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Case Study: Grain Auger Failure

By

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Subject

Inspection of a Westfield MK 130-71 Plus Auger in 2021. The damage to the auger was supposedly caused by a tornado in 2018, but not reported to the insurance company until 2020.

Inspection

Figure 1 shows the Westfield auger when it was inspected in February of 2021. The damage location was in the center of the auger and was primarily to the flange joint between the two center tubes. Figure 1 gives the descriptions used in this report for the damaged auger tubes.

Figure 1 – Auger and Tube Descriptions

The damage associated with the east tube flange joint is shown in Figure 2. The significant damage is the broken weld holding the flange to the auger tube. The flange joint had been repaired by welding and was repainted at some time prior to the inspection, and prior to the damage to the flange joint. The two tubes connected at this joint were repainted after the weld repairs. This is indicated by the painted-over labels shown in Figure 2.

The damage on the west side of the flange joint is shown in Figure 3. The flange weld on the west tube was broken. This weld had been repaired. There was a corrosion spot where the paint did not adhere after repainting. The corrosion of the steel has been going on for at least several years.

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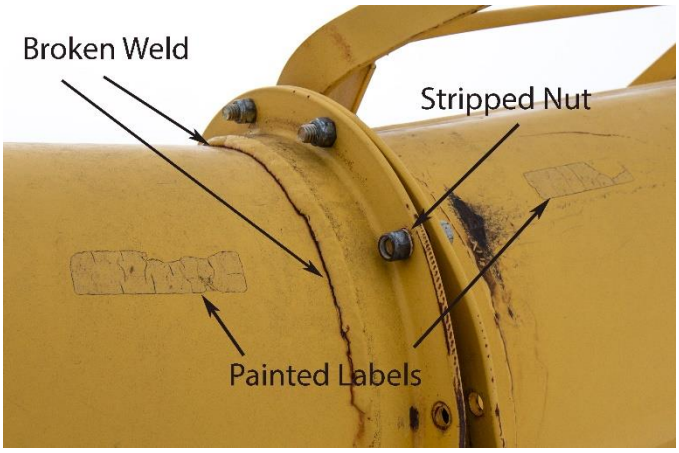

Figure 2 – Damage to East Flange

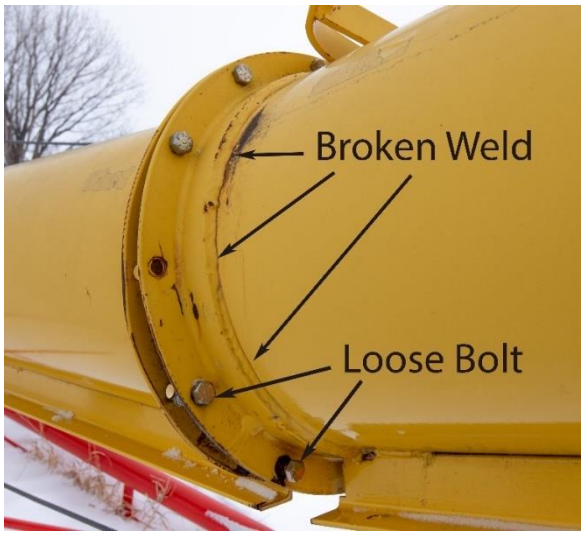

Figure 3 – Damage to West Flange

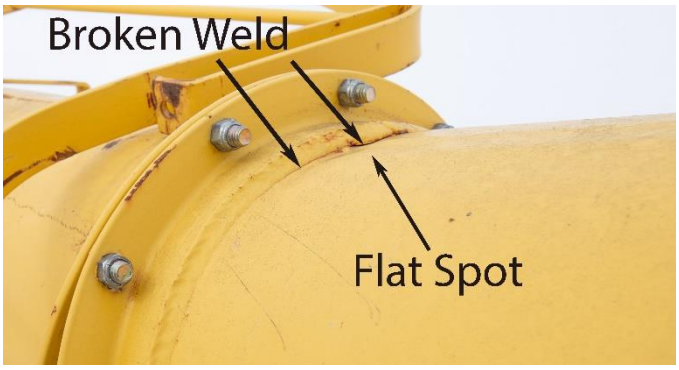

Figure 4 – Damage to East Flange

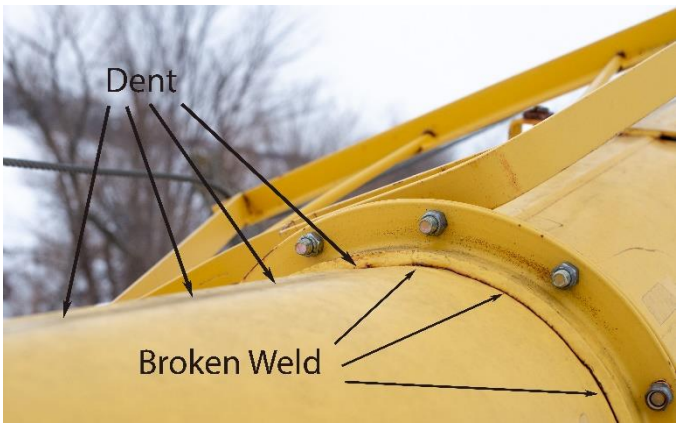

Figure 5 – Damage to East Flange

Broken welds and a flat spot or dent in the east tube is shown in Figures 4 and 5. The broken weld indicated in Figure 4 follows the profile of the flat spot, indicating that the spot was there when the weld was repaired. The dent on the east auger tube was present prior to the weld repairs to the two flanges in the center of the auger. Figure 5 shows the dent better. The dent runs along the tube for 12 to 18 inches.

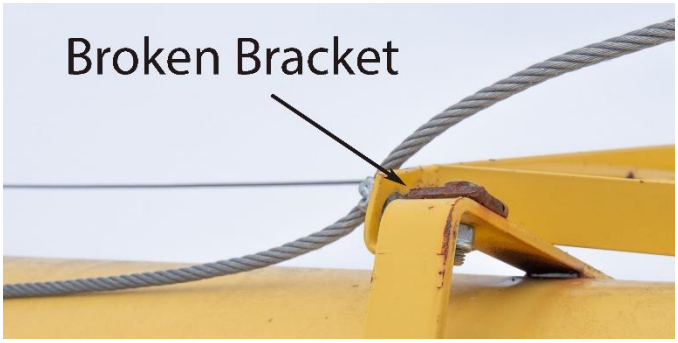

Figure 6 – Broken Support Bracket for Cable Gantry

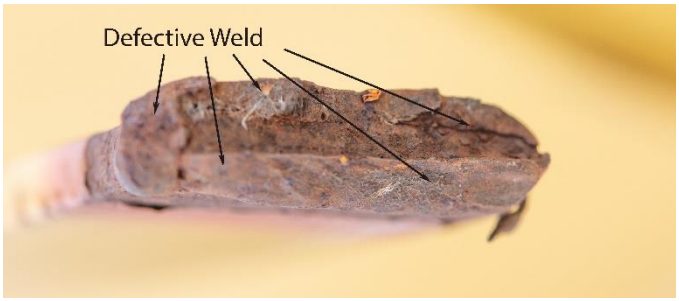

Figure 7 – Broken Bracket Defective Weld

There is a cable gantry that runs seventy five percent of the length of the auger. The broken support bracket was west of the damaged flanges. The portion of the bracket bolted to the auger is shown in Figure 6. This section of the bracket was heavily rusted. Figure 7 shows another section of the bracket frame. There is a defective weld present, indicating that the bracket had been repaired prior to the current damage to the auger. The weld-remains show a high percentage of lack of fusion, which is sufficient to reject any weld. The failure of this weld was likely caused by a one-time event that precipitated the current damage and failure of the auger. The purpose of the cable gantry was to provide tension to support the end section of the auger tubing, and to prevent excessive bending moments in the joint at the center of the auger.

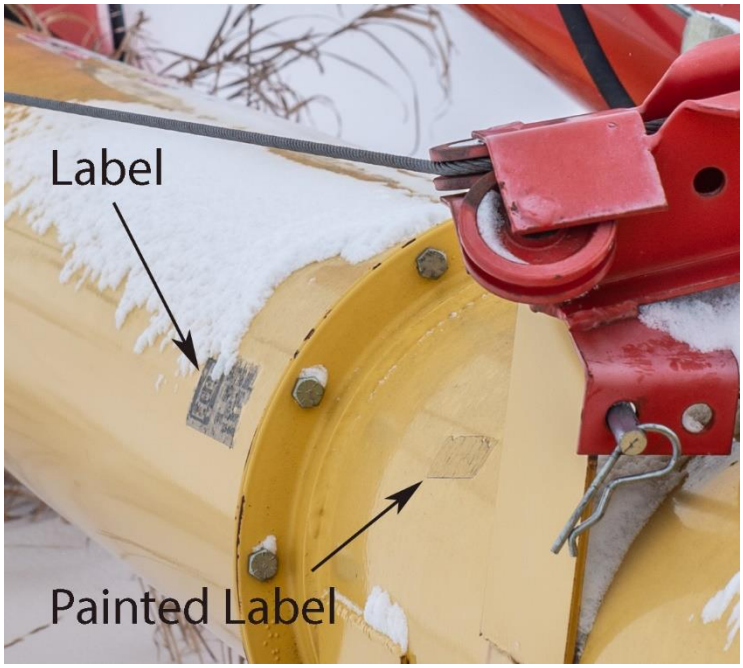

Figure 8 – Labels on Two Eastern Auger Tubes

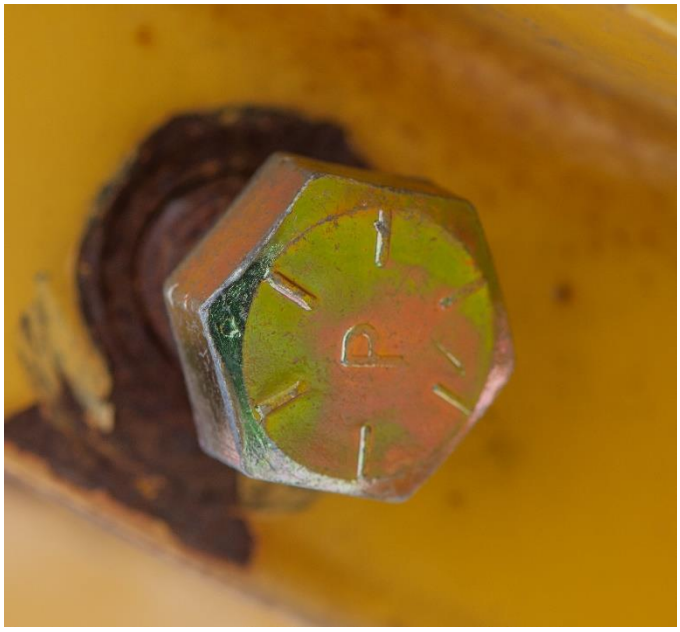
Figure 9 – Grade 8 Bolt Head

The flange joint between the two eastern tube sections is shown in Figure 8. The eastern most tube has a label that is free of paint. The other tube has a painted label, indicating that the entire tube was painted after the weld repairs were made.

Figure 9 shows the head of a Grade 8 bolt, indicated by six marks on the bolt head. All of the bolts used to hold the tube flanges together were Grade 8.

Figure 10 – Stripped Threads on Flange Bolt

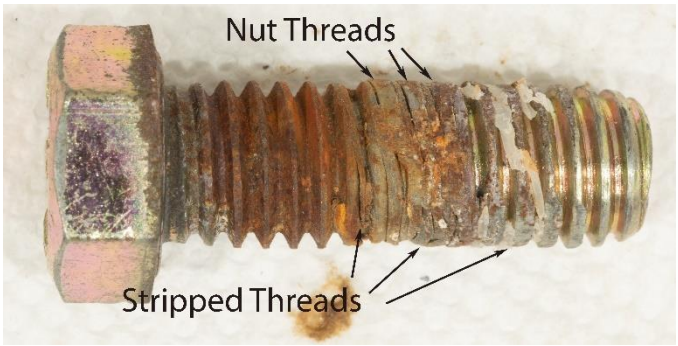

Figure 11 – Flange Bolt with Stripped Threads

Figures 10 and 11 show stripped threads on two flange bolts. Both the bolt threads and nut threads were stripped, the nut threads were imbedded between the bolt threads.

Stripping of the bolt and nut threads requires a considerable amount of force. The broken threads failed by shear fracture during a onetime overload event that broke the bolt threads, and sheared off the nut threads. No nuts were recovered or removed. The nuts used may not have been Grade 8 nuts, and could, therefore, have caused failing at a lower load than expected for Grade 8 nuts and bolts. When the auger was repaired, the bolts and nuts were likely replaced.

Discussion

It is quite clear that the Westfield MK 130-71 Plus Auger had been damaged and repaired prior to the damage claimed in the current claim. It is also quite clear that the repair of the damage was not up to typical industrial standards. This is illustrated by the broken bracket weld, Figure 7, and the broken flange-to-tube welds shown in Figures 2, 3, 4, and 5. The characteristics of these broken welds indicate lack of fusion. In the case shown in Figure 7, it was lack of fusion between bracket segments. In the case shown in Figures 2, 3, 4, and 5, it was lack of fusion between the weld and the auger tubes. Both of these cases are examples of poor workmanship.

The poor weld quality of the bracket, Figure 7, was definitely a major contributing factor to the auger damage that was currently being investigated. The breakage of the bracket weld could have been caused by moving the auger from one location to another, or by a tree or branch falling on the gantry during the 2018 tornado.

The most likely reason the flange bolts failed is that the lock nuts were not Grade 8. This can be tested for, but samples are needed for destructive testing and verification of the combined nut/bolt strength.

Opinion

It is my professional opinion to a responsible degree of scientific certainty based on the information available and presented in this report, that the damage to the Westfield MK 130-71 Plus Auger was the result of:

1) Poor weld quality bracket, Figure 7. This weld showed a considerable amount of lack of fusion and was not acceptable by any known industrial standard. Failure of this weld was the most likely cause of damage to the grain auger.

2) The auger tube-to-flange repair welds were defective, showing lack of fusion between the welds and auger tubes.

3) Indications were that the locking nuts used on the flange bolts were not Grade 8 to match the characteristics of the bolts, and therefore failed by stripping of the threads of both bolts and nuts.

4) The current damage to the auger was most likely the result of a one-time event, which is not determinable.