Research and Practice on New Technology for Architectural Green Environment in Cities

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Abstract. The importance of urban development has become a topic that has been discussed in all industries for a long time. How to make rational use of existing limited resources for redevelopment has become the primary issue in the future construction of a city. Designers have introduced green three-dimensional environmental design for a city into modern urban design. At present, Japan and South Korea focus on development of green three-dimensional environmental projects for cities, in which application of green three-dimensional building design is particularly prominent. This article learns from successful cases on urban three-dimensional environment design in Japan and Korea and makes profound discussion about how new city-model agriculture develops in China for the purpose of solving the problem of urban construction in China in the aspects of theory and Practice.

1. Background

When dealing with environmental problems, domestic enterprises usually take the way of post processing, and then develop "clean production technology" through engineering or internal improvement activities. Recently, environmental protection in domestic engineering and environmental protection problems on products are spreading rapidly. The whole world is actively tackling the problem of environmental pollution and sustainable development. Under the circumstances of actively carrying out activities of environmental pollution and sustainable development, solving environmental problems in industrial construction is a shortcut to fundamentally solve the global environmental problems.

However, most domestic business owners, product designers, environmental leaders and others cannot fully understand the concept and necessity of environmental protection design, or they doubt about the effectiveness of such design. In other words, some enterprises and related people believe that environment is the product of business operation. It is absolutely wrong to develop social economy and then to improve ecological environment for greater economic benefits. It is absolutely wrong not to pay attention to problems about environmental protection. However, in order to protect products and enterprises in their countries, the advanced countries such as Europe and America use environmental protection design as a trade barrier to protect products and enterprises in their countries. In Asia, Japan and South Korea are examples. In order to create this goal, Korean and Japanese governments and enterprises also regard environmental protection design as an axis of business operation. The governments and enterprises in Japan and South Korea don’t only develop economy, but also increase efforts for protection of ecological environment construction. Since the middle of 1990s, green agricultural products have been more and more popular. Due to expansion of eco-friendly agriculture-practicing farms and expansion of the market scale, the social interests are increasing. Since 2000, green agricultural products in South Korea increase steadily at the rate about 40% each year. In 2013, the market of environmental-friendly agricultural products in South Korea reached 31 trillion won, accounting for about 7 to 8% of the total agricultural output. Due to worry
about safety of agricultural products, the consumption behaviors on eco-friendly agricultural products have been changing recently.

2. Example analysis on modern three-dimensional green design

2.1. Korean hanging garden

The Seoul consortium in South Korea designed and built a hanging garden in 2017. The garden was made up of a 936-meters long overpass, which started to be built in May 2015. The hanging garden is actually an overpass, which includes economic business circles and public spaces. This hanging garden was invested and created jointly by Ben Kuipers (Danish landscape architect) and KECC (local HA landscape partner in Korea). A part of the hanging garden has plants placed as high as 16 meters from the ground. The garden also includes parks and botanical gardens. With the experience to make creation, the designers also increase fun brought by economic circles and public space facilities for public after users’ experience. Designers allow the audience to participate in the aspects of urban cultural and commercial levels in a smart manner and make radiation effect to the surrounding. It has become the landmark of Seoul City. The hanging garden is a good project to promote economic development (See table 1).

| Table 1. Seoul Hanging Garden. |
|--------------------------------|
| **Structure map:** A 936-meters long structure transformed from an overpass, with 16 small pavilions added as coffee shops, shops, exhibition halls, flower shops, trampolines, foot bath rooms, stages and children's theatres and visiting guidance center. |
| **Overlook:** 52 plants including trees, shrubs and flowers are grown in 645 basins. About 160 species and subspecies are collected. The park includes 24000 plants (trees, shrubs and flowers). |
| **Real picture:** In day time, pure white building structures and plants with flowers changing colors in four seasons show full of vitality. The design of blue lighting at night is a great luster for the night. Lighting art is also displayed. |

This project of Hanging Garden will serve as new reference for the future development of buildings in green three-dimensional environment in South Korea. The hanging garden aims to expand its scope to the peripheral of the overpass, and to transform it into economic space and public space with rising
environmental protection space and harmonious environmental development strategies. Interior design of the hanging garden increases the quantity of pedestrian streets and green squares so as to provide more space for building small gardens, green access, green roofs, green parking fields and terrace projects. These are part at the peripheral. More and more improved infrastructure will be convenient for residents, driving economy, saving land and vertically developing the new trend of modern urban architecture design by using existing resources.

Table 2. ACROS Fukuoka [5].

| Structure Diagram |
|-------------------|
| The Fukuoka Symphony Hall at floor 1, the party hall at underground floor 2, the international conference hall at floor 4, the rounded hall at floor 1. The exchange gallery at floor 2, seminar room at floor 1/2, large conference room at floor 7, exercise room at floors 1-5 and underground floor 2, Cultural Tourism and Information Plaza at floors 1-2, Craftsman Gallery at floor 2, exchange area at floor 1, Cultural Exhibition Corridor at floor 2, Akuros Fukuoka Ticket Center at floor 2, parking at underground floor 3. |

| Structure Diagram: |
|--------------------|
| This uses unique staircase models of the building, including various facilities such as the halls, stores, and office rooms. |

| Relativity image: |
|------------------|
| The garden roof is covered with 5000 plants, a total of 76 varieties, 60 meters above the ground. |
2.2. Famous green roof in Fukuoka, Japan

ACROS Fukuoka located in Fukuoka is one of the shocking representative works of green buildings in Fukuoka, Japan. It attracts people because of its unique design and more green space. One side of ACROS Fukuoka faces the most bustling commercial street in Fukuoka City and it is a glass wall, which makes it like a traditional office building. The other side is a huge green roof with layers downward. The layers are covered with 35000 plants. The landscape terrace extends to form a garden.

The building is 60 meters high above the ground. Its green roof is the side facing the sun and being covered with green vegetation. The covering plants include many species and they can change their colors with seasons. Just with these green plants, the whole building maintains a constant temperature level, which obviously reduces its energy consumption and forms a good ecological cycle. The designing thought and design plan for the building were jointly completed by the Argentina architects Emilio Ambasz and Associates. Such a large structure with a large leisure space brings people a unique visual feast and physical enjoyment.

Acros Fukuoka was established with a whole design. It is not that a roof was built before the garden. It's a roof garden that is conceived in advance and is combined with the building when it is designed. It is a real green building. The architectural form is designed with a three-dimensional design concept.

2.3. Application and display of architectural agriculture in modern green design

Because of the continuous development of modern agriculture, environmental problems such as environmental damage, water pollution, air pollution and soil pollution gradually appeared. Living environment has gradually become a bad cycle of environment, resulting in the phenomenon of heat islands with air temperatures rising. In the present developing society, what an efficient and fast production mode can better adapt to the development of the present era? In a limited space and increasingly harsh environment, it is necessary to establish a good commercial space for good environmental circulation in internal parts of buildings. In the urban farm system, a large number of production crops are produced, and development of architectural agriculture is necessary for development of urban agriculture. Architectural agriculture refers to the use of the relationship between organisms to make full use of space for combination of different species, obtainment of benefits and avoidance of harm, multi-species coexistence and multi-level configuration, then forming a three-dimensional agricultural management mode including three-dimensional plantation, three-dimensional breezing and three-dimensional plantation-breeding with energy recycling of multi-level materials. Now the buildings with a three-dimensional agricultural scale in a city are bound to be the direction of future agriculture.

2.4. Advantages of three-dimensional agriculture

In a unit area of land (water) or in certain areas, three-dimensional planting, three-dimensional breeding or three-dimensional compound planting with breeding are made. The process skillfully uses artificial input to improve an energy cycling efficiency, material conversion rate and the second-property material output for an agriculture mode with multi-species coexistence, multi-levels configuration, multi-time interleaving and multi-levels quality and energy transforming. Stereoscopic agriculture utilizes virtuous circulation relationship between organisms to make full use of space and to combine different biological groups for promoting profits, avoiding damages, co-existence with many species, configuration at multiple levels and recycling of multi-level material energy, so as to achieve efficient utilization of unit area. 1. Stable supply should be ensured to reach sustainable production in a whole year, not affected by climate change, natural disasters and other external environment variables; 2. Continuous improvement of quality should be made to ensure the production efficiency. 3. Improvement of food safety awareness (excluding pesticides). 4. Potential is great for future growth. 5. Through scientific management, high added value in agriculture should be ensured. 6. The practical research found that local food is effective to reduce carbon dioxide. 7. People can enjoy the charm of the city and the leisure life of beauty. 8. Construction of eco-friendly buildings for experience, education and tourism. 9. Through construction in the aspect of environmental protection,
agricultural plantation technology should be ensured to enhance national competitiveness. 10. Factory employment rate should be improved to create a good efficiency for factories.

![Image](https://example.com/architectural_agriculture.png)

**Figure 1.** Architectural Agricultural Simulation Chart.

### 3. Conclusion

Stereoscopic agriculture is a system with ecological functions. The existing resources are reused. Such repeated development forms a benign circular ecological environment. The technology of stereoscopic agriculture has been used for environmental agricultural facilities, but it hasn’t yet produced food in stereoscopic agriculture in the tall buildings in cities. The development of Stereoscopic agriculture is not only suitable for tall buildings. Upper parts of comprehensive buildings such as schools, restaurants and hospitals can become a variety of different fields for crop growing. These fields can provide fresh vegetables and fruits for people in the city to prevent modern health problems due to agriculture. Architectural agriculture can produce food without agricultural chemicals throughout the year. Fish and poultry can also be cultured indoors. Because the agriculture doesn’t use large agricultural machinery and trucks to transport grain from the countryside to cities, it reduces use of large amounts of fossil fuels and discharge of greenhouse gases.

### Reference

[1] Takamasamoto, 2008 *Electronic eng.* 8 64-8.

[2] Seoul Hanging Garden -- Source of Inspiration for Development of South Korea in the Future (Landscape in China).