# IMPLEMENTING GREEN DESIGN INITIATIVES IN THE UAE

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### Abstract

The drive for more sustainable built environment in the United Arab Emirates (UAE) received a significant boost in the period 2006-2008 supported by new legislations from the government and increased interest from major stakeholder especially municipalities. The absence of locally developed frameworks for evaluating sustainable design of buildings has created opportunities for the introduction of foreign ones. LEED has become popular in industry and has even influenced the current attempts to develop a local framework. The paper will report the findings of a research that, first, evaluated the effectiveness of LEED framework in dealing with local issues. Secondly the paper will examine two case studies where LEED was used in only one of them while both cases aimed to ensure the project development is sustainable. The analysis shows that "responsible design" produced more effective solutions for sustainability.

Keywords: Sustainable development, LEED, UAE, Responsible design.

# INTRODUCTION

The construction boom in the United Arab Emirates has created significant pressures and raised concerns about the impact of such boom on the environment and energy. This has prompted the local governments to issue directives and new regulations requiring all buildings in the major cities, such as Abu Dhabi and Dubai, to adhere to strict green standards prescribed worldwide

It is argued that global climate concerns can be largely alleviated by responsible design, may it be automotive, product, machinery or building design. Wann (1990) explains in his book *Biologic* that "environmental deterioration is a lack of relevant information [and that] poor design is responsible for many, if not most, of our environmental problems." It is not surprising that attention has focused on developing green building practices to substantially reduce or eliminate negative environmental impact of construction and operational practices. Reviewing design practices to that end may also contribute to reduce operational costs, enhance building marketability, increase worker productivity and reduce potential liability resulting from indoor air quality problems. Thus green design can have environmental, economic and social elements that benefit all building stakeholders.

Building design is heavily influenced by its geographical location and where architecture varies vastly from place to place in response to its regional context. The focus of this study is on designing sustainably and responsibly for the arid regions of Dubai. The inculcation of green design strategy made mandatory by governmental regulations in Dubai and the appropriate way of introducing and infusing them, into the pre-existing system is perceived as a challenge.

There is an opportunity to extrude applicable techniques from already developed practices elsewhere and identify opportunities for application in this region, taking into consideration the local, cultural and ecological conditions International rating systems like LEED have been used widely in Dubai and is seen by many, especially foreign consultants, as a valid tool to initiate the green journey

This study main objective is to evaluate the effectiveness of current effort to design buildings that are seen to be more environmentally friendly. Two case studies will be examined where in one of them LEED framework was used while the second case study worked without a reference to a rating framework.

### SUSTAINABILITY DECISION DRIVERS IN THE UAE

The unprecedented growth in the UAE construction industry in the late years coupled with its massive fossil fuel energy consumption has not escaped media attention. The LIVE PLANET report in 2006 revealed that UAE was responsible for the world's largest ecological footprint. World Wildlife Fund revealed that UAE was five times more unsustainable than any other country in the world.(Anon 2007, WSP 2009) It was observed that UAE had an Ecological Footprint of 11.9 hectares/person, while the global average is at 2.2 hectares/person and the sustainable average should be at 1.9 global hectares/person (Oehme, 2008).

In 2008, Dubai government released a directive proposing a regulation that requires all buildings in Dubai to adhere to strict green standards prescribed worldwide.(Sell 2007). Greening the future was the message delivered by the government of Dubai in its DM Circular 161 which underlines the fact that all buildings constructed in Dubai from the beginning of year 2009 shall conform to green standards.

The introduction of sustainability metrics should assist in turning the generic concept of green development into action. However, one must keep in mind that the fabric of the construction industry in Dubai is made up of a mix of small, medium and large sized local and foreign contractors, consultants and investors. The industry functioning under time and cost constraints largely depends on the cohesive symbiotic functioning of all of these diverse segments complementing each other to get the job done within desired project frameworks. Getting the message of the need for green development through, to these varied types of people involved, tagged with its high financial perception would be a matter of concern during actual implementation.

The difficulty also arises with the fact that LEED solutions were never designed to be used across multiple countries and often have features with a significant 'local' flavour. Hence the impact and effectiveness of the LEED system, which forms the basis of the proposed green regulations, needs to be critically analyzed as to whether these prescribed design

requirements suit the local context of Dubai. The next section will examine the applicability of LEED guidelines and their implementation in Dubai's construction projects.

# EFFECTIVENESS OF LEED IN DEALING WITH LOCAL ISSUES

Climate responsive design has been the underlying principle while identifying green building design elements. By understanding climatic conditions that are specific to a project's location, design teams are able to develop climate responsive sustainable building designs. Positive climatic attributes are enhanced and unwanted impacts are eliminated through careful design consideration. The result is a building that utilizes less energy and provides high quality and a comfortable environment for the occupants. Broadly, the UAE is defined as having a tropical desert climate, with high humidity. It experiences two distinct seasons: a hot summer at 50°C (120 °F) (May to October), and a milder winter ranging from 10°C (68 °F) to 25°C (77 °F) (November to April). Wind speed is generally quite high, and its direction variable (Arup, 2004). This air movement can be enhanced through responsible design to create desirable comfort conditions.

Sustainability criteria defined in LEED are evaluated in the local context and each of these parameters is explained in below.

### **Environment and Planning criteria**

The selection of an appropriate site has the biggest impact on a sustainable design. LEED stresses upon the utilization of previously developed land and brown fields for new developments and discourages new land development. Most of Dubai's land is undeveloped and only 20% of the emirate has been occupied so far (WSP, 2008). Hence it is not appropriate to restrict development to previously developed sites as against virgin land. However, preference should be given to developed sites as their infrastructural requirements will be limited leading to minimal environmental disruption. The availability of land in Dubai makes brown fields unattractive for development.

In Dubai, site selection is often based on the commercial viability of the location. Though connectivity is an important aspect it is not always a driving factor for site selection as most of the city commutes through privately owned vehicles. Besides care should be taken not to exploit the natural ecology by restricting developments along Creek area, land connecting to the mangroves which form habitat for migratory birds; along the beachside which are already over developed, desert zones with wildlife and such sensitive zones.

Building orientation in Dubai is in response to the adjacent development like roads or natural/manmade beaches to maximize commercial viability. The lack of natural landforms and expansive desert land has restricted the articulation of the building's architectural form. This is where the need for climate responsive design becomes critical and LEED pointers come in play. Accordingly landscaping should be planned to enhance the design and utilize natural resources to create comfort zones in design. Monotonous desert sprawls in the UAE are often landscaped mainly with turf grass lawns and high maintenance plants in discontinuous patches providing little relief from the building mass. The concept of a thoroughly thought building footprint has never been relevant. Much help can be sought by following the LEED principles. LEED credits for building orientation, planting hardwood trees, north facing windows, native vegetation, shadow profiling to mention a few could be most popularly used and are apt to be applied in Dubai.

LEED propagates minimal environmental disruption from a building footprint onto a site. Common issues faced in the region like heat island effects, reflected glare etc can be reduced by designing the building with underground parking hence reducing the building footprint. LEED suggests placing parking under cover like multistory, subterranean or shade structure or utilizing a parking deck. Parking facilities and roadways have negative impacts on the environment because impervious surfaces increase storm water run-off while contributing to urban heat island effects. Encouraging the use of mass transit reduces the demand for transportation thereby reducing the space needed for parking lots, which encroach on green space on the building site (USGBC, 2007).

Dubai also has the highest rate of car ownership in the world. LEED advocates various strategies to reduce the impact of vehicles, promote fuel efficient cars, car pooling and other alternative travel options. Alternative transportation are currently being reviewed and promoted by the government. One among them is the encouragement for the use of bicycles, as most new communities are being designed as being bicycle friendly. RTA has been instrumental in setting up Bicycle Network Master Plan that will be implemented in stages from 2008 (Noort, 2008) providing 1300 kms of cycling paths, as part of the 2015 strategic vision. To ensure the success of this strategy, it is important to provide amenities like bicycle storage and showering areas as support facilities as advised in LEED.

UAE has large urban sprawls of paved area under constant sunlight. In addition, hot air released from air conditioning units contributes to warming up of built spaces, leading to Heat islands (WSP,2008). The LEED point for Green roofs can be used efficiently here to reduce heat island effect by replacing heat absorbing surfaces with plants, shrubs etc for their insulating and aesthetic benefits. In the UAE this point can be altered to form Cool roofs wherein plant matter is substituted with photovoltaic panels or solar hot water collectors to utilize the enormous heat energy available.

Similarly photo pollution is a problem, arising from the reflection of excessive building lighting utilized commonly seen in this region. LEED suggests to classify projects as per lighting zones and to design accordingly. This should be adopted at design and a regional sensitivity to determine the type of environment the project falls under and then the design evaluated. Carefully designed exterior lighting solutions can reduce infrastructure costs and energy use.

# Water efficiency

UAE has one of the highest water consumption levels in the world due to climatic conditions and high per capita income (Chaudhury, 2005) though the country has virtually no natural supply of fresh water. Per capita demand in the UAE has been estimated at 378 litres/day compared with the international benchmarks of 189 - 265 liters per day. LEED water efficiency credits aims at reducing potable water consumption and generated wastewater volumes which can be applied effectively to this region.

Desalination, an expensive and energy intensive process, provides much of the potable water. Considering the extensive amount of energy and infrastructure invested in providing potable water, the careful use of water should be enforced through policies and awareness should be brought about amongst the public about water conservation. LEED credits on high-efficiency fixtures, use of automatic fixture sensors, metering controls, occupant sensors, flow restrictors, reduced flow aerators on lavatory, low consumption fixtures for sink and shower, dual-flush water closet and ultra low flush urinals, dry fixtures such as composting toilet systems and non water using urinals, should be employed to cut down wastewater volumes.

In the arid region of UAE where fresh water is scarcely available LEED advocates the need for reusing recycled gray water for non potable activities, which is now actively taken up by the government. The Dubai Municipality (DM) has an established network to distribute treated sewage effluent (TSE) and has undertaken, in conjunction with Dubai Electricity Water Authority (DEWA), to provide TSE to any new district cooling plants and community landscaping if required (DM, 2009). Building design should incorporate gray and storm water for non-potable applications such as toilet and urinal flushing and custodial uses. Similarly all car washing facilities can recover and reuse their wastewater.

The high humidity in Dubai results in significant amounts of condensate being produced by air conditioning equipment. Rather than draining this water into the sewer system, condensate can be captured and used for irrigation and other various non-potable water applications on site. One of the largest condensate recovery systems in the world has been incorporated into the design of the Burj Dubai (WSP,2008).

In Dubai, large amount of potable water is consumed in irrigation practices. Plants which are better adapted to hot arid climate, better known as Xeroscapes, consume less water and should be incorporated in the design along with night time irrigation with the help of experts in the field. Design should minimize the amount of land covered with turf due to its high water requirement. A large number of golf courses proposed in the UAE, are with expanses of green water-consuming turf.

### **Energy efficiency**

Dubai has the world's highest per capita energy consumption at 20,000kWh per year (Sinclair, 2008). Ventilation and air conditioning in Dubai's buildings has been shown to account for up to 60% of the total energy consumed in buildings (DM, 2009). The thermal performance of the building envelope is one of the main drivers in determining what the cooling load and resultant energy use will be. Hence it is important to consider the design of building envelope with primary significance. LEED, as well as DM, prescribes strict U values to adhere to, for Building thermal insulation.

The energy use of buildings are closely related to their size, use, the way they are operated, their construction characteristics, shape and of course the climate. The hot temperatures and humidity in UAE, necessitates that all buildings require air conditioning and mechanical ventilation to be installed. Mixed mode systems combining natural and mechanical ventilation should be encouraged as for five winter months of the year the weather is pleasant and air conditioning can be optional.

In Dubai's humid climate insulation plays an important part in reducing the heat exchange between the inside and the outside environment as well as the formation of condensation. Building envelope requirements should be based on UAE's climate zone 1A classification and must meet the minimum insulation and maximum U value and *Solar Heat Gain Coefficient* (SHGC) requirements listed by the DM. Better thermal performance by incorporating building entrance vestibules and thermal bridges at floor junctions and connection points of the building envelope will reduce the energy demand for cooling and prevent energy losses.

On the onset of a design programme it is essential to set minimum energy efficiency requirements for the project, for all the proposed building systems by complying with the mandatory provisions of ASHRAE Standard 90.1-2004 for the climate zone of 1A (Rogers, 2008). Design to accomplish energy demand reduction by optimizing building form and

orientation. Strategic planting can shade the building which can decrease cooling loads during warm months.

Due to the large temperature differential between the incoming and outgoing airstreams, such as that exists in Dubai, abundant waste energy can be recovered through exhaust air energy recovery systems, gray water heat recovery systems and cogeneration. Ducts, supplying conditioned air must be insulated to minimize heat loss and prevent condensation. TSE provided by the Municipality should be used for water cooled HVACs.

There is a growing demand for economical cooling alternatives in the UAE, such as District Cooling towers (Dubai News Online, 2008). The incorporation of district cooling should be an integral part of the building design. It helps to displace bulky equipment from the building facade and roofs as is often seen on Dubai. Thermal storage systems should be included inorder to offset energy demands from peak to off-peak periods and reduce electrical costs. Refrigerant management is often a concern with high volumes of air conditioning. The design should avoid the use of CFC-based refrigerants as CFC causes depletion of the Ozone layer.

Onsite renewable energy is gaining popularity worldwide. However there are difficulties associated with implementing it here in Dubai, as the technology is not developed sufficiently for it to be more cost effective than conventional energy sources, making it difficult to convince the market to invest in it. While companies like MASDAR are aiming at using an array of renewable sources, mainly PVCs for electricity generation to utilize the potential of the hot summer sun. The maintenance of Photovoltaic cells should be considered at the design stage and provisions made for the same. In the desert conditions of UAE, with high dust content and high humidity in the air there is a buildup of dust on the solar collector panels. This requires regular cleaning as the dust reduces the efficiency of the system.

Similarly, solar water heaters can be widely used. Solar Hot Water systems are the most cost effective means of using the power of the sun. Residential buildings, hotels, villas and labour accommodation with consistent need for hot water, and their large roof expanses can make the most of this technology. Design should consider incorporation of solar hot water systems as this will have a significant reduction on electricity usage.

#### **Materials & Resources**

Dubai is facing significant challenges associated with waste generation and disposal. Design of individual buildings should facilitate the appropriate collection and disposal of waste by sorting and reusing at preliminary levels. All efforts should concentrate on minimizing waste. Recognize that there is no such thing as waste, only resources out of place.

Along with the regulatory guidelines from DM, LEED construction credits for diverting waste from landfills, recycled content and the reuse of materials in design should be applied. Waste should be segregated at disposal and central collection and storage facilities provided during design. Provide sorting and storage facilities for recyclable materials. Involve local haulers to provide waste management services. Hazardous waste should be disposed as per regulations with authorized agencies.

Identify opportunities to incorporate salvaged materials into building design. Establish a project goal for recycled content materials and identify material suppliers that can achieve this goal.

LEED encourages the use of locally sourced materials to promote local economy and provides impetus for growth. This may not seem very relevant now in UAE, but with the

proposed development envisaged for the manufacturing units, it may be a potential design consideration in time to come. Some of the regional materials available here in the UAE are glass, cement, concrete, ceramics which should be locally sourced.

Similarly Forest Stewardship Council's (FSC)certified wood for wood building components and lower grades of wood (grade 2 or 3 for lumber or veneer rather than grade 1) should be specified in design to reduce pressure on forests.

#### Air quality management

Dubai faces high levels of pollutions from man-made sources like motor vehicles and fossil fuel burning power stations, dust from construction and other such activities. Particulate matter, suspended in air found in desert regions are typically higher during the summer months due to more unsettled weather conditions and higher air temperatures. During building design high level filtration system should be employed in air handling units processing both return air and outside supply air. Design permanent architectural entryway systems to limit the entry of pollutants into the building.

With enclosed buildings and recirculating air in Dubai, it is necessary to monitor and improve indoor air quality with adequate ventilation requirements. Design should provide adequate ventilation with focus on cross ventilation. All naturally ventilated spaces shall be manually operable openings. CO and CO2 should be constantly monitored in car parks with constant outdoor air supply to car parks.

A governmental regulation has restricted smoking in public places and smoking rooms must obtain permit to allow smoking. Locate exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows inorder to prevent ETS intake during outside air intake. Locate designated smoking rooms to effectively contain, capture and remove ETS from the building.

Rooms with pollutants like ETS, chemical storage room, printing area etc must be directly exhausted to the outdoors with no re-circulation of return air and enclosed with impermeable deck-to-deck partitions.

Specify low- VOC materials in adhesives, paints and coatings and sealants. Assemblies that contain no added urea-formaldehyde resins are preferred.

A typical Dubai building has glazed facades with no shading structure. This results in higher cooling loads and increased energy consumption. In addition, excessive brightness contrast between externally lit surfaces and building interiors causes visual discomfort. This is altered by switching on internal lights permanently, leading to unnecessary energy consumption.

A well considered daylighting approach in buildings will not only reduce the incidence of glare and discomfort but also reduce the need for electrical lighting if part of an integrated daylight strategy with lighting controls and external shading devices. Blinds and shading fins helps in reducing solar gains in the buildings and is an old popular and efficient technique used in building design of all temperate regions. LEED recommends direct line of sight to the outdoor environment via vision glazing to achieve a minimum glazing factor of 2% in regularly occupied areas. This needs to be carefully incorporated along the north facade in Dubai considering the heat gains from exposed glazing and high occupant loads. Also allow for comfort control adjustments to suit individual needs or those of groups in shared space. Integrate individual controls with occupancy sensors.

#### Vernacular design features

The architecture of today calls for 'a modern vernacular that is inspired by a responsive and sensitive balance between the knowhow and wisdom of the past and that which is sustainable, yet modern.' Vernacular design critically examines the possibilities of implementing local know-how in both a developmental and modern context. In response, contemporary Gulf architecture should be about applying tradition, culture and modernity in equal parts, to create something that is undeniably 'Gulf' yet clearly modern.

A traditional design takes advantage of the existing natural resources. Passive building design and material choices that avoid absorption of the sun's heat to promote thermal comfort and energy conservation, are traditional methods used by early inhabitants of UAE. Dubai's traditional buildings, like the ones at the Bastakiya have light coloured exterior finishes and they help in reducing energy use. Light exterior colours with high SRI are highly recommended.

It is common to see water features in the UAE used for aesthetic enhancement. Well maintained water features checked regularly for Legionella bacteria prevalent in this region due to high humidity, can be incorporated to promote passive cooling during the hot summer months. Water bodies add to the humidity levels during the summer months, causing further discomfort, hence their usage thoughtfully designed.

Courtyards provide relief by creating negative pressure zones hence attracting air movement as well as creating interesting interactive spaces. These along with wind catchers can be positioned to trap and filter breezes aiding natural ventilation during the cooler months of the year. Mechanical controls can be incorporated to shut off or promote air circulation.

# THE CASE STUDIES

Case studies are carried out in an attempt to understand the application of the principles and ideas reviewed above elements in project design and execution. Vast amount of information and project management techniques can be learnt from the practical experience gathered in case studies. Two projects were taken up to evaluate the current practices in green design and identify good practices.

The first project is a five star luxury beach resort in Dubai proposed to be a LEED accredited building. This is analyzed against evaluated LEED principles and compared against the list of green elements compiled from the study. A check list with reasoning for each of the elements was prepared and sustainability measure of the project verified. As the building is designed to be LEED rated, various design credit elements have already been incorporated. However, from the check list responses it was noticed that the five star nature of the project and the associated security and quality issue perceived has, in certain cases made it difficult to address a number of the sustainability criteria.

The case study revealed that a large number of design and execution points learnt in the planning techniques have been implemented to the design process of this resort building. A number of procedures have been put in place through an integrated design process to ensure the successful implementation right from the design stage. Careful execution forms a very important part for the success of the green initiatives endeavored in this project. A few

notable design measures implemented to increase the sustainability credentials of the Project include

- Translocating trees for reuse rather than removal;
- The use of native, desert adapted plants
- Cool roofs with solar thermal water heaters
- Graywater recycling through water saving shower heads, taps and low flush toilets etc;
- Energy saving technologies, such as insulation, building orientation, shading and energy saving bulbs;
- Use of locally sourced materials where possible,
- Waste management strategies during construction and operation;
- Sourcing of local and sustainably grown goods
- Sustainable transport linking of public transport systems to the Project
- Using savings on road and service infrastructure to invest in more energy efficient buildings, renewable energy systems and sustainable water management.

The need for no new infrastructure to be placed, due to the existence of the prior resort facility, has been a bonus to the site as no major excavation and laying of infrastructure lines is now required. The large expanse of building footprint spread all across the site necessitated by the nature of resort buildings, has disturbed the natural state of the site. Though this sort of spilling of building masses is dictated by the typology of resort building, careful addition of native planting and the restoration of existing site plant material being wisely incorporated in the landscaping scheme has added value to the quality of natural eco system created within the resort premises. An attempt is made to minimize disturbance to the eco system and factors to sustain and promote the existing system are put in place. Pointers from the sun and wind directions study have been utilized to enhance interior occupant comfort levels, which is seen through the in-corporation of architectural elements like a cascading roof providing shelter from the south sun, permanent manually adjustable wooden louvers and blinds, intermitted water bodies positioned in the flow of wind etc. Due to the lack of practice of sustainability elements within the region, there are no suppliers to provide specific green products. Local materials are very few and those available are not cost-effective.

It is noticed that sustainable design elements form an overarching component of the Project, and is considered in all aspects of the project design and execution. LEED is used to guide the Sustainable design process in which water, energy and resource demands as well as waste are attempted in being reduced without affecting the overall experience of the building and surrounding landscaping. To ensure efficient co-ordination between all team members, an integrated design approach was employed and LEED design workshops were help frequently. A LEED coordinator was essential in facilitating the progress of the design. The most difficult aspect was to reach at an environmentally friendly design while making sure that the commercial benefits were not impacted. On the whole this project is a good example of sustainable building design in practice in Dubai.

In the second case study sustainability was driven by what was considered to be "responsible" design. This project is a resort shopping destination (figure 1) within the urban city sprawl. It is a low rise building with a canal forming a central water body and smaller fragmented building masses connected to the main building through bridges facing the creek which ultimately culminates as the quayside.

This project was conceived in 2003; before the trend of green architecture and sustainability came about to Dubai. Nevertheless it was still considered as an excellent example of the use of passive elementary architectural features, which are easy to maintain and operate. Many systems and architectural elements were specifically designed to accommodate local conditions and create comfort zones.



Figure 1: Mall Building Composition

This case study was compared against the green elements shortlisted through the study of sustainable techniques. Some of the outstanding sustainability elements incorporated are discussed in below.

The creation of Microclimate by intelligent planting, features like cool walls, topiary misting, waterfalls, shading devices like Teflon coated canopies, building mass shading, drop down shades and temporary screens, green roofs and wind shield structures is highly notable. Modifying factors like the air and radiant temperatures, wind conditions and humidity helps create microclimates for comfortable external spaces.

The microclimate zones are provided with fully shaded walkways (figure 2) with reflective canopies that provide shelter from occasional rainfall. By providing additional surfaces such as cooling walls, planting and grass cover, the resultant temperature has greatly improved. In addition, high thermal mass of surrounding walls aid the pre-cooling process keeping the outdoors ambient.

To encourage air exchange, lightweight fans are situated below holes in canopy frame reducing heat sensation significantly. The traditional internal courtyard provides good shading by virtue of the enclosing buildings, and is aided by relatively small overhangs. Water features and planting provide local evaporative cooling, and are most effective when the relative humidity drops, typically mid-afternoon. The courtyard effect is achieved in between the building masses, at the canal walk and between building blocks, where shading is provided by the buildings and air movement is triggered by the stack effect.

In order to protect the space from uncomfortable wind conditions, planted trellises are used as wind breaks. High levels of planting and a green roof used reduces surface temperatures and offer shading.

Water features used intermittently and abundantly throughout the project provides relief from hardscape. Light coloured deep shaded pools help to lower the temperature of the water body. Sun protection is provided by building overhangs after a computer generated shading model

was studied. Drop down shades, temporary screens, awnings and trellis have been used to mitigate the sun.



Figure 2: Cooling of the canal side

The external envelope consists of high performance insulating glass units with solar control tempered glass and ceramic fritting where required to reduce glare. External walls are of natural stone, ceramic tiles, terracotta tiles used to reduce energy losses. Most of the components can easily be recycled at the end of their design life for reutilization.

The analysis shows that sustainability was not a guiding factor during the planning stages neither was it not considered as one of the primary aims of the project, yet best practices were employed in all sectors of design which in itself incorporated sustainability elements. No benchmarks for green building design were set at the conceptual design stage, however a design in response to climatic conditions was a part of the design brief. Enhancing the comfort level of occupants and providing a comfortable pleasant outdoor and indoor ambience was a design need. This necessitated the need to consider the environmental impact while designing unlike typical Dubai buildings. A detailed climatic study with the movement of sun, temperatures, wind, the impact of the large creek water body and associated humidity factors were considered.

Creation of a controllable Microclimate is an effective strategy that can be implemented in Dubai. Passive techniques, inspired from vernacular local architecture should be implemented as being a low-tech, low maintenance sustainable design feature. Though not all aspects of green design are considered in this project a variety of design recommendations found in LEED design submittals are covered. The mall, currently operational since 2 years, is very popular with heavy footfall and high retail sales. The popularity of this recreational destination speaks in itself about the success of comfortable sustainable design conditions that the consultants have attempted to create and succeeded.

This case study demonstrates that the use of a rating system is not essential to ensure that sustainability factors are achieved. Responsible design along with an awareness of the deteriorating environment and concern for minimizing consumption is the need of the hour. The project inculcates basic design criteria for good responsible design with worldwide best practices being adhered to. Along with it are age old proved and recommended techniques of wind catching, courtyard effect, water body enhancement and passive shading elements infused into the design to suit the contemporary context of a modern shopping mall. The resultant is a user friendly, eco-friendly sustainable development which responds to its duty of environmental wellness.

### DISCUSSION AND CONCLUSION

The case studies showcase that when we talk about green buildings, we are really talking about redesigning the design process – rethinking everything from the place to the schedule and pace of design.

Lessons learnt include that additional time and procedures need to be invested to formulate procedures and systems customized to individual site conditions. Thoughtful specification forms an important part of design development. It was also learnt that the Municipality procedures and infrastructure in place, like hazardous waste treatment facilities, an extensive TSE network to name a few, are very beneficial and aid the Green building design intent. The propagation and popularity of such projects will gradually tune the supply market too, for obtaining local and fair trade materials and stimulate the usage and market for green products and eventually successful green buildings.

Both the case studies highlighted the need for input from all members of the design and construction team. Building design requires the integration of many kinds of information. The construction industry is commonly characterized as technically and organizationally fragmented (Kaatz et al.2005 cites Egan,1998). This fragmentation is a key factor preventing a tangible transition to sustainable construction (Kaatz et al.2005 cites Sheath et al., 1996; Lee et al., 2000). In integrated design, process stakeholders are brought together at the earliest practical point in order to develop and execute a common project vision. These meetings create a communication space, where stakeholders work in close co-ordination and develop mutual understanding and trust. Integrated design clarifies client goals, design options and solutions, which allows for achieving the intended building performance.



Figure 3: Elements of an Integrated Design (WBDG Aesthetics Subcommittee, 2009)

Good buildings result from an appreciation by all involved of the importance of formal consistency throughout the design. Every successful mission, in any field of work, relates to the consistent sincere commitment of all members of a team towards an integrated goal. The same holds true for our buildings.

# REFERENCES

Anon. 2007, *Sustainability- Construction Week Special Report No.5*, December, Arabian Business.com; An ITP business publication.

Arup, 2004. Microclimate analysis and design, Shopping Mall- Dubai, Toronto: HOK .

Chaudhury Das Moushmi. 2005, UAE water consumption one of the highest in the world [online], *Khaleej Times*. 22 July, Available from: <u>http://www.khaleejtimes.com/DisplayArticle.asp?xfile=data/business/2005/July/business\_Jul</u> y470.xml&section=business [Accessed 20 June 2009]

Dubai news online. 2009, Palm District cooling pursues long-term strategic plan to leverage growing demand for economical cooling alternatives [online], *MCOnet International*. 26<sup>th</sup> February, Available from:

http://dubai.mconet.biz/index.php?action=fullnews&id=459537&category=886&category\_na me=dubai\_news [Accessed 20 June 2009]

Kaatz Ewelina, Root David and Bowen Paul. 2005, Broadening project participation through a modified building sustainability assessment, *Building research information*, 33(5), pp. 441-454

Noort, P. 2008, Dubai Bicycle Masterplan Implemented. Sustainable Mobility -The Way To Go [online], *Velo Mondial*. January 21. Available from: <u>http://velomondial.blogspot.com/2008/01/dubai-cycling-master-plan-to-be.html</u>

Oehme, S. 2008, *Sustainable Design and construction: Connecting the links*, Seminar on Sustainable design and construction, Abu Dhabi, 31 March,

Rogers, S. 2008, Build it Green Dubai, Dubai Municipality Conference, 10 August.

Sell, C. 2007, The changes that are afoot; *Sustainability- Construction Week Special Report* No.5, December, Arabian Business.com; An ITP business publication.

Sinclair, Z. 2008, Dubai Needs Renewable Energy, *Khaleej Times* [online], 5 October, Available online at:

http://www.khaleejtimes.com/DisplayArticleNew.asp?col=&section=theuae&xfile=data/theu ae/2008/October/theuae\_October89.xml [Accessed 4 July, 2009]

USGBC, U.S. Green building Council. 2007, *LEED for New Construction and Major Renovation Reference Guide*, Version 2.2, Washington DC.

Wann, D. 1990, *Bio Logic: Environmental Protection by Design*, Boulder, Colorado, Johnson Books.

World Wildlife Fund. 2006, *Living Planet Report*, Hailis. C, ed. Cambridge, Banson, Available from <u>http://assets.panda.org/downloads/living\_planet\_report.pdf</u>

WSP. 2008, Green Buildings Practice guides: Dubai ; DM and DEWA.

WSP. 2009, Environmental Impact assessment report: Beach Resort, Dubai. WSP.

WBDG Aesthetics Subcommittee. 2009, *Engage the Integrated Design Process*. Available from: <u>http://www.wbdg.org/design/engage\_process.php</u> [Accessed on 10July 09].