Application of BIM in Construction Management of Large Commercial Complex

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Abstract: This paper introduces the connection between construction management and BIM in large commercial complex projects. Through the technical means of BIM technology in construction site management, working face division, l design, steel structure deepening design, safety management, auxiliary simulation construction vehicle driving route, tower crane whole process management, etc. The purpose of shortening construction period, ensuring quality and quantity, ensuring safety and improving cooperation ability in the whole construction project is realized, and good economic benefit is obtained, and the application effect is remarkable.

1. Introduction

With the wide application of BIM technology in engineering construction projects, BIM technology can solve all kinds of complex buildings, drawing problems, road and bridge projects and other construction projects. By BIM, we can complete the functions of architectural design, parameter analysis and optimization, coordination and control of various specialties, fine management of engineering and coordination of integrated whole. Besides, BIM technology can go deep into the construction management stage of the project extensively, which plays a decisive role in simulating the construction process, visual bottom, site road layout, engineering quantity calculation, secondary optimization design and so on. As a result of the use of BIM, the construction period of the project has been reduced, the construction cost has been saved, the quality of the project has been improved, and the ability of coordination among various units and specialties has been improved.

Large commercial complex, can reflect a level of urban development, but also a collection of life, leisure, business, office, catering, entertainment and other full coverage of the comprehensive building. For large-scale commercial complex, structure selection usually involves prestressed concrete structure, steel structure, steel reinforced concrete structure, etc. At the same time, due to the uncertain demand of customers, it is often a trilateral project of design, construction and modification. The traditional two-dimensional architectural design is prone to problems such as drawing version out of sync, details can not be displayed, professional inconsistency, missing items and wrong items. By BIM technology visualization, information, collaborative design and other functions.

By marking and explaining the two-dimensional drawings derived from the BIM model, they are directly used as construction drawings. To ensure the relationship between relevant data is conducive to the modification of construction drawings design, reduce the trouble of post-processing, reduce the workload. Construction process is BIM to simulate, so that the progress plan of each construction process is displayed concretely and clearly, the rationality of the layout between the construction procedures is clearly understood, and the reasonable arrangement period between the construction processes is effectively assisted. BIM the auxiliary engineering quantity statistics, the concrete and masonry material list is derived directly with the help of the BIM schedule function, which provides the reference basis for each pouring concrete and masonry demand, and carries on the real-time comparison with the actual engineering quantity, strictly controls the error between the planned dosage and the actual dosage. Therefore, the application of BIM to large commercial complex can effectively reduce the design defects, save the project cost, improve the engineering quality, and solve the problem of engineering fine management.

2. Project overview

The project is located in the bustling area, the construction project land area of 63400m^2,4 underground ,7 above ground (local 9 stories), building height 60 m, total building surface 371900m^2.The building is a comprehensive leisure shopping center, One or two floors into the world's leading luxury brand flagship stores, 3-7 floors for shopping, dining and leisure activities; There are 11 large cinemas on the 4-7 floor, Can accommodate up to 1000 people to view the film; There's a big skating rink on the 6th floor, Ice rink covers 500m^2; Underground for shopping malls, parking lots, mechanical and electrical rooms and other construction, One of the first basement with a large supermarket, The 2-4 basement is mainly a parking lot, It can provide nearly 1300 parking spaces.

The project adopts the mixed structure of frame structure and steel structure, with many special-shaped structure members, complex joint treatment technology and large buried depth of structure (28-29m on the south side,22-23m on the north side).The whole structure belongs to super long seamless cast-in-place concrete structure. At the same time, the steel structure of the project is huge and the design joints are complex and diverse. The construction scale of the project is large, the special-shaped components are complex, involving many specialties, high quality requirements, difficult construction and tight construction period. through the application of BIM, taking green construction as the goal, ensuring that the energy consumption index, water consumption index, material loss rate, environmental management and so on meet the relevant standard indexes, the quality requirements, safety requirements and time limit requirements of the project are greatly improved.

3. Analysis of project priorities and difficulties

3.1. Organizational management focus analysis

(1) Small working face, difficult to implement

The site around the foundation pit of this project is narrow, and the site can be used in a limited way, especially in the construction process of underground structure, there is no sufficient site arrangement for the reinforcement processing plant and the parking point of large vehicles. Therefore, in the case of extremely narrow site, construction organization, working face division and site management are one of the difficulties in construction.

(2) Many construction staff, difficult management

The peak period of the construction staff of this project is more than 3000 people working at the same time, and the setting of the working face is difficult and the influence of cross operation is great. Therefore, when the construction personnel approach and face division is the most important in the construction preparation work.

(3) Engineering professional subcontracting, general contract management and coordination workload

This project specialty subcontracts many, needs the specialized staff to be more complex, each construction procedure joint operation time is many, therefore, how to carry on the subcontract to the project, each profession carries on the coordination is one of the construction difficulties.

(4) Engineering involves many specialties, complex work and many design nodes

This project involves many specialties, such as steel structure, curtain wall, fine decoration, mechanical and electrical installation engineering, outdoor overall engineering, etc., all of which need to be changed and coordinated twice.

(5) Large volume, tight duration

The single layer area of the project is large, the engineering volume is large, the foundation pit is deep, and there are many professional types of work involved, which span three winters during the construction period. How to complete the project construction work at the same time, coordinate the management of professional subcontracting, for them to create construction conditions in time, together with the general package to achieve the established goals, this is the problem we have to solve.

(6) Material and Equipment Procurement and Approach Organization

This project material construction fittings equipment variety, the quantity is big, and the new material, the new craft uses many, how guarantees the material construction fittings and the equipment on time guarantees the quality, the quantity enters the construction production is a management key point.

(7) Product protection

The fine decoration of the project is large, the standard is high, the professional interspersed quantity is large, the working team and the number of people are numerous, the protection of the finished building product is the key point of management.

(8) Vertical Material Transport Coordination

In this project, the vertical transportation distance is large, the transportation quantity is large, the construction peak period, especially the above ground structure construction stage, how to organize and distribute the vertical transportation capacity reasonably and effectively is the key point to ensure the smooth progress of the later project.

3.2. Analysis of construction technical difficulties

(1) The basement nodes are many and complex, the waterproof area is large, and the waterproof quality control is difficult

The basement area of this project is large, the waterproof work quantity is many, the strict request waterproof, the basement quantity is many settlement joint and so on, the construction procedure is complex, and the waterproof construction is unpredictable, needs to be taken as the focal point to carry on the management.

(2) High requirements for temperature and quality of concrete during construction

A large basement area ,1.2 m. thick floor Therefore, in order to control the excessive hydration heat in concrete and produce the large temperature stress caused by the excessive temperature difference between inside and outside of concrete, the concrete cracks are prevented. Therefore, one of the key points of this project is the control of mass concrete.

(3) The measurement requires high precision and complex measuring points

The irregular height and elevation shape make the plane axis cross with the elevation of the elevation to form different construction plans, the layout of the construction plane is complex, the selection of measuring points, the layout of pipelines, the construction of civil construction and so on have brought great inconvenience to the construction positioning. It is difficult to make clear the position of the axis and elevation of the project.

(4) Large amount of formwork is required and the form of supporting die is complex

The structure span of the project is large, the elevation between the layers of each structure is not uniform, the layer in some parts of the project is more than 19 m, and the design of the height and width of the beam section is accurate. Therefore mm, the demand of beam formwork is increased.

(5) High requirements for cracking prevention

The underground structure of the project is 294 meters long and 188 meters wide; the above ground part is 275 meters long and 167 meters wide; there is no expansion joint in the structure design drawing, which belongs to the typical super long concrete structure and is prone to harmful cracks. Therefore, the length of 60 meters after pouring belt.

(6) Steel structural members are widely distributed, with many structural styles and complicated construction difficulties

The steel structural members of this project are widely distributed, with many structural styles and complex construction difficulties. The total number of steel members such as steel tube concrete, steel

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truss structure and composite members is as many as 10,000. If the steel members can not be reasonably and meticulously divided, it will lead to the construction site to the specifications, quantity, material and other raw materials required for construction is not clear enough, which will have an impact on the construction quality and delay the construction progress. Therefore, the classification and quality control of steel structure is the focus of construction.

4. Application and Innovation of 4BIM in Construction

The key and difficult problems of the project are combined with the BIM, the characteristics of the BIM technology are brought into full play, the construction scheme and construction method are adjusted in time to avoid two reconstruction and save materials. Reduce time limit, etc. Below introduces BIM use and innovation research in construction.

4.1. BIM Auxiliary construction site management

Visualization is one of the characteristics of the BIM. Three-dimensional simulation of construction planning is carried out, and reasonable and efficient design of construction plane layout and field planning in construction site is carried out to avoid problems that may not be seen in two-dimensional plane. Figure 1 and Figure 2

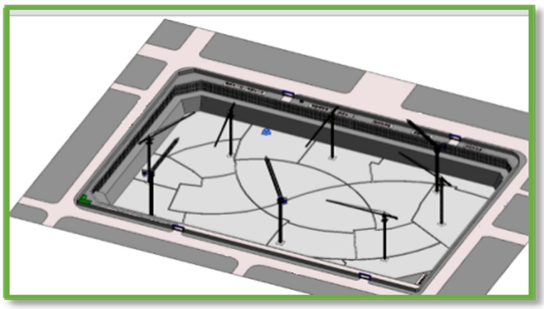


Figure 1 Visualization of construction site

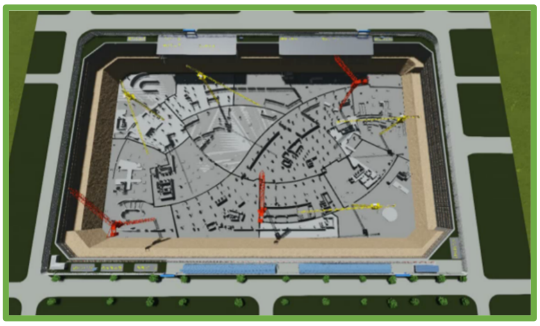


Figure 2 Three-dimensional simulation of construction planning

4.2. BIM Auxiliary work interface division

By using the BIM model, the working interface is divided into several different parts and distinguished by different colors, which can express the partition of the interface more intuitively, and at the same time, the specific boundary of each working interface can be viewed in the plane view. Clearly represent each partition. Figure 3 and Figure 4

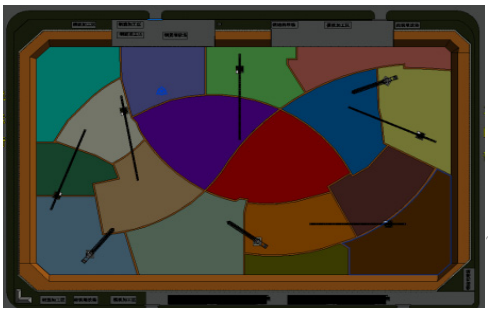


Figure 3 The working interface distinguished by different colors

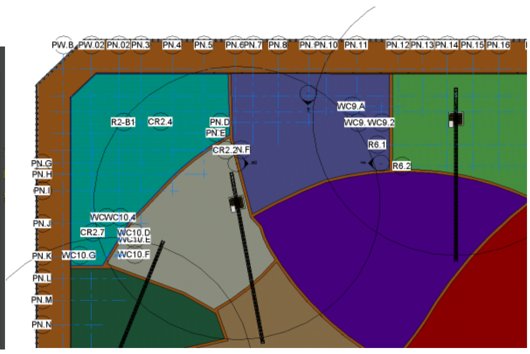


Figure 4 The specific boundary of each working interface in the plane view

4.3. BIM Optimization of connection point structure of steel bar and steel structure

For the more complex steel bar joints, the Revit software is used to model the steel bar layout of the column joints, the number and length of the steel bar, and the convenience of the steel bar processing. As shown in Figure 5

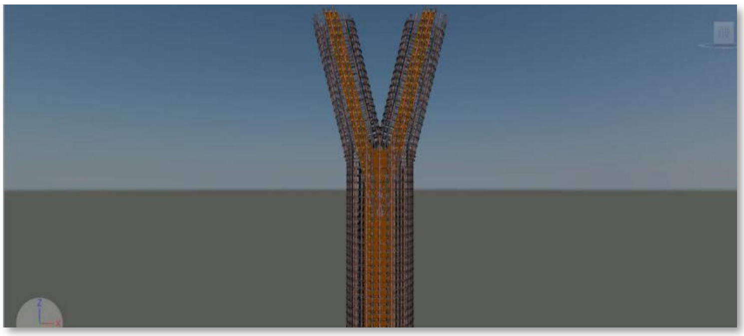
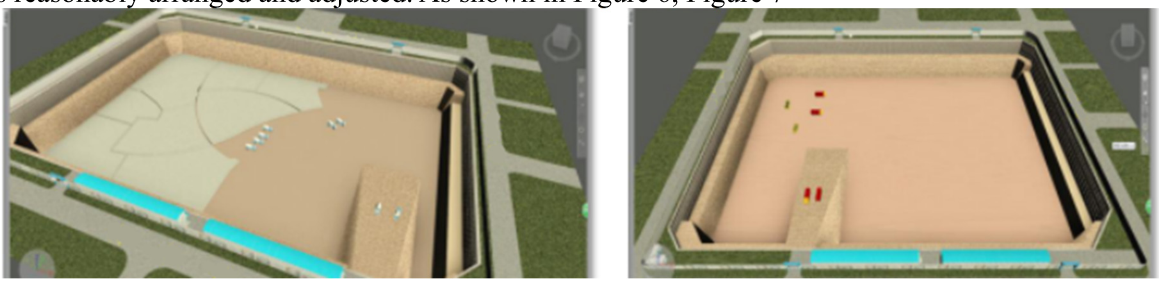


Figure 5 BIM Optimization of connection joints of auxiliary reinforcement and steel structure

4.4. BIM Auxiliary simulated construction vehicle route

By means of BIM simulation technology, the vehicle driving route in the field area is simulated during earthwork excavation and floor pouring, the site construction is guided, and the construction sequence is reasonably arranged and adjusted. As shown in Figure 6, Figure 7



BIM Road route for auxiliary construction vehicles
Figure 6 Vehicle driving simulation for pouring
Figure7 Vehicle driving simulation for concrete of bottom slabearth excavation

4.5. BIM Construction of Auxiliary Simulated Bottom Barrow Adjustment Method

By using BIM to simulate the construction of bottom plate, the rationality of sequence is discussed, and the best construction scheme and construction sequence are selected. As shown in Figure 8.

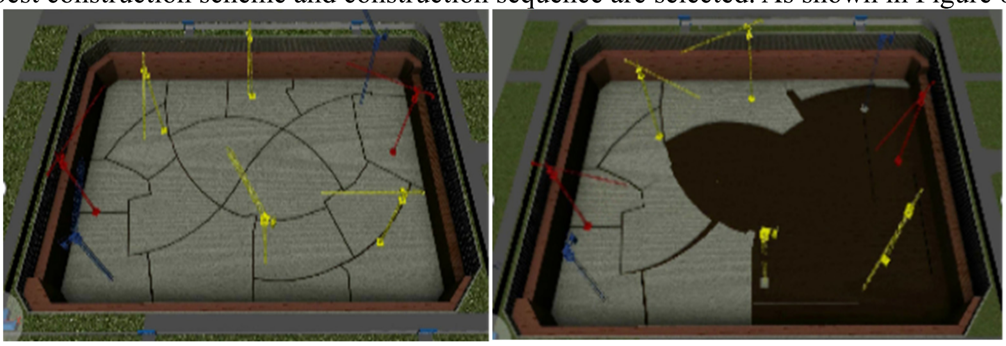


Figure 8 BIM Construction of Auxiliary Simulated Bottom Barrow Adjustment

4.6. BIM Auxiliary Construction Technology Simulation and Visualization

At the same time, the three-dimensional model is used to visualize the bottom, which is convenient to count the construction amount and prepare for the later resource consumption. As shown in Figure 9

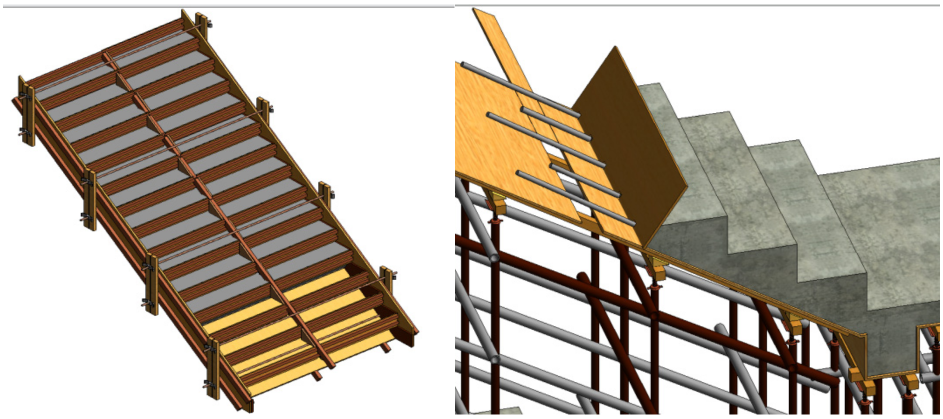


Figure 9 BIM Auxiliary Construction Technology Simulation and Visualization

4.7. BIM Construction of Auxiliary Giant Conversion Steel Beam

By using the BIM deepening design to carry on the reasonable section to the conversion steel beam, through the tower crane hoisting to the returned roof reinforcement floor slab carries on the section slip, the assembly, the welding, selects the hydraulic hoist to cooperate with the computer synchronous control and the sensor inspection system to carry on the one-time overall lifting. As shown in Figure 10

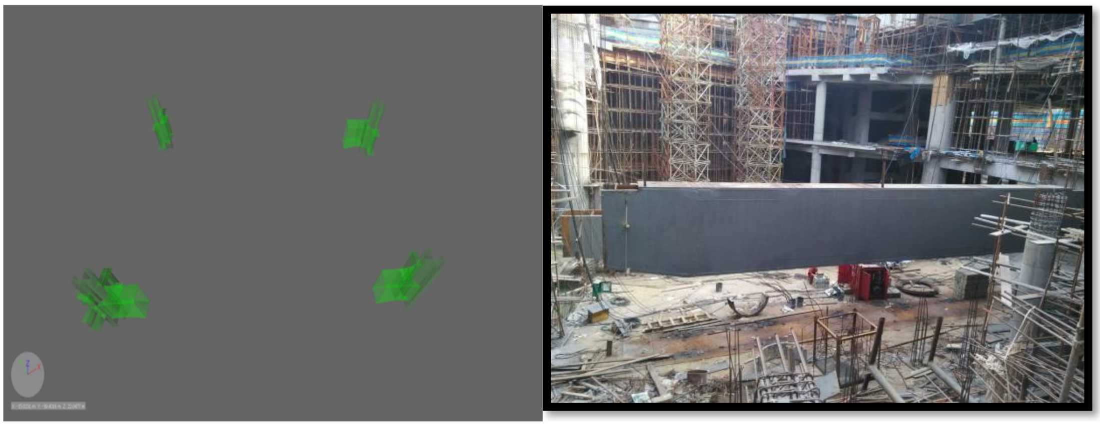
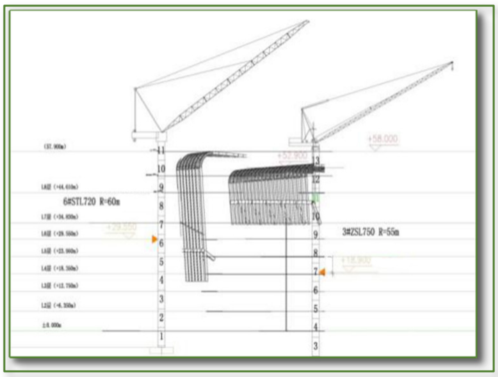


Figure 10 BIM Construction of Auxiliary Giant Converter Steel Beam

4.8. BIM Auxiliary tower crane selection arrangement, installation, demolition simulation and process control

A total of 12 tower cranes are set up on the spot, of which 6 heavy tower cranes are mainly responsible for the construction of steel structure within the coverage area. Using BIM to do any section of tower crane connection, the relationship between tower crane operation and main structure position is checked, and the rationality of group tower arrangement is studied. Figure 11

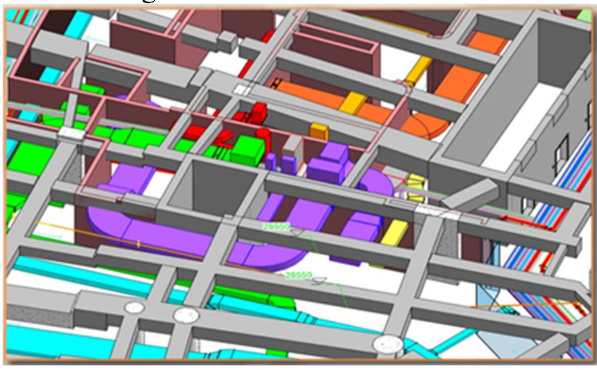


Number of tower crane	Model number of tower crane	Coverage area (m)	Max weight limit(t)	Tip weight limit (t)	Application
1#	STT293	74	18	2.7	steel structure
2#	STT753	80	40	5.4	steel structure
3#	ZSL750	55	50	7	steel structure
4#	TCT5513-6	45	5.21	1.95	
5#	TC8039-25	80	25	3.9	steel structure
6#	STL720	60	25	9	steel structure
7#	ZSL750	55	50	7	steel structure
8#	TCT5513-8	45	5.21	1.95	
9#	TCT5513-8	45	5.21	1.95	
10#	ST5515B	45	5.21	1.95	
11#	ST5510	45	6	1.62	
12#	TC6015-10E	40	8.49	3.09	

Figure 11 BIM Selection, Installation, Removal Simulation and Process Control of Auxiliary Tower Crane

4.9. Visualization of electromechanical design

The model of various parts (such as refrigeration room, thermal station, etc.) is established, and the architecture, electromechanical and structural specialties are integrated into one body to explore the rationality of the overall layout. And the collision check between the components of each model, as shown in Figure 12~15



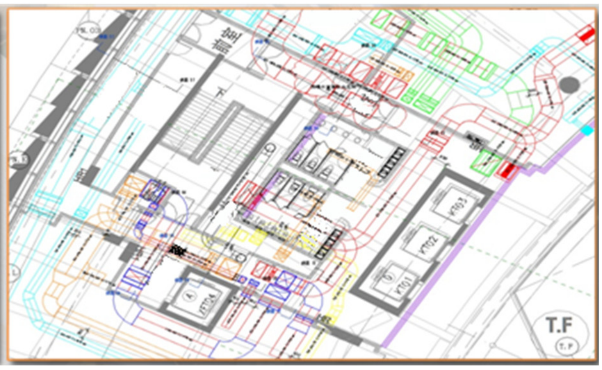


Figure 12 A partial 3D view of the fifth floor
Figure 13 Local ichnograph of the fifth floor

Figure 14 The ichnograph of the refrigerating station and heat power station in the west
Figure 15 The partial 3D view of the inside refrigerating stationin the west

4.10 .Pipeline collision detection and optimization

BIM is used to check the collision of electromechanical pipeline and generate collision report, so as to solve the collision site one by one. as shown in Figure 16; according to the inspection report, the 3d model of the pipeline is located and modified. Compare the beauty and cost of pipeline layout and

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select the best design scheme.

The following figure is a comparison of the comprehensive layout of the refrigeration engine room in Henglong West District of Dalian: as shown in Figure 17;

Conflict report

Conflict report project file:Y:\L5\BIM Model\L5-Ventilating model(full).rvt
Creation time:June 23,2014 20:48:29
Time last changed:

	A	B
1	air conduit:rectangular air conduit:DLHL air conduit-mark6057:ID2094445	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark4588:ID1373810
2	air conduit:rectangular air conduit:DLHL air conduit-mark6057:ID2094445	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark4589:ID1373812
3	air conduit:rectangular air conduit:DLHL air conduit-mark6057:ID2094445	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark4590:ID1373814
4	air conduit:rectangular air conduit:DLHL air conduit-mark6057:ID2094445	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark4591:ID1373835
5	air conduit:rectangular air conduit:DLHL air conduit-mark7711:ID2455957	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark5149:ID1402066
6	air conduit:rectangular air conduit:DLHL air conduit-mark6L6FFFFFFFFFFFFFFFFF:ID2128474	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark5349:ID1415074
7	air conduit:rectangular air conduit:DLHL air conduit-mark8161:ID2529749	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark5768:ID1439087
8	air conduit:rectangular air conduit:DLHL air conduit-mark8161:ID2529749	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark5770:ID1439140
9	air conduit:rectangular air conduit:DLHL air conduit-mark8161:ID2529749	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark5874:ID1445618
10	air conduit:rectangular air conduit:DLHL air conduit-mark8161:ID2529749	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark5875:ID1445656
11	air conduit:rectangular air conduit:DLHL air conduit-mark7389:ID2438607	L5-air conditional supervisor model(full).rvt:pipeline:pipeline type:DLHL air conditioning pipe-mark6299:ID1471865

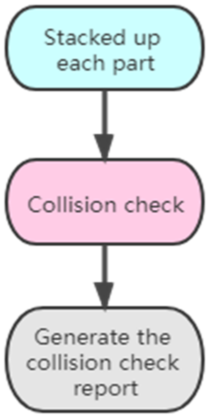
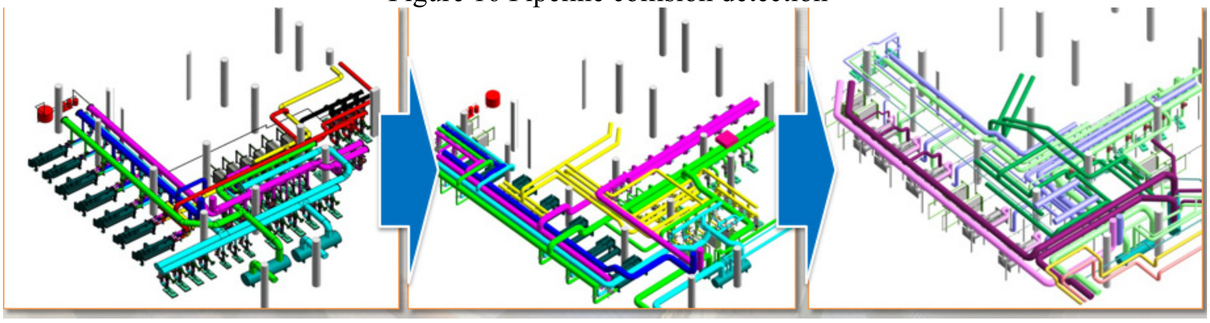


Figure 16 Pipeline collision detection



Plan1 The original layout of machine roompipeline and equipment
Plan2 Optimize machine roompipeline arrangement and refrigerating station
Plan3 The final optimization of machine room pipeline arrangement, refrigerating station and water pump etc.equipment

Figure 17 Dimensional optimization of pipe lines

5. Conclusions

Through the combination of BIM and the key and difficult problems of the project, giving full play to the advantages and characteristics of the BIM, carrying out the management of the construction site, the division of the working face, the parameterized design, the deepening design of the steel structure, the safety management, the auxiliary simulated construction vehicle driving route, the whole process management of the tower crane, etc., the construction management, the electromechanical installation management, the quality management, the safety management and the environmental management of the whole project are guaranteed to achieve the expected quality and safety objectives.

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