NUMERICAL STUDY ON SEISMIC BEHAVIOR REQUIREMENTS FOR STEEL PLATE SHEAR WALLS

By

Rehab Magdy Elsaied Rezk

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Structural Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

NUMERICAL STUDY ON SEISMIC BEHAVIOR REQUIREMENTS FOR STEEL PLATE SHEAR WALLS

By
Rehab Magdy Elsaied Rezk

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Structural Engineering

Under the Supervision of

Prof. Dr.
Sherif Ahmed Mourad

Professor of Steel structures and bridges
Structural Engineering Department
Faculty of Engineering
Cairo University

Prof. Dr.
Mohammed Hassanien serror

Professor of Steel structures and bridges
Structural Engineering Department
Faculty of Engineering
Cairo University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

NUMERICAL STUDY ON SEISMIC BEHAVIOR REQUIREMENTS FOR STEEL PLATE SHEAR WALLS

By

Rehab Magdy Elsaied Rezk

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
In
Structural Engineering

Approved by the
Examining Committee

____

Prof. Dr. Sherif Ahmed Mourad **(Thesis Main Advisor)**
Professor of Steel structures and Bridges-Structural Engineering Department
Faculty of Engineering, Cairo University

____

Prof. Dr. Mohammed Hassanien serror **(Advisor)**
Professor of Steel structures and Bridges-Structural Engineering Department
Faculty of Engineering, Cairo University

____

Prof. Dr. Hesham Elsayed Hamed **(Internal Examiner)**
Professor of Steel structures and Bridges-Structural Engineering Department
Faculty of Engineering, Cairo University

____

Prof. Dr. Mohamed Abdel kader Elaghoury **(External Examiner)**
Professor of Steel structures and Bridges-Structural Engineering Department
Faculty of Engineering, Ain Shams University

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
GIZA, EGYPT
2018

Engineer's Name: Rehab Magdy Elsaied Rezq
Date of Birth: 15 / 8 /1991
Nationality: Egyptian
E-mail: eng_rehab41@yahoo.com
Phone: 01062508603
Address: 69 street, Maadi

Registration Date: 1 / 3 / 2014
Awarding Date: …./…./2018
Degree: Master of Science
Department: Structural Engineering

Supervisors:

Prof. Dr. Sherif Ahmed Mourad.
Prof. Dr. Mohammed Hassanien serror.

Examiners:

Prof. Dr. Sherif Ahmed Mourad (Thesis main advisor)
Prof. Dr. Mohammed Hassanien serror (Advisor)
Prof. Dr. Hesham Elsayed Hamed (Internal examiner)
Prof. Dr. Mohamed Abdel kader Elaghoury (External examiner)
(Professor of steel Structures and Bridges. Faculty of Engineering, Ain-shams University)

Title of Thesis:

Numerical Study on Seismic Behavior Requirements for Steel Plate Shear Walls

Key Words:
Shear Strength- SPSW – Column- Tension Field- Stiffener

Summary:

Shear strength of unstiffened steel plate shear walls, SPSWs, was conventionally computed assuming fully yielded in-fill plate and collapse of boundary frame elements by uniform yielding mechanism at ultimate load. Accordingly, both Canadian and American seismic provisions for design of SPSWs did introduce a minimum stiffness for vertical boundary elements (VBE) to ensure the yielding capacity of the infill plate. These seismic provisions have been investigated numerically in this research work. Unexpected failure in the VBE has been observed despite the prescribed minimum stiffness by the codes. Hence, the infill plate could not achieve the target lateral load capacity. Accordingly, a comprehensive parametric study has been conducted on SPSWs, using nonlinear finite element analysis by ANSYS software, to modify the seismic requirements for the VBE. Both stiffened and Unstiffned SPSWs have been investigated. Based on the numerical results, equations for the modified minimum stiffness and strength of VBE have been proposed so that the infill plate attains the yielding capacity. The numerical results, based on the proposed equations, have been compared with the code target lateral load capacity where good fitting has been reported.

Acknowledgments

First and above of all, I have to thank Allah providing me with the opportunity to meet such helpful and wonderful people who helped me from the start of the thesis. All praises to Allah for giving me knowledge, strength, support and patience to present this work.

I would like to express my deepest sense of gratitude to my respectable supervisors; ***Prof. Dr. sherif Ahmed Mourad*** and ***Prof. Dr. Mohammed Hassanien serror***; who offered me the honor to be one of their students. I thank them for their continuous advice and encouragement, guidance, extreme caring, and great effort to provide me with an excellent atmosphere for doing this research.

I am indebted with great favor to ***Dr. Bassem Lamey Gendy*** for his positive discussions, guidance, continuous support and following me up through the study.

I would also like to express my heartfelt appreciation to my parents **Mr. Magdy Elsaied Rezq** and **Mrs. Magda Sayed Mansour** for lots of support. They were so patient throughout the thesis journey and they were my backbone in all times.

Finally, I would like to express my gratitude to all my friends and colleagues for supporting me and being by my side in all times.

Hoping this thesis would be a step towards a better understanding of our current needs and a better development of our country.

Rehab Magdy

Dedication

I Lovingly dedicate this work to *my father*, *my mother*, *my sister* (*Radwa*) and *my brother (Ahmed)*, for their care, guidance, help and patience. I do believe that, I could not success in all my life steps without their continuous support and prayers. May Allah bless them.

Table of Contents

List of Tables

List of Figures