Comparison of Loads for G+4 Residential Building with Conventional and Light Weight Bricks

[1]Mr. Jamaluddin Maghrabi, [2]Mr. Pradip Sonawane, [3]Mr. Shubham Tupe, [4]Mr. Raza Qureshi, [5]Mr. Prerna Parab, [6] Miss. Prerna Parab

[1&2]Assistant Professor, Department of Civil Engineering, Terna Engineering College, Nerul, Navi Mumbai, Maharashtra, India
[3,4,5,6] UG Student, Department of Civil Engineering, Terna Engineering College, Nerul, Navi Mumbai, Maharashtra, India

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Abstract : This paper discusses analytical design along with the specifics of several types of materials. The building's walls are made of both Siporex blocks and brickwork. Structural analysis is a rigorous assessment of a structure's stability, strength, and rigidity. The basic purpose of structural analysis and design is to build a structure that can sustain all applied loads without failing within its stated life. The primary function of any structure is to transfer or support loads. STAAD Pro Analytical Modeler is a tool for modeling your structure using analytical elements. The analytical model is a finite element model of the structure that is typically handled directly by the analysis and design engine. STAAD Pro Physical Modeler is used to model your building using physical

Index Terms **– STAAD Pro, Siporex block, Analysis, Strength, Durability**

I. INTRODUCTION

This Paper discusses the analytical design in conjunction with the details of various types of materials. The building is designed with both Siporex blocks and bricks on the walls. Structural analysis is the rigorous evaluation of a structure's stability, strength, and rigidity. The primary goal of structural analysis and design is to create a structure that can withstand all applied loads without failing over its specified life. The main function of a structure is to transfer or support loads. STAAD Pro Analytical Modeler: A tool for modeling your structure with analytical elements. The analytical model is a finite element model of the structure that is usually processed directly by the analysis and design engine. STAAD Pro Physical Modeler: Used for modeling your structure with physical elements.

1.1 Types of materials used for wall cladding:

BRICK:

i. A brick is a type of construction material used to build walls, pavements and other elements in masonry construction.
ii. It has a density of 18 KN/M & with mortar 20 KN/M.

SIPOREX BLOCK:

i. Siporex Autoclaved Aerated Concrete (AAC) blocks. It is a lightweight, precast building material that simultaneously provides structure, insulation, and fire and mould resistance.
ii. It has a density of 4 KN/M & with mortar 6 KN/M.

1.2 Aim and Objective:

Aim:

Load comparison of G+1 Residential Building on Brick & Siporex Material.

Objective:

1. To select optimum design load for a structure.
2. Variation in load with use of brick & Siporex.
3. Variation in column size with respect to loading of brick & Siporex material.
4. To do economical analysis of structure by taking minimum load among brick & Siporex.

II. LITERATURE REVIEW

1. **Bedabrata Bhattacharjee & A.S.V. Nagender:**
   In their paper "Computer aided analysis and design of multi-storeyed buildings" states that the design involves calculation of loads manually and analyzing entire structure by STAAD Pro. The design methods used in STAAD Pro analysis is limit state design method with referrence to the IS Code of Practice. STAAD. Pro has a easy to use user interface, visualization tools, powerful analysis and design engines with advanced finite element and capable of dynamic analysis. At initial stage they started with the analysis of simple 2-D frames and manually checked the accuracy of the

software with the results. The results proved to be very accurate. They analyzed and designed a G+7 storey building[2- D Frame] initially for various load combinations. Mr. K. Prabin kumar, R. Sanjaynath in their paper "A study on design of multi-storey residential building - a review" concluded that at first, the planning of the structure is done using AutoCAD. Calculations of loads were done manually and then the structure was analyzed using STAAD Pro.

2. **Monika Verma :**
   For high rise buildings, more reinforcement is required to be calculated for the top beam, hence greater region of steel is required in static analysis than dynamic analysis. As examine to static analysis deflection and shear bending is more in dynamic analysis. More steel is required in the lower beam of the structure in the dynamic evaluation as in contrast to static analysis. From the evaluation of columns, the vicinity and percentage of steel is discovered greater for dynamic load aggregate in contrast to static load combination. Analysis and design on "The storey shear force." Was found that the loaded irregular building longer and larger base shear than same regular building structure.

3. **Sai naveen jannala:**
   Its primary objective is to offer valuable insights to architects, engineers, builders, and researchers to facilitate informed decision-making in residential construction projects. It also considers factors such as sustainability and local availability. The research identifies Cellular Lightweight Concrete (CLC) bricks as the optimal choice for residential construction, given their compressive strength of up to 30–40% more than traditional bricks, along with excellent lateral load capacity and displacement ductility, also making them suitable for constructing partition walls. Modifications in composition, such as incorporating coconut and basalt fibres, result in a notable enhancement of approximately 17.4% in thermal insulation with minimal impact on thermal degradation. Ultimately, this review serves as a valuable reference for individuals seeking a deeper understanding of the diverse options available in bricks and building materials for modern residential construction.

4. **Debashish Gogoi:**
   In the realm of residential building construction, the use of traditional bricks has been an old practice, deeply rooted in conventional construction methods. However, the growing awareness of environmental concerns and the need for sustainable building practices have led to a paradigm shift in the choice of construction materials. This review paper delves into an extensive exploration of alternative bricks, examining their mechanical, thermal, and environmental properties and shedding light on their potential to revolutionize residential construction. The array of alternative bricks under scrutiny encompasses a diverse range of materials, each presenting unique characteristics and advantages. Cellular Lightweight Concrete (CLC) bricks are known for their low density and thermal insulation properties; however, Autoclaved Aerated Concrete (AAC) bricks are more known for their durability and eco-friendliness.

5. **R Klingner:**
   Autoclaved aerated concrete (AAC) is a concrete-like material with very light weight, obtained by uniformly distributed, closed air bubbles. Material specifications for this product are prescribed in ASTM C1386. Because AAC typically has one-sixth to one-third the density of conventional concrete, and about the same ratio of compressive strength, it is useful for cladding and in fills, and for bearing-wall components of low- to medium-rise structures. Because it's thermal conductivity is one-sixth or less that of concrete, it is energy-efficient. Because its fire rating is slightly longer than that of conventional concrete of the same thickness, it is very fire-resistant. It is not susceptible to mold. Because of its internal porosity, it has very low sound transmission, and is acoustically very effective.AAC was first produced commercially in Sweden, in 1923. Since that time, its production and use have spread to more than 40 countries on all continents, including North America, Central and South America, Europe, the Middle East, the Far East, and Australia. This wide experience has produced many case studies of use in different climates, and under different building codes. Background material on experience with AAC in Europe is given in RILEM (1993).

III. MATERIAL USED

I. Brick:

i. A brick is a type of construction material used to build walls, pavements and other elements in masonry construction.
ii. It has a density of 18 KN/m3 & with mortar 20 KN/m3.
iii. Bricks have been used since very old times, it is used in the construction work of walls in building work. It is very useful construction material for construction work, it is generally produced in the village.
iv. The production of bricks uses alumina 20%, silica 50% - 60%, lime 4% and iron oxide 4% - 6% production materials.
v. The standard size of red bricks is 190 X 90 X 90 mm but they are produced in the size of 200 X 20 X 20 mm as per usage.
vi. The production and use of red bricks has been in place since a very old time, but a large amount of wood is used in its production, which is causing great harm to our environment.

II. Siporex Block:

i. Siporex Autoclaved Aerated Concrete (AAC) blocks. It is a lightweight, precast building material that simultaneously provides structure, insulation, and fire and mold resistance.
ii. It has a density of 4 KN/m3 & with mortar 6 KN/m3.

iii. The AAC block was invented in 1924 by Johan Axel Eriksson, a Sweden Architect. It is the most used construction material in Europe and is growing rapidly in many countries around the world.

iv. AAC blocks are produced as per the requirement of the construction work, AAC blocks are manufactured from a mixture of pulverized fly Ash, lime, cement, aluminum powder, gypsum, sand, water and hardened by steam curing in autoclaves.

v. It offers a unique combination of strength, weight load, thermal insulation, sound absorption, unsurpassed fire resistance and unprecedented build ability.

vi. AAC block is a natural and non-toxic building material that saves energy and is environmentally friendly.

vii. Now good and efficient construction material like AAC block is being preferred.

IV. METHEDOLOGY

I. Selection of architectural Plan:

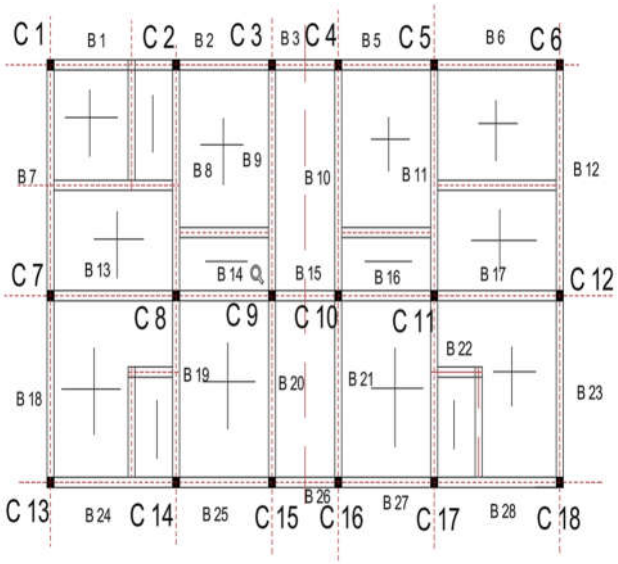
i. Selection of Architectural Plan& to make Structural plan of selected Plan. The plan is consist of 2 flats of 2BHK on each floor, typical up to 4th Floor with total No of Flat consist of 8 flats.

ii. The wall Sizes are External wall Thickness which is 230mm & Internal wall Thickness is125mm.

iii. The building has Stairs & is also provided with Lift for Vertical Movement of goods & Passengers.

II. Structural Drawing / Plan:

1. The structural plan consist of beams & columns Sizes, location of beams & columns
2. The Assumption while Designing beam & columns where 230mm x 700mm & 230mm x 230mm respectively.



III. Making Staad Model :

i. The 3D model is made by connecting nodes or by using Run Structural Wizard option for making 3D model on Staad Pro.

ii. For repeating the No of Floors use Transactional Repeat at y Direction up to 4th floor.

iii. Give properties to all the Beams & Columns of the Structure as concrete, also give dimensions to the beams & columns using Prismatic option

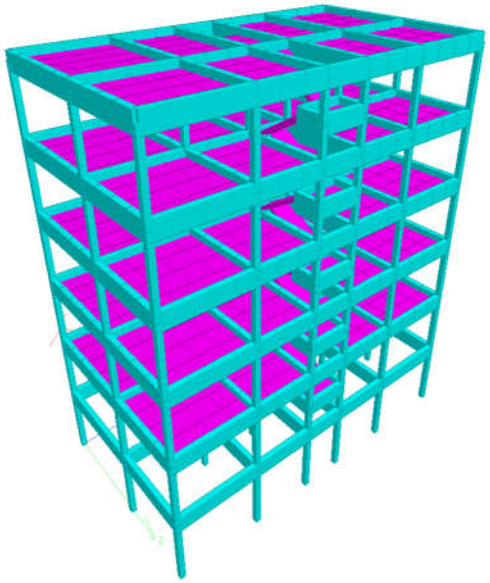
iv. Assumed dimensions are for beam 230mm width & 700mm depth and for column 230mm x 230mm (square column) & Slab of 150mm

v. Assign supports for the column of given Structure by add Support option.

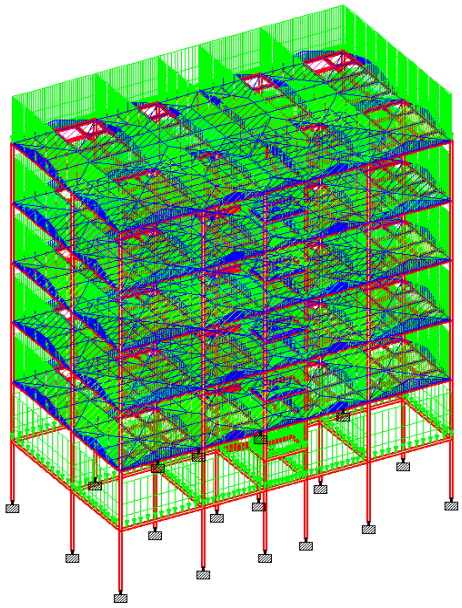
vi. Open 3D rendering view to view the 3D Model.

IV. Loading on Structure:

i. To assign the load, First go to loading option select load cases DL (dead load) add
ii. Self weight of structure as 1 KN/M Select whole Structure assign to all.
iii. For wall load select uniform force & calculate load by taking 2.3m height of wall after deducting beam depth head available, 0.23m width of wall (external) & density.
iv. For External wall = (2.3x0.23x20) x1.5 = 15.87KN/M (brick), For Internal wall = (2.3x0.125x20) = 8.625 KN/M (brick) & Parapet wall = (1.2x0.125x6) x1.5 = 4.5 (Brick).
v. For External wall = (2.3x0.23x6) x1.5 = 4.76 KN/M (Siporex) & for Internal wall = (2.3x0.125x6) x1.5 = 2.6 KN/M (Siporex) & Parapet wall = (1.2x0.125x6) x1.5 = 1.35KN/M.
vi. Floor finish = 2 KN/m2.
vii. Live load = 3 KN/m2.
viii. Combination of load as per Indian standards 875 (Part 5).



3D model of G+4 Residential



Loading on Structure

V. RESULTS & DISCUSSION

COLUMN	WITH CONVENTIONAL BRICK		WITH SIPOREX	
	LOAD (KN)	SIZE (mm)	LOAD(KN)	SIZE(MM)
C1	938	270x270	624	230 x 230
C2	1102	300x300	932	270 x 270
C3	1498	350x350	1016	300 x 300
C4	1502	350x350	1018	300 x 300
C5	1104	300x300	932	270 x 270
C6	940	270x270	625	230 x 230
C7	1386	325x325	1038	300 x 300
C8	1608	350x350	1247	300 x 300
C9	1382	325x325	1048	280 x 280
C10	1325	325x325	1012	280 x 280
C11	1605	350x350	1246	300 x 300
C12	1388	325x325	1038	280 x 280
C13	872	270x270	682	230 x 230
C14	1288	325x325	835	270 x 270
C15	1428	325x325	1189	300 x 300
C16	1430	325x325	1192	300 x 300
C17	1290	325x325	836	270 x 270
C18	872	260x260	684	230 x 230

VI. CONCLUSIONS

1. It can observed from the table of comparison that concrete quantity for the building with Conventional brick is 32.508m3 and with Siporex block is 24.61m3.
2. Hence there is reduction of concrete quantity by 7.9m3. It is about 25%.
3. The complete conclusion regarding using Siporex block can be obtained after complete estimation and costing of Concrete and Brickwork. This can be the scope for further studies.

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