SEISMIC BEHAVIOUR OF EARTHQUAKE RESISTANCE BUILDING AND DUCTILE DETAILING OF G+4 RC BUILDING USING IS 13920-2016

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Abstract- *Strong earthquakes, explosions, wind, moving loads, machinery, and enormous ocean waves have raised the need for more flexible civil engineering structures such as towering buildings and long span bridges, which are susceptible to unwanted vibration, deformation, and accelerations. Excessive vibration in structures is an undesired phenomena that causes human discomfort, energy loss, partial collapse of structural sections, transmits unneeded stresses, and poses a threat to structural safety, leading to collapse in some cases. It is vital to understand the behaviour and response of structural systems subjected to dynamic loads such as earthquakes and wind loads in order to eliminate the negative impacts of vibrations in structures. The study and design of earthquake-resistant tall buildings has gained traction in recent decades. Several studies have been conducted on tall structures subjected to wind and seismic loads, both theoretically and experimentally. Because structures are increasingly susceptible to seismic and wind-induced vibrations, engineers have increased the use of damping devices in structures to boost damping and thus reduce uncontrolled vibrations and accelerations that cause human discomfort. In this work, a G+4 multistory RC bare framed building is treated to four types of time history earthquakes utilising Staad for linear time history analysis. Pro*

Keywords- Seismic Behaviour, Earthquake Resistance Building ,Ductile Detailing,G+4 Rc Building,Is 13920-2016

I. INTRODUCTION

Strong earthquakes, explosions, wind, moving loads, machinery, and enormous ocean waves have raised the need for more flexible civil engineering structures such as towering buildings and long span bridges, which are susceptible to unwanted vibration, deformation, and accelerations. Excessive vibration in structures is an undesired phenomena that causes human discomfort, energy loss, partial collapse of structural sections, transmits unneeded stresses, and poses a threat to structural safety, leading to collapse in some cases. It is vital to understand the behaviour and response of structural systems subjected to dynamic loads such as earthquakes and wind loads in order to eliminate the negative impacts of vibrations in structures. The creation of creative design concepts to safeguard civil engineering structures from harm, including material contents and human occupants, from the hazards of strong winds and earthquakes is one of the key difficulties facing structural engineers in the current decade. To survive under extreme dynamic loading and blast loads, structural structures have traditionally depended on their inherent strength and capacity to dissipate energy. Inelastic cycle deformations at the extremely detailed plastic hinge areas of structural elements may cause energy dissipation in such systems. This produces localised structural damage since the structure must absorb much of the input energy from dynamic forces, which has a significant repair cost. Hospitals, police stations, and fire stations, on the other hand, must stay operational even after an earthquake.

Tall structures are a distinct type of structure with unique qualities and requirements. Tall buildings are frequently occupied by huge crowds. As a result, their destruction, loss of functionality, or collapse will have extremely serious and negative effects for human life and the economy of the impacted areas. Tall building analysis and design are often undertaken using more advanced approaches and methodologies because each tall building represents a major investment. Furthermore, most building codes are designed without special consideration for tall buildings, which account for a very small percentage of development activity in most areas. As a result, structural engineers and academics who want a better knowledge of the design and performance of these modern megacity landmarks must comprehend new approaches to seismic analysis and design of tall buildings. Innovative methods of improving structural functionality and safety against dynamic loadings have gained traction in recent years. To alleviate the consequences of these dynamic loadings, additional energy absorption and dissipation devices are used in structures. These systems function by absorbing and reflecting some of the energy that would otherwise be passed to the structure. Based on how they function to regulate vibrations, these systems can be classed as passive, active, semi-active, or hybrid vibration control systems.

II. CHARACTERISTICS OF EARTHQUAKE-RESISTANT BUILDINGS

Basic Principles of Conceptual Design

The aspect of seismic hazard shall be taken into consideration in the early stages of the conceptual design of the building.The guiding principles governing this conceptual design against seismic hazard are

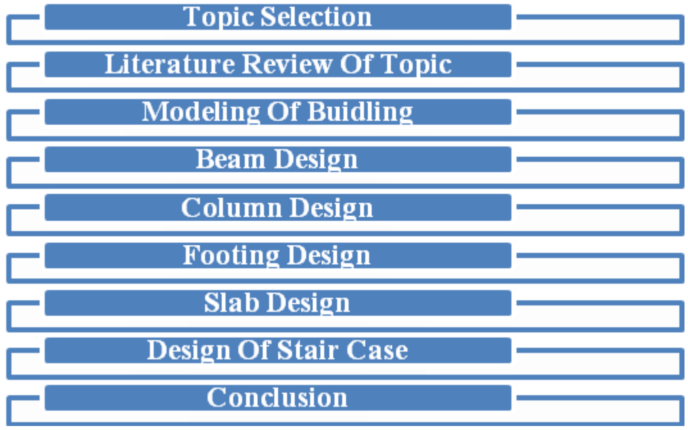
- Structural simplicity
- Uniformity and symmetry
- Redundancy
- Bidirectional resistance and stiffness
- Torsional resistance and stiffness
- Diaphragmatic action at storey level
- Adequate foundation.

OBJECTIVE OF THE WORK:-

- The present work aim at following objective
- To Study Ductile Detailing Of G+4 RC Building.
- To Study IS 13920-2016
- To study building components like Slab Design Column Footing Slab and Stair Case

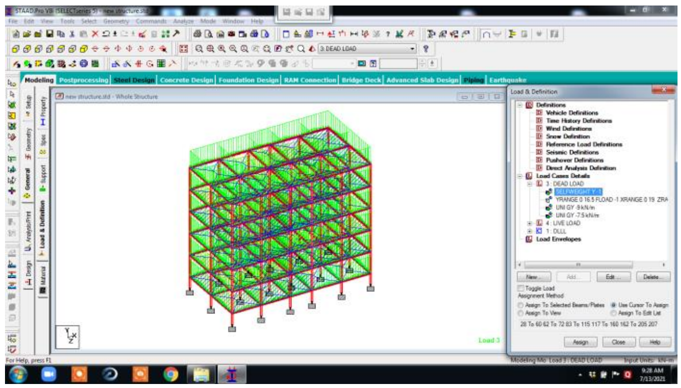
III. METHODOLOGY

Study of seismic behavior of earthquake resistance building and ductile detailing of g+4 rc building using is 13920-2016 is carried out. From literature survey it is found that which work was done on this project and which works are limited or not done.

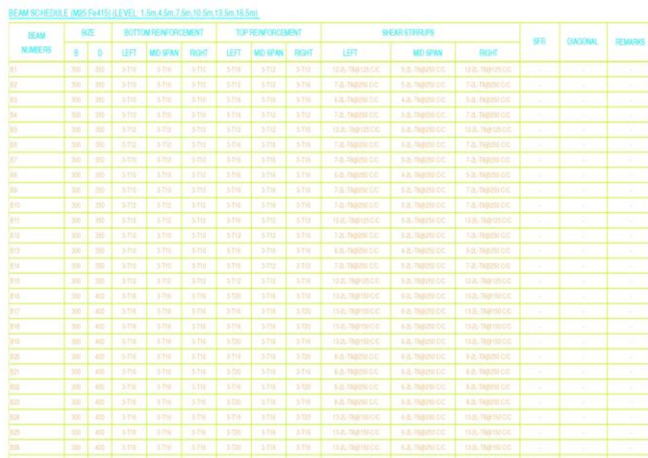


IV. MODELING AND DETAILING.

A. *Modeling Of Building*



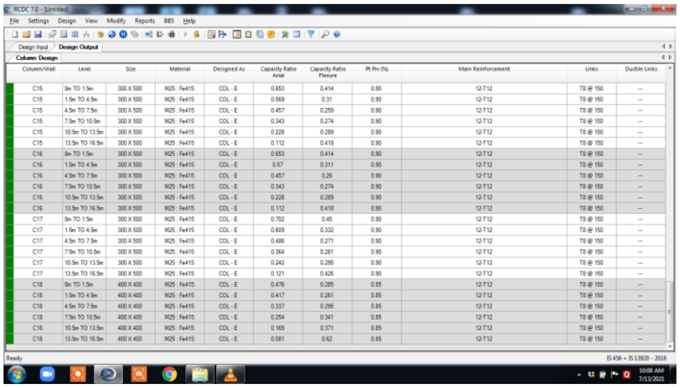
B. *Beam Design*



BEAM SCHEDULE (M25 Fe415) (LEVEL: 1.5m,4.5m,7.5m,10.5m,13.5m,16.5m)

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR	DIAGONAL	REMARKS
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT			
B1	300	350	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	12-2L-T8@125 C/C	5-2L-T8@250 C/C	12-2L-T8@125 C/C	-	-	-
B2	300	350	3-T10	3-T10	3-T10	3-T12	3-T12	3-T16	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B3	300	350	3-T10	3-T10	3-T10	3-T16	3-T16	3-T16	6-2L-T8@250 C/C	4-2L-T8@250 C/C	5-2L-T8@250 C/C	-	-	-
B4	300	350	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B5	300	350	3-T12	3-T12	3-T12	3-T12	3-T12	3-T16	12-2L-T8@125 C/C	5-2L-T8@250 C/C	12-2L-T8@125 C/C	-	-	-
B6	300	350	3-T12	3-T12	3-T12	3-T16	3-T16	3-T16	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B7	300	350	3-T10	3-T10	3-T10	3-T16	3-T16	3-T16	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B8	300	350	3-T10	3-T10	3-T10	3-T16	3-T16	3-T16	6-2L-T8@250 C/C	4-2L-T8@250 C/C	5-2L-T8@250 C/C	-	-	-
B9	300	350	3-T10	3-T10	3-T10	3-T16	3-T16	3-T16	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B10	300	350	3-T12	3-T12	3-T12	3-T16	3-T16	3-T16	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B11	300	350	3-T12	3-T12	3-T12	3-T16	3-T12	3-T12	12-2L-T8@125 C/C	5-2L-T8@250 C/C	12-2L-T8@125 C/C	-	-	-
B12	300	350	3-T10	3-T10	3-T10	3-T12	3-T12	3-T16	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B13	300	350	3-T10	3-T10	3-T10	3-T16	3-T16	3-T16	6-2L-T8@250 C/C	4-2L-T8@250 C/C	5-2L-T8@250 C/C	-	-	-
B14	300	350	3-T10	3-T10	3-T10	3-T16	3-T12	3-T12	7-2L-T8@250 C/C	5-2L-T8@250 C/C	7-2L-T8@250 C/C	-	-	-
B15	300	350	3-T12	3-T12	3-T12	3-T12	3-T12	3-T16	12-2L-T8@125 C/C	5-2L-T8@250 C/C	12-2L-T8@125 C/C	-	-	-
B16	300	400	3-T16	3-T16	3-T16	3-T20	3-T16	3-T16	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B17	300	400	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B18	300	400	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B19	300	400	3-T16	3-T16	3-T16	3-T20	3-T16	3-T16	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B20	300	400	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	8-2L-T8@250 C/C	6-2L-T8@250 C/C	8-2L-T8@250 C/C	-	-	-
B21	300	400	3-T16	3-T16	3-T16	3-T20	3-T16	3-T16	8-2L-T8@250 C/C	6-2L-T8@250 C/C	8-2L-T8@250 C/C	-	-	-
B22	300	400	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	8-2L-T8@250 C/C	6-2L-T8@250 C/C	8-2L-T8@250 C/C	-	-	-
B23	300	400	3-T16	3-T16	3-T16	3-T20	3-T16	3-T16	8-2L-T8@250 C/C	6-2L-T8@250 C/C	8-2L-T8@250 C/C	-	-	-
B24	300	400	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B25	300	400	3-T16	3-T16	3-T16	3-T20	3-T16	3-T16	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B26	300	400	3-T16	3-T16	3-T16	3-T20	3-T16	3-T16	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-
B27	300	400	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	13-2L-T8@150 C/C	6-2L-T8@250 C/C	13-2L-T8@150 C/C	-	-	-

C. *Column Design*

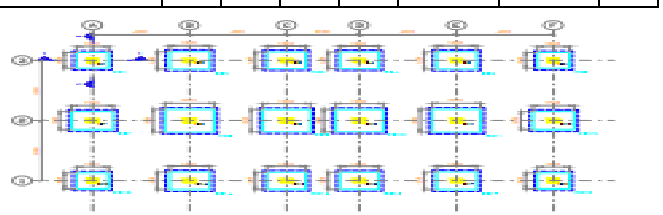


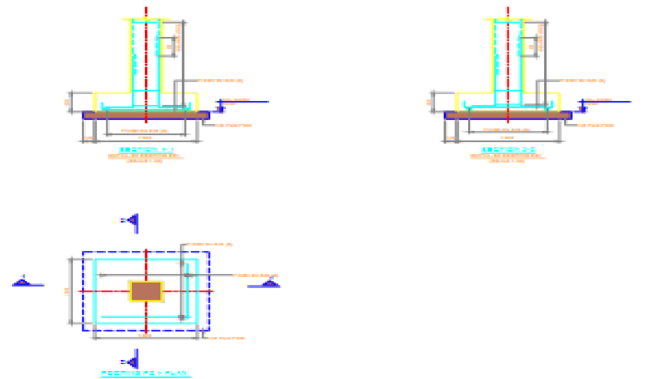
Column/Wall	Level	Size	Material	Designed As	Capacity Ratio Axial	Capacity Ratio Flexure	Pt Prv (%)	Main Reinforcement	Links	Ductile Links
C15	0m TO 1.5m	300 X 500	M25 : Fe415	COL - E	0.653	0.414	0.90	12-T12	T8 @ 150	--
C15	1.5m TO 4.5m	300 X 500	M25 : Fe415	COL - E	0.569	0.31	0.90	12-T12	T8 @ 150	--
C15	4.5m TO 7.5m	300 X 500	M25 : Fe415	COL - E	0.457	0.259	0.90	12-T12	T8 @ 150	--
C15	7.5m TO 10.5m	300 X 500	M25 : Fe415	COL - E	0.343	0.274	0.90	12-T12	T8 @ 150	--
C15	10.5m TO 13.5m	300 X 500	M25 : Fe415	COL - E	0.228	0.289	0.90	12-T12	T8 @ 150	--
C15	13.5m TO 16.5m	300 X 500	M25 : Fe415	COL - E	0.112	0.418	0.90	12-T12	T8 @ 150	--
C16	0m TO 1.5m	300 X 500	M25 : Fe415	COL - E	0.653	0.414	0.90	12-T12	T8 @ 150	--
C16	1.5m TO 4.5m	300 X 500	M25 : Fe415	COL - E	0.57	0.311	0.90	12-T12	T8 @ 150	--
C16	4.5m TO 7.5m	300 X 500	M25 : Fe415	COL - E	0.457	0.26	0.90	12-T12	T8 @ 150	--
C16	7.5m TO 10.5m	300 X 500	M25 : Fe415	COL - E	0.343	0.274	0.90	12-T12	T8 @ 150	--
C16	10.5m TO 13.5m	300 X 500	M25 : Fe415	COL - E	0.228	0.289	0.90	12-T12	T8 @ 150	--
C16	13.5m TO 16.5m	300 X 500	M25 : Fe415	COL - E	0.112	0.418	0.90	12-T12	T8 @ 150	--
C17	0m TO 1.5m	300 X 500	M25 : Fe415	COL - E	0.702	0.45	0.90	12-T12	T8 @ 150	--
C17	1.5m TO 4.5m	300 X 500	M25 : Fe415	COL - E	0.609	0.332	0.90	12-T12	T8 @ 150	--
C17	4.5m TO 7.5m	300 X 500	M25 : Fe415	COL - E	0.486	0.271	0.90	12-T12	T8 @ 150	--
C17	7.5m TO 10.5m	300 X 500	M25 : Fe415	COL - E	0.364	0.281	0.90	12-T12	T8 @ 150	--
C17	10.5m TO 13.5m	300 X 500	M25 : Fe415	COL - E	0.242	0.295	0.90	12-T12	T8 @ 150	--
C17	13.5m TO 16.5m	300 X 500	M25 : Fe415	COL - E	0.121	0.426	0.90	12-T12	T8 @ 150	--
C18	0m TO 1.5m	400 X 400	M25 : Fe415	COL - E	0.476	0.285	0.85	12-T12	T8 @ 150	--
C18	1.5m TO 4.5m	400 X 400	M25 : Fe415	COL - E	0.417	0.261	0.85	12-T12	T8 @ 150	--
C18	4.5m TO 7.5m	400 X 400	M25 : Fe415	COL - E	0.337	0.295	0.85	12-T12	T8 @ 150	--
C18	7.5m TO 10.5m	400 X 400	M25 : Fe415	COL - E	0.254	0.341	0.85	12-T12	T8 @ 150	--
C18	10.5m TO 13.5m	400 X 400	M25 : Fe415	COL - E	0.169	0.371	0.85	12-T12	T8 @ 150	--
C18	13.5m TO 16.5m	400 X 400	M25 : Fe415	COL - E	0.081	0.62	0.85	12-T12	T8 @ 150	--

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
1 TO 2	400 X 400	M25 : Fe415	1	1	909.99	18.27	26.91	0.85	0.28	12-T12	T8 @ 150
2 TO 3	400 X 400	M25 : Fe415	1	1	788.14	18.4	25.63	0.85	0.27	12-T12	T8 @ 150
3 TO 4	400 X 400	M25 : Fe415	1	1	633.28	20.97	28.51	0.85	0.31	12-T12	T8 @ 150
4 TO 5	400 X 400	M25 : Fe415	1	1	472.91	23.45	31.62	0.85	0.36	12-T12	T8 @ 150
5 TO 6	400 X 400	M25 : Fe415	1	1	325.39	-24.01	-32.33	0.85	0.39	12-T12	T8 @ 150
6 TO 7	400 X 400	M25 : Fe415	1	1	139.44	35.04	46.5	0.85	0.64	12-T12	T8 @ 150

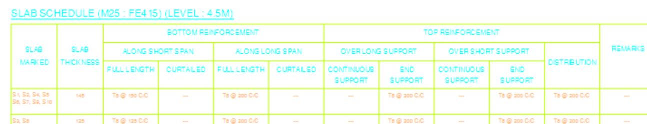
Footing Design

Size (LxBxD)	Bot @ L	Bot @ B	Top @ L	Top @ B	Shear @ L	Shear @ B	SFR
1300x1300x380	12-T10 @ 125	12-T10 @ 125	-	-	-	-	-



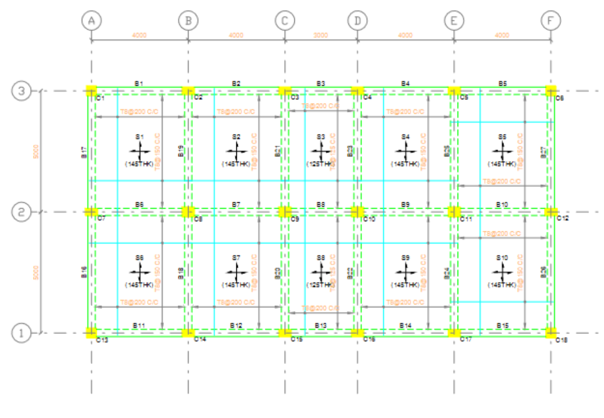


D. *Slab Design*



SLAB SCHEDULE (M25 : FE415) (LEVEL : 4.5M)

SLAB MARKED	SLAB THICKNESS	BOTTOM REINFORCEMENT				TOP REINFORCEMENT					REMARKS
		ALONG SHORT SPAN		ALONG LONG SPAN		OVER LONG SUPPORT		OVER SHORT SUPPORT		DISTRIBUTION	
		FULL LENGTH	CURTAILED	FULL LENGTH	CURTAILED	CONTINUOUS SUPPORT	END SUPPORT	CONTINUOUS SUPPORT	END SUPPORT		
S1, S2, S4, S5 S6, S7, S8, S10	145	T8 @ 150 C/C	---	T8 @ 200 C/C	---	---	T8 @ 200 C/C	---	T8 @ 200 C/C	T8 @ 200 C/C	---
S3, S8	125	T8 @ 125 C/C	---	T8 @ 200 C/C	---	---	T8 @ 200 C/C	---	T8 @ 200 C/C	T8 @ 200 C/C	---



V. CONCLUSION

CONCLUSION

We prepare modelling and detailing of Beam design, Column design, Footing design, Slab design, and Design of stair case in Staad pro and RCDC software for the research job as per the given issue description. Even non-ductile materials, such as concrete, can be used to develop ductile structures, as detailed in the preceding Chapter. This can be accomplished by placing the right amount of steel reinforcement at the right place. Large earthquake stresses are applied to joints, and it has been observed that beam reinforcement rips out of columns, causing the building to collapse. To avoid this, the IS: 13920 regulation advises that the beam reinforcement be secured into columns by a length of at least one metre. OBJ

Precautions during Construction

Construction oversight is also critical for a building's satisfactory performance during an earthquake. A number of failures have been reported as a result of defective construction. The construction joint is the most crucial place during construction. Water jets should be used to completely clean the old concrete surface before installing fresh concrete. Shear keys should be made with wooden blocks, which should be removed once the concrete has sat for a while. It is never a good idea to leave these blocks in place. The importance of splicing reinforcement during construction cannot be overstated. As previously stated, only half of the reinforcing bars should be spliced at the place, and splicing near the joints should be avoided. Stirrup anchorage is one of the most essential aspects that determines a building's safety.

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