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# DISSERTATION OUTLINE

SINSAMUTPADUNG NATDANAI

## Dissertation title

A study on low-cycle fatigue behavior of steel member in large plastic strain region under earthquake loading

## Abstract

This study aims to investigate low-cycle fatigue behaviors of steel member under earthquake loading. Since low-cycle fatigue behaviors are governed by local area behaviors, local strain approach based on effective notch strain concept with compatibility to design process were used. Local strain behaviors under earthquake loading were clarified via FE models of steel bridge piers subjected to earthquake acceleration histories. Large plastic strain range, strain rate, and variable strain pattern could be important factors on low-cycle fatigue behaviors under earthquake loading. Low-cycle fatigue tests were conducted on structural steel and steel welded joint to clarify influence of these factors. Finally, evaluation method and recommendation for low-cycle fatigue behaviors of steel member under earthquake loading has been established.

## Outline of the dissertation

**Chapter 1: Introduction**

A general background and problems of low-cycle fatigue damage of beam-to-column connection in steel bridge piers during earthquakes are stated. Purposes and objectives, as well as related research are provided

**Chapter 2: Local strain behavior during earthquakes based on the effective notch strain concept**

Local strain behavior in terms of effective notch strain range, strain rate, and plastic strain history are investigated. The cumulative density function (CDF) of the effective notch strain range is obtained, which is used to generate the loading range for the experimental study.

**Chapter 3: Dynamic strain effect on low-cycle fatigue behavior of structural steel**

Low-cycle fatigue behavior under dynamic strain on structural steel is investigated. Low-cycle fatigue tests were conducted on effective notch specimens. Fatigue life, as well as crack initiation and crack propagation behaviors are investigated and discussed. A countermeasure for dynamic strain effect is proposed.

**Chapter 4: Variable strain patterns on low-cycle fatigue behavior of structural steel**

Low-cycle fatigue behavior under variable strain patterns on structural steel is investigated. Low-cycle fatigue tests were conducted on effective notch specimens. Fatigue life, as well as crack initiation and crack propagation behaviors are investigated and discussed. A practical fatigue strength assessment for variable strain patterns based on the effective notch strain concept is proposed.

**Chapter 5: Low-cycle fatigue behavior of steel welded joint under earthquake loading**

Low-cycle fatigue behavior under earthquake loading on a steel welded joint is investigated. In order to simulate the earthquake loading pattern to be used in the experiment, loading range were obtained from the CDF of the effective notch strain range established in Chapter 2. Low-cycle fatigue tests were conducted on load-carrying cruciform joint specimens. A prediction method based on the effective notch strain concept in Chapter 4 is verified.

**Chapter 6: Effective notch strain based evaluation for steel member under earthquake loading**

An evaluation method based on the actual strain condition of effective notch strain range is established. To consider constraint effect at the local area of steel welded joints, a modification factor for determining actual strain condition for the effective notch strain in a steel welded joint is generated.

**Chapter 7: Conclusions**

The important points from the present study are highlighted. Potential future research based on the present study is discussed.