An ASI Success Story

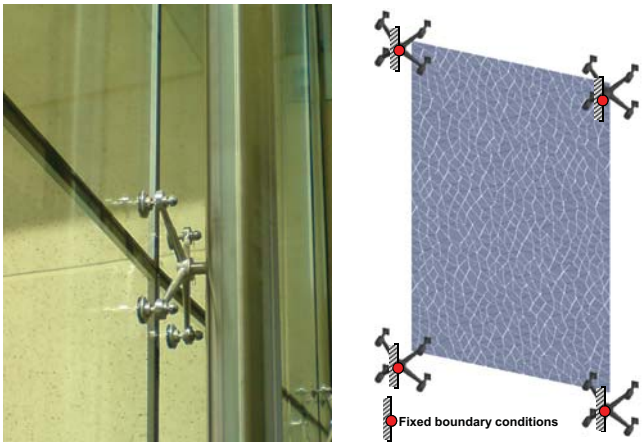
Blast Analysis of Building Glazing System

Khurasaniyah, KSA, February 2009

Saudi ARAMCO wanted to ensure the safety of the glass façade of a new office building, at Khurasaniyah, KSA. Based on hazard analysis, it was estimated that the glass façade of the building may be subjected to pressure as high as to 0.4 psi. ASI was tasked to investigate the behavior of glass panels for the windows and doors under the effect of blast loading. Two types of glass panels are investigated: single-layer glass panels and three-layer laminated glass panel with intermediate PVB layer.

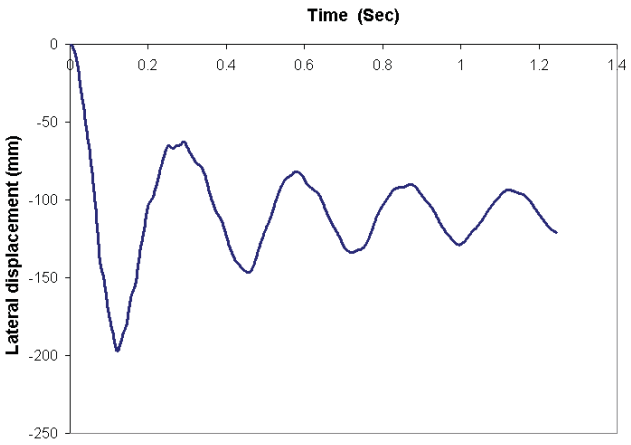
The random nature of the cracks generated in glass required using an element mesh with a random nature. Therefore, the Voronoi diagram (Delaunay triangulation) was used for meshing the glass. The support conditions for the doors and the windows were carefully taken into consideration in the analysis.

Views of the Building Facade



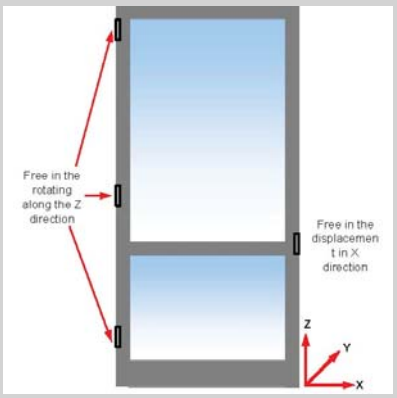
Boundary Conditions for the Windows

ASI used its patented in-house developed software Extreme Loading for Structures ELS® to perform the analysis. The nonlinear dynamic analysis showed that the 15.14-mm laminated windows and the single layer glass panels were both unsafe. ASI recommended strengthening the floor glass panels and the intermediate glass panel using structural films attached to the inner layer. ASI performed multiple analyses with different film thickness to calculate the optimum film thickness for floor panels and intermediate panels.



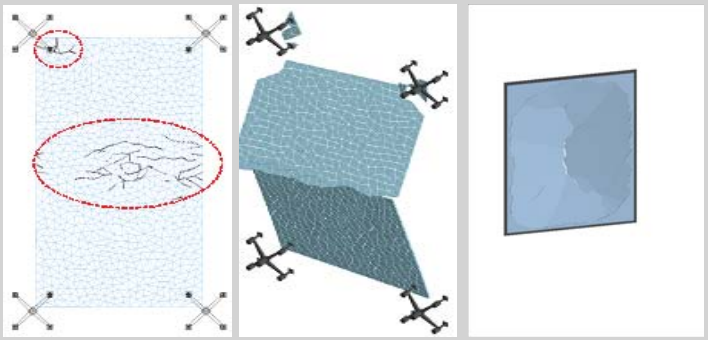
Vibration of the Glass Door due to Blast Loading

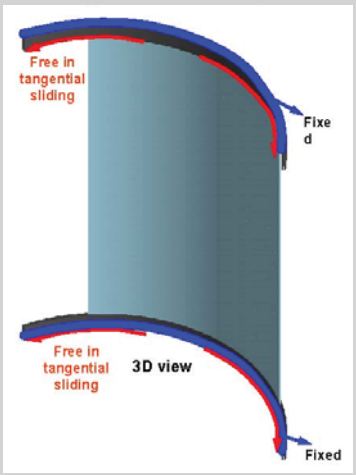
Another dynamic analysis was performed for both the side door and the sliding curved door. It was conservatively assumed that the doors are in the closed position and the boundary condition details were modeled explicitly in ELS. ASI performed the analysis for multiple layers of the laminated doors to optimize the design. It was finally concluded that by using 5 layers, (8 mm glass, 16 mm air space and laminated layers of two layers of glasses with 8 mm and 6 mm thicknesses with one PVB layer of 1.14 mm thickness), both the side doors and the curved doors are safe under the effect of the given blast pressure.



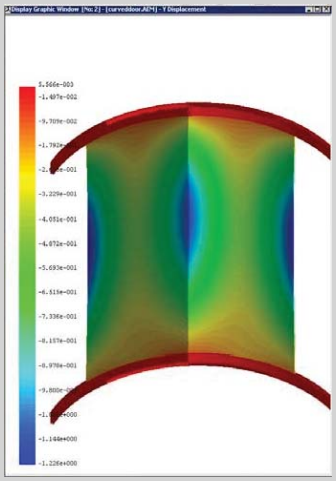
Boundary Conditions for Side Doors


Failure of a side door


Failure of the Window Panels



Boundary Conditions for Curved Doors


Stresses in Curved Door

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