

# Research on Visual Design of Railway 3D Structure Model Based on BIM

**Xiaogang Wang**

Jinan Design Institute of China Railway Engineering Design Consulting Group Co. LTD, Jinan 250022, Shandong, China  
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**Abstract:** In the project cost management, the formulation of project list is an important work based on the traditional method to prepare. In this process, the problem of low accuracy will appear. In this way, the integration of the data platform is realized, information is extracted through the attributes of the model components, the preparation of the bill of quantities is realized according to the specification of the bill of quantities, and the creation of the association between the bill of quantities and the model components is realized. In this way, the visualization of the bill of quantities is realized, the compliance of filling is guaranteed, and the accuracy and efficiency of the preparation of the bill of quantities is improved.

**Keywords:** BIM technology, railway, three-dimensional structure, design of model

## 1. Introduction

BIM, as the information technology, has been widely used in railway construction, operation and maintenance to meet the actual needs of railway construction and development in the new era. At present, BIM technology has been applied to railway engineering construction. In the design of railway engineering, BIM technology can meet the requirements of three-dimensional visualization design, so that the problems in traditional railway design can be solved.

## 2. Functional requirements of the system

For domestic software manufacturers, the Application Program Interface (API) is used to import the BIM model into the calculation software to compile the bill of quantities. This process will lead to the loss of model data, with the requirements for the budget specialist to realize the model check and secondary modeling processing. Therefore, the main functions of railway 3D structure model research and development based on BIM technology include the followings:

For one, model component and manifest subitems match each other. The model component is created automatically or manually, and matched and associated with the list subitem, so as to provide data support for meeting the requirements of the bill of quantities.

Second, the project feature description is automatically obtained. The model creates rich parameter attribute information, so as to provide data for automatically obtaining the project feature description, so as to generate the three-digit list refining classification code automatically, and design the project code with the nine-digit code in the list library to form different list items, and create automatic association with the model matching the project feature description.

## 3. Design of three-dimensional railway structure model

### 3.1 Methods of 3D modeling

#### 3.1.1 Basic voxel modeling

Simple shapes of software tools are used to merge, combine for model creation. Commonly used 3D modeling software can provide rich basic geometric shapes, including round table, cube, cone, prism, etc. Full use of this shape makes modeling more convenient. Figure 1 shows the modeling process of square body inspection well.

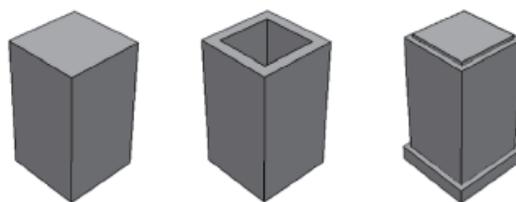


Figure 1. Modeling flow of square shaped inspection well

### 3.1.2 Stretch rotation scan transform method

The stretching rotation scanning transform method is generated by a line, a point, a body or a surface, and generates object modeling by drawing two-dimensional cross section and rotating and stretching. Figure. 2 shows the tensile construction model. The cantilever retaining wall with fixed interface of subgrade can be constructed by using the tensile model, and the hollow brick structure of subgrade slope can also be modeled by using this method.

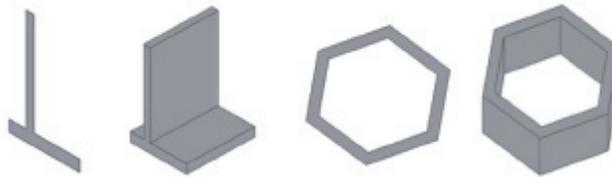


Figure 2. Tensile construction model

## 3.2 Model of railway three-dimensional structure

### 3.2.1 Building information model

Information completeness is mainly reflected in that the information generated at each stage is stored in the BIM model. The BIM model is used as a single tool data source of information, which can realize optimization analysis, including cost analysis, under the condition of visualization.

In the process of compiling the bill of quantities, the statistical quantities of different items are described according to the project characteristics. Therefore, in the process of creating the BIM model in the early stage, it should be combined with the engineering quantity calculation specification to expand the attributes of the characteristics of different components, to express model components, and to facilitate the screening and inventory workload calculation of the later model components so as to avoid avoid that the anti-missing components will result in the calculation inaccuracy or missing items and other problems.

For example, in the preparation of concrete statistical list of quantities, the list of quantities can be listed according to different requirements on the concrete strength grade. Therefore, in the process of modeling, the concrete strength grade should be added to the model as an extended attribute.

In addition, in order to create the matching association between the model component and the list subitem, the naming of the component types is implemented according to the list subitem naming convention. Table 1 shows the type name table of the model component. The standardized naming rules are used to quickly create the matching association between the model component and the list subitem, and the problem of division of the partial project is solved.

Table 1. Name table of model component type

| No | Type      | Name  |
|----|-----------|---|
| 1  | Pile      | Precast reinforced concrete square pile, Tubular pile, Plate, Log peg, Steel pipe                             |
| 2  | Beam      | Concrete box beam, Plate beam, Earth beam, Steel beam, etc  |
| 3  | Wall      | Underground diaphragm wall, Concrete retaining wall, Box culvert side wall, Threshold concrete retaining wall |
| 4  | Pile caps | Concrete bearing cap  |

### 3.2.2 Linear structure

In the 3D modeling software, the roadbed is edited and generated according to the design principles, the cross-sectional skeleton is created, and the cross-sectional skeleton is connected with each other by lofting or stretching modeling to generate the triangular and quadrilateral mesh body. The rationality of the model is tested by the visualization characteristics of the 3D model. To adjust the cross section of the unreasonable paragraph until it meets the specification. Finally, various basic modeling methods are used to achieve the fine design of each structure.

### 3.2.3 Presentation of comprehensive information

Creating various scene operations based on the central section of the bid section and special working points. Besides, the integration with camera settings, roaming effect and other functions can create vivid demonstration and report scripts, so as to realize the display of the surrounding environment and the construction situation of key construction areas, so that the staff can fully grasp the terrain and landform, and determine the location of the laboratory, the station and the mixing station.

Railway survey and design will be achieved with combination of the electronic construction log data and the organiza-

tion plan, so as to create a multi-dimensional progress space image. It can also realize the synchronous display of real-time monitoring video on site, and statistical analysis of the progress of key nodes and actual images of each construction bid section.

### 3.2.4 Three-dimensional human-computer interaction

Three-dimensional browsing, which is widely used in the modern industry, can only be seen without being moved. BIM technology is different from 3D graphics demonstration. Users B can realize train motion simulation while designing, such as space limit inspection, equipment inspection and visual distance inspection, and improve the design quality.

At present, 3DMAX and OpenGL are the most commonly used 3D human-computer interaction software in China with inflexibility in the data interface however. The core of the drawing software is Revit three-piece suite. Later, with the assistance of other software, this software can be capable of upgrading the original three-dimensional functions, and can be operated in the Autocad graphic environment, and to create a new three-dimensional metalibrary, with a good human-computer interaction interface.

3D CAD redevelopment interface is flexible and widely used in railway construction. The integration and detection of the multi-specialty Autodesk Revit model can avoid the collision between specialties, resulting in increased construction costs. Second, the use of Autodesk Revit software allows the owner to gain insight into the final shape of the design product.

At present, BIM technology has been used in structural design and calculation software to make the software more perfect. However, there are some defects in the software management, and project management runs through the whole life cycle. However, limited by the efficiency of use, it is still in the conceptual stage.

## 4. Conclusion

In railway construction, railway survey and design is an important work. In the process of the continuous development of technology, the perceptions for engineering is also deepening. Most railway engineering is conducted with the use of two-dimensional projection. In the process of continuous development of industrial design, railway operation mode is also undergoing constant changes, and the route selection is developing in virtual environment. Therefore, it is particularly important to use BIM application technology in railway survey and design to strengthen railway construction decision-making and management. Through this design, integrated BIM technology, Revit secondary development, railway 3D structure model can be developed, and railway construction model and bill of quantities can be prepared accordingly, so that the engineering design efficiency can be improved, as a result, to provide a reference for the construction project budget.

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