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“Unifying Affordability and Green Housing through Green Building Norms making it an Affordable Green Housing at Kolhapur city”

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Abstract: In this study, Moto is to find the best possible solution in building construction is make it sustainable also so that the environmental balance will not be hampered. Looking at the current development and expected increase in population growth large housing need was created and its effect on environment is harmful, adopting green building is the best possible solution. Thus unifying benefits of green building to affordable housing will benefit both consumers and environment. Along with huge number of benefit there always are some limitations and this research tends to study them. A case study/ survey were carried out to understand knowledge, awareness and opinion about the people. Affordable housing majorly for people from LIG and MIG group and their need was the major parameter for study.

Index Terms – Green building, affordable housing, and affordable green building.

I. INTRODUCTION

The construction industry is the 2nd largest industry after the agricultural sector in India, leading the way to new developments and setting moves for growth of all other sectors (Randive and Gaikwad 2006). It drains about 38 % of total energy globally and with the growing population total earth's resources are about to extent, which is a danger to imagine (green building concepts and awareness). Rapid urbanization, has led to development of cities, various job opportunities, migration of people to urban area, housing need, housing shortage, creation of slums, this is a chain reaction. People who suffer the most in it are economically weaker section EWS and low-income group LIG categories. There is a shortfall of 18.78 million home and 95 % is for LIG & MIG categories. Thus it is essential to increase affordable housing stock (IGBC) to overcome the shortage. If the backlog of housing is maintained, 30 million additional houses will be required by 20201 (JONES LANG LA SEILIE).

Considering this huge demand it is necessary to take some steps to counter it. In India, the developer does not pay attention to or has no interest in LIG and EWS housing segments but targets high and mid-end parts to earn profit or premium. Pradhan Mantra Awas Yojana (PMAY) was launched in 2015 by the government of India heads to provide housing for urban and rural poor. PMAY-U is targeting to build approx. Twelve million dwelling units for the urban poor by 2022. Depending on the categories, 30 sq. m. for EWS and 60 sq. for LIG (PMAY). Curtailing the capital cost to achieve affordability is tested inaccurate and interim solution might hamper the quality and wil boost the operating cost. While construction of this affordable housing to cater this huge demand with such quality of construction will effect consume and majorly the environment. Huge concrete jungle will be developed. Building green is the perfect solution for this problem.

Lewis et al. Defined Green Buildings as structures constructed and maintained with the least minimum resource, without any environmental imbalance, considering community and cultural reactivity (Lewis et al. 2010). Sustainability is based on three basic principles, resource efficiency, health and productivity; understanding this principle will view the complete cycle of the building project. (NUSHRAT SHABRIN). Green building used less water and energy generates less waste while construction adopting energy efficient, water efficient , eco-friendly environment by conserving natural resources and preserving them for future generation.

Thus Affordable housing with sustainable features would be the best possible solution to this housing problem. (Kenny 2003; Connie Susilamati). This design concept not only included space planning and proper architectural planning but also focused on the balanced job and housing development. This was the best strategy to reduce time spent on travelling and thus increase the housing supply. This concept also covered safe streets, historic restoration and green buildings (CHRISTINA M.WEBB). Green concepts and techniques unified with affordable housing will reduce energy and water consumption, improve health and hygiene, better sanitation, better ventilation and light in dwellings, fuel savings in travelling to the workplace and thus control associated pollution. (IGBC Rating System for Green Affordable Housing).

There are numerous benefits of green building and most them also applies for affordable green building and are discussed above. Major barriers in affordable green building are time, cost and risk which directly and indirectly are responsible for furthermore barriers. So, there is a need to investigate the level of awareness among different category of people.

I. NEED OF THE RESEARCH

With the growing population construction industry is in need to develop large scale housing option majorly for LIG and MIG category of people. Even many government bodies are taking in part along with real estate to cater this housing demand. PMAY scheme targets to provide home for all. While catering to such high housing stock, we must first consider its environmental impact. Global warming and greenhouse gas have already descended on us. Many articles have stated that our natural resources are nearly depleted, and people reject that “we need to change our living habits”.

The best possible solution for both the problem, huge housing demand and maintain environmental balance, is combing principles of green building along with affordability. Our governments have already known these facts and thus encourage the industry by providing incentives, subsidy, extra FSI. Thus affordable green building is a key to this entire mess.

But issue arises when consumer, real estate developer chooses convention building option over green building. It is important to understand why this is the condition after providing so many benefit. Thus principle aim of this project is investigate level of awareness about green building from two categories of people. Actual needs and demands of consume in case of housing i.e. affordable housing. Also its important to understand if affordable green building are actually cost efficient.

II. METHODOLOGY

Various literature reviews were viewed and studied for better understanding of research topic. Varsity of paper with wide range of topic like affordable housing, green building, sustainable development, energy conservation and many other were studied. Further for this research, primary data is collected through survey with help of interview and questionnaire. It is important to plan survey perfectly to gain optimum information. In survey sample size is also important and it depends on objective of research.

Total survey is divided in 2 sub-surveys, one of it is online survey and one is personal face to face interview. Survey 1 was personal interview individuals of LIG and EWS community which generally includes people like drivers, house helpers, richsow drivers, security person, and people working as labor in industry. And survey 2 was survey questionnaire were educated people say common man who might have knowledge about construction field but is directly involved in environment factors.

Selection of this sample of people is selected to get deep understanding of their actual needs and their awareness about the terms we use now-a-days like green building and sustainability and many more. Affordable green building is not only for environment but also for a group of people who do not have access to better facilities.

Survey analysis is the next step where analysis of collected data is done to gain the required information. Raw data without analysis is of no use and cannot bring any direct result. Thus a proper statistical analysis is done to produce simple conclusion from the complex data. Also questions like how any and how much and even open ended needs careful interpretation as they deal with numerical data.

III. CASE STUDY- (SURVEY)

Study of different categories of people was done to analyze affordable green building concept with all different perspective. Each group was studied with a different purpose and to discover diverse culture.

1. Survey A -

First case study, say “SURVEY A” was an online survey, with a set of questionnaire to analyze and investigate the level of awareness about green building and affordable green building, from the common people say consumers. The major intention of this survey has been to unlock the view of common people about this concept and this research will try helping them understand and think smarter. Hence to frame further awareness amongst the individuals and to enhance its importance, questions had been asked to a few people.

2. SURVEY B

“SURVEY B” was a personal interview survey of individual from EWS and LIG category, to understand actual needs and demand, say to study what affordability is. Total SAMPLE SIZE OF 20 participants were personally 11 male and 9 female participants from the age group of 19 to 50 years were interviewed. Participants were selected different background some of them were drivers, home servants, MIDC workers etc. so as to have a greater perspective. Affordable green building, our research topic revolves around this group of people and their opinion plays important role for research

The major intention of this survey was to know whether these people are aware of all those government schemes generated to help them and what are their actual demands from housing. Hence to frame further awareness amongst the individuals and to enhance its importance, questions had been asked to a few people.

Both surveys were carried out individually and interviews were the taken and converted in to an online form to handle easily. Questionnaire has been attached.

IV. RESULTS

As discussed above, survey was conducted and primary data was collected, collected data then was analyzed with the help of professional statistical analyst for clear and unbiased result. Depending on the question various hypothesis were built by clubbing some question and then their results are shown.

SYNTACTICAL ANALYSIS OF ONLINE SURVEY "A"

- **HYPOTHESIS 1: The awareness of consumer respondents towards green building/ sustainable housing/ eco-friendly home/environmental aspects is statistically significant.**

Table [1]

Q no.	Response	Yes	Neutral	no	total	mean	variance	Z cal	P value	conclusion
1	Are you aware of the term green building/ sustainable housing/ eco-friendly home?	35	3	2	40	2.825	0.2506	10.42	0.0001	Significant*
2	Do you consider the environmental aspects of the house/ building before buying them?	28	7	5	40	2.575	0.507	5.11	0.0001	Significant*

(Source: Primary data collection)

*: significant at 5% (Two sided)

From the table number [1], it is concluded that calculated value of Z lies in the rejection region i.e. 'P' value is < 0.05 . So that, null hypothesis is rejected. Therefore accept the hypothesis that the awareness of consumer respondents towards green building/ sustainable housing/ eco-friendly home/environmental aspects is statistically significant. People are aware of the concept and trying to know about it.

- **HYPOTHESIS 2: The measures/steps taken by consumer respondents to save energy at home are statistically significant**

Table [2]

Q no.	Response	Yes	No	total
4	Have you taken any measure to reduce water consumption at our home?	27	13	40
6	Have consider any alternative way to You're heating and cooling expenses in your home?	19	21	40
12	Do you prefer buying star energy star product for saving energy?	33	7	40
	Total	79	41	120

(Source: Primary data collection)

Sample proportion = 0.66,

Calculated value of Z = 2.003, 'P' value = 0.0452

As 'P' value < 0.05 , reject the null hypothesis. Hence, accept the hypothesis that the measures/steps taken by consumer respondents to save energy at home are statistically significant.

The above hypothesis proves that people are trying to incorporate some basic steps towards energy saving which leads to towards green building and thus educating them in right direction is necessary.

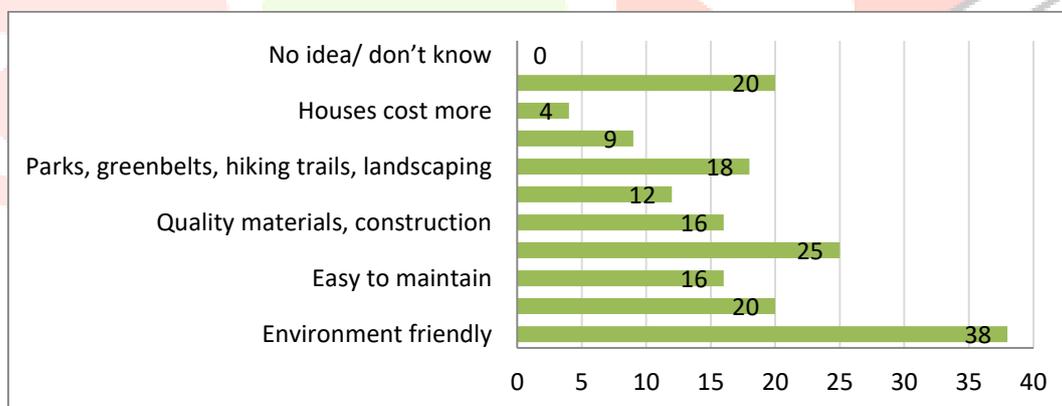
HYPOTHESIS 3: The opinion/interest of consumer respondents about the recycled water system, material, green marketing initiatives, and resale value of green building is statistically significant.

Table [3]

Q no.	Response	Yes	Neutral	no	total	mean	variance
5	Would you be interested in a water system that uses recycled water for all purpose other than drinking?	32	7	1	40	2.775	0.230
7	Do you think recycled material give better quality construction as compared to fresh material?	10	10	20	40	1.75	0.705
8	Do you think that Green Marketing activities actually helps environmental issues pertaining to green building?	31	3	6	40	2.625	0.548
9	Do you think that green buildings/ houses increases its resale value	31	2	7	40	2.6	0.605
	Total					9.75	2.088

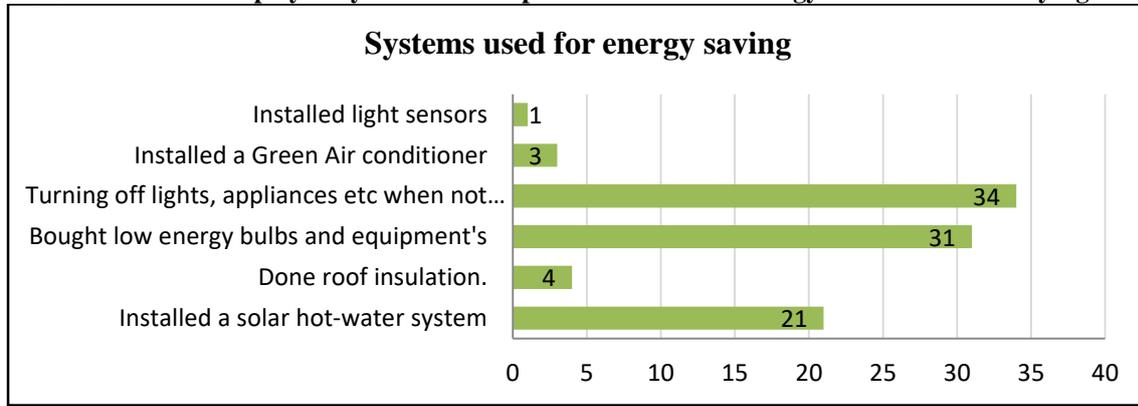
(Source: Primary data collection)

From the table number [3], it is concluded that Sample mean = 9.75, sample variance = 2.088, Calculated value of Z = 8.34, 'P' value = 0.0001 Calculated value of Z lies in the rejection region i.e. 'P' value is < 0.05. So that, null hypothesis is rejected. Therefore accept the hypothesis that the opinion/interest of consumer respondents about the recycled water system, material, green marketing initiatives, and resale value or say the price of such of green building is statistically significant. The above hypothesis proves that people are trying to understand new technologies and agrees that they will provide benefits to building and to them also. People agreed to the concepts they know, or have heard somewhere but they had no clue of new concepts and new technologies.



This shows that people are aware about the term green and maximum people understand that green building are directly related to environment. With 25 count preservation or say protection of natural resource was 2nd were as water efficient and healthy air quality both with 20 count were 3rd, 4th with 18 count parks landscape and green belts. Later quality material, construction and better built homes with 16 and 12 counts. With least count of 9 and 4 were, saves me money and costs more. This shows that people are not clear with the cost factor and some consider it as high and some people thinks it saves money. So it is necessary to make people understand benefits of green building in terms of cost.

HYPOTHESIS 4: Measures employed by consumer respondents to reduce energy bills are statistically significant



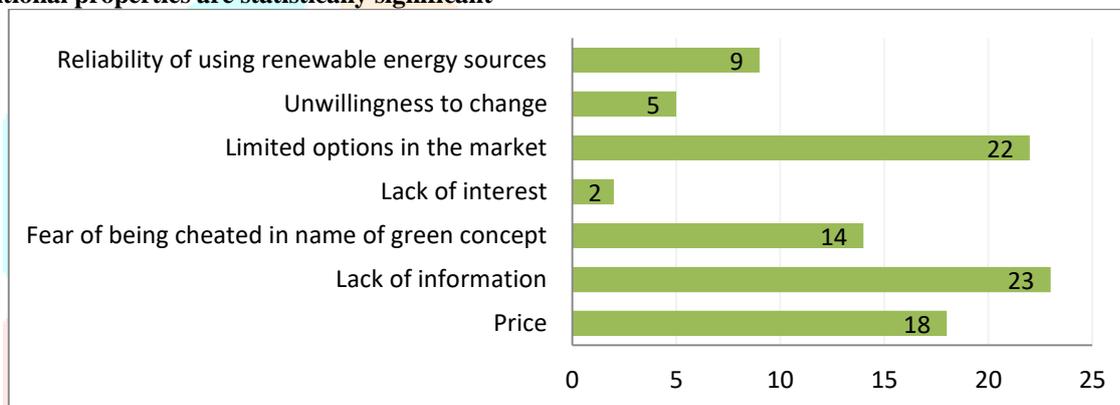
Sample proportion = 0.392,

Calculated value of Z = 1.37, 'P' value = 0.1707

As 'P' value > 0.05, (reject alternative hypothesis) accept the null hypothesis that measures employed by consumer respondents to reduce energy bills are not statistically significant.

The above analysis shows negative result, and shows that measures taken by people are not sufficiently enough to reduce energy consumption. New technologies are far away from peoples reach, due to lake of information. Thus it proves a need for a proper awareness program.

HYPOTHESIS 5: The barriers that are holding consumer respondents back from choosing green buildings over conventional properties are statistically significant



(Source: Primary data collection)

Here, Sample proportion = 0.332, Calculated value of Z = 2.124, 'P' value = 0.0338

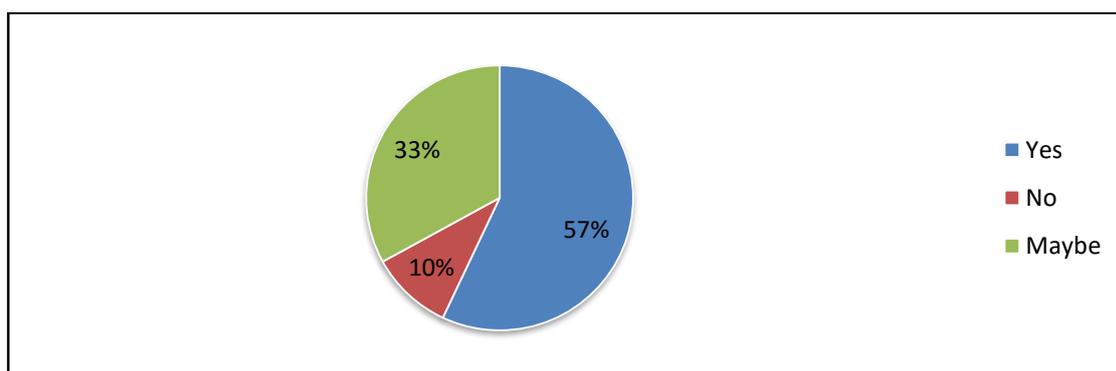
As 'P' value < 0.05, reject the null hypothesis. So accept the hypothesis that the barriers that are holding consumer respondents back from choosing green buildings over conventional properties are statistically significant. Lake of information being the most common selected cause.

Further while concluding the survey they were asked while purchasing home will you pay \$1 or 100 rs per sq. For energy efficient home as discussed above

Table [6]

Response	Yes	May be	No	Total
paid \$1/Rs.100 for energy efficient home	23	13	4	40

(Source: Primary data collection)

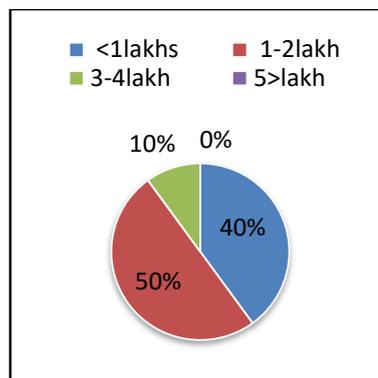
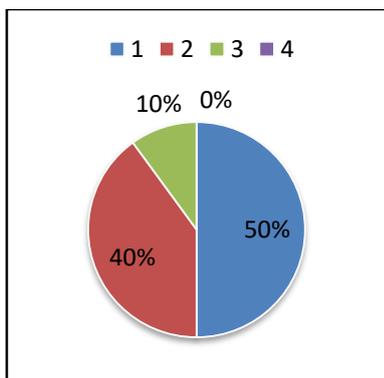


Percentage of people willing to pay \$1/Rs.100 for energy efficient home

Table 6; conclude that more than 50% people agreed to pay extra amount for energy efficient home. This show there is enormous interest among the people and they are ready to change for the sake of environment. The need is a proper training and guidance for the people.

Interview Survey Outcomes and Analysis for Survey B

At the start basic question were asked, how many family member they have, their occupation, their salary etc. number of member in their family working to earn and their response are shown graphically



Number of people earning in the family.

Total monthly income/annually income

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To know more they were requested to split their salary into their expenditure such as rent, food, education, medical expenses, energy bills, and some extra miscellaneous expenditure. Then their total expenses and saving were analyzed in a statistical manner for the end result.

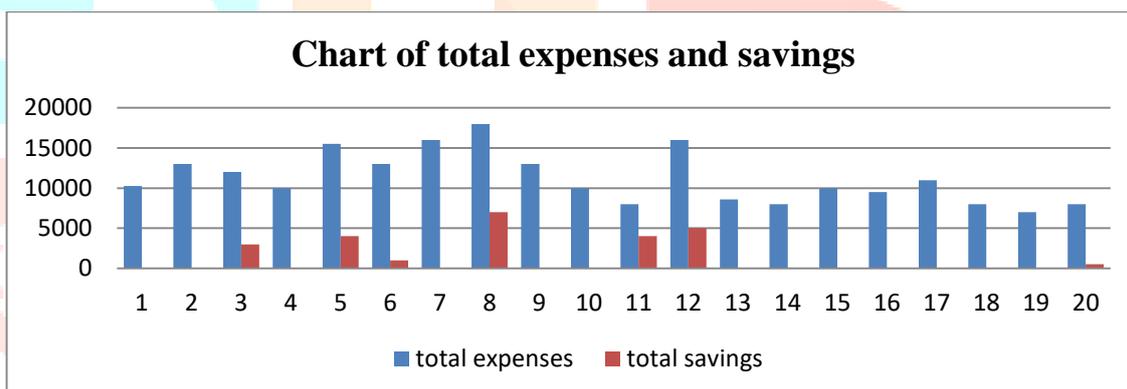


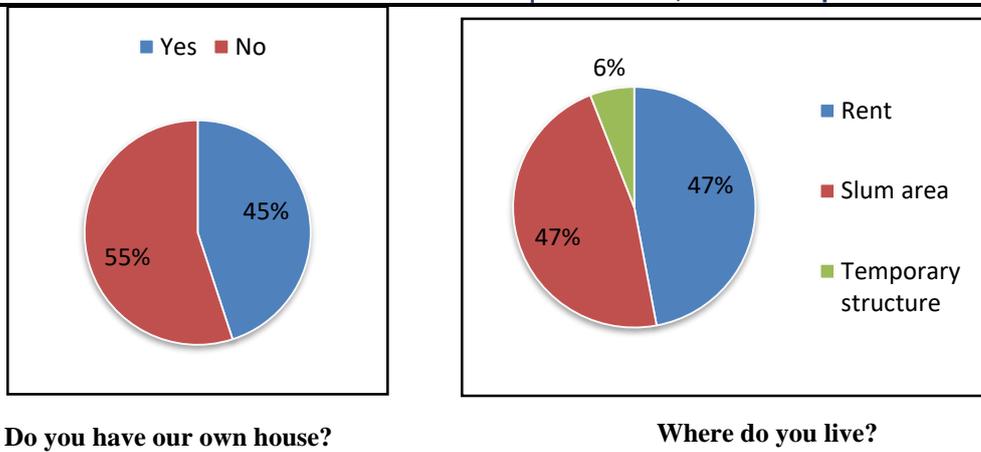
Table [2]

Response	Total	Mean	S.D.	C.V.
Expenses	224866	11243.30	3200.44	28.47
Savings	24500	1225	2130.45	133.94

(Source: Primary data collection)

Looking at the tables above it is observed that, an average the respondents of L.I.G and E.W.S category average expends Rs. 11243 with standard deviation (SD) RS. 3200.44 And coefficient of variation (CV) 23.47%. While that of saving Rs. 1223 with SD Rs 2130.45 and CV 133.94% which is much higher than CV of expenditure.

Hence there is more variation in saving than expenditure, showing there is less consistency in saving pattern of L.I.G and E.W.S respondents.



They were further asked about the primary question regarding their housing, do they have own house to which expected reason came out 55 % i.e. 11 people had no house. 45 % i.e. 9 people they had their own house. To understand their living culture it was necessary to find their housing type were participants stay to which 47% i.e. 9 participants said that they live in slum area and on rent basis and only 2 people said they live in temporary structure.

Hypothesis 1: LIG and EWS respondents are significantly awareness about housing scheme for their benefits.

Table [3]

Response	Yes	No	Total
Have you heard about PMAY or any other government housing scheme?	11	9	20
Are you interested in any of such government housing scheme if you get benefits from government while purchasing house.	13	7	20
Will you like to pay little more if you are provided affordable green building which are environmental friendly and gives large amount of benefits.	5	15	20
Total	29	31	60

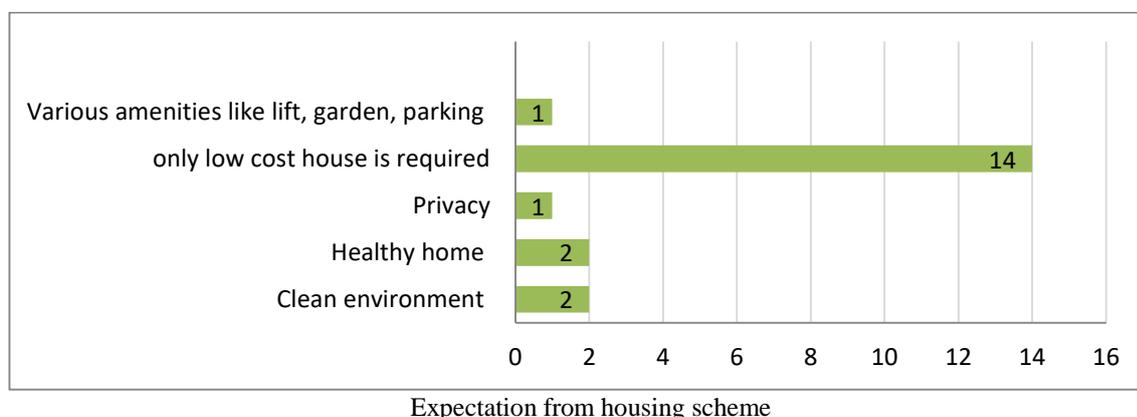
(Source: Primary data collection)

Sample proportion = 0.483,

Calculated value of |t| = 0.149, 'P' value = 0.883

As 'P' value > 0.05, accept the null hypothesis. That is LIG and EWS respondents are not significantly aware about any of the schemes created for them but they are eagerly interested in such scheme in which government will provide benefit. Some people said they have no trust in this scheme, were as one of the individual got selected to get house under one of such scheme but till date did not receive the house. People honestly have no clue about what is happening to environment and thus they refuse to go for or say accept green building thing. Awareness is only the reason behind this and thus it is important that to create awareness problems at this levels also and educate them.

Hypothesis 2: the benefits expected from housing scheme by LIG and EWS respondents are significant.



Sample proportion = 0.2, Calculated value of |t| = 2.68, 'P' value = 0.0148

As 'P' value < 0.05, reject the null hypothesis. Hence accept the hypothesis that the benefits expected from housing scheme by LIG and EWS respondents are significant. Thus from the survey it is statistically proved that these people have fewer requirements which are only a house to live and if provided additional amenities will be a privilege. Green building brings huge number of benefits with it but it is necessary to understand what actual needs of people of EWS category

I. CONCLUSION

This research incorporated survey with common educated people and people from LIG and MIG to understand their needs their view about the on-going affordable green building concept. Response collected in the survey is generous but has its own limitation while analysing it as it was for a small sample size.

From Online Survey A we can conclude that the, Awareness among this group of people is comparatively good towards green building concepts and tries to incorporated basic steps for overcoming environmental problems by choosing new techniques and technologies. But the major problem is lack of knowledge and information, of the right and wrongs things to do, to overcome this environmental issue. Thus lack of knowledge acts as major barriers in the way while making the choice of green building concepts. But people are willing to contribute to environments, and we can achieve this, only by making people understand what the concept is, why the concept is, and for who is the concept.

Online Survey B we can conclude, It is clearly observed that respondents from this survey were the most unaware people, they had very less knowledge about any of the government schemes, it's not only about housing but overall, this may be due to less education. It was also observed that their expenses were more than savings. Major aim of this part of survey was to understand what affordability is. It was clearly observed that their expectation and requirement is only for a house, and in a good community or say better environment, it was observed that maximum of them lived in slum and their living culture was the one thing they want or change so that their children have great future.

Observational data shows that green affordable buildings can contribute chain of benefits and will encourage green building policies. The concept will try to curtail the risk of poverty from LIG and EWS category people, planning in such a manner so as to get easy access to public transportation, healthy neighbourhood, well connected community and natural environment. While the research ends it brought many such points that need to be studied further one of it is to have an extra survey of people from construction industry. Their views might help little more to this research further.

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