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Review of Different Architectural Strategies for Creating Sustainable Universities

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Abstract

Nowadays Universities are considered as one source of environmental pollution due to their population and different activities occur in universities' campuses. A lot of energy and materials are consumed during teaching activities and research process in universities. Although some environmental protection strategies can be seen in some universities, but more sustainable approaches to reduce the negative impacts of those activities are neglected. Therefore, this paper reviews some strategies for achieving sustainable universities through economical, environmental and social aspects based on previous studies in terms of Planning, transportation, energy efficiency and indoor environment. Finding of this research can be used for designing future higher education spaces with sustainable approach.

Keywords: Sustainable University, Planning, Transportation, Energy efficiency, Indoor environment

1. Introduction

Educating the society is one of the responsibilities of the universities. society can be developed by the effect of training in the Universities (Viebahn, 2002).Sustainability is identified by economic development concurrently with social and efficiency in utilization of renewable energy(Lozano and Vallés, 2007). For creating sustainability, conservation and enhancement of resources, concept of economic growth, social and cultural development should be considered(Quaddus and Siddique, 2001).A sustainable university is recognized as spaces which have ability to minimize of negative environmental, economic, societal, and health effects during teaching and research activities(Velazquez et al., 2006).Cole (2003) stated that sustainable university protect and enhance the health and well-being of humans and ecosystems (Cole and Wright, 2003).

Sustainable university campus should be a healthy campus environment, with a successful economy through energy and resource conservation, waste reduction and an efficient environmental management. A balance between economic, social and environmental aspects can be provided within sustainable university (Newman, 2006).

Ecological, social, economic, cultural and spatial aspect are identified by Seiffert and Loch, 2005 essential dimensions within the concept of sustainability and these aspects should be considered in all spaces of universities such as classrooms, laboratories, housing, transportation and other services (Seiffert and Loch, 2005).The issue of sustainability in universities has been studied in many researches (Barnes and Jerman, 2002, Bernheim, 2003, Viebahn, 2002, Corcoran et al., 2002).Universities are acts as complex buildings like hospitals and hotels in terms of impact on environment (Alshuwaikhat and Abubakar, 2008).

2. Materials and Method

Different aspects of sustainability in the universities were identified through studying previous research. Furthermore the importance of sustainable approach in universities and campus universities were clarified. At last various strategies for creating more sustainable spaces for higher education campuses were reviewed in term of planning, transportation, energy efficiency and indoor environmental quality based on previous research to find out a method for complying different aspects of sustainability such as environment, economic and human aspects in designing universities.

3. Finding and Discussion

3.1Campus & Site Planning

Site of universities should be designed with the best use of land to minimize negative impacts on the land and surrounding area while the aesthetics of the site increase. The purpose is to minimize environmental impacts to the existing natural spaces therefore Strategies can be used are as follow:

Minimize the use of resources

Reduce the impact of the site on urban services

Reduce site disturbance during construction projects

Continue to support a compact, walk able campus, with accessible academic buildings

Maintain and renovate existing buildings to optimize the use of existing academic space

Utilize surface parking lots within the Ring Road for building sites

Strategies for construction are as follow:

Protect vegetation and ecologically sensitive areas during construction

Select a staging area for construction and materials which minimizes site disturbance and traffic impacts

3.2Transportation

Sustainable transportation options should be incorporated into sitting decisions to reduce dependence on car travel, For the purpose of reducing the rate of growth in traffic volumes and parking demand by providing and encouraging sustainable transportation choices. Campus strategies are as follow:

Maintain a pedestrian-friendly campus

Provide student-oriented housing opportunities on campus

Use parking management

Using electric bikes and vehicles

Continue to monitor traffic volumes

3.3 Energy Efficiency and Renewable Energy

Buildings are source of energy consumption in their construction and operation. The University should have three basic strategies for increasing energy performance: reducing demand, taking advantage of natural systems, and increasing efficiency.

Demand is reduced by optimizing the building footprint and orientation on the site, use of lighting controls, occupant controls and occupant behaviour changes. Natural systems can be utilized by orienting buildings to take advantage of day lighting and natural ventilation.

One way for creating sustainable university is to promote construction of green buildings and transportation facilities such as footpaths, cycle-ways, green way on the site of universities. Green buildings can reduce energy consumption and improve the well-being of the university community. The target of the energy-efficient green buildings is to have better lighting, temperature control, improved ventilation and indoor air quality which contribute to healthy environments by reducing air-pollutants in campus buildings.

A building's energy use is a primary consideration in environmental impact because both the heating and cooling design and the equipment selected contribute to this impact. Energy efficiency improves as building spaces are used efficiently with intelligent control systems.

The importance of energy efficiency of buildings and control of the indoor air quality has been considered the purpose of the building is savings energy. All the aspects of HVAC technology including building automation have

important role in energy consumption. Energy efficiency and conservation could be achieved through the following ways.

- Use more efficient HVAC systems with improved building control systems.

- Use of wind, solar sources for Thermal and day lighting which causes reductions in buildings operations and maintenance costs.

- Reduce energy costs by installing control systems to control off-hour heating, cooling, and lighting

- Reduce lighting loads and improve comfort by using energy-efficient lighting(Alshuwaikhat and Abubakar, 2008).

Increasing efficiency can be achieved through limited use of air conditioning, use of high-efficiency lighting and appliances. The goal is to minimize the total energy consumption of campus facilities and buildings, and minimize negative environmental effect and energy costs.

Some strategies for energy efficiency and renewable energy design are:

Utilize energy modeling for new buildings to optimize energy performance and assess options

Locate and orient the building to optimize solar access and day lighting opportunities

Utilize shading devices such as sunshades and overhangs to control solar gain

Develop design strategies that optimize the performance of the building envelope

Using sensors that control lighting in all spaces

Specify requirements for energy-efficient equipment and high-efficiency lighting and control systems

Specify standards for heating, ventilation, and air-conditioning (HVAC) systems.

Verify and monitor the performance of building systems to ensure they have been designed, installed

3.4 Indoor Environment

To provide interior environments that enhance user comfort, well-being, and productivity some Strategies were used which are:

Provide smoke-free buildings and relocate designated smoking areas away from building entrances

Separate air intakes from loading areas and building exhausts

Limit the use of mechanical air conditioning

Strategies were used in designing are:

Develop site plans to minimize potential pollutant sources in areas adjacent to the building. Consider to the location of roads and parking lots.

Develop design strategies to optimize natural ventilation.

Include occupant controls for airflow, temperature and lighting.

Maximize interior day lighting, particularly in office areas

Maximize view opportunities to provide a connection between interior and exterior space

Specify ventilation systems to comply with the most recent ASHRAE standards for Ventilation for acceptable Indoor Air Quality.

4. Conclusion

For creating sustainable universities, different strategies should be considered in pre-design, design, construction and using stage. However various criteria form environment, economic and human points of view can have significant effect on sustainability of the universities. This research only concentrates on strategies for planning of site and buildings, transportation, energy efficiency and renewable energy and indoor environmental quality solely. All these strategies have roles to create sustainable place for higher education spaces to meet the requirements of users while at least negative effect on environment is occurred. Therefore with consideration of these strategies in designing,

more sustainable universities can be designed.

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