

The present situation and the development of China's permanent template

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Abstract: With the development of industry, technical requirements and the limitation of construction conditions, more and more structures require using cast-in-place reinforced concrete structure. The selection of the template plays an important role in engineering quality, construction progress and construction cost. So the significance of concrete template is becoming more and more apparent. Without form stripping, permanent template, with its simplicity of structure and construction overcomes the traditional template faults such as bulky, inconvenience, so it can simplify construction process, reduces project cost, protect environment and so on. Thus a permanent template will become a development trend. This paper is aiming to introduce the development status of China's permanent template. This paper emphatically introduces GRC (glass fiber reinforced cement) permanent template, wire mesh concrete permanent template, TRC permanent template, FRP permanent template, Fast-easy convergent network concrete template, insulation seepage permanent template, FS insulation composite permanent template.

Keywords: Permanent template; Development status; Present situation

1. Introduction

At present, the reinforced concrete structures is divided into precast reinforced concrete structure and cast-in-place reinforced concrete structure. Precast reinforced concrete structures can be conveniently construct, speed up the construction progress, and lower the cost, but compared to the cast-in-place reinforced concrete structure, it's poor in stiffness, integrity and seismic performance. But the cast-in-place reinforced concrete structure needs large amount of template, heavy on-site workload, and long construction period. Traditional templates, includes steel template and wood template. Steel template although has strong stiffness, good integrity, recycled more than 40 times, but there also have some shortcomings :quality of hoisting is heavy, installation and disassembly is difficult and cost is higher. In contrast, wooden template has the advantage of light quality and can be cut and assembled freely. And its integrated unit price is low, but there is a big cost largely damage to the environment on the wood and the deformation is not easy to control.

With the development of technology, the disadvantages of existing template cannot satisfy our need for practical engineering any more, the new type of template appears constantly.

2. The Development Status of China's Permanent Template

With the progressing of technology, Chinese scholars made new attempt in permanent template.

2.1. GRC (Glass Fiber Reinforced Cement) Permanent Template[1]

GRC permanent template is a kind template of composite cement reinforced material , mixture of certain proportion glass fiber with the cement or cement mortar. Due to the glass fiber's property of anti-corrosive, template has stronger corrosion resistance ability. Glass fiber has good tensile and bending properties, thus the template with strong crack resistance. This template liking the concrete modification, make its have the uniform similar to the nature of the reinforcement. Because the glass fiber plays the role of resisting crack, there is no need to worry about corrosion.

2.2. Wire Mesh Concrete Permanent Template[2]

This template usually using fine aggregate concrete pouring by high-frequency vibration, use the wire mesh as a dispersion of reinforcement, and set it in concrete a layer of a layer. which can make the stress of concrete and steel evenly distributed to make full use of their mechanical properties. This template is thinner than usual template, normally only 3 to 4 cm, with full cross section of reinforcement on the plate. It's cling to the steel skeleton, and when pouring concrete you should put it layer by layer,. When the first layer of the cast concrete and wire mesh concrete permanent template to form a whole, the template not only played a role in protecting the layer of the steel skeleton, but also in bearing weight of the first layer situ-concrete. It can also bear the weight of the cast-in-place concrete that pouring after the first layer of con-

crete initial setting time. Since this template is made of multi-layer steel mesh, which is formed by pouring, so as a protective layer it has a strong crack resistance and impermeability. This template can also bear load in the concrete structure, which has a good effect on improving the mechanical properties of the structure.

2.3. TRC Permanent Template[3]

TRC permanent template is a fabric enhanced concrete plate. TRC is a fabric reinforced material, which can be made of glass fiber, carbon fiber and basalt fibers, woven into a mesh, and then formed by high-frequency vibration after pouring concrete fine concrete. Fabric has very strong tensile performance, reinforced several times of rebar, and much lighter than steel, but its shear performance is weak. This template is similar to the permanent template of the wire mesh concrete, but only turned the steel wire mesh into a fabric mesh. At the same time, it also has a good crack resistance performance and water resistance, but also has a relatively light weight advantages.

2.4. FRP Permanent Template[4]

FRP, namely fibre reinforced composite plastic, has the advantage of light quality, high strength, good corrosion resistance. Its tensile strength is several times of ordinary steel. Using the template of such a material could improve the comprehensive mechanics performance of concrete. With good plasticity, this material can be made into various shapes of concrete structure needed in the molten state. FRP is easy to cut, which enables it to replace wood template, reducing wood consumption and benefit to environmental protection. Surrounding the concrete with this template can play an excellent performance of FRP materials, a substantial increase in the flexural capacity of concrete. With its smooth and beautiful surface, FRP materials can reduce the modification works on the appearance of concrete structure surface.

2.5. Fast-easy Convergent Network Concrete Template[5]

Fast easy convergent network is a kind of thin hot dip galvanized steel as raw material, processed to become a one-way u-shaped rib and unidirectional three-dimensional grid template. It is light weight, easy cutting, easy bending and forming, easy to carry, easy to change the size and steel perforated. After forming the permanent template combined with concrete, there will form a rough mechanical joints, to make it become a tightly entirety between the cast concrete and templates.

2.6. Insulation Seepage Permanent Template

Due to the requirement of the construction industry and environmental protection, making the building insulation template has a larger development. Professor Xu ShiLang

and his team developed the ultra high toughness of cement composite materials, referred to as UHTCC. The material has some abilities such as high deformation, good toughness, this compensate for the defect that concrete brittle cracking easily. Li Hedong, Xu ShiLang, Liang Jianning put forward the idea to use the UHTCC as permanent template, and then conducted a preliminary study with permanent template. They found that UHTCC templates can significantly improve the structural durability[6]. After Qing-hua li, and other scholars in the ultra high toughness of cement composite materials add nano SiO₂ to modification, seepage control and heat conduction performance is improved. Templates with this kind of material have a higher seepage control and bending flexural performance[6]. The template main apply in mass concrete to reduce the temperature stress under the influence of temperature gradient, thus weakening the affection of external environment impact on the durability of concrete structure. The permanent template compared with template of organic insulation material (such as polyethylene, polystyrene, etc.) has high strength, good durability, etc. It can ensure the service life of the permanent template and work performance.

2.7. FS Insulation Composite Permanent Template[7]

Insulation composite permanent template made by extrusion plastic insulation board, stiffener, inside and outside the reinforced layer and thermal transition layer and so on. It has high mechanical properties, and it can be used directly outside as template. And it has good heat preservation and insulation performance, meeting standards of building energy efficiency by 65%.

FS insulation composite permanent template pouring with concrete as a whole, and have a reliable connection through the connector to form a cast-in-place reinforced concrete composite insulation structure system. FS insulation composite permanent template is made by the factory. It is made by composite insulation board, thermal insulation layer (extruded board), bonding layer, thermal transition layer, strengthen inside (outside) side of the binding layer, stiffener and fittings, etc.

FS insulation composite permanent template can be applied to insulation works of frame structure in the field of industrial and civil construction. FS insulation composite permanent template usually to cooperate with other thermal insulation construction, so as to achieve the effect of energy conservation and environmental protection. At the same time it can shorten the construction period, reduce cost and design and construction technology is simple and easy to expend. This template to achieve the requirements of integration, and meet the aim that the building insulation and structure have one life.

3. Summary

Most of these templates are permanent templates that modified by the material. The template itself has a high crack resistance performance and bending strength, through the template rough surface to achieve the bonding between the template and concrete. The new type of template usually has the following several characteristics:

- Light structure, convenient construction. In comparison to steel template, the modified concrete thin plate is used as permanent template, which reduces the weight of the structure. As a permanent template, it can survive demolition, reduced the transport, save manpower and material resources, so as to simplify the construction process, speed up the construction progress.
- Permanent templates also play a role in load bearing. The impact resistance of the permanent template can be assumed to be part of the load in the form of a concrete as a whole.
- Environmental protection in construction. Prefabricated in factory, it can do less occupation of arable land, and free of demolition, reduce construction waste.

Permanent template will have a huge potential of application. This template not only played a role in the formation of the concrete, but also in load bearing and improving the stress distribution. Various permanent templates may also have some other functions, such as waterproofing and insulation.etc. As permanent template is free of demolition, so it can simplify construction process and reduce the cost of for the removal and transport of template. It is advantageous to shorten the construction period, reduce the construction cost and reduce the labor intensity of workers. At the same time, using permanent

template to replace the steel templates or wooden template can reduce the cost of steel or wood significantly, improve the protection of environment. In terms of overall society, permanent template participating in the structure of the force can improve the structure of the durability, improve the overall economic benefits of the society. Therefore, permanent template has a broad development and application prospect.

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