IJSER - TEMPLATE

"A COMPARATIVE STUDY AND COST ANALYSIS OF BRICKS, METALS AND LIGHT WEIGHT PANELS FOR RESIDENTIAL STRUCTURE"

ABHISHEK SHIMPI, NAYANA NIKAM, KUNAL MORE, SNEHAL DESHMUKH, DARSHAN BEDSE

Abstract— Construction industry could be considered as a very important sector for development all over the World and the construction cost is the most important element in it. The construction project can vary from extremely profitable to barely worth it and sometimes end up costing the contractor more than what he or she is getting paid to complete it. In construction industry the aim of project control is to ensure the projects finish on time, within budget and achieving other project activities. Time and cost are two main concerns which increase importance of cost reduction techniques. Reduction of cost of construction is a constant goal for construction industry. One way of reducing construction cost is to develop innovative technologies as well as methodologies to increase productivity. This study was carried out to compare cost analysis of brick construction, metal construction and light weight panel construction.

Index Terms— Keywords: Construction, Cost, Value, Project, Brick Construction, Metal Construction, Light Weight Panel Construction, etc.

1 INTRODUCTION

1.1 Construction Industry

The construction industry is considered one of the most resource-intensive industry sectors in the global economy and is often exposed to several risks such as resource scarcity, availability, and prices of globally traded commodities. Decreasing the power of assets usedin construction is, in this way, critical for expanding industrial and economic resilience. In general, there are three sectors of construction: buildings, infrastructure and industrial. Building construction is usually further divided into residential and non- residential. Infrastructure, also called heavy civil or heavy engineering, includes large public works, dams, bridges, highways, railways, water or wastewater and utility distribution. Industrial construction includes offshore construction (mainly of energy installations), mining and quarrying, refineries, chemical processing, power generation, mills and manufacturing plants.

There are also other ways to break the industry into sectors or markets. For example, Engineering News-Record (ENR), a US-based construction trade magazine, has compiled and Engineering News-Record (ENR), reported data about the size of design and construction contractors. In 2020, it split the data into nine market segments: transportation, petroleum, buildings, power, industrial, water, manufacturing, sewer or waste, telecom, hazardous waste, and a tenth category for other projects. Engineering News- Record (ENR) used data on transportation, sewer, hazardous waste and water to rank firms as heavy contractors.

The Standard Industrial Classification and the newer North American Industry Classification System classify companies that perform or engage in construction into three subsectors:

building construction, heavy and civil engineering construction, and specialty trade contractors. There are also categories for professional services firms (e.g., engineering, architecture, surveying, project management) of construction on per square meter (or per square foot) basis for houses can vary dramatically based on site conditions, access routes, local regulations, economies of scale (custom-designed homes are often more expensive to build) and the availability of skilled trades people.

Residential construction actually addresses the housing needs of society. Housing construction takes many forms: individual homes, apartments, condominiums, townhouses, and prefabricated units like modular and manufactured homes. Individual homes are classified as single-family dwellings. Apartment condominiums and townhouses are all referred to as multi-family dwellings.

Residential construction is typically funded by private individuals or devel opers for their own use or for sale. Builders of individual homes generally fall within one of the three categories: they are custom builders constructing one-of-a-kind homes for specific customers on specific lots, they are single-family small- volume builders who built 25 or fewer homes a year, or they are single-family production builders who build more than 25 homes a year.

1.2 Design

In the industrialized world, construction usually involves the translation of designs into reality. Most commonly (i. e: in a design-bid-build project), the design team is employed by (i.e. in contract with) the property owner. Depending upon the type of project, a design team may include architects, civil engineers, mechanical engineers, electrical engineers, structural engineers, fire protection engineers, planning consultants, architectural consultants, and archaeological consultants. A 'lead designer' will normally be identified to help coordinate different disciplinary inputs to the overall design. This may be aided by integration of previously separate disciplines (often undertaken by separate firms) into multi-disciplinary firms with experts from all related fields, or by firms establishing relationships to support design-build processes. The increasing complexity of construction projects creates the need for design professionals trained in all phases of a project's life-cycle and develop an appreciation of the asset as an advanced technological system requiring close integration of many sub-systems and their individual components, including sustainability. For buildings, building engineering is an emerging discipline that attempts to meet this new challenge. Traditionally, design has involved the production of sketches, architectural and engineering drawings, and specifications. Until the late 20th century, drawings were largely hand-drafted; adoptionof computer-aided design (CAD) technologies then improved design productivity, while the 21st century introduction of building information modeling (BIM) processes has involved use of computer-generated models that can be used in their own right or to generate drawings and other visualisations as well as capturing non-geometric data about building components and systems.

On some projects, work on site will not start until design work is largely complete; on others, some design work may be undertaken concurrently with the early stages of on-site activity (for example, work on a building's foundations may commence while designers are still working on the detailed designs of the building's internal spaces). Some projects may include elements that are designed for off-site construction (see also prefabrication and modular building) and are then delivered to site ready for erection, installation or assembly.

Literature Review

2.1 Opening Remarks

The literature surveys including some previous research papers regarding the study of cost analysis of bricks, metals and light weight panels. These papers help in considering varying parameters which affect the study of this project and the results. This report also guides for the research procedure and helps in adopting a suitable methodology with respect to the earlier mentioned variable parameters. The literature is available on the study of cost analysis of bricks, metals and light weight panels which are discussed below:

2.2 Literatures Reviewed

Arun M. *et. al.* [2021] studied affordable housing: cost effective construction materials for economically weaker section. In any populous country shelter for everyone is an emerging need. This leads to a concept of affordable housing for developing countries, especially

for the Economically Weaker Section (EWS). An experimental investigation had been made with an aim to suggest a cost effective construction technique in order to build an affordable house for EWS people. In this attempt, various cost effective materials such as EPS (Expanded polystyrene), coconut shell, Foundry sand, Fly ash were used. A separate concrete mix proportion was designed and adopted for every cost effective material used in this work. The slab panel with the size of 1.5′×2′ and their companion test specimens were also cast and tested. Three different types of reinforcements were adopted in this investigation such as Geogrid, Mild steel rod of 6 mm diameter and two layer of wiremesh having 1 mm diameter with 10 mm spacing on both the directions were adopted as three different reinforcements in this investigation. Finally, 15 numbers of slab panels were tested for gradually increased uniformly distributed load with simply supported condition. The cost analysis to cast every slab was made and obtained an optimum cost effective material with high strength. **[1]**

Shafayet A. *et. al.* [2021] studied analysis of cost comparison and effects of change orders during construction: Study of a mass timber and a concrete building project. In recent years, timber had been considered as an alternative source of building material because of its sustainability and design efficiency. However, the cost competitiveness of timber buildings is still under study due to the lack of available cost information. This paper presented a comprehensive cost comparative analysis of a mass timber building mainly developed with cross-laminated timber (CLT). The actual construction cost of the project was compared with the modeled cost of the same building designed as a concrete option. The result showed that the construction cost of timber building is 6.43% higher than the modeled concrete building. The study further investigated the change orders associated with the project and found thatthe total cost of change orders contributed 5.62% to the final construction cost of mass timber building. The study was helpful to provide insight into the construction cost of typical mass timber buildings. It could also be used as a guide for the project owners to make decisions regarding their initial investments on a mass timber project. **[2]**

Musarat M. *et. al.* [2020] focused on impact of inflation rate on construction projects budget: A review. Owing to its significant contribution to GDP and other sectors, the construction industry plays an important role in economic growth. The economy of countries depends on a number of variables in which inflation is one of them. The position of inflationin economic growth cannot be overlooked, as it is retaliating either positively or negatively. This paper explored the role of inflation and how it affects the economy and the construction industry. It had concluded that the inflation rate is neglected in most of the construction projects economics and budgeting that causes the project cost overrun as the building materials prices, labour wages, and machinery hire rates were changing annually. Moreover, a framework has been proposed that highlights the strong relationship between the inflation rate and the construction industry. The framework was useful for the future budget estimation model to eliminate project cost overrun which occurs due to the inflation rate. **[3]**

2.3 Research Gap

In research work there is lack of study on construction of buildings by using light weight panels and metals. Hence it is taken into account for the study. Also, there is lack of research work available on residential construction using light weight panels.

2.4 Significance of Research

The research will encourage the new approach in construction field. The study surely is a step forward in the right direction to achieve economical construction and low cost housing.It is also helpful for low income group of peoples.

2.5 Concluding Remarks

Based on the critical review of literature, the principal aim of this study is to compare cost analysis by using bricks, metals and light weight panels in Indian construction sector. In poor countries severe problems like population growth, uncontrolled urbanization processes, deforestation and erosion are present as a result of misuse of all different kinds of resources; this is the fact also. Low-Cost construction is an essential part in the line of developing sustainable solutions for the provision of shelter for ordinary people in the third world.
.

3.Research Methodology

3.1Opening Remarks

This chapter describes the methodology adopted to achieve the aims and objectives of the study, details of the methods used, and the different procedures applied to analyse cost of bricks, metals and light weight panels used in residential construction.

3.2Problem Statement

In many construction projects, project managers and contractors find difficulties like poor planning of project, poor material, labour shortages, increased cost of material, delays in deliveries, wastage of material, over budgeting, unexpected weather changes, lapse in management and control, loss of material, poor communication etc. This result into cost and time overruns conflicts in project. So there is need to study different materials for construction projects effectively. The principal aim of this study is to compare cost analysisof bricks, metals and light weight panels for residential structure.
Thus the statement of the Project is,

"A Comparative Study and Cost Analysis of Bricks, Metals and Light Weight Panels for Residential Structure"

3.3Aim of the Study

India is a country where every family dreams of staying in the house they own. But with the current increase in land costs, construction material prices and labour charges, it is becoming difficult for middle class families to fulfill their dream of living in their own homes. So that we thought of putting forward some conclusion that can be helpful for such families to build the house of their dreams by using light weight panels. Reduction of cost of construction is a constant goal for construction industry. One way of reducing construction cost is to develop innovative technologies as well as methodologies to increase productivity.

3.4Objectives of the Study

The main purpose of study is to compare cost of bricks construction, metal construction andlight weight panel. Following are the objectives of the present study:-

To study different materials used in residential construction projects,

To estimate cost of 10 m x 10 m residential project using bricks construction,

To estimate cost of 10 m x 10 m residential project using metals construction,

To estimate cost of 10 m x 10 m residential project using light

weight panelsconstruction,

To compare estimated cost of 10 m x 10 m residential project using brickconstruction, metals construction and light weight panels construction.

3.1 Methodology of the Work

The different phases of this project of work are shown in the following diagram. The figuresimply describes the experimental strategy of this study step by step.

Review the existing literatures on oblique columns and Y-shaped columns,

Case Study on bricks construction, metal construction and light weight panels,

Estimation of 10 m x 10 m residential project using bricks construction,
Estimation of 10 m x 10 m residential project using metals construction,
Estimation of 10 m x 10 m residential project using light weight panels construction,

Comparative study between bricks construction, metals construction and light weightpanels construction for 10 m x 10 m residential project,Interpretation of results and conclusion.

- **Figures**

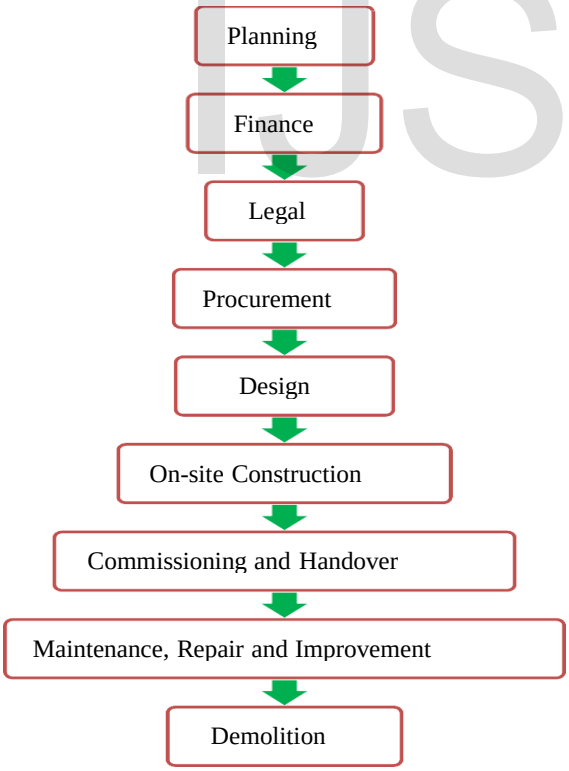

Figure 1.2: Construction Process

Brick Masonry Construction

Materials and Equipment Used in Brick Masonry Construction:-

a) Mortar Mix or Mason Mix Bricks

b) Tape measure

c) hammer

d) Hose, level, or Theodolite

e) Trowel Level

f) Wheelbarrow

g) Goggles

h) Jointer

i) And other equipment according to project ans personal preferences

The following points should be observed in the construction of brick masonry:

a) Use good quality bricks.

b) Ensure that brick courses are perfectly horizontal.

c) Verticality of the wall should be ensured by frequently checking with plumb-bob.

d) Whenever work is stopped brick masonry should be left with toothed end.

e) Use of brick bats should be avoided.

f) Raising walls by more than 1.5 m in one day shall be prevented.

g) Raise face joints to a depth of 12 to 20mm so as to be used as a key for plastering orpointing.

h) Brick masonry should be regularly cured for 2 weeks.

i) The thickness of mortar joints shall be 10 mm both horizontally and vertically.

Metal Construction

Metals are solid material that are generally hard, shiny, malleable, fusible, ductile, and have good electrical and thermal conductivity. Metals are commonly used in the construction due to their durability and strength to form structural components, pipework, cladding materials and other components. Steel is the most popular, most widely used metal in the construction industry. It's also the most recycled material on the planet, making it a very eco-friendly option for construction. People in the construction industry love steel because it can produce extremely sustainable structures that can be built quickly at low prices. Steel is found in countless construction projects, such as deck plates, coastal defenses, metal homes, educational buildings, skyscrapers, hospitals, commercial buildings, stadiums, and security fencing, just to name a few. If you've ever seen a metal building, you can bet it was built using steel with almost 100% certainty. A pre-engineered residential metal structure is the most durable and cost-effective solution to all your building needs. These easy-to-assemble structures can be erected quickly and efficiently, often without the need for professional help. Although they are self-assembly, pre-engineered steel buildings have a high-end customizable appearance.

Steel frame is typically consisting of vertical column and horizontal beams which are riveted, bolted or welded together in a rectilinear grid. Steel beams are horizontal structural members that resist loads applied laterally to their axis. Columns are vertical structural members that transfer compressive loads. It can be used to form the skeleton of a building. Structural steel framing is typically designed, fabricated and erected in accordance with applicable

standards for instance American Institute of Steel Construction (AISC) and Canadian Standard
Association (CSA) as well as Indian Standard Codes.

Residential Metal Construction

Following are the reasons for uses of metal in residential construction:

a) Strength, Beauty, Design Freedom

b) Fast, Efficient, Resourceful

c) Adaptable and Accessible

d) Less Columns, More Open Space

e) Endlessly Recyclable

f) Added Fire Resistance

g) Earthquake Resistance

h) Aesthetics, Meet Function

i) More Usable Space, Less Material

j) Lighter and Less Impacting on the Environment

Light Weight Panel Construction

These lightweight panels are created by sandwiching two calcium silicate panels with polystyrene beads and cement or ceramsite. They form a non-load bearing light weight composite panel that can be used in walls, flooring and roofing.

Advantages of light weig t panels are as follows: h

a) Since these panels are lightweight, the installation process is extremely easy and canbe done with simple construction tools.

b) They are highly d rable and have a lo g life span.

c) They are earthquake proof, soundproof and also fireproof.

d) Since they are lightweight, these panels can be easily assembled and reassembled atanother location thus making it an economical and environmentally-friendly solution.

Panel Construction

Specification of Light Weight Panel Construction

	75 mm
Built Type	Panel Build
Material	Cement
Brand	Birla Aerocon
Usage/Application	House
Core Filling	Fly Ash
Weight	57 Kg/Sq. m
Thermal Conductivity	0.21 W/m deg. K
Fire Propagation Index	3.7 I
Structurally Insulated	Yes
Ignitability	Class P
Length	2.7 m
Width	600 mm
Fire Rating	120 min.
Sound Transmission Coefficient	36 db
Flexural Strength	58 Kg/cm2
Axial Load	83 KN/m
Factor of Safety	2.5
Apparent Density	720 Kg/m3

Description of Light Weight Panels

Key Features of light weight panels are as follows:

1. *Savings:*

   a) **Cost:** Light-weight, therefore results in structural savings up to 20%.

   d) **Toxic emissions:** None.

2. *Space:*

   a) **Thinner walls:** Provides additional carpet area, up to 5%.

Types of Application:

a) **Partitions:** Offices, Malls, Educational Institutions, Hotels/ Restaurants, HousingResidential, Government or Defence, Industrial & Infrastructure, Textile units.

b) **Prefab Structures:** Accommodation Units, Site Offices, Security & Store Rooms,Warehouse or Godowns, Schools, Army Barrack, Low-Cost Housing.

   b) **Eco-friendly:** Use of fly ash.

3. *Safe:*

   a) **Fire:** Highly resistant.

   b) **Weather:** Can withstand adverse conditions.

   c) **Termite and water-resistant:** Doesn't permit the growth of bacteria and fungus.

c) **Mezzanine Flooring:** Industrial, SEZ, Warehouse, Godowns, Storerooms, ShoppingMalls, Government, Defence, etc.

d) **Cladding:** Shopping malls, School or College or University, Duct Covering, SiteOffices & Administration Offices, Industrial.

   d) **Strength:** Can build load-bearing structures

4. *Sustainable:*

   a) **Saves resources:** Cement and sand are not required.

   b) **Reusable:** The unique tongue & groove joint makes it easy to uninstall.

Boundary/Fencing: Residential, Commercial, Government, Defence etc

5. *Strength:*

   a) **Long-lasting:** cement-based panels

   b) High axial compression and bending

   b) **Time:** 10-20 times faster to construct.

   c) **Labour:** Pre-cured and ready-to-use, therefore eliminates on-site curing.

Concluding Remarks

From the above discussions, the methodology is fixed. The focus will be to get accurateresult.

References

I. Research Papers:-

[1] M. Arun, K. Baskar, B. S. Geethapriya, M. Jayabarathi and R. Angayarkkani, *"Affordable Housing: Cost Effective Construction Materials for Economically Weaker Section"*, Science Direct: Materilas Today: Proceedings, January 2021.

[2] Shafayet Ahmed and Ingrid Arocho, *"Analysis of Cost Comparison and Effects of Change Orders During Construction: Study of a Mass Timber and a Concrete Building Project"*, Science Direct: Journal of Building Engineering, 33, 101856, 2021.

[3] Muhammad Ali Musarat, Wesam Salah Alaloul and M.S. Liew, *"Impact of Inflation Rate on Construction Projects Budget: A Review"*, Science Direct: Ain Shams Engineering Journal, 2020.

[4] Hayssam O. Elhusseiny, Ibrahim Nosair and A. Samer Ezeldin, *"Systematic Processing Framework for Analyzing The Factors of Construction Projects Delays in Egypt"*, Science Direct: Ain Shams Engineering Journal, 2020.

[5] Akshay Gulghane, Nikhil Pitale and Sanket Sanghai, *"Time and Cost Optimization of Construction Project Using Mivan Technology"*, Journal of Engineering Research and Application, ISSN: 2248-9622, Volume 8, Issue 8 (Part -II), pp. 70-74. August 2018.

[6] Shabniya V, *"Factors Affecting Construction Cost Estimation of Building Projects"*, International Journal of Recent Trends in Engineering & Research (IJRTER), Volume 03, Issue 04, pp. 379-387, April 2017.

[7] AL Kulabi Ahmed and Hakob Avetisyanb, *"Reducing Time and Cost of Construction Projects by improving the Properties of Precast Normal-Weight Wall Panels"*, Science Direct : Procedia Engineering, Volume 145, pp. 1066 – 1073, 2016.

[8] Urmila A Mahadik, *"Cost Reduction in Construction Projects"*, International Journal of Engineering Technology, Management and Applied Sciences, Volume 3, Special Issue, pp. 397-400, September 2015.

[9] Anuja Rajguru and Parag Mahatme, *"Effective Techniques in Cost*

Optimization of Construction Project: A Review", International Journal of Research in Engineering and Technology (IRJET), Volume: 04 Issue: 03, pp. 464-469, March 2015.

[10] Nitesh Dogne and Ashish Choudhary, *"Smart Construction Materials & Techniques"*, AICMT: National conference on Alternative & Innovation Construction Materials & Techniques, pp. 12-16, September 2014.

[11] P. P. Bhangale and Ajay K. Mahajan, *"Cost Reduction through Cost Effective Construction Techniques"*, International Journal of Science and Research (IJSR), Volume 4, Issue 2, pp. 2167-2169, February 2015.

[12] Georgekutty C. K and Dr. George Mathew, *"Research Methodology for Material Optimization in Construction Projects"*, International Journal of Engineering Research & Technology (IJERT), Volume 1, Issue 6, August 2012.

II. IS Code:-

[1] 5042, *"Code of practice for construction of lightweight concrete block masonry [CED 53: Cement Matrix Products]"*, Second Revision, Bureau of Indian Standards (BIS), New Delhi, 1969 (Reaffirmed 2005).