A Thesis on

"TO STUDY THE IMPACT OF ALTERNATIVE CONSTRUCTION MATERIALS ON LOW COST HOUSING"

Submitted for partial fulfillment of award of

MASTER OF TECHNOLOGY

Degree in

CONSTRUCTION TECHNOLOGY & MANAGEMENT

By

BIPIN PEGHWAL

(1801103003)

Under the Supervision of

Mr. Anwar Ahmad

Associate Professor

Integral university

Department of Civil Engineering

Integral University,

Lucknow– 226026(U.P.)

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DECLARATION

I declare that the research thesis entitled **"TO STUDY THE IMPACT OF ALTERNATIVE CONSTRUCTION MATERIALS ON LOW COST HOUSING"** is the bonafide research work carried out by me, under the guidance of **Mr Anwar Ahmad Associate Professor, Department of Civil Engineering, Integral University, Lucknow**. Further I declare that this has not previously formed the basis of award of any degree, diploma, associate-ship or other similar degrees or diplomas, and has not been submitted anywhere else.

Date

Place: Lucknow

BIPIN PEGHWAL

1801103003

Department of Civil Engineering

Integral University

CERTIFICATE

Certified that the thesis entitled **"TO STUDY THE IMPACT OF ALTERNATIVE CONSTRUCTION MATERIALS ON LOW COST HOUSING"** is being submitted by **BIPIN PEGHWAL (1801103003)** in partial fulfilment of the requirement for the award of degree of Master of Technology (CTM) of Integral University, Lucknow, is a record of candidate's own work carried out by him/her under my supervision and guidance.

The results presented in this thesis have not been submitted to any other university or institute for the award of any other degree or diploma.

Mr. Anwar Ahmad
Associate Professor
Department of Civil
Engineering
Integral University

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Bipin Peghwal
1801103003

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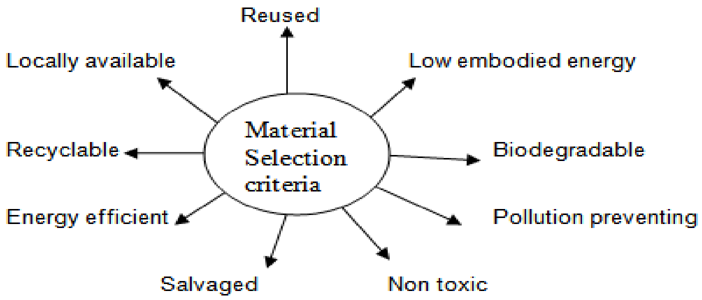
CHAPTER-1

INTRODUCTION

1.1. INTRODUCTION

Low cost Housing could be a distinctive concept which bargains with viable costing and taking after of procedures which offer assistance in lessening the taken a toll development through the utilize of faraway accessible materials close to with and innovation moved forward abilities without losing the power, performance and life of the structure. There's colossal misguided judgment that moo taken a toll lodging is appropriate for as it were subnormal works and they are built by utilizing cheap building materials of moo quality. The reality is that Moo cost housing is done by appropriate administration of assets. Economy is additionally accomplished by delaying wrapping up works or executing them in stages. Fetched of lessening is accomplished by choice of more proficient fabric or by moved forward plan. Development of moo fetched lodging by utilizing the low cost housing development materials increments the get to to buildings by moo pay gather people groups. t is exceptionally critical to have a protect of our claim. Major populace of our nation is underneath lower salary gather. Moo taken a toll lodging ventures for reasonable living are major concern for the government. Indian government have begun reasonable lodging plot as a pilot extend collaborating with open & private association in states of Maharashtra, Rajasthan, Kerala, Andhra Pradesh & Telangana. In this state of the craftsmanship writing audit; development of Moo taken a toll lodging in India is examined. In this case consider; a model demonstrate is proposed. Development of moo fetched lodging by utilizing the moo taken a toll building materials increments the get to to buildings by moo salary bunch individuals. Moo taken a toll lodging can be accomplished by the utilization of proficient arranging and venture administration, locally accessible materials, conservative development advances and utilize of substitute development strategies accessible.

Utilize of moo taken a toll building materials for development of moo taken a toll lodging increments the get to to buildings by moo pay bunch people groups. Moo taken a toll lodging can be accomplished by utilize of proficient arranging and extend administration, moo taken a toll materials, conservative development innovations and utilize of substitute development strategies accessible.



1.2 Selection of Low Cost Building Materials for Low Cost Housing

The primary step to moo fetched building material determination is to choose eco-friendly building materials. This too improves the economical plan principle. The life cycle of a building is pre-building, building and post-building stages. Each arrange of building ought to be such that they offer assistance moderate the vitality. These three stages show stream of building materials through diverse stages of a building. Pre-building organize primarily comprises of fabricate which is subdivided in handling, pressing and transport. The building stage primarily comprises of development, operation, upkeep and transfer finally arrange where the fabric can be reused or reused.

1.3 Manufacturing of Low Cost Building Materials

Fabricating of building materials ought to be environment inviting. Endeavors ought to be made to consider and change the innovations for creating great quality, productive building materials and ought to move forward the squander era amid fabricating. There comes about in lessening of poisons to environment.

1.3.1 Use of Recycled wastes as Low Cost Building Materials

The squanders which can be reused can and utilized in masonries while as wooden squanders can be utilized in fabricate of plywood or delicate sheets.

1.3.2 Use of Natural Low Cost Building Materials

The full vitality required to create a fabric is called encapsulated vitality. The more prominent a material's epitomized vitality; it requires a more noteworthy utilization of non-renewable sources. It is hence beneficial to utilize materials or composite materials arranged from the wastages. The characteristic materials such as stones, wood, lime, sand and bamboo can be utilized in adequate wherever conceivable. The normal materials affect more supportability to structures as well as they are friendlier to environment.

1.3.3 Use of Local Building Materials

The utilization of nearby materials decreases the reliance on transportation whose commitment to the building fabric taken a toll is tall for long remove. Utilize of locally accessible building materials not as it were diminishes the development taken a toll but too are reasonable for the neighborhood natural conditions.

1.3.4 Using Energy Efficient Building Materials

Vitality effectively of a building fabric can be measured through different variables as its R esteem, shading coefficient, glowing proficiency or fuel effectiveness. Vitality proficient materials must diminish the sum of created vitality.

1.3.5 Use of Non-Toxic Building Materials

Utilize of poisonous building materials can essentially affect the wellbeing of development individuals and the tenants of the building. In this way it is prudent to utilize the non-toxic building materials for construction. There are a few chemicals counting formaldehyde, benzene, smelling salts, tars, chemicals in insulations, handle sheets which are show in furniture and building fabric. The impact on wellbeing of these harmful materials must be considered whereas their determination and they ought to be utilized as it where-ever required.

Higher discuss cycling is prescribed whereas establishment of materials having unstable natural compound such as a few cements, paints, sealants, cleaners and so on.

1.3.6 Longevity, Durability and Maintenance of Building Materials

The utilization of tough development materials does not as it were upgrade the life of the building but too decreases the fetched of upkeep. The lower support costs actually spare a part of building working taken a toll. The materials utilized in building decide the long term costs of working.

1.3.7 Recyclability and Reusability of Building Materials

A fabric ought to be accessible in frame which can be recyclable or reusable. Ex – the plastics squander can be utilized for reusing and creating more current materials. The scrap from steel can be utilized to make the rcc bars, official covers and other random steel items in building development.

1.3.8 Biodegradability

A fabric ought to be able to break down actually when disposed of. Normal materials or natural materials would break down exceptionally effectively. It is additionally a really vital thought whether a fabric breaks down actually or produces a few harmful gasses.

1.3.9 Composites as Low Cost Building Materials

The composite building materials are made of composition of two or more materials which have upgraded property. Normal fiber materials are coming up as great substitutes for the winning building materials. Filaments like jute, sisal coconut, ramie, banana are cheap and ecologically suited as they are made from common strands. They are too supplanting the fiber fortified plastics.

Composite building materials show gigantic openings to supplant conventional materials as timber, steel, aluminum and concrete in buildings. They offer assistance in diminishment of erosion and their moo weight has been demonstrated valuable in numerous moo stretch applications. Each sort of composite has its possess characteristic properties and hence valuable for particular reason.

Jute fiber fortified polypropylene composites, coir fiber fortified composites, sisal fiber and wollastonite jute pultruded composites are some to be named. CBRI has created MDF composite entryways containing coir fiber, cashew nut, shell fluid (CNSL) as characteristic tar and Paraformaldehyde as major constituents.

Numerous composite building materials are produced from glass filaments and mechanical squanders. These materials are utilized for fabricating of convenient toilets, water capacity tanks, open air furniture, baths, insides enrichment, bowl, entryway, window outlines etc.

Hence the application of composite building materials in development change from cladding to inner furniture and the proprietor profoundly benefits due to their application since of their light weight, resistance to erosion and accessibility in several colours.

Pultrusion is most taken a toll successful strategy for creating composite profiles. It is commercially pertinent for light weight erosion free structures, electrical non conductive frameworks and so numerous other capacities.

The pultruded things are recognized and prescribed within the Worldwide markets. Pultruded segments are well built up elective to steel, wood and aluminum in created nations and catching quick in other parts of the world.

1.4 Why Low Cost Housing Construction Required?

For any country whether created or creating typically required for them to create their rural regions a major need for concern. Thriving of country lies within the truth that their country and in reverse zones are created sufficient to fulfill the necessities of the inhabitants living there.

So, it is more of a obligation of the government and in charge specialists to see out for them and make beyond any doubt that the provincial lodging is created and developed well.

1.4.1 Are Low Cost Houses Safe?

There's a myth in minds of numerous individuals; they think that at whatever point development is went with with low taken a toll the fabric utilized will continuously be of a low-grade quality. Well typically not the case continuously**.**

It depends on the judgment skills of the builder or gracious build you're working with. He ought to have the sufficient amount of information to require such choice which can cut the fetched of entirety project. So, you should always select admirably when it comes to your builder or any development company merely are trusting with the low-cost lodging extend for rustic.

1.5 Speedy and Low Cost Housing Construction Techniques for Rural:

Moo fetched lodging or building may be a concept of inventive thoughts of budgeting productively rather than corrupting the quality of fabric you have got been utilizing. You fair require the proper sum of aptitudes, innovation to help and the finest execution of the specialists working on the location to attain this objective of Rapid and Moo Fetched Lodging for Rustic without relinquishing for the fabric you have got been using Kangen Water.

So, there are some methodologies which can be adopted to cut the construction cost and still achieve the best:

1.5.1 Selection of Load Bearing and Framed Structures for Low Cost Housing Construction

When we format our plans for the development we ought to continuously concentrate fundamentally on the structure we have are aiming to utilize. So, typically the primary zone of concern i.e. the structure. It ought to ideally be Stack Bearing Structure rather than utilizing Outline structure. The Stack Bearing structure has a few preferences:

Cheaper in case of typical moo rise building. As the taken a toll of development is moo since lesser sum of concrete and steel bars are required. Less demanding to develop additionally it requires much lesser time. Hence this will serve both the purposes of moo fetched as well as in rapid processing. It is adaptable as well.

1.5.2 Foundation for Low Cost Housing Construction

Presently when we conversation around the establishment of a building we truly have to be exceptionally cautious because it is the most essential perspective of the venture. It includes 10-15% of the whole building cost. Generally, the profundity or the establishment of a building is 3-4 feet profound within the soil, but ready to then again make it up to 2 feet in profundity for ordinary soils. This spares a expansive sum of add up to taken a toll. In other fragile or delicate soils, such a fetched lessening cannot be executed exceptionally well. To maintain a strategic distance from the breaks within the establishment of your building it is exhorted to utilize cement mortar in fitting proportions.

1.5.3 Hollow Concrete Block Load Bearing Walls for Low Cost Housing Construction

Utilize of empty concrete pieces for stack bearing dividers has numerous focal points such as: They are way cheaper than stone bricks we customarily use. Since they are light in weight, they are exceptionally simple to handle and to work on. There's a uncommon advantage of cover to space air void. An awfully less sum of mortar is consumed. The foremost vital truth is that, these are environment inviting.

1.5.4 Staircase for Low Cost Housing Construction

Expectedly we have been utilizing the cast-in-situ stair development frameworks. But it is much more costly. So then again, ready to utilize an compelling and productive strategy which is additionally known as Precast Staircase Framework.

1.5.5 Precast staircase system has several advantages such as:

Its development is cheap and quick No difficult shape of work is required to build it. It can be essentially backed or can be backed with a cantilever.

1.5.6 Filler Slabs for Ceilings in Low Cost Housing Construction

These are the typical RCC pieces where the foot concrete is supplanted with filler materials such as bricks, tiles, cellular pieces, etc. But they don't compromise the quality of ceiling in any ways, in this way it is temperate, sensible and secure to utilize. They too give different sorts of satisfying designs as per your choice.

1.5.7 Prefabrication of Structural Elements

Pre-assembled development could be a concept where all the basic components of development are readymade and bought. So, it is very caught on that it'll spare a tremendous sum of time and makes a difference on concentrating on the durability of the work. Examples of certain pre-assembled materials that you just can utilize are: Materials for walls Roof and floor slabs Entryways and windows

1.5.8 Doors and Windows in Low Cost Housing Construction

It is now specified over that we ought to advance construction to be speedy and imaginative. But moreover, able to make beyond any doubt that we don't spend so much on the entryways and windows and fair seek for the most extreme strength of a plan which is given to you at exceptionally less and successful cost. Instead of taking after the customary carpeting strategies we ought to continuously go by the outlines for the entryways. There are so numerous sizes and choices that are accessible. This spare fetched up to 30% and spares time.

1.6 OBJECTIVE OF THE STUDY

- To find out the use of alternative construction materials in low cost housing in Lucknow region.
- To reduce the cost of housing by using some alternative construction material over conventional material

1.7 SCOPE OF THE STUDY

- The scope of this study is to minimize the cost of housing which will help to people for buying affordable houses which belong to low cost housing.

CHAPTER-2

LITERATURE REVIEW

Tam (2011) explained the cost effective of using low cost housing technology in construction. It is found that 26.11% and 22.68% of building cost can be saved by consuming low cost housing technologies in assessment with traditional construction method. Fei and Dale elaborated that glass fiber reinforcement is new technology which is precast. In which glass fiber reinforced are hollow wall panels with or without reinforced with concrete this type of wall are widely used in Australia and wall when tested have high axial and shear carrying capacity.

Chowdhury and Roy (2011) explained prospect of low cost housing in India, it is observed that in this paper alternative construction material mainly natural material such as bamboo, straw, bagasse, manmade material like fly ash, aircon panels were studied and potential of these material to be used as an alternative building material is brought out.

Najjar et al (2012) investigate the use of natural hemp fibre in improved load response of compacted clay, total 6 sample of unconsolidated untrained simple having 7.1cm diameter and 14.2cm length was prepared with reinforcement of hemp fiber of 0, 0.15, 0.3, 0.4, 0.5 and 1% in PVC pipe, the sample was compacted and was cut and tested in triaxial testing machine the result showed that inclusion of hemp fibres has positive impact on ductility and shear strength Increased Iron 0.15 % to 1% When effective content of fibre was (0.5 to 1%).

Mangesh and sachin (2012) explained that SBA which is otherwise landfilled was utilized in a construction material. SBA was tested and it proved its suitability pozzolonic and cementous material with thermal stability of 650 degree. SBA brick was prepared with constant composition of limit and was tested for physiochemical. The least result showed that brick was lighter, durable and energy efficient.

Taur and Devi (2012) explained low cost housing. It is observed that, this paper goal to argument out the various aspect of pre fabricated construction methodologies for low cost housing by highlighting different prefabrication technique and economical advantage accomplished by its adoption. In building the foundation wall, floring ,column, slab, are important component. The major Construction method's here are namely structural block wall, mortar fewer block wall, precast RC planes, pre cast concrete / ferro cerment panels are Considered.

Huma Yun and Pasha (2012) studied about sundried fly ash brick the aggregate binder ratio used for fly ash brick was given as l; 4. The average size of fly ash brick was 230 * 110 * 75mm and mortar joint of 10 to 12 mm was used And was tested using uniaxial monotonic compressive displacement loading with actuator of 250kN. Result showed it was 18.3%. higher, failure modes in masonry showed that good bond can be achieved by higher grade of mortar.

Caponetto and Fransis (2013) explained ecological material and technologies in low cost building system, it is observed than high recyclability of natural materials that can be use in low cost building associated with construction technique capable of exploiting the principle of bioclimatic architecture for liveliness needs allow us to create building environmentally conscious and responsible. At same time the project of special block was developed to meet need of sustainability and ease of construction.

Viahwas p. kukarni, Sanjay kumar N. Gaikwad (2013) In this paper three different concrete mixes with different the combination of natural material content namely 0%0% 20% 30%. Three sample specimen will be prepared for each concrete mixes. The aim behind this is to use low cost material like coconut shee and thus taking close to the concept of low cost housing. There is no need to treat the coconut shell before use as an a aggregate except for water absorption. Coconut shell is compatible with the cement. All precaution is taken to maintain serviceability, strength of the members. Thus it will be helpful for civil engineers and society to adopt this concept to fulfil the basic need of human that is housing.

Maninder Kaur, Manpreet Kaur (2013) In this paper, the utilization of coconut shell as a coarse aggregate has been discussed based on the results obtained from comprehensive review of literature. Every construction industry totally relies on cement, sand and aggregates for the production of concrete. Now a days, most of the researchers are doing the research on the material which can reduce the cost of construction as well as increase the strength. Use of coconut shells in cement concrete help in waste reduction and pollution reduction. The construction industries have identified many artificial and natural lightweight aggregate that have replaced conventional aggregate thereby reducing the size of structural members.

Daniel Yaw Osei (2013) In this paper, a concrete mix of 1:2:4 was used as control, while coconut shells were used to replace crushed granite by volume. The density and compressive strength of concrete reduced as the percentage replacement increased. The results of the study showed that concrete produced by replacing 18.5% of the crushed granite by coconut shells can be used in reinforced concrete construction. A potential exists for the use of coconut shells as replacement of conventional aggregate in both conventional reinforced concrete and lightweight reinforced concrete construction.

Kabiru Usman Rogo, Saleh Abubakar (2014) This paper contains a research conducted to explore the use of coconut shell as a coarse aggregate in concrete. Experimental approach was adopted to determine the suitability of coconut shell as full replacement for coarse aggregate in concrete work. The physical and mechanical properties of coconut shell and crushed granite rock were determine and compared. Since the concrete strength of coconut shell with mix ratio 1:1 1/2 :3 attained16.5N/mm2 at 28 days it can be used as plain concrete. Hence cost reduction of 48% was obtained.

Siti Aminah BtTukiman and Sabarudin Bin Mohd (2014) In this studies, five different concrete mixes with different the combination of natural material content namely 0%, 25%, 50%, 75% and 100%. The parameters will be tested are flexural strength, compressive strength, tensile strength, modulus of elasticity and deflection crack behavior. The combination of coconut shell and grained palm kernel shell has potential as lightweight aggregate in concrete. Also using the combination of coconut shell and grained palm kernel shell as aggregate in concrete can reduce the material cost in construction because of the low cost and abundant agricultural waste. The effect of aggregate content to workability will also examine. The expected outcome of the study is the combination of coconut shell and grained palm kernel shell has potential as lightweight aggregate in concrete.

Parag S. Kambli, Sandhya R. Mathapati (2014) In this paper coarse aggregate namely gravel and fine aggregate\ is sand in concrete will be used as control. While natural material is coconut shell as course aggregate will be investigate to replace the aggregate in concrete. In this study, three different concrete mixes namely M20, M35 & M50 grade with different combination of natural material CS content in the proportion 0%, 10%, 20%, 30% and 40% will be replaced. The parameters will be tested are compressive strength behavior of cube specimens for 7 & 28 days. the Coconut Shells are more suitable as low strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production. The main objective is to encourage the use of these waste products as construction materials in low-cost housing.

M. Rame Gowda (2012). developed and studied the strength of self compacting mortar(SCM) mixes using local materials like quarry dust and rice husk ash (RHA) as the partial replacement of cement and sand. The characterizatio of materials has been done and various tests conducted for cement were fineness, specific gravity, normal consistency ,setting time, compressive strength for 3, 7, 21, and 28 days as per EFNARC 2005 and IS 383: 1970[40- 41].

Muhammad Harunur Rashidetal. (2013) developed mortar incorporating RHA. The mortar mixes with ordinary Portland cement (OPC) and four other mixes using RHA with varying percentage by replacing OPC has been prepared. The compressive strength tests was carried out on these specimens according to ASTM C 109[42] for 7, 28, 90 days. The reported results were average of three samples. For determining the porosity of the mortar cylindrical specimen of 100 mm diameter and 200 mm height were casted. Samples were cured for 28 days and tested at 7, 28, 90 days. Results showed that the strengths of specimens at 28 days are slightly lower. The incorporation of RHA in mortar produced filler effect due to its fine particle size. The results suggested that RHA in this work were quite reactive and pozzolanic reaction starts at the age of 28 days onwards.

Wesam Amer Aules (2012) used the crumb rubber as partial replacement for sand in mortar. Various mixes were prepared with crumb rubber varying percentage and compared with reference mix proportion. The tests carried out on the mortar are compressive strength, fineness and setting time in accordance with ASTM C150-07 [43]. The strength of mixes with crumb rubber was lower than reference mix. Strength was reduced due to weak bond between crumb rubber aggregate and concrete.

Valeria Corinaldesietal (2011) explained the experimental results of use of paper mill sludge ash as supplementary cementitious material. The mortars containing 5% PA exhibited a compressive strength higher than that of conventional mortar at 28 days. The results presented encourage the researchers to undertake further study on the use of PA in concrete, which could lead to a reduction in the cost of concrete as well as a method for disposal of PA. The compressive strengths of mortars were measured after 1, 7, 28, and 60 days after casting.

Djwantoro Hardjito (2007) the results of study on effect of various parameters on mechanical\ properties of fly ash-based geo-polymer mortar with bottom ash as partial or full replacement for sand.Compressive strength of samples with 10% bottom ash (BA) was comparable to those with only sand. Further increase in bottom ash content decreased the compressive strength. However, the reverse tendency occurred after exposing the samples to 1000 oC for 24 hours.

Ahlawat and Kalurkar (2014) did experimental investigation on the effect of replacing granite with coconut shell on the tensile strength and workability of concrete. Forty five cylinders were casted of M 20 grade of concrete. The slump cone and compaction factor test were done to assess the workability of concrete. The tensile strength of cured concrete was evaluated at 7, 14 and 28 days. Increase in percentage replacement of granite lowered tensile strength, but increased workability. Concrete produced by 2.5%, 5%, 7.5%, 10% replacement attained 28 days tensile strength of 1.31,

Nagrale, Hajare and Modak (2015) evaluated how different contents of Rice Husk Ash added to concrete may influence its physical and mechanical properties. Sample

Cubes were tested with different percentage of RHA and different w/c ratio, replacing in mass the cement. Properties like Compressive strength, Water absorption and Slump retention were evaluated. With the addition of RHA weight density of concrete reduces by 72-75%.Thus, RHA concrete can be effectively used as light weight concrete for the construction of structures where the weight of structure is of supreme importance. The cost of 1 m3of OPC concrete works out to Rs. 1157 while that of RHA concrete works out to Rs. 959. Thus, the use of RHA in concrete leads to around 8-12% saving in material cost. So, the addition of RHA in concrete helps in making an economical concrete. The Compressive Strength will increase with the addition of RHA. The use of RHA considerably reduces the water absorption of concrete. Thus, concrete containing RHA can be effectively used in places where the concrete can come in contact with water or moisture. RHA has the potential to act as an admixture, which increases the strength, workability & pozzolanic properties of concrete.

Srinivasan and Sathiya (2015) investigated that Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 5%, 15% and 25% by weight of cement in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken was well as hardened concrete tests like compressive strength, split tensile strength, flexural strength and modulus of elasticity at the age of seven and 28 days was obtained. The result shows that the strength of concrete increased as percentage of bagasse ash replacement increased. The results showed that the SCBA in blended concrete had significantly higher compressive strength, tensile strength, and flexural strength compare to that of the concrete without SCBA. It is found that the cement could be advantageously replaced with SCBA up to maximum limit of 10%. Although, the optimal level of SCBA content was achieved with 1.0% replacement. Partial replacement of cement by SCBA increases workability of fresh concrete; therefore use of super plasticizer is not substantial. The density of concrete decreases with increase in SCBA content, low weight concrete produced in the society with waste materials (SCBA).

Kulkarni, Raje, Rajgor (2015) Bagasse ash can be utilized by replacing it with fly ash and lime in fly ash bricks. Trial bricks of size (230x100x75) mm were tested with different proportions of 0%, 10%, 20%, 30%, 40%, 50% and 60% with replacement of fly ash and 0%, 5%, 10%, 15% and 20% with replacement of lime. These bricks were tested in Compression test and Water absorption test as per Indian Standards. The maximum compressive strength has been obtained at 10% replacement of fly ash as bagasse ash.

Habeeb and Mahmud (2015) studied the properties of RHA and its use in concrete. They investigated the effect of RHA replacement on compressive strength and workability of concrete mixtures. They replaced cement with RHA up to 20% by weight. They found that the slump of RHA concrete was lower than the reference concrete. From their study, they also concluded that the compressive strength of blended concrete was increased as the content of RHA increased. The optimum value of replacement was 10% at which strength increased significantly as compared to reference mixture.

Khassaf et al (2015) found that the workability decreases with the increase of the replacement level of the cement with the RHA as shown in Figure 2. The slump reduced from 70 to 15 when the replacement level increased from 0% to 30%. They also observed that the compressive strength decreased with the increase in the RHA content at short term ages(7 and 28 days) and increased with the increase in the RHA content at long term ages(56 and 90 days). They also found that the compressive strength of concrete with up to 20% RHA replacement attained values more than that of control or reference concrete. The compressive strength behavior of concrete at different curing ages .

Kartini (2015) investigated the effect of RHA on compressive strength of different grades of concrete at different curing ages. He observed that compressive strengths were increased at 28, 60, 90 and 120 curing ages by the replacement of cement with RHA. He also found that the optimum replacement of OPC with RHA for Grade 30 and Grade 40 is 30%, while for Grade 50 is 20%. In case of workability, he concluded that workability decreases with the increase of the replacement level of the RHA with the cement, due to its absorptive character of cellular particles and of high fineness.

Rao et al (2015) demonstrated that at a fixed W/C ratio the compressive strength decreased with the increase in the RHA content at the initial ages (3 and 7 days) however as the age advances there was a significantly increased in the strength of concrete up to 7.5 % replacement level of RHA with the OPC.

Singh and Kumar (2014) examined the effect of RHA as cement replacement at levels of 0%, 5%, 10% and 15% by mass at fixed water cement ratio of .50. They demonstrated that the compressive strength increased at 5 % replacement level of RHA, and decreased with further increase in the RHA content at 7 and 14 days curing ages.

Tashima et al (2007) found that the addition of RHA causes an increment in the compressive strength due to the pozzolanic reactivity of RHA with the calcium hydroxide which is generated during the cement hydration. All the replacement level of RHA increased the compressive strength. For a 5% of RHA, 25% of increment is verified when compared with control mixture**.**

Buari et al. **(2013)** evaluated the potentials of GSA as partial replacement for cement in concrete. The compressive strength and splitting tensile strength were determined in their experiment. The results of experiment demonstrated that compressive strengths of the control (0%) and those of other percentage combinations of GSA increased with curing age but decreased with increased GSA percentage. So they concluded that the GSA concrete of 10% replacement performed better in comparison to the acceptable standard and more suitable for mass concrete production. The compressive strength behavior at different curing ages with various percentage of GSA.

Kambli and Mathapati (2014) observed that coconut shells have high potential as lightweight aggregate in concrete. They investigated the feasibility of the combination of coconut shell as coarse aggregate in concrete by determining its compressive strength and durability and concluded that the coconut shells were more suitable as low strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production

Kakade and Dhawale (2015) analyzed an investigation on the behavior of concrete specimens produce from coconut shell aggregate. They found that the concrete gave the strength of 21.31 N/mm2 at 25% replacement of aggregates with coconut shell which satisfied the requirement for structural lightweight.

Reddy et al (2014) examined the properties of coconut shell aggregate concrete. They analyzed the workability and strength characteristics of concrete by replacing aggregates with coconut shells and found that workability of concrete decreased as the percentage content of coconut shell increased. They also observed that the compressive and flexural strength of concrete decreased when coarse aggregates were replaced with coconut shells.

A.K Kasthurba et. al (2014) talks about the utilize of Laterite as a maintainable building fabric and highlights its benefits as of a locally accessible and cheap fabric as compared to the routine cutting edge materials. The endeavor is to create benchmarks for utilize of Laterite in building applications. The utilization of Laterite is marginalized since of the need of standardization and the trouble in conducting different testing strategies.

Standard estimate laterites of 390x190x190 mm were taken for testing and testing methods for deciding its different building properties which suggested the require for advancement of a appropriate classification since the test test had appeared expansive variety in quality but, for private employments it is adequate and the least quality prerequisite ought to be reevaluated.

B.V.V. Reddy (2011) had considered the reasonableness of fabricated sand as fine total fabric. In this ponder the characteristics of concrete and mortar utilizing M-sand as fine total were decided and compared with that of concrete with waterway sand. The mortar made with M-sand appeared superior designing properties (compressive quality, way better workability, bulk thickness etc.) as compared to that with stream sand. The concrete test was of M20 & M30 review which gave exceptionally palatable comes about when Msand was utilized in put of waterway sand. Thus the test program gave a positive viewpoint on the reasonableness of M-sand as an elective to stream sand conjointly makes a difference within the taken a toll decrease for constructional exercises.

M.M. Eldhose et. Al (2014) examined the physical properties of GFRG Board and the appropriateness of different reasonable filler materials with the assistance of different tests. The Physical properties of GFRG boards such as water assimilation, compressive quality and flexural quality were explored and comes about were gotten. The compressive quality was too tried by utilizing 3 sorts of filler materials (Ostensible mix-M25, Flyash concrete and Reused total concrete) which give d with 3 distinctive values.

Thus, it can be concluded that GFRG boards with appropriate filler fabric can be utilized effectively as a moo fetched development method. BMTPC (Building materials and innovation advancement chamber) whereas working beneath Service of Urban improvement and destitution lightening had overseen to discover inventive building materials which can be utilized as a substitute of wood and a few other conventional materials for lodging and building development segment. The utilization of bamboo through mechanical preparing have demonstrated that it can withstand upto 3656 kg/cm^2 of weight. The BMCS sheets have appeared great resistance to water, fire, rot, termites, creepy crawlies etc In India, Bamboo tangle sheets (BMB), Bamboo tangle lacquer composites (BMVC) and Bamboo tangle folded sheets BMCS created at IPIRTI has picked up client acknowledgment as substitute to wood plywood and folded ACC and GI sheets.

R.K. Watile et. al (2014) had gotten result of the different properties of interlocking squares through an exploratory exertion. The impact of GFRP with greatest rate of fly cinder in interlocking bricks is considered. Materials utilized for the casting of brick were cement, fly fiery remains, stone-dust, GFRP, fine total and water which were blended in changing extents and squares of estimate 230 x 100 x 75mm are gotten and were tried for diverse values of compressive quality and it was famous that the compressive quality of any person square shouldn't drop beneath the least normal compressive quality by more than 20%. The ponder appeared that the water retention of the bricks is straightforwardly corresponding to the fly fiery remains substance utilized and the quality of interlocking bricks increments with expanding fly cinder time to time. Interlocking bricks have adequate quality and are greatly reasonable for moo fetched lodging and non-load bearing structures

Alone and Sawant (2014) utilized scorecard approach to survey the variables causing concrete squander in building development and found that in India concrete squander makes around 4.7% portion of add up to fabric (year-2012). Based on location perceptions, interviews & survey overview a total set of 50 components, gathered in 5 categories was done. The esteem of squander list was calculated for each category and they found that venture administration, arranging and technique was the most noteworthy appraised figure with squander record 227 taken after by materials, apparatus and gear. This concluded that extend administration, arranging and technique is the figure causing most elevated impact to the era of concrete squander and subsequently expanding development costs. Ar. J.Jebaraj Samuel (2015) considered different taken a toll successful strategies at distinctive parts of a building. He accomplished taken a toll diminishment by supplanting ordinary materials with elective materials, legitimate planning approach, arranging, and administration of development and with great development aptitudes. For establishment, he proposed the utilize of curve establishment which spares establishment costs up to 40%.Replacement of plinth chunk by brick on edge can spare 35-50% plinth fetched. The utilize of rat-trap bond divider accomplishes the same quality as customary 250mm divider but requires 20% less bricks. Substitution of wooden outlines by concrete or steel outlines can be done for accomplishing taken a toll lessening up to 40%. Routine RCC lintels fetched 30-40% higher than brick curve lintels which can be utilized for littler ranges and for material, he proposed the utilization of filler pieces which is around 23% less costly than customary chunk.

Rinku Taur and Vidya Devi T. (2009) examined distinctive viewpoints of moo fetched lodging counting pre-assembled components, utilize of locally accessible materials and utilize of unused strategies for moving forward strength of customary moo taken a toll materials which makes them valuable to be utilized for today’s lodging prerequisites. Their investigation included utilize, points of interest and confinements of pre-assembled materials for different works. Execution of any elective innovation for mass lodging on huge scale may subject to economy and adequacy of the fabric and eventually its acknowledgment by showcase. So, the strategy for moo taken a toll lodging can be recommended as of middle sort rather than embracing an elective innovation for whole development.

A.D. Chougule et. al (2014) examines the utilize of filler chunk as an elective development strategy to the cutting edge ordinary strategies. The materials to be utilized as filler materials ought to be light weight, dormant and cheap with a specific estimate which so as to be can be suited inside the dividing fortification. Concurring to a think about conducted by Central building inquire about founded a filler piece with non-autoclaved cellular concrete squares can be utilized for economical development. A comparison was made between the filler chunk and routine RC chunk which demonstrates that the quality of routine chunk and filler chunk is nearly break even with and subsequently don't have any quality distortions and can be received in put of customary chunk. The filler slab technique could be a taken a toll viable strategy and spares upto 30% of concrete thus legitimizing its part as a proficient moo fetched development procedure.

Anwar Khitab (2015) The point of this term paper is to address the cutting edge development materials. Pertinent information of the advancements made amid the later past is too displayed. It is believed that nanotechnology is aiming to play a critical part within the advancement of cutting edge building materials. The developments might be two-fold; one is the adjustment of classical materials and the other ought to cover the development of novel materials. The essential objective of all such materials should be environment invitingness. Optionally, they ought to be strong and fetched compelling. Thirdly, they ought to address the space deficiency. Developments are required as man is additionally planning to colonize moon and other planets. Fourthly, they ought to have satisfactory quality to cater the characteristic and artificial calamities. In brief, they ought to serve the coming eras within the best conceivable way, which is the sole reason of a building teach.

Merry Magutu et al .This paper is based on a writing survey and an assessment of hones that have been I put Jerry Magutu et al .This paper is based on a writing survey and an assessment of hones that have been I put with regard to moo taken a toll building materials and innovations so as to lower costs and consequently make the buildings, particularly lodging for the larger part urban destitute who have scanty assets and subsequently cannot bear ordinarily built houses. The paper utilized both auxiliary information from the writing, and an observational ponder of pilot ventures that have been built in several locales of Kenya by utilizing conventional architectural research strategies associated to observational procedures within the social sciences, augmented by open-ended interviews and talks with the diverse performing artists within the backing and utilize of moo fetched materials and innovations in building.

Shruti Mutkekaretal (2015) Lodging is major issue confronted by creating nations like India. The foremost fundamental building fabric for development of lasting houses is the burnt clay brick, Cement and steel. A noteworthy amount of crude fabric and fuel is utilized in making these ordinary building materials and indeed the fabricating forms of these materials make natural issues. This paper presents ponder on feasible and low-cost elective building fabric – Flyash, having preferences on zones where ordinary building fabric for lodging is costly and unsafe to environment.

CHAPTER-3

ALTERNATIVE CONSTRUCTION MATERIALS

Growing urbanization has led to migration towards cities & resulted in an increased demand for affordable low cost housing. Low cost building materials not only increase access to permanent housing for people from low and middle income group but also contribute towards sustainability particularly . when locally available building material is used.

The materials commonly used for modern low cost construction are hollow concrete block,bamboo,extruded clay bricks, compressed earth bricks, concrete panels along with non conventionals materials like polymer and recycle composite bricks as they can reduce time by half.

1. **Bamboo:-** One of the first building material known to man along with stone and wood, bamboo is used even today in rural areas of countries in asia , Africa and latin America for building homes. It is a green building material which is very popular in India due to its low cost, low weight and durability but shuld be treated wih appropriate chemical to make it termite resisted. As India produces nearly half of the world bamboo, homes in earthquake prone areas of the country are built with bamboo. The material has better tensile strength than steel and is also fire resistance. More recently corregated sheet of bamboo have been developed and there are used for roofing.
2. **Concrete Blocks:-** Concrete blocks are fabricated according to specification home builders made by mixing OPC, water-stone or quartz their blocks can either be solid or hollow and are generally light weight, durable and fire resistant. These are used for the foundation, basement walls and partion walls as their pores can be filled with steel rods fir inhancing strength. As they are made of cement they are termite resistant, sound proof and provide natural insulation against heat and cold.
3. **Prefabricated Houses:-** These are increasily used for meeting the requiorement if permanent housing an these cost of regular bricks aand mortar homes continues to rise exponentially, these houses are made of components that are

factory manufacture and then assembled at the house site. The components includes steel frames, wooden panels, cement and gypsum for floors along with factory fabricated doors, windows , cielings and walls though these materials are 15% more expensive than traditional materials, their high level of efficiency and low labour cost bring down the overall construction expenses.

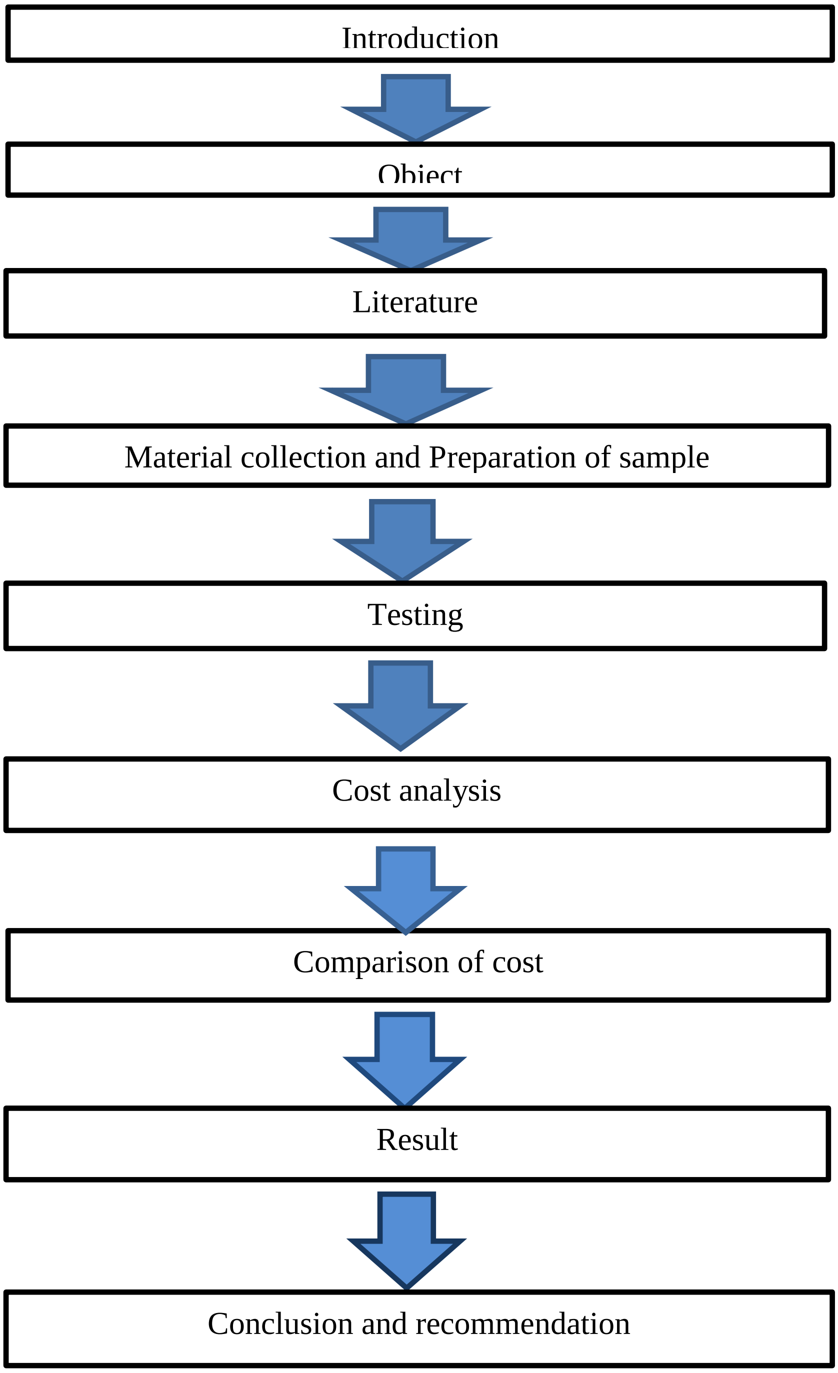
4. **Compressed earth bricks:-** These bricks are developed out of mud and reinforced with a mixture of lime and cement also known as adobe bricks, they have light weight, non- toxic and fire resistant. Compressed earth bricks are dense and generally used for exterior structural works and are considered one of the cheapest among low cost building materials.
5. **Inter-locking blocks:-** These bricks are depend with a projection on one side and a derpression on the other side that they light weight bricks of a similar types like a puzzeled to make wall. Inter locking bricks are made out of laterite stone powder, cement and gravel. They are considered green building materials when compared to baked bricks as they dry naturally and are just a sturdy.
6. **Mud brick reinforced by natural fibers from straws and coconut:-** This sustainable building material is commonly used in rural areas to make weather proof homes as they provide both strength and durability. Natural fibres like coconut and straw increses the strength and durability of pure mud while a coating of sulphur improve the water resistant and the walls. Other type of fire bricks are made with cereal straw, bagasse, corn straws and rice husk which are combined with cement to make then corrosion resistant and strong.
7. **Magnesiun oxide cement:-** It is also called an eco cement , this material is made out of several waste material but has high durability and requires only 20-40% of the energy needed for the production of OPC. It doesnot cost any harm to residents of homes where it is applied as a sustainable building material.
8. **Fly ash hollow brick**:- These bricks are used for construction load bearing wall of low rise building and are made of fly ash, stone powder or sand , slag and cement or gypsum for bonding. Some categories of fly ash bricks are also made out of menord residue, glass, water and fly ash and are energy efficient, water resistant and provide natural thermal insulation for a low cost house.

9. **Shipping containers home:-** Home made out of shipping containers and fast becoming popular exploring recyclable building material while the smallest one can make a 100sqft home. It is a cost effective as a pre-fabricated home and the container only needs to be arranged an a prepared foundation.
10. **Autoclaved aerated concrete or AAC blocks**:- It is compost of gypsum, lime ,quartz, sand , water and aluminium powder, these blocks are under heat and pressure within autoclave according to specific requirement. These blocks can be used for both exterior and interior walls and an known to be heat resistant and light weight. The material reduces energy cost as it pores and non- toxic. It is environment friendly to as it generate 30% less solid waste in comparison of traditional concrete.

CHAPTER-4

METHODLOGY

Research Methodology Flow Chart



Materials Used in Experiment

4.1 Bamboo

Bamboo as a building material has high compressive strength and low weight has been one of the most used building material as support for concrete, especially in those locations where it is found in abundance.

Bamboo as a building material is used for the construction of scaffolding, bridges and structures, houses. Due to a distinctive rhizome-dependent system, bamboos are one of the fastest-growing plants in the world and their growth is three times faster than most other species of plants. They are renewable and extremely versatile resource with multi-purpose usage. Among many uses of bamboo, Housing is one of the major areas applications especially in the wake of residential shortages around the globe.

Bamboo as a building material is conventionally associated with the region of Southeast Asia and South America where climate is best suitable for its cultivation. In many of the nations, bamboo is used to hold up suspension bridges or simply make places of dwelling.

Walls Construction with Bamboo as a Building Material

Bamboo is extensively used for construction of walls and partitions. Posts and beams are the main elements normally constructed with bamboo provide structural framework for walls. They positioned in a way to be able to withstand forces of nature. An infill is used between framing elements to add strength and stability to the walls.

Advantages of Bamboo as a Building Material

The various advantages of bamboo are as mentioned below:

1. **Tensile strength**: Bamboo has higher tensile strength than steel because its fibers run axially.

2. **Fire Resistance**: Capability of bamboo to resist fire is very high and it can withstand temperature up to 4000 C. This is due to the presence of high value of silicate acid and water.

3. **Elasticity**: Bamboo is widely preferred in earthquake prone regions due to its elastic features.

4. **Weight of bamboo**: Bamboos due to their low weight are easily displaced or installed making it very easier for transportation and construction.

5. Unlike other building materials like cement and asbestos, bamboo poses no danger to health.

6. They are cost effective and easy to use.

7. They are especially in great demand in earthquake prone areas.

Disadvantages of Bamboo

Bamboos come with their own set of drawbacks such as:

1. They require preservation

2. **Shrinkage:** Bamboo shrinks much greater than any other type of timber especially when it loses water.

3. **Durability**: Bamboo should be sufficiently treated against insect or fungus attack before being utilized for building purposes.

4. **Jointing:** Despite prevalence of various techniques of jointing, structural reliability of bamboo is questionable.

A bamboo panel of 1m x 1m

Plaster on bamboo panel (12mm)

4.2 Chicken Wire Mesh

Chicken wire, or poultry netting, is a mesh of wire commonly used to fence in fowl, such as chickens, in a run or coop. It is made of thin, flexible, galvanized steel wire with hexagonal gaps. Available in 1 inch (about 2.5 cm) diameter, 2 inch (about 5 cm) and 1/2 inch (about 1.3 cm), chicken wire is available in various gauges--usually 19 gauge (about 1 mm wire) to 22 gauge (about 0.7 mm wire). Chicken wire is occasionally used to build inexpensive pens for small animals (or to protect plants and property *from* animals) though the thinness and zinc content of galvanized wire may be inappropriate for animals prone to gnawing and will not keep out predators.

In construction, chicken wire or hardware cloth is used as a metal lath to hold cement or plaster, a process known as stuccoing. Concrete reinforced with chicken wire or hardware cloth yields ferrocement, a versatile construction material. It can also be used to make the armature for a papier-mâché sculpture, when relatively high strength is needed.

Chicken Wire mesh

4.3 Wire Mesh

As the development of the building energy efficiency and the new wall materials, the wall engineering faces kinds of problems such as, cracking and wall peeling. It has been found that the problems are due to the design, materials, construction, the base wall, the wall surface and the plaster layer. After the studying, the wall anti-cracking skill is summarized as design anti-cracking, material anti-cracking and construction anti-cracking. We have formulated some measures to solve the problems. For the material anti-cracking, we are going to use metal steel mesh, fiberglass mesh grid, chopped high performance organic fibers, elastic compound and so on.

The anti-cracking is needed for the parts between the column and the beam, and the parts on the door hole and the buried pipeline, we need welded wire mesh. The diameter of the wire is 1 mm–1.2 mm, and the mesh opening is 15 mm–20 mm. The galvanized expanded metal is also needed. The thickness both of the panel and the strand is 0.6 mm. The mesh opening is 10 mm × 20 mm. The weight is 0.56 kg/m^2.

Plastering on wire mesh

4.4 Gypsum Board

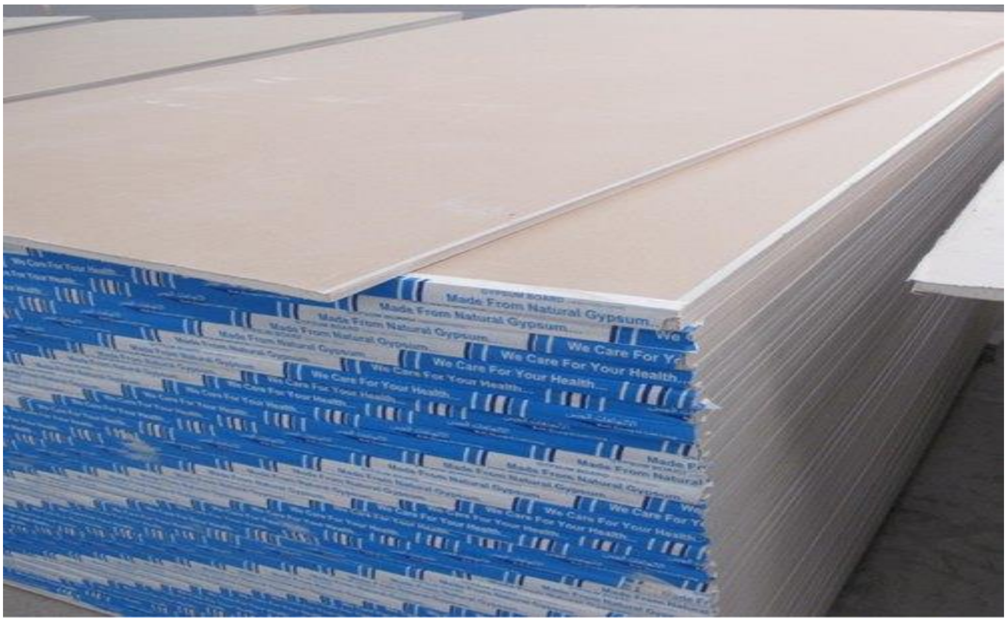
A panel made of gypsum plaster pressed between two thick sheets of paper is called gypsum board. Gypsum board is used to make interior walls and ceillings.

Types:-

- Standard gypsum board
- Gypsum board channel
- Gypsum board starch
- Gypsum ceiling boards

Advantages:-

- Fire proof
- Easy to install
- Sound isolation
- Economical
- Durable
- Versatile



4.5 Plywood

Plywood as a building material is very widely used due to its many useful properties. It is an economical, factory-produced sheet of wood with precise dimensions that does not warp or crack with changes in atmospheric moisture. Ply is an engineered wood product made from three or more 'plies' or thin sheets of wood. These are glued together to form a thicker, flat sheet. The logs used to make plywood as a building material are prepared by steaming or dipping in hot water. They are then fed into a lathe machine, which peels the log into thin plies of wood. each ply is usually between 1 and 4mm thick.

USES OF PLYWOOD AS A BUILDING MATERIAL

Plywood has a huge range of used within the construction industry. Some of its most common uses are:

- To make light partition or external walls
- To make formwork, or a mould for wet concrete
- To make furniture, especially cupboards, kitchen cabinets, and office tables
- As part of flooring systems
- For packaging
- To make light doors and shutters

CHAPTER-5

DATA ANALYSIS

S.No	Description	Unit	No.	Length	Breadth	Ht/Depth	Quantity
1.	Excavation in foundation Grid A(1-4)						
	c/c=5295mm	cum	1	6.195	0.9	0.9	5.01
	Grid 4(A to E)						
	c/c=4845mm	cum	1	3.945	0.9	0.9	3.195
	Grid 1(A to D)						
	c/c=3530mm	Cum	1	3.3	0.9	0.9	2.67
	Grid E(2-4)						
	c/c=4596	cum	1	5.496	0.9	0.9	4.44
	Grid 2(D-E)						
	c/c=1915mm	Cum	1	0.415	0.9	0.9	0.33
	Grid D(1-2)						
	c/c=699mm	Cum	1	1.599	0.9	0.9	1.29
	Grid 3(A-E)						
	c/c=4845mm	Cum	1	3.945	0.75	0.75	2.21
	Grid B(3-4)						
	c/c=2372mm	Cum	1	2.447	0.75	0.75	1.37
	Grid D(2-3)						
	c/c=2224mm	cum	1	1.399	0.75	0.75	0.786
							21.39
2.	PCC(1:5:10)					21.39x135=2887.65	
	Grid A(1-4)						
	c/c=5295mm	Cum	1	6.195	0.9	0.15	0.83
	Grid 4(A to E)						
	c/c=4845m	Cum	1	3.945	0.9	0.15	0.53
	Grid 1(A toD)						
	c/c=3530mm	Cum	1	3.3	0.9	0.15	0.44
	Grid E(2-4)						
	c/c=4596mm	Cum	1	5.49	0.9	0.15	0.74
							2.54
	Grid 2(D-E)						B/F=2.54
	c/c=1315mm	Cum	1	0.415	0.9	0.15	0.05
	Grid D (1-2)						
	c/c=699mm	Cum	1	1.599	0.9	0.15	0.21
	Grid 3(A-E)						
	c/c=4845mm	Cum	1	3.945	0.75	0.15	0.53
	Grid B(3-4)						

	c/c=2372mm	Cum	1	2.447	0.75	0.15	0.44
	Grid D(2-3)						
	c/c=699mm	Cum	1	1.399	0.75	0.15	0.15
							3.92
3.	Brickwork in foundation						
	Grade A(1-4)						3.92x4850=19012
	c/c=5295mm						
	1^{st} footing	Cum	1	5.985	0.69	0.15	0.62
	2^{nd} footing	Cum	1	5.878	0.575	0.15	0.50
	3^{rd} footing	Cum	1	5.755	0.46	0.15	0.39
	4^{th} footing	Cum	1	5.64	0.345	0.15	0.29
	Upto PB bottom	Cum	1	5.525	0.23	0.525	0.67
	Grid 4(A-E)						
	c/c=4845 1^{st} footing	Cum	1	4.155	0.69	0.15	0.43
	2^{nd} footing	Cum	1	4.27	0.575	0.15	0.37
	3^{rd} footing	Cum	1	4.385	0.46	0.15	0.30
	4^{th} footing	Cum	1	4.505	0.345	0.15	0.23
	Upto PB bottom	Cum	1	4.615	0.23	0.525	0.55
							4.35
	Grid 1(A-D)						B/F=4.35
	c/c=3530mm						
	1^{st} footing	Cum	1	0.284	0.69	0.15	0.29
	2^{nd} footing	Cum	1	2.955	0.575	0.15	0.25
	3^{rd} footing	Cum	1	3.07	0.460	0.15	0.21
	4^{th} footing	Cum	1	3.185	0.345	0.15	0.16
	Upto PB bottom	Cum	1	3.30	0.23	0.525	0.40
	Grid E(2-4)						
	c/c=4596mm						
		Cum	1	5.286	0.69	0.15	0.54
		Cum	1	5.171	0.575	0.15	0.44
		Cum	1	5.056	0.46	0.15	0.35
		Cum	1	4.941	0.345	0.15	0.26
		Cum	1	4.826	0.23	0.526	0.58
	Grid 2 (D-E)						
	c/c=1315mm						
		Cum	1	0.625	0.69	0.15	0.06
		Cum	1	0.74	0.575	0.15	0.06
		Cum	1	0.855	0.46	0.15	0.06
		Cum	1	0.97	0.345	0.15	0.05
		Cum	1	1.085	0.23	0.525	0.13
	Grid D(1-2)						
	c/c=699mm						
		Cum	1	1.389	0.69	0.15	0.14
		Cum	1	1.274	0.575	0.15	0.11

		Cum	1	1.159	0.46	0.15	0.08
		Cum	1	1.044	0.345	0.15	0.05
		Cum	1	0.929	0.23	0.525	0.11
							8.69
	Grid 3(A-6)						**B/F=8.69**
	c/c=4845mm	Cum	1	4.27	0.575	0.15	0.36
		Cum	1	4.385	0.46	0.15	0.30
		Cum	1	4.5	0.345	0.15	0.23
		Cum	1	4.615	0.23	0.525	0.55
	Grid B(3-4)						
	c/c=2372mm	Cum	1	1.797	0.575	0.15	0.15
		Cum	1	1.912	0.46	0.15	0.13
		Cum	1	2.027	0.345	0.15	0.104
		Cum	1	2.142	0.23	0.525	0.26
	Grid D(2-3)						
	c/c=2224mm	Cum	1	1.649	0.575	0.15	0.14
		Cum	1	1.764	0.460	0.15	0.12
		Cum	1	1.879	0.345	0.15	0.09
		Cum	1	1.994	0.23	0.525	0.24
							11.35
4.	RCC in PB(1:1.5:3)						11.35x50x50=57318
	Grid A(1-4)			5.525	0.23	0.075	0.095
	Grid E(2-4)			4.826	0.23	0.075	0.08
	Grid 4 (A-E)			4.615	0.23	0.075	0.08
	Grid 1(A-D)			3.30	0.23	0.075	0.06
	Grid D(1-2)			0.929	0.23	0.075	0.016
	Grid 2(D-E)			1.085	0.23	0.075	0.018
	Grid 3(A-E)			4.615	0.115	0.075	0.04
	Grid B(3-4)			2.2	0.115	0.075	0.01
	Grid D(2-4)			2.05	0.115	0.075	0.017
							0.42
5.	B/W in superstructure 230mm						
	c/c=5295mm	Cum	1	5.525	0.23	2.7	3.43
	Grid E(2-4)						
	c/c=4596mm	Cum	1	4.826	0.23	2.7	3.0
	Grid 4(A-E)						
	c/c=4845mm	Cum	1	4.615	0.23	2.7	2.86
	Grid 1(A-D)						
	c/c=3530mm	Cum	1	3.3	0.23	2.7	2.05
	Grid D(1-2)						
	c/c=699mm	Cum	1	0.925	0.23	2.7	0.57
	Grid 2(B-E)						
	c/c=1315mm	Cum	1	1.085	0.23	2.7	0.67
	Deduction						

	W_1(0.9x 1.2)	Cum	1	0.9	0.23	1.2	-.024
	V(0.6 x 0.3)	Cum	1	0.6	0.23	0.2	-0.04
	W_2(0.9 x 1.05)	Cum	1	0.9	0.23	1.05	-0.21
	W(1.5 x 1.2)	Cum	1	1.5	0.23	1.2	-0.414
	D_1(0.9 x 2.1)	Cum	1	0.9	0.23	0.1	-0.49
							11.23
6.	Half b/w in superstructure						11.23 x 5450=61204
	Grid 3 (A-E)						
	c/c=4845mm	Sqm	1	4.845		2.7	13.15
	Grid B (3-4)						
	c/c=2372mm	Sqm	1	2.142		2.7	5.78
	Grid D(2-3)						
	c/c=2224mm	Sqm	1	1.994		2.7	5.38
							24.26
	Deduction						
	D_1	Sqm	1	0.9		2.1	-1.89
	D_2 (2 nos)	Sqm	2	0.75		2.1	-3.15
							19.20
7.	Ceiling plaster(6mm)	Sqm	1	3.3	2.75		9.075
		Sqm	1	1.5	2.2		3.3
		Sqm	1	3	2.2		6.6
		Sqm	1	1.2	2.05		2.46
							21.44
8.	Plaster on wall(6mm)						21.44 x 145=3109
	Room 1	Sqm	1	2(3.3 +2.75)2.7			32.67
	Grid1 (A-D) Kitchen	Sqm	1	2(1.5 +2.2)2.7			19.98
	Grid A(1-3) WC	Sqm	1	2(1.2 +2.05)2.7			17.55
	Grid 3(A-D) Room 2	Sqm	1	2(3 +2.2)2.7			28.08
							98.25
	Deduction						
	Grid 3(A-E) W_1	Sqm	1	0.9	1.2		-1.08
	Grid 4(A-B) V	Sqm	1	0.9	2.1		-1.89
	Grid 4(B-E) D_2	Sqm	2x2	0.75	2.1		-6.3
	Grid A(3-4) D_1	Sqm	2x2	0.9	2.1		-7.56
	Grid B (3-4) W	Sqm	1	1.5	1.2		-1.8
	Grid E (3-4) W_2	Sqm	1	0.9	1.05		-0.945
							78.72
						78.7x180=14166	
9	External Plaster (12mm)						
		Sqm	1	5.525	2.875		15.88
		Sqm	1	5.075	2.875		14.6
		Sqm	1	5.525	2.875		15.88
		Sqm	1	5.075	2.875		14.6
	Deduction						

	W_1			0.9	1.2		-1.08
	V			0.6	0.3		-0.18
	W			1.5	1.2		-1.8
	W_2			0.9	1.05		-0.945
							56.9
						56.9x160=9104	
10	Internal Plaster on Wall	Sqm					78.72
11	Internal plaster on ceiling	Sqm					21.44
12	External plaster on walls	Sqm					56.9
13	Sand filling in floor	Cum	1	21.44x0.15			31216
14	PCC (1:5:10) in floor	Cum	1	21.44x0.075			1.61
15	CC (25mm) in floor	Cum	1	21.44x0.025			0.536
16	Plaster on parapet wall(12mm)						
		Cum	2	5.525	0.075		0.82
		Cum	2	4.615	0.075		0.69
							1.51
17	Shuttering in PB						
	Room 1	Sqm	1	2(3.3+2.75)0.075			0.90
	Room 2	Sqm	1	2(3+2.2)0.075			0.78
	Kitchen	Sqm	1	2(1.5+2.2)0.075			0.56
	WC	Sqm	1	2(1.2+2.05)0.075			0.48
	Shutter in LB						
	Room 1	Sqm	1	2(3.3+2.75)0.15			1.8
	Room 2	Sqm	1	2(3+2.2)0.15			1.56
	Kitchen	Sqm	1	2(1.5+2.2)1.50			1.11
	WC	Sqm	1	2(1.2+2.05)1.5			0.975
	Ceiling shutter	Sqm	1				21.44
	Shutter in beam	Sqm	2x1	4.615	0.12		0.55
	Shutter in door & window	Sqm	1	4.615	0.115		0.53
	Bottom	Sqm	1	2(5.075+5.525)1.5			3.18
		Sqm	1	2(5.075+5.525)0.11			2.33
							B/F=36
	Shutter of bottom in LB						
	D_1	Sqm	1	0.9	0.23		0.20
	V	Sqm	1	0.3	0.23		0.07
	W_1	Sqm	1	1.2	0.23		1.43
	W_2	Sqm	1	1.05	0.23		0.24
	D_1	Sqm	1	0.9	0.115		0.1
	D_2	Sqm	1	0.75	0.23		0.17
	D_2	Sqm	1	0.75	0.115		0.08
	W	Sqm	1	1.5	0.23		0.345
	Chajja						
	W_1	Sqm	1	1.43	0.6		0.86
		Sqm	1	1.63	0.075		0.12

	V	Sqm	1	0.53	0.6		0.32
		Sqm	1	1.23	0.075		0.09
		Sqm	1	4.50	0.6		2.7
		Sqm	1	5.7	0.075		0.43
						43.16+1.58=45	
	RCC in slab						
		Cum	1	5.075	5.525	0.11	3.1
	Deduction	Cum	1	0.699	1.315	0.11	-0.10
							3
	RCC in Chajja	Cum	1	1.43	0.6	0.075	0.06
		Cum	1	0.53	0.6	0.075	0.02
		Cum	1	4.50	0.6	0.075	0.20
							0.28

Data analysis of panel 2(Framed Structure)

S.No	Description	Unit	No.	Length	Breadth	Ht/Dt	Quantity
1.	Excavation in foundation						
	F1(1000x1000)	Cum	10	1.0	1.0	0.9	
	F2(900x900)	Cum	02	0.9	0.9	0.9	
2.	PCC(1:5:10) in foundation						
	F1(1000x1000)	Cum	10	1.0	1.0	0.1	
	F2(900x900)	Cum	02	0.9	0.9	0.1	
3.	RCC in PB(Plinth Beam)						
	230mm thick wall	Cum	5.525	0.23	0.23		
		Cum	3.242	0.23	0.23		
		Cum	0.929	0.23	0.23		
		Cum	1.085	0.23	0.23		
		Cum	4.826	0.23	0.23		
		Cum	4.845	0.23	0.23		
	115mm thick wall	Cum	4.845	0.23	0.23		
		Cum	2.026	0.23	0.23		
		Cum	2.052	0.25	0.25		
4.	Shuttering in PB						1.52
		Sqm	5.520	0.23			1.2
		Sqm	5.525		0.23		1.27
		Sqm	30242	0.23			0.74
		Sqm	3.242		0.23		0.74
		Sqm	4.845	0.23			1.1

		Sqm	4.845		0.23		1.1
		Sqm	4.826	0.23			1.1
		Sqm	4.826		0.23		1.1
		Sqm	0.929	0.23			0.21
		Sqm	0.929		0.23		0.21
		Sqm	1.315	0.23			0.3
		Sqm	1.315		0.23		0.9
		Sqm	2.028	0.23			0.46
		Sqm	2.028	0.23			0.46
		Sqm	2.08		0.23		0.46
		Sqm	2x1	4.845	0.23		1.1
		Sqm	1x1	4.845		0.23	1.1
		Sqm	2x1	1.994	0.23		0.87
		Sqm	1x1			0.23	0.23
		Sqm	1x1	3.2	0.23		0.76
		Sqm	1x1	2.75	0.23		0.63
		Sqm	1x1	1.5	0.23		0.345
		Sqm	1x1	2.2	0.23		0.506
		Sqm	1x1	2.2	0.23		0.506
		Sqm	1x1	3.3	0.23		0.76
		Sqm	1x1	1.2	0.23		0.28
		Sqm		2.05	0.23		0.47
	Reinforcement in RM						
	RCC in footing	Cum	10x1	0.9	0.9	0.45	3.645
		Cum	2x1	0.75	0.75	0.45	0.506
	Shutterig in footing	Sqm	10x1	2(0.9+0.9)0.45			16.2
			2x1	2(0.75+0.75)0.45			2.7
							18.9
	Reinforcement in footing						
	RCC in column	Cum	10x1	0.23	0.23	3.71	1.96
		Cum	2x1	0.23	0.23	3.71	0.39
							2.35
	Shuttering	Sqm	10x1	(0.23+0.23)2x3.6			33.12
		Sqm	2x1	(0.23+0.23)2x3.6			6.62
							39.72
	Reinforcement in column						
	RCC in grade Steel	Cum	1x1	5.075	5.525	0.1	2.8
	Deduction	Cum	1x1	0.699	1.315	0.1	0.09
							2.71
	Reinforcement in grade steel						

	Shuttering at edges	Sqm	1x1	(5.075+5.525)2x0.1			2.2

CHAPTER-6

RATE ANALYSIS

1. AAC Block

S.No	Description	Unit	Quantity	Rate	Amount
1	AAC Block	Sqmt	1	805	805

2. Bamboo + chicken mesh + plaster

S.No	Description	Unit	Quantity	Rate	Amount
1	Bamboo	Sqmt	1	326	326
2	Chicken mesh	Sqmt	2	65.2	130
3	Plaster	Sqmt	2	200	400
				Total	956

3. Wire mesh +chicken mesh + plaster

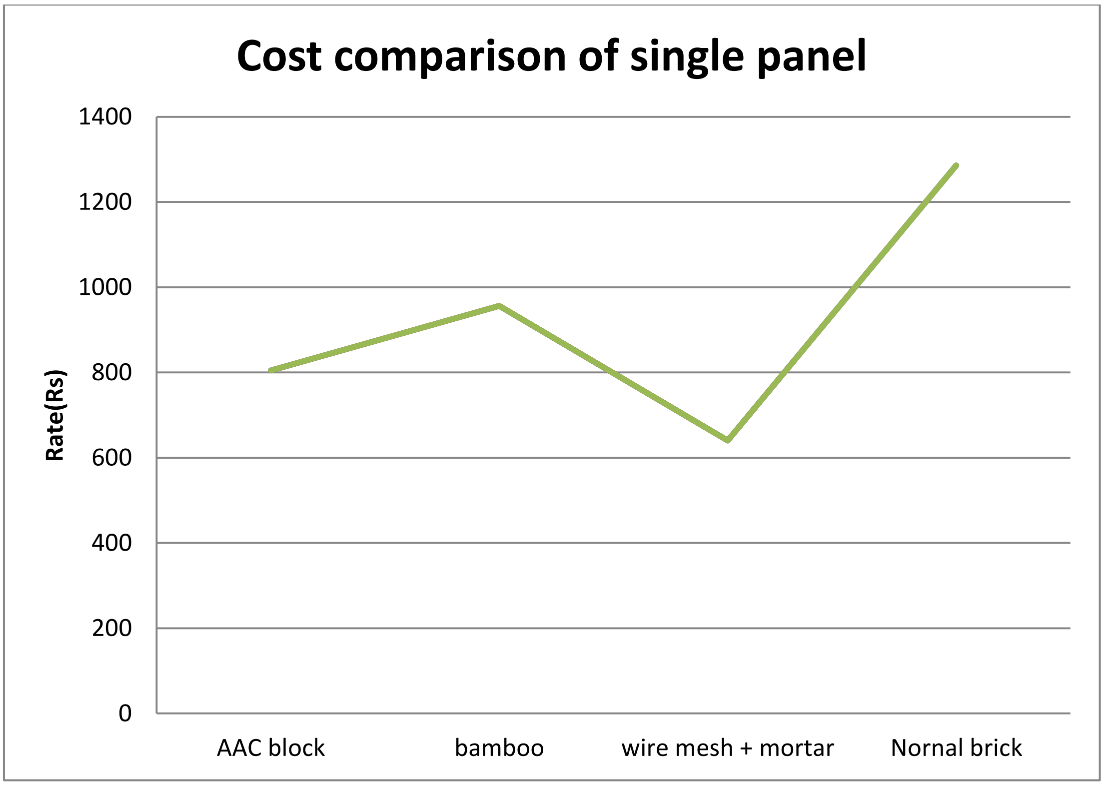
S.No	Description	Unit	Quantity	Rate	Amount
1	Wire mesh	Sqmt	1	110	110
2	Chicken mesh	Sqmt	2	65	130
3	Plaster	Sqmt	2	200	400
				Total	640

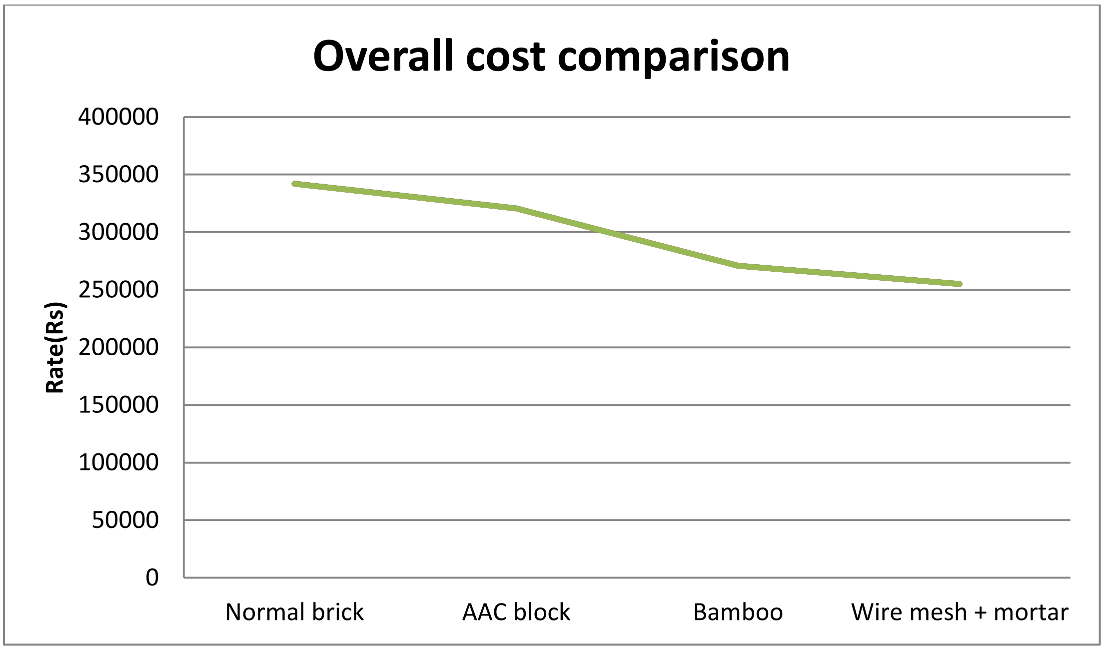
4. Traditional brickwork

S.No	Description	Unit	Quantity	Rate	Amount
1	Brick	Sqmt	1	1286	1286

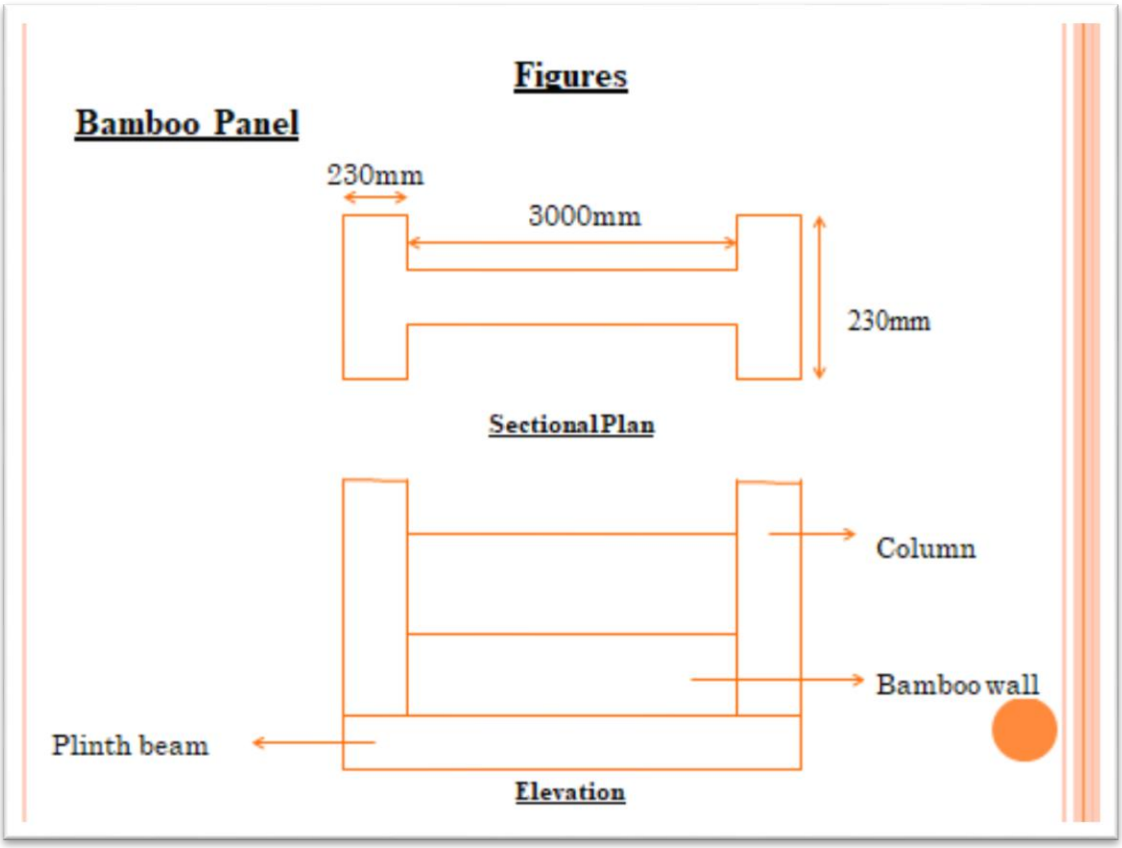
Cost Comparison

S.No	Description	Unit	Quantity	Rate	Amount
1	AAC block	Sqmt	1	805	805
2	Panel of bamboo	Sqmt	1	591.2	956
3	Panel of wire mesh	Sqmt	1	375	640
4	Normal brick	Sqmt	1	1286	1286





Overall cost comparison
Rate(Rs)
400000
350000
300000
250000
200000
150000
100000
50000
0
Normal brick
AAC block
Bamboo
Wire mesh + mortar



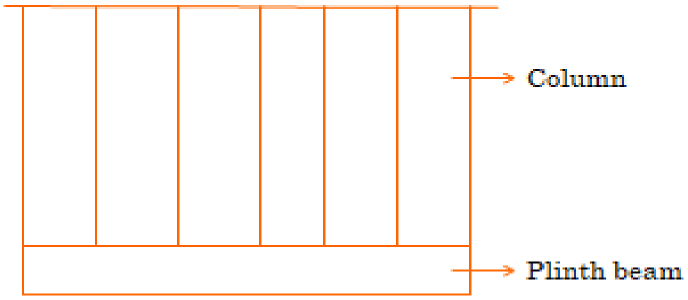
Figures
Bamboo Panel
230mm
3000mm
230mm
SectionalPlan
Column
Bamboo wall
Plinth beam
Elevation

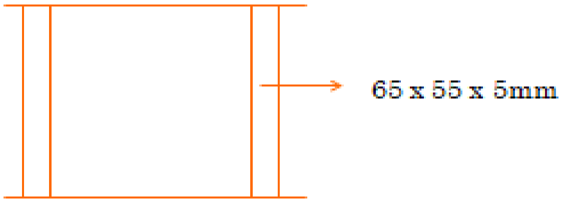
Chicken mesh + Wire mesh + Plaster panel

Sectional Plan

Elevation

Window jali + mortar

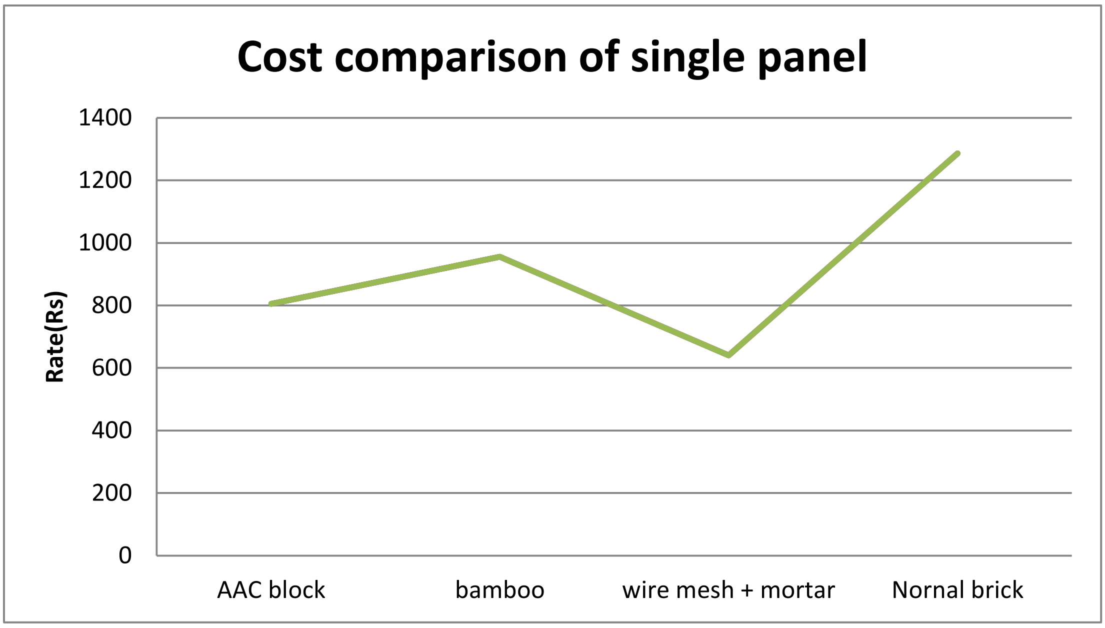


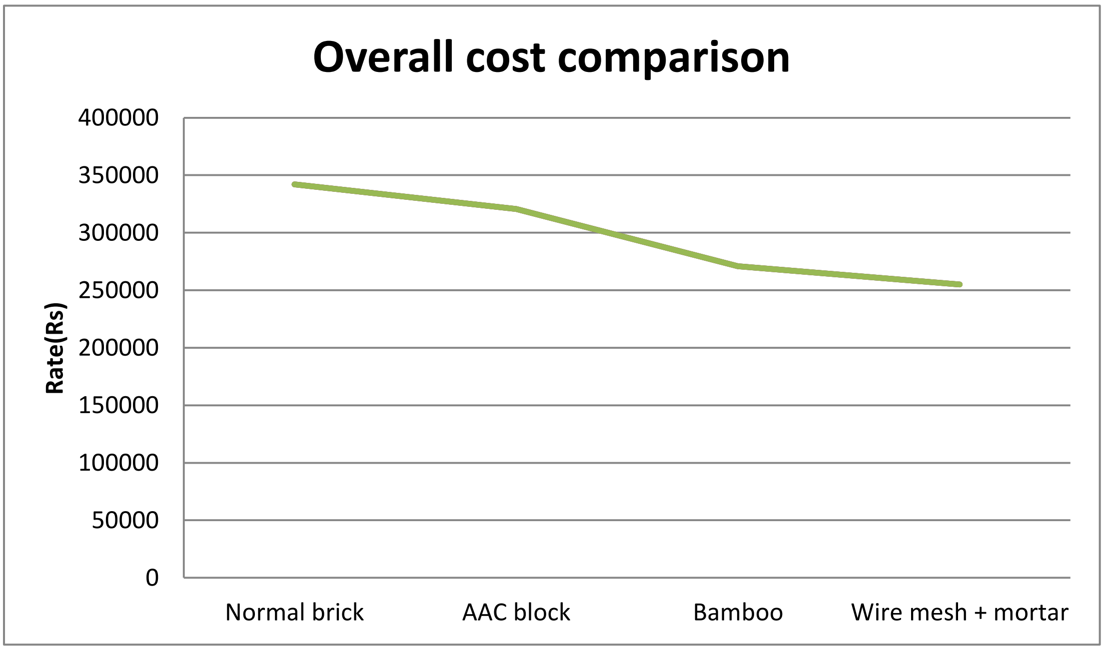


CHAPTER-7

7.1 RESULT

The result of the research can be well defined by reading the graph. In this graph it is clear that when we can use RCC Panels in place of walls made up of normal bricks for the economic construction.





7.2 CONCLUSION & RECOMMENDATION

After a detail research the following conclusion and recommendation are listed below.

1. The cost of construction of affordable house is found to be economical by using RCC panels having window jail, chicken mesh and 1:4 cement mortar.
2. The cost of house is also found economical in compare to house made up of Normal bricks when we use bamboo panel in place of wall made up of bricks.
3. Therefore it can be recommended that we can use RCC panels in place of walls made up of normal bricks.
4. Also we can use the walls made up of bamboo panels in place of normal bricks walls by making the bamboo termite proof and fire resistant and covering all the edges of the panels by angle iron.

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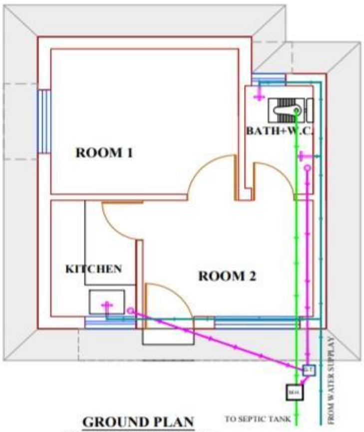
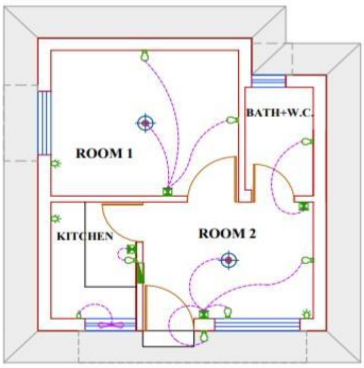
APPENDIX
PLAN



GROUND PLAN
(PULMBING & SANITARY)

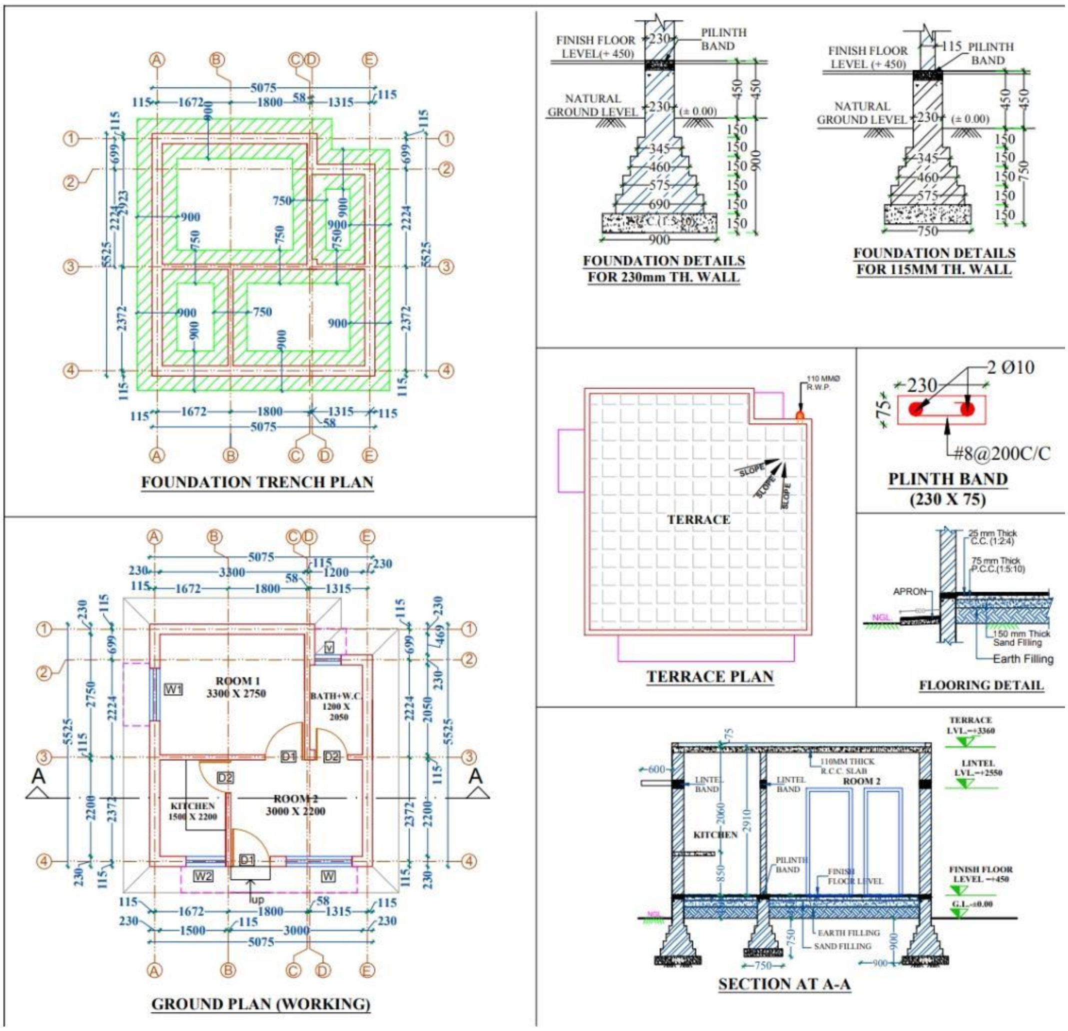
LEGEND (PULMBING & SANITARY)		
S.N.	SYMBOL	DESCRIPTION
1.		TAP
2.		FLOOR TRAP
3.	M.H.	MAIN HOLE
4.	G.T.	GULLY TRAP
5.		75 Ø WASTE WATER PIPE
6.		100 Ø SOIL WATER PIPE
7.		15MM Ø WATER SUPPLY PIPE
8.		100 Ø RAIN WATER PIPE
9.		SINK
10.		INDIAN TYPE ORISSA PATTERN WHITH LOW LEVEL CISTERN 10 LT. CAP.

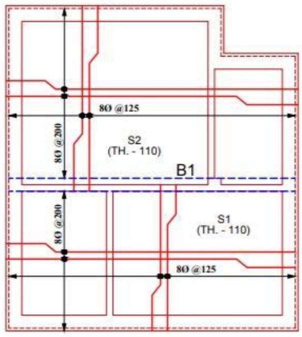


GROUND PLAN
(ELECTRICAL)

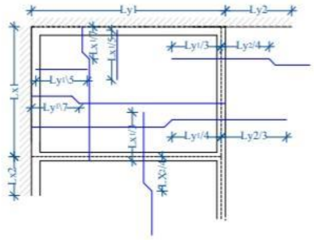
Electrical Facility Provided in the Model			
S.NO.	LOCATION	PROVIDED	NOS.
1.	ROOM-1	Fan Point	1
		Light Point	2
		Power Point 15/16 Amp	1
		Switch Socket	1
2.	ROOM-2	Fan Point	1
		Light Point	3
		Power Point 15/16 Amp	1
		Switch Socket	2
2.	KITCHEN	Exaust Fan Point	1
		Light Point	1
		Power Point 15/16 Amp	1
		Switch Socket	1
3.	BATH+W.C.	Light Point	1

LEGEND & ABBREVIATIONS (ELECTRICAL) -				
SYMBOL	DESCRIPTION	NAME	POSITION	QTY.
	SWITCH BOARD WITH 5 Amp. POWER PLUG	S.B.	1200	1
	POINT (5/6 AMP.)	P.	2500	1
	POWER POINT (15/16 AMP.)	P.P.	450	1
	BRACKET LIGHT	B.L.	2400	2
	EXHAUST FAN POINT	E.F.	WIN/VENT.	1
	CEILING FAN POINT	C.F.	–	2
	DISTRIBUTION BOARD	D.B.	1200	
	INDICATES CONTROLLING OF LIGHT/FAN FROM SWITCH BOARD			

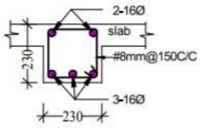

FOUNDATION TRENCH PLAN
FOUNDATION DETAILS FOR 230mm TH. WALL
FOUNDATION DETAILS FOR 115MM TH. WALL
FINISH FLOOR LEVEL(+ 450)
PILINTH BAND
NATURAL GROUND LEVEL
TERRACE
TERRACE PLAN
PLINTH BAND (230 X 75)
2 Ø10
#8@200C/C
FLOORING DETAIL
25 mm Thick C.C. (1:2:4)
75 mm Thick P.C.C.(1:5:10)
APRON
150 mm Thick Sand Filling
Earth Filling
GROUND PLAN (WORKING)
ROOM 1 3300 X 2750
BATH+W.C. 1200 X 2050
KITCHEN 1500 X 2200
ROOM 2 3000 X 2200
SECTION AT A-A
110MM THICK R.C.C. SLAB
TERRACE LVL.=+3360
LINTEL LVL.=+2550
FINISH FLOOR LEVEL =+450
G.L.=±0.00
EARTH FILLING
SAND FILLING



REINFORCEMENT DETAILS OF
SLAB AT FIRST FLOOR LEVEL
THICKNESS OF SLAB =110 M.M.

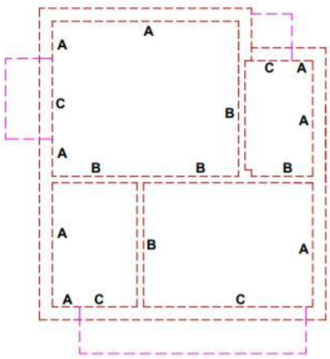


DETAILING OF BARS (TYPICAL)
FOR TWO WAY SLAB

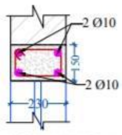


BEAM - B1
(230X230)

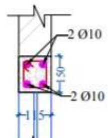
SCHEDULE OF SLAB ON FIRST FLOOR LEVEL				
ROOF TERRACE SLAB				
SLAB.	DEPTH	SHORT SPAN	LONG SPAN	TYPE OF SLAB
		(DIA)(SPACING)	(DIA)(SPACING)	
S1.	110 MM	8Ø@125	8Ø@200	TWO WAY
S2.	110 MM	8Ø@125	8Ø@200	



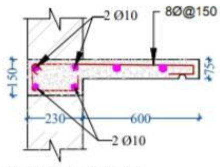
PLAN OF R.C.C BAND & CHAJJA
AT LINTEL LEVEL



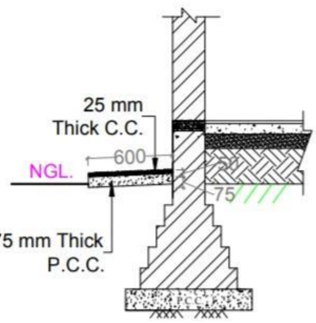
R.C.C BAND AT (A)
LINTEL LEVEL
(230 X 150)



R.C.C BAND AT (B)
LINTEL LEVEL
(115 X 150)



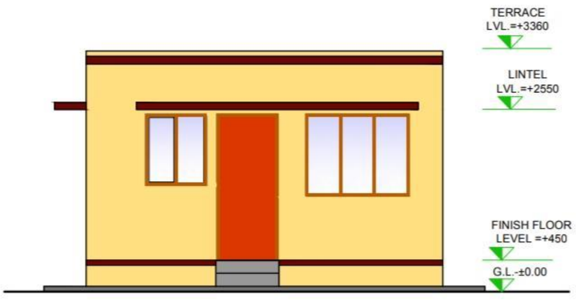
DETAIL OF CHAJJA (C)
AT LINTEL LVL.



APRON DETAIL

SCHEDULE OF DOORS, WINDOWS & VENTILATOR FOR MODEL (LOAD BEARING STRUCTURE)

DESCRIPTION	NO.'S	WIDTH	HEIGHT	FRAME	SPECIFICATION
DOOR -D1 (ONE LEAF)	2 NO.'S	900	2100	M.S.E.A. 35x35x5 @2.6 Kg/m	32mmCOMMERCIAL FLUSH DOOR
DOOR -D2 (ONE LEAF)	2 NO.S	750	2100	M.S.E.A. 35x35x5 @2.6 Kg/m	32mmCOMMERCIAL FLUSH DOOR
WINDOW -W (TWO LEAF)	1 NO.'S	1500	1200	Z-SECTION @1.33Kg/m	GLAZED OPENABLE
WINDOW -W1 (TWO LEAF)	1 NO.'S	900	1200	Z-SECTION @1.33Kg/m	GLAZED OPENABLE
WINDOW -W2 (TWO LEAF)	1 NO.'S	900	1050	Z-SECTION @1.33 Kg/m	GLAZED OPENABLE
VENTILATOR -V (ONE LEAF)	1 NO.'S	600	300	Z-SECTION @1.33 Kg/m	GLAZED OPENABLE



FRONT ELEVATION

PERSPECTIVE VIEW