Implementing Innovative Ideas in Structural Engineering and Project Management
*Edited by* Saha, S., Zhang, Y., Yazdani, S., and Singh, A.

ISBN: 978-0-9960437-1-7

# COMPARISON OF LEED'S ENERGY AND ATMOSPHERE STANDARDS FOR SOME DEVELOPING COUNTRIES

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All efforts for handling resources, including extraction, processing, transportation, and manufacturing require energy. Thus, energy is a very valuable, albeit an indirect resource in the development of any country. Dependence on energy has a direct impact on the environment as well as the cost of products. Sustainability efforts focus on minimizing environmental impacts within a reasonable cost. Green building rating and certification systems around the world handle energy-related issues by considering the regional priorities of the country where they were first introduced. Certification systems rely on standards that are in effect locally. Leadership in Energy and Environmental Design (LEED) was first introduced in the U.S. and is currently the most widely preferred green building certification system around the world. The "energy and atmosphere" category in LEED v4 NC amounts to 33 points, which corresponds to approximately 26.2% of the total points that a building can receive. Because LEED was first introduced in the U.S., it heavily relies on U.S. standards such as ANSI/ASHRAE/IESNA, which limit its applicability in countries other than the U.S. In this study, the standards that are referred to in the energy-related categories of the Pearl Building Rating System (ESTIDAMA) of Abu Dhabi and LEED-India are analyzed and compared to the standards referred to by LEED v4 NC. It is hoped that the outcome of the study will provide valuable knowhow for professionals in other countries where efforts are underway to improve existing standards and/or to introduce new ones.

Keywords: LEED, Energy and atmosphere, Standards, Green building certification systems, Developing countries.

## 1 INTRODUCTION

The LEED certification system was developed based on standards, codes and regulations that are in effect in the U.S. These standards, codes and regulations have been developed with regards to the industrial experience of the country. Thus, it has strong credibility in the country as well as the rest of the world. However, this also limits LEED's applicability in other countries, because of the lack of standards, codes and regulations in those countries. LEED v4's energy and atmosphere category consists of four prerequisites and seven credits. The prerequisites and credits in this category generally refer to ASHRAE Standard 90.1 Appendix G to sustain energy efficiency, and

they sum up to 33 points, which equals to the 26.19% of the total points that can be obtained. In this study, the energy-related categories of ESTIDAMA Pearl Building Rating System (PBRS) of Abu Dhabi, and LEED-India are compared to LEED v4 NC. This comparison is based on an evaluation of the standards referred to by the three certification systems. The objective is to explore the need for new standards in subject countries.

## 2 COMPARISON OF LEED E&A STANDARDS IN INDIA AND ABU DHABI

### 2.1 India

India has one of the largest populations in the world. Additionally, the country has considerable land coverage, with a large number of governmental entities for administration. The large surface area of the country spreads over five different climate zones from cold to hot-dry (Evans *et al.* 2009). The needs of the population, the large area of coverage, the large number of governmental entities, and climate variances make application of energy saving practices difficult.

To reflect the government's sustainability policy to the construction industry, the India Bureau of Energy Efficiency (BEE) introduced the Energy Conservation Building Code (ECBC) in 2007 (Komurlu *et al.* 2014, BEE 2007, Evans *et al.* 2009). The code was prepared by a committee of domestic and international professionals, some of whom are ASHRAE committee members. As a result, the code sets high standards for energy efficiency. However, compliance with the code is voluntary, and this limits its effect on the industry. India is among the first developing countries that have initiated the adoption of LEED to local properties. LEED-India has been introduced by the Indian Green Building Council in 2007. It generally refers to the previous versions of the standards referred in LEED v4. It also refers to ECBC in various credits. Finally, it suggests calculation methods for some credits instead of standard referral. It should be stated that, since the number of local standards is limited, the success of any sustainable practice is limited, including application of LEED-India.

### 2.2 Abu Dhabi

Abu Dhabi, the largest emirate and capital of UAE, is in dry desert, which points to high levels of energy use and air pollution related to oil and gas production, electricity generation and desalination of water (Mezher *et al.* 2011). Abu Dhabi Urban Planning Council (UPC) announced the launch of the ESTIDAMA PBRS in 2010 as a part of governmental sustainability policy to increase energy efficiency and reduce carbon emissions. The Emirates Authority for Standardization and Metrology (ESMA) and the Abu Dhabi Quality and Conformity Council (ADQCC 2013) introduced standards, codes and regulations for sustainable practices, incorporating weather and geographic data. However the number of these standards is still limited for efficient application. The Abu Dhabi Dept. of Municipal Affairs, on the other hand, introduced the International Energy Conservation Code in 2009.

PBRS does not refer to the standards, codes and regulations introduced by the Abu Dhabi Quality and Conformity Council, and does not mention the International Energy Conservation Code except in only one single credit. Instead, PBRS refers to ANSI/ASHRAE/IESNA Standard 90.1-2007: Energy Standard for Buildings Except

Low-Rise Residential as well as a number of standards introduced by the Chartered Institute of Building Services Engineers (CIBSE). A major difference between LEED v4 and ESTIDAMA PBRS is the four new credits introduced by PBRS, which are RE-2 - Cool Building Strategies, RE-3 - Energy Eff. Appliances, RE-4 - Vert. Transportation, RE-5 - Peak Load Reduction. Twelve points of the total forty four points are assigned to these new credits in PBRS.

Table 1. Comparison of LEED v4, LEED India NC, and Abu Dhabi ESTIDAMA PBRS on the basis of E&A category.

| **LEED v4** | | **LEED-India NC** | | **Abu Dhabi ESTIDAMA PBRS Dsgn. & Const. V1.0** | |
|---|---|---|---|---|---|
| **Energy and Atmosphere** | | **Energy and Atmosphere** | | **Resourceful Energy** | |
| **EA Prerequisites and Credits** | **Referenced Standards** | **EA Prereq. and Credits** | **Referenced Standards** | **Requisites and Credits** | **Referenced Standards** |
| EA Prereq. (1) - Fundamental Commissioning and Verification | • ASHRAE Guideline 0–2005, The Commissioning Process<br>• ASHRAE Guideline 1.1–2007, HVAC&R Tech. Req. for the Commissioning Process<br>• NIBS Guideline 3–2012, Exterior Enclosure Tech. Req. for the Commissioning Process | EA Prereq. 1 - Fundamental Building Sys. Commissioning | N/A | - | - |
| EA Prereq. (2) - Minimum Energy Performance | • ASHRAE 90.1–2010 and ASHRAE 90.1–2010 User's Man.<br>• ASHRAE 50% Advanced Energy Design Guides<br>• Advanced Buildings Core Perf. Guide<br>• COMNET Commercial Bldg. Energy Modeling Guidelines | EA Prereq. 2 - Minimum Energy Performance | • ASHRAE / IESNA Standard 90.1 - 2004 Sec. 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4<br>• ASHRAE / IESNA Standard 90.1 - 2004 Sections 5.5, 6.5, 7.5, and 9.5 | RE-R1 - Minimum Energy Performance | • ANSI / ASHRAE / IESNA Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential |
| EA Prereq. (3) - Building-Level Energy Metering | • Electricity. ANSI C12.20, Class 0.2 (± 0.2)<br>• Natural gas. ANSI B109<br>• Thermal energy (Btu meter or heat meter). EN-1434 | - | - | - | - |
| EA Prereq. (4) - Fundamental Refr. Mng. | • U.S. EPA Clean Air Act, Title VI, Section 608, | EA Prereq. 3 - CFC Red. in HVAC&R Equip. | Regulated by LEED-India NC itself. | RE-R3 - Ozone Imp. of Refr.& Fire | N/A |

| | | | | | |
|---|---|---|---|---|---|
| | Refrigerant Recycling Rule | | | Suppr. Sys. | |
| EA Cr. (1) - Enhanced Commissioning | • ASHRAE Guideline 0–2005, The Commissioning Process<br>• ASHRAE Guideline 1.1–2007, HVAC&R Technical Requirements for the Commissioning Process<br>• NIBS Guideline 3–2012, Exterior Enclosure Technical Requirements for the Commissioning Process | EA Cr. 3 - Additional Commissioning | N/A | - | - |
| EA Cr. (2) - Optimize Energy Performance | • ASHRAE 90.1–2010 and ASHRAE 90.1–2010 User's Man.<br>• ASHRAE 50% Advanced Energy Design Guides<br>• COMNET Commercial Buildings Energy Modeling Guidelines | EA Cr. 1 - Optimize Energy Performance | • ASHRAE/IESNA Sta. 90.1 - 2004 App. G<br>• ECBC of the Bureau of Energy Eff., India<br>• ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004<br>• Advanced Bldg. Benchmark v1.1 Basic Criteria and Prescriptive Measures | RE-1 - Improved Energy Performance | • ANSI/ASHRAE/IESNA Standard 90.1-2007: Energy Standard for Buildings Except Low-Rise Residential |
| EA Cr. (3) - Adv. Energy Metering | - | - | - | - | - |
| EA Cr. (4) - Demand Response | - | - | - | - | - |
| EA Cr. (5) - Renewable Energy Production | • Center for Resource Solutions Green-e Program<br>• Commercial Bldg. Energy Consumption Survey (CBECS) | EA Cr. 2 - Renewable Energy | N/A | RE-6 - Renewable Energy | • Center for Resource Solutions, Green-e Product Cert. Req. http://www.green-e.org/ |

| | | | | | |
|---|---|---|---|---|---|
| EA Cr. (6) - Enhanced Refrigerant Management | - | EA Cr. 4 - Ozone Depletion | N/A | RE-7: Global Warming Impacts of Refrig. & Fire Suppr. Sys. | - |
| - | - | EA Cr. 5 - Measurement and Verification | Int. Perf. Measurement & Verif. Prot. (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Cons, April, 2003. | RE-R2 - Energy Monitoring & Reporting | • GIL 65: Metering Energy Use in New Non-Domestic Buildings<br>• CIBSE TM39 2009: Building Energy Metering |
| EA Cr. (7) - Green Power and Carbon Offset | • Green-e Energy and Green-e Climate<br>• U.S. Dept. of Energy's Comm. Bldg. Energy Consump. Survey<br>• Building Owners and Managers Assoc. (BOMA)<br>• ENERGY STAR Portfolio Manager: Methodology for Greenhouse Gas Inventory and Tracking Calc.<br>• Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2010. Annex 2 Methodology and Data for Estimating CO2 Emissions from Fossil Fuel Combustion<br>• 2006 IPCC Guidelines for Nat. Greenhouse Gas Inventories<br>• eGRID2012 Version 1.0-U.S.E.P.A.<br>• WRI-WBCSD Greenhouse Gas Protocol | EA Cr. 6 - Green Power | Regulated by LEED-India NC itself. | - | - |

## 3 CONCLUSIONS

The following conclusions are reached about the subject countries based on the comparison presented in Table 1.

- ECBC, which LEED-India-NC refers to frequently, combines local conditions with international standards. However, voluntary compliance weakens its influence.
- The limited number of local standards and the limited number of professionals with knowledge of sustainable practices weaken the application of sustainable practices in India.
- Although it has been approximately a decade since the Emirates Authority for Standardization and Metrology (ESMA) was established, the number of standards introduced is still limited. Having unique geographic properties, the region needs ESMA and the Abu Dhabi Quality and Conformity Council ADQCC to introduce standards prepared in regards to regional conditions.
- Despite being extensive in its approach to energy efficiency, the International Energy Conservation Code, which was introduced by the Abu Dhabi Department of Municipal Affairs, is referred to in only one credit in ESTIDAMA PBRS.
- LEED-India and ESTIDAMA PBRS have both been prepared as an adaptation of LEED to local conditions and requirements. However, LEED-India is a simplified version as it refers to fewer standards in fewer prerequisite/credit requirements. ESTIDAMA PBRS, on the other hand, is more extensive, as it refers to local, US and British standards. In addition, PBRS has changed the category priorities as well as credit points with regard to the regional requirements by introducing changes such as development rate, $CO_2$ emissions, and desalination.

This study is expected to draw attention to the importance of local and regional standards that are needed for efficient application of sustainable practices in energy-related matters. Since green building certification systems heavily refer to standards, the success of these systems rely on the extent and maturity of the standards.

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