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Article

New Urbarchitectonic Design of Pedestrian Bridges

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Abstract:

Using ten realized examples from all over the world this paper confirms that the pedestrian bridges are not any longer only engineering and functional utility buildings connecting the shores and microambient urban entities. Designing-aesthetic and artistic dimension of formation of these physical structures in organic correlation with natural environment is an obligatory component with which the pedestrian bridges become iconic-cultural important architectonic futuristic references. Bridge designers in their quest for the best innovative designs apart from structural designing approaches have a concept of sculptural-artistic significant material compositions which have attractive complex geometrical forms living 24-hours a day. They are a result of application of computer and other technologies as well as the most contemporary artifact building materials.

Key words: urbarchitectonic design; functionality; sculptural; technology; building materials.

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Introduction

Construction of pedestrian bridges at the turn of 21st century posed the question of radically different shaping of their physical structures. The latest realized designs demonstrated that the presence of artistic-designing influences and concepts focused on sculptural forms are inevitable in designing, as well that solely utilitarian-functional, exclusively technical-engineering approaches are the thing of the past. New designing urbarchitectonic-artifact designs of pedestrian bridges, integrated with environment on the localities, bring about a different, organic outlook of a noticeably better, better designed, more aesthetic and humanized conceptualization of the public space (Fig. 1).

Exposition



Fig. 1. Zubizuri Pedestrian Bridge, Bilbao, Spain, 1997.

Pedestrian-bicycle sculptural and elegant bridge Zubizuri[1], across the Nervion river in Bilbao, is a work of art of the Spanish, neo-futurist famous architect and designer from Valensia, Santiago Calatrava. It is 75 meters long, and 17 meters high and it has a brilliant iconic character [13]. It was commissioned in 1997, simultaneously with the famous Guggenheim museum, nearby to the north-west. It connects the

[1] In Basque „zuri“ means white, and „zubi“ on the bridge.

Ensanche district and the area of Casco Viejo. The physical structure of the bridge is supported by the design with two visually powerful, strong parabolic and inclined, arched steel structures, in a delicate balance. They are connected with a total of 39 stainless steel cables on both sides, while the pedestrian deck is made of glass, providing sight of the lower bearing structural elements [14]. Because of the smooth and slippery glass surface, and protests of the users, the deck was subsequently coated with an anti-slip material. The transparency effect is emphasized using artifical night illumination, when the lights inside the glass deck turn on and when the bridges assumes a more persuasive, attractive and solemn appearance [15].



Fig. 2. Te Rewa Rewa Bridge, New Plymouth, NZ, 2010.

The design of the spectacular highly innovative bridge structure of the Te Rewa Rewa Bridge[2], across the Vaivhakaiho river, was done by the designer Peter Mulkueen[3] with an intention to create a sensation of wind, as the enduring spirit of the dead buried on the Reva Reva Pa locality (Fig. 2). For that reason, the structure of the iconic-sculptural bridge is lightweight and metabolic [16]. It was created from the contextual exploration of the relations of the people with the history of these parts, their tradition, customs, culture and environment. It consist of three tubes, two below the deck, and 19 arched steel elements of complex, parabolic geometry [17]. The elegant bridge is founded on solid igneous rock slabs. The backbone of the bridge composition is directed towards the holy volcanic mountain Taranaki in the vicinity, which is sight of the moving users. The bridge deck is defined so as to provide passage of service and emergency vehicles. The arched prefabricated bridge structure, 85 m long and weighing 85 tons was produced in a workshop only 1,5 km from the Te Reva Reva location, and then transported and assembled as a single structure [18].



Fig. 3. Lusail Pedestrian Bridge - Qatar.

Bridge, with the intertwined oval-elliptical form[4], with double pedestrian deck, with its geometry follows the radii of the coastline of the marina for 350 vessels on the island of Qetaifan in Qatar [19] (Fig. 3). The structure is supported by two slender columns of double circular tubes, of varying diameter of 1000-2000 mm, 32-50 mm thick, filled with concrete. They are lined with stainless steel. The static support cables are also made of stainless steel. Attractive designing bridge composition is above the artificial water canal in new urban district of the town of Lusail, having the surface area of 38km^2, 13 km north-east of Doha [20]. The structure of the bridge consists of four oval sections with the symmetrical deck sections of prestressed concrete, with the central span of 60m and tow lateral spans, each having

[2] Characteristics, Design: steel arch. Material: steel, concrete deck. Total length: 70m. Width: 2.5m. Height: 10m at highest point. Longest span: 68,8m. No. of spans: 1. Piers in Water: nil. Clearance below: 4.5m.

[3] Designed by: consortium Whitaker Civil Engineering, Novare Design Ltd, Apek Consultants Ltd (now Spiire) and Fitzroi Engineering.

[4] Client: Lusail Real Estate Development Corporation. Completion: 2017

30m. The total length of the bridge with the access surfaces is approximately 200 meter. Bridge deck and railing, as well as the kiosks on the bridge are made of 2000m^2 o laminated glass, which is in night conditions illuminated with LED lighting. The design of the spectacular bridge with the symbolical form was done by Safdie Rabines, an architect from San Diego [21].



Fig. 4. The Twist Bridge Over the Vlaardingse Vaart, Netherlands, 2009.

On the periphery of the city of Rotterdam, in Vlaardingen, a spiral bridge "The Twist" of an outstanding structural design was constructed [22] (Fig. 4). Pedestrian-cycling bridge is 42 meters long, connecting two adjacent urban entities: The Holy-Zuid district the Broekpolder. It was built of 400 galvanized steel welded sections having square cross-section, painted in red. Transversal rectangular cross-section of the truss is rotated around the horizontal axis towards the ends of the bridge, so the optical illusion shows an instable, deformed structure [23]. It was made in one piece, prefabricated, transported to the location and placed on its support points. In addition to the well-designed, sculptural appearance in the natural environment, the bridge with such engineering design obtained a considerable static stiffness and reduction of vibrations from the traffic load. The bridge design[5] was done in the West 8 Architects firm in Rotterdam [24].



Fig. 5. Prestigious arts building to the Kistefos Museum in Norway. Bridge at Kistefos Museum & Sculpture Park, 1996.

The park of the sculptures and the Kistefos Museum on the bridge across the winding Randselve river in Jevnaker, were made in 1996, north of Oslo, at a reforested location (Fig. 5). Contemporary design of the hybrid "Twist" form, 60 meters long, with the surface area of 1000m^2, synthesizes the elements of ecourbarchitecture, infrastructure and sculpture [25]. The structural from made of steel was created by rotation of a part of modulated shape and façade planes for 90^0, counterclockwise. The greatest change occurred in the middle, "articulated", level-separated part of the bridge. It was conceived as an informal area for sitting, and as a functional space for video projections, artistic performances and other events. So, in the interior space there is a vertical and horizontal volume with the series of connected galleries for exhibition of pictures, sculptures and installations [26]. The penetration of the natural light was provided to a half of the interior via a roof skylight. The other half of the structure obtained the lateral lighting through large insulated glass panes with reflective UV foil to prevent damage to the museum exhibition pieces. Façade surfaces without glass were constructed from the ground stainless steel. The designer[6] is of the opinion that the visitors of the museum of art on the bridge rather pay their visits because of its fascinating architectonic-sculptural and organic beauty than of its exhibited pieces [27].

[5] Awards: Finalist Dutch Design Awards 2009.
[6] Bjarke Ingels Group, Architecture firm in New York City. https://big.dk/#projects



Fig. 6. Coop Himmelblau - Dubai Gateway, 2008.

Coop Himmelb(l)au designed a bridge [7] over the water canal connecting Cornish Deira and Al Shandagha at the entrance of the Dubai Creek area, which is said to be the new city gate and an unforgettable iconic structure [28] (Fig. 6). The design contains unique, functional, spatial and sculptural characteristics interpretable in environmental-urbarchitectonic and parametric forms, so that the new bridge is definitively the most significant destination in Dubai. The concept of the bridge creates a scenic urban tension with the surrounding natural and artifact structure, connecting organically, with its extraordinary urban beauty and geometry, the city fabric and traffic communications. Strategically and functionally it helps establish a new urban model for this area in which artistic-esthetic and elevates city building-cultural dimensions to a extremely high level [29]. Dubai Gateway is a social magnet for the population and tourists for which the attractive complex created a 24h cultural-entertainment center and recreational hub. It is a generator of future urban development of the coast parts of the city with numerous shops, artistic galleries, cafés, restaurants etc. [30].

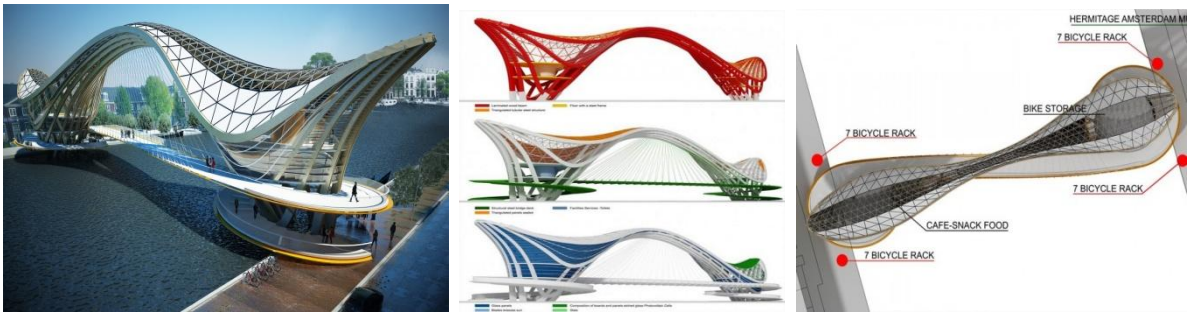


Fig. 7. Mixed-use Bridge for Amsterdam. Wooden Bridge [8] Amsterdam, 2012.

The design of the elegant cycling-pedestrian bridge across a canal in Amsterdam, with a fascinating design on an interesting location was done by the architect Laurent Saint-Val [9] [31] (Fig. 7). He sought the idea for the sculptural identity of the bridge in the wish to pay homage to the wooden material combined with steel structural elements and glass. After the catastrophic conflagrations of 1421 and 1452, wooden material as building material was forbidden in 1669. The outstanding technological revolution improved the quality of environment-friendly materials to the level where laminated wood became a primary material owing to its multiple qualities – static strength, flexibility for design and adaptation to other materials. As a contemporary, environment-friendly, traditional and universal natural material, it assumed the central position in civil engineering [32]. Use of the laminated wooden material achieved a superb creative esthetic-artistic, iconic-historical, urbarchitectonic and organic composition of the bridge. With the museum, café-restaurant, bicycle shop and a garden on top of the bridge in the vicinity, this place is nowadays a special cultural and attractive hub for people gathering – an Amsterdam gate with a European identity [33].

[7] http://desmena.com/2009/10/dubai-gateway-by-coop-himmelblau/

[8] Project details: Year 2012. Work started in 2012. Main structure Wood. Status Unrealised proposals. Type Parks, Public Gardens / Urban Furniture / Showrooms/Shops / Bars/Cafés / Pubs/Wineries / Restaurants / River and coastal redevelopment

[9] http://www.formakers.eu/project-334-laurent-saint-val-footbridge-cafrestaurant-bikestore



Fig. 8. Arganzuela coniaxial pedestrian bridge is one of the major bridges spanning the historic Manzanares River. Bridge in Madrid Rio Park, Madrid. Designed by Dominique Perrault, 2010.

The design of the pedestrian-cycling bridge Pasarela del Arganzuela - spiral bridge, in Madrid[10], connects two vibrant park promenades next to the Rio Manzanares river, without noise and pollution from the traffic (Fig. 8). Physical structure of the bridge, made of stainless steel is designed on the both sides with a conical, twisted tapering form [34]. Along the entire length it is lined with spirally metal latticework with 64 bent triangular fields: 30 on the north side and 34 fields on the south side of the spiral, with a total surface area of 48.420m^2, permitting natural light. For the users, it creates a feeling of safety from the gusts of wind, a feeling of transparency and long visual communications to the surrounding landscape [35]. At night, the skin is illuminated and from a distance appears as a golden, twisted, hovering rope across the river. The latticework was crucial for the esthetic-artistic charming and effective appearance of the bridge. The structural system of the bridge is formed by two independent self-supporting conical units, which in their central part meet on the platform which is the access to Manzanares park. Unusual design of the bridge is a picturesque association of the metabolic exchange with the natural, environmental forms in the surroundings [36].



Fig. 9. Peace Bridge Calgary (Gallery), Santiago Calatrava, Architects, 2010.

Conceptual solution for the tubular shape of pedestrian-cycling bridge[11], in bright red color, across the Bow River in Calgary, Canada, was made by the famous builder Santiago Calatrava [37] (Fig. 9). In contrast to the previous bridges dominated by the masts and tensioned steel cables, the designer introduced considerable designing and structural changes in this design. The bridge is 126 long, 8 meters wide and 5,85 high. It is symmetrical, covered in bent glass panel so that it can be used in winter conditions [38]. It is a tunnel type with lateral openings and separate pathways for the cyclists and pedestrians, for their safety. At night, the bridge is illuminated. Even though the design appears simple, without the central pier, the bridge is a complex engineering, and striking structure. It possesses sculptural-urbarchitectonic character and it is contrasting in relation to the natural environment. The pedestrian bridge connects the well-structured residential community.

The pedestrian bridge connects the residential community Sunnyside on the north river bank and the contemporary urban community Eau Claire on the south bank [39].

[10] Architects: Dominique Perrault Architecture. Location: Parque de la Arganzuela, Madrid, Spain Engineering: MC2 – Julio Martínez Calzón (structure) / TYPSA (mechanical engineering). Built area: Footbridge 150 m (section 1), 128 m (section 2) length, 5 to 12 m width. Completion: 2010.

[11] Designer: Santiago Calatrava. Constructed by: Graham Infrastructure Ltd. Construction start: March 2010. Design: Double helix tubular truss. Material: Steel. Total length: Out to Out 130.6 meters. Width: 6.2 meters. Height: 5.85 meters. No. of spans: 1.



Fig. 10. The Lucky Knot Bridge Opens In Changsha, China, 2016.

The architects of the Dutch design bureau "Next Architects" found inspiration for undulating pedestrian bridge, in the form of braided bend the "Lucky Knot"[12], in Changsha, China, in unification of ecourbarchitecture, culture, history, technology, traditional Chinese folk art and innovative forms of the Moebius strip [40] (Fig. 10). The unique structure of the bridge is formed by sinusoid bridge decks at various heights, 185 meters long. Spectacular three-segment bridge across the heavily loaded traffic route is 24 meters high, connecting the riverbanks of the Dragon King Harbour River and adjacent park areas [41]. It is painted in red, which symbolizes happiness in chinese culture, and associates of decorative craftsmanship in making of red ropes. The bridge design concept is based on recreational-touristic and environmental activities of the users. LED lights bring vibrancy to appearance of the bridge at night [42].

Conclusion

Based on the ten presented realized town-planning and architectonic designs of pedestrian bridges from all over the world after 2010, the analyses showed that:

1. Consideration of solely town planning or engineering-technincal conditions of designs of physical structures of pedestrian bridges in order to construct them is a thing of the past.
2. Infrastructural designs in urban agglomerations worldwide emphasize the tendency of the necessity of permanent participation of contemporary design in engineering-designing and construction business.
3. Creations of pedestrian-cycling bridges are harbingers of a new strategy in which unification of ecourbarcitecture, culture, history, technology, traditional folk art and innovative forms, will be imperatively necessary.
4. The focus on a simple and attractive design of bridge structures is a question of spirit and character of the place on a wider location, i.e. of the new organic connection of all structures in the environment, both natural and artifact and creation of new, very important historical urban memory.
5. When defining the functions of bridge structures it is not sufficient to evaluate only their utilitarian-static-communication function, but a more broad, all the public functions which encourage social contacts and reinforce cultural challenges for the users.
6. Pedestrian bridges which will be constructed in the new future must, not only connect two banks, but cover a wide conceptual spectrum with integrative urbarchitectonic esthetics in living environment. In modeling the design of pedestrian bridges it is not sufficient to implement only the fascinating modern materials and great building engineering, it is rather necessary to implement a simultaneous and active synthetic inclusion of sophisticated, innovative sculptural design.
7. Organic combination of technical and engineering skills with artistic-esthetic-designing elements in creation of pedestrian bridges is nowadays a crucial question.

[12] Architects: NEXT Architects. Project: Lucky Knot Bridge. Project team: Bart Reuser, Marijn Schenk, Michel Schreinemachers, John van de Water, Luuc Sonke, Michel van de Velden, Jiang Xiaofei, Wang Jifei, Wang Yan, Zhou Tong. Client: Changsha Meixi Lake Industrial Co. Ltd. Tiope: pedestrian bridge. Location: Changsha Meixi Lake District, China.

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Article Summary ***Design. Art. Industry*, 2021, Issue 8**

New Urbarchitectonic Design of Pedestrian Bridges [Новый урбархитектонический дизайн пешеходных мостов]

Аннотация:

Используя десять реализованных примеров со всего мира, эта статья подтверждает, что пешеходные мосты больше не являются только инженерными и функциональными хозяйственными зданиями, соединяющими берега и микроокружающие городские объекты. Дизайнерско-эстетическое и художественное измерение формирования этих физических структур в органической взаимосвязи с природной средой является обязательным компонентом, благодаря которому пешеходные мосты становятся культово-культурными важными архитектурными футуристическими отсылками. Дизайнеры мостов в своем стремлении к лучшим инновационным проектам, помимо структурных подходов к проектированию, используют концепцию скульптурно-художественных композиций из значимых материалов, которые имеют привлекательные сложные геометрические формы, живущие 24 часа в сутки. Они являются результатом применения компьютерных и других технологий, а также самых современных строительных материалов.

Ключевые слова: урбархитектонический дизайн; функциональность; скульптура; технология; строительные материалы.

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