Visualization of HVAC pipeline integrated arrangement based on BIM technology

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Abstract. With the relevant information and data of building project as a model basis, the building information model are established. It is an innovative building design, construction and management methods. Revit realized the transformation from simple information to information for specific purposes, maximizing to reduce collaboration failure in each design team by the professional cooperative technology, parametric technology and building performance-based simulation technology [1]. In order to improve the efficiency of integrated design of pipelines and the subsequent construction productivity, the study based on pipeline arrangement in hotel analysized visualization and explored BIM technology in the field of HVAC. Revit, Navosworks software were analyzed to support the visualization of BIM technology. The recommendation and idea will be carried out for promotion of BIM in the design of HVAC as well as the popularity of BIM family of software technology.

Introduction

The core of BIM (building information model) technology is a database contained in building, structure, equipment, and other professional design parameters and material information [2]. The Revit realized the transformation from simple information to information for specific purposes, maximizing to reduce collaboration failure in each design team by the professional cooperative technology, parametric technology and building performance-based simulation technology [3]. BIM not only realize the transformation of 2D to 3D, but also realize the change of the designer's visual angle. And Revit as the core of the domestic modeling information software plays an irreplaceable role in the process. In addition to modeling based on the CAD, the designer can directly map through the Revit platform [4]. MEP engineers create a template file, through the filter building water-supplying-draining, HVAC, electric three professional system. In order to meet the requirements of deep design, collaborative work, collision detection and so on are used do it [5].

Project Overview

The second-stage construction of the large hotel had a total construction area of 53630 square meters, the building height of 117.50 meters. The structure was made up of concrete structure. One to three layers underground were used to be equipment room, underground garage, wherein the three layer was for air defense region. Underground construction area was 12930 square meters.

Analysis of air conditioning project

Central air conditioning system was used in the podiums of 1-4 layers. Air conditioning water in

summer was provided by the screw electric refrigerator, in winter, it was provided by the basement of the heat exchange station. Combined air handling unit was accepted in banquet hall, banquet pre-hall. The toilet on the external walls, commercial and other part used fan-coil plus fresh air system. Because of the complexity of the various functions in the project, how to design MEP to match the civil engineering, coordinate and posit the various pipelines wind pipe, bridge and equipment is a challenge. Meanwhile, avoiding the unreasonable collision of equipment pipeline in the process of construction and improving the quality and efficiency of engineering construction are also bigger challenge. However, using BIM Technology provides a new solution and guidance for integrated pipeline, collision detection and follow-up project.

Methods

Collaborative design

Collaborative design is based on the same project. Design information was shared between each professional engineers. Project files and simulation pipeline comprehensive were synchronized timely, accurate and convenient for design management [6]. The BIM project manager created the working set and the task assigned to the professional engineers. Working set established, so that all project designers even if not in the same place, the same time, also can be in the center of the file, to achieve synchronization design and project update. Figure 1 is 3D model of underground one to three layers. Figure 2 is the linking model of underground layer. To ensure the accuracy of model integration, the link model accepted the same origin, and the way of linking is "the origin to the origin [7]. While elevation and axis-net were monitored, the position would be fixed in the process of creation.

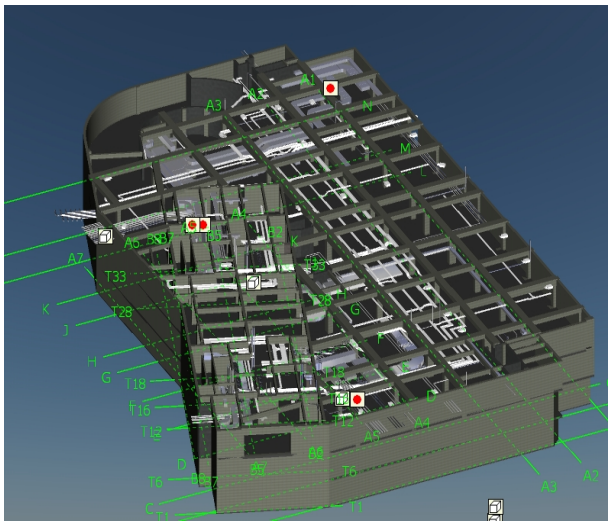

Fig.1 3D model of underground one to three layers

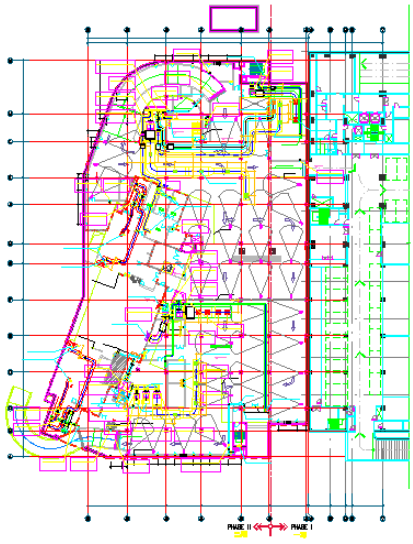

Fig.2 Linking model of underground layer

MEP model creation

Revit is designed for constructing building information modeling. The accuracy and efficiency of designing could be improved with the powerful 3D pipeline modeling, intuitive layout. The professional HVAC Engineer is rendering pipeline while drainage and electrical engineers can design drawing work, observing the process of work. The collision of pipelines can be observed in the early establishment and adjusted timely. Figure 3 is BIM model of local pipeline comprehensive plan of underground layer.

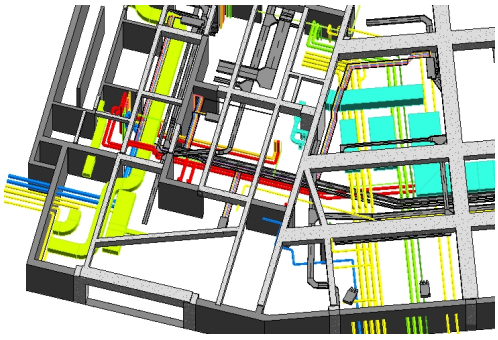

Fig.3 BIM model of local pipeline comprehensive 3D of underground layer

Collision detection

The principle of the collision detection is to use the mathematical equation to describe the object contour and call the function to detect the simultaneous equation of the object whether there is a solution [8]. The traditional design was drawn firstly in the two-dimensional plane. Secondly collision was detected in each profession, and the contradiction from the traditional design was needed to spend a lot of energy and time to reconcile. But with the support of BIM technology, various programs could proceed at the same time. Design and detection also carried out simultaneously. All effectively improve the efficiency and cost. Figure 4 described the differences between the traditional technology and BIM technology in the process of MEP design.

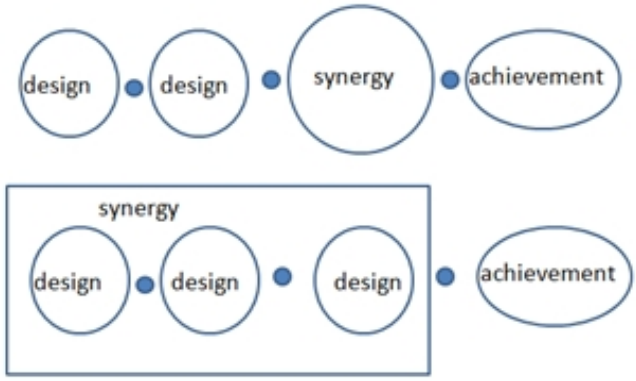

Fig.4 Differences in process of MEP design

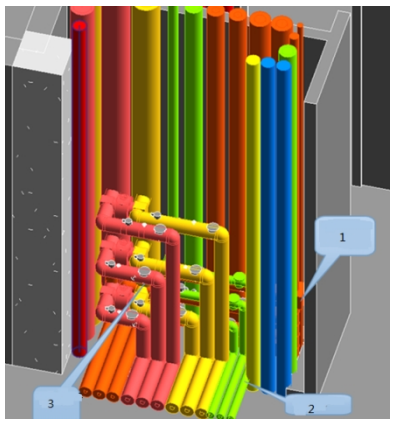

Fig.5 The details view of collision

In this project, collaborative design was applied fully. "Link model", "sharing" and "collision detection" and other functions were used to achieve the professional and efficient collaborative work. Among them, the "collision detection" was an important link in the design of the MEP project. MEP design is a unified aspect including design, construction, use and repair. In this process, entity collision called hard collision, soft collision [9] may also occur. Using Revit in the virtual 3D platform, all the professional pipeline comprehensive could be found directly, timely adjusted, achieving zero collision state. In the process of construction, if there is need to be adjusted, it can also be modified in Revit. For detailed observation and collision detection, the internal space to display and visualization of collision detection could be accepted by using Navisworks.

Cooperating with Revit software , the pipeline was adjusted and the design quality was improved.

Figure 5 showed collision detection in underground layer of MEP and collision detail view in Navisworks local 3D. Therefore, Revit, more precisely, could achieve efficiently cooperative work between profession and internal profession. In design stage, pipeline collision or insufficient clear

height could be avoided. And the cost and security risks for rework could also be avoided. According to the report of collision detection, the professional pipeline adjustment in Revit, can realize zero collision requirements. Therefore, with the support of BIM technology, through setting up the professional BIM model, the efficiency of pipeline design and production have been greatly improved, but also reducing the costs and construction delay caused by the construction coordination.

Conclusion

This project accepted the BIM technology in the engineering design, the visualization can avoid the pipeline collision in all branches of professional equipment, and improve the comprehensive efficiency of pipeline design and follow-up construction production. A higher quality and more accurate professional design for engineering projects were provided.

(1) there are some defects in the application of the software. For example, the running speed is slow, and the setting of some common functions is not comprehensive, and the cooperative pattern is irreversible, etc.

(2) BIM standard in China is not perfect and needs to be further standardized;

(3) There are obstacles for transformation of MEP design thinking

(4) Collaborative management needs to be improved.

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