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Precast Factory Management - A Review

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ABSTRACT: As a sustainable construction method, prefabricated construction is increasingly being adopted worldwide to enhance productivity and to alleviate the adverse environmental and social effects as a result of conventional construction activities. In addressing management issues of prefabricated construction, an impressive number of studies have been published by internationally renowned journals related to construction management over the past decades. However, it seems that a systematic summary on the research development in the management of prefabricated construction (MPC) discipline is lacking. Therefore, this paper examines the latest research trend in this discipline by analyzing published construction management research in 10 leading journals during the period from 2000 to 2013 (as of end of June) in terms of the annual number of MPC papers, contributions of institutions, adopted data collection and processing methods, and research interest. The analysis reveals that prefabrication is becoming increasingly important to the entire construction industry. In this present paper we are summaries all the material studies for undertaken precast factory management.

KEYWORDS: Precast factory, Management, Material tracking, optimization of cost.

I. INTRODUCTION

The arrival of computers, communications, and consumer electronics, commonly known as the 3C, has changed all levels of human life. Through the 3C technique, the dissemination and acquisition of information will become more convenient in the future and the electronization management technologies are moving towards the mobilization management concept. Radio Frequency Identification System (RFID) technologies have been widely applied to a variety of fields, particularly to commercial transactions and logistical management. Where the precast industry is concerned, the processing of complex management data requires the consideration of the portability and ease of processing for the development and application of an information mobilization system.

Developments, therefore, in the Personal Digital Assistant (PDA) and associated mobilization technologies have further enhanced the development potential of the future information mobilization. The precast industry is characterized by the synergy of the traditional manufacturing industries and the precast industry, while still requiring production lines and project sites. For years, traditional manufacturing industries have used barcode systems to manage finished products, yet the usage of barcode systems is inconvenient due to some problems: first, it is often hard to fix the barcode on the components or read the numbers on the barcode in a damp or dirty environment. Second, one must find the corresponding meaning of the numbers on the barcode before obtaining the needed information. This process of manually recording the numbers and finding the corresponding meaning makes it impossible to get instant feedback. The current precast production problems can be divided into two parts: inside the plant and outside the plant. Inside the plant, components must be produced according to schedule; over-early or over-late production will result in storage problems and delays in the construction site. Furthermore, the components in store are very hard to locate using the traditional method, thus the process of finding takes a long time. Outside the plant, the production and hanging of precast concrete components must go according to the schedule, so it is essential to know which component belongs to which floor and which part of the construction, but this cannot be done immediately using the traditional method like barcode. Using the PDA associated with RFID method, it is possible to know the current situation at the site from

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inside the plant, allowing production to follow up with the site progress. After the production and storage of each component, it is easy to quickly locate the target product when needed using the RFID tag.

Engineers in the precast industry conduct the majority of their activities outdoors and usually record plant management and quality inspection information such as the production quantity, the inventory quantity, the material quantity and the quality inspection information in notebooks; data are not entered into the computer for control processing until after returning to the office. Therefore, time and spatial gaps exist between the plant and the office, which cause not only reduced efficiency in the data management by the engineering personnel but also an increase in the number of data entry errors. When data cannot be written to or retrieved from the system in time, management may be deprived of advance decision-making opportunities due to the lack in data accuracy and timeliness. Through the combined usage of RFID and PDA, the plant can manufacture precast concrete components according to the construction schedule. After manufacture, information of the precast concrete components, such as which floor they belong to and quality control information, is input into the RFID. When it is time to transport the components to the construction site, their locations can be quickly found with the RFID, thus reducing the search time. RFID can also be used at the site, to quickly find out the hanging location of each precast concrete component.

Therefore, the advent of RFID technology and its bilateral communication properties provides a greater degree of flexibility for system control and information dissemination. Wireless transmissions make data exchanges much more convenient and eliminate the existence of time and spatial gaps between the plant and the office, thus enhancing data management efficiency. Use of these technologies will increase the precast industry's information processing and management efficiencies to enable management to acquire accurate and instant management information.

In the global economy and trade environment, the precast industry will face stiff international competition. If the domestic precast industry is to keep a competitive edge, industry management's first priority must be the introduction of information technologies and the use of electronic management tools. In the information digital era, the main key of fundamental competency is based upon the level of information and technology. Therefore if the development of digitalization in the construction industry can be sped up, the construction industry can be further upgraded to the category of mobilized information management.

The objective of this research study is to establish RFID technologies in the precast industry's production and inventory and transportation management systems. AS RFID systems are successfully introduced to the pre-cast industry, in addition to improving information accuracy and employee performance, industry management will be able to select appropriate data-processing instruments to be used by the frontline plant personnel for increasing the data processing convenience and efficiency through the simplification of data processing methods. Using RFID technology will eliminate the time and spatial gaps existing between the plant and the office and will improve the quality of the components and operations. The instant tracking of information relevant to quality control inspection of the precast components and inventory and transportation management will enable the components stockpile management on a point-of-time basis and the thorough management monitoring at a comprehensive level.

The system which integrating RFID with PDA in the precast industry's production, inventory, and transportation management has already been developed by the authors and applied on the production management of Ruentex's precast concrete components. Users can quickly locate the position of the precast concrete component in the plant and also find out the hanging location using PDA associated with RFID. With internet, users can further send the construction site percentage progress to the office, allowing the manager to check whether the schedule of precast concrete component matches the schedule of construction. Doing so, the manager can avoid the products being produced too slowly, causing delay of hangings, or the component being produced too quickly, causing shortage of storage space. The precast production management system is divided into two parts — quality control inspection management and inventory/transportation management. The quality control system controls the component's production quality. After the quality inspection, the system will automatically connect to the concrete materials purchasing system and the precast component molds inspection system to prepare for the concrete pouring and molding. The inventory/transportation system, which includes the inventory management system and the logistics management system, deals with the storage and transportation management of completed components.

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II. REVIEW OF RESEARCH PAPER

Zhaojing Wang, HaoHua, &Jie Gong [2017], This paper proposes a two-hierarchy simulation-GA hybrid model for precast production to ensure the on-time delivery of PCs with the minimum production cost while simultaneously optimizing the resource configuration to cut down the resource waste. In this model, the inherent limitation in the applicability of traditional production optimization methodology is improved based on the simulation of the real world production system, compensating for the neglect of process waiting in queue, the characteristics of operations, and uncertainty in processing time in previous studies.

Maria del Mar Casanovas-Rubio & Gonzalo Ramos [2017], This paper presents a quantitative environmental impact assessment tool for the decision making of construction processes including structures, infrastructures and buildings by means of an Environmental Impact Index (EII) to be applied at design and/or construction stages. The research is based on multi-attribute utility theory, interviews with expert's representatives of the different stakeholders in construction, and an analysis of fifty-nine European and Spanish environmental legislative acts. The research presented in this paper provides a new tool especially optimised for quantifying, assessing and comparing the cradle-to-gate environmental impact of different types of construction processes, including structure, infrastructure and building projects.

Jieh-Haur Chen, Li-Ren Yang &Hsing-Wei Tai [2016],The objective of this study is to perform process reengineering so as to create more efficient precast processes. The results of the literature review and advice from 16 experts suggest that the current process used to produce a precast element, which is comprised of 16 steps in a single module, should be redesigned to include 13 steps in 3 modules. Using historical data as input, the Arena software, Version 13, is adopted to simulate both the traditional and proposed methods, and then compare the results for practicability. An overall savings of production time of 24% can be reached by changing the current/traditional method to the flow-shop type production method.

VPS NiharNanyam, RiddhaBasua& Anil Sawhney [2017], The main aim of the research has been accomplished by proposing a cost analysis model for precast technology and comparing the time and cost aspects of precast buildings vs. conventional construction in two live projects. Time savings of 20-35% have been demonstrated using precast technology in comparison to the conventional method of construction. In contrary, cost comparison showed us that there is enormous cost variation when compared to the traditional/conventional method of construction. The cost incurred in adopting precast technology is 15-30% more than the cost of traditional/conventional technologies for the projects considered in the research.

J. Ranz, S. Aparicio& J.V. Fuente, et.al.[2016], In this paper a methodology for the quality control of the curing process in precast concrete plants is presented by non-destructive testing techniques. This methodology consists on a remote monitoring system and a method to estimate the strength gain of the precast elements during the curing process. The remote monitoring system is based on Wireless Sensor Networks (WSN) provided with temperature, humidity and ultrasonic sensors. In this paper, a methodology is proposed for the quality control of the curing process in precast slabs. This methodology is based on the prediction of compressive strength from the temperature and ultrasonic velocity values in the slabs. For that purpose, a remote monitoring system has been developed and different models are proposed to estimate the compressive strength value during the curing process.

RadanTomek [2017],The objective of this paper is to analyze and appraise the advantages and benefits of the innovative prefabrication approach in contrast to traditional cast-in-place construction method, and to come up with a set of conclusions and recommendations for the general practice.

Samuel Y.L. Yin & H. Ping Tserng, et.al.[2009], Radio Frequency Identification (RFID) is characterized with superior predispositions, including the recognition of multiple markers, communication ranges from five to six meters, and a storage database for thousands of data files. It is anticipated to integrate usage of Personal Digital Assistants (PDA) and the application of Radio Frequency Identification (RFID). Using RFID tag and reader to collect the information, and then transmit the multifaceted, mobilized information such as the production quantity, the materials quantity, quality control inspection and inventory and transportation management information to the manager office or the site worker via the PDA and wireless Internet. This precast production management system which has been developed by the author and utilized in precast production management encompasses inspection of incoming materials, production process inspection, molds inspection, specimen strength feedback, and logistic and receiving management.

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III. CONCLUSION

Rapid economic growth and limited availability of affordable land have restricted the horizontal mode of construction leading to vertical construction in most of the Indian cities. Urban India is mostly marked by tall buildings that are being built. Due to the economic slowdown and some governmental interventions, these building projects are seeing significant time and cost overrun, ultimately impacting the end-user. As these market pressures rise more and more, real estate developers are considering to adopt emerging technologies to compensate for these construction issues. Indian construction industry is undergoing a paradigm shift from traditional methods of construction to modern methods of construction. Precast technology is one such move which is expected to enhance the productivity of the construction process, thereby, optimizing the requirement of resources on the site, reducing waste generation and resulting in a faster delivery of the projects.

While internationally precast technology is considered as a mature technology, in India, it is not widely utilized, despite the advantages. Commonly cited constraints are high costs in comparison to traditional construction, economies of scale, logistics, skill level required, end user friendliness, etc. Primarily, this study focuses on identifying the challenges faced by the precast technology under various categories. This study also presents a cost analysis model for precast technology versus traditional construction to address some of the challenges. Presented cost model is applied to two projects wherein precast technology and conventional technology are utilized to construct the project and an inference is drawn comparing the time and cost aspects of precast technology. Amicable solutions are proposed for adoption of precast construction from an Indian perspective.

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