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Study on Designing a New Construction Enclosure Based on Green Construction

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Abstract

With the growing construction scale in China, the total amount of construction containment demand has surged. However, the traditional temporary containment not only causes a waste of resources but also has a certain negative impact on the environment. The new construction enclosure designed and discussed in this paper is a construction enclosure designed to achieve energy saving, environmental protection, convenience, and cleanliness, beautify urban ecology, and maintain the image of the city under the premise of actively responding to the call of the national green construction policy and construction safety. Its purpose is to adhere to the people-oriented principle and create a more comfortable living environment for the public.

Keywords

New construction enclosure
Convenient and clean
Green construction

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1. Introduction

In recent years, the pace of China's urbanization construction has continued to accelerate, the construction industry's requirements on the quality of building installation and construction environment continue to improve [1], and the scale of engineering construction is expanding, with the annual new construction projects in progress with its matching enclosure building volume of more than 70 million square meters, which shows the huge demand for the construction of enclosures. However, the current enclosures are generally brick-concrete structure enclosures or color steel plate enclosures. Brick-concrete structure steel plate enclosures are costly, difficult to deal with, etc.; the color steel plate enclosures have defects such as poor image, short service life, and poor strength. Therefore, it is not difficult to see that with the increasing demand for enclosures, the traditional enclosures not only affect the beauty of the city, but also cause a negative impact on the environment as well as lead to irreversible consequences for resource waste [2].

On May 15, 2023, the 19th International Green Building and Building Energy Efficiency Conference was

held in Shenyang, Liaoning Province, with the content of "Realizing the rapid development of the building industry under the premise of energy conservation, environmental protection, green and low carbon" [3]. It can be seen that green construction is the cornerstone of green buildings, and this concept has long been deeply imprinted in the hearts of Chinese people. Therefore, the new construction enclosure proposed in this paper is also bound to conform to the national green building policy and the green concept of Chinese people's environmental protection. Under the premise of ensuring construction safety, the construction environment is improved through scientific and technological design, so that the enclosure is convenient for cleaning and green environmental protection, and the purpose of maintaining the image of the city is achieved.

The new construction enclosure is easy to change and move, and can quickly establish the enclosure construction; under the premise of ensuring environmental protection, beauty, and economy, it offers the advantages of industrialized production and repeated use, with many economic and social benefits [4]. Based on this, this paper discusses its main composition, wind resistance, and application range.

2. New enclosure design improving the safety of the construction site and facilitating cleaning

The main use of the enclosure is to isolate the construction site from the external road environment, allowing the construction site to become a relatively closed environment, so that the operation will not be interfered with by the outside world and the safety of external residents can be ensured [5]. The traditional construction enclosure is no longer in line with the green construction concept advocated by the state, and the construction enclosure catering to its concept is an important direction of green construction innovation [6].

In view of some defects of the traditional construction enclosure and combined with the actual situation and conditions of the construction site, this paper proposes a new construction enclosure, the specific form is shown in **Figure 1**.

Based on the figure, (1) the support assembly 1 and the coaming assembly 2, and the enclosure base is prefabricated reinforced concrete; (2) the coaming plate assembly 2 is removable and connected between two adjacent support components 1, which is characterized in that the support assembly 1 comprises a support rod 11, a support plate 12, and a limit plate 13. The support plate 12 and the limit plate 13 are fixed on both sides of the support rod 11, and the top of the support plate 12 is fixed and the bottom of the limit plate 13 is connected. The limit plate 13 is inserted into the inside of the coaming plate assembly 2.

In **Figure 1**, the enclosure of the utility model is arranged with a staggered distribution nozzle, which is located on the front side and the rear side of the partition plate. When the nozzle sprays water, the sub-plate can guide the water flow to wash the front and back sides of the coiling assembly respectively, so that the enclosure does not require a cleaning truck to clean the inside of the coaming assembly, and the construction workers inside the coaming assembly can also get a better visual experience. As the nozzle is staggered on the splitter, the splitter and coaming assembly can be fixed so that they cannot move up. Therefore, the splitter and coaming assembly do not need to be restricted when installing the device [7].

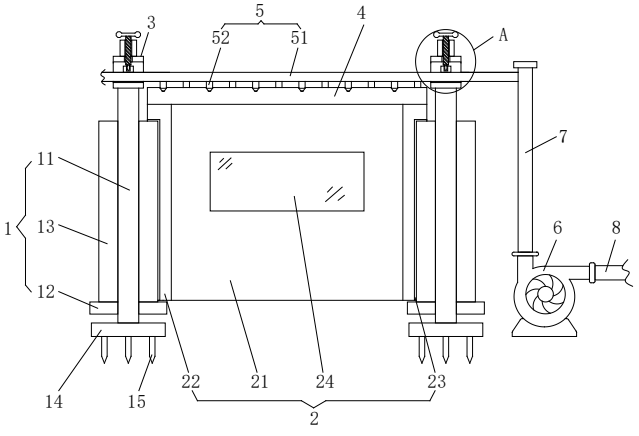

Figure 1. New enclosure front elevation diagram

3. Calculation of the wind resistance performance of the new enclosure and related treatment of dust and noise problems

The seamless connection of crowded public spaces coupled with the explosion of human traffic in modern society causes some problems in enclosures. Enclosures

are not only a safety function facility but also play a positive role in quality identification, in order to ensure the relative isolation of the construction site from the outside world as well as external safety. In the construction site, unexpected situations emerge endlessly. In order to cope with the sudden bad weather at the construction site, under the premise of ensuring the safety of the construction site stacking materials, and the safety of residents and pedestrians around the construction site, the construction enclosure first needs to have strong wind protection performance [8].

According to the "Unified Standard for the Design of Building Structure Reliability" [9], the enclosure is a temporary structure, and its design service life is generally 5–10 years. In order to ensure its safety, the junction coefficient is increased by one level to 1.0. According to the characteristics of the construction site, the height from the ground is 5 meters, and the ground roughness category is Class B. The gust coefficient is 1.7, the wind pressure height change coefficient is 1.0 [10], the basic wind pressure of Dalian City, Liaoning Province is 0.65 kN/m^2 [11], and the standard value of windscreen load is:

$$Wk = \beta gz\, \mu sl\, \mu z\, w0 = 1.7 \times 1.3 \times 1.0 \times 0.65 = 1.437\ kN/m^2 \quad (1)$$

With the progress of the project construction, dust will be generated, and the resulting dust will accumulate, seriously endangering the coordination of the project area and the city landscape. Vertical greening can be installed on the enclosure through the coordinated design of landscape modeling, greening, and beautification, and then according to the actual site placement and application of the enclosure, comprehensive consideration is done.

Vertical greening refers to a greening method where plants are pasted on the enclosure facade. Vertical greening can effectively improve the dirty appearance of the site and increase the greening scope of the construction site. Vertical greening has a significant effect on the improvement of the construction site (**Figure 2**):

(1) Reducing floating dust: The adsorption function of the plant itself is used to adsorb the dust generated by the construction on the surface of the plant, which reduces the dust generated by the construction site and also decreases the harm caused by particulate matter floating on the city.

(2) Reducing noise: Through absorption, reflection, scattering, and isolation, green plants can reduce the spread and impact of noise.

(3) Beautifying the city: Through the management and maintenance of the forms of vertical green plants, their ornamental effect can be maximized, forming a green landscape in the city [12].

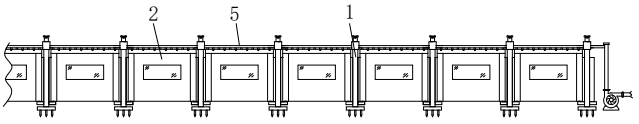

Figure 2. The overall effect of the new enclosure

4. Scope of application of new construction enclosures

The new enclosure designed in this paper is stable, beautiful, convenient, and clean, and meets the relevant requirements of the Technical Code for Temporary Buildings on Construction Site (JGJ 188-2009) [13] and Technical Code for Temporary Buildings on Construction Site (JGJ/T188-2009) [14]. It is suitable for the main structure of rail transit stations and sections, municipal engineering, and housing construction sites with a construction period of more than 1 month.

The following is a real scene of traditional construction enclosures used at a construction site in Liaoning Province (**Figures 3** and **4**).

Figure 3. Traditional construction enclosures are used in a construction site in Liaoning Province

Figure 4. Traditional color steel plate construction enclosure in real-scene use

5. Comparison between new construction enclosure and traditional construction enclosure

The wind resistance, dust, noise, and other aspects of traditional construction enclosures will affect the daily life and safety of surrounding residents, but the new construction enclosures designed in this paper can greatly improve these problems [15,16]. The details of the construction enclosure are shown in **Figure 5**.

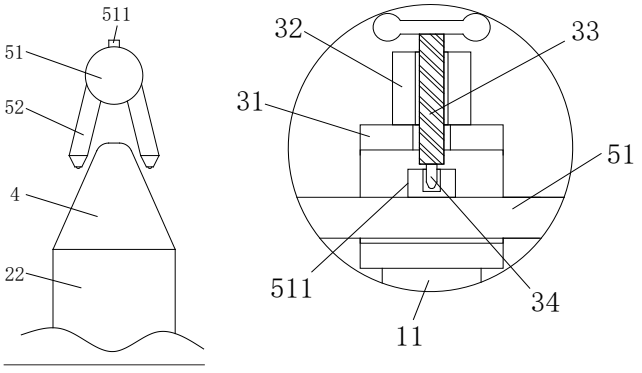

Figure 5. The construction enclosure details

The positioning pin 15 in **Figure 1** is made of high-carbon steel to minimize the possibility of bending. Its bottom is sharp, which can facilitate its piercing into the ground coaming panel assembly 2 that is fixed with a splice plate 4. The side section of splice plate 4 is an isosceles triangle. Cleaning assembly 5 comprises a horizontal pipe 51 and a nozzle 52, the horizontal pipe 51 is inserted from one end of the limit assembly 3 to the other end of the adjacent limit assembly 3; the nozzle 52 is connected to the bottom of the horizontal pipe 51, it is zigzag staggered on the horizontal pipe 51, and the two adjacent nozzles 52 are located in the front and back of the branch plate 4; after the horizontal pipe 51 is connected to the water source, water from nozzle 52 falls on panel 4 and flows down to flush coaming panel assembly 2.

It should be noted that the front and back sides of panel 4 should be in line with the front and back sides of coaming panel 2, respectively. The angle between splitter 4 and nozzle 52 should be set according to the different water pressure of nozzle 52, and the water sprayed by nozzle 52 should be prevented from sputtering to the outside environment as far as possible. In this embodiment, the angle between splitter 4 and nozzle 52 is 15 degrees.

In the present embodiment, the coaming panel assembly 2 comprises baffle 21, side panel 22, and observation window 24, the two side panels 22 are fixed on the left and right sides of baffle 21 respectively; the front of baffle 21 is provided with a recessed slot through the back of the observation window 24, the observation window 24 is arranged in the recessed slot, and the end of side panel 22 away from baffle 21 is provided with a limit slot 23. Limit slot 23 runs through the bottom of side panel 22, and limit plate 13 extends into limit slot 23.

In addition, the front and back of the observation window 24 should be in line with the front and back of the baffle 21, and the protruding part of the adhesive at the joint should be plowed to prevent the protruding adhesive from obstructing the flow of water to the observation window 24.

It should be noted that observation window 24 is made of tempered glass, which can minimize its damage due to splashing stones, in contrast to the easily damaged ordinary glass.

In the present embodiment, a limit assembly 3 comprises a limit frame 31, a threaded sleeve 32, a threaded rod 33, and an insert rod 34. A limit frame 31 is fixed on the top of a support rod 11, a threaded sleeve 32 is fixed on the top of a limit frame 31, a threaded rod

33 is threaded to a threaded sleeve 32, and threaded rod 33 is threaded through the inside of a limit frame 31. The plunger 34 is fixed at the bottom of the threaded rod 33, the transverse tube 51 is fixed away from the nozzle 52 end of the finite position block 511, and the plunger 34 extends to the inside of the limit block 511.

In addition, the internal height of limit frame 31 shall conform to the specifications of cleaning component 5, and cleaning component 5 shall be able to pass through the whole inside of limit frame 31. After connecting the coaming panel component 2 with the supporting component 1 in the equipment installation, it is passed through cleaning component 5, and then turned cleaning component 5 so that transverse tube 51 and nozzle 52 ride on the branch plate 4, and then turned the threaded rod 33 to move down. The pin 34 is inserted into the limit block 511, and when the limit assembly 3 completes the limit of cleaning assembly 5, it is ensured that cleaning assembly 5 also limits splitter 4 and coaming assembly 2.

In addition, the utility model also comprises a water pump 6; the water outlet of the water pump 6 is connected with a water supply pipe 7 connected with a horizontal pipe 51; the pumping port of water pump 6 is connected with a water inlet pipe 8, which is connected to the water source of the site, and water pump 6 extracts water from nozzle 52.

Table 1 compares the new construction enclosure with the traditional construction enclosure in many aspects [17].

6. Conclusion

The new green enclosure introduced in this paper has the following advantages:

(1) It can meet the requirements of rapid construction and installation and convenient observation of the outside environment.

(2) It has good wind resistance and dust and noise reduction effects.

(3) The new enclosure is stable, beautiful, and easy to clean.

(4) Repeated recycling reduces resource loss, saves costs, and has good social and economic benefits [19].

In summary, this new green enclosure can be used for municipal engineering, housing construction, and other construction sites, with a wide range of uses [20]. At the same time, it follows the basic principles of green sustainable development, implements convenient and efficient design concepts, and realizes the win-win situation of construction site beautification and external road safety.

Table 1. Multifaceted comparison table between new construction enclosure and traditional construction enclosure

Comparison	New construction enclosure	Traditional construction enclosures
Immobilization	The positioning nails made of high-carbon steel reduce the possibility of bending and have sharp spikes at the bottom to facilitate their insertion into the floor coaming assembly.	The efficiency of brick base construction is low, cannot be reused many times, and produce construction waste easily, with recycling difficulty.
Usage times	Multiple recycling	Once
Neatness	Easy to clean, a certain degree of viewing.	Appearance is easy to oxidize, not beautiful, and difficult to clean.
Environmental protection property	The material is easy to recycle and can be recycled many times to maintain the image of the city [18].	Low strength, cannot be used repeatedly, hard to handle.

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Disclosure statement

The authors declare no conflict of interest.

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