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Title(English)	Seismic Performance Evaluation Methodologies for Base-Isolated Buildings with Various Heights and Damping Mechanisms
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

専攻： Department of	人間環境システム　専攻	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of　（　工学　）
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The title of the thesis is "Seismic Performance Evaluation Methodologies for Base-Isolated Buildings with Various Heights and Damping Mechanisms". The summary for each chapter is described below.

Chapter 1 Introduction

Because of its excellent ability to protect buildings, their functions and their occupants, seismic isolation has been increasingly used in Japan, China, and other seismically active countries. Not only short, but also tall base-isolated buildings can be seen nowadays. To date, studies on seismic isolation have typically modeled buildings as two-degree-of-freedom (2DOF) system. However, 2DOF model does not simulate story-by-story responses such as inter-story drifts and floor accelerations, which can unevenly distribute throughout the building height. This study utilizes a multi-degree-of-freedom (MDOF) system which is essential for performance evaluation. Two performance evaluation methods which are based on probabilistic and simplified approaches are described.

Chapter 2 Seismic Responses of Base-Isolated Structures

In order to represent short, mid-rise, and tall buildings, 3-, 9-, and 20-story base-isolated buildings are selected for investigation. The buildings are designed according to the American standard design code. The isolation system is idealized as a ViscoElastic system. The analytical model of the building is a shear beam model which is simple, but can produce important story-by-story responses. Dynamic properties of the buildings determined from real-mode and complex-mode Eigenvalue analyses are examined and discussed. The buildings are subjected to several ground motions and the responses are discussed. Furthermore, base-isolated buildings having ElastoPlastic isolation systems are also investigated representing different damping hysteresis. The comparisons between these buildings are discussed. Modal contributions are also investigated.

Chapter 3 Response Comparison with Conventional Structures

3-, 9-, and 20-story conventional fixed-base buildings, designed according to the American standard design code, are investigated in order to the compare with the base-isolated buildings in the previous chapter. Modal contributions are also investigated and compared with those of the base-isolated buildings. The effectiveness of having base isolation is clearly identified.

Chapter 4 Probabilistic and Time-Based Performance Evaluation Methodology

The methodology from the Pacific Earthquake Engineering Research Center (PEER) framework which is based on the probabilistic approach is utilized for performance evaluation of base-isolated buildings. The result from the evaluation method is the return period which indicates the number of years that the building is expected to be functional without exceeding a specified damage state. Nonstructural components of partition wall and suspended ceilings are selected as they represent drift-sensitive and acceleration-sensitive components, respectively. The buildings described in Chapter 2 are used for performance evaluation. In order to represent other types of nonstructural components as well as to observe the sensitivity, the fragility functions of the partition wall and suspended ceiling are varied and the performance evaluations are conducted.

Chapter 5 Simplified Performance Evaluation Methodology

In order to simplify the evaluation methodology and make use of the response spectrum, the base-isolated building model having a 1-mass 2-layer system is proposed. The dynamic properties of the building model is described by using a complex approach. The accuracy of the dynamic properties as well as the responses

are verified and compared with those of the 2DOF system. Then the performance curve is developed. By specifying the ratio between isolation period and superstructure period and isolation damping ratio, the maximum responses of the base and superstructure can be obtained as also illustrated by a plot. 3-, 9-, and 20-story base isolated buildings with two types of superstructures, designed corresponding to the US and Japan, are used for verification. MDOF shear beam model is utilized to represent the base-isolated building. Several ground motions are used. The accuracy of the proposed model is shown. Furthermore, the verification is extended to cover the base-isolated buildings with highly-damped superstructure and having bilinear isolation system as well.

Chapter 6 Application to an Existing Base-Isolated Building

The performance evaluation methodologies described in Chapters 4 and 5 will be applied the actual base-isolated building. An existing J2 base-isolated building in Suzukakedai campus, Tokyo Institute of Technology is analyzed by using a 3D nonlinear sophisticated frame model. The accuracy of the J2 building is verified by comparing the responses with the recorded data during March 11 Tohoku Earthquake. The sophisticated model is then simplified to only shear beam model to capture major responses of the displacement, story drift ratio, and floor acceleration. The results of the shear beam model are compared and shown to be very accurate. By using this simple shear model, the performance of the J2 base-isolated building is evaluated by using the PEER framework described in Chapter 4. In Japan, clearance distance of the base floor is usually limited. Hence, the framework is extended to evaluate the performance considering this clearance distance. Furthermore, the performance curve proposed in Chapter 5 is also verified with the J2 building. Further application of the performance curve is described.

Chapter 7 Conclusions

This chapter summarizes the content of each chapter and propose future scope of the study.