Application of BIM Technology in Calculation of a Residential Building

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Abstract. This article summarizes some disadvantages that arise when not using BIM technology modeling to make engineering budgets. For example, traditional calculations are calculated manually by using two-dimensional maps so that the efficiency is low, repetitive modeling rates are high by using general modeling software to modeling, and the reuse rate of the built model is low, the model is not built accurately, and the model information cannot be shared. All the above disadvantages lead to inaccurate calculation of the engineering, and in the whole process of construction of the engineering, the participants of each engineering cannot contact and coordinate the work closely, resulting in serious waste of resources and seriously harming the interests of all parties so that the construction progress of the project is seriously affected. However, using the model built by BIM calculation software to solve the above problems can effectively solve the above problems, and make a great contribution to the development and innovation of engineering cost.

1. Introduction
BIM technology is basically mature abroad[1], but it is still in the development stage in China. Due to the obvious advantages of BIM technology in the construction industry, it has been greatly promoted by the Chinese government and has achieved good economic benefits. The application of BIM technology in the field of construction will be fully developed in the future.

2. Some problems in calculating engineering quantity by traditional engineering cost
The engineering cost has gone through decades of development, and its management methods have evolved with the changes of the times. We all know that one of the core indicators of engineering construction management is engineering cost. The engineering cost management includes two basic tasks: one is the statistics of the quantity of construction project; the other is the cost accounting of construction project[2]. The engineering quantity of traditional engineering cost is generally calculated based on the two-dimensional design drawings. The traditional hand-drawn drawings and CAD drawings are impossible to store component information in detail, so it will consume about 50%-80% of the time of cost engineer when statistic engineering quantities[3]. When using the traditional drawing tool CAD, the engineering cost uses most of the time to statistic the engineering quantities. In the past, the development of computer information technology is still relatively backward, which needs a large number of cost engineers need to carry out cumbersome manual calculations when
needing manual drawing. Until now we can model in the relevant cost software based on CAD drawings, and the work efficiency has certainly improved, but facing the increasing higher modern buildings and the more complex body, the statistics of engineering quantity are still cumbersome under such development trend, which is related to inaccurate and incomplete modeling information to a large extent.

Taking the stage of bidding budget as an example, when the bidding budget is calculated basing on the bidding documents, the construction drawings based often have lag problems. The engineering quantity calculated during the bidding phase is often related to the integrity of the construction drawings. For example, when modeling by using traditional calculation software, we will encounter some CAD drawing errors in doing budgeting, and the corresponding information on the drawings is inaccurate and incomplete, which requires the construction unit to deepen the treatment according to the situation at the construction site. In this way, the bidding budget is not the same as the calculation accuracy in engineering construction stage[4].

In addition, the incomplete construction drawings will affect the engineering quantity, which also has a great connection with the modeling level of the budget person. For example, for a profiled component, the information of these components cannot be drawn and expressed accurately in the general calculation software. That is, using profiled component to express by a custom, but the later calculation of the template engineering quantity requires further processing, and there will be a large error. For a project, due to the above factors, it is easy to appear the situations of the missing, less, and more calculations of the engineering quantity. Although it can be accepted to control the error of the engineering budget within 5% in the engineering cost industry, it is still not a small loss for the larger projects. And the late building model needs to be repeatedly drawn and processed, resulting in waste of corresponding time and further seriously affecting the efficiency of the budgetary staff. The cost of the developer's bidding budget, contractor's bidding budget, and engineering final cost are often very different, which seriously affects the interests of the participating parties.

The following takes business tender preparation in the bidding stage of a residential building as an example, and briefly explains the advantages of BIM calculation software.

3. Application of BIM calculation software in bidding stage

3.1. Three mainstream software used in the bidding phase

3.1.1. Glodon BIM steel bar calculation software: Glodon BIM steel bar calculation software GGJ2013 is very convenient when calculating the amount of steel in calculating the engineering cost, and after calculating the steel bars in the beams, plates and columns we can clearly check the three-dimensional layout of the steel bars, the model is very visual and intuitive, and it displays the position of the steel accurately. It can support Glodon structural construction drawing software GICD (Glodon structural construction drawing software GICD 2013 is a BIM-based structural construction drawing intelligent design system, which is an important part of Guanglianda BIM strategy. Value of GICD product: The true "BIM + smart" design software, open up the upstream and downstream data of structure design, which can bring revolutionary quality and efficiency improvement for engineers.) The introduction of
the model after the flat reinforcement can eliminate the process of repeated modeling and reinforcement. The calculation models of each professional can be related each other, and the calculation model can be connected with various software data in the construction field.

3.1.2. Glodon BIM civil engineering calculation software. Glodon BIM civil engineering calculation software GCL2013 also supports the introduction of mainstream BIM software models. Because this software supports the international common data standard IFC (Industry Foundation Classes, abbreviation of industrial base class, IAI organization: The International Alliance for Interoperability International, Collaborative Alliance established standard name. Through IFC, the communication between the various participants is enhanced throughout the life cycle of the construction project, which greatly improves the management and coordination control of engineering quality, cost and time, and establishes benchmark in universal sense for the information sharing of global building professionals and equipment professionals.) which is one-click reading of the format file. For issues such as IFC being too broad and not very targeted, The research and development of Glodon GFC (a plug-in that can read the BIM model and the BIM data format standard specially for engineering cost) can realize the one-click import of the 3D model drawn in Revit (Building information modeling software developed by Autodesk, a software that provides design, construction, and quality maintaining for designers to make work more efficient and convenient. It is not only widely used internationally but also is one of the most widely used software for BIM series software in China.) to the 2013 software of the Glodon BIM civil engineering calculation. It can mand the format of revit and GCL software exchange smoothly.
3.1.3. Glodon cloud pricing platform GCCP5.0. Glodon cloud pricing platform GCCP5.0 is a platform product to cater to the strategic transformation of service providers of digital construction platform, to provide data compilation, review, accumulation, analysis, mining and reusing in budget estimates, budgeting and settlement phases for pricing customers, which was developed and put on the market in 2015. Based on information technology such as big data and cloud computing, the platform realizes the integration of pricing and full-service, covering the whole process, so that the cost-making work is more efficient and smarter.

3.2. Application of three softwares in the case

3.2.1. Project Overview. This project is 7♯ residential building of the ××× project developed by Luoyang××× Co., Ltd. The first floor and the second floor are commercial service outlets, the third to sixth floors are residence, the building base area is 835.14 square meters, the building area of commercial service outlet is 1607 square meters, and the residential area is 1560.18 square meters, so the total construction area is 3617.18 square meters. The structure of the project is frame structure, the design has a service life of 50 years, the building height is 19.10 meters, the seismic fortification intensity is 6 degrees, the fire resistance level is 2nd grade, the project design scale is small-type, the roof waterproof level is 2nd. The total number of houses is 12 sets, residential unit type technical and economic indicator is AC.13.

3.2.2. Specific operations in the process of compiling the business tender in the bidding stage based on BIM technology. About the establishment of the 3D model of the engineering project, it can use Revit 2014 to build a model, and then use the GFS for Revit to export the architectural and structural models
established by Revit to the BIM model that can be read by the Glodon civil engineering calculation software. Convert Revit design files directly into calculation files by GFC. You can also directly use the Glodon BIM steel bar calculation software to directly model according to CAD drawings. Since all residential floors of this project are 6 floors, the model is directly established by using Glodon BIM steel bar calculation software.

![Image](image1.png)

Figure 6. Partial floor plan display of structure construction drawing of a residential building

Open Glodon BIM steel bar calculation software, the new project name is Building No.7, and fill in the corresponding project information, compilation information, specific gravity settings, and hook settings to complete the corresponding settings. Note that when filling in the specific gravity setting, there is currently no steel bar with a diameter of 6 on the market, so the diameter of the steel bar is changed to 6.5 from 6 and the specific gravity of the steel bar is 0.26.

Then proceed to the floor setup and fill in the corresponding concrete markings according to the general description of the structural design in the structure drawing of Building No. 7, and copy it to other floors.

![Image](image2.png)

Figure 7. Floor setting and concrete marking

Entering the drawing input interface, using the Glodon BIM steel bar calculation software, the built-in CAD drawing recognition function enables rapid modeling, which greatly saves the drawing efficiency of the cost engineers.
According to the CAD drawing to divide the corresponding floor, and then the grid, beam, plate, column and corresponding steel bars of each floor are separately identified and modeled. After the drawing is completed, the legality test of the main bars and the negative bars of the plate is carried out, and the red area of the reinforced red steel is modified accordingly, and finally the preliminary model is drawn.

Carry out detail processing of part profiled components (for example, when the wall of the parapet, the sloping roof, and the picking plate are used for the reinforcement setting, the custom line can be used for the reinforcement drawing), to make the established three-dimensional model more precise.

After the corresponding detail processing, complete the drawing of the entire No. 7 residential building, and obtain a complete three-dimensional steel budget model. As shown below:
Figure 11. Three-dimensional display of beams, plates, columns and reinforcements of a residential building

After the model is built, you can summarize the calculations, and then you can get the engineering quantity list of the steel bars, as shown in the figure:

Figure 12. Steel bars list of Building No.7 in a residential building

There is no need to repeat modeling for civil engineering calculations, you can directly import the model established by Glodon Steel bar Calculation Software into the civil engineering calculation software, and draw the earthwork and decoration parts to check whether the model is complete, and check the miss and fill vacancy according to the actual situation of the project.

Figure 13. Display of Glodon BIM civil engineering calculation model of a residential building

Open the report preview to see the engineering quantity list for the corresponding component

Figure 14. Report preview in the Glodon BIM civil engineering calculation
According to the contents of the bidding documents completed in the BIM bidding stage, combined with the bidding project quantity list documents, the BIM bidding quotation documents are completed through the Glodon cloud pricing platform GCCP5.0.

Figure 15. Compilation of bidding quotation documents for Building 7# of a residential building with Glodon cloud pricing platform GCCP5.0

According to the BIM bidding documents completed during the BIM bidding stage, combined with the completed BIM technical tender and BIM business tender, through the Glodon tender preparation software, a complete electronic bidding document is compiled and completed. We do not discuss more here.

This case is very small use in the application in engineering cost management based on BIM technology. If BIM technology is used to make decisions and manage the whole process of the entire project, it will bring huge benefits to the industry.

4. Conclusions
The popularization of BIM technology and development of corresponding software, especially the efficient use of BIM calculation software related to cost, brings great convenience to the vast number of cost engineers. After modeling by using BIM, its model can run through the entire building life cycle. The BIM software is used from the design stage to deepen the building model after design, and the model can be directly reused in the bidding stage, so that the heavy modeling work of the cost engineers is correspondingly alleviated. The biggest advantage is to avoid the problem, repetitive modeling waste work efficiency in the engineering cost process[5]. In traditional 2D Auto CAD, designers will express components based on different layers and colors. When modeling by calculating the engineering quantity, the cost personnel will use the recognition CAD drawing to define the corresponding floor, and identify the component elements in the corresponding floor. For modeling by using BIM technology related software, in addition to Glodon BIM series calculation software, there is lots of efficient and convenient modeling software, for example, Revit modeling software simulates building entities on a computer through its simulation technology. The corresponding components have carried out parametric modeling, and each component is given corresponding information (including size, model, materials, etc.). The information corresponds with the real thing in detail, which clarifies the cost information of each link. The information contains all the component information needed to calculate the engineering quantity in the calculation software. The calculation software and the BIM model get a better correspondence, so the better visualization effect is presented, so that the statistics of the engineering quantity have maximum precision, which greatly improve the work efficiency of the cost personnel.

The development of BIM technology is in line with the trend of social development. The golden age of BIM technology development has quietly arrived. In the future, the informatization construction by using BIM technology will usher in new opportunities and also will face new challenges. For example, how to put BIM technology into the construction industry and make it more popular is still a major problem. This not only requires the efforts of technical personnel related to the research and
development of BIM technology to make its application more convenient and more common, but also requires the government's strong support to make the concept and advantages of BIM more popular.

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