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BALKAN BUILDING STRUCTURES

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BALKAN BUILDING STRUCTURES

Overview of the different typologies of structures present in the Balkans

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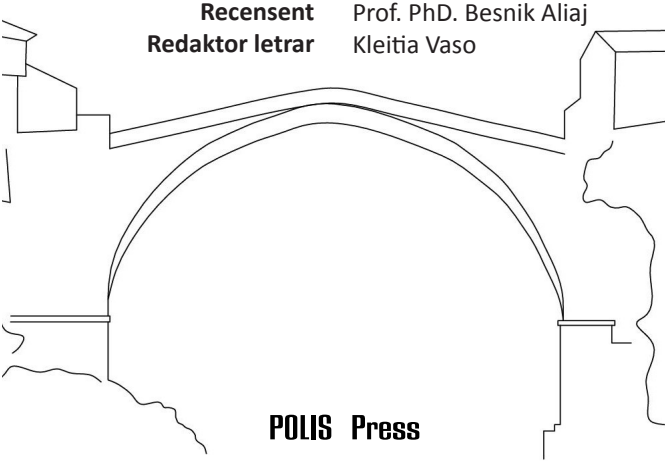

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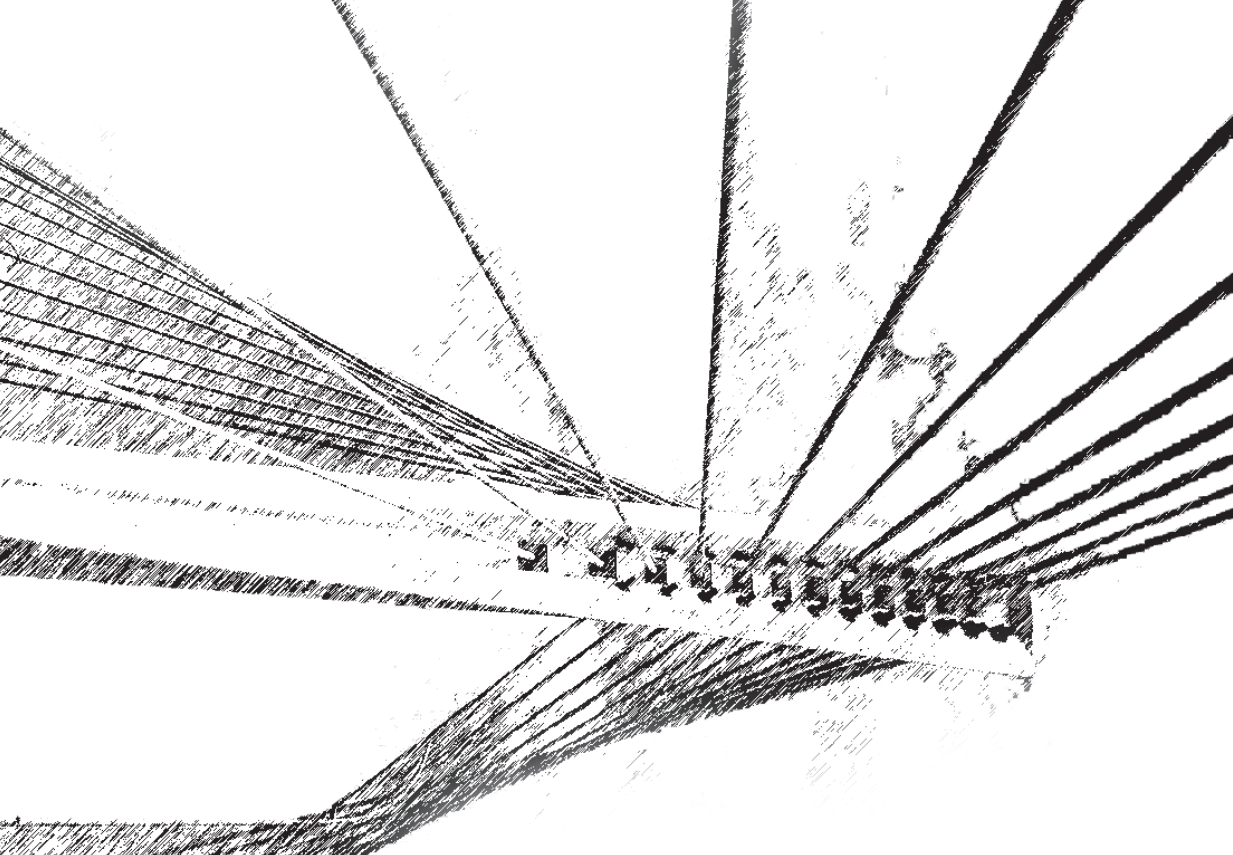


CONTENT

INTRODUCTION

This book is taught as a overview on the different typologies of structures present in the Balkans. The authors wanted to make a brief summary of the most famous objects in six Balkan countries starting from Albania and continuing with Bosnia, Kosovo, onwards with Montenegro, Macedonia, and finally with Serbia. The Balkans, although geographically contained, presents a variety of objects with significant cultural values which have also experienced different periods of playing a crucial role in the Balkan's architecture.

This analysis includes structures belonging to periods ranging from antiquity to nowadays. The development of architecture in the Balkans extends from late antiquity to the height of the

Ottoman Empire, covering not just ecclesiastical buildings but architectural enterprises ranging from urban conglomerations, simple houses, and palaces, to fortifications, cisterns, aqueducts, and bridges. It is important to mention that almost in each of the countries studied we have shown typical bridges which have played a very important role in linking countries and also the different cultures that represent the Balkan peninsula.

It remains to be emphasized that the Balkan countries carry a variety of structure types ranging from arch-shaped structures, dome structures combined with frame structures, to cable or very high structures. Another very important aspect in this architecture is the use of new and

Map of countries considered in this publication

traditional materials and in various countries of the Balkans, especially in the construction of ancient bridges up to today's bridges which connect big distances thanks to the avant-garde technology and construction tools. This progress can be observed in the evolution of these structures, for example in the transition from the arc-shaped bridge structure (the Mesi Bridge in Shkodër) to the case of cable bridge structure (the Ada Bridge) in the Serbian capital Belgrade. An important place in this analysis is also represented by active surface structures and active form structures as is the case of the building Belgrade Fair dome shaped and the National museum of aviation in Serbia where the space truss structure is used to achieve the arched shape that covers the facade of this object. The purpose of this publication is to present a description and analysis of some of the most famous structures in the Balkans to acquaint the reader with the variety and the main characteristics they represent.

ALBANIA
The Mesi bridge

Fig. 1- Mesi Bridge

Among the 100 stone bridges preserved now in our country, with its 112 meters, the Mesi bridge is the longest one. Built in 1768 f by Mehmed Pasha Bushati, it has, thus far, managed to endure the many inundations of the Kir river. This beautiful and huge bridge connecting Shkodra with the ancient town of Drisht, in addition to an important economic role, possesed an important political value, because it served to connected the mountainous territories of Shala and Dukagjin with the Shkodra castle. The Mesi bridge has 13 asymetrical arches, as a result of the various forms of the sustaining rocks, with the biggest arch is being 15 m high and 27 m wide at its basis.

In Albania arched bridges built in during various periods occupy an important place among historic engineering items. In the mountainous country of Albania consisting of valleys and

torrential streams, the stone or arched bridges were an imperial necessity. These bridges were built as a result of local funding and using the labour of local inhabitants. The oldest remains take us back to classical times, to the 1st century BC, during the time of the Roman Empire.

Because of damaging factors, the stone bridges that survive today in Albania date to the 17th century, when the Balkans were under the rule of the Ottoman Empire. There are so many bridges of different periods, which are protected by the state and hold the status of "Cultural Monument". In the north of Albania, in the Shkoder region, there are several medieval bridges because of the many rivers and streams. In the north-east, a few kilometres from the town of Shkoder on the Kir river, is the Mesi bridge is located near the village of Mesi, from which it takes its name. This bridge is 130 m long and one of the biggest bridges in the Balkans. From the outset, the bridge was a colossal construction with the top reaching its full height at the keystone of the main arch. Its origin cannot be older than the 18th century and it is not on the 1688 Carouell map, which includes all the region's bridges. Various facts link this bridge with

the works commisioned by the ruler of Pachalik of Shkoder, Mehmed Pacha Bushati (the Elder) in 1768, when he also built the Leaden Mosque in the Shkodra castle. In its ground plan, the Mesi Bridge does not follow a completely straight line, but takes a change of direction of 14 degrees towards the lower side about 5 m to the right of the big arch, enforced by the massive rocks on the river-bed.

We can see from its building techniques that the Mesi Bridge has two construction phases. The first phase saw the building of the big central arch and three others alongside, two on the left and one on the right. In the second construction phase, the Kir river flow outflunked the bridge and therefore the smaller arches were built at either end. Today the bridge consists of 13 arches. The biggest is in the centre, with a span of 21.5 m, created by a double vault rib 108 cm wide.

The bank is paved in river stones and is very uneven, later being reinforced with side bastions built of river stone. Technically, the bridge has been damaged over time by devastating floods. Such conditions have resulted in floodwaters

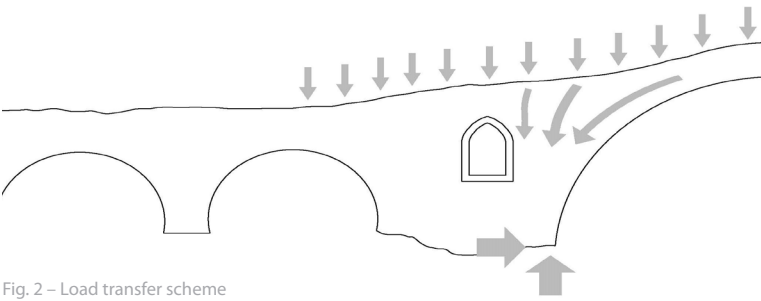
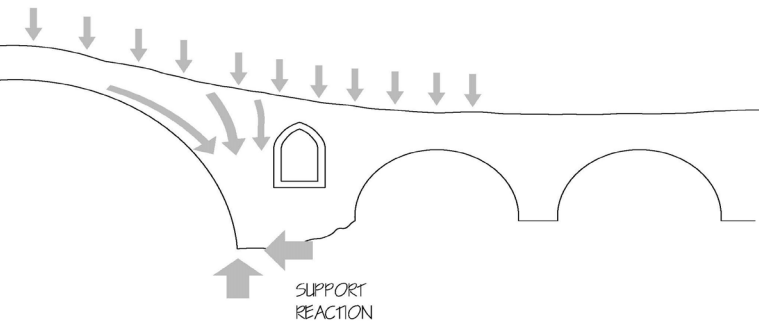


Fig. 2 – Load transfer scheme

cutting away at the arches on the right side. This has caused cracks in the hang of the arch. Even the main arch has suffered from cracks that also which jeopardise the bridge's stability.

The consolidation of the piers, the infill of the cracks from below and the creation of a hydrological system on the bridge in case of floods, are seen as necessary conservation actions. The implementation of these particular and technical works is pressing because of the eventual deterioration of this bridge.



Not implementing these works will cause damage to the very existence of this bridge, seen as cultural heritage at risk. We believe that the case of the Mesi bridge merits being in the 2004 edition of Heritage at Risk ICOMOS World Report of Monuments and Sites in Danger.

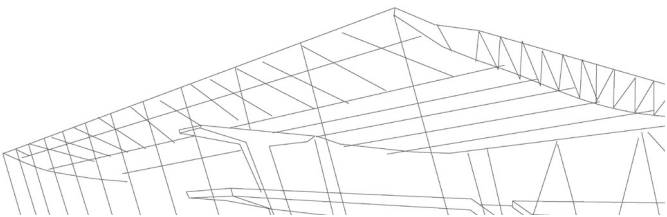
The Mesi bridge represents cultural heritage which extends beyond the national dimension. In With this aim in mind, it is worth analysing it in the technical reports of international cultural organisations.

Fig. 3 - Aerial view of the Mesi Bridge

Fig. 4 - Aerial view of the Mesi Bridge

The Tirana International Airport

Fig. 5 - Frontal view of Tirana International Airport "Nene Tereza"



The Tirana International Airport Nënë Tereza (TIA) (albanian: Aeroporti Ndërkombëtar i Tiranës Nënë Tereza) is Albania's only international airport. It is commonly known as Rinas International Airport, as it is located 11 km northwest of Tirana, in the village of Rinas. In 2001, the airport was named after Mother Teresa. The first airport was built during a period of two years, from 1955 to 1957. After the fall of communism political and social changes caused an increase in the number of airlines operating at the airport. Its reconstruction started in 2005 and terminated in 2008, considerably increasing the processing capacity of the airport. The airport currently has


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Fig. 6 - Picture of Tirana International Airport "Nene Tereza" taken from the bus station

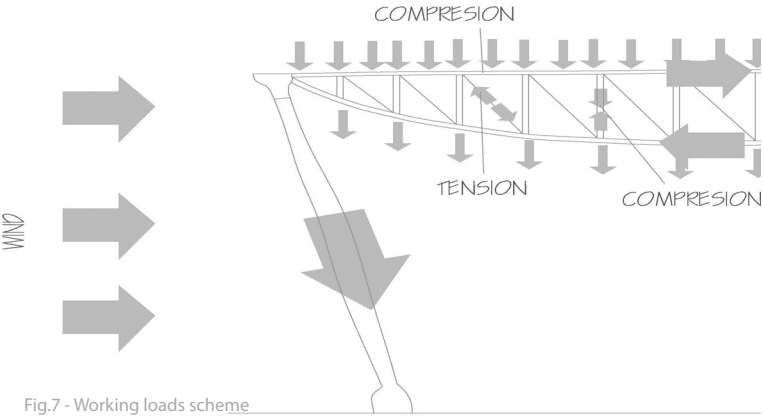
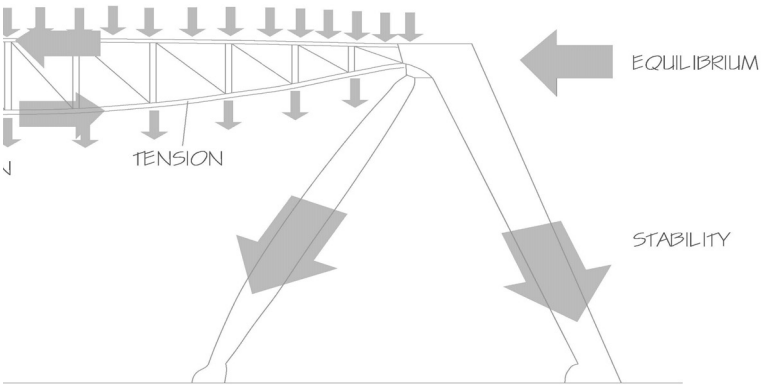


Fig.7 - Working loads scheme

the capacity to accomadate 1.8 million passengers per year.

The visible girders and pipes and the exposed ceiling elements give the new terminal a feeling of contemporality, functionality and the appearance of a work in progress. The café and the souvenir and duty-free shops could fairly easily be relocated inside the hall which can be taken in at a glance. The terminal's appearance is defined by a long narrow awning shaped like an aircraft wing. Pillars as slender as guy ropes seem to hold it in place.

The architect makes more of these subtle jokes as, for example, in the passport control area, where a layer of girders above and beside the electronic



gates gives passengers the feeling of walking into a cage.

The terminal designed by Tan, who worked for Santiago Calatrava on the design of the new Bilbao airport, could stand in any European city. Nonetheless, Tan employs obvious local elements in his arrivals hall. For example, what he calls his 'arrivals piazza' features locally quarried stone and is intended to give foreign visitors an immediate sense of 'Albanian hospitality'.

This is easier to achieve in such a small airport, of course, than in the likes of Frankfurt Airport which handles fifty times as many passengers. But, the Mother Teresa Airport does indeed have

Fig. 8 – Departing/arrival gates in Tirana International Airport "Nene Tereza"

something pleasantly well-balanced. Hin Tan hopes that returning Albanians will feel immediately at home. The real question is whether they will recognize their homeland. The new terminal at the airport in Tirana was built in two phases during the years 2005 - 2006 and 2008 - 2009. The first part of the steel structure encompassed an area of approximately 132 m x 112 m. The height of the structure was reduced from 16 m (input side) to 9 m on the side of Airfield.

The entire steel structure is divided into two parts: the by fish belly-truss covered truss area(truss zone) and the subsequent frame area (frame zone). The roof structure of the half-timbered area, which approximates 38 m, stretched far trusses in the center distance of 6 m rests on inclined supports at a distance of 12 m. The frame area consists of a rigid frame at intervals of 12 m with bolt spans

up to 18 m. All the main supports are hinged on individual foundations and anchor bolts anchored to train.

The cargo center is also next to the terminal created in the first planning phase. It consists of a 1 to 2 storey rigid, spatial reinforced concrete frame structure on an area of 43m x 21m with a maximum height of about 10 meters. The reinforced concrete slabs act as pulleys and guide the horizontal loads in the in-situ concrete frame, as no bracing wall panels were provided. The growing importance of the airport was a evidenced soon after the inauguration of the new terminal in 2007 Extension necessary. The hall was extended 30 m to the north and a canopy roof consisting of four connected porches. The increased wind and stabilizing loads had to be received by the existing bracing, which was accomplished by a three-dimensional calculation of the overall system.

BOSNIA
Stari Most (Old Bridge)

Fig. 9 – Historical view of the Stari Most bridge

Stari Most (english: old bridge) is a reconstruction of a 16th century Ottoman bridge in the city of Mostar (Bosnia & Herzegovina) that crosses the river Neretva and connects two parts of the city. The Old Bridge stood for 427 years, until it was destroyed on 9 November 1993 by the Bosnian and Croat forces during the Croat-Bosniak War. Subsequently, a project was set in motion to reconstruct it, and the rebuilt bridge was inaugurated on 23 July 2004. One of the country's most recognizable landmarks, it is also considered one of the most exemplary pieces of Islamic architecture in the Balkans and was designed by Mimar Hayruddin, a student and apprentice of the famous architect Mimar Sinan.

The bridge spans the Neretva river in the old town of Mostar, the city to which it gave its name. The city is the fourth-largest in the country, the center of the Herzegovina-Neretva Canton of the Federation of Bosnia and Herzegovina, and the

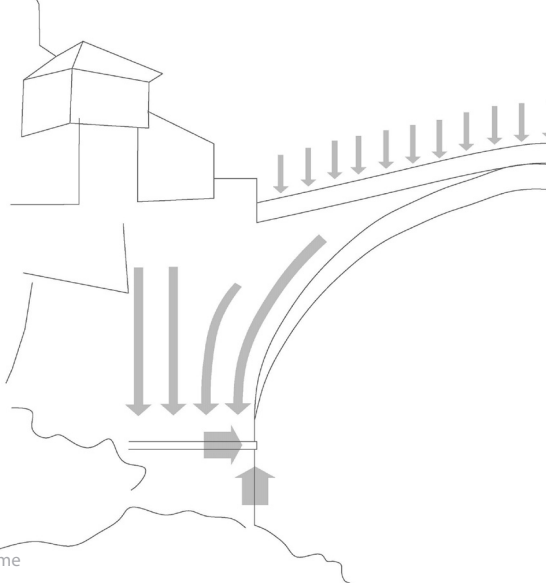
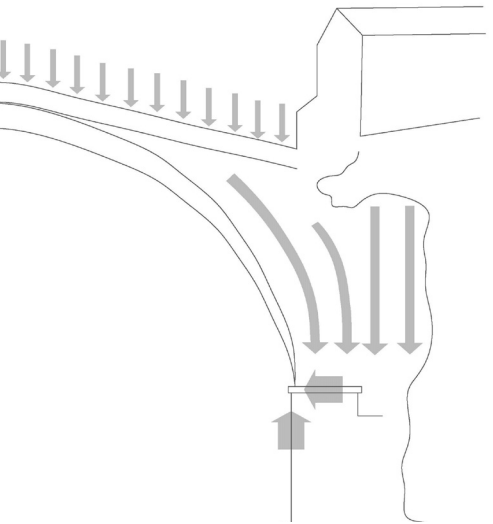


Fig. 10 – Load transfer scheme

unofficial capital of Herzegovina. The Stari Most is hump-backed, 4 metres wide and 30 metres long, and dominates the river from a height of 24 m. Two fortified towers protect it: the Helebija tower in the northeast and the Tara tower in the southwest, called "the bridge keepers".

The arch of the bridge was made of the local stone known as tenelija. The shape of the arch is the result of numerous irregularities produced by the deformation of the intrados (the inner line of the arch). The most accurate description would be that it is a circle the centre of which is depressed in relation to the string course.



Instead of foundations, the bridge has abutments of limestone linked to the wing walls along the waterside cliffs. Measuring from the summer water level of 40.05 m, abutments are erected to a height of 6.53 metres, from which the arch springs to its highest point. The beginning of the arch is emphasized by a molding 0.32 metres in height. The rise of the arch is 12.02 metres.

The original bridge was commissioned by Suleiman the Magnificent in 1557 to replace an older wooden suspension bridge of dubious stability. According to the 17th century Turkish traveler Evliya Çelebi, the name Mostar itself means

Fig. 11 –View of the Stari Most bridge from the river

«bridge-keeper». As Mostar›s economic and administrative importance grew with the growing presence of Ottoman rule, the precarious wooden suspension bridge over the Neretva gorge required replacement. Construction began in 1557 and took nine years: according to the inscription, the bridge was completed in 974 AH, corresponding to the period between 19 July 1566 and 7 July 1567. Tour directors used to state that the bridge was held together with metal pins and mortar made from the protein of egg whites. Little is known about the building of the bridge, and all that has been preserved in writing are memories and legends and the name of the builder, Mimar Hayruddin (student of Mimar Sinan, the Ottoman architect). Charged with death in case of failure to construct a bridge of such unprecedented dimensions, the architect reportedly prepared for his own funeral on the day the scaffolding

Fig. 12 –Aerial view of the bridge

was finally removed from the completed structure. Upon its completion it was the widest man-made arch in the world. Certain associated technical issues remain a mystery: how the scaffolding was erected, how the stone was transported from one bank to the other, how the scaffolding remained sound during the long building period. As a result, this bridge can be classified among the greatest architectural works of its time.

The bridge, 28 meters long and 20 meters high, quickly became a wonder in its own time. The famous traveler Evliya Çelebi wrote in the 17th century that: "the bridge is like a rainbow arch soaring up to the skies, extending from one cliff to

Fig. 13 – Stari Most undergoing reconstruction in 2003

the other. A poor and miserable slave of Allah, have passed through 16 countries, but I have never seen such a high bridge. It is thrown from rock to rock as high as the sky." The Old Bridge stood for 427 years, until it was destroyed on 9 November 1993 during the War in Bosnia and Herzegovina. After its destruction, a temporary cable bridge was erected in its place.Responsibility for the destruction of the bridge is attributed to the Bosnian Croat artillery fire. Starting on 8 November 1993 the Croatian Defence Council attacked the bridge with tank fire.

Sarajevo-based newspapers reported that more than 60 shells hit the bridge before it collapsed. After the destruction of the Stari Most,

Fig. 14 –Stari Most bridge in 2009

a spokesman for the Croats admitted that they deliberately destroyed it, claiming that it was of strategic importance. Academics have argued that the bridge held little strategic value and that its shelling was an example of deliberate cultural property destruction. Andras Riedlmayer terms the destruction an act of "killing memory", in which evidence of a shared cultural heritage and peaceful co-existence were deliberately destroyed.

Both sides of the city remained linked until the bridge´s reconstruction thanks to the Spanish military engineers assigned to UN UNPROFOR mission. After the end of the war, plans were made to reconstruct the bridge.

The World Bank, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Aga Khan Trust for Culture and the World Monuments Fund formed a coalition to oversee the reconstruction of the Stari Most and the historic city centre of Mostar. Additional funding was provided by Italy, the Netherlands, Turkey, Croatia and the Council of Europe Development Bank, as well as the Bosnian government.

In October 1998, UNESCO established an international committee of experts to oversee the design and reconstruction work. The decision was taken to build a bridge as similar as possible to the original, using the same technology

Fig. 15 – Stari Most bridge after reconstruction

and materials. The bridge was re-built with local materials by Er-Bu Construction Corp a Turkish company, using Ottoman construction techniques. Tenelia stone from local quarries was used and Hungarian army divers recovered stones from the original bridge from the river below. Reconstruction commenced on 7 June 2001. The reconstructed bridge was inaugurated on 23 July 2004.

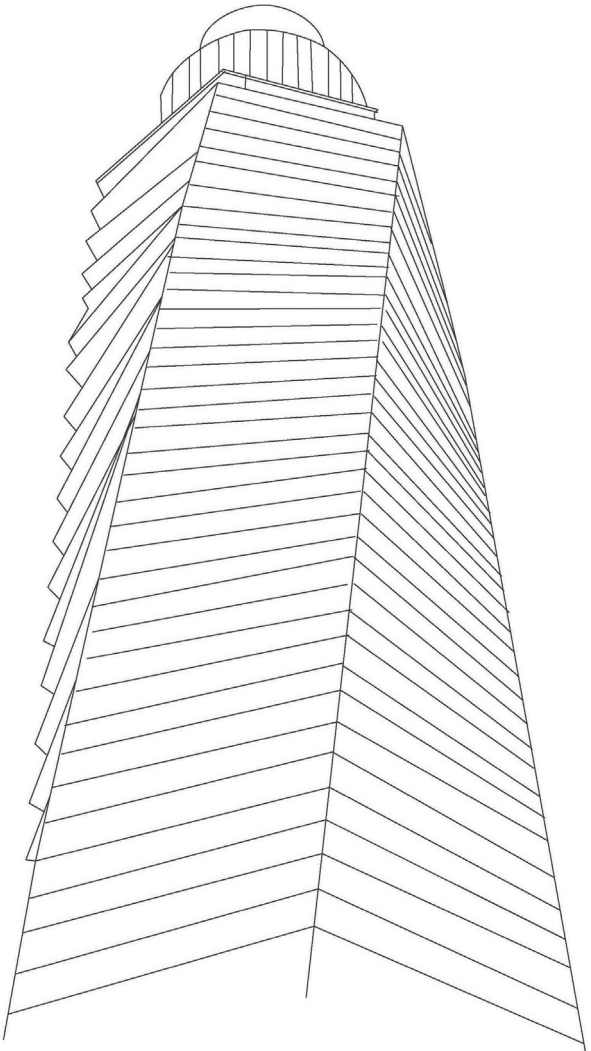
It is a ritual for the young men of the town to leap from the bridge into the Neretva. As the Neretva is very cold, this is a very risky feat and only the most skilled and best trained divers will attempt it. The practice dates back to the time the bridge was built, but the first recorded instance of someone diving off the bridge is from 1664. In 1968 a formal diving competition was inaugurated and held every summer. The first person to jump from the bridge since it was re-opened was Enej Kelecija, a local who now resides in the United States.

Avaz Twist Tower

The Avaz Twist Tower is a 176 m tall skyscraper within Sarajevo, Bosnia and Herzegovina. It is the headquarters for Dnevni avaz, a Bosnia and Herzegovina newspaper company. The tower is located in the Marijin Dvor district, Sarajevo's business district. Construction began in 2006 and was finished in 2008. The tower is famous for its twisted facade. At the height of 150 m, there is a public viewpoint from which the rest of the city can be seen.

This building has been brought in this text exclusively for it's structural and constructional features, rather than for it's architecture, which is

Fig. 16 – Drawing of the Avaz Twist Tower



clearly a representation of the 'turbofolk' culture in the Balkan region.

Avaz Twist Tower is the third garde building which is a six-year company, "Avaz" embellished Sarajevo. It is the highest office building in the region and one of the most spectacular buildings in Europe. The "Avaz" tower was listed among the ten most beautiful buildings in the world in a special competition held by "Schuco", the world's largest manufacturers of glass and aluminum facades. This prestigious award included applications of more than 140 objects from 70 different countries.

This future feature of BiH and the latest seat "Avaz", one of the most successful BiH companies. More than 20 floors of the spectacular tower accomodate offices and the newsroom of "Avazovih" editions. The Avaz Twist Tower is the culmination of the creation of new values and a reflection of persistent efforts to change the image of Sarajevo and to be an example and guide for other investors. The construction of this tower has demonstrated that the BiH architects, structural engineers and designers could compete on an equal basis with their counterparts in Kuala Lumpur, New York, Singapore. In additon to reaching a height of 175 meters and covering 32,000 square meters area-wise, this imposing tower's specific

Fig. 17 – The Avaz Twist Tower during construction

and strange single glass (twist) facade, required courage in order to be built. It was prepared with the assistance of German experts. Nowadays it is a landmark of this countryand offers a vantage point on the top of the tower, from a height of 150 feet, which presents the viewer with a magnificent an unprecedented view of the BiH capital.

And all this with the help of five lifts (two indoor and three panoramic) that traveling at five meters per second. From the 36th floor, the top floor, Sarajevo, especially at night, it looks unreal. Otherwise, the Avaz Twist Tower is built of 23,000 cubic meters of concrete and three million pounds of iron. The tower rests on foundations which are 30 feet below ground. The building of the tower lasted from 2006 to 2009, and included more than 200 construction and other companies with several thousand employees. The headquarters in the new "Avaz" tower installed the most modern high-tech equipment, from mechanical systems, air conditioning and ventilation, fire detection, fire extinguishing systems, central and surveillance systems.

One of the greatest achievements for our region is that the tower has the largest garage in BiH - six floors, with 420 parking spaces. Following the war which devastated the country, Bosnia

Fig. 18 – The Avaz Twist Tower by daylight


avaz

has experienced a positive boom in construction, which placed it as one of the countries with the most construction going on in south east Europe.

As the name suggests, the design is another twisting tower much in the same vein as the Calatrava's Turning Torso in Sweden. Clad in blue glass, the design is broken up in places by aluminium accents. The tower twists up towards its peak where it cuts inwards almost giving it the appearance of a light house with aluminium-coloured pillars.

It continues to be tiered to its peak almost making it look like a bride and groom should be planted on top instead of the spire there. The tower is mostly hexagonal in shape with the exception of the top two tiers which are rounded.

In the future, there will be 38 floors as well as a basement which will probably be designated for parking as well as a ground floor. Before the Twist tower, the Bosmal City Centre held the record for the tallest tower standing at 118 metres. Avaz's current home will be turned into offices along with a 5 star hotel.

Fig. 19 – View of Avaz Twist Tower

MAD MAGAZINE

KOSOVO

The Tersian Bridge

The Tersian bridge (albanian: ura e Terzive) sometimes called Tailors' Bridge, is located near the village of Bistrazin near Dakovica in Kosovo. It is a very important example of an Ottoman bridge building in Kosovo. It was built over the river Erenik, probably at the end of the 15th century, with its present appearance (from the 18th century), being a significant example of the terzijskog guild from Dakovica, from which it received its name. Major reconstruction and restoration to its original appearance was implemented from 1982 to 1984. Today, the bridge is under the protection of the Republic of Serbia as it was declared a Monument of Culture of Exceptional Importance in 1990. The exact date of the bridge's construction is not known, but it is thought to have been at the end of the 15th century. That opinion is based on the fact that the bridge was erected on a medieval route, which connected Dakovica with Prizren, and the fact

Fig. 20 – View of the Tersian bridge

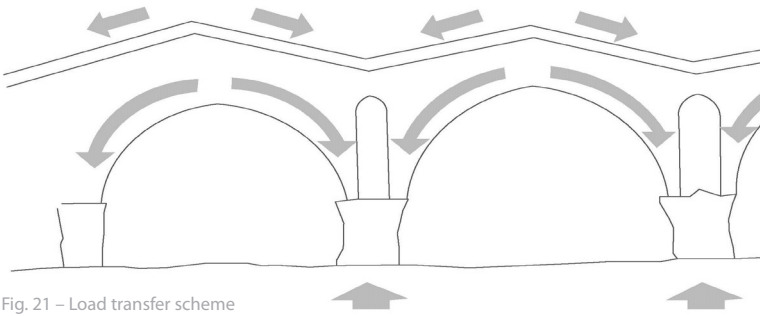
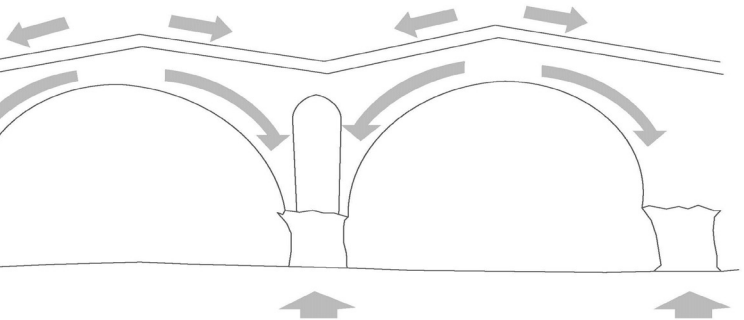


Fig. 21 – Load transfer scheme

that the bridge was later expanded, due to changes of flow in the river Erenik. In the 18th century, the bridge experienced major modifications, which gave it its current look. These works were financed by the Terzija guild from Dakovica, a fact which is confirmed by an inscription carved in Turkish on the bridge.

The bridge was built with trimmed stones, in dark gray and an ocher shade. Its length exceeds 190 meters, the width of the original pavement was over 3.5 meters and the bridge consists of 11 rounded arches, with embedded niches between them.



The Tersian bridge is one of the most important utilitarian monuments in Kosovo. It is constructed during the 15th century. This bridge is 190 meters long and has 11 arches standing above Erenik River. Once the longest bridge in Kosovo, the structure is closed to vehicular traffic, but it is clearly visible from the modern bridge constructed just alongside it. It was later dramatically remodeled in the XVIII century, funded by the Tailor's guild, after which the bridge is named. According to the decision on the protection of the bridge by a law passed in 1962, it is said that this bridge has historical, sociological, artistic, urban and cultural values.

Fig. 22 – The Tersian bridge

Fig. 23 – The Tersian bridge

The National Library, Pristina

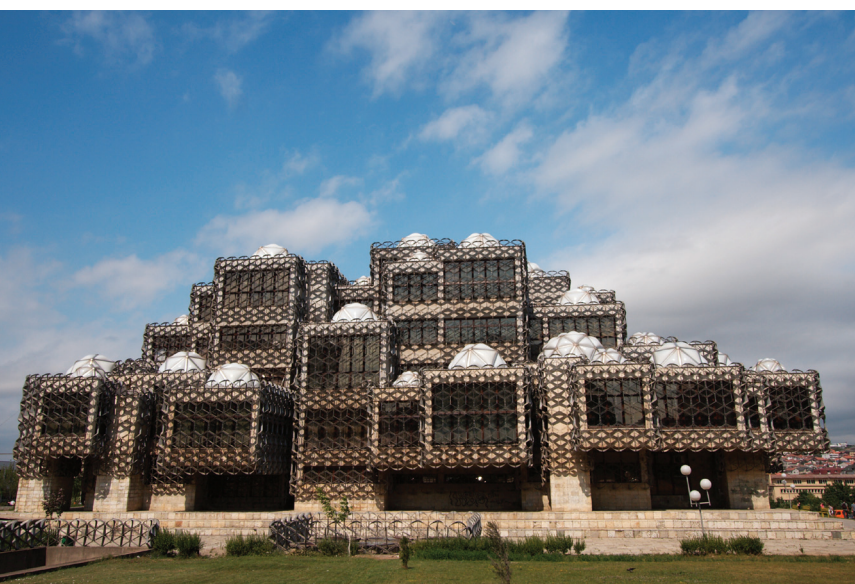


Fig. 24 – Frontal view of the National Library

This building is located in Pristina by Mother Teresa Street near the television station of RTK. This building's unique characteristic is the structure's entire coverage by a metal fishing net. Pristina is growing, and to hell with the consequences, even though urban planning and enforcement of building regulations have a very low priority. In order to accommodate the fast-growing population, vacant spots in the capital are being filled with apartment blocks in do-it-yourself architecture (concrete frames and big, red perforated masonry blocks), with space being transformed into a construction pit overnight, as happened with a bathhouse in the old Turkish area. The fact that the National Library by Andrija Mutnjakovic (1929) still looks the way it did a quarter of a century ago is a miracle considering the circumstances. Compared

with the 1982 photograph that hangs in the architect's studio in Zagreb, there are, at most, only a few more apartment buildings in the background. The library, with its 73 small domes, was supposed to be the focal point of the complex of university buildings, but in an area where daily life during the 1980s increasingly came to resemble a civil war, nothing came of these plans. Mutnjakovic's masterwork stands in a sandy, litter-strewn expanse where stray dogs sleep in the tall grass. The surroundings merely serve to strengthen the overwhelming effect of the building, an architectural oasis in a concrete wasteland.

When Mutnjakovic was commissioned to design a library for the ex-Yugoslavian province, the tension between Albanian and Serbian Kosovars was already palpable. Looking for a unifying symbol, he came up with the cube and dome, common features of the Ottoman and Byzantine architectural styles that define the appearance of the region. When they looked at the library, Kosovars would be able to recognize the Turkish baths in Prizren and the Orthodox patriarchate in Peja. From above, the library looks like a motley cluster of cubes, varying in size and height, rather like a village. The domes supply even, natural light to the reading rooms. The cube shape contributes

to the compactness and the sense of protection, which is further reinforced by the aluminum net of hexagons that is draped over the building.

At the opening in 1982, reactions from Serbian politicians were downright hostile. A quarter of a century and a civil war later, the rumour that the domes refer to the "PLIS", the traditional egg-shaped Albanian head covering, is still doing the rounds, but now in the other camp and with a positive spin. Equally persistent is the misapprehension that the library was originally designed as a palace for a Kuwaiti sheik. It recently turned up in a new travel guide for the area. Even though Mutnjakovic's building was actually intended as an "authentic national architectural expression" – as the architect put it in the original building plan. His regionalism was a reaction to the impersonality of the International Style and an attempt to combine function with regional traditions.

By the time NATO intervened in 1999, Mutnjakovic's library had become the commando headquarters of the Serbian army. Albanian students were denied entrance to the building years earlier. The library's best time is still to come. In post-war Kosova, where Albanian Kosovars call the shots, the building has little competition in order to become the new icon of the Nation.

The building by Croatian architect Andrija Mutnjakovic, inaugurated in 1982 projects a heroic image of itself in a Pristina devastated by years of war. A press photographer has captured the power of this immense pyramid of cubes, covered in glass domes. This symbol of contemporary architecture in the Balkans guards an important literary heritage with the iconic power of a mosque, hamam or fort.

In terms of form, the library was conceived through a rigorously geometric approach.It is based on a square-shaped plan and develops upwards in a regular succession of cubes with a total floor area of 16,500 m2.According to some scholars, the building, with its 99 white domes, recalls the historic architecture of the Hamam by Gazi Mehmed Pasha in Prizren or the Patriarchate in Pec. The solid structure in reinforced concrete is completely covered in a large-meshed metal grid that also acts as a sunscreen.

Fig. 25 – The facade of the National Library

Fig. 26 –View of the National Library

MACEDONIA
The National Theater and Opera House

The plan included a series of architectural competitions for cultural buildings located in the central area of the city, which would only be open to Yugoslav architects. And one of these competitions was won by a then young Slovenian office Biro 71. Biro 71 was influenced by Finnish organic architecture and was inspired by natural elements, such as mountains and topographic reliefs. Biro 71 took this organic approach to a whole new level by designing a massive complex of cultural buildings next to the Skopje's river. The Yugoslav government built only a third of their original plan, which today includes the Macedonian National Opera and Ballet Theatre.

Fig. 27 – Aerial view of National Theater and Opera House

Fig. 28 – View of National Theater and Opera House

Their Opera building is clad in white stone similar to the Alvar Aalto's Finlandia building in Helsinki.As a result, the building's shape is preserved and is aging better than other buildings throughout the city. The project had several setbacks: the original design for 1000 seats had to be cut to 300.

The main auditorium suffered from the severe reduction of seats due to budget cuts. Having little time to design the seats, they were built on a slope which followed the complex geometry of the floor. Sitting in one of those seats gives the strange feeling of being on a fast train as it accelerates down a steep hill.

Fig. 29 – Front view of National Theater and Opera House


МАКЕДОНСКА ОПЕРА И БАЛЕТ

Philip II Arena

Fig. 30 – Aerial view of the Philip II Arena

Philip II of Macedonia Arena (macedonian: Arena Filip II Makedonski) is a multi-purpose stadium in Skopje, Republic of Macedonia. It is currently used mostly for football matches, but sometimes also for music concerts or other events. It is the home stadium of FK Vardar and FK Rabotnički from Skopje, both of which compete in the Macedonian First League, as well as the home ground of the Macedonian national football team on almost all occasions (the other venue rarely chosen being the Goce Delčev). The project for the south stand was designed in 1977 by architects Dragan Krstev and Todorka Mavkova from Beton. Construction of the stadium in its present form began in 1978, with the building of the south stand taking two years to finish. The reconstruction and expansion started after a long delay in the project's implementation in January 2008. The construction of a new north stand was finished in August 2009 and was put in use

Fig. 31-32 – The Philip II Arena during construction

on 2 August 2009, on *Ilinden*, the Macedonian national holiday. Ten days later, on August 12th, the Macedonian national football team played a friendly match against the World Champions at the time, Spain, as part of the 100-year anniversary of football in Macedonia. Soon after, the construction of the new western and eastern stands started. By mid July 2012, the majority of the stadium was completed with the reconstruction of the new pitch and athletic track.

Since 2008, the stadium has seen investment of about two billion denari, or €32 million. The second phase, which got underway in November 2011, is the planned reconstruction of the pitch and athletic track. The athletic track around the pitch, from the original 6 will be extended to 8 running tracks and will use Tartan track surface. Total cost for this phase is €3.5 million. By 2013, it should be finished with the completion of a new illuminated outer facade. The total construction cost for all actions related to the stadium in the period 2008-2013 is estimated to reach over €60 million. Before its name changed to Philip II Arena, at the beginning of 2009, the stadium was known as the Skopje City Stadium (macedonian: Gradski stadion Skopje).

Fig. 33 – Perspective View of Philip II Arena


NATIONAL ARENA
SAMSUNG

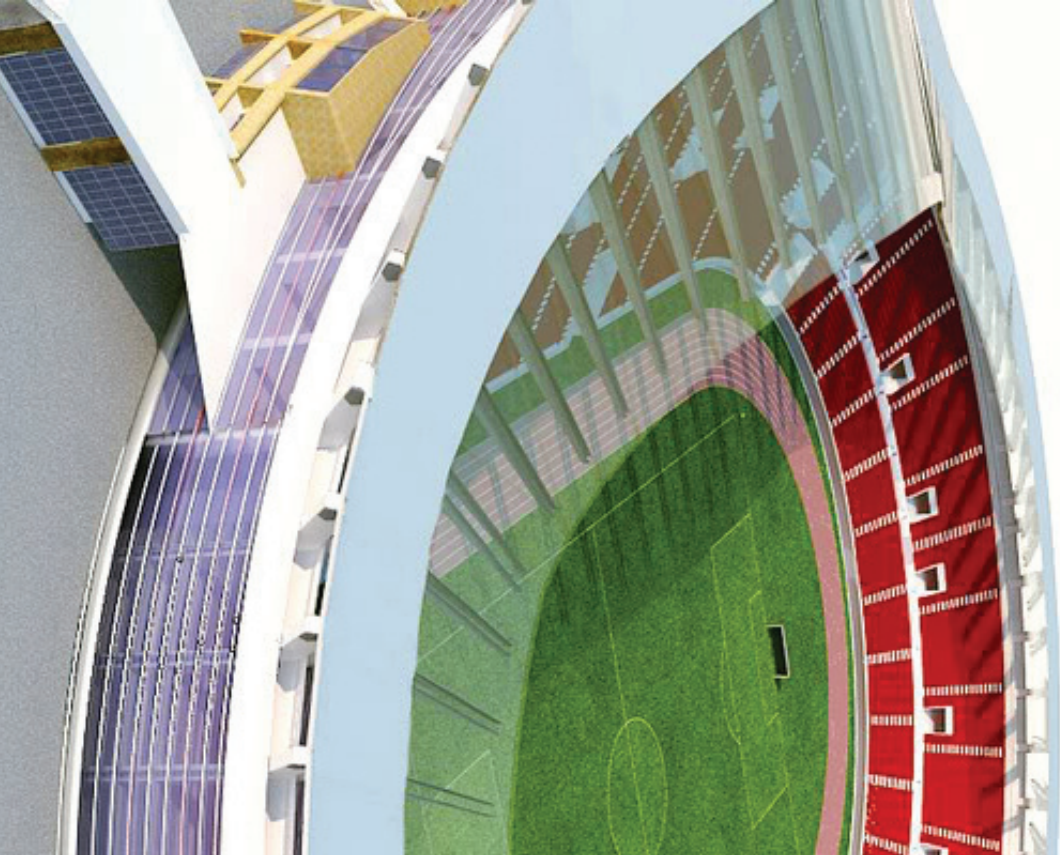


Fig. 34 – 3D digital model of the Philip II Arena

MONTENEGRO
Millenium Bridge

Fig. 35 – View of the Millenium Bridge

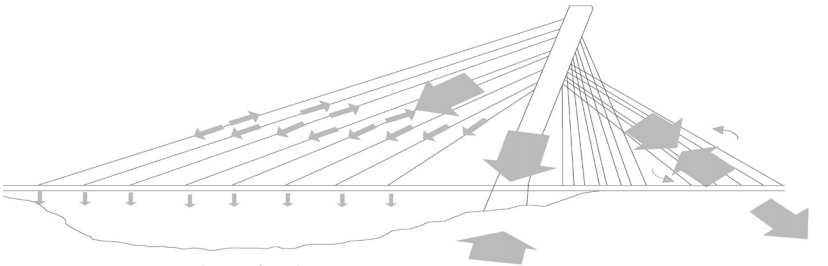


Fig. 36 – Loads transfer scheme

The Millennium Bridge is a cable-stayed bridge that spans the Morača River, in Podgorica, Montenegro. The bridge was designed by the Slovenian company Ponting and Mladen Ulićević, a professor at the Faculty of Civil Engineering in Podgorica. It was built by the Slovenian company Primorje, and opened on July 13th, 2005, Montenegro's National Day. It quickly became one of the city's most prominent landmarks. The bridge is 140 metres long, and the pylon soars 57 m above the roadbed. Twelve cables support the roadway deck, while twenty-four more are attached to the counterweights, creating an imposing image. The construction of the bridge began in 2005, and the building cost was approximately 7 million euros. The roadway carries two lanes of traffic and a pedestrian walkway in each direction. The bridge connects the Boulevard of Ivan Crnojević in the

Fig. 37-38 - Details of pylon and cables of the Millenium Bridge

city centre and July 13 street in the new part of city, thus relieving the other congested bridges connecting the city center with the densely populated districts over the Morača river.

Fig. 39 – Lateral view of the Millenium Bridge

Fig. 40 - Millennium Bridge Podgorica

The Blažo Jovanović Bridge

Fig. 41 – View of the Blažo Jovanović Bridge

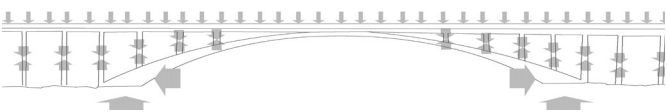


Fig. 42 – Load transfer scheme

The Blažo Jovanović bridge is a bridge across the Morača river in Podgorica, the capital city of Montenegro. The bridge is located near the confluence of Ribnica and Morača, and is part of the Saint Peter of Cetinje Boulevard. It's 115,20m long and 22,35m wide and is the city's busiest bridge. Most of Blaža Jovanovića was constructed between 1948 and 1950. It was projected designed by the famous Serbian architect Branko Žeželj. The bridge was named after the Montenegrin national hero Blažo Jovanović. The bridge underwent a major reconstruction in 2008 and was officially re-opened in March 2009.

Fig. 42 – View of the Blažo Jovanović Bridge

It was built in 1948 to 1950 and then it was one of the largest in Yugoslavia. As aforementioned, it was designed by the celebrated Branko Zezelj, who designed more than 60 of these and similar such structures. Podgorica's mixture of architectural styles reflects the turbulent history of the city and country: as one régime replaced another, the corresponding style was introduced. As part of the Ottoman Empire until 1878, Podgorica has many examples of Turkish architecture. The oldest parts of

the city, Stara Varoš (Old town) and Drač are typical of this kind of architecture, with two mosques, a Turkish clock tower and narrow, winding streets. When the city was incorporated into Montenegro, the urban core shifted to the other bank of the Ribnica River, where the town developed in a more European style: wider streets with an orthogonal layout. This part of the city is today traditionally regarded as the city's centre, and is called Nova Varoš (New town).

During World War II, Podgorica was almost razed to the ground, having been bombed over 70 times. After liberation, rebuilding began as in other cities of the communist-ruled SFRY. Mass residential blocks were erected, with basic design typical of Eastern bloc countries. The entire part of the city on the right bank of the Morača River was built this way. Even the empty spaces in the city centre were filled with near-brutalist structures, resulting in an unfortunate fusion of old and new. The residential and business blocks of the SFRY era provided ample housing but have been much criticized for their uninventive and grey appearance. The main contemporary traffic arteries were laid out during this period, extending the orthogonal street layout of city center, to the south and west. Residential and infrastructural developments in the SFRY era have mostly shaped the layout of today's Podgorica, and accommodated the unprecedented population growth that followed World War II. However, in the area immediately surrounding residential blocks, the city expanded in a form of often chaotic urban sprawl, with densely built private lowrise dwellings

leaving little space for streets and sidewalks. The trend of sprawling informal settlements was at its peak during the 1990s. Efforts have been made since to improve the infrastructure of those settlements, but many problems remain, especially in large lowrise neighbourhoods in north and northeast Podgorica.

A major advance in the architecture of Podgorica began in the late 1990s and, since then, the face of the city has rapidly changed. Residential and business construction are rapidly multiplying, incorporating contemporary glass-and-steel architectural trends. In an effort to create a recognizable and modern state capital, city officials are routing significant investments in city's public spaces. Thus, the city has gained entirely new squares, parks and monuments. New landmarks include the Hristovog Vaskrsenja orthodox temple and the Millennium Bridge, the main feature of the Podgorica skyline. Podgorica today is transforming rapidly from a featureless town to a modern European capital.

SERBIA
The Ada Bridge

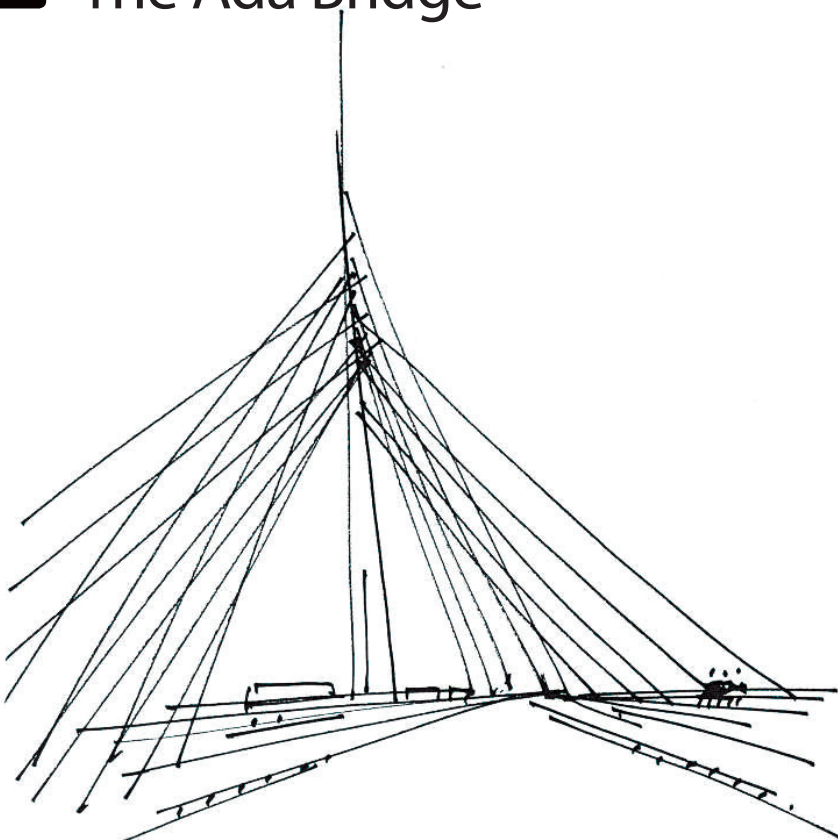


Fig. 43 – Ada Bridge, the conceptual sketch

The Ada Bridge or Sava bridge is a cable-stayed bridge over the Sava river in Belgrade, Serbia. The bridge crosses the tip of Ada Ciganlija island, connecting the municipalities of Čukarica and Novi Beograd. The bridge pylon is located on the tip of the island which has been reinforced with large amounts of concrete and has been slightly enlarged to provide stronger foundations. The bridge is the longest single-pylon cable-stayed bridge in the world. The construction began in 2008 and the bridge opened on December 31st 2011. All adjoining roads are planned to be constructed by 2013. The competition for the preliminary design of the bridge was held in 2004. Twelve companies submitted bids, with the winning design by the Slovenian company Ponting.

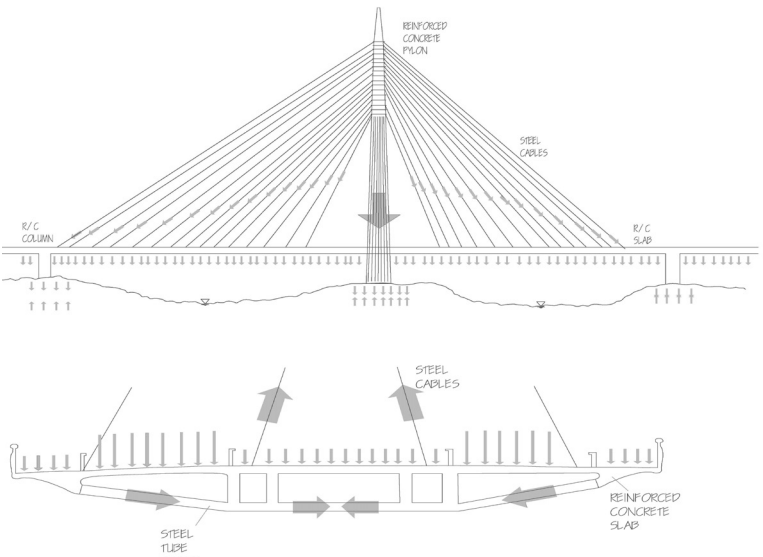


Fig. 44 – Load transfer mechanism in Ada Bridge

The bridge designers were the architects Viktor Markelj and Peter Gabrijelčič. The winning conceptual design was unanimously selected by the jury which was chaired by Nikola Hajdin, President of the Serbian Academy of Sciences and Arts and the architect of the New Railroad Bridge. The Belgrade Association of Architects also endorsed the project, assessing it as contemporary

Fig. 45 – Scale model of Ada Bridge

Fig. 46 –Transversal section of the scale model of Ada Bridge

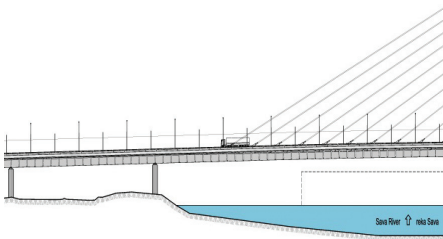
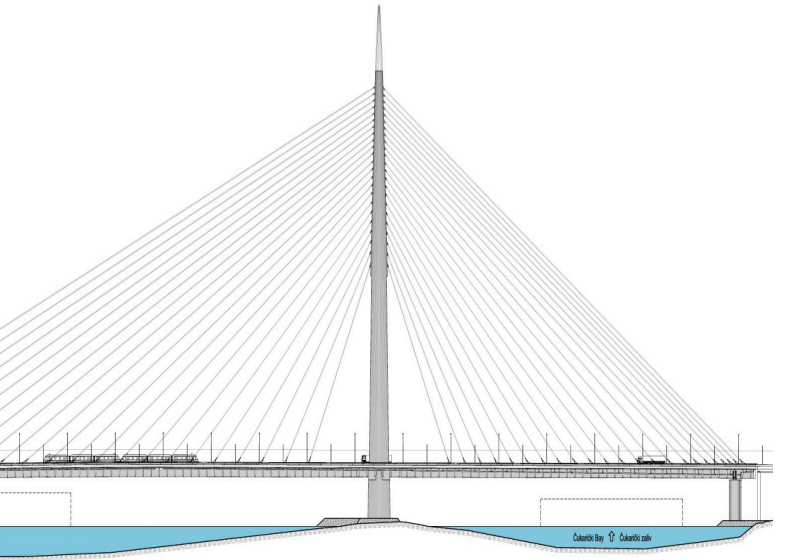


Fig. 47 – Project proposal of Ada Bridge

and relevant to the future skyline of Belgrade. The bridge is a cable-stayed design with a single pylon. The foundation for the pylon is a circular diaphragm wall with 113 bored piles. The main span is constructed from 8,600 tons of bridge construction steel supported by 80 stay cables, and is counter-balanced by a post-tensioned, reinforced concrete back span of 200m. The approach towards New Belgrade is constructed as a 388 m post-tensioned, reinforced concrete side span as continuous beam box girder with a similar arrangement of deck as the back span. The component parts of the deck were manufactured in China and delivered in



transportable units on a sea and river-route via Rotterdam through the Rhine/Main/Danube Canal to the pre-assembly yard next to the construction site at Mala Ciganlija in Belgrade. The stay cables used to support the bridge deck have a maximum length of approximately 373m, and in total 1280 tons of high grade steel is used for the 80 cables with up to 91 strands. The bridge is designed to significantly reduce traffic passing through the city centre and the older Gazela Bridge. It is planned as a part of the future Belgrade Inner City Semi-Ring Road. It will have three road lanes and a tram (light rail) track in each direction.

Fig. 48 – Aerial view of Ada Bridge

The Museum of Aviation

Fig. 49 – Fasade of the Museum of Aviation, Belgrade

The Museum of Aviation is a really astonishing building, and maybe the first building you see when you arrive at Belgrade's Nikola Tesla Airport This mushroom shaped location was designed by the bosnian (with slovenian roots) architect Ivan Straus and opened in 1989. He studied in Zagreb (Croatia) and he developed mostly of his projects in Sarajevo (Bosnia & Herzegovina) where he was also employed in Sarajevos' Architectural Faculty. The Museum of Aviation in Belgrade was created in 1957 as the Yugoslav Aeronautical Museum. The facility is located adjacent to the Nikola Tesla Airport. The current facility opened to the public on May 21st, 1989.

The main collection is housed in an architecturally noteworthy geodesic-based glass building, with additional aircraft displayed on the surrounding grounds. The museum owns over 200 aircraft machines that have been operated by the Serbian and Yugoslav Air Forces, Aeronautical clubs and Avio-companies, from gliders to helicopters to jet fighters. At any given time, around 50 of these are on display inside the building. A few of the aircrafts on display are the only surviving examples of their type, including the Fiat G.50.

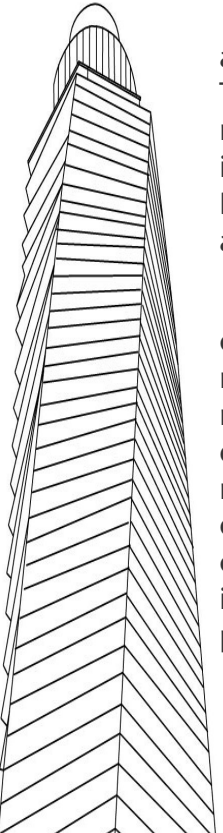
The museum also displays relics of US and NATO aircraft shot down during the 1990s Balkans conflicts\ 130 aviation engines, more radars, rockets, various aeronautical equipment, over 20,000 reference books and technical documentation as well as more than 200,000 photographs.

Fig. 52 –The Museum of Aviation during construction

Fig. 53 –The Museum of Aviation, interior view

Fig. 54 -The Museum of Aviation

CONCLUSION



This book presents an overview and analysis of different Balkan structures. This analysis helps us realize how rich the mastery or efficacy of these items was in different periods encountered by the Balkan society in the field of Architecture and Engineering.

Among many other elements that contribute to the existence of forms of materials such as houses, cars, trees or mobile beings, the structure is the most essential. Without structure, the form of materials can not be preserved, and without conservation the final destination facility itself can not claim itself. Therefore, it is a fact: without structure there is no performing complex, dynamic or not.

Rather than being merely exposed, the structural system can be employed as a design feature, celebrating the form and materiality of the structure. There are also those structures that dominate by the sheer forcefulness with which they express the way they resolve the forces acting on them. These types of structures often become iconic symbols due to their striking imagery. When judging whether a building celebrates its structure or not, we should be careful to differentiate structural expression from expressive forms which are not, in truth, structural, but only appear to be so.

There are examples of buildings that exposed their structural systems whether in timber, steel, or concrete using them effectively as the primary architectonic form-givers. The form of a structural system and the pattern of its supporting and span-

ning elements can be related to the spatial layout and composition of a design in two fundamental ways. The first is a correspondence between the form of the structural system and that of the spatial composition. The second is a looser fit in which the structural form and pattern allow more freedom or flexibility in the spatial layout.

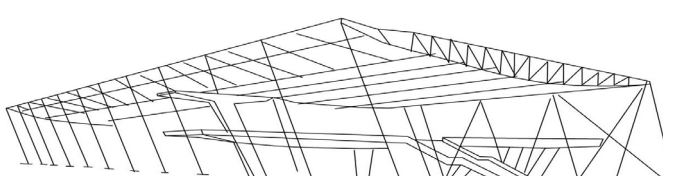
Where there is a correspondence between structural form and spatial composition, either the pattern of structural supports and spanning systems can prescribe the disposition of spaces within a building or the spatial layout can suggest a certain type of structural system. In ideal cases, we consider both space and structure co-determinants of architectural form. But composing spaces according to needs and desires often precedes thinking about structure. On the other hand, there are times when structural form can be the driving force in the design process.

When there is a lack of correspondence between structural form and spatial composition, either may take precedence. The structure may be large enough to shelter or encompass a series of spaces within its volume, or the spatial composition may dominate a concealed structure. An ir-

regular or asymmetrical structural system may envelop a more regular spatial composition, or a structural grid may provide a uniform set or network of points against which a freer spatial composition can be gauged or contrasted.

A distinction between space and structure may be desirable to provide flexibility of layout; allow for growth and expansion; make visible the identity of different building systems; or express differences between interior and exterior needs, desires, and relationships.

A system can be defined as an assembly of interrelated or interdependent parts forming a more complex and unified whole and serving a common purpose. A building can be understood to be the physical embodiment of a number of systems and subsystems that must necessarily be related, coordinated, and integrated with each other as well as with the three-dimensional form and the spatial organization of the building as a whole.



Given a specific attitude toward the expressive role of the structural system and the desired spatial composition, appropriate choices for a structural system can be made if one understands the formal attributes the various systems develop in responding to applied forces and redirecting these forces to their foundations. The structural system of a building, in particular, consists of a stable assembly of structural elements designed and constructed to support and transmit applied loads safely to the ground without exceeding the allowable stresses in the members.

Each of the structural members has a unitary character and exhibits a unique behavior under an applied load. But before individual structural elements and members can be isolated for study and resolution, it is important for the designer to understand how the structural system accommodates and supports in a holistic manner the desired programmatic and contextual forms, spaces, and relationships of an architectural scheme.

Regardless of the size and scale of a building, it comprises physical systems of structure and enclosure that define and organize its forms and spaces. As a structure depends less on weight or the material's rigidity and more on the geometry for its sustainability, as in the case of membrane structures and spatial reticular, its elements become thinner and thinner until they lose the ability to give a spatial scale and dimension.

Structures determine buildings in a fundamental way; their origin, existence and consequences. Thus, the concepts of structure development, eg: the basic structural project is an integral part of the true architectural design. Therefore, the main idea that there exists a difference between architectural and structural design that - in terms of objectives, procedures, and interpretation of their performances - is unfounded and contrary to reason and the idea of architecture. The difference between structural and architectural design must be dissolved. A very good example that confirms these conclusions are the structures and objects that are presented and analyzed in this book.

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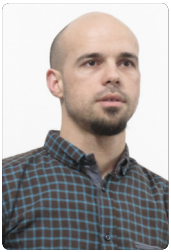

ERDI MYFTARAGA

Graduated at the Polytechnic University of Tirana, Faculty of Civil Engineering. His Master studies, (2010) were focused on geotechnical engineering and soil mechanics, with special application in reliability-based design methods and characterization of engineering soil properties.Starting his professional career working with the design and construction of a series of telecommunication antennas. Since 2011 he is part of the academic staff of Polis University as an internal lecturer in the "Construction Science" and "Advanced Structural Systems" courses. Since 2010 he has been active in publishing several scientific articles in international conferences regarding civil engineering, such as in Netherlands, Sweden, and Japan.

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