Design and Construction of Shear Walls

T.SHOBHA¹, S.ANANDA RAO²
¹Dept of Structural Engineering, AVR & SVR Engineering College Kurnool, AP, India, E-mail: shobhasmile98@gmail.com.
²Dept of Structural Engineering, AVR & SVR Engineering College Kurnool, AP, India.

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, a large gap still exists between demand and supply of housing units. Hence in order to accommodate huge population in a given area. So we have chosen this topic of “Design and Construction of Shear Walls”. This type of shear wall construction helps to build tall structure of about 20 floors which will become much quicker and efficient. Constructions made off shear walls are high in strength, they majorly resist the seismic forces, wind forces and even can be build on soils of weak bases by adopting various ground improvement techniques 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. Wind loads which are quite high in some zones can be taken by their shear walls efficiently and effectively. The formwork 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 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 dimensional accuracy of the formwork is of high order. Though this type of constructions is cost effective, shear wall constructions are going to be a solution to the problem of shelter in our nation. The main idea of 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.

Keywords: Shear Walls, MIVAN, shear center, rigidity factor.

I. 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 from 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 forces. These forces can literally tear 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 become 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. 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 shear walls can be constructed which reduces the area used and we can accommodate a large population 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 durability 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 ductility. The strength of shear walls tested is compared with the calculated strengths based on design codes.
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.

II. 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 earth quakes labour requirements, increase strength of 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 has 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 resist design of structures “describing a wall in a building which resist lateral loads originating from wind earth quakes are known as shear walls”. He considers flexural strength in the wall to be dominant force on which design of structure to be carried out in tall shear walls. He described about various types of shear walls with their load baring capacities as per code requirements. Mr A.P Jadhav associate professor Rajarambapu technology rajaramnagar, islamapur has given a detailed report on the form work which uses in the shear walls. Mr A.P Jadhav highlighted the importance in the construction and the need for earth quake resistant building for better sustainability of life. A report on opening in shear walls on seismic response on structures by sharminrizachowdary, 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 building. This report gives a detailed explanation of how stand pro can be effectively used to design shear walls.

III. SHEAR WALLS

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 design 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 walls are vertical truss. Lateral forces caused by wind, earth quake and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsion) forces. These forces can literally shear (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 earth quake 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.

A. Purpose of Construction Shear Walls

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 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, 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.

B. Comparisons of Shear Wall Construction of Conventional Load Bearing Walls

Load bearing masonry is very brittle material. Due to different kinds of stresses such as shear, tension, torsion, etc, caused by the earthquakes, the conventional
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unreinforced brick masonry collapses instantly during the unpredictable and sudden earthquakes. The RCC framed structures are slender, when compared to shear wall concept of box like three dimensional structures. Though it is possible to design the earthquake resistant RCC frame, it requires extraordinary skills at design, detailing and construction levels, which cannot be anticipated in all types of construction projects. On the other hand even moderately designed shear wall structures not only more stable, but also comparatively quite ductile. In safety terms it means that, during very severe earthquakes they will not suddenly collapse causing death of people. They give enough indicative warnings such as widening structural cracks, yielding rods, etc., offering most precious moments for people to run out off structures, before they totally collapse. For structural purposes we consider the exterior walls as the shear-resisting walls. Forces from the ceiling and roof diaphragms make their way to the outside along assumed paths, enter the walls, and exit at the foundation.

C. Forces on Shear Wall

Shear walls resist two types of forces: shear forces and uplift forces. Shear forces are generated in stationary buildings by accelerations resulting from ground movement and by external forces like wind and waves. This action creates shear forces throughout the height of the wall between the top and bottom shear wall connections. Uplift forces exist on shear walls because the horizontal forces are applied to the top of the wall. These uplift forces try to lift up one end of the wall and push the other end down. In some cases, the uplift forces are large enough to tip the wall over. Uplift forces are greater on tall short walls and less on low long walls. Bearing walls have less uplift than non-bearing walls because gravity loads on shear walls help them resist uplift. The hold down device then provides the necessary uplift resistance. Shear walls should be located on each level of the structure including the crawl space. To form an effective box structure, equal length shear walls should be placed symmetrically on all four exterior walls of the building. Shear walls are most efficient when they are aligned vertically and are supported on foundation walls or footings. When exterior shear walls do not provide sufficient strength, other parts of the building will need additional strengthening. Consider the common case of an interior wall supported by a sub floor over a crawl space and there is no continuous footing beneath the wall. For this wall to be used as a shear wall, the sub floor and its connections will have to be the reason why most retrofit work uses walls with continuous footings underneath them as shear walls.

D. Types of Shear Walls

- RC shear wall
- Plywood shear wall
- Mid ply shear wall
- RC Hollow concrete block masonry wall
- Steel plate shear wall

1. RC Shear Wall

It consists of reinforced concrete walls and reinforced concrete slabs. Wall thickness varies from 140mm to 500mm, depending on the number of stories, building age, and thermal insulation requirements. In general, these walls are continuous throughout the building height; however, some walls are discontinued at the street front or basement level to allow for commercial or parking spaces. Usually the wall layout is symmetrical with respect to at least one axis of symmetry in the plan.

Fig.1. Reinforced Concrete Shear Wall.

Floor slabs are their cast-in-situ flat slabs or less often, precast hollow-care slabs. Buildings are supported by concrete strip or mat foundation; the letter type is common for buildings with basements. Reinforcement requirements are based on building code requirements specific for each country. In general, the wall reinforcement consists of two layers of distributed reinforcement (horizontal and vertical) throughout the wall length. In addition, vertical reinforcement bars are provided close to the door and window openings, as well as at the wall end zones (also known as boundary elements or barbells).

2. Plywood Shear Wall

Plywood is the traditional material used in the construction of shear walls. The creation of preferable shear panels has made it possible to inject strong shear assemblies into small walls fall at either side of a opening in a shear wall. As well as the use of a sheet steel, and steel backed shear panel (i.e sure-board) in the place of structural use plywood shear walls, has proved to be far stronger in seismic when used in shear wall assemblies.

Fig.2. Plywood Shear Wall.
Plywood shear walls consist of:
- Plywood, to transfer shear forces
- Chords, to resist tension/compression generated by the
  overturning moments
- Base connections to transfer shear to foundations.

3. Midply Shear Wall
The MIDPLY shear wall is an improved timber shear wall that was developed by redesigning the joints between sheathing and framing members, so that the failure modes observed in standard wall testing are virtually eliminated at lateral load levels high enough to cause failures in standard walls. In MIDPLY shear wall design, one ply of sheathing material is placed at the center of the wall between a series of pairs of studs oriented in a 90° rotated position relative to those in standard shear walls.

4. RC Hollow Concrete Block Masonry Wall
RHCBM walls are constructed by reinforcing the hollow concrete block masonry, by taking advantage of hollow spaces and shapes of the hollow blocks. It requires continuous steel rods (reinforcement) both in the vertical and horizontal directions at structurally critical locations of the wall panels, packed with the fresh grout concrete in the hollow spaces of masonry blocks. Reinforced hollow concrete block masonry (RHCBM) elements are designed both as load bearing walls for gravity loads and also as shear walls for lateral seismic load, to safely withstand earthquakes. This structural system of construction is known as shear wall-diaphragm concept, which three-dimensional structural integrity for the buildings.

5. Steel Plate Shear Wall
In steel plate shear wall system consists of a steel plate wall, boundary columns and horizontal floor beams. Together, the steel plate wall and boundary columns act as a vertical plate girder. The columns act as flanges of the vertical plate girder and the steel plate wall act as its web. The horizontal floor beams act, more-or-less, as transverse stiffeners in a plate girder. Steel plate shear wall systems have been used in recent years in highly seismic areas to resist lateral loads. Figure shows two types of steel shear walls; un stiffened and stiffened with or without openings.

E. 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 their by reduces damage to its structure and its contents. Since shear walls carry large horizontal earthquake forces the overturning effects on them are large. Design of their foundations required 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 designs checks are required to ensure that the net cross section area of a wall at an opening is sufficient to carry the horizontal earthquake force. 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 lay out increases resistance of the building to twisting.

IV. CONSTRUCTION OF SHEAR WALLS
A. Excavation
After the initial surveying and soil test, excavation of land is carried out. If the land site is very hard with rocks and boulders, excavation is carried out by using heavy earthquakes, cranes and diggers. And in some cases if the land is very hard, blasting of site by using small amount of dynamites is preferred. Generally blasting of site is done during early mornings. Once the excavation is completed the excavated material is not wasted. It should be generally reused in the same construction work so that work is reduced. On the other side, if the land is very loose and site is being excavated very easily then earth movers of normal size are used. Once the excavation is completed marking of land for footings is carried out.
B. Foundation and Footings

Generally shear walls are opted for tall buildings which are more than 15 floors so that they can resist lateral load most effectively. Therefore for this type of buildings we need strong foundation, so that it can resist high loads due to self weight as well as lateral loads. Hence combined footings and isolated footings are generally preferred.

Fig.5. Drilling.

These footings are tied together by using tie beams so that the moment during lateral load is completely arrested. In accordance with footing neck columns are raised these neck columns once reached to the ground surface are tied together with plinth beam.

C. Bottom three floors and Waffle Slab

Once the complete process of building the foundation, raising the neck and joining the plinth beam is done and the area is filled with either excavated material or new material by using various leveling operation. Now if the building requires parking, the bottom two or three floors are built with heavy beams and columns of dimensions (0.9 x 0.3) m and (0.45 x0.3) m.

Fig.6. Footings Laid For Construction

Fig.7. Columns Beneath Shear Wall.

1. Waffle Slab

The slab here should be of high load bearing as it needs to bare the vehicles load as well as the top floor loads. Hence for this situation waffle slab is most preferred.

Fig.8. Waffle Slab Layout

Waffle slab is a kind of slab which is of thickness 40-45cm. But mostly empty with spacing as of waffles. The placing of the waffles is quite peculiar. A form is placed and on above the waffles are arranged, once the arrangement is done, reinforcement is arranged in such a way that it forms a chess board and squares the hollow and the area with lines act as beams.

Fig.9. Formwork for waffle slab.
The waffle slab after curing looks like a normal slab from top but from the lower or bottom side it is a chess board with hollow spacing.

Fig.10. Cured Upper Portion of Waffle Slab

Once the parking and waffle slab is completely laid then it comes the part of shear walls.

D. Shear Wall Construction

1. Shear Walls

Shear walls are generally casted monolithically, in this type of construction the beams and columns are placed inside the walls so that you can never find beams inside any floor in this type of construction.

a. Schedule of reinforcements

After the horizontal reinforcement is placed in accordance with the design, vertical reinforcement is placed.

Fig.11. Horizontal Reinforcement of Shear Wall

As per the design details the reinforcement of size 10mm spacing 30mm is placed in the middle of the wall of length 0.8=0.8 x 25 = 200 m and the edge reinforcement of 20 mm P 20 bars are placed in the remaining 0.2 space. The horizontal bars on the vertical reinforcement are placed of diameter 10mm spacing 300 mm distance.

Fig.12. Vertical Reinforcement of Shear Wall

The reinforcement in the horizontal direction is usually tied as double strand single tie with GI wire; this process can also be done by using rebar machine. Normally cover either cement or most preferably PVC cover is tied to the vertical reinforcement so that once form work is place it maintains a specific cover distance. Once the reinforcement is completely placed then comes the part of Mivan form work.

E. MIVAN Formwork

MIVAN is an upcoming technology which has empowered and motivated the mass construction projects throughout the world. Good quality construction should not reduce the project speed nor should it be uneconomical. Construction is done through MIVAN technology keeping a motto in mind that “Cost is long forgotten, but the Quality is remembered forever”. Mivan is an aluminum form work system developed by a European construction company. In 1990, the Mivan Company Ltd. From Malaysia started manufacturing these formwork systems. Today, more than 30,000 sqmts of formwork from Mivan Co Ltd is used across the world. There are a number of buildings in Mumbai that are being constructed with the help of the Mivan system, that has proven economical as well as satisfactory for the overall Indian construction environment. One of the architectural examples is XRBIA which uses MIVAN system to achieve its dream of “A House for Every Indian”.

Fig.13. MIVAN Formwork
MIVAN technology is suitable for constructing large number of houses in a short span of time using room size forms to construct walls and slabs in one continuous pour on concrete. In this system of formwork construction, cast -in -situ concrete wall and floor slabs cast monolithic provides the structural system in one continuous pour. To facilitate fast construction, easy removal of forms can be achieved by hot air curing / curing compounds. Large room sized forms for walls and floor slabs are erected at site. These strong and sturdy forms are fabricated with accuracy and are easy to handle. The concrete is produced in RMC batching plants under strict quality control and convey it to site with transit mixers. The frames for windows, doors, and ducts for services are placed in the form before concreting. Staircase flights, panels, chajjss, jails etc, and other pre fabricated items are also integrated into the structure. This proves to be a major advantage as compared to other modern construction techniques. High quality Mivan formwork panels ensure consistency of dimensions. On the removal of the formwork mould a high quality concrete finish is produced to accurate tolerances and verticality. The high tolerance of the finish means that, no further plastering is required.

1. Pins and Wedges

Pins actually resemble the rivets its top diameter of head is 12 mm and its tail is about 6-8 mm with a rectangular hole in it of 2 mm thickness.

G. Electrical Boards and Plumbing Lines

The shear walls in a building itself acts like column with no flexibility to drill and hence it becomes very important to place electrical lines and plumbing or sewer lines.
The electrical lines in slabs and wall also have a design

Fig.17. Electrical Lines in Slab

The plumber and sewer lines are left with gap to place into the wall exactly.

Fig.18. Gaps Left for Plumbing Lines

H. Concreting

Once the complete arrangement of the formwork i.e., wall ties, Pins and Wedges with electrical lines are placed completely up to an accuracy of 1 mm, precision is done so that no concrete will leak out of the formwork. The cement generally used in this of grade of concrete is. The size of aggregate should be 10mm or 12mm so that it moves easily inside the wall. Sand here used may be either robust sand or sea sand. Admixtures generally used are of self compacting nature. Reobuild and Gilinium are two admixtures which are used most effectively in the shear walls construction. These admixtures are generally mixed using a design mix in a transit mixer. Once the mixing is done accurately for specified time, this mixture of concrete is pumped using pipes. Once the form is arranged accurately concrete pouring is done using the hydraulic pumps. As the concrete used in this type is of self compacting nature, there is no need for additional compaction, but still pin vibrators are generally used to place in the wall and vibrate the concrete. After the wall form is completely filled with concrete with proper compaction it is left for one complete day to set includes its position.

I. Curing

After one's day of curing of wall, removal of form is done. Removal of form is done very carefully.

Fig.19. Shear wall after removal of formwork

Firstly the wedge is taken out by using a hammer and then pin is also removed. Now starting from top and one side form is carefully removed. The form removed is cleaned immediately, to remove the concrete on it, so that it can be reused effectively. Once the form is completely removed a smooth finish of wall is obtained which does not require any plastering. The wall which is now finished with the removal of form is cured with regular water i.e., water we use for drinking purpose. Curing of walls is done for 3-7 days continuously and for better curing and to reduce heat of hydration a white coating with lime powder is also preferred. Curing can also be done by covering walls with plastic covers and watering them so that it reduces the heat of hydration.

J. Holes in the Slab

There are rectangular holes in the slab left out to carry form work from bottom storey to top. As it becomes difficult to take form work through staircase for constructing the next floor, these holes are drilled in the slab of size a little more than the standard form work.

Fig.20. Holes Drilled in the Slab

Hence these holes play a key hole in transfer of mivan formwork.
H. Electrical and Plumbing Lines after Concreting

After the walls are completely built they are checked for electrical and plumbing connections as electrical lines are pre established with design pattern in the slab as well in the wall only thing needed is to arrange them with proper connection.

Fig.21. Electrical spaces left in wall

When it comes to the server lines holes or empty gaps are left over. And in these empty spaces the sewer pipes are placed exactly to match the empty spaces.

Fig.22. Gaps Left for Sewer Pipes

In this way electrical and plumbing lines are placed.

I. Painting and Finishing Works

As the wall which is obtained is perfectly plain with exact finishes there is no need for plastering work. It is said that finishing on shear wall is so perfect that plumb line drawn from the top storey meets the bottom storey exactly without any deflection or deviation. Generally for shear wall two coats of white wash and paint colour of our choice is enough. Special architectural features on the shear wall building like fall ceiling can also be done. Hence the construction of shear wall is completed which are resistant to lateral loads, quick in construction, aesthetic in view, these walls are generally built for tall structures hence they give lots of solace from pollution and noise as well.

V. CONCLUSION AND FUTURE SCOPE

A. Conclusion

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 12 mm bars with 300 mm spacing in vertical directions and 450 mm spacing in horizontal direction for 309 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. Thus shear walls are one of the most effective building elements in resisting lateral forces during earthquake and high winds can be minimized. When compared to the RCC framed structure the shear wall structural system is more stable. Totally we could not reduce the uplift force and shear forces but when compared to RCC frame we can resist to some extent. Shear walls construction will provide larger stiffness to the buildings there by reducing the damage to structure and its contents. Not only has its strength, in order to accommodate huge number of population in a small area tall structured with shear walls are considered to be most useful.

B. 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 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 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 depleashment. Hence in order to overcome the diverse effects of earthquake it's 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 lab our. 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, are shear walls also built for defense purpose. Presently The Hindustan Prefab Limited (HPL) is executing various re-locatable prefab structures for parliamentary forces especially the CRPF in Karnataka, UP, Chhattissgarh, 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 Jaiveer Sri vatsva said. “In structural engineering, a shear wall is a wall composed of braced panels to counter the effects of lateral loads 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. 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”.

VI. REFERENCES

[7] In I.S: 13920:1993 it gives the ductile detailing of shear wall as shear wall as per clause 9, where 9.1 gives general requirements.