The thesis titled "Seismic Performance Evaluation of Shape Memory Alloy Based Suspended Zipper Braced Frames" submitted by Major Mohammad Rezaul Karim, Roll No: 131210, Session: 2012-13 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master of Science in Engineering (M. Sc. Engg.) on 18 May, 2017.

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DECLARATION

I hereby declare that this thesis is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis.

This thesis has also not been submitted for any degree in any university previously.

_____

18 May, 2017 Mohammad Rezaul Karim

ACKNOWLEDGEMENT

At the very beginning we would like to express our deepest gratitude to Almighty Allah for giving me the strength and ability to accomplish this thesis work. During the time of my conducting thesis work I received a lot of support from various corners.

First and foremost, I am highly obliged to my thesis supervisor, Dr M. Shahria Alam whose inspiration gave me a lot of support to do my thesis work. Then, my co-supervisor Kamrul Islam, who has allowed me to encroach upon his precious time right from the very beginning of this thesis work till the completion. His expert guidance, affectionate encouragement and critical suggestion provided me necessary insight into the thesis subject and paved the way for a meaningful ending of this thesis work in a short duration. Without his constant supervision, valuable advices and suggestion from time to time I would not have to be able to complete the whole thesis in a right manner.

I am also very much indebted and grateful to Lecturar Khadiza of MIST and Capt Sazzad who have helped me in doing this thesis work.

I am also grateful to the authors of the books, journals papers etc those had been aids to my thesis work as mentioned in the bibliography.

ABSTRACT

The suspended zipper-braced frame (SZBF) is a modified version of inverted V braced frame in which zipper struts are added between the brace locations at the mid-span of floor beams and a hat truss is added between top floor to transfer the unbalanced vertical forces induced by brace buckling into the upper floors. Two reference steel braced frames, 3 storey (low rise) and 9 story (mid-rise) SAC model buildings, designed for the Los Angeles area are analyzed and the seismic performance of the structures with the conventional steel bracing (SZBF and chevron braced frame) are investigated and compared with the Shape Memory Alloys (SMA) SZBF. In this study, a 2-D finite element (FE) analysis of the SZBF is carried out in order to assess the seismic performance of the SZBF by exploiting the super elastic (SE) behavior of SMA. The nonlinearities of both geometric and material aspects are included in the FE models. Nonlinear static pushover analyses and incremental dynamic analyses under 20 earthquake excitations have been conducted. Results obtained from the analyses confirm the suitability of SMA braces to improve the seismic performance of SMA SZBFs to help achieve performance-based design objectives for steel buildings in high seismic zones by uniformly distributing inter-storey drift ratios over the height of the building and thus reducing the vulnerability of failure due to soft storey mechanism.

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LIST OF ABBREVIATIONS

ATC	-	Applied Technology Council
CBF	-	Chevron Braced Frame
DS	-	Damage State
EDP	-	Engineering Demand Parameter
FE	-	Finite Element
FEMA	-	Federal Emergency Management Agency
IM	-	Intensity Measure
PGA	-	Peak Ground Acceleration
PGV	-	Peak Ground Velocity
PSA	-	Probabilistic Safety Analysis
PSDM	-	Probabilistic Seismic Demand Model
SAC	-	SAC was formed by the joint venture of SEAoC (Structural Engineers Association of California), ATC (Applied Technology Council), and CUREE (California Universities for Research in Earthquake Engineering)
SE	-	Super Elastic
SMA	-	Shape Memory Alloy
SZBF	-	Suspended Zipper Braced Frame

LIST OF SYMBOLS

E	-	Modulus of elasticity
F_u	-	Ultimate strength
F_y	-	Yield strength
P	-	Probability of exceedance
R	-	Response modification factor
R_o	-	Over-strength factor
R_μ	-	Ductility factor
S_a	-	Spectral acceleration
S_s	-	Spectral acceleration for short period
S_1	-	Spectral acceleration for 1 sec period
T	-	Natural period
V	-	Shear force
V_d	-	Design base shear
V_e	-	Maximum base shear
V_y	-	Yield base shear
μ	-	Ductility
Δ	-	Displacement
Δ_y	-	Yield displacement
Δ_{max}	-	Maximum displacement