EVALUATION OF ADJACENT REINFORCED CONCRETE MULTI-STOREY BUILDING AGAINST POUNDING

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Abstract-Currently due to high cost of land many buildings are constructed up to their property line without considering the minimum separation distance of the buildings that leads collision of the building during an earthquake effect and also leads to total collapse of the buildings. Then this article mainly focused to solve this problem mainly for determining the separation distance of the adjacent buildings by considering zone IV and medium soil type. Modelling and analysis of the adjacent buildings has been done using finite element software and Indian standard code. Consequently, the result shows that the adjacent building has different modes and this leads for determining separation distance.

Key words-Pounding, adjacent units, storey displacement

I. Introduction

Earth quake may cause unexpected ground motion and shaking of the ground and this is transferred to the super structure. Building structures are often built close to each other with very less or no separation distance. This is mostly happened in highly populated areas due to high cost of land. Due to earthquake ground motions, these Buildings start vibrating out of phase and may collide with each other causing severe damage to structure, life and economy. This phenomenon is considered as pounding.

Building collision called pounding most of the time occur when there is an earth quake due to insufficient separation distance between the buildings and also due to different dynamic properties of the adjacent buildings. This is mostly happened in urban areas due to rapid development so; many buildings are constructed up to their property lines. This may lead to structural and non-structural damages of the buildings and may also cause total collapse of the building.

In the past, major earthquakes affecting large developed city areas have induced severe pounding damage. In some cases, the additional forces generated by the impact interactions have led to the collapse of structure. In the other hand, the buildings presented minor local damages, but indicating that pounding may be a series problem to the structures if a stronger earthquake take place.

The Indian Building Code Standard gives basic guidelines to prevent pounding effect of adjacent buildings during earthquake. There are many adjacent buildings, which are constructed and also still under construction with no separation distance. This is because the cost of land is very expensive in major town of India. To control this problem it is necessary to check the separation distance is sufficient or not for future earthquake. This study assessed that pounding between two adjacent buildings and is limited only to obtain the minimum required separation distance between the existing adjacent buildings considering their story displacement.

II. Structural modelling and Analysis

To evaluate the Seismic gap between adjacent buildings; it is better to model the structure in 3D with a help of engineering-software (ETABS2015).Eleven storey and eight storey adjacent buildings are selected cases for modelling and analysis located in zone IV and medium soil type. For the Seismic pounding effect between adjacent buildings, response spectrum analysis is carried out using the spectra for medium soil as per IS 1893, 2002(part one).

Figure 1: eleven storey and eight story adjacent buildings

All columns models are assumed to be fixed at the base. The height of ground floor and upper floor is 2.5 m and 3.3 m respectively for ten storey and 2.5m and 3m for seven storey in all stories considered. These buildings are separated by an expansion joint and are subjected to gravity and dynamic loading. The buildings are analysed in ETABS2015 and designed per IS 456-2000; on all the beams Wall thickness is of 230mm and grade of concrete is M-30 and M-25 for column and beam respectively for both buildings. Column and beam members are defined as 'frame elements' with the appropriate dimensions and reinforcement that is 300x300mm for beam and 500x500mm for column in eleven storeys similarly 300x450mm for beam and 300x420mm for column in eight storey. Slabs are defined as area elements having the properties of shell elements with the required thickness 150mm and 120mm for eleven storey and eight storey respectively; for lateral loads using IS 1893, 2002.

III. Results and discussions

After modelling and analysis of the adjacent buildings results of the analysis are discussed below and the following results are the first twelve modes of adjacent buildings.

Table 1: Response Spectrum Modal Information of eleven storeys

Mode	1	2	3	4	5	6	7	8	9	10	11	12
Period (sec)	1.54	1.51	1.33	0.488	0.48	0.42	0.269	0.266	0.236	0.175	0.174	0.154

Table 2: Response Spectrum Modal Information of eight storeys

Mode	1	2	3	4	5	6	7	8	9	10	11	12
Period (sec)	0.91	0.76	0.697	0.30	0.25	0.23	0.18	0.144	0.135	0.125	0.1	0.098

Based on the results of modal information the adjacent buildings (eleven storey and eight storey) have different fundamental periods due to this the adjacent buildings vibrations out-of-phase. This indicates that the calculation of the separation distance between the two buildings is necessary to evaluate using Indian standard code (IS 1893, 2002).

Table 3: Storey displacement of eleven storey and eight storey

story	Displacement for eleven storeys	Displacement for eight storeys
Story 11	23.5	
Story10	22.5	
Story9	21.2	
Story8	19.3	11.5
Story7	17	10.8
Story6	14.5	9.7
Story5	11.7	8.3
Story4	8.9	6.7
Story3	5.9	4.9
Story2	3.1	3.1
Story1	0.8	1.3
Base	0	0

IV. Conclusion

Based on the above results of story displacement the minimum required separation distance between the adjacent buildings has been calculated and summarized using Indian standard code (IS 1893, 2002) that is given by R (Response Reduction Factor) times the sum of calculated story displacement from the above (table 2) and ordinary RC moment resisting frame is considered for reduction factor in addition to this storey displacement observed increasingly high as height of building increase.

V. References

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