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論文審査の要旨及び審査員

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論文審査の要旨（2000 字程度）

The doctoral thesis entitled "Performance of Base-Isolated Buildings Subject to Near-Fault Ground Motion" has the objectives to (i) investigate the influence of bidirectional excitation on base-isolated buildings, (ii) assess the accuracy of the equivalent lateral force (ELF) procedure for the design of base-isolated buildings, (iii) investigate an appropriate approach of modeling viscous damping in nonlinear time-history analysis of base-isolated reinforced concrete (RC) buildings, (iv) develop impact force and contact element models for seismic pounding simulation of buildings, (v) assess the consequences of seismic pounding on typical base-isolated RC buildings under design and beyond-design level shaking, and (vi) investigate effectiveness of lower-bound and upper bound properties of isolators used in the design and time-history analysis of base-isolated buildings according to the current state of practice. Contents of the thesis are summarized as follows:

Chapter 1 - Introduction: Background and motivation of the research, a detailed literature review of previous related studies, and research objectives are discussed.

Chapter 2 - Estimation of displacement demand in isolation systems: Base displacement demands imposed by near-fault and far-fault ground motions on base-isolated buildings are assessed and the degree of accuracy of the ELF procedure of ASCE 7 standard, *Minimum Design Loads for Buildings and Other Structures*, is evaluated. An improved method of weighted scaling of ground motions is developed. The superstructure of the buildings is assumed to be rigid and earthquake excitation is considered to be bidirectional. It is determined that the ELF procedure of ASCE 7 provides reasonably good or conservative estimates of base displacement demands provided that non-pulse-like motions are selected and spectral matching is used for scaling.

Chapter 3 - Modeling viscous damping in time-history analysis of base-isolated buildings: Various commonly used damping ratios and approaches of modeling viscous damping in time-history analysis of base-isolated buildings are evaluated, using available shaking table test results of a reduced-scale three-story base-isolated RC building. It is concluded that 1% stiffness-proportional damping, where the coefficient multiplying the stiffness matrix is calculated from the frequency of the base-isolated building with the post-elastic stiffness of the isolation system is the most appropriate.

Chapter 4 - Seismic pounding simulation methodology: Impact force models used for the solution of contact-impact problems are evaluated from the viewpoint of structural pounding simulation. A modified Kelvin-Voigt (MKV) impact force model which does not have the limitations of the conventional model is developed and validated using available experimental data. The MKV model is then extended to develop a novel biaxial contact element to simulate pounding of base-isolated buildings with retaining walls at the base including friction. The new impact force model and the contact element are implemented in the finite element program OpenSees.

Chapter 5 - Response of base-isolated buildings under unidirectional excitation: The effects of seismic pounding on the performance of base-isolated RC buildings subject to unidirectional excitation of design earthquake (DE) level ground motions are investigated, by conducting three-dimensional nonlinear time-history analyses. In particular, seismic pounding of a typical 4-story base-isolated RC building with (i) a retaining wall on one side; (ii) a retaining wall and a 4-story fixed-base building on one side, which includes floor-to-column pounding; and (iii) retaining walls on both sides, is studied. It is determined that the superstructure of the building remains essentially elastic unless pounding occurs accidently and that seismic pounding with retaining walls at the base is more critical than that with the adjacent building.

Chapter 6 - Response of base-isolated buildings under bidirectional excitation: Nonlinear time-history analyses are carried out on a three-dimensional model of a four-story RC building considering bounding values of isolator properties and bidirectional excitation. It is concluded that if pounding is avoided, the performance of the building is satisfactory under DE level motions and risk-targeted maximum considered earthquake (MCE_R) level far-fault motions, while unacceptably large demands are imposed by MCE_R-level near-fault motions. Seismic pounding with retaining walls at the base under MCE_R-level near-fault motions has significant adverse effects on the building. Considering unidirectional excitation instead of bidirectional excitation for MCE_R-level near-fault motions provides highly unconservative estimates of superstructure demands.

Chapter 7 - Conclusions and recommendations: Conclusions of the research which will be useful for improving seismic design of base-isolated buildings, are presented and recommendations for future research are outlined.

This study provides significant contributions to the advancement of knowledge in the field of Earthquake Engineering. Therefore, this thesis is considered sufficient for the degree of Doctor of Philosophy.