

DESIGN OF BANK BUILDING

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ABSTRACT

Besides, food and clothing, shelter is a basic human need. India has been successful in meeting the food and clothing requirements of its vast population; however the problem of providing shelter of all is defying solutions. "While there has been an impressive growth in the total housing stock from 65 million in 1947 to 187.05 million in 2001, a large gap still exists between the demand and supply of housing units. The Working Group on Housing for the 9th five-year plan estimated the housing shortage in 2001 at 19.4 million units- 12.76 million in rural area and 6.64 million in urban area. The shortage of housing is acutely felt in urban areas –more so in the 35 Indian cities, which according to the 2001 census have a population of more than a million".

Hence in order to overcome this problem construction process should be quick, tall and effective to accommodate huge population in a given area. So we have chosen this topic of "DESIGN AND CONSTRUCTION OF SHEAR WALLS FOR BANK BUILDING". This type of shear wall construction helps to build tall structure of about 20 floors within no time. Hence the construction process will become much quicker and efficient.

Constructions made of shear walls are high in strength ,they majorly resist the seismic force, wind forces 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 bare horizontal loads is very high. Shear walls generally used in high earth quake prone areas, as they are highly efficient in taking the loads. Not only the earth quake loads but also winds loads which are quite high in some zones can be taken by these shear walls efficiently and effectively.

Though these types of constructions have their origin in western nations in early 90's, this ideology has changed rapidly and spread all over the world with in no time. The form work used in this type of construction is of a new kind in Indian construction scenario.

Certain patented systems based on imported technologies such as "Mascon System" (Canada), "Mivan System" (Malaysia) have come on the Indian scene in recent years. In these systems traditional column and beam construction is eliminated and instead walls and slabs are cast in one operation at site by use of specially designed, easy to handle (with minimum labor and without use of any equipment) light weight pre-engineered aluminum forms. Rapid construction of multiple units of a repetitive type can be achieved with a sort of assembly line production by deployment of a few semi-skilled labors.

The entire operation essentially comprises fitting and erecting the portion of shuttering as already determined (the optimization in use is determined by appropriate planning) and then carrying out concreting of the walls and slabs. Props are so designed that they stay in position while de-shuttering of slabs and/or takes place. The dimensional accuracy of the formwork is of high order. Therefore any

possibility of errors does not rise. Though this type of constructions are cost effective, still in order to build a better society and for satisfying present need of shelter , shear wall construction are going to be a solution to this problem of shelter in our nation.

The main idea of we taking this topic of “Design and construction of shear walls” is the challenging task in designing of shear walls. Shear walls have a peculiar behavior towards various types of loads. Calculation of rigidity factor, reactions, shear center, shear force and bending moment is a topic of interest. We are also verifying and designing this same structure using extended three dimensional analysis of buildings (ETABS) software.

INTRODUCTION

Shear walls are vertical elements of the horizontal force resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. When shear walls are designed and constructed properly, and they will have the strength and stiffness to resist the horizontal forces.

In building construction, a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced-concrete wall or vertical truss. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsion) forces. These forces can literally tear (shear) a building apart. Reinforcing a frame by attaching or placing a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints. Shear walls are especially important in high-rise buildings subjected to lateral wind and seismic forces.

In the last two decades, shear walls became an important part of mid and high-rise residential buildings. As part of an earthquake resistant building design, these walls are placed in building plans reducing lateral displacements

under earthquake loads. So shear-wall frame structures are obtained.

Shear wall buildings are usually regular in plan and in elevation. However, in some buildings, lower floors are used for commercial purposes and the buildings are characterized with larger plan dimensions at those floors. In other cases, there are setbacks at higher floor levels. Shear wall buildings are commonly used for residential purposes and can house from 100 to 500 inhabitants per building

1.2 Scope of the work

The aim of the shear wall is to investigate the different ways in which the tall structures can be stabilized against the effects of strong horizontal wind loading and seismic loading. Some other reasons why we use shear walls are tall structures can be constructed which reduces the area used and we can accommodate a large population in that particular area. Other objective is to construct a cost effective structure in less period of time. This study helps in the investigation of strength and ductility of walls.

The scope is to analyze the constructed shear wall that is to be constructed. Firstly the model is implemented into known computer software and then it is analyzed based on the investigation of strength and ductility. The strength of shear walls tested are compared with the calculated strengths based on design codes.

1.3 Objective

Shear walls are not only designed to resist gravity / vertical loads (due to its self-weight and other living / moving loads), but they are also designed for lateral loads of earthquakes / wind. The walls are structurally integrated with roofs / floors (diaphragms) and other lateral walls running across at right angles, thereby giving the three dimensional stability for the building structures.

Shear wall structural systems are more stable. Because, their supporting area (total cross-sectional area of all shear walls) with reference to total plans area of building, is comparatively more, unlike in the case of RCC framed structures. Walls have to resist the uplift forces caused by the pull of the wind. Walls have to resist the shear forces that try to push the walls over. Walls have to resist the lateral force of the wind that tries to push the walls in and pull them away from the building.

Shear walls are quick in construction, and in a country like India where shelter is very important in a short lapse of time shear walls can be built very quickly. The precision to which they are built is also very high compared to normally built brick structures. Hence the key objective of shear wall is to build a safe, tall, aesthetic building.

1.4 Organization

The colors of the rainbow light up your life at Rainbow Vistas. For the discerning individual and for those to whom quality of life is something they care about – Rainbow Vistas is a 4.3 acres 450 luxury apartments the best option and only solution. This dream housing project is strategically located near HI-TECH City, MMTS and the city's IT hub on one side and prime residential area on the other. A prestige project jointly promoted by Ashoka Developers and Builders Ltd and Cybercity Builders and Developers Pvt. Ltd, Rainbow Vistas adds value

to your dream. Rainbow Vistas is approved by GHMC and all leading banks and institutions offer loans for the property. The project has the first Hill-top club house and construction work is at full swing.

Review of literature:

Development of shear wall system for construction has advanced dramatically over the past few years. Shear wall systems were initially developed to reduce damage due to earthquakes labour requirements, increase strength of the building, shorten construction time reduce cost increase quality of life.

U.H. Varyani described about shear walled buildings under horizontal loads. Considering in his design “Reinforced concrete framed buildings are adequate for resisting both the vertical and the horizontal loads acting on shear walls of a building”. In his 2nd edition 2002 of “Design of structures”. He gave rigidity of shear wall, torsional rigidity and shear center of a building in a detailed description.

S.K. Duggal on his profound interest on structures gave a detailed description about reinforced concrete buildings in his book “ Earth quake resistant design of structures “describing a wall in a building which resist lateral loads originating from wind or earthquakes are known as shear walls”. He considered flexural strength in the wall to be dominant force based on which design of structure to be carried out in tall shear walls. He described in detail about various types of shear walls with their load bearing capacities as per code requirements.

Mr A.P. Jadhav Associate Professor Rajarambapu Institute of technology rajaramnagar, Islampur has given a detailed report on the form work used for the construction of shear walls.

Mr.A.P.Jadhav highlighted the importance of quickness in construction and the need for

earthquake resistant building for better sustainability of life.

A report on effects of openings in shear walls on seismic response of structure by sharminrizachowdhary, department of civil engineering dhake-1208, Bangladesh mostly focused on the design of shear walls with openings on seismic response using E-Tabs,i.e extended three dimensional analysis of buildings. This report gives a detailed explanation of how ETABS can be effectively used to design shear walls.

INDIAN STANDARD CODES:

I.S 456:2000 As per clause 32, design for wall describes, design of horizontal shear in clause 32.4 given details of how shear wall have to be constructed.

I.S:1893 Criteria of Earth Quake resistant Buildings Part (3) page 23, clause 4.2 gives the estimation of earth quake loads.

In IS: 13920:1993 it gives the ductile detailing of shear wall as per clause 9, where 9.1 gives general requirements.

SHEAR WALLS

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PURPOSE OF CONSTRUCTING SHEAR WALLS

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Shear walls are quick in construction, as the method adopted to construct is concreting the members using formwork. Shear walls doesn't need any extra plastering or finishing as the wall itself gives such a high level of precision, that it doesn't require plastering.

Scope for future work

Shear walls are considered to be a gift to the future construction industry. Scope of shear walls in construction field is immense. It's since their arrival in market there topic was always a topic of interest. Shear walls are the structures usually build to balance lateral loads acting on the structure. Where the lateral loads are most predominantly wind and earth quake loads. And predominantly earthquake loads are more intense in their effect on the building structures. Earthquakes are becoming more intense due to the key reason that is ground water depleasement. Hence in order to overcome the diverse effects of earthquake its always best to save ourselves from future disasters.

Shear walls are quick in construction, as the walls doesn't need any special brick arrangement or plastering they are very quick in their construction. It just requires an effective form work and very few skilled labour. It was estimated that a 20 floors building can be built within six months which is most astonishing.

Not only for the quickness in its work and resistance to earthquakes, shear walls are also build for defense purpose. Presently The Hindustan Prefab Limited (HPL) is executing various relocatable prefab structures for paramilitary forces especially for the CRPF in Karnataka, Uttar Pradesh, Chhattisgarh and Bihar among others. We are using "Shear Wall" technology with thermal curing –a fast track technology– for KMDA for Construction of houses in Kolkata, chairman and managing director HPL JaiveerSrivastava said.

"In structural engineering, a shear wall is a wall composed of braced panels to counter the effects of lateral load like wind and seismic acting on a structure. Under several building codes including the International Building Code and Uniform Building Code all exterior wall lines in wood or steel frame construction are braced. Plywood is the conventional material used in the construction of shear walls, but with advances in technology and modern building methods, there are other prefabricated options which have made it possible to inject shear assemblies into narrow walls that fall at either side of an opening in a shear wall. Sheet steel and steel-backed shear panels in the place of structural plywood in shear walls have proved to be far stronger in seismic resistance."

Conclusion about shear walls

As per our design by hand in chapter 4 the corner reinforcement of the shear wall of 25 meters is to be provided with 20 mm bars of 20 in numbers, and the middle area is provided with 10 mm bars with 300mm spacing in vertical direction and 450 mm spacing in horizontal direction for 300 mm wall. The values in the computer design also matched the theoretical design. It is estimated that whenever an opening is expected the bar diameter is increased and

lateral ties are provided inside the wall to replicate lintel beam in the wall for extra stability.

Advantages of Steel Plate Shear Wall to Resist Lateral Loads:

1. The system, designed and detailed properly is very ductile and has relatively large energy dissipation capability. As a result, steel shear walls can be very efficient and economical lateral load resisting systems.
 2. The steel shear wall system has relatively high initial stiffness, thus very effective in limiting the drift.
 3. Compared to reinforced concrete shear walls, the steel shear wall is much lighter which can result in less weight to be carried by the columns and foundations as well as less seismic load due to reduced mass of the structure.
 4. By using shop-welded, field-bolted steel shear walls, one can speed-up the erection process and reduce the cost of construction, field inspection and quality control resulting in making these systems even more efficient.
 5. Due to relatively small thickness of steel plate shear walls compared to reinforced concrete shear walls, from architectural point of view, steel plate shear walls occupy much less space than the equivalent reinforced concrete shear walls. In high-rises, if reinforced concrete shear walls are used, the walls in lower floors become very thick and occupy large area of the floor plan.
- Compared to reinforced concrete shear walls, steel plate shear walls can be much easier and faster to construct when they are used in seismic retrofit of existing building
7. Steel plate shear wall systems that can be constructed with shop welded-field bolted elements can make the steel plate shear walls

more efficient than the traditional systems. These systems can also be very practical and efficient for cold regions where concrete construction may not be economical under very low temperatures.

ARCHITECTURAL ASPECTS OF SHEAR WALLS

Most RC buildings with shear walls also have columns; these columns primarily carry gravity loads (i.e., those due to self-weight and contents of building). Shear walls provide large strength and stiffness to buildings in the direction of their orientation, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents.

Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large. Thus, design of their foundations requires special attention. Shear walls should be provided along preferably both length and width. However, if they are provided along only one direction, a proper grid of beams and columns in the vertical plane (called a moment-resistant frame) must be provided along the other direction to resist strong earthquake effects.

Door or window openings can be provided in shear walls, but their size must be small to ensure least interruption to force flow through walls. Moreover, openings should be symmetrically located. Special design checks are required to ensure that the net cross-sectional area of a wall at an opening is sufficient to carry the horizontal earthquake force.

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. Shear walls are more effective when located along exterior perimeter of the building – such a layout increases resistance of the building to twisting.

CONCLUSION

Thus shear walls are one of the most effective building elements in resisting lateral forces during earthquake. By constructing shear walls damages due to effect of lateral forces due to earthquake and high winds can be minimized. Shear walls construction will provide larger stiffness to the buildings there by reducing the damage to structure and its contents.

Not only its strength , in order to accommodate huge number of population in a small area tall structures with shear walls are considered to be most useful. Hence for a developing nation like India shear wall construction is considered to be a back bone for construction industry.

References

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 - Mr A.P. Jadhav Associate Professor Rajarambapu Institute of technology
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