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NEXT CHALLENGE OF SUSTAINABLE HOUSING CONSTRUCTION: EVIDENCE FROM CHINA

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ABSTRACT

With the strong support of government and the increasing level of public awareness, sustainable housing construction has become a hot topic which triggers debate in the academic worlds over the last decades. As a result, the body of knowledge seems to be well developed based on a series of analytical and empirical studies. However, whether the conceptual frameworks or analytical models, which are established by a certain kinds of conditions, constrains and assumptions, are really rational for practical application, still needs to be further examined. In addition, it is not unusual that a gap exists between "what needs to be done" and "what is really done" due to complex reasons. Therefore, the voice of practitioners, particularly in a specific project scenario, should be addressed carefully. In order to highlight the gap between research and practice on sustainable housing construction and to build a bridge there of, this study aims to conclude the laws and regulations as well as mainstream of sustainable housing construction in the past two decades in China and clarify the main obstacles and challenges for the implementation of sustainable housing construction.

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Through semi-structure interview, four crucial factors have been highlighted which includes detail incentive policies and promotion activities, sound and systematic standards, additional regulations on continuous inspections, integrated support from other industrial sectors and etc. Accordingly, we have proposed the issues which need to be addressed in future research and practice. The findings of this research provide a reference to governments, companies as well as academics to start the new journey for the next generations of sustainable housing construction.

Key words: Sustainable Construction, Green Building, Housing construction, Policy Making.

Introduction

In the past two decades, the development of sustainable housing construction has been a hot topic in the Chinese construction industry. Due to the problems caused by oil crisis and carbon emission, energy-saving and low carbon housing construction seems to be the only way for us to minimize the impact to environment and the consumption of natural resources in the construction industry. The concept of "sustainable" of housing construction includes multi-dimension meanings, which includes "environmental sustainable", "social sustainable" and "economic sustainable". Following this stream, the implementation of sustainable housing construction needs the endeavor of not only architects and engineers but also ecologist, sociologist and economist. In addition, besides technical issues, managerial issues are also quite important in terms of realizing sustainable housing construction.

The quick development of sustainable housing construction in China starts from 1990s. Since then, the government has made much endeavor to promote the implementation of sustainable housing construction including providing funds to support scientific research. Based on the research, a series of laws, regulation, policies, technical and managerial standards etc. have been formulated. Although these measures have taken great effects, some issues still need to be addressed,e.g. whether there exists a gap between "what needs to be done" and "what has really been done" due to complex reasons. Whether these policies really take effect in real practice? and etc. We need to listen to the voice of the professionals. Therefore, in this paper we conclude the former development of sustainable housing construction as well as the milestones in terms of policy making in China in the last twenty years and try to clarify the main obstacles and challenges in the future.

Promotion of sustainable construction in China

The Chinese government actively promoted the development of green building in China when the concept of green building was firstly brought into the domestic construction industry in the 1990s, e.g. in 1996, the national science foundation

committee formally supported "the research on green building system" as one of the key funding issues, then eco-building began to prosper in China. Afterwards, the government promulgated a number of related guidelines, laws, regulations and industrial standards of green building after taking full account of China's conditions, which gradually formed the green building technical and managerial system in China.

The policies on sustainable housing construction in China can be classified into three types. One type of policies is the laws which were made by the People's Congress. The second type of policies includes the regulations which were made by State Council. The third type includes the administrative policies as well as standards which were made by the Ministry of Construction (MOC).

Laws

Shown in table 1, the first two important laws on housing construction are the "National Law on land administration" which was issued in 1986 and revised, separately, in 1988, 1998, 2004 as well as the "National Law on Urban Planning" which was issued in 1990. These two laws are the fundamental systems which ensure the legality, reasonability, and consistency of urban and rural plan. With the quick development of real estate and construction industry from 1990s, two other important laws were enacted. One is the "National Law on Urban Real Estate Administration" issued in 1994 and revised in 2007. The other is the "National Construction Law" issued in 1997. These two laws have regulated the behavior in the real estate and construction industries.

A very important milestone on sustainable housing construction was the issue of the "National Laws on Energy Saving" in 1997, which attempts to drive the whole society to save energy, improve the efficient utilizations of energy, protect the environment, and to promote the sustainable development of society and economy. To a further step, the "National Laws on Renewable Energy" has been released in 2005, which intends to promote the utilization of renewable and clear energy. To be more reasonable and normative, it was revised in 2009.

Standards and guidelines

Based on the national laws and regulations, the MOC has made a series of administrative policies as well as standards to regulate and promote the implementation of project management, which is shown in table 1. In 2008, the " Regulations on energy conservation of civil building (draft) " was issued. This regulation can be regarded as an extension of the "National Law of energy saving" in civil building field. The requirement on energy saving of civil buildings has been explained in detail.

Table 1 : Policies related to sustainable housing construction in China[1]

Year	Name	Type
1986(revised in 1988, 1998,2004)	National Law on land administraton	Law
1990	National Law on Urban Planning	Law
1994 (revised in 2007	National Law on Urban Real Estate Adminstration	Law
1997	National Construciton Law	Law
1997	National Laws on Energy Saving	Law
2005	National Laws on Renewable Energy	Law
1986	Standard for Energy saving design of civil building — division of heating residential building	Standard
1994	Standard for Energy Saving Design in Heating and Ventilations of Hotel buildings for Tourism	Standard
2001	Technical specifications of the energy saving renovation in heating of existing residential buildings	Technical specifications
2001	Standard for energy saving inspection in heating of residential buildings	Standard
2001	Technical Manual for the Evaluation of Ecological Housing of China	Technical Manual
2005	Guidelines of Green Building Technology	Guideline
2005	Standard for Energy Saving Design of Public Buildings	Standard
2006	Evaluation Standard for Green Building	Standard
2006	Assessment Standard for green building innovation	Standard
2007	Inspection and acceptance standard of energy saving construction quality	Standard
2007	Guideline for green construction	Guideline
2008	Regulations on energy saving of civil buildings (draft)	Regulation

Exemplar projects

The government has made great effort on setting examples of green building. One of the typical exemplar projects of China is the Olympic Village in Beijing. The Olympic village is located in the northwest corner of the Beijing Olympic Park. It is composed of the southern residential area and northern temporary area with 66 hectares. Olympic village applies considerable advanced technologies and systems, such as LED building lighting system, self-luminous sign system, Light pipe illumination system, scenery complementary solar street lamp system, landscape ecological greening and permeable ground system, roof greening system, application of green building materials and indoor air quality control as well as recycled material utilization system, daily garbage biological treatment system, zero emissions renewable water heat pump cold and heat source system and centralized solar domestic hot water system. In addition, renewable energy, reclaimed water reuse, utilization of rainwater, green building materials as well as ecological landscape,

intelligent home furnishing, digital television, green lighting and barrier-free facilities also can be seen in the village in order to pursue the harmonious unity of humanity, building and environment[2]. Therefore, the Olympic village which covers an area of 160 acres is named "the world's largest green buildings" and has been awarded the first gold medal certificate of LEED outside America.

Another important project is the World Expo Center in Shanghai. The World Expo Center achieves an outstanding performance in energy conservation and environmental protection by strictly controlling the consumption of energy and water resources, the indoor air quality and the utilization of renewable materials. The whole building employs solar energy, LED lighting, ice storage system and water circulating cooling technology as well as ground source heat pump, rainwater collection technology and etc. In addition, the World Expo Center applies new environmental protection, energy-saving materials as much as possible, e.g. exterior wall of the building utilizes all composite curtain wall made up of glass in combination with aluminum plate, ceramic plate, stone and etc. Moreover, various new products, such as breathing type glass curtain wall system and low radiation glass also can be seen inside the building. It is the utilization of those advanced technologies that makes a perfect unity and organic combination of art and technology[3].

Research Methodology

In order to understand the voice of the professionals with regard to these policies, we adope the semi-structure interview methodology to conduct our research with open-ended questions.i.e. "what about your understanding of sustainable housing construction?" ; "What are the crucial factors in promoting sustainable building?". 10 professionals have been interviewed in one month. Two people come from owners' organizations. Three are from design consultant companies. Another three are from contractors' organizations. One comes from the government agency. In the next part of this paper we are going to provide the main findings of our interview.

Main findings

Understanding of sustainable housing construction

The understanding of "sustainable building" are diversified. Even the names on "sustainable building" are different as well, e.g. " Eco-efficient building" ," Ecological building", " Green Building" , " Enviromental friendly building", "Low carbon building"and etc. Although the Chinese Government has issued the "Evaluation Standard for Green Building" in 2006 that includes the main indicators of sustainable building, different professionals still have different views,e.g., "land saving" is a quite important indicator, but the "crowded" high plot ratio will definitely affect the comfortable living conditions of the residents.

In addition, the importance of each indicator on sustainable housing construction should be different according to the location and natural conditions of houses,e.g.the northern and west parts of China have serious problems of water resources. Therefore, special concerns need to given to water saving during the design and construction of sustainable housing. However, in the east part where water resource is sufficient, the understanding of water saving on sustainable housing is another story.

Another example is the utilization of renewable energy. Solar energy or wind energy are good resources of renewable energy. However, the conditions for accessing such energy are totally different due to the geographical location of buildings. Geothermal heating pump is going to be more popular in housing construction. Nevertheless, the effect of geothermal heating pump for a single house is good does not mean if the mass utilization of geothermal heating pump is a good solution for a large city. Whether there are any negative effects on the underground water resources still needs to reconsidered.

Crucial factors

In terms of the crucial factors on promoting sustainable housing construction, four points have been highlighted, which include detail incentive policies and promotion activities, sound and systematic standards, additional regulations on continuous inspections, and integrated support from other industrial sectors.

Detail incentive policies and promotion activities

All the interviewees acknowledge that incentive policies are very important for the implementation of sustainable housing construction. Actually, this is not a new topic for sustainable housing construction. However, the incentive policies should be quantitative rather than qualitative. Reward and punishment regulations corresponding to detail requirement on sustainable housing construction still need to be further developed. For instance, the MOC issued the " Guideline for green construction", which is an important documents to regulate the requirement of sustainable housing construction on site. As stated in the document, six sections of requirements cover sustainable construction management, environmental protection, raw materials saving and recycling, effective utilization of water, effective utilization of energy, as well as land saving and protection etc. However, detail requirements need to be made as clear as possible. For example, in the section of environmental protection, the reusing rates of construction waste and demolishing wastes should be more than 30% and 40%. But this is just general. In fact, the reusing rates of housing construction with steel structure, wood structure and reinforced concrete structure are differentiated. In addition, corresponding to the reusing rates of materials on site, award and punishment policies need to be made there of.

Systematic standards

Although some standards on sustainable housing construction have been made in the last several years, a series of systematical standards still need be further developed, e.g. the standards about sustainable housing construction are far less than the standards on sustainable design. However, construction stage is also quite important in terms of resource saving and enviromental protection. In addition, carbon emission is a serious problem for environmental protection which has been paid much attention to by the whole society. However, lack of standards in this area are mentioned by all the interviewees. How to regulate the design and construction in terms of reducing carbon emission need to be taken more consideration. Moreover, compared to technical standards, managerial standards are relatively less.

Additional regulations on continuous inspection

The present regulations, standards and guidelines mainly concentrates on the design and construction stages. However, the operation stage will show the final result of the implementation of design and construction. However, regulations on continuous inspections are still not enough. For instance, after a certain time of operation, what inspection activities should be carried out? How often should these operational inspection be conducted? Who are responsible for conducting these inspection activities? What indicators should be utilized for the inspection in the operational stage? Should it be compulsory that the designer revisits the projects he or she has designed during the operation stage and submits formal reports ? All these topics need to be further examined.

Integrated support from other industrial sectors

The implementation of sustainable housing construction needs the support of other related industrial sectors due to the fact that a construction project, as a kind of product, is the integration of products of different industries such as steel, concrete, wood, cement and etc. Resource saving and environmental protection issues of producing these materials will affect the sustainable performance of a house. Therefore, during the design and construction of a house, the designer and contractor must take the conditions of other related industrial sectors into consideration. Otherwise the "real" result will be far away from the "ideal" vision, e.g.wood and steel are more sustainable for housing construction compared to concrete as the main structure. However, whether the wood and steel industrial sectors could provide enough materials for the mass production of housing for so many large cities in China? In addition, the production of cement is not good for environmental protection. However, the cement materials is one of the key materials for housing construction after all. Therefore, sustainable production of cement materials is very crucial for the implementation of sustainable housing construction. In general, without the support of other industrial sectors, the sustainability on housing construction can

not be realized. Of course, we cannot just wait to start housing construction till the production of related materials is sustainable. What we should do is to find a relatively optimized solution under the restrictions of other related industrial sectors at present.

Conclusion

In this paper we have concluded the laws, regulations and policies as well as the activities related to promoting sustainable construction in China. Moreover, through semi-structure interview we have found that the understanding of sustainable housing construction was diversified and should be customized based on different implementing conditions. In addition, four critical factors have been identified for realizing sustainable housing construction. Following this stream, we modestly put forward four suggestions on future research and practice of sustainable housing construction. Firstly, it is essential to concentrate on the research on making more detail and quantitative incentive policies. Secondly, a series of standards, particularly managerial ones, should be further developed. Thirdly, the research which specifically addresses the issue on continuous inspection in the operational stage should be conducted. Fourthly, the research which integrates construction sectors with other industrial sectors should be paid more attention to in the future.

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