SUMMARY

Tremendous rate of real estate development across the globe is imposing immense pressure on the environment and its natural resources. Construction industry is growing rapidly all over the world. Buildings have major environmental impacts over their entire life cycle which ranges from their designing, construction, operation, maintenance, renovation and deconstruction. Resources such as ground cover, forests, water, and energy are depleted to give way to buildings. Humans face a range of negative impacts linked to the way buildings are designed, built, and maintained.

The world is now slowly realizing the importance of environmental conservation. In the later part of the twentieth century 'Go Green' philosophy has been developed. Building construction sector is no exception to this. The constructionindustry also has shown considerable awareness towards preserving the ecological balance through various green practices. Mounting concern for the environmental impact of real estate has necessitated the formulation of sustainable solutions. Sustainability has become increasingly important in the building industry in recent years. A movement has immerged in the building construction industry in more efficient and sustainable manner by reducing energy, water and resource use. This concern has led to the development of "Green Buildings". A Green building is one whose construction and lifetime of operation assure the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resources. The Greenness of the building is assessed on the five broad areas viz. Sustainable site, Water efficiency, Energy efficiency, Material and resources and Indoor environmental quality.

The major differences are that Green buildings have improved indoor environment and they offer operational savings. Green buildings can have tremendous benefits, both tangible and intangible. The intangible benefits of green buildings include enhanced lighting, health and wellbeing of the occupants, safety benefits and conservation of scarce natural resources. It

ensures maximum daylighting and cross ventilation and recognises measures to minimize indoor air pollutants. Green buildings can have a more significant impact on their occupant's health and productivity through improving indoor environment quality (IEQ). This can be achieved by using less toxic interiors, low-emitting adhesives, paints, carpets and composite wood, illuminating 75-90% of the space with natural light and thermal comfort due to local control over air conditioning and better ventilation.

There are some barriers in way of adopting green buildings such as the additional cost incurred in its construction and difficulty in getting positive returns on this extra investment of the builders and developers if their green building projects are not sold, lack of technical capacity for the planning, design and construction of green buildings, shortage of contractors and a lack of technical training capacity, lack of availability of funds, space and materials needed in the construction of green buildings, procuring green certification is difficult, lengthy and expensive process, lack of interest on the part of all the stakeholders, lack of awareness of the benefits amongst the users of building.

Voluntary green building rating systems have become a popular tool to encourage the construction sector to adopt sustainable practices. In India, the two main rating systems are the Green Rating Integrated Habitat Assessment (GRIHA), developed by TERI and the Ministry of New and Renewable Energy, and Leadership in Energy and Environment Design (LEED), operated by the Indian Green Building Council (IGBC). GRIHA uses a set of 34 criteria to assess buildings and incorporates all the relevant building codes and standards, including the ECBC, and has been adopted by the government Central Public Works Department.

Due to the fact that the construction industry is traditionally a large user of natural resources, the necessity to design buildings with a low environmental impact is increasing. Green building is accepted worldwide in the recent past, but there is still a vast community that either is unaware of sustainable design concept, indifferent to its cause, or unconvinced of its advantages. It is heartening to know that the concept of Green Buildings is now being adopted

in the Indian real estate industry. However, efforts are not enough and a greater push is required to make real estate environment sustainable. To convince owners, builders, and designers and other stakeholders about the benefits of sustainable design, it is necessary to make them understand the numerous advantages of green building concept.

Vadodara city has witnessed a remarkable growth in the construction of residential units. During the later part of the twentieth century and during the early year's twenty first century. At that time all the builders might not have paid much attention to its influence on the residents and environment. Now, that builders are also becoming conscious of environmental impact of constructions made by them, they incorporate several aspects so as to make the buildings environment friendly. Now the upcoming buildings are made "green" but the existing building can also be improved to make them environment friendly. There is a need to find out the extent to which the residential units constructed by the builders are "Green"- meaning environment friendly. Based on findings suggestions can be given to make them "Green". The extent of greenness of the existing residential buildings means that the building has to address a set of criteria such as site location, energy efficiency, water efficiency, sustainable material selection and indoor environmental quality.

It is also essential to find out the awareness of consumers, that is, the owners of the houses regarding the concept of green building as educated and aware consumer regarding the various aspects of green building is sure to influence many of the people around as well as their children who are going to build their own houses in future.

Aware consumer clientele can also influence the property market by pitching demand for green credentials of the buildings. Improved environmental performance of the buildings constructed by the builders can also add to their reputation and they can get returns of their investments in green buildings. However, it is necessary to find out the opinion of builders regarding green buildings and the reasons as well barriers they have for Green building

concepts / features. The opinion of the builders regarding the green building is sure to influence the projects they undertake for construction. It was also thought important to find the knowledge of the home owners whose houses were assessed.

The researcher did not find any study focusing on awareness of homeowners of existing (non-green buildings) regarding green buildings and also the assessment of it for the extent of its greenness. Opinion of the builders also needs to be assessed in Indian context.

Statement of Problem

The present research aims to assess selected houses of Vadodara City with regards to the extent they are “Green” and also the knowledge of the house owners regarding various aspects of “Green building”. It also aims to find out the opinion of builders of Vadodara City about Green building and the reasons and barriers in adopting Green building features in their construction.

Thus the present study has the following specific objectives

Objectives of the study

1. To find out the opinion of the selected builders of Vadodara City regarding the concept of Green Building.
2. To find out the extent of influence of reasons for adopting the Green Building design and construction by the builders of Vadodara City.
3. To find out the extent of barriers faced by the builders of Vadodara city in adopting Green Building design and construction.
4. To ascertain the background information about selected home owners of Vadodara city.
5. To assess the extent of knowledge of selected home owners regarding various aspects of Green Building.
6. To assess the extent of Greenness of the selected existing houses.

7. To prepare an educational package on various aspects of Green Building for various stakeholders and to test the efficacy of it.

Delimitation

The study was limited to

- 220 owners of the house residing in different residential areas of Vadodara city.
- the home owners who had constructed or purchased their houses (tenement/ bungalow) between 2005-2013.
- the Key decision maker who was willing to answer the questionnaire at the time of data collection.

Hypotheses

1. There exists a relationship between the opinion of builders regarding green building concept and their selected personal and situational variables.
2. There exists a relationship between the extent of influence of reasons in adopting Green Building design and construction and selected personal and situational variables of the builders.
3. There exists a relationship between the extent of barriers faced by the builders in adopting green building design and construction and their selected personal and situational variables.
4. There is an interrelationship between the extent of influence of reasons in adopting green building design and features of builders and extent of barriers faced in adopting green building design and construction and opinion of builders regarding green building concept.
5. The extent of knowledge of the home owners regarding various aspects of Green Building varies with their selected Personal, Family and Situational variables.
6. The extent of greenness of the selected house varies with the selected Personal, Family and Situational variables of the home owners.
7. There exists a 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.

8. There exists a relationship between the knowledge of home owners and the extent of greenness of the selected houses.
9. There exists a difference in the extent of knowledge of the home owners regarding Green buildings before and after the exposure to the educational programme on Green buildings

Methodology

The study was descriptive and experimental in nature. There were two units of inquiry – one was the builders and the other was the Home Owners of the residential units built by the same builders.

Builders: A questionnaire was developed by the researcher as a tool for data collection from the builders. Apart from background information of the builders the tool contained three summated rating scales viz. (i) Opinion of builders regarding Green Buildings, (ii) Extent of influence of reasons in adopting Green building design and construction, and (iii) Extent of barriers faced in adopting Green building design and construction. The Opinion of builders regarding Green Buildings scale 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. 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. 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.

A list of builder's was obtained from Confederation of Real Estate Developers' Association of India (CREDAI). Out of 300 member builders of Vadodara City, seventy five were selected through systematic random sampling method.

Home Owners: A questionnaire and an observation checklist were developed by the researcher to collect data from home owners. A summated rating scale containing statement 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. 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. From the housing colonies developed by the selected builders, 220 existing residential units were selected which were constructed between 2005 and 2013. The selection was done through Snow ball sampling method.

Validity and Reliability of the tools was established. To test the content validity of the scales prepared 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. The reliability of the scales was established through split-half and test-retest methods. Spearman-brown correction was applied where needed. The reliability values were found to be high for all the scales. The data were analyzed using descriptive statistics

(Frequency, percentage and mean) and relational statistics i.e.'t' – test, ANOVA, Co-efficient of Correlation and Chi – square were applied according to the nature of variables.

To create awareness among the masses regarding Green buildings, an educational programme was prepared in audio visual and print media. The respondents scoring low on knowledge scale and house owners of those houses which had low extent of greenness were exposed to educational programme in the form of Power point presentation with its explanation which was prepared to facilitate the respondents for better understanding. A booklet was also prepared consisting the same content to distribute it for their future reference. Both the media were prepared in English and Hindi language for wider applicability and acceptability. The content was developed based on the review of literature collected including the aspects such as 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).

The content validity was established of the educational programme prepared. Pre-testing of the programme was conducted to establish the reliability which was done through the paired t-test. For this the knowledge test was administered before and after the exposure of educational. The paired t-test results reflected the high efficacy of the educational programme prepared.

Major Findings

The major findings of the study are presented here.

1. Information regarding Builders

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.

Section I: Background Information of Builders

The mean age of the builders was 43.01 years. One half of the builders' belonged to 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 with a mean of 16.05 years. 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. Majority of the builders had incorporated Green Building element "Indoor Environment Quality" and "Water Efficiency" in their Private projects only.

Section II: Opinion of builders regarding Green Buildings

To find out the opinion of builders regarding Green buildings, several statements on Green building aspects were framed. More than one half of the builders strongly agreed and reflected that there is a need to promote Green Building design and construction due to the deteriorating condition of Vadodara city and it also helps in balancing the negative effect of various kind of pollution. The opinion of builders regarding Green buildings was presented as 'Most Favourable', 'Somewhat Favourable' and 'Least Favourable'. It was found that less than three fourth of the builders had "Somewhat Favourable" opinion regarding Green Buildings.

Section III: Extent of Influence of Reasons in adopting Green Building design and construction

It was thought necessary to find out the reasons that might have influenced the builders to adopt the Green building concept in their projects. It was reflected from the findings that less than one half of the respondents had "moderate extent of influence" of "economic reasons" for adopting Green building design and construction. The "environmental reasons" influenced "to a great extent" to less than two third of the builders. The "other reasons" were influential "to somewhat extent" to less than three fourth of the builders. 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 out of 1 and 3.

Section IV: Extent of Barrier faced in adopting Green Building Design and Construction

There were several barriers that builders faced in adopting Green building design and construction. It was found that majority of the builders reported lack of technical knowledge of builders, contractors, clerk and other project team to a high extent as a barrier in adopting Green building design and construction. More than three fourth of the builders faced “moderate extent” of barrier in availing funds, space and materials for constructing Green buildings. The computed weighted mean for each barrier faced by builders 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 out of 1 and 3.

Information regarding Home Owners

Section I: Background Information regarding the home owners

It was revealed that 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 females i.e. home makers as respondents. 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. 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 females i.e. home makers as respondents. 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. It was found that less than three fourth of the respondents were working in service sector. The total monthly family income ranged from Rs. 28,000 to Rs.

2, 00,000 with a mean income of Rs. 88,153.64. Majority of the respondents belonged to 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.

Section II: Knowledge of Home Owners regarding various aspects of Green Buildings

The knowledge of the home owners was assessed regarding Green buildings. The knowledge scale contained statements on various aspects of Green Buildings such as Meaning of Green Buildings, Energy Efficiency, Water Efficiency, Materials and resources and Indoor Environment Quality. It was found that majority of the home owners had moderate extent of knowledge regarding 'meaning of Green building'. Less than one half of the respondents had low extent of knowledge on 'sustainable site' as one of the feature of green buildings. 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 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. 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 out of the range 1 to 3.

Section III: Assessment of the selected houses for their extent of greenness

The house of the respondents was analysed for the extent of greenness. It was observed that regarding the 'sustainable site' less than three fourth of the houses had moderate extent of greenness. On the aspect of 'water efficiency',

more than three fourth of the houses had moderate extent of greenness. About the 'energy efficiency', more than one half of the houses had low extent of greenness. Regarding the 'material and resources' it was found that majority of the houses had moderate extent of greenness. Majority of the houses had moderate extent of greenness on 'indoor environment quality'. Regarding 'innovative aspects' the low extent of greenness was found in all of the houses. The computation of weighted mean reflected that majority of the selected houses assessed had moderate extent of greenness. 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 was 0.326 on the range of 0 to 1.

Testing of Hypotheses

To analyse relationship between selected variables t-test, Co efficient of Correlation, Chi square and Analysis of Variance were computed.

- A significant relationship was found between private projects undertaken by the builders and extent of influence of reasons in adopting Green building design and construction.
- A positive relationship was found between opinion of builders regarding Green building concept and sources of information on Green buildings.
- A significant relationship was found between extent of influence of reasons for adopting green building design and construction and opinion of builders regarding green building concept.
- A significant relationship was found between the opinion of builders regarding green building concept and extent of greenness of the selected houses.
- A positive relationship was found between the extent of knowledge of the home owners regarding various aspects of Green Building and their age.

- 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.
- A positive relationship was found between extent of knowledge of the home owners regarding Green Buildings and extent of greenness of the selected houses.
- The respondents significantly differed in their knowledge level regarding green buildings before and after the exposure to the educational programme on Green buildings.

Educational Programme

Those home owners who scored moderate and low on the knowledge regarding green buildings scale as well as those who scored low on the extent of greenness on the existing houses were exposed to the educational programme. The home owners were gathered and the power point presentation 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”. The paired t-test results revealed the net gain in the knowledge of the home owners regarding Green buildings which shows the efficacy of the educational programme prepared for the purpose.

Conclusions

The study on “Assessment of selected houses and knowledge of the owners regarding Green buildings” was conducted on selected Builders who had constructed the houses were considered as sample for the assessment for the extent of ‘Greenness’. Builders had a mean age of 43 years and were graduate and were in the field of construction since 11 to 20 years with the mean of 16 years. Majority of them had somewhat favourable opinion regarding Green buildings. About one half of the builders had high extent of influence of reasons for adopting Green building concepts in their construction. The ‘Environmental’ reasons were more influential than other

reasons. About two third of builders faced high extent of barriers in adopting Green building concept in their construction projects. A positive relationship was found between the extent of influence of reasons for adopting Green building concepts in their construction and their opinion regarding Green buildings. This indicates that more the influence of reasons more favourable opinion regarding Green buildings. A positive relationship between opinion of the builders regarding Green buildings and the extent of 'Greenness' of the houses assessed indicated that more favourable the opinion, more was the extent of 'Greenness' of the existing houses.

The study conducted on the selected home owners of the Vadodara city having mean age of 42 years, graduates staying in tenement/duplex revealed that majority of them had low extent of knowledge regarding Green buildings. The 'Greenness' of their houses reflected that they were Green to a moderate extent. The age and education of the home owners was found to be influencing their knowledge regarding Green buildings. The knowledge of the home owners influenced the extent to which the buildings were assessed as 'Green'. Thus, the extent of 'Greenness' of the houses were affected by the knowledge of the home owners and the opinion of the builders regarding Green buildings. The extent of Greenness of the existing selected houses was found to be influenced by the knowledge of the home owners and opinion of the builders regarding Green buildings. This reflects the need to make home owners and builders aware about the upcoming concept of 'Green buildings'. Hence, an educational programme consisting of power point presentation and a written material in booklet form was found to be effective as it enhanced the knowledge of the selected home owners on Green buildings. There was a significant gain in the knowledge of the house owners regarding Green buildings after the exposure to the educational programme prepared. This indicated the need to conduct such programmes more widely.

Implications of the Study

The findings of the study brought out number of implications for the field of Family and Community Resource Management and Educational Institutions which can play an important role in creating awareness among masses through curriculum and educational programme. Government can play an important role overcoming the barriers faced by the buildings in adopting

green concept in their construction. Government can also give subsidies to and incentives as a motivator for buyers and builders.