Introduction to BIM technology construction application

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Abstract. With the promotion of the country and the industry, BIM technology ushers in a tide of application, and although the overall effect is not as good as that of European and American countries, it can indeed solve many engineering problems and provide valuable experience for the development of construction projects in the new era. In this paper, we take Chongqing Jiangbei District People's Hospital Liangjiang Branch Project as an example to explain how to use BIM technology in the whole construction process to solve many practical engineering problems such as numerous subcontracting specialties, complicated systems, narrow sites and large height differences in the original landscape.

Keywords: BIM technology, construction application, deepening, intelligent construction.

1 Introduction

This project is an important project of Chongqing Municipal Government for the people's livelihood. After completion, it will become an important hub connecting the medical systems of Fusheng, Longxing and Yuzui. There are 470 total beds and 617 parking spaces. The construction includes outpatient department, infectious disease department, emergency department, medical technology department, inpatient department, etc.The hospital effect is shown in Figure 1.

The project is a high-rise public building with a total area of 23,285.87m² and a total construction area of 71,752.80m², with 2 floors underground and 11 floors above ground. The seismic intensity is 6°, the seismic protection category is B, and the design reasonable service life is 50 years.

Fig. 1. Hospital rendering

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2 The construction of important and difficult points and BIM solution measures

2.1 System is complicated, many specialties

1)Difficulty description.

The project has advanced design, many functional rooms and complete supporting facilities, involving 16 subcontracting specialties, among which sponge city, medical gas, intelligence, purification room and other subcontracting specialties are unique to hospital engineering. The work sequence is cross-intensive and the pipeline arrangement is difficult.

2)Solution measures.

Through the BIM model, analyze the prerequisites for construction of each work type, organize each subcontract to review the existing model, unify the opinions of all parties, then modify the model accordingly, and finally organize the construction process rationally and cooperate with the construction of important nodes to reduce the rework rate.

2.2 Small venue

1)Difficulty description.

The total area of this project is about 23,300 square meters, but the area available for construction field cloth is only less than 1,800 square meters. The excavation and support surface on the east and west south side of the project are close to the red line of the site, and the inlet and outlet channels, material stacking and processing yard are restricted to be set.

2)Solution measures.

Using BIM technology, the site layout simulation is carried out in advance in stages to judge the reasonableness and optimize the site layout plan by combining the opinions of many parties.

2.3 High difference in height of the original landform

1)Difficulty description.

The topography of the project site is generally in the form of three-step terrain, with a large difference in elevation. The original landscape is shown in Figure 2.The height difference on the north side is 17m, the height difference on the south side is 12.2m, the height difference on the east side is 24.7m, and the height difference on the west side is 8.1m, so it is not easy to work on earth and rock.

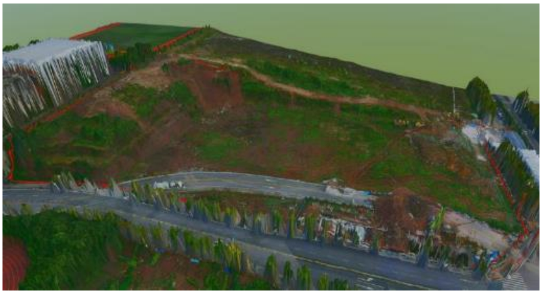

Fig. 2. Original landform

2)Solution measures.

Adopting UAV tilt photography technology, equipped with RTK ground signal station, it dynamically tracks the earthwork situation through the steps of fully automatic air three calculation, dense point cloud generation, construction of TIN network, and automatic texture mapping.

2.4 A wide range of medical equipment

1)Difficulty description.

There are many types of medical equipment and they cover a wide range of areas. Especially for large equipment, the procurement cycle is long and often requires deepening design, requiring managers to be forward-looking and difficult to manage.

2)Solution measures.

Using BIM technology, we can simulate the whole construction process, arrange the construction schedule according to the simulation results, make the equipment procurement plan accordingly, and kill the construction conflicts in the cradle.

2.5 Strict quality and high precision requirements

1)Difficulty description.

Medical machinery requires a high degree of precision. Electricity points, water supply and drainage points, etc. must be precisely controlled, otherwise it is easy to cause quality problems such as overlapping points, many points in the range and confusing arrangements.

2)Solution measures.

Use BIM technology to deepen the points. BIM out the drawings to ensure that each point has implementability and is installed according to the drawings.

3 The key control points

3.1 Geometry remeasurement

Structural components, such as walls, columns, beams and slabs in length, width and height, are remeasured on site; key components, such as valves, tees and elbows, are remeasured according to the samples provided by manufacturers; key equipment components, such as chillers and pumps, are remeasured according to the product manuals provided by manufacturers. To ensure the accuracy of the geometric data of each component.The geometric dimensions of the construction site were remeasured as shown in Figure 3.

Fig. 3. Geometric dimensional remeasurement

3.2 Minimum operating space review

Review the space of pipe arrangement, such as pipe spacing, pipe spacing with structural surface, insulation layer thickness, bracket setting space, maintenance space, cable laying space, connection fastening operation space, etc., to ensure the implementability of BIM model.

4 BIM implementation application

4.1 Dynamic simulation arrangement of narrow construction sites

Conduct site simulation layout for foundation, plus/minus and main structure construction stages respectively, and draw a site layout mockup. Carry out program comparison and optimization, and reasonably plan the approach and exit channels, material stacking and processing yards.[1]The site layout simulation is shown in Figure 4.

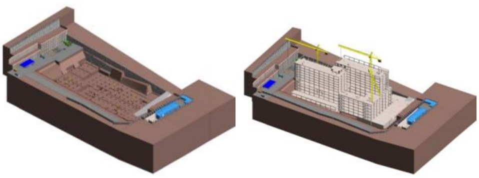

Fig. 4. Simulation of site layout

4.2 Earth balance analysis based on tilt photography realistic model

The site's original topography has a large height difference and involves a large number of excavation and filling operations, which can easily cause problems such as over-excavation and encroachment on the red line. UAV is used to tilt photography of the project and carry RTK ground signal station to dynamically track the earthwork operation.[3]UAV tilt photography is shown in Figure 5.

The estimated earthwork volume is carried out by using survey data (calculated excavation earthwork volume 240301.13m^3) and UAV aerial photography data (calculated excavation earthwork volume 230738.51m^3) respectively, and the difference is within 5% (loosening coefficient and compaction coefficient are considered 1.0), which provides the basis for the settlement of earthwork volume.

Put the foundation excavation design model into the tilt photography system for comparison, analyze the relationship between the excavation boundary and the red line of the site, and correct the deviation in time.The photographic record is shown in Figure 6.

Fig. 5. UAV tilt photography

Fig. 6. Photographic documentation

4.3 Integrated pipeline integrated deepening application

The comprehensive deepening application involves on-site structural re-measurement, support hanger deepening design, and pipeline installation review.

1)Site structural re-testing.

There are manual review and 3D scanning review.

The manual review is based on the civil model and is suitable for poor lighting conditions on site or multiple reviews in the same area, focusing on the review of the net height of the structure, the width of the aisle, the reserved holes and complex areas of pipelines, etc.

3D scanning review is based on the on-site scanning image, generating point cloud model, and comparing with Revit model to review the deviation of both. Compared with manual review, the batch is fast and covers a large area.The on-site structural review is shown in Figure 7.

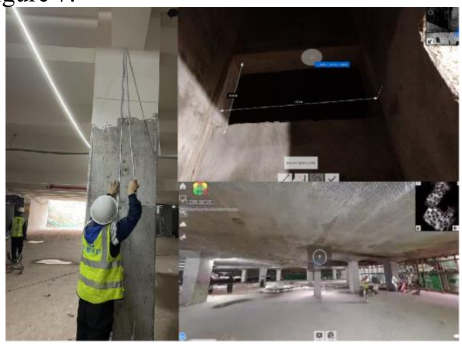

Fig. 7. On-site structural review

2)Support hanger deepening design.

Through the support hanger arrangement, in order to determine the plane position and installation elevation of each pipeline, draw the support hanger deepening drawings. The operator constructs according to this to ensure the consistency of construction model and field pipeline installation with implementability. The support hanger is installed on site as shown in Figure 8.

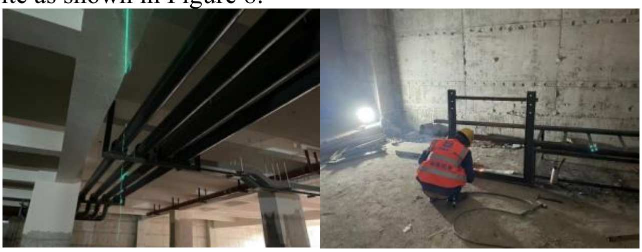

Fig. 8. Support hanger field installation

3)Pipeline installation review.

AR technology is used for pipeline installation handover, to understand the pipeline layout intuitively and assist on-site pipeline installation operation. During the installation process, the pipeline is reviewed on site, data is collected and compared with model values to find out error-prone points, average error values, etc., providing data basis for the subsequent deepening of the pipeline synthesis and turnaround. The installation process is reviewed in Figure 9.

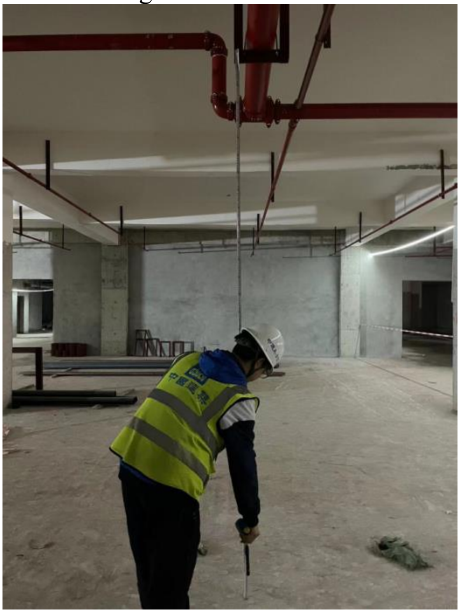

Fig. 9. Installation process review

4.4 Construction schedule simulation

Deepen the construction schedule plan into BIM visualization construction schedule simulation, reasonably analyze and check the reasonable compliance of the construction schedule plan, and propose optimization suggestions.

4.5 Auxiliary ultra-hazardous large program preparation and material quantity calculation

Cooperate with the technical department to prepare the construction plan of high support moulding and build the refined BIM model of high support moulding, the components include wooden formwork, steel pipe, mat, moment pipe, fasteners, bolts, etc.; the plan and vertical section layout of scaffolding can be directly exported to form the material list.[4]

4.6 Intelligent construction of IOT control

This project uses IOT + big data and other technical means to collect real-time data of personnel and machinery through front-end equipment (such as face recognition gates, personnel mobile positioning devices, video monitoring, noise, wind speed and dust monitoring, AI safety intelligent monitoring and other facilities) to provide intelligent warning and prediction for the management of the construction process, providing intelligent production, information construction and scientific management. Important guarantee.[5]

1)Man and vehicle management.

Real-time statistics on personnel attendance and attendance changes, personnel mobile positioning, vehicle entry and exit records, work distribution, safety monitoring and other data are analyzed to provide multi-dimensional data indicators to provide a basis for project labor management.

2)AI safety management, special equipment and video surveillance.

Through intelligent capture, special equipment monitoring and a full range of monitoring systems, the site operators are monitored for helmet and reflective clothing wear, equipment operation conditions and fire conditions, which are fed back to the engineering data application center to help users manage the construction site in a multi-dimensional manner.[2]

3)Wage supervision system.

Docking with banks for operators' salary accounts, the construction bureau of Liangjiang New Area allocates operators' salaries and provides the permission to view payment supervision information. Before paying wages, the real name system and attendance at the site are verified and passed before wages are paid.

5 Summary of BIM implementation

5.1 Economic benefits

See Table 1.

Table 1. Economic effects

Category	Applications	Benefit Analysis
Technology Management	BIM model-assisted drawing review	Identifying 16 major design problems and 231 effective problems, avoiding rework and reducing economic losses by about 500,000 RMB;
	Integrated pipeline integrated deepening application	A total of 847 collision tests were conducted to optimize the model pipeline paths and reduce the probability of reworking later in construction.
Site Management	Quality Management	To investigate a total of more than 400 quality problems, rectify them in a timely manner, improve management efficiency and simulate the observation route through BIM;
	Security Management	A total of more than 200 safety hazards were identified and rectified in a timely manner, with standardized arrangements for safety protection;

5.2 Social benefits

The Standing Committee of Chongqing Municipal Committee and Vice Mayor of Jiangbei District went to the project for research and field inspection of the project construction progress, and affirmed the application of new technologies such as BIM technology and intelligent construction system. Chongqing Municipal Committee Standing Committee to the project research as shown in Figure 10.

Fig. 10. Chongqing Municipal Committee Standing Committee to the project research

6 Conclusion

The application of BIM technology in Chongqing Jiangbei District People's Hospital Liangjiang Branch Project will enhance the efficient management of the project in terms of safety, quality, schedule, labor and green; provide important guarantee for the project cost saving, management level improvement, standardization system construction, talent training and brand promotion.

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