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Status And Development of Wall Materials in China

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Abstract. New wall materials are advanced materials with many excellent properties such as lightweight, high strength, sound absorption, heat preservation, energy saving and environmental protection, and represent the development trend of advanced wall materials technology. Based on this, this paper firstly introduces the development status of China and western countries, then shows the characteristics, types, uses and development status of new wall materials developed in China, and finally discusses the problems that need to be solved in its development. The results of the study show that: Western countries have established appropriate policies and relatively environmentally friendly building environments, and China is striving to develop new wall materials and shift to green buildings. Therefore, new wall materials will become the preferred building materials in the future, and new wall materials have their own advantages and disadvantages, which need to be combined with a variety of conditions for selection and further research and development.

Keywords: New wall materials, Bricks, Blocks, Panels.

1. Introduction

Although there is a huge difference in the demand for construction under the influence of the level of economic development and the distribution of resources in the country's location, the development direction of wall materials in construction is basically the same.

Although in the level of economic development, the country is located in different resource distribution and other conditions, construction demand there is a huge difference. However, the development direction of the wall materials in the construction project is basically the same, for this reason, some developed countries, such as Germany, Australia, the use of wall materials can be China's future development to bring a lot of enlightenment.

Germany's modern buildings are mainly trade, industry and public facilities, steel structure, steel mixed structure, concrete shear wall and frame structure mostly, lightweight partition wall panels become the structure of the enclosure and partition of the main wall materials. Civil housing is dominated by point-type buildings, mostly 2-3-storey wooden structures or brick-concrete structures and frame structures, with clay bricks, wood and concrete blocks as the main wall materials. The newly-built houses basically adopt various energy-saving measures, and wall materials with heat preservation and insulation properties are widely used in civil houses [1].

Australia has one of the most comprehensive systems of civil building laws in the world and was one of the first countries in the world to introduce environmental protection laws. As early as 1970, the State of Victoria formulated and enacted the Environmental Protection Act. These two legal systems have directly influenced and promoted the development of the construction industry and the development, production and application of wall materials.

The production and application of solid clay bricks in China has a history of more than 2,000 years, and the Qin bricks and Han tiles once had a glorious history. However, solid clay bricks have not only destroyed a lot of land and consumed energy, but also damaged the ecology. China must feed 22% of the world's population with 7% of the land, so the land resources are very precious. Therefore, the vigorous development of soil conservation, energy saving, waste disposal, environmental protection and improve the function of the building of new wall materials, to replace the solid clay

brick has far-reaching historical significance, is to achieve sustainable development of the major initiatives, the use of new materials is imperative.

Walls, as an integral part of the building, assume multiple roles and impacts. Walls are able to withstand natural erosion such as wind, snow and rain while bearing the loads of roofs and floors. And it divides the room into a number of small spaces to meet the different usage needs of the occupants. Due to the special nature of the materials used in the wall, the wall also has good thermal insulation, noise reduction and fire prevention, which can effectively improve the building's energy efficiency, safety and comfort in today's high-rise viaducts and bridges.

As China's economic level rises, the wave of urbanization continues to advance, the state attaches more and more importance to energy saving and environmental protection, the people's living conditions are improving, and people's demand for quality of life is also increasing. Therefore, the transformation of the construction industry is imperative, environmental protection, energy-saving wall materials and people's demand for quality-of-life match, they will be the future trend of wall development.

2. Types of New Wall Materials in China

2.1. Bricks

Brick's big break in architecture, on the other hand, began in the Roman period. In Europe, if not the whole world, the Romans were the first to fully understand vaults and domes [2]. The combination of brick with other materials, such as stone, creates the possibility of building large spaces. An example of this is the Pantheon, which at the time of its completion had the largest span in the world.

In China, the earliest brick building materials excavated to date were found in Huaxu Town, Lantian County, Xi'an, and Liaoyuan Village, Baqiao District, and the Great Wall of China, one of the Seven Wonders of the World, is a good example of oriental masonry, with a wall whose specific construction followed the local climate and was mostly made from locally sourced materials, with bricks being used in green bricks, clay-connected bricks, and mixed masonry structures [3].

In modern times, as the world's productivity rises rapidly new materials and technologies are emerging. New materials such as steel have been gradually adopted, and concrete has been used in many applications. Among them, the frame system liberates the masonry from the load-bearing structure, so that masonry materials such as brick and stone do not have to be too much bound by gravity during construction, and only need to solve their own load-bearing problems [4]. Many new masonry materials have emerged for this purpose.

2.1.1. Sintered shale bricks.

Sintered shale brick is a new type of energy-saving wall material made by using shale as raw material and high vacuum extrusion moulding technology. It has the characteristics of insulation, heat preservation, light weight, high strength and high construction efficiency, meanwhile, the porosity is more than 35%, as shown in Fig. 1 and Fig. 2, it can be divided into square hole type and round hole type, which reduces the weight of the wall, and it can be used in the load-bearing wall, and it can save the cost of the project.

Figure 1. Square hole shale brick [5]

Figure 2. Round hole shale brick [5]

2.1.2. Ceramic tile.

As shown in Fig. 3, ceramic brick is a new type of energy-saving and environmentally friendly building materials with the characteristics of light weight, high strength, heat insulation, waterproof and moisture-proof, sound insulation and sound absorption, energy saving and environmental protection. Particularly suitable for high-rise building frame (shear) structure of the external wall filling, internal partition wall, but also as a highway sound insulation wall panel (as shown in Fig. 4) and building decoration materials. The performance of terracotta bricks will be affected by the fineness of the mass, preheating guidelines and roasting guidelines.

Figure 3. Ceramic tile [6]

Figure 4. Ceramic wall panel [7]

2.2. Blocks

Block is a new type of wall material that is energy and soil efficient and has a larger standard size than clay bricks. At present, the main varieties of blocks in China include concrete small hollow blocks, autoclaved aerated concrete blocks and foam concrete blocks.

Single-material blocks often have defects in engineering applications, a large number of researchers have proposed the use of a variety of materials constructed into a composite block form, in order to reduce the shortcomings of a single material in engineering applications. The proposed new composite blocks are often able to overcome the shortcomings of traditional wall materials or a single wall material, with better thermal performance, lighter weight and economic and environmental protection characteristics of the material [8].

2.2.1. Concrete small hollow blocks.

Concrete small hollow blocks usually refer to blocks made of ordinary concrete materials such as sand, stone, cement and water mixed and poured in a certain proportion. The main specification size of the block is 390 mm × 190 mm × 190 mm, and the hollow ratio is 25% to 50%.

Concrete small hollow block (as shown in Fig. 5 and Fig. 6) has a wide range of applications, common industrial waste, slag, slag can be used as concrete small hollow block aggregate, the use of concrete small hollow block can be appropriate to save land resources and reduce energy consumption. The density of concrete small hollow core blocks is relatively low, in the project if the wall is made of concrete small hollow core blocks, it can effectively reduce the weight of the structure, which is very favorable for the seismic angle of the project [9].

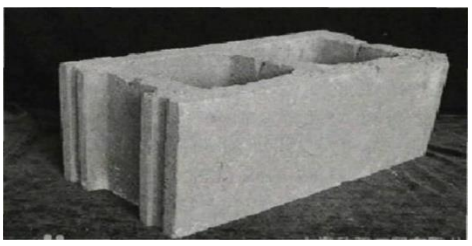

Figure 5. Concrete small hollow block [9]

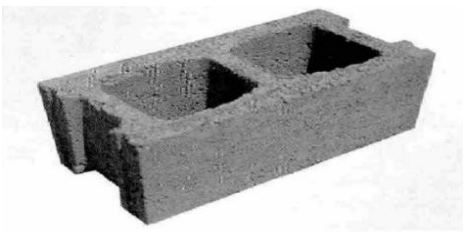

Figure 6. Small hollow block [10]

2.2.2. Autoclaved aerated concrete block.

Autoclaved aerated concrete blocks (shown in Fig. 7) are produced by mixing, stirring, gassing, autoclaving and maintenance of silica, calcium materials, foaming agent, etc., with light weight, high strength, low cost and other advantages, as well as better heat insulation, thermal insulation, fire prevention and other properties, is the current building wall of the new material is highly welcomed.

Compared with the concrete small hollow block, in addition to the water absorption rate, autoclaved aerated concrete block is generally larger than the concrete small hollow block, specifications and processing is convenient, save labor cost in masonry. Under the same strength conditions, autoclaved aerated concrete is about 35% to 47% lighter than small hollow concrete blocks [11]. Also, autoclaved aerated concrete has better frost resistance.

Figure 7. Autoclaved aerated concrete [12]

2.2.3. Foam concrete blocks.

Foam concrete blocks (as shown in Fig. 8) are made by adding cement and admixtures as well as admixtures to the mixer in proportion to make cement slurry, and the foam made with foaming agent is mixed with cement slurry thoroughly to make foam concrete. Then the foam concrete slurry is injected into different moulds, autoclaved and maintained for a certain period, and finally demoulded and made. The same is the addition of air holes in the block, but unlike autoclaved aerated concrete blocks, foam concrete blocks are made by foaming the foam in advance and adding it to the concrete, which reduces the effect of chemical blowing agents on the properties of the concrete. However, at the same time, due to the porous properties, foam concrete has high water absorption, which also leads to low frost resistance at the same time.

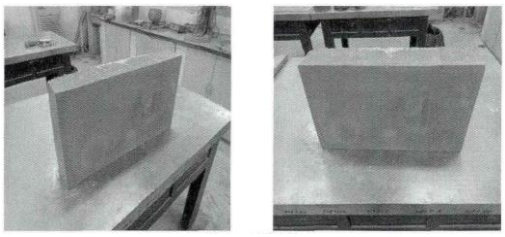

Figure 8. Foam concrete blocks [13]

2.3. Panels

Panels play an important role in construction and decoration, serving as wall, ceiling or floor elements, providing structural support, as well as enhancing interior decoration through different textures, colors and surface treatments, and achieving specific fire and moisture resistance. At the same time, the large size of the sheet can be constructed quickly, the surface is flat, the amount of whitewash is small, and because of its lightweight characteristics, it is more adaptable to the trend of the development of buildings towards ultra-high-rise.

Developed countries in the West consider the transformation of housing materials from blocks to slabs to be a great change. High-rise buildings are the product of highly developed science, technology and economy, and are the inevitable result of the high degree of urbanization of the market economy population [14]. The mandatory promotion of energy-saving buildings in China urgently

needs the development of composite panels for exterior wall insulation to match the energy-saving buildings of frame and steel structures. In order to adapt to the implementation of building energy efficiency standards in different regions of China, external wall insulation composite panels or panels should be developed to meet the needs of energy-saving buildings in different regions of the country. Moreover, multi-functional external wall insulation composite panels such as thermal insulation bearing, thermal insulation bearing and decorative panels should be developed and produced [15]. Among them appeared glass fibre reinforced cement (GRC) lightweight porous partition wall slats, fibre reinforced calcium silicate panels and other wall panels.

2.3.1. GRC lightweight porous partition panels.

GRC Lightweight Porous Partition Slabs is abbreviated as GRC Lightweight Partition Slabs or GRC Lightweight Wall Slabs. Cement as a cementitious material, alkali-resistant glass fibre as a reinforcing material, perlite, ceramic and other lightweight inorganic composite materials for lightweight aggregates, and mixed with fly ash slag and other external dopants made of hollow slabs. With light weight, high strength, fire, sound insulation, thermal insulation and other characteristics, the product does not contain any harmful substances, green. It is suitable for frame, multi-storey, high-rise buildings, old house renovation and other projects, and at the same time, it has good plasticity, and can be made into different shapes according to the requirements of architectural design, such as external curtain panel wall (shown in Fig. 9), which is an ideal wall supporting material for assembly building.

Figure 9. GRC curtain wall panel [16]

2.3.2. Fibre reinforced calcium silicate panel.

Fibre reinforced calcium silicate board is silicon, calcium as the main material, with roll pressure, pressurized exquisite technology, by pressure steam maintenance, surface polishing and other treatments, the production of decorative panels, lightweight, high strength, fire, smoke-free, waterproof, mildew-proof, moisture-proof, sound insulation, heat insulation, no deformation, not rupture of the excellent characteristics of the widely used in high-grade office buildings, shopping malls, restaurants, theatres, and public places of the partition wall, wall, ceiling, and other decoration etc. (as shown in Fig. 10).

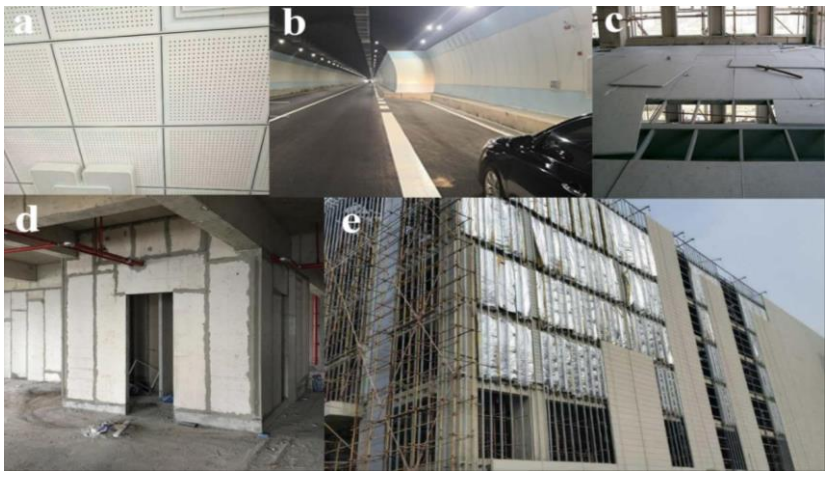

Figure 10. Widely used calcium silicate board: (a) ceiling board; (b) fireproof decorative board; (c) floor board; (d) partition board; (e) exterior wall board [17]

3. Importance of Developing New Wall Materials

With the rapid development of science and technology and the increasing awareness of environmental protection, the development of new wall materials is particularly important. This importance is not only reflected in the innovation and substitution of traditional building materials, but also lies in its far-reaching impact on environmental protection, resource conservation and the promotion of green development of the construction industry.

Traditional clay brick production requires large amounts of soil, which not only destroys arable land, but also exacerbates the tension of land resources. The application of new wall materials can effectively reduce the reliance on clay bricks, thereby reducing the damage to land and protecting valuable land resources. At the same time, these new materials often use industrial solid waste as raw materials, reducing the occupation and pollution of waste on the land, which is conducive to the improvement of the ecological environment.

Secondly, the development of new wall materials helps to save energy and improve resource utilisation efficiency. Traditional building materials in the production and use of the process is often high energy consumption, and poor thermal insulation performance. New wall materials, on the other hand, focus on energy saving and environmental protection, with lower energy consumption and excellent thermal insulation performance. This not only reduces the energy consumption of buildings, but also reduces the waste of energy and improves the efficiency of resource utilisation.

Meanwhile, with the intensification of global climate change and the rise of environmental awareness, the construction industry is facing unprecedented challenges and opportunities. The development and application of new wall materials, as an important part of green buildings, will help to improve the environmental performance and comfort of buildings, and promote the development of the construction industry in a greener and more sustainable direction.

4. Prospects and Challenges of New Wall Materials

4.1. Prospects

As an important part of the construction industry, new wall materials have a broad prospect and outlook. With the progress of science and technology and environmental awareness, new wall materials will play a more important role in the future.

4.1.1. Markets need.

New wall materials have great potential for development. With the acceleration of urbanisation and the improvement of people's requirements for the living environment. New wall materials have better thermal insulation, heat insulation, sound insulation and other properties, and can provide a more comfortable and healthier living environment, so they are chosen by more and more people.

4.1.2. Technological innovation.

With the continuous emergence of new materials and new processes, the performance of new wall materials will be further improved and the application fields will be expanded. For example, the development and application of new materials such as intelligent wall materials and self-cleaning wall materials will bring more innovation and change to the construction industry.

4.1.3. Government-orientated.

The Chinese Government recognizes the importance of promoting innovation in wall materials and energy-efficient buildings in order to protect arable land, conserve energy, improve the function of buildings, increase the efficiency of resource use and protect the environment. To that end, it had introduced a series of policies, including a gradual ban on the production and use of solid clay bricks and the encouragement of the development of new wall materials made from industrial solid waste, in order to improve resource efficiency and promote the development of a circular economy. At the

same time, the Government has also promoted the development of the new wall materials industry through supportive measures such as tax relief and the provision of policy-based investment.

4.2. Challenges

However, the development of new wall materials has also produced a series of problems such as: most of the new wall materials production enterprises lack of technical personnel support, insufficient innovation capacity, difficult to meet the requirements of innovative development and green development; remote areas in central and western China, the assembly of new wall materials and their components production is still in the blank or starting state, difficult to support the future demand of the construction market; new wall materials in rural areas with a low market share. The low market share of new wall materials in rural areas, influenced by traditional concepts and misunderstandings about new wall materials, coupled with the lack of new wall material substitutes suitable for use by rural residents, have created obstacles to their promotion, as well as the existence of a part of the new wall materials on the market that fails to meet the requirements of compressive strength and strength grade, which affects the safe use of such materials.

5. Conclusion

The continuous development of building materials is the embodiment of people's demand for new wall materials, the inevitable choice of the continuous development of the construction field, and the inevitable result of scientific and technological progress and social development. Therefore, it is very necessary to strengthen the application research of new wall materials and apply them widely in all aspects of construction projects. The overall development direction of new wall materials is green, energy-saving, low-carbon environmental protection; from single function to composite multi-functional type transformation, to functional, energy-saving, high-quality direction, which can ensure a more environmentally friendly, comfortable and safe working and living environment, and can realize mankind's More beautiful and realistic life needs, and truly realize a low-carbon and environmentally friendly living environment.

At the same time, there are many challenges and problems in the development of new wall materials, which need further thinking and researches. However, with the continuous development and application of various functional materials, functional new wall materials must be a new trend in the development of new wall materials in the future.

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