CHAPTER - III
METHODOLOGY

The present investigation was undertaken to find out the opinion of builders regarding Green buildings, the extent of influence of reason, barriers faced by the builders of Vadodara city and the level of knowledge of the home owners regarding "Green Buildings". The efficacy of the educational Programme was also tested. In order to achieve the aims of the present study, a detailed plan of work and sequential procedure followed are presented in this chapter under the following sub-heading:

3.1   Research Design

3.2   Variables and Conceptual Framework under study

- For Builders
- For Home Owners

3.3   Operational Definition

3.4   Locale of the Study

3.5   Unit of Enquiry

3.6   Sample size and Sampling procedure

3.7   Development of the Tool

3.8   Description of the Tool

3.9   Data Collection

3.10   Data Analysis

3.11   Educational Programme

The present study had been carried out in various parts as follows:

Part I: Opinion of the builders regarding green building

Part II: Knowledge of the home owners regarding green building

Part III: Assessing greenness of the house
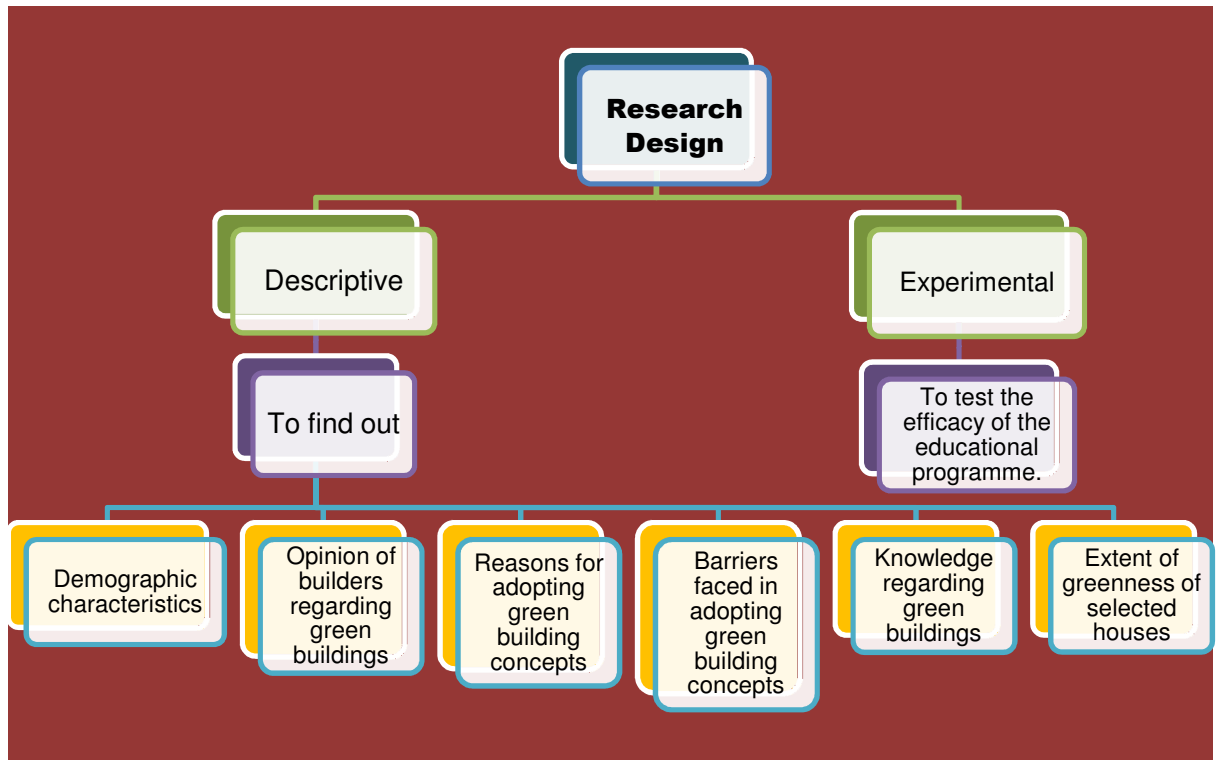
3.1 Research Design

Figure 1: Research Design of the Study

The research design for the present investigation was descriptive and experimental in nature. Descriptive research design is concerned with the conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing. It is primarily concerned with the present, although it often considers past events and influences as they relate to current conditions (Best and Kahn, 1983). The present study also aimed to find out and describe the demographic characteristics and opinion of builders regarding Green buildings, reasons and barriers faced by the builders in adoption Green building design and construction. The knowledge of the home owners was also found and the extent of greenness of the selected houses was assessed. Experimental research design was chosen to test the efficacy of the educational programme.

3.2 Variables and Conceptual Framework under study

The variables for the home owners and builders were considered separately in the present research.

3.2.1 Variables for Selected Builders

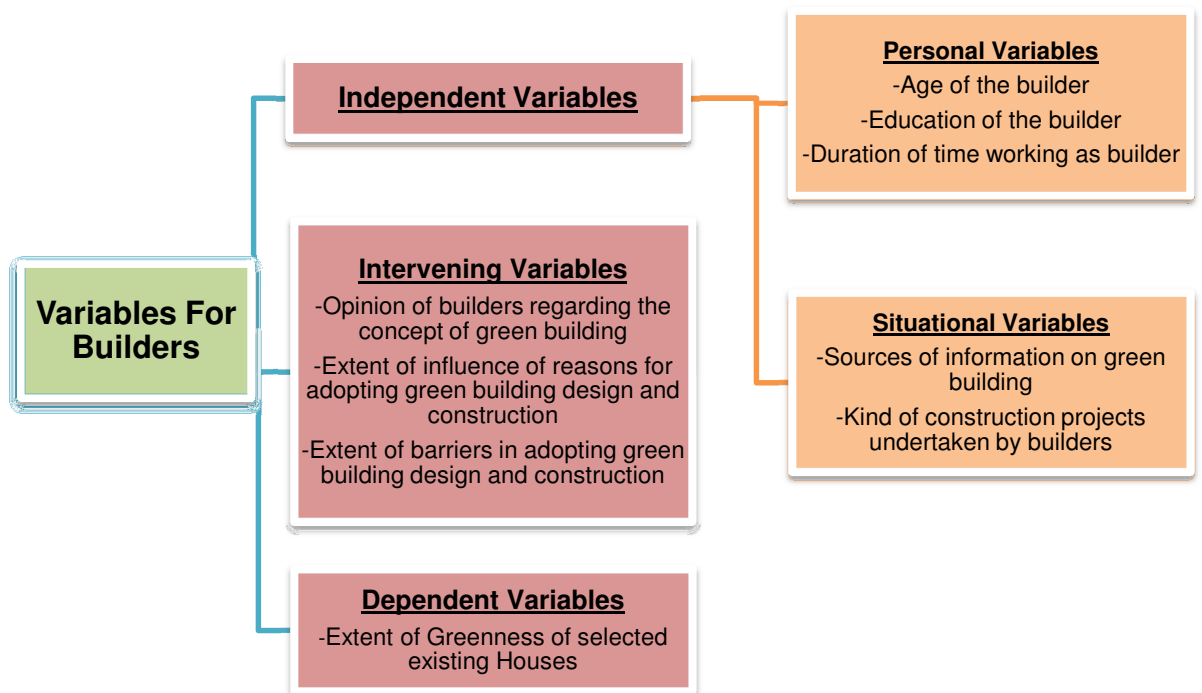The variables selected for builders were as follows:

Figure 2: Variables for Selected Builders

3.2.2 Variables for Selected Home Owners

There were three sets of variables viz. independent, intervening and dependent variables for selected home owners.
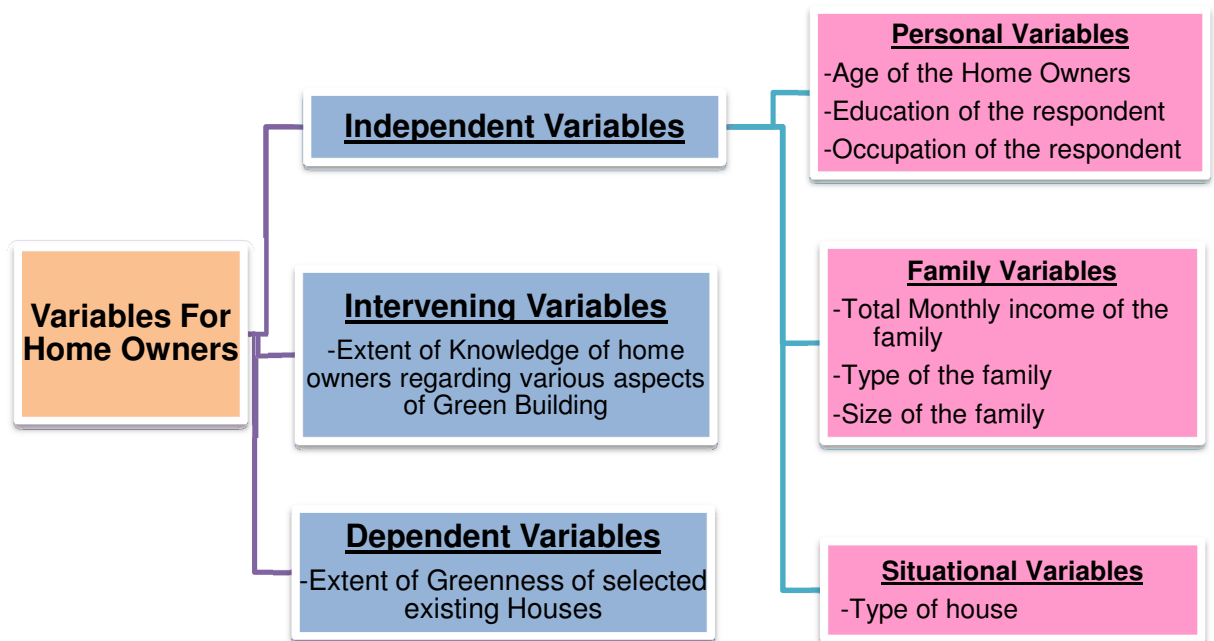
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                                                    ┌─────────────────────────────────┐
                                                    │      Personal Variables         │
                         ┌──────────────────────┐   │ -Age of the Home Owners         │
                         │ Independent Variables │───│ -Education of the respondent    │
                         └──────────────────────┘   │ -Occupation of the respondent   │
                                                     └─────────────────────────────────┘

                                                     ┌─────────────────────────────────┐
 ┌──────────────┐        ┌──────────────────────┐   │      Family Variables           │
 │ Variables For │       │ Intervening Variables │   │ -Total Monthly income of the    │
 │ Home Owners   │───────│ -Extent of Knowledge  │───│     family                      │
 └──────────────┘        │ of home owners        │   │ -Type of the family             │
                         │ regarding various     │   │ -Size of the family             │
                         │ aspects of Green      │   └─────────────────────────────────┘
                         │ Building              │
                         └──────────────────────┘   ┌─────────────────────────────────┐
                         ┌──────────────────────┐   │    Situational Variables        │
                         │ Dependent Variables   │   │ -Type of house                  │
                         │ -Extent of Greenness  │   └─────────────────────────────────┘
                         │ of selected existing  │
                         │ Houses                │
                         └──────────────────────┘
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Figure 3: Variables for Selected Home Owners

3.2.3. **Hypothetical Relationship between Variables:** A schematic diagram (Fig. 4) showing hypothetical relationship between selected variables for home owners and selected builders and its explanation is presented here.
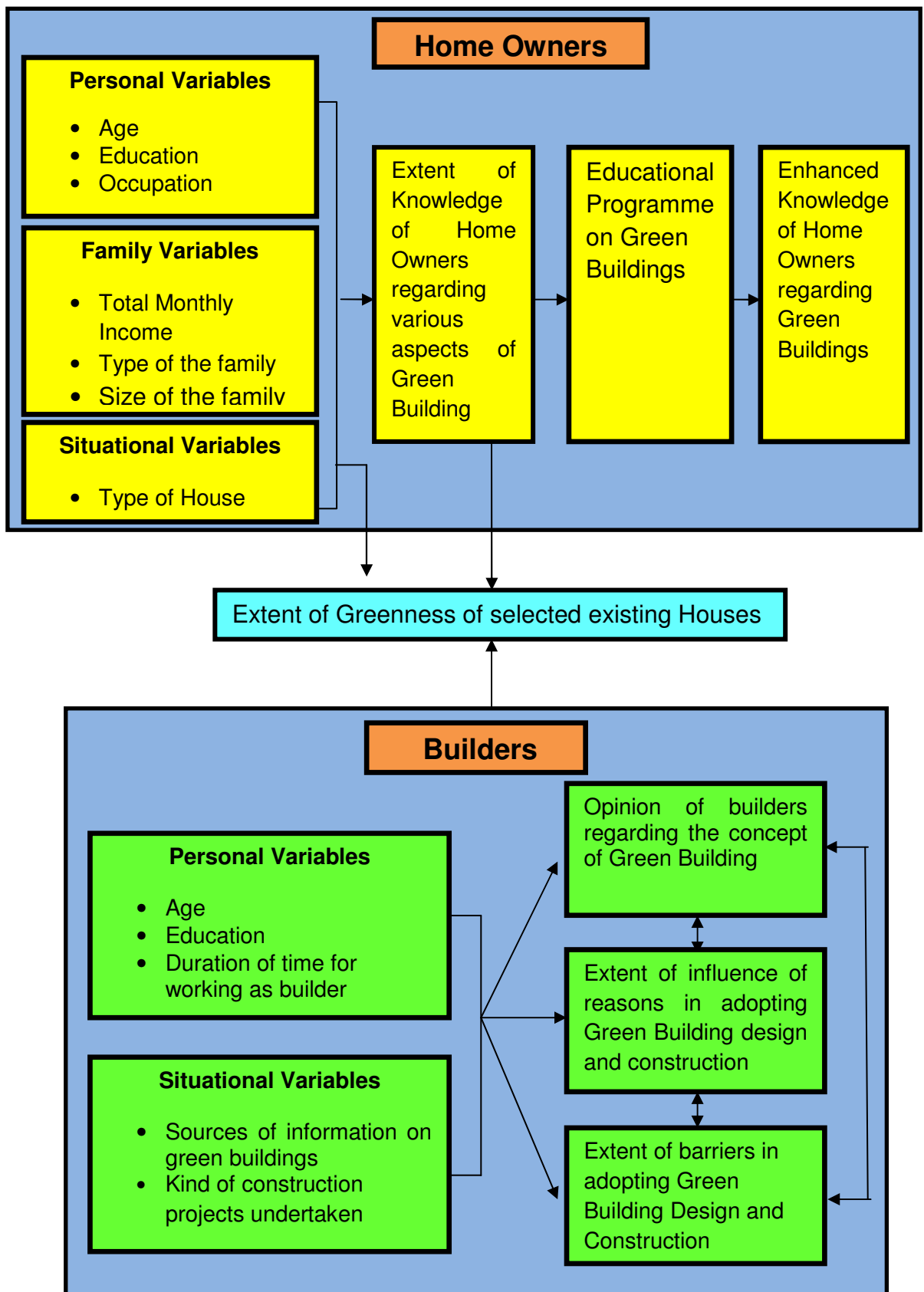
Home Owners

Personal Variables
- Age
- Education
- Occupation

Family Variables
- Total Monthly Income
- Type of the family
- Size of the family

Situational Variables
- Type of House

Extent of Knowledge of Home Owners regarding various aspects of Green Building

Educational Programme on Green Buildings

Enhanced Knowledge of Home Owners regarding Green Buildings

Extent of Greenness of selected existing Houses

Builders

Personal Variables
- Age
- Education
- Duration of time for working as builder

Situational Variables
- Sources of information on green buildings
- Kind of construction projects undertaken

Opinion of builders regarding the concept of Green Building

Extent of influence of reasons in adopting Green Building design and construction

Extent of barriers in adopting Green Building Design and Construction

Fig. 4: Schematic Framework to Show Hypothetical Relationship among Variables under Study

Explanation of Conceptual Framework

It was theorized that personal variables of the home owners such as age, education and occupation, their family variables such as total monthly income, type of the family and size of the family and their situational variable such as type of house have influence on the extent of knowledge of the home owners regarding green buildings and this might have influence on the extent of greenness of the houses. It was also theorized that the educational programme developed would enhance the knowledge of the home owners regarding Green buildings through intervention programme.

It was also theorized that personal variables of the builders such as age, education and duration of time working as builder and their situational barrier such as sources of information on green building and kinds of projects undertaken by the builders have direct influence on the reasons and barriers faced by the builders in adopting green building design and construction as well as on opinion of builders regarding green buildings. These variables have influence on the extent of greenness of the house.

3.3 Operational Definitions

The terms used in the present study were operationally defined as follows:

3.3.1 Green Buildings: Green Building (house) was operationally defined as the one which meets the standards for environmental performance of a building for selected aspects viz. sustainable site selection, water efficiency, energy efficiency, material and resources, indoor environmental quality and innovative ideas.

Each of these aspects was operationally defined as follows:

a. **Sustainable site selection:** It is operationally defined as the selection of site for construction of a residential unit (house) which helps to have minimum adverse impact on the environment.

b. **Water efficiency:** It referred to as minimal use of water in and around the house. It includes the management of water through the use of water efficient fixtures, water meters, water level controller in water tanks and economic use of water by the family members. Such plants and trees were grown which consumed less amount of water for their growth.

c. **Energy efficiency:** This referred to the minimal use of electricity and enhanced use of non-conventional sources of energy. It included the installation of CFC free equipments, Bureau of Energy Efficiency (BEE) rated electrical fittings and energy meters in the building. The energy efficiency within the building was enhanced by the installation of T5 tube lights, LED lights, and weather shed on windows etc. Use of solar energy in various ways was adopted to reduce the dependence on electricity from grid.

d. **Materials and resources:** This referred to the maximum utilisation of such materials and resources used in the construction which have less impact on environment. It included the use of local and recyclable building materials and reuse of renewable building materials, provisions to separate the household waste and its effective management.

e. **Indoor environment quality:** It referred to a healthy environment for the occupants of buildings. Proper cross ventilation, placement of exhaust systems in kitchen and bathrooms, proper placement of door and window, low or no VOC paints, and Provision for maximum daylighting all contribute in creating a quality indoor environment.

f. **Innovative ideas:** This referred to the new ideas, methods and equipments used in the building so that adverse environmental impact is reduced. In this provision are made for installation of rainwater harvesting systems, Grey water treatment plant, efficient irrigation systems etc. It encourages using new technologies and pushing the

market place into new and innovative areas of the green building industry.

3.3.2 Extent of Greenness of existing Houses: It was operationally defined as the extent to which the existing houses were environment friendly as reflected on the selected parameters viz., Sustainable Site Selection, Water Efficiency, and Energy Efficiency, Materials and resources, Indoor Environment Quality and Innovative ideas.

3.3.3 Extent of knowledge of Home Owners regarding various aspects of green buildings: It was operationally defined as the extent to which the respondents had knowledge regarding various aspects of Green buildings. It was assessed through a scale developed for the purpose.

3.3.4 Extent of influence of reasons for adopting green building design and construction: It was defined as the extent to which various reasons influenced builders to adopt green building design and construction.

This was reflected through summated rating scale where builders were asked whether they were influenced by the given reasons to great extent, to moderate extent and to low extent. These responses were given scores of 3 to 1 respectively. Higher scores reflected high extent of influence of reasons for adopting green building design and construction.

3.3.5 Extent of barriers faced in adopting green building design and construction: It was defined as the extent to which the builders faced barriers in adopting green building design and construction.

This was reflected through summated rating scale where builders were asked to state the extent to which they faced major, minor barriers or no barriers. These responses were given scores of 3 to 1 respectively.

Higher scores reflected low extent of barriers faced in adopting green building design and construction.

3.3.6 Opinion of builders regarding green buildings: It was defined as the extent to which the builders had favourable opinion regarding green buildings. This was reflected through summated rating scale where builders were asked state the extent to which they strongly agree, agree, were neutral, disagree and strongly disagree with the statements reflecting their opinion regarding green building. These responses were given scores of 5 through 1 respectively. Higher scores reflected more favourable opinion towards green building.

3.3.7 Existing residential buildings: It was operationally defined as the residential buildings which were constructed between 2005 and 2013 and were assessed on the basis of selected parameters for their environment friendly features.

3.3.8 Sources of information on green buildings: This referred to the various sources of information such as print, audio, audio-visual media, personal or educational programmes etc. from which builders receive information regarding Green Buildings.

3.4 Locale of the Study

The locale of the study was Vadodara city from where 220 houses constructed during 2005 to 2013 by various builders were identified as sample.

3.5 Unit of Inquiry

There were 2 units of enquiry

1. The selected **builders**. In case of group of builders in one company, the one who was willing to answer was considered as the respondent for the research.

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2. **Home Owners** –Home owners of the selected existing houses. They were the key decision makers regarding various aspects of the houses.
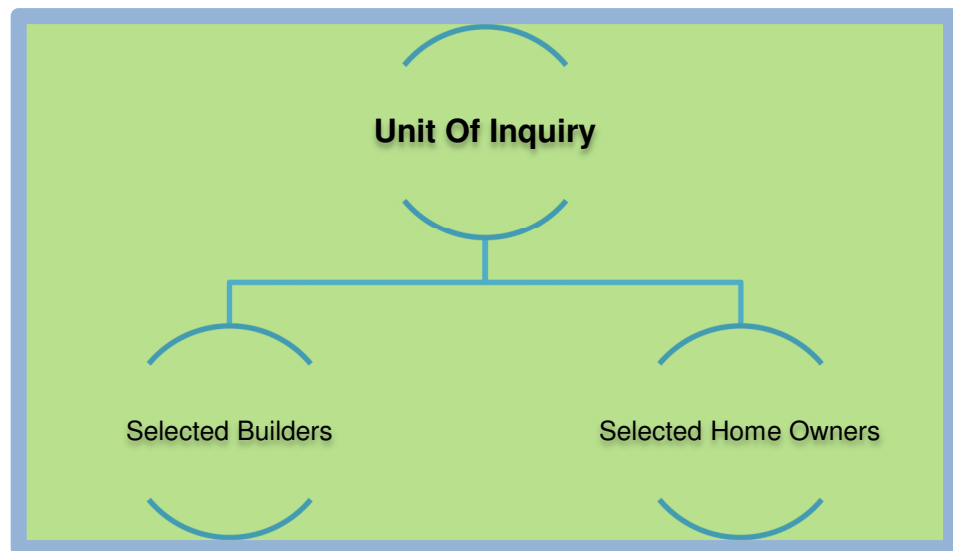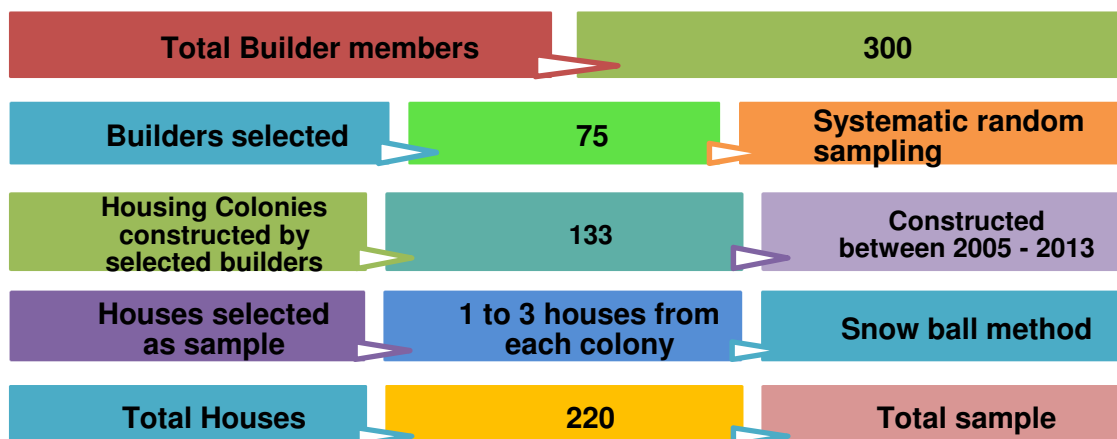

Figure 5: Unit of Inquiry

3.6 Sample size and Sampling procedure

A list of builders was obtained from Confederation of Real Estate Developers' Association of India(CREDAI). Out of 300 builders of Vadodara City, seventy five were selected through systematic random sampling. The housing colonies which were constructed by these selected builders between 2005 and 2013 were selected. Through Snow ball sampling method, the housing units (houses) were selected from these colonies. Houses from each of the colonies ranging from 1 to 3 were selected. Thus 220 houses were considered as sample for present study.

Total Builder members	300	
Builders selected	75	Systematic random sampling
Housing Colonies constructed by selected builders	133	Constructed between 2005 - 2013
Houses selected as sample	1 to 3 houses from each colony	Snow ball method
Total Houses	220	Total sample

Builder No.	No. of Residential Colonies of Builders	Selected Houses as sample	Builder No.	No. of Residential Colonies of Builders	Selected Houses as sample	Builder No.	No. of Residential Colonies of Builders	Selected Houses as sample
1	03	05	26	01	02	51	01	02
2	01	02	27	01	02	52	02	03
3	01	02	28	02	03	53	02	03
4	01	02	29	01	02	54	02	03
5	01	02	30	05	07	55	01	02
6	01	02	31	02	03	56	02	03
7	01	02	32	03	03	57	03	04
8	03	03	33	02	03	58	01	02
9	02	03	34	01	02	59	02	03
10	01	02	35	02	03	60	02	03
11	02	03	36	01	02	61	02	04
12	02	03	37	02	03	62	01	02
13	01	02	38	03	05	63	01	03
14	01	02	39	03	05	64	03	04
15	01	02	40	02	03	65	01	03
16	04	06	41	02	03	66	02	03
17	02	03	42	01	02	67	02	03
18	01	02	43	01	02	68	01	03
19	03	04	44	02	03	69	03	04
20	01	02	45	04	05	70	01	02
21	01	02	46	01	02	71	01	02
22	01	02	47	01	02	72	01	02
23	01	02	48	01	02	73	01	02
24	04	06	49	01	02	74	01	02
25	04	06	50	01	02	75	05	07
Total	**44**	**72**	**Total**	**46**	**73**	**Total**	**43**	**75**

Total Number of Builders as sample: 75
Total Number of Residential Colonies constructed by the builders considered as a sample: 133
Total Number of houses as sample: 220

3.7 Selection and Development of tool

3.7.1 Selection of the tool

For the present study, the data were collected through questionnaire from builders and home owners. Observation checklist was used for the assessment of the selected houses.

a) Part I: For builders and house owners

Questionnaire was used as an instrument for gathering data from house owners and builders due to the following reasons:

1. It is free from the bias of the interviewer; answers are in respondents' own words.
2. Respondents have adequate time to give well thought out answers.
3. The sample size can be large thus the results can be made more reliable.
4. Respondents may have greater confidence in their anonymity and thus feel free to express their views.

b) Part II: For assessing the selected houses

A Checklist was used as an observation instrument for assessing the greenness of the selected houses due to the following reasons:

1. The checklist is the simplest device prepared list of aspects/features.
2. The presence or absence of the aspect/feature of green building may be indicated by checking 'Yes' or 'No'.
3. The subjective bias is eliminated, if observation is done accurately.
4. This method is independent of respondents' willingness to record and as such is relatively less demanding of active cooperation on the part of respondents.

3.7.2 Development of the tool

Based on the information collected through review of related literature, questionnaire was prepared for the home owners and the builders. A care was taken to include all such questions that would elicit the information needed to attain the objectives of the study. Two separate questionnaires were prepared, one for the home owners and the other for the builders. An observation checklist was also prepared for the assessment of selected houses for their greenness.

3.8 Description of the tool

The tool is described here:
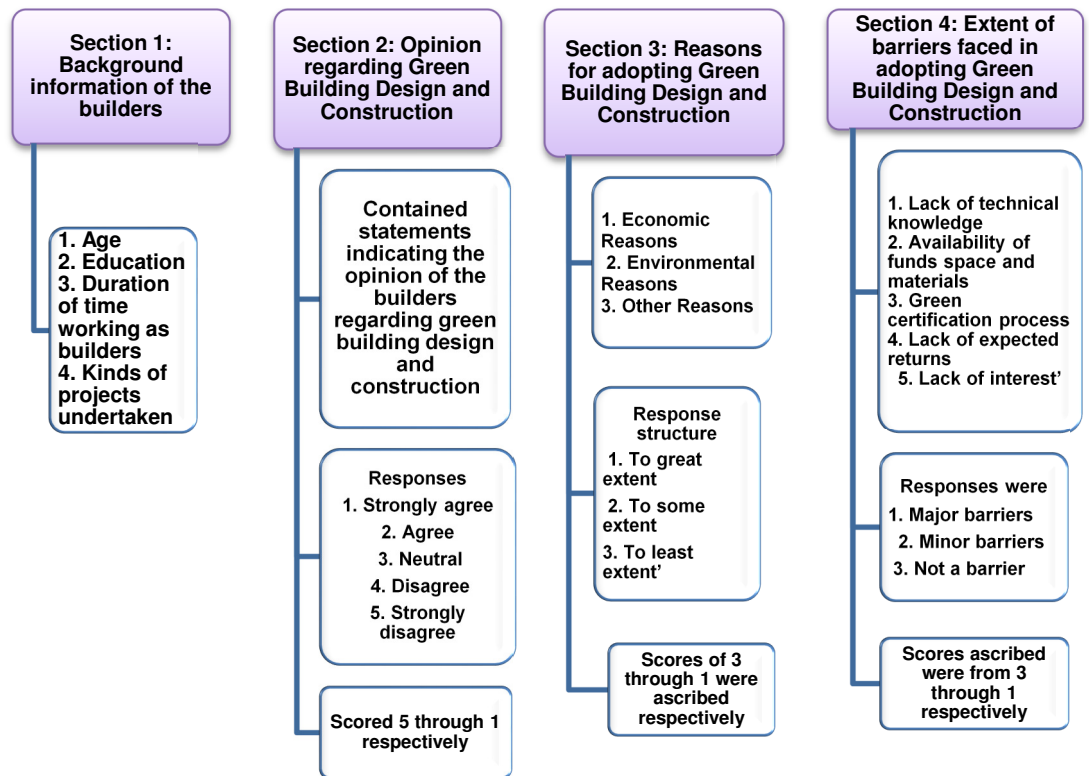
3.8.1 Questionnaire for builders

Figure 6: Sections of a Questionnaire for Selected Builders

The questionnaire comprised of 4 sections:

Section 1: Background information of the builders: This section contained questions regarding the background information of the builders such as age, education, duration of time working as builders, kinds of projects undertaken. The respondents were also asked to indicate the source of information about green building that they explored. It also contained questions regarding familiarity and influence of the concept and methods of green building, incorporation of green building elements in their work and kind of projects in which these elements were incorporated, and importance of green building aspects to them.

Section 2: Opinion regarding Green Building Design and Construction: This section contained Likert type summated rating scale having statements indicating the opinion of the builders regarding green building design and construction. It had 5 point continuum for the responses 'Strongly agree', 'Agree', 'Neutral', 'Disagree' and 'Strongly disagree' which were scored 5 through 1 respectively for the positive statements and for the negative statements the scoring was reversed. Higher scores reflected favourable opinion of builders towards green buildings. It was developed by the researcher and content validity and reliability were established.

Section 3: Reasons for adopting Green Building Design and Construction: This section contained various statements depicting the reasons for adopting green building design and construction. The reasons were categorized as 'Economic' 'Environmental' and 'Other' reasons. The respondents were required to state the extent to which they were influenced by the listed reasons with a response structure of 'To great extent', 'To some extent' and 'To least extent'. Scores of 3 through 1 were ascribed respectively to these responses. This was a Likert type of summated rating scale. It was developed by the researcher and content validity and reliability were established.

Section 4: Extent of barriers faced in adopting Green Building Design and Construction: This section contained various statements regarding the barriers faced by the builders while adopting green building design and construction. The barriers were classified as 'Lack of technical knowledge', 'Availability of funds, space and materials', 'Green certification process', 'Lack of expected returns' and 'Lack of interest'. The responses were 'Major barriers', 'Minor barriers' and 'Not a barrier' where the scores ascribed were from 3 through 1respectively to these responses. High scores reflected high extent of barriers faced by the builders in adopting green building design in their construction projects undertaken. This summated rating scale was developed by the researcher and content validity and reliability were established.

3.8.2 Questionnaire for house owners

Section 1: General information regarding the year of purchase/ construction of the house and decision taken regarding the same: In this section respondents were asked to indicate the year of purchase or construction of the house. The respondents were asked to tell the involvement of family members in taking decisions for the purchase of the house.

Section 2: Background information of the respondents: This section contained various questions regarding the background information of the respondents such as age, gender, education, occupation, family's monthly income, type and size. It also contained question regarding their type of house.

Section 3: Knowledge of the home owners regarding green building: It comprised of a summated rating scale of Likert type having statements related to meaning of green building and different aspects of green building viz. site selection, water efficiency, energy efficiency, materials and indoor environment quality. The respondents were asked to state whether they "Agree", "Undecided" and "Disagree" where the scores ascribed were from 3 through 1respectively to the positive statements. The scores were reversed in case of negative statements. It was developed by the researcher and content validity and reliability were established. Higher scores reflected higher extent of knowledge.
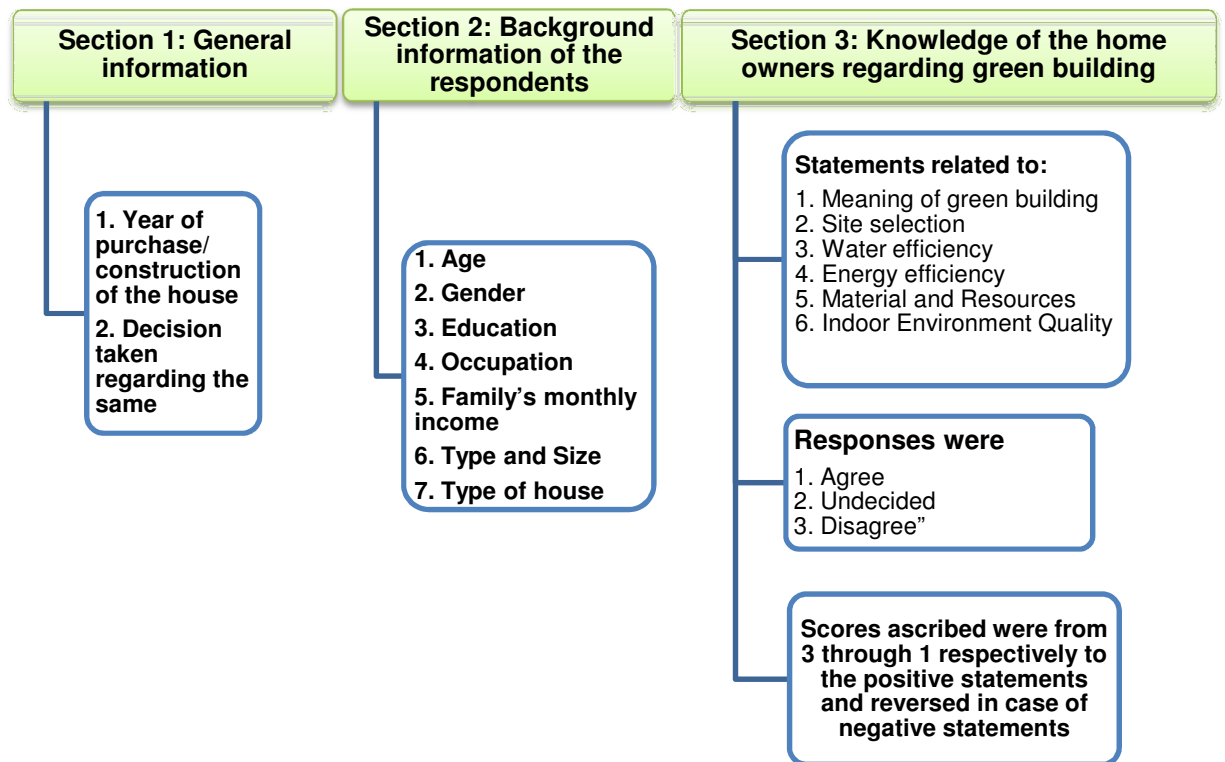
Section 1: General information	Section 2: Background information of the respondents	Section 3: Knowledge of the home owners regarding green building
1. Year of purchase/ construction of the house 2. Decision taken regarding the same	1. Age 2. Gender 3. Education 4. Occupation 5. Family's monthly income 6. Type and Size 7. Type of house	**Statements related to:** 1. Meaning of green building 2. Site selection 3. Water efficiency 4. Energy efficiency 5. Material and Resources 6. Indoor Environment Quality **Responses were** 1. Agree 2. Undecided 3. Disagree" Scores ascribed were from 3 through 1 respectively to the positive statements and reversed in case of negative statements

Figure 7: Section of a Questionnaire for Selected Home Owners

3.8.3 Observation checklist for the assessment of the selected houses for their Extent of Greenness

The observation checklist contained items indicating the greenness of the house in various aspects of the green building such as sustainable site selection, water efficiency, energy efficiency, material and resources, indoor environment quality and innovative ideas. The responses were "Yes" which indicated the presence of those aspects in the building and "No" reflected the absence of that aspect in the building. Each sub aspects were assigned scores thereby totalling them make the score of that aspect. Higher scores indicated high extent greenness of the house.

The minimum and maximum possible scores of each of the scales were divided into 3 categories having equal interval for all the scales which determined the extent of knowledge of the home owners regarding various aspects of Green Building, extent of greenness of the selected existing buildings, extent of influence of reasons, extent of barriers faced in adopting

green building design and construction and extent of favourableness about opinion of builders regarding green buildings.
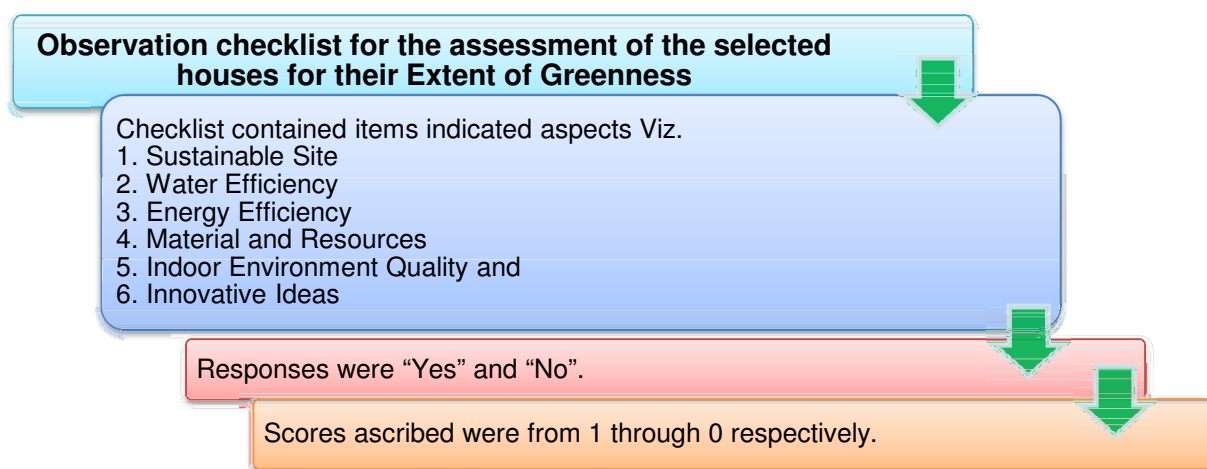

Observation checklist for the assessment of the selected houses for their Extent of Greenness

Checklist contained items indicated aspects Viz.
1. Sustainable Site
2. Water Efficiency
3. Energy Efficiency
4. Material and Resources
5. Indoor Environment Quality and
6. Innovative Ideas

Responses were "Yes" and "No".

Scores ascribed were from 1 through 0 respectively.

Figure 8: Observation Checklist for Assessment of Selected Houses

3.8.4 Establishment of Content Validity of scales

There were 5 scales prepared by the researcher. They were (i) Knowledge of home owners regarding green building, (ii) Observation checklist for the assessment of selected houses for their extent of greenness, (iii) Opinion of builders regarding green building, (iv) Reason for adopting green building design and construction, and (v) Barriers faced by builders in adopting green building design and construction. The content validity of various scales was established. For this purpose the scales were given to a panel of 11 judges from Department of Family and Community Resource Management, Faculty of Architecture, experts from other Universities (S.N.D.T. University, Mumbai), Practicing and working builders, architects and civil Engineers. They were requested to check the clarity and relevance of the content for each scale. They were also requested to state whether each statement fell in the category under which it was listed. A consensus of 80% among the judges was taken as a yardstick for inclusion of the statement in the final tool. No changes were required to be made in the tool.
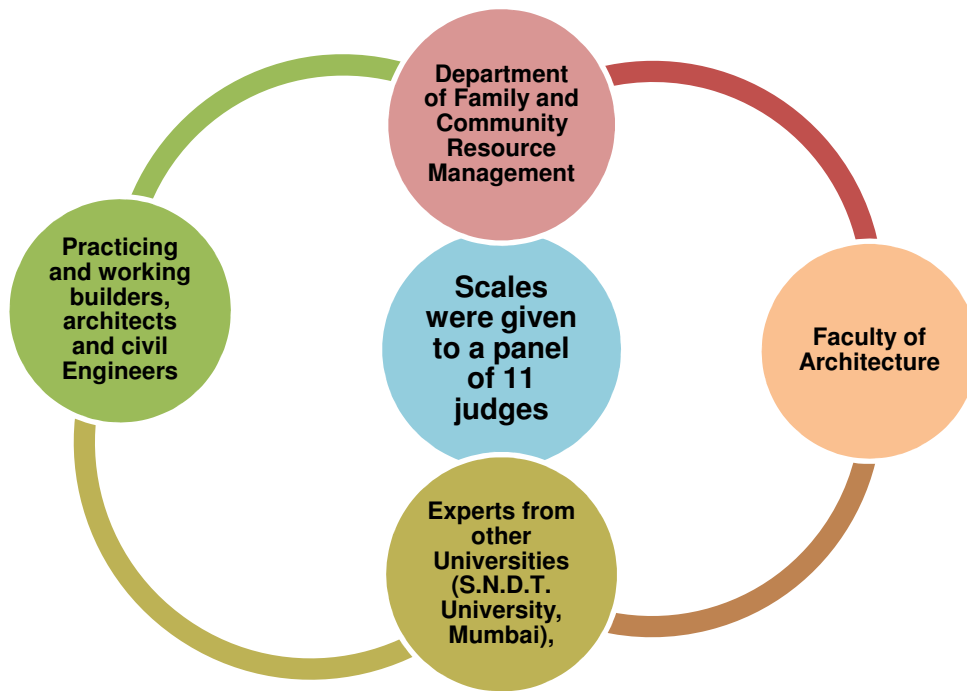
Figure 9: Establishment of Content Validity of the Scales

3.8.5 Establishment of Reliability

a. **Pretesting:** A pilot study was conducted to find out the feasibility and clarity of the scales developed. Therefore, the developed scales were pre-tested on 35 non-respondents builders and home owners of the selected houses of Vadodara city, who had similar characteristics as those of final respondents of the study.

b. **Reliability of the scales:** The reliability of the scales was established through split-half and test-retest methods. For split half method the scales were divided in two using odd and even method. The coefficient of correlation was found between the two halves. Spearman-Brown correction formula was applied to estimate the reliability coefficient for the entire scale.

For test-retest method the tool was given to the respondents and it was administered to the respondents once again after a gap of 21 days. Pearson's Product Moment Formula was used to find out the correlation in the scores between two administrations. The reliability values were found to be high for all the scales as reported here.

Sr. No.	Scale	Developed by	Reliability	
			Method used	Value
A.	**For Builders**			
1.	Opinion of builders regarding green buildings	Researcher	Split half	0.746
2.	Reasons for adopting green building design and construction	Researcher	Split half	0.846
3.	Extent of barriers faced in adopting green building design and construction	Researcher	Split half	0.647
B.	**For Home owners**			
1.	Knowledge of house owners regarding green buildings	Researcher	Split half	0.909
C.	**Assessment of selected houses for their extent of greenness**	Researcher	Test-Retest	0.786

3.9 Method of Data Collection

Data were gathered by the investigator from May to September, 2014. The homes were identified through snow ball technique from the residential colonies developed by the selected builders. The purpose of research was explained and a rapport was built so as to get the true responses. The investigator personally distributed and collected back the filled in questionnaire. The rate of return was 100%. The observations were recorded in the checklist by the researcher.

Parts	Study	Tool for data collection
I	Opinion, Reasons and Barriers of the builders regarding green building	Questionnaire
II	Knowledge of the home owners regarding green building	Questionnaire
III	Assessing greenness of the house	Observation sheet

3.9.1 Apparatus and Tools used to measure certain information

1. **Light Meter:** Light meter was used to measure natural light in the selected rooms viz. Living room, bed room, bathroom and kitchen. The

measurement was taken at the centre of the room during 11:00 am to 03:00 pm once only.

2. **Measuring Tape:** Measuring tape of metal was used to measure (i) the land area, and vegetated land area (2) size of the room, walls, windows and doors.

Plate 1: Light Meter

Plate 2: Measuring Tape

3.10 Data Analysis Procedure

The procedure used to analyse the data were categorization, coding, tabulation and statistical analysis.

3.10.1 Formula used in assessing factors of Greenness during data collection

Certain formula were used to find out the required inferences. They are as follows:

1. **For intensity of light and illumination level:** In order to measure the intensity of light in different rooms of a house, Lux meter was used. The formula applied for its calculation was as follows:

$$DQ = \frac{\text{Light intensity at measuring point } (E_i) \times 100}{\text{Light intensity in the open area}}$$

2. **For economic use of water by family members:** As per National Building Code the 200 lit./day per person is considered as economic use of water. It was calculated according to the formula given below:

Total consumption of water = Number of family members × 200 litre

3. **For measuring open available landscaped vegetative area:** For this the total open area and vegetated area was measured with the help of a measuring tape. Hence, the percentage of open vegetated area was calculated as below:

Percentage of landscaped area = <u>Total vegetated landscaped area</u> × 100
                              Total open space available

4. **For calculating the percentage of water efficient plumbing fixtures:** For this the total number of plumbing fixtures was noted and from that total number of water efficient plumbing fixtures were counted. Therefore, the percentage of water efficient plumbing fixture in a house was noted as per the formula given below:

Percentage of water
efficient plumbing fixtures = <u>Total number of water efficient plumbing fixtures</u> × 100
                            Total number of plumbing fixtures installed

5. **For calculating percentage of drought tolerant species of plants:** For this the number of plants, shrubs and trees planted were noted and then number of drought tolerant species of plants was counted. Finally the percentage of drought tolerant species was found through a formula as given below:

Percentage of drought
tolerant species planted = <u>Total number of drought tolerant species</u> × 100
                          Total number of planted plants, shrubs and trees

6. **For calculating BEE rated electrical fittings:** For this the number of electrical fittings was noted and then number of BEE rated equipments

was counted. Finally the percentage of BEE rated equipments were found.

Percentage of BEE
rated electrical fittings = $\dfrac{\text{Total number of BEE rated electrical fittings} \times 100}{\text{Total number of electrical fittings installed}}$

7. **For measuring provision for fresh ventilation in the living spaces, Kitchen and Bathrooms:** For this the percentage of percentage of doors and windows on walls of a room was calculated as per the following formula:

Provision for fresh air
ventilation in a room = $\dfrac{\text{Total area of doors and windows in a room} \times 100}{\text{Total area of walls in a room}}$

3.10.2 Categorization

The under mentioned categories were made to enable the researcher to analyze the data further for statistical application:

3.10.2.1 Categorization of the data for builders

The data gathered were categorized as follows:

i. **Age of the builders:** The obtained range of age of the respondents on the basis of equal intervals as follows:
    a) 21-35 years
    b) 36-50 years
    c) 51 years and above

ii. **Education of the builders:** The formal education obtained by the builders was categorized as follows:
    a) B. Arch.
    b) B.A.
    c) B.E. Civil
    d) Diploma in civil Engineer

iii. **Duration of time working as builder:** It referred to the time period since when they were working as builder. It was categorized as follows:

a) Less than 10 years

b) 11-20 years

c) 21-35 years

iv. **Kind of projects undertaken by the builders:** It referred to the kinds of projects undertaken by the builders. It was categorized as follows:

A	B	C
Residential	Renovation	Private
Commercial	New construction	Public
Institutional		

V. **Extent of Exposure to different sources of information:** It was judged in terms of their exposure to different sources of information used for gaining knowledge about green building. For each source of information referred the builders were given one point. The responses were summated and the extent of exposure to the different sources of information was categorized as follows:

Extent of exposure	Range of scores
High extent	9-12
Moderate extent	4-8
Low extent	0-3

Vi. **Extent of Opinion of builders regarding green buildings:** The minimum and maximum possible scores were divided into 3 categories on the basis of equal intervals as follows:

Opinion of builders	Range of scores
Most favourable	52-70
Somewhat favourable	33-51
Least favourable	14-32

vii. **Extent of Influence of reasons for adopting green building design and construction:** The possible range of score was divided into the following categories having almost equal interval of numbers as follows:

Sr. No.	Extent of influence of reasons for adopting green building design and construction	Range of scores of extent of influence of reasons		
		To a great extent	To some extent	To least extent
1.	Economic reasons	8-9	5-7	3-4
2.	Environmental reasons	22-27	15-21	9-14
3.	Other reasons	22-27	15-21	9-14
4.	Overall reasons	50-63	35-49	21-34

Viii. Extent of barriers faced while adopting green building design and construction: The scores were summated and the possible ranges of scores were divided into three categories having equal interval of numbers as shown here.

Sr. No.	Extent of barriers faced in adopting green building design and construction	Range of scores of extent of barriers		
		To a great extent	To some extent	To least extent
1.	Technical knowledge	12-15	8-11	5-7
2.	Availability of funds, space and materials	8-9	5-7	3-4
3.	Green certification process	10-12	7-9	4-6
4.	Lack of expected returns	8-9	5-7	3-4
5.	Lack of interest	10-12	7-9	4-6
6	Overall barriers	45-57	32-44	19-31

3.10.2.2 Categorization of the data about Home Owners

Data gathered about the home owners are as follows:

i. **Age of the respondents:** Based on the obtained information, the range of years was categorized on the basis of equal interval as follows:
    a) 21-35 years
    b) 36-50 years
    c) 51-65 years

ii **Education of the respondents:** Formal education obtained by the respondents was categorized as follows:
    b) Primary Education (Class V)
    c) Middle School (Class VIII)
    d) Higher Secondary/Intermediate

e) Graduate

f) Post Graduate

g) PhD or other Higher Degree

iii. Occupation of the respondents: It referred to the gainful employment status of the respondents at the time of data collection and was categorized as:

a) Service

b) Business

c) Self employed

d) Not employed

iv. **Total monthly income of the family:** It referred to the monthly monetary income of the family acquired from various sources in the duration of a month. It was categorized as follows:

a) ≤ Rs. 30,000

b) Rs. 30,001- Rs. 60,000

c) ≥ Rs. 60,001

v. **Size of family:** The size of the family was categorized on the basis of the number of family members staying together under one roof at the time of data collection was categorized as follows:

a) Small (2-5 members)

b) Medium (6-7 members)

c) Large (8-11 members)

vi. **Type of house:** It referred to the type of house in which respondents were staying at the time of data collection. It was categorized as follows:

a) Tenement/ Twin duplex

b) Independent bungalow

vii. **Extent of Knowledge of the home owners regarding various aspects of Green Buildings:** The minimum and maximum possible scores were divided into 3 categories on the basis of equal intervals as shown here.

Sr. No.	Aspects of green building	Range of scores of extent of knowledge on various aspects of Green Buildings		
		High extent	Moderate extent	Low extent
1.	Meaning of green building	15-18	10-14	6-9
2.	Site selection	10-12	7-9	4-6
3.	Water efficiency	19-24	14-18	8-13
4.	Energy efficiency	24-30	17-23	10-16
5.	Materials	19-24	14-18	8-13
6.	Indoor environment quality	10-16	17-23	10-16
7.	Overall	108-138	77-107	46-76

3.10.2.3 Categorization of scale for extent of greenness of selected houses

Data related to extent of greenness of the selected houses were categorized for further analysis.

i. **Extent of greenness of the selected houses:** This section contained statements featuring the aspects of green building. These aspects were used to assess the extent of greenness of selected houses. The scores were summated and the possible ranges of scores were divided into three categories having equal intervals of numbers to denote the extent of greenness. Higher the score more is the "Greenness".

Sr. No.	Aspects of green building used for assessing the selected houses	Range of scores of extent of greenness		
		High extent	Somewhat extent	Least extent
1.	Sustainable site	36-52	17-35	0-16
2.	Water efficiency	13-19	6-12	0-5
3.	Energy efficiency	33-49	16-32	0-15
4.	Materials and resources	13-18	6-12	0-5
5.	Indoor environment quality	20-28	9-19	0-8
6.	Innovative ideas	12-16	6-11	0-5
7.	Overall greenness	123-183	61-122	0-60

3.10.3 Coding: Coding is the process whereby the data are assigned a numerical code and value so that they can be more easily fitted into

appropriate categories (Bhattacharya, 2004). Code numbers were given to each answer then the information from each questionnaire and observation sheet were transferred on a coding sheet.

3.10.4Tabulation: Tabulation consists of counting the number of cases which fall into the established categories (Bhattacharya, 2004). The data were transferred from coding sheet into a tabular form to give a clear picture of findings to facilitate the analysis of data. The tabulation was done with the help of computer. The coded data of the present research were tabulated to arrive at tables that were required for describing the data.

3.10.5Statistical Analysis: The data were analyzed employing descriptive as well as relational statistics.

Descriptive statistics: The data were presented in frequencies, percentage, mean and standard deviation.

Relational statistics: Analysis of Variance, t test and Co efficient of Correlation were carried out to test the hypotheses postulated for the study.

3.11Educational Programme on "Green Buildings"

One of the objectives of the present research was the development of educational package, to create awareness regarding Green Buildings among the masses. It was prepared in print and audio-visual form. The home owners of those houses which had low extent of greenness and those scored low on knowledge scale were exposed to the educational programme.

3.11.1 Development of the Educational Programme
The title of the educational Programme was "Green Buildings: A Necessity for Sustainable Development".

3.11.1.1 Media for Educational Programme
Two media were selected for the educational Programme.

1. **Audio Visual Media:** Power point presentation was selected as a media for the educational programme, as it has been observed that audio-visual media is more effective on the audience due to its attractiveness. The programme was prepared in English and Hindi language so that maximum number of people can be made aware regarding "Green Buildings".

2. **Print Media:** A Booklet in English and Hindi language was also prepared consisting of the same content in print form with supportive pictures. This was prepared and distributed for their future reference.

3.11.1.2 Content of Educational Programme

Content regarding Green Buildings was developed based on the review of literature collected on the following aspects:

- 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:
  1. Site selection
  2. Water efficiency
  3. Energy conservation
  4. Material selection
  5. Indoor Environmental Quality

The content prepared in English language was translated in Hindi language. It was recorded in both the languages and the voice over was done with the slides prepared thereby, making a movie of 30 minutes.

3.11.2 Establishment of content validity of the Educational Programme

The educational programme was prepared by the researcher and was subjected to establishment of content validity. The power point presentation was shown to a panel of 5 judges from department of Family and Community Resource Management, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara. They were requested to judge the topics covered in the content, its relevance of the slide, clarity of text in relation to slide, quality of visuals, sound quality and overall presentation. A consensus of 80% among the judges was taken as a yardstick for inclusion of content finally in the educational programme. Suggestion given by judges to convert the content of the slides into Hindi language was incorporated.

3.11.3 Establishment of Reliability of the Educational Programme

The students of Department of Family and Community Resource Management, Bachelor's Degree Programme in Interior Design and Post Graduate Diploma in Hotel Interiors were selected as sample for pretesting. They were asked to fill questionnaire before and after the administration of the educational programme. The paired t-test was computed. The t-value was 15.28 which were found to be significant at 0.01 level.

3.11.4 Administration of educational Programme to the Home Owners

Those home owners who scored moderate and low on the knowledge scale regarding green buildings as well as those who scored low on the extent of greenness on the existing houses were exposed to the educational programme. They were gathered in the Dr. Mrunalini Devi Puar Auditorium of Faculty of Family and Community Sciences. The movie was shown to them and then immediately after that they were asked to fill the same knowledge scale. This was done to test the efficacy of the educational programme prepared and to test the change in knowledge level of the respondents regarding "Green Buildings". Paired t test was performed to test the efficacy of

the educational programme. The Paired t-test value (15.248) was found significant at 0.01 level of significance.

Plate 3: Introduction about the educational programme

Plate 4: Explaining the process of filling the Knowledge scale

Plate 5: Exposure to the educational programme

Plate 6: Students filling up the knowledge scale before and after the exposure to the educational programme