PARAMETRIC STUDY OF SMOKE EXTRACTION THROUGH FIRE DAMPERS

Samuel Gehrig – Pöyry Infra Ltd.
Introduction: Smoke Extraction

Yesterday: Transverse ventilation

Exhaust slots

Smoke zone > 300 m

Today: Remotely actuated mechanical fire dampers

Jet fans

Smoke zone 150 - 300 m

Exhaust duct

Carriageway

Fresh air duct

Exhaust duct

Fire damper
Task

• Which damper configuration extracts the smoke “best” under which conditions?
• Smoke extraction performance as a function of geometrical configuration and environmental parameters (fire power, extraction rate, ...).
• “Best” understood as:
  – highest smoke quantity extracted in given time
  – shortest extension of smoke zone
  – best quality of smoke layering in smoke zone
Definition of Parametric Study

Swiss Standard

Fire Location

Semi-transverse Ventilation with Dampers

Fire Dampers
CFD-Tools

Fire Dynamics Simulator
Results: Extraction Effectiveness

![Graph showing relative soot flow over time for different configurations and scenarios.](image-url)
Results: Soot Quantity

![Graph showing Soot Quantity over Time for different configurations and scenarios.](image)
Results: Visualisation

Config. 1

Config. 2

Config. 3
Conclusion

• A configuration with a finely distributed net of extraction dampers stands out by the following performance:
  – Its extraction effectiveness grows faster than and reaches steady-state before the others;
  – Its effective smoke zone extension is minimized;
  – The smoke layer remains stratified;
  – The smoke quantity remaining in the tunnel is minimized.

• The variation of the fire power and the exhaust flow does not affect this performance.

• The quality of the extraction is decisive for the self rescue of the people from the smoke zone during the first minutes of a fire.
Thank you for your attention!