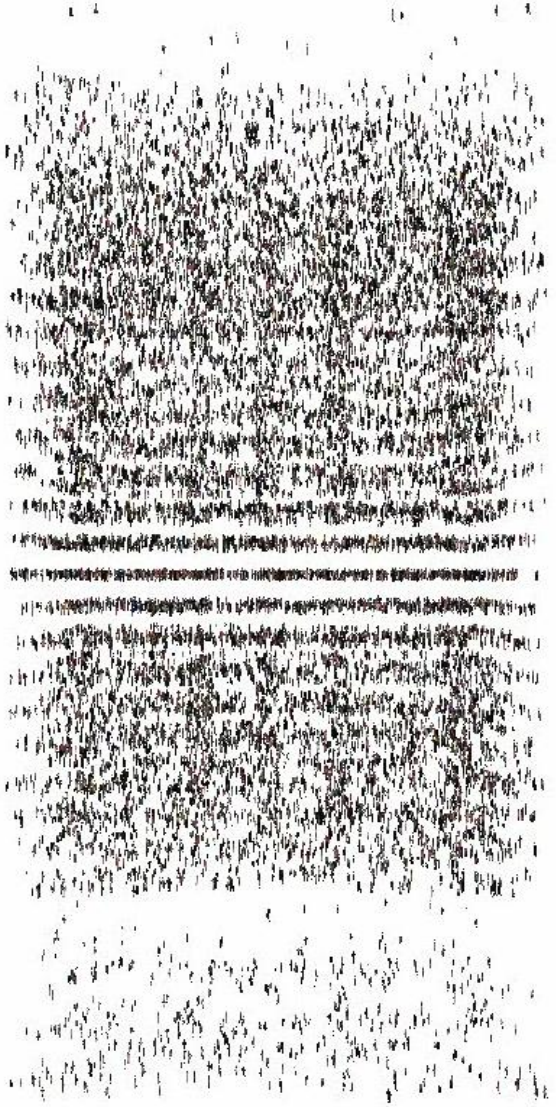
→ **Dr Aoife Hunt**
Market Leader, GHD

DON’T PANIC!

→ **Can we help people survive in emergencies?**

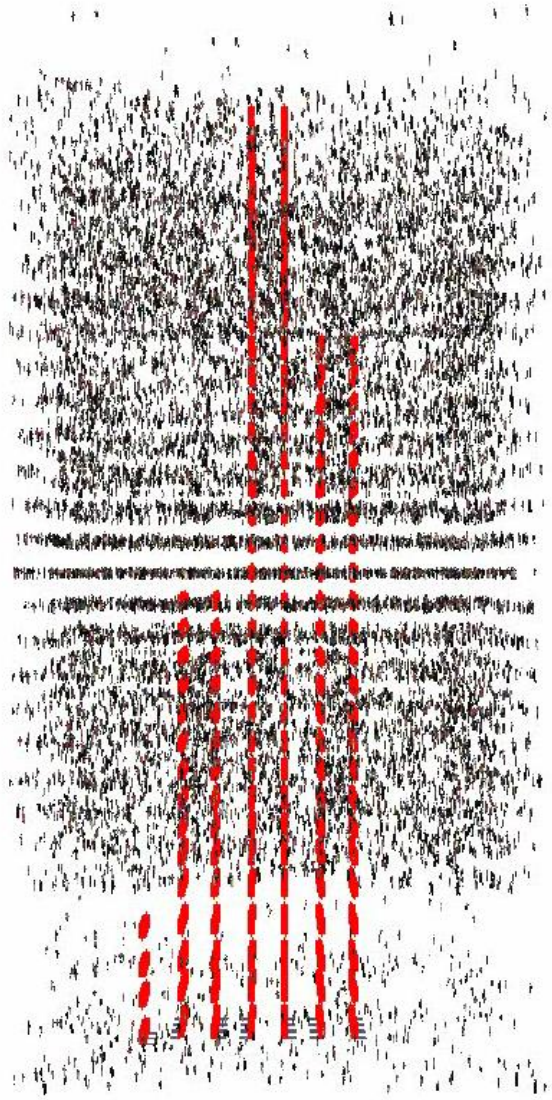
Fire and evacuation regulations are based upon*:

a) The time taken for the average person to walk 100m **(1.1 minutes)**
b) The assumed minimum for fire and rescue services response time **(8 minutes)**
c) The 95th percentile of total evacuation times from real incidents **(10 minutes)**
d) The average length of “God Save the King” **(2.5 minutes)**
e) The longest recorded time a sportscaster continuously shouted “GOAL!” **(1.1 minutes)**



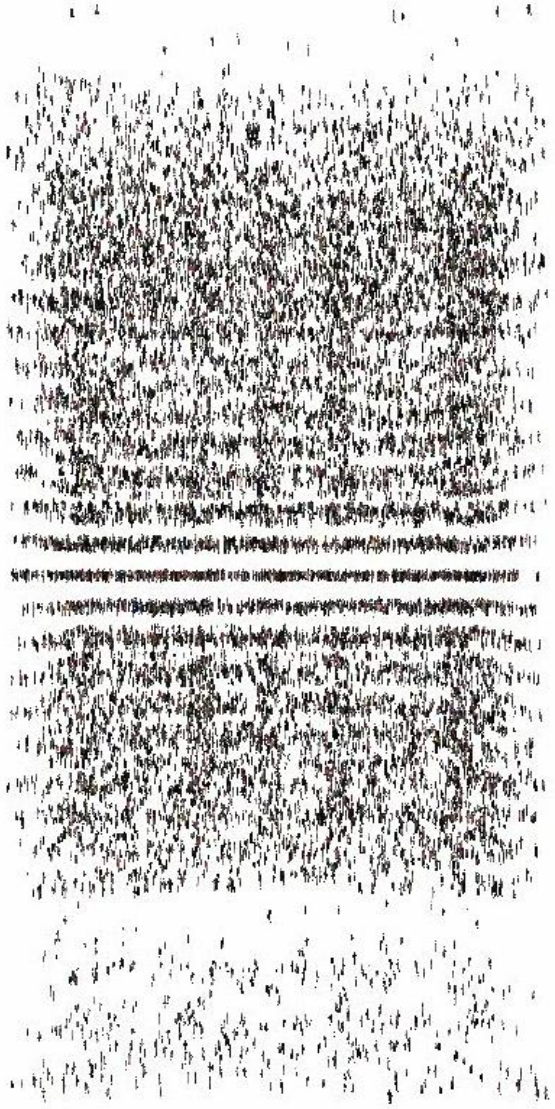
Note: some of these are fictional

Simulating emergency evacuations



← Lifts

No Lifts →




If there is an emergency,
what might people do?

It depends on the type of cue

Incident

Alarm

Information

How would we like people to respond to an alarm?

- Follow instructions
- Respond immediately
- Use the escape paths efficiently
- Move directly to a place of relative safety

How do people *really* respond to an alarm?

- Follow instructions
- Respond immediately
- Use the escape paths efficiently
- Move directly to a place of relative safety

- Misinterpret/ignore cues and instructions
- Interpret information in different ways
- May not move directly to a place of relative safety
  - Seek information and find people
  - Engage in non-evacuation activities
- Use routes according to familiarity rather than design

Gwynne, S., Engineering Human Response, 2016

Why?

We are biased towards normalcy and optimism

PANIC

Panic?

Christopher Andrew Lloyd (http://www.bbc.com/news/uk-england-london-41281170)

Panic?

"... there was no trouble during the mass evacuation. People were just singing and chanting as usual..."

https://www.theguardian.com/football/2016/may/16/manchester-united-fake-bomb-fiasco-call-for-investigation-old-trafford

~~PANIC~~

Decision-making

Real behaviours


Collecting belongings


Running


Hiding


Fighting


Investigating


Helping others


Milling


Information-seeking


Calling police

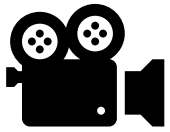

Searching for friends or family

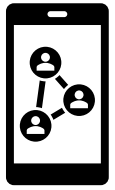

Going towards danger


Giving first aid


Calling friends or family


Taking selfies


Filming


Social media

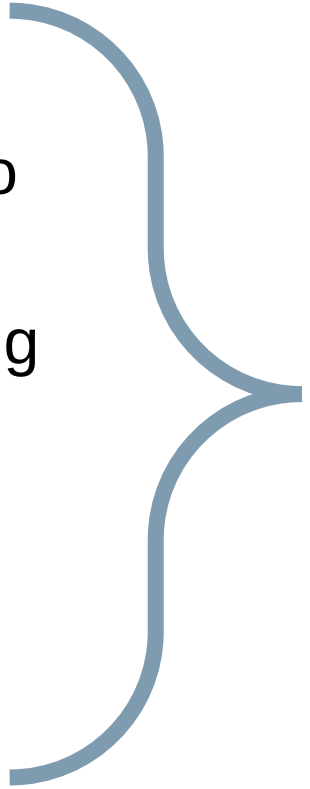

Carrying on with usual activities

#itscomplicated

What do we do when something is complicated?

The easy bit

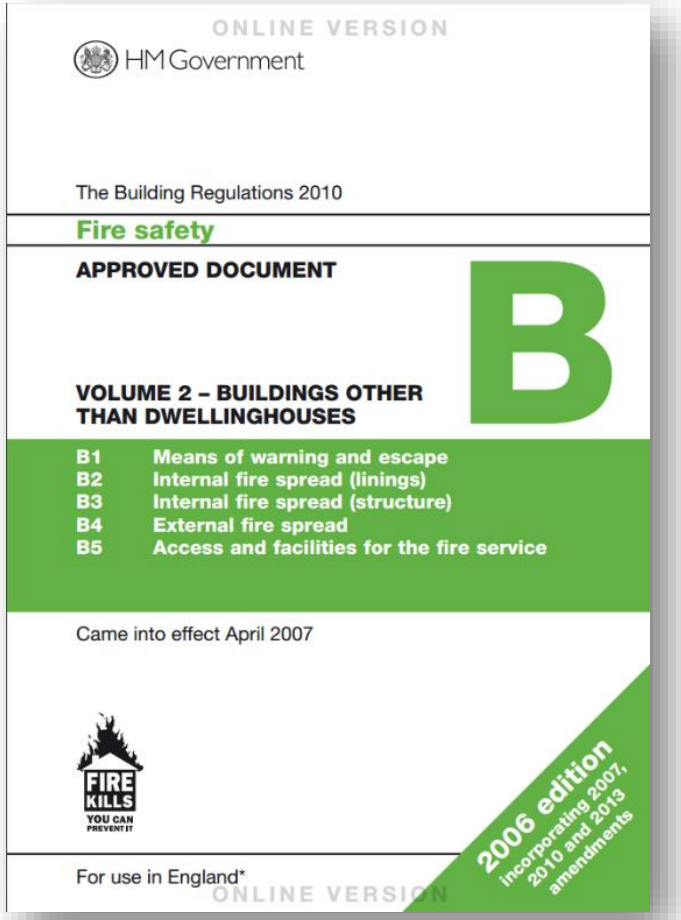
- The time taken to respond to an emergency
- The actions performed during an emergency
- Route and exit use, and the interpretation of information



Flow rates and egress times

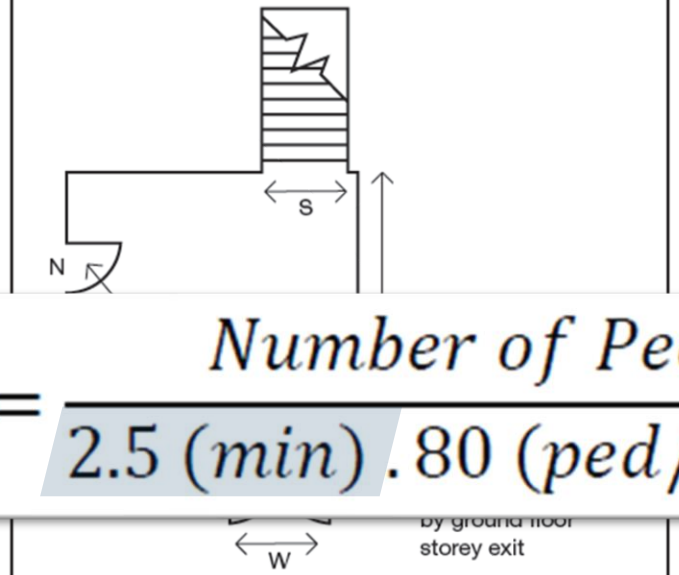
Magic numbers

Two and a half minutes



$$\text{Stair Width} = \frac{Number\ of\ People}{2.5\ (min)\ .80\ (ped/m/min)}$$

Diagram 15 **Merging flows at final exit**



This can be calculated from the following formula:

W = ((N/2.5) + (60S))/80

Where:

W = width of final exit, in metres

N = number of people served by ground floor storey exit

S = stair width in metres

Two and a half minutes

The time available for escape depends on several factors including the distance that has to be travelled to reach a place of safety and the risk rating of the premises. Established reasonable escape times are 2 minutes for higher risk premises, 2.5 minutes for normal risk premises and 3 minutes for lower risk premises. For calculation purposes these times are allowed for in the travel distances suggested in Table 2. Guidance on establishing the risk rating of your premises is given earlier in this section.

Two and a half minutes

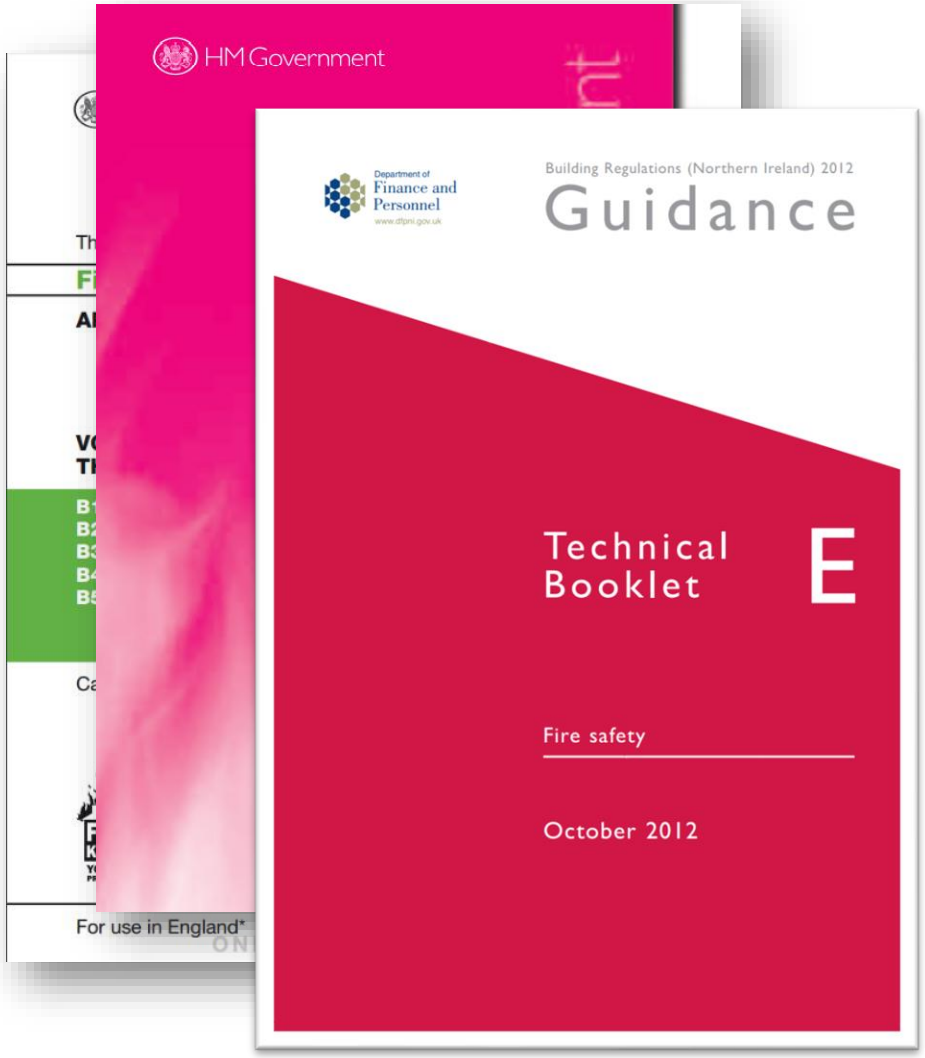


Table 2.4 Widths of escape routes and storey exits

Maximum number of people[1]	Minimum width[2][3] mm
50	750[4]
110	850
220	1100
More than 220	5 per person[5]

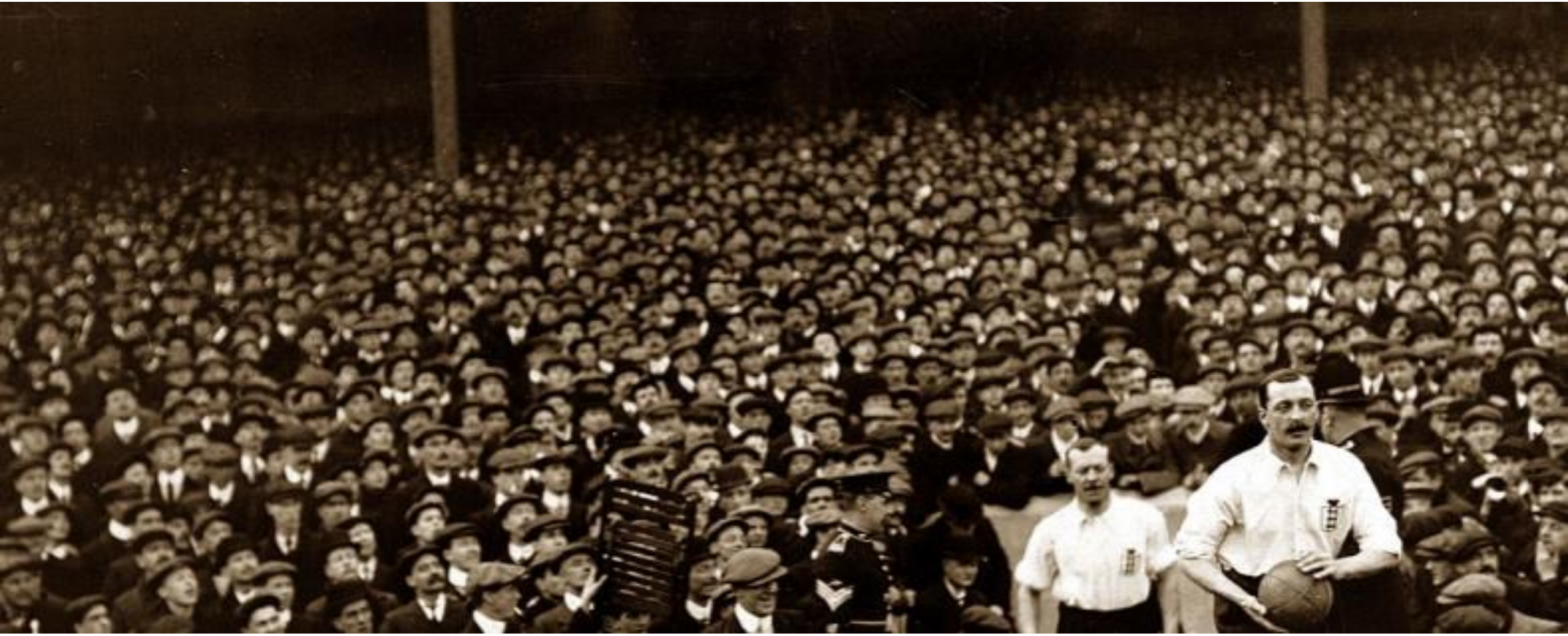
$$\text{Width} = \frac{\text{Number of People}}{2.5\,(min).80\,(ped/m/min)}$$

Empire Palace Theatre Fire 1911

2.5 minutes

= The average length of God Save the King; the British national anthem, when played in full, by a concert orchestra.

Things may have changed since then

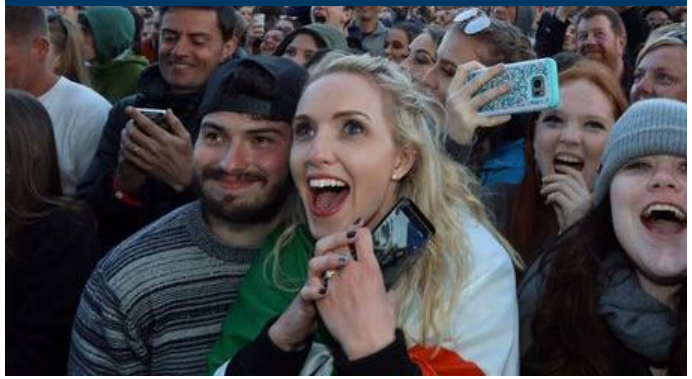


Who walks quicker?

England Football Fans

Rugby League Fans

Ed Sheeran Fans



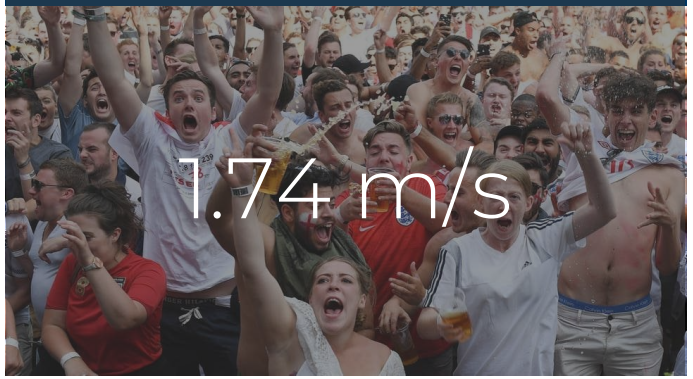
Taylor Swift Fans

Michael Mainelli

None of them: they all have the same speed

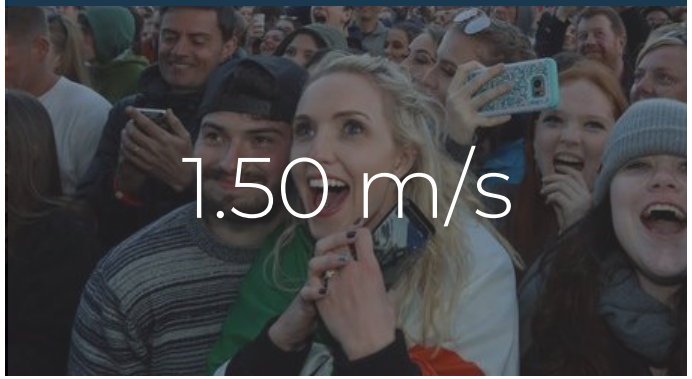
Who walks quicker?

England Football Fans

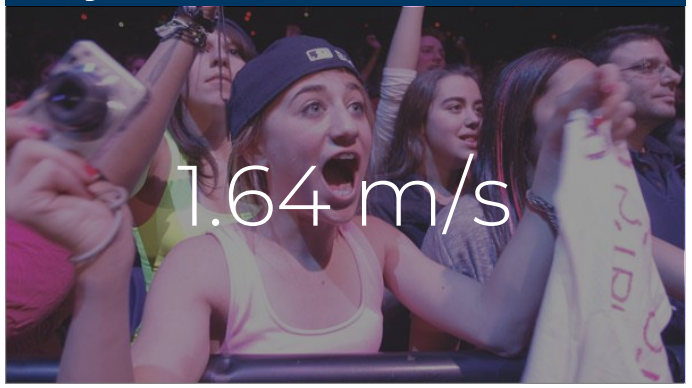


Rugby League Fans

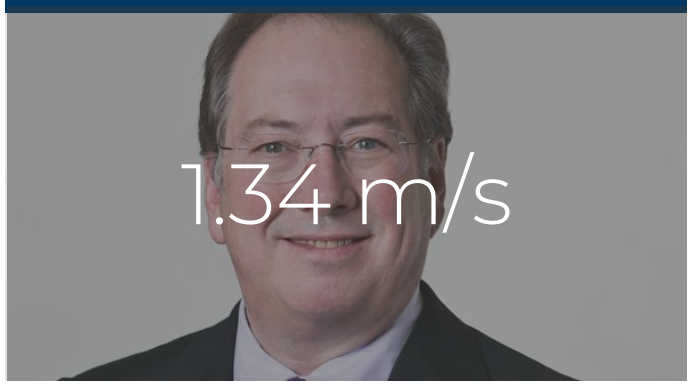
Ed Sheeran Fans



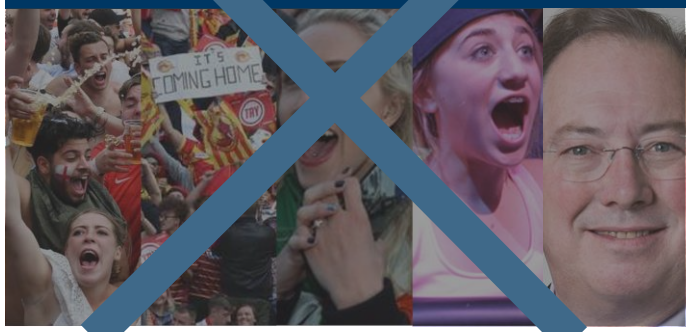
Taylor Swift Fans



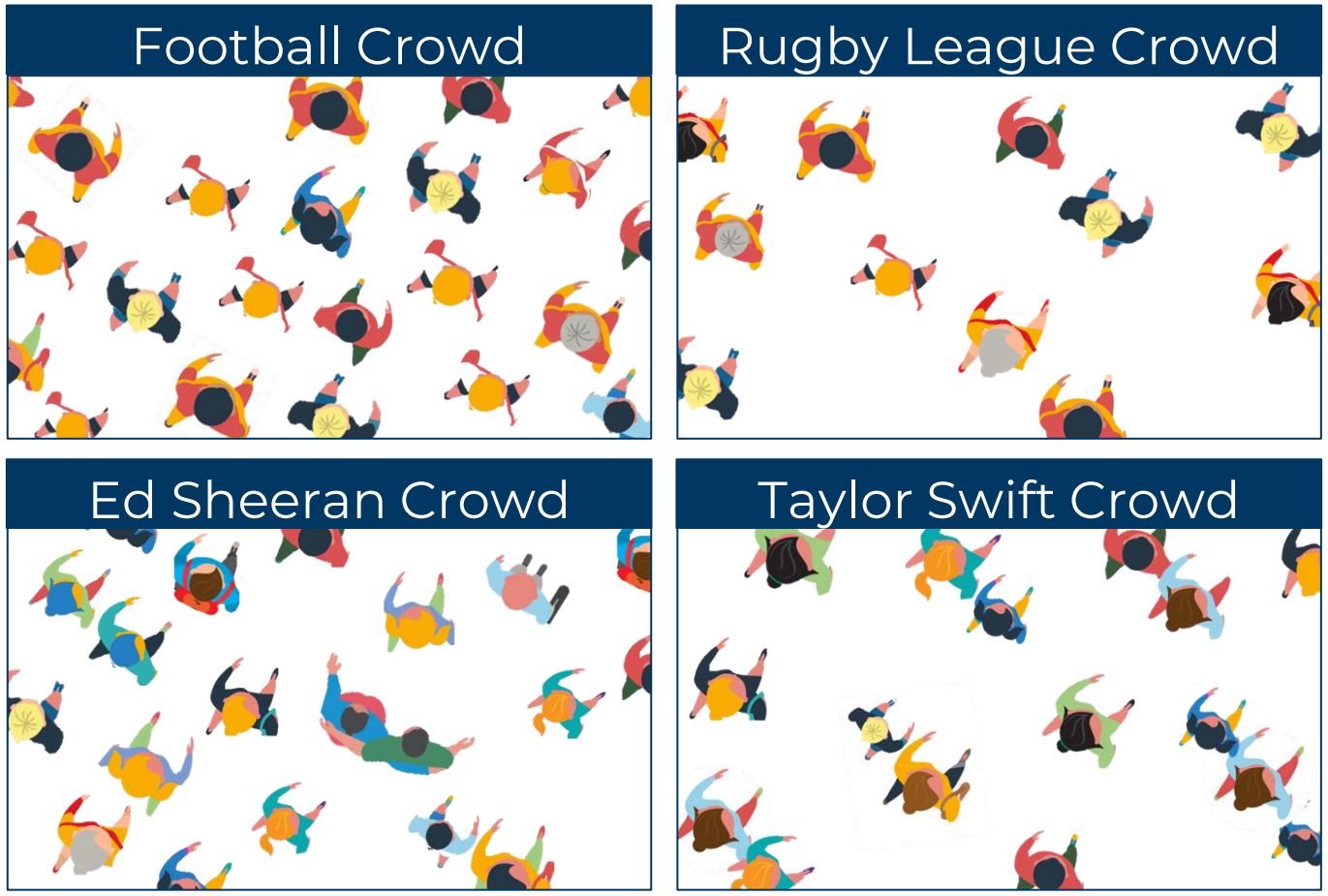
Michael Mainelli



None of them: they all have the same speed



Wembley research study



Research Partnership:

Dr Enrico Ronchi

Prof Steve Gwynne

Dr Aoife Hunt

The Analysis of Pedestrian Movement and Behaviour of Different Crowds during Stadium Egress

Anna Larsson & Elin Ranudd

Division of Fire Safety Engineering
Lund University
Sweden

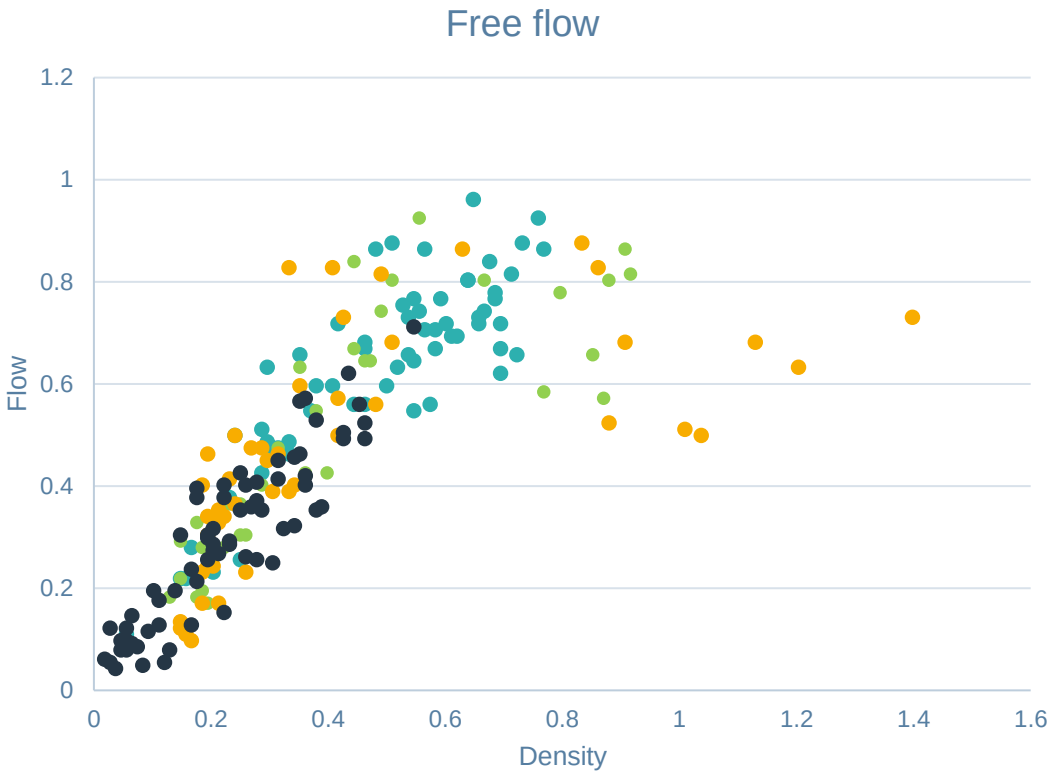
movement strategies

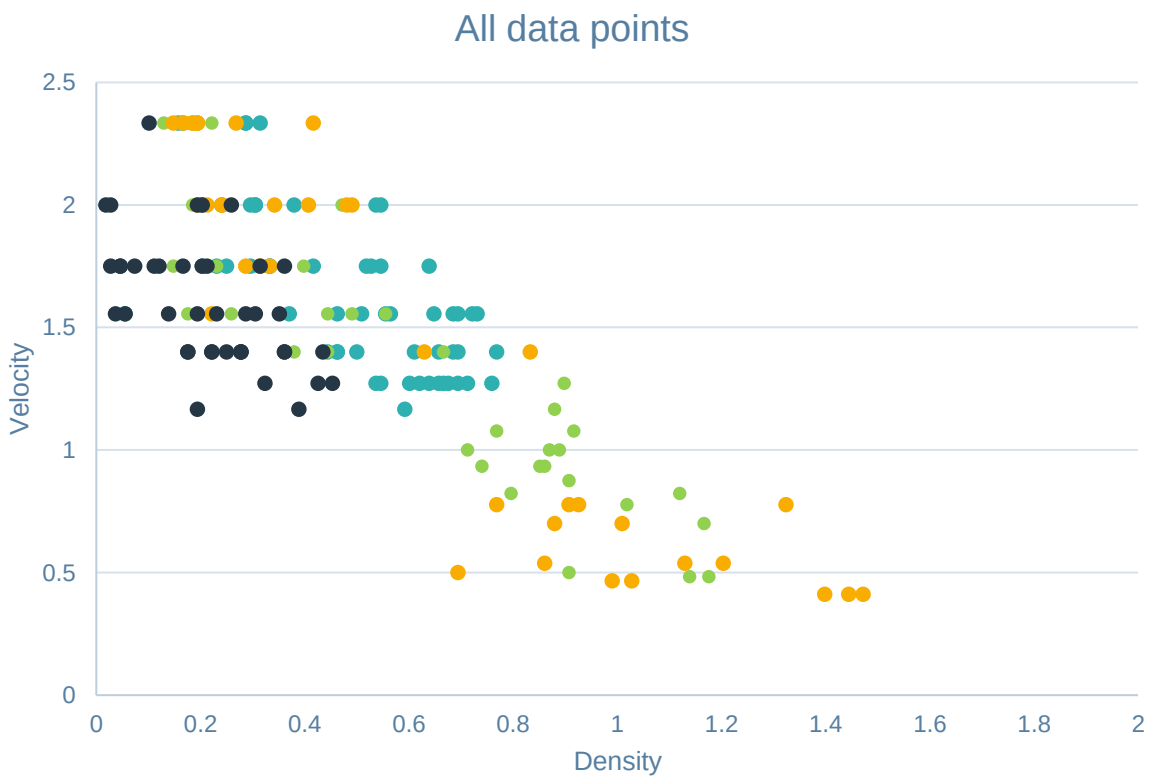
Canada NRC·CNRC

The FA FOR ALL

Lund University

Results





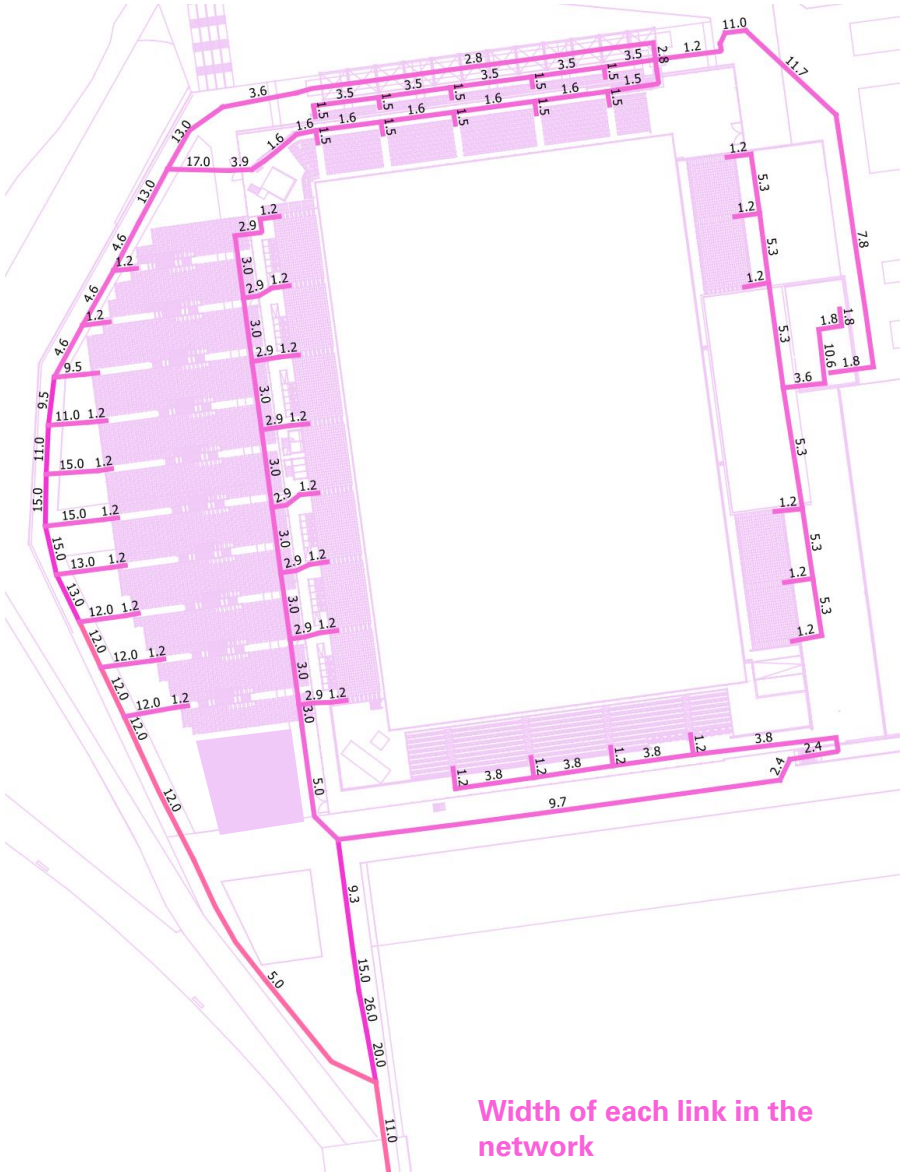
Football

Ed Sheeran Concert

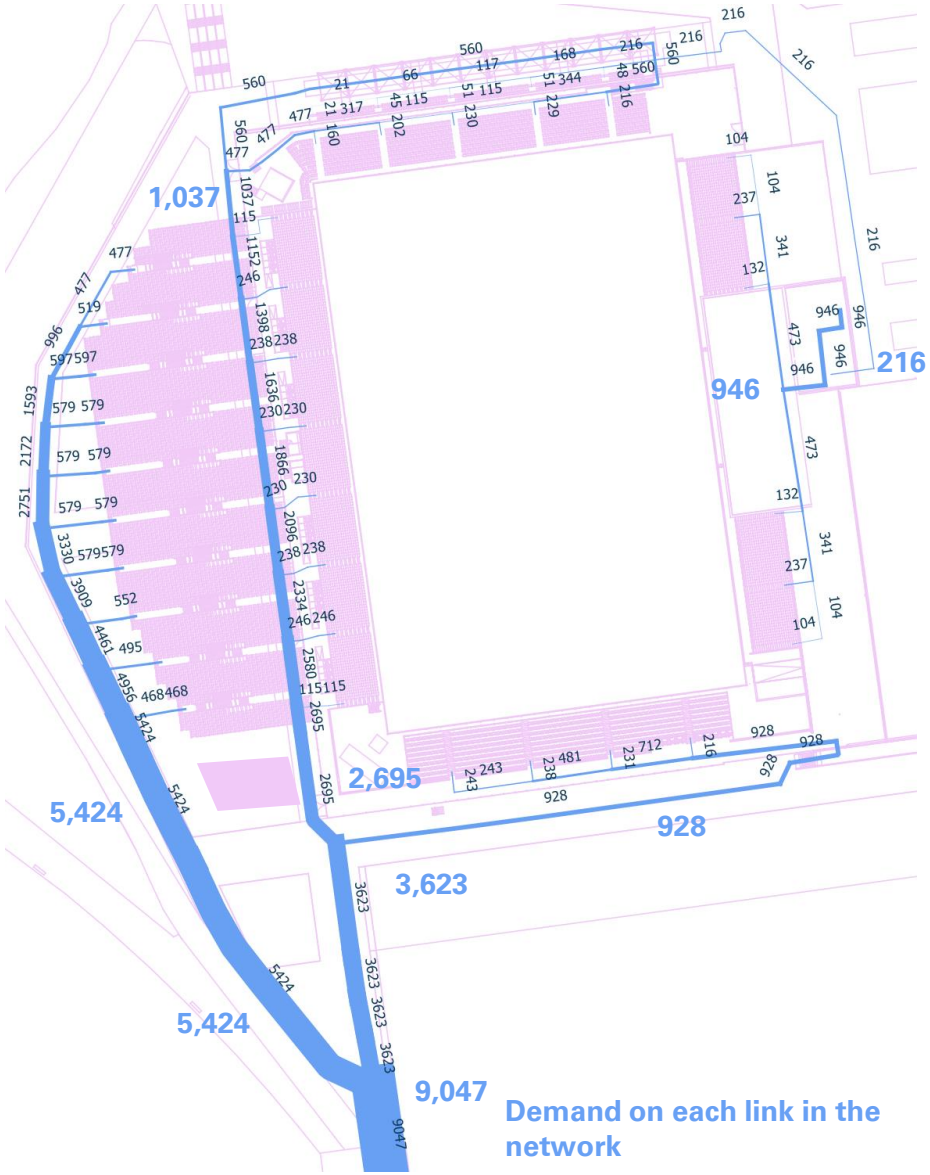
Rugby League

Taylor Swift Concert

Modelling capacity vs. demand



Width of each link in the network



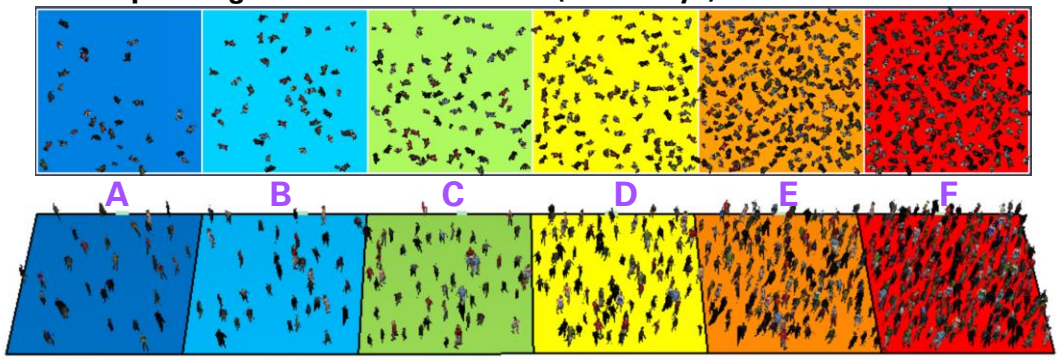
Demand on each link in the network

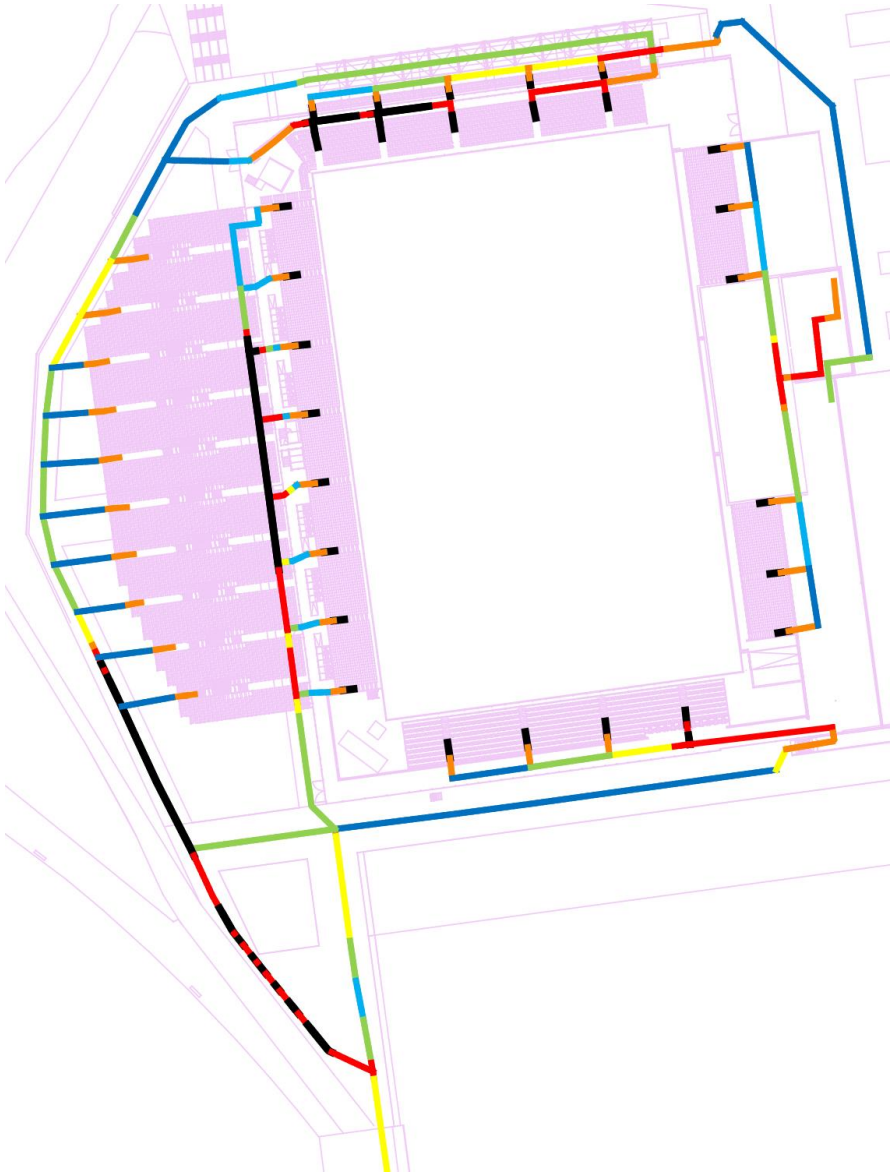
Crowd density analysis

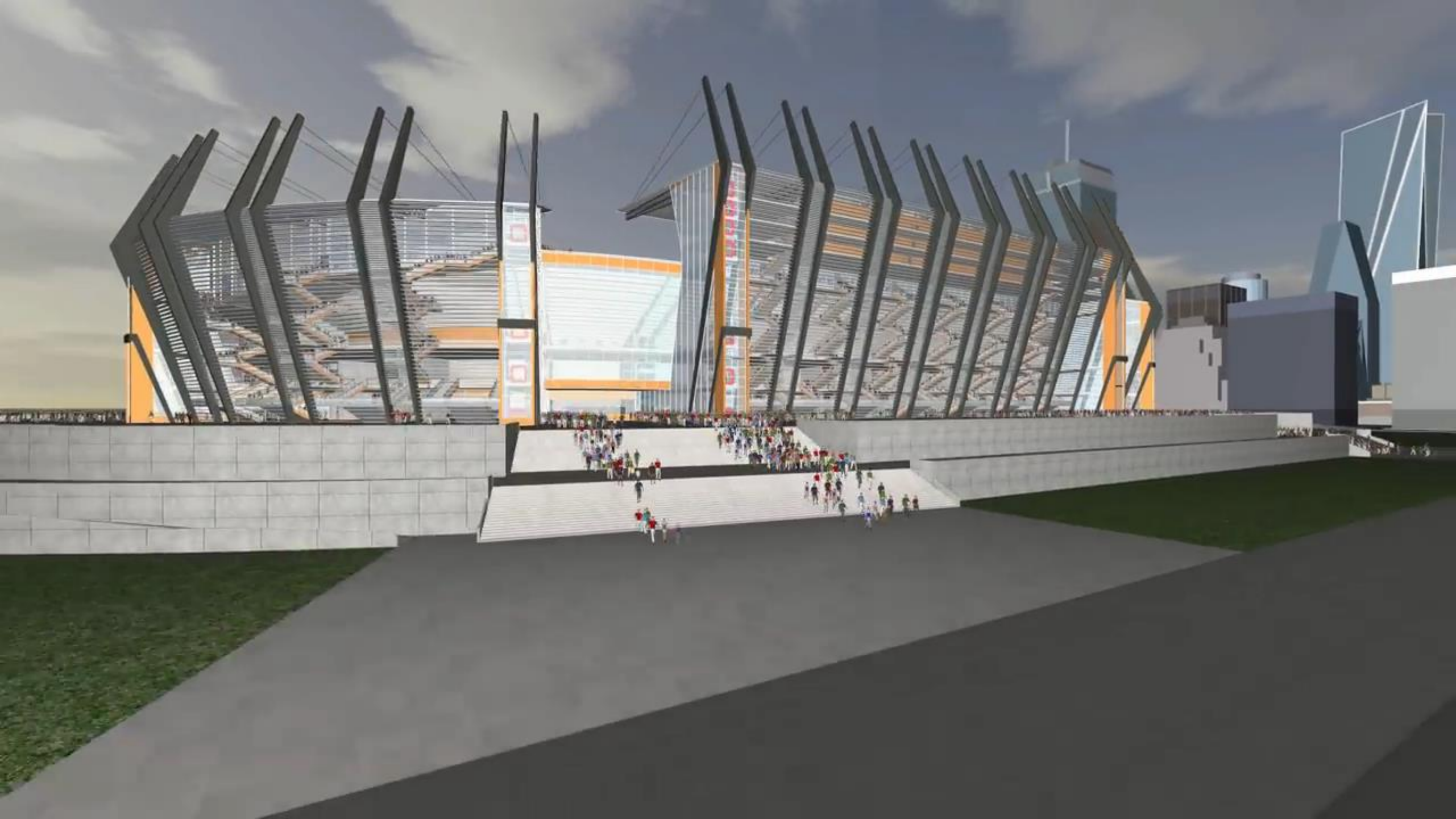
Peak Density in people/m²

- < 0.31
- 0.31 - 0.43
- 0.43 - 0.72
- 0.72 - 1.08
- 1.08 - 2.17
- 2.17 - 4
- > 4.0

Corresponding Fruin Level of Service (Walkways)







Business districts

Canary Wharf: estate-wide evacuation plan for 150,000+ people

What have we learned?


Emergency behaviour is complicated, but people rarely “panic”.


Building codes rely on old data, but research is catching up.


Cutting-edge simulation technology can help planning.

And…


Michael may increase his walking speed by attending Taylor Swift concerts.

*Thank You

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→ ghd.com/advisory

Why is it important to understand human behaviour?

- It influences the time to reach safety
- Determines effectiveness of our safety procedures and management
- Helps us to plan for better survivability