

- LEED Platinum for New Construction; 2014.
- Six Green Star SA Existing Building Performance Certification; 2015
- LEED Platinum for Existing Building Operation and Maintenance; 2015.

The main features of the building are as follows [28]:

- Energy Efficiency:
 - Energy is generated through 220 photovoltaic panels on roof and northern façade.
 - Three wind turbines
 - Installation of regenerative elevators where elevators generate energy while braking and save 30% of usual consumed energy.
 - Installation of gym equipment that generate energy
 - Heat pumps and ground loops cooling/heating system
 - Adopting passive design strategies to achieve extra energy efficiency
 - Energy-efficient LED lights
 - Installation of double glazed windows
- Incentives:
 - Guests are rewarded by Verdinos which is an in-house currency earned for being involved in the building's sustainability and green choices.
 - Guests receive a certificate proving that the carbon created by their stay has been offset
 - Providing priority parking for guests driving electric/hybrid/car pool vehicles.
- Sustainable Design:
 - Building energy model is used to get optimized design
 - Adopting socially responsible carbon neutral systems.
 - Intelligent building management system to monitor consumption of energy and resources.
 - Efficient, intelligent heating ventilation and air-conditioning system
 - Responsible, healthier, rapidly renewable, recycled and eco-friendly products used where feasible; this includes the following:
 - Paints, coatings, adhesive and sealants with low volatile organic compound concentrations
 - Carpets made of renewable wool, recycled tires and old carpets
- Water Saving:
 - Grey-water recycling system to save water.
 - Rainwater is collected to be used for irrigation.
 - Installing low-flow fittings on all taps and shower heads
 - Sub-soil drainage water used for irrigation, car-washing and external cleaning.
- Decreasing Waste:
 - Minimizing and preventing waste through new policies and strategies
 - Reusing, recycling and composting strategies
 - Avoid packaging
 - Composting food waste
- Green Conferences:
 - Using separate bins for items that can be recycled or composted

- Eco-friendly stationery, recycled paper, carbon-neutral printer
- Chalkboards to eliminate the need for energy or paper use
- Natural lighting
- Energy-efficient air conditioning, lighting and technology

5. EXPERIENCE IN EGYPT

Five smart buildings in Egypt were analyzed in order to stand on the main smart features and characteristic of SBP. The analyzed buildings were selected based on the following:

- a) Significant buildings SBP that were recommended by SBP experts.
- b) Analysis of researches that are concerned with this type of buildings.
- c) Preliminary research to collect data related to SBP in Egypt that were not covered in the two previous points.
- d) Towers were excluded from the study as they are considered special types of buildings.

5.1 Dar Headquarters

Dar office building in Smart Village; Egypt is shown in Fig. 7. Area of the building is 42,300 m², the construction cost is 100,000,000 USD and the monthly operating cost is 70,000 USD approximately.



Fig. 7. Dar Headquarters [29]

The features of the building were pointed out as follows [29]:

- Located in smart village which is considered the first smart city high-tech office park in Egypt.
- Achieved LEED Gold for construction
- Targeting LEED Gold for operation and maintenance
- The rooftop space is covered with 1000 SM of photovoltaic panels that gather solar energy and supply about 5% of total building energy requirements.
- A large glass atrium that draws in natural light from both the interior and exterior perimeter walls. This atrium is designed as a thermal buffer between the exterior climate and the conditioned climate of the building.
- 18 m² of operable skylight in the atrium roof provided to

accommodate the passive smoke evacuation system

- Combined sustainable strategies result in an approximate 30% energy reduction
- Water efficiency for both internal building use and irrigation use.
- Day lighting sensors to control office space lighting. Lights automatically shut off in areas where natural light is sufficient.
- Facility management system that was introduced during testing and commissioning phase.
- Computerized asset management system
- BMS and CCTV to manage and control the systems of the building and keep it safe.
- Electronic access control
- The monthly operating costs of the building represent 0.07% of the total construction cost.

5.2 ECG Premises

ECG Premises in Smart Village; Egypt is shown in Fig. 8. Area of the building is 15,540 m², the construction cost is 4,640,000 USD and the monthly operating cost is 38,000 USD approximately.



Fig. 8. ECG Premises [30]

The features of the building were pointed out as follows [31]:

- The building has two water supplying sources, potable water in addition to grey water which is used for planting.
- Double glazing and tinted glass to minimize cooling loads.
- Fire extinguishing system that is linked to Building Automation System (BAS).
- Elevators with intelligent traffic optimization system and linked to BAS.
- Security system and CCTV to assure safety of the building
- The monthly operating costs of the building represent 0.8% of the total construction cost.

5.3 Ministry Building

The New Administrative Capital is considered the first attempt to establish a smart city in Egypt; the responsible authorities have identified some guidelines that should be applied on buildings inside the new smart city. Fig.9. represents a ministry building in the new administrative capital.



Fig. 9. Ministry Building in the New Administrative Capital [32]

The main features of this smart building can be pointed out as follows [33]:

- 50% of the roof area of the building must be covered by PV system coated with dust control material of life span not less than 5 years.
- PV system feeds the AC power into the main distribution panel of the building when solar energy is available.
- The building is connected to the Command and Control Center (CCC) which is the main control building monitoring and managing safety and security across the city and overseeing any emergency situation.
- The building is connected to the City Operation Center (COC) which is responsible for managing all the services across the city, monitoring the key performance indicators (KPIs) and ensuring the success of smartness initiatives.
- BMS system covers the main equipment in the buildings.
- Providing comfortable work environment.
- Maximize using local products.
- Optimize construction, operation & maintenance costs.
-

5.4 Bank Premises

Fig.10. represents a bank premises that is located in the financial district within the New Administrative Capital. The building is in final design phase; the area of the building is 65,000 m².



Fig.10. Bank Premises, the New Administrative Capital

The main features of the building are as follows [34]:

- Flexible architectural design
- The building is formed of two connected blocks with a combining atrium space that provides day lighting for the office spaces and all common facilities are located within it.
- Optimal building performance.
- Energy efficient building.
- Sustainable green building design.
- Targeting LEED Gold certification.
- 50% of the roof area is covered with PV cells.
- Attain highest value at the lowest possible cost.
- Connected to the COC and CCC of the new administrative capital.
- Connected to the main data center of the new administrative capital.
- All building systems are connected to BMS.
- CCTV to ensure safety inside the building as well as its surroundings.

5.5 Crédit Agricole Egypt Head Office

- Fig.11. represents Crédit Agricole Egypt Head Office located in the 5th settlement, New Cairo, Egypt. The area of the building is 42,000 m². The construction cost of the building is 50,000, 000 USD.



Fig.11. Crédit Agricole Egypt Head Office [35]

The main features of the building are as follows [36]

- The design and construction of this building is based on the consideration of the triple bottom line: People, Planet and Profit.
- The Head Office depends on rationalizing power resources, in addition to providing maximum comfort to its staff.
- The building provides different facilities to optimize the co-working environment including well-equipped training and meeting rooms and an auditorium that can take up to 300 persons in addition to a cafeteria, a restaurant, a gym and a green area.
- A solar station with a capacity of 200 KWp is installed on the rooftop of the building; this solar station is contributing in the reduction of the bank's energy consumption rate by 7%.
- The building designed to save energy, use less water, generate less waste and provide higher levels of indoor quality and comfort.
- The building is the 1st building in Egypt and North Africa to obtain the platinum LEED certificate by the U.S. Green Building Council iconic design.
- The building aimed at reducing impacts on human health and on the environment through better site selection, construction, operation and maintenance.
- The building has launched the initiative "Go Digital" to rationalize the usage of resources comprising paper reduction through the digitalizing of processes and creating an awareness campaign for the staff; this is in addition to launching the e-statement service to integrate the customers in this initiative in favor of the environment.
- The bank has also applied a new initiative that matches its eco-friendly values which is collect old paper to be delivered to a charity organization, to be recycled into hand made products. The revenue of the sold products will be used to finance people in need to have a better life.

6. CONCLUSION

Based on analysis of the international SBP; the below remarks were pointed out:

- 1- In Europe; the analyzed SBPs aim at achieving lower energy and operational costs and improving the European economy. European SBP focuses on innovation, adopting sustainability, flexible design and IoT and BIM technologies in order to achieve this aim.
- 2- In America; SBP is a green and environmental friendly building that concentrates on sustainability aspects and efficient energy performance.
- 3- In Australia; sustainability and energy performance are the main features of SBP.
- 4- In Asia; the main smartness aspects of the analyzed SBPs are sustainability, energy efficiency and connectivity with other buildings.
- 5- In Africa; the analyzed SBP focused on energy efficiency sustainability in addition to innovation and incentives for improving sustainability and making green

choices.

6- The construction cost of SBP per m² ranges from 20,000 USD to 2000 USD. In Africa; the average construction cost of SBP per m² is 500 USD, this might be due to Africa's strategies that encourages reusing old materials and buildings; about 11% of the total construction cost SBP in Africa is allocated to sustainable interventions.

Based on analysis of SBP in Egypt; the below remarks were pointed out:

- 1- In Egypt; the smart features of SBP are not clear, they differ from one building to another according to the experience of owner, designer and project manager of each project.
- 2- Sustainability and green buildings and efficient energy performance are the main features of SBPs in Egypt.
- 3- In addition to sustainability and efficient energy performance; SBPs within Smart Village concentrate on facility management aspects; however; facility management is usually introduced during late project phases.
- 4- SBPs within the New Administrative Capital SBP focuses on IoT and BIM technologies, this is in addition to saving energy. Facility management is introduced during

testing and commissioning phase or after operation.

5- The construction cost of SBP per m² ranges from 700 USD to 3000 USD.

The main features of the analyzed SBP were classified into 8 main categories as follows:

- 1- Cost Savings
- 2- Efficient Facility Management (Operation and Maintenance, Safety, Comfort, Health, Sanitation, Satisfaction, etc.)
- 3- Efficient Architectural Design
- 4- Efficient Energy Performance
- 5- Internet of Things (IoT) technology, Automation, BIM applications, etc.
- 6- Accredited Buildings
- 7- Connectivity
- 8- Innovation / Incentives

Table (1) compares between the smart features of analyzed SBP in Egypt and worldwide after categorizing them into the above mentioned 8 categories.

Table 1. Comparison between Smart Buildings in Egypt and Worldwide

Project										
	The Edge Office Building	Apple Park Office Building "Spaceship Headquarters"	Pixel Smart Building	Princess Nora Bint Abdulrahman University (PNU)	Verde Hotel	Dar Headquarters	ECG Premises	Ministry Building	Bank Premises	Crédit Agricole Egypt Head Office
Location	Amsterdam, Netherlands, Europe	Cupertino, California, USA	Melbourne; Australia	Riyadh, KSA, Asia	Cape Town, South Africa	Smart Village	Smart Village	New Administrative Capital	New Administrative Capital	5 th Settlement ; New Cairo
Construction Year	2015	2017	2010	2012	2011	2014	2010	2021	2022	2013
Area (m ²)	40,000	260,000	1,137	3,000,000	13,000	42,300	38,000	13,000	65,000	42,000
Construction Cost (USD)	84,000,000	5,000,000,000	4,300,000	13,000,000,000	11,000,000	100,000,000	4,640,000	9,400,000	47,000,000	50,000,000
Features of Efficient energy performance	•	•	•	•	•		•	•	•	

Cost Savings	•	•	•	•	•		•	•	•	
Efficient facility management	•	•		•	•	•	•		•	
Efficient architectural design		•			•	•		•		
Applying Technology	•	•					•	•		
Accredited Building	•	•	•	•	•	•		•	•	
Connectivity				•			•	•		
Innovation Incentives	•								•	

Source: Author; Based on Analysis of SBP

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