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# To Study a Behavior of Multi Storey Structure by the Provision of Lead Rubber Bearing type Base Isolation, Subjected to Earthquake

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**ABSTRACT:** The structure which is located in the earthquake zone I, II and III should be design as earthquake resistant structure. There are number of ways for the design of earthquake resistant structure but it's a challenging task for every engineer as well as structural designer. Still many researches are going on to overcome the effect of earthquake on high-rise structures. This paper presents the use of lead rubber bearing as a base isolation. It behaves like a damper at the base of foundation. So we need to know the practical behaviour of such type of damper. The behaviour of damper we can rectify by design, making prototype modal, testing under different loading and by using software.

The different loads acting on the structure are Dead Load, Live Load, Impact Load, Wind Load and Earthquake Load. Structure is mainly design for all the loads except earthquake loads because it is very difficult to tackle the earthquake force. The seismic load is depends on energy released at the time of earthquake and formation of different waves.

A lead-rubber bearing is made by lead plug force fitted into a pre-formed hole in an elastomeric bearing. ETAB Software is used because it's yet easy to use, special purpose analysis and design program developed specifically for building systems.

**KEYWORDS:** Multi-Storey Structure, Earthquake Force, Lead Rubber Bearing type Base Isolation, ETAB Software,

## I. INTRODUCTION

A lead-rubber bearing is formed of a lead plug force-fitted into a pre-formed hole in an elastomeric bearing. The lead core provides rigidity under service loads and energy dissipation under high lateral loads. The top and bottom steel plates are used slightly thicker. The internal pole is used to accommodate mounting hardware. The entire bearing is encased in cover rubber to provide environmental protection.

ETABS is a sophisticated, yet easy to use, special purpose analysis and design program developed specifically for building systems. ETABS is an extension to the already existing software SAP 2000 and stands for Extended Three Dimensional Analysis of Building Systems. It features an intuitive and powerful graphical interface coupled with unmatched modeling, analytical and design procedures, all integrated using a common database. Although quick and easy for simple structures, ETABS can also handle the largest and most complex building models, including a wide range of non linear behaviors making it tool of choice for structural engineers in the building industry.

Most buildings are of made with geometry, horizontal beams and vertical columns. Although any building configuration is possible with ETABS, in most cases a simple grid system defined by horizontal floor and column lines can establish building geometry with minimal effort. Many of the floor levels in the building are similar. This can be used to dramatically reduce modeling and design time. The input and output conventions used correspond to common building terminology. With ETABS, the models are defined floor-by-floor, column-by-column, bay-by-bay and wall-by-wall and not as stream of non-descript nodes and elements as in general purpose programs. Thus, the structural definition is simple, concise and meaningful. In most buildings, the dimensions of the members are large in relation to the bay widths and storey heights. Those dimensions have a significant effect on the stiffness of the frame. ETABS



corrects for such effects in the formulation of the member stiffness, unlike most general-purpose programs that work on centre-to-center line dimensions. The results produced by the program should be in a form directly usable by the engineer. General purpose computer programs produce results in a general form that may need additional processing before they are usable in structural design.

II. RELATED WORK

*Selection of structure & its futures*

- No Of Floors: G + 7.
- Height Of Building: 24m.
- Shape Of Structure: Rectangular
- Type Of Building: RCC Framed
- Frame Structure Length of Building along X- direction: 20.85m
- Length of Building along Y- direction: 22.53m
- Typical Floor: 1st floor to 7th floor are typical floors
- The floor-to-floor height is 3m
- Terrace Floor: 8th floor is the terrace floor
- Soil Bearing Capacity: 200 KN/m<sup>2</sup>

*Loading Parameters*

*Self Weights (Dead Loads):* Self-weight of slab, beams, columns and other structural elements will be as per the dimensions adopted in the respective drawings. The self-weight of the various elements will be considered as per IS 875: 1987 Part 1 Table No 1 (Clause 2.1)

Material	Density
Density of Reinforced Concrete	25 KN/m <sup>3</sup>
Density of Plain Concrete	24 KN/m <sup>3</sup>
Density of Steel	78.5 KN/m <sup>3</sup>
Density of Floor Finish/ Plaster	20 KN/m <sup>3</sup>
Density of Soil	18 KN/ m <sup>3</sup>

*Live Loads:* The following are the imposed loads adopted in addition to the self weight. These parameters are adopted as IS 875: 1987 Part 2 Table No 1 (Clause 3.1, 3.1.1 and 4.1)

Description	Load
Rooms	2KN/m <sup>2</sup>
Baths	2 KN/m <sup>2</sup>
Toilets	2 KN/m <sup>2</sup>
Corridors	3 KN/m <sup>2</sup>
Staircases	3 KN/m <sup>2</sup>
Floor Finishes	2 KN/m <sup>2</sup>
Brick Bat Coba	3 KN/m <sup>2</sup>

*Wall Thickness and Materials:* The followings table contains the thickness and material used for the walls as indicated in the respective drawings.

Wall	Location	Thickness (mm)	Type
	External	230	Brick
	Internal	150	Brick
	Parapet	150	RCC



*Wind Loads:* Wind loads are calculated in accordance with IS 875: 1987 Part 3.

Basic Wind Speed ( $V_b$ ) = 50 m/s

Design wind speed ( $V_z$ ) = 53.6 m/s

Design wind pressure ( $P_z$ ) = 1723.78 N/m<sup>2</sup>

*Seismic Loads:* The seismic load can be calculated in accordance with IS 1893: 2002.

In Zone v Z=36, The Design Base Shear is given by  $V_b = Z \times I \times S_a 2 \times R \times g \times W$  As the proposed building is a Residential building, the importance factor I will be taken as 1.0. The Response reduction factor R will be taken as 5.

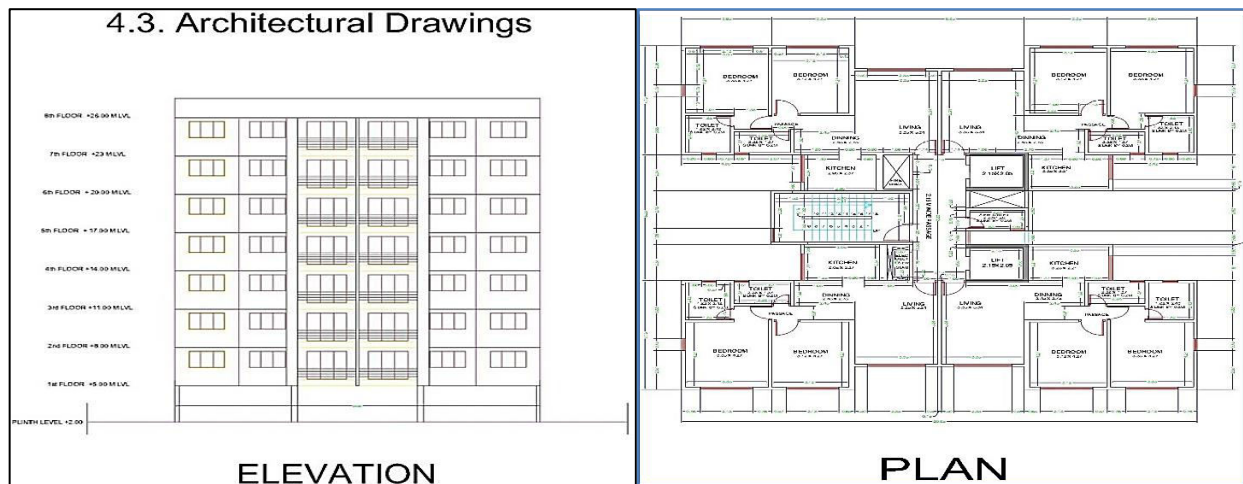
### III. METHODOLOGY

*Selection of Seismic Isolation:* The selection of seismic isolation system is based on structural dynamics. Earthquake engineering helps to evaluate basic seismic quantities like fundamental natural period and base shear of the structure. Lead Core Laminated Rubber Bearings were selected out of the wide range of seismic isolators.

*Analysis and Design of Multi Storey Structures:*

- Creation of design database consisting of different type of load cases.
- Determine the values adopted for various structural elements due to action of static and dynamic loadings as per the specified Indian Standard Codes.
- Generate structural drawings and line plans from the architectural drawings.
- Use computer software ETABS to generate the model of the structure as per structural line plan and elevation drawings.
- Define different loads cases along with their combinations from the design database to analyse the model.
- Revise the model for failed sections if any and recalculate the loads and update the new design section required and rerun the analysis and design procedure till the most optimum sections for a frame element are derived.

### IV. EXPERIMENTAL RESULTS



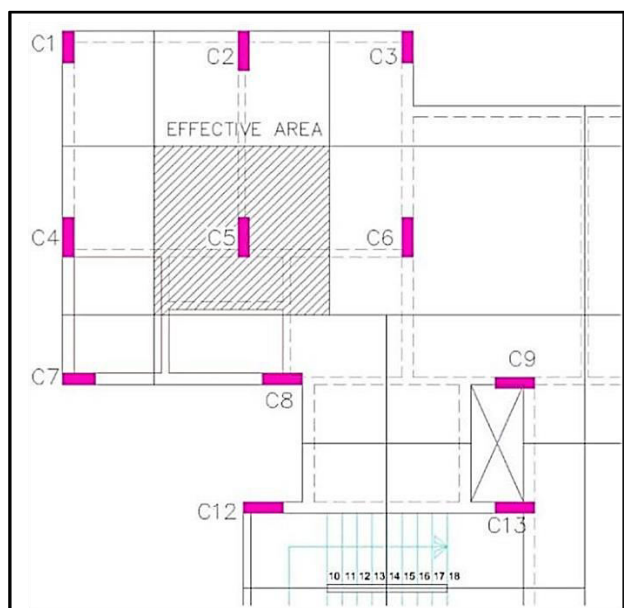
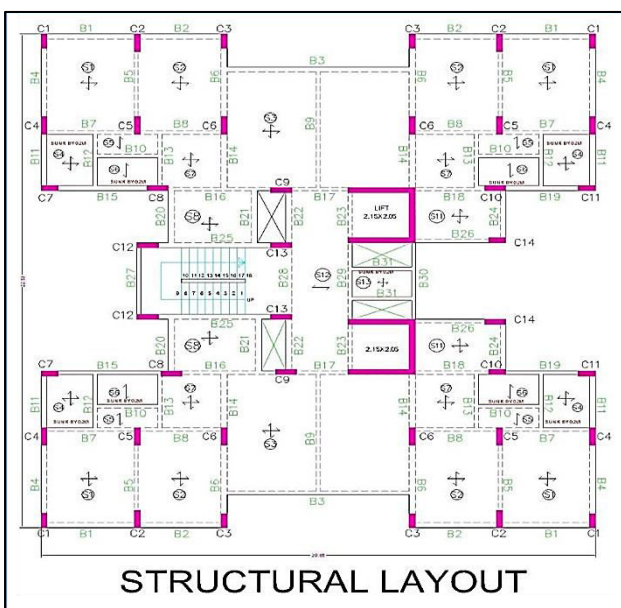
*Preparation of Structural Layouts and Column Positioning:* Once the functional plans were finalized the locations of columns in the layout are carried out. Only two beam cross sections are adopted, 230mm wide and 600mm deep for all main walls and 230mm wide by 600mm deep for the remaining. Column sizes were finalized according to load carrying capacity.

Column	Effective Slab Area	Beam length	Wall length	Slab load(kN)	Beam load(kN)	Wall load(kN)	Pu(kN)	Pu at PL	Width	Depth	fck
C1	4.24	4.16	4.16	39.75	13.99	71.76	125.5	932.24	230	350	30
C2	8.14	5.83	5.83	76.313	19.61	100.57	196.5	1471.43	230	500	30
C3	6.685	7.42	7.42	62.672	24.96	128	215.64	1597.12	230	550	30
C4	6.24	5.02	5.02	58.5	16.89	86.6	161.99	1209.32	230	400	30





C5	11.97	10.24	9.06	112.219	34.44	156.29	302.95	2267.31	230	750	30
C6	17.44	6.58	6.58	163.5	22.13	113.51	299.14	2279.61	230	750	30
C7	2.56	3.01	3.01	24	10.12	51.93	86.05	636.47	230	250	30
C8	8.52	8.14	8.14	79.875	27.38	140.42	247.68	1841.02	230	600	30
C9	9	8.84	6.59	84.375	29.74	113.68	227.8	1708.72	230	600	30
C10	7.22	7.12	7.12	67.688	23.95	122.82	214.46	1592.86	230	550	30
C11	2.56	3.23	3.23	24	10.86	55.72	90.58	668.92	230	250	30
C12	6.98	5.63	5.63	65.438	18.94	97.12	181.5	1711.96	230	600	30
C13	10.34	6.84	5.33	96.938	23.01	91.95	211.9	1990.73	230	650	30
C14	2.3	2.93	2.93	21.563	9.86	50.55	81.98	605.29	230	200	30



**Material Property Data**

Material Name: M30      Display Color:  Color

Type of Material:  Isotropic     Orthotropic      Type of Design: Design: Concrete

Analysis Property Data: Mass per unit Volume: 2.400E-09    Weight per unit Volume: 2.500E-05    Modulus of Elasticity: 27386.1278    Poisson's Ratio: 0.2    Coeff of Thermal Expansion: 9.900E-06    Shear Modulus: 11410.8866

Design Property Data (Indian IS 456:2000): Conc Cube Comp Strength, f<sub>ck</sub>: 30    Bending Reinf. Yield Stress, f<sub>y</sub>: 415    Shear Reinf. Yield Stress, f<sub>ys</sub>: 415     Lightweight Concrete    Shear Strength Reduc. Factor:

OK    Cancel

**Rectangular Section**

Section Name: C-230x600-M30

Properties: Section Properties...    Property Modifiers: Set Modifiers...    Material: M30

Dimensions: Depth (I3): 600    Width (I2): 230

Concrete:     Reinforcement...    Display Color:

OK    Cancel

**Rectangular Section**

Section Name: B-230x600-M30

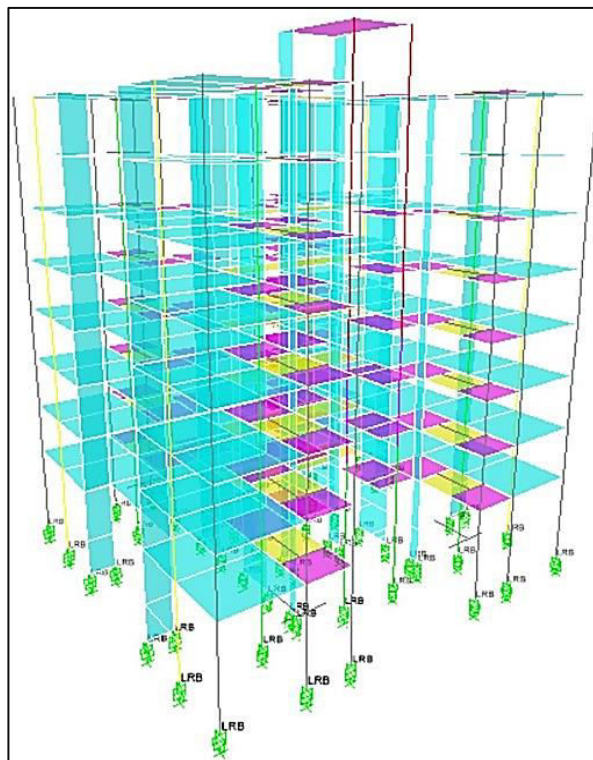
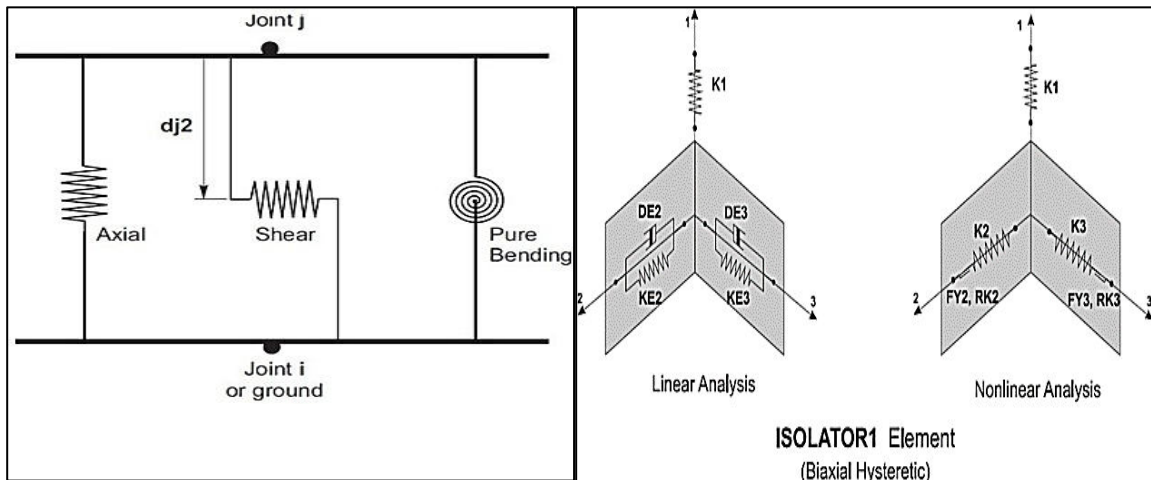
Properties: Section Properties...    Property Modifiers: Set Modifiers...    Material: M30

Dimensions: Depth (I3): 600    Width (I2): 230

Concrete:     Reinforcement...    Display Color:

OK    Cancel





### V. CONCLUSION

Analysis of multi storey structure indicates provision of base isolation will resist earthquake force at most sever condition compare to normal structure. The base shear generated from the respective response spectrum is distributed along the entire height of the building at all storey levels which tends to stretch during earthquakes, thus increasing the total displacement of diaphragms as compared to hinged base structures. It is observed from that there is a significant drop in the quantity of reinforcement required for the base isolated structure as compared to hinged base structure. The base isolated structure needs more initial investment as compared to an equivalent hinged base structure. So the base isolation can be provided for the structure located in the earthquake zone I, II and III.



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