



## COMPARISON BETWEEN 2D AND 3D DYNAMIC RESPONSE OF BASE-ISOLATED BUILDING SUPPORTED BY PILE FOUNDATION WITH VARYING LENGTHS IN INCLINED SOIL LAYERS

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Base isolation has been already extensively used for buildings in Japan. Recent seismic design codes stipulate that the response analysis should be realized by taking into consideration the superstructure, foundation and soil. On the other hand, pile foundation with varying lengths in inclined soil comes into effect substantially the seismic response of building speciality for torsional modes. Hence, in this paper, the investigation was focused on the following points:

- Effects of pile foundation in inclined soil on building response.
- Comparison between 2D and 3D responses.

Figure 1 and 2 show the 2D FEM and 3D FEM models of analysis.

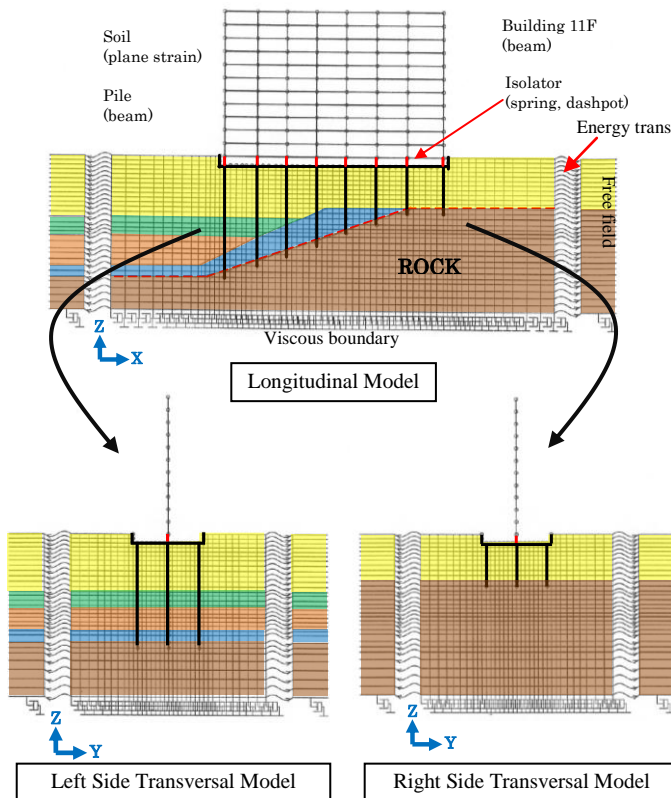


Figure 1. 2D FEM model of analysis

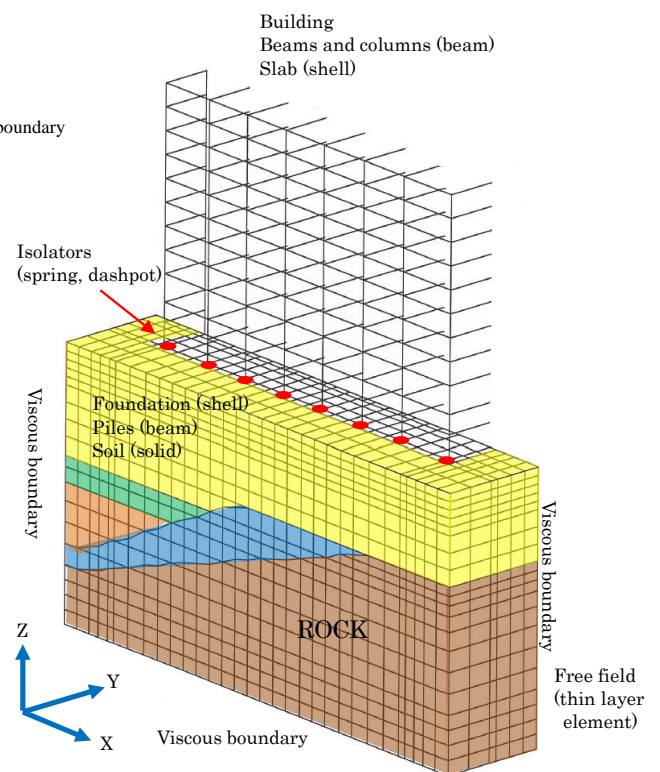


Figure 2. 3D FEM model of analysis(half model)

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The soil nonlinear behavior is considered by the equivalent nonlinear method and the calculations are conducted by the computer code SuperFLUSH/2D and SuperFLUSH/3D. Taking into account the structure symmetry, a half model is used for the 3D analysis. A strong earthquake defined by Building Center of Japan is used as input motion. In the 2D analysis, the same record is used for longitudinal and transversal models.

Effects of inclined soil are clearly noted for Y-direction input (Figure 4) with peaks around 0.3s, 0.6s and relatively small differences between 2D and 3D responses.

From horizontal response at building top(Figure 5), differences between left and right points are clearly noted for 3D analysis with peaks between 3s and 4s(isolators main periods), which is not visible for 2D analysis. This response confirms the effect of torsional mode of complete building–pile foundation–soil system. Furthermore peak around 0.18s is noted only for 2D right side transversal model, which illustrates the importance of a complete 3D modelling to obtain appropriate results.

The results of this study lead to following conclusions:

- Effects of pile foundation in inclined soil on the building response is clearly noted speciality for torsional mode.
- 3D analysis is recommended to take into account the complicated behavior of complete building–pile foundation–soil system.

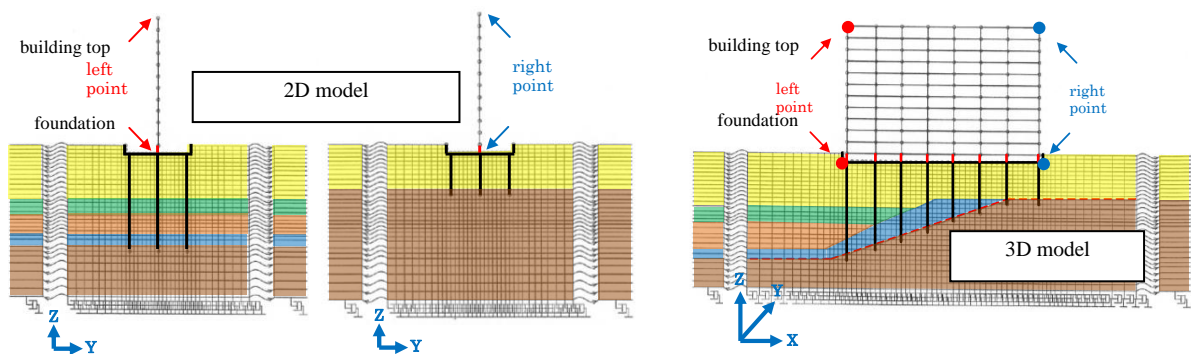


Figure 3. 2D and 3D model output points

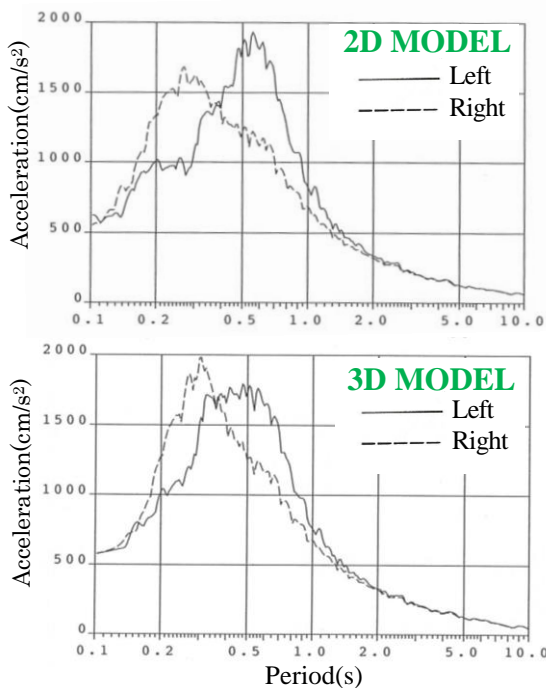


Figure 4. Y-dir. response spectra at foundation (Y-dir input)

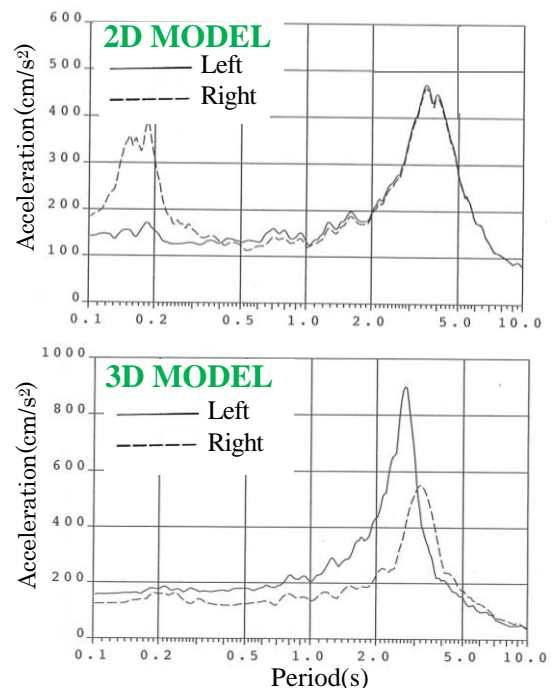


Figure 5. Y-dir. response spectra at building top (Y-dir input)

## REFERENCES

- Kozo Keikaku Engineering Inc. & Jishin Kougaku Kenkyusyo Inc.(2012) SuperFLUSH/2D Manual.  
 Kozo Keikaku Engineering Inc. & Jishin Kougaku Kenkyusyo Inc.(1995) SuperFLUSH/3D Manual.