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Elastoplasticity of Gravel Protecting Rockfall-Endangered Steel Pipelines

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This contribution deals with the development of a numerical model providing reliable estimates of the loading of a gravel-buried steel pipe subjected to rockfall. Gravel is modeled by Hooke's law and a Cap Model. Based on wave propagation tests and triaxial strength tests, the material parameters are identified. They correspond to the elastic properties, shear failure, and compaction of gravel. Moreover, loading assumptions, i.e., estimates of the penetration depth and the maximum impact-force arising from rockfall onto gravel, are deduced from impact tests. Finally, a real-scale rockfall test onto a gravel-buried steel pipe is re-analyzed by means of a three-dimensional Finite Element model considering the impact loads in a reasonably simplified manner. The simulated stress distributions referring to the pipe compare well to the experimental results. Therefore, the developed model is well suited to provide prognoses of the loading of a gravel-buried steel pipe for rockfall scenarios that were not investigated experimentally.

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