



Review on Reducing the Construction Time using different techniques utilizing waste materials

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Introduction

Many techniques have been discovered keeping in mind the importance of time and sustainable development. These techniques include 3D-printing in construction industry, Precast and Prefabrication, Structural Stay IN Place Structures and Building Information Modelling (BIM). The objective is to reduce the construction time while using waste material or reusing materials wherever possible. This paper reviews various researches done on constructing various structural components with these techniques.

In 3D printing, the printer takes instruction from CAD model to construct a 3D structure in considerably less time while performing miscellaneous functions automatically like reinforcements, aesthetic work like tiling of floors and walls and painting, plumbing, electrical and communications line wiring, etc. Precast and Prefabrication is a technique in which various components of a building are constructed individually in a controlled environment and then placed together on site to obtain the building. Structural Stay-In-Place structure (SIP) is a formwork which is not removed even after concrete has been cast and eliminates the need of reinforcement. Building Information Modelling, BIM is a technology which looks after the building construction management and takes account of every bit of information starting from construction planning to the post construction management. BIM also contains information regarding material, equipment, resource, and manufacturing data. Besides taking information and processing it, it can also track and monitor the construction site (Tay & Panda, 2017). All the mentioned technique aims to decrease construction time.

Literature Review

There has been an often mention of integrating BIM and 3D printing for optimise results (Tay & Panda, 2017). Tumminia studied (Tumminia et al. 2018) environmental impacts of precast and also mentioned that the various components of precast can be dismantled and reused. Radan Tomek focused on various advantages of precast technique especially in bridge construction (Tomek, 2017) stating that it will result in less maintenance cost. Wozniak performed experiments and thus suggested Strain Hardening Cement Composite (SHCC) SiP is better than traditional Steel SiP, also SHCC is mainly made up of glass fibres(that can be used recycled from the waste) (Wozniak et al., 2017). Another similar research on bonding between concrete and fibre reinforced polymers (FRP) SiP has been carried out (Goyal, Mukherjee, & Goyal, 2016). It is possible to create SiP elements using PVC like panels, connectors and bracing. Noran Wahab studied the flexural behaviour of concrete walls made using PVC SiP (Wahab & Soudki, 2013) and proved that PVC has improved ductility of wall system. Review papers written on BIM majorly focus on integrating it with other mentioned techniques.

Review Analysis

Although it is mentioned in every paper that these techniques are implemented to accelerate construction time, still there was no experiment conducted to determine how much time these techniques (precast and SIP) will save if implemented. Similarly, even though China constructed two-storey villa using 3D printing claiming that it can withstand an earthquake up to 8-Richter Scale, there has been no

Table 1: Contribution of various techniques towards sustainable growth

Technique	Paper	Contribution / Deductions
3 D printing	(Khoshnevis, 2003)	Speed : <2days for 200m ² double storey house Waste : no emission as equipment is electric, even consume waste generated
	(Perkins,2015)	Speed : Sq foot of wall will take 2 hours, whole room in a day, 200 sq m single storey building in a day
Precast	(Tomek, 2017),	Speed : increases speed by 2 to 3 times when compared to cast-in-situ
	(Tumminia, et al., 2018)	Environmental impact : less primary energy consumption during the Use-Stage of prefabricated house module compared on the basis of global energy requirement (GER)
Stay-In-Place	(Wozniak 2017)	Waste usage : glass waste can be used in preparing SHCC (Strain Hardening Cement Composite)
	(Wahab ,2013)	Waste usage : PVC waste can be utilized.
Building Information Modelling (BIM)	(Tay & Panda, 2017)	Waste management : since it can foresee various factors, thus can prevent waste of extra raw material and can save time

experimental research done on seismic properties of 3D printed structures. The table no.1 shows the contribution of various researches towards sustainable growth. The techniques also follow the 4Rs strategy. Prefabricated elements can easily be reused. Recycled glass waste and plastic waste can be adopted at various steps while implementing SIP. 3D printing reduces the wastage of raw material and it also provides the option to recover the wasted raw material.

Conclusion

As discussed, these techniques are capable of reducing construction time and it also utilizes waste up to some extent, increasing sustainable growth. Techniques like 3D printing produce very less negative impact on environment. Prefabricated module has proved to use comparatively less primary energy in the Use-Stage and has the potential to be used again; innovative Stay-In-Place structures made of SHCC and PVC can be used to utilize tons of waste whilst increasing speed and BIM can also save wastage of material and can speed up the process due to its decision-making property.

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