Detection of Architectural Drawings Errors in 3 Dimension

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Abstract

In construction projects architectural drawings are the main documents which show how a structure has to be built. In this sense, most of the data necessary for project management are prepared based on these drawings. Therefore, architectural drawing errors will adversely affect the constructability and hence, the time and cost of a construction project. On the other hand, although the structures are built 3D, architectural drawings are prepared 2D. This circumstance complicates the detection of drawing errors during the design phase. In other words, drawing errors are mostly encountered during the construction phase. In fact, drawing errors are risks which can be detected during the planning phase in nature. In this study, it was argued that to detect drawing errors in planning phase architectural and engineering drawings should be prepared 3D instead of 2D. In this context, drawings of an official approved hotel project were redrawn by means of BIM to determine whether there exists drawing errors. The results of the study revealed that drawings involved many errors and 3D drawings enable early detection of them.

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1. Introduction

Construction projects involve numerous uncertainties because of their complex nature. Since, these uncertainties mostly arise in the construction phase; they cause time and cost overruns, and quality reduction in the projects. In this sense, the primary goal of the design phase is to detect and eliminate or take precaution for these uncertainties.
before the construction starts. The interaction between design and construction phases in construction project is defined by the term constructability [1]. The Construction Industry Institute (CII) defines constructability as “the effective and timely integration of construction knowledge into the conceptual planning, design, construction, and field operations of a project to achieve the overall project objectives in the best possible time and accuracy at the most cost-effective levels.” [2]. Indeed, constructability is an indicator of the design quality. In other words, if the data obtained in the design phase are difficult to understand and interpret, then constructing the building will be so much complicated [3].

Many researches in the literature revealed that design errors are one of the most important risks in construction projects which cause time and cost overruns. Risk is simply defined as a condition which arises under certain circumstances with adverse effects. In other words, risk is a probabilistic condition. On the other side, architectural and engineering drawings show the dimensions and positions of the construction elements. To be constructible construction elements have to match up with these drawings after they are built.

In this sense, although drawing errors are often encountered in projects, they are preventable risks in nature. Indeed, drawing 3D construction elements in 2D prevents encountering the errors in the design phase. In this study, it was argued that architectural and engineering drawings should be prepared 3D to remove drawing errors before the construction starts. In this context, official approved drawings of a hotel project were redrawn as 3D by mean of BIM and potential errors which would be encountered in construction phase were determined.

2. Theoretical background and methodology

Basically, in design phase of construction projects it is determined how to meet customer requirements. In this context, design phase consists of two successive steps. In the first step, the architectural and engineering drawings are prepared from which also the other activities of design phase are derived. Based on these drawings in the second step the construction, procurement and management activities of the project are planned [4]. Although decisions made in design phase have a big impact on the projects’ time, cost and quality, they are taken with insufficient information [5]. This uncertain nature of the projects is prone to design errors which are mostly detected in the construction phase.

Since the design phase is too comprehensive, design errors also varies. However, design errors causing rework and design changes are accepted as the primary contributor to time and cost overruns [6]. 70% of reworks in construction projects are caused by design errors [7]. Although, design errors are hard to detect before the construction starts [8], errors are the products of a person’s cognitive capability and hence, they may be prevented [9]. In this sense, it is crucial to determine the design errors which can be detected before the construction starts.

Architectural and engineering drawings are a sort of installation guides for construction projects. They show the geometry and position of each construction element that will be built. Therefore, for a correct production these drawings should not include errors. However, in today’s construction industry 3D construction elements are build based on 2d drawings [10]. In other words, the restricted visualization provided by 2d drawings prevents the early detection of errors. On the other hand, Building Information Modelling (BIM) software which became popular in the recent years allows preparing a 3D visual model of the buildings. BIM provides an accurate geometrical representation of construction elements in an integrated data environment [11]. In addition, BIM also combines the separately prepared architectural and engineering drawings in a simple drawing. In this aspect, project participants can see what will be built in a simulated environment and identify potential drawing errors before the construction starts [12]. In this study, it was assumed that drawing errors are detectable in the design phase and argued that preparing the drawings 3D with BIM software instead of 2D will ease the detection of these errors. In this context, official approved drawings of a hotel project was redrawn as 3D by mean of BIM and checked whether drawing errors exists.
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