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Cycle Time Analysis of Precast Concrete Installation by Artificial Neural Networks

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Abstract

Precast concrete elements are generally used to provide faster project duration and higher quality construction projects. These elements are widely used in residential and commercial buildings across Singapore. However, there are many factors affecting productivity of precast construction which should be considered to provide more accurate estimates of activities such as production and erection of precast elements. The main objective of this study is to assess the productivity and analyze the cycle time for precast erection process using Artificial Neural Networks (ANN). Primary data for the study were collected through site visits. High prediction capability of the develop ANN showed the potential use of such a technique by construction managers and general estimators for their scheduling purposes.

Keywords: Productivity Analysis, Precast Concrete, Construction Management, Artificial Neural Networks.

1. INTRODUCTION

Precast Concrete (PC) framing, panel, and box systems including PC columns, beams, slabs, and 3-D components such as balconies, staircases, and toilets are one of the main categories of Industrialized Building System (IBS) elements [1]. IBS generally means to build on-site with components like floors, walls, columns, beams, roofs, etc. which are produced in prefabrication plants and then delivered to site for final installation [2]. Some of the main features of IBS can be listed as follows [3]:

- Most of the elements can be prefabricated off-site in a controlled environment (prefabrication plants).
- Several building works are assembled into larger prefabricated finished products in order to minimize activities on-site including erection, jointing, and finishing.
- On-site handling of materials is as mechanized as possible.
- Different processes such as design, production, and on-site installation are extremely interrelated which requires integrated planning and coordinating from system point of view.
- Automation may be used in different processes to improve quality and speed the project progress.

PC components are generally produced by inserting materials such as concrete mix and its components (including cement, aggregate, rebar cages, and other admixtures) into a mold. Some other fixtures such as mechanical/electrical conduits, window and door frames, inserts, bolts, and hangers are embedded into components to form final assemblies which are then delivered and installed on construction sites. Use of PC elements results in easier installation of the building structure, achieving higher quality projects, enhanced safety, lower total project cost, and better sustainability [4-6]. However, there are several factors that affect the productivity of PC projects. Some of these factors are common in most of the construction projects such as site conditions (cleanness, site layout, etc.), weather conditions, crew size and skill, and project management conditions to name a few [7]. On the other hand, there are specific factors that influence the productivity of PC projects such as big size of PC elements, site storage capacity, PC delivery methods, and erection sequence of PC components.

Allocation of time for erection activities in PC projects are based on site supervisors' and planners' experience and the accuracy of schedules for installation process affects floor cycle times which may result in