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EXTENDED ABSTRACT

Study of Seismic Behavior of Base-Isolated Buildings under Near and Far-Field Earthquakes by Considering the Soil-Structure Interaction

Maryam Rashidi, Mojtaba Fathi *, Afshin Naserpour

Department of Civil Engineering, Engineering Faculty, Razi University, Kermanshah, Iran

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Seismic isolation, Soil-structure interaction, Soft soil, Near field, Floor acceleration, Floor displacement.

1. Introduction

The present paper investigates the effect of soil-structure interaction on the seismic behavior of base-isolated frames under near and far-fault earthquakes. For this purpose, the nonlinear time history results of 1, 4 and 8-story base-isolated frames are compared with corresponding fixed base ones. ABAQUS finite element software is used for numerical modeling on which time history analyzes are performed.

2. Methodology

2.1. Studied models and analyses

The studied models are moment-resisting steel frames of 1, 4 and 8 stories. These frames are placed on different soil types and are considered as fixed base or base-isolated. To perform time history analysis on the study models, seven near-fault and far-fault earthquake records are used.

2.2. FE modeling

For numerical modeling, ABAQUS finite element software is used. In this modeling, the beam and column members are simulated by the linear beam element (B21). To define steel material, nonlinear elastoplastic model with combined isotropic and kinematic hardening is assigned. Also a rigid beam is used to consider the foundation.

Due to the semi-infinity of the soil, the energy applied to the model must be dissipated through the boundaries (geometric damping). To this end, infinite elements are used to define the semi-infinite soil environment and an elastic rock bed with a shear wave velocity of 900 m/s is taken into account at the bottom of the soil (Wolf, 1997; Minasidis, 2014; Karapetrou, 2015).

3. Results and discussion

3.1. Acceleration results

Fig. 1 shows the ratio of base acceleration at isolator level (ABI) to maximum ground acceleration (AG) for frames with and without soil-structure interaction. From this figure, it can be seen that the base acceleration ratio of frames for near-fault earthquakes is up to about 30% higher than that for far-fault ones. Also, the base

* Corresponding Author
E-mail addresses: rashidi6889@gmail.com (Maryam Rashidi), fathim@razi.ac.ir (Mojtaba Fathi), naserpour.afshin@gmail.com (Afshin Naserpour).

acceleration ratio reveals that in frames with a higher number of stories and located on soft soils, the use of base isolator requires more attention, especially for near-fault earthquakes.

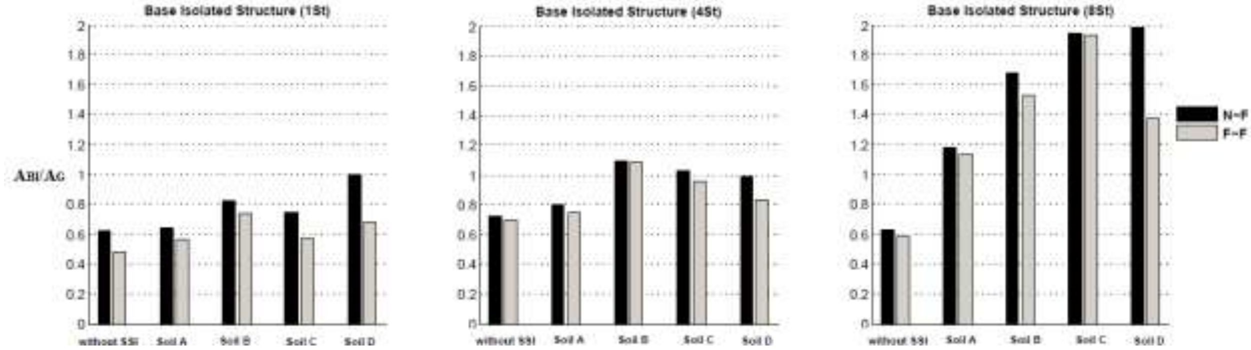

Fig. 1. Base acceleration ratio of studied models subjected to near and far-fault earthquakes

3.2. Base displacement results

Fig. 2 illustrates the maximum base displacement results of base-isolated frames for different soil types. In general, it can be seen that for all cases, the base displacement of the frames under near-fault earthquakes is higher than that under distant-fault earthquakes. It can also be observed that for 1- and 4-story models, considering soil-structure interaction does not have much effect on the base displacement results. However, for base-isolated 8-story models located on softer soils, the maximum base displacement is increased as compared to the frame without considering the soil-structure interaction.

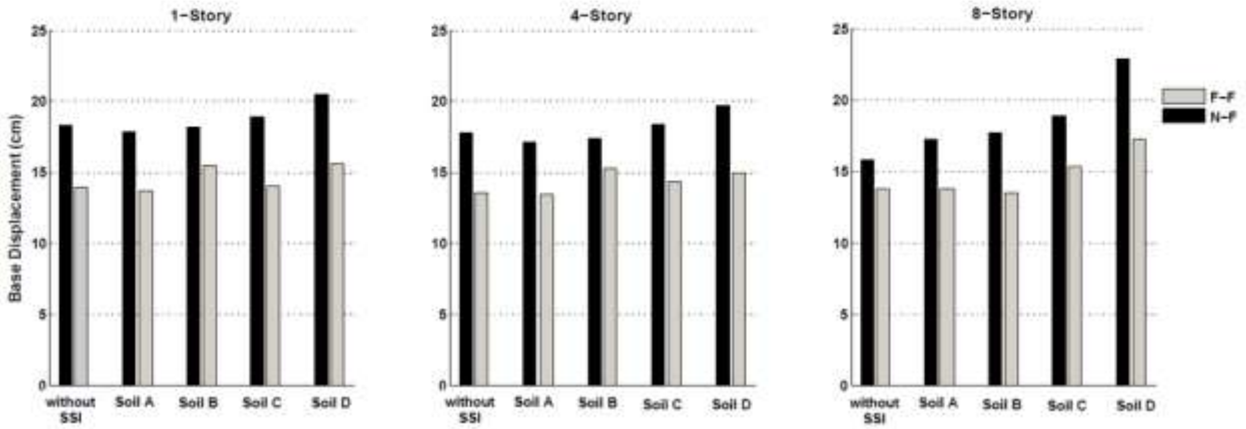

Fig. 2. Base displacement results of the base-isolated frames subjected near and far-fault earthquakes

4. Conclusions

The present study investigated the effect of soil-structure interaction on base-isolated frames under near- and far-fault earthquakes. According to the results, it can be obtained that the use of bas isolator for 1- and 4-story frames is suitable for all cases. However, for 8-story frames located on soft soil and subjected to near-fault earthquakes, the use of a base isolator is not very useful.

5. References

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