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Six Basic ElementsForSustainable Building Design

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Abstract: Sustainability is not a program or research activitiesfor professionals and academicians. This term is an important agenda that give a big positive impact to every single things in the world. One of the good effort known as sustainable building design become more popular among professionals, authorities, government and non-government organizationto create a balance positive impact to the building design and to the environment.Active and passive sustainable building elements are two main category that contribute to create a sustainable building design. Both of these categories should be operate together to provide a better lifestyle for the occupant. Unfortunately, various type of informationand different way of applications create a problem where most of us are not well educated about the basic strategies to create a sustainable building design. Moreover, it becomes worst when peoplefeel confuse to understand the different typesof rating tools from various organizations which should be function as their main references. Actually, most of the rating tools using a quite similarapproaches in term of archiving a sustainable building design level but there are certain basic important elements which are not been highlighted. Therefore, this paper will discuss some of the basic elementsby using a systematic literature review as the main methodology.All of these strategies were inspired according to a study on four type of rating tools that focus on sustainable building design such as Building Research Establishment Environmental Assessment Method (BREEAM), Leadership in Energy & Environment (LEED), BCA Green Mark and Green Building Index (GBI). The study reveals sixbasic elements to create a sustainable building design consist of site and land use, energy conservation, water management, sustainable materials, indoor environmental quality and innovation. All of these elements will educate people and function as a guidance to create a better building design.

Key words: Sustainability, six basic strategies, rating tools, sustainable building design.

INTRODUCTION

Humans need development that suit totheir lifestyle as well as to survive in current challenging world. They have to put a big effort to ensure their life will be better than before. Creating a sustainable lifestyle is the best way for a friendly development due to the current issues such as " exhaustion of natural resources, green house effect, serious economic results, increase in the frequency and violence of hurricanes and tropical storms, increase of the sea level and displacement of population (Roberto Lamberts, 2001)". As a continuous process,it is necessary to understandespecially on its main basic elements. Two main categories known as active and passive sustainable building elements, contribute a major role to create a sustainable building design. Passive sustainable building elementsare more effective in term of economical aspect, maintenance process, operation system and design ease compare to active sustainable building elements. Definitely, to create a passive sustainable building design may need a deep understanding in every single aspect. As a result, many programs and activities which are related in enhancing building design being attracted by most of professionals and academician especially from the construction field. It is necessary for them to be well educated about this effort thatgive positive values not only for themselves but this will affecting the construction industries to be more sustain. At the same time various type of rating system have been produced such as LEED, BREEAM, BCA Green Mark and GBI.This positive phenomena indicate us on how serious especially the government and non-government organization to make sustainable building designbecome as one of the necessary development process. Unfortunately, some of us especially professionals and academician feel confuse to choose the best references due to various type of information that related with sustainable building guidelines and sustainable building rating system. Different rating systems come from organizationsin different countriesin which case each of them confronts different issues in creating asustainable building designs. In the other hand, each place in the world has different type of climate, economy and culture which affect its sustainable building guidelines and rating system. It is necessary for us to understand thebasic elementsto create a sustainable buildingdesign. This paper highlights six main basic elements consist of site and land use, energy, water, materials, indoor environment quality and innovation according to the four type of rating tools as mention before. Each elements have different functions with different applications where this would help us to understand and apply all of these basic elements to create a sustainable building design.

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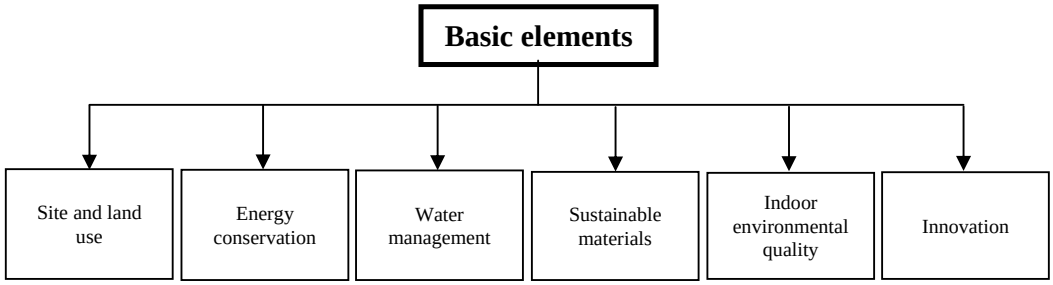

Fig. 1: Six basic elements for sustainable building design

RESULT AND DISCUSSION

Site And Land Use:

Land is one of the most essential elements that support the life of human, animal and plant. Human activities can give significant impact to the environment and have to be strategized properly tosupport flora and fauna.It is important to choose the most suitable site and create a sustainable building planning to enhance the land use as well as improving the site surrounding. In the other hand, sustainable development must considering every single impact not only to the site development but the other areas which may contribute in creating a sustainable development project.

A "brownfield" site is one of best wayin reducing the negative impact as well as to conserve the environment ecosystem. “Brownfeld sites are previously used sites. Previous uses can include any type of built structure, including industrial uses associated with contamination (Paola Sassi, 2006)".This method will reduces development on undeveloped land and greenfield sites. Besides, it will enhance the site and its surrounding appearances while regenerate the social even economic activities. This kind of development can use the certain previous building design elementssuch as main building structure and some of the materials can be reuse or recycle for a new building design. As a result, by choosing a brownfield site and create a well managements system of development can give a big positive impact as well as rejuvenating the site surrounding to become a better area to live.

Vehicles contribute to the most currently urgent issue known as global warming due to the fossil fuels and burning process. By using individual transport especially cars will create a bad lifestyle to human and negative impact to the environment. Program can be created by governments to encourage people to use public transports such as buses, trains and trams. Reducing parking spaces is one of the method in reducing the dependency on individual cars but it is not suitable forareas which possess inefficient public transport system. Reduction on individual transport, must be supported by effective planning to create an efficient public transport system. An effective planning means an area which been developed with effective localamenitiesand other supporting elements since the early stage of design process by considering the previous, current and future needs and issues. Other method known as car-free development is one part of the affective planning development by reducing road in certain area as well as encourages people to walk and using public transport. It can create a safeties area while reducing the amount of injured or killed people on roads.

A proper selection of a development site is one of the most critical factors in reducing the negative impact to the flora and fauna. A sustainable development must avoid destruction to the existing site and makes an early effort to select the natural site elements such as plant and trees. All of the natural elements should be considered and the building design must be properly executed in creating a harmony development with nature.

Energy Conservation:

Zero energy building is not a realistic solution but low energy building design would be the most possible target to achieve in sustainable building design. Every building need energy to operate and effective energy management will be the best method in reducing the negative impact to the environment. At the same time, active and passive sustainable building’s elements should operate together which may also depend on criteria such as climate, site location, social activities, economic issue, season and building use.

Currently, people have to spend extensively to receive good energy supply as well as to assure their buildings are well operated. Minimizing energy usage would be one of the best solutions to tackle some issues which related to the cost and maintenance. Building orientation should be designed according to the site condition. "Orientation is particularly important in perimeter dominated buildings with large aspect ratios (Vivian Loftness *et al*, 1999)". An early study will produce a better building design to receive natural sunlight and natural ventilation. This also may create another issue in term of glare or building may receive over amount of sunlight penetration. Shading device or louvers can reduce the amount of sunlight penetration while it also can control sunlight and ventilation to enter building spaces automatically.

Definitely, other energy sources are needed to make it functionand this strategy is related to the technology of building elements. Photovoltaic system is one of the effective technology to provide an extra or function as an alternative energy sources. "Photovoltaic (PV) cells are used to convert the energy of the sun directly into electricity, without noise or pollution and with little visual impact (John R. Goulding and J. Owen Lewis, 1997)".According to (Godfrey Boyle, 2004), PV cells can be integrated with building elements such as roof and walls to be more economical. Heat gain and loss are another issueswhere occupant prefer to use air conditioner to supply cold air and create a comfortable indoor environment space.This would be influenced by certain factor such as climate and season, site location, material and building uses. Due to all of these factorswill create different type of building operation that some buildings might need to reduce heat lose and some of it are not. Various methods can be applied by using different kind of materials, building orientation, building's structure, insulation and building space.

Due to the unrealistic effort to achieve a zero energy building, method called as zero-CO_2 would be another way to contribute towards a sustainable building design. At the same time, we must understand the difference between zero-CO_2 and renewable energy. Some energy sources such as river, wind and sun which considered as renewable energy are not included as zero-CO_2. Renewable energy needs some applications which are related with technology and system such as photovoltaic, solar thermal and wind energy. Unfortunately, these methods depend on certain criteria such as site, cost, planning and good knowledge to handle it. In other hand, green energy which related with technology or other energy sources to operate will considered as active sustainable design elements.

Water Management:

Water is one of the important elements that contributes towards a sustainable building designs. "Contemporary problems in water resources management andresources management in general, are characterized byincreasing complexity (Claudia Pahl-Wolst *et al*, 2007)".The big issues related with this element include water treatment, minimizing water usage and waste water discharge should be considered. Both passive and active sustainable strategies can be applied simultaneously but still restricted to certain criteria.

In reducing the amount of wastewater produced, the first step is to reduce the amount of water used by means of various types of water facilities and methods. To achieve this one of the best ways is tominimize theneed of water. Users also need to be educated about water facilities in their building and strategies to save water usage. At the same time, operation for maintenance should be considered in reducing accidental water losses such as water leaks problem. Some of basic water facilities in a building such as toilets, urinals, taps, landscaping, laundry and dishwashing contribute to create a sustainable water usage. Various sustainable toilet designs can be applied and each design possesses different concepts. Vacuum toilets were designed using air rather than water but it still need electricity to operate. Another method known as waterless toilets, use no or minimum water which can save about 40% of domestic water use. Other water facilities such as WCs can be designed to be a dual flush WCs consists of a full and half flush. Urinal should be provided with detector which can activates the water flush and this can prevent the amount of waste water. This method could be applied by installing taps where it can turn on and off automatically. Beside, wastewater and greywater (GW) can be reuse or recycle for other purposes to conserve domestic water usage. Before that, we must know that "GW is the wastewater collected separatelyfrom sewage flow from clothes washers, bathtubs,

showers and sinks, but does not includewastewater from kitchen sinks, dishwashers, ortoilets (Odeh R. Al-Jayyousi, 2003)".Landscape and plant contribute to create a green environment area for a sustainable building. It should be well maintenance and contribute to reduce water usage especially in improving its irrigation system. An automatic irrigation can solve this problem but this should be supported by a proper planning in choosing type of plants, climate and seasons.

Building design should be equipped with a system to collect rain water which can be used by the occupants and other purposes. Rain water harvesting can solve this problem while this would reduce the amount of domestic water usage. It collects rain water from the roofs and will be keep inside a storage tank after been passes through a filter to removes leaves and other debris. Some of it will be equipped with pumps and it depends on the amount of water usage as well as other related issues such as site constrain.

Sustainable Materials:

Sustainable materials give a big impact to building design starting from the aesthetic value to its cost and built ability. The impacts associated with material to building design and environment should be taken at the early stage in producing a sustainable building. Beside, the impact from the natural world should also be considered to create a sustainable building material."The natural world has an immenseamount to tell us about how to achieve sustainability. Ituses energy far more efficiently and effectively and iscapable of producing materials and structures that arefar more benign than anything we have achieved inindustry (Godfaurd John *et al*, 2005)".All factors in choosing building materials such as manufacturing process, transport requirements, final disposal and material's resources contribute in recognizing a sustainable building materials. It is essential

to know about the impacts of building's materials and one material's assessment known asLife Cycle Assessment (LCA) can evaluate the impact of construction elements to the environment."Life Cycle Assessment (LCA) is the assessment of the impacts associated with materials from their resourcing and manufacturing to their disposal (Paola Sassi, 2011)."Unfortunately, some of the building materials cannot be detected its impacts to the building and environment due to certain issues such as social issue and biodiversity.Designers should know to select the sustainable materials to protect the occupant from indoor pollution such as indoor air pollution. "Indoor air pollution includesparticulate matter from wood and coal smoke, as wellas carbon monoxide and other unburnt hydrocarbonsfrom wood, coal, and paraffin (Randal Spalding-Fecher, 2005)".

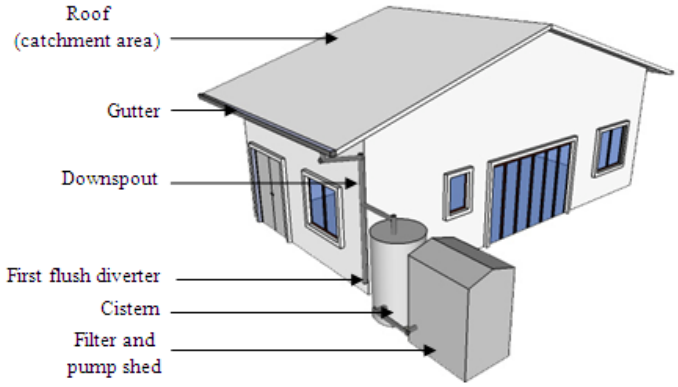

Fig. 2: Typical rain water harvesting system

According to the previous point, choosing to develop a building within brownfield site area would the best strategy. Some of the exists buildings elements can be reuse for the new development which can give many advantages compare to a building design developed on a greenfield area. There are some buildings which prefer to maintain the whole design unfortunately this strategy will gives certain negative impact such as bad building performances which not suitable with current issues and bad aesthetic value. Certain building structures or materials can be use but an early study should be done to determine its performance before adopt it into a new building design. It is better if building structures are designed to suit the current and future load. Besides, a flexible building's elements and structures can contribute towards a sustainable building design. By reusing existing building, building components and waste materials, these methods will reduce negative impacts associated with waste disposal.

All of building's products come from natural sources and need suitable manufacturing process to produce it. Every single building's product possesses different method which related with its embodied energy."The embodied energy of a material is the energy required to harvest or mine materials, transports them, process and manufactures them and finally installs them in a building(Paola Sassi, 2011)." It is essential to educated about each material's embodied energy in reducing all of negatives impact to the environment. Different materials have different amount of embodied energy. Unfortunately, the measure to determine the amount of embodied energy has not been standardized and produces different values for the same material.

Indoor Environmental Quality:

Indoor environment quality is another essential factor to create a sustainable building design. This factor can influence especially human's health which most of us do not realize. Deaths can happened due to the unhealthy indoor environment. Many kinds of development can affect our indoor environment which can give a negative impact without noticeable.

A healthy indoor environment can influence people's activities. A term known as Sick Building Syndrome which mainly associated with office building usually occurs in most building design. It happened due to certain problems associated with improper building design such as poor air quality,building control and limited natural light act. "This syndrome, known as Seasonal Affective Disorder (SAD) manifests itself through the occurrence of sleepiness, fatigue, depression, carbohydrate, carving and weight gain. In some individuals SAD has been successfully counteracted with the use of full-spectrum artificial lights (Paola Sassi, 2011)".

Good lighting either natural or artificial lighting is necessary element for a sustainable building design. Some of us may prefer to have natural light rather than using artificial light due to the energy usage associated with sustainable building and zero energy building design. According to the previous point, it is difficult to achieve zero energy building and we have to be realistic with it where active and passive sustainable design elements should be combined. Some of building design elements can be relevant to be integrated into the building such as skylight. It will encourage sunlight to be penetrated into the building but it depends on certain

criteria or rules especially to receive a quality of daylight. “The efficiency with which the well trasmits daylight is a function of the well wall reflectance and the shape of the well(G.Z. Brown and Mark Dekay 2001)".

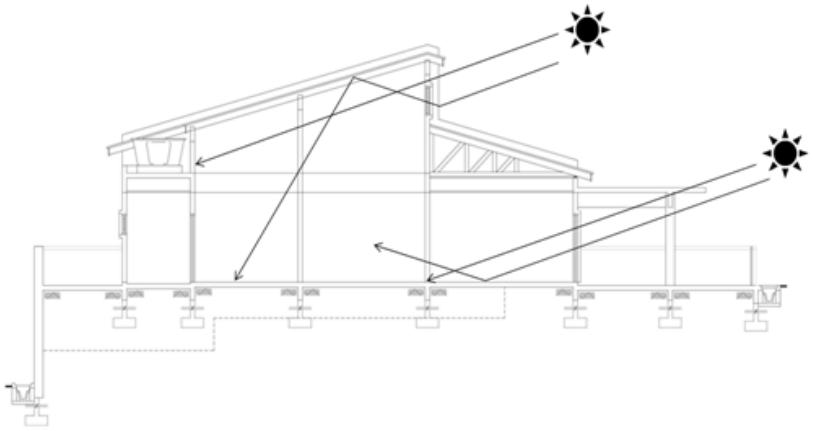

Fig. 3: Natural sunlight penetration in a building design

Beside, due to different climates and seasons thermal comfort would be another big factor to create a comfortable indoor environment. An early study should be done to create a building design which suitable to the local temperature. Buildings may need a different types of wall influenced by the local climates and seasons. Proper ventilation consist of natural and mechanical elements can prevent occupants from deseases which affect their daily life. Some of passive strategies can be implimented in the building design such as air well, blockage and partition, ventilation opening, building facade, corridoor and shading (C. C. Siew *et al*, 2011)". Big issue associated with mechanical ventilation which related with air conditioner,encourage designers to select an environmental friendly system. Minimising energy usage would be a big challenge and currently there are various method could be applied. Definitely, natural ventilation still remain as the main sources even a compulsory element in creating a sustainable building design.

Noise is another factor which influence occupant’s condition and good material or insulation should be considered to create a healthy indoor environment. It depends on building’s function as well as its surrounding to absorb or reflect certain unnecessary sound.

Innovation:

Innovation functioned as the compliment element to create a sustinable building design.It would be an element to encourage people and professionals to applied sustainable approach during construction process as well as in their daily life. Professionals consists of architects, engineers, surveyors and act are encouraged to impliment sustainable work environment as well as a positive strategy to attract people to be involved. Beside government will give certain advantages for a sustainable building project which implient a sustainable work progress. It can educate all of the professionals, clients, contractor and supplier to impliment sustainable approach as part of their work style.

Conclussion:

As mentioned at the introduction, sustainablility should not be considered as a program or activities for certain people doing their research even to earn extra knowledege. In the other hand, public should also be educated about sustainable building design. Six basic elements associted with sustainable buidling design must be understood and implimented in every single projects. A sustainable building design should be supported by the others positive developments by considering the six basic elements. This effort has a big potential and should be applied correctly because current building design could affect our future generations and we should not burden them with improper planning associated with building design.

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