Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2020, 7(4):133-137**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Development and application of aluminum frame security computing system based on REVIT

Shumei Cui[1], Xin Chen[1], Dan Qiao[2], Jingxia Wu[1]*

[1]School of Civil Engineering, Yantai University, China
[2]Vanke Real Estate Development Co. , Ltd. Yantai Branch, China
*Corresponding Author: Jingxia Wu (btx324@163.com)

Abstract Cast-in-situ concrete structures are widely used in civil engineering fields such as construction engineering and bridge engineering. A lot of formwork and scaffolding should be used in the construction of cast-in-place concrete structure. The use and safety of formwork and scaffolding are not only related to economic and technical benefits such as construction cost and time limit, but also to the safety of construction stage and the sustainable development of civil engineering. Aluminum frame with excellent performance, widely used at home and abroad. At present, although a small number of aluminum template safety calculation and analysis software exists on the market, only some components can be selected for calculation, and the component model cannot be intuitively displayed, and the components with problems cannot be automatically identified. In this paper, a revit-based aluminum template security computing system is created, which can detect the die matching components according to the standards and specifications, and label the unqualified products. In the front of the design to reduce casualties and economic losses.

Keywords Aluminum frame; Safety calculation; Revit secondary development

1. Introduction

As an important material for constructing a new green construction system, aluminum frame has been widely recognized at home and abroad for its excellent performance. With the advent of the information age, the Chinese government strongly advocates the realization of digital and intelligent development of the construction industry, and promotes the cross-border upgrading of the industry. Building Information Modeling (BIM), which integrates visualization, integration and parameterization, has become a key technology to promote the transformation and upgrading of the Building industry. As the main structural design and modeling software of BIM technology, Revit provides a programmable API interface for structural analysis. However, the major of Revit design is not comprehensive, so many third-party developers and scholars conduct secondary development of Revit. At present, Revit secondary development of the application plug-in is more, but has not been used in the aluminum frame security computing engineering field of software or plug-in. In this paper, the safety calculation system of aluminum formwork is proposed, and the aluminum formwork matching scheme of the safety calculation of shear resistance, bending resistance, deflection and bearing capacity of each part is verified by identifying the generated plane formwork, back lamination, drawing element information of members such as drawing bolt and other members by the building model in Revit, and the unqualified members are marked and identified. It can improve the automatic safety calculation level of aluminum frame, improve the safety calculation efficiency and accuracy of aluminum frame system in the design stage, and reduce the probability of frame collapse.

2. Safe Calculation of Plane Frame

2.1. Formula for Calculating the Characteristic Value of Bearing Capacity of Plane Formwork

Plane formwork mainly includes wall, column, beam and plate formwork. The safety calculation of plane formwork mainly depends on two aspects: bearing capacity and deformation checking calculation. The characteristic value of bearing capacity is calculated according to the technical specification of composite gold formwork, i.e

$$\alpha = \frac{Mmax}{Wa} \leq fa$$

In this paper, based on the empirical parameter method, it is determined that the standard value of ultimate load of the plane frame is G

$$G=G1K+G2K+G3K+G4K$$

According to the following formula, the calculation formula of the side pressure of newly poured concrete in aluminum formwork system of JGJ162 is the following formula. In the GB50666 code, in the actual calculation process, the smaller value of the formula should be taken:

$$F = 0.22\gamma ct0\beta 1\beta 2V^{\frac{1}{2}}$$

$$F = \gamma cH$$

The standard value of variable load of plane frame is Q:

$$Q = Q1k + Q2k + Q3k$$

In the JGJ162 specification, the living load value of the construction personnel and equipment is stipulated, and the values of the trabeculae of the formwork and the directly supported formwork, the main beam of the directly supported trabeculae, the support column and other supporting components are respectively determined. This article takes into account both the uniform distribution load and the concentrated load of the concrete transported by the trolley, as well as the uncertainty and non-uniform stacking load of the live load in the construction process. As 90% of the local load area is borne by the support riser, the adjacent supports bear less, and the support columns outside the area are almost unaffected, the revised formwork, xiaoleng and supporting riser in GB50666 uniformly adopt the uniform live load of 2.5kn /m^2.The standard value of wind load is determined according to the specification.

Then, the bearing capacity limit state is adopted according to the basic combination of load effect, and the following design expression should be used for template design according to the specification:

$$\gamma 0S \leq R$$

2.2. Plane Frame Safety Calculation

The calculated values of formwork normal stress and formwork deflection are checked in the welded and non-welded areas. The input box prompts the input of the corresponding value and the corresponding articulation data to check the calculation. For example, the input of the wall template data box in Fig. 1 can achieve the generation of the calculation book of the characteristic value of bearing capacity, and can also realize all the discrimination of all components.

Figure 1: Wall frame input data box

3. Safety Calculation of Back Lamination and Pull Bolt

3.1. Calculation and Output of the Safety Characteristic Value of Back Lamination and Pull Bolt

The safety calculation of this part mainly checks the bending and shear strength of welding zone and the bending and shear strength of non-welding zone. Generally speaking, the back lamination is simplified into a simple beam for calculation. By comparing the specifications JGJ162 and JGJ386, it is found that the information in the parameters of the pull bolt is larger in the axial force design of JGJ386, which is safer. Therefore, the specification value of JGJ386 is mainly used in the checking process.

The bearing capacity is calculated according to the bending strength of composite aluminum alloy formwork engineering technical regulations, that is:

$$\alpha = \frac{Mmax}{Ws} \leq fs$$

The shear strength shall conform to the following requirements:

$$\tau = \frac{VS0}{Istw} \leq fvs$$

Stiffness checking calculation shall calculate deformation calculation:

$$v = \frac{5qgkL^4}{384EsIs} \leq [v]$$

The deformation limit of the formwork is 1/400 of the calculated span of the formwork member, and the deformation limit of a single block formwork shall not exceed 1.5mm.

3.2. Safety Calculation of Pull Bolt and Back Blanking

Through the input of the data box in figure 2, the checking calculation of the above parts can be carried out, and the checking calculation results of different parts can be generated in the form of a calculation book.

Figure 2: Parameter input cross section of back blanking and pull bolt

4. Case Analysis

Atlia project is located in johor, Malaysia. This design is converted into a 3d BIM model through 2d plan and project construction elevation. The 3d model was imported, and the safety calculation analysis was carried out on the project plane frame, backboard and drawing bolt checking frame by using the new safety calculation system.

4.1. Safety Calculation and Analysis of Plane Frame

Taking the project aluminum wall template as an example, the software application is introduced. Take the beam frame as an example, through the calculation parameter input and identification in Figure 1, output the safety calculation statement of Figure 3 template, click on the qualification analysis table of all components output Figure 4, and mark the unqualified components.

Figure 3: Output interface of safety calculation book of wall frame panel

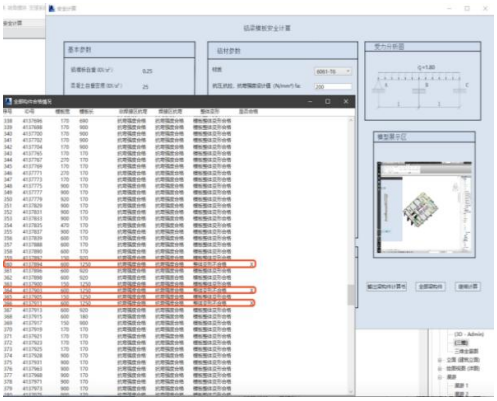

Figure 4: Qualification analysis interface of all beam formwork panels

4.2. Calculation and analysis of the safety of backing and pulling bolts

In order to ensure the safety of the project construction site, a limit of 800 was calculated for the distance between bolts and the distance between bolts. The selection specification of back blanking is 80mm*40mm*2.0mm, then the relevant parameters are automatically checked out according to the selection of back blanking specification. According to the input of project information, the pulling bolt with the diameter of 22mm thick was selected, and the pulling bolt with the diameter of 22mm thick was checked by the software to meet the requirements of strength, deflection and bearing capacity. Figure 5 shows the output interface of and security calculation book.

Figure 5: Output interface of safety calculation book of connecting components

5. Conclusion and Prospect

This paper probes into the aluminum frame based on REVIT safe computing systems, development and application of the safety calculation based on REVIT aluminum frame system, combining with related technical

specifications and the actual situation of the construction site construction, combed the aluminum formwork system security calculation process, give full play to the aluminum frame security calculation system in the design phase scheme layout and the advantages and value of safety checking.

Due to the huge safety calculation system of aluminum frame and the large number of aluminum frame manufacturers on the market, in order to ensure the quality of the frame and the safe use of the construction site, it is necessary to improve and refine the component checking experimental method and relevant force analysis calculation formula of aluminum frame safety calculation system, which can be directly referred to the calculation system.

References

[1]. Zhang Xulei. Research on BIM based CAD system of template and support engineering [D]. *Tsinghua university*, 2010.

[2]. Zhang Dan, Tao Zhong, Wan Fuxiong et al. Application value of BIM technology in aluminum alloy formwork support system [J]. *Sichuan building science research*, 2015 (04): 146-149.

[3]. Dong daze, Xu Xianghui, Guo Hu et al. Discussion on application of BIM technology in light aluminum mold engineering [J]. *Construction technology*, 2017 (S1): 543-545.

[4]. Huang Qiang. Implementation method of p-bim building information model based on engineering practice [J]. *Henan civil architecture*, 2015,35 (146): 2-20.

[5]. Dai Guiyang. Application of aluminum alloy formwork in building construction [J]. *China residential facilities*, 2012. (10): 51-53.

[6]. Zhou Fuliang. Application of BIM technology in the design of tall formwork bracket [J]. *Sichuan architecture* 2016,36 (1): 187-190.

[7]. Cui Shumei, Jordan, Cao Yueying et al. Research on construction and system development of aluminum template security computing system based on p-bim [J]. *Science and technology innovation journal*, 2018 (16): 156 + 159.