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

COME and Civil Eng. students welcome!

Master's Thesis

Modelling a discrete soil stratification with inclined boundaries by using Integral Transformation Methods

Motivation The increasing complexity of geotechnical problems demands advanced modeling techniques to accurately reflect the intricate nature of subsurface interactions. In this context, modeling an elastic halfspace with inclined layers becomes crucial for a more realistic representation of the dynamic interactions. The utilization of the Integral Transformation Method (ITM), specifically through the superposition of fundamental systems, is proposed to achieve this modeling objective. For an infinitely extended halfspace, an analytical solution can be derived using the ITM. This involves decoupling the *Lamé* differential equation through *Helmholtz*'s theorem, followed by a threefold *Fourier* transformation to convert it into a set of ordinary differential equations. The values of the unknowns are determined by applying boundary conditions at the surface of the halfspace. By carefully superposing such a fundamental solution of a halfspace, the model of a discrete soil stratification with inclined boundaries may be achieved, whereas the obtained model may be coupled to another halfspace to achieve a model of an elastic halfspace with inclined layers.

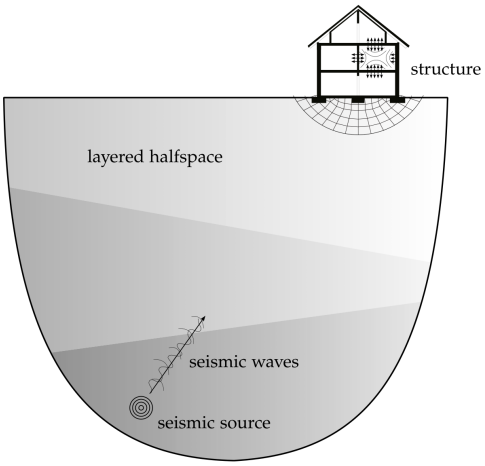

Figure 1: Source-to-structure problem

Tasks The primary goal of this master's thesis is to model an elastic halfspace with inclined layers using the ITM framework. By superimposing two halfspaces described by the fundamental ITM solution, we aim to capture the intricate behavior of the ground in the presence of inclined layers. The relevance of this research lies in its potential to enhance the accuracy of predictions by considering the influence of inclined layer boundaries, thereby providing a more realistic representation of real-world scenarios. To this end, the superposition procedure will be implemented into the Chair's MATLAB framework. The implementation must be validated by comparing the results to predictions from the fundamental systems.

Project Stages

- Develop a model for an elastic halfspace with inclined layers by superposing fundamental solutions given by ITM.
- Implement the superposition procedure into the Chair's existing MATLAB framework.
- Analyze and validate the implementation by comparing results with predictions from fundamental systems.
- Investigate the impact of inclined layers on the dynamic behavior of the ground through simulations.
- *Extension to a layered halfspace including a cavity (optional)

The thesis can be written either in English or German.

Literature

[1] Freisinger (2023): *Harmonic and transient three-dimensional Structure-Soil-Structure-Interaction applying a coupled ITM-FEM approach*. PhD thesis. Technical University of Munich.

[2] Kausel (2006): *Fundamental solutions in Elastodynamics*. Cambridge University Press. New York.

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