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MODELING, ANALYSIS AND DESIGN OF SHEAR WALL BUILDING USING STAAD PRO AND REVIT ARCHITECTURE

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Abstract: Shear walls are specially designed structural walls which are incorporated in buildings to resist lateral forces that are produced in the plane of wall due to earthquake, wind and flexural members. Structural walls provide an efficient bracing system and offer great potential for lateral load resistance. The properties of these seismic shear walls dominate the response of the buildings, and therefore, it is important to evaluate the seismic response of the walls appropriately. Effectiveness of shear wall has been studied with the help of four different models. - Recent days, structures are becoming more and more slender and susceptible to sway and hence dangerous in the earthquake. Researchers and engineers have worked out in the past to make the structures as earthquake resistant. After many practical studies it has shown that use of lateral load resisting systems in the building configuration has tremendously improved the performance of the structure in earthquake. Shear walls are mainly flexural members and usually provided in high rise buildings to avoid the total collapse of the high-rise buildings under seismic forces. In seismic design of multi-storeyed building, shear walls are most common structure adopted to make the structure earthquake resistant. These are constructed to counteract the lateral loads caused by wind load and seismic loads. Shear walls provide adequate stiffness to the structure. So that the lateral drift will be in limits. Generally, shear walls are the vertical cantilever which acts as a Column.

Index Terms – shear wall, letteral forces, wind load, earthquake zones, RCC buildings

I. INTRODUCTION

Shear wall are one of the excellent means of providing earthquake resistance to multi storied reinforced concrete building. The structure is still damaged due to some or the other reason during earthquakes. Behaviour of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building. To reduce the effect of earthquake reinforced concrete shear walls are used in the building. These can be used for improving seismic response of buildings. Structural design of buildings for seismic loading is primarily concerned with structural safety during major Earthquakes, in tall buildings, it is very important to ensure adequate lateral stiffness to resist lateral load. The provision of shear wall in building to achieve rigidity has been found effective and economical. When buildings are tall, beam, column sizes are quite heavy and steel required is large. So, there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy. Shear walls are usually used in tall building to avoid collapse of buildings. When shear wall are situated in advantageous positions in the building, they can form inefficient lateral force resisting system. In this present paper one model for bare frame type residential building and three models for dual type structural system are generated with and effectiveness has been checked adequate stiffness is to be ensured in high rise buildings for resistance to lateral loads induced by wind or seismic events. Reinforced concrete shear walls are designed for buildings located in seismic areas, because of their high bearing capacity, high ductility and rigidity. In high rise buildings, beam and column dimensions work out large and reinforcement at the beam column joins are quite heavy, so that, there is a lot of clogging at these joints and it is difficult to place and vibrate concrete at these places which does not contribute to the safety of buildings.These practical difficulties call for introduction of shear walls in High rise buildings.

Earthquake:

Rocks are made of elastic material, and so elastic strain energy is stored in them during the deformations that occur due to the gigantic tectonic plate actions that occur in the Earth. But, the material contained in rocks is also very brittle. Thus, when the rocks along a weak region in theEarth’s Crust reach their strength, a sudden movement takes place there opposite sides of the fault (a crack in the rocks where movement has taken place) suddenly slip and release the large elastic strain energy stored in the interface rocks. The sudden slip at the fault causes the earthquake - a violent shaking of the Earth when large elastic strain energy released spreads out through seismic waves that travel through the body and along the surface of the Earth. And, after the earthquake is over, the process of strain build-up at this modified interface between the rocks starts all over again. Earth scientists know this as the Elastic Rebound Theory. The material points at the fault over which slip occurs usually constitute an oblong three-dimensional volume, with its long dimension often running into tens of kilometres.

Seismic Zones of India

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required to identify these regions. Based on the levels of intensities sustained during damaging past earthquakes, the 1970 version of the zone map subdivided India into five zones – I, II, III, IV and V. The seismic zone maps are revised from time to time as more understanding is gained on the geology, the seism tectonics and the seismic activity in the country. The Indian Standards provided the first seismic zone map in 1962, which was later revised in1967 and again in 1970. The map has been revised again in 2002, and it now has only four seismic zones – II, III, IV and V.

Indian Seismic Codes

Seismic codes are unique to a particular region or country. They take into account the local seismology, accepted level of seismic risk, building typologies, and materials and methods used in construction. Further, they are indicative of the level of progress a country has made in the field of earthquake engineering. The first formal seismic code in India, namely IS 1893, was published in 1962. Today, the Bureau of Indian Standards (BIS) has the following seismic codes:

1. IS 1893 (Part I), 2002, Indian Standard Criteria for Earthquake Resistant Design
2. of Structures (5th Revision)
3. IS 4326, 1993, Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings (2nd Revision) \
4. IS 13827, 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Earthen Buildings.
5. IS 13828, 1993, Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings.
6. IS 13920, 1993, Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces

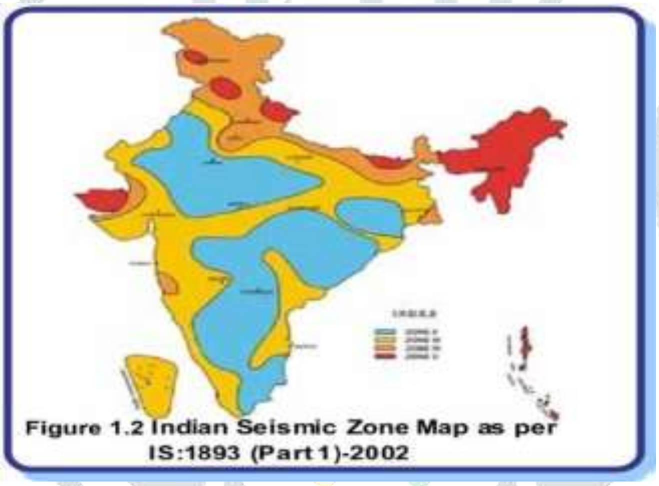

Figure 1.2 Indian Seismic Zone Map as per IS:1893 (Part1)-2002

Fig-1.0: Seismic Zones of India

Modal Analysis Method

Modal analysis is the study of the dynamic properties of structures under vibration excitation. Modal analysis is the field of measuring and analysing the dynamic response of structures and or fluids when excited by an input. In structural engineering, modal analysis uses the overall mass and stiffness of a structure to find the various periods at which it will naturally resonate. These periods of vibration are very important to note in earthquake engineering, as it is imperative that a building's natural frequency does not match the frequency of expected earthquakes in the region in which the building is to be constructed. If a structure's natural frequency matches an earthquake's frequency, the structure may continue to resonate and experience structural damage.

Although modal analysis is usually carried out by computers, it is possible to hand-calculate the period of vibration of any high-rise building through idealization as a fixed-ended cantilever with lumped masses.

In India most of the building structures fall under the category of low-rise buildings. So, for these structures reinforced concrete members are used widely because the construction becomes quite convenient and economical in nature. But since the population in cities is growing exponentially and the land is limited, there is a need of vertical growth of buildings in these cities. So, for the fulfilment of this purpose a large number of medium to high rise buildings are coming up these days. For these high-rise buildings, it has been found out that use of composite members in construction is more effective and economic than using reinforced concrete members. The popularity of steel-concrete composite construction incites can be owed to its advantage over the conventional reinforced concrete construction. Reinforced concretes frames are used in low rise buildings because loading is nominal. But in medium and high-rise buildings, the conventional reinforced concrete construction cannot be adopted as there is increased dead load along with span restrictions, less stiffness and framework which is quite vulnerable to hazards.In construction industry in India use of steel is very less as compared to other developing nations like China, Brazil etc. Seeing the development in India, there is a dire need to explore more in the field of construction and devise new improved techniques to use Steel as construction material wherever it is economical to use it. Steel concrete composite frames use more steel and prove to be an economic approach to solving the problems faced in medium thigh rise building structures.

MATERIALS AND METHODS:

A shear wall is a wall that is used to resist the shear, produced due to lateral forces. Many codes made the shear wall design for high rise buildings a mandatory. Shear walls are provided when the centre of gravity of building area and loads acted on structure differs by more than 30%. To bring the centre of gravity and centre of rigidity in range of 30%, concrete walls are provided i.e. lateral forces may not increase much. These shear walls start at foundation level and extend throughout the building height. The thickness of the shear wall may vary from 150mm to 400mm. Shear walls are oriented in vertical direction like wide beams which carry earthquake loads downwards to the foundation and they are usually provided along both width and length of the buildings. Shear walls in structures located at high seismic regions require special detailing. The construction of shear walls is simple, because reinforcement detailing of walls is relatively straight forward and easy to implement at the site. Shear walls are effective both in construction cost and effectiveness in minimizing earthquake damage to the structural and non-structural elements also.

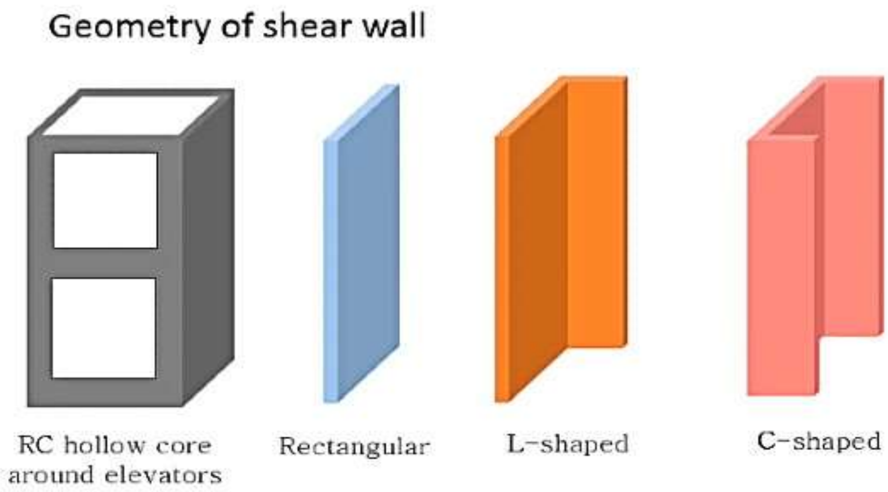

Fig-2.0:Geometry of Shear wall

COMPONENTS OF SHEAR WALLS

Reinforced concrete and reinforced masonry shear walls are seldom-simple walls which resist the lateral forces. Whenever a wall has doors, windows, or other openings, the wall must be considered as an assemblage of relatively flexible components like column segments and wall piers and relatively stiff elements like wall segments.

1. Column segments: A column segment is a vertical member whose height exceeds three times its thickness and whose width are less than two and one-half times its thickness. Its load is usually mainly axial. Although it may contribute little to the lateral force resistance of the shear wall is rigidity must be considered. When a column is built integral with a wall, the portion of the column that project from the face the wall is called a pilaster.
   Column segments shall be designed according to ACI 318 for concrete.
2. Wall piers: A wall pier is a segment of a wall whose horizontal length is between two and one-half and six times its thickness whose clear height is at least two times its horizontal length.
3. Wall segments: Wall segments are components of shear wall that are longer than wall piers.
   They are the primary resisting components in the shear wall.

Important features in planning and design of shear walls: For all high-rise buildings, the problem of providing adequate stiffness and preventing large displacements, are as important as providing adequate strength. Thus, shear wall system has two distinct advantages over a frame system.

Objectives and scope:

- the main objective of present work is to investigate the performance of G+2 RCC shear wall building with 3meters height of each storey
- to design and analysis the shear wall building using STAAD PRO software
- to model the G+2 RCC shear wall building separately using REVIT ACHITECTURE software

MODELING& RESULTS:

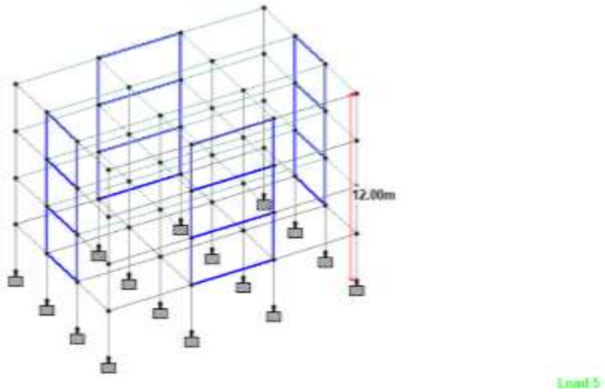

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Fig-3.0: Assigning shear walls

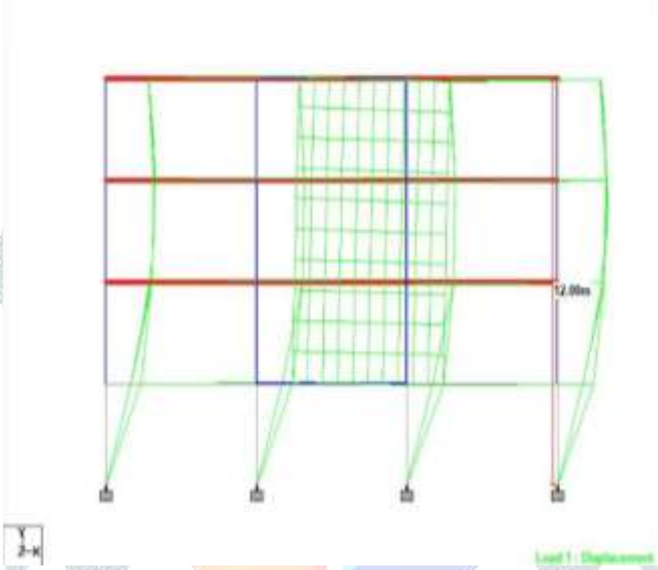

Fig-4.0:Deflection due to seismic in X-direction

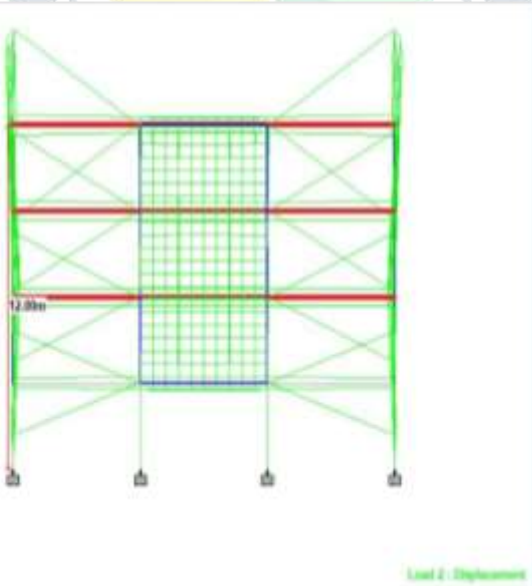

Fig-5.0: Deflection due to seismic in Z-direction

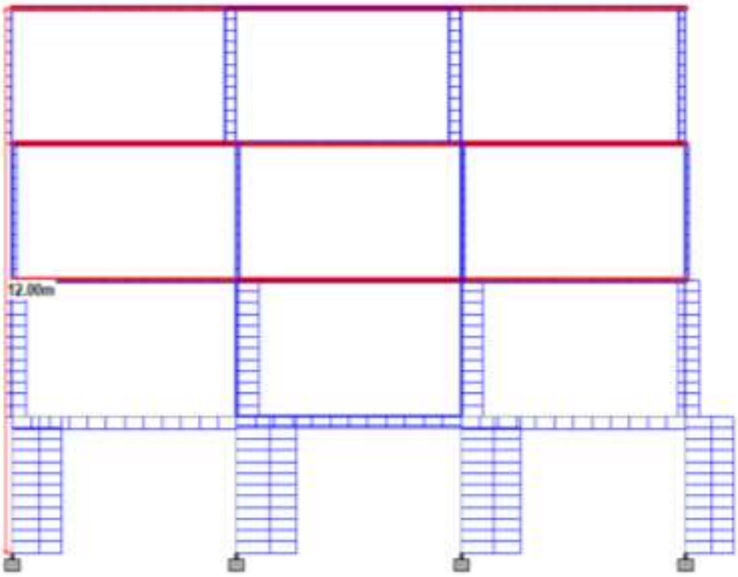

Fig-6.0: Shear force diagram of Structure

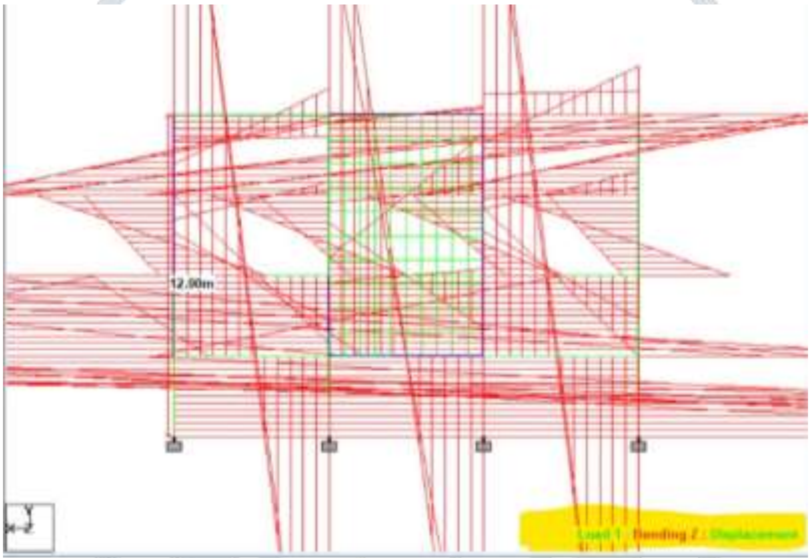

Fig-7.0:Bending moment diagram of structure

MODELING IN REVIT ARCHITECTURE:

Introduction:

The Revit Architecture software will give the plan view, 3d model with excellent elevation, detailing diagrams, schedules for each structural element, and with V-ray rendering software we can have realistic view with high efficiency, building information modelling (BIM) gives the information about project design, its different views, scope, quantities, and phases when you need it. In the Revit model, every project we did will give the 2d, 3d, section views, elevations with detailing and schedules, quantities also it will provide us. Revit Architecture collects information about each structural element's material its visualization realistic in nature and its design such as thickness height and in schedule it will give no of data such as cost type of family, no. of brick, no of doors, no. of windows etc across0all other representations of the project. In Revit we can have these all 2D, 3D, And sectional views, elevations and detailing drawing etc. in one complete sheet.

Building Information Modelling (BIM): •Now a days it is need of deliver of projects rapidly, more economically, and wit enhanced potential for reduced environmental impact.

•The purpose of Autodesk Revit Architecture is made for BIM. BIM is an integrated process built on coordinated, reliable information about a project from design through construction and to operations.

Fig-8: BIM process

CONCLUSIONS:

Shear wall building in STAAD PRO

From all the above analysis, it is observed that in 3 story building, constructing building with shear wall in short span at middle it is economical as compared with other models. From this it can be concluded that large dimension of shear wall is not effective in 3 stories or below 3 stories buildings. It is observed that the shear wall is economical and effective in high rise building.

Also observed that

1. Changing the position of shear wall will affect the attraction of forces, so that wall must be in proper position.
2. If the dimensions of shear wall are large then major amount of horizontal forces are taken by shear wall.
3. Providing shear walls at adequate locations substantially reduces the displacements due to earthquake.

shear wall building in Revit architecture

This project gives the realistic modelling of building and accurate families ranging from furniture to lighting fixtures, as well as import existing models from other software's like Auto CAD etc. We can get the approximate estimations of building also using Revit Architecture. In this Project we have done planning, modelling, and we have created families also for this building.

A clear design and modelling of a commercial building with the efficient0structural and architectural plans. It provides the overall knowledge of material take off in the model of the building defined in the project. 3D realistic view give he clear picture about the family and the components placed with in the building model.

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