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Seismic Performance of Multistorey Reinforced Concrete Buildings

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ABSTRACT: The buildings are constructed mostly based on the usual standard codes considering the gravity loads consisting of the self-weight of the structure and the live load. These structures are experiencing low magnitude loads in their design life that leads only to the elastic range response, however, strong loads such as a sudden earthquake will lead the structure beyond its elastic limit. The performance of Reinforced Concrete structures will be nonlinear under seismic loads so the nonlinear behavior of reinforced buildings will be defined by the formation of plastic hinges and loss of considerable stiffness. In this case we need a method to evaluate the performance level of the structure in the plastic range, hence we used pushover analysis to evaluate the response of the structure to the lateral loads.

In present study pushover analysis is carried out on G+4, G+11 and G+21 Building situated in New Delhi (Zone IV) according to IS 1893:2002 classification of seismic zones in India. Pushover analysis was performed in SAP2000 after it was designed for gravity loads in STAAD Pro based on IS-456-2000. The pushover curve, capacity spectrum, demand spectrum and Performance point of the building was found from the results of SAP2000 and hence it was concluded that the building response is highly dependent on the materials used in the design. Mostly the failure was noticed in the columns of ground story of the buildings. After using increased amount of reinforcement in the ground story the buildings have reached life safety performance level.

KEYWORDS: STAAD Pro, IS-456-2000, SAP2000

I. INTRODUCTION

The standard building codes define the significant design requirements to ensure the safety of residents in a sudden ground shaking events. We usually witness the natural disaster effects on buildings even designed based on building codes. Considering the devastating Nepal earthquake of 25th April 2015, many buildings satisfying minimum code requirements were also affected by this devastating event. Therefore it is important to analysis the building performance before physically constructing it. The performance based design gives you the choice to check the story drift, displacement at the roof level and the capacity before the building fails for certain ground motions. The performance based design ensures the safety for the Design Basis Earthquake (DBE) and Collapse prevention for Maximum Considered Earthquake (MCE).

The performance of building means how well it satisfies the needs of its users. Acceptable performance levels of damage indicates the uninterrupted functionality of the buildings structural elements as well as non-structural elements. The safety of non-structural elements can be ensured through performance based design with increase in cost of the construction. Consequently, performance-based design is the procedure or approach used by design specialists to construct buildings that possess functionality and the continued availability of services.

The performance based design methodology is not going to be the immediate substitute for design to the traditional code methods. Rather, it can be viewed as an opportunity to enhance and adapt the design to match the objectives. It will only help in enhancing the design criteria in determining the deformation based response.

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II. RELATED WORK



Figure 1.1: Flow Diagram showing Performance Based Design

II. EXPERIMENTAL RESULTS

The pushover curve is the plot of base shear vs displacement it shows the capacity of the building it should be noted that the design base shear which is calculated using the procedure given in the IS 1893 should always be less than that obtained in the pushover curve. Basically the pushover curve is the capacity curve which shows the capacity of the building that how much load the structure can take before it reaches the failure mechanism. In terms of performances there are various levels of performances, it should be chosen based on the economic conditions and the sensitivity of the structure. The higher the performance the higher will be the cost of the construction.

III. CONCLUSION

The Pushover analysis of G+4 RC Building. The following figure shows the Pushover curve base shear vs lateral displacement. The unit for Base Reaction is KN and Displacement is meter. The maximum node displacement is equal to 0.230m. The Pushover Curve shows that the building has objectively high Base Shear Capacity than the Design Base Shear. The Design base shear (VB) was found to be 1742 in chapter 3 and the capacity is 2900KN which is much higher, hence the building is safe for this level of earthquake.

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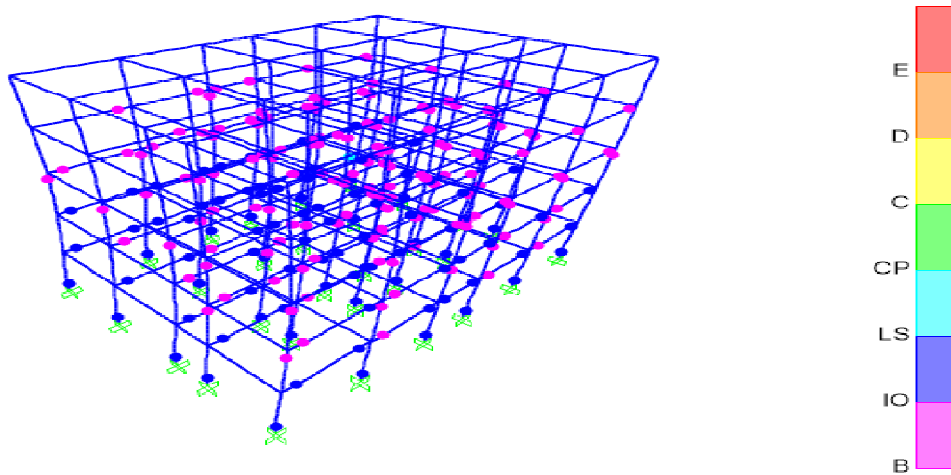
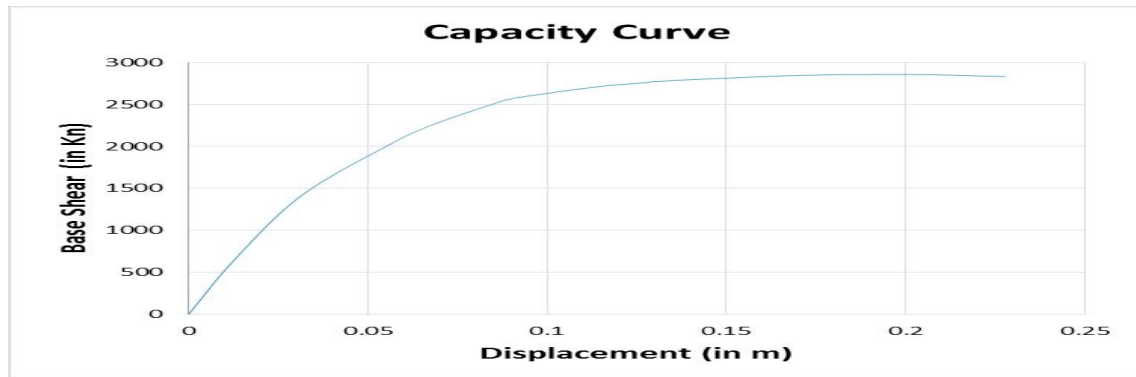


Fig 1.2 showing formation of hinges in 3D form

IV. CONCLUSION FROM PERFORMANCE POINT OF G+4

Base shear(KN)	2679.179	Roof displacement (m)	0.108
Spectral Acceleration, Sa (m/s)	0.488	Spectral displacement, Sd (m)	0.082
Effective time period, Teff (s)	0.823	Effective damping, β_{eff}	0.189

After studying all the curves and tables we came to the following conclusion that the Pushover Analysis result shows that the Building was able to achieve the performance point within its elastic range. Further we can conclude that:

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Pushover analysis the simplest way to get the response of existing or new structures. Considering three different RC building it was concluded if the buildings are designed with proper sections and reinforcement details as per standard codes will perform better under seismic forces. The performance of the pushover analysis mostly depends on the material used in the structure.

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