Improving the Energy Efficiency of Residential Green Heritage Buildings

تحسين كفاءة استهلاك الطاقة في المساكن التراثية الخضراء

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ملخص البحث

بحسب تقرير منظمة معلومات الطاقة الأمريكية (EIA)، فإن كمية الطاقة المستهلكة في المباني السكنية في الولايات المتحدة عام 2014 تقدر بأكثر من مرة ونصف ما تستهلكه المباني التجارية والإدارية1. لذا فإن عملية تحسين كفاءة الطاقة في المساكن القائمة والاعتماد على المصادر البديلة للطاقة المتجددة سيكون له الاثر الايجابي في تقليل استخدام الوقود الحفري في الطاقة وتقليل الانبعاث والآثار السلبية المترتبة عليه. وقد اولت العديد من الدول الكثير من الاهتمام على وضع معايير وأسس لتقييم المساكن القائمة الخضراء في مختلف النواحي اهمها كفاءة استهلاك الطاقة. وبالفعل تم اعتماد المئات من المساكن القائمة في مختلف انحاء العالم كمساكن خضراء من بينها مساكن تراثية تتنوع ما تحمله من قيم تراثية.

وتعاني مصر كسائر البلدان من مشكلة استهلاك الطاقة الكبير من الوقود الحفري. وتحتوي مصر على عدد كبير من اصول تراثية كثيرة ومتنوعة وعلى الرغم من هذا، فمازالت استراتيجيات الحفاظ على المباني التراثية في مصر ولاسيما المساكن التراثية خالية من سياسات تحسين كفاءة استهلاك الطاقة في تلك المباني. رغم اصدار نظام الهرم الاخضر لتقييم المباني الخضراء الذي مازال تطبيقه قاصرا على المنشآت الجديدة دون المباني القائمة بانواعها. **تهدف الورقة البحثية** إلى اجراء دراسة مقارنة لمعايير وتطبيقات تحسين كفاءة استهلاك الطاقة في كلا من نظامي تقييم المباني الخضراء " LEED، BREEAM " واللذان تم تطبيقهما بالفعل على مساكن تراثية خضراء، محاولة لزيادة كفاءة الطاقة في المباني التراثية السكنية في مصر دون المساس بقيم المبنى التراثية او التأثير عليها بالسلب.

Abstract:

According to the United States Environmental Protection Agency (EPA), The amount of energy consumed in the residential buildings in the United States in 2014 estimated at more than one and a half times the total energy is consumed by commercial and administrative buildings, therefore, improving the energy efficiency in existing residential Buildings, and rely on alternative sources of renewable energy will have a positive impact on reducing the use of fossil fuels energy and their emissions. Many countries have paid a great attention on set or develop their criteria for assessment the existing green residential buildings especially the energy efficiency. Now, there are hundreds of existing residential Buildings (including listed heritage buildings) have been certifies as green buildings.

Egypt as other countries needs to reduce its great energy consumption of Fossil fuels. It has rich with heritage assets that variety in their values, ages, usage and styles. Despite that, the most of the conservation strategies that deal with the residential heritage Buildings in Egypt don't care to improve the energy efficient performance of them. Despite of establishment of Green Pyramid Rating system that can be used for evaluating green new constructions only, and don't be applicable on all types of existing buildings. **The paper aims to** perform a comparison study between the criteria and applications of the LEED and BREEAM which have been usedto assess energy efficiency of the residential heritage buildings. The results will help to improve the energy efficiency of residential heritage buildings in Egypt without harming or losing its heritage features and values.

Accepted: 6 September, 2015

Key Words

Green Buildings- Heritage Buildings- Residential Green Heritage Buildings- Energy Efficiency Performance- LEED- BREEAM.

1. Introduction:

The tools of green rating systems have been launched in the beginning of the last decade of 20th century to meet the global trend toward the concept of green architecture. Since their emergence, these tools have been upgrading gradually to become measuring the efficiency of green buildings as the consumption of energy, water, using materials, as well as measuring the wellbeing and the indoor environmental quality for the buildings' users.

According to the United States Environmental Protection Agency (EPA), The amount of energy consumed in the residential buildings in the United States in 2014 estimated at more than one and a half times the total energy is consumed by commercial and administrative buildings, therefore, improving the energy efficiency in residential existing Buildings, and rely on alternative sources of renewable energy will have a positive impact on reducing the use of fossil fuels energy and their emissions.

Many countries have paid a great attention on setting or developing their criteria for assessing the existing green residential buildings especially the energy efficiency. Now, there are hundreds of residential existing buildings (including listed heritage buildings) that have been certified as green buildings.

The paper aims to perform a comparison study between the criteria and applications of the LEED and BREEAM which have been used to assess energy efficiency of the residential heritage buildings. The results will help to improve the energy efficiency of the residential heritage buildings in Egypt without harming or losing their heritage features and values.

1.1. Methodology:

Brief summaries of current strategies that deal with residential heritage buildings in Egypt, the tools of green rating systems that are used in assessing the existing green residential buildings, and their criteria for assessing the energy efficiency. Analysis of two residential heritage buildings that have been certified and become green buildings. The analysis studies have focused on the energy efficiency techniques that have been applied on these buildings and how they can be applied on residential heritage buildings in Egypt.

2. Residential Heritage Buildings in Egypt:

The current conservation strategies that deal with the residential heritage buildings that are classified as **monuments** (whatever they are palaces or villas) aim to expose and restore the internal and external heritage features and values of the assets, retain their original character ,and transform the usage of them (in most cases) into tourism activities as museums, or cultural activities such as: Beshtak palace (the house of Arab singing) , Prince Taz palace (culture events and festivals) in old Cairo, and Arab Kelly's House (Rosetta's Museum) in Rosetta. Fig. (1).

Fig(1). The external Façade of Taz Palace: Source of fig(1) : http://archive.aawsar.com

The current conversation strategy that deals with **listed heritage buildings** in the Khedive Cairo (Cairo's downtown) for example is only superficiality restoration. The strategy based on painting the exterior façades of the listed heritage buildings without any upgrade or restoration works for their internal parts. Fig. (2).

Fig. (2). The painting works of a heritage building at Downtown-Cairo: Source of fig(2) : http://elyoumnew.com/news/

From the pervious, **the most of the conservation strategies that deal with the residential heritage Buildings** in Egypt whatever they have been classified as monuments or listed buildings don't include the improvement of the efficient performance of the building in energy, as well as water, or indoor environmental quality.

3. Green Heritage buildings

3.1. Definition of Heritage Listed building:

It is a building of a great historical or artistic value that has official protection to prevent it from being changed or destroyed.

In the United States, the National Register of Historic Places (NRHP) is the official list of the USA's historic places worthy of preservation. It is part of a USA's national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. The National Register of Historic Places has established a set of criteria that heritage assets must meet in order to be eligible for or listed in the National Register.

The criteria for evaluation for the listed heritage Buildings depending on the quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association:

- Those that are associated with events that have made a significant contribution to the broad patterns of our history; or
- Those that are associated with the lives of persons significant in our past; or
- Those that embody the characteristics of a type, period, or method of construction, or those represent the work of a master, or that possess high artistic values.

In the United Kingdom, the National Heritage list for England (NHLE) is the official and up-to-date database of all UK's nationally designated heritage assets, including listed building, monuments and world heritage sites where located in UK.
The criteria for evaluation for the listed Building depending on if the building has a special features and values, therefore should be added to national heritage list: Architectural value: to be of special architectural value. A building must have an importance of its architectural design or decoration, or represents special building types and innovation techniques.

- Historic value: to be a special historic value. A building must illustrate important aspects of the UK's social, economic, cultural or military history, or has related with nationally important people in UK. The physical fabric of the building should have some quality to justify the statutory protection afforded by listing.

Heritage Buildings on the UK's Heritage list are graded to reflect their relative architectural and historic values. Buildings of historic value may justify a higher grading than would otherwise be appropriate.

- ***Grade I*** buildings are of exceptional value;
- ***Grade II**** buildings are particularly important buildings of more than special value;
- ***Grade II*** buildings are of special value, warranting every effort to preserve them.

In Egypt, the heritage assets have been classified into **Monuments** and **listed heritage buildings**.

The list of Islamic and Coptic monuments is the official database of all Egyptian Islamic and Coptic monuments that include mosques, churches, Palaces, and villas. Pharaonic and Roman assets have been listed in the List of Egyptian Monuments. Both of the two lists are affiliated to Ministry of Antiques.

The Urban harmony organization that is affiliated to Ministry of Culture is the official organization that lists **the heritage buildings** in Egypt, the criteria for evaluation the listed heritage building depending on the following.

1. The buildings that possess high architectural or artistic values.
2. The buildings that associated with events that have made significant contribution of the Egypt's National History.
3. The buildings that associated with the lives of persons significant in the Egypt's history.
4. The buildings that represent an era or significant period of Egypt History.
5. The buildings that considered as tourist destinations.

3.2. Green Buildings

Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building.

3.3. Definition of Green Heritage building:

It is a heritage building that has been refurbished and modified to be a green building without harming its heritage features or losing its values, or lead to be out of the list (if it has been listed by the national authority).

The Residential Green Heritage Building is a Green heritage building that has been used in a residential usage.

4. Green rating systems:

Green rating and certification systems define and evaluate new and existing buildings based on their environmental performance. They inform how environmentally sound a building is, providing clarity to what extent green components have been incorporated and which sustainable principles and practices have been employed. Rating systems can change the way designers, building owners, tenants evaluate buildings.

The features of each tools developed for different uses of buildings such as commercial, educational, health care, and residential, and depending on if these tools will be used to evaluate buildings on local or global level, as well as the design stage assessment (if it is use for a new building, or refurbishment) and also to the ongoing operation and management of the building. Each tool leads to a rating of the building which is used to market the building.

LEED and BREEAM rating systems have been selected for the study since they are globally identified as benchmarks for environmental certification of both new and existing buildings, and both of them are widely used and applicable all over the

world not only in the United Stated or United Kingdom.

LEED (Leadership in Energy and Environmental Design) rating system:

The **L**eadership in **E**nergy and **E**nvironmental **D**esign (LEED) is a voluntary, consensus-based, market-driven program that provides third-party verification of green buildings, from individual buildings and Houses, to entire neighborhoods, and applies to new and existing institional, commercial and residential buildings. LEED provides building owners and operators the tools they need to immediately impact their buildings' performance, while providing healthy indoor spaces for a building's occupants. LEED rating system adopts a scale from green certified to platinum to indicate a higher or lower rating.

4.1. LEED for Existing Buildings: Operation & Maintenance (O+M)

LEED operation & maintenance (O+M) can be used for existing buildings that already have been constructed, allow building's operators, owners and managers to make their building more efficient from the operational side.

LEED O+M can apply on existing buildings don't primarily serve K-12 educational, retails, data centers, warehouses and distribution centers or hospitality uses**.** It can apply on all existing commercial and institutional buildings and residential building.

Table (1). The credits of LEED O+M version 4, Source: based on: LEED Reference Guide For Building Operation and Maintenance, 2013 edition

	Credit	Points	% from Total
EAC01	**Energy Efficiency Best Management Practices**	Mandatory	-
Description	Prepare current facility requirements and operation and maintenance plan that contains the information necessary to operate the building efficiently.		
EAC02	**Minimum Energy Performance**	Mandatory	-
Description	Energy efficiency performance must be 25% better than energy efficiency performance of baseline.		
EAC03	**Building-Level Energy Metering**	Mandatory	-
Description	Use the existing energy meters of the building or install new meters that present (monthly/annual) total energy consumption of the building. Or Using monthly bills if the utility company measures total energy consumption of the building.		
EAC04	**Fundamental Refrigerant Management**	Mandatory	-
Description	Don't use new equipment that contains chlorofluorocarbon (CFC) refrigerants in heating, ventilation, air-conditioning, or third party audit make a replacement or conversion of the refrigerant system, or make CFC-phase out plan is in place. Small HVAC units less than 0.5 pound of refrigerant are exempt.		
EAC05	**Existing Building Commissioning— Analysis**	**2**	**%5.26**
Description	Develop an existing building commissioning plan that must include: update current facilities requirements, the commissioning team members and their roles and responsibilities during commissioning process, the process for reviewing, proposed schedule for commissioning. or develop an energy audit plan following the requirements.		

Table (1). Continued the credits of LEED O+M version 4, Source: based on: LEED Reference Guide for Building Operation and Maintenance, 2013 edition

EAC06	**Existing Building Commissioning—Implementation**	**2**	**%5.26**
Description	Create plan to implement no- and low cost measures, implement the plan, develop a five year implementation plan for capital improvements, and training for building operation staff		
EAC07	**Ongoing Commissioning**		
Description	Establish an ongoing commissioning process that includes planning, point monitoring, system testing, performance vertication and ongoing measurement.	**3**	**%7.9**
EAC08	**Optimize Energy Performance**	**20**	**52.6 %**
Description	Energy efficiency performance must be at least 26% up to 45% better than energy efficiency performance of baseline, or awarded energy star program's scores above 75, up to 95.		
EAC09	**Advanced Energy Metering**	**2**	**%5.26**
Description	Determine all energy sources that serve the building "renewable and nonrenewable and on-site sources" ,by install advanced meters for all whole building and major end uses that consume 20% or more of total annual energy of the building		
EAC10	**Demand Response**	**3**	**%7.9**
Description	Without using on-site electricity generation, the project can participate in a demand response program if it is exist. **If program doesn't exist**, the project can develop a comprehensive plan for shed at least 10% of the annual peak electricity demand that based on electricity bills**.** **or** install systems for peak load shifting that is capable of permanently shifting at least 10% of the measured or calculated peak load.		
EAC11	**Renewable Energy and Carbon Offsets**	**5**	**13.1%**
Description	The project can awarded all points if 7.5% of the annual energy use is met with renewable energy systems on-site **or** the project can purchase green e- power, carbon offsets, or Renewable Energy Certifications (RECs), in this case, the project should show the contracts (Min. 2 years for carbon-offsets, Min 10 years for RECs).		
EAC12	**Enhanced Refrigerant Management**	**1**	**2.6%**
Description	The project can award this credit if doesn't use any refrigerants **or** use low-impact refrigerants **or** all new and existing (HVAC&R) equipment must comply with the requirements that minimize ozone depletion (ODP) and warming global potential (GWP) .		
	Total points of Credits	**38**	**100%**

LEED require for the project need to assess under **LEED O+M** to be fully operational and occupied for at least one year. LEED O+M has six main credit categories :

Location and Transportation, Sustainable sites, Water efficiency, Energy and Atmosphere, Materials and Resources, Indoor environmental quality, and Innovation in design, plus additional bonus credit categories (Innovation in design and Regional priority are applied only on LEED's projects inside USA).

4.1.1. Energy and Atmosphere category:

Energy and atmosphere category of LEED O+M has 12 credits that have total 38 points, their total weighting constitute 38% from the total possible points of the LEED O+M scheme. See table (1).

This category encourages the specification and design of energy efficient

building solutions, systems and equipment that support the sustainable use of energy in the building and sustainable management in the building's operation.

4.2. BREEAM rating systems:

BREEAM (Building **R**esearch **E**stablishment's **E**nvironmental **A**ssessment **M**ethod**)** is the world's first sustainability rating system, for the built environment and has contributed much to the strong focus in the UK on sustainability in building design, construction and use. BREEAM is now an international standard that is locally adapted, operated and applied through a network of international operators, assessors and industry professionals. Through its application and use BREEAM helps clients measure and reduce the environmental impacts of their buildings and in doing so create higher value, lower risk assets. BREEAM rating system adopts a scale from pass to excellent to indicate a higher or lower rating.

According to BREEAM 2014, there are six schemes (rating systems) that address multiple project types, three of them are related to existing buildings.

- **BREEAM In-Use.** For existing non-residential buildings.
- **BREEAM non-domestic refurbishment and fit-out.** For non-residential projects in UK only.
- **BREEAM domestic Refurbishment.** For residential existing buildings.

4.2. BREEAM domestic Refurbishment scheme:

This BREEAM Scheme describes an environmental performance standard for domestic (residential) refurbishment projects in the UK can be assessed, rated and certified.

The BREEAM domestic Refurbishment scheme is designed to help building owners and occupiers to save operating costs, reduce the environmental impacts of refurbishments and to increase the sustainability of existing building stock. The scheme provides a methodology, software tool and certification for those responsible for delivering sustainable refurbishment projects.

The BREEAM Domestic Refurbishment Scheme has eight main categories as a following: Management, Health and wellbeing, Energy, Water, Waste, Pollution and Innovation.

BREEAM domestic refurbishment scheme has committed the team of any heritage listed project to work with their local authority conservation officer to deliver **the minimum standards** as far as practically possible. This can be demonstrated by producing a **report with confirmation** from the Local Authority conservation officer that the work carried out goes as far as is practically possible within the restrictions of any statutory obligations. In this context, BREEAM ensures that works have executed on heritage building under this scheme is compatible with its values as a heritage building, and don't conflict with them or result in the loss of these values, thus it become unlisted building.

4.2.1.Energy category:

Energy category of BREEAM Domestic refurbishment scheme has 10 credits that have total 29 points, their total weighting constitute 43% from the total possible points of the scheme. See table (2).

Table (2) The credits of Energy category of BREEAM refurbishment domestic buildings, Source: based on: BREEAM refurbishment domestic buildings (2014).

	Credit	Points	% from Total
Ene01	**Improvement in Energy Efficiency Rating**	**6**	20%
	Improving the energy efficiency rating of the building, if the improvement of energy efficiency rating [1]equal 5, the building awarded 0.5 credit, if it would be 60, the project awarded 6 credits Determine the energy efficiency rating before improvement and after improvement from SAP[2] or EPC [3]report.		
Ene02	**Energy Efficiency Rating Post Refurbishment**	**4**	14%
Description	Achieving high levels of energy efficiency rating, if the energy efficiency rating of the project is equal or greater than 85, the project can award 4 credits		
Ene03	**Primary Energy Demand**	**7**	24%
Description	Determine the annual primary energy demand of the building post refurbishment (kWh/m2/year) from SAP. if the primary energy demand from 371 to 400, the project award 0.5 credit, if the primary energy demand equal or less than 120, the project award 7 credits.		
Ene04	**Renewable Technologies**	**2**	7%
Description	This credit aims to encourage local energy that generate from renewable sources. The project can awarded 1point if the energy generated from low or zero carbon technologies is at least 10% from annual energy demand of the building, plus 220-250 kWh/m2/year is produced from renewable technologies.		
Ene05	**Energy Labelled White Goods**	**2**	7%
Description	Using an energy efficient white goods that reducing CO2 emissions. The first credit can be awarded if the building using fridges and freezers that label under the EU Energy efficiency Labeling scheme, the second credit could be awarded if using washing machines , dishwashers, washer-dryers that label under the EU Energy efficiency		
Ene06	**Drying space**		
Description	This credit aims to reduce energy by reduction the energy that using to dry clothing by creates an internal or external space with posts and footing for drying clothes. More than 4 m of dry line for 1-2 bedrooms, if it is an internal space, it should have a controlled ventilation to prevent mold growth.	**1**	3%
Ene07	**Lighting**	**2**	7%
Description	One credit can be awarded, if the building achieves the energy efficient space external lighting requirements, another credit can be awarded if the maximum average wattage across the total floor area of the internal lighting of the building is 9 watts/m2.		
Ene08	**Energy Display Devices**	**2**	7%
Description	One credit if using energy meter to measure electricity or fuel consumption and display data to occupants, two credits can be awarded if the electricity and fuel that use to provide heating can be measured by energy meter.		

[1] **The Energy Efficiency Rating** measures the overall energy efficiency of a residential building ranging from 1 to 100 (the higher the number, the higher the energy efficiency.

2 Energy performance certificate (EPC) which provides information on the energy efficiency of the building and recommendations for improvement.

[3] The Government's standard Assessment Procedure (SAP) is used for accounting the energy used in: space heating and cooling, hot water provision, and fixed lighting.

Table (2) Continued the credits of Energy category of BREEAM refurbishment domestic buildings, Source: based on: BREEAM refurbishment domestic buildings (2014).

Ene09	**Cycle Storage**		
Description	This credit encourages occupants to use cycle to reduce using car journeys and fuel consumptions and CO2 emissions. To award the credits, the number of cycle storage should be meet the criteria, for awarded 2 credits, should create 2 cycles storage per residential unit if it has 2-3 bedrooms. The location, access, size, type and roof cover of storage, should be met the requirements.	**2**	7%
Ene10	**Home Office**		
Description	Providing a suitable room has a sufficient services "telephone point, power sockets, window and adequate ventilation". Min. size space should be provided 1.8m to allow a desk, chair and bookshelf. This room reduce need to commute to work, the residents are able to work from their home	**1**	3%
	Total points of Credits	**29**	100%

4.3. Green Pyramid Rating System (GPRS):

The green pyramid rating system is an Egyptian environmental rating system; it has been established by **the Housing and Building National Research Center** that has affiliated to **the Egyptian Ministry of Housing, Utilities and Urban development** that has an interest in promoting green building as part of the ministry's overall sustainable policies. GPRS provide a benchmark enables building in Egypt to be assessed for their green credentials, and enables building designers, constructors and developers to make reasoned choic[1]es based upon the environmental impact of their decisions.

There are three levels for green building certification in GPRS: Silver pyramid, Golden pyramid, and Green Pyramid which is the highest level of certification in GPRS.

GPRS is designed for use in new building works. Despite that, no new buildings have assessed under GPRS and no other schemes have been launched to assess existing building until now.

[1] Rating

5. Case studies:

5.1. LEED case study: New York Governor's Executive Mansion – New York:

The building is located at 138 Eagle Street in Albany, New York. It is the official residence of the governor of New York; it was built in 1856 as a simple Italian structure as a banker's private home. The state has purchased the building in 1877 after Samuel Tilden (the New York's governor) reside in it. Over the years, many governors have affected the building; each of them had his own style and created his own traditions that add value to the values of this unique house where has been the home of three men who become later president of United State of America (*Grover Cleveland*, *Theodore Roosevelt*, and *Franklin Roosevelt*). *Theodore Roosevelt* had constructed a gymnasium during his stay in the building, *Franklin Roosevelt* constructed swimming pool, another governor had built a zoo, and other one had constructed tennis courts.

Fig (1). New York Governor's Executive Mansion, Source: http://www.nytimes.com/2010/11/04/nyregion/04mansion.html?_r=0

For the high historical value of the house, the governor *Nelson Rockefeller* fought to restore the building after a fire in 1961, after efforts to relocate the house to the burbs. In 1971, the site of the Executive Mansion "the building and its ground" has listed in the National Historic Register.

In 1983, There was restoration process had been carried out in the building to preserve the historic value of the house, the process included the entire first and second floors with the help of the private funding, the effects of this restoration process on the house's fabric still visible until today.

Greening House:

Greening the Mansion program was initiated in 2007 under the supervision of executive chamber and the New York state office of General services, working with USGBC[1] the green initiative aimed to[2]

- Reduced the total energy usage.
- Using clean and renewable resources.
- Using sustainable practice in maintenance and operation of the building.
- Adopting green concepts in energy usage, using recycled products, energy-efficient appliances, recycle household, lawn irrigation using river water, use alternative- fuel vehicles and whole building retro-commissioning.

The governor's mansion awarded **Gold LEED certification** under **LEED (O+M) v.2 in Feb. 2009.** The Mansion is the first Governor's residence in USA has earned gold status using LEED O+M rating system.

Energy Performance:

Table (3). The Energy category's checklist of New York Governor's Mansion that has been assessed under LEED O+M v.2, Source: USGBC's Official Website : http://www.usgbc.org, access (09.2015)

	Credits	**8/23**
EAC1	**Optimize energy Performance**	**4/10**
EAC2	**On-site and off-site renewable energy**	**0/4**
EAC3.1	**Building Operation and maintenance – Staff education**	**1/1**
EAC3.2	**Building Operation and maintenance – Building systems maintenance**	**1/1**
EAC3.1	**Building Operation and maintenance – monitoring**	**1/1**
EAC4	**Additional Ozone Protection**	**0/1**
EAC5.1	**Performance measurement – enhanced metering**	**0/1**
EAC5.2	**Performance measurement – enhanced metering**	**0/1**
EAC5.3	**Performance measurement – enhanced metering**	**0/1**
EAC5.4	**Performance measurement – enhanced reduction reporting**	**1/1**
EAC6	**Documenting sustainable building cost impacts**	**0/1**

[1] **USGBC:** U.S. Green Building Council
[2] Ibd

Governor's Mansion achieved 8 points from 23 possible points in the category **Energy and atmosphere**[1] by:

- Upgrading to the fan coil unit system.
- Increasing insulation in the attic spaces (using recycled jeans), ensuring consuming less energy in HVAC heating and cooling systems.
- Installing a solar pool canopy (3.5 kW Photovoltaic array) covers the indoor swimming pool.
- Using Energy star appliances & refrigerants.
- Whole building retro-commissioning.
- Lighting replacements and using photovoltaic panels optimizes the energy performance of the building. It expected energy saving of 25% over previous 3 years.
- Extra 1 point In "Innovation category "for reduced mercury content in light bulbs, the average mercury content of all light bulbs in the house less than 60 Picogram/lumen hour.

5.2. BREEAM case study: 29 Lansdowne Road- London:

29 Lansdowne Road is one half of a semi- detached house; its style belongs to early 19th century townhouses with house No.31. It was built around the 1840's. The building has 5 floors "Basement, Ground Level, 1st, 2nd, and 3rd floor". The building is located in the Ladbroke conservation area". In 1984, it has been listed in the National Heritage list as Grade II with No.31.

The building was built as a single house, then, it was converted as a block of apartments in the first half of the 20th century. After 1962, it has been converted back to a single house. In April 2000, there was a plan of works including added a study room in the garden. From this date, no maintenance or repair works carried out in the building. That's caused more deteriorate of the physical statue of the building.

Fig (2). 29 Lansdowne Road- London:
Source:Application for listed Building consent for alterations to : 29 Lansdowne Rd, Notting Hill – London "Design & Access Statement" , October 2014

29 Lansdowne has been listed in the national heritage list for England for its architecture, historic and group values, as a follows[2]

- **Architecture value:** It is one example of the classically designed, stock brick built and stuccoed paired townhouse that was developed in London across the country in the early of 19th century.

- **-Historic value:** the building is one of the houses built by the Ladbroke estate[3] that aimed to create a new high status residential for London in the early 19th century.
- **-Group value:** The list entry for listed building identifies the buildings No.29-47 as: "*a consecutive row of five contemporary and similarly classically designed paired villas along this side of Lansdowne Road*".

Restore and greening the building:

Restoring and greening the house's program was initiated in the 2014 under

[1] The credits of Energy and performance category in this case study belong to (LEED v.2). LEED v.4 has launched in September 2014 and be only applicable from that date until now. LEED v.4 has many changes in credits from LEED v.3 and LEED v.2.

[2] Turley Heritage, (Sep.2014), "Heritage Impact Assessment to accompany BREEAM Pre-Assessment Report – 29 Lansdowne Road, Royal Borough of Kensington and Chelsea".

[3] The Ladbroke estate: was established by a number of different developers from 1840's to the end of 1860's, the estate owned a number of substantial parcels of land in Kensington, then a largely suburban area. The estate developed these areas including " Notting Hill" where 29 Lansdowne is located. The areas have developed by Ladbroke estate is now a conservation area.

the supervision of local planning authority officers, the program aimed to:

- Improve the energy efficiency of the building as much as possible within its heritage fabric with the agreement of the conservation officer.
- All refurbishment and upgrading works has been achieved with the respecting the heritage important feature and overall aesthetic of the building.
- The building has previously been refurbished with no regard to the original and heritage features. The project aims to Expose and carefully restore original features, and retain the original character and integrity of the listed building including roof repairs, rendering and windows refurbishment. All of these have been carried out using materials that match the old materials under the supervision of the recommendations of the conservation officer's.
- All the W.C cisterns have been echo-flush and using the rainwater harvesting tanks that have been also used in the garden irrigation.
- 29 Lansdowne awarded (Very Good) for BREEAM certification under **BREEAM refurbishment domestic buildings' scheme** in 2014.

Energy performance:

Table (4). The Energy category's checklist of 29 Lansdowne that has been assessed BREEAM refurbishment domestic buildings (2014), Source: based on Turley Heritage, (Sep.2014)

	Credits	**20/29**
Ene01	**Improvement in Energy Efficiency Rating**	**2/6**
Ene02	**Energy Efficiency Rating Post Refurbishment**	**2.5/4**
Ene03	**Primary Energy Demand**	**5.5/7**
Ene04	**Renewable Technologies**	**0/2**
Ene05	**Energy Labelled White Goods**	**2/2**
Ene06	**Drying Space**	**1/1**
Ene07	**Lighting**	**2/2**
Ene08	**Display Energy Devices**	**2/2**
Ene09	**Cycle Storage**	**2/2**
Ene10	**Home Office**	**1/1**

29 Lansdowne achieved 20 points from 29 possible points in the Energy category by the following strategies

- Installing of Celotex insulation to external walls and poly pipe under floor heating, upgrading modern doors, windows and skylights at basement floor where no heritage features.
- No upgrade the insulation of external walls and windows for the ground, first and second floors for their heritage features.
- The existing pair of heritage windows at basement level will be retained and not replaced for their values.
- Any broken panes of glass will be replaced with heritage accurate substitutes.
- The two existing (non-original) conservation roof skylights are to be replaced with argon filled double glazed, these skylights cannot be seen from the street.
- All lighting will be low energy dimmable LEDs.
- The project's team didn't use renewable technologies within the garden area of the building's site that could be caused affecting the quality and character of existing public or private views of listing building and surrounding conservation area.
- Using energy efficient white goods.
- Creating internal and external adequate and secure drying spaces.
- Upgrading the existing lighting objects that are modern with energy efficient lighting objects.
- Installing a complaint energy display device.
- Creating cycle storage with secure covered location at modern garden for not harm the features of heritage listed building.
- Creating an appropriate space for a home office within the modern garden study.

6. Results and recommendations:

The comparison between Energy criteria of LEED O+M and BREEAM refurbishment domestic buildings' scheme that used for assessing Heritage Buildings, illustrates the following:

- The weighting of Energy category of BREEAM Refrub. Domestic (43% from the total points) is greater than the weighting of Energy and atmosphere of LEED (38% from the total points).
- There are mutual credits between two schemes such as "improvement the Energy efficient, optimize the energy efficient performance in LEED (post refurbishment in BREEAM), Energy Metering, Demand response, and Renewable Energy technologies. The total weighting of the mutual credits from the total Energy points is 77% for LEED and 66% for BREEAM.
- LEED has a goal of reducing ozone depletion and global warming in all LEED's scheme. So that, LEED O+M reduce using chlorofluorocarbons (CFCs) and other ozone depleting substances that has been used in refrigerants through two credits, one of them is mandatory (the project will be denied if doesn't achieve its requirements) and the other has 1 point. BREEAM refurb. Domestic scheme's energy category doesn't have any credit for this context.
- LEED O+M has a great concentration on commissioning processes through three optional credits that have 7 points constitute 18.42% from the total points of Energy category. BREEAM refurb. Domestic scheme's energy category doesn't have any credit related to commissioning.
- BREEAM refurb. Domestic scheme's energy category has a (**Cycle Storage**) credit; the same credit exists in the most of the LEED's Scheme (under the name of "**Bicycle facilities**" at the **Location and Transport** category). LEED O+M encouraging alternative transportation include using bicycle (at Location and transport category) but doesn't set specify credit related to bicycle storage.
- BREEAM refurb. Domestic scheme's energy category has "**lighting**", "**Energy labelled white goods**", and "**Home office**" credits. LEED O+M doesn't have any credit related to them.
- BREEAM refurb. Domestic scheme set minimum standard criteria related to heritage buildings in some categories (not include energy), they are mandatory for any projects carried out on heritage assets. BREEAM also requires for any works (including those related to energy) must execute within the agreement of the conservation officer. LEED O+M don't set any mandatory requirements in the case of using it for assessing heritage buildings.

The comparison between both case studies of LEED and BREEAM, illustrates the following:

- Both of the projects were awarded the second highest rating of those rating systems. The Governor's Mansion achieves Gold **LEED certification** under **LEED (O+M) v.2**, and 29 Lansdowne achieves **Very Good BREEAM certification** under **BREEAM refurbishment domestic buildings' scheme**.
- Both of the projects had been carried out under the supervision of local authority to ensure preserving the heritage values of the building. This was optional for LEED's project, and mandatory for BREEAM's project.
- The option for using the renewable technologies was ruled out in the two

projects, it will be harm the heritage features of the heritage buildings, especially using photovoltaic panels on the sloped roofs of heritage buildings that will affect the quality and character of existing public views.

- The preservation of heritage glasses and doors has a priority than achieving the requirements of energy efficiency performance as installing more efficient doors or double glazed windows.
- The old modifications and extensions that had been carried out without respect the original and heritage features of the heritage building may be an approach to improve the energy efficiency of the building such as use insulation at the non-heritage external walls in the heritage buildings.
- The applicable of the concept of Green heritage buildings has already exist, but need to be highlighted and focused by researches to produce a specified rating system can assess green heritage buildings only.

Recommendations for improving the energy efficiency of the Residential heritage buildings in Egypt:

- Using low energy dimmable LEDs, installing complaint energy display device, and using energy efficient white goods or high energy efficient appliances and refrigerants will improve the energy efficiency performance of the heritage buildings without harming or losing the heritage features and values of those building.
- The green pyramid rating system (GPRS) should launch a scheme for **Residential Green Existing Buildings**. This scheme should set mandatory criteria when using it for assessing residential heritage Buildings.
- The energy category of this scheme should include the following credits (that are mutual between LEED AND BREEAM schemes): **Improvement the Energy efficient, optimize the energy efficient performance, Energy Metering, Demand response, and Renewable Energy technologies.**
- Any plan of works carried out at any heritage buildings in Egypt should be relied and executed under the supervision of the representatives of the Urban Harmony organization in each Egyptian governorates.
- Due to the different climate between Egypt and (USA & UK), and the most of heritage buildings in Egypt don't have slope Roofs, the photovoltaic panels could be used on their flat roofs without harming the heritage values or affecting the quality and character of existing public views these buildings.

References:

[1]. Abbo-Assy, Hala Foad (2013), "**Sustainable Rating Systems**", Master thesis, Alexandria University, Alexandria, Egypt.

[2]. **BREEAM refurbishment domestic buildings**, technical manual SD5077– Issue: 1.0 – Issue Date: 30/10/2014, page 2.

[3]. Buddenborg, Jennifer Lynn (2006), "**Changing Mindsets: Sustaiable Design In Historic Preservation**", Master thesis, Cornell University, New York- United states, page 50.

[4]. Green building Education Services, LLC, "**LEED Green Associate Study Guide**", Revision 1.06, 1 September 2010, page 25.

[5]. **The Egyptian Law of preserve the monuments No. 117 of 1983.**

[6]. Turley Heritage, (Sep.2014), "**Heritage Impact Assessment to accompany BREEAM Pre-Assessment Report – 29 Lansdowne Road, Royal Borough of Kensington and Chelsea**", Turley Heritage Office- London.

[7]. Turley Heritage, (Sep.2014).

Links:

[8]. **Application for listed Building consent for alterations to : 29 Lansdowne Rd, Notting Hill – London** "Design & Access Statement" , October 2014, http://www.rbkc.gov.uk/ ,access date (09.2015).

[9]. Albany county convention & Visitors Bureau blog.,http://albanycvb.blogspot.com/2013/06/behind-gates-look-inside-executive.html ,access date (09.2015).

[10]. Cambridge dictionary, http://dictionary.cambridge.org/dictionary/british/heritage-listed-building, access date (09.2015).

[11]. "**National Register Brochure**", the National Register of Historic places-USA, http://www.nps.gov/nr/publications/bulletins/brochure/, access date (06/09.2015).

[12]. Macholda, Frantisek (2013), ***"LEED Or BREEAM For Commercial Development? Decision From Point of View of an Owner of a Project***", CESB13- Prague, Decision-support tools and assessment methods. http://www.cesb.cz/cesb13/proceedings/5_tools/CESB13_1381.pdf, access date (09.2015).

[13]. "**Principles of Selection for Listing Buildings**", Department for Culture, media and sport, https://www.gov.uk/government/publications/principles-of-selection-for-listing-buildings, access date (09.2015).

[14]. The Egyptian Law of Urban Harmony No.144 of 2006. http://www.urbanharmony.org, access date (09.2015).

[15]. The official website of "Governor's Mansion": http://www.governor.ny.gov/explore-governors-mansion ,access date (06/09.2015).

[16]. The official website of the Historic of England, http://www.historicengland.org.uk/listing/the-list/ access date (09.2015).

[17]. The official website of US. Green Building Council, http://www.usgbc.org/LEED#credits ,access date (09.2015).

[18]. U.S. Environmental Protection Agency, http://www.epa.gov/, access date (09.2015).

[19]. Cambridge dictionary, http://dictionary.cambridge.org/dictionary/british/heritage-listed-building ,access (June.2015).

[20]. http://www.epa.gov/greenbuilding/pubs/about.htm , access(June.2015)

[21]. http://www.usgbc.org/articles/rating-system-selection-guidance

[22]. Egyptian Green Building Council, http://www.Egypt-gbc.org/ratings.html

[23]. Application for listed Building consent for alterations to: 29 Lansdowne Rd, Notting Hill – London "Design & Access Statement, October 2014, http://www.rbkc.gov.uk/idoxWAM/doc/Other1336840.pdf?extension=.pdf&id=1336840&location=Volume2&contentType=application/pdf&pageCount=1