USING MASSMOTION, AN AGENT-BASED SIMULATION ON OPTIMIZING THE FIRE EVACAUTION IN ROAD TUNNEL – A CASE STUDY IN THE DARTFORD TUNNEL

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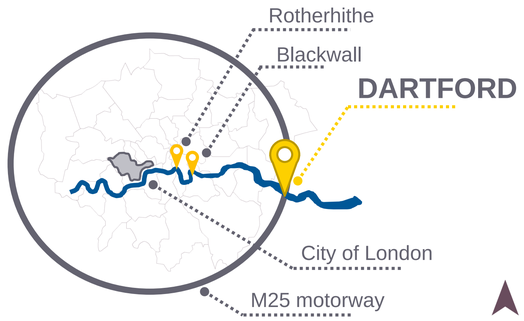
INTRODUCTION

Uncertainty in human behavior, due to environmental perceptions and social effects, can be dangerous when evacuating from a fire in a road tunnel. Computational simulation is effective for developing successful fire safety designs plan in ensuring the shortest egress time. This research uses MassMotion, an agent-based simulation developed by OveArup, to evaluate the safety of the current fire evacuation plan of the Dartford Tunnel in south-west London.



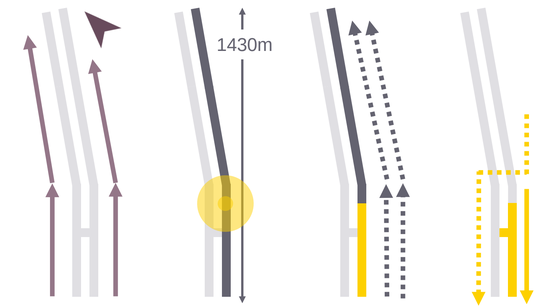
TUNNEL EVACUATION SCENARIO

75,000 DAILY TRAFFIC

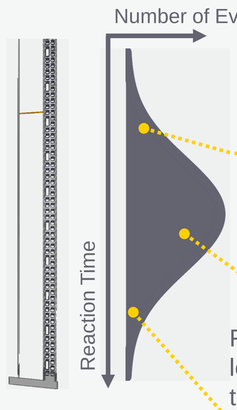
26% EVENT COUNT

SMOKE EXTRACT FLOW

SAFETY ESCAPE ROUTE



DIVERSITY ON PRE-MOVEMENT TIME



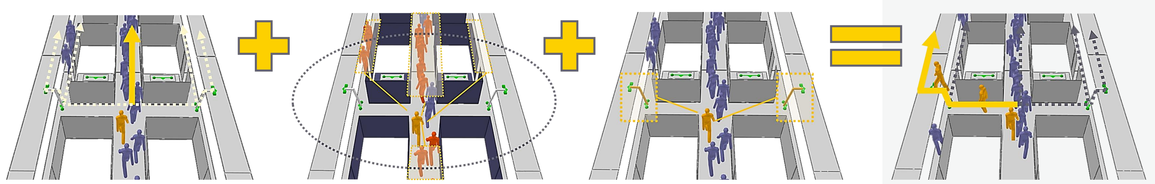
Frontmen observe the flame, smoke, and decide to move away earlier.

Most of the occupants wait and follow other's actions, as the result of **SOCIAL INFLUENCE**.

Few evacuees receive less cues, and do not start to evacuate until late.

AGENT-BASED BEHAVIORIAL SIMULATION

DISTANCE + CONGESTION + TRAVESAL = MassMotion



The route-finding algorithm is profiled by "**THE PRINCIPLE OF COST-OPTIMIZATION**". Each agent intelligently select the time-least pathway to reach the exit. The agent's walking speed and direction are dynamically controlled. Individual agent's properties can be assigned either deterministically (e.g. Body sizes), or randomly (e.g. Maximum Speed).

ACKNOWLEDGEMENT

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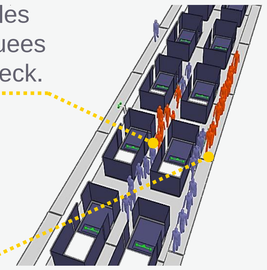
ARUP Oasys YOUR IDEAS BROUGHT TO LIFE

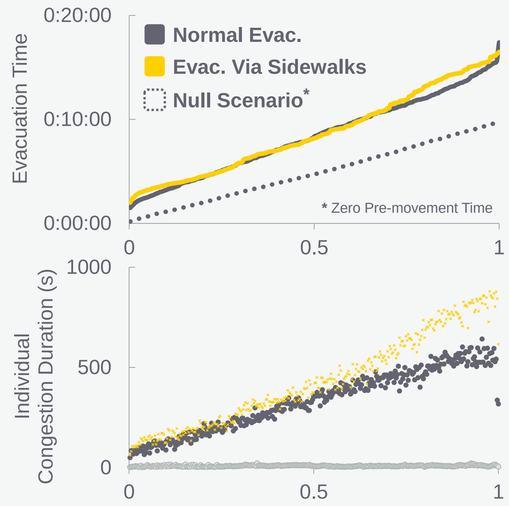
RESULT and SAFETY RECOMMENDATION

SOURCES OF EVACAUTION DELAY

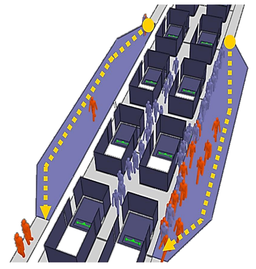
Highly compact vehicles conflict with the evacuees at the narrow bottle-neck.

As the only alternative, confined walking width on the sidewalks limits the agent's movement.

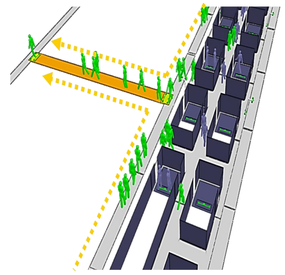


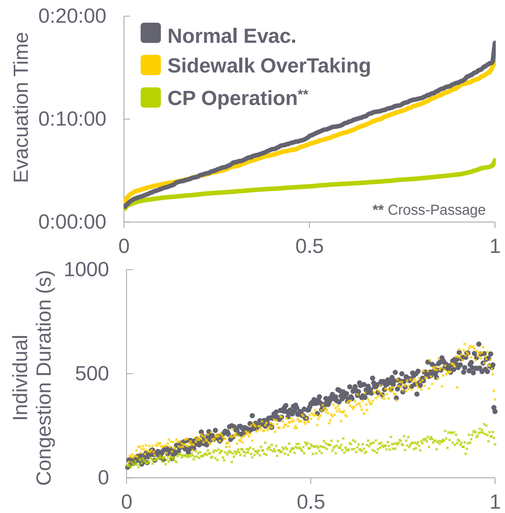


SIDEWALK OVERTAKING



CROSS-PASSAGE OPERATION





CYCLING PROCESS OF OPTIMIZATION

MODEL SIMULATION allows the engineer to observe the realistic crowd dynamics, and thus use the **RISK ANALYSIS** to tackle the safety issues.

The proposed **SAFETY UPGRADE** suggested that alleviating the congestion to reduce the individual evacuation time in optimizing the mono-exit evacuation plan of the Dartford Tunnel, by up to 58.4%.

A continuous effort on understanding the resultant **USER BEHAVIOR** and dynamics is required to improve the modeling accuracy and produce a long-lasting fire safety plan.

REFERENCE

Highway Agency. (2007). *Fire emergency report, Dartford Tunnel.*

Oasys Arup (2015). *MassMotion Oasys 7.0.* For more information and contacts, please visit: