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The Water Efficiency; A Main Rating Category for Sustainable New Construction in Egypt

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ملخص البحث:

إن الهدف من هذه الورقة البحثية هو توضيح للعناصر المستدامة لكفاءة إستهلاك المياه في المنشآت ضمن نظام وطني مقترح لتقييم وتصنيف المنشآت المستدامة الجديدة في مصر، وذلك لتحقيق الأهداف الرئيسية الآتية:

1- تحقيق الإستدامة البيئية المطلوبة لإستخدام المياه في المنشآت الجديدة شاملاً الآتي:
1-1 عدم تلويث المصادر الطبيعية للمياه.
2-1 خفض الإستهلاك والتسربات.
3-1 إستخدام مياه الصرف المعالجة في أغراض الري وفي شبكة المياه المبردة للتكييف وفي تغذية صناديق الطرد وفي الأغراض التشغيلية بالمشاريع الصناعية مثل مصانع الحديد ومصانع الكيماويات وغير ذلك.

2- تحقيق الإستدامة المجتمعية المطلوبة لإستخدام المياه في المنشآت الجديدة شاملاً الآتي:
1-2 تحقيق الكفاءة المائية لصالح المجتمع من خلال نقاء وجودة مياه الشرب بالمشروع وعمل نظام فلترة مركزي لضمان خلوها من الملوثات والشوائب والأملاح والكيماويات.

3- تحقيق الإستدامة الإقتصادية المطلوبة لإستخدام المياه في المنشآت الجديدة شاملاً الآتي:
1-3 التحكم بمعدلات إستهلاك مياه الصرف المعالجة مع ضمان تحقيق جودة محسوبة لها حتى لا تؤثر سلباً على الشبكات والأنظمة التي تستخدم المياه المعالجة ضمن عملياتها التشغيلية.

Abstract:

This paper is made for a partial fulfillment of a Ph.D. research made by the above mentioned authors to present a proposed national sustainable rating & certification system for new construction to promote the benefits of sustainable building practices, and embrace the potential of green buildings in Egypt, while the paper is describing one main category of the proposed system which is the Water Efficiency category, which is representing one main category among seven main categories of the proposed system.

The Water Efficiency category is mainly focusing to insure proper sustainable measures for all types of water supplied to the project and discharged from the project, under uniform & consistent Total Quality Assessment (TQA) procedures, and considering all applicable national & international codes and laws governing water activities of construction projects.

The Water Efficiency category, as detailed below, is having new assembly of mandatory and scoring credits complying with the sustainability three bottom lines; environmental, social, and economical aspects, to rectify the lack of some important issues related to water efficiency in new construction of Egypt, including protection of natural water planes, potable water quality, recycled water quality, unit-level water metering, and water pumps.

1. Introduction:

This paper is showing an assembly of the Water Efficiency category along with all its relevant mandatory and scoring credits, as listed below, after a thorough study made for the following three selected systems as they are currently the most popular, influential and technically advanced rating tools for the Egyptian sustainable new construction market:

A. LEED®-V4 Rating & Certification System (BD+C); for New Construction and Major Renovations-2013, USGBC-USA [1].
B. BREEAM®-International Rating & Certification System New Construction (NC) 2013 Scheme, BRE-UK [2].
C. GPRS® Green Pyramid Rating System for New Construction, GBC-Egypt [3].

2. Components Setting of the Water Efficiency Category:

After implementing a study for the built environment of the Egyptian construction market including laws, regulations, and difficulties\negative impacts affecting the main three bottom lines of sustainable construction, and after evaluating the above listed green rating systems w.r.t the construction criteria in Egypt, the proposed system dialogue of main categories, including the Water Efficiency category, along with their related credits was established in a form of a questionnaire for the purpose of validation, and it was forwarded to green professionals from the following parties in Egypt to make their evaluation & corrections for the skeleton of the proposed complete system:

- Housing and Building National Research Center (HBRC), Cairo.
- Faculty of Engineering, American University in Cairo.
- Faculty of Engineering, Cairo University.
- Faculty of Engineering, Ain-Shams University.
- Faculty of Engineering, Al-Azhar University in Cairo.
- Faculty of Engineering, Alexandria University.
- Egyptian Accredited Professionals approved by international green building councils.

The questionnaire was mainly particular about getting the following information/results from the green professionals in Egypt:

A- Identify the strength of total score deserved for each category.
B- Validate the mandatory credits and segregate them from the scoring credits.
C- Identify the degree of importance for the credit existence as per its scope summary.
D- Identify the score strength deserved for each scoring credit.
E- Identify the non-required credits that need to be removed from the system.

The questionnaire was validated by a group of (60) senior staff, and the results were received and analyzed, and the final assembly of the proposed system was set including all main categories along with their mandatory & scoring credits and the deserved score points for each category & for each credit, while this paper shows the resulted final assembly, scoring criteria, and score figures of the Water Efficiency category along with all its credits, and the validation process of this category resulted with (7) mandatory credits and (5) scoring credits with (18) available score points as shown below in table (1).

#	Category Title	Final Category Weighting	Final Category Score Points
1	Site Aspects (SA)	15.00%	15 Points
2	Water Efficiency (WE)	18.00%	18 Points
3	Energy Efficiency (EN)	20.00%	20 Points
4	Materials & Waste Mgmt (MW)	16.00%	16 Points
5	Quality Living (QL)	16.00%	16 Points
6	Integration & Management (IM)	15.00%	15 Points
7	Innovation and Creation Issues	6.00% Bonus	6 Pts Bonus
TOTAL FIGURES		**100% + Bonus (6%)**	**100 Pts + Bonus (6Pts)**

Table 1: Category weightings of the proposed national system.

3. Final Assembly of Credits for the Water Efficiency Category:

According to the main elements of the proposed system and the results of the questionnaire made, the followings represent complete final credits assembly of the Water Efficiency category for the main three sustainable new construction aspects (Environmental, Social, and Economical Aspects), and the next figure (1) shows the assembly summary:

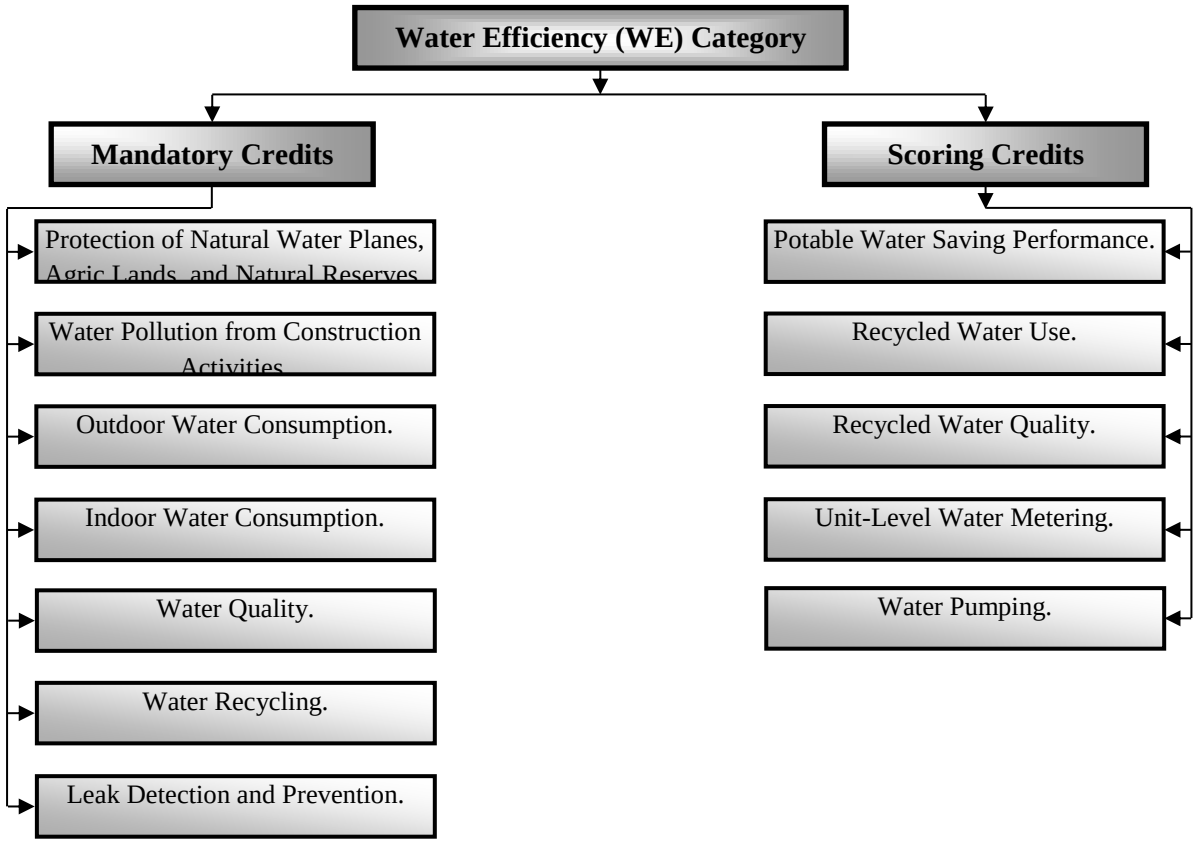

Figure 1: Components of 2[iiu] category; Water Efficiency

3.1 Mandatory Credits:

The followings represent all mandatory credits of the Water Efficiency category:

A. Protection of Natural Water Planes, Agric. Lands, and Natural Reserves (Mandatory):

A.1 General Criteria:

Credit scope is to control all construction and development activities in the protected areas of natural water planes, agricultural lands, and natural reserves.

A.2 Approach and Implementation:

(i) GBC-Egypt should review the building permit isn't violating green rules and legal laws of construction & site development on natural water planes (seas, rivers, lakes, storm watercourse). Refer to the following prevailing laws & standards:

- GPRS®-2017 technical seminar [4], 1st category of Sustainable Sites (SS), Credit#(SS.01)-Site Selection.
- Egyptian Prime Minister Decision#1383 at 2005, Protection of River Nile [5].
- Egyptian Ministry of Water Resources & Irrigation-MWRI, Irrigation & Drainage Laws#12 at 1984 & #102 at 2015 [6], Items#86,87,88, for Control of Construction Development on Water Beaches.
- Egyptian Ministry of Environment, Law#4 at 1994 [7], Items#73&74 for Prohibiting construction development on Natural Water Planes.
- Egyptian Ministry of Environment, Executive Agenda of Law#4 at 1994 [8], Items#59&60 for Prohibiting construction development on Nat. Water Planes.

(ii) GBC-Egypt should review that the building permit is not violating green rules and legal laws concerned about construction & site development on agricultural lands and natural reserves. Refer to the following prevailing laws and regulations:

- GPRS®-2017 technical seminar [4], 1st category of Sustainable Sites (SS), Credit#(SS.01)-Site Selection.
- Agriculture Law#53 at 1966 [9], Item#152 for Prohibiting construction development on Agricultural Lands.
- Urban Planning Law#3 at 1982 [10], Item#2 for Prohibiting construction development on Agricultural Lands.
- Natural Reserves Law#102 at 1983 [11], Item#2 for Prohibiting construction development on Natural Reserves.
- Electronic Gate of Cairo Governorate, Evaluation of the Environment in Egypt "http://www.cairo.gov.eg/information/Disenviro.aspx?ID=11" [12].

B. Water Pollution Resulting from Construction Activities (Mandatory):

B.1 General Criteria:

Credit scope is to ensure the proper management of construction site discharges to prevent water pollution during construction.

B.2 Approach and Implementation:

GBC-Egypt should ensure the project during construction isn't discharging pollutants towards any of the natural water planes. Refer to the following prevailing laws:

(i) Egyptian Law#48 at 21/6/1982, for Protection of River Nile from Pollution [13].

(ii) Egyptian Ministry of Environment, Law#4 at 1994 [7], Items#69&70 for Prohibiting Pollutant Drainage on Natural Water Planes.

(iii)Egyptian Ministry of Environment, Executive Agenda of Law#4 at 1994 [8], Items#57&58 for Prohibiting Pollutant Drainage on Natural Water Planes.

C. Outdoor Water Consumption (Mandatory):

C.1 General Criteria:

Credit scope is to control digging of water wells, water meters for outdoor activities, implement modern irrigation systems, and share the outdoor water usage data.

C.2 Approach and Implementation:

GBC-Egypt should ensure that the project is achieving the followings:

(i) To have a legal license incase of digging new water wells in the project facilities.

(ii) To have a legal permanent water meter for any water well and for governmental potable & recycled water supply to the external site facilities. The main purpose of water metering is not a financial purpose, but it is to monitor consumption rates.

(iii)To implement modern irrigation systems for all project green areas, and prohibit water plunging in the irrigation activities.

(iv)To commit sharing with the associated departments of GBC-Egypt, the resulting whole-project outdoor water usage data.

For achieving the above four conditions, refer to the following codes:

- GPRS®-2017 technical seminar [4], 3rd category of Water Efficiency (WE), Credit# (WE.02)-Water Efficient Landscaping.
- HBRC, Code#102, Egyptian Code of Water & Drainage Pipes [14].
- IPC-2015 [15], Chapter 14.

D. Indoor Water Consumption (Mandatory):

D.1 General Criteria:

Credit scope is to achieve reduction in the consumption of indoor water, have building-level water metering, and share the indoor water usage data.

D.2 Approach and Implementation:

GBC-Egypt should ensure that the project is achieving the followings:

(i) To have a building-level permanent water metering for all interior water use.

(ii) To achieve water consumption matching with the referenced rates and not exceeding them.

(iii)To commit sharing with the associated GBC-Egypt Council the resulting whole-project indoor water usage data.

For achieving the above four conditions, refer to the following codes:

- GPRS®-2017 technical seminar [4], 3rd category of Water Efficiency (WE), Credit# (WE.03)-Water Efficient Fixtures.
- HBRC, Code#301, Egyptian Code of Plumbing & Sanitary Installations for Buildings [16].
- HBRC, Code#102, Egyptian Code of Water & Drainage Pipes [14].
- IPC-2015 [15], Chapters 4&6&Appendix-E, Plumbing Fixtures & Water Distribution.
- UPC [17], Chapters 4&6&Appendix-A, Plumbing Fixtures & Water Distribution.

E. Water Quality (Mandatory):

E.1 General Criteria:

Credit scope is to ensure that the quality of potable water delivered to building users is satisfactory and meets the referenced drinking water quality standards at all points of use.

E.2 Approach and Implementation:

GBC-Egypt should review that the quality of potable water at all indoor & outdoor points of use of the project is complying with the referenced water quality standards & figures as per the following prevailing codes and standards:

(i) Decision of Egyptian Higher Committee of Water at 7/1/1975 for the Standards & Specification of Potable Water in Egypt [18].

(ii) HBRC, Code#602, Egyptian Code for Design of Accommodation Projects [19].

(iii) World Health Organization-WHO, Guidelines for Drinking Water Quality GDWQ-2011 [20].

(iv) EPA-United States Environmental Protection Agency, Water Quality Standards [21].

F. Water Recycling (Mandatory):

F.1 General Criteria:

Credit scope is to reduce the project overall water consumption by enhancing water recycling processes and reuse the treated water for some designated watering activities.

F.2 Approach and Implementation:

GBC-Egypt should ensure that all governmental projects, industrial projects, hospitals, and slaughter houses to discharge all their drainage either towards a special recycling/treatment plant within the project facilities or towards a legal recycling/treatment central plant. Refer to the following prevailing codes and laws:

(i) HBRC, Code#301, Egyptian Code of Plumbing & Sanitary Installations for Buildings [16].

(ii) HBRC, Code#101, Egyptian Code of Water & Sewage Treatment and Lifting Stations [22].

(iii) Egyptian Ministry of Environment, Executive Agenda of Law#4 at 1994 [8], Items#57&58.

(iv) American Society for Plumbing Engineers ASPE-2004 [23], Volume 2, Chapter 2.

(v) UPC [17], Appendix-G.

G. Leak Detection and Prevention (Mandatory):

G.1 General Criteria:

Credit scope is to prevent water and sewer leaks from all external and internal water and sewer structures and networks.

G.2 Approach and Implementation:

GBC-Egypt, during construction & startup of commissioning, should ensure that the project water and sewer lines are free of leak. Refer to the following prevailing codes:

(i) GPRS®-2017 technical seminar [4], 3rd category of Water Efficiency (WE), Credit# (WE.04)-Metering & Leak Detection System.

(ii) HBRC, Code#102, Egyptian Code of Water & Drainage Pipes [14].

3.2 Scoring Credits:

The followings represent all scoring credits of the Water Efficiency category:

A. Potable Water Saving Performance (4 Points):

A.1 General Criteria:

Credit scope is to reduce external and internal consumption of fresh (potable) water less than the referenced maximum rates/limits by specific percentages – (4 Points).

A.2 Approach and Implementation:

(i) The project indoor & outdoor potable water consumption is achieving lesser rates of consumption by a minimum of 10% of the above mandatory rates – (1 Point).

(ii) The project indoor & outdoor potable water consumption is achieving lesser rates of consumption by a minimum of 15% of the above mandatory rates – (2 Points).

(iii) The project indoor & outdoor potable water consumption is achieving lesser rates of consumption by a minimum of 20% of the above mandatory rates – (3 Points).

(iv) The project indoor & outdoor potable water consumption is achieving lesser rates of consumption by a minimum of 25% of the above mandatory rates – (4 Points).

B. Recycled Water Quality (4 Points):

B.1 General Criteria:

Credit scope is to inspect the recycled water quality delivered from treatment plant is satisfactory and meets the referenced water quality standards at all points of use – (4 Points). Refer to the following prevailing codes and standards:

(i) GPRS®-2017 technical seminar [4], 3rd category of Water Efficiency (WE), Credit# (WE.01)-Wastewater Reuse.

(ii) HBRC, Code#101, Egyptian Code of Water & Sewage Treatment and Lifting Stations [22].

(iii) HBRC, Code#501, Egyptian Code for Reuse of Sewage Treated Water in Agriculture Works [24].

(iv) American Society for Plumbing Engineers ASPE-2004 [23], Volume 2, Chapter 2.

(v) UPC [17], Appendix-G.

(vi) EPA-U.S Environmental Protection Agency, Water Quality Standards [21].

B.2 Approach and Implementation:

(i) The project indoor & outdoor treated water quality is achieving a minimum of 60% of the above mentioned potable water quality mandatory rates – (1 Point).

(ii) The project indoor & outdoor treated water quality is achieving a minimum of 70% of the above mentioned potable water quality mandatory rates – (2 Points).

(iii) The project indoor & outdoor treated water quality is achieving a minimum of 80% of the above mentioned potable water quality mandatory rates – (3 Points).

(iv) The project indoor & outdoor treated water quality is achieving a minimum of 90% of the above mentioned potable water quality mandatory rates – (4 Points).

C. Recycled Water Use (4 Points):

C.1 General Criteria:

Credit scope is to encourage reuse of recycled water in particular designated networks of the project – (4 Points). Refer to the following prevailing codes and standards:

(i) GPRS®-2017 technical seminar [4], 3rd category of Water Efficiency (WE), Credit# (WE.01)-Wastewater Reuse.
(ii) HBRC, Code#501, Egyptian Code for Reuse of Sewage Treated Water in Agriculture Works [24].
(iii) American Society for Plumbing Engineers ASPE-2004 [23], Volume 2, Chapter 2.
(iv) UPC [17], Appendix-G.
(v) Electronic Gate of Cairo Governorate, Evaluation of the Environment in Egypt "http://www.cairo.gov.eg/information/Disenviro.aspx?ID=11" [12].

C.2 Approach and Implementation:

(i) Full water demand of irrigation networks are from recycled water – (1 Point).
(ii) Full water demand of chilled water A/C network is from recycled water–(1 Point).
(iii) Full water demand of all W/Cs flushing is from recycled water – (1 Point).
(iv) The project is using recycled water for the full water demand of operational & productive purposes/networks (Industrial, Chemical, etc) – (1 Point).

D. Unit-Level Water Metering (4 Points):

D.1 General Criteria:

Credit scope is to encourage the installation of separate permanent water meter for each unit in the building – (4 Points). Refer to the following standards:

(i) GPRS®-2017 technical seminar [4], 3rd category of Water Efficiency (WE), Credit# (WE.04)-Metering & Leak Detection System.
(ii) IPC-2015 [15], Chapter 6.
(iii) UPC [17], Chapter 6.

D.2 Approach and Implementation:

(i) The project achieved to install separate water meters for a minimum of 70% of the total number of project individual units – (1 Point).
(ii) The project achieved to install separate water meters for a minimum of 80% of the total number of project individual units – (2 Points).
(iii) The project achieved to install separate water meters for a minimum of 90% of the total number of project individual units – (3 Points).
(iv) The project achieved to install separate water meters for all 100% of the total number of project individual units – (4 Points).

E. Water Pumping (2 Points):

E.1 General Criteria:

Credit scope is to reduce dependence on individual water pumps for each building unit, and avoid excessive energy consumption and prevent fading of water pressures.

E.2 Approach and Implementation:

GBC-Egypt should review that the project is having a constant water supply pressure for all individual units, by either relying on a constant pressure of governmental water supply network, or by relying on a central pumping unit towards overhead water storage tanks to feed all building units together with a

proper and constant water supply pressure – (2 Points). Refer to the following prevailing codes and standards:

(i) HBRC, Code#301, Egyptian Code of Plumbing & Sanitary Installations for Buildings [16].

(ii) HBRC, Code#602, Egyptian Code for Design of Accommodation Projects [19].

(iii) HBRC, Code#101, Egyptian Code of Water & Sewage Treatment and Lifting Stations [22].

4. Score Validation Results:

The score validation of the above mentioned questionnaire came with the following results:

4.1 The maximum total score points given to the Water Efficiency category is 18 points out of 100 total available points for all the system categories plus 6 bonus score points for approved innovation and creation issues.

4.2 The deserved score points for each credit in this category is shown below in table (2):

Credit Code	Credit Title	Awarding Criteria	
		Mandatory	Scoring
WE-01	Protection of Natural Water Planes, Agricultural Lands, and Natural Reserves	✓	
WE-02	Water Pollution Resulting from Construction Activities	✓	
WE-03	Outdoor Water Consumption	✓	
WE-04	Indoor Water Consumption	✓	
WE-05	Water Quality	✓	
WE-06	Water Recycling	✓	
WE-07	Leak Detection and Prevention	✓	
WE-08	Potable Water Saving Performance		4 Pts
WE-09	Recycled Water Quality		4 Pts
WE-10	Recycled Water Use		4 Pts
WE-11	Unit-Level Water Metering		4 Pts
WE-12	Water Pumping		2 Pts
Total Figures		**7 Credits**	**5Cr, 18Pts**

Table 2: Validation Results for credits of the Water Efficiency (WE) category.

5. Conclusion:

Based on the above constituents of the Water Efficiency category of the proposed Egyptian sustainable rating & certification system, the following conclusion can be drawn:

5.1 The Water Efficiency category is part of a complete proposed national new sustainable rating & certification system for new construction, while the category credits can be easily applicable for new construction activities in Egypt to strengthen the integrative work activities and implement the modern regulations to enhance the sustainability deliverables from the Egyptian new construction market.

5.2 The questionnaire survey made to validate the proposed national sustainable rating system came out with the above listed mandatory and scoring credits, while the resulted total available score points for the WE category is 18 points representing 18% of the total system score which is 100 points for all categories plus 6 bonus

score points for approved innovation and creation issues, and that shows the importance and professional appreciation of the WE category among other system categories.

5.3 The WE category as it is thoroughly studied and validated to cover the three bottom lines of sustainability, it is also containing the following new rating credits which are appearing for the first time among all other national and international sustainable rating systems:

A. The section of "Protection of Natural Water Planes" which is part of a credit named as: Protection of Natural Water Planes, Agricultural Lands, and Natural Reserves.
B. Recycled Water Quality.
C. Unit-Level Water Metering.
D. Water Pumping

5.4 The above detailed proposal for The WE category as part of a proposed Egyptian green/sustainable rating and certification system for new construction should strongly be taken into consideration during the release of periodical updates of the Egyptian national green rating & certification system; namely GPRS®.

Acknowledgement:

The authors of this paper are directly sponsoring that the results of the survey made in a form of a questionnaire are honestly transferred and analyzed as received from the Egyptian green professionals related to the agencies/firms listed above in this paper.

Notations:

Ph.D.	:	Philosophy and Directorate degree.
TQA	:	Total Quality Assessment.
LEED®	:	Leadership in Energy and Environmental Design, USA.
BD+C	:	Building Design and Construction.
USGBC	:	United States Green Building Council.
BREEAM®	:	Building Research Establishment's Environmental Assessment Method, UK.
NC	:	New Construction.
BRE	:	Building Research Establishment.
GPRS®	:	Green Pyramid Rating System, GBC-Egypt.
GBC-Egypt	:	Green Building Council-Egypt.
HBRC	:	Housing and Building National Research Center.
w.r.t	:	with respect to
SA	:	Site Aspects
WE	:	Water Efficiency
EN	:	Energy Efficiency
MW	:	Materials and Waste Management
QL	:	Quality Living
IM	:	Integration and Management.
Pts	:	Points.
SS	:	Sustainable Sites
MWRI	:	Egyptian Ministry of Water Resources and Irrigation
IPC	:	International Plumbing Code

UPC	:	Uniform Plumbing Code
WHO	:	World Health Organization
GDWQ	:	Guidelines for Drinking Water Quality
EPA	:	United States Environmental Protection Agency
ASPE	:	American Society for Plumbing Engineers
A/C	:	Air Conditioning
W/Cs	:	Water Closets
Cr	:	Credits.

References:

1. Technical Manual of LEED®-V4 Rating & Certification System (BD+C); for New Construction and Major Renovations, 2013, USGBC-USA.
2. Technical Manual of BREEAM®-International Rating & Certification System New Construction (NC), 2013 Scheme, BRE-UK.
3. Technical Manual of GPRS® Green Pyramid Rating System for New Construction, HBRC, GBC-Egypt.
4. The HBRC technical seminar dated in 2/6/2016 for the new edition of GPRS®-2017.
5. The Egyptian Prime Minister Decision#1383 at 2005, for Protection of River Nile.
6. The Egyptian Ministry of Water Resources & Irrigation-MWRI, Irrigation & Drainage Laws#12 at 1984 & #102 at 2015.
7. The Egyptian Ministry of Environment, Law#4 at 1994.
8. The Egyptian Ministry of Environment, Executive Agenda of Law#4 at 1994.
9. The Egyptian Agriculture Law#53 at 1966.
10. The Egyptian Urban Planning Law#3 at 1982.
11. The Egyptian Natural Reserves Law#102 at 1983.
12. Electronic Gate of Cairo Governorate, Evaluation of the Environment in Egypt "http://www.cairo.gov.eg/information/Disenviro.aspx?ID=11".
13. The Egyptian Law#48 at 21/6/1982, for Protection of River Nile from Pollution.
14. The Egyptian code of practice for Water and Drainage Pipes (HBRC, Code#102).
15. The International Plumbing Code-IPC 2015.
16. The Egyptian code of Plumbing & Sanitary Installations for Buildings (HBRC, Code#301).
17. The Uniform Plumbing Code-UPC.
18. Decision of Egyptian Higher Committee of Water at 7/1/1975 for the Standards & Specification of Potable Water in Egypt.
19. The Egyptian code for Design of Accommodation Projects (HBRC, Code#602).
20. World Health Organization-WHO, Guidelines for Drinking Water Quality GDWQ-2011.
21. The United States Environmental Protection Agency-EPA, Water Quality Standards.
22. The Egyptian code of Water & Sewage Treatment and Lifting Stations (HBRC, Code#101).
23. American Society for Plumbing Engineers-ASPE 2004.
24. Egyptian code for Reuse of Sewage Treated Water in Agriculture Works (HBRC, Code#501).