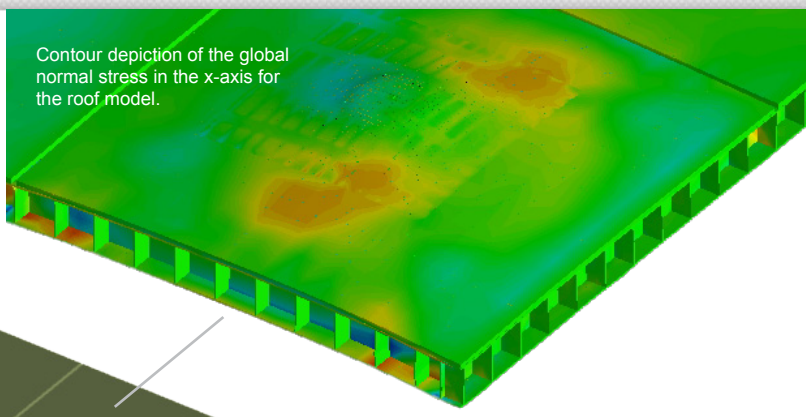
APPLIED SCIENCE INTERNATIONAL SUCCESS STORY

SUB-SEA TEST CELL

2012

Performance-Based Design For Structural Optimization

This project was completed in 2012 in cooperation with Eyeington Enterprises, Inc., as part of a series of specialized technical consultations provided for Halliburton. The project involved analysis of a petrochemical testing structure, referred to as the Sub-sea Test Cell, subjected to extreme loading conditions. The loading scenarios considered included a large hydrostatic pressure as well as the impact of multiple sizes of fragments at high velocity. Additionally, the effect of blast pressure due to a confined explosion on the whole structure was evaluated. Both theoretical and empirically derived equations were used to assess fragment velocities and pressure/time-history loadings with reflections for various components of the test equipment.



Contour depiction of the global normal stress in the x-axis for the roof model.

Applied Science International (ASI) used its proprietary nonlinear dynamic analysis software, Extreme Loading® for Structures (ELS), to perform the analysis. This allowed the creation of a three-dimensional model of the entire Test Cell, as depicted in Figure 1.

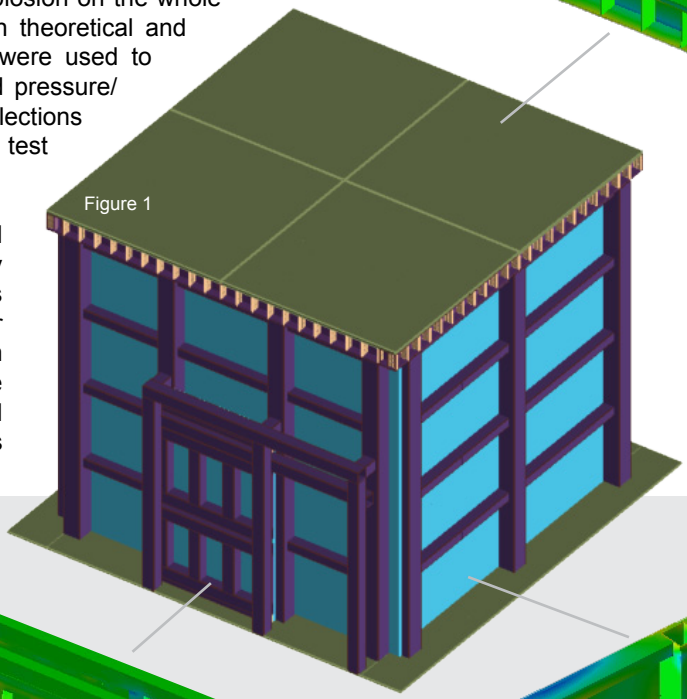
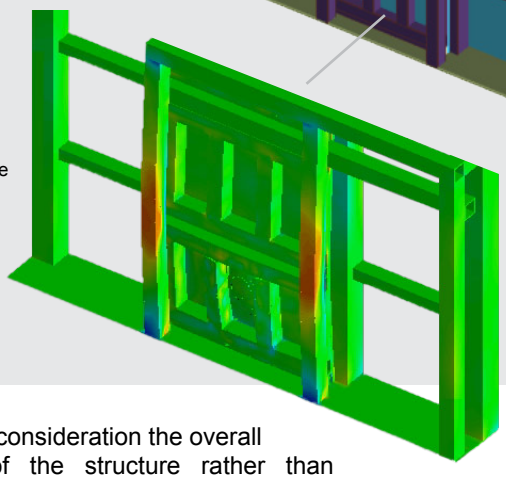
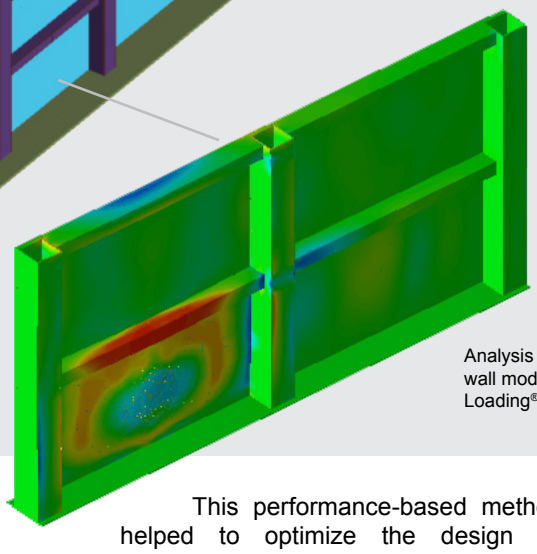


Figure 1

in resisting the loads as well as the dynamic interaction between the walls, the slab, and the foundations. ELS takes into consideration material and geometric nonlinearities as well as post buckling behavior to ensure a realistic estimate of the overall performance of the structure when subjected to extreme loads that exceed the range of the linear elastic response of the structure.



Analysis depicting stress contours of the isolated door model.



Analysis of the isolated wall model using Extreme Loading® for Structures.

This takes into consideration the overall performance of the structure rather than simplified component by component analysis done in traditional engineering analysis. The details of different connections and components were modeled using a high fidelity numerical model.

Using ELS, ASI predicted the potential failure modes for different structural components and different connections. This also permitted modeling the contribution of the secondary components

This performance-based method of design helped to optimize the design of structural components while meeting cost requirements and simultaneously ensuring a uniform and consistent factor of safety for all of the structural components.

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