Evaluation of Evacuation Design Approaches for Metro Stations in Turkey: Applied Case Generic Project

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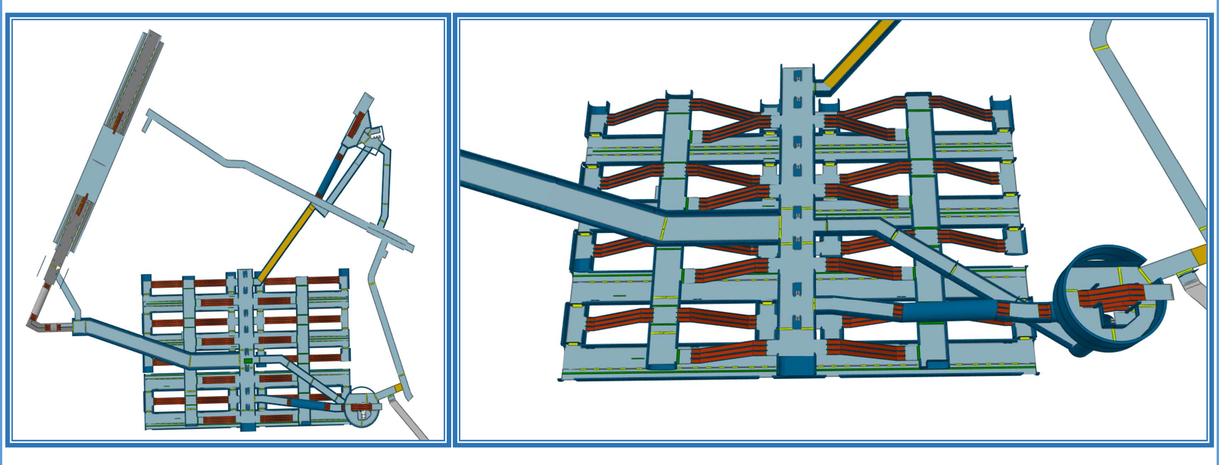
INTRODUCTION & STATION GEOMETRY

NFPA 130 is the main guide for evaluating evacuation in metro stations in Turkey. Prescriptive requirements are carried out 4-min / 6-min evacuation design criteria. However, debate continues whether emergency exits shall be provided for extra precaution regardless of the analysis. Moreover debate over providing emergency exit stairs to serve for both concourse levels and/or platforms becomes problematic.

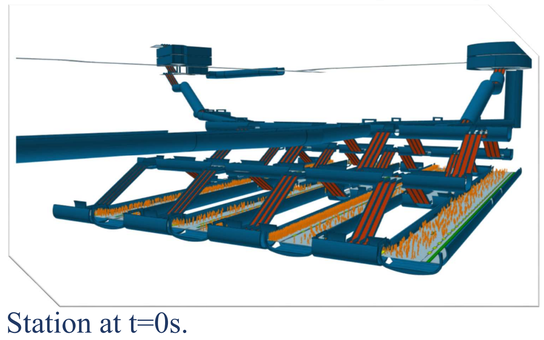
In order to better analyze the situation generic deep-mined station – a transfer station is introduced for analysis. The simulations are performed for a)no emergency exit; b)one emergency exit; c) two emergency exits connecting platforms to the place of safety. The lower level platform level serves two different metro lines, while the upper level platform serves another metro line. The general view of the station for this study is shown on the figure below.



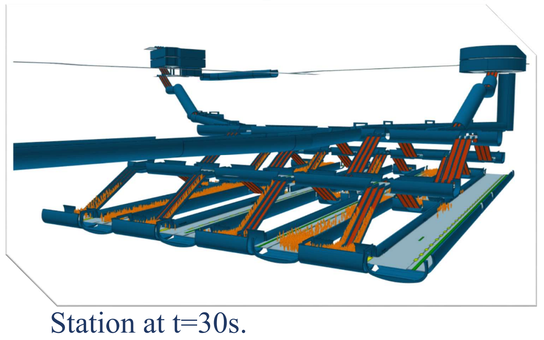
General view of the station and transit tunnel connection to the existing platform

STATION GEOMETRY & SCENARIOS

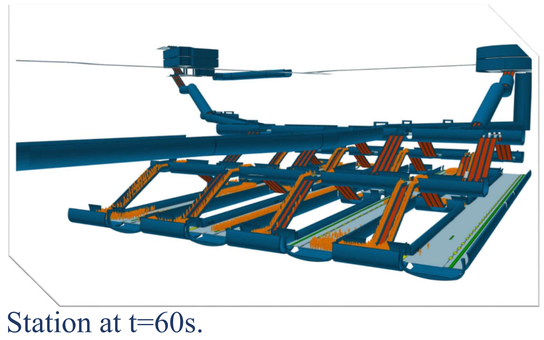
- Max. Number of passengers (peak load): 5874
  - ✓ Train from line 1 arrives at station with 2080 passengers at t=0s.
  - ✓ Train from line 2 arrives at station with 2080 passengers at t=30s.
  - ✓ 1714 passengers are distributed at the platform initially.
- Number of passengers (sensitivity analysis): 8320 – in addition to the above:
  - ✓ Train from line 1 arrives at station with 1560 passengers at t=60s.
  - ✓ 886 additional passengers are distributed at the platform initially.



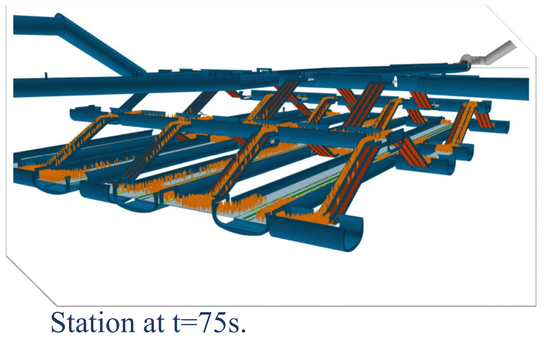
Station at t=0s.



Station at t=30s.



Station at t=60s.



Station at t=75s.

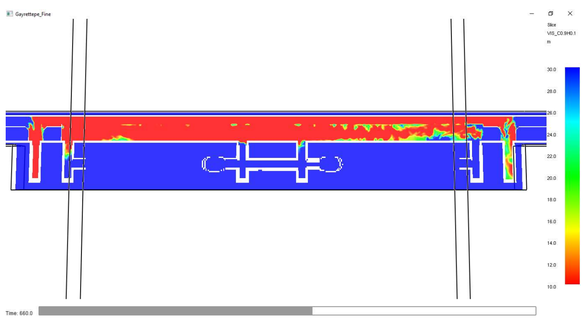
RESULTS

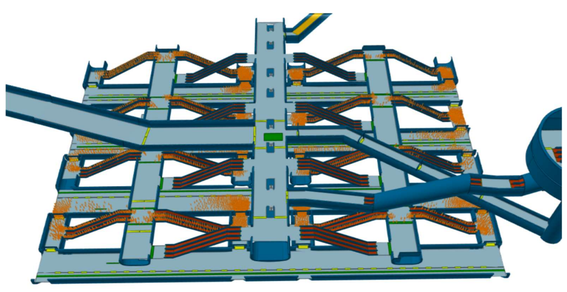
- In total there are 72 escalators:
  - 12 are assumed to be out of service.
  - 30 are assumed to be stopped.
  - 24 are assumed to be operating.
- ❖ CFD analysis yields ASET ≈ 600s. At 840s corridors become untenable.

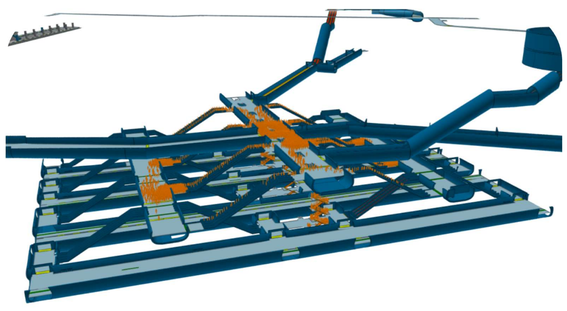
Without emergency exit:
- Platform evacuated in 310s (peak load)
- Platform evacuated in 395s (sensitivity)
- Place Of Safety reached in 400s (peak load)
- Place Of Safety reached in 505s (sensitivity)

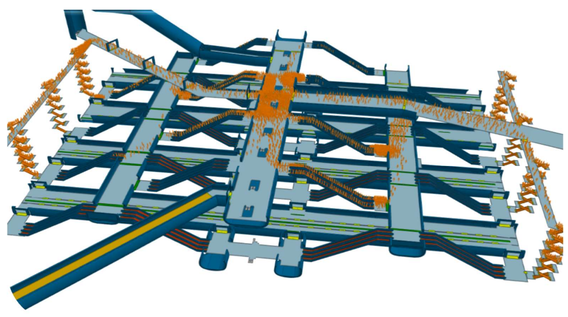
With one emergency exit:
- Platform evacuated in 275s (peak load)
- Platform evacuated in 335s (sensitivity)
- Place Of Safety reached in 335s (peak load)
- Place Of Safety reached in 400s (sensitivity)

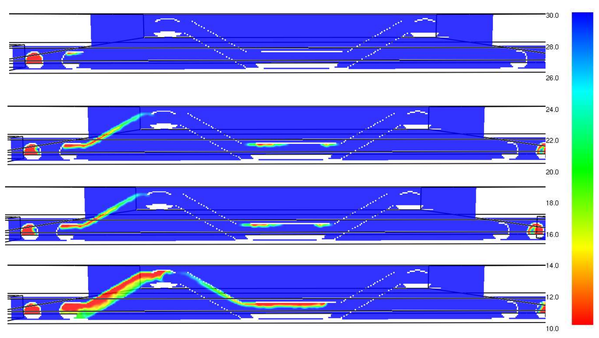
With two emergency exits:
- Platform evacuated in 285s (peak load)
- Platform evacuated in 340s (sensitivity)
- Place Of Safety reached in 355s(peak load)
- Place Of Safety reached in 415s (sensitivity)

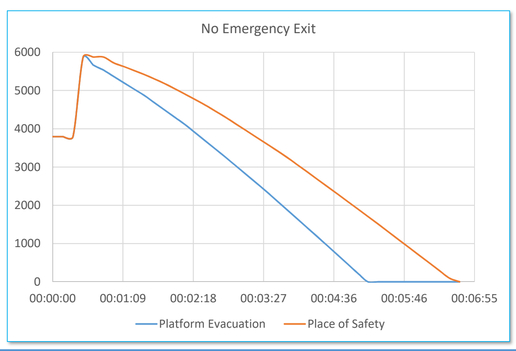


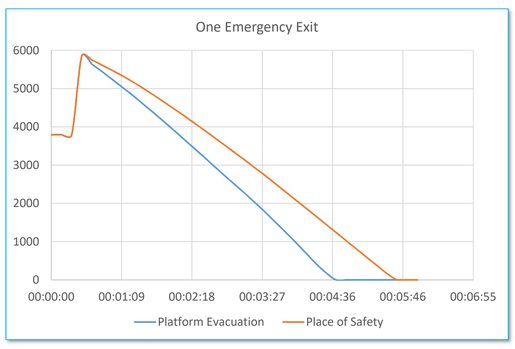






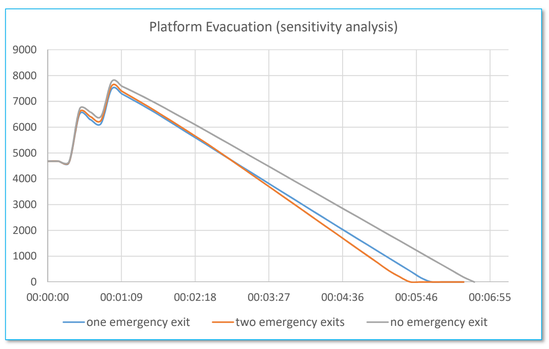


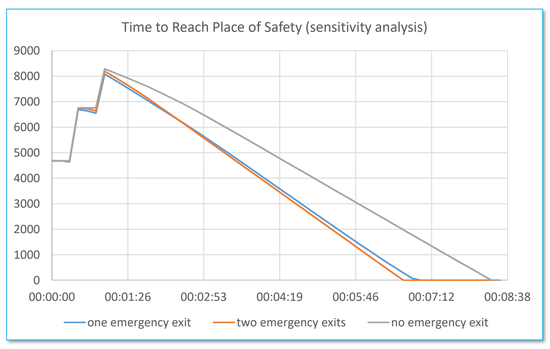




DISCUSSION

- RSET obtained vary between 275s – 310s. for platform evacuation.
- RSET obtained vary between 335s – 400s. for reaching place of safety.
- Additional emergency exit did not reduce evacuation time.
- Passengers' movement speeds vary between 0.65 m/s – 1.60 m/s. ±0.2 m/s





CONCLUSION & FUTURE STUDY

- ❖ Performing prescriptive 4 min / 6 min tests for complex stations might not yield satisfactory results.
- ❖ Simulation with one exit for each platform yield better results than with two exits for each platform for this case.
  - ❖Providing additional emergency exit does not guarantee quite reduction.
  - ❖Emergency exit planning and design in accordance with LOS analysis.
- ❖ Providing fire barriers through transit corridors for extra precaution:
  - ❖ Safe haven for injured/disabled passengers.
- ❖ Future study shall consider:
  - ❖ Factors affecting passengers' speed and decisions on exit door selection.
  - ❖ Passengers circulation from existing platform.
  - ❖ Reliance on escalators.

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