



International Conference on Sustainable Materials Processing and Manufacturing, SMPM 2017,  
23-25 January 2017, Kruger National Park

## Sustainability of Tilt-up Construction Method

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### Abstract

Tilt-up system has been used for years in developed and some developing countries resulting in good performance of construction projects. The system has been used majorly for industrial and warehouse buildings but it has been adapted for general building constructions in the quest for sustainable buildings. This study therefore examine advantages of Tilt-up system with a view to enhance construction sustainability. Pamphlets of main Tilt-up construction companies around the world were reviewed in conjunction with other relevant research materials in order to obtain necessary factors for the study. Using these variables, data were collected through questionnaires administered on construction professionals using 5-point Likert scale. Mean item score and standard deviation were employed in ranking the variables and the findings revealed that Tilt-up method is viable in South African construction industry. It will ensure end user satisfaction, less project duration, minimal maintenance costs and construction quality improvement. This will be achieved through minimal material wastage and less time for project construction. Government agencies as well as construction stakeholders should therefore fully implement Tilt-up method in public tenders as a method of construction, especially for schools and low cost housing projects, for greater benefits of achieving economic, social and environmental sustainable projects.

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Peer-review under responsibility of the organizing committee of SMPM 2017

*Keywords:* Conventional construction method, Construction process, Construction resources, Housing, Sustainable construction, Tilt-up.

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### 1. Introduction

Construction is forever evolving in its building techniques and material but brick, mortar and steel seem to be major raw materials for ages. Tilt-up system is the use of pre-cast concrete panels as walls and floors members

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joined permanently in various ways to create a whole structure [1]. [2] defined Tilt-up panel as an on-site or off-site flat concrete panel cast in horizontal position, initially lifted by rotation of one edge until in a vertical or near-vertical position, transported, lifted and placed into position and stabilized by bracing members until incorporated into the final structure.

This system dates back to 1893 when it was used by Hunter Aiken at Camp Logan, IL located north of the town of Zion [3]. The largest Tilt-up construction in square meters in the world is in South Africa which is a mall in Kwa Zulu Natal named Gateway [4]. The country, a developing nation, has a large construction sector with a lot of potential. However, a lot of structures need to be built in order to meet up with the infrastructure demand of the growing nation meeting world standards.

The nature of construction project delivery has changed in recent past with more project owners requesting shorter time and indication of actual project cost at the initial stage of project. For example, the construction of the 2010 soccer stadiums were thought of after the hosting right announcement made in 2004. Most of them were finished in the dying moments leading to opening ceremony of the event which could have been a disaster. This is a typical example of how some of the existing construction methods are becoming inefficient to deliver projects to required time. Tilt-up has been described as an efficient method to meet realistic deadline.

Tilt-Up offers a more economical and durable solution than competing building methods [4]. This system uses green orientated construction as its components can be recycled and places no harm to nature's wellbeing. The motivation for this research is to examine Tilt-up method as a sustainable development option with a view to aiding faster construction that are durable, environmentally friendly, long lasting and low in maintenance.

## 2. Literature Review

### 2.1. History of Tilt-up construction system

Pouring and casting of concrete before lifting them into place is not a new idea. Evidence shows the existence of this method during the Roma Empire and Middle Ages [5]. More recently, American settlers in the 1800s gathered for "barn raisings" where wood walls was constructed for their buildings and tipped them up into place. The inception of such a construction method gave rise to further innovations and as a result, the 20th century marked a significance use of Tilt-up system leading to greater awareness and advancement in the application of the system. [6] noted that the advancement of the system lead to the insertion of reinforcement bars in the casting of the building which allowed builders to have bigger and stronger buildings that can resist adverse weather and ensure stability. Such a break through lead to the growth and public trust of this construction method as it had addressed concerns relating to safety of people and durability to withstand high pressures of weather.

Over the years, [7] observed that industry experts have continued to refine and innovate the Tilt-up process, allowing builders, contractors and design-build construction managers to drive creativity and greater capabilities in its use. In 1986 the Tilt-up Concrete Association (TCA) was created to establish processes and standards to ensure continued growth in quality and acceptance for the method of construction [8].

### 2.2. Tilt-up and sustainable construction

Tilt-up system enhances faster delivery of projects which is rarely matched by any other construction method available [9]. The faster a project is completed, the quicker the contractor can move on and occupy other construction sites yielding higher yearly profits. The system of casting on site make this system very cost effective as it eliminates the cost of transportation and unnecessary waste. It is pre-casted in a factory and not constrained in panel size as those that are cast off-site are. With this form of casting, there is no vertical form work needed in place which also then means there is no scaffolding needed for the casting process [10].

With the understanding of these methods, a lot of things come apparent in terms of cost, durability or structural integrity, customer satisfaction and limited maintenance of the finished structure. As a result of this benefits and characteristics, Tilt-up ends up being resistant to the change of weather as it has high insulation [10]. The inclusion of insulation boards inside structure during construction help in managing the temperatures inside the building for convenient living [11]. In essence, less maintenance is needed making buildings self-sufficient and saving money

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