Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 03, March -2018

Shear Wall Design of A G+12 Structure In ETABS

C.JASMINE[1], B.HARISH NAIK[2]

[1]P.G Student, Department of Civil Engineering,
Shri Shirdi Sai Institute of Science and Engineering Anantapur, Andhra Pradesh, India.
[2]Assistant Professor, Department of Civil Engineering,
Shri Shirdi Sai Institute of Science and Engineering Anantapur, Andhra Pradesh, India

---

Abstract- *A shear wall is a structural system composed of braced panels (also known as shear panels).Reinforced concrete (RC) buildings often have vertical plate-like RC walls called shear walls in addition to slabs, beams and column. These walls are used to counter the effects of lateral load acting on a structure. Wind and seismic loads are the most common loads that shear walls are designed to carry. Shear walls resist in-plane loads that are applied along its height. The applied load is generally transferred to the wall by a diaphragm or collector or drag member to the foundation. Shear walls are easy to construct, because reinforcement detailing of walls is relatively straight-forward and therefore easily implemented at site. Shear walls are efficient, both in terms of construction cost and effectiveness in minimizing earthquake damage in structural and non-structural elements (like glass windows and building contents.). The shear walls requirements given in IS 13920: 1993 code book. Constructions made of shear walls are high in strength, they majorly resist the seismic force, wind force and even can be build on soils of weak bases by adopting various ground improvement techniques. Not only the quickness in construction process but the strength parameters and effectiveness to bear horizontal loads is very high. Shear walls generally used in earth quake prone areas, as they are highly efficient in taking the loads. There are a lot of literatures available to design and analyze the shear wall. However, the decision about the location of shear wall in a multi-storey building is not much discussed in any literatures. There are many software packages that are available to locate and design the shear wall in a structure such as ETABS .*

***Keywords**: braced panels, seismic loads, software ETABS, wind loads*

I. INTRODUCTION

Construction is a complex process involving basically the areas of Architectural planning, Engineering & Construction. There is growing realization today that speed of construction needs to be given greater importance especially for large housing projects. The traditional mode of construction for individual houses comprising load bearing walls with an appropriate roof above or reinforced concrete framed structure construction with infill masonry walls would be totally inadequate for mass housing construction industry in view of the rapid rate of construction. Further, such constructions are prone to poor quality control even in case of contractors with substantial resources and experience.

Structural design is an art of science of designing, with economy and elegance, a safe serviceable and durable structure. The process of designing commences with the planning of the structure, primary to meet the functional requirements of the user. The requirements delivered by the client may not be well defined and may be vague also but it is the work of the designer to understand the needs and design the structure accordingly. The functional requirements and economy of the structure for its intended use over the life span of the structure are intended to by the structural designer. Shear walls in buildings must be symmetrically located in plan to reduce ill-effects of twist in buildings. They could be placed symmetrically along one or both directions in plan.

A. STATEMENT OF PROJECT

1.1 Salient features

Utility of building : Residential complex
Total height of the structure: 39m
Slab thickness : 150mm
Total length of the building in X direction = 45m
Total length of the building in Y direction = 45m
Floor to floor height : 3m
Ground floor : 3m
Number of stories : G+12

1.2 Material properties

Concrete material

Table 1

M20	M25
Modulus of elasticity E_c=20000Mpa	Modulus of elasticity E_c=25000Mpa
Weight Density=24.99Kn/m^3	Weight Density=24.99Kn/m^3
Poisson's ratio=0.2	Poisson's ratio=0.2
Coefficient of thermal expansion=0.0000055/c	Coefficient of thermal expansion=0.0000055/c
Shear modulus(G)=10416.67	Shear modulus(G)=11410.89
Compressive strength =20N/mm^2	Compressive strength =25N/mm^2

The M20 Concrete used for all slabs and beams
The M25 concrete used for all column

Steel properties

Table 2

FE 415	**FE 500**
Mass density=7850kg/m^3	Mass density=7850kg/m^3
Modulus of elasticity E_s=2*10^5 Mpa	Modulus of elasticity E_s=2*10^5 Mpa
Coefficient of thermal expansion=0.0000117/c	Coefficient of thermal expansion=0.0000117/c
Minimum yield strength(F_y)=415Mpa	Minimum yield strength(F_y)=500Mpa
Minimum tensile strength (F_u)=485Mpa	Minimum tensile strength (F_u)=545Mpa

1.3 Software

This project is mostly based on software and it is essential to know the details about these software.

ABOUT ETABS : **ETABS 2015 Ultimate Version 15.1.0 Build 1250**
ETABS stands for Extended Three dimensional Analysis of Building System**.**
ETABS is a product of [CSI] Computers and Structure Inc.

ETABS is a sophisticated, yet easy to use, special purpose analysis and design program developed specifically for building systems. ETABS 2013 features an intuitive and powerful graphical interface coupled with unmatched modeling, analytical, design, and detailing procedures, all integrated using a common database. Although quick and easy for simple structures, ETABS can also handle the largest and most complex building models, including a wide range computers and computer interfaces evolved, nonlinear behavior, making it the tool of choice for structural engineers in the building industry.

1.4 Detailing features

Schematic construction drawings showing floor framing, column schedules, beam elevation and sections, steel connection schedules, and concrete shear wall reinforcing may be produced. Concrete reinforcement of beams, columns, and walls may be selected based on user-defined rules. Any number of drawings may be created, containing general notes, plan views, sections, elevations, tables, and schedules. Drawings may be printed directly from ETABS or exported to DXF or DWG files for further refinement.

CHAPTER II

PLAN AND LOADINGS

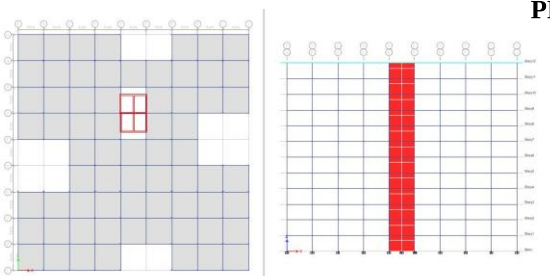


Fig : 2.1 plan and elevation

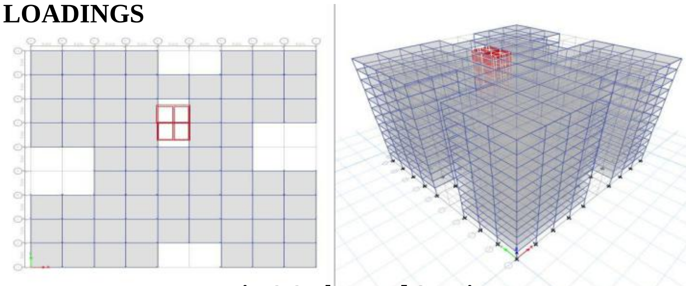


Fig:2.2 plan and 3D view

2.1 Structural systems

If a structural member is part of system, as it typically the case in light frame residential construction, its response is altered by the strength and stiffness characteristics of the system as a whole. In general, system performance includes two basic concepts known as load sharing and composite action. Load sharing is found in repetitive member systems and reflects the ability of the load on one member to be shared by another or, in the case of a uniform load, the ability of some of the load on a weaker member to be carried by adjacent members. Composite action is found in assemblies of components that, when connected to one another, from a "composite member" with greater capacity and stiffness than the some of the component parts.

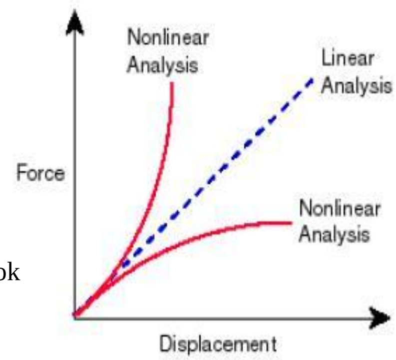
At this point, the readership should consider that the response of a structural system, not just its individual elements, determines the manner in which a structure distributes and resists horizontal and vertical loads.

2.2 Static and dynamic load

The choice of method to be used in any given case depends upon how the loading is defined. If the time variation of loading is fully known, even though it may be highly oscillatory or irregular in character, it will be referred to herein as a prescribed dynamic loading; and the analysis of the response of any specified structural system to a prescribed dynamic loading is defined as a deterministic analysis. On the other hand, if the time variation is not completely known but can be defined in a statistical sense, the loading is termed a random dynamic loading; and its corresponding analysis of response is defined as a nondeterministic analysis.

2.2.1 Linear analysis

The linearity of a mechanical system depends upon the linearity of its components which are mass, stiffness and damping. Linearity implies that the response of each of these components(i.e. acceleration, displacement, and velocity, respectively) bears a straight line or linear relationship to an applied force. The straight line relationship must extend over the whole range of movement of the component, negative as well as positive. All the principle of superposition are also valid.
In linear analysis we do not consider any cracking effects not do we look for strength loss.



2.2.2 Non-linear analysis

The need for nonlinear analysis has increased in recent years due to the need for use of optimized structures, use of new materials, addressing safety-related issues of structures more rigorously.

CHAPTER III

THE APPLIED LOADS

3.1 General

Loads are a primary consideration in any building design because they define the nature and magnitude of hazards are external forces that a building must resist to provide a reasonable performance (i.e., safety and serviceability) throughout the structures useful life. The anticipated loads are influenced by a buildings intended use (occupancy and function), configuration (size and shape) and location (climate and site conditions). Ultimately, the type and magnitude of design loads affect critical decisions such as material collection, construction details and architectural configuration.

Column dimensions: 230x270 mm^2
Beam dimensions: 230x230 mm^2

3.1.1 Dead load calculation

Weight density of RCC concrete = 25KN/m^3
Weight density of Cement mortar = 20KN/m^3

3.1.2 Slab self-weight

Slab thickness = 150mm
Slab self-weight = 0.15*25 = 3.75KN/m^2

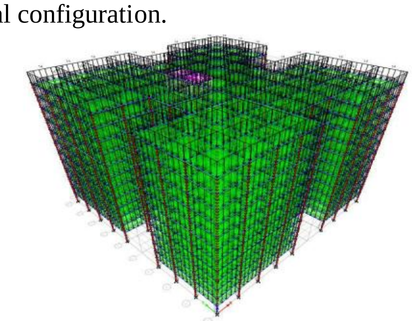


fig:3.1 dead load assignment

3.1.3 Slab floor finish

floor thickness=100mm

Floor finish = 0.01X25=0 .25KN/m^2

3.1.4 Wall loads

At Brick density = 20KN/m^3
Floor height = 3m
Outer wall Thickness = 230mm
At 230mm depth beam, wall load = 0.23X3X20 = 13.8KN/m
=14KN/m

3.1.5 Live loads

In Etabs we assign live load in terms of U.D.L
Live loads are calculated as per IS 875 part 2.
All rooms and kitchens, live load = 2KN/m^2
Toilet and bath rooms, live load = 2KN/m^2
At top floor, live load = 1.5KN/m^2
Corridors, passages, staircases including tire escapes and store rooms = 4KN/m

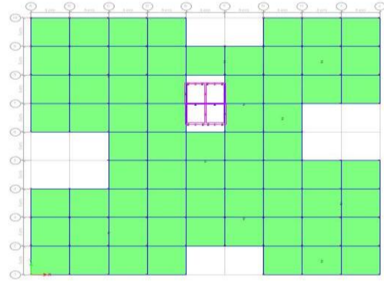


Fig:3.2live load assignment

3.1.6 Load combinations

All the load cases are tested by taking load factors and analyzing the building in different load combinations as per IS 456 and analyzed the building for all the load combinations and results are taken and maximum load combination is selected for the design.

CHAPTER IV

SHEAR WALL ANALYSIS

A shear wall is a structural system composed of braced panels (also known as shear panels). Reinforced concrete (RC) buildings often have vertical plate-like RC walls called shear Walls in addition to slabs, beams and columns. These walls used to counter the effects of lateral load acting on a structure. Wind and seismic loads are the most common loads that shear walls are designed to carry. Shear walls resist in-plane loads that are applied along its height.

Shear walls are easy to construct, because reinforcement detailing of walls is relatively straight-forward and therefore easily implemented at site. Shear walls are efficient, both in terms of construction cost and effectiveness in minimizing earthquake damage in structural and non-structural elements (like glass windows and building contents. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large. Thus, design of their foundations requires special attention.

4.1 Pattern of shear wall

Different geometries are possible. Shear walls are oblong in cross-section, i.e., one dimension of the cross-section is much larger than the other. While rectangular cross-section is common, L and U shaped sections are also used. Thin-walled hollow RC shafts around the elevator core of buildings also act as shear walls. If the shear wall locates on plan unsymmetrical then there are increased chances of torsion besides shear force and bending moment. Walls are connected by floor slabs or beams which are assumed to have negligible bending resistance Therefore, only horizontal interactive forces are transmitted.

4.2 Location of shear wall

Shear walls in buildings must be symmetrically located in plan to reduce ill-effects of twist in buildings. They could be placed symmetrically along one or both directions in plan. Individual wall may be subjected to axial, translational, and torsional displacements. The extent to which a wall will contribute to the resistance of overturning moments, storey forces, and storey torsion depends on its geometric configuration, orientation and location within the plane of the building.

Under the large overturning effects caused by horizontal earthquake forces, edges of shear walls experience high compressive and tensile stresses. To ensure that shear walls behave in a ductile way, concrete in the wall end regions must be reinforced in a special manner to sustain these load reversals without losing strength. Sometimes, the thickness of the shear wall in these boundary elements is also increased. RC walls with boundary elements have substantially higher bending strength and horizontal shear force carrying capacity, and are therefore less susceptible to earthquake damage than walls without boundary elements.
Shear wall material=M25Concrete.

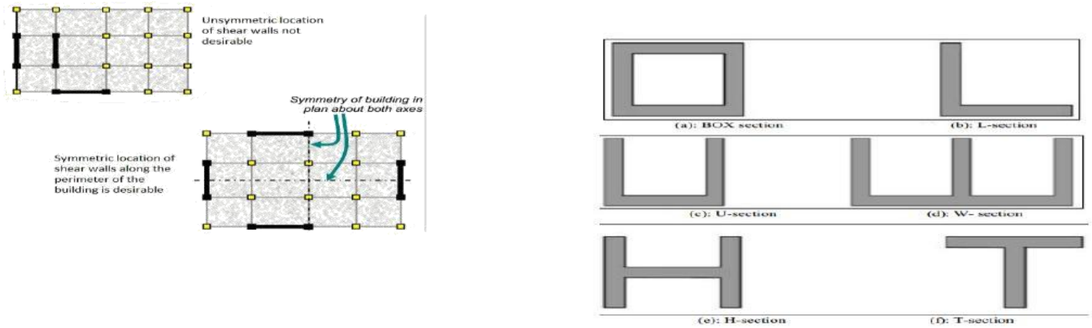


Fig 4.2 Shear wall plan layout (adapted from earthquake tips)

CHAPTER V
RESULTS AND DISCUSSIONS

5.1 Summary report of a beam

level	**element**	**Section ID**	**comboID**	**Station Loc**	**Length**	**LLRF**
Story12	B22	Bm230*230	DCon2	4885	5000	1
b(mm)	h(mm)	b_f(mm)	d_s(mm)	d_{ct}(mm)	d_{co}(mm)	b(mm)
230	230	230	0	20	20	230

Beam Element Details Type: Ductile Frame(Summary)

E_c(MPa)	**f_{ck}(MPa)**	**Lt.wt factor**	**f_y(MPa)**	**f_{yz}(MPa)**
22360.68	20	1	413.69	413.69

Factored forces and moments

Factored M(KN-m)	**Factored T(KN-m)**	**Factored V(KN-m)**	**Factored P(KN)**
-6.5067	0.0088	19.1461	2.127

Design Moments

Factored moment	**Factored moment(M_t)**	**Positive moment**	**Negative moment**
-6.5067	0.0104	0	-6.5171

Design moment and flexural reinforcement for moment

	Design -Moment	**Design +Moment**	**-Moment Rebar(mm^2)**	**+Moment Rebar(mm^2)**	**Minimum Rebar(mm^2)**	**Required Rebar(mm^2)**
Top(+2axis)	-6.5171		137	0	90	137
Bottom(-2axis)		0	45	0	0	45

Shear force and reinforcement for shear (KN)

Shear V_e	**Shear V_c**	**Shear V_s**	**Shear V_p**	**Rebar A_{sv}/s (mm^2/m)**
19.1461	18.2896	19.32	0	255.75

Torsion Force and Torsion Reinforcement for Torsion

T_u(KN-m)	V_u(KN)	Core b(mm)	Core d(mm)	Rebar A_{svt}/s(mm^2/m)
0.0088	19.1461	210	210	0

5.2 Column section details

Table IV

Column Element Details Type: Ductile Frame(Summary)

Level	Element	Section ID	Combo ID	Station Loc	length	LLRF
Story12	C77	Col230*270	DCon2	2770	3000	0.881
b(mm)	h(mm)	d_c(mm)	Cover(torsion)(mm)	b(mm)	h(mm)	d_c(mm)
230	270	60	30	230	270	60

E_c(MPa)	f_{ck}(MPa)	Lt.wt factor	f_y(MPa)	f_{yz}(MPa)
22360.68	20	1	413.69	413.69

Axial Force and Biaxial Moment Design :

Design P_u(KN)	Design M_{u2}(KN-m)	Design M_{u3}(KN-m)	Minimum M_2	Minimum M_3	Rebar Area	rebar %
309.0933	-31.6615	102.2121	6.1819	6.1819	o/s#2	o/s#2

Axial Force and Biaxial Moment Factors:

	K factor	Length(mm)	Initial moment	Additional moment	Minimum moment
Major Bend(M3)	3.143654	2770	-25.0251	41.5094	6.1819
Minor Bend(M2)	2.076159	2770	4.6765	21.2537	6.1819

Shear Design :

	Shear V_u	Shear V_c	Shear V_s	Shear V_p	Rebar A_{sv}/s
Major V_{u2}	0	0	0	0	0
Minor V_{u3}	7.978	56.4576	18.3602	0	300.23

Additional Moment Reduction Factor K:

A_g(cm^2)	A_{sc}(cm^2)	P_{uz}(KN)	P_b(KN)	P_u(KN)	K
621	69.1	2702.4615	199.8845	309.0933	0.956361

CHAPTER VI

Conclusions

This study deals with the analytical investigation of a structure subjected to gravity and lateral loads. Based on the results and comparisons the following conclusions are drawn Placement of shear wall inside mid greatly resisted by lateral loads other than shear wall. All the types of buildings whose length is same in X & Y direction, placing the shear wall would give the best resistant to lateral loads.

Future Scope of Study.

- Cost comparison.
- Placing right position of shear wall in unsymmetrical building to resist maximum lateral force.
- Analysis with constructing wall on beams with specific wall bond type and wall prismatic compressive strength is required.

References

[1] IS 1893-2002 Criteria for Earthquake Resistant Design of Structures Part 1 General Provisions and Buildings.

[2] C.V.R. MURTY , Earthquake tips.

[3] IS 875 Code of practice for design loads (other than earthquake) for buildings and structures.

[4] IS 13920, (1993), "Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces".

[5] Etabs manual.

[6] A report on effects of openings in shear walls on seismic response of structure by sharminriza chowdhary, department of civil engineering dhake-1208, Bangladesh mostly focused on the design of shear walls with openings on seismic response using E- Tabs.

[7] S.K. Duggal in his " Earth quake resistant design of structures" about shear wall.

