STRUCTURAL MECHANICS

RUB

Master's Thesis

High-fidelity computational modeling of frictional contact between rough concrete surfaces to assess the load transfer capacity of demountable connections

Supervisor: Dr.-Ing. Vladislav Gudžulić

Background:

The load transfer capacity of demountable connections made of reused concrete elements crucially depends on the properties of the interfaces of the connected structural components. Besides direct concrete-concrete contact, also thin elastic layers, so-called packers, inserted between the contact surfaces, as usually applied in ring joints of segmental tunnel linings made of bituminous, polymer compound or rubber material, attached to the cut surfaces.

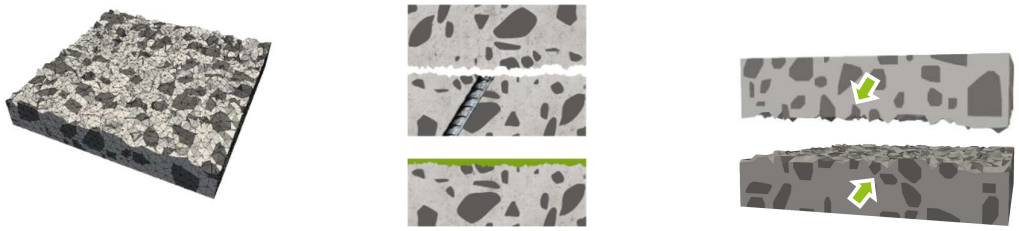

Figure 1: Microscale model of rough concrete contact surfaces: (a) 3D view of a coarse mesh representation of virtually generated rough concrete surface; (b) different possible contact cases: concrete-concrete (considering also cut rebar), and concrete-packer (packer shown in green); (c) finite element model setup

Tasks:

- Characterization of rough concrete surface topographies for different cutting techniques
- Numerical generation of synthetic rough surfaces
- Parametric studies of concrete-to-concrete and concrete-to-packer contact to assess the influence of surface roughness on effective contact area and packer deformation
- Mesh sensitivity studies

Future prospects:

The high-fidelity frictional contact modeling approaches developed in this Master's thesis can be used as a basis for development of suitable scale-bridging simulation models that can accurately describe the mechanical behavior of the connections between reused concrete elements - taking into account the contact stress, prestressing and concrete damage at the connection points. This work could potentially be continued during PhD studies at the Institute for Structural Mechanics, in the scope of A02 subproject of SFB 1683.

Requirements:

- Strong interest in theoretical development and implementation aspects of computational models for frictional contact and inelastic behavior of structures
- Above-average academic performance
- Familiarity with and enthusiasm to master programming in MATLAB, Python, and C++

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References:

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2. Pundir, M. and Anciaux, G. (2021). "Numerical generation and contact analysis of rough surfaces in concrete." J. Adv. Concr. Technol. 19(7): 864-885.