



**TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS**

DEPARTMENT OF CIVIL ENGINEERING

M.Sc. Program in Structural Engineering

Thesis no: S00104

**OUT OF PLANE SEISMIC RESPONSE OF INFILL
BRICK MASONRY WALL**

KRISHNA RAJ PANTHA

January- 2007



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A thesis submitted by
KRISHNA RAJ PANTHA

In partial fulfillment of the requirement for the degree of

**MASTER OF SCIENCE
IN
STRUCTURAL ENGINEERING**

January- 2007

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CERTIFICATE

This is to certify that the work contained in this thesis entitled “Out of Plane Seismic Response of Infill Brick Masonry Wall”, in partial fulfillment of the requirements for the degree of Master of Science in Structural Engineering, as a record of research work, has been carried out by Mr. Krishna Raj Pantha (061/MSS/r/106) under my supervision and guidance in the institute of Engineering, Pulchowk Campus, Lalitpur. The work embodied in this thesis has not been submitted elsewhere for a degree.

.....

Dr. Roshan Tuladhar
Department of Civil Engineering
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January, 2007

ACKNOWLEDGEMENT

I would like to express my deep indebtedness to my supervisor Dr. Roshan Tuladhar, Institute of Engineering, Pulchowk Campus for his proficient guidance, kind support, continuous suggestions and persistent encouragement for the betterment of work throughout my thesis work. The completion of this thesis work was possible only due to his abundant advice and rewarding technical support.

I would also like to express my profound gratitude to Prof. Dr. C.V.R. Murty, Indian Institute of Technology Kanpur, India for his precious suggestions and comments during initiation of this thesis work.

I am grateful to all the teachers of Department of Civil Engineering, Pulchowk Campus especially Prof. Dr. P.N. Maskey, Prof. Dr. Mohan Prasad Aryal, associate Prof. P.L. Pradhan for their kind suggestions and supports during entire period of this thesis work.

I am thankful to colleagues especially Radha Krishna Mallik for his kind cooperation during numerical modeling of the thesis work.

Finally I would like to express my sincere thanks to all my teachers and friends for their direct and indirect cooperation, advice and help during the period of this thesis work.

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ABSTRACT

Significance of RC bands in preventing failure of infill wall especially in out of plane direction was investigated. Also the change on magnitude of various stress components on bounding RC frames due to presence of RC bands was examined. Two types of models viz. the infill walls with and without RC bands were prepared and studied numerically to get comparative results. Micro modeling i.e. eight noded solid element for bricks, non-linear link elements for mortar and solid elements with sufficient subdivisions for bounding RC frame was carried out for one focused infill panel and macro modeling i.e. equivalent diagonal strut modeling for infill walls and single solid element for bounding RC frames was carried out for the infill walls except the focused infill panel. Non linear direct integration time history analysis was carried out for the both types of models. Only the output results of focused infill panel was studied for both types of models.

It was found that the presence of RC bands reduces the tendency of failure of infill wall especially in out of plane direction. It was concluded by studying the stresses on bricks, displacement of bricks and stresses on mortar. The probable crack propagation was plotted after studying the stresses on mortar determined from forces on link elements. Sufficient cracks were seen on wall without RC bands and fewer cracks were seen on walls with RC bands. The magnitude of maximum stresses on bounding frames i.e. beams and columns were found more in model without RC bands than in model with RC bands. But in model with RC bands, the stresses on the column at band column junction were significantly large in comparison with the stresses on the column at same location in model without RC bands. Hence except the stresses on band column junction overall responses for the model with RC bands were less in magnitude in comparison to the model without RC bands and therefore the provision of RC bands on infill wall was found beneficial if due care is given at band column junction.

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LIST OF ABBREVIATION

a	Width of equivalent strut
h_{col}	Column height between centerlines of beams
h_{inf}	Height of infill panel
E_{fe}	Expected modulus of elasticity of frame material
E_{me}	Expected modulus of elasticity of infill material
I_{col}	Moment of inertial of column
L_{inf}	Length of infill panel
r_{inf}	Diagonal length of infill panel
t_{inf}	Thickness of infill panel and equivalent strut
	Angle whose tangent is the infill height-to-length
E	Young's modulus of elasticity
	Density
	Poisson's ratio
V	Compressive wave velocity
K	Stiffness matrix
C	Damping matrix
M	Diagonal mass matrix
t	Time function
u	Displacement
	Velocity
\ddot{u}	Acceleration
r	Applied load
t	Time step
	Compressive strength of brick
f_m	Compressive strength of masonry prism
l	Relative stiffness parameter
n	Number of degree of freedom
	Modal matrix whose columns are Eigen vectors
	Natural frequency
τ_{max}	Shear strength of RCC