Chair of Structural Mechanics
TUM School of Engineering and Design
Technical University of Munich

Master's Thesis

Investigation of a non-linear soil structure interaction approach using the Ramberg Osgood model for geothermal induced seismicity

Motivation

Geothermal energy offers considerable potential for a carbon-neutral, weather-independent energy supply. However, the associated risk of induced seismicity requires evaluation, given that geothermal power plants are typically established in proximity to populated areas ensuring energy provision close to consumers. In the case of Enhanced Geothermal Systems (EGS), higher seismic magnitudes may occur, potentially activating nonlinear behaviour in the soil, the structure, and the soil–structure interaction. [1] In order to assess the seismic risk these nonlinearities need to be considered in modelling. The Ramberg and Osgood model is a well-established numerical material model that can effectively capture nonlinear behaviour regarding the stress-strain and shear stress-strain relationships of the soil [2].

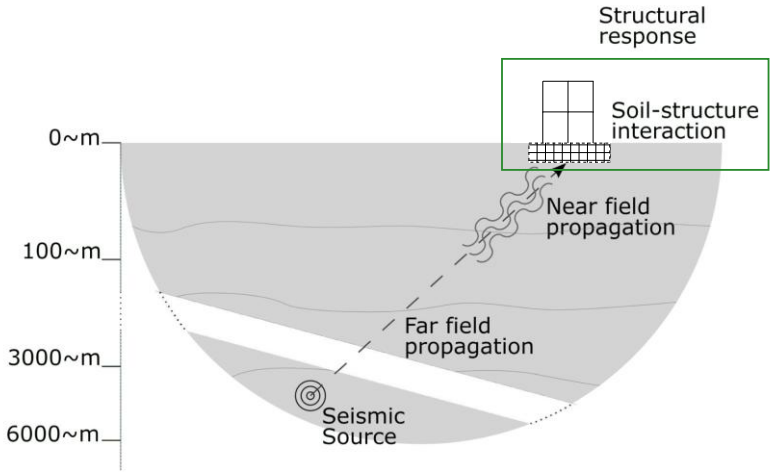

Fig. 1: Source to structure model

Tasks

In the scope of this master's thesis, a nonlinear soil structure interaction approach using the Ramberg-Osgood model is implemented into an already existing ANSYS building model. It is tested for representative building models exposed to induced earthquakes. The dynamic responses are evaluated and compared with the dynamic responses generated with linear soil structure interaction. The project stages are:

- Literature study about soil-structure interaction approaches and the Ramberg-Osgood model
- Study of the existing Ansys model
- Derivation and implementation of a nonlinear soil structure interaction approach
- Analysis of a representative building model with implemented nonlinear SSI approach excited by induced seismicity and comparison with a COMSOL model (FEM)
- Comparison of the dynamic building responses for linear SSI and nonlinear SSI

References

[1] https://www.cee.ed.tum.de/bm/forschung/forschungsprojekte/geothermal-alliance-bavaria/
[2] Mourlas, C., Khabele, N., Bark, H., Karamitros, D., Taddei, F., Markou, G., Papadrakakis, M., The effect of soil-structure interaction on nonlinear dynamic response of reinforced concrete structures. International Journal of Structural Stability and Dynamics 20(13) (2020)

Supervisor

Sonja Cebulj (Room N1150), sonja.cebulj@tum.de