Analysis of High Span Curved Net Frame Lifting

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Abstract. A proposed dry coal shed grid plan size is 99m*140m, through the establishment of structural model, using Midas Gen finite element analysis software for structural verification and analysis, and finally determine the best construction plan.

Keywords: Tall span; net frame lifting; finite element analysis.

1. Introduction

With the rapid development of social economy and construction industry, steel structure building has developed rapidly in recent years with its advantages of low cost, large space and good seismic performance, especially in public buildings, large venues, industrial construction and other facilities are widely used. The arch curved structure is loved by many construction units because of its large space, novel shape and beautiful features, and the wide application of high span steel structure grid has become a development trend. The traditional scaffolding work platform at high altitude for the scattering of nets exists a large number of turnover materials, long cycle time, high costs, higher safety and quality risks and other shortcomings, cannot meet the national and construction industry vigorously promote energy saving, environmental protection and efficiency requirements. This paper summarizes the key construction techniques of a heat source plant project using a new support system and assembly method.

2. Project Overview

A new thermal power plant project, dry coal shed net frame plane size of 99m * 140m, covering an area of 13,860 square meters, net shell thickness of 4m, using bolted ball node net frame and the lower chord column point support mode. The structure form is three-center cylindrical surface double layer mesh shell.

This project adopts the construction technology of tire frame support, large unit overall lifting and small unit block lifting, this construction technology is not only safe and reliable, good quality, but also solves the problems of large amount of turnover materials, low construction efficiency and high cost, which meets the requirements of energy saving, environmental protection and economy.

3. Building of analytical model

3.1. Calculation software

Midas Gen finite element analysis software is used to establish a reliable structural model, which can truly reflect the displacement of the structure and the stability of the members during the installation of the grid.

3.2. Building of structural analysis model

3.2.1. Calculation instructions

The structure calculation principle is designed according to the limit state of bearing capacity, the displacement is calculated by the standard combination of load, and the internal force and stress are calculated by the basic combination of load.

Constant load: Considering the self-weight of the bars and nodes, the steel capacity is 78.5kN/m³, and the self-weight of the structure is taken as 1.45 times the self-weight multiplier, while 1.2 times the power amplification factor is considered in the installation process, that is, a total of 1.45×1.2=1.74 times the self-weight multiplier is considered.

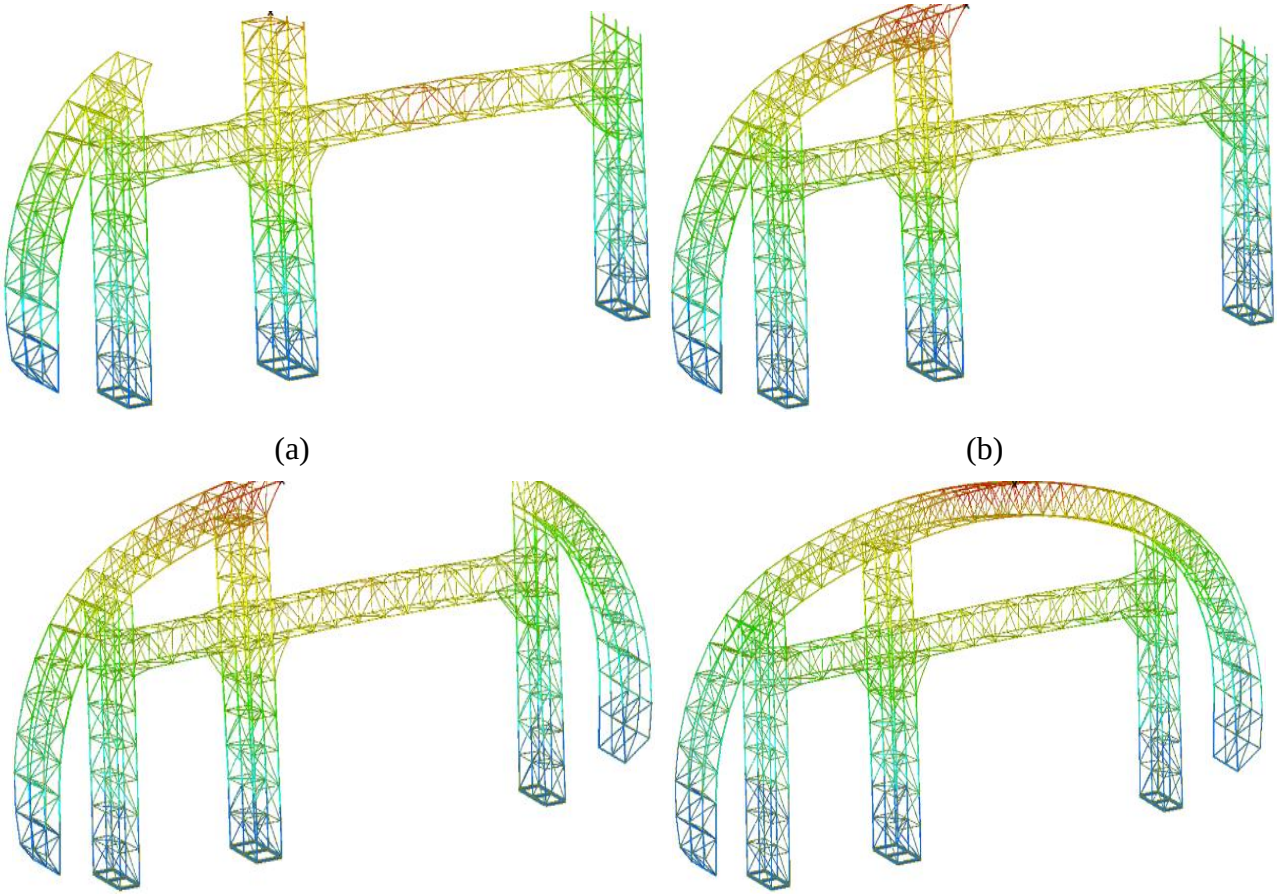
Wind load: The basic wind pressure is taken as 0.20kN/m2 input in accordance with the 10-year event, and the ground roughness is considered according to class B. The wind load on the structure is automatically calculated by the software and applied to the unit in the form of wind pressure on the beam unit.

Load combination:

Basic load combination: 1.3× (constant load) ± 1.5× (wind load)

Standard load combination: 1.0 × (constant load) ± 1.0 × (wind load)

3.2.2. Displacement model calculation



(a) (b)

(c) (d)

Figure 1. The model calculation.

As shown in Figure 1, under the standard load combination, the maximum displacement value of the structure during installation d = 33.505 mm < 46270/400 = 115.675 mm, which meets *The Structural Design Requirements* (Appendix B of the Steel Structure Design Standards (GB50017-2017)).

3.2.3. Component stability calculations

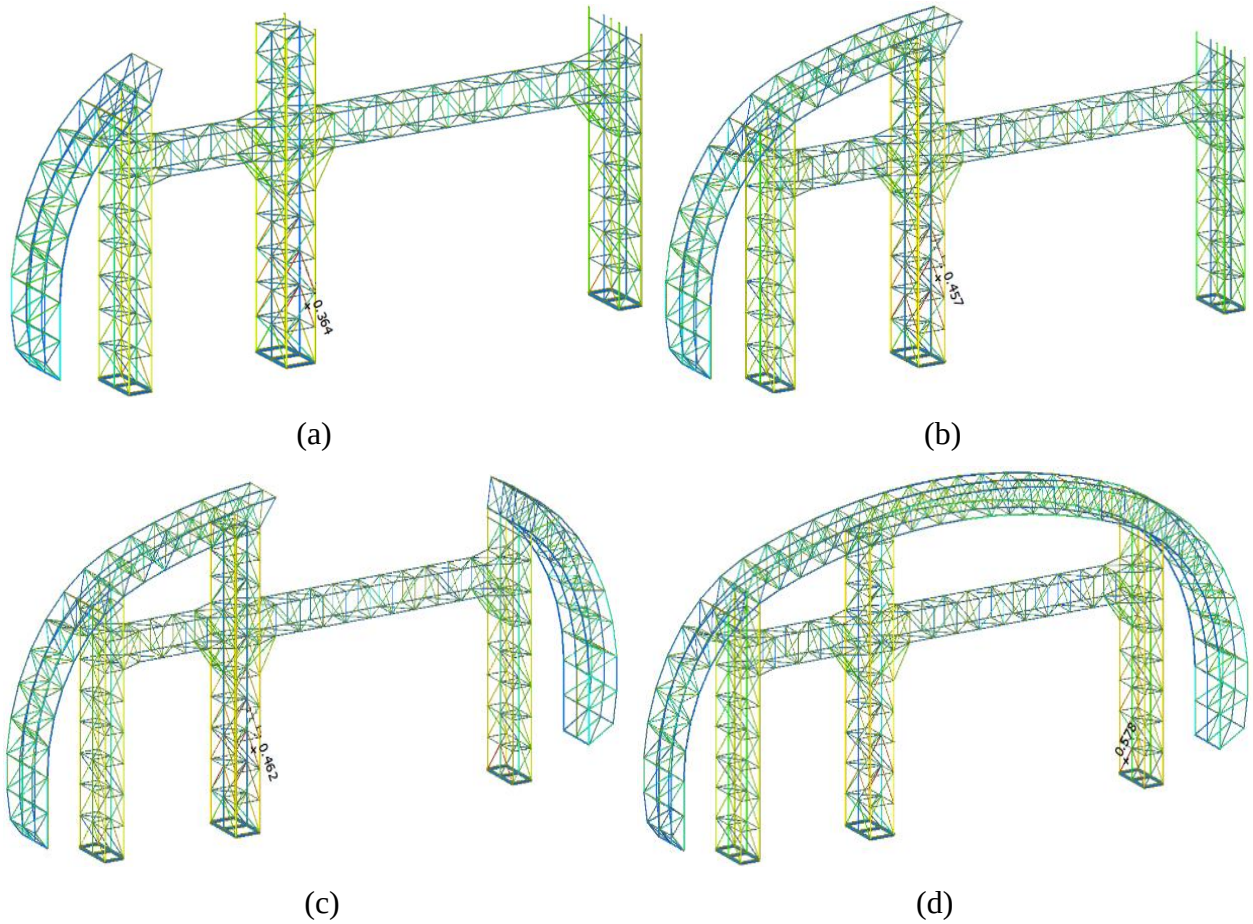


Figure 2. The stability calculations.

As shown in Figure 2, during the simulated installation of the tire frame, the maximum combined verification ratio of each bar of the structure is 0.578 < 1, which meets the specification requirements.

4. Summary analysis and performance evaluation in the practice process

Through the above analysis, it was finally determined that the tall span frame would be supported by the tire frame, and the construction process would combine the lifting of large units as a whole and the lifting of small units in pieces, and the following problems were solved.

(1) Quality. The lower part of the mesh frame is supported by tire frame, which solves the problem of large vertical displacement offset of the mesh frame and the inability to connect the bolt ball with the rod. At the same time, the ground assembly and overall lifting method was adopted for the first bay of the starting grid, which solved the problem of difficult loose assembly at high altitude and accurate positioning, which can effectively ensure the construction quality of the grid installation.

(2) In terms of construction period, there is no need to build scaffolding, fast construction rate. At the same time, it effectively reduces the overhead working time of the net frame installation workers, which can greatly shorten the construction period.

(3) In terms of Cost, compared with the traditional scaffolding support method, the tire frame support greatly reduces the use of turnover materials, and the construction speed is fast, saving man-hours, economic and social benefits are significant.

(4) In terms of durability and safety aspects, the mesh frame welded balls and rods are connected with high strength bolts, which avoids the characteristics of welding quality not easy to control and improves the durability and safety of the mesh frame.

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