Effective submodel for joints between precast concrete elements using second-order cone programming

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ABSTRACT

Construction using precast concrete elements has many advantages over conventional in-situ cast structures. The precast elements are cast and cured in a controlled environment and the construction phase is less labour intensive. Precast concrete elements also pose new challenges for the structural engineers because of the in-situ cast joints connecting the precast elements.

A numerical rigid plastic model for assessment of the load carrying capacity of structures is currently being developed. The scope is to be able to model the entire structural system using this method. For this to be viable a better understanding of the mechanics of the joints is needed. A detailed numerical rigid plastic model based on a triangular disk element developed by Poulsen and Damkilde [1] and Sloan [2] has been used to assess the shear capacity of keyed joints. This model was used to identify and investigate both local and global failure mechanisms of the joints.

While the detailed model provides an excellent tool for such analysis, it is simply not feasible to model every joint of a structure using that level of detail due to the sheer size and computational time required for the model.

This paper presents a submodel of a joint based on the stringer method [3] (i.e. still in the realm of rigid plasticity). The goal is to create an effective model that only requires a small number of stress variables and equilibrium equations, but still captures the key mechanisms of the joints identified by the detailed model. The simplified model uses the modified Mohr-Coulomb yield condition, which can be formulated for second-order cone programming and solved efficiently using primal-dual interior point class algorithms. The sub model will be compared to the detailed model for several different choices of material parameters and reinforcement configurations. The model will also be compared to experiments found in the literature.

REFERENCES

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