Application Research of BIM Technology Used in Port Handling System Design

Panpan Zhang 1, 2, *, and Qingwei Chen 1

1China Waterborne Transport Research Institute, Beijing, China.
2China Key Laboratory of Logistics Equipment & Control Engineering, Beijing, China.

*Corresponding author e-mail: zhangpanpan@wti.ac.cn

Abstract. Building information modelling (BIM) technology has been developing rapidly in recent year. BIM was firstly introduced in the area of architectures. With the development of the waterborne transport and the port construction in China, BIM technology is gradually being adopted. In this paper, applications of BIM technology used in port design were summarized. And a transfer station was built via BIM software packages. Based on the transfer station model, suggestions about the application of BIM technology on port design were given.

1. Introduction

BIM has been developed to address issues in the design, construction and implementation of building projects [1-3].

2D drawings have been used to carry out design and to provide presentations and working drawings in the construction industry using CAD and other software packages in many years.

One major drawback of 2D design is the limited coordination of different drawings for the same building, because each drawing is drawn as an independent plan. This means any changes are done separately with modifications required on every document relating to the structure.

Consequently, extra time, effort and costs are incurred to the project for any amendments made to the proposed structure.

BIM technology can show these issues because information is unified and compiled into a single database. This allows each BIM virtual model to contain automated information extracted from this database. Besides, there are other advantages of BIM such as the ease of modification to aspects of a project by using just one model, controlling the project processes, minimizing the time and costs of a project.

BIM technology can provide help in the life circle of each project shown in Figure 1. When a project is built, the BIM technology plays an important role in the project operation and maintenance.

In China, the Ministry of Transport has issued serial of policies to strength the application of the BIM technology in the areas of transportation, especially in port construction area.

Port design is a systematic project. In the Port handling system, the transfer station is an important part which can provide a transfer point for the handling system. In this paper, the application of BIM Technology Used in Port were summarized. And a transfer station was built via BIM software packages.
Based on the transfer station model, suggestions about the application of BIM technology on port design were given.

![Diagram of BIM technology application areas](image1)

**Figure 1.** The application areas of BIM technology

2. **Application of BIM technology used in ports**

BIM technology is now widely used in the architectures. Recently, with the development of port and the stimulus of related policy, BIM technology is gradually introduced and applied in the engineering construction.

Two unloading berths with capacity of 50,000 tons and a loading berth with capacity of 10,000 tons were designed shown in Figure 2 and 3 via BIM technology by the software packages Revit [4]. In the project, the software was chosen for the 3D collaborative design [4]. The 3D model was build and the process layout generated by 3D model could be handed over to the designer for auditing. If mistakes were found, the design can be corrected in the 3D model. In the traditional way, it takes long time to adjust related design. The BIM technology helps to improve the efficiency of engineering design.

![Overall layout of the projects](image2)

**Figure 2.** The overall layout of the projects

![Process layout generated by 3D Model](image3)

**Figure 3.** The process layout generated by 3D Model
The software REVIT was chosen to build the power pipe model in the design of liquid chemical berth and the part interference could be easily found and solved [5]. In the early stage of the power pipe design, interference was found via the BIM model shown in Figure 4(a). By using the BIM technology, the arrangement of steam pipes was adjusted and the interference problem was solved shown in Figure 4(b).

![Interference and adjustment of steam pipes](image)

(a) the interference of steam pipes (b) the adjustment of steam pipes

**Figure 4.** The part interference and the adjustment of the steam pipe

Figure 5 shows the detail method of harbor electrical design using BIM technology [6]. In this project, the software packages Revit was used. However, the cable and the wire could not be in this model which is a drawback of this kind of software.

![Harbor electrical design model](image)

**Figure 5.** The model of the harbor electrical design

3. **BIM design of the transfer station in the port design**
Steel structure is widely used in the port bulk handling process design. The transfer station is an important part for the belt delivery system. In this paper, the transfer station was introduced to manifest the BIM design process. The transfer station shown in figure 6 is basically consisted of the equipment platform, the ladder platform, the main structure and the guardrails.
Figure 6. The composition of the transfer station

In order to facilitate the transfer station design, several modules which are widely used in the steel structure such as the tapered beam shown in figure 7 and the foundation plate shown in figure 8 were developed.

Figure 7. The tapered beam module  Figure 8. The foundation plate module

Figure 9. The partial view of the transfer station

By using the modules, the efficiency of the steel structure design shown in figure 10 was greatly improved and can be easily modified.
4. Suggestions on the part handling design

In the port design including handling process and engineering construction design, BIM technology can provide efficiency for both the designers and constructors. It is a systematic project in port construction and in China the BIM technology used in ports is still in the early stage. According to the transfer station modelling process, suggestions about the application of BIM technology were put up as follows:

1) Basic design rules like software, data exchange standards should be made before the project design stage is carried out.

2) In the design stage, modules should be prepared in order to facilitate the design. And during the design process, the project owner, the designer and the contractor should get together and exchange opinions about the design to improve the design.

3) Data protection of the design should be paid extra attention because electronic data is critical for BIM technology.

5. Conclusion

As the information technology develops these year, the BIM technology has been widely spread and put into use. In this paper, application of BIM technology used in port design including the planning design, power pipe design and electrical design were summarized. A transfer station in the bulk handling process was introduced. Several BIM modules was developed in order to fasten the design efficiency. A BIM model of the transfer station was made. In the last, suggestions on BIM technology used on port design were put up. In future, BIM technology will play more and more important role in port.

References

[1] He Guanpei, Wang Yiqun, Ying Yuken. BIM Pandect. Beijing: Chinese Building Industry Press, 2005.

[2] Wilson W.S.Lu. Building information modeling and changing construction practices. Automation in Construction, 2011(20):99-100.

[3] Heikki L, Keijo P. A new-generation safety contest in the construction industry-along-term evaluation of a real-life intervention. Safety science, 2010, 48(5):12-13.

[4] Li Huashuai He Zunxiang, Application and Exploration of BIM Technology in Port Operation Design, Port Operation, 2016, 2:32-34.

[5] Huan Puhao, Xing Yaoyu, the application of BIM in the power pipe design for liquid chemical berth, Wuhan Investigation & Design, 2016.3:45-48.

[6] Wang Yang, Xia Jian, The Application of BIM in the Harbor Electrical Design, Construction& DesignForProject, 2015, 12:81-84+87.