A Rupture to Rafters Workflow incorporating Soil-Structure Interaction: A Case Study in Istanbul

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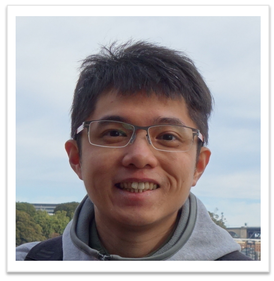

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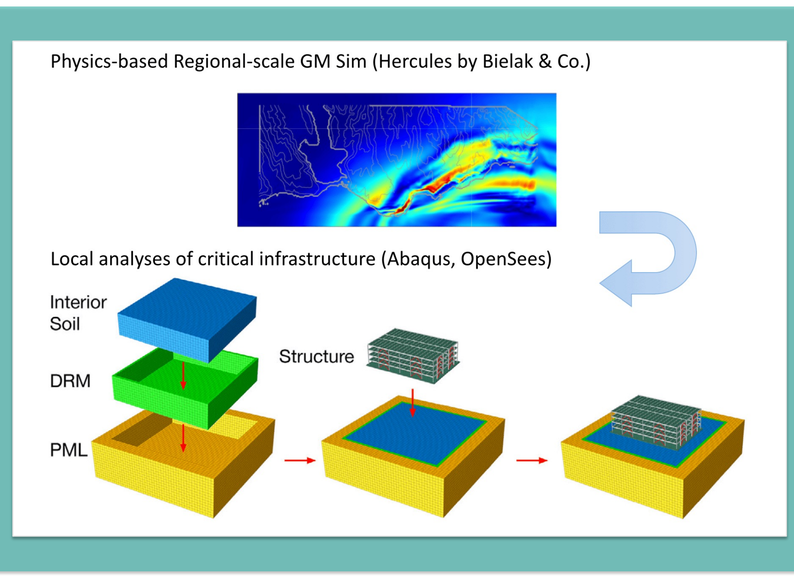
Responses from the **local** model with DRM and PML agree well with the **regional** model. The developed Python scripts enhance the **workflow's general applicability**.



Introduction

- **Hercules** is an octree-based finite element simulator for solving regional earthquake wave propagation problems.
- In this study, a Hercules simulation was conducted for a high-intensity (M_w=6.81) earthquake near Istanbul.
- An Abaqus model was devised to analyze the local response of a soil-structure foundation system.
- Hercules motions were consistently injected into the local (Abaqus) domain using the domain reduction method (DRM).
- Perfectly matched layers (PMLs) of the local domain absorbed the outbound/scattered waves.

Methods

- Responses from Hercules were utilized to compute effective nodal forces using the DRM proposed by Bielak et al. (2003).
- A soil-box-only Abaqus model was simulated for verification, confirming that responses from local and regional models align well.
- Multiple Python scripts were developed to semi-automate the workflow for broader applicability.
- A four-story steel-framed building was modeled, and EDPs were examined.

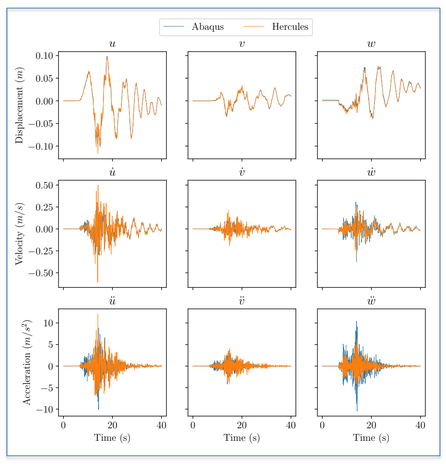


Fig. 1: Comparison of responses

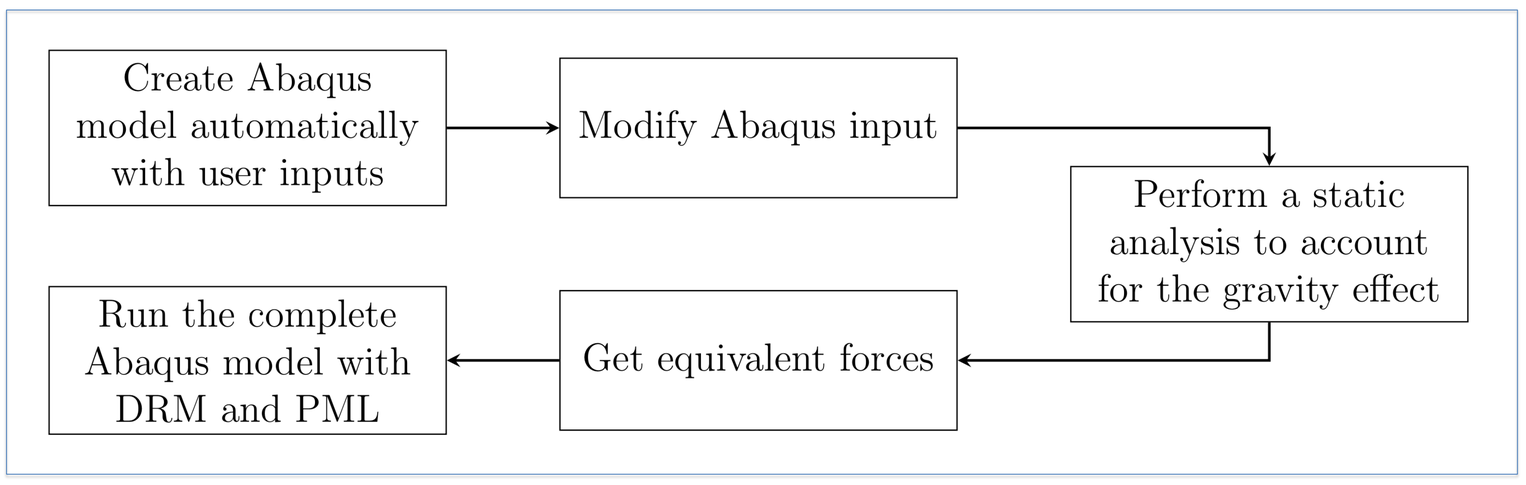


Fig. 2: The workflow of performing an SSI analysis

Results

- Maximum inter-story drift ratio and peak floor accelerations were obtained.
- Results with foundation input motions (FIM) applied to a building-only model were closer to the complete SSI model than free-field motions (FFM) applied to the building-only model.

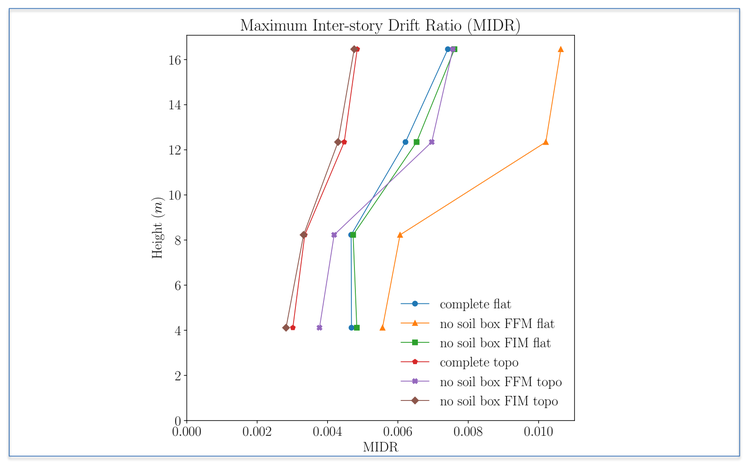


Fig. 3: Maximum Inter-story Drift Ratio

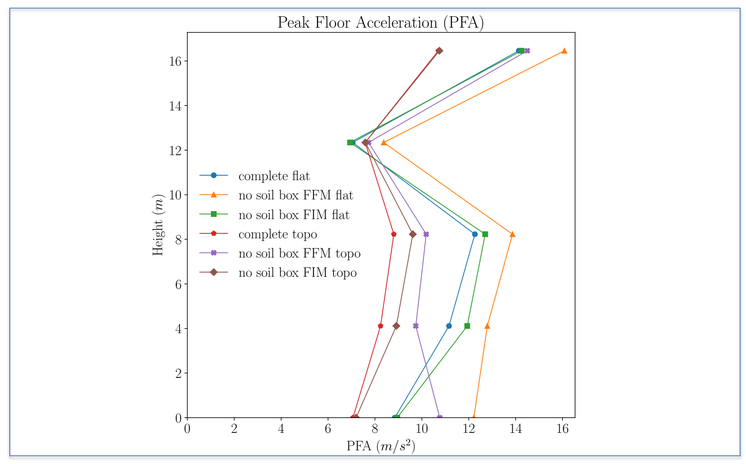


Fig. 4: Peak Floor Acceleration

Conclusions

- Responses and EDPs from local simulations closely align with regional ones with consideration of DRM and PML.
- The developed Python scripts streamline the workflow and are applicable to general cases.

References

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