TATA STEEL

TATA

Improving Mine Haul Roads by Using Advanced Instrument to Measure Haul Road Parameters

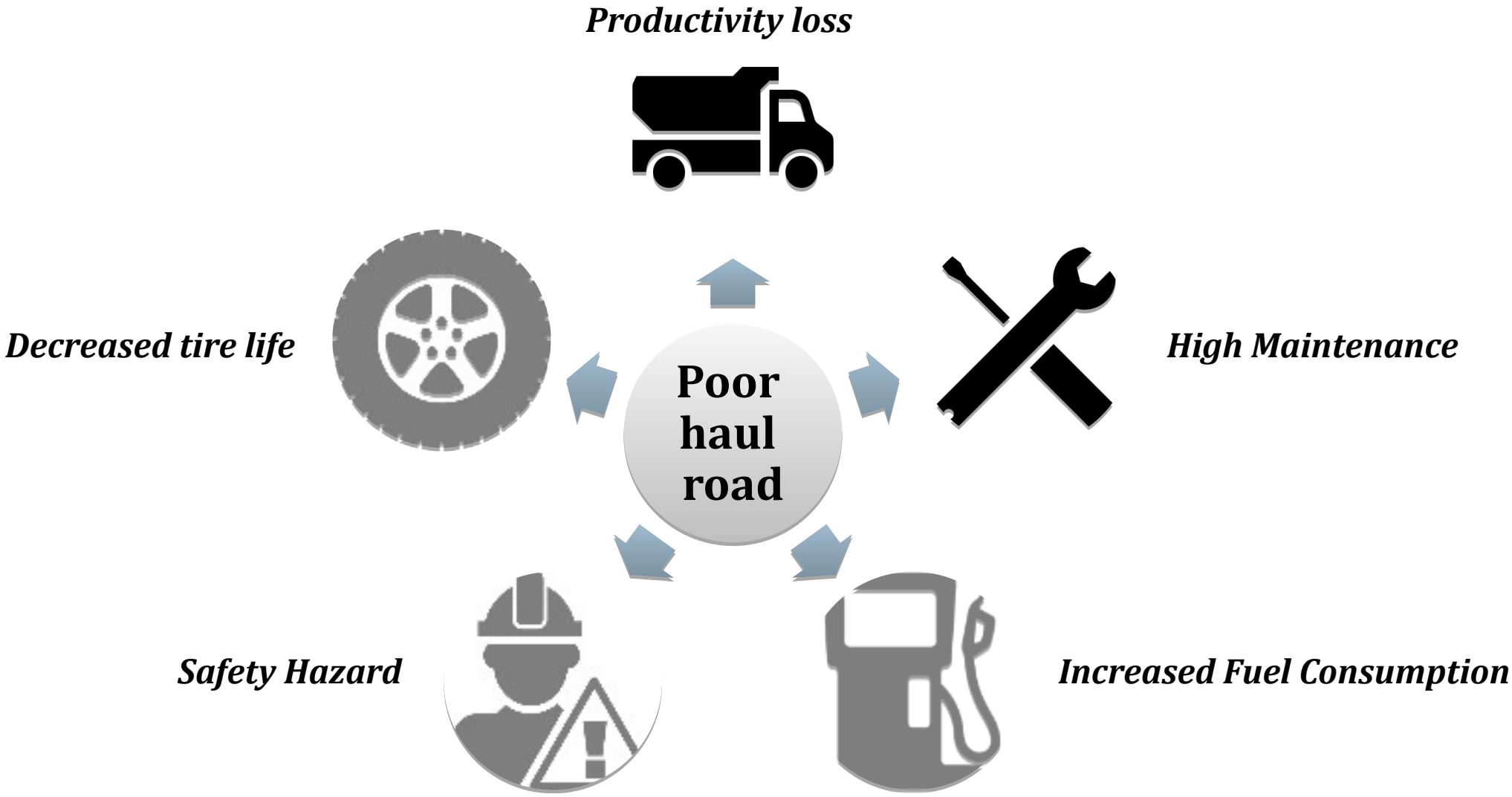
Alok Baranwal
Tata Steel

The haul road is either the mine's greatest asset or greatest liability

More than 50% of mining costs are associated with material loading and hauling out of pits. That translates into a significant opportunity to realize cost savings through improved haul road performance

TATA STEEL

Poorly designed and maintained haul roads can lead to:



Measurement is the first step that leads to control and eventually to improvement. If you can't measure something, you can't understand it. If you can't understand it, you can't control it. If you can't control it, you can't improve it.

H. James Harrington

Haul Road Parameters that should be measured

- **Grade - Smooth, constant grades**
- **Width - Determined by vehicle size and traffic**
- **Cross falls - minimum slope for drainage**
- **Curve radius and Superelevations – based on the speed**
- **Rolling resistance**
- **Road friction**

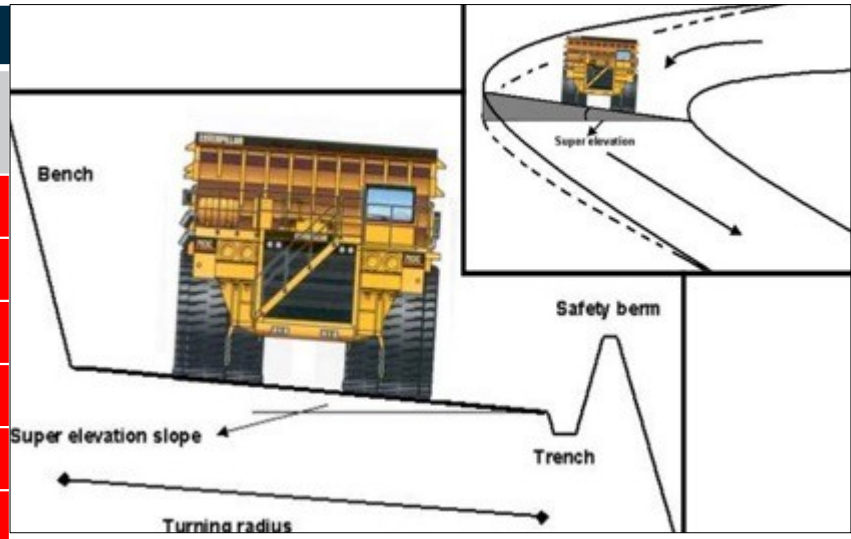
Existing system at Tata Steel Mines

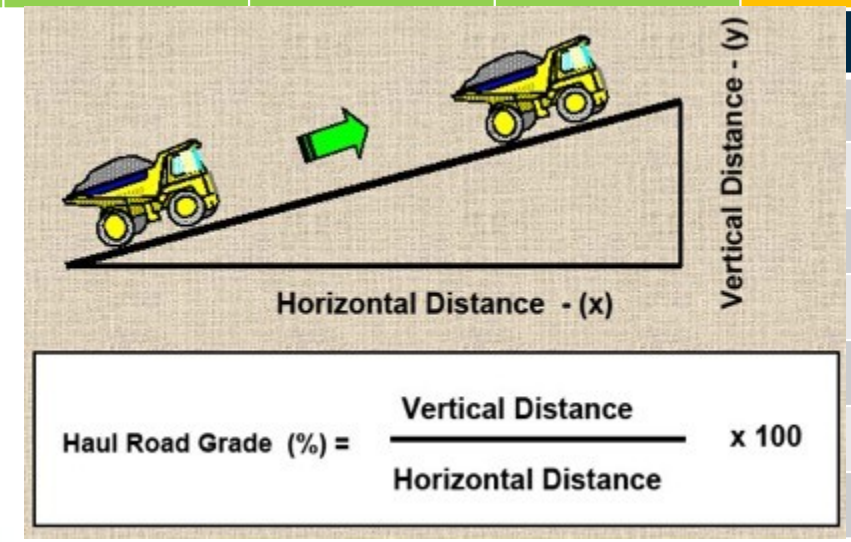
- **Overall gradient is measured**
- **Superelevation and curve radius is measured at the time of designing**
- **Rolling resistance and road friction is not measured but grader and compactor is used to improve it**

Benchmark Value

Recommended Superelevation

T (m)	Speed (km/h)					
	16	24	32	40	48	56
30	7%	15%	27%	-	-	-
45	4%	10%	18%	28%	-	-
60	3%	8%	13%	21%	30%	-
90	2%	5%	9%	14%	20%	27%
150	1%	3%	5%	8%	12%	16%
215	1%	2%	4%	6%	9%	12%
300	1%	2%	3%	4%	6%	8%





Recommended Gradient

Road Type	Maximum grade (%)
Permanent Surface haul roads	7
Permanent in pit haul roads	10
Temporary surface haul roads	7
Temporary in pit haul roads	10
On-bench roads	10
Light vehicle roads	20
Major bends	0

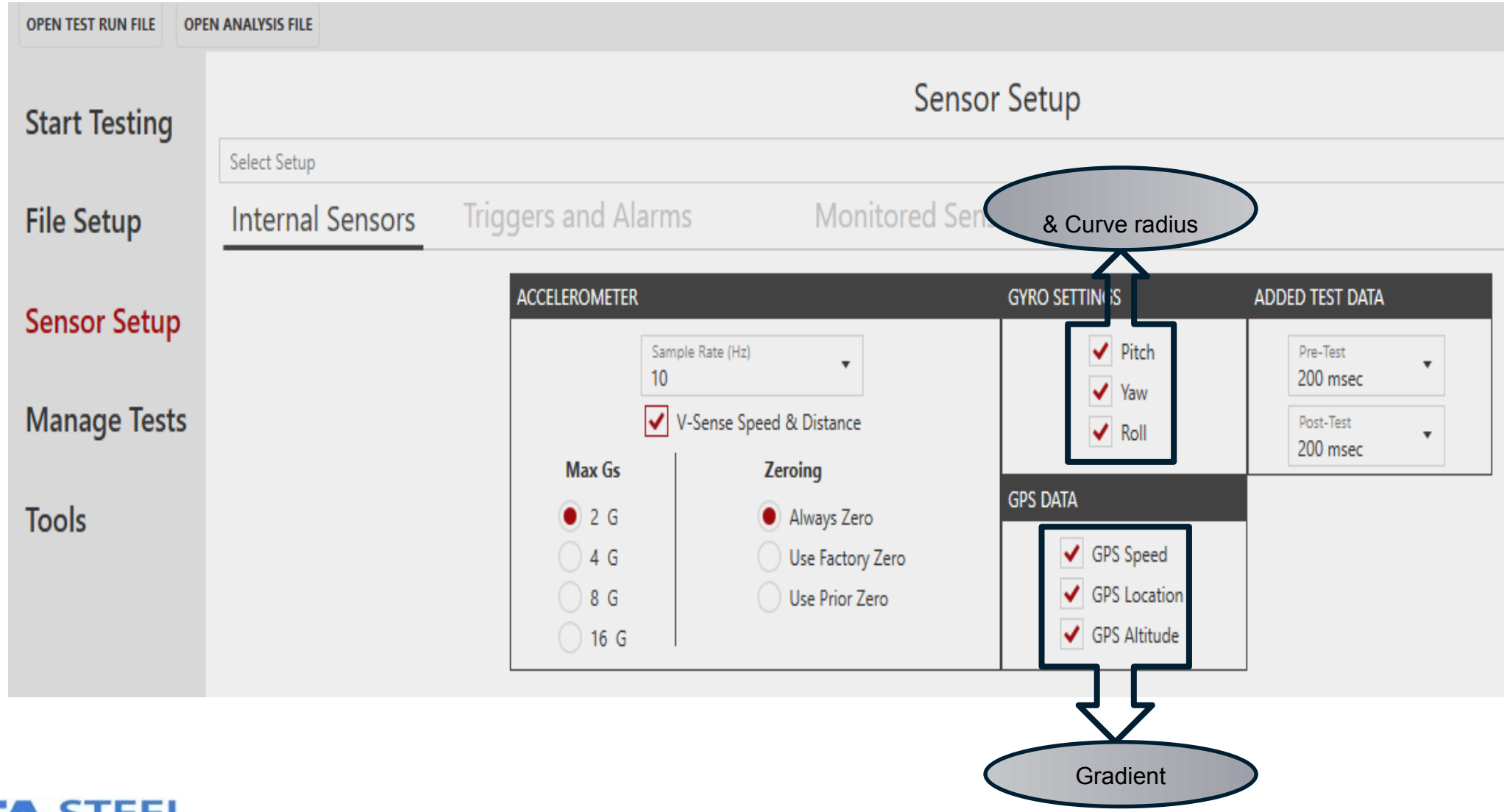
Source: mininginfosite/miner-s-toolbox/materials-handling/truck-haulage/haul-road-design-guidelines

Advance tool to measure haul road parameters

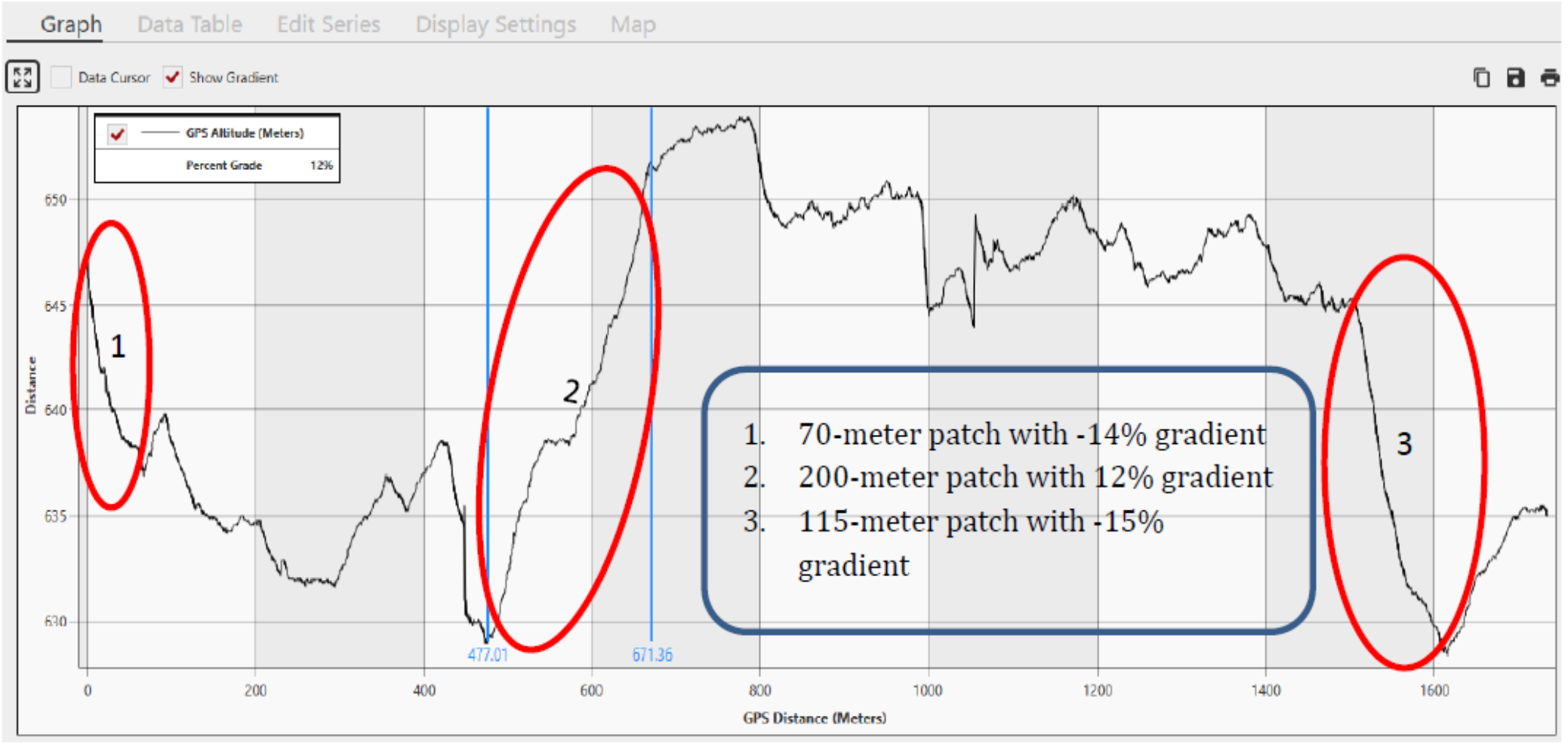
- **Haul road Gradient**
- **Rolling resistance**
- **Superelevation & curve radius**
- **Road friction (dust suppression)**

It has full 9-axis sensors (accelerometer for x,y,z; gyro in all dimensions, and magnetometer). It also includes internal GPS.

How to capture data



Gradient Measurement



Gradient Measurement

Data for different haul roads (Coal & Iron ore)

Coal Mine

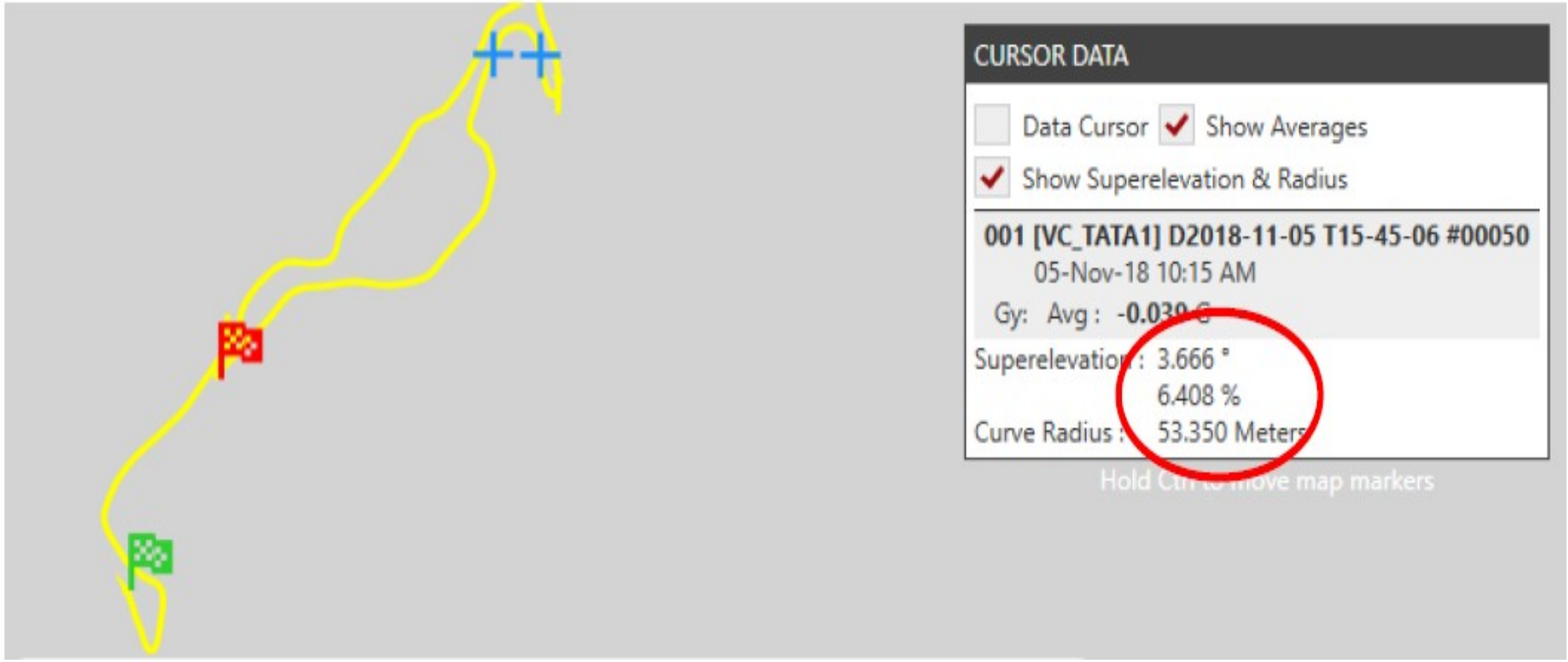
Length (m)	Overall gradient (%)	Length with gradient (>+/-8% and <+/-15%)	Length with gradient (>+/-15%)
750	4	135	124
915	-2	205	26
2700	3	1095	20
2050	5	487	75
510	-6	250	0

Recommended value is 7%

Iron ore Mine

Length (m)	Overall gradient (%)	Length with gradient (>+/-8% and <+/-15%)	Length with gradient (>+/-15%)
1835	3	310	115
1210	-4	163	205
2250	2	235	200

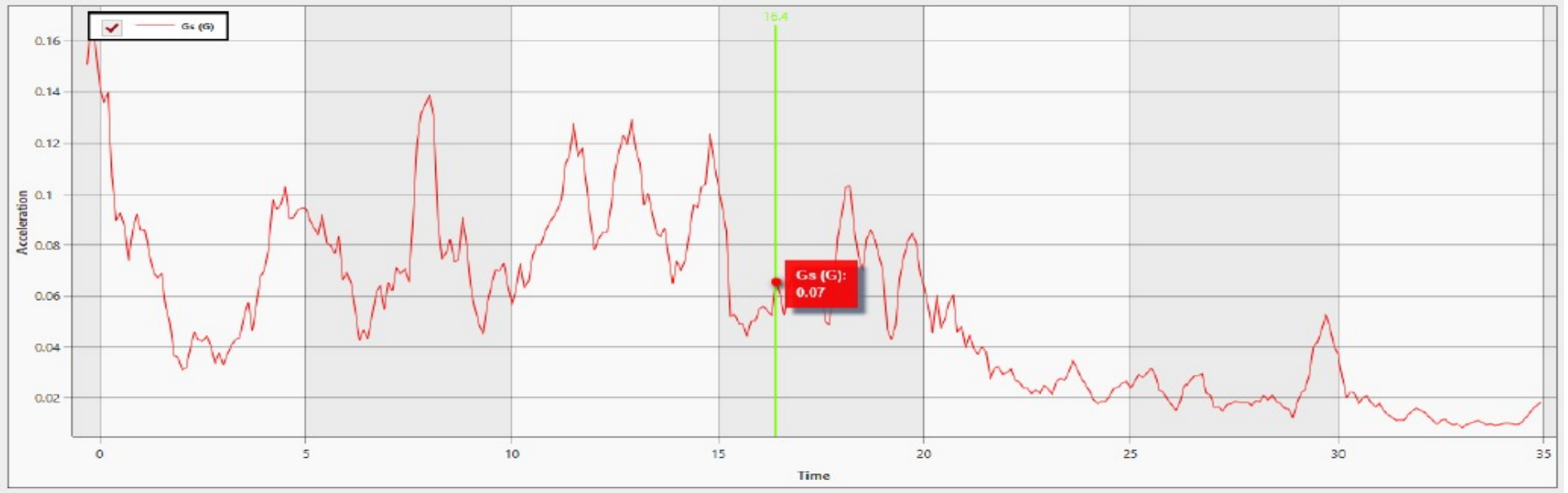
Superelevation and Curve radius

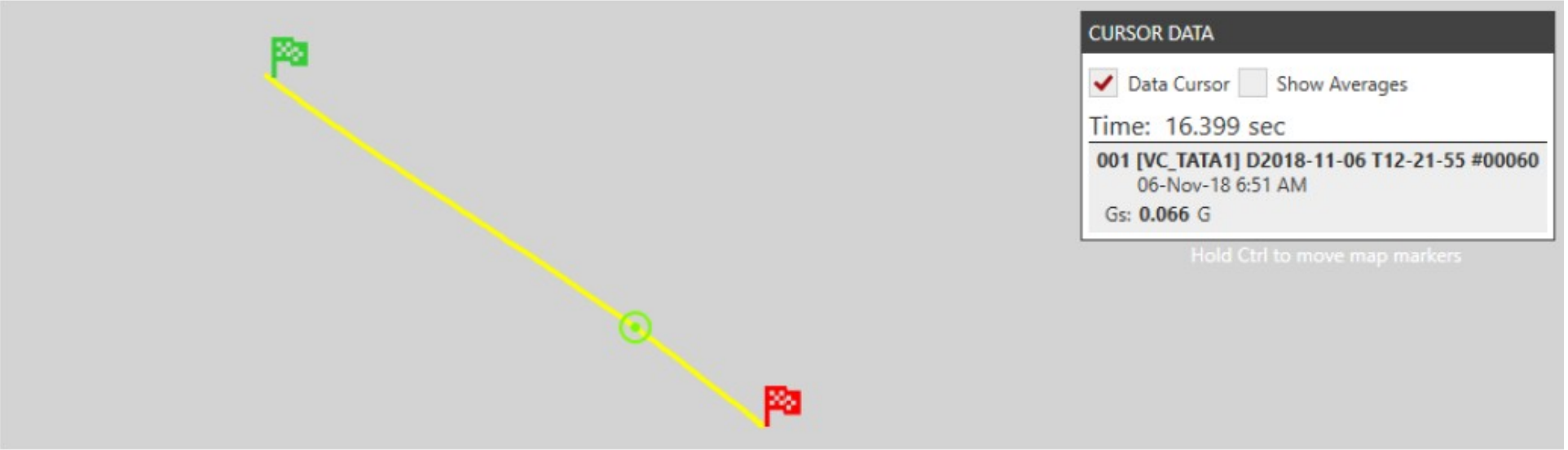


Data for different haul roads (Coal & Iron ore)

	Curve/Turn Radius	Superelevation (degree)	Superelevation (%)
Haul road 1	71.0	3.0	5.3
Haul road 2	23.0	17.0	30.7
Haul road 3	22.7	6.4	11.2
Haul road 4	26.0	15.3	27.3
Haul road 5	18.0	7.0	12.3
Haul road 6	48.9	6.9	12.0
Haul road 7	53.4	3.7	6.4

Rolling Resistance





Solution to improve haul roads

- **Re-designing of haul roads as per the recommended gradient and turn/curve radius**
- **Increased utilization of graders and compactors in critical area**
- **Introduction of advance dust suppression methodology: automated sensor based water sprinkling system, chemical/organic additive**
- **In rainy season, water drainage should be maintained**

Conclusions

- **Measurement of gradient, curve radius and superelevation can be done in 1-pass with 1-person**
- **Rolling resistance measurement of each point**
- **Brake test can be done separately**
- **Targeted maintenance can be carried out by prioritizing the critical area**
- **New haul roads can be designed in accordance with the recommended value**

Thank you !

.... Questions ?