International Journal of Scientific Engineering and Technology Research

ISSN 2319-8885
Vol.05,Issue.41
November-2016,
Pages:8563-8569

www.ijsetr.com

Analysis & Design of Commercial Building (C+G+15) By Shear Wall Design and Optimization using E-Tabs

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Abstract: The main objective of this project is to check and compare the seismic response of multi-storied building for different location of shear wall, so that one can choose the best alternative for construction in earthquake-prone area. Different location of shear wall in R.C. Building will be modeled in E-TABS software and the results in terms of natural period, frequency, storey displacement, storey drift, storey shear is compared. Looking to the past records of earthquake, there is increase in the demand of earthquake resisting building which can be fulfilled by providing the shear wall systems in the building. Also due to the major earthquakes in the recent pats the codal provisions revised and implementing more weight age on earthquake design of structure. The decision regarding provision of shear wall to resist lateral forces play most important role in choosing the appropriate structural system for given project. Generally structures are subjected to two types of loads i.e. Static and Dynamic. Static loads are constant while dynamic loads are varying with time. In majority civil structures only static loads are considered while dynamic loads are not calculated because the calculations are more complicated. This may cause disaster particularly during Earthquake due to seismic waves. By providing shear wall in multi-storied building we can resist seismic waves of earthquake. The loads are calculated by E-TABS software by providing shear walls at various parts of building.

Keywords: E-TABS Software, R.C. Building, Static Loads, Dynamic Loads.

I. INTRODUCTION

The objective of structural design is to plan a structure which meets the basic requirements of structural science and those of the user. The basic requirements of structural design are safety serviceability, durability and economy. In this project work it is proposed to design a multistoried residential building consisting of 4 floors. Each floor consists of 4 flats. The building is served by one stair case. The rapid increase in population and Industrial growth and of shelter there is considerable rise in the price of shelter there is considerable rise in the price of city land and as the space is limited, horizontal expansion is difficult. Hence vertical expansion has become compulsory. This has led to the conception of apartments or flats. An apartment consists of 3 to 7 storeys and each storey may accommodate 2 to 4 resentments. The land and other amenities of apartments are shared by all the occupants. Multi storeyed building has been broadly classified into five types

- Load bearing constructions.
- Composite Constructions.
- Framed Constructions.
- Reinforced Concrete framed Constructions.
- Steel framed Constructions.

The first method has got the limitation that it will be economical only up to 2 to 3 storeys. By means of composite constructions technique, the economy is achieved if the number is in between 3 to 5. Any building having more than 6 storey's has to be dealt by means of framed constructions building having more than 6 storeys has to be dealt by means of framed constructions. Structural design is an art and science of designing serviceable and durable structures with economy and elegance. The entire process of structural planning and design requires not only imagination and conceptual thinking but also sound knowledge of science and structural engineering, knowledge of practical aspects such as relevant design codes and bye-laws backed up by example experience in tuition and judgments. Construction is an ultimate objective. An engineer is key person for successful completion of any kind of project undertaken. Hence he should adopt all means to reduce cost of project to minimum, without unduly reducing the serviceability aspect of the project. An engineering structure is an assembly of members for elements transferring the load and providing a form, space, enclosure and or a cover to serve the desired function. The objective of structural design is to plan a structure which meets the basic requirements such as serviceability, safety, durability, economy, aesthetic beauty, feasibility, practicability and acceptability.

The purpose of structural design is, providing a safe structure with user's requirements. The design should evolve a structural solution for safety and serviceability throughout the design life, which gives the greatest overall economy for the first cost and for maintenance cost. Satisfactory design must ensure the achievement an acceptable probability that the specified life of a structure is not curtailed permanently due to attainment of an unsatisfactory serviceability condition called "LIMIT STATE".The acceptable probability should be chosen in such a way that a satisfactory balance is achieved between the cost of a possible structure and serviceability failure.It is a concept including some constants which are arrived at, after a series of experimentation and also out of experience of many senior engineers, architects etc. Limit states are concerned with structural safety and serviceability and covers all forms of failure. A structure could be rendered unit in many ways and these factors are conveniently grouped into main categories.

- **Ultimate Limit State:** Collapse of the structure due to normal or severe loading on the occurrence of catastrophic events like earthquakes etc.
- **Serviceability Limit State:** Deflection, cracking and vibration.
- **Other Limit States:** Fatigue, durability, fire resistance, lighting etc.

It is often possible that a given structure is required to satisfy one or more limit states simultaneously. The usual approach then is to design on the basis of the most critical limit states and check for the other limit states. Many times, satisfying one of one limit state would satisfy other limit states. For e.g., a structure is designed to keep the limit states for cracking within acceptable value, the limit for durability is also simultaneously satisfied. The concept of limit state provides a rational approach taking into account, variations in material strength and loads. This is in fact a rationalization of the ultimate load. Four reasons to justify the design of structures by limit state method are:

- Concept of separate partial safety factors of loads of different combinations in the two limits state methods.
- Concept of separate partial safety factors of materials depending on their quality control during preparation. Thus, γ_m for concrete is 1.5 and the same for steel is 1.15. This is more logical than one arbitrary value in the name of safety factor.
- A structure designed by employing limit state method of collapse and checked for other limit states will ensure the strength and stability requirements at the collapse.

III. DESIGN OF SLABS

A. General

A Slab is a flat, two dimensional planar, structural element having thickness small compared to its other two directions. It provides a working flat surface of covering shelter in buildings. It supports mainly transverse loads and transfers them to supports primarily by bending action in one or more directions. The R.C.C. slab is essentially a bending moment, like a beam, though it differs from beam with respect to following:

- The bending is in more than one vertical plane.
- The slab is designed as a strip of 1m wide.
- Shear stresses are usually low and shear reinforcement is not provided. However it is critical in flat slabs.
- Distribution steel is provided right angles to main flexural reinforcement to take care of temperature and shrinkage stresses.

B. Method of Analysis

The behavior and strength of slab depends upon, the shape and geometry (span), support and boundary conditions, loading level (service load, ultimate load) the state stress (elastic, in elastic, plastic). It may be noted that analysis of slabs is extremely difficult due to number of variables stated above with the result that rigorous or extract method are not available and therefore analytical, semi empirical methods are developed (IS 456-2000) allow design based on experimental investigations.

C. Classifications of Slabs

Slabs are classified on the basis of the following:

- Shape (rectangular, circular & other shapes).
- Support and boundary conditions (single span) slab known as one slabs, slabs supported on 4 edges known as two way slab, overhanging or cantilever slabs, simply supported slabs, slabs fixed or continuous at one or both ends.
- Type of support: simply supported on walls, slab cast monolithically with the supporting beams, slabs supported directly on columns (flat slabs).
- Spanning direction: simply supported slabs, slabs fixed or continuous at one or both ends.
- Use (roof slab, floor slab, wall slab, foundation slab etc).
- Sectional configuration: solid slab, ribbed plate, waffle plate, stiffened plate, corrugate plate, folded plate). Solid slab is a flat horizontal plate without ribs or stiffness). This is the most common type of slab.

Selection of suitable method for design of slab and classification of slabs for this project: I.S code method which is described in Annex-D of the code IS 456-2000 is selected because of its simplicity and adaptability. Limit state method is used for design of slabs. Clause 24.4, 37.1.2 of IS code states, for analysis of slabs spanning in two directions at right angles yield line theory or any other acceptable method may be used. Alternatively the provisions given in Annex- D may be followed. The slabs are classified according to boundary conditions, ratio of Ly/Lx, loading and span.

III. DESIGN OF BEAMS

A. General

Beam is a horizontal structure member subjected to transverse loads. When load acts on the beam it bends. For simply supported beam compression acts at the two fiber and tension acts at bottom and vice versa for cantilever beam. Beam has two axes:

- Longitudinal axis and
- Transverse axis.

In the cross section the load acts at the transverse axis, and the beam is subjected to shear force and bending moment only. If load is acting eccentrically with transverse axis then the beam is subjected to shear force, mending moment and torsion. There are two ways to solve the problem. First, we may increase the depth of the beam, which may not be feasible in many situations. In those cases, it is possible to increase both the compressive and tensile forces of the beam by providing steel reinforcement in compression face and additional reinforcement in tension face of the beam without increasing the depth. The reinforced concrete beam should be able to resist tensile, compressive & shear stresses induced in it by the loads on the beam. Concrete is fairly strong in compression but very weak in tension. Plain concrete beams are thus limited in carrying capacity by the low tensile strength. Steel is very strong in tension thus the tensile weakness of concrete is overcome by the provision of reinforcing steel in the tension zone to make a reinforced concrete beam. The beam & slabs in concrete structures are cast monolithic. Hence a structure becomes a slab which is stiffened by concrete ribs in which intermediate beams act as T- beams & beams around staircase, support frames, openings act as L-beams.

The portion of slabs that act as flange of T or L beam depends on its thickness & span. The flange of the T beam provides the necessary resistance to compression while the vertical ribs provide the depth & hence the necessary lever arm. The width of the rib must be such as to accommodate the tensile reinforcement. A certain portion of the slab on either slab may be considered forming the compression flange. If the supporting beam happens to be an end beam, the flange of the beam is present only on the side of the beam in such a case it is called an L-beam. The necessity of providing steel in the compression region arises due to two main reasons:

- The main reinforcement of a singly reinforced beam cannot be increased by more than 25% of balanced section by increasing steel only on tension side.
- At the support of the continuous beam the bending moment changes its sign. Such a situation may also arise in the design of a ring beam.

The beams may be singly reinforced or doubly reinforced. In case of singly reinforced beam the main reinforcement is provided near the face of the beam subjected to tension while in the case of a doubly reinforced beam, main reinforcement is provided near the face of the beam subjected to tension & compression. A doubly reinforced beam is generally provided in the following situations:

- When the depth & breadth of the beam are restricted & it has to resist greater bending moment than a singly reinforced beam of that section would do.
- When the beam is continuous over several supports, the section of the beam at the support is usually designed as a doubly reinforced section.
- When the member is subjected to eccentric loading.

Effective Span: Since the frame is analyzed as continuous frame the effective span is the distance between the centers of supporting members.

B. Guidelines for Finalizing the Beam Positions

- Normally beams shall be provided below all the walls.
- Beams shall be provided for supporting staircase fights at floor levels and at mid landing levels.
- Beams should be positioned so to restrict the slab thickness, to 15 cm, satisfying the deflection criteria. To achieve this, secondary beams shall be provided where necessary.
- As far as possible, cantilever beams should not be projected from beams, to avoid torsion.
- Beams of equal depths shall be provided on both side of the expansion joint from aesthetical point of view.
- Where secondary beam are proposed to reduce the slab thickness and to form a grid of beams, the secondary beams shall preferably be provided of lesser depth than the depth of supporting beams so that main reinforcement of secondary beams shall always pass above the main beams.
- In toilet block provide minimum number of secondary beams so that casting slabs and beam will be simple. 'No secondary beam' condition would be ideal.
- Beams which are required to give a planer look from the underside shall be provided as Inverted Beams, e.g. canopies. Alternatively hidden beams inside the slab having the same depth as thickness of slab may be adopted. Such hidden beams can be provided in toilet blocks, under partition wall etc. where a cluster of beams can be avoided.

C. Load Imposed On a Beam

Load on beam comprises of:

- Dead load from slab on either side
- Live load from slab on either side
- Load from walls on the beams.
- Load of the beam itself

D. Dispersion of Load of Slab on Beam

The load of the slab is dispersed on the supporting beam in accordance with the clause 24.5 of code which states that the load on beams supporting solid spans, spanning in two directions at right angles & supporting uniformly distributed loads, may be assumed in accordance. In the following pages the load on the supporting beam is determined by adopting simplified formula. Since the loaded area is trapezoidal & triangular in section, the calculation of load is rather cumbersome, that is why simplified formula has to be adopted. Equivalent uniformly distributed load B.M's are calculated by using the following formula for the longer span beam which produces the same B.M's of trapezoidal load for longer span beam. For one way slab which are resting over two opposite supports, the load carried by each supporting beam is given as load on support i.e. $W_sL_x/2$ /m run.

IV. ANALYSIS RESULTS

This chapter provides analysis results

A. Structure Results

TABLE I: Base Reactions

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
Dead	1.977E-06	0	128272.1999	1499397	-2496665	-2.444E-05	0	0	0
Live	0	0	34196.2068	399753.6575	-677663	0	0	0	0
wlxy 1	-1588.7016	0	0	0	-36446.9243	18571.9215	0	0	0
wlxy 2	0	-2645.3444	0	60687.7132	-6.062E-07	-51491.6283	0	0	0
wl-xy 1	0	2645.3444	0	-60687.7132	6.063E-07	51491.6283	0	0	0
wl-xy 2	-1588.7016	0	0	0	-36446.9243	18571.9215	0	0	0
eqx	-1385.5171	0	0	0	-44744.6735	16195.1822	0	0	0
eqy	0	-1341.528	0	43324.0678	0	-26512.332	0	0	0

Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
DCon2	2.951E-06	0	243702.6101	2848726	-4761492	-3.649E-05	0	0	0

B. Story Results Table

TABLE II: Story Forces

Story	Load Case/Combo	Location	P kN	VX kN	VY kN	T kN-m	MX kN-m	MY kN-m
Story14	DCon2	Top	14540.6423	0	0	0	169980.1088	-283207
Story14	DCon2	Bottom	17409.1181	0	0	0	203499.9847	-340134
Story13	DCon2	Top	31949.7605	0	0	0	373480.0935	-623341
Story13	DCon2	Bottom	34818.2363	0	0	0	406999.9694	-680268
Story12	DCon2	Top	49358.8786	0	0	-5.371E-07	576980.0782	-963475
Story12	DCon2	Bottom	52193.246	0	0	-5.283E-07	610114.1522	-1019878
Story11	DCon2	Top	66733.8883	0	0	-8.18E-07	780094.261	-1303086
Story11	DCon2	Bottom	69603.1169	0	0	-8.064E-07	813622.6351	-1360024
Story10	DCon2	Top	84143.7592	2.949E-06	0	-3.646E-05	983602.7439	-1643231
Story10	DCon2	Bottom	87012.8599	2.949E-06	0	-3.646E-05	1017130	-1700168
Story9	DCon2	Top	101553.5022	2.985E-06	0	-3.69E-05	1187110	-1983375
Story9	DCon2	Bottom	104423.1747	2.984E-06	0	-3.689E-05	1220644	-2040320
Story8	DCon2	Top	118963.8171	2.969E-06	0	-3.67E-05	1390624	-2323527
Story8	DCon2	Bottom	121834.0718	2.969E-06	0	-3.671E-05	1424165	-2380481
Story7	DCon2	Top	136374.7141	2.966E-06	0	-3.667E-05	1594145	-2663689
Story7	DCon2	Bottom	139243.7721	2.966E-06	0	-3.668E-05	1627673	-2720624
Story6	DCon2	Top	153784.4144	2.963E-06	0	-3.664E-05	1797653	-3003832
Story6	DCon2	Bottom	156653.4832	2.963E-06	0	-3.663E-05	1831180	-3060767
Story5	DCon2	Top	171194.1255	2.958E-06	0	-3.658E-05	2001160	-3343975
Story5	DCon2	Bottom	174063.7765	2.958E-06	0	-3.658E-05	2034695	-3400919
Story4	DCon2	Top	188604.4188	2.953E-06	0	-3.651E-05	2204675	-3684127
Story4	DCon2	Bottom	191473.493	2.953E-06	0	-3.651E-05	2238203	-3741062
Story3	DCon2	Top	206014.1353	2.951E-06	0	-3.65E-05	2408183	-4024270
Story3	DCon2	Bottom	208883.1987	2.952E-06	0	-3.65E-05	2441710	-4081206
Story2	DCon2	Top	223423.841	2.952E-06	0	-3.65E-05	2611690	-4364413
	DCon2	Bottom	226292.9044	Story2	0	-3.65E-05	2645218	-4421349
Story1	DCon2	Top	240833.5467	2.951E-06	0	-3.649E-05	2815198	-4704556
Story1	DCon2	Bottom	243702.6101	2.951E-06	0	-3.649E-05	2848726	-4761492
Story14	Dead	Top	7251.1753	0	0	0	84766.2398	-140400
Story14	Dead	Bottom	9163.4926	0	0	0	107112.8238	-178352
Story13	Dead	Top	16414.6679	0	0	0	191879.0636	-318752
Story13	Dead	Bottom	18326.9851	0	0	0	214225.6476	-356703
Story12	Dead	Top	25578.1605	0	0	0	298991.8874	-497103
Story12	Dead	Bottom	27467.7387	0	0	0	321081.2701	-534706
Story11	Dead	Top	34718.9141	0	0	-5.566E-07	405847.51	-675106
Story11	Dead	Bottom	36631.7331	0	0	-5.488E-07	428199.7593	-713065
Story10	Dead	Top	43882.9085	1.974E-06	0	-2.441E-05	512965.9992	-853465
Story10	Dead	Bottom	45795.6422	1.974E-06	0	-2.441E-05	535317.2712	-891423
Story9	Dead	Top	53046.8176	1.998E-06	0	-2.47E-05	620083.511	-1031823
Story9	Dead	Bottom	54959.9326	1.998E-06	0	-2.47E-05	642439.4884	-1069786
Story8	Dead	Top	62211.108	1.987E-06	0	-2.457E-05	727205.7283	-1210187
Story8	Dead	Bottom	64124.6111	1.988E-06	0	-2.458E-05	749566.5898	-1248156
Story7	Dead	Top	71375.7865	1.986E-06	0	-2.456E-05	834332.8296	-1388557
Story7	Dead	Bottom	73288.4918	1.986E-06	0	-2.456E-05	856684.5274	-1426514
Story6	Dead	Top	80539.6671	1.984E-06	0	-2.453E-05	941450.7673	-1566914
Story6	Dead	Bottom	82452.3797	1.984E-06	0	-2.453E-05	963802.4041	-1604871
Story5	Dead	Top	89703.555	1.981E-06	0	-2.449E-05	1048569	-1745272
Story5	Dead	Bottom	91616.6557	1.981E-06	0	-2.45E-05	1070925	-1783235
Story4	Dead	Top	98867.831	1.978E-06	0	-2.445E-05	1155691	-1923635
Story4	Dead	Bottom	100780.5471	1.977E-06	0	-2.445E-05	1178043	-1961593
Story3	Dead	Top	108031.7225	1.977E-06	0	-2.444E-05	1262809	-2101993
Story3	Dead	Bottom	109944.4314	1.977E-06	0	-2.444E-05	1285161	-2139950
Story2	Dead	Top	117195.6067	1.977E-06	0	-2.445E-05	1369927	-2280350
Story2	Dead	Bottom	119108.3157	1.977E-06	0	-2.444E-05	1392279	-2318308
Story1	Dead	Top	126359.491	1.977E-06	0	-2.444E-05	1477045	-2458708
Story1	Dead	Bottom	128272.1999	1.977E-06	0	-2.444E-05	1499397	-2496665
Story14	eqx	Top	0	-233.0544	0	2724.3189	0	0
Story14	eqx	Bottom	0	-233.5734	0	2730.2013	0	-699.9417
Story13	eqx	Top	0	-470.9629	0	5505.1283	0	-699.9417
Story13	eqx	Bottom	0	-471.1867	0	5507.7455	0	-2113.1661
Story12	eqx	Top	0	-673.4889	0	7872.4556	0	-2113.1661
Story12	eqx	Bottom	0	-673.4889	0	7872.4556	0	-4133.6327
Story11	eqx	Top	0	-843.3204	0	9857.7313	0	-4133.6327
Story11	eqx	Bottom	0	-843.6519	0	9861.4839	0	-6664.0995
Story10	eqx	Top	0	-984.1223	0	11503.4927	0	-6664.0995
Story10	eqx	Bottom	0	-984.3938	0	11506.5664	0	-9616.8772
Story9	eqx	Top	0	-1096.1772	0	12836.622	0	-9616.8772
Story9	eqx	Bottom	0	-1096.3971	0	12839.1116	0	-12911.7413
Story8	eqx	Top	0	-1188.3065	0	13890.0994	0	-12911.7413
Story8	eqx	Bottom	0	-1188.4787	0	13892.0488	-5.494E-07	-16476.9191
Story7	eqx	Top	0	-1257.3167	0	14696.7253	-5.507E-07	-16476.9191
Story7	eqx	Bottom	0	-1257.4418	0	14698.1434	-7.831E-07	-20249.0569
Story6	eqx	Top	0	-1308.0151	0	15289.3144	-7.829E-07	-20249.0569
Story6	eqx	Bottom	0	-1308.1087	0	15290.3755	-8.04E-07	-24178.2426
Story5	eqx	Top	0	-1343.2301	0	15700.9242	-8.032E-07	-24178.2426
Story5	eqx	Bottom	0	-1343.2946	0	15701.6544	-6.819E-07	-28203.0289
Story4	eqx	Top	0	-1365.7719	0	15964.4016	-6.821E-07	-28203.0289
Story4	eqx	Bottom	0	-1365.8139	0	15964.8775	0	-32300.4071
Story3	eqx	Top	0	-1378.4568	0	16112.6655	0	-32300.4071
Story3	eqx	Bottom	0	-1378.48	0	16112.9283	0	-36435.8127
Story2	eqx	Top	0	-1384.0994	0	16178.615	0	-36435.8127
Story2	eqx	Bottom	0	-1384.1097	0	16178.7318	0	-40588.1262
Story1	eqx	Top	0	-1385.5145	0	16195.153	0	-40588.1262
Story1	eqx	Bottom	0	-1385.5171	0	16195.1822	0	-44744.6735
Story14	eqy	Top	0	0	-225.6551	-4457.6075	0	0
Story14	eqy	Bottom	0	0	-226.1577	-4465.3224	677.7192	0
Story13	eqy	Top	0	0	-456.0102	-9010.0506	677.7192	0
Story13	eqy	Bottom	0	0	-456.2269	-9013.3767	2046.0749	0
Story12	eqy	Top	0	0	-652.1062	-12886.2463	2046.0749	0
Story12	eqy	Bottom	0	0	-652.1062	-12886.2463	4002.3935	0
Story11	eqy	Top	0	0	-816.5457	-16138.1771	4002.3935	0
Story11	eqy	Bottom	0	0	-816.8667	-16143.1041	6452.5201	0
Story10	eqy	Top	0	0	-952.8773	-18832.3405	6452.5201	0
Story10	eqy	Bottom	0	0	-953.1402	-18836.3761	9311.5495	0

Story	Load Case/Combo	Location	P kN	VX kN	VY kN	T kN-m	MX kN-m	MY kN-m
Story9	eqy	Top	0	0	-1063.311	-21014.6921	9311.5495	0
Story9	eqy	Bottom	0	0	-1063.5239	-21017.9609	12501.8045	0
Story8	eqy	Top	0	0	-1150.5787	-22739.196	12501.8045	0
Story8	eqy	Bottom	0	0	-1150.7455	-22741.7555	15953.7908	0
Story7	eqy	Top	0	0	-1217.398	-24059.5934	15953.7908	0
Story7	eqy	Bottom	0	0	-1217.5191	-24061.4532	19606.1664	0
Story6	eqy	Top	0	0	-1266.4867	-25029.6367	19606.1664	0
Story6	eqy	Bottom	0	0	-1266.5774	-25031.0284	23405.7626	0
Story5	eqy	Top	0	0	-1300.5837	-25703.394	23405.7626	0
Story5	eqy	Bottom	0	0	-1300.6461	-25704.3517	27307.6065	0
Story4	eqy	Top	0	0	-1322.4098	-26134.6607	27307.6065	0
Story4	eqy	Bottom	0	0	-1322.4505	-26135.2348	31274.8964	0
Story3	eqy	Top	0	0	-1334.692	-26377.3248	31274.8964	0
Story3	eqy	Bottom	0	0	-1334.7145	-26377.6696	35279.0063	0
Story2	eqy	Top	0	0	-1340.1554	-26485.2468	35279.0063	0
Story2	eqy	Bottom	0	0	-1340.1654	-26485.4	39299.4873	0
Story1	eqy	Top	0	0	-1341.5256	-26512.2937	39299.4873	0
Story1	eqy	Bottom	0	0	-1341.528	-26512.332	43324.0678	0
Story14	Live	Top	2442.5862	0	0	0	28553.8327	-48404.4685
Story14	Live	Bottom	2442.5862	0	0	0	28553.8327	-48404.4685
Story13	Live	Top	4885.1724	0	0	0	57107.6654	-96808.9369
Story13	Live	Bottom	4885.1724	0	0	0	57107.6654	-96808.9369
Story12	Live	Top	7327.7586	0	0	0	85661.498	-145213
Story12	Live	Bottom	7327.7586	0	0	0	85661.498	-145213
Story11	Live	Top	9770.3448	0	0	0	114215.3307	-193618
Story11	Live	Bottom	9770.3448	0	0	0	114215.3307	-193618
Story10	Live	Top	12212.931	0	0	0	142769.1634	-242022
Story10	Live	Bottom	12212.931	0	0	0	142769.1634	-242022
Story9	Live	Top	14655.5172	0	0	0	171322.9961	-290427
Story9	Live	Bottom	14655.5172	0	0	0	171322.9961	-290427
Story8	Live	Top	17098.1034	0	0	0	199876.8287	-338831
Story8	Live	Bottom	17098.1034	0	0	0	199876.8287	-338831
Story7	Live	Top	19540.6896	0	0	0	228430.6614	-387236
Story7	Live	Bottom	19540.6896	0	0	0	228430.6614	-387236
Story6	Live	Top	21983.2758	0	0	0	256984.4941	-435640
Story6	Live	Bottom	21983.2758	0	0	0	256984.4941	-435640
Story5	Live	Top	24425.862	0	0	0	285538.3268	-484045
Story5	Live	Bottom	24425.862	0	0	0	285538.3268	-484045
Story4	Live	Top	26868.4482	0	0	0	314092.1595	-532449
Story4	Live	Bottom	26868.4482	0	0	0	314092.1595	-532449
Story3	Live	Top	29311.0344	0	0	0	342645.9921	-580854
Story3	Live	Bottom	29311.0344	0	0	0	342645.9921	-580854
Story2	Live	Top	31753.6206	0	0	0	371199.8248	-629258
Story2	Live	Bottom	31753.6206	0	0	0	371199.8248	-629258
Story1	Live	Top	34196.2068	0	0	0	399753.6575	-677663
Story1	Live	Bottom	34196.2068	0	0	0	399753.6575	-677663
Story14	wlxy 1	Top	0	-67.3236	0	787.0132	0	0
Story14	wlxy 1	Bottom	0	-67.3236	0	787.0132	0	-201.9709
Story13	wlxy 1	Top	0	-200.7807	0	2347.1265	0	-201.9709
Story13	wlxy 1	Bottom	0	-200.7807	0	2347.1265	0	-604.313
Story12	wlxy 1	Top	0	-332.4604	0	3886.4619	0	-604.313
Story12	wlxy 1	Bottom	0	-332.4604	0	3886.4619	0	-1801.6942
Story11	wlxy 1	Top	0	-462.3746	0	5405.1585	0	-1801.6942

Story	Load Case/Combo	Location	P kN	VX kN	VY kN	T kN-m	MX kN-m	MY kN-m
Story11	wlxy 1	Bottom	0	-462.3746	0	5405.1585	0	-3188.8178
Story10	wlxy 1	Top	0	-590.245	0	6899.9642	0	-3188.8178
Story10	wlxy 1	Bottom	0	-590.245	0	6899.9642	0	-4959.5528
Story9	wlxy 1	Top	0	-714.9371	0	8357.6152	0	-4959.5528
Story9	wlxy 1	Bottom	0	-714.9371	0	8357.6152	0	-7104.3643
Story8	wlxy 1	Top	0	-836.2055	0	9775.2423	0	-7104.3643
Story8	wlxy 1	Bottom	0	-836.2055	0	9775.2423	0	-9612.9808
Story7	wlxy 1	Top	0	-954.065	0	11153.0193	0	-9612.9808
Story7	wlxy 1	Bottom	0	-954.065	0	11153.0193	-5.355E-07	-12475.1756
Story6	wlxy 1	Top	0	-1068.1862	0	12487.0965	-5.352E-07	-12475.1756
Story6	wlxy 1	Bottom	0	-1068.1862	0	12487.0965	-5.509E-07	-15679.7342
Story5	wlxy 1	Top	0	-1178.1739	0	13772.8523	-5.503E-07	-15679.7342
Story5	wlxy 1	Bottom	0	-1178.1739	0	13772.8523	0	-19214.2557
Story4	wlxy 1	Top	0	-1283.2862	0	15001.6159	0	-19214.2557
Story4	wlxy 1	Bottom	0	-1283.2862	0	15001.6159	0	-23064.1144
Story3	wlxy 1	Top	0	-1385.2562	0	16193.6448	0	-23064.1144
Story3	wlxy 1	Bottom	0	-1385.2562	0	16193.6448	0	-27219.8829
Story2	wlxy 1	Top	0	-1486.9789	0	17382.7832	0	-27219.8829
Story2	wlxy 1	Bottom	0	-1486.9789	0	17382.7832	0	-31680.8196
Story1	wlxy 1	Top	0	-1588.7016	0	18571.9215	0	-31680.8196
Story1	wlxy 1	Bottom	0	-1588.7016	0	18571.9215	0	-36446.9243
Story14	wlxy 2	Top	0	0	-112.1005	-2182.0354	0	0
Story14	wlxy 2	Bottom	0	0	-112.1005	-2182.0354	336.3014	0
Story13	wlxy 2	Top	0	0	-334.3196	-6507.5318	336.3014	0
Story13	wlxy 2	Bottom	0	0	-334.3196	-6507.5318	1339.2603	0
Story12	wlxy 2	Top	0	0	-553.5792	-10775.42	1339.2603	0
Story12	wlxy 2	Bottom	0	0	-553.5792	-10775.42	2999.998	0
Story11	wlxy 2	Top	0	0	-769.8991	-14986.0862	2999.998	0
Story11	wlxy 2	Bottom	0	0	-769.8991	-14986.0862	5309.6954	0
Story10	wlxy 2	Top	0	0	-982.816	-19130.5127	5309.6954	0
Story10	wlxy 2	Bottom	0	0	-982.816	-19130.5127	8258.1432	0
Story9	wlxy 2	Top	0	0	-1190.4406	-23171.9268	8258.1432	0
Story9	wlxy 2	Bottom	0	0	-1190.4406	-23171.9268	11829.4651	0
Story8	wlxy 2	Top	0	0	-1392.3644	-27102.3727	11829.4651	0
Story8	wlxy 2	Bottom	0	0	-1392.3644	-27102.3727	16006.5583	0
Story7	wlxy 2	Top	0	0	-1588.612	-30922.3318	16006.5583	0
Story7	wlxy 2	Bottom	0	0	-1588.612	-30922.3318	20772.3941	-5.245E-07
Story6	wlxy 2	Top	0	0	-1778.635	-34621.1309	20772.3941	-5.242E-07
Story6	wlxy 2	Bottom	0	0	-1778.635	-34621.1309	26108.2992	-5.44E-07
Story5	wlxy 2	Top	0	0	-1961.7753	-38185.9557	26108.2992	-5.435E-07
Story5	wlxy 2	Bottom	0	0	-1961.7753	-38185.9557	31993.6252	-5.569E-07
Story4	wlxy 2	Top	0	0	-2136.7978	-41592.7683	31993.6252	-5.565E-07
Story4	wlxy 2	Bottom	0	0	-2136.7978	-41592.7683	38404.0185	-5.552E-07
Story3	wlxy 2	Top	0	0	-2306.5878	-44897.7312	38404.0185	-5.553E-07
Story3	wlxy 2	Bottom	0	0	-2306.5878	-44897.7312	45323.7818	-5.634E-07
Story2	wlxy 2	Top	0	0	-2475.9661	-48194.6797	45323.7818	-5.644E-07
Story2	wlxy 2	Bottom	0	0	-2475.9661	-48194.6797	52751.68	-5.948E-07
Story1	wlxy 2	Top	0	0	-2645.3444	-51491.6283	52751.68	-5.952E-07
Story1	wlxy 2	Bottom	0	0	-2645.3444	-51491.6283	60687.7132	-6.062E-07
Story14	wl-xy 1	Top	0	0	112.1005	2182.0354	0	0
Story14	wl-xy 1	Bottom	0	0	112.1005	2182.0354	-336.3014	0
Story13	wl-xy 1	Top	0	0	334.3196	6507.5318	-336.3014	0

Story13	wi-xy 1	Bottom	0	0	334.8196	6507.5318	-1339.2603	0
Story12	wi-xy 1	Top	0	0	553.5792	10775.42	-1339.2603	0
Story12	wi-xy 1	Bottom	0	0	553.5792	10775.42	-2999.998	0
Story11	wi-xy 1	Top	0	0	769.8991	14986.0862	-2999.998	0
Story11	wi-xy 1	Bottom	0	0	769.8991	14986.0862	-5309.6954	0
Story10	wi-xy 1	Top	0	0	982.816	19130.5127	-5309.6954	0
Story10	wi-xy 1	Bottom	0	0	982.816	19130.5127	-8258.1432	0
Story9	wi-xy 1	Top	0	0	1190.4406	23171.9268	-8258.1432	0
Story9	wi-xy 1	Bottom	0	0	1190.4406	23171.9268	-11829.4651	0
Story8	wi-xy 1	Top	0	0	1392.3644	27102.3727	-11829.4651	0
Story8	wi-xy 1	Bottom	0	0	1392.3644	27102.3727	-16006.5583	0
Story7	wi-xy 1	Top	0	0	1588.612	30922.3318	-16006.5583	0
Story7	wi-xy 1	Bottom	0	0	1588.612	30922.3318	-20772.3941	5.245E-07
Story6	wi-xy 1	Top	0	0	1778.635	34621.1309	-20772.3941	5.242E-07
Story6	wi-xy 1	Bottom	0	0	1778.635	34621.1309	-26108.2992	5.442E-07
Story5	wi-xy 1	Top	0	0	1961.7753	38185.9567	-26108.2992	5.434E-07
Story5	wi-xy 1	Bottom	0	0	1961.7753	38185.9567	-31993.6252	5.569E-07
Story4	wi-xy 1	Top	0	0	2136.7978	41592.7683	-31993.6252	5.564E-07
Story4	wi-xy 1	Bottom	0	0	2136.7978	41592.7683	-38404.0185	5.552E-07
Story3	wi-xy 1	Top	0	0	2306.5878	44897.7312	-38404.0185	5.553E-07
Story3	wi-xy 1	Bottom	0	0	2306.5878	44897.7312	-45323.7818	5.634E-07
Story2	wi-xy 1	Top	0	0	2475.9661	48194.6797	-45323.7818	5.645E-07
Story2	wi-xy 1	Bottom	0	0	2475.9661	48194.6797	-52751.68	5.948E-07
Story1	wi-xy 1	Top	0	0	2645.3444	51491.6283	-52751.68	5.963E-07
Story1	wi-xy 1	Bottom	0	0	2645.3444	51491.6283	-60687.7132	6.063E-07
Story14	wi-xy 2	Top	0	-67.3236	0	787.0132	0	0
Story14	wi-xy 2	Bottom	0	-67.3236	0	787.0132	0	-201.9709
Story13	wi-xy 2	Top	0	-200.7807	0	2347.1265	0	-201.9709
Story13	wi-xy 2	Bottom	0	-200.7807	0	2347.1265	0	-804.313
Story12	wi-xy 2	Top	0	-332.4604	0	3886.4619	0	-804.313
Story12	wi-xy 2	Bottom	0	-332.4604	0	3886.4619	0	-1801.6942
Story11	wi-xy 2	Top	0	-462.3746	0	5405.1585	0	-1801.6942
Story11	wi-xy 2	Bottom	0	-462.3746	0	5405.1585	0	-3188.8178
Story10	wi-xy 2	Top	0	-590.245	0	6899.9642	0	-3188.8178
Story10	wi-xy 2	Bottom	0	-590.245	0	6899.9642	0	-4959.5528
Story9	wi-xy 2	Top	0	-714.9371	0	8357.6152	0	-4959.5528
Story9	wi-xy 2	Bottom	0	-714.9371	0	8357.6152	0	-7104.3643
Story8	wi-xy 2	Top	0	-836.2055	0	9775.2423	0	-7104.3643
Story8	wi-xy 2	Bottom	0	-836.2055	0	9775.2423	0	-9612.9808
Story7	wi-xy 2	Top	0	-954.065	0	11153.0193	0	-9612.9808
Story7	wi-xy 2	Bottom	0	-954.065	0	11153.0193	-5.395E-07	-12475.1756
Story6	wi-xy 2	Top	0	-1068.1862	0	12487.0965	-5.352E-07	-12475.1756
Story6	wi-xy 2	Bottom	0	-1068.1862	0	12487.0965	-5.509E-07	-15679.7342
Story5	wi-xy 2	Top	0	-1178.1739	0	13772.6523	-5.503E-07	-15679.7342
Story5	wi-xy 2	Bottom	0	-1178.1739	0	13772.6523	0	-19214.2557
Story4	wi-xy 2	Top	0	-1283.2862	0	15001.6159	0	-19214.2557
Story4	wi-xy 2	Bottom	0	-1283.2862	0	15001.6159	0	-23064.1144
Story3	wi-xy 2	Top	0	-1385.2562	0	16193.6448	0	-23064.1144
Story3	wi-xy 2	Bottom	0	-1385.2562	0	16193.6448	0	-27219.8829
Story2	wi-xy 2	Top	0	-1486.9789	0	17382.7832	0	-27219.8829
Story2	wi-xy 2	Bottom	0	-1486.9789	0	17382.7832	0	-31680.8196
Story1	wi-xy 2	Top	0	-1588.7016	0	18571.9215	0	-31680.8196
Story1	wi-xy 2	Bottom	0	-1588.7016	0	18571.9215	0	-36446.9243

TABLE III: Story Stiffness

Story	Load Case	Shear X kN	Drift X mm	Stiffness X kN/m	Shear Y kN	Drift Y mm	Stiffness Y kN/m
Story14	ex 1	233.5734	0.8	307605.764	0	0	0
Story13	ex 1	471.1867	0.5	964269.855	0	0	0
Story12	ex 1	673.4889	0.5	1278365.115	0	0	0
Story11	ex 1	843.6519	1.2	705679.258	0	0	0
Story10	ex 1	984.3938	3.2	306280.354	0	0	0
Story9	ex 1	1098.3971	0.6	1838807.202	0	0	0
Story8	ex 1	1188.4787	0.6	2086774.901	0	0	0
Story7	ex 1	1257.4418	0.6	2251258.037	0	0	0
Story6	ex 1	1308.1087	0.5	2543641.072	0	0	0
Story5	ex 1	1343.2946	0.5	2724840.037	0	0	0
Story4	ex 1	1365.8139	0.4	3094802.761	0	0	0
Story3	ex 1	1378.48	0.4	3876568.245	0	0	0
Story2	ex 1	1384.1097	0.3	5450247.471	0	0	0
Story1	ex 1	1385.5171	0.1	11602305	0	0	0
Story14	ex 1	0	0.0005357	0	226.1577	0.6	359179.054
Story13	ex 1	0	0.0005562	0	456.2269	0.6	723585.593
Story12	ex 1	0	0.0006319	0	652.1062	0.6	1020120.736
Story11	ex 1	0	0.0007083	0	816.8867	37	22068.376
Story10	ex 1	0	0.0007729	0	953.1402	155.6	6124.497
Story9	ex 1	0	0.0008244	0	1063.5239	0.6	1719969.579
Story8	ex 1	0	0.000858	0	1150.7455	0.6	1898450.616
Story7	ex 1	0	0.0008695	0	1217.5191	0.6	2120602.158
Story6	ex 1	0	0.0008548	0	1266.5774	0.5	2508948.196
Story5	ex 1	0	0.00081	0	1300.6461	0.5	2741483.152
Story4	ex 1	0	0.0007352	0	1322.4505	0.4	3268672.481
Story3	ex 1	0	0.0006171	0	1334.7145	0.3	4140264.259
Story2	ex 1	0	0	0	1340.1654	0.2	5945833.465
Story1	ex 1	0	0	0	1341.528	0.1	12261315

D. Modal Results

TABLE IV: Modal Periods and Frequencies

Case	Mode	Period sec	Frequency cyc/sec	Circular Frequency rad/sec	Eigenvalue rad²/sec²
Modal	1	7.613	0.131	0.8253	0.6811
Modal	2	7.537	0.133	0.8337	0.695
Modal	3	0.939	1.065	6.6899	44.7541
Modal	4	0.93	1.076	6.7593	45.6885
Modal	5	0.871	1.149	7.2177	52.0948
Modal	6	0.843	1.186	7.4543	55.5673
Modal	7	0.561	1.782	11.1953	125.3344
Modal	8	0.339	2.949	18.5286	343.3103
Modal	9	0.338	2.961	18.6031	346.0748
Modal	10	0.336	2.974	18.6841	349.097
Modal	11	0.32	3.122	19.6178	384.8575
Modal	12	0.319	3.135	19.6984	388.0287

TABLE V: Modal Participating Mass Ratios (Part 1 of 2)

Case	Mode	Period sec	UX	UY	UZ	Sum UX	Sum UY	Sum UZ
Modal	1	7.613	0	0.0001	0	0	0.0001	0
Modal	2	7.537	0	0.0001	0	0	0.0001	0
Modal	3	0.939	0.0014	0	0	0.0014	0.0001	0
Modal	4	0.93	0.0013	0	0	0.0026	0.0001	0
Modal	5	0.871	6.442E-06	0.6683	0	0.0026	0.6684	0
Modal	6	0.843	0.6965	6.116E-06	0	0.6991	0.6685	0
Modal	7	0.561	0	1.996E-05	0	0.6991	0.6685	0
Modal	8	0.339	7.799E-06	0	0	0.6991	0.6685	0
Modal	9	0.338	8.379E-07	0	0	0.6991	0.6685	0
Modal	10	0.336	6.293E-07	0	0	0.6991	0.6685	0
Modal	11	0.32	1.031E-06	0	0	0.6991	0.6685	0
Modal	12	0.319	0	0	0	0.6991	0.6685	0

TABLE VI: Modal Participating Mass Ratios(Part 2 of 2)

Case	Mode	RX	RY	RZ	Sum RX	Sum RY	Sum RZ
Modal	1	3.291E-05	0	6.654E-06	3.291E-05	0	6.654E-06
Modal	2	1.304E-05	0	6.588E-06	4.595E-05	0	1.324E-05
Modal	3	0	0.0006	0	4.595E-05	0.0006	1.356E-05
Modal	4	0	0.0005	0	4.595E-05	0.0011	1.385E-05
Modal	5	0.3475	2.9E-06	2.377E-05	0.3475	0.0011	3.762E-05
Modal	6	3.257E-06	0.3176	0	0.3475	0.3187	3.762E-05
Modal	7	1.466E-05	0	0.6759	0.3476	0.3187	0.6759
Modal	8	0	3.025E-05	0	0.3476	0.3188	0.6759
Modal	9	0	1.191E-06	0	0.3476	0.3188	0.6759
Modal	10	0	8.168E-07	0	0.3476	0.3188	0.6759
Modal	11	0	2.292E-06	0	0.3476	0.3188	0.6759
Modal	12	0	0	0	0.3476	0.3188	0.6759

TABLE VII: Modal Load Participation Ratios

Case	Item Type	Item	Static %	Dynamic %
Modal	Acceleration	UX	98.38	69.91
Modal	Acceleration	UY	98.51	66.85
Modal	Acceleration	UZ	0	0

V. CONCLUSION

Reinforced concrete is the most widely used construction material in the building industry. Orthodox criteria for design of RCC members are almost exclusively concerned with strength, while ductility and energy absorption receive little consideration. The guideline laid down by IS 13920: 2002 and IS 1893: 2002 and the explanations to achieve ductility and improved detailing have been described. The draft code IS 893 (Parts I and II) have also been referred wherever felt desirable. The possible sources of damages to RC construction and their prevention and restoration have been detailed. The fundamental principles of earthquake-resistant design applicable to RCC members are outlined. Shear walls, which form an important lateral load-resisting element, have been discussed in detail. A number of examples have been solved to illustrate the design principle outlines in the chapter. The variation of axial force & moments with stories is linear. The variation of shear force, storey lateral load, drifts & base shear with stories is non linear. If we compare the frame with shear wall & shear core to only frame model (s.m.r.f), the volume of R.C.C obtained for only frame is 100 % where frame with shear wall & shear core is 33.4 %. By providing a ductile shear walls and shear core for the s.m.r.f.(special moment resisting frame) ,the cross sectional properties are reduced and also axial forces, moments, shear forces, tensile forces, storey lateral loads and base shear are also reduced. Hence the design of building with shear wall & shear core is more economical and optimistic.

VI. REFERENCES

[1] National Building Code of India in 1983 and Building Construction by Rangwala

[2] Planning & Layout of drawings by using N. Srinivasulu, A. Kamal and S. Subramanyam

[3] Arum C and Akinkunmi A (2011) “Comparison of wind-induced displacement characteristics of buildings with different lateral load resisting system” Scientific Research Vol.3 PP. 236-247

[4] B.K.Thakkar (2012) “analysis of shear walls under compression and bending” current trends in technology and science vol: 1, Issue: 2.

[5] B.K.Thakkar (2012) “analysis of shear walls under compression and bending” current trends in technology and science vol: 1, Issue: 2.

[6] Structural analysis by Ramamrutham and Dr. Prakash Rao

[7] R.C.C by A.K.Ashok, Devdas Menon and Pilley, Carvay and Sha.

[8] Code of Practice (RCC) –IS-456-2000, IS-875-1987(part-2) & IS 1893-1 2002.