

# Studies on the Green Civil Building's Gradual Development Strategy

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**Abstract-** Green civil building development is an effective technique to deal with the housing industry's resource shortages and pollution. According to an examination of the characteristics of green civil construction, four strategies should be used: policy gradualism, technical gradualism, environmental adaptability gradualism, and environmental aware gradualism. The green civil building's steady development approach should be separated into three stages, each with its own aim. The conclusion has been formed that the "S"-type greening asymptotic curve development model is scientific and can meet the criteria of multi-objective optimal due to the thorough assessment of internal demands and external stress at various stages.

**Keywords-** Green civil building, gradual development, housing industry, strategy research.

## I. INTRODUCTION

Housing industry plays important role in the economic development and social development. It cannot be ignored that housing industry is a high pollution; high consumption industry. Civil building construction occupied large proportion of the housing investment whose energy consumption increased sharply along with the increasing demands from the society. It is predicted that Chinese energy consumption will reach 60 billion tons of coal by 2020 [1].

According to this background, sustainable development of civil building has been attracting more and more people's attention. Green civil building has become the effective way to realize the environment protection and realize the sustainable development.

As a kind of technological product, green building needs green construction technology, material technology, manufacturing technology, management methods. So it has the distinct character of the open complex system. The different demands come from different people in the society. More technology related with the green building is developing which may lead the cost increasing and produce negative influence when they yield the positive function. So how to develop the green civil building is a typical multiobjective optimal problem. There are many obstacles and inefficient factors which slow the development of the green civil building. Most of all these inefficient factors is that the actual short life of civil building cause by unscientific development strategy which lead the inefficient environment protection.

In this article, we build a hierarchical green building materials evaluation index system, and use AHP to determine all the weights of the involved indexes. From

the theoretical analysis and practical research, we found that "rate of costs and after abandonment ecological and environmental influences (B4)" is the most important main factor for the greening of building materials.

This result displays that people put great emphasis on the affordability of the materials, only when it is affordable and durable, the word "greening" becomes making sense, and on the other hand, full life cycle viewpoint is prevailing, people not only consider the ecological and environmental influences when the building materials are being produced and transported, however after abandonment influence is more important. So we need to think about how to deal with the discarded materials at the very beginning of design. Inculcating knowledge and concepts about green building materials should be put forward to enable people establish the concepts of sustainable development and environmental protection.

## II. ENVIRONMENTAL AND ECONOMIC ISSUES GREEN BUILDING

Global warming has been becoming a critical issue of international concern. Generally, buildings have considerable detrimental impacts on the environment. Environmental and economic issues considerations should go hand in hand as parts of the evaluation framework in green building [1].

Green building is an outcome of a design philosophy which aims to increase the efficiency of resource use and reduce building impacts on human health and the environment through better designs, constructions, operations, maintenances, and removals. However, it is a difficult task to find better green building design satisfying several conflicting criteria such as sustainable, economical, and environmental performance between the

build owner and consultants or architects. The more effective way is to maximize the benefits of green design is to introduce sustainability concepts and strategies at the early planning and design stages. Integrating sustainable strategies into the design from the beginning can eliminate increased costs, and is more effective [2].

Leadership in Energy & Environmental Design (LEED) is most efficient during the identification and preparation stages of a proposed project. LEED assessment will bring together to evaluate and articulate the project's goals and the level of certification sought [3].

An effective decision making is essential to facilitate in selecting the best alternative decision for most sustainable and profitable green building design. Decision makers involved in early design process often have conflicting priorities or preferences for both building design and construction materials and this makes decision making even more complicated. The behavior toward risk of the project owner and designers significantly influence the outcome of a decision-making process. Risk behavior is the chosen response of an individual or group to uncertainty that matters, influenced by perception. Understanding risk behavior is a critical success factor for effective decision-making [4].

Game theory is widely used to model human behavior that consistently deviates from rational behavior theory where an analytical method for making a decision concerning an action to take [5].

The value of a risky alternative to the decision maker may be different than the expected value of the alternative because of the risk that the alternative poses of serious losses. Game theory models the interactions among decision makers, or players in decision making. Games are useful since they analyze strategic interactions in which the outcome of one's choices depends upon the choices of others and attempts to predict outcomes. It involves the fact that both sides have to organize strategies directly linked to the anticipation of others' actions.

This paper presents a game model used to model the decision making processes in selecting the appropriate green building designs for an existing or constructed office buildings. Based on the LEED measurements, the proposed model is capable of assessing building sustainability and profitability and identifying suitable strategies to achieve desired certification goals with respect to dual decision maker's preference in different risk behaviors.

It is believed that there is a dichotomy between economic growth and sustainable development. Finding equilibrium point between the both issues is essential. The solution of the game may not be the most preferable for both players, but it is the best solution which satisfies both players. The

proposed game model consists of benefit cost analysis, multi criteria decision, and strategic decisions based on Nash equilibrium, which is capable of simulating the interactions between two players' behaviors in order to determine the most desirable green building design options. A case study involving an actual green building design was presented to illustrate the use of the proposed approach and demonstrates the capability of the model that can assist decision makers to better evaluate green building design alternatives.

### III. LIFE CYCLE OF CIVIL BUILDING AND ENVIRONMENT DESTRUCTION

According to architecture design standard, the average building life is 70 years while the actual average building life is only about 30 years caused by comprehensive reasons which results in resources waste and environment destruction [2].

The short life of civil building lead the negative situation related with a lot of resources waste and pollution problems generation. According to the relevant survey, it will produce 7000-12000 tons construction waste per ten thousand square meters demolition of old buildings [3]. At present, the amount of construction waste has been accounted for 25%- 35% of total municipal waste [4].

Short life of civil building mainly reflected in two aspects. On the one hand, the poor town planning leads to large dismantle behavior which produces substantial waste and environment pollution; on the other hand, the poor construction management including lacking effective development strategy causes the shortage of the life cycle of the architecture. In detail, there are three reasons of the short life of civil building caused environment destruction.

#### 1. Utilitarian consideration:

During the building development process, both the business developers and the management sector of the government have shown the characteristics of obtaining quick benefits. Enterprises are always in pursuit of profits and ignored the environment protection responsibility especially when the direct interests are not ensured. Government organizations do not pay enough attention to complete the task of energy saving and emission reduction targets, regarding that the economic development weighs out the environment protection. Therefore the sustainable development of green building was inefficient due to the utilitarian consideration.

#### 2. Short-term planning:

It is an important countermeasure that reconditions the existing high energy consumption buildings. Which technology and material should be used and how to reform is a complex system. While the new technology, materials have many advantages, they may not be applied due to the risk of the high cost. It is in the long run that the

technology must be innovated through the experiment, thus some risks must be taken instead of the short-term planning. But short-term thinking always obstacles the technical progress.

### 3. Ignorance of overall superiority:

Although some new management methods can meet the green standards present, it cannot be regarded that the advantages of the green building can be realized. The environment protections target, the quality target, the schedule target and the cost target are conflict of the green building. The management method should be considered comprehensively in order to realize overall superiority of the green building life cycle. It is harmful to ignore the coordination of the multiobjective optimal which will not be benefit for the environment protection.

## IV. GRADUAL STRATEGY OF GREENING CIVIL BUILDING DEVELOPMENT

Green civil building can maximize the advantages of resources conservation, environment protection, and pollution reduction which can provide people with healthy efficient space and harmonize with nature, which is requirements of people-oriented and harmony between people and nature. The core function includes energy saving, environmental protection, comfortable housing, and adaptation to local conditions [5].

Based on the comprehensive analysis, it is critical for green civil building development should be corresponded with the trend of sustainable development on the base of national conditions and should have clear development stage goals. And this gradual way should be the right option which is adapt with the world's energy and climate change trends [6]. Therefore the development strategy of green building must be abided by the law of gradually development. A. The synchronism of green building and urbanization from the perspective of housing production, housing industry development is an important channel for supplying residential housing. With the development of the housing industry, the urban residents have been significantly improved. It can be concluded that Chinese urbanization rate could increase to 65% ~ 75% [7].

In recent years, urban population increases about 15 million per year. It is predicted that there will be a half of people living in the urban in 2020 which means the urbanization will create 450 million square meters housing demands per year. So the green building should adapt to the development rate of the urbanization. B. The "S"-type asymptotic curve of Green Building The greening process of civil building is a complex process which can not be achieved through the effort in short period. Based on the urbanization, this greening process is divided into three phases that the first phase is the "initial stage"; the second

phase is with the urbanization rate reaching 50%; the third stage is with the urbanization rate approaching 70%. And four aspects including the policy gradualism, technical gradualism, environmental adaptability gradualism, environmental conscious gradualism should be researched comprehensively.

### 1. The policy gradualism:

The effective policy is established on the cornerstone of the law [8]. Compared with the United States and Europe, Chinese green policy should be improved due to the whole developing legal system which needs to be constructed continuously. So the green building development strategy cannot go beyond the scope of the current development of law which includes the basic legal, administrative and local laws, regulations and standards and micro-system.

### 2. The technical gradualism:

Green building technology is the integration of materials technology, mechanical technology, information technology, eco-technology and other key areas of technology. From a systematical point of view, the developments of these technologies are not parallel with green building technology which determines the gradualism of green building techniques.

### 3. The environmental adaptability gradualism:

The improvement of green civil buildings relies on manual control and can not be really compatible with the natural environment. The greening process is a huge systematic process which is a big challenge to integrate the nature environment. What should be improved and explored gradually to make the ultimate objective and to achieve greening by the aid of artificial intelligence is an efficient way to adapt the environmental changes. 4) The environmental conscious gradualism. According to Maslow's hierarchy needs theory, if the basic needs cannot be guaranteed; man will subconsciously ignore the surrounding environment. The causes of environmental degradation are over-exploitation and waste emissions and the fundamental driving force of sustainable development are the initiative sense of people. So the environment conscious gradualism is an necessary way to develop the green civil building.

## V. ANALYSIS OF THE GREEN CIVIL BUILDING "S" TYPE DEVELOPMENT CURVE

Along with the urbanization, a large number of migrant workers are moving into the cities and become the largest floating population and temporary residents. The contradictions between the strong demand for urban civil buildings and the lack of supply lead to the real estate market booms. Most potential buyers whose basic requirements for housing are the fundamental without more caring about the greening.

High income people requirements for housing focus on high degree of comfortable and more harmony to the local environment. It is obviously seen that the gradient “S” type development curve was influenced by the internal demands and external stress. A. Internal demands Due to the implementation of energy efficiency construction standards, the cost of civil building increased. Because the domestic demands for green building are different, some consumers pay more attention to the cost than the comfortable degree.

The demands of green building should be divided into two categories. One category is to apply more and comfortable green technology effectively to meet the higher demand; the other category is to pay attention to consider the balance of the greening demands and economic demands. According to the latest statistics, the increasing urban population is nearly 15 million every year, indicating that the rapid expansion of urban population [9]. Based on the different demands for green building, people can be divided into three groups which can be described respectively as “A”, “B” and “C”. “A” represents the high-income, higher education urban

It can be regarded that “C” are in a low comfortable, highcost grid which get greatest pressure. So “C” will ignore the capacity of energy-saving and comfortable degree relatively. But they will transfer firstly to the side of less pressure. When “C” have higher purchase ability to pay for the expensive buildings, they will have more demand for the soft and hard conditions the buildings they lived in. “B” type of crowd has a higher starting point than the “C” class of people at current.

In the middle state of pressure and demand, “B” has the same aspirations transferring into “A” class people. “A” class state is the fundamental objective of the development of green building. It showed that the internal demands of the green civil building influenced the different people differently which established the rate of the “S” type development curve

## VI. CONCLUSION

Green building development is an efficient way to cope with the shortage of resources and environmental pollution in housing industry. The relationship between the green building development and the process of urbanization can be reconditioned by the gradually strategy implementation of the green building. Four strategies should be applied which include the policy gradualism, the technical gradualism, the environmental adaptability gradualism and the environmental conscious gradualism.

The internal demands and external stress influence the green civil building development. Combined with the environment protection, “S” type asymptotic curve model of the greening civil building gradual development

integrated the strategies which can meet the demands of multi-objective optimal and can be chosen as an effective strategy.

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