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High Altitude Steel Roof Truck Crane Installation

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Abstract: In order to solve the problems of crane operating range in blind areas and insufficient weight support of crane for steel structure bubble roof lifting construction, it is a must to design propelling crane on the roof, so that it can move on selected routes, completing the lifting work of steel roofing bubble. Mainly introduce the technical measures and related technical preparation of propelling crane on the roof for steel structure lifting process, to ensure the originality of steel structure during lifting process and safety of construction work,also to guarantee the progress of steel structure lifting work.

Key words: Steel propelling, Hoisting, Crane

Introduction

With continuous development of construction field, growing use of construction sites, wider usage and development of spaces on the roof, the use of steel structures to increase building surface area as rooftop garden is also growing[1]. Fixation of steel structures on the roof of building is tedious and there are also high requirements on the hoisting techniques. All those problems are contributed by limitation of construction sites and constructions machinery[2]. In order to accomplish hoisting of steel structures on roof, it is a must to continuously upgrading construction techniques and measures,to assure the safety of steel structure hoisting work on the roof[3].In addition to full consideration of all kinds of factors, for steel structure bubble hoisting on the roof of Sasseur, truck crane was selected for steel structure bubble hoisting construction work.

1. Project Overview

Nanjing Sasseur project was situated at Jiangsu Province District, Jiangning District of Nanjing, Shuang Long Da Dao and Mozhoulu junction, which is the assembly point of office, commercial, leisure and entertainment hub, and also with subway alongside, is a unique artistic business complex. Construction area is 184,687 m^2 , with four floors of building with surface area 85,083 m^2, ground floor with surface area 99,604 m^2 . The roof was designed to have seven

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steel bubble and functions as rooftop garden, the main sections include steel column (Φ400* 20,Φ500* 20, Φ650 * 25), box-type steel beam (square 850×250×20,square 500×200×16, square 500×200×12, square 250×150×6, square150×80×3). The patterns/forms of steel connections mainly consist of bolt connection + welding connection and steel material coded as Q345B. Steel roofing bubble (Figure 1) distributed on the roof at various locations, total weight of steel structure is 1770t, with that the weight of single piece steel structure for 7# bubble (Figure 2) is1,100t, while 1#bubble (Figure 3) is weighted 300t and 2# ～ 6# has an average weight around 80t.

Figure 1 Sasseur Project Overview

Figure 2 7#Steel structure bubble three dimensional model

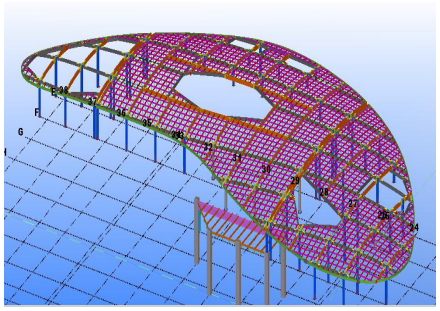

Figure 3 1#Steel structure bubble three dimensional model

2. Steel Roofing Bubble Lifting Overall Program

2.1 Confirmation of hoisting method

In addition to insufficient weight of crane on site to fulfill steel hoisting requirements, tight project schedule and in order to as-sure project accomplished in time for Sasseur steel roofing bubble section hoisting project, after consideration, it was confirmed that the eastern part of the roof was set up with a 20T, western part of roof set up with two 20T truck crane. This is to coordinate with the cranes used on site to undergo steel bubble steel column and steel beam hoisting work. Steel roofing bubble involved hoisting of parts and high altitude docking idea for installation.

2.2 Truck crane (20t) installation on roof construction technique

2.2.1 Choices of cranes

Roof part involved the use of QY20 truck crane with curb weight 24.5T. If to lift 24.5T crane up to the roof, when

choosing cranes, the crane lifting capacity need to be considered,as well as to consider the lifting points up to the roof at horizontal distance and vertical height, and also unfavorable factors and conditions on site. In this construction project, after involved consideration of all types of cranes working parameters and safety factor, 250T truck crane AC250-1 was chosen to lift 20T truck crane up to the top of roof (as illustrated in Figure 4) as to fulfill steel structure hoisting requirements.

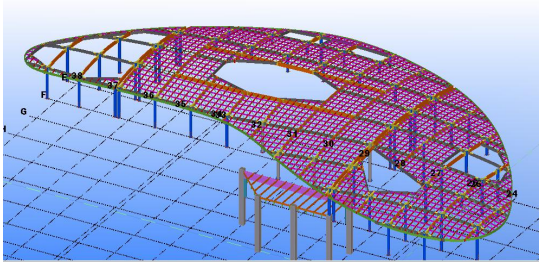

Figure 4 Lifting condition schematic diagram

2.2.2 Measures for lifting crane to the roof

(1) Eastern area near Mozhoulu construction channel was chosen, 250T truck crane was used to lift 20T truck crane up to the roof at specific areas (Figure5). Western area chose Zijin construction channel, same method was practiced to lift two 20T truck crane to the roof at specific areas(Figure 6).

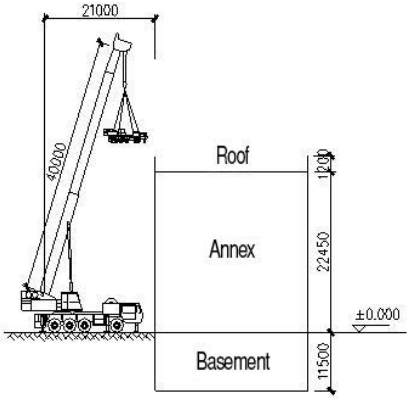

Figure 5 Truck crane position in Eastern area

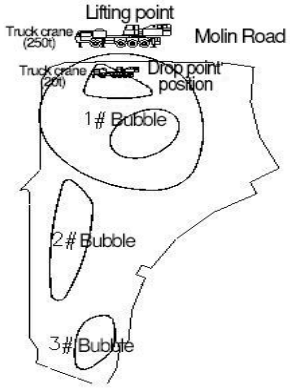

Figure 6 Truck crane position in Western area

(2) In order to fulfill the requirements for 250T truck crane lifting point hoisting position, at the construction site on the lifting surface, 2 cm thick steel plates was used for flooring as crane supporting leg imposed full energy on the steel plates, 38mm diameter steel rope used as sling (check with hardware manual seventh edition Table 6.72 steel rope weakest breaking force as784kN) tie at (pocket) 20T truck crane four supporting legs, after checking for any faults, the big crane was slowly lifted up, while lifting, the distance of crane from ground surface is 50 cm and remained for a minute, again after checking for any faults, lifting process were continued. In order to avoid lifting process to be affected by wind force and hence creating movement, four wind cable ropes were separately tied up at the four supporting legs of 20T truck crane, artificial rope was used to lift it up steadily.

Person to pick up the crane on the roof and hoisting personnel on the ground should keep contact using walkie talkie, to make sure 20T truck crane was lifted correctly and safely to the fixed positions. After the accomplishment of

steel bubble hoisting, same method was used to lift the truck crane back to ground surface.

2.2.3 Moving route of crane on the roof

In addition to dispersion of steel bubbles on different locations of the roof, and to fulfill the installation of steel bubbles, roof beam carrying capacity condition to fix the set up of truck crane moving route (Figure 7 & Figure 8)was combined. The moving route enabled hoisting crane to cover steel bubbles installation area and in order to ensure the safety of roof structure, cordons were set up at the two sides of truck crane moving route. Crane travelling on non-moving pathway should be avoided and when the crane is moving, person-in-charge should be responsible for commanding and alerting.

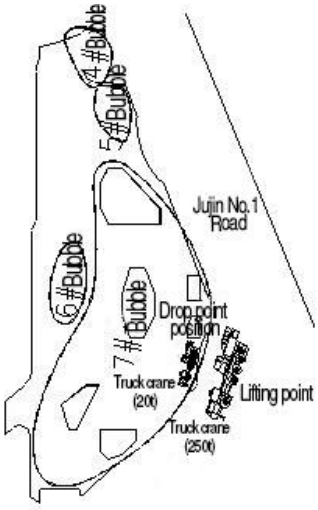

Figure 7 Truck crane moving route in Eastern area

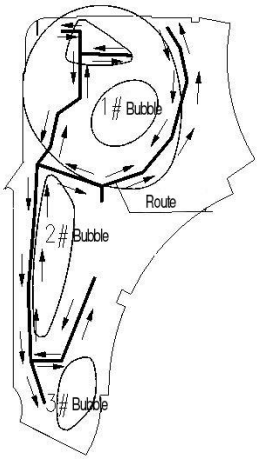

Figure 8 Truck crane moving route in Western area

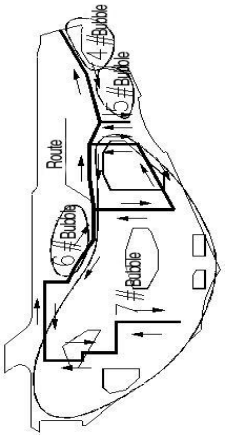

Figure 9 WB1 calculation schematic diagram

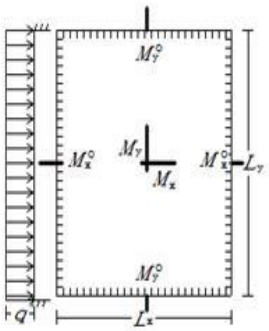

Figure 10 WB2 calculation schematic diagram

2.2.4 Roof plate bearing capacity check

As truck crane needs to be moved on the roof and also used for lifting operations, thus the moving area on the roof plate should be checked for its bearing capacity and its normal lifting condition. For example, roof WB1(3500 × 4700 mm bidirectional board) and roof WB2 (equivalent to4500 × 5600 mm rectangular two-way plate) as typical roof plate in the moving area, the width of roof plate is approximately 200 mm,concrete strength at C40. Roof plate WB1 (Figure 9) board reinforcement C10@100, bottom plate reinforcement C8@100; WB2 (Figure10) plate one side freed, trilateral clamped, board reinforcementC12@100, bottom plate reinforcement C10@100. After the reinforcement of these two typical roof plates, span deflection, bearing capacity calculation and crack width checking, the roof plates can fulfill the bearing capacity for truck crane hoisting process and also make sure the safety for normal use structural condition.

2.2.5 Lifting operations precaution steps

(1) Although calculation on roof plate is done and proven to fulfill the structural safety during truck crane operation procedure, four 1.2 × 1.2 × 0.2 m supporting steel box boards was positioned at each supporting points to expand the force area of bearing point.

(2) Before truck crane operation, it is a must to follow the pre-designed lifting points for lifting operations.

(3) Avoid setting lifting anchor at the span of floor.

(4) Avoid setting lifting anchor at the positions consist of cantilever plate.

(5) Avoid setting lifting anchor out of the range of non-driving area.

Conclusion

In addition to the choice of using walking (moving/mobile) truck crane for lifting operations on the roof, its wide coverage area could greatly improve working efficiency, shorten construction period,save a large number of manpower and cost of machines, hence accelerating the progress of project. With the wide use of roof spaces as light steel garden, it will surely be popular. Apart from a few large cranes, the use of truck crane on roof for steel structure installation will be hoisting mainstream. Whether crane can be lifted on the roof or not, is determined by scientific calculation on roof bearing capacity and so as to ensure the safety of roof structure.

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