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Analysis and Research of prefabricated building patent in China

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Abstract: Based on the concept of prefabricated building and the characteristics of prefabricated building, this paper analyzes and studies prefabricated building patents in China. This paper makes an in-depth analysis from five aspects, such as annual application volume, provincial distribution, legal status, patent applicant and technical hotspot, and finally gives some conclusions and Suggestions.

Keywords: China Prefabricated building Patent analysis

1. Introduction

Prefabricated buildings mainly include precast prefabricated concrete structures, steel structures and modern wooden structures, etc., which are the representatives of modern industrial production mode due to the adoption of standardized design, factory production, assembly construction, information management and intelligent application. Prefabricated buildings mainly include precast prefabricated concrete structures, steel structures and modern wooden structures, etc., which are the representatives of modern industrial production mode due to the adoption of standardized design, factory production, assembly construction, information management and intelligent application. China's prefab architecture started in the 1980s and has become one of the important architectural forms in China after the rapid development in the past four decades, especially in the past five years. Through patent analysis, the origin and development status of prefabricated building can be understood, and the technical life cycle of prefabricated building can be predicted by studying and judging technical hotspots, so as to give early warning to the whole industry and avoid technical traps and patent disputes.

2. Patent analysis of Prefabricated buildings in China

Through baoding Dawei patent software search and query, as of November 6, 2020, There are 9,063 prefabricated building patents registered in China. With the help of relevant tools, the analysis and research are as follows:

2.1 Annual application volume of prefabricated building patent

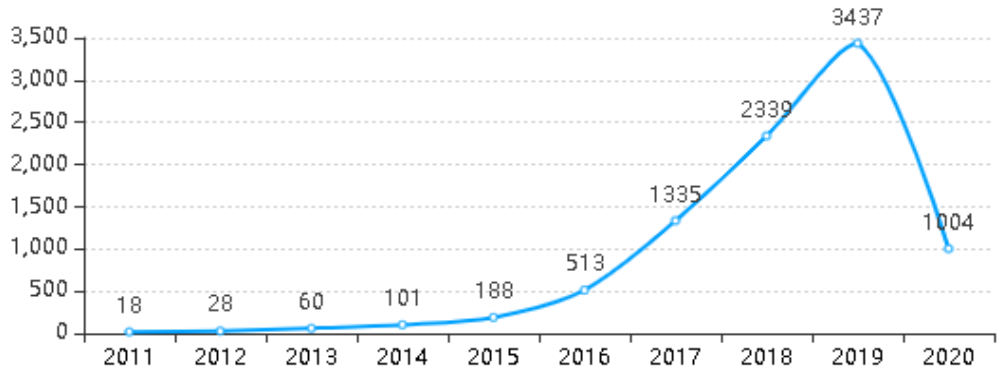

Figure 1 Annual application volume of prefabricated building patent in China in recent ten years

China's earliest prefabricated building patent appeared in 1988, the invention patent is a self-supporting

prefabricated building structure plate, the applicant is The Yugoslav Mokro M Milonwanavec and other five people. While prefab building patents continued to appear in subsequent years, they were in number each year until 2009, when four patents were filed. We call this stage the embryonic stage of prefabricated building patents. The phenomenon has improved since 2010, from 13 in 2010 to 188 in 2015. We call this period the rapid development of prefabricated building patents, which is mainly due to the advance of prefabricated technology and the continuous improvement of the cost performance of prefabricated products. The five years after 2016, which can be called the boom period of prefab building patents, saw an explosive increase in the number of annual patent applications, from 513 to 3,437 in just three years (see Figure 1). This stage is called the prefabricated building patent outbreak period. The reason for this phenomenon is the support and guidance from the government. At the end of 2015, the Ministry of Housing and Urban-rural Development issued the Evaluation Standards for Industrial Buildings, and decided to promote prefab buildings nationwide in 2016. In February 2016, the State Council issued the Guidance on The Vigorous Development of Prefabricated Buildings, which requires that prefabricated buildings such as prefabricated concrete structures, steel structures and modern wooden structures should be developed in accordance with local conditions. It is expected that prefabricated buildings will account for 30% of the newly built floor area within 10 years. In September 2016, the State Council issued the Guidance of the General Office of the State Council on The Vigorous Development of Prefab buildings, which clarified the major development targets of prefab buildings and steel structure key areas, the proportion of prefab buildings in the future, and the key development cities. The intensification of these policies will greatly promote the development of prefab buildings, reflecting a geometric increase in the number of annual patent filings. Due to the long periodicity of patent examination, the data of 2020 is only for reference, not for analysis.

2.2 Provincial distribution of prefabricated building patents

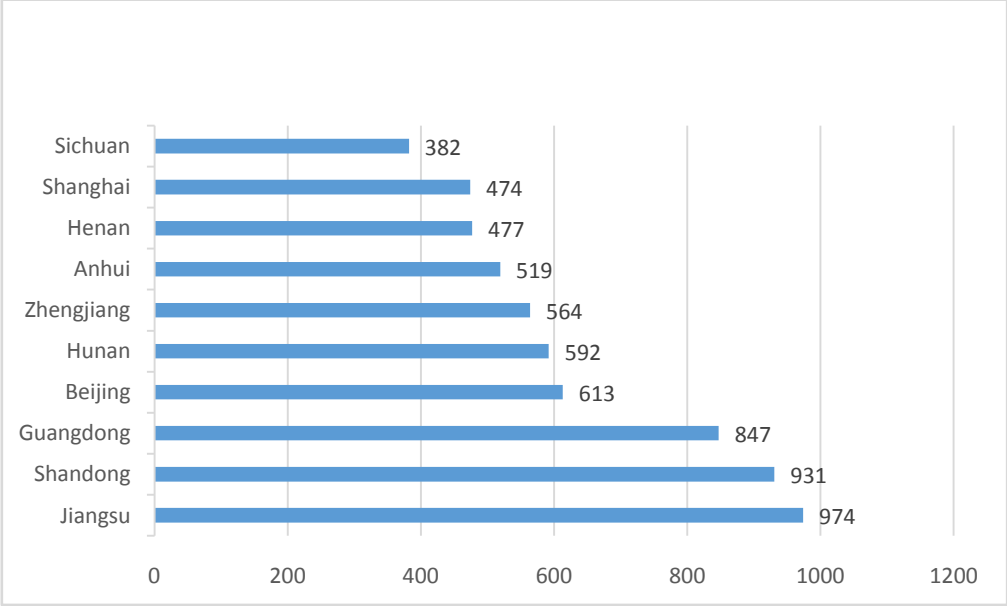

Fig.2 Provincial distribution of prefabricated building patents top 10

As shown in FIG. 2, jiangsu, Shandong and Guangdong are among the top ten provinces in China in terms of patent ownership of prefabricated buildings. The deep reasons for this phenomenon are inseparable from the policy guidance of local governments: Opinions on Bidding and Tendering for Prefabricated House

Construction Projects drafted by Jiangsu Provincial Office of Bidding and Tendering for Construction Projects in 2016 put forward specific measures to promote the rapid and healthy development of prefabricated house construction projects; The Opinions on Promoting The Reform and Development of The Construction Industry issued by the People's Government of Jiangsu Province in 2018 clearly requires that prefab buildings should account for 30% of the newly built construction area in the province by 2020. Shandong province introduced the green building and building energy saving development in shandong province "much starker choices-and graver consequences-in planning (2016-2020)", "clear, will strongly promote the development of prefabricated construction, develop the prefabricated concrete structures and steel structure building, actively advocate the development of the modern timberwork building, to planning the final, city divided into districts and county-level cities prefabricated construction accounted for the proportion of new buildings were 30%, 15%. The implementation of these local policy measures will greatly promote the development of local prefab buildings and lead to the explosive growth of their related patents.

2.3 Legal status of prefabricated building patents

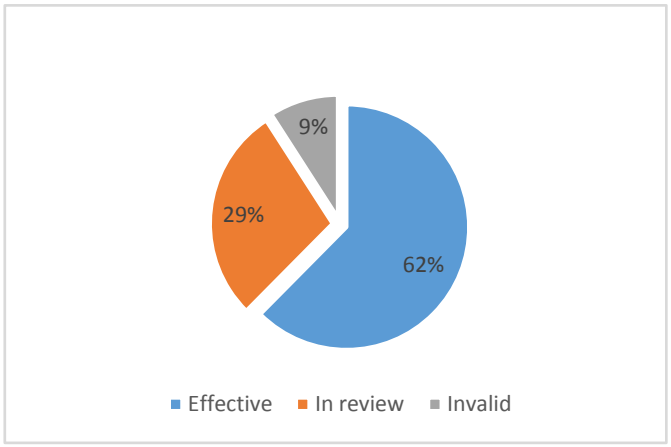

FIG. 3 Simple legal status of prefabricated building patents

The simple legal status of prefabricated building patents registered in China is shown in FIG. 3. It can be seen that the legal status in effect accounts for 62% (5,657) and has an absolute advantage. The number of patents reviewed accounted for 29% (2,581), indicating that new technologies for prefab construction have been emerging in recent years, and a large number of patent protection also confirms that the industry is in a booming stage of development. Only 9% (825) of the patents were invalid. Further analysis of invalid patents shows that the top three factors of invalid patents are 480 unpaid annual fees, 168 withdrawn and 128 rejected respectively.

2.4 Analysis of patent applicants for prefabricated buildings

Table 1 The top 10 applicants for prefabricated building patent Applications

The applicant	The number of patents
Zhongmin Zuyou Technology Investment Co., LTD	112
Yangdi Steel (Shanghai) Prefabricated Construction Co., LTD	84
Nantong Tonglian Long Construction Materials Co. LTD	72
Changsha Yuanda Residential Industrial Group Co. LTD	64

Sany Construction Technology Co. LTD	62
Guangdong Jiumi Space Technology Co. LTD	59
Shenyang Jianzhu University	58
Beijing Shanzhu Technology Co. LTD	56
Zhong Qing Da Prefab Construction Co. LTD	55
Henan Tianjiu prefabricated Construction Co. LTD	51

As can be seen from Table 1, although patent ownership ranks among the top in China, the number of patents held by the applicant is relatively small, accounting for a low proportion of all prefabricated building patents. This shows that prefabricated building technology is still in the primary stage of competition, and there is no technical oligopoly, let alone technical monopoly. Zhongmin Zuyou Technology Investment Co., Ltd. was founded in 2016. Its business scope covers full ecological chain of r&d, design, PC components, equipment, construction, decoration, garden, smart home and other businesses. Among the 112 patents, 67 were invention patents, accounting for 60%. 45 utility model patents, accounting for 40 percent; This shows that the enterprise has mastered the core technology of prefabricated building and has strong technical competitiveness in the market. At the same time, the number of patent applications of the company has been stable for many years, indicating that the company pays attention to technology research and development, has sustainable development momentum, and is an advantageous enterprise in the field of prefab construction. Yangdi Steel (Shanghai) Prefabricated Construction Co., No. 2, holds 84 prefabricated construction patents, but only 8 of its invention patents, the rest of which are utility model patents, reflecting the fact that its ability to control prefabricated construction core technologies needs to be further improved.

2.5 Hot spot analysis of prefabricated building technology

Table 2 Hot spots of prefabricated building technology

Sub class	IPC	The number of patents
E04B	General building structure; Walls, for example, partition walls; The roof; Floor; The ceiling; Isolation or other protection of a building	4229
E04G	Scaffolds and molds; The template. Construction appliances or other building auxiliaries, or their applications; Site handling of building materials	1510
E04C	Structural members; Building materials	1454
E04H	A purpose-built or similar structure; Swimming or spray bath or pool; The mast. The fence; A general tent or canopy	574
B28B	A clay or other ceramic composition, slag, or mixture containing a cement material, such as mortar	555
E04F	Renovations to buildings, e.g. stairs, floors	512
C04B	Lime; Magnesium oxide; Slag; Cement; Compositions such as mortar, concrete or similar building materials; Artificial stone; ceramic	241
B66C	Crane; A load hanging element or device for a crane, winch, winch, or tackle	224

E02D	Basis; Excavation; Fill; An underground or underwater structure	188
G06F	Electrical digital data processing	177

At present, prefabricated building technology in China is mainly focused on the construction technology of walls and floors, so the number of patent applications in this area is also the largest, reaching 4229 (accounting for 46.7%). This is also consistent with the actual situation. Prefabricated building is most widely used in buildings, such as walls, floors and roofs, etc., for which its technical force is also the largest. Therefore, it is not surprising that prefabricated building patents have made breakthroughs here. The second major technical focus of prefabricated buildings focuses on construction techniques and appliances, because the construction of prefabricated buildings is fundamentally different from that of traditional buildings. Only continuous technological innovation can meet the new construction requirements. Building materials are another technical hotspot that cannot be ignored. Only the continuous application of new building materials can promote the rapid development of prefabricated buildings, and building materials naturally become the fertile area of patents.

Conclusions and recommendations

Prefabricated building is a new building model actively advocated by both national and local governments. It has a broad space for development, which can be confirmed by the number of patent applications in recent years. However, it should be noted that prefab construction enterprises are not prominent and need government support and guidance. The focus of prefabricated building technology research and development is too concentrated, which tends to lead to low-level repeated development. Therefore, it is necessary for relevant enterprises or r&d personnel to make reasonable assessment and early warning, so as to prevent the imbalance of input and output.

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