COMPARASION OF MULTI STORED STRUCTURE WITH COMPOSITE COLUMN AND STEEL COLUMN BY USING ETABS

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Abstract: The present work seeks to research in the unstable behavior of the typical standard moment resisting framed structure with composite columns and standard steel column and examine key style problems involved. The present study deals with the unstable behavior of a typical G+12 stored framed structure assessed through equivalent static technique of the study as per code IS 1893:2002 for moderate and unstable zone 3 exploitation in ETABS commercial software package . the analysis square measured performed on a collection two form of a standard moment resisting framed 3D area models with totally different column varieties – normal concrete column , steel column and composite column. The analysis dispensed and therefore the results square measured compared in terms of important earthquake response parameters like storey Drifts, , bending moments , and storey overturning moments.

Key Words: unstable behavior ,Composite columns, steel columns, multistory structure , Seismic

I.INTRODUCTION

Structural engineers do not traditionally consider fire as a load on the structural frame. This is in contrast to other loads they must consider. Seismic design relies on modeling, risk analysis and changes to the structural stiffness. Wind design relies on additional structural members and wind tunnel tests. Fire design relies on very simple, single element tests and adding insulating material to the frame. Thermal induced forces are generally not calculated or designed. Natural disasters are inevitable and it is not possible to get full control over them. The history of human civilization reveals that man has been combating with natural disasters from its origin but natural disasters like floods, cyclones, earthquakes, volcanic eruptions have various times not only disturbed the normal life pattern but also caused huge losses to life and property and interrupted the process of development. Building construction is that the engineering offers with the development of constructing akin to residential buildings in a really effortless constructing will probably be outline as an enclose area via partitions with roof, food, fabric and accordingly the basic desires of contributors. Inside the early earlier interval people lived in caves, over bushes or beneath bushes, to safeguard themselves from wild animals, rain, sun, etc. Because the occasions handed as people being started dwelling in huts created from trees branches. The shelters of these previous are developed at the moment into wonderful residences. Rich individuals reside in sophisticated houses.Structures are the primary indicator of social growth of the county. Every human has wished to possess cozy houses on an average most commonly one spends his two-third life occasions within the houses. . A constructing body consists of variety of bays and STOREY. A multi-storey, multi-paneled body would be a tricky statically intermediate structure. A design of R.C building of G+20 flooring body work is preoccupied. The constructing in arrange (40×28) consists of columns designed monolithically forming a community. The scale of constructing is 40x28m. The amounts of columns are eighty five. It is residential advanced.The design is created by using ETABS software. The constructing subjected to every the vertical hundreds additionally as horizontal masses. The vertical load consists of lifeless load of structural elements equivalent to beams, columns, slabs etc and are living loads. The horizontal load includes the wind forces so building is intended for lifeless load, reside load and wind load as per IS 875. The constructing is meant as two dimensional vertical body and analyzed as per IS 456-2000. Composite columns are often used in structures due to the ease and speed of erection, and high performance in fire situation. Concrete filled tubes are steel tubes that are in site filled with reinforced concrete. In normal situation column works as composite while in fire situation majority of the load is carried by the reinforced concrete core. There are numerous publications about this type of columns but all of them use very simplified methods. Especially regarding the calculation of the neutral axis of circular columns. Also the shear resistance of the column is often omitted.

COMPOSITE COLUMNS

Composite columns are constructed using various combinations of structural steel and concrete in an attempt to utilize the beneficial properties of each material. The interactive and integral behavior of concrete and the structural steel elements makes the composite column a very stiff, more ductile, cost effective and consequently a structurally efficient member in building and bridge constructions.

In early 1900's, concrete was used to encase steel columns and beams, and as a filler material for floor systems. In 1907, the first experimental test was carried out by Emperger on built up composite columns under concentric load. Experimental investigations on concrete encased steel composite columns have been conducted by different researchers since long before. Analytical method was developed in early 1900 to investigate the behavior of FEC columns.

STEEL BUILDINGS

A steel building is a metal structure fabricated with steel for the internal support and for exterior cladding, as opposed to steel framed buildings which generally use other materials for floors, walls, and external envelope. Steel buildings are used for a variety of purposes including storage, work spaces and living accommodation. They are classified into specific types depending on how they are used.

TYPES OF STEEL BUILDINGS

Some common types of steel buildings are "straight-walled" and "arch," or Nissen or Quonset hut. Further, the structural type may be classed as clear span or multiple span. A clear span building does not have structural supports (e.g. columns) in the interior occupied space.

Straight-walled and arch type refer to the outside shape of the building. More generally, these are both structural arch forms if they rely on a rigid frame structure. However, curved roof structures are typically associated with the arch term.Steel arch buildings may be cost efficient for specific applications. They are commonly used in the agricultural industry. Straight-walled buildings provide more usable space when compared to arch buildings. They are also easier to blend into existing architecture. Straight-walled buildings are commonly used for commercial, industrial, and many other occupancy types.

Clear span refers to the internal construction. Clear span steel buildings utilize large overhead support beams, thus reducing the need for internal supporting columns. Clear span steel buildings tend to be less cost efficient than structures with interior columns. However, other practical considerations may influence the selection of framing style such as an occupancy where interior structural obstructions are undesirable (e.g. aircraft hangars or sport arenas).Long Bay buildings are designed for use in bay spans of over 35'. They use prefabricated metal frames combined with conventional joists to provide larger openings and clearances in buildings.

OBJECTIVE OF THE PROJECT:

1. To study irregularities in structures analyze and design of G+13 storied structure as per code (IS1893:2002) provision by using cross sections of the columns I section

2. To analyze the buildings in ETABS carry out the storey deflection, storey drift, storey shear force and base shear of structures using response spectrum analysis and compare the results

3. Ductility-based earthquake-resistant design as per IS 13920.

4. Comparison of steel building and general building , with composite building and results are compared .

5.to analyze the structure regarding to storey drift , storey force, storey moment, and building torsion and comparing all the three general, steel and composite structure

6.to find the best structure that using both residential and as well as commercial to minimize the structural sizes .i.e columns . beams .

II.LITERATURE REVIEW

Dr. K. R. C. Reddy, Sandip A. Tupa et., al. (2014) In the present study a multistoried building is analyzed for earthquake loads in various zones based on IS 1893 and for wind loads IS 875 code is used. The wind loads are estimated based on the design wind speed of that zone with a variation of 20%. The wind loads so obtained on the building have been compared with that of earthquake loads. Finally it is found the wind loads are more critical than the earthquake loads in most of the cases.The wind loads and earthquake loads are estimated for a twelve storied RC framed structure. Based on the results obtained the following conclusions are made. The wind and earthquake loads increases with height of structure. Wind loads are more critical for tall structures than the earthquake loads. Structures should be designed for loads obtained in both directions independently for critical forces of wind or earthquake.

Baldev D. Prajapati, D. R. Panchal et., al. (2013) This paper discusses the analysis & design procedure adopted for the evaluation of symmetric high rise multi-storey building (G+30) under effect of Wind and EQ. forces. In these building R.C.C., Steel, & Composite building with shear wall considered to resist lateral forces resisting system. This study examines G+30 stories building is analyzed and design under effect of wind and earthquake using ETABS. Total 21 numbers of various models are analyzed & designed & it proves that steel-concrete composite building is better option. Analytical results are compared to achieve the most suitable resisting system & economic structure against the lateral forces.Composite steel-concrete is relatively a new design concept in the Indian context and no appropriate updated codes are available for the design of same. The present work not only eliminates the costly experimentation required but also facilitates design with multiple options for the steel sections and shear connectors with adequacy checks. Keeping span and loading unaltered, smaller structural steel sections are required in composite construction compared to non-composite construction. This reduction in overall weight of the composite structure compared to other structure results in less cost of structure and foundation.

III.METHODS OF ANALYSIS OF STRUCTURES

The seismic analysis should be carried out for the buildings that have lack of resistance to earthquake forces. Seismic analysis will consider dynamic effects hence the exact analysis sometimes become complex This type of analysis will be carried out for regular and low rise buildings and this method will give good results for this type of buildings. Dynamic analysis will be carried out for the building as specified by code IS 1893-2002 (part1). Dynamic analysis will be carried out either by Response spectrum method or site specific Time hiSTOREY method. Following methods are adopted to carry out the analysis procedure.

A.EQUIVALENT STATIC ANALYSIS:

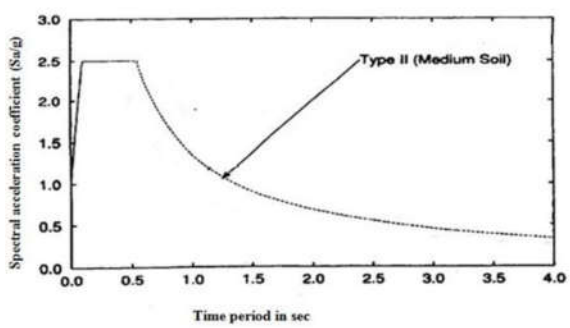
This approach defines a series of forces acting on building to represent the effect of earthquake ground motion, typically defined by a seismic design response spectrum. It assumes that the building responds in its fundamental mode. For this to be true, the building must be low-rise and must not twist significantly when the ground moves. The response is read from a design response spectrum, given the natural frequency of the building (either calculated or defined by the building code). The applicability of this method is extended in many building codes by applying factors to account for higher buildings with some higher modes, and for low levels of twisting. To account for effects due to "yielding" of the structure, many codes apply modification factors that reduce the design forces (e.g., force reduction factors).

B.LINEAR DYNAMIC ANALYSIS:

Static procedures are appropriate when higher mode effects are not significant. This is generally true for short, regular buildings. Therefore, for tall buildings, buildings with torsional irregularities, or non-orthogonal systems, a dynamic procedure is required. In the linear dynamic procedure, the building is modeled as a multi-degree-of-freedom (MDOF) system with a linear elastic stiffness matrix and an equivalent viscous damping matrix.In linear dynamic analysis, the response of the structure to ground motion is calculated in the time domain, and all phase information is therefore maintained. Only linear properties are assumed. The analytical method can use modal decomposition as a means of reducing the degrees of freedom in the analysis.

C. RESPONSE SPECTRUM METHOD:

The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should beentered from IS 1893-2002(part1). The standard response spectra for type of soil considered is applied to building for the analysis in ETABS 2013 software. Following diagram shows the standard response spectrum for medium soil type and that can be given in the form of timeperiod versus spectral acceleration coefficient (Sa/g).



This approach permits the multiple modes of response of a building to be taken in to account (in the frequency domain). This is required in many building codes for all except very simple or very complex structures. The response of a structure can be defined as a combination of many special shapes (modes) that in a vibrating string correspond to the "harmonic" computer analysis can be used to determine these modes for a structure. For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. In this we have to calculate the magnitude of forces in all directions i.e. X, Y & Z and then see the effects on the building. Combination methods include the following:

- absolute - peak values are added together
- square root of the sum of the squares (SRSS)

- complete quadratic combination (CQC) - a method that is an improvement on SRSS for closely spaced modes

The result of a response spectrum analysis using the response spectrum from a ground motion is typically different from that which would be calculated directly from a linear dynamic analysis using that ground motion directly, since phase information is lost in the process of generating the response spectrum.

NON LINEAR STATIC ANALYSIS:

As the performance objective of the structure implies greater inelastic demands, the uncertainty with linear procedures increases to a point that requires a high level of conservatism in demand assumptions and acceptability criteria to avoid unintended performance. Therefore, procedures incorporating inelastic analysis can reduce the uncertainty and conservatism. This approach is also known as "pushover" analysis. A pattern of forces is applied to a structural model that includes non-linear properties (such as steel yield), and the total force is plotted against a reference displacement to define a capacity curve. This can then be combined with a demand curve (typically in the form of an acceleration-displacement response spectrum (ADRS)). This essentially reduces the problem to a single degree of freedom (SDOF) system.

Nonlinear static procedures use equivalent SDOF structural models and represent seismic ground motion with response spectra. STOREY drifts and component actions are related subsequently to the global demand parameter by the pushover or capacity curves that are the basis of the non-linear static procedures.

NON LINEAR DYNAMIC ANALYSIS

In non-linear dynamic analysis, the non-linear properties of the structure are considered as part of a time domain analysis. This approach is the most rigorous, and is required by some building codes for buildings of unusual configuration or of special importance. However, the calculated response can be very sensitive to the characteristics of the individual ground motion used as seismic input; therefore, several analyses are required using different ground motion records to achieve a reliable estimation of the probabilistic distribution of structural response. Since the properties of the seismic response depend on the intensity, or severity, of the seismic shaking, a comprehensive assessment calls for numerous nonlinear dynamic analyses at various levels of intensity to represent different possible earthquake scenarios. This has led to the emergence of methods like the Incremental Dynamic Analysis.

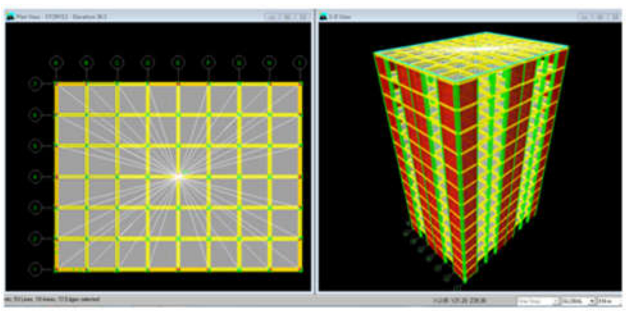
PROBLEM STATEMENT

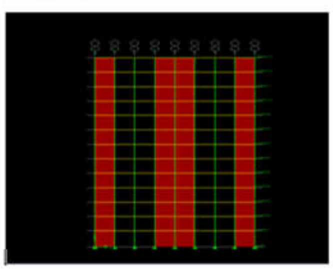
S.NO	DETAILS OF THE STRUCTURE	MEASUREMENTS
1	GRID DATA NO OF BAYS IN X DIRECTION NO OF BAYS IN X DIRECTION BAY TO BAY SPACING	9 NOS 7 NOS 3 MTS
2	BEAM SIZE DEAD LOAD ON THE BEAM BEAM LENTH	0.35 X0.35 MTS 2.94 KN 3 MTS
3	COLUMN SIZE DEAD LOAD ON THE COLUMN COLUMN LENGTH	0.45 X0.45 MTS 4.86 KN 3 MTS
4	SLAB DETAILS A.SLAB THICKNESS B. LOADS ACTING ON SLAB C. LIVE ON THE SLAB D. FLOOR LOAD ON THE SLAB E. EARTHQUAKE LOAD ON THE STRUCTURE F. WIND LOAD	0.12 MTS 3.75 KN 3 KN 1.5 KN 1.5 KN (50% OF LIVE LOAD) 39KMPH, TC-3.
5	DIAPHRAGM	RIGID

	STEEL BUILDING DETAILS	
6	COLUMN OUT SIDE (T3) TOP FLANGE WIDTH (T2) TOP FLANGR THICKNESS(TF) BOTTOM FLANGE WIDTH (T2 B) BOTTOM FLANGE THICKNESS (TFB)	I SECTION 0.4 MTS 0.2 MTS 0.05 MTS 0.2 MTS 0.05 MTS
7	BEAM	0.30X0.30 MTS
8	**LOADS AS GENERAL BUILDING**	
9	**COMPOSITE COLUMN BUILDING**	
10	COLUMN (1) OUT SIDE (T3) TOP FLANGE WIDTH (T2) TOP FLANGR THICKNESS(TF) BOTTOM FLANGE WIDTH (T2 B) BOTTOM FLANGE THICKNESS (TFB)	I SECTION 0.4 MTS 0.2 MTS 0.05 MTS 0.2 MTS 0.05 MTS
11	COLUMN SIZE DEAD LOAD ON THE COLUMN COLUMN LENGTH	0.45 X0.45 MTS 4.86 KN 3 MTS
12	SLAB DETAILS A.SLAB THICKNESS B. LOADS ACTING ON SLAB C. LIVE ON THE SLAB D. FLOOR LOAD ON THE SLAB E. EARTHQUAKE LOAD ON THE STRUCTURE F. WIND LOAD	0.12 MTS 3.75 KN 3 KN 1.5 KN 1.5 KN (50% OF LIVE LOAD) 44 KMPH, TC-3.
13	DIAPHRAGM	RIGID

Models in ETABS

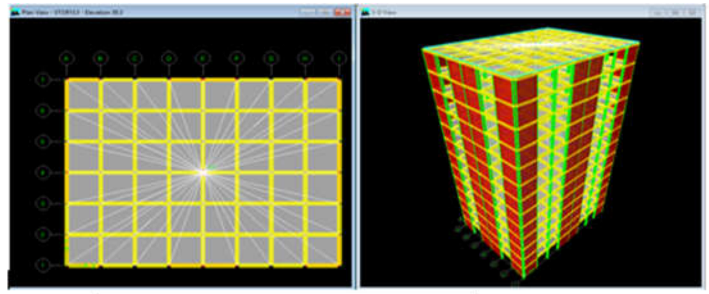
General Building

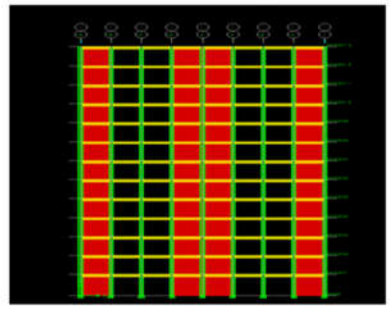




plan and 3 D view of general building
Elevation of the general building

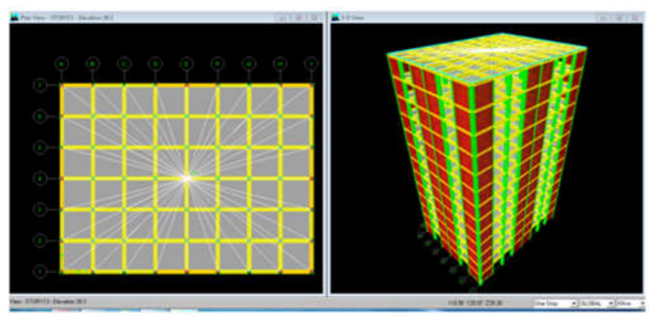
Steel building

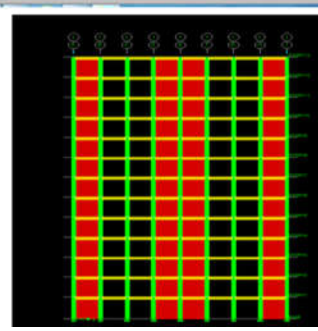




plan and 3 D view of Steel building
Elevation of the building

Composite building



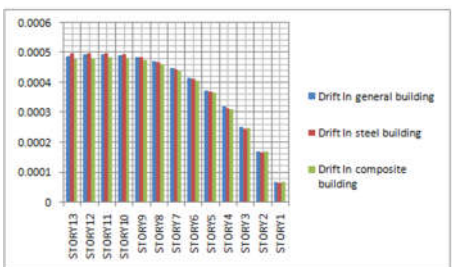


plan and 3 D view of the composite building
Elevation of the composite building

IV.RESULTS AND ANALYSIS

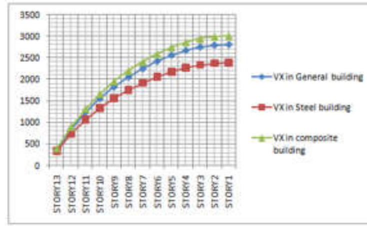
STOREY DRIFT

STOREY	Drift In general building	Drift In steel building	Drift In composite building
STOREY13	0.00049	0.000497	0.000479
STOREY12	0.000494	0.000499	0.000483
STOREY11	0.000495	0.000499	0.000484
STOREY10	0.000493	0.000495	0.000482
STOREY9	0.000486	0.000486	0.000475
STOREY8	0.000471	0.00047	0.000461
STOREY7	0.000449	0.000446	0.000439
STOREY6	0.000417	0.000412	0.000408
STOREY5	0.000374	0.000369	0.000366
STOREY4	0.00032	0.000314	0.000313
STOREY3	0.000253	0.000247	0.000248
STOREY2	0.000172	0.000167	0.000169
STOREY1	0.00007	0.000067	0.00007



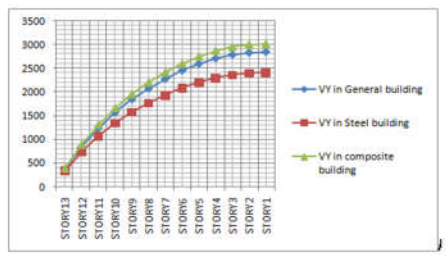
SHEAR FORCE IN X DIRECTION

STOREY	VX in General building	VX in Steel building	VX in composite building
STOREY13	378.06	338.98	398.37
STOREY12	845.32	736.58	898.97
STOREY11	1235.02	1065.86	1317.43
STOREY10	1557.65	1336.72	1664.54
STOREY9	1826.37	1561.4	1953.91
STOREY8	2054.31	1751.97	2199.21
STOREY7	2251.32	1917.35	2410.77
STOREY6	2421.81	2061.37	2593.37
STOREY5	2564.84	2182.91	2746.19
STOREY4	2676.44	2278.14	2865.3
STOREY3	2753.17	2343.72	2947.22
STOREY2	2795.54	2379.88	2992.56
STOREY1	2810.59	2392.59	3008.81



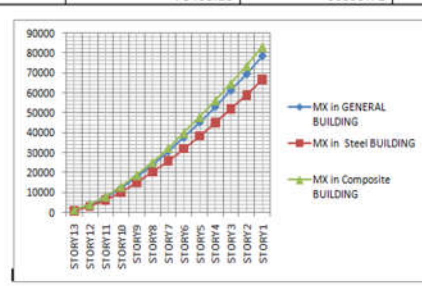
SHEAR FORCE IN Y DIRECTION

STOREY	VY in General building	VY in Steel building	VY in composite building
STOREY13	381.28	340.91	399.73
STOREY12	853.75	741.61	902.58
STOREY11	1248.97	1074.23	1323.47
STOREY10	1577.09	1348.42	1673
STOREY9	1850.93	1576.2	1964.65
STOREY8	2083.29	1769.42	2211.92
STOREY7	2283.79	1936.85	2425.06
STOREY6	2456.78	2082.3	2608.78
STOREY5	2601.44	2204.74	2762.36
STOREY4	2713.99	2300.47	2881.91
STOREY3	2791.21	2366.29	2964.07
STOREY2	2833.79	2402.54	3009.53
STOREY1	2848.89	2415.27	3025.82



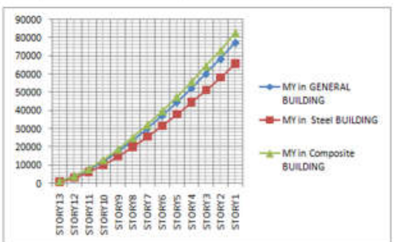
BENDING MOMENT IN X DIRECTION

STOREY	MX in GENERAL BUILDING	MX in Steel BUILDING	MX in Composite BUILDING
STOREY13	1143.833	1022.734	1199.193
STOREY12	3703.063	3245.706	3904.82
STOREY11	7441.107	6460.152	7865.989
STOREY10	12147.05	10481.85	12858.59
STOREY9	17643.94	15158.47	18694.16
STOREY8	23791.57	20371.81	25222.98
STOREY7	30482.38	26033.62	32329.89
STOREY6	37631.58	32076.19	39924.03
STOREY5	45164.9	38440.82	47925.99
STOREY4	53008.43	45068.29	56257.11
STOREY3	61084.48	51894.9	64834.98
STOREY2	69315.12	58855.48	73577.06
STOREY1	78468.18	66599.72	83299.09



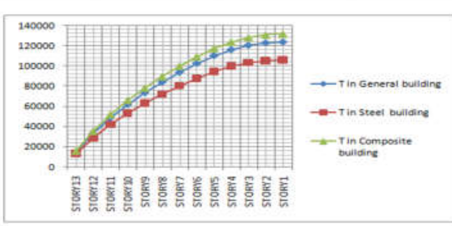
BENDING MOMENT IN Y DIRECTION

STOREY	MY in GENERAL BUILDING	MY in Steel BUILDING	MY in Composite BUILDING
STOREY13	1134.17	1016.932	1195.117
STOREY12	3668.054	3224.77	3889.889
STOREY11	7364.101	6414.008	7832.895
STOREY10	12011.25	10400.28	12799.9
STOREY9	17433.34	15031.75	18602.75
STOREY8	23491.91	20191.33	25092.47
STOREY7	30081.89	25792.36	32155
STOREY6	37121.42	31768.97	39700.77
STOREY5	44539.17	38064.31	47651.68
STOREY4	52263.84	44620.72	55930.22
STOREY3	60219.73	51375.7	64454.87
STOREY2	68330.26	58264.84	73143.69
STOREY1	77352.07	65931.11	82807.46



BUILDING TORSION

STOREY	T in General building	T in Steel building	T in Composite building
STOREY13	14852.45	13285.09	15582.14
STOREY12	33293.33	28935.96	35224.89
STOREY11	48859.77	42062.98	51815.72
STOREY10	62117.85	53201.64	65945.66
STOREY9	73743.5	62981.02	78325.25
STOREY8	84296.57	71908.01	89548.18
STOREY7	94029.24	80196.91	99887.35
STOREY6	102861.2	87759.76	109265.1
STOREY5	110490.1	94314.1	117367.6
STOREY4	116554.8	99530.55	123815.9
STOREY3	120797.1	103176.1	128336.9
STOREY2	123196.5	105230.4	130905
STOREY1	124085.3	105981.8	131867.3



V.CONCLUSIONS

I. The STOREY Drifts in the composite building shows that the less values from top STOREY to the sixth STOREY and the lateral displacement increases from sixth STOREY to first STOREY and the steel building having higher displacements through the structure.

II. The shear force in the X direction as compared to the general building, composite building and steel building, the composite building having higher values from the top STOREY to the bottom STOREY. The steel building shows less shear forces in X direction and general building shows that moderate shear force in the X direction.

III. The shear force in the Y direction as compared to the general building, composite building and steel building, the composite building having higher values from the top STOREY to the bottom STOREY. The steel building shows less shear forces in Y direction and general building shows that moderate shear force in the Y direction.

IV. The Bending moment in the X direction as compared to the general building, composite building and steel building, the composite building having higher values from the top STOREY to the bottom STOREY. The steel building shows less shear forces in X direction and general building shows that moderate shear force in the X direction.

V. The Bending moment in the Y direction as compared to the general building, composite building and steel building, the composite building having higher values from the top STOREY to the bottom STOREY. The steel building shows less shear forces in Y direction and general building shows that moderate shear force in the Y direction.

VI. The building torsion also shows that the less values in steel building as compared to the composite, general buildings. The Building torsion shows higher values in the composite building then that of steel building.

VII. By considering all the above conclusions that the composite building shows the best in the structure as compared to the general building and economical point of view the composite building shows that economical towards steel building.

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