

PAPER • OPEN ACCESS

Review of Extravagant Projects by Santiago Calatrava

To cite this article: Bartosz Mazur 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **471** 072018

View the [article online](#) for updates and enhancements.

Review of Extravagant Projects by Santiago Calatrava

Bartosz Mazur¹

¹ Kielce University of Technology, Al. Tysiąclecia Państwa Polskiego 7, 25-314
Kielce, Poland

bmazur@tu.kielce.pl

Abstract. The topic of the article is a review of the most interesting and extravagant projects of Santiago Calatrava from the moment of his architectural beginning in civil engineering to the present. I focused on structures that caused the greatest wave of admiration and at the same time criticism of this known in the world architect. I chose objects, e.g.: buildings, structures, bridges and footbridges. I described the most important information, e.g.: construction time, construction costs, functionality, architectural style, technology and curiosities. The idea for the paper arose from my trip to the United States of America, where I had the opportunity to see one of the most interesting buildings - The World Trade Center Transportation Hub in New York. In addition, Santiago Calatrava's projects I discussed during lesson that in my university. The first part of the paper describes the author, his education, fascination with architecture, ideas for work and the future. In addition, I have included trivia related to childhood and adulthood of the architect. I described Calatrava's approach to projects and the entire implementation process from concept to finished construction. The following parts describe specific projects that I chose for analysis, these are: Stadelhofen railway station in Zurich, Bac de Roda bridge in Barcelona, Puente del Alamillo Expo 92 in Seville, Atrium of Brookfield Place in Toronto, Gare de Lyon Saint Exupéry railway station in Lyon, Gare do Oriente in Lisbon, Milwaukee Art Museum in Milwaukee, Auditorio de Tenerife in the Canary Islands, Science Museum in Valencia, Museum of Tomorrow in Rio de Janeiro, The World Trade Center Transportation Hub in New York. In the article, I've also placed interesting pictures that perfectly illustrate the architectural style, the scale of the building, and assess whether the object fits into the surroundings. In summary, I checked all the information and expressed my opinion on Calatrava's projects, its approach to architecture and described future plans for new buildings.

1. Introduction

Santiago Calatrava, loved and beloved by some, and hated and condemned by others for his extravagant approach to architecture and construction. From the very beginning his projects have met with great publicity and echoed around the world. He brings something new, fresh and different into the world of building art. He is the type of creator whom he respects and admits or forgives. Unfortunately, in our time everyone who tries to change something, transform and break away from the standard encounters such comments. Very often, objects coming from the architect's hand are treated as tourist attractions and therefore many cities ask Santiago to design a building in his area.

In my lecture I will try to present different perspectives on Calatrava projects. I chose the most controversial, interesting ones in my opinion, which still evoke the greatest voice of praise and criticism.



2. Santiago Calatrava



Figure 1. Architect Santiago Calatrava discussing the World Trade Center Transportation Hub, 2005.
Photo by Mario Tama/Getty Images News/Getty Images

The architect was born in Valencia on July 28, 1951 and is now 66 years old. He is a Spanish architect, construction engineer, sculptor and painter. He studied drawing and painting and architecture, he wanted to be an artist, he was inspired by the book on La Corbusier's work entitled *Artist and Architect*. Most often in his projects uses sculptural forms often resembling living organisms. Most often, he designs bridges, railway stations, stadiums and museums. It has offices in New York, Doha and Zurich.

3. First projects and international attention

Stadelhofen Station,

Location: Zurich, Switzerland,

Date: 1990.

The expansion and transformation of the station located in Zurich, serving as a city transit hub for fast public transport, was the subject of a competition, where Santiago Calatrava participated with architect Arnold Amsler and landscape architect Werner Rueger. The Stadelhofen railway station, closely adjacent to the green slope of the nearby Bellevueplatz area near the Theaterstrasse, shows its structure only when the traveler is on the platform.



Figure 2. Railway station in Zurich, [1]

Thanks to the transparent, glass roof that covers the platforms along their entire length, a lot of natural light reaches here, despite the fact that it is basically a closed space. Designing to indent in the existing slope and change it while maintaining the slope of the escarpment, the architects got rid of the need to build a tunnel.

Unfolded metal elements that enable the creation of a *transparent, green roof, which strongly soften the entrance of the station into the existing surroundings*. Oval entrances and hatches are designed to allow this beautiful commercial space to be closed in the evening.

The station and platform building has been included in the Swiss list of cultural goods of national importance, [2, 3].

Viaduct Bach de Roda - Felipe II

Location: Barcelona, Spain

Date: 1987

The complete length of the overpass is 128 meters. The whole structure consists of two identical twin, inclined and split arches. These steel arches are inclined at an angle of 60 degrees. The viaduct connected the streets of Bach de Roda and Felipe II. It was built over an uninhabited area where only railway tracks run, which contributed to bringing the greater part of the city closer to the sea. Calatrava observed the hierarchy of materials and forms whose selection was imposed by the distance from the earth. He combined powerful concrete supports, monolithic granite columns and steel arches, and composed a structure that grew light as construction progressed.



Figure 3. Viaduct Bach de Roda - Felipe II, [1]

4. Projects from the 90s

The Puente del Alamillo Expo 92 Bridge

Location: Seville, Spain

Date: 1992

A suspended bridge in Seville connects the shores of the Guadalquivir River. It was erected by the Spanish visionary, engineer and architect Santiago Calatrava. The construction of the bridge was started in 1989, and in 1992 it was completed, [4].

It was built to create a new connection with the abandoned La Cartuja island, where Expo 92 was planned. It is a cantilever suspended bridge with one pylon, which is also a counterweight for a 200-meter span together with twenty-six different lengths of steel ropes in turn in pairs on two sides of the central footbridge.



Figure 4. The Puente del Alamillo Expo 92 Bridge, [5].

Gare do Oriente Communication Hub

Location: Lisbon, Portugal

Date: 1998

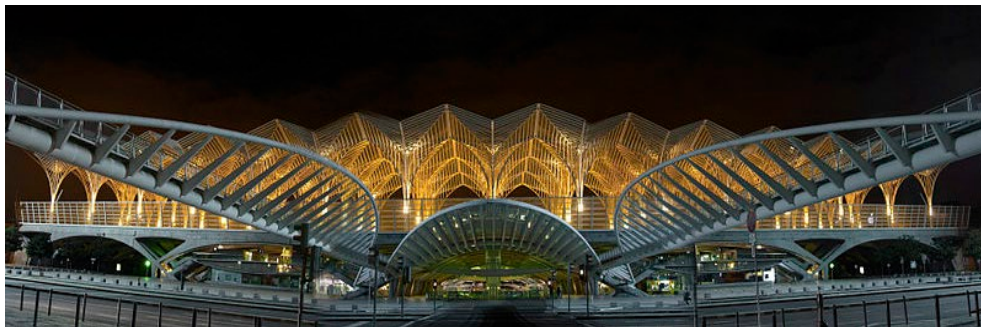


Figure 5. Gare do Oriente Communication Hub, [6].

Oriente Station was completed in 1998, and its activity was started exactly May 19, 1998. This great building made of steel, concrete and glass was constructed and built to serve the EXPO exhibition in 1998. The construction itself lasted more than 5 years. The main designer of the building is the Spanish architect Santiago Calatrava, while the railway station was built by the Nesco company.

Oriente Station is practically one of the main transport hubs in Lisbon. It is located in its complex at the same time a railway station that supports long-distance and local trains, a subway station, a public transport station, an intercity and international bus station. The characteristic element of the beautiful station are four platforms with eight platforms, where there is a *forest* of several dozen 20-meter columns, which support a steel, openwork roof structure. These columns and the structure are similar to the palm forest, and the entire area of this extraordinary roof covers over 19,000 square meters.

It is not only the largest station in Portugal, but also one of the largest in the world - over 75 million passengers a year.

5. Museums, concert halls and skyscrapers (2000-2010)

Museum of Milwaukee Art

Location: Milwaukee, Wisconsin, USA

Date: 2001

Calatrava designed a construction similar to the pavilion on the axis of Wisconsin Avenue, the main street of central Milwaukee. Created as an independent unit, the pavilion blends with existing buildings in both geometry and materials as a white steel-concrete ship-like form, [4].



Figure 6. Museum of Milwaukee Art, [7].

The project adds 13,200 square meters to the existing 14,900 square meters, including a sash (made of glass and stainless steel, with a lamellar roof), set at right angles to the Saarinen structure. On the coastal level, there is an atrium: 1500 square meters of gallery space for temporary exhibitions, an education center with a 300-seater lecture hall and a souvenir shop.

The pavilion has a spectacular kinetic structure: bris-soleil with shutters that open and close like the wings of a great bird. After opening, the shape also becomes a sign placed on the background of the lake to herald the inauguration of new exhibitions. The bris-soleil slat line is based on the linear mast axis inclined at an angle of 47 degrees parallel to the neighboring mast of the bridge.

Museum of science and Planetarium

Location: Valencia, Spain

Date: 2006

The entire complex forms a linear sequence from west to east. The fifth structure, known as L'Umbracle, is a promenade and garage, built on the principle of an open arcade, which is a contemporary winter garden. The raised, axial sidewalk, overlooking the sea, serves as the first element, with gardens and reflecting pools on both sides. The Museum of Science is a spatial block measuring 104 meters and 241 meters long. Like the large exhibition pavilions from the past, it is a longitudinal building, created from the modular development of cross-sections that repeat along the entire length of the object, [11].

Five concrete *trees* branch out to support the combination of the roof and façade on a scale that allows the integration of elevator cores and staircases. Triangular structures supporting the ends of the building

also mean the entrances. The white concrete supporting frames of the southern façade are filled with glass, the northern façade is a continuous glass and steel curtain along the entire length of the building. The Planetarium Theater is reminiscent of a human eye set on a 24,000-square-foot swimming pool. The concrete *eye socket* has an eyelid made of vertical, articulated metal beams that can be raised to allow a view of the pool.



Figure 7. Museum of science and Planetarium, [8].

An axial sidewalk that surrounds the building and is connected to the gallery enters the planetarium. The opera house in Valencia creates a large venue for spectacular art and a dynamic, monumental landmark. The main components of the building are an auditorium housing 1,300 people, suitable for opera performances, as well as concerts and ballet, a room for 400 seats for chamber music, drama and other performances, and an open-air auditorium, roofed, seating up to 2,000 people and offering spectacular views of the complex, as well as the opportunity to watch performances on special video screens.

6. Recent big projects and Calatrava's plans (2011-)

The World Trade Center Transportation Hub

Location: New York, USA

Date: 2016



Figure 8. The World Trade Centre Transportation Hub, [1].

Calatrava's first major design decision for the WTC Transportation Hub was to design an *Oculus*-class building as a free-standing structure. Such land development creates a pause between dense skyscrapers and combines the area of green areas stretching from City Hall Park to St. Paul's Cemetery, across the WTC Transportation Hub to the Memorial and Battery Park along Hudson. *Oculus* consists of steel ribs and glass arranged in a large elliptical shape. The ribs extend to form two canopies over the northern and southern part of the square, [10].

Rafters grow from two 350-meter arches surrounding the central axis of the project. Between the arcades, a working 330-foot skylight surrounds a piece of New York sky and opens on moderate days and once a year on September 11. Although it suggests motifs from many traditions, you can summarize the form, according to Santiago Calatrava, the image of a bird released from the hands of a child. This *Oculus* allows flooding with natural daylight WTC Transportation Hub. At night, the illuminated building will serve as a lighthouse in its neighborhood. Santiago Calatrava speaks of light as a structural element at the WTC Transportation Hub, saying that the building is supported by columns of light.

Access to the building is provided from Church and Greenwich through the eastern and western *Oculus* arch foothlights.

The combination of natural light and sculptural form gives dignity and beauty to buildings at lower levels and pedestrian sidewalks, and provides New York public space that he did not like before.

UAE Pavilion At Expo 2020

Location: Dubai, United Arab Emirates

Date: 2020



Figure 9. UAE Pavilion at Expo 2020, [1].

After completion, the pavilion designed by Calatrava is to have an area of approximately 15,000 square meters and will include numerous exhibition areas, auditorium, dining venues and VIP venues. It will be designed to meet the LEED Platinum sustainable building standards.

The pavilion will be one of the largest Expo icons. The project will bring back the pioneering spirit and power of connections that have transformed the United Arab Emirates from a small, deserted community into a global connection point - said the Minister of State for International Cooperation UAE and Director General of Expo 2020 Dubai H.E. Reem Ebrahim Al Hashima. The United Arab Emirates Pavilion will become an important cornerstone on our site and will have an existing plan that reflects our hopes and ambitions for many years to come.

Dubai World Expo 2020 is a six-month event presenting architecture, global culture and innovation that will bring participants from 180 countries and six continents. It will include over 200 participants, including nations, multilateral organizations, corporations and educational institutions [12,13]. The theme of this year's edition of Connecting minds, creating the future underlines how the modern world is *connected with each other* and the need to generate permanent solutions to global problems.

7. Controversy and opinions on Calatrava's projects

He is one of the greatest architects in the world, known for his complex aesthetic and complicated projects. But behind the Spanish Santiago Calatrava is the trace of frustrated customers, from the wine cellar near La Rioja, whose leaky roof causes a lack of control over humidity, with the dazzling City of Arts and Sciences in Valencia, whose final cost was four times higher than the original price.

The largest and perhaps the most controversial collection of his works is in the hometown of Valencia. The City of Arts and Sciences complex, which includes a concert hall, an opera house and a planetarium, has seen a cost increase of over EUR 1 billion. Since the opening of the auditorium in 2005, the authorities have complained about a leaky roof and fragments of a complicated mosaic departing during strong winds.

Despite all his global success, the architect remains a controversial figure in Spain. In Bilbao, called a glass-walled footbridge, it began to be called a bridge with a howl, with passers-by slipping and falling every time it rained, while the airport on the outskirts of the city was built without an arrival hall, which left the airport authorities to build glass shelters on their own so that visitors do not stay cold. In La Rioja, northern Spain, the Ysios wine cellar has initiated a lawsuit on a leaky roof that has compromised its ability to control humidity, while in Oviedo the court ordered Calatrava and his team to pay 2.9 million euros after part of the conference center broke down during construction.

When asked about cost overruns, Calatrava pointed to the building design process - *There is a sketch, competition and contract award. And from there you hope that you have a fair price. But it is very difficult because there are a thousand variables that no one can control. For example, he said, building in Manhattan was more expensive because the cost of transporting goods to the island was very expensive. But we all try to be more precise.*

At the age of 63, Calatrava said he hoped that the best in his career is yet to come - *Many architects whom I admire gave the best. I hope I will do the same.*

8. Conclusions

During his career, Calatrava designed dozens of buildings - from the Turning Torso skyscraper in Malmö, Sweden, to the Athens roof of the Olympic Stadium. He is currently designing a 6-mile bridge in Doha, Qatar, and was recently selected to design three bridges near Wuhan, China. Despite the fact that his projects both meet with adoration and a wave of criticism, it should be admitted that he is changing architecture and introducing it into a new period. His ideas are unique and impossible to forge. Many architects around the world follow the Calatrava style. During his work as an engineer and architect, he led to the construction of many beautiful buildings and structures that change the close surroundings and refer to natural, original shapes. In my opinion, the Calatrava designs are so characteristic that everyone who has seen even one of his objects will recognize all the ones that came out from under the pencil of this genius architect. In summary, he is one of the geniuses and visionaries of world architecture worthy of imitation, and those who criticize him most probably just jealous of him.

References

- [1] <http://www.calatrava.com/main.htm>, access: 22.04.2018
- [2] Harbison R., *Creatures from the Mind of the Engineer: The Architecture of Santiago Calatrava*, Zurich & Munich, Artemis, Verlags AG, 1992.
- [3] Tzonis A., *Santiago Calatrava's Creative Process*, Birkhauser, Basel, Boston Berlin, 2001.
- [4] Tzonis A., *Santiago Calatrava: The Athens Olympics*. Rizzoli, New York, 2005.
- [5] https://en.wikipedia.org/wiki/Puente_del_Alamillo, access: 22.04.2018
- [6] https://en.wikipedia.org/wiki/Gare_do_Oriente, access: 22.04.2018
- [7] https://en.wikipedia.org/wiki/Milwaukee_Art_Museum, access: 22.04.2018
- [8] www.polityka.pl, Museum of science and Planetarium, , access: 22.04.2018
- [9] Feuerstein G., *Biomorphic Architecture: Human and Animal Forms in Architecture*. Stuttgart, Menges, 2002.
- [10] McQuaid M., *Santiago Calatrava : structure and expression*. The Museum of Modern Art. New

York, 1993.

- [11] Tarazona-Vento A., Santiago Calatrava and the 'Power of Faith': Global Imaginaries in Valencia. *International Journal of Urban and Regional Research* no 39, 2015.
- [12] Kossakowski P., Wciślik W., Bakalarz M., Selected Aspects Of Application of Aluminium Alloys In Building Structures. *Structure And Environment* no 4, 2017.
- [13] Wciślik W., Kossakowski P., Sokołowski P., Stainless Steel in Building Structures – Advantages and Examples of Application. *Structure and Environment* no 3, 2017.