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A REVIEW ON SEISMIC PERFORMANCE OF RC BUILDING WITH LIGHTWEIGHT BRICKS AND CONVENTIONAL BRICKS

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Abstract: *Bricks remain one of the most important building materials in the country. During recent decades, the lightweight materials are used in construction instead of conventional materials. Lightweight construction is considered to be favorable due to the saving in construction cost and materials. AAC block is a lightweight structural material with excellent acoustic and thermal insulation properties. Due to the use of lightweight material in construction in seismic zone reduce the percentage of damages. Most of the researchers studied the building frame is designed as per Indian standard i.e. IS 456:2000, IS 1893:2002 and IS 1893:2016. From the papers the main objective of the study which we need to consider while analyzing it for the seismic loading given in IS 1893:2002 (Part-I) and to compare seismic behavior of RC Structure by using IS code 1893:2016 (Part-I).Researchers studied the analysis and design of structural model in STAAD PRO software by using lightweight bricks and conventional bricks by Response Spectrum Method. Considering the comparison of various parameters like shear force, Axial force, Bending moment, Displacement, Time period, Storey Drift, Natural Frequency. This Review focuses on the study of various parameters analyzed by using the lightweight bricks and conventional bricks and general conclusions have been drawn concerning the various parameters.*

Keywords: Lightweight Bricks, Conventional Bricks, STAAD PRO Software, Analysis, Response Spectrum Method.

I. INTRODUCTION

A brick is a man-made building material. Bricks remain one of the most important building materials in the country. Red bricks are the oldest and the most common type of brick. Red bricks are made from the clay which is naturally available material but it reduces the top fertile soil cover. Hence, it is not eco-friendly. The popularity of red bricks can be to its easy availability, durability, low cost and convenience. Sometimes to reduce the weight of structure instead of increasing in the strength, especially in heavy structure where the weight of structure is more dominating part in designing of that structure.

The Autoclaved Aerated Concrete (AAC) material was developed in 1924 by a Sweden architect. Autoclaved Aerated Concrete is an eco-friendly and certified green building material which is lightweight, load-bearing, high-insulating, durable building product, which is produced in a wide range of sizes and stability. AAC block is fire and pest resistant, and is economically and environmentally superior to the more common structural building materials such as concrete, wood, brick and stone. The density of AAC block is around $1/3^{rd}$ of conventional clay bricks hence reduces the seismic forces on the structure. Research and innovations has lead to the invention of alternative masonry units which are environment friendly. AAC blocks are relatively new building materials which are now used as an alternative to red bricks.

II. LITERATURE REVIEW

Ajay Patre et.al (2016), The research work is on comparison of seismic analysis and design of G+15 building using ALC (Aerated light weight concrete block) and conventional bricks. Structural analysis and design is done by STAAD Pro by RSM (Response Spectrum Method). The analyzed structure is symmetrical, G+ 11, Ordinary RC moment-resting frames (OMRF). Indian standard criteria for earthquake Resistant Design of structures IS Code 1893(Part 1): 2002 is used for calculating seismic design force. This force depends on mass and seismic coefficient of the structure and also depends on properties like seismic zone in which structure lies, importance of the structure, soil etc. 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 loading. The ALC block material can basically be used to replace conventional bricks as infill material for RC frames built in the earthquake prone region.

K Srividhya et.al (2019), Project aims to carrying out the seismic response of the high rise building with conventional brick and light weight brick. In this a high rise office building of G+14 is considered for the analysis purpose using ETABS software. The building is located in zone III. In this investigation, the main focus is carried on the analysis of two categories of G+14 structures ,one, with conventional brick and other with light weight brick .The study of parameters like fundamental natural frequencies, time periods, base shear and displacements under earthquake forces are compared. It is observed that in case of lightweight bricks time period has increased, base shear is reduced and storey drift increases more at the base and less at the top.

Ms. Kajal Goel (2015), In this work an attempt has been made to study the dynamic behavior of multistoried building frame (Symmetric) using IS1893 (part 1):2002 code recommended Response Spectrum Method. Analysis has been carried out using the STAAD Pro software. Here they compare two materials of infill i.e., AAC and conventional Bricks. The phases are as follows: - Phase1-R.C.C. Frame with Infill Masonry Wall and Phase 2- R.C.C. Frame with Infill AAC (Autoclaved Aerated Concrete) Wall. In Conventional Brick the base shear is higher than the base shear for AAC Infill. From the dynamic analysis of G+8 RCC frames with plan irregularity they have got the following conclusions. For higher and unsymmetrical buildings, Response Spectrum Method should be used for unsymmetrical building. But for unsymmetrical building requires more accurate analysis therefore Response Spectrum Method should be used.

Vidhya P. Namboothiri (2016), In this study the assumed structure is a building of G+ 3 storeys in seismic zone III with a medium soil stratum. They studied the influence of AAC blocks on various responses of RC framed structure. To evaluate the effect of infill on the structure they derived and compared the value of base shear, storey displacements and inter-storey drift. Modeling of the G+3 storey reinforced concrete frame and frame with AAC block infill walls done using ETABS software and static analysis is also carried out and results are compared with each other. After the complete analysis, they witnessed various conclusions. Compared to bare frame, infill frame has less storey displacement as well as storey drift. If partially infill frame is compared with fully infill frame, partially infill frame is more subjected to storey displacement as well as storey drift. Storey shear is maximum in fully infill and then infill frame with opening, partially infill frame and minimum in bare frame.

Rajguru R. S. et.al (2015), In this paper G+14 storey RC frame building models are studied that includes bare frame, infill frame and open first storey frame and infill material of brick and autoclave aerated concrete blocks. L shape building plan is consider for analysis. The parameters which are studied are time period, base shear and storey drift. The base shear of infill frame is 32 % more than bare frame and hence there will be a considerably difference in the lateral force along the height of the building. The storey drift of bare frame is more than infill frame and it is less than of bare frame around 50 %. Base Shear of AAC infill is less than around 27% than conventional bricks. Drift of AAC infill model at 1st floor is than around 25%. Displacement at 14th floor for infill model is much less than bare model. It is found that infill not take into account for analysis, but the infill effects on the increase of ductility, stiffness and the flexural strength of the members.

Santosh Kumar Adhikari et.al (2015), In this project models of (G+5) and (G+9) RC framed building is assumed to be located in Seismic zone-V have been considered. For Case 1: Six storey building and Case 2: Ten Storey Building 4models for each case is considered to studied. Response spectrum analysis has been performed as per IS code 1893:2002 for each building. Non – Linear static Pushover analysis has been used to study the effect of infills on dynamic characteristics, yield patterns and seismic performance. The results are compared with various parameters like natural period, storey shear, storey drift, displacement. After the analysis various conclusion is studied. The fundamental period of vibration was lower for fully infill model and higher for bare frame model. Axial forces on columns have increased and bending moment has decreased due to introduction of infill in the frames.

Sagar Wankhede et.al (2018), This project includes the analysis, design and estimates of structure, comparing between autoclave aerated concrete and conventional brick. For this study, a 10-storey building regular in plan is modeled. The plan of the building model to be studied i.e. Model 1: RCC building with Conventional Clay Bricks as infill material, Model 2: RCC building with AAC block as infill material. The various parameter has to be studied are Base shear, Beam forces, Displacement, Column Forces, Storey Shear and Storey drift for both model. It has been observed that the base shear, lateral forces, bending moment and storey shear for a structure with AAC blocks is significantly less as compared with the structure in-filled with brick masonry.

Sumit S. Khandare et.al (2019), In this paper the attempt has been made to carry out the project comparative study of seismic analysis of building with lightweight and conventional material. Structural model of multi storey building analysis is carried out in STAAD-Pro by RSM (Response Spectrum Method). The Indian Standard Criteria for Earthquake Resistant Design of structures IS code 1893 (Part 1):2002 is used. After the complete analysis the following we studied. It is observed that for lightweight building structure the base shear are reduced 20% to 25% than the conventional building structure in response spectrum analysis. The axial force in lightweight structure is found to be less than conventional structure in linear dynamic analysis. The shear force in response spectrum analysis is found to be less by 15% to 25% in lightweight structure than the conventional structure. The maximum negative bending moment in lightweight structure is found to be reduced by 20% to 25% than conventional building structure.

G. Ranganayagi et.al (2021), In this Project work on comparison of seismic analysis and design of G+12 building using AAC (Autoclaved aerated concrete blocks) and conventional bricks were analyzed by under Time history analysis. This study investigates the seismic behavior of multi storey reinforced concrete frame building with 12- storey for residential use. Response spectrum analysis and Time history analysis is used for analyzing the performance of the considered building models under earthquake motions. Lateral seismic force RC frame is carried out by using Equivalent Static Method as per IS code 1893(part 1):2002 for earthquake. The results are compared with storey acceleration, storey displacement, storey drift, storey stiffness to know the suitable infill material in seismic prone zones. The performance of AAC block infill was better than conventional brick infill in RC framed structures.

Ms. Rajashri A. Deshmukh et.al (2015), In the present study an investigation has been made to study the behavior of RC frames with AAC block and conventional clay bricks infill with varying percentage of opening subjected to Seismic loadings. In this study, the RC frame G+5 building model located in zone III are analyzed for brick masonry and AAC masonry. These building were designed to IS Code 1893-2002 –Indian code of practice for Seismic Resistant Design of Buildings. It has been observed that the base shear, lateral forces and storey shear for a structure with AAC blocks is less as compared with brick masonry. The deflection and bending moments for members of structure with AAC block in all cases were less as compared with corresponding cases of structure with brick masonry.

Prakash A Nayakar (2018), In present report, comparative study of the effect of type of infill wall material on seismic response of structure has been presented. In the present, a Ten-storey RC Framed type of building is considered. The Building is located in Zone III and type of soil is medium soil. A Response spectrum is considered as per IS code 1893(Part 1):2002.Three models are considered to study for comparison. One is bare frame, second is infill frame and third is infill frame with open ground storey. The parameters to be studied are Base Shear, Displacement, Beam Forces, Column Forces, Storey Shear and Storey drift for the Brick infill and AAC block infill. The displacement, storey shear, storey drift in AAC is lower than brick masonry.

Aditi H. Deshmukh et.al (2019), In this study, an attempt is made to do comparative analysis and design of the structure when the structure is modelled using different types of infill walls. The RC frame building G+15 which is located in Zone II and it used IS code 456-2000 for limit state method conforming and IS code 1893-2002 for Equivalent Static Analysis Method. The RCC frame is analyzed & designed by using STAAD-Pro software. It study the model which include Bare frame model, Conventional Clay Bricks Masonry model, AAC Block model The analytical results of the building frame will be compared and analyzed to obtain the storey drift, base shear, Lateral displacement, shear force and bending moment. It is observed that the conventional brick have minimum lateral displacement then AAC block infill model because the diagonal compressive strength of conventional brick is more than AAC Block as AAC blocks are lightweight and less compressive strength it also concluded that due to infill walls in building the base shear is increased because of increased in seismic weight of the structure.

Jasdeep Singh Rehal et.al (2016), In the present work it is proposed to carry out seismic analysis of multi-storey RCC building using Response spectrum analysis method considering bare and infill frames with the help of STAAD PRO software. A study is undertaken which involves the seismic analysis of RC frame buildings with different models that include bare frame and infilled frame. The parameters such as base shear, time period, natural frequency, story drift and lateral displacement are studied. When compared the bare-frame model and equivalent diagonal strut models results for seismic load analysis observed that without considering the stiffness of infill frame in bare model stiffness of the building is very less where are the strut models which considered the stiffness of infill as strut has more stiffness of the building and also economical in section area of steel.

R.R. Sarode et.al (2019), This project includes Analysis, design and estimates of structures comparing between AAC block and conventional bricks .Analysis and design (G+10) by using ETABS software in all zones. The Seismic Lateral displacement Parameters is also compared. There are consists of two models: Model 1: RC frame model are consist of brick infill, Model 2: RC frame model are consist of AAC block infill. For the comparison it has been concluded that in column, considering the AAC infill wall effect, the value of axial force, bending moment, Ast is less as compared to bricks infill. Lateral displacement in X or Y direction for AAC block model is less as compare to conventional brick. P. G. Patel et.al (2012), In the present paper an investigation has been made to study the behavior of RC frames with ALC block and Conventional clay bricks infill when subjected to dynamic earthquake loadings. In this study, models of a fourteen storey building which is symmetrical in the plan are considered. The dynamic seismic analysis was used to determine earthquake response of the structure using STAAD PRO. In this model response spectrum method is adopted. The result of the RC frames with infill effect are compared and conclusions are made in point of view of IS 1893:2002 code. The dynamic seismic earthquake behavior of the two types of infill material as ALC block and conventional bricks was investigated. The performance of ALC block infill was superior to that of conventional infill in RC frame.

Vikas P. Jadhao et.al (2013), In the present paper an investigation has been made to study the behavior of RC frames with AAC block and conventional clay bricks infill when subjected to Seismic loads. The study of seismic performance for both bricks infill in RC frames are compared by using SAP2000.In this study , model of G+3 building is considered. A bare frame model and a model with full infill is considered for both conventional brick masonry and AAC block masonry. The Building is analyzed using seismic coefficient method. In this IS 1893(Part 1):2002 code is used to calculate the lateral load. The base shear experienced by models with AAC blocks was smaller than with conventional clay bricks which results in reduction in member forces which leads to reduction in required amount of Ast to resist member force.

Hiren Dudhat et.al (2019), In this research work, two G+8 storey building model which is located in seismic zone III. The RC frame is analyzed by using ETABS software. Five different types of models have been analyzed for both AAC and Conventional brick. The study includes the modeling of G+8 storey building having regular and irregular plan. The various parameters are studied such as storey displacement, maximum storey drift, base shear and fundamental time period. The analysis has been carried using Non- linear analysis with IS 1893:2016 code specified design response spectrum .After the overall analysis of model, the following conclusion we studied. The AAC block infill model have smaller base shear as compared with conventional brick infill models. RC frame structure with brick infill show better performance in storey displacement and maximum storey drift than structure with AAC block infill. Building with brick infill has lower time period than building with AAC block infill.

Ayman Abd-Elhamed et.al (2015), The present research work investigates the seismic response of reinforced concrete frame building considering the effect of modeling masonry infill walls. The seismic behavior of multistoried reinforced concrete frame building with six storeys, considering and ignoring the effect of masonry and it investigated using response spectrum method. Two developed building models in terms of bare frame and infill walls frame are used in the study. The results of the base shear, displacements and internal forces for the bare frame as well as the infill walls frame are presented in comparative way. The total storey shear force increases as the stiffness of the building increases due to presence of masonry infills. Masonry infill walls decrease the displacements, drifts and building natural period due to the increase in overall stiffness for the building.

Ravikant S.Sathe et.al (2019), This is research work on comparison of seismic analysis and design of G+5 Building using Aerated light weight concrete block and conventional bricks. Modeling of structure is done as per STAAD Pro.V8i software. Linear static analysis has been carried out for fixed in hard soil condition, to know the effect of earthquake loading. The various results are compared to know such as base shear, top storey displacement, natural the suitable infill material in seismic prone zones. The dead weight of the structure is almost 32.47% reduced in case of lightweight weight bricks as compared to conventional clay bricks.

III. CONCLUSION:

Bricks remain one of the most important building materials in the country. The lightweight materials are used in construction instead of conventional materials. From the above literature, it is seen that the researchers have been broadly carried out the studies on the behavior of AAC block and conventional bricks. The various parameters like Shear forces, Base shear, Srorey

displacement, Storey Drift, Time Period, shear force and bending moment are studied. From the literature some conclusion is observed that the axial force in lightweight structure is found to be less than conventional structure in linear dynamic analysis. The shear force in response spectrum analysis is found to be less in lightweight structure than the conventional structure. However, most of the studies have been analyzed with focus on AAC block building resting on plain ground with regular building or performing experiment on AAC block and conventional brick for the static and dynamic loads. Therefore, this shows that there is a strong need to investigate the further research and by the help of software we find a great result.

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