International Journal For Technological Research In Engineering
Volume 3, Issue 10, June-2016 *ISSN (Online): 2347 - 4718*

COMPARATIVE ANALYSIS AND DESIGN OF HIGH RISE STRUCTURE USING LIGHT WEIGHT INFILL BLOCKS AND CONVENTIONAL BRICKS

Mr. Ajay Patre[1], Mr. Laxmikant Vairagade[2]
[1]PG Student, [2]Assistant Professor
Dept. of Civil Engineering, G. H. Raisoni Academy of Engineering & Technology, Nagpur – 16, India

ABSTRACT: In this paper the attempt has been made to carry out the project high rise buildings effect of infill wall using light weight block and conventional bricks. Structural analysis and design in STAAD Pro by Equivalent Static Method. High rise building using infill ALC(Aerated light weight concrete block) and conventional clay brick masonry are designed for the same seismic hazard in accordance with the applicable provisions given in Indian codes. The analytical results of the high rise buildings will be compared and analyzed obtained are cost, lateral displacement, storey drift, equivalent diagonal strut, axial force and shear force in beam and column when subjected to dynamic earthquake loadings. And the structure properties are optimized for most economical dimensions. The project is also aimed at getting familiarity with STAAD Pro.2008.
Keywords: ALC (Aerated light weight concrete block), Infill RC frame, Equivalent Diagonal Strut, Base shear, Base moment, Floors wise displacement.

I. INTRODUCTION

Autoclaved Aerated Concrete or AAC is a steam-cured cementitous product manufactured from a mix of pulverized fly ash, cement, lime, gypsum and an aeration agent, giving it its unique porous nature. AAC is an intelligent building solutions system because of its light weight, excellent thermal insulation and acoustic properties and energy efficiency. AAC today is considered a revolutionary precast building material offering a unique combination of high durability and strength, low weight, unprecedented build ability and superior ecological green features. This material is a state of the art green building material which is in other parts of the country fast replacing ordinary red clay bricks and fly ash bricks for its superior quality and saving potentials in the first and revenue maintenance cost of building. The blocks and panels are used for all kinds of walls, external or internal, load bearing or non-load bearing walls etc. AAC is the material of choice for all building applications. Autoclaved Aerated Concrete technology was invented by a Swedish scientist Mr. John Axel Ericson during 1920s. However, it took a long time for the invention to be commercially viable and to be in wide use in a developing. Economy like INDIA. However, AAC blocks are widely used in Europe, Middle East, South East Asia, China and USA.

The steps of AAC Block manufacturing process:

- Raw material preparation and mixing
- Panel reinforcement preparation
- Cutting
- Green separation
- Autoclaving
- Packaging

II. EFFECT OF INFILL

- The stresses, in the infill wall, however, were found to increase with the increase in Young's Modulus of elasticity due to the increase in stiffness of the system, attracting more forces to the infill.
- The infill wall enhances the lateral stiffness of the framed structures; however, the presence of openings within the infill wall would reduce the lateral stiffness.
- The fundamental period only slightly increases as the infill wall thickness increases, since the increase in thickness only increases the mass of the structure rather than its stiffness.
- The infill was assumed to crack once the stress in the infill exceeded the ultimate compressive stress of the infill material.
- The strength if infill in terms of its Young's modulus (Ei) has a significant influence on the global performance of the structure. The structural responses such as roof displacements, inter-storey drift ratios and the stresses in the infill wall decrease with increase in (Ei) values due to increase in stiffness of the model.
- The opening size of the infill has a significant influence on the fundamental period, inter-storey drift ratios, infill stresses and the structural member forces. Generally, they increase as the opening size increases, indicating that the decrease in stiffness is more significant than the decrease in mass.
- The specific weight of reinforced masonry is smaller, the thermal and somniferous conductivity of the masonry is worse and it also has better resistance against fire and chemicals.
- The wall can be loaded right after finishing the construction.

III. ROLE OF INFILL

Existence of infilling is noted to increase the ultimate lateral resistance of the system while resulting in less ultimate lateral deflection for lower infilling. The effect on both parameters is more pronounced for higher percentages of infilling. Two phenomena arise through the stage of loading and result in the response nonlinearity. First is to find the stiffness degradation of the reinforced concrete with load-induced orthotrophy depending on both the applied dynamic load and the inherent deformational characteristics of the frame. Second is to find the progressive strength reduction of either of the diagonal struts, which is supposed to be sequential according to level of loading. Conventional half-brick wall infilling is noted to affect nearly all of the dynamic parameters of reinforced concrete frames. Infill influence on the kinetic and kinematic coefficients related to lateral excitation is found to depend on frame features such as number of stories and number of bays as well as infill amount and position. Lower location yields the higher strength, stiffness, and frequency of the system. Nonlinearity of the behavior is basically due to stiffness degradation, which consequently results in frequency attenuation during the loading regime.

IV. EQUIVALENT DIAGONAL STRUT FRAME METHOD

Significant experimental and analytical research is reported in literature, which attempts to understand the behaviour of infilled frames. Studies show that infill walls decrease inter-storey drifts and increase stiffness and strength of a structure. Ductility of infilled structure, however, is less than that of bare structures. Quality of infill material, workmanship and quality of frame-infill interface significantly affect the behaviour of infilled frames. Different types of analytical macro-models, based on the physical understanding of the overall behaviour of an infill panel, were developed over the years to mimic the behaviour of infilled frames. The single model is the most widely used, though multi-strut modals are also sometimes reported to give better results of the available models. Thus, RC frames with unreinforced masonry walls are modelled as equivalent braced frames (EBF) with infills walls replaced by “equivalent struts”.

Equivalent Diagonal Strut Method is used for modelling the infill wall. In this method the infill wall is idealized as diagonal strut and the frame is modelled as beam or truss element. Frame analysis techniques are used for the elastic analysis. The idealization is based on the assumption that there is no bond between frame and infill.

The width of the diagonal strut is given as

$W= 0.5(\alpha h^2+\alpha L^2)^{0.5}$ and $Ad= tw$

$Ld= (h^2+L^2)^{0.5}$

$Ib= (bd)^3/12\ m^4$ and $Ic= (bd)^3/12\ m^4$

$\theta= \tan^{-1}(h/L)$, $Ef= 5000\sqrt{40}$

$\alpha h= \prod/2((EfIch/2Emtsin2\theta))^{0.5}$

$\alpha L= \prod((EfIbh/2Emtsin2\theta))^{0.5}$

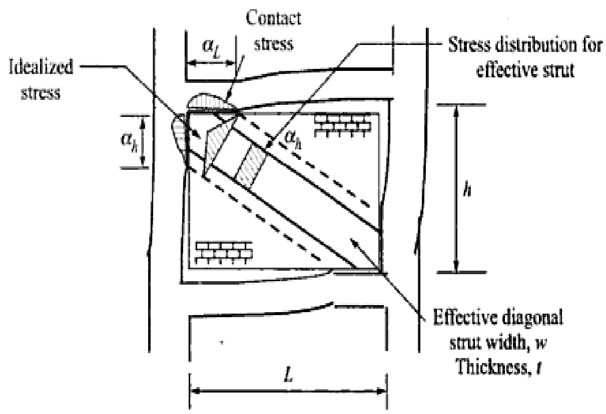

Fig.1. Diagonal strut modelling of infill panel

Where,
Ei = modulus of elasticity of infill material
Ef = modulus of elasticity of frame material
L = beam length between centre lines of columns
L' = length of infill wall
h = column height between centre lines of beams
h' = height of infill wall
Ic = moment of inertia of column
t = thickness of infill wall
d' = diagonal length of strut
θ = angle between diagonal of infill wall and the horizontal in radian.

4. Method of Analysis of Building as per IS 1893 (part I):2002

Seismic codes are unique to a particular region or country. In India, Indian standard criteria for Earthquake Resistant Design of Structures IS 1893 (Part I): 2002 is the main code that provides outline for calculating seismic design force. This force depends on the mass and seismic coefficient of the structure and the latter in turn depends on properties like seismic zone in which structure lies, importance of the structure, its stiffness, the soil on which it rests, and its ductility. The code recommends following method of analysis.
1. Equivalent static analysis.
2. Dynamic Analysis

V. DATA TABULATION

In this study, models of a high rise building symmetrical in the plan are considered. Usually in a building 60% presence of Masonry infills are effective as the remaining portion of the Masonry Infills is meant for functional purpose such as doors and windows openings. In this study the buildings are modeled using 60 % Masonry Infills with ALC blocks and conventional bricks but arranging them in different manner. Further inputs include unit weight of the concrete is 25 kN/m3, Elastic modulus of steel is 2 x l08 kN/m2, Elastic Modulus of concrete is 22.36 x l06 kN/m2, Strength of concrete is 20 N/mm2 (M20), Yield strength of steel is 415 N/mm2 (Fe-415).

The following material properties have been used for masonry infill. Thickness of infill masonry is 230 mm.

Material Properties of ALC block

Density = 6.50 kN/m3

Shear Modulus (G) = 763N/mm^2

Young's modulus of elasticity(E) = 1840 MPa

Poisson ratio = 0.25

Material Properties of Conventional bricks

Density = 19 kN/m3

Shear Modulus (G) = 1840N/mm

Young's modulus of elasticity(E) = 2640 MPa

Poisson ratio = 0.16

Dead Load Calculation

External Wall = (0.250*3*19) = 14.25 kN/m

Internal Wall = (0.150*3*19) = 8.55 kN/m

Dead Load of Slab = (0.150*25) = 3.75 kN/m

Live Load = 3 kN/m^2

Roof Live = 1.5 kN/m^2

VI. RESULTS

Comparison of Base Shear in X-dir (kN) for different models.

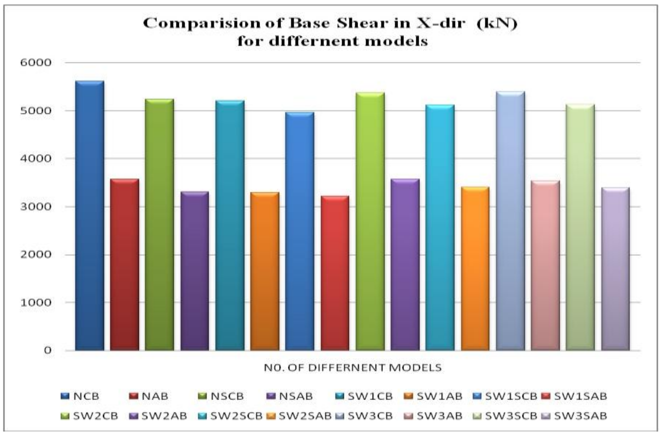

Fig. 2 Comparison of Base Shear in X-dir (kN).

Comparison of Base Shear in Z-dir (kN) for different models.

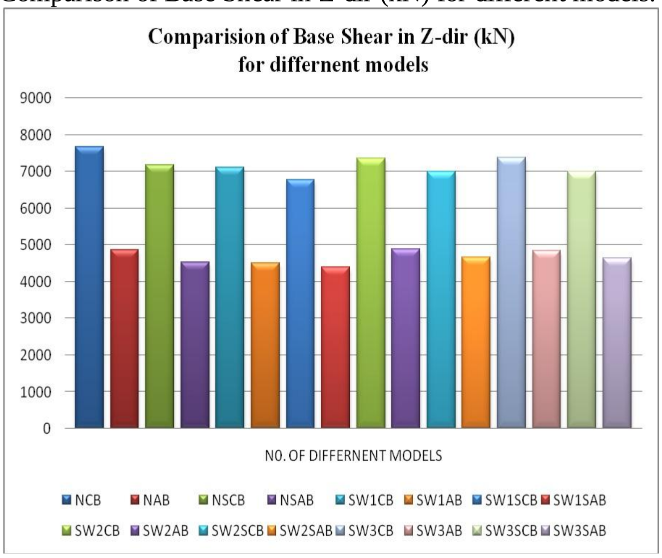

Fig. 3 Comparison of Base Shear in Z-dir (kN).

Comparison of Base Moment in X-dir (kN) for different models.

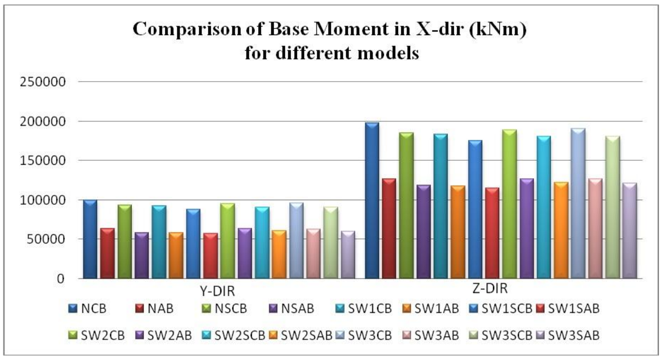

Fig. 4 Comparison of Base Moment in X-dir (kNm).

Comparison of Base Moment in Z-dir (kN) for different models.

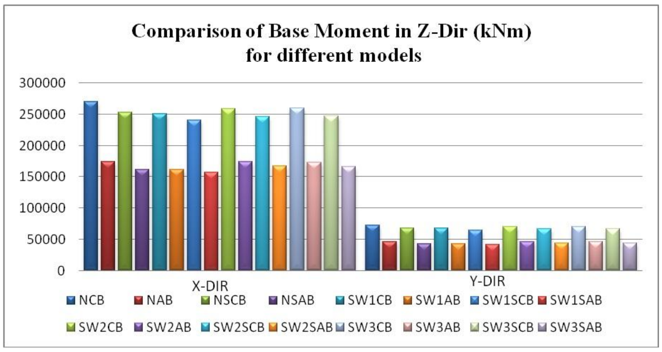

Fig. 5 Comparison of Base Moment in X-dir (kNm).

Comparison of Floor Wise Displacement (mm) for different models.

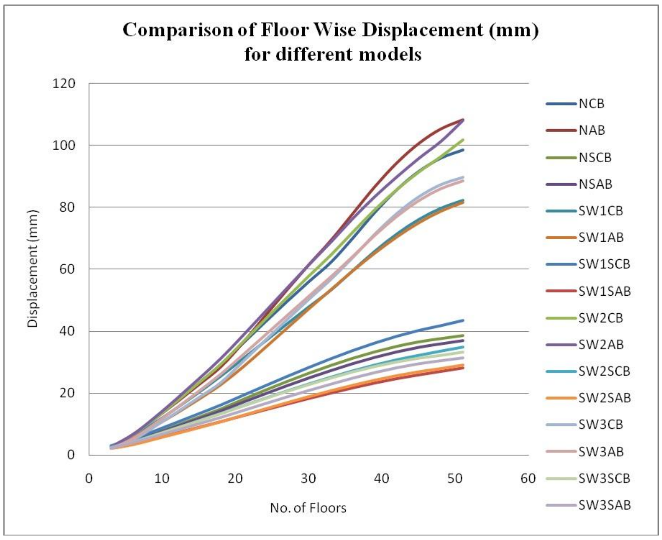

Fig. 6 Comparison of Floor wise displacement in X-dir (mm).

VII. CONCULSION

- The ALC block material can basically be used to replace conventional bricks as infill material for RC frames built in the earthquake prone region.
- Shearwall construction will provide large stiffness to the building by reducing the damage to the structure.

- In the Base Shear in X and Z-direction SW1AB is more efficient than NCB and the % variation is 40 to 45.
- In the Base Moment in X and Z-direction SW1AB is more efficient than NCB and the % variation is 40 to 45.
- In the Floor Wise Displacement SW1AB is more efficient than NCB and the % variation is 70 to 75.
- By considering the infill wall the roof displacement of the structure reduces.

REFERENCES

[1] Das, D., Murty, C. V. R., Brick masonry infills in seismic design of RC framed buildings: Part 1 –Cost implications" The Indian Concrete Journal, 2004, vol78.

[2] Fema 306: "Evaluation of earthquake damaged concrete and masonry wall buildings" Washington D.C.

[3] Hossain Mohammad Muyeed-Ul-Azam and Khan Mahmud Amanat [1] (2005). Effect of Infill as a Structural Component on the Column Design of Multi-storied Building. UAP Journal of Civil and Environmental Engineering Vol. 1, No. 1, 2005.

[4] Imran I. and, Aryanto A. " Behavior of Reinforced Concrete Frames Infilled with Lightweight Materials under Seismic Loads" Civil Engineering Dimension,2009, Vol. 11, No. 2, 69-77.

[5] IS:1893(Part I)-2002, Criteria for Earthquake Resistant Design of Structure, General Provisions and Buildings, Bureau of Indian Standards, New Delhi.

[6] Pauley, T. and Priestley, M.J.N. (1992) "Seismic design of reinforced and masonry buildings" Wiley Interscience Inc., USA,

[7] J. Dorji and D.P. Thambiratnam [2] (2009). Modeling and Analysis of Infilled Frame Structures under Seismic Loads. The Open Construction and Building Technology Journal, 2009, 3, 119-126.

[8] Kashif Mahmud, Md. Rashadul Islam and Md. Al-Amin (2010). Study of the Reinforced Concrete Frame with Brick.

