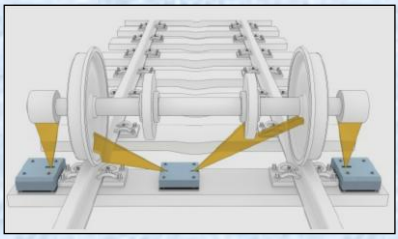
केवल कार्यालयीन उपयोग हेतु
For Official Use Only

भारत सरकार - GOVERNMENT OF INDIA

रेल मंत्रालय - MINISTRY OF RAILWAYS

व्हील इम्पैक्ट लोड डिटेक्टर
Wheel Impact Load Detector



केमटेक/2019/सि/WILD/1.0

CAMTECH/2019/C/WILD/1.0

मई - 2019/ May - 2019

अअमासं RDSO रेल अनुसंधान Transforming Railways

Excellence In Maintenance

Indian Railways

Centre for Advanced Maintenance Technology

महाराजपुर, ग्वालियर - 474005 (भारत)

Maharajpur, Gwalior - 474 005 (INDIA)

✆ : 0751 - 2470869 & Fax : 0751 - 2470841

व्हील इम्पैक्ट लोड डिटेक्टर
Wheel Impact Load Detector

प्राक्कथन

व्हील इम्पैक्ट लोड डिटेक्टर (WILD) मानव रहित प्रज्ञ ट्रैक साइड डाटा अधिग्रहण प्रणाली है जो ट्रैक पर पहियों के गतिशील प्रभाव भार को मापता है।

CAMTECH द्वारा WILD पर यह पुस्तिका उन कर्मचारियों में ज्ञान ज्ञान प्रसारण के उद्देश्य से तैयार की गई है जो रोलिंग स्टॉक तथा ट्रैक के रखरखाव में कार्यरत हैं।

मुझे उम्मीद है कि यह पुस्तिका रेल अभियन्ताओं को WILD की बुनियादी जानकारी प्रदान करने में एवं खराब रोलिंग स्टॉक तथा ट्रैक को तुरंत ठीक करने में सहायक होगी।

केमटेक/ग्वालियर ***(डी के गुप्ता)***

21 मई, 2019 ***संयुक्त निदेशक/सिविल***

FOREWORD

Wheel Impact Load Detector (WILD) is unmanned intelligent track side data acquisition systems that measure the dynamic impact load of wheels on the track.

This hand book on WILD is prepared by the CAMTECH with the objective to disseminate the informative knowledge of WILD to the staff who are engaged in maintenance work of Rolling stock and Track.

I hope that this hand book will be helpful to provide basic information about the WILD system and to assist the railway engineers to attend the defective rolling stock and track immediately.

CAMTECH/Gwalior ***(D.K. Gupta)***
21 May, 2019 ***JD/Civil***

प्रस्तावना

भारतीय रेलवे में व्हील इम्पैक्ट लोड डिटेक्टर (WILD) सिस्टम का उपयोग किया जा रहा है। व्हील इफेक्ट लोड डिटेक्टर सिस्टम से रोलिंग स्टोक एवं ट्रैक की अनियोजित अनुरक्षण कीमत को कम करने में सहायता मिलती है।

"व्हील इम्पैक्ट लोड डिटेक्टर" पर यह पुस्तिका फील्ड में कार्यरत अभियन्ताओं को WILD के बारे में बुनियादी सूचना देने हेतु तैयार की गई है। यह पुस्तिका WILD के बारे में परिचयात्मक सूचना एवं इसकी कार्यशैली, स्थान के चयन की उपयुक्तता, रिपोर्ट बनाने एवं उच्च संघात (धमक) के कारण इत्यादि को समाहित कर तैयार की गई है।

यह पुस्तिका विषय से जुड़े हुए रेलवे बोर्ड, जोनल रेलवे, IRPWM के किसी भी मौजूदा निर्देश का अधिक्रमण नहीं करती है।

यह पुस्तिका वैधानिक नहीं है तथा इसमें दी गई जानकारी रोलिंग स्टोक एवं ट्रैक रखरखाव के कार्य में शामिल कर्मियों को सूचना देने के उद्देश्य से है। यहाँ वर्णित डेटा और जानकारी किसी न किसी रूप में अन्य मुद्रित सामाग्री में उपलब्ध हैं।

हम पुस्तिका में अधिक सुधार के लिए अपने पाठकों के किसी भी सुझाव का स्वागत करते हैं।

केमटेक/ ग्वालियर ***(डी के गुप्ता)*** ***मनोज कुमार***

21 मई, 2019 ***संयुक्त निदेशक (सिविल)*** ***संयुक्त निदेशक (यांत्रिक)***

PREFACE

Wheel Impact Load Detector (WILD) systems are used in Indian Railways. Wheel impact load detector system helps to Reduces Service Failures and Unplanned Maintenance Cost of Rolling Stocks & Tracks.

This hand book on "Wheel Impact Load Detector" is prepared to provide basic information about the Wheel Impact Load Detector (WILD) to field engineers. This hand book is prepared to give introductory information on WILD, and its working principal, criterion for site selection, reports generation and causes of high impact load etc

This hand book does not supercede any existing instructions from Railway Board, Zonal Railway, IRPWM and reports on the subject.

This handbook is not statutory and contents are only for the purpose of information to the staff who are engaged in maintenance work of Rolling stock and track. The data & information mentioned herein are available in some form or in the other printed matters.

We welcome any suggestions from our users for further improvement.

CAMTECH/Gwalior	***(D.K. Gupta)***	***(Manoj Kumar)***
21th May, 2019	***JD/Civil***	***JD/Mech***

विषय सूची / CONTENTS

क्र.सं./ S. No.	विवरण / Description	पृष्ठ संख्या Page No.
	प्राक्कथन / Foreword	*(i)*
	भूमिका / Preface	*(ii)*
	विषय सूची / Content	*(iii)*
	सुधार पर्ची / Correction Slip	*(iv)*
1.0	परिचय / INTRODUCTION	2
2.0	WILD क्या है / WHAT IS WILD	2
3.0	WILD की आवश्यकता / NEED FOR WILD	8
4.0	उच्च संघात भार के कारण / CAUSES OF HIGH IMPACT LOAD	8
5.0	WILD की कार्यशैली / WORKING OF WILD	11
6.0	WILD रिपोर्ट्स / REPORTS IN WILD	14
7.0	WILD प्रणाली हेतु साइट चयन के लिए उपयुक्तता / CRITERION FOR SITE SELECTION FOR WILD SYSTEM	16
8.0	WILD की स्थापना हेतु रेलवे टीम / RAILWAY TEAM FOR INSTALLATION	19
	संदर्भ / References	20
	टिप्पणी / Notes	21
	गुणवत्ता नीति / Quality Policy	22

संशोधन पर्चियों का प्रकाशन

इस लघु पुस्तिका के लिए भविष्य में प्रकाशित होने वाली संशोधन पर्चियों को निम्नानुसार संख्यांकित किया जाएगा।

केमटेक/सि/2019/WILD/1.0 सीएस # XX दिनांक ----------

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

प्रकाशित संशोधन पर्चियाँ

क्र.सं.	प्रकाशन की तारीख	संशोधित पृष्ठ संख्या तथा मद संख्या	टिप्पणी

ISSUE OF CORRECTION SLIPS

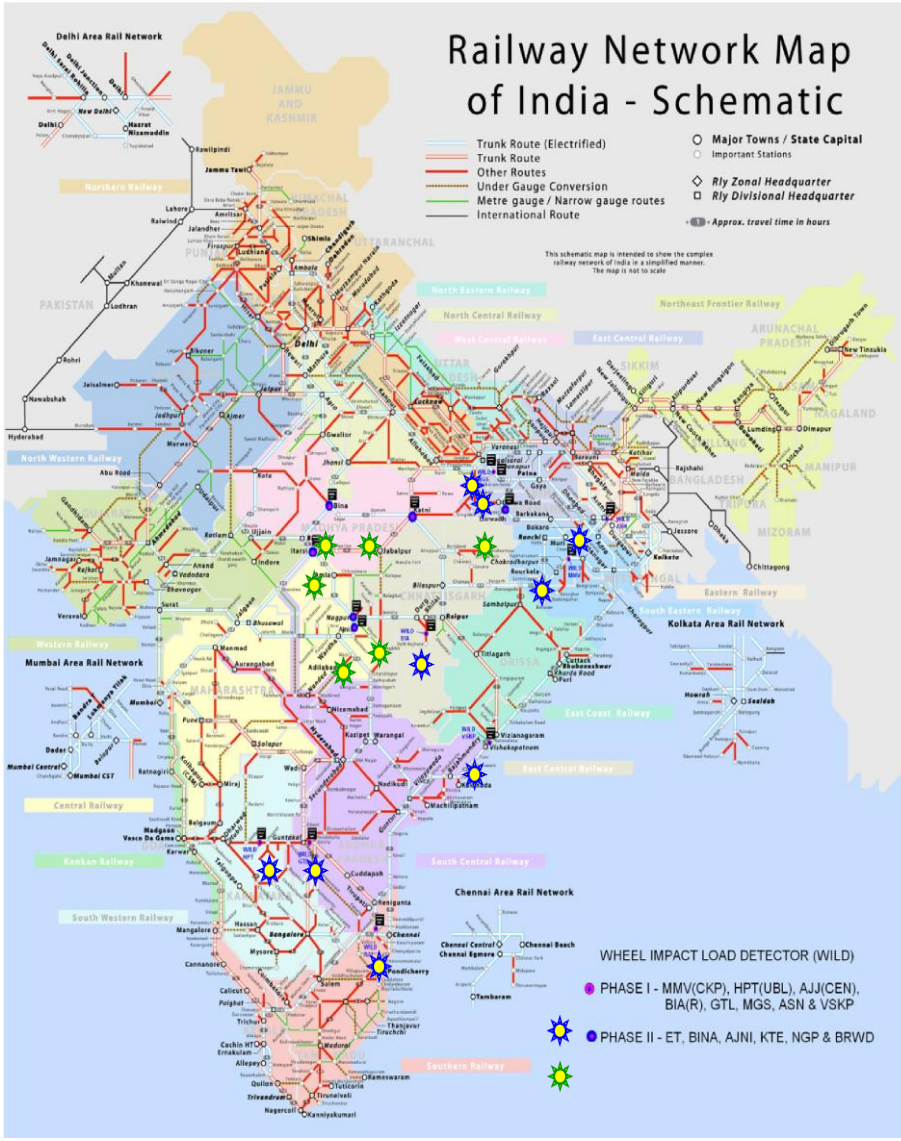
The correction slips to be issued in future for this booklet will be numbered as follows:

CAMTECH/C/2019/WILD/1.0/CS # XX date .....

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

CORRECTION SLIPS ISSUED

S. No.	Date of issue	Page no. and Item No. modified	Remarks


Railway Network Map of India - Schematic
Trunk Route (Electrified)
Trunk Route
Other Routes
Under Gauge Conversion
Metre gauge / Narrow gauge routes
International Route
Major Towns / State Capital
Important Stations
Rly Zonal Headquarter
Rly Divisional Headquarter
Approx. travel time in hours
This schematic map is intended to show the complex railway network of India in a simplified manner. The map is not to scale
Delhi Area Rail Network
Mumbai Area Rail Network
Kolkata Area Rail Network
Chennai Area Rail Network
WHEEL IMPACT LOAD DETECTOR (WILD)
PHASE I - MMV(CKP), HPT(UBL), AJJ(CEN), BIA(R), GTL, MGS, ASN & VSKP
PHASE II - ET, BINA, AJNI, KTE, NGP & BRWD

1.0 परिचय / INTRODUCTION

WILD (Wheel Impact Load Detector) systems were developed jointly by RDSO and IIT, Kanpur in the year 2005.

Over the years 15 sites were installed on the Indian Railways.

In the first phase WILD system were installed at Mahalimarup (CKP), Hospet (Karnataka), Arakkunam (tamilnadu), Bhilai (Chattisgarh), Guntukal (Andhra pradsh), MGS, ASN and VSKP.

In the second phase, they were installed at Itarsi, Bina, Ajani, Katni, Nagpur and Barwadeh.

2.0 WILD क्या है / WHAT IS WILD

The Wheel Impact Load Detector is a set of rails instrumented with strain gauges. The system uses strain gauges stuck on the web of the rail to measure the shear strain from which the corresponding shearing load (the wheel load) is determined. The strain gauges are connected to a data acquisition system which acquires data, computes the values and relays these to the internet based servers.

2.1 Components of WILD

As shown in Fig 1, following are the components of WILD –

1. Instrumented Tracks
2. Signal conditioning unit
3. Train Trigger Sensor
4. Real time Embedded controller
5. Impact Load Analyzer Software
6. Wireless data transfer
7. Power back up
8. Calibration Setup

WILD Block Diagram

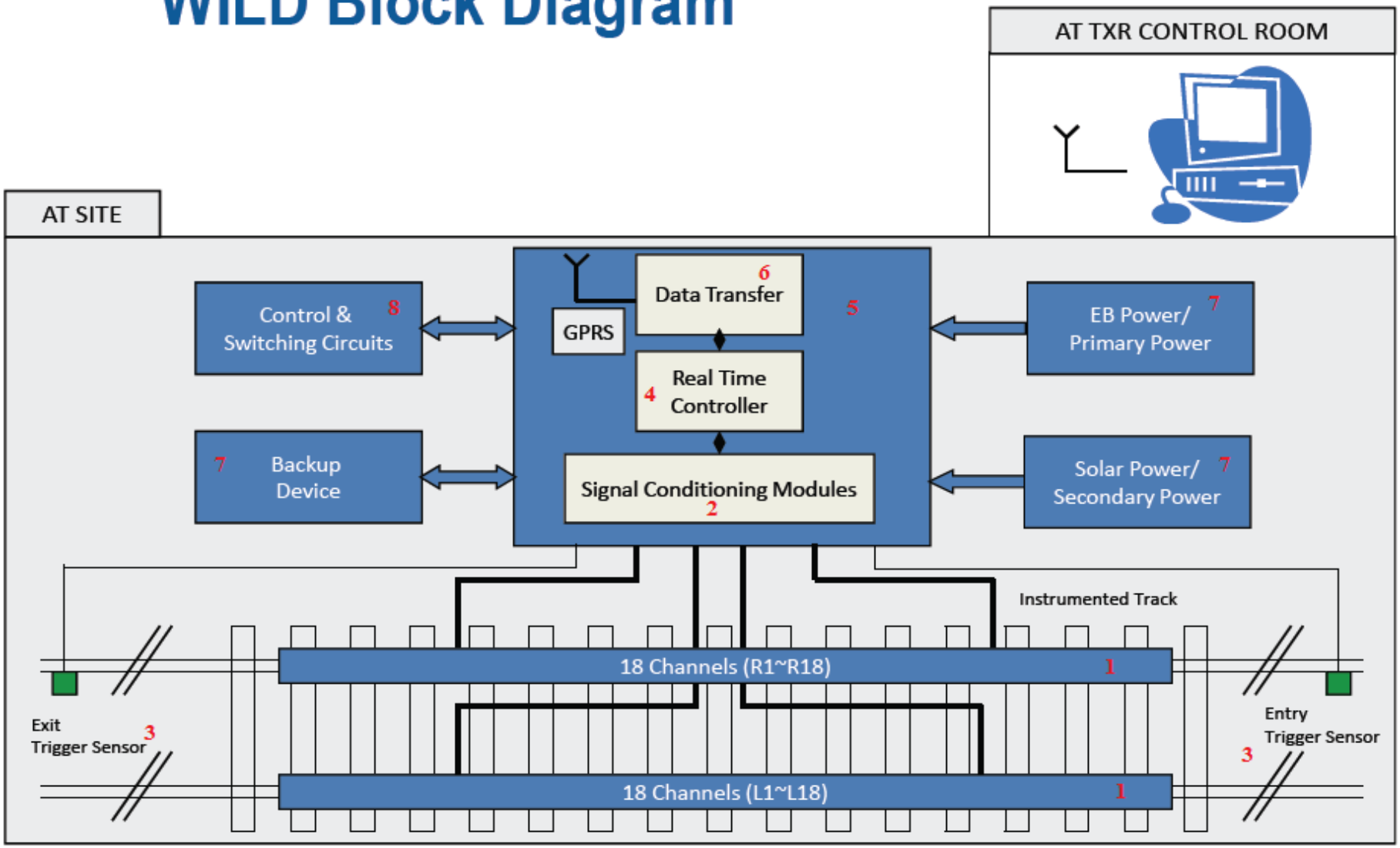


Fig. 1

2.1.1 Instrumented Tracks

- Tracks are instrumented with strain gauges to measure the load pattern of the wheel on the rail.
- The track consists of 18 strain gauge measuring channels.
- Each channel has a full bridge consisting of 4 Rosette type strain gauges.



Instrumented Track Junction Box System Display

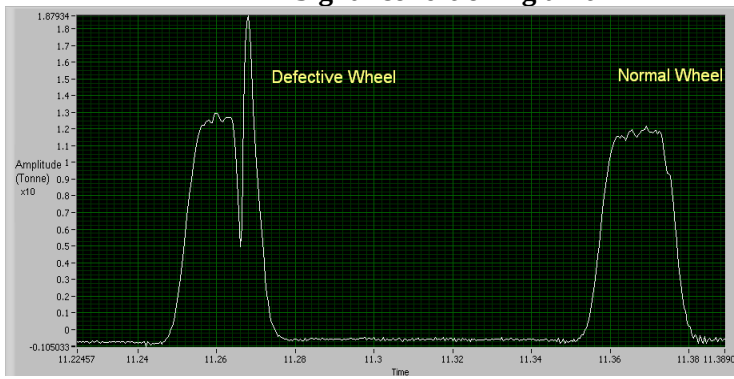


2.1.2 Signal conditioning unit

- Signals from strain gauges are connected Signal conditioning unit.
- Inbuilt Surge Protection to meet harsh field conditions.
  - Surge Protector is an appliance or device designed to protect electrical devices from voltage spikes.
  - Surge protector attempts to limit the voltage supplied to an electric device by either blocking or shorting to ground any unwanted voltages above a safe threshold.
- Real time embedded controller analyze the conditioned signal and prepare the summary report for publishing in the website



Signal conditioning unit



Signal from Instrumented Track

2.1.3 Train Trigger Sensor

- Automatic Diagnosis of faulty channels and switching them off to avoid erroneous data at every start.
- Automatic start of Data Acquisition (DAQ) on the arrival of train in response to the start trigger switch.
- Automatic stop of DAQ after the passage of train by intelligently identifying the event.
- Uploads analyzed data to remote server .

2.1.4 Real time Embedded controller

Real-time systems are computer systems that monitor, respond to, or control an external environment. This environment is connected to the computer system through sensors, actuators, and other input-output interfaces. The primary purpose of these systems is to respond to or react to signals from their environment.

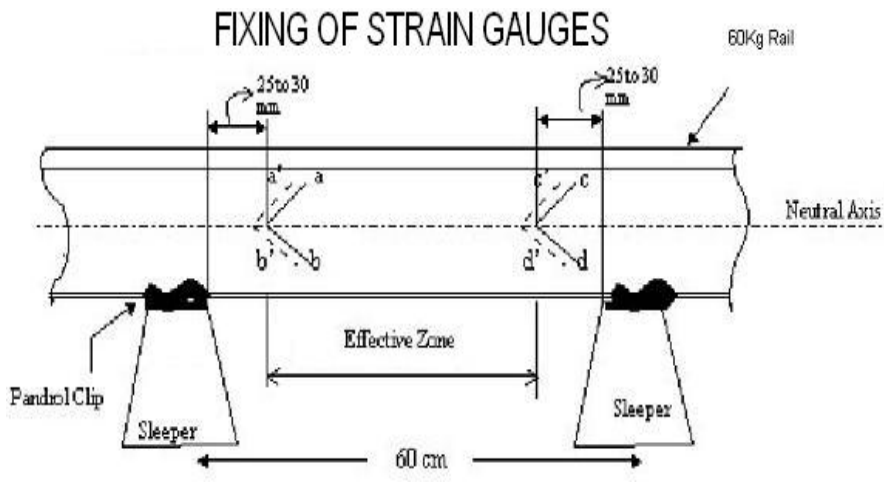
A real-time computer system may be a component of a larger system in which it is embedded; reasonably, such a computer component is called an *embedded system*.

2.1.5 Impact Load Analyzer Software

- Starts acquisition once train trigger is received.
- Logs all the data in to file for analysis.
- Stops acquisition and logging after the train crosses the instrumented track.
- Calls an analysis program that loads each channel data and furnishes processed data.

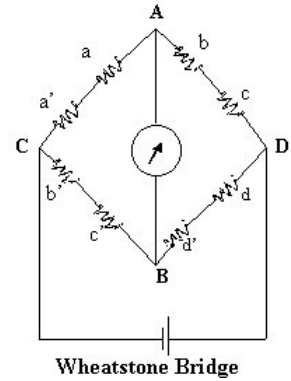
Summary report is produced and is transmitted to remote server. Server stores the report and publish in the website.

2.1.6 Strain Gauges on Instrumented Rails



2.1.7 Strain Gauge Mounting

- 350 Ohm strain gauge.
- 8 strain gauges electrically connected to give a full bridge configuration.
- Each arm of the bridge consists of two gauges.
- The individual arms & gauges wired in a way to measure vertical load.



2.1.8 WILD records load of all wheels passing over the instrumented rail and these loads may be normal wheel loads or loads coming on rails due to many possible defects in rolling stocks. These defects are not necessarily always flat tyres, as is normally

understood. Various possible causes for heavy loads are wheel flats, shelling marks, out of roundness of wheels, suspension problems, misalignment of bogies etc.

3.0 WILD की आवश्यकता / NEED FOR WILD

- Defective rolling stock produces high impact loads.
- These loads over a prolonged period of time, leads to Rail/Wagon failure, wheel bearing failure etc.
- WILD measures impact load independent of the cause.
- WILD system assists railway engineers to attend to the defective rolling stock immediately.
- WILD reduces Service Failures and Unplanned Maintenance Cost of Rolling Stocks & Tracks.
- WILD is used to catch the defects in the early stage and thereby protecting Rail Infrastructure & avoids Catastrophic Failures.

4.0 उच्च संघात भार के कारण / CAUSES OF HIGH IMPACT LOAD

Defects that can cause high Impact load are:

1. Wheel Flat
2. Broken Spring
3. Dashpot Oil Leak
4. Unevenness in Side Bearer
5. Cone Defect
6. (a) PU Pad / (b) EM Pad
7. CC Housing
8. Axle Bolt Cant

9. Friction Liner
10. Bolster
11. Uneven Loading
12. Coil Spring Weak
13. Shell Tread
14. Snubber Spring Broken
15. Defect in Suspension
16. Skid mark, etc.
17. Loose/Compacted Ballast
18. Track Twist
19. Track Geometry Defects
20. Welding Defects in Welded Rails
21. Expansion Joint Defects
22. Broken/Damaged Sleepers
23. Fractured Rails



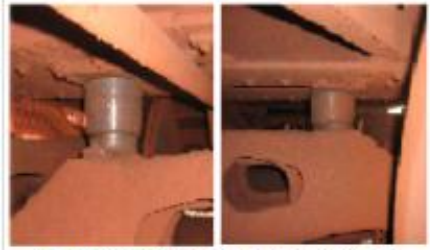
1. Wheel Flat



2. Broken Spring



3. Dashpot Oil Leak



4. Unevenness in Side Bearer



5. Cone Defect



6 (a) PU Pad



6 (b) EM Pad



7. CC Housing



8. Axle Bolt Cant



9. Friction Liner



10. Bolster

5.0 WILD की कार्यशैली / WORKING OF WILD

- WILD uses instrumented rails.
- The space between sleepers is instrumented using strain gauges and any load that appears in the effective zone is considered.
- Various such measuring zones are formed along the track.
- The maximum load measured in all instrumented portion is treated as the impact load.
- As wheel rolls over the rail, various portions of the wheel fall in the effective zone and dead zone (sleepers).
- As a result various diameters of wheel have different coverage.
- The instrumented portions can be determined and prepositioned to give best coverage for the wheels of interest.
- Once installed the system's wheel coverage pattern does not change.
- Each channel produces a portion of load profile for all the wheels.
- Accumulating all the data, a complete load profile of the wheel is obtained.
- The maximum load detected by the channels is primarily used to flag the defective axle/wheel.

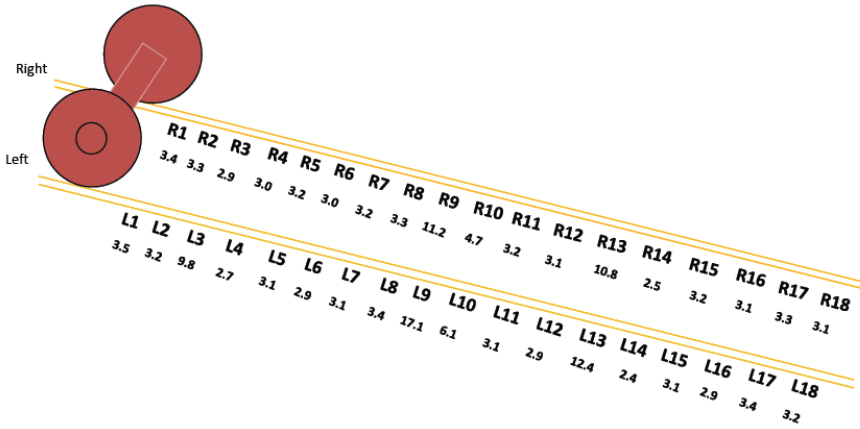
- Wild system flags the defects purely based on the impact load measured.
- The limit is set by the RDSO/Railway board.
- The system however features a facility for the end user to set the limit.

5.1 Calculation of Impact Load Factor

Impact load factor (ILF) can be calculated by the formula i.e.

$$ILF = \frac{\text{Maximum Dynamic Wheel Load on Track}}{\text{Average Dynamic Wheel Load}}$$

The illustrated example of calculation is as follows –



	Left	Load (Tonne)	Right	Load (Tonne)	
	L1	3.5	R1	3.4	Third Right Max
	L2	3.2	R2	3.3	
Third Left Max	L3	9.8	R3	2.9	
	L4	2.7	R4	3	
	L5	3.1	R5	3.2	
	L6	2.9	R6	3	
	L7	3.1	R7	3.2	
	L8	3.4	R8	3.3	
First Left Max	L9	17.1	R9	11.2	First Right Max
	L10	6.1	R10	4.7	
	L11	3.1	R11	3.2	
	L12	2.9	R12	3.1	
Second Left Max	L13	12.4	R13	10.8	Second Right Max
	L14	2.4	R14	2.5	
	L15	3.1	R15	3.2	
	L16	2.9	R16	3.1	
	L17	3.4	R17	3.3	
	L18	3.2	R18	3.1	

Left Maximum Dy Wheel Load = 17.1
Left Average Dy Wheel Load = 3.27

$$\text{Left Impact Load Factor} = \frac{\text{Left Max. Dy Wheel Load (17.1)}}{\text{Left Avg. Dy Wheel Load (3.27) (Avg. of Lowest fifteen readings)}}$$

Left Impact Load Factor (LILF) = 5.23

Right Maximum Dy Wheel Load = 11.2
Right Average Dy Wheel Load = 3.21

$$\text{Right Impact Load Factor} = \frac{\text{Right Max. Dy Wheel Load (11.2)}}{\text{Right Avg. Dy Wheel Load (3.21) (Avg. of Lowest ten readings)}}$$

Right Impact Load Factor (RILF) = 3.49

5.2 Impact load limits

Maximum Load (Inclusive)		ILF	Flagged as	Action to be taken
20 T to 35 T	Or	2.0 to 4.5 Inclusive)	Maintenance alarm	Attention to be given during next schedule maintenance.
More than 35 T	Or	4.5	Critical alarm	Attended at the nearest TXR point or detach in next station in less than 50 Km.

6.0 WILD रिपोर्ट्स / REPORTS IN WILD

- The WILD System offers the end user to generate various reports.
- Month wise, Year wise, Train wise & Wheel wise standard reports available.
- Provision for new standard reports.
- Summary reports can be drawn out based on
  - Wheel loads
  - Rolling stock (Engine, Wagon, Tanker etc.)
  - Defective rolling stock
- Master Mode
  - All train reports
  - Consolidated reports
  - Alarm log reports
  - Wheel wise analysis
  - Train wise analysis
- TXR Mode
  - Latest train report
- Data Entry Mode
  - Feedback for the alarm

Vide Report No. SECR/ENGG/BIA-II/PW/1/Pt-V/258, dated 01.02.2018 of ADEN/II/BIA/ SECR, the details of WILD Data of rakes loaded with iron ore and running at a maximum speed 50 kmph in Non-Electrified Section of Bhilai - Maroda from Jan-2017 to Nov-2017 is reproduced as under –

Detail of WILD Report of BIA-MXA from Jan-2017 to Nov-2017

Month	Total Trains Passed	Total Trains Analysed	Total Wheels Analysed	Total critical alarms				Remark		
				Impact Load>35t	ILF>4.5	Both	Total Critical Alarm cases	Detached	Defects found cases	Defects found within permissible limit
JAN-2017	518	516	146588	-	-	-	-	-	-	-
FEB-2017	466	464	136520	-	-	-	-	-	-	-
MAR-2017	557	548	164420	-	-	-	-	-	-	-
APR-2017	372	371	103756	-	-	-	-	-	-	-
MAY-2017	402	395	109876	2	2	2	2	-	-	2
JUN-2017	375	374	105332	-	-	-	-	-	-	-
JUL-2017	383	373	113400	4	-	-	-	-	-	4
AUG-2017	436	344	122415	-	-	-	-	-	-	-
SEP-2017	398	397	114644	-	-	-	-	-	-	-
OCT-2017	300	298	94476	-	-	-	-	-	-	-
NOV-2017	410	406	127172	-	-	-	-	-	-	-

Analysis of Maintenance Alarms in Month of Sep-2017

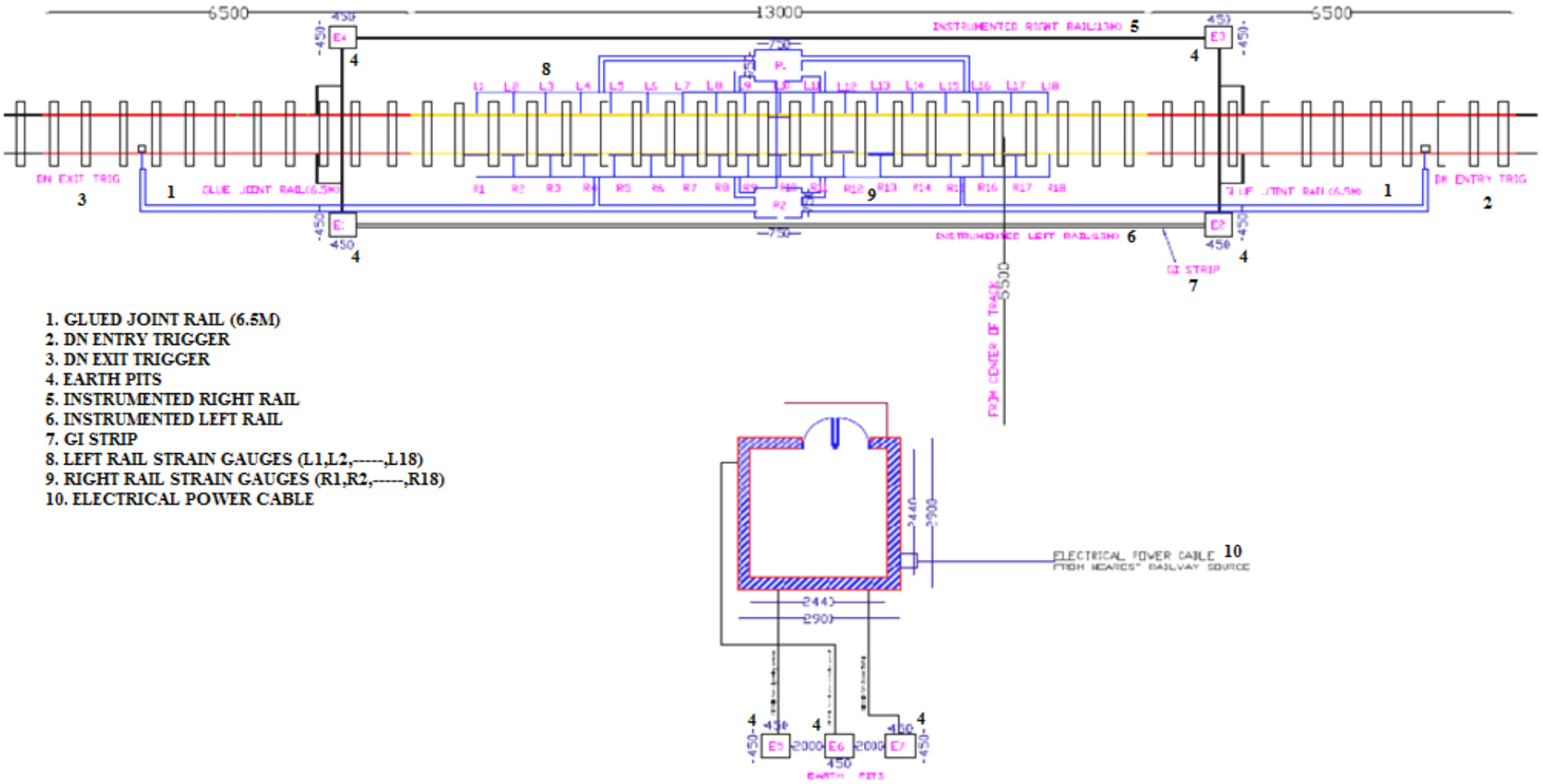
Date	Vehicle No.	Wheel Left/Right	ILF (Left)/(Right)	Impact Load (Left)/(Right)	Defect Found	Action Taken	Train No./BPC No.
02.09.17	Loco No. 12863	Left	3.06	34.929 (left)	Found OK	All wagons are checked by C & W staff and allowed for run.	DBC/105 C-1 BPC No. 4120, dt. 02.09.17
18.09.17	SE 75071610021	Right	-	20.29 (right)	-		DBC/191 G3 BPC No. 4142, dt. 15.09.17
19.09.17	SE 75079117003	Left	-	20.478 (left)	Slight skidded		DBC/198 J13 BPC No. 4121, dt. 12.09.17
21.09.17	SEC 75141611156	Left	-	20.153 (left)	Dent mark		DBC/206 D3 BPC No. 4126, dt. 18.08.17
	SEC 75100648599	Left	-	20.413 (left)			
21.09.17	ECR 75100648599	Right	2.274 (right)	-	-		BDC/212 B7 BPC No. 4223, dt. 13.09.17
23.09.17	CR 75019360018	Left	2.08 (left)	-	Found OK		BDC/220 E4 BPC No. 4127, dt. 19.09.17
25.09.17	SC 75099714039	Left	2.028 (left)	-	Slight skidded		DBC/230 D6 BPC No. 4126, dt. 19.09.17
29.09.17	NR 75038985758	Left	2.025 (left)	-	Dent mark		BDC/252 J BPC No. 4128, dt. 23.09.17
	SE 81678	Left	2.025 (left)	-	Found OK		
30.09.17	Engine No. 4126	Right	-	20.179 (right)	-		BDC/258 D10 BPC No. 4126, dt. 18.09.17
		Right	-	20.033 (right)	-		

7.0 WILD प्रणाली हेतु साइट चयन के लिए उपयुक्तता / CRITERION FOR SITE SELECTION FOR WILD SYSTEM

- These criteria are drafted out based on the site conditions given in COFMOW's WILD Specification No. COFMOW/ IR/WILD/2013.
- The system will be installed on straight and level track of minimum 250 m length including approaches to the site.
- There should not be any permanent speed restriction at site of WILD system.
- The rail section shall be 60 kg/m with flat foot laid on Pre-Stressed Concrete (PSC) Sleepers at 60 cm spacing with elastic fastenings viz. pandrol clips on rubber grooved sole and clean ballast cushion of 250/300 mm.
- The site will not be very close to any station or at the approach of a signal to avoid acceleration or braking over the instrumented rails.
- The railways (DRM/Mechanical) shall ensure advance arrangement like sanction etc. to meet out recurring expenditure after one year of installation.
- The Railway shall ensure provision of reliable 230V+10% single phase electric power supply anywhere in 3 km along track from the site of installation of the system before system installation is taken up by the firm.
- Site should have proper road approach for taking 13m instrumented rail near site through trailer.
- Site should have good GSM network connectivity for sending the reports.
- Proper locality to safe guard the system from theft/untoward activity.
- Preferred power connecting from OHE through Auxiliary

transformer or nearby power resource from Railway infrastructure. Power taken from agriculture field will lead to lot of fluctuation and improper working.

- At least one side of the ground area is closed to the level track and soil is strong and good for earthing.
- In case of double line, system should be installed in a line where loaded trains traffic is more.
- Panel room should not be placed where area is marked as railways future expansion area.
- Old set of sleepers has to be replaced with new one.
- Railways to provide 04 nos. glued joint per system. Each glued joint to be fixed at each end of the two instrumented rails. Also ensure that the rails are welded on to the track.
- Railways to provide all permissions, line blocks to work on the site. All relevant departments to provide approval for the site, since once installation process begins, changing of exact site location (even by a few meters) would be extremely difficult.
- Railways to arrange for adequate security for men and materials.



1. GLUED JOINT RAIL (6.5M)
2. DN ENTRY TRIGGER
3. DN EXIT TRIGGER
4. EARTH PITS
5. INSTRUMENTED RIGHT RAIL
6. INSTRUMENTED LEFT RAIL
7. GI STRIP
8. LEFT RAIL STRAIN GAUGES (L1,L2,-----,L18)
9. RIGHT RAIL STRAIN GAUGES (R1,R2,-----,R18)
10. ELECTRICAL POWER CABLE

8.0 WILD की स्थापना हेतु रेलवे टीम / RAILWAY TEAM FOR INSTALLATION

The Railway DRM (mechanical) is the owner for the system from date of receipt of material and shall ensure advance arrangement like sanction etc. to meet out recurring expenditure after one year installation. In addition, DRM (mechanical) has to coordinate with other department (engineering, operation/traffic, S&T/TRD and Security) during installation and post installation requirements.

S. No.	Department	Responsibility
1	Mechanical C&W	• Owner for the system from date of receipt of material • Has to coordinate with other department during installation and post installation requirements.
2	Engineering	• To confirm all the site conditions • Instrumented rail with Glued joint rail installations. • Changing of sleepers with new ones. • Periodic checking of pandrol clips in instrumented area. • Confirmation for civil works like construction of building, Trenching work for strain gauge wires, Trenching work for power line, earth pits and similar works etc.
3	Operations/ Traffic	• Blocks required during rail fixing, Proving out test and routine Calibration
4	S&T/TRD	• To ensure track continuity is there after installation of glued joint Rail
5	Security	• Security for the materials and people who install the system.

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संदर्भ / References

S. No.	Description
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टिप्पणी / NOTES

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गुणवत्ता नीति

रेलों में यात्री और माल यातायात की बढ़ती माँग को पूरा करने के लिए गुणवत्ता प्रबंध प्रणाली में अनुसंधान, डिज़ाइनों और मानकों में उत्कृष्टता तथा सतत सुधारों के माध्यम से सांविधिक और नियामक अपेक्षाओं को पूरा करते हुए सुरक्षित, आधुनिक और किफ़ायती रेल प्रौद्योगिकी का विकास करना।

QUALITY POLICY

To develop safe, modern and cost effective Railway technology complying with Statutory and Regulatory requirements, through excellence in Research, Designs & Standards and Continual improvements in Quality Management System to cater to growing demand of passenger and freight traffic on the Railways.

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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 & any specific comments, please write to us:

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