Crowd egress — Row 24, seat 16

Crowd egress studies are providing information for improved building regulations and better guides for the design of buildings.

The year: 1845; the place: Canton, China. What began as a pleasant theatre performance ended in the largest loss of life in a single building fire yet recorded, when over 1,600 people perished.

A soccer match in progress in Glasgow, Scotland, in 1971, was not a particularly interesting game. Large numbers of people decided to leave the grandstand. Minutes later, the score was tied. As people surged back to the game, several barricades on a wide stairway collapsed and 66 people were killed.

These two events, over a century apart and in different parts of the world, have one common denominator — both are concerned with crowd egress, the movement of large numbers of people out of buildings.

Crowd egression is an area which even today has been only sparsely explored. At the present time, only a few researchers in North America are working on crowd movement in buildings and perhaps the most active of these is Mr. Jake Pauls of the National Research Council of Canada's Building Design and Use Section, Division of Building Research. In 1969, two years before the Glasgow incident, he completed his undergraduate thesis in architecture. The topic: how people respond to fire emergency situations in high buildings. Later that year, British Columbia Hydro planned an evacuation of their 22-storey office building, and because Mr. Pauls had studied the problems involved, he was asked to supervise observations of the evacuation.

"It appears, from the study of fire safety literature that this was the first time that an evacuation of a high building was documented in such detail," says Mr. Pauls.

This, in turn, led to an invitation by Canada's Dominion Fire Commissioner to conduct observations of a variety of evacuation exercises in federal government-occupied buildings in Ottawa. Between 1970 and 1974, nearly 40 test evacuations involving some 20,000 evacuees were observed in office buildings ranging between eight and 29 storeys in height.

"Our objective," says Mr. Pauls, "is to develop information in an area where not very much exists, in order to produce improved building regulations and better guides for the design of buildings."

In Canada, research officers with NRC's Division of Building Research are technical advisers to the committees that prepare the model codes known as the National Building Code of Canada and the National Fire Code of Canada. This facilitates a two-way exchange so that up-to-date information is made available to committees and new areas for research are identified. This exchange has been particularly significant for the Division's Building Design and Use Section, "which," explains Mr. Pauls, "has a major goal of developing information on the human requirements in buildings, particularly requirements relating to safety."

Research in the area of architectural design has advanced very slowly. The design guides used by the designer and building codes which greatly influence how a building is built are based on only limited research. In some cases, the guidance given to designers and the assumptions underlying safety rules are in error.

"In the past, 'rule of thumb' formulas have been applied to the design of buildings," explains Mr. Pauls. "Many of these become fixed in practice and end up in print. Today, many of the old 'rules' no longer apply, especially as they relate to high-rise structures, and this is why we have to go back to re-examine them."

Preliminary findings in the high-rise office evacuations proved to be a typical case. Conventional codes regulate stairs on the basis of 22-inch (55 cm) widths, assuming that people descend shoulder to shoulder. Mr. Pauls' observations showed that shoulder-to-shoulder movement is rare and that people usually try to locate themselves on stairs so as to maximize the spacing or "body buffer zone" between them.

Another long-standing misconception concerns the flow of people on stairs. Existing literature suggests a flow of up to 45 persons per minute per 22 inches (55 cm) of stair width. However, Mr. Pauls found that this was only possible in experimental situations involving people who were specially instructed and motivated. Depending on a number of conditions including evacuee's use of heavy outdoor clothing, the mean flows he observed ranged between 20 and 30 persons per minute. With crowd flows on stairs much smaller than previously assumed, the actual total evacuation times for buildings were 50 to 100 percent longer than previously predicted.

These findings are particularly timely in view of the fact that major changes are being made in building and fire codes in North America to deal with the problems of fire in high buildings, "and one important aspect is the reassessment of the role of evacuation as a life-safety measure," says Mr. Pauls.

The need for studies of crowd egress from grandstands became evident in 1972 when a new triple-tiered, 17,000-seat