STRUCTURAL RESPONSE TO HIGH EXPLOSIVE BLAST LOADING

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ABSTRACT

Buro Happold has a contract for the engineering of a large civil structure to be attached to an existing building. As part of the design of the structure, Buro Happold asked Century Dynamics to consider blast loading and response of the new facade to a large charge placed some distance from the building. Buro Happold also conducted a second set of simulations to investigate the response of a predominantly glass entrance lobby. This paper will describe the simulation work conducted using the ANSYS AUTODYN software and discuss the results of these analyses.

Simulations of the global response of the new steel structure used beam elements to represent two vertical walls and the roof with the geometry imported from an existing FE model. Shell elements were included to represent the glazing and other sources of dead weight. The analysis was conducted in two stages, with blast loads recorded in the initial stage then applied to the structure model in a second analysis. Very little plastic deformation was seen in the structure for the 100kg TNT charge considered, indicating that the structure is likely to withstand the blast loading without collapsing. Another key output was time histories of the reaction forces at the locations where the new structure is attached to the existing masonry structure.

The effects of a smaller explosion within an entrance lobby were also considered in a more detailed model. These simulations included the glazing and supporting structures at the inner and outer façades and a 'frangible' roof section intended to fail and allow venting following an explosion. The simulations lead to a design change in the inner glazing with polycarbonate substituting glass to prevent fragments being projected into the main atrium of the building. There was significant damage to the external façade consisting of glass and polycarbonate double glazing, although the polycarbonate did remain intact. During the simulations it was observed that the 'frangible' roof section remained intact although there was significant yielding at the connection between the roof and the purlins suggesting that the results of the analysis could be sensitive to the connection design.