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INTERACTION MECHANISMS IN BONDED ANCHOR SYSTEMS UNDER SUSTAINED LOAD

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ABSTRACT:

Bonded anchors find a wide range of applications in structural engineering, e.g. connecting different structural members, assembling precast elements, and attaching non-load components. The economic damage caused by the failure of a single anchor is several magnitudes higher than the cost of the anchor itself. Thus, their safe design requires a more accurate prediction of their long-term performance under sustained loads. Current design and approval guidelines for the sustained load behavior are based on a semi-empirical approach. According to this, a simple power law is fitted to structural deformation data of bonded anchors installed in concrete and –extrapolated to the life-time of the fastener. This approach is unable to account for the contribution of each material, - i.e. concrete, steel, and polymer based mortars-potential stress redistributions in course of time, and evolving damage. In this investigation, the contribution of each material to the entire system response is studied systematically. The creep response of concrete is predicted based on short-term and long-term material tests by a model that couples hydration, diffusion, and heat transport. The response of the adhesive is calibrated inversely in terms of a visco-elastic bond law utilizing available pull-out tests and sustained load anchor tests. The model is validated on sustained load tests of different geometries, with a very good predictive capacity. Finally, numerical parameter studies are presented that reveal the relationship between the evolving bond stress distribution and the interacting viscoe-elastic materials.