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Application of BIM Modeling in Comprehensive Optimization of Underground Garage Electromechanical Pipeline

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Abstract

This paper studies the advantages of BIM Technology compared with traditional design technology, and the application of BIM based electromechanical pipeline in different design schemes. To explore whether the introduction of BIM Technology in the design process of large underground garage can play a guiding and strategic role in the key stage of its construction, that is, in the deepening stage of electromechanical pipeline. And through the case study -- Plot 2, North District, Jiangshan City (Jiangshan Wangfu) - In the basement BIM modeling project, BIM Technology is introduced into the project, and the electromechanical pipeline optimization model is established. The application results of the model are tested, and the economic and technical analysis is carried out. The application of BIM modeling in the comprehensive optimization of underground garage electromechanical pipeline can improve efficiency, reduce cost and shorten construction period.

Keywords

BIM Modeling; Pipeline Application.

1. Development and Application of BIM Technology

BIM modeling is a new kind of information management, which is more and more used in the construction industry. Its full name is building information modeling, which requires all parties involved in the construction to integrate all the information in a unified database in the design, construction, project management, project operation and other processes, the real information of buildings is simulated by digital information simulation, which provides a platform for the whole life cycle management of buildings. In the operation process of the whole system, the owner, designer, supervisor, general contractor, subcontractor and supplier are required to coordinate in multiple channels and directions, and carry out daily maintenance and management through the online file management collaboration platform.

Taking the actual case as the research object, BIM building information model is established to restore the processof comprehensive optimization of electromechanical pipelines in underground garage. The promotion of constructionprojects is divided into four stages: early decision-making, scheme design, construction and operation. According to the depth of design, the project design stage can be divided into three stages: scheme design, preliminary design andconstruction drawing design. BIM Technology is gradually applied in all stages of the construction field, from the schemedesign to the construction stage and the later operation and maintenance stage, there is BIM application space. From the perspective of requirement analysis, the scheme design stage will determine the framework of the whole project and reflect the relationship between function and cost. This stage is very meaningful for the whole project cycle; The cornerstone of the preliminary design of the whole project is the embodiment of technicality and professionalism. Through many calculations, the design and layout of professional components such as architecture, structure and equipment are completed, and the

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relationship between relevant specialties is coordinated; In the construction drawing stage, the creativity is small and the workload is large. In this stage, more attention is paid to the implement ability of the design results and the later operation of the project, which is more reflected in the operability, and the structural details of each specialty need to be solved. The influence of BIM Technology in the whole life cycle of buildings is shown in Figure 1. By introducing BIM Technology into engineering projects, the errors in construction stage can be effectively reduced before the construction unit starts construction, such as comprehensive pipeline adjustment, staggered work of various specialties, etc. Research and practice show that BIM Technology can play a huge role in the whole life cycle of engineering projects, Specific performance in accurate planning, accurate and timely construction, improve the overall efficiency of the project and other aspects.

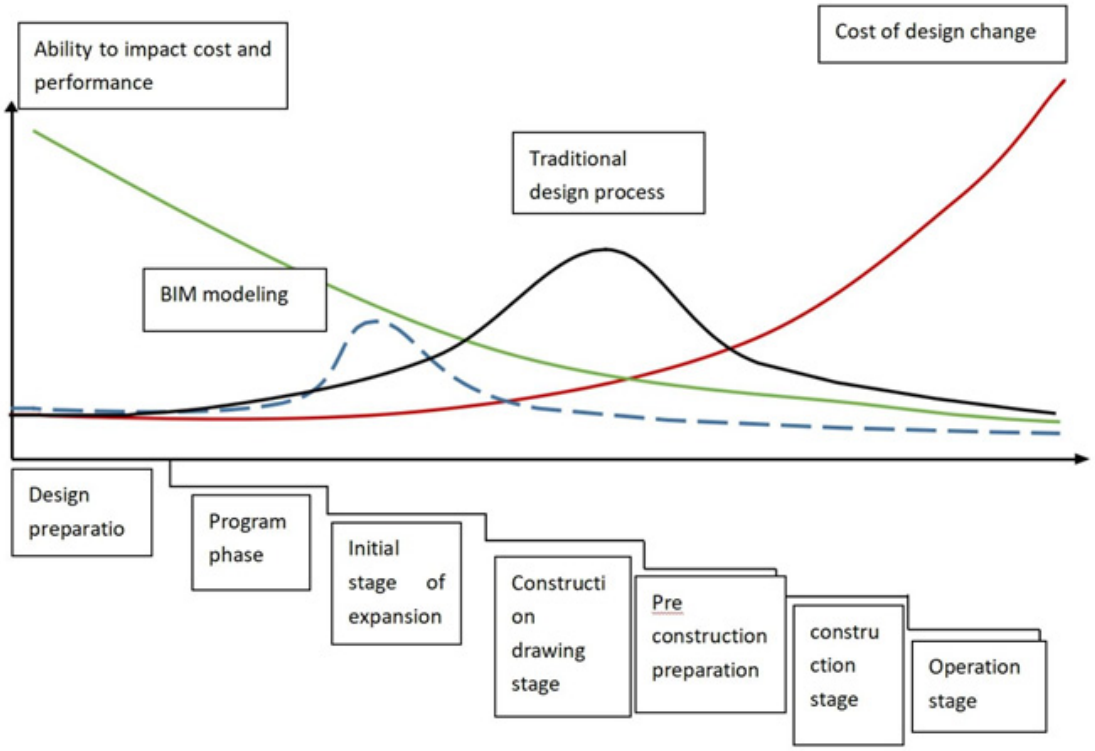

Figure 1. Impact of BIM Technology on the whole life cycle of Construction Engineering

The application of BIM modeling in the comprehensive optimization of underground garage electromechanical pipeline has the following significance: first, the 3D visualization of design drawings can be realized, which can more intuitively see the pipeline layout; second, through the introduction of BIM model, it is easier to find the staggered difficulties of pipeline layout, find the areas with dense pipelines, and find the solutions; third, through the introduction of BIM model, it is easier to find the staggered difficulties of pipeline layout, It can effectively strengthen the communication among different specialties and reduce the construction conflicts among different specialties; fourthly, it can effectively reduce the number of rework; fifthly, it can shorten the construction time of electromechanical pipeline design stage and electromechanical pipeline installation stage.

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2. Application of BIM Modeling in Comprehensive Optimization of Underground Garage Electromechanical Pipeline

There are a large number of professional components in the large underground garage, and the traditional design drawings are miscellaneous, so it is difficult for the relevant staff to find the conflicts and contradictions among the components in the drawing review and inspection stage; there are many kinds of comprehensive pipelines in the underground garage, such as air ducts, pipes, pipes, etc Strong and weak current bridge system, water supply and drainage system, heating system, water pipe and so on, each system component is numerous, pipeline cross layout, in the local pipeline dense area cannot meet the net height requirements of the garage.

(1) During the progress of the project, the BIM modeling file directory is compiled, as shown in Figure 2.

BIM Technology can usually be applied in the following stages: bidding stage, award stage, comprehensive management stage and construction stage. According to different application requirements, there are respective application standards. The application stage of this project is the construction stage, which requires high accuracy of the model. BIM application is carried out according to the BIM application standards in the construction stage.

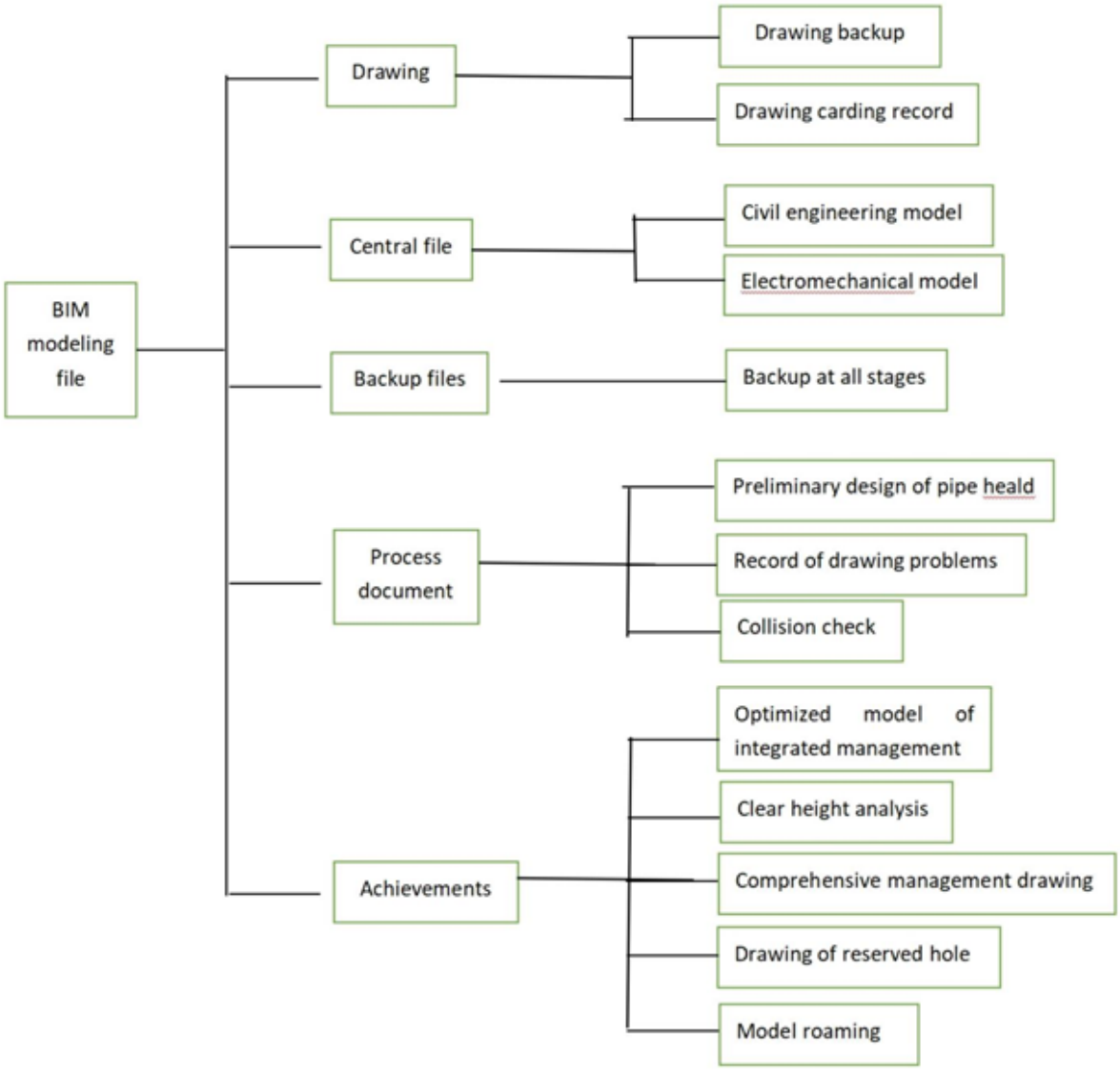

Figure 2. BIM modeling file directory

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(2) This paper analyzes the shortcomings of the traditional integrated pipeline design process and design, as well as the requirements of integrated pipeline design optimization. Combined with the characteristics of BIM, the advantages of BIM are obtained.

The traditional in-depth design is carried out on the 2D level. In the aspect of software application, most of them are realized through CAD, which is not the case In the aspect of information transmission, there are great defects. Due to the lack of information transmission, the professional communication is not smooth, and the information can not be better expressed. In the process of mechanical and electrical deepening, the staff need to design the system design drawing of mechanical and electrical installation through the preliminary design given by the designer, taking the actual project requirements as the benchmark, and taking the structure of the building as the reference In this drawing, we need to make clear the work purpose and work demand of each specialty, so as to integrate the construction drawings of each specialty, give the specific requirements, and then delegate to each professional personnel for detailed drawing design. Due to the fact that the design drawings of different specialties are often completed independently by their own professionals before the start of the project, and the lack of communication and information sharing in the early stage of the project, the drawings obtained in the mechanical and electrical deepening process are highly independent and cannot be used directly. If they are constructed directly, there will be inevitable contradictions. However, the traditional in-depth design completely relies on manual inspection, and the drawings of various specialties are integrated together to compare conflicts and differences, which brings great work pressure to the relevant staff, and it is difficult to ensure the accuracy of the work. It creates great difficulties to find the pipeline concentration area in the comprehensive pipeline layout, which can not be solved by the traditional in-depth design. There is a certain priority for the coordination between specialties. The priority is determined by the industry habits and the actual situation of specific construction projects. Generally speaking, it should be ranked from high to low, from HVAC specialty, water supply and drainage specialty to strong and weak power system. In case of contradiction, the lower ranked specialty will give way to the higher ranked specialty. However, there are obvious deficiencies in this professional coordination mode, which not only can not guarantee the achievement of the initial goal of the project, but also easily cause conflicts and dissatisfaction among professional construction personnel, and reduce the construction efficiency and overall quality of the whole project. Therefore, the traditional mechanical and electrical deepening design method has the disadvantage of unadjustable. There are many kinds of software based on BIM Technology, including basic modeling software, such as Revit, Tekla, roaming software, such as NavisWorks, fuzor, rendering software, such as Lumion, based on the model management platform: bim5d, BIM Technology in the information transfer function has gradually met the needs of the construction site, and can achieve more two-dimensional expression based on the original can not achieve the goal.

After introducing BIM Technology, the in-depth design method can effectively make up for the shortcomings of the traditional mechanical and electrical in-depth design. The construction process and construction design have been qualitatively changed, which completely breaks the traditional mechanical and electrical in-depth construction process. It can greatly improve the work efficiency of the whole project team and reduce the conflicts and frictions between various professions, Achieve the overall goal of the project on the premise of ensuring the achievement of each professional goal.

Based on BIM Technology, the mechanical and electrical pipeline deepening design method through the application of BIM Software, through the computer to build a model, to construct a 1:1 architectural design model with the actual project, so as to integrate the two-dimensional drawings of various specialties in the early stage of construction, import into the computer model, in the modeling process, you can find problems online and adjust the pipeline layout,

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find the collision points in the modeling process, and solve the collision points synchronously through communication with various specialties, Effectively avoid the late pipeline collision and professional contradictions. The current model operation method is still based on the premise of deepening scheme formulation, which requires manual modeling and synchronous inspection, and also has the function of model self inspection. The model can automatically check the collision points of pipelines, and then manually screen the dense areas and collision points. Although there are many manual steps in the current BIM modeling process, compared with the traditional deepening method, after the introduction of BIM Technology, the mechanical and electrical deepening design process becomes more simple and efficient, and effectively improves the accuracy of the design, which can ensure the overall planning of the project as well as the design objectives of each specialty.

At the same time, the introduction of BIM Technology in the deepening design can directly obtain the 2D drawings of the design and the required labor workload, effectively reduce the manpower input, reduce the waste of materials and time. When designing large-scale projects, stakeholders such as owners and investors often need to follow up in the construction process. The application of BIM Technology can enable the owners to carry out three-dimensional simulation, test the engineering effect, eliminate the concerns of the owners, and intuitively show the overall appearance of the building and the layout direction of pipelines to the owners.

(3) On the basis of traditional integrated pipeline design, combined with BIM Technology, the implementation content and method of integrated pipeline design based on BIM are proposed. The integrated pipeline optimization under BIM application is mainly divided into two stages, stage 1 and stage 2, which are modeling stage and integrated optimization stage respectively. Through the establishment and combination of three-dimensional models, the model roaming, collision detection, finding out the design "error, collision, leakage and deficiency" problems are completed, and then the optimization is realized through BIM modeling.

In the detailed design stage of BIM Technology Application, the application forms include: model, three-dimensional visualization to guide the construction, issuing the single professional drawing, reserved hole drawing, support and hanger layout drawing after the comprehensive deepening of the pipeline, etc., which realizes the visualization that cannot be realized in the traditional detailed design, and is more conducive to the on-site construction of the project. Taking the support and hanger as an example, the layout of the support and hanger can be fully expressed in the model, and the type of support and hanger arranged at each node can be directly arranged in the model. Observe the effect in advance, and check the support and hanger by using BIM software to check whether it meets the stress requirements. BIM is not only applied in the support and hanger It can also achieve the effect of recheck calculation of equipment parameters, collision check, model roaming, and realize the reasonable layout of the construction site.

BIM modeling is applied to the comprehensive optimization of underground garage mechanical and electrical pipelines. Based on the expression of BIM model, the process of model building, roaming and comprehensive through the software such as Revit, NavisWorks and fuzor. This process replaces the actual situation of the construction site in the construction process, and the design is adjusted according to the model in the design process. The comparative analysis of traditional in-depth design and BIM modeling is shown in Table 1.

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Table 1. Comparative analysis of traditional in-depth design and BIM modeling

Traditional deepening design	Modeling with BIM	
(1) Manual calculation of civil engineering quantity	(1) Be able to use BIM software to build civil engineering model, scientifically calculate civil engineering quantity and prepare civil engineering budget	Civil engineering calculation
(2) Manual calculation of installation quantities	(2) Be able to use "BIM installation calculation" software to establish installation model, scientifically calculate installation quantities, and prepare installation budget	Installed calculation
(3) None	(3) Can use "BIM browser" for full professional model browsing, animation roaming	BIM browser
((4) Two dimensional drawings can not check the problems in mechanical and electrical installation	(4) Be able to use "BIM drawing review software" for collision detection of professional models, systems, components, etc	BIM image review software
(5) None	(5) Be able to use "bim5d" to simulate the construction process, predict the capital, materials and labor required every month and every week, find problems in advance and optimize them	BIM 5D

3. Application Case of Underground Garage Electromechanical Pipeline Comprehensive Optimization

In the case of BIM modeling project of basement of No.2 block in Jiangshan North District (Jiangshan Wangfu), the basic situation of the project is shown in Table 2, and the application of BIM is analyzed and verified The role of technology in the optimization of underground garage mechanical and electrical pipelines is committed to helping the project designers of construction units find and solve the problems of pipeline collision and too many rework times in the design stage of large underground garage mechanical and electrical pipelines, so as to provide some practical and theoretical reference for the in-depth design of underground garage mechanical and electrical pipelines.

Check the basement pipeline of No.2 plot (Jiangshan Wangfu) - basement in Jiangshan North District. See Figure 2 for the collision inspection of air pipe and spray pipe. In this paper, the existing problems in the construction of underground garage in the basement BIM modeling project of "Jiangshan North District plot 2 (Jiangshan Wangfu)" are sorted out, and the optimization suggestions are put forward. The improvement is made from the aspects of BIM application standard, model creation, pipeline collision inspection and integrated management optimization design. The specific research contents are as follows:

During the collision inspection between the electromechanical model of BIM modeling project of No. 2 plot (Jiangshan Wangfu) basement in Jiangshan North District, more than 500 collision points were found by using multi-disciplinary BIM model. Figure 3: air duct and spray pipe collision, intersection of axis D of axis C and axis C of axis B. If the construction is carried out according to the original CAD drawings, it will cause unnecessary bending to spend about 120000 yuan. According to the principle of optimization design, the collision point is optimized, which greatly reduces the problems in the design drawings, avoids the rework and cost waste in the later construction of the project, and improves the design and construction efficiency and construction quality. In BIM modeling project of No.2 plot (Jiangshan Wangfu) - basement in

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North District of Jiangshan City, material utilization by BIM Technology can save 10% of materials, control the material mobilization plan, reduce the time required for material personnel to statistics materials, and achieve the goal of local material inspection and overall control.

Table 2. Basic information of plot 2 (Jiangshan Wangfu) in North District of Jiangshan City

entry name	Plot 2, North District, Jiangshan City (Jiangshan Wangfu) - basement	Construction unit	Jiangshan Jinghong Real Estate Co., Ltd
Project classification	Housing construction engineering	Project territory	Plot 2, North District, Jiangshan City
Nature of construction	Newly build	Engineering purpose	Civil architecture
Contract category	To subcontract	Contract signing date	September 12, 2019
Total investment (10000 yuan)	1020	Total area (M2)	43003.7
Parking spaces of underground garage	1088	Classification of fire protection design	Class 1
Seismic fortification intensity	6 degrees	Protection grade of civil air defense engineering	Class a nuclear grade 6, grade 6, chemical protection grade (c)
Construction scale	The construction area of the project is 43003.7m2, the civil air defense area is 10109.05m2, and the number of building floors is one underground floor. (BIM modeling, component collision inspection, clear height analysis, electromechanical comprehensive optimization)		

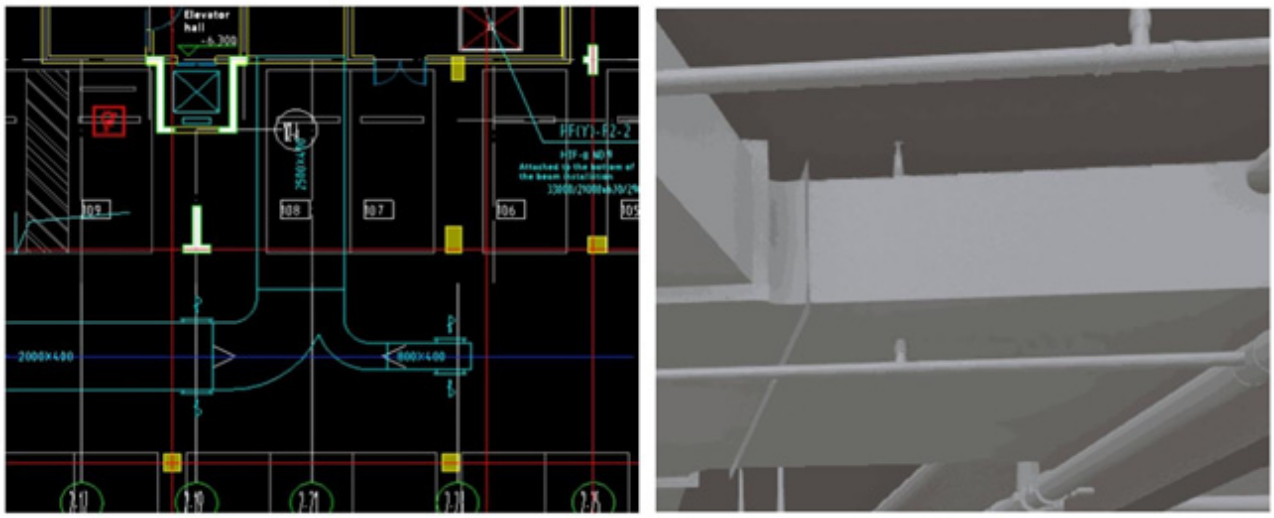

Figure 3. Air duct and spray pipe collide, and the intersection of axis D of axis C and axis C of B

4. Summary

BIM Technology is superior to traditional design technology. The designers of the construction unit find and solve the problems of pipeline collision and too many rework times in the design stage of the mechanical and electrical pipelines in large underground garage, and the application research of the comparison and selection of electromechanical pipelines based on BIM in different design schemes. The paper explores whether BIM Technology can play a guiding and strategic role in the key stage of construction, that is, in the deepening stage of

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mechanical and electrical pipelines. The case "BIM modeling project of Jiangshan North District (Jiangshan Wangfu) - basement" proposed that BIM Technology was introduced into the project, and the optimization model of mechanical and electrical pipelines was established. The application results of the model were tested and the economic and technical analysis was carried out. BIM modeling of basement. The repeated setting and overlapping of work contents are avoided, and the unclear responsibilities and the phenomenon of mutual disfigurement are avoided; 3D visualization of design drawings can be realized, and the pipeline layout can be seen more intuitively; through the introduction of BIM model, It is easier to find the staggered difficulties of pipeline layout, find the area with dense pipelines and find solutions; effectively strengthen the communication among various disciplines, reduce construction conflicts of each discipline; effectively reduce rework quantity; shorten the construction time in the design stage and installation stage of mechanical and electrical pipelines.

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References

[1] Rongmunich, Zhang Erlong, golly, etc.Application of BIM Technology in the synthesis of mechanical and electrical pipelines [J]. Building technology, 2016, 47 (2): 142-143.

[2] Tengshuai. On the application of Bim in the field of construction engineering [J]. Jiangxi building materials, 2011 (11): 261264.

[3] Kongsong. Application and Prospect of BIM Technology in Architectural Electrical Design [J]. Modern building electrical, 2013, 4 (9).

[4] Niubosheng. Application of BIM Technology in project progress management [D]. Chongqing University, 2012.

[5] Application of Yu Si Wen BIM Technology in pipeline balance of chain supermarket installation engineering [D]. Nanchang University, 2014.

[6] Lijianbo, mu Huaqian. Analysis of BIM collaborative design of building electrical based on Revit. Intelligent building electrical technology, 2015, 10.