Investigating State of the Sustainable Building Design Parameters

Reihaneh Aram, Eastern Mediterranean University, Northern Cyprus
Halil Z. Alibaba, Eastern Mediterranean University, Northern Cyprus

The Asian Conference on Sustainability, Energy & the Environment 2018
Official Conference Proceedings

Abstract
Sustainability is understood to be the solution to environmental challenges. Sustainable architecture involves an environmentally friendly design, which has a minimum negative effect on the natural environment. Due to the basic environmental pollution caused by energy generation, improving the environmental performance must involve all sustainable building elements throughout design and energy efficiency. The aim of this study is to discuss sustainable building design in the context of green architecture principles, such as Eco-friendly and energy efficiency throughout the building performance. Furthermore, this paper deals with sustainable building performance, which depends on the sustainable design parameters implemented. This is a qualitative study whose methodology is based on descriptive and analytic methods. The discussion part includes comparison, analysis, and general discussion of the relevant information through the literature reviews and document information. This research depicts that building design parameters and building performance were faced with a conceptual revolution by the advent of sustainable buildings systems, even as the sustainability concept influences the occupants. Additionally the concept of the sustainable energy building ideals effect on the human thoughts and lifestyle, which it has contrast with last decades. For instance, in the hot climate, windows blind left open on the south facade of the building throughout summer can contribute to increasing heat gain, as the same time it's vital for having further mechanical cooling. However, if design operable windows in the left open overnights during winter, it would cause useless heating, overall the users have a major role in the whole building energy usage.

Keywords: Sustainable Parameters, Building, Design

Introduction

Four efficient measurements of sustainable development were proposed at the UN Conference on the Environment and Development in 1992. These measures were: "Agenda 21"; the "climate change convention", which took the form of an agreement between countries that provided an actionable framework for the reduction of greenhouse gas-related global warming; the "biodiversity convention"; and "the statement of principles", the primary concerns of which are worldwide forest conservation and sustainable development management (Edwards, 1999).

The concept of sustainability evolved from a primarily environmental consideration into a concern in architectural design, such as space construction, energy volume, economy, and environment. As a concept, sustainability finds its basis in varying environmental, social, and economic viewpoints, and is also affected by the various elements that emerge from the combination of art and technology (Ruzbahani, Shemirani & Ekhlasi 2016). Though complex, the concept of sustainable architecture helps to raise awareness regarding the importance of the planet's non-human creatures. Humanity's goal of creating suitable models of living standards that are able to accommodate all its activities without avoidable adverse impacts on the environment is reflected in green, sustainable, and eco-friendly architecture, which have reoriented architectural goals in the direction of greener architecture (Mahdavinejad et al., 2014. Ragheb, El-Shimy & Ragheb 2016).

Energy is a foundational element of the economies, societies, and sustainable development goals of different countries. Modern infrastructural developments have had the effect of making increasing energy demands a serious concern (Shaikh et al., 2017). A United States' report concluded that a significant percentage (41%) of energy consumption is accounted for by the Building Sector (EIA 2010.Nguyen 2013).

The realization of buildings that embody the principles of sustainable development requires that some methodological considerations regarding the protection of the environment and energy conservation are taken into account. First, the method must be energy efficient and economically practical. Second, the means of measuring energy savings must be beneficial to the environment. Lastly, the method must sufficiently balance current and anticipated environmental requirements and energy needs while simultaneously ensuring the conservation of energy resources and environmental cleanliness. Three building types emerge from the utilization of the three methodological approaches outlined above: environmentally friendly, energy efficient, and sustainable buildings. Energy efficiency, however, is fundamental to the sustainability of any building. Some of the bolder characteristics of energy efficient buildings include an appropriate envelope, suitable thermal properties, heating, adjustable cooling controls, and effective electric systems (Chwieduk, 2003).

The goal of this study is to provide an assessment of the fundamental principles of sustainable architecture as they relate to the consumption of energy, green architecture, passive performance strategies, and the concept of environmental-friendliness with the overall objective of attaining a satisfactory building performance level.

Literature review

Since the 1970 energy crisis, the sustainable development concept has been intrinsically tied to the problem of environmental pollution. As the 1987 Broadland Report famously defined it, sustainable development is seen as "the development which is the response to the present requirements without compromise the future generation ability to respond their requirements" (Mao et al., 2009).

The prevalent contemporary understanding of the 'green building' is founded in the applications and facilities that emerged from sustainable construction. Such construction aimed at improving the health of occupants, the efficient use of resources, and energy conservation, thus minimizing the adverse impact on the natural environment (Mao et al., 2009). A primary impediment to the implementation of green building is the regulation of the energy used by the building sector in some countries (Shaikh et.al 2017). The desire of the green building sector to increase awareness of sustainable development engendered a corresponding rise in environment-related legislation in various countries. In the European Union (EU), for example, the Building Energy Performance Directive (EPBD) requires that from 2006, every building must receive documentation certifying its energy performance and also satisfy a minimal energy performance principle (EPBD, 2009. Hwang & Tan 2012).

A project sponsored by the OECD argued that sustainable buildings are best understood as buildings, which have an integral quality (economic, environmental, and social) and a minimal degree of impact in the natural environment. The project went further to outline five primary goals of sustainable building, which include: the efficient use of resources, minimizing gas emissions and the efficient use of energy, mitigating pollution, harmonizing the environment, and integrated and systematic approaches (OECD, 2002. Clements & Jeronimidis, 2005).

The Eco-efficiency building is a primary example of sustainable architecture. While such buildings have a variety of definitions, they are all geared towards the same target. The World Business Council of Sustainable Development (WBCSD) defines them as a suitable human quality affordance service despite the competition for human gratification, while minimizing ecological impact and resource consumption, as well as accounting for life-cycle and the WBCSD's 1992 Earth estimation. As introduced in the 1990s, the concept of sustainability was intended for use as an analytical instrument (Caiado et al., 2017). The principles of sustainable development found in construction sectors, such as the building sector, hold that it is necessary to ensure an appropriate level of performance and functionality while ensuring that adverse environmental impacts are kept at a minimum. This requires, however, that the necessary developments in both the economic and social (cultural) dimensions contribute to standardization on the local and international (global) levels (ISO 2008. Hakkinen & Belloni 2011).

The economic advantages offered by Green buildings center primarily on three business principles: acquisition (initial review, identifying recurring problems), transformation (audits, environmental declaration), and assimilation (LCA, a plan of action and assessable objectives). Additionally, the methods of energy conservation, waste management, enhancing the productivity of occupants, water sources,

maintenance, and operation costs can also be included in the budget (USGBC, 2003. Hwang & Tan 2012).

When assessing building performance, it is imperative that the comfort of the occupants and how they are impacted psychologically by the building are also taken into consideration. In terms of sustainability in the building sector, the overall comfort of the users can both be linked to and defined by thermal comfort. The satisfaction of the occupants thus serves as an efficient factor in determining building performance. While thermal comfort is understood to be a primarily mental condition expressing satisfaction with the thermal environment (ASHRAE standard 55), it can also be defined in terms of energy consumption. In this sense, it concerns the environmental system of the building itself, which is important for the sustainability approach (Yao, Li, & Liu 2009).

In terms of measurement, psychological adaptation is neither simply nor directly quantifiable. It is typically portrayed as a reaction, an altered subjective perception, or sensory information over the duration of a previous thermal experience (De Dear, Brager 2002. Yao, Li, & Liu, 2009). Repeated exposure reduces the sensitivity if the human body to a thermal stimulus, thus relaxing expectations due to a reasonable degree of sensitivity (Frisancho, 1981. Glaser, 1966).

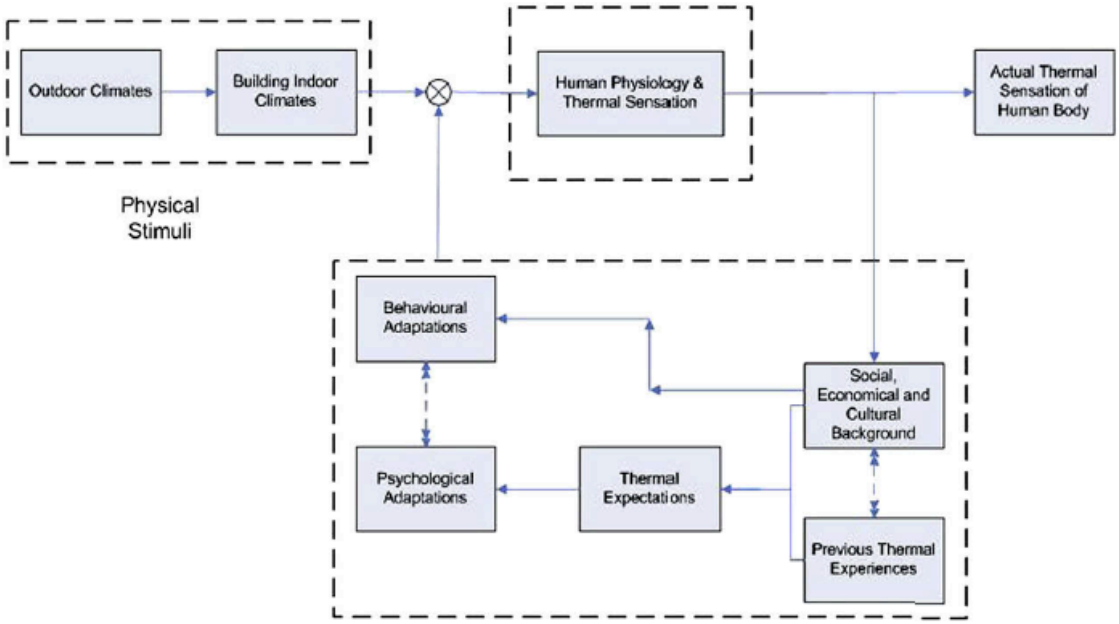

Figure 1: the adaptations thermal comfort mechanism model (Yao, Li, & Liu 2009).

A rival understanding of sustainable architecture as Eco-medical is underpinned by arguments regarding design-specific sustainability concerns, which are geared towards a view of individual health as a humanist and social issue (Isabelle and Lawrence, 1999. Guy & Farmer, 2001). The recognition of the importance of individual health in light of this debate has spurred a growing need for healthy environmental conditions. Legitimate links have been drawn between human health and the influence of factors from the external environment, such as air, water quality, and urban spaces. This relatively novel line of thinking has drawn the attention of medical scholarship to how physical and psychological health problems can result due

to the effects of various built environments (Guy & Farmer 2001). Various studies exploring the efficient use of energy resources have found that artificial lightning and air conditioning directly affect the thermal comfort of the building occupants (Kwong & Ali 2011).

Understood to be a relatively common approach to architecture, sustainability can alternatively be defined as either green design or green architecture. Any definition of green design requires, first, a proper understanding of the different categories of environmentally friendly architecture. The characteristics shared by this type of architecture include: maximal use of the passive solar system, utilizing natural sources of power like solar and wind power, spatial efficiency, recycling old buildings by adapting them to modern use, adequately designed ventilation systems for efficient heating and cooling, energy-efficient lighting and appliance systems, minimizing adverse effects on the environment, the use of local materials like wood and stone, utilizing non-synthetic and non-toxic materials, a water-saving plumbing system, and utilizing architectural salvage. Although not all big green buildings have all of these characteristics, what is uniquely common to their green design is a higher degree of sustainability (Ragheb, El-Shimy & Ragheb, 2016).

Building Energy Performance

One important consideration in building sustainability concerns the energy consumption of the building, which is intrinsically linked to sustainable development measurements and thus, helps define green architecture. Kothari et al. argue that sustainable development is directly related to energy. Furthermore, renewable energy sources, such as waves, solar, wind, etc., play a vital role in sustainability (Kothari, Tyagi & Pathak, 2010. Ghaffarian et al., 2013).

When evaluating the sustainability dimension of the design of a building system, it is possible to assign ratings based on how well the design satisfies green building criteria or parameters. Different building systems are typically evaluated differently in terms of the relevant sustainability framework or parameters, which are determined by regional variations in environmental conditions and to a lesser degree, cultural differences. It is generally understood that evaluating any particular building system requires that the sustainability parameters applicable to each particular region and environment are identified (Al-Gahtani et al., 2016).

A prominent example, the inspiration for the LEED building came primarily from the occupants, who caused the engineer to take more sustainable design considerations into account. The LEED building embodies a wide variety of sustainability considerations, including: sustainable resources and materials, energy and atmosphere, indoor environment quality, sustainable sites, and water efficiency. The Materials and Resources (MR) group awards points for reductions in extraction, transportation, processing, and destruction of the building, as well as the construction of building materials. The Energy and Atmosphere (EA) sector concerns design efficiency, particularly the utilization of renewable energy sources. Indoor Environment Quality (IEQ) focuses on the improvement of thermal and visual comfort, and air quality. Sustainable Sites (SS) involve the integration of local and regional systems, including the natural system for biodiversity and transport. Lastly, Water Efficiency (WE) concerns the efficient and reduced consumption for both indoor and outdoor usage (Shealy 2016).

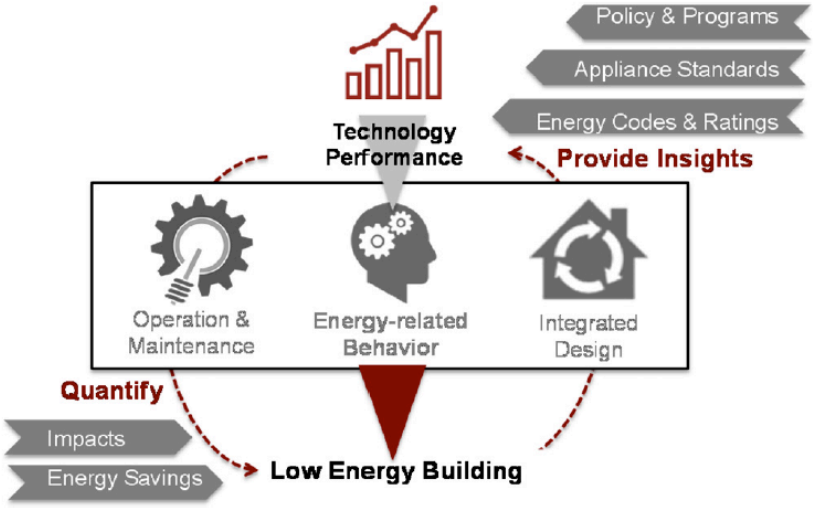

Figure 2: the key factors strategies to low energy building (Hong et.al. 2016).

Zero Energy Building

The Zero Energy Building (ZEB) is a prominent example of green architecture and energy efficiency. The concept guiding the design of such buildings is a realistic solution to the present problems of reducing building energy consumption and minimizing CO2 emissions, although it is also suited to serving future demands (Lund, Marszal, & Heiselberg, 2011).

A type of Eco-efficiency building, ZEB buildings offer a combination of an energy efficient design with the technical advantages offered by using building equipment to reduce the demand for cooling, heating, and electricity. Additionally, they utilize the on-site generation of renewable energy from solar panels, heat pumps, PV panels, and small micro CHP units (Lund, Marszal, & Heiselberg, 2011). In regards to the social dimension of the sustainability approach, which includes the needs of the users, the energy sources in ZEB buildings produce sufficient energy to satisfy users' demand. Calculating the aggregate building energy sources for ZEB buildings requires that both import and export energy levels are measured to determine the site-to-source energy parameter (Torcellini et al., 2006).

Methodology

Descriptive and Analytic Methodology

This research is primarily qualitative and involves the use of description and analysis to provide a theoretical study. A comprehensive survey was carried out on the sustainable building approaches utilized in various architectural design disciplines, which primarily concern sustainability in terms of environmental concerns. The collection of data for this study was done through a survey of a variety of relevant documents, periodical chapters, and journal articles. Internet websites were also used to aid the description of the systems.

Results and Discussions

A sustainable building can be described in terms of a consideration concept that encompasses a building's entire life cycle, its functional and environmental qualities,

as well as its future value features. In sustainable design, a building should aim at integrating architecture with the electrical, structural, and mechanical engineering resources. It can, however, also include the orientation, shadow, light, proportion scale, texture, and traditional aesthetics of the design, which should be processed while taking the environmental, social, and economic approaches into consideration. As such, the human quality of life element is more important for the building than other considerations (John, Clements & Jeronimidis 2005). Although educating the users can be another important issue. Because by applying some modern sustainable application into the building cannot achieve the high amount of occupants satisfaction and sustainability target whenever they don't know how might use completely.

Nevertheless, according to the public law of Energy policy in 2005, was published that occupants' health and productivity have an effective role in the building performance, however, the building energy efficiency has the same proportion into the building evaluation.

Energy efficient design strategies are commonplace for a variety of building types. Regardless, however, a successful building design strategy depends on user-building interactions.

While passive design strategies, such as those using natural daylighting and ventilation, are much better at minimizing energy consumption, this is not necessarily the case when users are generally uninformed about the operation of the buildings energy-efficiency systems. For example, leaving a window on the building's south façade open throughout a summer day and into the weekend would result in a high heat gain, thus requiring more energy for mechanical cooling. Conversely, leaving design operable windows on the south façade open overnight during winter does not contribute to building heating.

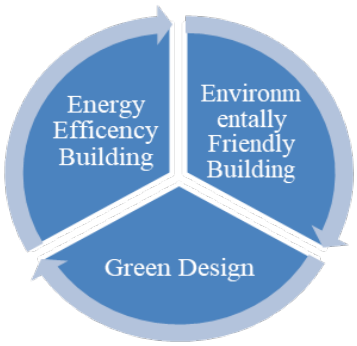

Figure 3: the effective parameters for developing the building performance (source: Author).

To the end of achieving the sustainable energy building, more sustainable designs can be created by taking into account three sustainable architecture approaches. The three architectural approaches protect the relationship between the building construction and the environment, as well as the features of the natural environment. These approaches are the primary and most effective means of realizing sustainable buildings in terms of a clean environment and the use of clean energy. Figure 3 illustrates how the circular relationship between energy efficiency building,

environmental building, and green design is vital to the realization of the goal of a sustainable building.

As common sustainable building design can mention the ZEB or Net Zero buildings. Also, these type of building turns to be popular in many countries.Such buildings are particularly remarkable in that they have been satisfactorily successful in terms of energy efficiency, as well as in regards to their adherence to the parameters of sustainable development.

A directive from the European Union dealing with the energy performance of buildings requires that all new buildings must be either zero or near zero energy buildings by the end of the decade (EPBD, 2010).

The controversial issue about the ZEB or Net Zero buildings according to economic sustainability is it's not affordable for everyone so it needs to investment by some companies so the users are not satisfied with their payment. However, of course, this sort of payments have to circulate investment throughout longterm.

Similarly, the USA's Department of Energy's (DOE) buildings technologies program is working towards the provision of viable zero energy homes by 2020 and zero energy commercial buildings by 2025, although realizing such a level of standardization might prove difficult regardless of these specifications (Sartori, Napolitano & Voss 2012). Sustainability rating systems are particularly important to the goal of achieving sustainable building through the promotion of suitable architectural designs, methods, and construction. (Hu, Cunningham, & Gilloran, 2017).

Masoso and Grobler (2010) argue that less energy is used during working hours (44%), opposed to non-working hours (56%). They argue that this is due primarily to a tendency for lights and equipment to be left running at the end of the workday (Masoso & Grobler, 2010; Day and Gunderson, 2015). These findings illustrate the importance of educating users on the necessity of certain lifestyle changes if there is any hope of ensuring that their actions support the principles of sustainability.

In terms of the economic aspect of sustainability, how clients perceive different market aspects determines how green buildings are economically assessed. The corresponding economic costs for the potential environmental benefits of a sustainable (green) building are determined by the criteria found in the Green Building Index (GBI), which include: 1. Water Efficiency (WE), 2. Innovation (IN), 3. Sustainable Management and Site Planning (MS), 4. Materials and Resources (MR), 5. Energy Efficiency (EE), and 6. Internal Environmental Quality (EQ). The six GBI criteria outlined above are useful in improving the design of any building. Water Efficiency (WE), for example, involves the harvesting and use of suitable rainwater, as well as water saving and recycling in sustainable buildings. In terms of Innovation (IN), innovative and creative design parameters help in successfully satisfying the objectives outlined by the green buildings index. In terms of Suitable Management and Site Planning (MS), the building and the site should be planned in such a way that affords them the best opportunity to access open spaces, landscapes, and public transportation while simultaneously ensuring the conservation of environmentally sensitive spaces and circumventing unnecessarily inconvenient

construction. Materials and Resources (MR) requires the use materials that are recycled or environmentally sensitive, as well as properly managing and storing waste and utilizing recyclable and reusable waste materials. In terms of Energy Efficiency (EE), a building can be made more energy efficient through the use of renewable energy resources, using the building envelope to minimize solar heat gain, daylight harvesting, and ultimately by developing the energy consumption of the building by finding the optimal orientation. Improving the indoor performance of the building involves optimizing visual comfort, thermal comfort, air quality, and internal acoustic (Halil, et al., 2016). Hereby the remarkable point is how can manage and combine all of the GBI criteria into a building. As the economic sustainable issue, how much these parameters can be affordable by the building owners.

One practical example of utilizing sustainable building parameters involves utilizing sustainable criteria in the selection of materials. The important material selection factors are pollution, minimum embodied energy, waste, and energy consumption, which directly increase environmental burdens. The choice of construction material also affects sustainability in the social and economic dimensions, although largely indirectly. Overall, this novel approach to sustainability led to the development of the green materials index, an adequate and fitting solution to sustainable building. Additionally, this sort of materials selection is useful in improving the sustainability rankings of building systems (Khoshnava, et al., 2016). As an example Iranian vernacular materials as a sustainable environmental solution for rural spaces, however, it can be a permanent solution for modern architecture if it is affordable and accessible. According to the architectural design view, the achievable point of the traditional Iranian sustainable can figure out that architectural building such as dome, windward, central courtyard and shading devices can act as environmentally friendly and with the same concept of green architecture. also these spaces can act energy efficiency without any negative environmental effects.

For instance, in the south of Iran which it has the hot and humid climate, there is traditional useful architectural design. One of the common sustainable design parameters is ventilation- shaft or windward. This element can cause thermal comfort according to the microclimate and be parallel with the sustainable architectural concept. It means that by building these elements having the energy efficiency design, environmentally friendly and green architectural building. In contrast with the modern building design which applied in these areas. In this sort of building caused a high amount of the energy usage, however, tried to build eco-friendly buildings. But as users view it generate some issues.

Conclusion

The concept of sustainable buildings revolutionized the kinds of designs found in the building sector. Sustainability ideals also affect the lifestyle and thoughts of the human user. The targets set by sustainability parameters have a significant impact regardless of the particular methodology, which can range from simple to complex. Particularly important is how sufficient a particular method is to meet economic, environmental, and social requirements. A collective human awareness of the diverse and harmful changes occurring in the Earth's ecosystem has redirected attention to the environment, particularly its physical and mental effects on the planet's inhabitants.

This is the origin of the broad and complex concept of sustainability, which is remarkably being applied in the design of architectural products.

A variety of systems can be used in architectural design to satisfy sustainability parameters. Examples of such systems include the fuel cell, passive design elementarily strategy, recycling material, wind turbine generation, roof garden system, geothermal energy generation, and photovoltaic solar panels. The benefits of these systems significantly outweigh their potential costs and they can be used to improve users' indoor comfort with only minimal environmental impact.

On the other end of the spectrum, ensuring users' comfort in buildings typically requires the expensive use of resources by mechanical and electrical equipment and when these resources are depleted, building equipment stops working. As such, a constant move towards sustainability is required for the continued wellbeing of human beings. In light of this, there is a growing trend towards the use of renewable energy sources, including solar, hydro, and wind energy systems.

In conclusion, there is an overall increase in the number of building systems that utilize the sustainable parameters mentioned in this study. The increasing prevalence of sustainable architecture in modern architectural practices signified an equally increasing environmental sensitivity relative to other sustainability dimensions where building performance is concerned, particular in terms of energy consumption. Regardless, it is also necessary to take other physical aspects into consideration, such as the design and performance of the building, as well as their psychological effect on the users.

References

Akbulut, M. T., Akbulut, D. E., & Oral, G. K. The Parameters Effect on Sustainable Built Environment Design. 1st International CIB Endorsed METU Postgraduate Conference Built Environment & Information Technologies, Ankara, 2006.

Al-Gahtani, K., Alsulaihi, I., El-Hawary, M., & Marzouk, M. (2016). Investigating sustainability parameters of administrative buildings in Saudi Arabia. Technological Forecasting and Social Change, 105, 41-48.

Caiado, R. G. G., de Freitas Dias, R., Mattos, L. V., Quelhas, O. L. G., & Leal Filho, W. (2017). Towards sustainable development from the perspective of the eco-efficiency-A systematic literature review. Journal of Cleaner Production, 165, 890-904.

Chwieduk, D. (2003). Towards sustainable-energy buildings. Applied Energy, 76(1), 211-217.

De Dear, R. J., & Brager, G. S. (2002). Thermal comfort in naturally ventilated buildings: revisions to ASHRAE Standard 55. Energy and buildings, 34(6), 549-561.

Day, J. K., & Gunderson, D. E. (2015). Understanding high performance buildings: The link between occupant knowledge of passive design systems, corresponding behaviors, occupant comfort and environmental satisfaction. Building and Environment, 84, 114-124.

EPBD recast, Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast), Official Journal of the European Union, (2010) 18/06/2010.

Energy Policy Act of 2005, public law 109-058, section 914 EPA Overview of greenhouse gases. 2013. Retrieved from, http://www.epa.gov/climatechange/ghgemissionsgases.html.

EIA, Annual Energy Review 2010, Annual report, The World Business Council for Sustainable Development, October 2011.

Edwards, B. (1999). Sustainable architecture: European directives and building design. Butterworth Architecture.

Energy Performance of Buildings Directive (EPBD). 2009. Concerted Action – Energy Performance of Buildings Directive. EU EPBD. http://www.epbd-ca.org/. Frisancho AR. Human adaptation. University of Michigan Press; 1981.

Glaser E. The physiological basis of habituation. London: O.U.P.; 1966.

Guy, S., & Farmer, G. (2001). Reinterpreting sustainable architecture: the place of technology. Journal of Architectural Education, 54(3), 140-148.

Hong, T., Taylor-Lange, S. C., D'Oca, S., Yan, D., & Corgnati, S. P. (2016). Advances in research and applications of energy-related occupant behavior in buildings. Energy and Buildings, 116, 694-702.

Hu, M., Cunningham, P., & Gilloran, S. (2017). Sustainable design rating system comparison using a life-cycle methodology. Building and Environment, 126, 410-421.
Halil, F. M., Nasir, N. M., Hassan, A. A., & Shukur, A. S. (2016). Feasibility Study and Economic Assessment in Green Building Projects. Procedia-Social and Behavioral Sciences, 222, 56-64.

Ghaffarian Hoseini, A., Dahlan, N. D., Berardi, U., GhaffarianHoseini, A., Makaremi, N., & GhaffarianHoseini, M. (2013). Sustainable energy performances of green buildings: A review of current theories, implementations and challenges. Renewable and Sustainable Energy Reviews, 25, 1-17.

Hwang, B. G., & Tan, J. S. (2012). Green building project management: obstacles and solutions for sustainable development. Sustainable development, 20(5), 335-349.

Hakkinen, T., & Belloni, K. (2011). Barriers and drivers for sustainable building. Building Research & Information, 39(3), 239-255.

International Organization for Standardization (ISO) (2008) ISO 15392. 2008-05-01. Sustainability in Building Construction – General Principles, ISO, Geneva.
Isabelle Lanthier and Lawrence Olivier, "The Construction of Environmental Awareness," in Eric Darier, ed., Discourses of the Environment (Oxford: Blackwell, 1999), p. 65.

John, G., Clements-Croome, D., & Jeronimidis, G. (2005). Sustainable building solutions: a review of lessons from the natural world. Building and environment, 40(3), 319-328.

Kothari, R., Tyagi, V. V., & Pathak, A. (2010). Waste-to-energy: A way from renewable energy sources to sustainable development. Renewable and Sustainable Energy Reviews, 14(9), 3164-3170.

Komurlu, R., Arditi, D., & Gurgun, A. P. (2015). Energy and atmosphere standards for sustainable design and construction in different countries. Energy and Buildings, 90, 156-165.

Khoshnava, S. M., Rostami, R., Valipour, A., Ismail, M., & Rahmat, A. R. (2016). Rank of green building material criteria based on the three pillars of sustainability using the hybrid multi criteria decision making method. Journal of Cleaner Production, 173: 82-99.

Kwong, Q. J., & Ali, Y. (2011). A review of energy efficiency potentials in tropical buildings–Perspective of enclosed common areas. Renewable and Sustainable Energy Reviews, 15(9), 4548-4553.

Lund, H., Marszal, A., & Heiselberg, P. (2011). Zero energy buildings and mismatch compensation factors. Energy and Buildings, 43(7), 1646-1654.

Mahdavinejad, M., Zia, A., Larki, A. N., Ghanavati, S., & Elmi, N. (2014). Dilemma of green and pseudo green architecture based on LEED norms in case of developing countries. International Journal of Sustainable Built Environment, 3(2), 235-246.

Masoso, O. T., & Grobler, L. J. (2010). The dark side of occupants' behaviour on building energy use. Energy and buildings, 42(2), 173-177.

Mao, X., Lu, H., & Li, Q. (2009, September). A comparison study of mainstream sustainable/green building rating tools in the world. In Management and Service Science, 2009. MASS'09. International Conference on (pp. 1-5). IEEE.
Nguyen, T. A., & Aiello, M. (2013). Energy intelligent buildings based on user activity: A survey. Energy and buildings, 56, 244-257.

OECD. Design of sustainable building policies. Paris: OECD; http://www.uea.ac.uk/env/; 2002.

Ragheb, A., El-Shimy, H., & Ragheb, G. (2016). Green architecture: a concept of sustainability. Procedia-Social and Behavioral Sciences, 216, 778-787.

Ruzbahani, N. A., Shemirani, S. M. M., & Ekhlasi, A. (2016). Sustainable Tectonics: a conceptual framework to formulate formal structure of sustainable designs.

Sartori, I., Napolitano, A., & Voss, K. (2012). Net zero energy buildings: A consistent definition framework. Energy and buildings, 48, 220-232.

Standard, A. S. H. R. A. E. (2010). Standard 55-2010:"Thermal Environmental Conditions for Human Occupancy"; ASHRAE. Atlanta USA.

Shealy, T. (2016). Do sustainable buildings inspire more sustainable buildings?. Procedia Engineering, 145, 412-419.

Shaikh, P. H., Nor, N. B. M., Sahito, A. A., Nallagownden, P., Elamvazuthi, I., & Shaikh, M. S. (2017). Building energy for sustainable development in Malaysia: A review. Renewable and Sustainable Energy Reviews, 75, 1392-1403.

Trusty, W. (2009). Standards versus recommended practice: separating process and prescriptive measures from building performance. In Common Ground, Consensus Building and Continual Improvement: International Standards and Sustainable Building. ASTM International.

Torcellini, P., Pless, S., Deru, M., & Crawley, D. (2006). Zero energy buildings: a critical look at the definition. National Renewable Energy Laboratory and Department of Energy, US.

US Green Building Council (USGBC). 2003. Green Building Costs and Financial Benefits. Capital E. http://www.usgbc.org/Docs/News/News477.

Yao, R., Li, B., & Liu, J. (2009). A theoretical adaptive model of thermal comfort–Adaptive Predicted Mean Vote (a PMV). Building and environment, 44(10), 2089-2096.

Contact emails: aireen1371@gmail.com, halil.alibaba@emu.edu.tr