

Comparative Analysis of G+10 RCC Building with AAC Blocks and Conventional Blocks

Gulam Rizwan Gulam Firoz¹, Prakash Suresh waghode ², R.R. Sarode³

^{1,2}Student, Padm Dr.V.B.kolte College of Engineering Malkapur

³Prof & Head, Department of Civil Engineering, Padm Dr. VBKCOE Malkapur

Abstract - A building has be defined is an enclosed structure intended for human occupancy. Constructions work has be seen in most the countries developing. With the increases an material cost in the construction work, there is a need to find more cost saving alternatives so as to maintain the cost of construction houses, multi-storey etc, which can be affordable to people. In the manufacturing of burnt clay bricks, smoke evolved at a great extent and also some toxic gases which can harm an environment. So as to overcome with all these problem, Autoclaved Aerated Concrete (AAC) blocks are used which is more economical and eco-friendly. This project includes the analysis, design and estimates of structure, comparing between autoclave aerated concrete and conventional brick in the form of steel consumptions. Autoclaved Aerated Concrete (AAC) is a lightweight concrete building material cut into masonry blocks or formed larger planks and panels. Currently it has not seen widespread use in the United States. However, in other parts of the world it has been used successfully as a building material. Cost of construction is reduced and it will be safe and economical in earthquake forces also. The seismic Parameter Lateral displacements are also compared.

Key Words: AAC block, conventional blocks, E-Tab software, diagonal strut, infill wall with opening,

1. INTRODUCTION

Brick has the building material for construction and the structural Analysis is the most commonly used. There are the brick is just only a partition member in building. Further, although the clay brick is comparatively cheaper as compared to AAC block allows construction with speed and economy considering the benefits of natural lightweight and savings on foundation structure work, mortar work, and labour and energy consumption. Therefore, the focus should be now more on seeking eco - friendly solutions for green environment. The Analysis of burnt clay brick and non - conventional material on cost, energy consumption and carbon emission parameters helps in construction analysis options for sustainable construction. AAC block, gives a prospective solution to building construction. In this paper, attempt has been made to replace the red bricks with eco - friendly AAC blocks. The use of AAC block reduces the cost of construction up to 20% as reduction of dead load of wall on beam and column makes it a comparatively lighter members and reducing the loads or moment. The use of AAC block also

reduces the requirement of materials such as cement and sand up-to 50%.

ETABS stands for Extended Three Dimensional Analysis of building. Comparison of analysis and design of regular and irregular configuration of multi storied building in various seismic zones using ETABS software. ETABS has the present rising software in structural analysis is design software in the market. Much construction company's using this software for analyzing and deterring the load and moment at every member. So, this paper mainly deals with the comparative analysis of the results obtained from the analysis of a multi storied building structure when analyzed manually and using ETABS software. The effective design and construction of earthquake resistant structures have great importance all over the world. This project presents multi-storeyed residential building analyzed or designed with lateral loading effect of earthquake using ETABS. This project is designed as per INDIAN CODES- IS 1893-part2:2002, IS 456:2000.

Structural response to earthquake depends on Dynamic characteristics of the structures and intensity, duration and frequency content of existing ground motion. Structural analysis means determination of the general shape and all the specific dimensions of a particular structure so that it perform the function for which it is created and will safely withstand the influences which will act on it throughout its useful life.

Brick is the most commonly used building material in construction. AAC blocks are new construction material. 3 times lighter than traditional brick (clay brick);it means it covers more area in same weight as clay brick gives in one bricks. In this paper; attempt has been made to replace the clay brick with light weight AAC blocks. The usage of AAC block reduces the cost of construction up-to 25% as reduction of dead load of wall on beam makes it comparatively lighter members. The use of AAC block also reduces the requirement of materials such as cement and sand up-to 55%.

1.1 AERATED AUTOCLAVE CONCRETE

Autoclaved Aerated Concrete (AAC) block is a newly-adopted green building material in India which is used as a substitute of the conventional red clay bricks in residential, commercial and industrial construction activities. AAC block, which is also known as autoclaved cellular concrete or autoclaved lightweight concrete or aerated brick, is an eco-

friendly building material used in construction activities; they may be an alternative to reinforced concrete frame structures. On the other hand masonry structures are commonly associated with poor seismic performance as observed in past earthquakes. This negative perception is caused mainly by many non-engineered masonry structures, mostly stone masonry houses which, if not properly designed and strengthened regarding seismic provisions, will not behave satisfactory under seismic excitations. On the contrary, modern approaches to masonry constructions regarding seismic detailing with convenient conception or innovative materials and solutions, may lead to safer and economical constructions especially concerning small constructions. Therefore a complete methodological approach to the seismic performance assessment of unreinforced AAC masonry buildings is presented on this work, enhancing the possibility to use nonlinear static procedures in the reproduction of the dynamic behavior of AAC masonry buildings.

1.2 PROBLEM STATEMENT

The high rise buildings now-a-days are provided with soft storey's for parking purpose. When such building is located in the earthquake prone area, can be subjected to heavy lateral forces. Due to the presence of soft storey in a building, the lateral load resisting capacity of building decreases, thereby the stiffness of building decreases. This leads to sudden failure of structure. To increase the lateral strength and stiffness of a structure, AAC BLOCK is introduced in a structure, such that the building can sustain under the seismic loads and decrease the overall cost of building.

1.3 SEISMIS ANALYSIS OF RC FRAMES WITH INFILL WALL

While analyzing multi storey buildings, designers usually neglect the contribution of masonry infill in resisting loads. They consider only dead weight of masonry and analysis is done by bare frame method. It is very common now days to construct multistoried buildings with open ground storey. Since there is a sudden change in stiffness at first floor level, ground floor columns will attract greater horizontal force and hence they should be designed for a larger force than that obtained using bare frame analysis. As per IS 1893:2002, the columns and beams of the soft storey are to be designed 2.5 times the storey shears and moments calculated under seismic loads.

Masonry infill walls are laterally much stiffer than the RC frames, and therefore, the initial stiffness of the masonry infilled RC frames largely depends upon the stiffness of masonry infill walls. Accordingly, it is quite important to have a reliable method to estimate the stiffness of the MI walls. Investigations showed that, one of the most appropriate ways of analyzing the masonry infilled concrete frames is to use single equivalent diagonal strut.

2. LITERATURE REVIEW

1) P.S. Bhandari and and at all (2014).

Investigate the performance of cellular lightweight concrete in terms of density and compressive strength. The Compressive strength for cellular lightweight concrete is low for lower density mixture. The compressive strength also decreases with the increment of voids. Compressive strength of 53 grade cement is slightly higher than 43 grade cement, but as strength increases its density also increases. Cellular lightweight concrete is acceptable for framed structure. Cellular lightweight concrete can be suitable for earthquake areas.

2) K.Krishna Bhavani Siram (2012) .

Made an attempt to compare CLC blocks and Clay bricks and recommend a replacement material to red bricks in construction industry. Burnt clay Brick is the predominant construction material in the country. The CO2 emissions in the brick manufacture process have been acknowledged as a significant factor to global warming and also focus on the environment solution for greener environment because red bricks requires high energy to burn in kiln to produce it. This study has also shown that the use of fly ash in foamed concrete, can improve the properties of CLC blocks.

3) Alim Shaikh (2013)

Brick is the most commonly used building material in construction. AAC blocks are new construction material which is very light in weight. Compare to same size of (200mm x 100mm x 100mm,its 3 times lighter than traditional brick (clay brick);it means it covers more area in same weight as clay brick gives in one bricks. In this paper; attempt has been made to replace the clay brick with light weight AAC blocks. The usage of AAC block reduces the cost of construction up-to 25% as reduction of dead load of wall on beam makes it comparatively lighter members. The use of AAC block also reduces the requirement of materials such as cement and sand up-to 55%.

4) Riyaz Sameer Shah (2016).

This paper presents the economics of autoclave aerated concrete vis-à-vis conventional brick. This project includes the analysis, design and estimates of structure, comparing between autoclave aerated concrete and conventional brick in the form of steel consumptions. Autoclaved Aerated Concrete (AAC) is a lightweight concrete building material cut into masonry blocks or formed larger planks and panels. Currently it has not seen widespread use in the United States. However, in other parts of the world it use has been used successfully as a building material. In this work we are comparing reinforced concrete design using autoclave aerated concrete and conventional brick as a construction material, as the weight of autoclave aerated concrete is much lesser than the conventional brick, by using this advantage we think, we can reduce the weight of infill wall on beams, columns, footings if conventional bricks replace by AAC block and simultaneously we can save reinforced steel.

5) Nagesh. Mustapure and at all (2014).

Made an attempt to study on cellular lightweight concrete blocks, and following experiment has done to check the properties of CLC blocks of Grade B, such as compressive strength, water absorption, thermal conductivity of CLC blocks for 800 kg/m³, 900 kg/m³, 1000 kg/m³, 1100 kg/m³. The excellent insulating property of foam concrete is due to the great number of closed cavities forming the multi-cellular structure and the study shows that CLC blocks may be used for construction purpose, which is advantageous in terms of general construction properties as well as eco-friendliness.

6) Dr. B G Naresh kumar and at all (2013)

In this experimental study the feasibility of using aerated concrete block as an alternative to the conventional masonry units has been investigated. The preliminary studies focused on the estimating physical, strength and elastic properties of light weight concrete blocks i.e. Autoclaved aerated concrete blocks (AAC). These include initial rate of absorption, density test, water absorption test etc. The compressive strength, modulus of elasticity and the flexural strength of the units were obtained.

7) Prakash T M and at all (2013)

Investigate the feasibility of using lightweight concrete block as an alternative to the conventional masonry units. The preliminary studies focused on estimating physical and elastic properties of cellular lightweight block units. These included initial rate of absorption, density test, water absorption test etc. The compressive strength, stress-strain characteristics and the flexural strength of the units were obtained. And the results are comparing with that of conventional masonry units.

8) Ali J. Hamad (2014)

This paper is attention to classified of aerated lightweight concrete into foamed concrete and autoclaved concrete. The literature review of aerated lightweight concrete on material production, properties and its applications. The aerated lightweight properties are focuses on the porosity, permeability, compressive strength and splitting strength. It possess many beneficial such as low density with higher strength compared with conventional concrete, enhanced in thermal and sound insulation, reduced dead load in the could result several advantages in decrease structural elements and reduce the transferred load to the foundations and bearing capacity. Aerated concrete is consider economy in materials and consumptions of by-product and wastes materials such as fly ash.

3. OBJECTIVES OF THE STADY

- To reduce the stiffening effect of infill frame.
- To reduce the cost of construction.
- Usage reduces overall dead load of a building, thereby allowing construction of a taller building.

4. Modeling of Building on Etab

ETABS SOFTWARE:- As our country is the fastest growing country across the globe so the need of shelter for highly populated cities where the cost of land is high and further horizontal expansion is not possible due to unavailability of space, so the only solution is vertical expansion. Structural design is the primary aspect of civil engineering. The foremost basics in structure are the design of simple basic components and members of a building like slabs, beams, columns, and footings. In order to design them it is important to first obtain the plan of the particular building. Thereby depending on the suitability plan layout of beams and the position of columns are fixed. Thereafter, the vertical loads are calculated namely the dead load and live load. Once the loads are obtained, the component takes the load first i.e. the slabs can be designed. Designing of slabs depends upon whether it is a one-way or a two-way slab, the end condition and the loading. From the slabs, the loads are transferred to the beam. The loads coming from the slabs onto the beam may be trapezoidal or triangular. Depending on this, the beam may be designed. Thereafter, the loads (mainly shear) from the beams are taken by the columns. For designing columns, it is necessary to know the moments they are subjected to for this purpose; frame analysis is done by Kanis method.

5. METHOLOGY

The RC Framed structure is modeled by using ETABS software for the following cases.

Building plans

5.1 Model 1: conventional brick infill frame without opening.

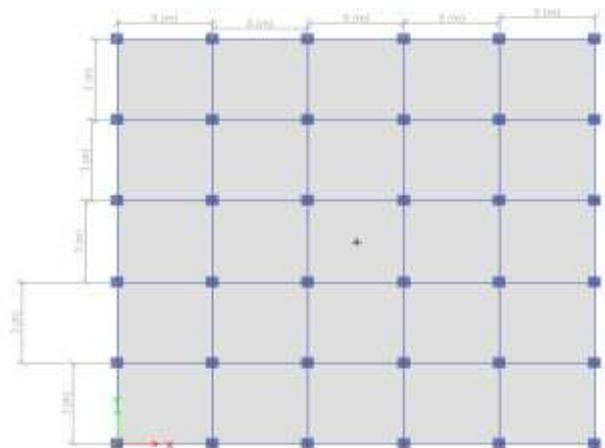


Fig. 5.1 RCC building with Conventional Clay bricks as infill material.
(Plan of building with Conventional Clay Bricks as infill material)

- Elevation of RCC Building showing Conventional Clay Bricks modelled as inclined STRUT

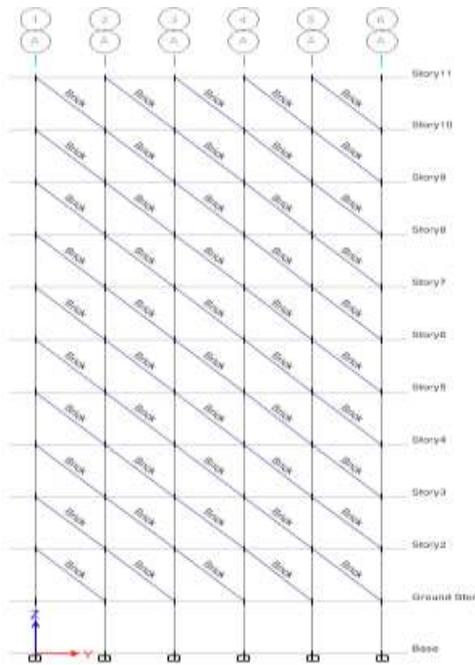


Fig. Elevation

- 3D render view of building with Conventional bricks as inclined struts

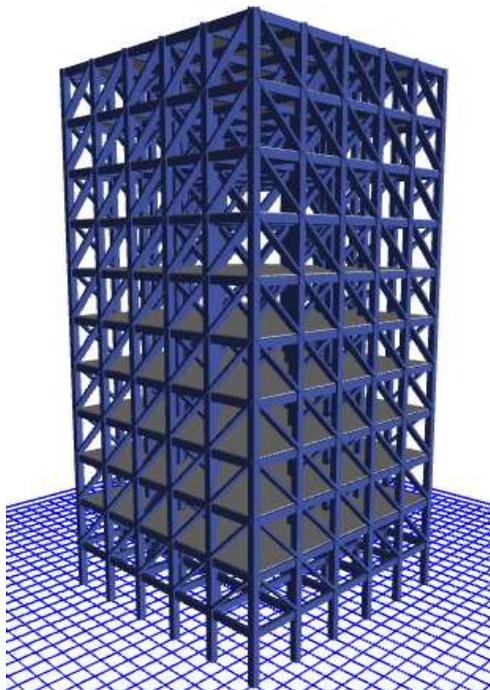


Fig. 3D Render view

5.2 Model 2: RCC building with AAC block as infill material (plan of AAC block)

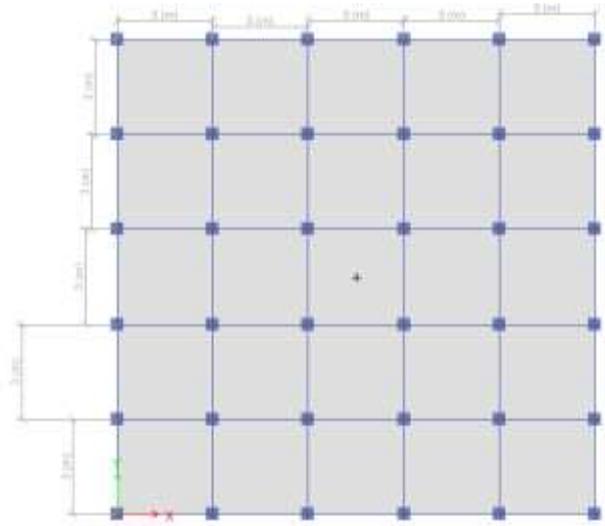


Fig. 5.2 RCC building with AAC bricks as infill material. (Plan of building with AAC Bricks as infill material)

- Elevation of RCC Building showing AAC blocks modelled as inclined Strut

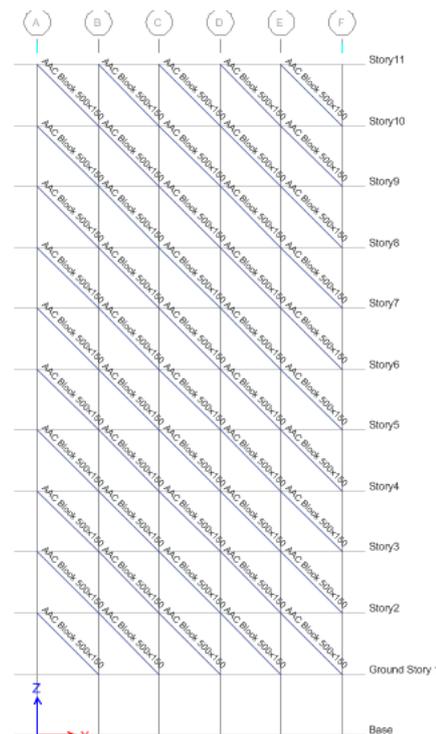


Fig. Elevation

- 3D render view of building with AAC blocks as inclined struts

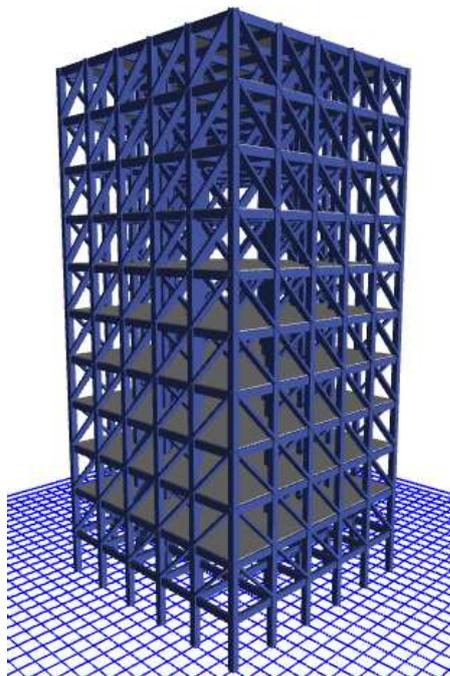


Fig. 3D Render view

NO OF STORES	G+10
EACH STOREY HEIGHT	3 m
THICKNESS OF SLAB	150 mm
GRAD OF CONCRETE	M20
GRAD OF STEEL	Fe415
SIZE OF BEAM	0.23mX0.35m
SIZE OF COLUMN	0.3mX0.3m
SIZE OF COLUMN	0.150mm
DENSITY OF BRICK INFILL	20 kN/m ³
DENSITY OF ACC INFILL	6.5 kN/M ³

6. RESULT AND DISCUSSION

The seismic analysis for the all RC frame models are consist of brick infill (M-1), model with full infill (modeling infill as a AAC block infill element) (M-2) and full infill with has been done for both the infill materials i.e. for brick masonry infill and AAC block masonry infill by using software ETABS and the results are presented below. The parameters which have to be studied are Base Shear, Displacement, Beam Forces, Column Forces, Storey Shear and Storey drift by changing the material of infill as Brick infill and AAC block infill.

Lateral Displacement

Mode 1:- Brick infill

storey	Diaphragm	Load Case/Combo	UX
Storey11	D1	EQX	32.727
Storey10	D1	EQX	31.337

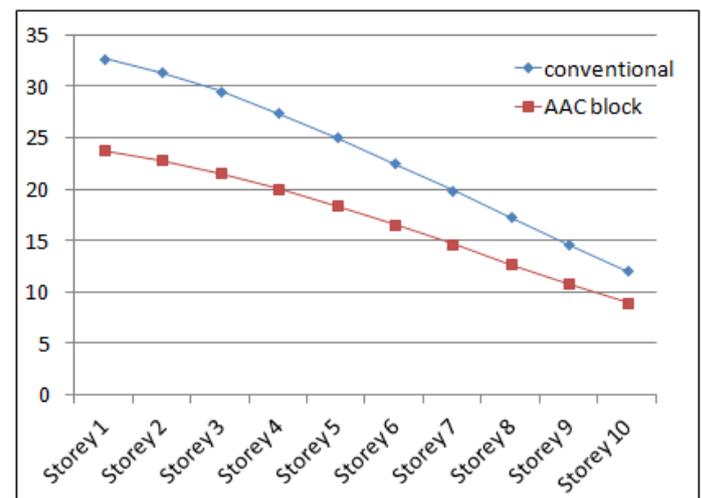
Storey9	D1	EQX	29.541
Storey8	D1	EQX	27.419
Storey7	D1	EQX	25.053
Storey6	D1	EQX	22.52
Storey5	D1	EQX	19.892
Storey4	D1	EQX	17.237
Storey3	D1	EQX	14.615
Storey2	D1	EQX	12.083

Model 2 AAC block infill

storey	Diaphragm	Load Case/Combo	UX
Storey11	D1	EQX	23.81
Storey10	D1	EQX	22.839
Storey9	D1	EQX	21.567
Storey8	D1	EQX	20.054
Storey7	D1	EQX	18.359
Storey6	D1	EQX	16.537
Storey5	D1	EQX	14.641
Storey4	D1	EQX	12.718
Storey3	D1	EQX	10.812
Storey2	D1	EQX	8.958

Lateral displacement in X or Y direction for all model in all zones are as in graph

Graph: story's wise of lateral displacement.



Therefore, The AAC block material can basically be used to replace conventional bricks as infill material for RC frames built in the earthquake prone region. The results shows that, the minimum cost of building and maximum strength of AAC brick wall in a building can helps to reduce the deflection and story drift in a building. Some studies deals with the evaluation of steel and cost of building required for the building provided with AAC BLOCK masonry wall.

7. CONCLUSIONS

This work is a small attempt towards the understanding of the effect of AAC infill masonry and brick infill masonry on the seismic behavior of RC structures. In this work, the seismic behavior of brick infill panels and AAC in-filled panel was studied and compared in a systematic manner. The main conclusions are summarized below:-

In column, considering AAC infill wall effect, the value of axial force, bending moment, Ast is less compared to brick infill frame. Because of infill wall effect, there is drastic decrease in the value of axial force in column. Maximum Axial Force is at the foundation level.

It has been observed that the base shear, lateral forces and story shear for a structure with AAC blocks is significantly less as compared with the structure in-filled with brick masonry due to low weight density of AAC blocks. Lesser base shear will result in lesser lateral forces and as the weight density of AAC blocks is less as compare with brick masonry the dead load of AAC block masonry is less as compared brick masonry and hence economy in design can be achieved by replacing brick masonry with AAC block masonry.

The response of a structure in terms of bending moments is greatly improved in an infill model. The bending moments is reduced greatly by the introduction of infill panels. The bending moments for members of structure with AAC block in all cases were less as compared with corresponding cases of structure with brick masonry.

Therefore the corresponding benefits of construction cost are lower than conventional bricks material in RC frame structure.

Area of footing there is 24.3% of saving n footings there is 24.3% savings while using AAC blocks over clay bricks.

This was the only savings which we could clearly see but while using AAC blocks over clay bricks, more savings would be seen in per unit rate of AAC blocks and very less use of plastering and mortar while brickwork, as compared to Clay Bricks . AAC blocks proved to be the best constructional material amidst other bricks having just a much selected few disadvantages.

REFERENCES

- [1] D. Kornack and P. Rakic, "Cell Proliferation without Neurogenesis in Adult Primate Neocortex," Science
- [2] Hemant B. Kaushik; Durgesh C. Rai; and Sudhir K. Jain, " A rotational approach to analytical modeling of masonry infills in reinforced concrete frame buildings" The 14th World Conference on Earthquake Engineering October 12-17, 2008, Beijing, China.

- [3] Rafic Ahmad, „Brick masonry and hollow concrete block masonry- A comparative study, 2013, 14-21.
- [4] IS: 6041-1985, "Code of practice for AAC block masonry", Bureau of Indian Standard, New Delhi.
- [5] Rahul P. Rathi , Dr. P.S. Pajgade "Study of Masonry Infilled R.C. Frame With & Without Opening" International Journal of Scientific & Engineering Research Volume 3, Issue 6, June-2012 1 ISSN 2229-5518
- [6] 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.
- [7] IS: 1893(Part I)-2002, Criteria for Earthquake Resistant Design of Structure, General Provisions and Buildings, Bureau of Indian Standards, New Delhi.
- [8] Fema 306: "Evaluation of earthquake damaged concrete and masonry wall buildings" Washington D.C.
- [9] P.S. Bhandari and Mr. V. P. Jamnekar, Dr. P. V. Durge "Seismic evaluation of brick masonry infill" International Journal of Emerging Trends in Engineering & Technology (IJETET) Vol. 02, No. 01, 2013 ISSN No. 2248-9592
- [10] Prakash T M, Naresh kumar B G, Karisiddappa ,Raghunath S "Properties of Aerated (Foamed) Concrete Blocks" International Journal of Scientific & Engineering Research Volume 4, Issue 1, January-2013 1 ISSN 2229-5518

BIOGRAPHIES



Gulam Rizwan Gulam Firoz
Student, civil engineering
department ,Padm Dr.V.B.kolte
College of engineering
Malkapur.443101



Prakash Suresh waghode
Student, civil engineering
department ,Padm Dr.V.B.kolte
College of engineering
Malkapur.443101