# FIRE ANALYSIS OF RC PRE-CAST SEGMENTAL TUNNELS

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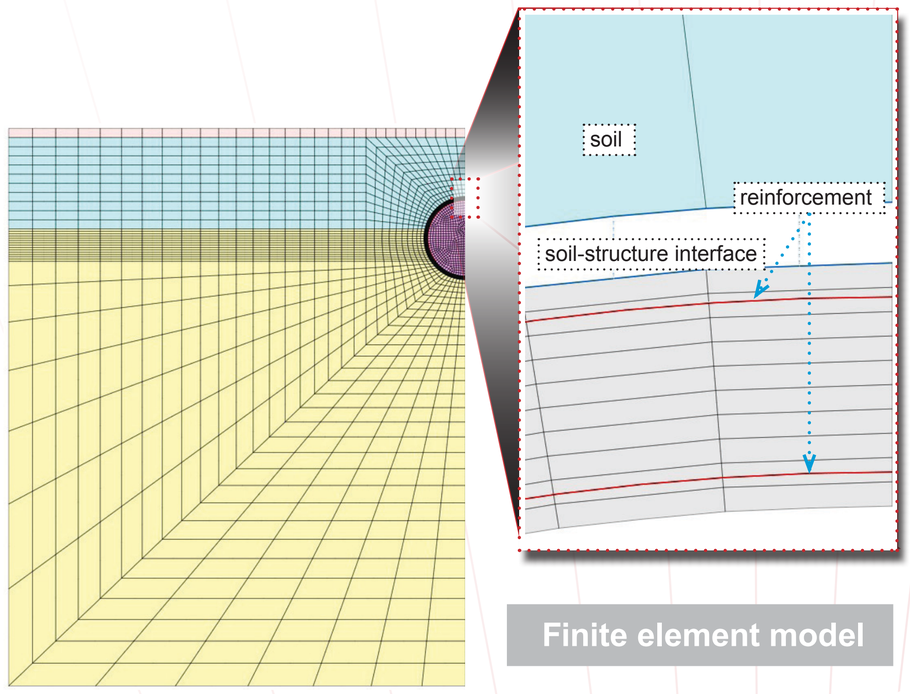
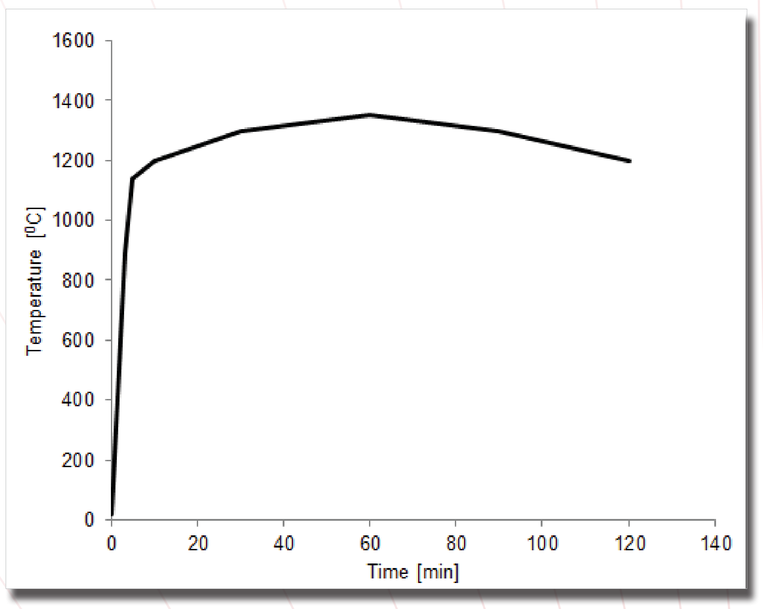


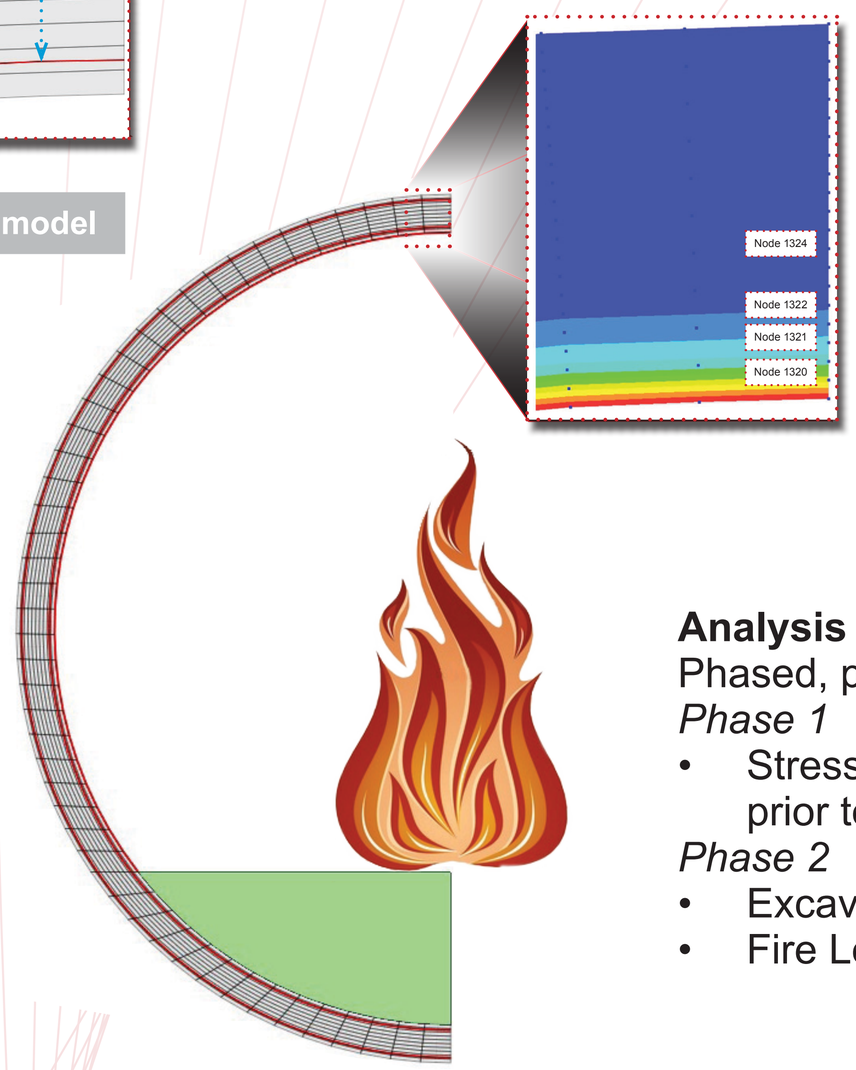

Finite element model

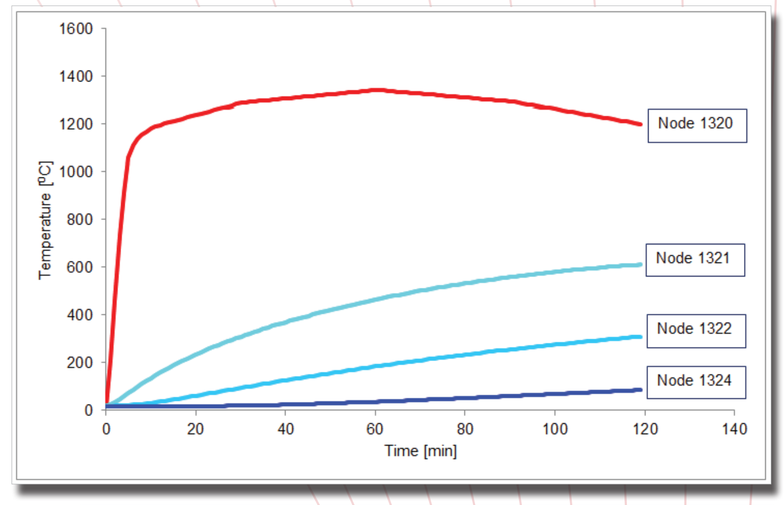
## Model

- 2D plain strain, quadratic structural elements
- boundary elements for convective and radiative heat transfer
- quadratic interface elements for soil-structure interaction
- embedded reinforcements




Fire load inside tunnel




Temperature distribution outside tunnel

## Analysis

Phased, partially coupled thermal-stress

*Phase 1*

- Stress initialisation with KO procedure in the soil prior to construction of the tunnel

*Phase 2*

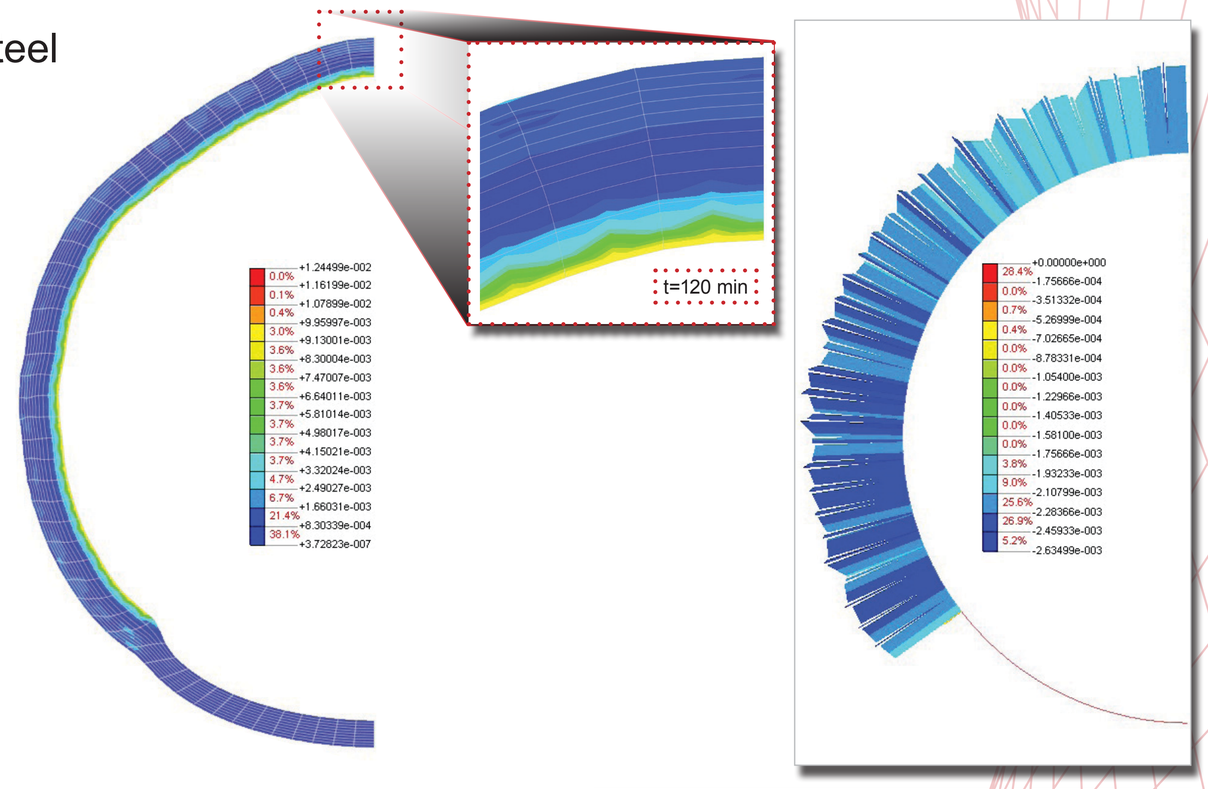
- Excavation and installation of the tunnel segment
- Fire Load

## Materials

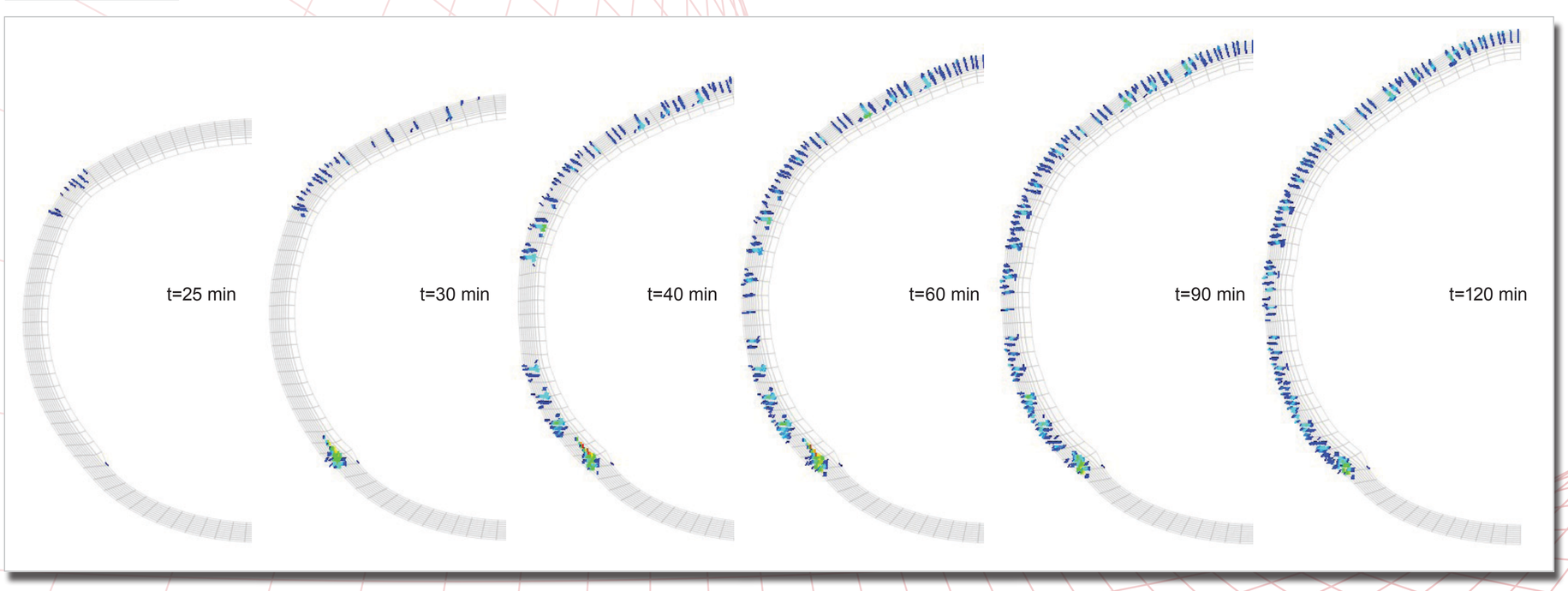
- Mohr-Coulomb for soil
- friction-Coulomb with tension cut-off for interfaces
- temperature dependent thermal properties
- temperature dependent mechanical properties for concrete and steel following EN1992-1-2
- total strain based crack model for concrete
  - brittle in tension
  - compression as specified in EN1992-1-2
- Von Mises elasto- perfectly plastic for reinforcements

## Results

- extensive cracking at the extrados, with reduction of stresses induced by differential thermal expansion
- limited damage at the intrados, caused by thermal degradation of the material properties
- yielding of reinforcements at the intrados
- structure remains stable up to 120 min fire




Cracking




Equivalent plastic strains in concrete (left) and plastic strains in the reinforcement at the intrados (right)

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