Why buildings collapse

Application of theoretical models against progressive collapse of flat slab concrete structures

Academic: *Dr Juan Sagaseta*

Current building regulations are based on engineering intuition and experience of structural failures dating back to the early 1970s. The urgent need for accurate theoretical models to ensure the robustness of concrete buildings was the driving force behind this IAA project.

Considering progressive collapse when designing structures such as buildings or bridges is a relatively recent development. The concept of robustness was first introduced in building regulations in the UK in the early 1970s after the Ronan Point collapse in 1968, triggered by a domestic gas explosion. Accidental loads such as vehicle impacts against columns in underground car parks or a local fire inside a building are possible events, which in some cases have led to structural failures and loss of lives in the last decade.

Lead researcher Dr Juan Sagaseta of the University of Surrey's Department of Civil Engineering collaborated with multinational engineering company Arup to address the huge knowledge gap that exists in modelling the structural response of these types of concrete structures. Current building regulations in the UK are based on outdated prescriptive rules with little supporting scientific evidence, and knowledge focuses on static rather than dynamic situations. The IAA project took an innovative theoretical dynamic model and applied it to real structures.

The research team first reviewed available literature on the subject and then applied a model (developed by Dr Sagaseta for a previous EPSRC project) to a known UK office building, establishing its probability of failing based on different local damage scenarios.

Dr Sagaseta explains: "Our achievement has been to use a theoretical model to solve real, complex issues, and to reduce uncertainty by enabling the design of more robust buildings.

"Our next step will be to write guidelines based on our findings which could ultimately be incorporated into UK building regulations. Since there is a similar lack of knowledge elsewhere, they could potentially become part of Eurocode and used in countries across Europe, as well as in US regulations. The impact could be significant."

Ronan Point collapse (*The Daily Telegraph*)