A REVIEW ON: ANALYSIS OF HIGH RISE BUILDING USING LIGHT WEIGHT INFILL BLOCKS AND CONVENTIONAL BRICKS

Mr. Ajay Patre
PG Student, Dept. of Civil Engineering
G. H. Raisoni Academy of Engineering & Technology
Nagpur – 16, India
Email:ajay.patre3@gmail.com

Mr.Laxmikant Vairagade
Assistant Professor, Dept. of Civil Engineering
G. H. Raisoni Academy of Engineering & Technology
Nagpur-16
Email: laxmikant.vairagade@raisoni.net

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 RSM (Response Spectrum 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, Storey drift, Cost, & Lateral displacement.

1. 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

2. 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.

3. 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.

4. 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

$$w = 0.175\ (\lambda' h)\text{-}0.4d'$$

Contact length parameter,

$$\lambda H = H[E_m t \text{Sin}2\theta / 4E_c I_c h_m]^{0.25}$$

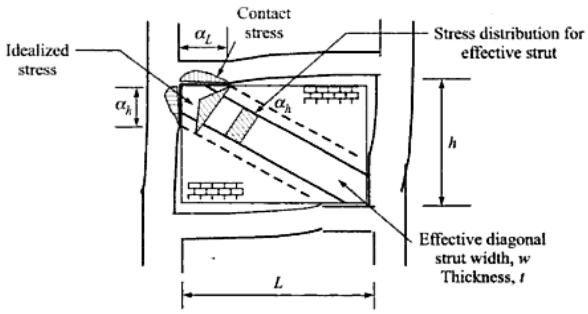

Fig.1. Diagonal strut modelling of infill panel

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.RESPONSE SPECTRUM METHOD

The basic mode superposition method, which is restricted to linearly elastic analysis, produces the complete time history response of joint displacements and member forces. In the past there have been two major disadvantages in the use of this approach. First, the method produces a large amount of output information that can require a significant amount of computational effort to conduct all possible design checks as a function of time.

Second, the analysis must be repeated for several different earthquake motions in order to assure that all frequencies are excited, since a response spectrum for one earthquake in a specified direction is not a smooth function. There are computational advantages in using the response spectrum method of seismic analysis for prediction of displacements and member forces in structural systems. The method involves the calculation of only the maximum values of the displacements and member forces in each mode using smooth design spectra that are the average of several earthquake motions.

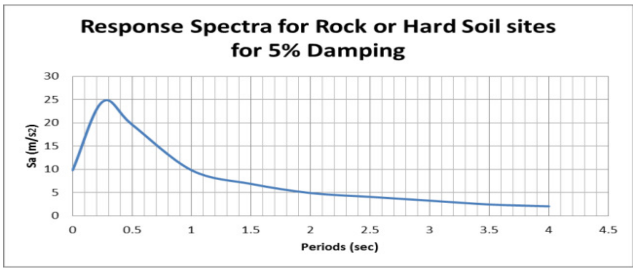

Fig. 2 Spectra Curve for finding Base Shear from Fundamental Time Period

5.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) and Live load is 2 kN/m2.
The following material properties have been used for masonry infill. Thickness of infill masonry is 230 mm.
(a)ALC block
Density = 6.50 kN/m3
Compressive strength = 3 MPa
Young's modulus of elasticity =1840 MPa
Poisson ratio =0.25
(b)Conventional brick
Density = 19.20 kN/m3
Compressive strength = 4.3 MPa
Young's modulus of elasticity =2640 MPa
Poisson ratio =0.16

6.APPROXIMATE RESULTS

- The dynamic seismic earthquake behaviour of the two types of infills material as ALC block & Conventional bricks was investigated.
- The performance of ALC block infill was superior to that of Conventional brick infill in RC frame. Therefore, The ALC block material can basically be used to replace conventional bricks as infill material for RC frames built in the earthquake prone region.
- The behavior of an infilled frame is dependent on the properties of frame and infill; hence, the response of such frames should be based on overall frame to infill composite action rather than on isolated bare frame behavior.
- Effect of dynamic loading on the behavior of masonry infilled R.C. frame may be investigated to determine the characteristics with ease.
- The contribution of partial infill walls must be well identified so that while analyzing models for real structures, the composite action of the frame and infill would be realized.
- By considering the infill wall the roof displacement of the structure reduces.

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