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Selection framework for evaluating housing technologies

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Abstract

Recent survey by KPMG specifies that there is a requirement of 11 crore housing units to be built by 2022 in India. This leads to adoption of innovative technologies which have to be looked upon from the point of affordability as well as sustainability. As the Indian housing value chain is very complex, a plethora of factors and issues need to be addressed in this regard. Emerging technologies for building up the housing requirement are to be selected based on number of attributes. A scientific, holistic and transparent evaluation framework is not available to decide the appropriate technology. This paper highlights the evaluation framework consisting of mandatory attributes and preferred attributes, based on which the emerging housing technologies are selected for adoption. This framework is analyzed for two case studies to check the applicability.

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1. Introduction

In the recent years, enormous advancement of construction technology, from traditional site-based methods to a “*more dynamic combination of methods*” [1], has given new possibilities for residential construction. As per Berge’ 2009, a large number of innovative alternate building materials and low cost construction techniques have been developed through intensive research and development efforts during last four decades. The evidence of such an evolution of global housing-construction philosophy can be seen in the increasing growth of prefabricated house building in Japan [2]; off-site fabricated housing in Germany [3]; industrialized building in Malaysia [4]; off-site manufacture in Australia [5] and prefabricated high-rise structures in Hong Kong [6] [7].

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Coming to India, a large population base, rising income level and rapid urbanization has made housing industry a booming sector Indian Economy. According to the Ministry of Housing and Urban Poverty Alleviation (MHUPA) in 2012 “*there were 18.78 million units housing units short in urban India; nearly 95% of this shortfall was in the economically weaker sections (EWS) and low income group (LIG) housing*”. To meet the huge demand of affordable and sustainable housing, the sector must use these technologies. But selection of the most appropriate one among these emerging technologies is a complex process and depends upon many factors like cost and time certainty, speed of construction, energy efficiency, effectiveness in the use of materials, design flexibility, future maintenance requirements and performance throughout the housing life-cycle, customer satisfaction and acceptance, compliance with building regulation etc. It becomes difficult to make a decision considering so many qualitative and quantitative factors in tandem. Also, a decision maker’s preference needs to be taken into consideration while assessing these materials, for instance, low cost of a material may be most preferred by a person but may not be by another. Apart from this there are challenges like deficiency of local knowledge about appropriate housing design and current construction practices, non-availability of specialized training to apprise the selection of housing technology, imported housing technologies and materials consume high energy for better conditions, causing cost overrun and imbalance in environment. Repair and maintenance works disturb the quality of the habitat and damage the architectural integrity, building materials and skilled labour are in short supply, leading to inflated prices. Thus there arises a need for the development of a standard framework considering all the attributes which will aid the practitioners in decision making regarding emerging technologies of housing construction.

Objective: The goal of this research is to develop a multi-criteria evaluation framework for the emerging systems and technologies of residential construction. In order to accomplish the afore-said goal following research objectives have been set:

- Identification and understanding of the issues and attributes of the emerging housing systems and technologies that affect, both positively and negatively, decisions to utilize them in residential construction
- Selection of appropriate decision making tool capable of processing both qualitative and quantitative information on the emerging housing systems and technologies to be evaluated
- Design of the evaluation framework for emerging housing systems and technologies based on the information and knowledge acquired in the previous steps

2. Research Methodology

The development of the holistic evaluation framework proposed in this research will be multi-step process. These steps are as follows:

- **Identification of attributes for the emerging housing systems and technologies under consideration:** Different attributes pertaining to emerging housing systems and technologies are identified in this context and ensured that all the parameters are listed in a systematic way for building evaluation framework. All the identified attributes are broadly classified into two categories, namely “Mandatory Attributes” and “Preferred & Desired Attributes” which are then further classified into secondary and tertiary attributes
- **Definition and criteria for the identified attributes:** All primary, secondary and tertiary level attributes are defined along with their respective evaluation criteria.
- **Review of the attributes by the Technical Advisory Group (TAG):** Attributes along with definitions identified in the above step are presented to the TAG for review and finalization. All the improvements, additions, and revisions suggested by the TAG are incorporated in the list of attributes.
- **Collection of expert opinions:** Attributes reviewed by the TAG are then presented to industry-experts with more than 20 years of experience in housing sector, for their comments.
- **Finalization of Attributes:** The final attribute list is finalized after incorporating the improvements and modifications suggested by the experts.
- **Development of Evaluation Frameworks:** It is essential for any housing technology to fulfil each and every selection criteria enlisted under “Mandatory Attributes”, so in the process of decision making all the mandatory

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