Kiln Access Ramp Load - Test Report

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Revision: A

Introduction:

This document demonstrates tests that were done to ensure the kiln access ramp is safe to use for up to 15,000lb live load with a safety factor of three. The ramp was analyzed with a finite element analysis simulation on SolidWorks with 100% load and it was confirmed with a +100% weight load test before the machine was shipped to the customer.

Finite Element Analysis:

Shell meshing was used in the FEA, and the ramp was considered straight to avoid complications in the analysis. SolidWorks assumes consistent global bonding all around the structure, linear isotropic material (6061-T6) and there is no warping after welding is complete. These idealizations will skew the analysis results, but the overall integrity of the weldment is well represented.

One end of the bridge is fixed in all directions simulating how it would mount onto the ramp pedestal and the other end is fixed on a sliding roller which also is a close approximation of the landing feet. Maximum bending would occur in the middle of the bridge when the 15,000lb load is applied.
The load was applied for two different scenarios:

1) All load is distributed to simulate a forklift or skid steerer on its wheel track. Refer to *figure 1* for the distribution of the load.

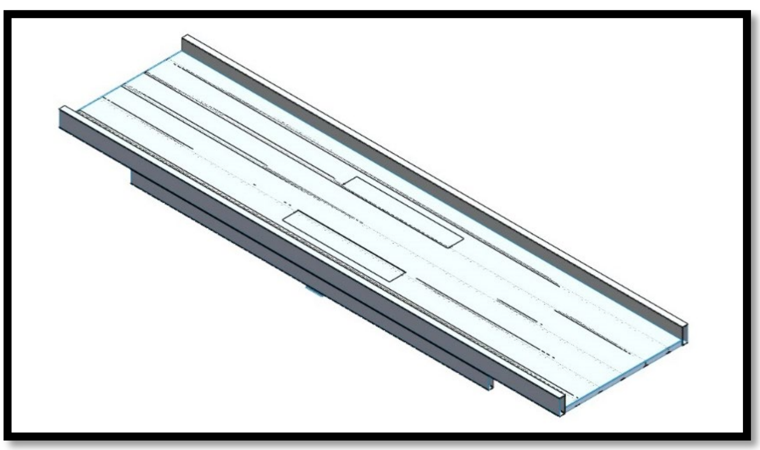

Figure 1: Distributed load was applied on the split faces in the middle of the ramp. The dimensions of the split faces are typical equipment dimensions.

2) All load is heavily concentrated on the center of the deck to simulate the in-house load testing to confirm later. *Refer to figure 2.*

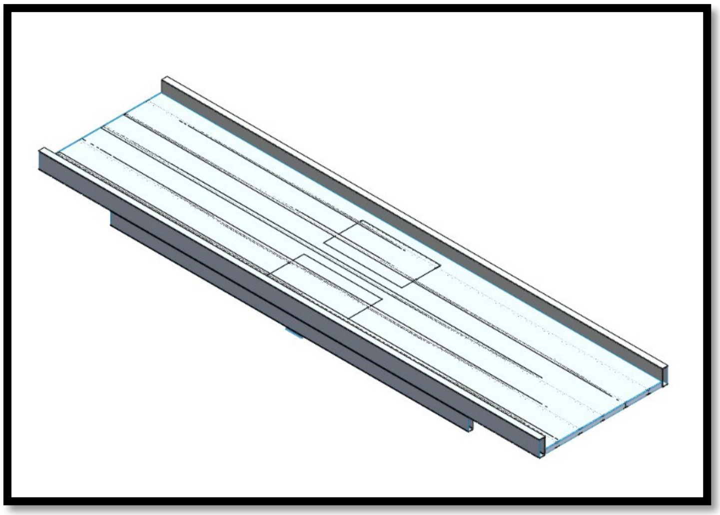

Figure 2: Distributed 17,000kg load was applied on the split faces in the middle of the ramp.
These split faces are 2x4 ft which represents the actual weight blocks that were used in the in-house load test

Test 1 result is shown in *figure 3.* Max deflection and maximum von mises were taken into consideration. Maximum deflection is more meaningful to the analysis because we can get a direct comparison with the in-house testing later. The FEA estimates maximum deflection will occur on the outermost I-beams which is estimated to be **0.95 inches**.

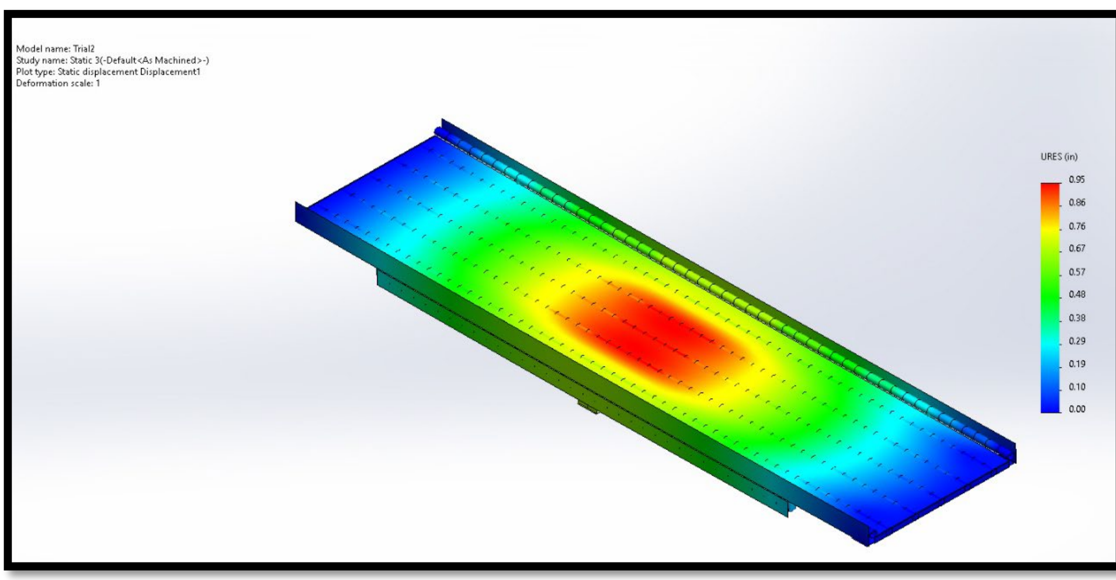

Figure 3: Red-colored areas are where the maximum deflection occurs.

Test 2 results are shown in *figure 4.* Similarly, the I-beams underneath the bridge experiences the most stress under the load conditions. The loads are more concentrated in a smaller area than test 1 therefore there is more deflection of **1.31”.**

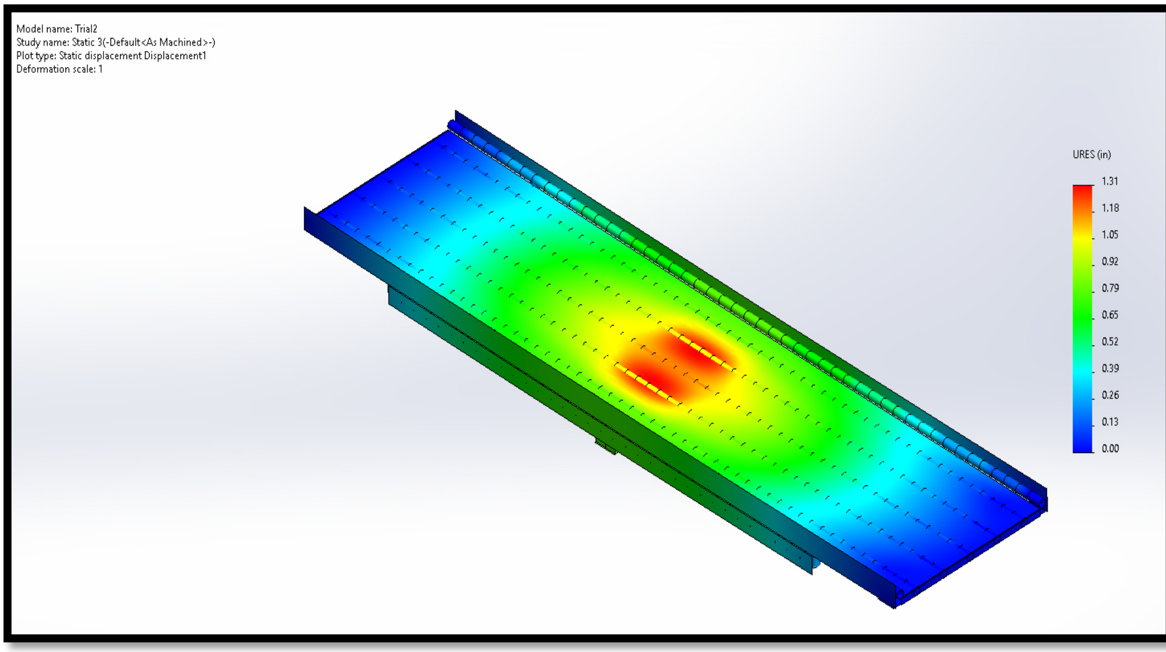

Figure 4: Red-colored areas are where the maximum deflection occurs.

In-House Load Testing:

The in-house non-destructive load testing mirrored the FEA **test 2** as much as possible. The bridge section was set up outside one side is resting on saddles and the other end is resting on its landing feet. Four ~4000lb weight blocks were added one by one in the middle totaling **16,935lbs**. Deflection on both sides of the channels and the I-beams were measured after each weight block was added. Refer to *figure 5* for the test setup. Refer to *figure 6* for I-beam measurements.

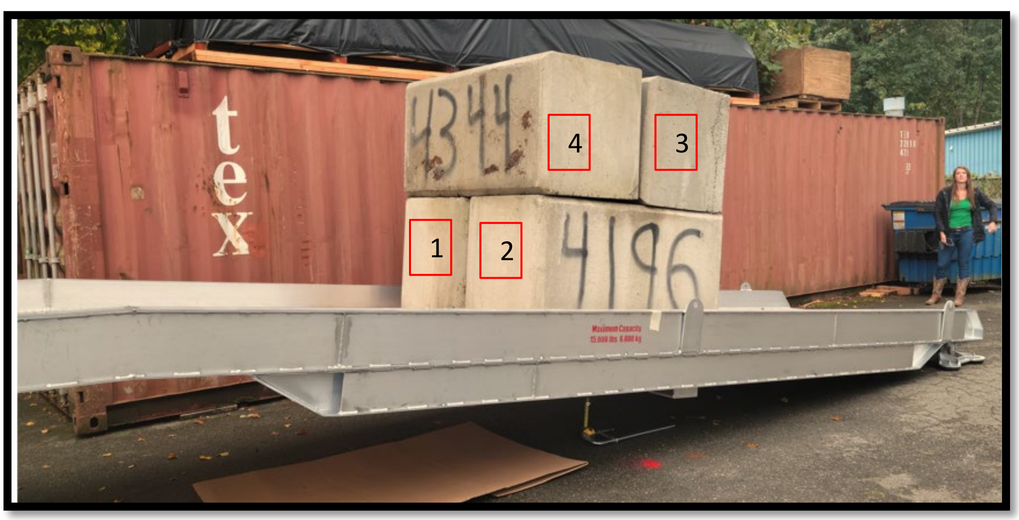

Figure 5: Blocks are labeled in the order it was loaded onto the ramp.

Figure 6: A string with a washer is attached to the I-beam,
this allowed us to see deflection without going underneath the bridge while it was loaded.

Collected Data:

Table 1 shows the collected measurements when the weight blocks were added. The right and left sides of the bridge were tilted from the start and the tilt stayed the same throughout the test. As more weight got loaded onto the bridge the amount of deflection decreased.

#	BLOCK (LB)	RIGHT	BOTTOM	LEFT
1	4274	18.28	0	18.75
2	4176	17.875	1	18
3	4176	17.5	1.5	17.75
4	4308	17.25	1.75	17.5
TOTAL	**16934**			
MAX DEFLECTION		**1.03**	**1.75**	**1.25**

Table 1: Deflection measurements.

Conclusion:

Overall, this bridge is safe to use for equipment with a load total of up to 15,000lb. The in-house 100% load testing resulted in no signs of yielding or weld cracks. The difference between the FEA **test 2 and** load test is due to the idealizations of SolidWorks. Most of the bridge components are stitch welded to minimize warping and the spacing between the welds acts as a stress relief when the bridge is loaded which is one of the reasons why the in-house load testing deflected more than the FEA result.