

ADOPTION OF GREEN CONSTRUCTION IN INDIA: A ROAD LESS TRAVELLED

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Abstract: The rationale of this paper is to present the existing situation of green construction in India and emphasize the key drivers and challenges faced by the Indian construction industry. This paper uses secondary data available upon findings of a workshop organized in New Delhi to assess the current state of green construction in India which was conducted through two sources; a survey and a facilitated brainstorming session. The data provides a prospect to evaluate practices in India in relation with international trends and provides a podium to assemble data on more experiential knowledge about green construction in India. Some of the major findings of this research paper are: there is an consciousness concerning green construction in India; It is principally motivated by the governmental and global set of laws; with the current energy crisis customers in India are actually eager to pay additional funds for going green; and there is a lack of accurate lifecycle cost assessment models which results in misconceptions about connected costs of going green. This paper depicts the present state of green construction in India. It also point out major challenges and drivers for implementation of concept of going green in construction industry in India. This research work can offer practitioners, regulators, and academicians's acquaintance about way to spotlight their future efforts in implementation of going green concept in Indian construction sector.

Keywords: India, Construction industry, Waste reduction, going green, lifecycle cost.

INTRODUCTION

An up to date testimony titled 'Buildings and Climate Change' unconfined by the United Nations (UN), declares that 30-40% of every single one of chief vigour is applied in edifices. With mounting worries on the subject of the environment and the fragmentary verve catastrophe, the conception of green building was urbanized. These buildings are premeditated, erected and activated to

encompass a least amount collision on the environment and intends at preserving power. Green buildings speed up the taking up of building run through that upshot in well-organized use of natural, sustainable and renewable possessions for housing and business-related construction. Further, it is a fraction of the wide-ranging metropolitan enlargement program equipped toward advancement of sustainable societies with sustainable urban infrastructure. This rehearsal is in addition attaining thrust as the commercial globe strategizes for amalgamating ecological apprehension into their manoeuvres in traditions that bring into line by means of nucleus industry stratagem, foundation- queue ambitions and communal residency. Enhanced atmosphere eminence and diminution in power statements would be momentous settlements increased by ordinary populace. Contemporary building rehearsals give you an idea about petite regard for power competence, environmental or societal bang of the built environment in excess of their complete life sequence. This haphazard employment of natural possessions places load on top of the ecological unit. Buildings insatiably devour natural assets, building construction generates enormous magnitudes of squander material and building procedures donate comprehensively to environmental contamination. Away from each other from this, underprivileged prototypes of building plans show the way to clogging and uneconomical employment of terra firma, consequential in superior power utilization, thrashing of yield, contaminated overflow to facade stream and wastewater management schemes, trouncing of farming lands, disjointed surroundings and economic strain to local neighbourhoods. In Buildings and environment transform, the United Nations Environment Program in recent times reported that on a global origin 30-40% of all principal energy is worn in buildings. That's why, it necessitates the all-encompassing computation of not simply construction, manoeuvres,

and preservation, however the contact of possessions augmentations above the building's productive subsistence and eradication and discarding afterward. As individuals countenance the blame of environmental impairment, leaders in the office block industry are cognisant about the necessity to see the sight solutions that are environmentally tuneful, resulting in proficient use of natural, sustainable and renewable possessions. This has heightened the requirement of the thought called Green Building. It is in addition known as sustainable building and proposes customs and methods to diminish and eradicate the collision of buildings on the environment and human wellbeing. They put prominence on taking advantage of the profit of recyclable resources, e.g., using sunrays through solar gears and photovoltaic modus operandi and using flora and plants in the path of green covering's, rainwater gardens, and for lessening of rain overflow. It in addition bring into play former run through like by means of packed gravel for parking lots in place of concrete or asphalt helps in enhancing replacement of earth streams. More Than 51% of the architects, engineers, contractors, owners anticipate that by 2015 almost 60% of their activities will be green.

India has rich customs, history and record in holistic stratagem for buildings and construction. Regardless of this the agenda of sustainable buildings at present receives limited attention in India. While there are very few confined projects which are upholding sustainable buildings which include research, advocacy projects, there these are not synchronized and harmonized to address the sustainable buildings agenda in India. In the last two decades green issues have gained considerable prominence. With the rise in depletion of non renewable resources and phenomenon like global warming affecting us, it is of the essence that we should adapt by making our infrastructure resilient. Major issues that fall under the "Going Green", philosophy are sustainability, environment, energy, waste minimization, etc. With initiatives like Kyoto Protocol, ISO 14000 the adaptation of the "Going Green" ideology is being regulated and incentivised. The major drivers behind adaptation to going green are: regulations; cost savings through reduction in energy costs and waste minimization; promotion of corporate green image; and corporate social responsibility.

Globally business sector is influenced by environmental concerns. Around 60 percent of world population is expected to be shifting towards urban areas by the year 2030 (Syal et al., 2006), as a result gigantic construction activity is taking place worldwide. In recent years India is undergoing major economic growth and as a result of this the construction activities have accelerated on a significant note. In India the current yearly venture in

construction sector is around \$70 billion with a recognised need for an additional \$50 billion and a proposed annual growth rate of 15 percent. It is estimated that ancillary infrastructure will need a venture of approximately \$163 billion over the next ten years (CIDC, 2004). With a scarcity of 41 million housing units to house the breathing population (Tiwari, 2001), construction activities of all kind are taking place at a vigorous pace.

However, with increased construction activities bring with it increased environmental anxiety. In developed countries where the advantages of going green are comprehensively acknowledged, and construction sector is encouraged to go green and promote sustainability, there is a lack of enthusiasm among companies to execute at corporate policy level to environmental concerns (Ofori, 1998, 2000). However, it would be appealing to extract the opinions of the Indian construction sector on the issue of green construction practices and analyze the challenges that can potentially restrain the adoption of sustainable practices in a growing economy. In order to achieve this objective secondary data has been used based upon a workshop which was organized in New Delhi, India in July 2008 accompanied by a survey, which had participants from the regulatory bodies, public and private construction companies, academics, and researchers from India. Regulatory bodies, private corporations, government agencies and ultimate consumers view concept of going green from dissimilar perspectives and use diverse sets of variables to choose the path of going green. In the supply chain of any construction project views of participating individuals are different, drivers are different and hence a view of these drivers for different stakeholders is important to understand how the philosophy of going green can be made successful and accepted.

The major objective's of this research paper is: (a) To study the present state of affairs of green construction in India. (b) To measure major drivers and challenges of adoption of going green philosophy in Indian construction industry. (c) To propose some recommendations and suggestions.

This paper has focused upon limited definition of going green related to issues like environmentally friendly, energy efficient and minimisation of waste in India.

To achieve the objectives of the study the paper is divided into following sections, Section 1 i.e the present section gives details aspects of green construction in India and environmental consciousness. Section 11 gives a brief snap shot of review of existing literature. Section 111 gives data and methodological issues. Section IV gives the

complete analysis of green construction state in India, its major objectives, drivers and recommendations.

REVIEW OF LITERATURE

The following section gives a comprehensive review of literature in India and across the globe. Faniran and Caban (1998) opined of strategies to minimize waste and its relative significance in context of waste developed from construction and demolition activities and the important sources of construction and demolition waste were last moment design changes, over ordering, poor weather, left over materials etc. Lawson *et al.* (2001) depicted the presence of guidelines for the classification of construction and demolition waste as contaminated or vice versa. Construction and Demolition waste can be contaminated either through spillage from industrial processes or concussion with contaminated land. The contamination of construction and demolition waste is a potential barrier to recycling and reuse of much of the construction and demolition waste. Treloar (2003) presented the exploration of the alliance between cost and combined energy savings from waste minimisation and recycling of construction and demolition waste. Availability of raw materials used in construction of residential buildings cause negative impact on environment. Laquatra (2004) presented the observance of weight and volume of debris produced at construction and demolition site and investigation of alternatives to landfill discard for each item in the waste stream, development of an awareness program for home builders based on project results. Dainty & Brooke (2004) opined about exploration of the waste minimisation strategies utilised in high profile construction projects and refinement of transferable framework measures capable of being transferred to other major projects. Kulatunga *et al.* (2006) expressed the identification of attitude and preconceived notions of workforce in construction and demolition waste management practices in construction industry. The attitudes and perceptions of workforce can dominate the effective formation and implementation of waste management strategies. Branco (2007) depicted an investigation on the incidence of residential construction waste in Texas. Construction and Demolition waste has proved to have a negative effect on the economic health of construction companies and on the environment. Papu *et al.* (2007) expressed that "MSW generated in Indian cities at present was eight times as compared to situation in 1947. In India about 960 million tonnes of solid waste was being generated and construction waste accounts for 14.5% of total waste. The expected rise in per capita amount of Municipal Solid Waste was 1.33% p.a. manufacturing of various construction materials caused decomposition of calcium carbonate, lime and cement manufacturing, high concentrated carbon

monoxide, oxides of nitrogen and sulphur in to the atmosphere. W.Y Tam *et al.* (2007) presented the screening of the effectiveness of government's regulatory measures in spreading the concept of construction waste management. Arif *et al.* (2009) depicted critical analysis of green practices in construction sector's supply chain, room to cover (issues, challenges, success determinants, research factors) in green practices in overall supply chain in Indian construction industry, engagement of people in the alliance of organisations and institutions with in supply chain, sharing of experience and learning from others involved in the process. Yousiff (2010) opined of minimization of waste at construction site by recycling of construction and demolition waste. Jeffrey (2011) expressed a comprehensive overview of current methods for reusing and recycling construction and demolition (C&D) waste materials in Europe and North America. Construction and demolition practices are also examined along with policies and legislation influencing construction and demolition waste management. Papargyropoulou *et al.* (2011) expressed the industry's appetite and commitment to sustainable waste management and ultimately guide the future development of a framework for the management of construction and demolition wastes in Malaysia. Yuan *et al.* (2011) expressed the identification of the major hindrances that blocked improvement in construction and demolition waste management in China. Arif *et al.* (2012) opined of incorporation of waste management practices in construction and demolition projects in India and major barriers in implementation of these practices and development in waste and project management practices respectively for better results. Jain (2012) opined of relationship of construction and demolition waste generation and its management with national as well as global economic growth and spotlighted issues like- lack of awareness regarding construction and demolition waste management, practices in Indian construction industry and evaluation of economic feasibility of construction waste management (3R -: reduce, recycle and reuse). Muhwezi *et al.* (2012) expressed the identification of the major attributes of construction wastes on building projects in Uganda and to propose the possible measures of minimizing their occurrences.

DATA AND METHODOLOGY

This paper uses secondary data available in journals, reports and government sources; the data provides a prospect to evaluate practices in India in relation with international trends and provides a podium to assemble data on more experiential knowledge about green construction in India.

ANALYSIS AND INTERPRETATIONS

The following section gives a detailed analysis of state of green construction in India, major drivers and challenges of adoption of going green philosophy in Indian construction industry along with certain recommendations and suggestions.

Present State of Green Construction in India

India being a seventh ubiquitous nation state of the sphere is also a most important economic system and residence place of more than one billion individuals breathing in a variety of climatic regions. The nation's economy has been on the increase at a swift velocity eternally from the time when the progression of financial modifications took place in 1991. The green building interest group in the realm organized by Confederation of Indian Industry (CII) is attaining thrust by means of innovative venture's are being sanctioned underneath the Leadership in Energy and Environmental Design (LEED) rating structure, the mainstream extensively acknowledged yardstick for green buildings the planet over. Construction plays an exceptionally imperative function in its financial system donating on an average 6.5% of the Gross Domestic Product. Mercantile and suburban sectors prolong to be a key marketplace for the construction sector. The segments devour a bundle of vigour right the way through the verve cycle of buildings consequently happen to be a foremost provider to greenhouse gas emanations.

Given the constantly mounting town expansion, the number of buildings, energy exploitation and the momentous carbon secretion's is on a rise in the country. Vigour utilization in Indian buildings is probably to supplement substantially owing to economic advancement, building increase and human being development. The prerequisite for energy to sprint appliances such as TVs, air conditioning and heating units, refrigerators and mobile handset chargers will boost substantially as livelihood standards go up and about in India. In addition the augmentation in business-related sector and the budge from rural to urban living will persist to take position. That will consequence in a considerable boost in follow-on emissions from the buildings subdivision alone and necessitates concerted efforts to bring downhill the energy spending by buildings through an assortment of measures.

The country has a numeral of strategy initiatives to conventional energy effectiveness and green buildings as straight and authoritarian instruments, including machine standards, obligatory labelling and certification, energy competence obligations, and usefulness DSM(Demand side management) programs; fiscal and market-based instruments; fiscal instruments and incentives; hold up, information and

charitable action. Numerals of these are momentarily put in plain words in the following section:

(a) Energy Conservation Building Code 2007- The Energy Conservation Act 2001 makes available for the organization of state energy conservation societies to map and implement programs. The Act led to the configuration of Bureau of Energy Efficiency (BEE) that formulates the Energy Conservation Building Code (ECBC). It targets building vigour effectiveness and was initiated in the year 2007. This is the nation's initial building energy code and aspires to have a chief collision on energy-efficiency in buildings. It is a charitable cipher for all buildings with a associated load of 500 KW and on the whole likely to be converted into a compulsory code. It covers bare minimum obligations for building envelope presentation as well as for automatic systems and gears, including heating, airing and air conditioning (HVAC) system, core and outer lighting system, service boiling water, electrical power and motors in direction to achieve energy efficiency in diverse climatic sectors of India. (b) The Ministry of Environment and Forests (MoEF), Environmental Impact Assessment (EIA) and Clearance. This is a obligatory prerequisite for all buildings with a built up area above 20,000 sq. m and such projects have to be appraised by the MoEF's Environmental Appraisal Committees (EACs) and the State Environmental Appraisal Committees (SEACs). (c) The Ministry of New and Renewable Energy has commenced several programs focusing on the exploitation of renewable energy sources in buildings.

Sustainable Habitat Mission under the National Action Plan on Climate Change National Action Plan on Climate change was initiated by the honourable Prime Minister, Dr. Manmohan Singh on June 30, 2008. It includes a broad and wide-ranging series of measures, and focuses on eight assignments, which will be followed as key elements of the policy for sustainable growth. These consist of missions on stellar energy, improved energy efficiency, sustainable locale, conserving water, sustaining the Himalayan bionetwork, creating a "Green India," sustainable husbandry and, finally, establishing a strategic acquaintance platform for climate alteration. For the environment mission, the strategies projected endeavour at promoting efficiency in residential and commercial sector through various measures such as, modification in building bye laws, aptitude building, research and development in new technologies, learning and awareness, etc., administration of municipal solid wastes, and endorsement of urban public transportation.

Major Drivers of Green Construction in India

There are many different factors driving future green building activity, and they vary around the world and the firm type. In order to encourage future green building adoption, professionals need to take these factors into consideration and tailor conversations appropriately.

Changes over time

The focus on market transformation indicates that those doing green were driven primarily by an idealistic desire to have a positive impact. However green building is increasingly seen as business opportunity. Client demand and market demand have become dominant forces in the market. It is clear that market is motivated by those who consider low operating cost. This shift is supported by looking at the difference between those firms that are heavily involved in green work i.e. doing 60% of their projects following green ideology compared to those that are not doing any green work

Social and environmental reasons for going green

Improved health and productivity benefits are driving green building more today as compared to past years. Across the world these are the top two most important social reasons to build green. Though energy savings are by far the most critical environmental reasons i.e. water use reduction; lower green house gas emissions; natural resource conservation etc for building green.

Firms are expecting green building to yield financial business benefits

There are a number of benefits reported by those engaged in green building i.e. both for new green buildings as well as greening of existing buildings through retrofits & renovation projects. With these expected benefits, measuring the success of green building investments will become increasingly important particularly to the investment community. Despite this need majority of the firms are not using any metric to track performance. This is a critical gap and a need that the construction industry should address in future.

Poverty

It is a major obstacle to implementation of green principles. Quite often people, despite knowing about the savings over the life cycle, are not able to afford the additional upfront costs of implementation. This practice results in buying cheaper goods and services, which tend to be less environmentally friendly.

Low level of research and development

Low level of research and development in greener issues is low, and the technology transfer from other

countries that have investigated these issues extensively is slow. More needs to be done in this area.

Cultural deterioration

“We keep the inside of the house clean but we don’t think that way for the surrounding.” Therefore, a fundamental cultural shift is needed to address this issue. On the other hand older religious activities-involved use of trees, and respect for the environment was part of the culture. Respect for trees and the environment formed part of rituals for several Indian religions. However, people have somehow lost sight of that respect for trees and the environment in their day-to-day practice.

MAJOR CHALLENGES ASSOCIATED WITH GREEN CONSTRUCTION IN INDIA

Green buildings may be seen as cornerstone of global strategies to address global warming. But, this approach is being perceived as new and unusual and people tend to be suspicious of new things. Building projects are by and large financed by external lenders, who do not differentiate between green building and conventional construction. Their indifference could be ascribed to their inadequate knowledge to determine the value of green buildings. Although, building designers and specialists are likely to be the most informed group about this approach, yet there is still widespread misinformation in this sector. Hence there is lot of uncertainty over costs, economic benefits, reliability and building performance of green building technologies. The resolution of this issue can be achieved through education of design professionals so that they understand the importance of design team performance coupled with an emphasis on the expertise of design team members. Therefore, it is incumbent upon the construction industry invested in going green to help more effectively make the business case for the market. This will require better measures and performance tracking, and building operators will need to become involved and educated on green so, that they can maximize the performance of green buildings, since even the greenest buildings can only yield results if it is operated and maintained efficiently. Some notable results are -

Insufficient regulations

The importance of complete governmental regulations for supporting construction and demolition waste management has been extensively investigated. For example, although the Hong Kong government has implemented various types of regulations to minimize construction and demolition waste production, it is found by Tam (2008) that the mandatory system in implementing the waste management plan for all construction projects would

significant affect the productivity of companies. This is echoed by the study from Shen and Tam (2002), suggesting that legal measures are not effective for implementing environmental management in Hong Kong construction. In all the regulations in Bulgaria, construction and demolition waste is mentioned jointly with municipal waste and the majority of measures envisaged are aimed at the improvement of municipal waste management (Hadjieva-Zaharieva *et al.*, 2003). It is also reported by Kartam *et al.* (2004) that clear regulations and rules from Kuwait Municipality are lacking for allowing and persuading contractors to use recycled products made from construction and demolition waste.

Lack of a well-developed waste recycling market

One of the most important factors in the recycling of construction and demolition waste is the availability of markets for receiving the recycled product (Mills *et al.*, 1999). Peng *et al.* (1997) also stated that recycling requires an antagonistic marketing effort to position markets and sell materials at the highest possible prices. A rather low level of market development indicates that considerable time and money must be invested in establishing relationships, keeping track of pricing changes and becoming a reliable supplier of materials, in order to ensure a continuous intake of construction materials. Therefore, lack of a well-developed waste recycling market will to a large extent hinder the effective implementation of waste recycling.

Insufficient awareness about construction and demolition waste management

Although practitioners' awareness about construction and demolition waste management is vitally important to effective waste management, waste management is perceived as a low project priority (Teo and Loosemore, 2001). Consequences caused by the weak awareness of major practitioners have been extensively investigated. Innes (2004) and Poon *et al.* (2004), for example, found that about one-third of construction waste could arise from design decisions because designers attached relatively little importance to the potential for waste reduction when choosing building materials. Lam (1997) found that very few contractors had exhausted efforts in considering the environment and developing the notion of recycling building materials. Because contractors ranked timing as their top priority, their effort was always focused on completing the project in the unswerving time, to a certain extent than the environment (Poon *et al.*, 2001). Therefore, changing practitioners' awareness of construction and demolition waste management can make a significant contribution to the implementation of construction and demolition waste management (Teo and Loosemore, 2001).

Inadequate economic incentive

Many industry practitioners were reluctant to join the activity of embracing waste minimization simply because it meant higher costs (Mills *et al.*, 1999). According to Chen *et al.* (2002), rewarding and penalizing methods in regard to on-site material handling can be used to effectively stimulate practitioners' efforts to minimize waste on-site. This is supported by Osmani *et al.* (2008), who found that financial reward was perceived as a key incentive that could drive waste reduction during the design process.

Poor skills of operatives

Skill is one of the main factors affecting the amounts of waste produced by operatives (Chen *et al.*, 2002). Significant amount of construction and demolition waste caused by various construction activities, such as cut-corner of construction formwork, poor plastering work, deformation during transportation and delivering, could be largely reduced if skills of operatives can be improved (Wang *et al.*, 2004). Clearly, poor skill of the operative is a significant contributor to the large amount of construction and demolition waste generation.

RECOMMENDATIONS AND SUGGESTIONS

The secure and financially viable management of construction and demolition waste has been an unrealized opportunity for numerous years. Regardless of the widespread sagacity value in reducing, reusing, and recycling construction and demolition waste, the barricade's to implementing waste management procedure's have been a expedient justification to continuing the conventional practices of burning and land filling. On the other hand, waste management system may also have its boundaries. Proper market for recycling and reusing of waste will require an aggressive marketing endeavour to position markets to put up for sale waste material to be recycled and then processed recycled material to be sold at appropriate prices. At present, low level of market development means that significant time and cash must be devoted in establishing associations, keeping pathway of pricing changes and fetching a trustworthy supplier of materials, in a bid to make certain a continuous ingestion of construction waste materials. The worker also has to locate and develop relationships with demolition and general contractors with ventures in the region to promote their construction recycling trade as the dumping option of alternative for the contractors. **Construction and Demolition Waste Management Plan should lecture to the following aspects of the Project:** (a) Analysis of the waste arising/material surpluses; (b) Specific waste management objectives for the project; (c) Methods

proposed for prevention, reuse and recycling of wastes; (d) Material handling procedures; and (e) Proposals for education of workforce and plan diffusion programme. (f) Construction & Demolition Waste Management Plans need not to be complex documents and should focus on those reasonable measures that can be engaged to perk up the management of construction and demolition waste within projects. (g) They can also be made available as a reserve to contractors and subcontractors who may have been required by both specification and contractual requirements to get ready Construction & Demolition Waste Management Plans. (h) Designers and Developers shall have gaze at the parliamentary prerequisites in terms of waste permits. (i) The effectiveness of the construction and demolition Waste Management ideology and its implementation should be trailed through customary checks and audits approved out on site, which should centre on material contributions to the project and the waste outputs for each element of plan. (j) The audits should also investigate into the operational factors and management policies that contribute to the generation of waste and recognize appropriate corrective actions. (k) It is indispensable that reassessment of waste management practices should take place all the way through each stage of the project. (l) The construction & demolition waste management plan should article proposals for the management of C&D waste in a few words as possible. For simplicity, C&D Waste Management Plan should be prearranged methodically.

SUMMARY AND CONCLUSIONS

This piece of writing is an attempt to identify the various sources of construction and demolition waste to develop the strategies for reduction in wastes and tries to eliminate the hindrances that can slow down the pace of improvement in reduction of construction and demolition waste strategies. Socially it would be a great help for the strategists and policy makers to know the ground realities of implementing green construction concept that is still in its infancy in India. The results would also help deepen industry practitioners' understanding about these ground realities of construction and demolition waste management in India to enable them to develop policies to be designed on the desired lines so that construction and demolition waste management practices can be implemented smoothly to reap their full potential.

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