

論文 / 著書情報
Article / Book Information

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Title(English)	Strain-Based Damage Evaluation of Structural and Non-Structural RC Walls for Performance-Based Seismic Design
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Type(English)	Outline

Thesis Outline

Title: Strain-Based Damage Evaluation of Structural and Non-Structural RC Walls for Performance-Based Seismic Design

The doctoral thesis entitled “Strain-Based Damage Evaluation of Structural and Non-Structural RC Walls for Performance-Based Seismic Design” has the following primary objectives: (a) propose material strain limits as a means to evaluate seismic damage to structural RC walls during the design phase using numerical modeling, (b) investigate the key parameters influencing the damage of structural RC walls, (c) propose material strain limits tailored to evaluate seismic damage to non-structural RC walls using numerical modeling, and (d) develop predictive equations and fragility curves to estimate seismic damage to non-structural RC walls. The outline and contents of the thesis are summarized as follows:

Chapter 1 – Introduction: provides the background for the research, emphasizing the importance of limiting damage to ensure building functionality under seismic hazards. It highlights the performance-based design framework as a strategy to achieve this goal and outlines the research needs, objectives, and scope of the study.

Chapter 2 – Literature Review: presents an overview of existing research on the behavior of RC walls under seismic loading, identifying key damage mechanisms, and discussing current methods for evaluating damage. It highlights gaps in the literature, including limited focus on intermediate damage levels and insufficient tools for predicting damage during the design phase. Specific research gaps are highlighted to establish the need for further investigation.

Chapter 3 – Numerical Simulation of Reinforced Concrete Walls: discusses the requirements for numerical models to evaluate damage to structural and non-structural RC walls. It reviews various modeling approaches, selects the most suitable ones for each wall type, and validates their accuracy using experimental results. This chapter sets the foundation for the rest of the chapters.

Chapter 4 – Damage Evaluation of Structural Reinforced Concrete Walls: proposes strain-based limit states for various damage levels, as defined in the Japanese guidelines for post-earthquake damage evaluation, to enable prediction of structural RC wall damage during the design phase. These strain limits are validated using experimental data from RC walls with a wide range of material, section, geometry, and loading parameters. The proposed limits are also compared with performance levels in ASCE/SEI 41.

Chapter 5 – Parametric Study to Identify Variables Affecting Damage Levels of Structural Reinforced Concrete Walls: investigates the influence of design variables on damage levels of structural

RC walls through systematic parametric study. Since ultimate deformation is an indicator of structural performance, it is also examined alongside damage levels. The findings provide insights for optimizing structural RC wall designs to achieve the desired damage performance under seismic loading.

Chapter 6 – Damage Evaluation of Non-Structural Reinforced Concrete Walls: defines damage states for non-structural RC walls based on their performance requirements and proposes strain-based limit states corresponding to these damage states. The proposed strain limits are validated using damage observations from experimental tests, providing a framework for evaluating damage to non-structural RC walls under seismic loading.

Chapter 7 – Empirical Equations and Fragility Functions for Damage Evaluation of Non-structural Reinforced Concrete Walls: develops predictive tools to estimate damage states and guide design optimizations for non-structural RC walls. Empirical equations predict the wall drift ratios at different damage states based on design variables and fragility functions establish relationships between the wall drift ratio and damage probabilities.

Chapter 8 – Summary, Conclusions, and Recommendations: provides a summary of the thesis, highlighting key conclusions and research contributions. The chapter also offers recommendations for future research to further enhance the damage evaluation of RC walls.

In addition to the content discussed in the main body of the thesis, **Appendices A to C** offer supplementary details/information that support research findings.