Push Over Analysis of High Rise L-Shaped RC Building in the Seisic Zones of II and IV

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Abstract: ***The utilization of nonlinear static examination weakling investigation came into training in 1970's nevertheless the capability of sucker examination has been perceived for last 10 to 15 years. This system is for the most part used to evaluate the quality and float limit of existing structure and the seismic interest for this structure exposed to chosen quake. Push over is a static nonlinear examination strategy where a structure is exposed to gravity stacking and a monotonic relocation controlled sidelong burden design which constantly increments through flexible and inelastic conduct until an extreme condition is come to. Sidelong burden ay speaks to the scope of base shear actuated by quake stacking, and its design might be corresponding to the circulation of mass along structure stature, tribute shapes, or another useful method. Push over investigation causes us see how a structure carries on after some harm on auxiliary part would happen, all together for the planner to utilize the conduct of the structure when it would get some harm yet it would stay away from complete breakdown. In this present investigation the examination is completed according to Indian standard codes IS 456:2000 utilized for solid plan, IS 875:1987 (section 3) utilized for wind examination and IS 1893-2002 utilized for the seismic tremor examination. The principle goal of the present examination is to think about the presentation of a L-formed tall structure in the quake zones of II and IV. The exhibition dimension of the structure in seismic zone-II is better contrasted with the presentation of the structure in seismic zone-IV.***

Keywords: push over analysis, base shear, story shear, story drift, performance point, capacity curve E-tabs

1. Introduction

The static weakling investigation is turning into a well-known instrument for seismic execution assessment of existing and new structures. The desire is that the weakling investigation will give satisfactory data on seismic requests forced by the plan ground movement on the basic framework and its segments. The reason for the paper is to condense the fundamental ideas on which the sucker examination can be based, evaluate the exactness of weakling forecasts, recognize conditions under which the weakling will give satisfactory data and, maybe more significantly, distinguish cases in which the weakling expectations will be lacking or notwithstanding deceptive. The current structure can turn out to be seismically lacking since seismic plan code prerequisites are continually redesigned and headway in designing information. Further, Indian structures worked over recent decades are seismically insufficient in light of absence of mindfulness with respect to seismic conduct of structures. The broad harm particularly to RC structures amid quakes uncovered the development works on being embraced far and wide, and created an extraordinary interest for seismic assessment and retrofitting of existing structure stocks. Structures exposed to seismic tremor shaking at their base sway forward and backward in each of the three bearings. Under low dimensions of shaking, their amplitudes of shaking and headings of shaking are subject to how they are proportioned geometrically and as far as firmness all through the structure in plan and rise. Under solid quake shaking, structures experience harm too. Controlling the harm type and arrangement of harm in different auxiliary components is the fundamental focal point of tremor safe plan. It is conceivable to get a sensible comprehension of the general component of disappointment of the structure by appropriate nonlinear static examination. Numerous insufficiencies examined in this record can be distinguished at the plan arrange itself, and the basic setups and structure and itemizing of individuals adjusted to make the structure oppose the seismic tremor impacts produced in the structure amid solid quake shaking.

2. Methodologies

2.1 Non-direct Static Push-over Analysis

The static sucker examination is turning into a famous instrument for seismic execution assessment of existing furthermore, new structures. The desire is that the weakling examination will give sufficient data on seismic requests forced by the plan ground movement on the basic framework and its parts. The motivation behind the paper is to condense the essential ideas on which the sucker examination can be based, survey the precision of weakling forecasts, recognize conditions under which the sucker will give sufficient data and, maybe more significantly, recognize cases in which the weakling expectations will be lacking or notwithstanding deceptive.

2.2 Motivation behind Non-Straight Static Push-over Examination

The motivation behind sucker investigation is to assess the normal execution of basic frameworks by evaluating execution of an auxiliary framework by assessing its quality and twisting requests in structure seismic tremors by methods for static inelastic investigation, and looking at these requests to accessible limits at the execution dimensions of intrigue.

- The reasonable power requests on possibly fragile components, for example, pivotal power requests on segments, power requests on support associations, minute requests on pillar to section associations, shear power requests in profound strengthened cement spandrel shafts, shear power requests in unreinforced workmanship divider docks, and so on.
- Estimates of the misshapenness requests for components that need to shape in elastically so as to disperse the vitality bestowed to the structure.
- Consequences of the quality decay of individual components on conduct auxiliary framework.
- Consequences of the quality deteriation of the individual components on the conduct of the basic framework.
- Identification of the basic areas in which the disfigurement requests are expected to be high and that need to turn into the concentration through enumerating.

2.3 Target Displacement

The principal question in the execution of the sucker investigation is the greatness of the objective relocation at which seismic execution assessment of the structure is to be performed. The target relocation fills in as a gauge of the worldwide removal of the structure is normal to involvement in a plan quake. It is the rooftop removal at the focal point of mass of the structure. In the weakling investigation it is expected that the objective relocation for the MDOF structure can be assessed as the uprooting interest for the comparing equal SDOF framework changed to the SDOF area using a shape factor. This supposition, which is dependably an estimate, must be acknowledged inside confinements and just be acknowledged inside constraints and just if extraordinary consideration is taken in joining in the anticipated SDOF dislodging request all the significant ground movement and auxiliary reaction qualities that altogether influence the most extreme relocation of the MDOF structure

2.4 Confinements of Non-Linear Static Analysis

There are numerous unsolved issues that should be tended to through more research and advancement. Instances of the significant issues that should be researched are:

1) Fuse of torsional impacts (because of mass, firmness and quality abnormalities).
2) 3-D issues (symmetry impacts, course of stacking, semi-inflexible stomachs, and so forth)
3) Utilization of site explicit spectra.
4) Aggregate harm issues.
5) Generally demon

Government Emergency Management Agency (FEMA) and Applied Technical Council (ATC) are the two organizations which defined and proposed the Non-direct Static Analysis or Pushover Analysis under seismic restoration projects and rules. This included archives FEMA-356, FEMA-273 and ATC-40.

2.5 Introduction to FEMA-356

The main role of FEMA-356 archive is to give actually stable and broadly worthy rules for the seismic recovery of structures. The rules for the seismic recovery of the structures are expected to fill in as a prepared device for plan proficient for doing the structure and investigation of the structures, a reference record for the structure administrative authorities and an establishment for the future advancement and usage of the construction regulation arrangements and models.

2.6 Introduction to ATC-40

Seismic assessment and retrofit of solid structures generally alluded to as ATC-40 was created by the Applied Technology Council (ATC) with financing from California Safety Commission. In spite of the fact that the strategies suggested in this report are for solid structures, they are appropriate to most structure types.

2.7 Kinds of pushover analysis

By and by, there are two non-straight static examination systems accessible, one named as the Displacement Coefficient Method (DCM), archived FEMA-356 and other the Capacity Spectrum Method (CSM) reported in ATC-40. The two techniques rely upon parallel burden distortion variety acquired by non-straight static investigation under the gravity stacking and romanticized horizontal stacking because of the seismic activity. This investigation is called Pushover Analysis.

2.8 Limit Spectrum Method

Limit Spectrum Method is a non-straight static examination technique which gives a graphical portrayal of the normal seismic execution of the structure by meeting the structure's ability range with the reaction range (request range) of the quake. The convergence point is called as the execution point, and the dislodging coordinate dp of the execution point is the evaluated relocation request on the structure for the predetermined dimension of seismic risk.

2.9 Uprooting Coefficient Method:

Uprooting Coefficient Method is a non-direct static investigation system which gives a numerical procedure to evaluating the dislodging request on the structure, by utilizing a bilinear portrayal of the limit bend and a progression of change components or coefficients to figure an objective relocation. The point on the limit bend at the objective relocation is what could be compared to the execution point in the limit range technique.

3. Modeling and analysis in e-tabs

Enhanced three dimensional analyses and building system/structures. It was developed by computer structures incorporation (csi 1976). This is mainly used for internal analysis and design of the structures. The method used for

the analysis of the structure was FEM (finite element method). It includes three steps
1) Pre processing
2) Processing
3) Post processing

3.1 Material Properties

M30 grade of concrete and Fe 415 grade of Steel are used for all slabs columns and beams of the building. Elastic material properties of these materials are taken as per IS 456-2000. The short-term modulus of elasticity (Ec) of concrete is taken as:

$\boldsymbol{Ec} = \mathbf{5000}\sqrt{\boldsymbol{fck}}$ Mpa

Where $\boldsymbol{fck}$ =characteristic compressive strength of concrete cube

For the Steel rebar with stress and modulus of elasticity is taken as per IS 456-2000.

3.2 Structural Elements

The size of the structural elements is taken as different based on the concrete design of the building. The size of the column and beam are changed the after completion of the concrete design of the model. The size of the elements is changed as per the requirement of the structure, to protect the structure from the unusual failure

Table 1: Loadings

Wall load	13.8 kN/m
Parapet wall load	4.6 kN/m
Slab weight	2.875 kN/m^2
Wind loads	As per IS 1893:2002
Seismic loads	As per IS 875 : 1987 (part 3)

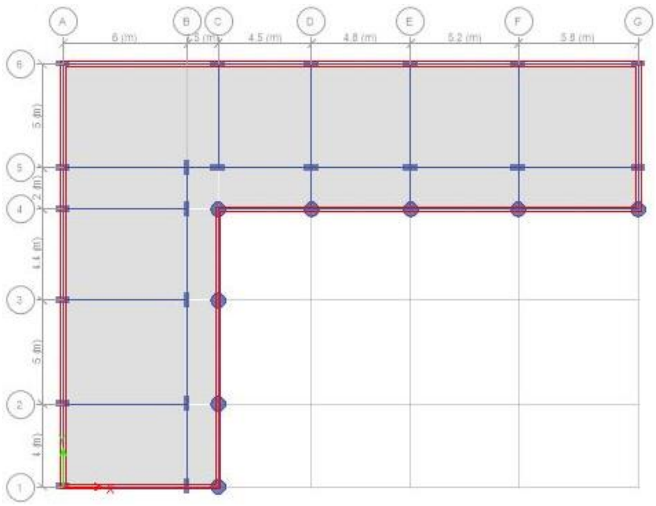

Figure 1: Plan of the building

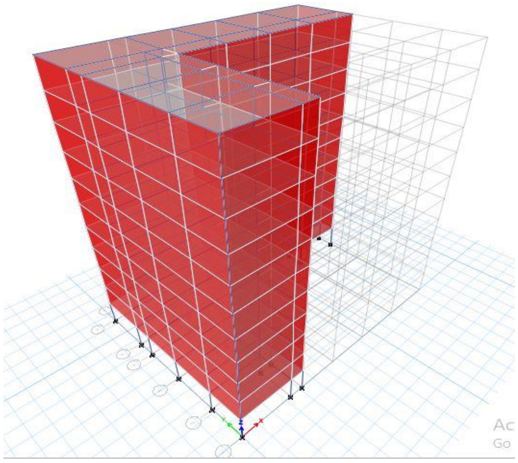

Figure 2: 3D view of the building

Table 2: Section properties of the structure

No of stories	G+10
Beam	230mmX600mm. 450mmX230mm 380X230mm 250X230mm
Circular Column	700mm
Rectangular column	700mmX300mm. 1500X350mm
Slab thickness	125mm
Bottom story height	3m
Each story height	3m
Total height of the structure	33m

4. Results and Discussion

Nonlinear static analysis is performed on the model. Loads are calculated and distributed as per code IS 1893 (Part I):2002 using ETABS. The results obtained from analysis are compared with respect to the following parameters. The parameters which were studied are storey drifts, target displacement, hinge responses, lateral displacement, and base shear for the Model in zones II and zone IV.

- The obtained story drifts are within the limits. The maximum story drift obtained in the seismic zone 2 is **0.003549** and the value is obtained at story1. The maximum story drift obtained in the seismic zone 4 is **0.002739** and **the** value is obtained at story1.
- The maximum story forces are 28847.52 kN and 32103.82 KN in the seismic zones 2 and zone 4 respectively. The obtained story force in zone4 is more than the zone2
- The maximum displacement observed in zone2 was 8.166mm and in zone 4 was 7.416mm
- The performance point was also found in the present analysis and the target displacement also found.
- The lateral displacements of the are more in the zone 4 at top stories compared to the lateral displacements in the zone2

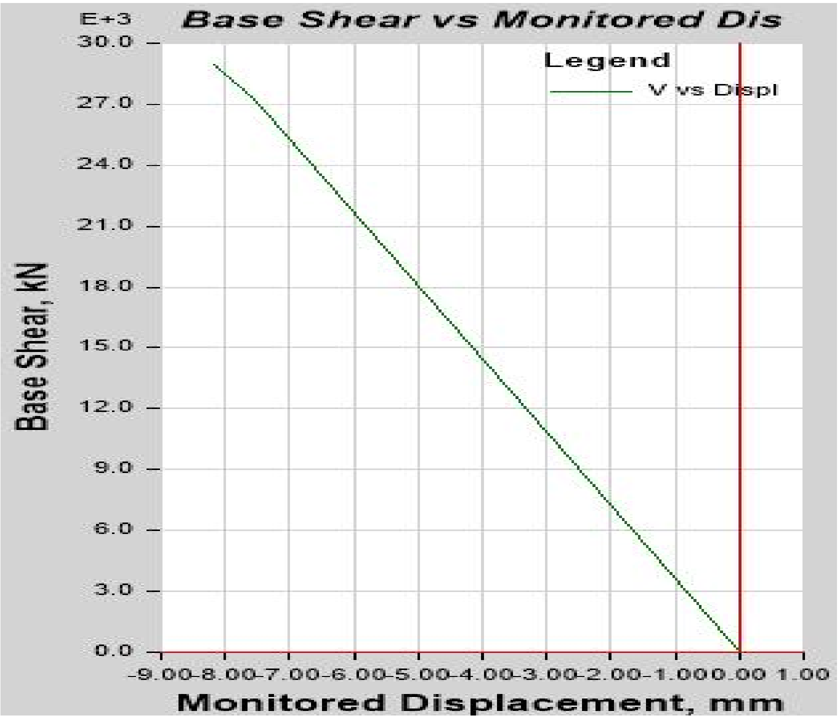

Figure 3: Push over curve in zone 2

Table 3: Push over curve results zone 2

Step	Monitored Displacement	Base Force	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
	Mm	kN										
0	0	0	3120	0	0	0	0	3120	0	0	0	3120
1	-3.751	13554.4	3118	2	0	0	0	3120	0	0	0	3120
2	-7.562	27256.8	3036	84	0	0	0	3110	2	0	8	3120
3	-8.163	28962.1	3025	95	0	0	0	3098	11	0	11	3120
4	-8.166	28967.8	3025	95	0	0	0	3098	11	0	11	3120

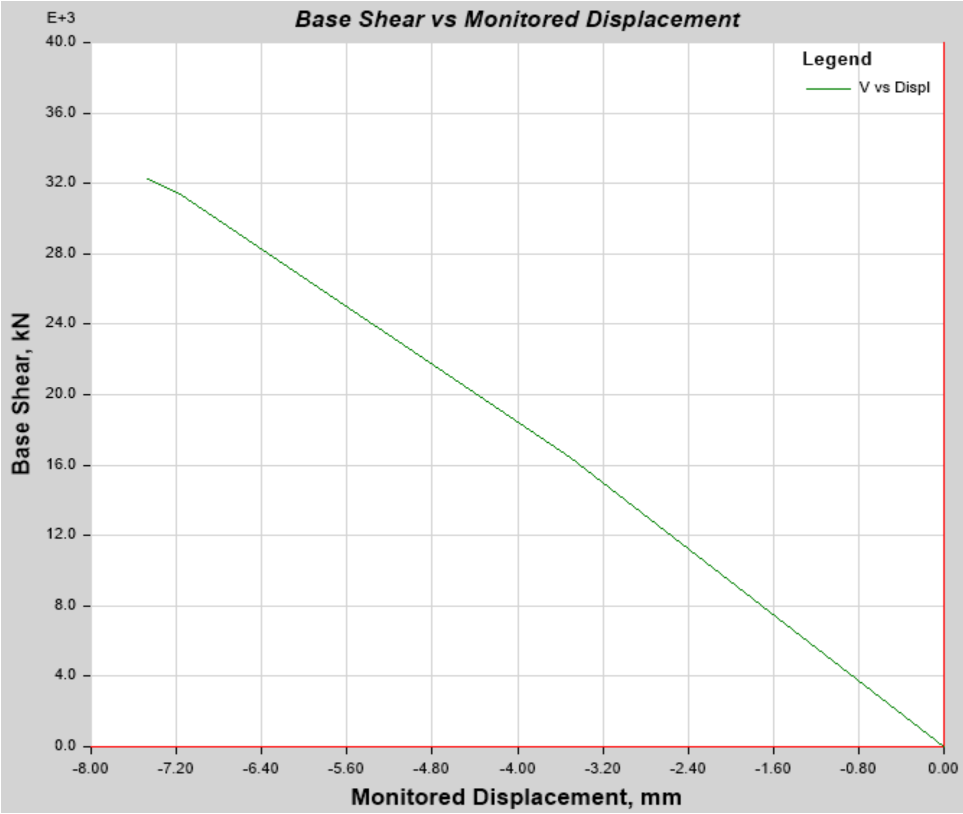

Figure 4: Push over curve in zone 4

Table 4: Push over curve results zone 4

Step	Monitored Displacement	Base Force	A-B	B-C	C-D	D-E	>E	A-IO	IO-LS	LS-CP	>CP	Total
	Mm	Kn										
0	0	0	3120	0	0	0	0	3120	0	0	0	3120
1	-3.507	16425.7	3118	2	0	0	0	3120	0	0	0	3120
2	-7.145	31294.4	3028	92	0	0	0	3116	4	0	0	3120
3	-7.476	32251.7	3020	100	0	0	0	3116	4	0	0	3120

5. Conclusions

The existing building can become seismically deficient since seismic design code requirements are constantly upgraded and advancement in engineering knowledge. Further, Indian buildings built over past two decades are seismically deficient because of lack of awareness regarding seismic behavior of structures. The widespread damage especially to RC buildings during earthquakes exposed the construction practices being adopted around the world, and generated a great demand for seismic evaluation and retrofitting of existing building stocks.
Pushover analysis produces a pushover curve consists of capacity spectrum, demand spectrum and performance point.

It shows the performance level of the building components and also maximum base shear carrying capacity of the structure

- Performance point of the structure in zone-II was found at 58657.0575 kN in the X- direction
- Performance point of the structure in zone-IV was found at 50734.610 kN in the Y- direction

The performance points of the structure in the seismic zones II and III are more compared to the obtained maximum base shear.

The target displacement is intended to represent the maximum displacement likely to be experienced during the design earthquake.

- The maximum displacement of the structure in zone II is 16.23 mm
- The maximum displacement of the structure in zone IV is 10.832 mm
- The story drifts observed of the structure are found within the limit as specified by code (IS: 1893-2002, part-1) in the present analysis.

It was found that the seismic performance of the studied building is adequate in zone II and IV in both X-direction and Y-direction because there are no elements exceeding the limit level between life safety and collapse prevention

As the performance point of the building lies within the limit no need of retrofitting are recommended. Hence the structure is safe.

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