BRIDGES IN HUNGARY

From the Roman heritage until today's giants

1. Hungary's longest and best known arched bridge was built in 1833 at the ancient crossing place of the Hortobágy.

4. One of the 1400 bridges destroyed in World war II, the Berettyó-bridge of Szeghalom was built with remnant materials from a Tisza-bridge.

2. Széchenyi's Chain Bridge was completed in 1849, at the time of its construction its 202 m span was a world record. Our first permanent Danube-bridge is a symbol of Budapest.

5. In Esztergom the Danube-bridge built in 1895 was rebuilt 57 years after its explosion in its original form with EU support.

3. The first reinforced concrete bridge was built in Solt in 1889.

6. The 1860 m long Danube-bridge of motorway M0's Megyer section will be our first cable-stayed bridge.

The front cover shows the Pentele Danube-bridge built in Dunaújváros in 2007; its riverbed span is the largest (304 m) in the world amongst the basket-handle arch bridges.

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From the Roman heritage until today's giants

Budapest, 2008

Welcome

„A bridge means more than stones and steel, it expresses mankind's strive to create, it makes tight connections between nations, it leads roads across in order to ease people's lives." István Széchenyi

Bridges are ancient, important, real and symbolic connections, without them social life is impossible. They are more than simple "bridging structures"; they are the less known yet respected aspects of our technical culture. In the past ten years of Hungarian bridge building and especially nowadays an extremely large number of important and enormous sized bridges have been built. In 2007 travellers could already cross the world record keeper Pentele Danube-bridge near Dunaújváros, and the 1870 m long reinforced concrete bridge of motorway M7 spanning at a height of 88 m over the valley by Kőröshegy. The Danube-bridge of the northern section of motorway M0, named Megyer-bridge, which will not only be our first cable-stayed structure but also Hungary's largest square footage bridge, is proceeding at a good pace.

The simultaneous construction of the three giants is unique in national bridge building; therefore the opportunity is given to compile a short overview of our road bridges.

Surely, we hardly know our bridges since we all tend to dash across them within moments and during our travels we do not even consider stopping by an old, precious, interesting, nice bridge; yet what we do not know we will not value and will not protect either. We are convinced that to learn about our bridges is necessary and worthwhile. Although we do not posses such ancient and gigantic bridges as the Italians, the Spanish, the British or the Americans do, we do not have to be ashamed of the works produced by the past and present bridge designers and builders. Just to mention a few examples, the boat bridges (Buda, Esztergom, Vác), our monumental wooden bridges on the river Rába, from 1562 on the river Tisza, both the Chain Bridge (1849) and the Elisabeth Bridge (1903) were world records, the Ferenc József/Szabadság Bridge (1896) is considered the world's most beautiful hinged cantilever bridge. Regarding the construction of reinforced concrete bridges Szilárd Zielinski (1905) and Győző Mihailich (1908) have inscribed their names in the history of bridge building by existing structures that were acknowledged world records. Amongst the welded structures the Rába-bridge built in Győr (1934) was a European record, the aluminium structure built in Szabadszállás (1950) was the world's fifth such type structure, the Pentele Danube-bridge completed recently is the world's largest amongst the basket handled arch bridges; the out-standing works of our bridge building activity could be listed at length.

It was in May of 2006 at a Santiago Calatrava exhibition in Copenhagen that I first encountered Bernhard Graf's book introducing the world's best known miraculous bridges. I was so taken by the book that having procured its translation rights we published it in Hungarian under the title of "Bridges that changed the world" ("Hidak, melyek összekötik a világot") not for commercial circulation but rather for the bridge building industry's use.

This book inspired me to produce a similar reference book on our own bridges. So out of the almost 13000 Hungarian road bridges we picked 70 that were peculiar due to their material, structure, construction circumstances or technology. We do hope that our book will be enjoyable for not only the bridge building experts but also for those non-professionals who simply like bridges. This publication is a kind of continuation of Péter Gyukics's and Ernő Tóth's photo album compiled on almost 160 bridges in 2005. We did not wish to copy Bernhard Graf's work, only in that to each full paged picture there is one page of illustrated text on the introduced bridge, in a few occasions mentioning bridges that are similar in their age or structure.

Leaf through and read this book with the interest and love, as we have prepared it.

László Sitku
September, 2007

Introduction

This book with the introduction of 70 prominent bridges endeavours to provide a comprehensive overview of road bridges — that carry traffic to this day except for three structures — within today's Hungarian borders from the Roman ages until today. It was not our objective to copy Bernhard Graf's book except for its layout in that to each full page photograph of an introduced structure there is a page of illustrated explanatory text, in a few cases referring to bridges with similar structures.

This book does not simply introduce the largest of the almost 13000 road bridges but it also gives an account of all the most representative bridge types in a chronological order through one or more examples.

The bridges built in the Roman ages and most of the ones built after the settlement of the Hungarians in the Carpathian basin were made of timber and thus deteriorated, therefore only five arches (Öskü, Sopron, Vác, Káptalanfa, Olaszliszka) are described of the ones built before the 19th century. Nonetheless there are more of these within Hungary.

In the 19th century "permanent" bridges, arches and from 1810 on territories outside of today's borders iron bridges were built at a fast pace. Later, after the completion of the Chain Bridge in 1849 at first with the involvement of foreign contractors and gradually with domestic designers and builders structures were built over smaller water courses and rivers as well; in addition in 1889 even a reinforced concrete structure was built. The reader can learn about fourteen bridges — seven vaults, five steel- and two reinforced concrete structures — from this heroic era of bridge building, some of which are well known e.g.: the Stonebridge of the Hortobágy, the Margaret Bridge, and some are less known e.g.: the five-span vault of Jászdózsa or the two-span reinforced concrete vault of Solt.

In the 20th century World war II caused enormous damages in the national public road bridge "stock": 1404 structures were destroyed. The structures built before 1945 are represented by a total of eleven, seven steel and four reinforced concrete bridges. All of these described works, except for the Petőfi Bridge of Budapest and the viaduct of Veszprém, are less known yet many of them e.g. the arch bridge and the welded Rába-bridge of Győr were internationally significant structures at the time of their construction.

Among the bridges built between 1945 and 1990 quite a number, in fact 23 are enlisted in this book, since with the reconstruction of our river bridges and the application of new bridge building technologies and techniques remarkable works had been produced. The most well-known of these is the Elisabeth Bridge of Budapest, nonetheless there are a number of important, significant and nice structures that are less known e.g. the Berettyó-bridge of Szeghalom, the viaduct of Varasd, the cable-stayed pedestrian bridge of Győr.

1990 was considered a milestone in the chronology because since then several prominent works have been produced in the Danube-, the Tisza- and the motorway bridge construction: on the Danube two bridges were built in Budapest and three elsewhere in Esztergom, Szekszárd and Dunaújváros; in addition the Megyer-bridge of motorway M0 is being built. Among the structures built over the Tisza four are noted in this book. Last but not least one of the giants, the Kőröshegy viaduct is also introduced. 17 years are represented by 17 bridges.

Besides showing pictures, a relatively short history of the bridges is also revealed to the reader. The story of some of the structures is hectic and full of turmoil: devastations caused by nature or war, reconstructions. On several occasions only a few facts or interesting features can be highlighted out of the literature available in the libraries.

In the case of some bridges — especially of the older ones — the history of their construction is unexplored and most probably due to lack of sources this will remain the case.

The bridges introduced do not represent the entire spectrum of Hungarian bridge building for several reasons. On the one hand, due to the fact that in June of 1920 the larger portion of Hungary's territory was given to the neighbouring countries the interesting and valuable bridges built in those areas were lost. On the other hand, because of the devastation of weather, ice, and fire a number of structures disappeared, in addition World war II caused extremely serious damages. Among the bridges that had been destroyed and have not been reconstructed in their original form let us mention the five-span Zala-bridge of Zalalövő (1829); in addition several other vaulted bridges had become victims of the war's destructions in 1944.

The Tisza-bridge of Szeged which was built by the Eiffel Company based on the plans of János Feketeházy (1882), and the Tisza-bridge of Tokaj designed by Róbert Totth were outstanding structures amongst steel bridges due to their unique layout.

The Elisabeth Bridge of Budapest (1903) was a world recorder for 25 years with its 290 m large middle span, not to mention that it is used to be amongst the tops in the beauty contest of chain bridges.

The Danube-bridge of Dunaföldvár was built based on the plans of Professor János Kossalka in 1930, this was our first continuous truss structured river bridge; at the time of its construction it was within the number ones of its category. In 1944 it was also exploded. Of the numerous bridges that are missing from this book the Kossuth Bridge deserves to be mentioned, which was purposefully built as temporary structure in 1946; in addition let us make a note of the several Ipoly-bridges which will hopefully be rebuilt nowadays.

A few nice bridges, worthwhile to be introduced have been left out due to restrictions of length, hopefully besides the bridges not mentioned here newly built ones will also be included in the continuation of this book.

We were determined to name the designers, contractors and investors of the introduced bridges, and when possible we also provided at least their short biography. This may have been the more difficult task, since the creation of significant bridges is usually the work of a number of people and many times it is not obvious who should be the one or ones mentioned as the creator(s). Gathering the biographical information was not an easy task either since the encyclopaedias are quite harsh on well known engineers. Despite all of these difficulties we have compiled a biographical database of not only designers and builders, but also scientists establishing theory, university teachers and bridge history researchers.

This novel type of book, that is somewhere between a scientific literary piece and a photo album, was written for experts in the first place, however we do hope — that with the help of the short list of terminology provided — all of those who are interested will understand the descriptions, thus will learn more about bridges and as a result will better respect these important, interesting and beautiful works.

The writers of the book are younger or older bridge engineers, all colleagues of the Bridge Department of the Coordination Center for Transport Development (Közlekedés fejlesztési Koordinációs Központ Hídosztálya), except one of them Bence Hajós (Adam Clark's great-great-great-grandson), who was a colleague of this department, earlier, too.

Most of the pictures, that are an extremely significant part of this book were taken by the photographer, Péter Gyukics. The photographers of the rest of the pictures are all individually listed in the imprint.

Ernő Tóth DSc

The Tisza-bridges of Szolnok and Tokaj, the Elisabeth Bridge of Budapest and the Danube-bridge of Dunaföldvár were destroyed in World war II so we can only commemorate them by publishing these images

1. Öskü, arch of the Kikeri Lake Dam

Built by legionaries, used to be part of a fish-pond

Built: *Roman ages*
Designer: *unknown*
Contractor: *unknown*

In Pannonia the Romans built an extensive roadnet, of which the most well known was probably the so called "limes" following the route of the river Danube and the so called Borostyánkőút (Amber Road). Nevertheless, the roads called Savaria-Aquincum and Savaria-Sopianae were also quite important routes with their several significant bridges.

It is most likely that there weren't any stone bridges within today's borders of the country. There were boat bridges on the Danube in the Danube bend, and a pile bridge at Aquincum. There were wooden bridges on the river Zala at Zalalövő, on the river Rába at Körmend, Árpás and Győr, on the river Sió at Mezőkomárom and Szekszárd, and on the river Sárvíz at Gorsium (Tác).

A reconstructed part of the Roman aqueduct in Aquincum.

There must have been arched bridges over smaller rills, like in the Ördög valley (Szarvas square), and Aranyhegyi valley (Mozaik street) and several other places that now belong to the town of Budapest. The bridges in Ráckeresztúr and Százhalombatta were noted Roman, although the former was dismantled in 1937 and the latter's origin was never proven definitely. In some places archeologists propose explorations.

Aqueducts were also built in several places nearby Savaria (Szombathely) or Brigetio (Szőny) and of course at Aquincum (Budapest). The history and dimensions of this latter one is probably the best known: it is 4.5-5 km long, in 1923 it still had 23 pillars standing, and altogether 116 pillars had been excavated. In 1976, when highway no. 11 was renovated two of its sections were reconstructed. The 4.5 m large work of art once – before the surrounding area was backfilled – was more prominent and impressing.

Instead of introducing in detail the above mentioned bridges we introduce the arch laying underneath highway no. 8 near Öskü, since it is generally accepted by relevant bibliographies that the Lake Kikeri dam is from Roman ages and the arch is

Vaulted bridge near Százhalombatta.

part of this structure. It was widened in 1937 when the highway was built. Nevertheless, the piece of art was kept in its original form.

This bridge is not a historic monument, it is difficult to approach, yet its introduction is justified since in general there is very little left of the extremely rich Roman inheritance. The giant 40-50 cm thick quader stone layers and the arch were built by Roman legionaries.

2. Sopron, Ikva-bridge

Hiding street bridge

Built: *1420*
Designer: *unknown*
Contractor: *unknown*

The bridge of Ikva standing on the Castle boulevard of Sopron, facing the Statue of Mary – first officially noted in 1420 – is a unique architectural construction in Hungary since houses were built on it. The laying basket shaped arch bridge was in fact made up of three separate pieces, which were built together: the middle section carries the road, the two side sections carry the houses on each side of the street, in such a way that people who do not know that they are crossing a bridge probably would not even notice it.

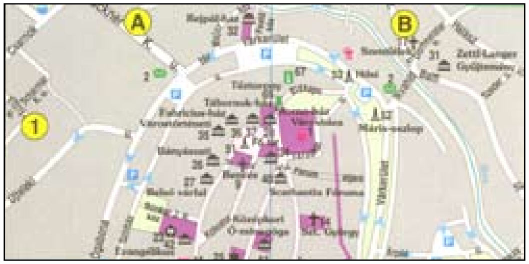
It is most likely that the middle section, the one that carries the street was built first; its arch is built of large carved stones, many of which carry stone worker signs. The second western section is also made of stone but the pieces are much smaller. The last eastern section contains a large number of bricks.

The three spans are a little different in size: the middle one is 5.75 m, the western one is 5.95 m and the eastern one is 7.30 m large. The total width of the bridge is 24.20 m, the middle section is 8.53 m, the western one is 8.87 and the eastern one is 6.80 m wide. The total length of the bridge is 8.00 m; the street that runs over the bridge is 50 m long.

There are two houses standing on the western section of the bridge. The façade of the older house reaches up to Szentlélek Street, and has a bend in its alignment. This is the point, where the road of the Ikva-bridge is the narrowest, only 7.00 m wide. The predecessor of the other house, dismantled in 1828, was a little wider than the house standing there now. The new house is a narrow, so called chemist's house which was built in the same year based on the designs of Vencel Hild.

The Ikva-bridge was once called "Hospital Bridge" since on its eastern side where the second house stands, there was a medieval city hospital the so called Johannita Hospital. The hospital as well as the Saint Elizabeth Church standing next to it was dismantled in 1798. The western side of the bridge was built in, at a width of 8.87 m, as opposed to this, the eastern side used only 6.80 m therefore a narrow line of rooms could be placed here.

As a result of its orientation the bridge can literally only be seen from one certain point, which can be reached via the narrow passage leading through the



courtyard of the house at Castle boulevard 25, and then across a wooden bridge. This bridge is certainly unique in its style therefore it could be a tourist attraction of the city provided the water bank could be approach in an easier way.

The arch standing in the village Grábóc in Tolna county is very similar to the Ikva-bridge of Sopron, although it is much younger. The bridge most probably used to have a building, maybe a mill in it.

Very rarely were permanent bridges built in the Middle Ages. Stone or brick arches were built over smaller waterways, but over larger ones wooden bridges were erected or ferry service was provided. Permanent bridges in most cases were only built if the structure could be protected like in the case of the Sopron Ikva-bridge. This is why, many times – besides several written memories – only the pillars of most bridges remained unharmed. A few relatively small arched bridges also remained intact to this day. There are several documentations available about wooden bridges e.g. Úrhida, Fövenypuszta, Fehérvár, Sajó-bridge at Muhi, Rába-bridges etc. Arched bridges are mentioned in much fewer documents. In castles and towns arches were built with several unique functions: "street bridges" connected buildings over streets. Many of these could be found in the Castle District of Buda, and one of these in Balta alley, is still standing.

Street bridge in Buda, Balta alley

3. Vác, Gombás-stream bridge

Our 250-year-old statue decorared bridge

M

Built: *1757*
Designer: *Ignác Oracsek*
Contractor: *Ignác Oracsek*

The Gombás-stream bridge of Vác is standing on highway no. 2 leading from Budapest to Vác. This stone bridge is one of our most valuable historic sites. There are altogether six statues on the pedestals standing on the river piers and at the riverbank ends of the parapet walls.

The statue of Saint John of Nepomuk is standing on the pier in the middle of the riverbed, on the side of the river course. On the opposite side there is the statue of Saint Peter and Paul. The ends of the wing walls are decorated by the statues of Saint Venentius and Saint Tadeus Judas on the Budapest side, and the statues of Saint Camillus and Saint Barbara on the Vác side. The works of the well-known artist József Bechart form an imposing collection of artistic pieces.

The front walls of the bridge were made of stone. The arches are half circle shaped barrel vaults. The upper storey of the parapet wall is level. The wing wall ends are not a direct continuation of the parapet walls, but are slightly spanned outward, this way widening the bridge deck and thus making it easier to turn onto the bridge. In 1753 the builder, the bishop of Vác, Károly Mihály Althann assigned Ignác Oracsek the head architect of the court with the designing and constructing of the bridge. The corner stone of the bridge was laid

on August 1, 1753 and the construction was finished in 1757.

The first statue decorating the bridge was also ordered by the builder, bishop Althann in 1752 but the bridge was dedicated when bishop Forgács was in reign. Besides the statue of Saint John of Nepomuk, all other five statues were ordered after the bridge was finished between 1758 and 1759. It is most likely that the idea of composing a collection of statues came from either bishop Forgács or prebend Ferenc Würth.

During its 250-year-old history, the 1775 icy flood of the Danube flooded the bridge and its surroundings; it ruined the bridge as well as the statues. Restoration followed shortly after the flood. The 1834 flood of the Danube again damaged both the bridge and the statues.

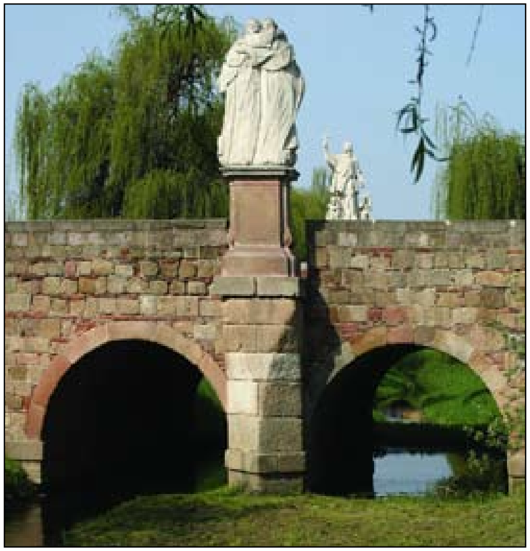
During the 1849 freedom fight, the bridge provided the venues for an important battle. On April 10, the troops of Damjanich caught up with the retreating Austrian troops and a heavy fire fight ruined the statues.

It is considered extreme luck that amidst the destroying of bridges during World War II the bridge standing on a main road remained intact.

Dismantling the bridge was already on the agenda at the end of the 1930-ies. As a result of the alteration of the country's borders the road gained more of importance, but luckily the planned destruction of the bridge never materialized, because the idea of protecting national monuments became more prevalent in official circles.

The bridge was widened and strengthened at the end of 1948. The original, 3 fathoms (5.70 m) wide bridge deck was widened to 12.10 m. The statues decorating the bridge were conserved, in their damaged condition, in order to prevent them from further damage. The widening of this bridge was unique in the practice of restoring national monuments.

During the 1965 spring/summer flood, the creek damaged the old stone arch to a great extent. The renovation of the bridge was conducted in two phases, half the width at a time.



4. Káptalanfa, double-span bridge

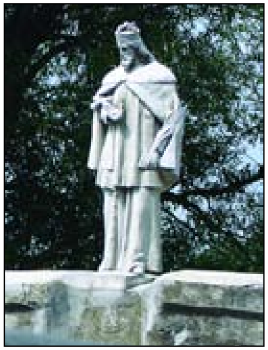
One of our most beautiful bridges

Built: *1794*
Designer: *Ignác Hartner*
Contractor: *Ignác Hartner*

The road leading from Devecser to Sümeg crosses the Sáros-stream at the northern border of Káptalanfa (Veszprém county). The two-span stone bridge standing here was built in 1794, by Ignác Hartner, a master mason from Sümeg. It cost 256 guldens (old forints). At that time to build one square foot of wall section cost 2 guldens, and to build one square foot of arch section cost 3 guldens.

The county of Veszprém was leading in building stone bridges. In 1791, the general assembly adjudicated that in the future bridges should be built of stone rather than wood. The plan was materialized: in 1820 the general assembly declared: "the bridges that used to be made of wood, by now are mostly built of stone", which statement is attested by records of that time, e.g.: a census of roads and bridges from 1837, which mentions this bridge as "a large stone bridge at the border of Hany and Káptalan".

In 1794 it was ordered that magistrate Oszterhueber made arrangements to build the Káptalanfa bridge as well as other bridges. Actions were taken, and extremely quickly, in that year the bridge with 4.1 + 4.1 m wide spans, a 6.3 m wide deck between the parapet walls, and a length of almost 38 m was erected. This bridge – made of chopped stones – had its parapet walls raised in the middle section and was decorated by a statue. According to the records of Imre Gáll DEng in 1970 the statue was standing in the church yard, but now – nicely restored – it decorates the bridge again.



Nowadays the noble shaped bridge is in good condition; still it is not considered a protected national monument. Nevertheless, the management of the highway control company takes care of it as a protected technical relic. It should be mentioned that the load bearing capacity of the bridge is appropriate, and its width is just enough so that it could not be dismantled with reference to modernization.

In Veszprém county there are several other interesting historic bridges, like the two-span arch in Hegyesd over the Eger-stream. The bridge spans are 4.4 m wide, its total widths, including the parapet walls, is 5.7 m and its full length is 22 m. The statue chamber, in which the statue of Saint John of Nepomuk used to stand behind wrought iron bars, still remains on the parapet wall of the bridge. The Eger-stream is a considerable watercourse even in the dry season so it runs underneath both openings of the bridge. The story of the construction of the Hegyesd-bridge is unrevealed; but it is conceivable that the totally similar bridges built in the nearby Diszel between 1791 and 1793, and in Örvényes served as samples for each other.

The bridge in Hegyesd

The statue decorated historic bridge in Diszel was built over the main arm and the mill ditch of the Eger-stream with five, 3.8 m wide spans. It is 7.6 m wide including the parapet walls. Its length reaches almost 45 m. This bridge was built by Károly Schracz, a master mason from Sümeg also to the order of magistrate Oszterhueber.

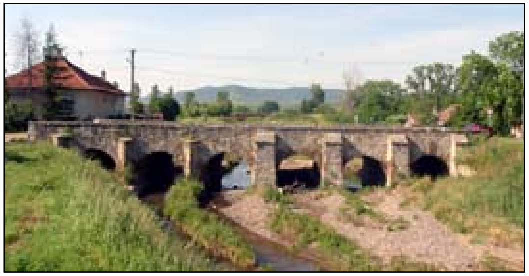
The Örvényes two-span chopped stone bridge on the old highway no. 71 – today a secondary road – was most probably built in 1791. Its spans are one fathom wide each, it has axes that are not parallel to each other and its central pier reaches three meters in width on its water-course side. The brick built statue chamber with the statue of Saint John of Nepomuk is above this pillar. One of its spans lets through the Pécsely-creek, while the other, the water running from a nearby watermill. This bridge is also a historic site.

5. Olaszliszka, Olasz(Italian)-ditch bridge

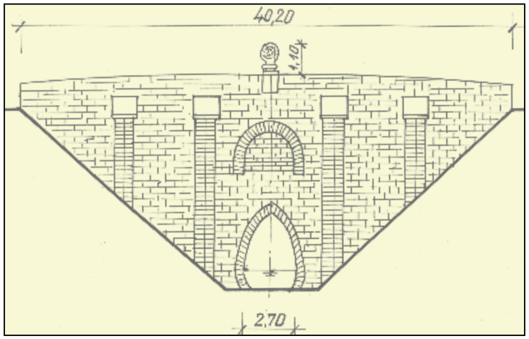
Bridge chapel: unique pointed arch

Built: *1796*
Designer: *unknown*
Contractor: *unknown*

Borsod-Abaúj-Zemplén county's most interesting bridge is standing between Bodrogkeresztúr and Sárospatak. This road was one of the most important transit roads of the Austro-Hungarian Monarchy, which – very uniquely to this country – has its old bridges preserved. It was part of the road leading from Pest to Miskolc through Gyöngyös, and from there leading to Galicia through Szerencs and Sátoraljaújhely. On its section between Bodrogkeresztúr and Sárospatak the road runs through several villages, which belong to the world famous Tokaj-Hegyalja (Tokaj Foothills) region. There are still several beautiful and interesting arched bridges on this road; three of them are one-span, two are two-span, one is three-span and another one is six-span. The road retained its importance up until 1950-51, when highway no. 37 was built between Miskolc and Sátoraljaújhely bypassing the in-between villages.



The dimensions and structure of the bridge implicate that its current shape was formed in the 18th century, by remodelling an older bridge. There is no data available regarding the construction of the bridge; however, it is believed to have been built in 1796. The total length of the bridge is 40.2 m, but its span is only 2.7 m wide. The bridge spans over a large ravine, which explains this great discrepancy in dimensions. The original arch is 8 m



high and half circle shaped on the outflow side. This high arch is supported by pointed prop up ribs at the façade wall and at three other places. This way the high, half circle shaped arch is surrounded by walls, but its contour is distinct.

The bridge has an approximately 11 m high wing wall supported by four strong ribs on its valley side; because of the great difference in elevation there is only a smaller wing wall and a slope on the hill side. On the outflow side, an arch section supported by two half circle shaped beams, was built next to the bridge. The parapet wall is the tallest in the middle, 1 m high above the bridge deck, and slopes a bit towards the sides. The middle sections of the parapet walls were decorated by 1.1 m high stone roses, unfortunately the first one and later the other as well disappeared.

The one-span, pointed arched stone bridge has a particularly unique structure. There are four known pointed arched bridges in the country: one can be found in Kisdörgicse, in Transdanubia, and three on the old Galician road. However, to our knowledge no other bridges, not even abroad, were built with interior supporting ribs.

6. Karcag, Zádor-bridge

Incomplete bridge in the Great Plains

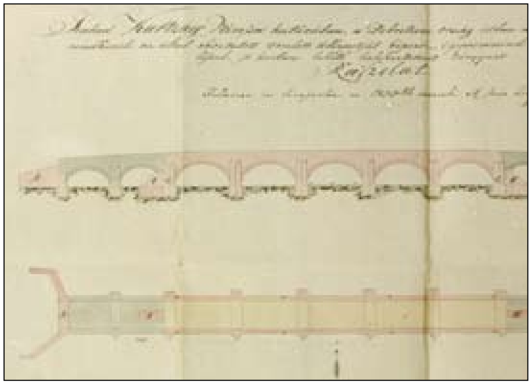
Built: *1809*
Designer: *Lőrinc Bedekovics*
Contractor: *József Magurányi*

Those who want to see the Zádor-bridge are undertaking a tiring journey. The road leading from Karcag to Nádudvar – former part of the Szolnok-Debrecen route – where the five-span stone bridge is standing kept its one hundred year old image: the road on it is still a dusty-muddy dirt road without any pavement.

This gravel road served as the route for salt shipments and postal carriages.

The distinct bare wing walls and the high parapet walls rising high above ground level make the bridge recognizable from a far away distance. The bridge leading through Zádor was first mentioned in 1783. This is when the son of the miller, István Góc (Gőz), had a wooden bridge built over the watercourse.

In order to guarantee the flow of traffic on the road and because the wooden bridge was constantly deteriorating a 40 fathom-long, nine-span stone bridge was built between 1806 and 1809 which at the time of its construction was the longest arched stone bridge with the most number of spans. The construction was supervised by József Magurányi, a master mason from Eger and Ferenc Laczka “districtus comissarius” (today: technical supervisor) based on the plans of Lőrinc Bedekovics, the county’s surveyor. The bricks were burnt on site and the stones were brought from the the Bükk Mountains.



The bridge served its duties effectively for over 20 years, until 1830 when the great flood of the Tisza destroyed it. Because of the very high water level, such huge amount of water flooded the open water basin between Tiszadob and Polgár that two spans on each end of the bridge were swept away. Because of the bridge being destructed the road traffic also stopped. Until the flood marched away one could not even think about remodelling the stone bridge, therefore a solution had to be found which allowed the restoration of road traffic as quickly as possible at the least of expense.

In 1833 András Bozóky the judge of the Court of Appeal from the palatine took charge of the issues con-

cerning the bridge. Of the original nine spans of the bridge, five – each 3 fathom and 3 feet wide – were kept, the two fallen spans on each end were dismantled, and the wing-walls were moved to the river piers on the edges of the remaining bridge section. The budget of the bridge was calculated by Fábián Dobrovai a master mason from Abony, so most conceivably he was in charge of the renovation of the bridge.

Further changes appeared following the water management project of the river system. As part of the Széchenyi-Vásárhelyi plan of great Tisza-regulation, an 11 km long dam was built first between Tiszadob and Polgár, which saved the Hortobágy from further floods of the Tisza. The old watercourses dried out or narrowed down, and channels were built to replace them.

7. Sárvár, castle entrance bridge

Our arch bridge with most spans illustrated also on a coffee-cup

Built: *1810*
Designer: *unknown*
Contractor: *unknown*

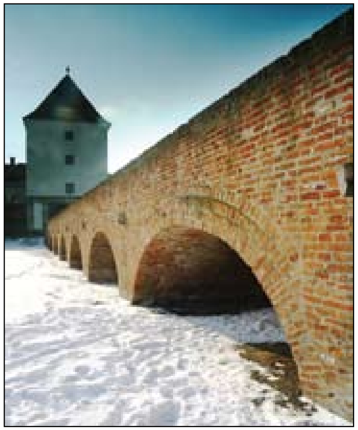
There was a royal castle in Sárvár as early as in the 12th century, which was the only one castle in Hungary that had never been overtaken by the Turks. Sárvár was also a cultural center under the leadership of Tamás Nádasdy: here was published the New Testament in Hungarian in 1541. The castle was pentagon shaped, and following the general practice of the times of the 16th century, there was a wooden bridge – with an opening section – leading up to it.

The 61 meter long bridge now has eleven, 4.4 m wide spans, and its total width including the parapet walls is 5.8 m. A beautiful painted coffee cup recorded the time of its construction. The cup made in 1822 shows 8-10 year-old trees next to the entrance of the bridge, therefore this bridge is considered to be one of the older arches.

As our castles gained more of an importance in terms of protection, brick made arches were built in various places starting in the 18th century. The oldest one was built in Tata in 1755 with four spans. This extraordinary, various brick layered bridge was designed by our famous architect, Jakab Fellner. Similar to this one is the Mosonmagyaróvár 44 m long arched castle entrance with five spans. This valued historic monument was built around 1800.

The most interesting castle entrance bridge, a five-span arch built in 1750, is the one in Siklós. Its spans are 2.4-2.5 m wide and it has a bascule bridge section. It is only at this castle that the brick arch is surpassed spherical vault masonry.

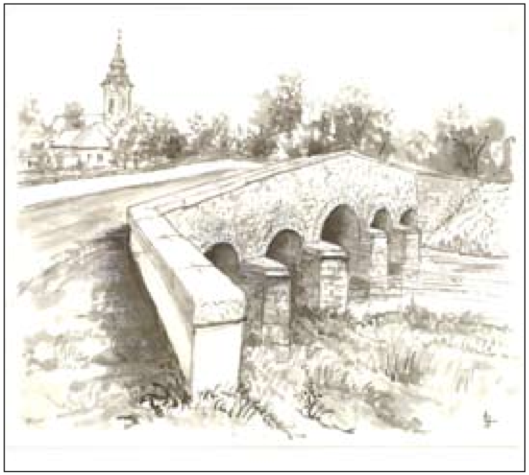
The arched bridge of the Sárvár castle entrance was built on solid stone foundations, nevertheless, in 1968 due to the deterioration of the un-insulated brick walls it had to be remodeled. Three of its spans are the original but the other ones had to be rebuilt. As part of the renovation an insulated reinforced concrete slab was inserted. The trees nearby the bridge that provided a nice site but were harmful in terms of maintaining its condition were cut. The bridge can serve as a memento of the high standards of our building culture for a long time.



8. Jászdózsa, Dead-Tarna-bridge

Contractor problems 200 years ago

Built: *1813*
Designer: *József Magurányi*
Contractor: *Károly Rábl*



The Tarna-bridge is on the road leading from the train station to the town of Jászdózsa, right next to the village's market square. The idea of building a stone bridge first came up in 1807. There must have been many problems with the wooden bridge that used to stand in the place of today's stone bridge, therefore the construction of a new stone bridge was requested. Captain József Dósa and the county engineer, Lőrinc Bedekovics were assigned with the task of building the bridge. The budget of the bridge was calculated in that year based on the plans prepared by József Magurányi, a master mason from Eger. The original plan included one more span, than what was later in effect built. The local assembly cut off one of the spans from the plan and the budget was petitioned to the palatine. Since bridge construction was a technical issue the palatine did not make a decision alone, but forwarded the issue to the Construction Directorate for official proceeds. The directorate made new plans and a new budget for the bridge and brought into the county's attention to start negotiations with Magurányi, to see whether he would take on the construction assignment. The first talks were not successful and later the resentful Magurányi refused to take on the bridge building task. Nevertehless, Károly Rábl form Gyöngyös accepted the challenge. The village of Jászdózsa agreed with the hewer master, András Huterlerner – who worked in the Solymos stone mine – to provide the necessary amount of carved stones for the construction of the bridge.

The construction of the 40 m long, five-span stone bridge started in 1811. The stones carved in Solymos ran out by June so stones made in the Deménd mine were borrowed. In 1813 the last covering stone was put in place and thus the Tarna-bridge of Jászdózsa was completed. The five-span bridge has high parapet walls rising in the middle; its arch has a low basket shaped slope. The approximately 45 degree angled wing walls are a continuation of the parapet walls with identical slope and shape.

It is unique that the almost 200 year-old bridge is still in its original form, there is no record of major repairs. In the 1960-ies because of the great flood the idea of dismantling the bridge was brought up but luckily it never materialized. This was partly due the fact that in 1979 a new reinforced concrete bridge, bypassing the town was built over the river Tarna.

The bridge was declared a historic monument by the National Historic Monument Inspectorate.

9. Tarnaméra, Old-Tarna-bridge

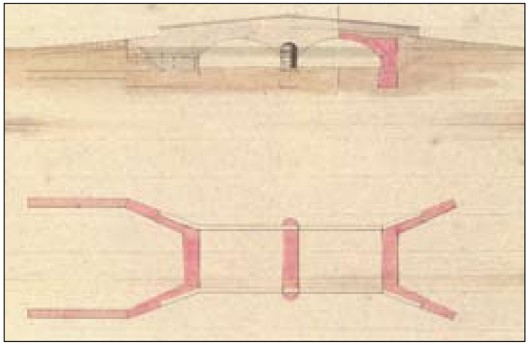
Fine monument in Heves county rich in stone bridges

M

Built: *1813*
Designer: *Károly Rábl*
Contractor: *Károly Rábl*

In Tarnaméra the 7.6+7.6 m span, nicely shaped bridge was built before the water management project of the water course as a result it does not fit in perfectly with the route of today road and its width of 5.7 m is slightly narrow. However, due to aspects of protecting historic monuments there was no opportunity for widening it. The length of the bridge is more than 26 meters. On its parapet wall the artistic statue of the Saint John of Nepomuk can be found.

The bridge was designed and built by Károly Rábl.



Interestingly, based on the same design he built another two-span bridge in Detk, although that bridge has a different story. The plans of the bridge remained.

The condition of the almost 180 year old bridge in Gyöngyössolymos built of riolit tuff deteriorated a great deal in the 1990-ies. Gábor Zsámboki and later István Németh made various versions of the renovation plans, of which the National Historic Monument Inspectorate accepted the plan which called for a reinforced concrete strengthening over the existing arch. The parapet walls had to be dismantled due to their poor condition. The reinforcement and renovation of the bridge was finished in 1995.

In 1970, Imre Gáll DEng, the outstanding and pioneer characteristic of the national bridge history research wrote in his book, “Old Hungarian Bridges”: “The rigid financial calculations would justify the dismantling of the bridge and the construction of a structure that would stand in line with the centerline of the road. Due to its beauty and historic value the bridge so far had withstood the pressure of financial reasoning.” In 1995 it was successfully saved.

The work of the famous master mason from Gyöngyös will hopefully remain a pride of Heves county for a long time to come. It is noteworthy that in Heves there still are 47 arches on the national municipal roads, which is the highest number in the country, 13 per cent of the total number of bridges.

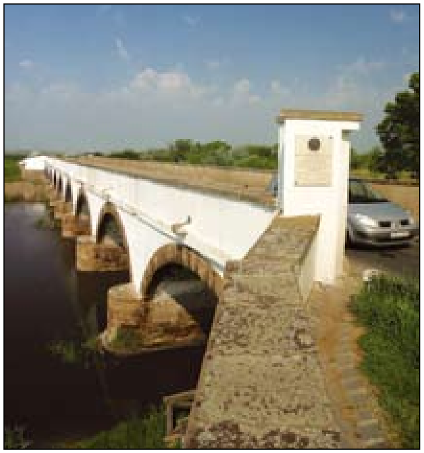
Historic monument arch bridge in Gyöngyöspata

Historic monument arch bridge in Visznek

10. Hortobágy, Nine-holed bridge

The longest and most famous “stone bridge” in Hungary

Built: *1833*
Designer: *Ferenc Provolni*
Contractor: *József Litsmann*



The Nine-holed bridge is standing right in the middle of the plains, where the Füzesabony-Debrecen road crosses the river Hortobágy. As early as in 1346, there used to be some type of a bridge, on the old cow-herding road, in the place of today’s bridge, however it was dismantled during the Turkish occupation. The wooden bridge built between 1697 and 1699 stood until the construction of the stone bridge. There was a considerable traffic on the bridge because during the times when the river Tisza was flooding, the cow herds from Debrecen used the route leading through the bridge of the Hortobágy to Szolnok and then to Vienna instead of using the ferry in Csege.

At the beginning of the 19th century, it caused an increasingly growing financial burden to keep the aged wooden bridge in good condition; therefore a new bridge had to be built at the Máta Inn. The dimension of the bridge to be built here was determined by the extent of the river Tisza’s flood in this area.

The General Assembly made a decision whereby three plans and budgets had to be produced. Ferenc Povolni, construction master’s proposal was a nine-span arched stone bridge using a mixture of “pozzolana-soil” and lime mortar as the binding component. József Litsmann’s proposal called for a five-span bridge using “oil putty mortar” as the binding component. György Köhler also would have used “oil putty mortar” to build the proposed nine-span, arched stone bridge.

Ferenc Povolni won the tender; still József Litsmann was assigned with the construction task in 1827. At the same time the town’s senate ordered the necessary amount of trees from the Hortobágy-Ohat woods that were needed to burn four-hundred thousand bricks. The bridge was built from bricks, although its piers have stone covers. The construction of the bridge had several obstacles.

The finished bridge is 92 m long but if the length of the parapet walls is added it reaches 167 m. These long parapets were necessary in order to be able to herd the animals onto the bridge.

Jókai’s novel “Sárga rózsa” (“Yellow Rose”) and Csontváry’s painting “Vihar a Hortobágyon” (“Storm in the Hortobágy) are both records of the bridge.

During the more than 150 years that passed, since it was built, the bridge did not suffer any major detriments. Nevertheless, the more and more frequently appearing surface damages destroyed the bridge’s aesthetic appearance. The bridge’s renovation plans were prepared in 1981 by the Roads and Railways Design Co. (Uvaterv Rt.), and the contractor was the Debrecen Road Building Co. (Debreceni Közúti Építő Vállalat) The first task was to build the approximately 250 m long bypassing road and the twice 15 m long provisory Herbert-bridges. During the renovation project the piers and the arches were strengthened and a load bearing reinforced concrete deck was built. In 1997, the Bridge Techniques Ltd. (Hídtechnika Kft.) completed the historic renovation of the base and stone structures of the bridge.

The extent and the composition of the traffic on highway no. 33 have recently changed. The narrowness of the bridge causes a considerable problem – its width is 5.73 m between the drains on each side and the stone-carved marker posts – but widening it is not an option. Its renovation is due again therefore, several issues arose regarding the protection of the historic site as well as the control of its traffic.

11. Héhalom, three-span arch bridge

As old as the Nine-arch bridge in the Hortobágy

Built: *1833*
Designer: *unknown, renovation: Főmterv, J. Gubányi-Kléber*
Contractor: *unknown*

The name of the designer and builder of the bridge is not known, nevertheless, we do know that the person, who organized the project, was László Fehér the juror, who urged the construction of the old wooden bridge.

The three-span (7.4+9.2+7.4 m) bridge is built of large, grey-coloured carved stones. The cover stones on top of the parapet walls are also quite large (63x31 cm). The bridge is 6.3 m wide and its total length is 38 m. At the two side spans the stream bed is built up a great deal which is the reason why the bridge, when one points it out as travelling across the new bridge built not far from the old one, does not look monumental. The road from Verseg to Héhalom runs with a sharp curve at its intersection with the Bér-stream, so a new reinforced concrete bridge was built here in 1975.

The bridge's condition is rather deteriorated, despite the fact that it has not been used for over 30 years. In 1988, a renovation plan was worked out and a few repairs were completed at this time.

This bridge should also be given a function and its regular maintenance should be taken care of. In 2003, a comprehensive plan was worked out to achieve this, but unfortunately, this plan has not materialized since then.

The slightly sloping parapet walls and the ice breakers made of a different colour material than that of the rest of the bridge give the 175 year-old bridge a unique appearance. It is called the White bridge because of the colour of its stones.

There are no documentations regarding the construction of the bridge, therefore it is only a presumption that in 1829 when the palatine travelled this way work was already undergoing. Nevertheless, according to the carving on the cover stones its construction was not finished until 1833.

The bridge is a protected monument. Nógrád county is a proud proprietor of two other nice three-span historic bridges besides this one.

200-year-old vault in Patak, painted by Tőzsérné Balázs Mária

The statue decorated monument in Romhány

12. Zalaszentgrót, Zala-bridge

Built by prisoners, today the arched bridge has no continuation

Built:	*1844-46*
Designer:	*József Csepely; renovation: Főmterv, Zsolt Nagy*
Contractor:	*Mihály Kugler*

Szentgrót was a toll-keeper place in 1247 already; its castle was first noted in 1299. We do know that its castle used to be situated on an island; therefore it could only be reached by a bridge.

The need for building a permanent bridge was first mentioned in 1795; its plans – surprisingly for a wooden bridge – were not submitted for approval until 1834. A real step forward was when Károly Tolnay became the chief constable in 1844, when similarly to how it was done in Zalalövő, he suggested that prisoners should build the bridge. In 1846 the bridge was already finished. The bridge's spans are 8.8 m wide, its total length is 43.0 m, and its width is 6.7 m.

It is apparent that due to conditions of the local terrain (there used to be floodplain bridges as well) a shorter and smaller spanned bridge was built with a wider bridge deck. In addition, instead of the half circled

arch, the "segmental" arch requiring less room was used which was made of carved stones and bricks.

This highest quality constructed bridge built by Mihály Kugler, withstood well the roughness of times. In March of 1945 sergeant-major Hatamov saved the bridge from devastation. In 1965, a memorial plaque was placed on the bridge to remember this event. Imre Gáll DEng made tremendous efforts in order to achieve that the bridge be declared a protected historic monument.

An expert bridge engineer of the highway patrol suggested the construction of a new bridge in an official report, since that was a more favourable solution both in terms of traffic control and water management than reinforcing the bridge built in 1846.

The designing of the new Zala-bridge started in 1970 and its construction began in 1974.

Once the new bridge was dedicated, the issue regarding the maintenance of the old bridge remained unresolved. That job was taken on later by the State Property Agency. Its renovation was already needed; therefore in 1997 its building permit plans were prepared by the Unionplan Ltd. (Unionplan Kft.) and the Traffic Control Board gave approval for the project.

However, in 1998 the span near the Zala-bed caved in, and in 1999 the other two spans fell down as well. As a result of the changed conditions a revised plan was prepared: a purely brick bridge was designed instead of the proportioned reinforced concrete arched shell. The three spans of the bridge were completely rebuilt out of necessity. Unfortunately, the bridge dedicated with great rejoice, by today is leaking through so unless the problem of its waterproofing is solved most probably, its condition would deteriorate again within a few years.

13. Budapest, the Széchenyi Chain Bridge

English and Scottish link of chain between Buda and Pest

Ⓜ

Built: *originally: 1849; reconstruction: 1949*
Designer: *originally: William Tierney Clark; reconstruction: Pál Sávoly, György Méhes, Gusztáv Faber*
Contractor: *originally: Adam Clark; reconstruction: István Zimányi, Ernő Bors, Géza Bujdosó, Danube Bridge Construction Work Team*

The construction of our first permanent Danube Bridge was ordered in the 26th Act in 1836 as a result of István Széchenyi's heroic struggle. William Tierney Clark planned a suspension bridge with three spans. The designer and contractor W. T. Clark, who was a member of the British Royal Chamber, sent the Scottish Adam Clark to Hungary as his substitute.

Adam Clark was an excellent choice for his namesake, since Adam Clark as the engineer who was assigned earlier with the dredging of the Danube's riverbed knew well not only the river but also the conditions in Hungary. In addition, his name was known and he was welcome back in Hungary. At this time, the still quite young only 28-year-old engineer took on the great task with an extraordinary flamboyance. His superior, Tierney Clark appeared very seldom at the construction site and even then for only a short period of time, therefore as result of the long absences of the designer, Adam Clark was left totally alone with the supervision and the responsibility of the job.

The running of this project came with a lot of travelling. Adam Clark personally visited the mines and the woods. Organizing the construction workers required quite an effort as well. The stonemasons came from Italy, and the skilled workers arrived from England and Scotland. Clark made a detailed scale-model of each phase of the construction, so that he coluld demonstrate his orders to the construction workers.

The drifting ice on the river caused the most problems during the construction of the piers which was the most critical phase of the project. An ice-breaker was built specifically to protect the dam. The laying of the foundation-stone ceremony was held in the river bed of the Danube after three years of work, on

August 24, 1842. The ceremonial occasion had two thousand invited guests besides the palatine. Miklós Barabás's painting, "A Lánchíd alapkőletétele" (The laying of the foundation-stone of the Chain Bridge) recorded the event. There were times when 800-1400 people worked on the bridge simultaneously.

The 1848-49 freedom fight – ongoing during the construction of the Chain Bridge – considerably slowed down the progress. Once the several months of turmoil passed away the bridge could be dedicated on November 20, 1849. Traffic was allowed to cross and the collection of the bridge toll began. The 202 m wide middle span of the bridge was the largest in our country until 1903, when the Elisabeth Bridge was constructed.

Following the turn of the century the harmful oscillations of the bridge increased to such an extent that the strengthening of the structure could not be delayed any longer. Because of the necessary strengthening works the whole iron structure was rebuilt. The remodelling started in 1913 and was only finished by the end of 1915. The plans of reconstruction were prepared by the most outstanding engineers of the time, József Beke and István Gállik, based on the calculations of Antal Kherndl. Thanks to their superb job, the bridge's original shape was preserved even

though structurally it had to be changed and strengthened significantly.

At the end of World War II, the Chain Bridge along with the other Budapest bridges was blown up. Its reconstruction was finished for the 100 year anniversary of its dedication, November 20, 1949. The plans for reconstruction were prepared by Pál Sávoly and György Méhes DEng

14. Budapest, Margaret Bridge

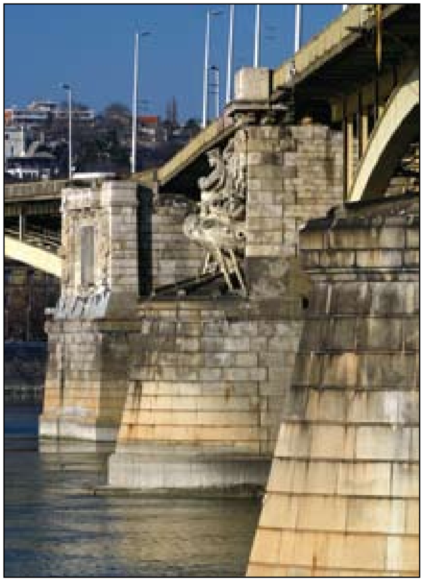
Widened and reconstructed bridge ornamented by statues

Ⓜ

Built: *originally: 1876; reconstruction: 1948*
Designer: *originally: E. Gouin; reconstruction: Pál Sávoly, György Méhes; Ganz Danubius; Janos Papp; Laszló Venetianer; Kováts Oszkár*
Contractor: *originally: Société de Construction de Batignolles; reconstruction: MÁVAG: István Zimányi, Ernő Bors, Géza Bujdosó*

The bridge was built between 1873 and 1876 as a continuation of the Nagykörút (Great Boulevard), based on the plans of the French E. Gouin. The statues are also French made one of them has been missing since World War II. The construction was supervised by Mihály Deák, senior engineer of Hungarian National Railway (MÁV) and the later famous bridge engineer Aurél Czekelius as assistant engineer.

This riverbed bridge is unique in that its centreline turns in a 30˚ angle in the middle; therefore the piers stand parallel to the direction of flow in both Danube arms. As traffic increased later on, this change in direction caused problems; vehicles ran onto the sidewalk or fell into the Danube.



The span widths of the six-span bridge grow from 73 m to 88 m from the two banks towards the centre pier. This feature is aesthetically quite beneficial. In each span there are six parallel arches with their ends propping against plates. X-shaped grids were placed between the arches and the bridge deck, and as a result the structure was statically multiply indeterminate. The widths of the bridge deck was 11.06 m, the sidewalks were 2.90 m each.

As a continuation of the riverbed bridge, there is a “bank bridge” on each riverbank with a 20 m wide span, constructed with a similar structure to that of the riverbed bridge. These were the first Hungarian bridge construction jobs of the Hungarian State Wagon and Machine Factory (MÁVAG).

The bridge was originally constructed so that there wolutd be a connection to the Margaret Island, however the bridge leading onto the island was only built in 1900, its structure is also similar to that of the riverbed bridge.

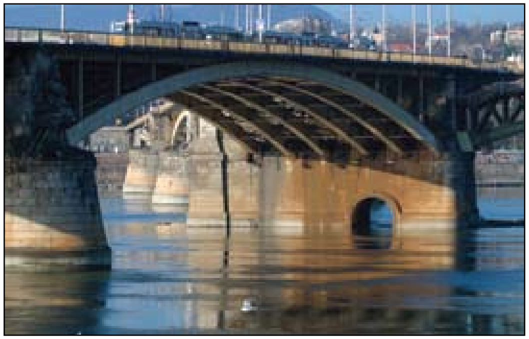
From 1879 a horse drawn train service and from 1894 a tram service was provided on the bridge. The tram tracks ran next to the sidewalks.

In 1935-37, due to the increasing traffic and the deterioration of certain structural parts the bridge was widened southbound by two new main arches. At the same time the arches were changed to double hinged arches. This procedure was considered a technical bravura since it was executed while traffic was running. The tram tracks were placed to the middle.

In the autumn of 1944 the three Pest side spans of the bridge collapsed while full traffic was running – presumably as a result of an accidental explosion – causing the death of several hundred victims. In January of 1945 the Buda side of the bridge was also exploded. The island wing bridge remained intact.

Reconstruction happened in two phases in 1947 and 1948. The new bridge had six double hinged arches in each span resulting in better load bearing capacity and slightly different shaped structure. Several memorial plaques recorded the reconstruction.

The last major renovation job was done in 1972. Another maintenance project would be extremely needed, but so far it could not happen since there is no alternative for the detouring of traffic.



15. Solt, reinforced concrete arched canal bridge

The first Monier-system reinforced concrete bridge in Hungary

Built: *1889*
Designer: *Győző Zoltán*
Contractor: *Wayss G. A.*

Our first reinforced concrete road bridge was built in 1889, at that time its location was described as "The church square bridge on the road between Budapest and Zimony, in the town of Solt". Today it is a section of highway no. 51, the Budapest-Baja-Hercegszántó secondary road. Its curiosity is that Monier, the inventor of the system, was a gardener in Paris, who made various flower- and water pots in such a way that a pre-constructed frame, made of iron rods was covered with cement. Győző Zoltán a royal engineer – who was the designer of this bridge – summarized this technique at the Hungarian Engineer and Architect Association's meeting in January 29, 1890 as follows: "The Monier-system is nothing but combining a frame made of various strength iron rods with a cement shell; or more precisely: covering different diameter iron rods with cement, based on the load bearing need, where the dimensions are always determined by static calculation."

As a result of the improvement of the above system, the first reinforced concrete arched canal bridge could be built in our country, which has been serving the traffic ever since.

The bridge in Solt has two parabola shaped 5 m spans and a height of 3 m. The thickness of the arch is 14 cm in the middle, and 21 cm at the shoulders. The foundation of the abutments and the piers reach 120 cm deep into the good quality soil. The original grid was made of 1 cm diameter rods 7 cm apart. The workers placed the iron rods on top of each other overlapping 5 cm, and fastened them with thin iron wires. These iron wires were used at the intersections as well so that the grid should not move when pouring the concrete. The speed of this construction was impressive, since only 28 days were needed to assemble the above mentioned structure, and two weeks later the load bearing tests could be executed.

At that time, many people were afraid that the new technology would not be reliable and the bridge would collapse. Luckily, time greatly falsified the sceptics, since the first Hungarian reinforced concrete bridge is already 117 years old. Truly, in the meantime it needed to be widened and strengthened to fulfil traffic needs. The bridge was widened with a reinforced concrete slab in 1942, when the road crossing the town of Solt was covered with a permanent road surface. This structure served the traffic until 2002, when because of the continuously increasing traffic, the bridge needed to be partially rebuilt and strengthened.

When the bridge was rebuilt in 2002 an arched structure, similar to that of the original, was ordered and designed instead of the widened structure used in 1942. Thus, the bridge that was originally planned to carry the weight of a 20 ton steam plough, was strengthened enough to be certified with the Road Bridge Building Code's class "A" load bearing capacity. At one time, there was a significant water flow underneath the bridge, which by today had tamed down to a narrow stream, therefore, as another change, one of the spans could be converted into a "pedestrian underpass". Owing respect to the great predecessors, the rebuilt and strengthened bridge got a parapet wall-like, tracery, locally poured concrete railing, which is very similar to the original. In addition a memorial plaque was also placed.

16. Komárom, Elisabeth Danube-bridge

Our first crescent shaped road bridge is 115 years old

Built: *originally: 1892; reconstruction: 1946; renovation: 2006*
Designer: *originally: János Feketeházy; renovation: Pont-TERV Co.: Miklós Pálossy*
Contractor: *originally: Gregersen and Sons, MÁV Machine Factory; renovation: Bridge Technique Ltd. – Közgép Co., László Kovács*

Today's Komárom was a significant crossing place of the Danube long before the Roman times. The castle built for the protection of the crossing place saved refugees seeking shelter under the time of the Tartar invasion already. King Matthias had done a lot for the development of the castle; he started the construction of a bridge but could not finish it because of his death. Road descriptions from 1573 report on the ruins of the bridge. During the Turkish occupation, the castle was an extremely significant part of the border fortress system. Once the nearby forts had fallen – due to the protection of Vienna – its significance increased even more, therefore in 1543 it was strengthened. Lajos Jurisich a bridge master from Pozsony (Bratislava) built a boat bridge in 1589.

In order to even more increase the importance of the castle the construction of a permanent bridge was urged.

In 1891 Gábor Baross, the minister of transport approved with his signature the construction of the bridge and signed a contract with the general contractor, Gregersen and Sons. The superstructure of the steel truss bridge was manufactured and assembled by the Hungarian Royal State Wagon and Machine Factory.

This was the first crescent shaped, truss river bridge, which was the "invention" of its designer János Feketeházy. Later this design became the sample for other Danube-bridges (Esztergom, Baja).

The bridge that had four 100 m wide spans was made of the so called puddle iron and weighed 2225 tons. The foundations of the piers as well as the abutments were poured using caissons. The structure was assembled using scaffolding built on wooden pole auxiliary supports. The bridge is made up of four detached, parabolic arched truss structures. The official dedication ceremony of the bridge was held at midnight, on September 1, 1892.

In 1914 based on the plans of Szilárd Zielinski DEng a prefabricated reinforced concrete bridge deck with asphalt covering was constructed for the bridge. The retreating German troops exploded the bridge in March of 1945, when the steel structure of the two middle spans collapsed into the water. In 1946 Czechoslovakia rebuilt the two middle spans using the original plans. A wooden bridge deck was built for the two middle spans, which in 1962 was replaced with a prefabricated reinforced concrete structure.

In 1992 as one of the events of the "Bridges on the Danube" ("Hidak a Dunán") international conference the two cities, Komárom and Komárno, organized a stylish event to celebrate the centenary of this important Danube-bridge. In 2006 as a result of joint efforts Hungary and Slovakia replaced the damaged reinforced concrete bridge deck sections, developed a new road covering layer structure, renovated the pedestrian sidewalk cantilevers and repainted the bridge.

The Elisabeth Danube-bridge – built to replace the ancient ferry – a steel structured truss bridge, considered to be quite modern at the time had been serving traffic needs and social connections for 115 years already, except for a short period of time as a result of the insane destructions of the war.

17. City Park in Budapest (Városliget), Wünsch Bridge

An early rigid steel reinforced concrete bridge

Built: *1896*
Designer: *Róbert Wünsch; renovation: Főmterv, Adrián Horváth*
Contractor: *Róbert Wünsch*

The construction of the continent's first electric underground train was started on August 13, 1984 by the general contractor, Róbert Wünsch, a "cement technician", and had to be finished by the 1896 Millennium Celebrations. The 3.7 km long train (of which 3.2 is under the ground) was opened for public traffic on May 3, 1896.

The original terminal station of the subway was at the Széchenyi Bath. A pedestrian bridge needed to be built at the Zoo exit of the tunnel, over the cutting and even though by today it had lost its function, it is still standing (the hook holding the electrical overhead cables can still be seen).

The monolith reinforced concrete arch bridge and the rest of the reinforced concrete structures of the tunnel: the parapet walls and the arches above the railway tracks were built on the basis of Róbert Wünsch's trademarked technique. The use of rigid insert structure was an important trend in the early phases of reinforced concrete construction.

One of the significant national representatives of the trend was Róbert Wünsch. The idea of the method developed by him, trademarked in 1880, was that the bottom surfaces of the slabs were arch shaped and both belts had a steel insert, the upper one was aligned horizontally while the lower one was connected to the arch. The side stress of the arch is taken up by the steel inserts, fastened to the abutments by iron hooks, and then is carried to the base structure with the help of the iron inserts anchored to the bases of the abutments and run through the iron hooks. In the arches and in the upper belt the T shaped profiles (25/29/4 mm) are placed 15-50 cm apart, which carry the dead load and the live load by themselves. Later however, not this but the Hennebique-type of system trademarked in 1892 became widespread.

The span of the bridge is 10.7 m, its width is 2.6 m; the width available for traffic is 2.0 m. At the Zoo end of the bridge a one armed centreline directed staircase, while at the City Park end a two armed perpendicularly aligned staircase was built. The staircases are supported by Wünsch-type reinforced concrete arches. The arch above the span is partial circle shaped, while the arches below the staircases are basket curve shaped. The facades above the arches are closed by reinforced concrete lids, the balustrades are prefabricated reinforced concrete slabs, set into the holes left in the lids. The balustrades are closed by a line of concrete covering lids. The arch above the opening has moved a few centimetres over the decades, therefore subsequently a drainage system needed to be built in. A circle shaped concrete memorial

plaque commemorating the construction of the bridge is placed in the cabin of the City Park end abutment.

In 1973 the subway was extended by two new stations until Mexikói street. During this project these additional tracks were also moved underground thus the bridge lost its function. Vandals have demolished and broken all moveable parts of the bridge. These were remanufactured during the 1981 renovation project. Following this, the bridge once again was not taken proper care of for a long time; finally in 2006 it was renovated again.

The bridge before renovation

18. Budapest, Ferenc József, today Liberty Bridge

The most beautiful Gerber-hinged, truss bridge in the world

Built: *originally: 1896; reconstruction: 1946*

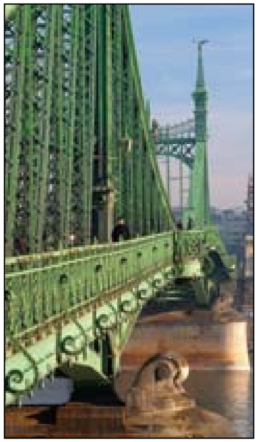
Designer: *originally: János Feketeházy, Virgil Nagy; reconstruction: Pál Sávoly, renovation: Főmterv,- Magyar Scetaurute*

Contractor: *originally: substructure: Gaertner, Zsigmondy; steel structure: MÁV Machine Factory; reconstruction: MÁVAG*

A joint international tender was called for the construction of Budapest's third Danube-bridge and the Elisabeth Bridge. János Feketeházy's application won second prize and the Ferenc József Bridge was built based on these plans between 1894 and 1896. The superstructure is a three-span truss structure, its spans are 78, 175 and 78 m wide respectively, its length is 333.6 m, and thus this is Budapest's shortest Danube-bridge. This was the first large bridge that was built based on Hungarian plans, and was made of Hungarian manufactured rolled steel. The bridge resembling a suspension bridge in its shape, is really a hinged truss structure and is considered the most beautiful of its style. The main factor of its beauty – besides the delineation of the main girders – is the shape of its gateway, which is the merit of Virgil Nagy. The placement of the "turul" bird statues (mythical falco of the ancient Hungarians) and the coat of arms are also worth mentioning. There are several memorial plaques on the bridge, furthermore, on the Pest side the original toll-collector houses are stills standing, one of them providing room for a small museum.

The width of the bridge between its railings is 20.1 m; its road deck is 10.5 m wide, which is considerably narrow for two tram tracks and one traffic lane in each direction. The structure of the main girders made it necessary to add 600 tons of counterweight nearby the abutments of the bridge on each side.

The bridge was exploded in January of 1945, but luckily only the suspension and some of the cantilevers fell into the water. Using the remaining pieces, the Russian troops quite quickly began to fix up the bridge enough so that temporary crossing could be allowed. However, they did not take into consideration that having lost the original cantilevers, the bridge structurally was converted into a single span structure, and thus the counterweights became not only needless, but also harmful. Therefore, the Buda structure tilted because of the buckling of the upper chord, which set back the final reconstruction. Nonetheless, a temporary bridge – using five barges – was quickly constructed and was in operation until the icy drift of January 1946. At this time, the ice swept away the middle, temporary section. Thanks to the new floating cranes the reconstruction was completed in record time and the bridge was reopened – under the name of Liberty Bridge – on August 20, 1946. As a result, tram service could be provided again between Buda and Pest. On the rebuilt sections, the railings were not identical, only similar to the originals. The designer of the reconstruction was Pál Sávoly, its contractor was the Hungarian State Wagon and Machine Factory (MÁVAG).

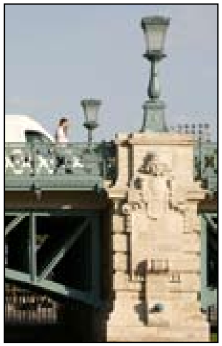


There had been several major renovation projects on the bridge since its reconstruction, for instance when the supporting structures of the earlier mentioned counterweights were completely replaced. Because of the corrosion of the sections going through the bridge deck once one of the members of the truss structure tilted a bit which caused the banning of traffic for a while. In 2007 and 2008, another major renovation project is due.

19. Városliget (City Park in Budapest), Zielinski Bridge

The gateway to the Városliget

Built: *1896*
Designer: *Szilárd Zielinski*
Contractor: *iron structure: Ganz Danubius; substructure: Szilárd Zielinski*



At the end of the 18th century, the prince primate József Batthyány, started to develop today's layout of the Városliget (City Park) based on the designs of Rudolf Witsch, a German engineer. However, for various personnel and financial reasons the development of this park dragged on for too long and died off. Later (1813) a design tender for the development of the Városliget, announced by the "Beautifying Committee" established by Palatine József, gave new zest to the project. The final push was the need to finish the project by the 1896 World Fair. The minister of trades, as the chair of the millennium fair, published a tender to construct a bridge leading to the Palatine-island of the City Park. A curiosity of the tender was that no prize was offered, but the designer of the best plan was given the opportunity to construct the bridge.

Szilárd Zielinski DEng, who compiled two proposals, a stone- and an iron structure, won the tender. The jury chose the less expensive iron structure. The bridge – as restricted in the specifications of the tender – was an 82 m long, three-span, truss bridge that rested on two middle piers and on the abutments with hinges . The bridge road was 10 m wide to which a pedestrian sidewalk was connected on each side. At the middle of the bridge the free height above the elevation of the lake was 3 m.

The substructures of the 1896 bridge were built by Zielinski, while the iron structure was manufactured and assembled by the Ganz-Danubius factory. The completed bridge was a worthy continuation of the city's most beautiful avenue, the Andrássy street.

The bridge served the continuously growing traffic in its original shape for almost 30 years. By the end of the 1920-ies, its original wooden block deck deteriorated so much that a renovation was needed. The plans for reconstruction were done by Győző Mihailich DEng, professor at the Technical University. In 1929 based on this design the structure of the old road deck and sidewalk was dismantled, and then the rebuilt and strengthened iron structure was given a reinforced concrete bridge deck.

The Millennium Bridge "blissfully" survived World War II; only the fancy candelabra were destroyed, which were partially replaced with the intact remnant lamps of the blown up Chain Bridge.

After the 1929 reconstruction, only minor maintenance jobs were needed on the bridge for over 50 years, in 1952 and in 1969 it was repainted.

In 1981 – because of the increasing traffic and the corrosion caused by lack of insulation – the existing steel structure needed to be strengthened and protected against corrosion; while the reinforced concrete bridge deck needed to be insulated. The Bridge Building Co. (Hídépítő Vállalat) and two other companies took on the responsibility to fulfill these jobs in 1981-82.

In 1994 at the 70th anniversary of his death, the grateful posterity named the bridge Zielinski Bridge in order to honour and owe respect to the designer.

The last major renovation job was completed during the summer of 2005, when based on the plans of the Magyar Scetaroute Ltd. the aged insulation and the functionless dilatations were replaced, the defaults of the parapet walls and the piers were smoothed, and the entire structure – both the iron and the concrete parts – were protected against corrosion by the Bridge Technique Ltd. (Hídtechnika Kft.).

20. Szekszárd-Palánk, Sió-bridge

An iron bridge in its original form at the ancient crossing place

Built: *1900*
Designer: *State Building Office, Szekszárd*
Contractor: *substructure: Gáspár Szélig; superstructure: The Resica Factory of the Austro-Hungarian National Railway*

On the Sárvíz-stream nearby today's Szekszárd-Palánk Sió-bridge, there must have alreadybeen a crossing place in the Roman ages: since the so called "limes" road ran through here. Following the foundation of the Hungarian state the Jerusalem pilgrimage road and the military road ran also here. In 1529 the diary of Suleiman mentions having crossed the bridge, and later in 1555 a traveller Hans Dunschwam reports on a long wooden bridge here, to which a dam lined with lumber and stones was also connected. Later on, the bridge is mentioned in several other sources. In 1596 the Turks rebuilt the damaged bridge, and built a fort to guard it. This is what the today used expression "palánk" (plank) bridge refers to. It is known from a survey dated in 1726 that the bridge was 105 fathoms long.

The fact that in 1899-1900 the today still standing bridge – which was the county's longest spanned "iron bridge" – was built here signifies the importance of this crossing place. The designer of the substructure was the State Building Office in Szekszárd, its contractor was Gáspár Szélig a builder in Szekszárd, its construction supervisor was József Baisz, a royal engineer, the designer and contractor of the superstructure was the Resica factory of the Austro–Hungarian National Railway; and its construction supervisor was Ferenc Novák, a royal engineer.

The abutments' foundation are driven wooden piles. The upright wall and the wing walls at each end were made of bricks laid into portland cement mortar.

The bridge is a one-span, riveted, segment shaped truss structured through bridge. The height of the main girders is 2.00 m at the bridge ends and in the middle of the span it is 7.50 m. The axle distance of the main girders is 6.40 m, the widths of the road deck is 4.80 m. The two main girders are connected with truss shaped cross beams at the top at the five middle joints. The cross beam at the highest point of the arch is 2.00 m high. The bottom of the structure is stiffened by cross girders and wind lattices at each joint. The bridge deck was made of five I 500 type longitudinal beams and cross girders, on which omega-section beams were placed next to each other, which was then covered with crushed gravel and an asphalt layer. The raised pedestrian sidewalk was covered with planking fastened to bolstering, the iron structure was grey coloured.

The bridge was first inspected in 1912. In 1924 it was repainted and the wooden planks of the sidewalk were replaced with reinforced concrete. In 1928 it was ordered that the steam plough, weighing 20 tons, can only travel in the middle of the bridge. In 1931 the covering of the road deck was removed, the gaps between the omega-section beams were filled with concrete, and the deck was covered with a 5 cm thick asphalt layer. In 1945 the middle section of the bridge was exploded, the explosion tore the deck structure and damaged several other structural elements. Following this, the deck structure was renovated but the total reconstruction did not materialize. In 1984 a high vehicle damaged the upper cross beams, which based on the plans of TETA co-op was fixed in that year by the Közgép Co.

In 1990 there was an even more serious car accident, and the bridge needed to be closed from traffic. Half a year later based on plans worked out by TETA 4.40 m high protecting gates were built.

The complete renovation of the bridge was done in 1993, when the omega-section beam bridge deck was replaced with a reinforced concrete deck. The painting of the bridge was also renewed. Today there is a 16-ton weight restriction on the 107-year-old bridge.

21. Balatonföldvár, Zielinski-footbridge

One of our historic monument reinforced concrete bridges

Built:	*1905*
Designer:	*Szilárd Zielinski*
Contractor:	*unknown*

Szilárd Zielinski was a determining figure in the early use of reinforced concrete; his role was extraordinary in the dispersing of the Hennebique-type of reinforcing technique, which he had learned at the 1900 Paris World Fair. In addition, some of his steel structures are still standing today. In 1890 he founded his own office, and until his death in 1924 he had produced uncounted ingenious works in various segments of the building industry.

According to his own records, between 1890 and 1897, he had designed 35 steel bridges, 15 of which were definitely built. There are detailed records regarding the activities of his offices between 1897 and 1918. According to these records, so many plans were produced that some were marked with as high job numbers as 1258. Of these works 455 included bridge drawings, at times several versions. So these 455 items include altogether 823 bridge plans, 70% of which is one-span, and 30% include more than one span. Apart from a few exceptions they are all reinforced concrete structures, using various abutment-, pier-, yoke structures. A larger part of them are beam bridges, some of them are slab bridges and a few are arched bridges. The spans of the slab bridges were normally quite small, 2-8 m; the beam bridges had 25-30 m wide spans whereas the spans of the arched bridges could even reach 60 m.

Several of his plans had been lost by today and the histories of various structures built by him remain unknown. The history of his footbridge – which is one of the few reinforced concrete bridges in our country that is considered a national heritage – built in Balatonföldvár in 1905 is also quite difficult to reveal. The year of its construction was recorded on a mosaic square imbedded into the fresh concrete. The six-span reinforced concrete bridge leading up to the west pier is a continuous, straight beam bridge, with a square shaped reinforced concrete pier. The end spans are 15, the middle ones are 18 m wide, and the total length of the bridge is 102 m. There is a 35 by 40 cm thick longitudinal beam running in the spans, which is covered with a 14 cm thick and 195 cm wide reinforced concrete slab. There is wedging and a cross girder at the intersection of the beam, the posts and slab. At each pier one meter high reinforced concrete posts hold the original wrought iron railing.

Designing a continuous main girder was a brave and good decision. The slight wedging at the piers, propping the bridge deck with a cross girder, and placing the reinforced concrete railing posts at 15-18 meters were very carefully thought out and economical solutions which resulted in an airy and slender bridge.

The bridge that have been standing for over 100 years is in good shape to these days, and practically never needed any renovation that would have touched its load bearing structure.

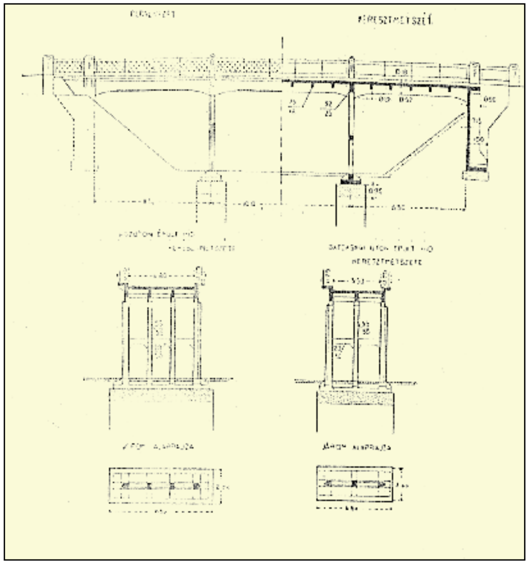
22. Bridge on the tide-reducing canal of the river Répce

A 100-year-old monument of the water management project

Built: *1908*
Designer: *Aladár Kovács Sebestyén*
Contractor: *Rába Water Management Association*

In 1906, for the order of the Rába Water Management Association, Aladár Kovács Sebestyén designed a slender, three-span, reinforced concrete frame bridge with its spans being 8.5, 10, and 8.5 m wide respectively. In those days, two standard types of bridges were built: on the municipal roads, the road widths had to be 4.8 m between the curbs, while the lower ranked ones had to be 3.5 m wide. The load bearing capacity of the former ones was a 20-ton steam plough, while the latter ones was a 12-ton vehicle.

The slenderness of the bridge shown on the picture, nearby the village of Rábakecöl is eye-catching. The pier posts are 35 by 35 cm thick, the height of the main beams is 52 cm, while the wing beams are 75 cm high.



The almost 100-year-old bridge that still carries road traffic contains 50 m^3 of concrete in its foundations, 102 m^3 in its superstructure and 17.8 tons of reinforcing steel. The condition of the extremely slender shape, the brave structure truly proved how superior the reinforced concrete construction was in the early times.

Bridges were built quite speedily, building the scaffolding and the formwork took three weeks, the reinforcement took 3-4 days, and pouring the concrete took one day for 60-70 workers.

As a result of the national water drainage projects several bridges were built, but unfortunately only few of them remained intact because of the destructions of the war and other reasons. There should be a place for these slender bridges amongst the national technical heritages.

Another type of frame bridge over a waterway designed by Sabathiel.

23. Gyoma, Hármas-Körös-bridge

The bridge with a 117-year-old middle span

Built: *1909*
Designer: *State Building Office, Gyula Kikindai*
Contractor: *József Kádár, Dávid Pellegrini; Schlick Factory*

The five-span truss structured steel bridge was first opened for traffic, at the place it is standing now, in 1909. Even though it has been strengthened and remodelled several times since then it essentially kept the original concept of its designers and builders. During the water regulation project of the Hármas-Körös a cut through was dug in Gyoma, so a 50 m long wooden bridge was built here in 1882.

When the project of directing the water flow was continued it turned out that the size of this bridge was not sufficient therefore in 1889 a 50 m long permanent (steel) riverbed span and wooden side spans were designed by Gyula Kikindai, an engineer of the State Building Office of Gyula. Construction went on with compelling speed, and in October of 1890 the load bearing tests were done. The 214 m long bridge was a nice piece of work, but the floods were very trying on the small-span (12m) wooden structured sections of the bridge, therefore in 1907 an invitation was published for a public tender to replace for other spans with steel structures. József Kádár and Dávid Pellegrini builders from Arad built new piers and abutments standing on wooden posts, and then the Schlick-factory manufactured riveted truss structures for the bridge spans. Construction was completed in 1909.

Several other similar bridges were built in the country; the reason the one in Gyoma is worth mentioning is that it survived the destructions of World War II. Troops were speedily marching here; therefore there was “no time” to explode the bridge.

During the almost 100-year long history of the bridge, traffic had increased significantly, that is why it was strengthened in 1939 and in 1962. The advantage of steel structures is that they can quite easily be strengthened, nonetheless at the same time the reinforced concrete bridge deck needed to be altered as well.

Destroyed not in the war, but by a high vehicle

This was the first bridge in our country which was destroyed by a high vehicle in 1971. The main girders of the bridge were connected with a cross beam over the deck which was damaged so much in the collision that one of the openings of the bridge fell down. The bridge was extremely needed therefore temporarily a pontoon bridge was built to carry the traffic, while the torn down span was replaced with a prefabricated two-span beam structure.

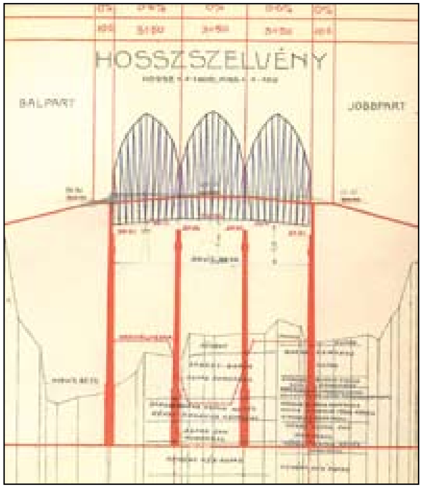
High vehicles still remained an endangering factor; nevertheless it was reasonable to save the bridge that was otherwise in good condition, therefore in 2000 it was strengthened with such a method that the upper cross beams were not necessary anymore. This way the bridge became more airy and most importantly safer for drivers.

24. Fok, Sebes-Körös-bridge

The early joint use of steel and reinforced concrete

Built: *1910*
Designer: *State Building Office; Kálmán Móré, Gergely Gút*
Contractor: *DanubiusShip and Machine Factory; Miklós Kálmán*

In Szeghalom a nine-span more than 100 m long yoked wooden bridge used to be situated. The public tender that was published in 1908 to construct a new bridge, allowed the possibility to build “iron enforced” sections. Even though at that time there was very limited experience in using reinforced concrete, the contractor took this opportunity.



Originally the general contractor and the architect were the same, the State Buildingl Office (Lajos Vízvári and László Szedlacsek). The idea of building reinforced concrete side section connected to the already built bridge was suggested by Miklós Kálmán.

The foundation of the bridge is spread footing, the piers are made of concrete with a stone covering at their arched sections. The floodplain spans are approximately 15 m wide, using a continuous, five main beam structure. The height of the main beams is 1.2 m at the pillars and 0.8 m at the centre of the span. The riverbed span is a 30 m long, traditional, segmental shaped truss structure. The two main trusses were stiffened by three upper cross beams and wind braces.

The substructure and the reinforced concrete structure were designed by Kálmán Móré and Gergely Gút.

The manufacturer of the steel structure was the Danubius Ship and Machine Factory (Danubius Hajó- és Gépgyár). The bridge was opened for traffic in November of 1910.

The results of the bridge’s major inspections taken in the years 1925 and 1935 are known. That was when rivets were replaced and the bridge was painted.

Luckily, the bridge escaped the devastations of World War II.

In January of 1977, a tall vehicle collided with the upper cross beam of the bridge, and it almost lost its stability. The maintainer of the bridge replaced the deformed structural part very shortly.

Nevertheless, in the meantime, the bridge’s condition deteriorated and in 1994, a weight restriction needed to be

enforced. At this time a decision was made regarding the future of the bridge that the destructions caused by high vehicles need to eliminated by removing the cross beams and the structure needs to be strengthened. An ingenious solution was applied for the renovation and the modernization as a provisory was attached to one side of the bridge therefore traffic could be kept on going during construction.

The plans for the modernization of the bridge were prepared by István Szatmári, the contractor was the Bridge Building Co. (Hídépítő Rt.).

25. The mixed-traffic Tisza-bridge at Kisköre

The one and only road- and railway bridge

Built: *1923; reconstruction: 1958*
Designer: *originally: MÁVAG; reconstruction: Uvaterv*
Contractor: *originally: MÁVAG; reconstruction: Ganz-MÁVAG, MÁV Bridge Construction Management*

One of the transportation routes of the coal, lumber, stone and other industrial products of the Salgótarján region headed towards Kisújszállás and its surroundings. The Mátra Regional Railway was built between 1888 and 1890 in order to on the one hand reduce the length of the transport route, and on the other to connect the Hatvan-Miskolc and Szajol-Debrecen railway routes.

The first Tisza-bridge at Kisköre – a railroad bridge only – was built in 1889 to cross the Tisza and its floodplain area. The supporting and spanning structures of the 780 m long bridge were built of lumber. A total of 65, 9.4-10.0 m wide wedged wooden structured bridge sections were built over the floodplain and the riverbed bridge was made of three 48 m wide wooden truss structures.

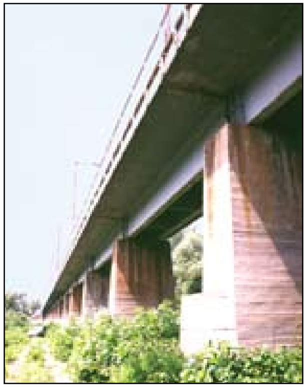
In 1916, the three riverbed spans were rebuilt into a through bridge with a run iron truss structure. The structure was manufactured and assembled by the MÁVAG. The pace of construction typically took one summer employing a large number of workers.

In 1919 during the military operations the iron structures of the riverbed were exploded, and most of the spans of the floodplain area brunt down. Reconstruction was started and finished in 1923. While this renovation was going on the spans of the floodplain area were also rebuilt, a Gerber-type iron structure was constructed using puddle iron made longitudinal beams of the old Southern Connecting Railway Bridge of Budapest.

The shortened bridge was 589 m long, the second longest amongst the railway bridges.

In 1944 the three riverbed spans were exploded again, the iron structures fell into the water. The wrecks of the bridge were lifted out of the river in 1946 and at this time it turned out that of the three sections the middle one could not be used, however the side ones with necessary replacements could be reused.

The capacity for manufacturing iron structures and constructing bridges was for the longest time concentrated on the reconstruction of other, more important Danube- and Tisza-bridges. Therefore, it was not until 1956 that the rebuilding of the side and riverbed spans was started. The steel structure just like in 1923 was manufactured by the MÁVAG again. The Tisza-bridge – suitable for both rail and road traffic – was dedicated in November of 1958.



In 1971 the Ministry of Transport and Postal Affairs (KPM) assigned Roads and Railways Design Co. (Uvaterv), to prepare a feasibility study of a new railway route because the spans in the floodplain area were very shaky and the construction of a new barrage was in the plans as well. The building of the new bridge never materialized for financial reasons, nevertheless in 1974 the construction of new composite structured floodplain spans was started. A scaffold was built to construct the welded, 8 ton heavy web steel structures of the floodplain area. The structures of two spans were pulled in simultaneously thus the railroad needed to be closed down only once, and before the rail traffic was opened again the load bearings test could also be taken. In 1976 the first composite structured bridge of the Hungarian State Railways (MÁV) was completed.

There are both railway and vehicle traffic running on the bridge to this day. The bridge has one set of railroad tracks for the train traffic and a 3.5 m wide road for the vehicle traffic.

In 1998, a preliminary feasibility study was ordered by the Road Management and Coordinating Board (UKIG) and the Hungarian State Railways (MÁV) to explore the opportunities of dividing the two functions. The study analyzed two possible methods: either building a new municipal road bridge or moving the municipal road to the service bridge at the Kisköre barrage.

Nowadays the Traffic Development Coordinating Centre (Közlekedésfejlesztési Koordinációs Központ) (the successor of the UKIG) and the Hungarian Public Road Association (Magyar Közút Kht) are pushing for the preparing of a feasibility study of a new Tisza-bridge at Kisköre. The new public road and bridge is planned to be positioned between the Tisza-lake and the railway.

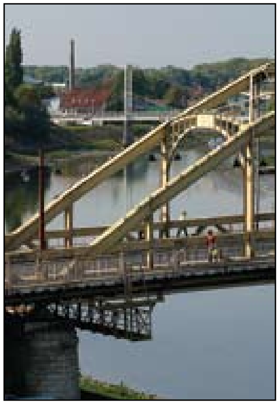
26. Győr, Kossuth Bridge

Our first Langer-type bridge generated international interest

Built: *1928*
Designer: *József Beke, József Déri*
Contractor: *Béla Zsigmondi, Hungarian Wagon and Machine Factory*

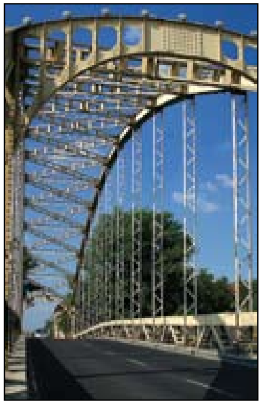
The history of the bridge goes back to more than 700 years. It is a letter of patent issued in 1296 that first mentions the position of the bridge. After having settled in new residents, the bishop of Győr offered them perpetual relief from duty and a ferry port forever. The idea of constructing a permanent bridge came up in 1809, during the Napoleon War already, although at that time only a boat bridge was built. In the 1880-ies the city made the decision the build a wooden bridge because of the huge maintenance expenses of the boat bridge. Construction was finished in 1899 by the Hets brothers. The pile yokes of the bridge were lifted high up from the riverbed, that is why the wooden structure had "long legs", thus it was called the "Goat-bridge". Due to heavy traffic very soon the idea of building an iron bridge instead of the temporary-like wooden bridge, built for pedestrian traffic, came up.

The draft plans of the new iron bridge were prepared by 1912, however because of World War I. construction could not be started until 1926 based on József Beke's final construction drawings, using international loans. József Déri had also contributed to the aesthetic design of the bridge. Construction was executed in record time by the engineer Béla Zsigmondi's company, the Hlatky-Schlichter and Son Co., and the Hungarian Wagon and Machine Factory. The bridge was opened for traffic in 1928. This was Hungary's first stiffened Langer-type bridge and was a unique iron structure because of its light weight (359 tons). It was a significant step forward in that its supporting structure was manufactured of carbon steel in the factory of the Hungarian Wagon and Machine Factory instead of the previously used run iron. The slender arches reaching up high carry the weight of the bridge deck with the greatest of ease with the help of the seemingly implausibly narrow vertical poles. The arched through bridge had become the pride of the city and following the Vienna congress report held on the designing of this bridge in 1928, several bridges with this structure were built in Germany.



This bridge did not survive the destructions of the war either, in March of 1945 it was exploded. It was in 1947 that the first attempt was made to lift the wrecks from the river using the reinforced concrete barge left here by the German troops, but the beams broke and the wreck slid back into the water. At last it could be lifted after a diving exploration and an underwater explosion. Reconstruction was finished in 1950 by the Hungarian Wagon and Machine Factory, using mostly the original straightened pieces.

The load bearing capacity and the width of the bridge, as well as the alignment of the connecting roads could not fulfil the needs of the increasing traffic; therefore, in 1977 the construction of a new Mosoni-Danube-bridge was started. Once that was finished, in 1979 the reconstruction of the Kossuth-bridge could be started. Work was executed based on the original plans, keeping the bridge's noble main structure and influential decoration. The flagpoles at each end of the bridge and the cast-iron bases of the lampposts are still the originals. The rebuilt bridge, which by



providing a pleasant site proves the skills of its designers and builders, have been serving the traffic of the city in its original beauty for 79 years.

27. The Gróf Tisza István Sebes-Körös-bridge

A nice example of an early reinforced concrete beam bridge

Built: *1928*
Designer: *Zsigmond Tóth*
Contractor: *Dezső and László Gajdóczki*

There was a wooden bridge over the Sebes-Körös as early as in 1785; a public tender was published for the construction of a permanent bridge structure in 1927. The plans of the bridge were prepared by Zsigmond Tóth, a Budapest engineer, and Dezső and László Gajdóczki, master builders were assigned with its construction.

The spans of the bridge were divided unusually, 20+2x25+20 m respectively, because one of the pile footed pillars was positioned in the centre of the riverbed. Otherwise, the bridge is a standard structured, four main-beam, wedged, reinforced concrete beam bridge, with its main beams being 1.7-2.2 m high.

Our country was leading in the construction of the multispan continuous or hinged large span bridges, but a number of these were built outside of today's Hungarian borders or were exploded during World War II. The bridge named after Gróf (Count) István Tisza remained almost intact, only the second span from Zsadány was exploded. This was rebuilt in 1947 and thus the almost 80-year-old work of art is a nice memento of our bridge building history. Many of Szilárd Zielinski's large bridges were outstanding works with regards to the early, national reinforced concrete bridge building. Nowadays only a few of them are standing.

In the middle and at the end of the 1920-ies quite a number of bridges were built under difficult financial circumstances. It is a peculiar miracle that this bridge could remain in its original shape. Not even in the 1950-ies were anyone's eyes caught on the marble plaque with the name of a Prime Minister who at that time was unequivocally considered guilty.

The history of the bridge is well documented, besides the names of its designer and builder, the names of the assigners, construction supervisors and technical inspectors were also known: Sándor Dömötör and Alajos Kováts were well known experts of the ministry. After 1945, Alajos Kováts was the chief leader of the rebuilding of railway bridges. The bridge's first main inspection was carried out by Győző Haviár DEng, the later head of the Bridge Department of the ministry and Béla Oláh, the head engineer of the Berettyóújfalu State Building Office. Obviously, many others have contributed to the fact that this bridge, to this day can still carry the increased public road traffic.

The superstructure built after 1945 near Komádi represents a different, newer style.

28. Győr, Petőfi Rába-bridge

Our first welded road bridge, a European top at the time of its construction

Built: *1934*
Designer: *Hungarian Wagon and Machine Factory; József Lengyel*
Contractor: *Hungarian Wagon and Machine Factory*

In Győr, in the city of waters, where three rivers run through, there had been a wooden bridge for hundreds of years across the river Rába, before the 107 m long, three-span iron truss bridge was built for the first time in 1892. It carried the traffic of the main road leading to Vienna. By 1932 the heavy loaded bridge could not fulfill the needs because of its narrow width and its condition; therefore the city planned the construction of a new bridge and asked for government financial aid.

The ministry accepted the plans and a 450.000 pengő-loan was offered to the city instead of the financial aid, thus in March of 1933 a tender could be published. There was a huge interest, 26 contractors submitted 72 proposals. According to the specs the 53 m spanned riverbed section needed to be iron structured, the other sections however could be made of reinforced concrete.

At last, a decision was made that a local builder, the Hungarian Wagon and Machine Factory could build the parallel belted, truss structured riverbed span.

The factory suggested the construction of a welded structure, which was a pioneer deed in that at first a smaller welded bridge was built in Europe in 1927, and in Hungary the one and only welded bridge was a pedestrian bridge in Balatonszemes built in 1931. The construction of welded bridges was not even regulated; therefore, the specifications used in architecture were applied. The factory already had experience in architectural welding, and invested resources into the training of welders. Thus, the factory could materialize the construction of a good quality bridge – which was a European top at the time – in such a way that it complimented the skills of its designers and implementers. Welding was done with the welding rods manufactured in the Rimamurány-Salgótarján Ironworks, in such good quality that out of one thousand examined welds not one had to be redone.

The load-bearing test of the bridge dedicated in December of 1934 was reassuring in all respects. The structure was economical; almost 15% (110 tons) less steel was needed for the 53 m long structure.

The bridge decorated with the crest of the city and later named after Miklós Horthy was exploded at two cross sections on March 28 of 1945, right before the last payment was made on the state loan. A temporary bridging solution was built on top of the wrecks on which traffic could run until early March of 1946 when the remnants were lifted from the river and the structure could be reconstructed using 25 additional tons of material. The welding passed the tests with excellent results.

The outstanding work of national bridge building – which was honoured an international prize in 1938 – was last renovated in 2002 and it serves the traffic to this day.

The planning and production of the bridge is merited to the entire Hungarian Wagon and Machine Factory, nevertheless the name of József Lengyel who was the head engineer of the factory after World War II, the main designer of the steel structure needs to be highlighted.

It was Pál Tantó who managed in the ministry the reconstruction of the novel bridge.

29. Budapest, Petőfi Bridge

A deck truss bridge different from the one winning the tender

Built: *originally: 1937; reconstruction: 1952*
Designer: *originally: Pál Álgyay Hubert; reconstruction: Civil Engineer Architectural Co.; Pál Sávoly, Gusztáv Faber*
Contractor: *originally: MÁVAG, Béla Zsigmondy, Fábián, Somogyi, György Company; reconstruction: MÁVAG, Károly Massányi, Miklós Perényi, Géza Bujdosó; Bridge Building Co., Kornél Laber*

A tender was published – together with the Árpád Bridge – for the Danube-bridge to be built at the southern end of the Great Boulevard of Pest. The winning tenders designed full or partial through bridges, yet finally a decision was made to build a deck bridge. The four main truss beams together with the powerful cross girders form a grid, thus the requirements regarding load bearing capacity and bending could both be fulfilled. The plans were prepared under the leadership of Pál Álgyay Hubert DEng.

The spans of the riverbed bridge are 112 + 154 + 112 m wide, to which a four-span frame structure is connected on the Pest side and a one-span beam bridge on the Buda side. The cross section layout is 3.5 + 15.7 + 3.5 m. A loop-lined terminal station was built for some of the boulevard trams in the Pest side abutment, since only every third tram was directed to Buda. Running up to and down from the bridge was directed to an opposite curved track section, bypassing the above mentioned station.

The steel structures were manufactured and assembled by the MÁVAG, the civil engineering tasks were undertaken by Béla Zsigmondy, the Fábián, Somogyi, György Company and several other contractors. The bridge, named Horthy Miklós Bridge, was opened for traffic in 1937. A marine memorial was set up at the Buda side abutment.

The bridge was exploded – together with the other Danube-bridges – in January of 1945. The structure was not destroyed totally; some of it could be reused after having been dismantled. A temporary bridge was built over the wrecks, and once that was dismantled, a pontoon bridge was built. During the reconstruction the bridge was widened a bit, and its longitudinal section was slightly modified. The terminal tram station was closed at the Pest abutment and a bridge ramp with a better delineation, tram stop and pedestrian underpasses was built.

The bridge was opened for traffic again in 1952, named Petőfi Bridge. The designers of the reconstruction were Pál Sávoly and Gusztáv Faber of the Civil Engineer Design Co. (Mélyépítési Tervező Vállalat), its subcontractors were the MÁVAG (Károly Massányi, Miklós Perényi, Géza Bujdosó) and the Bridge Builder Co. (Hídépítő Vállalat) (Kornél Laber).

In 1979 prefabricated reinforced concrete structures were built to replace the deteriorated steel frame structures of the Pest side abutment. At the same time, the entire reinforced concrete bridge deck of the riverbed bridge section was rebuilt. Following this, the falling pollution impeded the functioning of the moving bearings, which required the regulating of the the bearings. However, in order to achieve this the problem of being able to lift the bridge needed to be solved subsequently, so the regulating of them could not indeed realized until 1996.

30. Veszprém, Szent István Viaduct

A symbol of Veszprém, a masterpiece by Róbert Folly

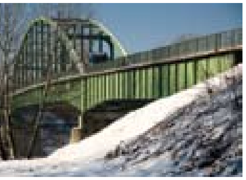
Built: *1937*
Designer: *Róbert Folly*
Contractor: *Palatinus Construction and Real Estate Co..*

In Veszprém the Séd-stream – bypassing the castle mountain – divides the city into two sections; this steep valley forms a natural obstacle for the municipal road traffic. The roads meeting in the city are mostly of medieval origin, later it was attempted to build an east-west direction cross road, but this ran through narrow, zigzag and steep streets. The increased traffic required an east-west direction road, which meant a new route across the steep valley of the Séd-stream. The building of the national highway no. 8 between Székesfehérvár and Graz was included in the road building program in 1934. As a part of this, the planning and construction of the viaduct was started in 1936. Its designer, the engineer Róbert Folly was characterized by an extremely good sense of statics, who believed that the most important and the trace to be followed was pure logic and simple forms; he avoided decorations. The designing of several significant reinforced concrete structures is connected to his name.

The shape of the arches and the technically well thought-out layout of the entire structure compliment the aesthetic taste and constructive sense of its architect. The viaduct is made up of not one but two pieces. It has a 100 m long section which contains the a 45 m span large arch, and crosses the Séd-creek, and a smaller 75 m long section which contains two 26 m spans. The two structural sections are connected with a 14 m long, 6-7 m high embankment. The total length of the bridging across the valley is 185 m. The main span is bridged by a 15 m high, third grade parabola shaped arch, the bridge deck elevation of which is at a height of 26 m above ground level. The contractor of the bridge – the Palatinus Construction and Real Estate Co. (Palatinus Építő és Ingatlanforgalmi Rt) – poured the concrete at night; and in the cold winter weather heated water and steaming needed to be used as well. The cantilevered bridge deck with varying thickness – with the conveying of longitudinal and cross supports – is situated on individually laid foundations and arch supported yokes. The slab on grade foundation of the structure is reclining on the cliffs. On December 22 of 1937 in order to honour the 900 year anniversary of the death of our first king, the viaduct was named after St. Steven.

At the end of World War II the receding German troops prepared the bridge for being exploded, however József Takács, head mechanic risking his own life, removed the igniters. Finally, at the time of the city's evacuation, in March of 1945, one of the smaller arches was exploded, half of which collapsed. A provisory was built above this section, which was used until the 1947-48 reconstruction. During this renovation, the damaged arch was rebuilt using the original plans. In the following decade, the bridge's condition continuously deteriorated. It was tested and fixed several times, and finally in 1978 a three-ton weight restriction and speed limit needed to be enforced. In the meantime, the so called northern ring road – the road bypassing the northern end of the city – which was meant to ease the traffic of highway no. 8, was completed; and thus the viaduct could be strengthened. Preparations for the reconstruction began in 1979 already; plans were prepared in 1982 by the Technical College of Transport and Telecommunication in Győr. As a result of the strengthening buses can use the bridge again. The bridge had been declared a national monument since then, and in 2003 it was renovated again.

Later an even larger spanned arched bridge was built on highway no. 6. Nevertheless, this deck-type viaduct is not only the symbol of Veszprém because of its appearance in the natural view and the city site, but it is also piece of architectural work that the posterity considers significant, beautiful and to be preserved.



31. Vásárosnamény, Rákóczi Ferenc II Tisza-bridge

The gateway to the Bereg region

Built: *1948*
Designer: *Pál Tantó, Elek Hilvert*
Contractor: *Hungarian Wagon and Machine Factory*

We have very few municipal road bridges the long history of which would be so well known and which would have had so much turmoil and change during its lifetime as the Vásárosnamény Tisza-bridge. The first wooden bridge was built in 1836 at the ancient ferry port. The first permanent iron bridge was designed and built by the Cathry and Wagner Company through an international tender in 1886. The section over the riverbed was bridged by a suspended structure. The bridge's foundation was made of wooden posts. Several mistakes were made during the design of the foundation, which resulted that the bridge later needed to be fixed and modified.

During the 1919 battles, the span over the riverbed was exploded. The reconstruction of this was done in an extremely spectacular manner. The bridge section was fully preassembled on the riverbank, was swum in place on boats and was lifted up by capstans (see small picture).

In 1936, because of the continuous wash-out problems, the bridge was lengthened by a new 42 m span section. During this construction project, while the two piers were totally rebuilt, traffic continuously kept going. In order to achieve this an "S" shaped temporary wooden bridge was built.

The bridge was exploded during World War II. Reconstruction took place in 1948-49. Pál Tantó and Elek Hilvert designed a completely new bridge structure. Leaving out the pier most endangered by being washed out, a 102 m main span was built instead of the earlier 60 m long one.

The new bridge marked the beginning of an era in many respects. Components of the bridge were made in a factory in large, 20-ton pieces, and such huge parts were delivered to site. During the manufacturing welding was applied – even at a 70 mm flange thickness – which at the time was considered a novelty. The 102 m main span – instead of a scaffold being built up to its full height – was assembled on top of the side spans and was pulled into its final position with the help of few temporary yokes. Although there are load bearing problems nowadays, these can be fixed without having to change the steel structured main beam. The weight restriction can be lifted by simply reconstructing the reinforced concrete road deck, which proves the outstanding design of the main beam.

The bridge connected two cities Vásárosnamény and Beregszász at the time of its construction. The country border was the dividing line between the two cities and at the same time 21 villages of the Bereg region were wedged between the river Tisza and the border.

The main route to reach these villages leads through the Vásárosnamény Tisza-bridge.

In 1926, the bridge was officially named after Rákóczi Ferenc II. to commemorate that it was right here where his troops led by Tamás Esze crossed the river Tisza in 1703.

32. Szeged, Downtown Tisza-bridge

A worthy successor of the Feketeházy-Eiffel-type bridge

Built: *1948*
Designer: *Győző Mihailich , Antal Schwertner*
Contractor: *Hungarian Wagon and Machine Factory, MÁVAG*

Szeged's development, beginning in the 12th century, was obviously enhanced by the city's transportation-geographic importance, the salt delivery on the river Maros and the good crossing possibility over the river Tisza.

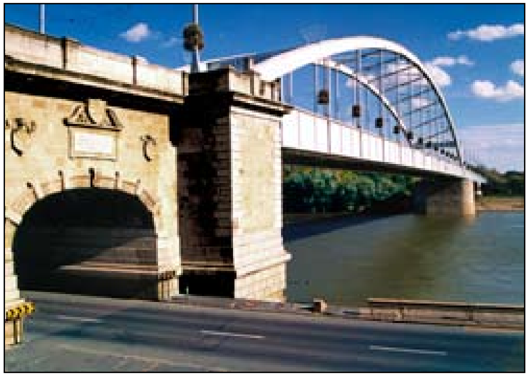
As early as in 1858, Szeged already had a Tisza-bridge. Although only a railway bridge, it was the second permanent river bridge in our country. In 1879 after the terrible flood of the Tisza it became obvious that as part of the reconstruction of the city a road bridge needs to be built. The specifications and guidelines for submitting tenders were published in two languages at an exemplary speed, by July 1, 1880. The specs referred to the size of the riverbed span, the height and width of the bridge, the materials to be used, the maximum cost (max. 1.250.000 Ft) and the deadline of construction (May, 1883). There was a significant interest: 14 applicants submitted 29 proposals.

The design of Eiffel's company – well known in our country as well – prepared by János Feketeházy was accepted. It is known from reports that the construction of the bridge was started in December of 1880, and the project was set back by the flooding of the Tisza. The arched superstructures were built with complete scaffolds and despite the difficulties, the iron structure of the riverbed span was completed by April 19, 1883. The bridge was dedicated on September 16 by provost, Pál Oltványi.

The iron structure of the bridge weighed 1535 tons. An extremely slender, lace-like, four-span arched structure was built in Szeged, which was the third road river bridge in our country. In 1908, double tracked tram traffic was started on the bridge. In 1923, the Ministry of Trade and Transport and officials from the city of Szeged held a bridge inspection and based on the findings of this the renovation of the bridge was ordered. Despite the completed jobs the condition of the bridge was not reassuring.

In 1943, another bridge inspection was ordered and temporary ties were installed in order to correct the tilting of the riverbed pier. The beautiful bridge of Szeged was exploded by the retreating German troops on October 9, 1944.

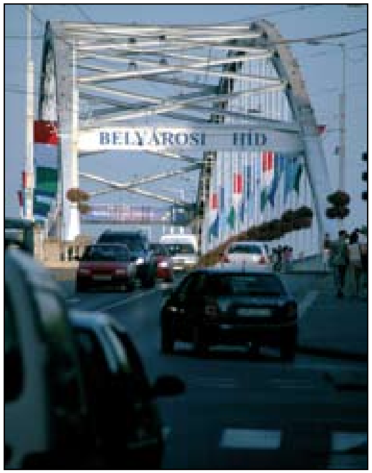
The reconstruction of the bridge was preceded by extremely thorough examinations. The new bridge was designed with a different span layout because of the pier movements experienced earlier. The plans were prepared by the work team of the No. 2 Bridge Building Department under the leadership of Győző Mihailich DEng and Antal Schwertner DEng. The plans of the substructure were prepared by Sándor Major. Removing the wrecks started in 1946, construction began in the spring of 1947, the manufacturing of the superstructure was started on November 28, 1947 and was finished on May 26, 1948.



The steel structure was manufactured by the Wagon and Machine Factory of Győr , the Ganz factory, and five smaller factories. The onsite assembly was done by the MÁVAG. It is worth mentioning that the MÁVAG converted the structures of the two intact spans into the main beams of four other bridges (Berettyóújfalu, Szeghalom, Ráckeve, Marcaltő) in an impromptu bridge building shop built on site. The spans of the floodplain area were built with complete scaffolding; the 147 m wide Langer-supported riverbed span was built with three auxiliary supports. The remaining piers needed to be widened. The bridge's construction went on at a strained pace. The installation of the steel structure was finished on October 15, 1948, and the load bearing tests were taken on November 18.

In 1951-52, a surveyor's inspection was done on the bridge and the results were reassuring. The four-span bridge section at the downtown end of the bridge was rebuilt with a reinforced concrete structure in 1968. In 1969, the tram service on the bridge was discontinued.

Following the completion of the new northern (today Bertalan) Tisza-bridge, in 1983 the steel structure was repaired. The renovation done between 1993 and 1996 extended to the entire – 492 m – length of the bridge. There is a memorial plaque to commemorate the name of János Feketeházy, the ingenious designer of the old bridge.



33. Balatonhídvég, Zala-bridge

A slender steel bridge, a nice work of the “bridge battle” in the 1950’s

Built: *1949*
Designer: *Pál Tantó, Elek Hilvert*
Contractor: *Lajos Márkus Iron Structure and Chain Factory, János Márk*

The village of Hídvég and its bridge toll was mentioned in documents as early as in 1330. During the Turkish occupation, in 1561, a ferry served for the crossing of the river instead of the bridge, because of the difficulties of guarding the bridge. A new bridge was built after the expelling of the Turks. A permanent bridge was built in 1925-26, following the water management project of the river Zala. The two side spans were wooden structured, the riverbed span was a riveted, trussed through bridge.

In March of 1945 the bridge was exploded. A temporary wooden provisory was built to replace the bridge.

The reconstruction of the structure was done based on the plans of Elek Hilvert in 1948-1949. The span of the superstructure of the new bridge is 42.0 m wide. The Langer-system structure was built with a compact arch; the stiffener girder was manufactured with symmetric webbing. This is the only steel bridge with a structure like this in Hungary. The new bridge is situated in the place of the old one, on the remnant abutments. The distance between the main girders is 8.00 m; the height of the arch is 7.85 m. At the bottom the truss and joints are riveted and at the top the arch is welded. The main girders are braced with a wind bracing in four sections. The reinforced concrete slab works together with the steel structure. The bridge was strengthened in 1951-52.

It happened several times that an oversized vehicle collided with the upper bracings of the extremely slender bridge. The last, almost fatal collision happened in November of 1996, despite the photoelectric celled height inspection device. The examinations done by an expert engineer suggested that the cross bracings on the sides should be lifted by one meter. The examination was done by István Szatmári. In 1997 together with the lifting of the braces smaller strengthening jobs had also been done, which had allowed that the slender bridge structure could be saved.

34. Szeghalom, Berettyó-bridge

Made of the materials from the Feketeházy-Eiffel-type Tisza-bridge

Built: *1949*
Designer: *Hugó Székely, Elemér Bölcskei*
Contractor: *Stieber Construction and Industrial Co., MÁVAG*

When the riverbed section of the Tisza-bridge of Szeged was exploded the two floodplain sections remained intact. It was totally impossible to rebuild the old bridge because of the foundation problems of the riverbed pier; therefore the two intact arched deck structures were dismantled and disassembled so that they could be converted into approximately 65 m long through bridge arches. In 1948-49, four such almost identical bridges were built using these sections to replace the bridges exploded in World War II:

- the Berettyó-bridge in Berettyóújfalu on highway no. 42,
- the Berettyó-bridge in Szeghalom on highway no. 47,
- the Árpád Bridge in Ráckeve over the Ráckeve-Danube, and
- the Rába-bridge in Marcaltő.

The plans of the Szeghalom bridge were prepared by Hugó Székely and Elemér Bölcskei, private engineers. It was the first structure like this in Hungary. The 65 m spanned steel structure was manufactured by the Stieber Building and Industrial Co. (Stieber-féle Építési és Ipari Rt) and was assembled by the MÁVAG.

These bridges during the decades – by and large in accordance with the extent of traffic and the salting proportionate with it – gradually deteriorated. The bridge on highway no. 42 needed to be reconstructed first, since this was in the worst condition and on an international highway a Class “B” load bearing capacity bridge would not have been adequate.

In Szeghalom and in Ráckeve it was achieved – using the method described below – that the bridges would receive Class “B” load bearing classification and thus their existence could be assured. The Rába-bridge is relatively in the best shape, here a similar type of renovation job will be due in the near future.

The reinforced concrete bridge deck of the Szeghalom Berettyó-bridge was renovated in 1985-86; still the bridge had increasing difficulties carrying the traffic of the main highway.

On the basis of István Szatmári’s suggestion the bridge deck of the Szeghalom (and the Ráckeve) bridge was converted into a steel deck. This job was executed by the Ganz-MÁVAG under extremely difficult conditions, while traffic kept on going and half of the deck was closed down.

The Ráckeve-Danube-bridge.

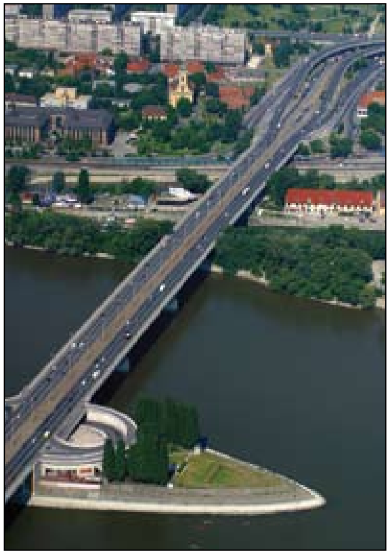
35. Budapest, Árpád Bridge

It was the longest bridge of Hungary for 57 years

Built: *originally: 1950; widening: 1984*
Designer: *originally: Károly Széchy, Pál Sávoly; steel structure: MÁVAG; widening: Uvaterv, Jenő Knebel*
Contractor: *originally: MÁVAG, Zsigmondy– Endre Széchy Company; widening: Bridge Building Co., Endre Apáthy; Ganz-MÁVAG, Károly Pintyőke*

Preparations for the building of the bridge began as early as in 1903; however the public tender for its plans were not published until 1929. The two first prizes were won by János Kossalka and Győző Mihailich. There was a lot of debate regarding the centreline alignment of the bridge, when finally in 1937 based on the suggestion of Károly Széchy , the straight centreline was accepted, which also meant the lengthening of Margaret Island. The bridge is made up of five sections leading from Pest to Buda:

- one-span steel bridge on the riverbank,
- three-span steel bridge over the Pest side Danube arm (76 + 102 + 76 m),
- four-span steel bridge over the Buda side Danube arm (82 + 103 + 103 + 82 m),
- one-span reinforced concrete bridge over the ship factory's area,



- two-span steel bridge over the riverbank. The total length of the bridge is 928 m.

An expansive reinforced concrete structure was built on Margaret Island between the two riverbed bridges, in order to provide room for the non-intersecting ramps leading up and down between the bridge and the island.

The steel bridges are four main beam deck structures, with an innovative type of wedging near the piers. The planned total width was 27.6 m, with an 18.8 m wide road and a double tracked tram line in the middle. The general plan was prepared by Károly Széchy, the island piece was designed by Pál Sávoly. The steel structure was planned by the MÁVAG. The contractors were the MÁVAG and the Zsigmondy–Endre Széchy Company.

The construction of the bridge was started in 1938 and ran until 1943. Most of the base structures, the two-span bridge in Óbuda and one of the spans of the four-span section with a 20 m cantilever were finished. At this point construction ceased because of the war. Luckily the incomplete structure was not exploded, so the work could be continued in 1949. For economic reasons, only the construction of the two main beams in the middle was continued, to carry the 11.0 m wide road and two 1.0 m wide sidewalks. This way only one narrow lane could be provided in each direction next to the tram tracks. The bridge was opened for traffic on November 7, 1950. Temporarily – until the Újpest railway Danube-bridge was rebuilt in 1955 – freight trains also used its track.

The increased traffic required that the full-fledged bridge be built, moreover the construction of a 35.4 m wide, larger than the original bridge was necessary. Therefore the existing main beams on the sides were dismantled thus the remaining beams of the bridge could only carry the tram tracks. Next to the tracks two new, completely detached steel deck structures were built, each of which could carry three lanes. The plans were prepared by the Roads and Railways Design Co. (Uvaterv) (Jenő Knebel), the contractors were the Bridge Building Co. (Hídépítő Vállalat) and the Ganz-MÁVAG. This reconstruction which took place between 1981 and 1984 did not change the general appearance of the bridge. At the same time, by building two curved layout bridges in Flórián square a non-intersecting connection was made between the Danube-bridge and the road leading to Szentendre.

Nowadays, the Árpád Bridge is our busiest road bridge. In 2002 the crossing of approximately 150 000 vehicles was recorded daily, the highest rate of all Hungarian bridges.

36. Dunaföldvár, Beszédes József Danube-bridge

The longest continuous steel truss bridge in Hungary

Built: *rebuilt: 1951; reconstructed: 2001*
Designer: *rebuilding ÁMTI, Pál Sávoly; reconstruction: Pont-TERV Co., Iván Pozsonyi*
Contractor: *rebuilding: Hungarian Wagon and Machine Factory, József Lengyel; MÁVAG, Károly Massányi, János Fekete; Bridge Building Co., Kornél Kaplanek, József Bonta; reconstruction: Bridge Building - Közgép Consortium, Attila Lipót, György Dúzs*

The first Danube-bridge in Dunaföldvár – as part of the transversal road bypassing Budapest – was built between 1928 and 1930 for the road and railway traffic.

The spans of the continuous steel truss structure are 107 + 133 + 133 + 107 m long. The width of its road was 5.5 m, with 1.5 m wide sidewalks outside of the main girders. Its plans were prepared by János Kossalka DEng, construction was executed by the MÁVAG under the leadership of Károly Massányi. The structure was made of high strenght silicon steel. In the autumn of 1944 the bridge was exploded, so much that the steel structure became unusable, and the substructures were seriously damaged. Its reconstruction was done between 1948 and 1951.

The new bridge is also a continuous steel truss structure, but with a different profile from that of the original. The width of the road was enlarged to 7.0 m, and the railway tracks were positioned eccentrically. The two main girders are not identical in terms of load bearing capacity because originally the construction of a third main girder was planned in the long run so that the railway and vehicle traffic could be split.

The plans of the reconstruction were prepared in the State Civil Engineering Scientific and Planning Institute (ÁMTI) under the leadership of Pál Sávoly. The substructures were built by the National Bridge Building Co. (Hídépítő Nemzeti Vállalat) Most of the steel structure was manufactured by the Hungarian Wagon and Machine Factory of Győr (Győri Magyar Vagon- és Gépgyár), and some was made by the MÁVAG, who executed the assembly of the structure. Because of the different weight of the main girders the structure was assembled on scaffolds.

The mixing of road and railway traffic started to become more and more unfavourable because of the increasing road traffic, even though the railway traffic was continuously decreasing and by time it ceased completely.

The reinforced concrete deck of the bridge – because of its non impeccable quality and the large number of overweight vehicles – wore through in 1998. In addition to the immediate repair of the damage, the replacement of the entire road deck needed to be thought over. As a result of long negotiations it was finally achieved that the Hungarian State Railways (MÁV) would be willing to give up the operation of its railway tracks on the bridge, therefore the opportunity arose to build a new orthotropic steel deck structure. The construction of this was executed in 2001 on half the width of the bridge while traffic kept going. Naturally, the building of the third main support was taken off the agenda. The cross-section of the bridge had also changed: a new sidewalk appropriate for bicyclists as well, was built on the outflow side. The fact that 86 000 m^2 of corrosion protection coating needed to be applied, show the magnitude of the job. The plans were prepared by the Pont-TERV Co. (Iván Pozsonyi), the contractor was the Bridge Builder and Közgép Consortium (Hídépítő-Közgép Konzorcium).

A highway, bypassing the city was built in place of the ceased railway tracks.

In 2002 the bridge was named after József Beszédes, a well-known engineer of the town of Dunaföldvár.

37. Győr, promenade Rába-bridge

The unique slenderness makes the Gerber-structure bridge so prominent

Built: *1953*
Designer: *Uvaterv, Ádám Kemény*
Contractor: *Bridge Building Company, Kálmán Gulyás*

The Romans' most important, at all times kept up and passable route from Old Buda to Vienna ran on the right hand shore of the Danube crossing the river Rába, for the protection of which a military post, called Arrabona, was established. As early as in 1566 Nicolo Aginelli portrayed the bridge on his drawing, and later the Rába-bridge in front of the Vienna gate can be seen on the Hoefnagel-engraving in 1597. In 1869 the construction of a draw bridge type of yoked wooden structure meant a great step forward. The building of a permanent bridge was urged by János Feketeházy as well, who – for the city's request – inspected the wooden bridge in 1889. The results of the examination were appalling. The city considered it necessary to build an iron bridge, nevertheless the tender could not be published until 1892, and the winner, the builder Gregersen and Son Co. received the permits for construction in 1893. The double hinged, arched, double main beam, 52.7 m long span iron structure was assembled in Resica. The pilings for the foundations were driven by a steam engine pile driving device. The middle part of the bridge consisted of a section that had 9.3 m long free span, and could be lifted up to a height of 2.6 m by manpower. The characteristic, permanent drawbridge built on the main road, which even appeared on advertisements and postcards meant a great deal in the city's life. In 1931 the bridge was strengthened, but in 1945 it became a victim of the war's insane devastation. The Rába-bridge at the promenade was exactly 50 years and 5 months old. The bridge builders of the Russian troops constructed a strong, large load bearing capacity wooden bridge on the wrecks, but this structure was not long lasting.

To replace it, in 1950 the today still standing one span, Gerber-type, reinforced concrete bridge, designed by Ádám Kemény of Roads and Railways Design Co. (Uvaterv) was built. The cantilever, counter weight, underneath arched shaped beam bridge with a suspended beam is prominent because of its slenderness, since to its 52 m span it only has a 1.35 m height in the centreline. The three-main-beam structure was built with a box shaped cross section at the ends of the span, while the suspended section is ribbed.

The Gerber-system structure required careful work not only from the designer but also from the builder, since in the suspended span there are big bending moments and at the hinges – zero-moment points – big shear forces must suffered with half height.. In addition significant pulling forces are disengaged as a result of the friction of the bearings; these forces also need to be taken up. Moreover at the place of the hinges the deck needs to be broken, which required the incorporation of a bridge deck dilatation. Nevertheless, an unquestionable advantage of the Gerber-system is that being statically definite, the movements of the shoulders do not cause any incidental stresses. Despite the compound play of powers, the aesthetically pleasing structure allows the beauty of the surrounding area and the city district to prevail undisturbed.

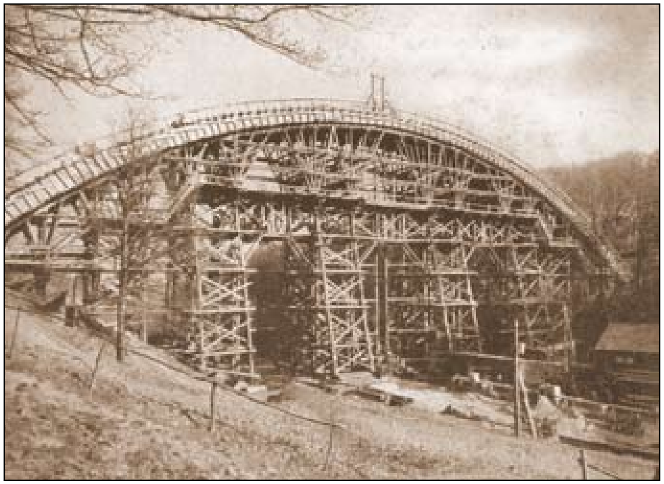
The arrangement of the bridge is similar to that of Győző Mihailich's world record bridge built in Temesvár in 1908. In Hungary several bridges had been built with such structural arrangement e.g. the Industrial Channel-bridge in Győr (1912), the Sió-bridges (Jut, Mezőkomárom, Ozora, Pálfa, 1927-30), the Dockyard Island-bridge in Budapest (1968).

In 1985 the use of Gerber-hinges was discontinued based on the plans prepared by the Technical College of Győr. The structure works impeccably ever since then.

38. Varasd, the viaduct

Our largest reinforced concrete arch bridge

Built: *1953*
Designer: *Civil Engineering Planning Co. (Mélyépterv), Elemér Bölcskei*
Contractora *Bridge Building Co., Kornél Laber*



The new section of highway no. 6 – the main road between Budapest and Pécs – leading through the Mecsek Mountains was built on a completely new route. The highway crosses two deep valleys at the outskirts of the village, Apátvarasd. The first viaduct, counting from Budapest is approximately 170 m long, and it is 32 m high above the deepest point of the valley. The span of the arch is 98 m; the bridge deck is supported by reinforced concrete posts in every 7.8 m above the arch and the connecting sections. The grandiose highway planning, the conditions of the terrain and the favourable rocky substratum made the planning of Hungary's third arch deck bridge possible.

Similar, but much smaller and less flat arched bridges were built on highway no. 8, in Veszprém and in Városlőd in 1936-37. The former one still exists and has become the symbol of its city.

The longitudinal section of the old road was extremely unfavourable. A 4.5 m spanned vault bridged the stream trickling at the bottom of the valley.

Plans of the new bridge were prepared by the Civil Engineering Design Co. (Mélyépterv) (Elemér Bölcskei), the contractor was the Bridge Building Co. (Hídépítő Vállalat). Tibor Pál fulfilled the duties of the technical supervisor. The calculations were double checked by a committee of university professors and outstanding designers; even a small steel model was prepared which is displayed at the Technical University of Budapest to this day.

The deck of the bridge is level which is disadvantageous regarding water drainage.

A 250 m spanned cable crane helped the construction. The scaffolding of the arch required an extremely large-scale carpentry job. The concrete pouring capacity was 60 m3/day, pouring the concrete took place in 25 parts. The scaffold was lowered in 37 phases. The scaffolding material of the arch was used for the scaffolding of the sections above the arch.

Later, to the detriment of the pedestrian sidewalks, the road was widened from 7.0 m to 7.8 m, but it is still narrower compared to what is customary on other large bridges.

During the more than 50 years since its construction, the vegetation has grown so tall that the entire beauty of the bridge is difficult to recognize. The traveller can hardly sense having crossed the bridge.

39. The Bolond road viaduct on highway no. 6

Our first larger beams prefabricated onsite

Built:	*1954*
Designer:	*Civil Engineering Planning Co. (Mélyépterv)*, Elemér Bölcskei
Contractor:	*Bridge Building Co., Kornél Laber, Gábor Radó*

The new section of highway no. 6 – the main road between Budapest and Pécs – leading through the Mecsek Mountains was built on a completely new route, close to the extremely badly routed old highway no. 63. The road – crossing two deep valleys – had four anusable sections, three of which were extremely steep, and one was unreasonably winding. This latter one was called the Bolond (Fool) road.

The second viaduct, counting from Budapest is 140 m long, and it is approximately 27 m high above the deepest point of the valley. The openings are 25 + 3x30 + 25 m long. In the case of the three middle spans the option of preassembly presented itself, thus serious scaffolding jobs could be avoided. The side spans were made on scaffolds. The plans were prepared by the Civil Engineering Design Co. (Mélyépterv) (Elemér Bölcskei), the contractor was the Bridge Building Co. (Hídépítő Vállalat).

The manufacturing of the two, right angled square shape cross sectioned (40x185 cm), reinforced concrete beams per each span was done at the bottom and the slopes of the valley, and thus only minimal amount of scaffolding was required. Lifting devices made of Herbert military-bridge parts were placed on top of the piers, which would have simultaneously lifted the two main beams fitting into one opening. During the first lifting the beams stiffened at their top with horizontal bracing device – due to the accumulation of several unfavourable conditions – broke and fell down, pulling along the lifting devices. The accident set back the technology.

The inspection following the accident found that the other beams were not suitable for being lifted either, therefore all six main beams needed to be remanufactured at the same place but with a slightly altered cross section. The new beams' cross section was T-shaped instead of the original square shape, which allowed that no horizontal bracing was necessary during the lifting phase. The weight of the beams to be lifted was approximately 60 tons. The lifting was done with four 20 ton load bearing capacity hoists, with the insertion of one fly to each. Once having been lifted, the moving of the beams at a right angle to the centreline of the bridge was solved by slightly slanting the hoists. This was necessary because the beams did not fit perfectly between the piers, therefore they could not be manufactured between the piers, right underneath where their final position was going to be.

Once one set of the main beams was lifted in place the hoisting device was moved to the next set of beams. After all of the remanufactured main beams were lifted and the side span girders were cast, the main girders were made continuous. The steel inserts sticking out of the main girders were welded together at the piers, the gaps between the beams over the piers were filled with concrete, moreover nearby the piers at a length of 5 m on each side were concreted to the full height of the main beams. Once these concrete sections set, the cross beams and the hung scaffolding of the bridge deck was constructed, and then once the frameworks and steelworks were finished the concrete was poured.

During the past 53 years the bridge has been bearing well the continuously increasing traffic of the highway.


Alexandra

40. Tiszalök, Bocskai Bridge on the Eastern Main Channel

Similar, yet different bridges

Built: *1956*
Designer: *Roads and Railways Design Co. (Uvaterv), Endre Reiner*
Contractor: *Waterworks Building Company*

The construction of the Eastern Main Channel was first started in the 1940-ies and then continued in 1953. In order to lead the intersecting roads across the channel 20 bridges needed to be built. On the flat terrain the aim was to achieve low structure height, therefore the building of a reinforced concrete arched through bridge was the most ideal. The plans were prepared by Elemér Bölcskei and his colleagues (Gyula Huszár, László Lipták, Endre Reiner, János Szalai) of the Roads and Railways Design Co. (Uvaterv). Such arched bridges were built earlier (e.g. on highway no. 8). It was a novelty that pulled cables were used instead of ties on the Eastern Main Channel bridges. Specific types of provisions were required because of the greater stretching of these (temporary hinges, bridge deck disjointing, preloading).

The contractor was the Waterworks Building Company (Vízműépítő Vállalat), the construction supervision from the Ministry of Traffic and Postal Affairs (KPM) was undertaken by István Dobó, Rudolf Hídvéghi, Mózes László and Herbert Träger.

The bridge decks of the first bridges were made with traditional cross- and longitudinal beams; between 1954 and 1957 six such bridges were built. The pre-manufacturing of the half arches was planned but later the idea was waived.

The lower bracings were removed at Hajdúszoboszló.

Nevertheless – for the sake of trying – pre-manufactured bridge deck parts were used on only one of these bridges. The spans of these bridges – depending on the angle of the intersection – were between 45 and 60 m.

Once a few bridges were built, the engineers converted to building level bottom surfaced reinforced concrete bridge decks, which further reduced the height of the structure. Ten such bridges were built.

A further development was that as per the suggestion of Gyula Tarpai the pulling force was taken up by Prestressed cables built into the bridge deck instead of pulled cables. This significantly changed the entire construction schedule, and several previous problems disappeared. The first bridge with such structure was built in 1957 and three further ones were finished by 1962.

Serious corrosion damages appeared on the pulled cables of the earlier, non-Prestressed decked bridges, especially in places where the cables ran through the end of the arch. Since the damaged cables could not be replaced, following the suggestion of Herbert Träger outside cables were installed, which could take over the entire pulling force. All six freely run cabled bridges could be saved with this method.

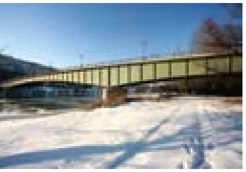
The lowest cross bracings of the arched bridges are approximately 4.5 m above the bridge deck level. High vehicles breaking the Highway Code have damaged and broken these bracings several times. As per Kálmán Szalai's suggestion the lowest bracings – based on preliminary calculations and following the casing of the arch that was necessary anyway – were removed on the most important routes, first on highway no. 4.

The bridge in Tiszalök has a 58 m span; it was built using Endre Reiner's plans under the leadership of Antal Csendes. The structure of its deck is traditional ribbed reinforced concrete slab. Its traffic is light compared to the other bridges of the main channel.

Recently, a major renovation project took place on the Bocskai Bridge.

There is a bridge without bracings in Kecskéd.


BOCSKAI HÍD



41. Tokaj, Queen Elisabeth Tisza-bridge

The Wine of the Kings – the Bridge of the Queen

Built: *1959*
Designer: *Roads and Railways Design Co. (Uvaterv), Jenő Knebel*
Contractor: *Bridge Building Co., Kornél Laber*

Tokaj is the capital of wines; the Tokaj Wine Region was named after this town. The town on the outskirts of the wine growing area – thanks to the traffic routes – is privileged to be so well situated. Tokaj is an ancient crossing place at the intersection of the rivers Bodrog and Tisza. Several early records remained that mention the place as a ferry port, while later records refer to the history of the bridge.

Following earlier wooden bridges the first permanent-like iron structured bridge was opened for traffic in the year of the Millennium. The middle main span of the 210 m long bridge was 107.6 m. The bridge had a unique appearance which is due to its interesting, chain-bridge-like shape. Nevertheless, the bridge was not a suspension bridge, only the shape of the webbing resembled the shape of the chains, similarly to the case of the Liberty Bridge in Budapest. The plans of the bridge were prepared by Róbert Totth, an outstanding bridge engineer.

At its dedication ceremony the bridge was named after Queen Elisabeth. The Danube-bridge in Komárom, dedicated in 1892, was also named after Queen Elisabeth and later, in 1903 the fourth road Danube-bridge of Budapest was named after her majesty as well. It is pleasing that the Tokaj-bridge not only was “baptised” but its name is being used by today. The fact that in 1996 when the bridge was last renovated this “baptism” was revived by a splendid ceremony and by the dedication of a memorial plaque, contributes to this publicity.

The Tokaj Tisza-bridge was exploded in 1919; its reconstruction to the original form was not finished until 1922. In 1944 it was exploded again. The beautiful structure designed by Róbert Totth collapsed into the Tisza finally. A temporary bridge was built for the traffic, and then reconstruction could be started.

The new Tokaj Tisza-bridge was built between 1956 and 1959 with the rebuilding of the old piers. The new structure was planned by Jenő Knebel. The main girders of the new bridge are steel web beams with a reinforced concrete bridge deck.

Even nowadays traffic is quite heavy on the bridge. First and foremost this is the route for transporting the extremely high quality building stones to the Tiszántúl Region of the Alföld (east of the Tisza regions of the Great Plain) from the Tokaj region mines. The pedestrian traffic of the bridge is not insignificant either, since the town and the wine cellars lie on the right side of the Tisza while the numerous establishments of water life, i.e. beaches and campings are situated on the other side.

Besides having to serve the extreme traffic the bridge must meet the requirements of the touristy downtown of Tokaj. The town was chosen as one of the World Heritage sites and the onset of its most frequently visited pedestrian precinct is at the foot of the bridge. In order to better fit the bridge into this environment, as part of the last renovation project the lampposts of the bridge were replaced by ones that go well with the atmosphere of this pedestrian street.

42. Tihany, harbour-bridge

On the sine curve wearing high heels

Built: *1961*
Designer: *László Lipták*
Contractor: *Bridge Building Co.*

In spite of the existing constraints the unity of structure, shape and function was expressed in the design of this bridge. The route almost exactly parallel to the shore line, running in a narrow space in small radius curves was repositioned onto an elevated roadway. The objective of the correction was that the structure bridging the valley should provide means for tourists arriving on boat or by car to approach the downtown areas of Tihany without disturbing the traffic of the road. The uniquely shaped structure could only be seen from the harbour due to the connection between the bridge and the surrounding terrain.

The designer László Lipták appropriately recognized that the overpass needed to be adjusted to the free and easy mood of people on a vacation or excursion, therefore the grave, powerful, massive, large spanned solutions were rejected. The most feasible solution for the task seemed to be the application of a slab structure, with which the ratio of the spans could favourably be chosen because of the structure's relatively easy and inexpensive foundation requirements.

This is how the 80 m long slab bridge, with ten 8.0 m long spans was designed. One of the abutments was sunk into the terrain, suggesting as if the bridge deck was arising from the terrain. The bridge is supported by circle cross sectioned piers, thickening upwards, which are rigidly connected to the slab and suspected to be hinged connected to the terrain.

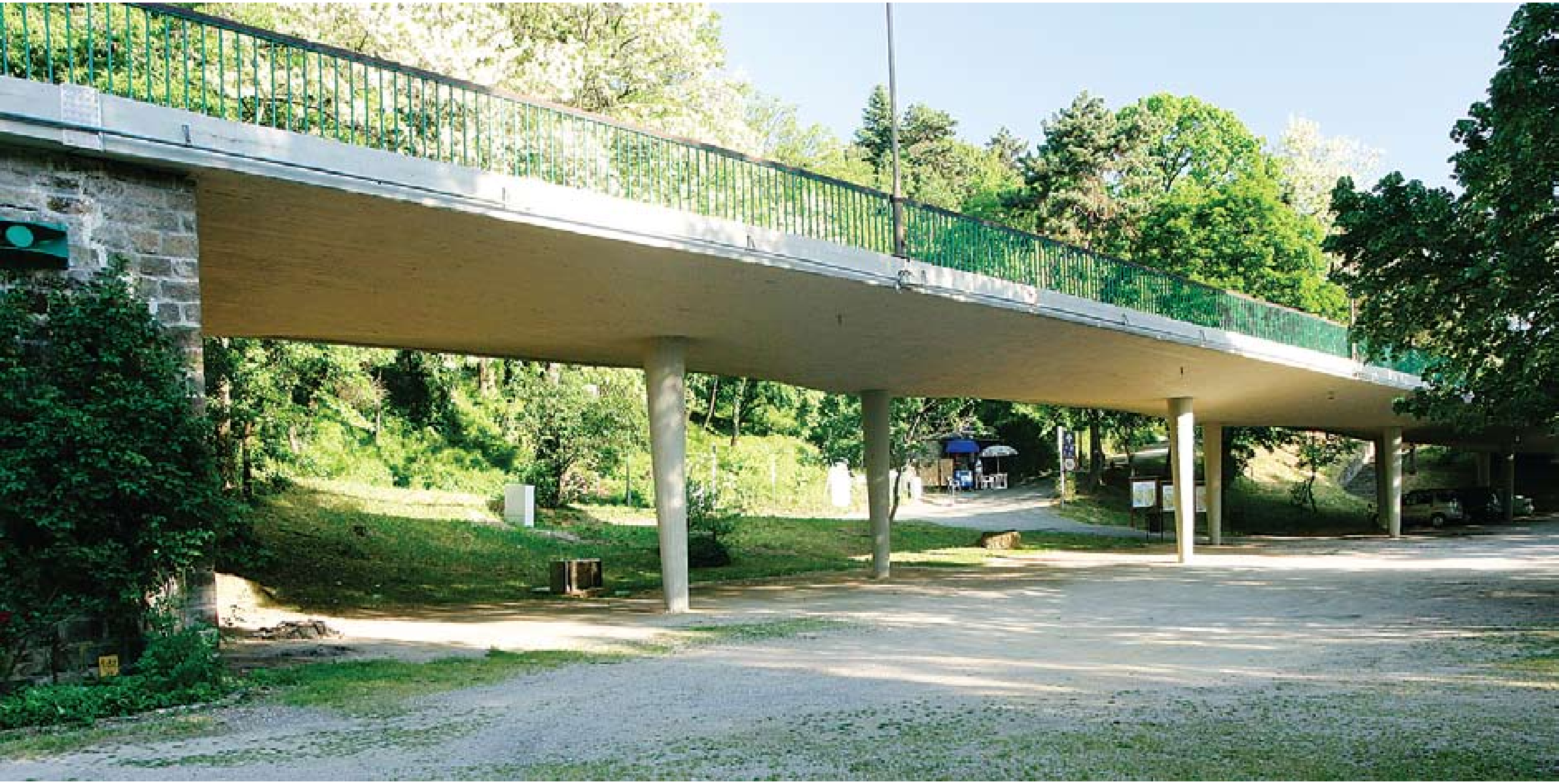
When choosing the bridge deck the designer kept in mind human and structural aspects. “The human aspect would require bottom surfaces ascending outwards, since for those people who look out from underneath the bridge that would ensure the sensation of wishing perspective, openness and freedom.” Not even the requirements of sturdiness had contradicted this theory. When looking at it from the bottom up, the intermittently positioned posts, between the maximum points of the sine curve required a bridge deck that becomes thinner towards the edges in terms of the torsion. Due to the significance of the torsion stress instead of the non-load-bearing light concreted pedestrian sidewalk, the more favourable reinforced concrete edges were built that would work together with the bridge deck. With respect to the bending, the structure is akin to the continuous structures where the most strained cross sections are right above the piers.

The view of the bridge generates an airy, playful, dynamic feeling with the downwards thinning slender legs that are sensed as if they formed a rhythmically changing group

when approached from any direction, with the outward ascending distorted surfaces on the bottom of the deck and with the wavy surfaces dividing these. The detailed static calculations of the novel structure were prepared by Egon Éliás.

An additional curiosity of the bridge is the formation of the railings, in that for the first time in Hungary, the lighting for the road is provided by a string of fluorescent lights mounted onto the handrails. The distinguished bridge was built in outstanding quality by the Bridge Building Co. (Hídépítő Vállalat)

These were the thoughts that prevailed when one of our nicest and aesthetically most pleasing bridge embedded in nature was born, which by making use of the strength characteristics of the material and the structure could realize in a significantly more economical structure than what one was traditionally accustomed to.



43. Szolnok, city Tisza- bridge

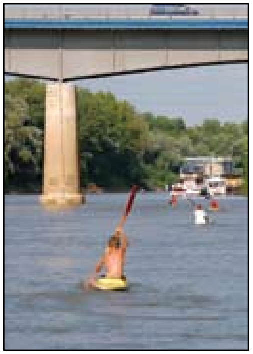
Preliminary study for the steel slab of Elisabeth Bridge in Budapest

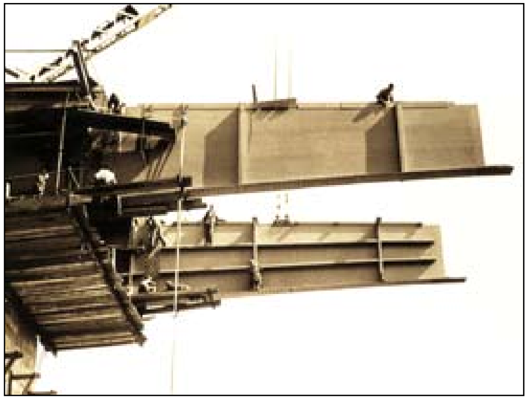
Built: *1962*
Designer: *Uvaterv, Jenő Knebel*
Contractor: *Bridge Building Co., Iván Bándy, Sándor Tóth; Ganz-MÁVAG, Ernő Bors, János Orbán*

Wooden bridges have been standing at the ancient crossing place since 1562; the first permanent bridge was built in 1911 based on the plans of Győző Mihailich. The bridge resembling the Ferenc József Bridge of Budapest was exploded in 1919 and 1944.

A half permanent bridge was built in 1946, the main span of which was identical to the main span of the Kossuth Bridge of Budapest, except it was built in better quality. The side spans were 50 m wide standard provisory structures. Since the given bridge spans were 55 meter wide each of these needed to be extended by a 5 m structure. The half permanent bridge was built on the piers that were meant to be kept; therefore in 1961 before the reconstruction was started the structure had to be pulled aside and placed temporary on auxiliary supports. The two day long pulling aside project was an outstanding event in the life of the city, since crossing was completely ceased for this time.

The new 55 + 79 + 55 m span, 190 m long bridge was a continuous deck structure. The level surfaced steel deck is supported by densely placed longitudinal stiffeners, and less densely placed cross girders and main beams. This was the first larger bridge with a similar structure, following the construction of a smaller, 18 m span bridge. At the same time the project provided an opportunity to gain sufficient experience for the construction of the Elisabeth Bridge in Budapest. The bridge was planned by the Roads and Railways Design Co. Uvaterv (Jenő Knebel), and built by the Bridge Building Co. (Hídépítő Vállalat) and the Ganz-MÁVAG using free assembly technique. This structure, weighing 800 tons marked the beginning of an era in the national construction of welded bridges, in that the bridge structure (bridge deck, longitudinal stiffeners, cross girders) was produced using welding exclusively. The partly high strength steel main girder also has welded connections. The bridge deck was welded in 8.5 x 7.0 m large pieces on a special rotating device manufactured for this specific purpose. As a result of the good preparatory work the Ganz-MÁVAG built the entire steel structure in half a year.





At the same time a “centipede” bridge was built in the floodplain area on a different route, using sections manufactured on site and assembled with prestressing. On the ministry’s part, the project was led by Herbert Träger.

The sidewalks of the riverbed bridge were made of 8 cm thick prefabricated reinforced concrete slabs, which deteriorated as a result of the salting. Therefore in 1998 – as part of a major renovation project – a steel deck was built underneath the sidewalks as well. The plans were prepared by the Magyar Scetauroute Ltd. (Mrs. Endre Bácskai), the contractor was the Bridge Building Co. (Hídépítő Vállalat) and the Ganz Steel Structures Co. (Ganz Acélszerkezet Rt.) again.

“Centipede” bridge in the floodplain area.

The two lane bridge was crossed by approximately 20 000 vehicles daily before 1992. Since the new section of highway no. 4, bypassing the city of Szolnok was built, the bridge is not part of the main route anymore; nevertheless its traffic is still quite heavy.

44. Budapest, Elisabeth Bridge

A worthy successor of the former world champion Elisabeth chain-bridge

Built: *1964*
Designer: *reconstruction: Uvaterv, under the leadership of Pál Sávoly*
Contractor: *reconstruction: Bridge Building Co., Tibor Penkala, Ernő Petik; MÁVAG, János Fekete, Sándor Domanovszky*

The "middle" Budapest Danube-bridge – the fourth road bridge in row – was completed in 1903. A public tender was published for its design together with the Ferenc József Bridge on Fővám square.

The bridge was not only the world's largest span chain bridge in its time, but also a nice chain bridge as well. The title of "world's largest" was taken away by a Brazilian – not to mention quite ugly – bridge in 1926.

This is the only bridge in Budapest that does not have a riverbed pier. The bridge was planned by Aurél Czekelius, István Gállik and József Beke. The substructure was constructed by the companies of the Gross E. and Associates and Henrik Fischer. The superstructure was built the MÁVAG. Construction was a bit delayed, since the thermal water rushing next to the abutment caused problems. In order to overcome this obstacle a so called fore-building was stood in front of the abutment, underneath the riverbank road, and supplementary weights – called statue pedestals – were placed on top of the abutments. The assembly of the superstructure was done with complete scaffolding; independent bridges were incorporated into the scaffolding to allow room for shipping.

The truss-type stiffening girders of the superstructure were continuous and 44 + 290 + 44 m spanned. The 11 m wide road and the two 3.5 m wide sidewalks also were between the stiffening girders. The tram tracks used to be on the sides of the bridge road.

Similarly to other bridges this was also exploded in January of 1945. Due to difficulties in lifting the wrecks and debates regarding the manner of its reconstruction the bridge was not reopened until November of 1964. Because of the closeness of the downtown church opposite curves needed to be built into the Pest side ramps, and an up to date, non intersecting junction was built for the Buda side ramp with a system of interestingly routed reinforced concrete bridges.

The new bridge was planned by the Roads and Railways Design Co. (Uvaterv) (Pál Sávoly). The traffic required six lanes including the tram tracks which could not be achieved with a traditional chain bridge, therefore keeping the original dimensions a cable bridge was built, where the sidewalks were positioned outside of the suspensions.

The width of the new road is 18.2 m, the tram tracks were placed in the middle. The bridge deck is orthotropic structured; the experiences gained in Szolnok could be well utilized. The bridge which was wider than the original (27 m)

and had a larger load bearing capacity was built using about half amount of steel (6300 tons).

The abutments needed to be completely rebuilt in order to be able to anchor the cables. The assembly of the superstructure was done with almost no use of scaffolding at all. The bridge structure was assembled to the main cables - prefabricated with the help of a catwalk - in 10 m long sections using two 100 ton floating cranes. The structure continuously changed its shape during construction, therefore temporary joints needed to be mounted between the sections. The contractors were the Bridge Building Co. (Hídépítő Vállalat) and the MÁVAG.

The completion of the east-west subway line (1973-75) allowed the removing of the tram tracks, which resulted in the elimination of significant sources of damages. In later years considerable renovation jobs were done, one of them the removing of the reinforced concrete sidewalk in 1999.

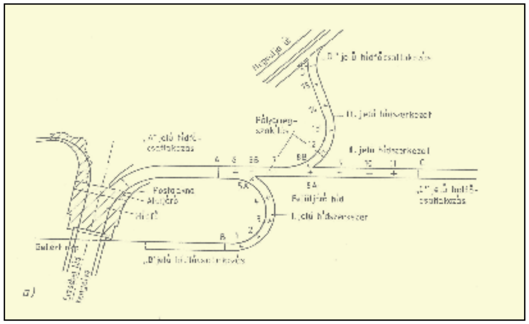
45. Budapest, Elisabeth Bridge, Buda-side bridge ramp structures

Our first large-scale, branched reinforced concrete bridge

Built: *1959-1964*
Designer: *Uvaterv, Miklós Loykó*
Contractor: *Bridge Building Co., Tibor Penkala, Ernő Petik*

The reconstruction of the old Elisabeth Bridge exploded during World War II started in 1959.

When designing the shape and planning the positioning of the ramp it needed to be considered on the one hand that the traffic running off the bridge diverts into three directions (Attila Rd., Hegyalja Rd., Gellért Embankment), and on the other hand that the ramp coming down from the bridge should not intersect in elevation with the tram traffic and the vehicle traffic running up the bridge. All of this could be achieved with the construction of a three branched bridge structure. The radius of the curves measuring on the inside edge is 25 m. The total length of this piece of art is 330 m, which only has one, 25 m long level section, otherwise slanting sections are alternated.



The load bearing soil, the marl of Buda is 7-10 m below ground level at the area affected; the soil levels above are not suitable for carrying any foundations, therefore piling foundation had to be chosen by all means. 120 cm diameter reinforced concrete piles were applied. A difficulty regarding the placing of the footings was that due to the closeness of the thermal water fountains the groundwater in the covering soil above the marl was warm and aggressive for concrete.

The piers are climbable hollow reinforced concrete structures. When forming their shape – and the shape of the entire piece – an important aspect was that the structure should show the least amount of weight. Twin piers were used at the junctions in two places.

Because of the complicated layout of the structure a significant question was as to how large sections of the hollow box girder, 1.19-1.24 m high superstructure should work together, and as to where the in-between piers should be positioned which was mainly determined by the build up of existing structures on the lower level. Finally, spans between 13 and 23 m were used. The break points were placed after each junction, the fix shoulders of the superstructure were also positioned here on top of the twin piers, therefore three multi-supported structures were formed which were connected to each other at two points.

Structure no. I at one end was connected to the Elisabeth Bridge while at the other end, on the one hand it followed the Attila Street direction (north) and was connected to structure no. II, and on the other hand it led the traffic towards the Gellért Embankment (east and then south).

Structure no. II led the traffic towards Attila Street and was connected to structure no. III westbound. Structure no. III led the traffic towards Hegyalja Road. The width of the upper part of structure no. I is varying, 10.1–6.6 m, while no. II and no. III are 7.0 m wide. The width of the lower part of structure no. I is 5.0–4.0 m, while no. II and no. III are 4.0 m wide. The bridge deck is 21 cm thick; the lower slab is 15-25 cm thick. The height of the ribs is steady in structures no. I and no. III, and varying in structure no II. There are cross girders only above the shoulders.

The curviness of the axis needed to be taken into consideration when figuring the static calculation of the structure. The quite advantageous torsion stiffness of the box girders could also be calculated.

Significant changes were made on the bridge during its 2001 rehabilitation Bridge Building Co. (Hídépítő Rt.), the most important of these was that the deck's breakpoints were eliminated therefore today the superstructure is a uniform continuous multi-supported structure.

46. Motorway M7, V-legged frame-bridge

Jumping footbridge

Built: *1967*
Designer: *Uvaterv, Mrs. Lajos Királyföldi*
Contractor: *Contractor: Bridge Building Co.*

The construction of the V-legged frame-bridge of motorway M7 (looks slanted legged) had its antecedents.

A V-legged reinforced concrete frame bridge was built in 1952 as per the suggestion of Elemér Bölcskei on the section of highway no. 6 bypassing the city of Dunaújváros over the Dunaújváros-Rétszilas railway route. The bridge is different from the usual frame-bridges in that the main beam is rested on pulled-pushed poles placed in a V shape – which acts as a stiff triangle – instead of on the bent posts and wedging. The distance between the joints is 23.0 m. The bending moments of the V-legged structure are much smaller than those of the double-joint frame bridge. An additional advantage is that no abutments are needed.

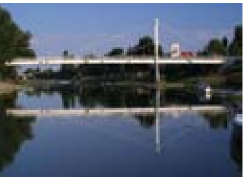
A similar bridge was built over the Budapest-Székesfehérvár railway for a local road, but there the pulled posts are below the line of the embankment therefore they cannot be seen. As a result the structure looks as if it was a slanted legged frame and is similar to an existing slanted legged bridge, the Szakadék-bridge of Mecseknádasd, which runs over a deeply cut valley. This structure was designed by Elemér Bölcskei. A curiosity of this latter bridge is that later when a crawler lane was built it was widened with prefabricated beams; but the beams did not need the slanted support.

At the Kápolnásnyék rest area of motorway M7 (45 km) a V-legged pedestrian bridge was built over the motorway where the pulled poles are also placed in the embankment therefore the bridge looks as if it was slanted legged, This bridge was designed by Mrs. Lajos Királyföldi of Roads and Railways Design Co. (Uvaterv), and built by the Bridge Building Co. (Hídépítő Vállalat). The length of the very slender bridge is 80 m; its longitudinal drop in elevation is 8%. The Kápolnásnyék bridge of motorway M7 is so slender that the contractor was only willing to dismantle its scaffolding when its designer was standing underneath the bridge. Aesthetically the slanted legged bridges (or bridges that look like those) are interesting. It is a popular application of the V-legged frame when in reality it looks slanted legged. .

Another pedestrian bridge over motorway M7 at the 14 km section, designed by Imre Néveri of Roads and Railways Design Co. (Uvaterv) is really slanted legged.

V-lagged frame bridge on the main road nr.6

A really slanted lagged pedestrian bridge over the motorway M7



47. Győr, Vásárhelyi Pál Footbridge

Our first cable stayed bridge

Built: *1969*
Designer: *Architectural Co. of Győr, János Mányoki*
Contractor: *Public Utility Building and Civil Engineering Co., Hungarian Wagon and Machine Factory*

The traffic from the Szigetköz to Győr ran with the help of a ferry up until the end of the 19th century through Hédervári Rd. via Híd St. The "Commercial Assembly of Győr" urged the building of a bridge as early as in 1863. The wooden bridge with waist-thick red pine piers and piles was built in 1888. The "ten legged bridge" had served its duties for 56 years, when in 1944 the German troops dismantled it and built a larger load bearing capacity wooden bridge to replace it. However, they exploded it when their troops were retreating. A makeshift bridge was on the wrecks within days. Later the city rehabilitated the bridge using ordinary black pine, but during the 1957 ice flood some of the bridge piers were lopsided by the ice floes, and as a result it could only carry pedestrian traffic and utility lines.

For the order of the county and city council János Mányoki of the Planning Co. of Győr (Győri Tervező Vállalat) designed a new pedestrian bridge in order to provide means for the pedestrian traffic between the Island and Révfalu, When designing the shape of the bridge the architect's primary objective was that the lively structure rarely supported by piers fit into the environment which was a place of summer entertainment, a world of beaches and boat houses.

The bridge nicknamed the "Little Elisabeth Bridge" is a modern and trendy piece, being an asymmetric, single pylon, cable stayed, self anchored, stiffener beam, harp form bridge. The 101 m long continuous main beam lies on four reinforced concrete supports, which split the bridge into three, 25, 60 and 15 m long sections respectively. The rectangular cross-sectioned, welded steel structure pylon is a closed swinging frame made of two posts, and lower and upper cross girders. The "harp" is made of two pairs of parallel run cables which were made by the Hungarian Cable Works from the leftover cable material manufactured for the Elisabeth Bridge. The 2.5 m wide 90 ton heavy bridge is resting on driven reinforced concrete piles. The foundation and reinforced concrete works were done by the Utility and Structural Engineering Company (Kőzmű- és Mélyépítő Vállalat), while the steel superstructure was manufactured and assembled by the Hungarian Wagon and Machine Factory of Győr.

The completed main beam was delivered to site in 17 m-long sections where it was assembled with its final connections in full length on a scaffold built as the continuation of the bridge axis. Finally it was pulled above the planned elevation and was lowered onto the bearings using the help

of rollers. Following this the upper section of the pylon was erected, the cable pulling scaffolds were built and the supporting cables were pulled in place. The screw-threacked build-up of the cable connections made it possible to change the position of the cable heads in relation to the main beam, and the adjustment of the cable forces. The static and dynamic load bearing tests of the completed bridge were done by the Mechanical Department of the Budapest University of Technology.

The new bridge was opened for traffic on August 16 of 1969.

An interesting episode in the history of the bridge was when due to its swings, the self-frequency of the structure needed to be retuned which was solved by applying an additional layer of asphalt to the deck.

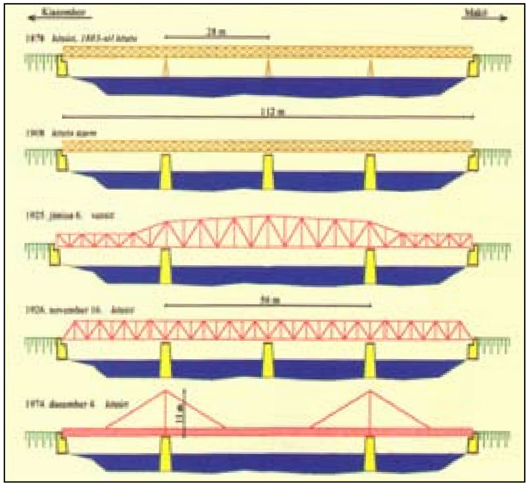
48. Makó, Maros-bridge

Steel monogram

Built: *1974*
Designer: *Uvaterv, Endre Darvas*
Contractor: *Bridge Building Co., Public Road Machine Works Co.*

The crossing place of Makó has always been important in the city's life. In 1840 the governing council initiated that a postal road should be built between Szeged and Makó. The Rónay family secured rights for operating the ferry and in 1846 installed a rope ferry at the outskirts of Makó. The increasing traffic required the construction of a permanent road bridge and the building of the railway line.

In 1875 the major of the city announced the building of the riverbed bridge and the two flood plain bridges. The general contractor finally was the Vienna based Adalbert Birnbaum and Associates. The construction was started in June of 1877, and the four-span 100 m long wooden truss bridge as well as the 18 and 10 span floodplain bridges were opened for traffic on March 14, 1878.



The railway constructors soon reached Makó as well. On December 31, 1881 the railway company leased the city's wooden bridge for 40 years and converted the bridge for mixed traffic. Originally, the railway tracks ran along the centreline of the wide wooden bridge. The operation and maintenance of the wooden bridge required a lot of money. In order to reduce costs, in 1908 reinforced concrete piers were built based on the plans of Szilárd Zielinski, a technical university teacher. It is unique in the Hungarian history of bridges that this significant bridge operated as a wooden bridge for half a century from 1878 until 1927, and of these years for 34 years it served dual purposes, moreover in the first 30 years even its piers were made of wood.

Railway traffic was ceased on the old wooden structure and thus the work of art was returned to the city. According to the contract, before the return, the railway company should have totally reconstructed the bridge, but instead the railway company decided to pay the city an earmarked sum in cash which then could be used for the realization of a new steel road bridge.

As early as in 1925 Gerő Szikszay ministry advisor planned the new, also four-spanned roadway riverbed bridge. Construction was started in July of 1926 and just a few months later, following a load bearing test taken on November 16, 1926 the bridge was opened for traffic. The floodplain bridges were riveted main beam structures working together with the reinforced concrete deck.

On September 26, 1944 the riverbed bridge was partially exploded. The bridge was only slightly damaged thanks to which it was possible to reconstruct it quickly. The final rehabilitation did not materialize until September 10, 1948.

Due to the opening of the Nagylak border patrol station and the modernization of highway no. 43 all three structures crossing the river Maros were replaced with up-to-date bridges using the original routes. The plans of the riverbed bridge were prepared by Endre Darvas DEng of Roads and Railways Design Co.(Uvaterv), while the two flood plain bridges were designed by Géza Répay DEng. The substructures and the floodplain bridges were built by the Bridge Building Co. (Hídépítő Vállalat), the superstructure of the riverbed bridge was constructed by the Közgép Co. The bridge was opened for traffic on December 4, 1974.

The riverbed bridge is a continuous, three-span, rod stayed steel structure built on the existing substructures. The two floodplain bridges are monolith reinforced concrete structures.

The stay-rods are beneficial for the statics of the structure. The slanted suspending rods made it possible to achieve a 46% decrease in the stresses of the main beam. The posts and the slanted rods are closed rectangular cross sectioned. The on-site joints of the welded structure are high strength bolted. Once the riverbed structure was completely assembled on the riverbed embankment it was placed in its final position by longitudinal launching.

49. Kápolnásnyék, bridge over a railway line

Our first totally prefabricated bridge

Built: *1975*
Designer: *Uvaterv, Gyögy Kerényi*
Contractor: *Pest County Transport Building Co., István Rigler*

The use of prefabricated superstructures for the construction of road bridges became widely accessible from 1971, when the manufacturing of prefabricated bridge beams (EHG), suitable for the bridging of spans larger than 10 m was started. A further developed version of this beam was the so called EHGE beam which was used for the construction of Hungary's first totally prefabricated bridge in Kápolnásnyék. Even the substructure of this bridge was prefabricated. The reason for this was that the difference in elevation between the ground level and the bridge deck is larger than 13 m (except for the Adony side abutment, which had a considerably smaller height). The bridge was built in 1975-76 over the Budapest-Murakeresztúr railway line and highway no. 7 to carry the traffic connecting the motorway M7. The complete prefabricating was a great advantage in that only minimal traffic restrictions were required during its construction. The bridge was designed by György Kerényi of the Roads and Railways Design Co. (Uvaterv), the contractors were the Transport Building Co. (KÉV) of Székesfehérvár and Pest County.

The five spanned (2x14 + 3x20 m), 96.6 m long bridge is the largest area bridge in the county Fejér, not considering the motorway bridges, with its 1142 m^2 large surface. Its construction was a great venture. The prefabrication of the substructure needed to be arranged as well and its lifting in place was a spectacular, non-customary task.

The piers were made with pile footings using NC 90 driven piles. The invariable cross sectioned (60 x 110 cm) piles are standing in 120 and 150 cm deep cups, which were formed in monolith reinforced concrete slabs. The piers are 8-12 m long, and weigh 13-19 tons. The cross section of the 85x85 cm thick, 12.6 m long and 20.6 ton heavy pier cups girders is reduced to a thickness of 40x85 cm at the cantilever sections. The structural beam is connected to the superstructure with junction reinforcing.

The superstructure is made of 14.6 and 20.6 m long EHGE beams, which were lifted in place with a Jones 851 type crane of 40 ton load bearing capacity. A railway steam crane was used in the span over the tracks. The thickness of the slab working together is between 17 and 29 cm, and it is reinforced over the in-between shoulders for a smaller, often weight. The total height of the structure is 1.32 m.

When preparing the static calculations the different stages of construction needed special attention especially regarding the piers, where on the one hand the eccentricity deriving form the imprecise placement (1% of the length of the post), and on the other the case when the girders of the superstructure were placed in only one of the openings needed to be considered. Moreover, the wind force and the case when the embankment is finished up to the elevation of the piles before the pouring of the superstructure at the abutments also needed special attention.

It is noteworthy that the construction of the 1142 m^2 area, modern bridge took only 6 months with which the designers and the contractors passed the examination successfully. Except for the sinking of the backside embankment, no major flaws appeared on the bridge that is 30 years old by today.

50. Kunszentmárton, Hármas-Körös-bridge

Prestressed reinforced concrete bridges on the Körös rivers built without temporary supports

Built: *1975*
Designer: *Uvaterv, János Reviczky, Péter Wellner*
Contractor: *Bridge Building Co., József Vörös*

The events of World War II spared the area of the Körös rivers with regards to its bridges, several steel truss bridges remained intact here, however – due to their narrowness and small load bearing capacity – they had become the obstacles of traffic. Most of the new bridges were built on new routes, while the old bridges were either dismantled or given to the propriety of the local councils.

At first – between 1973 and 1975 – the Hármas-Körös-bridge of Kunszentmárton on highway no. 44 was built. Water management needs required a 70 m wide middle span. In order to meet this need the establishment of a new technology, namely the use of prestressed reinforced concrete structures made of prefabricated parts and erected with a free assembly method was proposed. A French method and assisting structures were purchased for the implementation. The plans were prepared by the Roads and Railways Design Co. (Uvaterv, János Reviczky), the contractor was the Bridge Building Co. (Hídépítő Vállalat, József Vörös). A group of the associated colleagues received the National Award for this project.

The 36 + 72 + 36 m span structure above the riverbed was built using the above mentioned method with all the difficulties of implementing a new technique. The superstructure is made of two hollow-box cross sectioned girders. The girders were made of 2.0–3.5 m long, 22-26 ton heavy sections. They were mounted in a scale-type of launching method approaching in two directions starting from the starting blocks built on the riverbed piers. The sections were manufactured concreting to each other. Two sections were mounted each day. They were glued to the previous sections, and then were connected for good by stressing. In order to ensure the planned shape of the bridge extremely careful planning and placing was required, with numerous testing measurements. The strains on the structure in different assembly phases were distinctly different from that of the completed structure, as a result variously aligned stressing cables needed to be applied. In order to achieve the planned durability of the structure quite careful filling of the cable tubes was needed.

A three-span floodplain bridge is connected to the main bridge on the left bank of the river, which is made of prestressed reinforced concrete beams prefabricated in sections in Algyő and assembled on site with post-stressing.

In the following years similar bridges were continuously built in the order below:

- in 1977 the Kettős-Körös-bridge of Köröstarcsa on highway no. 47 with one floodplain span,
- in 1979 the Sebes-Körös-bridge of Körösladány on highway no. 47 with slanted layout,
- in 1982 the Kettős-Körös-bridge of Doboz with two monolithically connected floodplain spans,
- in 1985 the Kettős-Körös- bridge of Békés with an identical layout.

In the meantime the typical spans increased to 85 m.

Bridge building in Körösladány.

51. Budapest, structures in the junction of Hungária boulevard and Kacsóh Pongrác road

Reinforced concrete embroidery

Built: *1983*
Designer: *Capital Civil Engineering Co.(Főmterv)*
Contractor: *Bridge Building Co.*

In the 1960-ies Budapest prepared a development plan for the construction of a city freeway en route with the Hungária Blvd. An extremely significant and heavy traffic junction of this road is the intersection of Hungária Blvd and Kacsóh Pongrác Rd. which is also the starting point of motorway M3. There are two railway intersections nearby the junction (Róbert Károly Blvd. – MÁV Szob and Cegléd lines, and the Kacsóh Pongrác Rd., motorway M3 – MÁV Cegléd line). Moreover, the traffic requirement of the junction was quite high, a total of 60 000 vehicles per day. All of these factors required the construction of a very complex junction consisting of several structures. The designer of the structure was the Budapest Civil Engineering Co. (Főmterv), and its contractor was the Bridge Building Co. (Hídépítő Vállalat) all along.

In the first phase of its construction the structures over the railway tracks were erected. The Róbert Károly Blvd. flyover was built in half width between 1967 and 1971. At this time the structure was built to provide room for a double lane road, a dividing lane in the middle and pedestrian sidewalks on the edges in such a way that when the freeway system would be extended the tram tracks could also be placed. Due to the good quality sand layer underneath the structure, its foundation is slab-on-grade type. At each pier, three, circle cross sectioned reinforced concrete posts, incorporated into the foundation are resting on the reinforced concrete beam of the footing. The layout of the support is usually slanted to a varying degree. The altogether ten-span superstructure is made up of three continuous, cantilevered, seven-cell, reinforced concrete box shaped structures, with cross girders above the piers and at midspans. A Gerber-structured, restrictedly prestressed structure was built over the railway tracks, where it had to be ensured that the bottom surface would be crack free. The spans of the structure are between 26 and 35 m, its total length is 302 m.

The Kacsóh Pongrác Rd. flyover which was built in the 1st phase (1969-70) runs the traffic in two directions. Today it leads a part of the traffic between the Hungária Blvd and the Kacsóh Pongrác Rd in such a way that at the southern end of the bridge the road splits into two directions. Its foundation is slab-on-grade type as well, on which two hinged up and below concreted steel tube posts are standing per each shoulder. The supports are also slanted. The superstructure is a four-span, restrictedly prestressed reinforced concrete slab, where it had to be ensured again that the bottom surface would be crack free. The spans of the bridge are between 15.5 and 24.0 m, its length is 79 m.

Following this the construction of the junction was continued in several phases: in 1979-85 motorway M3 was joined into the Hungária Blvd. junction, during which project branch "A" leading towards M3 from the Városliget and Árpád Bridge, and branch "B" leading from M3 towards the Városliget and Hungária Blvd were also built. Branch "A" is a curved, 15 span, reinforced concrete structure, in which three of the spans are of EHGT beams, and eleven of them are three cell monolith reinforced concrete beams, where there are two Gerber-hinges in each beam. Branch "B" is very similar to the previous one. When the new sections were completed the bridge built in 1970 was closed and renovated. By 1987 the Hungária Blvd flyover was completed to its total width with a pedestrian underpass system and the tracks for tram no. 1.

Several construction projects were realized besides the bridge building projects in connection to the junction. In 1960 a pedestrian underpass was built underneath the railway tracks, and in 1973 the route of the Millennium Underground Train was extended up to Mexikói Rd. by being diverted underneath the railway tracks.

The 1997-98 rehabilitation of the junction was planned by the Budapest Civil Engineering Co. (Főmterv), however in the final execution the prestressing method developed by the Pannon Freyssinet Ltd. was applied for the elimination of the Gerber-hinges.. The general contractor of the project was the Bridge Building Co. (Hídépítő Rt.)

52. Budapest, Flórián Square, bridges and pedestrian underpass

Curved bridges over Roman ruins

Built: *1984*
Designer: *Főmterv Co.*
Contractor: *Bridge Building Co.*

The traffic of Budapest is continuously increasing at a huge pace and the Danube-bridges by the 1970-ies had already become too narrow for the traffic of the capital. In the heaviest traffic hours the capacity of all Budapest Danube-bridges, except the Elisabeth-bridge, was exhausted by 1976, in the case of the Árpád Bridge this had been so since 1971. Therefore it had become indispensable to widen the bridge, and in conjunction to arrange the traffic of the connecting Flórián square which due to the existing conditions meant the forming of multilevel overpasses.

Two detached bridge structures were built for the traffic route of Szentendrei Rd. – Árpád Bridge. Because of the circumstances of the location the layout of both bridges is curved, with a smallest radius of 150 m, to which a perfect connection could have been made with the application of post-stressed box girder structures. However, due to construction difficulties a decision was made to apply custom altered EHGT-beams.

Each of the bridges are eleven-span with an axle distance of 26 and 34 m between the piers, the radius of the vertical convex rounded curve is a minimum of 1800 m, the highest rise in elevation of 5.3 %. The lengths of the bridges are 320 m and 360 m respectively.

The substratum of the area unquestionably required the use of pile footings there were 1.3 m diameter drilled Soil- Mec piles applied.

Since the superstructure was designed with straight axis main beams, they follow the curve in a polygonal shape. The main beams were constructed with a 5 cm heightening of the EHGT-beams, the working together is ensured by a better than usual quality reinforced concrete deck. The pier caps are trapezoid shaped, and almost all of them are different sized. The piers are single posts in order to run the traffic of the lower roads sufficiently. The dilatation of the bridges is ensured by dilatations of the asphalt layer. One end of each gap is fixed, while the other is moving.

As part of the traffic rearrangement of Flórián square a pedestrian underpass was also built, which at the time was significantly different from other underpasses of the capital both in terms of its size (4998 m^2 of covered, 2280 m^2 of open area), and in terms of its formation.

Remarkable Roman ruins were found during the archeological excavations before construction, amongst others the remains of a sanctuary built for the honor of Mithras, the Persian

Sun-0god, and a uniquely large sized bath were discovered. Because of the extendedness and richness of the excavation area the saving of the ruins was continued during construction.

The ruins required and the substratum allowed that the underpass could be built without a base slab. The floor structure was made of

14.80-12.80 m long EHGT-70 type beams with monolith reinforced concrete slab working together. The piers are implanted to the spread footing foundation at the bottom and to the superstructure at the top. The ascending wall parallel to the beams is 50 cm thick, while the ones carrying the floor are 55 cm thick. The base slab and the side wall of the covered areas are double hinged frames, while that of the floor is double supported slab, the open parts are monolith reinforced concrete U frames.


Raiffeisen

53. Hídvégardó, Bódva-bridge

The only timber bridge on the national road network

Built: *1988*
Designer: *Ybl Miklós College, Géza Buti*
Contractor: *unknown*

A unique and extraordinary bridge: a four-span steel girder bridge, with 8 m wide spans is connected to the four vaulted floodplain arches.

It is surprising that bridges like this can only be seen here and on municipal roads, although in 1955, there were 122 of them in the county of Borsod-Abaúj-Zemplén; and nationally almost 900 wooden or provisory structured bridges used to exist. The small-bridge rehabilitation project entitled to Árpád Apáthy eliminated 100 temporary bridges annually. This bridge is still in existence because of its insignificant traffic. The Hungarian-Slovakian border is in the center line of the bridge.

Our national wooden bridges of course have an extremely old history, going back to the Roman ages when bridges stood over the rivers Zala, Rába and Sió. Starting in the Árpád's ages the history of several wooden bridges has been recorded (Muhi 1241).

In 1562 the Turks had a bridge built over the river Tisza at Szolnok by a carpenter from Debrecen. The last successor of this bridge was destroyed by the 1909 flood.

Boat bridges existed on our large rivers not only under but also before and after the Turkish era. The covered wooden bridges, the 25-48 m spanned huge structures, built in Transylvania between 1778 and 1842 were very famous. The most well known of these, the Aranyos-bridge of Torda served the passengers until 1909.

It is not well known that we have had several large, covered wooden bridges within today's national borders for instance in Eger, in Dunaföldvár and other places as well. Moreover, in 1889 a 780 m long covered Tisza-bridge was built. Similar size railway bridges and not much smaller wooden bridges were built in large numbers.

Nowadays for road traffic wooden bridges are only built in exceptional cases using a glued technique, mainly because it is not easy to prevent wood from deterioration.

Nevertheless, the construction of wooden bridges for pedestrian and bicycle traffic is having its renaissance worldwide.

Even in Hungary, in certain counties several interesting bridges have been built, e.g. at the Small-Balaton or near Polgár at the Archeological Park.

Kányavár, pedestrian bridge on the Small-Balaton.

The application of wood in bridge construction has been justified again by the use of new technologies and new solutions. The Bódva-bridge at Hídvégardó built in 1988 based of the design of the Ybl Miklós Construction Technology College (Géza Buti) is considered a sprout since it was erected to replace a provisory bridge built in 1959.

A bridge resembling the old covered wooden bridges was built at Polgár.

54. Motorway M0, Háros Danube-bridge

The first Danube-bridge built at a new location after World War II.

Built: *1990*
Designer: *Uvaterv Co., Tibor Sigrai*
Contractor: *Bridge Building Co., Kálmán Rapkay, Károly Hlatky, Balázs Vörös; Ganz Steel Structures Co., Károly Pintyőke, Endre Gáll, László Sitku*

The first section of motorway M0, the ring road that will eventually bypass Budapest was built between highway no. 6 and motorway M5. Two large bridges needed to be built on this section. The larger one ensures the flow of traffic between Budafok and the Csepel Island.

The first motorway section was built as a highway in the first phase and because it was financed by a World Bank loan an international tender needed to be published for its construction, which was closed in 1986. The Bridge Building Co. (Hídépítő Rt.) won the tender with plans prepared by the Roads and Railways Design Co. (Uvaterv).

The Danube-bridge is in the 15 km section of the motorway. The bridge is built up of three individual sections; its total length is 770 m. The 3x108.5 m spanned riverbed bridge as well as the 3x73.5 m spanned Buda side and Csepel Island floodplain bridges are continuous composite girder structures. The contractor of the bridge's substructures and reinforced concrete bridge deck was the Bridge Building Co. (Hídépítő Rt.), while the steel structure was manufactured and assembled by the Ganz-MÁVAG.

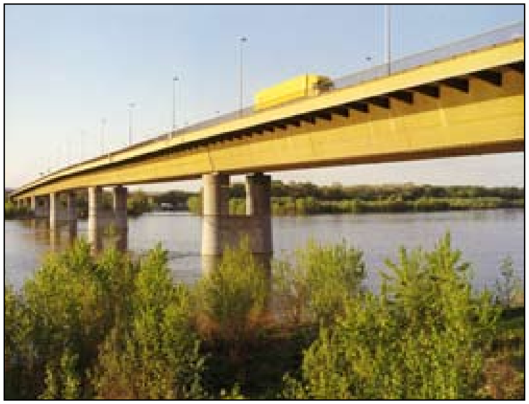
It was here that the method of making precast concrete shaft sections on shore and then lifting them in place in one piece with a floating crane was used at first for the construction for the pile footings of the riverbed bridge. One such concrete piece was 19 m long, 3 m wide and 3.5 m high, its wall thickness was 20 cm, and it weighed 90-95 tons. Once these sections were poured with concrete, the water retaining wall placed on top protected the work area so that the piers could be constructed in a practically dry environment.

The superstructures of both the floodplain as well as the riverbed bridges are slanted web, one cell box girder cross sectioned composite deck structures. The height of the box girders is steady, 4.75 m all along. The bottom of the steel box is 9 m wide; there are 12 m between the upper points of the web. The reinforced concrete bridge deck is supported by steel cross girders in every 3.5 m. The connection between the steel structure and the reinforced concrete bridge deck is provided by specially welded headed bolts. It

was here that this technology was used on bridges for the first time in Hungary

Another curiosity is the assembly method of the steel structure. The structures preassembled at the Lágymányos plant of the Ganz-MÁVAG were delivered to the construction site on the river on barges and were lifted in place by a floating crane. The floodplain structures were assembled on the starting yokes built on the shores, and then were launched in place lengthways, using the PTFE sheet technology instead of the steel rollers. The assembly of the riverbed bridge was done using the classic free assembly technology.

It is worth mentioning that when prestressing the reinforced concrete bridge deck not only prestressing cables were used but also the so called 'countersinking the bearings' technology, which meant that the steel structure at the in-between piers was built 2 m above the final clamp level, and then was



lowered in place after the bridge deck was poured and the concrete set, this way ensuring the development of the required pressure in the upper chord.

The construction of the bridge started in 1987 and it was opened for traffic on November 16, 1990.

55. Motorway M0, Soroksár-Danube bridge

Use of the free concreting on a motorway

Built: *1990*
Designer: *Uvaterv Co., József Varga*
Contractor: *Contractor: Bridge Building Co., Mihály Prjevara*

The highway crosses between Budapest and Dunaharaszti the Soroksár-Danube and the floating swamp connected to the river. The main bridge is a 34 + 74 + 34 m span, freely concreted, Prestressed reinforced concrete structure. Following the Mosoni-Duna-bridge of Győr and the Tisza-bridge of Csongrád this was the third bridge built with the same technique. On the left shore two while on the right shore twelve floodplain spans are connected to the bridge. The total length of the bridge is approximately 500 m and it has 1.7% drop in longitudinal elevation.

The plans were prepared by the Roads and Railways Design Co. (Uvaterv Co.) (József Varga), the general contractor was the Bridge Building Co. (Hídépítő Vállalat), which submitted the most favorable proposal for the international tender. The bridge was built between 1987 and 1990. The road is 17.5 m wide, its north side has a 3.35 m wide sidewalk while the south side has a service sidewalk.

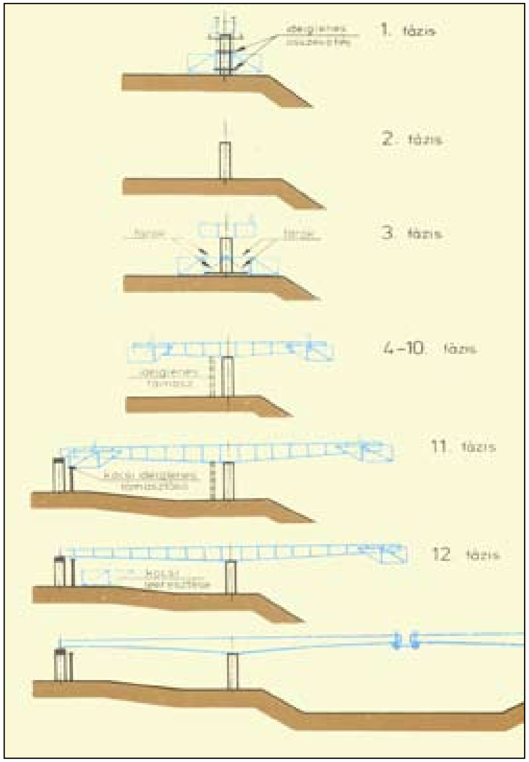
The foundation was built with Soil-Mec piles. The continuous Soil-Mec pile is a joint patent of the Bridge Building Co. (Hídépítő Vállalat) and the Uvaterv. The load bearing test of the piles was done with VUIS-method. The piers are 10–12 m high, their completion usually required one week.

The main bridge is made of two box shaped main girders built one after the other which are connected at the middle of the bridge with a cross girder Prestressed with a Dywidag-rod. The height of the beam varies between 2.0 and 4.4 m. The length of the starting block and the individual freely concreted blocks is 3.9 m. The starting block was partially made in the formwork as well. Austrian cement was used for the mixing of C30 quality concrete. This construction method is different from the free assembly technique, here the sections are not prefabricated on the ground but rather they are made in the formwork hung onto the already completed supports. The cycle period of the free concreting was 7 days. Most of the material was delivered by ferry. The concrete was produced at the mixing plant set up on the left shore. The structure differed from the previously built two similar bridges in that the steel pipe yoke built 3.5 m away from the pillar served the stabilizing of the structure during construction; the cantilever is larger than 3 m therefore it is supplemented by post-concreted hollow box beams on the sidewalk side. Computer technology had also advanced in the meantime.

Later the riverbed section of the Szent István Tisza-bridge near Szolnok with a 120 meter wide main span was built using this technology. The Kőröshegy viaduct of motorway M7 was also partially built using the free concreting technique.

The connecting bridges contain 12 UB marked, 24.8 m long prefabricated girders in each span. No in-between dilatation structures were built on these bridges. A partial see-through sound screening wall was built on the edge the bridge.

Built in materials: 2000 meters of piles, 11500 m^3 of concrete, 1300 tons of reinforcing steel, 300 tons of prestressed steel, 168 pieces of prefabricated girders.



Phases of the free concreting.

56. Cigánd, Ferenc Rákóczi II. Tisza-bridge

Juggling with 410 tons

Built: *1994*
Designer: *Uvaterv Co., László Mátyássy; Budapest University of Technology, István Szatmári*
Contractor: *Strabag Hungary Ltd, Ganz Steel Structures Co., Bridge Building Special Ltd. (Speciál Kft.)*

The area wedged between the rivers Bodrog and Tisza called the Bodrogköz, for the longest time had had quite poor transportation connections. It was the Tisza-bridge of Balsa built in 1930 that brought the real breakthrough and the economical boom. The bridge served not only the road traffic but also the connecting of the narrow-gauged railway lines of the Nyírvidék and the Bodrogköz. The fact that up until the destructions of World War II a modern, rapid transit train had run between Nyíregyháza and Sátoraljaújhely, proves the bridge's accentuated importance in local transportation.

During the war, along with many other river bridges, the bridge of Balsa was also destroyed. Although the idea of its rehabilitation has come up several times, it has not materialized to this day. To provide for the needs of transportation and allow the approachability of the Bodrogköz a pontoon bridge was built between Dombrád and Cigánd. The floating bridge structure was in operation until the Ferenc Rákóczi II. new Tisza-bridge between Cigánd and Tiszakanyár was opened in 1994. The Tisza-bridge of Polgár was completely reconstructed in 1989; a new, up-to-date beam bridge was built to replace it. The old, original structure built between 1938 and 1941 based on the design of Győző Mihailich DEng and Róbert Folly became redundant. The new bridge at the outskirts of Cigánd could be built with the reuse of the 106+106 m spanned truss structure that was superfluous in Polgár. The transportation of the structure was a brilliant juggling act, since the dimensions of the delivered product were impressive. The 106 m long, 9 m wide and 10.5 m high truss structures weighed 410 tons.

The bridge structure was placed on barges in two sections, and then was hauled in place upstream on the river Tisza. During its transport it was an extraordinary task to execute the sluicing at Tiszalök, and the crossing underneath the railway and road bridges in Tokaj with the unusual shipment.

The structure delivered to Cigánd and lifted onto the piers from the barges was strengthened; in addition a new bridge deck was built therefore the previous load bearing capacity could be improved.

Parallel to the transportation the substructures, the abutments and the piers were built. Besides the two main spans delivered to site the bridge sections for the shores were also built. On the left shore a 40 m spanned, while on the right shore 7x40 m spanned prestressed reinforced concrete bridge section was built.

The road width on the saved riverbed structure is only 6.5 m since that was all that the truss main girders allowed. The width of the newly built floodplain sections is the standard required 8.5 m.

Bridge construction over the river with such assembly and transportation technology and replacement of structures is considered unique. Since the dedication of this bridge, several Hungarian bridges were built using similar methods, moving considerably larger weights. Nevertheless, there has not been another example for such long and complicated transportation route since then.

57. Budapest, Lágymányos Danube-bridge

The first new Danube-bridge in Budapest after World War II.

Built: *1995*
Designer: *Uvaterv Co., Tibor Sigrai, Sándor Divinyi*
Contractor: *Bridge Building Co., Kálmán Rapkay, Károly Hlatky, Balázs Vörös; Ganz Steel Structures Co., Károly Pintyőke, Endre Gáll, László Sitku*

The Lágymányos-bridge is a six-span (49 + 4x98 + 49 m), continuous, two cell, trapeze cross sectioned, box beamed, orthotropic steel deck structure, suspended onto the pylons over the piers with slanted poles. It leads the traffic of Hungária Blvd. of Pest over to the Buda side. It draws one's attention with its angular shapes, it blends in with the mass and the riverbed piers of the railway bridge concealed behind it. One of its curiosities is that the method of lighting its bridge deck is one that has never been used before on any other bridges. Dazzle lights are fastened to the pylons and their light is "spread around" evenly with the help of mirrors mounted and set at a height of 35 m.

The Roads and Railways Design Co. (Uvaterv Rt.) prepared the plans for the construction of the bridge, calculating with a new railway bridge as well, in 1972 already. When planning the structural specification of the bridge the pier allocation of the railway bridge and the shipping regulations – according to which piers could not be longer than 11 m – needed to be taken into consideration. Another regulation was that the width of the bridge deck had to be at least 30 m, including a double tracked tram line and two 3.5 m wide road lanes going each direction, as well as a bicycle lane and pedestrian sidewalk on the north side and a service sidewalk on the south side.

Construction of the bridge started in 1992 based on the plans prepared by the Roads and Railways Design Co. (Uvaterv Rt.) in 1991. The substructures were built by the Bridge Building Co. (Hídépítő Rt.). The tested technology

used at the construction of the Háros Danube-bridge, that is using precast concrete shaft sections, was applied for the construction of the piers.

Most of the steel structure was manufactured in the Budapest plant of the Ganz Steel Structures Co. (Ganz Acélszerkezet Rt.) The manufactured pieces were assembled into 90-100 ton sections, which were then lifted in place as one unit by the Clark Ádám floating crane. 286 thousand high strength prestressed bolts were needed for the assembly of the superstructure. In order to fit one cross-section in place 1400 bolts needed to be placed during one overtime shift before the crane could safely release the unit. Following this the butt welds of the bridge deck were prepared, and the stiffening beams were welded. In the summer heat it was not uncommon that despite the continuous cooling the temperature was 40-50C^{0} in the closed structure.

The bridge along with the connecting road sections was completed by October 30, 1995 when it was opened for traffic.

The Lágymányos-bridge favourably eases the disturbing sight of the nearby robust railway bridge and with its even worldwide unique appearance it is a worthy continuation of the construction of elegant Danube-bridges.

58. Záhony, Tisza-bridge

Three adjacent bridges between Hungary and Ukraine

Built: *reconstruction: 1963; expansion: 1997*
Designer: *reconstruction: Szojuzdorprojekt; expansion: Főmterv Co., Uvaterv Co.*
Contractor: *reconstruction: Glavdorsztroj; expansion: Ganz Steel Structures Co., Bridge Building Co., Mosztozahin-Mosztobud, Kiev*

The first wooden Tisza-bridge of Záhony was built in 1884, using cross latticed beams which was a widespread technology of the time, named after Howe an American engineer. In the 19th century several such structure – both road and railway bridges – had been built in Hungary. One of our largest bridges built with this technology, was the 420 m long railway bridge structure built over the river Tisza at the outskirts of Tekeháza in Subcarpathia.

The wooden road bridge of Záhony was rebuilt into a steel structure in 1910-11, with caisson footings still in use today and three identical 62 m wide spans. The three-span truss bridge was exploded in 1944.

The reconstruction of the bridge was not started until 1960. The primary reason for this was a political objective at the time to completely isolate the Soviet-Hungarian border. Transportation of goods was important both in terms of military and economic aspects therefore the railway bridge on the Tisza in Záhony was reconstructed practically immediately after the war.

There is rather little information available regarding the reconstruction of the road bridge. Today's structure was built on the original piers by the Soviets. There had been considerable problems with the condition of the bridge and its capacity in terms of the passport and customs controls, to which a final solution was the complete rehabilitation in 1996-97.

First, new steel bridges were built for the cargo traffic on each side of the truss bridge. In order to achieve this, the old piers were widened with cantilevers. The next step was the renovation and partial rebuilding of the truss structure built by the Soviets so that it meets today's needs. As a result today, there are altogether four lanes available on the modernized bridge complex.

Basically – following the reconstruction over the riverbed – three bridge structures built right next to each other serve the road traffic. Similarly there are three structures right next to each other in the floodplains as well, so altogether there are six large bridges within a few hundred meters.

Not only is the positioning of the border bridges interesting but also the traffic passing through them. The border and passport control is at the foot of the bridge on each side; therefore usually cars and trucks waiting to pass controls are standing on the bridge in long lines. The completely packed bridge not only has a unique site but also an extraordinary weight burden. When designing the new lorry bridges this special aspect was taken into consideration.

59. Tiszaug, Tisza-bridge on the main road no. 44

Terminating the joint use by an up-to-date steel bridge

Built: *2001*
Designer: *Pont-Terv Co., László Mátyássy*
Contractor: *Bridge Building Co., Sándor Ötvös; Ganz Steel Structures Co.*

The development of the national road system and the boom in exchanging goods more and more urged the need of available crossing places over our larger rivers. It was in 1897 when the city of Kecskemét considered it desirable to also run secondary railway tracks across the bridge between Kecskemét and Kunszentmárton.

The bridge was designed by a committee chaired by Ferenc Novák, deputy undersecretary of state. Construction of the bridge was started in October of 1927. The bridge is a four span – 50.0+100.0+100.0+50.0 m – non continuous, riveted steel truss through bridge. The superstructure was manufactured by the Hungarian State Iron and Steel Factory (Magyar Állami Vas- Acél- és Gépgyár) with excellent quality steel from Diósgyőr and Ózd.

The bridge was dedicated in October of 1929, when the venue of the ceremony was decorated by 215 Hungarian flags and 154 coats of arms; the national tricolor ribbon was cut by Miklós Horthy, the governor himself.

In October of 1944 the retreating German troops exploded three spans of the bridge. Its reconstruction was completed according to the original plans. The destroyed parts of its 50.0 m spans and one of the 100.0 m spans were replaced with the remnants of the sections lifted from the river, therefore only one new span needed to be manufactured.

Although the reconstruction project was finished in 1947, the railway traffic could not run on the bridge until 1952.

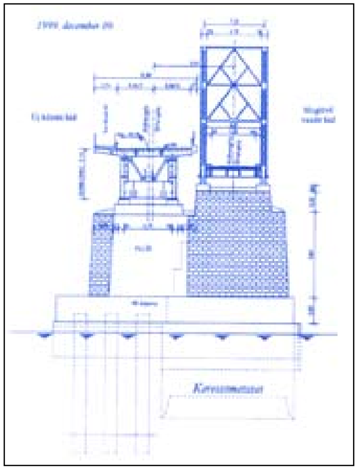
In 1987 due to the batters of the omega-section bridge deck and the corrosion damages a 20 ton weight restriction was introduced on the bridge. The bridge deck was rebuilt in 1991-1992. During the project the road traffic was diverted onto a TS barges, special barges which originally were used for the construction of provisory bridges, floating perpendicular to the river.

Due to the narrowness of the old bridge deck (5.3 m) and to cease the disadvantages of the dual function bridge in 1999 the construction of a new road bridge was started with the widening of the existing substructures. The old bridges now serve only the railway crossing. The new bridge's superstructure is a continuous, steel deck bridge with two main girders, 310.0 m long in total. The construction of the lightweight steel superstructure in this span range was justified by the difficulties in building the foundations of the widened piers.

The plans were prepared by the Pont-TERV Co. and the Magyar Scetauroute Ltd. the main contractor of the project was the Bridge Building Co.- Ganz Steel Structures Co. Consortium (Hídépítő-Ganz Acélszerkezet Konzorcium). The construction work was led by Sándor Ötvös and István Gyöngyösi.

The onsite assembly of the superstructure was done in sections on a 110 m long assembly area. The first section of the assembled main beam was first pulled on the tracks mounted on the assembly area and the yokes, until it reached over the Tisza with the at least 50 m long cantilever. At this point it was supported by a scaffold mounted on a floating structure which helped pulling the structure in place. Thanks to this up-to-date bridge assembly technique work was completed in June, 2001, months before the deadline.

This capacity development opened opportunities for growth for residents of Békés county. This bridge connected South-eastern-Hungary into the circulation of the country and the constriction of the arteries was relieved on highway no. 44.



60. Budapest, Circular bridge above the joint section of motorways M1-M7

Our only bridge with a full circle layout

Built: 2000
Designer: Főmterv Co., Adrián Horváth,Zsolt Nagy, Viktor László
Contractor: Bridge Building Co., Közgép Unió Co.

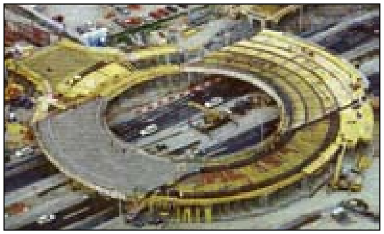
In Budaörs with the construction of the Tesco Mall the increased traffic needs necessitated the construction of a new flyover, which created extraordinary demands for the architects.

Besides having to keep its original function, the new structure compound built to replace the dismantled overpass, needed to provide means to approach the shopping mall complex to be established on the left side of the westbound motorway from Budapest. The concept of building a roundabout trafficked bridge over the motorway was developed on the basis of traffic surveys. The unusually small radius curve deriving from the local conditions created an exceptional task for the designers. The tasks regarding the positioning of the bearings, the formation of the expansion joints, and the designing of the safety elements to be applied as a result of the curved geometry need to be highlighted from a structural point of view. Another problem was to ensure the fulfilment of visibility requirements. To achieve that a 7.0 m wide area, closed for traffic was developed. Constraints derived from the fact that bridges are connected to the round structure from four different directions. The M7 upward ramp is an approximately 70 m long, while the Tesco up- and downward ramp is a 140 m long monolith reinforced concrete bridge structure. The monolith section of the round structure connects to the north and south sections of Károly Király Rd.

The permitting authorities paid careful attention and prescribed strict regulation regarding protection against slippery road surfaces and objects falling off vehicles. The condition of the pavement is monitored by built in sensors that relay information to the maintainer of the road, so that in case of icing immediate action can be taken. Another serious requirement was that a double line of railings needed to be mounted on the inner edge of the curbs on both the outer and inner curves. To supplement this on the outer edge of the curbs a 20 mm thick fibre strengthened plexiglass wall was built which was meant to protect against loads falling off trucks over the motorway and service roads.

The structure is definitely unique in Europe. The 24 m inner radius structure needed to be built over the motorway. The construction site was opened on June 6, 2000. The circle shaped bridge over the motorway was built by the Bridge Building Co. (Hídépítő Rt.) and the Közgép Unió. Several unforeseen problems had arisen during the realization of the project; first of all public utilities were the most significant obstacles of construction, which meant that jobs had to be held up until utilities were rearranged. Nevertheless, during this period the manufacturing of curved, steel box girders was continued.

The section over the motorway of the circle shaped bridge carrying the roundabout traffic has a three support, composite steel-concrete beam structure, in which the height of the



steel structure is 1.17 m and the thickness of the bridge deck is 20 cm. The beams were adjoined of three assembly sections over the dividing lane of the motorway, and then were hoisted in position at night during complete closure of the motorway, which required a total of five nights.

The thickness of the double sided, 1400 m^2 apiece surfaced reinforced concrete bridge decks is 70 cm. Their formwork and reinforcement was performed continuously, the concreting of the decks was done in four phases, so that work area could be provided for the insulation jobs as quickly as possible. Following insulation the formwork and reinforcement of the curbs was immediately started.

The surface of the bridge is 3700 m^2, and 254 tons of steel was used for its construction.

By November 22, 2000 the bridge was completely finished, its load bearing inspection was completed, and only minor touch-ups were to do. The bridge was opened for traffic on November 29, 2000.

61. Esztergom, Mária Valéria Danube-bridge

The storming lifed Danube-bridge was revived after 57 years

Built: *reconstruction: 2001*
Designer: *reconstruction: Pont-TERV Co., Jenő Knebel; Dopravoprojekt, Miroslav Matascik*
Contractor: *reconstruction: Ganz Steel Structures Co., Közgép Co., Inženierské Stavby*

The Danube-bridge between Esztergom and Párkány was first built between 1893 and 1895. The basic idea of using sickle shaped, double supported truss beams originated from János Feketeházy; several similar structures had been built elsewhere in those years. This bridge was an 85 + 102 + 119 + 102 + 85 m spanned structure where the spans increasing in length towards the centre are aesthetically advantageous. The contractor was Szaléz Cathry and Son, the steel structure was assembled by the Machine Factory of the Hungarian State Railways. The placement of railway tracks on the bridge was also in the plans but it never had materialized.

In 1919 the end span on the Párkány side collapsed for yet unclarified reasons; the final reconstruction was completed in 1926 when the outdated wooden bridge deck was replaced with a reinforced concrete deck.

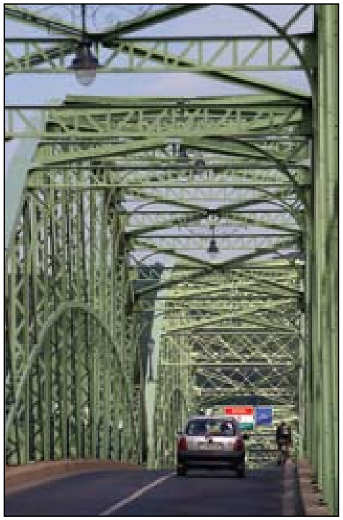
At Christmas time of 1944, after 18 years of operation the Germans exploded the three middle spans of the bridge and the remnants of the bridge were left there for almost 57 years; only a ferry service was available for crossing the river.

On September 16, 1999 following numerous negotiations a prime ministers' agreement was made regarding the re-

building of the bridge. Solutions for several versions were rejected before a decision was made that having strengthened and renovated the existing two spans the three new spans should be identical to the originals in appearance, with an up-to-date, welded, high strength prestressed bolted structure. The bridge has a steel deck in the side spans as well. Because of shipping requirements the elevation of the deck needed to be significantly raised for which the piers needed to be heightened and the existing structures needed to be lifted as well. The Esztergom-side span was built into a modern structure similar in appearance to the old one.

The new, 500-600 ton apiece heavy truss structures were assembled on the Párkány side, a few kilometres away from the site and were delivered to site on water, in one piece per each span, where they were lifted and placed onto the piers with a special on water lifting device made for this specific purpose. These procedures were executed for the amusement and interest of residents living on both sides of the river. One of the floatings was done just during a conference for bridge engineers.

The plans were prepared by the Pont-TERV Co. (László Mátyássy) and the Slovakian Dopravoprojekt a.s. An international consortium was assigned as the general contractor of the project, in which the substructures were built by the Slovakian Inženierské Stavby and the steel structures were constructed by the Ganz Steel Structures Co. (Ganz Acélszerkezetek Rt.) and the Közgép Co. (Közgép Rt.) with the participation of the Bridge Building Special Ltd. (Hídépítő Speciál Kft.).



62. Esztergom, Árok-street Small-Danube bridge

A slender composite structure that keeps the traditions,

Built: *2003*
Designer: *Pont-TERV Co., Miklós Pálossy*
Contractor: *Strabag Co., Közgép Co.*

Following the reconstruction of the Mária Valéria Bridge of Esztergom the increased traffic required the building of the Árok-street Danube-branch Bridge. The new road bypassing downtown, running through Prímás Island crosses the side arm of the Danube with only one 50 m long slim structure.

The developer's needs, the geometric circumstances and the water management requirements demanded the construction of a bridge, which – due to its short structure height – would fit in well with the slender Mária Valéria Bridge and the other bridges. Another novelty of the project was that unlike with previous jobs, here the architect-designer also helped the project, so that the completed structure would blend in the most with its surroundings, and would carry the distinctive features of the historic city. Consequently, besides functionality, aesthetics, that is "dressing up the bridge", also played a significant role in the forming of the structure. The delicately shaped banisters, cantilevers and the magnificent stone coverings all served this purpose. Right next to the foot of the bridge a statue of Saint John of Nepomuk was also placed.

The structural build-up of the bridge is the following: The span of the frame bridge at the centreline of the abutments' walls is 48 m, the free span is 45.5 m. The road profile in which the bridge is situated has a 600 m radius convex curve. The width of the road is 8 m, to which a 1.5 m wide pedestrian sidewalk is connected on each side. The superstructure consists of four, variable height web beams, the bottom edge of which curves in the shape of a quadratic parabola. The structural height is 1.6 m in the middle and 2.4 m at the abutments. The main beams are bridged with a reinforced concrete deck constructed on site, the thickness of which varies between 20 and 30 cm. The main beams are braced with cross girders in every 8 m.

The closed rectangle shaped, pile intersecting diaphragm stiffened wall foundation provided the necessary rigidity at the abutments to take over the pressures of the horizontal forces, so that the structure could indeed function as a frame bridge.

The high water level of the Danube caused considerable turmoil during construction, which hindered workers' progress on several occasions. The lifting in and holding in place of the steel girders in one piece was also a challenge for the builders.

The bridge was opened for traffic on May 12, 2002.

63. Szekszárd, Szent László Danube-bridge

Motorway M9, the first section of a new connection

Built: *2003*
Designer: *Pont-TERV Co., Jenő Knebel; designer of riverbed bridge: Pont-TERV Co., László Mátyássy; designer of floodplain bridges: Uvaterv, Zsolt Kovács*
Contractor: *MAHÍD 2000 Co*

The first road Danube-bridge below Budapest was built in 1930 in Dunaföldvár, and until 2003 beside this bridge there was only one dual function road and railway Danube-bridge in Baja. In the past twenty years developers of the public road network – partly as a result of public pressure – dealt a lot with the establishment of new bridges over the Danube and public routes leading to them. There was a unanimous agreement in that the Budapest centered public road system must be relieved by east-west directed roads. The roads M8 and M9 – which in time could be developed into motorways – are both segments of this new road concept. The first 20 km long section of motorway M9 incorporates the Szent László Danube-bridge in the vicinities of Szekszárd.

The new bridge is a 916 m long, 11 spanned, steel hollow box girder permanent cross sectioned deck bridge. The superstructure of the riverbed bridge is steel decked, while the floodplain bridges are composite bridges working together with the reinforced concrete decks. The floodplain structures are 3x65 m spanned on each side, while the spans of the riverbed structure are 80+3x120+80 m respectively. The cross-section of the altogether 14 m wide deck is one road lane each direction, a pedestrian and bicycle lane on the north side and a service sidewalk on the south side. Eight of the twelve piers were built on the shores or in the floodplain areas, while four were constructed in the riverbed with large diameter (1.3 m) drilled piles six underneath each floodplain and eight underneath each riverbed pier.

When building the foundation it was a novelty that in order to minimize the construction time of the riverbed piers, 8 m wide, 16 m long and 4 m high so called shaft pieces were used. These pieces were accurately lifted in place and were secured by pouring rocks around them. The pile footings were poured via steel tubes welded in place previously, and then – once the water proofing concrete was poured – the traditional pier construction could be continued using large piece formworks in a dry area.

The steel superstructure was manufactured in the Budapest plant of the Ganz Steel Structure Co. (Ganz Acélszerkezet Rt) and the Közgép Co. (Közgép Rt.).

The flood plain bridges were built with a traditional technique using assembly yokes. The composite bridge planned by the Roads and Railways Design Co. (Uvaterv) consists of 26 assembly sections, and each assembly section is made up of two parts. The sections are 14-17 m long and their weight varies between 20 and 31 tons. They were delivered to site on road after having been preassembled and treated against corrosion.

The riverbed bridge was built based on the plans of Pont-TERV. A novelty in its assembly was that the preassembled structure was not dismantled but rather the 80-120 m long sections were floated to the side from the Csepel plant of the Ganz Steel Structure Co. (Ganz Acélszerkezet Rt) and then were lifted in place in one piece. A special technology needed to be developed for the turning around of the assembly sections so that they should not disturb shipping traffic and that they would fit between the piers of the Dunaföldvár-bridge. The technology of floating and lifting in “one piece” was first developed in 1995 in connection to the construction of the bridge at Cigánd. This technique was further developed, minimizing on site work, thus the assembly phase became more economical since considerably less prestressed bolts needed to be used to attach the sections.

The main contractor was the Hungarian Bridge Builder Consortium (Magyar Hídépítő Konzorcium) and the official dedication ceremony was held on July 4, 2003.

64. Sárvár, Ferenc Nádasdy Rába-bridge

The model of the Pentele Danube-bridge

Built: *2004*
Designer: *Főmterv Co., Zs.Nagy, A Horváth, B. Goda*
Contractor: *Mahíd 2000 Co., the Ganz Steel Structure Co.*

The reinforced concrete arched bridge in Sárvár leading across the river Rába, was built in 1948 with a rigid tube frame structure which proved advantageous during its building. The bridge carries the characteristic features and faults of its age, and has an increasing difficulty in carrying the cumulating traffic of highway no. 84.

In 2003 the construction of the road section bypassing the city was begun, as a part of which an arched bridge was planned where the road intersected the river Rába so as to serve as a preliminary study of the Danube-bridge at Dunaújváros.

The construction plans of the bridge were prepared by the Budapest Civil Engineering Co. (Főmterv Rt.) with the involvement of the Faculty of Bridges and Structures of the Budapest University of Technology and Economics. The versatility of the river was taken into account during the planning phase, therefore in the middle span the superstructure is suspended onto the arches proceeding from the base structures, thus the flood waves can subside undisturbed. The general contractor Hungarian Bridge Builders 2000 Co. (Mahíd 2000 Rt) assigned the Ganz Steel Structure Co. (Ganz Acélszerkezet Rt) with the manufacturing and on-site assembly of the steel superstructure. The substructure was made with drilled reinforced concrete piles. The superstructure (span widths: 21.0+78.0+27.0 m) is a three span orthotropic decked, stiffened beam bridge, hung onto steel arches, which is supported by uniquely shaped reinforced concrete substructures.

Because of the complicated technology, the ascending walls of the aesthetically pleasing and nationwide unique geometric riverbed piers were poured with self-compacting concrete.

The stiffener is a constant height, three-span, open steel structure with four main supports. In the 78.0 m span, the stiffeners are suspended in every 6 m with cables. The two steel arches that are rigidly attached to the base structures and are slanted 10° inwards relative to the vertical plane, are connected with four closed sectioned cross bracings. The production of the steel structure was divided into three main phases, the manufacturing of the stiffener, the arch structure and the other structures. The surface treatment was done in a factory environment so that the structure would be more enduring against corrosion damages arising later. The structural sections produced in a plant were assembled by the Ganz-BVG Ltd (Ganz-BVG Kft) on on-site assembly area and then were placed in position with a longitudinal pulling method. The assembling and moving of the steel structure was executed in 70 steps within 4 phases. The strains and the shape alterations of the stiffeners needed to be checked in each step.

It is eye catching for the first site that the bridge does not carry the traditional characteristics of an arched bridge. The nice shape is not self-serving; the combination of the novel formation of structural details and the use of modern building materials well represent that national bridge builders are able to keep up with the international competitors.

65. Motorway M7. Korongi-bridge near Letenye

The first extradosed structure in Hungary

Built: *2004*
Designer: *Bridge Building Co., János Becze*
Contractor: *Bridge Building Co.*

Hungary's first extradosed – prestressed-suspended - raised cable bridge was built on one of the ramps of the M7 - M70 junction. Following a public tender process, the structure was named after the area in which it is situated.

Originally Roads and Railways Design Co. (Uvaterv Rt.) planned a four-span, hollowed, monolith, reinforced concrete beam-bridge for this place. During the execution of the project engineers of the general contractor, the Bridge Building Co. (Hídépítő Rt) – while keeping in mind the local conditions – changed this structure into a modern reinforced concrete structure that required less number of supports. This was achieved by the application of a structural solution that had never before been used in Hungary.

The main characteristics of the bridge in numbers: its total length is 116 m, its spans are 52 and 62 m, the width of its road is 12.6 m, its total width is 16.0 m, to top of the pylon is at 11 m measuring from the bottom line of the superstructure. The abutments and the piers stand on 70 cm diameter Franki-plers. The bent cups of the abutments – built together with the parapet walls and the parallel wing walls – were placed directly onto the pile bracing sheets. The threading of the main beam's free cables was done in 1.8 m wide 6.0 m long chambers built in line with the wing walls. Two rows of 2x15 piles were built underneath the pier. The superstructure of the bridge is a two-span, continuous, hollowed reinforced concrete structure. The main beams running on each side of the bridge are 2.5 m high and 0.5 m wide, while the longitudinal beams underneath the roadway are 1.6 m high and also 0.5 m wide. The width of the cross girders placed in every 6.2 m is 0.45 m. The main beam of the bridge structure is strengthened by outside sliding cables that are run at a height of 11 m over the middle pylon. Lifted out of the cross section of the main beam, the sliding cables of the Prestressed reinforced concrete superstructure exert their static influence, via the pylons built above the support. The innovative design of the structure lies in that the sliding cables are run on the outside. The free cables are VT system, so called greasy cables. The cables ascending from the main beam were taken along the structure two at a level and were anchored to the front of the two ends of the main beam. The sliding cables run parallel to the bottom edge starting from the abutments up to the breakpoints, from where they step out of the main beam at a 15-20° angle. The cables led up to the pylon are not fastened therefore their sliding movement is allowed.

The official dedication ceremony of the bridge was held on September 18, 2004. The bridge was awarded the Hungarian Innovation Association's grand prize.

66. Motorway M3, Tisza-bridge near Oszlár

Thousand tons floated in one single piece

Built: *2004*
Designer: *Uvaterv Co., Zsolt Kovács*
Contractor: *Mahíd 2000 Co., Ganz Steel Structure Co.*

Two identical continuous beam bridges resting on joint base structures lead motorway M3 across the river Tisza at Oszlár. Several new designer's principles and technical solutions were applied during the planning and construction of the bridge.

The superstructure of the riverbed bridge is a three-span, 72+112+72 m spanned, variable height, open main girder steel structure that works together with the reinforced concrete deck. One bridge was built for each direction. The Tisza-bridge of Algyő built in 1974 is a similar type of – composite structured – large-river bridge.

The planning of the riverbed bridge was supervised by Zsolt Kovács of the Roads and Railways Design Co. (Uvaterv Rt.), the general contractor was the Hungarian Bridge Builder Consortium (MAHÍD Konzorcium). The manufacturing, on-site assembly and surface treatment of the riverbed bridge's steel structure was assigned to the Ganz Steel Structure Co. (Ganz Acélszerkezet Rt).

This was the first time that a composite bridge was built without auxiliary supports, with sectional concreting. The bridge in Oszlár is made up of one riverbed bridge and two floodplain bridges.

It was the first time in Hungary that instead of bundles of steel flanges, large, 100 mm thick chords were applied during the manufacturing and almost every joint of the bridge was made with on site welding. The thickness of the upper and lower flanges vary between 30, 50, 80, 100 mm, the upper chord is 800 mm, while the lower chord is 1200 mm wide.

A new technological solution was used on the substructures as well. When building the foundation of the piers, for the first time in Hungarian bridge building, the 1.2 m diameter drilled piles were made with 35.0 m shaft tubes placed all along.

In September of 2001, once the 16 m long – which was the deliverable length – main beam sections were manufactured, the on-site assembly could be started and it was finished in less than four months. The assembly was done on the right hand shore of the Tisza, perpendicularly to the river, approximately 60.0 m downstream from the final position of the bridge on a 300.0 m long assembly deck. The 257.0 m long, 1050 tons apiece heavy structures were pulled onto detached floating lifting devices (the ones used at the lifting of the Mária Valéria Danube bridge in Esztergom) and for the first time in Hungarian bridge building history they were floated in position in one piece onto the piers standing 60.0 m away.

The reinforced concrete deck of the composite bridge was poured symmetrically to the centreline of the bridge without using auxiliary supports, which is considered unique in Hungarian practice. Unusually, the first concreting phase was done over the riverbed piers, while the last one was done over the centre of the riverbed.

Earlier the construction of a Tisza-bridge used to last at least two years, in comparison the superstructure of this one was completed in half a year. The new technology of assembly meant the change of an era in the Hungarian large-river bridge construction.

67. Motorway M7, Ebhegy-viaduct

A launched bridge in the valley

Built: *2005*
Designer: *Pont-TERV Co, László Mátyássy, András Lontai*
Contractor: *Bridge Building Co., Emil Kovács*

The seven-span viaduct between Balatonszárszó and Ordacsehi was built with a type of technology which had already been used in Hungary 17 years ago in Berettyóújfalu.

As early as in 1975 larger than 30 m span bridges were built without scaffolds, with a scale type construction method using free assembly technology, in Győr a bridge was built using free concreting in 1979.

This is a new and significantly different construction method from the ones used previously: the section built behind one of the abutments is launched forward with the help of jacks, then the following piece is built and stressed to the previous section after which the launching forward of the finished bridge section is continued. There are several advantages to this solution: jobs are better organizable, the substructure can be built in phases, the shape of the structure can be very securely maintained, the sections do not have to be lifted, individual bridge sections do not have to be joined subsequently etc.

In 1988-90 for the initiation of the Bridge Building Co. (Hídépítő Vállalat) a three-span (32+50+32 m) bridge was built over the river Berettyó at Berettyóújfalu. The construction method became widespread quickly: in 1991-92 the floodplain spans (a total of 418 m) of the new Tisza-bridge in Szolnok and two railway bridges were built this way. This technology was used for the Rába-bridge of motorway M1 near Győr in 1994, the Dulácska-viaduct of motorway M0 and several other bridges, e.g. for the floodplain spans of the Tisza-bridge at Cigánd.

This building technique is applicable for bridges with spans between 25 to 60 m.It is interesting nowadays, that the longest span built with this technology is the one in h. at. Berettyóújfalu.

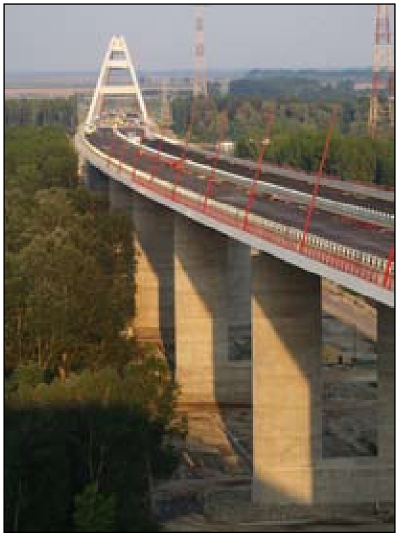
During the construction of the sections of motorway M7 several viaducts were built with the incremental launching technique near lake Balaton, for instance the bridge marked S16 shown on the next page. The plans of this bridge were prepared by the Pont-TERV Co.; its contractor was the Bridge Building Co (Hídépítő Rt.). The 266 m long, seven span bridge is resting on 16-22 m high piers. The spans of the bridge are 32+5x40+32 m. The construction and launching of the two times 15 m wide bridge's superstructure was started in 2004 at a construction pace of 20 m/week and was structurally finished by the beginning of 2005 already.

The 17 year-old – although continuously modernized – technology was applied once again successfully, even in the shadow of the Kőröshegy viaduct, proving that the on-site prefabricating of bridge structures is an ideal solution similarly to the monolithic solutions.

68. Motorway M8, Pentele Danube-bridge

World record in “basket handle”

Built: *2007*
Designer: *Főmterv Co., Adrián Horváth; Pont-TERV Co, László Mátyássy*
Contractor: *Danube New Bridge Consortium*



The 1642 m long Danube-bridge was built during 33 months. The dedication ceremony held on July 23, 2007 was a milestone in the Hungarian history of motorway construction, since this was the first 2x2 lane motorway that crossed the river Danube. The 104–year–old Hungarian record that had been held by the Elisabeth-bridge with its 290 m span was also broken. The 307.8 m span of the Pentele Danube-bridge is not only a national record but also a world record amongst the “basket handle” bridges; moreover the total width of the bridge is also a Hungarian record.

The investor had already been looking for the ideal location of the bridge 10 years before the permits were issued. Five prominent bridge designer offices were invited to participate in the public tender published prior to the actual planning phase. The solution proposed by the winner of the tender, the Budapest Civil Engineering Co. (Főmterv Zrt.) was analyzed by a committee of national and international experts. The plum stone shaped forming of the substructures, the shape of the riverbed bridge’s arch, its cable alignment, the bridge’s final harmony in colours, and its uniform aesthetic appearance all prove the designer’s exceptional carefulness. In the autumn of 2004 all contracts necessary for the realization of the project were signed. The Danube New Bridge Consortium (Duna Újhíd Konzorcium) established by the Vegyépszer Co. (Vegyépszer Zrt.) and the Bridge Building Co. (Hídépítő Zrt.) for this special task was the winner of the public tender.

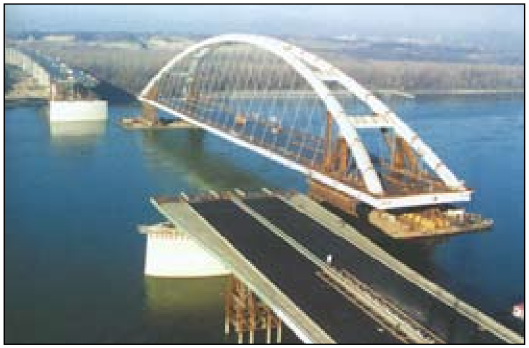
The general contractor applied several very important innovations during construction. For instance, the right shore 1062 m long floodplain structures were assembled from the water and were launched in place in one piece. The launching technology that was extremely helpful and the mechanical device that came along with the technology were designed by Hungarian engineers. Sections were manufactured in nine different plants all around the country.

The foundation of the right shore floodplain- and the riverbed-bridge was made with altogether 387 pieces of 1500 mm diameter 17-33 m long drilled reinforced concrete pile footings, while that of the left shore bridge was built with 7-14 m long continuously drilled reinforced concrete piles. The walls of the piers were cast in a sliding formwork. Altogether 70 000 m^3 concrete was needed for the substructures. Due to the water retaining wall formwork construction system applied, the two 41 m long and 14 m wide interestingly shaped riverbed piers were completed in record time, each one within six winter months.

The bridge structures are mostly made of S235, and S355 type of material, the arches and the connecting stiffening girders – for the first time in Hungary here – were made of increased strength, fine grain, thermo mechanically rolled, S460 quality steel. All joints of the superstructure were welded. The total length of all welds is more than 300 000 m, the length of the weld lines is a multiple of this.

The structure of the riverbed bridge is a tied basket handled arch bridge. Tied means that the horizontal components of the arch forces are taken over by the main girders underneath the bridge deck. Basket handled means that the 48 m high inclining arches adjoining in the centre resemble the shape of a basket’s handles. The stiffening beams that are made of slant hollow box shaped main girders and the orthotropic bridge deck are suspended by cables.

The assembly of the riverbed bridge was executed in 100 ton sections using floating cranes on the assembly area built on the left shore of the Danube. The assembly of the superstructure that is larger than three soccer fields took 14 months. The assembly of the 48 m high arch was helped by a 500 ton load bearing capacity special caterpillar crane.



The altogether 8650 ton heavy superstructure was floated in position from the assembly area by two times four specially connected barges that were large enough to carry 1600 tons of weight apiece. The successful manoeuvre held on December 6, 2006 was a worldwide record, such heavy and large steel structure had never before been placed with the floating-in method.

69. Motorway M7, Kőröshegy-viaduct

Higher than a church tower

Built: *2007*
Designer: *Bridge Builder Co., Péter Wellner; Pont-TERV Co, László Mátyássy*
Contractor: *Bridge Builder Co., György Hoffman*

The 1872 m long Kőröshegy viaduct, Hungary's longest bridge was built in almost exactly three years. Following the dedication ceremony held in August 8 of 2007, those who aretravelling to the southern shores of lake Balaton or to the sea shores of Croatia will need one minute to cross the four lane divided freeway bridge built at a height of 88 m.

The investor, the National Expressway Co. (Nemzeti Autópálya Rt.) after a seven year long preparatory and planning period contracted with the Viaduct Consortium (Völgyhíd Konzorcium) – whose members were the Bridge Builder Co. (Hídépítő Zrt) and the Strabag Co. (Strabag Zrt) – to build a 15 km long highway section including the construction of the viaduct. The final construction drawings were prepared by the Pont-TERV Co. (Pont-TERV Zrt.) This section included a 168 m long bridge before and a 300 m long viaduct after the Kőröshegy-viaduct.

According to the winning bidder's concept the bridge spanning near the village of Kőröshegy would be a "multi-span, continuous, variable height, parabolic wedged towards the piers, single boxed, two-cell, Prestressed reinforced concrete beam deck bridge". The winning bid – instead of the originally planned 15 spans – making use of a much more favourable abutment structure contained 17 spans. The 13 main spans of the structure are each 120 m long whereas the spans at the ends shrink to 95 and 60 m. The viaduct fits nicely into the Southern Balaton landscape with its 4000 m horizontal curve and its universal 2.86% slope.

The weight of the bridge is carried to the ground by large diameter piles varying in depth between 25 and 34 m, adding up to 19 km in length. At the centre supports of the viaduct, the tennis field large structure that holds together the piles contains 2000 m^3 of concrete. Seven of the piers reach or pass 70 m in height, and two of them are 30 cm short of 80 m. The tower crane used for building the piers at times had a jib height of 100 m. Obviously at this extreme height construction work could only be done with moderate wind speed, therefore work had to be stopped several times because of high gusting winds blowing from lake Balaton.

The contractor started to build the superstructure from the two abutments using free assembly technology. The formwork of the more than 700 ton-heavy concrete pieces, that is the 11.25 m long and 23.20 m wide bridge deck was held by two 1600 tons apiece assembly bridges constructed in Germany specifically for this purpose. The steel structure manoeuvred by more than 150 hydraulic jacks helped to reduce the cycle time – following the learning period – to 14-15 days. Nevertheless, the close dedication deadline, and the fact that a longer bridge enlarged by two spans had to be built forced the contractor to change their building technology.

The new construction technology called for making sections of the bridge 1.5 m shorter on the ground, and then the slightly "lighter" 620-670 ton pieces were lifted in place by the assembly bridges converted for the free assembly technology, which was in fact a special lifting jack and strands. As a result of using the accelerated technology – following the learning period – almost two thirds of the bridge "grew" 45 m in 5-7 day periods. This construction speed made it possible to meet the close deadlines.

Altogether almost 140 000 m^3 of concrete was used to build the bridge. Such large quantity and high quality concrete (the substructure C35/40, the superstructure C45/55 quality) could only be produced by a large capacity concrete mixing plant on site.

Passengers travelling across this viaduct will not only be amazed by its uniqueness and construction peculiarity but also by the incredible view of lake Balaton and its pearl, the Tihany peninsula, with its nine hundred year-old abbey.

70. Motorway M0, Megyer Danube-bridge

Harp over the Danube

Épül: *2008*
Designer: *Céh Co., Mátyás Hunyadi*
Contractor: *Bridge Builder Co., Ganz Steel Structures Co.*

The construction of the M0 bypass road around Budapest is continued as part of Hungary's large-scale motorway network development, which following the construction of a Danube-bridge at the southern end of the city will now lead across the river at the northern outskirts as well. The new bridge that is already being built consists of five independent structures. Its most spectacular section is the two pylon cable stayed bridge over the main arm of the Danube. When it is finished it will be Hungary's second longest bridge with its 1862 meter length.

The version chosen by a jury of experts and the investor, the National Motorway Co. (Nemzeti Autópálya Rt.) reached its present shape after several minor alterations initiated in the past eleven years based on needs, consents and approvals.

The protection of environmental assets was utmost accentuated during the planning phase since the bridge is situated on an environmentally protected area. Exceptionally rigorous specifications needed to be kept in mind with special attention regarding the design of the bridge since its foundation to be built was positioned on the protected drinking water supply base of the Budapest Waterworks. This practically stipulated the span layout of the bridge, its foundation works, and the restraints to be considered during construction.

In the anticipation of increased traffic on the bridge there is a possibility to run two times three lanes of traffic without a shoulder lane, in-between the guarding rails without the altering of the bridge structures. A bicycle lane suitable for the handicapped is built on the northern side of the bridge, while a pedestrian sidewalk is built on its southern side.

The bridge will have street lighting and signalling lights (nautical and aeronautical) and in addition, decorative lights will also be mounted.

Structurally there are five bridges, and the abutments on the shores can also be considered independent structures, therefore the entire piece can be divided into seven structures.

The flood prevention embankments are bridged by floodplain bridges. On the protected side of the flood prevention embankments, in front of the abutments room was provided for the widening of Váci Rd., and for the construction of a Danube bank road on the Buda side. The left side floodplain bridge crosses the existing highway no. 2.

The road connecting to the bridge will be built to the specs of a four-lane divided outskirts highway. Two times two lanes, with a shoulder lane will be built on the bridge. The left and right side lanes will be run across the bridge on detached structures divided by airspace, except for the cable stayed bridge over the main arm of the Danube where the structural solution of the suspension would not allow for the division by airspace.

The left shore floodplain bridge is a 37 + 2x33 + 45 m span, hollow box cross-sectioned, prestressed reinforced concrete structure.

The Danube main arm bridge is a cable stayed three span (145 + 300 + 145 m), steel structure. The fan designed cables are suspended onto the stiffener beams in two planes in every 12 m.

The two, 97 m high, pylons form an "A" shape and the pylon legs are made of hollow-box cross sectioned prestressed reinforced concrete.

The total width of the superstructure is 35.1 m; the traffic lanes as well as the sidewalks in each direction are run across on one single structure. The bridge deck was made with an orthotropic steel structure and with a longitudinal beam in the centreline, and crossgirders , which are connected to closed box cross-sectioned stiffening girders underneath the level of the cables on each side.

The suspending cables are anchored to the pylons and the box of the stiffening girder. Altogether 88, 2x44 stay cables are manufactured.

The Szentendre-island bridge is a twelve span, hollow box cross-sectioned, Prestressed reinforced concrete structure which was placed in position with the incremental launching technique.

The Szentendre Danube-arm bridge is a 94 + 144 + 94 m span, continuous, three span steel structure, with a steel plate decked, one cell, parallel belt box girder. The factory and on-site joints are welded. The bridge section will be placed in position with the floating technique.

The right shore floodplain bridge is a 43 + 3x44 + 43 m span, continuous, hollow box cross-sectioned, Prestressed reinforced concrete structure. The superstructure was built on the assembly deck behind the abutment, with sectional concreting and was placed in position with the longitudinal launching technique.

The left- and right-shore abutments are both multilevel, with maintenance rooms inside the structure such as transformer, electrical distributor, telecommunication rooms. In addition in the left shore abutment there is a room for the bridge master as well.

The Names of Our Bridges

The Chain Bridge is Széchenyi's bridge

The Chain Bridge, our first permanent Danube-bridge was opened for traffic on November 20, 1849. It is regrettable that it was Haynau who could first walk across the bridge and not István Széchenyi (1791-1860) the man who first dreamt about it and had arranged its construction. The bridge has always been and still is the Chain Bridge. Kornél Zelovich, a university teacher, suggested that the bridge should be given Széchenyi's name on its 50th anniversary. There was a great consent in this, nevertheless the dedication ceremony, that lacked all solemnity because of the war, had to be awaited until November 27, 1915. This was when the completely rebuilt iron structure was opened for traffic. In World War II. the Széchenyi Chain Bridge was destroyed as well and once it was reconstructed its name appeared as the Chain Bridge only.

Even today, although the full bridge name is known, the pride of our capital is referred to in the press or in the average people's communication as the Chain Bridge, yet Széchenyi should deserve that his work be honoured by using the name it was given in 1915.

Our first bridge marked with an official name

The Margaret Bridge was dedicated on April 30, 1876, as János Arany had chanted it was named after the Virgin Saint Margaret. The Academy was requested to word the text of the memorial plaque, which is still mounted on the centre pier but is not legible. On this plaque Saint Margaret's name is written nevertheless it has always simply been called the Margaret Bridge. Pál Gyulai the rigorous critique named the bridge. It is well known that the daughter of King Béla IV. who had a sacred life (1242-1271) lived on the Isle of the Rabbits in the Dominican monastery. She received the title of a Saint in 1943. It never appeared, not even after the devastations of World War II., that the tragic fated bridge should not be named after the princess Margaret.

The first Elisabeth

The permanent Danube-bridge in Komárom was opened for traffic at midnight on September 1, 1892 and this was when the bridge was named after Elisabeth (1837-1898), the wife of the emperor and king, of course with the permission of the supreme leaders. After 1945 Elisabeth's name did not become one that should be forgotten, that is why the bridge bombed in 1945 and rebuilt in 1946 still bears the name of the queen who was loved by many people.

Named after the daughter of the royal family

In Esztergom in 1895, the journalist of "Esztergom and its Vicinities" reported that although the new Danube-bridge was hoped to be named after Saint Stephen, the Minister Daniel suggested that it should be named after the "most Hungarian" princess Mária Valéria (1868-1924). The father approved the suggestion. Mária Valéria was a less known personality.

Named after its designer and builder

Róbert Wünsch, the "cement technician" – that is the concrete builder – designed and built a pedestrian bridge over the underground train in the City Park for the Millennium. His name is recorded on a circle shaped memorial plaque, as an early type of advertisement. The master had built several hundred bridges still, within today's Hungarian borders this is the only significant work that remained intact. Most probably it was because of this bridge that the posterity did not forget the name of the person who invented a unique reinforced concrete building system. Although there are no records of an official name giving ceremony this is how the bridge that by today had lost its function has always been known.

Received the Queen's name twice

In 1896 another bridge, the Tisza-bridge of Tokaj was also dedicated. The exceptionally beautiful bridge was named after Queen Elisabeth. The Queen was extremely popular in this area.

After 1945 the bridge that had been exploded twice was not mentioned as Elisabeth Bridge. For a local initiative, following its renovation in 1997, in the course of an official dedication ceremony – where a member of the royal family was also represented – the bridge was once again given the name, Elisabeth.

In memory of the murdered queen

In 1903 after several years of work, the world record keeper bridge that spanned across the Danube with one single span was completed. The bridge was given Queen Elisabeth's name at the official dedication ceremony held on October 10. Several large plaques recorded its name. Of these, only one can be seen in front of the Museum of Transportation. In 1932 following a number of tenders the queen's statue was also erected on the Pest side on Esküsquare, which expresses the respect shown towards her majesty. In the spring of 1945, not only the bridge was destroyed but also the statue was moved from its place. Mihály Ráday the well-known protector of historic city relics explored its place of storage, thus in 1986 the statue could be returned to its bridge although not in the original place and manner it used to stand before.

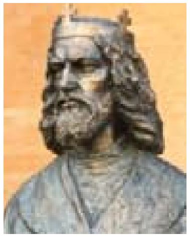
The bridge was reconstructed after nearly 20 years, nonetheless nobody for the exception of one journalist wished to change its name.

The Tisza-bridge named after the great prince

In 1926 the interestingly shaped Tisza-bridge of Vásárosnamény was named after Ferenc Rákóczi II. (1676-1735) to commemorate that in 1703 this was where the great prince crossed the river with his troops. A memorial plaque used to proclaim Rákóczi's name on the rebuilt monumental bridge that had been bombed twice (1919 and 1944), but the plaque was vandalized.

The bridge named after a prime minister

In 1928 a Sebes-Kőrös-bridge was built in Körösszakál. The four span reinforced concrete bridge was named after count István Tisza (1864-1918), the prime minister whose life ended in a tragic way and whose historic role was debated. His name is recorded on a memorial plaque placed on the bridge. It is almost unbelievable that for decades no one bothered to notice this plaque. Yet, in those days tons of statues were melted down. The preserving of the memorial plaque could be due to the fact that only one span of the bridge was damaged in World War II.



The baptism commemorating the anniversary of Saint Stephen's death

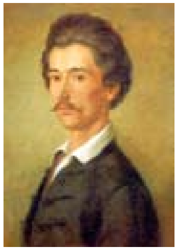
The bridge consisting of one large and two small arches were built in Veszprém in 1936-37 and in order to commemorate the 900th anniversary of Saint Stephen's (977-1038) death it was given Saint Stephen's name. Thanks to its brave saviour, the largest span survived World War II. without being damaged. However, the bridge's name was not kept, temporarily it was named after the communist leader Mátyás Rákosi. After 1956 it was cited as the Viaduct and nowadays the bridge that in the meantime was declared a historic monument once again bears our first king's name.

The two names are remembered on a memorial plaque

The first Budapest Danube-bridge reconstructed after the war was dedicated on August 20, 1946. The bridge was originally dedicated on October 4, 1896 when it was named after King Ferenc József, who attended the ceremony as it can be read even today on the memorial plaque placed on the Pest side of the bridge. Following its reconstruction, it was given the name Szabadság (Liberty) which may have been due to the nearby Statue of Liberty. This name is also remembered on a memorial plaque showing how significant the role of politics was in the naming of our bridges.

Named after Chieftain Árpád fifty years ago

The Budapest/Óbuda Danube-bridge – the construction of which started in 1939 and then was paused because of World War II. – was dedicated on November 7, 1950. This was the only one of our bridges that was given Stalin's name; however, neither the public nor its designer/builder Károly Széchy had used this name. In a 1952 publication he mentions it as the Óbuda-bridge and then in 1957 when he transcribed the history of our bridge that had been the longest until recently he called it the Árpád (……-920) Bridge. Earlier this name was given to the Danube-branch-bridge built in Ráckeve for the millennium.



Named after the governor and then Petőfi

The Budapest Danube-bridge rebuilt at Boráros-square was dedicated on November 25, 1952 and was named after Sándor Petőfi (1823-1849). It is probably known that the bridge was given Miklós Horthy's (1868-1957) name at its original dedication ceremony held on September 12, 1937. Nonetheless, it is probably less known that as early as in 1930 an article of an Act stipulated that the bridge must be built and given the governor's name.

Remembering the revolution and freedom fight

On March 15, 1948 at the centenary of the freedom fight the Rába-bridge in Győr, the reconstruction of which was finished on December 14, 1946 was named after Sándor Petőfi. At the time of its completion, the welded Rába-bridge was the largest spanned of its kind in Europe. In 1935 it was given Miklós Horthy's name.

One of our Kossuth bridges

In March 1950 the nice stiffened arch Révfalu-bridge in Győr – which simply was called Révfalu-bridge earlier – was dedicated and named after the governor, Lajos Kossuth (1802-1898) which at the time was an exceptionally common name to be given. We know that Budapest's first Danube-bridge in the winter of 1946 was called Kossuth Bridge as well. A memorial plaque commemorates this. As a curiosity Lajos Kossuth's son was en engineer and a Berettyó-bridge in Hajdú-Bihar-county was named after him.

Named after its ingenious designer and builder

In 1972 the capital named the steel arched bridge built in the City Park for the Millennium after its designer and builder Szilárd Zielinski (1860-1924). Interestingly, there are only two bridges in Hungary, both in the City Park, that bear the name of their designer/builder. Moreover it is also quite strange that a steel bridge bears Zielisnki's name in spite of the fact that he was the one who established the domestic reinforced concrete bridge building.

The Danube-bridge named after the wise philosopher of the nation.

The first large bridge built after the fall of communism, the southern Danube-bridge of motorway M0, was opened for traffic on November 16, 1990. The bridge was given a characteristic geographical name: Hárosi. However, the renaissance of the bridge naming had reached this structure as well and it was suggested that it should be named after Ferenc Deák (1803-1876). The Geographical Name Committee accepted the suggestion, nevertheless the name does not appear on maps, and thus it is not known that the bridge was named after the wise philosopher of our nation.

Our second Tisza-bridge bearing Ferenc Rákóczi II.'s name

The bridge that fostered the exploration of the Bodrogköz area was dedicated on November 24, 1994. It had kept the structure of the Tisza-bridge near Polgár and has a name identical to that of the Tisza-bridge in Vásárosnamény.

Given a geographical name only

The year 1995 was an important year in the traffic of Budapest, since the new road bridge beside the Southern Connecting Railway Danube-bridge was completed. Attempts were made to name this bridge, but none were successful, therefore it was given the most obvious geographical name: Lágymányosi. Unquestionably, such name giving principles are helpful in terms of orientation; nonetheless, it is also important to name significant engineering structures after noted individuals of our history.

Eiffel's Feketeházy-bridge won its name on a tender

In 2001 the city of Szeged published a tender for the naming of the Tisza-bridge rebuilt in 1948 as the successor of the structure built in 1883. The original bridge was designed by János Feketeházy for Eiffel's request, therefore it would have been obvious to name the structure after one of our most outstanding engineers, but instead the undoubtedly logical, yet quite grey name, Belvárosi (Downtown) was given. Szeged's other Tisza-bridge was named after Lajos Bertalan who was a noted hydraulic engineer. The bridge that is called Belvárosi today was named after Rákosi in 1951, the name painted on the bridge was not removed until 1957.

A noted engineer became the name giver

The year 2002 in certain respect was a milestone in Hungarian bridge naming. On March 23 of this year the Danube-bridge modernized in the previous year was named after the famous engineer, József Beszédes (1787-1852) who lived in the same era as Vásárhelyi did and died in Dunaföldvár. This event is important because this was when it turned out that the rules of bridge naming are not recorded. So following this event a study was prepared which serves as a point of reference ever since.

Named after our king so attached to Szekszárd

In 2003 after 73 years, a new Danube-bridge was built south of Budapest in the vicinity of Szekszárd. Following long preparations and numerous debates, the bridge was named after our king Saint László (1040-1095) who was especially attached to Szekszárd. It is worth mentioning how lively debates had formulated between the municipalities as to after whose town or which important person the bridge should be named.

The novel shaped bridge of motorway M7 near Letenye is called Korongi

Hungary's first extradosed, prestressed-suspended novel shaped reinforced concrete bridge was dedicated on September 18, 2004. A unique name was meant to be given to this structure. There was a tender in which the local residents suggested the name Korongi, referring to the name of an area of the village and thus this became its official name.

The name of the prince on the bridge of the main channel

In November 2004 the proprietor of the Easter Main Channel-bridges – which were fifty years old at the time – published a tender for naming the three bridges. The bridge enlisted in our book, situated in Tiszalök was named after the prince István Bocskai (1556-1606) because of his local connection. He not only was prince of Transylvania but also that of Hungary. The name "Prisoners' Bridge" had also been discussed since as it is known political prisoners had also worked on the construction of this bridge. Not to mention that their work was impeccable.

Sárvár's remembrance to its great son

In Sárvár on November 11, 2004 a new Rába-bridge was dedicated. It was obvious that the bridge should be named after the Nádasdys who were connected to the town, namely count Ferenc Nádasdy (1625-1671).

The stormy naming process of our Danube-bridge being built

In 2006 a novel, in its form inappropriate tender was published for the naming of the northern Danube-bridge of motorway M0. The internet voting process had become frivolous. Pál Pató, the lazy character from a funny Petőfi-poem could be considered humorous, but the appearance of American figures on the list of suggestions proved that a public vote could only bring serious results if the process is carefully prepared. The capital and the Ministry of Economy and Transport picked the names that could be considered serious suggestions and forwarded them to the Committee for Geographical Names, which categorically accepted the name Megyeri. This name not only refers to the places Káposztásmegyer and Békásmegyer (the two Budapest areas the bridge connects) but also to the Megyer tribe, the ancestors of the Magyars (Hungarians).

The world record holder bridge named after the 900-year-old town

In June of 2007 the naming of the world record keeper Danube-bridge built in Dunaújváros took place in the last moment. The municipality and the ministry suggested the name of the town's predecessor, Pentele.

Biographies

Pál Álgyay Hubert
1894: He was born in Szeged.
1921: He received a diploma in engineering, and then became an assistant lecturer to Kossalka at the Bridge Building Department; he was an assistant professor from 1924, when he received his doctorate.
1926: He started to work in the Ministry of Trades and Transport. 1935: He became head of the Danube Bridge Building Department, then undersecretary. He had an outstanding role in the construction of the Boráros-square and Óbuda Danube-bridges, and the widening of Margaret Bridge. 1936-40: He was the vice-president of the Capital's Council of Communal Jobs.
His most significant work was the designing of the Boráros-square bridge. He solved and calculated the working together of the main beams of the four main girder bridge with a method that had never before been used. His work in publishing specialized literature was also quite significant.
1945: He died in Budapest under tragic circumstances.

Árpád Apáthy
1912: He was born in Segesvár.
1935: He received a diploma in engineering.
1935: He was an assistant engineer, then royal engineer and finally head engineer at the State Building Office in Eger. 1949: became director of the State Building Office in Eger. 1952: appointed at the Bridge Department of the Ministry of Transport and Postal Affairs (KPM). 1955: He became deputy department head; it was his initiative that the small bridge rehabilitation project was started. 1962-73: He became director of the Bridge Department.
1973: He retired at his request, but stayed active in his field until the very end.
Besides having held leadership positions at the Ministry his work in publishing specialized literature, in the modernization of the bridge inventory and the updating of the Bridge Building Code was also quite significant. As technical inspector, he participated in the modernization projects of several large bridges.
1995: He passed away in Budapest.

Endre Apáthy
1945: He was born in Eger.
1970: He received a diploma in engineering.
1970: He started to work at the Bridge Building Co. as a construction supervisor, senior construction supervisor, head engineer and then from 1992 as the general director.
His most important jobs: the Tisza-bridges in Algyő and Szeged, the widening of Árpád Bridge and related projects.

György Balázs
1926: He was born in Rábaszentandrás.
1950: He received a diploma in engineering.
1950: He started as an assistant lecturer to professor Mihailich and then in 1959 he became an assistant professor.
1963: He continued to work at the Building Materials Department where in 1965 he became an associate professor.
1984: He became a university teacher. 1976-91 he was the head of the department.
1995: He retired.
Besides his work as a university teacher he was involved in a wide range of public life activities: Scientific Association for Transport, Institute for Continuing Studies at the Budapest University of Technology, University Scientific Student Body Council etc.
Bridge building and related scientific studies had played a significant role during his entire career.
Since his retirement, he had been publishing an even wider array of studies than he had done so before: Concrete and Reinforced Concrete Series; Biographical volumes on Mihailich, Palotás and other building engineers
Awards: a total of 45, amongst others: Jáky-prize (1965), Széchenyi-prize (2000), Prof Emeritus (2001), The Bridge Builder of the Year (2005)

János Becze
1948: He was born in Budapest.
1967: He started to work at the Roads and Railways Design Co. as a technician.
1973: He received a diploma in engineering at the Budapest University of Technology. He had excelled with the designing of several important bridges at the Roads and Railways Design Co. between 1973 and 1987, and at the Bridge Building Co. from 1987. (Berettyó-bridge of Berettyóújfalu; a series of launched structures in Szolnok, Debrecen; extradosed structure of motorway M7.)
2005: His work was appreciated by the Palotás László-prize.
His involvement in the designing of the Kőröshegy viaduct was as important as in the designing of the launched railway bridge structures of Nagyrákos.

József Beke
1867: He was born in Pápa.
1889: He received a diploma in engineering in Budapest. Similarly to his brother, Manó Beke he was extremely talented. He was an assistant lecturer at the university until 1892, and then appointed at the Ministry of Trades first at the Department of Design, and later at the Department of Danube-bridges.
Together with István Gállik he was the senior static engineer at the construction of the Ferenc József and Elisabeth Bridges and later at the reconstruction of the Chain Bridge. He was the designer of several Tisza-bridges, and the Langer-type bridge of Győr, he had played a significant role in the theoretical establishment of reinforced concrete bridges.
1922: he was put in retirement but luckily as a private engineer, he had prepared the plans of several important bridges (Rába-, Sió- etc.).
1940: He died in Budapest.

Ernő Bors
1915: He was born.
1940: He received a diploma in engineering.
1941-63: He worked at the Bridge Department of the Ganz-MÁVAG in various positions.
1963-80: He was a designer at the Roads and Railways Design Co. (Uvaterv)
He participated in the planning of the reconstruction of Árpád Bridge, the Újvidék railway Danube-bridge, the Chain Bridge, the Gubacsi Danube-branch-bridge, the Margaret Bridge and the rehabilitation of the Danube-bridge of Medve. He was the senior construction supervisor at the construction and reconstruction of the Margaret Bridge, the Chain Bridge, the Danube-bridge of Baja, the Tisza-bridge of Polgár and several other important bridges.
2003: He passed away.

Imre Böröcz
1923: He was born Budapest.
1946: He started to run a designer's office together with József Thoma. He wrote an important technical book on prestressed concrete (1957), moreover, he developed his own stressing method.
1964-69: He was a colleague at the Research Institute for Road Affairs (KÖTUKI).
1969-82: He was a colleague at the Research Institute for Water Management Affairs (VITUKI). His work as innovator and inventor was widespread and successful.
1982: He retired.
1994: He passed away.

Szaléz Cathry
1834: He was born in Andermatt (Switzerland).
He came to Hungary for the assignment of the Internationale Gesellschaft für Bergbahnen Co. of Basel, and has built a cog-rail as the third in the world, which was put into operation in 1874.
His company was one of the builders of the Danube-bridge built in Bratislava in 1890 and the Danube-bridge dedicated in Esztergom in 1895.
1901: He passed away in Budapest.

Adam Clark

1811: He was born in Kelson (Great Britain). He finished his studies at a technical college in Glasgow, and was employed by the Hunter and English Machine Factory.
1834: Széchenyi ordered a dredger in this factory and Clark was suggested as the mechanic to accompany the machinery, so between 1834 and 1836 he travelled on the Danube with the dredger.
Starting in 1840 he was the supervisor of the building of the Chain Bridge. In 1848 Széchenyi assigned him to be the head of one of the departments in an advisory position.
Following the completion of the building of the Chain Bridge Clark had settled down in Hungary for good and got married here.
In 1852 he built the tunnel underneath Castle Hill, buildings, further bridges in Vienna.
1866: He died.

William Tierney Clark

1783: He was born near Bristol and became orphaned at an early age thus was forced to manage his life by himself.
1808: Rennie, the famous bridge builder hired Clark in his plant. Between 1824 and 1827 he was actively involved in the construction of Hammersmith's suspended bridge. The suspended (chain) bridge of the river Thames by Marlow was completed in 1832. This was when he met Széchenyi, who asked for his opinion and then invited him for the construction of the Danube-bridge.
1837: He became a member of the Royal Society, which at the time was considered the highest scientific acknowledgement.
He prepared the plans for the Chain Bridge and followed through the works, however once it was completed he never returned to our country.
1852: He was buried in St. Paul's Cathedral.

Aurél Czekelius

1844: He was born in Csiklovabánya.
1869: He started to serve at the Hungarian State Railways, (MÁV) his first significant work was the supervision of the Margaret Bridge's construction.
1881: He was ordered to work at the Ministry of Communal Jobs and Transport Affairs.
1885: He became a construction inspector of public projects and ran the Designer's Office of the ministry. The supervision of the building of the Tisza-bridges in Szeged and Vásárosnamény were also his jobs. 1888: He started to publish standardized plans for bridges and completed the research tasks for the building of several large river bridges (Tiszafüred, Tokaj).
1894: He was assigned with the leadership of the Danube-bridge special department and from this time on a number of large river bridges had been built under his leadership (Esztergom, Ferenc József, Elisabeth Danube-bridges, etc.). In 1904 he became another manager, one that supervises the issues related to public roads.
1905: He asked for his release.
1927: He passed away.
István Gállik wrote about him: "The engineers department which until recently served as an auxiliary organization which was only in an advisory position to the ministry, gradually managed to achieve to take a hold of the administration of issues and to posses the right of action as well. Czekelius was the first engineer who had reached the position and the authority of the head of an independent specialized department."

Tibor Dalmy

1930: He was born in Debrecen.
1952: He received his diploma.
1952: He started to work at the Budapest Civil Engineering Design Co. 1976-90: He was a senior engineer. His main activity was the designing and building of the structures related to the subway. (Astoria, Baross-square, Batthyány-square, HÉV entry, bridges of Albertfalva, Hungária Blvd., Árpád Rd., BAH intersection, Könyves Kálmán Blvd., Sibrik Miklós Rd.).
1972: He received his university doctorate.
1977: He became the ministry commissionaire for the rehabilitation of the capital's Danube-bridges: Margaret Bridge (1978-79), Petőfi Bridge (1980), Szabadság Bridge; the widening of Árpád Bridge and its connecting structures (1981-84).
1985: He received the State Award for the reconstruction of the Capital's Danube-bridges.
1990: He became an engineer of the Pannon Freyssinet Ltd.

Darvas Endre

1925: He was born in Budapest.
1948: He received a diploma in engineering.
1972: He received his university doctorate.
1981: He received the title of the honorary associate professor.
He was a designer at the State Civil Engineering Scientific and Planning Institute (ÁMTI) and the Civil Engineering Design Co. (Mélyépterv) between 1949 and 1953, and then at the Roads and Railways Design Co. (Uvaterv) between 1953 and 1981.
A few of his significant designs: the Industrial Channel Bridge of Győr, Elisabeth Bridge Pest side ramp, the Dockyard Danube-branch-bridge, the prestressed steel Rába-bridge of Győr, the Maros-bridge stiffened with slanted rods in Makó.
1963-80: He was a lecturer on designing of welded structures at the University of Technology.
From 1981 he has been a national and international expert.
His activity was significant in the field of railway bridges as well as in international export jobs. His work in publishing specialized literature was also extensive.
2003: He died.

Sándor Domanovszky

1933: He was born in Budapest.
1956: He received a diploma in engineering.
1956-2004: at the MÁVAG, Ganz-MÁVAG, Ganz Steel Structures and their successors.
1956-58: planning engineer. 1959. factory engineer, 1960-61: Construction supervisor. 1962-70. technologist and welding engineer, 1971-75. assistant senior engineer.
1976-80 senior engineer, 1981-87. technical advisor, 1988-92: senior engineer of quality assurance, 1993-2004. director of quality assurance and welding. During his career, he has been involved in the construction of all the bridges – from the Elisabeth Bridge to the nowadays built Danube-bridge of Dunaújváros – that had been built by the old historic factory.
1994: Eötvös-prize, Ganz Ábrahám-main prize, 1995: Hungarian Engineer Academic Award, 2001: Széchenyi-prize, 2002: Bánki Donát-prize.
His work in lecturing, publishing specialized literature and photography was also extensive.

Gusztáv Faber

1901: He was born in Budapest.
1927: He received his diploma in engineering.
1927: He started his career at the Bridge Department of the MÁVAG, 1940-44: He built a railway bridge in Transylvania. 1945-47: He was the director of the MÁVAG's Bridge Department.
1949: He was appointed at the State Civil Engineering Scientific Planning Institute (ÁMTI); his task was the rehabilitation of the Danube-bridges. 1951-69. university teacher at the Budapest University of Technlogy.
1969: He passed away in Budapest.

János Feketeházy

1842: He was born in Vágsellye.
1866: He received his diploma in Zürich.
He was a determining personality of bridge designing first in Vienna, and then in Budapest serving the Hungarian State Railways (MÁV) from 1873. Besides having designed railway bridges his work was outstanding in the field of road bridges as well: on behalf of the Eiffel Co. he had prepared the award winning plans in Szeged (1880), his sickle shaped truss bridge structure was applied in Komárom (1891-92), then in Esztergom, and later in several other places.
His most famous work was the Ferenc József (now Liberty) Bridge, which was considered the best designed at an international tender.
He was not involved in the planning phase; nevertheless, the beautiful bridge compliments his ingeniousness.
The designer who was not really appreciated in his lifetime died in Vágsellye in 1927 due to an accident suffered in his home.

Róbert Folly

1889: He was born in Brennbergbánya.
1915: He received a diploma in engineering in Budapest.
1920-24: He was an assistant professor to professor Mihailich.
1924: He opened his own designer's office; this was when he designed besides other structures the viaducts of Városlőd and Veszprém, and the Boldva-bridge of Szendrőlád.
1949-50: He was a senior static engineer in designer's offices and an editor of technical periodicals. Most of the recollections that remained are from the designing of the Veszprém viaduct, according to which he was an extremely demanding, outstanding expert who did everything by himself.
1965: He died in Budapest.

Imre Gáll

1909: He was born in Irsa.
1931: He received a diploma in engineering, and worked at the Capital between 1931 and 1946.
1938: He received his doctorate in law and political science.
1946: He started to deal with the reconstruction of bridges and then with jobs related to designing and research (Roads and Railways Design Co. (Uvaterv), Budapest Civil Engineering Design Co, (Főmterv) and Research Institute for Roads (UKI).
1955: His first script on bridge history was published, he continued his research with enormous drive, and in 1958 he won an award with the historic description of the Karcag Zádor-bridge.
1970: His reference book based on his research of archives entitled "Old Hungarian Bridges" and later in 1984 his great success book the "Budapest Danube-bridges" was published. An adapted and expanded issue of this book was published in 2005.
1970: He retired but he continued his research work and publishing activity up until his death. Characteristic of his diversity was that he won the Hungarian championship in sailing several times and he was an outstanding pianist.
2006: He passed away.

István Gállik, Sr.

1866: He was born in Budapest.
1888: He received his diploma.
His father was János Dömötör, but supporting a family with seven children, the education of the children meant a great burden for the family therefore his mother's sister and her husband adopted the smart child.
After having received his diploma, he became an assistant lecturer to Antal Kherndl.
1892: He was appointed to the Bridge Department of the Ministry of Trade Affairs, which he became a director of in 1918. He was the senior static engineer of extremely important designs: the reconstruction of the Ferenc József and the Elisabeth Danube-bridges and the Chain Bridge.
1922: The university honoured him with the honorary doctorate title.
1926: He retired with the honorary under-secretary title, but at the ministry, he continuously dealt very successfully with the issues related to the development of steel structures. His work in publishing specialized literature was also quite significant. His name proclaims his achievements on the memorial plaques of the Szabadság Bridge.
In addition to the above, he participated in the designing of the steel structure of the Tisza-bridge in Tiszaug, in the preparatory jobs for the widening of the Margaret Bridge, in the review of the designing of the Óbuda Danube-bridge, and in the preparatory jobs of the building for the Boráros-square bridge.
1945: He passed away in Budapest.

Jenő Gergely
1880: He was born.
1901: He received a diploma in engineering in Budapest.
He worked at the Bridge Department of Ganz until 1903, then at Zielinski's designer office until 1908.
Starting in 1908, he had designed several important bridges together with Árpád Gút, and then between 1945 and 1948 he kept up the designer's office by himself. Starting in 1948, he designed reinforced concrete structures for structural engineering. The fact that 173 bridges were built based on his plans denotes his exceptionally active involvement.

Ferenc Gottlieb
1859: He was born in Debrecen.
1881: He received a diploma in engineering.
1881: He started to participate in the design and the construction of several large bridges at the Bridge Department of the MÁVAG. 1905: He became the head of the Bridge Department and in 1918 he was appointed deputy manager of MÁVAG. One of the most outstanding jobs of his career was the reconstruction of the Chain Bridge (1913-15), for which he received the Greguss-prize together with József Beke and István Gállik.
1919: He passed away in Budapest.

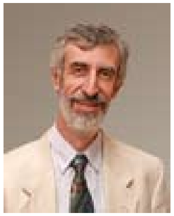
Guilbrand Gregersen
1824: He was born in Strand (Norway) and studied to become a carpenter.
1847: He arrived in Pest where he became involved in bridge building at a famous company.
From 1848 he had participated in the freedom fights and then escaped to Italy; he returned in 1851.
1852: He built bridges and railways. 1853: He worked at the railway station in Buda and at the construction of the castle hill tunnel.
His significant works are the railway Tisza-bridge of Szolnok and the projects related to the rebuilding of the city of Szeged.
1890-92: He was the contractor for the substructures of the Komárom Danube-bridge.
A Norwegian carpenter had become a successful, hard working Hungarian builder. (He had 18 children many of whom had become engineers).
1910: He passed away in Budapest.

Jenő Hargitai
1912: He was born in Gyömrő.
1927-32: He was manual labourer.
1932-36: He finished the College of Applied Arts.
1937: He participated in significant bridge buildings at the Ministry of Trades and Transport Affairs, and in the technical inspection of the Vámosszabadi Danube-bridge's construction.
1945: He became actively involved in the reconstruction of bridges first in Budapest, and later in the country: building of pontoon bridges (Kalocsa-Gerjen), lifting of bridge wrecks.
1960: He started to utilize his expertise in the dismantling of the Kossuth Bridge, then in the construction of the Elisabeth Bridge, and later in the technical supervision of the larger structures built in Budapest. 1970-73: The last extensive jobs of his active career were the building of the Kacsóh Pongrác Rd. bridges and then the lengthening of the Millennium subway.
1972: He became involved with the Bridge Building Co.
During his retired years he had put in writing and drawing the history of 1500 bridges. He had compiled individual albums on the more important Danube-bridges and Budapest overpasses.
2000: He passed away in Budapest.

Győző Haviár
1895: He was born in Pöstyén.
1920: He received a diploma in engineering in Budapest.
1920: He became an assistant lecturer to Kossalka, and then assistant professor.
He participated in the designing of the Dunaföldvár Danube-bridge, and then in the design tender of the Boráros-square and the Óbuda Danube-bridges.
1933: He became a colleague of the Ministry of Trades and Transport Affairs.
1930: He received his doctorate in engineering and the private lecturer's title.
After 1945 he had a leading role in the reconstruction of bridges especially with regards to the Szabadság Bridge and the Tisza-bridge of Szeged.
In his scientific research, his achievements were outstanding in the development of the theory regarding the large span, through arch bridges.
1954-57: He was the head of the Bridge Department of the Ministry.
After his retirement, he worked as an expert at the Hungarian Academy of Sci-ences.
1965: He received a university lecturer's title besides various other awards.
1970: He passed away in Budapest.

Rudolf Hidvéghi
1930: He was born in Budapest.
1952: He received his diploma in engineering.
1952-64: He worked at the Bridge Department of the Ministry.
1954-57: His important job was the inspection of the Eastern Main Channel-bridges.
1964-68: His main job at the Transport Development Trust was the supervision of the Bridge Building Co. and the Road Bridge Maintenance Co.
1968-80: He organized the mass renovation project of the small and medium span bridges at the Road Building Trust: His main task was to organize the manufacturing of the EHG beams (Roads and Railways Design Co. (Uvaterv), Building Industrial Quality Control Institute (ÉMI), Concrete and Reinforced Concrete Industrial Works (BVM)) and the building of bridges with prefabricated beams.
1980-90: He worked at the Transport and Subway Building Co. 1986: He became its technical director and then from 1989 he was the senior technical advisor.
He received several awards: e.g.: in 1973, he was awarded the Eötvös-prize.
His work in scientific associations, as publisher of scientific studies and as an inventor was also significant.
2000: He died.

Elek Hilvert
1895: He was born in Budapest.
1919: He received his diploma.
1919-25: He worked in a designer's offices.
He continued his engineering activity in Romania in 1925, and then between 1933 and 1937 in the Soviet Union.
1945: He became actively involved in the reconstruction of large river bridges: Kossuth Bridge, Szabadság Bridge, Margaret Bridge, Tisza-bridge of Vásárosnamény. He designed both wooden and steel structures.
1950: He was appointed as the director of the Mélyépterv, He retired for the first time in 1958 and then in 1970 for good.
He was a lecturer at the Budapest University of Technology.
1977: He passed away in Budapest.



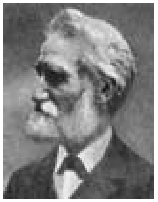
Ad rián Horváth
1954: He was born in Budapest.
1979: He received a diploma in engineering.
1986: He received a diploma in professional engineering as an engineer-mathematician.
1979: He became an engineer of the Budapest Civil Engineering Design Co, from 1983 its senior engineer, from 1991 department head, later head of a bigger department, from 2007 director of civil engineering.
His most important bridge designing jobs: building permit plans of 22 bridges on motorway M6; building permit and implementation plans of the Rába-bridge of Sárvár; designing of the Danube-bridge of Dunaújváros.
Besides this, he supervised the designing of subway stations, the general inspections of bridges, as well as bridge development and designing projects.
He received 2008. Széchenyi-prize

Mátyás Hunyadi
1933: He was born in Nagyszalonta.
1958: He received a diploma in engineering.
2002: He received a diploma in European engineering.
1958: He started to work at the Bridge designing office of the Roads and Railways Design Co. (Uvaterv) as a design engineer.
As a member of the design team he participated in the designing of the Elisabeth Bridge, the Szentendre-Danube-bridge in Tahitótfalu, Tisza-bridges, exported bridges built for Eastern Germany and Yugoslavia, and the Sfax-Tripoli railway line's bridges.
As the designer in charge, besides the study on the Danube-bridge in Baja, and the designing of the Bertalan-bridge of Szeged, the Kamarás Danube-bridge, the Sajó-bridge of Sajóecseg and the Zagyva-bridge of Hatvan he had planned several road- and railway bridges as well as structures for all of the motorways.
He has dealt with the possibility of applying fibre reinforced concrete in bridge building. In connection to his designing jobs, he has always been and still is in touch with the university. Moreover, he is a consultant to students working on their theses and he evaluates their thesis proposals. He is one of the board members of the Bridge Department of the Chamber of Engineers.
He prepared the feasibility study and building permit plans for the Danube-bridge on motorway M0, the ring-road bypassing Budapest, which is the first cable-stayed bridge of Hungary.

Gyula Huszár
1921: He was born in Rohonc.
1950: He received a diploma in engineering.
1950-52: He started his career at the Civil Engineering Design Co.
1952-83: He was a designer at the Roads and Railways Design Co. (Uvaterv).
1957-66: He was a leading designer.
1961: He received a diploma in architectural engineering.
1966-74: He was department head, 1974-83: he was a vice deputy manager.
He was a designer of mainly reinforced concrete bridges: Eastern Main Channel-bridges, Bodrog-bridge of Alsóberecki, Tisza-bridge of Csongrád, prestressed reinforced concrete bridges over the railway in Szolnok.
He had shown a special interest in the aesthetic aspects of bridges, in his retirement years he deals with fine arts.

Zsigmond Jemnitz
1865: He was born.
1904-18: He designed hundreds of reinforced concrete bridges with a remarkable feel, in Szilárd Zielinski designer's office. Based on evidence from the remaining plans it is most conceivable that the plans prepared in Zielinski's office were made by Jemnitz alone.
1918: Zielinski started to sell off his office. Therefore, Jemnitz continued the operation of the office that gathered a number of excellent engineers. 1939: He died.

György Kerényi
1936: He was born in Budapest.
1958: After having received his diploma, he started his engineering career at the Roads and Railways Design Co. (Uvaterv). Having had various positions he participated in the designing of the motorway M7 bridges, in the application of reinforced soil buttress in bridge building, in the development of the EHGT beams, in addition he was the senior designer of the first prefabricated (Kápolnásnyék) bridge.
1986-90: He continued his bridge designing work at the Víziterv.
1991: He he returned to the Roads and Railways Design Co. as a department head. 1997: He died in Budapest.

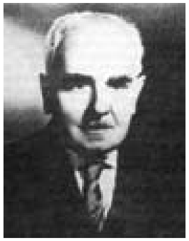


Antal Kherndll
1842: He was born in Zseliz.
1864: He received a diploma in engineering in Zürich, (he was an assistant to Cullmann).
1867: He was assistant lecturer at the Uni-versity of Technology in Budapest; from 1869 he was a university teacher.
1884: He became a corresponding member of the Hungarian Academy of Sciences; in 1898 he became a regular member.
Besides having been a valuable asset in the publication of specialized studies and in teaching, he had also been the absolutely most respected member of the committee evaluating the public tenders for the construction of largeriver bridges.
His work in the field of calculations on suspended bridges was especially significant, which was the basis for the planning of the Elisabeth and Chain Bridge's construction and later the Chain Bridge's reconstruction.
1914: He retired.
His work in the civil sphere and in associations was important.
He was an internationally acknowledged founder of Hungarian bridge building.
1919: He died in Budapest.

Mrs. Lajos Királyföldi
1932: She was born.
1950: She started to work as a drafter in the State Civil Engineering Scientific and Planning Institute (ÁMTI), 1951: She became a technician.
1961: She received her diploma in engineering.
Her main job was the designing of road bridges, in which field several significant structures are connected to her name.
1972: She became involved in college and then from 1977 in university teaching.
1990: She started to work at the Traffic Control Office. She received a number of acknowledgments for her extensive work, e.g. in 2002 the title of honorary associate professor.

Jenő Knebel
1927: Born in Budapest.
1949: He received a diploma in engineering.
1974: He received a university doctorate.
1977: He became an honorary university associate professor.
1949: He became a designing engineer at the State Civil Engineering Scientific and Planning Institute (ÁMTI) and the Civil Engineering Design Co. (Mélypterv).
1953-96: He worked at the Roads and Railways Design Co. (Uvaterv), where from 1958 he was the leading engineer. His outstanding works are: Tokaj, Kisar, Szolnok Tisza-bridges; Barcs Dráva-bridge; and the Elisabeth Bridge.

1971-93: He was assistant head clerk, then department head. He designed a number of national and international large-river bridges: Danube-bridges in Zombor and Újvidék, the Árpád Bridge of Budapest.
1997: He became senior advisor at the Pont-TERV Co. He had had an outstanding role in the designing of the Danube-bridges of Esztergom, Szekszárd and Dunaföldvár as well as in the designing of several other large bridges.
He received the Eötvös Loránd- and Széchenyi-prizes.



Imre Korányi
1896: He was born in Máramarossziget.
1917: He received a diploma in engineering; he became an assistant lecturer and then an assistant professor at the University of Technology.
1926: He started to serve at the Hungarian State Railways (MÁV), where he dealt with bridge designing and the technical supervision of bridge construction projects.
1927: He received his doctorate in technical studies. 1937: He became a certified private teacher.
1945: He became a substituting teacher at the University of Technology. 1947: He started to serve as a regular teacher.
Until 1947 – besides his teaching duties – he participated in the planning of the bridge reconstructions: Tisza-bridges of Algyő, Csongrád, Szolnok; Danube-bridges of Baja, Dunaföldvár and Budapest.
Starting in 1948 he dealt with the revision of the Railway Bridge Building Code and until 1959 he continued his teaching and research activities.
1959-64: He was a member of the Elisabeth Bridge's designing committee of expertise, until 1975 he worked at the Bridge Department of the Roads and Railways Design Co. as a retiree.
He had been a teacher for generations of engineers, and his work in the field of strengthening iron bridges was significant.
1989: He passed away in Budapest.

János Kossalka
1871: He was born in Vajdahunyad.
1893: He received his diploma in engineering, his academic achievements had been excellent all along his studies, later he became assistant lecturer to Antal Kherndl.
1903: He received his doctorate at the University of Technology, from 1909 he was a private teacher, from 1916 he was the head of the bridge building department. He wrote essential textbooks (The statics of beams, The statics and kinematics of beams).
Based on his proposal the Danube-bridge of Dunaföldvár, for the first time in our country was built with a continuous truss structure. He received first prize on the tenders for the Boráros-square and Óbuda Danube-bridges.
His wide range of civil society activities also deserve to be mentioned: he was a member of the Capital's municipal board, he was a parliamentary representative, and he was the president of the Chamber of Engineers for nine years.
1944: He died together with his family during the bombing of the Hatvan railway station.

Aladár Sebestyén Kovács
1858: He was born in Buda.
1880: He received his diploma in engineering in Zürich.
1881: He started to serve the state. From 1889 he acted as the head of the River Engineering Office in Temesvár. 1893: He was appointed to Budapest.
1896: He started to work at the Hydraulic Engineering Department of the University of Technology; he had had significant achievements in the field of designing hydraulic structures. He prepared the plans for the Malom-square and Széna-square bridges in Temesvár. The Kéménd Garam–, the Garamkövesd Garam–, the Herkules-fürdő Cserna-bridge and the seven bridges on the Répce tide reducing canal are attached to his name.
1921: He died.
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Zsolt Kovács
1941: He was born in Budapest.
1964: He received a diploma in engineering.
1964: He has been working at the Roads and Railways Design Co. (Uvaterv), nowadays he is the director of bridge division.
1969: He received a diploma in specialist engineering.
A few of his designs that are worth mentioning: Danube-branch-bridge of Győr, the incrementally launched Rába-bridge of motorway M1, the Oszlár Tisza-bridge of motorway M3, the Danube-bridge of Szekszárd.

Alajos Kováts
1898: He was born.
1922: He received his diploma in engineering.
1928: He worked at the State Building Office in Székesfehérvár and in Berettyóújfalu.
1928: He was assigned with the on site supervision of the Dunaföldvár Danube-bridge's construction.
1931: He started to work at the Road Bridge Building Special Department of the Ministry of Trade and Transport Affairs.
1933-37: He was the central supervisor at the construction of the Petőfi Bridge.
1943: He was appointed as a director at the Hungarian State Railways (MÁV). From 1945 he dealt with the rebuilding of railway bridges, for which activity he received the Kossuth-prize in 1948.
1960: He retired.
1967: He died in Budapest.

Károly Kozma
1922: He was born in Budapest.
1946: He received a diploma in engineering.
1946-52: He prepared the plans for the reconstruction of bridges (Chain Bridge, Árpád Bridge, Petőfi Bridge, Danube-bridge of Dunaföldvár).
1954: He started to work at the Roads and Railways Design Co. as an engineer, department head. He was the designer of several bridges all around the country. Nowadays he is the immensely experienced expert and advisor regarding the Budapest Danube-bridges at the Capital's Public Property Maintenance Ltd. The rehabilitation plans of important bridges are attached to his name: Margaret Bridge, Petőfi Bridge.

Kornél Laber
1922: He was born.
1944: He received a diploma in engineering.
1950-82: He worked at the Bridge Building Co. in various positions, construction supervisor, senior construction supervisor; his large jobs were the viaduct of main road no. 6, the Tisza-bridge of Tokaj.
1986: He died in Budapest.

László Lipták
1927: He was born in Budapest.
1949: He received a diploma in engineering.
1949: He worked at the State Civil Engineering Scientific and Planning Institute (ÁMTI), then at its successor the Civil Engineering Design Co. (Mélyépterv), and later at the Bridge Office of the Roads and Railways Design Co. (Uvaterv). Besides the reinforced concrete and steel bridges, he also designed aerial towers. His work in the field of designing arched bridges is everlasting.
1959: He worked at the Tisza-area Chemical Factory's (TVK) general planning main departments. While working here he designed the novel shaped overpass in Tihany, which made his name widely well known.
Around 1960 he received the candidate's title.
He completed designer's jobs at the Víziterv, at the Petrolber between 1963 and 1968, and at the Design Development and Standard Design Institute from 1979. Even during this time, important bridge designs for various tenders were connected to his name (viaduct of motorway M3, several smaller bridges).
From 1982 until his retirement, he worked at the TETA Engineers' Co-op.
1987: He started to participate in significant bridge planning projects at the Magyar Scetauroute Ltd. as a retiree (e.g. the capacity development of the Tiszaug Tisza-bridge, the designing of the Zalaegerszeg railway bridge on the river Zala).
His activity in publishing specialized literature is also significant.

József Litsman
1776: He was born.
1802: He became a member of the mason's guild in Debrecen, he was a master builder.
1806: He started to build the Great Church of Debrecen, and other significant buildings.
1827-33: He was the builder of the Nine-arched Bridge of the Hortobágy.

Károly Massányi
1901: He was born in Selmecbánya.
1923: He received a diploma in engineering in Budapest, and he had worked at the MÁVAG from this time until his retirement.
1926: He dealt with the strengthening of the Maros-bridge of Makó, the Tisza-bridge of Szeged and later the Palatine Bridge in the City Park.
1929-30: He prepared the section plans for the Dunaföldvár Danube-bridge and led the construction of the bridge.
1948-52: He was the head of the MÁVAG's bridge factory. 1953-70: He was its senior engineer.
1970: He retired and continued to write studies and give lectures.
1949-68: He was a lecturer on several subjects at the Budapest University of Technology.
1966: He received the title of honorary university assistant professor.
1982: He died in Budapest.

László Mátyássy
1949: He was born in Budapest.
1972: He received a diploma in engineering, and started his career as a designer at the Roads and Railways Design Co. (Uvaterv), where he worked until 1984 except for a one year break.
1984-88: He was involved in bridge designing at the Trades Designing Co. (Kereskedelmi Tervező Vállalat), and then between 1988 and 1994 at the Roads and Railways Design Co. again.
1994: He became managing director of the Pont-TERV, and in 2001 he was appointed its general director.
The more important projects in which he participated are the Tisza-bridge of Szeged; the widening of the Árpád Bridge in Budapest; the Szent István Tisza-bridge of Szolnok.
He led the construction of the motorway M0 Dulácska viaduct, the Tisza-bridge of Cigánd, the new Tisza-bridge of Tiszaug, the reconstruction of the Mária Valéria Danube-bridge of Esztergom, the Szent László riverbed Danube-bridge in Szekszárd, the Kőröshegy viaduct, the floodplain Danube-bridges in Dunaújváros.

Gábor Medved
1935: He was born in Budapest.
1958: He received a diploma in engineering.
1958-73: He worked at the Road Bridge Department of the Ministry of Transport and Postal Affairs (KPM), thus he was involved in the inspection of the Tisza-bridges of Kisar, Szolnok, Tiszafüred, Algyő, the Maros-bridge of Makó, the Hármas-Körös-bridge of Endrőd, and the Rába-bridge of Győr.
1967: He received a diploma in specialized welding engineering. He received his technical doctorate.
1973-81: He was the director of the Bridge Building Co., this was the time when the reconstruction of the Margaret, the Petőfi and the Szabadság Bridges were completed; and the Tahitótfalu Danube-branch-bridge, the Csongrád Tisza-, the Kunszentmárton and other Körös-bridges, the Csenger Szamos-bridge and various other important structures were built.
1981-83: He was the vice head clerk of a department in the Roads and Railways Design Co.
1984-88: He was vice department head of the National Technology Development Committee.
1988-91: He was an assistant manager of the Institute for Transport Sciences. 1991-93: He was a consulting private engineer.
1993-2000: He was a professor in Japan.
2003: He became senior engineer of the bridge department at the National Motorway Co.
His entire career he was closely connected to the theoretical and practical aspects of bridge building. His activity as a professor and publisher of specialized literature was significant.
2005: He died in Budapest.

Győző Mihailich
1877: He was born in Temesrékas.
1899: He received a summa cum laude diploma in engineering at the Royal József University of Technology, and then in 1906 he received his doctorate.
1920: He became regular teacher at the No. 2 Bridge Building Department, from 1938 he was an academic.
He led the department until 1957, when he was 80 years old.
The Liget road bridge in Temesvár that he designed in 1908 was a world record keeper with its span.
Besides designing reinforced concrete bridges, he planned the Tisza-bridges of Szolnok (1910) and Polgár (1938), the widening of the Margaret Bridge, the reconstruction of the Tisza-bridge in Szeged (1949) and several other bridges.
He was awarded the Kossuth-prize and other honours.
1966: He died; his statue is in the university yard.

Tamás Mihalek
1951: He was born in Budapest.
1975: He received a diploma in engineering and started to work at the Bridge Building Co.
He participated in the construction of the motorway M1 bridges, and later in the construction of the free-concreted bridge over the Moson-Danube in Győr.
1979: He was transferred to the company's technical department, since then he had had a leading role in the designing of several bridges (Homokkert overpass in Debrecen, the 1400 m long Prestressed railway bridge in Nagyrákos, the motorway M7 viaduct, the Kőröshegy viaduct). He had participated successfully in several tenders, for instance together with his partner in the tender published for the Galvani Road Danube-bridge, which received 2nd prize. He was awarded the innovation main prize for the structure built by Nagyrákos and the bridge designed over the Ferencváros railway station.

Virgil Nagy
1859: He was born in Temesvár.
1885: He received his diploma in architecture.
He became a colleague at the bridge department of the ministry. He had an important role in the designing of the Ferenc József Bridge, about which he had written an interesting article. The Hungarian Association of Engineers and Architects honoured him with the Hollán-prize for this plan. He was an assistant lecturer and then private teacher at the university.
1905: He became a teacher of ancient architecture.
1921: He died in Budapest.

Ignác Oracsek
He was born around 1720.
He was the designer and builder of the Gombás-stream-bridge in Vác.
1750: He became a member of the mason's guild.
1762: He was the builder of the Esztergom Basilica. He is more well known of his structural engineering activities.
1767: He died in Esztergom.

László Palotás

1905: He was born in Érsekújvár.
1928: He received a summa cum laude diploma in engineering. He spent almost eight years as a university assistant lecturer during which time he participated in the designing of the Boráros-square, the Óbuda and the Margaret Bridges.
1936: He was appointed to the Bridge Department of the Ministry of Trading Affairs.
1937: He received his doctorate and then in 1944 private teacher title.
After 1945 he participated in the reconstruction of the Budapest Danube-bridges. (He had a leading role in the reconstruction of the Óbuda, Margaret and Chain Bridge.)
1948: He became director of the State Civil Engineering Scientific and Planning Institute (ÁMTI) (the predecessor of the Roads and Railways Design Co. (Uvaterv) and the Civil Engineering Design Co. (Mélyépterv)).
1950: He became assistant managing director of the Underground Railway.
1954: He started to teach at the University of Technology (at the time ÉKME), between 1963 and 1968 he led the Department of Building Materials. A number of important books are connected to his name (The Engineer's Handbook etc.)
1962: He received the Kossuth-prize.
1992: He became a regular member of the Academy of Sciences.
1993: He died in Budapest; his statue is in the university yard.

Tibor Penkala
1928: He was born in Budapest.
1950: He received a diploma in engineering, and then he became a construction supervisor and later senior construction supervisor at the Bridge Building Co. From 1969 he was a department head.
His more important works: reconstruction of the Petőfi Bridge, from 1959 the building of the Elisabeth Bridge, the Bodrog-bridge of Alsóberecki, the Tisza-bridge of Kisar.
1979-91: He was a department head at the Concrete and Reinforced Concrete Industrial Works.
1991: He retired.
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Miklós Perényi
1903: He was born in Aszód.
1928: He received a diploma in engineering, and then he began to serve the MÁVAG.
He participated in the building of the Danube-bridges of Dunaföldvár and Budapest Boráros-square, and the Tisza-bridge of Vásárosnamény.
1938: He started to work at the Technical Department of the MÁVAG.
1948-50: He led the construction works of the Árpád Bridge in Budapest.
1950-52: He was the construction supervisor of the Petőfi Bridge's assembly.
1957: He became director of the assembly department at the Ganz-MÁVAG's Bridge Factory Unit. The road Tisza-bridge of Tokaj was built under his leadership. He participated in the building of the Elisabeth Bridge in Budapest.
1968: He retired.
1992: He passed away.

Ernő Petik
1928: He was born in Pestszentlőrinc.
1950: He worked at the Bridge Building Co., this was when he received his diploma in engineering.
1960-64: He was construction supervisor first at the Elisabeth Bridge, then from 1971 at the Kacsóh Pongrác Rd. structures, and then from 1973 at the lengthening of the Millennium underground train.
1973: He became senior construction supervisor (Margaret Bridge, HÉV entry, Sibrik Miklós Rd. overpass etc.), the reconstruction and renovation of the Budapest bridges was also done under his supervision (Margaret, Petőfi, Szabadság and Chain Bridge).
2006: He died in Budapest.

Alajos Petúr
1916: He was born in Sátoraljaújhely.
1939: He received a diploma in engineering.
1939-44: He was employed by the Ministry of Defence.
1941: He started to serve in the military and was transferred to the Airplane Technical Institute.
1941: He became an assistant lecturer at the Mechanical Department of the University of Technology.
1943: He received his technical doctorate.
1945-48: He designed as a private engineer.
1948: He dealt with bridge designing first at the State Civil Engineering Scientific and Planning Institute (ÁMTI), later at the Civil Engineering Design Co. (Mélyépterv), and then at the Roads and Railways Design Co (Uvaterv).
1966-83: He had the position of a senior engineer of a specialized field.
The wide range of planning jobs he had completed had spread from airplane designing through the prefabricated bridge sections (Prestressed planks and beams), and the supporting cables of the Elisabeth Bridge, to the widening of the Arpád Bridge and many other important fields. Amongst the numerous prizes he had been awarded the State-prize (1973) was the highest ranked.
2006: He passed away in Budapest.

Iván Pozsonyi
1940: He was born.
1971: He received a diploma in engineering.
1963-1994: He was a designer, leading designer, division and then department head at the Roads and Railways Design Co.
1994: He became managing director of the Pont-TERV and then from 1997 he became its president-director.
Several important bridge planning projects were done with his participation: Algyő, Tisza-bridge; Szeged, Tisza-bridge; Budapest, Árpád Bridge; motorway M3 bridges; motorway M0, Háros Danube-bridge; Polgár, Tisza-bridge; Budapest, Lágymányosi Danube-bridge section plans; Baja, Danube-bridge cantilever strengthening final plans; Tiszaug, Tiszabridge capacity development; Dunaföldvár, Danube-bridge modernization plans; Szekszárd, Szent László Danube-bridge riverbed span final plans; Esztergom, Árok-street Small-Danube-bridge final plans.

Károly Rábl (Rábel)
1748: He was born.
The building master from Gyöngyös was the master who built more bridges in the country. A number of his bridges carry the traffic to this day.
l786: He built a 10 m span bridge over the Nagy-patak (Great-stream) in Gyöngyös, which for unknown reasons had collapsed, nevertheless our master did not have a breakdown, moreover, he kept on building nice and lasting arched bridges with a great flamboyance even after he had reached age 70. The nice arched bridge he built in Gyöngyöspata in 1822 and in Visznek in 1824 are standing to this day.
Structures built by him had remained in other counties as well. He built several churches, amongst others the Presbyterian Great Church in Debrecen.
1828: He died.

János Reviczky
1925: He was born in Esztergom.
1950: He received his diploma and started to work at the Roads and Railways Design Co. (Uvaterv) until 1986, where he became leading designer in 1955 and deputy department head in 1980. His more important designs: supplementary tasks of the Elisabeth Bridge, Bodrog-bridge of Sárospatak, bridges of the motorway M7, free assembled Körös-bridges form 1975.
He was awarded the Eötvös-prize in 1977 and the State-prize in 1978.
As a retiree, he continues to work as a designer.

Pál Sávoly
1893: He was born in Budapest.
1919: He received a diploma in engineering at the József Nádor University of Technology.
1920-25: He worked abroad (Germany, The Netherlands, Luxembourg, Belgium).
1925-45: He worked at an engineering office; he participated in the tenders published for the Budapest Danube-bridges. He took part in the designing of the Óbuda Danube-bridge.
1945-48: He designed the Ferenc József, and then the Chain Bridge for which he received the Kossuth-prize.
1948: During the nationalization, he started to work in the organization of the State Civil Engineering Scientific and Plan-ning Institute (ÁMTI). He led the bridge office of the Civil Engineering Design Co. from 1950 (Mélyépterv), and then from 1953 that of the Roads and Railways Design Co. (Uvaterv). The most important large-river bridges were constructed under his leadership (Baja and Dunaföldvár Danube-bridges, Petőfi and Árpád Bridge etc.)
The Tisza-bridges of Tokaj and Szolnok, the bridges of the Eastern Main Channel as well as the viaduct of main road no. 6 were also designed under his leadership. His greatest work was reconstruction of the Elisabeth Bridge. He received the State Prize for his masterwork.
He led the bridge office of the Roads and Railways Design Co. until 1966. (Significant structures such as the Rába-, Zala-, Bodrog-bridges etc. were built during this time.) 1966-68: He was senior technologist.
1968: He died in Budapest.

Gyula Seefehlner
1847: He was born in Pest.
1868: He received a diploma in engineering in Zürich.
1871: He moved to Pest and became employed by the MÁVAG where he worked until the end of his career.
1880: He became a private teacher at the university.
His greatest works were the Southern Connecting Railway Bridge, the Ferenc József, and the Elisabeth Bridges.
1905: He retired because his health deteriorated.
His work in publishing specialized literature was significant. He had serious arguments with Feketeházy.
1906: He died in Budapest.

Tibor Sigrai
1931: He was born in Budapest.
1954: He received his diploma in engineering, and in 1977 his diploma in specialized engineering and his technical doctorate.
1956: He started to work at the Roads and Railways Design Co. (Uvaterv), from 1970 as a head clerk and then as a director.
His most significant design works were the Elisabeth Bridge, the road Tisza-bridge of Algyő, the motorway M0 Háros Danube-bridge (1987), the Lágymányosi Danube-bridge (1992). Besides these, he had de-signed numerous bridges on the motorways.
He was awarded the Eötvös-prize in 1984 and the Széchenyi-prize in 1991 for his activity.

István Szatmári
1938: He was born in Békéscsaba.
1961: He received his diploma in engineering, 1968: He received his technical doctorate, 1980: he became a candidate of science, habilitation 2001.
1961-62: He worked at the Ganz-MÁVAG.
1962: He became an assistant lecturer at the Steel Structures Department of the Technical University of Building and Transport (ÉKME) and the Budapest University of Technology, 1969-80 assistant professor, 1980-2001 associate professor, 2002: university private teacher.
His most significant designs: Solt, Danube-branch--bridge reconstruction; Szeged, downtown Tisza-bridge building permit plans; Ráckeve, Árpád Bridge tender plans; Cigánd, Tisza-bridge building permit-, tender- and riverbed structure final plans; Szeghalom and Fok, Sebes-Körös-bridges renovation plans; Szeghalom, Berettyó-bridge renovation plans; Main road no. 37, Hernád-bridge final plans; Gyoma, Hármas-Körös-bridge renovation plans; Baja, Danube-bridge decision preparatory plans; Dunaföldvár, Danube-bridge building permit and final plans (associate designer); Sajókaza, Sajó-bridge final plans; Dunaújváros, Danube-bridge technology plans (associate designer); final plans for a floating hoist.

Károly Széchy
1903: He was born in Budapest.
1926: He received his diploma in engineering.
1926-27: He was an assistant lecturer, for one year on a scholarship. 1928-32: He worked as a private designer. 1933: He received his doctorate in law.
1932-45: He worked at the bridge department of the ministry. He led the widening of the Margaret Bridge, and then the construction of Árpád Bridge
1945-50: He was the head of bridge department of the ministry he led the reconstruction of the blown up bridges.
1948: He received the Kossuth-prize and was appointed as a university private teacher.
His most significant works: Margaret, Kossuth, Ferenc József, Chain and Árpád Bridge.
1950-53: He became managing director of the Underground Railway Investment Co.
1952: He became a corresponding member of the Academy of Sciences.
1953: He became a teacher of foundations and tunnel building at the University of Technology. His textbook on tunnel building received international appreciation.
1959: He started to participate in the reconstruction planning of the Elisabeth Bridge.
1972: He died in Budapest

Hugó Székely
1886: He was born.
1904: He received his diploma in engineering; he worked as a private engineer at both a national and a Vienna company.
1909: He started to design structural engineering reinforced concrete structures.
1916: He received his doctorate in engineering.
He worked in Czechoslovakia after World War I.
1928-48: He had his own private (static) designer's office.
1948-59: He worked at designer companies.
Besides his structural engineering designs, he dealt with bridges as well.
1982: He died.

Antal Szittner
1926: He was born in Szeged.
1951: He received a diploma in engineering.
1950-93: He worked at the Bridge Building and then at the Steel Structures Depart-ment of the Technial University Budapest. The priority field in his works was the behaviour and the load bearing testing of bridges. His most important works are the inspection of the Budapest Danube-bridges: Margaret, Szabadság, Chain, Petőfi and Elisabeth Bridge.
2003: He received the Korányi Imre-prize for his valuable work.
His work in publishing specialized literature is extremely widespread.

Pál Tantó
1883: He was born.
1906: He received a diploma in engineering.
After having spent some years at the State Building Office (ÁÉH) in Zalaegerszeg he worked at the bridge department of the ministry. His main field of interest was the steel structures, more precisely welding. In 1934 our country's first welded road bridge in Győr was built with his involvement.
He participated in the construction of the Tisza-bridges in Tiszaug and Polgár.
His work in the construction of the Boráros-square and Óbuda Danube-bridges is also worth mentioning.
1936-40: He was the head of the bridge department in the Ministry of Trade and Transport.
1943: He retired, after which he dealt with the development of concrete and welded structures at the Institute for Building Sciences.
1963: He died in Budapest.

Róbert Totth
1856: He was born in Resica.
He completed his studies in Zürich.
He was the talented head of the Bridge Department of the Resica Iron Works. His most significant designing jobs were the road Tisza-bridge of Tokaj, the Ferenc József Bridge in Temesvár, the Maros-bridge of Arad. He was awarded a prize on a tender for the Eskü-square and Fővám-square Danube-bridges.
His work in publishing specialized literature is valuable.
1913: He died in Resica.

Zoltán Ullrich
1902: He was born in Somorja.
1924: He received a diploma in engineering.
1924-26: He was assistant lecturer to Győző Mihailich.
1926: He became technical inspector of large bridge building projects: 1930: Tisza-floodplain-bridge of Poroszló, verifying calculations of the Margate Bridge, 1933: Modernization of the Tisza-bridge in Vásárosnamény, 1935-37: Widening of the Margate Bridge, 1938-42: Construction of the Danube-bridge of Medve.
1945: He started to serve at the bridge department of the Ministry of Transport and Postal Affairs, 1950-55: department head, his largest job was the reconstruction of Margaret Bridge and then the Petőfi Bridge was next, later he verified the static calculations of the Elisabeth Bridge.
1963: He retired but stayed active as a retiree at the ministry.
1974: He died in Budapest.

László Vakarcs
1950: He was born.
1974: He received a diploma in engineering.
1974-1986: He was a designing engineer at the Roads and Railways Design Co. 1987-93: He was a leading engineer at the same company.
1992: He became a specialised engineer in reinforced concrete construction.
1994-97: He was deputy department head. 1998: He became head clerk at the Roads and Railways Design Co. (Uvaterv).
His more significant design jobs: the final plans of the bridges in the Budapest-Tatabánya section of motorway M1; the plans for converting the Szekszárd Sió-bridge on main road no. 6 into a four-lane bridge; the plans of the substructures of the Dulácska viaduct of motorway M0; the final plans of the bridges in the Győr-Hegyeshalom section of motorway M1; the final plans of the bridges of section 1/B of motorway M0; seven bridges of main road no. 2; the final plans of four bridges on motorway M5; the plans of the substructures of the Szekszárd Danube-bridge; the bridge plans of motorway M3; the bridge plans of motorway M7.

József Varga
1928: He was born.
1950: He started his career at the State Civil Engineering Scientific and Planning Institute (ÁMTI), then he worked at its legal successor, the Roads and Railways Design Co. (Uvaterv) until his death.

1972-92: Department head. 1992-95: Specialized senior engineer. 1995: He became a retired bridge expert.
He designed a series of the free concreted and incrementally launched bridges: Mosoni-Danube-bridge of Győr, Szent István Tisza-bridge of Szolnok, Soroksár-Danube-bridge of motorway M0 and many other bridges.
He received the pro Roads and Railways Design Co. (Uvaterv) prize twice during his career. In addition, in 1989 he received the Eötvös-prize for his work performed in the development of free concreting technology.
2000: He died in Budapest.

József Vörös
1946: He was born in Budapest.
1964-68: He worked as a technician at the Bridge Building Co.
1974: He received his diploma in engineering, at this time he became a construction supervisor, senior construction supervisor and then technologist at the Bridge Building Co. He was actively involved in the introduction of free assembly and then free concreted reinforced concrete construction (Kunszentmárton, Győr and other places). In 1978 he received the State-prize for his work performed in the construction of free assembled bridges.
1991: He became advising engineer at the Bridge and Structural Engineering Main Department of the Hungarian State Railways(MÁV), then he was the head of the bridge department, and later the head of the division.
He had served as a teacher at the College of Technology for Transport and Telecommunication Studies in Győr, and later at the Budapest University of Technology. The Association of Transport Sciences awarded him the Jáky-prize. He is the author or co-author of several specialized books; he publishes articles in specialized journals.

Péter Wellner
1933: He was born in Kolozsvár.
1957: He received his diploma in engineering.
1957-74: He was a designer at the Roads and Railways Design Co., he participated in the designing of the motorway M7, the Tisza-bridge of Szolnok and the Elisabeth Bridge.
1974: He became employed by the Bridge Building Co., he participated in the realization of the free assembled Körös-bridges.
1978: He received the State-prize.
Besides having been responsible for several important bridges, he was the one who led the designing of the 1400 m long Prestressed reinforced concrete bridge on the railway connecting Hungary with Slovenia. Together with his colleagues, they received the Innovation Prize for this job. On public tenders, he had received first prize several times (Lágymányosi Danube-bridge, Tisza-bridge of Csongrád, Danube-bridge of Baja). He was the senior designer of the Kőröshegy viaduct on motorway M7.
2000: He received the Palotás László-prize. 2003: He received the Golden Milestone-prize.

Szilárd Zielinski
1860: He was born in Mátészalka, he was a descendant of a Polish noble family.
He was a bridge- and structure builder.
1901: He was the first person to receive a technical doctorate in our country.
He was the establisher of reinforced concrete construction in Hungary, the president of the Chamber of Engineers.
He was a teacher at the University of Technology; he was the head of the Road- and Railway Construction Department for decades.
The designing and building of several viaducts, bridges, water towers (Szeged, Margaret-island), and public buildings are attached to his name.
His activity was greatly influenced by the new technology experienced at the 1900 World Fair in Paris and the several years of work in France.
1924: He died.

Béla Zsigmondy
1843: He was born in Pest.
He received his diploma in engineering in Zurich.
1876: His uncle, Vilmos Zsigmondy handed over to him the leadership of the company.
1880: The Zsigmondy Co. completed the soil mechanical surveys for the reconstruction of Szeged.
1894: Partnering with Gärtner, an engineer from Vienna, the company started to do bridge building jobs as well: Ferenc József Bridge, Elisabeth Bridge, Tisza-bridge of Csongrád and then the reconstruction of the Chain Bridge.
1916: He died in Budapest.

Sándor Zsömböly
1946: He was born.
1971: He received his diploma in engineering. 1979: He received his diploma in specialized engineering.
1971-80: He designed at the Roads and Railways Design Co. (Uvaterv) and then in Algeria.
1988: He became designing engineer then from 1989 he was department head.
1994: He became managing director and then commercial director at the Pont-TERV.
His road bridge designs: pedestrian overpasses in Budapest and in Tatabánya, building permit plans for motorways, the Győr bypass section of motorway M1.
The Rácalmás Small-Danube-branch-bridge, the reconstruction plans for the bridges on motorway M7, the plans of the bridges on motorway M30, study plans for the Mura-bridge of Murakeresztúr.
The number of his railway bridge plans was approximately the same as that of his road bridge plans. His design jobs abroad (Algeria) were also significant.

The biographical data on bridge designers and builders can hardly be found in lexicons or specialized books, therefore we had completed a special research for this book using earlier sources, and a book containing the biographies of bridge engineers published recently.

Our book contains the name of mostly designers and builder, only a few of the leaders from the Ministry are included, the ones whose roles were outstanding in bridge building and development.

A few engineers are listed whose achievements in the research of national bridge building history and in the publishing of studies were imperishable.

It is our wish that this schematic compilation be a motivation for researching, gathering and publishing further data on our sometimes remembered and other times unnoticed engineers who not only build structures that ease people's lives but also create opportunities to utilize the connections between neighbouring geographical areas, towns, city sections and countries.

Bridge History

Wooden bridges

1st and 2nd Century Zalalövő, Árpás, Győr Roman inheritance
977 Úrhida, Sárvíz-bridge was a pile bridge as well as the ones built afterwards
1241 Muhi, Sajó-bridge has historic importance
1346 The ancient bridge of Hortobágy first mentioned in an official document
1556 Boat bridge between Buda and Pest, and then in several other places
1562 Szolnok, Tisza-bridge
1685 Sárospatak, Bodrog-bridge
1778 Covered bridges with ties*
1840 Tokaj, Tisza-bridge (arched structure)
1884 Záhony Tisza-bridge (trussed wooden structure)

Stone-, brick- and concrete arches

1st and 2nd Century Öskü, Százhalombatta, aqueducts (1)
1266 Ipolyság, multi spanned Ipoly-bridge (destroyed)
1420 Sopron, street bridge on the Ikva (2)
1600 Esztergom, two-span arch
1731 Eger, Minorita Bridge with 10 statues
1757 Vác, Gombás-stream bridge (3)
1791 Rárós, Ipoly-bridge (rebuilt in 1904)
1809 Karcag, nine-span Zádor-bridge (6)
1816 Gyula, Kapus Bridge
1833 Hortobágy, Nine-Arched Bridge (10)
1842 Miskolc, Sajó-bridge (dismantled in 1942)
1930 Concrete arch of Bősárkány
1937 Concrete arch of Dobogókő

Iron- and steel bridges

1615 Drawing of the Verancsics iron bridge
1810 Cast-iron bridge of Kisgaram*
1833 Maderspach-type cast-iron arched bridge with ties*
1849 Chain Bridge, our first permanent large-river bridge (a suspended bridge) (13)
1876 Margaret Bridge (arched bridge)
1883 Szeged, Tisza-bridge (arched bridge), partially home made
1896 Ferenc József Bridge (Gerber-structure), completely home made (18)
1903 Elisabeth chain-bridge
1926 Győr, Langer-type Rába-bridge (26)
1934 Győr, Rába-bridge, welded truss structure (28)
1946 Kossuth Bridge (dismantled)
1950 Szabadszállás, aluminium-bridge (dismantled)
1962 Szolnok, Tisza-bridge with a steel bridge deck (43)
1962 Taktaharkány, Takta-bridge with high strength Prestressed bolted joints
1964 Elisabeth cable-bridge (44)
1994 Tisza-bridge of Cigánd, with a hoisting and floating device (56) (61) (63) (66)

Reinforced concrete and stressed concrete bridges

1889 The first Monier-type bridge in Solt (15)
1896 The bridge of Wünsch in the City Park of Buapest (17)
1905 Balatonföldvár, pedestrian bridge (21)
1927 Poroszló, Eger-creek bridge
1937 Arched and frame bridges on main road no. 8 (30)
1950 Prefabricating and stressing (39)
1975 Free assembly (Kunszentmárton) (50)
1979 Free concreting (Győr, on the Mosoni Danube) (55) (69)
1990 Incremental launching (Berettyóújfalu) (67)

Notation:: * outside of today's countryborders
(10) the number of the bridge's description in this book

The Largest Bridge Spans

Wooden bridges

1731 Szolnok, Tisza-bridge, plans for an approx. 10 m timber bridge

1778 Fogaras, Olt-bridge 49 m, covered bridges with ties,

1840 Tokaj, Tisza-bridge, 28 m arched

1884 Záhony, Tisza-bridge, 44 m truss structure

Arches

1731 Eger, Bridge of the Minoritas 7.6 m (stood until 1878)

1786 Gyöngyös, Nagy-stream-bridge 10 m (dismantled in 1972)

1816 Gyula, Kapus Bridge 12 m (municipal)

1833 Nine-arched Bridge of the Hortobágy 8.5 m

1842 Miskolc, Sajó-bridge 12.3 m (dismantled in 1942)

1930 Bősárkány, concrete arch 24 m (exploded, rebuilt in 1944)

Iron and steel bridges (a few other bridge structures besides the suspended ones)

1810 Kisgaram, cast-iron arched bridge 5 m (stood until 1962)

1826 Budapest City Park, wire-bridge our first suspended bridge 20 m (stood until 1875)

1842 Karánsebes, Maderspach-type cast-iron arched bridge with ties (stood until 1902)

1849 Chain Bridge, 202 m suspended bridge (with other bridge structures the limiting span is much smaller)

1876 Margaret Bridge, 86 m arch bridge

1883 Szeged, Tisza-bridge, 110 m arch bridge

1895 Esztergom, 115 m truss beam bridge (Komárom 100 m)

1896 Ferenc József Bridge, 175 m Gerber-structure truss bridge

1903 Csongrád Tisza-bridge, 120 m truss girder bridge

1903 Elisabeth chain-bridge, 290 m world record (exploded in 1945)

1930 Dunaföldvár, Danube-bridge, 133 m continuous truss structure

1948 Szeged, Tisza-bridge 147 m Langer-type bridge

2007 Dunaújváros, Pentele Bridge, 304 m, the largest of the basket handled bridges

Reinforced concrete bridges

1889 Solt, 5 m arch

1890 Sárbogárd, 18 m arch

1919 Győr Industrial Channel, 33 m Gerber-type bridge

1937 Veszprém, 45 m arch deck bridge

1940 Berettyóújfalu, Berettyó-bridge, 70 m (exploded in 1944)

1952 Varasd, Viaduct of main road no. 6, 94 m arched deck bridge

1992 Szolnok, Tisza-bridge 116 m prestressed girder bridge

The largest spans of the domestic – within today's borders – permanent road bridges are as follows:

1731 Eger, bridge of the Minoritas 7.6 m

1786 Gyöngyös, Nagy- stream-bridge 10 m

1816 Gyula, Kapus Bridge 12 m

1826 Budapest City Park, wire-bridge 20 m

1903 Elisabeth chain-bridge 290 m

2007 Dunaújváros, Pentele Bridge 304 m

The Largest Bridges in Hungary

The Longest

The lengths of wooden bridges in the 13th century many times reached or even passed 100 m. In 1556 the boat bridge between Buda and Pest, and later the ones in Esztergom and Komárom were around 350 m long.

Until the water regulation projects considerably long wooden bridges were built e.g.: the Kapos-bridge of Dombóvár built in 1726 was 1160 m long, at the beginning of the railway building projects a 780 m long Tisza-bridge was built by Kisköre.

The multi spanned arch of Százhalombatta, with its 60 m length, was probably our longest permanent bridge in 1766.

The Nine-arched Bridge of the Hortobágy built in 1833, which is 94 m long between its abutments and 167 m long between the ends of its wing walls, even nowadays is the longest amongst the arch structures.

The 380 m length of the Chain Bridge completed in 1849 could not be a Hungarian record keeper for a long time.

The Margaret Bridge finished in 1876 reached 607 m in length and became a record keeper for 74 years.

The Árpád Bridge dedicated in 1950 with its 928 m length was the longest national road bridge until recently.

The 761 m long second Tisza-bridge of Szeged built in 1979, is worth mentioning amongst the national road bridges. It was the longest until 1990 when the 770 m long Háros Danube-bridge took over this title. The Danube-bridges of Budapest are in the propriety of the city's local government.

The Pentele Bridge of Dunaújváros, dedicated in July of 2007, which is 750 m longer (1680 m) than the Árpád Bridge, could only be the holder of this title for a very short period of time since the Kőröshegy viaduct of motorway M7, dedicated in August of 2007 is 1872 m long.

The Highest

The title of the highest Hungarian bridge is held by the motorway M7 viaduct spanning across the valley at a height of 88 m..

The viaduct built in 1937 by Veszprém ran 26 m above the bottom of the valley, and the two-span arch bridge of Városlőd built at the same time carried across its passenger only at a height of 18 m. The arch deck bridge built in 1952 by Apátvarasd with its 30 m height above the valley was the record holder until recently.

The Largest Area

The year 2007 was record breaking in terms of the largest square footage bridge as well. The Bertalan Tisza-bridge of Szeged had been the largest area bridge nationwide since 1979.

The Danube-bridge of Dunaújváros – our first motorway cross sectioned Danube-bridge – with its area of 57219 m² is more than three times larger. An interesting data for the reader's information would be that amongst the national road bridge stock the cumulative surface of all the bridges have not reached this number in any of the counties.

The Kőröshegy viaduct of motorway M7 holds only the title of the longest bridge since its area is "only" 44506 m².

In 2008 the Megyer Danube-bridge of motorway M0 will take over the title of the largest area bridge.

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Terminology

STRUCTURES: Engineering

Compression: Stress characterized by pressing together.
Dead load: The weight of the structure itself, independent of traffic or the environment, which must be supported by the structure. Compare to **live load.**
Deflection: The perpendicular distance a beam bends from straight, due to load and span.
Force: External influence on an object, which tends to produce a change in its shape or causes movement.
Live load: The dynamic or moving weight, such as traffic, carried by a structure. Compare to **dead load.**
Moment: The tendency of a force to cause a rotating motion.
Perpendicular: Positioning of a member so that it projects out from or crosses another at a right angle.
Post-tension: A type of **Prestressing** in which reinforcing tendons are fed through tubes which are covered by concrete poured into the form. Once the concrete cures and the forms are removed, the tendon is clamped on one end and jacked tighter on the other until the required tension is achieved. This produces a reinforced concrete beam with a positive camber, which is able to withstand greater loads without deflection as compared to unreinforced beams of similar dimensions. Compare to **pretension.**
Prestressing: Methods of increasing the load bearing capacity of concrete by applying increased tension on steel tendons or bars inside a beam. Types of prestressing include **post-tension** and **pretension.**
Pretension: A type of **prestressing** in which reinforcing tendons stretched to a desired tension and then covered by concrete poured into the form. Once the concrete cures and the forms are removed, the tension of tendon is transferred to the concrete increasing its compression and creating a positive camber. This produces a reinforced concrete beam, which is able to withstand greater loads without deflection as compared to unreinforced beams of similar dimensions. Compare to **post-tension.**
Also, cable hangers (or suspenders) used to support a bridge deck are commonly pre-tensioned before being attached to the deck.
Shear: Stress placed transversely on a member in opposite directions.
Statically indeterminate: Such complicated structures, the bending moments can't be determined by simple static calculation methods
Strain: The deformation of an object caused by a force acting upon it. Compressive strain is the shortening of an object in compression. Tensile strain is the elongation of an object in tension. Shearing strain is a lateral deformation caused by a force, which tends to move part of an object more than another. Compare to **stress.**
Stress: The resistance of an object to external force. Compressive stress develops as an object in compression resists being shortened. Tensile stress develops as an object in tension resists being elongated. Shearing stress develops as an object subject to shearing forces resists deformation. Compare to **strain.**
Structure: A stable assembly of components which carries a load while resisting various applied stresses, and transfers the load though its foundation to the ground.
Surpassed spherical vault: special form of the brick vaults
Tension: Stress characterized by pulling apart.

STRUCTURES: Bridges

Abutment: Part of a structure which supports the end of a span or accepts the thrust of an arch; often supports and retains the approach embankment.
Anchor span: Located at the outermost end, it counterbalances the arm of span extending in the opposite direction from a major point of support. Often attached to an abutment.
Anchorage: Located at the outermost ends, the part of a suspension bridge to which the cables are attached. Similar in location to an abutment of a beam bridge.
Aqueduct: A pipe or channel, open or enclosed, which carries water. May also be used as part of a canal to carry boats. Sometimes carried by a bridge.
Arch: A curved structure, which supports a vertical load mainly by axial compression.
Arch resting on slabs: A deck type arch, without hinges, which is statically multiply indeterminate
Ballustrade: A decorative railing, especially one constructed of concrete or stone, including the top and bottom rail and the vertical supports called balusters.
Beam: A horizontal structure member supporting vertical loads by resisting bending. A girder is a larger beam, especially when made of multiple plates. Deeper, longer members are created by using trusses.
Bearing: A device at the ends of beams, which is placed on top of a pier or abutment. The ends of the beam rest on the bearing.
Bent: Part of a bridge substructure. A rigid frame commonly made of reinforced concrete or steel, which supports a vertical load and is placed transverse to the length of a structure. Bents are commonly used to support beams and girders. An **end bent** is the supporting frame forming part of an abutment.
Each vertical member of a bent may be called a **column**, **pier**, or **pile**. The horizontal member resting on top of the columns is a **bent cap**. The columns stand on top of some type of foundation or footer, which is usually hidden below grade.
A bent commonly has at least two or more vertical supports. Another term used to describe a bent is **capped pile pier**. A support having a single column with bent cap is sometimes called a **"hammerhead" pier**.
Box girder: A steel beam built-up from many shapes to form a hollow cross-section.
Brace-ribbed arch (trussed arch): An arch with parallel chords connected by open webbing.
Bridge: A raised structure built to carry vehicles or pedestrians over an obstacle.
Buckling: When part of a structure loses its stability because of pressure
Cable: Part of a suspension bridge extending from an anchorage over the tops of the towers and down to the opposite anchorage. Suspenders or hangers are attached along its length to support the deck.
Cable-stayed bridge: A variation of suspension bridge in which the tension members extend from one or more towers at varying angles to carry the deck. Allowing much more freedom in design form, this type does not use cables draped over towers, nor the anchorages at each end, as in a traditional suspension bridge.
Camber: A positive, upward curve built into a beam which compensates for some of the vertical load and anticipated deflection.
Cantilever: A structural member, which projects beyond a supporting column or wall and is counterbalanced and/or supported at only one end.

Chord: Either of the two principal members of a truss extending from end to end, connected by web members.
Column: A vertical structural member used to support compressive loads. Also see **pier** and **pile**.

Continuous span: A superstructure, which extends as one piece over multiple supports.
Crown: On road surfaces, where the centre is the highest point and the surface slopes downward in opposite directions, assisting in drainage. Also a point at the top of an arch.
Culvert: A drain, pipe or channel which allows water to pass under a road, railroad or embankment.
Counterweight: A large dead load, put generally near the abutments in order to stabilise the structure during construction
Deck: The top surface of a bridge, which carries the traffic.
Deck truss: A truss, which carries its deck on its top chord.
EHGT-girder: a family of the prefabricated, Prestressed girders, with a T-profile, for spans of 10-30 m
End post: The outwardmost vertical or angled compression member of a truss.
Expansion joint: A meeting point between two parts of a structure, which is designed to allow for movement of the parts due to thermal or moisture factors while protecting the parts from damage. Commonly visible on a bridge deck as a hinged or movable connection.
Extrados: The outer exposed curve of an arch; defines the lower arc of a spandrel.
Fill: Earth, stone or other material used to raise the ground level, form an embankment or fill the inside of an abutment, pier or closed spandrel.
Fixed arch: A structure anchored in its position. Compare to **hinged arch.**
Floor beam: Horizontal members, which are placed transversely to the major beams, girders, or trusses; used to support the deck.
Footing: The enlarged lower portion of the substructure or foundation which rests directly on the soil, bedrock, or piles; usually below grade and not visible.
Franki-pile: a type of large diameter (0.6 – 1.0 m) drilled pile with a tube into which a ca 1 m high dry concrete block will be driven
Girder: A horizontal structure member supporting vertical loads by resisting bending. A girder is a larger beam, especially when made of multiple metal plates. The plates are usually riveted or welded together.
Gusset plate: A metal plate used to unite multiple structural members of a truss.
Hennebique-system: an early form of reinforced concrete, introduced by Szilárd Zielinski
Hinged arch: A two-hinged arch is supported by a pinned connection at each end. A three-hinged arch also includes a third pinned connection at the crown of the arch near the middle of a span. Compare to **fixed arch.**
Hoist: Equipment for the lifting of big loads/for lifting big laods
Langer-structure: A type of through arch, in which the stiffening girder takes part in the bearing of the bending moments
Lateral bracing: Members used to stabilize a structure by introducing diagonal connections.
Member: One of many parts of a structure, especially one of the parts of a truss.
Parapet: A low wall along the outside edge of a bridge deck used to protect vehicles and pedestrians.
Pier: A vertical structure, which supports the ends of a multi-span superstructure at a location between abutments. Also see **column** and **pile**.
Pile: A long column driven deep into the ground to form part of a foundation or substructure. Also see **column** and **pier**.
Pile bridge: generally a wooden bridge, built on rows of piles
Pin: A cylindrical bar which is used to connect various members of a truss; such as those inserted through the holes of a meeting pair of eye bars.
Pontoon: A floating equipment, usually made of steel to support floating bridges
Portal: The opening at the ends of a **through truss** with forms the entrance. Also the open entrance of a tunnel.
Post: One of the vertical compression members of a truss, which is perpendicular to the bottom chord.
Prestressed-suspended: a construction method between the Prestressed and cable-stayed bridges, some of the cables are detached from the structure and run freely to reach the pylon
Pylon: A monumental vertical structure marking the entrance to a bridge or forming part of a gateway.
Ramp: a part of the road, which approaches the abutment of the bridge
Reinforcement: Adding strength or bearing capacity to a structural member. Examples include the placing of metal rebar into forms before pouring concrete, or attaching gusset plates at the intersection of multiple members of a truss.
Rib: Any one of the arched series of members which is parallel to the length of a bridge, especially those on a metal arch bridge.
Rigid frame bridge: A type of girder bridge, in which the piers and deck girder are fastened to form a single unit. Unlike typical girder bridges, which are constructed so that the deck rests on bearings atop the piers, a rigid frame bridge acts as a unit. Pier design may vary.
Rise: The measure of an arch from the spring line to the highest part of the intrados, which is to say from its base support to the crown.
Segmental arch: An arch formed along an arc, which is drawn from a point below its spring line, thus forming a less than semicircular arch. The intrados of a Roman arch follows an arc drawn from a point on its spring line, thus forming a semi-circle.
Simple span: A span in which the effective length is the same as the length of the spanning structure. The spanning superstructure extends from one vertical support, abutment or pier, to another, without crossing over an intermediate support or creating a cantilever.
Soil-Mec pile: a type of large diameter drilled pile, where the drilled hole is supported by high density soil mixture
Span: The horizontal space between two supports of a structure. Also refers to the structure itself. May be used as a noun or a verb.
The **clear span** is the space between the inside surfaces of piers or other vertical supports. The **effective span** is the distance between the centres of two supports.
Steam plough: a large vehicle of 20 tons, prescribed in old regulations, as critical load for road bridges
Stiffener: On plate girders, structural steel shapes, such as an **angle**, are attached to the **web** to add intermediate strength.
Stiffening girder: Longitudinal part of suspended and arch bridges, which bears the bending moments and thus stiffens the very flexible structure
Strand: Cable, twisted by thin wires
Stringer: A beam aligned with the length of a span, which supports the deck.
Strut: A compressive member.
Substructure: The portion of a bridge structure including abutments and piers, which supports the superstructure.
Superstructure: The portion of a bridge structure, which carries the traffic load and passes that load to the substructure.
Supporting rib: a structure used for stiffening wall sections, which is perdendicular to the plain of the wall.

Supporting grid: A system of longitudinal and transversal girders.
Suspended span: A simple beam supported by cantilevers of adjacent spans, commonly connected by pins.
Suspenders: Tension members of a suspension bridge, which hang from the main cable to support the deck. Also similar tension members of an arch bridge which features a suspended deck. Also called hangers.
Suspension bridge: A bridge, which carries its deck with many tension members attached to cables draped over tower piers.
Through truss: A truss, which carries its traffic through the interior of the structure with crossbracing between the parallel top and bottom chords. Compare to **deck truss.**
Tie: A tension member of a truss.
Tied arch: An arch, which has a tension member across its base, which connects one end to the other.
Tower: A tall pier or frame supporting the cable of a suspension bridge.
Truss: A structural form which is used in the same way as a beam, but because it is made of an web-like assembly of smaller members it can be made longer, deeper, and therefore, stronger than a **beam** or **girder** while being lighter than a beam of similar dimensions.
Trussed arch: A metal arch bridge, which features a curved truss.
TS-barge: A barge of 1600 tons anchored perpendicularly to the river, originally developed for establishing floating bridges. Nowadays, it is used as a provisory to approach bridges during construction.
UB-girder: A family of prefabricated, Prestressed girders, for spans of 10-24 m.
Upper chord: Top chord of a truss.
Vault: An enclosing structure formed by building a series of adjacent arches.
Viaduct: A long, multi-span structure, especially one constructed of concrete. More commonly used in relation to structures carrying motor vehicles. **Voussoir:** Any one of the wedge shaped block used to form an arch.
Water retaining formwork: A provisory ring wall built around the substructure in order to provide a dry working area.
Web: The system of members connecting the top and bottom chords of a truss, or the vertical portion of an I-beam or girder.
Wing walls: Extensions of a retaining wall as part of an abutment; used to contain the fill of an approach embankment. A structural part supporting the soil of the approach embankment.

MATERIALS: Masonry

Aggregate: Crushed stone, gravel, or sand added to cement to make concrete.
Concrete: An artificial, stone-like building material made by combining cement with aggregate and adding sufficient water to cause it to set and bind the materials together. There are various mixtures to meet specific performance requirements. It is also commonly reinforced by placing steel mesh or rods before pouring into the forms.
Masonry: Construction method using units such as stone, brick, and concrete block which are usually joined with a binding agent such as mortar. Mortar is a mixture of lime and/or pulverized clay (cement) with very fine sand and water. Less often, the units are held in place by their own weight, especially with very large stones. Also includes concrete construction.
Pozzolana soil: early hydraulic material
Reinforced concrete: Concrete, which gains added strength by placing wire mesh or rods into the formwork before the concrete it poured.

MATERIALS: Metal

Alloy: Two or more metals, or metal combined with non-metallic substances, to obtain a desired performance characteristic, such as hardness, elasticity, corrosion resistance, etc.
Angle: Structural steel shape resembling L. May be Equal Leg Angle or Unequal Leg Angle (shown). Used in trusses and built-up girders.
Extrusion: A structural member formed by forcing a material, such as steel, through a hole of the desired cross section; refers to both the process and the final product.
Flange: The horizontal portions at the top and bottom which are perpendicular to the **web**.
High strength Prestressed bolt: bolt made of high strength steel, which allows for the transition of loads per friction
I-beam: Structural steel shape, which has a cross-section resembling an I with sloped inner **flange** surfaces adjacent to the **web.** May be formed by extrusion or rolling.
Inspection of welds: Different methods for the controlling of welding jobs.
Iron: A malleable (may be pressed and shaped without returning to its original form), ductile (may be stretched or hammered without breaking), metallic element. The main ingredient used in the production of steel. Once a common building material for bridges, but was gradually replaced by steel around the turn of the 20th century. **Cast iron** has a higher carbon content (2.0% - 4.5%) and is less malleable (more brittle). It is shaped by pouring it in a fluid, molten state into moulds. **Steel** alloys are next in decreasing order of carbon content (approx. 0.2% - 2.0%), followed by **wrought iron**, which has less carbon content (approx. 0.2%). This makes wrought iron tough, but more malleable. It is more easily shaped by heating and hammering (forging).
PTFE: Polytetrafluoroethylene, a material with very low friction coefficient, for the sliding of very big loads. It is used as a lubricant to reduce friction, wear and energy consumption of machinery.
Puddle iron: A type of wrought iron, used mainly in construction. Its production process was invented at the end the eighteenth century, following an increase in the need for wrought iron. It is produced in a puddling furnace. The process results with an iron that contains a slightly increased carbon content compared to wrought iron. This provides it with a higher tensile strength. The puddling furnace also allows a better control of the chemical composition of the iron. The Eiffel Tower was built with puddle iron for a large part of its structure, as was the framework of the Statue of Liberty. Other standing structures such as bridges also used puddle iron.
Rivet: A metal fastener with a large head on one end, used to connect multiple metal plates by passing the shank through aligned holes in the plates and hammering the plain end to form a second head.
Rolled section: A structural member formed by heating a material, such as steel, a passing it through a series of rollers to achieve a desired shape.
Steel: Any of a variety of iron-based metallic alloys having less carbon content than cast iron, but more than wrought iron.
Web: On structural steel shapes, the flat portion, which is perpendicular to and joining the flanges. Also, the system of members connecting the top and bottom chords of a truss.
Weld: Joining two metal pieces by heating them and allowing them to flow together.

Index

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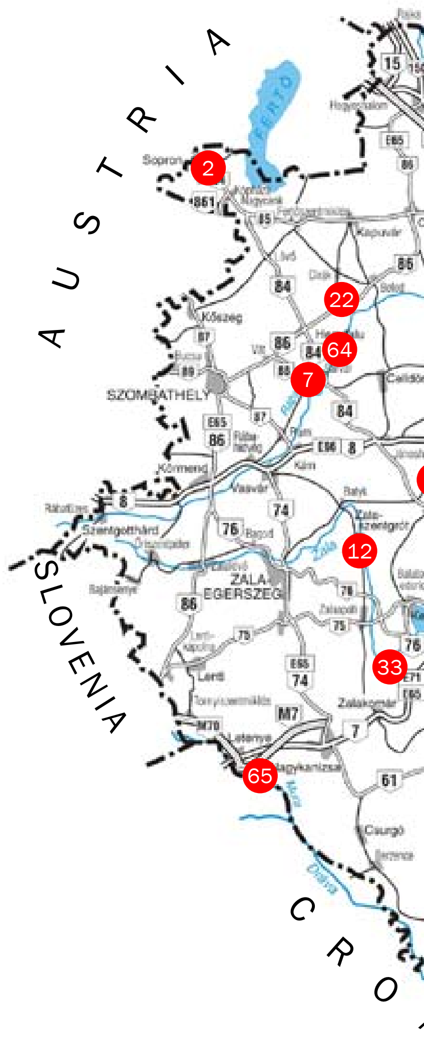

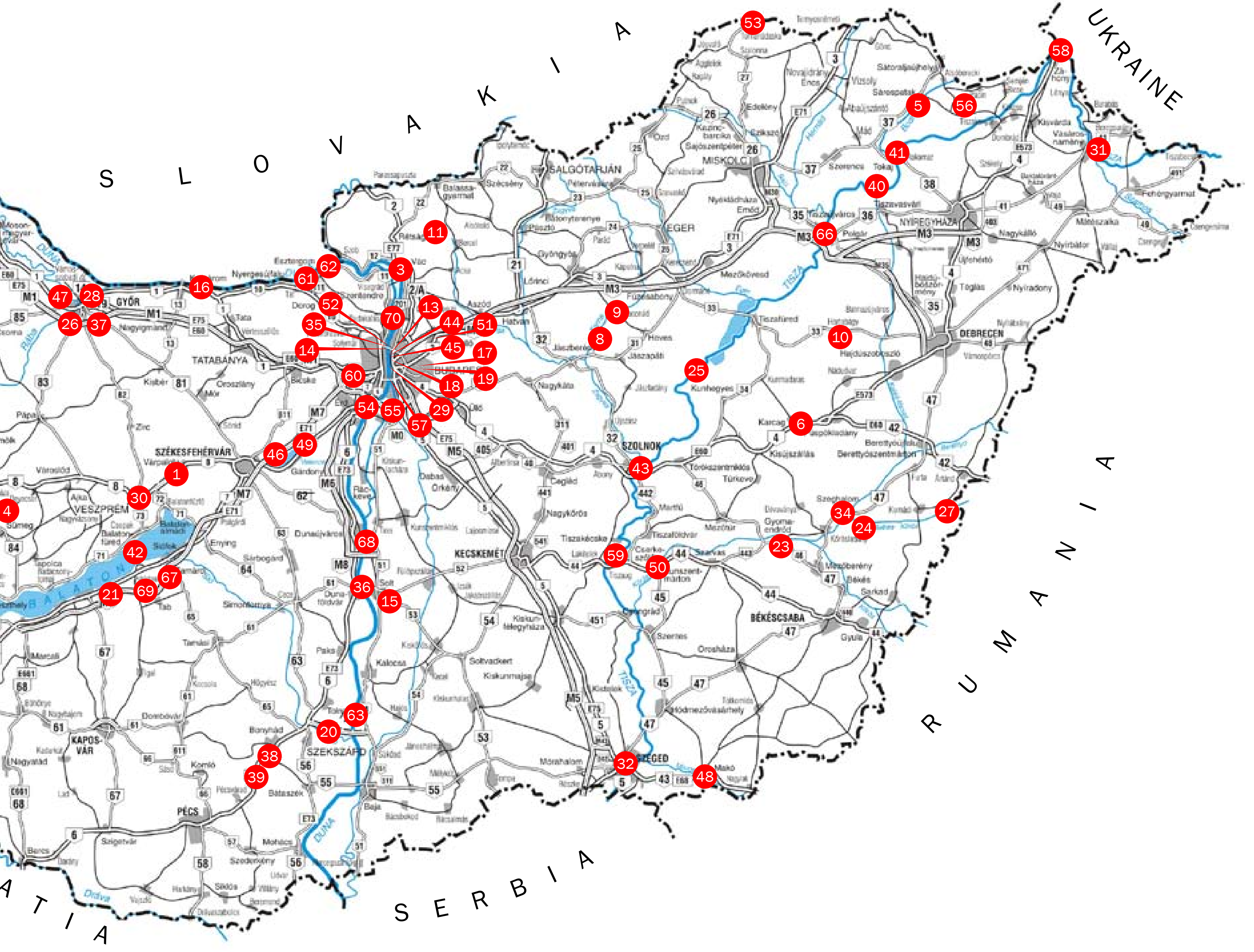
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The Gombás-stream bridge of Vác, Hungary's 250–year-old statue decorated bridge is a valued art relic.

From the Roman heritage until today's giants

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- 70 bridges of the 13 thousand, from 19 counties and the capital, illustrated with nearly 300 photographs, drawings, and short histories.
- A short list of terminology and a bibliography of bridge designers, builders, scientists, teachers and researchers.
- A historic portray of prominent individuals whose names were given to bridges.
- The Hungarian road bridge building in a nutshell. The road towards building the largest spanned and longest bridge.

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The Kőröshegy viaduct of motorway M7 built 2007 is the longest (1872 m) and highest bridge of Hungary