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Training need of construction professionals regarding green buildings: Change in the knowledge and skills

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ABSTRACT

The construction sector is emerging at staggering heights for meeting the needs of the rising population in India. Despite the growth in the construction industry leading to an increase in GHG emissions, in turn leading to boosting climate change and global warming has led to turmoil in the environment. For combating the effects of climate change and rising GHG emissions, it becomes essential to develop sustainably. One solution which the global thinkers are trying to seek is to develop green buildings in the country which requires a trained workforce. An acute shortage of trained professionals is found in the Indian construction sector. This gap can be covered by developing capacities of construction professionals. A pre-post intervention study was conducted to determine the change in the knowledge and skills of construction professionals on green buildings. Locale selected for the study was Delhi-NCR Regions. The pre-post assessment was done on a sample of eighty construction professionals. The methods used for collecting data were knowledge and skill testing questionnaire for the study. Pre-intervention scores of the sample for knowledge were 24% and for skills were 4%, respectively. An absolute majority (92.5%) of the respondents lacked professional training on green buildings indicating the dire need for training to enhance green building movement effectively. An overall change in post-intervention scores of the sample for knowledge was 54% and for skills were 63%, respectively indicating a positive effect of training. The knowledge and skill change for pre-post intervention was found to be significant at $t(80) = 29.132$, $p < 0.0001$ for knowledge and $t(80) = 30.439$, $p < 0.0001$ for skill indicating training has achieved its objectives. This research paper provides a way forward for enhancing the knowledge and skills of construction professionals which can be achieved by training and giving a boost to green building momentum in the country.

Key Words : Construction industry, Environment, Green buildings, Sustainable development, Training

INTRODUCTION

The construction sector is emerging at staggering heights for meeting the needs of the rising population in India. According to McKinsey, the urban population is rising speedily in India. The urban population of India totaled 320 million (in 2008) and this is expected to nearly double to 590 million (by 2030). It is estimated that the number of consumer class will increase, further leading to an increase in residential, retail and commercial types of building in the construction sector (ITE Build and Interiors Reprot, 2016).

In India, construction is the second largest economic activity after agriculture. In the construction sector more than 35 million people are employed. This sector is accounting for the second highest inflow of FDI and is estimated at over USD 126 billion. It is valued that approximately USD 650 billion will be invested in urban infrastructure in the next 20 years (Make in India, n.d.).

An observation done by scientists studying climate change is that the Earth is rapidly heating each day. This is mainly a result of human activities which are playing a

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significant role. The construction industry has led to carbon dioxide emissions and is responsible for this phenomena. The trapping of carbon-di-oxide in the atmosphere leads to green- house gas effect, further leading to warming the Earth. It is estimated that the global cement industry is leading to 5% of global emissions approximately. One of the most harmful impacts of construction is the usage of heavy machinery in mining which is contributing to climate change. For reducing the environmental effects of construction, a collaborative effort is required from different stakeholders (Tyler, 2017).

As per The World Bank Reports, 660 million people are uplifted from poverty and income levels of million people had been raised giving a boost to economic growth in the last two decades. But, the sad demise is that this growth was observed at the cost of environment and not been inclusive. The massive amount of environmental resources were consumed in ways which are wasteful and economically inefficient. To fulfill the needs of the poor and providing scope for a growing cleaner economy, sustained growth is required. There is a need for growth which is green, required, affordable, efficient and essential. Green growth is an essential tool for leading a path towards sustainable development. A conference held in Rio in 1992 on environment and development failed to include growth and rather focused more on environment and inclusion. Following the conferences in Rio+20, the Prime Minister of Norway (Brundtland, 1987) stated: *"What is needed now is a new era of economic growth - growth that is forceful and at the same time socially and environmentally sustainable."* In today's world, there is a need to lay emphasis towards the triple bottom line and moving towards a path of sustainable development which should be inclusive of green growth (The World bank, 2018).

The Indian construction industry is advancing speedily and has understood the criticality of the situation, they have come up with innovative solutions for saving the earth. The need of the hour is to go for green buildings or sustainable construction to save the environment from the negative impacts of construction. All over the world individuals are worried about climate change, global warming and the irreversible damages that are caused on earth due to human activities. From individuals to organizations, states, and countries everyone is trying to make an effort to save the ecosystem. One solution which the global thinkers are trying to seek is to develop green buildings in the country.

Concept of green buildings:

To develop a better understanding of green buildings, one needs to understand the various definitions given by different organizations (Table 1):

Experts on green building stated that the construction industry in India has massive potential for adoption of sustainable construction practices, further leading in the creation of great environmental impacts. As per them, sustainable features should be adopted at initial design and planning phases and cannot be adopted at later stages when the construction has begun. An agreement was signed on January 2017 between Ministry of Power (GOI), Bureau of Energy Efficiency (BEE) and Green Business Certification Inc. (GBCI) with the aim of increasing energy efficiency in the building sectors (Akhaury, 2016).

Need of skilling: Construction industry:

Boston consulting group conducted a study for PHD Chamber of Commerce and Industry which estimates a huge shortage of 47 million working people worldwide

Table 1: Definitions of Green Buildings

Definition	Organizations
"A 'green' building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life"	World Green Building Council (2018)
"A green building is one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building."	Indian Green Building Council (2015)
"The planning, design, construction, and operations of buildings with several central, foremost considerations: energy use, water use, indoor environmental quality, material section and the building's effects on its site."	USGBC (2018)

(Source: World Green Building Council, 2018; (Indian Green Building Council, 2015; (U.S. Green Building Council, n.d.)

by 2020 but India will have a surplus of 56 million people. For bridging this gap and reaping benefits of the Indian economy, there is a dire need to build a skilled workforce. Majority of Indians fall in the working age group of 15-59 years. In the next five years, the population and working age will see an upswing trend of 1.4% and 2.15%, respectively. It was observed that the Indian workforce is not equipped with identifiable or marketable skills in rural and urban areas (Saxena, 2017).

A report from the Ministry of Skill Development and Entrepreneurship, estimated that the training needs of India will be 1268.72 lakhs (approximately) over the time period (2017-2022) across 34 sectors. The highest rated sector is the construction sector which requires a trained workforce of nearly 320 lakhs. Following this, trained workforce is required in retail (107 lakhs), beauty and wellness (82 lakhs), electronics IT-ITeS (69 lakhs), road transport and highways (62.2 lakhs), Textile Handloom and Handicrafts (60 lakhs) and similarly as shown in the Fig. 1. On an account, 80% of the trained workforce is required in India amongst these top 10 sectors (MSDE, 2017).

Source : Adapted from MSDE, Annual Report (2016-17)

Fig. 1 : Estimated Training Needs (2017-2022) across the top ten sectors

A report from NSDC states that the construction sector has been facing an acute shortage of talent and skilled professionals. This further leads to an increase in project costs and risks. To meet these demands the various schemes that are running and the training offered were inadequate. The existing system of training institutions is not able to provide the right number of sufficient candidates who are skilled to perform the various jobs like engineering, surveying, project management, contract management etc. One of the findings of NSSO seconded that the majority (97%) of individuals in the age group of 15-65 years have no exposure to training. This is clearly indicating that there is an urgency to set up models, increasing the number of training providers and training institutes for meeting the demands of the growing construction industry (NSDC Report, 2017).

Thus, keeping in line with the above view an attempt is made through this research paper to emphasize the need for training on green buildings. Moreover, this gap can be achieved by empowering construction professionals in creating a best in-depth analysis of sustainable design concepts in India and begin the quest for a better alternative

Objectives:

The objectives of this research paper are:

– To study the need for training on green buildings in the construction sector

– To determine the change in the knowledge and skills of construction professionals

METHODOLOGY

A pre-post intervention study was conducted to determine the change in the knowledge and skills of construction professionals on green buildings. Locale selected for the study was Delhi-NCR Regions. Delhi is the hub of many construction organisations and construction professionals were selected for the study. The sample size selected for the study were eighty construction professionals. These professionals comprised of architects, engineers, project managers, supervisors, middle level managers and others construction professionals working in the field. It was made sure that these construction professionals were having minimum experience of one year. The methods used for collecting data were visits, meeting with experts and knowledge and skill testing questionnaire (pre-post assessment) for the study.

RESULTS AND DISCUSSION

Profile of the sample:

The sample was in the range of 18-60 and above years. Majority of the sample (72.5%) constituted the age group of 18-25 years. Another 15% of the sample

was in the range of 26-35 years and 12.5% of the sample belongs to 36-60 years, respectively. Majority of the sample comprised of the young generation. Majority of the respondents were male (91%) and female (9%). Regarding education, more than half (55%) of respondents were graduate/B. Tech and 14% of the respondents were postgraduate, respectively. A small portion (16.25%, 15%) of respondents was 12th pass and diploma holders. For an experience in construction industry, the majority (80%) of respondents had experiences varying from 0-10 years, 15% of respondents had experience from 11-20 years and others had experience of above 20 years. The sample comprises of mixed working professionals, the intervention was designed considering in mind their education and varied interest.

Overall knowledge change: Comparison of pretest and post-test knowledge scores:

Scoring of the responses obtained on knowledge and skill testing questionnaire was done. Mean, percentage and standard deviation of each category were calculated. The overall change in knowledge (mean score=74.55) was depicted with pre-test and post-test mean and mean percentage of total knowledge score (maximum score=138). It was observed that the respondents scored a total mean score of 32.99 (S.D. = 29.74) in the pre-test. Respondent knowledge was low in areas related to sustainable development, green buildings, rating systems and application of credits. The respondents showed keen interest to learn the aforementioned topics. A positive effect of the intervention was observed as respondents score a total mean of 107.54 (S.D. = 11.33) during post-test. Fig. 2 depicts that 54% change in knowledge was observed.

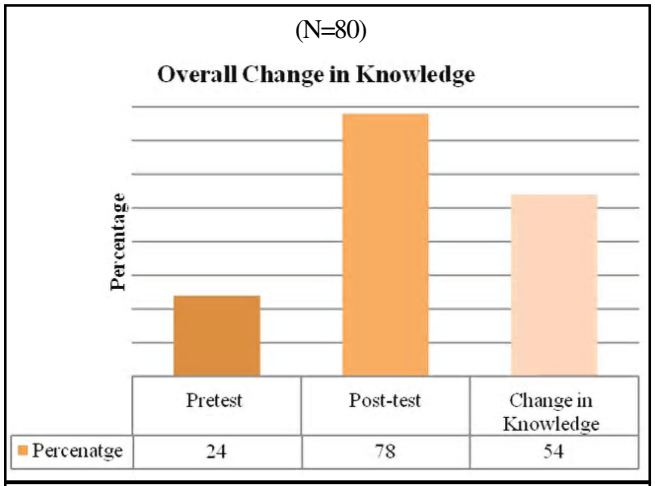

Fig. 2 : Overall Change in Knowledge

Overall skill change: Comparison of pretest and post-test skill scores:

The overall change in skill (mean score = 15.83) is depicted with pre-test and post-test of total skill score (maximum score = 25). It was observed that sample scored a total mean score of 0.92 (S.D. =1.65) in the pre-test. Scores of the sample were low in areas related to calculation and evaluation of points in a credit list. The respondents showed keen interest to learn about the above mentioned concepts. A positive effect of the intervention was observed as the sample score a total mean of 16.76 (S.D. = 4.15) during post-test. Fig. 3 depicts that 63% change in skills was observed.

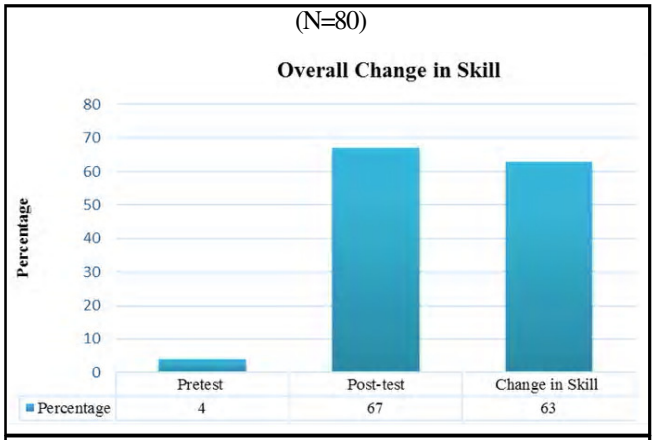

Fig. 2 : Overall Change in Skill

Category wise knowledge scores:

For a deeper understanding, the knowledge scores were categorized under various categories like climate change, Indian construction industry, sustainable development, green buildings, green buildings rating system and application of credits. Each category composed of a set of questions with varying marks assigned to a specific question. The total score is the maximum marks a sample can score in a particular category. The category of rating systems scored the lowest (6.18%) in pretest followed by application of credits (19.2%), green buildings (26.3%), sustainable development (34.82), climate change (35.92%) and construction industry (38.3%). For post-test results, a major change was observed in topics related to sustainable development (100%), climate change (88.9%), green buildings (82.4%), construction industry (72.7%),

Table 2 : Category-wise Pre-test and Post-test Knowledge Scores (N=80)

Category	Total Score	Pre-test			Post-test			Change in knowledge
		Mean	SD	Percentage	Mean	SD	Percentage	
Climate Change	35	3.14	7.089	35.929	7.78	11.291	88.929	53.00
Indian Construction Industry	6	0.383	0.486	38.333	0.727	0.455	72.708	34.38
Sustainable Development	7	0.812	1.373	34.821	1.91	1.818	100.000	65.18
Green Buildings	43	1.03	3.024	26.366	3.22	4.702	82.471	56.10
Green Buildings Rating Systems	36	0.556	1.91	6.181	5.846	4.155	64.965	58.78
Application of credits	11	0.211	0.446	19.205	0.745	0.507	67.727	48.52

application of credits (67.7%) and rating systems (64.9%). It was quite interesting to know that respondents scored considerably well in categories of sustainable development, green buildings and rating systems as they showed major improvement and scores increased significantly to 65.18%, 56.1% and 58.78%, respectively and likewise for other categories (Table 2).

Categorization of knowledge scores into hierarchical categories:

Knowledge scores attained by the sample were categorized into Hierarchical categories for developing a better understanding. This helped in determining the performance of respondents scoring high or low in pretest and post-test. From Table 3, it can be seen that 71.25% of respondents scored very low (56.2%) and low (15%), respectively. One-fourth (25%) respondents performed average. Only 3% of respondents scored high as they may have prior knowledge or attended training programs on green buildings. A drastic change was noticed in the post-test scores, the majority (98.75%) scored high and very high and a meager portion (1.25%) scored average. The interesting thing to note to observe was none of the respondents was in very low and low categories.

Overall, an interesting observation was that respondent's fall in the range of 0-60% in pre-test result. A major shift was seen post-intervention and the respondents fall in the range of 61-100% post-training. This clearly depicts that respondents understood the content as they were able to score in higher categories showing that the training conducted was effective.

Categorization as per KUA:

The three parameters used for segregating the scores were: Knowledge, Understanding and Application. Each parameter was composed of a set of questions with varying marks assigned to each question. The total score is the maximum marks a sample can attain for a particular parameter. It was seen respondents performed best in the application as the mean score in pretest is 9.2 and increased to 31.46 in post-test. Respondents performed well in understanding and showed an increase of 33.15 in the mean score. An increase of 19.14 (mean score) was seen in the knowledge of the respondents. Further,

Table 3 : Categorization of Knowledge Scores into Hierarchical Categories(N=80)

Category	Test Scores	Percentage	Pre-test(N=80)		Post-test (N=80)	
	Max=138		Scores	Percentage	Scores	Percentage
Very Low	Below 28	0-20%	45	56.25	0	0
Low	29-56	21-40%	12	15	0	0
Average	57- 84	41-60%	20	25	1	1.25
High	85-112	61-80%	3	3.75	53	66.25
Very High	113-140	81-100%	0	0	26	32.5

Table 4: Categorization of Scores as per KUA (N=80)

Parameters	Total Score	Pre-test(N=80)			Post-test (N=80)			Change in Knowledge
		Obtained Scores	Mean	Percentage	Obtained Scores	Mean	Percentage	
Knowledge	36	523	6.53	18.15	2054	25.67	71.31	53.15
Understanding	62	1380	17.25	27.82	4032	50.4	81.29	53.46
Application	40	736	9.2	23	2517	31.46	78.65	55.65

it can be inferred that there was an increase in the mean scores of the sample. Increase in Application level of the sample had reached the maximum possible goal. The knowledge and understanding of these concepts also show a definite increase in level (Table 4).

Conclusion:

Due to the increasing demands of the Indian economy and immense construction activities, there is a dire need to focus on the development of green buildings. Green building practices can substantially help in reducing the negative environmental impacts and improving the existing unsustainable design, construction, and operational practices. As an added advantage, green design helps in measuring the reduction in operating costs, enhancing building marketability, increasing the productivity of workers and employees and reducing potential liability resulting from indoor air quality problems.

An attempt was made through this research paper to determine the change in the knowledge and skills of construction professionals regarding green buildings and other related concepts. It was found that pre-intervention scores of the sample for knowledge were 24% and for skills were 4%, respectively. An absolute majority (92.5%) of the respondents lacked professional training on green buildings indicating the dire need for training to enhance green building movement effectively. An overall change in post-intervention scores of the sample for knowledge was 54% and for skills were 63%, respectively indicating a positive effect of training. The knowledge and skill change for pre-post intervention was found to be significant at $t(80) = 29.132$, $p < 0.0001$ for knowledge and $t(80) = 30.439$, $p < 0.0001$ for skill indicating training has achieved its objectives.

Construction professionals play a pivotal role in accelerating green building movement and achieving sustainable development. These professionals hold the potential to mobilise and navigating the pathway of India's growth and development towards sustainable construction practices. This research paper provides a way forward for enhancing the knowledge and skills of construction professionals which can be achieved by training and giving a boost to green building momentum in the country.

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