The Parametric study of SSI analysis for Large Mat Foundation Structure

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1. Introduction

The developments of in-structure response spectrum (IRS) are major procedures of Generic Implementation Procedure (GIP) for the resolution of USI A-46. There are many factors influencing to IRS characteristics; especially the characteristics of surrounding soil of foundation affect the frequency and amplification IRS peaks. The most of soil-structure interaction (SSI) analyses for a large mat foundation such as base of the auxiliary building complex have been performed by simplified approaches, because of its complexity and huge computing cost.

In this paper, the parametric study of SSI analysis about large mat foundation was performed. As a tool of SSI analyses, the program SASSI[2] was used.

2. Analysis Models

2.1 Structure model

The objected superstructure (means upper parts of base mat) model was referred from reference [1]. This model is consisted of mass nodes, beam elements & soil springs. To use as the model for SASSI, the mass nodes denoted base mat and the soil springs were changed. The Figure 1 represents the configuration of superstructure model.

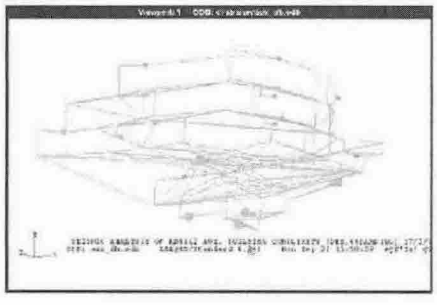
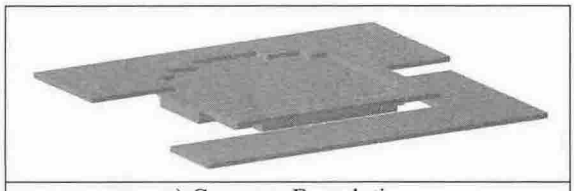


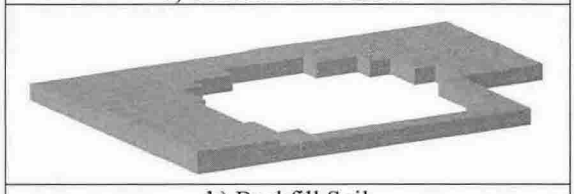
Figure 1. Structure model for SSI analysis

2.2 Foundation and soil model

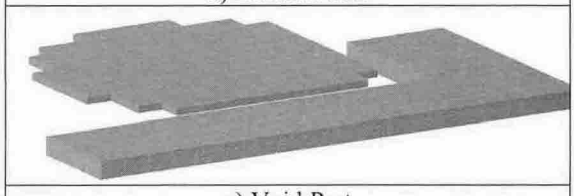
In SASSI analysis, the parts below the ground level including empty space have to be modeled by solid type element. The nodes consisting solid elements are acting as interaction node of SSI. The solid element meshes of foundation model are shown in Figure 2.



a) Concrete Foundation



b) Backfill Soil



c) Void Part

Figure 2. Foundation and soil model

Even the thickness of base mat is varied from 3 to 5 ft, for simplifying the model, the thickness of base mat was assumed 4'.

The foundation of auxiliary building complex is arranged in form of embracing that of the containment building. Therefore, the base mats of auxiliary building & containment building were modeled together. The effects of containment base were considered in parametric study.

Since, the shape of foundation is not rectangular exactly, the solid model of foundation includes the backfill soil. The properties of this soil part are assumed adequate values.

To represent wave propagation, the maximum sizes of element used in foundation model analysis were limited the value corresponding to 33Hz.

3. Parametric analysis

3.1 Analysis Parameters

The parameters considered in analysis were the shear wave velocity, the flexibility of foundation and structure-soil-structure interaction (SSSI).

The values of considered shear wave velocities were 2400, 3900, 7800 and 12000 ft/sec. These values were corresponding to 1/3, 1/2, 1.0 and 3/2 times of original site shear wave velocity of site, respectively.

The foundation flexibility parameter was introduced by the change of foundation material properties.

For the SSSI effect, three types of analysis models, such as, auxiliary building and foundation, auxiliary building and foundation with containment foundation, auxiliary building and foundation with containment building and foundation, were assumed.

The responses of the analyses models were compared by IRS at auxiliary building complex.

The input motions used in analysis were the design input motion of UCN 3&4.

3.2 Results of analysis

3.2.1 Shear wave velocity

As increment of shear wave velocities, the response of high frequency range showed larger amplified peaks. Especially, in case of 12000ft/sec, the main peak of IRS was located different frequency range compare to other cases of shear wave velocities. However, the response of fixed base superstructure did not show the frequency shift of main peak. Therefore, the assumption of high shear wave velocity for simulation of rigid foundation is inadequate.

3.2.2 Foundation flexibility

The effects of foundation flexibility were mainly showed in the response amplification differences of each floor level. The response amplification differences of rigid foundation cases were larger than that of flexible foundation. This trend was outstanding in stick type super structure such as containment building.

Additionally, the responses in high frequency range were more amplified by the rigid foundation.

3.2.3 SSI effect

The SSSI effect in IRS is shown in Figure 3. In this graph, dfs11650, dap1650, dfs31650 mean the auxiliary complex only, auxiliary complex with containment foundation, auxiliary complex with containment building and foundation, respectively.

As shown in this figure, the existence of containment foundation did not much affect the responses of auxiliary building, but this response was affected by the existence of superstructure of containment building. Especially, the response of high frequency range is greatly amplified compare to that of low frequency range. In view point of equipment seismic verification, the SSSI effects of adjacent super structures have to be carefully checked in this frequency range.

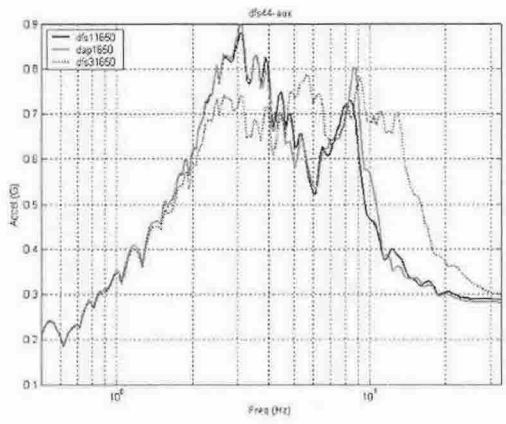


Figure 3. Foundation and soil model

4. Conclusion

In this study, the parametric study of SSI analysis about large mat foundation was performed. The effects of considered three parameters were compared and analyzed by means of IRS.

Acknowledgement

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