Introduction to WILD
Why is WILD needed

• Defective rolling stock produce high impact loads.
• These loads over a prolonged period of time leads to Rail/Wagon failure, wheel bearing failure etc..
• WILD measures the impact load independent of the cause.
• WILD system assists the railway engineer to attend to the defective rolling stock immediately.
• 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.
Defects that can cause High Impact Load

- Uneven loading
- Coil spring weak
- Shell Tread
- Friction liner broken
- Snubber spring broken
- Axle box canting
- PU/CC/EM Pad Shifted/Pressed/Perished
- CC housing broken
- S/Bearer roof/Friction Liner welding open
- Bolster tilted one side
- Defect in suspension
- Broken spring
- Skid mark, etc.

List Released by RDSO on 23rd March 2011
Defects that Cause High Impact Load

- Wheel Flat
- Broken Spring
- Dashpot Oil Leak
- Unevenness in Side Bearer
- Cone Defect
Defects that Cause High Impact Load

- EM Pad
- CC Housing
- Axle Box Cant
- Friction Liner
- Bolster
- PU Pad
WILD – Wheel Impact Load Detector in India
WILD Components
Components of WILD

- Instrumented Tracks
- Signal conditioning unit
- Train Trigger Sensor
- Real time Embedded controller
- Impact Load Analyzer Software
- Wireless data transfer
- Power back up
- Calibration Setup
WILD Sites
WILD System Architecture

Step 1
- WILD Site
- Instrumented Rail

Step 2
- IR WILD Server

Step 3
- Audio Visual at C&W Control Room
- SMS Notification for Alarm Condition
- Any Authentic users

Alarm
Measuring concept of WILD

- WILD uses instrumented rails.
- The space between sleepers are 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 of the instrumented portion is treated as the impact load.
- As wheel of 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.
Instrumented Track

- 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
Signal from Instrumented Track

Defective Wheel

Normal Wheel
Strain Gauges on Instrumented Rail

FIXING OF STRAIN GAUGES

Neutral Axis

Effective Zone

60 cm

Pandrol Clip

Sleeper

Sleeper

60Kg Rail

25 to 30 mm

25 to 30 mm
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.
How Does it Work?

• 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.
How does WILD system flag defects

- WILD system flags the defects purely based on the impact load measured.
- The limits are set by the RDSO/Railway Board
- The system however features a facility for the end user to set the limits as well.

<table>
<thead>
<tr>
<th>Max Load (MDIL)</th>
<th>ILF</th>
<th>Flagged As</th>
<th>Action to be taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>20t to 35t</td>
<td>Or 2.0 to 4.5 (inclusive)</td>
<td>Maintenance Alarm</td>
<td>Attention to be given during next scheduled maintenance</td>
</tr>
<tr>
<td>&gt;35t</td>
<td>Or &gt;4.5</td>
<td>Critical Alarm</td>
<td>Attend at the nearest TXR point or detach in station in &lt;50km</td>
</tr>
</tbody>
</table>
Calculation (WILD-II Ver. 36channel)
### Calculation (WILD-II Ver. 36channel)

<table>
<thead>
<tr>
<th>Left</th>
<th>Load (Tonne)</th>
<th>Right</th>
<th>Load (Tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>3.5</td>
<td>R1</td>
<td>3.4</td>
</tr>
<tr>
<td>L2</td>
<td>3.2</td>
<td>R2</td>
<td>3.3</td>
</tr>
<tr>
<td>L3</td>
<td>2.8</td>
<td>R3</td>
<td>2.9</td>
</tr>
<tr>
<td>L4</td>
<td>2.7</td>
<td>R4</td>
<td>3</td>
</tr>
<tr>
<td>L5</td>
<td>3.1</td>
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<tr>
<td>L6</td>
<td>2.9</td>
<td>R6</td>
<td>3</td>
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<td>L7</td>
<td>3.1</td>
<td>R7</td>
<td>3.2</td>
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<tr>
<td>L8</td>
<td>3.4</td>
<td>R8</td>
<td>3.3</td>
</tr>
<tr>
<td>L9</td>
<td>17.1</td>
<td>R9</td>
<td>11.2</td>
</tr>
<tr>
<td>L10</td>
<td>6.1</td>
<td>R10</td>
<td>4.7</td>
</tr>
<tr>
<td>L11</td>
<td>3.1</td>
<td>R11</td>
<td>3.2</td>
</tr>
<tr>
<td>L12</td>
<td>2.9</td>
<td>R12</td>
<td>3.1</td>
</tr>
<tr>
<td>L13</td>
<td>12.4</td>
<td>R13</td>
<td>10.8</td>
</tr>
<tr>
<td>L14</td>
<td>2.4</td>
<td>R14</td>
<td>2.5</td>
</tr>
<tr>
<td>L15</td>
<td>3.1</td>
<td>R15</td>
<td>3.2</td>
</tr>
<tr>
<td>L16</td>
<td>2.9</td>
<td>R16</td>
<td>3.1</td>
</tr>
<tr>
<td>L17</td>
<td>3.4</td>
<td>R17</td>
<td>3.3</td>
</tr>
<tr>
<td>L18</td>
<td>3.2</td>
<td>R18</td>
<td>3.1</td>
</tr>
</tbody>
</table>

- **First Right Max**: L9 17.1 R9 11.2
- **Second Left Max**: L13 12.4 R13 10.8
- **Second Right Max**: L14 2.4 R14 2.5
- **Third Right Max**: L3 9.8 R3 2.9
- **Third Left Max**: L9 17.1 R9 11.2
- **First Left Max**: L9 17.1 R9 11.2
- **Second Right Max**: L13 12.4 R13 10.8
- **Second Right Max**: L14 2.4 R14 2.5
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<td>R4</td>
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<td>3.1</td>
<td>R11</td>
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<td>R12</td>
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<td>3.4</td>
<td>R17</td>
<td>3.3</td>
</tr>
<tr>
<td>L18</td>
<td>3.2</td>
<td>R18</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Left Maximum Dy Wheel Load = 17.1**

**Left Average Dy Wheel Load = 3.27**

**Left Impact Load Factor (L ILF) = 5.23**

\[
\text{Left Impact Load Factor} = \frac{\text{Left Maximum Dy Wheel Load} (17.1)}{\text{Left Average Dy Wheel Load (3.27)}} \quad \text{(Avg. Of Lowest fifteen readings)}
\]

**Right Maximum Dy Wheel Load = 11.2**

**Right Average Dy Wheel Load = 3.49**

**Right Impact Load Factor (RILF) = 3.49**

\[
\text{Right Impact Load Factor} = \frac{\text{Left Maximum Dy Wheel Load (11.2)}}{\text{Left Average Dy Wheel Load (3.21)}} \quad \text{(Avg. Of Lowest ten readings)}
\]
Signal Conditioning & Data Acquisition Unit

- Signals from strain gauges are connected to a signal conditioning unit.
- Inbuilt Surge Protection to meet harsh field conditions.
- Real-time embedded controller analyzes the conditioned signal and prepares a summary report for publishing on the website.
System Capabilities
System capabilities

- Counts number of axles from various measurement channels.
- Measures Average Dynamic Wheel Load for all wheels.
- Determines Maximum Dynamic Wheel Load (WA) for all points of contact.
- Calculates speed of each axle and the average speed of train.
- Identifies and counts defective wheels as per specified thresholds and rates them according to the severity of defect.
- Points out exact position of defective wheel from loco for easy examination.
- Has solar panel providing a power backup.
System capabilities

- Identifies and count number of Engines, Coaches / Wagons and Brake Vans.
- Relates each axle with engine or coach / wagon or brake van. Also it’s position in the identified rolling stock.
- Operates 24x7 without any human assistance.
- Transmits run reports to a central server that can be accessed by simple web browser*.
- Can operate from a low speed of 30Km/hr.

* Based on the network connectivity available at site
System capabilities: Wheel Coverage - 12 Channel
System capabilities: Wheel Coverage - 18 Channel
Automation Features

- 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.
Software Flow

- Starts acquisition once train trigger is received.
- Logs all the data into 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.
WHEEL IMPACT LOAD DETECTOR
Web Report Demo
Reports in WILD

- The WILD system offer 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
WILD – Login Details (www.railman.in)

- 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
WILD – Login (www.railman.in)
WILD - Train Report Generation

Wheel Impact Load Detector

Train Report

Location: Select
Date: 17/10/2011
Train Time: Select

Site Alarm Counter
- Total Maint Alarm for today: 8
- Total Critical Alarm for today: 0
- Total Monthly Maint Alarm: 1948
- Total Monthly Critical Alarm: 1

Site Status
- Last communication at: 20-10-2011, 10:20:04 AM
- Dongargarh (DGG)

SOUTH EAST CENTRAL RAILWAY
- View more detail
WILD – Various Report Generation of the Train
WILD – Web Report

Wheel Impact Load Detector

Summarised Information
Date: 05/05/2011  Time: 15:34:21  Run No: 00050011213415  Train Direction: UP

Train Information
Total Axles: 30  Avg. Train speed (kmph): 70.00  Number of Alarms: 0  Train Type: -
Engine = 1  Coach/Wagon (8 WHEELER) = 8  Tender (4 WHEELER) = 0  Brake Van (4 WHEELER) = 0

Defective Wheel Information
No Alarms in this Report

Notes:
1. Maintenance Alarm Level (*): 2<ILF<4.5 or 2ILF<VA<3ILF
2. Critical Alarm (***): 4.5<ILF or VA<3ILF

Detailed Information

<table>
<thead>
<tr>
<th>Axle No. (From Front)</th>
<th>Average Normal Dynamic Veh Load (VNL) for Left Wheel (TON)</th>
<th>Average Normal Dynamic Veh Load (VNL) for Right Wheel (TON)</th>
<th>Maximum Dynamic Veh Load Recorded (VNL) for Left Wheel (TON)</th>
<th>Maximum Dynamic Veh Load Recorded (VNL) for Right Wheel (TON)</th>
<th>Ratio of Max. to Normal Average Dynamic Veh Load for Left Wheel (LF1)</th>
<th>Ratio of Max. to Normal Average Dynamic Veh Load for Right Wheel (LF2)</th>
<th>Speed (kmph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.060</td>
<td>10.044</td>
<td>12.401</td>
<td>12.301</td>
<td>1.131</td>
<td>1.291</td>
<td>73.51</td>
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<tr>
<td>2</td>
<td>10.938</td>
<td>9.679</td>
<td>12.502</td>
<td>11.948</td>
<td>1.117</td>
<td>1.206</td>
<td>73.51</td>
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<tr>
<td>3</td>
<td>10.314</td>
<td>9.070</td>
<td>12.203</td>
<td>12.033</td>
<td>1.161</td>
<td>1.212</td>
<td>73.66</td>
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<tr>
<td>4</td>
<td>10.636</td>
<td>9.460</td>
<td>12.546</td>
<td>12.144</td>
<td>1.192</td>
<td>1.284</td>
<td>73.56</td>
</tr>
</tbody>
</table>
WILD - Website Usage

• All the wheel impact loads recorded are stored in the central server.
• WILD system is ready but not equipped with Automatic Equipment Identification to enable trending of the Wagon behavior.
• Nevertheless the WILD website irwild.net offers features for the user to enter the wagon details for the defective wagon along with defect identified.
• This helps the railways to track the information on the particular wagon as its health declines (from maintenance alarm to critical alarm).
# Alarm Log

## WILD SYSTEM - ALARM LOG

**Location:** Ajni (AJNI)  
**Date:** 29/09/2011  
**Time:** 00:32:53  
**Run No.:** 29092011533200  
**Direction:** UP

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>**</td>
<td>75</td>
<td>1B</td>
<td>1</td>
<td>1.161</td>
<td>8.106</td>
<td>5.12</td>
<td>32.093</td>
</tr>
</tbody>
</table>

### DEFECTIVE STOCK DETAILS

**ENGINE**  
Ex: WAP4/SRC 22329

**WAGON/COACH**  
Zone Code  
Select  
Rolling Stock Type  
Select  
Wagon Number (First 6 digits)  
Wagon Number (Last 5 digits)

**BRAKE VAN**  
Ex: BVZI 22329

### DIAGNOSIS DETAILS

- Flat Place
- Length: [ ] MM
- Width: [ ] MM
- Depth: [ ] MM
- Out Of Roundness
- Defect In Suspension
- Mis Alignment Of Bogie
- Uneven Loading
- Skewness In Car Body
- Others

### TRAIN DETAILS

- Train Name
- DEPOT INFO
  - Zone
  - Division
  - Depot
  - Air Brake Cert No

### Action Taken

- [ ] DETACHED  
- [ ] ALLOWED TO RUN  
- [ ] FEEDBACK NOT RECEIVED

[Finish] [Cancel]
General misconception of WILD

- **Wheel flat does not give critical alarm**
  - The visual defect does not correlate to Impact load.
  - Impact load is proportional to sharpness and depth than length.

- **WILD gives a critical alarm and nothing could be found in visual inspection**
  - The most critical defects damaging Railway assets are mostly not visible. Hence the need for WILD system.
  - The visual defect does not correlate to Impact load
  - Impact load is proportional to sharpness and depth than length

- **WILD system depends on load condition of the wagon**
  - As the system measures the impact load it directly depends on the load of the wagon
  - The system is likely to pass unloaded wagon with a defect as it produces munch lower impact loads

- **WILD system is directional dependent**
  - The above statement is not true
  - It is more a perception if the there are more loaded wagons plying in one direction than the other
Typical Hurdles in Efficient Utilization of WILD

- Trains stopping, stalling, accelerating/decelerating, braking hard on the system.
- GSM signals weak or erratic (Can be overcome by using Indian Railways’ OFC Network).
- Huge Power surges, outages
- Theft
- Non-utilisation of data trending features
- Unclear understanding of the system.
WILD Site Selection Details
Site Selection Criteria (As per Tender)

These criteria are drafted out based on the site conditions given in COFMOW’s WILD Specification no: COFMOW/IR/WILD/2006 and our recommendation.

- The system will be installed on **straight and level track of minimum 250m** length including approaches to the site.
- There **should not be any permanent speed restriction** at site of WILD system.
- The rail section shall be 60Kg/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 Railways shall ensure provision of reliable **230 V + 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.
Addional Site Selection Criteria

- 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 (Preferably TATA INDICOMM.)
- **Proper locality** to safe guard the system from Theft / untoward activities.
- At least one side of the ground area is **close to the level of Track** and soil is strong and good for earthing.
- Preferred **power connecting from OHE** through Auxiliary transformer or near by power resource from Railway infrastructure. Power taken from agriculture field will lead to lot of fluctuation and improper working.
Additional Installation Requirements

- 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 ones**.
- Railways to provide 4 nos glued joint per system. Each **glued joint to be fixed at each end** of the two instrumented rails. Railways also to ensure 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**.
# Railways Team for WILD Installation

<table>
<thead>
<tr>
<th>S. No</th>
<th>Department</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mechanical C&amp; W</td>
<td>- Owner for the system from date of receipt of material.&lt;br&gt;- Has to coordinate with other department during installation and post installation requirements.</td>
</tr>
<tr>
<td>2</td>
<td>Engineering</td>
<td>- To confirm all the site conditions&lt;br&gt;- Instrumented rail with Glued joint rail installations.&lt;br&gt;- Changing of sleepers with new ones.&lt;br&gt;- Periodic checking of pandrol clips in instrumented area.&lt;br&gt;- 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.</td>
</tr>
<tr>
<td>3</td>
<td>Operations/Traffic</td>
<td>- Blocks required during rail fixing, Proving out test and routine calibration</td>
</tr>
<tr>
<td>4</td>
<td>S&amp;T/TRD</td>
<td>- To ensure track continuity is there after installation of glued joint rail</td>
</tr>
<tr>
<td>5</td>
<td>Security</td>
<td>- Security for the materials and people who install the system.</td>
</tr>
</tbody>
</table>
Thank You