

PROJECT DESCRIPTION

ARCADIS

Nice, FRANCE



FLAC3D models are conducted with the aim to simulate the response of underground tramway structures in Nice, France, under earthquake loading. Three geometries are studied, including a preselected station (Figure 1) and two tunnel sections. For each model geometry, three synthetic accelerograms are used to evaluate the capacity of the concrete liner.

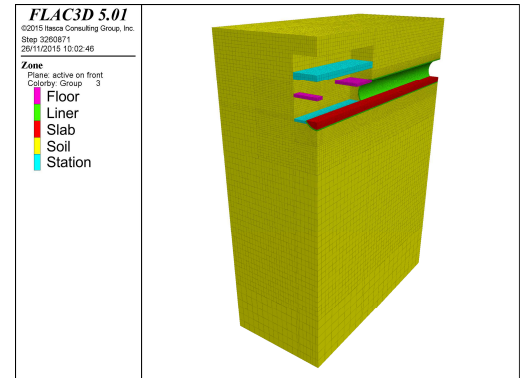


Figure 1: Model geometry including a station.

ITASCA'S ROLE

The model is built taking into account the geometry of the geological layers. The concrete liner, as well as the cemented slab, are represented by volumetric elements. The station is represented by a rectangular box divided by horizontal concrete slabs. The soil materials are simulated by an elastic – perfectly plastic Mohr-Coulomb law while concrete structures are modeled by a purely elastic law. First, excavation of the tunnel and station yields an initial static state. Thereafter, earthquake loads are applied on the bottom boundary, in terms of stress histories, whereas absorbing boundaries are set on all lateral boundaries. The dynamic simulations are performed over about 16 seconds, during which displacement, velocity and acceleration histories are monitored at predefined locations. The loads on the concrete liner, in terms of bending moment, shear force and normal force (Figure 2), are verified at several critical times in the dynamic simulations.

PROJECT RESULTS

- The loads carried by the concrete liner are more pronounced during the dynamic phase, compared to those produced during the static phase.
- Smaller loads are observed on the concrete liner near the station. The loads on the concrete liner increase when moving away from the station.

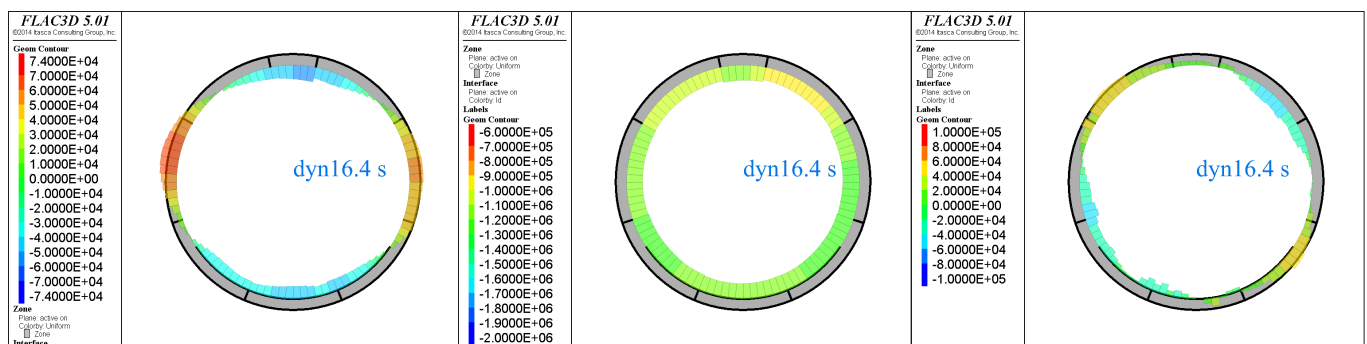


Figure 2: Bending moment (left, in N-m), shear force (middle, in N) and normal force (right, in N) on a section of the concrete liner, at 16.4 seconds.