RESEARCH ARTICLE OPEN ACCESS

Increase in Earthquake Resistance of Two Storey Single Room Building by Providing Beam throughout at Lintel Level

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ABSTRACT
Nepal earthquake caused great disaster. This called for earthquake resistant structure for poor villagers who live even in single room houses. Generally these one room houses are RCC frame structures having columns at corners and beams at plinth and roof/floor levels. The structural rigidity of these RCC frame structures against lateral earthquake loads can be increased drastically by providing extra beams at lintel level throughout the structure. Both of these structures were modelled and analysed in STAAD Pro software under same loading conditions and by keeping all other factors same. The results of analysis showed that lintel level beam throughout the structure was safer by 19% than that of simple RCC frame structure.

I. INTRODUCTION

Earthquake is the most devastating natural calamity. Thousands of lives have been lost and several billions Dollar of properties have been demolished due to it. Recent earthquakes of Nepal has once again rung the alarm bell of impeding danger.Earthquake may be defined as sudden shaking of the earth crust with release of tremendous amount of energy in the form of shock waves.Sliding of tectonic plates against each other and consequent deformation in them is reason behind this energy. Buildings can be made earthquake disaster proof by suitable designing at some extra cost. Poor people in villages are deprived of this technical knowhow and neither they are financially strong enough to bear the extra cost. These people are the most vulnerable to earthquake disaster and this paper aims to find a solution for them. These people generally live in one room homes made of load bearing walls. But nowadays here is trend for RCC frame buildings. In villages these building are made by masons using thumb rules and no proper designing is done. It is proposed in this paper that the earthquake resistance of these one room buildings can be increased substantially by providing beams at lintel level throughout the structure.

II. PROPOSED STUDY

A one room two storey building is selected for study. Firstly simple RCC framed structure having plinth beam, roof/floor beam and columns is modelled. Then in second case extra beams at lintel level are provided throughout the building in both storey apart from what have been provided in the first case. The all other dimensions such as room sizes, height etc. are kept same. Even dimensions of columns and beams are kept same. The dimensions of lintel level beams in second case are taken equal to dimensions of roof/floor beams in first case. These two cases are modelled and analysed on STAAD Pro software to assess their earthquake resistance capacities.

III. SIMPLE RCC BUILDING

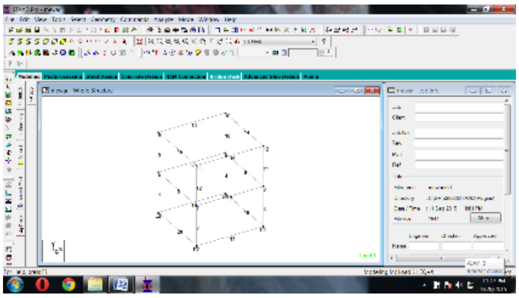

Fig.-I: Nodes

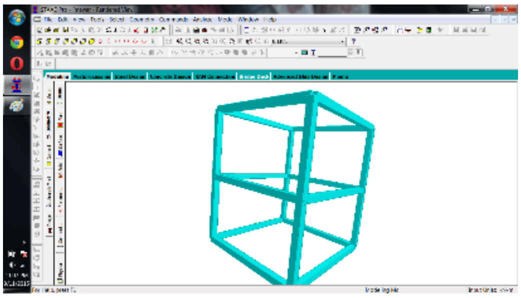

Fig.-II: Model

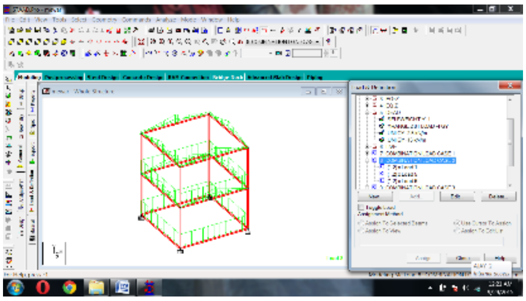

Fig.-III: Loading

Room Dimension: 5m X 5m
Beam Dimension: 250mm X 250mm
Height: 3m
Column Dimension: 250mm X 250mm

IV. HROUGHOUT BEAM AT LINTEL LEVEL BUILDING

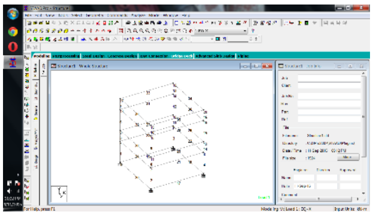

Fig.-IV: Nodes

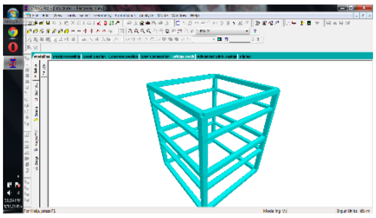

Fig.-V: Model

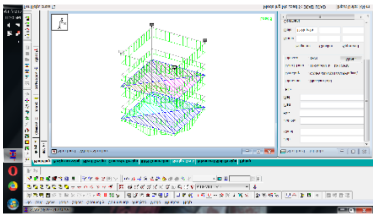

Fig.-VI: Loading

Room Dimension: 5m X 5m
Beam Dimension: 250mm X 250mm
Height: 3m
Column Dimension: 250mm X 250mm
Lintel level throughout beam Dimension: 250mm X 250mm
Lintel Level: 2m

V. LOADING

Live Load: 2 KN/M2 (IS 802)
Dead Load: 4 KN/M2
Concrete Unit Weight: 25 KN/M3Brick **Unit Weight:** 18 KN/M3
Seismic Loading (As per IS 1893):
Seismic Zone: III
Importance Factor: 1
Response Reduction Factor: 3 (OMRF)

Dead load was taken high as villagers use the roofs for storing goods. In first case whole brick wall load is taken by plinth beam and roof beam, but in second case lintel level beam takes the load of brick wall above it.

VI. ANALYSIS

Both cases were modelled and analysed on STAAD Pro software. First nodes were created as per the dimension of building. Then nodes were joined to create beams and columns. Then dimensions and material property were assigned to beam and column members. Loads were assigned as above. Second case will be having eight more nodes (four for each storey) than the first case and consequently eight more beam members. These eight beams provided extra rigidity to the structure. All other factors and variables were kept same to see the effect of only adding lintel level beams throughout the structure.

VII. RESULT

The Moments at the base of one of ground floor column for various load combinations is shown below. The percentage decrease in moments is also shown. Similar results were obtained for other column bases also.

Table-I: Comparison of End Support Moments

Cases	End Support Moments for Various Load Combinations (kNm)								
Simple RCC Frame	5.96	5.96	0.00	0.00	25.12	0.96	36.23	36.14	46.62
Linel Level Beam	5.81	5.81	0.00	0.00	19.36	0.13	29.24	30.37	37.77
% Decrease	3 %	3 %	0 %	0 %	23 %	14 %	19 %	16 %	19 %

The result is also shown in following chart where decrease in base moments are distinctly marked.

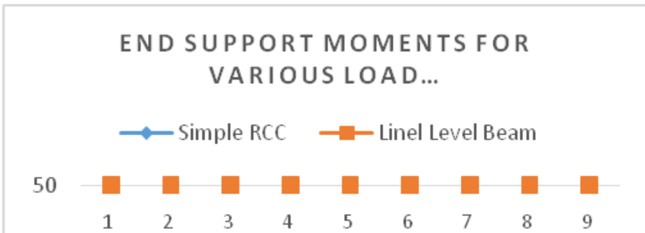

Chart-I: Comparison of End Moments

VIII. CONCLUSION

As rural houses are no designed we will concentrate on maximum moment which decreases from 46.62 kNm to 37.77 kNm, a decrease of 19%. This can be interpreted as a proportionate increase in the earthquake resistance capacity of the building. Hence, practically at the same cost we can make a building 19% safer against earthquake disaster by providing beam at lintel level throughout the structure. This result have been derived for one room two storey building, but it's encouraging results will prompt us to investigate for more complicated RCC framed structures. Lintel level beams increased the rigidity of the overall structure. These beams as acting as tie bars of columns. The lateral load generated due to earthquake is getting distributed through more points and hence the moment caused by it at the base of support is getting reduced substantially.

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