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ORIGINAL ARTICLE

Green Architecture Approach for Sustainable Urban Development

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ABSTRACT
Green architecture and sustainability are interlocked and it is difficult to separate them when one considers sustainable urbanism. The present paper was formulated in order to determine three most important principles of green architecture (i.e. economy of resources, life cycle design, and humane design) in view of sustainable urbanism. Three strategies are considered in economy of resources, i.e. energy conservation, water conservation, and material conservation. Economy of resources is attributed to make suitable use of non-renewable resources and energies in one hand and reduce consumption rate, on the other. The principle considers construction in three stages, i.e. pre-construction, construction, and post-construction. Life cycle design is the second principle of green architecture which is based upon the fact that materials are turned from one usable form to another without damage to its usability. Humane design is rooted in requirements necessary for keeping chain elements of ecosystem which in turn, ensure human existence. The principle consists of three strategies, i.e. conservation of natural resources, urban-site design, and human comfort.
Keywords: *Green architecture, sustainable cities, economy of resources, life cycle design, humane design.*

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INTRODUCTION

Green architecture is a novel approach of architecture which has been paid much attention in recent years. Several contemporary designers and architects have paid much attention to green principles of architecture. This approach which has been arisen from concepts of sustainable architecture aims at achieving a coordination and consistency with environment which is considered one of the most important requirements of the present-day world. Green architecture prevents cities from adverse effects of constructions [1].

The issue of sustainable cities has recently gained a vast publicity as it is directly related to higher quality of life and values of urban living, especially in big cities. In this regard, several urban planners have recently focused on undeniable importance of green thinking in urban design. Fikret oglu Huseynov (2011) believes that "planning of sustainable cities indisputably adds notable value, eminence and physical integrity to thecity, and promotes cultural heritage. Furthermore, urban planning can be considered a road towards sustainability, as urban planning often tackles many detrimental environmental problems, which haverecently been considered characteristic of crowded city centers and urban environments" [2].Also,Amiri Mohammadabadi and Ghoreshi (2011) state that "designer's attention towards sustainability issues in architecture andcreating an approach where buildings are designed in the most proficient and aesthetic manner andmeanwhile imposing the least possible harm on the environment have been one of the major issues inarchitecture designing" [3].

Green architecture and sustainability are interlocked and it is difficult to separate them when one considers sustainable urbanism. Zhe et al. (2011) believe that "green architecture and sustainable development is the inexorable trend for the future of architecture design. On the basis of meeting the function of residence, human beings can combine the esthetic arts and the eco-culture of architecture to express their traditional historical culture, strengthen the recognition ofthe eco-culture of architecture, promote the aesthetic consciousness of the whole nation and root theconcept of green architecture, energy saving and sustainable development deeply into people's hearts by applying new technology, new construction materials and new techniques" [4]. Oktay (2012) believes that "Many progressive leaders

now envision and champion a win-win balance between human needs, both social and economic, and of nature. It is widely recognized that the power of thoughtful urbanism to induce people to willingly live a more human-powered and less resource intensive lifestyle" [5].

The present paper was formulated in order to determine three most important principles of green architecture (i.e. economy of resources, life cycle design, and humane design) in view of sustainable urbanism.

ECONOMY OF RESOURCES

Economy of resources is attributed to make suitable use of non-renewable resources and energies in one hand and reduce consumption rate, on the other. Furthermore, better exploitation of natural resources should be paid serious attention as they are regarded as renewable and sustainable resources. Three strategies are considered in economy of resources, i.e. energy conservation, water conservation, and material conservation [1].

In the case of resources in green architecture for achieving sustainable cities, Lehmann (2010) believes that to attain more sustainable cities, urban designers must appreciate and applythe essential principles of Green Urbanism in a systematic and adapted way. These principles can be operational in different urban situations, but they almost always require to be modified in terms of the context and the project's scale, to the site's constraints and opportunities. It is necessary to develop a septic approach for eachunique site and situation, adapting the principles to the particular climatic conditions, site context, availability of technology, social conditions, project scale, client's brief, diverse stakeholder organizations, and so on. It is an approach to urban design thatrequires an optimization process and a solid understanding of the development's wider context and its many dimensions before thedesigner can produce an effective design outcome [6].

On the other hand, climate-friendly design of cities leads to great savings in the case of energy and resources. Consumption of fossil fuels amounts to the largest share of CO_2 emission in the world which is mainly attributed to fossil fuel-based power stations. In many countries, coal is still considered as the main energy source. To overcome this problem, utilizing renewable energy resources have been emphasized as the components built last over decades with minimal requirement for maintenance [7].

A proper urban design and planning is required for creation of the infrastructures essential for supporting such clean energy resources as the sun and wind at a scale suitable to power a city. Although it sounds hard to find places to install wind turbines near urban areas, considerable opportunities can be sought to overcome this barrier [8].

Another aspect of utilizing green energy sources during green architecture for attaining sustainable cities is to capture rainwater as a potential energy source and to reduce the amount of energy and cost needed for provision of utilities for cities. Freilich (2011) proposed 8 measures to be taken in order to capture rainwater as efficiently as possible:

1) Reduction of impermeable surfaces
2) Use of permeable paving materials
3) Rain-store detention and treatment
4) Bio-swales instead of culverts and pipes
5) Delete curbs – sheet drain to swales
6) Restore wetlands
7) Rainwater harvesting systems
8) Major reductions in water utility rates/costs [9].

Freilich (2011) also believes that sound use of renewable energies can substantially reduce costs in cities. By using such green energy resources, consumption of fossil energy will decrease and financial saving can be achieved.

- Rooftop solar energy systems reduce utility energy purchases by 80%
- Rainwater capture systems reduce utility water purchases by 30 – 50%
- Building mounted wind turbine facility of 4 – 10 kW cost $30,000 - $40,000 installed and can meet 100% of the needs of a typical home
- Installing solar and wind facilities, bonding the savings of energy costs to the purchaser, will reduce the cost to the developer by 100% [9].

Li (2011) states that it is necessary to emphasize on energy efficiency, the full use and recyclable use of resources, which yields rules of 4Rin design process:

- "Rule of reducing: this rule requires reducing the needs for energy, water, land, and materials used in buildings. Perhaps it can be simplistic for the design focus to be centered on consumption for winter heating, summer air conditioning and light. For this purpose, many technologies have been developed, such as improving natural ventilation of microclimate and active systems, using clean and renewable energy systems, and selecting sustainable materials and water, which can

be taken account into the design. Sustainable materials are less energy intensive in their production and that are not harmful to the environment.

- Rule of recycle: Sustainable design should select the recyclable materials as the building materials where possible. At present, the rain water recycling and wastewater systems may be the examples for this.
- Rule of reuse: The continuous usefulness of most building materials most be considered in design process, which means that at the end of material useful life it should be used as postconsumer resource and give new life in the form of new materials and fabricated components of recycled into new materials and fabricated components or alternative uses. The approach to the construction of any new facility should be to maximize the efficiency of the building fabric in order to conserve resources in future operation. In this context, the existing building stock must be seen as an important resource.
- Rule of renewable: It should be to make widest possible use of renewable sources in sustainable design. Renewable energy is source from renewable sources, which are not rapidly replaceable. Many renewable energy sources have been developed, such as wind energy, photovoltaic systems, solar thermal systems for water heating, ground source heat pump for heating and cooling. etc., which are adopted in recent projects more and more" [10].

Kim (1998) proposed methods for application of economy of resources (Fig. 1).

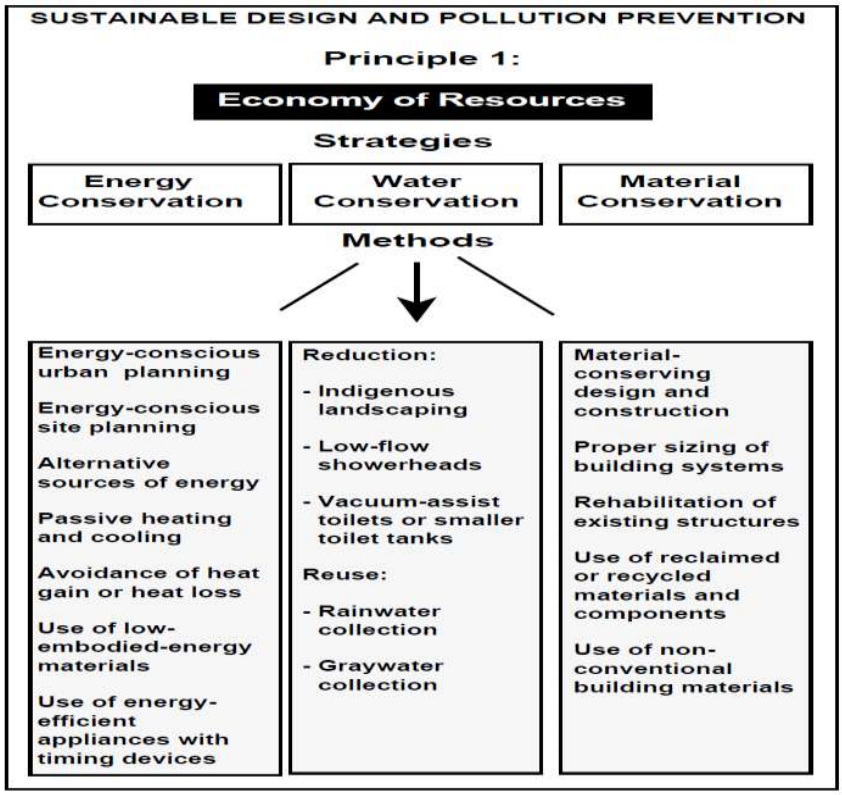

Figure 1: economy of resources methods as proposed by Kim (1998)

LIFE CYCLE DESIGN

Life cycle design is the second principle of green architecture which is based upon the fact that materials are turned from one usable form to another without damage to its usability. On the other hand, one of designers' tasks in this principle is to prevent environment from pollution. The principle considers construction in three stages, i.e. pre-construction, construction, and post-construction. It is noteworthy that these stages are interconnected and there is no vivid frontier between them [1].

Green buildings are considered one of the main criteria for a sound green architecture.Green building is referred mostly to use green materials for constructions. In this regard, a great attention has been paid to design so-called carbon-neutral cities [8, 10, and 11].

A life cycle assessment (LCA) can help avoid a limited viewpoint on environmental, social and economic worriesby evaluating variety of influences related to all phases of a process: from extraction of raw materials through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Impacts taken into account include (among others) embodied energy, global warming potential, resource use, air pollution, water pollution, and waste.In terms of green building, the

last few years have seen a shift away from a prescriptive approach, which assumes that certain prescribed practices are better for the environment, toward the scientific evaluation of actual performance through LCA.Although LCA is widely recognized as the best way to evaluate the environmental impacts of buildings (ISO 14040 provides a recognized LCA methodology), it is not yet a consistent requirement of green building rating systems and codes, despite the fact that embodied energy and other life cycle impacts are critical to the design of environmentally responsible buildings [12].
Kim (1998) elucidates three phases of life cycle design as follows:

- Pre-Building Phase: This phase includes site selection, building design, and building material processes, up to but not including installation. Under the sustainable-design strategy, we examine the environmental consequences of the structure's design, orientation, impact on the landscape, and materials used. The procurement of building materials impacts the environment: harvesting trees could result in deforestation; mining mineral resources (iron for steel; bauxite for aluminum; sand, gravel, and limestone for concrete) disturbs the natural environment; even the transport of these materials can be a highly polluting activity, depending on their weight and distance from the site. The manufacturing of building products also requires energy and creates environmental pollution: for example, a high level of energy is required to manufacture steel or aluminum products.
- Building Phase: This phase refers to the stage of a building's life cycle when a building is physically being constructed and operated. In the sustainable-design strategy, we examine the construction and operation processes for ways to reduce the environmental impact of resource consumption; we also consider long-term health effects of the building environment on its occupants.
- Post-Building Phase: This phase begins when the useful life of a building has ended. In this stage, building materials become resources for other buildings or waste to be returned to nature. The sustainable design strategy focuses on reducing construction waste (which currently comprises 60% of the solid waste in landfills1) by recycling and reusing buildings and building materials [13].

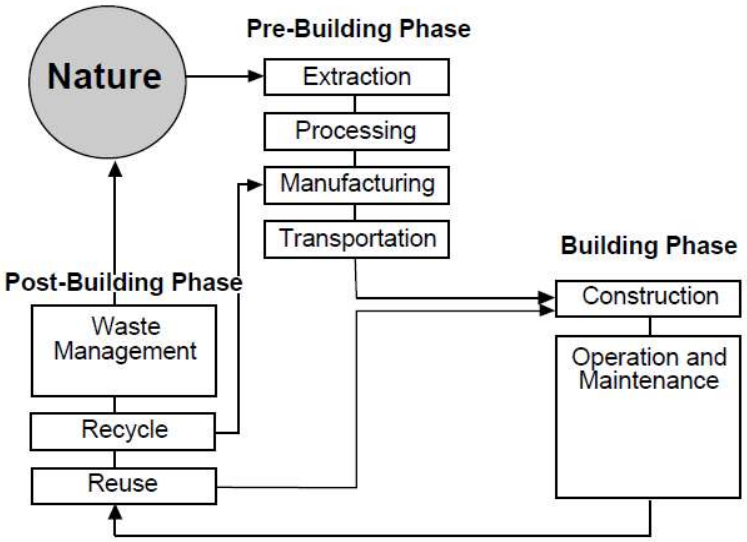

Figure 2: Three phases of life cycle design as proposed by Kim (1998)
Kim (1998) proposed methods for application of life cycle design (Fig. 3).

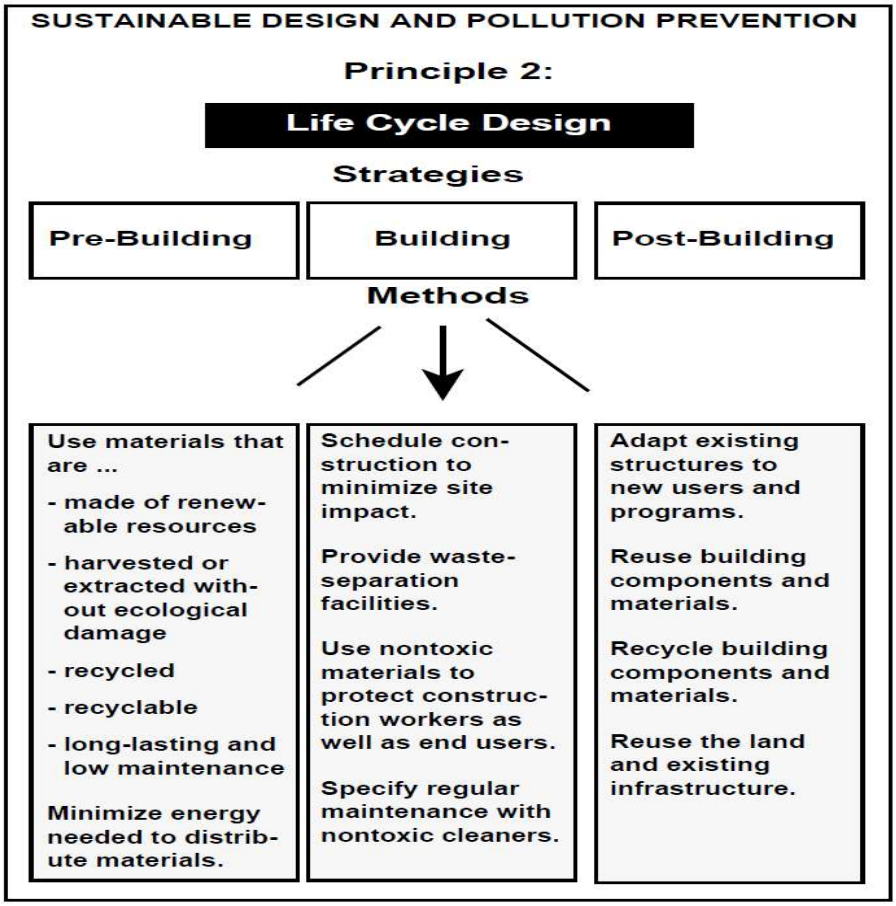

Figure 3: Life cycle design methods as proposed by Kim (1998)

HUMANE DESIGN

Humane design is the last and perhaps the most important principle of green architecture. It is rooted in requirements necessary for keeping chain elements of ecosystem which in turn, ensure human existence. The principle consists of three strategies, i.e. conservation of natural resources, urban-site design, and human comfort. The strategies have been designed in order to increase consistency between buildings and their surroundings as well as buildings and users [1 and 13].

Kim (1998) believes that in modern society, more than 70% of a person's lifespan is spent indoors. An essential role of architecture is to provide built environments that sustain occupants' safety, health, physiological comfort, psychological well-being, and productivity [13].

A brief description of the above-mentioned strategies is provided below:

- Preservation of Natural Conditions: An architect should minimize the impact of a building on its local ecosystem (e.g., existing topography, plants, and wildlife).
- Urban Design and Site Planning: Neighborhoods, cities, and entire geographic regions can benefit from cooperative planning to reduce energy and water demands. The result can be a more pleasant urban environment, free of pollution and welcoming to nature.
- Human Comfort: Sustainable design need not preclude human comfort. Design should enhance the work and home environments. This can improve productivity, reduce stress, and positively affect health and well-being [13].

As for the other two principles, Kim (1998) suggested methods for application of human design (Fig. 4).

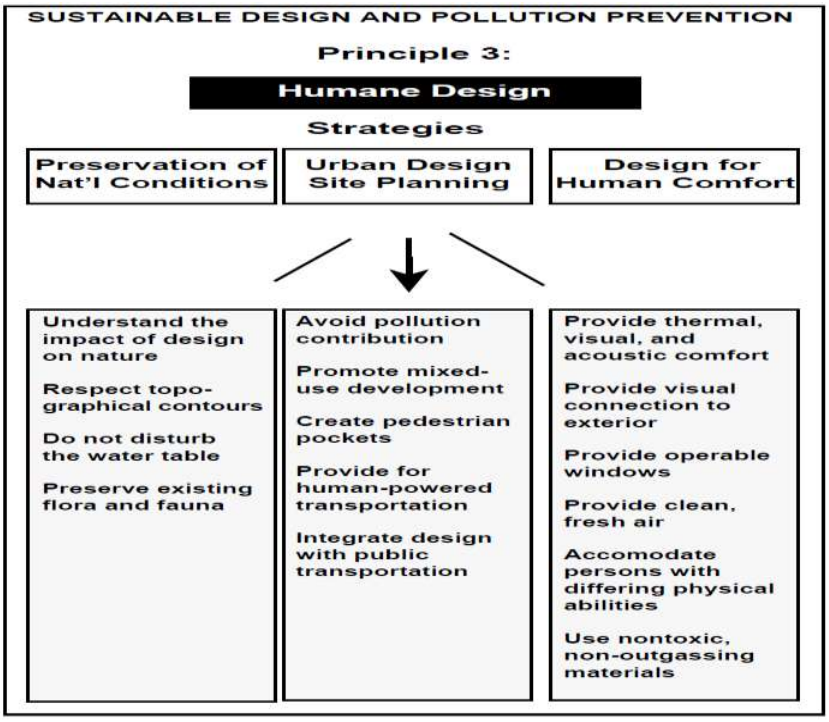

Figure 4: Humane design methods as proposed by Kim (1998)

CONCLUSION

Green architecture has been extensively adopted in several countries all around the world. Green architecture guarantees the highest ease for humans while consuming the least energy and other natural resources, and producing less dangerous materials to the environment, meeting environmental safety necessities and maintaining the coordinated mixture of man and nature [14].

In order to improve environmental sustainability, a building must holistically balance and integrate all three principles (i.e. Sustainable Design, Economy of Resources, and Life Cycle Design) in design, construction, operation and maintenance, and recycling and reuse of architectural resources. These principles include a conceptual framework for sustainable architectural design. This framework is envisioned to help designers pursue resolutions rather than giving them a set of solutions. Specific design solutions well-matched with a given design problem will stem from these principles [13].

It seems that a lot of work must be done to achieve objectives of green architecture to have sustainable cities. Considering the strategies proposed in the three principles of green architecture can be a silver bullet to attain sustainability in urbanism.

REFERENCES

1. Wikipedia (2013) Green architecture; retrieved from http://fa.wikipedia.org/.
2. Fikret oglu Huseynov, E. (2011) Planning of sustainable cities in view of green architecture; Procedia Engineering, p. 534-542.
3. Amiri Mohammadabadi, M., Ghoreshi, Sh. (2011) Green Architecture in clinical centres with an approach toIranian sustainable vernacular architecture (Kashan City); Procedia Engineering 21, p. 580-590.
4. Zhe, W., Li, Zh., Jing, Sh. (2011) On the beauty of green expo architecture and sustainabledevelopment - taking "China Pavilion" as an example; Procedia Engineering 21, p. 163-167.
5. Oktay, D. (2012) Human Sustainable Urbanism: In Pursuit of Ecological and Social-Cultural Sustainability; Procedia - Social and Behavioral Sciences 36,p. 16-27.
6. Lehmann, S. (2010) Green Urbanism: Formulating a Series of Holistic Principles; Veolia Environment, S.A.P.I.EN.S, Vol. 3, No. 2, p. 1-10.
7. Lehmann, S. (2007) Sustainability on the urban scale: "Green Urbanism";International Conference on Sustainable Architectural Design and Urban Planning Hanoi Architectural University, May 15-16, 2007, Hanoi, Vietnam.
8. Newman, P. () Green urbanism and its application to Singapore; Asia Research Institute, Working paper series no. 151.
9. Freilich, R.H. (2011) From Sprawl to Sustainability: Smart Growth, New Urbanism, Green Development and Renewable Energyin Santa Fe County, N.M.; Rocky Mountain Land Use Institute.
10. Li, W. (2011) Sustainable design for low carbon architecture;Procedia Environmental Sciences 5, p. 173–177.
11. Lerch, D. (2007) Post carbon cities: planning for energy and climate uncertainty; Portland, OR: post carbon.
12. Wikipedia (2013) Green Building; retrieved from http://en.wikipedia.org/wiki.

13. Kim, J.J. (1998) Sustainable Architecture Module:Introduction toSustainable Design; National Pollution Prevention Center for Higher Education.
14. Lang, N.T. (2013) Cultural and Social Elements in the Development of GreenArchitecture in Vietnam; Procedia - Social and Behavioral Sciences 85, p. 16 – 26.

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