EVALUATION OF SUSTAINABLE SITE DEVELOPMENT OF SUNNY VIEW COMPLEX, LAHORE ACCORDING TO LEED RATING SYSTEM

By

Imran Tariq[1], Dr. Sabahat Alamgir[2] and Muhammad Arif Khan[2]

Abstract :
20th century brought the revolution in science and technology as well as in construction industry. Commercialization of inventions has truly changed the human lifestyle and dependency on non-renewable resources in turn increased remarkably. Modernization in construction industry and intention to build majestic structures stretched the technology to its limits, resulting in environmentally unfriendly buildings. Towards the end of 20th century the degrading environment and fast depleting earth resources, rang the bell to adapt to environment friendly techniques, reduce the dependency on non-renewable energy resources and construct sustainable buildings. In last decade of 20th century lots of rating systems for evaluation of sustainable green buildings were initialized, and LEED® was one of them. The scope of this paper is limited to evaluation of sustainable site development of Sunny View Complex, Lahore according to LEED® rating system. The project is evaluated and credited as per the LEED® parameter requirements, as part of term assignment course on Sustainable Building Structures, at Department of Architectural Engineering & Design at the University of Engineering & Technology, Lahore.

Key Words:
Construction, Green Building, Environment, Sustainable, LEED®

1. Introduction

20th century was the era of commercialization of inventions and industrialization. Discovery and exploration of fossil fuel has remarkably boosted the pace of progress, invention of diesel engine made it easy to transport experts, technology, materials and equipments from one country to another. Modernization in construction industry and intention to build majestic buildings has stretched the technology to its limits [1]. With the improved composition of structural steel, high strength concrete, new inventions in glass industry, new glazing and cladding materials, air conditioning and HVAC systems and artificial lighting changed the construction industry altogether. This resulted in environmentally adverse buildings, which are largely dependant on non-renewable energy resources and higher carbon foot prints to maintain indoor climate, hence increasing the operation as well as maintenance costs of the buildings [2]. Unlike the indigenous buildings, which were evolved over the years and were well harmonized to the local climate; these modern buildings are using mechanical means to control comfort level of occupants. Further the increasing property prices and growing population has forced the developers to utilize maximum possible space available. The rapid growth of cities and heat island effect phenomenon burdened the communities by higher summer time peak energy demands, air conditioning costs, air pollution, green house gas emission, heat related illness and mortality. Generally the heat island effect can increase the annual mean air temperature of a city of one million population by 1 to 3 ^{o}C, and in evening the difference could be as high as 12 ^{o}C [3]. In the energy deficient country like Pakistan, this difference in temperature is really a situation to seriously ponder upon.

Towards the end of 20th century, the degrading environment and fast depleting earth resources, rang the bell to adapt the environment friendly techniques, decreasing the dependency on non-renewable energy resources and construct sustainable buildings. During last decade of 20th century lots of rating systems around the developed countries with energy consciousness to

---

1. M.Sc. Student at Department of Architecture Engineering & Design, University of Engineering & Technology Lahore.

2. Faculty Members at Department of Architecture Engineering & Design, University of Engineering & Technology Lahore.
evaluate green buildings initialized for sustainability. Table-1 below lists different prevailing rating systems initialized by the different developed countries.

Table – 1: Prevailing Sustainable/ Green Buildings Rating Systems [4]

Rating System	Country of Origin	Initiation Year	Level of Certification
BREEAM	Great Britain	1990	i. Pass ii. Good iii. Very Good iv. Excellent v. Outstanding
LEED	USA	1998	i. LEED Certified ii. LEED Silver iii. LEED Gold iv. LEED Platinum
Minergie	Switzerland	1998	i. Minergie ii. Minergie – P iii. Minergie – Eco iv. Minergie – P-Eco
CASBEE	Japan	2001	i. C (Poor) ii. B iii. B+ iv. A v. S (Excellent)
Green Star	Australia	2003	i. 4 Stars, Best Practice ii. 5 Stars, Australien Excellent iii. 6 Stars, World Leadership
DGNB	Germany	2007	i. Bronze ii. Silver iii. Gold

Purpose of any rating system is to evaluate and measure the sustainability level of green buildings and provide best practical experience in their highest certification level. With certain benchmarks the sustainable site development, Design, construction and operation of these buildings are evaluated and certified.

2. Literature review

The literature available to the authors with reference to evaluation of LEED® rating of New Construction has been reviewed, to grasp better application of the study.

Suzlon - One Earth, is a commercial office building of Suzlon Energy Limited, situated in village Sade Satra nalli Hadapsar, Pune India. It achieved Platinum LEED for New Construction Rating in March 1, 2010. Project fulfils 100% of its energy requirements from renewable energy resources i.e. wind and solar energy, further it harvests 100% of rain water for horticultural needs and recycles 100% waste water in toilet flushing which in turn reduced the overall water requirements of the project by 60%. The design of envelop, use of LED lighting and lighting sensors, solar water heating, optimized utilization of day lighting and selection of water cooled and multistage evaporative cooling systems resulted in 47% of energy saving[5].

Tribeca Green is a 27 storey, 357,000 sq. ft. green residential building, situated in North End Avenue in lower Manhattan, New York, USA. It achieved Silver rating of LEED® for new construction. The project fulfils its partial energy requirements from photovoltaic solar panels

installed on the façade of the building along with a cogeneration system i.e. a micro-turbine, which provides renewable energy to the project. The project utilizes the recycled waste water as well as it harvests rain water. The building is constructed on the fill created during the excavation of the Hudson River, hence scored for brown field development of sustainable site credit. The project is a reinforced concrete structure, percentage of slag is added to concrete in order to achieve strength and score LEED® rating [6].

UC Davis Brewery, Winery and Food is a 30,000 sq. ft educational project, situated at Hilgard lane Davis, California, USA. It achieved Platinum rating of LEED® for New Construction on 10th December, 2010. The project includes Teaching and Research Winery, Brewery, Food Science and milk processing Laboratory. The project meets its energy requirements from photovoltaic panels installed on the roof of the campus by a power purchase agreement. The overall project area is almost 2.5 acres, which constitute a reasonable catchment - area to harvest the rainwater, Almost half of the acre landscaping, is served by the harvested rainwater as well as sewerage grey water. As the project area is a semi arid valley, therefore, the landscape plantation is carefully selected, having net irrigation requirements of zero. Enhanced envelop and night purge ventilation has reduced the cooling load of the project, also the use of local material with recycled content make the project eligible to obtain material and Resource credits. As there are brewery and wine research laboratories situated in the campus, the fermenters require cyclic cleaning and washing. The water, energy and chemical usage has been reduced by using clean-in-place system. Used water is recycled and reused almost eight times, similarly carbon dioxide produced during fermentation is sequestered through calcium hydroxide scrubber to maintain concentration level below 5,000 parts per million (ppm) and trapped CO_2 is solidified and used as soil supplement [7] [8].

The three main reasons for the users of a green building are operational savings, daylight utilization and enhanced views and air quality. Whereas it is a general perception among public that green buildings are costlier than the conventional buildings, research and analysis indicates that the high cost depends upon the extent of eco-friendly features that have been introduced in any project, however the cost may comparatively be less if the baselines for design of a conventional building are not highly conflicting with the local environment of the project. Furthermore, if the cost of a green building is analysed over its life cycle (may be 50 to100 years LCC), the operational cost of a green building is only 80-85% to that of a conventional building as compared to 8-10% higher initial investment. The 2nd perception is that a green building must be air-conditioned, whereas there is no such compulsion imposed by LEED® and same system is also applicable to non air-conditioned buildings as well. The 3rd perception in general public about green buildings is that they take more construction time, as compared to conventional buildings. There is no reality in it, both buildings have same construction time once appropriate decisions about type of material, building systems and landscape development etc, are taken at the design stage [9].

3. LEED® green building rating system

Leadership in Energy and Environmental Design (LEED®) is voluntary, consensus based certification system, which evaluate the environmental performance and certify the successful Green Building design, construction and operation. LEED® rating system provides guidelines to architects, engineers, building owners, designers and real estate developers to construct sustainable buildings. Sustainable building practices, substantially reduce or even eliminate negative environmental impacts and improve the design.

LEED® addresses different project development processes, like LEED® for existing buildings, New Construction, Schools, Neighbourhood Development, Retails, Healthcare, Homes, and for Commercial Interiors etc. Project which wishes to obtain LEED® certification is to be registered with Green Building Certification Institute (GBCI), which was established in 2008 as a separately incorporated entity with the support of the U.S. Green Building Council and administers credentialing and certification programs related to sustainable building practice. These

programs support the application of proven strategies for increasing and measuring the performance of buildings and communities as defined by industry systems such as LEED®.

3.1 Features of LEED®

The rating systems are developed for various uses of the buildings. These systems evaluate following five environmental categories;

i. Sustainable Sites

ii. Water Efficiency

iii. Energy and Atmosphere

iv. Material and Resources

v. Indoor Environmental Quality

Whereas, Innovation in Design is the sixth category in addition to above five; it addresses the sustainable building expertise and design measures which were not covered in above five categories. There are some regional bonus points as well, which weigh the local conditions in determining the best environmental design and practices.

3.2 Credit weightings in LEED®

In LEED® 2009, following impact categories are evaluated on the basis of their potential environmental impacts and human benefits;

- The environmental or human effect of the design
- Construction
- Operation and maintenance of the building, for example GHG emission, air and water pollutions, use of fossil fuel and indoor climatic conditions.

Whereas, the credit weighting evaluation process is based on the parameters given below, so that consistency and usability across rating systems may be maintained[10];

- All LEED® credits are worth a minimum of one point.
- All LEED® credits are positive whole numbers; there are no fraction or negative values.
- All LEED® credits receive a single, static weight in each rating system; there are no individualized scorecards based on project location.
- All LEED® rating systems have 100 base points; Innovation in Design (or Operations) and Regional Priority credits provide opportunities for upto 10 bonus points.

The Regional Priority Credits for incentives addresses geographically environmental issues; furthermore the Alternate Compliance Paths (ACPs) facilitate the developers outside USA. ACPs actually substitute credits and prerequisites outside USA, as per individual project / environmental conditions. Prerequisites and credits in LEED® for new construction and major renovation address the following topics;

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)

- Indoor Environmental Quality (IEQ)
- Innovation in Design (ID)
- Regional Priority (RP)

4. Scope of case study

The project under study is a proposed complex comprised of different buildings in Lahore, and will be evaluated under LEED® Green Building Rating System for New Construction and Major Renovations.

LEED® for New Construction is a vast and comprehensive system comprising of different aspects of a project/building construction and renovation works. However the scope of this study is limited to Credit 1 to Credit 4.4 of Sustainable Sites (SS) development, which are as follows;

- SS Prerequisite 1: Construction Activity Pollution Prevention Required.
- SS Credit 1: Site Selection.
- SS Credit 2: Development Density and Community Connectivity.
- SS Credit 3: Brownfield Redevelopment.
- SS Credit 4.1: Alternate Transportation – Public Transportation Access
- SS Credit 4.2: Alternate Transportation – Bicycle Storage and Changing Rooms.
- SS Credit 4.3: Alternate Transportation – Low Emitting and Fuel Efficient Vehicles.
- SS Credit 4.4: Alternate Transportation – Parking Facility.

5. Evaluation of the project: sunny view complex, Lahore

The project is owned by Water and Power Development Authority (WAPDA). WAPDA is a semi autonomous corporate body and has to shoulder the responsibilities of planning and development of the water and power resources on a unified and multipurpose basis. In terms of actual projects these responsibilities are; the generation, transmission and distribution of electric power; conservation and development of sub-surface water resources to promote irrigation; harness the rivers for flood control purposes; investigation and construction of dams; promotion of inland navigation; fighting the menace of water logging and salinity. With the expansion of the organization, provision of office accommodation has become difficult, to maintain and improve the standard of efficiency so far attained, without which it would not be possible to achieve the targets prescribed for the Authority. Since the construction of WAPDA House the need has been felt that the existing facilities are not enough to accommodate the present increased requirements of WAPDA, because of increased number of irrigation and hydropower development projects. WAPDA owns a land measuring 452,713 sq. ft (about 100 kanals), called Sunny View Estates on Kashmir Road, on which WAPDA has several single storey buildings, prefabricated cabins, printing press, WAPDA Grid Station and an active busses shed. Except Grid Station all buildings are in a condition of decay and need to be demolished and replaced by a modern useful and prestigious office complex. It has been decided by WAPDA Authorities to develop Sunny View Complex to fulfil its present and future needs of space. The project is included in the budgetary framework of WAPDA for the year 2012-2015 and is 100% self financed for an estimated amount of Rs. 3152.66 million.

Figure – 1 : Existing offices at sunny view complex, Lahore

5.1 Location

The Sunny View Complex to be constructed in Lahore is approximately 358 ft above mean sea level. The site is on a plain land with a level difference of about 3 ft between Kashmir Road and Empress Road. The site is located between the outer wall of the Governor House on the South and the commercial area on the North facing Kashmir road and Egerten road. The present American Consulate is across the Empress road towards East. The site is easily approachable from Shahrah-e-Quaid-e-Azam as well as from Egerten road through Kashmir road and from Shimla hill through Empress Road.

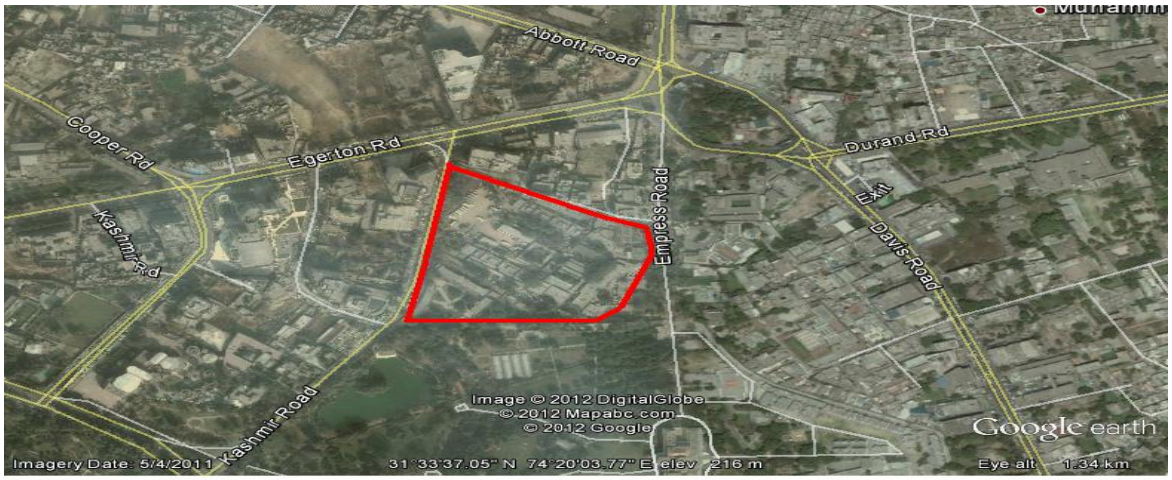

Figure – 2 : Location map of Sunny view Complex, Lahore

5.2 Project Development Salient Features

The overall project development objective is expansion of offices, official residential accommodations and acquiring other required facilities in order to increase capacity of WAPDA to meet its essential needs. It will help to reduce dependency on the others.

It is believed that planning of such project's building structures is a technical, environmental, aesthetic and construction function. Building plans must be effective, functional and economical, capable of meeting the demands of various technical and operational activities as well as climatic requirements. The main objectives on which the planning and design approach of the Project is based are;

- To prepare the typical design of various buildings and accommodations, so that it satisfies the requirements of all the functions of the project for all their users.
- To utilize site potential to the maximum possible extent.
- To plan secure & cost efficient buildings and encourage social interaction.
- To plan the buildings on human scale and design to respond to the indigenous climate.
- To plan and design the proposed uses as required for the project according to the best standards keeping in view the safety and durability of the structure.
- To conceive the office building as landmark of the project area meeting all their security, functional and aesthetic requirements.
- To plan the project buildings energy efficient, minimizing circulation area and maximizing usable space.

- To provide enough space for future horizontal and vertical extension of the project buildings / facilities in systematic manner.
- The compact planning, perhaps, be more desirable to reduce infrastructure and ultimately expenses. Inconvenience in moving from one place to other will also be at the minimum particularly in the severe weather conditions.

- Combination of RCC frame structure with infilling brick / block masonry walls construction depending upon the span of the structure would be perhaps more desirable from the point of view of flexibility, economy, thermal insulation and durability.

- Efforts will be made to evolve an "Environment friendly Architecture" keeping in view the local micro climatic conditions and rich social and cultural traditions of climatic regions of Pakistan.

- The water supply, sewerage, drainage, seismic, geotech and geohydrology problems will be dealt carefully in the structural and foundation design of the proposed buildings from economy and safety point of view.

- While planning, efforts are made that the existing drainage of the area is not disturbed.

Following aspects are the prime consideration for the development of the project ;

a. As the site is located in the heart of Lahore, maximum built up area has been proposed by consultant.

b. Emphasis is given to openness and open green area.

c. The height of the complex is upto the maximum permissible limits as per LDA by-laws.

d. Due to proximity of the site to the Governor House;
   - Distances of building blocks are away from the boundary of Governor House. The tall blocks are kept further away.

   - Nearest block does not have any windows towards the Governor House.

5.3 Components of the project

The complex consists of ;
Commercial Block

- Auditorium
- Office Block A
- Office Block B
- Office Block C
- Mosque C-1
- Office Block D
- Office Block E
- WAPDA Training Centre H
- Hostel I

- Apartments I-1
- Technical Building

And the services to be provided in the complex are;

- Road works
- HVAC works
- Water supply and sewerage system
- Car parking
- Tennis court
- External electrification and development.

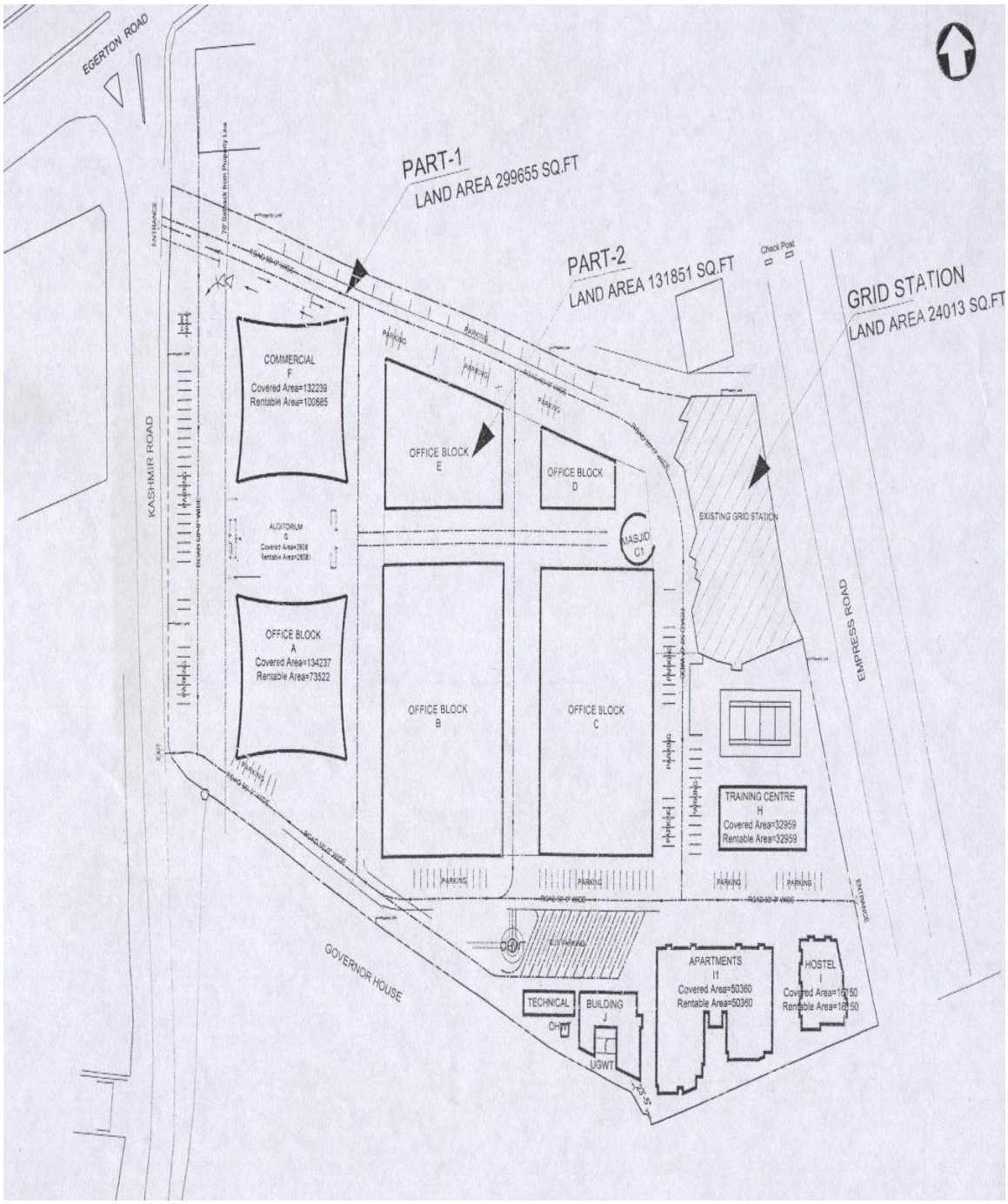

Figure – 3: Proposed Components of Sunny View complex, Lahore

5.4 Project evaluation

LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name: Sunny View Complex, Lahore

Date: 23.04.2012

Y	?	N		Sustainable Sites	Possible Points: 19	Credit Points	Notes:
15	0	0					
Y			C		**Construction Activity Pollution Prevention**		
√				**Prereq 1**	Prevent loss of soil during construction by stormwater runoff and/or wind erosion, including protecting topsoil by stock piling for reuse.		
	√				To prevent sedimentation of storm sewers or receiving streams.		
√					To prevent pollution of the air with dust and particulate matter.		
1			d		**Site Selection**	1	
					Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any of the following criteria:		
		√			High-value farmland as defined by the relevant local, regional, state, provincial or federal government agency.		
		√			Previously undeveloped land within areas classified at high or very high hydrogeologic risk, including any land whose elevation is lower than 5 feet (1.5 meters) above the elevation of the 100-year flood.		
		√		**Credit 1**	Land specifically identified as habitat for any species listed as threatened or endangered by the national, state, provincial, territorial or regional authority.		
		√			Land within 100 feet (30 meters) of a wetland listed as being of high ecological value by the relevant local, regional, state, provincial or federal government agency. Renovation of an existing building is allowed if construction impact is limited to the existing development footprint.		
		√			Previously undeveloped land that is within 50 feet (15 meters) of a water body, defined as seas, lakes, rivers, streams and tributaries that supports that supports or could support aquatic life, recreation or industrial use, as determined by a professional biologist.		
		√			Land that prior to acquisition for the project was public parkland except for projects which are operated by and support the function of the park.		

4			d		**Development Density and Community Connectivity**	5	
					Development Density		
√					Construct or renovate a building on a previously developed site AND in a community with a minimum density of 60,000 square feet per acre net		
					Community Connectivity		
√					Is located on a previously developed site		
		√			Is within 1/2 mile (800 meters) of a residential area or neighborhood with an average density of 10 units per acre net (10 units per 0.4 hectare net)		
					Is within 1/2 mile (800 meters) of at least 10 basic services		
√				**Credit 2**	1. Bank		
√					2. Place of Worship		
		√			3. Hospital		
√					4. Pharmacy		
√					5. School		
		√			6. Super Market		
√					7. Restaurant		
√					8. Library		
√					9. Park		
		√			10. Post Office		
√					Has pedestrian access between the building and the services		
1			d		**Brownfield Redevelopment**	1	
	√			**Credit 3**	Develop on a site where the risk of contamination has been determined via relevant local, state, provincial, or federal contamination risk protocols. Where site contamination was identified, demonstrate that site remediation was completed according to the relevant local, state, provincial, or federal requirements.		
6			d		**Alternative Transportation–Public Transportation Access**	6	
√				**Credit 4.1**	Locate the project within 1/4-mile (400-meter) walking distance (measured from a main building entrance) of 1 or more stops for at least 2 rideshare options for 4 or more passengers (and at least 2 passengers for human-powered conveyances). Rideshare options include passenger ferry terminals, vans and human-powered conveyances, such as rickshaws, that are authorized by the local transit authority and that meet the definition of public transportation		
1			d		**Alternative Transportation–Bicycle Storage and Changing Rooms**	1	
					CASE 1. Commercial or Institutional Projects		
√				**Credit 4.2**	Provide secure bicycle racks and/or storage within 200 yards (200 meters) of a building entrance for 5% or more of all building users (measured at peak periods)		
√					Provide shower and changing facilities in the building, or within 200 yards (200 meters) of a building entrance, for 0.5% of full-time equivalent (FTE) occupants.		

0			d		**Alternative Transportation–Low-Emitting and Fuel-Efficient Vehicles**	3	
					Option - 1		WAPDA Transport Directorate operates different type of transport vehicles including Buses, mini buses and commuter vans for commutation of WAPDA Employees. All the commuter vehicles are Diesel Engine vehicles, with no alternative low emmission fuel like Compressed Natural Gas (CNG) option installed. Further more there are staff car /vehicles used by WAPDA officers, however these vehicles are mostly petrol driven. there is hardly 1% to 2% vehicle installed with low emmission fuel i.e. CNG kits.
		√			Provide preferred parking 1. For low-emitting and fuel-efficient vehicles 2. For 5% of the total vehicle parking capacity of the site.		
					Option - 2		
		√			Install alternative-fuel fueling stations for 3% of the total vehicle parking capacity of the site. Liquid or gaseous fueling facilities must be separately ventilated or located		
					option - 3		
		√			Provide low-emitting and fuel-efficient vehicles for 3% of full-time equivalent (FTE) occupants. Provide preferred parking1 for these vehicles.		
					Option - 4		
		√		**Credit 4.3**	Provide building occupants access to a low-emitting or fuel-efficient vehicle-sharing program. The following requirements must be met: • One low-emitting or fuel-efficient vehicle must be provided per 3% of FTE occupants, assuming that 1 shared vehicle can carry 8 persons (i.e., 1 vehicle per 267 FTE occupants). For buildings with fewer than 267 FTE occupants, at least 1 low emitting or fuel-efficient vehicle must be provided. • A vehicle-sharing contract must be provided that has an agreement of at least 2 years. • The estimated number of customers served per vehicle must be supported by documentation. • A narrative explaining the vehicle-sharing program and its administration must be submitted. • Parking for low-emitting and fuel-efficient vehicles must be located in the nearest available spaces in the nearest available parking area. Provide a site plan or area map clearly highlighting the walking path from the parking area to the project site and noting the distance.		
2			d		**Alternative Transportation–Parking Capacity**	2	
√				**Credit 4.4**	For projects that have no minimum parking requirements, do not exceed 3.5 spaces per 1,000 square feet (95 square meters) of gross floor area or 1 parking space for every full time equivalent (FTE), whichever is less.		
√					Provide preferred parking for carpools or vanpools for 5% of the total parking spaces.		
Total						Possible Points:	19
						Gained Points:	15

6. Conclusions & recommendations

- Sunny View Complex Project has been analysed/ rated for “Site Sustainability”, Credit – 1 to Credit 4.4

- Sunny View Complex Project secured 15 points out of 19 maximum possible points.

- Alternative transportation means having low carbon emission and fuel efficiency is dire need of time, it is strongly recommended that Hybrid vehicle may be introduced, and importers of such vehicles may be facilitated.

- Means of Rapid Transit should be encouraged and traffic lanes may be dedicated for Mass Transit System in order to save the fuel and avoid traffic congestion on roads.

Reference

[1] Gann M. David, Building innovation Complex Constructs in Changing World; Thomas Telffor Publisher Tomas Ltd. 1 Heron, Quay, London, May 1999.

[2] Alison G. Kwok, Nicholas B. Rajkovich; Addressing Climate Change in Comfort Standards; International Symposium on the Interaction between Human and Building Environment Special Issue Section, Volume 45, Issue 1, January 2010.

[3] http://www.epa.gov/hiri/ visited on 05-May-2012

[4] Bauer, Michael., Mösle, Peter. and Schwarz, Micheal; Green Building – Guide Book for Sustainable Architecture; Drees and Sommer Advanced Building Technologies, GmbH, Germany.

[5] http://demo.usgbc.name/projects/suzlon-one-earth visited on 06-May-2012

[6] http://www.cement.org/buildings_green_tribeca.asp visited on 03-May-2012.

[7] http://demo.usgbc.name/projects/uc-davis-brewery-winery-and food?quicktabs_=first#quicktabs- visited on 06-May-2012

[8] http://demo.usgbc.name/projects/uc-davis-brewery-winery-and-food visited on 06-May-2012

[9] Srinivas, S, Green Buildings in India: Lessons Learnt, Confederation of Indian Industry.

[10] LEED 2009 for New Construction and Major Renovations; USGBC Member Approved November 2008 (Updated 2011), pg xii