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Analysis of the Sustainability of Standards and Criteria of the Authority for Educational Buildings in the Architectural Design of Elementary Schools in Egypt

تحليل استدامة معايير واشتراطات هيئة الأبنية التعليمية الخاصة بالتصميم المعماري لمدارس التعليم الأساسي في مصر

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ملخص

المعرفة والتعليم من أهم وسائل تقدم الأمم، وحيث أن المبنى المدرسي يعد من أهم عناصر المنظومة التعليمية، فقد تناول البحث مباني مدارس التعليم الأساسي خاصة والتي تستضيف التلاميذ من عمر 4 إلى 15 عاماً، كما نتاح لمرحلة التعليم الأساسي الفرصة الأكبر لتنشئة جيل واع بمفاهيم الاستدامة. يهدف البحث إلى تحليل معايير واشتراطات هيئة الأبنية التعليمية لتصميم مدارس التعليم الأساسي في مصر للوقوف على مدى تحقيق هذه الاشتراطات لمعايير التصميم المستدام. يستند التحليل على مقارنة بين معايير الاستدامة لهيئة الأبنية التعليمية (باعتبارها الكود الإلزامي لاعتماد مباني المدارس في مصر) مع معايير التقييم المستدام في نظم التقييم السائدة عالمياً (LEED 2009 for Schools and BREEAM Education)، والتي تهتم بتقييم الاستدامة لمباني التعليمية تحديداً، حيث لا يوجد نظام تقييم مصري مخصص للمباني التعليمية فقط ولكن "نظام تقييم الهرم الأخضر" للمباني كلها دون تحديد وظيفة معينة للمبنى، لذا تم استبعاده من المقارنة والتركيز على معايير هيئة الأبنية التعليمية المعتمدة لتصميم وتنفيذ مباني المدارس في مصر. استخلص البحث من نتائج الدراسة قوائم محددات التقييم المستدام المتبعة عالمياً التي تم مناقشتها في تقارير هيئة الأبنية التعليمية، والتعرف على بقية المحددات التي لم تناقش به، واختتم بمجموعة من النتائج والتوصيات لدمج محددات قياسية عالمية إلى معايير الهيئة في صورة خطوط إرشادية من أجل تصميم مبان تعليمية أكثر استدامة.

Abstract

Learning is one of the most important elements of progress and prosperity of nations, since school buildings are the most important elements of the educational process. The research targets elementary schools of students in the age between 4 and 15 years. It is arguable that elementary education has the greatest potential to raise a generation conscious concept of sustainability.

The research aims to analyze the environmental sustainability of criteria and standards of the Authority for Educational Buildings in the Architectural Design of Elementary Schools in Egypt, to state to what extent the sustainability design criteria have been achieved in those standards. The analysis is based on the comparison of determinants of sustainable design in the Authority's standards and criteria with those of world's most prevalent rating systems (LEED 2009 for Schools and BREEAM Education), as both rating systems have standards are specifically targeted at the analysis of educational buildings in sustainability terms. There is no Egyptian rating system that is specified to educational building, but the "Green Pyramid Rating System" is for all building types without specifying, so the research ignored the (GPRS) rating system and focused on the Authority for Educational Buildings which is responsible for schools buildings design and construction approval.

The research concluded which determinants of international sustainable rating systems are discussed through the Authority's documents, and which are not, and gives recommendations for the State of Authority's design criteria in the form of guidelines for robust sustainable enhancements.

Keywords: Sustainability – Educational Buildings – Elementary Schools – Sustainable Rating Systems – Design Standards and Criteria.

1- Introduction

Learning and transmission of knowledge across generations have a big role as one of the most important elements of progress and prosperity of nations. It is considered one of the most important ways to the development of human resources to attain advanced society as education initiates the preparation of young generations to future life, and enables humans in general to deal with life updates with the various conditions. Education and preparation for life go hand in hand; the first one as the means, while the second as the aim.

Among the most important elements of the educational process, is the school building, in which all elements of the educational process are grouped (teacher-student-curriculum). If successful, school buildings can provide the appropriate atmosphere to reach the healthy growth of students.

The research deals with elementary schools specifically as these schools host students of age between (4-12) years old, as elementary education has the greatest opportunity to raise a generation conscious concepts of sustainability and preservation of the right of future generations in the energy and resources.

Basic education is more than an aim in itself, it is the basis for teaching sustainable and human development, which led to change the modern concept of basic education and make it revolves around providing the individual with the skills and abilities essential to adapt with the environment and society and enhance their capabilities in order to be productive and able to work.

1-1- Problem

Current crises in Egypt in the field of energy, and the frequent interruptions in electrical current at all buildings and also public buildings specially educational, so there was a need to look for mechanisms and design practices as an alternative that ensures the rationalization of energy consumption in educational buildings, and

aims these buildings to reach self-sufficiency, and may also benefit the surrounding society with energy surplus.

The educational building should serve as a tool for education in itself; raising the awareness of students towards the basic requirements of global issues such as pollution, water and energy consumption and the concepts of reuse and resource conservation.

1-2- Aim and Methodology

The research aims to state to what extent the sustainability design criteria have been achieved in criteria and standards of the Authority for Educational Buildings in the Architectural Design of Elementary Schools in Egypt.

The analysis is based on the comparison of determinants of sustainable design in the Authority's standards and criteria with those of the world's most prevalent rating systems, stated here as:

- "LEED 2009 for Schools new construction and major renovation".
- "BREEAM Education 2008" (The Building Research Establishment Environmental Assessment Method).

Both system standards are specifically targeted at the analysis of educational buildings in sustainability terms.

1-3- International rating systems

1-3-1- LEED 2009 for Schools

The "LEED 2009 for Schools new construction and major renovation Rating System" for schools new construction and major renovations is a set of performance standards for certifying the design and construction of school buildings of all sizes. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

Prerequisites and credits in the LEED Green Building Rating Systems address 7 topics: (Sustainable Sites - Water Efficiency - Energy and Atmosphere - Materials and Resources - Indoor Environmental Quality - Innovation in Design - Regional Priority)

LEED 2009 for Schools New Construction and Major Renovations certifications are awarded according to the following scale: [Certified 40–49 points , Silver 50–59 points , Gold 60–79 points , Platinum 80 points and above].⁽¹⁾

1-3-2- BREEAM Education 2008

BREEAM (Building Research Establishment’s Environmental Assessment Method) is the world’s leading and most widely used environmental assessment method for buildings, with over 115,000 buildings certified and nearly 700,000 registered. It sets the standard for best practice in sustainable design and has become the de facto measure used to describe a building’s environmental performance. Credits are awarded in ten categories according to performance. These credits are then added together to produce a single overall score on a scale of Pass, Good, Very Good, Excellent and

Outstanding. The operation of BREEAM is overseen by an independent Sustainability Board, representing a wide cross-section of construction industry stakeholders.⁽²⁾

This BREEAM scheme covers ten categories of sustainability including: (Management - Health &Wellbeing – Energy – Transport – Water – Materials – Waste - Land Use and Ecology – Pollution – Innovation). BREEAM certifications are awarded according to the following scale: [Unclassified less than 30%, Pass ≥ 30%, Good ≥ 45%, V Good ≥ 55%, Excellent ≥ 70%, Outstanding ≥ 70%].

1-3-3- Shared determinants of assessment in LEED and BREEAM

As a result of analysis of the assessment criteria of the two rating systems mentioned above, the total determinants included in green rating criteria can be formed as appears in Figure (1):

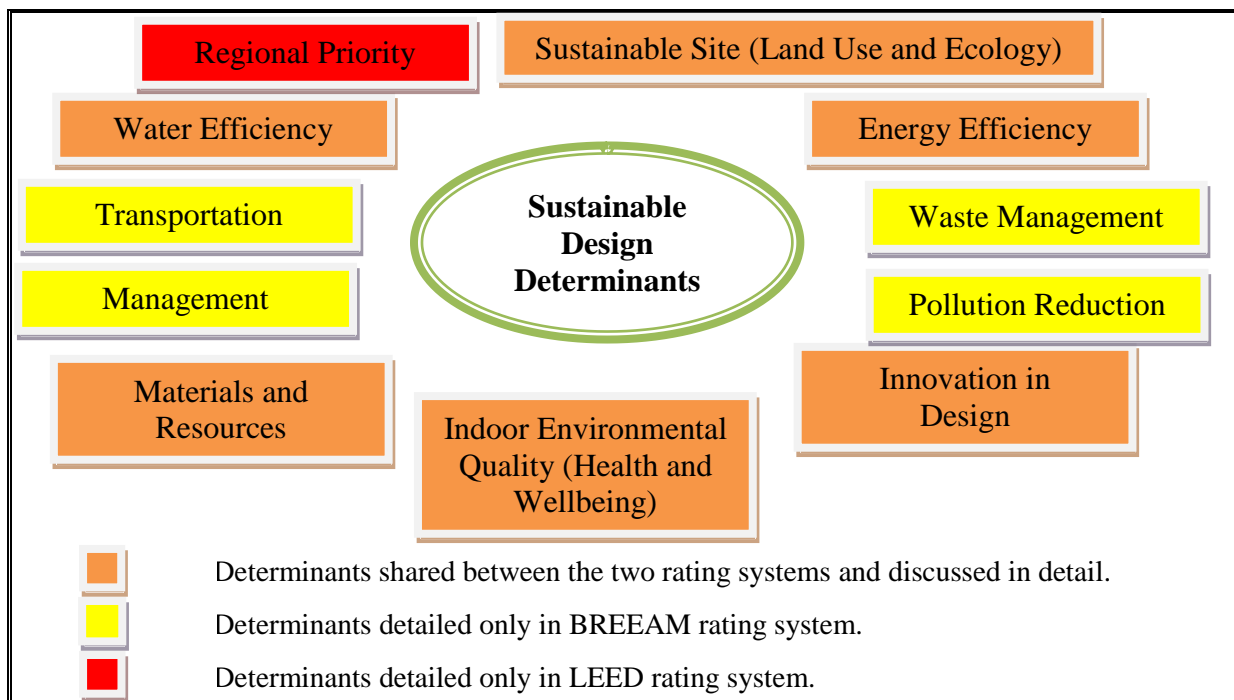


Figure (1), “Shared determinants of assessment in LEED and BREEAM”.

Source: processed by authors after references no. (3), (4).

2- Authority for Educational Buildings for the Elementary Schools in Egypt

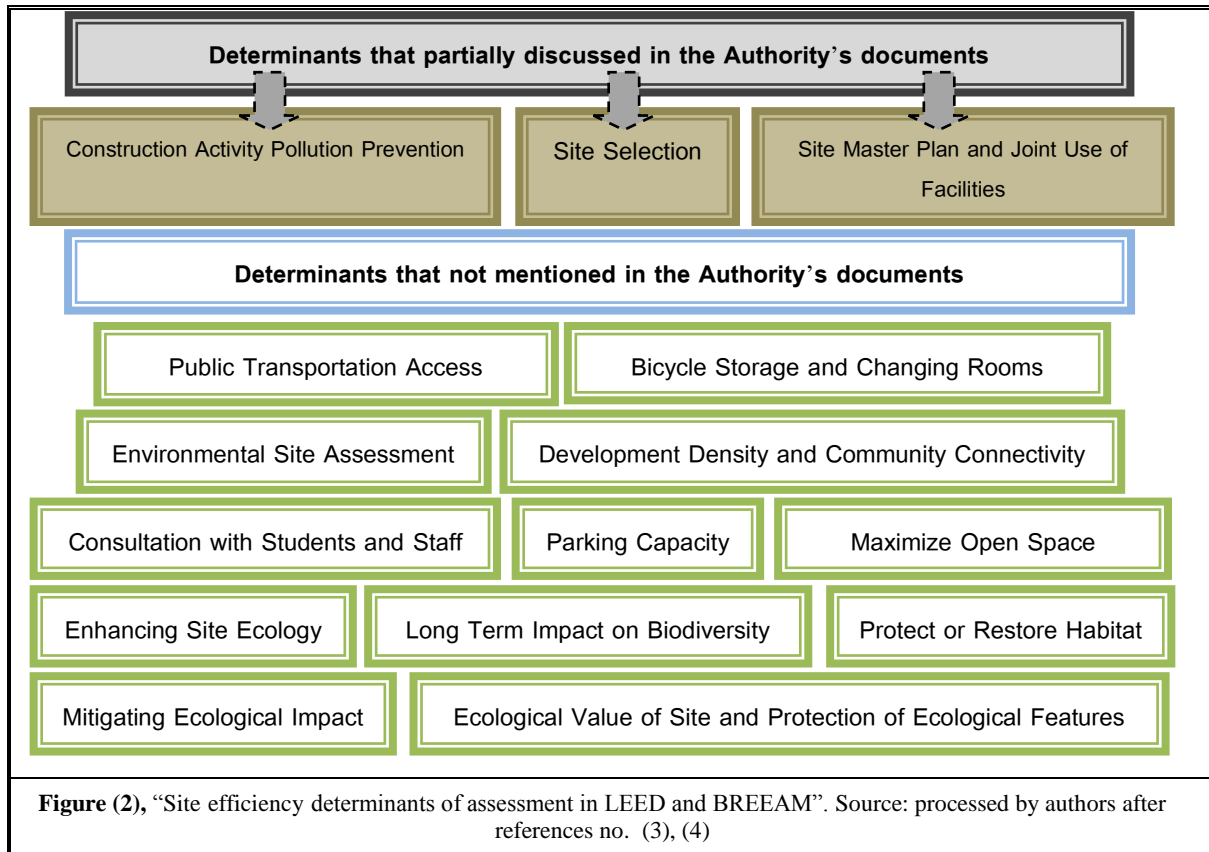
This section demonstrates the analysis of design criteria of the Authority

for Educational Buildings for the elementary schools. It discusses the general determinants influencing the environmental performance of the building, drawn from the analysis of the most famous internationally approved

rating systems. It aims to identify to what extent national design standards in Egypt have achieved the determinants of sustainability and environmental design universally followed, through the potential environmental and climatic conditions in Egypt.

2-1- Site efficiency

The major points stated at the rating systems “LEED and BREEAM” about sustainable site and site efficiency compared with documents of Authority for Educational Buildings could be summarized as appears in Figure (2):



The major points stated at the Authority's documents about sustainable site and site efficiency illustrated in figure (2) could be summarized as follows: ^{(5)P.68}

a) Site Flexibility: In terms of the shape and proportions of the site, the absorptive capacity of the site, topography, and the nature of the soil, and the relationship of educational services.

b) Security and safety: Site relationship with road network and the prevention of accidents and fires, and the limits of the spacing distances from roads intersections.

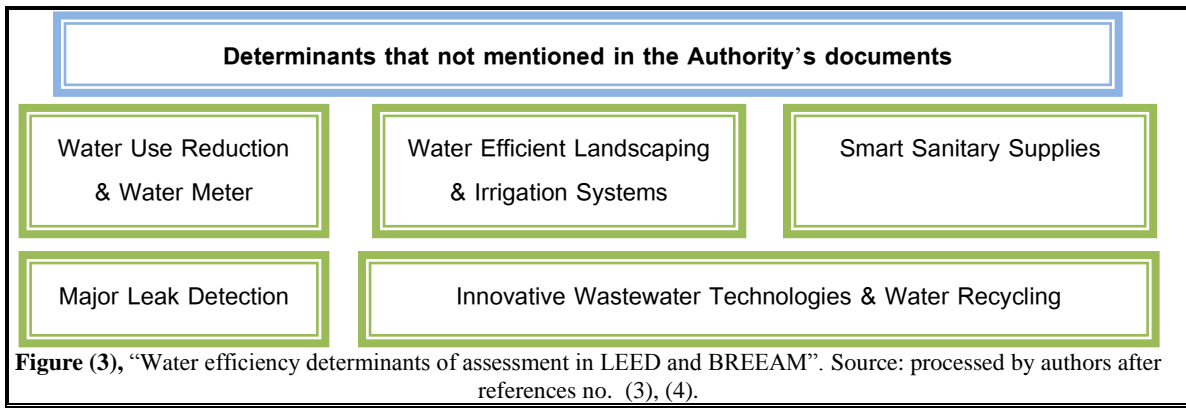
c) Availability of facilities: Drinking water, electricity, sewage, natural gas, telecommunications, and garbage disposal.

d) Availability of services: Medical, social, cultural, sports and entertainment.

e) Pollution prevention: Noise from traffic, workshops and factories, air pollution from factories and garbage, visual pollution.

2-2- Water efficiency

The major points stated at the rating systems “LEED and BREEAM” about water efficiency could be summarized as appears in Figure (3):



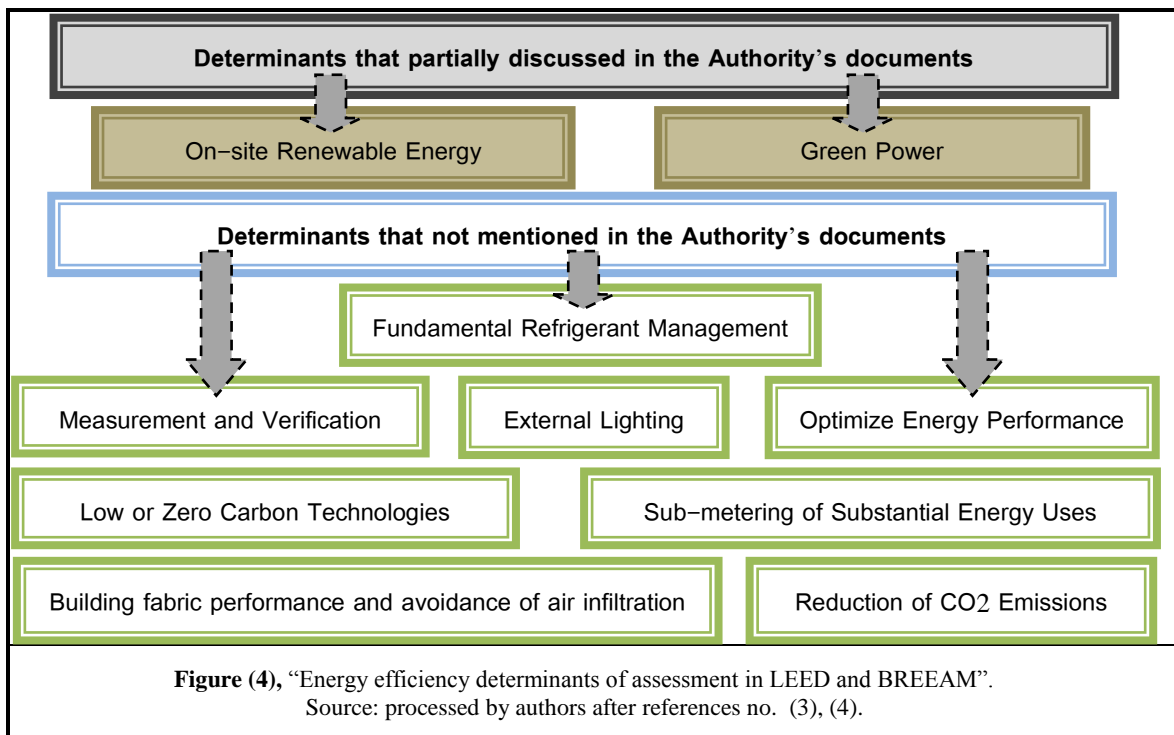
None of the above points in figure (3) were recommended in the Authority's documents, but major points stated about water efficiency could be summarized as follows: ^{(6) P.13}

- a) Infrastructure and distance spacing of potable water resources to be far from pollution sources, and power lines.
- b) Connecting average water consumption rates for basic education schools with the number of classrooms and the number of students.
- c) Technical specifications such as pipes materials of galvanized iron or copper.

- d) Technical specifications for sewage networks, such as pipe diameters and its materials and slopes.
- e) Rain water drainage to the sewer lines.

2-3- Energy efficiency

The major points stated at the rating systems “LEED and BREEAM” about energy efficiency compared with documents of Authority for Educational Buildings could be summarized as appears in Figure (4):



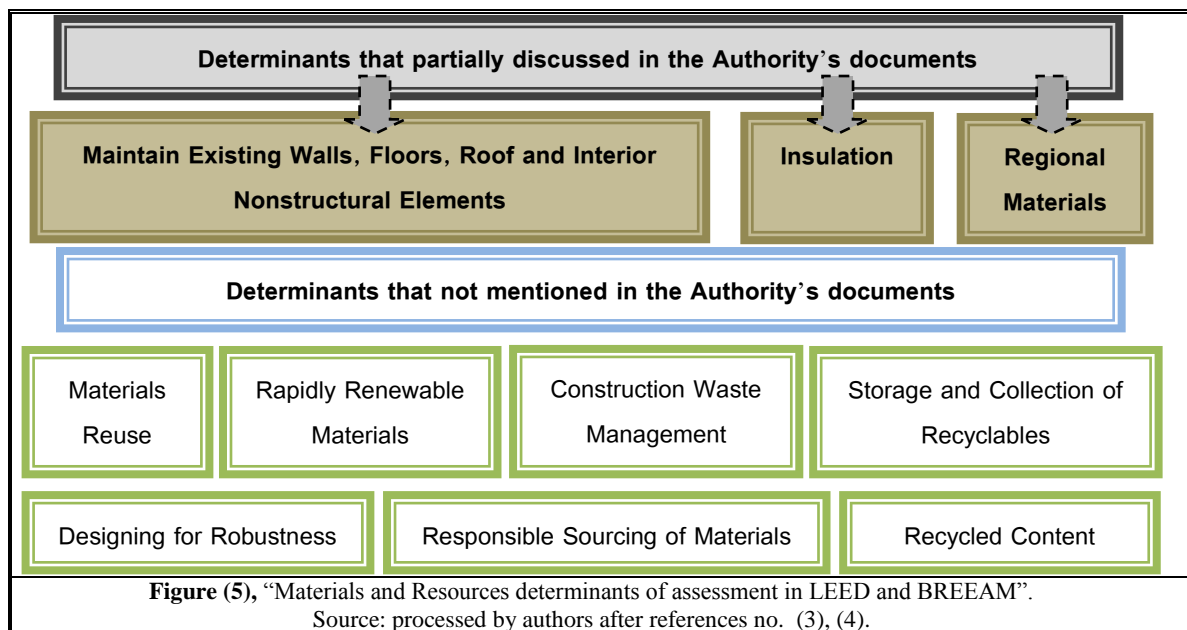
The major points stated at the Authority’s documents about energy efficiency illustrated in figure (4) could be summarized as follows: ^{(5)P.70-71}

- a) Urge to use of renewable energies in educational buildings, especially mentioned solar energy in the report of “Standards of planning and design appropriate environmental conditions for the schools of basic education.”
- b) General advice for the use of renewable energies in the lighting and

water heating processes, not in the form of mandatory requirements or technical standards.

2-4- Materials and Resources

The major points stated at the rating systems “LEED and BREEAM” about Materials and Resources compared with documents of Authority for Educational Buildings could be summarized as appears in Figure (5):

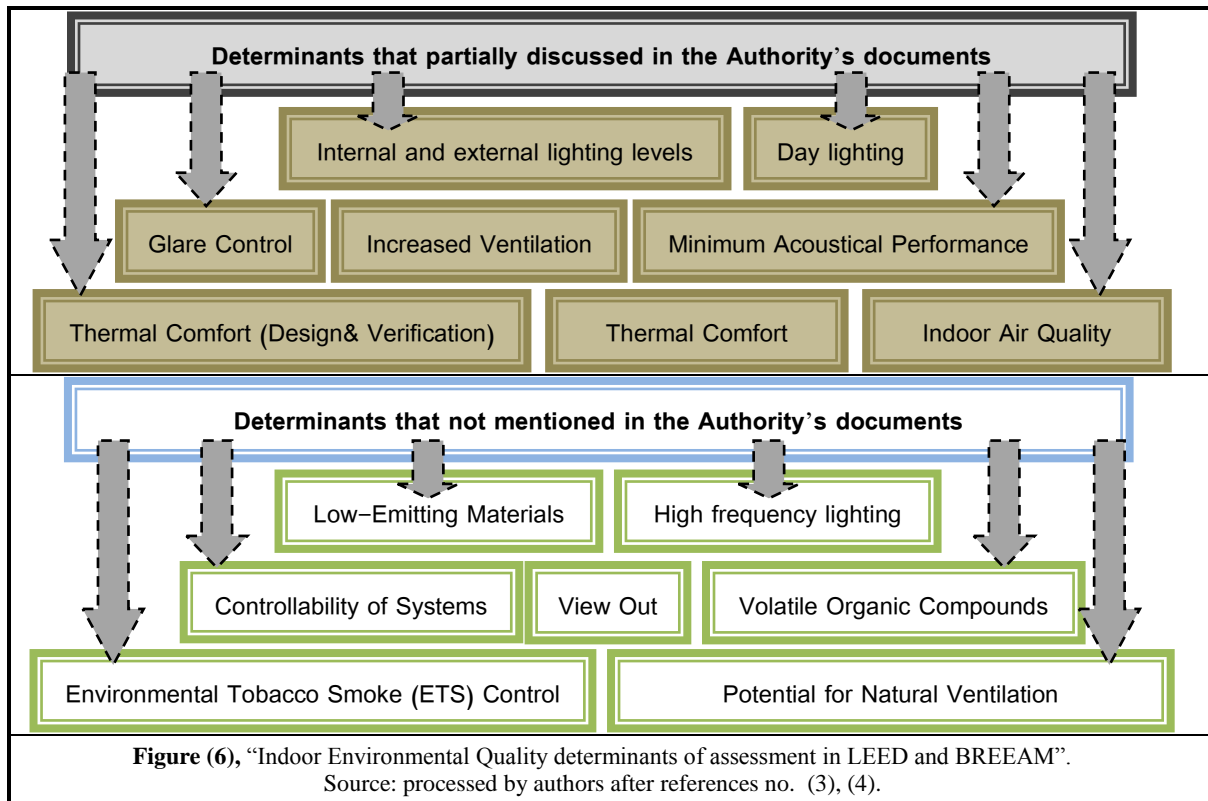


The major points stated at the Authority’s documents about Materials and Resources illustrated in figure (5) could be summarized as follows: ^{(5)P.117}

- a) Finishing material schedules for floors, ceilings and walls with specific materials. ^{(6)P.113-119}
- b) Explaining the technical specifications for construction materials, and external and internal finishes and insulation materials.
- c) Clarification components and implementation steps and methods of installation of materials.

2-5- Indoor Environmental Quality

The major points stated at the rating systems “LEED and BREEAM” about Indoor Environmental Quality compared with documents of Authority for Educational Buildings could be summarized as follows: (Thermal Environmental Quality - Natural ventilation - Natural lighting – Acoustics), detailed in Figure (6):



The major points stated at the Authority's documents about Materials and Resources illustrated in figure (5) could be summarized as follows:

2-5-1- Thermal Environmental Quality

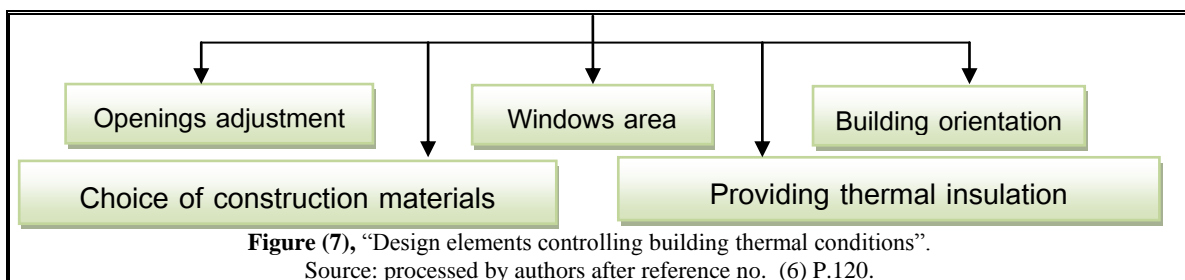
Thermal Environmental Quality depends on the following factors: (Interior air temperature, the temperature of the indoor surrounding surfaces, the humidity of the air, air movement and speed). These factors depend in turn on:

- a) Climatic characteristics of the city and the region - Outside air temperature - Intensity of solar radiation on the outer surfaces of the building - Wind speed -

And rely less importance on the rates of relative humidity of the air.

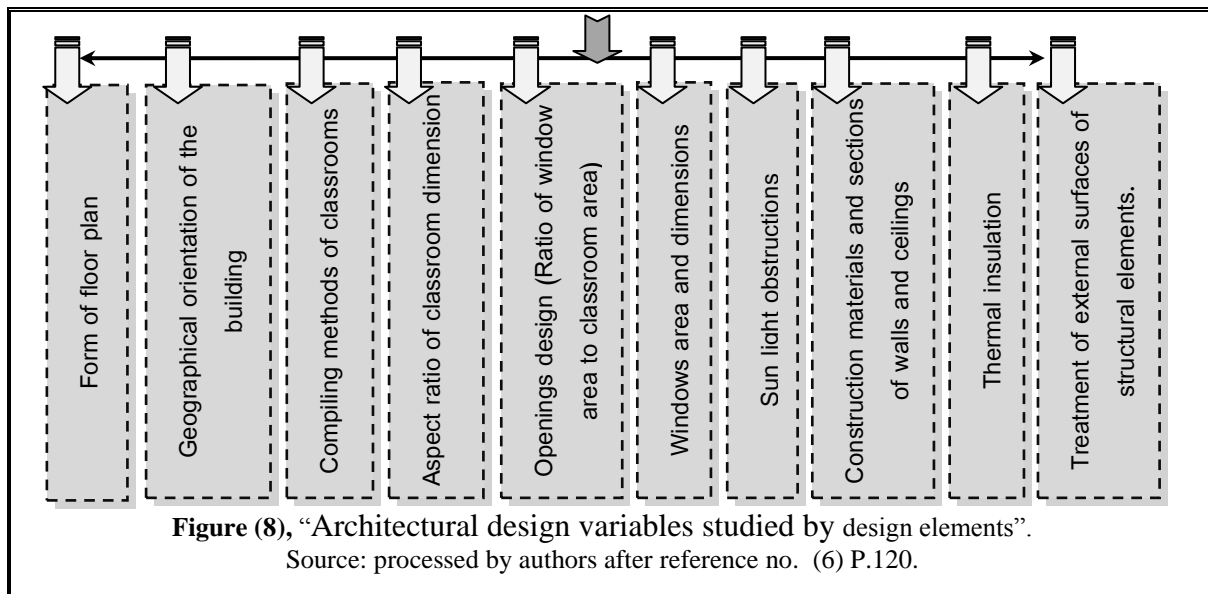
- b) Heat acquired internally by occupancy of the space, which results of number and age of occupants of space, the timetable for occupancy, furniture, as well as electrical equipment and industrial lighting sources.

On the basis of the possibility of proportional control in thermal conditions for internal vacuum through the design elements of the building, appearing in Figure (7)



So these design standards dealt study and analysis of architectural design variables to reach the recommendations to raise the

thermal performance of the school building efficiency, but still just recommendations, appearing in Figure (8):-



2-5-2- Natural ventilation

The criteria focused on natural ventilation for the purpose of:

- a) Maintaining the air quality in the building above the minimum requirements of air renewal, which depends on the function of the vacuum and the number of occupants.
- b) Thermal comfort by increasing heat loss from the body to the occupants, especially in the warm months of the year.
- c) Considered as a means to cool the building naturally for a suitable thermal environment.

Ventilation is processed in several ways, including (control openings area and orienting openings for air direction).

2-5-3- Natural lighting (quantity and quality)

Since natural lighting directly impacts the student mind stimulation to interact with the events and the ability to assimilation.

- a) To provide an appropriate level of lighting required in a vacuum at all points of the work.
- b) Good distribution of the variance in the field of vision.

- c) Avoid having reflective surfaces obstruct vision.

- d) Avoid shadows on the work surface to avoid distracting the attention of the student or strain his eyes.

- e) Choose the colors of the surrounding elements depending on the reflection coefficients for each color, and the degree of impact on the physiology of the students

2-5-4- Acoustics

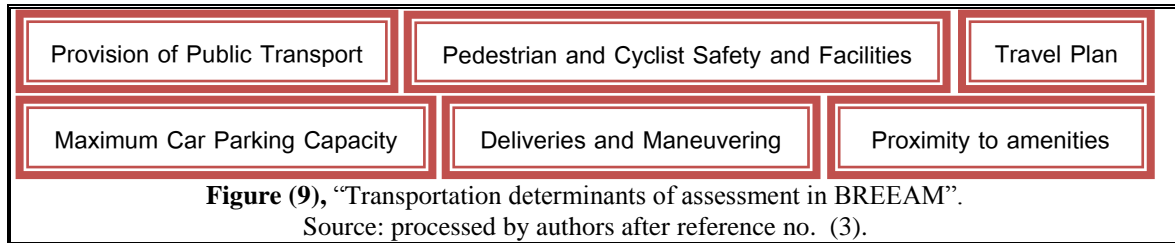
Acoustics is considered as one of the key factors that enhance the functional performance of school building.

- a) Methods of classrooms compiling: since the noise entering the classrooms moves to it either from another classroom or from external sources in addition to the voices from inside the same classroom.
- b) Order of seats in the classroom: affects the free domain of the ear, through which it can receive sound wave.
- c) Selecting indoor finishing materials: affects mainly on acoustics efficiency because of the different sound absorption efficiency from one material to another.

d) Internal and external walls insulation: must exceed the difference between the level of noise intensity and the allowable limit of noise in the classroom.

2-6- Transportation

The major points stated at the rating system “BREAM” about transportation could be summarized as follows:



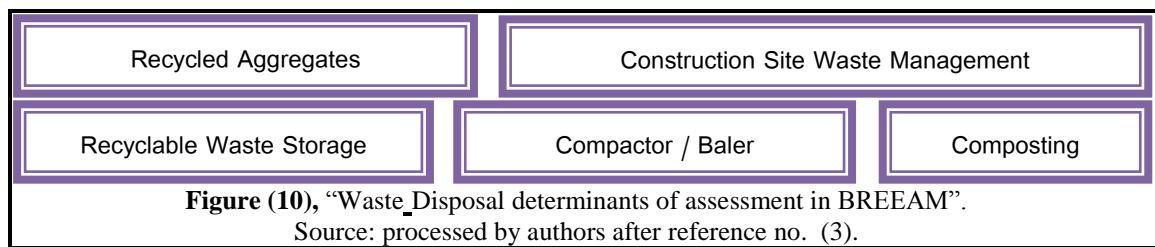
In the Authority’s documents the major points stated about transportation could be summarized as follows:

- a) Accessibility to the school building and its relationship with the surrounding streets.
- b) Standards of parking, its area, and its relationship with the number of

residents in the district and the number of parking places.

2-7- Waste Disposal

The points stated at the rating system “BREAM” only about waste disposal could be summarized in Figure (10):



In the Authority’s documents the major points stated about waste disposal could be summarized as follows:

- a) Reviewing its bad effects on student health and the community.
- b) General advices for methods to collect waste and divide it to types (reusable waste, non-reusable waste, organic waste).
- c) General guidance on how to divide the school to sectors and to distribute waste baskets and disposal of garbage periodically and recycling of recyclable waste.

for the Authority for Educational Buildings for schools of basic education are general non-mandatory guidelines for design enhancement, while the mandatory requirements are strict to requirements of the site dimensions, area of buildings and courtyards compared to the number of students and room tag schedule according to school size. These instructions and advices in their non-mandatory phase do not necessarily achieve the concept of sustainable design, which is to meets the needs of subsequent generations while achieving needs of the current generation of students.

Figure (11) summarizes the result of which determinants of international sustainable rating systems are discussed through the Authority’s documents, and which are not.

Conclusion and Recommendations

Reviewing the previous points, it could be concluded that the design criteria

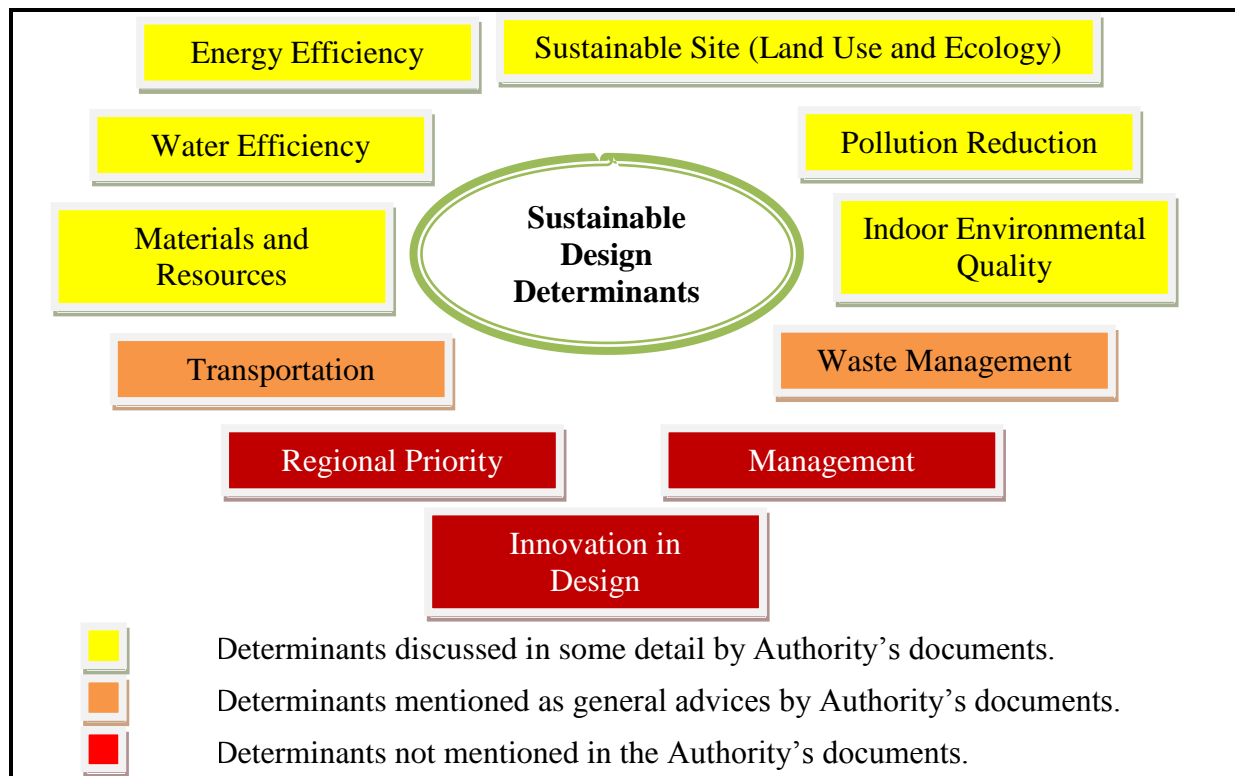


Figure (11), “Common determinants between Authority of Educational Buildings and international rating systems LEED and BREEAM”. Source: processed by authors.

To bridge the gaps concluded and illustrated above in figure (11), the following recommendations are offered:

As the available resources and capabilities cannot cover the high costs of integrating renewable energy systems or smart plumbing fixtures which rationalize water consumption and using smart materials to reduce energy loss, it is recommended that the Authority for Educational Buildings should commit the private education section with sustainability requirements. For example private school projects in Egypt are primarily investment projects that aim to gain profits as well as being educational service.

It is more worthy of investors in this field to trend to environmental sustainable design and bear the burden of technology cost from the project profit and not to overload the public utilities and networks. This can be achieved by adopting all or some of the international criteria and standards discussed above as the LEED and BREEAM, in the Authority's documentations.

In order to convince investors to adopt sustainable design elements, the government should encourage sustainable schools by rewards such as tax cuts, reduce public utilities bills, and giving high rate in the Ministry of Education which may be developed to be a complete rating system of schools buildings in Egypt or a new edition of (The Green Pyramid Rating System) that deal with educational building in particular.

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