Development of guidelines for creating 3D model deliverables for detailed design

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1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has been examining the utilization of BIM/CIM (Building/Construction Information Modeling/Management) in processes such as surveys, investigation, and design in order to solve problems and improve the efficiency of the entire construction production and management system. In addition, MLIT has been promoting a BIM/CIM utilization project to create models necessary for later processes. The goal is to apply BIM/CIM to, in principle, all design and construction projects except for small-scale projects in FY2023, so it is necessary to develop various related conditions such as standards to achieve the goal.

In order to efficiently utilize BIM/CIM in the construction phase, it is necessary to use a BIM/CIM 3D model as a contract document. Therefore, with a focus on detailed design and contract documents, trials were performed to use a 3D model as a contract document by itself. As a result, also considering the status of implementation overseas, "Guidelines for Preparation of 3D Model Deliverables (Draft)" (March 2021) were formulated, in which 2D drawings are used as contract documents and 3D models are developed as models that satisfy the requirements for contract documents. The guidelines have been revised annually to increase the types of work, etc. This paper summarizes the background history that led to the development of the draft guidelines and their details.

2. Trial of using a 3D model as a contract document

Since 2D drawings are conventionally used as contract documents, the conventional method generates inefficient work such as creating both 2D drawings and 3D models and checking their consistency with 2D drawings in order to utilize 3D models. However, using a 3D model as a contract document eliminates this problem and improves work efficiency. In addition, using a 3D model as a contract document will lead to the employment of quality/work progress control and supervision/inspection methods based on new measurement technologies, such as work progress control using a laser scanner. On the other hand, the trials revealed that using a 3D model by abolishing a 2D drawing as a contract document has many problems such as a large amount of work and inadequate support by software.

3. Survey of contract methods overseas

Based on this issue, a survey was performed on overseas contract methods for construction projects using BIM and 3D models.

When the UK introduced BIM, the delivery of both BIM models and 2D drawings was required. The current contract stipulation states that if there is any inconsistency between the two, the 2D drawings shall prevail. However, it requires that 2D drawings be cut from the BIM model, eliminating the inconsistency.

In Germany, for the time being, contractors are required to deliver, along with 3D BIM models, 2D design drawings based on the conventional design document guidelines. When both 2D drawings and 3D models are lent at the start of a project, the contractor is required to check for any inconsistencies between the lent 2D drawings and 3D models and to point out any inconsistencies to the client.

4. Guidelines for creating 3D model deliverables (draft)

Referring to overseas contracts where BIM is utilized, draft guidelines for creating 3D model deliverables for detailed design work were created so that 3D models can be utilized as equivalents of contract documents, assuming that 2D drawings are used as contract documents.

The purpose of the draft guidelines is to show the methods and requirements for the creation of 3D model deliverables for detailed design work in order to improve design quality and to utilize 3D model deliverables, as equivalents of contract documents, in later phases of work.

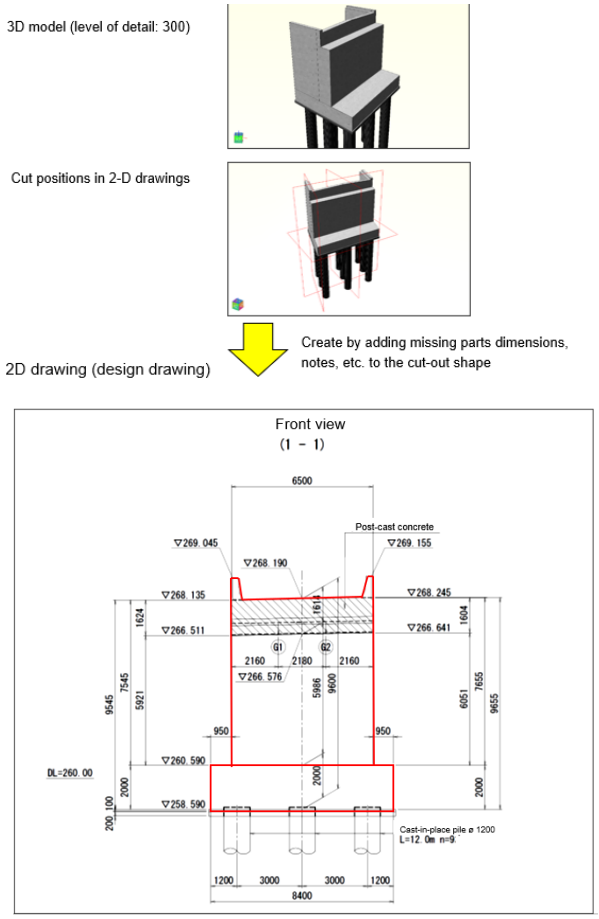

Figure 1: Development of a contract document (2D drawing)

The basic flow of detailed design work remains the same even when BIM/CIM is utilized. However, work that was previously performed using 2D drawings (design verification, meetings, stakeholder consultations, etc.) will be replaced by work utilizing 3D models.

The basic idea is to create a 2D drawing as the final product by adding dimensional lines and notes to 2D shape data developed by cutting or projection from a 3D model instead of creating a 3D model after creating a 2D drawing as in the past (Figure 1). However, the 3D model shall not include dimensions or notes, and the level of detail shall be about 300 to accurately represent the main structure, which is mainly used for contract documents. This does not apply to the level of detail of 3D models

that are created in stages during the course of work.

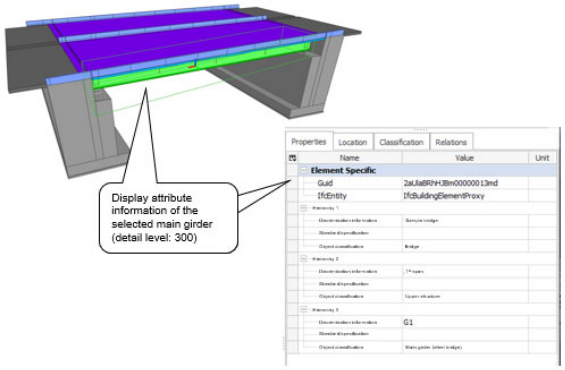

Figure 2: Example of assigning object classification and attribute information in detailed bridge design

It was decided to assign a minimum number of attributes to 3D models, and the hierarchy of attribute information to be assigned was defined at four levels for each object (Figure 2). Attribute information for Hierarchy 4 (members) is defined as arbitrary because there is a lot of information to be assigned and the requirements vary depending on the target member.

The draft guidelines not only define the requirements for 3D model deliverables but also present the basic method of creating a 3D model from the beginning of the design process, followed by discussions among related parties, design confirmation by clients, and design verification, leading to the creation of final 3D model deliverables.

In addition to using 3D models to create 2D drawings, the guidelines employ a policy to actively utilize 3D models during the course of work as well. For example, the quality of design results including 3D models can be assured by using 3D models to check the design results of detailed design work in stages. Furthermore, by using 3D models for design verification and stakeholder discussions, which were conventionally conducted using 2D drawings, it is possible to reduce the number of 2D drawings to be created during the course of work.

5. Summary

In using 3D models as contract documents, system-related and technical issues were clarified, and standards and procedures were developed in stages. It is expected that the draft guidelines will be utilized in public construction practice so that BIM/CIM will be applied, in principle, to construction work.

☞ For more information:

1) Guidelines for Preparation of 3D Model Deliverables (Draft)
https://www.mlit.go.jp/tec/content/001395713.pdf