Low Cost Housing Using Innovative And Advanced Techniques

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ABSTRACT

Housing is a basic social need where families can have a comfortable living and work in a sustainable environment. To stay healthy one need a proper place to reside for the entire life and that is home. This is one important component of one's life. But contrary to this, in India type and number of homes available is not adequate as per the estimation reported by the Ministry of Housing and Urban Poverty Alleviation, Government of India. Our country is developing country, and to transform it into developed country the main thing that will help is infrastructural development. Providing housing facility to the low income group people will help our country for the development. But as we know that for building a simple house cost involved is very high; and this will not be affordable for people, so that government had laid no. of schemes; so that everyone will have a comfortable house. But it is observed that funds provided under this scheme are not sufficient; so that there is need to develop the new techniques; which will reduce the cost but will give same strength as per conventional methods. This paper is focusing on the materials and methods of construction; which will provide effective and economical housing facility.

INTRODUCTION

Low cost house is a new concept which deals with effective budgeting and use of techniques which help in reducing the cost of construction by the use of locally available materials along with improved skills and technology without compromising the strength, performance and life of the structure. In low cost housing cost of construction can be reduced by proper management of resources. By use of natural materials like straw, bamboo, fibres (jute, coir), earth etc. as an old practice in India, These materials apart from being locally available have easy workability and speedy construction hence reducing costs. It is also observed that some waste from industries like fly ash, rice husks have pozzolonic properties so that we can use it for construction work and it helps in reducing cost of construction material.

1.2 Study of Various Govt. Schemes of housing for low income group and people in rural areas:

Table1. Introduction to various Govt. schemes

Name Of Scheme	Fund Provided Under the Scheme	More Info.
Pradhan Mantri Awas Yojana (PMAY)	They provide home loan interest subsidy for those buying their first home in urban area They provide 3-4% of home loan upto 9-12Lakh	Launched in2015
Pradhan Mantri Gramin Awas Yojana (PMGAY)		Previously known as Indira Awas Yojana Funds Provided For Area 25 sqm
Rajiv Awas Yojana (RAY)	75,000 Per economically weaker sections Size of Dwelling – 21-40sqm	Launched in 2009 It is For Slum Area To have affordable housing Govt. have approved Affordable Housing in Partnership (AHP)

Type of Area	As per IAS	As per PMGAY
Plain	70,000	1,20,000
Hilly	75,000	1,30,000

These schemes not only provide houses to people in rural areas; but also provide help for low income groups for housing loans.

INTRODUCTION TO GOVERNMENT SCHEMES FOR HOUSING

1. PRADHAN MANTRI AWAS YOJNA (URBAN)

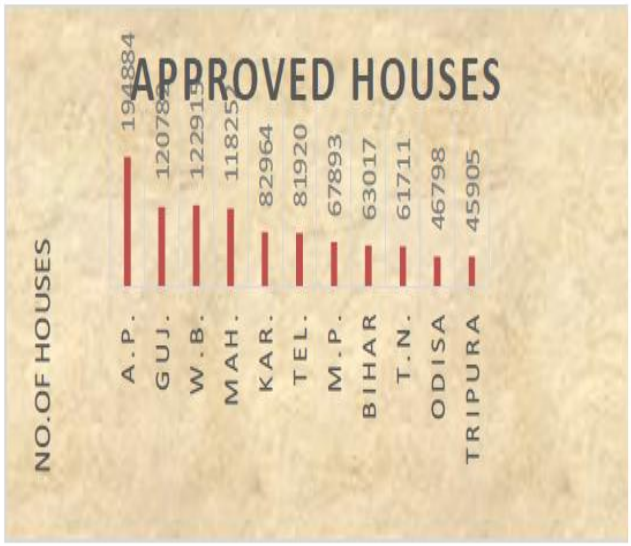
The Hon'ble President of India, in his address to the Joint Session of Parliament on 9th June, 2014 had announced "By the time the Nation completes 75 years of its Independence, every family will have a pucca house with water connection, toilet facilities, 24x7 electricity supply and access."

Hon'ble Prime Minister envisioned Housing for All by 2022 when the Nation completes 75 years of its Independence. In order to achieve this objective, Central Government has launched a comprehensive mission "Housing for All by 2022".

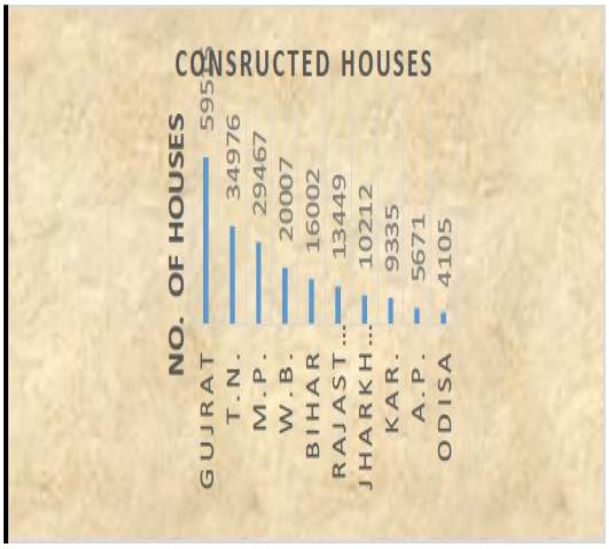
The mission seeks to address the housing requirement of urban poor including slum dwellers through following programme verticals:

- Slum rehabilitation of Slum Dwellers with participation of private developers using land as a resource
- Promotion of Affordable Housing for weaker section through credit linked subsidy
- Affordable Housing in Partnership with Public & Private sectors
- Subsidy for beneficiary-led individual house construction

Under PMAY launched in June 25, 2015, with the goal of building 2 crore houses for the poor in urban areas, a total of 12, 27, 088 affordable houses for urban areas have so far been approved with a central assistance commitment of Rs. 19,682 cr. Of which Rs. 6182 cr. has been already released. The construction of 2, 21, 373 houses has started of which 48,236 have been built.



Graph 1: Graph of no. of houses approved for various states

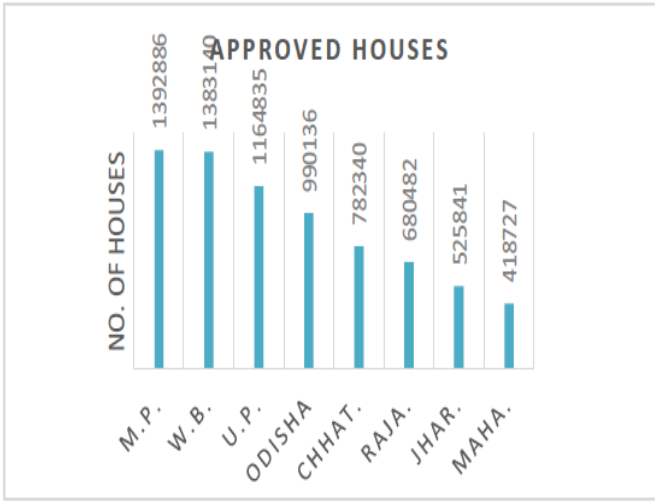


Graph 2: Graph Showing houses constructed upto 2018 in various states

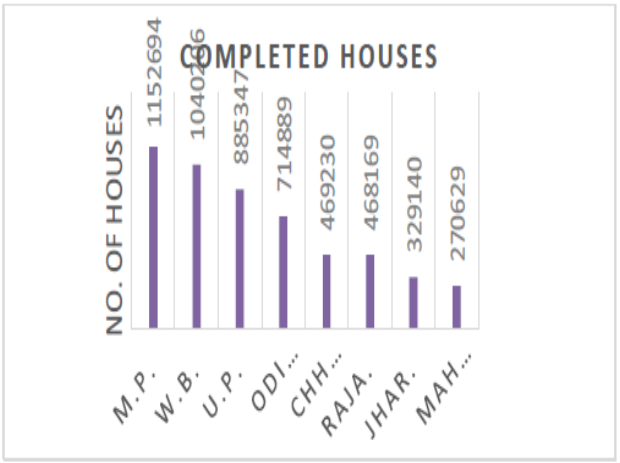
1. PRADHAN MANTRI AWAS YOJNA (RURAL)

PMAY (Gramin) was launched on November 20, 2016, and aimed to complete 1 crore new houses by March 31, 2019. This yojna was previously known as Indira Awas Yojna.

New designs, local construction material, use of technology through rural mason training are the hallmark of the new rural housing scheme. The omes are designed by best of institutions after studying existing local design typologies and are designed by beneficiaries as per their need. These homes not only changing rural landscape but also bringing about a social transformation in villages across the country. The poor are getting safe homes and can live with dignity with facilities like toilet, LPG connection, electricity connection, drinking water facility, etc.



Graph 3: Approved houses v/s states (For Rural Areas)



Graph 4: Constructed houses v/s states (For Rural Areas)

3. RAJIV AWAS YOJNA

Rajiv Awas Yojana (RAY) scheme ran between 2009 and 2014 as a central sector scheme focusing on slum free India. This scheme is now succeeded by Pradhan Mantri Awas Yojana (Urban).

Rajiv Awas Yojana (RAY) was a scheme announced by the President earlier in 2009, focuses on slum dwellers and the urban poor. This scheme aimed at promoting a slum-free India in five years and focused on according property rights to slum dwellers. The scheme focused on according property rights to slum dwellers and the urban poor by the states and union territories. It have aimed provide basic amenities such as water supply, sewerage, drainage, internal and approach roads, street lighting and social infrastructure facilities in slums and low income settlements adopting a 'whole city' approach. It would also provide subsidized credit.

Allocation for housing and provision of basic amenities to urban poor enhanced to Rs.3,973 crore in the Union Budget 2009-10. This included provision of Rs. 150 Crore for Rajiv Awas Yojana (RAY). As per the UPA government's proposal for this scheme , the schemes for affordable housing through partnership and the scheme for interest subsidy for urban housing dovetailed into the Rajiv Awas Yojana which would extend support under JNNURM to States that are willing to assign property rights to people living in slum areas. The Government's effort were to create a slum free India through the Rajiv Awas Yojana.

The Concept Note on RAY was finalized and sent to Planning Commission for their 'in principle' approval. The Planning Commission had accorded its 'in principle' approval for the proposed scheme recently. The draft guidelines of the scheme had been prepared and circulated to all States/UTs/Central Ministries and experts/NGOs for comments.

Developing a robust database on slums was critical for implementation of the proposed Rajiv Awas Yojana (RAY). The Ministry of HUPA had released funds for Slum/Household/Livelihoods surveys in 394 class I cities having more than one lakh population in the country.

1.3 Study of conventional method of constructions –

1.3.1 R.C.C. Construction work –

This is general method of construction using various materials. In this type of construction, about 30% - 50% cost of whole construction work incurred in material.

Various materials used in RCC constructions are as follows:

1.3.1.1 Cement –

Important material required in construction. It acts as binding material.

Well known cement manufacturing companies in India are;

1) L&T Cement
2) ACC Cement
3) Ambuja Cement
4) Birla Cement
5) Ultra tech cement
6) JK Cement etc.

Cement is most expensive ingredient in concrete. Price of cement bag changes from company to company depends on the it's quality.

Now a days fly ash is used as replacement for cement to achieve economy.

1.3.1.2 Sand –

Also called as fine aggregate. Aggregate passing through 4.75mm IS sieve are called as fine aggregate. It is second high cost material in concrete.

1.3.1.3 Coarse Aggregate

Aggregate retained on 4.75mm IS sieve are called as coarse aggregate. This is chief element.

Cost of all these material is varying and day by day it is increasing, so that replacement for this material is needed to achieve economy in construction. Various methods can be used for the construction; so that cost of construction can be reduced and also the time required for the construction.

1.3.2 Limitations of RCC construction work and reasons to develop low cost techniques:

1. Duration of constructions because of time required for setting of concrete and also assembling of scaffolding and formwork.
2. Accurate design of each and every structural element which takes time.
3. Proper concrete mix design as per importance and requirement of structure to achieve required strength.
4. Risk associated with construction is also very high at site.
5. Maximum work carried out at site, requires more time.
6. Skilled labours and skilled supervision is required to check dimensions, accuracy of structural element.
7. Storage of material is another problem at site. Proper storage is required to maintain quality of material. Storage of cement bag should be given proper attention.
8. Most importantly the cost of material; As the cost of cement, sand are very high. Wastage of these material should be avoided, otherwise it will result in increase in cost of construction.

Because of all this reasons; It is important to focus on developing new techniques to reduce the cost of material, duration of construction. Low cost techniques helps in achieving this.

LITERATURE REVIEW

2.1 Opening Remark:

Review of related literature helps the researcher to understand the topic better. The researcher can collect the all the relevant information on the research topic. The review is always helpful in finding out what were their methods used, what were suggestions given for further research. The review of related literature certainly make new researcher well equipped with previous background of the topic and area of research. It makes researcher more critical and provides sound foundation and deep insight into the problem.

A careful review of the research journal, books, thesis and other source of information on the problem to be

investigated is one of the important steps in planning of any research study.

2.2 REVIEW OF PREVIOUS RESEARCHERS:

1. "Low Cost Housing Environment: Compromising Quality Of Life", by Hafazah Abdul Karim
   This paper is based on a research that examines the quality of life for the lower income residents in planned housing areas. Based on the subjective matter of this research, a combination of quantitative and qualitative approach was utilised to facilitate in collecting data, in analysing data and in procuring the findings. Quality of life is indicated by Comfort, Convenience, Satisfaction, Safety, usage for occupants.
2. "Home Making in Low Cost Housing Area", by Azhan Abdul Aziz and Abdullah Sani Ahmad
   Studies assessing the conditions of low cost housing have mostly focused on satisfaction levels and subjective perception of quality particularly with regard to the dwelling units or the larger neighbourhood characteristics. However, residents usually react upon their immediate environment to achieve satisfaction and make the surrounding area as their home. This paper relates appropriation, attachment and identity as home making mechanisms through which residents strive to achieve those satisfactions.
3. "Users perception of Public Low Income Housing Management in Kuala Lumpur", by Firdaus Chek Sulaiman, Ramly Hasan, *et.al.*
   This research is regarding a study on low – cost housing management for the low – income groups. The impact from that Kuala Lumpur now is crowded by the urban poor who is low- income group are doesn't have to own the affordable house. This research also evaluates the management of low cost housing provisions to the low-income group. The both cooperation and commitment from public residential management centre can make the harmonies situation without conflict and challenges.
4. "Safety Performance Assessment Scheme for Low Cost Housing: A Comparative Study by Husrul Nizam Husin, Abdul Hsdi Nawawi *et.al.*
   This paper aims to compare the safety performance assessment schemes use for low cost housing, namely Building Quality Assessment (BQA), Building safety and Condition Index (BSCI), Building Environmental Assessment Method (HK-BEAM), Comprehensive Environmental Performance Assessment Scheme for Buildings (CEPAS), Standard of House Performance Appraisal (SHPA) and Housing Performance Evaluation Model (HPEM). The objective of reviewing safety performance assessments is to indicate a construct validity whether safety issues are concern in the scheme. It can be concluded that majority of the aspects are relates to significant of safety towards occupants of low cost housing.
5. "Assessing factors influencing Performance of Malaysian Low- Cost Public Housing in Sustainable Environment", by Ahmad Ezanee Hashim, Siti Aida Samikon *et.al.*
   The aim of the study is to assess the factors influencing performance of Malaysian low-cost public housing. In this paper factors influencing the overall building defects are discussed. Also the Investigation of public housing management and to provide necessary strategies for better building management. In this study also investigated resident's satisfaction towards the building services and it's facilities of low cost public housing.
6. "The Methods of Using Low Cost Housing Techniques in India", by Manjesh Srivastava, Vika Kumar
   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 economical advantages achieved by its adaptation.
7. "Effects of thermal insulation on thermal comfort in low-income tropical housing", by Arman Hashemia.
   This paper evaluates the effects of thermal insulation in low-income tropical housing in Uganda. This paper aimed to provide design and recommendations to improve thermal comfort conditions for the low-income housing. The results of this study indicate that the roof insulation is the most effective phenomenon to improve thermal comfort and reduce the risk of overheating.
8. "Sustainable Issues in Low Cost Housing Alteration Projects", by Zarina Isnin, Rohaslinda Ramli *et.al.*
   This paper helps in finding out the problems related to the house and surrounding areas due to the lack of practices of proper construction process and procedures in housing alteration projects. This paper give an idea on social, environment and the people involved either directly or indirectly. This paper concentrate on Health and safety of workers, occupants and neighbours that can be affected during the alteration construction process. Thus it gives some of the process which requires careful planning and design of the house, equipment, work area and method of working.
9. "Cost Effectiveness of using Low Cost Housing Technologies in Construction", by Vivian W. Y. Tam1.
   This paper focus on the use of different housing technologies for the reductions of cost and providing affordable house to low income group. This paper gives an definition of Cost effective housing as – It is a relative concept and has more to do with budget and to reduce construction cost

through better management, appropriate use of local materials, skills and technology but without affecting the quality and the life of structure.

10. "Low cost Housing ", by Shaikh Ajim1, Badhe Ajinkya2 *et.al.*
    This research is regarding of how we can reduce the cost of structure by using effective construction materials. This paper helps in studying the basic requirements in designing the house such as Strength and stability, Comfort and convenience , Protection , Resistance to moisture penetration and Thermal insulation .
11. "Safety and Health Factors Influencing Performance of Malaysian Low-Cost Housing: Structural Equation Modeling (SEM) Approach",by Azuin Ramlia, Zainal Abidin Akasahb *et.al.*
    Housing quality is a very complicated issue, which is related to people's daily lives. Therefore, there is a need for a sustainable strategy towards building a safer, healthier, and more sustainable built environment. This paper concentrate on safety and health aspect for the individuals and society, which may contribute for economic productivity and prosperity. This study helps in finding out various factors which influence the building safety and health performance of low-cost housing in Malaysia. From this study the factors which have significant effect on the safety and health are found out they are, architecture, building services, external environment.
12. "A Comparative Study of Walking Behaviour to Community Facilities in Low-Cost and Medium Cost Housing",by Diyanah Inani Azmi & Hafazah Abdul Karim.
    This paper is based on a comparative study of walking behaviour of residents in neighbourhood area to community facilities. The findings show that low cost housing area is within walking distance as compared to the medium cost housing area in reaching the community facilities as there is certain factor that affects the walking behaviour such as distance, catchment area radius, location, accessibility, density and land use pattern.
13. "Affordable Mosaic Housing: Rethinking Low-Cost Housing", by Anniz Fazli Ibrahim Bajunida and Mazlin Ghazalib.
    This paper give the three least aspects to location. The first aspect is that of geographical location. The second aspect is the physical quality of the environment around the house. And the third aspect is the social quality of the environment. In the Mosaic Housing model, there is an try to avoid segregation of houses by the income categories. In these study the main rethinking was 32done on the neighbourhood and the zoning.
14. "Correlation Analysis of Occupants' Satisfaction and Safety Performance Level in Low Cost Housing", by Husrul Nizam Husina b, Abdul Hadi Nawawi b *et.al.*
    This paper aims to evaluate the safety performance of low cost houses.For this study they carried out survey of 24 low cost houses in Kuala Lumpur, Malaysia. They used Post Occupancy Evaluation (POE) as tool for safety performance assessment.
15. "A Review on Environmental Characteristic that Influence Children Physical Activities in Low Cost Housing ", by Nurul Liyana Hanapi, Sabarinah Sh Ahmad.
    This paper focused on the effects of physical environment of low cost housing upon children's physical activities. It also ensured that designer need to be more crucial in designing a space in the low-cost housing that promotes children's physical activities.
16. "Liveability and Low-income Housing in Nigeria", by Mohammad Abdul Mohit, Sule Abbas Iyanda.
    This paper aimed to study the liveability in the environment of low cost housing. For this, they done the case study of low cost housing in Nigeria.For that they carried out model studies.
17. "Life cycle cost of different Walling material used for affordable housing in tropics", by Chameera Udawattha , Rangika Halwatura.
18. "Evaluating Offsite Technologies for Affordable Housing", by VPS Nihar Nanyama, Anil Sawhneyb *et.al.*
    These research aims to evaluate different technologies in Offsite Construction so as to utilize them in housing construction and adopt the best and suitable technology. The materials used in the manufacturing of different offsite components or panels can be handled with better efficiency. This paper give an importance of technology that it helps in reducing about 90% of site wastage when it was compared to conventional construction practice. The result of these study is that in India to overcome the shortage in housing stock many agencies adopt such offsite technologies in constructions.
19. "Comparison of Design, Cost and Duration of LGS and SCIP Construction With Conventional RC Construction", by L. A. Qureshi *et.al.*
    This paper aims to evaluate the comparison between conventional method and modern techniques of construction. It also stated how LGS is more advantageous over RCC construction work. It considered some factors for comparison like duration of construction work, cost of material, ease with which construction can be done.

METHODOLOGY:

3.1 Opening Remark:

To make construction economical, easy, faster, within the budget for people in rural areas and slum areas various methods can be used; which not only help in reducing cost; also time for the construction. Some materials and methods are as follows:

3.1.1 Hollow concrete blocks –

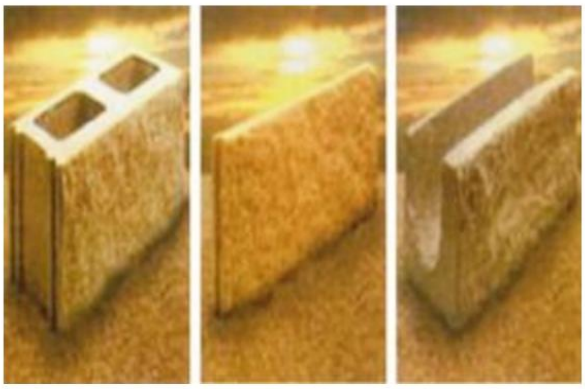


Fig7: Hollow Concrete Block

These blocks are light weight, raw materials for this are cement, light weight aggregates like pumice, fly ash, furnace slag, cinder.

Advantages:

1. Faster construction
2. Lightweight
3. Simple manufacturing
4. Used for walls

3.1.2 Cement waste slag bricks:

1. Used for load bearing walls of low rise building
2. Obtained by recycling of lot of waste slag
   Materials are Waste slag (80 %) (fly ash, coal gangue, slag),Aggregate, bonding agent (20 %) (Cement or Gypsum)

Fig8. Cement waste slag bricks

2.1.3 3E panels (Ecological, Economical, Extruding Process):

1. Specially designed for low cost housing
2. 3E house (easy, energy saving, ensure) can be install and constructed rapidly using 3E panels.
3. Raw materials - cement, fly ash (optional), glass fibre or steel , aggregate (option: sand, stone, blast furnace slag, pearlite, ceramisite, pumice, and other slags)

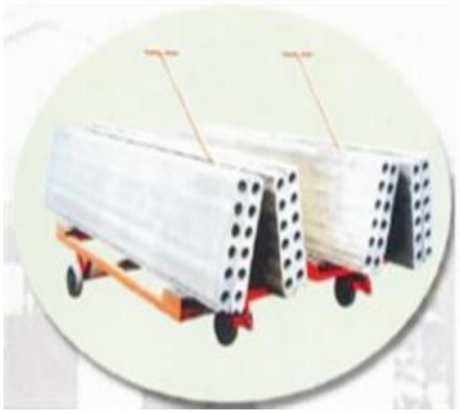


Fig9. 3E panels

3.1.4 Light Gauge Steel:

This can also be used for construction of low cost housing. As, it is light weight and less costly; we are recommending to use it for the construction of houses in rural areas also in slum areas. Faster Construction is possible.

2.2 Detailed information about Light Gauge steel construction:

1. Light gauge construction is similar to wood framed construction, only the wooden framing members are replaced with thin steel sections.
2. Steel sections are cold formed sections. Cold formed steel is shaped by guiding thin sheets of steel through a series of rollers, each roller changing the shape very slightly, with the net results of converting a flat sheet of steel into a C or S-shaped section.
3. Steel used is coated with zinc or mixture of zinc and aluminium (called zincalume) to protect it from corrosion. Thickness of coating depends on environment. Typically marine environment require more protection and least in arid regions.
4. Thickness of steel used here range from about 1 to 3mm for structural sections.

Advantages of Light gauge steel construction:

1. They are light, and allow quick building without heavy tools or equipments. Every component can easily be carried by hand. The main tool is a light, handheld screw-gun. Since steel is strong, LGS structures are lighter than wood framed structures of equivalent strength.
2. It is able to shape itself to any form and can be clad and insulated with a wide range of materials.
3. It is easy to modify the construction at any point of time during its lifespan.
4. Light gauge steel structures do not rot, shrink and they can be used in the areas where there is probability of termite attack.

Advantages of LGS over RCC structure:

1. LGS construction is cheaper than RC construction. The costs of LGS are half as compared to that of conventional construction.
2. Faster construction as compared to conventional method.

3. Cold roll structural steel is 98% recyclable and has 60% industry recycling rate while conventional construction is only 50% recyclable.
4. LGS is lighter structure and with strong connections resulting in less seismic forces.
5. Saving in excavation in LGS as compared to conventional method. Depth of footing is also less.
6. Duration for construction is half that of conventional const.
7. Environmental Friendly.
8. Structurally sound building
9. Excellent thermal insulation
10. Accuracy and quality finishes in construction

Limitations:

It has high carbon content. It is non-combustible material, but in presence of fire it loses its strength; hence proper fire resistant material for insulation and cladding needed to be provided.

Fig10. Light Gauge Steel Structure

Construction using LGS:

It is off-sight technique. Maximum manufacturing is carried out at factory and components are assembled on site.

Components of LGS are:

1. wall panels or trusses
2.
3. cold formed steel sections made from thin gauge high strength galvanized steel sheets
4. Rivets or self-tapping screws

All components are assembled to form structural wallpanels and/or trusses which are transported to site. The wall frames are clad externally and internally on site with a range of alternatives cladding materials with services (electrical and plumbing) and insulation material installed in the wall cavity. Any type of roofing material can be used.

Fig11: LGS Frame

4) CONCLUSION

From this paper, We concluded that, In India population under low income group is more as compared high income group and they can't afford houses, because of increasing cost of construction material. It is necessary to develop such techniques which will not only reduce the construction cost but also achieve the same strength as that of conventional methods. In this paper we studied light gauge steel whichi lighter thinner, having less cost, but at the same time using this material we can construct single storey building as well as multistoreyed building with same strength.

5) ACKNOWLEDGEMENTS

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