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Guard Rail and Point Asset Inspection Technology to Reduce Risk



SEATTLE, WA

WRI2025RT



RAIL TRANSIT SEMINAR



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2025

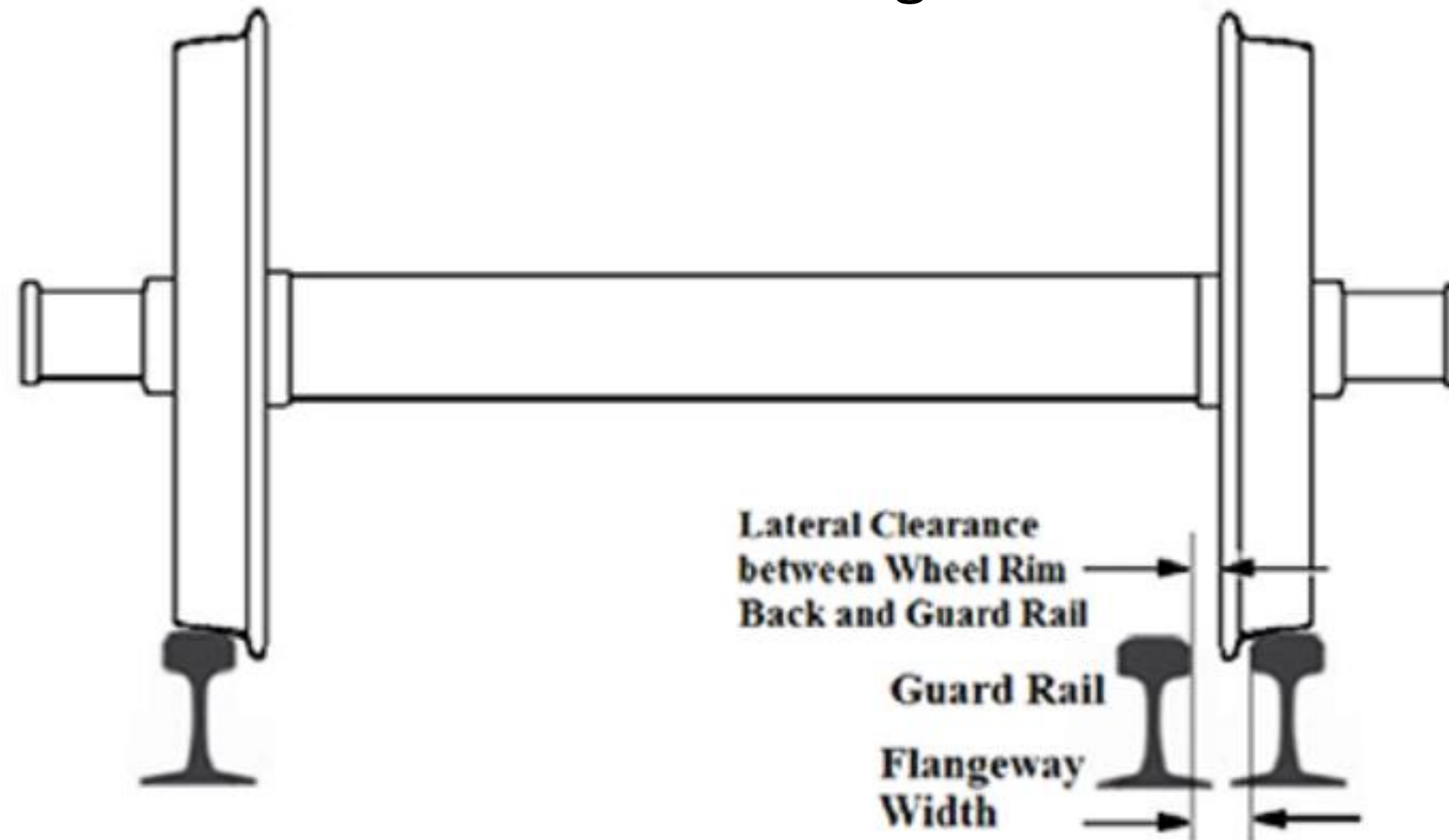


What is a Flangeway

- Flangeway is the gap between the gage point of the running rail and the guard rail
- The gap is typically between 1.5 and 2.25 inches wide
- The gap must be tight enough to fulfill its purpose of restricting wheel climb in curves or provide nose protection in turnouts
- The gap must be wide enough to allow for limited lateral free movement of the wheel
- The guard rail must be high enough to prevent the flange climbing up

Flangeway Example

This graph shows a wheelset on a track with a guard rail



Source: Centre for Railway Engineering, CQUniversity, Rockhampton, QLD, Australia

Nomenclature

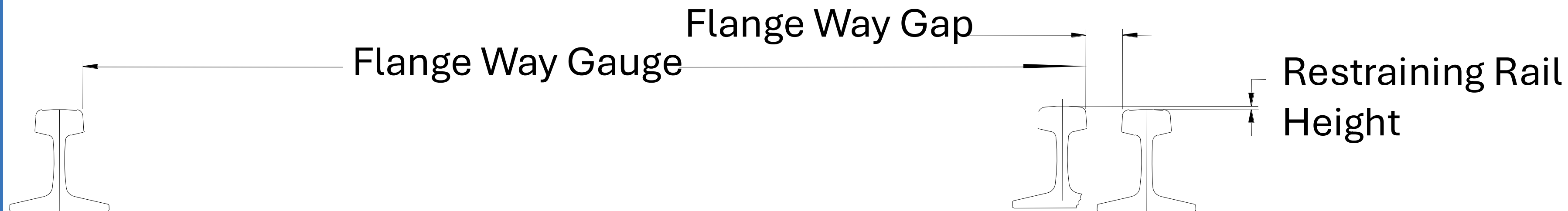
- There are different expressions in use:
 - Flangeway
 - Gap
 - Guard Rail Gap
 - Guard Rail Clearance
 - Flange Gap
 - Flange Clearance
 - Flange Passage
 - Check Rail Gap



Flangeway Dimensions

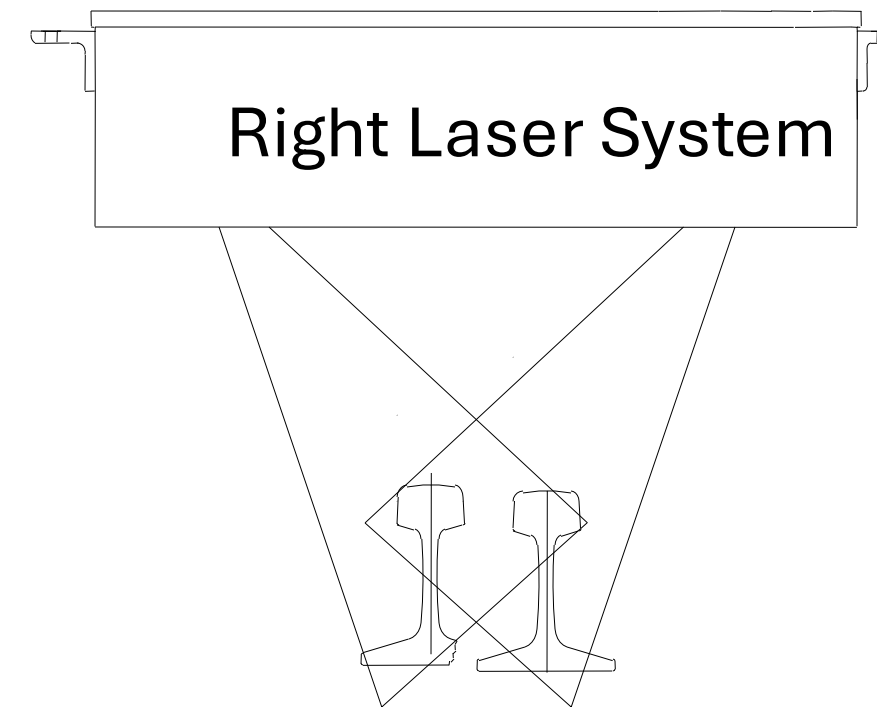
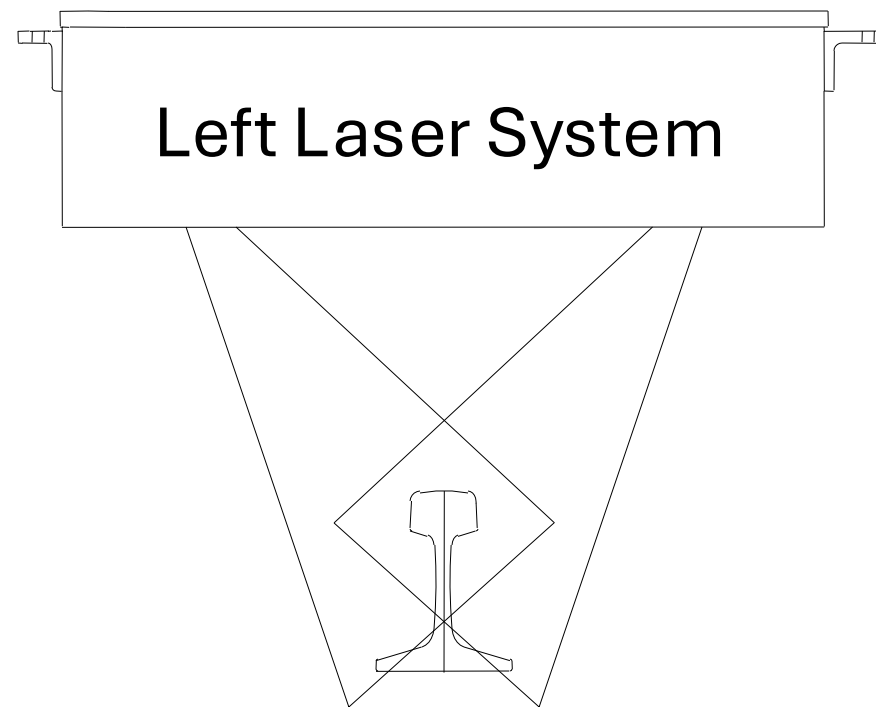
The three typical Flange Way measurement parameters are:

- Flangeway Gauge (also called “Guard Gauge”)
- Flangeway Gap
- Restraining Rail Height



Flangeway Measurement

Flangeway is measured with the Rail Profile Measurement System
Flangeway Parameters are in addition to rail profile parameters
In turnout areas, sampling frequency can be increased to capture beginning and end dimensions in a finer roster

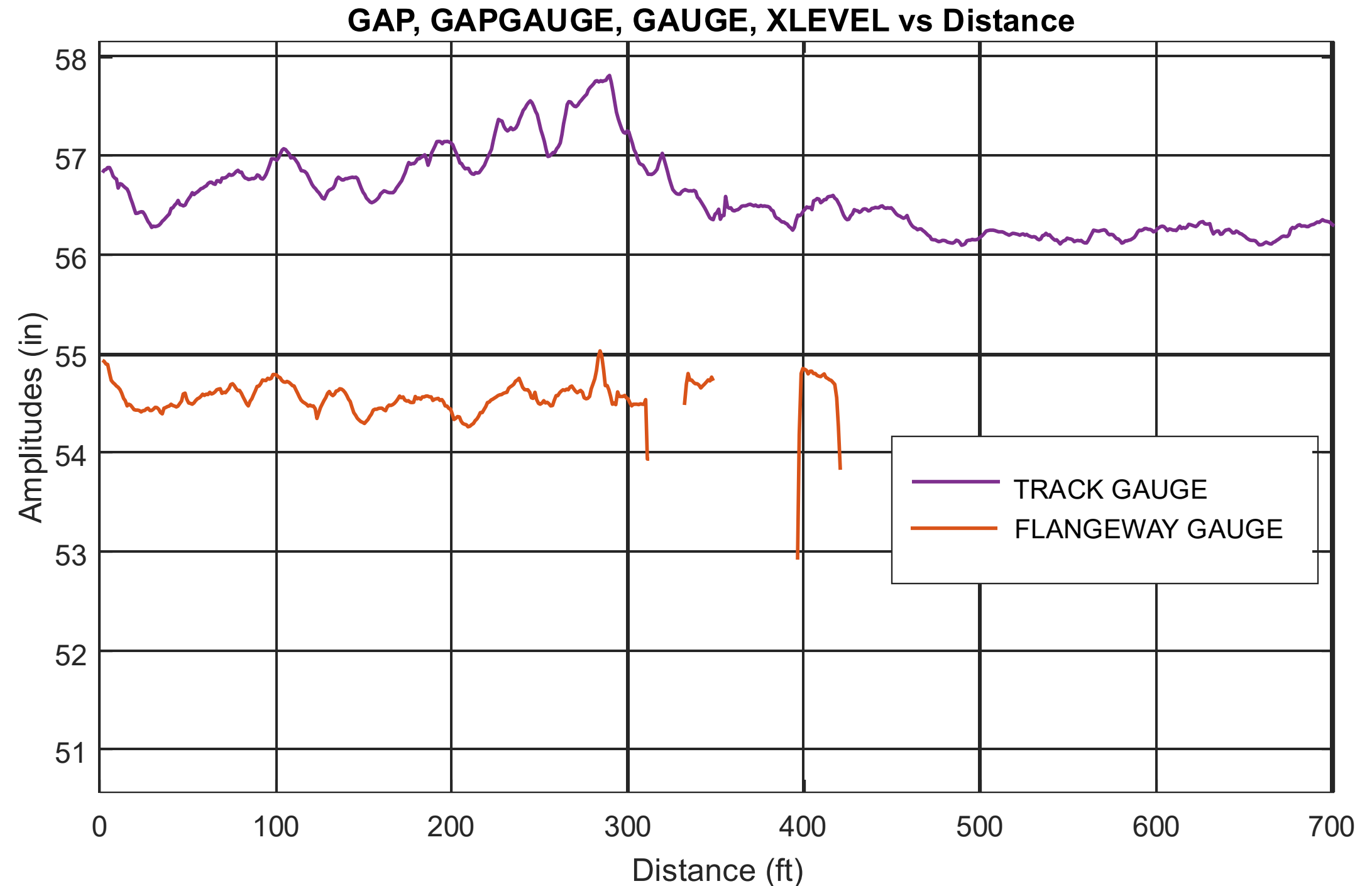


Flangeway Measurement Example



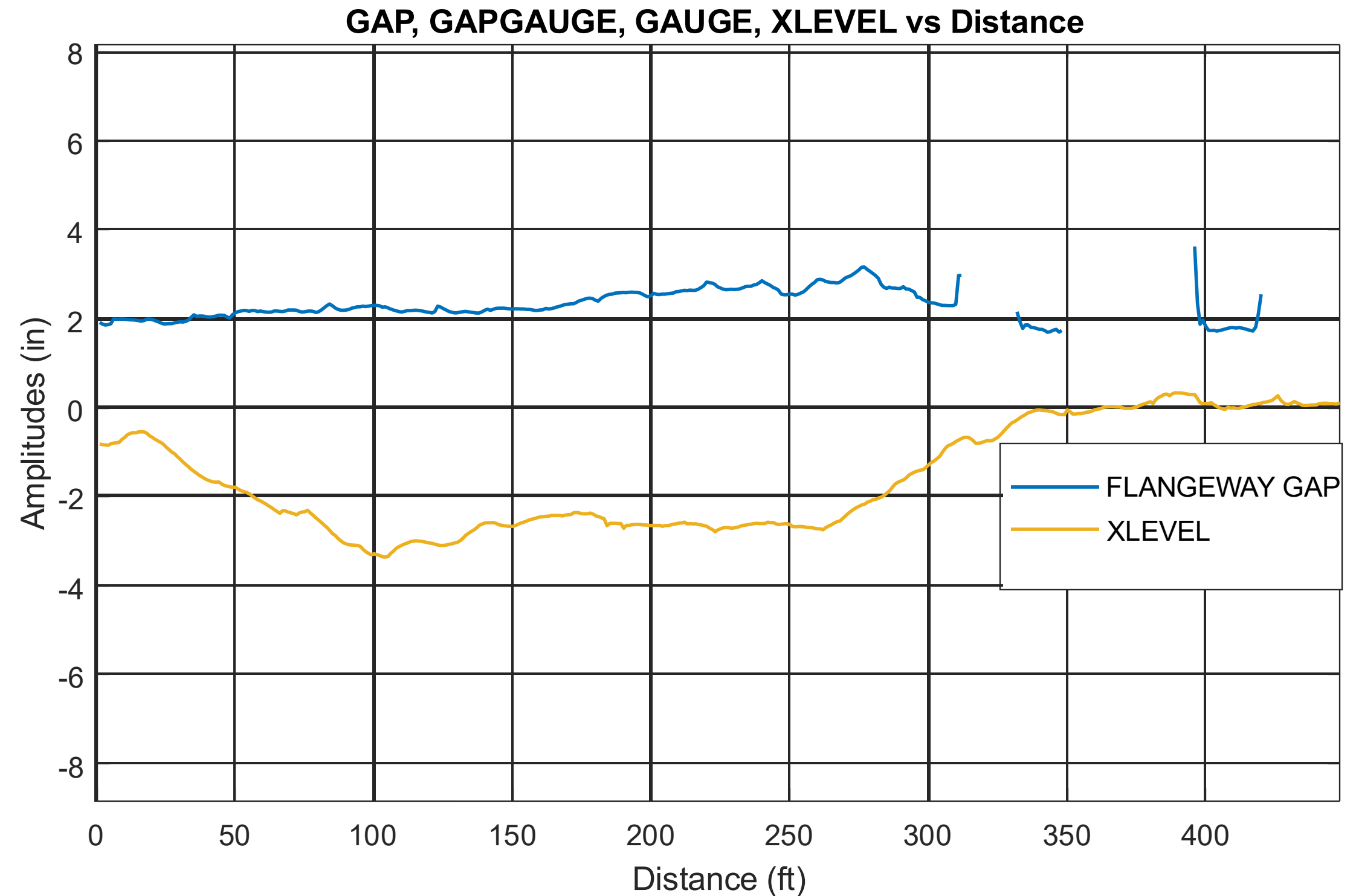
Flangeway Measurement Signal Signature

A typical signal Signature of Gauge and GAP Gauge is shown in the Graph.
GAP is the difference signal



Flangeway Measurement Signal Signature

GAP
Measurement
Also including
XLEVEL





NYCT Typical Design Parameters

- 1 ¾" Flangeway for frogs and crossings
- 2" Flangeway for restraining rails in curves with $200' \leq R < 750'$
- 2 ¼" Flangeway for restraining rails in curves with $R < 200'$

NYCT Typical Flange Way Exceptions

TABLE 108.8A FLANGEWAY STANDARDS - GUARDED CURVES			
ACTION	CAUTION	24-HR. INSP.	<i>STANDARD FLANGEWAY</i>
Condition	Severity 3	Severity 2	
Maximum Flangeway	$\geq 2 \frac{1}{2}$	$\geq 3"$	2"
	$\geq 2 \frac{3}{4}"$	$\geq 3 \frac{1}{4}"$	$2 \frac{1}{4}"$
Minimum Flangeway	$\leq 1 \frac{3}{4}"$	$\leq 1 \frac{1}{2}"$	2" and $2 \frac{1}{4}"$

(< : less than; > : greater than; \leq : less than or equal to; \geq : greater than or equal to)

NOTE: Prompt corrective action must be performed if the flangeway is less than 1 ½ in.



NYCT Typical Flange Way Exceptions

TABLE 109.6 GUARD RAIL STANDARDS - SPECIAL WORK				
SPEED	UNRESTRICTED SPEED	REDUCED OR SLOW SPEED 25 / 10 MPH ⁽¹⁾	SUPERVISE OPERATION	STANDARD
Condition	Severity 3	Severity 2	Severity 1	
Maximum Flangeway	$\geq 2"$	$\geq 2 \frac{1}{4}"$	$\geq 2 \frac{3}{8}"$	$1 \frac{3}{4}"$
	$\geq 2 \frac{1}{4}"$	$\geq 2 \frac{1}{2}"$	$\geq 2 \frac{3}{4}"$	2"
	$\geq 2 \frac{1}{2}"$	$\geq 2 \frac{3}{4}"$	$\geq 3"$	$2 \frac{1}{4}"$
Frog Guard Rail Gauge ⁽²⁾	$\leq 54 \frac{1}{2}"$	$\leq 54 \frac{1}{4}"$	$\leq 54 \frac{1}{8}"$	$54 \frac{3}{4}"$
Frog "Back to Back" Gauge ⁽³⁾	$\geq 53 \frac{1}{8}"$	$\geq 53 \frac{1}{4}"$	$\geq 53 \frac{3}{8}"$	$53"$ $52 \frac{3}{4}"$ $52 \frac{1}{2}"$

(< : less than; > : greater than; \leq : less than or equal to; \geq : greater than or equal to)

NOTES: ⁽¹⁾ If so determined by a qualified Inspector. See paragraph 104.3 (B).

⁽²⁾ Guard Rail Gauge is measured from the point of frog to its corresponding guard rail face.

⁽³⁾ "Back to Back" Gauge is measured from the guarding face of a frog wing rail to the corresponding guard rail face.

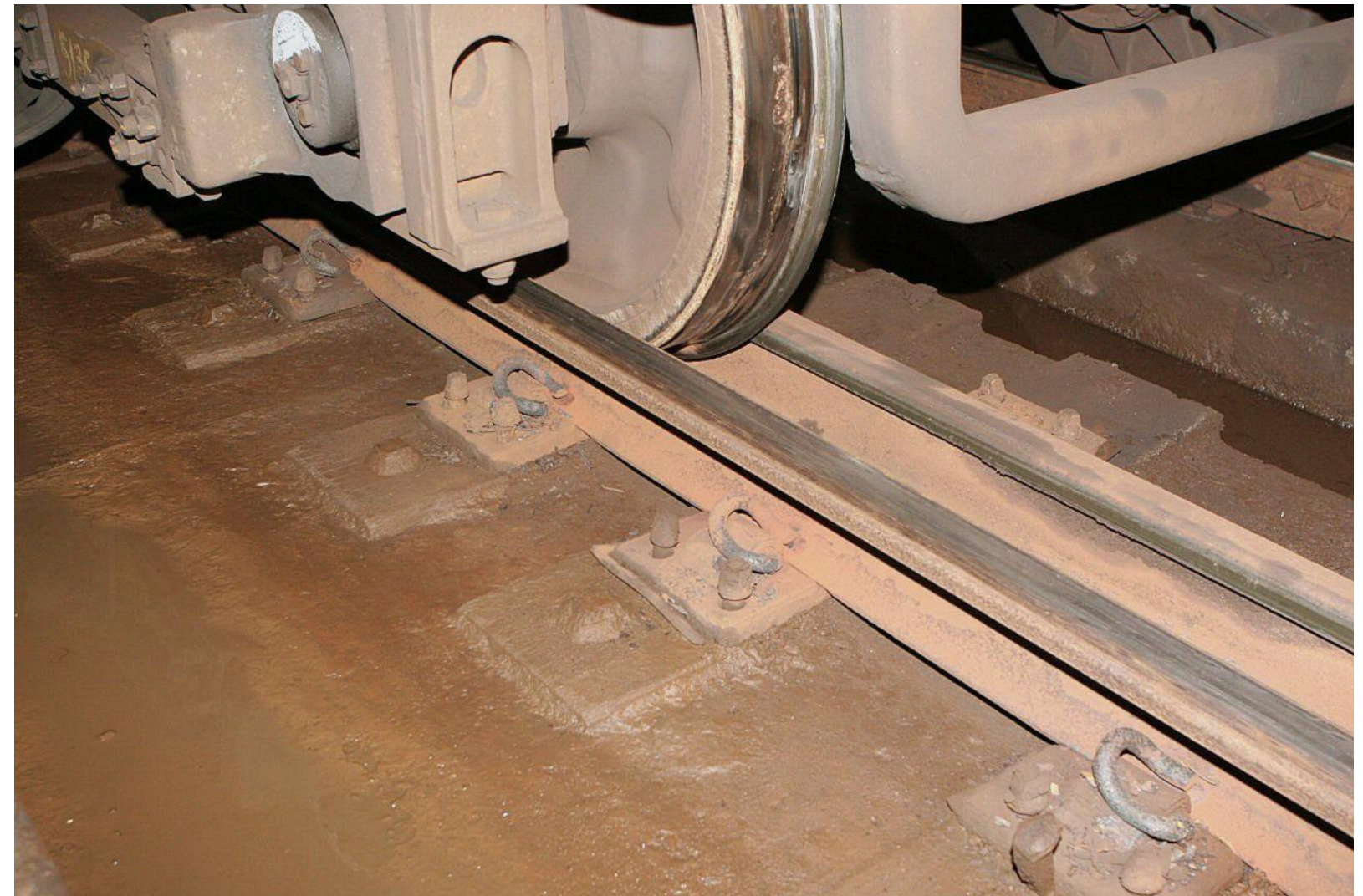


Implications of Flange Way Exceptions

- Wide Flangeway:
 - Wheels press hard against the frog point, or the high rail in curves, resulting in point damage, potential wheel climb and excessive wheel flange and rail wear
 - Loose restraining rail separator blocks, which the wheel flanges could hit, and ride over them and derail
- Tight Flangeway:
 - Excessive rubbing of the back of the wheel against the restraining rail (could lead to rail climb if lack of lubrication)
 - High rates of restraining rail and back of wheel wear, noise and degradation

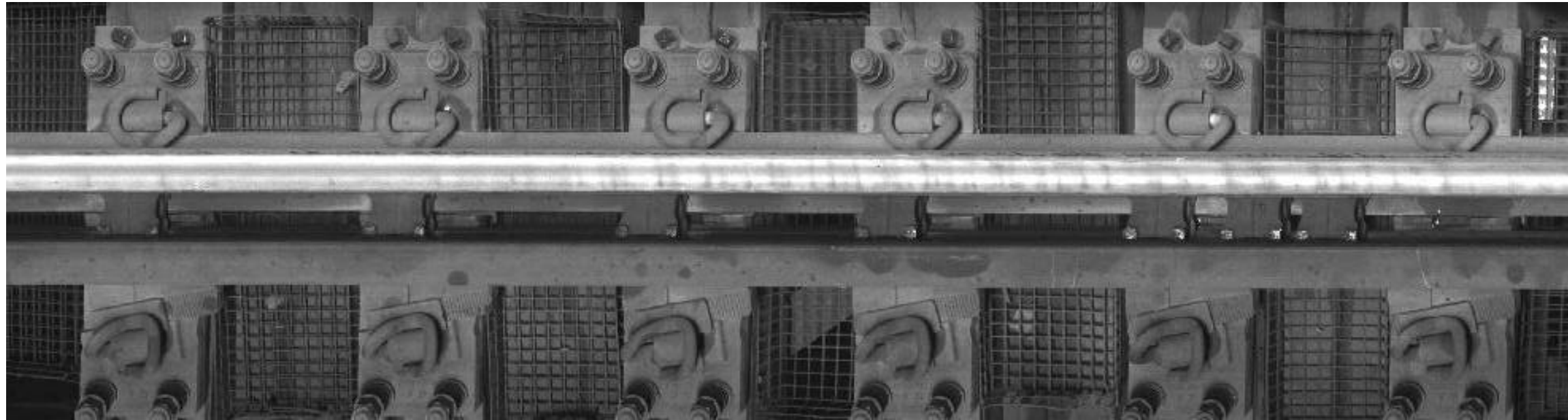
Photos of Track and Vehicle Defects

- Missing Spacer Blocks



Photos of Track and Vehicle Defects

- Spacer Blocks hit by wheel flange



Photos of Track and Vehicle Defects

- GAP issues caused by missing and loose fasteners

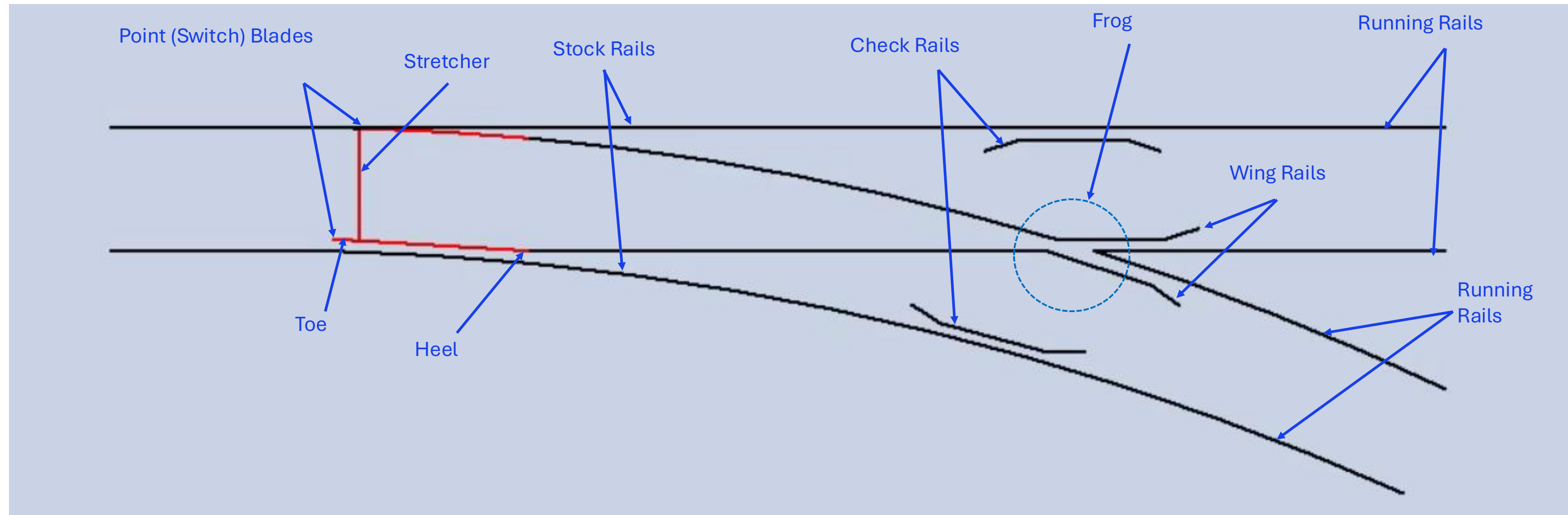




Automated Turnout Measurement

- Typical additional to flange way parameters measured in turnouts are:
 - Switch tip and crossing gauge
 - Gauge
 - Cross-level
 - Switch Point Opening
 - Switch Point Height
 - Switch Blade Inclination
 - Throat opening
 - Frog Height and Flangeway Depth
 - Crossing wing rail – vertical wear

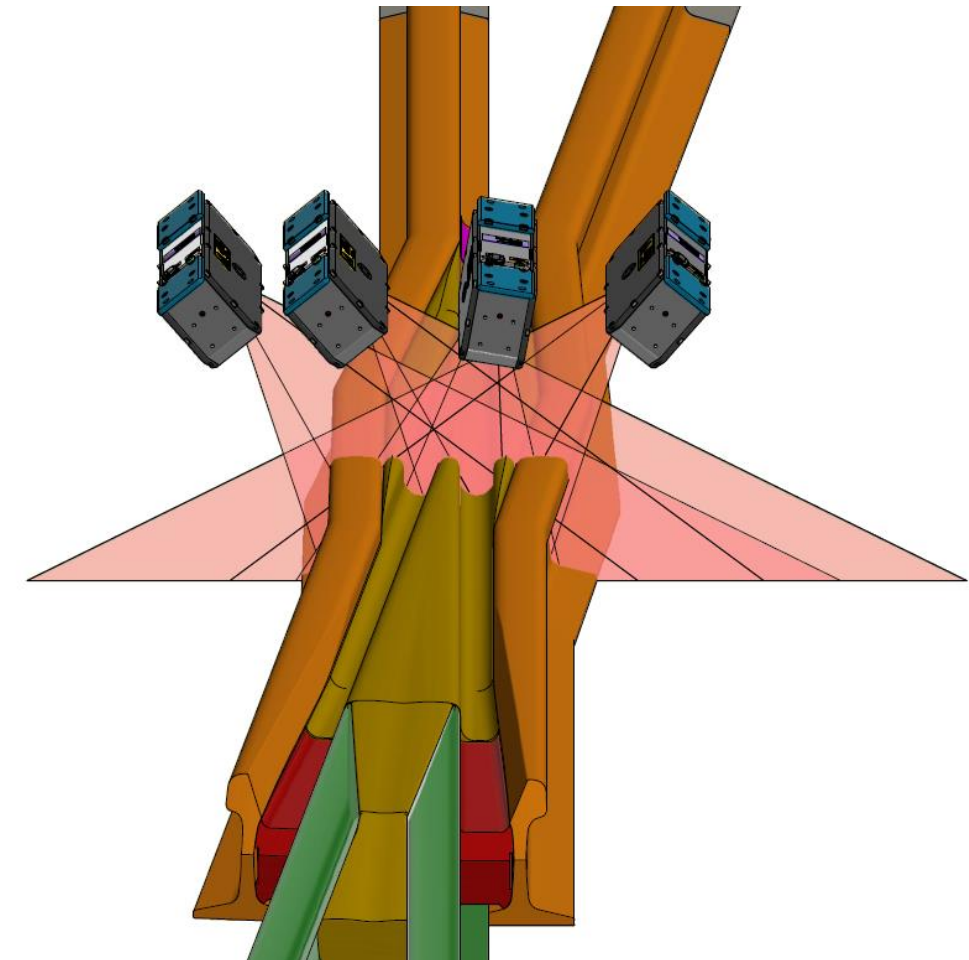
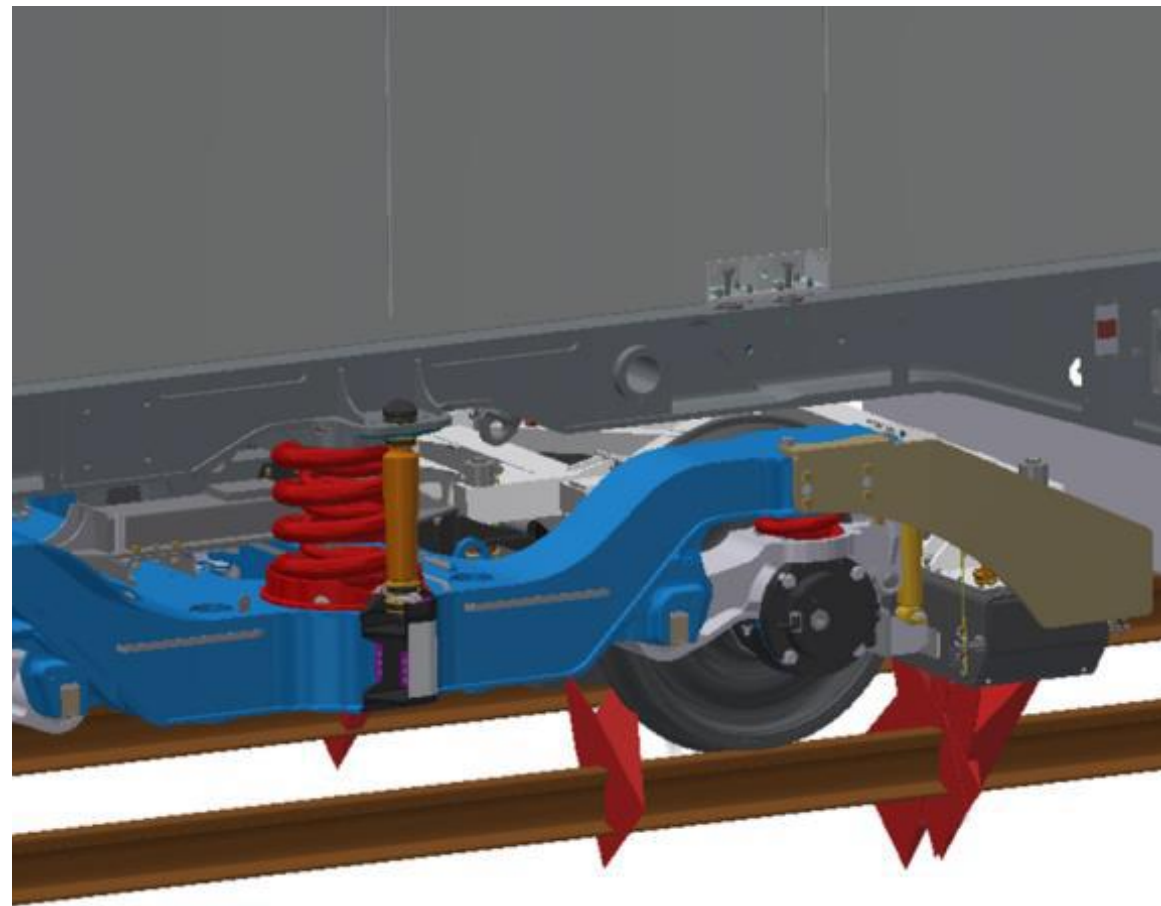
Turnout Components





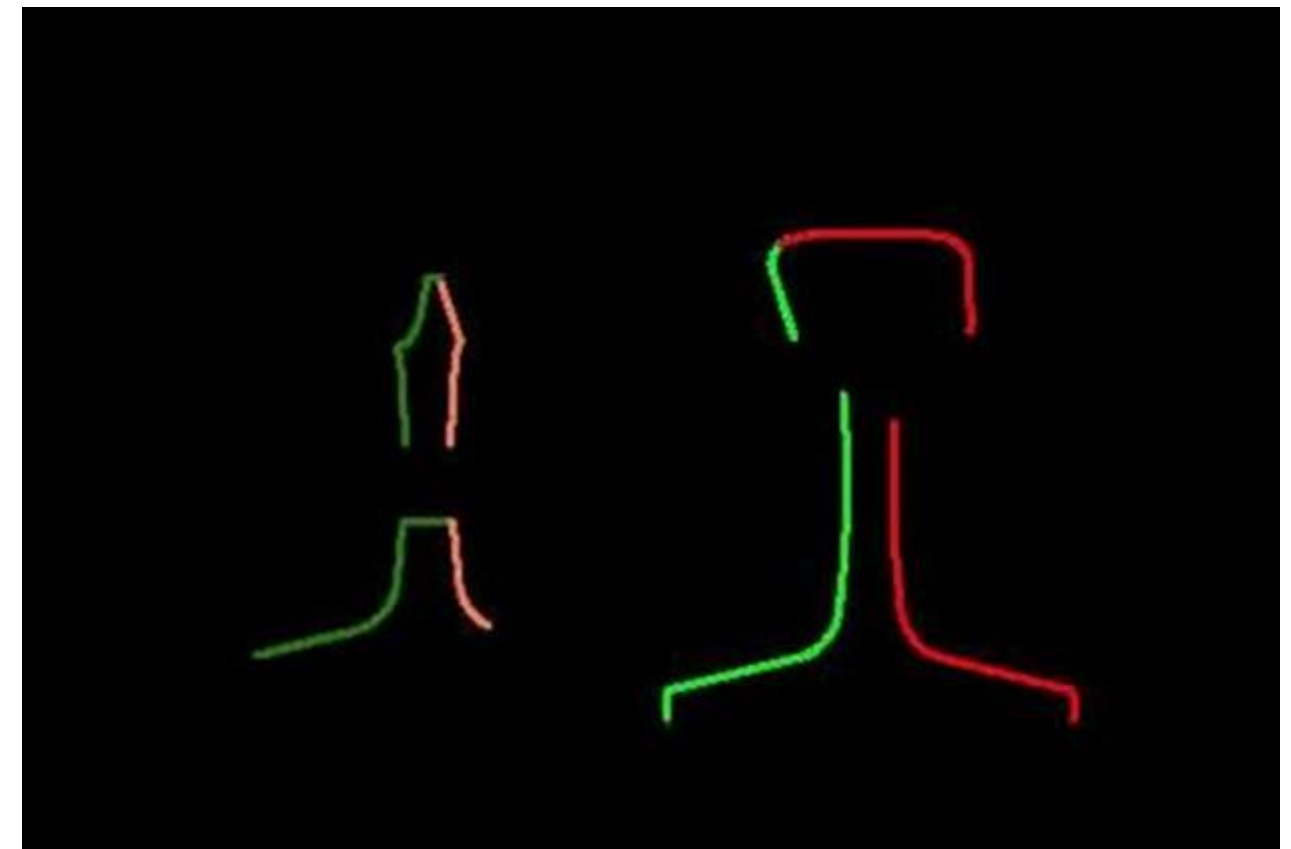
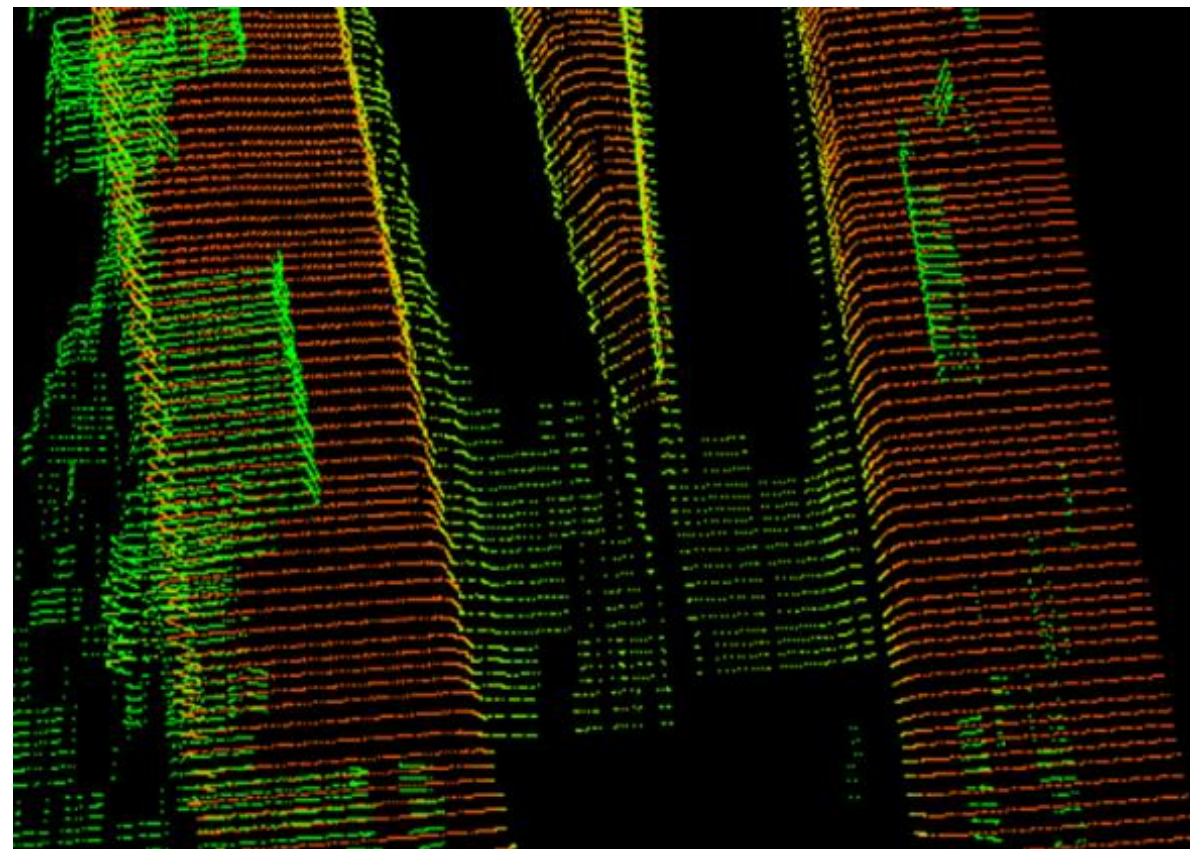
Turnout Measurement System Internals

- To measure turnout parameters, more lasers and a higher sampling rate are required.
- Typical sampling is 1" per cross section

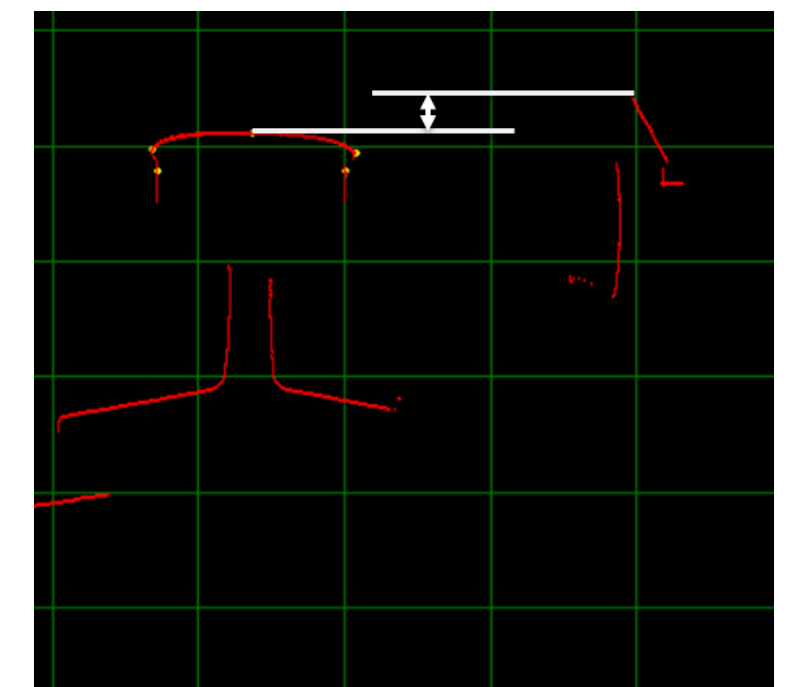
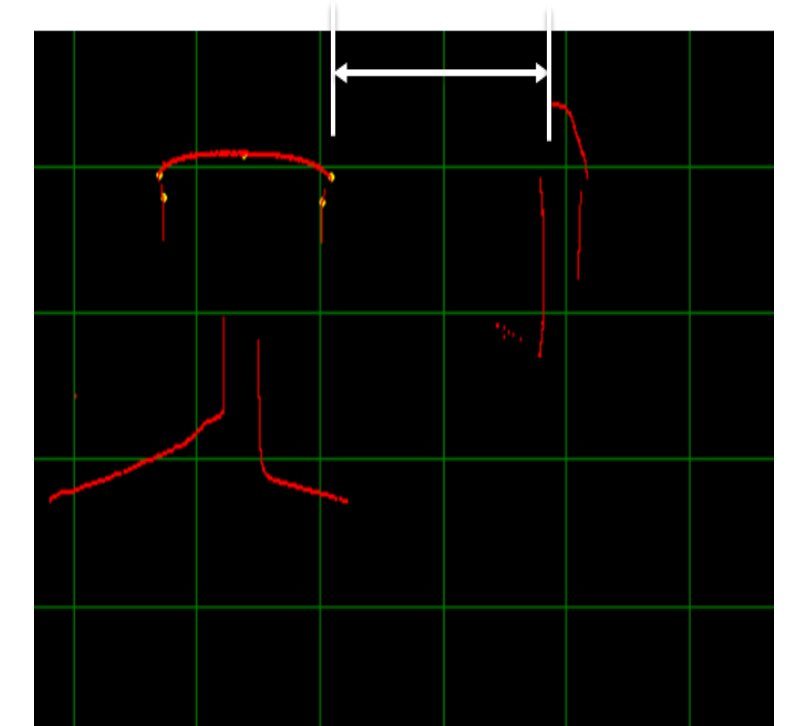
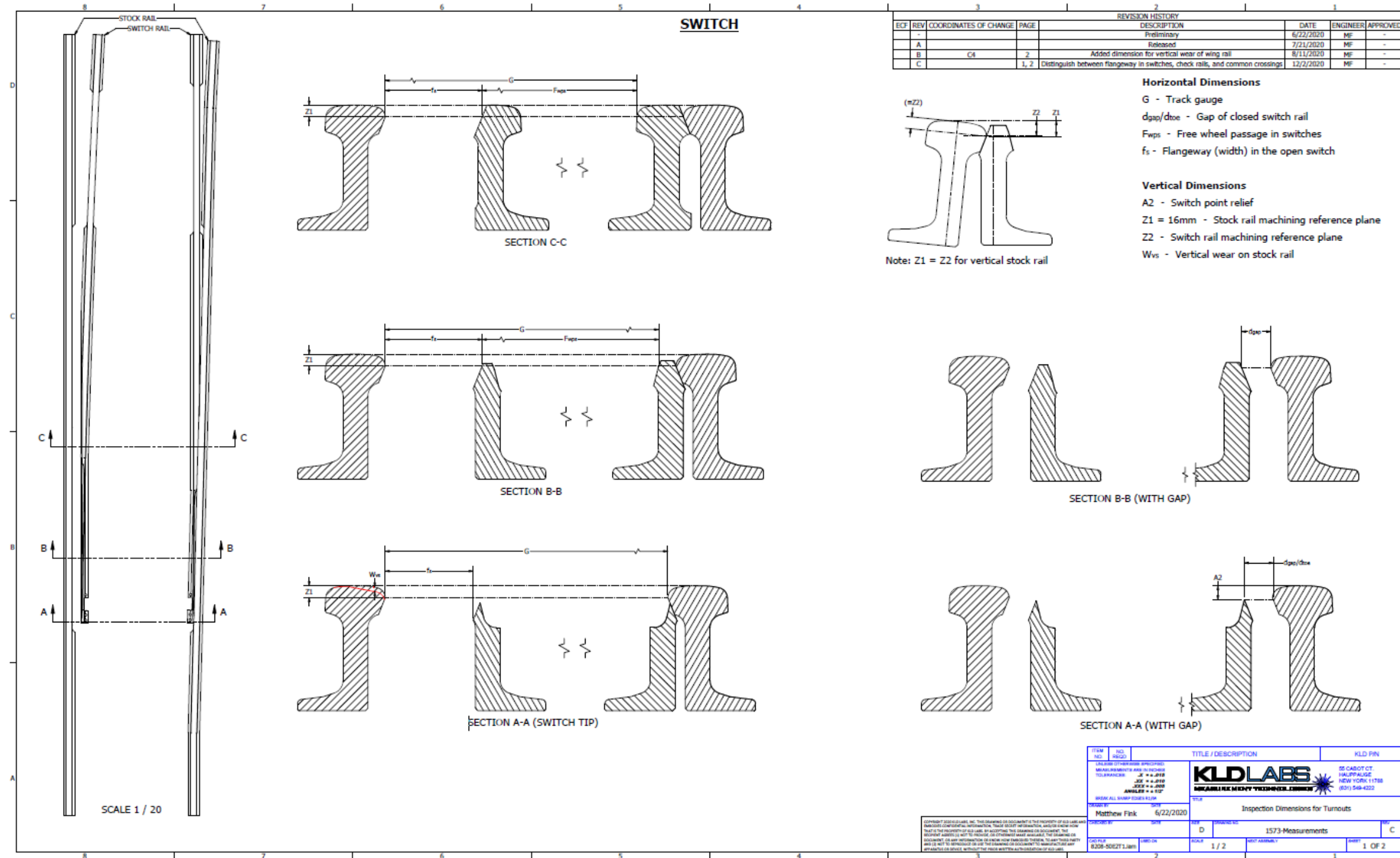


Turnout Measurement System Data

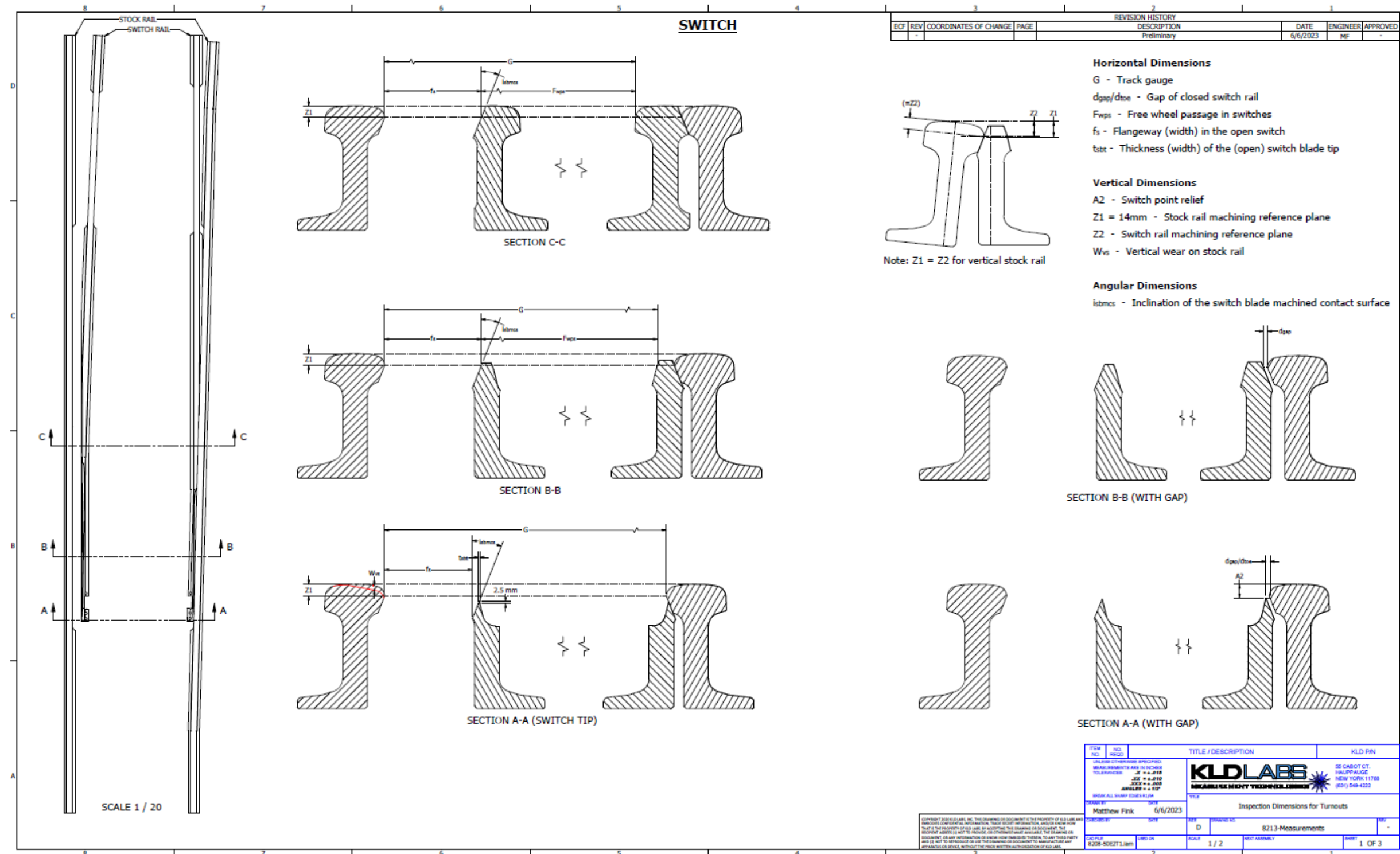
- Turnout measurements are taken in e.g. 1 inch step
- 3D crosscuts can be displayed
- For analysis, each slice is analyzed



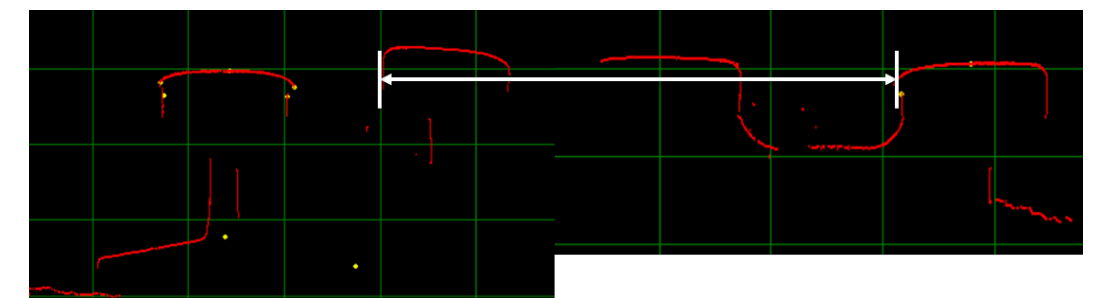
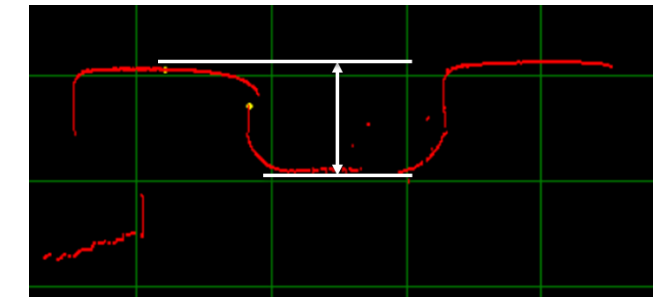
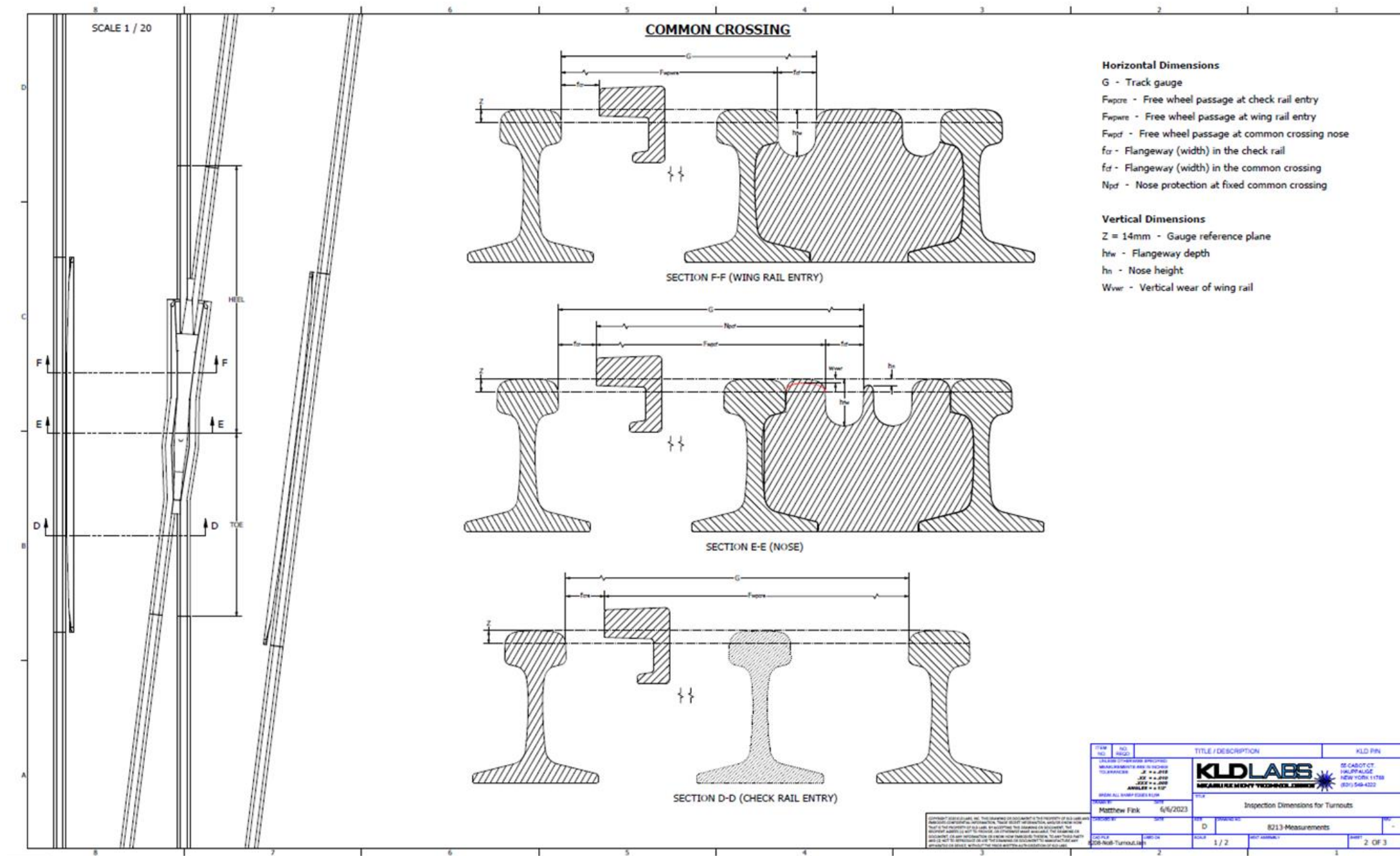
Turnout Parameter Examples



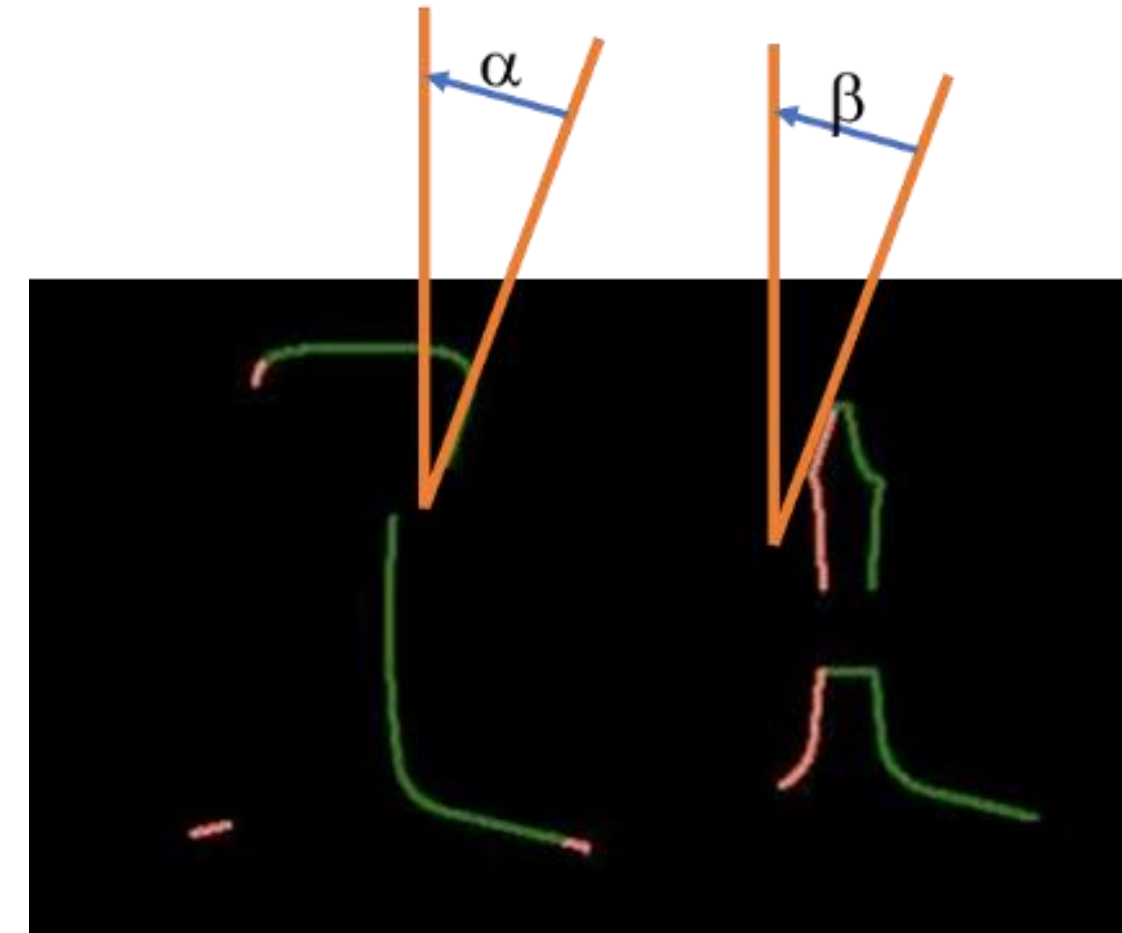
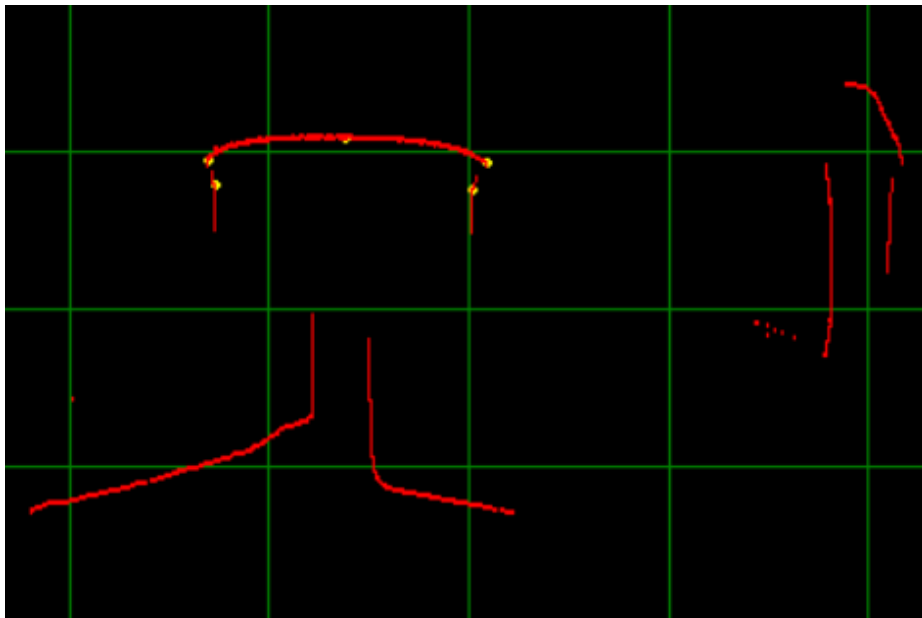
Turnout Parameter Examples



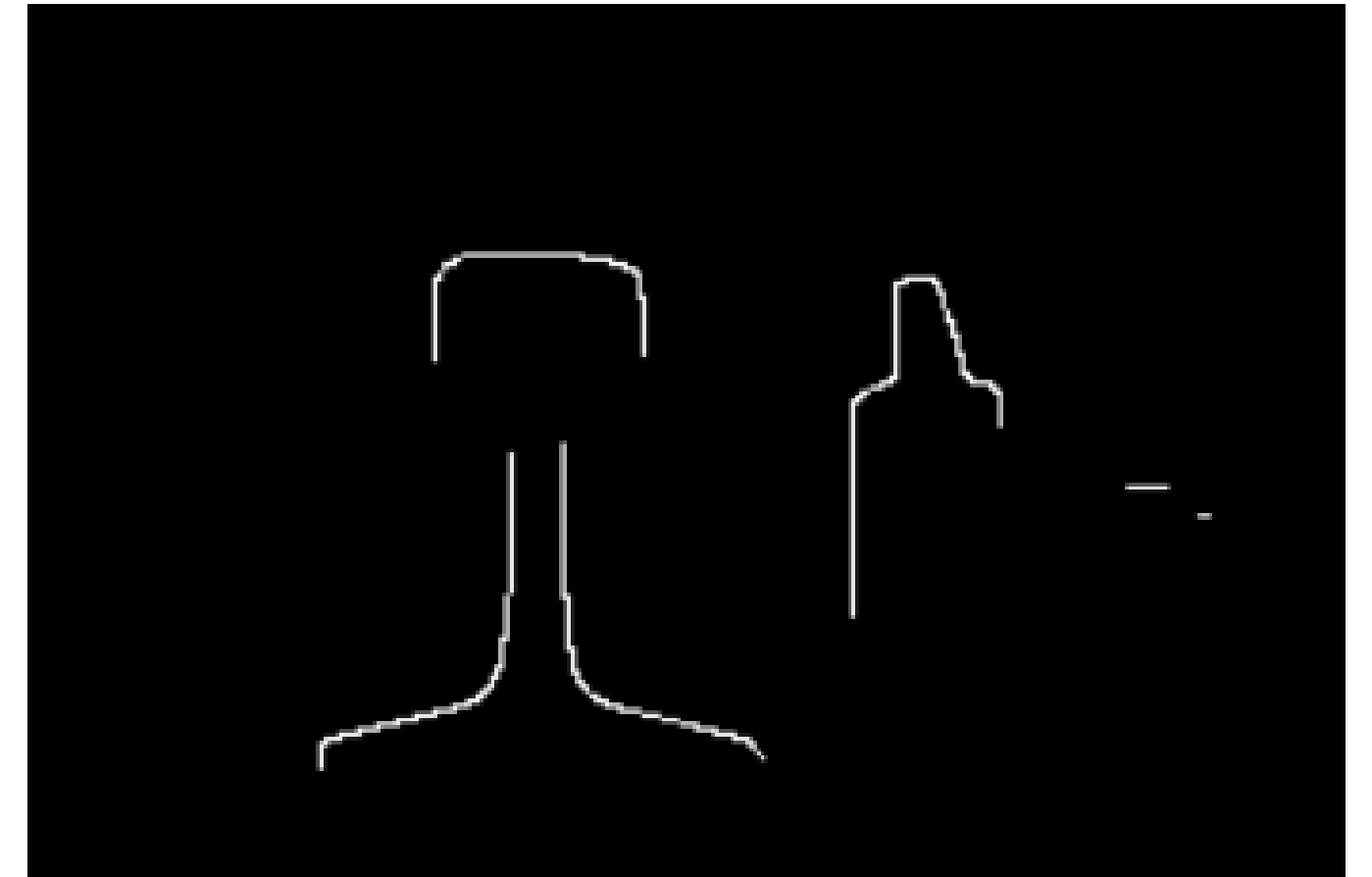
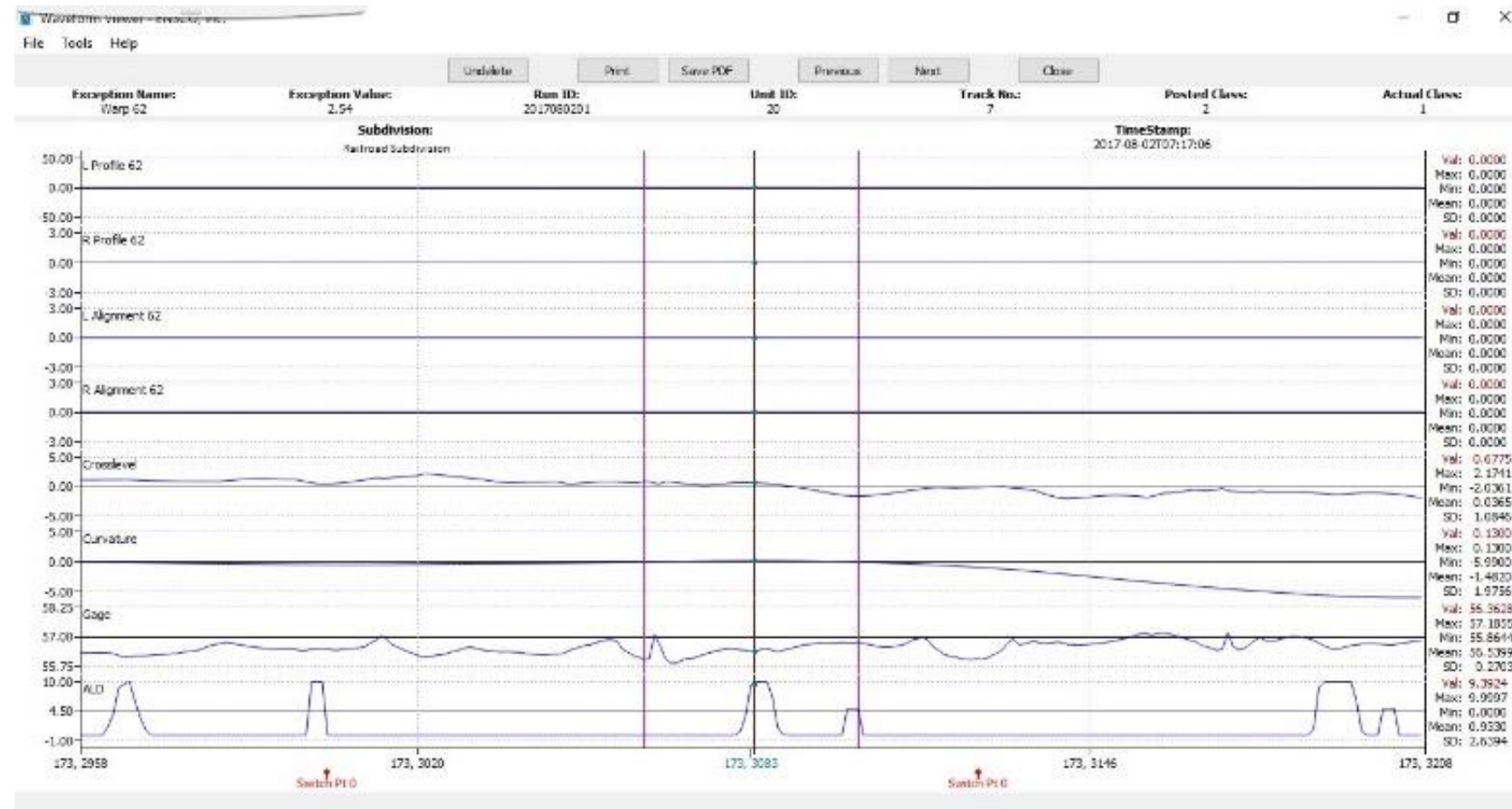
Turnout Parameter Examples



Turnout Parameter Examples



Turnout Parameter Examples



Display and Reports

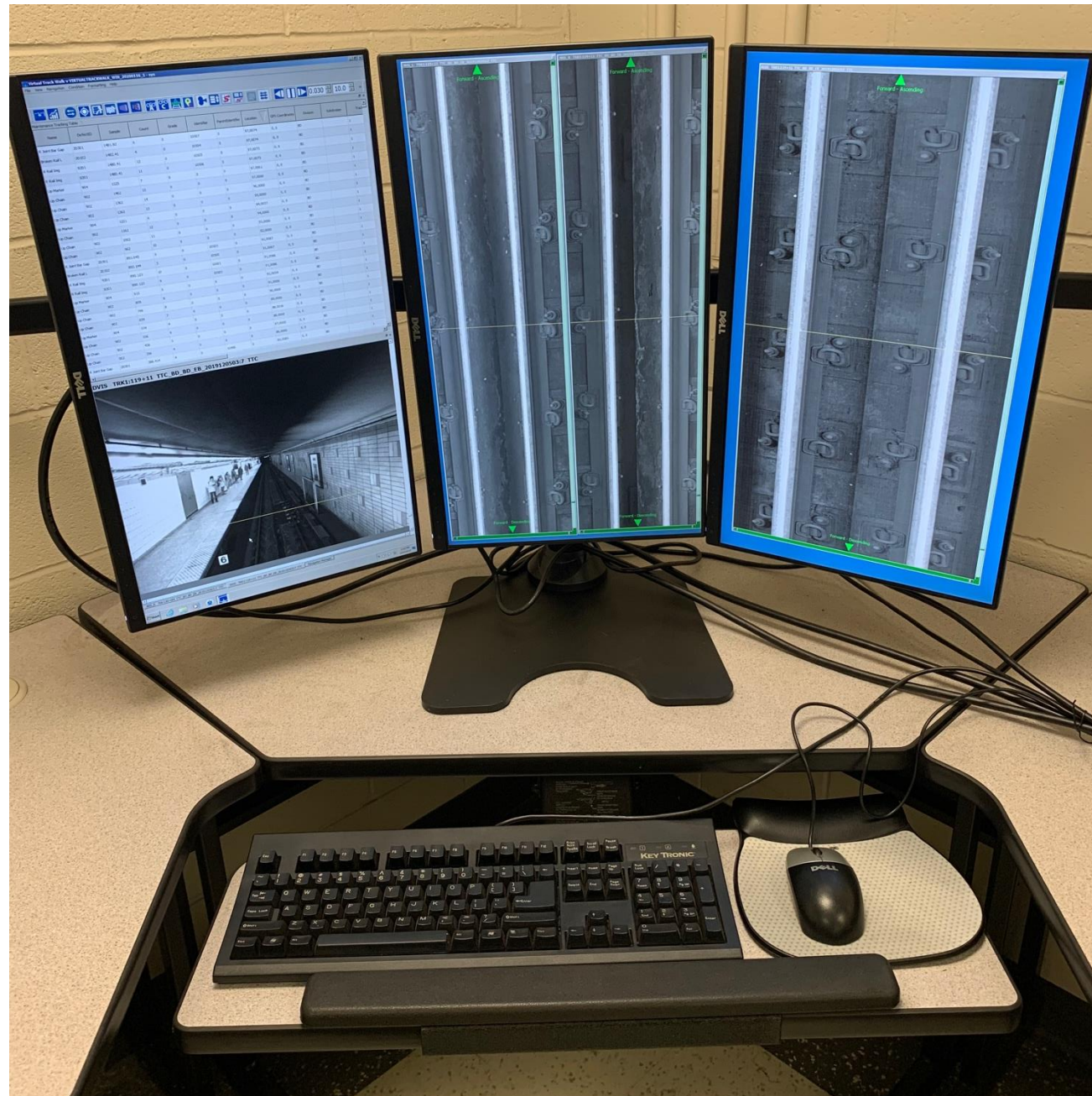
- Turnout measurements are typically transferred into a report for

Switch Set for Normal				Switch Set for Reverse			
Loc	Parameter	Design (mm)	Number Exceeding	Loc.	Parameter	Design (mm)	Number Exceeding
-	Switch Stop Clearance - Closed	<2		-	Switch Stop Clearance - Closed	<2	
-	Switch Roller Clearance - Closed	Move Freely		-	Switch Roller Clearance - Closed	Move Freely	
-	Gap btw Blade Foot & Slide Plate	<1		-	Gap btw Blade Foot & Slide Plate	<1	
-	LH Anti-Creep Gap (Bearer 29)	POS >6 FROG >6		-	RH Anti-Creep Gap (Bearer 29)	POS >6 FROG >6	

Frog Test Parameters (Refer to Frog Diagram)							
Switch Set for Normal				Switch Set for Reverse			
Loc	Parameter	Design (mm)	Actual (mm)	Loc	Parameter	Design (mm)	Actual (mm)
	Throat Opening				Throat Opening		
	Point Rail opening				Point Rail opening		
	Point / Wing Rail Tip Closed Clearance	<1		-	Point / Wing Rail Tip Closed Clearance	<1	
C1	Point Rail Pickup Location (measured from tip)	450-1200		C1	Point Rail Pickup Location (measured from Tip)	450-1200	
	Gap btw Point Rail Foot and Base Plate	<1			Gap btw Point Rail Foot and Base Plate	<1	
	Ramp Length (Point Rail level with Wing Rail)						



Display and Reports





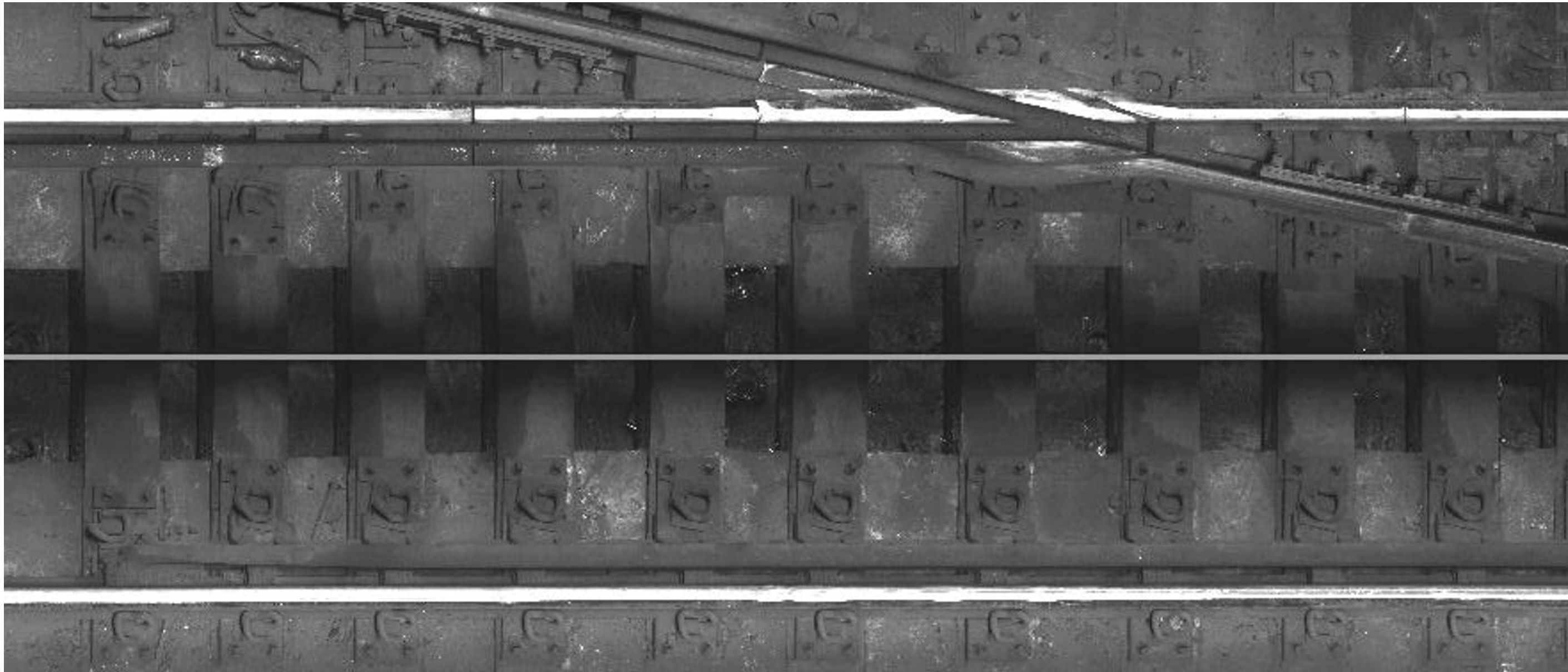
Measurement System Augmentation

- Vision Systems aid in Flangeway and Turnout Parameter Analysis



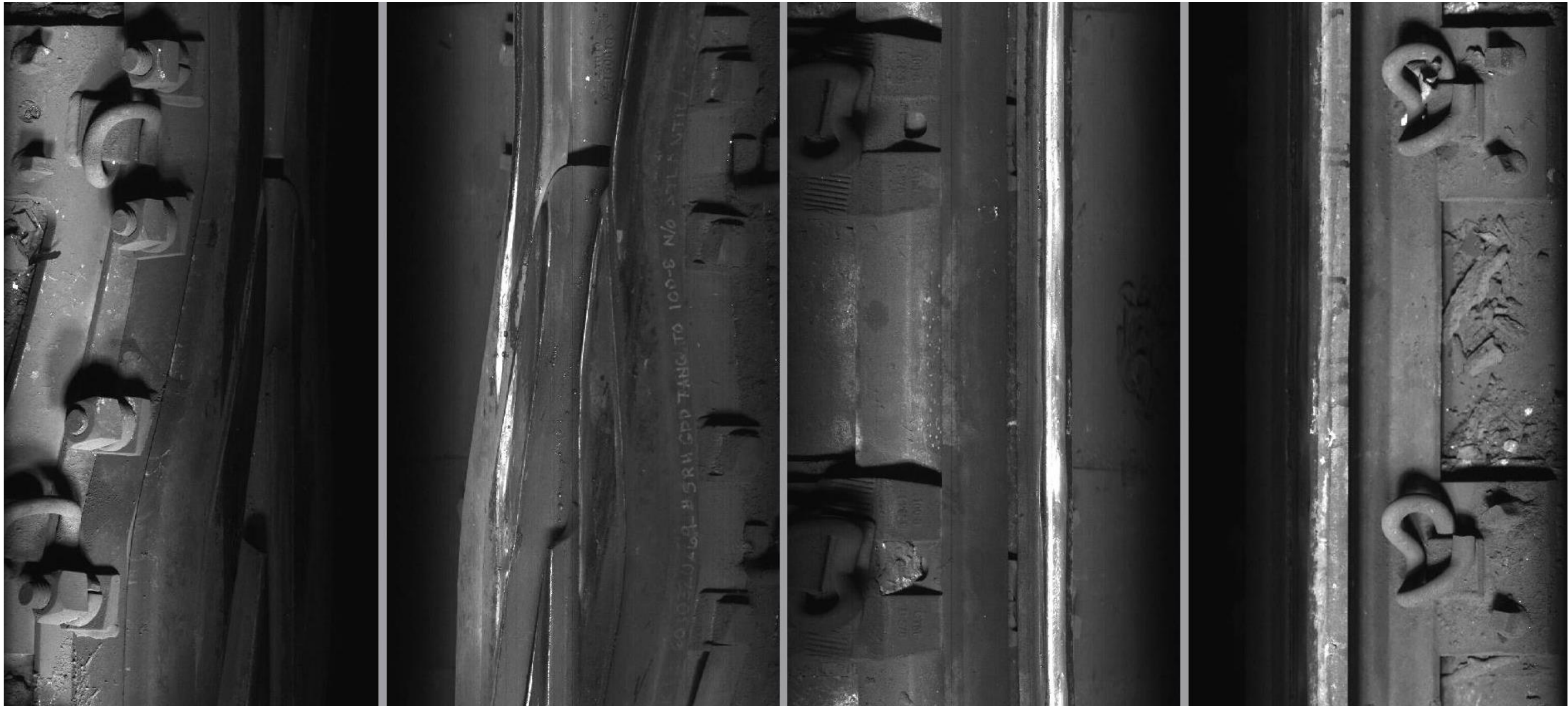
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Measurement System Augmentation

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Other Interesting Facts

- Europe has established standard EN-13232
 - **EN 13232** is a comprehensive European standard that defines the **design, manufacture, and maintenance** of **railway turnouts and other track systems** in **standard gauge** railways. It is broken down into multiple parts (EN 13232-1 to EN 13232-9), each covering different aspects of turnouts and crossings.
- ISO/TC 269/SC 1 WG10 is working on standard ISO 22074 for switches and crossings
 - The standard is based on EN 13232 but will also include North American elements





Questions?

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