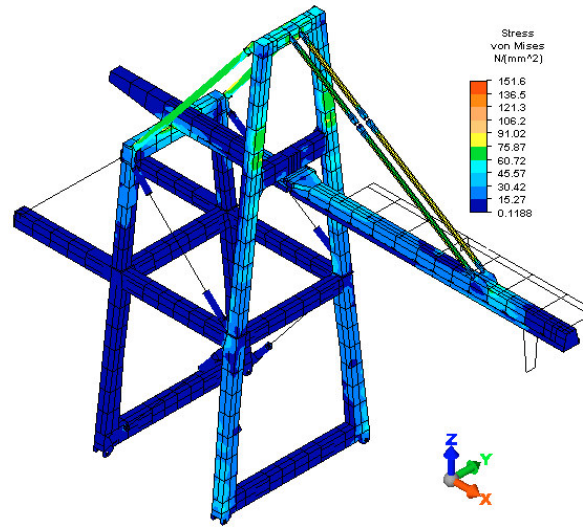


SHIPUNLOADER – ALUMAR PORT

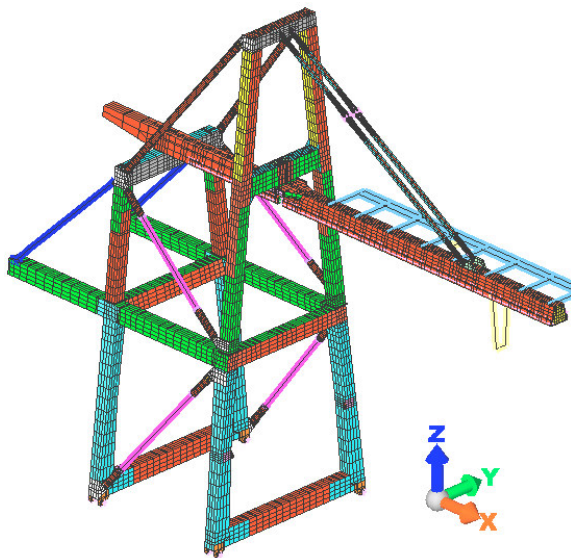
PCE made a structural analysis of the Shipunloader of the port of Alumar Consortium – São Luis – MA – Brazil, using the Algor Inc. finite element method software. Also it was made instrumentation with strain gages.

This analysis was made because a rupture occurred at one of the Shipunloader tie beam.

A fatigue analysis was made at the critical points using PCE’s Fatigraph software.



Von Mises stress map

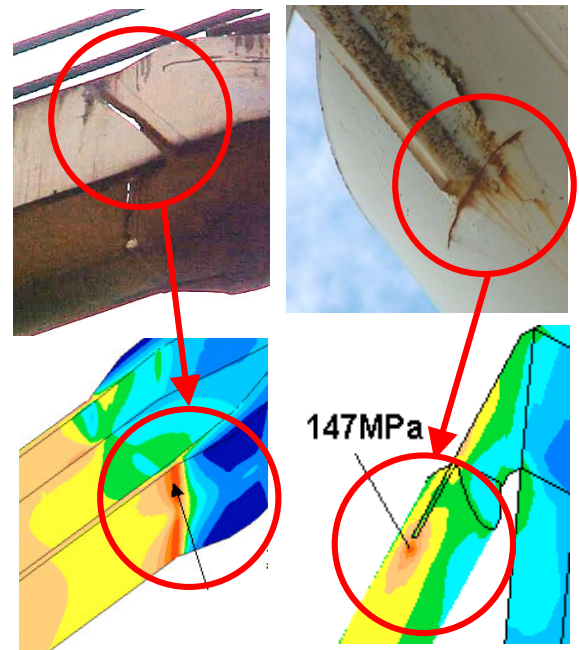


FEA model with mesh.

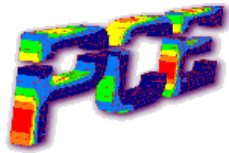
With the documentation supplied by Alumar (drawings and reports) a whole structure finite element model was made of the Shipunloader, using truss, beam, shell and brick Algor elements types.

The model consisted of the crane arm and the lower and higher gantry of the structure. The cabin, walkways, bucket, trolley and bauxite were applied as loading, using beam elements with densities calibrated so that these beams had the weight of these parts. On the lower and higher structure of the gantry the loading of other parts on this was applied as distribute loading. The figure besides shows the FEA model.

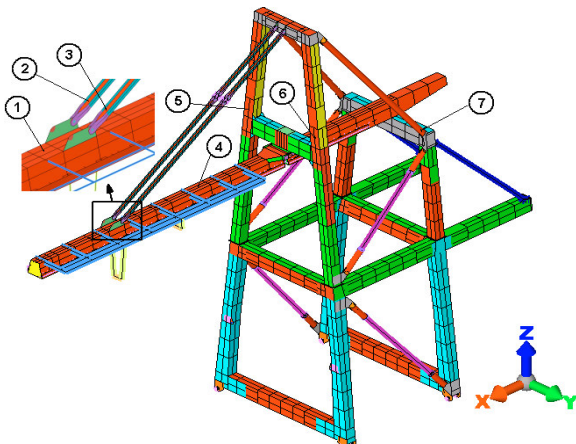
The next figures show some of the results of the analysis.



Failure regions of the structure.



Some points were chosen on the structure and measured the stresses on this points with strain gages during the operation of the Shipunloader under normal conditions for the calibration of the model. This strain gages were oriented as the principal stresses directions on the parts, connected to a signal conditioner board and this to a microcomputer with a data acquisition software, given output stress values in N/mm^2 (MPa). These points are shown on the picture below.



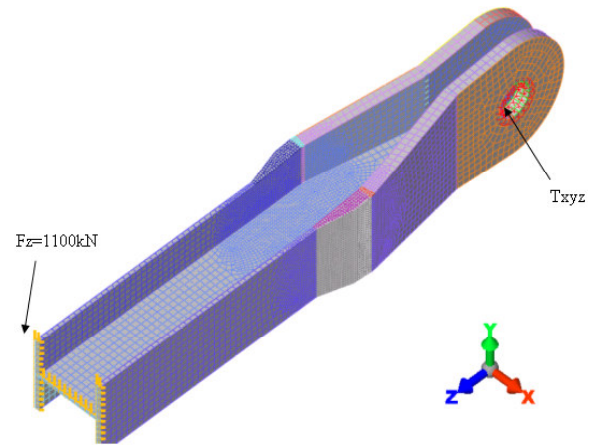
Instrumentation points

The figure below shows the results of the measurements.



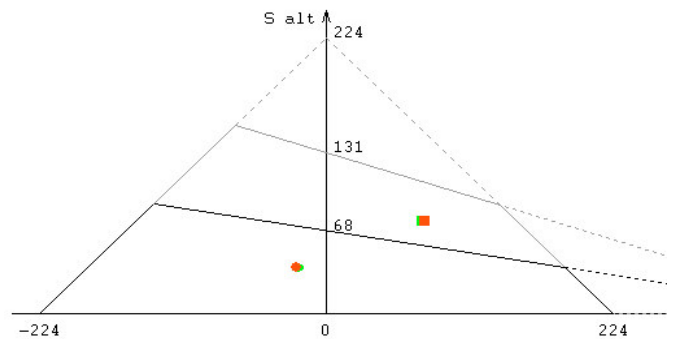
A typical measurement results on the instrumented points.

Some local analysis were made of some parts of the structure with a more refined mesh. The results were used for the fatigue analysis. The figure below shows a refined mesh of the tie beam at the extreme of the crane arm.



Tie beam refined model

The next figures show the stresses of the model and the Haigh fatigue life diagram.



Haigh diagram with critical FEM nodes

Using Algor Inc. software and instrumentation techniques it was possible to make a complete structural evaluation of the Shipunloader structure, identifying critical regions and suggesting the best way to avoid stresses concentrations and increase the life of the whole structure.