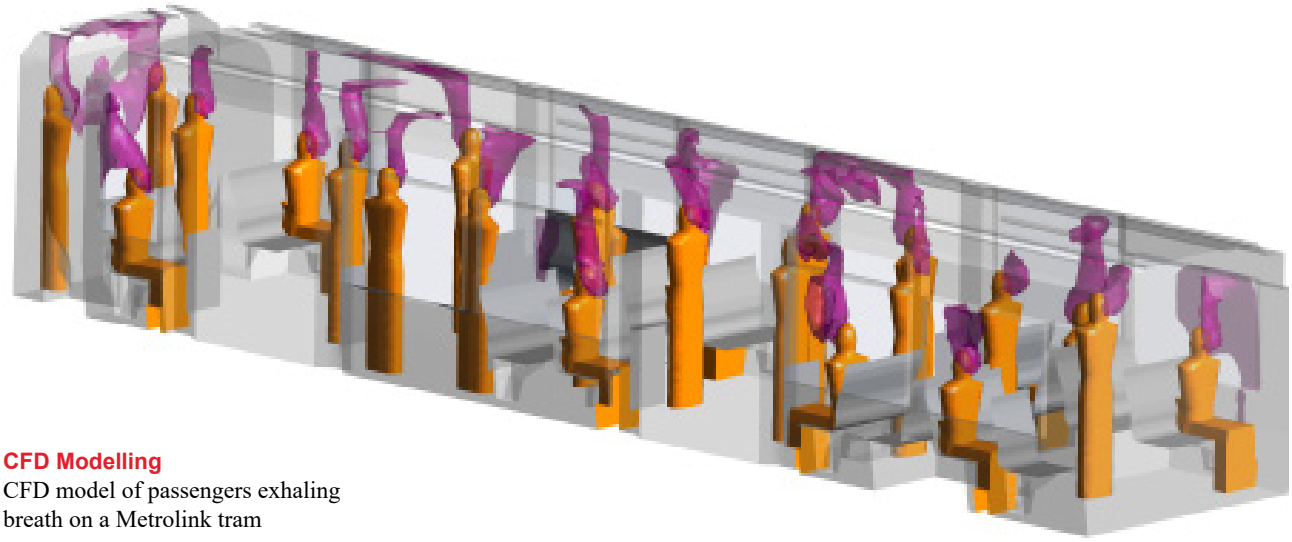
Case study



CFD Modelling
CFD model of passengers exhaling breath on a Metrolink tram

Building Physics is the application of the principles of physics to understand the movement of air, heat, sunlight, moisture and airborne pollutants inside and around buildings. Building physics is important for the prediction of thermal comfort and air quality in buildings as well as the performance of building envelopes and ventilation systems.

We use state-of-the-art digital tools to carry out virtual prototyping to investigate the suitability of different design options and to examine specific building physics issues. These analysis techniques, in combination with our design experience and creativity, enable us to help clients achieve spaces that respond well to the climatic conditions of their chosen site, function efficiently, are pleasant and healthy to occupy and energy efficient and economic to run. We work across the whole range of building sectors including healthcare, commercial offices, transport, cultural venues, science and industrial facilities.

By using building physics, Arup delivers design solutions that ensure buildings are:

- healthy and comfortable
- sustainable and energy-efficient
- subject to reduced risk
- have increased amenity and usability

Modelling Manchester's Trams

Transport for Greater Manchester (TfGM) commissioned Arup to undertake Computational Fluid Dynamics modelling of its M5000 trams – the first study of its kind in the United Kingdom.

The modelling assessed the air flow within the vehicle, with particular focus on how this relates to the potential for aerosol transmission of viruses, by looking at how exhaled breath spreads through the vehicle, and how that is affected by factors like opening windows, mask wearing and activity levels.

Metrolink's trams are ventilated through fans on the roof and air diffusers in the ceiling, with air exhausted from under-seat vent holes.

Even with the ventilation system operating at half capacity, the study found that there were approximately 20 air changes per hour, which is better than the recommendation in a recent paper from the Scientific Advisory Group for Emergencies (SAGE).

Arup's modelling also showed that the risk of transmission is greatly reduced when face coverings are worn, while heavy-breathing – such as after a short run and/or loud talking and shouting – increase the risk of aerosol transmission.

The modelling has been shared with the Department for Transport and light rail industry body, UK Tram.