

Sustainability Implementation on UAE Residential Building Projects

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Abstract: Abu Dhabi Urban planning council (UPC) drives and supports the Abu Dhabi urban development strategy and transferring the plan and vision 2030. Physical setting and developing strategic development plan that create the guides principle and regulations that cascade over strategic project designed to shape the country by a sustainable program under the name of (ESTIDAMA is the Arabic meaning of sustainability), and is not only a rating method or something that people have to do, but it's a strategic vision to achieve a new sustainable lifestyle in the Abu Dhabi and UAE. ESTIDAMA goal is to develop and make a new way for the life in the UAE as a physical and cultural identity and improving the quality of life for the residents and society in four equal pillars of sustainability that including, environmental, economy, and social and the culture. The green building and sustainability practice considerations into all stages of the building construction projects and focuses on the stages of design, construction and operation. The ultimate goal of sustainable building is to provide the occupant with a healthy, productive and safe way of living for communities. The aim of this paper is to study and discover the process of the green building implementation on residential building projects in Abu Dhabi and measure the degree of sustainability achieved in implementation of residential building in Abu Dhabi city for the future projects by depth study in this field of sustainability.

Keywords: Abu Dhabi, GBP, ESTIDAMA, PRS, sustainability, residential Construction. UAE.

1. INTRODUCTION

Abu Dhabi is the federal capital of the United Arab Emirates and the largest one of the seven emirates. The Abu Dhabi Vision 2030 plan and the (AUPC) Vision 2030, that presents a combined overview of the entire Emirate through the development plans of 'Capital 2030' (Abu Dhabi Metropolitan Area), 'Al Ain 2030' (Eastern Region) and 'Al Gharbia 2030' (Western Region). ESTIDAMA is the first environmental assessment method that has been developed in the Gulf countries (AUPC 2010). The Green Building procedures are implemented in the all stages of the residential building projects in Abu Dhabi according to the ESTIDAMA Green Building regulations. However, a separate file, Planning for ESTIDAMA, identifies ESTIDAMA -linked submissions for each phase of the Development Review process. These submissions confirm that projects are on the pathway to achieve the required 1 Pearl credit. The Pearls Rating System (PRS) is a framework for sustainable design, construction and operation of communities, buildings and villas. It has been designed to support sustainable development from design to construction to operational accountability and provides guidance and requirements to rate a project's potential performance in relation to the four pillars of ESTIDAMA.

ESTIDAMA added the culture aspect to be the fourth pillar in the rating system because this element is very important to completing the vision of ESTIDAMA to improve the construction sector and to meet with the local culture and heritage of the region (ESTIDAMA Training Course, Nov 2014).

2. DEFINITIONS OF GREEN BUILDING

Sustainability is defined as being capable of being borne or endured, capable of being upheld or maintained at certain rate or level. In recent years, people have exerted more effort to encourage sustainable development than before, especially in the building sector. (Weifeng Li 2013). Sustainability is a systemic concept, relating to the continuity of economic, social,

institutional and environmental aspects of human society, as well as the non-human environment. Sustainability affects every level of organization, from the local neighborhood to the entire planet.

However, Green Building transforms the way buildings are designed, built and operated to create more comfortable, healthier and sustainable built environments, whilst reducing energy consumption, greenhouse gas emissions, water consumption and solid waste generation. Moreover reduce cost and liabilities whilst increasing value and achieving more predictable results in built environments is thought to be achievable. The cumulative impact of the design, construction and operation of built environments has profound implications for human health.

In Abu Dhabi, the Green Building procedures implement the seven main credits of the ESTIDAMA rating system: Integrated Development Process (IDP), Natural Systems (NS), Livable Buildings (LB), Precious Water (PW), Resourceful Energy (RE), Stewarding Materials (SM) and Innovating Practice (IP). Three rating stages have been established: the design rating system, the construction rating system and the operation rating system all of this three rating is important (PBRs, 2010).

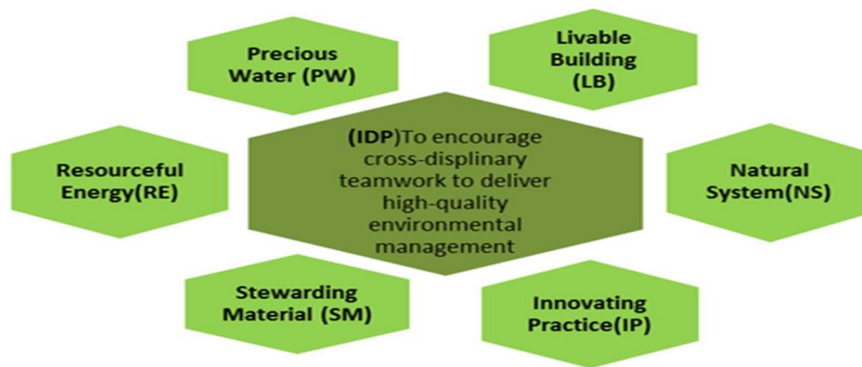


Fig.1: The seven main credits of the ESTIDAMA rating system for implementing Green Building Procedures.

3. CURRENT GREEN BUILDINGS IN UAE

Abu Dhabi is one of the cities that follow and implement Green Building procedures for saving energy, water and cost. In the UAE, which has one of the highest per capita water and energy consumptions, individuals are expected to make a considerable contribution to decreasing their consumption. Indeed, a united community effort to achieve this may eliminate the need for new power and desalination plants to be built. The average consumption of water per person is 350 to 500 liters per day. If every one of the 4 million population of the UAE were to decrease their water consumption by 3.5 liters per day (about 10% or less), 14 million liters could be saved every single day (EmiratesGBC, 2012).

USGBC said it had more than 80 member organizations in the UAE, and that the country has the fourth-largest number of LEED-accredited construction professionals in the world behind the US, Canada and China. (Issa & Al Abbar, 2015) as shown in Table 1.

Table 1: UAE on the List of Top 10 Green Building Nations (Issa & Al Abbar, 2015)

Nation	GSM of LEED-certified space (million)	Total GSM of LEED-certified and registered space (millions)	Total number of LEED-certified and registered project
Canada	17.74	58.66	4,068
China	14.30	96.22	1,638
India	11.64	66.22	1,657
South Korea	3.84	16.61	242
Taiwan	2.98	6.97	114
Germany	2.90	7.32	365
Brazil	2.85	23.24	829
Singapore	2.16	3.86	91
United Arab Emirates	1.82	47.16	850
Finland	1.45	3.56	148

The importance of applying Green Building procedures in Abu Dhabi could help in reducing fossil fuel energy consumption with a proportion of energy production shifting to renewable sources. Reduction in water usage is also a primary focus due to the amount of fossil fuels currently used to desalinate seawater, along with the residual air pollution and brine production that this entails. Waste infrastructure is now being developed along with the supply of sustainable products to reduce the quantity of waste being sent to landfill and to deal with legacy waste deposits. With ESTIDAMA, Abu Dhabi is making a positive contribution to the global need for sustainable development by focusing on the four pre-defined pillars of economic, social, cultural and environmental sustainability which echo the Bedouin ideals and historic ecological and cultural principles. Abu Dhabi may well be on its way to nurturing a first generation green society (Abu Dhabi UPC, 2010), which is in line with the EmiratesGBC vision for the UAE as one of the 5 global leaders in the reduction of the built environment's ecological footprint by next years (EmiratesGBC, 2012).

4. RESIDENTIAL BUILDING IN ABU DHABI

In the 1970s, Abu Dhabi was planned for a maximum population of 600 thousand. According to what was considered to be perfect urban planning at the time, the city has high-density tower blocks and a wide network of roads. The maximum population density is located on the northerly end of the island. The main streets are lined with twenty- to thirty-story buildings or towers. In this area of towers there is a typical network of roads with lower density buildings between two-story villas to six-story blocks. Abu Dhabi's Urban Planning Council was established in 2007 and is responsible for Abu Dhabi's future urban environment and is the expert authority behind Abu Dhabi Plan 2030 to enhance the city's development through a twenty-five year program of urban improvement (Abu Dhabi Vision 2030, 2011).

Due to the rapid development in Abu Dhabi, some challenges to the organization of the city's urban environment have developed: today, the population has increased dramatically compared to the original designed maximum population resulting in traffic congestion and car parking shortages and overcrowding in the city center (Abu Dhabi Urban Planning Council, 2011). Residential building numbers in Abu Dhabi have rapidly grown since 1968, as depicted in Figure 2.

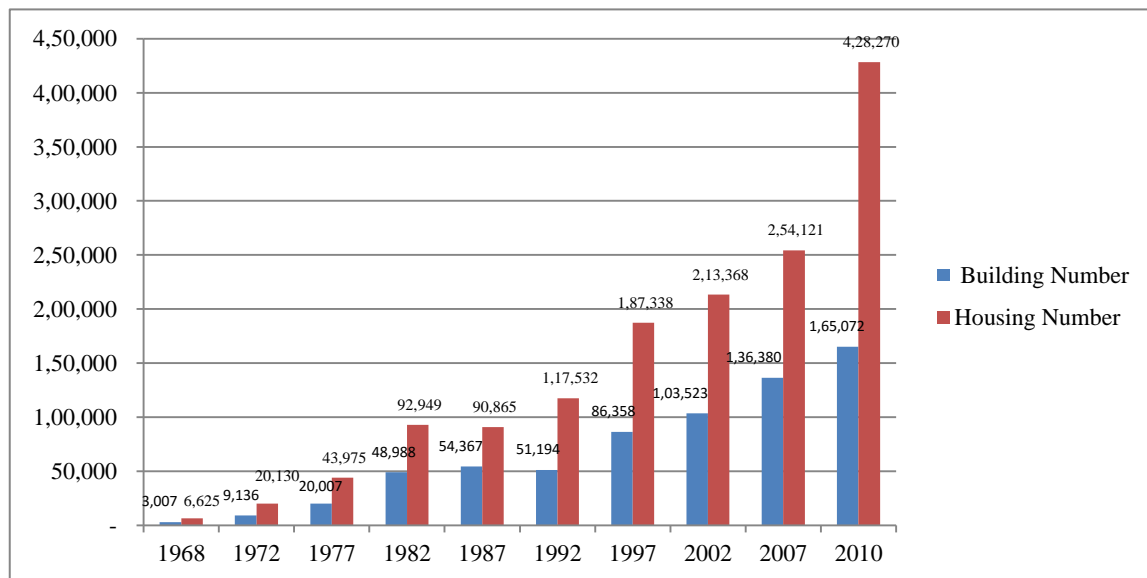


Fig. 2: The growth of building and housing in Abu Dhabi from 1969 up to 2010 (Abu Dhabi, 2010).

4.1 Residential Building Development

Recently the Abu Dhabi Government has strongly focused on planning and building high-quality, modern, sustainable homes that build on Emirati traditions and heritage. These developments consist of communities of flexible and adaptable homes with a network of pathways and streets that link people to places and community services that meet the requirements of the residents along with open places for meeting and recreation; in short they support a lively and cohesive society. The new housing provides around 5000 homes for Emirati families (shown in Figure 2.7) in nine different types of villas in Al Falah, 1,372 luxury villas in Khalifa City A, 488 villas on Yas Island (Phase I), 2000 Emirati villas in Ain Al Fayda, 600 villas in Al Ghuraibah (Phase I), 422 villas in Al Ghuraibah (Phase II), 3000 villas in JabalHafeet and a 448-villa development in Sila'a (UPC, 2010).



Fig. 3: Emirati Houses-The Wind Tower Barajeel in Dry and Hot Region (AUPC, 2010).

5. GREEN BUILDING ADVANTAGES

Green buildings and sustainable buildings save money because they conserve resources and enhance efficiency through:

1. Controlling energy conservation and efficiency by optimizing building orientation and integrating natural daylight and ventilation inside building.
2. Using natural insulation such as roof gardens and sustainable materials.
3. Using a new technology such as solar panels, fuel cells.
4. Conserving water and reducing run off using solar water heating, contour landscaping, and water conserving or water-recycling methods.

Green buildings technology reduces the environmental impacts by:

1. Using materials that are selected based on their life-cycle environmental impacts and good for high quality.
2. Making use of renewable energy resources to meet the sustainable requirements for the building.
3. Reducing the use of mined rare metals and persistent synthetic compounds
4. Applying reduce, reuse, and recycle to materials in all phases of construction and demolition in all stages of project.
5. Reducing harmful waste products produced during construction and recycling.

Green buildings enhance occupant safety, health, and comfort:

1. Eliminating toxic and harmful materials and finishes through building process.
2. Applying maintenance and operational practices that reduce or eliminate harmful effects on people and the natural environment, location safety and Employing personal, local control over temperature, air flow, and lighting.

6. ESTIDAMA PEARL BUILDING RATING SYSTEM (PBRS)

PBRS rating has the compulsory and optional credits, for each section there are points that given for each optional credit obtained. To achieve a 1 Pearl rating, all the compulsory credit requirements must be met. To achieve a higher Pearl rating, all the compulsory credit requirements must be met along with a minimum number of credit points (PBRS, 2010). While, the number of credit points obtainable in a given section defines the weighting of that section, as shown in Tables (2,3).

Table 2: Pearl Building Rating levels (AUPC, 2010)

Requirement	Pearl Rating Achieved
All compulsory credits	1 Pearl
All compulsory credits + 60 credit points	2 Pearl
All compulsory credits + 85 credit points	3 Pearl
All compulsory credits + 115 credit points	4 Pearl
All compulsory credits + 140 credit points	5 Pearl

The Pearl Building Rating system (PBRS) and Pearl Villa Rating system(PVRS) includespecified Credit Points Available for Each Section as shown below:-

Table 3: Maximum Credit Points Available for Pearl Rating System (AUPC, 2010)

Sr.No	PRS categories	Description	Maximum Credit Points For(PBRS)	Maximum Credit Points For (PVRS)
1	Integrated Development Process (IDP)	Used for cross-disciplinary teamwork and is based upon sound thinking to provide good quality ecological management during the life of the project.	13	10
2	Natural Systems (NS):	Anticipated to enhance the control of natural resources and sustainable land usage through analysis and valuation of all natural systems on the site.	12	5
3	Livable Outdoor (LBo) and Livable Indoors (LBi)	Encouraging the provision of outdoor space - private, as well as public - to encourage active urban environments. The livable indoors credit aims to create comfortable environments such as ventilation quality during normal building operation.	37	15
4	Precious Water (PW)	Design and Construction contains the building water calculator that helps in identifying how and where decreases in the use of potable water may be made.	43	21
5	Resourceful Energy (RE)	This focuses on reducing the demand for energy through passive environmental design, suitable selection of highly efficient mechanical and electrical equipment and the enablement of renewable energy systems.	44	21
6	Stewarding Materials (SM)	This helps design and improvement teams to consider the entire continuum of the life cycle when choosing and identifying materials, with an overall objective to develop the community and ecological outcomes.	28	18
7	Innovating Practice (IP)	IP encourages the development's success and contributes to sustainability in the UAE through addressing the pillars of sustainability through innovative design solutions.	3	3
Total			177	90

6.1. The Pearl Rating System Preparation Steps:



Fig. 4: The Pearl Rating System Preparation Steps (Abu AUPC, 2010)

For the (PRS) the processes for implementing green building procedures is, the first step is the Pearl Rating Process (PRP) and the second one is the Development Review Process (DRP) (AUPC, 2010).

- (i) **PRP** designed to be a simple and active way of learning to evaluate the sustainability of a specific development. The general stages that developers and consultants in the process must follow are summarized in Tables 4, 5 and 6
- (ii) **POR** is two years after construction completion, after a building has reached a minimum occupancy of 80%, submissions can be prepared for the Pearl Operational Rating which is currently under development by ESTIDAMA and UPC.

Table 4: All Pearl Ratings (AUPC, 2010)

Steps	Requirements
Step 1	Register the development with ESTIDAMA for the relevant Pearl Rating System.
Step 2	Appoint a PQP to facilitate the rating process and co-ordinate the submission.
Step 3	Conduct workshops in compliance with the ESTIDAMA Integrated Development Process (EIDP) with facilitation by the PQP.

Table 5: Pearl Design Rating (AUPC, 2010)

Steps	Requirements
Step DR4	Review and update credit submissions on a regular basis throughout the design process.
Step DR5	Issue the final design credit submissions to ESTIDAMA at the end of the construction documentation stage.
Step DR6	The submission will be reviewed by a Pearl Assessor, who may request clarifications or additional information from the PQP as necessary.
Step DR7	The Pearl Assessor will award a Pearl Design Rating based on the credits achieved by the development.

Table 6: Pearl Construction Rating (AUPC, 2010)

Steps	Requirements
Step CR4	Review and update credit submissions on a regular basis throughout the construction process.
Step CR5	Issue the final construction credit submissions to ESTIDAMA after construction is complete.
Step CR6	The submission will be reviewed by a Pearl Assessor, who may request clarifications or additional information from the PQP. ESTIDAMA reserves the right to undertake on-site verification if deemed necessary.
Step CR7	The Pearl Assessor will award a Pearl Construction Rating based on the credits achieved by the development.

7. COMPARING ESTIDAMA PEARLS RATING SYSTEM TO LEED, BREEAM

Understanding the differences between the ESTIDAMA Pearls Rating System (PRS), BREEAM, LEED, Green Star and MGBC is required to understand the history of each one of the five systems. The (PRS) is a government initiative approved by the Abu Dhabi Urban Planning Council (AUPC) and issued in 2010 (Moktar, 2012). Secondly, the British Research Establishment (BRE) was a government supported research body when BREEAM was established in order to deliver pertinent information and research to the construction industry about the types of method that best support sustainable development and environmental protection in UK (Kubba, 2010). Thirdly, the USGBC is a national non-profit membership body, including around 20,000 member establishments. Since its commencement in 1998, LEED has worked to change the building market using a harmonization approach and implemented a commercial method to market itself. LEED is a listed brand name and a trade market (Cole, 2006).

The comparison above gives the idea that while the PRS is an independent rating system, it has numerous similarities with the LEED and BREEAM rating systems. ESTIDAMA seems to have selected certain fundamentals from these two systems between other bases of inspiration, but still provided a method that is distinctly local and quite progressive. The extent to which the market will adopt a system with such a great bar is yet to be defined as project teams engage with the system. The PRS focuses on post-occupancy assessment thereby showing that it has learned from other rating systems in creating a system that assesses consequences rather than intentions, and while performance assessment rating systems exists in the UK and in the US, their scope is independent from the Green Buildings Rating systems and limited to energy. Lastly, the mixture of enforceability of portions of Pearls and the integration of Pearls within ESTIDAMA's greater development framework which aims to encourage the efforts of the market-driven Emirates Green Building Council and support an Integrative Design Process, all have the ability to accelerate the market's acceptance of Green Building practices at a rate that is possibly will be in the UAE as more rapid than those seen in the US and the UK over the past 20 years (Karim, 2010).

8. CONCLUSION

The study evaluated the current situation of implementing green building procedures in residential building in Abu Dhabi by measuring many variables such as the understanding of green building procedures (ESTIDAMA) by construction firm, the impacts and benefits of implementing green building procedure, and the obstacles and challenges to the implementation of green building procedures in Abu Dhabi. Moreover, to identify the benefits of implementing green building for the residential building in Abu Dhabi, this research paper measured the variables of reducing water consumption, improving the efficiency of energy consumption, cost saving, improving benefits to humans & society, and improving the environment.

Evaluation of the implementation of the green building for the residential building in Abu Dhabi depends on the understanding of green building regulations (ESTIDAMA) for Residential Building in Abu Dhabi by construction firm and the government efforts to increase the awareness. Furthermore, it is important to measure the obstacles and challenges that facing the implementation of the green building procedure in residential building such as Lack in training courses, lack of professional expert green building design firms, lack of building material and information, lack of familiarity with green building procedures within the building firms, Costly and lack of understanding ESTIDAMA Frame Work and regulation. The findings from this study will be validated and compared with the relevant findings from Europe, USA, Singapore and also UAE that addressed in the next residential projects in Abu Dhabi.

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