GREX®

Real Rail Solutions

Next Generation Tie Inspection Program and Tie Gang Efficiencies with Automated Inspection Technology

Todd Euston, PE

Vice President Engineering

Georgetown Rail Equipment Co.

UIUC History

GEORGETOWN RAIL EQUIPMENT COMPANY

A DETERMINATION OF THE COMPARATIVE VALUES OF CROSS-TIES OF DIFFERENT MATERIALS

BY

NEIL NELSON CAMPBELL

PAUL KAUTZ

THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN

RAILWAY CIVIL ENGINEERING, NEIL NELSON CAMPBELL

IN

CIVIL ENGINEERING, PAUL KAUTZ

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

PRESENTED JUNE, 1910

-43-

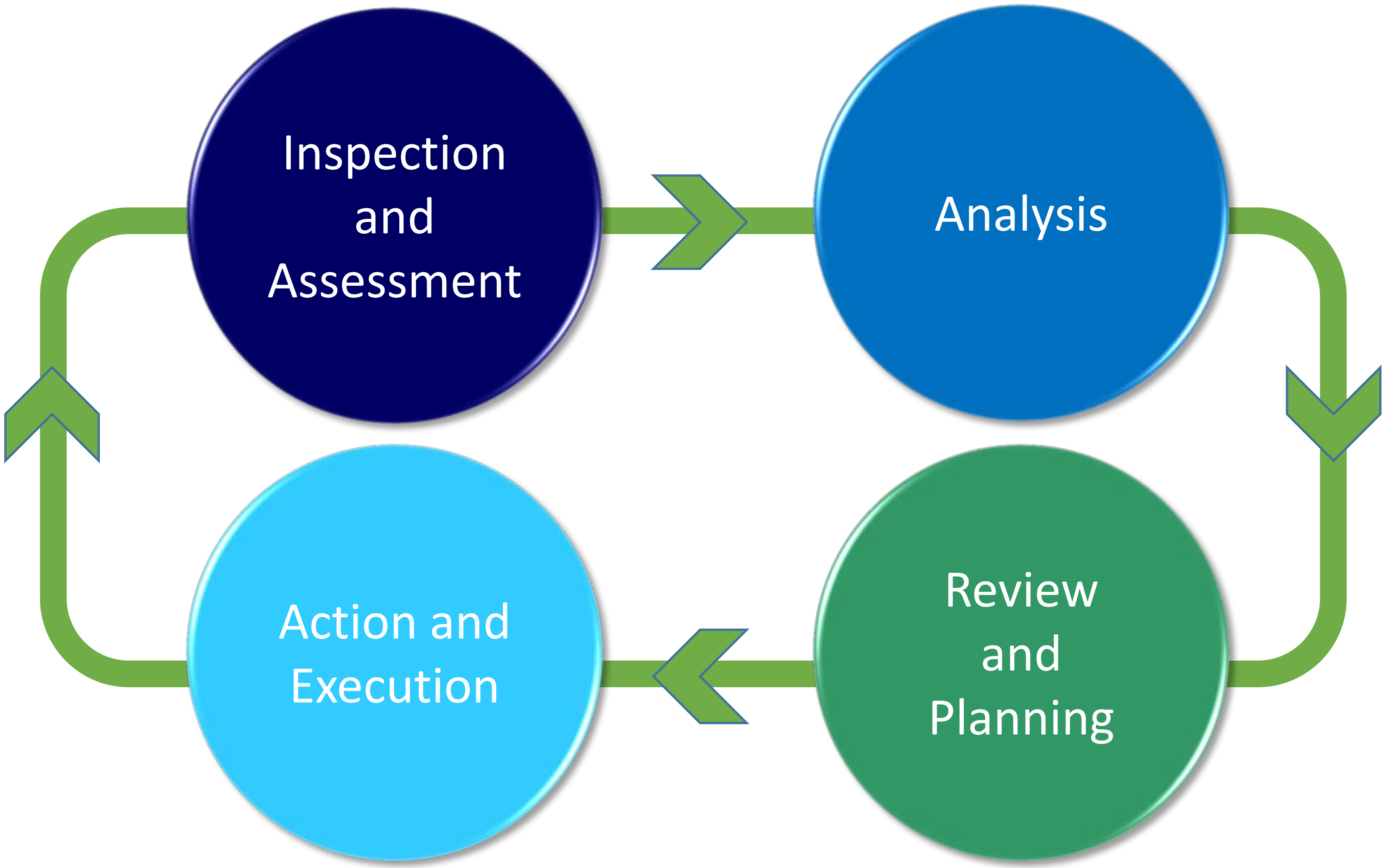
TABLE 5a

Table Showing Data of Table 5 Arranged in Order of Merit.

Nº	Kind of Material	Treatment if any	Average Life	Total Cost in Track	Capitalization	Annual Cost
1	Catalpa	None	20.0	$0.880	$1.619	$0.065
2	Cypress	None	10.0	0.820	2.179	0.087
3	Chestnut	None	9.0	0.655*	2.202	0.088
4	Pine	Creosote	15.0	1.030	2.202	0.088
5	Gum	Creosote	17.5	1.135	2.272	0.091
6	Locust	Rueping	17.0	1.040	2.282	0.091
7	White Oak	None	9.0	0.680*	2.286	0.091
8	Cypress	Rueping	15.0	1.090	2.337	0.093
9	Gum	Rueping	15.0	1.090	2.337	0.093
10	Hemlock	Rueping	15.0	1.090	2.337	0.093
11	Hickory	Rueping	15.0	1.090	2.337	0.093
12	Tamarack	Rueping	15.0	1.090	2.337	0.093
13	Maple	Rueping	15.0	1.090	2.337	0.093
14	Birch	Rueping	15.0	1.090	2.337	0.093
15	Elm	Rueping	15.0	1.090	2.337	0.093
16	Locust	Creosote	20.0	1.280	2.355	0.094
17	Locust	None	12.0	0.980	2.370	0.095
18	Other Oaks	Creosote	15.0	1.107	2.375	0.095
19	Fir	Zinc Chloride	15.0	1.110	2.382	0.095
20	Beech	Rueping	15.0	1.120	2.404	0.096
21	Cypress	Creosote	17.5	1.230	2.467	0.099
22	Hemlock	Creosote	17.5	1.230	2.467	0.099
23	Beech	Creosote	17.5	1.230	2.467	0.099
24	Hickory	Creosote	17.5	1.230	2.467	0.099
25	Other Oaks	Zinc Chloride	11.0	1.010	2.598	0.104
26	Other Oaks	None	6.0	0.625*	2.981	0.119
27	Gum	None	5.0	0.550*	3.089	0.124
28	Fir	None	7.0	0.900	3.097	0.124
29	Redwood	None	10.0	1.130	3.135	0.125
30	Pine	Zinc Chloride	8.0	0.990	3.151	0.126
31	Pine	None	6.0	0.895	3.448	0.138
32	Beech	None	4.0	0.550*	3.787	0.151
33	Maple	None	4.0	0.550*	3.787	0.151
34	Birch	None	4.0	0.550*	3.787	0.151

*No tie plates used on these ties.

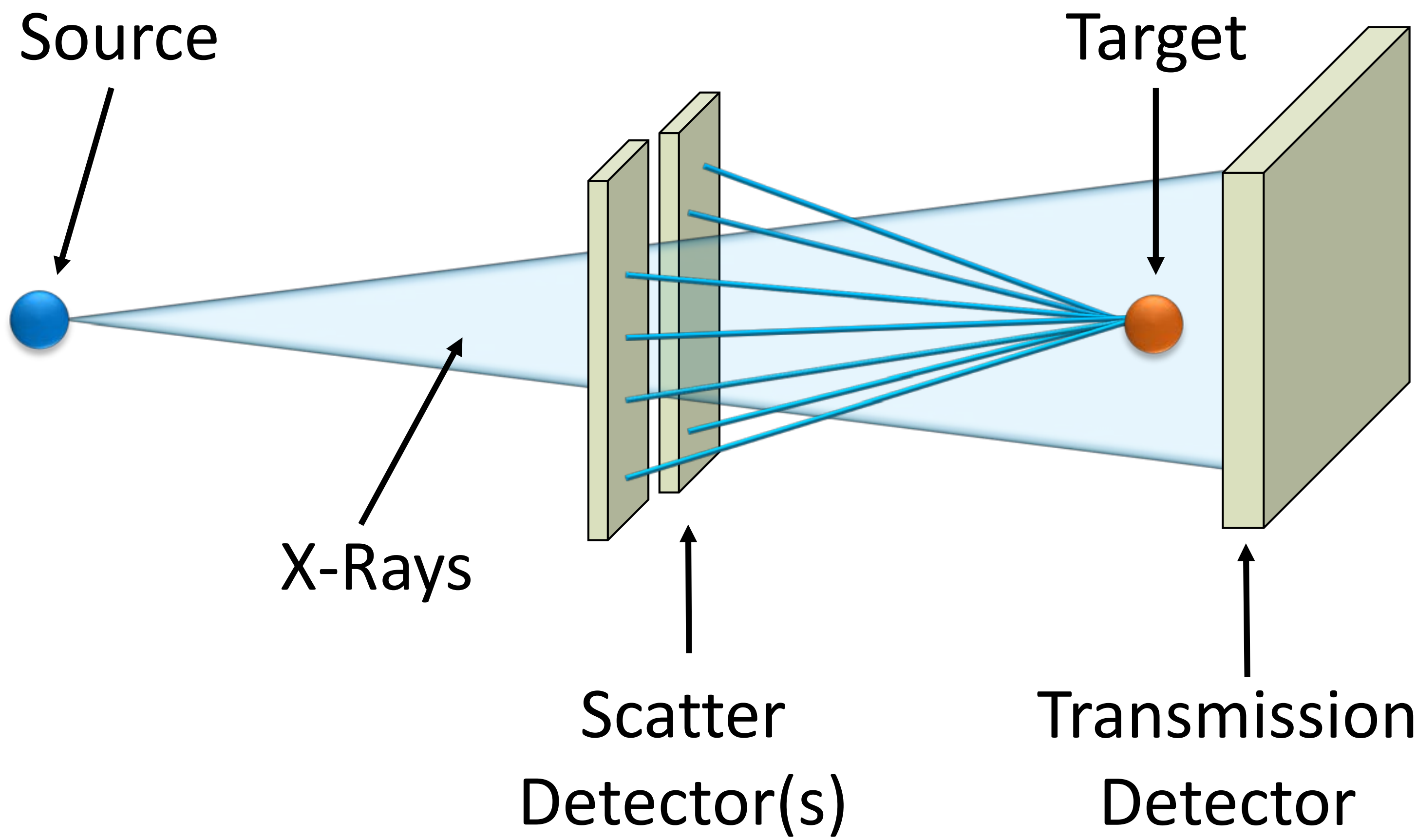
Tie Replacement Cycle



Aurora X^{i} Production System

GREX

G E O R G E T O W N   R A I L   E Q U I P M E N T   C O M P A N Y


Source
Target
X-Rays
Scatter
Detector(s)
Transmission
Detector

Viewer and Integrated Data Streams

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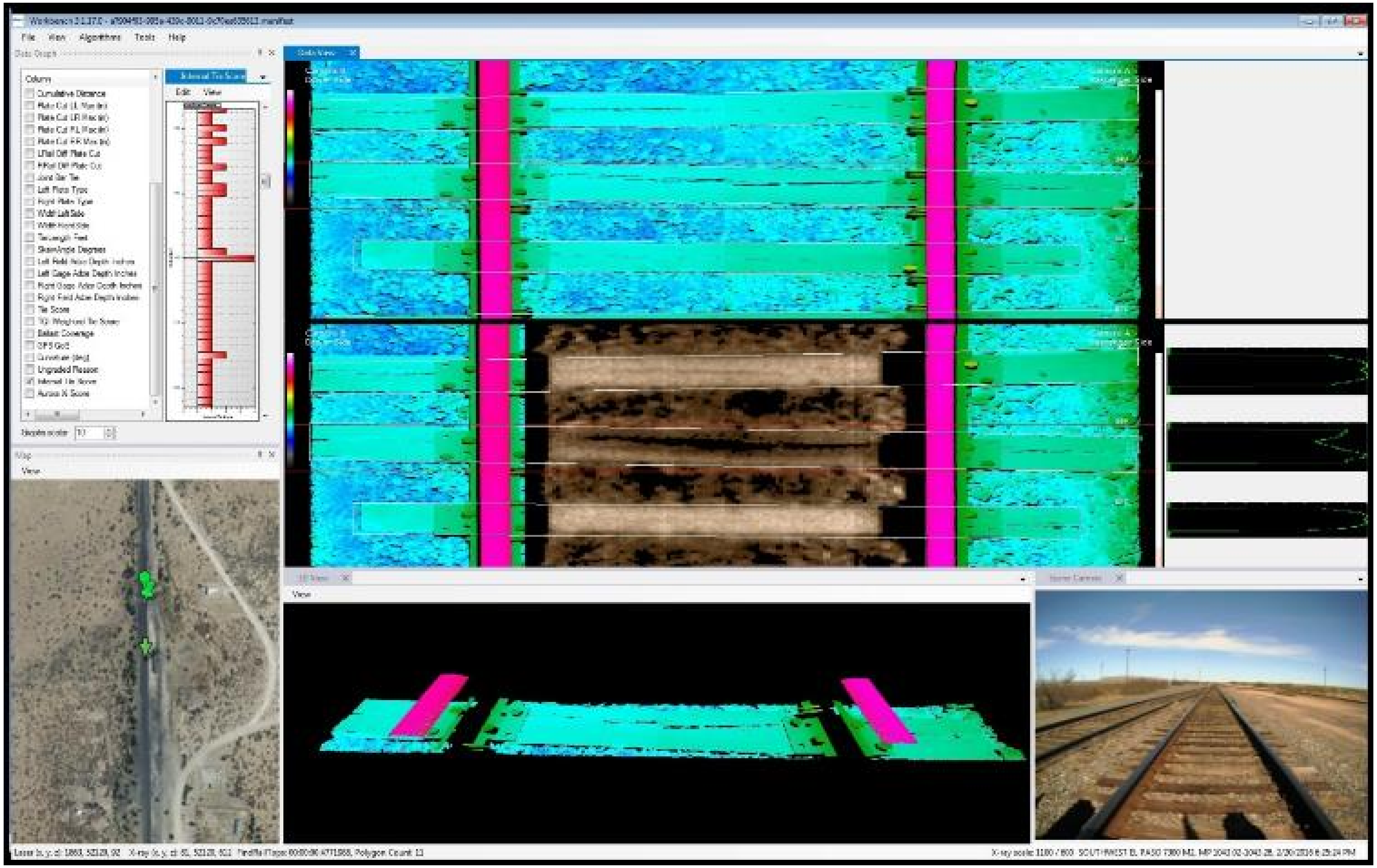


Relative Strengths of X-Ray and Laser Profiling Systems

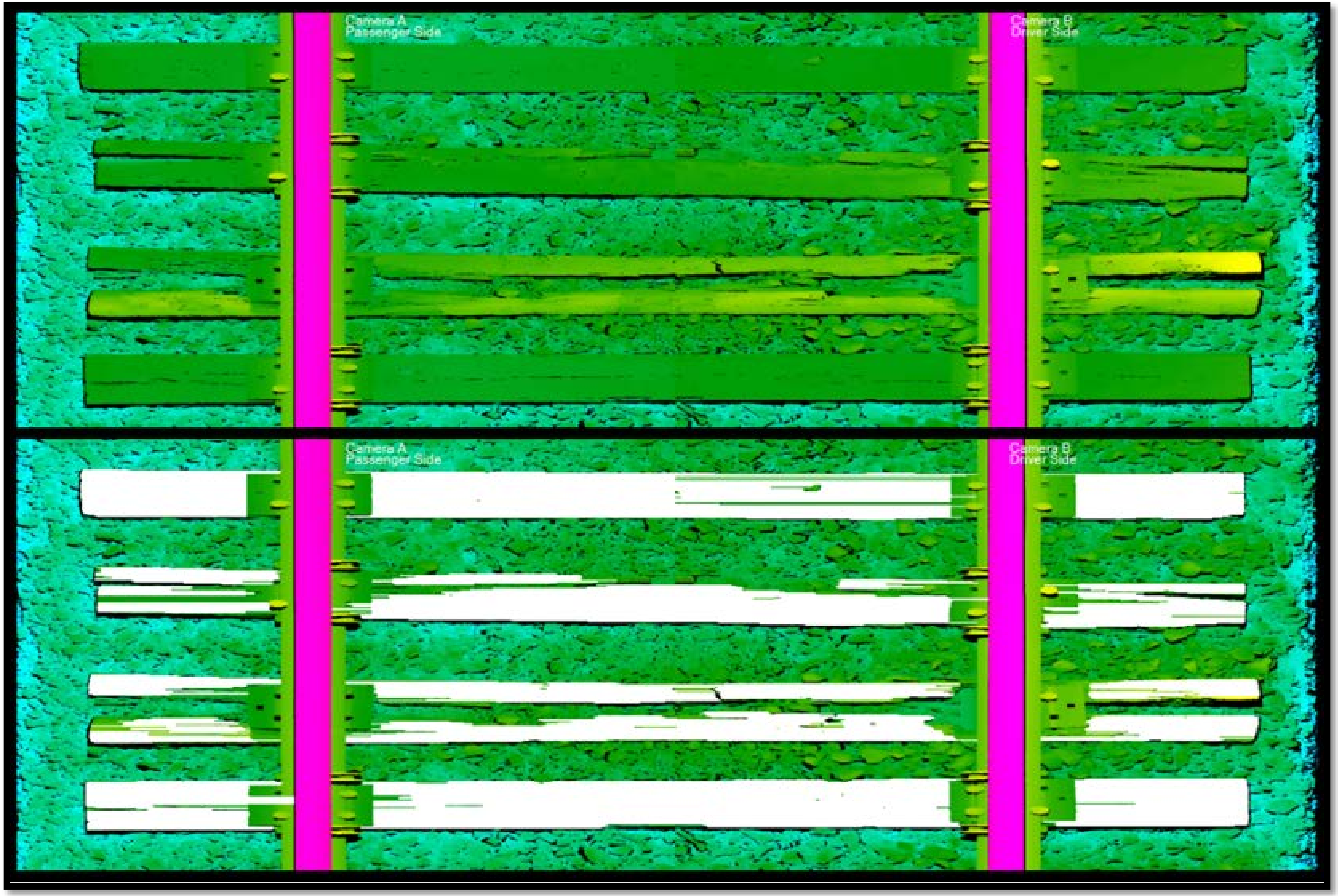
<u>Laser 3D Profiling (Surface)</u>

- Height Discrimination
- Edge and Contour Mapping
- Field of View

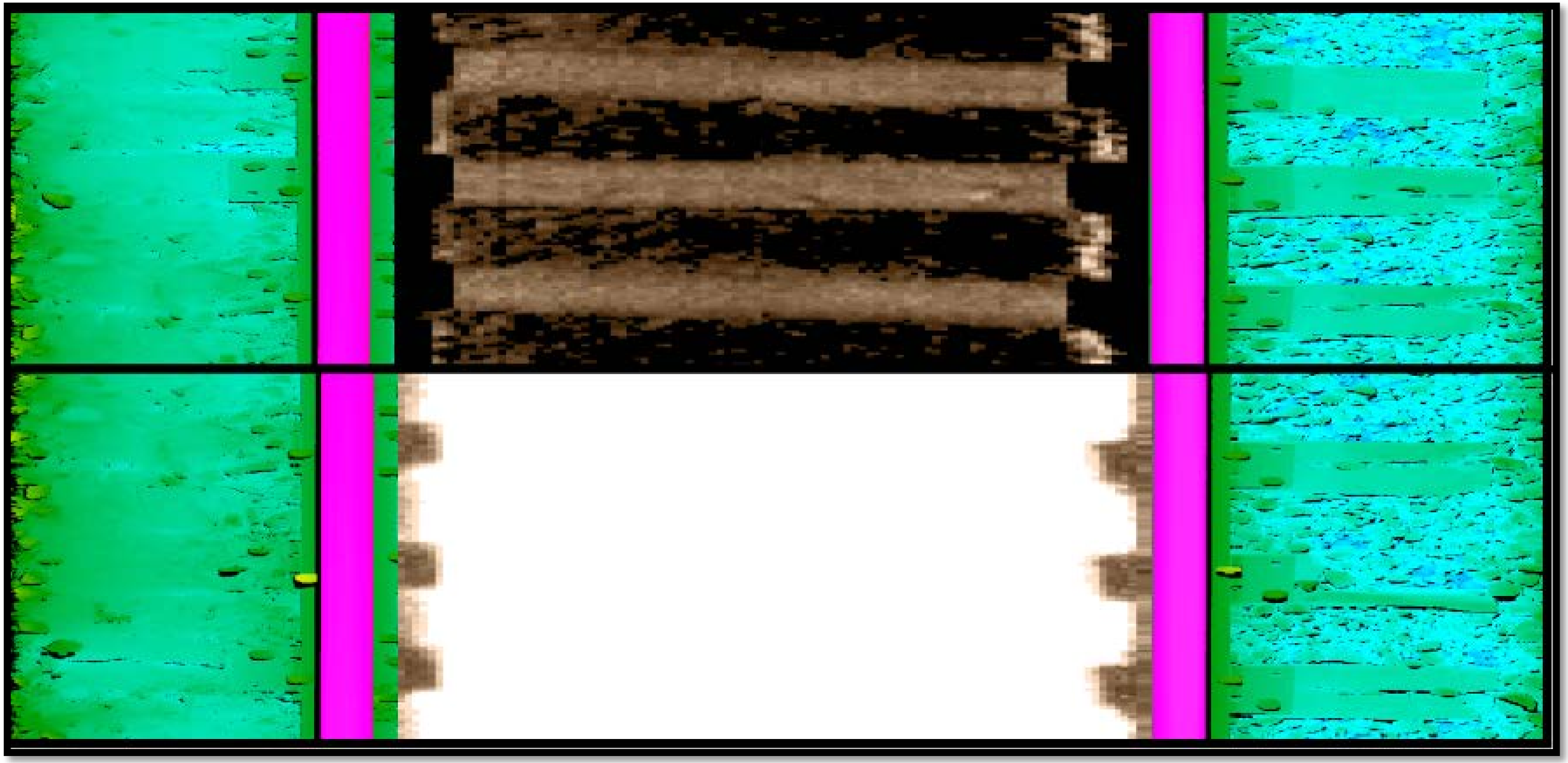
<u>X-Ray Backscatter (Sub-Surface)</u>

- Density Information
- Material Discrimination
- Depth of Penetration
- See Through Obstructions

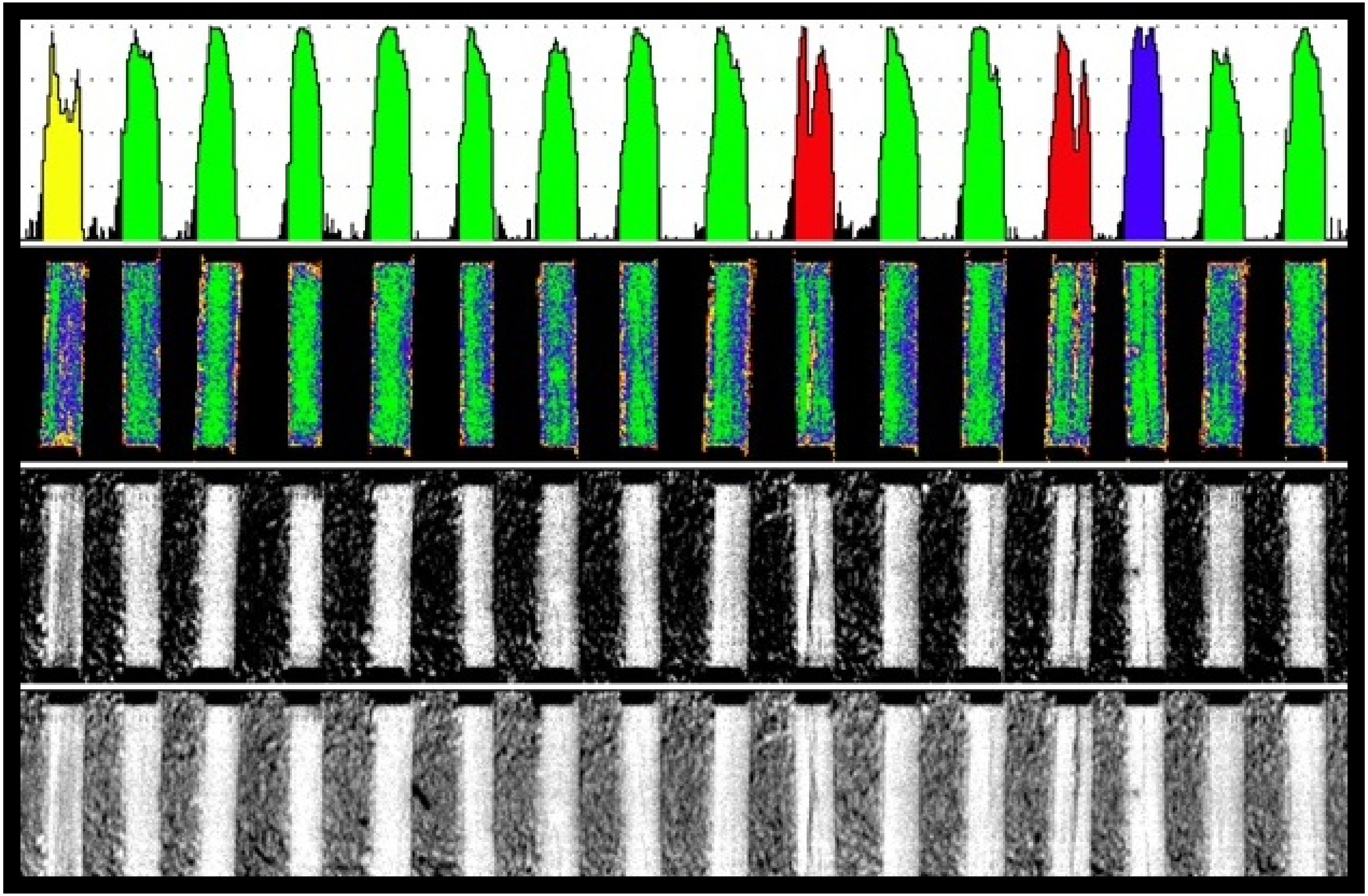
Laser Image Segmentation



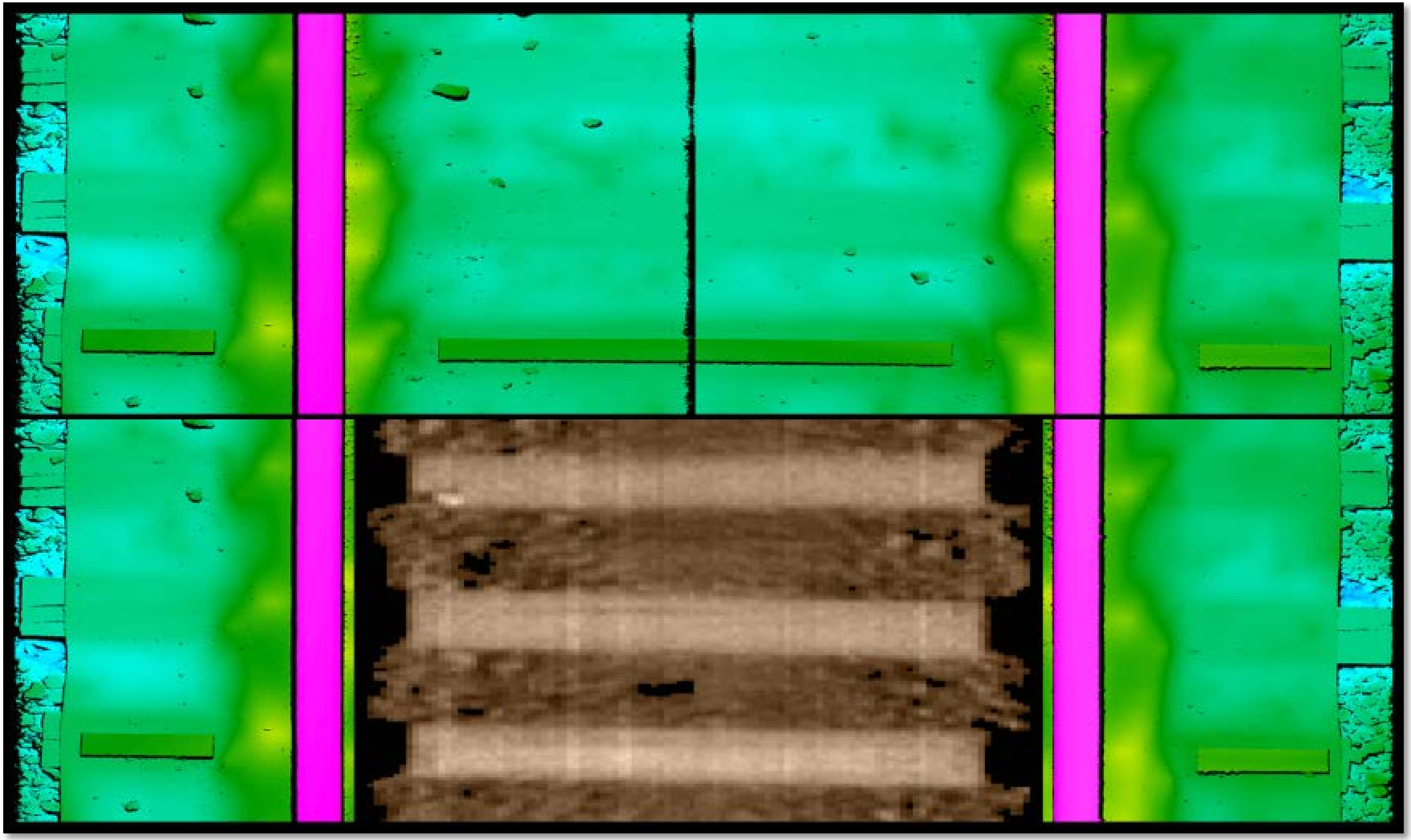
X-Ray Image Segmentation



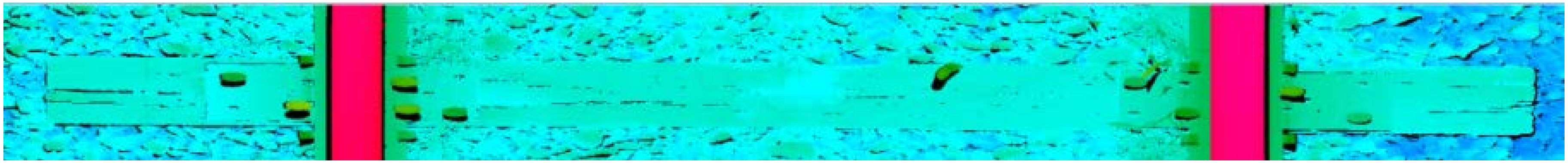
X-Ray Image Segmentation

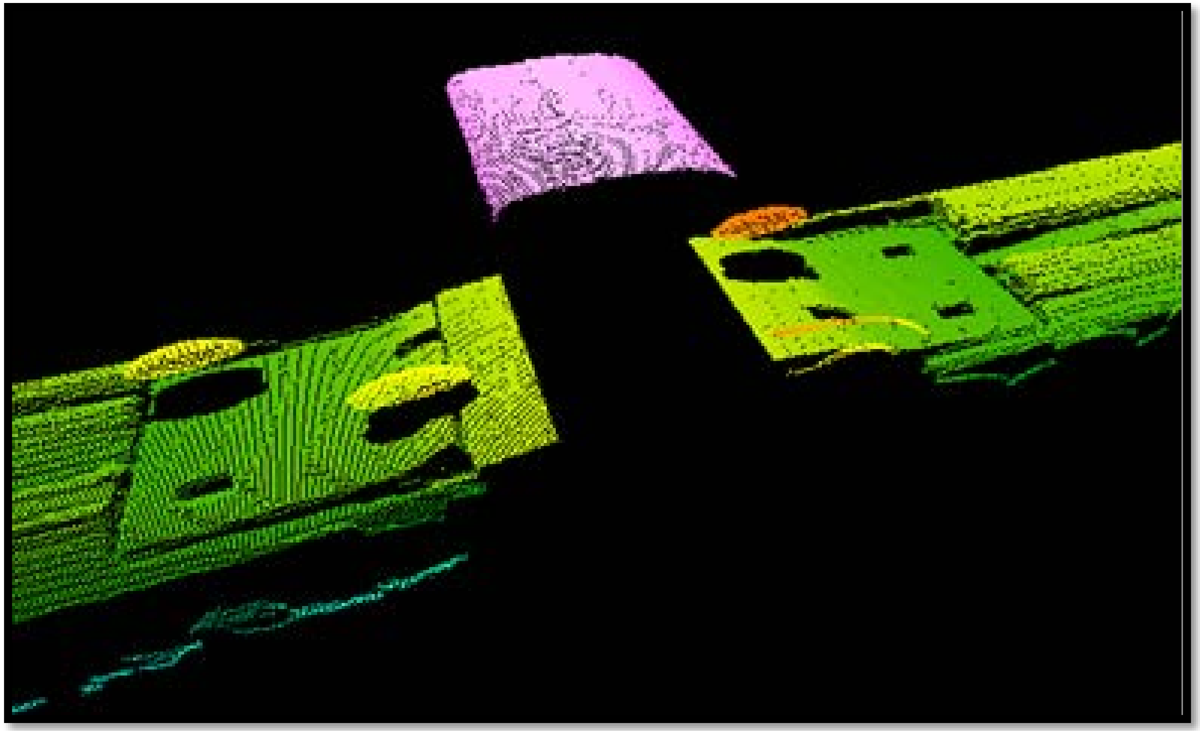


Lubricator Mats and Obstructions

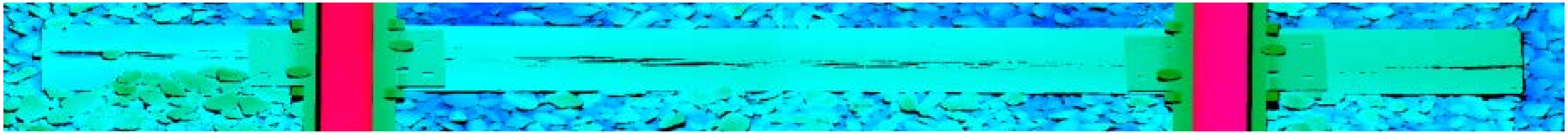


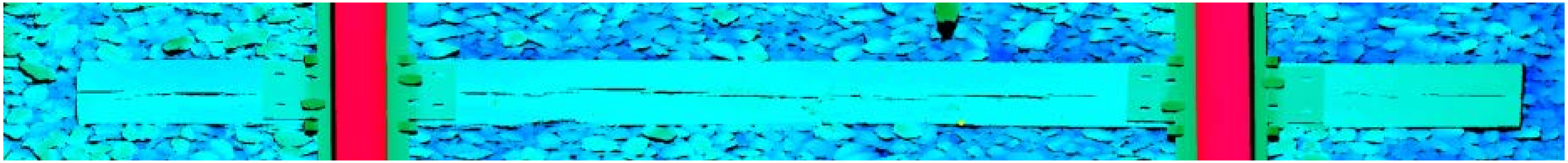
Surface Observed - Plate Cutting



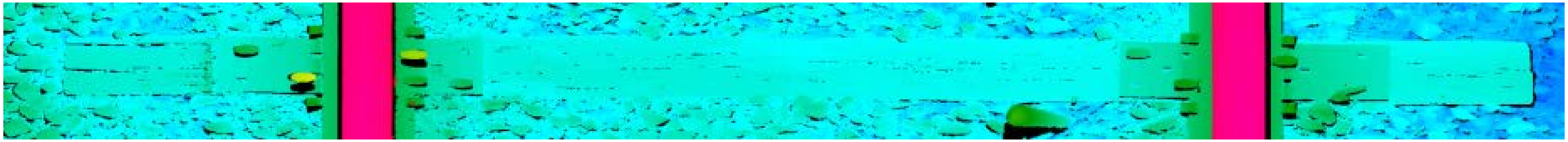


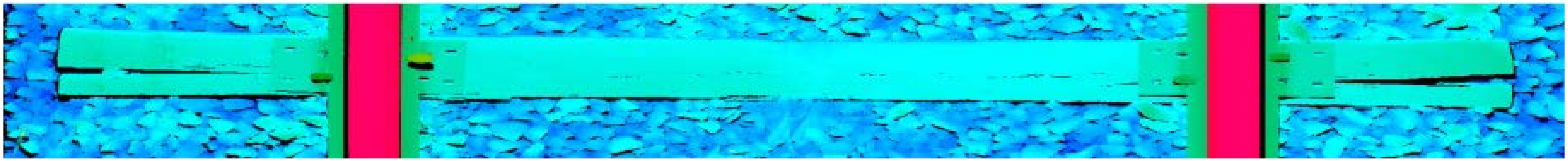
Surface Observed - Splitting



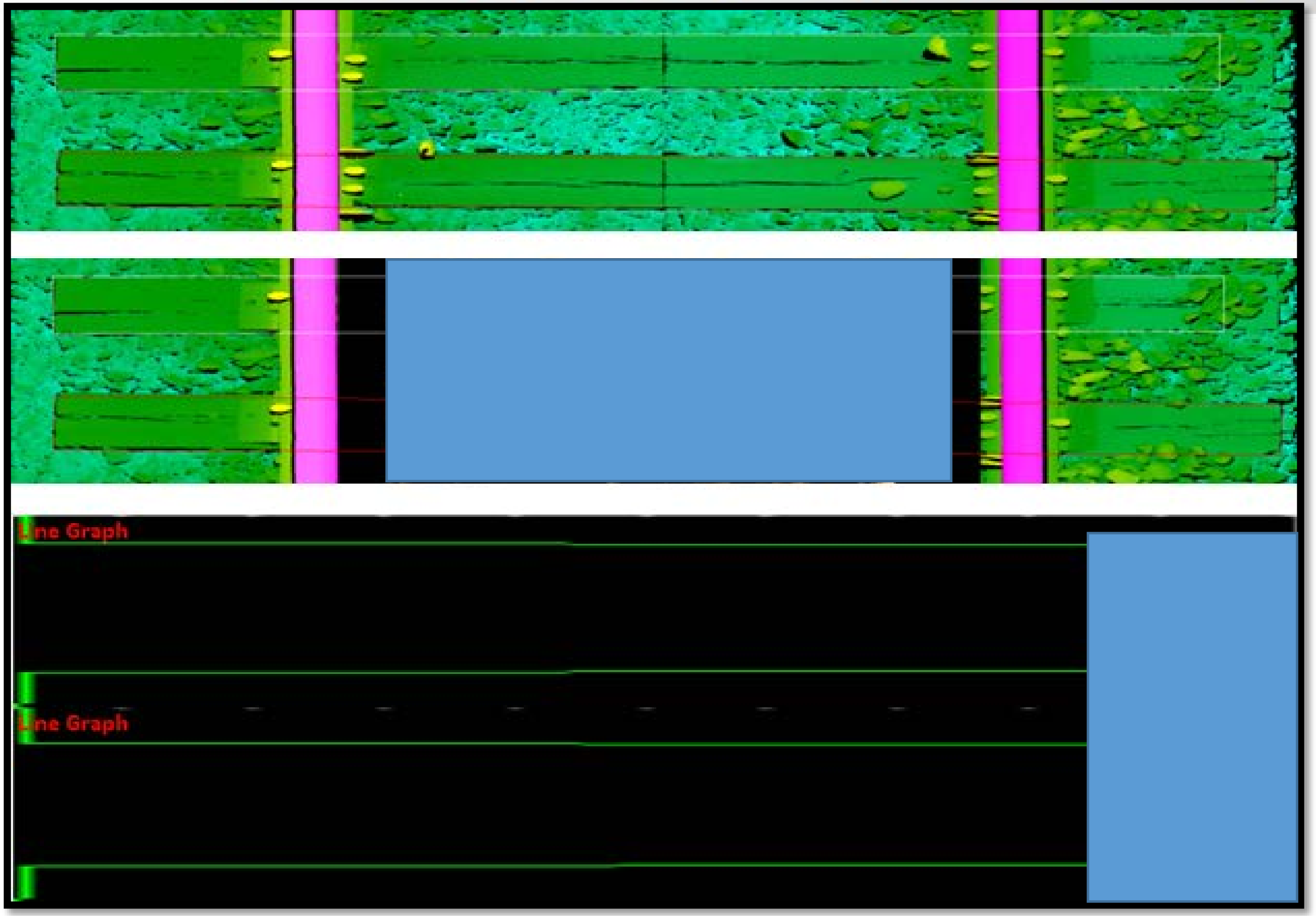


Surface Observed – Loss of Spike Holding

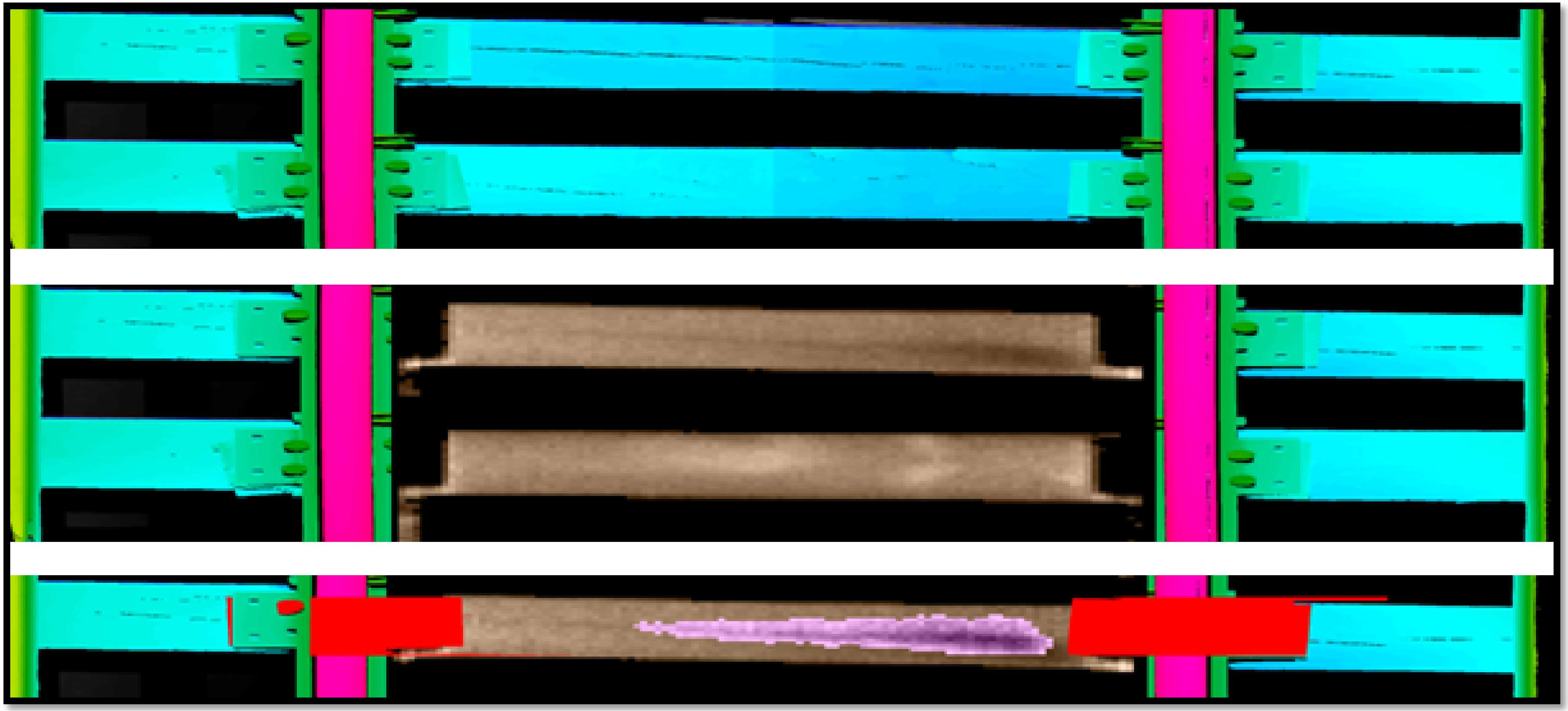




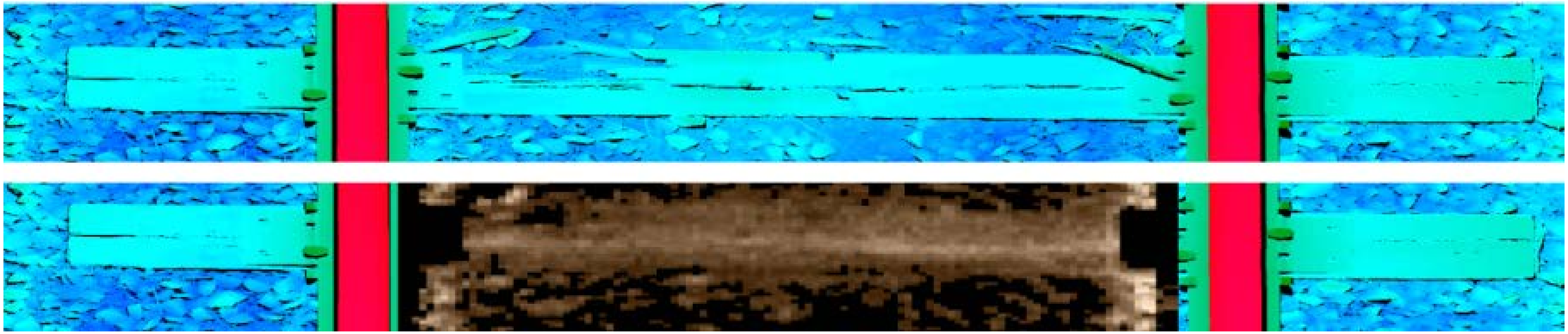
Internal Observed - Splitting Vs. Checking

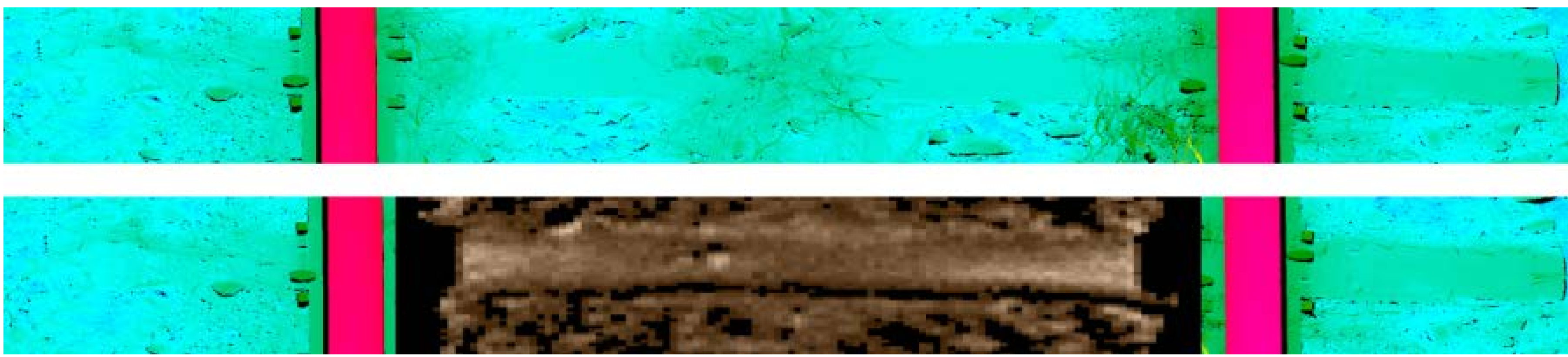


Internal Observed - Localized Flaws

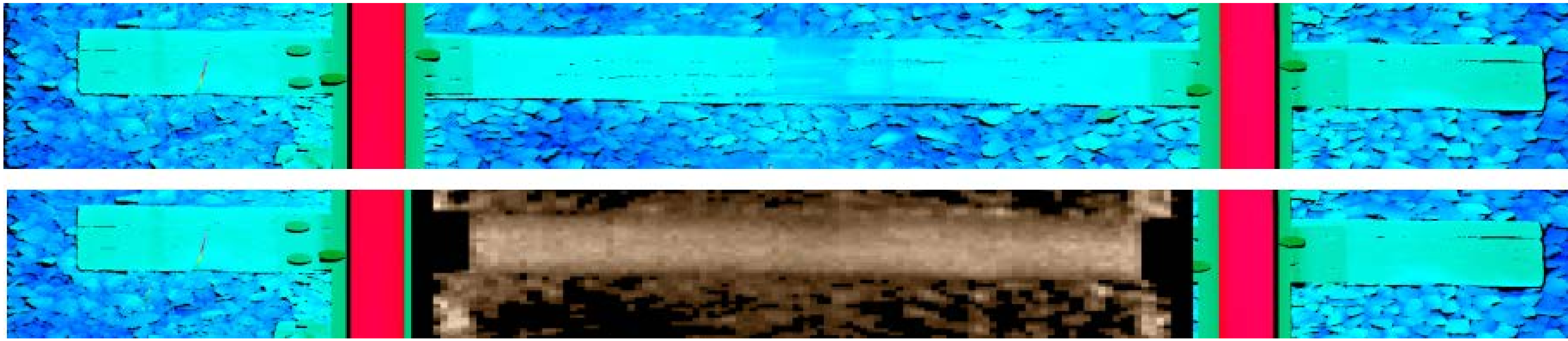


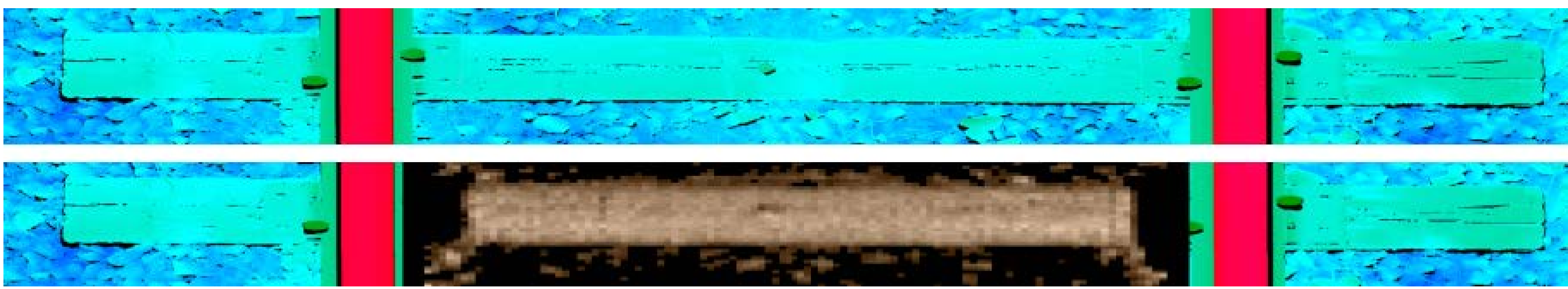
Internal Observed – Plank Ties





Internal Observed – Ugly Surface, but Solid





Integrated Tie Grading

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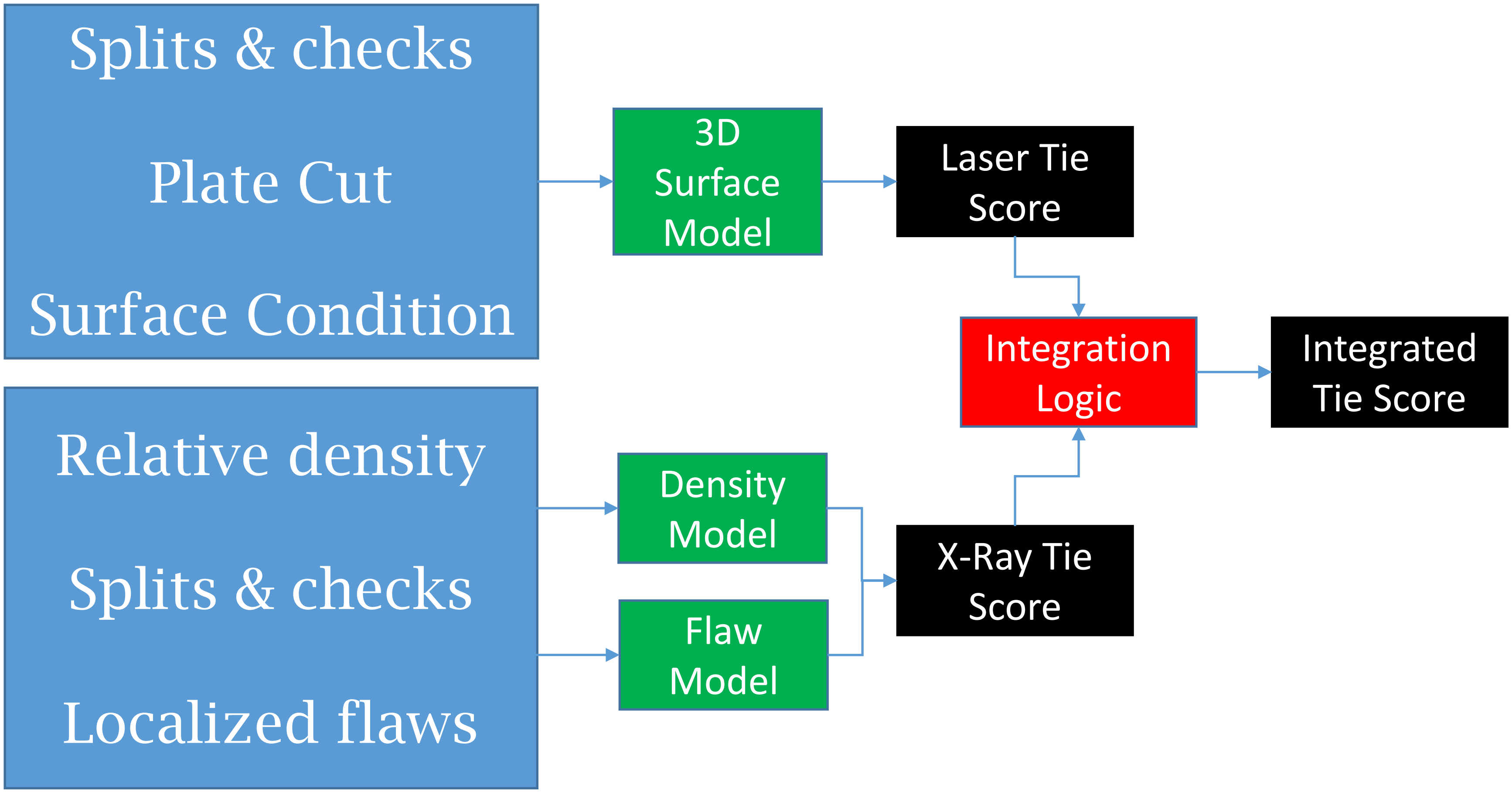
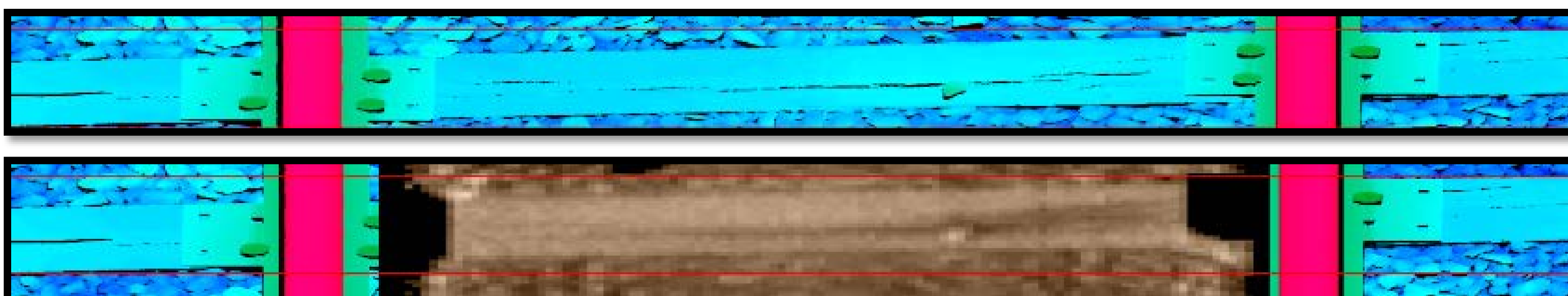


X-Ray Drives Tie Grade

Good ← Grading Scale → Bad

1	2	3	4

Laser Tie Score	X-Ray Score	Integrated Score
2	4	4

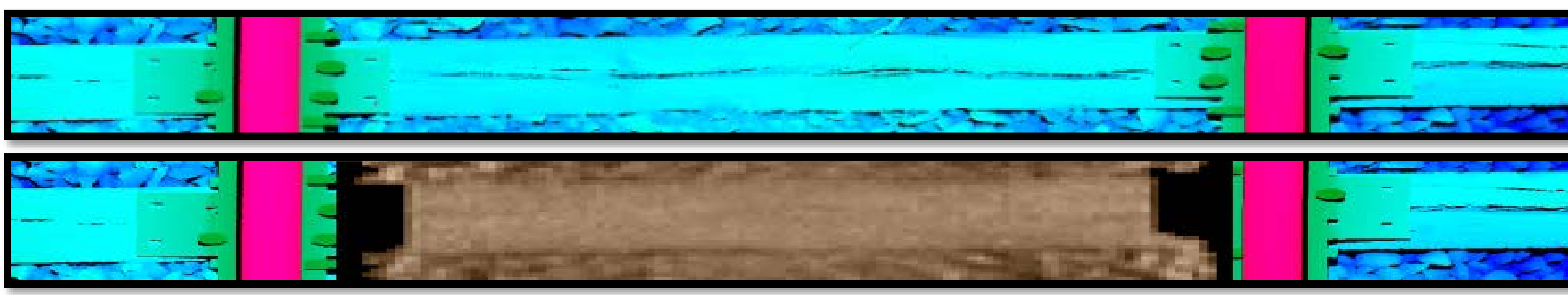


X-Ray Drives Tie Grade

Good ← Grading Scale → Bad

1	2	3	4

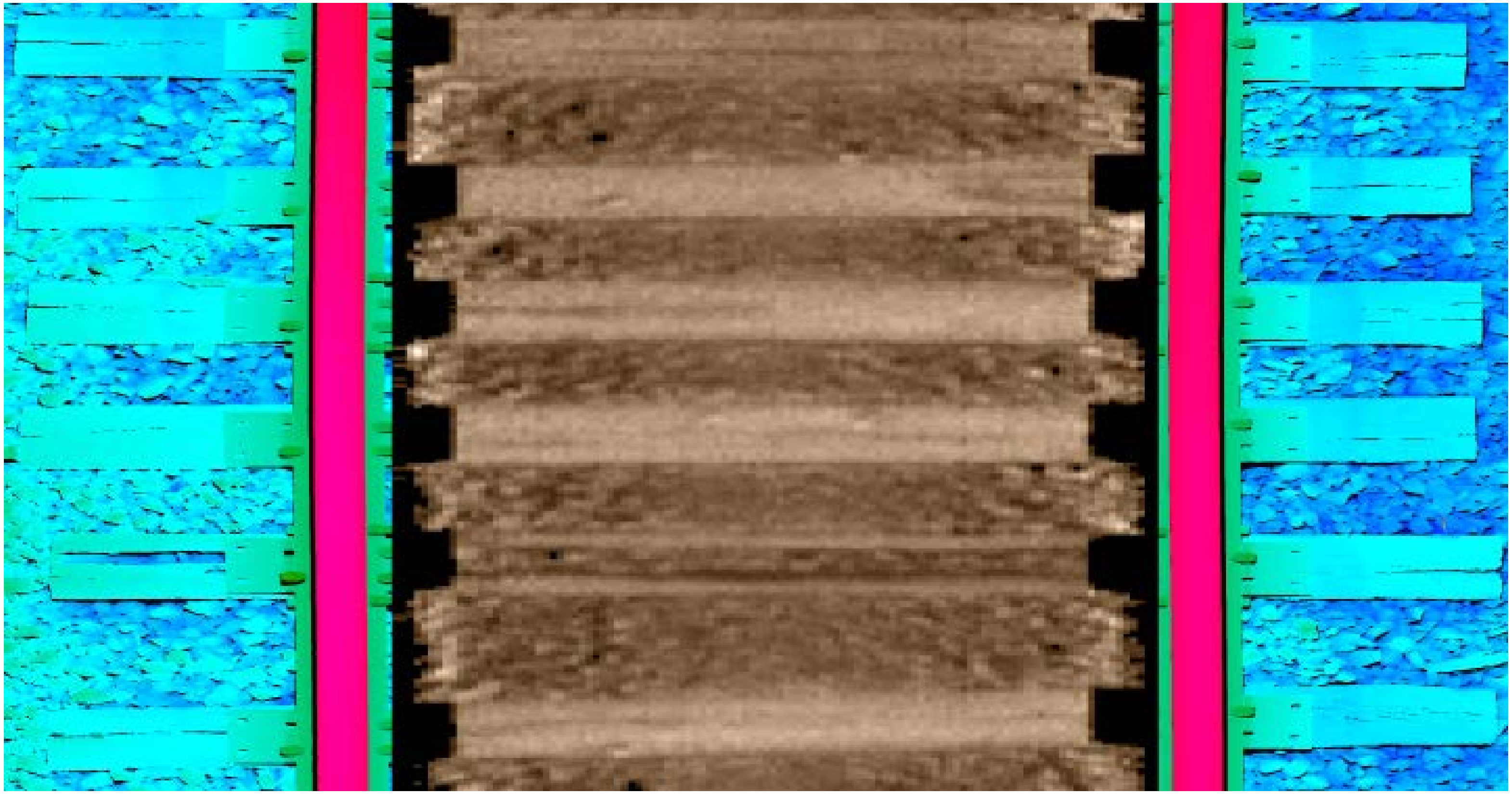
Laser Tie Score	X-Ray Score	Integrated Score
3	1	1



Why Are Accurate Tie Grades Important?

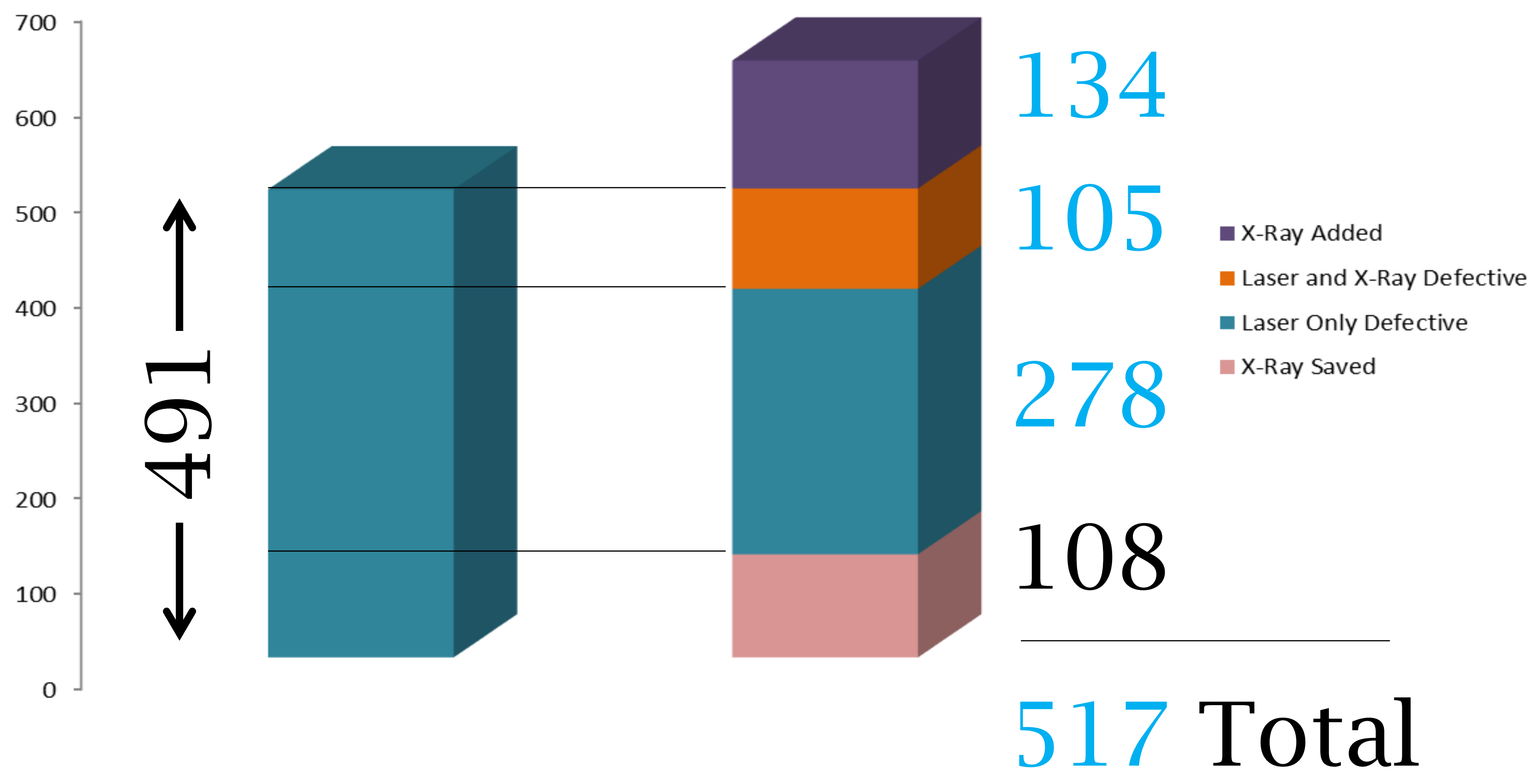
- Pulling ties early wastes asset value
- Leaving defective ties increases chance of intervention
  - Slow orders
  - Spot replacement
  - Return of gang sooner than expected
- Planning capital needs
  - Put the right number of ties in the right place
- Planning gang work
  - Optimized ties
  - Increased speed of gang

Internal Defective Tie Cluster – Automated Inspection



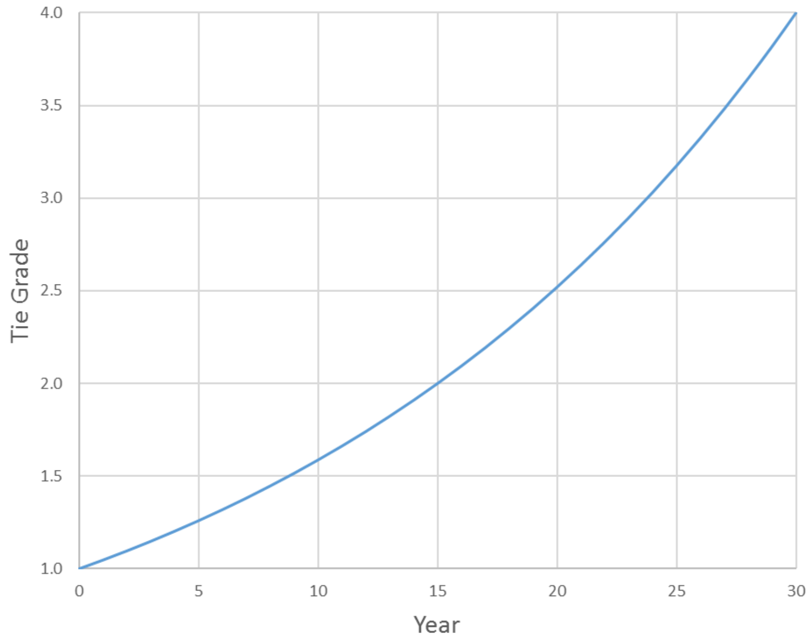
Defective Tie Cluster – Field Inspection

Sample Per-Mile Impact



Assumptions:

- Exponential Degradation from 1 to 4
- Expected Tie Life: 30 years
- Defective Tie Grade = 2.5+
- G = gd^t
  - d = $\sqrt[30]{4}$
  - g = current tie grade
  - t = time in years
  - G = Predicted Tie Grade



Tie Replacement Impact

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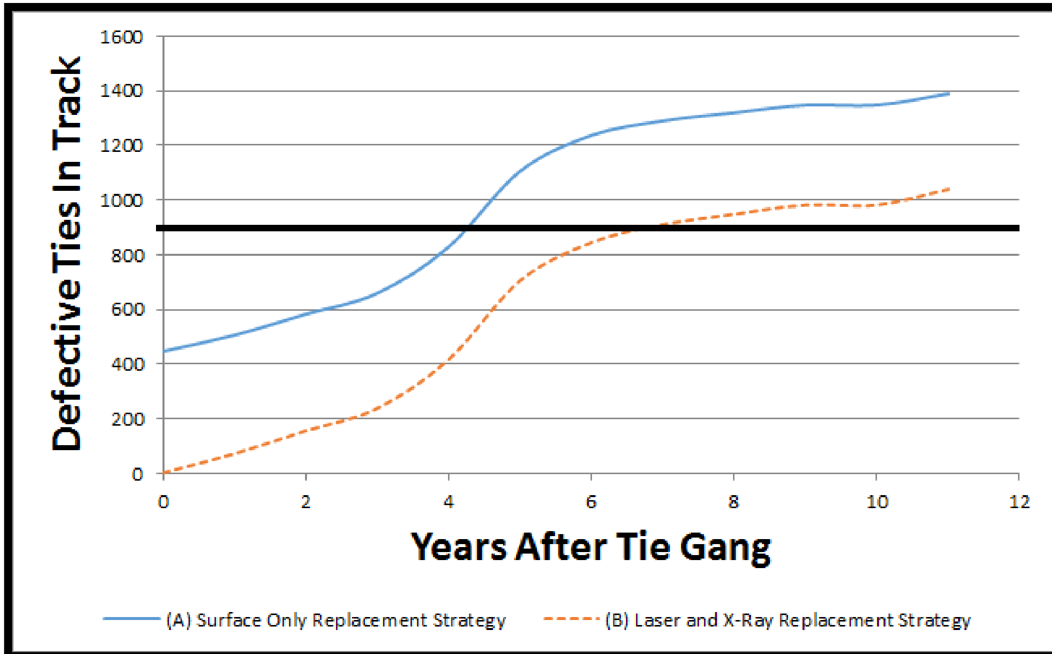
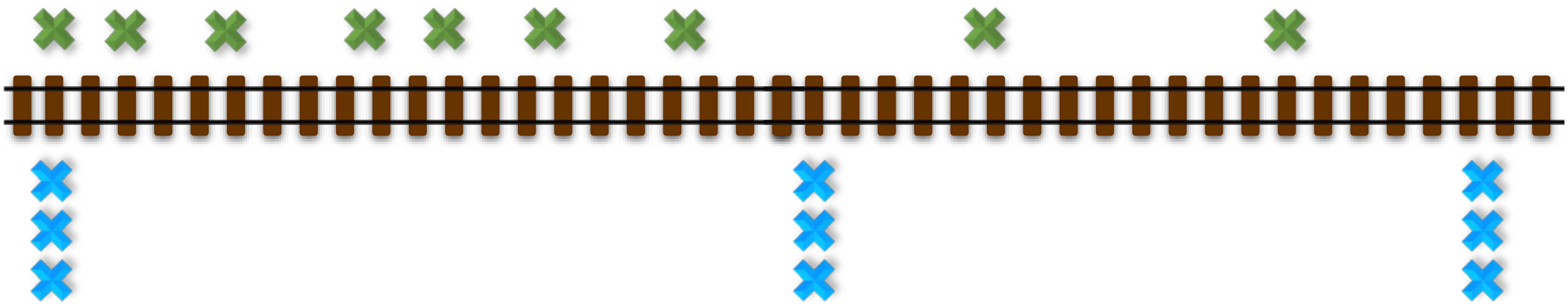


		Year											
	Now	0	1	2	3	4	5	6	7	8	9	10	11
A	985	449	508	585	661	830	1107	1238	1291	1321	1349	1349	1390
B	985	0	70	154	236	415	704	844	910	948	982	982	1039

Inefficient Tie Placement



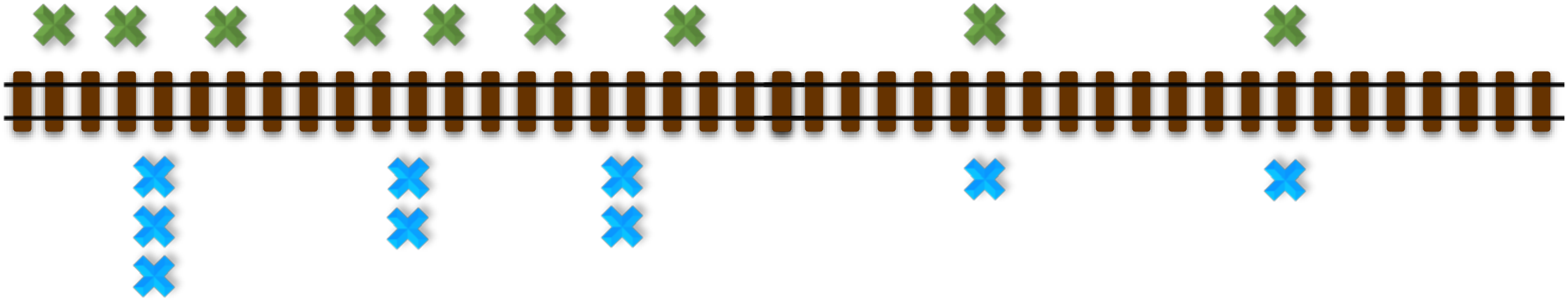
= Location Where New Tie Needed

= Location Where New Tie Placed

Optimization Parameters

- Max Drop Distance
- Tie Gang Direction
- Max Ties Per Drop
- Initial Single Drop Tie Count
- Distance From First Tie
- Minimum Distance Before The Target
- Maximum Distance Before The Target

Optimized Tie Set Out Program



Reduced tie handling by replacement gangs and increased gang productivity

Conclusion

- Recent developments in X-Ray inspection technology optimize distribution of new tie assets. Net result is longer cycle times between maintenance programs creating more time for revenue generation.

- Efficient tie setout programs improve tie gang efficiencies and reduce maintenance time.

- Continued development of technologies at each stage of tie life cycle should reduce, not increase, time needed for maintenance-of-way.

- Technology will expand to other applications including open-deck bridge tie assessment, composite tie analysis, and tie-plant inspection among others.