CHAPTER – IV

FINDINGS AND DISCUSSION

Findings of the research work on Green Buildings are described, discussed and presented in this chapter. The findings are presented in composite frequency and percentage summary tables. These are followed by statistical application for testing the hypotheses. The results are summarized as per the objectives of the study under various parts.

The presentation of this chapter is in the following sections:

Section 4.1 Information regarding Builders

4.1.1 Background information of the builders of Vadodara city.
4.1.2 Opinion of builders regarding Green Buildings.
4.1.3 Reasons for adopting Green building design and construction.
4.1.4 Barriers faced by builders in adopting Green Building design and construction.

Section 4.2 Information regarding Home Owners

4.2.1 Background information regarding the respondents of the study
4.1.2 Knowledge of the respondents regarding the Green Buildings
4.1.3 Assessment of the selected houses for their extent of green-ness

Section 4.3 Testing of Hypotheses

Section 4.4 Educational Program

Section 4.1

4.1 Information regarding Builders

This section deals with information regarding selected builders of Vadodara city.It contains information regarding background details of the builders, sources of information on Green Building, Familiarity of builders with the concepts and methods of Green Building, extent of influence of Green Building concept on builders, kinds of projects in which Green Building elements were incorporated, extent of Green Building aspects incorporated in the projects undertaken by them, and importance of Green Building aspects for builders. A probe was made to find out the reasons for adopting Green Building concepts by the builders in their projects, barriers faced in adopting Green Building design and construction and opinion of builders regarding Green Buildings.

4.1.1 Background Information of the builders of Vadodara city

This section consists of the background information about the selected builders of Vadodara city. The information about their age, education, and duration of work as builder is presented here.

The age of the builders ranged between 21 to 51 years and above with a mean age of 43.01 years. Very few i.e. 18.66 and 14.66 percentage of the builders were aged between 21 to 35 years and 51 to 70 years respectively. It was found that more than one third of the builders had diploma degree in civil engineering. More than one fourth of the builder's were Bachelor's degree holder in Arts. Less than one fourth of the builders had bachelor's degree in civil engineering. It can be concluded that two third of the respondents were graduate and one third were diploma degree holder in Civil Engineering. Nearly two third of the respondents were from field related to construction (B.Arch., B.E. Civil and Diploma in Civil Engineering) and one fourth were from arts field. Less than one half of the respondents were working as builders since 11 to 20 years. One third of the builders were in the field of building construction since 21 to 35 years (Table-1, Fig. 10).

Table 1: Distribution of the builders according to their background information

Sr. No.	Background Information	Respondents (n = 75)	
		F	%
1.	**Age (in years)**		
	21 – 35	14	18.66
	36 – 50	50	66.66
	51 and above	11	14.66
	Mean	**43.01**	
	Sd	**10.54**	
2.	**Education of the builder**		
	B.Arch.	10	13.33
	B.A.	20	26.66
	B.E. Civil	17	22.6
	Diploma in Civil Engineering	28	37.33
3.	**Duration of time Work as Builder**		
	Less than 10 years	18	24.0
	11-20 years	32	42.6
	21-35 years	25	33.3
	Mean	**16.05**	
	Sd	**8.62**	

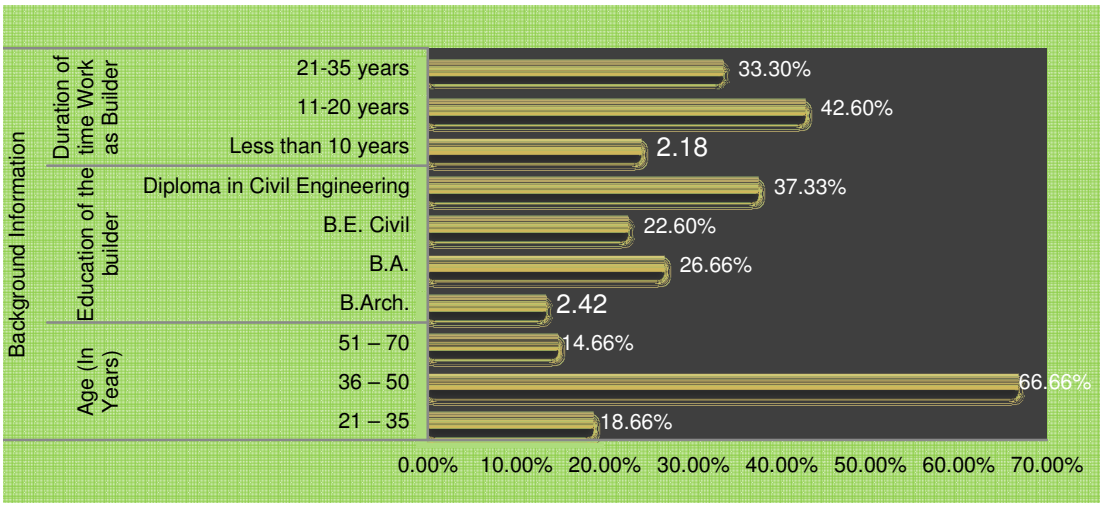

Figure 10: Percentage Distribution of the builders according to their Age, Education and Duration of time working as Builder

4.1.2 Source of Information on Green Building

Generally, apart from their own experiences, the builders might make use of some sources of information which would make them aware of various aspects of Green Buildings. The sources of information regarding green buildings might help builders in adopting Green Building concept. The respondents were asked to state their main source of information on green buildings. Different sources were print media, audio visual media, word of mouth and formal education/ seminar.

Table 2: Distribution of Respondents according to various sources of information on Green Building

Sr. No.	Source of Information	Respondents (n = 75)	
		f	%
1.	**Print Media**		
I	Newspaper	42	56.00
Ii	Magazine Article	39	52.00
2.	**Audio/Visual Media**		
Iii	Television Programs	19	25.33
3.	**Word of Mouth**		
Iv	Friends	29	38.66
V	Clients	20	26.66
Vi	Professional Associates	39	52.00
4.	**Formal Education/Seminar**		
Vii	Continuing Educational Workshops / Programs	14	18.66
Viii	Different Courses on Green Buildings	02	2.66
Ix	Conferences / Seminars	20	26.66
X	Through Formal Education	04	5.33
Xi	Professional Organizations	14	18.66
Xii	Personal Research	08	10.66

Note: Total exceeds due to multiple responses

It was found that newspaper (56.0%), magazine articles (52.0%) and professional associates (52.00%) were the main source of information for more than one half of the builders (Table 2, Fig.11). More than one third of the builders got information regarding Green Buildings through their friends. More than one fourth of the respondents gained information regarding Green

Buildings from their clients, attending conferences or seminars related to Green Buildings and television programmes. Continuing Educational Workshops or programmes and Professional organizations were the source of information which gave information regarding Green Buildings to only 18.66 per cent of the builders. Research conducted by **Anderle (2010)** revealed that professional organization was the most effective channels for receiving information on Green buildings as stated by 69% of respondents. About 55% of the respondents reported web resources such as blogs, e-news etc. as channel in finding information on Green buildings. Conferences were also found as important channel in getting information on Green Buildings by 48% of the respondents. In the present study about one fourth (26.66%) of the respondents gained information from conferences and seminars.

Very few (10.66%, 5.33% and 2.66%) of the builders got information about Green Buildings through personal research, formal education and Different courses on Green Buildings respectively (Table 2, Fig.11). This indicates a need to include the concept of Green building in the formal education.

The word of mouth was a source of gaining information about Green Buildings for most of the selected builders. About 52 per cent got it from professional associates.

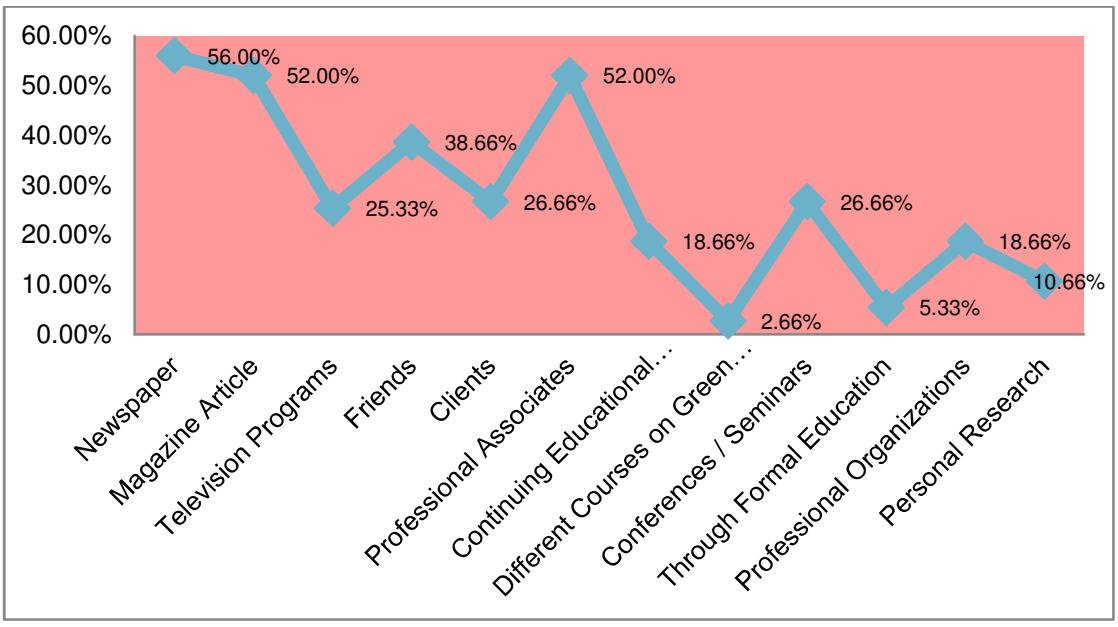

Figure 11: Percentage Distribution of respondents according to Source of Information Regarding Green Buildings

4.1.3 Extent of exposure to the sources of information on green building: The builders were asked to state that from various sources of information (12) as per the list provided, which ones they referred to gather information regarding Green Building. The responses of 'referred' and 'not referred' were given scores of 1 and zero respectively. The possible scores of 0 to 12 obtained on the different sources of information regarding green buildings were divided into three categories having equal interval which determined the extent of exposure to the sources of information on green buildings. It was found that the more than one half of the respondents had low extent of exposure and less than one half of the respondents had moderate extent of exposure (Table 3, Fig.12).

Table 3: Distribution of respondents according to their extent of exposure to different sources of information

Sr. No.	Extent of exposure	Respondents (n=75)	
		f	%
1.	High extent of exposure (9-12)	03	4.00
2.	Moderate extent of exposure (4-8)	33	44.00
3.	Low extent of exposure (0-3)	39	52.00
	Total	**75**	**100**

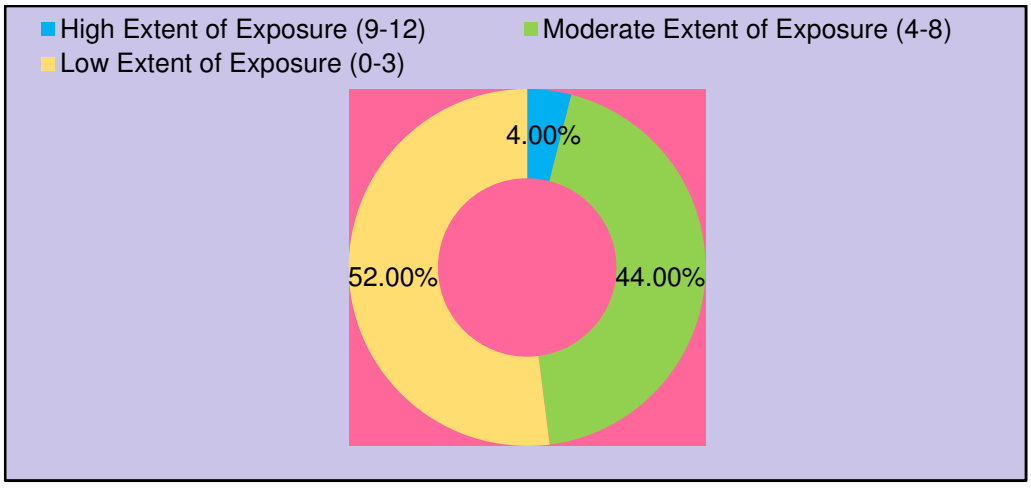

Figure 12: Percentage Distribution of respondents according to their Extent of Exposure to Different Sources of Information

4.1.4 Familiarity with the concepts & methods of Green Buildings

As the concept of green building came into existence in India since 2001, it was thought that the builders being in construction industry must be familiar about this concept. The builders were asked to tell the level of familiarity with the concepts and methods of Green Buildings.

Table 4: Distribution of Respondents according to their familiarity with the concepts & methods of Green Buildings

Sr. No.	Level of Familiarity with the concepts & methods of Green Buildings	Respondents (n = 75)	
		f	%
1	Very Much Familiar	14	18.66
2	Somewhat Familiar	47	62.66
3	Barely Familiar	14	18.66
	Total	**75**	**100**

It was found that most of the builders were somewhat familiar about the concepts and method of Green Buildings. Equal percentage (18.66 %) of the builders was very much familiar and barely familiar with the concepts and methods of Green Buildings (Table 4, Fig.13).

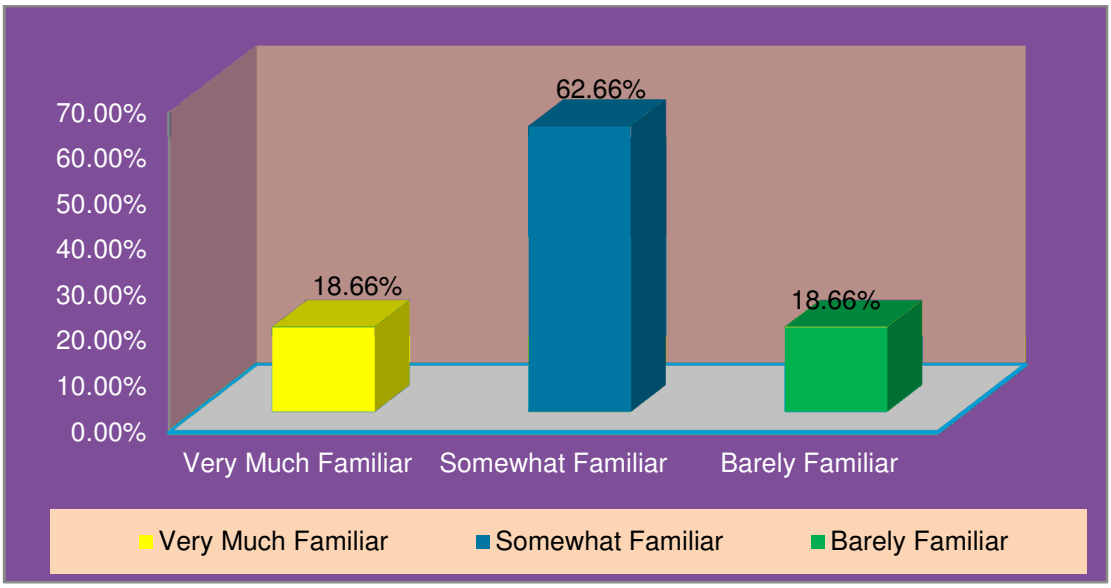

Figure 13: Percentage Distribution of respondents according to their Level of Familiarity with the Concepts and Methods of Green Buildings

4.1.5 Extent of Influence of Green Building Concept on Builders: Their Perception

The investigator was interested in finding out the extent of influence of Green Building concept on builders as perceived by themselves. It was thought that the extent of influence might motivate them in incorporating the Green Building concepts in their construction projects.

Table5: Distribution of Respondents according to extent of influence of Green Building design and Construction on builders

Sr. No.	Extent of Influence of Green Building Concept on Builders	Respondents (n = 75)	
		f	%
1	Great Extent	14	18.66
2	Somewhat Extent	42	56.00
3	Least Extent	19	25.33
	Total	**75**	**100**

The data revealed that more than one half of the builders were somewhat influenced by the concept of Green Building. One fourth of the builders were influenced by the Green Building concept to least extent. Only 18.66 per cent of the builders were influenced by Green Building concept by great extent (Table-5, Fig.14).

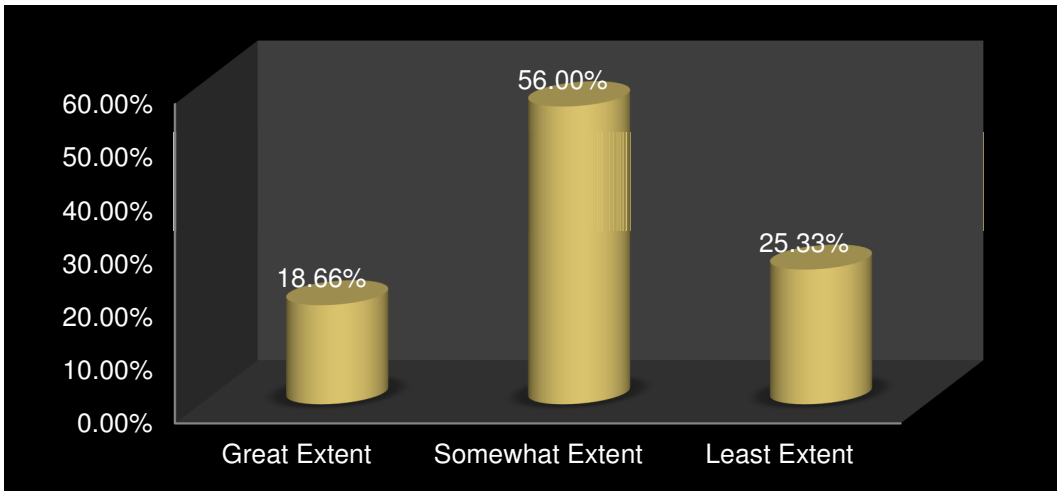

Figure 14: Percentage Distribution of the respondents according to Extent of Influence of Green Building Concept on Builders

4.1.5 Kind of Projects undertaken by builders in which Green Building elements were incorporated

In this section the builders were asked to reflect the kinds of building projects in which they had incorporated Green Building elements. The projects identified were public or private projects in which the builders had worked so far.

Table 6: Distribution of Respondents according to incorporation of Green Building elements in various kinds of Projects undertaken by them

Sr. No.	Kinds of Projects in which Green Building elements are incorporated	Respondents (n = 75)	
		f	%
a.	Private	70	93.33
b.	Public	05	6.66
	Total	**75**	**100**

The results indicated that majority of the builders had incorporated Green Building elements in Private projects. Only 6.66 per cent of the builders had incorporated Green Building elements in public projects. It can be concluded from the findings that the builders might had felt freedom in implementing Green Building elements in their private projects (Table-6, Fig.15).

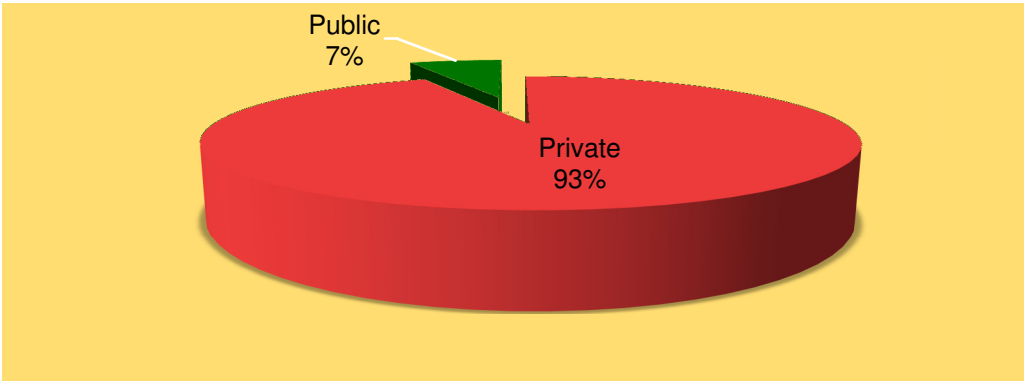

Figure 15: Percentage Distribution of respondents according to incorporation of Green Building elements in various kinds of Project undertaken by them

4.1.6 Extent of Green Building aspects incorporated in the projects undertaken by builders

Green Building aspects include site selection and planning, energy conservation, water conservation, material selection, indoor environment quality and innovative ideas. It was thought to find out the extent of incorporation of which of the green building aspects in the builders project. For which the builders were asked to state their extent of incorporation of various green building aspects in their projects.

Table 7: Distribution of Respondents according to extent of incorporation of Green Building aspects in the projects undertaken by builders

Sr. No.	Green Building Aspects incorporated in projects	Respondents (n = 75)						
		To a Great Extent		To Somewhat Extent		To Least Extent		W M (3-1)
		F	%	f	%	f	%	
1.	Water Conservation	34	45.33	29	38.66	12	16.00	2.29
2.	Indoor Environment quality: Occupant's Wellbeing& Protection	34	45.33	29	38.66	12	16.00	2.29
3.	Energy Conservation	30	40.00	33	44.00	12	16.00	2.24
4.	Innovation & Design	29	38.66	29	38.66	17	22.66	2.16
5.	Site Selection & Planning: sensitivity to land use context	20	26.66	35	46.66	20	26.66	2.0
6.	Material Selection: Solid Waste Minimization	18	24.00	38	50.66	19	25.33	1.99
	Total Weighted Mean							**2.16**

It was observed from the results that less than one half of the builders had incorporated water conservation and indoor environment quality and energy conservation aspects in their projects to great extent. More than one third of the builders had incorporated innovation and design in their projects. More than one fourth of the builders had incorporated site selection and planning aspects in their projects. Material selection as aspects of green building was incorporated by less than one fourth of the builders while one half of the builders had incorporated it to somewhat extent (Table-7, Fig.16). The

weighted mean computed for each item showed that “Water Conservation” and “Indoor Environment Quality” scored highest out of 3.

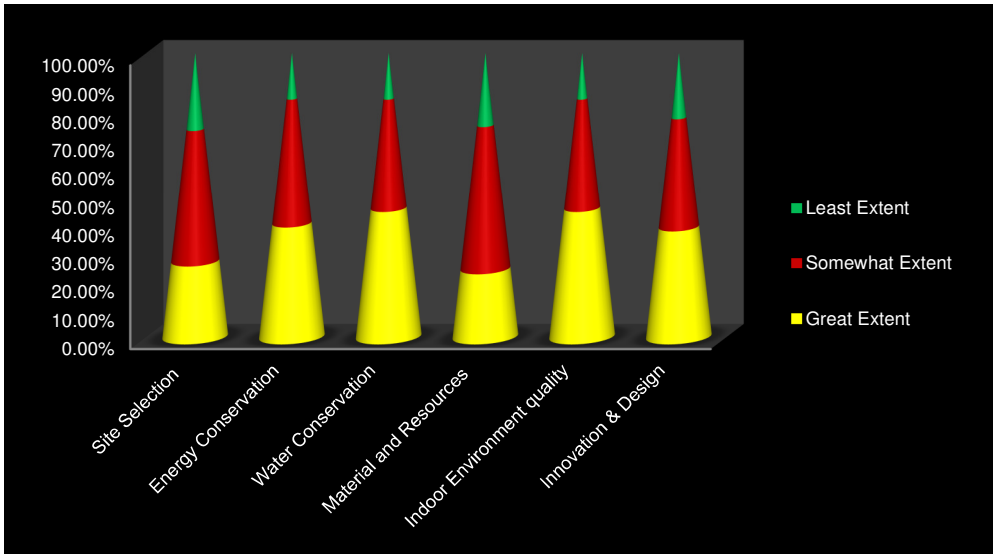

Figure 16: Percentage Distribution of respondents according to extent of incorporation of Green Building aspects in the projects undertaken by builders

4.1.7 Importance of Green Building Aspects for builders

The respondents were asked to rank various aspects of green building in order of importance to them. The aspects were energy efficiency, material and resources, indoor environmental quality, water conservation and sustainable site planning.

It was found that nearly two third of the respondents considered energy efficiency, indoor environment quality and water conservation aspects of green building as most important as other aspects (Table-8, Fig. 17).Material resources and sustainable site planning were considered most important by less than one half of the respondents respectively.

Fleming (2009) in Green Building survey of developers, corporate real estate executives and city and county government officials conducted by National Real Estate Investors in partnership with the U.S. Green Building Council, an overwhelming majority of developers (88%) and corporate executives (86%) indicated that they consider green design important.

A survey conducted by **Turner Green Building Market Barometer (2004)** showed that more than half of the executives cited energy efficiency as most important quality of Green building. Indoor environment quality was rated most important by 23% of executives.

Table 8: Distribution of Respondents according to the rank of importance given by them for Green Building Aspects

Sr. No.	Green Building Aspects	Respondents (n = 75)										
		Most Important		Somewhat Important		Moderately Important		Somewhat Un-important		Least Important		W M (1 -5)
		f	%	f	%	F	%	f	%	F	%	
1.	Indoor Environmental Quality	51	68.00	21	28.0	02	2.7	01	1.3	00	00.0	4.63
2.	Water Conservation	48	64.00	21	28.0	05	6.7	01	1.3	00	00.0	4.55
3.	Energy Efficiency	47	62.66	17	22.7	10	13.3	01	1.3	00	00.0	4.46
4.	Materials & Resources	37	49.33	20	26.7	13	17.3	02	2.7	03	4.0	4.14
5	Sustainable Site Planning	33	44.00	24	32.0	10	13.33	07	9.3	01	1.3	4.08
	Total Weighted Mean											**4.37**

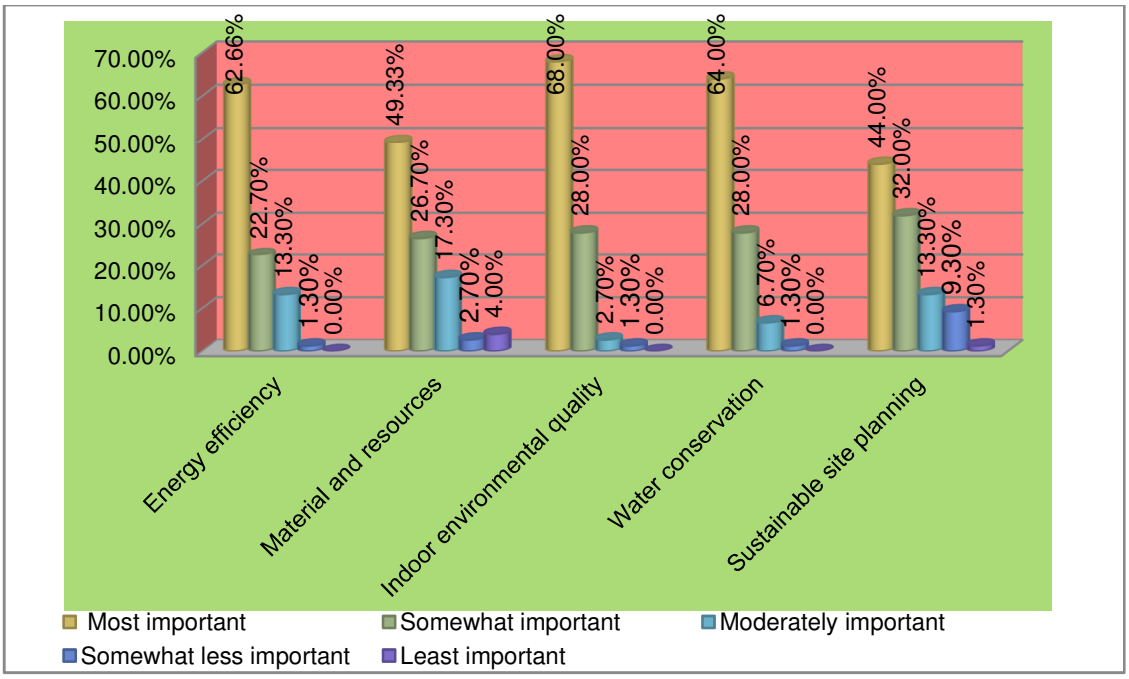

Figure 17: Percentage Distribution of respondents according to the rank of importance given by them for Green Building Aspects

4.1.3 Opinion of builders regarding Green Buildings

It was thought important to find out the opinion of the builders regarding green building aspects because it was assumed that the consumers will purchase or choose the house which are built on green building principles only if the builder's will provide it. Builder's opinion regarding green building design and construction will affect their consumers. Several statements were framed to find out the opinion of the builders regarding green building aspects.

The data in table 9 revealed that more than one half (56.0%) of the builders strongly agreed that "Due to the deterioting environmental quality of Vadodara city, the Green Building design and construction should be promoted". The weighted mean scores were found to be the highest for this statement (Table-9). It was followed by the statement that "Green Building design and construction helps in balancing the negative effect of various kind of pollution, hence should be implemented in Vadodara city" (50.7%). A little less than one half said that "Green Building design and construction is a tool which enables the designer to apply green concepts and criteria, so as to reduce the environmental impacts". Same percentage of the builders agreed that "People of Vadodara city are environment conscious so Green Building design and construction is encouraged by them" (49.3 %) "As the city of Vadodara is witnessing tremendous growth in infrastructure and construction development, Green Building design and construction can aid growth in a sustainable manner" (46.7 %). Less than one half of the builders were neutral about the concept that "Constructing a Green Building proves to be costlier than ordinary building" (45.3%). Less than one third of the builders disagreed that it is difficult to design the building as per the standards and recommendation of LEED than designing the simple houses (61.3%). Less than one half of the builders strongly disagreed that people at present are not aware of Green Building design and construction, therefore, they do not opt for such housing (40.0%).

Table 9: Distribution of Builders as per their opinion about Green Buildings

Sr. No.	Opinion of Builders about Green Buildings	Respondents (n = 75)										
		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		W M (1-5)
		f	%	f	%	f	%	f	%	f	%	
1 (+)	Due to the deterioting environmental quality of Vadodara city, the Green Building design and construction should be promoted.	42	56.0	27	36.0	05	6.7	01	1.3	00	00.0	4.46
2 (+)	People of Vadodara city are environment conscious so Green Building design and construction is encouraged by them.	19	25.3	37	49.3	12	16.0	05	6.7	02	2.7	3.88
3 (+)	Green Building design and construction helps in balancing the negative effect of various kind of pollution, hence should be implemented in Vadodara city.	38	50.7	32	42.7	04	5.3	01	1.3	00	00.00	4.42
4 (+)	As the city of Vadodara is witnessing tremendous growth in infrastructure and construction development, Green Building design and construction can aid growth in a sustainable manner.	27	36.0	35	46.7	08	10.7	05	6.7	00	00.00	4.12
5 (+)	Green Building design and construction is a tool which enables the designer to apply green concepts and criteria, so as to reduce the environmental impacts.	37	49.3	26	34.7	11	14.7	01	1.3	00	00.00	4.32
6 (-)	Green building design and construction should be promoted in Vadodara city because it is in fashion.	03	4.0	26	34.7	19	25.3	21	28.0	06	8.0	3.01
7 (+)	Green Building design and construction ensures conservation of energy hence should be promoted in Vadodara city.	33	44.0	32	42.7	07	9.3	03	4.0	00	00.00	4.26
8 (+)	Green building utilizes recycled water which would reduce water problem faced by the people of Vadodara city.	40	53.3	25	33.3	09	12.0	01	1.3	00	00.00	4.38
9 (-)	Constructing a Green Building proves to be costlier than ordinary building.	07	9.3	09	12.0	34	45.3	25	33.3	00	00.00	3.02

Sr. No.	Opinion of Builders about Green Buildings	Respondents (n = 75)										
		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		W M (1-5)
		f	%	f	%	f	%	f	%	f	%	
10 (-)	Since people at present are not aware of Green Building design and construction, they do not opt for such housing.	01	1.3	11	14.7	10	13.3	23	30.7	30	40.0	3.93
11 (-)	It is difficult to design the building as per the standards and recommendation of LEED than designing the simple houses.	01	1.3	09	12.0	08	10.7	46	61.3	11	14.7	3.76
12 (-)	It is difficult to get certificate from LEED for the building as “Green Building”.	01	1.3	16	21.3	19	25.3	34	45.3	05	6.7	3.34
13 (-)	Unless there is a certificate from LEED or other such recognized agency, the people do not accept the claim that the building is green.	01	1.3	10	13.3	18	24.0	40	53.3	06	8.0	3.53
14 (-)	Using the term “Green” for building is just one or more “sales gimmicks” by the builders.	04	5.3	22	29.3	04	5.3	29	38.7	16	21.3	3.41
	Total Weighted Mean											**3.84**

4.1.2.1 Opinion regarding Green Buildings: Overall View

The responses of builders about their opinion regarding green buildings ("Strongly Agree", "Agree", "Neutral", "Disagree" and "Strongly Disagree") were given scores of 5 through 1 respectively. The possible maximum and minimum scores was divided in three categories having equal intervals. Higher the scores indicated most favourable opinion of builders regarding green buildings.

Table 10: Distribution of respondents according to their opinion regarding Green Buildings

Opinion of Builders regarding Green Buildings	Range of Scores	Respondents (n = 75)	
		f	%
Most Favourable	52 – 70	18	24.0
Somewhat Favourable	33 – 51	56	74.67
Least Favourable	14 – 32	1	1.3
Total		**75**	**100.0**

It could be concluded from the data that less than three fourth of the builders had "Somewhat favourable" opinion regarding Green Buildings. Less than one fourth of the respondents had "most favourable" opinion regarding green buildings (Table-10, Fig. 18).

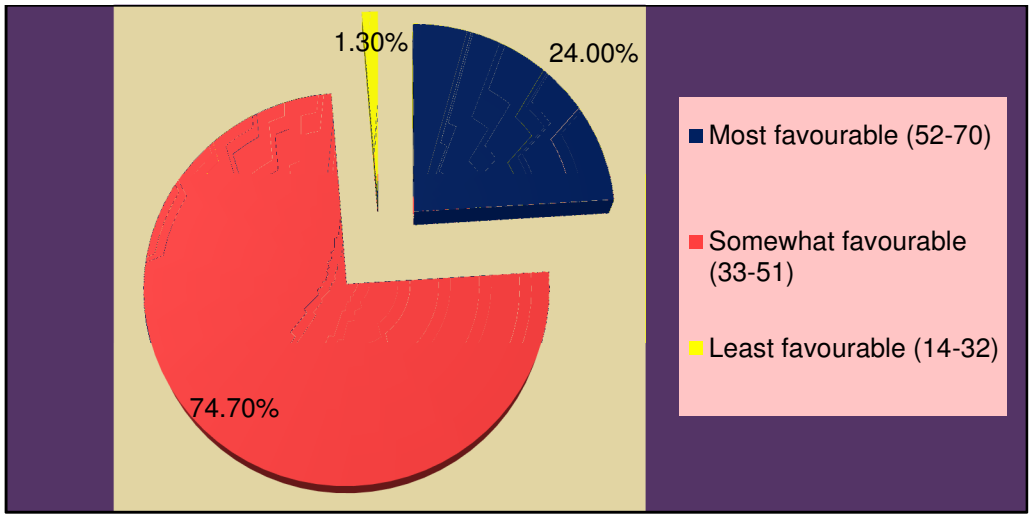

Figure 18: Percentage Distribution of the respondents according to their Opinion regarding Green Buildings

4.1.4 Reasons for adopting Green Building Concepts by the builders in their projects

This section deals with various reasons which influenced the builders to adopt green building concept. The researcher considered it important to find out the reasons which influenced builders to adopt the green building concepts in their projects. The reasons were categorized into three sub scales viz. “Economic reasons”, “Environmental reasons” and “Other reasons”. The responses were sought in terms of “To great extent”, “To some extent” and “To least extent”, which were ascribed scores of 3 through 1. They were summated and the extent of influence was found out. The weighted mean score of each reason were also computed.

It was reflected from the data regarding the economic reasons(Table-11) that the builders were influenced to somewhat extent (49.3%) and to great extent (45.3%) by the reason that “concept of green building design and construction it attracts more people”. Forty per cent of the builders were influenced to the least extent by the reason that “In order to adopt the Green Building concept, people are ready to pay the amount demanded”. Regarding the environmental reasons, it was found that majority of the builders were influenced to a great extent by the reasons “Green Buildings are energy efficient” (78.6 %), “Green Buildings provide provision for maximum daylighting thereby reducing the dependence on electric energy” (76.0 %) and “Green Buildings help in reducing air pollution by providing easy access to public transport” (74.7%) respectively. While less than one half of the respondents were somewhat influenced by the environmental reason that “Green Buildings provides facilities for recycling of waste generated by building occupants”.

More than one half of the builders were influence by other reasons such as “To adopt new idea or a concept of Green Building” and “Impressed by the concept of Green Building” to great extent. More than one half of the builders were somewhat influenced by “To have a different experience” and “To gain popularity among masses” respectively as other reason in adopting green building concept.

A survey conducted by **National Association of Industrial and Office Properties Research Foundation in (2007)** reported that respondents believe that the most significant incentive or trigger that has been effective in promoting green building is “an internal philosophy to build green” (44%) and “when business case benefits are recognized and desired by tenants” (33%).

Research conducted by **Anderle (2010)** stated energy efficiency as the strongest factor in market by 50% of the respondents whereas the present research more than 78 per cent of the respondents were influenced to a great extent by the reasons that green buildings are energy efficient. Environmental case was reported by 36% of the respondents in the research conducted by **Anderle (2010).** In the present research environmental reasons had highest mean weighted score (2.61 out of 3.00) amongst all the reasons (Table-11).

Table 11: Distribution of Respondents according to the reasons given by them for adopting Green Building design and construction

Sr. No.	Reasons for adopting green building design and construction	Respondents (n = 75)						
		To Great Extent		To Some Extent		To Least Extent		W M (1-3)
		f	%	f	%	f	%	
A	**Economic Reasons**							
1	The green building project sells by its name.	14	18.7	49	65.3	12	16.0	2.03
2	The concept of green building design and construction attracts more people.	34	45.3	37	49.3	04	5.3	2.4
3	In order to adopt the Green Building concept, people are ready to pay the amount demanded.	14	18.7	31	41.3	30	40.0	1.79
	Total Weighted Mean							**2.07**
B	**Environmental Reasons**							
1	Green Buildings are energy efficient.	59	78.6	16	21.3	00	00.0	2.79
2	Green Buildings help in reducing air pollution by providing easy access to public transport.	56	74.7	17	22.7	02	2.7	2.72
3	By encouraging the installation of CFC free equipments Green Buildings reduce ozone layer depletion	46	61.3	25	33.3	04	5.3	2.56
4	Green Buildings encourage the use of renewable technologies such as solar, wind, geothermal, bi-mass and hydro strategies.	43	57.3	29	38.7	03	4.0	2.53
5	Green buildings encourage the use of rapidly renewable materials.	47	62.7	24	32.0	04	5.3	2.57
6	Green Buildings enhance indoor environment quality through the use of low VOC materials and efficient cross ventilation and such other ways.	52	69.3	22	29.3	01	1.3	2.68
7	Green Buildings provide provision for maximum daylighting thereby reducing the dependence on electric energy.	57	76.0	18	24.0	00	00.0	2.76
8	Green Buildings provide facilities for recycling of waste generated by building	38	50.6	32	42.7	05	6.7	2.44

Sr. No.	Reasons for adopting green building design and construction	Respondents (n = 75)						
		To Great Extent		To Some Extent		To Least Extent		W M (1-3)
		f	%	f	%	f	%	
	occupants.							
9	Green Buildings help in conservation of natural resources like wood by using forest certified wood.	41	54.7	26	34.7	08	10.7	2.44
	Total Weighted Mean							**2.61**
C	**Other Reasons**							
1	Green Building design and construction is in fashion.	15	20.0	35	46.7	25	33.3	1.87
2	To gain popularity among masses.	21	28.0	39	52.0	15	20.0	2.08
3	Green Building design and construction gives better recognition as builders amongst people.	29	38.7	37	49.3	09	12.0	2.27
4	To have a different experience.	23	30.6	43	57.3	09	12.0	2.19
5	To get media coverage.	17	22.7	36	48.0	22	29.3	1.93
6	To adopt new idea or a concept.	39	52.0	27	36.0	09	12.0	2.40
7	Impressed by the concept of Green Building.	39	52.0	30	40.0	06	8.0	2.44
8	Influenced by the peer group/friends as they have adopted it.	27	36.0	28	37.3	20	26.7	2.09
9	To actually implement the concept of Green Building.	35	46.7	33	44.0	07	9.3	2.37
	Total Weighted Mean							**2.18**

4.1.3.1 Extent of influence of reasons for adopting green building design and construction

The responses of builders about extent of influence of reasons ("To great extent", "To some extent" and "To least extent") were given scores of 3 through 1 respectively. The possible range of maximum and minimum scores was divided in three categories having equal intervals. Higher the score indicated high extent of influence of reasons for adopting green building design and construction by the builders in their projects.

Table 12: Distribution of Respondents according to their extent of influence of reasons for adopting green building features in their construction projects

Sr. No.	Extent of influence of reasons for adopting green building design and construction	Range of Scores	Respondents (n = 75)	
			f	%
A	**Economic Reasons**			
	High Extent	8 – 9	16	21.3
	Moderate Extent	5 – 7	46	61.3
	Low Extent	3 - 4	13	17.3
	Total Weighted Mean	**1 - 3**	**2.07**	
B	**Environmental Reasons**			
	High Extent	22 – 27	46	61.3
	Moderate Extent	15 – 21	28	37.3
	Low Extent	9 – 14	01	1.3
	Total Weighted Mean	**1 - 3**	**2.61**	
C	**Other Reasons**			
	High Extent	22 – 27	23	30.7
	Moderate Extent	15 – 21	46	61.3
	Low Extent	9 – 14	06	8.0
	Total Weighted Mean	**1 - 3**	**2.18**	
D	**Total**			
	High Extent	50 - 63	35	46.7
	Moderate Extent	35 – 49	36	48.0
	Low Extent	21 - 34	04	5.3
	Total Weighted Mean	**1 - 3**	**2.29**	

Less than one half of the respondents had moderate extent of influence of economic reasons in adopting Green Building design and construction. The

environmental reasons were influencing to a great extent to less than two third of the builders for adopting green building while other reasons such as to adopt new idea and concept were influential to somewhat extent. The other reasons for adopting green building design and construction were influential to somewhat extent to less than three fourth of the builders. Less than one half of the respondents had moderated extent of influence while nearly same percentage of respondents had high extent of influence of reasons. The mean weighted score for the sub aspects supported this finding (Table 12, Fig. 19).

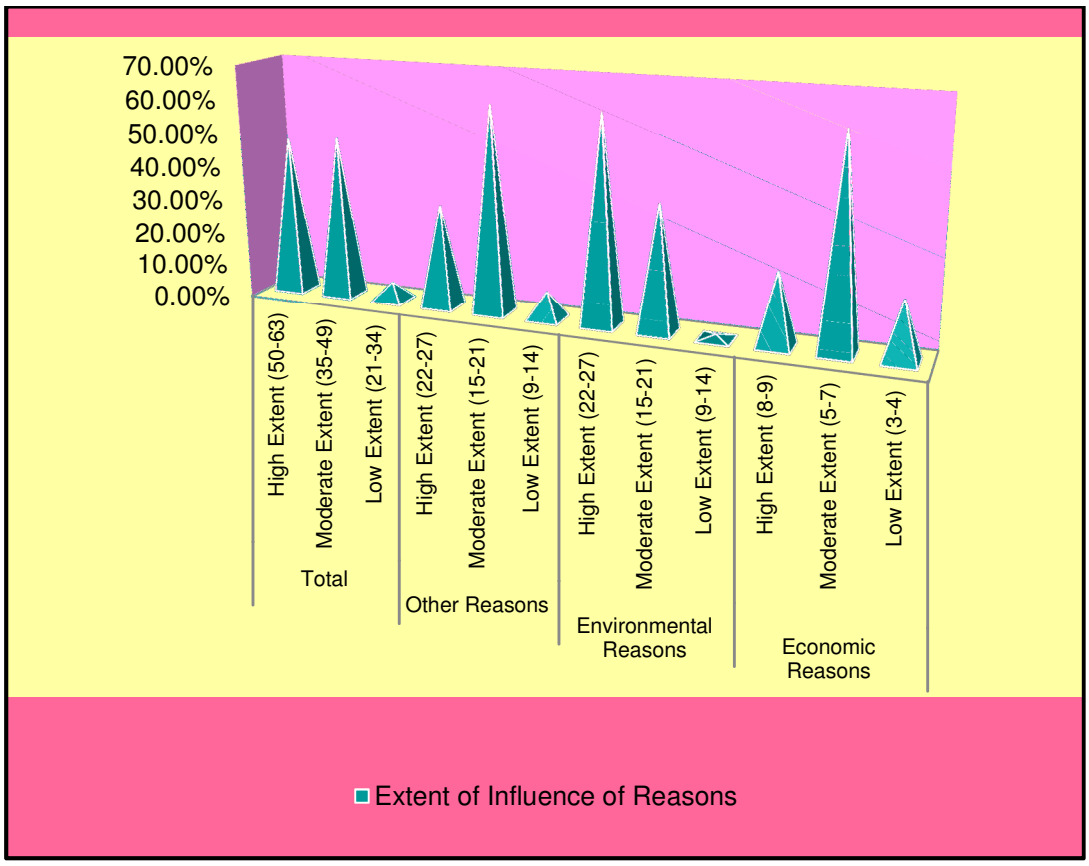

Figure 19: Percentage Distribution of respondents according to Extent of Influence of Reasons for Adopting Green Building Design and Construction

The weighted mean (item intensity) for each of the statement and for each of the category of reasons for adopting green building concept by the selected builders of Vadodara city was found. It is reported in Table 12.

Table 13: Weighted mean for the reasons for adopting green building concept

Sr. No	Reasons for adopting green building concept	Total Weighted mean (1-3) (intensity index)
A.	Economic reasons	2.07
B.	Environmental reasons	2.61
C.	Other reasons	2.18
	Overall weighted mean	**2.29**

The computed weighted mean for each reason for adopting Green building concept revealed that "Environmental reasons" were the most influential reasons for adopting Green building concept by the builders of Vadodara city.The overall weighted mean on all the factors was 2.29 (Table 13, Figure 20).

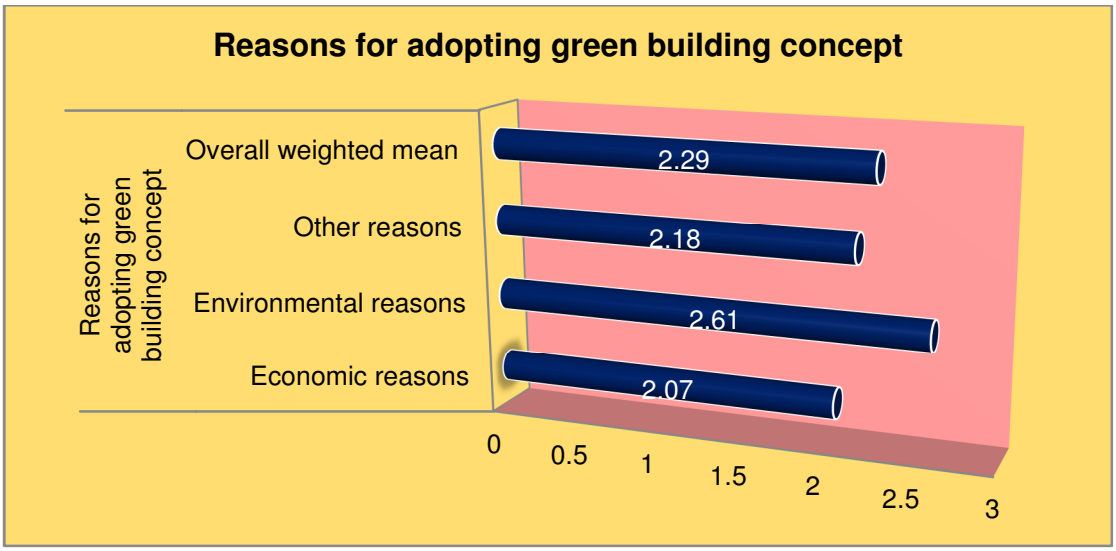

Figure 20: Weighted Mean for the reasons for adopting green building concept

4.1.4 Barriers faced in adopting Green Building design and construction in the projects undertaken by the selected builders

There were several reasons for adopting green building design and construction but the builders faced lot of barriers in adopting the same. The

barriers considered were listed as “Technical barriers”, “Availability of funds, space and materials”, “Green Certification process”, “Lack of expected returns” and “Lack of interest”. The responses were sought in terms of “Major Barrier”, “Minor Barrier” and “Not a Barrier”, which were ascribed scores of 3 through 1 respectively.

It was found that less than three fourth of the builders faced technical knowledge as a major barrier such as “Lack of training / education of builders in Green building design/ construction” and “Lack of technical understanding on the part of subcontractors” respectively to a major extent (Table-13). More than one half of the builders faced minor barriers in availability of funds, space and materials such as “Green” products not available in that area” and “Site selection for a Green Building project was a problem” respectively. Less than three fourth of the builders faced minor barriers in procuring green certification because “The process of certification is not easy to understand” while more than on half of the builders faced minor barriers in green certification process because they found process of certification very expensive. One half of the builders face major barrier in adopting green building design and construction because of lack of expected returns as Some small builder’s “Green Building projects did not get economic rewards as expected”. More than one half of the builders faced major barriers due to lack of expressed interest from potential owners/people and also from builders/developers to implement Green Building projects respectively. The computed weighted mean supported the findings.

A survey was conducted by **Turner Construction Company in 2008** which focused on the executives involved with commercial real estate. It was found that the “cost of documentation for LEED certification” was rated as very significant barrier to Green construction by 54% of executives followed by “higher construction cost” and “long payback periods” (50%). In the present research also similar percentage of builders reported this (Table-13).

The 3rd Annual Green Building Survey conducted by **Allen Matkins(2009)**, Constructive Technology Group and Green Building Insider reported that

contractors believed that greatest risk for green construction were “design and construction defects”, “impact to the owner”, and “not recouping capital costs”. Architects, Engineers and owners felt “not recouping capital costs” were the greatest risk. All of them also perceived that all the risks decreases with green construction experience.

A survey conducted by **National Association of Industrial and Office Properties Research Foundation in 2007** reported that the most significant barrier to the rapid growth of green buildings is “perceived cost increase” (41%). In developers’ opinions, the second highest barrier is the “lack of knowledge of how to build green” (18%). In the present research 65 percent of respondents faced this as a major barrier in adopting green building design and construction in their projects (Table -13).

A survey conducted of Green Building in **2005 by Turner Construction Company** Rating of potential obstacles to Green construction of Educational Facilities as stated by executives representing various organizations including architectural/engineering firms, consultants, developers, building owners, corporate owners-occupants and educational institutions, higher construction costs were most often rated as a major obstacle (74%) to the construction of Green K-12 facilities, while 66% of the executives said same about construction of Green college and university facilities. “Short term budget horizons” (57%) were cited as a very extremely significant obstacle to Green construction of K-12 facilities and to Green construction of college and university facilities by 54% of the executives. “Lack of awareness of the benefits of Green construction” was seen as another important obstacle, cited by 67% of executives involved with K-12 facilities and by 59% of those involved with higher educational facilities. LEED documentation cost was the obstacle stated by 55% of the executives involved with K-12 facilities and 52% of those involved with higher educational facilities. The builders of the present study reported cost of certification of LEED as minor barriers (54 %) but it was felt as major barrier by 29 per cent of the builders.**Khanna et.al. (2014)** reported that developers in China cited higher incremental cost as one of the barrier to invest in Green buildings.

Griffin et.al. (2010) reported the perceived increased cost, regulations that do not recognize new green materials and systems and availability of the materials as the primary barriers in implementing sustainable structural materials.

Factors relating to cost were ranked as some of the most important obstacles to Green construction cited by 68% of the executives. Nearly 50% of the executives rated short-term budget horizons of many organizations and a payback from Green construction that is felt to be too long as obstacles to the Green construction.

Through informal talks with the builders some additional barriers were reported by them and suggestions they reported which are discussed here:

- Green buildings takes time to construct, but the public wants the possession of their houses as early as possible.
- Constructing Green buildings proves to be costlier, therefore people are not ready to purchase.
- There is lack of awareness among the masse regarding Green buildings.
- The meeting should be conducted with the architects for discussing the concept of green building.
- Local bylaws do not allow fully constructing a building according to green building principles.
- Green building once constructed, it is not sure that the residents will maintain it or not after occupancy.
- Government should take initiatives in promoting the construction of Green buildings.
- Government should make it compulsory to implement the Green design concept and principles in every construction projects.

Table 14: Distribution of builders according to the barriers faced by them in adopting Green Building Design & Construction

Sr. No.	Barriers faced by builders in adopting green building design and construction	Respondents (n = 75)						
		Major Barrier		Minor Barrier		Not a Barrier		W M (1-3)
		f	%	f	%	f	%	
A	**Technical Knowledge**							
1	Lack of training / education of builders in Green building design/ construction.	49	65.3	16	21.3	10	13.3	2.52
2	Lack of technical understanding on the part of subcontractors.	48	64.0	24	32.0	03	4.0	2.6
3	Lack of technical understanding on the part of others on the project team.	43	57.3	29	38.7	03	4.0	2.5
4	Lack of technical understanding on the part of the clerk of the works.	32	42.7	34	45.3	09	12.0	2.3
5	Not sure where to get information on sustainable building methods.	29	38.7	31	41.3	15	20.0	2.18
	Total Weighted Mean							**2.42**
B	**Availability of Funds, Space & Materials**							
1	“Green” products not available in that area.	31	41.3	41	54.7	03	4.0	2.37
2	Difficult to obtain financing from banks for Green Building projects.	18	24.0	32	42.7	25	33.3	1.9
3	Site selection for a Green Building project was a problem.	29	38.7	38	50.7	08	10.7	2.28
	Total Weighted Mean							**2.18**
C	**Green Certificate Process**							
1	Getting Green Building certification is difficult.	18	24.0	37	49.3	20	26.7	1.97
2	The process of getting Green Building certification is very lengthy.	20	26.7	38	50.7	17	22.7	2.04
3	The process of certification is not easy to understand.	20	26.7	46	61.3	09	12.0	2.14
4	The process of certification is very expensive.	22	29.3	41	54.7	12	16.0	2.13

Sr. No.	Barriers faced by builders in adopting green building design and construction	Respondents (n = 75)						
		Major Barrier		Minor Barrier		Not a Barrier		W M (1-3)
		f	%	f	%	f	%	
	Total Weighted Mean							**2.07**
D	**Lack of Expected Returns**							
1	Some builder's Green Building projects did not get economic rewards as expected.	38	50.7	28	37.3	09	12.0	2.38
2	Green Building does not get recognition by people easily.	33	44.0	29	38.7	13	17.3	2.26
3	Some builder's did not get the expected certification for their Green Building projects, hence it is demotivating.	28	37.3	36	48.0	11	14.7	2.22
	Total Weighted Mean							**2.28**
E	**Lack of Interest**							
1	Lack of interest of builders/developers to implement Green Building projects.	44	57.3	25	33.3	06	8.0	2.5
2	Lack of interest from architects/designers to design Green Building.	32	42.7	30	40.0	13	17.3	2.25
3	Lack of interest of funding agencies to fund for Green building.	34	45.3	29	38.7	12	16.0	2.29
4	Lack of expressed interest from potential owners/people.	44	58.7	26	34.7	05	6.7	2.52
	Total Weighted Mean							**2.39**

4.1.4.1 Extent of Barriers Faced in Adopting Green Building Design and Construction

The responses of builders about extent of barriers faced ("Major Barriers", "Minor Barriers" and "Not a barrier") were given scores of 3 through 1 respectively. The possible maximum and minimum scores were divided in three categories having equal interval. Higher scores indicated high extent of barriers faced by the builders in adopting green building design and construction.

Table 15: Distribution of Respondents according to the barriers faced in adopting Green Building design and construction

Sr. No.	Extent of barriers faced by the builders in adopting green building design and construction	Range of Scores	Respondents (n = 75)	
			f	%
A	**Technical Knowledge**			
	High Extent	12 – 15	53	70.7
	Moderate Extent	8 – 11	19	25.3
	Low Extent	5 – 7	03	4.0
	Total Weighted Mean	**1 - 3**	**2.42**	
B	**Availability of Funds, Space & Materials**			
	High Extent	8 – 9	17	22.7
	Moderate Extent	5 – 7	52	69.3
	Low Extent	3 – 4	06	8.0
	Total Weighted Mean	**1 - 3**	**2.18**	
C	**Green Certification Process**			
	High Extent	10 – 12	18	24.0
	Moderate Extent	7 – 9	44	58.7
	Low Extent	4 – 6	13	17.3
	Total Weighted Mean	**1 - 3**	**2.07**	
D	**Lack of Expected Returns**			
	High Extent	8 – 9	35	46.7
	Moderate Extent	5 – 7	33	44.0
	Low Extent	3 - 4	07	9.3
	Total Weighted Mean	**1 - 3**	**2.28**	
E	**Lack of Interest**			
	High Extent	10 – 12	41	54.7
	Moderate Extent	7 – 9	26	34.7
	Low Extent	4 – 6	08	10.7
	Total Weighted Mean	**1 - 3**	**2.39**	
F	**Total**			
	High Extent	45 – 57	34	45.3
	Moderate Extent	32 – 44	37	49.3
	Low Extent	19 – 31	04	5.3
	Overall Weighted Mean	**1 – 3**	**2.27**	

Regarding extent of barriers faced by the respondents in adopting green building, it was found that lack of technical knowledge of the builders, contractors, clerk and the other project team was found to be at a high extent as barrier faced by majority of the respondents amongst all other categories. More than three fourth of the respondents faced moderate extent of barriers in availing funds, space and materials for constructing green buildings (Table-15, Fig.21). Less than one half of the builders faced moderate extent of barriers in adopting Green building design and construction while almost similar percentage of builders faced high extent of barriers in adopting Green building design and construction. The mean weighted score computed for the each category of barriers supported this finding.

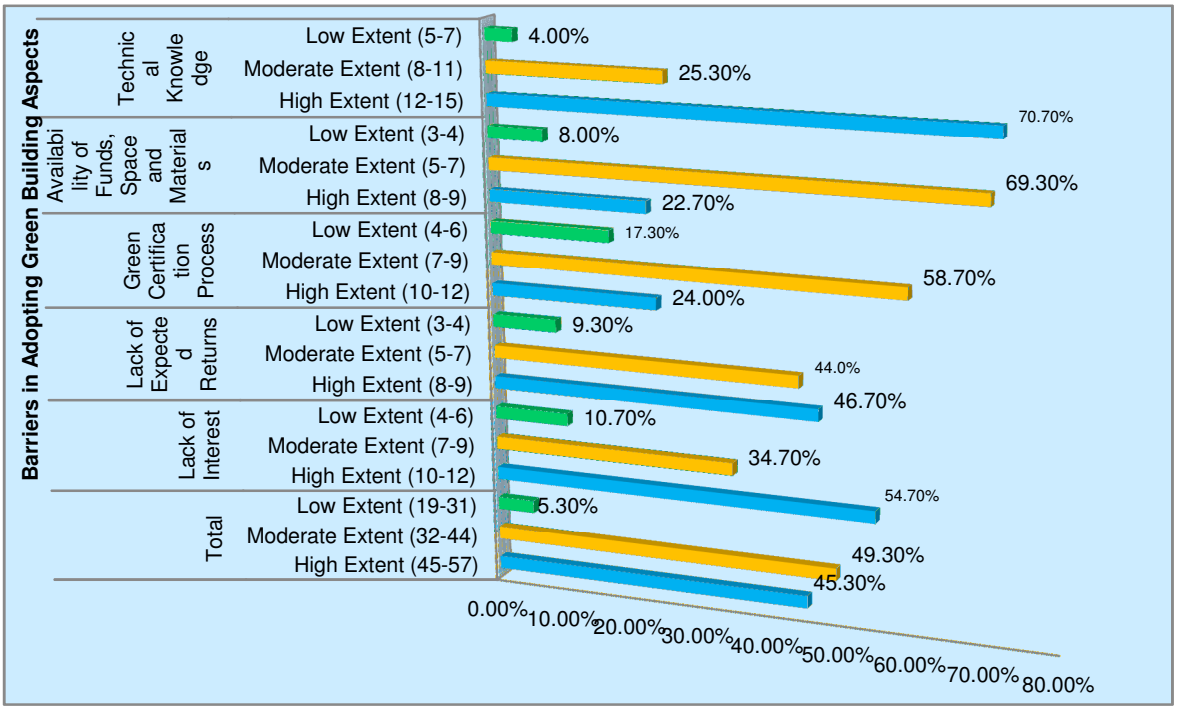

Figure 21: Percentage Distribution of the respondents according to the barriers faced in adopting Green Building design and construction

The weighted mean (item intensity) for each of the barrier faced in adopting Green Building concept was found. It is reported in Table 15 and Figure 21.

Table 16: Weighted mean for barriers faced by builders in adopting Green Building concept

Sr. No	Barriers in adopting Green Building concept	Total Weighted mean (1-3) (intensity index)
A.	Technical knowledge	2.42
B.	Availability of Funds, Space & Materials	2.18
C.	Green Certification Process	2.07
D.	Lack of Expected Returns	2.28
E.	Lack of Interest	2.39
	Overall weighted mean	**2.27**

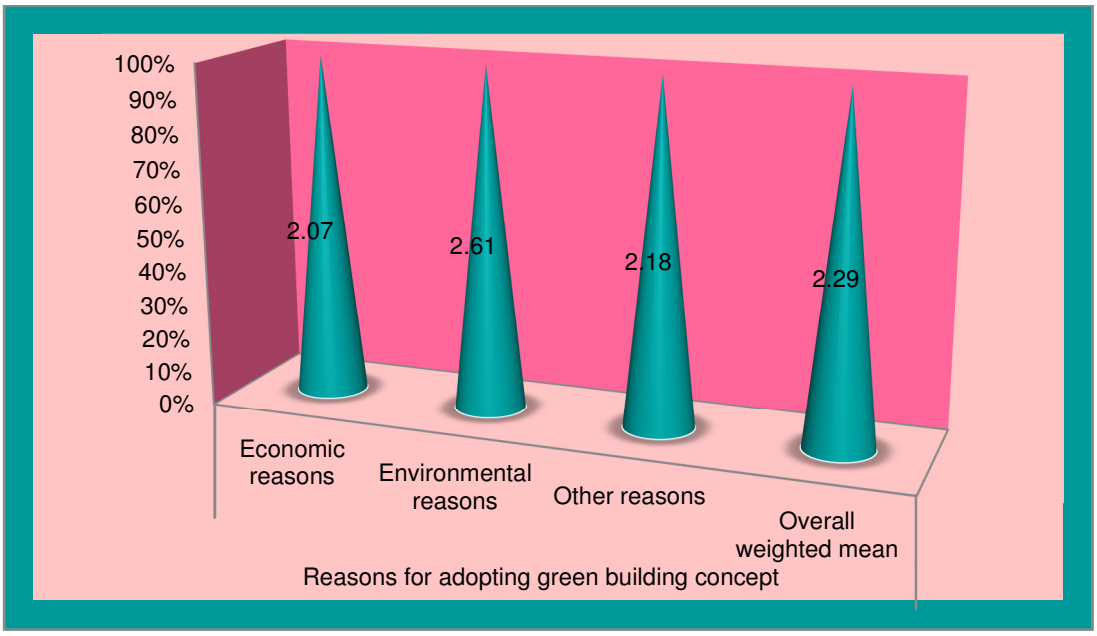

Figure 22: Weighted mean for the barriers faced by the builders in Adopting Green Building Concept

The computed weighted mean for each barrier faced in adopting Green Building showed that “Technical Knowledge” and “Lack of Interest” were the categories for which the selected builders faced major barriers in adopting Green Building concept. The overall weighted mean for the entire sale was 2.27 (Table 16, Figure 22).

Section 4.2

4.2 Information regarding Home Owners

This part includes general information regarding the purchase of the house, background information of the respondents, knowledge of the respondents regarding Green Buildings, and assessment of the selected houses for their extent of green-ness. The term 'home owners' is referred to the respondents who were one of the key decision makers regarding owing/ purchasing/ constructing the house. The term 'home owners' and 'respondents' are used interchangeably in the present study.

4.2.1 General information regarding the respondents of the study

The information on decision regarding the purchase or construction of the house and the gender of the key respondent is presented here:

Decision regarding the purchase / construction of the house: The respondents were asked to indicate the key decision maker of the family who took decision regarding the purchase of the house. In case of joint decisions, that family member who was available at the time of data collection and reflected his/her willingness to co-operate was selected as the key respondent.

Husband and wife together took decision regarding the purchase or construction of the house in less than one half of the cases. In one third of the cases the decision regarding the purchase or construction of the house was taken by husband, wife and children together. Husbands alone took decision regarding the purchase or construction of the house in only 12.3 per cent of the cases (Table-17, Fig.23). Hence, it can also be concluded that the husbands jointly or independently participated more in decision making process regarding the purchase or construction of the house. In all the cases husbands were involved in decision making except only in about 2 percent of the cases.

Table 17:Distribution of Respondents according to the decisions taken regarding the purchase / construction of the house

Sr. No.	Decision makers	Respondents (n = 220)	
		F	%
1	Husband only	27	12.3
2	Wife only	3	1.4
3	Children only	0	0.0
4	Others only	2	0.9
5	Husband and wife together	90	40.9
6	Husband and children together	2	0.9
7	Husband and others together	3	1.4
8	Husband, wife and children together	74	33.63
9	Husband, wife, children and others together	19	8.6
10	Wife and children together	0	0.0
11	Wife and others together	0	0.0
12	Wife, children and others together	0	0.0
13	Children and other's together	0	0.0
	Total	**220**	**100**

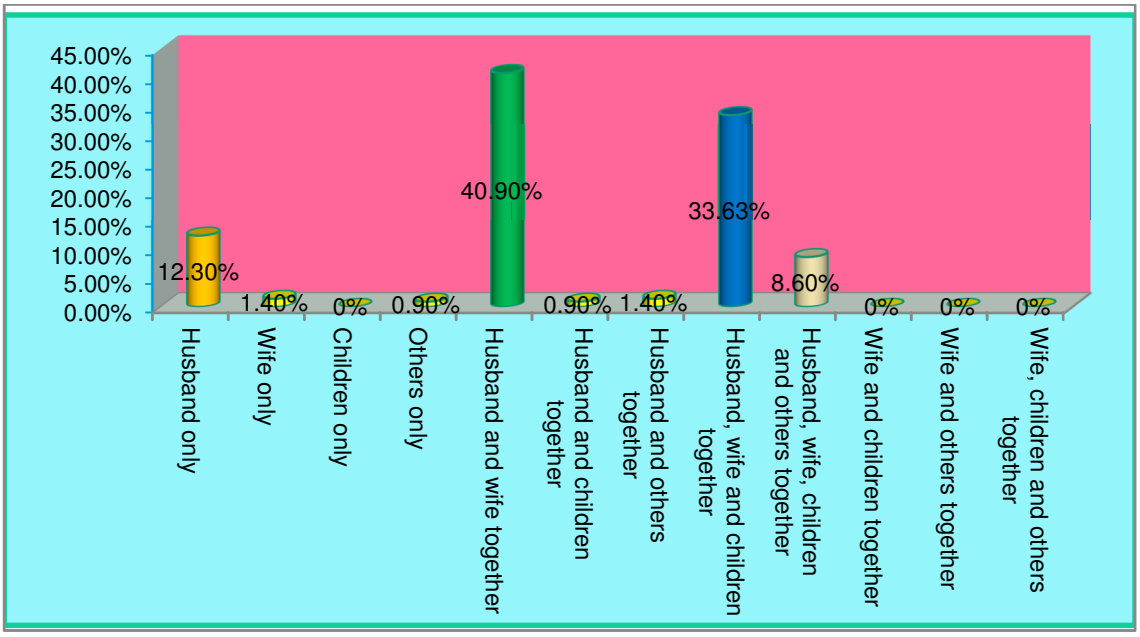

Figure 23: Percentage Distribution of respondents according to Decisions taken regarding the Purchase / Construction of the House

Gender of the Key Respondent: The family members amongst the key decision makers who were ready to become key respondent, their gender were noted.

Table 18: Distribution of the respondents according to their gender

Sr. No.	Gender of the key respondent	Respondents (n = 220)	
		f	%
1.	Male	180	81.8
2.	Female	40	18.2
	Total	**220**	**100**

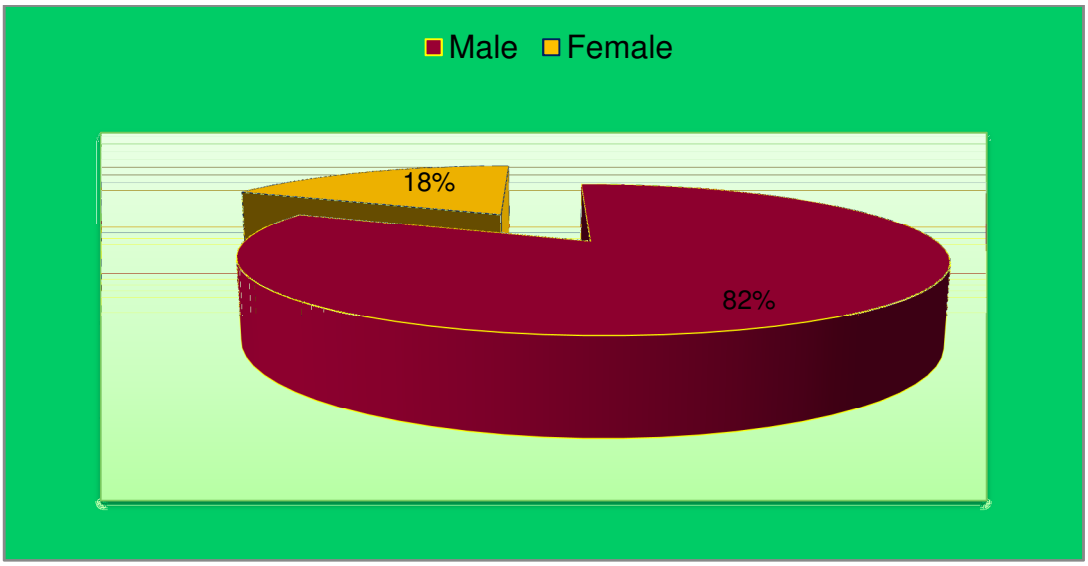

Figure 24: Percentage Distribution of the respondents according to their Gender

Majority of the decision makers/house owners who jointly or independently took decision regarding the purchase or construction of the house were male. Majority of the respondents were husbands and a little less than one fifth were female i.e. home makers were the respondents (Table-18, Fig.24).

4.2.2 Background Information of the Home Owners (the Respondents)

The information regarding the respondent's age, gender, education, occupation, total monthly family income, type of family, number of family members and their knowledge regarding various aspects of green buildings are described in this section.

Table 19: Distribution of Respondents according to their personal variables

Sr. No.	Personal Variables	Respondents (n = 220)	
		F	%
1.	**Age (in years)**		
	21-35	54	24.54
	36-50	129	58.63
	51-65	37	16.81
	Mean	**42.05**	
	Sd	**8.955**	
2.	**Education**		
	Primary Education (Class V)	4	1.8
	Middle School (Class VIII)	6	2.7
	Higher Secondary / Intermediate	20	9.1
	Graduate	91	41.4
	Post Graduate	77	35.0
	Ph.D or other High Degree	22	10.0
3.	**Occupation**		
	Service	145	65.9
	Business	63	28.6
	Self Employed	12	5.5
	Not Employed	0	0.0

4.2.2.1 Personal variables

Age: The mean age of the respondents was 42.05 years. More than one half of the respondents belonged to the age group of 36 to 50 years and little less than one fourth was in the age group of 21 to 35 years (Table-19, Fig. 25).

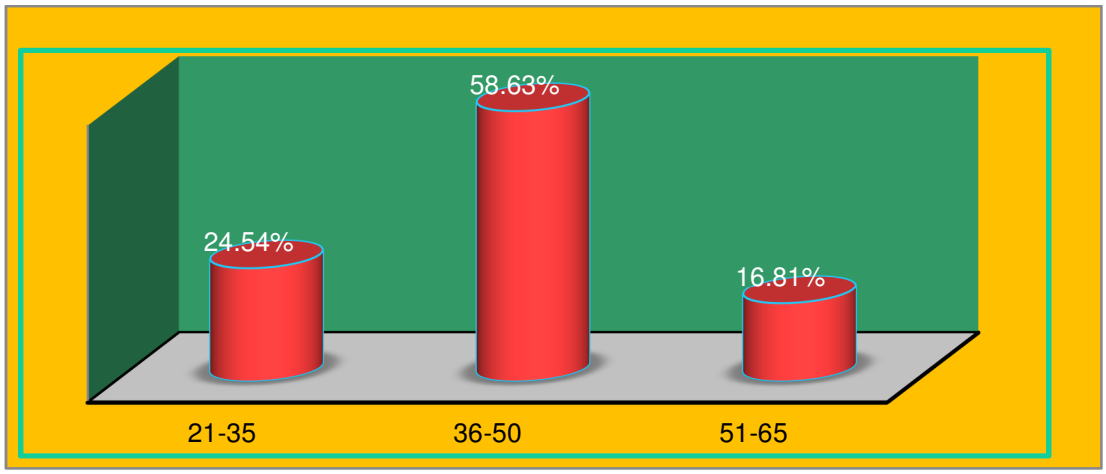

Figure 25: Percentage Distribution of respondents according to Age

Education: Information regarding the education of the respondents highlighted that less than one half of the respondents were graduates and more than one third of the respondent were post graduate (Table-19, Fig.26). Very few per cent of the respondents i.e., 10.0 and 9.1 per cent were Ph.D. or any other higher degree holder and higher secondary/ Intermediate respectively.

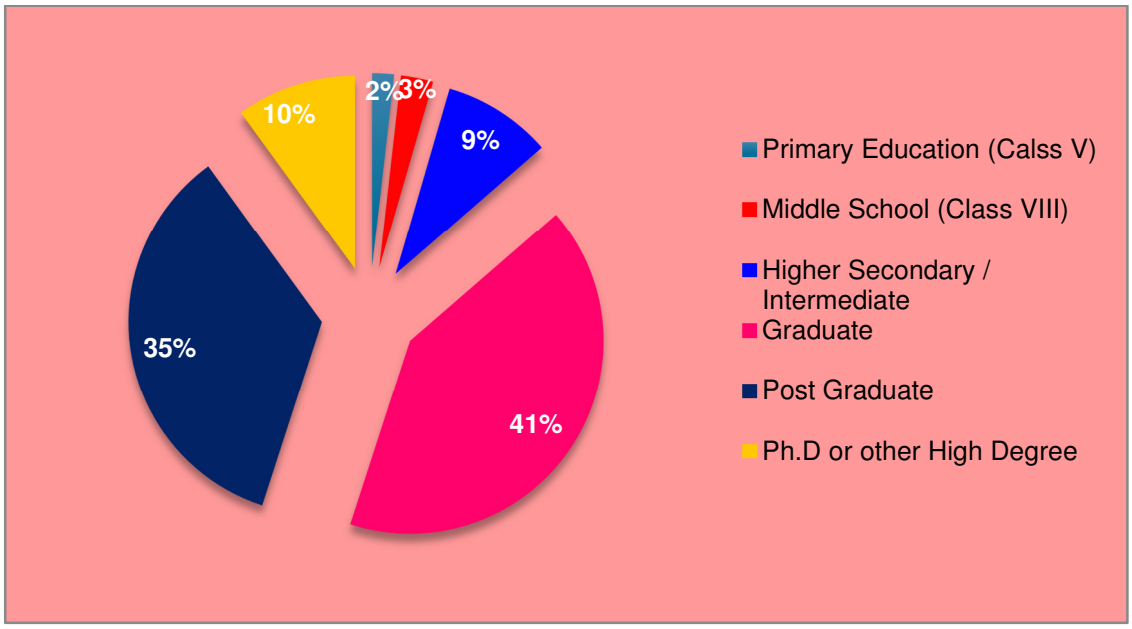

Figure 26: Percentage Distribution of respondents according to their Education

Occupation: It was observed that less than three fourth of the respondents' families were having service as means of their income and more than one fourth of the respondents were generating their income from business. A very less per cent (5.5%) of the respondents were earning money from self-employment (Table-19, Fig. 27).

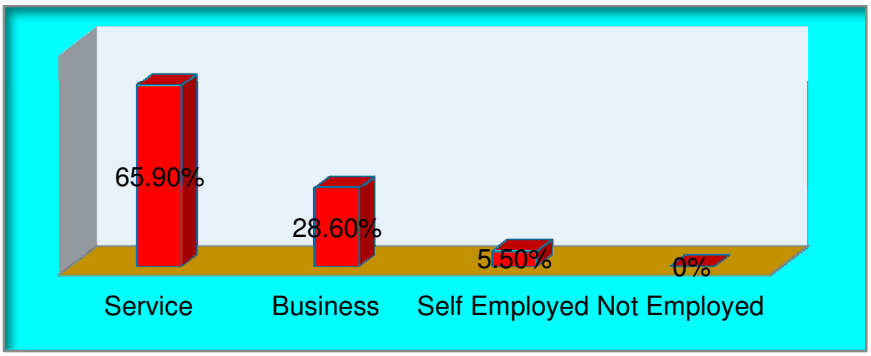

Figure 27: Percentage Distribution of respondents according to their Occupation

4.2.2.2 Family variables

Monthly Family Income: The total monthly family income ranged from Rs. 28,000 to Rs. 2, 00,000. This was categorised into three groups (Table-20, Fig.28). The mean monthly family income was Rs. 88,153.64. Less than one half of the respondents had total monthly family income between Rs. 30,000 to Rs. 60,000. Less than one third of the respondents had more than Rs. 60,000 as their total monthly income of the family. One fourth of the respondents had total monthly family income less than Rs. 30,000.

Table 20: Distribution of Respondents according to their familial variables

Sr. No.	Familial variables	Respondents (n = 220)	
		F	%
1.	**Family Income**		
	≤ Rs. 30,000	57	25.90
	Rs. 30,001- Rs. 60,000	95	43.18
	≥ Rs. 60,001	68	30.90
	Mean	**88,153.64**	
	Sd	**1,77,230.202**	
2.	**Type of Family**		
	Nuclear	168	76.4
	Joint	52	23.6
3.	**Size of Family**		
	Small (2 – 5)	197	89.5
	Medium (6 - 7)	18	8.2
	Large (8 – 11)	5	2.3

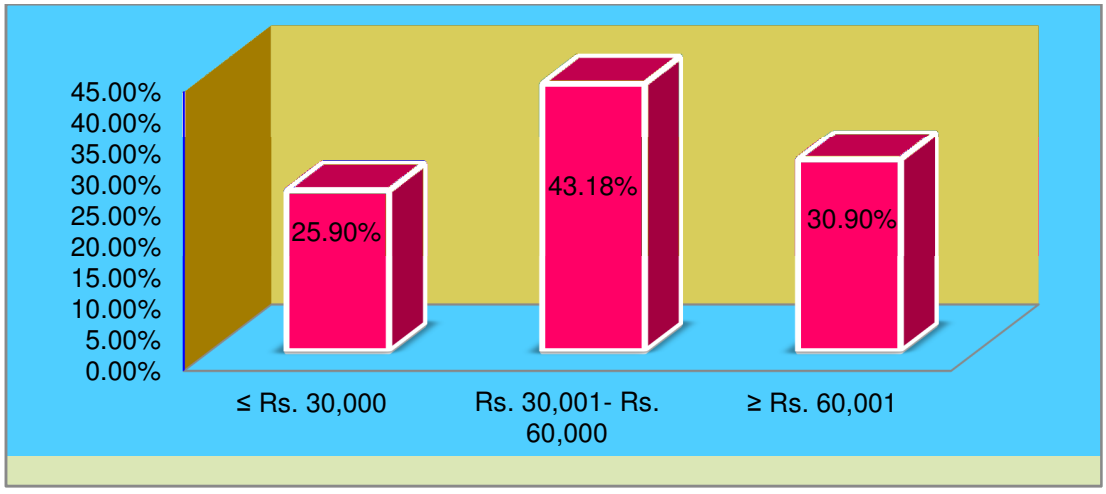

Figure 28: Percentage Distribution of respondents according to their Total Monthly Family Income

Type and Size of the Family: Majority of the respondents belonged to nuclear family and less than one fourth of the respondents were from joint family (Table-10, Fig. 29).Among the selected families majority of the respondents had small size of families consisting of two to five family members (Table-20, Fig.30). A very less per cent (8.2% and 2.3%) of respondents reported medium and large sized families' of6 or more family members respectively.

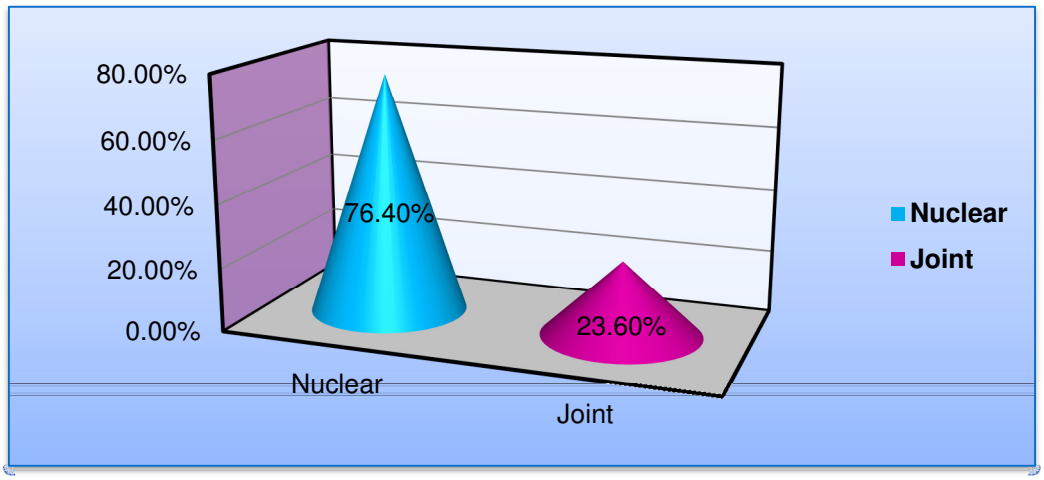

Figure 29: Percentage Distribution of the respondents according to their Type of Family

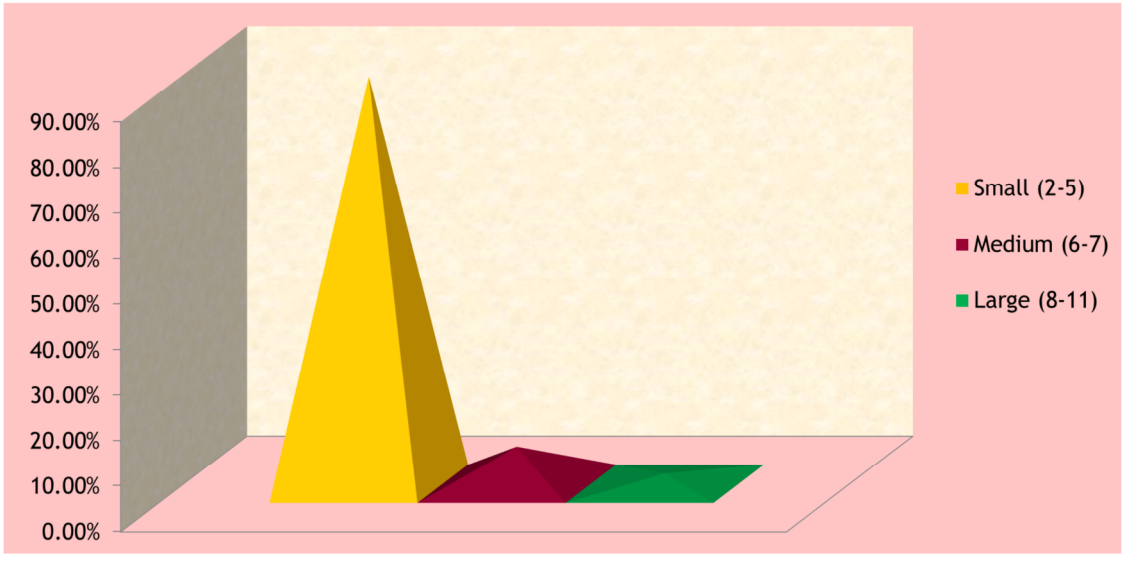

Figure 30: Percentage Distribution of the respondents according to their Size of Family

4.2.2.3 Details about the House

For the purpose of the study it was considered important to record information regarding the type of house in which the respondents were residing. Respondents who were owner of tenement or twin duplex or of independent bungalow were considered for data collection.

Type of House: It was found that majority of the respondent's house was of tenement or twin duplex type. Rest of the respondents i.e. less than one third were owners of independent bungalows (Table-21, Fig.31).

Table 21: Distribution of Respondents according to their Type of House

Sr.No.	Type of House	Respondents (n = 220)	
		f	%
a.	Tenement / Twin Duplex	154	70.0
b.	Independent Bungalow	66	30.0
	Total	**220**	**100**

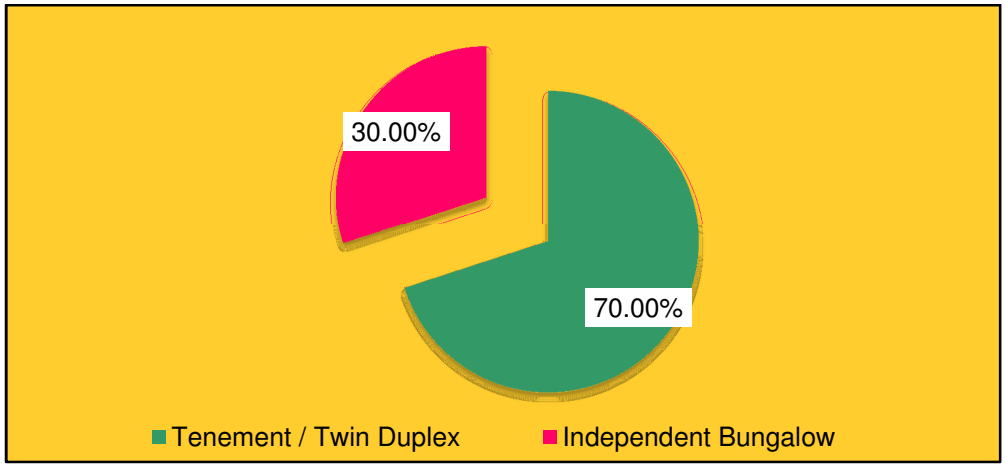

Figure 31: Percentage Distribution of the respondents according to their Type of House

Year of Purchase / Construction of the House: The respondents were asked to state the year in which they had purchased or constructed their house. The year of purchase of houses were categorized into three i.e., between 2005 to 2007, 2008 to 2010 and 2011 to 2013.

Table 22:Distribution of Respondents according to year of purchase or construction of their house

Sr. No.	Year of Purchase / Construction of the House	Respondents (n = 220)	
		f	%
a.	2005-2007	62	28.18
b.	2008-2010	91	41.36
c.	2011-2013	67	30.45
	Total	**220**	**100**

It was found that less than one half of the respondents had purchased or constructed their house between the years 2008 and 2010. Less than one third of the respondents purchased or constructed their house between the years 2011 and 2013. The houses were purchased or constructed between the years 2005 to 2007 by more than one fourth of the respondents (Table-22, Fig.32).

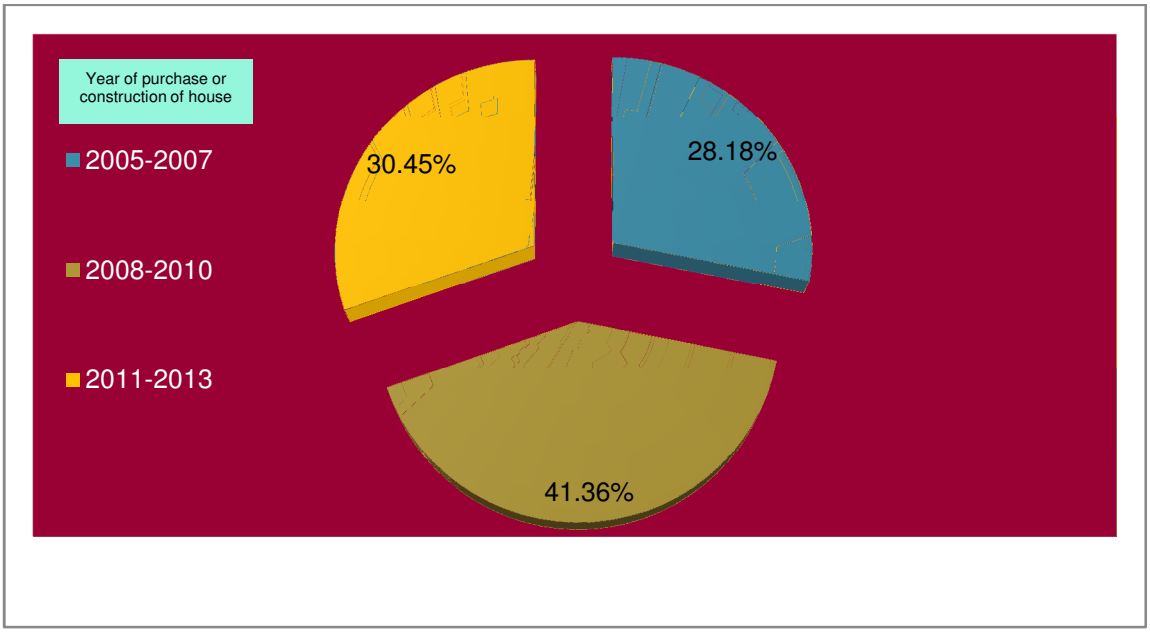

Figure 32: Percentage Distribution of respondents according to Year of Purchase or Construction of their House

4.2.3 Knowledge of the Home Owners regarding Green Building

An attempt was made to assess the knowledge of the home owners regarding Green Building through a scale. It contained various aspects of Green

Buildings such as Meaning of Green Buildings, Energy Efficiency, Water Efficiency, Materials and resources and Indoor Environment Quality. Statements were framed in positive and negative form. Respondents were asked to indicate whether they agree or disagree with the statements or they are undecided. This was a summated rating scale. There scores were summated for each statement. The range of maximum and minimum possible scores was divided into three categories on the basis of equal interval reflecting low extent, moderate extent and high extent of knowledge regarding "Green Buildings". The weighted mean (item mean) was computed for each statement as well as for each of the sub-scale. It ranged between 1 and 3. This gave a strong base for comparison amongst and sub-scales. They are:

4.2.3.1 Meaning of Green Building

4.2.3.2 Site selection

4.2.3.3 Energy efficiency

4.2.3.4 Water efficiency

4.2.3.5 Materials and Resources and

4.2.3.6 Indoor environment quality

4.1.7.1 Knowledge of the home owners regarding "Meaning of Green Building"

To find out the knowledge of the respondents regarding Green buildings the statements regarding meaning of Green buildings were framed.

Regarding the knowledge of the respondents on green buildings, it was found that more than three fourth of respondents had correct knowledge regarding meaning of green buildings that "Building made up of eco-friendly construction technology that does not harm environment is known as "Green Building" whereas **Jamison (2008)** found in his study that majority of the respondents stated that they did not know the meaning of Green Buildings. More than one half of the respondents of the present study had correct knowledge that "Green building is based on the premise of increased efficiency and minimal wastage during its lifecycle" as they agreed with these statements (Table-23). Less than one half of the respondents had correct knowledge regarding the meaning of green building because they agreed that "A Green Building is that

which meets the standards for environmental performance of the building constituting selected aspects such as sustainable site development, water saving, energy efficiency, material selection and indoor environmental quality" while more than one third of the respondents had incorrect knowledge regarding the same.

Porzel(2008) in his Green Building awareness and sustainability report found that 21% of the respondents associated environment friendliness with Green Building followed by healthy Indoor Environment (12.7%), Energy efficiency was also related with Green Building (11.8%) followed by preservation of natural resources (9.0%). In the present research more percentage of the respondents have shown their correct knowledge regarding these aspects.

Table 23: Distribution of Respondents according to their Knowledge regarding "Meaning of Green Buildings"

Sr. No.	Aspect of Green Building	Respondents (n = 220)			
		A	UD	D	WM
		f (%)	f (%)	f (%)	(1-3)
I	**Meaning of Green Building**				
1. (+)	Building made up of eco-friendly construction technology that does not harm environment is known as "Green Building".	168 (76.4)	30 (13.6)	22 (10.0)	2.7
2. (+)	Green building is based on the premise of increased resource efficiency and minimal wastage during its lifecycle.	118 (53.6)	71 (32.3)	31 (14.1)	2.4
3. (-)	Green Building is designed and constructed in such a way that it blends into the environment through style and looks, hence it is known as Green Building.	138 (62.7)	44 (20.0)	38 (17.3)	1.5
4. (+)	A Green Building is that which meets the standards for environmental performance of the building constituting selected aspects such as sustainable site development, water saving, energy efficiency, material selection and indoor environmental quality.	94 (42.7)	49 (22.3)	77 (35.0)	2.1
5. (-)	A building /house painted with green colour is known as Green Building.	135 (61.4)	28 (12.7)	57 (25.9)	1.7
6. (-)	A building having green lawn all around is known as Green building.	139 (63.2)	34 (15.5)	47 (21.4)	1.6
	Total Weighted Mean				**2.0**

Key: A= Agree, UD= Undecided, D= Disagree, WM= Weighted Mean
Figures in parenthesis show percentage

4.1.3.2 Knowledge of the home owners regarding the "Site selection" in green buildings

First and foremost features to construct a Green building are the 'Site selection'. A Green building is situated at such a location that the basic amenities are within easy reach which helps in reducing vehicular pollution caused due to transportation. The site has provision to capture extra rainwater in recharge bore. The measures are adopted to reduce soil erosion from around the building. The vegetation in and around the building is maintained while the paved areas around the building are paved with permeable paving or open grid paver blocks are used.

Table 24: Distribution of Respondents according to knowledge regarding "Site selection" in Green Buildings

II	Features of Green Building	Respondents (n = 220)			
		A	UD	D	W M
A	Site Selection	f (%)	f (%)	f (%)	(1-3)
1. (+)	Green buildings are so situated that various facilities are within easy reach, hence use of polluting vehicles is reduced.	59 (26.8)	62 (28.2)	99 (45.0)	1.8
2. (-)	The extra rainwater flows on the surface of the land or roads around the Green buildings.	119 (54.1)	73 (33.2)	28 (12.7)	1.6
3. (+)	Green building reduces soil erosion by planting more and more trees around the building.	61 (27.7)	58 (26.4)	101 (45.9)	1.8
4. (+)	Green Buildings have paved areas with permeable paving which helps water to percolate and add to underground water table and can be also used by the nearby plants.	54 (24.5)	70 (31.8)	96 (43.6)	1.8
	Total Weighted Mean				**1.75**

Key: A= Agree, UD= Undecided, D= Disagree, WM= Weighted Mean

Figures in parenthesis show percentage

Less than one half (45.9%) of the respondents had incorrect knowledge regarding one of the statement of site selection of green buildings because they disagreed that "Green building reduces soil erosion by planting more and more trees around the building" while more than one fourth of the respondent

had correct knowledge regarding this (Table-24). Less than one half of the respondents (45.0%) had incorrect knowledge on a statement of site selection aspect as they disagreed that “Green buildings are so situated that various facilities are within easy reach, hence use of polluting vehicles is reduced” while more than one fourth of the respondents had correct knowledge regarding the same (Table-24). More than half (54.1%) of the respondents agreed that “The extra rainwater flows on the surface of the land or roads around the Green buildings” which reflects their incorrect knowledge regarding the same while one third (33.2%) of the respondents were undecided regarding the same. Less than one half (43.6%) of the respondents had incorrect knowledge that “Green Buildings have paved areas with permeable paving which helps water to percolate and add to underground water table and can be also used by the nearby plants” while less than one fourth (24.5%) of the respondents had correct knowledge regarding the same. The mean weighted scores computed was found to be the same for three statements.

4.1.3.3 Knowledge of the home owners regarding “Water efficiency” in Green buildings

One of the important features of Green Building is the measures to ensure efficient use of water. The Green building incorporates rainwater harvesting from roof and other areas around the house, installation of water efficient plumbing fixtures, such a landscape which has plantation or vegetation which require minimum use of water. It also makes provision for waste water treatment and re-use of that water. The knowledge of respondents regarding this aspect was found.

Data in table-25 revealed that more than two third (67.3%) of the respondents had incorrect knowledge regarding one of the statement in the ‘water efficiency’ in green buildings because they agreed that “Green building ensures maximum utilization of fresh water” while less than one fourth (21.4%) were undecided regarding this statement. The mean weighted score was found to be the lowest for this item. Two third (66.4%) of the respondents wrongly agreed that “Green Buildings have provision for growing trees and

plants requiring more of water for their growth" while one fourth (25.0%) of the respondents were undecided about this statement. More than one half of the respondents wrongly agreed that "It is not necessary to install water meters to monitor water consumption in Green buildings" while less than three fourth of the respondents were undecided regarding this statement. Less than one half(46.8%) of the respondents also had incorrect knowledge regarding the statement that "Water efficient plumbing faucets are installed in order to reduce overall water demanded in Green Buildings" while more than one fourth of the respondents were undecided about this statement. Less than one half of the respondents had incorrect knowledge regarding the statement that "Efficient irrigation management system is installed in Green buildings which help in reducing the wastage of water" as they disagreed with it. More than one third (39.5%) of the respondents were undecided regarding the statement that "Grey water (water that comes from clothes washer, bath tub, showers, bathroom wash basin, kitchen sinks and dishwashers) treatment systems are provided in Green buildings to treat at least 50% of it generated in the building" while a little more than one third (36.8%) of the respondents had incorrect knowledge regarding the same as they disagreed with the statement.

Table25: Distribution of Respondents according to knowledge regarding "Water efficiency" in Green Buildings

II	Features of Green Building	Respondents (n = 220)			
		A	UD	D	WM
B	Water Efficiency	f (%)	f (%)	f (%)	(1-3)
1. (-)	Green Buildings have provision for growing trees and plants requiring more of water for their growth.	146 (66.4)	55 (25.0)	19 (8.6)	1.4
2. (+)	Water efficient plumbing faucets are installed in order to reduce overall water demanded in Green Buildings.	49 (22.3)	68 (30.9)	103 (46.8)	1.7
3. (-)	Green building ensures maximum utilization of fresh water.	148 (67.3)	47 21.4)	25 (11.4)	1.4
4. (-)	It is not necessary to install water meters to monitor water consumption in Green buildings.	120 (54.5)	70 (31.8)	30 (13.6)	1.6
5. (+)	Water tanks installed in Green buildings have a water level controller.	65 (29.5)	70 (31.8)	85 (38.6)	1.9

II	Features of Green Building	Respondents (n = 220)			
		A	UD	D	WM
B	**Water Efficiency**	f (%)	f (%)	f (%)	(1-3)
6. (+)	Green buildings provide Rainwater Harvesting or storage system to capture at least 50% of runoff volumes from roof surface.	78 (35.5)	74 (33.6)	68 (30.9)	2.0
7. (+)	Grey water (water that comes from clothes washer, bath tub, showers, bathroom wash basin, kitchen sinks and dishwashers) treatment systems are provided in Green buildings to treat at least 50% of it generated in the building.	52 (23.6)	87 (39.5)	81 (36.8)	1.9
8. (+)	Efficient irrigation management system is installed in Green buildings which help in reducing the wastage of water.	60 (27.3)	65 (29.5)	95 (43.2)	1.8
	Total Weighted Mean				**1.71**

Key: A= Agree, UD= Undecided, D= Disagree, WM= Weighted Mean
Figures in parenthesis show percentage

A little more than one third of the respondents had correct knowledge that "Green buildings provide Rainwater Harvesting or storage system to capture at least 50% of runoff volumes from roof surface". About one third were undecided about it whereas little less than that percentage of the respondents wrongly disagreed with that. The item mean was highest for this statement amongst all under the sub-scale of "Water Efficiency".

4.1.3.4 Knowledge of the home owners regarding "Energy efficiency" in Green buildings

A Green building incorporates the feature of 'Energy efficiency'. The energy efficient electrical fixtures are installed in Green Buildings which are BEE rated. Energy meters are also installed in Green buildings. The high performance glasses having low u value are used in the door and windows which reduces the heat entering the room. Green buildings encourage their residents to use CFC free electrical equipments. It also makes provision for the use of renewable sources of energy. Measures are also adopted in construction to stop penetration of heat in the house.

Table 26: Distribution of Respondents according to knowledge regarding "Energy efficiency" in Green Buildings

II	Features of Green Building	Respondents (n = 220)			
		A	UD	D	W M
C	**Energy Efficiency**	f(%)	f(%)	f(%)	(1-3)
1. (-)	Green buildings do not favour the installation of CFC free equipment which depletes ozone layer.	122 (55.5)	82 (37.3)	16 (7.3)	1.5
2. (+)	Low energy consuming lighting fixtures are installed in all the areas of Green Building.	69 (31.4)	63 (28.6)	88 (40.0)	1.9
3. (+)	The use of solar energy is encouraged in Green buildings.	74 (33.6)	47 (21.4)	99 (45.0)	1.9
4. (+)	Electrical equipment and fittings installed should have energy efficient star rating.	66 (30.0)	53 (24.1)	101(45 .9)	1.8
5. (-)	Since Green Building is energy efficient, there is no need to install energy meters.	122 (55.5)	70 (31.8)	28 (12.7)	1.6
6. (-)	Diesel or electricity operated generator sets are used in Green Building for electricity backup.	125 (56.8)	66 (30.0)	29 (13.2)	1.6
7. (-)	The glasses in door, windows and ventilations are such which absorbs maximum heat.	146 (66.4)	55 (25.0)	19 (8.6)	1.4
8. (-)	Movement sensors for lighting control are not installed in green buildings as they are very costly.	108 (49.1)	76 (34.5)	36 (16.4)	1.7
9. (+)	The walls of Green Buildings are constructed thick so that they do not allow heat to penetrate inside the building.	59 (26.8)	63 (28.6)	98 (44.5)	1.8
10. (+)	Shading (perbolas, trees etc) is provided outside the Green Building which restricts the entrance of heat inside the building.	53 (24.1)	65 (29.5)	102 (46.4)	1.8
	Total Weighted Mean				**1.7**

Key: A= Agree, UD= Undecided, D= Disagree, WM= Weighted Mean, Figures in parenthesis show percentage

It was found that three fourth of the respondents had incorrect knowledge regarding the energy efficiency in green buildings because they agreed that "The glasses in door, windows and ventilations are such which absorbs maximum heat" while one fourth of the respondents were undecided about the same (Table 26). The weighted mean was found to be lowest for this statement. More than one half of the respondents had incorrect knowledge regarding the statement that "Diesel or electricity operated generator sets are used in Green Building for electricity backup", "Green buildings do not favour the installation of CFC free equipment which depletes ozone layer" and "Since Green Building is energy efficient, there is no need to install energy meters" respectively because they agreed with these statements but around one third of the respondents were undecided about these statements. Less than one half of the respondents had incorrect knowledge but more than one fourth

were undecided regarding the statement that “Shading (perbolas, trees etc) is provided outside the Green Building which restricts the entrance of heat inside the building.”, “The walls of Green Buildings are constructed thick so that they do not allow heat to penetrate inside the building” and “Low energy consuming lighting fixtures are installed in all the areas of Green Building.”A little more than one third of the respondents were that about “Movement sensors for lighting control are not installed in green buildings as they are very costly”.

One third of the respondents had correct knowledge that “The use of solar energy is encouraged in Green buildings”. Less than one third of the respondents had correct knowledge that “Low energy consuming lighting fixtures are installed in all the areas of Green Building.” and “Electrical equipments and fittings installed should have energy efficient star rating.”

4.1.3.5 Knowledge of the home owners regarding “Materials and Resources” used in green building

This feature of Green Building incorporates aspects regarding the kind of materials used in the construction of Green building, handling of construction waste material and post occupancy household waste management.

The findings related to knowledge of the home owners regarding this aspect revealed that less than three fourth of the respondents had incorrect knowledge regarding the negative statement that “One large bin is provided in the Green Building to collect organic, paper, metal, glass and other types of waste” (Post occupancy) and less than one third of the respondents were undecided regarding the same. The item mean was the least amongst all the statement of this category. More than one half of the respondents had incorrect knowledge that “As Green Building design and construction is unique, the materials used for its construction are transported from particular places which may be far away from the site of construction” and more than one third of the respondents were undecided about the same. One half of the respondents had incorrect knowledge (Table-27) regarding the statements that “Most of the wood used in construction of Green Building is not Forest

Certified" and "Building materials which are recycled such as recycled concrete, dry wall, fly ash etc. are never used for constructing Green Buildings" while more than one third of the respondents were undecided about the same. The weighted mean for these statements was found to be the same (1.6/3.00).

Table 27: Distribution of Respondents according to knowledge regarding "Materials and Resources" used in Green Buildings

II	Features of Green Building	Respondents (n = 220)			
		A	UD	D	W M
D	**Materials selection**	f (%)	f (%)	f (%)	(1-3)
1. (-)	One large bin is provided in the Green Building to collect organic, paper, metal, glass and other types of waste.	135 (61.4)	68 (30.9)	17 (7.7)	1.4
2. (+)	Salvaged building materials are used in construction of Green buildings.	48 (21.8)	106 (48.2)	66 (30.0)	1.9
3. (-)	Building materials which are recycled such as recycled concrete, dry wall, fly ash etc are never used for constructing Green Buildings.	110 (50.0)	83 (37.7)	27 (12.3)	1.6
4. (+)	Green Buildings are constructed using materials harvested and processed in the region, within 500 miles in order to cut down transportation impacts associated with bringing then from farther away.	40 (18.2)	111 (50.5)	69 (31.4)	1.9
5. (+)	Building materials such as bamboo, cork, straw-board cabinetry are used in construction of Green Building because they are rapidly renewable having ten years of regeneration time or less.	66 (30.0)	86 (39.1)	68 (30.9)	2.0
6. (-)	Most of the wood used in construction of Green Building is not Forest Certified.	112 (50.9)	75 (34.1)	33 (15.0)	1.6
7. (+)	Organic waste treatment plant with suitable capacity is designed in the Green building.	61 (27.7)	82 (37.3)	77 (35.0)	1.9
8. (-)	As Green Building design and construction is unique, the materials used for its construction are transported from particular places which may be far away from the site of construction.	117 (53.2)	78 (35.5)	25 (11.4)	1.6
	Total Weighted Mean				**1.73**

Key: A= Agree, UD= Undecided, D= Disagree, WM= Weighted Mean

Figures in parenthesis show percentage

One half of the respondents were undecided that " Green Buildings are constructed using materials harvested and processed in the region, within 500 miles in order to cut down transportation impacts associated with bringing then from farther away" while less than one third of the respondents had incorrect knowledge regarding the same. Less than one half of the respondents were undecided that "Salvaged building materials are used in construction of Green buildings" and less than one third of the respondents had incorrect knowledge regarding the same. More than one third of the respondents were undecided that "Building materials such as bamboo, cork, straw-board cabinetry are used in construction of Green Building because they are rapidly renewable having ten years of regeneration time or less" but thirty per cent of the respondents had correct and the same percentage had incorrect knowledge regarding the same. More than one third of the respondents were undecided that "Organic waste treatment plant with suitable capacity is designed in the Green building" and little more than one third of the respondents had correct knowledge about the same (Table-27). The mean weighted scores computed supported this finding.

4.1.3.6 Knowledge of the home owners regarding "Indoor Environment Quality" in green building

Knowledge of the house owners regarding an important aspect of Green Buildings viz. Indoor Environment Quality was assessed. Indoor Environment Quality was incorporates provision of fresh air and cross ventilation, maximum use of daylight and reduction in the use of artificial light, use of low VOC materials in the house and similar aspects.

More than one half of the respondents were wrong in agreeing with the statement that "The occupants of Green Building make maximum use of artificial lighting." Less than one fourth of the respondents were undecided regarding the same (Table-28). The mean weighted score was found to be the lowest for this statement. A little more than one half of the respondents had incorrect knowledge that "Very few window openings are provided in Green Buildings so as to reduce outside heat entering into it". Similar percentage of

the respondents was incorrect in saying that “Since there is provision for cross ventilation in green buildings there is no need to keep adequate space between dwelling units”. One half of the respondents had incorrect knowledge regarding provision of exhaust systems in bathrooms and kitchen in Green Building”. One half of the respondents agreed with negative statement that “Fresh air vents in air conditioned spaces is not designed in Green Building because it may reduce the cooling of the room”. This reflected their incorrect knowledge.

Table 28: Distribution of Respondents according to knowledge regarding “Indoor Environment Quality”

II	Features of Green Building	Respondents (n = 220)			
		A	UD	D	W M
E	Indoor Environment Quality	f (%)	f (%)	f (%)	(1-3)
1. (-)	There are no exhaust systems in bathrooms and kitchen in Green Building.	111 (50.5)	61 (27.7)	48 (21.8)	1.7
2. (+)	Carpets made of naturally available materials like coir, wool etc. are used in Green Building.	51 (23.2)	75 (34.1)	94 (42.7)	1.8
3. (+)	Openings on at least two different directions of the house are constructed in Green Buildings so as to allow cross ventilation.	64 (42.7)	54 (24.5)	102 (46.4)	1.8
4. (+)	Green building design encourages the use of materials such as low VOC (Volatile Organic Compound) paints so as to reduce adverse health impacts for building occupants.	52 (23.6)	73 (33.2)	95 (43.2)	1.8
5. (+)	Green buildings design provides adequate daylighting for interior workspace, using skylights.	74 (33.6)	45 (20.5)	101 (45.9)	1.9
6. (-)	The occupants of Green Building make maximum use of artificial lighting.	129 (58.6)	48 (21.8)	43 (19.5)	1.3
7. (+)	Green Building has designated areas for smoking.	52 (23.6)	82 (37.3)	86 (39.1)	1.8
8. (-)	Very few windows openings are provided in Green Buildings so as to reduce outside heat entering into it.	117 (53.2)	66 (30.0)	37 (16.8)	1.6
9. (-)	Fresh air vents in air conditioned spaces is not designed in Green Building because it may reduce the cooling of the room.	112 (50.9)	71 (32.3)	37 (16.8)	1.6
10. (-)	Since there is provision for cross ventilation in green buildings there is no need to keep adequate space between dwelling units.	116 (52.7)	69 (31.4)	35 (15.9)	1.6
	Total Weighted Mean				**1.69**

Key: A= Agree, UD= Undecided, D= Disagree, WM= Weighted Mean

Figures in parenthesis show percentage

Table 28 indicates that less than one half of the respondents had incorrect knowledge that “Openings on at least two different directions of the house are constructed in Green Buildings so as to allow cross ventilation” while less than one fourth of the respondents were undecided about the same. Less than one half of the respondents had incorrect knowledge regarding the positive statement that “Green buildings design provides adequate daylighting for interior workspace, using skylights”. Only one third of the respondents had correct knowledge regarding the same. Less than one half of the respondents had incorrect knowledge that “Green building design encourages the use of materials such as low VOC (Volatile Organic Compound) paints so as to reduce adverse health impacts for building occupants” while one third of the respondents were undecided regarding the same. More than one third of the respondents had incorrect knowledge that “Green Building has designated areas for smoking” as they disagreed with this statement while a little more than one third of the respondents were undecided regarding the same. The weighted mean score for this aspect was found to be lowest amongst all.

4.2.3.2 Extent of Knowledge on various aspects of Green Building: An Overall View

An attempt was made to find out the extent of knowledge of the respondents regarding various aspects of Green Building. In order to find out the extent of knowledge of the respondents on various aspects of green building the responses were given scores of 3 through 1 respectively for the responses “Agree”, “Undecided” and “Disagree” while the score of 1 through 3 were ascribed respectively for the negative statements. The possible range of maximum and minimum scores was divided into three categories having equal intervals. Higher scores indicated high extent of knowledge (Table 29, Fig.33).

Table29: Distribution of Respondents according to their Extent of Knowledge on various aspects of Green Building

Sr. No.	Aspects of Green Buildings	Range of Scores	Respondents (n = 220)	
			f	%
I	**Meaning of Green building**			
	High Extent	15-18	28	12.7
	Moderate Extent	10-14	152	69.1
	Low Extent	6-9	28	12.7
	Weighted Mean	**1 – 3**	**2.0**	
II	**Site selection**			
	High Extent	10-12	32	14.5
	Moderate Extent	7-9	83	37.7
	Low Extent	4-6	105	47.7
	Weighted Mean	**1 – 3**	**1.75**	
III	**Water efficiency**			
	High Extent	19-24	19	8.6
	Moderate Extent	14-18	80	36.4
	Low Extent	8-13	121	55.0
	Weighted Mean	**1 – 3**	**1.71**	
IV	**Energy efficiency**			
	High Extent	24-30	15	6.8
	Moderate Extent	17-23	86	39.1
	Low Extent	10-16	119	54.1
	Weighted Mean	**1 – 3**	**1.70**	
V	**Material and Resources**			
	High Extent	19-24	11	5.0
	Moderate Extent	14-18	105	47.7
	Low Extent	8-13	104	47.3
	Weighted Mean	**1 – 3**	**1.73**	
VI	**Indoor environment quality**			
	High Extent	24-30	0	0.0
	Moderate Extent	17-23	0	0.0
	Low Extent	10-16	220	100.0
	Weighted Mean	**1 – 3**	**1.69**	
VII	**Total Scale**			
	High Extent	108-138	17	7.7
	Moderate Extent	77-107	65	29.5
	Low Extent	46-76	138	62.7
	Total Weighted Mean	**1 – 3**	**1.76**	

It was found that majority of the respondents had moderate extent of knowledge regarding the meaning of green buildings. The same

percentage(12.7%) of respondents had high and low extent of knowledge regarding the meaning of green buildings. Less than one half of the respondents had low extent of knowledge on sustainable site as one of the feature of green buildings. On the other hand more than one third of the respondents had moderate extent of knowledge and very few respondents i.e., 14.5 per cent had high extent of knowledge regarding the same. More than one half of the respondents had low extent of knowledge regarding water efficiency and similar percentage of respondents had low extent of knowledge regarding energy efficiency as a feature of green buildings. A little less than one half i.e., 47.7 per cent and 47.3 per cent of the respondents had moderate extent and low extent of knowledge regarding the material and resources in green buildings respectively. All of the respondents had low extent of knowledge regarding the indoor environment quality in the green buildings.Less than two third of the respondents had low extent of knowledge on the entire scale of various aspects of green buildings. Less than one third of the respondents had moderate extent of knowledge on the overall scale. This clearly reflected a need to educate people for various aspects of Green Buildings.

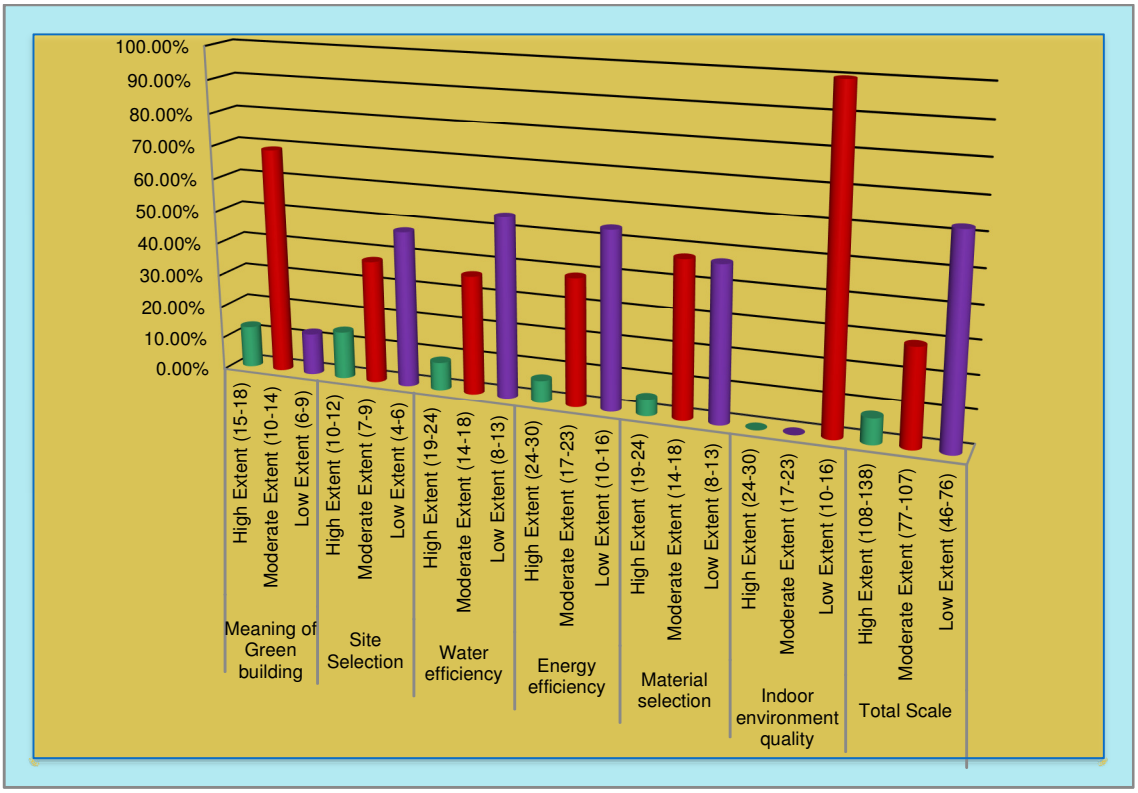

Figure 33:Percentage Distribution of respondents according to Extent of their Knowledge on various aspects of Green Building

The weighted mean (item intensity) for each of the statement and for each of the aspects of Green Buildings was found. It is reported in Table 29.

Kumar (2013) observed that people were unaware and unprepared to make heavy investments in constructing green buildings. Therefore, there is a need to create awareness regarding green buildings.

Elias and Lin (2015) reported in findings of the study conducted by them on green building implementation from the perspective of housing developers revealed that that 77 per cent of the respondents were aware of green residential concept.

Table30: Weighted mean for the Extent of knowledge on various aspects of Green Buildings

Sr. No	Extent of Knowledge on various aspects of Green Buildings	Total Weighted mean (1-3) (intensity index)
I.	Meaning of Green Building	2.0
II.	Site Selection	1.75
III.	Material Selection	1.73
IV.	Water Efficiency	1.71
V.	Energy Efficiency	1.70
VI.	Indoor Environment Quality	1.69
	Overall weighted mean	**1.76**

The weighted mean computed for each of the aspects reflected that the respondents had higher score for knowledge regarding the “meaning of Green Building”. It was also found that respondents had least score on knowledge regarding “Indoor Environment Quality”. The overall weighted mean on all the aspects was 1.76 (Table 30, Figure 34).

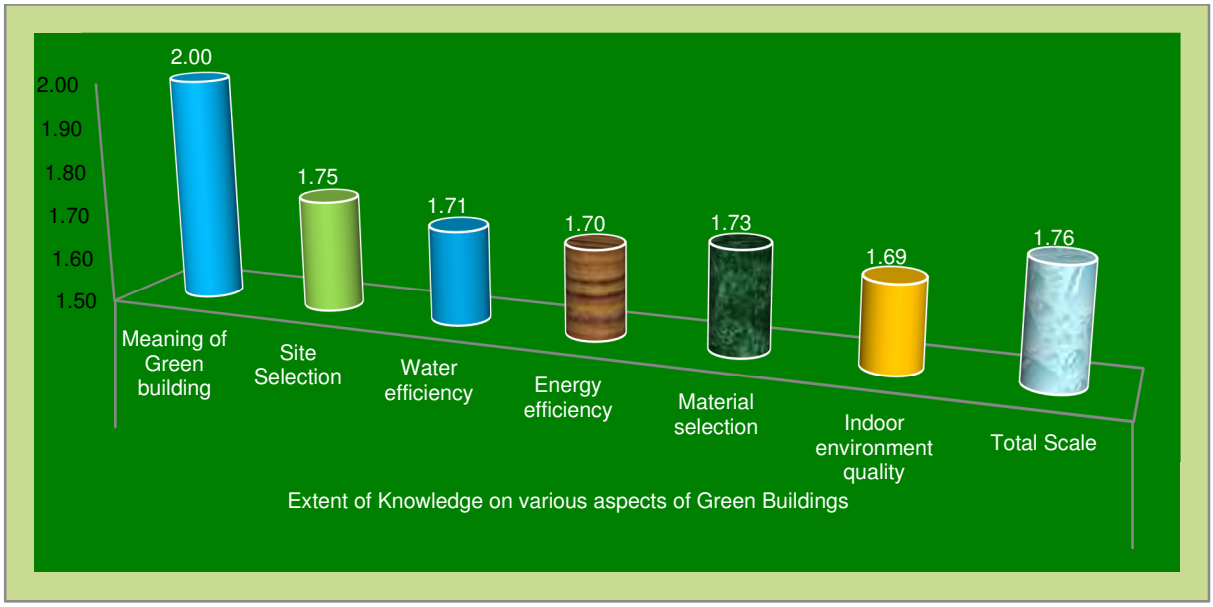

Figure 34: Weighted mean for the Extent of Knowledge on various aspects of Green Building: For sub scales and total

4.2.4 Assessment of the selected houses for their extent of greenness

An attempt was made in present research to assess the selected houses of the Vadodara city to find out the extent of greenness of the houses. A checklist was developed for this purpose. The checklist consisted of statements related to the aspects/ features of Green Building viz. Site selection, Water efficiency, Energy efficiency, Material and resources, Indoor environment quality and Innovative ideas on the basis of guidelines given by LEED and GRIHA. For the purpose of analysis and discussion each of these aspects were referred as sub scales. The factors were assessed through observation and for some factors equipments were used. The presence and absence of the factor were assessed by response “Followed” or “Not Followed”, “Present” or “Not Present”, “Applied” or “Not Applied” but in order to maintain consistency and clarity in the responses the responses are presented here in the form of “Yes” and “No”. Each factor was assigned marks. For each positive response the marks assigned were given and for negative response ‘zero’ was assigned. The marks obtained were counted for each sub scale for each of the respondent.

4.2.4.1 “Site selection” as factor for assessing the selected houses

The statements under this group were mainly related to the local regulations, certifications, landscape and garden, measures to reduce soil erosion, basic amenities around the house, measure to reduce heat island effect both roof and non-roof and stormwater management techniques. The entire sub scale was assessed by observation.

Plate 7: Shading from trees

Plate 8: Potted plants on the terrace

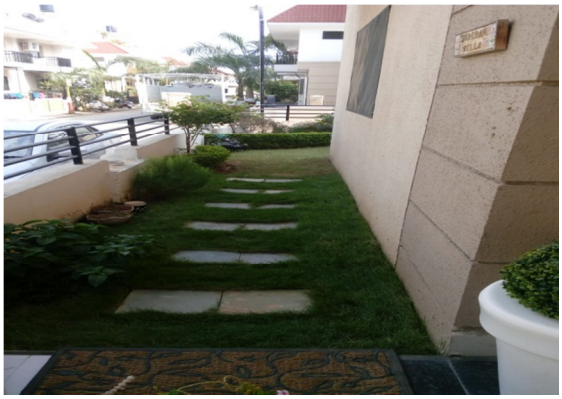

Plate 9: Permanent and Temporary Seeding

Plate 10: Earth Dikes

Table 31: Distribution of selected houses according to factor "Site selection"

Sr. No.	Factors considered for assessing building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes	No	W M
			f (%)	f (%)	(0-1)
A.	**Site Selection**	**53**			
I	**Local regulations**	**02**			
1.	The plan is approved from the competent local government authority.	01	220 (100)	0 (0.0)	1.0
2.	"Fit for occupancy" document is obtained from the competent local government authority.	01	220 (100)	0 (0.0)	1.0
	Total weighted Mean				**1.0**
II	**Certification**	**01**			
1.	Building has been certified under any of the Green Certification programme: (at least one)	01			
	a. Leadership in Energy and Environment Design (LEED)		3 (1.4)	217(98.6)	**0.014**
	b. Green Rating for Integrated Habitat Assessment (GRIHA)		0 (0.0)	220 (100.0)	0.00
	Total weighted Mean				**0.014**
III	**Landscape and Garden**	**07**			
1.	Grown mature trees in one of the following direction of the house so as to give shade and reduce heat.	02			
	a. West	01	167(75.9)	53 (24.1)	0.759
	b. South	01	89 (40.5)	131 (59.5)	0.405
2.	Roof surface is vegetated with the following:	02			
	a. Potted plants	01	180 (81.8)	40 (18.2)	0.818
	b. Direct on roof surface	01	2 (0.9)	218 (99.1)	0.009
	c. Both potted plants and direct on roof surface	02	1 (0.5)	219 (99.5)	0.005

Sr. No.	Factors considered for assessing building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes	No	W M
			f (%)	f (%)	(0-1)
3.	Which types of fertilizers are mostly used for the plants?	02			
	a. Only chemical fertilizers	00	89 (40.5)	131(59.5)	0.405
	b. Sometimes organic and sometimes chemical fertilizers	01	110 (50.0)	110(50.0)	0.500
	c. Only organic fertilizers	02	6 (2.7)	214 (97.3)	0.027
	Total weighted Mean				**0.366**
IV	**Measures to reduce soil erosion**	**12**			
1.	Adopted any of the following measures in order to reduce soil erosion in available landscape:	07			
	a. Permanent seeding	01	20 (9.1)	200 (90.9)	0.091
	b. Temporary seeding	01	16(7.3)	204(92.7)	0.073
	c. Mulching	01	21 (9.5)	199 (90.5)	0.095
	d. Earth dikes	01	1 (0.5)	219 (99.5)	0.005
	e. Silt fencing	01	0 (0.0)	220 (100.0)	0.00
	f. Sediment traps	01	0 (0.0)	220 (100.0)	0.00
	g. Sediment basins	01	0 (0.0)	220 (100.0)	0.00
2.	Extent of open available area is landscaped with vegetation (e.g., grass, tree, shrubs).	04			
	a. 0% - 24% approx.	01	155 (70.5)	65 (29.5)	0.705
	a. 25% - 49% approx.	02	25 (11.4)	195 (88.6)	0.114
	b. 50% - 74% approx.	03	5 (2.3)	215 (97.7)	0.023
	c. 75% - 100% approx.	04	1 (0.5)	219 (99.5)	0.005

Sr. No.	Factors considered for assessing building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes	No	W M
			f (%)	f (%)	(0-1)
3.	Paved areas are constructed with permeable materials.	01	75 (34.1)	145 (65.9)	0.341
4.	Impermeable surfaces direct all run off towards any of the following:	01			
	a. Drainage system	00	197 (89.5)	23 (10.5)	0.895
	b. Storm water collection pit	01	16 (7.3)	204 (92.7)	0.073
	Total weighted Mean				**0.173**
V	**Basic amenities**	**09**			
1.	Site has access to at least five amenities, within a walking distance of 1 km. (any five)	05			
	a. Grocery store		217 (98.6)	3 (1.4)	0.986
	b. Electrician/plumbing services		198 (90.0)	22 (10.0)	0.900
	d. Dhobi/ laundry		196 (89.1)	24 (10.9)	0.891
	e. Bank/ATM		147 (66.8)	73 (33.2)	0.668
	f. Crèche		7 (3.2)	213 (96.8)	0.032
	g. Fitness centre/ Gym		48 (21.8)	172 (78.2)	0.218
	h. Library		7(3.2)	213 (96.8)	0.032
	i. Medical clinic/ Hospital		141 (64.1)	79 (35.9)	0.641
	j. Pharmacy		180 (81.8)	40 (18.2)	0.818
	k. Post office/ courier service		113 (51.4)	107 (48.6)	0.514
	l. Place of worship		215 (97.7)	5 (2.3)	0.977
	m. Restaurant		19488.2)	26 (11.8)	0.500
	n. Supermarket		110 (50.0)	110 (50.0)	0.250

Sr. No.	Factors considered for assessing building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes	No	W M
			f (%)	f (%)	(0-1)
	o. Other neighbourhood-serving retail		55 (25.0)	165 (75.0)	0.091
	p. Electricity/ water utility bills payment counter		20 (9.1)	200 (90.0)	0.918
	q. Playground		202 (91.8)	18 (8.2)	0.414
	r. Jogging track		91 (41.4)	129 (58.6)	
2.	The building is located within 800 mt. of the following:	02			
	a. Auto stand	01	216 (98.2)	4 (1.8)	0.982
	b. City bus stop	01	120 (54.5)	100 (45.5)	0.545
3.	The building is located within 400 mt. of the following:	02			
	a. 2 or more bus lines.	01	24 (10.9)	196 (89.1)	0.109
	b. Railway station	01	9 (4.1)	95.9	0.041
	Total weighted Mean				**0.526**
VI.	**Measures to reduce Heat Island effect**	**17**			
1.	Reduce heat island effect through any of the following measures (Non Roof):	12			
	a. Shade from trees falls on :	03			
	i. Pathway	01	142 (64.5)	78 (35.5)	0.645
	ii. Parking	02	46 (20.9)	174 (79.1)	0.209
	iii. Building	03	33 (15.0)	187 (85.0)	0.150
	b. Any of the following materials used in parking area	06			
	i. Galvanized Iron sheet	00	5 (2.3)	215 (97.7)	0.023
	ii. RCC plain	01	126 (57.3)	9 (42.7)	0.573

Sr. No.	Factors considered for assessing building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes	No	W M
			f (%)	f (%)	(0-1)
	iii. RCC with white or mosaic tiles	02	6 (2.7)	214 (97.3)	0.027
	iv. Aluminum sheet	03	3 (1.4)	217 (98.6)	0.014
	v. FRP (Fiber Reinenforced Plastic)	04	57 (25.9)	163 (74.1)	0.259
	vi. Manglore tiles	05	12 (5.5)	208 (94.5)	0.055
	vii. RCC with turfing	06	0 (0.0)	220 (100.0)	0.000
	c. Any of the following materials is used for paving on walkways in the garden	03			
	i. Impervious				
	• RCC	00	26 (11.8)	194 (88.2)	0.118
	• Tiles/Paver blocks with closed joints	01	38 (17.3)	182 (82.7)	0.173
	ii. Semi-pervious				
	• Tiles/Bricks/Paver blocks with open joints	01	15 (6.8)	205 (93.2)	0.068
	• Pebbles with open joints	02	1 (0.5)	219 (99.5)	0.005
	iii. Pervious (Kaccha road)	03	6 (2.7)	214 (97.3)	0.027
2.	Reduce heat island effect on roof through any of the following measures adopted:	05			
	a. White/mosaic tiles	01	197 (89.5)	23 (10.5)	0.895
	b. Constructed swimming pool	02	0 (0.0)	220 (100.0)	0.014
	c. Potted plants	03	10 (4.5)	210 (95.5)	0.045
	d. Plants grown direct on roof surface	04	6 (2.7)	214 (97.3)	0.027
	e. Installed solar photovoltaic panels on roof	05	2 (0.9)	218 (99.1)	0.009
	Total weighted Mean				**0.167**

Sr. No.	Factors considered for assessing building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes	No	W M
			f (%)	f (%)	(0-1)
VII.	**Storm water management**	**05**			
1.	Incorporated any of the storm water management techniques.	05			
	a. Tiled floor around the building	01	180 (81.8)	40 (18.2)	0.818
	b. Paver blocks around the building	02	27 (12.3)	193 (87.7)	0.123
	c. Grown grass around the building	03	18 (8.2)	202 (91.8)	0.082
	d. Open space covered with brickbat, grit or sand around the building	04	6 (2.7)	214 (97.3)	0.027
	e. Constructed recharge bore where terrace water is collected in bore or tank.	05	1 (0.5)	219 (99.5)	0.005
	Total weighted Mean				**0.211**

Plate 11: Measuring total landscaped area around the house

Plate 12: Impermeable Surface directing all run off towards Storm water collection pit

Plate 13: Paved area constructed with permeable paving

Plate 14: Manglore Tiles roofing in parking area

Plate 15: Tiles on the terrace

Regarding the “Site selection” it was found that the house plan was approved from the competent local government authority of the all respondent and they had obtained “Fit for occupancy” document. The mean weighted score was found to be highest for this aspect (Table-31). Majority of the houses did not have Green Certification from Leadership in Energy and Environment Design (LEED) or Green Rating for Integrated Habitat Assessment (GRIHA). The mean weighted score for this aspect was found to be the lowest amongst all of the factors of sub aspects of “Site selection”. It was found that two of the houses had received ‘Gold’ rating from LEED and one had received Pre certification from LEED at the time of data collection.In a survey conducted by **Porzel (2008)**, it was found that 36% of the respondents perceived their current home as “green”. The Green Building standards ranged from China Green Label (69.84%), to LEED certified buildings (12.7%) to Energy Star rated buildings (14.29%). Consumer survey on Green Buildings Awareness conducted by **Jamison(2007)** revealed that Energy star was the most recognized of all of the residential Green home certification programs.

Mature trees were grown in west direction of the house so as to give shade and reduce heat in majority of houses (Table-31). The roof surface was vegetated with potted plants in majority of the houses. One half of the respondents used sometimes organic and sometimes chemical fertilizers for the plants. Nearly forty per cent of the respondents used only chemical fertilizers for plants. Very few respondents (9.5 per cent and 9.1 per cent) had adopted mulching and permanent seeding as one of the measures to reduce soil erosion in available landscape respectively. Approximately 0 to 24 per cent of the total open available area was found to be landscaped with vegetation in majority of the houses. Three fourth of the respondents had not used permeable material for paved areas in their houses. In majority of the houses the impermeable surfaces directed all run off towards drainage system.

Majority of the houses had access to at least five amenities, within walking distance of 1 km. the most common amenities which were within walking distance of 1 km of the houses were Grocery store (98.6%), Place of worship

(97.7%), Playground (91.8%), Electrician/plumbing services (90.4%), Dhobi/Laundry (89.1%), Restaurant (88.2%) and Pharmacy (81.8%). In the survey conducted by **Porzel(2008)**the most requested supporting facilities within a community were bank (8.7%), a supermarket (7.8%), a convenience store (7.3%) and a school (7.0%). The least desired facility was the theatre (2.8%).

In the present study, majority of the houses were located within 800 meters of the auto stand.More than one half of the houses were located within 800 meters of the city bus stop.

The shade from tree falls on pathway of less than three fourth of the houses, on parking area of less than one fourth of the houses and on the entire building of only fifteen per cent of the houses (Table-31). RCC plain material was used in parking area of more than one half of the houses followed by Fiber Reinforced Plastic (25.9 per cent). Very few per cent of the houses had used various paving materials on walkways in the garden such as impervious paving materials viz. tiles/ paver blocks with closed joints (17.3%) and RCC (11.8%), semi-pervious materials such as tiles/bricks/paver blocks with open joints (6.8%) and pebbles (0.5%) and pervious materials in the form of kaccha road (2.7%). Majority of the houses had white/mosaic tiles constructed on the terrace as one of the measure adopted to reduce heat island effect.

Majority of the houses had tiled floor around the building. Recharge bore was constructed where terrace water was collected in bore or tank in only 0.5 per cent of the houses which is one of the storm water management techniques. The sub factor “Certification” had the lowest weighted mean and “Basic Amenities” had the highest weighted mean in the range of 0 to 1 (Table-31).

4.1.4.2“Water Efficiency” as factor for assessing the houses

This sub scale consisted of statements related to installation of water efficient fixtures, water meter, water level controller in water tank, plantation of drought tolerant species of plants and economic use of water by the family members (Table-32). The aspects of water efficiency were assessed through

observation while economic use of water by the family members was calculated through a formula.

In more than half of the houses approximately hundred per cent of the water efficient fixtures and fittings for potable water usage and water efficient flushing systems were installed. Majority of the houses had not installed main water meters. None of the houses had installed submeters for domestic hot water and domestic hot water. Only 2 respondents (i.e. 0.9 per cent) of the houses had installed submeters for landscape water consumption. Majority of houses had installed a water level controller in overhead water tank. The weighted mean for this aspect was found to be highest amongst all aspects. Less than three fourth of the houses had grown 25 per cent of drought tolerant species of plants, shrubs and trees in their garden. Majority of the respondents and their family members economically used water. The weighted mean was found to be lowest for “Grown drought tolerant species of plants” and highest in “Economic use of water by family members” sub factors.

Plate 16: Water Efficient fixtures installed for portable water usage

Plate 17: Installed submeters for various water usage

Plate 18: Installed water level controller in water tanks

Plate 19: Plants that consume less water

Table 32: Distribution of houses according to "Water Efficiency" in selected houses

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
B]	**WATER EFFICIENCY**	**19**			
I.	**Installed water efficient fixtures**	**08**			
1.	Percentage of water efficient fixtures and fitting installed for potable water usage. (6-12 litre / min)	04			
	a. 25% approx.	01	14 (6.4)	206 (93.6)	0.064
	b. 50% approx.	02	15 (6.8)	205 (93.2)	0.068
	c. 75% approx.	03	10 (4.5)	210 (95.5)	0.045
	d. 100% approx.	04	126 (57.3)	94 (42.8)	0.591
2.	Percentage of water efficient flushing system is installed. (3-6 litre per flush)	04			
	a. 25% approx.	01	9 (4.1)	211 (95.9)	0.041
	b. 50% approx.	02	14 (6.4)	206 (93.6)	0.064
	c. 75% approx.	03	7 (3.2)	213 (96.8)	0.032
	d. 100% approx.	04	125 (56.8)	95 (43.2)	0.568
	Total weighted Mean				**0.184**
II.	**Installed water meter**	**04**			
1.	Installed main water meters for the building.	01	207 (94.1)	13 (5.9)	0.941
2.	Installed submeters for one or more of the following water subsystems:	03			
	a. Domestic hot water	01	0 (0.0)	220 (100.0)	0.000
	b. Domestic water	01	0 (0.0)	220 (100.0)	0.005
	c. Landscape water consumption	01	2 (0.9)	218 (99.1)	0.009
	Total weighted Mean				**0.239**
III.	**Installed water level controller in water tank**	**02**			

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
1.	Installed water level controller in tank.	02			
	a. Overhead tank	01	213 (96.8)	7 (3.2)	0.968
	b. Underground tank	01	35 (15.9)	185 (84.1)	0.159
	Total weighted Mean				**0.564**
IV.	**Grown drought tolerant species of plants**	**04**			
1.	Percentage of Plants, shrubs and trees planted which consume less water.	04			
	a. 25%	01	140 (63.6)	80 (36.4)	0.636
	b. 50%	02	11 (5.0)	209 (95.0)	0.050
	c. 75%	03	3 (1.4)	217 (98.6)	0.014
	d. 100%	04	0 (0.0)	220 (100.0)	0.009
	Total weighted Mean				**0.177**
V.	**Economic use of water by family members**	**01**			
1.	Economic use of water is made considering 200 lit/day per person with flushing facilities as per NBC. (Number of family members×200 litre=Total consumption of water, Capacity of water tank and How many times the tank is filled in a day)		213 (96.8)	7 (3.2)	0.968
	Total weighted Mean	**0.968**			

4.1.4.3 "Energy Efficiency" as factor for assessing the houses

The aspect on "Energy Efficiency" included the statements related to installation of CFC free equipments, energy meters, BEE rated electric fittings, solar lights and solar water heaters. Other statements were related to energy performance within the building. All the factors were assessed through observation (Table 33).

It was found that majority of the respondents had installed CFC free Refrigerators while more than one half of the respondents had installed CFC free Air conditioners in their houses. All the respondents had installed energy meters for lighting at their houses. Majority of the respondents had not installed BEE rated electrical fittings in their houses. A little more than three fourth of the respondents had installed 3 star rated refrigerators. More than one half of the respondents had installed 3 star rated air conditioner. Very few respondents i.e. 15.0 per cent, 8.2 per cent and 3.2 per cent had installed 3 stars, 4 stars and 5 stars rated washing machines respectively. Very less respondents i.e. 14.1 per cent, 4.1 per cent and 0.9 per cent had installed 3 stars, 4 stars and 5 stars rated Television respectively. Less than one half of respondents had installed T5 tube lights everywhere in their home but more than three fourth had installed it at some places (Table-33). Less than three fourth of the respondents had installed LED lights at some places in the house. Majority of the respondents had electronic regulators at their house.

Majority of the respondents had constructed weather shed (97.7%), fixed blinds or curtains on doors and windows (96.8%), set the thermostat of the refrigerator at correct temperature (90.0%) and left enough space between refrigerator and wall. Less than one half of the respondents had not placed television, room heaters and other electrical appliances near Air conditioner (Table-33). Majority of the houses had illumination level of lights less than 50% of the regularly occupied rooms in the house. Very few respondents had installed solar lights at their houses while only 20.9 per cent of the respondents had installed solar water heaters at their houses. The sub factor "Electric fittings installed with BEE (Bureau of Energy Efficiency) rating" had the lowest weighted item mean and "Installed CFC-free equipments" had the highest weighted item mean in the range of 0 to 1.

Table 33: Distribution of houses according to "Energy Efficiency" in selected houses

Sr. No	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
C]	**ENERGY EFFICIENCY**	**49**			
I.	**Installed CFC-free equipment**	**02**			
1.	Installed following equipment which does not use CFC based refrigerants.	02			
	a. Refrigerator	01	201 (91.4)	19 (8.6)	0.914
	b. Air conditioner	01	126 (57.3)	94 (42.7)	0.573
	Total weighted Mean				**0.743**
II.	**Installed Energy meter**	**03**			
1.	Installed energy meters for the following:				
	a. Air conditioning		0 (0.0)	220(100.0)	0.045
	b. Lighting		220 (100.0)	0 (0.0)	0.827
	c. Municipal water pump		4 (1.8)	216 (98.2)	0.018
	Total weighted Mean				**0.297**
III.	**Electric fittings installed with BEE (Bureau of Energy Efficiency) rating**	**28**			
1.	Percentage of fittings rated BEE in the entire building	04			
	a. 25% approx.	01	21 (9.5)	199 (90.5)	0.095
	b. 50% approx.	02	18 (8.2)	202 (91.8)	0.081
	c. 75% approx.	03	12 (5.5)	208 (94.5)	0.054
	d. 100% approx.	04	5 (2.3)	215 (97.7)	0.022
2.	Installed following equipments with their energy efficient star ratings:	24			
	a. Refrigerators				

Sr. No	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
	i. 3 star	01	148 (67.3)	72 (32.7)	0.672
	ii. 4 star	02	15 (6.8)	205 (93.2)	0.068
	iii. 5 star	03	40 (18.2)	180 (81.8)	0.181
	b. Air conditioner				
	i. 3 star	01	126 (57.3)	94 (42.7)	0.572
	ii. 4 star	02	12 (5.5)	208 (94.5)	0.054
	iii. 5 star	03	28 (12.7)	192 (87.3)	0.127
	c. Electric ovens				
	i. 3 star	01	23 (10.5)	197 (89.5)	0.104
	ii. 4 star	02	7 (3.2)	213 (96.8)	0.031
	iii. 5 star	03	2 (0.9)	218 (99.1)	0.009
	d. Hot water geysers				
	i. 3 star	01	23 (10.5)	197 (89.5)	0.104
	ii. 4 star	02	4 (1.8)	216 (98.2)	0.018
	iii. 5 star	03	7 (3.2)	213 (96.8)	0.031
	e. Washing machine				
	i. 3 star	01	33 (15.0)	187 (85.0)	0.15
	ii. 4 star	02	7 (3.2)	213 (96.8)	0.031
	iii. 5 star	03	18 (8.2)	202 (91.8)	0.081
	f. Dishwashers				
	i. 3 star	01	1 (0.5)	219 (99.5)	0.004
	ii. 4 star	02	0 (0.0)	220 (100.0)	0.00

Sr. No	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
	iii. 5 star	03	0 (0.0)	220 (100.0)	0.00
	g. Electric Chimney				
	i. 3 star	01	18 (8.2)	202 (91.8)	0.081
	ii. 4 star	02	4 (1.8)	216 (98.2)	0.081
	iii. 5 star	03	0 (0.0)	220 (100.0)	0.00
	h. Television				
	i. 3 star	01	31 (14.1)	189 (85.9)	0.140
	ii. 4 star	02	9 (4.1)	211 (95.9)	0.040
	iii. 5 star	03	2 (0.9)	218 (99.1)	0.009
	Total weighted Mean	**0.101**			
IV.	**Energy performance within the building**	**13**			
1.	Installed any of the following fixtures:	05			
	a. T5 tube lights				
	i. At some places (min. 50% of the total installed)	01	87 (39.5)	133 (60.5)	0.395
	ii. Everywhere	02	104 (47.3)	116 (52.7)	0.472
	b. LED lights				
	i. At some places (min. 50% of the total installed)	01	140 (63.6)	80 (36.4)	0.636
	ii. Everywhere	02	17 (7.7)	203 (92.3)	0.077
	c. Regulators				
	i. Electric resistance type	00	6 (2.7)	214 (97.3)	0.027
	ii. Electronic	01	213 (96.8)	7 (3.2)	0.968
2.	Weather shed windows are constructed in order to reduce afternoon temperature entering in the	01	215 (97.7)	5 (2.3)	0.977

Sr. No	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
	house.				
3.	Fixed blinds or curtains on doors and windows to cut down the heat coming in the house.	01	213 (96.8)	7 (3.2)	0.968
4.	Spread gunny bags on the terrace and pour water on them in order to keep the house cool.	01	0 (0.0)	220 (100.0)	0.018
5.	Television, room heaters and other electrical appliances are not placed near AC.	01	91 (41.4)	129 (58.6)	0.413
6.	The thermostat of the refrigerators is set at correct temperature.	01	200 (90.9)	20 (9.1)	0.909
7.	Enough space is left between refrigerator and wall.	01	187 (85.0)	33 (15.0)	0.85
8.	Partially or fully shield is provided over all fixtures so that they do not directly emit light to the night sky.	01	124 (56.4)	96 (43.6)	0.563
9.	The illumination level of lights measured with the lights “ON” is not more than 20% above the level measured with the lights “OFF during day time.	02			
	a. Less than 50% of the regularly occupied rooms in the house.	01	212 (96.4)	8 (3.6)	0.963
	b. More than and equal to 50% of the regularly occupied rooms in the house.	02	4 (1.8)	216 (98.2)	0.018
	Total weighted Mean				**0.550**
VI.	**Use of Solar energy**	**02**			
1.	Installed Solar lights	01	17 (7.7)	203 (92.3)	0.077
2.	Installed solar water heaters	01	46 (20.9)	174 (79.1)	0.209
	Total weighted Mean				**0.143**

Plate 20: BEE 3 star rated refrigerator

Plate 21: Installed T-5 Tube lights

Plate 22: Installed LED lights

Plate 23: Weather shed windows constructed to reduce afternoon heat entering the house

Plate 24 : Installed Solar water heater

Plate 25: Installed Solar lights on the roof

4.1.4.4"Material and Resources" as factor for assessing the houses

The section on "Material and Resources" contained statements regarding the extent of use of local materials, provision for separation of waste, adoption of waste management techniques, use of recycle materials and other building materials. The scale was assessed through inquiry from the respondents and observation (Table 34).

It was observed that less than three fourth of the houses had used 75 per cent of the local building materials in the construction of the house. One third of the houses had used 50 per cent of the local building materials in construction of the house. Majority of the houses did not have provision for separate bins to collect organic waste, plastic, paper, glass etc. Majority of the respondents had not adopted waste management techniques such as Vermicomposting and Bio gasifiers at their house. Recycled tiles were used in less than one half of the houses. Conventional bricks were used in the construction of walls of the houses (Table-34). Tinted glasses were used for doors, windows and ventilation in more than one half of the houses while less than one fourth houses used plain glasses for the same. More than one half of the houses' exterior walls were finished by water repellent paints. The weighted item mean was found to be lowest for "Provision for separation of waste" and highest in "Local materials used in construction" sub factors.

Plate 26 :Bio gas Plant

Plate 27: Double Pane glasses

Table 34: Distribution of houses according to "Material and Resources" in selected houses

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
D]	**MATERIALS AND RESOURCES**	**18**			
I.	**Local materials used in construction**	**02**			
1.	Percentage of local building materials used in construction of the house which are manufactured within a radius of 500 km.	02			
	a. 50% approx.	01	74 (33.6)	146 (66.4)	0.336
	b. 75% approx.	01	141 (64.1)	79 (35.9)	0.640
	Total weighted Mean				**0.488**
II.	**Provision for Separation of waste**	**01**			
1.	Separate bins are provided to collect organic waste, plastic, paper, glass etc.	01	10 (4.5)	210 (95.5)	0.045
	Total weighted Mean				**0.045**
III.	**Adopted Waste management techniques**	**01**			
1.	Adopted any one of the strategies for waste management :	01			
	a. Vermicomposting	01	2 (0.9)	218 (99.1)	0.022
	b. Bio gasifiers	01	2 (0.9)	218 (99.1)	0.031
	Total weighted Mean				**0.265**
IV.	**Recycle materials used in construction of building**	**05**			
1.	Used any of the following recycled building materials in the construction of the house:	05			
	a. Glass	01	20 (9.1)	200 (90.9)	0.090
	b. Aluminum	01	4 (1.8)	216 (98.2)	0.018

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
	c. Wood	01	10 (4.5)	210 (95.5)	0.045
	d. Bricks	01	22 (10.0)	198 (90.0)	0.1
	e. Tiles	01	102 (46.4)	118 (53.6)	0.463
	Total weighted Mean				**0.143**
V.	**Building Materials**	**09**			
1.	Used bricks of any of the following type for construction of walls:	03			
	a. Conventional bricks	01	187 (85.0)	33 (15.0)	0.85
	b. Fly ash bricks	02	29 (13.2)	191 (86.8)	0.131
	c. Hollow bricks	03	0 (0.0)	220 (100.0)	0.00
2.	Used glass of any of the following type for doors, windows and ventilation:	03			
	a. Plain	01	100 (45.5)	120 (54.5)	0.454
	b. Film	02	12 (5.5)	208 (94.5)	0.054
	c. Tinted	03	114 (51.8)	106 (48.2)	0.518
3.	Use any of the following types of finish on exterior walls of the building:	03			
	a. Whitewash/Distemper	01	47 (21.4)	173 (78.6)	
	b. Water repellent paints	02	113 (51.4)	107 (48.6)	0.513
	c. Solar reflective paints	03	60 (27.3)	160 (72.7)	0.272
	Total weighted Mean				**0.334**

4.1.4.5 “Indoor Environment Quality” as factor for assessing the houses

The indoor environment quality included the statements related to type of window constructed, provision for cross ventilation, paints used on the wall, material of carpets, provision for daylighting and installation of exhaust systems (Table 35). The scale was assessed through observation and light meter was used for finding out the day lighting quotient of different rooms and the readings were then applied in the formula.

Openable type of window was constructed in living room, kitchen and bedrooms of majority of the houses. Majority of the houses had Venetian blinds with louver in the bathroom window. Majority of the houses had openings on at least two different directions of the house for cross ventilation. Majority of the houses did not have ventilators for fresh air intake in the rooms where split AC’s were installed. Almost all of the houses were provided with adequate windows and door for fresh ventilation in the living area, kitchen and bathrooms. Interior walls were painted with low VOC paints in one half of the houses. More than one third of the houses had whitewash/Distemper/Wall paper/Texture as a finish on interior walls. Carpets made of naturally available materials like coir, wool etc were used in majority of the houses. Majority of the houses had forced ventilation (exhaust fan) in the kitchen. More than three fourth of the houses had forced ventilation in toilets while one fourth of the houses had it in bathrooms(Table-35). Majority of the houses had exact daylighting provision in bedrooms, kitchen and living room respectively while less than three fourth of the houses had exact provision of daylighting in bathrooms. The sub factor “Paints used on the walls” had the lowest weighted item mean and “Material of carpets” had the highest weighted item mean.

Leaman (2007) conducted a post occupancy evaluation in Green building and reported significant association between perceived productivity and overall comfort consisting of lighting, ventilation, thermal comforts and noise, which were found to be better in Green buildings.

Allen et.al. (2015) reported that the Indoor Environment Quality of the Green Building, they assessed had lower levels of VOCs, formaldehydes, allergens, ETS, NO2 and PM.

Plate 28: Openings on two directions of the room for cross ventilation

Plate 29: Exhaust fan in bathroom

Table 35: Distribution of houses according to "Indoor Environment Quality" in selected houses

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
E]	**INDOOR ENVIRONMENT QUALITY**	**28**			
I.	**Type of window constructed**	**08**			
1.	Constructed any of the following type of window within certain areas of the house:	08			
	a. Living area				
	i. Openable window	01	182 (82.7)	38 (17.3)	0.827
	ii. Sliding window	02	37 (16.8)	183 (83.2)	0.168
	b. Bathrooms				
	i. Venetian blinds with louver	01	215 (97.7)	5 (2.3)	0.977
	ii. Sliding window	02	4 (1.8)	216 (98.2)	0.018
	c. Kitchen				
	i. Openable window	01	184 (83.6)	36 (16.4)	0.836
	ii. Sliding window	02	36 (16.4)	184 (83.6)	0.163
	d. Bedrooms				
	i. Openable window	01	182 (82.7)	38 (17.3)	0.827
	ii. Sliding window	02	37 (16.8)	183 (83.2)	0.168
	Total weighted Mean				**0.498**
II.	**Provision for Cross ventilation**	**05**			
1.	Constructed openings on at least two different directions of the house so as to allow cross ventilation.	01	176 (80.0)	44 (20.0)	0.8
2.	Ventilators provided for fresh air intake in the rooms where split AC's are installed.	01			
	a. No	00	59 (26.8)	161 (73.2)	0.268

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
	b. Yes	01	10 (4.5)	210 (95.5)	0.045
3.	Provided the percentage of windows and doors in the following areas for adequate fresh air ventilation in the building.	03			
	a. Living spaces (10%)	01	218 (99.1)	2 (0.9)	0.990
	b. Kitchen (8%)	01	28 (99.1)	2 (0.9)	0.990
	c. Bathrooms (4%)	01	218 (99.1)	2 (0.9)	0.990
	Total weighted Mean				**0.680**
III.	**Paints used on the walls**	**03**			
1.	Used any of the following types of finish on interior walls of the building:	03			
	a. Paints with high VOC content	00	2 (0.9)	218 (99.1)	0.009
	b. Whitewash/Distemper/Wall paper/Texture	01	87 (39.5)	133 (60.5)	0.395
	c. Low VOC content in paints	02	111 (50.5)	109 (49.5)	0.504
	d. No VOC content in paints	03	27 (12.3)	193 (87.7)	0.122
	Total weighted Mean				**0.258**
IV.	**Material of Carpets**	**01**			
1.	Using carpets made of naturally available materials like coir, wool etc.	01	203 (92.3)	17 (7.7)	0.922
	Total weighted Mean				**0.922**
V.	**Installed Exhaust systems**	**03**			
1.	Forced ventilation (Exhaust fans) are installed in the following areas:	03			
	a. Kitchen	01	193 (87.7)	27 (12.3)	0.877
	b. Bathroom	01	56 (25.5)	164 (74.5)	0.254
	c. Toilets	01	149 (67.7)	71 (32.3)	0.677

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
	Total weighted Mean				**0.603**
VI.	**Provision for Day lighting**	**08**			
1	Provision for day lighting available in each of the following area: (8) DQ= light intensity at measuring point (Ei)×100 / light intensity in the open (Ea)				
	a. Living area (minimum daylight quotient=1.5)				
	• Below 1.5	00	5 (2.3)	215 (97.7)	0.222
	• Exact 1.5	01	176 (80.0)	44 (20.0)	0.8
	• Above 1.5	02	35 (15.9)	185 (84.1)	0.159
	b. Bathrooms (minimum daylight quotient=1)				
	• Below 1	00	70 (31.8)	150 (68.2)	0.318
	• Exact 1	01	139 (63.2)	81 (36.8)	0.631
	• Above 1	02	8 (3.6)	212 (96.4)	0.036
	c. Kitchen (minimum daylight quotient=1.5)				
	• Below 1.5	00	4 (1.8)	216 (98.2)	0.0181
	• Exact 1.5	01	190 (86.4)	30 (13.6)	0.863
	• Above 1.5	02	22 (10.0)	198 (90.0)	0.1
	d. Bedrooms (minimum daylight quotient=1)				
	• Below 1.5	00	2 (0.9)	218 (99.1)	0.009
	• Exact 1.5	01	203 (92.3)	17 (7.7)	0.922
	• Above 1.5	02	12 (5.5)	208 (94.5)	0.054
	Total weighted Mean				**0.339**

Plate 30: Measuring Daylight in the open area around the house with Light Meter

Plate 31: Measuring Daylight inside the house with Light Meter

Plate 32: Measuring the area of a room

Plate 33: Measuring the size of a window

Plate 34: Sliding Windows in various rooms

4.1.4.6"Innovative Ideas" as factor for assessing the selected houses

Innovative idea is a factor which is considered with the thinking that some respondents might be aware about the new technology and hence might have adopted it in their houses. These factors were provision for rainwater harvesting, installation of grey water treatment plant, management of irrigation system and others. Observation technique was used to assess this sub scale (Table 36).

Majority of the houses did not have provision for collecting and reusing roof rainwater for non-portable uses such as for irrigation, urinal flushing and toilet purposes. Provision for collection and reuse of roof rainwater for ground water recharging through filtration media and recharge bore, collecting pond, impervious surface and landscaping respectively were not provided in majority of the houses. Grey water treatment plant was not installed for irrigation purpose in all of the houses and for flushing purpose in majority of the houses. The entire houses had not installed central shut-off valve (tap) and sprinklers, very few had installed porous pipes for irrigation, drip irrigation and time based controller for the valves respectively as efficient irrigation technologies for landscaping(Table-36). None of the houses had installed sucking flushing systems and waterless urinals. The sub factor "Others" which included statements regarding installation of sucking flushing systems and waterless urinals had the lowest weighted mean and "Provision for Rainwater Harvesting System" had the highest weighted item mean in the range of 0 to 1.

Plate 35: Rain water collection pipe

Plate 36: Occupancy sensors

Table 36: Distribution of houses according to "Innovative Ideas" in selected houses

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
F]	**INNOVATIVE IDEAS**	**16**			
I.	**Provision for Rainwater harvesting system**	**07**			
1.	Collect and reuse roof rainwater for any of the following uses:	07			
	a. Non-potable uses such as landscape irrigation, toilet and urinal flushing	03			
	i. Irrigation	01	7 (3.2)	213 (96.8)	0.031
	ii. Toilet	01	12 (5.5)	208 (94.5)	0.054
	iii. Urinal flushing	01	11 (5.0)	209 (95.0)	0.050
	b. For ground water recharging through:	04			
	i. Filtration media and recharge bore	01	0 (0.0)	220 (100.0)	0.000
	ii. Impervious surface	01	3 (1.4)	217 (98.6)	0.013
	iii. Landscaping	01	7 (3.2)	213 (96.8)	0.031
	iv. Collecting pond which act as percolation tank and water bodies.	01	1 (0.5)	219 (99.5)	0.004
	Total weighted Mean				**0.026**
II.	**Installed Grey water treatment plant**	**02**			
1.	Grey water treatment plant is installed.	02			
	a. For irrigation	01	0 (0.0)	220 (100.0)	0.000
	b. For flushing	01	1 (0.5)	219 (99.5)	0.004
	Total weighted Mean				**0.002**
III.	**Management of irrigation system**	**05**			
	Installed any one of the following high efficiency irrigation technologies for landscaping done on available space:	05			
	a. Time based controller for the valves	01	1 (0.5)	219 (99.5)	0.004
	b. Drip irrigation	01	2 (0.9)	218 (99.1)	0.009
	c. Central shut-off valve (tap)	01	0 (0.0)	220 (100.0)	0.000
	d. Sprinklers	01	0 (0.0)	220 (100.0)	0.000
	e. Porous pipes are constructed for irrigation	01	3 (1.8)	217 (98.2)	0.018
	Total weighted Mean				**0.006**

Sr. No.	Factors considered for assessing green building for the extent they are green	Respondents (n=220)			
		Maximum Possible Score	Yes f (%)	No f (%)	W M (0-1)
IV.	**Others**	**02**			
1.	Sucking flushing system is installed.	01	0 (0.0)	220 (100.0)	0.00
2.	Waterless urinals are installed.	01	0 (0.0)	220 (100.0)	0.00
	Total weighted Mean				**0.00**

Plate 37: Porous pipes for irrigation purpose

Plate 38: Permanent water filteration plant for swimming pool

Plate 39: Sewage Treatment plant

4.1.4.7 Extent of "Greenness" of the selected houses: Overall View

The extent of greenness was analysed in terms of high, medium and low scores obtained on sub-scales and on the entire checklist. The scores on each of the item of the scale were summated and possible range of minimum to maximum scores was divided into three categories having equal intervals. The high scores were considered as high extent of greenness. The possible score on the scale was 0 to 183 (Table-37).

Table 37: Distribution of houses according "Extent of Greenness" of the selected houses: Aspect wise and overall

Sr. No.	Factors for assessing the existing selected buildings	Range of Scores	Respondents (n=220)	
			F	%
A.	**Sustainable site**			
	High Extent	36 – 52	01	0.5
	Moderate Extent	17 – 35	137	62.3
	Low Extent	0 – 16	82	37.3
	Total weighted Mean	**0 – 1**	**0.351**	
B	**Water efficiency**			
	High Extent	13 – 19	10	4.5
	Moderate Extent	6 – 12	153	69.5
	Low Extent	0 – 12	57	25.9
	Total weighted Mean	**0 – 1**	**0.426**	
C	**Energy efficiency**			
	High Extent	33 – 49	01	0.5
	Moderate Extent	16 – 32	90	40.9
	Low Extent	0 – 15	129	58.6
	Total weighted Mean	**0 – 1**	**0.367**	
D	**Material and Resources**			
	High Extent	13 – 18	08	3.6
	Moderate Extent	6 – 12	190	86.4
	Low Extent	0 – 5	22	10.0
	Total weighted Mean	**0 – 1**	**0.255**	
E	**Indoor environment quality**			
	High Extent	20 – 28	33	15.0
	Moderate Extent	9 – 19	187	85.0
	Low Extent	0 – 8	0	0.0
	Total weighted Mean	**0 – 1**	**0.550**	
F	**Innovative ideas**			
	High Extent	12 – 16	00	0.0
	Moderate Extent	6 – 11	03	1.36
	Low Extent	0 – 5	217	98.63
	Total weighted Mean	**0 – 1**	**0.008**	
E.	**Overall**			
	High Extent	123 – 183	03	1.36
	Moderate Extent	61 – 122	164	74.5
	Low Extent	0 – 60	53	24.0
	Total weighted Mean	**0 – 1**	**0.326**	

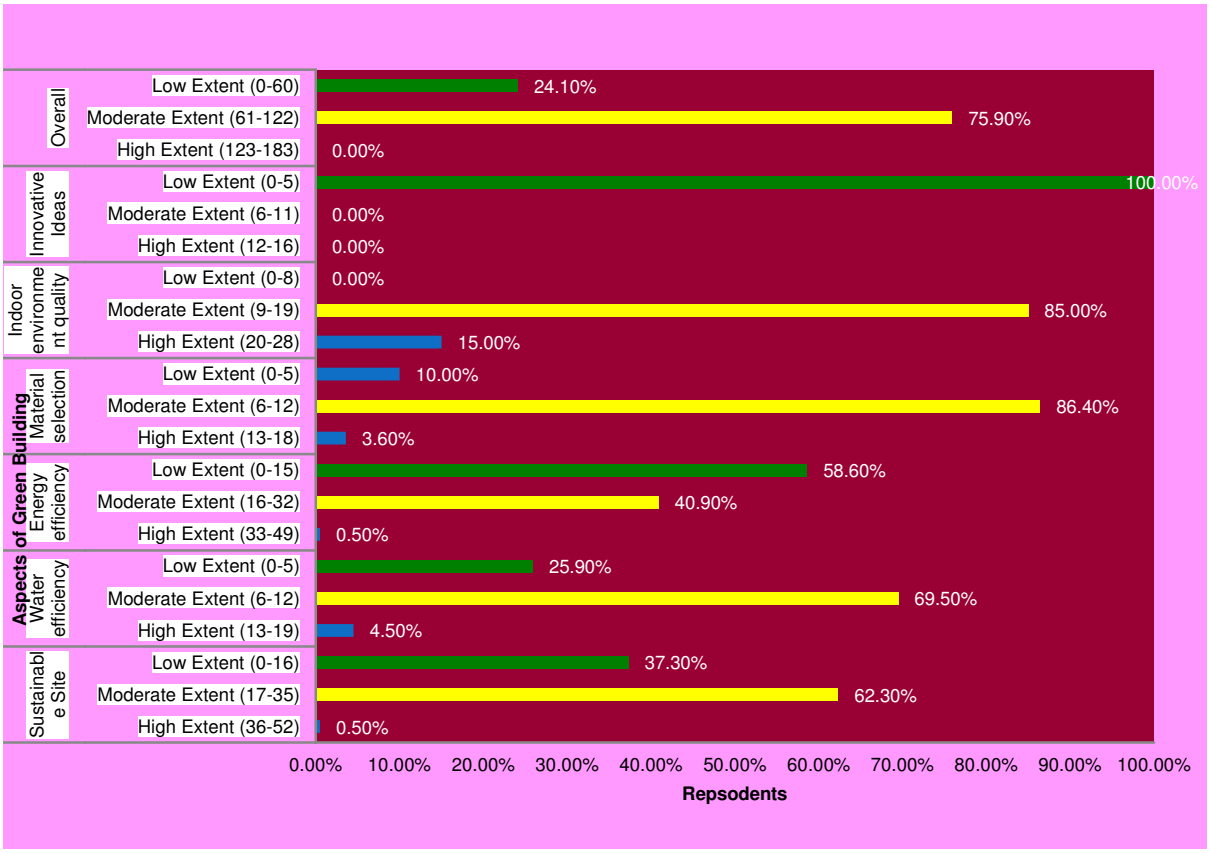

Figure 35: Percentage Distribution of according to "Extent of Greenness" of the selected houses

Analysing the entire scale, it was observed thatnone of the houses were found having high extent of greenness. Majority of the houses were green to moderate extent. Low extent of greenness was reflected in less than one fourth of the cases.

Regarding the sustainable site less than three fourth of the houses had moderate extent of greenness. More than one third of the houses had low extent of greenness (Table 37, Fig.35). On the aspect of water efficiency, more than three fourth of the houses had moderate extent of greenness and one half of the houses had low extent of greenness. About the energy efficiency, more than one half of the houses had low extent of greenness while less than one half of the houses had moderate extent of greenness. Regarding the material and resources, majority of the houses had moderate extent of greenness. Majority of the houses had moderate extent of greenness on indoor environment quality aspect while only 15 per cent had

high extent of greenness. Regarding innovative aspects, low extent of greenness was found in all of the houses.

The weighted mean (item intensity) for each of the statement and for each of the factors for assessing the existing selected buildings was found. It is reported in Table 37.

Table 38: Weighted mean for the "Extent of Greenness" of the selected houses: Overall

Sr. No	Factors for assessing the existing selected buildings	Total Weighted mean (0 - 1) (intensity index)
A.	Indoor Environment Quality	0.550
B.	Water Efficiency	0.426
C.	Energy Efficiency	0.367
D.	Site Selection	0.351
E.	Material Selection	0.255
F.	Innovative Ideas	0.008
	Overall weighted mean	**0.326**

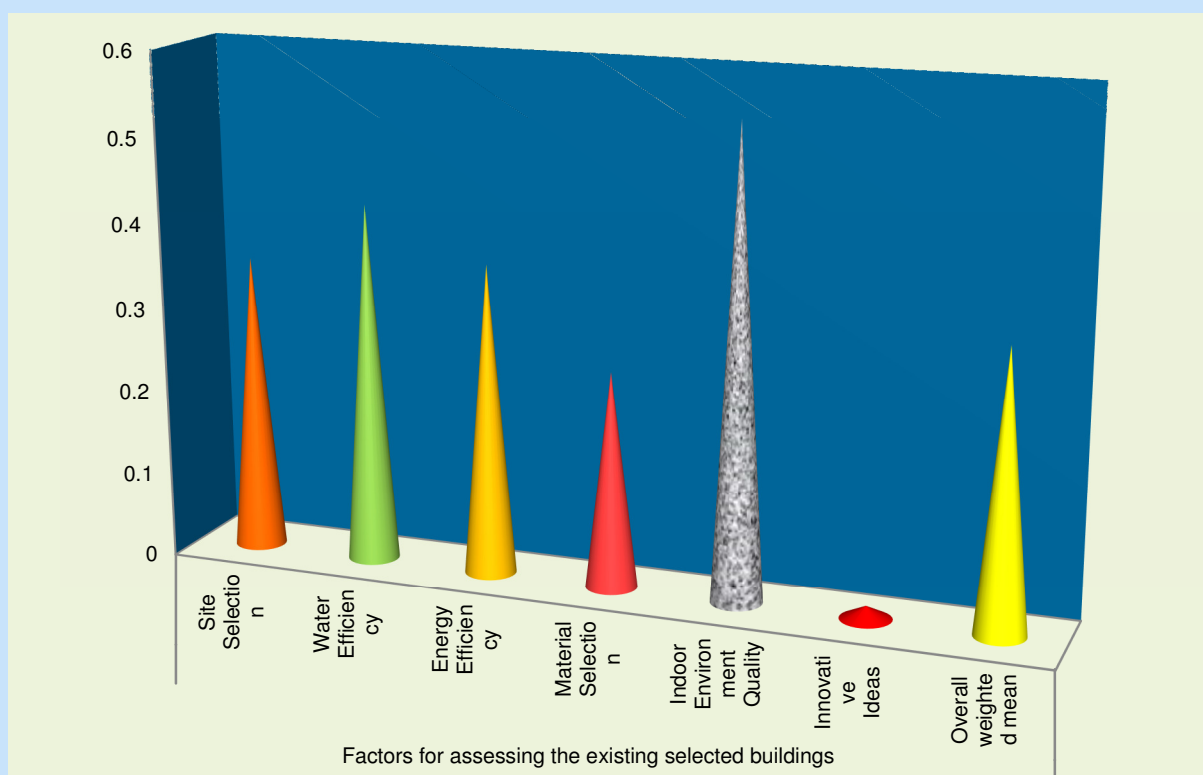

Figure 36: Weighted mean for the "Extent of Greenness" of the selected houses

The weighted mean computed for each factors for assessing the existing selected buildings reflected that the scores for “Indoor Environment Quality” was found to be the highest amongst all the aspects. The aspect of “Innovative Ideas” scored the lowest. The overall weighted mean on all the factors was0.327 (Table 38, Figure 36).

Conclusion

The data were collected from the builders to find out their opining regarding green buildings, extent of influence of reasons and extent of barriers faced in adopting green building design and construction. The mean age of the builders was 43.01 years. One half of the builders’ belonged to a age group of 36 to 50 years. More than one third of the builders had done diploma in civil engineering. Less than one half of the builders were working as builders since 11 to 20 years. More than one half of the builders knew about Green buildings from newspapers, magazine articles and from professional associates. It was found that more than one half of the respondents had low extent of exposure to the sources of information on green building. Most of the builders were ‘somewhat familiar’ about the concept and methods of Green Buildings. More than one half of the builders were somewhat influenced by the concept of Green Building. Majority of the builders had incorporated aspects of “Indoor Environment Quality” and “Water Efficiency” in their Private projects only. Most of the builders considered “Indoor Environment Quality” aspect of Green Building as most important as compared to other aspects.

Most of the builders were influenced by the “Environmental Reasons” to a high extent for adopting Green Building design and construction. More than one half of the builders faced “Lack of Technical Knowledge” as high extent of barrier in adopting Green Building design and construction. Less than three fourth of the builders had “Somewhat Favourable” opinion regarding Green Buildings.

It can be concluded from the findings that in less than one half of the cases both husband and wife together took decision regarding the purchase or construction of the house. It was found that husbands jointly or independently participated more in decision making process related to the purchase or construction of the house. Therefore, it can be said majority of the respondents were male (husbands). The mean age of the respondents was 42.05 years. More than on half of the respondents belonged to the age group of 36 to 50 years. More than one half of the respondents were graduate. Less than three fourth of the respondents were employed in a service sector. The mean income of the respondents was Rs. 88,153.64. Majority of the respondents belonged to a nuclear family with a small family size consisting of two to five family members. Majority of the respondents were residing in tenement or twin duplex type houses. Less than one half of the respondents purchased or constructed their house between the year 2008 and 2010.

The extent of knowledge regarding various aspects of Green Building was found which reflected that less than three fourth of the respondents had low extent of knowledge regarding various aspects of Green Building. Less than one third of the respondents had moderated extent of knowledge on the overall scale. On comparing the mean weighted scores, it was found that the respondents had highest score for “Meaning of Green Building” aspects and lowest for “Indoor Environment Quality” aspect of Green Building.

The existing house of the respondents were analysed for the extent of greenness. Majority of the houses had moderate extent of greenness for all the sub aspects except “Energy Efficiency”. About three fourth of the respondents’ houses had moderate extent of greenness on the overall scale. On computing the mean scores, the scores were found highest for the sub aspect “Indoor Environment Quality” and lowest for “Innovative Ideas” sub aspect.

Section 4.3

4.3 Testing of Hypotheses

In order to test the hypotheses formulated for the present investigation, as per the nature of variables t-test, chi-square, coefficient of correlation, Analysis of Variance were computed. For the purpose of statistical analysis, the hypotheses were formulated in null form. The results are presented in this section.

Ho_1: There exists no relationship between the opinion of builders regarding green building concept and their selected personal and situational variables

To find out the relationship between the opinion of builders regarding green building concept and their selected personal and situational variables, co-efficient of correlation and chi square were computed.

Table39: Co-efficient of Correlation showing relationship between opinion of builders regarding green building concept and their age, duration of time working as builder and sources of information on green buildings

	Selected variables	n	r-value	Level of significance
I.	Opinion of builders regarding green building concept	75	-0.018	N.S.*
	Age of the builders			
II.	Opinion of builders regarding green building concept	75	0.012	N.S.*
	Duration of time as builder			
III.	Opinion of builders regarding green building concept	75	0.290	0.05
	Sources of information on green buildings			

Note: *N.S. =Not Significant

The results revealed no significant relationship between the opinion of builders regarding green building concept their age and duration of time working as builder (Table-39). But it was found significant for sources of information on green buildings. Hence the null hypothesis was partially accepted.

Ho_2: There exists no relationship between the extent of influence of reasons in adopting Green Building design and construction and selected personal and situational variables of the builders

Co-efficient of Correlation and chi square were computed to test this hypothesis.

$Ho_{2.1}$: There is no relationship between the extent of influence of reasons in adopting Green Building design and construction of the builders and their age, duration of time working as builder and sources of information on green buildings

Table 40: Co-efficient of Correlation showing relationship between extent of influence of reasons in adopting Green Building design of the builders and their age, duration of time working as builder and sources of information on green buildings

	Selected variables	n	r-value	Level of significance
I.	Extent of influence of reasons in adopting Green Building design and construction	75	0.109	N.S.*
	Age of the builders			
II.	Extent of influence of reasons in adopting Green Building design and construction	75	0.031	N.S.*
	Duration of time working as builder			
III.	Extent of influence of reasons in adopting Green Building design and construction	75	-0.045	N.S.*
	Sources of information on green buildings			

Note: *N.S. =Not Significant

The results revealed no significant relationship between extent of influence of reasons in adopting Green Building design and construction of the builders and their age, duration of time working as builder and sources of information on green buildings (Table-40). Hence the null hypothesis was accepted.

$Ho_{2.2}$: There is no variation in extent of influence of reasons for adopting green building design and construction of the builders due to kind of construction projects undertaken by them

Chi square was computed to test this hypothesis.

Table 41: Chi-square values for selected variable

Variables	Chi-square values	df	Level of Significance
Kind of projects			
i. Residential	5.456	4	N.S.*
ii. Commercial	1.683	4	N.S.*
iii. Institutional	8.716	4	N.S.*
iv. Renovation	8.437	4	N.S.*
v. New construction	6.212	4	N.S.*
vi. Private	8.647	2	0.05

Note: *N.S. =Not Significant, df=Degree of Freedom

Chi-square value was found to be significant only for private projects undertaken by the builders and extent of influence of reasons for adopting Green building design and construction (Table-41). Thus, the null hypothesis was partially rejected. It can be because builders might have freedom to express their environmental concern in the construction in private projects undertaken by them.

Ho_3: There exists no relationship between the extent of barriers faced by the builders in adopting green building design and construction and their selected personal and situational variables

To find out the relationship between extent of barriers faced by the builders in adopting green building design and construction and their selected personal and situational variables, co-efficient of correlation and chi square were computed.

$Ho_{3.1}$: There is no relationship between the extent of barriers faced by the builders in adopting Green Building design and construction and their age, duration of time working as builder and sources of information on green buildings

Table 42: Co-efficient of Correlation showing relationship between extent of barriers faced by the builders in adopting Green Building design and their age, duration of time working as builder and sources of information on green buildings

	Selected variables	n	r-value	Level of significance
I.	Extent of barriers faced by the builders in adopting Green Building design and construction	75	0.230	N.S.*
	Age of the builders			
II.	Extent of barriers faced by the builders in adopting Green Building design and construction	75	0.178	N.S.*
	Duration of time as builder			
III.	Extent of barriers faced by the builders in adopting Green Building design and construction	75	-0.078	N.S.*
	Sources of information on green buildings			

Note: *N.S. =Not Significant

The results revealed no significant relationship between extent of barriers faced by the builders in adopting Green Building design and construction and their age, duration of time working as builder and sources of information on green buildings (Table-42). Hence the null hypothesis was accepted.

$Ho_{3.2}$: There is no variation in extent of barriers faced by builders in adopting green building design and construction due to kind of construction projects undertaken by them

Chi square was computed to test this hypothesis.

Table 43: Chi-square values for selected variable

Variables	Chi-square values	df	Level of Significance
Kind of projects			
i. Residential	6.779	4	N.S.*
ii. Commercial	3.974	4	N.S.*
iii. Institutional	2.233	4	N.S.*
iv. Renovation	0.864	4	N.S.*
v. New construction	3.965	4	N.S.*
vi. Private	0.120	2	N.S.*

Note: *N.S. =Not Significant, df=Degree of Freedom

Chi-square value was not found significant for any kind of projects undertaken by the builders and the extent of barriers faced by them in adopting Green building design and construction (Table-43). Thus, the null hypothesis was accepted.

Ho_4: There is no interrelationship between the extent of influence of reasons in adopting green building design and features of builders, extent of barriers faced in adopting green building design and construction and opinion of builders regarding green building concept

Coefficient of correlation was computed to test this hypothesis.

Table 44: Coefficient of Correlation showing relationship between selected variables

	Selected variables	n	r-value	Level of significance
I.	Extent of influence of reasons for adopting green building design and construction	75	0.138	N.S.*
	Extent of barriers faced in adopting green building design and construction			
II.	Extent of influence of reasons for adopting green building design and construction	75	0.400	0.01
	Opinion of builders regarding green building concept			
III.	Extent of barriers faced in adopting green building design and construction	75	-0.091	N.S.*
	Opinion of builders regarding green building concept			

Note: *N.S. =Not Significant

Computation of coefficient of correlation indicated that there is a significant relationship between extent of influence of reasons for adopting green building design and construction and Opinion of builders regarding green building concept (Table-44). Hence, the null hypothesis was rejected in this case. Since the relationship was found positive, it could be concluded that more the extent of influence of reasons more the favourable opinion of the builders regarding Green Buildings. No significant relationship was found

between the extent of influence of reasons and extent of barriers faced by the builders in adopting Green building design and construction and also between extent of barriers faced by the builders in adopting Green building design and construction and opinion of builders regarding Green building concepts. Thus the null hypothesis is accepted in these cases.

Ho_5: The extent of knowledge of the home owners regarding various aspects of Green Building does not vary with their selected Personal, Family and Situational variables

For the purpose of testing several sub hypotheses as per the application of the tests were framed in a null form.

$Ho_{5.1}$: There exists no relationship between the extent of knowledge of the home owners regarding various aspects of Green Building and their age and monthly family income

Co-efficient of Correlation was computed to test this hypothesis.

Table 45: Co-efficient of Correlation showing relationship between extent of knowledge of the Home owners regarding various aspects of Green Buildings and their age and monthly family income

	Selected variables	n	r-value	Level of significance
I.	Extent of Knowledge of the home owners regarding Green Buildings	220	0.159	0.05
	Age of the home owners			
II.	Extent of Knowledge of the home owners regarding Green Buildings	220	-0.087	N.S.*
	Monthly family income of the home owners			

Note: *N.S. =Not Significant

A positive relationship was found between the extent of knowledge of the home owners regarding various aspects of Green Building and their age. Hence, the null hypothesis was rejected. It could be concluded that the extent of knowledge of the home owners regarding various aspects of green building was related with their age(Table- 45).

$Ho_{5.2}$: There exists no variation in the extent of knowledge of the home owners on various aspects of Green Building with their educational level and occupation.

Analysis of Variance was computed to test this hypothesis.

Table46: Analysis of Variance showing variation in the extent of knowledge of the home owners regarding various aspects of Green Buildings by their educational level and occupation

Sr. No.	Selected variables	df	Sum of squares	Mean squares	F value	Level of significance
1.	**Education**					
	Between Groups	5	3979.636	795.927	3.351	0.01
	Within Group	214	50832.801	237.536		
2.	**Occupation**					
	Between Groups	2	276.497	138.249	0.550	N.S.*
	Within Groups	217	54535.939	251.318		

Note: *N.S. =Not Significant, df=Degree of Freedom

The results showed a significant variation in the extent of knowledge of the home owners on various aspects of Green Building with their educational level. Hence, the null hypothesis was rejected. This reflected that the extent of knowledge of the home owners on various aspects of Green Building varied with their educational level (Table-46).The F value was not found to be significant hence, it did not show any variation in the extent of knowledge of the home owners on various aspects of Green Building with their occupation. Thus the null hypothesis was accepted. Hence, it was inferred that the occupation of the home owners had no significant effect on their extent of knowledge on various aspects of Green Building.

$HO_{5.3}$: There is no difference in the extent of knowledge of the home owners on various aspects of Green Building and their type of family and type of house

To study the difference in extent of knowledge of the home owners on various aspects of Green Building and their type of family and type of house, t test were computed.

Table 47: t-test showing the difference in the extent of knowledge of the home owners regarding various aspects of Green Buildings and their type of family and type of house

Sr. No.	Variables	Mean Scores	t value	df	Level of Significance
1.	**Type of family**		1.057	218	N.S.*
	Nuclear	81.50			
	Joint	78.85			
2.	**Type of house**		0.200	205	N.S.*
	Tenement/ Twin Duplex	81.56			
	Independent Bungalow	81.06			

Note: *N.S. =Not Significant, df=Degree of Freedom

The t values were not found to be significant (Table-47). Hence the null hypotheses were accepted. Thus it could be concluded that the extent of knowledge of the home owners on various aspects of Green Building does not differ with their type of family and the type of house.

Ho_6: The extent of greenness of the selected house does not vary with the selected Personal, Family and Situational variables of the home owners

For the purpose of statistical analysis, sub hypotheses were framed in null form.

$Ho_{6.1}$: There exists no relationship between the extent of greenness of the selected house and age and monthly family income of the home owners

Co-efficient of Correlation was computed to find out relationship between the extent of greenness of the selected house and age and monthly family income of the home owners.

Table 48: Co-efficient of correlation showing relationship between extent of greenness of the selected house and age and monthly family income of the home owners

	Selected variables	n	r-value	Level of significance
I.	Extent of greenness of the selected houses	220	0.010	N.S.*
	Age of the home owners			
II.	Extent of greenness of the selected houses	220	-0.081	N.S.*
	Monthly family income of the home owners			

Note: *N.S. =Not Significant

The computation of Co-efficient of Correlation was not found significant. Hence the null hypothesis was accepted in both the cases (Table-48).

$HO_{6.2}$: There exists no variation in the extent of greenness of the selected houses with the educational level and occupation of the home owners

Analysis of Variance was computed to test the hypothesis.

Table 49: Analysis of Variance showing variation in the extent of greenness of the selected houses by the educational level and occupation of home owners

Sr. No.	Selected variables	df	Sum of squares	Mean squares	F value	Level of significance
1.	**Education**				0.795	N.S.*
	Between Groups	5	675.862	135.172		
	Within Group	214	36374.915	169.976		
2.	**Occupation**				0.038	N.S.*
	Between Groups	2	12.916	6.458		
	Within Groups	217	37037.862	170.681		

Note: *N.S. =Not Significant, df=Degree of Freedom

The F values were not found to be significant for the variation in the extent of greenness of the selected houses with the educational level and occupation of home owners (Table-49). Hence, the null hypothesis was accepted and it was concluded that extent of greenness of the selected houses did not vary with the education of the home owners.

$HO_{6.3}$: There is no difference in the extent of greenness of the selected houses and type of family and type of house of the home owners

Table 50: t-test showing the difference in the extent of greenness of the selected houses and type of family and type of house of the home owners

Sr. No.	Variables	Mean Scores	t value	df	Level of Significance
1.	**Type of family**				
	Nuclear	67.89	1.60	218	N.S.*
	Joint	71.19			
2.	**Type of house**				
	Tenement/ Twin Duplex	69.06	0.29	205	N.S.*
	Independent Bungalow	69.00			

Note: *N.S. =Not Significant, df=Degree of Freedom

The computation of t value did not show any significant difference in the extent of greenness of the selected houses and type of family and type of house of the home owners (Table-50). Thus the null hypothesis was accepted. Thus, it was inferred that the type of the family and type of house did not cause any difference in the extent of greenness of the selected house.

Ho_7: There exists no relationship between the extent of greenness of the selected houses and extent of influence of reasons in adopting Green Building design and construction of the builders, barrier faced by the builders in adopting Green Building design and construction and opinion of builders regarding Green Building concept

Computation of co-efficient of correlation reflected no significant relationship between the extent influence of reasons and barriers faced in adopting green building green building design and construction and extent of greenness of the selected houses (Table-51). But a significant relationship was found between the opinion of builders regarding green building concept and extent of greenness of the selected houses. Hence the null hypothesis was partially accepted. Those builders who had favourable opinion, the house constructed by them had more “greenness”.

Table 51: Co-efficient of correlation showing relationship between extent of greenness of the selected houses and extent of influence of reasons in adopting Green Building design and construction of the builders, barrier faced by the builders in adopting Green Building design and construction and opinion of builders regarding Green Building concept

	Selected variables	n	r-value	Level of significance
I.	Extent of influence of reasons in adopting Green Building design and construction	75	0.107	N.S.*
	Extent of greenness of the selected houses			
II.	Extent of barriers faced by builders in adopting Green Building design and construction	75	-0.069	N.S.*
	Extent of greenness of the selected houses			
III.	Opinion of builders regarding Green Buildings concept	75	0.438	0.01
	Extent of greenness of the selected houses			

Note: *N.S. =Not Significant

Ho_8: There exists no relationship between the knowledge of home owners and the extent of greenness of the selected houses

Co-efficient of correlation was computed to test this hypothesis.

Table 52: Co-efficient of correlation showing relationship between extent of knowledge of the home owners regarding Green Buildings and extent of greenness of their houses

	Selected variables	n	r-value	Level of significance
I.	Extent of Knowledge of the home owners regarding Green Buildings	220	0.193	0.01
	Extent of greenness of the selected houses			

A positive relationship was found between extent of knowledge of the home owners regarding Green Buildings and extent of greenness of the selected houses (Table-52). Hence, the null hypothesis was rejected and it was concluded that the extent of greenness of the selected house was affected by extent of knowledge of the home owners regarding Green Buildings.

Ho_9: There exists no difference in the extent of knowledge of the home owners regarding Green buildings before and after the exposure to the educational program on Green buildings

Paired t-test was computed to find out the difference in the extent of knowledge of the home owners regarding Green buildings before and after the administration of educational program on Green buildings.

Table 53: Paired t-test showing the difference in extent of knowledge of the home owners regarding Green buildings in pre and post test

Variables	Mean Scores	Mean Difference	t value	df	Level of Significance
Before administration of an educational program	68.9	43.7	25.047	59	0.01
After administration of an educational program	112.6				

Results of paired t test indicated that there was a significant difference in the knowledge of the home owners before and after the administration of the educational program. Paired t test was found to be highly significant at 0.01 level for all the aspects of Green building (Table-53). Thus, the null hypothesis was rejected. Thus it can be concluded that the knowledge of the home owners increased significantly after the exposure to the educational program prepared on Green buildings. This proves a high efficacy of the educational program.

Conclusion

A significant relationship was found between the extent of knowledge of home owners regarding green building and their age. There was a significant variation in the extent of knowledge of home owners regarding green building with their educational level. A positive relationship was found between the extent of knowledge of the house owners regarding Green Buildings and extent of greenness of the selected houses.

A significant relationship was found between the extent of influence of reasons in adopting green building design and construction and private projects undertaken by the builders. There was a significant relationship between the extent of influence of reasons in adopting green building design and construction and opinion of builders regarding green buildings. A positive relationship was found between the opinion of builders regarding green building and extent of greenness of the selected houses. A significant relationship was found before and after the administration of the educational program on Green buildings. This reflected the high efficacy of the educational program prepared for the purpose.

Section 4.4
4.4 Educational Programme

One of the objectives of the present research was to prepare an educational program on Green buildings. For this an educational program comprising of power point presentation with its explanation in Hindi and English language and a booklet were prepared. To establish the efficacy of an educational program, it was administered to the respondents scoring low on knowledge scale and house owners of those houses which had low extent of greenness. The educational program consisted information related to Present environmental condition, Construction Facts, Need of Green Buildings, Definition of Green Building, Meaning of Green Buildings, Benefits of Green Buildings, Green Rating Systems, Features of Green Buildings, Going Green in Existing Buildings by following guidelines (Site selection, Water efficiency, Energy conservation, Material selection and Indoor Environmental Quality). To assess difference in the knowledge of the respondents regarding Green buildings they were asked to fill the questionnaire having the same knowledge scale which they filled earlier. This helped the researcher to test the efficacy of the educational program prepared for the purpose. There were 138 respondents scoring low on the knowledge scale, therefore, they were invited to attend the educational program. Out of them 60 attended the educational program. They were exposed to Audio visual educational programme

prepared in Hindi language. Results of pre and post data for them are presented as here.

Table 54: Distribution of Respondents according to their extent of knowledge regarding various aspects Green Building before and after the exposure to the Education Program: An Overall View

Sr. No.	Aspects of Green Buildings	Range of Scores	Pre test (n=60)		Post test (n=60)	
			f	%	f	%
I	**Meaning of Green building**					
	High Extent	15-18	1	1.67	36	60.00
	Moderate Extent	10-14	44	73.33	24	40.00
	Low Extent	6-9	15	25.00	0	0.00
	Weighted Mean	**1-3**	**1.96**		**2.73**	
II	**Site selection**					
	High Extent	10-12	1	1.67	53	88.33
	Moderate Extent	7-9	13	21.67	7	11.67
	Low Extent	4-6	46	76.67	0	0.00
	Weighted Mean	**1-3**	**1.79**		**2.63**	
III	**Water efficiency**					
	High Extent	19-24	0	0.00	44	73.33
	Moderate Extent	14-18	10	16.67	16	26.67
	Low Extent	8-13	50	83.33	0	0.00
	Weighted Mean	**1-3**	**2.03**		**2.49**	
IV	**Energy efficiency**					
	High Extent	24-30	0	0.00	41	68.33
	Moderate Extent	17-23	15	25.00	19	31.67
	Low Extent	10-16	45	75.00	0	0.00
	Weighted Mean	**1-3**	**2.17**		**2.37**	
V	**Material and Selections**					
	High Extent	19-24	0	0.00	38	63.33
	Moderate Extent	14-18	11	18.33	22	36.67
	Low Extent	8-13	49	81.67	0	0.00
	Weighted Mean	**1-3**	**2.18**		**2.34**	
VI	**Indoor environment quality**					
	High Extent	24-30	0	0.00	43	71.67
	Moderate Extent	17-23	10	16.67	17	28.33
	Low Extent	10-16	50	83.33	0	0.00
	Weighted Mean	**1-3**	**2.11**		**2.17**	
VII	**Total Scale**					
	High Extent	108-138	0	0.00	44	73.33
	Moderate Extent	77-107	1	1.67	16	26.67
	Low Extent	46-76	59	98.33	0	0.00
	Total Weighted Mean	**1-3**	**2.04**		**2.45**	

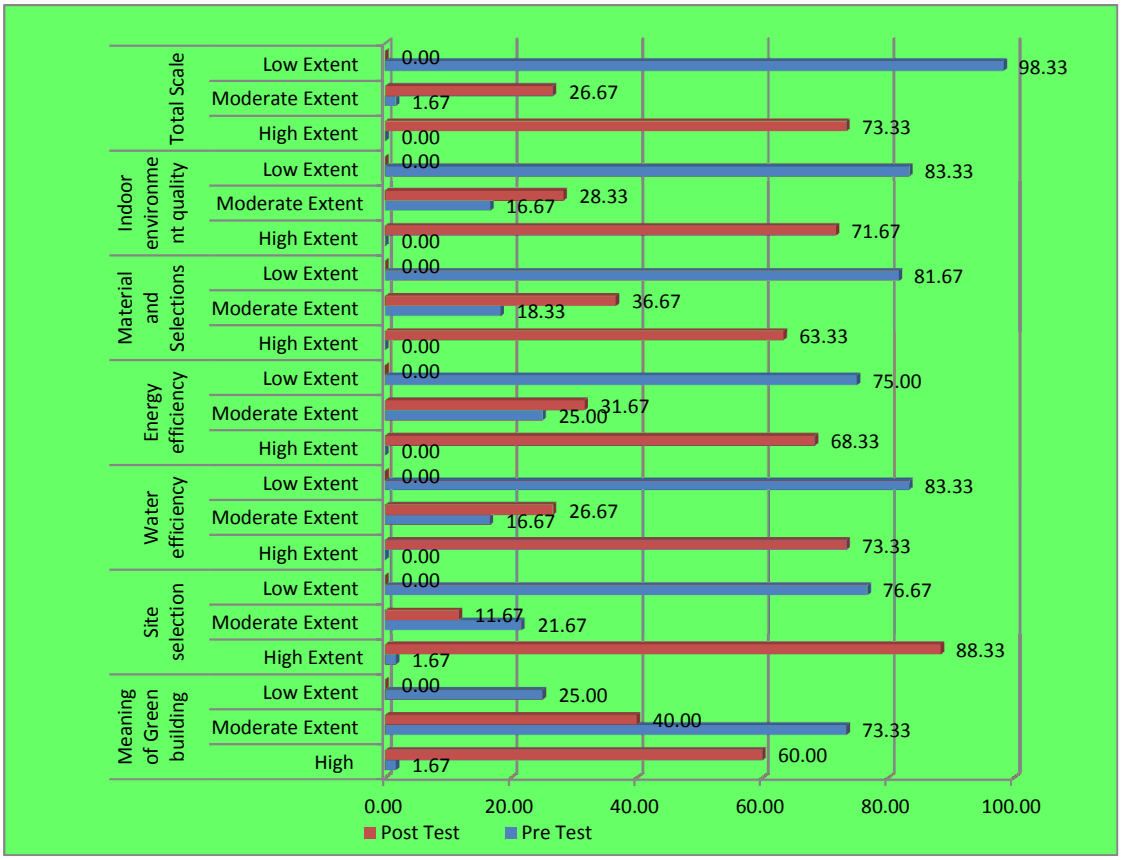

Figure 37: Distribution of Respondents according to their extent of knowledge regarding various aspects Green Building before and after the exposure to the Education Program: An Overall View

It was found from the table-54, fig. 37 that after the administration of an educational program there were no low scores for all the aspect of Green Buildings. A little less than three fourth had high extent of knowledge regarding "Meaning of Green buildings" after the administration of an educational program. Majority of the respondents had high extent of knowledge regarding "Site Selection", "Water Efficiency" and "Indoor Environment Quality" after viewing the educational program. There was increase in knowledge of the respondents regarding "Energy Efficiency" and "Material Selection" in nearly three fourth of the cases. On the total scale, it was observed that majority of the respondents' knowledge regarding various aspects of green building increased after the administration of an educational program.

Table 55: Weighted mean for the extent of knowledge regarding various aspects of Green building before and after the administration of the educational program

Sr. No.	Aspects of Green Buildings	Mean Weighted Score (Range 1 to 3)		
		Pre test (n=60)	Post test (n=60)	Net Gain
1	Meaning of Green building	1.96	2.73	0.77
2	Site selection	1.79	2.63	0.84
3	Water efficiency	2.03	2.49	0.46
4	Energy efficiency	2.17	2.37	0.19
5	Material and Selections	2.18	2.34	0.16
6	Indoor environment quality	2.11	2.17	0.06
	Total Net Gain	**2.04**	**2.45**	**0.41**

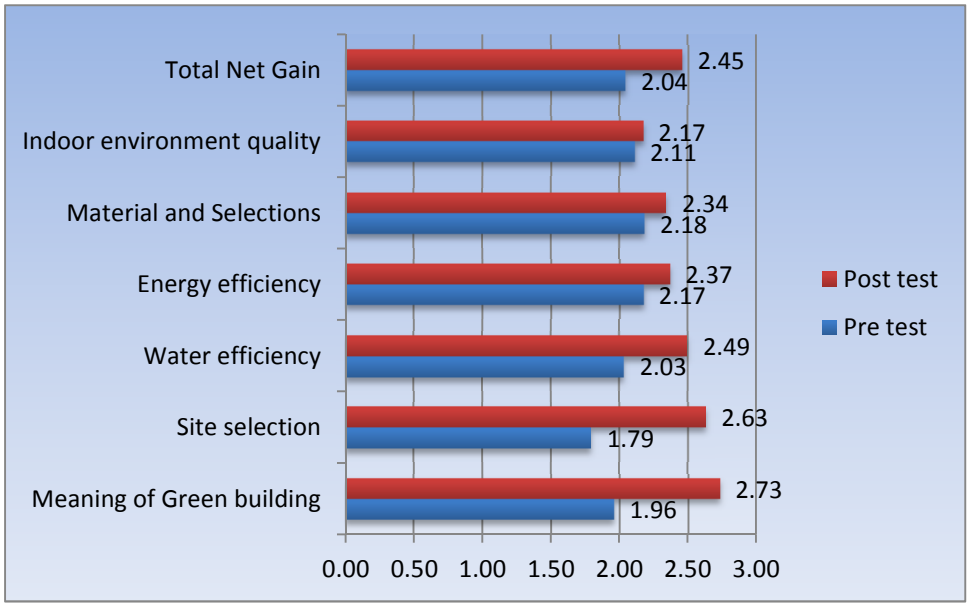

Figure 38: Weighted mean for the extent of knowledge regarding various aspects of Green building before and after the administration of the educational program

It was observed that for almost all the aspects related to green building, the extent of knowledge was found high after the administration of an educational program. Overall knowledge related to various aspects of green building had increased from 2.04 in pre test to 2.45 in post test. Total net gain in the knowledge regarding various aspects of green buildings was of 0.41 (Table-55, Fig. 38). It is supported by the hypothesis Ho9 (wide table- 53).

Thus, it could be concluded that the enhancement of knowledge of the respondents established the efficacy of the educational program prepared for the purpose (Table-54). This educational program can be used widely on various stakeholders to make them aware about the concept of Green Buildings.

Plate 40: Introduction to the theme and purpose of the educational programme

Plate 41: Respondents listening and watching the educational programme

Plate 42: Respondents filling up the knowledge scale after exposure to the educational programme

Plate 43: Distribution of the booklet