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Abstract

As housing demand in India is continuously growing, different government schemes are being implemented to cater to the need of mass housing for the poor and lower income group people. Use of appropriate Cost-effective Eco-friendly Construction Technologies (CECT) in housing sector in India has the potential to be the most appropriate in terms of economy and acceptability. The reduced cost of building, enhancement of comfort level and non-compromise on safety may establish appropriateness of CECT, which will also act as a market force and demand for such technologies is expected to grow-up. Previously the appropriateness of CECT in Indian context ZDV QHYHU H[SORUHG 7KLV SDSHU VWXGLHG WKH DFFHSWDELOLW\ DQG DGDSWD VXUYH\ OLWHUDWXUH VWXG\ DQG WHFKQLFDO FDOFXODWLRQV DQG WULHG WR ¿

Indian Housing Scenario; Cost-E ective Eco-Friendly Construction Technology; Safety; Comfort; Acceptability; Adaptability

In order to meet growing demand of housing, government of India has planned to provide shelter for every shelter-less people and also to build disaster-resistant housing in rural and urban areas. Di erent government schemes of mass housing are being implemented to cater to the need of housing. In India the buildings constructed under mass housing schemes are all low-energy buildings.

As per the Census reports of India and other reports by di erent Government Departments, the house types are gradually transforming to Permanent ("Pucca" Houses – in which the walls and roof of which are made of permanent material) and Semi Permanent ("Semi Pucca Houses" – in which either the walls or the roof is made of permanent material) types from Temporary ("Kutcha Houses" - in which both the walls and roof are made of materials that needs to be replaced frequently) in both rural and urban areas. "Report of Technical Group on Urban Housing Shortage (TG-12) (2012-2017)" prepared by the National Building Organisation of India (2012) is the latest document available in this subject which have thoroughly investigated through primary survey, the rural to urban shi of labour resulting in shortage of dwelling houses in urban areas of India – particularly in the Lower Income Group (LIG) and Economically Weaker Section (EWS) segment. Dra prepared in 2012 by the Working Group on Rural Housing for XII Five Year Plan, 2011, Ministry of Rural Development, Govt. of India, has provided a detailed study and analysis on housing shortage in rural areas. Need of introduction and use of eco-friendly and cost-e ective housing technologies were included in the document under clause 5.3.1(iii).

Indira Awaas Yojna – one of the agship rural housing schemes, was launched in 1985-86 and guidelines were revised time-to-time with the latest issued in 2012. In its introduction, the objective of the scheme was stated as "upgradation of unserviceable kutcha houses". In the same chapter emphasis was given on "use of cost a ective, disaster resistant and environment friendly technologies in rural housing".

e following gures may be taken into consideration to assess housing shortage in India during its 12th Five Year Plan (2012-2017):

(i) Housing shortage in Urban Areas as assessed by Technical Group on Urban Housing Shortage of National Building Organization-18.78 million units of which 95.62% i.e. 17.96 millions belongs to Economically Weaker section and Low Income Group families.

(ii) Housing shortage in Rural Areas as assessed by Working Group on Rural Housing, Ministry of Rural Development, Govt. of India for the 12th Five Year Plan-48.81 million units of which 90% i.e. 43.93 million belongs to Below Poverty Level families.

e trend of conversion from Temporary to Permanent or Semi-Permanent structures is likely to continue in view of economic upli ment of common people and di erent government schemes on providing durable shelters to people of economically weaker section

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that that buildings will be built with masonry wall and R.C.C. roof to ensure durability, ful ll peoples' perception and meet with the provisions in the Indian Standard Codes.

Use of Cost-e ective Eco-friendly Construction Technologies (CECT) to construct safe, durable, comfortable houses can bring down

durable and poor man's material, (b) technical and scienti c expertise for this technology is not easily available, (c) composition and strength of production of CSEB varies on location, type of available earth and type of stabilisers, thus making it di cult to convince common people and local artisans.

Bamboo-reinforced Cement Concrete (BRCC) has also been considered as a low-cost building material, but its use is very much limited to the bamboo-producing zones of the country and where trained personnel are available for such technology. Zackirson [7] have worked with BRCC as a cheap and energy-e cient building material. Bamboo should be treated immediately when cut at the bamboo grove. ere are tendencies to develop crack along cleavage due to low strength along bres of bamboo and also strength varies from species to species. e alkaline property of concrete may also have adverse e ect on bamboos embedded in concrete. However, cost e ectiveness, eco-

warmth from sunlight and kept closed between 5 P.M. to 7 A.M. to reduce loss of heat from inside of the room and protect the interior from rapid cooling. To coincide with the practice, it would be appropriate to construct the buildings with such materials or technologies which are capable of reducing convection of heat through building envelop [13].

Heat transferred through per square meter of 0.25 m thick rat-trap bond masonry walls in still air condition and for a temperature di erence of 5 degree is approx. 5.93 W (Appendix 3) compared to that of a solid 0.25 m thick masonry wall as 13.84 W (Appendix 4). In Rat-trap bond the air gap between the two wythes of bricks provide the necessary barrier for heat transfer. Similarly it can be calculated that heat transferred through per square meter of 0.11 m thick R.C.C. ller slab in still air condition and for a temperature di erence of 5 degree is approximately 16.50 W and that for a solid 0.11 m thick R.C.C. slab is approx. 25.91 W. is is due to the two layers of clay tiles at the bottom of the slab and the air gap between them [14].

ese properties of rat-trap bond wall and ller slab result in reduction of heat ow through the wall surface and roof and thus ensure more comfort for the inhabitants and reduction in use of air circulators or air coolers during summer time and heating requirements during winter.

From the above study and analysis it can be concluded that Rat-trap bond wall and Filler Slab roof would be the most appropriate and acceptable CECT among people belonging to

Middle Income Group and below in India as they are satisfying all their guiding criteria and capable of providing the following advantages:

(i) Use of locally available traditional materials and can be used by local artisans,

(ii) uch cheaper than presently-followed type of construction of permanent buildings,

(iii) Safe as per Indian Standards,

(iv) Comfortable in all weather, and

(v) Aesthetically pleasant.

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