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GREEN BUILDING: CONCEPTS AND AWARENESS

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Abstract - The building industry is one of the major energy consumers and emitters of Green House Gasses (GHG). It consumes 38% of the global energy; and this does not include the usage of other resources such as water. Globally, this has increased the crisis of global warming and has led to development of Green buildings. In the Sub Saharan Africa alone, 56% of energy used is by building operations. Green buildings are marketed as economical, resource efficient and environmentally friendly compared to the convectional buildings. This study investigated the extent of adoption of green building concepts in commercial buildings and the key challenges arising from their adoption with the aim of determining appropriate strategies for implementing them. The study was conducted through a survey method and used questionnaires, interviews, observations for data collection. It also reviewed documented data from available records including journals and books. The study revealed that large percentage of the building construction players and professionals involved in the recently sampled constructed commercial buildings in our country were aware of the green building concepts but only small percentage of the concepts had been incorporated in the buildings. In this paper a study is conducted which determine the main concepts involve in the construction of green buildings moreover the strategies are also discussed which can help to create awareness in between people regarding the benefits of green building and could be a step towards green building practice for the future world.

Key Words : Greenhouse gases ,strategies ,commercial building

1. INTRODUCTION

The building industry's sustainability ethics is based on the principles of resource efficiency, health and productivity and realizing these principles involves an integrated approach in which a building project and its components are viewed on a full cycle basis. [6], 'This ''cradle to cradle'' approach known as 'green' or 'sustainable' building, considers a building's total economic and environmental impact and performance from material extraction and product manufacture to product transportation, building design and construction, operation and maintenance and building re use and disposal [6]. Green buildings use less energy, water and natural resources compared to the convectional buildings. They also create less waste and provide healthier living environment, further they incorporate features such as efficient use of water, energy efficient and eco-friendly environment. The buildings use renewable energy and recycled materials, embrace effective use of landscape and have improved indoor quality for health and comfort [19]. In the United States more than 30 states and regional programs promote some level of energy efficiency and environmental responsibility for the residential construction [13]. The green buildings have been marketed as economical and as alternatives to convectional buildings [10], and the total number of commercial green building commissioned has hit the 10,000th mark .In Canada more than 212 green buildings had been accredited since 2010 [1] whereas in India the green concept has taken root with two green rating systems namely Leadership in Energy and Environmental Design green rating system (LEED) and Green Rating for Integrated Habitat Assessment (GRIHA) already in use. In the developing world such as Africa, sustainable construction has not received sufficient attention despite being an important aspect of sustainable development (Adebayo, 2000). According to the World Bank Development report of 2009, only South Africa has an established Green Building Council (GBC) but this is slowly changing with Morocco, Mauritius and Egypt being in the process of establishing their councils [7]

2. Green Buildings

Green building also known as green construction refers to a structure using a process that is environmentally responsible and resource-efficient throughout a building's life-cycle from sitting to design, construction, operation, maintenance, renovation, and demolition [6]. This requires close cooperation of the entire project stakeholders all project stages [24]. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort [23]. Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by efficiently using energy, water and other resources , protecting occupants' health and improving employee productivity and reducing waste, pollution and environmental degradation [23].

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Green buildings include measures to reduce energy consumption. To reduce operating energy use, designers use details that reduce air leakage through the building envelope. They also specify high-performance windows and extra insulation in walls, ceilings, and floors. Designers orient windows and walls and place awnings, porches, to shade windows and roofs [19]. In addition, effective window placement can provide more natural light and lessen the need for electric lighting during the day. Solar water heating further reduces energy costs. Buildings account for about 70% of the electricity load, 40% of all energy consumption, and 40% of CO_2 emissions [5] Hence, making buildings more energy efficient can be one of the fastest and, with rising energy prices, most cost effective ways to reduce greenhouse gas emissions. In the United States more than 30 states promote some level of energy efficiency in residential construction alone [13]. This argument is further emphasized by National Science and Technology Council that by adopting sustainability concepts there is reduction in energy, operation and maintenance cost, reduced building related illnesses and reduced waste and pollution [17].

2.1. Energy Efficiency

Building heating and cooling are the most energy-intensive activities, followed by electricity use for lighting and appliances [8]. Greenhouse gas emissions from buildings energy use significantly exceed those from transportation. The increasing demand for residential and commercial building spaces in developing countries will further push up energy consumption from building. According to US Environmental Protection Agency, most buildings can reach energy efficiency levels beyond the requirements in the green standards when passive design strategies such as building shape and orientation, passive solar design and use of natural lighting are taken into consideration. International Panel on Climate Change (IPCC) predicted that CO_2 emissions from buildings including through the use of electricity could increase from 8.6 billion tons in 2004 to 15.6 in 2030 under a high growth scenario. Developing countries will contribute substantial increases in CO_2 because of high energy usage from the building sector. IPCC argues that such a building boom offers an opportunity to commercialize energy efficient technologies to reduce both CO_2 emissions and energy usage. Improved efficiency in the building sector and de-carbonizing the power sector could offer significant potential emissions reduction [9].

2.2. Ways of Reducing Energy consumption

Studies show that there are several ways of reducing energy consumption in buildings and much effort has sought to apply renewable materials and renewable energy resources in buildings to use energy efficiently [3]. Discussed below is how reduction in energy consumption can be achieved in buildings.

2.3. Lighting

Lighting accounts for 4% of energy consumption in houses and up to 30% of energy use in commercial buildings [18]. Light control and smart meters are being promoted as good practice to reduce energy use in buildings. They consist of a network of sensors that can turn off lights when there are no people in the building. Smart meter scan monitor where and how energy is used in the building, and thus helps to identify the solution to improve energy efficiency [18].

Electricity can also be reduced through improved Light Emitting Diode (LED) or increased use of natural lighting and the use of energy-efficient appliances. Integrated building design and the modification of building shapes, orientation and materials can also reduce energy use [22].LED lighting offers better brightness and contrast, energy savings, ten times as efficient as 8 traditional bulbs. It will reduce electricity demand by 75% if used. [12]. According to an IEA report, lighting accounts for 19% of the world's electricity consumption and produces 1.9Gt of CO_2 annually [12)]. LED lighting and smart-control are more efficient than traditional lighting technologies. However, they are more expensive than conventional lamps. The market transformation from conventional lighting to LEDs requires financial support from government to support the LED market. China is the first country to establish a large LED programs, installing 210,000 LED street lamps in 21 cities in China.

Table 1: How different Bulbs Compare in terms of Power consumption

Minimum Light Strength	**Electricity Consumption in Watts**		
(Lumen)	Incandescent	Compact Fluorescent	LED
450	40	9 – 13	4 – 9
800	60	13 – 15	10 – 15
1,100	75	18 – 25	Not Available
1,600	100	23 – 30	Not Available
2,600	150	30 – 52	Not Available

2.4. Temperature Control

Most of energy use in building in Europe goes to heating, ventilation and air conditioning (HVAC) cooling, accounting for 55% of energy use in residential buildings and 35%in commercial buildings [19]. The heat generated from computers and other electronic appliances can be recycled to heat the building if the rooms are properly designed. Heat pumps and heat exchangers can transfer heat from IT server rooms to other parts of a building or to heat up offices during cold seasons. This argument by Scott is advanced by Green economy that a more holistic approach to the design of buildings and their use also requires consideration of all energy related components including appliances [14]

Siemens has proven with its energy efficiency solutions that every building has already today an energy efficiency improvement potential of 20-30% on average this can be achieved by optimizing the building management system, lighting, heating and cooling system, water and energy distribution and many more areas. In the local context, heating is not common even though cooling is in hotels and a few residential buildings. Despite kerosene, charcoal and gas being commonly used for heating in most homes; commercial buildings prefer the use of electricity for heating and lighting.

2.5. Passive design strategies

Studies such as the U.S Life Cycle Inventory data base project show that buildings built primarily on wood will have a lower embodied energy than those built primarily with brick, concrete or steel. In order to reduce the embodied energy, high efficiency windows and insulation in walls, ceiling and floors increase the efficiency of the building envelop.

Use of passive solar building designs are other strategies that designers put in place to achieve energy efficiency. They orient windows, walls and place trees to shade windows and roofs to maximize solar gain. Additionally, correct window placement for day lighting provides more natural light and lessen the need for electric lighting during the day [14].

According to Rode, passive design strategies can dramatically affect building energy performance. The measures include shape, orientation, passive solar design and use of natural lighting. A study by Lamonica, appears to confirm that passive technologies like solar collectors can heat up buildings' water up to 200 degrees and provide energy savings

2.6. Waste and Material benefits of Green buildings

Considering efficiency in materials, green buildings address growing scarcity issues that many societies face due to unsustainable use of ecosystem services. To reduce building impact and to fulfill a complete life cycle of building and material construction impact, it is necessary to establish low impact criteria during design, construction, maintenance and disposal [14].

The criteria to be followed include resource availability, minimal environmental impact, embodied energy efficiency, potential re use and recyclability. Reducing the number of material components in products as well as separating natural from synthetic material allows higher rates of recyclability and reuse [4]. According to Lawson the above criteria show that, for example, sustainably sourced wood is one of the best options for ensuring low embodied energy and minimal environmental impact. Lawson's study reported that 95 per cent of embodied energy that would otherwise go to waste can be saved by the reuse of building materials [11].Studies on re cycling indicate that environmental impacts caused by reused materials are at 55 per cent of the impact caused if all materials had been new [21]. Although recycling materials requires energy consumption, studies show that recycling materials still delivers net emissions savings [16]. In developing societies recycled building components are often cheaper and of higher quality than conventional materials [22].

3. Criteria, Evaluation and Rating of Green Buildings

In order to assess the sustainability of buildings and construction activities it is necessary to be able to measure and verify their performance. Various criteria and rating systems have been designed that provide an indication of the performance of buildings and construction activities in terms of sustainability. These systems main objectives are; to aid the design of sustainable buildings and to help evaluate the sustainability of buildings [20].The predominant rating systems include Building Research Establishment Environmental Assessment Method (BREEAM) widely used in the UK, Leadership in Energy and Environmental Design LEED which was developed by the US Green Building Council (USGBC), Green Star developed by the Green Building Council of Australia and the Green Rating for Integrated Habitat Assessment GRIHA of India among others [20]. No single measuring scheme can provide a fully comprehensive and undisputable assessment of all sustainability aspects of a building [15].

Early rating systems like BREEM and LEED began as basic checklist on what to do and not what to do and progressed further to systems that awarded points for certain achievements. The focus areas try to combine environmental, social and economic aspects of sustainability [20]. The environmental dimension contains criteria related to energy use, water and material use and waste management; the social dimension range from accessibility of the building, occupants' well-being and preservation of social and cultural values while economic criteria relate to aspects of affordability and life cycle costs [20]. LEED rating system encompasses five environmental categories namely sustainable sites, water efficiency energy and atmosphere, materials and resources and indoor environmental quality plus innovation and design category [2]. It also quantifies aspects such as energy consumption, waste generation and renewable energy adoption and evaluates the environmental performance of a building holistically over its entire life cycle. The four sub categories of GRIHA are site selection and planning, building planning and construction, building operation and maintenance and innovation [20].BREEAM on the other hand is used measure the sustainability of new non domestic buildings in the United Kingdom. It has a two stage assessment process including the design stage and post construction. The areas for assessment include energy, water, materials, waste, health and well-being, pollution transport and biodiversity .This study will attempt to relate how these inputs have a bearing on the degree of adoption of the green building concepts. The figure below shows the output - green building, being the independent variable and the inputs the dependable variables. The other variables will be the external factors outside the system boundary as indicated in figure 1 below.

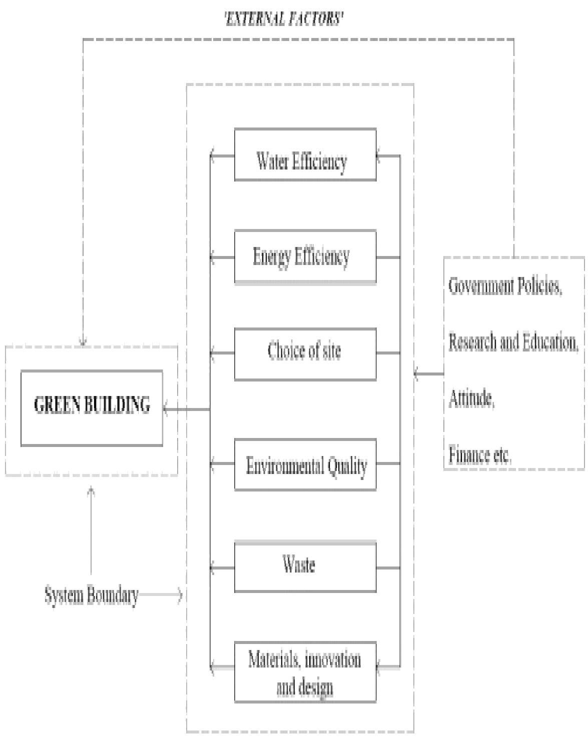


Figure 1: Conceptual Frame Work

3.1. Hindrances to the Adoption of Green building concepts

To determine the challenges faced by practitioners in the adoption of green building concepts, respondents were asked to use a 5 point scale to determine the extent the identified challenges in the literature review hinder increased adoption. A mean score was calculated where a lower mean meant that the factor posed a high challenge whereas a higher mean was interpreted as a less challenge in adopting the concept.

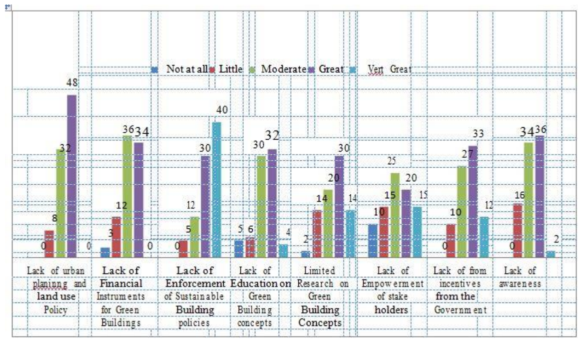


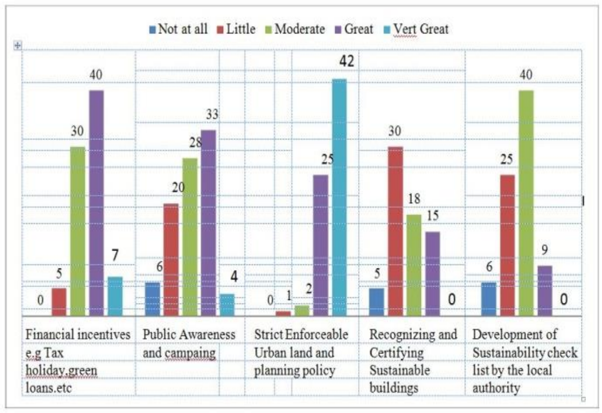
Figure 2: Responses to challenges in the adoption of the green building Concepts.

	Uptake Challenges	Mean
1	Lack of enforcement of sustainable building policies	1.81
2	Lack of incentives from the govt. e.g. Tax holiday, green loans etc	2.43
3	Limited research on GBC	2.50
4	Lack of urban planning and land use policy	2.56
5	Investment in Green Building related research	2.69
6	Lack of financial instruments for green buildings	2.81
7	Lack of empowerment of stake holders	2.82
8	Lack of awareness	3.74

Table 1: Mean score for uptake challenges

3.2 Green Building Concepts Strategies

The last objective of the study was to determine appropriate strategies for implementing green building concepts in commercial building in Nairobi. In this objective respondents were asked to use a 5 point scale to determine appropriate strategies that can be used to promote uptake of green building concepts. A mean score for the strategies was calculated where a lower mean meant that the strategy promoted uptake whereas a higher mean was interpreted not to be the fastest way to promote uptake of the concepts. Figure 2 and Table 1 indicate the responses and the mean item score on the factors that are considered to promote uptake of green building concepts.



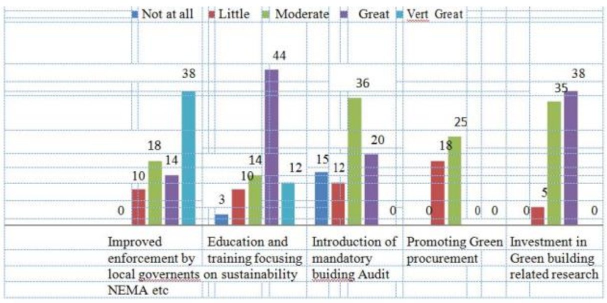


Figure 3 : Factors promoting uptake of Green building concept

Conclusion

According to my knowledge and research related to my work brings me to a close decision that strict enforceable urban land and planning policy, improved enforcement of bylaws by local government as well as education and training focusing on sustainability are some of the appropriate strategies that this study concluded to be among the approaches that can be adopted to promote uptake. Strict enforcement of policies especially at the point of building plans approvals would drive the industry practitioners to embrace green construction in their practices. Education training and research right from the lower school systems and to institutions of higher learning would produce environmentally focused graduates who will easily embrace sustainability concepts in their projects.

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5. REFERENCES

1. CaGBC. (2010). List of certified Projects in Canada. Retrieved from http://www.cagbc.org
2. Cassidy, R. (2003). White Paper on Sustainability - A Report on the Green Building Movement. Oak Brook, Illinoise: Building Design and Construction.
3. CIBSE. (2004). Energy Efficiency in buildings. London:CIBSE.
4. Donough, W. M., & Mbraungart. (2002). Cradle to Cradle: Remaking the way we make things. New York: North Point Press.
5. Gioregetti, L. (2010). Sustainable Building Practices for low cost housing. Implication for Climate Change Mitigation and Adaptation in Developing Countries, draft. Retrieved from Search. scrip.org/references/7833062
6. Gottfried, D. A. (1996). Sustainable Building Technical Manual - Green Building Design, Construction and operation. Selecting Enviromentally and Economically Balanced Building Materials,Washington DC:Building Green.
7. Habitat, (2010). Green Buiding rating in Africa. Promoting Green Building Rating in Africa (p. 5). Nairobi: Conference on Promoting Green Building Rating in Africa.
8. Harvey, F. (2009). Efforts increase to improve sustainability, Financial Times,.
9. IEA, I. E. (2008). Worldwide Trends in Energy use and Efficiency. Retrieved December 2012, from http://www.iea.org/Papers
10. Issa, M., Mohammed, A., & Christian, J. (2011). Energy consumption i convectioanal,energy - retrofitted and green LEED Toronto Schools.Construction Management and Economics, 383.
11. Lawson, B. (1996). Building Materials Energy and the environment: Towards ecological Sustainable Development. Australia: Royal Australian institute of Architects.
12. Nuttall, C. (2010). LED makers promise to trip the light fantastic with consumers. UK: Financial Times.
13. Reposa, J. H. (2009, May 27). Comparison of USGBC LEED for homes and the NAHB National green building Program. International Journal for Construction Education and Research, 108.
14. Rode, P. (2011). Towards a green economy, investing in energy and resource efficiency.
15. Roy, T., & Gupta, A. K. (2008). Cost efficiency of Green Buildings in India. (J. L. Meghraj, Producer) Retrieved from www.jllm.co.in
16. Sa'ra, B. (2001). Aplication of life cycle assessment (LCA) Methodologyfor volarization of building demolition materials and products. Retrieved from http://link.aip.org/link/?PSI/4193/382
17. Science and Technology Council. (1995). Construction and Building. National Science and Technology council,Committee on Civilian Industrial Technology,Subcommittee on construction and Building. Washington DC: Federal Research and Development.
18. Scott, M. (2009). The small things add up. UK: Finacial Times.
19. Simpson, J. (2002). Improved Estimates of tree-shade effects on residential energy use,.

20. Tessema, F., Taipale, K., & Jan Bethge. (2010). Sustainable Buildings & Construction in Africa. Johannesburg: Basehabitat.
21. Thormark, C. (2006). The effectof material choice on the total energy need and recycling potential of a building. Building and environment.41(8), 1019-1026
22. UNEP (2010). Sustainable Building and Climate Change Initiative,Retrieved From http://www.unep.org/sbci
23. US Enviromental Protection Agency. (2009, December). Green buildings. Retrieved, from http://www.epa.gov
24. Yan Ji, S. P. (2006). Design for Sustainability. Beijing: China Architecture and Building Press

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