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A Study on Earthquake Resistant Construction in Nepal

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Abstract-Nepal has a long history of earthquake activities due to its position. Recently the devastating earthquake occurred in Nepal touched 7.9 Magnitude at the Richter scale. Almost 8,673 people lost their lives and 21,954 injured, approximately 4,89,500 buildings were completely destroyed and near about 2,62,600 were partially destroyed in Lumjung-Kathmandu-Nepal. Many roads damaged including ring road in the capital city. Also 78 people lost their lives in INDIA and at least 25 people in CHINA and many more were injured. The earthquake occurred at the hypocentre of 15 km and the epicentre was Lumjung, Kathmandu. The main cause of this earthquake was the movement of INDIAN Tectonic Plate going under the Eurasian Plate.The purpose of this research paper is how to save lives at the low cost of construction through use of horizontal bands and proper seismic knowledge and also use of principles of earthquake resistant design.
Keywords: Non-Engineered construction, Modern Architect design, Lack of behaviour of seismicity, Proper confinement and use of bands.

I. INTRODUCTION

An Earthquake (also known as a quake, tremor and temblor) is the result of a sudden release of energy in the earth's crust that creates seismic waves. Earthquakes are measured using observations from seismometers. An earthquakes point of initial rupture is called its focus or hypocentre. The epicentre is the point at ground level directly above the hypocentre.In Nepal there are three major fault lines (ICIMOD, 2007) the main central thrust (MCT) at the foot of the greater Himalaya joining the midland mountain, but the main boundary fault (BMF) at the junction of the lesser Himalaya. This faults line is the main cause of movement of Indian plates going under the Eurasian plates.The first earthquake was reported by Nepal in 1255 AD then after there were several earthquakes reported but the earthquake occurred in 1934 (Bihar-Nepal) is quite devastated for Kathmandu valley.I have written this paper for improvement of the quality of the construction as well as the cost effective solutions for constructing seismic resistant houses in developing countries like Nepal, India. I have also used the horizontal bands and proper bindings of the joints either column or beams.

Figure 1: damaged dharahara tower, kathmandu

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Figure 2: column, joints fail

Figure 3: total house collapsed

There were almost 5 lack houses were collapsed in the Lumjung-Kathmandu-Nepal on the devastating quake occurred April 25, 2015 at 11:56AM. I vested all the affected places in Kathmandu valley and collect all the data which is required to prepare this paper. I have to discuss some points regarding failure of buildings during earthquake such as unreinforced masonry buildings, soft story effects, in adequate confinement of steel in RCC structure, soil liquefaction, poor detailing of reinforcement, seismically weak sot story at the first floor, insufficient shear reinforcement.

II. REASONS WHY BUILDINGS FAILURE IN NEPAL

A. Lack Of Joints Confinement

Detailing and proper confinement is very important not only for the proper execution of the structures but for the safety of the structure as well as living lives.

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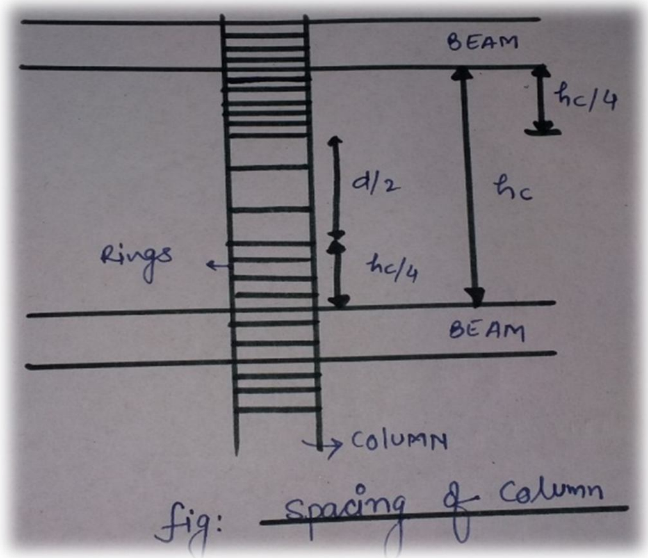

Figure 4: Shows column beam confinement

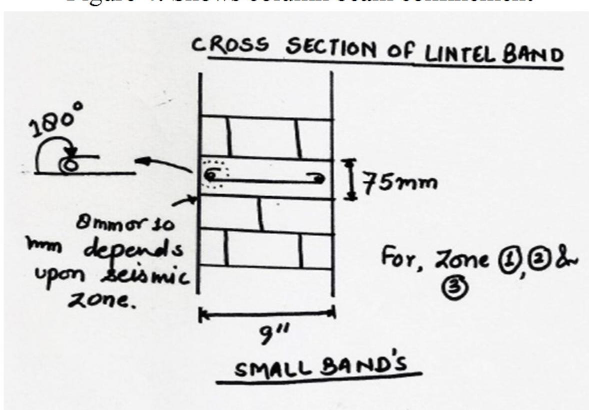

Figure 5: Cross section of lintel band for small bands

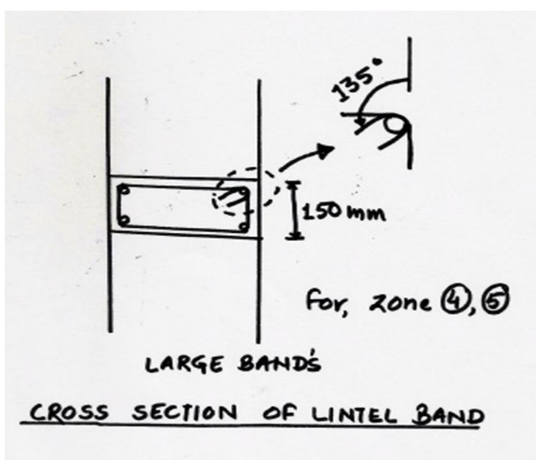

Figure 6: Cross section of Lintel bands for large bands

B. No Use Of Horizontal Bands

Horizontal bands are the most important earthquake resistant feature in masonry building. The bands are provided to hold masonry buildings as a single unit by tying all the walls together, and are similar to a closed belt provided around cardboard boxes. The lintel

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bands are the most important of all and needs to be provided in almost all buildings.

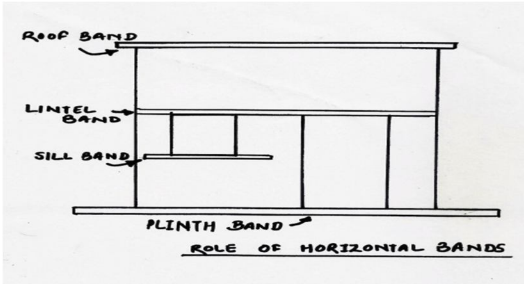

Figure 7: Bands

C. No Use Of Shear Wall

Designed to resist lateral forces and these are the excellent structural system to resist earthquake and also provided throughout the entire height of wall. It provides large strength and stiffness in the direction of orientation. This is efficient in terms of construction cost and effectiveness in minimizing earthquake damages.

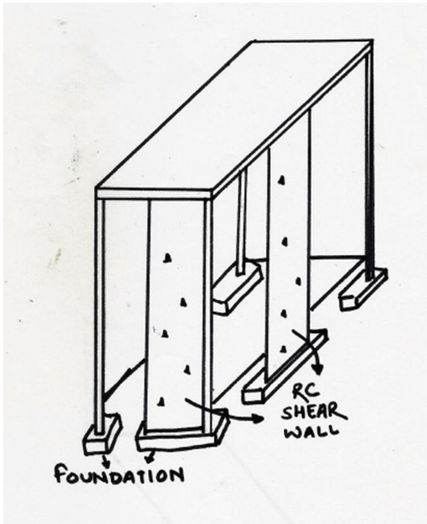

Figure 8: RC structural walls

III. NEW TECHNOLOGIES USES:

A. Bamboo House

Only developed bamboo that is a minimum of three years ancient and free from destruction will be used. It is desirable that treated bamboo will be used. The behaviour may be carried out in a out-dated manner. One of the simplest ways is to soak the bamboo in running water continuously for two to three weeks**.**

B. Timber House

Nearby available timber can be used. Treated timber is preferable to raw timber. The treatment may be done in a traditional manner. Sal wood, or any other locally available hardwood timber, shall be used in preference to softwood timber for the main structural elements such as beams, columns, bands, etc. (According to indigenous experience, deciduous trees are much less vulnerable to microbial and insect decay if felled during August to December)

C. MUD Walls

The mud used for walls will be free from living materials. It should be neither too sandy nor too clayey. The sand content shall not be more than 40 % by volume.

D. Composite house

The composite house is constructing through timber wall with its bamboo roof of the house. This is the cheapest method for constructing the structure even uneven surface or locations.

IV. EFFECTIVE ROLE OF CIVIL AND EARTHQUAKE ENGINEERS

This is not the earthquake which destroys the societies but it is the insecure buildings which is accountable for the destruction. Keeping in opinion the huge loss of being and things in modern tremors, it has become a warm issue and worldwide lot of study is successful on to understand the aims of such failures and knowledge useful lessons to ease the repetition of such destruction. If buildings are built earthquake resistant at its first place (as is being done in advanced countries like USA, Japan etc.) we will be most successfully modifying the earthquake tragedies. The professionals involved in the project and construction of such structures is civil engineers. Who are responsible for building earthquake resistant structures and keep the society at large in a safe environment.

V. GENERAL REQUIREMENTS FOR EARTHQUAKE RESISTANT CONSTRUCTION:

For India: In count to the main earthquake design code 1893 the BIS (Bureau of Indian Standards) has available other relevant earthquake design codes for quake resistant construction Masonry structures (IS-13828 1993).

For Nepal: A number of booklets for improved seismic-resistant construction have been prepared under the National Building Code Development Project (NEP/88/054/21.03) in 1993. Rules for Earthquake Resistant Building Construction: Earthen Buildings (EB) is one of them. This paper provides basic strategies for the earthquake resistance of earthen buildings in particular.

A. Proper Site Selection

The construction site has to be stable and safe enough to resist the total building load, including that of its occupants and their properties. A proper site for the buildings shall be selected in accordance with this guideline.

B. Suitable planings

The form, size and sizes of a building are important for its seismic safety according to the rules. Buildings with asymmetric plans and elevations are weaker to earthquakes than those having symmetrical ones. The recommended form and proportion of buildings will be constructed by these guidelines.

C. Proper Bonding Between Masonry Walls

The category and quality of the bond within the enclosing elements is the main contributor to the integrity and strength of the walls. All the masonry units have to be properly rested to provide the reliability.

D. Box Action

A structure performs single box action for get good results during quake. This can be achieved by joining certain elements in its construction.

1) *Vertical reinforcement.*
2) *Horizontal bans.*
3) *Transverse bracings.*
4) *Lateral Chains.*

E. Minimum openings

The masonry buildings as well as soft story structure have used lesser number of openings. According to seismic zone 4 and 5 we have to provide sill bands at the opening areas to prevent from quake effects, the size of opening should be minimum and locations of opening have to be controlled.

VI. CONCLUSION

Knowledge is obtainable to significantly lessen the earthquake related tragedies. This is confirmed by slight damage generally without any loss of lives when modest to severe earthquake strikes advanced countries (USA and JAPAN) whereas even a moderate earthquake cause’s huge desolation in developing countries as has been observed in recent earthquakes.

The government system is efficient and effective in developed countries, and it’s not the same in developing countries – so the government should ensure the application of earthquake resistant design rules. So, it is that civil, structural and earthquake engineers need a countless part to play in modifying the sufferings caused by earthquake related disasters.Towards the end, I would like to conclude my study with scope of further developments of earthquake resistant design for small houses and buildings and that too considering the economy factor.

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