

## Analysis on New Type of Wall Plate Assembled Steel Structure Residential System and Its Technical Points

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**Abstract:** In recent years, China has continued to promote urbanization, which provides a good opportunity for the development of housing industrialization and the development of fabricated steel-structured dwellings. In this paper, based on the advantages of existing prefabricated steel structure residential systems at home and abroad, a new type of wall plate fabricated steel structure residential system suitable for multi-story and high-rise residential buildings is proposed. The system is composed of modular load-bearing wallboards, non-forced wallboards and integrated floorboards. It has the advantages of standardized production of components, high degree of integration, on-site non-welding operation, high construction quality and comprehensive economic benefits.

### 1. Introduction

In the 1980s, Western developed countries proposed the new concept of “Green Building Challenge” (Green Building Challenge), introduced the “ecological concept” of modern environment and development in architectural design, explored the sustainable development path of the construction industry, and began to promote The development of eco-friendly residential construction projects such as “green ecological housing”, “ecological building” and “green building”. In the modern “ecological concept”, green buildings reflect the resource conservation and recycling economy in their entire life cycle (design, construction, use, maintenance, and demolition); reduce pollution, safety and health; ecological harmony and beautiful environment theme. Undoubtedly, proceeding from the sustainable development strategy of the modern construction industry, adhering to resource conservation and environmental friendliness will be an important direction of mainstream construction in this century, and it is an inevitable trend. Responding to this trend in the world and striving to promote the development of the recycling-based green building industry is our common responsibility.

Steel-structured residential technology is an advanced building technology. It is a product of socio-economic development and scientific and technological progress in the construction industry, and it meets the requirements of housing industrialization and the sustainable development of building resources. Steel structure has the advantages of good anti-seismic performance, fast construction speed, and can be recycled. It is a technology-intensive industry. With the development of new wall building materials combining thermal insulation and waste utilization, it can achieve energy-saving and environmentally-friendly construction. The request. With the banned use of clay bricks and the production of several hundred million tons of steel per year, coupled with the gradual completion of relevant standards and regulations for steel-structured houses, it is feasible and necessary to vigorously develop steel-structured houses.

### 2. Design of a New Type of Wallboard Assembled Steel Structure System

The prefabricated residential system is mainly divided into three types: frame-plate type (composed of frame and floor, wallboard), combined wallboard type (prepared large plate) and box-type (fully assembled type). Each has its own advantages. This type is particularly important. As described in the first chapter, at present, the domestically-developed and more mature prefabricated steel structural systems include the Beixin Thin-sheet Steel Bone Housing System and

the vast assembly-type diagonal bracing steel structural system. The Beixin sheet metal housing system consists of wall plates, floors and trusses made of cold-formed thin-wall steel. The vast prefabricated diagonal bracing steel structure system is composed of oblique support of rectangular steel pipe columns of the truss main board. Both of these systems belong to the framework of sheet-type buildings, although they have the advantages of good seismic performance, high degree of standardization, and construction and assembly, but they also have some shortcomings and deficiencies. The Beixin sheet metal housing system is only suitable for the promotion of low-rise residential buildings, which can not be promoted to a large number of people and high-rise buildings. The force model of the wall load-bearing structure also restricts the flexibility of the building space. In addition, all of its building materials are made of lightweight materials, which reduce the weight of the house and increase the seismic performance, while at the expense of comfort during normal use. The vast assembly type diagonal bracing steel structure system adopts a joint bracing reinforced steel frame structure. Although the anti-lateral stiffness of the structural system is improved compared with the pure frame structure, the structural ductility is poor. The system has many on-site installation operations, and the degree of integration is low. As a result, the site needs to gradually install the column floor diagonal support wall plate, which is cumbersome. In addition, the main force member “bent bracing” also affects the function of interior use in the later period to a certain extent [1].

### **3. Common steel structure residential system**

Pure steel structure frame refers to the structural system that consists of the frame as the main component that resists lateral forces and resists lateral forces in both the longitudinal and transverse directions of the house. The beam and column of the frame structure should be rigidly connected; in some cases, to increase the ductility of the structure, or to prevent the brittle fracture of the connection between the beam and the column, a semi-rigid connection structure is also adopted. This kind of system has clear forces, simple production and installation, and high construction speed. Because there is no diagonal bar on the vertical plane, the building can form a large space, providing flexibility for the layout of the plane; the stiffness of each part of the structure is compared [2]. Uniform, the structure is the simplest; the beam and column components of the frame structure are easy to standardize, shape, and assembly, and the construction speed is fast. Under the action of horizontal loads, the lateral displacement component of the frame consists of three parts: the floor shear causes the frame columns to produce bending deformation and shear deformation perpendicular to the column axis, resulting in the displacement between the layers; because the beams and columns are just joined, the columns of the frame columns The bending moment causes the frame beam to produce anti-symmetrical bending deformation and the inter-layer displacement caused by the shear deformation; due to the overturning moment, the column on one side of the structure generates axial compression deformation and the other side generates axial tensile deformation. The overall structure The bending produces a corresponding layer displacement. The proportion of side shift components caused by column axial deformation is small, and the proportion of side shift components caused by bending deformation and shear deformation of beams and columns is larger, so the overall deformation of the frame caused by horizontal loads is caused. In terms of the lateral shift curve shape, the frame belongs to the shear type.

### **4. New wall panels**

It mainly consists of steel wire mesh polystyrene sandwich panels (GJ panels for short) and steel wire mesh cement polystyrene sandwich panels (abbreviated as GSJ panels). In the factory, the cold-drawn low-carbon galvanized steel wire is welded into a three-dimensional space grid, and the flame-retardant polystyrene foam with an oxygen index of not less than 30 in the middle forms a rigid whole, ie, a steel wire grid polystyrene core board (GJ After the board is shipped to the site, it is assembled according to the design, and then the cement mortar not less than 25mm is wiped (sprayed) on both sides of the GJ board to form a complete lightweight wallboard, ie a steel wire

mesh cement polystyrene sandwich board (GSJ board) [3]. The new type of sheet has good thermal insulation, thermal insulation and sound insulation properties, improves the comfort of the residence, and has a lighter weight, which improves the economic efficiency of the entire building structural system. Most of the components and processes are completed in the factory by the production line, which can shorten the construction period, and its cost is low. Therefore, it is a new type of wall material worthy of promotion and application.

The full name of GRC is Glass fiber reinforced cement, which is made of alkali-resistant glass fiber reinforced material, low-alkali sulphoaluminate cement lightweight mortar as the base material, and a bar-shaped plate with a number of holes in the middle made by using a certain process technology. In addition to the strip sheet, GRC can also be made into a composite wallboard. It is made of GRC material, with reinforced concrete ribs in the middle, and filled with thermal insulation material as the core, which is a lightweight composite wallboard. The main characteristics of GRC products are light weight, high strength, good impact resistance, good water and fire resistance, and saving raw materials. The process is simple and can be used for various exterior boards, partition boards, roof panels and decorative boards. Its main specifications are 2400mm to 3000mm long, 600mm wide and 50 to 90mm thick. The thickness of the GRC surface layer is 10mm and the thickness of the core layer is 100mm. The thermal resistance of the GRC composite outer wall panel of cement perlite is 0.933 (m<sup>2</sup>K/W), and its fire resistance is greater than 4 hours. The GRC composite exterior wall panel and the main body structure adopt a flexible connection structure, and the iron members are reserved on the wall panel to be connected with the steel structure or welded with the embedded structure or reinforcing steel of the concrete structure. Shandong province's steel structure energy-saving residential area - Laiwu Iron and Steel Group's South Park Area, South Building, No. 4 building uses GRC panels, although the increase in energy-saving cost, but consider the overall economic benefits, but make the total cost of reduction. Tianjin Liyuan Steel Structure Pilot Residential Building No. 1 with 90mm thick GRC panels for internal partitions. The split wall is double-layered with a 20mm thick rock wool in the middle of the GRC plate, with a total thickness of 200mm.

The ALC (Autoclaved Lightweight Concrete) board is an autoclaved light-weight aerated concrete board, which is a lightweight board made of calcium materials, siliceous materials, gypsum, gas generating agents, water, and steel bars. Among them, calcareous materials and siliceous materials are the main raw materials. These raw materials generate hydrothermal synthesis products based on tobalite during the autoclave curing process, which play a key role in the physical properties of the products; gypsum is used as a binder. Mixing can improve the fluidity of the slurry and the physical properties of the product. The foaming agent can use aluminum powder, and when the aluminum powder reacts with the slaked lime, it can generate hydrogen; the reinforcing steel can enhance the bending strength of the plate.

The OSB board uses small-diameter logs as raw materials, and thin strips of shavings obtained by flaking are basic wooden units. After applying adhesives and other additives, artificial slabs are obtained through oriented pavement and hot pressing. When constructing the wall, two layers of OSB board can be filled with thermal insulation material to form the wall, and the inner wall surface and the top surface can be decorated with gypsum board. The outer wall surface is covered with a polyethylene film or similar material to shield the moisture. Plywood panels, plastic panels or wall tiles. The OSB board has become an indispensable and irreplaceable structural component in light steel keel residential buildings in Europe and America. The OSB board has excellent sound insulation performance. It is directly connected to the light steel keel by means of self-drilling tapping screws and is wrapped around the outside of the light steel keel structure in a "skin" manner to form a structure called a "plate rib" combination. Improve the seismic performance of the structure [4]. The OSB board is also currently used in cold-formed thin-walled steel systems in China, as a "board rib" structure, or as a composite wallboard with other materials. See also the new floor practices for profiled steel sheets + OSB sheets. In summary, China's new wall materials are varied and varied. At present, the retaining walls are two major systems, one is a single material made of sheet material, such as ALC board; the other is a composite wallboard, the inside and

outside are high-strength sheet, the middle set of polystyrene or mineral wool, on-site Assembled and sprayed on site to form an integral composite wall. Such as wire mesh polystyrene core board. There are many types of internal partitions, either block or wall panels. However, all kinds of wallboards have high construction costs, especially the exterior wallboards, which are about 280-300 yuan per square meter (including internal and external paints), accounting for about one fourth of the total cost. Therefore, they should be selected according to the specific conditions of the project. Traditional blocks are cheap but have a large amount of wet work. From the perspective of development trends, with the steel structure residential system, good physical and mechanical properties, easy construction and installation, and reliable connection of new standardized prefabricated composite wall panels become the first choice. Secondly, heat insulation (polystyrene or mineral wool, etc.) core boards can be used [5]. The boards with high strength on both sides can be assembled on site and sprayed on site to form an integrated composite wall. Some new lightweight blocks with good performance can also achieve good results after reliable connection with the main structure through necessary structural means.

## 5. Conclusion

Steel structure is a product of social and economic development and scientific and technological progress, and it meets the requirements of industrialization and sustainable development of housing. Steel-structured dwellings have the advantages of good anti-seismic performance, fast construction speed, and recycling and other advantages. It is feasible and necessary to vigorously develop steel dwellings. This paper summarizes the development of steel structure housing from the aspects of structural system, new components, new nodes and enclosure system.

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