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A Three-Dimensional Shield Tunnel Model Based on Generalized-FEM

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Summary

Shield tunnel linings compose of segments , bolts, liners, et.al., which are quite different in geometry and mechanics. Traditional beam-spring joint model and shell-spring joint model is hard to simulate accurately the detailed characteristic. Classical three-dimensional FEM may cause serious mesh-generation difficulty and expensive calculation cost. Based on generalized finite element method and characteristics of shield tunnel, a three-dimensional shield tunnel structure model is established. In the proposed model a sixteen-node solid-shell generalized FE is devised and employed to simulate segments. Joints between segments or rings are modeled with a surface to surface contact generalized FE which comprise hidden-bolts and hidden-liners. Foundation stiffness is also coupled into solid-shell generalized FE. The proposed model demonstrates such advantage in analyzing of shield tunnel as followings: 3D geometric and mechanical property can be simulated exactly. Details of joint such as bolts, liners, et.al. can be directly and conveniently modeled and no joint stiffness value is specified. Since the performance of generalized FE can be enhanced by heightening the order of local cover function instead of densifing meshes, only coarse gridding is needed in the proposed model which simplify mesh-generation. Finally several examples show the validity and effectivity of the model.