

Wheel Rail Interaction 2015

Atlanta, Georgia

MAY 18-21, 2015

Introduction

- Railroads strive to maximize performance
 - Increased axle loads
 - Rail grinding
 - Lubrication
 - Wheel grinding
- Rail life exceed 2,500 MGT and is projected to reach 5,700 MGT
- Rail life is beginning to exceed the life of welds
- Fatigue defects are becoming prominent
- Options are being researched and implemented that will be able to extend rail/weld life

AAR initiates Heavy Axle Load (HAL) Research Program in 1988

- Guidance to NA RR industry on increasing axle loads
- Determine most economic payload consistent with safety
- Research showed
 - Technically feasible
 - Economically desirable
 - Technology able to mitigate adverse effects
- 1991
 - Industry accepts 286k GVW cars in interchange service
- 2010
 - 100% of coal traffic
 - 30% of general freight
- 2013
 - 90% of equipment acquired is rated for 286k GVW

Extent of HAL Implementation in 2012

(Commodities with an average of more than 104 tons/load on at least two Class I railroads)

	Corn	Wheat	Iron Ore	Coal	Crushed Stone	Sand Gravel	Hydraulic Cement
BNSF	106.1	107.3	105.6	119.2	106.7	101.5	106.5
CSX	105.0	104.6	106.2	113.9	101.3	99.0	108.5
GTW	100.8	103.8	78.3	117.5	84.9	103.0	111.5
KCS	103.0	102.4		120.2	110.1	110.2	104.0
NS	104.4	102.4	94.7	111.9	103.8	101.7	107.0
SOO	100.1	100.8		118.7		106.2	107.7
UP	106.9	104.4	97.4	118.3	104.6	104.3	107.2
Average	104.8	105.1	86.1	116.7	102.4	102.9	107.3
% Implmt	0-40%	0-40%	0-50%	90-100%	0-20%	0-25%	20-60%

Source of Data: STB Quarterly Report of Freight Commodity Statistics, Third Quarter 2012.

Rail Improvements

- Rail is getting longer
 - 1831 – 16 foot lengths
 - 1880 – 39 foot lengths
 - 1940 – 78 foot lengths
 - 1988 – 80 foot lengths
 - 2002 – 480 foot lengths
- Rail is getting harder and stronger
 - Tensile Strengths at 200,000psi
 - Hardness at 430 HB

Different Types of Defects are Becoming Prominent

- Fatigue related defects
- Reverse TDs
- SSC – Shelling, Spalling & Cracking

One Class I's Problem

Track Issue Caused by HAL



Rail/Weld Issue Caused by HAL



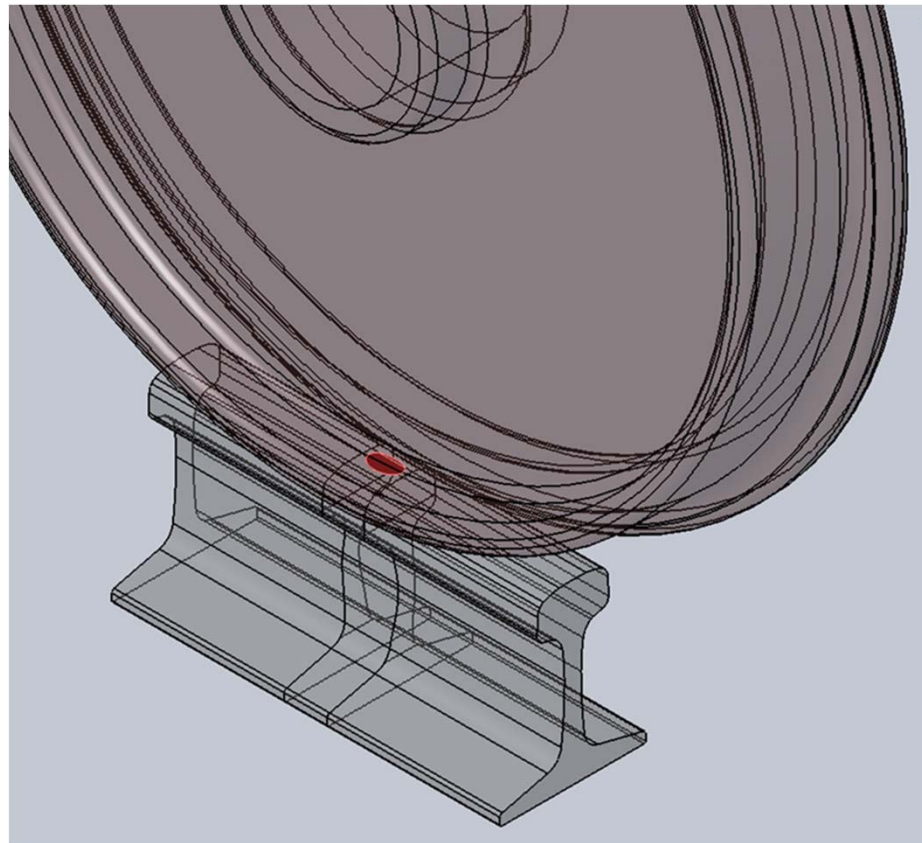
Rail/Weld Issue



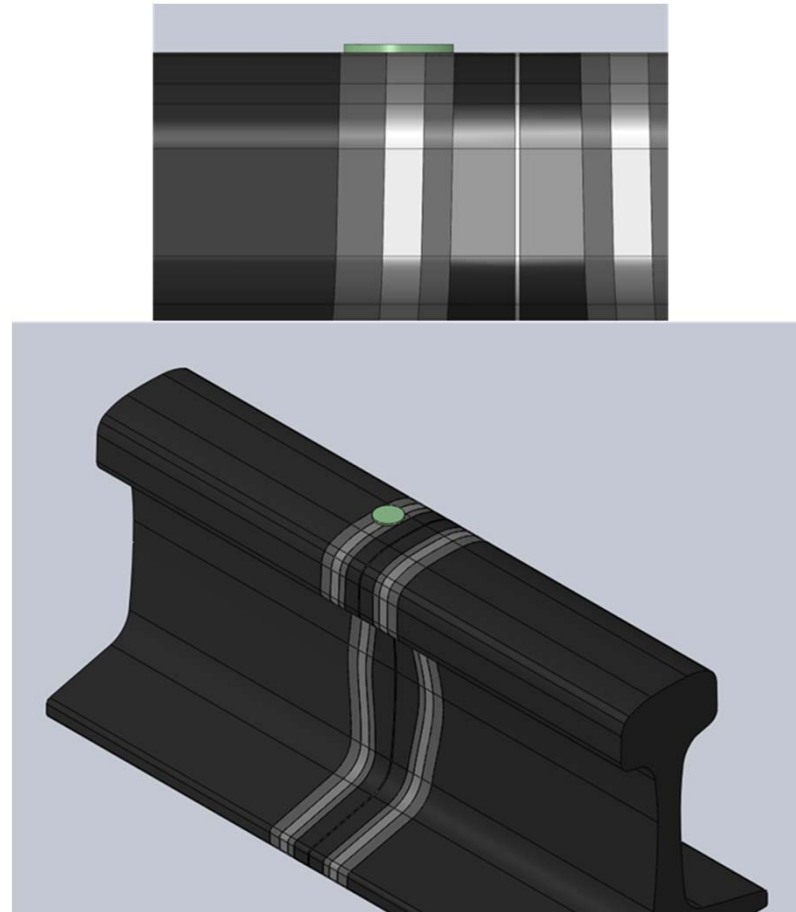
SSC – Shelling, Spalling, Cracking



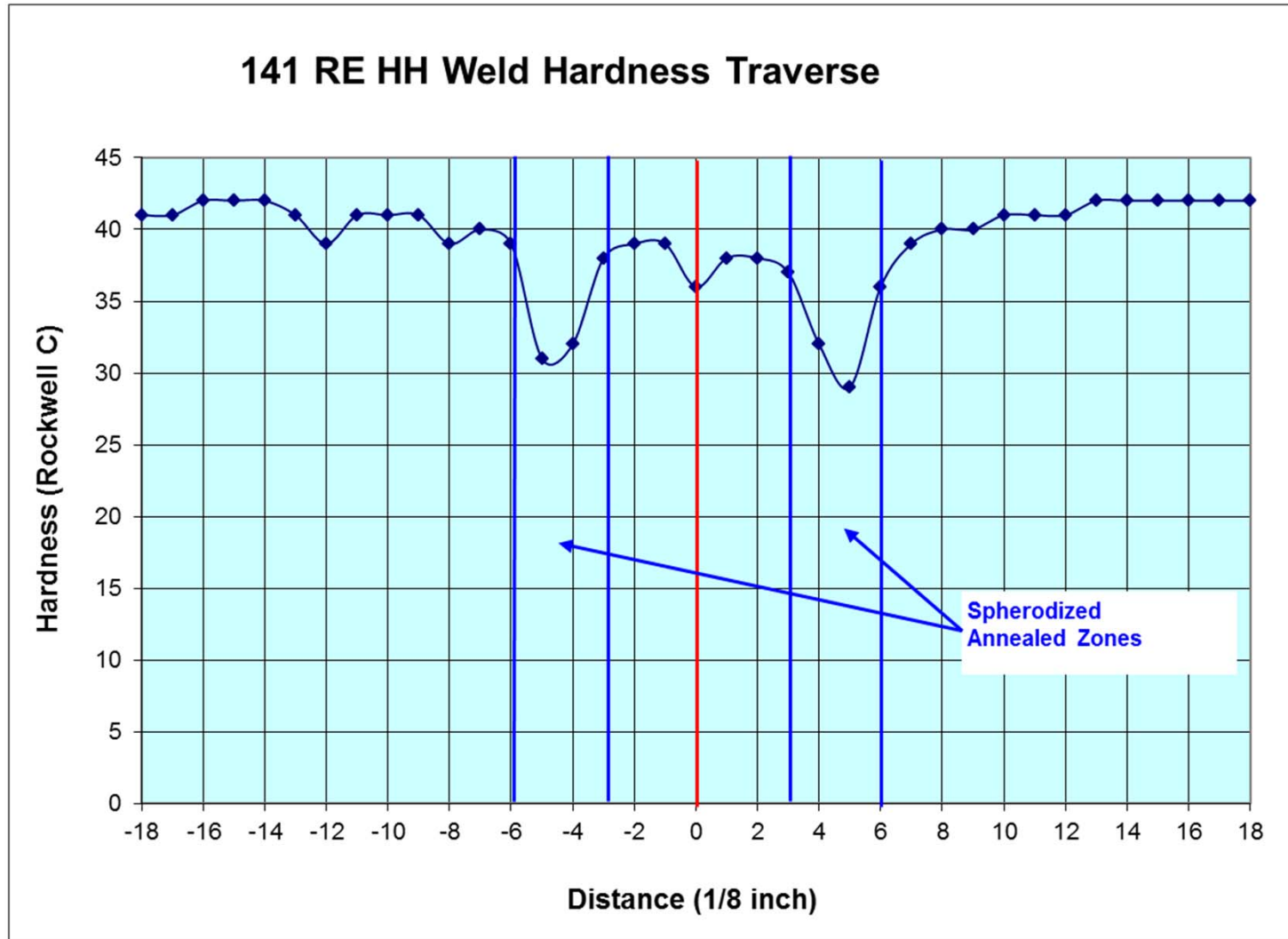
High Stresses Generated at Wheel/Rail Contact



Contact Patch Can Not Bridge Softened Zones of Weld



Weld Hardness Profile



Spherodized Soft Zones

- Rail steel has a hard pearlitic microstructure
- The weld zone becomes austenitic +1300 degrees F
- Moving away from the weld, the maximum rail temperature has never reached a temperature high enough for the material to re-austenitize.
- Soft zones are caused by time at temperature in locations where the rail has remained pearlitic. The plates of pearlite become soft (annealed) rounded spheres.
- There is no way to avoid this

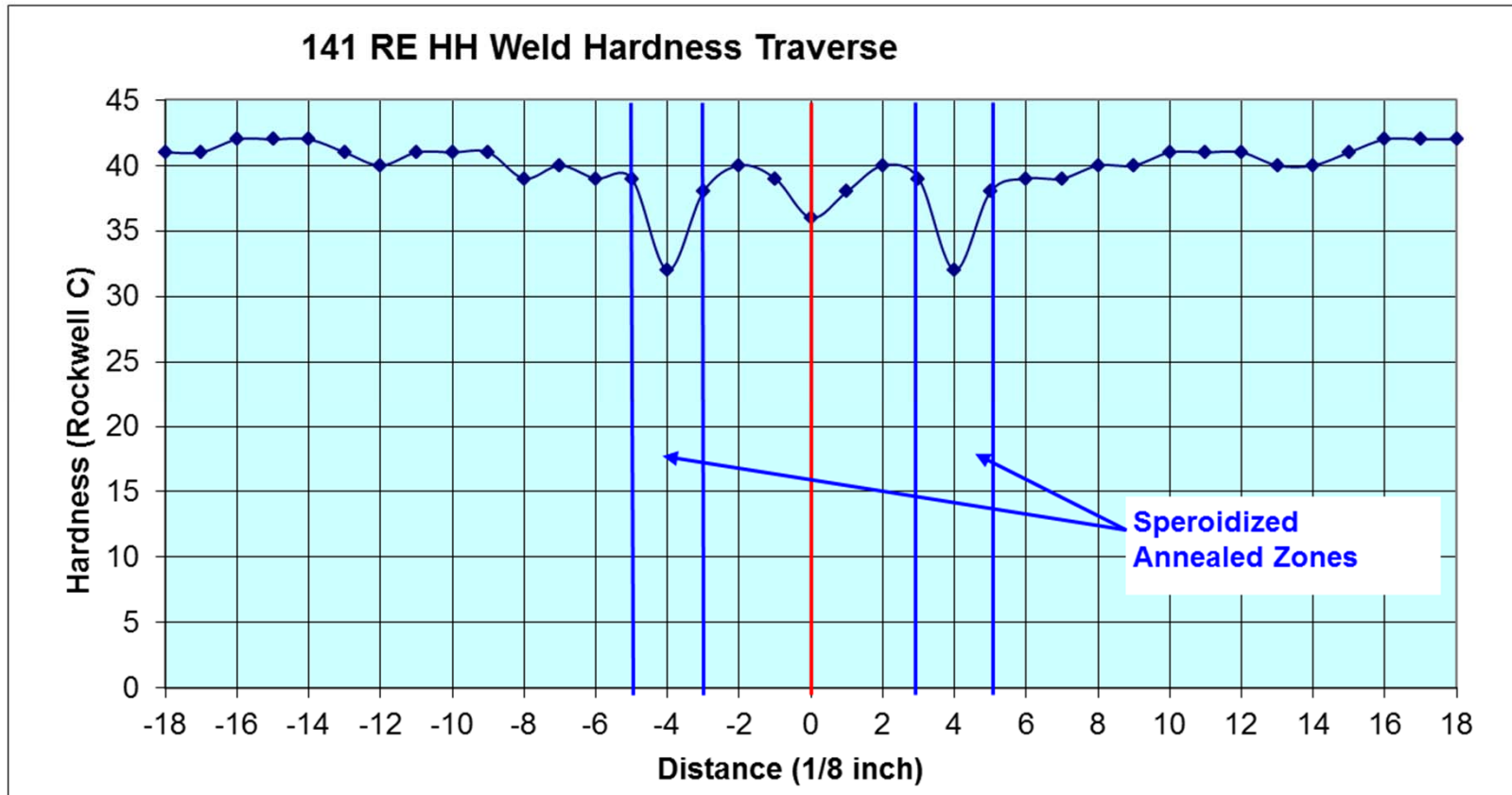
Solution One

Address the Weld Making Process

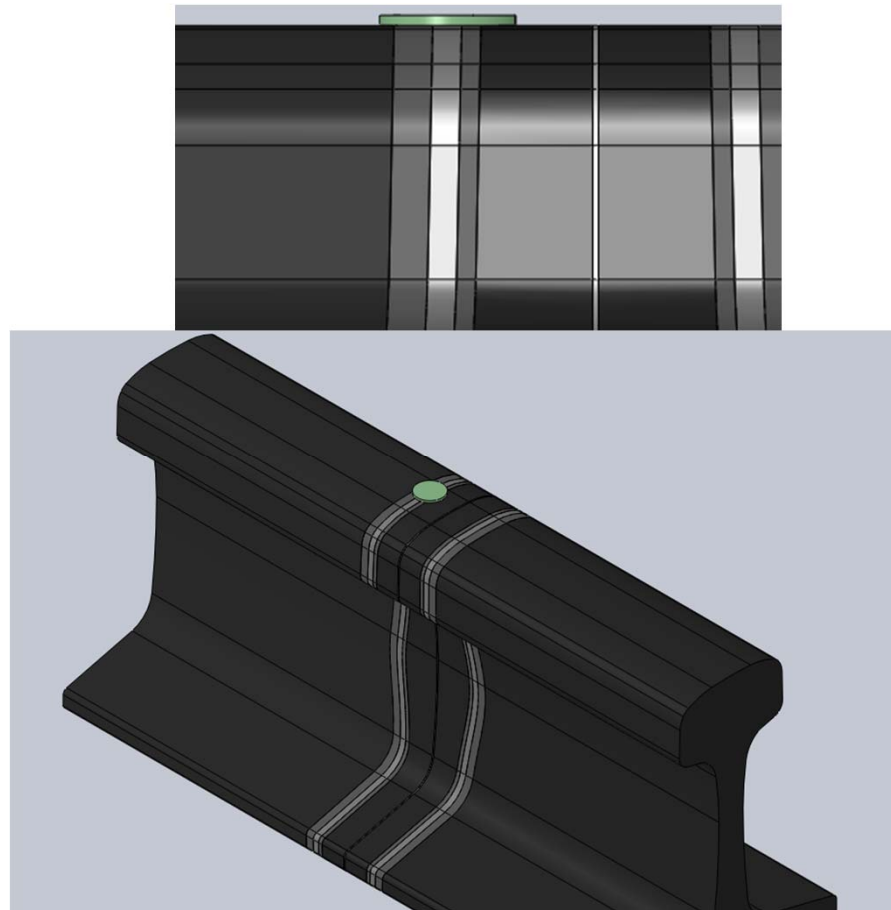
Weld Making Process Options

- Reduce the size of the spherodized zones
 - Less heat input
 - Potential weld hardness issues
 - Potential high residual stress issues in the weld
- Welding process changes
 - Reduce heat to a minimum while avoiding too high of a hardness or undesirable microstructures
 - Slow down cooling in the web to mitigate residual stresses

Reduce the Spheroidized Zones



Contact Patch Can Better Bridge the Softened Zones of the Weld



Solution Two

Minimize the Population of
Welds in Track

Benefit of Long Rail

- Rail is traditionally 80 ft in length
- Rail produced 480 ft in length
requires fewer welds
- Rail welds per mile $5280 / 480 = 11$
- Rail welds per mile $5280 / 80 = 66$
- 480 ft lengths require 17% of the welds per mile as 80 ft lengths

Railroads and Suppliers Working Together

- Class I railroad
- Rail Suppliers
- Rail Welding Company

Long Rail in North America

Start with a Greenfield Site Port of Stockton



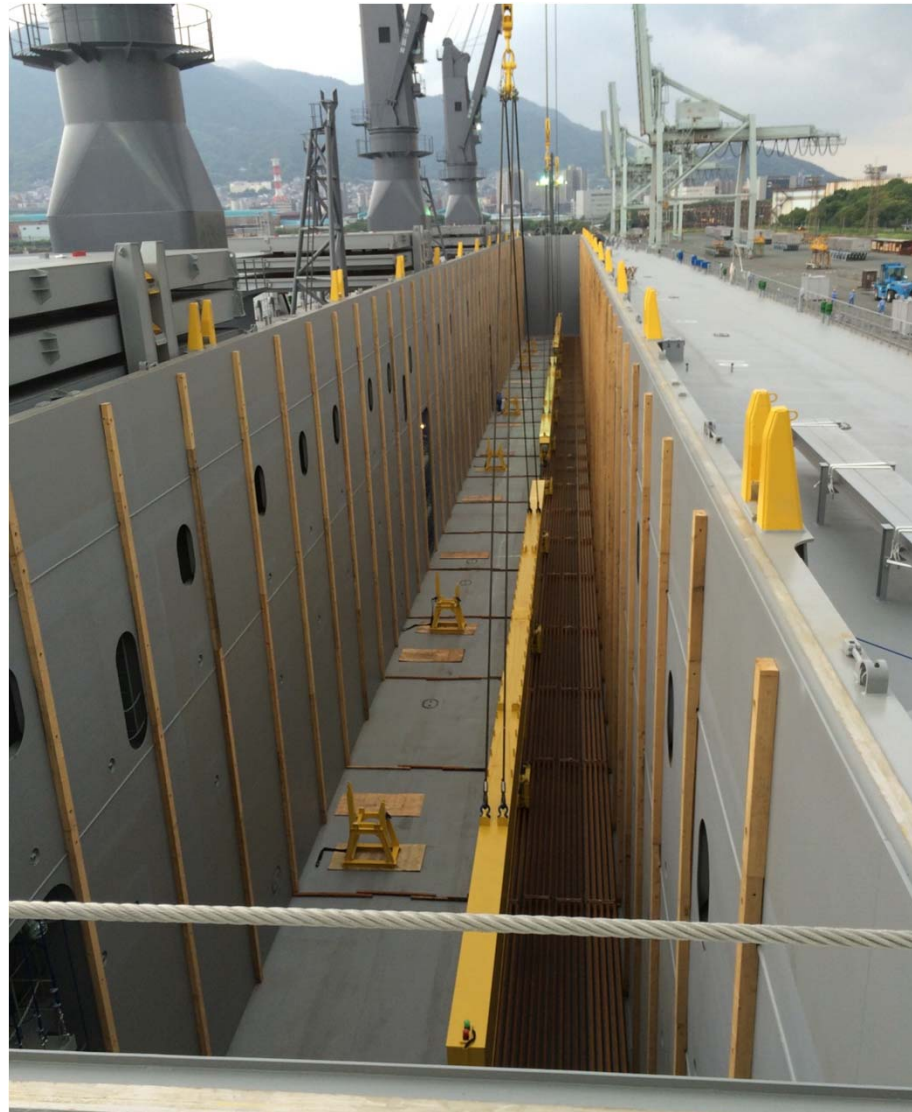
Method to Transport Rail to NA



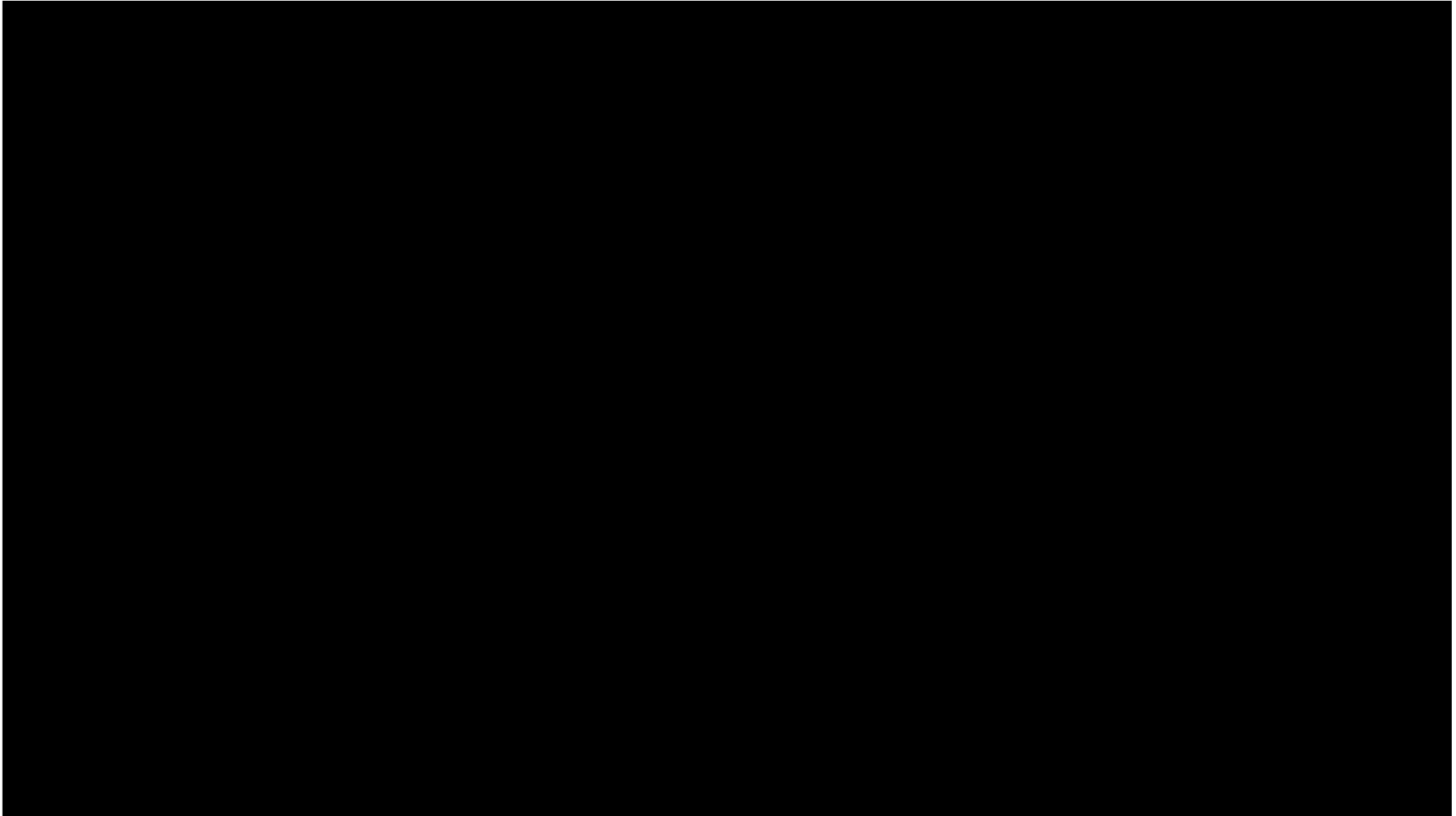
LRC 480



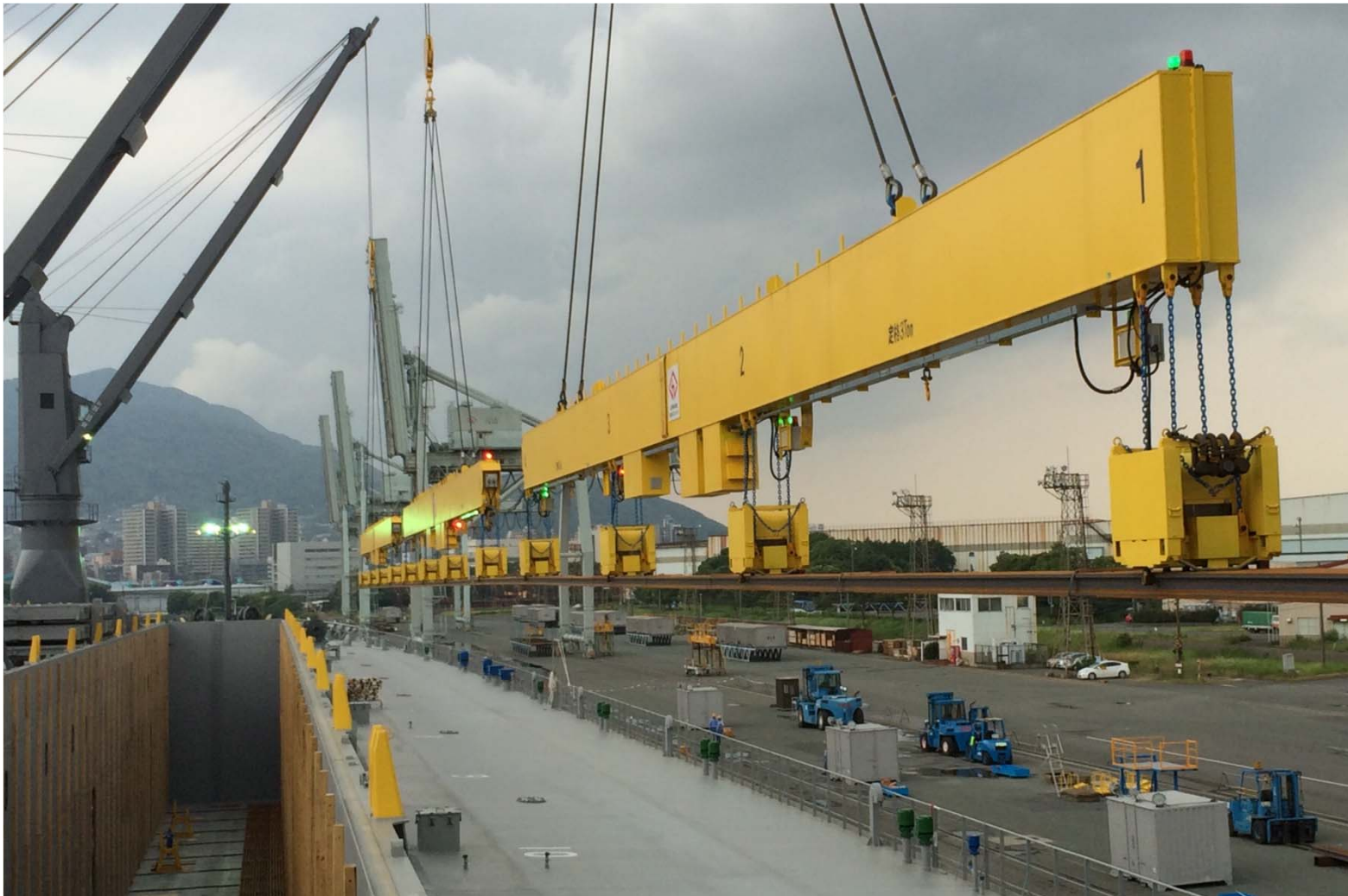
Hold to Carry the Rail



View Around the Ship



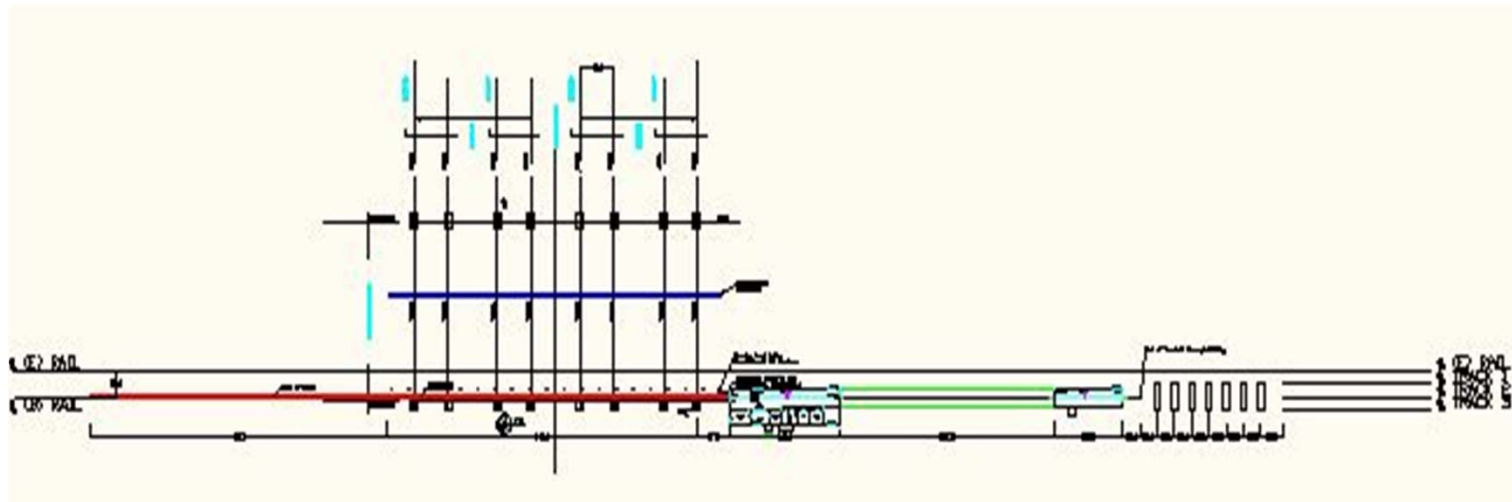
Method to Load/Unload the Rail



Method to Bring the Rail to the Ship



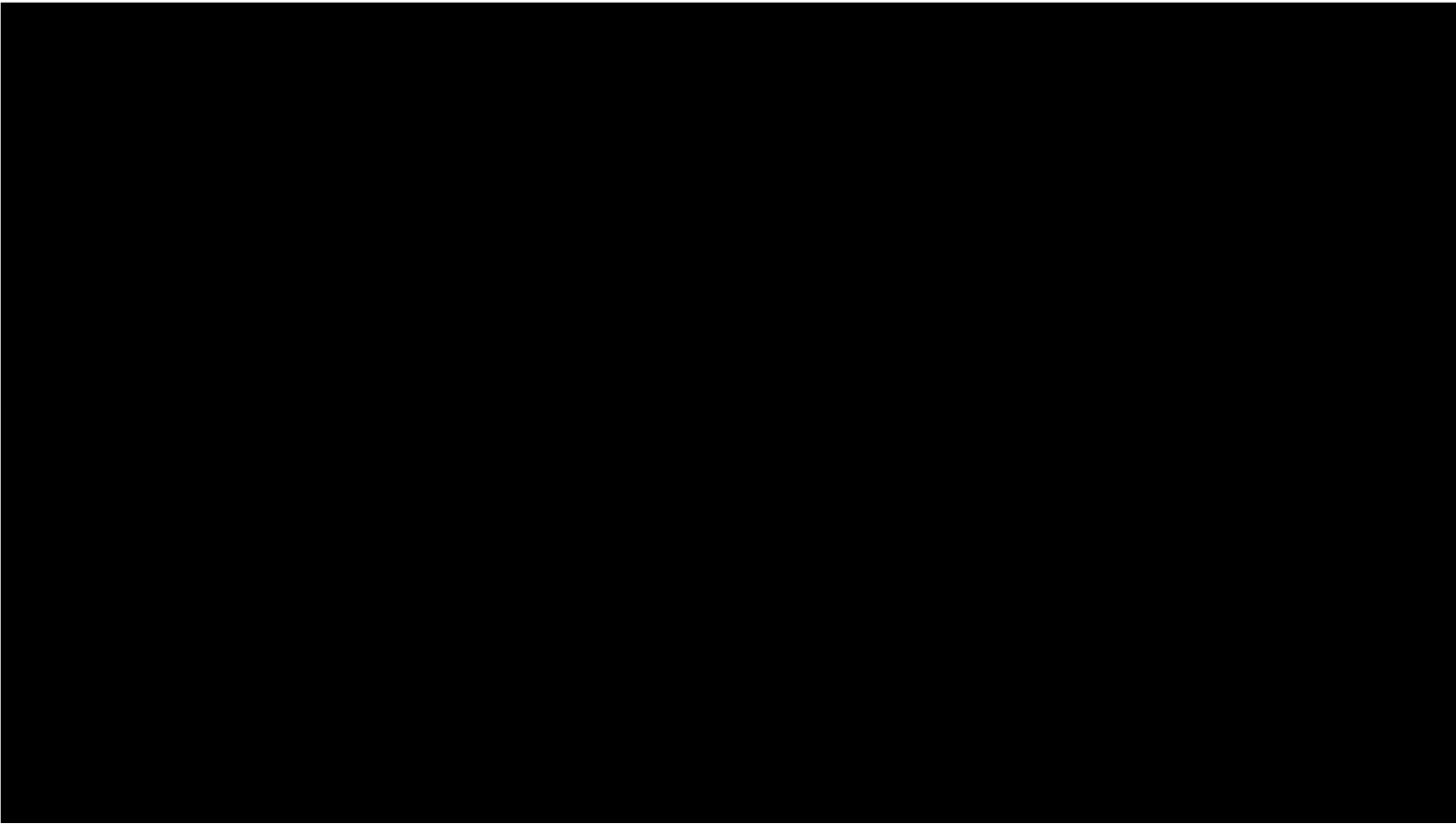
Concept to Store/Weld the Rail



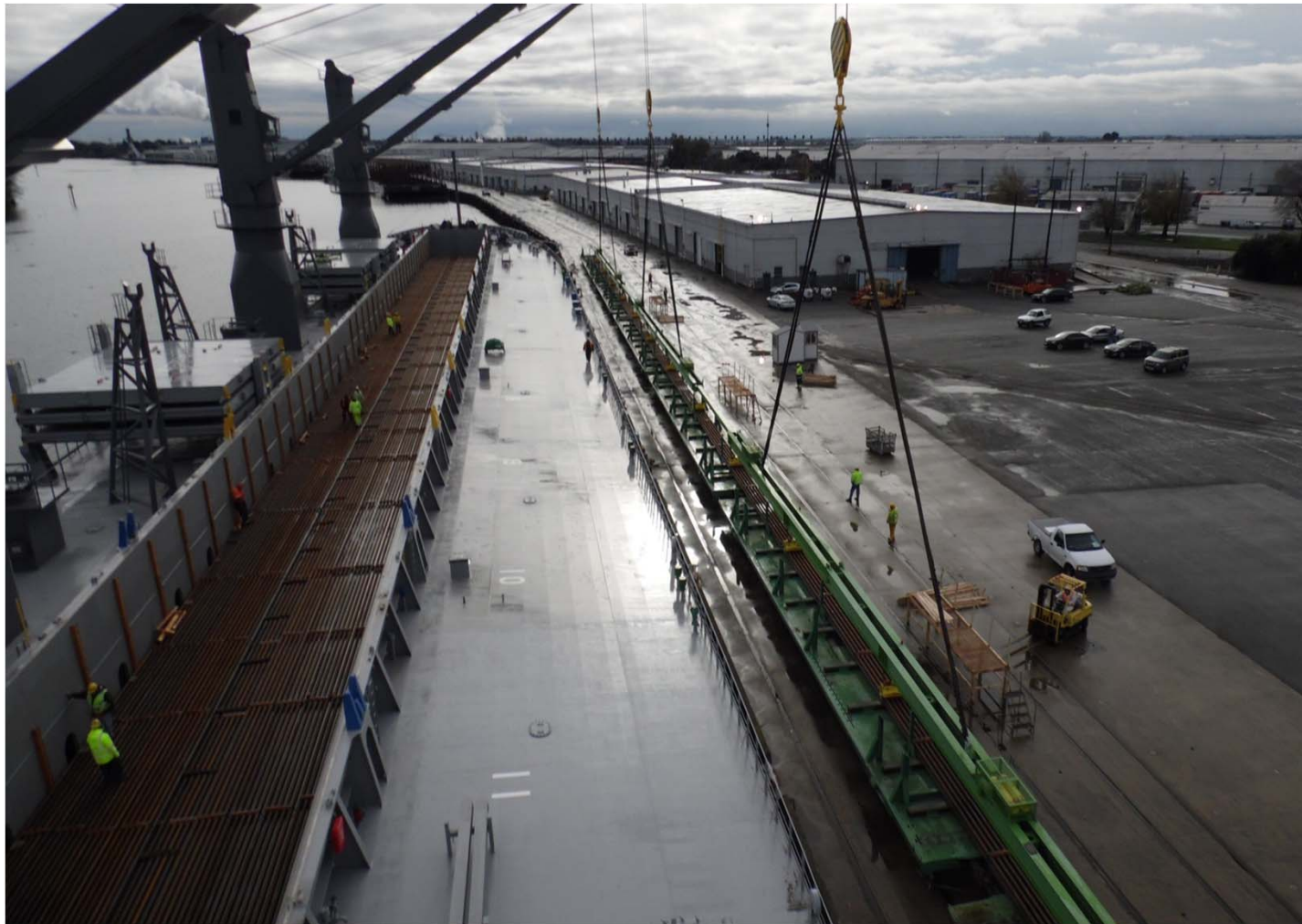
Facility to Store/Weld the Rail



Constructing the Facility



Train to Transport the Rail from the Ship to the Welding/Storage Facility



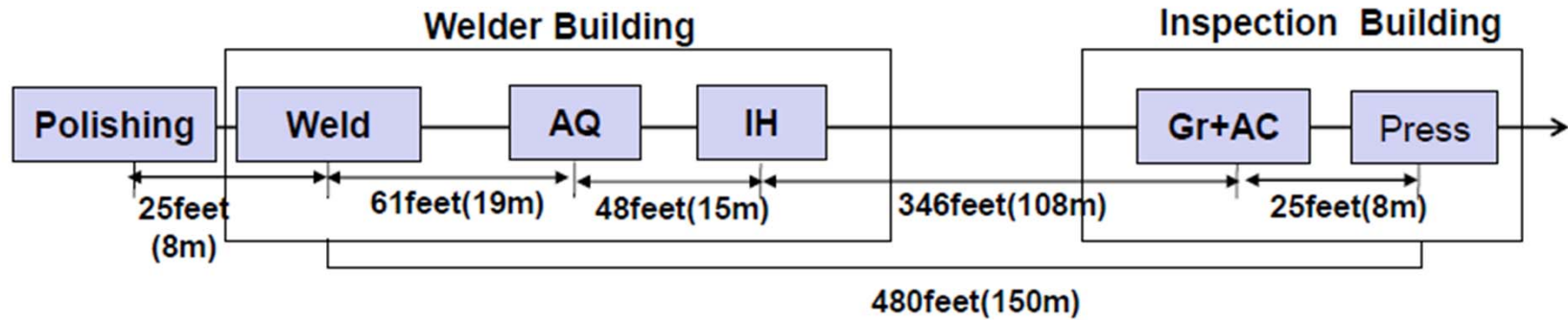
Rail Can go to Welding Feed Tables or in to Storage



Storage Facility



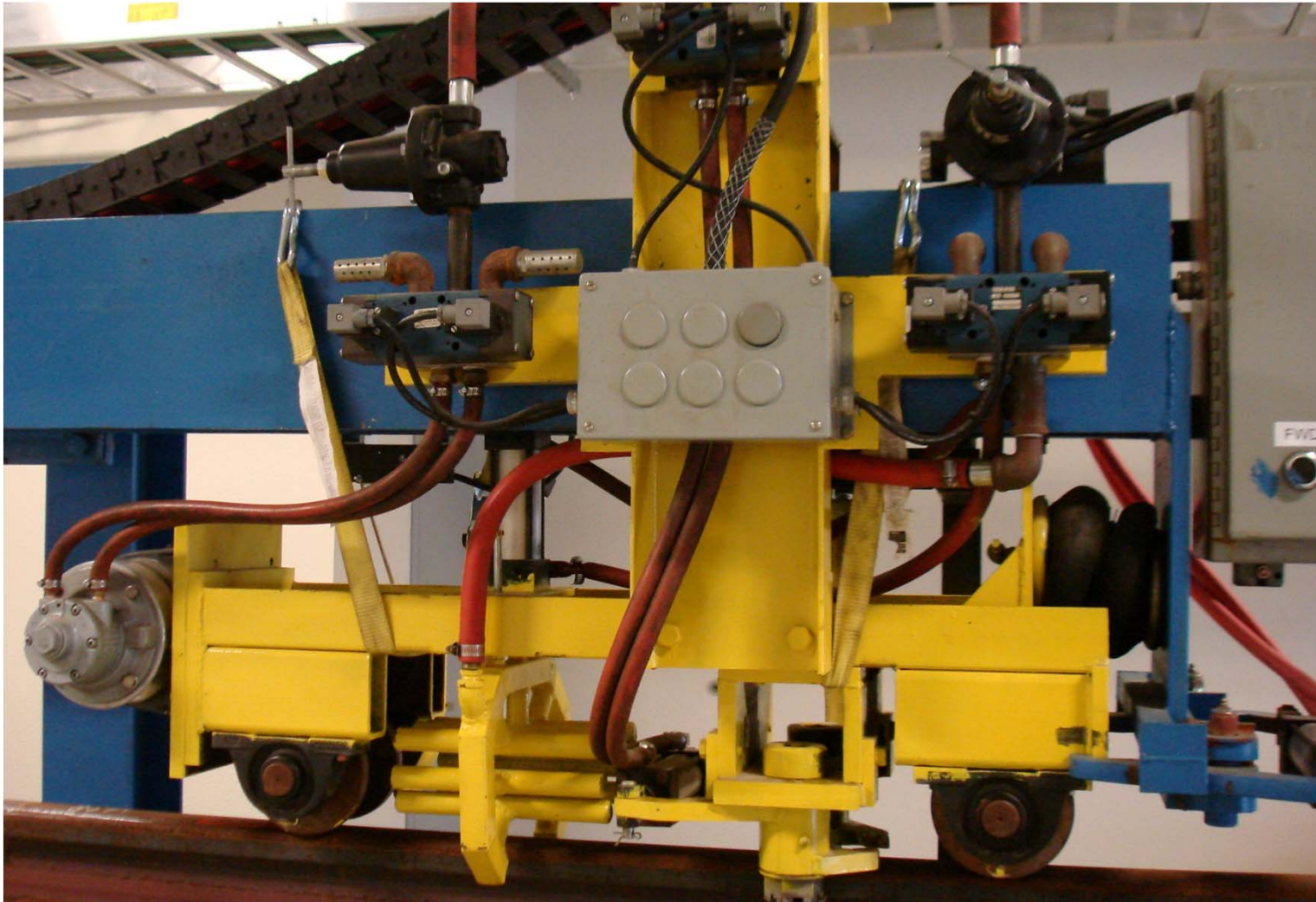
Welding Facility Layout



Welding Facility



Automatic Quench



Post Weld Heat Treat Station



PWHT to Reduce Residual Stresses



Lead Out Stands



In Conclusion

- Heavy axle loads appear to be shortening the potential life of the rail
- Technology and methods exist to address the rail issues caused by HAL
- Railroads are looking for and implementing new technologies and methods to prolong the life of rail assets

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Questions

Thank You