Studying explosion-induced flows inside buildings using a modular shock tube

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When an explosion occurs inside a room of a building, the pressure first builds up in the first room and then propagates inside the whole building. Damages and casualties can thus be caused far from the explosion location, sometimes in unexpected areas. Studying internal flows induced by explosions is thus a critical issue for the design or the safety assessment of buildings.

Using full-scale buildings is merely impossible in practice and small-scale models are used. They generally either consist in a small chamber put at the end of a shock tube or in a reinforced model with a fixed layout in which a small high explosive charge is detonated. Even though these experiments allows a detailed characterization of the flow, the first ones are limited to the study of elemental parts of buildings and the second ones only offer a limited variability in terms of internal layout.

An original setup has thus been designed to overcome these limitations. It is a modular shock tube which allows representing arbitrary building layouts at a reduced scale of 1/20th and in which the high pressure chamber represents the location of the explosion. Two kinds of modules can be assembled together in various shapes and in an arbitrary number. The first one is cubic and represents a room, the second one represents a corridor and is long enough to fit two room modules in its length. All modules feature several doors which can be let open or closed with a plug which can be equipped with a pressure sensor and a thermocouple. The ceiling and the floor of each module is made of glass which allows the making of shadowgraphs. The setup thus allows the simultaneous measurement of pressure and the visualization of the flow in each module.

In further work, these experimental data will be used to validate a dedicated fast-running model. In the long term, new modules could be made to represent other types of rooms, such as, hallways or staircases and expand the range of accessible layouts.

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