Cameras, tape recorders and two-way radios are used by observers to study crowd movement.

Les observateurs qui étudient le mouvement des foules se servent de caméras, d'enregistreurs à bandes magnétiques et de communications radio.

Crowd leaves Calgary grandstand via escalators. Note lack of channelization before permanent railings were installed.

La foule quitte les tribunes de Calgary par ascenseur. A noter la congestion avant que des rails de guidage permanents aient été installés.

grandstand was being planned for Calgary, Alberta. The proposed grandstand, to be completed in 1974, was to be over seven storeys high, 600 feet (180 m) long, and contain 200 flights of stairs and stepped aisles. Building designers and officials of the city of Calgary asked the Division of Building Research to provide information on evacuation times and on crowd flow down stairs.

In order to complement the evacuation studies of office buildings, the Building Design and Use Section began, in 1973, to observe the movement of people after grandstand shows, football games and theatre performances in Ottawa. This pilot study tested observation methods and provided preliminary data describing crowd movement as influenced by various configurations of seating, aisles, passageways, stairs and ramps.

At the National Arts Centre, for example, the Opera, which has a continental seating arrangement for some 2,300 people, clears in one to two minutes. The Theatre, on the other hand, which has a mixed-aisle continental system and is much smaller, takes twice as long to clear.

In the case of grandstands, these structures are in the open and the risks of fire are not so great as in enclosed high-rise buildings or theatres. "We are not only studying emergency situations," continues Mr. Pauls, "but normal evacuations — those which occur every day, or several times a day. However, the important thing is not whether there is an emergency situation, but how people perceive the situation. For example, an injury or even a large-scale emergency may occur as a result of one person falling."

The Calgary grandstand uses stairs (rather than ramps as in most grandstands) for egress, as well as escalators. When it was first used at maximum occupancy in July 1974, during the Calgary Stampede, Mr. Pauls and Mr. P.L. Li, Chief Building Inspector for the City of Calgary, organized the extensive observation effort required to assess the new grandstand's egress facilities.

"This particular study was important," Mr. Pauls points out, "because it was one of the first occasions that a building inspection department had worked with a research agency to carry out the evacuation of a building. We had to determine if egress from the building really worked with reduced exit stairs designed to perhaps one-third of what was required in the code. We wanted to see what kind of information we could gather from this building which would help designers of other buildings, perhaps by changing the code. We found that although the building is underdesigned relative to the building code as far as the exit stairs are concerned, it clears extremely fast."

While the stairs created no problem, the escalators did. People hesitated while moving from one escalator to another and began to crowd together. With the large numbers involved, people could have been badly injured. Mr. Pauls made recommendations to temporarily correct this situation during the Stampede, and permanent railings were later installed.

"It appears that the more railings and more channelization provided, the better the crowd movement," he says.

With the building of a new 7,800-seat upper tier at Ottawa's Landsdowne Park stadium there was an opportunity to explore this hypothesis. The designer and City of Ottawa Building Inspection Department, after consulting with Mr. Pauls, revised the configuration of aisles to produce greater channelization of crowd movement than was the case with the comparable lower tier of existing seats. Upon completion and first use of the new tier of seating in August 1975, Mr. Pauls conducted observations of crowd flow in both the older lower tier and the newer upper tier. Analysis of video tape and films of crowd movement is now under way.

Another opportunity to study a new grandstand also presented itself last summer with the first use of a new section of over 15,000 seats in Toronto's CNE Stadium. With this building, as with those in Calgary and Ottawa, considerable cooperation of grandstand management authorities facilitated the detailed observations made by Mr. Pauls and other NRC researchers.

"These studies are excellent examples of what can be accomplished when persons representing building management, design regulations, and research are involved jointly in a major building evaluation," concludes Mr. Pauls. "Besides influencing future design modifications and operating procedures for the observed grandstands, results of the study should contribute to safety regulations and the design and operation of other grandstands." □

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