iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** XI **Month of publication:** November 2020

DOI: https://doi.org/10.22214/ijraset.2020.32094

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XI Nov 2020- Available at www.ijraset.com

Comparative Study and Analysis of a Building Subjected to Blast Load and Earthquake Load

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Abstract: As by the past attacks on structures being subjected to blast load, they have gained huge importance due to the accidental events or natural events. Generally, we as of now for the conventional structures do not designed for blast load due to the reason that the magnitude of load by blast is very huge, and also the cost of design and construction is very high. Design and Structural Evaluation for the Building systems which is being subjected to a blast load forms a very important task of the present generation. Unlike the earthquake design, blast resistant design is a new concept that has now gained a huge importance in order to make structures safe again blast effect. The present study is concerned with comparative analysis of blast load and earthquake load with the variations in the building floors. In this study we analysed the buildings with different floor numbers for blast loads and earthquake loads in particular directions to obtain comparative results. The blast parameters are obtained from the Is codes and same magnitude to earthquake load is applied. The analysis and the results are obtained from the ETABS software. The comparative results are considered in the study for different parameters as base shear, max moments, Shear and other parameters. The results help to understand the effects that would be caused by the loads acting such as, type of blast load and earthquake loads and their comparative results would help us to understand how a structure acts for same earthquake and blast loads and how will the structure behave for the cases.
Keywords: Blast load, earthquake load, ETABS, base shear, max moments and shear

I. INTRODUCTION

The increased cases of terrorist attacks in the previous years has shown us that the effect of blast loads on buildings is a very serious matter that should be taken into account for the analysis and design process. The terrorist attacks on buildings has become an emerging issue for every country now. Hence by providing security to the residents of the building against terrorist attacks is gaining importance day by day. It includes prevention, prediction & lessening of such kind of acts. Although these kind of attacks are very rare cases, man-made disasters; blast loads are in fact dynamic loads that is needed to be carefully calculated just like earthquake, wind loads and other load. Damage to the property, social panic and loss of life are the main factors that are affected by the threat of any terrorist action. Designing the structures to be fully blast resistant is not a realistic and economical option, however with the modern civil engineering knowledge and experiences designing a building to be blast resistant within considerable limits will be very much possible. An explosive can be a solid or liquid substance, or mixture of substances, which on the application of a suitable impetus to a small portion of explosive's mass, is converted in a very short interval of time into other more stable substances which forms a largely or entirely gaseous, with the development of a high temperature and pressure. And similarly the Earthquake is also a dynamic effect and is a natural disaster, for long times we have been designing for the Earthquake loads and this are also very important for consideration. The earthquake loads are assumed as per the previous occurrence and the zone are being divided on the basis of the effect of the earthquake in that area. The Earthquake can be of dynamic nature of any type and can be even hazardous that other loads. Thus it is very important to understand the effect of building under blast load and also for an earthquake load in so as to protect a structure against its effect.

A. Key Parameters of Surface Blast Waves

After the detonation, waves travel toward the structure and hit the structure at tA, with maximum pressure of PSO and this pressure eventually decreases to that of ambient pressure, PO, at time tO, positive phase duration. Then the pressure decreases bellow the value of ambient pressure at tO -, negative phase duration. Simultaneously, waves are reflected by the ground and the structure, and this pressure is higher than PSO. This reflected pressure has a magnitude of Pr.

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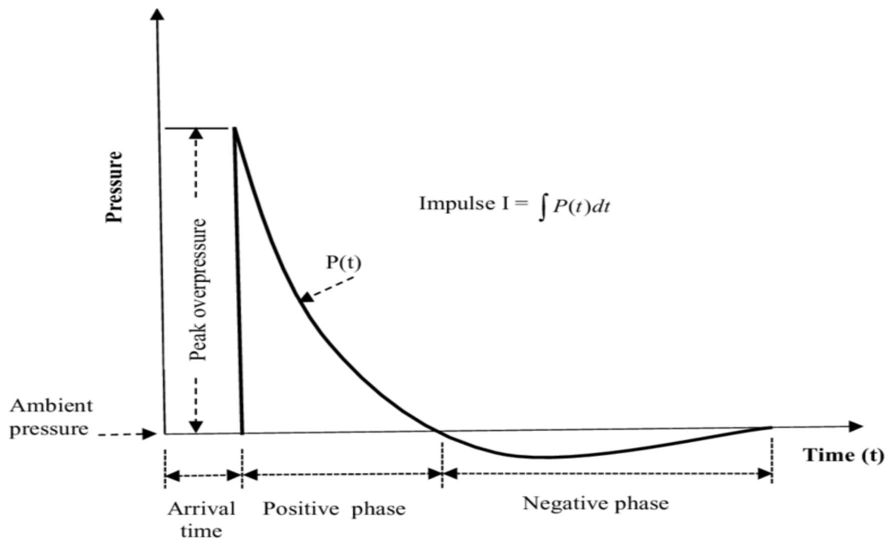

II. OBJECTIVE

By understanding the performance of a high-rise building the explosion is of great importance to provide buildings which eliminates or minimizes the damage to building and property in the event of explosion, especially with the recent surgence in extreme activities of targeting at a structures with viable commercial values. As earthquake has been a very important measure that is to be taken into account we would see what the effect would be occurring on to a structure for a similar load.

A. The motto of the study is to get an idea of blast and earthquake phenomenon and to understand their effects on a building.
B. For judging the chances of occurrence of an explosion in the lifetime of a building & the impact factor that is to be considered based on the importance of the structure.
C. To understand the response of a building when subjected to blast loadings and earthquake using ETABS software as per IS Code 4991.
D. To understand the results for the analysis of a building with different construction elements and techniques
E. Assessing of results obtained for high rise buildings subjected to load from the analysis.

III. METHODOLOGY

In this study, a ten, fifteen and twenty storey RCC buildings are considered and are then subjected to surface blast of around 150kg charge weight of explosive. The building is having a plan dimension of 14 x 16 m with bottom storey height as 3m and typical storey height of also 3m each. It is then analysed by using ETABS software for different standoff distances of 35m from the front face of the building. The peak reflected overpressure obtained from IS:4991-1968 is multiplied with its tributary area and this blast load is applied as the joint load on the joints of the front face of the building in the 'x' direction and time history method is carried out. The response of the building with earthquake loads is carried out and also for the blast source of varying building floor numbers is determined by creating different model.

A. Building Description

Model: = 4 bays spaced 4m each
Y direction = 4 bays, 2 bays spaced 4m and other 2 spaced 3m

1) Material Properties

Density of concrete = 30 kN/m3, Density of steel = 78.5 kN/m3
Grade of concrete = M30,
Grade of rebar (steel) = Fe500

2) Sectional Properties

Beam = 600mm × 400mm, Slab = 150mm

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
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Column

COLUMN	STOREY	10 STOREY	15 STOREY	20 STOREY
SIZES	1-5	500X1000	600X1200	600X1200
	5-10	500X1000	500X1000	500X1000
	10-15	-	400X800	400X800
	15-20	-	-	300X600

B. *Loads Considered in Analysis*

The following loads are considered for the analysis of various phases of structure.
Gravity loads: The intensity of dead load and live load considered in the study are given below:
Dead loads: Dead load comprising of self-weight of members i.e. Beam, Column and Slab.
Floor finish load = 1 kN/m2,
Live load (IS 875, part 2) = 3 kN/m2 (floor)

C. *Blast Load and Parameters*

Stand-off Distance (R) and Weight of the Explosive (W)
One important parameter in determining the intensity of the blast load is the location of the explosive or stand-off distance from the structure and another important parameter is the weight of explosive.

D. *Scaled Factor (Z)*

On the basis of the distance of the explosive from the building, effects of the blast waves on the structure can vary.

1) *Earthquake Load:* Earthquake design is done in accordance with IS 1893 (part I):2002 and has been taken by specifying the zone in which structure is located. These RC framed building is located in zone IV V. The parameter to be used for analysis and design are given below:-

Zone factor (Z)	IV and V	0.36
Response Reduction factor (RF)	SMRF	5
Importance factor	All general building	1
Rock/Soil type	Medium soil	2
Type of structure	RC frame building	1
Damping Ratio		5%

IV. DIFFERENT MODAL CONDITIONS WITH DIFFERENT CASES

The building is analysed for different models with case factors caused on the building

A. *Modal 1 – A 10 (ten) Storey Building*

1) *Case 1:* Building affected by the blast load of 150kg with the standoff distance of 35meters with normal Frame.
2) *Case 2:* Building affected by the blast load of 150kg with the standoff distance of 35meters with shear walls
3) *Case 3:* Building affected by the Earthquake load of same amount of lateral loads as by blast loads.
4) *Case 4:* Building affected by the Earthquake load of same amount of lateral loads as by blast loads with shear walls.

B. *Modal 2 – A 15 (fifteen) Storey Building*

1) *Case 1:* Building affected by the blast load of 150kg with the standoff distance of 35meters with normal Frame
2) *Case 2:* Building affected by the blast load of 150kg with the standoff distance of 35meters with shear walls.
3) *Case 3:* Building affected by the Earthquake load of same amount of lateral loads as by blast loads.
4) *Case 4:* Building affected by the Earthquake load of same amount of lateral loads as by blast loads with shear walls

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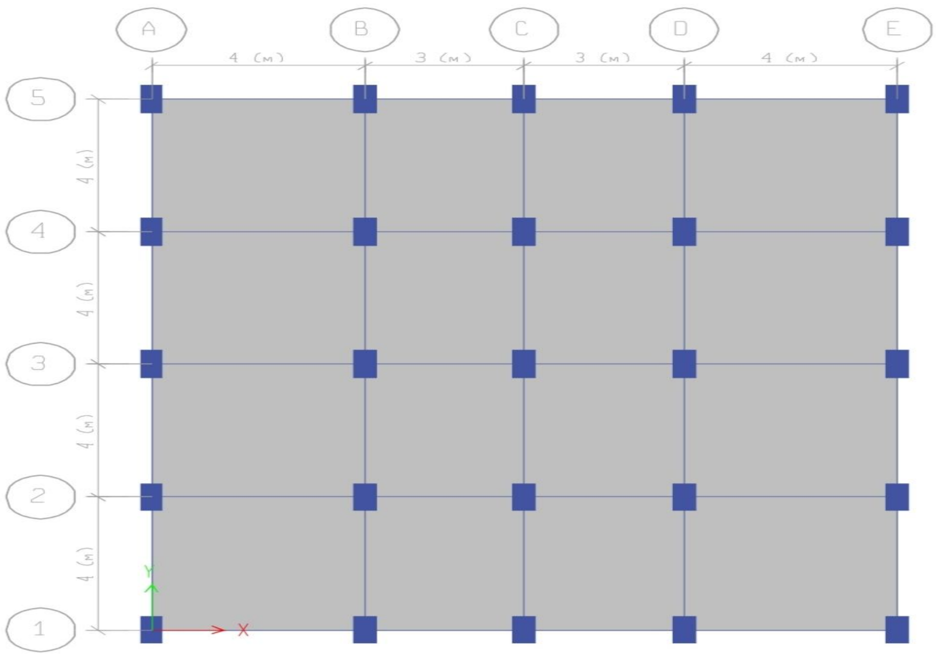
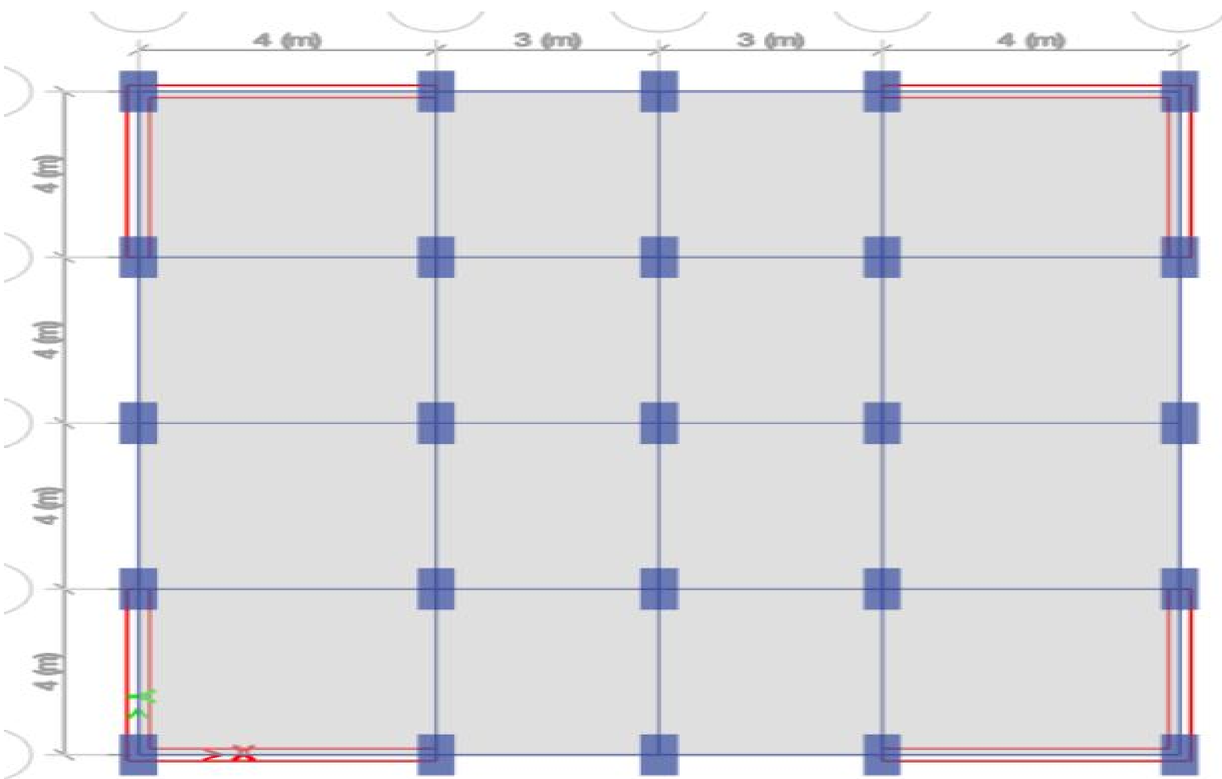
C. Modal 3 – A twenty (20) Storey Building

1) *Case 1:* Building affected by the blast load of 150kg with the standoff distance of 35meters with normal Frame
2) *Case 2:* Building affected by the blast load of 150kg with the standoff distance of 35meters with shear walls.
3) *Case 3:* Building affected by the Earthquake load of same amount of lateral loads as by blast loads.
4) *Case 4:* Building affected by the Earthquake load of same amount of lateral loads as by blast loads with shear walls



Plan of the Model



Plan of the Model with shear wall

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V. BLAST LOAD CALCULATIONS

1) MODAL 1 – 10 Floor Building

Weight = 150kg Standoff distance = 35m

10 Floors				FROM TABLE 1					SCALED						
FLOOR	WEIGHT (ton)	STAND OFF (m)	SCALED DIST. (m)	Pso (kg/cm^2)	to1	td2	qo	Pro (kg/cm^2)	to (ms)	td (ms)	Pso (kn/m^2)	Pro (kn/m^2)	Area(m^2)	Pso (kn)	Pro (kn)
	0.15	35.9	**67.57**	0.329	38.44	29.01	0.037	0.74	20.42	15.41	32.27	72.59	3	96.82	217.78
1	0.15	35.2	**66.29**	0.338	38.12	28.8	0.038	0.76	20.25	15.30	33.16	74.56	6	198.95	447.34
	0.15	35	**65.87**	0.341	38.01	28.71	0.039	0.77	20.20	15.25	33.45	75.54	6	200.71	453.22
	0.15	36	**67.79**	0.328	38.5	29.05	0.036	0.74	20.46	15.44	32.18	72.59	6	193.06	435.56
2	0.15	35.4	**66.53**	0.336	38.18	28.84	0.038	0.761	20.29	15.32	32.96	74.65	12	395.54	895.85
	0.15	35.1	**66.10**	0.339	38.07	28.77	0.039	0.768	20.23	15.29	33.26	75.34	12	399.07	904.09
	0.15	36.4	**68.51**	0.323	38.68	29.16	0.034	0.728	20.55	15.49	31.69	71.42	6	190.12	428.50
3	0.15	35.7	**67.25**	0.331	38.36	28.96	0.037	0.748	20.38	15.39	32.47	73.38	12	389.65	880.55
	0.15	35.5	**66.83**	0.334	38.26	28.89	0.038	0.756	20.33	15.35	32.77	74.16	12	393.18	889.96
	0.15	37	**69.66**	0.315	38.97	29.38	0.034	0.709	20.71	15.61	30.90	69.55	6	185.41	417.32
4	0.15	36.4	**68.43**	0.323	38.66	29.15	0.035	0.729	20.54	15.49	31.69	71.51	12	380.24	858.18
	0.15	36.1	**68.00**	0.326	38.55	29.08	0.036	0.736	20.48	15.45	31.98	72.20	12	383.77	866.42
	0.15	37.9	**71.24**	0.305	39.370	29.713	0.032	0.683	20.92	15.79	29.93	66.97	6	179.56	401.82
5	0.15	37.2	**70.03**	0.313	39.068	29.463	0.034	0.703	20.76	15.65	30.72	68.95	12	368.62	827.38
	0.15	37	**69.64**	0.316	38.970	29.382	0.034	0.709	20.71	15.61	30.97	69.59	12	371.68	835.03

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	0.15	38.9	**73.23**	0.292	39.872	30.214	0.029	0.650	21.18	16.05	28.63	63.72	6	171.75	382.30
6	0.15	38.3	**72.05**	0.300	39.573	29.884	0.031	0.669	21.03	15.88	29.40	65.65	12	352.77	787.74
	0.15	38.1	**71.65**	0.302	39.473	29.798	0.031	0.676	20.97	15.83	29.66	66.30	12	355.91	795.59
	0.15	40.2	**75.58**	0.276	40.413	30.930	0.026	0.612	21.47	16.43	27.09	60.06	6	162.53	360.38
7	0.15	39.6	**74.45**	0.284	40.181	30.556	0.028	0.629	21.35	16.24	27.83	61.72	12	333.93	740.66
	0.15	39.4	**74.06**	0.286	40.082	30.447	0.028	0.636	21.30	16.18	28.08	62.36	12	336.99	748.31
	0.15	41.6	**78.29**	0.259	40.870	31.857	0.023	0.577	21.72	16.93	25.41	56.61	6	152.47	339.68
8	0.15	41	**77.16**	0.266	40.666	31.531	0.024	0.591	21.61	16.75	26.06	58.00	12	312.66	695.96
	0.15	40.8	**76.81**	0.268	40.610	31.398	0.025	0.596	21.58	16.68	26.28	58.45	12	315.41	701.45
	0.15	43.2	**81.27**	0.249	41.640	31.927	0.022	0.548	22.12	16.96	24.44	53.78	6	146.62	322.67
9	0.15	42.6	**80.21**	0.251	41.370	31.916	0.022	0.552	21.98	16.96	24.59	54.14	12	295.05	649.70
	0.15	42.4	**79.88**	0.254	41.280	31.894	0.022	0.561	21.93	16.95	24.89	55.05	12	298.69	660.64
	0.15	44.9	**84.54**	0.238	42.430	32.047	0.020	0.525	22.54	17.03	23.37	51.46	3	70.10	154.39
10	0.15	44.4	**83.53**	0.242	42.220	31.987	0.020	0.533	22.43	17.00	23.70	52.30	6	142.19	313.80
	0.15	44.2	**83.19**	0.243	42.130	31.978	0.021	0.535	22.38	16.99	23.81	52.52	6	142.85	315.14

Similarly for all the cases we would find out the final loads

A. Assigning Earth quake Load on Structure by ETABS

1) Define all the live load, dead load and other gravity loads.
2) Define load pattern as earthquake load and select the Is-code
3) Define function as response spectrum for the required conditions.
4) Assign the load case with the defined function as per the response spectrum.
5) Now check for the result section table in base shear form after analysis.
6) The obtained base shear should be equal to the sum of the lateral point loads due to the blast loads. If not obtained we can change the acceleration scale factor to obtain the required results.
7) It is done in order to obtain a comparative results cause by same magnitude.

B. Assigning Blast Load on Structure by ETABS

1) Define a load pattern for blast load. Separate case for each joint.
2) Assign joint load on the external surface and the required direction.
3) Define time history function for each load pattern (Time-Value relation).
4) Define a time history load case for each load pattern and function, and add the related blast load and function.
5) Run modal analysis

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VI. RESULTS

Column - Blast

ELEMENT - COLUMN									
Story	COLUMN	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	C13	1.2DL + 1.2LL + 1.2BL	Max	-2505.71	4036.77	0.00	0.00	0.00	7303.24
Story2	C13	1.2DL + 1.2LL + 1.2BL	Max	-2260.66	4285.23	0.00	0.00	0.00	6625.31
Story3	C13	1.2DL + 1.2LL + 1.2BL	Max	-2011.63	4218.67	0.00	0.00	0.00	6266.03
Story4	C13	1.2DL + 1.2LL + 1.2BL	Max	-1761.10	3785.61	0.00	0.00	0.00	5437.37
Story5	C13	1.2DL + 1.2LL + 1.2BL	Max	-1509.35	3920.01	0.00	0.00	0.00	6147.72
Story6	C13	1.2DL + 1.2LL + 1.2BL	Max	-1256.83	4571.91	0.00	0.00	0.00	6991.84
Story7	C13	1.2DL + 1.2LL + 1.2BL	Max	-1003.76	4591.90	0.00	0.00	0.00	6771.71
Story8	C13	1.2DL + 1.2LL + 1.2BL	Max	-750.20	3789.31	0.00	0.00	0.00	5334.27
Story9	C13	1.2DL + 1.2LL + 1.2BL	Max	-496.70	2453.43	0.00	0.00	0.00	3230.26
Story10	C13	1.2DL + 1.2LL + 1.2BL	Max	-204.84	1107.02	0.00	0.00	0.00	1365.10

Shear Wall -- Column Blast

ELEMENT - COLUMN									
Story	COLUMN	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	C13	1.2DL + 1.2LL + 1.2BL	Max	3.84E-05	395.5497	0.0007	8.83E-07	0.001	764.2216
Story2	C13	1.2DL + 1.2LL + 1.2BL	Max	0.0001	598.1498	0.0005	3.41E-05	1.1601	1032.552
Story3	C13	1.2DL + 1.2LL + 1.2BL	Max	0.0001	850.9526	0.0004	3.97E-05	0.001	1376.622
Story4	C13	1.2DL + 1.2LL + 1.2BL	Max	4.55E-05	1111.77	0.0005	4E-05	0.0003	1879.211
Story5	C13	1.2DL + 1.2LL + 1.2BL	Max	4.55E-06	1713.477	0.0006	1.04E-05	0.0009	2793.311
Story6	C13	1.2DL + 1.2LL + 1.2BL	Max	0	2294.242	0.0011	1.42E-05	0.0022	3614.375
Story7	C13	1.2DL + 1.2LL + 1.2BL	Max	5.34E-06	2628.163	0.0005	0.0001	0.0009	4008.99
Story8	C13	1.2DL + 1.2LL + 1.2BL	Max	2.12E-05	2592.272	0.0004	5.19E-06	1.28E-05	3849.425
Story9	C13	1.2DL + 1.2LL + 1.2BL	Max	1.81E-05	2322.362	0.0007	2.49E-06	0.0012	3381.954
Story10	C13	1.2DL + 1.2LL + 1.2BL	Max	8.91E-06	2104.856	0.0011	3.22E-05	0.0023	2812.44

Column - Earthquake

ELEMENT - COLUMN									
Story	COLUMN	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	976.8539	3.35E-05	7.94E-07	0.0001	1806.073
Story2	C13	1.2DL + 1.2LL + 1.2EQL	Max	6.01E-07	1074.541	3.47E-05	2.1E-06	0.0001	1660.911
Story3	C13	1.2DL + 1.2LL + 1.2EQL	Max	5.75E-07	1034.371	0.0001	2.97E-06	0.0001	1546.891
Story4	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	966.6563	4.79E-05	2.92E-06	0.0001	1430.747
Story5	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	877.554	3.52E-05	1.94E-06	4.07E-05	1287.946
Story6	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	770.0086	0.0001	8.43E-07	0.0001	1118.629
Story7	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	644.8488	0.0001	1.49E-06	0.0001	923.3748
Story8	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	502.1835	5E-06	2.56E-06	4.7E-05	702.2052
Story9	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	341.0972	0.0001	2.88E-06	0.0001	455.4972
Story10	C13	1.2DL + 1.2LL + 1.2EQL	Max	0	170.3252	0.0001	2.14E-06	1.77E-05	206.7134

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Column - Earthquake Shear Wall

ELEMENT - COLUMN									
Story	COLUMN	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	C13	1.2DL + 1.2LL + 1.2EQL	Max	-1359.44	134.0152	2.84E-05	6.86E-07	4.53E-05	257.8286
Story2	C13	1.2DL + 1.2LL + 1.2EQL	Max	-1223.76	187.4685	2.37E-05	1.51E-06	3.88E-05	305.7118
Story3	C13	1.2DL + 1.2LL + 1.2EQL	Max	-1086.96	235.5463	1.46E-05	2.12E-06	3.05E-05	370.7303
Story4	C13	1.2DL + 1.2LL + 1.2EQL	Max	-950.261	266.2799	1.64E-05	1.41E-06	1.63E-05	410.5102
Story5	C13	1.2DL + 1.2LL + 1.2EQL	Max	-813.785	281.0397	3.73E-05	2.99E-06	0.0001	427.2219
Story6	C13	1.2DL + 1.2LL + 1.2EQL	Max	-677.703	283.4229	2.87E-05	1.46E-06	0.0001	426.3401
Story7	C13	1.2DL + 1.2LL + 1.2EQL	Max	-542.06	275.7234	2.79E-05	2.68E-06	4.25E-05	411.1711
Story8	C13	1.2DL + 1.2LL + 1.2EQL	Max	-406.791	260.213	2.59E-05	1.65E-06	4.22E-05	385.3356
Story9	C13	1.2DL + 1.2LL + 1.2EQL	Max	-271.962	241.5379	3.59E-05	1.54E-06	4.78E-05	354.4176
Story10	C13	1.2DL + 1.2LL + 1.2EQL	Max	-136.927	228.443	3.47E-05	1.31E-06	0.0001	306.9147

Beam - Blast

ELEMENT - BEAM									
Story	Beam	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	B21	1.2DL + 1.2LL + 1.2BL	Max	460.33	2327.28	6.09	6.23	4.82	4425.16
Story2	B21	1.2DL + 1.2LL + 1.2BL	Max	59.00	2581.36	4.14	6.35	3.01	4864.29
Story3	B21	1.2DL + 1.2LL + 1.2BL	Max	41.34	2439.28	3.91	6.00	2.42	4603.48
Story4	B21	1.2DL + 1.2LL + 1.2BL	Max	18.02	2184.95	3.56	4.60	2.12	4126.21
Story5	B21	1.2DL + 1.2LL + 1.2BL	Max	37.02	2599.42	3.63	6.96	2.15	4899.57
Story6	B21	1.2DL + 1.2LL + 1.2BL	Max	39.53	2789.08	3.03	8.15	1.79	5254.72
Story7	B21	1.2DL + 1.2LL + 1.2BL	Max	23.58	2544.18	2.04	6.86	1.21	4799.78
Story8	B21	1.2DL + 1.2LL + 1.2BL	Max	30.95	1893.87	3.75	3.40	2.29	3590.82
Story9	B21	1.2DL + 1.2LL + 1.2BL	Max	92.04	1066.44	4.54	-1.01	3.02	2044.41
Story10	B21	1.2DL + 1.2LL + 1.2BL	Max	-2.23	419.06	8.07	-7.45	4.21	866.03

Beam - Blast Shear

ELEMENT - BEAM									
Story	Beam	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	B21	1.2DL + 1.2LL + 1.2BL	Max	316.5852	27.6896	7.8265	6.0015	0.3929	238.2737
Story2	B21	1.2DL + 1.2LL + 1.2BL	Max	203.0471	20.6005	10.2688	7.7328	0.5846	175.4104
Story3	B21	1.2DL + 1.2LL + 1.2BL	Max	132.6202	17.1225	13.7445	10.2643	0.3086	142.4816
Story4	B21	1.2DL + 1.2LL + 1.2BL	Max	75.1551	15.5877	21.5428	12.8876	0.3307	98.0902
Story5	B21	1.2DL + 1.2LL + 1.2BL	Max	40.5326	25.6848	40.8423	21.7466	28.4784	124.5922
Story6	B21	1.2DL + 1.2LL + 1.2BL	Max	32.9161	38.2745	24.7674	28.2213	18.2712	172.5352
Story7	B21	1.2DL + 1.2LL + 1.2BL	Max	210.5024	36.9398	17.0489	29.3372	13.0911	171.2003
Story8	B21	1.2DL + 1.2LL + 1.2BL	Max	345.1593	23.3784	3.9069	24.847	4.4197	117.6958
Story9	B21	1.2DL + 1.2LL + 1.2BL	Max	699.1967	19.8128	6.7812	16.2365	7.848	62.8908
Story10	B21	1.2DL + 1.2LL + 1.2BL	Max	540.2117	25.4599	18.7062	34.2477	10.362	246.1151

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue XI Nov 2020- Available at www.ijraset.com

Beam - Earthquake

ELEMENT - BEAM									
Story	Beam	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	B21	1.2DL + 1.2LL + 1.2EQL	Max	107.3659	601.6674	1.4402	3.1228	1.165	1125.433
Story2	B21	1.2DL + 1.2LL + 1.2EQL	Max	5.7911	654.9196	0.6196	3.1704	0.5119	1215.616
Story3	B21	1.2DL + 1.2LL + 1.2EQL	Max	3.3752	628.51	0.529	3.1576	0.3381	1166.736
Story4	B21	1.2DL + 1.2LL + 1.2EQL	Max	2.6663	579.8929	0.4844	2.958	0.2909	1076.302
Story5	B21	1.2DL + 1.2LL + 1.2EQL	Max	2.3496	518.0877	0.5125	2.6809	0.3037	961.5846
Story6	B21	1.2DL + 1.2LL + 1.2EQL	Max	2.5756	444.7607	0.5603	2.3411	0.3304	825.4881
Story7	B21	1.2DL + 1.2LL + 1.2EQL	Max	2.3766	360.3451	0.6185	1.9419	0.3649	668.7989
Story8	B21	1.2DL + 1.2LL + 1.2EQL	Max	2.4595	265.0619	0.6796	1.4975	0.4105	492.0867
Story9	B21	1.2DL + 1.2LL + 1.2EQL	Max	11.6485	160.7217	0.7654	0.9713	0.4888	297.302
Story10	B21	1.2DL + 1.2LL + 1.2EQL	Max	2.3976	70.8443	0.9579	0.4995	0.5322	135.0978

Beam - Earthquake Shear Wall

ELEMENT - BEAM									
Story	Beam	Combination		P	V2	V3	T	M2	M3
				kN	kN	kN	kN-m	kN-m	kN-m
Story1	B21	1.2DL + 1.2LL + 1.2EQL	Max	147.7333	7.5489	0.7873	1.8007	0.7716	34.1029
Story2	B21	1.2DL + 1.2LL + 1.2EQL	Max	106.6552	5.1271	0.3743	2.4433	0.9483	27.9399
Story3	B21	1.2DL + 1.2LL + 1.2EQL	Max	79.9459	3.8523	0.6425	2.789	0.6188	24.4258
Story4	B21	1.2DL + 1.2LL + 1.2EQL	Max	57.6845	2.6142	0.7101	2.7758	0.4834	20.8965
Story5	B21	1.2DL + 1.2LL + 1.2EQL	Max	39.7045	1.4643	0.5104	2.6357	0.4671	17.3133
Story6	B21	1.2DL + 1.2LL + 1.2EQL	Max	27.9841	0.3701	0.2018	2.3978	0.5247	13.6022
Story7	B21	1.2DL + 1.2LL + 1.2EQL	Max	22.8317	-0.6454	-0.1271	2.068	0.7326	9.6556
Story8	B21	1.2DL + 1.2LL + 1.2EQL	Max	21.0361	2.9196	1.5799	1.6395	0.906	7.0224
Story9	B21	1.2DL + 1.2LL + 1.2EQL	Max	37.8337	3.9638	2.8277	0.9391	1.6347	10.6914
Story10	B21	1.2DL + 1.2LL + 1.2EQL	Max	83.0324	7.6822	2.7493	2.3543	2.1368	29.1245

Base Shear

Conditions	10 storey building	15 storey building	20 storey building
Unit	kn	kn	kn
Blast Load	65700	61314	42991
Blast Load with shear wall	138683	94425	66061
Seismic Load	17727	24129	28224
Seismic Load with shear wall	17730	41978	46530

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VII. CONCLUSIONS

After completing the current work for the analysis of building subjected to blast load and Earthquake load of similar magnitude for a ten, fifteen, and twenty storey building. Our study done in the above chapters and all the analysis results and outputs have been obtained and with the obtained results we have come to the following conclusions.

A. Our comparative analysis has given us quite clear results that a building of different floor heights is more damaged by a blast load as compared to an earthquake load.

B. The building elements are compared such that a particular similar element is selected in all the floors and then they are compared for the moments and shear forces on to it.

C. The results for the elements show that higher values are obtained for a building with higher stories and building which is subjected to blast loads.

D. A building having more no. of Stories is more sensitive for the dynamic loads and proper design and quality should be maintained for the high rise building.

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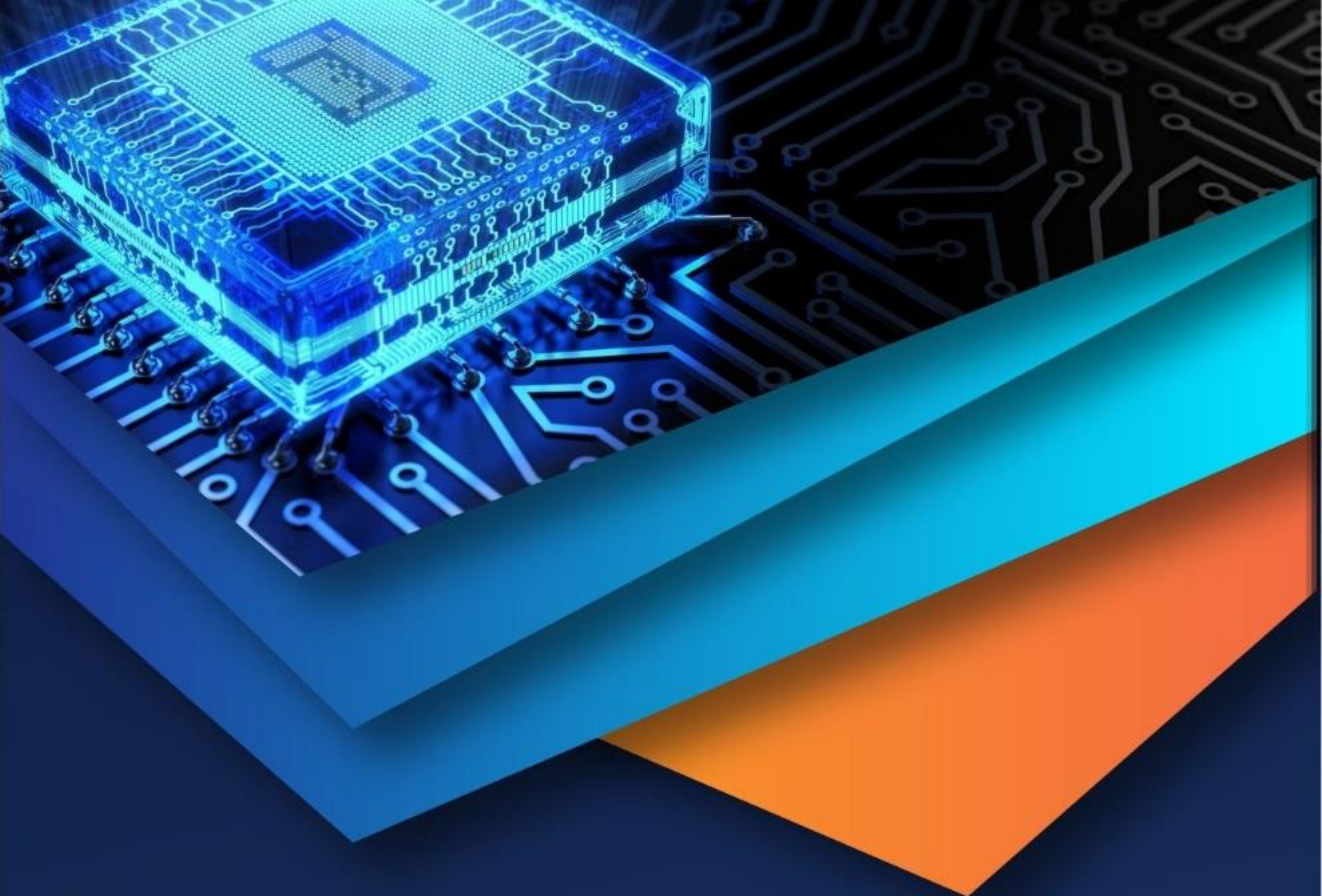

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