Analysis of Finite Element Analysis of Steel Concrete Conversion Beam Tip Node

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Keywords: Type Steel Concrete Beam, Girder Tansfer, Finite Element Analysis.

Abstract: With the continuous expansion of my country's urban rail transit, the construction projects on the subway have been widely used in recent years. The beam -type conversion structure is widely used in subway projects due to its clear path transmission path, convenient construction, and low cost. The connection nodes of the steel concrete conversion beam and wall of a project in this article are research objects. The ABAQUS software analyzes the stress strain and deformation of the node. The results of the finite element analysis indicate that the design of the type steel concrete conversion beam can meet the engineering needs. Some suggestions on the measures for strengthening nodes are put forward, which can provide reference for similar projects.

1 INTRODUCTION

In order to improve the utilization rate of urban land and make full use of the subway vehicle section and the upper space of the vehicle base, the converter structure is usually used. The commonly used conversion structures include beam -type conversion and thick plate conversion. The beam -type conversion is widely used in the subway projects due to its clear path transmission path, convenient construction, and low cost.

Based on a subway roof project, this paper uses ABAQUS finite element analysis software to calculate and analyze the connection joints of steel-reinforced concrete transfer beams and frame-supported wall columns. At the same time, according to the stress-strain results calculated by ABAQUS, some strengthening measures of transfer beams and frame-supported wall columns are proposed.

2 PROJECT OVERVIEW

Fuzhou a metro covered with a layer of garages layer, the cover of the next layer of the subway out of line, the throat area, the run-time library and the maintenance of the library, garage-layer upper for residential layer or business layer it. The project according to the vertical using functions from the lower to the upper divided into: under the cover of Metro operational layer, cover with a garage layers, the upper portion of the residential layer or business layer, the cross-sectional view is shown in Figure 1.

The project is a multi-column frame supported shear wall structure, the Metro cover a total of 39, building high-rise residential and other centralized commercial and matching floor, the cover with a total construction area of about 45208.6 Square meter. The basis of the use of 800~1000 millimeter diameter of the concrete strength for the C35 perfusion pile.

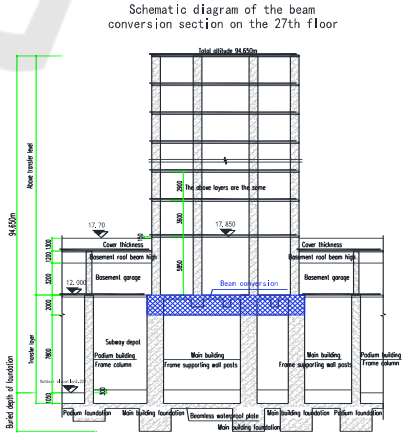

Figure 1. The structure cross-sectional view.

In order to meet cover the following functional requirements, while ensuring that the structure is safe, suitable, economically, the conversion layer using a

Liu, W.
Analysis of Finite Element Analysis of Steel Concrete Conversion Beam Tip Node.
DOI: 10.5220/0012285500003807

In *Proceedings of the 2nd International Seminar on Artificial Intelligence, Networking and Information Technology (ANIT 2023)*, pages 437-441
ISBN: 978-989-758-677-4

Girder tansfer solution. Girder tansfer structure of the power transmission path is clear, the construction is convenient, the cost is relatively low (Wang C Y.- Cheng X H).

Connection cover and under the cover of the converted beam is passed loads of important structural member, and the“strong node of the weak member”so that the node design is especially important.

3 FINITE ELEMENT MODELING

3.1 Conversion Member Location Select

Selected to take the structure in the most adverse conditions typical steel transfer beams and frame branch wall column of connected nodes for ABAQUS analysis and calculation, the conversion of the beam position as shown in Figure 2 shown. Steel beam cross-sectional dimensions as shown in Figure 3 is shown for 1200x2000(300x1500x32x32), the most unfavorable conditions of the beam span is 11. 4m.

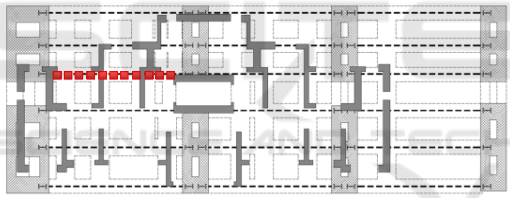

Figure 2. Conversion of the beam position of the figure.

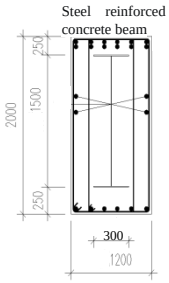

Figure 3: Conversion of the beam size chart.

3.2 Element Types and Meshing

Concrete using eight-node linear hexahedral elements and reduced integration, hourglass control the format of the three-dimensional solid elements (C3D8R) were simulated. The longitudinal reinforcement and stirrups of the selection of the two-node linear three-dimensional Truss element T3D2 simulation. Type of steel using tetrahedral shell element S4R simulation.

In the meshing is required prior to first determine to meet the accuracy of the mesh density, the use of finite element software to provide the structured meshing technique for the finite element model for cell division.The grid is divided as Figure 4 shows.

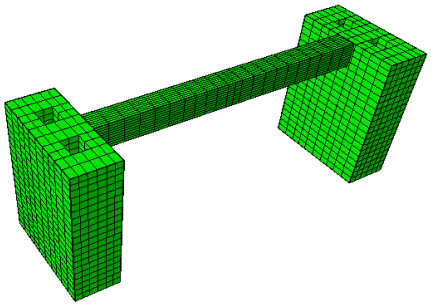

Figure 4. Meshing diagram.

3.3 Material Constitutive Relationship

Conversion beams concrete used C40 strength, in-the-wall concrete used C30 strength, the elastic stage of the Poisson's ratio υ 0. 2, the density is taken 2400kg/m^3. Steel pipe adopts Q345, reinforced the use of HRB400. The steel used to meet the Mises yield criterion of the elastic-plastic model, the concrete using shaping injury model.

Concrete consists of two types of concrete components, one is the stirrups constraints of the concrete, and another for the stirrups outside unconstrained concrete, two types of inconsistent, which means that the stress-strain relationship of the model used must be targeted. Stirrups constraints concrete takes into account the distribution of the Hoop characteristic value of the concrete stress-strain relationship model, the model of the mathematical formulas expressed as follows (Qian J R - Han L H).

$$y=\begin{cases} Ax+(3-2A)x^2+(A-2)x^3 & (0\le x\le 1) \\ x/\left[(1-0.87\lambda^{0.2})B(x-1)^2+x\right] & (x>1) \end{cases} \quad (1)$$

The formula parameters are defined in detail in the literature (Han L H, 2016).

3.4 Contact Interface Analog

Through the Embedded region (built-in area of the longitudinal reinforcement and stirrups of the steel skeleton embedded into the concrete below. Steel beams with lap walls of the node selected binding Tie) constraints.

Steel and concrete between the along the normal to the direction of use is considered normal contact

stress in the steel tube and the concrete completely passed the“hard”contact, and by the force of the process, allowing the steel and concrete in contact with each other after separation; along the tangential direction using the Coulomb friction model.

3.5 Boundary Conditions

The wall base is applied to the solid end of the constraint, limiting its six directions of the degrees of freedom. The walls of the ring to the constraint, floor lateral support as a safety Reserve will not be considered.

3.6 Load

Load: material parameters, beam, floor permanent loads and variable loads are by design take the value 1.3 D+1.5 L; the weight of the load by density and acceleration of gravity finish is applied; a conversion layer of the upper shear wall load by extracting YJK big shock to calculate the bottom of the column force data obtained, regardless of the adjustment factors.

4 CALCULATION RESULTS AND ANALYSIS

4.1 Concrete Stress Analysis

Figure 5 visible wall in concrete the maximum compressive stress is 64.46MPa, is greater than the concrete tensile strength design value, in the corner near the place; the maximum tensile stress of 2.10MPa, is greater than the concrete compressive strength design value, in the beams of the wall node position.Figure 6 visible beam in concrete the maximum compressive stress is 14.61MPa, less than the concrete compressive strength design value; the maximum tensile stress of 2.0MPa, is greater than the concrete tensile strength design value, in the beams of the wall node position. Concrete plastic strain as shown in Figure 7, the maximum plastic strain value is 0.0246, located in the beam and the wall at the junction of the neighborhood. The maximum plastic strain value is very small, the material does not occur destroyed.

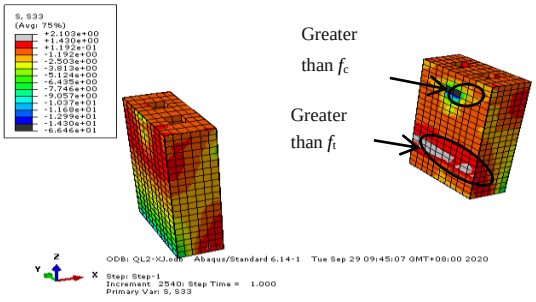

Figure 5. Wall in concrete stress cloud diagram.

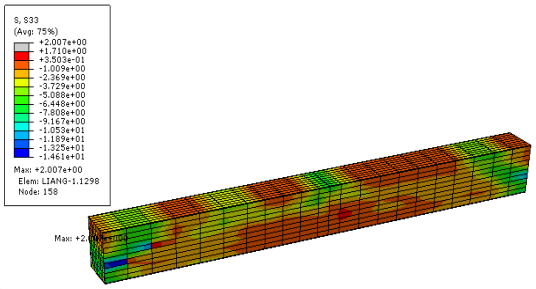

Figure 6. Beams in concrete stress cloud diagram.

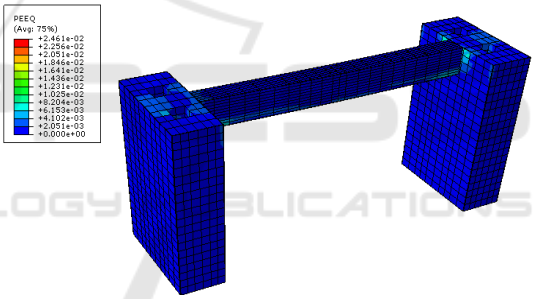

Figure 7. Concrete equivalent plastic strain figure.

4.2 Reinforced with Steel Stress Analysis

Analysis of reinforced and steel using the Mises yield criterion, i.e., the Fourth of the yield strength of the theory.Figure 8 shows the type of steel, the maximum stress is 345MPa, and the stress is mainly concentrated in the beam bottom tension and and frame branch wall connecting the nodes around.Figure 9 visible reinforced the maximum stress of 360 MPa, the mid-span position of the beam and bottom beam surface of the longitudinal reinforcement of a larger force, and frame branch wall connected to the node position of the beam reinforced by the force is also larger.Overall, the block support walls and conversion beam connecting node of stress throughout the stage are more than their yield stress.

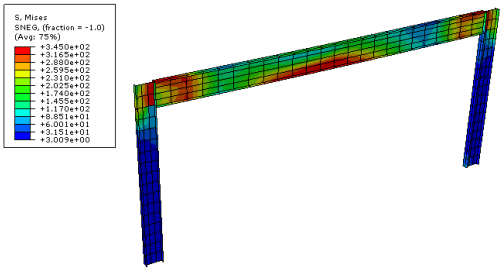

Figure 8. Type steel Mises stress cloud diagram

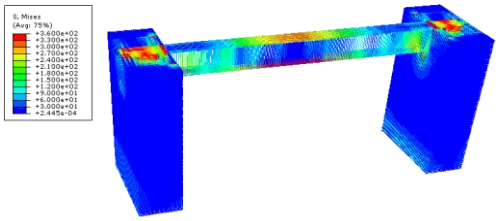

Figure 9. Reinforced Mises stress cloud diagram.

4.3 Summary

In the most unfavorable load combination, the conversion beams and frame branch wall of the connection node of the concrete local damage, the concrete portion enters the plastic State, but the magnitude is small. Steel and rebar are not the yield, the structure is subjected to slight damage, the overall node in the rare case of an earthquake under the force of good performance, meet the needs of large earthquakes do not pour the principles.

5 NODE PROCESSING MEASURES

5.1 Frame Branch Wall Column and the Conversion of Beam-Column Node Practices

Follow the “strong node of the weak member”of the principle of frame branch wall column and the conversion of beam-column node to take the corresponding reinforcement measures, steel beam inside the steel and rebar connection sample detailed in Figure 10, the frame supported the wall of the column and convert the beam node a large sample detailed in Figure 11.

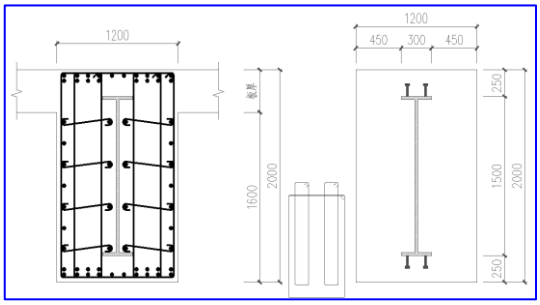

Figure 10. A large section of steel beam.

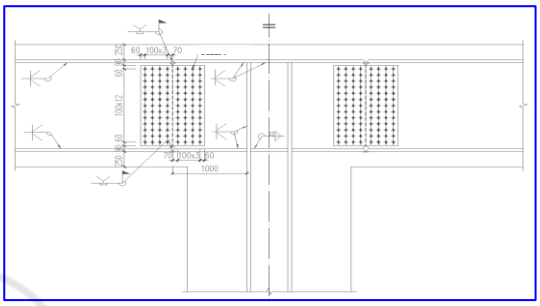

Figure 11. Large sample of frame support wallcolumn and transfer beam joint

5.2 Conversion Member Construction Technical Measures

Steel splice should be member of the welding surface of the oil, rust removal. Bear welding work, welder, according to the leading industry standard for the steel structural welding code stipulates that certificates.

Steel structure installation should be strictly according to the drawings specified axis and the position of the positioning, force and holes should be correct; the lifting process should use the relevant equipment strict calibration of vertical, and timely positioning. Installation of the vertical degree, field of lifting the error range should be consistent with the national standards of the steel structure engineering construction quality acceptance criteria of GB50205 the provision.

Steel plate hole, you should use the factory lathe prepared hole, forbidden to live with oxygen cutting openings.

Pegs before welding, should be a member of the welding surface of the oil, rust removal, welding inspection after the peg height of the allowable deviation should be within±2mm, at the same time, according to the relevant provisions of the sampling check its quality of welding.

Steel reinforced concrete member within the steel without coating processing.

6 CONCLUSIONS

The present text to a subway on the cover of the project as the basis for steel reinforced concrete transfer beams of the wall node to the ABAQUS finite element calculation and analysis. Results showed that the conversion of the beam and frame branch wall in a large earthquake case of a partial concrete into a plastic State, but the number was smaller, rebar and steel are not to exceed the respective yield stress.Verify in the most adverse conditions and still maintain good mechanical performance, can meet large earthquake conditions performance requirements. This article for conversion beams and frame branch wall design calculation of ideas and the node processing measures may be for the same project reference.

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