Safeguarding iconic buildings from bomb explosions

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Credit: Queensland University of Technology (QUT)

QUT researchers have developed a technique to prevent glass facades on iconic buildings from shattering if the building is targeted by terrorists in a bomb explosion.

In the study, published in the journal *Engineering Failure Analysis*, the research team of Dr. Ruwanika Piyasena, Professor David Thambiratnam, Professor Tommy Chan and Adjunct Professor Nimal Perera, looked at the "maximum credible load" of an explosion and how to minimize the problem of a deadly wave of shattered glass which can cause traumatic injury and death.

Professor Thambiratnam said the study went beyond previous research in the field with a sophisticated coupling analysis, which did not just look at the way the glass responds to an explosion but also modeled the explosive source, the pressure wave transmission and fluid-structure interaction.

"We modeled the shock waves that traveled through the air and then we studied how it hit the structures," Professor Thambiratnam said.

The solution, detailed in the paper, is to absorb the energy of the blast with a shock absorbing layer between the glass panels in the laminated glass and through the members of the supporting system as well as to make the cable trusses stronger.

"The glass is certainly going to crack, but this interlayer holds the particles together," Professor Thambiratnam said.

Dr. Piyasena said this research was innovative in providing design recommendations for optimized blast-resistant cable supported facades without any expensive external devices.

"Development of the fully coupled modeling technique enabled the realistic modeling of double skin facades and identified the effects of appending an additional skin," Dr. Piyasena said.

The double skin facades would be two glass skins separated by an air

corridor.

"This double skin feature can be used as a retrofitting method for converting existing conventional facades to blast-resistant facades," Dr. Piyasena said.

"Attaching additional skin will be more economically feasible than removing the existing façade and replacing with a new blast-resistant facade, as double skin feature will also provide energy efficient characteristics."

The researchers specifically looked at cable truss facades, which are mostly used in hotel lobbies, shopping malls and airport terminals, where the structure of the large glass area is secured by twin convex and concave cables behind the glass.

The researchers examined case studies of real blast scenarios and found that up to 90 percent of blast-related injuries, in bomb attacks, were due to flying glass fragments and other façade debris.

Professor Thambiratnam said previous research had used an uncoupled method of analysis which calculated blast pressure hitting a façade as uniformly distributed, whereas examining the explosive waves in an explosion showed that blast pressures at lower levels of the facade would be higher than those at the upper level.

Dr. Piyasena said the developed modeling techniques can be augmented and altered to study the response of debris impact such as hailstorms on cable supported glass facades (by incorporating the load model for the debris in a coupled analysis).

More information: R.R.C. Piyasena et al. Fully coupled modeling technique for blast analysis of cable truss facades, *Engineering Failure*

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