Precast Plank and Joist roof

Figure 01: Plank and Joist roof

Overview

Plank and joist roof is a building system in which precast reinforced cement concrete planks (rectangular slab elements) of size 300mm x 1500mm, are placed on precast RCC joists. The roof gets completed with in-situ concrete poured over the haunch space between adjacent rows of planks and over the partially precast joists, thus ensuring monolithic action of individual precast elements. A joist of cross section 150mm x 150mm can be used up to a span 4 metres. Due to the modular nature of the system, the room dimensions are in multiples of the plank size.

The roofing system has been found to be economical in low-rise construction of EWS housing for industrial workers in Bawana, NCR. It saves about 14% steel, 27% concrete and 20% saving in overall costing of the roof, besides saving in time. The scale of the system lends itself well to on-site manufacturing, thereby leading to additional job creation. The system has been technically validated and promoted as a cost effective roofing alternative by the BMTPC.

CATEGORY	ATTRIBUTE	INPUT	SOURCE
Resource Efficiency	**Embodied energy CO_2 emission**	EE: 327.7 MJ/ m^2 ; CO_2 Emission: 84.3 $kgCO_2$ / m^2 (Values for 110mm thickness in M20 CC)	*Source: Calculations based on material specifications. Kishore, Naveen & S. Chouhan, J. (2014). Embodied Energy Assessment and Comparisons for a Residential Building Using Conventional and Alternative Materials in Indian Context. Journal of The Institution of Engineers (India)*
	Critical Resource Use	36.3	*Source: Calculated critical use index (0-100)*
	Current Recycled content	Nil	*No use of any recycled material/ industrial waste in production and construction*
	Future reusability	Low. High generation of C&D waste	
	Water use during construction and manufacturing	308.7 L/m^2	*Source: Source: Calculated from material specifications*

Operational performance	**Durability**	High – comparable to in-situ RCC	
	Ease and frequency of maintenance	Low frequency of maintenance– comparable to in-situ RCC slab	
	Impact on cooling or heating loads	Cooling energy (kWh/m^2/y) savings under different climatic zones Composite: 3.61 (7%) Warm & humid: 3.82 (9%) Hot & dry: 3.55 (8%) Temperate: 2.37 (16%) Heating energy savings in cold climate: 3.59 (8%)	*Source: Based on simulations. Values in savings from base case: 100mm RCC + 100mm lime concrete roofing.*
	Noise transmission	*No data available*	
	Thermal mass (absorption, storage and release of heat)	187.8 kg/m^2;	*Source: Milan Ostry, Pavel Charvat, Materials for Advanced Heat Storage in buildings, 2013*
	Thermal performance (flow of heat)	U-value: 2 W/m^2K for a 60mm thick RC plank in assembly with 40mm creed.	*Source: BMTPC publication- Case study for Bawana Industrial Workers Housing project, Data provided by Adlakha Associates Pvt.Ltd.*
User Experience	**Familiarity with the material**	Low	
	Modification ability	Low: not modifiable	
Economic impact	**Construction cost**	INR 1014/m^2	*Source: Calculations based on inputs from Adlakha Associates*
	Skill requirement	Medium for production and construction (24.7%)	*Source: Calculations based on inputs from Adlakha Associates*
	Supply chain	On-site production on a project basis	
	Duration of Construction	Casting of precast plank and joist slab is more than 2 times faster than conventional RCC slab	*Source: Demonstrating Cost Effective Technologies - A Case Study of Bawana Industrial Workers Housing Project,* BMTPC Publication
	Job creation	1.5 man-days/m^2	*Source: Calculations based on inputs from Adlakha Associates*