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Window Proximity Tracking Method for Tall Building Construction

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Abstract

Window work is a major process that must precede the finishing work and has a high influence on the entire construction period of a tall buildings. Conventional window work in a tall building construction typically begins several floors below the structural work floor to prevent interference with the auto-climbing system and with the lifting of the window frame. This, however, causes a gap in the process between the structural work and the window work, which increases construction duration and cost. This study proposed a window proximity tracking method for tall building construction (WPTM) that could reduce construction cost and duration by minimizing the process gap. In a case study, the WPTM showed lower construction costs and a shorter duration than those of the existing method.

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Keywords: window proximity tracking, overlapping method, tall building, construction, window work

1. Introduction

Window work in tall buildings is a major process in a tall building construction, and the time of commencing this process is a crucial factor in determining the overall construction duration. This work, which is a successor process of structural work, is crucial since it should be implemented prior to finishing works. Thus, window work should begin as soon as curing of framework is complete in order to execute finishing works with the fewest delay, which account

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for 40% of the entire construction period of tall buildings (Kim 2002). However, is first applied to floors to which windows can be lifted without being disturbed by ongoing structural work, which is a predecessor process, because the start time of a successor process is determined by the characteristics of both processes and their relationship (Bogus et al. 2011). An auto-climbing system(ACS) is typically installed at the exterior of tall buildings to ensure safety during construction in Korea (Kim et al. 2007), and a hoist for lifting windows requires a certain amount of space above a cage for masts and driving parts. Thus, window work typically begins after window frames are lifted to seven to eight floors below the floor of structural work.

A gap in the process between structural work and window work leads to additional work time and cost of a project. It also delays the commencement of finishing works, thereby affecting the construction duration of the entire project. Moreover, additional safety facilities should be installed because openings occur on several floors below the ACS where windows cannot be installed. Furthermore, since an additional working plate is required for external window caulking works, either temporary facilities should be implemented on each floor or a suspended working platform should be installed after structural work. The installment of additional safety facilities and temporary facilities increases the amount of work and its related time and cost incurred. To solve this problem, gaps between processes should be removed. However, essential problems related to these gaps have not been overcome in previous studies on the process of constructing windows, which have focused on specific processes only such as in preventing delays to the period of window work and increasing efficiency through automated construction.

In this study, a window proximity tracking method (WPTM) that can reduce process gaps between structural work and window work is proposed. The proposed method is expected to help tall building construction managers to ensure more cost-effective alternative in short term.

2. Literature Review

Most of previous studies on early start of window work were conducted using process management technique. Kim et al.(2003) and Shin et al.(2010) proposed a tact planning and scheduling process model for reduction of finishing work duration in building construction projects. Lee et al.(2010) proposed construction planning model for using the working space of high-rise building construction to reduce the construction duration. Lee et al.(2011) proposed study proposes a method of identifying the main risk factors on the curtain wall work delay of the high-rise building construction based on the FMEA method to predict the parts which has potential to be a problem and also proposed a process to decrease the risk to prepare for it in advance. Irina et al.(2013) presented, by concept of lean construction, a method for pull flow control at the operational level through real-time prioritization of pending work packages and daily regulation of crew assignments and trades' production capacities in interior and finishing works. Chung et al.(2010) and Yu et al.(2007) proposed the master device applied to the task of fitting a large glass window panel at a construction site for replacing worker and increasing window work efficiency. However, these previous researches have been studied from the perspective of physical strength for handling curtain wall and process management. Also, there is a limitation in eliminating the increase of the entire construction period due to the gaps of four floors or more between the frame construction floor and the finishing (window) construction floor.

3. Existing Window Work Process

The existing process of window work in tall buildings is shown in Fig. 1. Placing and curing works are performed from the placement floor (or the Nth floor) to the (N – 2)th floor, and a support is dismantled on the (N – 3)th floor. The ACS is installed up to the (N – 2)th floor for surface preparation of ~~the~~ framework. A protection net for guarding against falling objects, a safety handrail, and a dust filter net are installed from floors (N – 4)th to (N – 6)th where windows cannot be lifted into place in order to prevent drop accidents. Windows are lifted and installed from the (N – 7)th floor. The cycle of window work is faster than that of structural work. For this reason, a unit of five floors or higher is typically applied in window work, thereby leading to a distance of seven to eleven floors from the placement