

# Study on the impacts of April 2015 earthquake at Lisankhu Village, Sindhupalchok Nepal

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## 1. Introduction

Devastating earthquake hit Nepal on 25<sup>th</sup> April, 2015 taking lives of more than 8800 people. The major cause of the deaths was the collapse of the houses and other structures especially build using traditional building materials in traditional way by local masons. After the major earthquake, it has been obvious that there is a need for new earthquake resistant structure. However there are risks that locals in rural village may build the same kind of structure. So, there is a burning need to conduct research on complications on introducing new earthquake resistant structure and find out the solution for them. This research identifies the methods to introduce earthquake resistant technology in rural Lisankhu village of Sindhupalchok district in Nepal.

## 2. Method

Two different approaches are taken to identify cause of the damage of houses and other structures in the village.

First one is field survey of the houses in Lisankhu Village Development Committee. With the help of Lisankhu Great Earthquake Assistance Committee, we were able to collect the data of 1045 local houses, government building, educational institution and temples and monasteries.

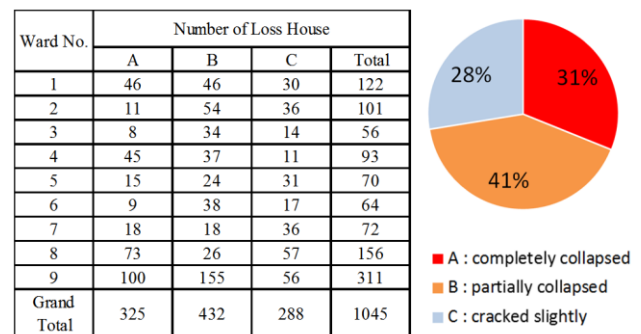
Second one is questionnaire survey and interaction with the local villagers and masons. This survey is done to find the future structural plans for building houses.

## 3. Data analysis

### 1) Field survey

The structural damage in the houses in Lisankhu village, Sindhupalchok Nepal is shown on the Fig. 1, 31% of houses

were completely damaged, 41% were partially damaged and 28% of houses were slightly cracked. All the three category of houses were unsuitable for living. Out of 1045 houses only 4 houses have reinforced concrete structural frame.



**Fig. 1** Impacts of earthquake on houses in Lisankhu village

From the field survey following structural damages was seen in the most of the cases:

- No through stone is used in the corner wall, mostly small size stones are used (Fig.2).
- No earthquake resistant features in the wall (Fig.3).
- Shaking weakens the walls causing diagonal cracks at door and windows opening (Fig. 4).
- Roof was collapsed after damage in support wall (Fig.5).



(a) Crack

(b) Collapse

**Fig. 2** Crack and collapse in corner



**Fig. 3** Collapse of middle portion of long walls.



**Fig. 4** Diagonal cracks at door and windows opening.



**Fig. 5** Roof collapse after damage in support wall

Following damages were observed during field survey:

- Almost all the houses were stone masonry cemented by mud mortar. Earthquake shake causes tension in masonry wall which are weak in tension, hence causes damage. Damages ranges from fine cracks to wider and deeper cracks and even partial and total collapse of the structure.
- Earthquake resistant features were absent in the structure. Absence of 'through' stones and 'long corner' stones in stone walls
- Quality of construction material and masonry work was not good.
- Masonry wall was not reinforced with any kind of material. It causes the wall to be brittle with weak in tension force.

## 2) Questionnaire survey and interaction with the local villagers



**Fig. 6** Questionnaire survey at Lisankhu village

Results from Questionnaire survey:

- 71% people are living in tent, 25% in steel plate house and 4% in bamboo cottage.
- 87% of the people in the village want to build houses with in 1 year, but there is lack of budget, well trained manpower, for building houses.
- If possible everyone wants to build earthquake resistant houses. So, everyone wants training for building low cost earthquake resistant houses.
- 52% wants to build 1 floor house, 48% wants to build 2 floor houses.
- All the houses were designed without considering the building codes.
- No soil survey is done before construction of building.

## 3. Conclusion

From the field survey we found absence of earthquake resistant features in most of the houses in the village. And from questionnaire survey we found that there is no adequate budget and technical skill to build earthquake resistant houses. It is very important that low cost earthquake resistant structure should be introduced and local masons should be trained to build them. Building code and soil test should be introduced and government should provide support to get engineers and architects for design and construction supervision of houses in the rural village. Similarly, retrofitting of the traditional stone masonry houses should be done in the region where the earthquake has not hit to prevent the structure from the damage during earthquake.

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