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Author: Yasser Mahgoub, Qatar University

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Dr. Yasser Mahgoub

Department of Architecture and Urban Planning, College of Engineering, Qatar University



Dr. Yasser Mahgoub

Biography

Dr. Yasser Mahgoub, is an architect, academic, and scholar. Received Doctorate in Architecture from The University of Michigan, Ann Arbor, USA in 1990. Held several academic positions at Ain Shams University, United Arab Emirates University, Kuwait University and Qatar University. Practiced as professional architect in Egypt and was a founding member in 1980 of "The Egyptian Designers" architectural firm in Cairo, Egypt. Participated as a consultant in Egypt, UAE, Kuwait and Qatar. Teaches architectural design studios, research, environment and behavior and professional practice. Research interests include social and cultural aspects of architecture, sustainable architecture, architectural education and the impact of globalization on architecture. Published several refereed research papers and book chapters. Dr. Mahgoub served as a reviewer in the Aga Khan Award 2010 Cycle.

Abstract

Tall buildings are sources of national pride and cultural identity expressing globalization and economic prosperity. They pose several challenges to integrate them with the urban fabric of emerging cities. Gulf Cooperation Council (GCC) countries are racing in competition to construct tall buildings to meet growing demands for office spaces. This paper discusses the rapid development of tall buildings in Doha due to the rapid urbanization and development that it has been going through since the middle of the 20th century. With large number of towers being constructed in Al Dafna and West Bay areas of Doha, these buildings affect different aspects of the built and urban environment, i.e. city image, traffic, urban spaces and physical conform. The paper addresses the importance of developing urban planning legislations for designing eco-tall buildings. At the outset, tall buildings cannot be considered green buildings because of their consumption of large amounts of building materials during construction and energy resource during operation and demolition. Tall buildings require greater material content to construct their structural system to withstand the higher bending moments caused by wind forces at the upper levels. They consume energy due to transportation of materials and services. Additional energy is consumed for the mechanized movement of people up and down its elevators, and other aspects arising from its excessive verticality. On the other hand, tall buildings will continue to meet the demands of urban and city growth and concentration of services and resources. As a result, designers should seek to mitigate its negative environmental impacts and to make it habitable as possible. The paper suggests principles that government should include in building legislations and regulations for building a skyscraper in order to achieve ecological and sustainable urban environment.

Keywords: Tall Buildings, Sustainability, GCC, Doha, Qatar.

Towards Eco-Tall Buildings Legislations in Doha, Qatar

Introduction

Gulf Cooperation Council (GCC) countries are racing in competition to construct tall buildings and the tallest skyscrapers in the world. While these structures are sources of national pride and cultural identity facilitated by economic prosperity, they pose several challenges to integrate with the urban fabric of the city. This paper discusses the rapid development of tall buildings in Doha, Qatar due to the rapid urbanization that it has been going through since the middle of the 20th century. With large number of towers constructed in Al Dafna and West Bay areas of Doha, these buildings affect different aspects of the built and urban environment, i.e. city image, traffic, urban spaces and physical conform. The paper addresses the importance of developing urban planning legislations for designing eco-tall buildings.

The city is considered to be an accumulative process of human interaction. Some studies indicate that culture and social factors are one of the main factors which form a built environment, therefore physical planning cannot be understood without studying or understanding the prevailing culture. (El-Ghul et al, 2010)

Tall buildings provide high-density developments that satisfies increasing demands for office spaces in city centres. As Reddy pointed out, "it appears that this is the only rational way of redevelopment that could be adopted" (Reddy, 1996). Also, as El-Ghul et al indicated, "economy has become a major factor in forming architecture and cities; also a leader of planning policy. Tall buildings appear to become a phenomenon of modern cities." (El-Ghul et al, 2010) On the other hand, the aesthetic quality of tall buildings is empathised by many observers. As Ada Huxtable explains that, "in its most familiar and exhilarating aspect, the skyscraper has been a celebration of modern building technology and often in spite of it, the skyscraper is still an art form. The tall building has that in common with all major works of architecture consciously conceived in aesthetic terms" (Huxtable, 1992). Tall buildings do not only satisfy a functional needs but they are also sources of national pride and cultural identity facilitated by economic prosperity. They pose several challenges to integrate with the urban fabric of the city. Stephen Kellert argues that office towers, shopping malls, and housing developments are designed in abstract, universal ways that are disconnected from both local culture and ecology (Kellert, 2005). Gulf States are racing to build the world's tallest towers, especially in Dubai and Doha. (Figure 1) The construction of tall buildings became possible due to the increasing wealth generated by economic prosperity.



Figure 1. GCC Tall buildings.

History of tall buildings in Doha

Historically, Doha was a fishing and pearl diving town. Up to the mid 1960's, the majority of the buildings were individual traditional houses that responded to the surrounding physical and socio-cultural conditions. During the 1970's it was transformed into a modernized city and this development and change slowed down in the 1980's and early 1990's because of economic and political problems, during which Qatar depended on the resources and economy of Gulf countries. Following the discovery of gas during the late 1990's, Qatar planned to construct various investment projects either for public or private sectors. The Public Works Authority "*Ashghal*" was established by his Hines Sheikh Hamad bin Khalifa Al Thani in 2004 to monitor the changes that occurred as a result of rapid construction process to host the Asian Games on 2006. This resulted in growth at all levels from urban development and infrastructure provision to cultural and educational facilities. As a result of the success of Asian Games about 180 Towers were planned to be constructed and completed by 2009 in Doha's West Bay business and commercial districts to fitful Qatar demands for vacant office spaces which were estimated at 330,000 m². (Figure 2) There was an aspiration to enlarge the area to 500,000 m² by 2010. New office spaces in the West Bay added 300,000 m² of gross leasable area by 2010. Doha's modernization process was an attempt to follow the city of Dubai's image as a model of a global city. According to Qatar Tourism Authority, more than 100 buildings and towers were going up in Doha and cranes filled the sky to build different types of building such as hotels, offices and financial centers at Doha West Bay to become a world-class business and leisure center. Therefore, there are about 40 hotels that were constructed in Doha by 2009 including Sofitel's twin 27-story towers; Hotel Khalifa, Hilton, Hyatt and Millennium hotels. With all of this construction activity, Doha became a symbol of a globalized city.

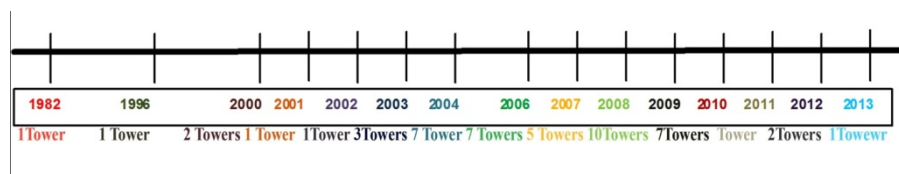


Figure 2. The evolution of tall buildings in Qatar.

Development of Tall Buildings Codes in Doha

These new constructions were required to acquire building permits approved by the concerned Municipality, Planning Departments and other services authorities including Electricity, Water and Civil Defense. A completion certificate was also required to ensure fulfillment of all regulations. Building legislations were issued during the period of 1970-1990, as follows:

- 1975 Law No 3 related to commercial, industrial and public buildings.
- 1974 Law No 8 related to general cleanliness.
- 1985 Law No 3 related to controlling buildings.
- 1989 Law No. 2 related to precautions to be taken for public safety to avoid hazards from building construction.
- 1989 Law No. 2 related to technical and architectural specifications for buildings.
- 1989 Law No. 2 related to the transport of solid and liquid waste.

In addition to the above legislations, the Planning Department of the Ministry of Municipal Affairs and Agriculture has published several planning and building regulations under the existing law giving specifications for the main development types in urban areas. These include:

- Regulations for Flats and Flat Complexes.
- Regulations for Villa and Villa Complexes.
- Qatar Commercial Development Manual.
- Planning Regulations for Residential Developments in Al Rayyan Municipality.
- Planning Regulations for Commercial Developments in Al Rayyan Municipality.
- Sub-division Regulations.

- Interim Zoning Regulation.

During Doha's modernization process, the city has adopted new building codes specified for high rise buildings. They specified that towers height should range between 15-56 floors and that the setbacks surrounding the towers should be 6 meters from each side. The external appearance of the tall buildings is determined by its exterior materials and type of glazing. The regulation for glazing is that glazing could not exceed 60% and the type of glazing should be double glazed about 12mm. Glass cleaning is done using elevators suspended by cables. Parking capacity depends on the use of tall buildings. One car parking is required for each 25m square commercial and business offices. For commercial and residential buildings each three apartments should be provided by one parking structure. Three to four basement floors are allowed ranging 2000 to 3000 square meters. Most West Bay tall buildings have dark curtain walls with a zero thermal mass because it doesn't reflect the sunlight and cause heat.

West Bay Area

West Bay area is the preferred location for many head offices of companies, governmental ministries and a number of international oil and gas companies. West Bay has a link with Doha International Airport and easily accessible for business travelers within few minutes driving distance from Doha metropolitan area. (Figures 3,4, and 5) It hosts several premium hotels such as the Ritz Carlton, Four Seasons, Sheraton and the W Hotel. West Bay provides many excellent amenities for the business community including the City Centre Mall, one of the largest and most popular shopping malls in Doha, and the new International Convention Centre, scheduled to open in 2013. This new Convention Centre will provide a variety of business and conference facilities hosted in several towers height ranging from 16 to 105 floors.

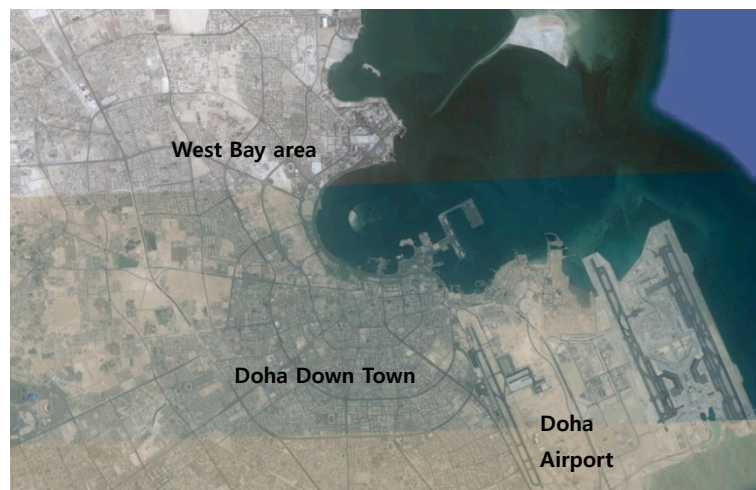


Figure 3. Doha City map.



Figure 4. Location of West Bay towers, Qatar



Figure 5. West Bay Zone 1 towers.

The Tornado tower has been awarded the best tall building in the Middle East and Africa from the Council of Tall Buildings and Urban Habitat (CTBUH). The iconic 52 storey Tornado tower provides views of the city and Corniche. (Figure 6) The tower incorporates highly flexible space with a choice of floors, ranging from 696 to 2,001 sqm. Individually, or in combination, these floors can provide accommodation for occupiers of almost any size of company. The innovative, architectural design of Tornado tower presents column free floor plates offering 360 panoramic views as well as flexible and efficient work space. The entrance to Tornado Tower comprises an impressive double height lobby with security access barriers allowing 24/7 admission and a media belt broadcasting up-to-the minute business news. High speed lifts, travelling at 7.5 meters per second directs tenants very fast to their destination in the tower. It has approximately 1,700 car parking spaces, at a ratio of one space per 35 sq m of office accommodation. On the 28th floor, the tower has a fine dining restaurant and lounge area with outstanding 360 degree views of Doha and the bay. On the 27th floor, tenants enjoy exclusive access to a fully equipped gym to unwind and relax before, during or at the end of the day. Its external faced has more than 30,000 m² of Wicona unitised curtain walling, installed as 6,000 glazed panels in 50 size variations. The facade allows the curvature of this iconic building to be expressed without the need for curved glass. Trapezoidal panels and their collection of angles give the 200m high building its signature curve and hyperboloid shape that depict a whirlwind in a desert storm. The Wicona

unitised facade were assembled and glazed off site, holding 34mm reflective glass for the vision areas and opaque glazing to conceal the building structure between floors. The panels also support an external steel 'lattice'. This outer structure is a key architectural feature and the lighting system installed at the junction points of the steelwork accentuates the form of the building at night to spectacular effect, using 35,000 different light combinations. The external lighting system - designed by famous light artist Thomas Emde.

Zone1 contains more than ten of the most significant towers in Doha. An investigation was conducted using photography and systematic observations relating the towers to application of building legislations in Doha. The goal was to evaluate the impact of the application of the available laws on the urban environment around the towers and also to suggest possible future legislations to be developed. The towers were studied focusing on the aspects shading devices utilization, connectivity between the towers and the surrounding built environment, function of tower, visible signs, and types of cladding, green open spaces, and parking areas. Unlike other towers in Doha and Gulf countries, where multi use towers that host residential, commercial and offices exist. All ten towers in Zone 1 are used for business and offices. Visibility of entrance signage, located at the entrance does not allow visitors and users to recognize the entrance location. This aspect is obvious in Barzan, Al-Salam, Al-Mirqab twin towers, and Al-Naser Twin Towers. On the other hand The Commercial Bank Plaza has a logo at the top of its elevation and not on the front elevation that can be seen from the main street. Its exterior skin is made of double glazing and variety of cladding materials; granite, aluminum, and concrete. Unlike other towers in Zone 1, this tower adheres to the 60% maximum glazing area. Few towers use full percentage of cladding. There is enough capacity of parking areas at the ground level around the tower and the basement of the 10 towers according to the parking regulation. Also there is a specified parking for the fire engine in two towers which are Tornado and Al-Mirqab and Al-Salam twin Towers. (Figure 8)



Figure 6. Tornado Tower.



Figure 7. Commercial Bank Tower



Figure 8. Commercial Bank Entrance.

Types of shading devices attached to the exterior envelop of buildings include projected porch entrance, external detached canopy, and external building skin working as a shading device. It has been noticed that some towers use a projected porch to provide shading and define the main entrance of the building; such as Al-Nasir Twin Towers, Barzan Tower, Al-Bida Tower, and Al-Mirqab and Al-Salam Twin Towers. On the other hand, some towers have an external canopy that allows for more interaction on the urban scale, such as Barzan Tower and Al-Zaji Tower. As for the rest of the towers, there was no consideration for the usage of shading devices, such as Tornado and Palms Towers. The urban and landscape connectivity between towers is observed in several towers, such as the Commercial Bank, Al-Jazi Tower, Al-Bida Tower, Al-Mirqab and Al-Salam Twin Towers, Tornado Tower, Palms Towers, where landscaped green areas allow a degree of interaction as well as connectivity to each other. (Figure 9)



Figure 9. Commercial Bank entrance.

Results and Discussion

At the outset, tall buildings cannot be considered green buildings because of their consumption of large amounts of building materials during construction and energy resource during operation and demolition. Tall buildings require greater material content to construct their structural system to withstand the higher bending moments caused by wind forces at the upper levels. They consume energy due to transportation of materials and services. Additional energy is consumed for the mechanized movement of people up and down its elevators, and other aspects arising from its excessive verticality. On the other hand, the skyscraper as a building type will continue to meet the demands of urban and city growth and concentration of services and resources. As a result, designers should seek to mitigate its negative environmental impacts and to make it habitable as possible. For instance to meet intensive accommodation requirements, tall buildings should be built near a transportation hubs to reduce transportation energy consumption and parking requirements.

Applying sustainability strategies is one way to achieve eco-design as an improvement of the connectivity between tall buildings and the surrounding landscape, both horizontally and vertically. This ensures a wider level of connectivity, interaction, mobility and sharing of resources across boundaries. First, providing ecological corridors and linkages in regional planning is essential in making urban patterns more biologically viable. Second, it must be extended vertically within the skyscraper, with organic connectivity stretching upwards within the built form to its roof escape, as a form of vertical landscaping. Third, another method is the improvement of the site ecology which is the first consideration in designing the eco skyscraper to physically merge with the ecosystems and the ecology of the locality. The result is minimizing the local impact and the total damage of the entire land area. Eco-skyscrapers built form has lesser impact on the site's ecology, and if the site remains vegetated it provides greater land area for surface water filter back into the earth. The last strategy of the eco-design deals with both the built form and operational systems of the skyscrapers so that they are not dependant on non-renewable sources of energy. Achieving this strategy should result in low energy to create internal comfort conditions within the tall building built form.

Eco-design requires the designer to use green materials and components that facilitate reuse and recycling of construction materials. The materials of the tall buildings should be reused and recycled of the built form and how it is connected and fabricated. It is an integration of our built forms and its operational systems and

internal processes with the ecosystems in nature. But these don't integrate with the natural system and they integrate after their manufacture and use only through biodegradation. That helps in the problem of deposition of waste. Not only organic waste (e.g. sewage, rainwater runoff, wastewater, food wastes etc.) should be recycled but also the inorganic ones as well. Eco skyscrapers and bio-climatic design solutions focus on low energy systems of passive cooling and also on the literal 'greening' of the site in the form of vertical gardens. These include vertical landscaping, to allow natural daylight and natural ventilation. Sky courts next to the structural lift core and sky-plazas are used to assist natural cooling and serve as interstitial zones between the internal areas and external areas. Bio-climatic features include passively cool the building through a combined system of natural ventilation, evaporation and shading systems.

Conclusions

It has been argued that, "given rapid urbanization and limited land available for development, and the need to look at sustainability issues associated with developments as a whole, tall buildings offer a more sustainable solution for many of today's cities." (Pank, 2002) Dalton and John argue that "The sustainability outcomes will only be fully successful if sustainability priorities are shared by the planners, investors, developers, landlords, occupants, and their respective supply chains." (Dalton and John, 2008) Sustainability issues associated with tall buildings need to be considered in the context of the wider development picture. (Dalton and John, 2008)

The paper suggests the following key principles that government should include on their legislation and regulation for building a skyscraper in order to achieve ecological and sustainable systems in Doha:

- Improve public circulation around and between buildings to achieve good spatial continuity that usually occurs on the street-level activities and those spaces at the upper-floors, i.e. landscaped ramps, as well as street activities; stalls, shops, cafes, performance spaces and viewing decks (floors) through ramps.
- Encourage use of extensive solar-shielding of the eastern and western facades.
- Use of indigenous landscape vegetation and garden terraces to assist ambient cooling of the façade.
- Installation of photovoltaic panels to reduce energy consumption.
- Water recycling and purification associated with rainwater and grey-water reuse in flushing water closets, watering of sky courts, landscaping and planter boxes.
- Encourage use of solar energy, natural ventilation and 'mixed-mode' to achieve balance between embodied and operational energy.
- Use of wind funnels to ensure that all lift lobbies, toilets and fire stairs are naturally ventilated.
- Use eco-cells as passive method for bringing sunlight and fresh air into the basement.
- Use sun-shading devices as an integral part of the cladding system.
- Wind wall to force wind inside buildings which contributes to evaporation subsequently reducing the indoor air temperature.

The paper investigated aspects of tall buildings design and impact on the surrounding environment as illustrated in the case of tall buildings in Doha, Qatar. It concluded that many key principles should be addressed during the design of tall buildings. To achieve sustainability and green strategies, these key principles should be an integral part of urban and building codes and legislation. While increasing awareness and rewarding best practices is desirable, the impact of building legislations and codes on practice is far reaching.

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