Application of BIM in Pipeline and Equipment Project of an Energy Centre

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Abstract. This paper is based on BIM chemical plant upgrade project energy centre plant design, BIM Technology is applied to the project pipeline comprehensive design, using the Revit to complete the professional system modelling, using Naviswork to analyse the collision conflict between various disciplines and generate collision conflict report, through the pipeline comprehensive adjustment optimization model, improve the design quality.

1. Introduction
In the pipeline design and construction of energy center, attention should be paid to the comprehensive layout technology of pipelines and reasonable use of comprehensive supports and hangers [1]. Based on the characteristics of BIM, this paper explores the role of BIM in the layout of construction site, the simulation of construction process, the formation of tender offer and the preparation of technical bid. In this paper, Revit is used for site layout and roaming simulation is carried out. The rationality of vehicle access and safety facilities location is analyzed, and the existing site layout is optimized. The three-dimensional model is associated with the construction schedule and resource plan, and dynamically tracked during the construction process. The actual progress is compared with the planned progress, and the actual resource consumption is compared with the planned resource consumption. The deviation is found in time, the causes are analyzed, and the necessary measures are adopted for timely adjustment, so as to realize the effective control of the construction progress and resource consumption.

2. BIM Construction of energy center project

2.1. Construction of BIM mode for engineering model
The energy center adopts the mode of sub professional modeling, mainly with professional engineers. Therefore, in order to enable each engineer to better build the model and ensure the consistency of the project model, it is necessary to make a unified and exclusive template file for the project [2]. The production of the template file can ensure that the construction of each system is built on the same grid and elevation, which is ready for the collision detection of various systems in the later stage.

In the modeling and design of mechanical and electrical equipment, the construction of engineering model is to create a sense of space, and the model construction of each system can only be carried out in this space, so that the comprehensive pipeline layout can be realistic. Before placing the independent foundation, separate the drawing of the foundation in CAD, and then link it to Revit. Select "apply to
current view only", "select mm for import unit" and "select origin to origin" when linking [3]. After importing the sheet, unlock it, align it with the grid drawn before, and then lock it to avoid careless operation. Load the independent foundation from the family library master, modify the foundation size and material to be consistent with the drawing, and then place it in the corresponding position. Pay attention to the elevation and placement position of the lower column pier [4]. After the independent foundation is placed, the raft is drawn, and the raft is drawn after the corresponding information is set in the structural foundation: floor.

The establishment of the Revit model basically follows the following steps: select family type → set component type property → set component property. Building professional model is composed of wall, floor, building column, roof, apron and other components. Due to the different functions of each room, there will be many kinds of walls in the whole building, so before drawing the wall, first define the wall, click the upper "building" → click "wall" → select the wall type to be drawn → click "edit type" → "Edit", and then add and define the wall materials. After defining the wall, draw the elements in the floor plan or 3D view. The construction of engineering model is shown in Figure 1.

![Figure 1. Construction of engineering model](image)

### 2.2. Construction of BIM model for equipment and pipeline

According to the requirements, all pipelines are imported into BIM model according to the system custom color and connection mode. The BIM model of pipeline and equipment is shown in Figure 2. For example, the specialty will establish different air duct systems according to the large system, small system air conditioning, small system ventilation, and customize the default elbow, reducer, pipeline installation professional models, including various pipeline models and electrical systems. There are
many components and complex components in the pipeline system, and the establishment process is usually more difficult than the engineering part [5]. Here, take the gas supply pipe as an example: to draw the gas supply system, it is necessary to establish the pipeline system, set the pipe size in the type parameters, so as to set the relationship between the nominal diameter, inner diameter and outer diameter, and finally set up the components of the pipeline system.

Figure 2. Construction of equipment and pipeline model
3. Integration of BIM models

Before the collision analysis, it is necessary to integrate the models of different disciplines into a whole. There are two main methods for model integration. One method is to copy the mechanical and electrical professional models together in the Revit software, and link the building and structural models for integration. However, when the various systems are integrated together, there are too many model components, so it is quite difficult to run. The other integration method is based on Navisworks software, which can be used for construction simulation and collision inspection, and can be converted with the Revit model. Navisworks can be run to check the collision, realize multi-directional, multi interface and multi angle observation [6]. The collision problems can be marked down and can be directly returned to the Revit software for adjustment. The specific method is to export the professional models created in Revit, use Navisworks to open the professional files together, and the software will automatically integrate the models. The integrated model is shown in Figure 3.

![Collision detection model](image1)

**Figure 3.** Collision detection model

After the BIM model integration is completed, collision detection and integrated pipeline adjustment are started. BIM software can comprehensively detect all the collision problems between pipelines and between pipelines and civil engineering, and provide them to professional designers for adjustment. In theory, all pipeline collision problems can be eliminated. Some typical collision types are shown in Figure 4. Through Navisworks collision detection, we can detect each system separately according to their own needs, and export the number, screenshot and position of collisions as reports.

![Collision detection modification](image2)

**Figure 4.** Collision detection modification
In this project, BIM Technology is used to connect the model with the project progress and funds, and integrate the spatial information and time information into a structured project model database. Construction enterprises can review the progress of the project anytime and anywhere, and effectively control the project progress and capital resources of the entire energy center.

4. Conclusion
The application of BIM Technology in the pipeline comprehensive design of this project can find out the collision conflicts among multiple disciplines in the construction process in advance. By analyzing the collision conflict report, we can clearly grasp the main causes of waste caused by delayed work and rework, avoid unnecessary losses and improve the design quality. At the same time, this paper also explores the application of BIM. In the design and construction of equipment pipeline, attention should be paid to the comprehensive layout technology of pipeline.

References
[1] S. Azhar, M. Khalfan, T. Maqsood, Building information modelling (BIM): now and beyond, Australas. J. Constr. Econ. Build. 12 (4) (2012) 15-28.
[2] M. Ibrahim, R. Krawczyk, G. Schipporeit, Two approaches to BIM: a comparative study, Proceedings of Education and Research in computer aided architectural design in Europe, ECAADe, 2004, vol. 22, 2004, pp. 610-616.
[3] Kim, C., Son, H., & Kim, C. Automated construction progress measurement using a 4D building information model and 3D data. Automation in Construction, 31 (2013) 75-82.
[4] K. Ku, M. Taiebat, BIM experiences and expectations: the constructors' perspective, Int. J. Constr. Educ. Res. 7 (3) (2011) 175-197.
[5] J. Goedert, P. Meadati, Integrating construction process documentation into building information modeling, J. Constr. Eng. Manag. 134 (7) (2008) 509-516.
[6] Howard, B. Björk, Building information modelling - experts' views on standardisation and industry deployment, Adv. Eng. Inform. 22 (2) (April 2008) 271-280.