WHEEL IMPACT MONITORING AND OVERLOAD DETECTION

TLC ENGINEERING SOLUTIONS (Pty) Ltd

Causes Of Wheel Impacts

- Damaged Wheels on Rolling Stock
  - Spalling
  - Shelling
  - Skids
- Defects occur due to
  - Overloading
  - Bad Quality Practices of Operators
  - Defective Braking Systems

Effects of Wheel Impacts

- Reduced Life of Wheel
- Reduced Life of Suspension System
- Reduced Life of Bearings
- Reduced Life of Rail Infrastructure
- Reduced Ride Quality – Passenger Discomfort
- Increase in Fuel (or Electricity) Consumption
- Severe Safety Threat

Effects From Wheel Impacts – Infrastructure Damage

- High rail stresses
- Accelerated rail flaw development
- Cracking of sleepers
- Ballast crushing
- Ballast flow
- Noise pollution
- Fatigue and damage to bogies - especially under high axle loads

Implications of Replacing Damaged Wheels

- Disruptive to Operations Flow
- Loss of Revenue during Repair Time

Implications of not Changing Damaged Wheels

- Damage to Rail
  - Damage occurs on every wheel rotation
  - Accelerated rail flaw development
- Damage to Track Structure
  - Impacts transmitted via rail to ballast and subgrade
    - Cracking of sleepers
    - Ballast crushing
    - Ballast Flow
- Damage to Journal Bearings
- Damage to Suspension
- Increased Fuel (or Electricity) Consumption

When to Change Wheels

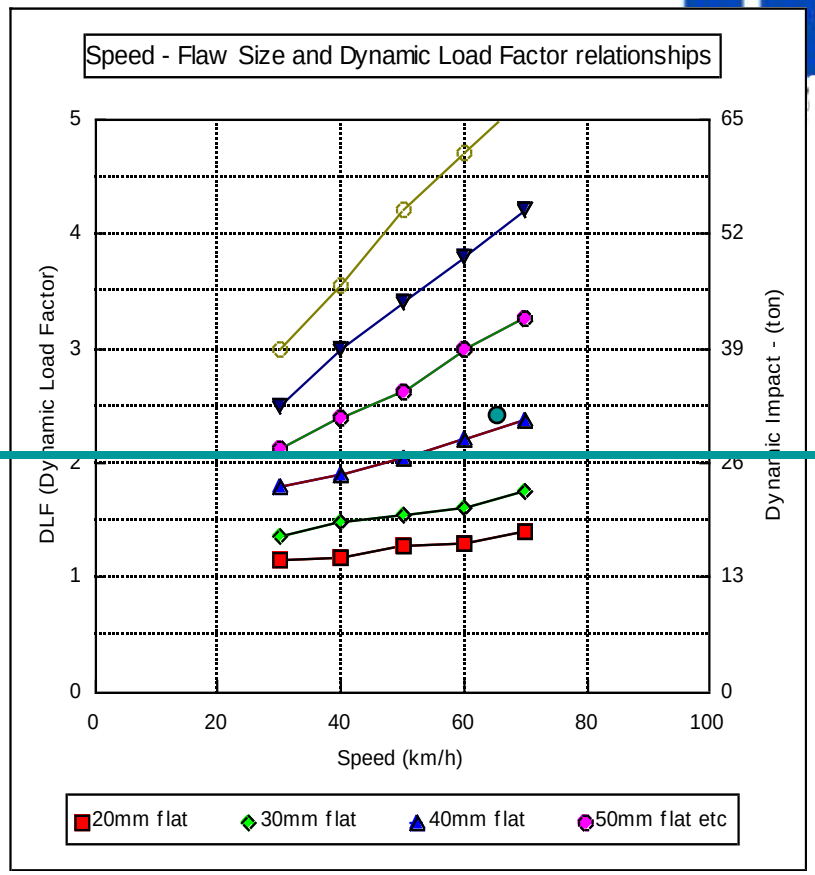
- Study by the American Association of Railways (AAR):
  - Incremental Cost/Benefit curve shows positive cost savings when wheel impacts exceed 38 tons
- Spoornet (South Africa) recommends
  - reconditioning / replacement for impacts exceeding 28 tons

Wheel Impacts

Maintenance Intervention for 26 ton/axle

Impact value dependant on

- Speed
- Size
- Depth - not really length
- Age - roll out of flaw
- Reject level based on induced stresses with respect to sleeper stress (11.5MPa on slp centre)



WIM-WIM SYSTEM

- System configuration
  - Strain gauge based
  - 13 measuring points per rail for wheel impacts based on new 915mm wheels (Can be expanded to more than 16)
  - 1 to 3 measuring points per rail for lateral forces
- Standard computer technology
  - Intel Pentium processor
  - 512 Mbyte Memory
  - Windows XP Operating System

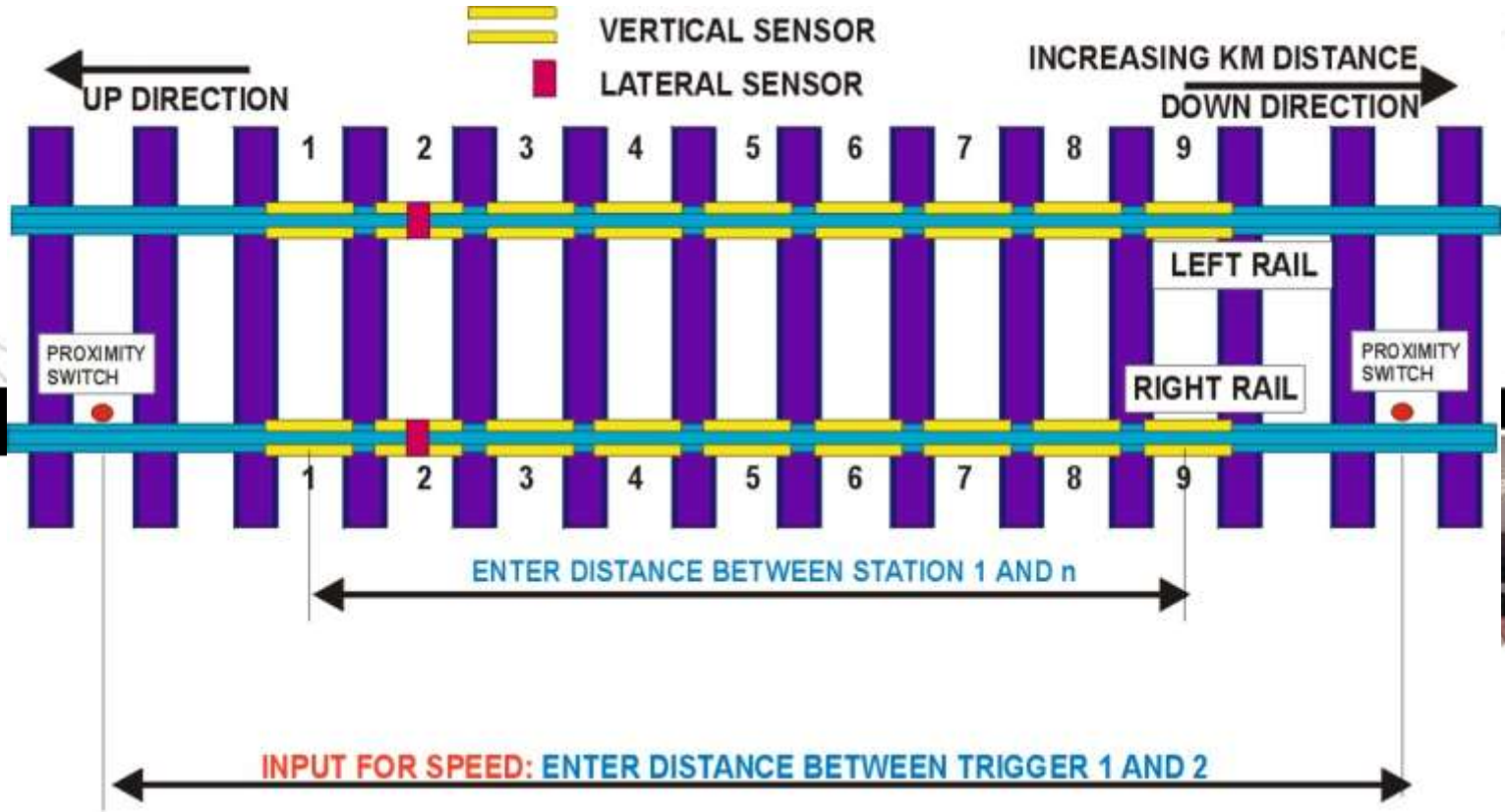
How are Wheel Defects Detected ?

- Wayside Monitoring Equipment is installed at strategic points in the rail network for maximum system coverage (**WIMWIM** System)
- Data from the monitoring points are communicated to a central point using ITCMS
- Reports are produced allowing management of the output
  - Invisible to the operation
  - Installed without Major Disruption to Traffic
  - Sites Strategically placed for max. Coverage

WIMWIM System - Overview

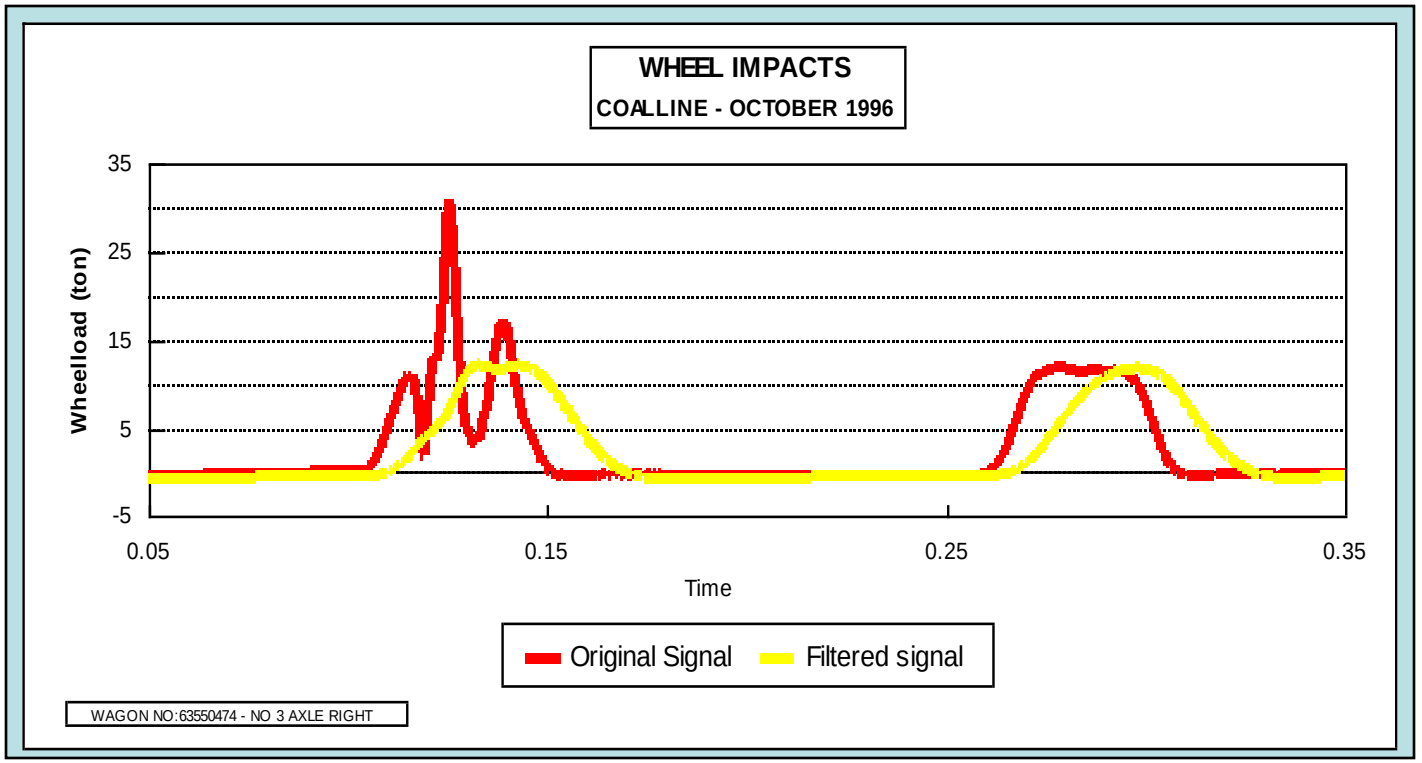
- STRAIN GAUGES – Measurement of Principal Strains
- Similar system also known as WILD systems - USA & Britain
- Advantages
  - No expensive calibration methods
  - Relatively cheap and fast repairs
  - Longer Cabling
  - Detect out-of-round wheels
  - Outputs in understandable engineering units
  - Doubling as an in-motion weigh bridge
- Disadvantages
  - Initial expensive cost. Higher Wheel Coverage requires more sensors
  - Prone to lightning strikes. WimWim has extensive lightning protection hardware.

Site Layout And Configuration



Concept Of Wheel Impact Detection

- Signal of wheel impact and normal wheel



- Signal is filtered and compared to original signal

Wheel Defect Types

What the system Detected:

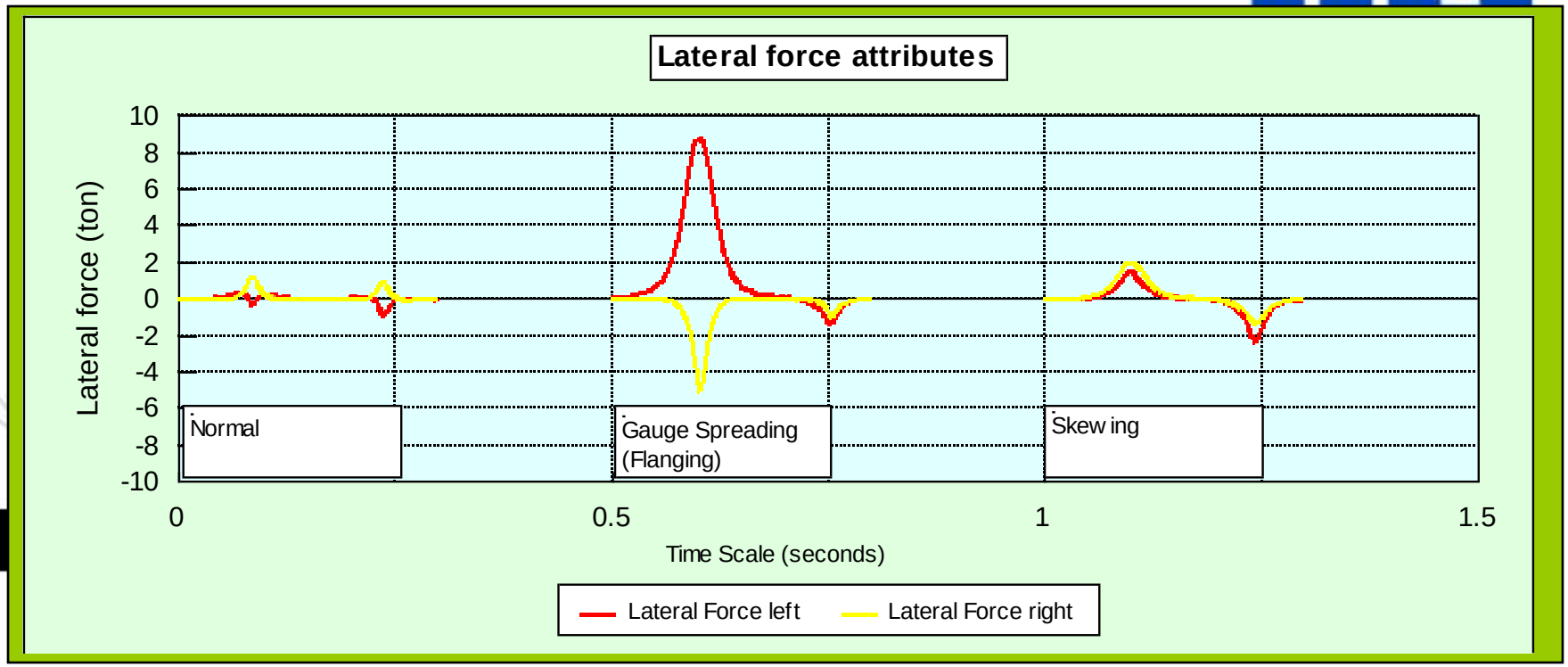
What that Skid Caused

Collapsed Suspension

Skew Bogie Detection

- Identifies bogies that track skew
- Signal generated from web of rail
- Not sensitive to position of vertical load on head of rail
- Elimination of accelerated flange and wheel wear

Interpretation Of Signals For Bogie Analysis



Normal Flanging Skewing

In-motion Mass Measurement

- The WIMWIM system is able to weigh cars to an accuracy of better than 2% when calibrated.
- Total train mass is better than 0.5%.
- Calibration of such a system showed the following statistics.
- The test was done with 6 vehicles weighing more than 100 ton,
- 8 vehicles weighing 75 to 90 ton and
- 6 vehicles weighing less than 70 ton.
- Ten runs were made in both directions at varying speeds.

Typical In-motion Weighing Statistics

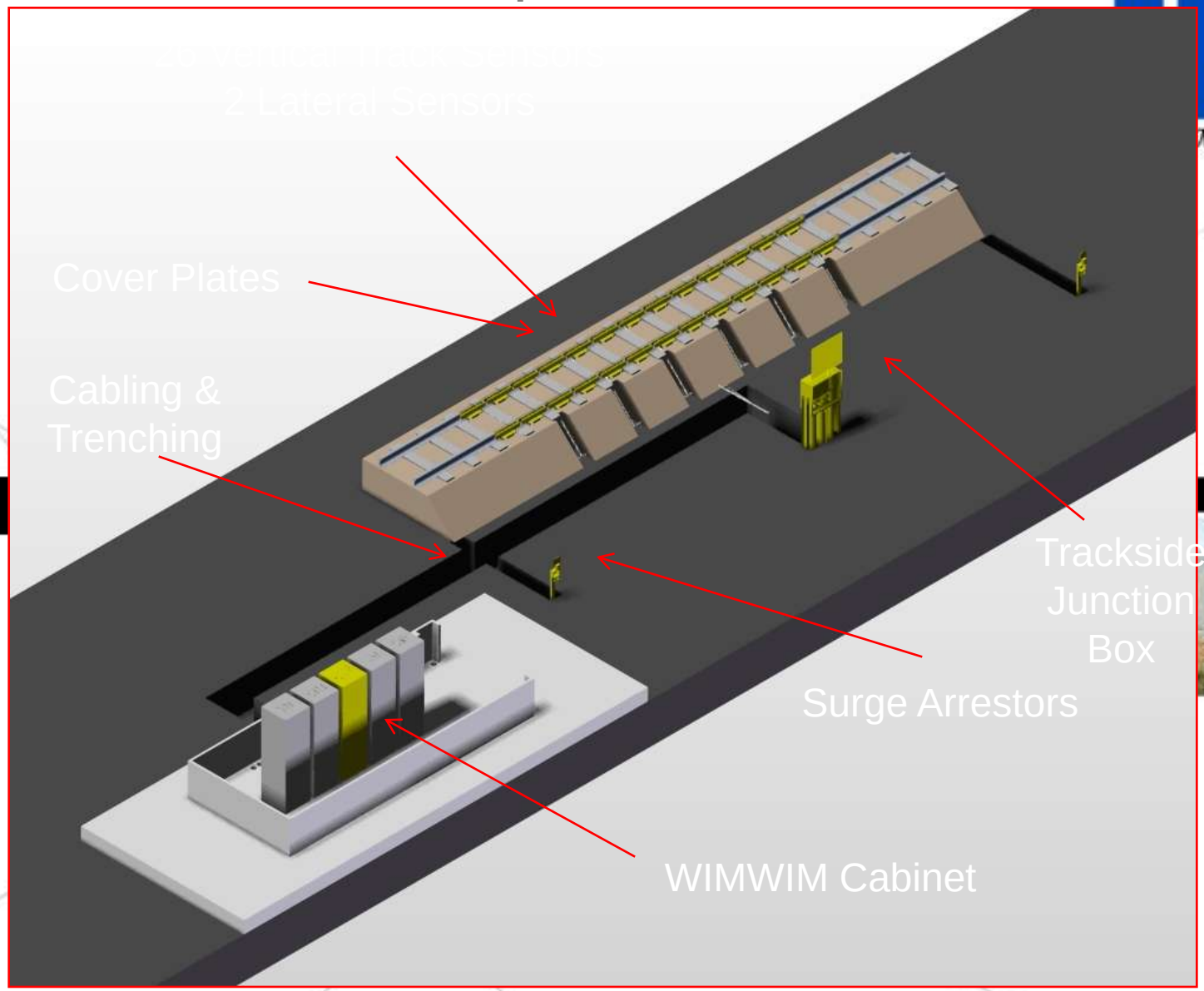
(26 Ton axles with good wheels)

Error category	Total	% of total	
No of samples	180	100	
Exceeding 2%	1	0.6	
Exceeding 1%	4	2.2	
Better than 1%	176	97.8	100
Better than 0.5%	124	68.9	90
Better than 0.3%	90	50.0	60

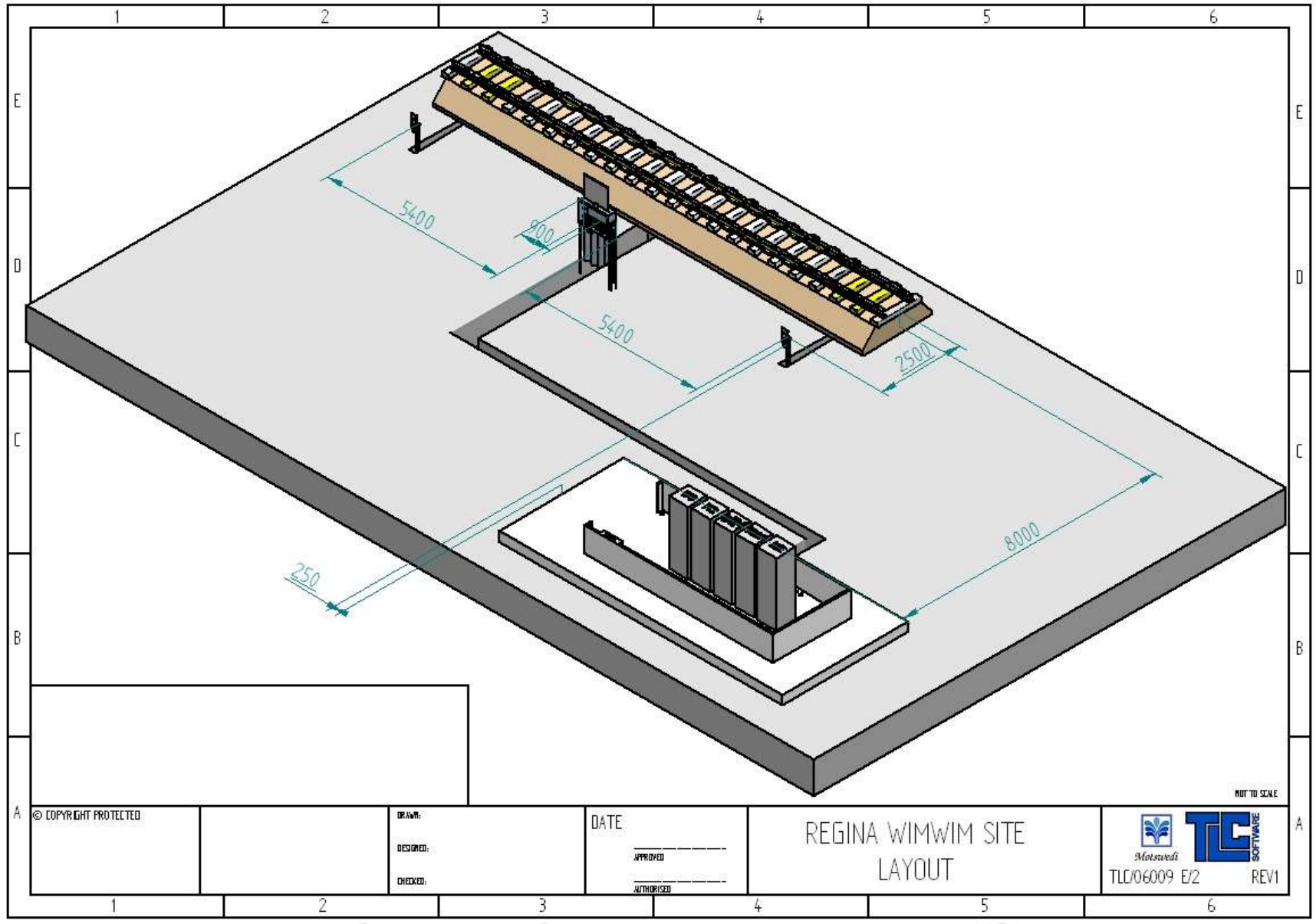
WIMWIM vs SkewBogie

- WIMWIM
  - Wheel Impacts
  - Skew & Flanging Bogie
  - In Motion Weighing (Non-Assized) for Overloads
- Skew Bogie
  - Skew & Flanging Bogie

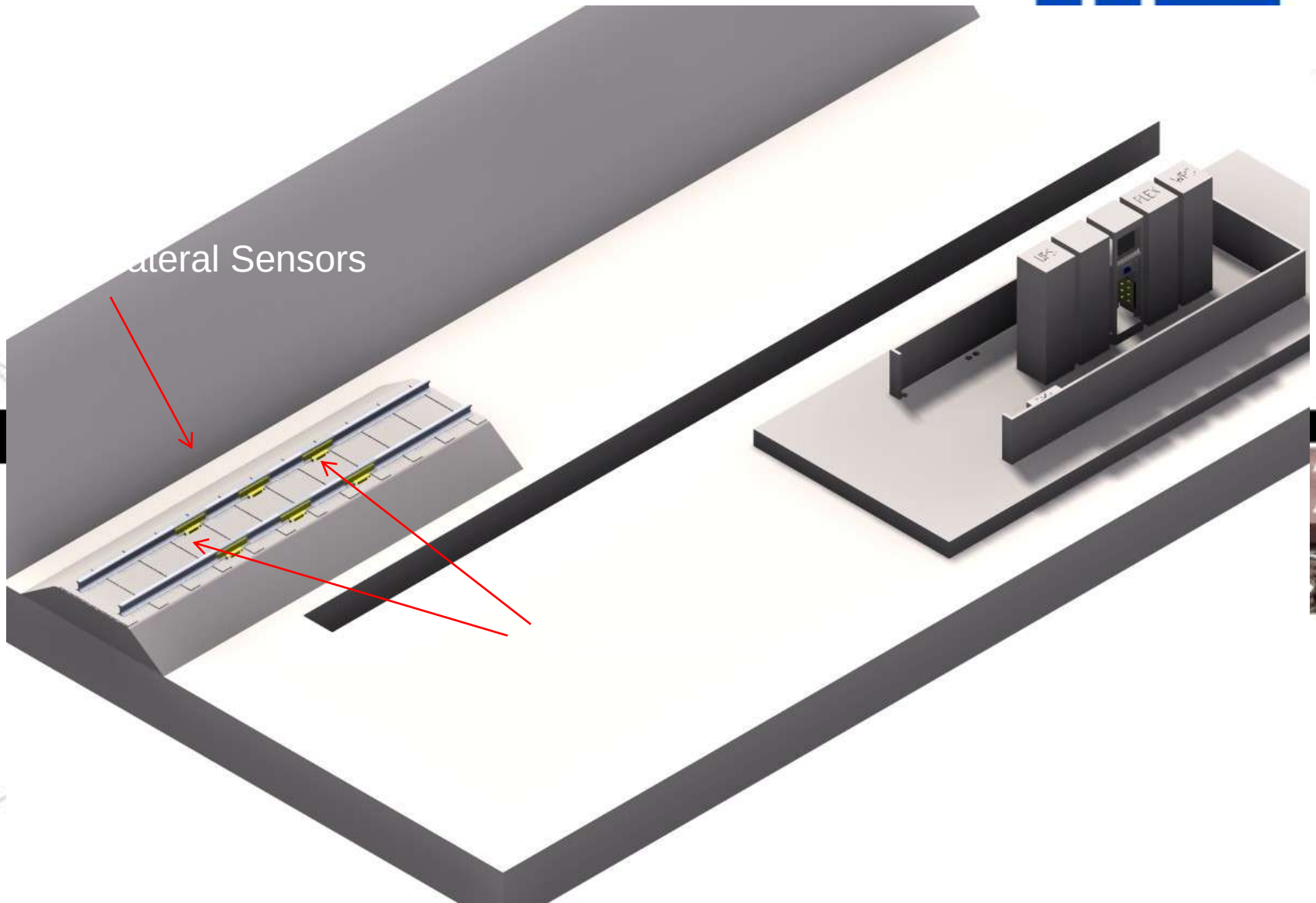
WIMWIM Site Components



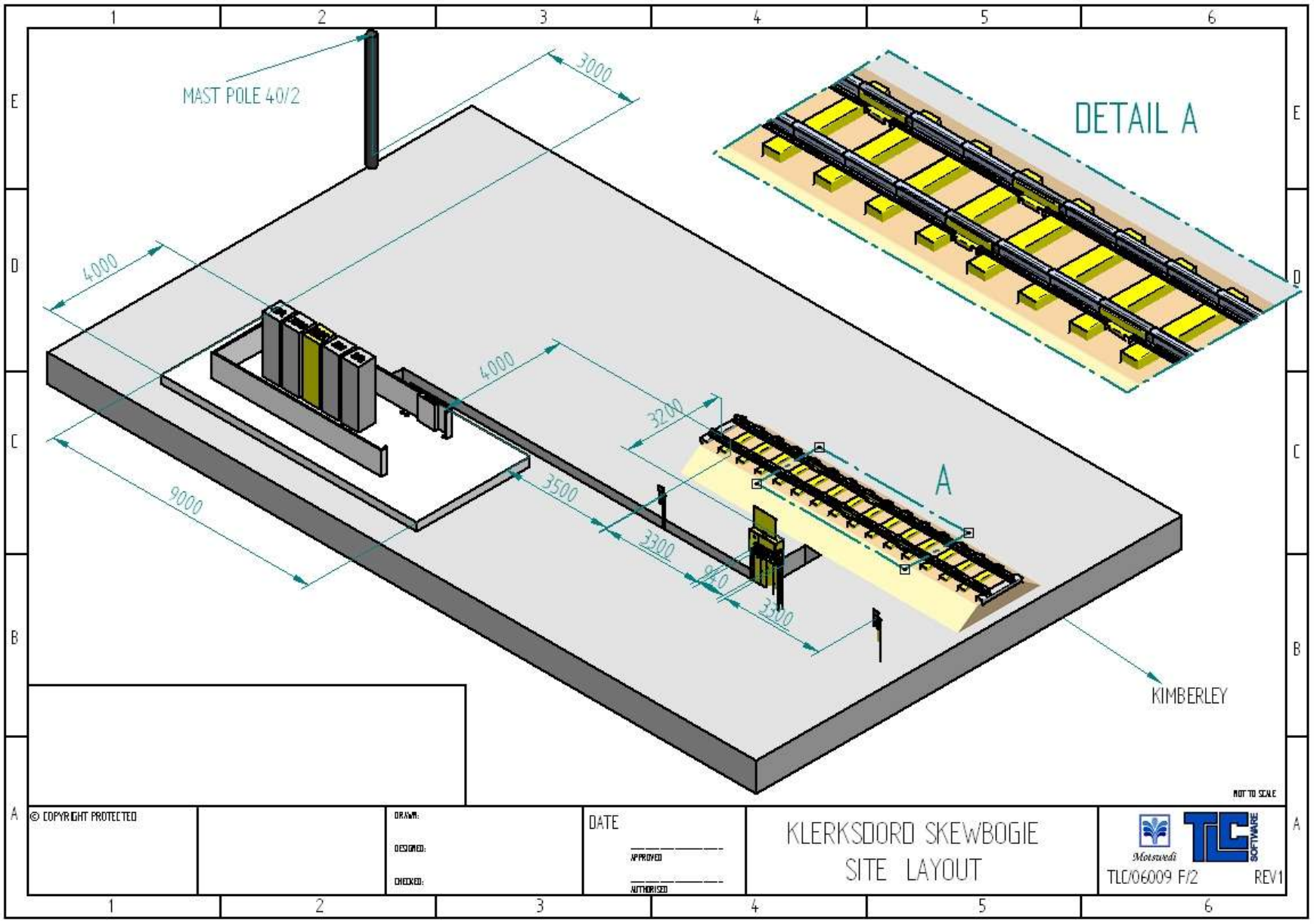
WIMWIM Site Layout



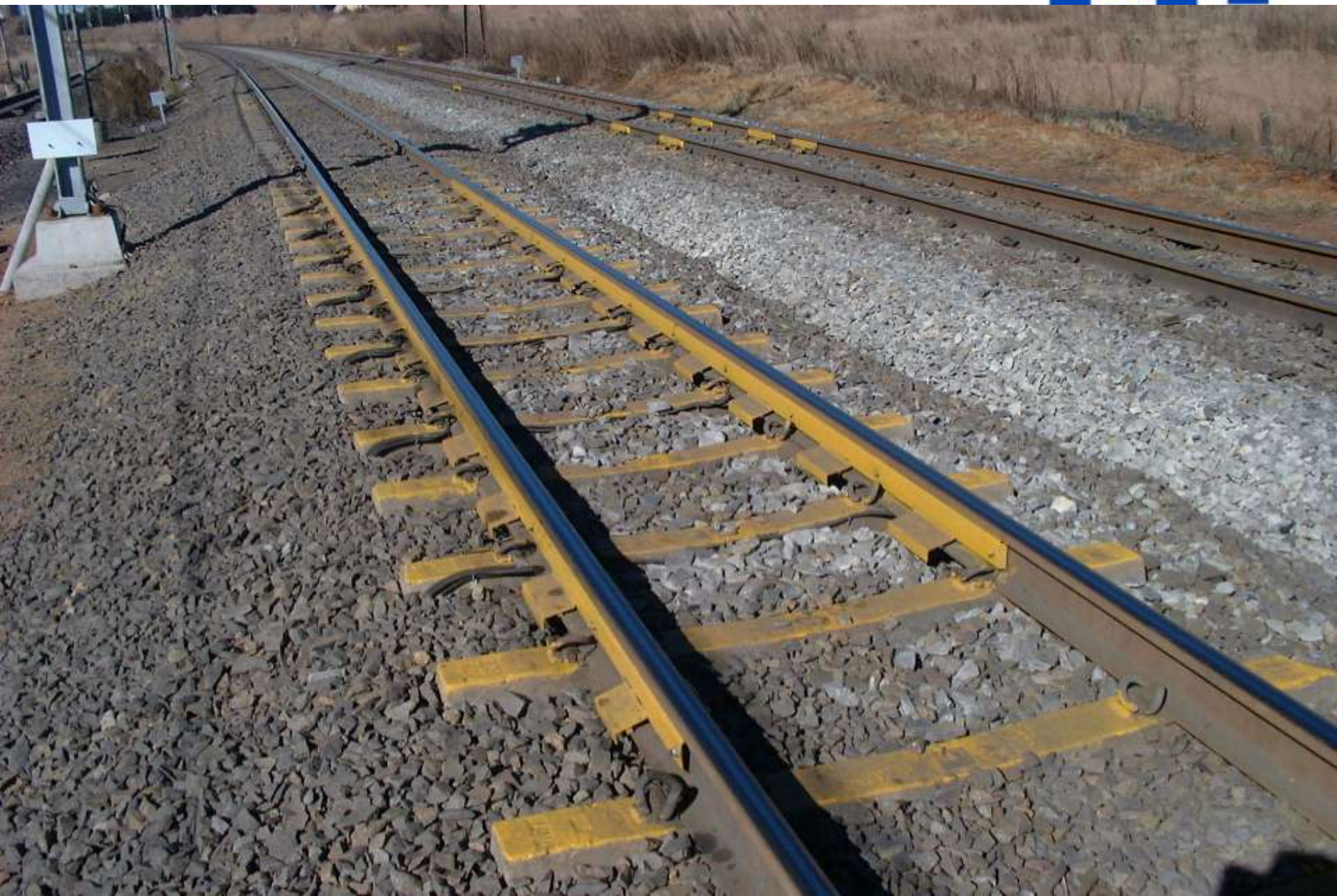
SkewBogie Site Components



SkewBogie Site Layout

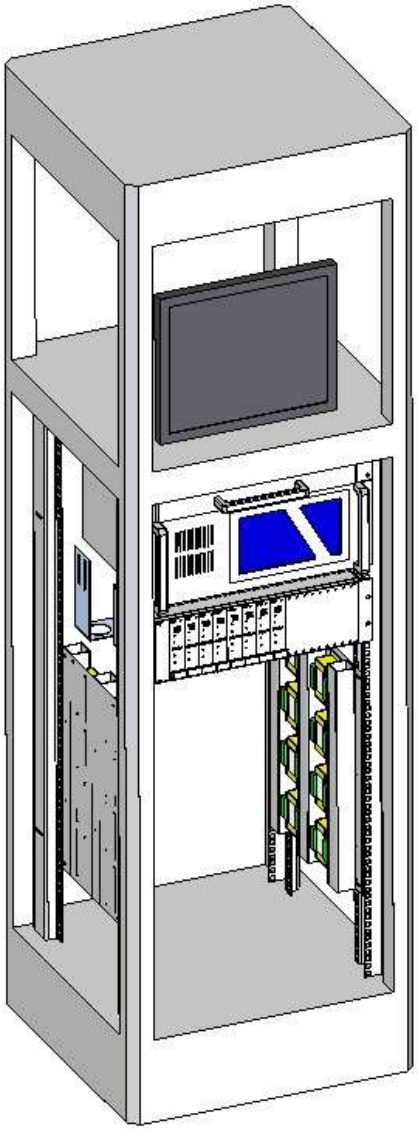


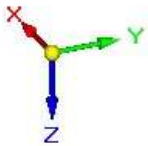
WIMWIM Installation Track Mounted Equipment



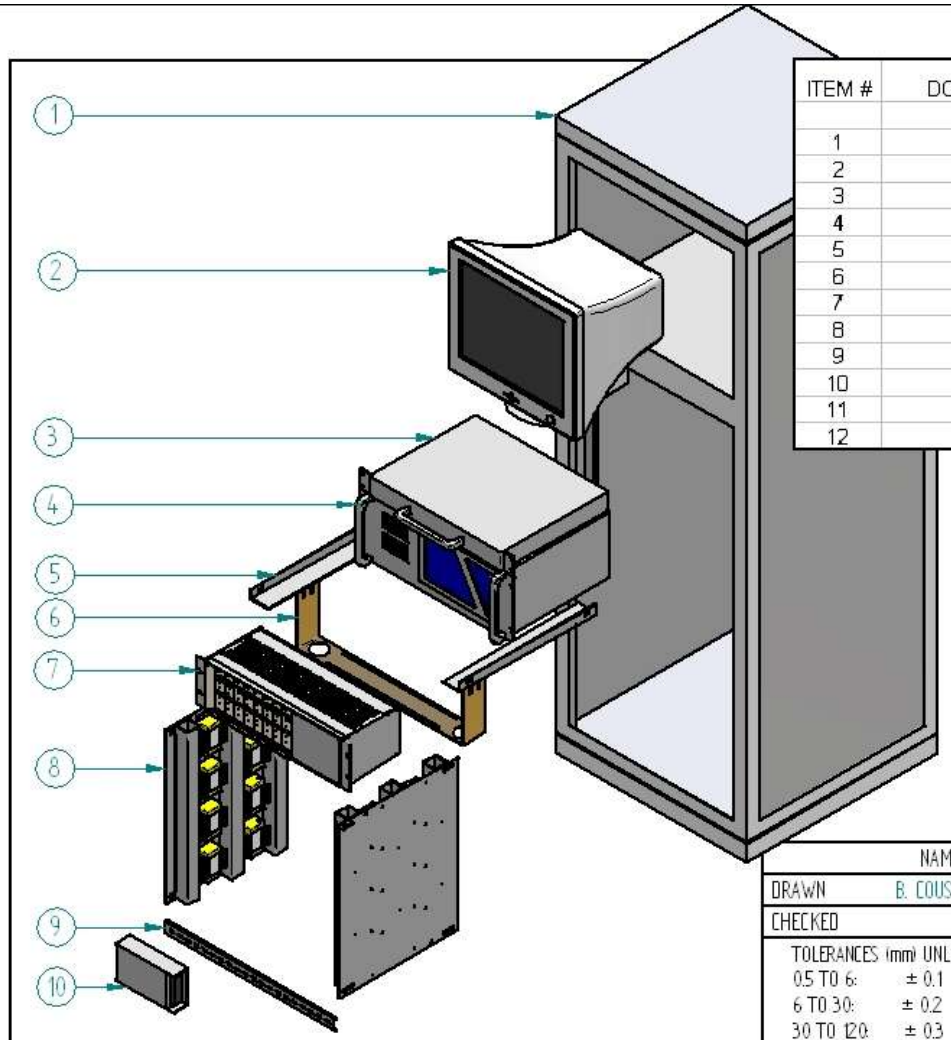
Track Sensors

Container Equipment





19” Instrument Cabinet



ITEM #	DOC #	TITLE	MATERIAL	QUANTITY
1		38U RACK		1
2		PC MONITOR		1
3		KEYBOARD TRAY		1
4		INDUSTRIAL PC & NI CARD		1
5		PC BRACKET	430mm	2
6		WIRING BRACKET		1
7		SGA RACK		1
8		LIGHTNING PROT. ASSM.		2
9		DIN RAIL	530mm	1
10		POWER SUPPLY		1
11				
12				

	NAME	DATE
DRAWN	B. COUSINS	09/28/06
CHECKED		

TOLERANCES (mm) UNLESS STATED:
0.5 TO 6: ± 0.1
6 TO 30: ± 0.2
30 TO 120: ± 0.3
120 TO 315: ± 0.5
315 TO 1000: ± 0.8
1000 TO 2000: ± 1

MOTSWEDI TLC (PTY) LTD

TITLE: WIM WIM RACK GA

SIZE	PROJECT NO:	REV
A4		1

FILE NAME: full2.dft

SCALE:	WEIGHT:	SHEET 1 OF 1

WIMWIM Rack Equipment

Lightning Protection

WIMWIM Installation
Analysis Computer

CONCLUSION

- Wheel Defects can easily be detected
- Timeous Repair of Defects saves
  - Track
  - Suspension
  - Bearings
- therefore Money and Lives

Contact Details

For more information contact:

TLC ENGINEERING SOLUTIONS (Pty) Ltd

Web: www.tlc.co.za

E-mail: sales@tlc.co.za

Office: +27-11-463-3860

Fax: +27-11-463-2591