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Determination of Cumulative Dynamics of RC Frame Structure

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***Abstract*: Forced structures such as earthquakes must be opposed to the structure as they are powerful in nature. It creates an unsafe situation. Performance analysis is required. This can be achieved by increasing dynamic analysis (IDA) which can be done via SAP (static pushover analysis) but in Digital Dynamic analysis it is more accurate. Powerful engagement analysis includes the strength of the ground movement selected for complete collapse. In the current analysis of the dynamic performance of the certified concrete G + 7 and G + 11 made the properties affected by the check, the inter story drift ratio from IS 1893: 2002 is examined. The core shear strengths of G + 7 and G + 11 are calculated from the shear curve for high migration compared to SPA (static pushover analysis). Manage enforcement where side loads are used with a small increase. The distance at which the structure is equal to the horizontal translation. This paper deals with Digital Dynamic analysis of the G + 7 and G + 11 structures.**

***Keywords*: Cumulative dynamics, Earthquake engineering.**

1. Introduction

IDA (Incremental Dynamic Analysis) is powerful mean to study the overall behavior 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 (Incremental Dynamic Analysis) is actually response due to earthquake on it.

2. Objectives

1) To carry out the incremental dynamic analysis of existing RC building.
2) To calculate probability of yielding and probability of collapse with respect to peak ground acceleration.
3) To decide whether the building can withstand the particular considered earthquake or not.
4) To study the building serviceability to the considered earthquake.
5) To compare the response of the structure from incremental dynamic analysis with that of static pushover analysis.

3. Literature Review

D. Vamvatsikos and C. Cornell (2002), The Incremental Dynamic Analysis and its Application to Performance-Based Earthquake Engineering.

- Twenty different earthquakes are applied to the structure to carry out IDA.
- Application of Incremental Dynamic Analysis to Performance-Based Earthquake Engineering (PBEE) is studied and limit states such as immediate occupancy, collapse prevention are defined.

Nicolas Luco and C. Allin Cornell, M. EERI, Structure-Specific Scalar Intensity Measures for Near-Source and Ordinary Earthquake Ground Motions Earthquake Spectra in April, 2001.

- LA20 building model, for example, the third mode of (elastic) response can be taken into account in addition to the first and second modes.
- Moreover, the inelastic spectral displacement considered for the first-mode can be computed for a trilinear oscillator (i.e., EPP followed by a negative stiffness) or even a bilinear oscillator with negative post-yield stiffness.
- Yet another possibility is to adjust the (elastic) modal participation factors that are used so as to reflect the effects of P-Δ or a soft odd story

Ronald O. Hamburger, Chair, John D. Hooper, Thomas Sabol, Structural Engineers Association of California (SEAOC) Applied Technology Council (ATC) California Universities for Research in Earthquake Engineering (CUREe) Prepared for SAC Joint Venture Partnership by Guidelines.

- An historic perspective of the development of steel moment-frame design and construction practice in the United States. It also includes discussion of the performance of welded steel moment-frame construction in recent earthquakes and the causes for much of the damage observed in this construction.
- Modification of individual moment-resisting connections to reduce their susceptibility to ground-shaking-induced brittle fracture.

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M. Maniyar, R. Khare (2009), Incremental Dynamic Analysis of 3 Storey RCC Building.

- Performed IDA of three storey RCC frame using 14-time history data by using IDARC program.
- In the performance IDA curve are plotted and probabilistic analysis of the building is carried out for varying steel percentage in column and beams.

Mander J., Dhakal R., Mashiko N. and Solberg K. (2007), Dynamic analysis applied to seismic financial risk assessment

- Dynamic analysis performance-based earthquake engineering context to investigate expected structural response, damage outcomes, and financial loss from highway bridges.
- This quantitative risk analysis procedure consists of adopting a suitable suite of ground motions and performing IDA on a nonlinear model of the prototype structure; summarizing and parameterizing the IDA results into various percentile performance bounds; and integrating the results with respect to hazard intensity–recurrence relations into a probabilistic risk format
- An illustrative example of the procedure is given for reinforced concrete highway bridge piers, designed to New Zealand, Japan and Caltrans specifications.

4. Methodology

Determine steel and concrete structures of column elements such as beam; column size is preferred. The model is adjusted by the creation of the earth. The column is considered fixed; the level of freedom is adjusted because the column is considered adjusted. Earthquakes are selected as inputs as the size will vary depending on the design. Choose feedback such as interstory drift ratio, basic shear. Select ground movement as per location. Generate a flexible analysis curve of the G + 7 and G + 11 architecture. The software used is Seismostruct and ETAB. Seismo Struct version 7.0.3 is used to perform a powerful dynamic analysis. Based on a finished and predictable object migration, the performance of the space framework is due to the constant and dynamic loading.

A. Determination of cumulative dynamic of G+7 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

The G + 7 structure is built on ETABS with parameters such as inter storey drift ratio, ground acceleration, and base shear available. Construction framework, analysis of coefficient measurement and response spectrum is performed with dead load and a combination of live loads. The dead load and the living load are used in accordance with IS 875. The consolidation of loads given in IS 1893: 2000 is for the construction of the building. Strong ascending analysis was performed on the Seismo Struct for the designed reinforcement.

Table 1
Column and beam dimensions and reinforcement

Member	Size (mm)	Steel
Column	230 x 650	4#20 + 2#16
Beam	230 x 550	3#20 at top 3#20 at bottom

1) Building plan

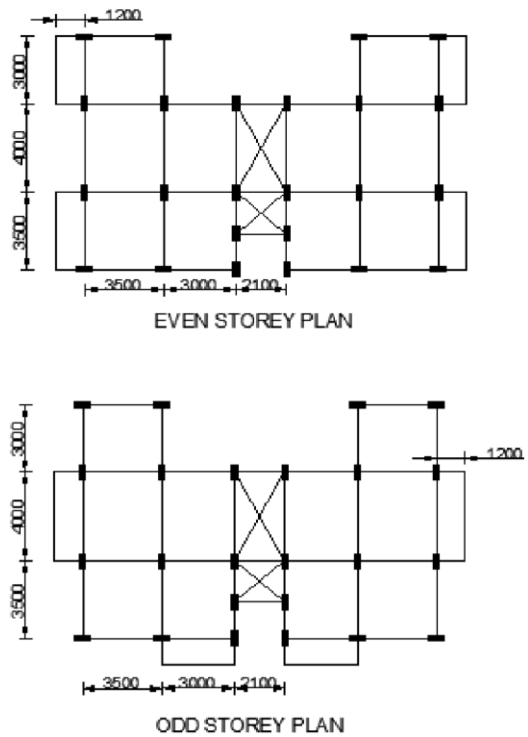

Fig. 1. Odd Storey and Even Storey

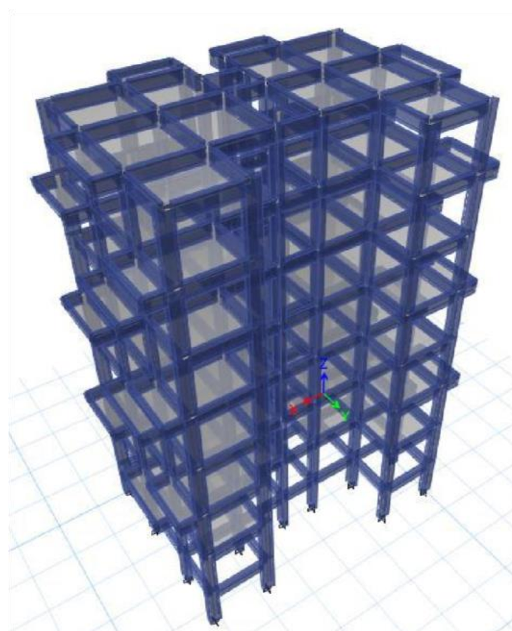

Fig. 2. ETABS model

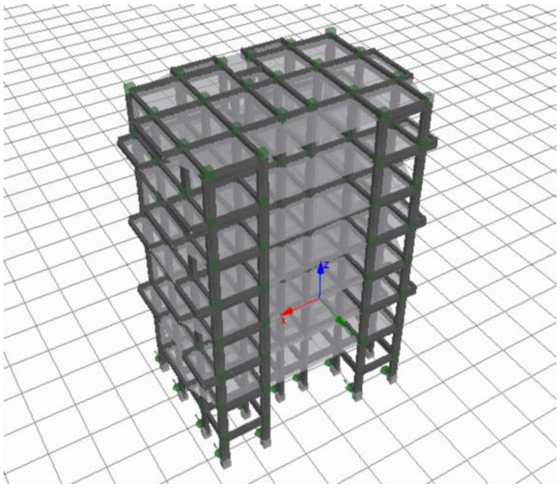

Fig. 3. Seismo Struct model of G+7 Building

B. Determination of cumulative dynamic 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

Table 2
Column and beam dimensions and reinforcement

Member	Size(mm)	Steel
Column (base to storey 6)	300 x 800	14#20
Column (storey 7 to store 12)	300 x 800	10#20
Beam	300 x 650	3#12 at top 3#20+2#16 at bottom

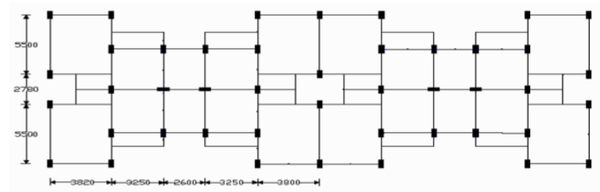

Fig. 4. Plan of G+11 building

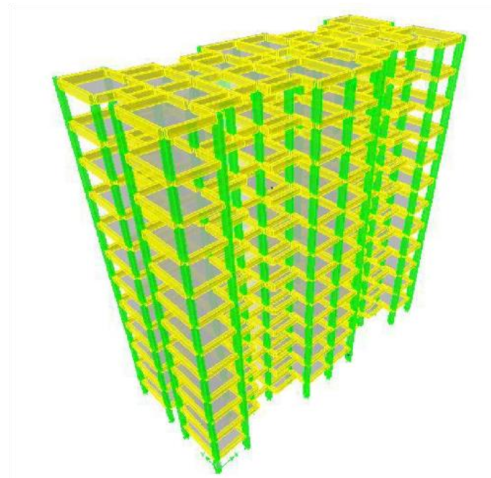

Fig. 5. ETABS model of building G+11

G+7 building yields at the peak ground acceleration of 0.29g in both X and Y direction. A building collapse occurs at a ground speed of 0.37g in the X direction and 0.38g in the Y direction. Therefore, we can find the tendency of the building in any other time history. If at any time the history has a PGA below 0.29g, we can say that the building can support that earthquake otherwise the construction fails to support that earthquake and the size of the column needs to be updated.

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

Time History	Station	PGA (g)	Yield PGA(g) X direction on	Collapse PGA(g) X direction on	Yield PGA(g) Y direction on	Collapse PGA(g) Y direction on
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

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
1995 Chamba	Chamba L	0.14	0.65	0.77	0.55	0.70
1995 Chamba	Chamba T	0.12	0.64	0.76	0.54	0.72
1986 Dharmshala	Dharmshala L	0.17	0.63	0.79	0.52	0.74
1986 Dharmshala	Dharmshala T	0.18	0.61	0.74	0.53	0.69
India1995 Burma border	Katakhal L	0.14	0.61	0.72	0.56	0.68
India1995 Burma border	Katakhal T	0.16	0.63	0.75	0.58	0.70
1991 Uttarkashi	Bhatwari T	0.25	0.59	0.65	0.51	0.62
1967 Koyna	Koyna L	0.34	0.56	0.73	0.52	0.71
1967 Koyna	Koyna T	0.40	0.54	0.65	0.51	0.60
Median			0.61	0.74	0.53	0.70

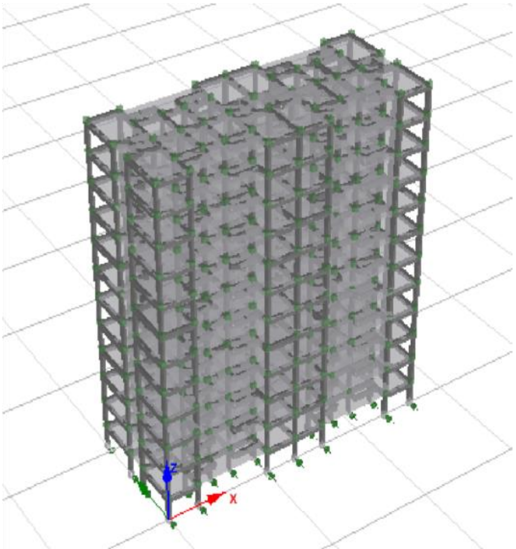

Fig. 6. Seismo Struct model of the building G+11

5. Conclusion

G+7 building yields at the peak ground acceleration of 0.29g in both X and Y direction. A building collapse occurs at a ground speed of 0.37g in the X direction and 0.38g in the Y direction. Therefore, we can find the tendency of the building in any other time history. If at any time the history has a PGA below 0.29g, we can say that the building can support that earthquake otherwise the construction fails to support that earthquake and the size of the column needs to be updated. G + 11 building blocks at a high ground height of 0.61g in the X direction and 0.58g in the Y direction. The collapse of the structure occurred at 0.73g in the X direction and 0.71g in the Y direction. Therefore, in any case when the ground speed is less than 0.53g, we can say that construction can support that earthquake.

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