The Research of the Green Building and Land Efficiency and the Outer Environmental Indicators in the Actual Design of Technical Measures

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Abstract. Through introducing some national green buildings, the paper analyzes the measurable technology method about target of land efficiency and outer environment in green buildings design, at the same time, the practical examples including the residential building and public building are introduced about the method of land efficiency and outer environment. It is put forward that the experiments and reference about development of green building in our country.

Summary

With the gradual formation of the worldwide ecological concepts and the consensus, the government make the "sustainable development" as a basic national policy. People have a larger change of concept on the building of the ecological attributes and cultural connotations gradually, the quality of the ecological environment in the architectural design referred to an unprecedented important height, to accomplish something in eco-building research, and made significant results in the implementation. Green building design reflects the ecological priority principles and the spirit of the era of sustainable development in the new century. The large-scale building of our country needs a lot of energy, thus saving and efficient use of energy has already become an important part of the strategy of sustainable development. In recent years, a higher demand on the construction quality, health, environmental protection, comfortable and safe living space is being more and more attention. The new stage of the development of our human living environment towards a green residential building. To this end, we should seriously draw on the useful experience at home and abroad, and actively promote green building design concepts based on resource conservation, recycling, cycle production.

Land Efficiency and Outdoor Environmental Indicators Requirements

Green residential building design is the requirements of the times that combined with the environment, science and technology, culture and other aspects, and is also the design concept of the sustainable development potential. However, many of its contents and forms are derived from Europe, America and other developed regions, combined with national conditions and local characteristics in our country practice, so that green residential building design can be implemented.

For the implementation of national economic policy, to conserve resources and protect the environment and promote sustainable development, and standardize the evaluation of green building, our country has implemented the Green Building Evaluation Standard (GB/T50378-2006) hereinafter referred to as Evaluation Criteria formally on June 1st, 2006, which has six types of indicators in it and divided into a star to three-star level. Land efficiency and the outdoor environment is one of the main contents of the green building evaluation index system, residential including four controlling indicators, nine general indicators and a preferred indicator; controlling indicators of public buildings, including three controlling indicators, eight general indicators and
three preferred indicators. To achieve the Green Building one-star, two-star, three-star standard, the residential public buildings land efficiency and outdoor environment general indicators should be conformed to the Table 1 conditions except meeting the demand of the controlling indicators, preferences indicators, and the other 5 jointly meet the requirements.

Table 1. The green buildings land efficiency and outdoor environment general indicator requirements.

<table>
<thead>
<tr>
<th>Construction category</th>
<th>Total number of items</th>
<th>Different evaluation level qualifying number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>One-star    Two-star    Three-star</td>
</tr>
<tr>
<td>Residence</td>
<td>9</td>
<td>4           6           7</td>
</tr>
<tr>
<td>Public buildings</td>
<td>8</td>
<td>3           5           7</td>
</tr>
</tbody>
</table>

The evaluation index system land efficiency and outdoor environments including construction sites, outdoor environmental quality, diverse aspects of greening, rational use of underground space. To achieve green building truly, the first thing is to take appropriate technical measures to achieve these targets in architectural design.

Technical Measures Analysis in the Domestic Building Design

Although green buildings have a late start in our country, there are numbers of residential and public buildings to have got the star rating of green buildings. Analysis of the architectural design experience, concluding green building design technology measures on section places and outdoor environment to get several aspects to learn: including take advantage of the venues selected, the use of the basement space, permeable ground, green roofs, sky gardens and artificial wetlands and Landscape combine, etc.. Through specific project examples below give a brief account in the design of the above-mentioned technical measures.

Engineering Example 1 (residential district)

Located in the Minhang District of Shanghai, Shanghai million colonies Run Park Engineering in 2008 was named the first "green building two-star" in Shanghai residential district. Community takes numbers of measures to achieve a green building rating standards on land efficiency and outdoor environment.

1. The district takes full advantage of natural environmental resources in the overall layout, focusing on the fusion of the natural environment and human environment, to retain the pre-existing venues arbor dozens of trees, the main types of camphor and Metasequoia. The green area of 4862m² Riverside Park is an extension of Riverfront Park along the City Garden Hua Xin Port, along the river 22m wide, 221m long, to retain the original water surface of 4600 m² within the district, located in the district after transformation eastern central become internal water features. To meet the Evaluation Criteria in the construction of site does not destroy the local heritage and natural water systems, wetlands, prime farmland, forests and other protected areas.

2. There are the shopping, recreation and schools and other living facilities surrounding it, the southern entrance is connected to the municipal roads, residential courtyard space and the central square area. To meet the “Evaluation Criteria Settlements public service facilities planning with the construction, reasonably comprehensive building and share it with the surrounding area meet the Evaluation Criteria and location and settlements entrance, set up to facilitate residents make full use of the public transport network, settlements entrance to reach the public walking distance of the traffic the site is no more than 500m requirements.

3. The architectural form performance in the region, 40% of the "garden house" retreat desktop residential, every household with a terrace garden. A wide hall, full access to the South to the sun; South transparent, good ventilation; Ming design, the main living space sunny, wide field of vision. To meet the Evaluation Criteria, settlements building layout to guarantee sunshine outside the indoor environment, lighting and ventilation requirements, to meet the requirements of the “Urban

Figure 1. The landscape, greening and road.

4. The local landscape and greening stressed the close harmony between man and nature to create the scale and pleasant shared space. Derived from the spatial relationship of the seven elements of the interaction of people and neighborhoods, roads, squares, rivers, courtyard, trees, playground the three Parkway, the five themes Plaza and seven tour courtyard (Fig. 1). The rich variety of plants, more than 120 kinds, scattered about the landscape level, multi-functional planted in 30 kinds of health plant the neighborhood greening rate of 40%, per capita public green area of 5.14 m². Meet the "evaluation criteria" in the settlements, green land rate of not less than 30% of the per capita public green area of 1-2m/ "natural distribution" according to the local climatic conditions and plant characteristics, planting many types of plants, Joe shrub and grass combined with the multi-level plant community, the amount of trees ≥3strains / 100m² green area and Green Planting Native plants to adapt to the local climate and soil conditions, the choice of less maintenance, weathering resistance, pest less harmful to humans plants requirements.

5. Trunk road sets the previous concrete pavement (Fig. 2), with a total area of approximately 3500 m², the north and south entrance laying permeable performance good Shubu Locke cement brick (Fig. 2) with a total area of approximately 5000 m². The permeable pavement (including greenbelt hollow floor) accounts for 80% of the total pavement, the rainy pavement basic anhydrous. Requirements meet the evaluation criteria in the settlements non-motor vehicle roads, surface parking lots and other hard flooring permeable ground, and landscaping to provide shade outdoor permeable ground area of not less than 40%.

Figure 2. Permeable pavement Virtual.

6. The district underground construction covers an area of 23887 m², which civil air defense covers 3355 m2 and 85 parking spaces, the half underground garage covers 5770 m² and 234 parking spaces. Garage entrance is located in the entrance area, making people and vehicles distributed at the real sense. Pedestrian entrances located within the cell, combined with the height difference of the construction site, the formation of the upper and lower channels connected to the ground, underground space. The intersection set deceleration zone and change the flooring made deceleration with sidewalk convergence at the ramp; branched, or one-way lane width 4m, the road once set sidewalk, significantly reduce vehicle noise and dust. To meet the Evaluation Criteria in the development and utilization of underground space, such as the use of underground space for the use of public spaces, garage or storage room and to meet the requirements of the provisions of the Urban Area Environmental Noise Standards (GB3096) settlements ambient noise.

In addition, the district design has also taken other measures to reflect the energy, water and materials, protection of the environment and other green concepts. Create a natural harmony, health, comfort, safety and environmental protection, high-quality living environment, green residential
area of health needs in the broad sense of the guarantee occupants physiological, psychological, social and humanities.

**Engineering Example 2 (public buildings)**

Located on the edge of the core area of the sub-center in northeast district, Shanghai pentagon square 19th floor international plaza Shanhai greenland inno quasi-A office building covers an floor area of 25,000 m², two basement which is the first batch of green building design evaluation identifies two-star in 2008. The project on the basis of controlling indicators and general indicators meet the evaluation criteria, the prominent feature is the use of green roofs (Fig. 3) and the permeable ground.

1. A planted roof has the function of regulating the climate and environment, using of rainwater, building protection, thermal insulation, beautifying the environment. Taking the new roofing construction into account and retrofitting the original roofing layer waterproofing membrane layer of resistance to root pierced, shallow-rooted plant selection to resistance, drought resistance, barren seedlings (Sedum) mainly with simple daily maintenance, growing well, the landscape effect.

2. The Non-motorized vehicles using permeable concrete floor, laying of permeable paving materials, the impermeable floor tiles replaced with permeable brick, grass permeable plaid parking. The total percentage of permeable ground reached 71.5%.

![Figure 3. The planted roof perspective and real map.](image)

![Figure 4. The expand green roof.](image)

**Engineering Example 3 (high-rise building)**

A tall building in Guangzhou, the height of building is 475.8m, construction area of 4936000 m² million, including the tower, podium and basement. The architectural design goal is for the Green Building "three-star" level. The main features in the section with the outdoor environment technology system is permeable ground towers Hanging Gardens of sub-floor roof garden. The high-rise building, in order to improve the greening rate, the project uses vertical greening rich architectural forms, improve the built environment, at the same time made to improve the microclimate, adjust the indoor temperature and humidity, absorb carbon dioxide and release oxygen, to improve the air quality of the ecological benefits. In accordance with the requirements of 200 m² / thousands of office workers, totaling Hanging Gardens of 4200 m², the building in the 95-story building sightseeing layer set sky garden of 2000 m², every layer set a 4m high, independent garden area of 200 m², the whole building from top to bottom of 11, with a total area of 2200 m². In addition, the podium roof area of 5000 m², Guangzhou region has abundant rainfall, roof garden less demand for irrigation water, semi-intensive and expand green roof (Fig. 4) waterproof layer using corrosion-resistant, resistant to mildew anti plant roots thorn wear, good water resistance waterproof material.

**Conclusion**

By the analysis above, it shows that green building design can achieve the appropriate star indicators of the festival grounds and outdoor environments by certain technical measures. Implementing meaningful measures are summarized below:

1. On the aspect of venue selected utilization, we should make full use of the existing resources of
the site and the surrounding, living facilities, such as water, plants, commercial buildings, entertainment, leisure, education and road transport to meet the evaluation criteria related indicators.

2. On the aspect of utilization of underground space, design basement and semi-basement rational as a function of civil air defense and underground garage, reducing the floor space, and at the same time meet the evaluation criteria related indicators.

3. Reasonable use permeable ground, including the ground of pervious concrete, permeable brick ground and grass permeable grillwork and other forms, in order to meet the requirements of the evaluation criteria.

4. While the ground greening select to appropriate planting varieties, to take waterproof measures, use the green roof, sky gardens and artificial wetland landscape combination such as vertical greening the way, while the advancement of green rate, rich architectural forms, improve the built environment, and at the same time made to improve the micro-climate, adjust the indoor temperature and humidity, absorb carbon dioxide and release oxygen, to improve the air quality of the ecological benefits.

In short, by the above-mentioned measures can achieve green building design and land, and the star of the outdoor environment indicators. Of course, in the practical application of the process should also be adapted to local conditions, combined with the other five indicators, and continuous improvement and development of the technical aspects, really to be achieved so that the green building, and to achieve a higher standard.

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References
