Defects Sub-Division, P.W.I.-wise Analysis

Date of Test : January 1981

Division : Guntakal

A.E.N. Sub-Division : Guntakal/M.G.

Section	P.W.I.	No. of defects recorded						Average No. of defects per km.	
		Previous Test of comparable period February 1980			Current Test January 1981			Previous Test February 1980	Current Test January 1981
		Alignment	Packing	Total	Alignment	Packing	Total		
GTL-DMM.	GTL/M.G	1	20	21	3	13	16	0.65	0.50
Do	ATP	7	31	38	7	36	43	0.54	0.61
DMM-PAK	KRY	10	31	41	9	26	35	0.53	0.44
A.E.N./GTL	. .	18	82	100	19	75	94	0.55	0.52

STATEMENT NO. 2

Detailed Notes

Date of Test : 12th January, 1981. Section : GTL-DMM-PAK
Train No. 86 Express Direction : Up
From : GTL Km. 279/0
To : KDT Km. 246/15 P.W.I. Section : GTL (M.G.)

Packing	Speed	Alignment	Speed
249/8-9	60	250/9-10	65
257/15-14	65	270/15-16	70
258/7-8	65	277/13-14	60
258/11-12			
269/4-5	70		
270/3-4	70		
		Note -	
272/10-11	70	Alignment defects 3	
273/15-16	70	Packing defects 13	
274/11-11	70		
274/12-13	70	Total 16	
275/7-8	65		
276/5-6	65		

(6) *Attention to track defects recorded :* – The Permanent Way Inspector should verify track defects indicated by chart at site, take expeditious action and report to the Assistant Engineer within a month.

On receipt of the Assistant Engineer's report the Divisional Engineer should get the chart examined with previous records and issue any orders he may consider necessary.

615. Oscillograph Car (1) *Brief description of the car :*– The main equipment in this car is an accelerometer, which consists essentially of a mass attached to one end of thin flexible plate, the other end of the plate being fixed firmly to the casing of the accelerometer. The space within the accelerometer casing is filled with a damping fluid (usually silicon liquid). The cantilever plate is strain gauged so that the deflection of the mass 'm' is sensed. This is calibrated to indicate the acceleration to which the mass is subjected. This acceleration is recorded in the form of an accelerogram. Thus the vertical and lateral acceleration on any part of the vehicle where the accelerometer is installed can be recorded. In track monitoring runs the accelerations at the loco cab floor are recorded by keeping the accelerometer as close to bogie pivot as possible.

(2) *Details of recording :* – the following parameters are recorded in the oscillograph car runs:–

(a) Vertical acceleration of loco cab.
(b) Lateral acceleration of loco cab.

In addition to the above, timing marks-one for every second-telegraph and km. marks and even marks such as station buildings,bridges etc., are also recorded on the chart. The primary spring deflections left and right are also recorded.

The chart obtained in an oscillograph car run can be seen at **Annexure 6/5.**

(3) *Frequency of recording* – These cars are used to monitor high speed routes where the sectional speed exceeds 100km./h. on B.G. and 75km./h. on M.G.These cars are run once in six months to assess the riding quality of the track as distinct from actual track geometry recorded by the Track Recording Cars. Recording is done at the maximum sanctioned speed of the section. On Rajdhani routes recording is done once in 4 months.

616. Analysis of oscillograms and interpretation of results –

(1) The Oscillograms obtained from the oscillograph car are analysed for the vertical and lateral acceleration.

(2) The analysis of records is done on the following lines :–

(a) All peaks are to be measured from the base or zero line i.e.,no allowance is to be given when the trace shifts because of cant deficiency on curves. However, for the purpose of "ride index" calculations, lateral acceleration peaks are to be measured from the shifted base line on curves.

(b) The vertical and lateral accelerations above the threshold values are separately counted:

Threshold value of acceleration may be taken as follows :–

(i) *In Loco Cab floor* – The threshold value of acceleration in vertical mode is taken as 0.20 g. for all locos (Diesel and Eletric).

The threshold value of acceleration in lateral mode is taken as **0.20g**. for diesel and electric locos with double stage suspension (i.e., for WDM-3, WDM-4, WDM-1, WDM-2/3 and WAG-2) with the exception of WDM-2 modified with single stage suspension.

In case of other locos, with single stage suspension (i.e.,WDM-2 std., WAM-1, WAM-4, WAG-1,WAG-3,WAG-4,WCG-2, WCAM, WCM, WCM-2, WCM-4 and WCM-5) the threshold value may be taken as **0.30g**.

(ii) *On Passenger Coach Floor :–* The threshold value of acceleration for both vertical and lateral modes shall be taken as **0.15g.**

(iii) The analysis is done kilometer-wise and results are given under the following heads, after counting the peaks above threshold value for the particular locomotive –

Station Yards,

Other than Station Yards(Isolated locations),

Active continuous stretches,

Speed grouping table is also prepared.

Typical Statement prepared in connection with an Oscillograph run are given below (Statement 'A' to 'C') –

STATEMENT 'A'

Oscillograph Results (Para 616)

Total length of Section : 232 Kms. Section : BBQ—KZJ.
Length recorded : 185 Kms. Loco No.....
Date of recording : 22nd March 1982 Type of Loco.....

Station Yards (Peaks above Threshold values)

SI. No.	Name of Yard and Location	Speed in Km. p. h.	Vertical acceleration	Lateral acceleration	Remarks
1	SRUR FP-2	100	. .	0.26	
2	MCI TP-1 TP-2	100 100	0.22 0.22	. .	
3	PPZ FP-1 FP-2	100 105	0.20 0.20	. . . .	
4	BGSF 324/10-11	110	. .	0.22	
5	OPL 343/5-6	100	0.26	. .	
6	HSP TP-1	100	0.20	. .	

STATEMENT ' B '

Date of recording : 22nd March 1982. Section : BPQ—KZJ (K.m. 367-K.m. 135)

Loco No..... Length recorded: 185 Km.

Type of Loco..... Total length: 232 Kin.

Oscillograph Results in Places other than Station Yards

Isolaled Locations (Peaks above Threshold value)

SI. No.	Location	Speed in K.m. p. h.	Vertical acceleration	Lateral acceleration	Remarks
1	146/1-2 ...	100	..	0.28	Curve.
2	148/15-16	110	..	0.28	Br.
3	149/7-8 ...	110	0.28	..	
4	149/7-8 ...	110	0.35	..	Br.
5	151/8-9 ...	110	..	0.24	
6	151/8-9 ...	110	..	0.32	
7	151/11-12...	105	..	0.24	
8	160/7-8 ...	110	..	0.22	Curve
9	164/9-10 ...	110	0.24	..	
10	168/1-2 ...	100	and so on.	0. 30	

STATEMENT ' C '

Date of recording : 22nd March 1982. Section : BPQ—KZJ (Km. 135-Km. 367)

Loco No. :..... Length recorded : 185Km.

Type of Loco :..... Total lenth :232Km.

OSCILLOGRAPH RESULTS

Active Continuous Stretches

SI. No.	Kms.		Distance in Km.	Speed in Km.p.h.	Active in mode	Total No of peaks above 0.20'g.	Maximum value	No. of peaks between 0.20g. 0.35g.	No. of peaks above 0.25g.	Remarks
	From	To								
						Nil				

Note – If there are on an average more than 10 peaks above the threshold value per km., the length may be included in this statement.

617. Use of Oscillograph Car recordings :–

(1) Threshold values of acceleration are given in Para 616(2)/b. For ensuring good riding, track should be attended to at such locations where peaks above threshold values are noticed.

(2) Efforts should be made not only to check the extent of defect but also to find out whether it is occurring in an active patch; as such condition may lead to excessive oscillations.

618 Portable Accelerometers-

(1) *General*- OMS-2000 equipment's are portable accelerometers used for Oscillation monitoring using a portable accelerometer and transducers converting the oscillations to electrical signals which can be recorded electronically and processed on PC.

(2) *Operation***-** The OMS Accelerometer is kept in the cabin of locomotive or on the coach floor, as close to the bogie pivot as possible. It is preferable that same coach and the same vehicular position are used in successive runs. The accelerations recorded are transferred to electronic recorder and are readable on the LCD display on real time basis. The stored data can be downloaded on TMS Computer for maintenance planning.

This equipment measures the Track Performance by measurement of vehicle response in terms of vertical and lateral accelerations. The real time output of the equipment is in the form of value of peaks exceeding the limiting value, their location and Ride Index. These values are available for both vertical and lateral accelerations.

(3) *Frequency of Recording:*

(A) Broad Gauge :

Speed above 100 Kmph	Once every month.
Others	Once in two months

(B) Meter Gauge :

Speed above 75 Kmph	Once every month
Others	Once in two months

The above schedule is only a guideline. Chief Engineers may vary it, depending upon the availability of instrument and its use. For the time being A, B and C routes are to be covered once a month and other routes can be covered as per capacity and need.

(4) *Recording of Defects:* To assess the track quality, vertical and lateral acceleration peaks exceeding the values as below are to be considered:

Broad Gauge:

High Speed Routes above 110 Kmph On A & B routes	greater than 0.15 g.
Other Routes upto 110 Kmph	greater than 0.2 g
Meter Gauge :	greater than 0.2 g

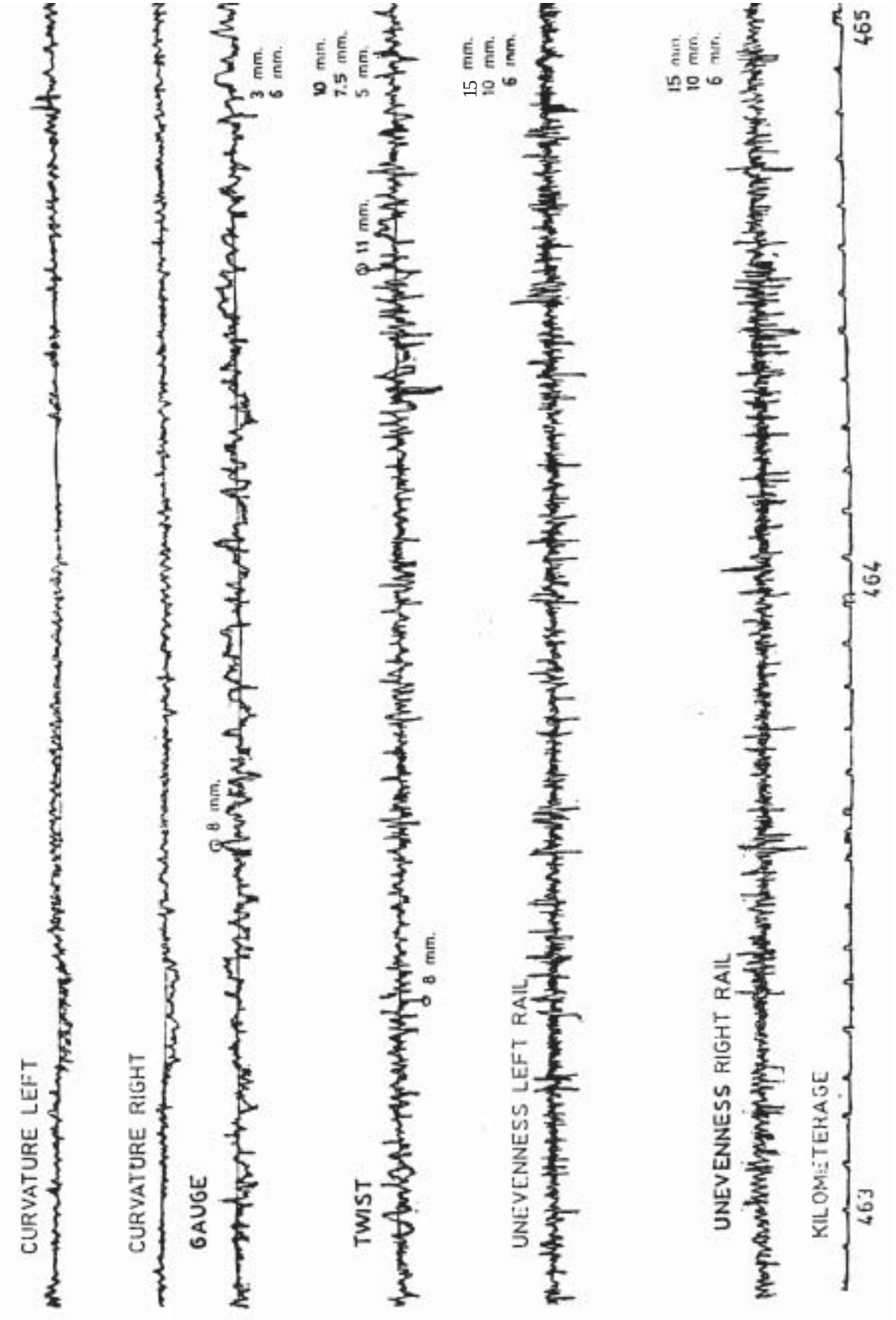
(5) *Classification of Track Quality* **-** To classify a continuous section's (PWI's jurisdiction/sub-division/ division) track quality, the following criteria is to be used (average total number of peaks per km.):

	Very Good	Good	Average
High Speed	Less than 1.0	1 - 2	Greater than 2
Others	Less than 1.5	1.5-3.0	Greater than 3

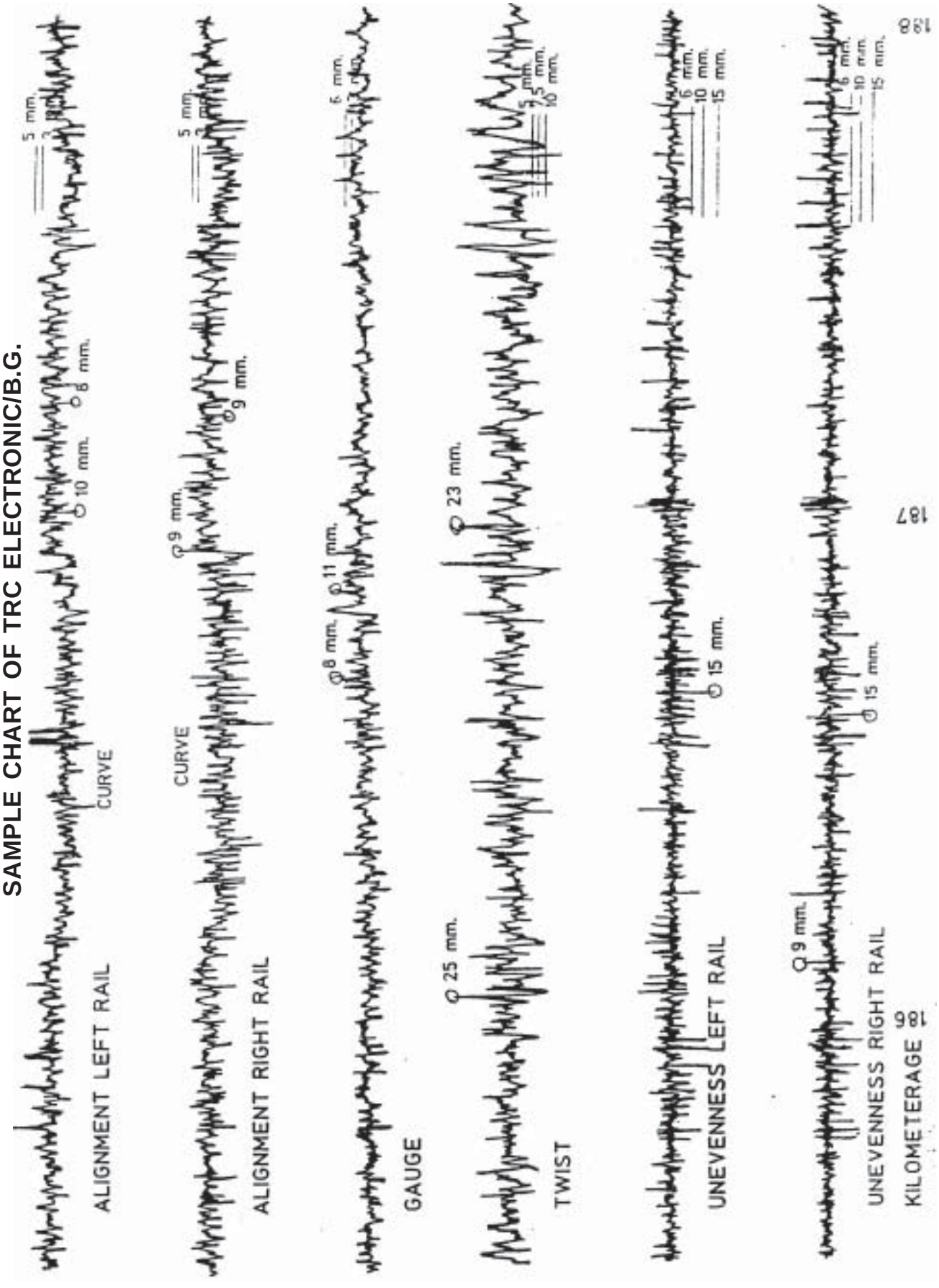
The above criteria are for judging the quality of track. However, if the average number of peaks of vertical and lateral accelerations exceeding 0.30g is more than 0.25 per km or more than one in any particular kilometer, the track will need attention : At locations where peaks of lateral and vertical accelerations exceed 0.35g, the track will have to be attended to urgently.

ANNEXURE - 6/1 PARA 607

SAMPLE CHART OF TRC MECHANICAL/B.G.

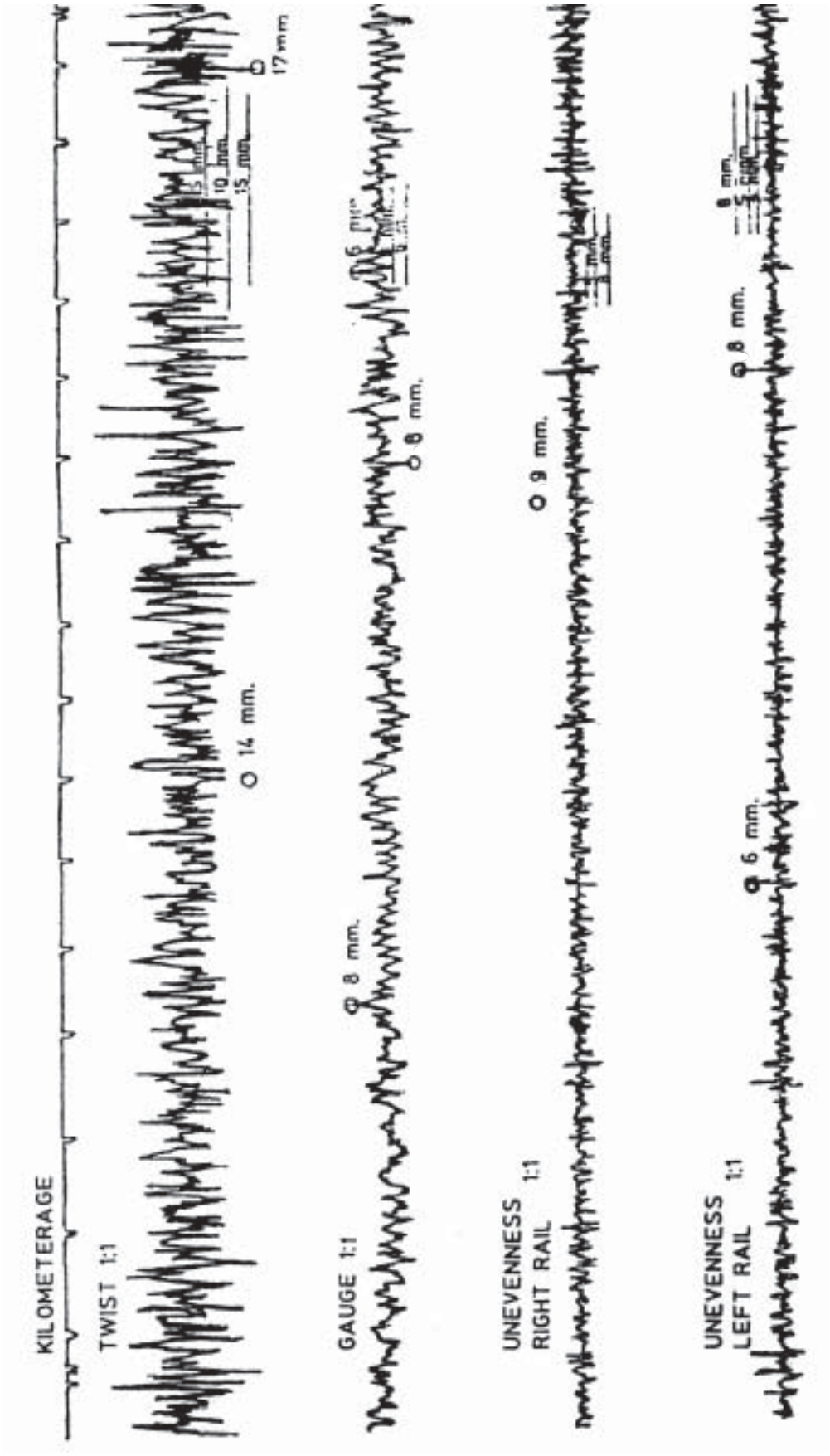


SAMPLE CHART OF TRC ELECTRONIC/B.G.



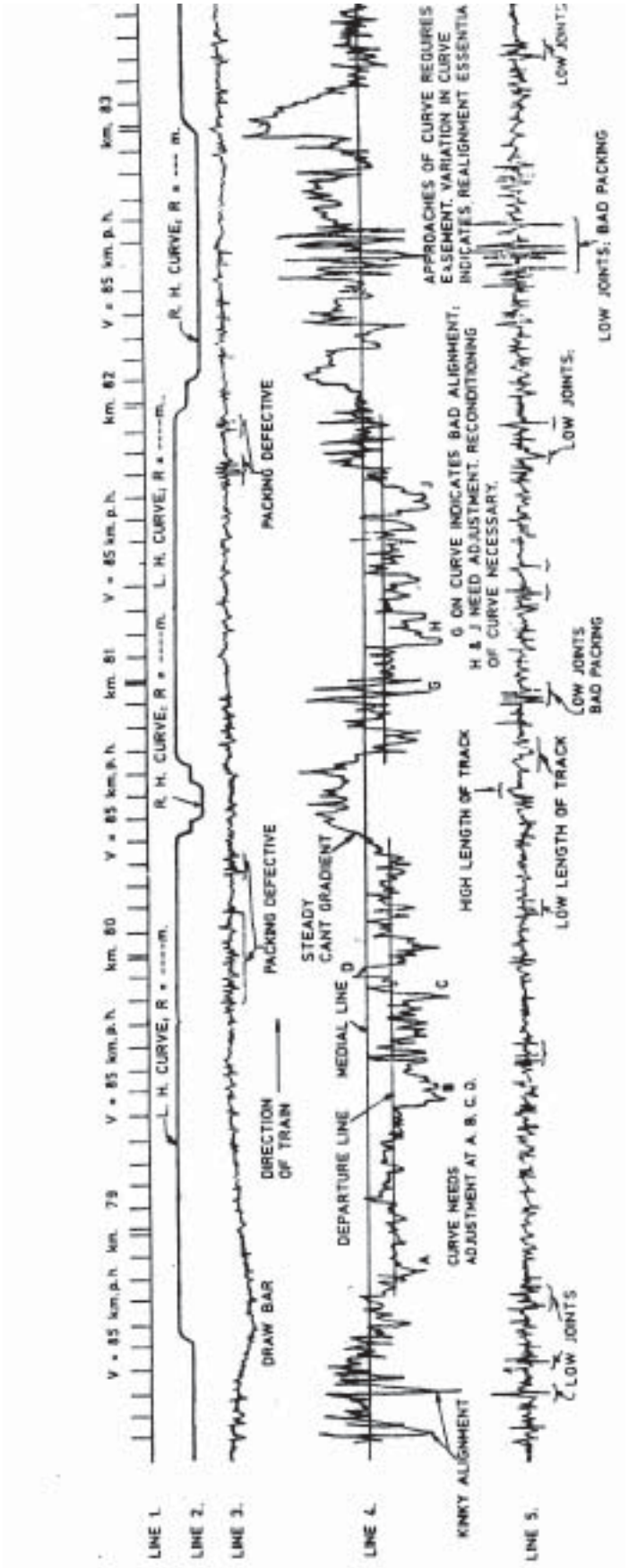
ANNEXURE - 6/3 PARA 607

SAMPLE CHART OF TRC ELECTRONIC/M.G.



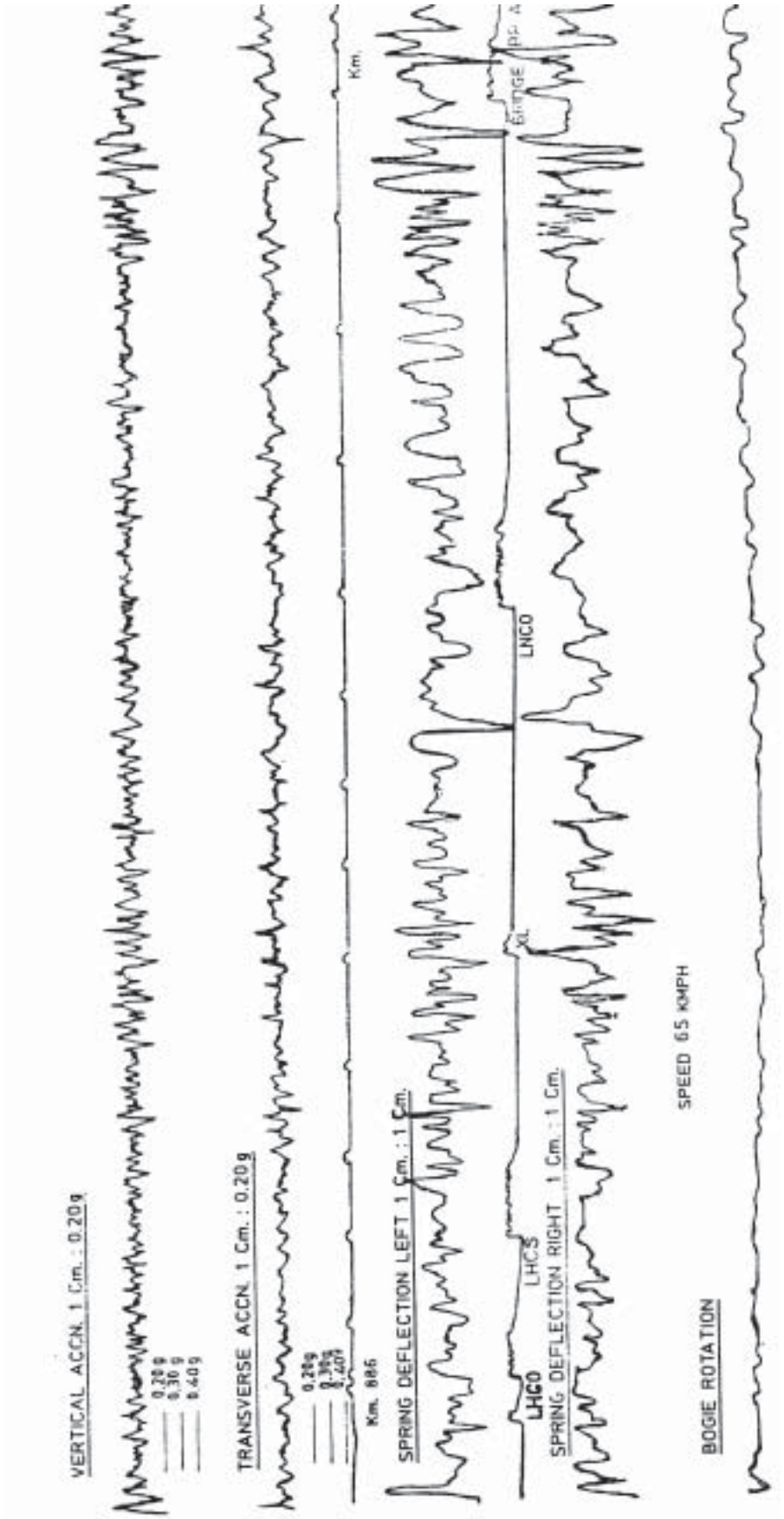
ANNEXURE - 6/4 PARA 614

SAMPLE HALLADE CHART



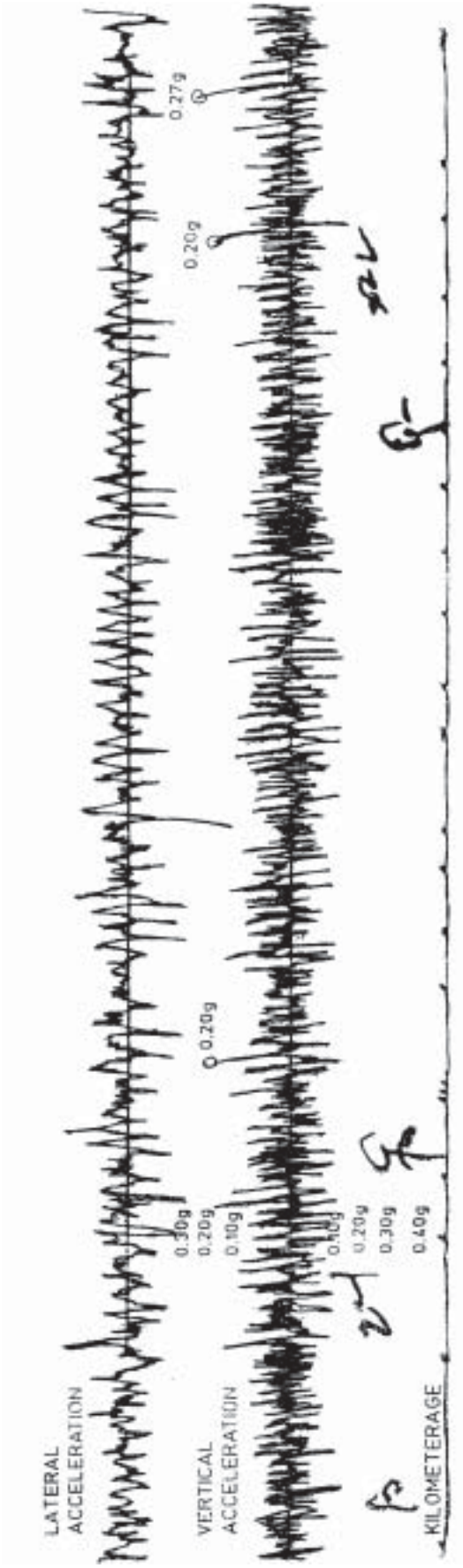
ANNEXURE - 6/5 PARA 615

TYPICAL CHART OF AN OSCILLOGRAPH CAR/B.G.



ANNEXURE - 6/6 PARA 618

SAMPLE CHART OF PORTABLE ACCELEROMETER



CHAPTER VII

ACTION DURING ACCIDENTS INCLUDING BREACHES AND PRE-MONSOON PRECAUTIONARY MEASURES

PART 'A'

Action during Accidents including Breaches

701. Observance of Rules – (1) Any occurrence which does or may affect the safety of the Railways, its engines, rolling stock, permanent way, works, passengers or servants which affects the safety of others or which does or may cause delays to trains or loss to the Railway, is termed an accident.

Occurrence outside the Railway limits threatening the safety of the line or trains should also be reported as accidents. For instance a flood outside Railway limits may seriously threaten the safety of the line and should be treated as an accident.

(2) Rules for reporting and joint enquiries into the accidents are contained in the Accident Manual issued by Railways and in the Railway (Notices of and Enquiries into Accident) Rules, 1973, issued under Section 84 of Indian Railway Act,1890.

(3) Rule 2.11 of General Rules, 1976 Edition enjoins that –

(a) Every Railway servant shall –

(i) see that every exertion is made for ensuring the safety of the public ;

(ii) promptly report to his superior any occurrence affecting the safe or proper working of the railway which may come to his notice; and

(iii) render on demand all possible assistance in the case of an accident or obstruction.

(b) Every Railway servant who observes –

(i) that any signal is defective;

(ii) any obstruction, failure, or threatened failure of any part of the way or works;

(iii) anything wrong with a train; or

(iv) any unusual circumstance likely to interfere with the safe running of trains or the safety of the public;

shall take immediate steps, such as the circumstances of the case may demand, to prevent accident; and where necessary, advise the nearest Station Master by the quickest possible means:

Provided that in the case of a train having parted, he shall not show a stop hand signal but shall endeavour to attract the attention of the Driver or Guard by shouting, gesticulating or other means.

702. Report of Accident to the Station Master / Railway servant in-charge of Block Hut– (1) Engineering representative (if he is the first to reach the site of the accident) while reporting an accident to the nearest Station Master/Railway servant in charge should furnish the following information to enable the Station Master/Railway servant in-charge to issue an all concerned message:

- Station at or stations between which the accident has occurred.
- Kilometrage at which the accident has occurred.
- Number and description of the train or trains involved.
- Date and time of the accident.
- Particulars of loss of life and injuries to passengers and staff.
- Nature and cause, if known, of accident.
- Damage to Permanent Way, Works, Bridges, Overhead equipment (in case of electrified section), signal and interlocking gear, engines or vehicles.
- Probable duration the line may be blocked.
- Whether transhipment is required and if so whether it is feasible.
- Assistance (if any required) such as Medical assistance, break-down train etc.

(2) Acknowledgment of the receipt of message should invariably be taken from the Station Master.

703. Accidents impairing through traffic –(1) *Engineers and Inspectors to proceed to site* –

(a) On receipt of intimation of the occurrence of an accident resulting in damage to any part of the Way/ Works /Bridges and affecting the free passage of trains, the concerned Permanent Way Inspector / Works or Bridge Inspector and the Assistant Engineer shall proceed to the site of accident, by the quickest available means. On their way, they should collect information about the extent of damage to Permanent Way / Works / Bridges and arrange for movement of materials required for restoration. They should also collect additional staff and tools as required; the engineering tool van should be sent to the site, if so considered necessary, by the quickest means.

(b) On receipt of intimation of an accident, the Divisional Engineer shall contact the section control and the Assistant Engineer in-charge and get the information regarding the extent of damage to Permanent Way and Works, check on the arrangements made for labour and materials, etc., supplement them if necessary and proceed to the site of the accident by the quickest available means, if the seriousness of the accident requires his personal supervision and direction.

(2) *Accident in an adjacent division*-In the event of an accident taking place on a division, where assistance could be more expeditiously rendered by officials of an adjacent division, such officials and the Assistant Engineer/ Divisional Engineer of the concerned adjacent division should be advised; these officials should proceed at once to the site of accident with their Inspectors and render every possible assistance.

704. Action at site – (1) *By Permanent Way and other Engineering Inspectors* –

(a) *Protect Train* – Any engineering staff available at the site of the accident shall assist the Guard and Driver to protect the train in accordance with the General Rules 6.03 and 9.10 (1976). The Inspector should ensure that protection has been afforded to the train in front and in the rear, in accordance with the rules. In the case of double line, if the other line is also affected by the accident, steps shall be taken to protect both the lines. If no infringement exists, trains must be controlled and passed cautiously on the unaffected track.

(b) *First aid and Rescue* – The Inspector should arrange for first aid to injured passengers and Railway staff and rescue of trapped persons. If there is any Medical Practitioner on the train, his assistance should be obtained.

(c) *Advice to nearest Station Master* – After a rapid survey of the position, particulars should be sent to the nearest Station Master as in **(Para 702)** above. In case of controlled sections, a field telephone should be got commissioned at once.

(d) *Line Clear examination* - If the Engineering official has reached the site and no traffic official is available he should carefully secure the line clear token or ticket and any caution order, where necessary. If the accident has occurred in a station yard, the train register book must be seized and if necessary, statement of staff concerned recorded; if line badges are in use, it should be recorded as to in whose possession each line badge was. The position of block instruments, signals, points, point levers, indicators, keys, etc. should be noted and recorded, jointly with the Inspectors of the other concerned departments, available at site.

(e) *Preliminary clearing operation and preservation of clues* –

(i) In all instances in which the means taken for the restoration of communication are likely to obliterate marks on the road and other evidence needed at a joint enquiry, the senior official who arrives first on the spot should carefully examine the track, train or vehicle and as soon as possible make notes, sketches etc. and hand over the same to his superior or produce them at the enquiry. He will, when the nature of the accident is such as will involve the question of eye-sight of any of the staff, verify (in case of those permitted to wear glasses) that they had worn glasses at the time of the accident and had carried a spare pair of glasses with them.

(ii) In all cases of accidents, the cause of which might possibly due to sabotage, it is essential that the clearance and restoration operations are not commenced till the Police officials arrive at the site and intimate their agreement to the commencement of clearance and restoration work, after, making thorough investigations.

A factual note of the conditions obtaining at the site prior to restoration work should be prepared and signed jointly by the senior-most Police and Railway officials at the site. In the event of any difference of opinion between the Police and the Railway officials, such difference of opinion may be recorded on the joint factual note.

This should not, however, be allowed to interfere with rendering of first aid to the injured, which is the first essential in all accidents.

(iii) In other cases, clearance and restoration operations can commence even before the arrival of the Police and it is not necessary that all the rails, sleepers and fastenings involved in an accident should be preserved, but only those, whether serviceable or otherwise, which bear wheel marks, etc., specially between the points of mount and drop. In all cases of serious derailments, these are essential for a later reconstruction of the scene and should be preserved and/or recorded by the first responsible official to reach the site of the accident, as these would be valuable evidence to ascertain the cause of the accident.

(iv) After the injured persons have been attended to and arrangements made for the onward journey of the stranded passengers, the Railway officers at the site of the accident should arrange to record the preliminary statements of the staff concerned, as any delay in doing so, might result in some facts being suppressed or some evidence being fabricated during subsequent enquiries.

(v) In case sabotage is suspected, the procedure as outlined in clause (ii) above should be followed. In addition it should be ascertained promptly from the C.R.S. if he would like to inspect the site, etc. before the commencement of clearance and restoration work and then action should be taken in accordance with his wishes. Before clearance and restoration operations are commenced all relevant clues, materials and damages and the deficiencies on Rolling Stock, etc. must be noted and preserved. In other serious accidents, however, the same procedure as outlined in Clause (iii) above should be strictly followed.

(f) *Contacting higher officials* – The inspector should get in touch with the Assistant Engineer or Divisional Engineer, explain the position on telephone, wherever possible ; if not, he should himself organise the restoration of through running including ordering of ballast trains, requisitioning of required materials and tools and send information to Assistant Engineer and Divisional Engineer of the preliminary measures undertaken, by the quickest possible means.

(g) *Recording of details and advice regarding restoration time* – He should arrange to record the details of the accident and prepare notes on any special features bearing on its cause, which may be of help in the enquiry. He should send by any means available and relay a concise report of the accident as per **(Para 702)** to the nearest Station Master to enable him to issue all concerned message.

(h) *Preservation of clues* – He should arrange to preserve all clues to enable reconstruction of the scene of the accident as detailed *vide* **(Para 704)**

(i) Photographs showing the details of damage to Permanent Way and Rolling Stock at the site of accident should be taken wherever necessary; in case of suspected sabotage, the photographs of the site of the accident showing the damage and possible clues should invariably be taken.

(2) *By Assistant Engineer* –

(a) He should ensure that action specified under sub-para 704 (1) has been taken by the Inspector. If he is the first to arrive at site, the Assistant Engineer should take action as specified in the case of the Inspector.

(b) He should get in touch with the Divisional Engineer and the Controller / Chief Controller and furnish complete information advising the details of action being taken and the probable time for restoring through running.

(c) He should arrange to organise the measure for expeditious restoration of through running and ensure incessant working until this is effected.

(d) A preliminary report should be prepared.

(3) *By Divisional Engineer* –

(a) He should examine the adequacy of measures taken for restoration of through running and ensure expeditious work.

(b) He should assess and advise the position to the Divisional Railway Manager and Chief Engineer, with brief particulars (over the field telephones on Controlled Sections) and probable time of restoration. The Chief Engineer / Addl. Chief Engineer may proceed to site in case of very serious accidents.

(c) A report should be prepared and submitted to the Chief Engineer and Divisional Railway Manager.

(d)The Divisional Engineer shall ensure that the fractured pieces of rail/weld are preserved and sent to RDSO for detailed investigations, at the earliest possible, in all cases of accidents, where rail/weld is a prima facie cause of the train accident.

(4) The senior-most Railway Officer at the scene of accident shall be responsible for the general appraisal of the situation and co-ordination of all works.

705. Report to the Chief Engineer – (1) *Report* – (a) the Senior Engineer at the site of the accident shall after initiating measures for restoring traffic, submit a brief report to the Chief Engineer with a copy to the Divisional Railway Manager which will include the following particulars:

(i) Nature of the accident,
(ii) Cause, if known.
(iii) Particulars of loss of life and injuries to passengers and staff.
(iv) Extent of damage to Way, Works and Bridges.
(v) Particulars of rainfall and patrolling, in the case of damage by floods.
(vi) Steps taken for resumption of traffic.
(vii) Probable time, when normal working is likely to be resumed.
(viii) Whether transhipment is necessary and if so, for how long.
(ix) Whether a diversion is necessary and if so, when it is likely to be opened.
(x) Details of any assistance required, such as additional staff, labour, ballast trains and other Permanent Way and Bridging materials.

(b) A sketch showing important dimensions, positions of vehicles, tracks made by derailed vehicles, marks on rails, particulars of condition of track for an adequate distance in the rear of the point of derailment and any other information likely to be of use in elucidating the cause of accident should accompany the report.

(2) *Remedial measures* – In the case of damages caused by floods, the Divisional Engineer should initiate necessary investigation and submit a technical report with drawings, to the Chief Engineer, detailing the remedial measures required, with the past history, if any, of the kilometrage affected, within a month of the occurrence.

706. Attendance of Police at site – Arrangements should be made for the police to attend the scene of accident in the case of derailment of a train carrying passengers (or of any other train when it is considered necessary) in order that they may observe the extent of disturbances caused to the line, keeping guard over loose materials laying about and over any evidence affecting the cause of the accident and safeguard passengers' luggage and mail as required.

707. Examination of site and preparation of sketches – The first Engineering representative to arrive at site shall attend to the following :–

(1) He should examine the entire site inclusive of track over which the train has passed immediately before derailing, noting down any unusual features observed, especially any parts of vehicles or other material lying on or near the track.

(2) A dimensioned sketch should be prepared covering the entire site of accident, showing all relevant features inclusive of track leading up to point of derailment, showing position of derailed vehicles, point of mount and drop and other relevant details. All the details given in **Annexure 7/1** should be incorporated in the sketch.

(3) He should record the particulars as detailed in **Para 708(1).**

(4) An examination of the derailed vehicle/ vehicles for defects not caused by the derailment but which may have been the cause of the derailment should be made. He should make out notes for inclusion in the joint report.

(5) He should examine the gang-charts/diary books to ascertain the date when track was last attended.

(6) Details of Engineering works in progress, if any, at the site of accident, caution orders in force and nature of protection should be noted.

708. Recording particulars at site of accident – (1) *Permanent Way particulars* – Permanent Way particulars shall be recorded jointly with the Inspectors of the other concerned departments as per **Annexure 7/2.** These records will *inter alia* include particulars of the track structures, the condition of the track components, track geometry and other relevant details.

(2) *Particulars with respect to Rolling Stock and signalling* – Engineering representative should associate himself with the concerned representative of the other departments in recording measurements of –

(a) The locomotive and tender;

(b) Carriages and Wagons; and

(c) Signalling and Telecommunication equipment.

(3) *Operating particulars* – The following operating particulars should also be recorded wherever relevant :–

(a) Speed – The actual speed at the time of derailment, from the speedometer graph or if the locomotive is not provided with the speedometer graph, by referring to inter-station timings.

(b) The direction of the locomotive i.e., shorthood or longhood leading.

(c) The brake power of the train.

(d) The marshalling of the train with reference to orders applicable on the section.

(e) Whether there has been sudden application of brakes.

(f) Whether there was sudden opening of regulators.

(g) Condition of loading in wagons, specially unequal loading, light loading, empties between loaded vehicles, over loading, moving loads and any infringement to standard dimensions.

(h) Particulars of Caution Orders issued to the Driver/Guard.

709. Use of Recorded Data – The object of recording all available data at site and of evidence is to ascertain the cause of the accident with a view to prevent its recurrence, and where the cause is due to negligence, to fix responsibility.

Restoration of Through Running

710. Repairs to damaged track :– Repairs to the track should in the first instance, be kept to the minimum necessary to restore traffic with the least possible delay, the required materials being expeditiously arranged for. Soon after, the track should be brought to its proper standard.

711. Procurement and Arrangement of Labour – (1) Adequate labour is the very first essential for restoration of through running. Engineers and Inspectors should acquaint themselves with all possible sources from which labour could be readily obtainable in the event of a breach or a serious derailment on their section. Labour should, as far as practicable, be conveyed to the site of accident by train.

(2) Labour should be obtained in one or more of the following ways :

(a)By ordering temporary gangs such as relaying gangs, special gangs, construction gangs, remodelling gangs, yard gangs, within a reasonable distance to proceed to the site.

(b)By ordering two or more men from each permanent gangs to proceed to the site.

(c)By obtaining labour from adjoining divisions, of considered necessary and possible.

(d)By calling on the Revenue authorities to supply labour.

(e)By recruiting temporary labour locally or from known sources.

(f)By arranging labour through reliable Contractors (wages should be fixed prior to their engagement).

(3) In case contractor's labour is engaged, it is preferable to allot work in such a way that the departmental labour and contractor's labour do not get mixed up. Settlement of claims should be prompt. Labour should be organised in batches under the charge of Inspectors. Proper muster sheets should be maintained.

(4) In emergencies, Assistant Engineers/ Permanent Way Inspectors may authorise Station Masters by telegram/memo to issue proceed order for the journey of Gangman/Labour required for the work along with their tools and equipment from specified station to the nearest station from the site of accident. As far as possible, all departmental labour shall move with complete tools and equipment.

(5) Adequate arrangements should be made for food, shelter, water and lighting.

712. Diversion – (1) *General* – Should a diversion be decided upon, the work should be commenced as quickly as possible.

(2) *Classification of diversions* – These may be classified as –

(a) Temporary

(b) Semi-permanent

A temporary diversion is one which is not likely to be in use, for more than 10 days. All trains must "Stop-dead" before entering a temporary diversion and proceed at 10 Km./h. speed.

A semi–permanent diversion, is one constructed for the special purpose of facilitating the reconstruction of the line and/or bridges likely to be in use for a period of more than ten days. On a semi-permanent diversion, trains may proceed at a non stop reduced speed after adequate period of consolidation.

(3) *Curvature and Gradients* – As far as possible the radius of curve should not be less than 450 meter, 300 meteres and 45 meters for B.G. ,M.G., and N.G., respectively. Gradient should not be steeper than 1 in 100, 1 in 80 and 1 in 40 on the B.G., M.G. and N.G. respectively, compensated for curvature.

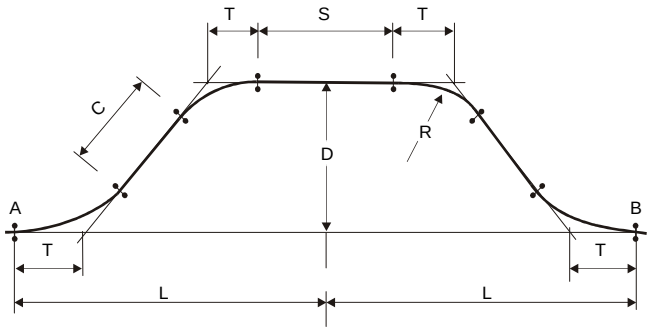
In difficult terrain it may be necessary to lay curves of radius not less than 225 meters and 125 meters on B.G. and M.G. respectively and adopt grades up to the ruling gradient on the section. There should be no superelevation, in case of temporary diversions.

(4) Calculation for setting out diversion –

While setting out diversion, the following formula will be found handy :–

$$L = \sqrt{C^2 + 4RD - D^2} + \frac{S}{2}$$

$$T = \frac{RD}{L - \frac{S}{2} + C}$$



All measurements to be taken in same units, where

AB = Portion of existing line to be diverted.

L = Length of half the diversion, measured along the original alignment.

D = Maximum distance of diversion from original alignment.

S = Straight portion of diversion.

C = Length of straight between reverse curves.

R = Radius of curves.

T = Length of tangent.

(5) *Opening for traffic* – The diversion track should be adequately consolidated and tested by locomotive/ wagons before opening for traffic.

The most vulnerable portion of the diversion is at the junction of the old bank with the new bank. Care should, therefore, be taken to provide benching of slopes at the junction. Cross levels should be checked after passage of every train and rectified till the track gets stabilised.

(6) *Issue of safety certificate* – In an emergency the line may be opened to traffic on the safety certificate issued by the Engineer-in-charge, without the prior sanction of the C. R. S. However if the use of temporary diversion is likely to be extended to more than three days, the Commissioner of Railway Safety, may if he considers it necessary, take the earliest opportunity of inspecting it.

713. Transhipment – The decision, as to whether transhipment is to be done, is taken by Transportation/Commercial Department. If it is decided to provide gangways, footpath etc., purely for the purpose of transhipment, these should, as far as possible, be laid away from the site of repairs, so that the progress of restoration is not interfered with.

714. Funds required during Emergencies – (1) The divisional Engineer or the Assistant Engineer on his behalf may draw upon the station earnings according to the instructions prescribed by the Administration under note to **(Para 1405-G)** for the following purposes :–

(a) Payment to daily labour employment at the site of breach or accident.

(b) Purchase of tools or materials required in connection with accident which cannot be supplied in time by the Store Department.

(c) To provide food to engineering labour at the site of breach or accident with the assistance of Station Master or Inspectors of the Commercial Department.

(Supply of food free of charge is permitted in special circumstances at the discretion of the administration to facilitate expeditious restoration of traffic.

When food is supplied free at the site of an accident to engineering and other labour, the expenditure per head per day shall not exceed the prescribed limit).

(2) The Accounts Officer should be advised immediately by telegram of each sum taken from station earnings.

In all cases, Engineers obtaining advances from Station earnings should do so under a clear receipt. The purpose for which the money has been drawn should be clearly stated on the receipt.

A complete account should be submitted at the earliest possible date to the Accounts Department supported by pay sheets and vouchers.

(3) All payment to labour should be witnessed by the Assistant Engineer at site.

715. Obstructions found on track – When obstructions are found on the track those should be cleared after protecting the line and informing the nearest Station Master. Where sabotage is suspected, the Police should be advised immediately. The Permanent Way Inspector should, if so required, arrange to meet the Police Official at the place of occurrence. A detailed report should be submitted by Permanent Way Inspector to the Assistant/ Divisional Engineer. The Divisional Engineer should in turn report such occurrences whether or not sabotage is suspected to the Divisional Railway Manager and Chief Engineer.

716. Flooded Causeways / Dips –

(1) *Permissible depth of water for passage of trains* – In the case of causeways that are flooded and the velocity of current is insignificant, trains may be permitted to pass when the depth of water above rail-level does not exceed the following values, provided in each case Permanent Way Inspector has satisfied himself by walking over and probing that Permanent Way is intact and in a fit condition :–

Gauge	Passenger and Mixed trains	Goods train
B.G.	300mm.	450mm.
M.G.	230mm.	300mm.
N.G.	230mm.	230mm.

(2)(a) *Indication posts* – Indication posts about 1200 mm. in height shall be fixed at each dip, one at each end of the level portion, with flat bar attached to them to indicate level mentioned in **Para 716(1).**

(b) The posts should be painted black and white in 300 mm. length so arranged that the flat bars which shall be painted white, show up against 300 mm. length of black colour.

(c) The posts shall be fixed 3 metres from the centre of the track in the case of Broad Gauge and 2.5 metres from the centre of track in the case of Metre and Narrow Gauge.

(3) In the section where electric locos/stock and or diesel locos ply, special gauges may be provided by the administration at the place liable to flooding, indicating the depth at which these locos/ stock have to be stopped from the operation. These depths should be specified for each type of locos/ stock by the administration.

717. Special precautions when track is submerged – (1) The following precautions shall be observed when the track is submerged :

(a) In all cases train shall be stopped dead and allowed to proceed at a speed not exceeding 10 km. p. h.

(b) If water rises over the top of the ballast but is below rail level, the track should be checked before each train, by two men walking abreast one at either end of the sleepers, and only if the track has not been disturbed, should the train be allowed over the track.

(c) When water overtops the rails, the Permanent Way Inspector shall pilot the train, after ensuring that the track is safe, by walking over the track and checking by means of probing, subject to depths specified in **Para 716** not being exceeded.

(2) Telegraphic advise should be sent by the Permanent Way Inspector to the Assistant and Divisional Engineer, Divisional Railway Manager and Chief Engineer when water rises above ballast level and again when it subsides. This should be followed up by special reports to the Assistant Engineer and Divisional Engineer. Records of such occurrences should be entered in the Permanent Way Inspector's section register.

718. Driver's Report on Defects in Track – (1) *Intimation of defects* – (a) When a driver reports to a Station Master that the track over which his train has passed is unsafe for the passage of any further train, with particulars of location, the Station Master will block the section concerned and issue a wire to the Permanent Way Inspector, copying it to the Assistant Engineer, Divisional Engineer and Control. No train will be admitted on the section concerned, until the Permanent Way Inspector has inspected the kilometrage and certifies to the Station Master that the section is safe for the passage of trains, specifying the speed restriction, if necessary.

(b) When a Driver reports to a Station Master that the track over which his train has passed requires a restriction of speed, with particulars of location, the Station Master will impose the speed restriction over the section concerned and issue a wire to the Permanent Way Inspector copying it to the Assistant Engineer, Divisional Engineer and Control. Caution orders will continue to be issued on the section concerned until the Permanent Way Inspector has inspected the kilometrage and certifies to the Station Master that the section is safe for passage of trains specifying the revised speed restriction, if necessary.

(2) *Action on receipt of reports of defective track* – (a) *By Permanent Way Inspector* –

The Permanent Way Inspector shall –

(i) Proceed as quickly as possible to site, inspect the length of track reported on and record particulars in detail. Then arrange to rectify the track and remove or modify the restriction imposed, as found necessary.

(ii) Submit a detailed report to the Assistant Engineer and copy the same to the Divisional Engineer.

(b) *By Assistant Engineer* – Whenever possible, the Assistant Engineer should personally examine the track reported on for defects and make a detailed report to the Divisional Engineer.

719. Abnormal occurrences attributable to Locomotives and other Rolling Stock –

(1) Whenever distortion of track or any other abnormal occurrence attributable to locomotives or any other rolling-stock is noticed, the Permanent Way Inspector shall –

(a) Immediately impose speed restriction as necessary and arrange protection of the line as per rules.

(b) Report the occurrence by wire to the Loco Foreman concerned copying the message to the Assistant Engineer/Divisional Engineer and Divisional Mechanical Engineer, Control and Station Master on either side of the block section. Whenever possible, the number of engine/rolling-stock considered to be responsible for distorting the track should be given.

(c) Make a careful examination of the affected track with a view to finding out if any inherent weakness or defect in the track has contributed in bringing about the "abnormal occurrences", Particulars of defects should be noted in detail.

(d) Attend to defects as necessary and having done this, remove or modify the restriction as necessary.

(e) Submit a detailed report to the Assistant Engineer and copy the same to the Divisional Engineer.

(2) On receipt of intimation of any abnormal occurrence attributable to locomotive/Rolling-stock, Assistant Engineer should proceed to the site, examine the track minutely with reference to the report made by Permanent Way Inspector and submit a special report to the Divisional Engineer on the possible cause of damage with suggestion to prevent recurrence.

720. Accident not affecting through traffic– (1) The Permanent Way Inspector should immediately proceed to the site of the accident and take such measures, as necessary, to clear the obstruction and restore the line.

(2) The accident report in the prescribed form together with a sketch and statements of track particulars taken over sufficient length should be submitted in duplicate by the Permanent Way Inspector to the Assistant Engineer who will forward one copy of the report to the Divisional Engineer with remarks.

Accident reports should be scrutinised by the Divisional Engineer in all respects with particular reference to the time taken in restoring the line. Such instructions may be issued by the Divisional Engineer to the Assistant Engineers and Permanent Way Inspectors and to other departments, as may be deemed necessary.

The accident report form shall include particulars of date and time, kilometerage, description of accident, cause if known, number and type of train, engine, vehicles involved, names of Drivers and Guards, extent and cost of damage to the permanent way and rolling stock, time of restoration and the Permanent Way Inspector's special remarks. Accidents such as damage to the gate leaves/barriers by road vehicles, cattle run over and fire in which track is not affected, should be reported separately.

(3) As far as possible the Assistant Engineer should proceed to the site of accident of sufficient importance, such as derailments on running lines, gathering lines and of locomotives.

721. Records of accidents – (1) Apart from individual files, all important accidents, breaches, washouts and subsidence of track should be carefully recorded with complete particulars in the section register by Permanent Way Inspector.

(2) In the case of damage by flood at important bridges, detailed particulars with remedial measures adopted should be entered by Assistant Engineer in the Rivers and Floods Register and reference made thereto in the Bridge Inspection Register.

(3) Records of all the accidents should be maintained systematically in the offices of Permanent Way Inspectors, Assistant Engineer and Divisional Engineer so as to facilitate supply of statistical and other information as may be required.

722. Accident statements to the Railway Board – (1) Returns of the accidents under specified categories are compiled by the Operating Departments for submission to the Railway Board. Relevant particulars should be promptly furnished by the Divisional Engineer and Works Manager/ Deputy Chief Engineer of Engineering Workshops to the proper authority on such forms as may be prescribed.

(2) Workshop accident fall under Factories Act and should be reported according to the rules in force and to such local authority as may be specified.

PART 'B'

Pre-Monsoon Precautionary Measures

723. General precautions to be taken before monsoon – It is necessary to take certain precautions, and carry out certain essential works before the commencement of monsoon, such as

(1) All catch water drains and side drains must be cleared of silt, vegetation and other obstructions to ensure free flow and quick drainage of storm water.

The waterways of bridges must be cleared of vegetation and other obstructions. If silting is noticed in some spans, it should be removed to ensure that the full waterways is available for the discharge of flood water. During desilting, care should be taken to remove the silt only upto the bed level.

(2) Protective and river training works must be maintained in good condition and repairs carried out wherever necessary. Scour holes should be filled with boulders.

(3) The High Flood Level (HFL), Full Supply Level (FSL) in the case of canals, and Danger Level (DL) must be painted. The danger level mark shall be painted with bright red band across each pier adjacent to the abutment so as to be clearly visible to the Patrolmen, Special Watchmen and Drivers. Flood gauges shall be painted on important bridges as specified.

(4) Water shall not be allowed to stagnate on the track. For this purpose, cross drains should be provided at regular intervals. In yards, cross drains and longitudinal drains should be cleared/provided to proper grades.

(5) In hilly areas, where there is incidence of falling boulders, a survey should be carried out to locate loose boulders. Such loose boulders should be dropped in a systematic manner.

(6) Selection of Patrolman and Watchman should be made in accordance with **Para 1008** and they must be trained and tested for their knowledge of rules. The duties to be performed by them should be clearly explained to them.

The equipment of Patrolmen and other watchman shall be complete in all respects.

(7) Spare trollies should be kept in readiness at the headquarters of the Permanent Way Inspector and at other stations in the proximity of vulnerable locations. Motor Trollies must be overhauled and kept in fit condition.

(8) Rivers in the upstream reaches should be inspected for guarding against possible change in water course.

(9) The prescribed reserve stock of boulders, empty cement bags, wire netting and sand/quarry dust should be kept at specified locations for rushing to site, in case of emergency and should be made good, in case of deficiency.

(10) Action should be taken as envisaged in **Para 726(3)** in the case of Railway affecting works.

(11) The temporary Engineering indicators must be painted and kept ready for use.

(12) The rain gauges should be inspected before the monsoon and it should be ensured that they are in perfect working condition.

(13) Vulnerable locations/kilometrages should be reviewed jointly by the Assistant Engineers and Divisional Engineers and on the basis of past history and pre-monsoon inspections and the register of vulnerable locations should be brought up-to-date.

724. Materials for Emergencies – (1) Arrangements should be made to stock sufficient quantities of rails, sleepers, materials for cribs, ballast, sand/quarry dust and boulders at suitable points near vulnerable locations, so that the materials may be rushed to site as required.

(2) Before the onset of monsoon, specified number of wagons loaded with sand/quarry dust, ballast and boulders should be kept at appropriate stations for quick movement to vulnerable locations."

(3) During monsoon, as far as possible, ballast train should be programmed to work in the vicinity of the vulnerable zones so that they may be utilised without delay in emergency.

(4) Locations and quantities of reserve stocks should be made known to all Divisional Engineers and Assistant Engineers by the Chief Engineer. Reserve stock should not be used except in an emergency. When it is used, it should be recouped.

Divisional Engineer should send a certificate to the Chief Engineer to the effect that monsoon reserve stock is in order and to the scale laid down, by the prescribed date.

(5) Bridge Engineer/ Divisional Engineer should arrange to keep equipment like service spans, trestles, cribs, derricks, compressor, equipment and materials required for blasting, pavement breakers, welding sets etc., ready for use in emergencies. These should be stocked at convenient places so that they can be despatched to the site of breaches without delay.

725. Service Spans and Rail Clusters

(1) *Service spans* – details of temporary service spans available on each railway should be listed and circulated for the guidance of Assistant Engineers and Divisional Engineers before the monsoon.

(2) *Rail Clusters*- It is some times necessary to provide rail clusters to pass traffic in emergencies. Rail cluster may be used as a temporary measure in emergency subject to following conditions :–

(i) Speed restriction shall be 10 km. p. h.

(ii) Rails forming clusters must be clamped together with head and foot alternatively.

(iii) Rail cluster must extend over the full dimension of the sleeper crib and must be spiked to the top sleepers.

Drawings showing details of section of rail/ No. of rails/clear span to be used under each running rail, shall be issued by the Chief Engineer of the railway for the guidance of Permanent Way Inspectors and Assistant Engineers, who should be in the possession of the same.

726. Railway Affecting Works (including Railway Affecting Tanks) – (1) *Definition* – The term "Railway affecting Work" may broadly be taken to mean any work which if not constructed and maintained properly, or not operated properly may result in danger to Railway Line (Bridge/ embankment). This may include tanks, storage works, canals, bunds, etc.

(2) *Register of Railway affecting works* – The Divisional Engineer/ Assistant Engineer will maintain an up-to-date list of Railway affecting works as jointly approved by the Railway and the state Government. The list shall invariably show the particulars of state Authority responsible for maintenance of each railway affecting work.

(3) *Inspection of Railway affecting tanks* – Where as per current practice the Public Works or Revenue Department forwards to the Divisional Engineer every year, their inspection reports on the condition of these tanks which are classified as Railway affecting, action should be taken as follows:–

(a) The Divisional Engineer should peruse the reports carefully and mark those tanks which he considers are not in satisfactory state of repair. He should then forward the reports to the Assistant Engineer with instructions that the tanks so marked should be inspected and reported on.

(b) The Assistant Engineer should inspect those tanks and report to the Divisional Engineer details of the action being taken by the Public Works or Revenue Department. The Divisional Engineer should prevail on the authorities concerned to carry out all necessary repairs before the ensuing monsoon.

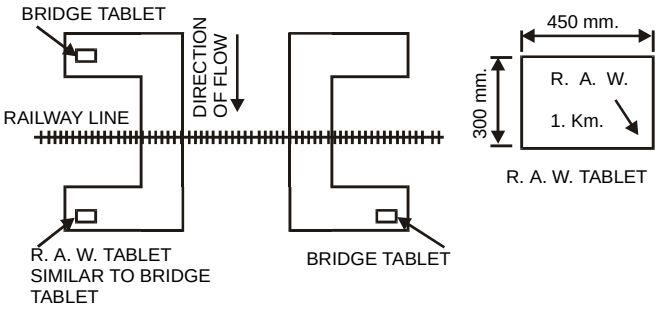
(c) Copies of the inspection notes of 'Railway Affecting' tanks as received from the Public Works or Revenue Department with particulars of date of inspection and notes of action taken or proposed by him should be included in the Register of Railway Affecting Works maintained by the Assistant Engineer.

727. Vigilance over Railway Affecting tanks during heavy rains – (1) the Divisional Engineer and the Assistant Engineer should arrange with the local authorities/village headman in whose jurisdiction 'Railway Affecting' tanks are situated to watch them during periods of heavy rain and give timely intimation to the nearest Station Master, if there is likelihood of any tank failing. The Station Master will telephone/ telegraph reports received from village Headman to the Permanent Way Inspector, Assistant Engineer and Divisional Engineer.

(2) When the railway line is threatened, the Assistant Engineer and Permanent Way Inspector shall take adequate steps to ensure the safety of Railway property and staff and arrange patrolling of the line and or post watchmen with necessary equipment at the place or places threatened and advise the Divisional Engineer accordingly.

(3) All the Bridges which are likely to be affected by Railway affecting tanks or other storage works should be provided with a tablet on top of one of the parapets, with the letters RAW engraved on it, followed by an arrow mark pointing in the direction of the railway affecting storage work in question.

A typical sketch of R.A.W. tablet is shown below–



NOTE:

1) R.A.W. TABLET TO BE PAINTED IN WHITE.
2) LETTERS AND ARROWS TO BE PAINTED IN RED.

DETAILS OF "RAILWAY AFFECTING WORKS" TABLET (R. A. W.)

(4) If the bridge in whose catchment a Railway affecting tank is located is classified as a vulnerable location, stationary watchmen should be posted during monsoon. If for any reason, repairs as envisaged during the inspection, as per para 726(3) is not carried out, the section of the Railway line likely to be affected should be considered as vulnerable and watchman as considered necessary posted.

728. Weather warnings and action to be taken – (1) *General* – (a) Arrangement should be made with the concerned Meteorological Centre for receipt of bad weather warnings.

(b) The bad weather warnings to be received should cover both high velocity winds and cyclones as well as heavy rainfall and arrangement should be made for receipt of the same throughout the year.

(c) The list of Officers who should receive the bad weather warnings and their addresses should be discussed at personal level with the Meteorological Department. The list should be reviewed and updated every year.

(d)Detailed instructions and full-proof arrangement should exist for prompt communication of bad weather warnings on receipt to the line staff.

(e) Anemometer should be installed at one of the adjacent stations of specially selected bridges where very high velocity winds are experienced and where there is a danger of vehicles capsizing.

(f) Suitable working rules should be framed prescribing for each location the danger level of wind velocity and enjoining upon the Station Master to control (stop) the traffic on the section concerned when the wind velocity exceeds the danger level and also to inform the Station Master on the other side and the Section Controller of the need to control the traffic.

(2) *Precautions to be taken by Station Master, Driver and Guard – Regarding controlling of trains* – (a) When a weather warning message has been received forecasting heavy or cyclonic storm and there is reasonable doubt that a severe storm and high winds are going to break through, that may endanger the safety of passengers/ train, the Station Master may, in consultation with the Guard and Driver, detain the train until the storm and high winds abate and it is considered safe to allow the train to proceed from his station.

(b) In spite of the action outlined above should the Driver be still caught on run in a storm and high winds of an intensity which in his opinion are likely to endanger the safety of passengers/ train, he should bring his train with the least delay to a halt, avoiding such stoppage at places like sharp curves, high embankments, cuttings and bridges. The train could be restarted in consultation with the Guard only after the storm and high winds abate and it is considered safe to proceed.

(3) *Action by the P.W.I* – (a) The Permanent Way Inspector on receipt of weather/cyclone warning, should arrange to advise monsoon patrolmen/ watchmen and Gang Mates to be extra vigilant.

During the fair season, he should introduce monsoon patrolling as soon as possible and also post watchman as required at all vulnerable locations and bridges by day as well as by night for a period extending upto 48 hours beyond the period specified in the weather/ cyclone warning message.

(b) The Permanent Way Inspector should be out in his section as far as possible by trolley during the period of warning and 48 hours beyond.

(4*) Action by the Gang Mates* – On receipt of advice from the Station Master the Gang Mate should take the following action :– (a) During the fair season, the Mate of station yard gang should depute two reliable gangmen provided with patrolmen's equipment for patrolling the block sections on either side and for alerting the intermediate Gangmates.

(b) During monsoon period also the Mate of the station yard gang should send two gangmen in opposite directions to alert intermediate Gangmates, patrolmen and watchmen.

(c) Should there be very heavy rain or a severe storm weather during the monsoon or fair season, the Mate and Gangmen of all gangs on their own initiative should commence monsoon patrolling by day as well as night. Similar action to carry out patrolling should be taken on receipt of bad weather warning for the duration of warning and 48 hours beyond.

(5) The individual Railway may issue instructions in the form of joint circular to suit the local requirements.

(6) Inspecting officials should test the knowledge of Gang Mates and Gangmen about these instructions issued.

ANNEXURE 7/1 (Para 707)

The following details are to be shown on the dimensioned sketch to be prepared in the case of accidents :

(1) The train number, the date and kilometerage of site of accident should be furnished.

(2) The North point should be indicated.

(3) It should indicate prominently the direction of movement, and also the names of stations in rear and advance of the accident site.

(4) It should a cover a length of about 300 meters behind the point of mount an almost an equal distance in front.

(5) Each track of the Permanent Way must be denoted by a pair of lines.

(6) The position of level crossings, Telegraph posts/ Electrical posts, Bridges, Tunnels, Gradient posts with Gradient symbols, curves, demarcating the beginning and end, giving details of degree of curvature, prescribed super elevation and length of transitions should be indicated.

(7) It should also indicate the position :

(a) of all derailed vehicles and the marks left by them either on sleepers, rails or ballast,

(b) of the point of mount with position of rail joint on either side,

(c) of the point of drop,

(d) of the pair of wheels of the first derailed vehicle,

(e) in which every displaced rail/ wagon or part of a rail/wagon and detachable components were found.

Note – In all cases, dimension from nearest kilometre post and centre line of track should be given.

(8) In case of accidents within station limits, sufficient details about the station layout should be shown in order to fully explain the movement of the affected train in relation to the topography of the place. The signal aspects at the time of accident should be correctly depicted.

(9) The distance of the site of accident from a permanent structure to fix the site of accident precisely should be indicated.

(10) The distance should be indicated to show the extent of the disturbance caused in the Permanent Way or train composition on account of the accident.

(11) Any marks on sleepers or other track fittings should be clearly indicated in their exact position in relation to the track or vehicles.

(12) Broken parts of other extraneous material, if found on the site of accident, should be shown in the sketch, with details giving their precise position in relation to track.

(13) If necessary, more than one sketch should be enclosed one clarifying the yard layout and the system of working it and the other giving details, such as, position of wheels, wheel marks etc. In the former, one line should be used to represent both rails of track and such position of the station yard (in case of accidents within station limits) should be covered as may be necessary. All necessary details relevant to the issue must be embodied in the sketch. The terminal station on the down side should be mentioned on the right extremity of the sketch, the terminal station on the up side being mentioned on the left extremity. If the accidents take place within station limits the shorter sketch should be based on the station working diagram.

(14) Details of track structure should be shown in the sketch.

(15) Details of damages to bridges involved, spanwise should be shown.

(16) In the case of accidents to and near level crossings, full details of the level crossings should be furnished.

(17) Any other details as may be considered necessary to reconstruct the scene of the accident should also be shown.

ANNEXURE-7/2 PARA 708 (1)

PART - A

Pro forma showing the detailed particulars to be collected in the case of Permanent Way during an Accident

Soil			Type of Formation	Rain Fall	Ballast		
Sl. No.	Type e.g. Sandy, loamy clay, Moorum, Black cotton etc.	Condition - firm, wet, slushy etc.			Type/stone, Moorum, Sand, Ash etc.	Depth below sleeper bottom in cms. Stating whether clean or caked	Drainage
1	2	3	4	5	6	7	8

Width of shoulders in cm. from outside of				Sleepers				
Rail								
Left	Right	Left	Right	Type - Wooden CST - 9 steel trough etc.	Condition - New second hand, damaged,unservic-eable etc.	Density	Square or not	Packing loose or sound
9	10	11	12	13	14	15	16	17

ANNEXURE-7/2 Contd...

Rails		Rail fastenings		Rail joints		
Weight 52 Kg./ 90R/75 R etc.	Condition of wear (attach rail profile if wear is heavy)	Dog/screw spikes, keys, tie bars, cotters, loose jaws etc.		Condition: Hogged battered, low etc.	Staggered or square	Creep-Direction and extent of creep, type of creep anchors used with numbers per rail in the affected section
		Number per sleeper seat	Condition: Tight or loose or missing (in each sleeper)			
18	19	20	21	22	23	24

General remarks about cracks or fracture of fish-plates, fish bolts and other components	Description of anti-sabotage measures like reverse jaws welded rails etc.	Location of points of mount		Location of points of derailment	
		Whether on straight, curve or transition	Whether on a falling grade, level or rising grade and or on sag	Whether on straight, curve or transition	Whether on a falling grade, level or rising grade and or on sag
25	26	27	28	29	30

Note –

(1) Left and right are with respect to direction of Train movement.

(2) The data in Col. 2 to 25 need not be collected when the defect is obviously and indisputably on account of sabotage and/or obstruction on track.

(3) Only broken track material which is not indisputably to be broken after the accident should be included in Col. 25 and should be preserved.

(4) Col. 26 need be filled in only when there is a suspicion about sabotage being the cause of derailment.

(5) Sag extends 90 metres on either side of theoretical junction of the grade lines Col. 28 and 30.

ANNEXURE-7/2 Contd... PARA 708 (1)

PART - B

Track Measurements

Station No.	Distance apart in metres	Gauge slack or tight from the exact (mm.)	Cross Level (mm.)		Marks on sleepers or rail top	Grinding or rubbing marks on rails
			Under no load condition	Under load condition to be measured with a locomotive/fully loaded wagon/coaching stock bogie		
1	2	3	4	5	6	7

Examination of alignment for perceptible kinds of track distortion in the vicinity of the point of derailment	Subsidence of track	Versine in mm.			
		On 20 M. or 10 M. chord depending on practice prevalent on the Railway for flat curves more than 600 M. radius	On 10 M. or such shorter chords as considered necessary for sharp curves (less than 600 M. radius on B. G. and M. G.)	Remarks regarding length of transition, degree of curve and specified superelevation general alignment etc.	Longitudinal level to be recorded in the case of M. G. and N. G. in case of sags and curves
8	9	10	11	12	13

Note –

(1) The point of mount should be marked station No. 0 and the stations numbered serially as (+) for measurements ahead of site of derailment and (—) for measurements in rear.

(2) The cross level will be measured on the left rail only as determined from the direction of movement.

(3) Normally measurement will be taken at station 3 M. apart for a distance of 45 metres on either side of 0 station if the cause of derailment is indisputably known, otherwise they will be taken for a distance of 90 metres in rear and 45 metres ahead of zero station.

(4) Where necessary measurements for Col. 3, 4 and 5 may in addition be taken at individual sleepers.

(5) This proforma need not be filled when the cause of derailment is obviously established as due to sabotage, obstruction on track, broken axle, and/or spring having fallen off prior to point of derailment.

(6) Longitudinal levels should be recorded for 300 metres on rear and 100 metres in front, in case of straights at the middle of each rail and at versine recording points on curves @ 20/10 M intervals.

CHAPTER VIII

ENGINEERING RESTRICTIONS AND INDICATORS AND USE OF DETONATING AND FLARE SIGNALS

801. Work involving Danger to Train or Traffic– A gang shall not commence or carry on any work which will involve danger to trains or to traffic without the previous permission of the Inspector of Way and Works or of some competent Railway servant appointed on this behalf by special instructions. The Railway servant who has given the permission should be himself present at the site to supervise the work.

802. Carrying out of Works, in case of Emergency – In the case of emergency, when the requirements of safety warrant the commencement of the work by the gangmate, before the arrival of the railway servant, the gangmate shall himself ensure that Engineering signals are exhibited at specified distances according to rules and flagmen are posted with necessary equipment to man them, before commencing the work.

803. Responsibility of the Railway servant in-charge of the work – The Railway servant in-charge of the work, who is present at the site work, shall ensure that Engineering signals are exhibited at the specified distance according to rules and flagmen are posted with necessary equipment to man them. Trains shall be permitted over the track under repair at such restricted speed as is specified, only after the track is rendered safe for the traffic. He should ensure that the provisions of **Para 804** are fulfilled before commencing the work.

804. Precautions before commencing operations which would obstruct the line – No person employed on the way, works or bridges shall change or turn a rail, disconnect points or signals or commence any other operation which would obstruct the line without obtaining the written permission of the Station Master who shall ensure that all necessary signals have been placed at 'ON'. In addition, the employee mentioned above shall also ensure that the necessary stop signals like banner flags and detonators and hand signal flags have also been placed/exhibited at the prescribed locations as per **para 806**.

Provided further that in emergent cases the persons undertaking such operations shall first bring the train to stop as stipulated in para 812 and advise the driver of the train about the need to stop the train through a written memo. The railway servant shall simultaneously arrange to send a message to the Station Master for the need to block the track as per para 810 and obtain written confirmation of the same. The work which may lead to obstruction to the track shall however be done only during the traffic block, the written confirmation for which shall be obtained from the concerned Station Master. On completion of the work again the authorised railway servant shall advise the driver through a written memo to proceed at the prescribed speed.

805. Categories of Engineering Works – Engineering works can be broadly divided into three categories –

(1) *Category 1* – Works of routine maintenance, requiring no speed restriction, not necessitating exhibition of hand signals and involving no danger to trains or traffic.

These include works of routine maintenance such as through packing, picking up slacks and overhauling of track etc.

(2) *Category 2* – **Works of short duration –**

(a) Works such as casual renewals of rails and sleepers, adjustment of creep and lubrication of rail joints which are completed by sunset of the day of commencement and no restriction of speed thereafter is required, are termed "works of short duration".

(b) Hand-signal and banner flags and fog-signals shall be used at specified distances to afford protection to trains.

(3) *Category 3* – **Works of long duration –**

(a) Works such as relaying, bridge construction, diversions which extend over a few days, or weeks during which period a continuous restriction of speed is to be in force, are termed as "works of long duration".

(b) Temporary Engineering fixed signals shall be used at specified distances to afford protection to trains. These works should be carried out to a programme, about which all concerned will be advised in advance.

806. Works of short duration – *Protection in block section and procedure for passing of trains* – Before commencing any work of such category the Permanent Way Inspector or authorised Railway servant should issue a notice to the Station Master/ Block hut in-charge at each end of the Block section and obtain their acknowledgment. Depending as to whether the train is to be passed through the work site, after stopping or at a restricted speed, the line should be protected in the following manner :–

(1) *When the train is required to stop at the site of work (in Block section)* –

(a) Post a flagman with hand signals at a distance of 30 metres in rear of the place of obstruction, to show stop hand signals.

(b) Post a flagman with hand signals and place a banner flag across the track at a distance of 600 metres on Broad Gauge and 400 metres on Metre Gauge and Narrow Gauge in rear of the work. The flag man will show stop hand signals

(c) Post a flagman with hand signals and detonators at a distance of 1200 metres in the case of Broad Gauge and 800 metres in the case of Metre and Narrow Gauge in rear of the work. The flagman shall fix three detonators on the line 10 metres apart and take stand at a place not less than 45 metres from the three detonators, from where he can obtain a clear view of the approaching train. He will show stop hand signals.

Note – In M.G. Sections with trains running at a maximum speed of more than 75 km.p.h. the distances (b) and (c) shall be as specified under approved special instructions.

(d) The man at the site of obstruction shall give proceed hand signal to indicate to the Driver, when he may resume normal speed after the train has been hand signalled past the obstruction (**Annexure 8/1).**

(2) *When the train can pass over the workspot at restricted speed in Block section* – Keeping in view the provisions in para 1501.1(C) /GR.1976 the following protections should be adopted in the above cases :–

(a) Post a flagman exhibiting caution hand signals at a distance of 30 metres from the place of obstruction.

(b) Post a flagman exhibiting caution hand signals at a distance of 1200 metres for Broad Gauge and 800 metres for Metre Gauge and Narrow Gauge from the place of obstruction.

(c) Post a intermediate flagman with hand signals at a distance of 600 metres for Broad Gauge and 400 metres for Metre Gauge and Narrow Gauge from the place of obstruction. He will also place a banner flag across the track. The intermediate banner flag must be kept across the line until the speed of the train has been reduced, after which the banner flag shall be removed and the train hand signalled forward.

In Metre Gauge sections with trains running at a maximum speed of more than 75 km.p.h. the distance in (b) & (c) shall be increased as specified under approved special instructions.

(d) The railway servant at the site of work should give proceed hand signals to indicate to the Driver, that he may resume normal speed after the train has been signalled past the site of work- (**Annexure 8/2).**

(3) The following points should be kept in view, while protecting the track in the cases mentioned in sub-para (1) and (2) above :–

(a) On single line, the line must be so protected on both sides of the work.

(b) At places where there are curves or falling gradients and at times of poor visibility the distances laid down in sub-paras (1) and (2) above may be suitably increased wherever necessary and intermediate flagman posted to relay hand signals.

(c) The location of the banner flag, detonators and hand signals should be so selected as to avoid stopping of trains, as far as possible, on continuous steep rising gradients.

(d) If in an emergency, it becomes necessary to carry out such works at night, the provisions for protection of line as detailed in sub-pares (1) and (2) must be complied with except that red light must be exhibited in the direction of approaching trains in place of red hand signaling flags and banner flags.

(e) In an Emergency, when it is necessary on considerations of safety, the Permanent Way Inspector, or authorised railway servant may commence such work after protecting the line before issuing notice to the Signalman. If the work is likely to be prolonged he should notify the Signalman as soon as possible.

(4) *Works to be carried out in station limits* –

(a) No work should be commenced on running line at a station without the written permission of the Station Master and until the relevant signals have been placed at 'ON'.

(b) Before commencing a work on a line which can be isolated from the other running lines, the Permanent Way Inspector should ensure that the line has been isolated and retain the keys of locking device in his possession. Where isolation is effected by the setting of points, they must be locked by means of clamps or bolts and cotters.

(c) Before commencing work on a line which cannot be isolated from other running lines the Permanent Way Inspector should provide the prescribed hand signals, detonators and banner flags as detailed in **para 806**.

(5) *Works in Automatic Territory* – In automatic territory, if the distance from the place of works/ obstruction to the automatic signal controlling entry of a train into the signalling section is less than 1200 metres on Broad Gauge and 800 metres on Metre Gauge/Narrow Gauge and the automatic signal is secured at 'ON' the banner flag and three detonators may be provided at 90 and 180 metres respectively.

807. Works of long duration –

(1) *Preliminary arrangements* –

(a) For doing such works the Engineering Department will arrange with the Operating Department for the issue of the circular notice as per extant instructions.

(b)The concerned Divisional Engineer will be responsible for obtaining the sanction of Commissioner of Railway Safety wherever necessary and sending Safety Certificate on completion of such works.

(c) The Permanent Way Inspector should obtain permission to commence work from D.E.N./ A.E.N. and should arrange to block the line when work is proposed to be done under block with the permission of the Controller/Chief Controller on the day of block and issue a notice to the Station Master on either side.

(d) Caution orders will be issued by the Station Masters concerned as necessary.

(e) The necessary temporary Engineering fixed signals as prescribed should be provided.

(f) In an emergency, when it is necessary on considerations of safety, the Permanent Way Inspector, or Authorised Railway servant may commence such work before issuing the notice, under the protection of hand signals and banner flags. As soon as possible, he should issue the notice and replace the hand signals and banner flags by temporary engineering fixed signals.

(2) *Protection of line in block section* –

(a) In case where stop dead restriction is to be imposed when restriction is to last for more than a day, the following temporary Engineering indicators should be exhibited at the appropriate distance :–

(i) Caution indicator.

(ii) Stop indicator.

(iii) Termination indicators.

(b) In case where the train is not required to stop (non-stop restriction) and the restriction is likely to last for more than a day the following temporary Engineering indicators should be exhibited at the appropriate distances :–

(i) Caution indicator.

(ii) Speed indicator.

(iii) Termination indicators.

Note — (i) Annexure 8/3 and 8/3 A indicate the distances at which these are to be fixed.

(ii) When during the course of the work, on consideration of safety it is not desirable to pass trains over the site of work for the time being, the track should be further protected by hand signals and banner flags, by the authorised Railway servant.

(3) *Protection of line in station limits* – Special instructions will be issued by the Divisional Railway Manager (Operating) after consultations with Divisional Engineer and Divisional Signal and Telecommunication Engineer in regard to the use of temporary Engineering signals in conjunction with station fixed signals. In urgent cases these will be issued by the Station Master at the request of Permanent Way Inspector.

808. Temporary Engineering Fixed Signals-Location and details – (1) These consists of :

(a) Caution indicator.

(b) Speed indicator.

(c) Stop indicator.

(d) Termination indicators (T/P & T/G).

(2)(a) *Multi Speed Restriction* (i.e. existence of two or more than two speed restrictions in continuation): When work of deep screening or sleeper renewal is in progress, there is situation of having two or more than two speed restrictions in continuation. In such situation, placement of speed boards for following speed restriction shall be as under:

(i) In case of following speed restriction being more restrictive, a minimum of 200m track should be under earlier speed restriction zone. If not, then only one SR board should be provided, considering that the previous speed restriction is at par with the following SR, which is more restrictive.

(ii) In case of following speed restriction being less restrictive, corresponding speed indicator board for following speed restriction shall be placed at a distance equal to the length of the longest goods train operating on the section after termination point of previous speed restriction zone.

(2) (b)The details and position of fixing each indicator are detailed **in Annexures 8/4, 8/3 and 8/3 A**.

(3) During the hours of night, the lamps of the temporary indicators which are not reflective type should be lit at sunset and kept burning till sunrise, where trains run at night. Reflective type temporary indicators need not be lit.

(4) For intermediate tracks on triple or multiple lines, Engineering indicators should be fixed between tracks to within 300 mm. from rail-level, to avoid infringements of standard dimensions.

(5) All indicators should be placed on the left hand side as seen by the Drivers except on CTC sections (single line) where they should be placed on Right hand side.

(6) Each Permanent Way Inspector should have in his possession at least one complete set of signals consisting of 2 caution indicators, 2 speed indicators, 2 stop indicators and two sets of termination indicators (2 Nos **T/P** & **T/G** indicators).

(7) One termination indicator bearing letters **T/G** should be located at a distance equal to the length of the longest goods trains operating on the section from the place of work. Another Termination indicator bearing the letters **T/P** should be located at a distance equal to the length of the longest passenger train operating on the section from the place of work which will help the passenger trains to pick up speed after reaching **T/P** indicator, without losing time. The Guard of a passenger train shorter than the longest passenger train will exhibit an "all-clear" signal to his Driver when the rearmost vehicle has cleared the restricted length and the Driver will resume normal speed. In the case of light-engines or single unit rail cars, the Drivers will resume normal speed after clearing the restricted length.

809. Procedure for Passing Trains at stop dead Restrictions – The flagman at the stop indicators shall present his restriction book to the Driver who should stop in the rear of the stop indicator.

The "restriction book" should be to the following form:

Engineering indicator at km……

Date	Train No.	Time	Signature of the Driver

After the flagman has obtained the signature of the Driver at the indicator, he should exhibit proceed with caution signal to the Driver. The Driver will then be authorised to pass the stop indicator and continue at this speed until his train has cleared the restricted length, after which he will resume normal speed.

810. Procedure for blocking line for Engineering purposes – (1) *Arrangements for block–*

(a) Except in very urgent cases arrangements for Blocking the lines between stations shall be made by the Divisional Engineer in consultation with the Divisional Operating Manager, sometime before the block is imposed.

(b) The Divisional Operating Manager will issue instructions to the Station Masters on either side of the section to be blocked and Station Masters/Yard Masters of train ordering stations concerned about the last train to pass over the section before the block is imposed, the trains to be cancelled because of the block and any other particulars and will conclude by stating which official of the Engineering Department will impose and remove the block. The instructions will be acknowledged by those to whom issued.

(c) In an emergency when there is no time to refer to Divisional Operating Manager or where block will not interfere appreciably with the traffic the Station Master (after consulting control on controlled section) will arrange directly with the Engineering Official requiring the block.

(2) Imposition of Engineering Block – (a)The Inspector or authorised railway servant who blocks the line should transmit a message to the Station Master on either side of the block section to be blocked, copy to the Divisional Engineer, Assistant Engineer, Loco Foreman, Controller on controlled sections and Divisional Operating Manager, advising them of the time from which the block is to be imposed and the kilometrage and asking for acknowledgement from the concerned Station Masters.

(b) The Station Master receiving the message for transmission will sign for it, noting the time of receipt and shall transmit the message to the Station Master on the other side of the block section, which is to be blocked, and to the Controller.The Station Master on the other side will acknowledge receipt by a message addressed to Permanent Way Inspector or authorised railway servant and the Station Master of the transmitting station.

(c) On receipt of this message the Station Master of the station from which the message was transmitted will block the line in the manner prescribed and hand over a signed copy to the Inspector.

(d) Field telephone should be used for liaison with the Control during the block.

(3) Removal of Engineering Block – (a) When removing a block the Inspector or authorised railway servant responsible will transmit a message to the Station Master on either side of the block section blocked, copy to the Divisional Engineer, Assistant Engineer, Loco Foreman, Controller, Divisional Operating Manager etc., advising them that the block has been removed and asking for acknowledgement from Station Masters. Particulars of kilometrage, restriction of speed and position of Engineering Indicators should be given in the telegram.

(b) The Station Master who receives the message for transmission will sign for it, noting the time of receipt and transmit the message to the Station Master of the other station. The message must be acknowledged by the latter, addressed to the Inspector and Station Master of the transmitting station.

On receipt of this acknowledgement the Station Master who originally imposed the block, will remove it in the manner prescribed. The Control or the Divisional Operating Manager, will advise the Station Masters on the train ordering stations when a block is finally removed.

(4) Issue of Caution Orders to Drivers – Caution order to Drivers of all trains will be issued by the Station Masters for temporary engineering restrictions. Caution order will indicate the exact kilometrage, speed restrictions, stops, as the case may be, but will not include permanent restrictions that are notified in the working time-table.

811. Works at times of poor visibility – In thick foggy or tempestuous weather impairing visibility, no rail shall be displaced and no other work which is likely to cause obstruction to the passage of trains shall be performed except in case of emergency.

When such work has to be undertaken and the site is protected by temporary engineering fixed signals, 2 detonators on the line 10 metres apart should be fixed not less than 270 metres in rear of the caution indicator and a caution hand signal exhibited to approaching trains.

812. Temporary Signals in Emergency –

(1) Whenever in consequence of an obstruction of a line or for any other reason it is necessary for a railway servant to stop approaching train he shall plant a danger signal at the spot and proceed with all haste in the direction of an approaching train with a danger signal (red flag by day and red light by night) to a point 600 metres for Broad Gauge and 400 metres for Metre Gauge and Narrow Gauge from the obstruction and place one detonator on the line after which he shall proceed further for not less than 1200 metres for Broad Gauge and 800 metres for Metre Gauge and Narrow Gauge from the obstruction and place three detonators on the line 10 metres apart. He should then take a stand at a place not less than 45 metres from there from where he can obtain a good view of an approaching train and continue to exhibit the danger signal, until recalled. If recalled, he shall leave on the line three detonators and on his way back pick up the intermediate detonator continuing to show the danger signal. In case of those Metre Gauge sections where the maximum speed is more than 75 km.p.h. these distances will be as per approved special instructions.

(2) On single line the line must be protected on each side of obstruction.

(3) Where there are adjacent lines and it is necessary to protect such lines, action should be taken on each such line in a similar manner.

813. Periodical notice of Engineering Restrictions – For works involving restriction of speeds of trains the Divisional Engineer will arrange publication in the periodical gazette of the railway furnishing following details :–

(1) The names of the block stations on either side of the site where the engineering work will be undertaken in order that caution orders may be issued.

(2) Kilometrage of site of work.

(3) Restricted speed and stop dead restriction to be observed by the Driver.

(4) Nature of work being undertaken or reasons for restriction.

(5) Probable duration.

814. Permanent speed restriction indicators– (1) *Permanent speed restriction boards–*

(a) Permanent speed restrictions in force are notified in working time-tables. The speed indicators are erected to indicate to the Drivers the speed restrictions to be observed e.g., between stations, and at stations due to weaker/non standard track/ bridges, restrictions on curves, grades and points and crossings etc.

(b) The indicators to be used are similar to those used for temporary restrictions, namely, caution indicator, speed/stop indicators and termination indicators (T/P&T/G). The details of the indicators and the distance at which they are to be fixed are the same in both the cases **(Annexure 8/3 & 8/4)**.

(c) The permanent indicators need not be flood lit at night as in the case of temporary indicators/ signals.

(2) *Siding Boards.*- When speed restriction has been imposed on account of facing points of an outlying siding an 'S' marker (a circular board of 1 metre dia. painted yellow, with 300 mm. letter 'S' painted in black on it) should be fixed at the points in addition to the speed and caution boards fixed in rear of the points. Where however, the sanctioned speed of the section does not exceed 50 km.p.h. the speed indicator and the 'S' board need not be provided except where the speed over the points is less than sanctioned speed of the section. 'S' marker should be so fixed that the centre of the board is 2 metres above the rail level.

(3) *Board indicating speed over points* – Where the speed over the points at a station is less than the speed sanctioned at other stations on the same section, a permanent speed indicator should be fixed on the first approach signal of the station.

(4)The posts of permanent speed indicator marker boards should be painted with 300 mm. high bands in white and black.

(5) Where a permanent speed restriction is in force on any intermediate track on triple or multiple lines, the engineering indicators should be fixed between tracks to within 300 mm. from rail-level to avoid infringement of standard dimensions.

815. Indicators (General) – (1) Where indicators are provided under special instructions to furnish information to Drivers, these should be in black letters or figures on yellow back ground.

(2) *Whistle indicator* – (a) Whistle boards should be provided in rear of all places where the view of the Drivers is obstructed by cuttings or tunnels or curves and where it is necessary to give audible warnings of the approach of a train to those working on the track. The whistle boards are fixed at a distance of 600 metres.

(b) *Whistle indicator for level crossings* – Whistle boards are also provided on the approach of all unmanned level crossings and in case of manned level crossings, where a clear view is not obtained. These bear the letters W/L. The details of these whistle boards are described in Para 916(1)/ Chapter on Level Crossings and Gateman.

(3) *Shunting limit Boards* – They are provided at an adequate distance in advance of the trailing points. This shall consist of 600 mm. x 1000 mm. rectangular board painted yellow with a black cross on the top and words "shunting limit" written in black below it. Its height should be 2 metres from the rail level to the underside of the portion containing the cross and the post on which it is fixed, painted with 300 mm. high bands in white and black. It should be fitted with a lamp showing white light in both directions.

816. Detonating signals – Detonating signals otherwise known as detonators or fog signals are appliances which are fixed on the rails, and when an Engine (or vehicle) passes over them, they explode with a loud report so as to attract the attention of the Driver.

817. Care and Custody – (1) Detonators should be protected against damp. They should be stored in tin cases with papers wrapped over them, a layer of waste cotton must be kept at bottom and top of the tin cases to avoid contact with the metal.

(2) In one tin case not more than twelve detonators should be kept.

(3) The tin cases should be stored in wooden boxes which should be kept in dry places and not left in contact with the brick walls, damp wood, chloride of lime or other disinfectants; these should not be exposed to steam or other vapours.

(4) Unexploded detonators should not be as far as possible sent from place to place by consignment; they should be conveyed personally or by a messenger.

818. Stock with Engineering Staff – (1) Each way, Works and Bridge Inspector shall have a stock of detonators sufficient to recoup the number annually tested and any which may be exploded for works and emergency. The Permanent Way Inspector shall ensure that all Gangs, Gatemen, Keymen, Patrolmen and Watchmen are equipped with the specified number of detonators.

(2) Every Assistant Engineer, Gangmate, Keyman, Gateman, Patrolman and Watchman, whose duties include protection of track shall carry the specified stock of detonators with him on duty, for use during an emergency.

(3) The month and year of manufacture are shown on the label outside each case and also stamped on each detonator. Detonators should be used in the order of the dates stamped on them, the oldest being used first. To facilitate ready withdrawal in this sequence, they should be stored also accordingly.

819. Use of Detonators – (1) The staff in possession of detonators shall not make any improper use of them. Engineers and Inspectors are responsible to ensure that the staff working under them know how and when to use detonators.

(2) A detonator when required to be used shall be placed on the rail with the label or brand facing upwards and shall be fixed to the rail by bending the clasps around the head of the rail.

(3)In the case of a mixed gauge, detonators shall be placed on the common rail or on the rail of each gauge.

820. Testing – (1) Once a year, one detonator shall be taken by the Permanent Way Inspector from his own stock and from Gangmate, Keyman, Gateman, Patrolman and Watchman for testing, one also from each of the lots in the personal custody of Divisional Engineer, Bridge Engineer, Assistant Engineer, works and relieving Permanent Way Inspector where the headquarters of these officials falls within the P.W.I.'s jurisdiction. The oldest detonators should be selected for the test.

(2) The testing of detonators should be done under an empty 4-wheeled B.G./M.G./N.G. wagon propelled by an engine and moving at walking speed under the direct supervision of the Permanent Way Inspector, who shall ensure safety range during testing. Results of tests should be entered in a Register.

(3) The P.W.I. shall submit by the end of the year (31st December) a certificate in duplicate to the Assistant Engineer to the effect. "I certify that I have tested the detonators from stocks mentioned below in accordance with standing orders for the year ending ….. and append a list of those that failed to explode." The Assistant Engineer shall countersign and forward one copy of the certificate to the Divisional Engineer with remarks, if any. Orders regarding the return or destruction of those lots, the samples from which failed to explode, shall be issued by the Divisional Engineer.

821. Life of detonators – The normal life of detonators is seven years. The life of the detonators can be extended to ten years on an yearly basis subject to the condition that two detonators from each lot of over 7 year old ones are tested for the explosive content and the results being found satisfactory. Such time extended detonators can be used on all sections after satisfactory testing. In case the results are not satisfactory, they should be destroyed as envisaged in **Para 822**. In any case no detonator should be kept in use after ten years.

822. Disposal of time-barred Detonators – No detonator that bears any sign of rust and is time-barred shall be held in stock. Such detonators shall be destroyed by one of the following methods

(1) By soaking them in light mineral oil for 48 hours and then throwing them one by one into fire with due precautions.

(2) By burning them in incinerator.

(3) By detonating them under wagon during shunting operations.

(4) By throwing them in deep sea.

The destruction of time-barred detonators should be done in the presence of a Permanent Way Inspector who should ensure that every care is taken to see that splinters of detonators do not cause any injury to life and property. They should not be buried or thrown in places from where they could be recovered.

823. Safety Range – When detonators are being tested, no person should be allowed within a radius of 50 metres from the detonators to be exploded; the engine crew shall remain well within the cab. In practice, splinters from detonators when exploded seldom fly in a direction to the rear of the wheel which detonates them. Staff should therefore, when observing the safety radius, place themselves, as far as possible on the rear side.

824. Flare Signals- Descriptions – A flare signal which includes a fusee emits a bright red flame, when lighted and is used for warning the Driver of an approaching train of any obstruction. The fusee normally used burns for about seven minutes.

825. Use of flare signals – When it becomes necessary to protect an obstruction in a Block section, a flare signal may be used, while the railway servant proceeds to place detonators. A fusee is to be lit to give timely warning to the Driver of an approaching train of any obstruction such as derailed train obstructing adjacent lines, breaches, wash away floods, landslides etc., when the Railway servant does not have adequate time to do the protection in the normal manner with detonators as envisaged under rules; besides fusees detonators should also be placed on the line. Fusees are effective only in night time. In day time it can be used in foggy weather.

826. Safeworking of contractors - A large number of men and machinery are deployed by the contractors for track renewals, gauge conversions, doublings, bridge rebuilding etc. It is therefore essential that adequate safety measures are taken for safety of the trains as well as the work force. The following measures should invariably be adopted:

(i) The contractor shall not start any work without the presence of railway supervisor or his representative and contractors supervisor at site.

(ii) Wherever the road vehicles and/or machinery are required to work in the close vicinity of railway line, the work shall be so carried out that there is no infringement to the railway's schedule of dimensions. For this purpose the area where road vehicles and/or machinery are required to ply, shall be demarcated and acknowledged by the contractor. Special care shall be taken for turning/reversal of road vehicles/machinery without infringing the running track. Barricading shall be provided wherever justified and feasible as per site conditions.

(iii) The look out and whistle caution orders shall be issued to the trains and speed restrictions imposed where considered necessary. Suitable flagmen/detonators shall be provided where necessary for protection of trains.

(iv) The supervisor/workmen should be counselled about safety measures. A competency certificate to the contractor's supervisor as per proforma annexed shall be issued by AEN which will be valid only for the work for which it has been issued. **(Annexure 8/5)**.

(v) The unloaded ballast/rails/sleepers/other P.Way materials after unloading along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.

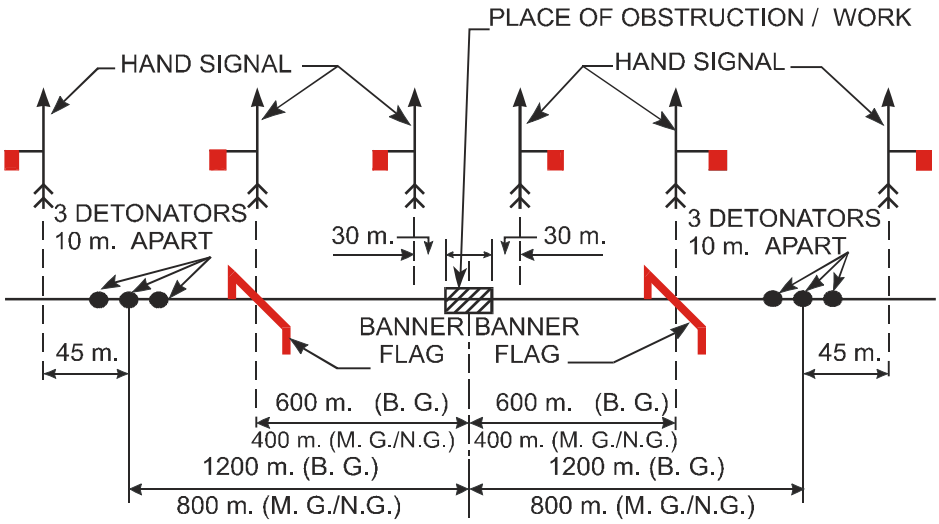
(vi) Supplementary site specific instructions, wherever considered necessary, shall be issued by the Engineer in Charge.

(vii) The Engineer in-charge shall approve the methodology proposed to be adopted by the contractor, with a view to ensure safety of trains, passengers and workers and he shall also ensure that the methods and arrangements are actually available at site before start of the work and the contractor's supervisors and the workers have clearly understood the safety aspects and requirements to be adopted/ followed while executing the work.

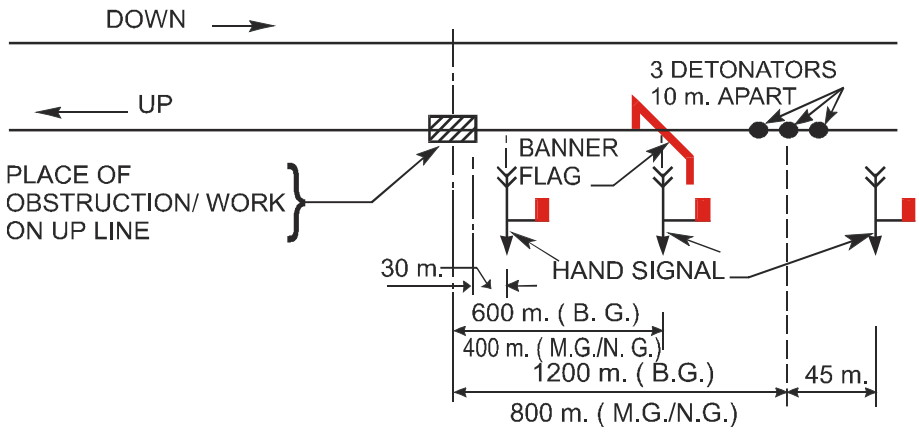
There shall be an assurance register kept at each site, which will have to be signed by both, i.e. Railway Supervisor or his representative as well as the contractor's supervisor as a token of their having understood the safety precautions to be observed at site.

ANNEXURE 8/1 - PARA 806(1)

WORKS OF SHORT DURATION - PROTECTION OF LINE IN CASE OF STOP DEAD RESTRICTION



SINGLE LINE



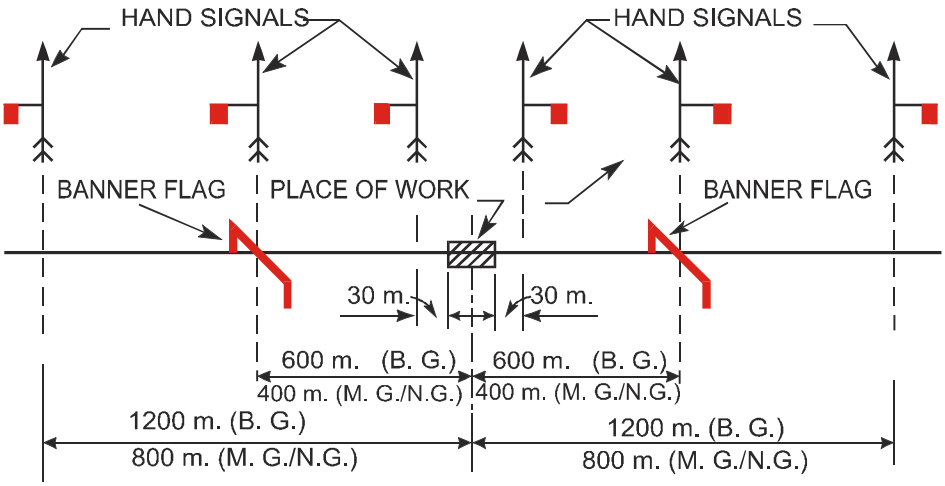
DOUBLE LINE

NOTE :

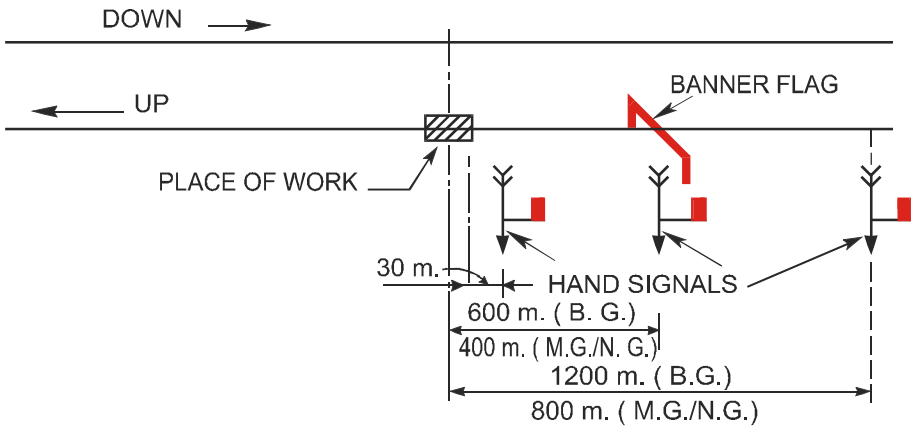
IN THE CASE OF M.G. SECTIONS WHERE THE TRAINS RUN AT A SPEED MORE THAN 75 Km. P.H. THE DISTANCES OF HAND - SIGNALS AND DETONATORS SHALL BE INCREASED SUITABLY AS PER APPROVED SPECIAL INSTRUCTIONS.

ANNEXURE 8/2 - PARA 806(2)

WORKS OF SHORT DURATION - PROTECTION OF LINE IN CASE OF REDUCED SPEED



SINGLE LINE



DOUBLE LINE

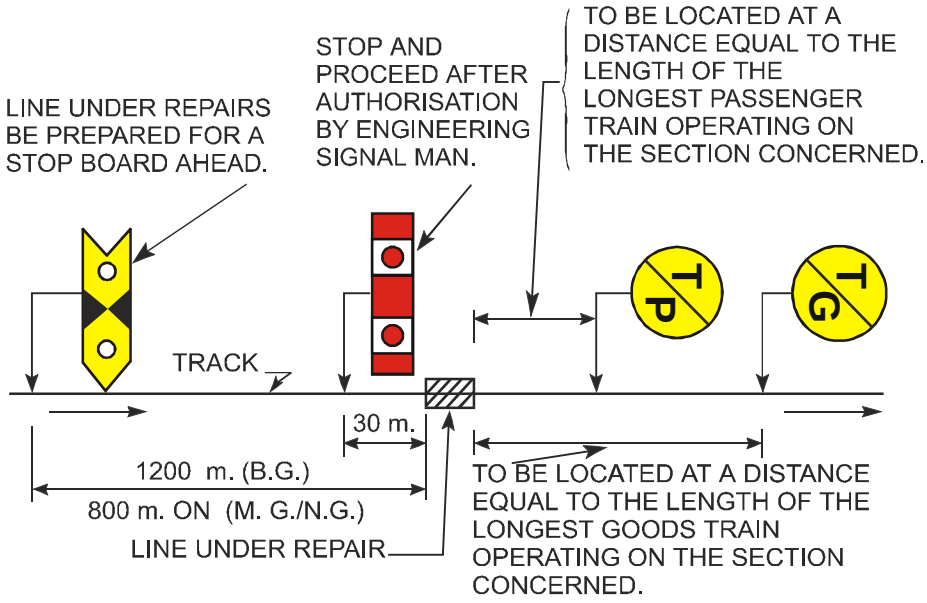
NOTE:

(1) INTERMEDIATE FLAGMAN WILL KEEP BANNER FLAG UNTIL THE SPEED OF THE TRAIN HAS BEEN REDUCED, AFTER WHICH THE BANNER FLAG WILL BE REMOVED AND TRAIN HAND - SIGNALLED FORWARD.

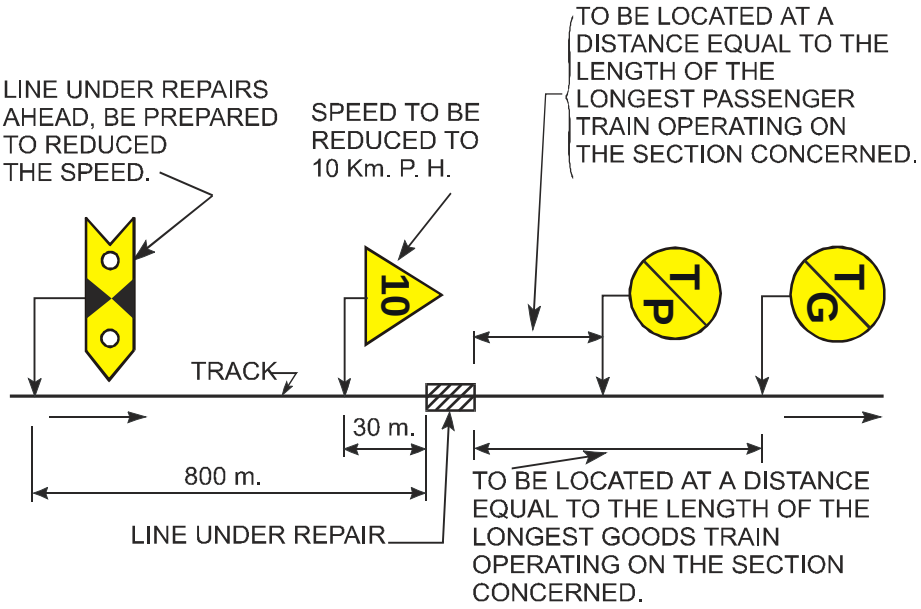
(2) IN CASE OF M.G. SECTIONS WHERE THE TRAINS RUN AT A SPEED MORE THAN 75 Km. P.H. THE DISTANCE OF HAND SIGNALS AND DETONATORS SHALL BE INCREASED SUITABLY AS PER APPROVED SPECIAL INSTRUCTIONS.

ANNEXURE 8/3 - PARA 807 & 808

FIXTURE OF ENGINEERING INDICATORS FOR DEAD STOP & NON STOP RESTRICTIONS OUTSIDE STATION LIMITS FOR STOP - DEAD RESTRICTIONS



FOR REDUCED SPEED



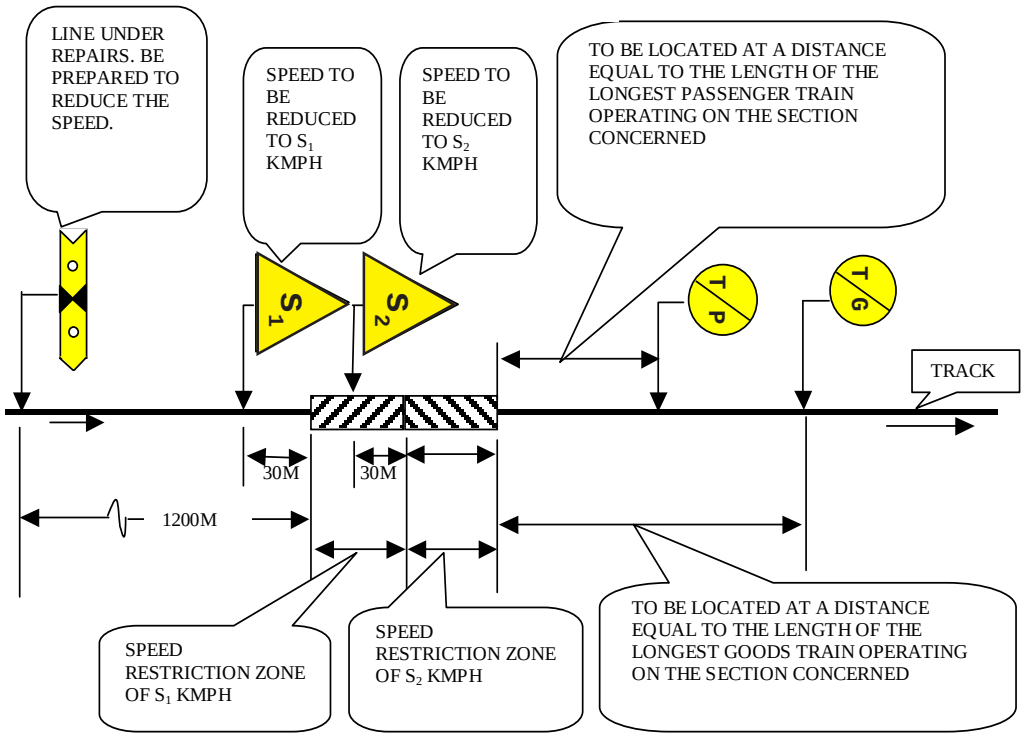
Note :

When, during the course of the work, on consideration of safety, it is not desirable to pass trains over the site of work for the time being, the track should be further protected by hand signals and banner flags, by the authorized Railway servant.

ANNEXURE 8/3A-PARA 807 & 808

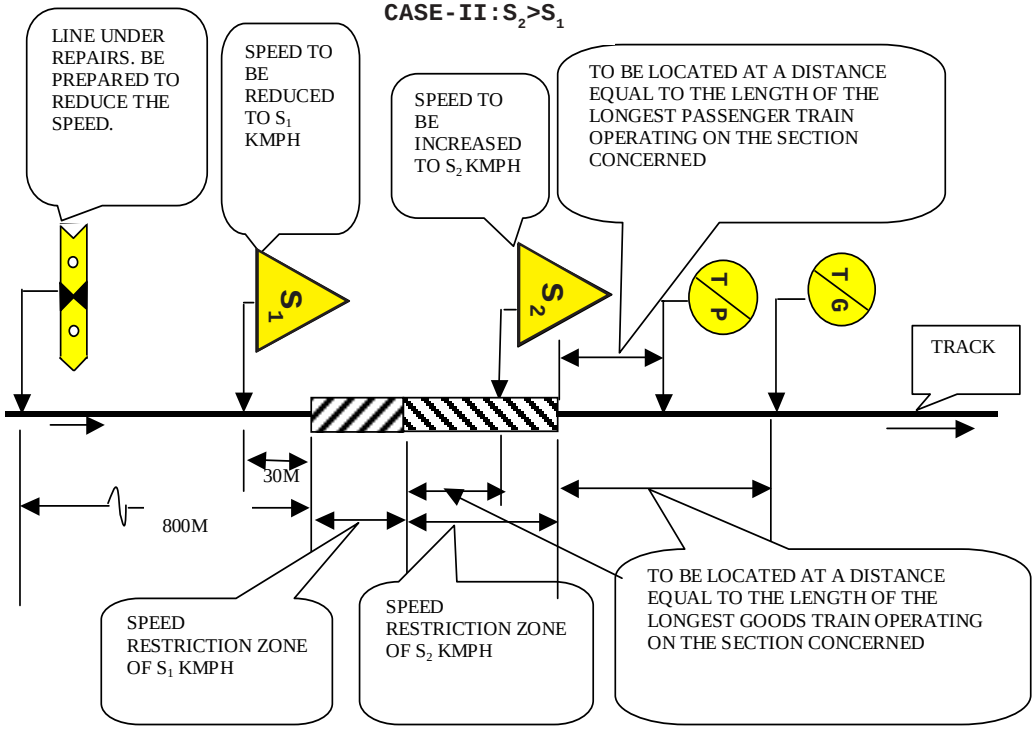
POSITION OF ENGINEERING INDICATORS IN CASE OF MULTI SPEED RESTRICTIONS

CASE-I: $S_2 < S_1$



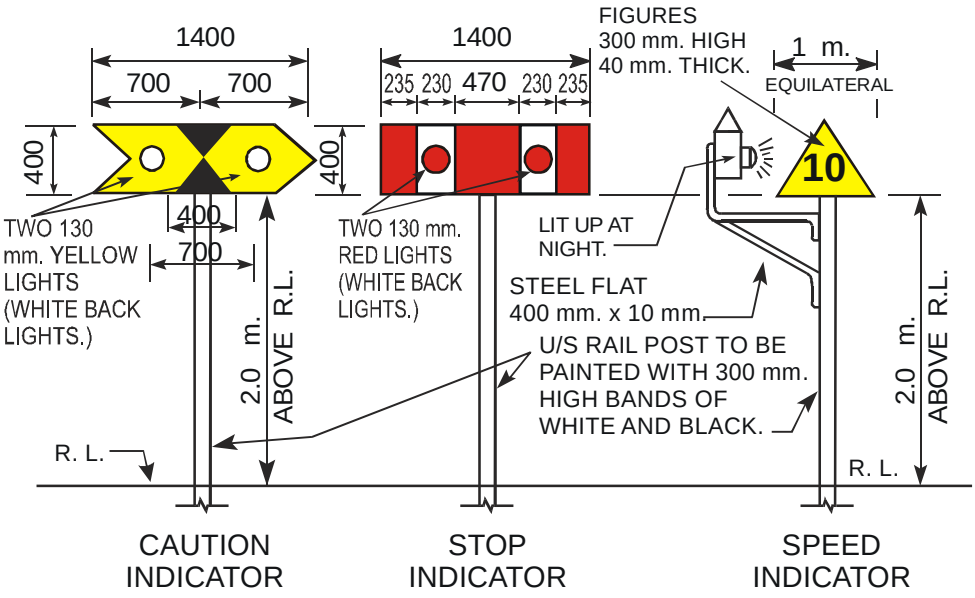
NOTE : MIN LENGTH OF SPEED RESTRICTION ZONE OF S_1 KMPH SHOULD BE 200M. OTHERWISE SPEED INDICATOR BOARD S_2 SHALL BE PROVIDED AT THE PLACE OF S_1

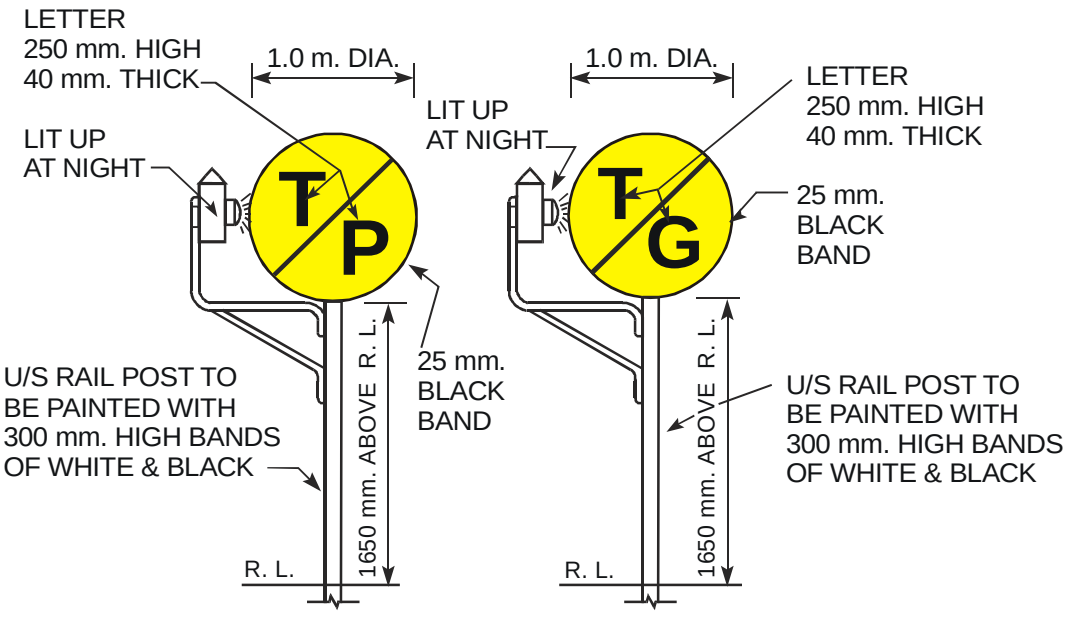
CASE-II: $S_2 > S_1$



ANNEXURE 8/4 - PARA 807 & 808

ENGINEERING INDICATORS FOR TEMPORARY RESTRICTIONS





ANNEXURE 8/5 - PARA 826 (iv)

COMPETENCY CERTIFICATE

Certified that shri..... P.way supervisor of M/s. ..... has been examined regarding P.Way working on ..... work. His knowledge has been found satisfactory and he is capable of supervising the work safely.

Assistant Engineer

CHAPTER IX

LEVEL CROSSING AND GATEMAN

901 General Location : As far as possible, new Level Crossings may not be located in busy station yards where heavy detention to the road traffic and other operational problems are likely to be encountered. If provision of Level Crossing is inescapable, it may be located outside the outermost facing points. For Level Crossings already located within busy station yards affecting Railway operations and causing heavy detention to the road traffic, efforts should be made to replace them by Road Over/ Under Bridges as per extant rules or shift them outside the outer most facing points, especially during planning of gauge conversions, yard re-modeling and doublings and its operation from the cabin should be possible.

902. Classification of Level Crossings –

(1) The classification of level crossings shall be based on the volume of rail and road traffic and visibility conditions.

(2) The classification of level crossings shall be as under:

Class	Criteria
(a) 'Special .. for roads	TVUs greater than 50,000
(b) 'A' class .. for roads	TVUs between 50,000 & 30,000 **Or** Line capacity utilization 80% (on single line) and number of road vehicles greater than 1000
(c) 'B' class…for roads	TVUs between 30,000 and 20,000 and number of road vehicles greater than 750

'B' Class is further subdivided as following :

B1 class…for roads	TVUs between 30,000 and 25,000
B2 class…for roads	TVUs between 25,000 and 20,000
(d) 'C' class…for roads	All other level crossings for road not covered in above classes
(e) 'D' class … for cattle crossings.	

(3) Level crossings over colliery, factory and other similar sidings where Railway traffic is light may however be dealt with according to local conditions, subject to the approval of the Commissioner of Railway Safety concerned being obtained in each case to the measures adopted for the safe working of trains over the crossing.

903. Categories of Roads – (1) For the purpose of this standard, Roads shall be categorised as under –

(a) Class I roads –

(i) National Highways,

(ii) State Highways,

(iii) Important roads within municipal towns, and

(iv) Roads in and around towns where road and rail traffic is heavy.

(b) Class II roads –

(i) Major and other District roads,

(ii) Unimportant roads within municipal towns,

(iii) Roads within non-Municipal towns including those within shunting limits of Railway stations, and

(iv) Other surfaced roads.

(c) Class III roads –

(i) Earth roads, and

(ii) Cart tracks.

(d) Class IV roads –

Cattle crossings and foot-path.

904. Standards for different classes of level crossings – The standards to be follow2ed (within the Railway limits) for the various parameters in respect of different classes of level crossings will be as shown in **Annexure 9/1.** These standards are applicable to all new constructions and also in the case of upgradation of the existing level crossings. The existing level crossings which are of a lower standards than those prescribed in Annexure 9/1 need not be altered or modified merely to suit these standards.

905. Gates and Locking Arrangements –

(1) Gates –

(a) The gates may be in the form of chains, lifting barriers or movable gates of approved design.

(b) At new manned level crossings or when existing unmanned level crossings are upgraded to manned level crossings, lifting barriers should normally be provided which should be coupled so

as to operate simultaneously. Chains or swing gates at existing manned level crossings should be replaced by lifting barriers on a programmed basis, giving priority to the important and busy level crossings.

(2) Locking arrangements –

(a) Lifting type barriers, swing gates or chains when closed against road traffic shall be securely locked.

When the locking arrangement is of the hasp and staple type with padlocks, two spare chains with loops at both ends should be provided for locking the gates when the locking arrangement goes out of order.

(b) Stops should be provided to prevent level crossing gates from swinging towards the track and causing infringement. Catches should be provided to secure gates when in the open position to avoid obstruction to road traffic.

(c) In the case of all manned level crossings, two long spare chains with loops at both ends, should be kept as reserve for use as an alternate to the barrier/gate, in case of damage to them. Two discs painted red with the words "stop" with arrangements for fixing them on the ground should also form part of the spare equipment. Separate rail posts should be erected near the gate, so that the chains can be fixed on them **(Annexure 9/2).**

906. Skew Level Crossings –

(1) All roads should preferably cross the railway line at right angles. In special cases, when modification is required to suit the road approaches the angle of crossing should not be less than 45^0.

(2) At all level crossings the gate posts shall be fixed square to the road.

907. Normal Position of Gates –

(1) General – Subject to such Special Instructions in that behalf as are permitted by these rules, all gates at level crossings shall be kept constantly closed and securely fastened across the through fare on both sides of the railway and shall only be opened when it is necessary and safe to open them for the passage of road traffic; provided that any Railway Administration may from time to time issue special instructions for any particular level crossing or class of level crossing and may by such special instructions permit the gates at any level crossing or class of level crossings to be normally kept open to road traffic and may therein prescribe the conditions under which gates are to be kept closed against road traffic for the passage of a train or trains or for the purposes of any other railway operation.

(2) At all level crossings over which trains are required to pass, the normal position of gates may be as under –

(a) All level crossings in Special, A, and B1 classes will be interlocked and protected by Signals and kept 'Normally open to Road traffic, and may only be closed against the road traffic for the passage of trains or for any other Railway operation by taking off the signals.

(i) The gates must normally be kept open to road traffic and may only be closed against the road traffic for the passage of trains or for any other railway operation by taking off the signals.

(ii) The signals must be interlocked with the gates.

(b) Level crossings provided with gates and not protected by signals – The gates must normally be kept closed and securely fastened against road traffic and may only be opened for the passage of road traffic when it is necessary and safe to do so. The Railway Administration may under special instructions permit gates of level crossings not protected by signals to be normally kept open to road traffic prescribing the conditions under which they may be kept closed against road traffic for passage of trains or any other railway operation.

(c) The normal position of gates at level crossings between station limits shall be as sub-para (a) and (b) above, fixed station signals not being regarded as affording any protection unless the gates are interlocked with signals.

(d) Level crossings having heavy seasonal traffic – In case of level crossings having heavy seasonal road traffic with normal position of gates closed to road traffic, the Railway Administration may permit gates of such level crossings, to be kept open to the road traffic during the busy season, when road traffic is heavy, by issuing special instructions and prescribing the conditions, under which they may be kept closed to road traffic for passage of trains or any other railway operation. The special instructions should be incorporated in the working rules for the gates and stations concerned.

(3) Gateman, where provided, shall at all level crossings other than those controlled by gates designed to close across the line, be prepared, wherever such level crossings be open to road traffic, to show a danger signal to any approaching train and for this purpose invariably keep a hand signal lit during night to show Red throughout the period the level crossing is open to Road traffic.

908.Gate Lamps and Blinders –

(1) Fixture of gate lamps and indicators to road users – Gate lamp should be mounted preferably in rectangular sockets over gates so as to give correct indication to road users vide item 6 of **Annexure 9/1.** The lamp should be lighted by the Gateman at sunset and remain lighted till sunrise.

(2) Provision of Blinders to Gate lamps –

(a) All gate lamps should be provided with blinders to conform with item 6 of **Annexure 9/1.**

(b) Drivers of trains shall get no light indication from the gate lamp except at "Special Class" level crossings where they will observe red lights when the gates are closed across the railway line and are open for road traffic.

909. Traffic and Engineering Gates –

(1) Traffic Gates –

(a) The manning and operation of the gates at level crossings located between the outermost stop signals shall be under the control of Operating Department. The level crossings and structures pertaining thereto shall be maintained by the Engineering Department.

(b) When protected by signals the equipment shall be governed by the signals of the station/block hut and the operation as per the station working rules.

(2) Engineering Gates –

(a) Level crossings beyond the outermost stop signals shall be under the control of the Permanent Pay Inspectors both as regards to their operation and maintenance.

(b) Where the level crossing is protected by Signals, fixed signals shall be provided in each direction in accordance with the relevant general rules(**G.R.3.34 New Rules**)/approved special instructions.

(3) The maintenance of signals, interlocking and communication equipment will rest with the Signal Department in the case of all level crossing gates, whether located within or outside the outermost stop signals.

(4) (a) The working instructions including the signalling diagram of level crossings equipped with gate signals and situated beyond the outermost stop signals in either direction of a block station and/or provided with telephone connections with the nearest adjacent station on either side, shall be kept at the gate-lodge. A copy of the working instructions shall also be kept at the station concerned.

(b) The working instructions in English and local language of every level crossing within outermost stop signals of a block station, and also of level crossing beyond the outermost stop signals which are provided with telephone connections and whose operation is governed by the system of exchange of private numbers under special instructions, should be incorporated as an appendix to the Station Working Rules of the station concerned and kept at the gate-lodge.

910. Equipment At Level Crossings – (1) The equipment for a manned level crossing shall be as follows; in addition to such others as may be prescribed by special instructions :–

(a) 2 hand signal lamps, tri-colour provided with bright reflectors,

(b) 1 hand signal flag, green.

(c) 2 hand signal flags, red.

(d) 1 staff suitable for exhibition of red lamp or red flag.

(e) 2 long spare chains with "stop" marked disc attachment at the center to cover the full width of the gate, for use in case the gates/barriers are damaged **(Annexure 9/2).**

(f) 2 spare small chains and padlocks for locking gates, in case locking arrangements of gates become defective.

(g) 12 detonators.

(h) 1 tin case for flags.

(i) 1 tin case for detonators.

(j) 1 canister for muster sheet.

(k) 1 can for oil.

(l) 1 tommy bar.

(m) 1 water pot or bucket.

(n) 1 mortar pan.

(o) 1 powrah.

(p) 1 rammer.

(q) 1 pick-axe.

(r) 1 tool list (with columns drawn for checking of tools).

(s) 1 book of safety rules in Hindi or regional language.

(t) Duty roster.

(u) Complaint book for road users.

(v) Inspection register.

(w) Level crossing working instructions (in local language) where applicable.

(x) Two gate lamps.

(y) Gatemen working on double line/multiple lines, ghats, suburban and automatic block territories shall be provided with three fusees. Gatemen working on single line sections shall be supplied with one fusee.

(z) Diagram indicating the method of protection to be adopted, in case of obstruction in the level crossing.

z(i) Wall clocks in gate-lodges at all manned level crossings to enable the gateman to correctly record the time of exchange of private number, expected and actual time of passage of train, time for opening and closing of level crossing, etc

Note : In the case of level crossings in multiple lines the hand signal flags/lamps, detonators shall be increased suitably.

(2) There should be sufficient supply of kerosene oil, wicks and matches at the gate-lodge. The Gateman should always keep their hand signal lamps trimmed and ready for lighting and use at a moment's notice. During night, one of the hand signal lamps should be kept lit throughout to show danger stop signal to an approaching train. When the level crossing is closed to road traffic, the hand signal lamps should be kept lit dimly only.

(3) At every manned level crossing there should be distinct indication at 600 meters and 1200 meters on Broad Gauge and 400 meters and 800 meters on Meter Gauge and Narrow Gauge and at specified distances suitably increased on M. G. high speed routes where trains run at speeds above 75 km.p.h.,on either side to guide the Gateman for placing the detonators in case of obstruction at the level crossing. Indicator posts should be provided with one dot and three dots at these distances to indicate the number of detonators to be placed. Arrangements for exhibiting the danger signal at a distance of 5 meters during emergency should be made at each level crossing.

(4) *Height Gauges on Electrified Sections.*- (a) Adequate arrangements shall be made to erect height gauges on either side of the overhead equipment or other equipment at every level crossing so as to ensure that all vehicles and moving structures passing under the height gauge also pass under the overhead equipment or other equipment with adequate clearance.

(b) The adequate clearance referred to in sub-rule (a) shall be sanctioned under approved special instructions.

(c) Height Gauges should be located at a minimum distance of 8 metre from gate posts. In exceptional circumstances where site condition do not permit, Chief Engineer can give exemption in these standards subject to a minimum of 8 metre distance from the centre line of the track. Road surface upto this point may be at the same level as the road surface inside the gate posts.

(d) Vehicles and moving structures, which can not pass under the height gauge without striking or touching it, shall not be permitted to pass the overhead equipment or other equipment except in accordance with special instructions.

911. Siting of Gate-Lodges –

(1) Gate-Lodges shall be so sited that a clear and unobstructed view is obtained of all approaching trains and road vehicles, care being taken that allowance is made for all future extensions, e.g., doubling of line or widening of roadway.

(2) Where the level crossing is on a curve, the gate-lodge should be built on the outside of the curve.

(3) Level crossing at cuttings or near cuttings should be avoided as far as possible.

912. Appointment of Gatemen, Rosters and Medical fitness Certificates –

(1) Before appointment, the Permanent Way Inspector should ensure that competent men selected as gatemen have obtained Certificates of fitness for class A3 from the Medical Department and

that they are examined thereafter at periods stipulated by the rules in force. In all level crossings provided with telephone connections literate Gateman capable of exchanging private numbers, should be posted.

(2) The hours of duty for the Gateman should be laid down and must confirm to the regulations in force. The rosters detailing the hours of duty and rest for each Gateman shall be maintained at the gate-lodge. The roster should indicate clearly as to which gateman is required to be on duty at any particular time. No Gateman shall change his hours of duty without the order of the Permanent Way Inspector.

(3) Full particulars regarding the periodical medical examination and vision test of each Gateman shall be maintained at the gate-lodge.

(4) When handing or taking over charge, the Gateman and their relievers should jointly check all the equipment and test all the gears to see that they are in order.

(5) Every Gateman shall be fully conversant with the use of hand signals, detonators, fusees and protection rules.

913. Duties of Gateman –

(1) *Alertness* – The Gateman should be on the alert and be prepared to take immediate action, should danger be apprehended. The keys of the gates shall be on his person.

(2) *Position during passage of trains* – The Gatemen should stand facing the track on the gate-lodge side of the approaching train. He should observe all passing trains and be prepared to take such action as may be necessary to ensure safety of trains.

(3) *Action in emergency* – In case of an obstruction at the level crossing the Gateman should maintain the gate signals, if any, in the "ON" position and if unable to remove it, protect the line as under-

(a) On double line, if both lines are obstructed during day, he shall plant a red banner flag at a distance of 5 metres from the end of check rails on the line on which a train is expected to arrive first, then plant another red banner flag on the other line at the site of obstruction. He shall then pick up red hand signal and showing it, proceed on that line towards the direction of an approaching train to a point 600 metres on Broad Gauge and 400 metres on Metre Gauge and Narrow Gauge from the level crossing and place one detonator on the line, after which proceed further to not less than 1200 metres from the level crossing on Broad Gauge and 800 metres on Metre Gauge and Narrow Gauge and place 3 detonators on the line about 10 metres apart. Having thus protected the line on which a train is expected to approach first, he should return to the level crossing, picking up the intermediate detonators on his way back. He shall then proceed on the other line showing red hand signal, place detonators similarly and return to the site of obstruction to warn the Driver of an approaching train.

Provided that on those Metre Gauge sections where trains run at more than 75 Km/h, the detonators shall be placed at distance to be specified under special instructions by the Administration **(Annexure 9/3)**.

(b) On single line, if the line is obstructed during day, he shall plant a red banner flag at a distance of 5 metres from the end of check rails towards the direction from which a train is expected to arrive first, then plant another banner flag towards the opposite direction at the site of obstruction. He shall then pick up red hand signal and as in sub-para (a) above, protect the line in the direction from which a train is expected to approach first, return to the site of obstruction, and proceed with all haste in the other direction to protect the line. Having protected the line on both sides, he should station himself at the place of obstruction to warn the Driver of an approaching train **(Annexure 9/3)**.

(c) At night the Gateman should light the two hand signal lamps and take action to exhibit red light and protect the lines as in sub-paras (a) and (b) above.

(d) Gateman should take immediate action to inform the Mate, P.W.I. and the nearest Station Master about the obstruction at the level crossing through messenger or other means available.

(4) *Parting of a Train* -If a Gateman notices that a train has parted he shall not show a stop hand signal to the Driver, but shall endeavour to attract the attention of the Driver and the Guard by shouting, gesticulating or other means.

(5) The Gateman should ensure that the gate lamps and lamps of all gate signals are lighted and kept burning continuously from sunset to sunrise.

(6) No Gateman shall leave his gate unless other Gateman has taken charge of it. If it is

necessary to leave his gate in an emergency, before doing so, he should close and lock the gates against the public road.

(7) The Gateman should see that the channel for the flange of the wheel is kept clear.

(8) The Gateman should keep the road surface well watered and rammed.

(9) At level crossings, if any gate or barrier gets damaged / out of order the Gateman should use the spare chain and disc, for closing against the road traffic.

(10) As soon as possible, the Gateman should report to the nearest Station Master, Gang Mate or Permanent Way Inspector any defect in his gate or the apparatus pertaining to it.

(11) At gates the signal or signals of which have become defective, the Gateman should close and lock the gates on sighting of train and hand signal or pilot the train past the defective signal. In such case he should inform the Driver to report about the defective signal or signals to the Station Master at the next station.

(12) In the event of a gate signal becoming defective the Gateman should maintain the signal in the 'ON' position by disconnecting the signal or the wire if necessary.

(13) The Gateman should ensure that the equipment supplied to the gate is in good order and ready for immediate use.

(14) Every Gateman shall as for as possible prevent trespassing by persons or cattle.

914. Maintenance of Level Crossing, Examination of Gate equipment and Gateman in Rules – (1) By Permanent Way Inspectors –

(a) *Obstruction of view* – All trees, bushes or undergrowth that interfere or tend to interfere with the view from the Railway or road way when approaching level crossings, should be cut down taking care to comply with the procedure laid down in **para 222.**

(b) *Inspection and Maintenance* – (i) Each level crossing except those laid with PSC sleepers must be opened out and the condition of sleepers and fittings, rails and fastenings inspected at least once a year or more frequently, as warranted by conditions. However, level crossings laid with PSC sleepers should be overhauled with each cycle of machine packing or more frequently as warranted by conditions and in no case shall opening be delayed by more than two years. In all cases, rails and fastenings in contact with the road shall be thoroughly cleaned with wire brush and a coat of coaltar/anti-corrosive paint applied. Flange way clearances, cross level, gauge and alignment should be checked and corrected as necessary, and the track packed thoroughly before reopening the level crossing for road traffic.

(ii) The painting of gates and discs should be done at regular intervals.

(iii) The Permanent Way Inspector should keep a manuscript register of repairs for all level crossings on his section. This register should show the date of opening, the condition of sleepers with their age and time, the date and type of each sleeper changed and other requisite particulars.

(iv) The Permanent Way Inspector will be responsible for the proper upkeep and maintenance of whistle boards and 'STOP' boards provided on the approaches to level crossings.

(v) Check rails of level crossing are required to be removed for tamping operations, overhauling of level crossings, distressing of LWR or track renewals etc. Check rails should be re-fixed as quickly as possible and preferably before leaving site.

Should a situation arise where check rails cannot be re-fixed for any reason and trains have to be passed, a speed restriction of 30 kmph should be imposed besides ensuring that road traffic is diverted till the check rails are put in place. In case such diversion is not possible, temporary arrangements should be made for passage of road traffic till the check rails areput in place. However, in both these cases, the check rails should necessarily be provided latest by close of next day. In such cases, a stationary watchman shall be posted to ensure safety.

(c) *Checking equipment and examination of Gateman in rules* – (i) The equipment with the Gateman shall be checked by Permanent Way Inspector once in a month.

(ii) The Permanent Way Inspector shall ensure that the Gateman have a correct knowledge of rules by examining them periodically during his trolly inspection and on appointment, promotion or transfer. He should not only educate them in rules, but also conduct practical demonstration of protection of level crossing in case of emergency.

(d) Surprise day/night inspection of level crossing should be carried out to ensure presence and alertness of Gateman.

(2) By Assistant Engineer –

The Assistant Engineer should inspect the equipment at every manned level crossing on the sub-division once in six months, and examine the Gateman in rules during his inspection.

The Assistant Engineer should scrutinise the manuscript register of level crossings maintained by the Permanent Way Inspectors and inspect as many level crossings as possible, when they are completely opened out during the year.

915. Level Crossing Registers – In the office of the Divisional Engineer, Assistant Engineer and Permanent Way Inspector, complete particulars of level crossings in serial order should be maintained in a register as shown in **Annexure 9/4**.

Whenever additions and alterations or improvement to level crossings are made, the level crossing registers should be amended and where necessary a copy of the new or revised working instructions with the revised signal and interlocking diagram posted at the gate-lodge.

916. Level Crossing indicators –

(1) Whistle indicator – (i) At the approaches to all unmanned 'C' class level crossings or manned level crossings where the view is not clear on either side for a distance of 600 meters and those which have normal position open to road traffic, without interlocking and protection by signals, under special conditions, bilingual whistle boards as per design **(Annexure 9/5)** should be erected at 600 meters along the track from the level crossing to enjoin the Drivers of approaching trains to give audible warning of the approach of a train to the road users. The Drivers of approaching trains should whistle continuously from the time they pass whistle boards to the time they cross the level crossing. However, the distance of W/L boards for unmanned level crossings on single line section where visibility is clear, should be reduced to 350m.

(ii) The whistle indicator shall consist of two 600 mm. square boards painted yellow and bearing letter W/L in black. Its height shall be 2100 mm. from the rail level to the underside and the post on which it is fixed, painted with 300 mm. high bands in white and black. It shall not be lighted at night.

(2) 'Stop' Boards – (a) On the road approaches to all unmanned 'C' class level crossings 'Stop' boards should be provided on the road at either side of the level crossings at suitable points, within the railway boundary.

(b) This shall consist of a board 675 mm.X525 mm. on a suitable post bearing the indication of an engine and the legend **"Stop, look out for trains before crossing"** in English, Hindi and Regional language. The paint used shall preferably be of luminous variety. The distance of the "Stop" board from the track on the approaches of the unmanned level crossings shall be 5 meters from centre line of the nearest track, within the Railway boundary.

(c) The vertical post shall be painted black and white, each strip to be 300 mm. in height starting with black paint at the bottom.

917. Visibility Requirements for unmanned Level Crossings – For new unmanned level crossings the visibility requirements for road users along the track shall be 600 M. with single or double line track. Where this is not feasible, the distance may be reduced suitably with the approval of the Chief Engineer provided the maximum permissible speed is less than 100 km.p.h. and/or there is only a single track to be crossed on the level crossing. Visibility of trains for road users at unmanned level crossing may be assessed, from a distance of 5 meters from the centre of the track.

918. Provision of speed breakers on the approaches of level crossing –

Provision of rumble strips on approaches of level crossings as per the standard design is the responsibility of Road authorities. Matter may be persued with all State Governments/Road authorities to ensure that rumble strips are provided on all level crossings as per standard design over the total width of the road i.e. edge of the berm to edge of berm with proper road warning signs as per the standard design. However, it is incumbent upon Railways to provide speed breakers as per the standard design on both manned as well as unmanned level crossing irrespective of whether the approach road are metalled or un-metalled, as a temporary safety measure, till such time these are replaced with rumble strips of proper design by the Road authorities. While providing speed breakers, following guidelines may be observed:-

(1) One speed breaker should be provided on either approach of level crossings located within the Railway land boundary at a distance maximum feasible but not exceeding 20m covering full width of the road including berms as per **Annexure - 9/6.** For safety reasons, the paint marking should be provided and their maintenance ensured.

(2) Standard warning signs for speed breakers as per **Annexure - 9/7** should be invariably provided at a prescribed distance as indicated in item 19 of **Annexure 9/1 to Para 904.**

(3) Speed breakers should be constructed with hot pre-mix bituminous material, well compacted after laying on well prepared surface. Enough time is to be allowed for the bituminous material to harden before opening it to the traffic. On berms and unmetalled roads, the speed breakers should be supported on proper base of compacted road metal.

919. Census of Traffic at Level Crossings, Unmanned/Manned – (1) Periodical census of traffic at all level crossings, unmanned/manned shall be taken once every three years. This shall be carried out for 7 days and total Train vehicle Units (TVUs)/ day (train units x Road vehicle units) are worked out. Train, Road vehicle, Bullock carts and Tongas being considered as one unit; cycle rickshaw/Auto rickshaw being considered as half unit. The census shall be carried out by a multi-disciplinary inspectorial team consisting of representatives of CE, S&T and Traffic Departments. The mechanism shall be set up by the Divisional Railway Manager to ensure that the representatives are present for the census by laying down advance time table for carrying out of census of level crossings.

(2) In the case of unmanned level crossing involved in an accident, census should be conducted immediately, to determine whether manning is required.

(3) In the case of manned level crossings, the quinquennial census should be substituted by a census-cum-job analysis so as to avail of the opportunity of checking up the adequacy of men on consideration of Hours of Employment Regulations.

920. Unmanned 'C' class Level Crossings – The upkeep of all unmanned 'C' class level crossings should be to the same standard of maintenance as that of manned level crossings. The posts at such unmanned level crossings may be either of unserviceable steel sleepers or unserviceable rail pieces, painted white.

The keyman during his daily beat should pay requisite attention to the general condition of such level crossings and keep the flange ways clear and free from obstruction.

921. Track Structure in Level Crossings

(1) In level crossings 'U' category sleepers (durable) should preferably be used.

(2) All sleepers used in level crossings should be provided with suitable bearing plates.

(3) Rail joints should be avoided in check rails and on the running rails, within the level crossings and three meters on either side.

(4) In each rail seat, four spikes should be provided.

(5) In the case of S.W.R., the short welded panel may be continued through the level crossing, avoiding fish plated joint on the level crossing and within six meters from the end of level crossing.

(6) The level crossing should not fall within the breathing length of L.W.R., as per the provisions contained in L.W.R. Manual.

922. Manning of the unmanned Level crossings through Member of Parliament Local Area Development Scheme (MPLADS) :

(1) The manning of unmanned Level Crossings has been included in the list of works covered under Member of Parliament Local Area Development Scheme (MPLADS). The funds for capital cost of construction covering the cost of road, provision of lifting barrier, arrangement of water and electricity, quarters for the gatemen, duty hut etc. will be provided by Member of Parliament from MPLADS Fund and recurring maintenance and operation cost will be borne by the Railways.

(2) Unmanned level crossings equal to number of level crossings manned through Member of Parliament Local Area Development Scheme, will be converted into manned level crossing at Railway's cost as selected in consultation with Member of Parliament concerned.

(3) Preferably, selected unmanned Level Crossings, should fall in the category I-V with priority given to Level Crossings falling in Category-I followed by Category-II, III, IV, V. For Level crossings falling in the same category on different routes, priority shall

be given to A route followed by B, C, D-Spl., E-Spl, D and E-routes.

(4) Divisional Railway Managers will liaison with the District Authorities and the Hon'ble Member of Parliaments in selecting the Level Crossings for manning. On identification of the Level Crossings, Member of Parliament will send his recommendations to the District Magistrate/ Dy. Commissioner for releasing the funds. Railway will provide an estimate for the work and any other details to the District Administration as required. Departmental charges shall not be levied on these works and supervision and establishment charges will be kept to the minimum as provided in the case of similar Railway works. Separate accounts shall be maintained for each work and `Utilisation Certificate' will be submitted to the District Administration on completion of the work.

923. Level Crossings on National Highways/State Highways and Other Important roads.

(1) In case of National Highway/State Highways or their bypasses and important city roads, no new Level Crossing to be provided and only grade separators agreed to be provided.

(2) In case of other important roads, it is preferable to provide grade separators. However, depending upon the traffic density envisaged, manned Level Crossings can also be considered.

(3) Relaxation of the above (1) will require Board's prior approval.

924. Provision of New Level Crossings/ Manning/Demanning/Elimination:-

(a) *Provision of the new level crossings:* If, provision of new level crossing is inescapable, then only manned level crossing is to be provided. This is applicable to all existing lines, new constructions and gauge conversions. However, these instructions are not applicable in case of private sidings.

(b) *Manning of Unmanned Level Crossing :*

(i) Based on traffic density, visibility and regular plying of buses etc. unmanned level crossings have been categories into I-III for manning at Railways cost in a phased manner on a programmed basis as per following priority:

Category I - Level crossing where TVUs exceed 6000, number of road vehicles exceed 180 and where visibility is clear.

Category II - Level crossing where TVUs exceed 6000, number of road vehicles exceed 120 and where visibility is restricted.

Category III - Level crossing where TVUs is between 3000 and 6000 and where visibility is restricted.

Further, manning of any unamanned level crossing shall not be done if motor vehicles do not ply regularly. Manning of category –III level crossings should be considered once manning of first two categories is over. Further, if any unmanned level crossings gets involved in more than 3 accidents in 3 years, it should be manned immediately irrespective of the category to which it belongs.

All proposals for manning of unmanned level crossings should be processed in consultation/association with the Chief Safety Officer of the Railway.

(ii) All unmanned level crossings on Rajdhani and Shatabdi routes where maximum permissible speed is 120 Kmph or more should be manned on priority.

Further train route wise priority to be followed for manning will be ‘A’ route followed by ‘B’ ‘C’ ‘D’ ‘D Spl” ‘E Spl’ and ‘E’

(iii) For manning of unmanned level crossings with traffic density more than 10000 TVUs, Board's approval is not required. However, in all other cases Board's sanction is required.

(c) *De-Manning/Elimination of the Level Crossing:* The existing manned level crossings should not be demanned. However, the detailed review/survey of the existing level crossings both manned and unmanned to be carried out with a view to eliminate them by either passing the road through an existing bridge or by constructing link roads to combine two or more level crossings etc.

However Railways may de-man an existing level crossing gate in case the TVU level falls below 80% of the value of the criteria laid down for manning in sub-para (b) (i) above.

925. Criteria for replacement of existing level crossings (other than those provided on deposit terms') with Road Over/Under Bridges on cost sharing basis:

(1) Minimum Train Vehicle Units on a Level Crossing should be 1 lakh per day to become eligible

for replacement with Road Over/Under Bridges on `Cost Sharing' basis. However, this could be relaxed in the following cases:-

(a) Suburban sections having high frequency of train services; and

(b) Near stations where detentions to road traffic are very high on account of either shunting operations or multi-directional receipt/despatch of trains or stabling of trains etc.

(2) Preference should be given to the Level Crossings located on trunk routes vis-à-vis those located on branch lines. In any case, minimum number of times the level crossing is required to be closed against the road traffic should at least be 12 times per day.

(3) Subject to (1) and (2) above, priority should generally be accorded by the concerned State Government giving preference to Level crossings on National Highways.

(4) In case of Road Over/Under Bridges constructed in replacement of busy level crossings situated in Municipal/ Corporation/ Metropolitan areas where Light Vehicular traffic is considerable and where the Railways are satisfied that closure of the level crossings would cause hardship, additional provision may be made for construction of the sub-way or a light Over Bridge with ramps for the use of light vehicular traffic at the time of framing the proposal for the construction of Road Over/Under Bridges. The proposals for providing the ramps/sub-way should be examined critically and should be provided for only in the case of genuine hardships and not as a matter of course. The cost of these ramps/subway will be shared equally with the Sponsoring Authority on 50:50 basis.

(5) Closure of the Level Crossings should be ensured before commissioning of the Road Over/ Under Bridges. All such cases where State/Local Authorities do not agree to abide by this should be reported to the Railway Board promptly.

ANNEXURE-9/1 Para 904

GOVERNMENT OF INDIA – RAILWAY DEPARTMENT (RAILWAY BOARD)

CLASSIFICATION AND STANDARD SPECIFICATION FOR LEVEL CROSSINGS
(Within Railway Limits)

(No. IRS (M) 2 of May 28 Revised June, 31 and corrected upto September 1982)

Note – (1) The revised specification apply only when any new level crossings constructed or old one altered.
(2) Wherever the new standards differ from the old standards, the old standards have been given below the new standards for reference.
In other cases the old standards and new standards are the same.

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
1	Minimum width of gates at right angles to the centre line of the road.	The minimum width of gates will be governed by the class of roads on which the level crossing is situated and will be as under— Across Class I roads – 9 metres or X+2.5M. whichever is more. Across Class II roads –7.5 metres or X+2 M, whichever is more. Across Class III roads – 5.0 metres or X+ 1.25 M. whichever is more. Across Class IV roads – suitable width subject to 2 M. being the minimum.					Where X = width of Carriage way. Gates shall be provided at special 'A' and 'B' class crossings. Gates or chains shall be provided at 'C' and 'D' class level crossings only in the following cases :– (i) When the line is on curve and the road and rail view is not clear. (ii) When speed of trains and volume of traffic are great. (iii)When the level crossing is within those limits at a station between which shunting is normally likely to be carried out. (iv) On portions of the line which are fenced through out on one or both sides, except when efficient cattle guards are provided.
	Old Standards : –	7.5 metres (24') or 9.0 metre (30').	5.5 metres (18') . .	5.5 metres (18') . .	3.0 m. (9') if un-manned 5.5m (18') if manned.	2.0m. (6')	
2	Minimum length of guard rail (for a square crossing)	2 metres more than width of gate.	2 metres more than width of gate.	2 metres more than width of gate.	2 metres more than width of gate.	Not to be provided ..	In the case of skew crossing the length of the guard rail must be increased in accordance with the formula : $= X = \frac{L}{\sin A}$ where X = required length, L = Minimum length measured at right angles to the centre line of the road, A = Angle between the centre line of the Road and Railway.
3	Angle of crossing between gates.	Not less than 45° between centre line of road and Railway,	Not less than 45° between centre line of road and Railway,	Not less than 45° between centre line of road and Railway,	Not less than 45° between centre line of road and Railway,	At right angle to the centre line of the Railway.	.....

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
4	Provision of Wicket gates for foot passengers.	To be provided except where foot over bridges are provided.	To be provided except where foot over bridges are provided.	To be provided except where foot over bridges are provided.	Not to be provided . .	Not to be provided . .	Design of Wicket gate should be such that trespassing by cattle is prevented.
5	Position of gates when open to road traffic.	Across or towards the line.	Away from or towards but not across the line.	Away from or towards but not across the line.	Away from or towards but not across the line if gates are provided.	Same as ' C ' class but stakes shall be fixed between the gate posts to prevent passage of Road	(i) At new manned level crossing or when existing unmanned level crossings are upgraded to manned level crossings, lifting barriers should normally be provided, which should be coupled, so as to operate simultaneously Chain and Swing gates at existing manned level crossings should be replaced by lifting barriers on a programmed baste, giving priority to the important and busy level crossings. (ii) Where lifting barriers are provided, the beams will be in vertical position.
6	Provision of lights on gates at nights. (a) Light as observed by road users.	Red when either gate is closed to the Road, white when both gates open to the Road.	Red when either gate is closed to the Road, white when both gates open to the Road.	Red when either gate is closed to the Road, white when both gates open to the Road.	Red when either gate is closed to the road, white when both gates are open to the Road. But provision of gate lamps is not obligatory and should normally be provided at only those level crossings where there is Motor Traffic. Where there is no Motor Traffic the gate should be painted white and red disc provided. If posts and chains are provided the posts should be painted white with red disc provided on the chains at the centre and reflectors, luminous	Not to be provided . .	(iii) At all important level crossing gates where electric power supply is available flashing lights to give indication to the road users about lowering or raising of lifting barriers should be provided. An economical arrangement would be to fit the gate lamp to the revolving hinge post and to fit the fixed gate post a cowl to mask the lamp in both directions along the track. If local conditions make it expedient to fit the lamp in the centre of the gate, a suitable rod operated cowl must be provided.

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
					paint or scotchlite tape may be provided on the red disc as an alternative to lamps.		
	(b) Light as observed by Drivers of approaching trains.	Red when gates are closed across track.	Nil.	Nil.	Nil.	Nil.	
7	Minimum distance of gate posts from centre line of track.	For B.G. 3 metres For M.G. } 2.5 M. and N.G. }	3 metres 2.5 metres	3 metres 2.5 metres	3 metres 2.5 metres	3 metres 2.5 metres	
8	Minimum distance of gate logde from –						
	(a) Centre line of nearest track.	6 metres	6 metres	6 metres	6 metres	6 metres	If the line of approach road is on a curve at or near a level crossing, the gate lodge must be built on the out side of curve.
	(b) Edge of Road metalling.	6 metres	6 metres	6 metres	6 metres	6 metres	
	Old Standards –	6 metres	4.5 metres	4.5 metres	3 metres	3 metres	
9	Interlocking and Communication Devices to be provided						
	(a) Normal Position of gate	Open to road traffic	Open to road traffic	Closed to road traffic. Can be kept open to road traffic provided either gates are interlocked with signals and provided telephone communication with adjacent stations/ cabins or when the following conditions are satisfied:	Closed to road traffic. Can be kept open to road traffic provided either gates are interlocked with signals and provided telephone communication with adjacent stations/ cabins or when the following conditions are satisfied:		

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
				(i) L.C. should not be located in a Suburban Section. (ii) L.C. should not be in Automatic Block Signallling or Automatic permissible block signallling territories. (iii) Should have a telephone connection with the nearest station with exchange of private numbers. (iv) Visibility at the level crossing should be good. (v) Should be provided with whistle boards on either side at adequate distance to enjoin the Drivers of approaching trains to give audible warning of the approach of a train to the road users. (vi) As long as the level crossing gate is kept open to road traffic a red flag by day time and red light (by using hand signal lamp) during night, should be displayed towards the approaching trains on either side of level crossing.	(i) L.C. should not be located in a Suburban Section. (ii) L.C. should not be in Automatic Block Signallling or Automatic permissible block signallling territories. (iii) Should have a telephone connection with the nearest station with exchange of private numbers. (iv) Visibility at the level crossing should be good. (v) Should be provided with whistle boards on either side at adequate distance to enjoin the Drivers of approaching trains to give audible warning of the approach of a train to the road users. (vi) As long as the level crossing gate is kept open to road traffic a red flag by day time and red light (by using hand signal lamp) during night, should be displayed towards the approaching trains on either side of level crossing.		
				Note*: The above decision should be taken Personally by D. R. Ms. approved by C. E. and C. T. S. S. and position reviewed every two years.			

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
	(b) Interlocking of gates with signals –	Should be interlocked with station signals.	Should be interlocked with station signals.	Should be interlocked with signals.	Should be interlocked with signals.		(i) The level crossing inside station limits should be beyond the limits upto which shunting is normally carried out or at an adequate distance of at least 250 metres ahead of the starters and trailing points of the station where Advanced Starters/Shunting Limit Boards are not provided.
	(i) If within station limits.			(i) In Suburban Sections. (ii) In non-Suburban sections where operated from cabins. (iii) In Automatic Signalling and automatic permissive block territories.	(i) Within station limits where operated from cabin, (ii) in automatic signalling and Automatic permissive block terriories.		(ii) In case of level crossings falling on Suburban Sections they may be considered for upgradation to 'B' class in the event of their not qualifying for upgradation to "Special" or 'A' class and when so upgraded to ' B ' class the facilities as indicated in column 5 should be provided.
	(ii) If outside station limits.	Should be interlocked with gate signals,	Should be interlocked with gote signals,	To be interlocked (1) In luburban sections (2) In autoinatic signalling and automatic permissive block territories.	To be interlocked in automatic signalling and automatic permi-ssive block territories.		(i) In the case of level crossings protected by signals where the sighting of the signal by an engine Driver is inadequate a warning board should be placed at not less than the emergency braking distance in rear of the gate stop signal. The board should be vertical 2000 mm. by 450 mm. with alternate black and yellow strips 125 mm. wide painted on it at an angle of 45°. The top of the board should be 4 M. above Rail level. The board need not be lit at night but should as far as possible be provided with scotchlite or other effective light reflectors. (ii) Where level crossing is situated outside station limits but in close proximity thereof, the clear distance between the level crossing and an outer signal should not be less than a full train length.
	(c) Telephone Communication from gate-lodge –						
	(i) Within station limits.	Telecommunication with A. S. M.'s Office to be provided.	Telecommunication with A. S. M.'s Office to be provided.	Telecommunication with A. S. M.'s Office to be provided.	Telecommunication with A. S. M.'s Office to be provided in case of manned level crossings.		In cases where communication with A. S. M. is stipulated, the connection may be given to the Switchman in the Cabin as per the local condition.
	(ii) Outside station limits.	Telecommunication with A. S. M.'s Office of adjoining station should be provided.	Telecommunication with A. S. M.'s Office of adjoining station should be provided.	Telecommunication with adjoining station to be provided on—	Telecommunication with adjoining station to be provided –		

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
				(a) All level crossings on Rajdhani route; (b) On suburban sections; and (c) On curves obstructing the view of the level crossing from approaching train and vice versa.	(a) On all level croissings on Rajdhani route; (b) On Suburban sections; and (c) On curves obstructing the view of the level crossing from approaching train* and vice versa.		
	(d) warning bell operated by approaching train.	Should be provided where L.C. is outside station limits.	Should be provided where L.C. is outside station limits in all a suburban sections and on non-suburban sections provided with automatic signalling and in APB territories.	Shall be provided where L.C. is outside station limits. In all suburban sections and on non-suburban sections provided with automatic signalling and in APB territories.	Shall be provided where L.C. is outside station limits in all Suburban sections and non-Suburban sections provided with automatic signalling and in APB territories.		Provision of warning bells operated by approaching trains should be confined to interlocked level crossings only,
10	Minimum no. of Gate Keepers.	Three	Two	Two	Two if manned (one if the gate is closed and locked at night in accordance with the provision of GR.16.03).	Two if manned (one if the gate is closed and locked at night in accordance with the provision of GR.16.03).	Note.— (1) Gate Keepers will not be provided at 'C' and 'D' class level. crossings where gates/chains are not provided. (2) Gate Keepers may be dispensed with at gates within station limits when operated by station staff in accordance with special instructions. (3) Gate Keepers may be dispensed with at 'C' class level crossings on canal roads which are provided with gates if the following conditons are fulfilled :— (a) The gates are generally closed to the road and locked. (b) The roads are the private property of the Irrigation, Public Works Department and are not public thorough fares.

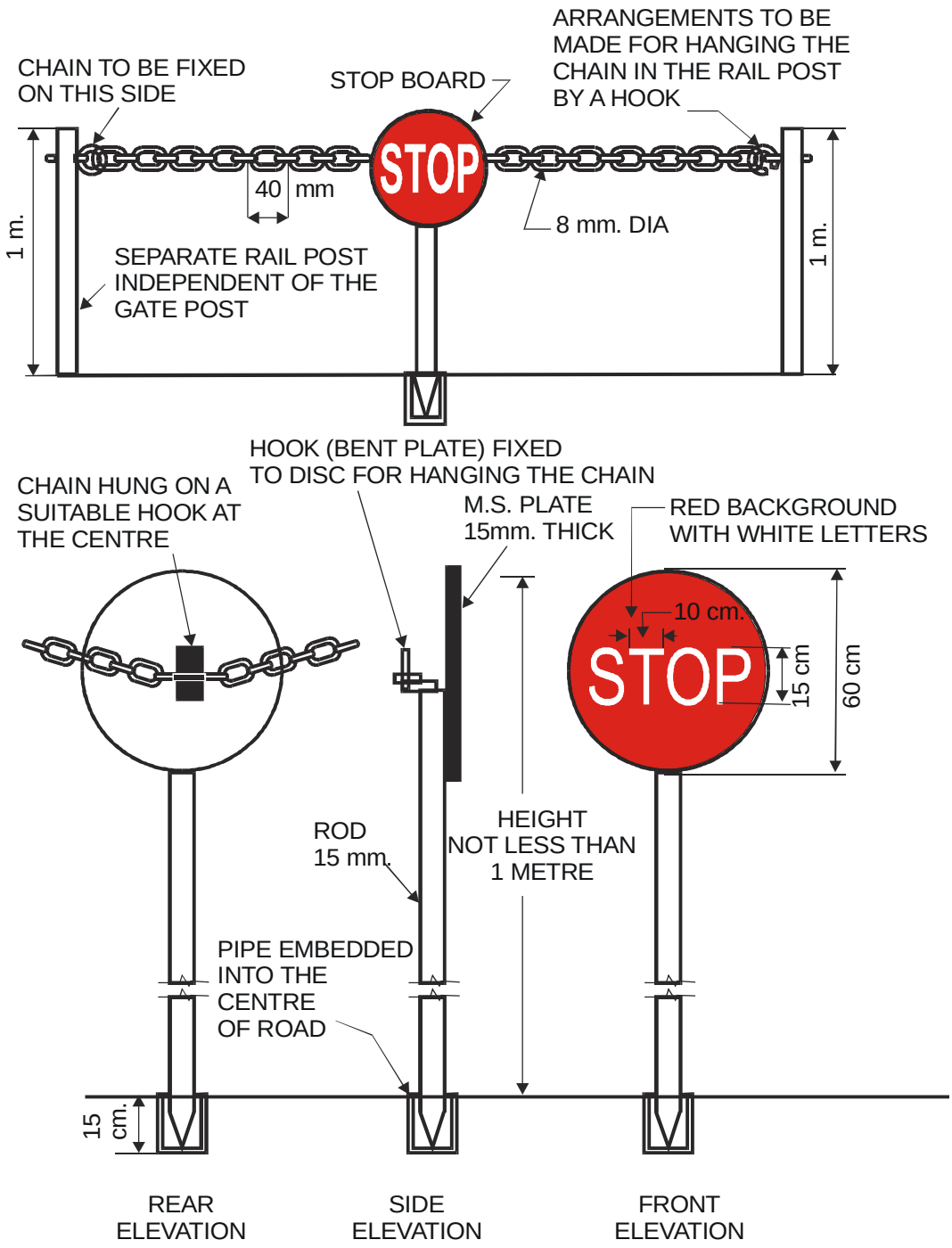
Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
							(c) The keys of the gates are issued to a few responsible Government Officials. (d) The traffic over the level crossing is very light. (4) One Gate Keeper may be dispensed with if there is no traffic in the night in accordance with GR. 16.03.
11	Fencing on lines which are not fenced throughout • their length.	Minimum length of 15 m. from each gate post parallel to track	Minimum length of 15 m. from each gate post parallel to track	Minimum length of 15 m. from each gate post parallel to track	Minimum length of 15 M. for manned level crossing outside station limits and level crossing within station limits provided with gates/chains.	Fencing should be provided for level crossings if manned with gates/chains within station limits for 15 M. length.	
12	Width of metalling— (a) Between gates ...	Same as that of the width of gates.	Same as that of the width of gates.	Same as that of the width of gates.	same as that of the width of gates or the width between gate posts where gate leaves are not provided.	same as that of the width of gates or the width between gate posts where gate leaves are not provided.	
	(b) Outside gates ...	Minimum width of metalling immediately outside gates (but tapering off to the existing carriage way width within a distance of 30 M from the gate) shall be as follows depending on the class of road over which the L. C. is situated :—					
		Class I road : 7 M or the width of existing carriage way whichever is greater.	Class II Road: 5.5 M or the width of existing carriage way whichever is greater.	Class III road: 3.78 M or the width existing of carriage way whichever is greater.	Class IV road, suitable width subject to 2M being the minimum.		
	Old Strands -	Same width as metalling outside the Railway Boundry.					If the surface outside is cement concrete, black top surface may be provided. For class I and II roads, it is desirable to have black topped surface for a distance of at least 30 M beyond each gate.
13	(a) Type of pavement between gates.	Same standard as that of the road surface outside the Railway Boundary.					
	(b) Outside gates ...	Same standard as that of the road surface outside the Railway Boundary.					
14	Minimum width of road formation outside the gates for a distance of 30 M beyond the gate.	Depending on the class of road ove rwhich level crossing is situated the minimum width of road formation will be as under –					
		Class I roads:C+5M.	Class II roads:C+5M.	Class III roads:C+5M.	Class IV roads, suitable width 3 metres being the minimum.		
		Note.—C = width of metalling just outside the gate.					

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
	Old Standards –	'Special class' — Same as rest of the road outside Railway Boundary	'A' Class— 4 metres wider than metalling.	'B' Class— 3 metres wider than metalling.	C' Class— ' 2 metres wider than metalling.	'D' Class— 3m.	
15	Level length and gradients – (a) Between gates...	Level	Level	Level	Level	Level	
	(b) Outside gates ...	Depending upon the class of road over which the level crossing is situated the level length and gradient will be as follows:—					
		Class I roads—	Class II roads—	Class III roads—	Class IV roads—		
	Level upto ...	15 metres beyond.	8 metres beyond.	8 metres beyond.			
	Not steeper than	1 in 40 beyond. ...	1 in 30 beyond. ...	1 in 20 beyond. ...	1 in 15 beyond. ...		
	Old Standards —	Special —	'A' Class —	'B' Class —	'C' Class —	'D' Class —	
	Level for ,...	8 metres beyond.	6 metres beyond.	6 metres beyond.	6 metres beyond.		
	Not steeper than	1 in 40 beyond.	1 in 30 beyond.	1 in 30 beyond.	1 in 20 beyond.	1 in 10 beyond.	
16	Minimum radius of centre line of road on curved approaches.	(i) In the case of Level crossings situated on National or State Highways, the following minimum radius may be adopted ;— i Plain or rolling country ... 250 metres. Hilly country ... ... 90 metres. (ii) In difficult terrain, the radius may he reduced with the concurrence of road authorities. (iii) The aim should be to provide the greatest possible radius. (iv) In the case of other roads the best possible radius, having regard to safety of Road traffic may be adopted.					
	Old Standards —	Special — 60 M. (200 ft.)	'A' Class — 45 M. (150 ft.)	'B' Class — 30 M. (100 ft.)	'C' Class — 21 M. (70 ft.)	'D' Class — 8 M. (25 ft.)	

Vertical curves should be-provided at change of grades within Railway Boundary according to Indian Road Congress Standard, beyond the level portion.

Item	Details	Dimensions and details for Various classes of crossings					Remarks
		Special	'A' Class	'B' Class	'C' Class	'D' class	
1	2	3	4	5	6	7	8
17	Minimum and desirable straight length of Road outside the gate.	Depending on the class of road over which the level crossing is situated the following minimum and desirable length may be adopted:-					
		Class I —	Class II —	Class III —			
(i)	Desirable	30 M.	22.5 M	15 • M.			
(ii)	Minimum	15 M.	9 M.	4.5 M.			
	Old Standards —	Special — 12 M.	'A' Class — 9 M.	'B' Class — 6 M.	'C' Class — 3 M.	'D' Class — Nil.	
18	Minimum sight distance of level crossing gate from road in the vicinity of level crossing	Depending on the class of road over which the level crossing is situated the following sight distances may he adopted :—					
		Class I —	Class II —	Class III —			At unmanned level crossings sight triangle may he demarcated in the four corners on the basis of speeds of trains and the road vehicles, clear of any obstruction to sight.
(i)	Plain or rolling country.	120 M.	60 to 90 M.	40 M.			
(ii)	Hilly country ...	60 M.	40 to 50 M.	30 M.			
19	Warning to road traffic of proximity of level crossing—	The distance of road sign posts from level crossing :—					1) Road signs conforming to the standards prescribed must be erected by the Road Authority in advance of the level crossing at the specified distances.
		Class I —	Class II —	Class III —			
	(a) Plain country ...	120 M.	60 to 90 M.	40 M.			2) 'Stop' boards bearing the prescribed legend to be provided on the road on either side at suitable points within the Railway Boundary at the approaches to all unmanned level crossings.
	(b) Hillycountry ...	60 M.	40 to 50 M.	30 M.			3) Gate posts should be provided invariably. Even in cases where no gates are provided posts should be painted white. Gates should be painted white with a red disc not less than 600 mm. dia. in the centre of gate.

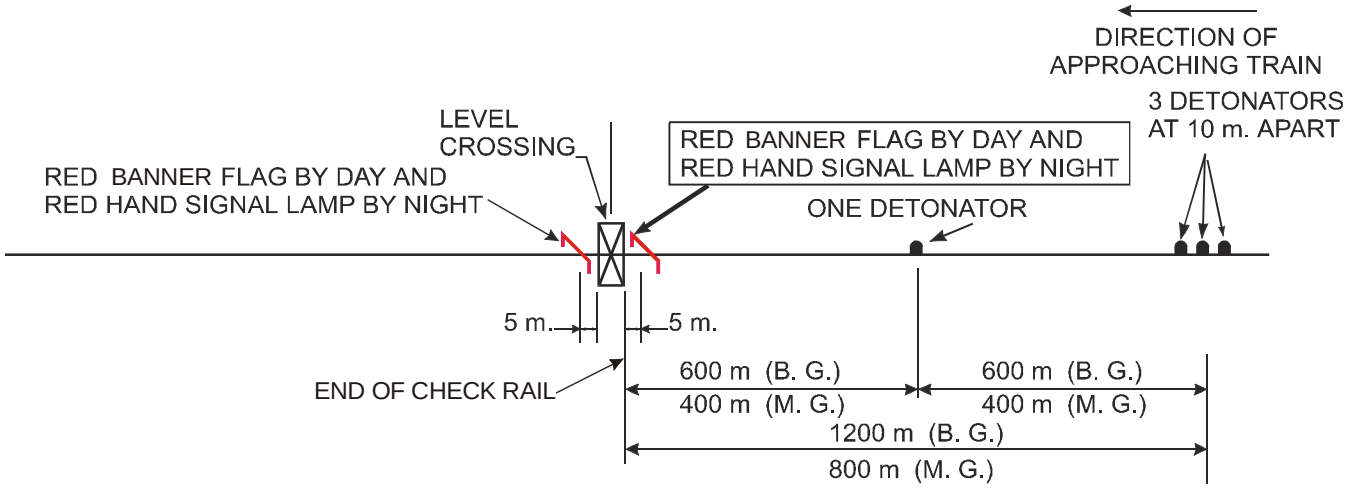
ANNEXURE 9/2 PARA 905



DETAILS OF STOP DISC TO BE PROVIDED ALONG WITH SAFETY CHAIN AT MANNED LEVEL CROSSINGS

ANNEXURE 9/3 PARA 913 (3)

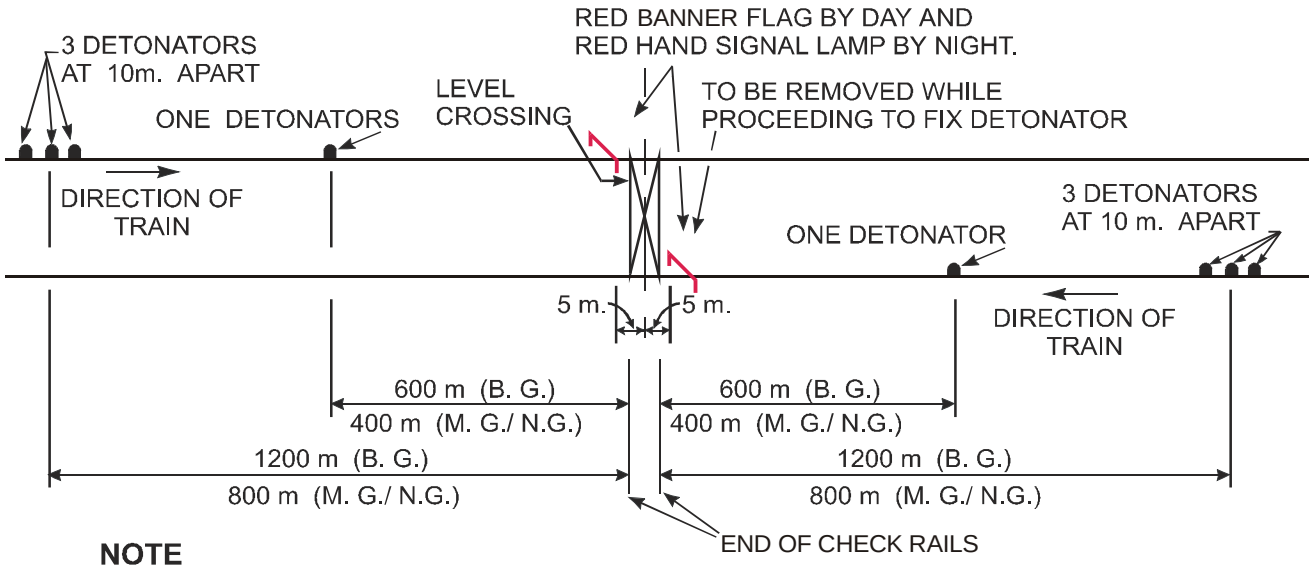
SINGLE LINE



NOTE

PROTECTION FOR THE DIRECTION OPPOSITE TO THAT OF APPROACHING TRAIN TO BE REPEATED ON THE OTHER SIDE ALSO.

DOUBLE LINE



NOTE

IN THE CASE OF M. G. SECTIONS WHERE TRAINS RUN AT MORE THAN 75 Km. P. H. THE DETONATORS SHALL BE PLACED AT DISTANCES TO BE SPECIFIED UNDER SPECIAL INSTRUCTIONS BY THE ADMINISTRATION.

ANNEXURE-9/4 PARA 915

..... RAILWAY

LEVEL CROSSING REGISTER

Division ..... Sub Division ..... P. W. I's Section .....

General Details of Level Crossings

Level Crossing No. ..... Kilometrage ..... Between Stations..... Inside station Limits of Station .....

Class of Level Crossing ..... Manned / Unmanned / ..... If manned No. of Gate keepers ..... Roster Classification .....

Type of Barrier : Movable/lifting/gates/chains/..... whether located in suburban/A. P. B. territory/Automatic block signalling .....

Whether interlocked or not ..... Whether Provided with telephone .....

1. Particulars of Road Across which the Level Crossing is Situated –

a) Name of Road ... ...

b) Road connecting village/town ... ...

c) Class of Road (whether Class I, II, III or IV) ... .

d) Road authority in-charge of maintenance of road (National Highway/State Highway/Municipality /Panchayat/P. W. D./Others.) .....

e) Civil District where located ... ...

f) State in which located ... ...

g) Type of road surface (Kutcha/Moorum/Water Bound Macadam/Bituminous surface/concrete etc.) .....

2. Width of gates at right angles to centre line of road.....

3. Length of check rails/check flats ... ...

4. Angle of crossing of road way, if skew ... ...

5. Whether wicket gates or stiles have been provided for pedestrians. .....

6. Position of gates when open to Road traffic Across/ Away from tracks. .....

7. a) Whether lamps have been provided on the gate on both sides for the road users. .....

b) In the absence of lamps, whether the gate has been painted white and red disc provided. .....

c) Whether reflectors have been provided on the stop disc on both sides of the gate. .....

8. Whether the red light meant for road users has been blanked off towards the approaching train except for special class level crossing where gates are closed across the track. .....

9. Distance of gate posts from centre line of track ... .

10. a) Whether gate-lodge/bunk has been provided ... .

    b) Distance of gate-lodge from centre line of nearest track. .....

    c) Distance of gate-lodge from edge of metalling ... .

    d) If on a curve, whether gate-lodge is located on outside of the curves. .....

    e) Whether quarters have been provided for Gateman ? If so, How many. .....

11. Type of fencing and length ... ... Left side ..... Right side .....
    Prior. Prior.
    Left side ..... Right side .....
    after. after.

12. Interlocking and Communication Devices Provided –

    a) Normal position of gate (whether closed to road traffic or open to road traffic). .....

    b) Whether barriers/gates are interlocked with separate signals or with the station signals. .....

    c) Distance of gate signals and warning boards from level crossing. Up Direction .....
    Dn. Direction .....

    d) Whether there is a telephone (Magneto), connection and facility for exchange of private Nos. and the station to which connected. .....

    e) Whether there is warning bell-operated by approaching train. .....

    f) Whether the gate/barriers can be operated simultaneously. .....

13. Details of Road and Approaches –

    a) Width of road-way at right angle to centre line of Road outside gate. .....

    b) Width of metalling between gates ... ...

    c) Width of metalling outside gates ... ...

    d) Minimum width of road formation outside gates for a distance of 30 M. beyond gate. .....

    e) Whether it is level between gates ... ...

f) Level length outside the gates. Details of gradient on approaches — L H side .....
R H side .....

g) Length of straight outside gates. — L H side .....
R H side .....

h) Whether rumble strip has been provided. (Manned Level Crossing only). .....

i) Whether speed breaker/bumps has been provided on either approach (unmanned level crossing only). .....

14. Visibility, Road, Signs, Whistle Boards etc. –

a) Has Whistle boards (W/L.) been provided on the approach of Level Crossing. If so distance of whistle boards from the Level Crossing. — Up Direction .....
Down Direction .....

b) Distance of clear view of approaching trains from Level Crossing (gate lodge) at manned level crossing. — Up Direction .....
Down Direction .....

c) Visibility of trains for road users at unmanned level crossings at a distance of 5 metres. — Up Direction .....
Down Direction .....

d) Whether warning boards for road users have been provided. If so, the type and the distance at which it is provided. — L H side .....
R H side .....

e) Whether stop boards have been provided on both the approaches at the gate in the case of unmanned level crossings. .....

15. a) Dates of taking last Census (for seven days) ... .

b) No. of trains per day ... ...

c) No. of Trains/Vehicle Units per day ... ...

d) Whether there is motor traffic and No. of motor vehicles per day.

16. Track structure at Level Crossing –

a) Type of Track - Free rail/S W R/L W R/C W R. .....
..... lbs./kgs. Rails on ..... sleepers.

b) Date of last overhauling ... ...

c) Date of painting gate ... ...

17. Safety Items –

a) Whether locking arrngements have been provided for both gates. .....

b) Whether stops have been provided to prevent gates from swinging towards track.

c) Whether spare chains have been provided for emergencies. .....

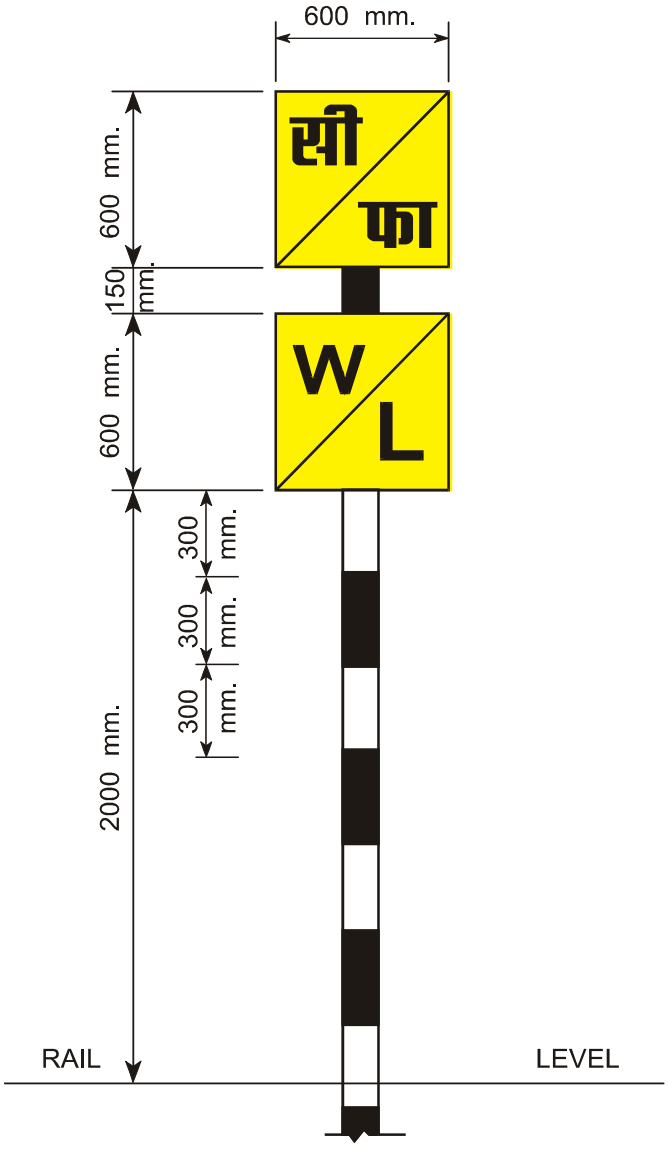
d) Whether working instructions of level crossing in English and Local language are available at the gate. .....

e) Whether distinct indications are provided for guiding the gateman to place the detonators and also the staff/lamp near the gate, to warn the approaching train in case of emergency. .....

f) Whether height gauge have been provided on both sides of level crossing, in the case of electrical terriory. .....

g) Whether protection diagram has been exhibited at gate. .....

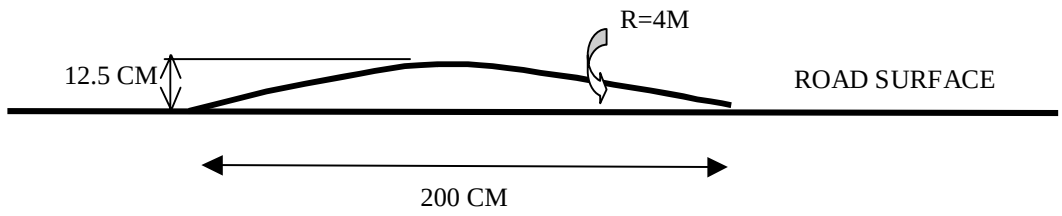
ANNEXURE-9/5 PARA 916 (1)



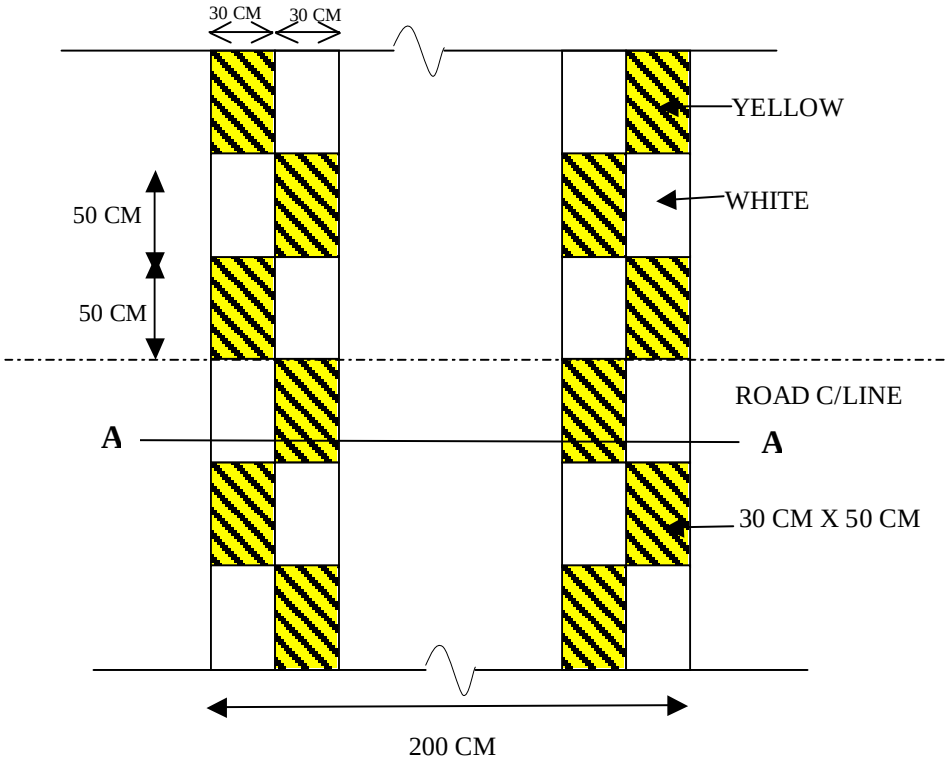
DETAILS OF WHISTLE BOARD ON THE APPROACH OF A LEVEL CROSSING

ANNEXURE-9/6 PARA 918 (1)

SPEED BREAKER DESIGN



SPEED BREAKER – SECTION –'AA'

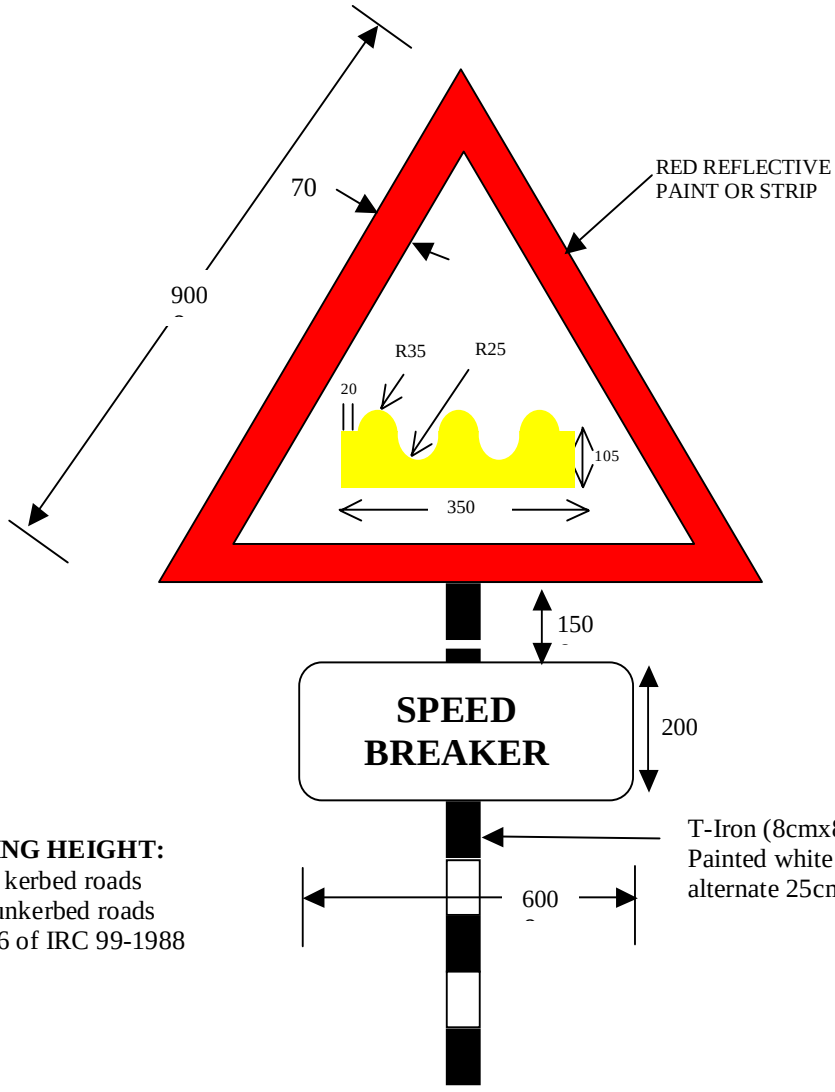


NOTE - THE HUMP SHOULD EXTEND TO THE FULL ROADWAY WIDTH. APPROPRIATE BASE COURSEMATERIAL SHOULD BE EXTENDED OVER THE SHOULDERS FOR PLACING THE HUMPS OVER THESE.

ANNEXURE-9/7 PARA 918 (2)

WARNING SIGN

(DIMENSIONS IN mm)



MOUNTING HEIGHT:
2.0m on kerbed roads
1.5m on unkerbed roads
Ref: Figure 6 of IRC 99-1988

LOCATION- TO BE SO PLACED ON ROAD FORMATION THAT NO PART OF THE SIGN COMES OF THE VEHICLES

CHAPTER X

PATROLLING OF THE RAILWAY LINE

1001. Types of Patrolling : (1) The following are the types of patrolling in vogue :

(a) Keyman's daily patrol.

(b) Gang patrol during abnormal rainfall or storm.

(c) Night patrolling during monsoon.

(d) Security patrolling during civil disturbances and for movement of VIP specials.

(e) Hot weather patrolling for long welded rails/ continuous welded rails.

(f) Watchmen at vulnerable locations.

(2) *Keyman's Daily Patrol* - Every portion of the permanent way shall be inspected daily on foot by the keyman of the beat in which the portion of the track falls. Provided that the interval between such inspections may, under special instructions, issued by Chief Engineer be increased to once in two days in the case of specified section of lines with light and infrequent traffic.

(3) *Gang Patrol during Abnormal Rainfall or Storm* – In the event of abnormal rainfall or storm during day or night, the Mate should, on his own initiative organise patrolling over the length affected, independently of other patrolling, if any being done. This patrol should, in case of heavy rainfall, confine its inspection to known points of danger, such as cutting or culverts likely to scour, banks affected by tanks likely to breach and bridge approaches. In case of high winds, the patrolman should inspect the length of track likely to be fouled by falling of tree etc.

Arrangements exist with the Meteorological Department of the Government of India for issuing telegrams of warning, wherever storms, gales, or heavy rainfall are expected. On receipt of such information from the Control, the Permanent way Inspector will arrange to advise monsoon patrolmen, watchmen and gangmates to be extra vigilant and be prepared to introduce patrolling, as necessary (for detailed instructions **Para 728 of IRPWM** may be referred to).

(4) *Night Patrolling during Monsoon* – During the monsoon, certain section of the railway line, as may be specified, shall be patrolled to detect damage by flood, such as breaches, settlements, slips and scours and immediate action taken to protect trains, when so warranted.

(5) *Security Patrolling during Civil Disturbance and on Special occasions* –

(a) On apprehension of a Civil disturbance, the Divisional authorities should contact the local Civil authority and arrange, as circumstances may warrant for security patrolling of the railway line. This may be arranged on the pattern of the monsoon patrolling with modifications, as deemed necessary, in consultation with Civil authorities.

b) Security patrolling on special occasions should be carried out according to the special instructions issued by the administration.

(c)The primary duty of the patrolman employed on Security patrolling shall be to protect trains against any condition of danger, such as tampering with track or obstruction placed on line.

(6) *Hot weather Patrolling for LWR/CWR* **–** Hot weather patrol is carried out when the rail temperature reaches t_d + 20 degree or above.

The patrolling should be done in accordance with the provisions of Manual of Long Welded Rails.

(7) *Watchmen at vulnerable locations*. In addition to patrolmen, stationary watchmen are posted at known or likely locations of danger or trouble.

1002. Protection of line in case of Emergency – Should any patrolman/stationary Watchman/Gangman/Keyman deputed for the purpose of patrolling notice any condition likely to affect the safety of trains, he shall at once protect the line and report the damage to the nearest Station Master as laid down in **Para 1011.**

Monsoon Patrolling

1003. Comencement and Termination – The sections, which are normally to be patrolled during monsoon will be identified and notified by the Divisional Engineer. For every such section, the Divisional Engineer shall prescribe the period of year, when normal monsoon patrolling is to be done; patrolling should be started on these notified sections on the dates specified. If the local conditions warrant, the Permanent Way Inspector of the section concerned may introduce or continue night patrolling outside the stipulated dates, duly advising all concerned.

1004. Preparation of Patrol Charts – (1) The Divisional Engineer will prepare patrol charts for each of the sections where monsoon patrolling is required to be done, taking into consideration the train timings of the time table in force during this period. The principles governing the preparation of patrol charts shall be -

(a) Ordinarily patrolling will be carried out by a single patrolman, but in regions where danger from wild animals, dacoits and other risks as in ghat sections exist, patrolling in pairs may be introduced with the approval of the Chief Engineer.

(b) All trains carrying passengers between sunset and sunrise get the maximum protection possible.

(c) As far as possible, each block section will be treated as a unit and the length will be divided into equal beats. The length of each patrol beat should not normally exceed 5 km. Where the block section is more than 10 km. an intermediate flag station, if any, or any other suitable point may be fixed as intermediate station, to keep the length of beat at about 5 km.

(d) The walking speed of a patrolman may be taken as 3 km. per hour.

(e) The maximum distance covered by a patrolman should not normally exceed 20 km. in a day.

(f) A period of at least half an hour rest is desirable between consecutive beats.

(g) If the frequency of train services is high, and one set of patrolmen is not able to cover all the trains in the section, a second set of patrolmen may be introduced to reduce the interval.

(h) For giving better protection to all passenger trains, between sun-set and sun-rise it would be advantageous to plot the scheduled paths of all passenger trains and then plot the patrol movement in such a way, so as to minimise the time interval between patrolling of the beat and passage of train.

(i) Patrol charts should show all vulnerable locations where stationary watchmen are posted.

(2) Sample patrol charts are appended for guidance, as **Annexure 10/1, 10/2, 10/3.**

1005. Distribution of Patrol Charts – Before commencement of the monsoon, requisite number of copies of patrol charts should be supplied by the Divisional Engineer to the Assistant Engineers, Permanent Way Inspectors, the Divisional Operating Superintendent (for distribution to the Control staff), Station Masters and Foremen of running sheds. The Foremen will acquaint Drivers of passenger trains, when they may expect to pass patrolmen, if running to time. By inviting drivers to lookout for patrolling, an immediate and practical means of supervising the patrolmen is introduced. The task of dispatching patrolmen at the right time and signing their patrol book when they arrive at or depart from a station devolves upon the Station Master/Block Hut-in-charge.

1006. Patrol books and Systematic Patrolling – A patrol book containing sufficient number of pages should be supplied to each patrol with a tin case.

The books shall be serially numbered to correspond with the number of patrol on each section. The first page of the book shall contain the name of patrolman, kilometrage of patrol section and its number. The remaining pages will contain columns for date, station, time of arrival and departure and signature of Station Master.

Patrolmen shall be on duty at the time specified for each in the patrol chart.

The patrolman whose beat commences/ terminates at a station shall present the patrol-book in his possession to the Station Master/Block hut-in-charge who will enter therein the time of arrival and departure and sign the book. The Station Master/ Block hut-in-charge will also record the time of arrival and departure in his Diary/Train Register Book. The patrolman shall then patrol his length at the end of which, he will exchange his patrol book with that of the next patrolman and retrace his beat. The intermediate patrols do likewise. In this way each patrol-book will be conveyed from one station to the other and back again. Owing to close proximity of stations, patrolbooks may be passed through one or more intermediate stations, before it is returned to the original station.

If a patrolman on arrival at the end of his beat does not find the next patrolman to take over the book, he must proceed ahead, until he meets him. The patrolman should report the absence of any man from his beat to the Mate the next day.

Station Maters will see that the men come on duty sober and fully equipped, that their lamps are trimmed and filled with oil and that they leave for their patrol duty in time.

If a patrolman who is due to arrive at a station does not turn in time or does not turn up at all, the Station Master/Block hut-in-charge will advise Station Master/Block hut-in-charge at the other end of the block section of the absence of the patrolman and both Station Masters/Block hut-in-charges will issue caution orders to all trains entering the section until the patrolman from the other end of the "patrol-section" arrives at the station and reports that all is well.

1007. Equipment of Patrolmen – (1) Each patrolman shall be provided with the following equipment and such other, as may be prescribed by special instructions:

(a) One staff.

(b) Number plate 15 cm. Square (to be numbered consecutively from the beginning of each Permanent Way Inspector's length in white letters on black background).

(c) 12 fog signals in a tin case.

(d) Two tricolour hand signal lamps.

(e) Protective clothing according to local dress regulations.

(f) One match box.

(g) Two red flags and one green flag (day patrol only).

(h) Patrol book in a tin case.

(i) One three cell Electric torch.

(j) Whistle thunderer.

(k) One haversack.

(l) Three flare signals (fusees) on double/ multiple lines, ghats, suburban and automatic block territories and one fusee on single line sections.

(2) Where patrolling is undertaken in pairs or stationary patrol consists of two men, the equipment need not be duplicated but the additional patrolman will be provided with an extra hand signal lamp, whistle thunderer and protective clothing.

1008. **Selection of Patrolman –** Intelligent, experienced and trustworthy men should be selected from the Permanent Gangs by Permanent Way Inspectors to work as Patrolmen and Watchmen, preferably those who can read bridge and telegraph post numbers. Temporary substitutes should be appointed in their places to work for the gangs. Twice the number required should be selected to serve as relief, in case of illness, to provide for rest giver patrolman etc. The men selected from each gang should be sent to the Divisional Medical Officer for vision test and shall not be employed as patrolmen unless they have passed the requisite medical test.

1009. Certificate to be submitted by Permanent Way Inspector – The Permanent Way Inspector shall submit a certificate to the Divisional Engineer through Assistant Engineer a month in advance before the commencement of the monsoon that he has made all arrangements for monsoon patrolling and for watching vulnerable locations/ bridges and that the patrolmen and the watchmen have been made conversant with their duties, rules for the protections of the line and vulnerable locations in their beats. He will also submit to the Assistant Engineer a list of names of patrolmen and watchmen with their duties/locations assigned during the patrolling season.

1010. **Duties of Patrolmen –** (1) The duties of a patrolman shall be as follows :

(a) Walk to and fro over the beat in accordance with the chart pertaining to his "patrol-section" looking out for subsidence, slips, signs of erosion, trees blown across the track during storms or any other causes likely to endanger the safety of line. Bridges and their approaches should be especially watched.

(b) Apprehend damage to line when

(i) the flood exceeds danger level at any of the bridges.

(ii) when there is damage to the protection work or on approaches even before danger level is reached.

(iii) the water on one side of the embankment is at a much higher level than on the other side.

(iv) when any obstruction such as a fallen tree is blocking the water-way of a bridge.

(v) the track shows signs of a settlement.

(c) Take immediate steps in accordance with **Para 1011** to stop trains when any portion of the line is likely to be rendered unsafe due to abnormal rain or flood or any other cause.

(d) When no danger is apprehended, stand on the cess on the left hand side facing the train and exhibit his number plate, turning the light of his lamp on to it, so that the number can be seen from the passing train. He should also blow the whistle, when the engine and the brake-van of the train pass him.

(e) Obtain the signature of the Station Master/ Block Hut-in-charge on duty at the Station/ Block Hut concerned for his arrival and departure and exchange patrol books with adjacent patrolmen.

(f) Exchange the reports as to the conditions on their beats with adjacent patrol men and stationary watchmen on the way.

(g) Heed instructions from drivers who may report a condition of danger at a kilometrage and proceed to the place indicated and take necessary measures.

(2) It is of supreme importance that patrolmen and watchmen thoroughly understand what they have to do in the event of emergency. Every effort should be made to instruct and drill the men in their duties. In the event of an emergency the patrolmen should devote their whole time and energy to the protection of the line and summoning of assistance. Having protected the line and summoned assistance, they should resume their patrolling.

1011. Action When Damage is Observed – In the event of any portion of the line being breached or otherwise rendered unsafe for traffic the following procedure shall be observed

(A) In the case where two patrolmen are employed :

(1) *Protecting the line* – a) The second lamp should be lit and danger signals shown at once in both the directions.

(b) The two patrolmen shall then proceed in opposite directions showing the danger signals(red flag by day and red light by night) and when at 600M. on Broad Gauge and 400 M. on Metre Gauge and Narrow Gauge from the point of danger, each should place one detonator on to the rail; they shall then proceed to a distance of 1200 M. on Broad Gauge and 800 M. on Metre Gauge/Narrow Gauge from the point of danger where they should place three detonators on the rail about 10 metres apart.

On the double line the detonators must be placed on the line, in the direction on which the trains will approach. On Metre Gauge sections where trains run at maximum permissible speed of more than 75 km.p.h. the distances at which the detonators are to be placed shall be specified by the administration.

(c) Should the nature of obstruction be such as to render it impossible for either of patrolmen to get across the gap, as for instance a wash away with strong flood, one of the men should show the danger signal and endeavour to stop trains approaching the gap from the other side while the other man should proceed towards the station on his side of the gap, fix the detonators and act as in(b).

(2) *Reporting the damage to Station Master and Gangmate* – (a) After protecting the track one of the two patrolmen who is nearest to the station and in case mentioned in (c) the patrolmen who has protected the track will proceed in all haste, showing the danger signal, to the station and inform the station master of the danger. On his way back, if he meets with any gang quarter, he should inform the Mate of the occurrence and the gang must immediately proceed to the affected kilometrege and take necessary action to attend to the repairs.

b) After protecting the track the other patrolman will proceed to the site of obstruction, and remain there showing the danger signal, until the first patrolmen joins him. In case the other patrolman has not been able to locate the gang hut on his way back from the station, one of them should proceed to the gang hut and inform the gangmate.

B. In case where one patrol man is employed–

(1) *Protection of line* – (a)*When damage is detected on single line –*

(i) Place a red lamp during the night and a red flag during the day in a prominent position to warn a train which may approach from one direction. Then run in the opposite direction from which direction train is likely to come, with a danger signal (red flag by day and red light by night) and place one detonator at 600 M. on Broad Gauge and 400 M. on Metre Gauge and Narrow Gauge and three detonators at 10 metres apart at 1200 M. on Broad Gauge and 800 M. on Metre Gauge/ Narrow Gauge from the site of obstruction/damage.

Provided that on those Metre Gauge Sections where trains run at maximum speed of more than 75km.p.h., the distances at which the detonators are to be placed shall be specified by the administration.

(ii) Return to the site of obstruction/ damage and protect the other side with detonators similarly.

(iii) In the event of it being impossible to get the other side of the obstruction/damage (as in a washaway) place the red lamp so that it can be seen from as great distance as possible by a train approaching from that direction and protect the other side with the detonators etc. as detailed in sub-para(a) (i).

(b) When damage is detected on double line –

(i) Place the red flag/ lamp in prominent position so as to warn an approaching train on one track. Then run along the other track on which train is expected first and place the detonators as in sub-para(a) (i)

(ii) Run back and protect with detonators the line on which the lamp/flag was prominently placed earlier.

Official	By train	By trolly
P.W.I. Gr. III/II P.W.I. in- charge	Once a fortnight Once a month	Frequency to be prescribed by the Chief Engineer depending on the local condition

(2) *Reporting the damage to the Station Master*– The patrolman will return to the site of obstruction after protecting the line in both the directions and shall remain at the place of obstruction and send word about the danger through the first railway employee or other persons he is able to contact at the spot itself.

1012. Responsibility of Engineering Officials in the Matter of Patrolling –

(1) *Inspection of Patrol Books* – The Permanent Way Inspector must examine the patrol books, initial the entries each time he trollies and take up irregularities. The Assistant Engineer should examine the patrol books during his inspection.

(2) *Supply of Equipment to Patrolmen and Watchmen* – The Permanent Way Inspectors will be responsible for seeing that each (patrolman) is provided with the equipment specified, and for periodical distribution of consumable stores like kerosene oil, match box etc. The Mate will be responsible for seeing that the patrolman and stationary watchman posses the correct equipment specified.

(3) The Permanent way Inspector will be responsible for instructing the patrolmen in their duties, in the rules for the protection of the lines and in acquainting them with all vulnerable points on their beats. In addition to oral instructions, the Permanent Way Inspector shall by practical demonstrations, drill the patrolmen in their detailed duties and responsibilities.

(4) *Inspection Of Equipment*- The permanent way Inspector should check the equipment of all patrolmen and watchmen once a month, record the results in patrolbook and take steps to recoup deficiencies.

(5) *Check over Patrolling at Nights – (a) By Permanent Way Inspectors*- The following are the schedule of inspection of night patrolling for the inspector Grade III/ II and the Permanent Way Inspectors- in - charge; by train/trolly :

(b) The Assistant Engineer shall cover his entire sub-division once in a month by train/push trolly/ Motor trolley in the night and check the patrolmen.

1013. Action by Assistant Engineer and Permanent Way Inspectors On Receipt of Information Regarding Damage to the line – On the receipt of information of any damage to the line, the Assistant Engineer and the Permanent Way Inspector -in-charge and Permanent Way Inspector (Grade III/II) concerned should proceed to site by the quickest possible means and take necessary action for restoration.

1014 Vulnerable locations (points)– (1)*Definition* – Vulnerable locations (points) are those, where conditions unsafe for the passage of trains are apprehended and there is need for stopping of trains in time in case such conditions develop e.g.-

(a) Bridges, having inadequate water-way, liable to scour in foundations, oblique/ parallel flow of water to the approaches, rise of flood above danger level frequently.

(b) Bad banks liable to slips and subsidence.

(c) Bridges located across river courses fed by Railway affecting tanks.

(d) Cuttings and Hill slopes frequently affected by the landslides and boulder-falls.

(e) Water over flowing over the track.

(f) And any other condition likely to affect the safety of the track.

(2) *List of Vulnerable locations* **–** A list of vulnerable locations should be maintained by each Assistant Engineer/Divisional Engineer in a register form and should be reviewed and brought up-to-date.

(3) *Guarding of vulnerable locations* – (a) Stationary watchman should be posted round the clock at every nominated location during the monsoon period.

(b)He should keep a watch on vulnerable location and in case he apprehends danger he should take action to protect the line in accordance with **Para 1011.**

(c) The equipment for the watchman should be on the same scale as patrolman except that a watch man will not be provided with –

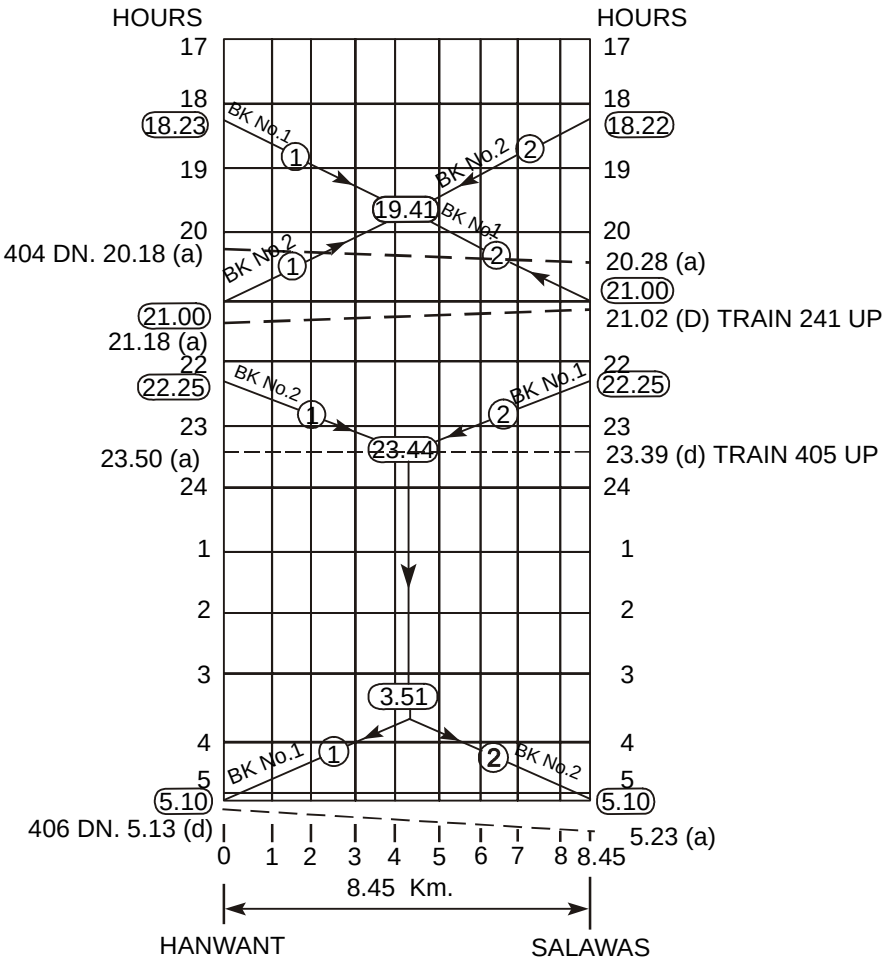
(i) Number plate.

(ii) Haversack.

(iii) Patrol book in tin case.

A notebook should however be provided to the watch man.

ANNEXURE-10/1 PARA 1004



REFERENCE :

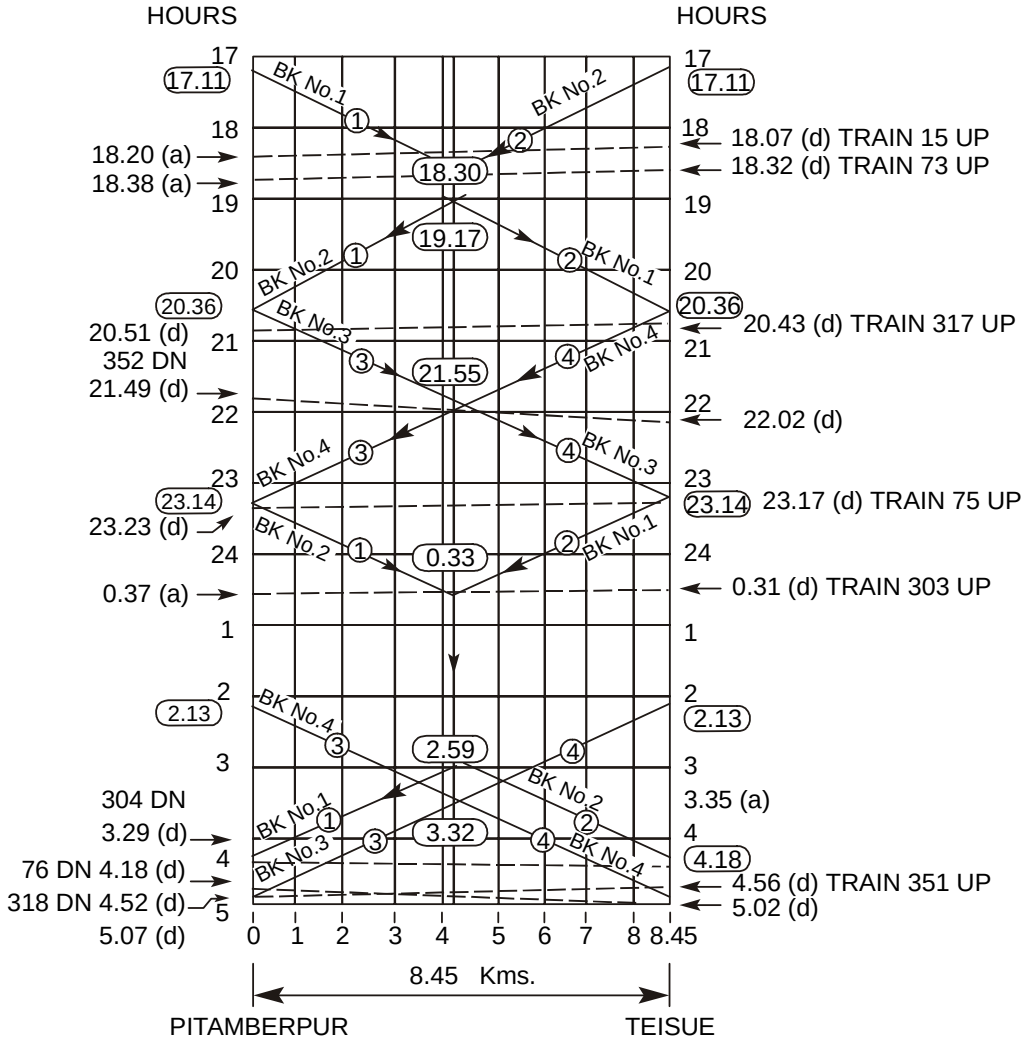
1. —(2)—◯— INDICATES PETROL MEN.
2. —(18.22)— INDICATES TIME OF ARRIVAL & DEPARTURE OF PETROL MEN..

SPECIMEN PATROLLING CHART

MAIN LINE & BRANCH LINE DENSITY TRAFFIC

2 BEATS LENGTH 8.45 Kms.
JODHPUR - MARWAR SECTION

ANNEXURE-10/2 PARA 1004



REFERENCE:

1) —②— INDICATES PETROL MEN

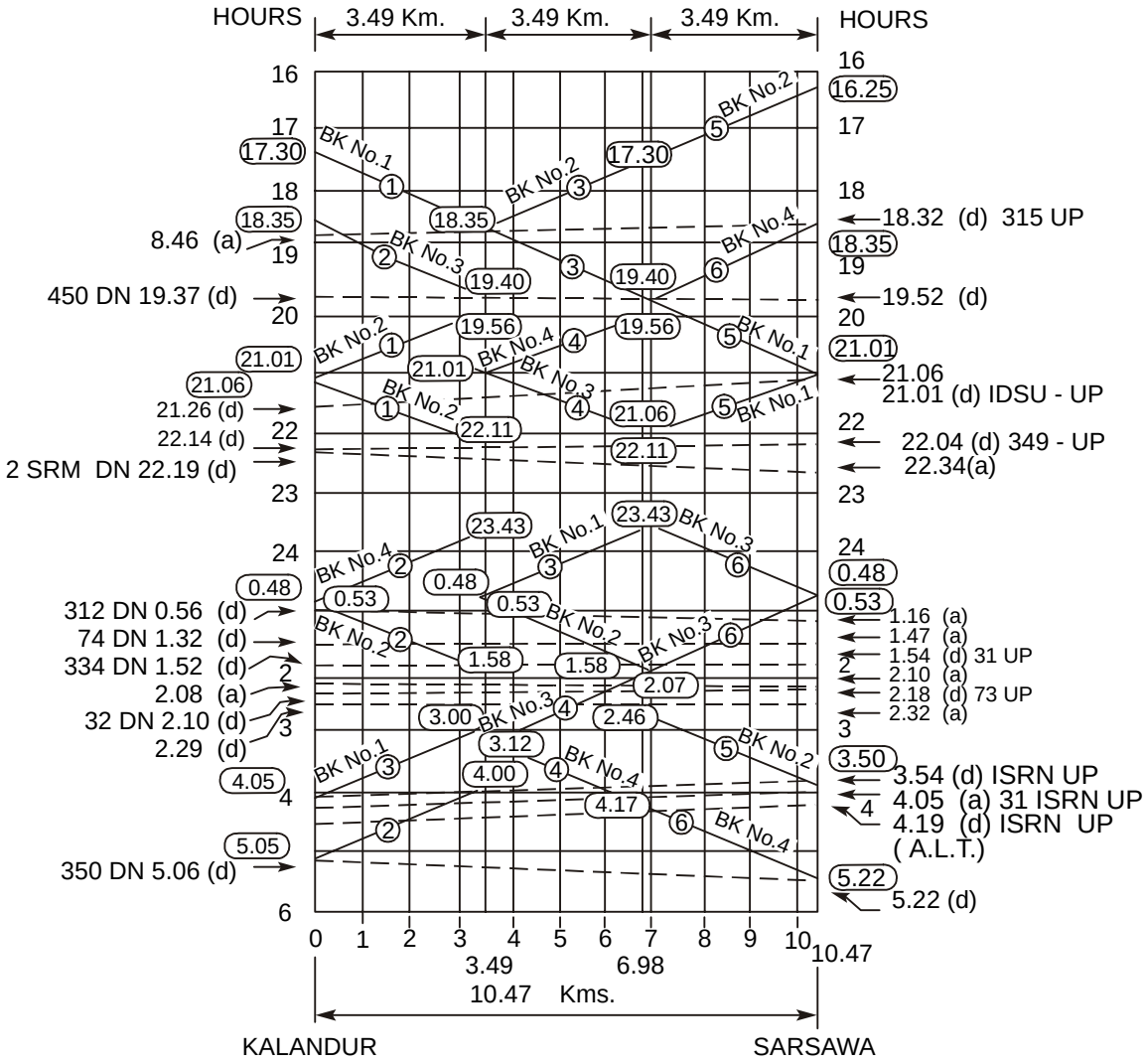
2) —2.13— INDICATES TIME OF ARRIVAL AND DEPARTURE OF PETROL MEN.

SPECIMEN PATROLLING CHART

MAIN LINE HEAVY DENSITY TRAFFIC
2 BEATS LENGTH 8.45 Kms.

ROSA - BAREILLY SECTION
(DOUBLE LINE)

ANNEXURE-10/3 PARA 1004



REFERENCE :

1. PETROL MEN ① ③ & ⑤ EXCHANGE BOOK No. 1 & 2.
2. PETROL MEN ② ④ & ⑥ EXCHANGE BOOK No. 3 & 4.

SPECIMEN PATROLLING CHART

MAIN LINE HEAVY DENSITY TRAFFIC
3 BEATS LENGTH 10.47 Kms.

SAHARANPUR - LUDHIANA SECTION
(DOUBLE LINE)

CHAPTER XI

THE WORKING OF TROLLIES, MOTOR TROLLIES AND LORRIES

1101. General instructions – The Rules for working trollies, motor trollies and lorries are contained in **Paras 15(18) to 15(27) of chapter XV-B of General Rules (1976),** supplemented by the subsidiary rules issued by individual railways. The instructions contained in this chapter are in amplification of these rules and will not supersede the general and subsidiary rules of Railways.

1102. Distinction between Trolly, Motor Trolly and Lorry –

(i) A vehicle which can be lifted bodily off the line by four men shall be deemed to be a trolly. Any similar but heavier vehicle (which includes Dip Lorry) shall be deemed to be a lorry.

(ii) Any trolly which is self-propelled, by means of a motor, is a motor trolly.

(iii) A trolly shall not, except in cases of emergency, be used for the carriage of permanent way or other heavy material, and when a trolly is so loaded, it shall be deemed, to be a lorry.

1103. Certificate of Competency –

(i) No trolly, motor trolly or lorry shall be placed on the line except by a qualified person appointed in this behalf by special instructions.

(ii) Such qualified person shall accompany the trolly, motor trolly or lorry and shall be responsible for its proper protection and for its being used in accordance with special instructions.

(iii) The qualified person shall hold a certificate of competency which shall be issued according to prescribed instructions.

(iv) Staff in whose favour a certificate is issued should be literate, having knowledge of Hindi or other local languages, should have passed the prescribed Medical test and should be conversant with the rules for working of trollies, motor trollies and lorries, as the case may be. The certificate of competency will be issued for a specified period by an officer authorised to do so and renewed periodically.

1104. Officials Permitted to use Trollies, Motor Trollies and Lorries – Subject to their being certified competent, the following officials of the Engineering Department are permitted to use trollies/ lorries :

(i) *Trollies/Lorries* –

(a) All officers and inspectors of Engineering Department.

(b) Permanent way Mistries and Section Mates, Head Trollymen as may be authorised.

(ii) *Motor Trollies* – All officers of Engineering Department - motor trolly Drivers and such Inspectors as may be authorised.

1105. Responsibility for safe working –

(1) The official-in-charge of trolly/ motor trolly/ lorry is responsible at all times for its safe working. When more than one person holding competency certificate travels in a trolly, the official working the trolly is responsible for its safe working.

(2) It shall be clearly understood by officers and staff that they are to take every possible precaution and protection against accidents. When entering a tunnel or cutting or proceeding over a long bridge or curve, the official-in-charge will make sure that no train is likely to be met. While approaching a level crossing the official-in-charge, should look out for road traffic and ensure safe passage of his vehicle over the level crossing.

1106. Efficient Brakes – No lorry, trolly or motor trolly shall be placed on the line unless, it is fitted with efficient brakes. The brakes should be tested before the commencement of each journey. It is desirable that trollies and lorries working on ghat section are fitted with screw down brakes in addition to ordinary hand/foot brakes. It will be the responsibility of the official-in-charge to ensure the adequacy of braking.

1107. Attachment to Trains Prohibited – No trolly / motor trolly/ lorry shall be attached to a train.

1108. Working on Track Circuited Sections and Sections Provided with Treadles – Each Railway shall issue subsidiary rules for the working of trollies/ motor trollies/ lorries in sections where treadles or track circuits form part of the Block instruments or where automatic signalling has been provided.

1109. Numbering of Trollies/ Motor Trollies/ Lorries – Each trolly/ motor trolly and lorry shall be marked with its number, code initials of the department, the designation and headquarters of the official-in-charge.

1110. Conveyance of Trollies/ Motor Trollies/ Lorries by Trains –

(1) No trolly, motor trolly/ lorry should be loaded in a train without the consent of the Guard in-charge of the train, who will direct where it is to be placed.

(2) In the case of an accident/emergency, trollies/ motor trollies may be carried by Mail /Express trains on which there are restrictions normally for loading of trolly/ motor trolly.

(3) When loading a motor trolly with petrol in the tank , the following rule extracted from **Para 1106 of the I.R.C.A. Coaching Tariff No. 21, Part I / 1972** as applicable to carriages, motor-cars, boats etc., should be adhered to –

" ..... a quantity of petrol not exceeding 9.00 litres may be left in the tank provided that,

(a) The flow of petrol in the carburettor has been cut off;

(b) Any pressure has been released from the tanks;

(c) The tank is in sound condition and closed by a well fitting cap;

(d) The engine has been run by the official-in-charge until the carburettor has become exhausted and the engine stops automatically."

1111. Trollies, Motor Trollies and Lorries not in use –

(1) A trolly, motor trolly or lorry, when not in use shall be placed clear of the line, and wheels thereof secured with a chain and padlock.

(2) When a trolly / motor trolly is placed on a platform to be loaded into a train, it should be under the charge of a trollyman and placed where it will not be in the way of passengers or working staff.

(3) Whenever possible, motor trollies, should be placed in a shed, the key of which, shall be in the possession of the official-in-charge.

1112. Conveyance of Non-Railway officials–

Trollies shall not be used for the conveyance of persons other than railway officials. In special cases, Magistrates, Police, Civil, Telegraph, Military, Medical and Forest Department Personnel or a person requiring medical aid, may be conveyed by trolly by order of the competent authority (The Assistant Engineer or above), after a bond on form in **Annexure 11/1** is signed indemnifying the Railways against all liabilities and risks.

Contractors and their Agents may be conveyed on trolly in connection with works, provided they have executed a general indemnity bond similar to Form **Annexure 11/1.**

1113. Trolly-Permits for Private Sidings – A non-railway official is permitted to use a trolly on private sidings when he is in possession of a permit signed by the competent authority. Such permits are granted for use of the trolly on sidings where there is no passenger traffic. The party shall execute a bond on Form **Annexure 11/2** indemnifying the Railways against all liabilities and risks. The issue of trolly permits will be subject to such rules as may be prescribed. In such cases, the Head trollyman shall hold a certificate of competency issued by the authorised Railway Official.

1114. Military officers using trollies in Ordnance Depots – The Military authorities are aware that the Railway Board are not prepared to accept any liability whatsoever for damage or compensation arising out of accidents caused in the working of trollies used by Military Officers on duty in Ordnance Factories in respect of claims of Officers themselves or third persons.

1115. Trolly Refuges and Observation Posts–

(1) *Trolly Refuges* – Trolly refuges over long Bridges should be provided at such intervals, as prescribed in the Schedule of Dimensions. In cuttings and high banks trolly refuges should be provided at suitable intervals.

(2) *Observation Posts* – Where, owing to curves in cuttings or other causes view of the line is restricted, "observation posts" should be established at such sites as command the best view in both directions for the use of Flagmen, thus enabling hand signals being conveyed to the trolly on line.

1116. Equipment for Trolly/ Motor Trolly / Lorry – Each trolly/ motor trolly/ lorry shall have the following equipment :

(a) Two hand signal lamps;

(b) Two red and two green hand signal flags;

(c) Detonators 12 nos;

(d) A chain and a padlock;

(e) A copy of the Working Time Table and all correction slips and appendices, if any, in force on that section of the railway over which the trolly, lorry or motor trolly is to run;

(f) A motor horn and a search light (for motor trolly only);

(g) Two banner flags and additional detonators (for lorry only); and

(h) Such other articles as may be prescribed by the Railway Administration in this behalf.

Note – The official-in-charge of the trolly/ motor trolly / lorry shall also be in possesion of a watch in addition to the prescribed equipment.

1117. Signals for Trolly/ Motor Trolly / Lorry–

(1) *Day Signal* - Every trolly, Motor trolly or Lorry when on the line shall show a red flag by day, fixed to a staff which will be placed on a socket and conspicuously visible in both directions.

(2) *Night Signal* – On a double line the night signal shall be red light in the direction from which trains are expected and white in the other direction and on a single line, red in both directions. Where on double line, single line working is introduced, the night signal should be as per a single line. When working within the station limits, the light displayed at night shall be red in both directions.

(3) *Signals within long tunnels* – On sections where there are long and dark tunnels, the night signals prescribed must be displayed during the day in addition to the red flag, in the case of Trollies, Motor trollies and Lorries. In the case of thick foggy or tempestuous weather impairing visibility, light signals must be displayed in addition to the red flag.

(4) *Removal of Trolly/ Motor trolly/ Lorry* – As soon as a Trolly/ Motor trolly/ Lorry is removed from the track and placed clear of it, the red flag or light signal shall be removed, but care should be taken to see that this signal is not taken off before the lines have been cleared of all the obstructions.

1118. Working Of Trollies –

(1) *Manning of trollies* – Trollies in all cases shall be manned by four men.

(2) *Mode of working of trolly* – Trollies in all cases should be pushed and not pulled.

(3) Working under Block protection –

(a) Trolly may be worked under Block protection wherever it is possible to do so without interference to train service.

(b) Trollies should be worked under Block protection in the night.

(c) During day time in foggy weather and during dust storm, when the visibility is poor, a Trolly should be worked under Block protection.

(d) Sections with restricted visibility due to curves, cuttings or due to other local conditions specified by Railway Administration, wherever practicable, should be traversed under Block protection.

(e) When working under Block protection Trollies will be worked in the same manner as trains.

(4) *Working without Block protection* –

(a) During day time in sections with normal visibility the official-in-charge shall before leaving a station/ Block post, ascertain the whereabouts of the trains likely to be met and set off on trolly.

(b) In sections with restricted visibility [specified sections, **Ref-Para 1118(3) (d)**] when the official-in-charge, is not able to block the section and work under Block protection, he will follow the following procedure :

(i) The Station Master/ Signalman will on receipt of advice from official-in-charge (in triplicate on **Form Annexure 11/3**) giving his trolly programme ascertain and fill in particulars of trains running on the section, retain one copy and return the other two to the official-in-charge of the trolly.

(ii) As a reminder that the block section is occupied by the trolly and caution orders must be issued, a small placard with words " Trolly on line", will be hung in front of the block instrument, until advice of the removal of the trolly is received.

(iii) If telegraph and telephone communications are interrupted and the Station Master/ Signalman is unable to communicate with the station at the other end of the block section, the official-in-charge of the trolly will be advised of this fact and form **Annexure 11/3** endorsed accordingly. When communication between the two stations is restored, the messages referred to above will be exchanged, if the trolly has not cleared the section or removal report has not been received.

(iv) From the time of exchange of the messages, until intimation has been received that the trolly has cleared the block section, the Station Master/ Signalman at both ends of the block section shall issue caution orders to Drivers of all trains entering the block section. On the double line, caution order should be issued for both up and down trains.

(v) The issue of caution orders in no way relieves the official-in-charge of the duty of complying strictly with the rules for protecting the trolly.

(vi) On arrival of the trolly at the other end of the block section, the person-in-charge of the trolly shall fill in the removal report and send it to the Station Master/Signalman who will return the third copy signed. The Station Master/Signalman will then advise the Station Master/Signal man at the other end of the block section of the trolly having cleared the section.

(vii) If the trolly is removed from the track at the station not provided with telegraph or telephone instruments or in the block section and if it is not intended to place it on the track again, the official-in-charge of the trolly shall fill in the removal report and send it to the Station Master / Signalman at the nearest block station. In the former case, the Station Master will send written advice by the first train in either direction to the next block station. The Station Master / Signalman at the latter station should then advise the Station Master / Signalman at the other end of the removal of the trolly.

(viii) Station Masters/Signalmen at the both ends, of the block section will enter remarks in the train registers pertaining to the block section concerned showing the times at which the trolly entered and cleared the block section and the number of the trolly.

(5) *Protection In Block Section -*

(a) When a trolly is worked other than under the rules for working of trains i.e., without block protection and when a clear view is not obtainable for an adequate distance of 1200 M. on Broad Gauge and 800 M. on Metre Gauge / Narrow Gauge, the following precautions should be taken **(Annexure 11/4) :–**

(i) On a double line, he must depute a Flagman with detonators to precede or follow the trolly, and to exhibit a hand danger signal at a distance of not less than 1200 M. on Broad Gauge, and 800 M. on Metre Gauge / Narrow Gauge in the direction from which trains may approach.

(ii) On single line, depute a Flagman with detonators to precede and another to follow the trolly and to exhibit hand danger signals at a distance of not less than 1200 M. on Broad Gauge and 800 M. on Metre Gauge and Narrow Gauge.

(iii) Where necessary, intermediate Flagman should be posted to relay signals.

(b) The distance at which the signals are to be exhibited may be suitably increased in the case of Metre Gauge High speed routes where the speeds are more than 75 km.p.h., under special instructions by the Railway Administration.

(c) The flagman should only be withdrawn when a clear view of at least 1200 M. on Broad Gauge and 800 M. on Metre Gauge and Narrow Gauge can be obtained in the direction from which trains may approach.

(d) When a train is sighted, the Flagman should wave the red flag vigorously to warn the official-in-charge of the trolly of the approach of the train, and at the same time place three detonators 10 M. apart on the line to protect the trolly. The detonators should be removed only on receipts of hand signals from the official-in-charge by waving of a green flag to withdraw the danger signal indicating that the trolly has been removed.

When conditions are such that the Flagman can not be seen by the official-in-charge of trolly, the latter must arrange before entering the section to take with him sufficient men with hand signals who will be placed in suitable positions between the trolly and the Flagman so that the signals from the Flagman can be repeated to the person-in-charge of the trolly and vice versa.

(e) On sighting an approaching train or the Flagman's signal, the trolly must be removed clear of the line and kept in such a manner that it can not roll towards the line.

(6) *Trollies travelling together* – When two or more trollies are running together in the same direction in the same line, care should be taken to ensure that they are kept at least 100 M. apart to safeguard the trolly in rear from colliding with the front one, in case the front trolly has to be stopped suddenly for any reason.

1119. Working of Motor trollies – (1) A motor trolly shall only be run in accordance with special instructions .

(2) A motor trolly may be worked under block protection or without block protection, as may be prescribed by the Railway Administration.

(3) *Working under block protection* – (a) A motor trolly should be run only under block protection (i) during night; (ii) during day time, when the visibility is poor due to fog or dust storm.

(b) Sections of restricted visibility should invariably be traversed under block protection. A list of "sections of restricted visibility" may be specified for the guidance of all concerned, either in the subsidiary rules or in the working time table.

(c) When a motor trolly that is worked under block protection breaks down in the block section, the official-in-charge should remove it clear of the line and send a written advice to the nearest Station Master / Block Hut -in-charge returning the line clear ticket or token or in the case of a motor trolly when the token has been clamped for a preceding train the key of the padlock. He should not replace the motor trolly on the line without the written permission of either Station Master / Block Hut-in-charge at the end of the block section concerned. On arrival at the other end, the official-in-charge will deliver the authority to the Station Master after the trolly has arrived complete.

(4) *Following a Train /Motor trolly* – Motor trolly may follow a fully vacuum brake train or another motor trolly in the same block section during day light hours and in clear weather under special instructions issued by the Railway Administration.

(5) *Working without block protection* – (a) When a motor trolly is worked without block protection, it should be manned by at least four men.

(b) In case a motor trolly is worked without block protection, the procedure outlined in **Para 1118(4)(b)** for trollies shall be followed for working of the motor trollies.

(c) When a motor trolly is worked without block protection, as per special instructions, the procedure outlined in **Para 1118 (5)** should be followed for the protection of trolly in block section.

1120. Working of Lorries – (1) *Mode of working of lorry* – Lorries in all cases should be pushed and never pulled. Riding of persons on the same is prohibited.

(2) *Manning of Lorries* – When running under block, a lorry must be accompanied on foot by not less than four men in addition to the number of men required for expeditiously loading and unloading materials being conveyed on the lorry.

When running without block protection a lorry should be accompanied on foot by an adequate number of men required to remove the lorry and its contents readily off the line in addition to Flagman for its protection. The Duties of Flagman should invariably be entrusted to trained men experienced in the working of lorries and who have passed the vision test.

(3) *Working under block protection* – (a) Whenever it is possible to block the line without interference to trains, the lorry shall be worked under block protection, after blocking the line.

(b) A lorry shall be worked only under block protection when –

(i) It is necessary during an emergency to run it at night.

(ii) The visibility is restricted due to sharp curves/cuttings etc., as on certain specified sections.

(iii) It is loaded with rails, girders or specially heavy materials which will cause delay in unloading.

(c) *Actual working of lorry* – (i) Before obtaining line clear, the offiicial-in-charge of a lorry should advise the Station Master / Block Hut-in-charge, whether it is his intention to return to that station, to run to the other end of block section, or to remove the lorry in mid-section.

(ii) The official-in-charge, after getting the authority to proceed in the form of line clear ticket / token, double line certificate or shunting key, as the case may be, should work his lorry.

(iii) He should, after completion of his work, hand over the authority to proceed to the concerned Station Master / Block Hut-in-charge and remove his lorry.

(iv) In case the lorry is off loaded in the mid section, the authority to proceed should be returned by a special messenger to the nearest station after ensuring that the lorry is kept clear off the line.

(v) On the double line the official-in-charge should run the lorry on the proper road. The lorry should be taken along the line in the direction in which the trains will run; except when returning to the original starting station/Block Hut.

(4) *Working without Block protection* – (a) A lorry shall ordinarily be run only by day and when the weather is sufficiently clear for a signal to be distinctly seen from an adequate distance, which shall never be less than 1200 metres on Broad Gauge and 800 metres on Metre Gauge and Narrow Gauge. Distance may be specified by administration in Metre Gauge high speed routes where the maximum speed is more than 75 km.p.h. In such cases the lorry can be worked without block protection when it is not possible to block the line without interference to train service.

(b) *Procedure for working* – (i) When a lorry is to enter a block section without line clear, Form **Annexure 11/3** should be prepared by the official-in-charge in triplicate and necessary particulars filled in by the Station Master / Signalman who will retain one copy and return the other two to the official-in-charge.

(ii) Until the "lorry removed from section" signal has been despatched and received, both Station Masters / Signalman shall issue caution orders to the Drivers of all trains entering the section on which the lorry is working. All trains booked to run through and extra, special and other out of schedule trains should be stopped at the station in order that this advice may be given.

(iii) Lorries should be removed clear of the main line or if within station limits, of the line on which a train is to run, at least 15 minutes before the train is due.

(iv) On completion of work, the lorry removal report in Form **Annexure 11/3** should be completed and handed over to the Station Master / Signalman concerned and his acknowledgement obtained.

(c) *Protection of lorry in Block Section* – When the line has not been blocked and a lorry whether loaded or empty is placed on the line without block protection the lorry shall be protected as detailed in sub-para below (**Annexure 11/5**) –

(i) On double line, by one or two men as required at a distance of 600 metres on the Broad Gauge and 400 metres on the Metre Gauge and the Narrow Gauge, carrying a Banner Flag across the track and another man plainly showing a stop hand signal at a distance of not less than 1200 metres on the Broad Gauge and 800 metres on the Metre Gauge and the Narrow Gauge from the lorry in the direction from which trains may approach, or

(ii) On single line, by one or two men as required, following and preceding the lorry at a distance of 600 metres on the Broad Gauge and 400 metres on the Metre Gauge and Narrow Gauge carrying a banner flag across the track and another man plainly showing stop hand signal at a distance of not less than 1200 metres on Broad Gauge and 800 metres on Metre Gauge and Narrow Gauge from the lorry on either side.

(iii) Each man so following or preceding the lorry at a distance of 1200 metres on Broad Gauge and 800 metres on Metre Gauge and Narrow Gauge shall be provided with detonators and place three on the line 10 metres apart, immediately the lorry comes to a stand for the purpose of either loading or unloading and continue to display the Stop hand signal.

(iv) The man or men carrying the banner flag shall immediatly fix the banner flag across the track immediatly the lorry comes to a halt or a train is seen approaching, and continue to display the Stop hand signal.

(v) In all cases, where the Flagman in advance or in rear can not be kept in view from the lorry, additional intermediate signalman as required should be posted to relay the signals.

(vi) The Stop Signals and detonators shall not be removed until the Flagman, receives the orders to withdraw them from the official-in-charge of lorry.

Note : In M.G. section High speed routes where the maximum speed is more than 75 km.p.h. the distances should be specified by the administration.

(5) (a) *Working in Station limits* – When a lorry is required to work within Station limits, the permission of the Station Master shall be obtained in writing before working the lorry and the lorry should be worked as per the approved special instructions.

(b) *Protection in Station limits* – When a lorry works in a station yard the Flagman must exhibit danger signals at such a distance on both sides as will ensure safety. When the lorry is required to remain stationary for more than 15 minutes, it must be protected by banner flags placed at an adequate distance supplemented by three detonators on both sides.

(c) When a lorry has to work on a section with a steep down gradient (gradients steeper than 1/100), the same should not only be controlled by hand brakes, but by a rope tied in the rear and held in tension by men following a lorry.

1121. Working of Cycle Trollies and Moped Trollies :– (1) *Cycle Trollies* – Cycle trollies are those trollies which are propelled, by pedalling instead of pushing. It may be pushed when necessary but not pulled. A cycle trolly shall be manned by at least four men, including the persons pedalling or driving. They may be worked as per rules pertaining to a "Trolly" **(Para 1118).**

(2) *Moped Trollies* – These are light motor trollies, which can be lifted off the track normally by three men. They should be manned by at least three men including the Driver. These may be worked as per the rules pertaining to a Trolly, for which the Railway Administration may issue special instructions, as necessary.

1122. Rail Dolleys

(1) Rail dolley is a device with two or more wheels which in balanced condition can be moved manually on one rail of track and can carry one rail/sleeper in suspended condition. When necessary, the suspended material can be dropped and rail dolley cleared off the track.

(2) *Manning of Rail Dolley*

Every rail dolley shall be manned by not less than two able bodied persons. The person-in-charge for the working of rail dolleys shall be a railway servant not lower in rank than a keyman. The official in-charge should have passed in medical category A-3 and must hold a valid certificate of competency for working rail dolleys. Certificate of competency shall be issued by a PWI of the section who must satisfy himself that the person to whom competency certificate is being issued is fully aware of the rules for the working of rail dolleys and is also well acquainted with the concerned section.

(3) *Working of Rail Dolleys*

(i) The railway servant in-charge of rail dolleys must inspect the section in advance particularly in reference to heaping of ballast, girder bridges and any other special features which make it difficult to drop the material and remove the rail dolley in the event of an approaching train. He shall get the ballast heaps cleared and work the dolley(s) only when the visibility is clear for at least 1200 metre on Broad gauge and 800 metre on MG/NG and the rails/sleepers can be dropped off safely without affecting the safety of trains and workers both.

(ii) Rail dolley shall not be worked on sections having gradients steeper than 1 in 200.

(iii) Not more than 6 rail dolleys should be worked in a group in any one block section.

(iv) Normally, not longer than 3 rail welded panels should be carried by rail dolleys. The rail dolleys must not be worked after sunset and before sunrise and in bad weather when the visibility is poor. Rail dolleys should not be worked in deep cuttings, steep grades, sharp curves and heavily built up areas where the visibility is not clear for 1200 metres on BG and 800 metre on MG/NG. In such locations, the rail dolleys should be worked under block protection.

(v) In case, a rail dolley is to carry rails longer than 3 rail panel or it is required to move over x overs in yard crossing more than one line in deep cuttings and curves then it should work under block protection.

(4) *Working of Rail Dolleys*

(i) No traffic block or caution order is normally necessary for working of rail dolleys except as indicated in para 3(iv) and (v) above.

(ii) Every rail dolley/group of rail dolley when on line shall exhibit a red flag.

(iii) The rail dolley shall be protected by a flagman at a distance of 1200 metre on Broad Gauge and 800 metre on MG/NG from the rail dolley, on a double line in the direction from which trains may approach, and by two flagmen one on either direction on single line. The flagmen shall also carry three detonators for use in any emergency.

(iv) Where necessary intermediate Flagman should be posted to relay signals.

(v) When a train is sighted, the Flagman should wave the red flag vigorously to warn the official-incharge of the dolley of the train and at the same time place three detonators 10M apart on the line to protect the rail dolley(s). The detonators should be removed only on receipt of hand signals from the official-in-charge by waving of a green signal to withdraw the danger signals from indicating that rail dolleys have been removed.

(vi) The official-in-charge of the rail dolley shall keep a look out for approaching trains and will get the rail dolley(s) and materials cleared off the track as soon as an approaching train is sighted.

(vii) While approaching level crossings, the official in-charge shall look out for road vehicles and ensure safe passage of rail dolleys.

(viii) The official in-charge shall be fully responsible for the safe working of rail dolleys.

ANNEXURE-11/1 PARA 1112

Indemnity Bond in Connection with the Permission Granted to Travel on a Railway

.....Trolly/Motor Trolly

In consideration of my being granted permission to travel between ..... and .....on ..... Railway .....Trolly/Motor Trolly I ..... hereby undertake and agree that the Railway shall be free from all responsibility or liability for any delay or detention or for any injury or loss to me or to any property of whatsoever kind accompanying me occasioned during the journey for which the permission is granted or whilst I am or the said property is within Railway limits.

I further undertake that I shall not interfere with or obstruct ..... on his duties and shall obey all reasonable directions he shall give me to be subject to the bye-laws and other general regulations of the Railway.

I further undertake to indemnify and keep indemnified and save harmless the Railway Administration for and against any loss or damage done to the property of the Railway through any act or omission on my part or on the part of my agent or servants while so travelling on the Trolly/Motor Trolly.

Dated ..... Name .....

Witness – Designation .....

1. ..... Address ....

....

2. ....

....

(To be executed on stamp paper)

ANNEXURE-11/2 PARA 1113

THIS INDENTURE made the ..... day of ..... between ..... of the one part and the President of India as owner of and administering the .....Railway (hereinafter called "the Administration") of the other part WHEREAS by an Agreement dated the ..... day of .....and made between the Administration of the one part and the said .....of the other part, the President of India agreed to allow the said ..... to use and work a private trolly on the railway line of the said .... Railway between ..... and whereas prior to the execution of the agreement the said ..... agreed to execute these presented.

NOW THIS INDENTURE WITNESSETH AS follows :

The said .....shall henceforth at all times perform and observe the stipulations, provisions and conditions on his part to be performed and observed and contained in the aforesaid agreement.

The said ..... shall observe and perform the bye-laws, rules and regulations of the .....Railways for the time-being in force.

The said ..... shall not in any way interfere with or hamper the working of the ..... Railway.

The said ..... shall from time-to-time and at all times hereafter indemnify and keep indemnified the Administration from and against all actions, claims, demands, costs, losses, damages and expenses including claims by 3rd parties Workmen's Compensation and Employees' liability which may be brought against or made upon the Administration or which the Administration may, pay, incur, sustain or be put to by reason of any loss of life or injury or damage to any person or property caused by or arising out of or from the user and for working of a private trolly by the said ..... on the said railway line and the user of permanent way in pursuance of the said agreement.

IN WITNESS where of the said ..... has hereunto set his hand and seal the ..... day and .....year first herein/above written.

Signed, Sealed and Delivered by

the said .....

In the presence of :

ANNEXURE-11/3 PARA 1118 (4)/1120 (4)

Trolly/Motor Trolly/Lorry Notice

(Working without line clear)

Notice No. ..... Station .....

Dated .....

To

The Station Master/Signalman ..... Station.

Trolly / Motor Trolly / lorry No..... is required to work between ..... and ..... It will leave ..... station at ..... hours Kilometre ..... at ..... hours } this day for ..... Station.

Kilometre .....

.....

Offical - in - charge

To

The Official-in-charge

Daily and extra trains due to arrive at or pass this station upto ..... hours have actually done so except.

No ..... minutes late

.....

.....

The following extra trains, special trains and light engines will enter ..... section as shown.

.....

.....

I have exchanged advice with ..... station/block post and shall issue caution orders to all Drivers until I receive advice of removal of the trolly/motor trolly/lorry.

.....

Station Master/Signalman

Removal Report

Reference trolly/motor trolly/lorry Notice No. ..... dated ..... trolly/motor trolly/lorry No. ..... arrived at .... at ..... hours.

was removed from the track at kilometre.

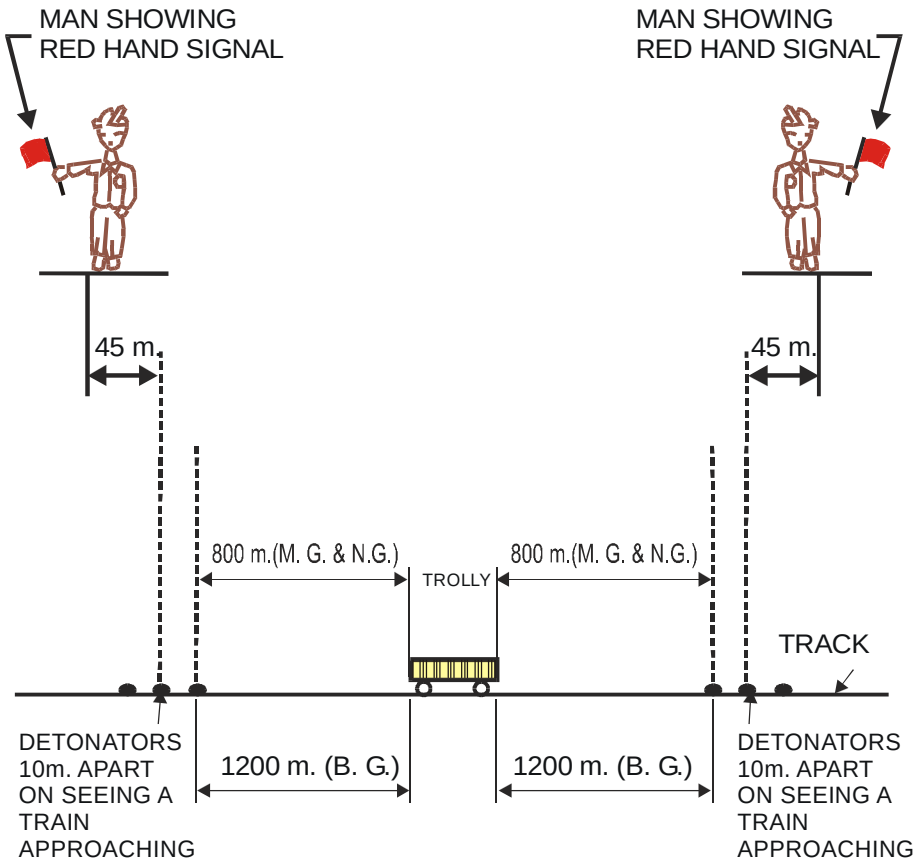
Removal report received at ..... hours.

Station Master/Signalman, ... Station.

Official - in - charge.

ANNEXURE-11/4 PARA 1118 (5)

PROTECTION OF TROLLY ON LINE



SINGLE LINE

Note:

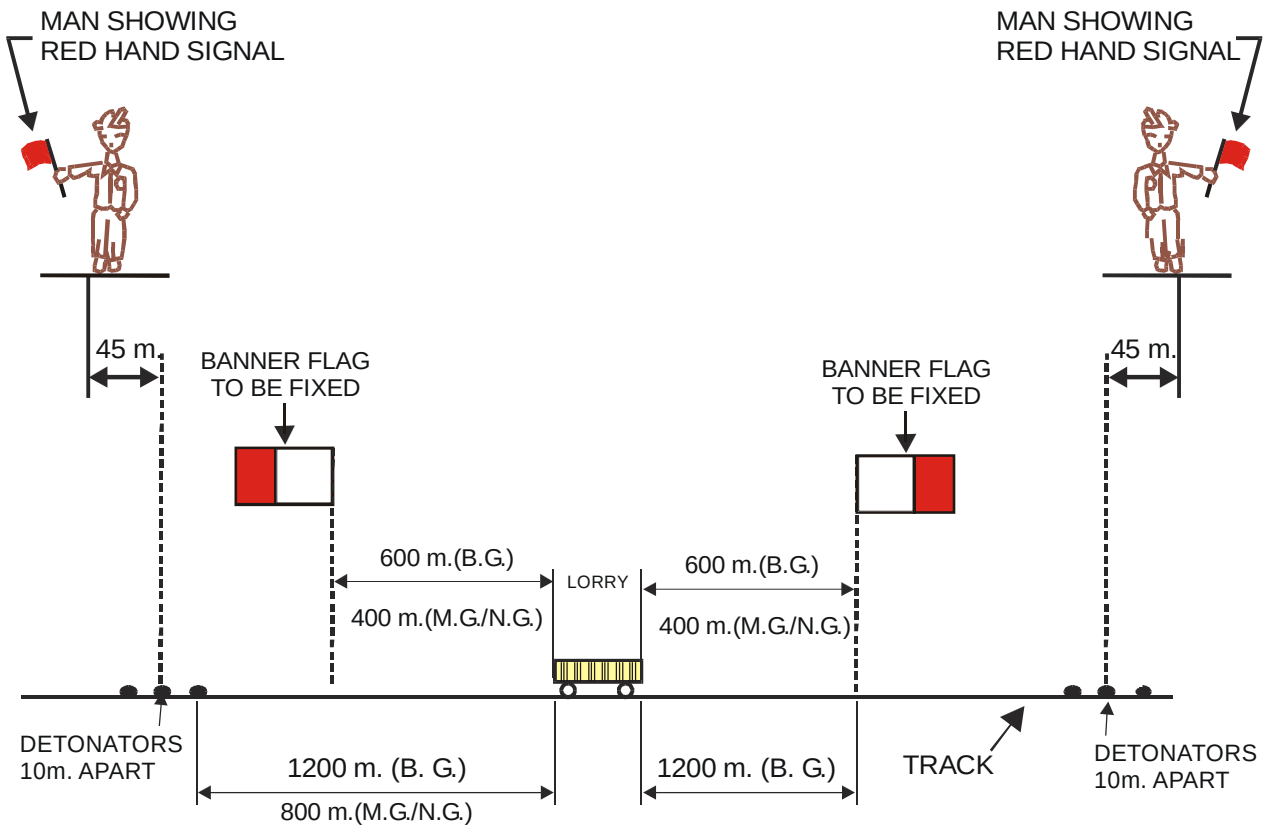
1. In metre gauge sections, where sanctioned speed is more than 75 km. p. h., the distance of protection will be increased as specified by the administration.

2. In case of double line, the flag-man is to be deputed either to follow or to precede the trolly, as the case may be.

PROTECTION OF TROLLY ON LINE

ANNEXURE-11/5 PARA 1120 (4)(C)

PROTECTION OF LORRY ON LINE



SINGLE LINE

Note:

1. In metre gauge sections, where maximum speed is more than 75 km. p. h., the distance of protection will be increased as specified by the administration.

2. In double line, protection is to be done in direction of Approaching train.

3. Detonators should be placed on the line when the lorry comes to a stop.

PROTECTION OF LORRY ON LINE

CHAPTER XII

WORKING OF MATERIAL TRAINS AND TRACK MACHINES

1201. Rules for Working – The rules for the working of material trains are outlined in :

(1) **Appendix IX of the Indian Railway Code for the Engineering Department,** and **Paras 4.62 to 4.65 of General Rules for Indian Railways (1976)** and **Subsidiary Rules** thereto –

When the quantity of material is such as could be conveniently trained out in stages, wagon-loads may be attached to goods trains by arrangement with the Operating Department.

1202. Material Train – Material Train means a departmental train intended solely or mainly for carriage of railway material when picked or put down for execution of works, either between stations or within station limits. The railway material may include stone boulders, ballast, sand, cinder, moorum, rails, sleepers and fittings etc.

1203.**Economical Working** – Material train should be expeditiously and economically worked. The Assistant Engineer should arrange to form a train of maximum capacity consistent with the haulage capacity of the engine and tonnage approved for the section. In consultation with the Operating Department, the running of goods trains should be suitably regulated so as to provide as long a working time for material train as possible. Delays in working should be traced to their source and remedies applied as circumstances demand.

1204. **Restrictions in Running** – (1) Except with the permission of the Assistant Engineer or Divisional Engineer, a Material Train should not be permitted to work during periods of poor visibility due to fog, storm or any other cause.

(2) Except in an emergency such as, an accident or breach of the railway line, working of material trains carrying labour should not be permitted between sunset and sunrise. If due to certain circumstances it is necessary to work Material Trains during night, permission to do so should be obtained from the Divisional Operating Superintendent.

1205. **Brake-vans and Shelter wagons** – (1) A Material train must be equipped with at least one brake- van in the rear. When running through between stations the engine should be marshalled at one end of the train, and the brake-van at the other end.

(2) Vehicles with vacuum brakes should be attached next to the engine when practicable and vacuum brake connected up with the engine.

(3) Covered wagons to afford shelter to the labour may be coupled to the material train as required.

1206. Ordering of Material Trains – **Authority Ordering** – Operating Department is the authority for ordering a material train. On receipt of requisition from the Assistant Engineer/Divisional Engineer, the Divisional Operating Superintendent shall advise the staff concerned by letter, detailing the composition of train, the loading kilometrages, the sections over which the train will work, the date of commencement of work, the station at which the rake will be stabled and the engineering official who will be deputed to be in-charge of the train. The notice to be given by the Engineering department should not normally be less than a week.

1207. **Issue of "Fit-to- Run" Certificate** – Before a material train is allowed to work, the complete rake should be examined by the carriage and wagon staff and a "fit-to-run" certificate issued to the Guard. The rake may also be examined by the carriage and wagon staff each time it arrives at the train examining station and whenever possible, once a week .

1208. Official -in -charge of Material Train –Whenever a material train is worked it shall be accompanied by a Guard. As the Guard is not qualified to carry out such duties as working of hoppers, distribution of ballast/materials, supervising loading and unloading, maintaining muster rolls and daily reports of labour and preparation of daily reports on material train working, a qualified engineering official should be deputed on the train to ensure working of material train to the programme specified by Assistant Engineer.

1209. **Equipment** – Every material train Guard must have with him while on duty:

(a) A copy of General and Subsidiary Rules or such of them as relate to his duties.

(b) An up-to-date copy of Working Time Table with correction slips and appendices, relating to the section of the Railway over which the material train is to be worked.

(c) A watch.

(d) Hand signal lamps.

(e) Two red flags and a green flag .

(f) A whistle.

(g) Not less than 12 detonators in a tin case.

(h) A carriage key.

(i) Padlocks as prescribed by special instructions.

(j) A set of clamp for point locking and/or other locking devices.

(k) A spare pair of glasses if he is required to wear glasses.

(l) First aid box.

(m) Sprags and chains.

(n) A tail lamp/L.V. Board.

(o) Portable telephone (on controlled sections),and any other equipment and stores prescribed by special instructions.

1210. **Testing of Brake Power** – (1) Before starting from a station, the Guard should ensure that the train is equipped with requisite brake power prescribed for the load.

(2) Each vehicle of material train whether or not provided with vacuum brake, must be provided with an efficient hand brake capable of being fastened down.

1211. Working in Block section – (1)A material train shall be worked with the permission of the Station Master on either side and in accordance with the provisions and system of working in force on the section. Before a Material Train enters a block section for work, the Station Master should advise the Driver and the Guard in writing of the time by which the train must clear the block and whether it is to proceed to the block station in advance or return to the same station.

(2) On double line, a material train must not push back to the Station in rear but should run through to the station in advance and return on proper running line except when otherwise directed.

Where provided, lever collars or other visual indicators must be used to remind Station Master that the material train is working in the block section.

(3) The Guard/Engineering official-in charge shall ensure efficient and proper working and adhere to sanctioned time and occupation of block section. Materials should not be left fouling the track, signal wires and interlocking gears. If it is necessary for the train to leave the site of work before this is done, it should be ensured that sufficient labour is left to do so, in-charge of a competent railway servant and that the site is protected until the work is completed.

(4) When a material train enters a block section to work under instructions of other than under the normal system of working, the Guard and the Driver of the train shall ensure that the train is protected from the direction a train is approaching on double line and in both directions on a single line in accordance with General Rules.

If for any reason, it becomes necessary to detach the engine of a material train in the block section to run to the station in advance, the Guard should ensure that the train is protected both in front and rear.

(5) On stopping a material train on a grade the Driver should give a long blast of the whistle to call the attention of the Guard and thereafter three sharp blasts, the signal for application of hand brakes. The brakes must not be released until the Driver has signalled for this by giving two sharp blasts.

Before entering a section on which a ballast train is required to stand on a grade of 1 in 50 or steeper, the engine should be so attached that when the train is standing the engine is at the down-hill end of the train.

(6) A material train should not be divided outside station limits except in an emergency. Before the train is divided the Guard should put the hand brake in the brake-van hard on, and pin down the hand brakes of sufficient number of vehicles and if necessary, lock by means of safety chains or sprags a sufficient number of wheels, in each portion of the train. He should further ensure that the workers/ labour are detrained before dividing the train.. Vehicles should not be detached from a material train on a grade of 1 in 100 and steeper. The engine itself may be detached with the Guard's permission after he has ensured that hand brakes on each vehicle are properly applied and the wheels spragged against any movement.

1212. Pushing of Material Trains – On down gradient steeper than 1 in 100, pushing is not permitted. On gradient easier than 1 in 100 ascending or descending pushing may be permitted at a speed not exceeding 25 Km./h. provided the brake-van occupied by Guard is the leading vehicle. **The speed will be restricted to 10 Km./h., if the brake van is not leading.**

1213. Procedure to be followed while pushing back – When it is necessary for a material train to push back into the station from which it started to work in the block section, the following procedure should be observed :–

(1) No train must be allowed to push back without a written authority from the Station Master of the station from which it entered the section. Where line clear tickets are in use, the Station Master shall endorse the line clear ticket as follows " to push back to this station".

(2) The Station Master of a station where the train starts from and pushes back to, must advise the station in advance on the telephone or telegraph instrument and also the Controller on controlled sections that the train will push back to the station. He will then obtain the acceptance of the "is line clear for a train stopping in the section" signal on the block instruments or on the Morse instrument, where block instruments are not provided from the station in advance and then give the "train entering section" signal in the usual way.

(3) On the return of the train, the Guard will intimate that the whole of the train has returned to the station complete, from the section and sign in the trains register book to the effect and return the "authority to push back" to the Station Master which must be cancelled by the latter. The Station Master will then give "cancel last signal " signal on the block or on the Morse instrument, as the case may be, and endorse the remarks that " train pushed back" in the trains register book or the line clear enquiry book against the entry of the train.

(4) When it has been arranged for a train to push back from the section, it must always do so and not go through to the station in advance.

(5) Before starting, a green flag must be tied to a convenient fixture in front (or on the tender if running tender- foremost) of the engine and also at the back of the rear brake-van to indicate to men working on the line that the train will push back.

(6) On the double line, when the train is required to be pushed back into a station, the train must come to a stand outside the advance starting signal and the Driver shall whistle, when, if a line is clear for its reception, it must be piloted into the station. If there is no advance starting signal, the train must be brought to a stand opposite the outer signal pertaining to the opposite direction and then be piloted into the station.

(7) On the single line, when a train is required to be pushed back into an interlocked station, it must come to a stand outside the outer signal and whistle, when, if a line is clear the home and the outer signals may be taken "off" for its reception. At a non-interlocked station, the train must also come to a stand outside the outer signal whence it must be piloted into the station on signals being lowered.

(8) Except in an emergency, material trains may push back during day-light only. If in case of an accident or for any other unavoidable reason, a train has to push back during the night, it must do so at a walking pace and the Guard or a competent railway servant must walk at least 600 metres on B.G. and 400 metres on M.G. and N. G. in advance, exhibiting a danger signal until the train comes to a stand as detailed in **sub-paras 6 & 7.**

1214. Running on Ghat Section and Descending Grade – (1) On Ghat sections, it may be necessary to attach an engine to bank the load in addition to the engine in front.

(2) When a material train is descending a long and continuous steep grade, the brake levers of as many wagons as may be necessary to assist in controlling the speed, should be notched down by the Guard under arrangements with the Driver.

1215. Passage over Points – The Driver of a material train should stop the train short of all catch, loop or spring points which are facing for his train and which are not protected by signals. The Guard should ensure that these are correctly set and locked and then hand signal the Driver past the points.

1216. Speed of Material Trains – (1) When running between block stations with the engine leading, the speed of material train shall not exceed that prescribed for a goods train with a similar load.

(2) When the engine is pushing the train and when as in the case of emergencies the brake-van is not leading -

(a) The speed must not exceed 10 km. p.h.

(b) The Guard must travel on the leading vehicle and exhibit hand signals to the Driver.

(c) When passing over points, the Guard should take action as in **Para 1215** above.

1217. **Stabling of a material train –** (1) Material train shall not be stabled on running lines at a station, except in unavoidable circumstances.

(2) When a material train is stabled at a station it shall be protected in the following manner and Station Master shall ensure that –

(a) The vehicles of the material train have been properly secured and are not fouling any points and crossings,

(b) All necessary points have been set against the line on which the material train is stabled and such points have been secured with clamps or bolts and cotters and padlocks, and

(c) The keys of such padlocks are kept in his personal custody until the material train is ready to leave the siding or line.

(3) The Guard shall not relinquish charge until he has satisfied himself that the material train has been protected as prescribed in this rule.

(4) When the train is ready to leave, the Guard must advise the Station Master in writing. The Station Master must then arrange for correct setting of the points.

(5) When a material train is stabled in an outlying siding, the Guard must ensure that it is inside the trap, clear of fouling marks and clear of running line. He must pin down sufficient number of brakes and if necessary, lock by means of safety chains or sprag the wheels.

1218. Reporting Deficiencies and Damages– The Guard of the material train should at once bring to the notice of the Train Examiner under advice to the Assistant Engineer, any deficiency or damage which may have escaped the attention of the train examining staff. The Guard will also keep a record of all damages caused to the vehicles during the work and report to the Assistant Engineer the circumstances in which they occurred.

In every case, the Assistant Engineer on receipt of such reports should arrange for the train-examining staff to attend to the damages and deficiencies expeditiously.

1219. Warning to workers on Material Trains –(1) The Guard of a material train shall before giving the signal to start, see that all the workers are on the train, and warn them to sit down.

(2) Before moving his trains, the Driver must sound the whistle, according to the prescribed code, as a warning to the labourers that the train is about to move.

(3) Before commencing any shunting with his train, the Guard must ensure personally that all labourers have been detrained.

(4) In the event of it being necessary to part a material train, the Guard must ensure personally that all labourers have been detrained before doing so.

1220. Engine Crew's Hours of Duty – Drivers, Assistant Drivers and Fireman employed on material train should be relieved according to their duty rosters. Only in exceptional and emergent cases such as breaches on the line, may the engine crew be kept on duty, for long hours, in which case, a special certificate should be given to the Engine Crew by the Engineering Official-in-charge.

LOADING AND UNLOADING FROM HOPPER BALLAST WAGONS

1221. Loading at Ballast Depots – The staff at the ballast depots are responsible to ensure that the wagons are loaded to the correct level.

1222. Working Trip – (1) The train Guard or Engineering official-in-charge shall be responsible for working the train to the instructions issued by the Assistant Engineer. The Permanent Way Inspector shall arrange for the inspection and clearing of track behind the train.

(2) A " Working Trip " is a trip when one or more wagons are to be unloaded between two stations. A "Running Trip" is a trip from one station to the other when no wagons have to be unloaded on the way. Before departing on a 'Working Trip' the Permanent Way Inspector shall supply the Material Train Guard/Official-in-charge with a memo furnishing the kilometrage at which the wagons shall be unloaded and the quantity to be unloaded.

1223. Operation of Hoppers – The hopper valves shall be operated according to the prescribed instructions under the direct supervision of the train guard or official-in-charge. As far as possible one hopper may be unloaded at a time moving at walking speed. The official-in-charge should walk on the side and instruct the labour as to when to open or close the hopper valves. The train should not be stopped, while ballast is being discharged ; labour should not be moved from the platform without first stopping the train.

1224. Training out material and daily reports of working – (1) Training out of material and ballast should be done to a programme sanctioned by the Divisional or Assistant Engineer.

(2) The Guard/Engineering official-in-charge should adhere to the sanctioned programme and submit daily report on prescribed form **Annexure 12/1** (Material Train Journal) to the Assistant Engineer through the concerned Inspector. Where the contract for the working of the material train provides for the employment of a minimum number of labourers and the contractor is paid for the actual labour so supplied for loading and unloading of ballast, permanent way or other materials the daily report should show the correct number of labourers of each class employed and the nature and approximate quantity of work done. Muster rolls should be maintained by the Guard or Engineering Official-in-charge and checked and initialled frequently by the Inspector concerned when the training out is done by departmental labour.

(3) In cases where the material is not loaded in bulk *e.g.,* rail girders and bricks, the actual weight and number loaded should be given in the daily report.

(4) Sufficient number of copies of daily reports should be prepared by the Guard/Engineering Official-in-charge and submitted to the concerned officers *e.g.,* Engineering, Operating, Mechanical etc.

(5) The number of wagons on the train with their capacity and painted numbers should be indicated on the form of daily report. Particulars of detention to the train other than for Engineering work should also be indicated.

(6) Before forwarding the daily reports of material train working to the Assistant Engineer, the Inspector may add relevant remarks as considered necessary. The Assistant Engineer should scrutinise the daily reports and take such action as considered necessary to avoid or minimise detentions in the working of the material train, before forwarding the same to the Divisional Engineer for allocation, initials and record.

1225. Charges for Material Train Working– For purposes of debiting the charges on account of Material train working to the heads of revenue working expenses concerned a monthly or fortnightly "Material Train Return" on the form given in **Para 1466-E** will be prepared by Operating Department and sent to the Divisional Engineer for completion and submission to the Accounts Department, for necessary action. On this return, the hire charges for wagons and engine will be separately shown.

1226. Register of Engineering Vehicles – (1) When Engineering wagons are not in use, these should be stabled in the siding allotted for this purpose in specific station yards.

(2) The Divisional Engineer and Assistant Engineer should maintain subdivision-wise a complete inventory in the form of a register of all closed wagons, open wagons, hoppers, etc., on the division. The register should contain :

Vehicle numbers;

Type of vehicle;

Capacity;

Condition of vehicle;
Locations and particulars of periodical overhaul, when carried out and due.

The register should be kept current to facilitate issue of instructions when ordering a material train.

(3) A monthly return of engineering vehicles on the sub-division should be submitted by the Assistant Engineer to the Divisional Engineer with complete particulars of each vehicle for record in his office. It should be the Assistant Engineer's responsibility to keep track of all Engineering vehicles allotted to his sub-division and see that those that are sent to workshops for periodical overhaul are returned expeditiously.

1227. Working of Track Maintenance Machines – (1) All 'on track' machines shall be worked only under traffic block with the permission of the concerned Station Masters and in accordance with the special instructions issued in this regard.

(2) (a) Each machine shall be in direct charge of a nominated track machine operator. The operator shall be responsible for the working of the machine under his charge. He shall be fully conversant with the rules of working of trains and of protection in case of emergency. He shall also ensure that the other staff deployed on the machine are fully conversant with the protection rules. He shall hold a valid certificate of competency for driving and working of the machine.

(b) The track machine shall work under the direct supervision of an engineering official not below the rank of PWI who will be responsible for taking the traffic block, for protection of the line while the work is in progress and clearing of the block after completion of the work when the last machine clears the block section and certifying that the track is fit for train movement.

(c) When the track machine is required to move from one block station to another block station, the operator shall run the machine with the proper authority to proceed as defined in GR 1.02/6.

(3) Each unit shall carry all safety equipments as specified under **Para 1209.**

(4) When more than one track machine is running in a block section, there should be a minimum distance of 120 metres between two units.

(5) While working on double/multiple lines, the engineering officials supervising the work of track machine shall ensure that no part of the machine fouls the adjacent track. In case infringement to adjacent track is inherent to the machine working which can be cleared at a short notice, the work should be carried out by protecting the infringed line by Engineering signals by Permanent Way Inspector as envisaged in **Para 806.**

(6) Each unit will run within the maximum permissible speed sanctioned for that type of machine on that section.

ANNEXURE-12/1 PARA 1224

DAILY REPORT OF MATERIAL TRAIN WORKING

Material Train Report of ..... train, ordered vide Divisional Engineer's/Assistant Engineer's No. ..... working from kilometre ..... to kilometre ..... Engine No. ..... Class ..... composition of train ..... labour ..... Mistries/Mates ..... Men ..... Women ..... Name of the Contractor .....

Station		Time		Hours occupied	Trip No.	Work done	Trains crossed	Allcation	
From	To	From	To					Name of work	Head of Account

At		Trip No.	Contents			At		Trip No.	Contents		
Kilometre	T. P.		Wagon	Description of material	Quantity	Kilometre	T. P.		Wagon	Description of material	Quantity

Contractor or his authorised agent ..... 198.....

Inspector No. ..... Section ..... 198.....

Material Train Guard/ Official. ..... 198.....

Assistant Engineer. Sub-Division ..... 198.....

Divisional Engineer. Division ..... 198.....

Note – On reverse of this form the class, capacity and number of each wagon should be shown; also, particulars of detentions to train other than for Engineering Work.

CHAPTER XIII

PROCEDURE FOR OBTAINING SANCTION AND CARRYING OUT WORKS AFFECTING SAFETY OF THE RUNNING LINE AND FOR OPENING NEW WORKS

GENERAL

1301. References to Rules –

(1) The safety of travelling public is governed (ensured) by the rules laid down in :

(a) Indian Railways Act of 1890(as amended from time-to-time),

(b)The General Rules of Indian Railways,

(c) The rules for opening of a Railway or a section of a Railway for the public carriage of passangers,1933(as amended from time-to-time), and

(d) The Indian Railway Schedule of Dimensions.

(2) These rules specify the authority competent to sanction and the procedure for obtaining sanction for any work which affects a running line, before the work is started or brought into use and before a new section of line is opened for public traffic.

1302. Works requiring the sanction of Commissioner of Railway Safety and Notice therefor –

(1) Under section 20 of Indian Railways Act and chapter VI of the "Rules for opening of a Railway or Section of a Railway for the public carriage of passengers,1933", the sanction of Commissioner of Railway Safety is required for the execution of any work on the open line, which will affect the running of trains carrying passengers and any temporary arrangement necessary for carrying it out, except in cases of emergency.

(2) For the commencement and opening of the following works, when they are connected with or form part of Railway already opened, the sanction of the Commissioner of Railway Safety shall be obtained :

(a) Additions, extensions or alternations to running lines.

(b) Alterations to points and crossings in running lines.

(c) New signalling and interlocking installations or alterations to existing installations.

(d) New stations, temporary or permanent.

(e) The construction (but not the removal) of an ash pit on a running line.

(f) Heavy regrading of running lines involving lowering/ raising of track in excess of 500mm.

(g) New bridges including road over and under bridges, foot over- bridges, strengthening, raising, reconstruction or extension of existing bridges, addition or replacement of existing girders, including provision of temporary girders.

(h) Provision of new level crossing, shifting of existing level crossing on running lines, demanning and downgrading of level crossing, manning of unmanned level crossings, upgrading of level crossing involving changes in the method of working or operation (such as interlocking, provision of lifting barriers in place of gates etc.) and closing down of level crossings.

(i) Permanent diversion (deviation) more than 2 kms. in length without any station in between and irrespective of length, when a new station is involved.

Note :– Permanent diversions more than 2 kms. in length, and irrespective of length when a new station is involved, are to be treated as new lines covered by the provisions of section 17 to 19 of Indian Railway Act.

(k) Temporary diversion irrespective of length, except those laid for restoration of through communication after accident.

(l) Addition or alterations to the electrical installations of tracks equipped for electrical traction.

(3) Application for any alterations, reconstruction or additions that require the sanction of Commissioner of Railway Safety should ordinarily be made 30 days in advance of the expected commencement of such work.

If for any reason a sanctioned work is not taken in hand within 12 months from the date of sanction, the Commissioner of Railway Safety should be approached for renewal of the sanction.

1303. Application for sanction of Works –

(1) Application to the Commissioner of Railway Safety, for sanction for carrying out works affecting the running lines should be submitted in the manner specified below :

(a) In the case of the Divisional Works the application should be made by Senior Divisional Engineer and/or Senior Divisional Signal and Telecommunication Engineer, for track, bridges and signalling and interlocking works as the case may be. When a Junior Administrative Grade Officer does not exist on the division in any department the Divisional Railway Manager / Additional Divisional Railway Manager should sign the application. In case of works executed by Construction Organisation whether for Civil Engineering or Signal and Interlocking, applications will be signed by the Junior Administrative Grade Officers for Chief Engineer(Construction), or Chief Signal and Telecommunication Engineer (Construction) as the case may be.

(b) For Divisional works which involve both Civil Engineering and Signal and Interlocking, application shall be signed jointly by the Junior Administrative Grade Officers of both Civil Engineering and Signal and Telecommunication Departments of the division. In the absence of a Junior Administrative Grade Officer, the application will be signed by Divisional Railway Manager/ Additional Divisional Railway Manager. In the case of works executed by Construction Organisation, application shall be signed by Junior Administrative Grade officers representing chief engineer (Construction) and Chief Signal and Telecommunication Engineer (Construction).

(2) In all cases, the name and designation of the signatory should invariably be given.

1304. Documents to accompany Applications – (1) Documents to accompany the application are detailed in Form (**Annexure 13/1**) and they should be complete in every respect.

(2) The officer should furnish along with his application a Track Certificate where applicable, on Form (**Annexure 13/2**) signed by Deputy Chief Engineer (Track) and in his absence by Additional Chief Engineer (Track) to the effect that the track is suitable for the maximum axle loads stated therein. The certificate will be countersigned by the Chief Track Engineer/Chief Engineer.

(3) For a major bridge, or when non standard girders or designs are used, a certificate on Form (**Annexure 13/3**) issued by Deputy Chief Engineer (Bridges) to the effect that the bridge or bridges are designed to carry the axle loads proposed to be run, should accompany the application. The bridge certificate will be countersigned by the Chief Bridge Engineer/Chief Engineer.

(4) For purpose of Forms (**Annexure 13/2 and 13/3**) the Chief Operating Superintendent should be consulted in regard to the types of locomotives and rolling stock to be used, their axle loads and speeds. The rules for traffic working obtained from the Operating Department and particulars of electric block-signalling work, if any from the Signal and Telecommunication Department should accompany the application.

1305. Submission of Safety Certificate –

(1) The Commissioner of Railway Safety in according his sanction may or may not propose to inspect the works.

(2) If the Commissioner of Railway Safety decide to inspect the work prior to opening, he will, after inspection in the company of the officers concerned, communicate in writing his sanction to open the work.

(3) Should the Commissioner of Railway Safety decide not to inspect the work prior to opening, the Safety Certificate in Form (**Annexure 13/5**), together with the certificates referred to therein shall be completed and submitted before the work is opened, by the Engineer(s)-in-charge and a telegram despatched to Commissioner of Railway Safety. Copies of Safety Certificate should be send to the Divisional Railway Manager and Chief Engineer and/ or Chief Signal and Telecommunication Engineer.

(4) The Safety Certificate for engineering works should be signed by the Assistant Engineer concerned and countersigned by the Divisional Engineer. If any conditional sanction is given, it should be specifically certified that the conditions as stipulated are fulfilled. If the signalling/interlocking work is involved, the Safety Certificate should be signed jointly by the officers of Signal and Tele-communication department.

(5) Safety Certificate shall be despatched to the Commissioner of Railway Safety expeditiously.

(6) When phase working is involved, separate Safety Certificate should be issued, whenever each phase of work is completed.

1306. Deviations from Plans approved by Commissioner of Railway Safety –

If any deviations from the plans approved by the Commissioner of Railway Safety which affects the layout of lines or the arrangement of signals or the working rules, are found necessary, his prior approval to such deviations should be obtained with reference to his sanction.

1307. Applications for running of new types of locomotives and/or rolling stock for increase in speed –

(1) Application to the Commissioner of Railway Safety for sanctioning the running of new types of locomotives or rolling stock or increasing the maximum permissible speed on a specified section or sections, or for Double Heading/Multiple Heading should ordinarily be made by the Chief Engineer one month in advance and accompanied by the following documents :

(a) Load diagram.

(b) Certificates for track-strength.

(c)Certificates for the strength of girders.

(d) Speed clearance certificate issued by the R. D. S. O.

(e) Reports of test runs/oscillation trials (to be obtained from RDSO if required by C. R. S.)

(f) Certificate on Form (**Annexure 13/4**) signed jointly by Chief Mechanical Engineer and Chief Engineer for steam and Diesel Locos and Chief Electrical Engineer and Chief Engineer in the case of straight electric locos and E. M. U. rolling stock. The certificate should also be signed by the Chief Operating Superintendent and Chief Signal and Telecommunication Engineer of the Railway, where maximum permissible speed for any class or classes of trains or rolling stock is proposed to be raised.

(g) A statement in the **Form XI of the "Rules for the opening of a Railway or section of a Railway for the public carriage of passengers"** detailing any infringement of maximum and minimum dimensions involved in the running of the locomotive or rolling stock.

(2) On receipt of such an application, the Commissioner of Railway Safety will, if he so desires inspect and/or try out the new locomotive and/or rolling stock and the Railway Administration will afford him the necessary assistance to do so.

1308. Notification to Railway Officials when opening works –

Except as described in (**para 1309**), no new work affecting the running of trains or the traffic working at stations should be brought into use until staff of all departments have been notified by means of a circular notice issued by the Divisional Safety Officer/Divisional Operating Superintendent. Timely intimation of the date of opening of works should be sent to the Divisional Operating Superintendent / Divisional Safety Officer, wherever any new or revised working rules are to be brought into operation, to enable him to give the running staff due notice.

1309. Works arising out of accidents including breaches –

(1) An abbreviated procedure to be adopted in the case of accidents as laid down in Section 21 of the Indian Railways Act, is reproduced below :

"When an accident has occurred resulting in a temporary suspension of traffic, and either the original line and work has been rapidly restored to their original standard, or a temporary diversion has been laid for the purpose of restoring communication, the original line and works so restored, or the temporary Diversion, as the case may be, in the absence of Commissioner of Railway Safety, be opened for the public carriage of passengers, subject to the following conditions, namely :

(a)That the Railway servant in-charge of the works undertaken by reason of the accident has certified in writing that the opening of the restored line and work or of the temporary diversion, will not, in his opinion be attended with danger to the public using the line and works or the diversion; and

(b) That notice by the Telegraph of the opening of line and works or the diversion shall be sent, as soon as may be, to the Commissioner of Railway Safety.

(2) The certificate on Form (**Annexure 13/6**) which is worded in accordance with Section 21(a) must be written out and signed by representative of Engineering Department in-charge of the work before opening it. This certificate shall be despatched by Telegram to the Officers concerned followed by confirmatory copies by letter. The Engineering representative should hand over a copy of the certificate to the representative of the Operating Department at the site of accident; the latter will not permit the passage of traffic over the restored road or the diversion until he is in possession of the certificate.

(3) Diversions should, wherever possible, be tested by running a Material train, or light engine over them, before opening for public traffic.

(4) The Certificate and Telegraph advice to Commissioner of Railway Safety need not be sent when the line is restored for through communication within 24 hours.

(5) Where the use of temporary diversion is likely to be extended for more than three days, the Commissioner of Railway Safety may if, he considers necessary take the earliest opportunity of inspecting it.

1310. Opening of New Lines –

Whenever it is proposed to open a new line for traffic, or to initiate the use of Electic Motive Power on a line already opened, or to commission a line where guage conversion has been done - Rules and procedure contained in the relevant Chapters of "Rules for opening of the Railway or a section of the Railway for the public carriage of passengers" shall be strictly followed.

ANNEXURE 13/1 (Sheet 1) Para 1304

..... RAILWAY

Application for Sanction

No. ..... Dated 198

From : .....

To

The Commissioner of Railway Safety,

..... Circle.

Sir,

I hereby apply for your sanction to .....

.....

..... being commenced and opened for the public carriage of passengers, when ready.

(2) With reference to **Chapter VI of the Rules for the Opening of a Railway,** I beg to enquire whether you wish to inspect the work prior to its opening for the public carriage of passengers, in which case intimation will be given of the date of completion.

(3) In the event of your deciding not to inspect the work prior to opening, the Engineer-in-charge will, on completion of the work, submit the Safety Certificate duly signed by him, prior to the opening of the work for public carriage of passengers and when required, also despatch a telegram ** to your address intimating that the work has been opened and the Safety Certificate has been signed by him.

(4) The application for the use of locomotives and rolling-stock to be drawn or propelled thereby on the proposed line, in accordance with **Section 16(1) of the Indian Railways Act, 1890 (IX of 1890),** in sent herewith/not required.

(5) The following documents are appended :–

Temporary works –

(a) Description of proposed works.

(b) Drawing of temporary works.

(c) List of infringements to Schedule of Dimensions.

(d) List of deviations from the Manuals of Instructions for Signalling and Interlocking and Block Signalling.

(e) List of deviations from General and Subsidiary Rules.

(f) Restrictions.

(g) Rules for Traffic Working.

(h) Documents for bridges as per Chapter VII of the Rules for the Opening of a Railway.

(2) *Permanent works –*

(a) Description of proposed works.

(b) Drawing of permanent works.

(c) List of infringments to Schedule of Dimensions.

(d) List of deviations from the Manuals of Instructions for Signalling and Interlocking and Block Signalling.

(e) List of deviations from General and Subsidary Rules.

ANNEXURE 13/1 (Sheet 2) Para 1304 Cont.

(f) Restrictions.

(g) Rules for Traffic Working.

(h) Documents for bridges as per **Chapter VII of the Rules for opening of a Railway.**

(6) Certified that a detailed examination of the strength and arrangement of the materials to be used in the temporary/permanent works in above connection, have been made and that the design and the materials to be used are upto the loads, which will be required to carry and that their opening for public carriage of passengers will not be attended with any danger.

(Delete temporary or permanent work, as the case may be).

Yours faithfully,

No. .....

Dated .....

From

The Commissioner of Railway Safety,

..... Circle.

To,

The .....

..... Railway.

Sir,

Your No. .....

Sanction is accorded to the above work being carried out.

* I do not propose to inspect the work prior to its opening for the carriage of passengers. When ready, it may be opened on a Safety Certificate (vide Paragraph 3 of your letter), which should be submitted to me direct without any delay.

* I propose to inspect the work prior to its opening for the public carriage of passengers. Advice of the date when the work will be ready for inspection should be intimated at least 14 days before it is proposed to open it.

Commissioner of Railway Safety.

Note : * Strike out paragraph not applicable.

* Here enter name of work and mention whether permanent or temporary.

** Form telegram – "Reference sanction No. ..... dated ..... Work opened for public traffic on ..... First train to pass ..... No danger to Public. Certificate signed".

+ If any of the documents are not sent, " NIL" to be written against such items.

Working rules for extensive remodelling schemes may be sent in not later than one month before the date on which the work is to be brought into use and in such cases 'will follow' should be written instead of 'NIL'.

ANNEXURE 13/2 (Para 1304)

Track Certificate

(To accompany application)

I do hereby certify that the track on section.....(station.....to station.....) from.....km. to.....km, the * weakest portion of which consists of.....kg. rails .....metres long each with a maximum wear of.....% on.....sleepers of density.....and minimum depth of.....ballast cushion below sleepers out of which.....minimum of clean ballast exists under sleepers on consolidated and stable formation is to the required strength which can safely take.....rolling stock (brief description) ** upto.....tonnes axle load at a minimum speed of.....km.p.h. subject of the local speed restrictions noted below –

Sl.No.	From	To	KM.....to KM.....	Nature of restriction	Brief reason for restriction

Countersigned by.....

.....
Additional Chief Engineer (Track)/ Deputy Chief Engineer (Track)

.....
Chief Track Engineer/Chief Engineer

Note – * The weakest portion on which no speed restriction has been imposed only need to be given.

** The maximum number of locomotives proposed to be coupled together for multiple operation shall be specifically mentioned.

Annexure 13/3 (Para 1304)

Bridge Certificate

(To accompany application)

1. Certified that the bridges on Section (station).....to.....
(station) from.....Km. to.....K.m. the minimum strength of superstructure being.....% of RBG/M. G., M. L. standard as per Bridge Rules 1941/1964 Revised corrected upto and inclusive of.....Correction slip No.....dated.....are safe to carry ..... (Rolling stock) not exceeding.....units (in the case of locomotive) coupled together, at a maximum speed of .....km.p.h.subject to the following restriction :

Sl.No.	Bridge No.	Location Km.	Spans and description	Nature of restriction	Brief reasons

2. Sub-structures of all the bridges are in satisfactory condition and safe to carry the above rolling stock at the speed proposed, conforming to the provisions of the I. R. S. Sub-structure (Code.....)corrected upto Correction Slip No.....except those that are weak and distressed which will be kept under observation with adequate speed restrictions on the same as follows :–

Sl.No.	Bridge No.	Location Km.	Spans and description	Nature of restriction	Brief reasons

Countersigned.

.....
Dy.Chief Engineer
(Bridge Design)

Chief Engineer/Chief Bridge Engineer

ANNEXURE 13/4 Para 1307

Joint Safety Certificate for the use of New types of Locomotive and/or Rolling Stock

Certified that it is safe to run..... .....(Particulars of locomotives and rolling stock proposed to run) not exceeding.....

.....units (in the case of locomotives) coupled together on the section (station).....to.....(station) from.....Km. to.....Km. of the.....Railway at a maximum speed of.....km.p.h. against a maximum speed of..... km.p.h. certified by R.D.S.O. subject to the following speed restrictions and conditions :

(a) Speed Restrictions

Sl.No.	From Km..... To Km.....	Nature of speed restriction	Brief reasons for restrictions

.....
C.M.E.

.....
C.E.

.....
C.E.E.

.....
C.S.T.E.

.....
C. O. P. S.

Note —

(1) When the speed of a loco/rolling stock is to be increased or increase in speed is contemplated over the maximum sanctioned speed for that category of train (Passenger or Goods) over a particular section, the C. O. P. S. and C.S.T.E. should be associated.

(2) C.E.E. should also sign wherever electric traction is involved.

ANNEXURE 13/5 (Sheet 1) Para 1305

Safety Certificate

(When the Commissioner of Railway Safety does not inspect the work prior to opening, this certificate must be signed before opening temporary or new works).

From

The Divisional Railway Manager / Divisional Engineer/
Divisional Signal & Telecommunication Engineer,
.....Division.

To

The Commissioner of Railway Safety,
.....Circle.

Description of work .....

.....

Reference : Chief Engineer/Divisional Railway Manager.....

Application No.....dated..... sanctioned under Commissioner of Railway Safety No.....dated..... to commence and open the above work.

Following Permanent / Temporary work has been done.....

.....

.....

.....

(1) I do hereby certify that, in the work abovementioned –

(i) The Schedule of Dimensions has not been infringed* except in regard to the items sanctioned under.....letter No.....dated.....

(ii) Engineering work has been carried out in accordance with Plan No.....

*except in regard to the alterations sanctioned under.....letter no..... dated.....

(iii) *The weight of rails, strength of bridges and general structural character of the works are such as have been prescribed under the rules.

(iv) The*Signalling/*Interlocking/*Block-signalling has been carried out in accordance with Signalling Plan No.....and the requirements laid down in the Manuals of Instructions for the installation and maintenance of Signalling, Interlocking and *Block-signalling apparatus have been fully complied with *except in regard to the items sanctioned under letter No.....dated.....

ANNEXURE 13/5 — (Sheet 2) Para 1305 Contd.

(b) The work has been carried out in accordance with the documents already supplied.

(2) A certificate from the Divisional Operating Superintendent/Divisional Safety Officer stating that the necessary working rules have been issued and giving reference in regard to sanction to deviation (if any) from General and Subsidiary Rules is attached/not required.

(3) I hereby certify that on the.....19...., I have carefully inspected (and tested +) the above work and that I have satisfied myself that it has been properly completed (and is in good working order +) and that the work can be opened for public carriage of passengers without endangering the safety of the travelling public or of the employees of the Railway, *subject to the following speed restrictions :–

Temporary.....Km.p.h.....due To.....

Permanent.....Km.p.h.....due To.....

(4) The work is being opened on.....

.....
Assistant Engineer

Dated .....

Countersigned by .....

Dated.....

.....
Assistant Signal & Telecommunication Engineer

Countersigned by .....

.....
Assistant Bridge Engineer

Dated .....

.....

No.....

Dated.....

Copy forwarded to .....for information.

Note – * To be scored out if not applicable.
+ Necessary in case of Signalling and Interlocking works only.

ANNEXURE 13/6 Para 1309

Telegraphic Advice in connection with Restoration of through Running after Accidents

Commissioner of Railway Safety,.....

Copy—Chief Engineer, Chief signal and Telecommunication Engineer, Chief Operating Superintendent, Divisional Railway Manager, Divisional Engineer, Divisional Operating Superintendent, Divisional Signal and Telecommunication Engineer, Station Masters.

Station Master's.....All concerned Message No.....dated.....Line and works restored to working order/temporary Diversion laid. Certificate signed. Work being opened to traffic without danger to public or goods, subject to a speed restriction of.....
.....km. p. h.

.....

Engineer-in-charge.

CHAPTER XIV

LAYING AND MAINTENANCE OF CONCRETE SLEEPERS

GENERAL

1401. Types of concrete sleepers – Two types of concrete sleepers are in use, on the Indian Railways–

(a) Monoblock prestressed concrete sleepers consisting of two types, post-tensioned and pre-tensioned.

(b) Two block reinforced concrete sleepers.

1402. Identification of Sleepers at Site – Concrete sleepers can be identified by the type-lettering showing the name of the manufacturer, the year of manufacture, and code letter of the sleeper type engraved on the top surface of sleepers. Permanent Way staff should take care to see that they are not obliterated during maintenance.

1403. Fittings to be used - Only approved types of fittings and fastenings shall be used with concrete sleepers.

1404. Locations where Concrete Sleepers are used-Concrete sleepers should normally be used only with LWR/CWR track. Hence the condition for laying LWR/CWR should equally apply for laying concrete sleepers.

Use of concrete sleepers on long lengths of track where provisions of check rails or guard rails is necessary, is prohibited unless special arrangements are made to provide the necessary flange way clearance.

Where concrete sleepers are used in yards with fish - plated track, provision of wooden sleepers at the joints and first shoulder is desirable.

Laying of Concrete Sleepers

1405. Laying of Concrete Sleepers – Concrete sleepers are heavy and manual handling is not only difficult but may even cause damage to the sleepers. Mechanical handling of concrete sleepers, therefore, becomes necessary. For this purpose, the Mechanical Relaying Systems consisting of portal cranes are used. Normally a set will consist of two portal cranes. For laying of concrete sleepers for fan shaped turnout, the instructions given in **Para 1413** be followed.

1406. Operations connected with Relaying– (1) *Preparatory work at site of relaying*- (a) Since concrete sleepers are laid with LWR/CWR all preparatory works as listed in LWR Manual should be carried out before laying concrete sleepers. In addition, longitudinal section showing the existing rail levels should be plotted and proposed rail level determined taking into consideration the following points :–

(i) 300mm. ballast cushion is available below the concrete sleepers.

(ii) Clearances to structures are maintained within the accepted limits.

(iii) The track and the road surface are suitably raised and approaches regraded.

(iv) Where lifting of track is not possible at places like-below over line structures, on girder bridges and in yards, etc., suitable ramping out should be done.

(b) The proposed predetermined rail level should be indicated at suitable intervals along the tracks.

(c) Auxiliary track should be laid at 3.4 M. gauge keeping its centre line same as that of the existing track.

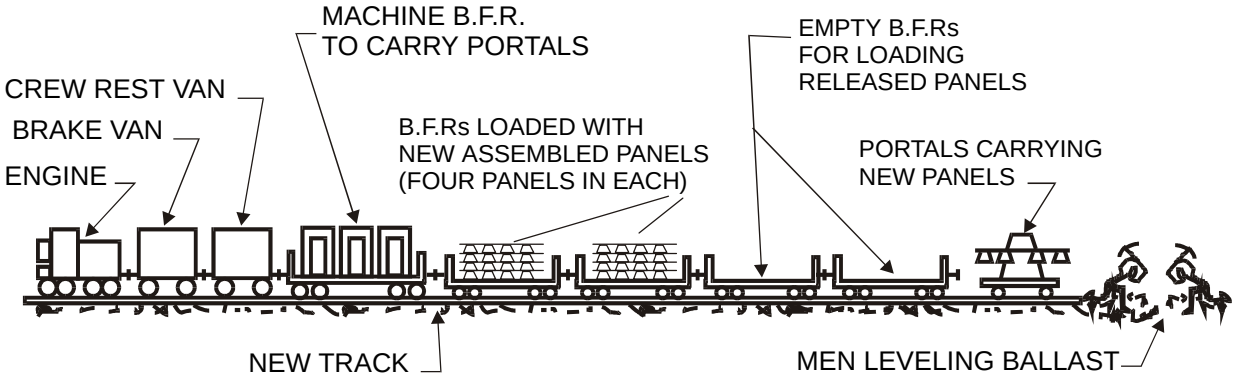
(d) The existing welded rails should be converted into panels of suitable lengths such that the capacity of the portal crane is not exceeded by handling the old panel.

(2) *Pre-assembly of Panels* – Sleepers received from the Concrete Sleeper plant are unloaded and stacked at the base depot. Handling of Concrete Sleepers is done by portal cranes or separate cranes provided for the purpose. These sleepers are assembled into panels making use of service rails. While assembling the panels, elastic fastenings complete in all respects should be provided and correct uniform spacings of sleepers should be ensured.

The assembled panels are stacked and are later loaded in BFRs in three to four tiers.

(3) *Formation of relaying train* – The relaying train shall consists of two empty BFRs for loading released track panels, adequate number of BFRs loaded with pre assembled panels, BFRs loaded with portal cranes, one equipment and tool van, one crew rest van, one brake van and an engine. A typical marshalling order of the relaying train is indicated in the figure below :

MECHANISED RELAYING OF CONCRETE SLEEPERS



(4) *Actual Relaying* – At speed restriction of 20 km. p. h. is imposed at the place of relaying and preliminary works such as loosening of fastenings, removal of ballast etc. are carried out in advance. On the day of relaying, traffic block is imposed and the relaying train enters the block section. After the relaying train is positioned, the portal cranes unload by themselves on the auxiliary track. The old track is dismantled and loaded by the portal cranes on the empty BFRs. The ballast is then levelled and the pre-assembled panels are laid in position. The new and existing tracks are joined by closure rails. After the last panel is laid, a ramp is made in two rail lengths between the existing track and the new track, to run out the difference in levels. The relaying train returns to the base depot where the old track panels are unloaded.

(5) *Post relaying works* – In subsequent blocks the service rails should be replaced by welded panels.

The newly laid track is tamped and speed restrictions relaxed in stages as per schedules mentioned in **Para 308**. Before relaxing the speed to normal, provisions of proper L.W.R. ballast profile should be ensured.

1407. Procedure for Manual Laying – (1) Manual Laying will not normally be adopted except under exceptional circumstances.

(2) Loading and Unloading –

(a) Concrete sleepers shall be placed perpendicular to the length of the BFR.

(b) Manual unloading shall be done sleeper by sleeper. Wooden sleepers provided with hooks at the top ends for gripping the side of the BFR shall be used as ramps for sliding the sleepers down to the cess level. Damage by over-running shall be prevented by placing the lower ends of the ramps either inside an old motor truck tyre or between gunny bags filled with wood shavings and the sleeper allowed to move down the ramp. Two men shall stand on the cess with crowbars planted into the cess and control the downward sliding of the concrete sleepers

(c) After unloading, the sleepers shall be placed on the cess approximately alongside the final position. Where the width of the cess is sufficient, the concrete sleeper should be kept supported by wooden blocks so as to be approximately at the same level as in its final position in track. Individual concrete sleepers may be transported conveniently on a rail dolly to **R.D.S.O. Drawing No.MA.3031.**

(3) *Laying Procedure* – The following procedure shall be adopted for manual laying of concrete sleepers in place of existing fish-plate track :

(a) Just prior to the line block, a speed restriction of 25 km./h. shall be imposed on the portion to be re-laid during the block and rail sleeper fastenings shall be removed from the alternate sleepers. Ballast cribs between sleepers shall be exposed upto bottom level of sleepers. It shall be ensured that the number of sleepers taken up for replacement during the line block period shall not be more than that which can be given at least one mechanical tamping with 'on track' tamper before the first train is allowed after the replacement of the sleepers.

(b) After taking the line block, the rails over the length to be dealt with during the line block period shall be disconnected and removed. The sleepers shall then be taken out, taking care to disturb the ballast bed only to the minimum extent.

(c) The new concrete sleepers shall then be laid in position by means of sleeper slings taking care to ensure the correct longitudinal and lateral alignment. When the sleepers are being placed in position, the prepared ballast bed should be disturbed only as little as possible. Care should be taken not to damage the edges of the sleepers or to chip the concrete. After the sleepers are placed, rubber pads shall be placed at the rail seats. Elastic clips shall be loosely fastened at this stage. If the original rails are to be continued after relaying, the track rails shall be laid and connected on either side.

(d) After the sleepers are packed, the rails shall be secured in position by inserting the insulators and elastic fastenings and firmly fastened.

1408. Maintenance of concrete sleeper track –

(1) *General*

(a) Concrete sleeper track should be maintained by heavy on-duty track tampers.

(b) An annual machine deployment programme shall be drawn by zonal railway and be circulated to the divisions before the beginning of the year.

(c) For spot attention/slack picking, multi-purpose Tampers adn Off-track Tampers shall be used as a regular measure on Concrete Sleeper Track, in the following areas of application :

(i) Picking up slacks in isolated stretches.

(ii) Points and Crossing areas,

(iii) Approaches to bridges and level crossings,

(iv) Buffer rail joints/glued joints in LWR section,

(v) Block insulated joints/glued joints in track circuited stretches.

For Off-track tampers, the working instructions, issued by Railway Board/RDSO as amended from time to time, should be followed.

As an interium measure, where Off-track tampers are not available, the packing may be done with the help of Crowbar/ Beater, duly taking care that the concrete sleepers are not damaged.

(d) Pre-tamping, during tamping and post-tamping attentions should be given to track as indicated in **Para 226. (For further details, Chapter 3 of Indian Railways Track Machine Manual** may be referred to).

(2) *Annual Systematic Attention on PRC track*

In addition to machine tamping, the gangs will carry out annual systematic attention to track from one end of gang beat to the other during work season. This will include -

(a) Examination of rails, sleepers and fastenings including measurement of toe load of ERCs.

(b) Inspection of and attention to insulated joints, switch expansion joints etc.

(c) Packing of approaches of bridges, level crossings, breathing lengths of LWRs and bad formation areas etc.

(d) Shallow screening of track.

(e) Through packing of track not maintained by machine, e.g. tracks not on PSC sleepers including all running lines of the yards and points and crossings in such running lines.

(f) Minor repairs to cess of bank.

(g) Boxing and dressing of ballast.

(h) Replacement of damage/missing rubber pads, liners and ERCs.

(3) Annual Programme of maintenance of PRC track

The annual maintenance programme for machine maintained concrete sleeper track would be as under:-

Period	Work
(a) Post monsoon attention : (For six-seven months after end of monsoon)	Immediately after end of monsoon, attend to run down stretches in the entire gang length. Thereafter, the following schedule of work shall be followed : (i) Picking of slack 1-2 days in a week (ii) Remaining days shall be allotted to : (a) Annual systematic attention. (b) Overhauling of level crossings. (c) Destressing of LWRs. (d) Spot renewals of rails, sleepers etc. (e) De-weeding. (f) Cold weather patrolling, etc.
(b) Pre-monsoon attention : (For two months prior to onset of monsoon)	(i) Picking of slacks 1-2 days in a week. (ii) Remaining days shall be allotted to : (a) Cleaning and repairs to side and catch water drains and cleaning of waterways. (b) Attention to yard drainage. (c) Spot renewals of rails, sleepers etc. (d) Shallow screening of specified lengths. (e) Hot weather patrolling.
(c) Attention during monsoon : (For three-four months)	(a) Picking of slacks as required. (b) Normal track maintenance of yard lines. (c) Cleaning, removal of loose boulders from cuttings and tunnels to ensure free flow of water. (d) Monsoon patrolling. (e) Maintenance of side and catch water drains. (f) Repairs to cess and bank.

Note : (i) For maintenance schedule on LWR track, special instructions in the LWR Manual should, in addition, be followed.

(ii) Spot renewal of rails and sleepers shall be done as per requirement any time of the year.

(iii) Destressing of LWRs shall be done as per requirement and schedule to be prepared by the PWI, as per provisions of LWR Manual.

(iv) Main tamping, pre and post tamping works shall be done as per schedule of working of the tamper. PWI and AEN should be advised at least one month in advance of the programme of the machine to enable them to complete pre-tamping operations.

(v) Lubrication of ERCs shall be done by Keyman throughout the year as per **Para 1411(5) (b) of the Manual.**

(vi) Oiling and greasing and visual inspection of fish plated joints shall be done as per Para 241 of the Manual.

1409. Casual Renewal of Concrete Sleepers– While carrying out casual renewal of Concrete sleepers, manual handling becomes necessary and precautions indicated in **Para 1407** should be observed.

In addition, the provisions of L.W.R. Manual regarding the precautions to be taken for casual renewal of sleepers shall be followed. Special care shall be taken to consolidate the shoulders of the ballast section after renewal of the sleepers.

1410. Corrosion of Steel In Concrete Sleepers – Both the ends of concrete sleepers should be painted with an approved type of anti-corrosive paint periodically to prevent corrosion of the exposed ends of prestressing wires. In case of two-block sleepers, tie bars should be examined every year and if any sign of corrosion is noticed, the affected portion should be painted with an approved type of paint.

1411. Maintenance of Concrete Sleeper Fastenings – (1) *Pandrol clips/Elastic Rail clips* – The essential feature of the pandrol clip/elastic rail clip is the correct driving of the clip which should be checked by the keyman during his daily round. The clip should be driven so that the leg of the clip is flush with the end face of the insert. Over driving and under driving shall be guarded against by observations of the clips in position. Clips should be driven/taken out with clip applicator/extractor.

Over driving/under driving of the clip causes eccentric load on the insulators and results in their displacement and variation of toe load. A vigilant watch should be kept to ascertain that no creep is taking place in any of the portion of the concrete sleepered track or excessive movement near SEJs. The elastic fastenings should be checked for corrosion and corroded fastenings should be replaced.

(2) *Rubber Pads* – It must be ensured that the rubber pads are in correct position. Whenever it is found that the rubber pads have developed a permanent set, these should be replaced by new ones. Such examinations can be done at the time of destressing. Loss of toe load can also be due to ineffective pads. The load should be occasionally checked particularly, if any creep is noticed resulting in excessive movements of the SEJs.

(3) *Insulating liners* – Nylon/composite insulating liners used with pandrol clip shall be examined periodically for sign of cracking and breakage. Adequate care should be exercised while driving the clip at the time of installation to prevent damage. On first laying a small indentation on the nylon insulating liner will be formed due to the toe-load of the clip. This is not objectionable so long as the insulating liner does not crack up. All cracked insulating liners should be replaced with fresh ones.

(4)(a) *Renewal of fastenings* – Renewal of fastenings shall be done in accordance with the provisions of the L.W.R./C.W.R. Manual and large scale replacement of fastenings must be done under the supervision of a P.W.I. The cause for large scale development of defects must be investigated by the Assistant Engineer.

(b) *Periodicity of Measurement of Performance of Elastic Fastening Components.*

(1) SAMPLES, SIZE AND TESTING FREQUENCY:

(i) SAMPLE SIZE :

Toe load of elastic rail clip should be measured on 1% of ERCs randomly on every 100 sleepers (all 4 ERCs to be measured on one sleeper).

(ii) TESTING FREQUENCY:

Initial testing of ERCs is to be done after four years or passage of 200 GMT of traffic, whichever is earlier. In corrosion prone area, the initial testing of ERC is to be done after two years or passage of 100 GMT, whichever is earlier.

(iii) Subsequent testing will be done every four years or 200 GMT in normal areas and two years or 100 GMT in corrosion prone areas, whichever is earlier. However, if 20% or more of sample size records toe load below 600 Kg. both frequency of inspection and sample size are to be doubled.

(2) REPLACEMENT OF ERC:

(i) If 20% or more of sample size records toe load below 400 Kg which is to be confirmed by 5% sample size, proposal of through fastening renewal should be initiated.

(ii) The provisions given above are only for guidance of Railways. The Railways on the basis of the overall condition of track, pattern of traffic and the required level of maintenance should undertake the large-scale replacement of the fastening.

(iii) Further, as the loss of toe load is reflective of conditions of other elastic fastening components like groove rubber sole plate, GFN/metal liners etc. as well, the railways may also record condition of these components along with measuring toe loads for elastic rail clips.

(5) *Measures to prevent corrosion and seizure of E.R.Cs with M.C.I. inserts – (a) Initial treatment –* At the base depot, all the elastic rail clips and M.C.I. Inserts should be thoroughly cleaned. Grease to **IS:408-1981(Specification for Grease No. 'O' Graphited)** should then be applied on the central leg of the E.R.C. and eye of the M.C.I. insert and then the clip should be driven at the time of assembly of the service panel.

(b) *Lubrication of ERCs :* Grease Graphite to the specification **IS-408-1981 Gr. O** should be used for this purpose. This work should not be carried out during extreme of summer and heavy rainfall. At a time ERCs should not be removed form more than one sleeper. If for any reasons mass lubrication of ERCs is taken up, at least 15 sleepers shall be kept intact between any two sleepers taken up for lubrication of ERCs at the same time. The ERCs should be cleaned by wire brush and emery paper. The eye of the insert shall also be cleaned by suitable brush. After cleaning, grease graphite shall be applied to the inside surface of eye of insert and leg of ERC. Inside/Outside ERCs should be interchanged and fixed again.

(c) The lubrication of ERCs and insert at the time of initial laying should be done 100% and thereafter should be done once in a year in corrosion prone areas & platform lines and once in two years in other areas.

1412. Action in case of Derailments – (1) When the damage is extensive and track is distorted in such a way that it is not possible to pass traffic even at a restricted speed, the affected portion should be isolated by introducing buffer rails on either end of the affected portion. The distorted track should be removed and replaced by track laid on single rail panels with available type of rails and sleepers. The traffic should be restored at a restricted speed. The section should then be converted to long welded Rails by using concrete sleepers taking usual precautions as laid down in L.W.R. Manual.

(2) When the damage is not extensive and it is possible to pass traffic at a restricted speed, suitable speed restriction should be imposed after assessing the damage to track. Sleepers should be replaced as in the case of casual renewals taking precautions as laid down in L.W.R. Manual. After all the damaged sleepers are replaced, the affected portion and 100 metres on either side adjacent to it should be destressed, and normal speed should be restored after consolidation.

1413 Laying of fan shaped turnout sleepers –

(1) Loading of PSC turnout sleepers in BFRs.

(a) Sleeper of the approach and sleepers meant for lock bar crank will be loaded at right angles to the track.

(b) The remaining sleepers will be loaded parallel to the track on the BFRs.

(c) Suitable nos. of wooden battens to support the sleepers in between layers of turnout sleepers will be used as in case of main line sleepers to prevent damage.

(2) *Unloading :*

(a) Depending upon the process of laying of the turnout adopted, the sleepers shall be unloaded either near the proposed location on firm & level ground or adjacent to a nearby siding or on a goods platform by means of a crane.

(b) While unloading due care shall be taken that the sleepers or the inserts are not damaged.

(3) *Site preparation for laying:*

(a) Ensure that a clean ballast cushion of 30 cm below the bottom of sleeper is available.

(b) These turnout sleepers are to be laid where the approach track is also laid with PRC sleepers. Thus there would be no need to lower the formation to provide adequate ballast cushion.

(c) The ballast bed has to be perfectly level. Any variation in level may affect the gauge adversely.

(d) Enough ballast shall be stacked along the cess to enable the filling of ballast in the cribs on the same day.

(e) Longitudinal and cross drains may be provided in turnout area to avoid accumulation of water.

(f) The site preparation to be completed well before laying turnout ensuring deep screening of ballast in turnout length and 30m on either side along the track.

(4) *Assembling:*

(a) Ensure the availability of all fittings at site strictly as per requirement of latest drawings for switch portion, lead and crossing portion.

(b) The complete turnout will be assembled on a level ground adjacent to the site of laying or on the loop line connected to turnout.

(c) Red/blue rounded marking on the sleepers should invariably be kept on the right hand side irrespective of left hand or right hand turnout.

(d) Spacing of sleepers should be strictly as per layout drawing.

(e) The sleepers shall be perpendicular to the straight track in switch portion only.

(f) In lead portion, the sleepers will be inclined at half the angle between the normals to straight and curved track at that point. Proposed disposition is appended as **Annexure-14/1**.

(g) To ensure correct layout, laying of sleeper falling at transition from switch to lead and lead to crossing portion should be paid special attention. Sleepers in the switch portion, lead portion and crossing portion are as under:-

Turnout	Switch	Lead	Crossing
1:8.5	1-13	14-41	42-54
1:12	1-20	21-64	65-83

(h) The spacing of the sleepers in the lead portion should be as per layout drawing to make a radial or fan shaped layout. The spacing has been worked out separately for both the rails. This separate spacing on two rails make the layout fan shaped in lead portion.

(i) The sleepers in the crossing portion shall be perpendicular to bisecting line of crossing.

(j) Sleeper no. 3 & 4 may be placed for housing motor with the extended portion of sleeper in reverse direction only in circumstances where it cannot be avoided.

(k) The approach sleeper in advance of switch portion should be provided without fail, they are for gradual elimination of slope of rail top (1:20).

(l) The exit sleepers behind the crossing portion should also be provided for gradual introduction of rail slope (1:20).

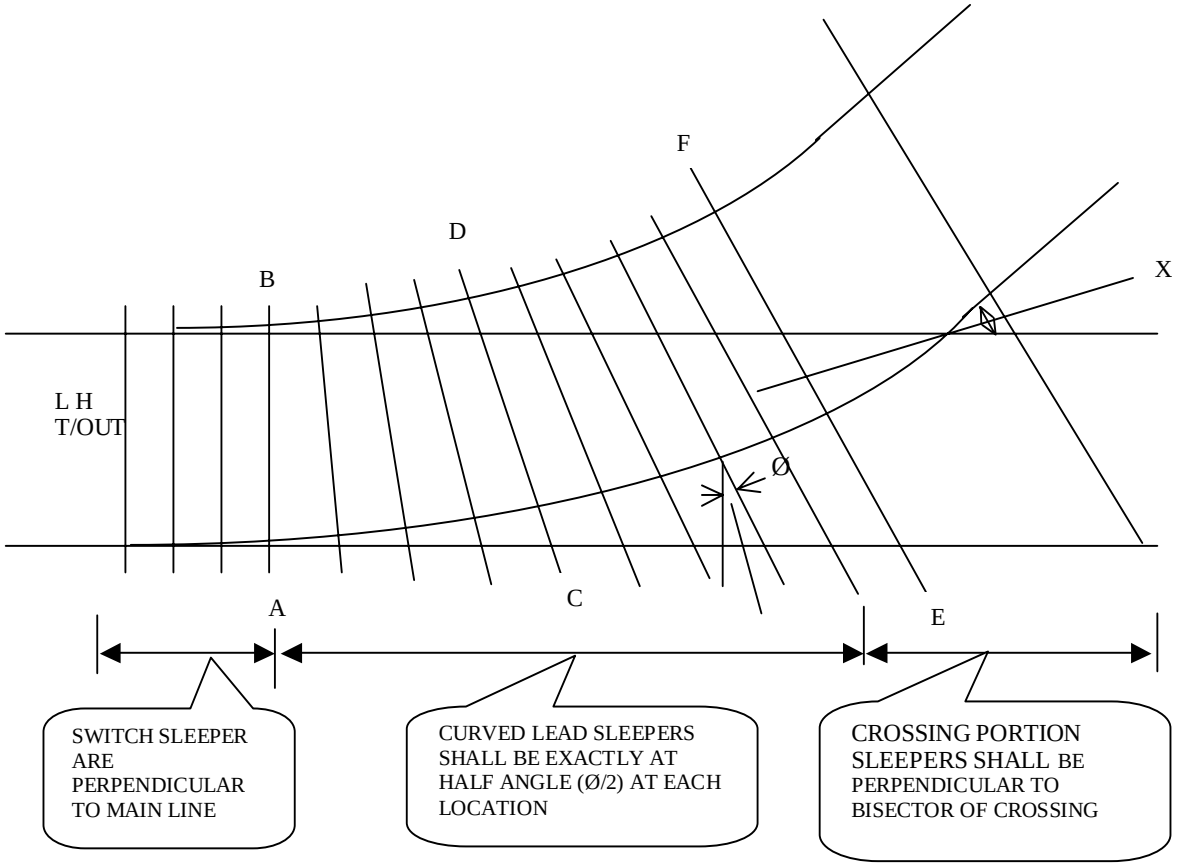
(5) Insertion of pre-assembled turnout :

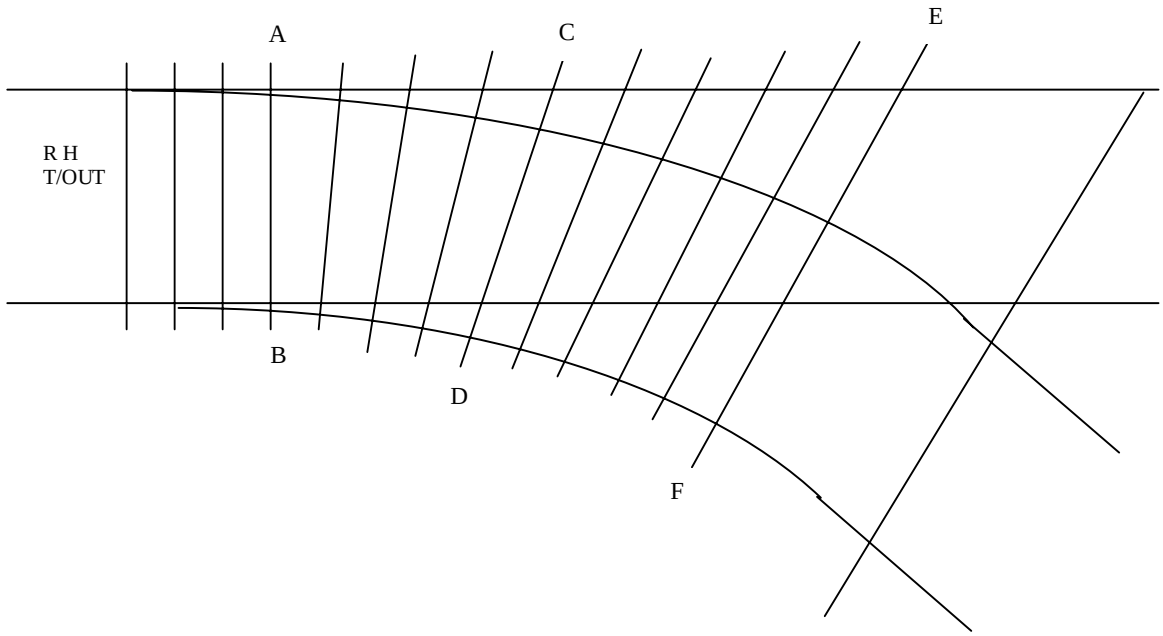
The complete assembled turnout shall be inserted in position after breaking it into three panels viz. Switch, lead and crossing portions by means of cranes or rollers.

(6) *Manual insertion* - In case the PSC turnout sleepers are to be manually inserted, then the same must be done sleeper by sleeper ensuring that at no time the alignment and level is beyond permissible limits. This work may be done under a suitable speed restriction if necessary and adequate mechanical means for packing the sleepers must also be available.

ANNEXURE 14/1-PARA 1413

PROPOSED DISPOSITION





CHAPTER XV

TRAINING FOR PERMANENT WAY STAFF

1501. Types of Training Courses – Permanent way staff need to be trained for their jobs both through theoretical class room training and practical work at site using the tools and equipments of the particular trade. Training is a continuous process right from the time of recruitment. Following four types of training courses should be organized in the Training Institutes run by the Railway Administration :

(1) Initial/Induction Courses.

(2) Promotional Courses.

(3) Refresher Courses.

(4) Special Courses.

1502. Initial / Induction Courses –

(1) *General* – The Initial Courses is for new entrants and should include induction course as well. It is meant for directly recruited categories such as Gangmen, Permanent Way Mistries and Apprentice Permanent Way Inspectors. The syllabi and the training programme for the initial course should be drawn up by the Railway Administration, keeping in mind the guidelines given in the subsequent paras below.

(2) *Induction Course for Gangmen/Gatemen*– This course is intended to be held at the Divisional Training Centre under the direction of a Permanent Way Inspector. The course should be of about two weeks duration. The course content should, in addition to field training, include class room lectures during which time the new entrant is first introduced to the working of the Departments in general and to the gang work, in particular. It should include introduction to the subject of permanent way in a clear and simple manner.

The Class room lectures should broadly cover the following topics: - Personal safety and safe working methods, Railway traffic movements, Basic signalling, and action in case of emergencies. Emphasis should be more on the job-training in the field, which should include the following items :–

Maintenance of track, Protection of track in emergencies, Track renewals, Level crossings and patrolling.

(3) *Initial/Induction Course for Permanent Way Mistries* – (a) Initial/Induction Course for Permanent Way Mistries should be held at the Zonal Railway Training Schools. The duration of the course should be six months. The course content should include class room lectures as well as training in the field.

(b) The Class Room lectures should include the following items :

(i) *General* – General working of the various departments of the Railways.

Labour relations, Personnel rules pertaining to Salary, Leave, Discipline and Appeal Rules, Payment of Wages Act, Muster Roll maintenance and Channels of Promotion etc.

(ii) *Permanent Way* – Organization of Permanent Way, Maintenance and Incidental works connected with Permanent Way including renewals.

(iii) *The lectures should cover* – The Systems and Methods of maintenance Ballast, Sleepers and fastenings, Rails and fastenings, Points and Crossings, Curves, Monsoon protection and Patrolling, Level Crossings, Track on Bridges, working of push/material trolly, Schedule of dimensions, Accidents and Breaches, Re-timbering of girder bridges, Maintenance of welded track, Speed restrictions and Re-conditioning of Permanent way materials. It should also include instructions contained in G. and S.R. pertaining to protection of Permanent Way, the duties of various Permanent Way Officials and Safety in Permanent Way works.

(c) *Practical training* – Practical training in the field should receive high priority and should include the following items :

(i) Identification of various permanent way materials and tools and their use.

(ii) Rails and fastenings, Sleepers and fastenings, Ballast, Points and crossings, Bridges, Curves, Level Crossings, Annual maintenance programme, Different systems and methods of maintenance, Maintenance of welded track, Lubrication of rail joints, Diversions, Track renewals and Re-conditioning of Permanent Way Materials.

(4) *Initial Course for Apprentice Permanent Way Inspectors* – (a) This course should be held at the Zonal Training School and the period of training should be one year. The course content should include class room lectures, field demonstrations and practical training.

(b) The Class Room lectures should include –

(i) General working of the railways and organisation of various departments.

(ii) All establishment matters including extant rules and various Acts viz., Workmen's Compensation Act, Factories Act, Industrial Disputes Act, Payment of Wages Act, Hours of Employment Regulations, Discipline and Appeal Rules, Labour Relations, and Permanent Negotiating Machinery, Rules regarding leave, salary and passes.

(iii) *Permanent Way* – Organisation and distribution of permanent way staff. Maintenance of Permanent Way consisting of the following :

Methods and systems, works incidental to maintenance, Rails and fastenings, Rail joints, Sleepers and fastenings, Ballast, Formation, Maintenance in Electrified and Track circuited areas, Permanent Way renewals, Maintenance and laying of curved track, Inspection systems and speed indicators, Patrolling during monsoon and emergency, Pre-monsoon precautions, Action to be taken during accidents and breaches, Level crossings, working of Trollies, Motor Trollies and Lorries, Laying and Maintenance of concrete sleepers, S.W.R. and L.W.R./C.W.R., Maintenance of High speed routes, Reclamation and reconditioning of permanent Way fittings, points and crossings and Layouts-Maintenance and laying, Maintenance of tools and other common equipment in use and Details of Track Structure.

(iv) *Transportation* **–** General Rules, fixed and detonating signals, various systems of train working and signalling, Failure of communication on single, double and Multiple lines.

(v) *Office work* – Correspondence, Recruitment of Casual Labour, Submission of returns, Accountal of stores and Permanent Way Materials, Imprest, Tools and Plants, Stock Verification, Classification and disposal of surplus material and Materials at site Account.

(c) *Practical Training* – Practical training shall include visits to various sites where Permanent Way maintenance/Construction work is being done. It should inter-alia include working with the gangs, linking of turn-outs, general maintenance of track, works incidental to maintenance such as deep screening pulling back rails, lubrication of rail joints, re-timbering of bridges, realignment of curves, lifting and lowering of track and relaying and remodelling works. Training should also include exposure to working at breach and accident sites, attending to yard derailments, practical training in stores, working in an Engineering Stores depot, Engineering workshop, Bridge workshop and welding depots. Safety in Engineering works should also receive special attention.

1503. Promotional Courses – (1) *General* – The course for promotional training will be necessary in the case of staff promoted from a lower to a higher status by a process of selection and is applicable in the following cases :

(a) Promotion from Gangmen/Gatemen/ Keymen to Mates.

(b) Promotion from Keymen/Mates to Permanent Way Mistries.

(c) Promotion from Permanent Way Mistries to Permanent Way Inspector Grade III.

(2) *Promotion from Gangmen/Gatemen/ Keymen to Mates* – (a) The Promotional Training for the above should be held at the Divisional Training Centres. The promotional training courses should be undergone by the employees immediately after the promotion at the first available opportunity. The duration of training will be two weeks in this case.

(b) The course content will include class room lectures as well as practical training/demonstrations in the field. The subject to be covered shall be the same as for initial course but to a reduced scale.

(3) *Promotion from Keymen/Mates to Permanent Way Mistries* – (a) The promotional training will be imparted in the Zonal Training School and the duration of the course will be four weeks. The course shall include class room lectures, in association with practical working of the various items of work connected with Permanent way.

(b) Class room lectures shall include the following items :

(i) Drafting of memos and maintenance of registers,

(ii) General working of the various departments,

(iii) *Permanent way* – The lectures will cover the same subjects as dealt with in the Initial Course for Permanent Way Mistries but with a reduced scale.

(c) *Practical training* – Practical training shall include working of material trains, push trollies/ material lorries, works connected with maintenance, measurement of versines on curves and local adjustments, linking of turn-outs, assembling of various types of sleepers, fixing of creep anchors, deep screening, pulling back rails, renewals of rails, sleepers and points and crossings, checking of monsoon patrolling and inspections of level crossings, bridges and gang working.

(4) *Promotion from Permanent Way Mistries to PWI Grade III* –

(a) *General* – The object of training Permanent Way Mistries for promotion to Permanent Way Inspectors Gr. III is to train them for effective working in a Supervisory category. The training should be imparted in the Zonal Training School for a period of six week. The course content should include class room lectures, field demonstrations, study tours and screening of instructional films. It should also include an assessment by an examination at the end of the course.

(b) The class room lectures shall be on the same subjects as prescribed for Initial Course for Permanent Way Inspectors Gr. III, but the extent of coverage shall be at a reduced scale, since the serving Permanent Way Mistries would be having adequate experience in all spheres of practical working. In addition, the lectures shall include procedure for obtaining traffic blocks including messages to be exchanged with the SMs, submission of requisitions for obtaining green notices, routine correspondence with superiors and officials of the other departments etc.

(c) The Instructional Tours should include visit to Relaying sites, Flash Butt welding plants, Engineering Workshops, Engineering Stores Depots, offices of PWI & AEN, Control office, Loco Sheds, TXR Depots and S & T Workshop. Special emphasis should also be made on safe working methods.

1504. Refresher Courses – It will be necessary to conduct Refresher Courses to enable the staff to keep themselves abreast with the latest rules and techniques. Keymen, Mates, Permanent Way Mistries, and Permanent Way Inspectors should be sent for Refresher Courses once in five years. In the Refresher Courses, all subjects pertaining to the concerned categories shall be dealt with as enumerated under promotional courses but the extent of coverage will be on a limited scale. The duration of the Refresher Courses shall be two weeks.

1505. Special Courses – In addition to the regular courses mentioned above, special courses on any of the following subjects should also be arranged periodically to increase a sense of awareness of the staff on these subjects :–

Points and Crossings, Maintenance of SWR and LWR, Welding techniques, Track renewals, Ultrasonic Testing of rails, High Speed Track, Track recording, Curves and Reclamations of Permanent way materials.

All the above subjects should be for Permanent Way Inspectors Gr. III and for other categories of staff. It is desirable that the staff posted for the maintenance of welded track and on sections maintained by Machines, should be given a special training on the relevant subjects pertaining to their duties in a short course arranged for the purpose before they are posted on these areas.

CHAPTER XVI

BOOKS OF REFERENCE

1601. Books of Reference – Books of reference listed in **Annexure 16/1** and other publications from R.D.S.O. and IRICEN/Pune including Technical monograms considered essential should be supplied to the officers and the Permanent Way Inspectors of each Division.

The Chief Engineers' and the Divisional Engineers' Offices should be equipped with adequate number of copies of each publication. The publications should be accounted in the Dead Stock Register. Officials for whose personal use publications are supplied shall be responsible for their custody and handing them over prior to retirement from service.

1602. Circulation of Technical Papers – The Chief Engineer may arrange to circulate sufficient number of copies of the following publications and such other journals relating to Permanent Way as deemed necessary to the Headquarters Officers and Divisional Engineers who in turn should circulate them to their Assistant Engineers :–

(a) Reports of the Track Standards Committee.

(b) Journal of the Institution of Permanent Way Engineers (India).

(c) Permanent Way Bulletins issued by IRICEN/Pune.

(d) Technical papers pertaining to Civil Engineering as and when published by the Railway Board.

(e) Permanent Way and Structures Digest.

ANNEXURE 16/1 Para 1601

List of Books of Reference

Item No.	Publications	Offices which should be equipped with a copy of the publication			
		For the personal use of such officers and inspectors as may be prescribed	Divisional Engineer's office	Assistant Engineer's office	Permanent Way Inspector's office
1	Act, Indian Electricity and Rules issued and State Government Publications.	..	1	..	..
2	Act, Indian Explosives and State Government Publications.	.	1		
3	Act, Indian Factories and State Government Publicalioos.	..	1	..	..
4	Act, Indian Mines and State Government Publications.	..	1	1	..
5	Act, Indian Petroleum and State Government Publications and Petroleum Rules.	..	1	1	1
6	Act, Indian Railways ...	..	1	. 1	1
7	Act, Land Acquisition and State Government Publications.	..	1	1	1
8	Act, Payment of Wages, with Notifications as issued.	..	1	1	1
9	Act, Workmen s Compensation...	...	1	1	1
10	Alphabetical List of Railway Stations	..	1	1	1
11	Circulars State Government -Re : Constructions near Railway limits and Taxations	..	1	1	..
12	Circulars State Government or Joint regarding Tanks affecting Railway lines.	..	1	1	1
13	Code, Indian Railway for the Engineering Department.	..	1	1	1
14	Code, Indian Railway for the Stores Department.	..	1	1	1
15	Code, Indian Railway for the, Mechanical Department.	..	1	..	..
16	Code, Indian Railway for the Accounts Department.	..	1	..	..
17	Code, Indian Railway Establishment	...	1	1	1
I8	Code, Indian Railway General	...	1	1	..
19	Conference Regulations. Part III	..	1	1	1

ANNEXURE 16/1 Para 1601 **Contd.**

List of Books of Reference

Item No.	Publications	Offices which should be equipped with a copy of the publication			
		For the personal use of such officers and inspectors as may be prescribed	Divisional Engineer's office	Assistant Engineers office	Permanent Way Inspector's office
20	Engineering Formulae Pocket Book	..	1	1	..
21	Indian Railway Permanent Way Manual ...	1	1	1	1
22	Indian Railway Works Manual	1	1	1	1
23	Indian Railway Bridge Manual	1	1	1	1
24	Manual, Signalling and Interlocking	..	1	1	1
25	Manual, Block	..	1	1	1
26	Manual, Indian Railway Standard Track, and concerned Drawings.	..	1	1	1
27	Manual, - Accident, or Circulars pertaining to Accidents.	1	1	1	1
28	Permanent Way Drawings or Hand Book of the Railway.	..	1	1	1
29	Price lists of Stores or Stores nomenclature and circulars as applicable.	..	1	1	1
30	Red Tariff No. 16, Indian Railway Conference Association.	..	1	1	...
31	Regulations, Hours of Employment, with Notifications as issued.	..	1	1	1
32	Regulations governing the placing of electric transmission lines across and underground cables under Railway track.	..	1	1	..
33	Rules for the opening of a Railway for the public carriage of passengers.	..	1	..	..
34	Rules, General and Subsidiary, Parts I & II	1	1	1	1
35	Rules, Re : Leave, Passes and P. T. 0s. ...	...	1	1	1
36	Safety First" Rules ...	1	1	1	1
37	Schedule of Dimensions	1	1	1	1
38	Schedule of Powers of Divisional and Assistant Engineers.	.....	1	1	1
39	Special Orders on matters of general importance concerning the staff as issued.	1	1	1	1

ANNEXURE 16/1 Para 1601 **Contd.**

List of Books of Reference

Item No.	Publications	Offices which should be equipped with a copy of the publication			
		For the personal use of such officers and inspectors as may be prescribed	Divisional Engineer's office	Assistant Engineer's office	Permanent Way Inspector's office
40	Standing Orders Engineering Department	1	1	1	1
41	Standing Orders Operating Department ...	---	1	1	---
42	Telegraph Code	1	1	1	1
43	wooden Sleepers Specifications	---	1	1	1
44	Works Hand Book of General Conditions of Contract and Specifications for Materials and Works .	1	1	1	1
45	Working Time Table and Appendix thereto	1	1	1	1
46	Working of Cranes and Hoists, as issued ...	---	1	1	---
47	Manual of instructions for laying concrete sleepers with machines.	---	1	1	1
48	Manual of instructions for fabrication, installation aftd maintenance of glued insulated rail joints.	---	1	1	1
49	Indian Railway Standard Specification for pre-stressed concrete Sleepers.	---	1	1	---
50	Code of practice for Flash Butt Welding of rails.	---	1	1	1
51	Code of Practice for Welding of Rail joints by Alumino Thermit process.	---	1	1	1
52	Chief Eagineers Circulars on 'Permanent Way'.	---	1	1	1
53	River Training and Protection Work for Railway - Bridges Monogram by I. R. I. A. T.T., Pune.	---	1	1	1
54	Monsoon instructions issued by the Railway	---	1	1	1