THE IMPEDIMENTS IN CONSTRUCTION OF SUSTAINABLE BUILDINGS IN PAKISTAN

Dr. Salahuddin Azad
PhD, Asst. Prof., Zarmina Akbar
National University of Science and Technology Pakistan

Abstract

The Concept of "Sustainable building" is the design and construction of buildings using methods and materials that are resource efficient, well-being of the building's occupants, workers, health and environment friendly. Construction of Sustainable building plays an important Role in GDP of a Country and provides a wide range benefits for the society but their development suffers from different kinds of market barriers in developing countries including Pakistan. In order to find out the Impediments in Pakistan, A Survey based (Through Questionnaire) study was conducted in General Area of Rawalpindi.

The Questionnaire was designed to assess the present problems faced by construction industry in Pakistan. The Response remained 63.7% and ranking of identified barriers were compared with other Asian countries. The results indicate that lack of credit resources to cover up front cost and risk of investment are one of the most important factors contributing barriers against sustainable construction. Whereas the Government support, public awareness and promotion idea of sustainable building are the recommended solution for sustainable construction

Keywords: Sustainability, Sustainable construction, Barriers

Introduction:

Climate change has caused invariable rise in temperature all over the world, especially in South Asia. Summer duration has drastically increased. Moreover the rainfall has contracted in Southern Asia and Mediterranean. The pattern of winds have changed which is causing scarcity in the world and it has expanded since 1970s (Jc Howe, 2010).

Sustainable building is in unceasing phase of development which can be defined as: The practice of increasing the efficiency with which buildings and their sites use energy, water, and materials (M.Baum, 2007) and reducing building impacts on human health and the environment, through better citing,

design, construction, operation, maintenance (J.Allen, 2004) and removal of the complete building life cycle (O.Hansen, 2004). Likewise, the Environmental Protection Agency (EPA USA, 2010) describes sustainable designs as "The practice of creating structures and using processes that is environmentally responsible and resource-efficient throughout a building's life-cycle from citing to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort (Saunders et al, 2007). Green building is also known as a sustainable or 'high performance' building."(Francis and Hoban, 2002)

Pakistan is highly affected by energy crisis for last decade. Pakistan total power generation capacity is 23,538MW, which has grown to 80 percent in last two decades. According to Water and Power Development Authority (Wapda), this demand will grow to 40,000 Mega Watts till 2022. In last 5 years the annual consumption of energy in Pakistan has raised up to 4.8 percent. It is expected to rise at 8 to 10 percent yearly.

Sustainable building is the only viable solution and is an effective alternative to energy efficient buildings (Black et al, 2000). This research is an effort to identify the barriers to sustainable building construction in Pakistan. Based upon results recommendations are suggested that can be helpful in promoting sustainable construction in PakistanThis leads to development of different tactics for sustainable building designs which include: passive houses, sustainable building and bioclimatic designs

Material and Methods

To carry out the Research a survey through well-defined questionnaires was conducted. The data was collected by taking the interviews of all the stakeholders. Flowchart layout of the methodology has been shown in Figure -1 21 barriers were identified Table-1 After the pilot study, the questionnaire was further reviewed and adjustments were made by reducing barriers to seventeen (17) to make it suitable for Pakistan. A five-point likert scale, with 1 being very low and 5 being very high, was utilized to judge the current level of effectiveness of barriers to Pakistan construction industry. All the stakeholders including clients, consultants and contractors/subcontractors were made part of this survey. The questionnaires were given to all the leading companies register with Pakistan Engineering Council and limited solar companies operating in Pakistan. There were 152 questionnaires which were circulated and 106 were received. 9 incomplete questionnaires were dispensed and the final research was carried out basing on 97 questionnaires. The category of respondents was 18 clients, 25 consultant and 55 contractor/ sub-contractor. Statistical Package for the Social Sciences SPSS 20 was used to examine the data collected from the

questionnaire. The reliability of data was also conducted with the help of Cronbach's Alpha. To verify the data being parametric or non-parametric Shapiro-Wilk Normality Test was used. To identify the variances in perception Kruskal-Wallis test was conducted. The significance level was considered to be 5% to show the statistically significant relationships. Barriers to sustainable building of Pakistan were assessed using mean value method.

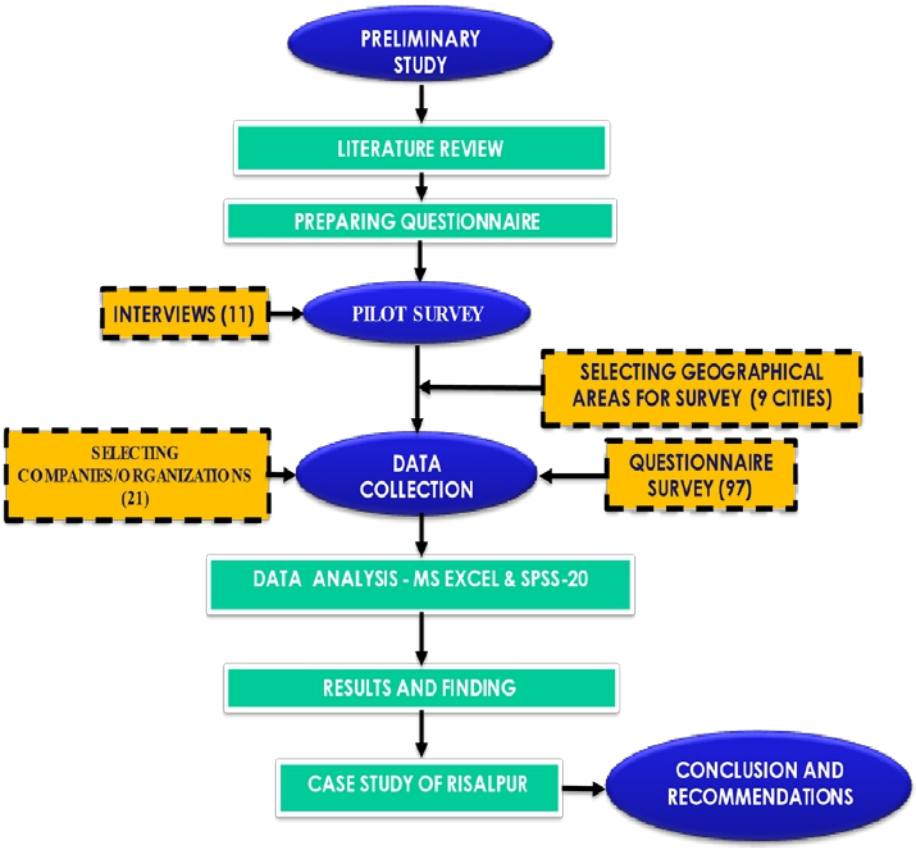

Figure 1: Methodology of Research

Table -1: Worldwide Impediments in Sustainable Building

#	Barriers	Reference
1	Lack of credit resources to cover up front cost	Milad S (2013), Miriam L (1999)
2	Risk of investment	Miriam L (1999), Milad S (2013)
3	Lack of training/education in sustainable design/construction	Miriam L (1999), Milad S (2013)
4	Lack of demand	Milad S (2013)
5	Higher final price	Miriam L (1999), Soheila B (2008), Milad S (2013)
6	Lack of government support	Miriam L (1999), Soheila B (2008), Milad S (2013)
7	Lack of building codes and regulation	Miriam L (1999), Milad S (2013)

8	Lack of professional knowledge	Miriam L (1999), Soheila B (2008), Milad S (2013)
9	Lack of design and construction team	Milad S (2013), Miriam L (1999)
10	Lack of strategy to promote green building	Milad S (2013), Miriam L (1999)
11	"Green" products not available in my area	Soheila B (2008)
12	Lack of expertise	Milad S (2013)
13	Higher investment cost	Milad S (2013)
14	Lack of incentives	Milad S (2013)
15	Lack of technology	Milad S (2013)
16	Lack of Public awareness	Milad S (2013), Soheila B (2008)
17	Lake of database and information	Milad S (2013)
18	Applicability of sustainable buildings	Hanby (2004)
19	Lack of incentives	Wood (2007)
20	Clerk knowledge of sustainable design	Miriam L (1999)
21	Difficult to obtain financing from banks	Miriam L (1999)

The population for the sample was the construction industry of Pakistan. There are approximately 30,000 construction companies registered with PEC till January 2014. This population was fairly large. Companies/organizations included in the survey were located in Islamabad, Rawalpindi, Lahore, Karachi, Quetta, Gujranwala, Hyderabad, Peshawar, Multan and Kharian. Respondents were amply qualified and experienced. Around 77.3% (75) respondents had an experience of 10 years in construction industry, 15.4% (15) having 6-10 years construction experience, whereas only 7.2% (7) had less than 5 years of experience in construction. Assuming the experience by the respondents it can be said that the information was quite reliable. The Sampling error, Population size and Confidence level were the aspects catered for while calculating the sample size with following formula:

$$Ns = [(Np)(P)(1-P)] / [(Np-1)(B/C)2 + (P)(1-P)]$$

Where

Ns = Sample size

Np= population size i.e. 30000

P= Proportion of the population that is expected to choose one of the response categories (yes/no), P = 0.5

B= acceptable sampling error; (±10% or ±0.10)

C=Statistic associated with the confidence level

Characteristics of Respondents-Frequencies and Percentages Grouping of the Respondents. The valid questionnaires received were 97 out of 152. Grouping of respondents has been shown Table-2.

Table -2: Respondents Grouping

Respondents	No of Questionnaires Returned	Percentage	Cumulative Percentage
Clients	18	18.5	18.5
Consultants	24	24.7	43.2
Contractors/Subcontractors	55	56.7	100
Total	97	100	-

Stakeholders Experience in the Pakistan Construction Industry; The respondents having more than 10 years of experience are 55.3% (84), 28.9% (44) have the experience of 6 to 10 years and only 15.8% (24) have less than 5 years of construction experience. Thus the survey conducted covers the experience of all the brackets and is quite realistic and consistent. Experience of stakeholders are shown in Table-3

Table-3 Stakeholder Experience in Construction Industry

Respondents Experience	Respondents Frequency	Respondents Percentage	Cumulative Percentage
0-5 years	7	7.2	7.2
6-10 years	15	15.46	22.6
11-15 years	36	37.11	59.71
16-20 years	28	28.8	88.57
20+ years	11	11.33	100.0
Total	97	100.0	-

Respondents Position in the Construction Industry

Respondents to this survey belong to different levels. In Table-4 the percentages of different positions of the respondents have been shown. Around 39.5% (37) of the respondents are managers at different levels, 26.8% (26) field engineers, 14.4% (14) supervisors/foremen, 8.2% (8) workers and 12.3% (12) are performing the duties of solar engineer.

Table-4 Respondents Position in Construction Industry

Positions of the Respondents	Frequency of Respondents	Percentage of Respondents	Cumulative Percentage
Managers	37	39.5	38.1
Field Engineers	26	26.8	64.9
Solar Engineers	12	12.3	77.2
Supervisor/Foreman	14	14.4	91.6
Workers	8	8.2	100
Total	97	100	-

PEC Category of the Respondents Companies

Distribution of construction companies based on PEC categories is given in Table-5 which indicates that 16 companies are in category higher than C-5 whereas no company from C-6 category is included in the survey.

Table-5 Frequency of Respondents based upon PEC Categories

PEC Category	Financial Limit of Each Category	Respondents Frequency	Respondents Percentage	Cumulative Percentage
C-A	No financial limit	12	12.3	12.3
C-B	2000 Million	11	11.3	23.6
C-1	1000 Million	16	16.4	40
C-2	500 Million	12	12.3	52.3
C-3	250 Million	8	9.2	61.5
C-4	100 Million	4	4.1	65.6
C-5	30 Million	5	5.1	70.7
C-6	15 Million	-	0	70.7
Total	-	68	70.7	-

Sectors of the Respondents

Respondents belong to both public and private sectors. 16.5% of the respondents are from public sector, whereas 83.5% are from private sector, as shown in Table- 6

Table- 6 Frequency of Respondents basing on Type of Sectors

Type of Sectors	Respondents Frequency	Respondents Percentage	Cumulative Percentage
Public	16	16.5	16.5
Private	81	83.5	100.0

Location of the Respondents in Pakistan

Respondents to this survey belong to companies situated at different cities of Pakistan.

Table -7 Location of Projects Included in the Survey

Location	Questionnaire Received
Lahore	18
Karachi	12
Rawalpindi/Islamabad	36
Peshawar	8
Quetta	5
Multan	6
Kharian	7
Hyderabad	2
Gujranwala	3
Total	**97**

Results and Discussion

The valid replies received were 97 out of 152 showing 64% response of the circulated questionnaire. The good response considered to be 30% in construction industry Thus the received response was acceptable for the research.Talking this number as the population sizes the sample was calculated. Confidence level for sample selection was taken as 95%. Considering the answer to be homogeneous, the p value was 0.5. By putting the values in above formula the size of sample was calculated as 96 with a sampling error of ±10%. SPSS was used to analyze the collected data, which gave the sampling error of ±9.91%, thus validating the sample size as the error less then ±10%. Therefore the sample size was found reliable for carrying out the analysis.

Statistical Analysis The data once categorized was evaluated by using the Coefficient Alpha method one of the most common methods used for calculating the reliability of a sample and results have been shown below in Table-8.

Table-8 Reliability Statistics

Analysis				Cronbach's Alpha	0.81
		N	%		
Values	Valid	97	100.0		
	Excluded a	0	.0	Number of Items	17
	Total	97	100.0		

Normality Test Result

Shapiro Wilk normality test was used to check whether the data is normality disturbed or else, which indicates that data is parametric in nature or non-parametric .For this test the sample size must be less than 2000. Value of significance came out to be 0.00. This shows the data is not normally distributed hence non-parametric techniques was applied to check the perception of different stakeholders. Results have been shown in Table-9 and figure-2

Table-9 Shapiro Wilk Test - Normality Check

Barriers	**Shapiro-Wilk Test**	
	Statistic	**Sig.**
Lack of credit resources to cover up front cost	.789	.000
Risk of investment	.789	.000
Lack of training/education in sustainable design/construction	.804	.000
Lack of demand	.807	.000
Higher final price	.811	.000
Lack of government support	.811	.000

Lack of building codes and regulation	.828	.000
Lack of professional knowledge	.836	.000
Lack of design and construction team	.858	.000
Lack of strategy to promote green building	.806	.000
"Green" products not available in my area	.890	.000
Lack of expertise	.818	.000
Higher investment cost	.858	.000
Lack of incentives	.898	.000
Lack of technology	.906	.000
Lack of Public awareness	.882	.000
Lake of database and information	.907	.000
Sig: significance value		

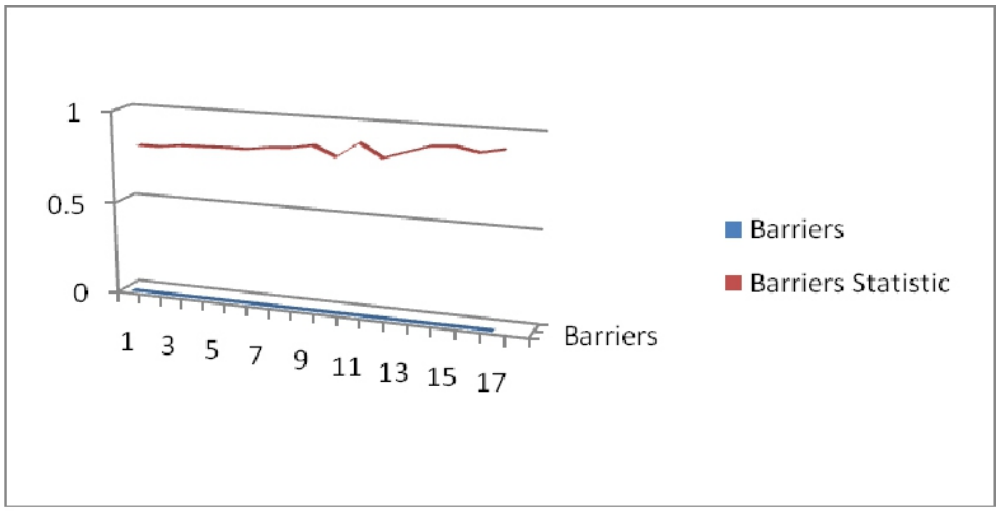

Figure-2 Normality Check

Kruskal Wallis Test

This test was used to identify the perception of different stakeholders. Table-10 shows the result of Kruskal Wallis test. Result indicates that stakeholder's perception towards barriers is generally same.

Table-10 Kruskal Wallis Test for all Barriers

#	**Safety Factors**	**Significance**
1	Lack of credit resources to cover up front cost	.718
2	Risk of investment	.231
3	Lack of training/education in sustainable design/construction	.458
4	Lack of demand	.387
5	Higher final price	.588
6	Lack of government support	.424
7	Lack of building codes and regulation	.275
8	Lack of professional knowledge	.141

9	Lack of design and construction team	.640
10	Lack of strategy to promote green building	.294
11	"Green" products not available in my area	1.045
12	Lack of expertise	.774
13	Higher investment cost	.231
14	Lack of incentives	.491
15	Lack of technology	.379
16	Lack of Public awareness	.603
17	Lake of database and information	1.183
Kruskal Wallis Test Grouping Variable: Stakeholders (Client, Consultant and Contractor)		

Ranking of Barriers to sustainability faced by construction industry of Pakistan; A total seventeen barriers were selected and ranked based upon mean value on Likert scale. The questionnaires gathered from 97 respondents were examined by using software i.e. SPSS-20 and Microsoft Excel. The results have been shown in Table-11and Figure-3. The cumulative average of mean values was assessed to be 3.70. This shows that at present considerable barriers exists towards adoption of sustainable construction.

Table -11 Ranking of Barriers

#	Barriers	Mean	Ranking
1	Lack of credit resources to cover up front cost	4.31	1
2	Risk of investment	4.21	2
3	Lack of training/education in sustainable design/construction	4.10	3
4	Lack of demand	4.09	4
5	Higher final price	4.04	5
6	Lack of government support	4.02	6
7	Lack of building codes and regulation	4.00	7
8	Lack of professional knowledge	3.75	8
9	Lack of design and construction team	3.73	9
10	Lack of strategy to promote green building	3.68	10
11	"Green" products not available in my area	3.66	11
12	Lack of expertise	3.65	12
13	Higher investment cost	3.51	13
14	Lack of incentives	3.31	14
15	Lack of technology	3.12	15
16	Lack of Public awareness	2.90	16
17	Lake of database and information	2.87	17
Average mean value		3.70	

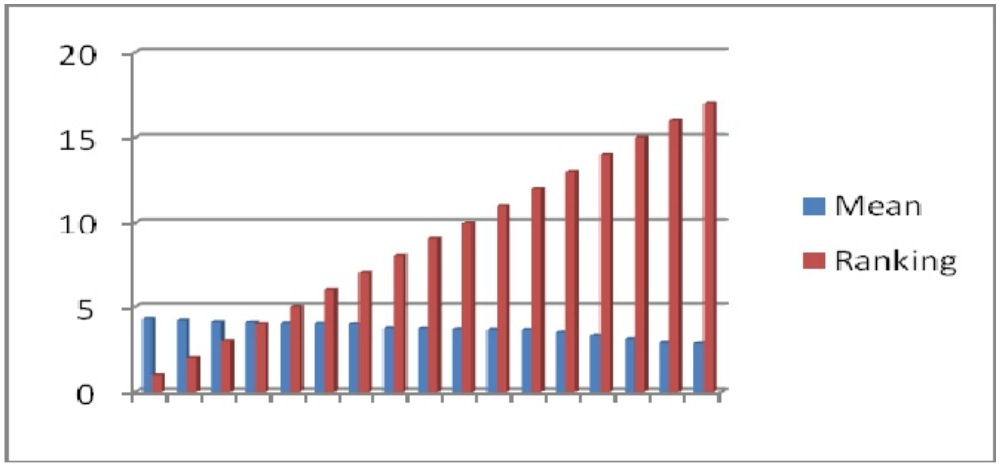

Figure-3 Ranking of Barriers with Mean Value

Conclusion

The main barrier to sustainable building relates to the perception gap in understanding of sustainable buildings. Moreover the higher upfront cost (new design, technology and construction method) are the main impediments to sustainable building development in Pakistan. Many of the organization / construction companies have the risk of investment which is merely a wrong perception, if considering the life span of a project. In Pakistan construction industry the lack of understanding increases the apparent cost of sustainable buildings, even experts with real understanding are inclined to assess the costs as relatively significant. Lack of training / education the benefits of sustainable building cannot be fully explored. Pakistan construction industry also lack in training for sustainable design, which is one of the important barrier faced by construction industry.

Lack of demand and higher final cost relates to awareness of client. Due to lack of education and awareness in Pakistan, the benefits of sustainable construction are not understood at micro level. The knowledge of general public about sustainable design is very important to promote sustainable construction Support of government is very essential to encourage sustainable construction which does not exist in Pakistan. Lack of government support is one of the major barriers in Pakistan construction industry. Government must provide some monetary benefits to promote sustainable building designs both in commercial and residential communities.

References:

JC Howe, 2010. The increasing prevalence and severity of Summer in the Asia due to increasing Climate Change. Occup. Environ. Const. 69 (10):649-50.

M.Baum and W. K. Morgan. 2007. Sustainable Building is the forthcoming Necessity. Am. J. Public Health. 64 (3):212-4.

J Allen, and H. Austin. 2004. Confounding by time since hire in internal comparisons of cumulative exposure to occupational discomfort studies. Environ 4 (4):326-41.

O.Hansen, 2004. Some confounding factors in the study of weather constraints. Am. J. Environ 117(1):177-88.

Saunders, Henneberger, P. K., and M. D. Attfield. 2007. Environmental Impacts on citing of Buildings. *Am.j. Crit. Care. Energy* 163 (5):1560-6.

H.Francis and V. Vallyathan Hoban, 2002. How People perceive to live comfortable in well cited Buildings. Occup. Environ. 62(4):207-43.

B.Bandy,Kibelstis, J. A., E. J. Morgan, R. Reger, N. L. Lapp, A. Seaton, and W. K. Morgan. 2007. How make the Buildings Energy Efficient . Am. Re.f Environ 118 (4):826-93.

S.Varane,Kuempel, E. D., M. W. Wheeler, R. J. Smith, V. Vallyathan, and F. H. Green. 2000. Contribution of Sustainable Buildings in Energy Economy in the United States. Am. J. Crit. Care. Environ. 170 (3):227-64.

J.Black,Meijers, J. M., G. M. Swaen, and J. J. Slangen. 2000. Climate change effects on construction Activities Occup. Environ. 50(10):718-13