Green Initiative Program For Small Scale Residential Project

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Abstract- *With the increasing awareness of sustainable development in the construction industry, implementation of a green rating procedure to assess buildings is becoming more important. The research started off with a literature survey and makes a questionnaire which have all simple basic important criteria's of small scale residential construction project. Experts from the construction industry Architectures, Engineers and builders were approached, to know their opinion and suggestions on this questionnaire. This comprises the qualitative study such as Delphi method. Based on the inputs received from the experts, a checklist was designed such as all simple criteria's includes regarding small scale green building construction. Perform Fuzzy assessment on this checklist to find minimum criteria for giving the various incentives and subsidies by the local government. Since the main focus of the study was to initiate green program awareness in local peoples, architectures, engineers and builders. From this study all members from construction industry are motivate and participate in large numbers for green construction.*

Keywords *- Sustainable development, Rating system, GRIHA, Delphi, Fuzzy logic*

I. INTRODUCTION

The green building trend has increased rapidly in India recent decades. The idea of green rating of buildings has also taken roots in local cities and urban. A green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building." Green or sustainable Building is a designing concept that reduces the environmental impact of buildings through innovative land use and construction strategies. In this study is we collect data regarding small scale green building construction from various rating systems and sustainable constructions magazines.

My research is too aware the local peoples and construction experts about small scale green building construction. Due to green initiative program local municipal bodies achieve green agenda simply and economically.

From Study of literature review we understand the concept of Sustainable development, Rating Systems and green initiative programs. Define a questionnaire with the help of Delphi survey and prepare a general checklist for small scale residential project. To minimize the uncertainty from fuzzy assessment perform on that checklist and find the minimum rating for small scale residential project. To give ratings with the help of this checklist to a building for selected case study of project.

II. DELPHI METHOD

The Delphi technique involves an iterative process in which expert opinions are processed and used as a feedback for further refinement of opinions generated in the earlier round. The Delphi approach typically elicits a high response rate because the respondent receives almost immediate feedback. If the topic area is perceived to be of high importance, high participation is also likely. The Delphi technique is not intended to replace or substitute for statistical and model-based techniques or human judgment, but it is intended for use where objective decisions are not possible in the absence of historic, economical, or technical data pertinent to the subject. The Delphi technique captures decisions related to a specific issue made by a group having diverse experience and interest. In this research, the Delphi group is represented by design, construction experts and people having experience in different expertise such as reality developers, architect, engineers as well as representatives from the construction industry.

Delphi analysis allows synthesis of the collective opinion of experts when the issues are more of strategic nature and difficult to numerically quantify. The Delphi process consisted of four steps toward group decision-making. The overall process involved the following steps:

1) Assembling the Delphi group,
2) Developing and administrating the questionnaire,
3) Processing the responses,
4) Providing controlled feedback to the participating experts to review their judgment until convergence is achieved, and finally

5) Processing and summarizing the outcomes of the survey. A flow chart of the Delphi process adopted for the research is presented in Figure.

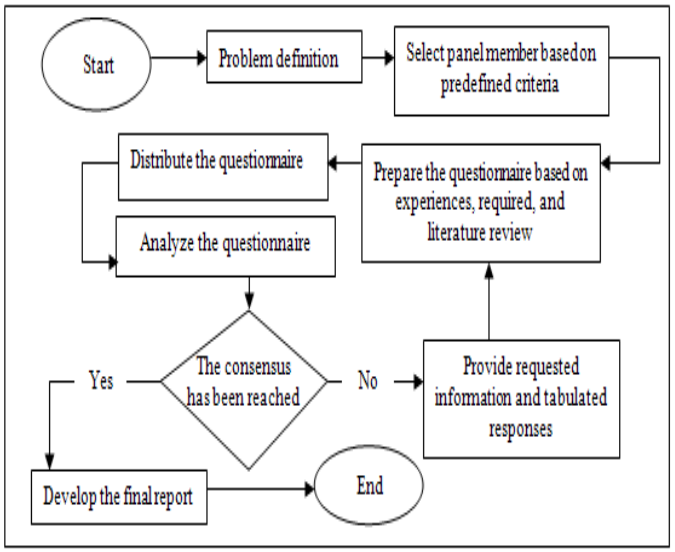


Figure no.1: Steps Of Delphi method

2.1 Delphi group

The first step toward Delphi decision-making is formation of the expert group. While the Delphi method doesn't have a specific requirement for the number of participants, for a successful implementation of the method, it is critical to have an appropriate selection of Experts group. The participants should be experts in the field that is being analyzed. The key to a successful Delphi study lies in the selection of participants. Since the results of a Delphi depend on the knowledge and cooperation of the panelists, it is essential to include persons who are likely to contribute valuable ideas.

2.2 Selection of expert panel

One of the vital considerations when carrying out Delphi study is to identify and select potential members to constitute the panel of experts. The selection of members or panelists is important because the validity of the study is directly related to this selection process. In this Delphi survey, the researchers attempted to identify panelists who meet all the following selection criteria:

(1) Having sufficient working experience or knowledge in the building and construction field,
(2) Working in relevant organizations in the building industry

2.3 Determining the level of consensus

One of the more difficult aspects of the Delphi process is the appropriate method of measuring consensus. While it is common to use variance as a measure of consensus, guidance that describes the level of variance that represents consensus is not available in literature. Kendall's coefficient of concordance W, represents criteria level of consensus between the participants was calculated along with the mean rank and standard deviation. Kendall's coefficient of concordance ranges from 0 to 1, indicating the degree of consensus reached by the panel (strong consensus for $W > 0.7$; moderate consensus for $W = 0.5$; and weak consensus for $W < 0.3$). This coefficient of concordance is also a scale for determining the level of coordination and agreement between several ranks of n phenomenon. All the experts have sufficient experience and expertise in building projects.

Sr. No	Type of firm / department	Number
1.	Architect	10
2.	Engineer	5
3.	Builders	5
	Total	20

Table No. 1 Number of the experts working professionals in the building industry

The sufficient working experience, senior job positions and relevant organizations of the selected experts ensure the validity of this Delphi research.

2.4 The Questionnaires in each round are as follows:

Questionnaire 1: From the study of sustainable construction, GRIHA, LEED rating systems find out the basic simple criteria's used for small scale residential construction.

Questionnaire2: Please give ratings to most important criteria according to importance and maximum time used in small scale construction by experts.

Questionnaire3: Only frequently used or above level of significance will be selected from point 2 and find suitable checklist.

2.5 Delphi method Analysis-

The first round of the questionnaire survey was conducted as the exploration process and was of crucial importance. From studying of sustainable construction, GRIHA and LEED rating system making most appropriate criteria's required for small scale residential projects. . The findings in the literature review were also provided for their reference. All these criteria's are genuine and important for small scale residential projects. After the completion of first round survey, criteria's

suggested were carefully analyzed and a list was formed. Finally, 32 important basic criteria's were consolidated, which is shown in following Table

Table No. 2 List of Important sustainable construction Criteria's for small scale residential project

Sr. no	Important sustainable construction Criteria's for small scale residential projects.	Expert frequency
1.	Do you have site selection feasibility	1.5
2.	Can you preserve and protect landscape/trees/soil during construction?	1.75
3.	Do you take initiative to protect natural site conditions & soil conservation during const.	2.3
4.	Do your design include orientation of Bldg. for enhancing outdoor lighting system	4.05
5.	Did your plan utilities efficiently and optimize on site circulation efficiency?	3.1
6.	Did your projects are following Building regulations and bye laws?	4.55
7.	In your site there is the minimum level of sanitation provided?	3.35
8.	Do you have techniques building design to reduce building water use?	3.4
9.	Did your Building Waste water treatment and reuse?	3.15
10.	Do you have rainwater harvesting plan for your design?	4.2
11.	Provide Water efficient fittings for plumbing?	4.05
12.	Arrangement of water leak detection and prevention system?	2.35
13.	Reduction in construction waste management	4
14.	Resource recovery from waste/reuse of structure/building reuse	2.55
15.	Utilization of waste materials like fly ash in construction?	4.05
16.	Arrangement for storage and disposal of wastes?	3.25
17.	Did you use of green and local Material?	3.15
18.	Which wood you use for construction is certified?	2.6
19.	Does the renewable energy based resources like solar water, wind mill system used?	4
20.	Are you provided energy efficient and saving appliances in whole project?	4.15
21.	Is there any Energy improvement/green power program?	2.75
22.	The building plan is optimize to use natural conventional resources to reduce the energy demand	3.6
23.	Do your projects design as naturally ventilated?	3.65
24.	Is any arrangement of thermal insulation on roof and exterior wall?	2.6
25.	Did you provide of Exhaust system for your project?	4.1
26.	Is in your project acceptable indoor and outdoor noise levels?	2.75
27.	The use of low emitting material, VOC paints/adhesives/sealants in interiors?	3.45
28.	The use of minimize ozone depleting substances?	2.05
29.	CFC reduction in HVAC equipment?	2.75
30.	Did you provide safety facilities for construction workers?	4.35
31.	Did you have techniques for reducing air pollution during construction?	3.55
32	The tobacco and smoke consumption is prohibited on site?	3.1

III. APPROACH OF FUZZY LOGIC FOR SMALL SCALE RESIDENTIAL BUILDING CHECKLIST

There is a set of 10 criteria's with differential weightage which gives total 40 points and after evaluation of each criteria by different experts. No points are granted for partial compliance i.e. if an evaluated criterion is satisfied then full point is awarded and if criteria is partially or not satisfied then 0 point is awarded. There is no provision of intermediate points in between for corresponding to partially satisfied or partially acceptable cases. If the membership value ($\mu(x)$) of satisfaction is considered as 1 then for not satisfaction it will be 0, nothing will be in between 1 and 0. Whereas it is seldom possible that a criteria is fully satisfied but can be complied to a certain degree of satisfaction for which the membership value ($\mu(x)$) of satisfaction can be any value within [1,0] due to involvement of uncertainty in between two zones of satisfaction and not satisfaction of the expert. Thus it is very difficult to make genuine assessment based only on full points allotted logic. Instead we will have to consider all degree of perceptions of expert within [1,0].

Here are total 10 criteria's in Checklist for rating of greenness of a small scale residential building and for all cases evaluation is done by human being where there is certainly a limitation of knowledge or intellectual functionaries. The statistical observations or data so obtained for rating of a green building against 10 criteria's are not always crisp or precise. Most of the data are non-numeric or unreliable statistical data rather linguistic and hedges viz. "good site", "very good water

quality", "less noisy", "less landscape", "well designed", "more renewable energy", "highly acceptable", etc. due to the involvement of uncertainty. Every expert hesitates more or less on every evaluation activity in between of all the above conditions because some part of his perception contributes to truthness and some part to falseness when he allots the points against different criterias. Thus uncertainty is an integral part of the accuracy of the assessments of each criterion which can be solved by the approach of fuzzy logic. Such types of imprecise data are fuzzy in nature.

Evaluation of many criteria here is not always possible with numerical valued description for which basis we awarded the full point as per Checklist. All the out put evaluation results of criteria's are 100% based on the satisfaction level and the perception level of the experts which can never be same for all the situations, indoor as well as outdoor environment. Consequently it is ideal to adopt a proper mathematical tool to do a proper and genuine judgment and rating of a green building and certainly fuzzy logic is the most suitable for the purpose. Because of this obvious reason we adopt fuzzy logic in the present work. Now we propose a methodology of fuzzy assessment for rating of a green building based on criteria's by proposed checklist.

Consider a project 'Assessment of rating of a green building'. To assess the rating of green building, we consider criteria's of proposed checklist as attributes (xi) of proposed methodology. We also consider all the points assigned against each criterion as weightage (Wi) of that particular attribute. Considering favourable aspects of green building, the 10 attributes with their weightage are:-

x1 = Orientation of Building for enhancing outdoor lighting system (W1=4)

x2 = Building regulations and bye laws (W2=5)

x3 = Rainwater harvesting (W3= 4)

x4 = Water efficient fittings for plumbing (W4=5)

x5 = Construction waste management (W5=4)

x6 = Utilization of waste materials like fly ash (W6=3)

x7 = Use of renewable energy based resources like solar water, wind mill etc.(W7=4)

x8 = Energy efficient and Saving appliances in whole project (W8=6)

x9 = Provision of Exhaust system (W9=2)

x10 = Provide safety facilities for construction workers (W10=5)

Naturally, all independent expert's views for individual attribute will lead to a fuzzy set of the universe U, where U = { x1, x2, x3, x4, x5, ……, x10 }.

Now the job is to assign values to these attributes. This can be done either by direct observation or by collecting views from all the stakeholders. Let us suppose that the data collected for an attribute xi reveals that more or less 70 % are in support of the truthness of the attribute and the rest 30% are in support of falseness then the membership value of fuzzy set will be $\mu A(xi) = 0.7$. Suppose the membership values of each attribute judged by different experts are as below:

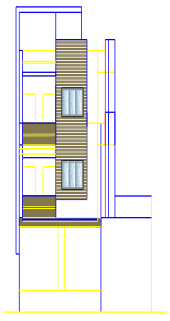
Table No. 3 Attributes judged by experts of the building industry

Attribute	In support of truthness μ(x)	In support of falseness =(1-μ(x))	Weight of the attribute Wx	Weighted Rating μ(x) x Wx
X1	0.5	0.5	4	2
X2	0.9	0.1	5	4.5
X3	0.9	0.1	4	3.6
X4	0.8	0.2	5	4
X5	0.55	0.45	4	2
X6	0.7	0.3	3	2.1
X7	0.75	0.25	4	3
X8	0.7	0.3	6	4.2
X9	0.55	0.45	2	1.1
X10	0.9	0.1	5	4.5
Total Weighted Rating (a (μ)) =				31

Result: From the result of fuzzy assessment, the 'Total Weighted Rating (a(μ)) value is = 31

This is the minimum rating for small scale residential project is considered.

IV. CASE STUDY



Location :Malkapur, Karad
Site Area : 80 sqm
Built-up Area : 50 sqm
Client : Ikbal Sande, Malkapur.
Planning & Execution Engineer: Iliyas Sande, karad.
Architect: Nasir Inamdar, Gote.
Structural Consultant: Khalil Momin, Bhalwani.
Masonary work: Farid Shekh, Karad.
Contractor: Dilawar sande, Gote.
Electrical Consultant: Ashpak Sande, Vijaynagar.
Plumbing & Sanitation: Mohammad Jamadar.

Table No. 4 10 green point scale for small scale residential building project

Sr. no	Important sustainable construction Criteria's for small scale residential projects.	Criteria's Score
1	Orientation of Building for enhancing outdoor lighting system.	4
2	Building regulations and bye laws.	5
3	Rainwater harvesting	2
4	Water efficient fittings for plumbing	5
5	Construction waste management (50% or 100%)	3
6	Utilization of waste materials like fly ash	2
7	Use of renewable energy based resources like solar water, wind mill etc.	2
8	Energy efficient and Saving appliances in whole project	4
9	Provision of Exhaust system	0
10	Provide safety facilities for construction workers.	5
Total		32

The total weighted rating value for case study of this residential project is 32 which are greater than the minimum weighted rating value. Therefore this building is certified as small scale green building.

V. CONCLUSION

This checklist is simple and effective, so architects, Engineers and builders can use for small scale residential project easily. From this study all members from construction industry are motivate and participate in large numbers for green construction. Helpful for small-scale project Architectures, Engineers and builders to achieve green agenda simply and economically. Aware the people for green initiative program for small-scale projects. Suggest Municipal Corporation gives incentives, subsidy and rebate on property tax for small scale building project.

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