Exploration Application of BIM technology on artificial island engineering

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Abstract. With the continuous development of the transportation industry, the project of artificial traffic island is attracting more and more attention. However, the traditional design method has not met requirements for the complex structures of artificial islands. This paper discusses the application of BIM technology in the field of the design for artificial islands. Based on the practical engineering, the paper further proposes how to effectively use the BIM technology in the complex designs of artificial traffic islands, and presents the application effect. Finally, the BIM technology is successfully and effectively applied to the implement of 3D collaborative design, visualization of engineering design, and demonstration of construction progress.

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1. Introduction

With the continuous development of the transportation industry, great bridges such as the cross-sea bridge is becoming more and more common, and the traffic artificial island is becoming more and more concerned as the important transportation hub of the bridge. The traffic artificial island project generally undertakes the transition joint function of bridge and submarine tunneling, involves many specialized types, many specialized interfaces and complex management, and the traditional design method is difficult to integrate and close the information during the whole design process[1]. As a new design method, BIM technology, based on 3D digital technology, integrate the building life cycle stages of engineering information and include physical information and geometry information, engineering information, manufacturing and assembly of the cost information, etc.; It is support for all participants of the project to invoke, modify and store the project information so as to realize all the phase of the building and the sharing of all the participating engineering information. [2]Using BIM technology to construct artificial island engineering construction will solve many problems existing in the construction of artificial island, and provide data support for operation of artificial island.

The Marine artificial island project generally includes[3] [4]: investigation stage, design stage, construction stage and operation maintenance stage; its construction has a standard complex, complicated construction conditions, construction technology, complexity in construction organization, supporting facilities and engineering scale, high investment cost, etc[5]; at the same time, the key technology lies in the determination of construction standard, location selection, acquisition of basic data, plane form, land domain formation and basic processing, monitoring and control etc.[6]

2. Methods
This article will take a look at the application of BIM technology in the construction of artificial islands and the current application of BIM technology in the practical engineering of the BIM technology, which is to explore the application of BIM technology in the works of artificial islands.

Application point of BIM technology on artificial island engineering:

1) Application of BIM technology in the exploration phase of artificial island

Based on BIM technology, it can more directly show the terrain geology of the area of the project area by using the software's powerful data processing power, which make the designer could better grasp the three-dimensional geological information and facilitate the design personnel to make reasonable site selection for the project. Because the software has strong data relevance, the modification of data can be timely reflected in the completed 3D model, which saves a lot of manpower due to data modification[7]. At the same time, according to the established 3D model earth volume can be directly calculated by the software, greatly reducing the workload of the designers.

2) Application of BIM technology in the design stage of artificial island

1) Multi-professional collaborative design applications

There are so many different types of engineering, and there are three major categories of hydraulic, road bridges, and buildings, each of which has more than a dozen separate specialties in each direction. In the construction of the traffic artificial island, each profession often needs to know each other's design intention, so as to carry on the accurate interface design, but the traditional design method, the concept has a great difficulty in the design of reasonable interface. Through BIM technology, a collaborative design platform can be used to establish a project document organization framework and develop a unified workspace and working environment. In the collaborative design platform, each professional can directly reference the established model and promote the orderly design of the project. At the same time, using the real-time update of the collaborative design platform, the modifications of the design can be returned to the associated professional in time, it can save the time of the manual delivery, and avoid problems such as delay in design feedback.

2) Application of BIM design in each specialty

The construction of the traffic artificial island generally takes on the function of island tunneling and bridge tunnel switching. The design of island tunneling and bridge tunneling interface is complicated, and the traditional 2D plane design is difficult to accurately indicate and communicate the design intent of the designer. Based on this complex spatial structure, the 3D space model can be created by using the BIM technology, the "What you see is what you get" is more directly presented in the design intent, which is convenient for the owner to make a prior decision, and reduce the amount of rework designed; based on the strong data correlation of software, the real-time feedback of modification design to the model is realized, and the labor time cost of modifying the design content is reduced. When the model is created, it's a quick way to calculate and produce the materials, and reduce the amount of repetitive labor, it's a lot more accurate than the human calculation. In conclusion, based on the BIM method, it is possible to improve the quality of the drawings by using technology to monitor the quality of the problem, and reduce the "error, leakage, collision and vacancy"[8].

3) Application of BIM technology in construction stage of artificial island

The construction of artificial island is lack of land support, which makes the construction more difficult, and its construction organization is more complicated. Before the construction of artificial island, BIM technology can be used to simulate the whole construction process by analyzing the construction model, and fully understand the nodes and difficulties of the project construction, so as to make reasonable construction organization plan and guide the construction in a reasonable and orderly manner[9][10].

4) Application of BIM technology in operation and maintenance of artificial island

Traffic island as a transport hub plays an important role in the whole traffic routes, guarantee the effective operation is necessary for the whole traffic routes open. As a result, the operation and maintenance phase of possible contingencies for early warning, emergency equipment damage to its important position quickly locate replacement maintenance is very necessary, and the traditional design method has been difficult to meet the requirements of the traffic island in the operating maintenance phase. BIM technology could correlate the complete and accurate correlation between real engineering
project and data model. Through simulation calculation of data model, it is possible to reasonably arrange the emergency plan, quickly and accurately position the engineering project to age and repair the emergency plan, and improve the operation and maintenance efficiency of the project.

3. Results and Discussion

This is an example of the work of the BIM design process in the construction of the artificial island, and the application of BIM technology in the construction of the artificial island is explained.

(1) Project introduction
The axis of the artificial island is 625m, lateral at its widest point is 456 m, the length of the revetment is 1622m, backfill forms an land area of 13.7 million m3, the structure of the island wall is adopted by inserting steel pipe pile structure + Pavement accropodes scheme.

(2) The establishment of the model
1) Software selection: Bentley digital platform for the series of software
2) Application of BIM technology
   a) Set up a project structure and work space
      The project uses ProjectWise based on Bentley of digital platform to create the file structure, hydraulic engineering designed by the professional staff will be the model into the appropriate folder for other professional design personnel reference, at the same time, it develops a unified work space and standard, ensure the unified data model.
   b) The creation of geological model
      The project is modeled on the geology of the project, which is based on the fact that it is based on a Bentley digital platform, and it is a model of the geology of the project, and it is transformed into a digital model, and the design team is able to get an intuitive sense of the region's geological vulnerabilities(Figure 1), and then take the appropriate measures to ensure that the design is in order.

   ![Figure 1. Geological Model](image)

   c) Terrain Processing
   The project uses the GeoPak which under the Bentley digital platform to process the terrain, and provides the basic conditions for the structure design of the structural profession(Figure 2).
d) The founding of Island structure model
As the main structure of artificial island, the island structure has some technical difficulties in its modeling processing, for example, the intersection between island structure and the terrain after the processing and other structures (such as the structural model of land formation, the structure model of rescue wharf). At the same time, as the breast wall of the island structure is made of the prefabricated concrete components, the problem of structural joints between breast walls also adds difficulty to model creation. Considering the above difficulties, the project uses Power Civil (referred to as PC), the software of Bentley digital platform, to building the body model of the island, and uses Open Bridge Modeler (OBD) to create a breast wall model (Figure 3). As a result of PC and OBD which are both professional linear modeling tools, the concrete idea of model creation is to draw the cross section of island structure and breast wall structure in the above software and then to form the island structure model by linear pay-off.
e) The structural model creating of rescue wharf
The project uses MicroStation and AECOsim Building Designer under the software of Bentley digital platform to build model. The special ideas are as follows: the common components such as caissons, bollards, mooring rings and tetrapod block are created into shared units by MS; and the general components such as backfill stones are directly created by the MS into a three-dimensional model; and the attribute information are given to each component by ABD, and finally make up the overall rescue wharf model (Figure 4).

\[ Figure 4. \text{The rescue wharf model} \]

3) The exploration and application of BIM Technology in the project
The project creates overall model by the Bentley digital platform (Figure 5), and it can analyze the created digital three-dimensional model. as a result we can quickly extract the engineering quantity and material list (Figure 6) and cut the model to form the sectional view and carry out the demonstration of construction simulation (Figure 7). Thanks to the BIM, the problems existing in the artificial island construction which because of using the traditional design method are solved, and the artificial island design and construction method are optimized\[11]. However, due to the current BIM technology in the field of artificial islands is still in its initial stage and its application is shallow. The application of BIM for engineering design did not carry out a deeper level of application and the application of maintenance phase and operation.

\[ Figure 5. \text{The overall model} \]
4. Conclusion

From the current situation and industry trends, BIM technology becomes an important force in engineering construction to achieve a high level of information technology. This paper shows that BIM technology can provide technical support for artificial island engineering in design, construction, operation and maintenance, which make the construction of artificial island more scientific and reasonable, and the operation and maintenance are more convenient and faster. This paper provide some reference for the application of BIM technology in artificial island engineering.

Although the BIM technology is known as a new technological revolution in the construction industry, there is no technical standard for BIM in the field of water transport at present, which has a result in the immature development of BIM technology and the difficulty of comprehensive promotion.

In conclusion, the application of BIM technology in the field of water transport is still in its infancy currently, and the application of artificial island technology is rarely reported. The paper only give a brief analysis on BIM technology about the artificial island engineering application points and the application effect; and it explain the application status of BIM technology in the artificial island field; we can improve the work efficiency of engineering project group by using collaborative design of BIM technology; the 3D digital modeling feature of "what you see is what you get " by using BIM technology
can more intuitively present the designer's design idea and at the same time it can avoid the possible mistakes of two-dimensional drawings such as "error, leakage, collision and vacancy", it also improve the efficiency of the design part of the work; the use of BIM technology on construction progress demonstration function also has a great visual presentation, which provide the construction organization a data support to develop more reasonable construction process. In short, the current application of BIM technology in the design field has a great exaltation on the engineering design, construction efficiency and project quality. However, more deeper application of BIM technology in the artificial island area remains to be explored.

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