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Comparision of Base Shear Capacity of RC Frame By IDA And SPA

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Abstract - *Structures subjected to force like earthquake must be resisted by structure as they are dynamic in nature. It causes unsafe condition. Performance based analysis of structure is required. This can be achieved by incremental dynamic analysis (IDA) which can be done by SAP (static pushover analysis) but in Incremental Dynamic analysis is more accurate. Incremental dynamic analysis involves different intensity of ground motion which is selected for complete collapse. In present work increment dynamic analysis of reinforced concrete G+ 7 and G+ 11 building is carried out buildings susceptible is check, inter story drift ratio from IS 1893 : 2002 is checked. Basic base shear capacity of G+ 7 and G+ 11 are calculated base shear curve of top displacement is compared with SPA (static pushover analysis).pushover analysis is of two types Force control and displacement control. Force control in which lateral loads are applied in small increment. Distance by which structure is proportional to horizontal translation.This paper deals with the Incremental Dynamic analysis of G+7 and G+11 building.*

Key Words*: *IDA; SAP; Earthquake analysis

1. INTRODUCTION

In this chapter, building capacity is found out by using both incremental dynamic analysis and static pushover analysis. Graph of base shear to top displacement from incremental dynamic analysis is compared with that of static pushover analysis. Capacity base shear from both the methods are compared for G+7 and G+11 building.

1.1 Methodology

We have applied number of time histories to the structure and their acceleration data points are scaled from zero up to up to collapse of the structure. For every scaling factor of every time history data, base shear and top displacement are found out and graph of base shear to top displacement is plotted for earthquake in X and Y direction. From the IDA curve, we have calculated the yield and collapse stages of the structure with respect to peak ground acceleration. Base shear at yield acceleration will be base shear at yielding stage of the structure and base shear at collapse acceleration will be a base shear at collapse stage of the structure. Then the base shear to top displacement graph for every time history is combined into one generalized graph for both the direction. In this way, final collapse base shear of the structure by incremental dynamic analysis is found out.

1.2. Incremental Dynamic Analysis of G+7 Building

Above procedure is followed to find out the collapse base shear of G+7 building by using incremental dynamic analysis. Table 1 shows the yield and collapse base shear of G+7 building from incremental dynamic analysis

It is observed that yield and collapse base shear both are more than designed base shear which indicates that building can retain more shear force than the shear for which building was actually designed for. Figure 6.1 shows the base shear response of the building for various time histories.

.**Table : 1** Yield and collapse base shear G+7 Building

Time History	**Station**	**Yield Base Shear (kN) X direction**	**Collapse Base Shear (kN) X direction**	**Yield Base Shear (kN) Y direction**	**Collapse Base Shear (kN) Y direction**
2001 Bhuj	Bhuj L	1400	1990	1450	2100
1991Uttarkashi	UttarkashiT	1370	1920	1410	2080
1967 Koyna	Koyna L	1500	2190	1575	2210
1991Uttarkashi	BhatwariT	1450	1880	1480	1930
1967 Koyna	KoynaT	1380	1890	1400	1930
1986Dharmshala	DharmshalL	1510	1920	1575	1980
1986Dharmshala	DharmshalaT	1280	1820	1350	1870
1995 Chamba	ChambaL	1345	1830	1360	1900
1995 Chamba	ChambaT	1330	1850	1390	1880
Median		1375	1885	1405	1950
Base Shear (IS:1893)		850		880	

2. Building Plan

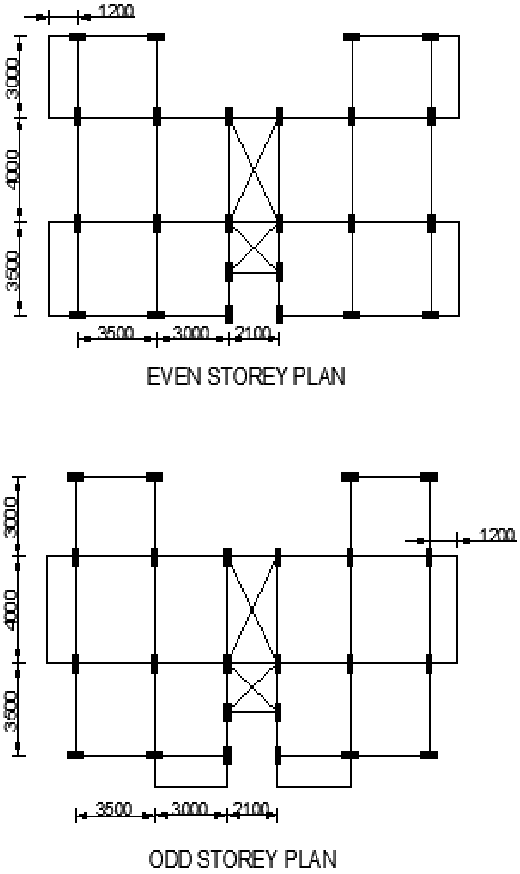

Fig1: Plan of building G+7

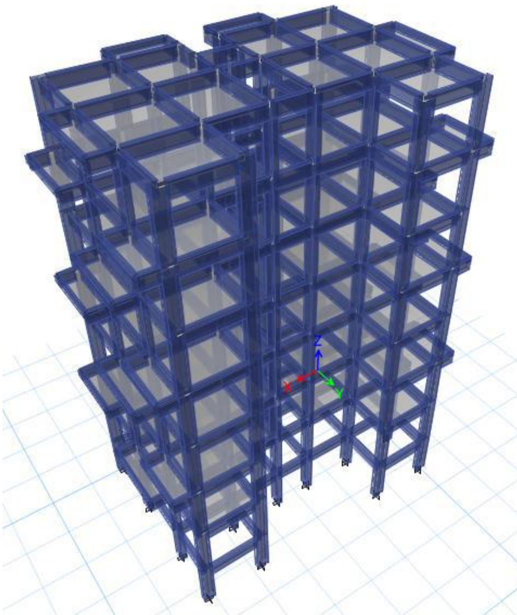

Fig2 ETABS model

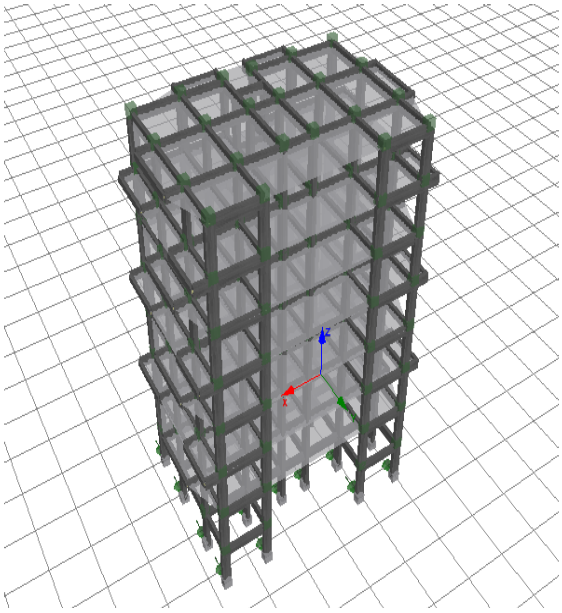

Fig 3: SeismoStruct model of G+7 Building

2. Incremental Dynamic Analysis of G+11 building

To calculate the base shear capacity of G+11 building, same procedure is followed as that for G+7 building. Table 2 shows the yield and collapse base shear of G+11 building.

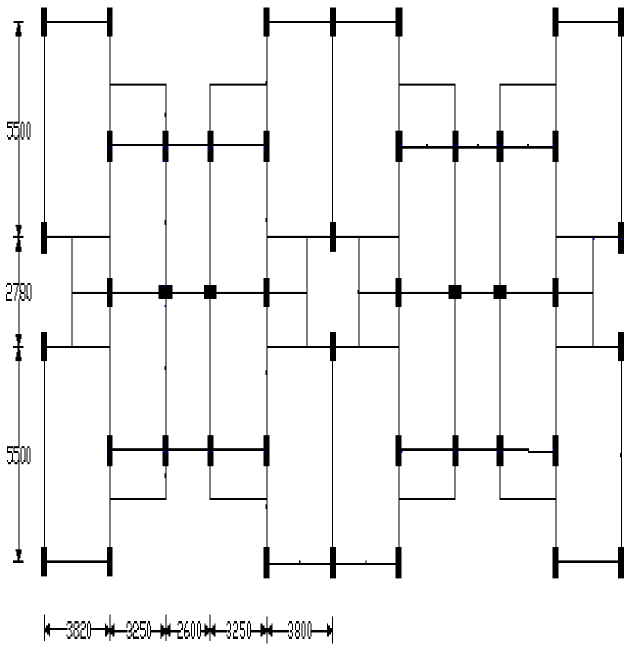

Fig 4: Plan of G+11 building

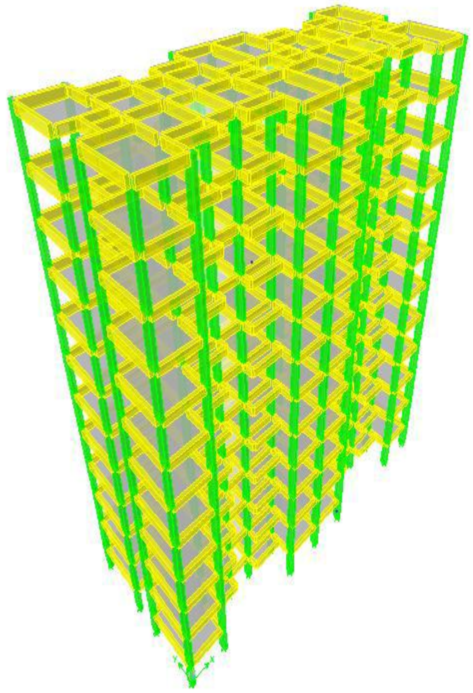

Fig5: ETABS model of G+11 building

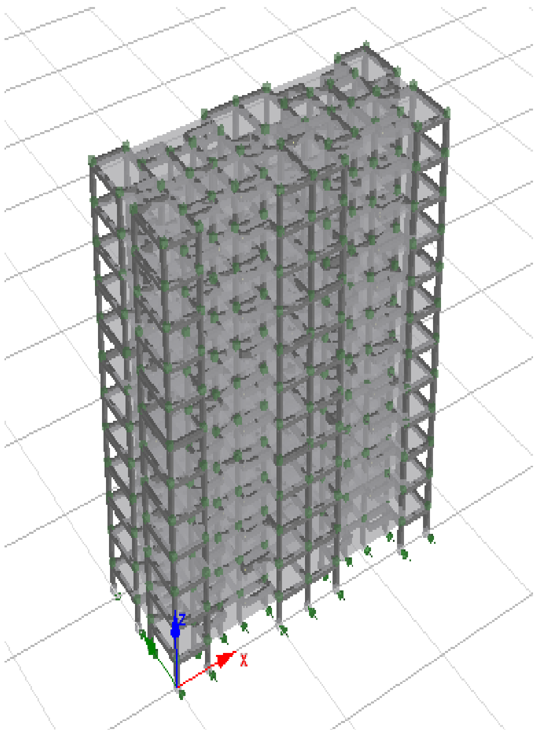

Fig 6: SeismoStruct Model of the building of G+11 building

Table: 2 Yield and collapse base shear of G+11 building

Time History	Station	Yield Base Shear (kN) X direction	Collapse Base Shear (kN) X direction	Yield Base Shear (kN) Y direction	Collapse Base Shear (kN) Y direction
1995 Chamba	ChambaL	4178	4750	3744	4492
1995 Chamba	ChambaT	3868	4870	3600	4450
1986 Dharmshala	DharmshalaL	3992	4912	3234	4059
1986 Dharmshala	DharmshalaT	4125	5031	3310	4300
1995 India-Burma border	KatakhalL	4150	4600	3656	4100
1995 India-Burma border	KatakhalT	4010	4950	3510	4145
1991 Uttarkashi	BhatwariT	4135	4987	3467	4400
1967 Koyna	KoynaL	3956	5056	3765	4612
1967 Koyna	KoynaT	4100	5145	3489	4687
Median		4100	4950	3510	4400
Base Shear (IS:1893)		2100		1770	

3. Static Pushover Methodology

ATC 40, FEMA 273, FEMA 356 and FEMA 440 have described the pushover analysis procedure, modeling of different components and acceptable limits. Two methods, namely Capacity Spectrum method and Displacement Coefficient method are introduced in FEMA 440. The pushover analysis procedure considers only first mode shape of the equivalent single degree of freedom system. This is the limitation of this method. Still it is a very efficient analysis procedure because it gives insight of the nonlinear behavior of the structure. A key requirement of any meaningful performance based analysis is the ability to assess seismic demands and capacities with a reasonable degree of certainty.

Capacity: The overall capacity of a structure depends on the strength and deformation capacity of the individual components of the structure. In order to determine the capacities beyond elastic limits, some form of nonlinear analysis, such as the pushover procedure, is required. This procedure uses a series of sequential elastic analysis, superimposed to approximate a force displacement capacity diagram of the overall structure. A lateral force distribution is again applied until additional components yield. This process is continued until the structure becomes unstable or until a predetermined limit is reached.

Demand: Ground motion during an earthquake produces complex horizontal displacement patterns in the structures. It is impractical to trace this lateral displacement at each time-step to determine the structural design parameters. The traditional design methods use equivalent lateral forces to represent the design condition. For nonlinear methods it is easier and more direct to use a set of lateral displacements as the design condition. For a given structure and ground motion, the displacement demand is an estimate of the maximum expected response of the building during the ground motion. Once, a capacity curve and demand displacement, are defined, a performance check can be done.

4. Comparison between Incremental Dynamic Analysis (IDA) and Static Pushover Analysis (SPA).

Base shear capacity from incremental dynamic analysis is compared with that of static pushover analysis of both the G+7 and G+11 building.

Table 3: Collapse base shear capacity (kN)

Building	Collapse base shear (kN) X direction			Collapse base shear (kN) Y direction		
	IDA	SPA	Base Shear (IS: 1893)	IDA	SPA	Base Shear (IS: 1893)
G+7	1885	2200	850	1950	2300	880
G+11	4950	5640	2100	4400	5200	1770

Building base shear capacity by both the methods is more than base shear for which the building was actually designed as per the load combinations given in IS 1893: 2000.Base shear capacity by IDA method is observed to be lesser than that of SPA method.

5. Future Scope

In this work, different earthquakes are applied to building, earthquake data is incremented and response of building is plotted at each time. Yielding and collapse stages of the building are plotted with respect to peak ground acceleration of the considered earthquake.For the building location considering zone of earthquake, time histories should be selected and response spectrum curve should be plotted for each time history. Now, this curve can be incremented and response can be studied. Yielding and collapse stages to be plotted will be with respect to spectral acceleration. Demand curve and capacity curve can be plotted and performance point can be identified for various time histories by incremental dynamic analysis. Same curve can be plotted by static pushover analysis and compared with that of IDA. In this way, building capacity can be found out using both the methods

Conclusion

Static pushover analysis gives higher values of base shear than from incremental dynamic analysis. Incremental dynamic analysis is tedious and very much time consuming, if the structure is of much importance and high accuracy is needed, then only incremental dynamic analysis is preferred.

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