# Innovative design exploration of building information model based on Revit and VR technology

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**Abstract:** In architectural design, architects often use two-dimensional modeling and three-dimensional modeling method supported by advanced mapping technology Revit for design and analysis. Due to the high degree of technical specialization in Revit, it is easy and appropriate for professional engineers to understand and execute the intent of building design, but it is difficult and inappropriate for non-professional owners to communicate with this highly specialized software. How to solve the effective communication between designers and owners, VR technology has the advantages of simulation and visualization, will effectively solve the communication problem between designers and owners. This paper explores the innovative design of building information model based on Revit and VR technology.

## 1. Building 3D information modeling

With the rapid development of society, the popularization of intelligence, the rapid development of computer applications. Using computer graphics and image processing technology has become the main means of modern engineering design and drawing.[3] "Building information modeling technology" will become an important means and development direction for the traditional construction industry and even the entire engineering construction industry to combine with information technology in the future to achieve industrial structure adjustment and transformation and upgrading.

### 1.1 Advanced mapping technology Revit

Advanced mapping technology Revit uses Auto CAD and UG technology for two-dimensional drawing and design, and generates three-dimensional building information model methods and skills,[1] which can help architectural design, construction and maintenance of building software with better quality and higher energy efficiency, and is one of the most widely used software in the BIM system of China's construction industry.[2] Its core features are: building information model based on BIM; 3D modeling: provides an intuitive way to create architectural models; Powerful analysis and simulation: It can analyze the mechanics, energy consumption and lighting of the building structure, and identify problems and optimize the space; Visualization and real-time rendering: Support realistic rendering of architectural models; Material calculation and cost control: Automatically estimate the quantity and cost of materials needed to help with budgeting and cost control.

### 1.2 Construction of building information model under advanced mapping technology

For architects, the use of two-dimensional drawing software, including CAD, to assist design has greatly improved the convenience of drawing in architectural design. However, because the building information established by two-dimensional drawing is flat, the architectural drawings are difficult to read and the communication between different types of work is not smooth.In order to improve the shortcomings of these two-dimensional drawings in architectural design and construction, in architectural design, the advanced mapping technology Revit is used to conduct three-dimensional

architectural information modeling design, which can effectively solve the above problems, that is, to draw the appearance and internal structure of the building model in proportion to the building, and distinguish each component of the building in more detail. In the drawing board, it can intuitively and clearly draw the corresponding dimensions and materials of different building entities and components that make up the building entities.

Taking the architectural design of a kindergarten as an example, the model is based on a high degree of complexity of shape, and the floor plan and elevation cannot reflect the beauty of the shape of the building. Only by designing it into a three-dimensional model can it show its uniqueness more. With the forward design process as the main line, Revit software is applied in the whole process from the creation of the basic model to the design of the printed drawing. Figure 1 and Figure 2 are the models established by two-dimensional modeling software CAD, and Figure 3 and Figure 4 are the graphs formed after modeling Revit.
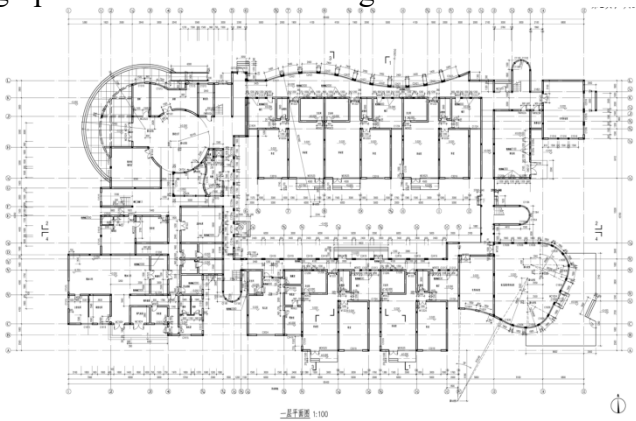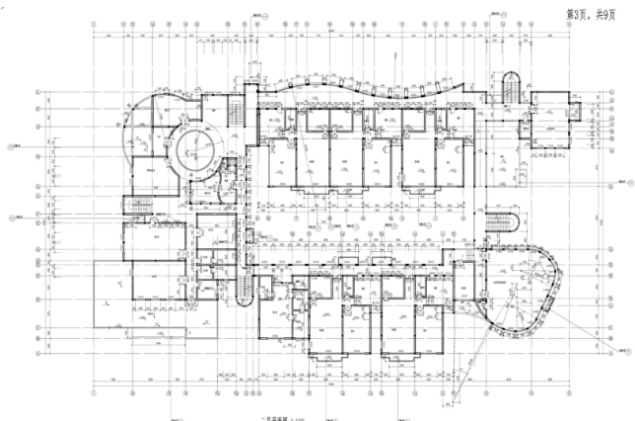


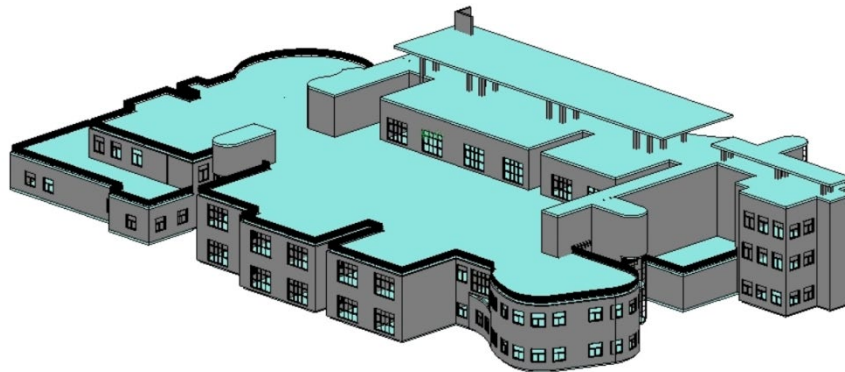Figure 1 Floor plan of the first floor    Figure 2 Two-storey floor plan



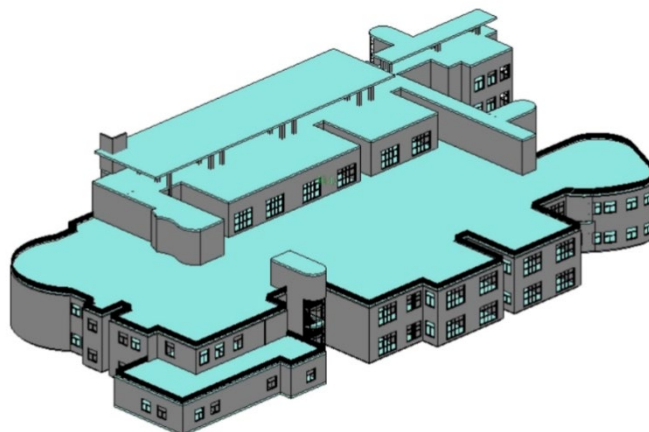Figure 3 Southeast axis mapping



Figure 4 Northwest upper axis mapping

## 2. VR technology

Virtual Reality technology (Virtual Reality, abbreviated as VR), as the name suggests is the combination of virtual and reality, also known as virtual reality or psychic technology, VR technology is a combination of virtual and reality technology.[6] The virtual world created by VR technology is not something we can touch directly, but a virtual world close to reality with the help of computer, electronic information and simulation technology to produce a realistic vision and other real sensory experience of 3D dynamic model, which has achieved good results in 3D games, design simulation and industrial design and other fields. As shown in Figures 5 and 6.

VR technology has many advantages compared with the traditional plane image: it can apply computer software and simulation technology to virtual physical landscape to make the image more three-dimensional and real, and users can make the atmosphere and immersion stronger through hearing and vision. In the way of 360-degree image representation, users enter the virtual world, and the real feeling is almost consistent with the real world; At present, VR technology is not only used in game entertainment but also has been applied in many fields, and has also obtained some good results. At the same time, it also brings good results. For example, in the field of education and training, scene display in tourism promotional videos, urban planning, architectural exhibition, online concert, character modeling under AI technology, trade, industrial manufacturing, and so on: What VR creates is a virtual world, and the virtual world needs to be artificially set, so you can actually control the virtual environment to be expressed, customize the scene suitable for different scenes and different occasions, and not limited to other various factors.

For example, in the construction industry, we can construct the physical condition of the building in different seasons and different areas in different light. In the tourism industry, we can simulate the different landscapes of different scenic spots in different time periods; There are many more, with the help of this controllable VR technology, we can solve many problems that are difficult to solve in reality in a low-cost way; With the maturity of gesture recognition, facial capture and other technologies in VR, the new interactive experience mode can restore people's full-body movements and expressions by wearing the corresponding devices. You can already interact with other people and things with a person's real behavior in the virtual world. This interactive experience is currently not available in all other media. This is an interactive experience that no other medium currently offers.



Figure 5[8]: Virtual reality technology

## 3. Combine Revit and VR technology to realize visualization and simulation of innovative design exploration for building information model construction

VR technology has appeared as early as the 1960s because of technical requirements and cost difficulties have not been popularized to the public, and the innovation of equipment technology in 2016 has made virtual simulation technology slowly deeper into the daily life of the public has been used. VR technology has three characteristics of immersion, interactivity and illusion, [4] VR technology is the connection channel of the new beginning of the virtual world, and can be applied

in all walks of life. As for the professional characteristics of architectural design, the biggest change of VR to architecture is that it provides a humanistic perspective of the first-person role, so that people can immerse themselves in and interact with this open space system, which changes the traditional way of architecture's cognition of space. This change also subverts the traditional creation mode of architecture, enabling the "experiential participatory" creation mode to realize architectural design from the perspective of first-person humanism, to recognize the spatial scale and other elements of a large number of architectural practice projects, and to shorten the years required for the accumulation of spatial cognitive experience.[5]

The processing of VR technology on the basis of the 3D model, 2D drawings and renderings derived from BIM can deliver the building information in the building scheme to the owner or user more clearly and intuitively. Architects can fully and carefully display their design results to clients. On a certain basis, they can not only make the solid model of the building more clearly displayed to clients, but also reduce the cognitive threshold of the owners or the public, improve the transmission efficiency of the information of the design scheme, and thus improve the work efficiency of architects.

Design elements such as the volume of a building, the relationship between space composition, form and line, the emptiness and reality of space and the sense of light are usually not directly displayed. In the process of traditional architectural practice, the expression of traditional architectural design is usually completed by the rendering company, and whether the expression of architectural scheme is appropriate and in line with the architect's idea depends on the ability and quality of the renderer's staff and the communication with the designer .[5]With the continuous updating and iteration of VR technology, the needs of architects and the industry can be met from the aspects of ease of operation, software compatibility and continuity of use, etc. The improvement of resource library such as plants, materials and furniture in VR technology will further promote the real texture of architectural scheme expression. [7]

In the architectural design, we should not only consider the components of the building and the processes and techniques used in the building, but also pay attention to the appearance design of the building itself, such as the material and color of the materials to be used.The architectural characteristics of the building are also important, and the building should conform to the main tone of the city and have its own characteristics. 3D modeling and 2D drawings cannot directly combine different distances and different light senses to reflect architectural effects. VR technology can reflect the texture of buildings, and pictures of different distances from buildings can be captured in VR to bring about completion effects with different textures. In VR, the architect can intuitively feel the impact of the texture of the board used on the texture of the building to ensure that the building can coordinate the surrounding environment while showing its own architectural advantages. Owners and the public can also intuitively feel the physical effect of the building after completion.

The architectural design based on VR technology software will break the traditional architectural creation design mode. The process mode of VR architectural creation process can be simply described as seven main steps: "Plan a hand-drawn conceptual sketch, build a model, enter the VR space to make decisions, modify the model, draw CAD 2D result drawings, and output VR renderings and moving surfaces". After the completion of the conceptual sketch, the architect can build the model, and then guide the model file to the VR software for simple processing, so that the VR hardware equipment can be used to quickly enter the scheme space to experience the preliminary architectural space.

In this stage, we choose a three-dimensional modeling of a memorial hall, which must be able to display the outdoor environment of the building, the exterior shape of the building, the interior space and various ancillary facilities in a visual, dynamic and all-round perspective, so that architects and users can experience the room, inside and outside space of the real building in the future in a virtual VR environment, determine materials, arrange the selection of building materials and plant configuration, and be able to roam in real time in the VR virtual world. As shown in Figure 7 to 10.
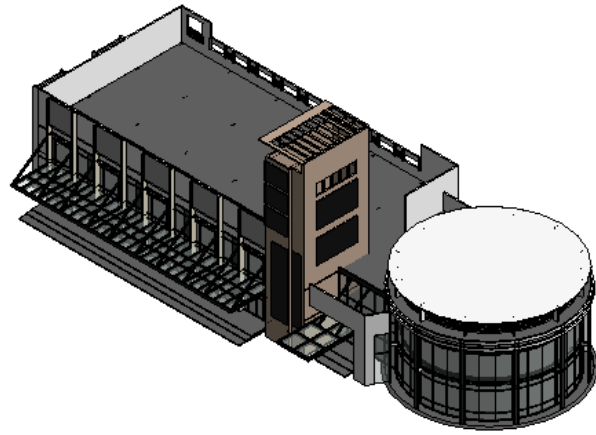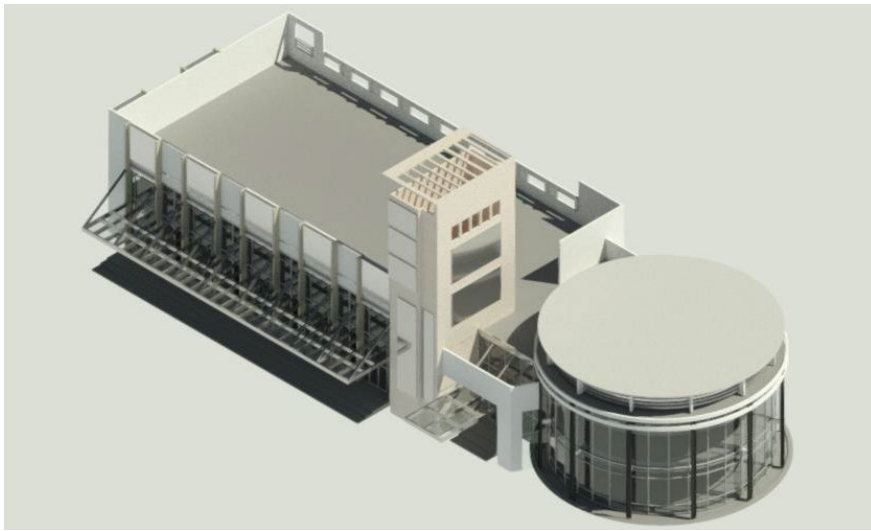
Figure 6 Building model
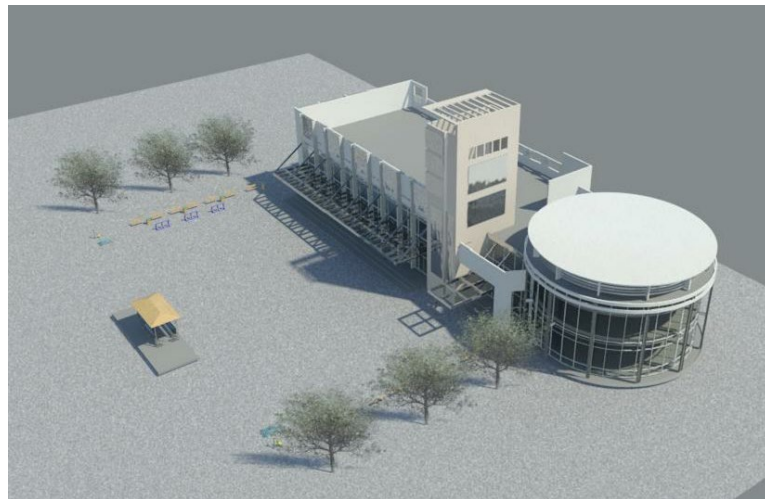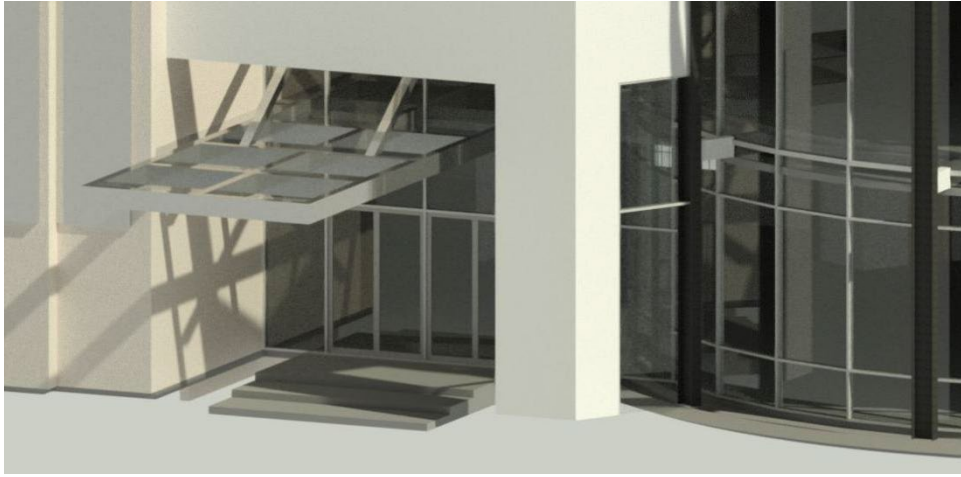


Figure 7 Preliminary effect



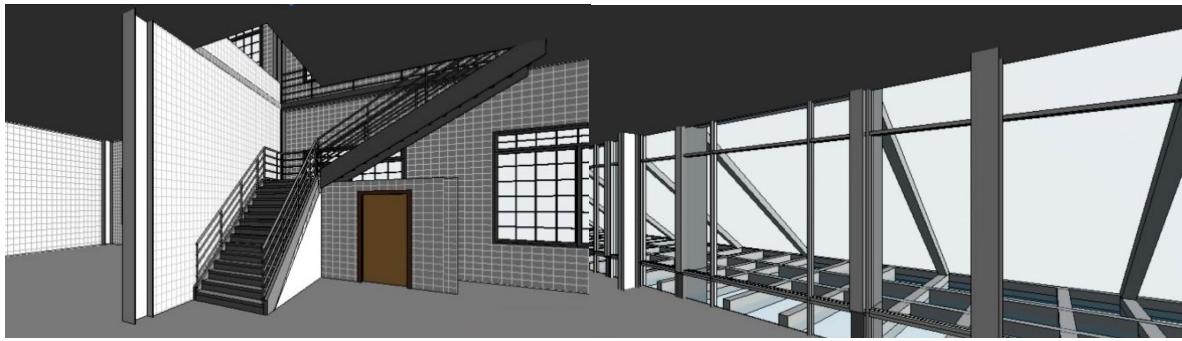Figure 8 Final effect

Figure 9 Detailed drawing



Figure10 Internal perspective

## 4. Conclusion

Revit technology is a more mature 3D modeling software, through which architects can present building entities in a more intuitive modeling way to the owner. VR technology is to virtual reality through computer and simulation technology, but also can more clearly express the three-dimensional architectural model. Combined with VR technology, Revit can present the changes of buildings to owners in the form of animation in different scenes and different times on the basis of 3D modeling. Therefore, the use of VR technology in the presentation of building modeling is not only the most intuitive but also the best embodiment of the details of the building model, and the acceptance of the public and owners will be significantly improved. VR technology will be an effective development trend for architects to display architectural models.

## Acknowledgement

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