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" Study of Sesmic Analysis of Masonry Wall Structure"

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ABSTRACT

Earthquakes are natural trouble under which disasters are mainly caused by damage or collapse of the structure and other man-made structures. When an earthquake occurs natural period of vibration is more on heavy loaded building and less in light loaded building. If the building is light weighted, i.e. steel is less then economy of structure is also achieved. Hence it is necessary to find out natural/fundamental time period when mass changes with different type of brick masonry and concrete masonry.This is necessary because IS 1893:2002 does not incorporate the effect of mass in a formula which they have mentioned for brick masonary structure. Thedesign will also analyze with ETAB software.

Keywords: Time period of structure, Steel economy ,Brick masonry, concrete wall ,IS 1893:2002, Etab software

I. INTRODUCTION

A vertical load bearing member whose breadth is more than four times its thickness is called a wall. Earthquake damage depends on many parameters, intensity, duration and frequency content of ground motion, geologic and soil condition, quality of construction, etc. In reinforced wall if the percentage of the steel is not less the 0.4 so that the strength of the reinforcement can also be taken into consideration when calculating its load carrying capacity. In this research work different types of bricks and concrete wall are taken with their respective density. The Scope of this project to calculate the Fundamental natural period of the structure with respect to variation of different size and different type of structure with using different densities of bricks. The behavior of masonry structures under seismic loading, and to determine their safety. The primary focus is on historic arched or vaulted structures, but more modern unreinforced masonry structures are also considered.[1]The formulation consists of beam-column cubic finite elements accounting for geometric non-linearity's and material inelasticity.[2]The performance of unreinforced masonry buildings in the Newcastle area building during the 1989 earthquake. In particular, 3 story masonry apartment building which suffered a combined soft-story and tensional modes of failure are analyzed.[3]The design of the column, design of beams, design of slab, design of footing with as per IS code.[4]The seismic retrofitting consists in upgrading the strength of an existing structure with the aim to increase it's a capacity to withstand future earthquakes. The seismic evaluation and strengthening of the existing reinforced concrete buildings.[5]The analysis was carried out by means of two distinct nonlinear models, in terms of the load patterns. The first model was used until all struts at a given intermediate story collapsed, leading to a substantial change in the deformation and load pattern. The subsequent second model differed from the first model by the removal of the struts that had collapsed. A sensitivity analysis was carried out by changing the strength parameters of the diagonal struts.[6] Seismic performance assessments indicate that, of the configurations considered (bare, partially-in filled and fully-in filled frames), the fully-in filled frame has the lowest collapse risk and the bare frame is found to be the most vulnerable to earthquake-induced collapse. Depending on the infill configuration, the median collapse capacity varies by a factor of 1.3 to 2.5.[7]The effect of masonry infill on the performance of reinforced concrete frames subjected to earthquake ground motions. The masonry-in filled modeled by means of equivalent strut elements, which can only carry compressive loads, characterized by an idealized degrading hysteretic behavior. The adopted mathematical models was validated by comparing numerical and test results.[8]Shear walls, is considered as major earthquake resisting member. Structural wall gives an effective bracing system and offer good potential for lateral load resistance. So it is important to determine the seismic response of the wall or shear wall. In this study main focus is to determine the location for the shear wall in multi story building.[9]The design of structures subjected to natural hazards such as earthquakes and typhoons demands safety of structures which is governed by the natural frequencies and the amount of damping in each mode of vibration. The dynamic behavior of structures is governed by the fundamental natural frequency and the amount of damping exhibited by each mode of vibration.[10]The buildings were categorized as medium and high-rise reinforced concrete moment resisting frames. There are four types of analyses adopted; (i) Free Vibration Analysis (FVA), (ii) Earthquake Static Equivalent Analysis (ESEA),(iii) Static Wind Analysis (SWA), and (iv) Earthquake Dynamic Response Spectrum Analysis(EDRSA). Results from free vibration analysis showed that five out of seven buildings produced high dynamic amplification factor in the range of 2.01 to 5.16.[11]Apart from the modern techniques which are well documented in the codes of practice, there are some other old traditional earthquake resistant techniques which have proved to be effective for resisting earthquake loading and are also cost effective with easy constructability. Disasters are unexpected events which have adversely affected humans since the dawn of our existence. In response to such events, there have been attempts to mitigate devastating effects of these disasters.[12]Construction industry boom can be seen in almost all the developing countries. With the increase in material costs in the construction industry, there is a need to find more cost saving alternatives so as to maintain the cost of constructing houses at prices affordable to people. There is need to develop an alternative system of building component which would impart more benefits and are multifunctional with optimum use of labor and material.[13]Present situation growth of Multistory building is very high because of rapid urbanization all over the world. Open first storey is generally provided for parking, reception lobbies, communication halls or any purpose in multi-storey building. But in case of earthquake multi-storey building with soft storey gives poor performance. There are various factors affect on the behaviour of multi-storey building i.e. irregularity in plan and elevations, uneven distribution of mass etc. Infill wall in frame building provides stiffness and improves the behaviour of building under lateral loads. In the present work, study of different infill materials on the seismic behaviour of multi-storey building with soft stories is carried out.[14]Floating columns are a typical feature in the modern multi-storey construction in urban India and are highly undesirable in buildings built in seismically active areas. In this paper static analysis is done for a multi-storey building with and without floating columns. Different cases of the building are studied by varying the location of floating columns floor wise. The structural response of the building models with respect to, Base shear, and Storey displacements is investigated. The analysis is carried out using software sap2000v17[15]The analytical research carried out to study the behavior flat slab building with and without shear wall reported in the present work. For analysis 15 storied flat slab building is analyzed for seismic behavior. Response spectrum method is used for analysis considering different shear wall positions using ETABS software. Five different positions of shear wall were studied for analysis. From this analysis shear wall at core having square shape is most suitable case for construction of shear wall.[16]An earthquake is a natural phenomenon associated with violent shaking of the ground. They are vibrations of the earth's surface caused by sudden movements of earth crust mostly due to tectonic movements. Hence to improve the seismic response of buildings in earthquake prone areas, passive energy absorbing devices are used. In order to mitigate the vibration, different approaches have been proposed, among which Tuned Mass Dampers (TMDs) and Base isolation (BI) is the most preferable and have been widely used in practice. A Tuned mass damper (TMD) is a device consisting of a mass, and spring that is attached to a structure in order to reduce the dynamic response of the structure.[17]Masonry buildings are brittle structures and one of the most vulnerable of the entire building stock under strong earthquake shaking. Ground vibrations during earthquakes cause inertia forces at locations of mass in the building. These forces travel through the roof and walls to thefoundation. The main emphasis is on ensuring thatthese forces reach the ground without causing majordamage or collapse. Of the three components of amasonry building (roof, wall and foundation) the walls are most vulnerable to damage causedby horizontal forces due to earthquake.[18].The risks of earthquakes can not be avoided completely, but one can be reduce the damages a structure vulnerability. From the evidence of baste earthquakes, researchers put some guidelines for designing and construction of several structures. Herein, in this paper, steel structures, reinforced concrete and masonry constructions would be discussed briefly, and how each kind respond and performed during an earthquake.[19,20]

II. METHODOLOGY

This chapter gives the idea about the methodology used for the study purpose. The steps followed to accomplish the research objectives and the thesis has developed over time are described briefly. The reinforced structural design of G+3 is done manually, but for that different masonry with they are considered as follows. Such as Red brick masonry is 18 kN/m³, siporex brick is 8 kN/m³, Fly ash brick 10 kN/m³ and concrete wall is 25 kN/m³. According to this weight all the reinforcement details of G+3 building with L,C, and Square shape are manually calculated. The all design is done by Limit State Method. In theoretical calculation the structural analysis of the building is done. In that Slab design, beam design, Column design,Footing design and seismic design.The natural period of the structure is calculated by using analytical method and software analysis ETAB. ETAB is the software which used by structural analysis. There isa design of all structural members Slab, Beam, Column, Footing. There are three types of structure are taken with different frequency and shape. Design of all parts of the building by the analytical method and also calculate steel quantity of structure. By using analytical method the natural period of all structure is same by the reference IS 1893:2002. Density of Red Brick is high, so the steel quantity of is also getting more. Density of Siforex Brick is low so the steel quantity gets lower the other brick masonry structure. In IS 1893:2002 clearly mention the fundamental natural period of vibration (Ta), in seconds, of all other buildings, including moment –resisting frame building with brick infill panels[8]

$Ta = 0.09\ h / \sqrt{d}$….(1) [Caluse no 7.6.2.(page no 24)[7]]

Where h = Height of building in meter. d = Base dimension of the building at the plinth level, in meter, along the consideration of the lateral force. When an earthquake is done natural period of vibration is more on heavy loaded building and less in light loaded building. If the building is light weighted, i.e. steel is less and economy of structure is also achieved.

Design and Analysis in ETAB 2009:

III. PROBLEM STATEMENT

A G+3 story with square shape building is designed by three different bricks,Red, Fly Ash and Siporex.

Table no 1. Building Data

Building shape	Square shape	L shape building	C shape building
Building size	3x3 (each room)	12x12mm	12x12mm
Soil type	Hard soil	Hard soil	Hard soil
Seismic zone	IV	IV	IV
Response reduction factor	5	5	5
Importance factor	1	1	1
Height of building	13.10m	13.10m	13.10m
Floor to floor height	3m	3m	3m
Thickness of slab	150mm	150mm	150mm
Beam size	230x450mm	230x450mm	230x450mm
Column size	230x230mm	230x230mm	230x230mm
2nd floor	300x300mm	300x300mm	300x300mm
3rd floor	300x300mm	300x300mm	300x300mm
Material property	M20 (Grade of concrete)	M20 (Grade of concrete)	M20 (Grade of concrete)

SQUARE SHAPE BUILDING

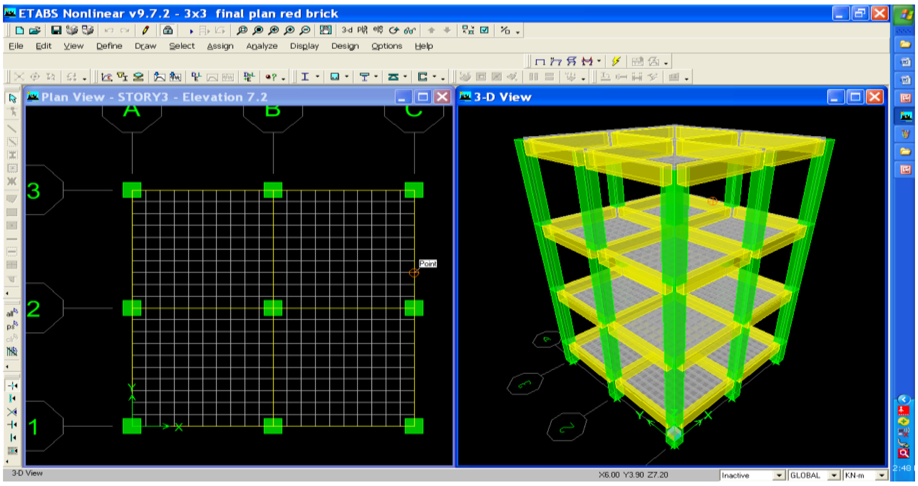

Fig no 1: Sqaure shape Models

LSHAPE BUILDING

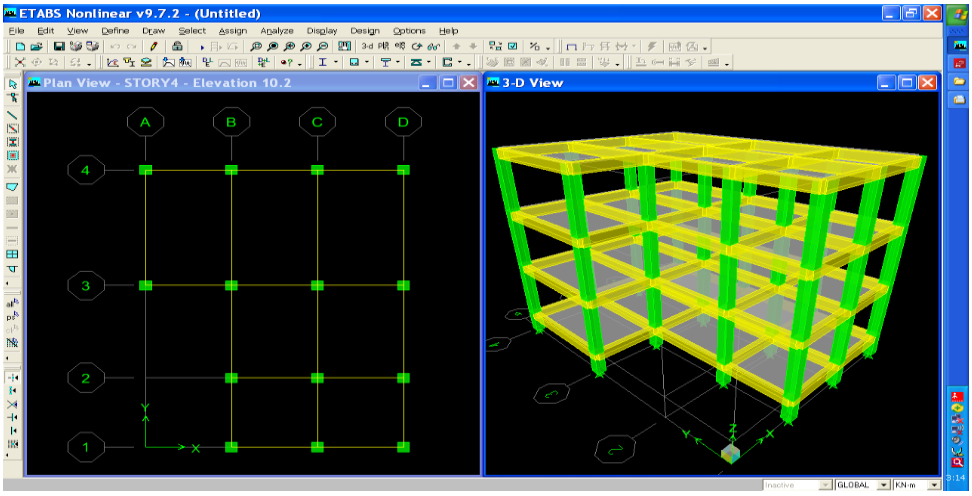

Fig no 2: L Shape Model

C SHAPE BUILDING

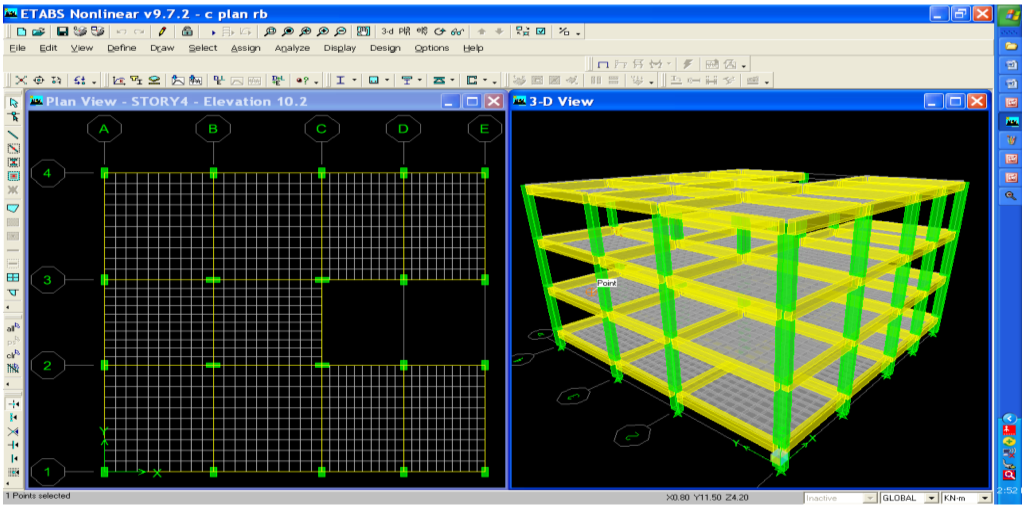

Fig No 3: C Shape Model

IV. RESULTS AND DISCUSSION

In this paper, the analysis and design of three types of building such as Square, L, C shape with different brick and densities were done. So, here the results are time period calculated by analytical method is same in all types of masses, but if compared with software analysis, time period varies with different masses. Light structure is more suitable during seismic vibration. The Scope of this study to calculate the fundamental natural period of the structure with respect to variation of different size and different type of structure with using different densities of bricks.[27]Prepare various models in ETAB with their respective dimensions.This is results by table format in which there is a comparison of the time period by analytical and Using ETAB software. [28]

SQUARE SHAPE BUILDING :-

Table No 2 : Comparison of bricks in Square Shape Model

MATERIAL CONSUMPTION	RED BRICK	FLYASH BRICK	CIPOREX BRICK
TOTAL WEIGHT ON STRUCTURE(kN)	1174.33	848.2	767
TIME PERIOD (Sec)	0.374	0.374	0.374
TIME PERIOD BY ETAB ANALYSIS (Sec)	0.32	0.28	0.24

In this table, Square shape, structure, total weight of the structure and the time period of total structure is calculated by manually and using ETAB software.

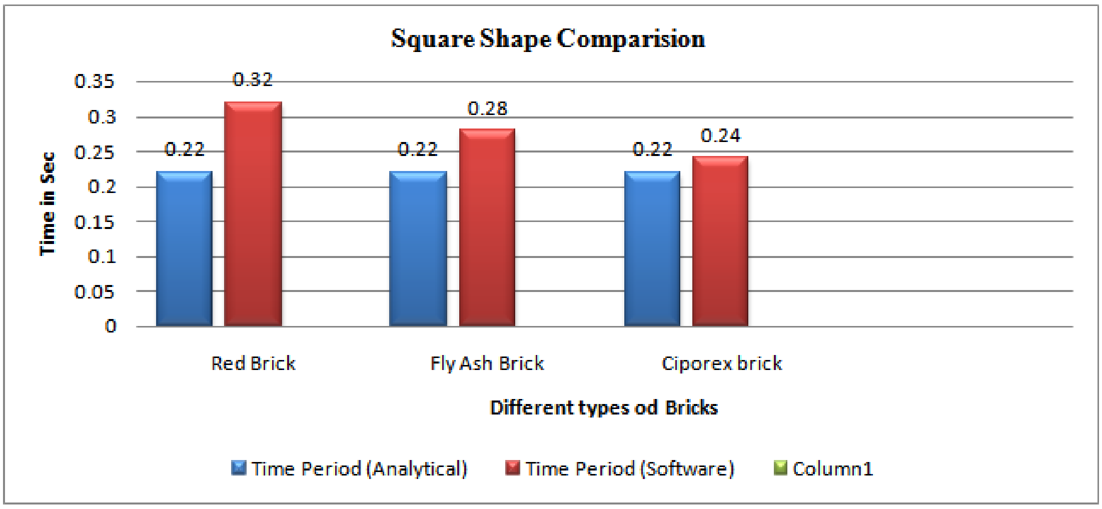

Figure No 4 : Plot of graph Time Vs Bricks

From the fig 4 it is observed that, there is a comparison of three bricks with different total weight. But above graph it is observed time period calculated by manually means 0.22Sec is equal in all types of brick structure, but it is calculated in software the time is changed with Types of brick,i.e.Red Brick 0.32 Sec, Flyash brick 0.28 Sec andSiporex brick it is 0.24 Se

L SHAPE BUILDING

Table No 3 : Comparison of bricks in L Shape Model

MATERIAL CONSUMPTION	RED BRICK	FLY ASH BRICK	CIPOREX BRICK
TOTAL WEIGHT ON STRUCTURE	7126.60	4927.65	3404.78
TIME PERIOD (Sec)	0.306	0.306	0.306
TIME PERIOD BY ETAB ANALYSIS (Sec)	0.32	0.26	0.22

In this table, L shape, structure, total weight of the structure and the time period of total structure is calculated by manually and using ETAB software.

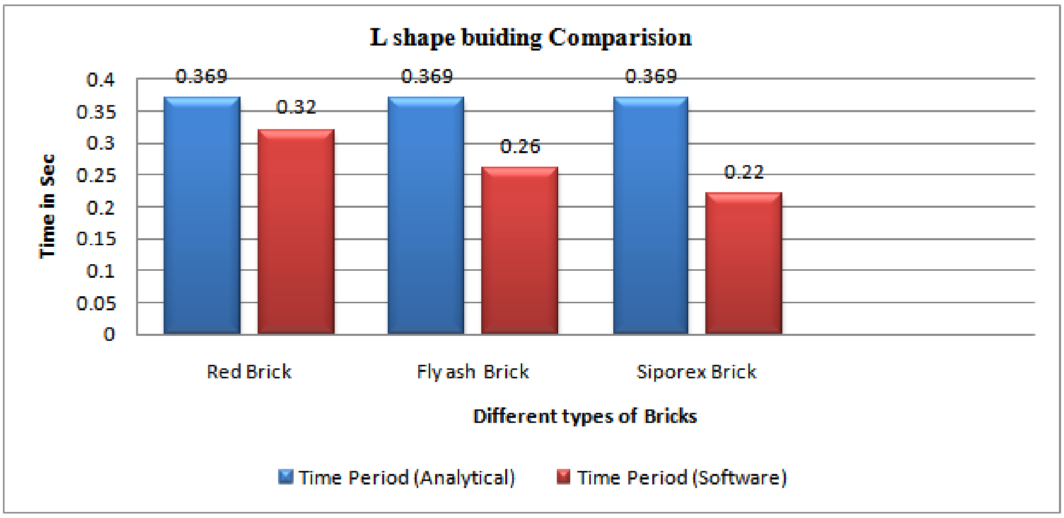

Figure No 5 : Plot Of graph Time Vs Bricks

From the fig 5 it is observed that, there is a comparison of three bricks with different total weight. But above graph it is observed time period calculated by manually means 0.369 Sec is equal in all types of brick structure, but it is calculated in software the time is changed with Types of brick, i.e. Red Brick 0.32Sec, Flyash brick 0.26 Sec and Siporex brick it is 0.22 Sec.

C SHAPE BUILDING

Table No 4 : Comparison of bricks in C Shape Model

MATERIAL CONSUMPTION	RED BRICK	FLYASH BRICK	CIPOREX BRICK
TOTAL WEIGHT ON STRUCTURE	9453.82	4532.28	3522.72
TIME PERIOD (Sec)	0.218	0.218	0.218
TIME PERIOD BY ETAB ANALYSIS (Sec)	0.36	0.3	0.26

In this table, C shape, structure, total weight of the structure and the time period of total structure is calculated by manually and using ETAB software.

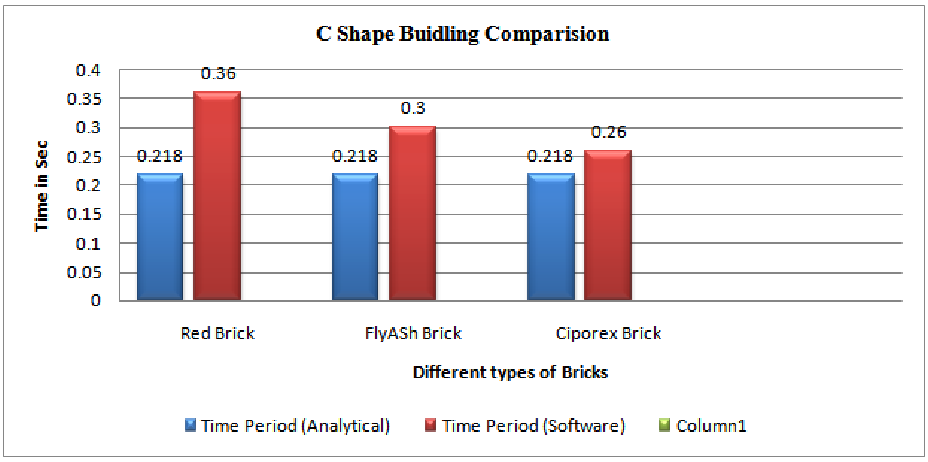

Figure No 6 : Plot Of graph Time Vs Bricks

From the fig 6 it is observed that, there is a comparison of three bricks with different total weight. But above graph it is observed time period calculated by manually means 0.218 Sec is equal in all types of brick structure, but it is calculated in software the time is changed with Types of brick, i.e. Red Brick 0.36 Sec,Flyash brick 0.3 Sec and Siporex brick it is 0.26 Sec

V. CONCLUSION

1) Different brick with different densities affect on mass of the structure. When an earthquake occurs, the natural period of vibration is more on heavy loaded building and less in light loaded building.
2) When mass of each building is different then the natural time period of the building is also different, but IS 1893:2000 do not incorporate the effect of mass in a formula which they have mentioned for brick infilled structure .
3) When the natural time period of eachstructureiscalculated by manually with time period formula mentionedin IS code 1893-2000 is same for all types of structures, but when the time period is calculated by ETAB software analysis it's different to the different mass of the structure.

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