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Feasibility immersed tunnel in seismic region

The municipality of Istanbul investigates the possibility of a tunnel crossing the Golden Horn, the major inlet to the Bosphorus. Apart from the geometrical challenges to design a tunnel with traffic interchanges at the densely built banks, one of the major conditions relates to the seismic activity of the region. Due to the relatively deep and narrow cross section of the Golden Horn, the tunnel has to be immersed on piers somewhere in between the river bed and the water surface. The resulting dynamic behaviour of the entire system (bedrock, piers, tunnel sections and transition structures) differs significantly from the usual behaviour of a tunnel immersed in a backfilled trench.

In order to evaluate the feasibility, a preliminary design had to be performed in which special attention was paid to the behaviour under seismic loading. Several structural calculation models have been used to investigate the dynamic characteristics of the structure: a n-block-spring-damper model for the sensitivity study, and DIANA FE-models to integrate the soil behaviour, the soil-structure-interaction (user-supplied) and the (nonlinear) structural behaviour.

The analyses resulted in a more-or-less optimised design, with particular solutions for flexible joints between tunnel sections and transition structures.

Apart from a general introduction to the project and the specific structural challenges, the presentation covers the way we dealt with soil-structure-interaction and the associated material models.

Figure: Traction in the (user supplied) P-Y-springs for soil-structure interaction

