
January 2001
News

Beat the crush

> *"Alright people, listen up. The harder you push, the faster we will all get out of here."*
>
> Police Chief Wiggum,
> The Simpsons

We all know that this prescription from the staggeringly inept Police Chief Wiggum is dead wrong, but what can be done in real life to protect people in a crowd panic situation?

Every time there is a fatal crush in a sports stadium or disco, there are calls that such a thing should "never happen again". Such crushes can be caused by serious events such as the outbreak of fire, or by apparently trivial things such as a last−minute goal prompting fans who left a football ground early to avoid the traffic jams to turn around and try to get back in. Such tragic accidents often seem, in retrospect, to be horribly avoidable − for example, it may turn out that one exit was hardly used while people were crushed to death at another.

Architects and planners are expected to come up with ways of making buildings and crowd events safer during emergencies. But how can they do this?

The problem with planning buildings and events to avoid crushes is that people behave differently from normal in panic situations − they don't just do a speeded up version of what they normally do. They lose their inhibitions about pressing against each other, and friction comes into play, with people jammed shoulder to shoulder, unable even to turn around, and perhaps being severely crushed. They also herd, following other people to one exit while another may be ignored.

If you don't know how people in a crowd will react in a panic, you can't plan to protect them. So the first step is to provide a realistic description of such behaviour − which is exactly what a group of researchers, based in Dresden and Budapest, have done.

Their model takes advantage of recent massive increases in computer power and memory to model all the people in a crowd separately. Each person is represented by a little disc, which is given a mass, friction, and the desire to move in a particular direction without bumping into other people. The disc−people are then set free to roam around a representation of a room or building. Their behaviour in the computer model turns out to reproduce much of the detail seen in real−life crowd situations.

One chillingly lifelike feature of the model is what happens when all the disc−people are given the desire to move fast (about 1.5 metres per second or higher − a bit above normal walking speed) away from some particular point in a room − which might represent a fire. To model what happens in real life, when the forces on a disc go above a certain point, the disc is "hurt" and immobilised. What the researchers saw was a crush forming around the exit, with discs becoming jammed against each other, and many becoming hurt. The number of discs able to leave slowed to a trickle.

A particular feature of real crowd situations the researchers noticed was that widening part of a corridor is counterproductive − the flow of people speeds up and then forms a bottleneck when the corridor narrows again. They also observed that placing a pillar or other barrier asymmetrically in front of an exit appeared to reduce jamming at the exit, by absorbing pressure from the crowd and allowing people at the exit to move freely.

No computer model can provide fail−safe prescriptions for crowd safety. But this model is certainly an improvement on earlier approaches, where crowd flow through a building was modelled as fluid flow, or where crowd panic was treated primarily as a psychological phenomenon, rather than to do with velocities, masses and friction. By representing moving people as separate entities, rather than as part of a single flow, this model could help planners test different building plans, and hopefully save lives.

Helen Joyce
