SEISMIC BEHAVIOR OF STRENGTHENED ADOBE MASONRY STRUCTURES

(CASE STUDY: DISTRICT AWARAN)

SYNDICATE DS: LT COL DR. SHAHID IQBAL

SYNDICATE MEMBERS:

CAPT HAMZA AMEEN (SYN LDR)	PA 43226
CAPT AZEEM ASLAM	PA 43218
CAPT TOUQEER AHMED	PA 43285
CAPT ASIM SHAHZAD	PA 43836

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
MILITARY COLLEGE OF ENGINEERING RISALPUR

ACKNOWLEDGEMENT

I am thankful to Almighty Allah, who gave me strength to complete my research. I would like to pay debt of gratitude to my advisor Dr. Shahid Iqbal, for his fathomless guidance, valuable time and encouragement, to complete my research work. I am also extremely grateful to the co-supervisor, Dr Hassan Farooq, for his sincere guidance to complete my research work. I owe my special thanks to Dr Naveed for assisting me throughout my research work. In the end, I pay my earnest gratitude with sincere sense of respect to my parents for their unending support, encouragement, prayers and patience.

ABSTRACT

Earth quake engineering in Pakistan became popular in last few decades for both assessment and design of structures. Innovation in design codes for all structural topologies with the incorporation of seismic assessment, procedures based on identification of damage status in terms of displacement thresholds have brought revolution in the said field. Most of the rural areas in Pakistan employ Adobe and mud masonry for construction dwelling.

In Pakistan, most of the rural areas use Adobe and mud masonry construction for dwelling primarily because, one, they are poor and, second, it is cheap and extreme environmental conditions favor this construction. In Baluchistan, 80% of the population is living in houses constructed of Adobe masonry. Baluchistan is an earthquake prone area and has seen many earthquakes in the past. Thus, it is essential that houses constructed in Baluchistan should be properly designed to perform well during earthquakes. Adobe and mud masonry construction did not perform well during the past earthquakes and most of the houses were severely damaged. During recent Awaran Earthquake, more than 80% of houses in earthquake hit area were completely destroyed resulting into loss of life and property. Thus, there is a need to make this type of construction better earthquake resistant.

In this research, gravity load and seismic analysis of Adobe Wall Panel (12 feet x 10 feet) having 18 inches thickness and Adobe room (12 feet x 12 feet x 10 feet) was performed using commercial software SAP2000. Nonlinear Static Pushover and Nonlinear Dynamic Time History Analysis procedures were used for Seismic Analysis. First, simple Adobe Wall Panels and then Adobe room were analyzed and the weaknesses were identified. Then, Adobe Wall Panels and Adobe room strengthened with locally available Bamboos and Palm Leaves were analyzed. Lateral displacement and shear stresses were studied under all kinds of loadings.

Before seismic and gravity load analysis, material like Adobe unit, Bamboos and Palm Leaves were obtained from Awaran area. Compressive strength, tensile strength, stress-strain curves and elastic modulus of Adobe unit and bamboos and tensile strength of Palm Leaves was determined using Universal Testing Machine of MCE. Compressive strength of Adobe prism and Adobe block is 105 psi and 42 psi, respectively. Tensile strength of Bamboos and Palm Leaves is 12886 psi and 12132 psi, respectively.

Lateral displacement of Simple Adobe Wall, Adobe Wall strengthened with Bamboos and Adobe Wall strengthened with Bamboos and Palm Leaves found from Pushover analysis is 6 in, 4.97 in and 1.2 inches, respectively. Thus, lateral displacement of Adobe Wall strengthened with Bamboos and Palm Leaves is significantly reduced as Palm Leaves provide confinement to the Adobe Wall which prevents wall from disintegration and significant energy is dissipated.

Maximum shear stress value in Simple Adobe Wall, Adobe Wall strengthened with Bamboos and Adobe Wall strengthened with Bamboos and Palm Leaves found from Time History Analysis is 71.5 psi, 31.2 in and 13 inches, respectively. Thus, shear stresses in Adobe Wall strengthened with Bamboos and Palm Leaves is significantly reduced as Palm Leaves provide confinement to the Adobe Wall which prevents wall from disintegration and significant energy is dissipated.

Keeping in view the results of adobe wall an adobe room was modeled and analyzed for shear stresses against time history analysis. There was a uniformity in distribution of shear stresses observed in reinforced adobe room. No significant concentration of shear stresses on corners of wall openings and adobe wall.

From this study, it is found that seismic performance of Adobe masonry can be significantly improved by using Bamboos and Palm Leaves which are locally available and are also cheap.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES