NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

May 10, 2013

MATERIALS LABORATORY FACTUAL REPORT Report No. 13-037

A. ACCIDENT INFORMATION

Place	:	Paulsboro, New Jersey
Date	:	November 30, 2012
Vehicle	:	Freight Train FC4230
Operator	;	Consolidated Rail Corp. (Conrail)
NTSB No.	:	DCA13MR002
Investigator	:	Cy Gura, RPH

B. COMPONENTS EXAMINED

Deck Side Locking Portions of the Paulsboro Movable Bridge
Hydraulic Cylinder Piston Shaft

C. DETAILS OF THE EXAMINATION

The deck side locking portions of the swing bridge were examined at a Conrail warehouse in Philadelphia, Pennsylvania on January 9, 2013. Representatives of Conrail and the FRA were present to assist.

The examined bridge and mating land-side components are displayed in figure 1 and arranged in their approximate original bridge closed relative positions. All of the recovered bridge deck-level locking components were examined including approximately 10 to 15 feet of running rail on either side of the bridge to land interface.

The north and south ends of the bridge contained independent locking mechanisms. Though of different mechanical component details, they operated on the same principle. With the bridge structure in the closed position (closed to marine traffic open to rail traffic), sliding blocks on the swing span were actuated through deck side operating rods by under deck mechanisms. The sliding blocks extend outward from the swing span and engaged slots on the land side fixed structures. Both the north and south ends had mirrored locking components associated with each of the running rails (east and west). According to Conrail representatives, with the bridge closed the gap between running rails at the bridge to land interface was specified as 2 ¾ inches. Figure 2 contains an illustration of the bridge showing the locking mechanisms in both the unlocked (left) and locked (right) positions. Note the positions of the red sliding blocks in each illustration.

As previously noted, the locking mechanisms at the north and south ends were slightly different designs utilizing completely different components. However, both designs used the running rails to form the gage sides of the locking mechanisms.

At the north end, four specialty blocks (two per rail) guided the field sides of the slide blocks on the swing span and two blocks (one per rail) formed the field sides of each slot on the fixed land side, see figure 3. The field side heads of the running rail are trimmed to accommodate the shape of the slide blocks. The approximate length of engagement of the sliding block into the fixed side slot is also indicated in figure 3. Proximity detectors were mounted on brackets attached to the fixed side guide blocks for both east and west rails. The centerlines of proximity detectors located 6.5 inches north of the ends of the fixed running rails. Gage side wheel flange guards were incorporated into the support structures of both the swing and fixed side mechanisms.

For the south end lock mechanisms, the bottom flanges of short sections of stock rails were butted against the bottom flanges of the running rail adjacent to the gap on both the swing span and land side to form the slot for the sliding blocks, see figure 4. The south sliding blocks were machined so as to ride in the web area pockets formed by the running rail profile and the short stock rail sections. The approximate length of engagement of the sliding block into the fixed side slot is also indicated in figure 4. The south end proximity detectors were located in the webs of the fixed stock rail sections. The detector centerlines were located about 5 inches south of the northern tips of the stock rail sections. Due to the near proximity of the bridge pivot to the south edge of the bridge, the southern bridge to land interface components were heavily angled to accommodate the short pivot radius.

North Side Lock Components

Examinations of the north side components found the north corner of the fixed northwest flange guard overstress fractured but no other fractures of major components were present on either the east or west rail locks. The brackets holding the proximity detectors had been removed prior to the time of this inspection. The end of the running rails (east and west) showed battering deformation for 2 to 3 inches on both the swing and fixed spans, see figure 5. Both east and west slide blocks moved relatively easily in greased areas on the swing span. Displaced grease in the fixed side slots indicated a normal slide block engagement of approximately 8 inches.

The north ends of the slide blocks were undamaged as were the mating areas of the fixed side slot components. Multiple marks and dents consistent with wheel flange impacts were noted on the swing span components including the gauge side wheel flange guard at the northwest rail and on top of the field side guide blocks of the northeast rail. Wheel flange marks are denoted in figure 6 for both the west and east sides.

South Side Lock Components

The proximity switches were present on the south lock components and were removed for testing.

Disturbed grease lines on the fixed side components indicated about 5 to 6 inches of engagement of the slide blocks. Minimal battering deformation was noted on the rail heads on either side of the gaps in the south side running rails.

The fixed southwest running rail was fractured though the web for approximately 18 inches, see figure 7. Conrail representatives indicated that the rail was originally found intact but was fractured during recovery from the bridge. The separated piece reportedly fell into the waterway and was not recovered. The remainder of the southwest swing and fixed locking mechanism was intact with little apparent damage.

In contrast, the southeast locking components showed significant damage. On the swing span, the slide block and guide rail were separated from the swing side bed plate. The slide block was reportedly found some distance south on the land. The guide rail was not recovered. The bolts holding the guide rail were separated and one sheared bolt remained in the bed plate, see figure 8. The operating rod for the southeast rail slide block was also separated and not recovered.

The north end of the fixed southeast running rail was fractured through the web and head separating two pieces as shown in upper view figure 9. The fractures were overstress with features indicating bending loads to the gage side of the rail. The north head fracture was located at the grease indicated south tip of the slide block in the locked position as shown in lower view of figure 9. Dents were apparent on the base flange side fractures consistent with wheel impacts after fracturing, see figure 10.

Hydraulic Cylinder Piston Shaft

The end of the piston shaft for the hydraulic cylinder that actuates the swing mechanism was fractured near the end as shown in the upper view of figure 11. Examinations of the fracture, shown in the lower view of figure 11, revealed features consistent with a bending overstress separation. No indications or preexisting corrosion or progressive cracking was apparent.

Joe Epperson
Senior Metallurgist

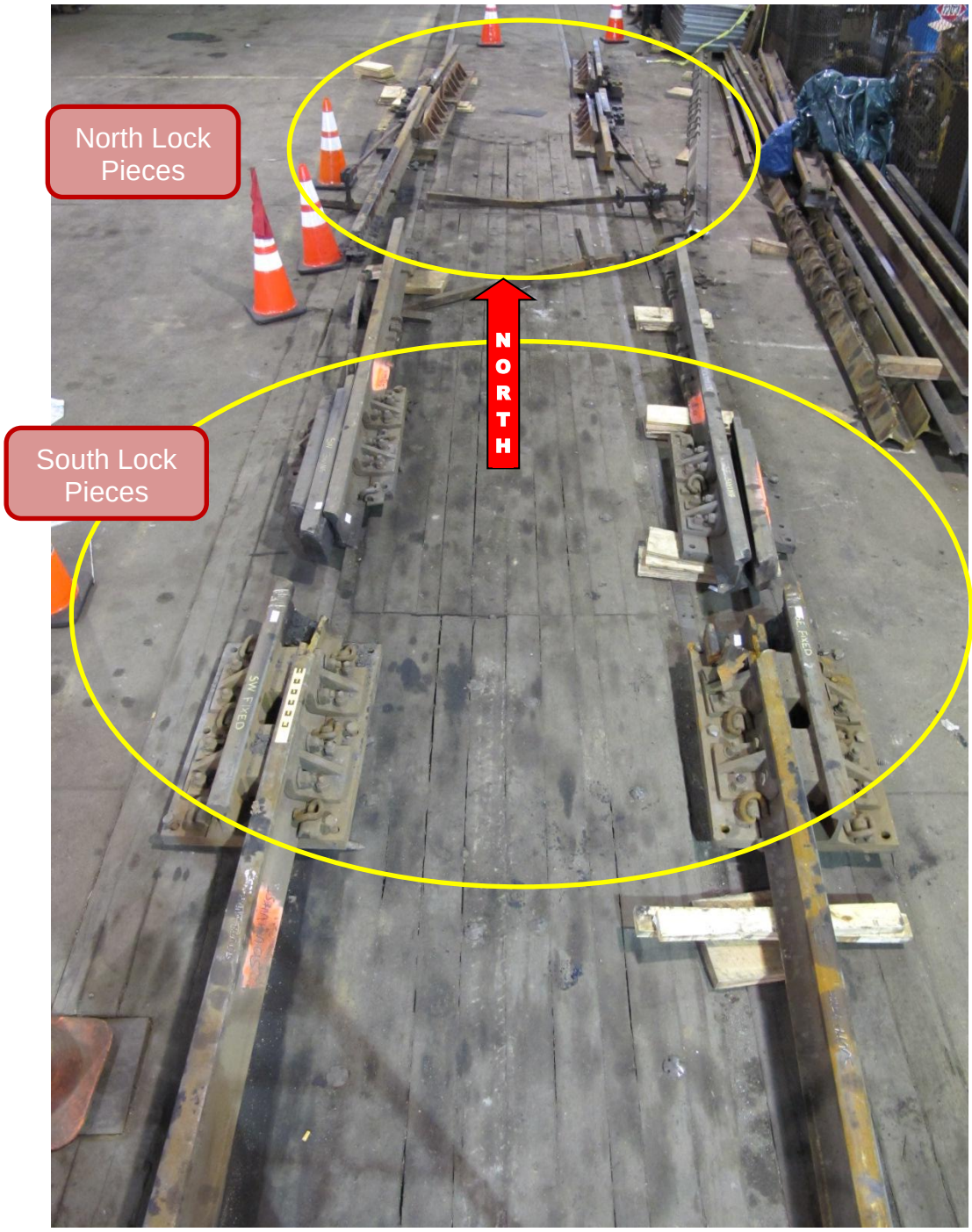


Figure 1. Overall view of the examined lock pieces relatively arranged as if on the bridge.

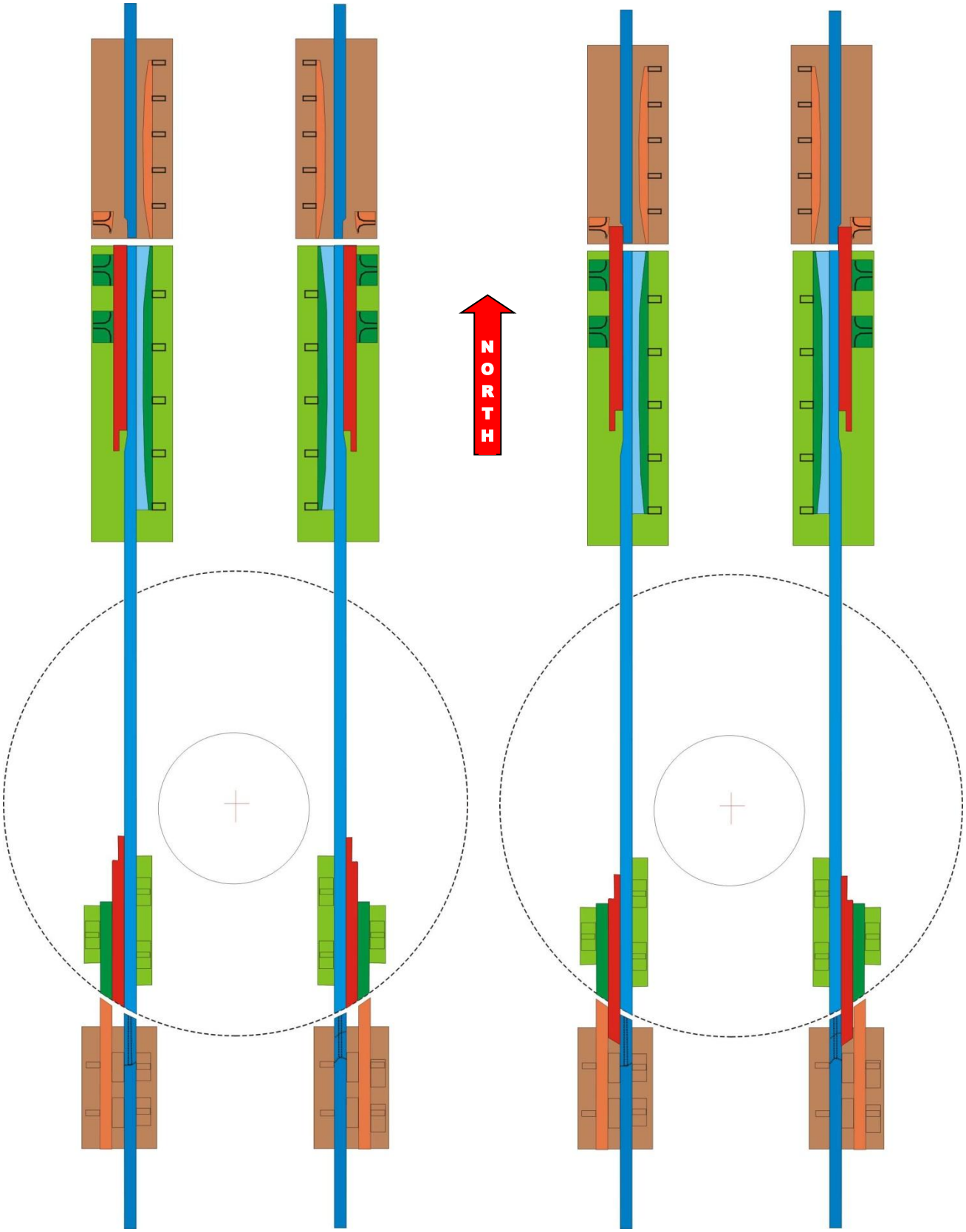


Figure 2. Illustrations of the bridge locking mechanisms at the north and south ends. Not to scale. Left illustration shows the sliding blocks (red) in the unlocked (retracted) position. The right illustration shows the blocks in the locked (extended) position.

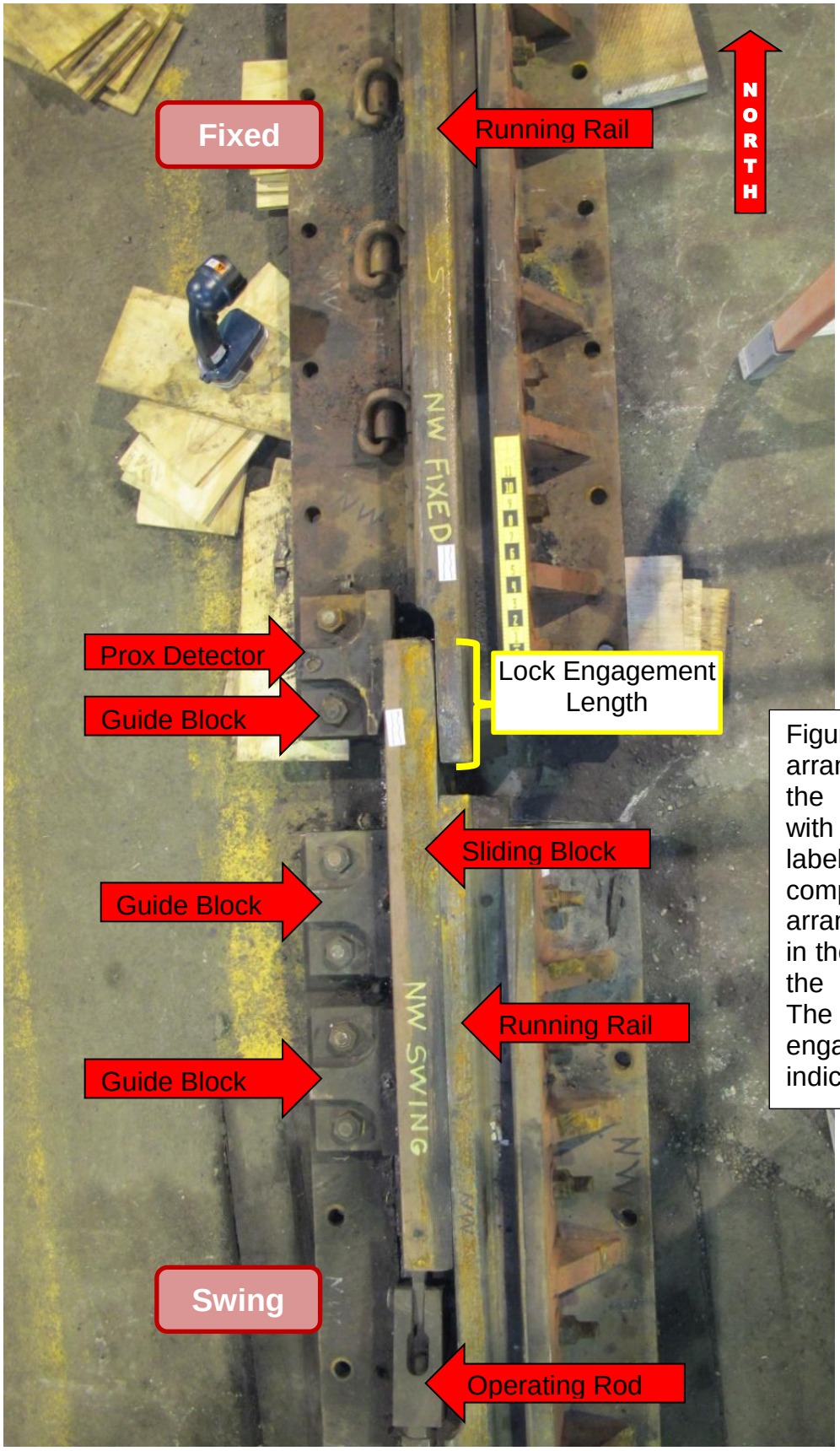


Figure 3. Image showing the arrangement of components at the north side of the bridge with many of the components labeled. West rail shown. The components have been arranged with the sliding block in the locked position engaging the fixed side components. The approximate lock engagement length is also indicated.

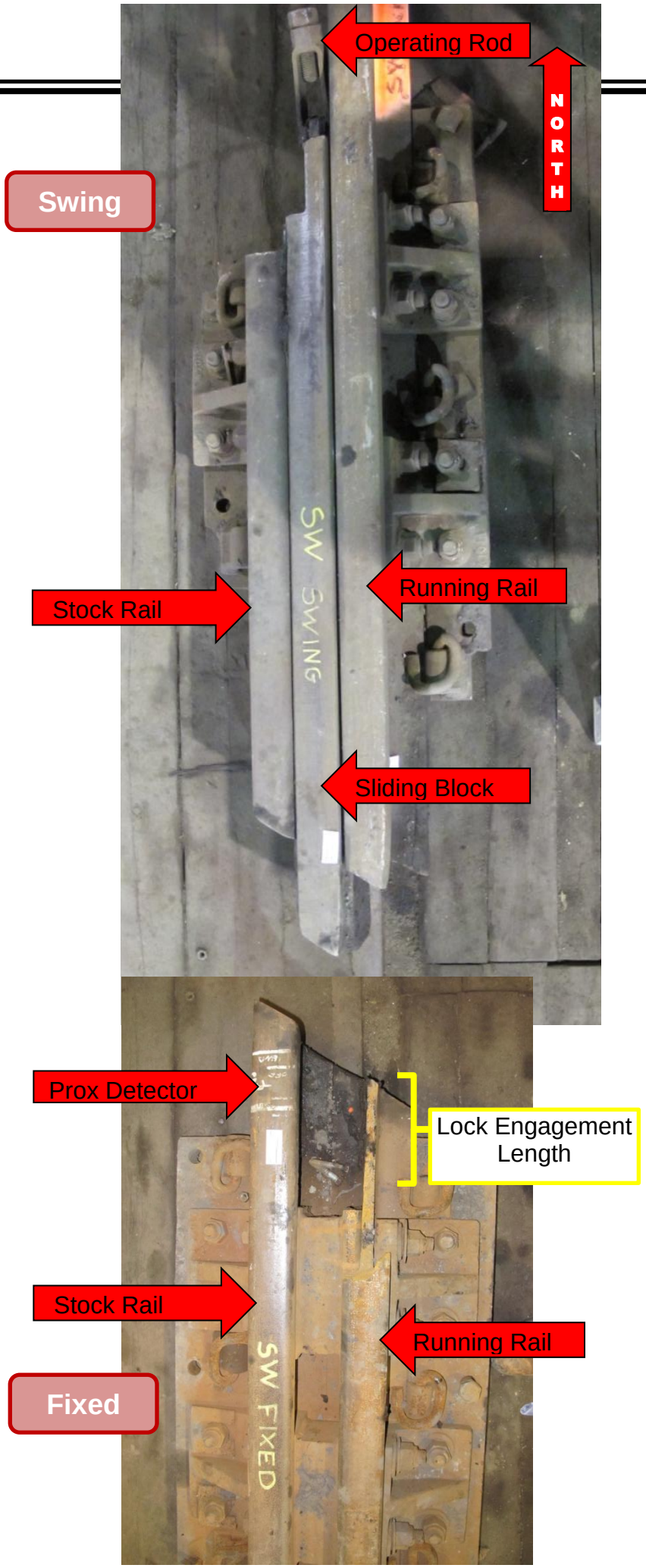


Figure 4. Images showing the arrangement of components at the south side of the bridge with many of the components labeled. West rail shown. The swing side components have been arranged with the sliding block in the extended locked position but not engaging the fixed side components (shown below). The approximate lock engagement length is also indicated.

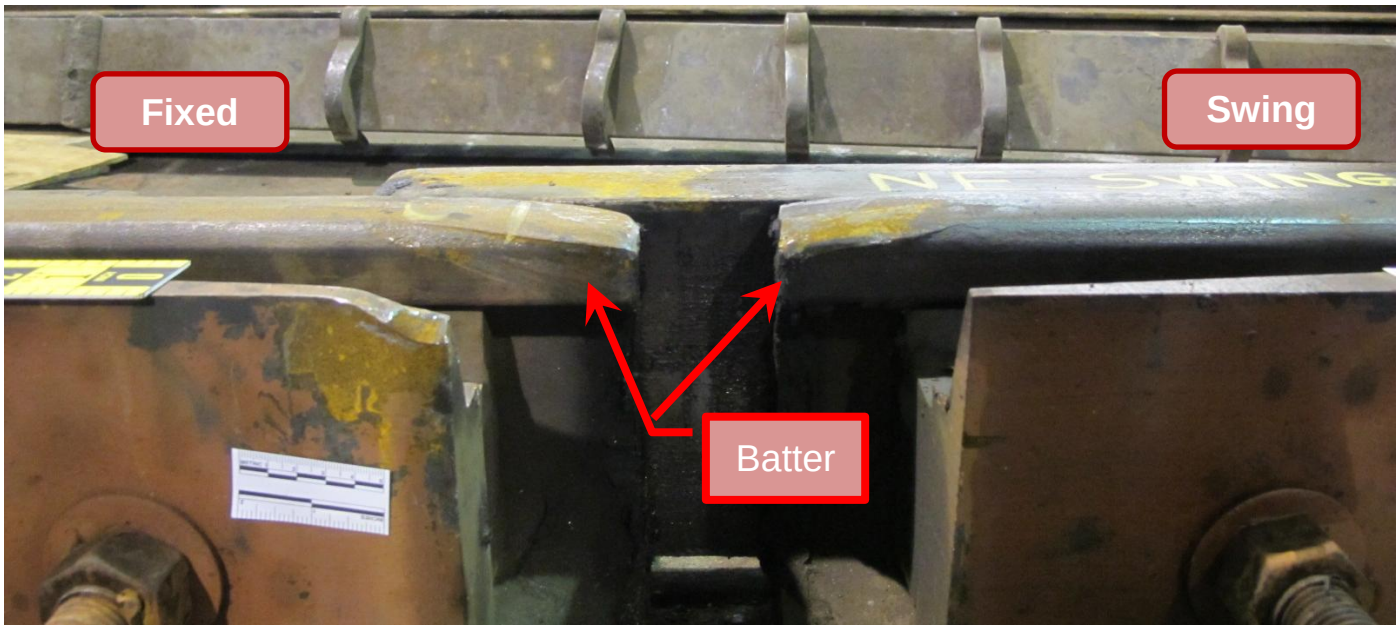


Figure 5. Side view looking east at the rail end battering on the running rail at the at the north bridge end gap. East rail shown, also typical of the west rail.

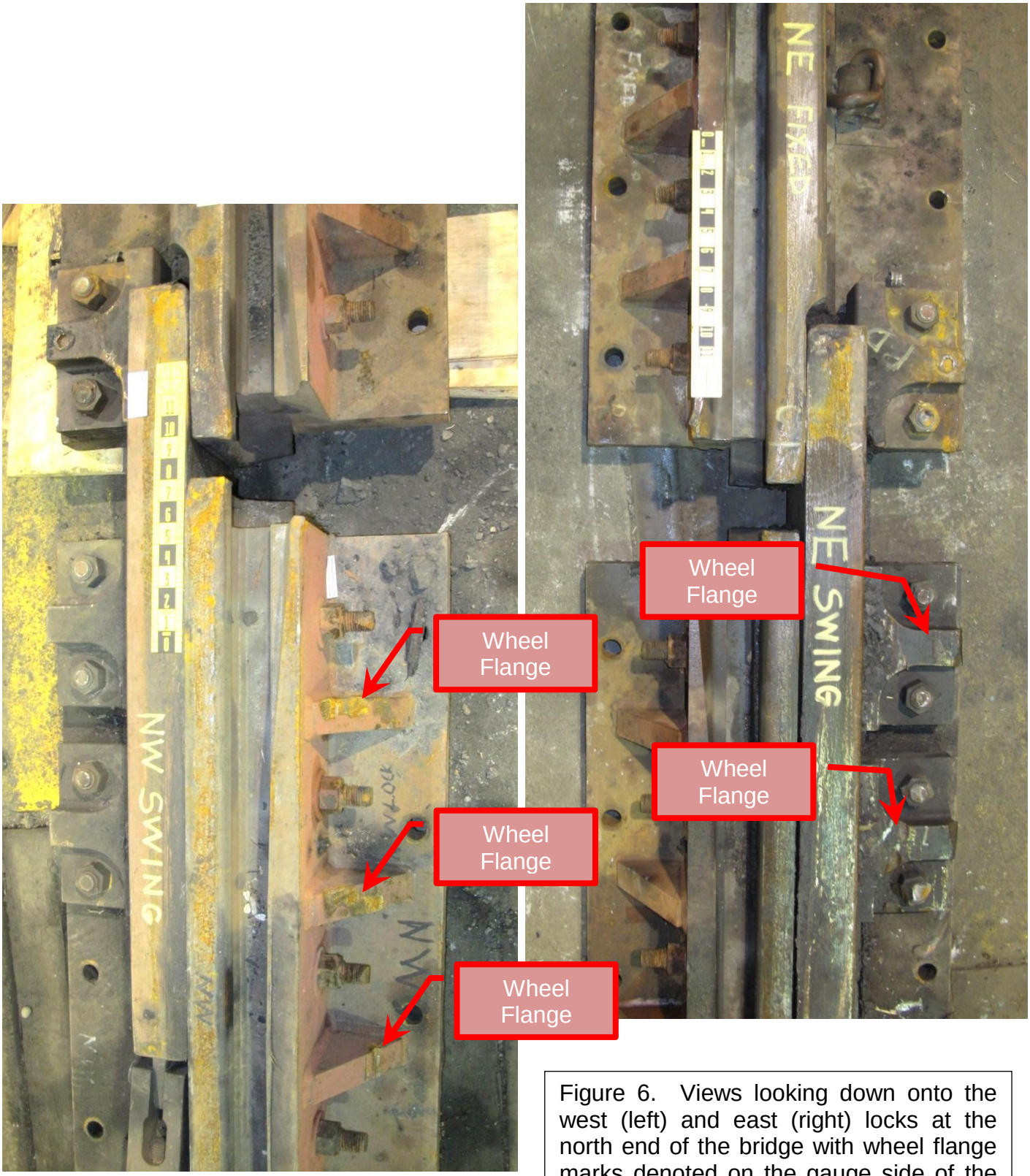


Figure 6. Views looking down onto the west (left) and east (right) locks at the north end of the bridge with wheel flange marks denoted on the gauge side of the west rail and field side of the east rail.

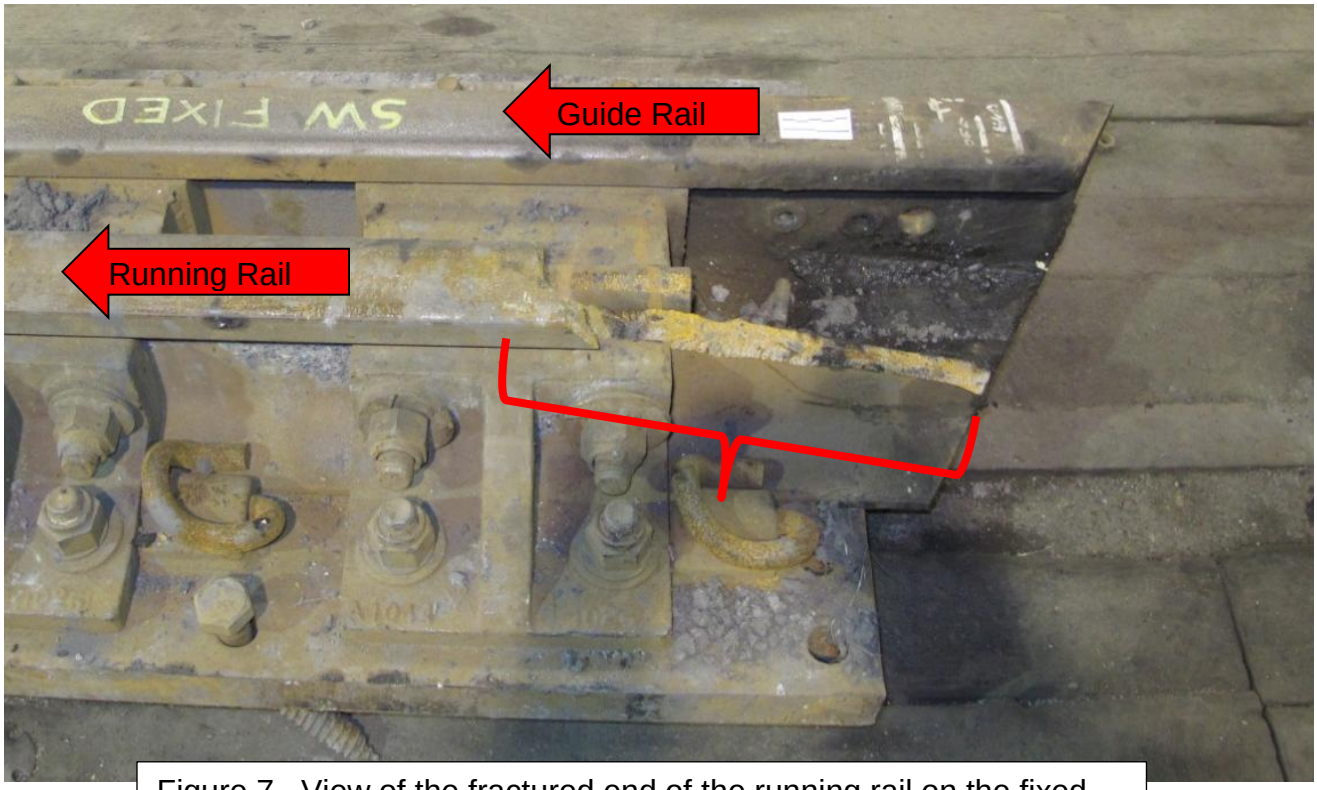


Figure 7. View of the fractured end of the running rail on the fixed south side west rail. View looking west.

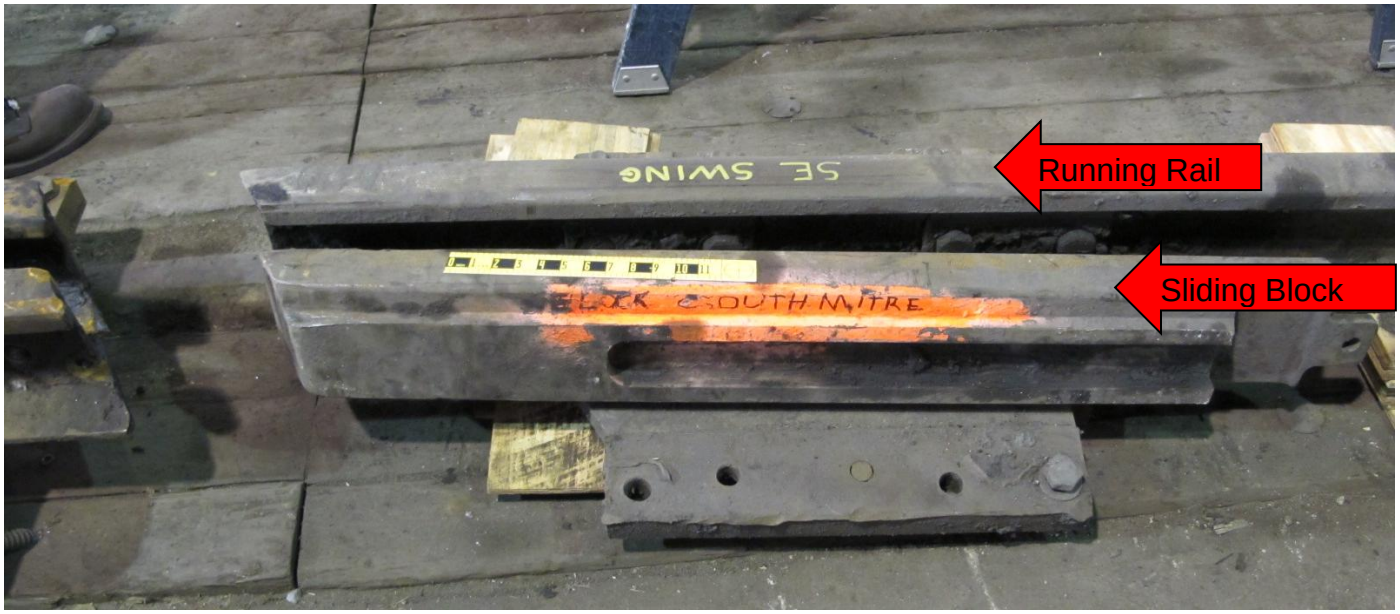
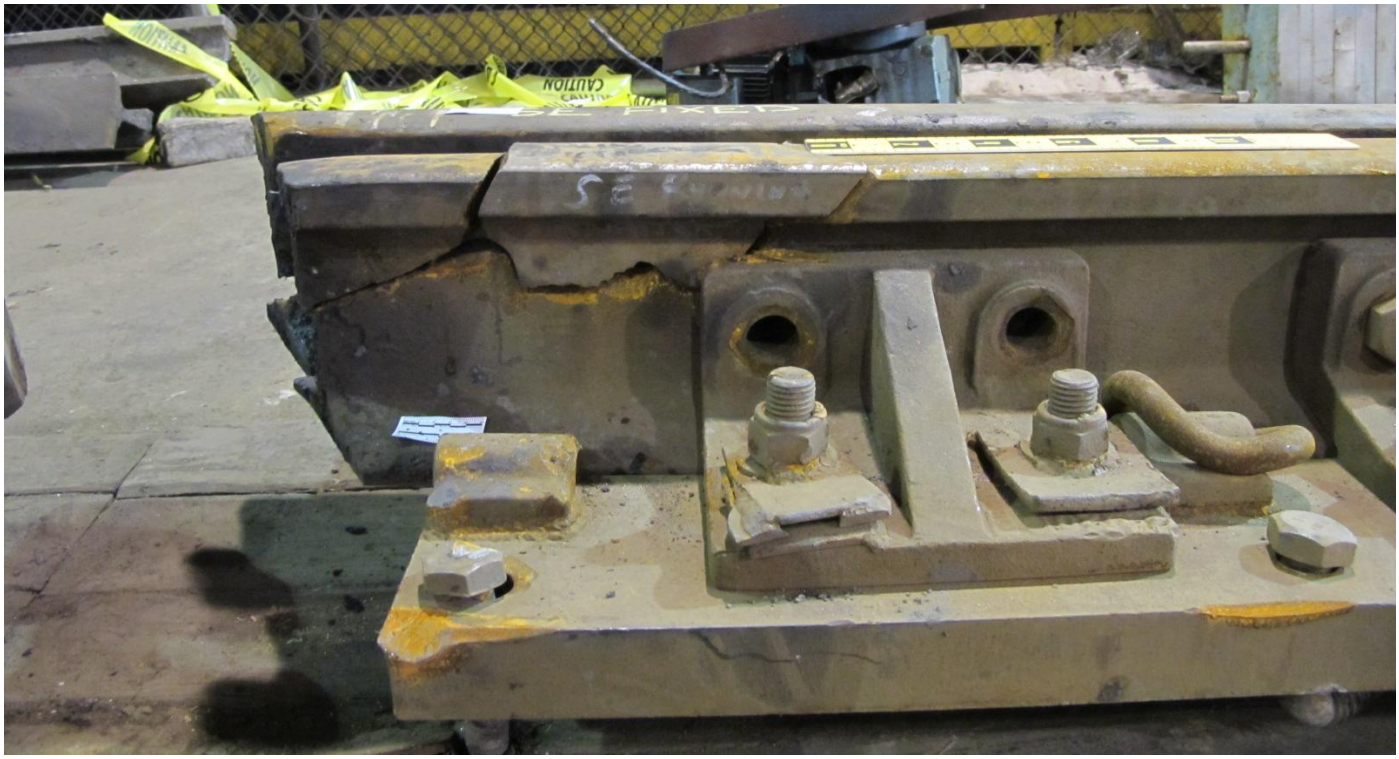


Figure 8. View of the south side east rail lock showing extensive damage to the bridge side components including; separation of the guide rail section with fracturing of the attaching bolts and release of the sliding block. View looking west.



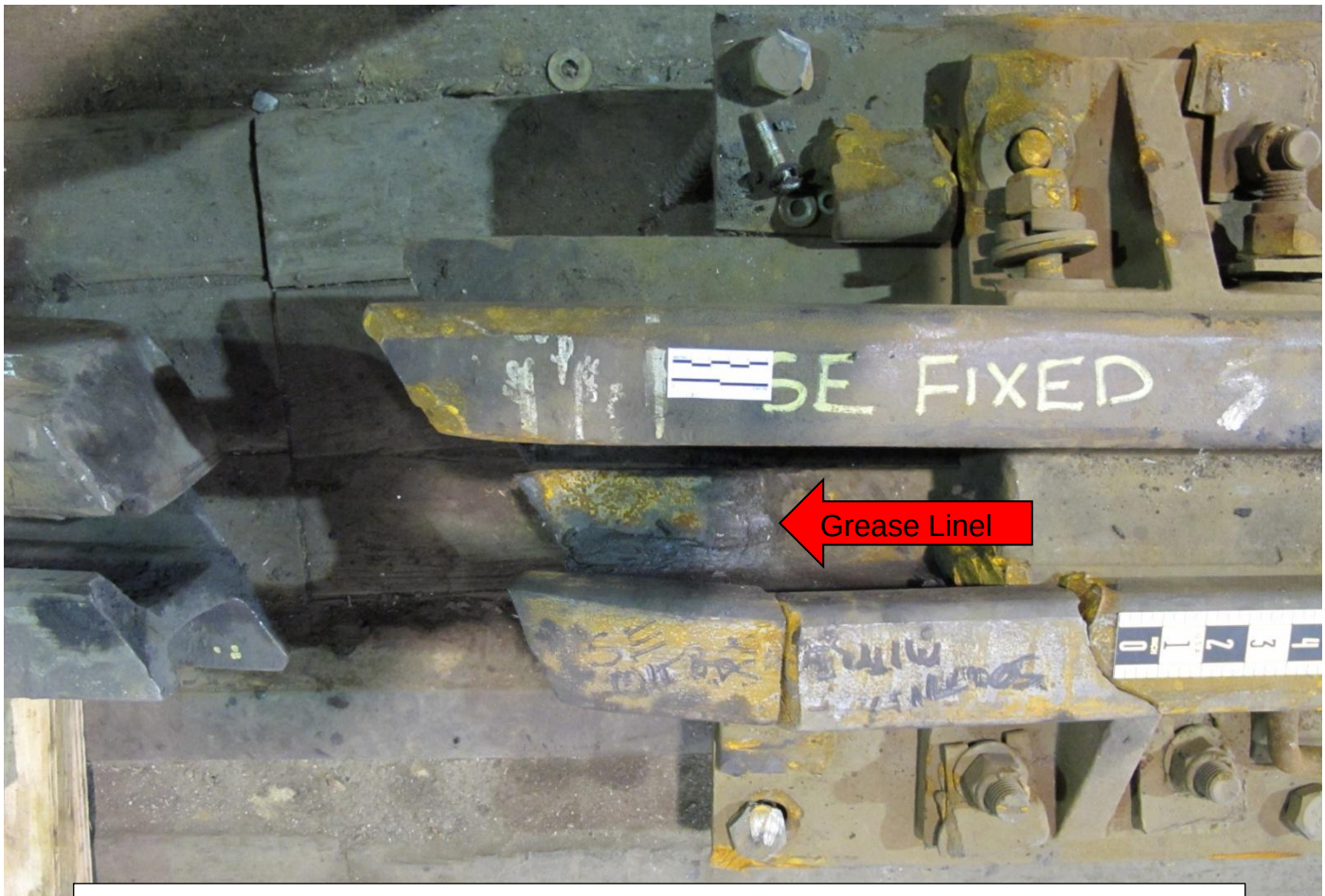


Figure 9. Upper view shows a side view looking east at the fractures in the fixed east running rail, south side adjacent to the gap. Lower view shows the same fractures from above relative to the grease line in the locking slot.

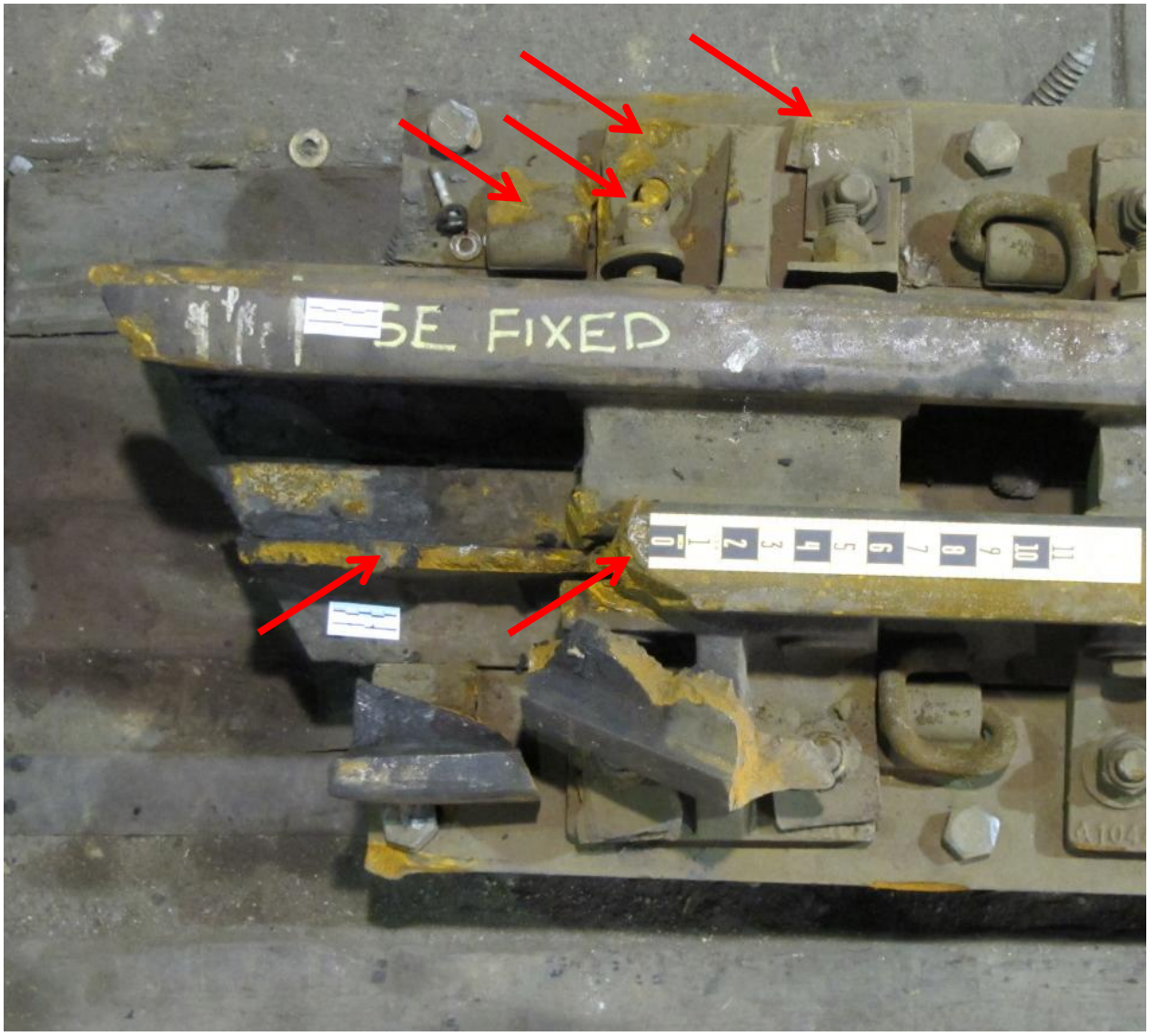


Figure 10. The fractured south side, east running rail with areas of wheel impact damaged denoted by arrows.

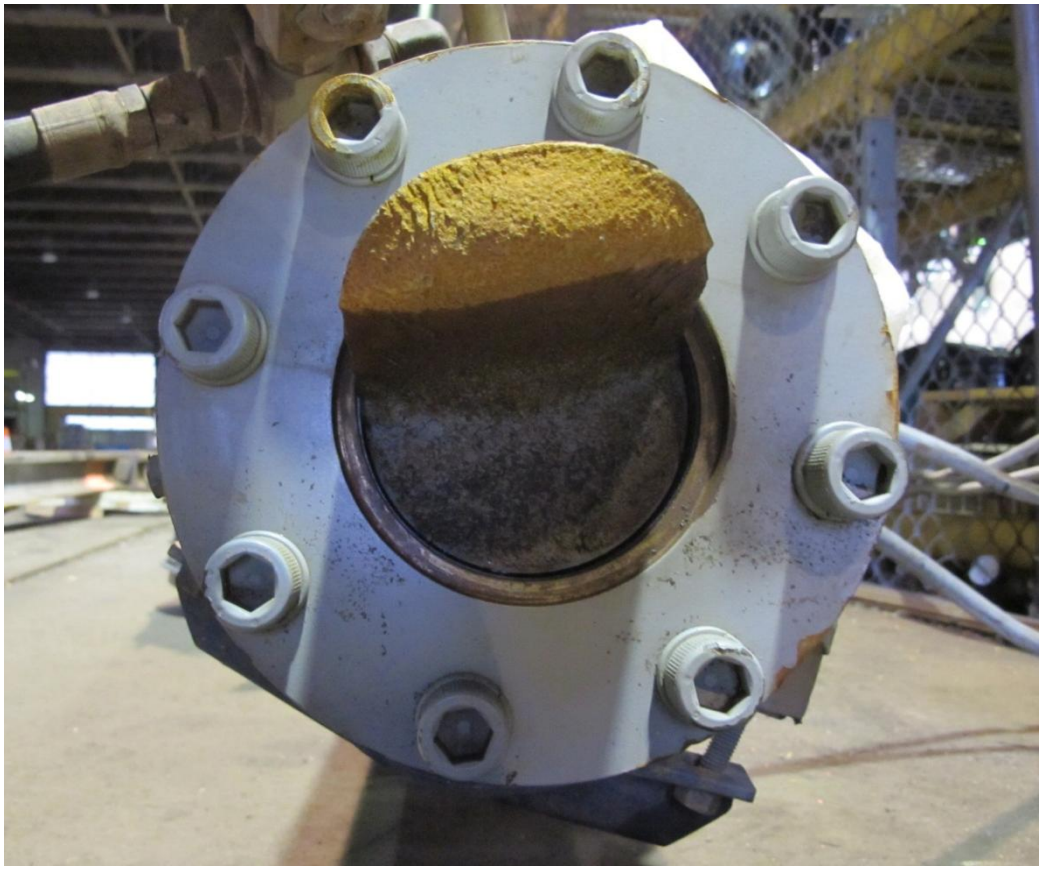


Figure 11. Overall view of the swing actuating hydraulic cylinder above with a closer view of the fracture below.