

Transformation and Upgrading of Construction Enclosure Based on the Shortcomings of Traditional Construction Enclosure

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Abstract

With the increasing development of engineering construction in China, construction enclosures play a significant role throughout the construction process. The new enclosure designed in this article is a transformation and upgrade aimed at addressing some of the shortcomings of traditional enclosures. Compared to traditional enclosures, the new construction enclosure effectively reduces costs and saves resources. The new construction enclosure designed and discussed in this article was made based on national environmental protection policies and the concept of national green construction. This new construction enclosure is safe, reliable, and environmentally friendly. We have maintained the city's image and actively responded to national policy calls.

Keywords

New construction enclosure
Green construction
Environmental protection

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1. Introduction

At present, the traditional enclosure functions selected for construction sites are single, most of which are high in cost and difficult to recycle, while others have unattractive appearance, poor environmental protection, and low safety. In the survey results, it was found that construction fences often cause distress to surrounding residents and pedestrians, with significant traffic and living problems.

The purpose of the Green Building Technology and Investment Development Conference is to propose the

goals of “3060 carbon peak” and “carbon neutrality”^[1]. Green buildings, green residential areas, green design, green building materials^[2], and green construction will become important footholds for the construction industry to help achieve the dual carbon goals and promote high-quality development of the industry^[3]. The new construction fence designed in this article is people-oriented^[4], catering to the national green development concept, promoting urban economic development, and maintaining the city's image as the goal.

2. Concept diagram and introduction of new construction enclosure

The main purpose of construction enclosure is to isolate the road construction site from the external road environment, making the construction site a relatively closed environment. Through this, construction operations will not be disturbed by the outside world, and it also ensures the safety of external residents^[5].

The construction enclosure surrounds the road construction site, isolating the chaotic construction site from the urban environment, in order to protect the city's image. Due to the diffuse dust in the construction environment, which is mostly close to the highway outside the construction environment^[6], it is easy for dust to accumulate on both sides of the construction enclosure. Excessive dust can also affect the aesthetics. Generally, construction sites will be equipped with cleaning trucks to regularly wash the external surface of the enclosure, but only the internal surface of the enclosure can be cleaned, which wastes driver labor and has low efficiency^[7]. Therefore, a convenient cleaning mechanism for construction enclosures is proposed. From the computer-aided design (CAD) concept map (Figure 1), it can be intuitively seen that the new construction enclosure is neat, making the construction site a scenic spot in the city.

3. The shortcomings of traditional enclosures compared to new enclosures

In the early stages of construction, the transportation and arrangement of traditional enclosures require a large amount of machinery and manpower. As the construction period progresses, the update and arrangement time for the enclosure is also more stringent. In the event of complex terrain or adverse weather conditions, the construction period of the enclosure will also be correspondingly extended, which will affect the overall construction progress and delay the construction schedule. The incomplete guarantee of personnel safety has also become a major issue. In the event of an accident, a significant amount of time and economic expenses will still be required in terms of personal security. At the same time, traditional enclosures are relatively rough in terms of materials, which have low tolerance. In emergencies

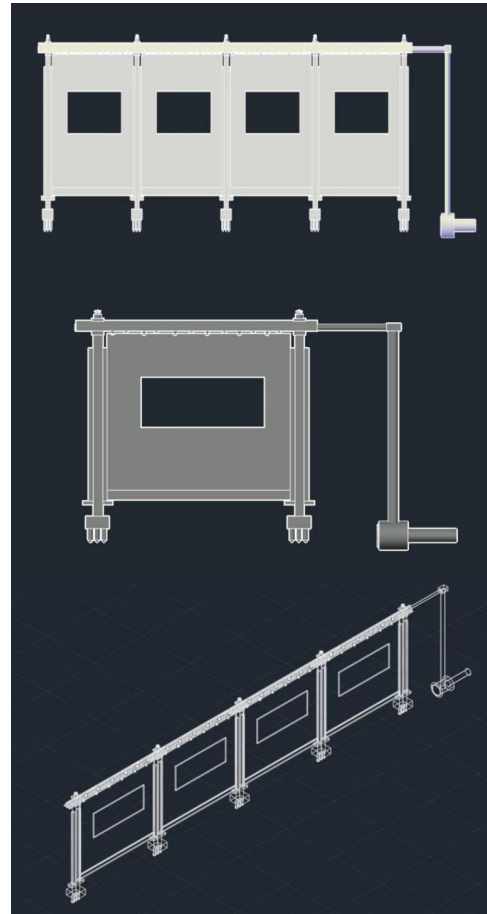


Figure 1. Concept diagram of new construction enclosure CAD from various angles

or accidents, traditional enclosures cannot guarantee the safety of the construction site without severe deformation, leading to a threat to people's safety, resulting in waste of material resources and corresponding environmental pollution^[8].

The front elevation of the new construction enclosure is displayed in **Figure 2**: (1) Support component 1 and enclosure component 2, and the enclosure base is made of prefabricated reinforced concrete. (2) The shroud component 2 can be detachably connected between two adjacent support components 1, characterized in that the support component 1 includes a support rod 11, a support plate 12, and a limit plate 13. The support plate 12 and limit plate 13 are fixed on both sides of the support rod 11, the top of the support plate 12 is fixedly connected to the bottom of the limit plate 13, and the limit plate 13 is inserted into the interior of the shroud component 2.

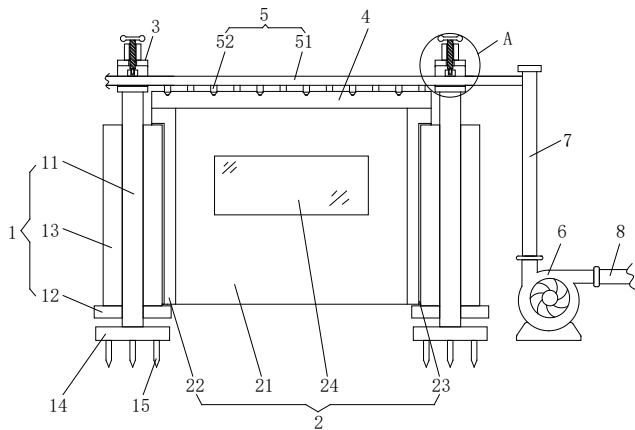


Figure 2. Schematic diagram of the front elevation of the new construction enclosure

In **Figure 1**, the enclosure of the utility model is arranged with staggered distribution nozzles, which are located on the front and rear sides of the partition board. When the nozzle sprays water, the setting of the subplate can guide the water flow to wash the front and rear sides of the enclosure components separately, so that the enclosure can be cleaned on the inside of the enclosure components without the need for a cleaning truck. The construction workers inside the enclosure components can also have a better visual experience. Due to the staggered distribution of nozzles on the sub-panels, it is possible to limit the sub-panels and enclosure components, preventing them from moving up. When installing equipment, there is no need to limit the sub-panels and enclosure components separately.

4. The advantages of new enclosures in terms of labor, machinery, and materials

With the development and progress of contemporary technology, more and more new materials have emerged. New green barriers not only utilize new materials but also adopt more efficient and simple assembly methods. They not only use environmentally friendly materials but also have high tolerance. The materials can have high tolerance even in the face of various unexpected situations, greatly reducing various irreversible losses and minimizing risks to the greatest extent. At the same time, the enclosure design is unique, with a novel appearance and strong material plasticity. In terms of outsourcing, its ability to resist rust and damage has been enhanced. Due

to the use of cutting-edge technology, there have been varying degrees of reduction in labor, time, and other aspects, which not only greatly shorten the construction period, but also reduce the impact of the objective environment on various aspects of the project^[9].

The new type of enclosure is also more functional. Due to the extensive use of automated tools in the construction of the enclosure, it not only reduces human labor but also greatly ensures the safety of the construction process. Overall, compared to traditional fences, the new fence has undergone a qualitative change, reducing the need for maintenance and repair as well as the overall maintenance costs. In terms of material selection, refractory materials are used to reduce fire hazards, and monitoring is installed on the existing foundation to comprehensively monitor the surrounding area of the enclosure, greatly protecting personnel safety and site measures^[10].

In summary, the new enclosure has the following two advantages compared to the traditional enclosure:

- (1) The new type of enclosure works with new mechanical equipment in various aspects, so it is more convenient and efficient in transportation, layout, and cleaning compared to traditional enclosures, and reduces the transportation intensity of mechanical equipment. At the same time, due to the installation of nozzles and water diversion devices, the cleaning efficiency of the new enclosure is far stronger than that of traditional enclosures, which not only accelerates the semi-automatic process of enclosures but also reduces a large amount of manual consumption.
- (2) The new type of enclosure adopts new materials, which are not only more environmentally friendly compared to traditional enclosures, but also enhance its resistance. While reducing foundation load and making it more stable, it also reduces material loss^[11].

5. Economic advantages of new enclosures compared to traditional enclosures

Compared to traditional enclosures, new enclosures have lower costs, labor requirements, and investment risks, and are both efficient and energy-saving. They are

a new type of project that conforms to the development trend of the times and meets the needs of today's era ^[12]. With the continuous changes in the construction site, the new construction environment has broken the rigid traditional thinking. Reasonable planning of land use can not only reduce economic expenses and save building material costs, but also reduce safety hazards for workers in an orderly environment, making the construction environment more high-quality ^[13].

Selecting materials through reasonable planning, while avoiding excessive waste of materials, also reduces the cost of unnecessary materials ^[14]. If the materials are recyclable or reusable, it can also save costs. In terms of environmental issues, it also reduces the cost of waste disposal and the overall economic burden of the project.

The development of new enclosures is mainly aimed at reducing the economic burden. In comparison with the same demand or quality, the party with lower prices and higher safety factors has more advantages, and the economy is the first constraint. When selecting new building materials, the company also plays a crucial role in its development. A green and safe appearance will inevitably attract more consumers to stay, so as to obtain more investment from developers, expand its strength and scale ^[15]; and from a small perspective, it reduces expenses and creates a green environment, which can better promote harmonious coexistence between humans and nature ^[16].

From an economic perspective, traditional enclosures have higher economic losses than new enclosures (**Table 1**). From the current construction site, traditional enclosures are mostly made of material splicing combinations, including steel, aluminum, PVC materials, and a series of other products ^[17]. Therefore, they require a higher investment than new enclosures, and the price of the same-sized construction site is twice or even more times higher. Moreover, in terms of installation and maintenance, a large amount of labor, machinery, and time is required, which will significantly increase the total cost of the construction project. The time invested in the installation and dismantling of traditional enclosures will greatly delay the progress of the project. This has led to an increase in a series of additional expenses such as worker wages and equipment rental fees, which has increased investment costs ^[18].

Table 1. Investment costs of traditional enclosures

Cleaning of the structural enclosure	25–97 yuan/m ²
Steel structure enclosure	80–300 yuan/m ²
Aluminum plastic enclosure	150–450 yuan/m ²
PVC enclosure	50–100 yuan/m ²

The selection of materials for traditional enclosures is usually a one-time use material, which will be discarded after construction, increasing resource waste, violating the concept of sustainable development, and increasing the cost of waste disposal. Moreover, the traditional enclosure style is not aesthetically pleasing, which has a significant impact on the surrounding landscape and urban image, leading to potential economic losses. In terms of maintenance, traditional enclosures require regular maintenance during use, which increases the cost of additional maintenance, repair, and replacement of damaged components. Moreover, in terms of safety, the non-standard arrangement of construction fences may lead to accidents and increase losses on the construction site in the event of adverse weather conditions ^[19].

Taking these factors into account, traditional enclosures may have some negative impacts on the economy. Therefore, it is urgent to find a more cost-effective and recyclable new type of enclosure replacement ^[20].

6. Conclusion

It is an inevitable trend for new enclosures to replace traditional ones in various construction sites. New enclosures have greatly broken the original technical means and deadlock in terms of materials, labor, safety, and other factors, allowing the traditional construction industry to undergo transformation and upgrading in various aspects, meeting the consumer needs of developers. The economy is the top priority of industry development, and with the support of technology, traditional industries have been revitalized. We hope that the various aspects of new enclosures can trigger reflection and progress in the construction industry.

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References

- [1] Li J, 2023, The First China Green Building Technology and Investment Development Conference Held in Beijing. *Interior Architecture of China*, 2023(13): 20–21.
- [2] Chen J, 2023, Design and Construction Method Application of Foundation Pit Support Structure. *Jiangxi Building Materials*, 2023(4): 215–216 + 221.
- [3] Liu P, 2023, Gansu (Lanzhou) Green Building Industry Expo, viewed September 17, 2023, <https://img.jdzt.com/UserDocument/mallpic/18160536504/dn/zl5470.pdf>
- [4] Jia F, 2010, Strengthening Front-End Guidance for Systematic Creative Innovation, Xinhua News Agency Journalism Academic Annual Conference, Xinhua News Agency Institute of Journalism, Economic Information Editorial Department, Beijing.
- [5] What is a Construction Site Fence, 2022, viewed September 17, 2023, <https://zhuanlan.zhihu.com/p/576116536>.
- [6] Chen J, Zhang H, Nie Z, et al., 2023, Simulation Study on the Impact of Different Enclosure Heights on Road Construction Dust Based on FLUENT. *Mechanical Engineer*, 2023(3): 48–51 + 54.
- [7] Chen Y, 2023, Discussion on Dust Control Technology in Green Building Construction. *Industry and Technology Forum*, 22(21): 55–57.
- [8] Ma C, 2021, Construction Technology and Application of Irregular Fencing Steel Structure Closure. *Building Technology Development*, 48(14): 3–5.
- [9] Liu H, 2019, Construction Technology of Temporary Fence Assembly Foundation, Guangzhou Xie'an Construction Engineering Co., Ltd., Guangdong Province.
- [10] Cheng K, 2022, Research on Special Governance of Urban Construction, dissertation, Zhengzhou University.
- [11] Ren T, 2023, Fences are Both “Walls” and “Windows,” *China Construction News*.
- [12] Li J, Xu W, Zong Q, et al., 2019, Discussion on Green Prefabricated Construction Fencing for Fuzhou Metro. *Fujian Architecture*, 2019(9): 88–91.
- [13] Peng Z, Wu J, Fan Y, 2023, Application of Green Prefabricated Technology in Temporary Excavation Engineering. *Building Technology*, 54(17): 2085–2087.
- [14] Huang Y, Luo G, Wu K, 2023, Research on the Application of New Urban Lighting Integrated Assembly Environmental Protection Fence, Chinese Civil Engineering Society, China National Railway Group Co., Ltd. Proceedings of the 2022 Academic Annual Meeting of the Chinese Civil Engineering Society. China Construction Industry Press, 2023:7.
- [15] Xue K, Chen K, Shen X, et al., 2018, Research on a green and breathable enclosure based on coastal construction sites. *Shanghai Building Materials*, 2018(5): 21–23.
- [16] Huang S, 2020, Analysis of Livable City Construction from the Perspective of Ecological Aesthetics. *Art Tech*, 12(2): 111–114.

- [17] Gao Y, Ba J, Wang L, et al., 2023, Research and Practice on Comprehensive Fencing Systems for Construction Projects. *Construction Workers*, 44(1): 9–11.
- [18] Ge S, 2018, Application of Value Engineering in Cost Control of Construction Project Measures. *Engineering and Construction*, 32(2): 274–276.
- [19] Zhang C, 2022, Application of Safety Protection Enclosure Construction Technology for PCF Structure Without Scaffold System. *Engineering Technology Research*, 7(11): 71–73.
- [20] Tan S, Wu Y, 2020, New Combined Fencing Construction Technology and Application, MCC Construction Research Institute Co., Ltd. Paper Collection of the 2020 Industrial Architecture Academic Exchange Conference (Volume 2). 20th MCC Construction Co., Ltd, Shanghai, 2020:3.

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