# INCREMENTAL DYNAMIC ANALYSIS OF RC FRAMES

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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

IDA (I*ncremental Dynamic Analysis)* is powerful mean to study the overall behaviour of structural earthquake of different intensity are applied on the model till the collapse. When slope of incremental dynamic analysis changes from linear to nonlinear yield is reached when incremental dynamic analysis curve become flat or slope less than 20% then we can say yield is reached. To start with incremental dynamic analysis earthquake applied from low intensity to high intensity. Structure collapse at very high intensity measure. Nonlinear dynamic analysis means combining ground motion records with the model. Static pushover analysis is the procedure in which loading increases in lateral direction with predefined failure pattern response from the structure in IDA(I*ncremental Dynamic Analysis)* is actually response due to earthquake on the

### 1.1 Methodology

Decide steel and concrete properties structural column components such as beam, column their size is selected. model is prepared with seismostruct. Column are considered fixed, degree of freedom is fixed because column is considered as fixed. Earthquake is selected as input as intensity will vary depending upon zoning. Select response like inters tory drift ratio, base shear. Select ground motion as per zone. Generate incremental dynamic analysis curve for G+7 and G+11 building. Software used are Seismostruct and ETAB. Seismo Struct version 7.0.3 is used to carry out incremental dynamic analysis. Based on finite element and capable of predicting large displacement, behaviour of space frame due to static and dynamic loading.

### 1.2 . Incremental Dynamic Analysis of G+7 Building

Floor Height = 3.5 m
Column Dimension = (230 x650) mm
Beam Dimension = (230 x 550) mm
Building Location = Zone IV
Boundary Condition = fixed on ground
Material properties = M25, Fe415

G+7 building is designed in ETABS and parameters such as inter storey drift ratio, floor acceleration, and base shear are found out. For the building frame, seismic coefficient and response spectrum analysis is carried out along with dead load and live load combinations. Dead load and live load is applied as per IS 875. Load combinations given in IS 1893-2000 are considered for the design of building. Incremental dynamic analysis is carried out in Seismo Struct for the designed reinforcement

**Table1 :** Column and beam dimensions and reinforcement

| Member | Size (mm) | Steel |
|---|---|---|
| Column | 230 x 650 | 4#20 + 2#16 |
| Beam | 230 x 550 | 2#20 at top<br>2#20 at bottom |

## 2. Building Plan

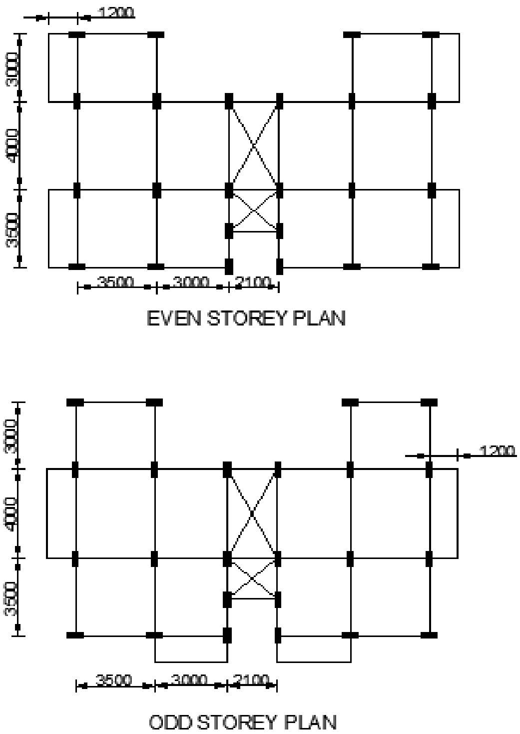


**Fig1:** Odd Storey and Even Storey

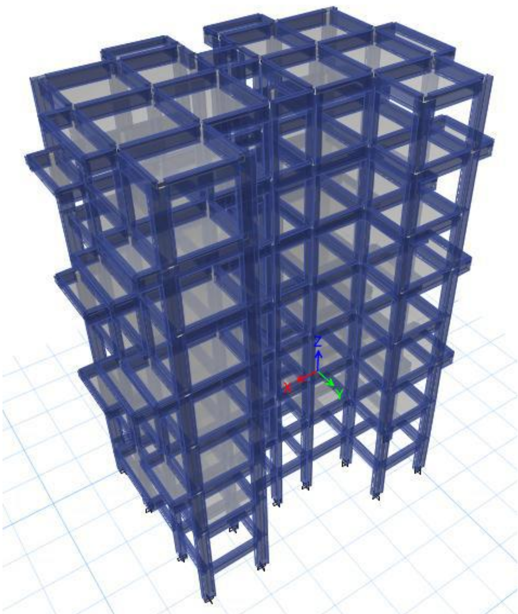

**Fig2 :** ETABS model

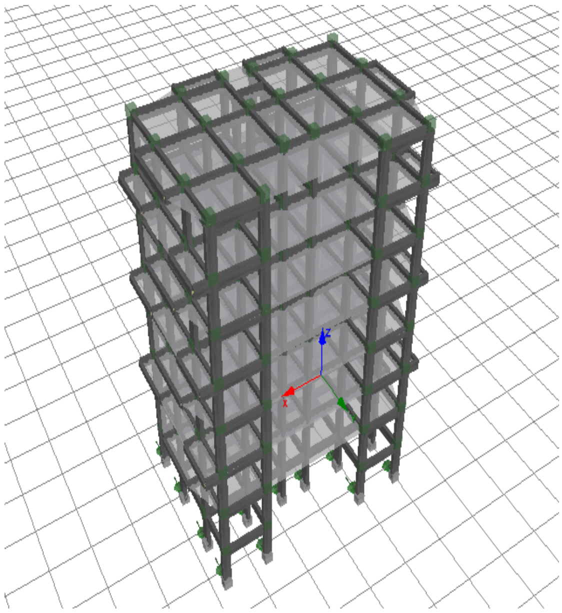

**Figure 3:** SeismoStruct model of G+7 Building

### 2.1 Incremental Dynamic Analysis of G+11 Building

Floor Height = 3.5 m
Column Dimension = (230 x650) mm
Beam Dimension = (230 x 550) mm
Slab thickness = 150 mm
Building Location = Zone IV
Boundary Condition = fixed on ground
Material properties = M25, Fe415

**Table2 :** Column and beam dimensions and reinforcement

| Member | Size(mm) | Steel |
|---|---|---|
| Column (base to storey6) | 300 x 800 | 14#20 |
| Column(storey7 to store12) | 300 x 800 | 10#20 |
| Beam | 300 x 650 | 3#20 at top 3#20 at bottom |

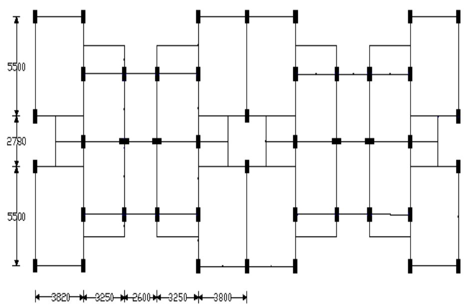

**Fig 4:** Plan of G+11 building

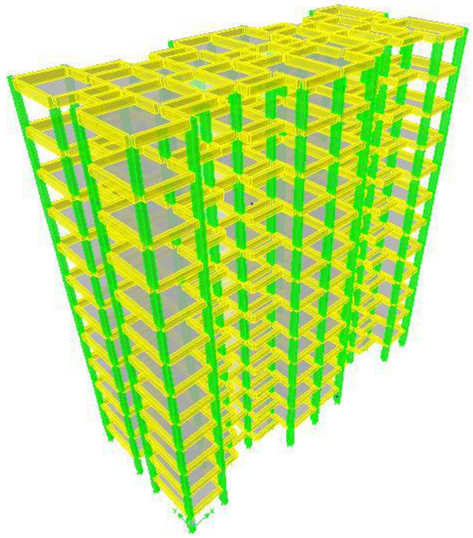

**Fig5:** ETABS model of building G+11

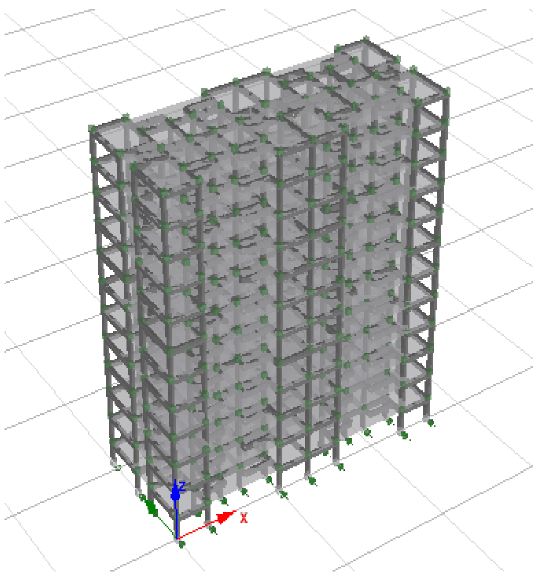

**Fig 6:** SeismoStruct model Model of the building G+11

**Table 3:**Yield and collapse peak ground acceleration of G+7 building

| Time History | Station | PGA (g) | Yield PGA(g) X direction | Collapse PGA(g) X direction | Yield PGA(g) Y direction | Collapse PGA(g) Y direction |
|---|---|---|---|---|---|---|
| 2001 Bhuj | Bhuj L | 0.11 | 0.32 | 0.42 | 0.29 | 0.38 |
| 1991 Uttarkashi | Uttarkashi T | 0.26 | 0.29 | 0.37 | 0.30 | 0.40 |
| 1967 Koyna | Koyna L | 0.34 | **0.18** | **0.26** | **0.19** | **0.28** |
| 1991 Uttarkashi | Bhatwari T | 0.25 | 0.29 | 0.38 | 0.30 | 0.40 |
| 1967 Koyna | Koyna T | 0.40 | **0.21** | **0.30** | **0.24** | **0.34** |
| 1986 Dharmshala | Dharmshal L | 0.17 | 0.38 | 0.44 | 0.40 | 0.45 |
| 1986 Dharmshala | Dharmshala T | 0.18 | 0.30 | 0.37 | 0.27 | 0.37 |
| 1995 Chamba | Chamba L | 0.14 | 0.27 | 0.36 | 0.29 | 0.39 |
| 1995 Chamba | Chamba T | 0.12 | 0.27 | 0.40 | 0.27 | 0.38 |
| **Median** | | | 0.29 | 0.37 | 0.29 | 0.38 |

G+7 building yields at the peak ground acceleration of 0.29g in both X and Y direction. Building collapse occurs at peak ground acceleration of 0.37g in X direction and 0.38g in Y direction. So, we can find out the building susceptibility for any other time history. If any time history has PGA less than 0.29g, we can say that building can sustain that earthquake otherwise building fails to sustain that earthquake and column dimensions need to be revised.

**Table 4:**Yield and collapse peak ground acceleration of G+11 building

| Time History | Station | PGA (g) | Yield PGA(g) X direction | Collapse PGA(g) X direction | Yield PGA(g) Y direction | Collapse PGA(g) Y direction |
|---|---|---|---|---|---|---|
| 1995Chamba | Chamba L | 0.14 | 0.65 | 0.77 | 0.55 | 0.70 |
| 1995Chamba | Chamba T | 0.12 | 0.64 | 0.76 | 0.54 | 0.72 |
| 1986Dharmshala | Dharmshala L | 0.17 | 0.63 | 0.79 | 0.52 | 0.74 |
| 1986Dharmshala | Dharmshala T | 0.18 | 0.61 | 0.74 | 0.53 | 0.69 |
| India-1995Burma border | Katakhal L | 0.14 | 0.61 | 0.72 | 0.56 | 0.68 |

| | | | | | | |
|---|---|---|---|---|---|---|
| India-1995Burma border | Katakhal T | 0.16 | 0.63 | 0.75 | 0.58 | 0.70 |
| 1991Uttarkashi | Bhatwari T | 0.25 | 0.59 | 0.65 | 0.51 | 0.62 |
| 1967Koyna | Koyna L | 0.34 | 0.56 | 0.73 | 0.52 | 0.71 |
| 1967Koyna | Koyna T | 0.40 | 0.54 | 0.65 | 0.51 | 0.60 |
| **Median** | | | 0.61 | 0.74 | 0.53 | 0.70 |

## 3. Conclusion

G+7 building yields at the peak ground acceleration of 0.29g in both X and Y direction. Building collapse occurs at peak ground acceleration of 0.37g in X direction and 0.38g in Y direction. So, we can find out the building susceptibility for any other time history. If any time history has PGA less than 0.29g, we can say that building can sustain that earthquake otherwise building fails to sustain that earthquake and column dimensions need to be revised.
G+11 building yields at peak ground acceleration of 0.61g in X direction and 0.58g in Y direction. Building collapse occurs at 0.73g in X direction and 0.71g in Y direction.So, any time history having peak ground acceleration lower than 0.53g, we can say that building can sustain that earthquake.

## 4. Acknowledgement

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