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Static and Seismic Analysis of a Pole Mounted Electronics Enclosure

Objective: Design and analyze a sheet metal bracket system that will support a pole mounted electronics enclosure.

Modeling Assumptions and Details: The finite element analysis (FEA) model was constructed based on geometry provided by client. The structure was idealized into a plate FEA model with the bolted connections modeled using beam elements for the bolts and rigid links for their connections onto the plate elements.

The purpose of this model was to predict the stresses in the bracket system. The enclosure was only included into the model to provide the correct load application into the bracket model.

The material used for the brackets was A36 with a nominal yield strength of 36,000 psi. The enclosure was modeled as aluminum.

The brackets were evaluated under the Telecordia GR-63-Core seismic specification (prior specification was Bellcore GR-63-Core) for NEBS Requirements under Zone 4 seismic response. The GR-63 is part of the larger Telecordia specification GR-487. The other major load case used the UL60950-1 Section 4.2.10 specification that required that the brackets support three times the weight of the enclosure. Wind loads were not considered on this cabinet.

The GR-63-Core seismic analysis was performed using the response spectrum analysis method with the Zone 4 response curve. The response curve was applied in all three orthogonal directions to determine which direction created the most severe response. The bracket design was then quickly modified to meet the allowable stress targets. The final certification load required that all three directions be summed via the SRSS method.

The static load case developed only minimal stresses in the structure. This was simply due to the fact that the Zone 4 seismic response is more or less at a level of 5 g.

Note: This analysis work was also discussed in a white paper title “Linear Dynamics for Everyone” published in Desktop Engineering.

Summary: The sheet metal bracket was put into production and is has been successful implemented by the client.

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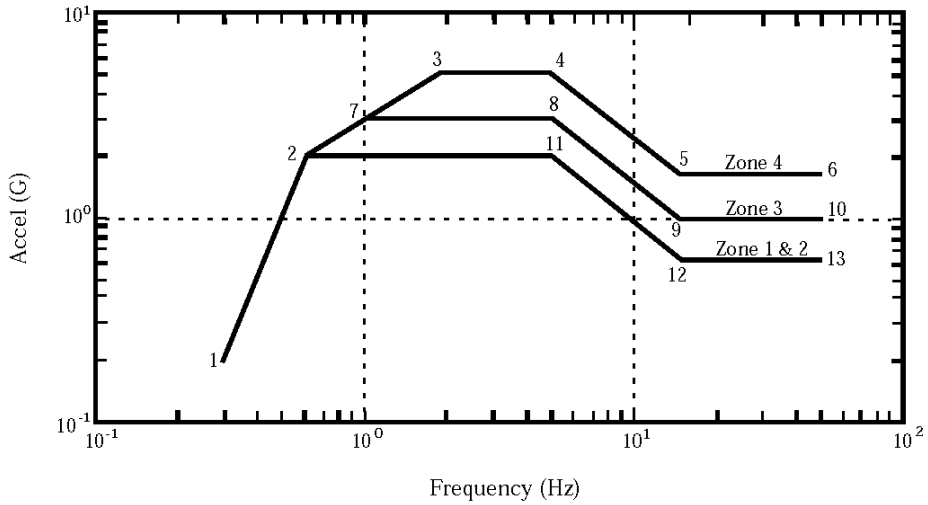
GR-63-CORE Physical Protection deals with physical characteristics of the equipment. The earthquake simulation of GR-63-CORE is a comparatively severe test. It simulates a 32s pulse with the shock response spectra at the base of the frame in the range of 5g with an amplitude of approximately 10 in. peak-to-peak.

GR-63-CORE
Issue 2, April 2002

NEBS Requirements: Physical Protection
Environmental Test Methods

2% Damping should be used.



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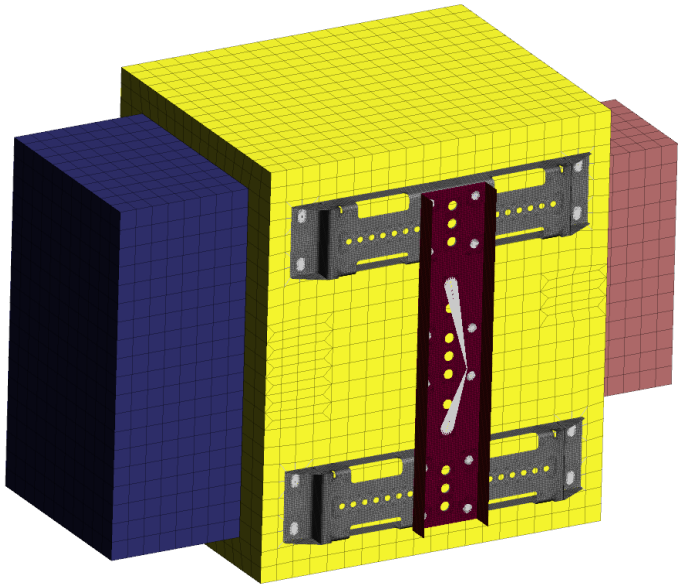

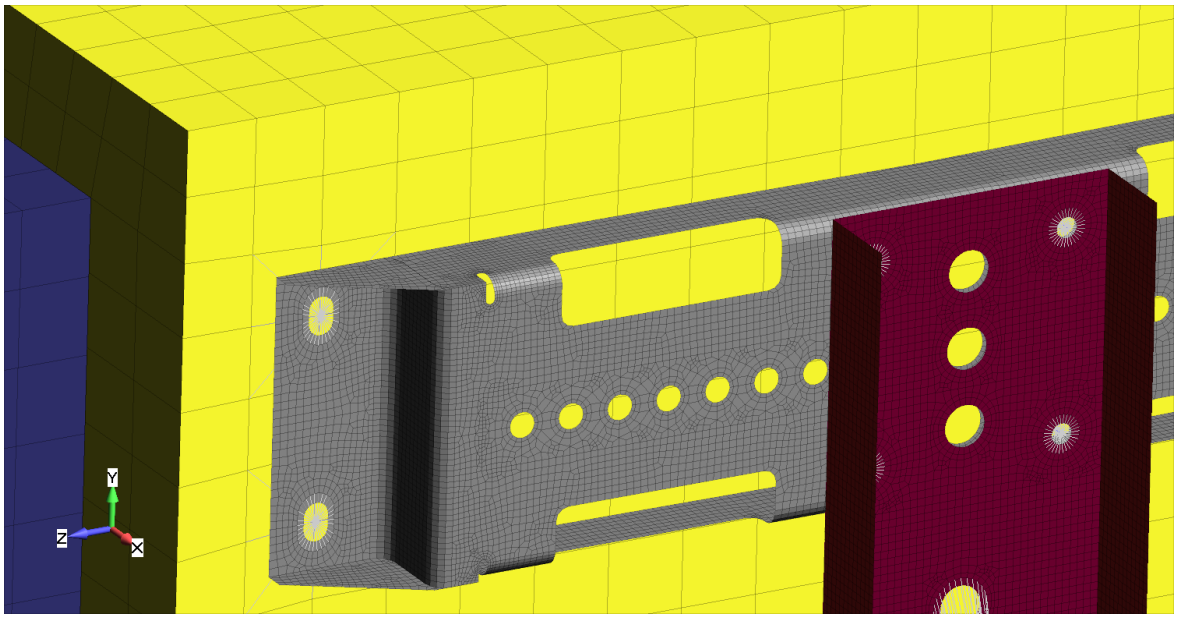

The complete structure was idealized using plate elements and was a very lightweight efficient model with a total of 46,000 nodes and 45,000 elements. The electronic enclosure had air conditioners mounted at each end and the interior of the main box was packed with electronic components. The weight of these devices was simulated using mass elements suspended within the boxes. The center-of-gravity of the combined enclosure was matched to client supplied data.

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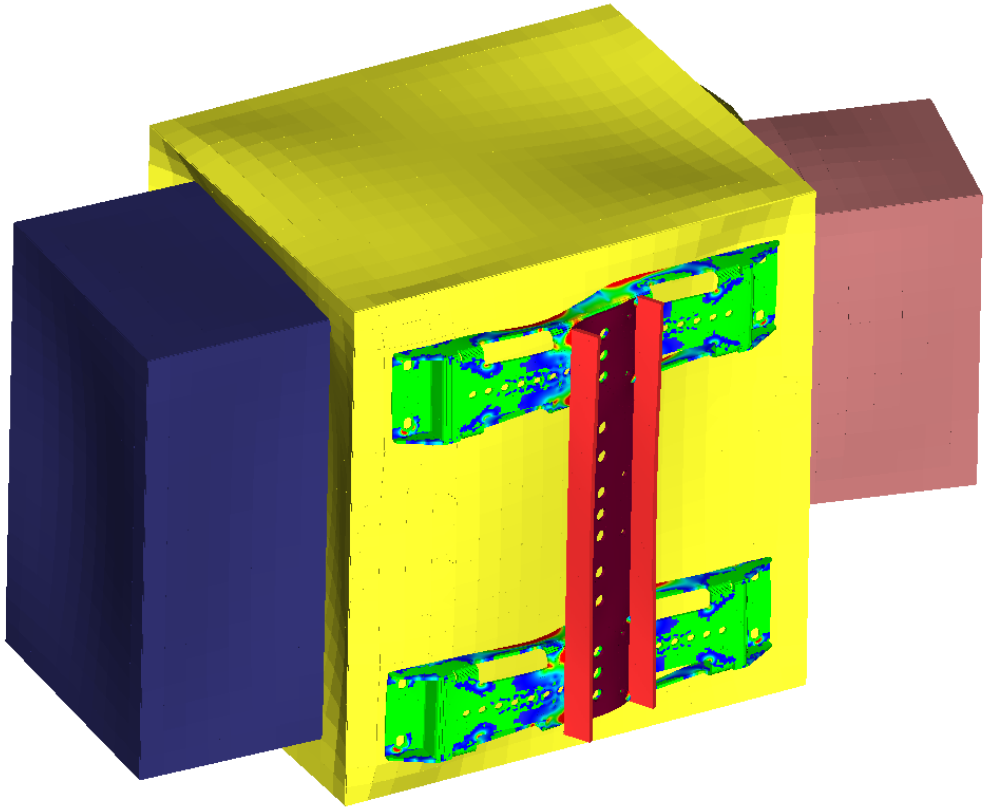

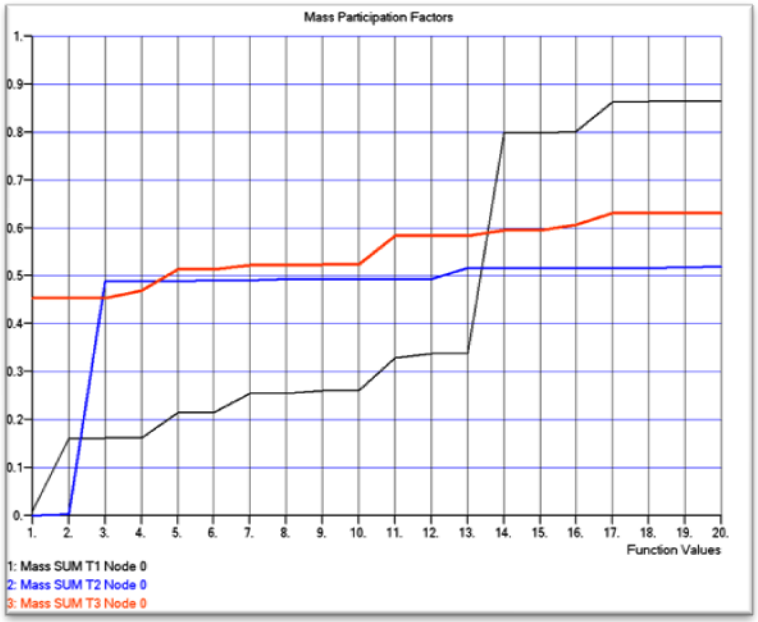

The first natural mode of the three bracket system is at 8.26 Hz. The mass participation graph indicates that this first mode is dominant (the red line at Sum T3 (Z-direction)) and accounts for 45% of the mass of the enclosure. In the GR-63-Core test, it can be estimate that 45% of the mass will be excited by the 5.0 g acceleration at 8.26 Hz. This will be a very strong response and dominate the bracket design work.

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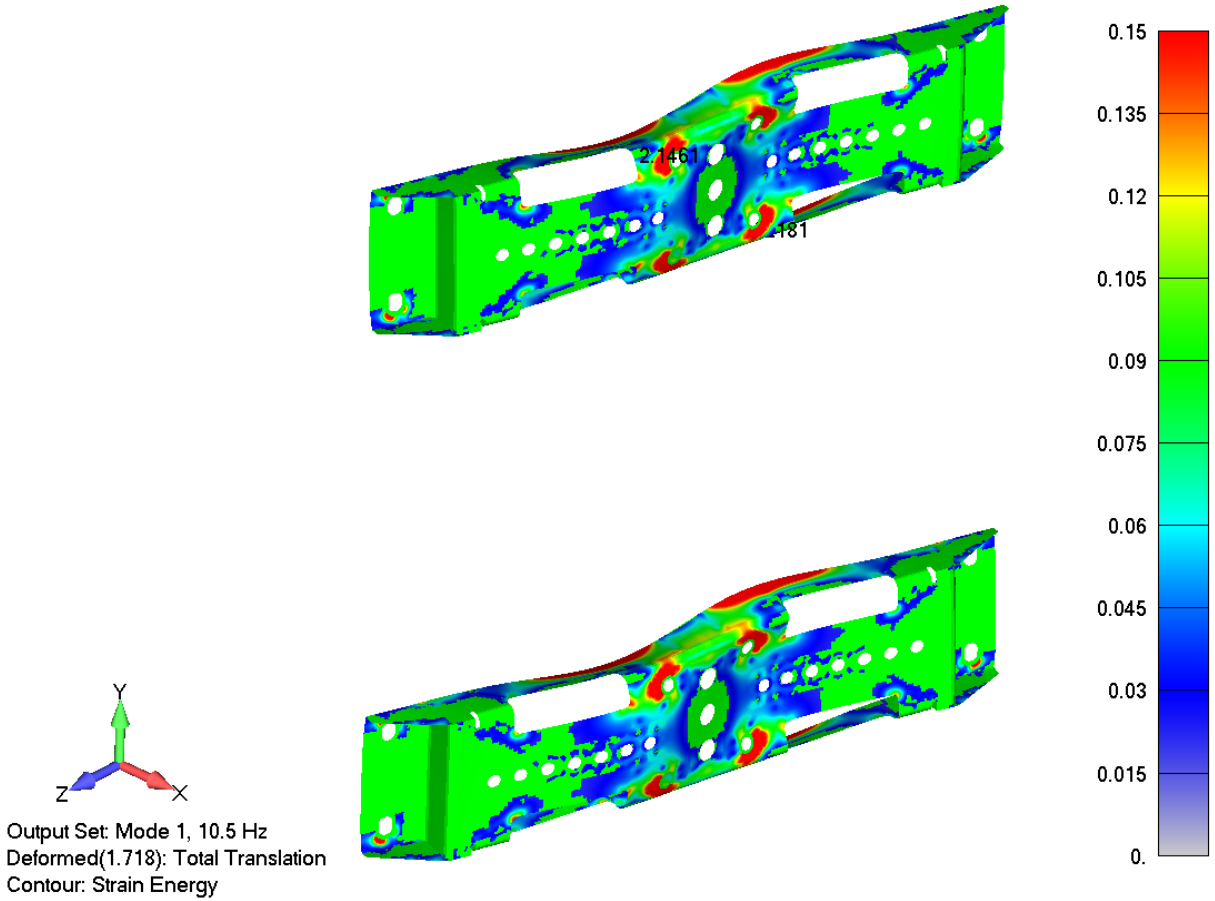

A key optimization tool for the bracket design work was to use modal strain energy plots to increase the stiffness of the bracket and thereby reduce its response to the seismic excitation of the GR-63-Core. The red regions above show where the bracket should be stiffened to increase its natural frequency.

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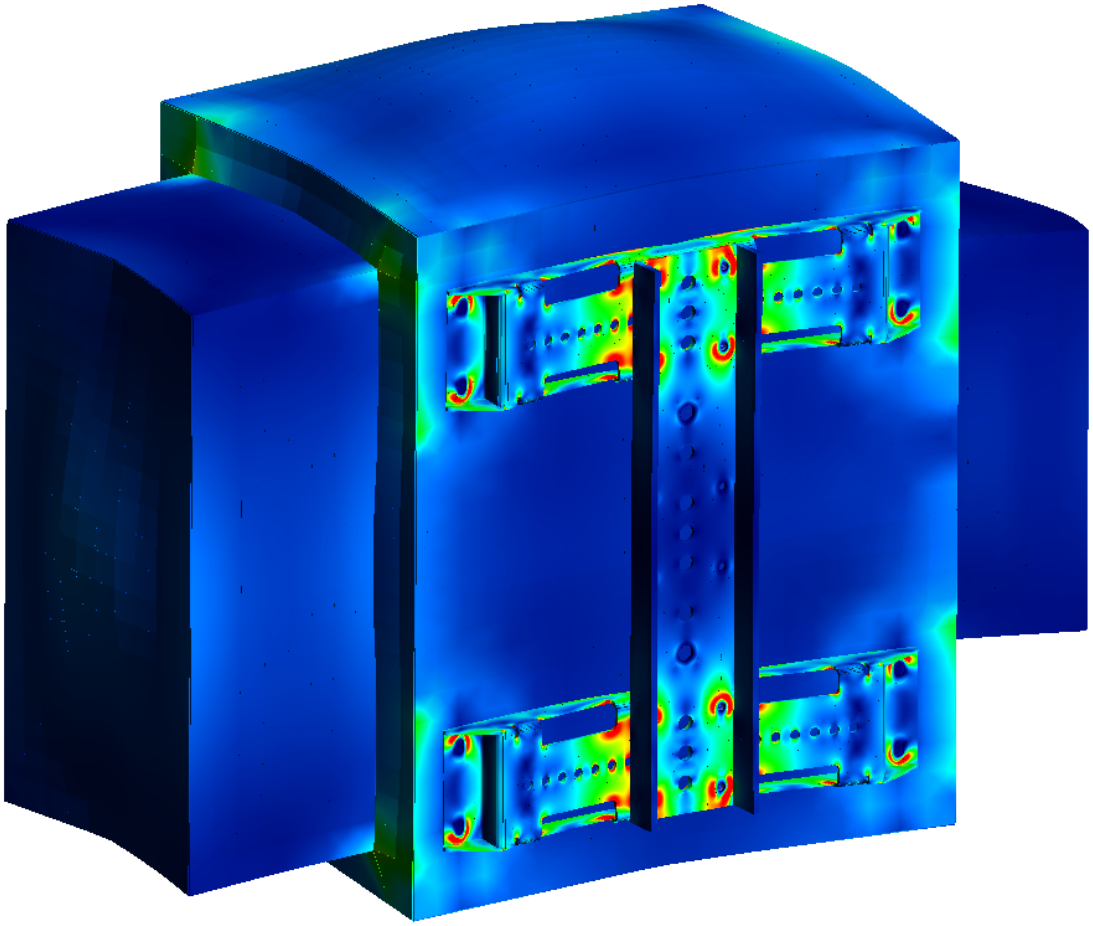

The final analysis load case is a linear combination of the GR-63-Core Zone 4 response and the 3x gravity load per UL60950-1 Section 4.2.10. Final tweaks were made to the design of the bracket to permit easier sheet metal fabrication and it was put into production.