

Project title	Structural Finite Element Analysis: Rail Corrugation Analyser
Date	June 2020

## SCOPE/OBJECTIVE

To verify that the bogie-mounted RCA equipment does not pose a detachment and hence derailment risk to the railway infrastructure and has adequate structural capabilities for the operating conditions. Railway safety assurance methods require new equipment to be assessed against specified criteria and load cases as outlined in the mandated standards.

AEGIS Engineering Systems Ltd worked with our client to provide engineering assistance with the safety assurance, approvals, and certification of the Rail Grinding machine to support its introduction to the UK. A Rail Corrugation Analyser is a unit attached to the bogie frame which measures running rail corrugation through instrumented wheels that are lowered onto the track.

Structural Finite Element Analyses were undertaken to assess the compliance of the RCA design with BS EN 13749:2011 "Railway applications - Wheelsets and bogies - Method of specifying the structural requirements of bogie frames." were applied as per BS EN13749. These stress magnitudes were compared against the allowable yield strengths of the corresponding material for each individual load case.

## FATIGUE ASSESSMENT

The larger of the maximum or minimum principal node stresses generated at the weld locations were extracted when each set of fatigue accelerations was assigned to the structure. These stresses were used in the process of calculating the weld damage (based on  $2 \times 10^7$  fatigue life cycles) which validates the design against the allocated weld classes.

## BOLT ASSESSMENT

Axial and shear bolt forces were extracted for the 132 assigned bolts when each of the exceptional load cases were applied. A slip check, utilizing each bolt's preload, stress area, friction coefficient and stiffness factor was then performed and used to determine the method of calculating the bolt stresses. The bolt stresses were then calculated for each bolt and compared

against the corresponding bolt capacity to determine whether they are adequate for the application.

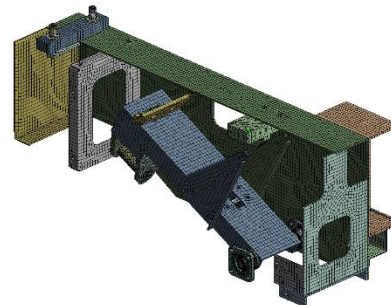
## TECHNOLOGY USED (IF APPLICABLE)

ANSYS Mechanical  
SpaceClaim  
SOLIDWORKS 3D CAD

## HOW WE HELPED

AEGIS has worked closely with the client's designers throughout the duration of the project, providing them with the required assistance and consultancy.

- AEGIS provided an initial set of results which identified any non-compliant areas of the design.
- AEGIS then suggested a set of proposed design changes, which would enhance the overall performance of the structure to ensure its compliance with the appropriate Standards.
- The details of the design modifications were discussed with the designers and a solution was developed which meets all structural requirements whilst optimizing the design's manufacturability.



Fine meshing attributes are applied to the combination of mid-plane surfaces and solid components

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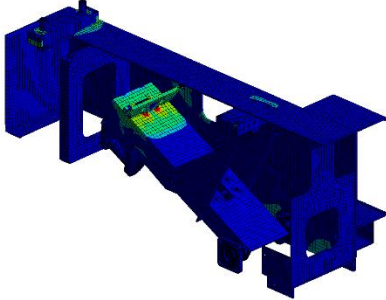
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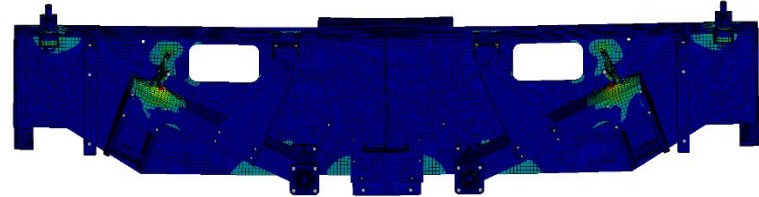
## AEGIS Case Study



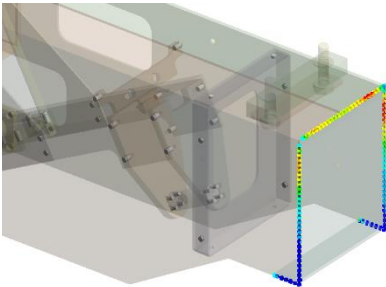
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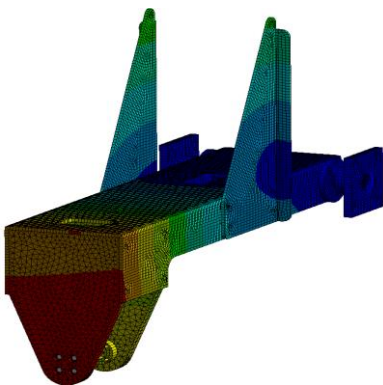
Equivalent Von-Mises stress distribution used for the assessment of the proof stress when the structure is subjected to the various exceptional load cases



Stress Distribution within the structural parts of the Rail Corrugation Analyser under a vertical downward acceleration of 225,630 mm/s<sup>2</sup> as per BS EN13749:2011



The larger of the maximum or minimum principal node stresses generated at the weld locations are extracted and subjected to weld assessment



Total deformation of the RCA's axle arms as part of the Operating Mode analysis

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