Research on Cross Platform Model Display Technology of BIM

Junjie Huang, Jia Wang and Xiaoping Zhou

1 Introduction

BIM (Building Information Modeling) is a kind of information management technology which runs through the whole life cycle of the building [1]. This is the first construction information model application engineering standard, put forward the basic requirements of the construction information model application, will lay the foundation for the improvement of the national construction industry information technology ability [2].

At present, application development and use are faced with legal, technical, cost and other aspects of the risks and challenge [3]. How to reduce the implementation cost of application services [4], so that BIM service consumers at the cost of economic input BIM technology implementation benefits [5], and reduce the difficulty of using the application, reduce the BIM software user learning pressure, software Developers should consider the important issue [6], is also the starting point of this study.

2 Building Information Model Based on IFC Standard

2.1 Introduction to IFC Standards

In order to realize the sharing and exchange of building information, the Building SMART Alliance has established the current general IFC standard data format [7]. As an open international standard, IFC has a relatively complete

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Table 1 IFC certified software and vendor

Supplier name	Application name
Autodesk	Revit
Bentley	ABD
Cad Line Ltd	ARCH Line.XP
Graphisoft	Archi CAD
NEMETSCHEK	Allplan
Tekla	Tekla Structures
Glodon Software	Glodon Takeoff

Table 2 Model file statistics table

File name	.rvt file (MB)	.ifc file (MB)
B01structure	74.7	25.2
B02structure	65.4	23.0
B03structure	59.1	15.5
Foundation structure	12.7	6.2

information classification and data structure, which can exchange data and information between many BIM applications Shared provides a uniform specification [8].

The official website lists the certified and certified software vendors and application name list, including the import and export of data to guide the two-way process, as shown in Table 1, this article statistics and lists the two-way through IFC V2.0 certified software vendors and Software Products. Which includes Revit and ABD and other commonly used BIM design software.

The IFC standard file is implemented in EXPRESS language, and the text has the advantages of clear structure, easy to understand and machine-friendly. In addition, this paper through the modeling experiment comparison, the same model case, IFC format file size is. Rvt file about 1/4, as shown in Table 2, Fig. 1 corresponds to the four models of the three-dimensional view. In addition, IFC data standards have a complete description of norms and implementation guidance, to facilitate the extraction of information and related application development, data delivery and information sharing is a good medium.

2.2 IFC Standard Scene Organization Structure

The IFC file specifies the architectural structure of the building project, by defining the spatial structure elements and the relationships between them. Spatial structure elements include the site (Site), building (Building), floor (Storey) and space (Space) and so on. An IFC file has and can only define a project object as a container for all project objects. Most of the building components are associated with the space that the floor or floor is split to determine the dependencies and their coordinates in the entire 3D model.

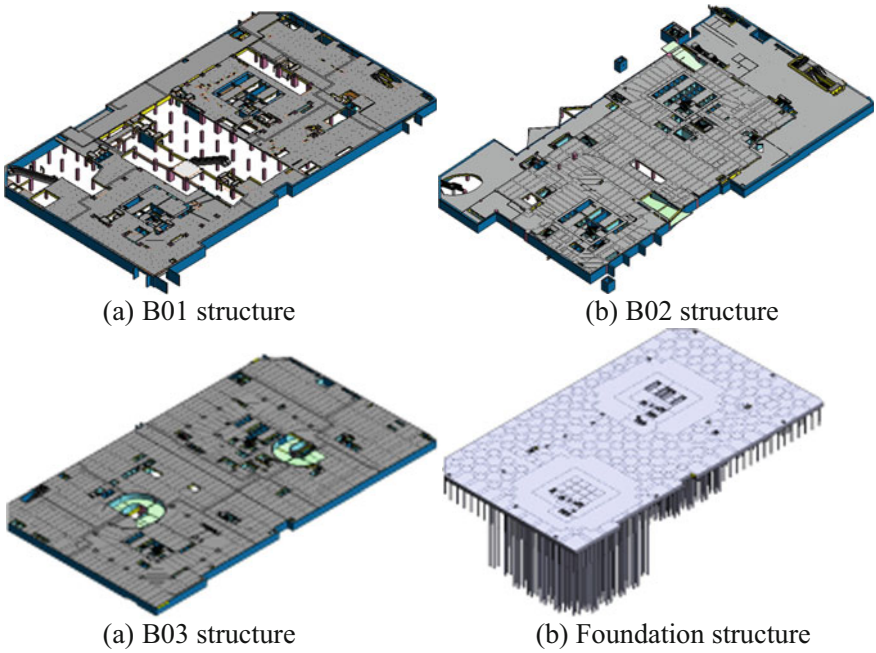


Fig. 1 Three dimensional view of experimental model

The scene organization structure describes the hierarchical framework of the building information model, and also provides a spatial topological relation for 3D rendering visualization of the model through computer graphics processing.

2.3 Parametric Component Definition

IFC standard not only establishes the macro scene organization structure, but also defines the comprehensive information of the professional building components. The IFC standard is mainly from the geometric information, attribute information and relation information on three aspects of this kind of component information description and data storage, so according to the geometry information of components is analyzed.

The IFC file uses a geometric entity representation method when describing the geometric model of the component. As shown in Fig. 2, this paper excludes the IFC file content of a wall from the experimental model data. It can be seen that the IFC file uses the Swept Solid description method when describing the geometric information of the wall. The data processing part of the data is transformed into the three-dimensional rendering data of the computer. 3D visualization.

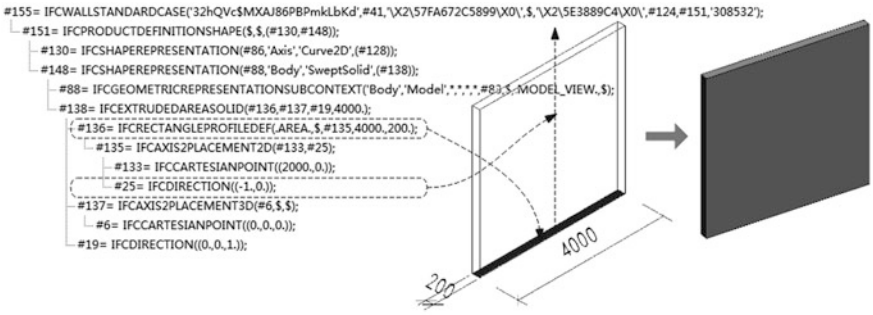


Fig. 2 Geometric representation of components

3 Data Processing

In computer graphics processing, discrete data is required to represent geometries. For example, curves need to be approximated by straight segments, and surfaces are mostly approximated by polygons or triangles. Using a triangular mesh to represent surfaces is often used in graphical processing, and the density and quality of the mesh can be adjusted according to the application accuracy requirements. This process is also known as triangular meshing in computer graphics. Using a triangular mesh to represent surfaces requires triangulation, sheet traversal, data compression, and so on. The rendering data generated by the model presentation technique described in this paper is the triangular mesh data of the geometric model.

After the above steps, the geometric data defined by the IFC standard in Fig. 3 is converted into the triangular mesh data shown in Fig. 4. As can be seen from Fig. 4, the triangular mesh data generated by the object is stored as a JSON object, Such an object storage method for network transmission and database storage [9]. Is currently the most commonly used network application data format.


```
{
  "positions": [
4000,100,0,4000,100,4000,0,100,0,0,100,4000,0,100,0,0,100,40000,-100,0,0,-100,4000,0,-100,0,0,-100,
          4000,4000,-100,0,4000,-100,4000,4000,-100,0,4000,-100,4000,4000,100,0,4000,100,4000,4000,100,0,0,
          100,0,0,-100,0,4000,-100,0,4000,100,4000,0,100,4000,0,-100,4000,4000,-100,4000]
   "indices": [ 1,0,3,3,0,2,5,4,6,7,5,6,9,8,10,11,9,10,13,12,14,
          15,13,14,17,19,18,17,16,19,22,23,21,23,20,21],
  "normals": [ 0,1,0,0,1,0,0,1,0,0,1,0,-1,0,0,-1,0,0,-1,0,0,-1,0,0,
          0,-1,0,0,-1,0,0,-1,0,0,-1,0,1,0,0,1,0,0,1,0,0,1,0,0,
          0,0,-1,0,0,-1, 0,0,-1,0,0,-1,0,0,1,0,0,1,0,0,1,0,0,1],
    "matrix": [ 1,0,0,0,0,1,0,0,0,0,1,0,0,0,0,1],
    "colors": [0.5019608,0.5019608,0.5019608,1],
 "materials": [ 0,0,0,0,0,0,0,0,0,0,0,0 ],
      "type": "IfcWallStandardCase"
      "guid": "32hQVc$MXAJ86PBPmkLbKd",
}
```

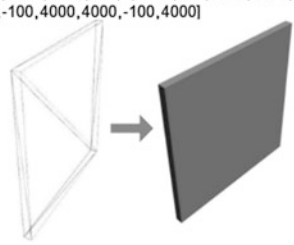
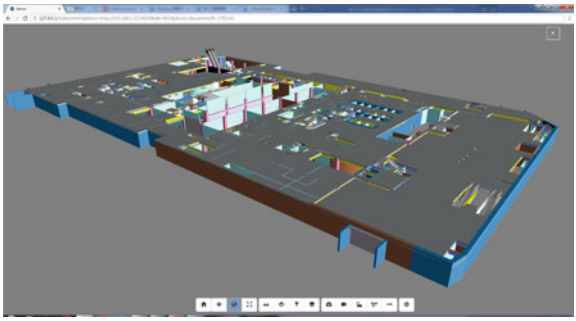
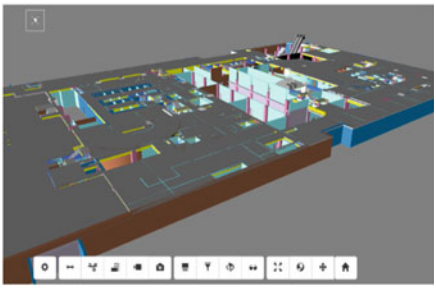



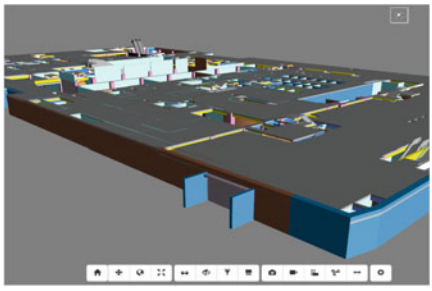
Fig. 3 Geometric representation of the rendering data



(a) PC browser



(b) Iphone6 browser



(c) Xiao Mi 2 generation

Fig. 4 Shows the effect of the model

4 Model Display

4.1 Web GL-Based Model Display

Web GL is a set of JavaScript APIs developed by KHRONOSGROP that allows developers to embed embedded 3D graphics that support hardware acceleration directly in the browser. As an open WEB standard, Google, Apple and other companies are involved in the development and promotion of the standard. Tencent, Baidu as the representative of the Internet companies are working on Web GL research and application. The <canvas> tag in HTML5 provides the context for the Web GL element. Web GL is a subset of Open GL ES 2.0 that can run on different hardware devices such as desktops, tablets, phones, or smart TVs. The application of the technology provides the browser to achieve human-computer interaction, games, data visualization, 3D modeling and physical simulation and other technical support.

4.2 Model Show Effect

In this paper, we introduce the BIM model of B01 structure as an example to introduce the model display effect of building information model display system. First, we use Revit software to build the BIM model of the building and export the model file in IFC format and upload it to the server. The parsing service parses the IFC file and stores it in the database. The database then responds to the data request of the model browser and sends the data to the front end application. Front-end application to complete the model rendering and display in the web browser, the cross-platform terminal actual test, PC, MAC, iPad, iPhone, Android phone, Android tablet device can achieve smooth model display and interactive operation, as shown in Fig. 4 Visualization of three typical devices.

4.3 Model Interaction Function

The BIM model presentation system introduced in this paper also designs a variety of functional extensions for model interaction to meet the user's need for detailed analysis of the model. First, the component selection function, the application

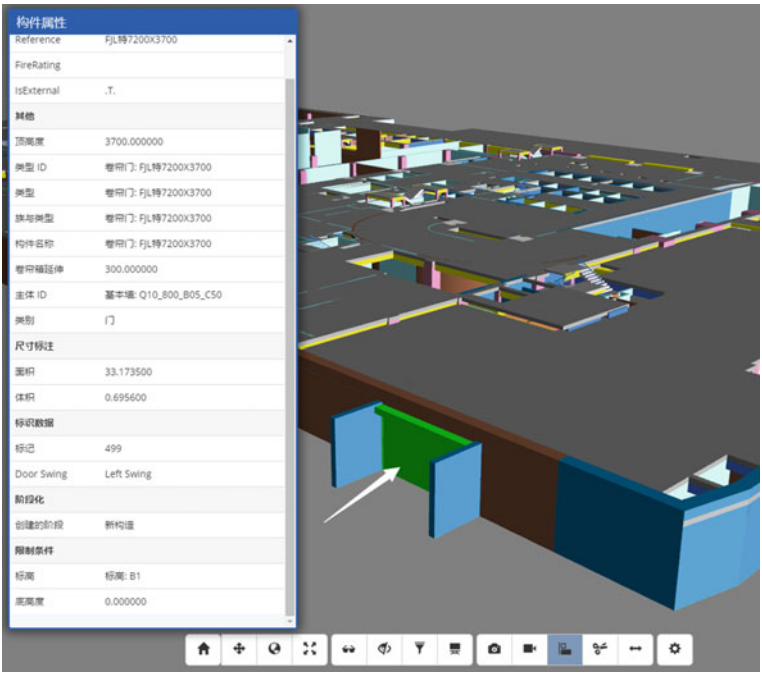


Fig. 5 Component selected effect

Fig. 6 Roaming effect map

design is selected for the green highlight state, and when the property display window is called to read the selected member of the property information, as shown in Fig. 5. In addition, by controlling the camera position and angle changes in the scene, you can achieve the first person perspective in the model of simulation roaming, roaming effect shown in Fig. 6. In order to realize the model analysis, the model is designed to cut the bounding box. The six faces of the moving bounding box can be cut from six directions. The cutting effect is shown in Fig. 7.

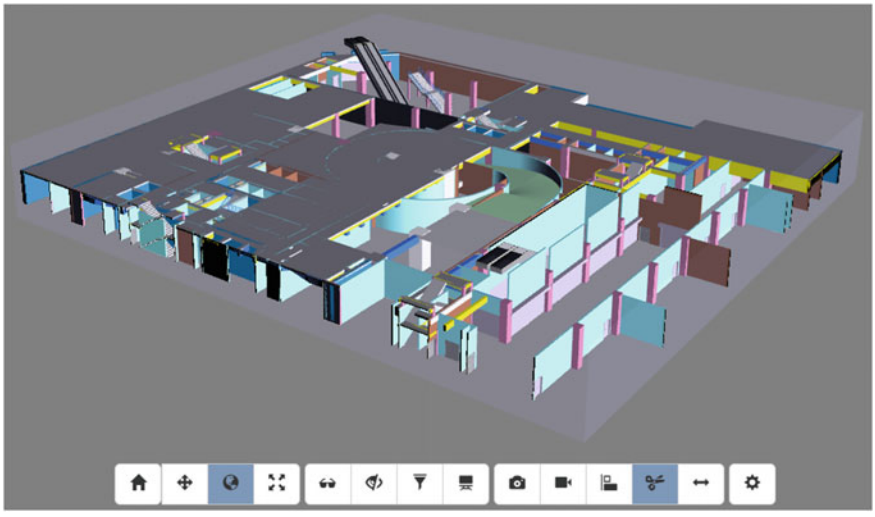


Fig. 7 Cut the effect of figure

5 Design of BIM Application Architecture Based on HTML5 Technology

In October 2014, the HTML5 standard was developed by the World Wide Web Consortium (W3C). Native Web GL technology was able to provide a three-dimensional model of web-based applications without plug-ins, providing a model for BIM applications. BIM application based on HTML5 technology has the advantages of short development period, easy cloud deployment and strong autonomy in the application of the construction information model presentation technology proposed in this paper.

6 Conclusion

In order to solve the problem that BIM application data sharing is poor, equipment hardware requirements are high, application service is not flexible, this paper presents a low cost, cross platform and easy expansion of building information model display technology application method. On the basis of the model display system introduced in the text, it can easily expand the peripheral application system integration, quickly realize the development of the network application platform in the construction field, plan the discussion of the planning stage, the calculation of the drawings at the design stage, the progress of the construction, The three-dimensional visualization of the operation and fire emergency and other construction applications to provide model display services. The application of this technology not only extends the BIM model to use the scene, but also a lot of savings in hardware input costs and user learning costs. In the subsequent study, data compression, information security, interactive features of the rich will be the focus of the study.

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