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भारत सरकार - Government of India

रेल मंत्रालय - Ministry of Railways

ओपन लाइन अनुरक्षण के लिए सेस का चौड़ीकरण / मरम्मत

Widening / Repair of Cess for Open Line Maintenance

केमटेक/2023/सि/डब्ल्यूआर-सेस/1.0
CAMTECH/2023/C/WR-CESS/1.0

जुलाई - 2023
July – 2023

EXCELLENCE IN MAINTENANCE
Indian Railways
Centre for Advanced Maintenance Technology

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Widening / Repair of Cess for Open Line Maintenance

Foreword

Maintenance of track foundation is the prime responsibility of field engineers of open line to keep the track in a satisfactory and safe condition for train movement on the Indian Railway. The regular inspection as per the schedule specified in IRPWM shall be carried out to identify any problem in the formation. Generally, the existing formation becomes weak due to mud pumping, heaving of ballast, settlement of banks, cracks on the cess, erosion of slope/cess & slope failure.

The document prepared by CAMTECH on "Widening/Repair of Cess for Open Line Maintenance" is informative and serves as a ready reference to field engineers of open line for maintaining the ballast profile at the desired level.

I hope that this document will be quite helpful to field engineers of open line, who are engaged in the inspection and maintenance of track foundation in Indian Railways.

CAMTECH/Gwalior ***(Jitendra Singh)***
31st July, 2023 ***Principal Executive Director***

Preface

Cess as an extended portion of formation keeps the track in adequate confinement and minimizes track settlement. It facilitates the track-related activities, which are carried out by field engineers of open line during the casual renewal of rails/ sleepers, welding of rails, de-stressing of LWR/CWR, movement of small track machines, and unloading/loading of free rails/rail panels/sleepers and placing them on cess before and after the renewal.

During the course of the service life of the track foundation, the cess gets damaged due to various reasons such as weak formation, mud pumping, mud heaving, erosion of slope, trespassing, and due to which desired ballast profile cannot be maintained.

In the current document, the methodology adopted during the work of cess repair/ widening as part of open line maintenance is being discussed with the objective to provide adequate information as available in relevant codes & manuals of Indian Railways. The special cases requiring special treatment/ rehabilitation having weak sub-soils or bad formations are not covered in this document.

It is expected that the document will be highly useful to field engineers of open line of Indian Railways and will serve as a ready reference during the inspection and maintenance of cess.

The document is not statutory & its contents are only for the purpose of knowledge dissemination. Most of the data & information in some form or the other are based on literature available and internet search. For more in-depth information/knowledge, the relevant detailed literature, BIS Codes, IRPWM, IRICEN/RDSO literature, etc. as available on the subject may be referred to.

I am grateful for the assistance given by Shri K.C. Shakya, SSE/Civil for his continuous study, hard work, sincere efforts & dedication to make this publication useful for open line maintenance personnel of Indian Railways.

We welcome valuable suggestions from our readers for further improvements to this document.

CAMTECH/Gwalior ***(Deepak Mehra)***
27th July, 2023 ***Director/Civil***

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संशोधन पर्चियों का प्रकाशन

ISSUE OF CORRECTION SLIPS

इस हस्तपुस्तिका के लिए भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जाएगा :

The correction slips to be issued in future for this handbook will be numbered as follows:

केमटेक/2023/सि/टीईआईबी/1.0/सीएस# XX दिनांक_____

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जहाँ XX संबन्धित संशोधन पर्ची की क्रम संख्या है (01 से प्रारम्भ होकर आगे की ओर)

Where "XX" is the serial number of the concerned correction slip (starting from 01 onwards).

प्रकाशित संशोधन पर्चियाँ
CORRECTION SLIPS ISSUED

क्र.सं./ Sr. No.	**प्रकाशन दिनांक/ Date of issue**	**संशोधित पृष्ठ संख्या तथा मद संख्या/ Page No. and Item No. modified**	**टिप्पणी/ Remarks**

1.0 INTRODUCTION

It is the responsibility of SSE/P.Way (in-charge) to inspect and maintain the track in a satisfactory and safe condition for train movement. Maintaining the ballast profile at desired level is one of the means to achieve this objective. The portion, which is extending from toe of ballast to the edge of top of formation level, is marked as Cess along the running track. Due to various reasons such as weak formation, mud pumping, mud heaving, erosion of slope, trespassing, cess gets damaged and due to which desired ballast profile cannot be maintained. Whenever it is found during inspection of existing track that the cess is not adequate as per requirement of relevant provisions of Indian Railways, it requires certain repairs/widening. In general, the repair of cess is a pre-monsoon activity that should be carried out normally 2 to 3 days in a week.

In this document, the methodology adopted during work of cess repair/ widening as part of open line maintenance is being discussed with the objective to provide adequate information as available in relevant codes & manuals of Indian Railways. The most of the contents of the current document have been taken from Comprehensive Guidelines and Specifications for Railway Formation issued vide Specification No. RDSO/2020/GE: IRS-0004, September 2020.

2.0 SCOPE OF DOCUMENT

The scope of this document is limited only to cover the aspects related to work of cess repair/ widening of existing track. The document so prepared is intended to serve as ready reference for SSE/JEs of open line on the subject covering the aspects related to

- Preliminary work including field survey,
- Identification of suitable earth,
- Targeted theoretical profile, and
- Execution including procedure adopted, machinery/rollers involved for compaction, etc.

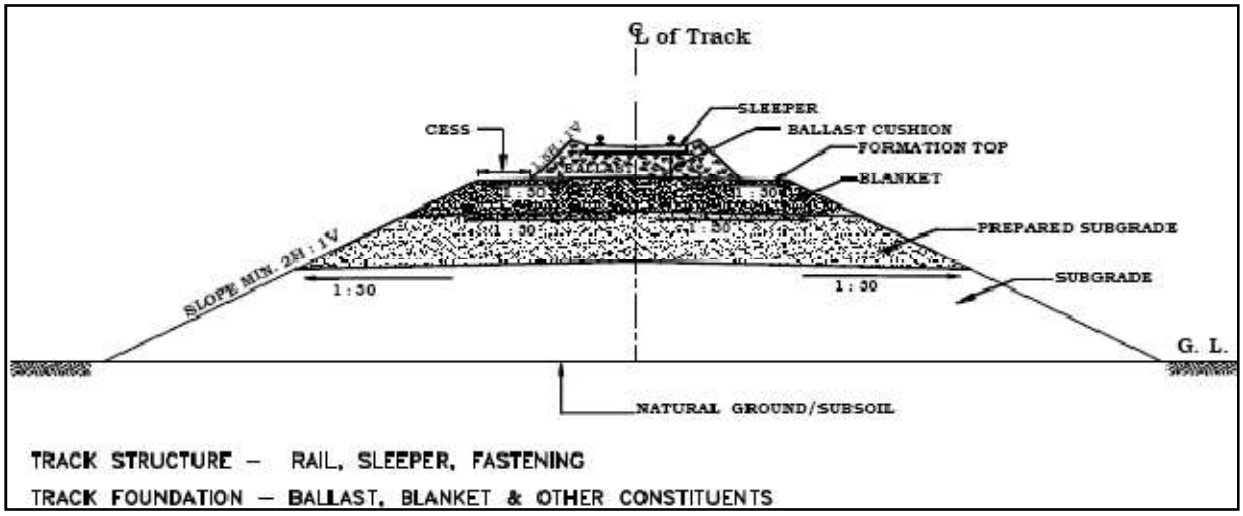
However, special cases requiring special treatment/ rehabilitation having weak sub soils or bad formations are not covered in this document.

Note: *Comprehensive Guidelines and Specifications for Railway Formation issued vide Specification No. RDSO/2020/GE:IRS-0004, dated September 2020 should be referred for more detail.*

3.0 COMPONENTS OF FORMATION AND ITS CODAL PROVISIONS

Formation comprises of granular layer (blanket) over prepared sub-grade and/ or sub-grade. Existing formations may be single layer (sub-grade layer only) or two-layer construction (Prepared sub-grade layer over sub-grade layer) construction. Also blanket layer may or may not be present.

General profile of formation is given below:



Note:

(i) **As per latest provisions of IRSOD** (Para 16 & Para 17 of Chapter 1 of Schedule 1)/ IRPWM (Para 212), the top width of formations for straight tracks is as follows:

Type of work	Minimum Top width of formation in mm		Cutting/ Embankment
	For single line track	For double line track	
For new works/ alteration to existing works	7850	13160	In both cutting (excluding side drains) & embankment
For existing works	6850	12150	In embankment
	6250	11550	In cutting (excluding side drains)

The minimum formation width is based on:

a) Ballast section having 1.5:1 side slope.
b) Cross slope on top of formation of 1 in 30
c) Track centre in case of double line section is 5300 mm

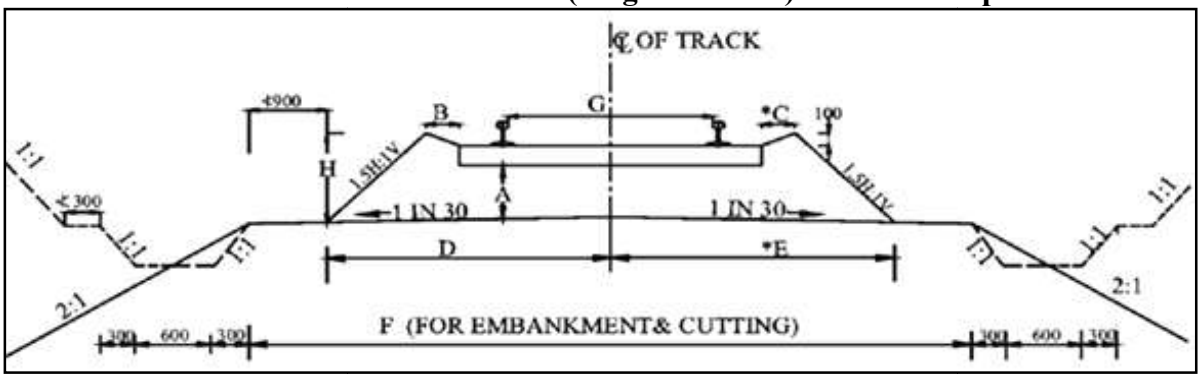
(ii) **Formation width on curves (as per Para 18 (a) of IRSOD):** On curves, additional formation width over (i) above, shall have to be ensured as given below:

(a) ***Increase due to extra widening of ballast shoulder on outer side of curves in both single/double line:*** On curves, the actual width to be provided should take into account 150mm extra widening of ballast shoulder (500mm in place of 350mm) required on the outer side of curves.

(b) ***Increase on double line due to effect of super-elevation:*** Due to requirement of extra clearances on double line on curves, increase in track centre with corresponding increase in formation width would be necessary to take into account the effect of super-elevation.

Increase in formation width on curves will be decided after taking into account the increase mentioned in (a) & (b) above.

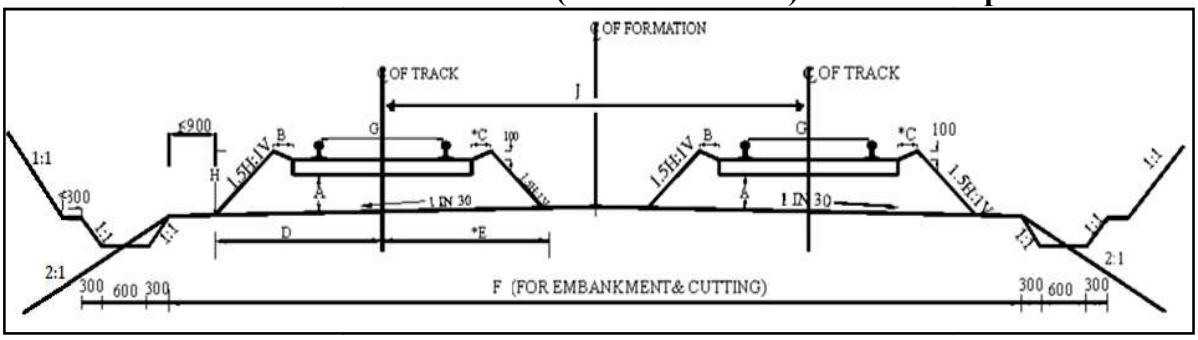
Ballast Profile for LWR Track (Single Line BG) for PRC Sleepers



G Gauge	Type of Sleeper	A	B	C*	D	E*	F	H
1676 mm	PRC	250	350	500	2693	2851	7850	646
		300	350	500	2772	2930	7850	698
		350	350	500	2851	3009	7850	751

All dimensions are in mm. *On outer side of curves only.

Ballast Profile for LWR Track (Double Line BG) for PRC Sleepers



G Gauge	Type of Sleeper	A	B	C*	D	E*	F	H	J
1676 mm	PRC	250	350	500	2785	2943	13160	707	5300
		300	350	500	2864	3022	13160	760	5300
		350	350	500	2943	3101	13160	812	5300

All dimensions are in mm. *On outer side of curves only.

Where,

A – Depth of Ballast Section
B – Width of Ballast Shoulder
C* – Width of Ballast Shoulder on Curves
D – Bottom Width of Ballast from Centre of Track
E* – Bottom Width of Ballast from Centre of Track on Curves
F – Width of Formation Top
H – Height of Rail Top from Formation Top
J – c/c Distance of Double Line BG

(iii) Minimum Cess width of 900 mm shall also have to be ensured for both straight track & on curves, along with ensuring minimum Formation width as specified for Single/Double line including additional formation width on curves as described above.

(iv) If even after provision of additional formation width, cess width on the outer side of curves reduces below 90 cm on account of increased ballast width due to super-elevation, formation width shall be increased further, over and above additional width as stipulated in Note (ii) above, to meet the requirement of minimum cess width of 90 cm.

4.0 FORMATION PROBLEMS

The health condition of a track length may be derived from the following sources:

a) *Keyman Diary* – As Keyman is the only P.Way official, who inspects his whole section daily.
b) *Gang Chart* – The frequency of attention & nature of maintenance at any section may be derived from it.
c) *Trolley/ Foot Plate* inspection of various P.Way officials such as JE, SSE & ADEN.
d) OMS/TRC Recording
e) Failures in the section such as fractures, creep, buckling, piping, erosion of slope etc.
f) Control message of driver/guard/ any official

Based on the information from above sources and actual site condition, any problem in the section should be investigated in depth and suitable measures as per IRPWM should be taken. If problem persists and formation troubles such as mud pumping, heaving of ballast, settlement of banks, cracks on the cess, erosion of slope/cess & slope failure are encountered, it may be a case of weak formation.

Para 218 of IRPWM stipulates that weak formation shall be identified based on either of the following condition:

(i) Stretches having speed restrictions due to weak formation.
(ii) Stretches where more than normal track attention is required.

(iii) Stretches where ballast penetration profile is of 'W' shape and maximum depth of penetration is more than 30 cm.

In case any of the above conditions are met in field, then the 4-step action plan given below is to be followed:

(i) Make the formation width, cess level and side drains strictly in accordance with prescribed profile.
(ii) Carry out shallow screening of ballast section (or deep screening where required).
(iii) Ensure no loose or missing fitting.
(iv) Increase the depth of ballast section to 30 cm or even up to 35 cm.

If track maintenance problem persists even after adoption of above measures, then it is a suspect formation and further detailed Geotechnical investigation is to be done for assessing the problem. Based on investigation results, the formation is to be classified as Bad Formation, if warranted. Remedial measures for rehabilitation/Strengthening of bad formation should be taken accordingly.

Note: *The formation rehabilitation/ strengthening of bad formation are not covered in this document. Comprehensive Guidelines and Specifications for Railway Formation issued vide Specification No. RDSO/2020/GE:IRS-0004, dated September 2020 should be referred for more detail.*

5.0 PURPOSE OF CESS IN FORMATION

As defined earlier the cess is the portion, which extends from toe of ballast to the edge of top of formation level along the running track. As a part of top of formation, it serves the following purposes:

- To provide adequate confinement and to minimize track settlement.
- For efficient and safe execution of track maintenance/renewal activities like casual renewal of rails/sleepers
- Welding of rails
- De-stressing of LWR/CWR
- Operation/placement/movement of Small track machines.
- Unloading/loading of free rails/rail panels/sleepers and placing them on cess before and after the renewal.

6.0 NEED FOR REPAIR/ WIDENING OF CESS

- Repair/widening of cess is required to provide adequate formation width, ballast profile and cess width/ height so as the desired track geometry is maintained.
- Further as discussed earlier if bad (or weak) formation is suspected, cess as a part of formation should be repaired/ widened to make it as per codal requirement.

- Further, 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.
- In general, the minor repair of cess is a pre-monsoon activity that should be carried out normally 2 to 3 days in a week by gangs.
- Also repair and widening of cess as part of widening of formation is necessary in case of track renewal works, if stipulated formation width is not available at site. Also formation rehabilitation should also be planned in case of bad formation.
- The work of cess repairs may be planned when the distance of edge of formation, from centre of track, becomes less than 3300 mm.
- The cess width should be made minimum 1200 mm during cess repair work, considering additional extra margin for any shrinkage/ settlement.

7.0 PRELIMINARY WORK

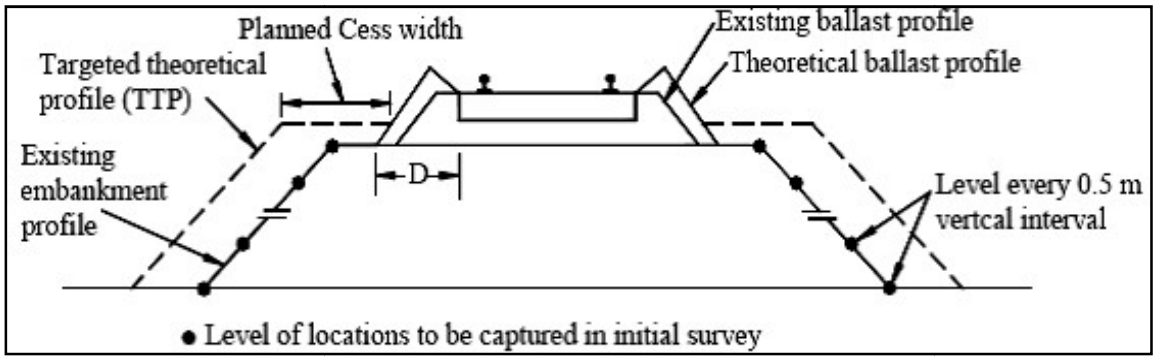
Before undertaking the cess repair work, following preliminary work should be carried out:

a- Detailed field survey to plot the existing profile & Targeted Theoretical Profile (TTP) of track including embankment,
b- Fixing Targeted Theoretical Profile (TTP) of cess for proposed work, and
c- Identification of suitable earth for carrying out cess repair.

Each item of preliminary work has been discussed in detail as follows:

(A) Detailed Field Survey to plot the existing profile & Targeted Theoretical Profile (TTP) of track including embankment:

a) Longitudinal level of rail at every 30m interval should be recorded along with existing cess level.
b) Cross sectional profile including that of existing embankment should be taken at every 30m. The distinctive points of reference in cross section are rail level, toe of ballast, edge of cess and level at every 50cm interval (vertical height) of slope of embankment.



c) The TTP with required longitudinal level of rail and cess at every 30m and also cross section as mentioned in above Para should also be plotted. Proposed rail level, cess level, edge of cess and level at every 50cm vertical interval on slope for TTP should be

calculated and plotted. These levels should be recorded by SSE/SE and got approved by ADEN.

d) In case of existence of level crossings, bridges or any other prominent track features, additional cross sections should be drawn based on site specific requirements.
e) Location of Trolley Refuges etc. should also be identified and levels at these locations should be taken in sufficient detail to work out the quantity of earth required.
f) The TTP should include cess width to be made up, proposed raising of cess, if any and flattening of side slopes.
g) In case, track renewal, deep screening, track lifting works are sanctioned, targeted theoretical profile should be finalized taking into account proposed longitudinal level of rail & cess, additional cess width required and sub bank, if any required.
h) On bridge approaches (up to the length of 50m on either side) where height of bank is more than 3m, extra 300mm cess width should be provided in addition to calculated above for cess repaired.
i) The TTP should also include any additional width of cess or milder slope of embankment or sub-bank requirement based on site conditions and specific requirements with approval of Sr. DEN/DEN in charge of section.

(B) Fixing Targeted Theoretical Profile (TTP) of cess for proposed work:

a) Proposed TTP for longitudinal levels of Rail/Cess and at every cross section drawn as per above at every 30m interval should be fixed.
b) Due care should be taken while fixing TTP and must take into account any future proposed lifting to improve track geometry.

(C) Identification of suitable earth for carrying out cess repair:

a. It is advisable that locally available soils of adequate strength can be used and soils, which are unsuitable for construction, are normally avoided.
b. There are some soils, which are normally unsuitable for construction of formation as listed below:

    i) Organic clays, organic silts, peat, chalks, marl, dispersive soils and soil containing soluble material (e.g. rock salt or gypsum).
    ii) Poorly graded sand and gravel with Cu < 2.0, should not be used to safeguard against liquefaction. Generally, most liquefiable soils as falling in gradation zone as indicated in the Figure below & having coefficient of uniformity, Cu < 2.0 shall not be used.
    iii) Clays and Silts of high plasticity (CH & MH) in top 3 m of Embankment.
    iv) Shales and soft rocks which become muddy after coming into contact with water.

c. To the extent possible, railway earth if found suitable, may be used for cess repairs.
d. The borrow pits should be dug along the edge of the railway boundary, duly ensuring that no borrow pits are dug within (H+3) m distance from the toe of the embankment, where "H" is the height of embankment.
e. The borrow pits may be used as rain harvesting structure.
f. In case of non-availability of railway earth, suitable contractor's earth may be used.

8.0 EXECUTION

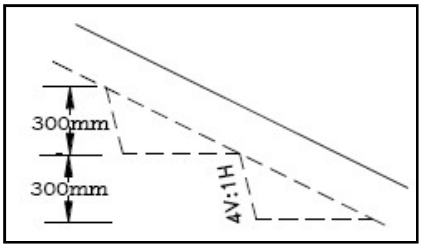
Before starting the earthwork, the site, where the work of cess repair/ widening is to be done, should be cleared of by uprooting vegetation, trees, bushes, etc., and taking away from the site of work.

8.1 Earthwork: Before taking up of actual execution of work, detailed drawings need to be prepared for the entire length to facilitate smooth execution at site.

- Earthwork shall be carried out in layers.
- The width of each layer of earthwork shall be in excess by 300mm of the designed profile to enable compaction near the edges.
- The excess width, thereafter, be cut and dressed, so as to achieve the required embankment profile.
- After completing the earthwork of full height and compacting the final layer, the slope may be dressed so as the surface of earthwork executed must be as per desired level and slope to the satisfaction of the engineer in charge's representative.

The earthwork may be carried out with the suitable machinery/ equipments such as earth excavator, backhoe, etc. as per site conditions.

- *Benching Work:* Starting from the toe, benching on the slope at every 0.3m (vertical height) shall be carried out on the slope surface during earthwork on slopes, so as to provide proper amalgamation between the old and new earthwork.



- *Addition of Moisture:* Moisture to be added in the earth, to bring it near the Optimum Moisture Content (OMC) value, shall be calculated and added to the soil. The moisture shall be mixed thoroughly using suitable means.
  - ✓ Proper control of moisture content in soil is necessary for achieving desired density.
    - Maximum density with minimum compacting effort can be achieved by compaction of soil near its OMC.
    - If natural moisture content of the soil is less than the OMC, a calculated amount of water should be added with sprinkler attached to the water tanker and mixed with soil by motor grader for uniform moisture content.
    - When soil is too wet, it is required to be dried by aeration to reach up to OMC.
  - ✓ Use of hose pipes for water need to be avoided.
  - ✓ As per IS 2720 (Part 2): 1973 (Reaffirmed-May 2015), moisture content is determined quickly by Rapid Moisture Meter at site as compared to Oven Dry Method, which generally takes 16 to 24 hrs.

  Experience shows that most suitable water content falls within a small range of 3% below to 1% above the OMC for most of the soil.

8.2 Compaction: Performance of cess whether repaired or widened would depend to large extent on the quality of compaction done during execution.

- Each layer should be compacted with recommended type of roller up to required level of compaction, commencing from the sides, before putting the next upper layer.
- Each layer of earthwork is compacted with 10 passes of small vibratory rollers of around 0.9m width (which are available in the market).
- In top layers, where the working of rollers is not practical, suitable plate compactor may be used.
- After completing the earthwork of full height, the slope may be dressed and compacted with 10 passes of slope vibratory roller/compactor.
- The compaction on cess and slopes shall be kept as a separately payable item.

The compaction procedure to be adopted will depend on the type of soil being used in construction.

a) The Sandy & gravely soils should be compacted with vibratory rollers. If fines are less in these types of soils, it can be compacted with minimum number of passes of vibratory rollers without strict control of moisture to achieve desired Relative Density. With higher percentage fines, sandy and gravely soils need to be brought to OMC level to get effective compaction. Uniformly graded sand and gravel are difficult to be compacted.

b) Silty soils can be compacted satisfactorily near about OMC either with smooth rollers or vibratory rollers. Vibratory roller will give high degree of compaction and higher lift.

c) In case of compaction of Clays, Sheep foot rollers are most effective in breaking the clods and filling large spaces. Thickness of layer should not be more than depth of feet of roller plus 50 mm.

The following machinery is used in compaction of earth:

- ***Small Width Vibratory Roller (Drum width 90 cm):*** Proper compaction in the widened portion of embankment is difficult to achieve with conventional means of compaction like ramming & hand rollers. The small width vibratory roller is to achieve the desired compaction of earthwork in narrow width portion.



Source: RDSO' Specification No. RDSO/2020/GE: IRS-0004 (September 2020)

- ***Suitable Plate Compactor:*** The vibratory plate compactor is power-engines, walk-behind equipment that imparts powerful vibratory compaction effort to loose materials, by transmitting vibration through the vibrating plate which generates power from the single rotor in vibration case.



Source: RDSO' Specification No. RDSO/2020/GE: IRS-0004 (September 2020)

A plate compactor works by vibrating or driving a flat metal plate against the ground over and over. This flat plate helps to compress and smoothen out the rough and uneven dirt. Plate compactors work best on granular soil, such as sand and gravel. These vary in weight from 100 kg to 2 tonne with plate areas between 0.16 sq m and 1.6 sq cm. They usually travel at about 0.7 km/h.

- ***Slope Vibratory Roller:*** Slope Vibratory Compactor is a unique attachment which can be attached to any Excavators/ Backhoes/ Long Reach. This attachment is specially designed for various applications like Railway track extension/ Canal/ Dam Slope Compaction and sloping surface where compaction is required. This attachment is capable of reaching surfaces where normal compactors cannot reach and can-do deep compaction than an ordinary compactor.



Source: RDSO' Specification No. RDSO/2020/GE: IRS-0004 (September 2020)

On Steep Slopes, slushy and most difficult terrains, where the normal Roller would easily swamp down, Slope Vibratory Compactors can easily work. These rollers work on the double vibratory principle that provides superior compaction.

- ***Slope Vibratory Compactor:*** Slope Vibratory Compactor is an attachment to normal excavators. The major advantage of this compactor is that it can compact 360 degrees for a height of 2m to 17m depending on size of excavator and attachment length.



Source: RDSO' Specification No. RDSO/2020/GE: IRS-0004 (September 2020)

8.3 Erosion Control Measure: For the repair work done on slope(s) of the existing formation, suitable erosion control measures shall be adopted based on the site condition.

- Soil erosion is the process of detachment and transportation of soil particles by erosive agents such as wind, water and gravity.
- Resultant loss of soil due to erosion from railway formation is a matter of serious concern as the slope stability of embankments supporting permanent ways is governed by the degree of damage suffered by them due to erosion.
- Unchecked erosion may result in cuts, rills or gullies and slide problems. It is, therefore, essential to study the nature of erosion in existing slopes and take adequate measures for controlling it.
- The prime agents of erosion are wind, water (mainly rain water) and gravity. These agents combine in a variety of ways to perform the dual role of abrading and simultaneously transporting the soil.

Erosion control systems for the treatment of exposed slopes could be classified into four broad categories:

i) Bio-technical system,
ii) Conventional non-agronomical system,
iii) Engineering system, and
iv) Non- conventional hydro-seeding/hydro-mulching system.

Bio-Technical System makes use of vegetative cover to check erosion. Protection of bare soil is effected by live plant cover afforded by maturing crops or by mulching derived from crop residue such as straw, wood shavings, sawdust, etc. This is the most economical and site suited method on exposed slopes. This may be attempted by using 'Simple Turfing Method'. Its use is advocated solely on site consideration. Deep rooted species of grass such as *vetiver grass* are suitable for use on soft soil slope.

Conventional Non-Agronomic Treatments include asphalting, aprons, stone-pitching, soil cement stabilisation, retaining walls, toe-walls, break walls, gabion & rivet mattresses etc. Large scale adoption of these techniques is often restricted on economic considerations, even though some of them may offer long lasting solutions.

Engineered Systems of erosion control include jute netting, coir netting, geo-grids mesh, geo-synthetics, geo-jute, etc. At locations where a simple turfing method cannot ensure vegetation cover, natural fibre based netting can be adopted to support vegetation growth. Where vegetation cover alone is insufficient and soil surface needs to be protected in the absence of vegetation cover in certain patches, root reinforcing geo-synthetic systems (3-D mats) can be used. Depending upon the duration for which protection needed (short term - 2 to 3 years or for longer term), either natural fibre based or polymer based 3-D mats can be adopted. For slope heights more than 5 m, root reinforcing systems would be better suited.

Non- Conventional Methods such as organic mulch application (either manually or by using hydro seeding/hydro-mulching) can be adopted to aid simple vegetative turfing. By using hydro seeding/hydro-mulching method, inaccessible and near vertical slopes can be successfully vegetated and hydro seeding method can be used in combination with nettings/ mats to make them even more effective.

The appropriate Erosion Control method needs to be decided depending on site conditions, techno-economic, topographical, climatic and other considerations. For further details, RDSO' Specification No. RDSO/2020/GE: IRS-0004 (September 2020), Guidelines on Erosion Control and Drainage of Railway Formation (Guideline No. GE: G-4, February- 2005) and Guidelines for Cuttings in Railway Formations (Guidelines No. GE: G-2, April – 2005) may be referred.

8.4 Drainage Arrangement: Drainage is defined as interception, collection and disposal of water away from track. Water is main culprit in damaging banks/ cuttings as it reduces

shear strength, results in erosion and adds to the weight of slope. Therefore, effective drainage is the most important aspect to safeguard the slope.

There are three sources of entering water into the track sub structure viz**.** precipitation, surface flow, and sub-surface seepage. The ingress of water into formation leads to puncturing of ballast, results in mud pumping, erodes soil & ultimately causing failure of slope. In cuttings, non-provision of drainage systems results in boulder falls and landslides etc. Therefore, quick disposal of water from formation top/ slopes is very essential. In view of this, drainage system should be carefully planned, designed and provided. Drainage system should be effective in preventing the stagnation of water and allow quick disposal of water.

For effective drainage, following points may be kept in view:

i. Top of formation should be finished to a cross slope of 1 in 30.
ii. In cuttings, properly designed side drains and catch water drains of adequate capacity should be provided.
iii. Catch water drains should be located slightly away (as per site conditions) from the top edge of cutting and water flow should be led into the nearby culvert or natural low ground.
iv. Catch water drains should have well designed out fall with protection against tail-end erosion.
v. Minimum gradient of drain should be in range of 1 in 400 to 1 in 700.
vi. Drains provided should be cleaned and repaired regularly, preferably before monsoon.

For further details, RDSO' Specification No. RDSO/2020/GE: IRS-0004 (September 2020), Guidelines on Erosion Control and Drainage of Railway Formation (Guideline No. GE: G-4, February- 2005) and Guidelines for Cuttings in Railway Formations (Guidelines No. GE: G-2, April – 2005) may be referred.

9.0 FIELD MEASUREMENT

- Levels should be recorded at 30m length after completion of cess repair work and "as done" profiles should be plotted on the same sheets. Payment of cess repairs shall be based on the quantities worked out from the cross sectional calculations.
- Any excess repair work done beyond 10 cm of the TTP shall not be paid.
- In cess repair work, field measurement of compaction such as density and moisture content may not be insisted upon. Instead, ***record of compaction*** done, with machinery used & number of passes shall be maintained for each layer of earthwork done by concerned SSE, and duly checked by ADEN/AXEN.

Performa for Field Compaction Record to be maintained by SSE and duly checked by ADEN

Date of Laying	Layer No.	Location of coordinate for check	Type of machinery used	No. Of passes	Sig. & name of Rly officer	Sig. & name of contractor	Remarks
1	2	3	4	5	6	7	8

***

REFERENCES

S. No.	Description
1.	Indian Railways Permanent Way Manual, June 2020 (Corrected up to ACS-7)
2.	Indian Railways Schedule of Dimensions, 1676 Gauge, BG, Revised, 2022
3.	RDSO's Specification No. RDSO/2020/GE: IRS-0004 (September 2020) (Including ACS No-01 dated 16.12.2021)
4.	RDSO's Guidelines on Erosion Control and Drainage of Railway Formation (Guideline No. GE: G-4), February- 2005
5.	RDSO's Guidelines for Cuttings in Railway Formations (Guidelines No. GE: G-2), April - 2005
6.	Handbook on Railway Construction – Northern Railway, Second Edition (June 2020)

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If at any point contradiction is observed, then Indian Standards, regulations issued by Government bodies, Railway Board/ RDSO guidelines shall be referred.

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हमारा उद्देश्य

अनुरक्षण प्रौद्योगिकी और कार्यप्रणाली को उन्नयन करना तथा उत्पादकता और रेल्वे की परिसंपत्ति एवं जनशक्ति के निष्पादन में सुधार करना जिससे अन्तर्विषयों में विश्वसनीयता, उपयोगिता और दक्षता प्राप्त की जा सके।

यदि आप इस संदर्भ में कोई विचार और सुझाव देना चाहते हों तो कृपया हमें इस पते पर लिखें।

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Our Objective

To upgrade Maintenance Technologies and Methodologies and achieve improvement in productivity and performance of all Railway assets and manpower which inter-alia would cover Reliability, Availability, and Utilisation.

***If you have any suggestion & comments, please write to us*:**

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