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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 “Improved Seismic Design Procedures and Analysis Methods for Reinforced Concrete Moment Resisting Frame Buildings with Viscous Dampers” has the objectives: (i) propose a non-iterative alternative design methodology for the seismic retrofit of reinforced concrete moment resisting frame (RC-MRF) buildings with viscous dampers, (ii) develop new equations for the inelastic displacement ratio and inelastic velocity ratio for buildings with damping systems for near-fault ground motions to be used in the direct displacement-based design (DDBD) procedure, (iii) propose correction factors to calculate the peak velocity from the design velocity of the viscous dampers in the DDBD procedure, and (iv) evaluate the performance of RC-MRF building with viscous dampers by using the conditional mean spectrum (CMS).　The 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 - An alternative design method for the seismic retrofit of RC-MRF buildings with viscous dampers: A non-iterative four-step design methodology is proposed to calculate the viscous damper characteristics to retrofit RC-MRF buildings, to achieve a prescribed target performance level.　The proposed design methodology is applied and it is shown that the retrofitted buildings satisfy the target performance.
Chapter 3 - Inelastic displacement and inelastic velocity ratios for buildings with damping systems for near-fault ground motions: Equations for inelastic displacement ratio and inelastic velocity ratio are proposed for single degree of freedom (SDOF) systems for near-fault ground motions in terms of viscous damping ratio, displacement ductility, and elastic period.　Proposed equations are used in the DDBD procedure and show better results than the conventional design method.
Chapter 4 - Peak velocity of viscous dampers for direct displacement-based design (DDBD) of RC-MRF buildings: Damper velocity correction factors are proposed along the height to calculate the peak velocity of viscous dampers from the design velocity of viscous dampers to design RC-MRFs with linear viscous dampers (LVDs) using the DDBD procedure. In addition, the DDBD procedure is also applied to design the RC-MRF with non-linear viscous dampers (NLVDs) using the proposed damper velocity correction factor.　When the damper velocity correction factor is used, the design LVD forces and design NLVD forces are close to the nonlinear response history analysis (NLRHA) results.
Chapter 5 - Performance of buildings with different methods used to distribute viscous damper constants: The responses of the RC-MRFs are compared when different methods are used to distribute the viscous damper constants.　The RC-MRFs were designed using the DDBD procedure from Chapter 4 (standard method).　The total peak viscous damper forces calculated from the DDBD procedure is kept constant, and viscous damper constants in each story are proportional to story mass (SM), design story shear force (SS), or design inter-story drift ratio (IDR) of the story.　In addition, viscous dampers with the same damper constant are distributed in the top half of the building (THD) and bottom half of the building (BHD).　The NLRHA results indicate that there is no significant difference in peak IDR, peak floor displacements, peak story shear forces, and sum of the peak viscous damper constants when using the standard method, and when viscous damper constants are proportional to SM, SS, and IDR.　When the damper constants are distributed using THD and BHD it is not possible to control the response indicators of the stories where dampers are not installed.
Chapter 6 - Performance assessment of RC-MRF buildings with viscous dampers using the conditional mean spectrum (CMS):　The NLRHA results obtained using ground motions scaled to the CMS and the uniform hazard spectrum (UHS) are compared.　The retrofitted 4-story RC-MRF with LVDs discussed in Chapter 2 is used.　Conditional mean spectra are constructed by using a target period close to the fundamental period, twice the fundamental period, and second mode period. The building response is maximum when the target period of the CMS is close to the fundamental period of the buildings and the responses are close to the results obtained using UHS.
Chapter 7 - Conclusions and recommendations: Conclusions of the research which will be useful for improving seismic design of RC-MRF buildings with viscous dampers 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 research is considered sufficient for the degree of Doctor of Philosophy.