Selected Modern Public Culture and Educational Buildings in Countries of the Persian Gulf

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Abstract. Over the past few decades Persian Gulf countries have been strategically working towards diversification of their economies by transforming their natural resources exploitation incomes into other areas of investment and infrastructure. Economic transformation have always affected on urban development. New urban identity of the leading countries of the Persian Gulf creates a new paradigm by constructing a new tradition as alternative contemporary heritage. Analyzing the development strategy of the Gulf cities, which main goal was to achieve the global city statute, three directions of this transformation can be distinguished. The first one is to transform the city into a replica of global metropolises such as New York, Chicago or Hong Kong. The second is the implementation of international projects related to the construction of cultural and educational buildings of global importance. The third direction is related to the concept of organizing global events. In this paper, the authors focused on the architectural and structural analysis of selected public culture and educational buildings in Doha (Qatar) and Dubai (United Arab Emirates). These countries have developed their vision for the future by giving unprecedented importance to the cultural and educational sector and have invested in economically powerful and rapidly growing regional cultural and educational hubs, what has provided domestic and international benefits of both the financial and reputational nature. At the beginning of the XXI century, Dubai and Doha introduced a new model of urbanism. As a result, Doha was designated as the “Arab Capital of Culture” by UNESCO in 2010. Doha's and Dubai's plan for world class of cultural and educational buildings include, among others, buildings such as the National Museum of Qatar, the Museum of Islamic Art, the Qatar National Congress Center, the Dubai Opera House and the Dubai Future Museum.

1. Introduction

The Persian Gulf region is the oil and natural gas reserve of the world. The largest extraction of these raw materials takes place primarily in Saudi Arabia, Kuwait, The United Arab Emirates, Qatar and Bahrain. In the past, young oil states were very backward in economic terms, and their economic development in the first decade after the discovery of fields was slow and varied. The sharp rise in oil prices in the 1970s led to the emergence of huge revenues for exporting countries. Until the late 1990s, monarchies were seen only through the prism of energy resources. The first decade of the 21st century brought an economic boom to the world. The rapid growth rate of the world's leading economies again led to a sharp rise in the price of energy sources. The main beneficiaries of high oil and natural gas prices were the Persian Gulf Countries. Due to different priorities and their own development policy
related primarily to educational development, Dubai in the United Arab Emirates and Doha in Qatar are the indisputable leaders among the cities of the Persian Gulf regarding the development of infrastructure and buildings. Both of these cities play a leading role in creating contemporary architecture. The development of the economy in these countries contributed to rapid urban development, and there was seen to be a need to create iconic architecture. Saudi Arabia intends to join the visionary architecture of these two countries by implementing a plan to build the desert megacity of Neom as part of the Vision 2030 project, with the main investor being Prince Mohammed Bin Salman. Nowadays, the democratization of space in the projects of outstanding foreign architects means that public buildings have begun to play an important role in the spatial composition of cities.

2. The Urban Development of Doha

Over the past four decades, Doha has changed from being a fishing and pearl hunter village into a modern metropolis. Earlier, Qatari traditional architecture was characterized by low houses with spacious courtyards. Until the mid-1960s, most constructions were single traditional buildings. In the 1970s, Doha was transformed into a modernized city [1]. An important element of this transformation was the design of the main Al Corniche road along the bay. In 1974, Llewelyn Davis was appointed to design an urban plan covering the center of Doha. His project was based on creating a concentric road system. A new city center was created, based on this new zoning urban plan, with multi-storey residential buildings. Another investment conducted at that time was the expansion of the built-up area by changing the coastline. This area was earlier occupied by the shallow waters of Doha Bay. William L. Pereira was designated as the main author of urban planning for the new area, and he proposed at the northern end of the Al Corniche a project of the Sheraton hotel and the construction of a new West Bay business center. Then, along with the increase in wealth resulting from the export of oil and natural gas, as well as the upturn of business in the early 1990s, the interest in building high-rise buildings, especially in the West Bay district, increased.

At the initial stage, Doha's development was a great challenge for local and foreign architects. The aim was to present the Arab identity and national heritage and balance it with functional, climate and energy-efficient requirements. Currently, Qatar and the Persian Gulf countries are experiencing the birth of a new and distinctive Arab architecture. The development in Qatar has also revealed a significant emphasis on culture, and thus the establishment of the main cultural center of the Persian Gulf region in the capital of Qatar. The reform of education and culture is the key to achieving this vision, and the development of education in the city and the construction of new cultural buildings is an important step in this process. This strategy is a long-term plan focusing on three pillars, namely, education, science and community development. The National Council of Arts, Culture and National Heritage planned a broad program of building cultural buildings such as museums, libraries and university centers. World-renowned architects and designers were invited to participate in this project, including Arata Isozaki, Jean Nouvel, Ricardo and Victor Legorreta, David Chipperfield, Rem Koolhaas, Antoine Predock, Jason Moriyama, Cesar Pelli and Fred Clarke.

3. The Urban Development of Dubai

Since the establishment of the United Arab Emirates in 1971, the country has received a large number of immigrants whose presence radically changed the geography of the emerging country. The demand for workers from various countries coincided with the recent economic boom, which was the result of huge revenues from oil. The government has invested in colossal projects that were aimed at building the country's infrastructure. Dubai, Abu Dhabi and other large urban centers have experienced enormous population growth and urban development. As in the case of Qatar, the majority of the population were involved in fishing and trade. Dubai was characterized by slow economic growth until 1955. Its population lived in traditional single-storey houses made of palm leaves and the country was characterized by poor infrastructure. In 1957, the first urban plan was established and developed, which resulted in the appearance of a road system, a new city center and the construction of modern buildings made of concrete blocks [2]. The development of the city maintained a slow pace until the
early seventies. The discovery of oil in 1966 stimulated economic development and influenced the development of infrastructure in Dubai.

The Dubai Emirate became one of the 7 United Arab Emirates in 1971. A new urban plan was implemented in the years 1971–1985. New districts were created to the east (Al Qsais, Al Twar, Um Ramool and Al Rashidiya), to the west (Al Satwa, Al Jaffiliya and Al Jumeirah) and to the south (Mirdif, Al Warqa, Ras Al Khur, Al Karama, Zaabeel, Al Satwa and Al Wasl).

Dubai made a strategic decision to become a significant international metropolis in the early 1990s. A new urban plan was prepared for the years 1993-2012, which aimed to show the city's development path and introduce it into the 21st century. This resulted in a series of mega projects of so-called cities within the city to be implemented. The rapid development of the city changed Dubai from a small regional business center into a financial and recreational global center of the world. During the urbanization process, most capital was invested in a dozen or so gigantic construction projects, including the construction of skyscrapers such as the world's highest building Burj Khalifa, as well as artificial man made islands (Palma Jumeirah, Palma Jebel Ali, Palma Deirah, The World, Dubai Waterfront). One of the main reasons for the construction boom in Dubai is the drive towards diversification of the economy. The Dubai government does not want to rely on its oil reserves, which will soon be depleted. Currently, its economy is based on the development of commercial and corporate activities. Tourism is also being developed at a rapid pace with the construction of Dubai Land and the implementation of other projects that include the construction of giant shopping centers, amusement parks, resorts, stadiums and other tourist attractions. From the very beginning of the first decade of the 21st century, a new era of construction began with the huge expansion of new agglomerations. Outstanding foreign architects had a significant impact on the architecture of Dubai, including Zaha Hadid, Norman Foster, Janus Rostock, and Shauna Kille.

4. Selected public cultural and educational buildings

4.1 National Museum of Qatar (Doha)

The Qatar National Museum is a building designed by the architectural studio of Jean Nouvel, the 2008 Pritzker prize winner, figure 1. The building has many functions and includes: galleries, an auditorium, a TV studio, two cafes, a restaurant, and a museum. It is surrounded by a park with an artificial lagoon and a parking lot. The museum building has a truss structure and is a composition of 600 double-curved steel disks of various sizes. The disks intersect with each other to form an outer shell that defines the building's internal functions [3], occurring in the walls, ceilings, roofs and floors. They are supplemented by glazed façades.

The designed complex has dimensions of about 400 m x 250 m and its maximum height is 40 m [4]. Conceptually, the building’s body follows a wavy loop that gently rises and falls, reproducing the natural contours of the desert. At the end of the loop is the Fariq Al Salatah Palace, a historic building that is an integral part of the museum. The unique shape of the building was inspired by the desert rose. The architect, Jean Nouvel, explained that this form of the building is trying to express Qatar's progressive cultural perspective and technological opportunities that have contributed to its expansion and economic growth. The building plan creates an elliptical perimeter that leads visitors through a sequence of galleries that occupy irregular spaces between interlocking geometric planes, figure 2. Thirteen permanent galleries occupy the interior like Nomad camps, surrounding a central courtyard that refers to the traditional Baraha - a place where travelers unloaded their goods. The museum tour stretches for about 1.5 kilometers, where the history of Qatar from ancient times to the present is presented chronologically. The columns hidden in the vertical disks transfer the weight of the shell flake of the structure to the foundation. The building shell is made of glass fiber reinforced concrete panels that have the same sand-beige color inside and outside the building. The building was designed as energy-saving in accordance with the silver LEED certificate. The disks that make up its structure are heavy and form a kind of barrier that works like a sunscreen. When the sun shines on the building from east or west, the discs cast long protective shadows. The building does not have many openings,
with the few windows which are constructed being receding, and therefore always out of reach of the sun. The façade panels are double glazed, low emission and filled with argon to reduce the energy consumption by air conditioning. The building design assumed 21% energy savings in its internal water consumption. The choice of native plant species such as pomegranate trees, date palms and the Sidra – the national tree of Qatar, have reduced water consumption by 55%.

Figure 1. National Museum of Qatar: view from the north (photo by authors)

Figure 2. National Museum of Qatar: ground floor plan (developed by authors on the basis of [5])

4.2 Museum of Islamic Art (Doha)
The building of the Museum of Islamic Art was designed by Ieoh Pey, winner of the 1983 Pritzker Prize. The form of the building is the result of a journey he made to understand the diversity of Islamic architecture [6], figure 3. During visits to the Great Mosque of Cordoba in Spain, Fatehpur Sikri in India, the Great Umayad Mosque in Damascus in Syria, and the fortresses of Ribat in the Monastery and Sousse in Tunisia, Pey discovered that the influence of climate and local culture has led to many interpretations of Islamic architecture. The final source of inspiration for the Pey project was the 13th century sabil (ablution fountain) of the Ahmad Ibn Tulun Mosque in Cairo, Egypt. The sabil offered an "almost cubist expression of geometric progress" which evoked an abstract vision of key elements of Islamic architecture [7].
Figure 3. National Museum of Qatar: a) view from the south-west side, b) fragment of the façade (photo by authors)

Figure 4. National Museum of Qatar: ground floor plan (developed by authors on the basis of [5])

An extremely important element of the project was its location. Not wanting to build a structure on any of the proposed locations along the main street Corniche, Pey suggested the creation of an independent artificial man-made island, so that any buildings built in the future would never cover the museum. The C-shaped peninsula and the park on the coast behind the museum constitute a picturesque composition. The museum consists of a five-story main building and a two-story educational wing, which are connected by a central courtyard. Two bridges lead to the museum - a wide arcaded bridge-ramp and a smaller roofed one. The main arcaded bridge is for both pedestrians and vehicles and has a cascade water channel on the axis and side walkways, both of which are framed by two rows of palm trees. A parking lot was designed under the bridge. The bridge extends and at the same time closes one of the city's main streets. The axis of this monumental access to the museum is a water channel flanked by fountains on a circular and octagonal plan. An octagonal fountain was erected in the middle of a four-sided courtyard, which constitutes the end of the bridge. On the sides of the courtyard there are lamp-pillars on the plan of an isosceles cross, and elevators in the form of cuboids and staircases.

The museum, designed on a rectangular plan (figure 4), consists of a 7-storey main building (museum rooms, restaurant) and a 4-storey educational wing (library, computer rooms), which are separated by a courtyard. The body of the building has a stepped arrangement. The basement is on a quadrangle plan that changes on the upper floors into an octagon, and then higher into an isosceles cross, which at the top has a quadrangle shape (tower). On the north side, a 45 m high polygonal apse was designed on the axis of the building. The apse (bay) is located on the bay side with a view of the West Bay business district with skyscrapers. The high bay refers to the high, vertical form of skyscrapers. On the southern side, an entrance was designed that is placed in the arcaded blind window and covered with a roof in the form of an openwork steel structure on an octagonal plan. The entrance part is flanked by two low wings, decorated with horizontal black granite stripes on the background of light stone, which accentuate the entrance area. On the west side of the museum there is
a courtyard with fountains, stairs and a bridge for guests arriving by boat. The entrance is flanked by
two lanterns that form a kind of gate. The second courtyard, separating the museum and educational
center, is surrounded by arcaded arcades, pools and a central gazebo. The courtyards have the same
façade on each side, with three arcaded windows or doors on the wall axis. The inner courtyards have
fountains that are characteristic of Arab culture. In the central part of the main building there is a 50 m
high atrium covered with a two-shell dome that has a round ring made of stainless steel. The dome
with an oculus on tromps is turned by an angle of 45° in relation to the interior. This construction was
also supported on tromps and pillars set in the corners of the interior. The tromps have tops that are
finished with a steel form. The southern tromps were additionally placed on the walls, hence the
dome's supports received an asymmetrical composition. The interior of the atrium is divided into two
parts by glass bridges supported on a steel structure. The northern part is for resting, with a fountain in
the middle and a three-sided apse. In the southern part of the atrium there are stairs on a circular plan
which lead to the first floor. In the corners of the room, staircases were designed that have internal
walls decorated with horizontal black stripes which refer in form to the external façade. Side porches
and glass bridges create a bypass around the atrium and the entrance to the exhibition halls. The cover
for them is made up of concrete coffered domes, finished with individual forms that originate from the
Abbasid era. The use of smaller domes on the entire roof surface is one of the important features of
late Islamic architecture. Magny and Chamesson limestone from France, Jet Mist granite from the
United States, stainless steel from Germany and architectural concrete from Qatar were used to build
the museum.

4.3 Qatar National Convention Center

The Qatar National Convention Center building was designed by Arata Isozaki, the 2019 Pritzker
prize winner. The design of the National Convention Center refers to the holy tree Sidra of Islam
(figure 5), which symbolizes the end of the seventh heaven and the meaning of life, evolution and
eternal renewal [9]. According to Isozaki, the tree is an educational lantern, as well as a haven for
poets and scholars who gathered around it to share knowledge. Located on the campus of the Qatar
foundation in Doha, it is the largest convention center in the Middle East.

The building was erected along a multi-lane road that provides easy access to the building. The
surrounding area rises to the level of the flyover built from the front. The building consists of two
separately built parts - a vestibule covered with a cantilever roof and a glass façade with vertical
windows, and the main part with a glass façade with horizontal divisions. The side glass façades are
additionally printed. The main façade is formed by a pair of steel columns with branches, creating the
illusion of two trees supporting the concave-convex cantilever roof structure. The glass wall cuts
through the structure of the tree trunks, which are visible both outside and inside the vestibule.

The Qatar National Congress Center is a four-storey building with dimensions of 250 m x 115 m,
located on a single-storey podium with dimensions of 420 m x 175 m, figure 6. The building includes
10 conference and exhibition rooms, with one room containing 4,000 seats, a theater with 2,500 seats
and 52 smaller meeting rooms. The main entrance to the building leads to the lobby, which covers the
entire width of the façade. On the perpendicular axis, a second hall illuminated by upper-side light was
designed. On its axis there is a fountain illuminated by a glass roof. In the background there are stairs
on a semi-ellipse plan which lead to the first floor. The conference and exhibition rooms, as well as the
theater, were designed along the lobby. The main auditorium hall is constructed of 14 radial steel
frames located on two concentric reinforced concrete shells. Its roof is supported by two 45-meter
truss girders. The stage was made of a steel structure with precast hollow core slabs and is acoustically
insulated from the rest of the building. In the Convention Center, the theater was designed as a
building inside the building in order to isolate external interference. Its interior is distinguished by a
wall covered with multi-colored geometric patterns. To prevent vibrations from the concert halls, as
well as vibrations from moving to the upper floors of the conference rooms, 16 tuned mass vibration
dampers with a total weight of 220 tons were used.
Figure 5. Qatar National Convention Center: view (photo by authors)

Figure 6. Qatar National Convention Center: general floor plan (developed by authors on the basis of [10])

Side staircases covered with steel cladding lead to the underground and above-ground floors and are surrounded by a wall covered with a colorful mosaic. The Qatar National Convention Center building was designed to be energy-efficient according to the gold LEED certificate and is the first building of this type in the region. 3,700 square meters of solar panels were installed in the building, which provide about 12% of the total power. The center is also equipped with water-saving devices, LED lighting, carbon dioxide monitors and variable air volume systems that minimize resource consumption and improve indoor air quality.

4.4 Opera House

The Opera House building was designed by Janus Rostock, who joined Atkins global networks in 2006 and became part of the team working on the Dubai Promenade and Cape Town Waterfront masterplan. The building is located in Downtown West next to the world's tallest skyscraper Burj Khalifa and Dubai Mall and near a multi-lane road. The Opera House was erected on different levels that descend towards the water channel. Patterns on the sidewalk floor create wavy lines which highlight the convex shape of the building, figure 7. Shallow pools and a water cascade were designed along the side façades. The Opera House is one of the most significant multifunctional entertainment centers in the Middle East with a capacity of 2,000 seats. The opera design is deeply rooted in Dubai's maritime history, and the Arab Dhow ship has inspired the architecture of the building (figure 8). A restaurant with an open garden was designed on the top floor. The western entrance façade is distinguished by a high rectangular blend with revolving and sliding doors. Additional entrances are located in the side walls. The ground floor creates a kind of pedestal with a glass façade, above which is an overhung openwork truss with geometric patterns referring to Arabic Mashrabiya. Mashrabiya
was placed in the west and partly in the side façades. The remaining part of the side façade is decorated with horizontal strips of wooden slats, the number of which decreases to the east. The glass façade along the entire height causes it to reflect horizontal divisions, geometric patterns and the surrounding landscape.

The main roof is a complex steel structural spatial structure with a total length of 130 m and a width of 80 m, which is supported by perimeter columns that range from 38 m to 42 m in height [11]. Precast columns that taper upwards are set obliquely to fit the shape of the façade. The overhanging roof extends beyond the glazed façade to a length of 9 m from the east, 5 m from the west and 3 m along the sides. The longest steel truss, forming part of the roof support, is 37 m long. The roof trusses are curved to match the building’s geometry. Annular beam trusses are set between the perimeter columns and connect all the primary trusses.

The Opera House has a double glazed façade with the largest panel size being 2.7 m x 3.9 m, coated on both sides with low-iron anti-reflective glass. The interior uses a combination of ash slats, inlay panels and metal screens, reflecting the forms of sailors on dhow ships, as well as a contemporary interpretation of traditional Mashrabiya screens.

**Figure 7.** Opera House: a) west façade, b) east façade (photo by authors)

**Figure 8.** Opera House: floor plan (developed by authors on the basis of [12])

### 4.5 The Museum of the Future

The Museum of the Future building was designed by Shauna Killa's Design studio. The construction of the museum was inspired by the Dubai Sheikh Mohammed bin Rashid Al Maktoum. The main inspiration of the museum was to create a form representing the vision of the future, in which the physical building represents and contains in its exhibition spaces an understanding of the "future" [13]. The building is located on a green elevation for greater exposure of its futuristic form, figure 9.
Figure 9. The Museum of the Future: a) model (photo by authors), b) structural drawing [14]

The Museum of the Future has a torus shape with an elliptical open center. The building’s body represents humanity, with all its strength, artistry and also ability to be creative in harmony with the environment. The elliptical hole in the upper structure represents innovation by creating an empty space that shows the future to which humanity can symbolically look forward to. The museum building has 9 floors above ground level and one underground floor, which include: a three-story podium containing restaurants, an auditorium, shops and a parking lot; six exhibition floors and one administrative floor. The façade of the museum is perfectly smooth and in the colour of silver. The jointless assembly of 890 unique panels made of an alloy of stainless steel and fiberglass was made using methods borrowed from the aviation industry. The panels are covered with Arabic calligraphy about the future, showing the human passion for art and creation.

The building has a complex reinforced concrete and steel structure. A diagrid type steel structure with composite floor slabs is based on a reinforced concrete core [15]. This type of design solution allows columns to be omitted in the structure. A free standing staircase inside the building with a double spiral, which was inspired by the form of human DNA, was a great structural challenge.

The Museum of the Future is an energy-efficient building in accordance with the highest platinum LEED certificate due to its use of many innovative solutions, which include parametric design, passive solar architecture, low energy and low water engineering solutions, energy and water recovery strategies and integrated renewable energy sources.

5. Conclusions
The Persian Gulf in recent years has seen competition, not for priority in oil and gas extraction, but for the title of cultural leader of the region. Doha and Abu Dhabi are trying to catch up with Dubai, where for several years - in addition to multi-functional skyscrapers - magnificent cultural public facilities such as the Opera House and the Museum of the Future have been built. At present, Doha is a distinctive city in the Persian Gulf, in which many mega-museums have been built, including the Museum of Contemporary Arab Art - Mathaf, the Museum of Islamic Art, the Gallery of Oriental Art and the National Museum of Qatar. The urban development of these cities is associated with the desire to erect cultural buildings with a very complex geometric form as an expression of modernity, globalization and economic prosperity. This expansion has created many challenges related to environmental and urban planning.

The main goal is to design public buildings and monumental urban layouts with extensive rest areas of the highest international standard. Four of the five discussed buildings refer in their form to buildings or elements of the natural environment specific to a given country. The architects designing the Museum of Islamic Art in Doha and the Dubai Opera modeled their designs on buildings created by people of earlier eras. The National Museum and Qatar Convention Center in Doha refer to the world of nature. The forms of the Museum of the Future and the National Museum are more closely related to computer technology than to tradition. Most of the facilities are surrounded by greenery and water, which in a hot climate gives shade and coolness. Light also plays an important role. The Dubai
Opera and Qatar Convention Center give the impression of buildings overexposed by the sun. Glass façades and trusses in the form of Mashrabiya cause the interior to connect closely with the surroundings. The museum buildings, due to the need to protect the collections against light and sun, have façades that are faced with stone, concrete or steel. In order to better display the body, buildings can be located on an elevation (the Convention Center in Doha, the Museum of the Future in Dubai), be free-standing in a large space (National Museum and Museum of Islamic Art in Doha - surrounded by water) or nearby. The Opera House in Dubai is a lower construction among other high rise buildings. In the presented buildings, the entrance area was accentuated in various ways with the use of roofing (the most impressive being in the Convention Center) or by a blind window. In Persian Gulf countries, public buildings have become multifunctional, and each have conference and exhibition rooms, restaurants, cafes, fountains and greenery.

References
[1] F. Wiedmann, A. Salama, A. Thierstein, “Urban Evolution of the City of Doha: An Investigation into the Impact of Economic Transformations on Urban Structures”, METU JFA, vol. 2, pp. 35–61, 2012.
[2] A. Ogaily, “Urban Planning in Dubai; Cultural and Human Scale Context”, CTBUCH Research Paper, pp. 74-87, 2015.
[3] W. Sobek, “National Museum of Qatar”, Available online: https://www.wernersobek.de/en/projects/focus-en/structures/national-museum-katar/ (Accessed on 5 August 2019).
[4] Qatar Museums. “National Museum of Qatar – Heartbeat of Our Heritage”, Available online: http://www.qm.org.qa/en/project/national-museum-qatar/ (Accessed on 5 August 2019).
[5] J. Nouvel, “The national museum of Qatar, Doha”, Available online: https://afasiaarchzine.com/2019/03/jean-nouvel-46/ (Accessed on 2 July 2019)
[6] M. Fairs, “Museum of Islamic Art by IM Pei”, Available online: https://www.dezeen.com/2008/12/02/museum-of-islamic-art-by-im-pei/ (Accessed on 4 August 2018).
[7] M. S. Ferwati, “The Museum of Islamic Art, perception, and environment”, International Journal of Inclusive Museum, vol. 6, pp. 1-16, 2014.
[8] I. M. Pei, “Museum of Islamic Art: By I. M. Pei”, Available online: http://housevariety.blogspot.com/2011/02/museum-of-islamic-art-by-im-pei.html/ (Accessed on 2 July 2018).
[9] T. Tomasetti, “Qatar National Convention Center”, Available online: https://www.thorntontomasetti.com/ projects/qatar_national_convention_centre/ (Accessed on 5 August 2019).
[10] Qatar National Convention Center – Floor Plans & Capacity Charts, Available online: https://www.qncc.qa/organisers/floor-plans-capacity-charts/ (Accessed on 2 July 2018).
[11] Tekla, “The Opera House at Downtown Dubai (OHDD)”, Available online: https://www.tekla.com/bim-awards/opera-house-downtown-dubai-ohdd/ (Accessed on 5 August 2019).
[12] E. Shaheen, “The Dubai Opera House”, bulletin – Quarterly Magazine of Consolidated Contractors Company”, Issue 120, pp. 10-17, 4th Quarter 2016.
[13] Tekla, “Museum of Future”, Available online: https://www.tekla.com/ae/bim-awards/museum-future/ (Accessed on 5 August 2019).
[14] The Museum of the Future in Dubai, Available online: http://lusive.com/lusivelife/post/dubais-futuristic-architecture (Accessed on 4 November 2019).
[15] K. O’Connell, “Dubai’s Museum of the Future Is Shaping Up as the World’s Most Complex Building”, Available online: https://www.autodesk.com/redshift/museum-of-the-future/ (Accessed on 10 September 2019).