A STUDY ON SUSTAINABLE AND COST EFFECTIVE BUILDING CONSTRUCTION IN HOUSING SECTOR

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***Abstract:** This project deals with the study of cost effective construction materials and technologies in rural sector. The basic need of everyone in this world is shelter, but not everyone has the sufficient finance to construct their dream home and have some limitations. Now a days the increase in the cost of construction materials is a great issue that we face in our society, that is due to the scarcity of natural resources. India is a developing country so various constructions are taking place in our country day by day. And also various researches are now conducted in several places to reduce the cost of building construction. While constructing a building we must aware about the safety of the environment by promoting more eco-friendly construction in our world. Through this we can maintain sustainability. We humans all are highly depend on non renewable energy resources for various constructions, so natural resources become vanished and cost and demand of materials increases as a result . There should be an end in the increase in the cost of construction field and keep sustainability. The main aim of this project is to reduce the cost of building construction in a housing sector by adopting innovative materials and techniques. By using this innovative ideas we can make a great contribution in the construction industry.*

The methods of the project work are done by the data collection from the selected jurisdiction, area studying, preparation of cost effective plan, comparison of cost effective building materials and techniques, inventory of cost effective building materials and testing , interviews with LIFE beneficiaries, discussion with the concerned legal authorities , review of case studies and the study about the relevant provisions given in LIFE requirements.

Keywords: Low cost construction,LIFE mission,sustainability,low cost construction materials and techniques

I. INTRODUCTION

A small home of his own to live in is the cherished dream of every man in every country whether he is a daily laborer, a small farmer, a low paid employee in public or government sector or other service or a petty merchant, more often his dreams remains unfulfilled. This is mainly because of the price hike in the building material and construction methods and it is also because of the insane craze for the so called new fashion in the house building which the large majority of our engineers are advocating and persuading their clientele to adopt. Very often the poor householder is at the mercy of the "all knowing engineers" and he cannot or dare not have his way as to what sort of house he really wants, it has been recognized that the responsibility for providing shelter to homeless people rests with the government in a great measure.

The consequence of failure to find an adequate solution to this gigantic problem of housing for homeless will be too disastrous to contemplate. Despite the laurels of euphoria of successful social support and security strategy, the problems of minority and under privileged sections in particularly those of who remain outside the main stream tendencies of development remain unchanged. Huge amount of money have been spent in the form of grant and subsidy to help the Economically Weaker Sections(EWS) to own a habitable building, but scientific studies on the suitability and acceptability of public housing schemes clearly indicate that partial financial assistance did not help the target group to satisfy their dwelling needs. Unavailability of suitable building technology. low cost building material and poor beneficiary participation in the building process are reported to be the major constraining factors. It has been pointed out that (a) the technology is often unavailable. (b)even if the technology is available, it

is neither affordable nor acceptable to EWS in this context, it is imperative to have an evaluation of the mass housing schemes for understanding about the technology suitable for the specificities of Kerala for meaningful public intervention in the housing sector.

Under shri. Pinarayi Vijayan, The Honourable Chief Minister of Kerala State , the Govt. of Kerala has initiated a newly framed sustainable project named mission LIFE(Livelihood Inclusion and Financial Empowerment)which helps in reducing the unemployment and providing dwellings for the underprivileged sections of the state.

1.2 SCOPE

In association with a welfare and development project called**"LIF MISSION"** undertaken by the Govt.of Kerala, a housing project is to be done at the Sooranad Village in Kollam district.

Baselios Mathews ll College Of Engineering being a partner of the "LIFE MISSION PROJECT" aims at providing technical assistance to the housing scheme and skills development initiatives which they have designed for the under privilaged sections of Sooranad Village. This project aims at finding the most cost effective, sustainable and environment friendly construction technology for the housing and incorporating the skill development program as a part of the construction activities within the restricted allocation of funding from the Government of Kerala. The scope of the project includes the following,

- A study on available literature concerned with the topic
- Site visit and preliminary investigation
- Functional planning according to KBR
- Estimation and preparation of abstract
- Scheduling and costing

SCOPE OF PMAY AND LIFE MISSION IN THIS PROJECT

"LIFE MISSION" is the mission taken forward by the Government of Kerala under the leadership of shri. Pinarayi Vijayan, The Hon'ble Chief Ministry of Kerala.

The mission aims at providing shelter for homeless and landless people and also to enhance the livelihood of poorer sections across the State of Kerala within the next five years. The beneficiaries were selected through proper surveys conducted using the government missionaries and system.

PRADHAN MANTRI AWAS YOJANA(PMAY)is an initiative by Government of India in which affordable housing will be provided to the urban poor with a target of building 20 million affordable houses by 31 march 2022. It has two components: **PradhanMantri Awas Yojana (urban)(PMAY-U)** for the urban poor and **Pradhan MantriAwas Yojana (Gramin)(PMAY-G** and also **PMAY-R)**for the rural poor This scheme is converged with other schemes to ensure houses have a toilet, Saubhagya Yojana electricity connection, Ujjwala Yojana LPG gas connection,access to drinking water and Jan Dhan banking facilities, etc.

cumulative total number of funded houses approved thus far is 39,25,240 in urban area including the construction of 5 million rural houses by march 2018 and 10 million rural houses by march 2019.

2.LITERATURE REVIEW

Vivian et al (2000) explained that adequate shelter for all people is one of the pressing challenges faced by the developing countries. India is currently facing a shortage of about 17.6 million houses. The dream of owning a house particularly for low – income and middle income facilities is becoming a difficult reality. Hence it has become a necessity to adopt cost effective, innovative and environment- friendly housing technologies for the construction of houses and buildings for enabling the common people to construct houses at affordable cost. This paper compares construction cost for the traditional and low cost housing technologies. Case studies in India are used for the investigation. construction methods of foundation, walling, roofing and lintel are compared. Strength and durability of the structure, stability, safety and mental satisfaction are factors that assume top priority during cost reduction. It is found that about 26.11%and 22.66%of the construction cost can be saved by using low cost housing technologies in comparison with the traditional construction methods in the case studies for walling and roofing respectively. This proves that using low cost housing technologies is a cost effective construction approach for the industry.

TheMethods of Using Low Cost Housing Techniques in India(2017) Explained that low cost housing refers to those housing units which are affordable by that section of society whose income is below than median household income. This depends on three key parameters—income level, size of dwelling unit and affordability. This paper aims to point out the various aspects of predestined building methodologies by highlighting the different available techniques, and the economical advantages achieved by its adoption. In a building the walls, floors and roofs are the most important sections, which can be analyzed distinctively based on the needs, thus, improving the speed of construction and reducing the construction cost. This paper also aims to cover the use of local materials in the different components of building to make them as low cost available solutions for low income groups.

3. PRESENT SITUATION

A shelter is a basic architectural structure or building that provides protection from the local environment. Having a place of shelter,of safety and of retreat is commonly considered a fundamental pshycological human need,the foundation from which to develop higher human motivations.

Fundementally this project can be linked with PMAY and LIFE scheme. As a part of this to know more about the constructions under PMAY,site study should be conducted. From that we can understand that majority of the houses are incomplete due to several reasons. Consequently they cannot find a better shelter for their accomodation. The incomplete house constructed under PMAY scheme is shown in the figure given below.

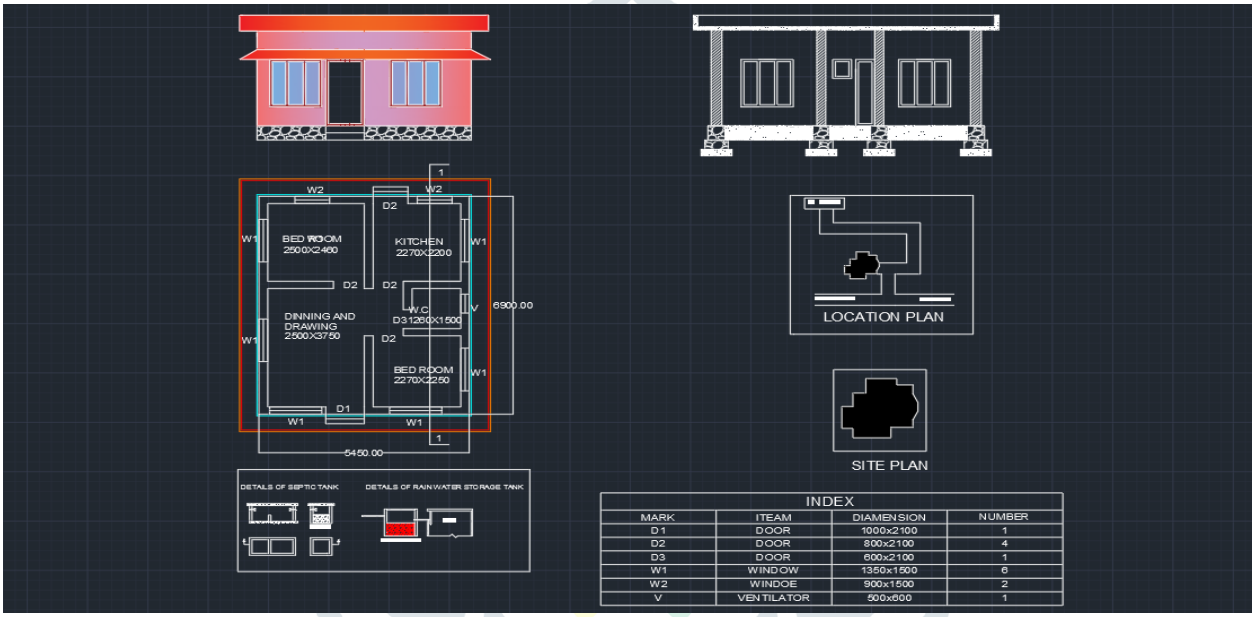
Fig 3.1 Present situation of PMAY and LIFE MISSION homes

(i) REASONS BEHIND THIS SITUATION

Cost of construction tends to increase substantially after the construction of the basement and reaches high during the construction. The labour as well as the material costs of interior and exterior plastering are high. Lack of fund availability from the government sector,increase in the cost of material due to scarcity of natural materials,lack of labour availability,increase in labour cost, less awareness about the innovative low cost building materials and technologies are the major reason behind the incomplete housing constructions under PMAY and LIFE MISSION.

4. FUNCTIONAL PLANNING

The plan of the building was drawn taking into consideration the minimum requirements of the client according to KBR, the requirements of the client include two bed rooms,a living and dinning room,kitchen and toilet.The plan is drawn in such a way that there is a safe transfer of loads and the wall lies in the same line whichmakes the plan simple and elegant.



5. DESIGN OF STRUCTURAL MEMBERS

In the design of funicular shells structure, the aim is to provide a safe, serviceable, durable,ecnomical and aesthetically pleasing structure. For the structure to be safe it must be able to resist the wrost loading condition. Under the normal working conditions the deformation and cracking must not be excessive for the structure to be serviceable, durable,and aesthetically pleasing during the extended design life. Furthermore, the structure should be ecnomical with regard to both construction and maintanance cost. We use limit state method for designing the elements.

5.1 BRIEF DISCUSSION OF IS CODE USED

Various leading nations have formulated their own national codes which lay down the guidelines for the design as well as construction of structure in their countries. These codes have evolved from a collective wisdom of structural engineers gained over the years and are still evolving. Building codes are developed, changed and enforced for one main reason-safety.

THE VARIOUS CODES ARE USED IN THIS PROJECT ARE LISTED BELOW

1. IS:456 2000 Indian Standard- "Plain and reinforced concrete"- "Plain and reinforced concrete-Code of practice", Bureau of Indian Standards(BIS) ,2000,New Delhi.

2. IS;875(part 1)-1987 "Indian Standards code of practice for design loads for building and structures", Bureau of Indian Standards(BIS) ,2000,New Delhi.

3. IS;875(part ll)-1987 "Indian Standards code of practice for design loads for building and structures", Bureau of Indian Standards(BIS) ,2000,New Delhi.

5.2 LOAD CALCULATIONS

GENERAL DATA

Grade of beams, M20 :20N/mm^2

Density of concrete :25N/mm^2

(i)LOADS

Dead load-IS 875(part 1)

Dead load is the self weight of the funicular shell, beams and walls, it could be the weight of the material or any other components in the structure that will remain permanant throughout the life of structure. Dead load has to be considered in order to make the structural design accordingly. The dead loads vary from structure to structure as every building is unique and has different considerations. Hence for a building the dead load includes the weight of the funicular shell, beam and walls.

(ii)Live load IS 875(part ll)

The live loads are imposed loads on a building by use and are considered as movable or temporary which includes people, furniture and movable equipments. The minimum live load specified in the code is determined from studying the history of their effects on existing structure. Usually these loads include additional protection against excessive deflection or sudden overload.

(iii)Load combination

According to is 1893(part 1):2002, clause 6.3.1.2 page 13 in the limit state dsign of reinforced concrete structure the following load combination shall be accounted load combinations are used for the analysis which is given below.

1.5(D.L+L.L)

6.LOW COST MATERIALS AND TECHNIQUES

1.Porotherm:It is the clay brick which is used for the masonry works. It acts a light weight infill material. Construction block technology offers a speedier, cost effective, environmentally sound alternative to conventional walling material. The brick is the main material in construction due to strengthen, durability, loading, compactness and lightweight. This brick provides excellent thermal insulation that is 45% higher than conventional walling material. Also it has an exceptionally long life with zero maintenance. It improves the speed of construction without compromising on quality and safety. It would reduce its weight as well as selling price and makes its more affordable. There is a great impact in worldwide towards recycling industrial waste by-products and their utilization as renewable construction materials. Leaving the waste material to the environment directly, can cause environment problems. Wastes can be used to produce a new product or can be used as admixtures so that natural source are used more efficiently and the environment is saved from waste deposits.

2.Blunger sand: One of the major factors affecting the construction field is the non availability of building material expecially sand. The demand for building material has increased to an extent that natural sources are not sufficient to meet the need. The

problem is serious mainly in the construction of mass houses for the low and middle income group. So many techniques are used at present to make alternate building material.

As sand with clay has less binding property as compared to sand alone and alsa sand with clay is acidic in nature, ths make the sand not suitable for construction purposes. Around 30,000 tonnes of ceramic sand waste is accumulated every year. This huge amount of sand is now used mainly for land filling.

As the cost of river sand is increasing day by day and its shortage in availability the reclamation of sand from ceramic waste gain extreme importance. Here studies are made on the waste (ceramic sand)from the"The Kerala Ceramics Ltd."the aim of experiment is to separate the ceramic sand from clay and use it as a substitute for river sand(fine aggregate)in the construction industry.

3.Funicular shell:Funicular shells are doubly curved structure which constructed by utilizing natural waste materials. Its three dimensional structure provides the desired state of stress in its body for the given loading and boundary conditions. The stress desired in an unreinforced concrete shell will be pure compression without shear and bending stresses. The funicular shell is constructed in such a way that to withstand compression alone.Under any other conditions of loading, bending moments would develop in the shell and will not behave purely as a funicular element. Scientifically, it is possible to evaluate the funicular surface of any ground plan for the given loading conditions. The funicular shell is constructed as per the configuration obtained from the analysis. Funicular shells can be cast to satisfy simple loading and boundary conditions by employing simple techniques like the use of a sagging fabric which improves the load bearing capacity of beam while simultaneously reducing the beam section.

Funicular shells can be shape of triangular, square, rectangular, circular or elliptic of required dimensions as it allows ample flexibility in design.This is a roofing system made with materials of good compressive strength such as waste stone pieces and brick tiles and supported on reinforced edge beams. For many structures, funicular shells of different sizes and shapes have been tried as roof element.A series of funicular shells arranged in variable geometric configurations supported on a grid of concrete beams satisfies an attractive roof for small to medium spans.Shell structures maximized the ability to span over large areas with a minimum amount of material.Most of the super structures are fulfil their function by two separate systems.One is the space covering system to cover the space by concrete slab and are supported by a second system of beams and columns.In case of shells, the space covers by concrete slab without beams and column.As funicular shell develop only pure compression,theoretically no reinforcement will be needed except in the edge members.

6. RESULTS AND DISCUSSIONS

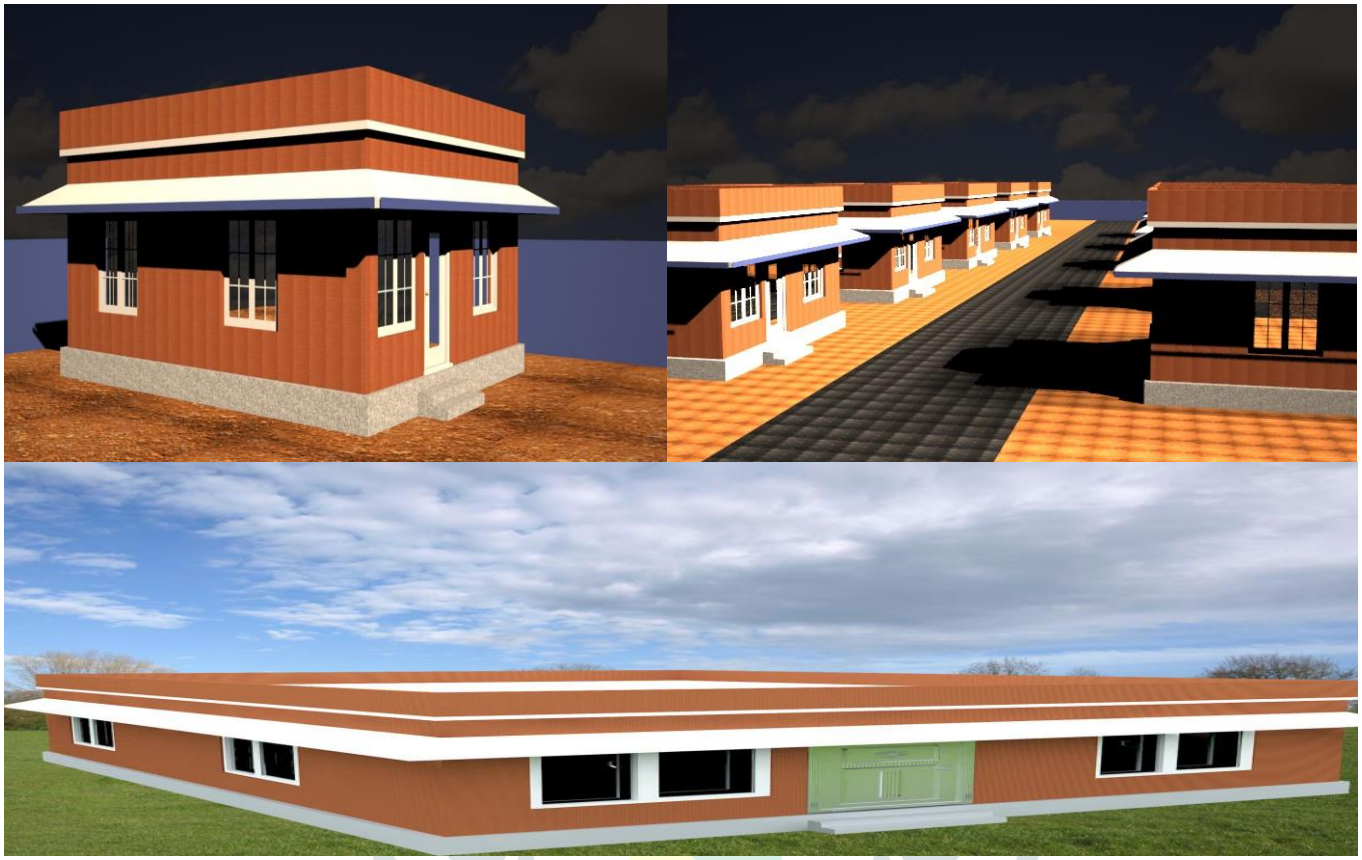
6.1 ABSTRACT OF ESTIMATION

Sl.NO.	ITEM	NO.	L(m)	B(m)	H(m)	V(m3)	Cost/unit	Total cost
1.	Earthwork excavation	1	35.28	0.9	0.8	25.4	200	5080.32
.2.	Foundation	1	35.28	0.45	0.9	14.28	2600	37149.84
3.	Basement	1	35.28	0.3	0.4	4.233	8000	33868.8

4.	Earth filling Master bed room Bed room Drawing&Dinning Kitchen Toilet Total	 1 1 1 1 1	 2.13 2.17 2.13 2.17 1.02	 2.37 2.02 3.52 1.97 1.27	 0.45 0.45 0.45 0.45 0.45	 2.271 1.975 3.373 1.923 0.582 10.124	 200	 2024.8
5.	Wall Deduction door Deduction window Deduction ventilator. Deduction lintel Total Total brick work	1 6 6 1 1	38.63 2.65 1.35 0.6 38.63	0.23 0.69 023 0.23 0.23	3 6.3 1.5 1.6 0.15	26.65 2.583 2.794 0.220 1.332 6.929 19.721	 3600	 70995.6
6.	Funicular shell + placing	36					1100	39600
7.	Beam	10					3600	36000
8.	Lintel RCC		38.63	0.23	0.10	0.88	15000	13200
9.	Interior plastering						LS	18000
10.	Electrification						LS	9000
11.	Plumbing						LS	6000
12.	PCC for flooring						LS	10000
13.	Sunshade						LS	35000
14.	Window(steel frame)	6					4000	24000
15.	Door+fixtures	6					5000	30000
16.	Water proofing						LS	5000
17.	Parapet construction						LS	5000
18.	Septic tank						LS	9600

	Total							389520/-

6.2 3D MODELING OF PROPOSED LIFE HOME



7. CONCLUSIONS

The primary goal of the project was to propose a cost effective study that addresses the problems of mass housing schemes and the inadequate cost effective practises.For this purpose,identified cost effective building materials and technologies without sacrificing the quality,strength and durability.Newly introducing building material blunger sand can be used replacement as river sand.This ceramic sand waste results sustainable and ecofriendly construction.The usage of porotherm bricks made the construction process faster and also helped in reducing the quantity of cement mortar use,thereby reducing the construction and labour costs.Moreover this also helped in reducing the interior room temperature compared to conventional concrete blocks.The usage of funicular shell was found to be a major boost in providing employment opportunities to the unskilled labourers residing nearby.And these building materials developed properly hold the key to address the current housing needs.

We proposed that by this cost effective building construction reduce 30% of total estimated cost.

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