

Construction Activity Dependency and Sequencing Analysis for Robotic Construction Methods based on Graph Analysis

**Tessa Beauchat,¹ Edward Blazejewski,² Yuqing Hu, PhD,³
Robert M. Leicht, PhD,⁴ Clinton Suanico⁵**

¹Department of Architectural Engineering, The Pennsylvania State University, University Park, PA 16802, United States of America, tnb5265@psu.edu

²Department of Architectural Engineering, The Pennsylvania State University, University Park, PA 16802, United States of America, emb5933@psu.edu

³Department of Architectural Engineering, The Pennsylvania State University, University Park, PA 16802, United States of America, yfh5204@psu.edu

⁴Department of Architectural Engineering, The Pennsylvania State University, University Park, PA 16802, United States of America, rml167@psu.edu

⁵Department of Architectural Engineering, The Pennsylvania State University, University Park, PA 16802, United States of America, cfs5455@psu.edu

ABSTRACT

The interdependencies among construction activities are a key factor to define the construction schedule. The application of robots in construction projects not only impacts a single task, but also the sequence and interdependency between tasks. The difference between humans and robots in physical characteristics, work constraints, and work performance will change the means and methods of construction, and potentially the dependencies or sequence of construction activities. This study develops a method for analyzing the impacts of using robots as alternative methods within network schedules to understand the impacts of employing robots in construction tasks. We first summarize the typical construction sequence dependencies and their causes based on extant literature. Then, we analyze the impact of emerging or currently used site construction robots on these dependencies based upon robots' characteristics and work methods, as well as the potential propagation of changes through the network using graph theory. A case study project is analyzed to compare the proposed use of robotic construction in lieu of the actual methods employed, understanding the changes with and without robotic methods to analyze the sequence differences. The outcome is a defined process and four types of schedule changes identified through the use of construction robotics in construction sequences and network schedule dependencies.