



Budapest Danube bridges

László Dunai



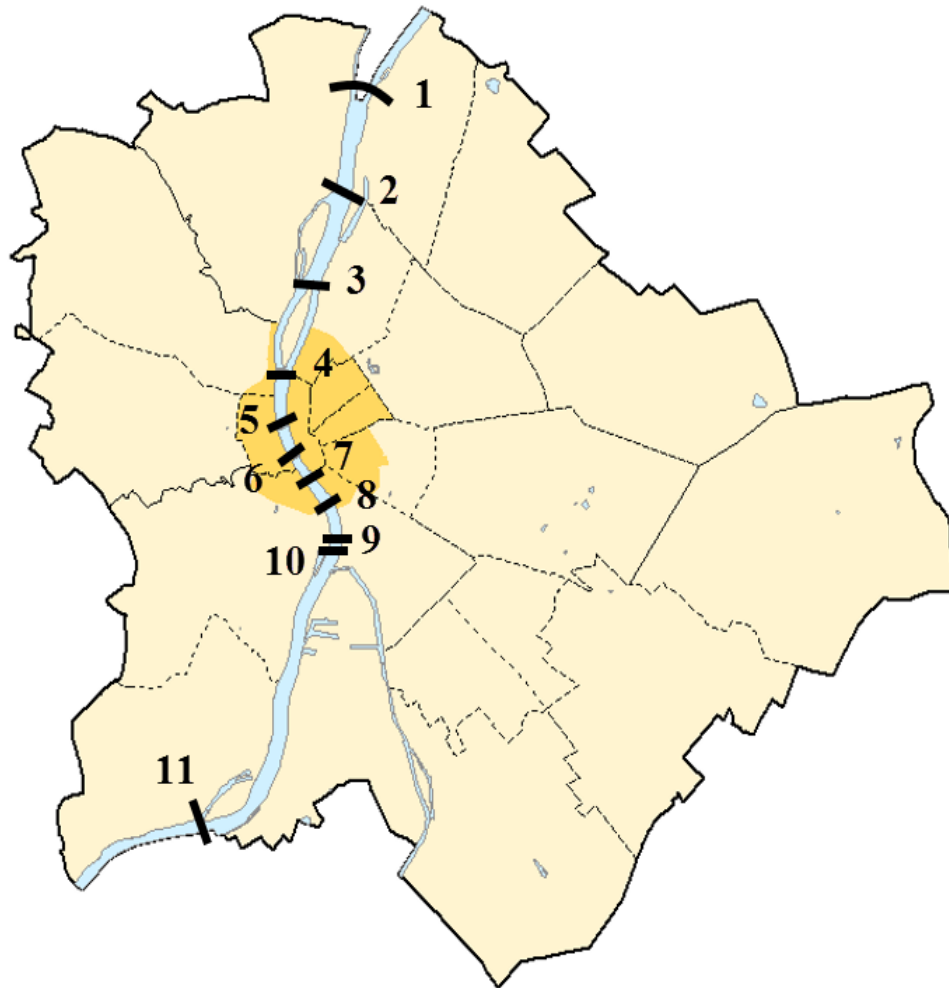




Budapest - 1872

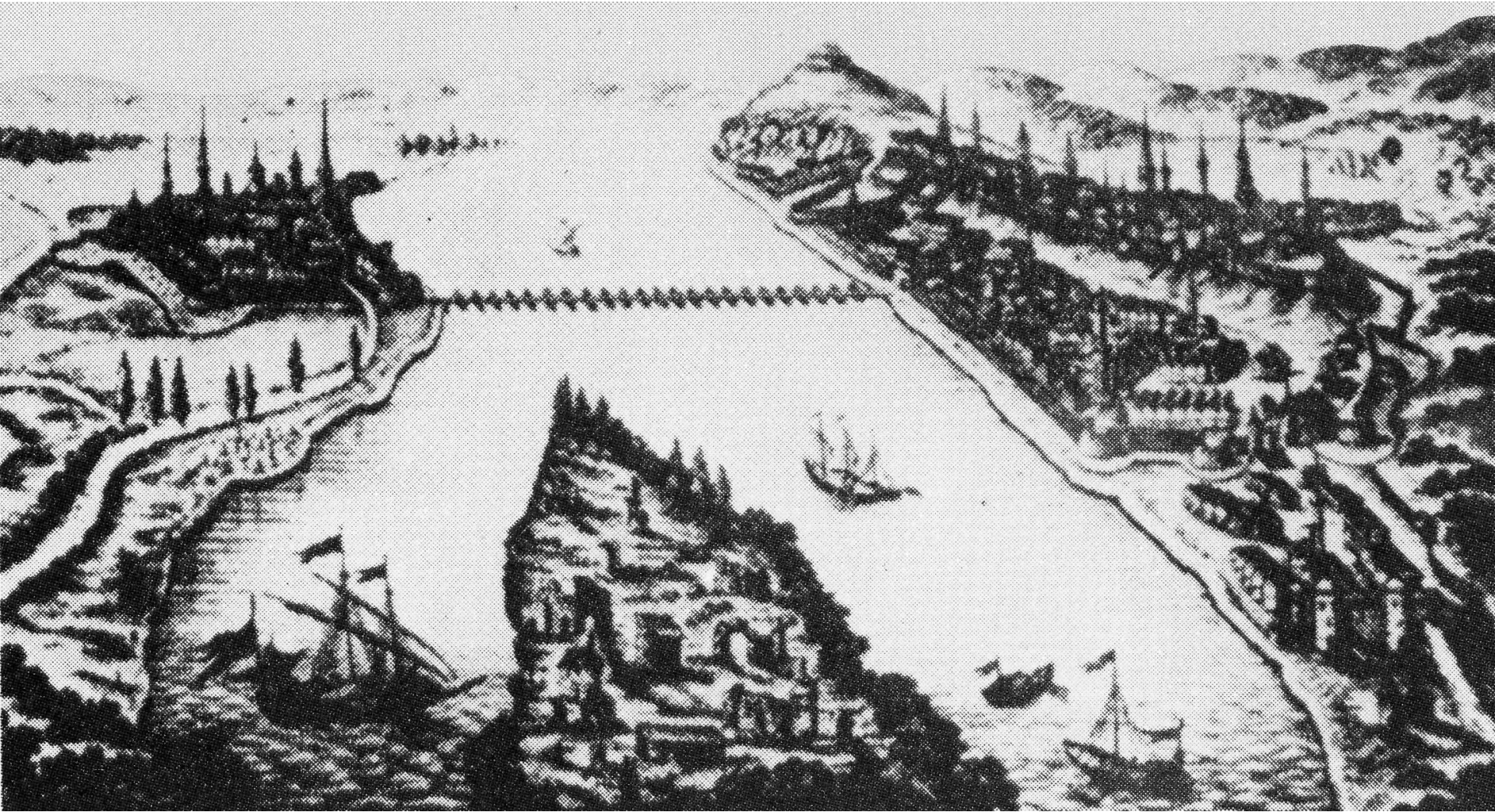
Buda + BRIDGE + Pest

Danube bridges in Budapest



1. M0 Megyeri highway bridge
2. Northern railway bridge
3. Árpád bridge
4. Margaret bridge
5. Széchenyi chain bridge
6. Elizabeth bridge
7. Liberty bridge
8. Petőfi bridge
9. Rákóczi bridge
10. Southern railway bridge
11. M0 Háros highway bridge

Temporary bridges – ship bridge XVII. century



Towards a permanent bridge

From 1780's to 1820'

Stone arch, 13, 22 piers,

Stone arch, 6 piers – Charles Bridge in Prague

Stone piers and timber arches

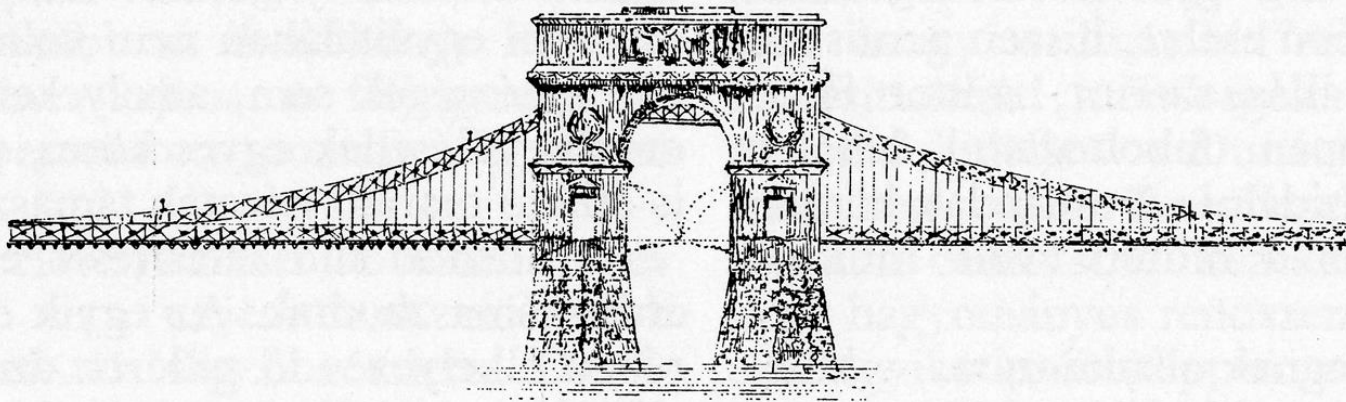
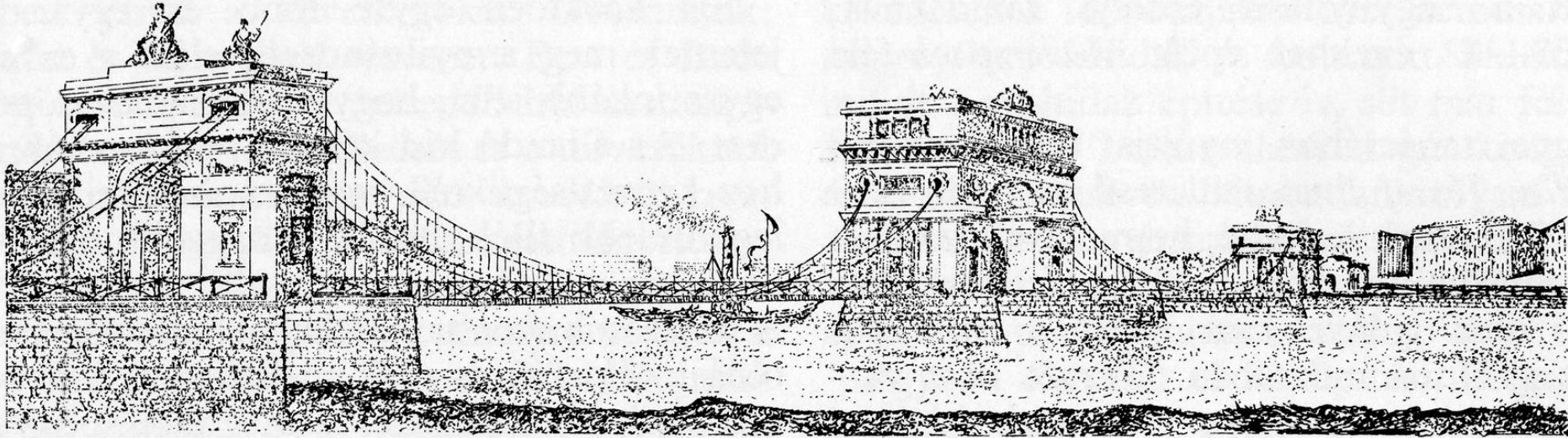
1820 –

Steel as bridge material

1832 -

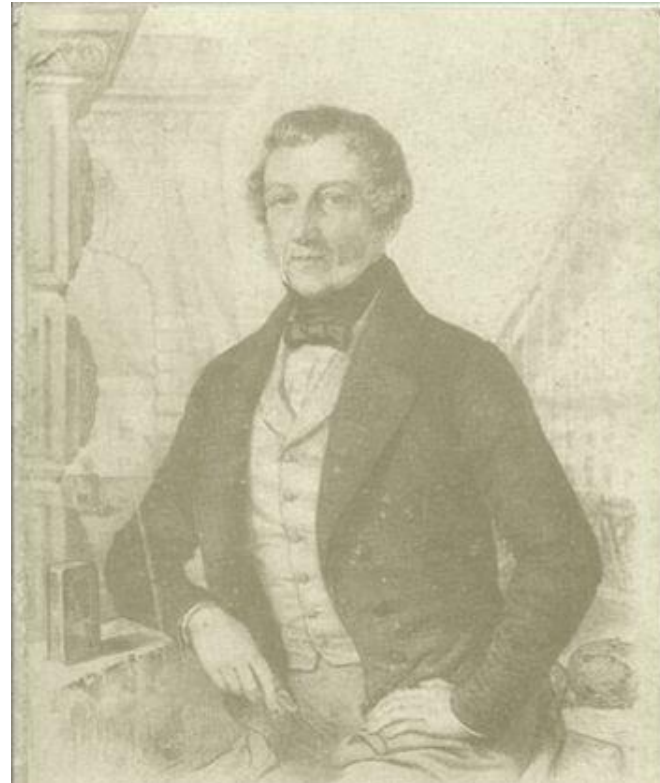
Bridge Corporation by Count Széchenyi

Design by Pál Vásárhelyi – bridge with ship gate, 1832



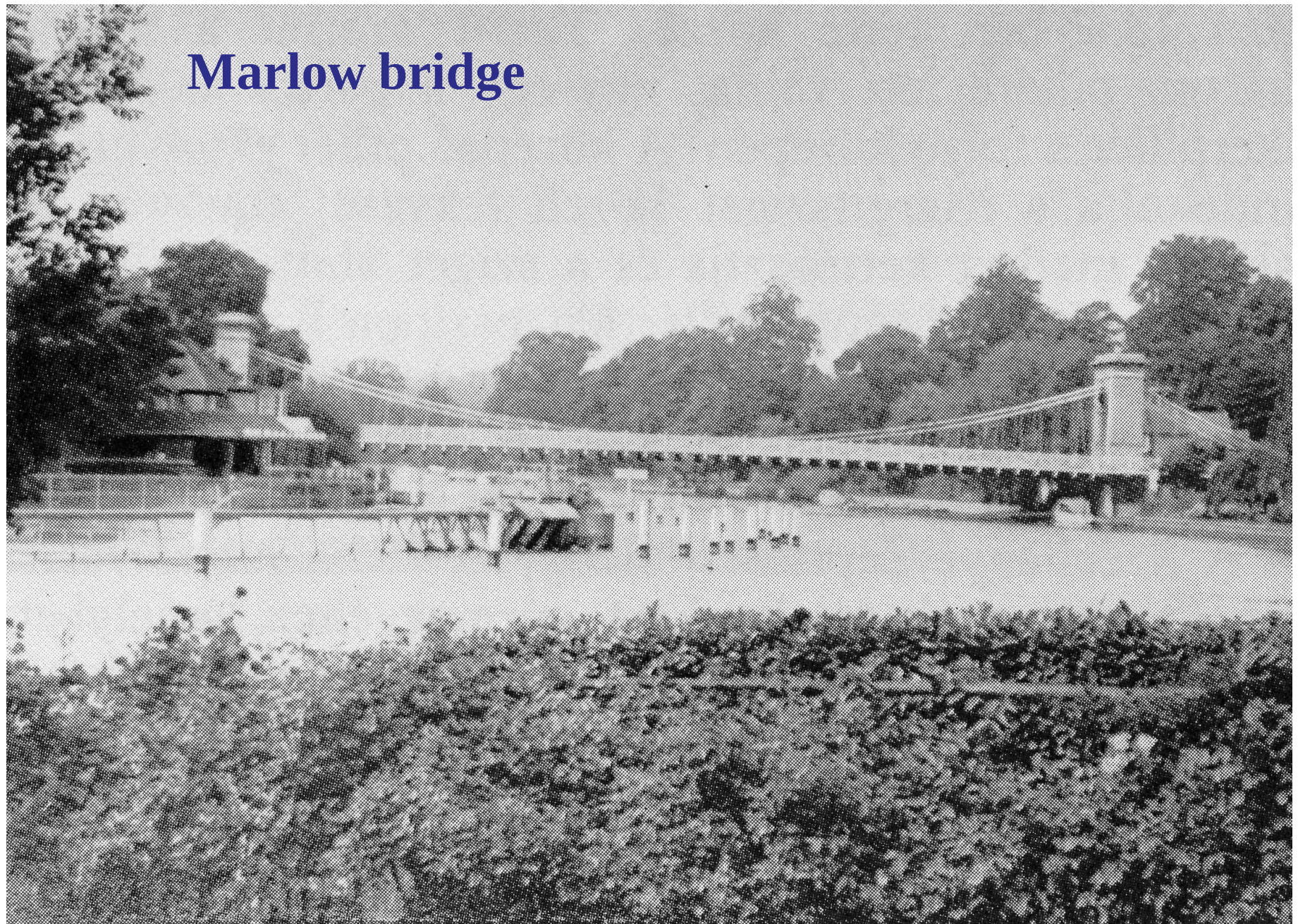
Study trip to England – August-November 1832

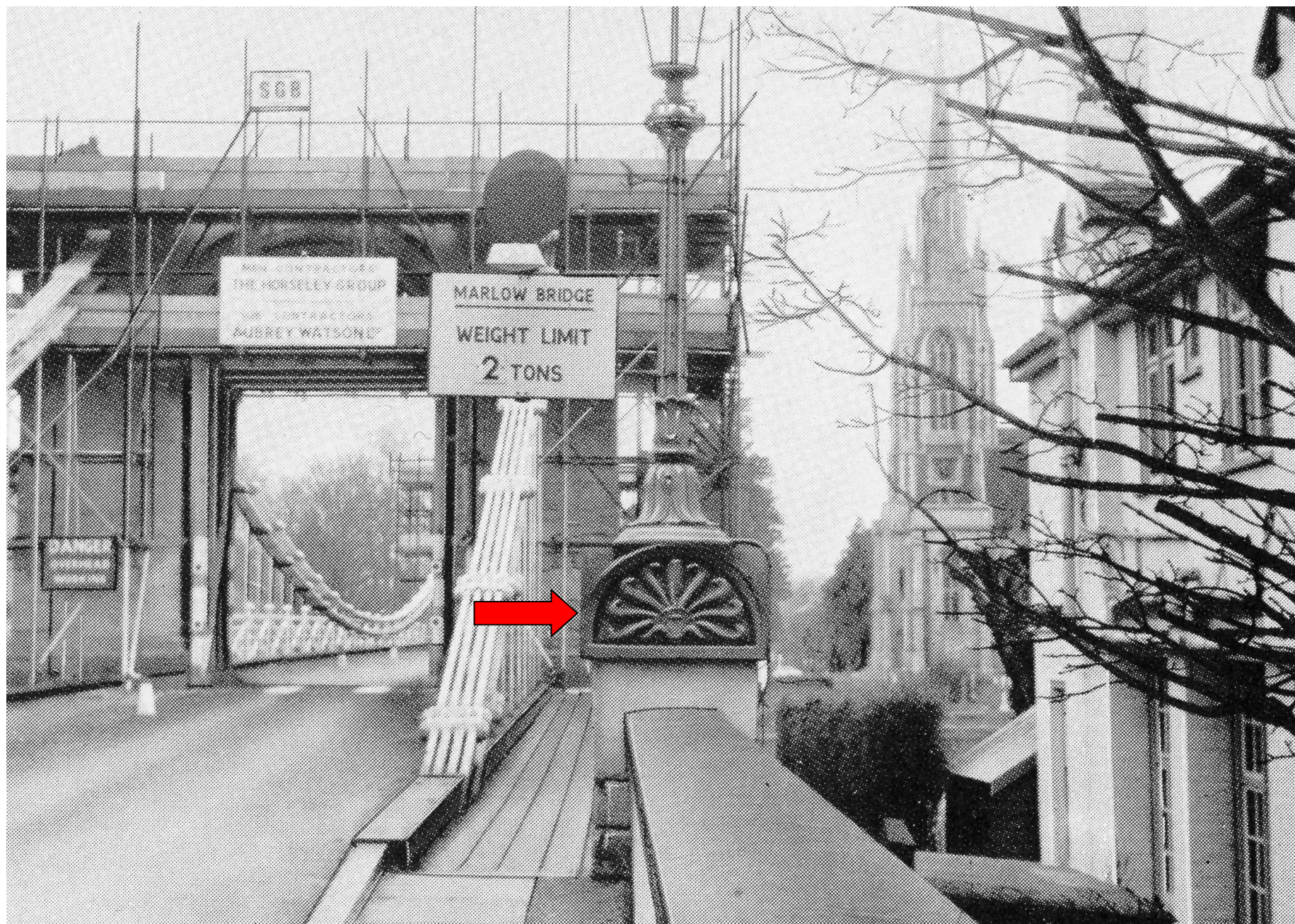
**Bridge visits in
Hammersmith
Shoreham
Marlow**



William Thierny Clark

Marlow bridge



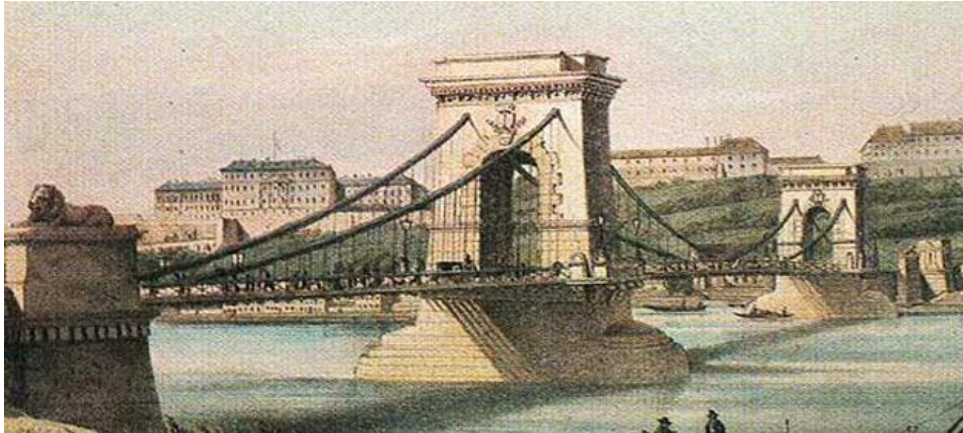


Széchenyi chain bridge

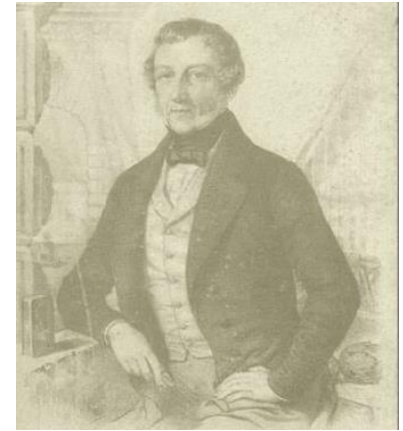


History

Built: 1839-49



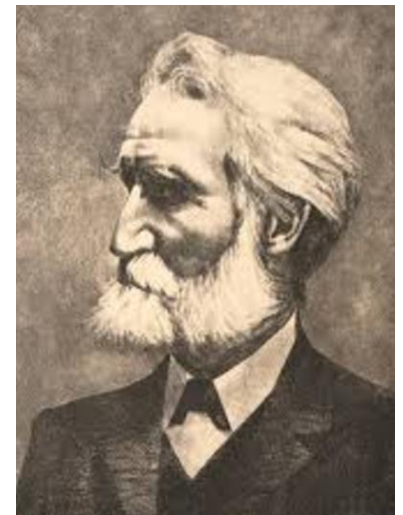
William Thierny Clark



Re-built #1: 1913-15



Antal Kherndl

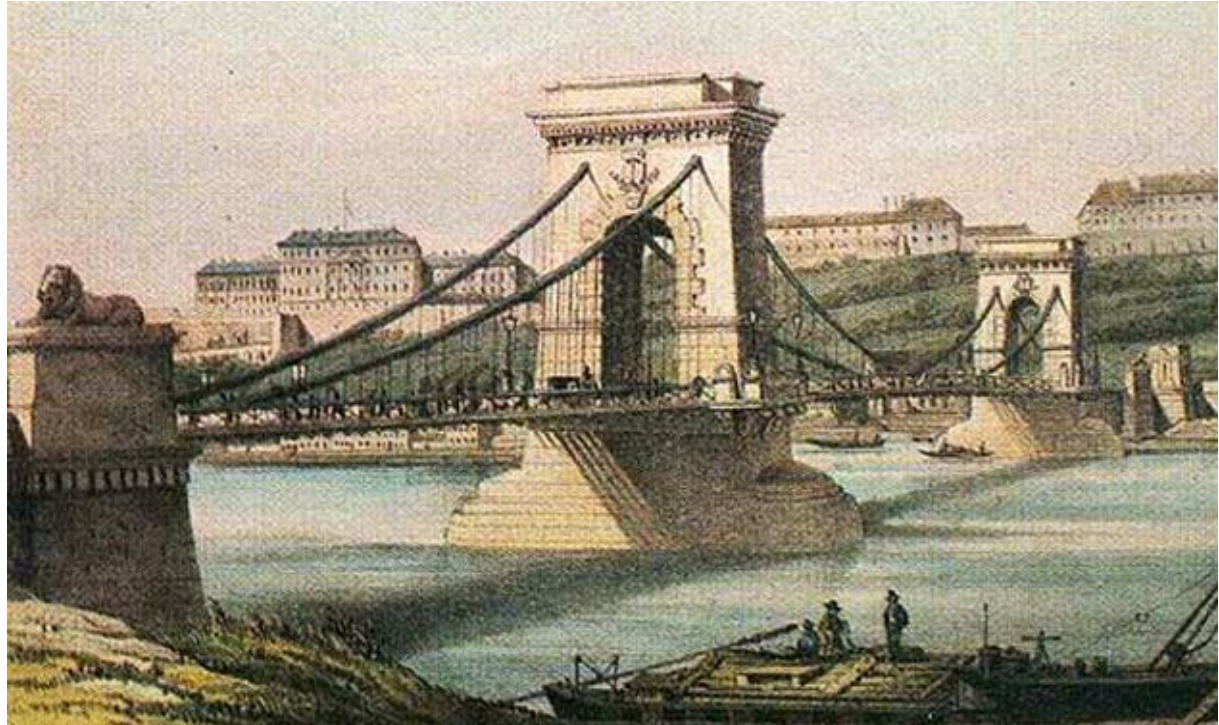


Széchenyi chain bridge – original

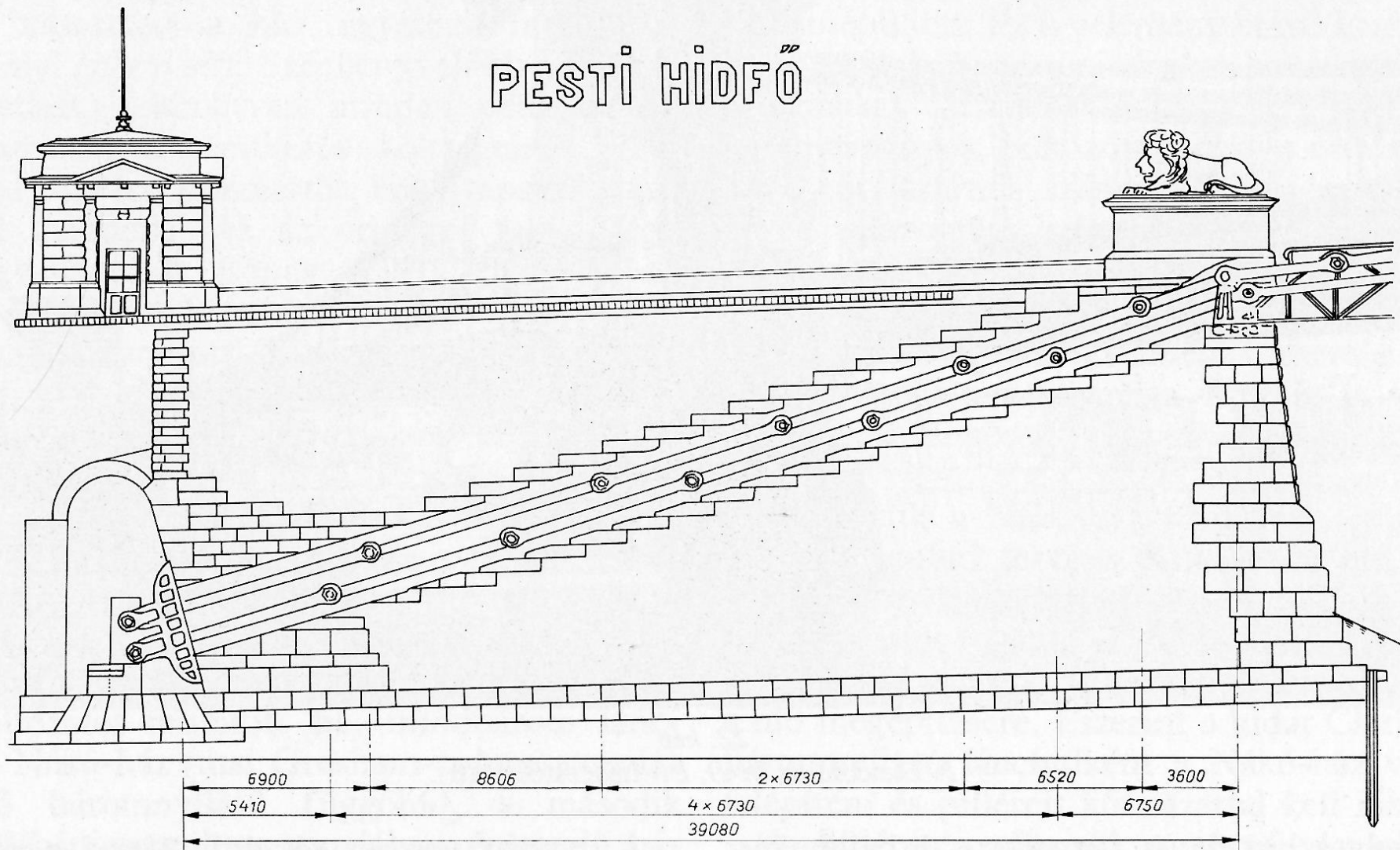
Date of erection/reconstruction:
1839-49, 1913-15, 1948-49,
1987-89, 2017-19

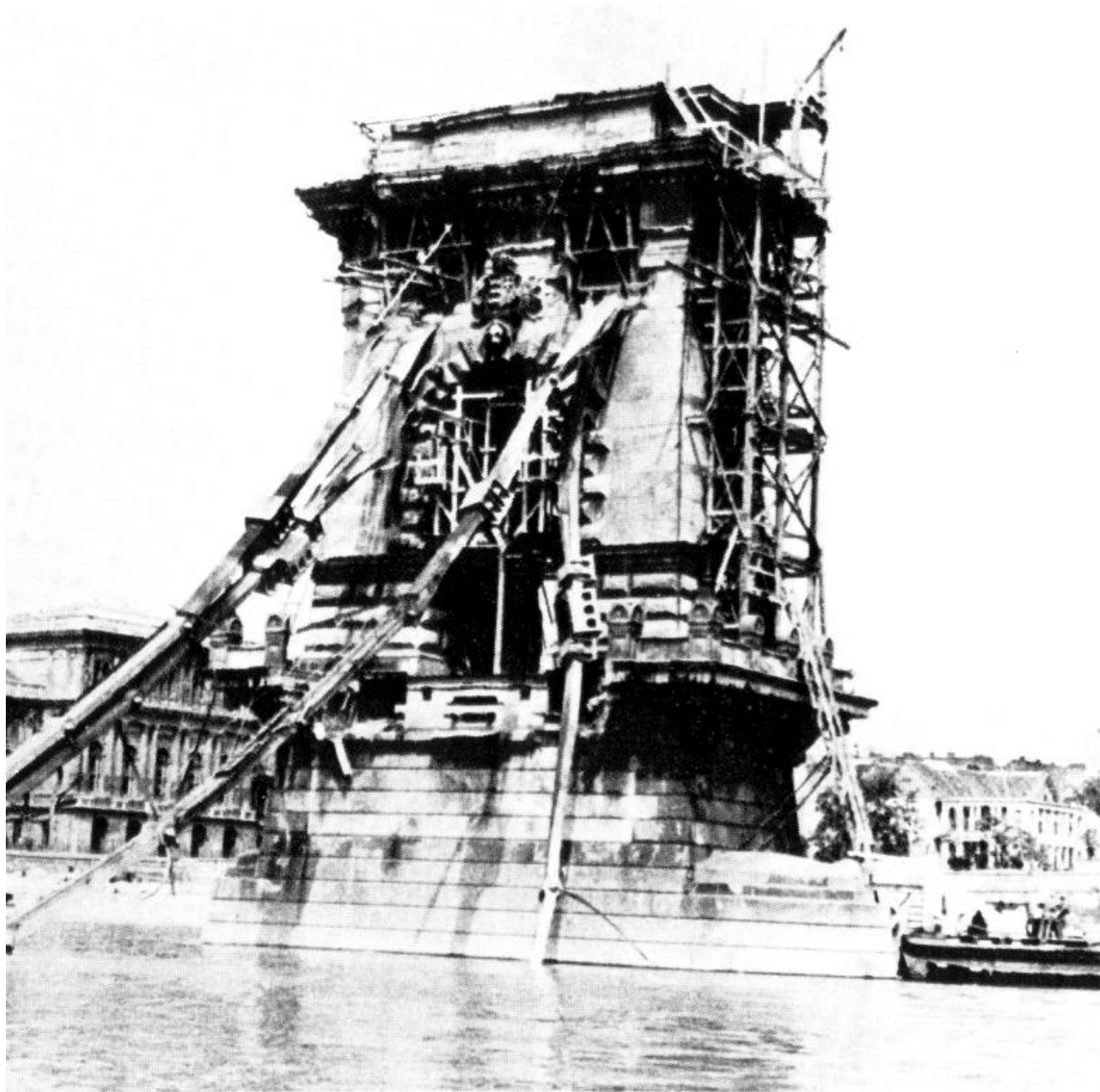
Structural system:
chain suspension bridge

Length/maximum span:
380 m / 202,6 m



PESTI HÍDFŐ⁷⁷





Széchenyi chain bridge – reconstructed

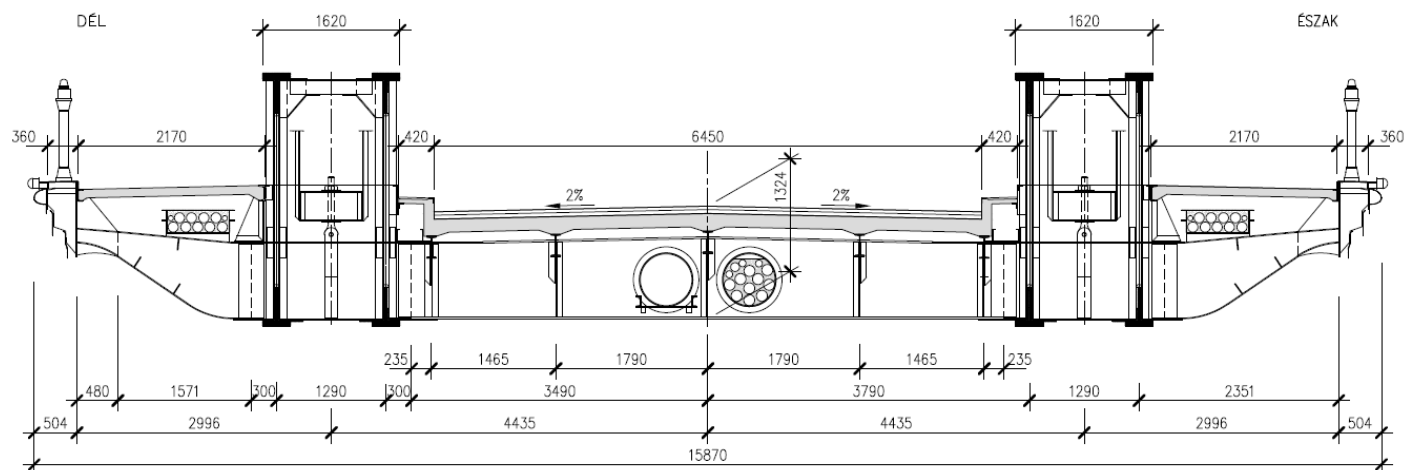
Date of erection/reconstruction:
1839-49, 1913-15, 1948-49,
1987-89, 2017-19

Structural system:
chain suspension bridge

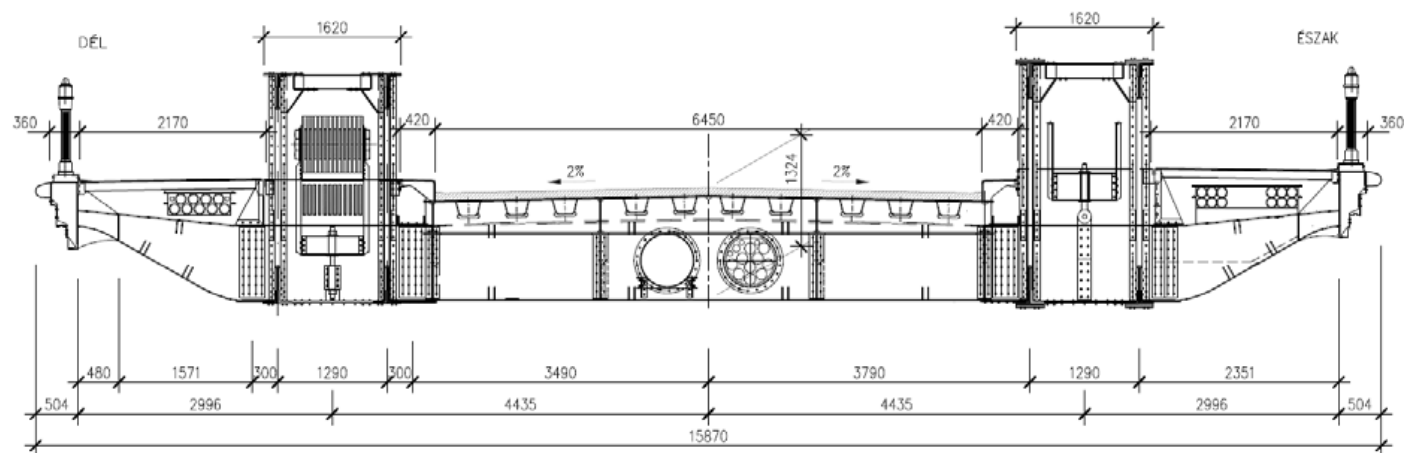
Length/maximum span:
380 m / 202,6 m



Current cross-section composite – RC deck on 5 steel girders

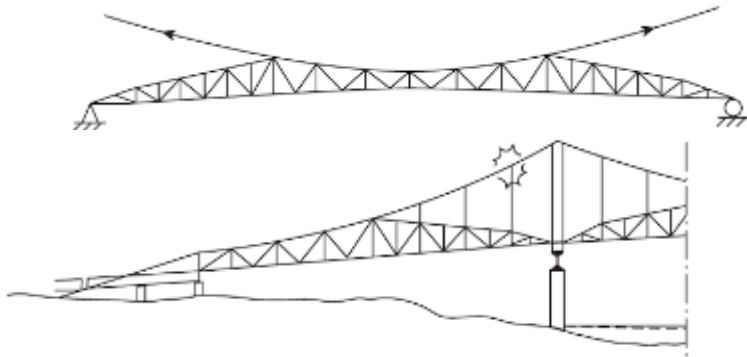


New cross-section orthotropic steel deck supported by 4 steel girders



Failure on similar bridge

Silver bridge: 1928 - 1967

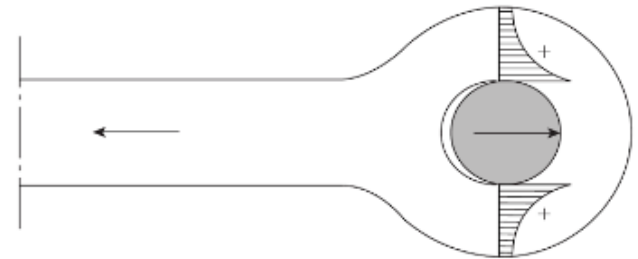
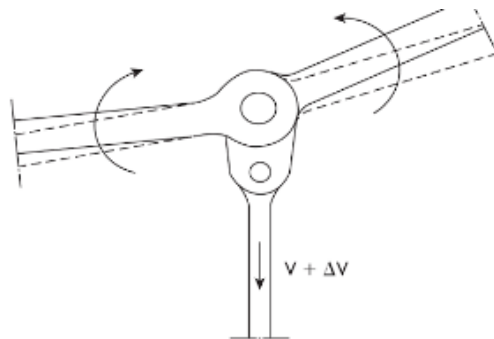
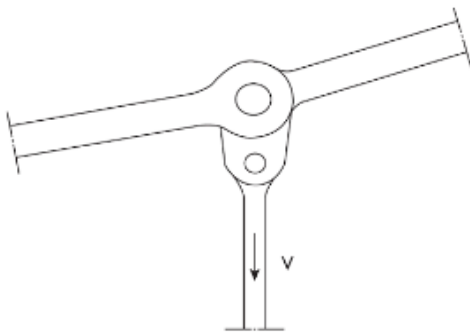


- three-span bridge over the Ohio river
- plummeted in the river in 1967



reason: - pin became fixed (corrosion)
- low redundancy level
- low ductility

→ fatigue crack → progressive failure



Special focus in the reconstruction

More than a bridge ...



Margaret bridge



History

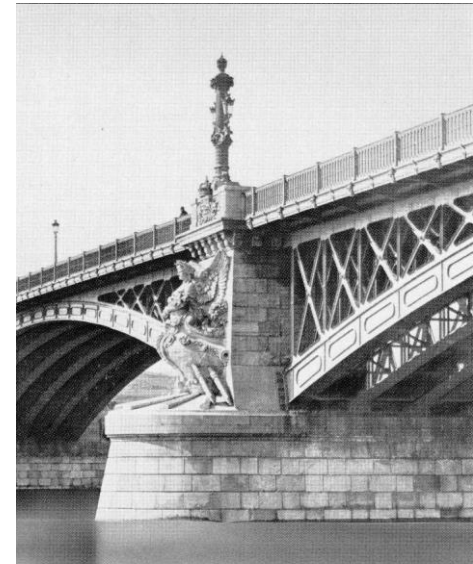
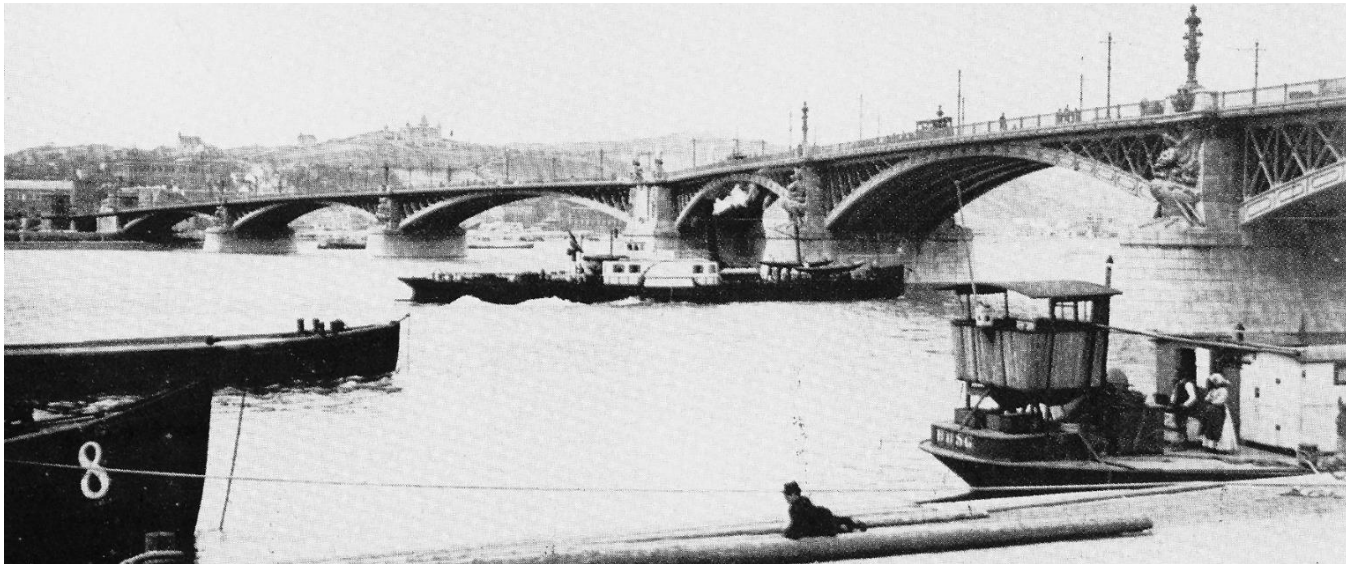
Built: 1872-76
Re-built #1: 1935-37
Re-built #2: 1946-48
Re-built #3: 2010-12

Ernest Gouin



System: 6-span-hinged arch
Length: 607 m

Spans: 73.50, 82.67, 87.88
Width: 11.06/16.80/18.00 m



Explosion – progressive collapse







ECCS Steel Bridges Award 2012

Category: Bridge Refurbishment



Design competition for 2 new bridges

1893 – competition

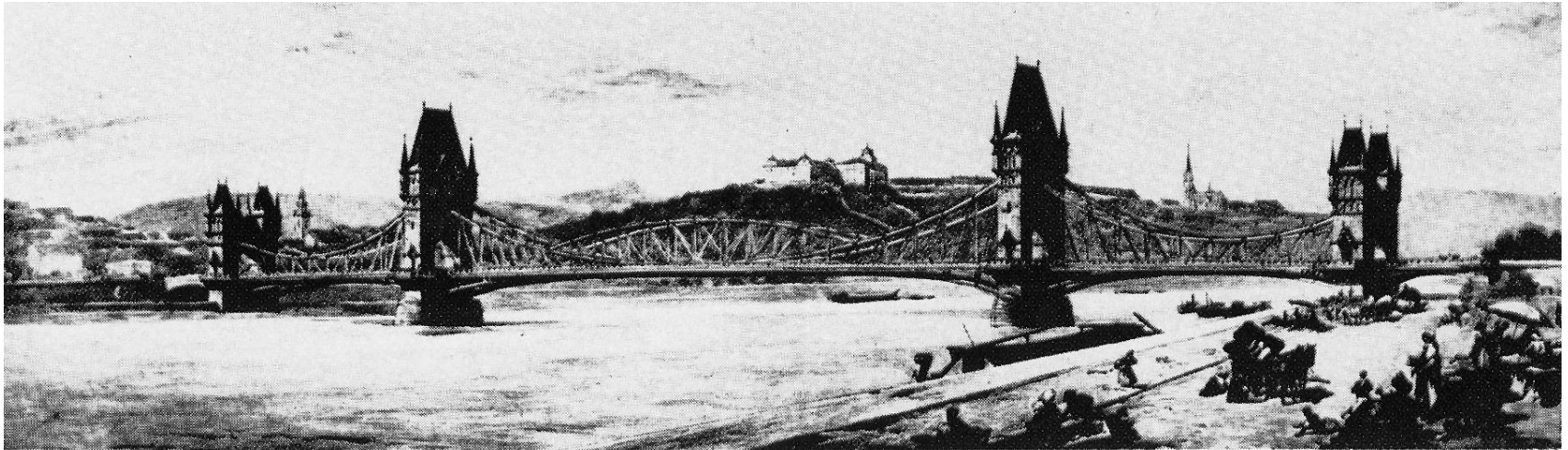
Liberty Bridge: 21 design --- 1896

Elizabeth Bridge: 53 design --- 1903

Liberty bridge



Bridge competition – 1893



History

Built: 1894-96 – **Franz Joseph Bridge**

Re-built #1: 1945-46 – **Liberty Bridge**

Re-built #2: 1980/81- 1985/86

Re-built #3: 2007-08

János Feketeházy



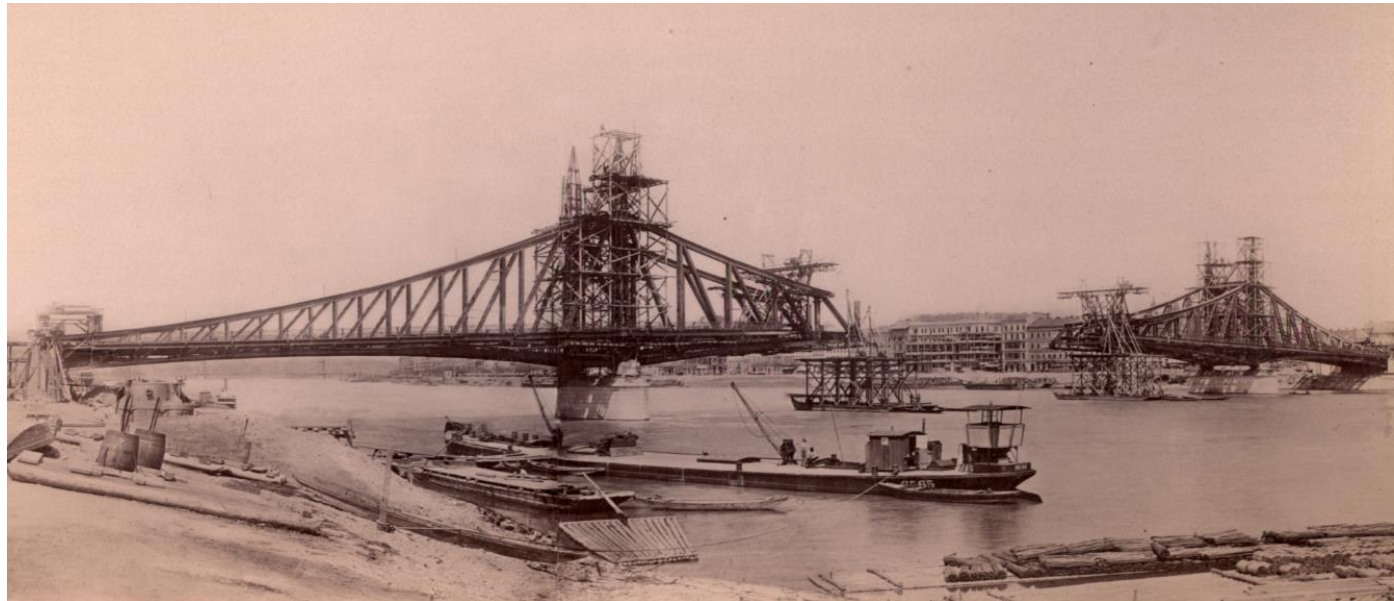
System: cantilever truss

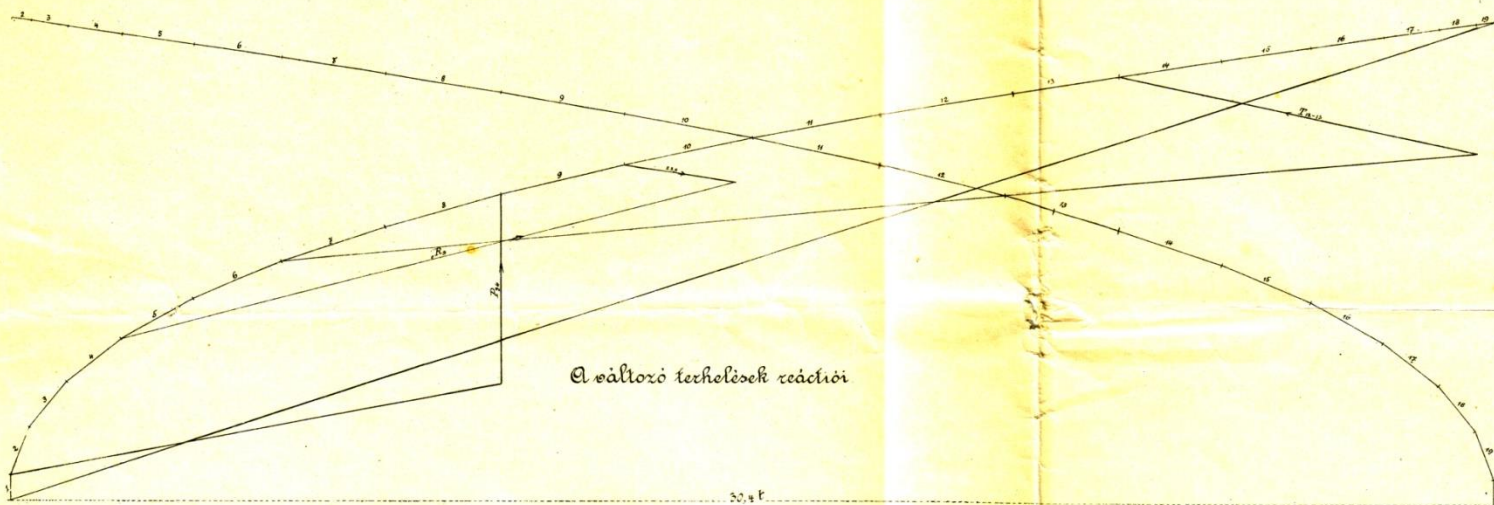
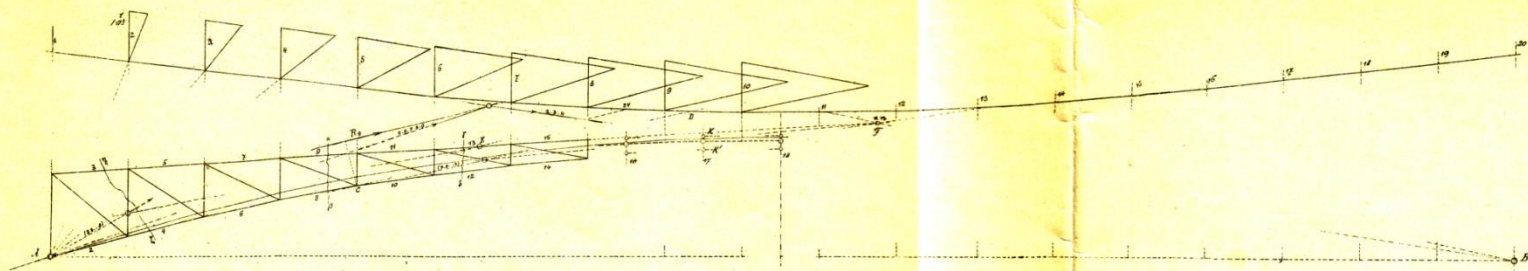
Gerber-type

Length: 331.2 m

Spans: 175.00 m

Width: 10.50 m





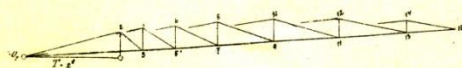
A változó terhelések reakciói

Erők:

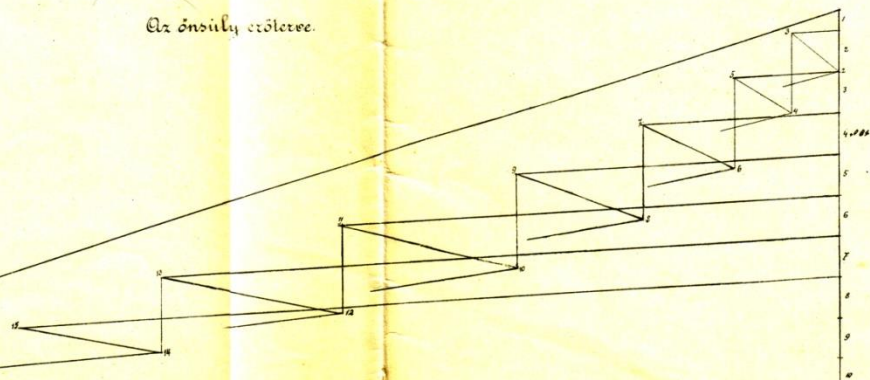
Hosszak:

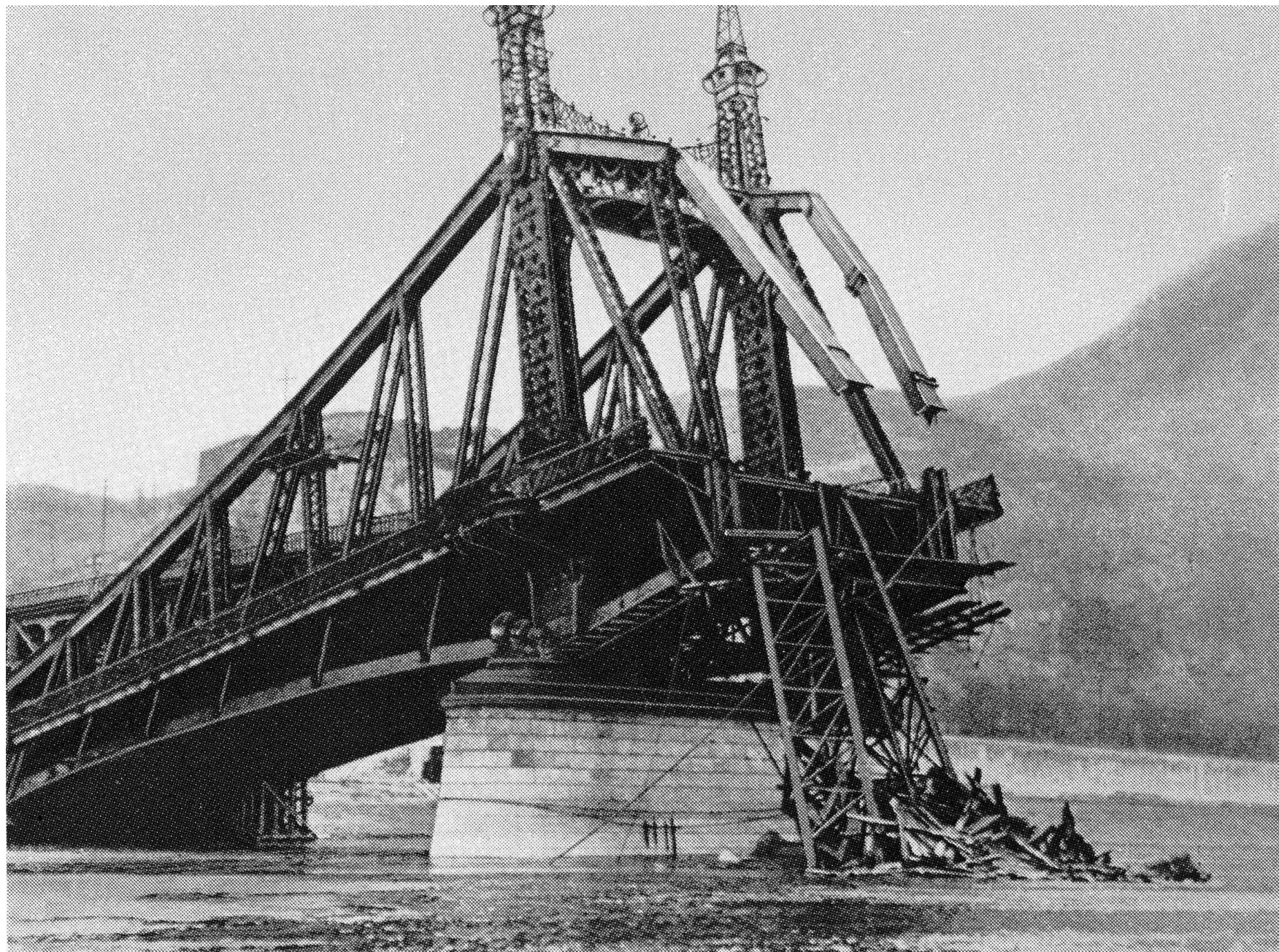
A hőmérséklet változása által okozott belső erők.

$t = \pm 35^\circ$



Az ónsúly erőterve.

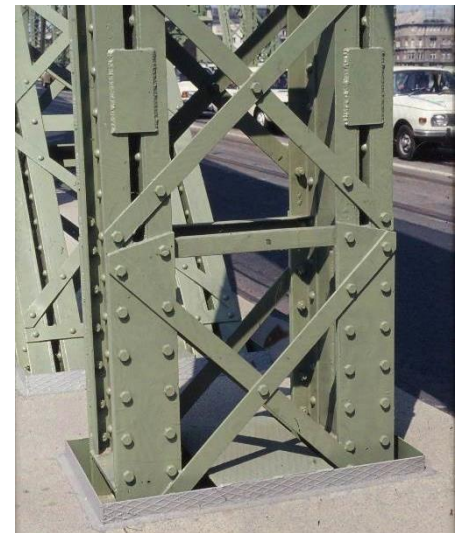




Re-built 1945-1946 – colour, symbols



Reconstruction 1985-1986 – corrosion



Summer weekends...



Elizabeth bridge



Elizabeth bridge – original

Date of erection/reconstruction:
1898-1903, 1960-64, 1975-76,
1985

Structural system:
chain suspension bridge

Length/maximum span:
380 m / 290 m



Design – erection

Built: 1898-1903

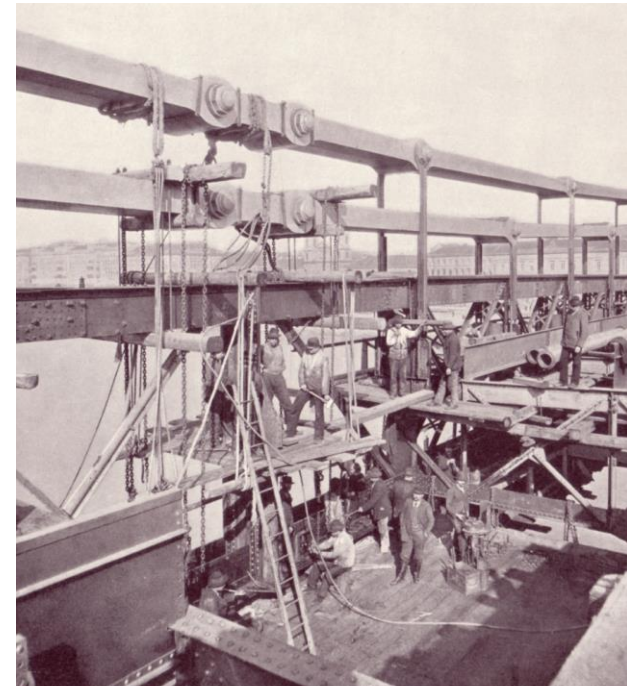
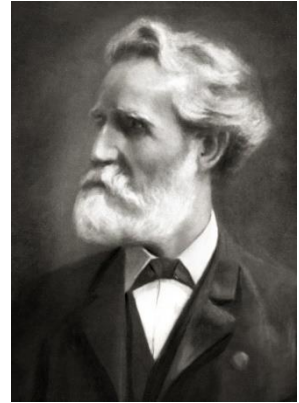
System: chain suspension bridge
truss stiffening girder

Length: 379 m

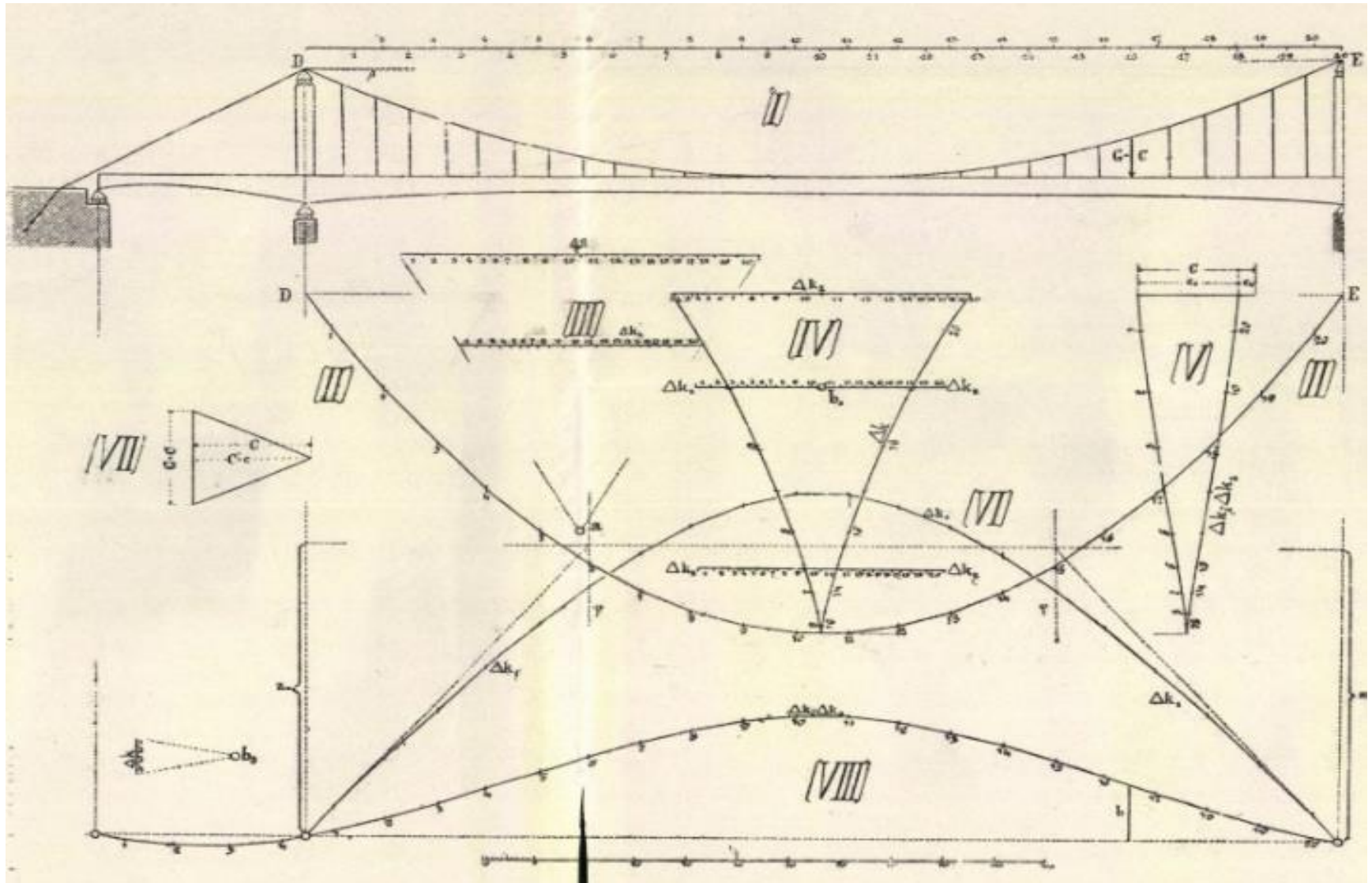
Spans: 290.00 m

Width: 11.00/18.20 m

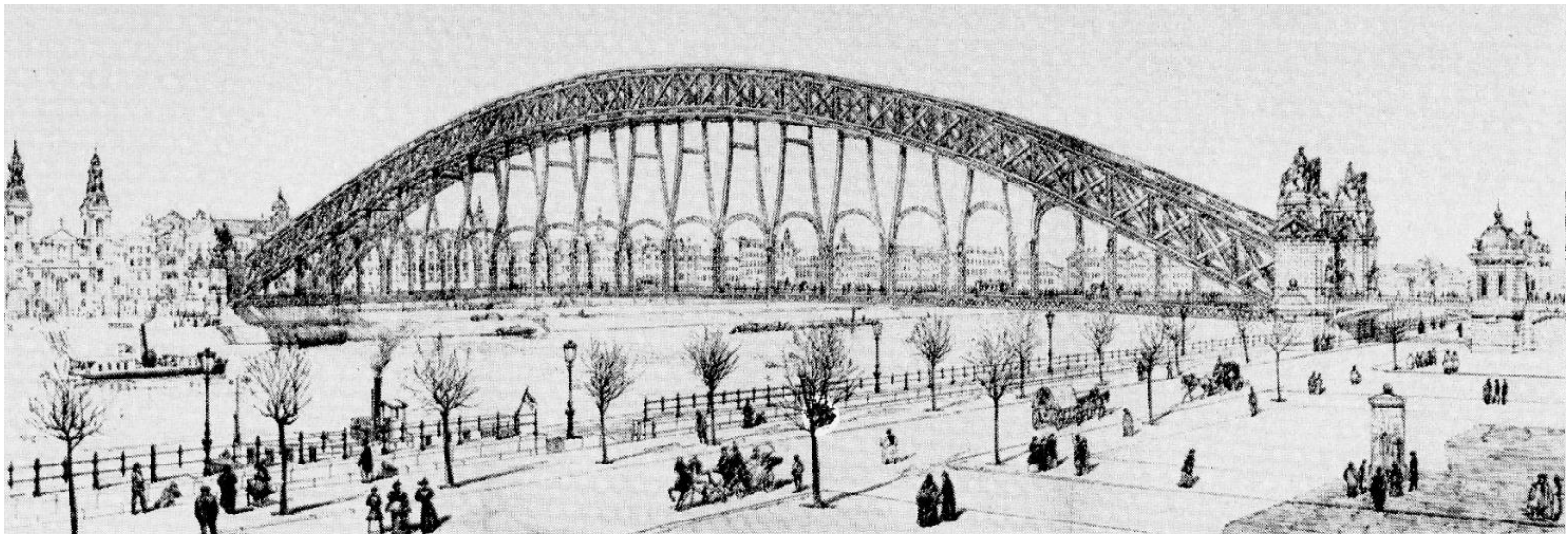
Antal Kherndl



Graphostatic analysis



Bridge competition – 1893





Elizabeth bridge – reconstructed

Date of erection/reconstruction:
1898-1903, 1960-64, 1975-76,
1985

Structural system:
cable suspension bridge

Length/maximum span:
380 m / 290 m



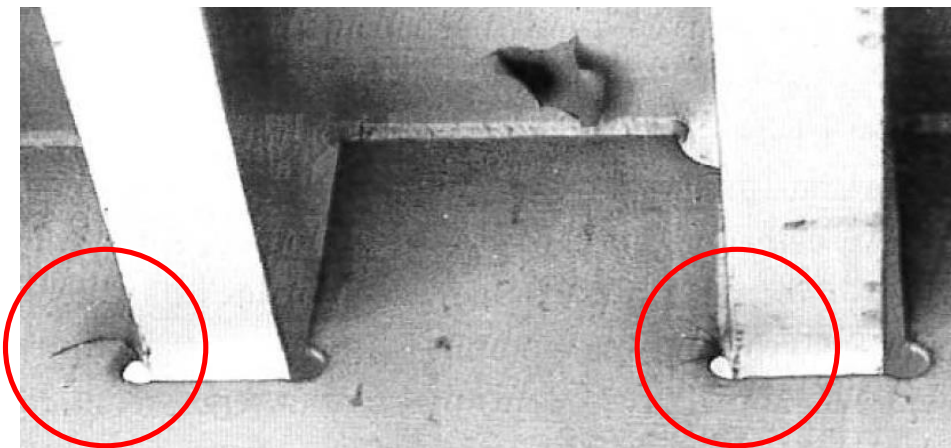
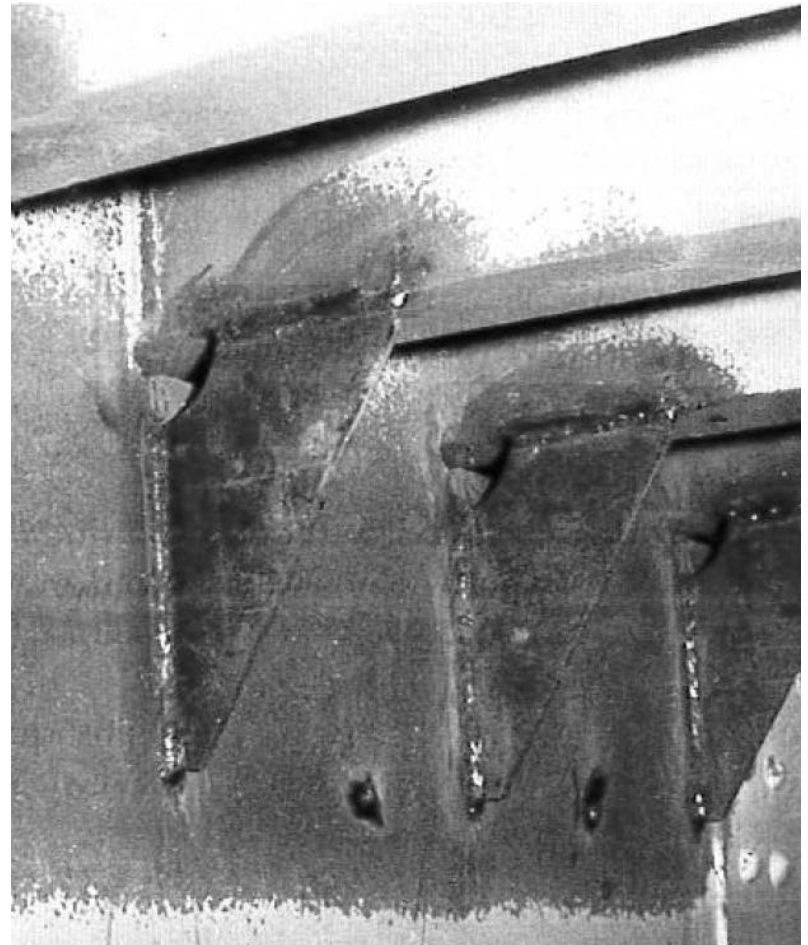
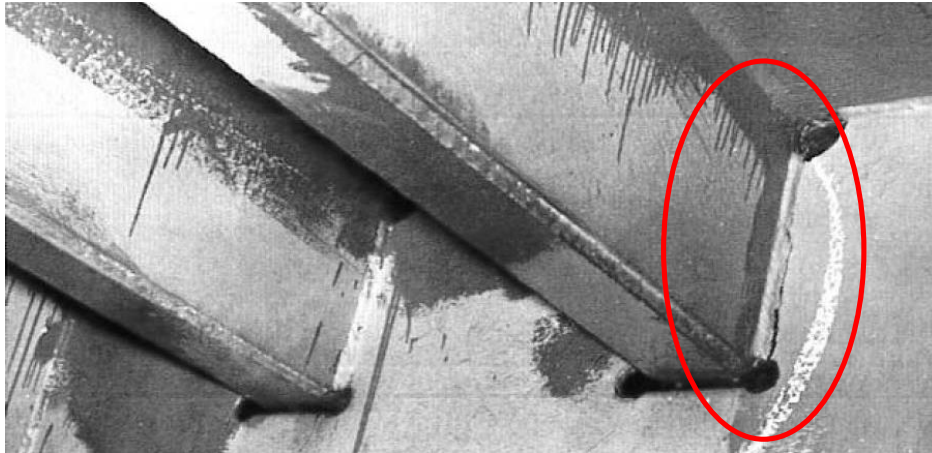
Re-built 1959-1964

- System:
- cable suspension bridge
 - I-section stiffening girders - riveted
 - wider bridge deck - welded
 - pinned pilons - riveted
 - 2x2 vehicular lines
 - 2 tramway tracks



Fatigue of bridge deck

tram traffic → fatigue cracks → tram stopped !



Lighting 2009



Design by Ishii Motoko

Petőfi bridge



Petőfi bridge

Built: 1933-1937

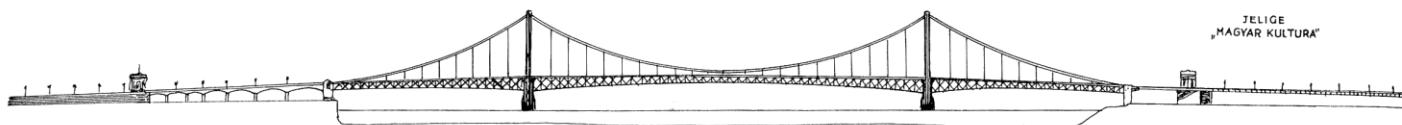
Re-built #1: 1950-52

Systems: continuous truss girder

Length: 378 m

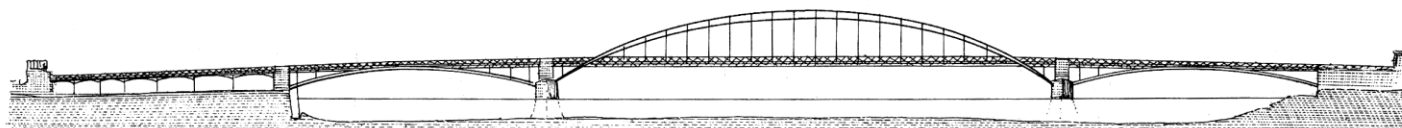
Main span: 154.00 m

Width: 15.70 / 18.00 m



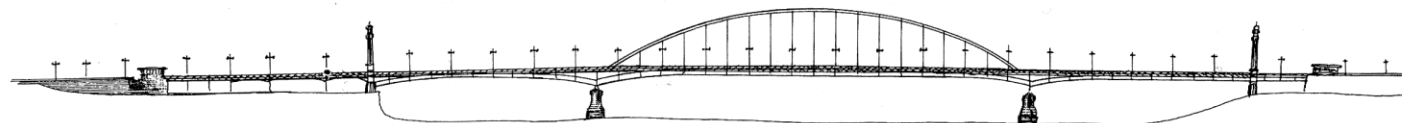
120. kép

A Boráros téri híd 1930-ban készített I. díjas pályaterv. Tervezők *Kossalka János dr.*
és *Wälder Gyula*



121. kép

A Boráros téri híd 1930-ban készített II. díjas pályaterv. Tervezők: *Mihailich Győző dr.*
és *Kotsis Iván dr.*



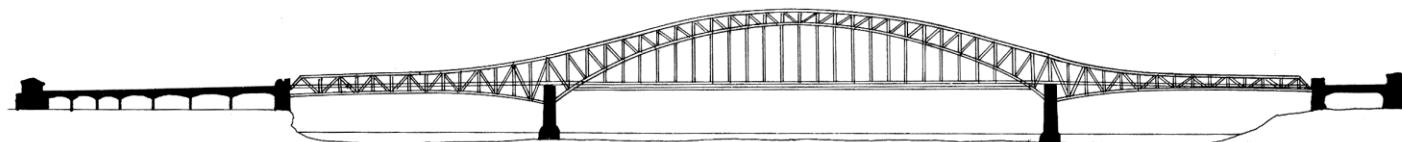
122. kép

A Boráros téri híd 1930-ban készített III. díjas pályaterv. Tervezők: *Kiss Jenő, Sávolgy Pál*
és *Rottmann Elemér*



123. kép

A Boráros téri híd 1930-ban készített és megvett pályaterv. Tervezők: *Beke József,*
Frigyes Sándor és Rerrich Béla



124. kép

A Boráros téri híd 1930-ban készített és megvett pályaterv. Tervező: *Folly Róbert*

Árpád bridge



Árpád bridge

Built: 1939-1950
1981-84

Systems: continuous plate girder

Length: 772 m

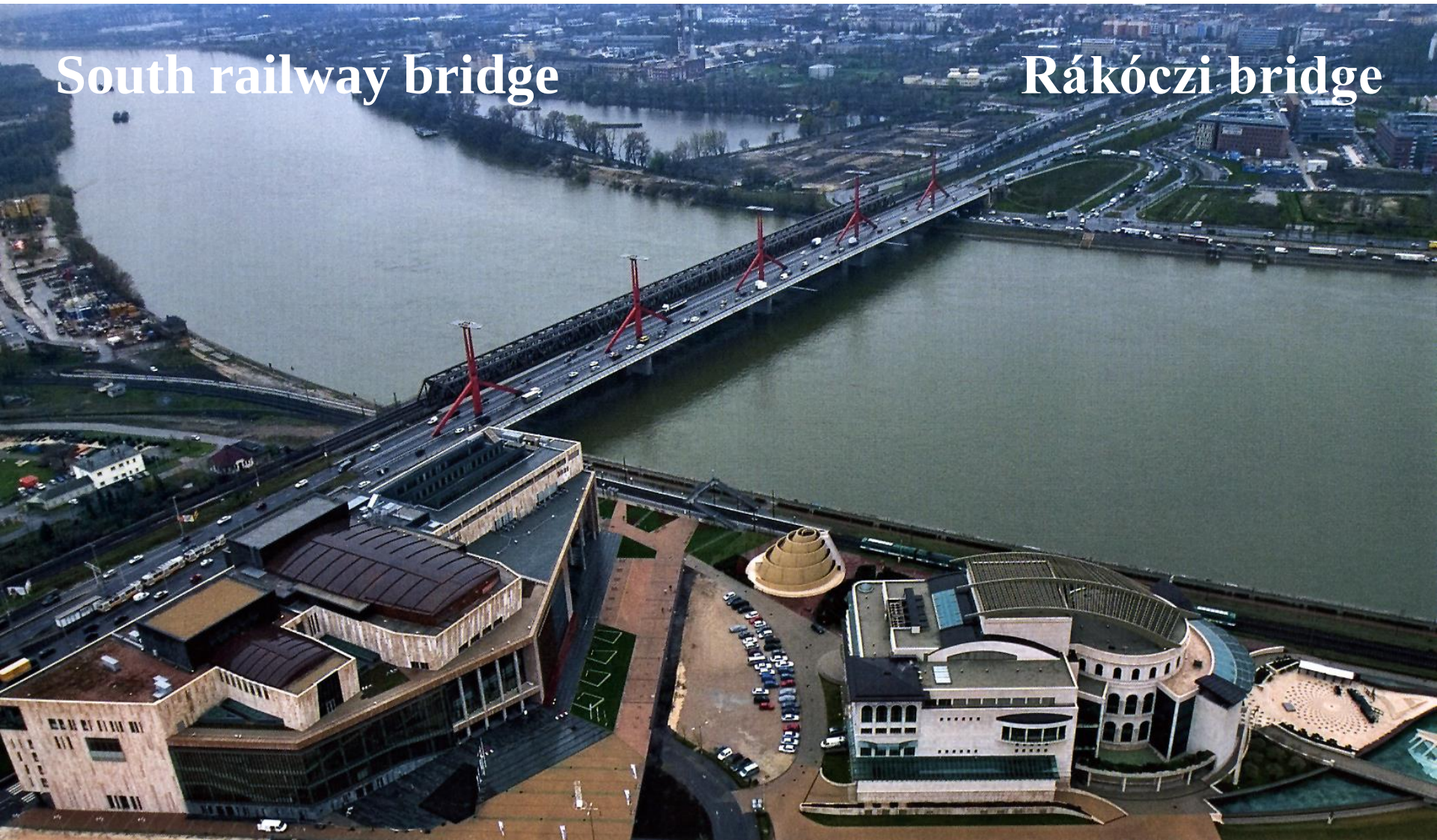
Main span: 103.00 m

Width: 11.00 / 22.00 m



South railway bridge

Rákóczi bridge



South railway bridge

Built: 1873-1877

Re-built #1: 1897-1899

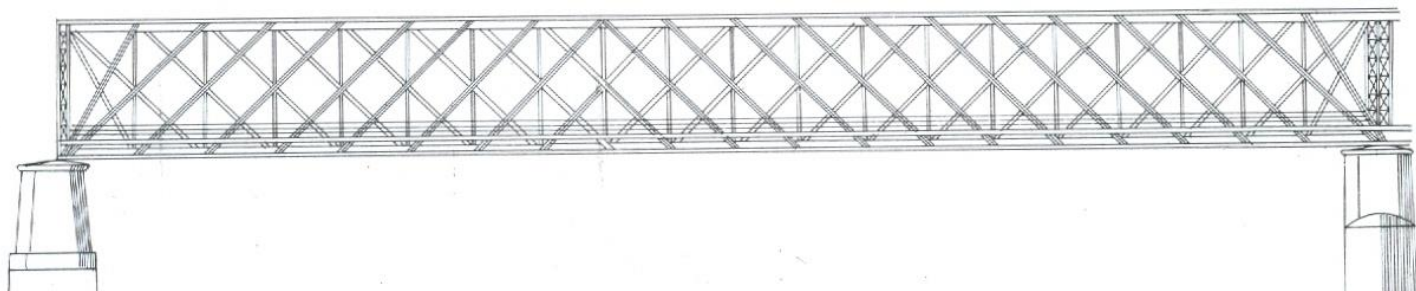
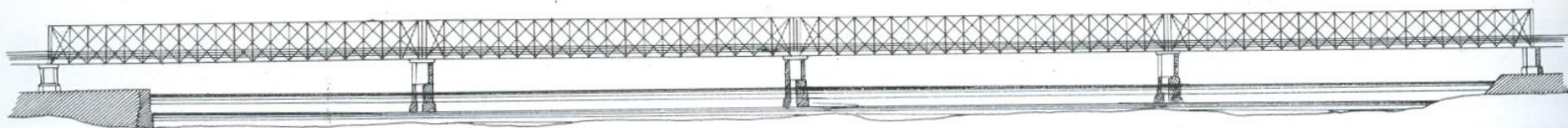
Re-built #2: 1910-1913

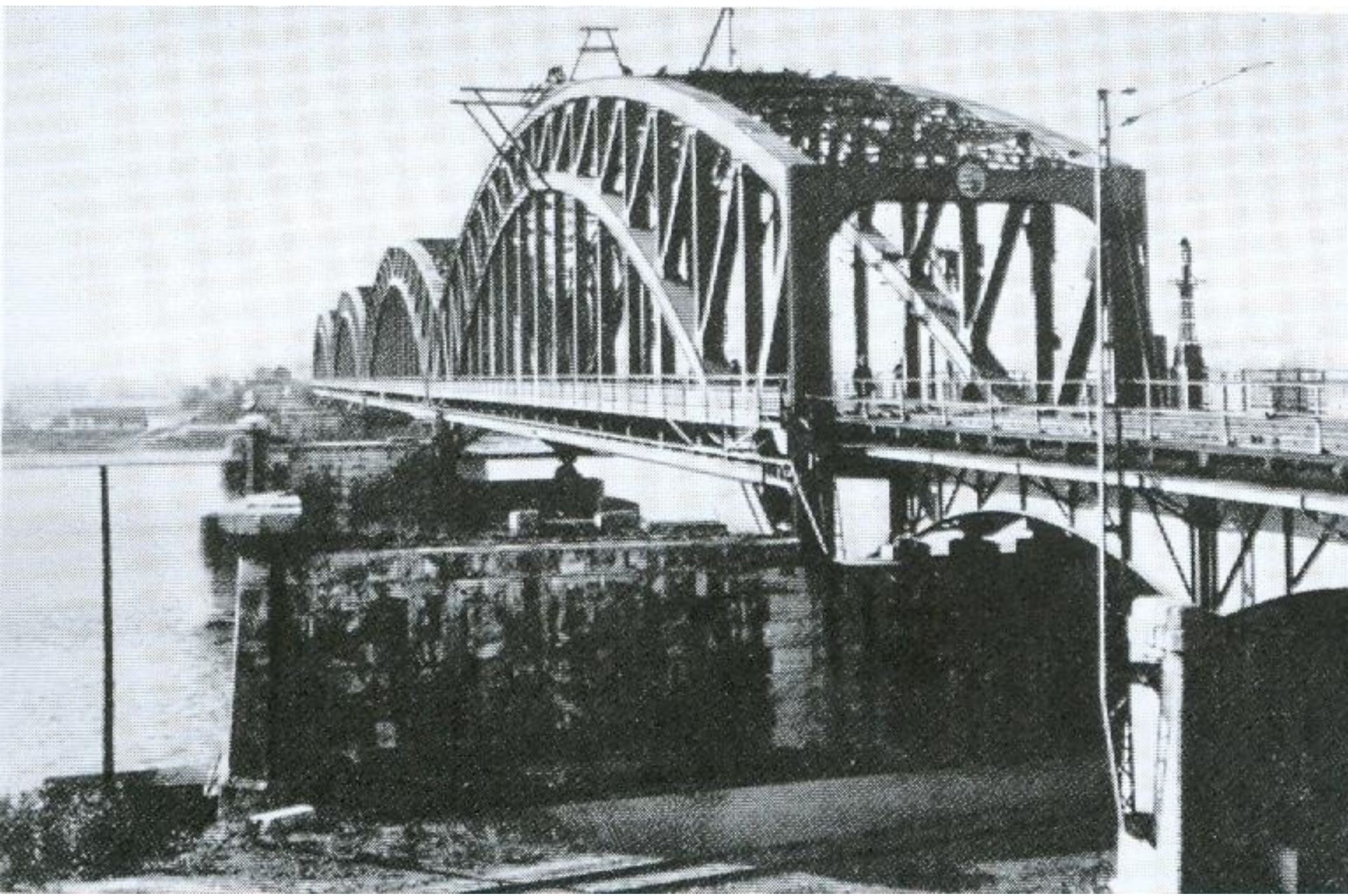
Re-built #3: 1946-1948/53

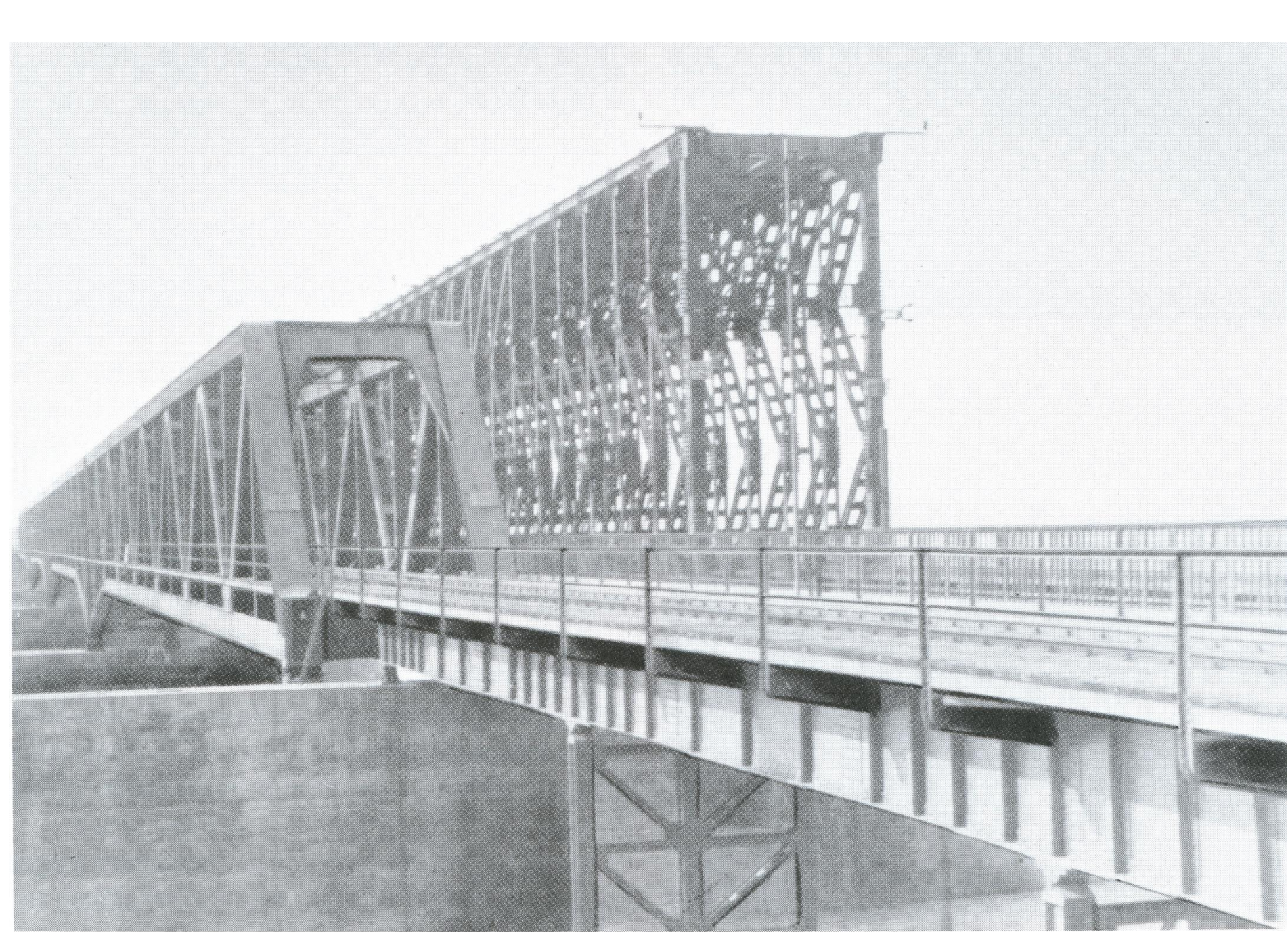
Systems: 6-span-continuous truss

Length: 495 m

Spans: 45.08, 94.72, 94.72 m, sym.









Rákóczi bridge

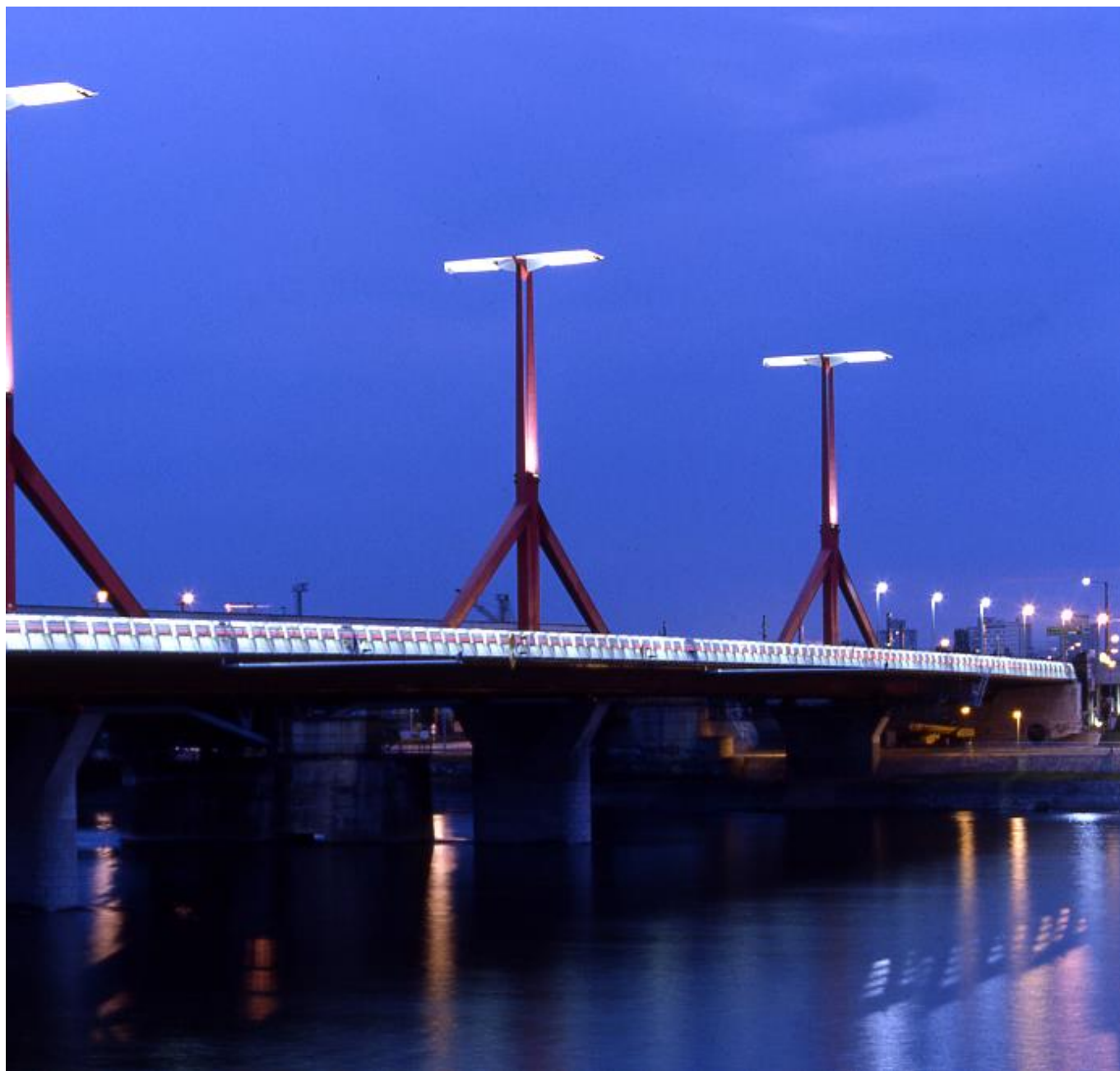
Built: 1992-1995

Systems: 6-span-continuous box

Length: 495 m

Spans: 45.08, 94.72, 94.72 m, sym.

Width: 30.60 m





North railway bridge

Built: 1894-1896

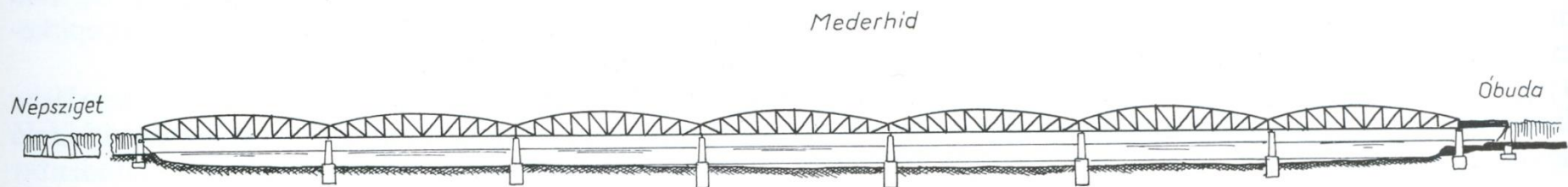
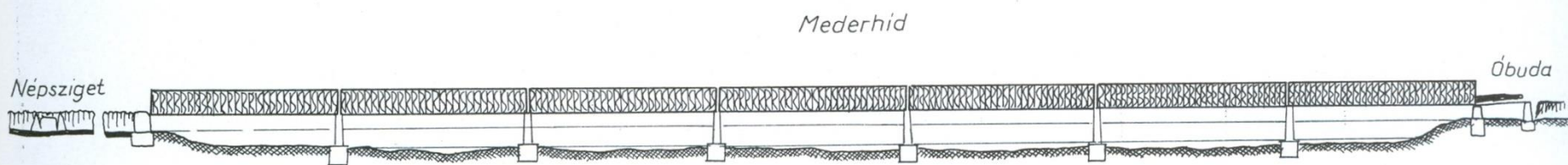
Re-built #1: 1954-1955

Re-built #2: 2008

Systems: 7-span-continuous truss

Length: 658 m

Spans: 7x93,0 m







Megyeri bridge

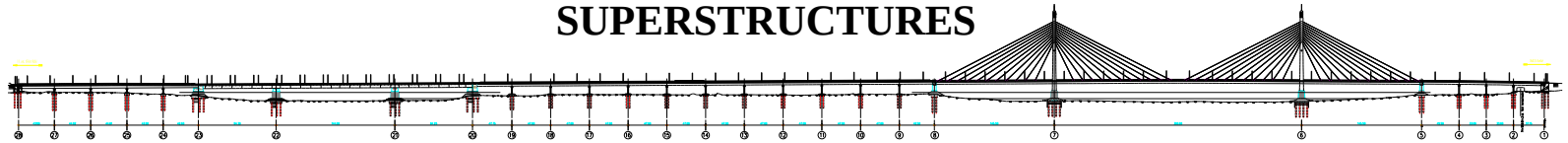


**LENGTH OF
THE BRIDGE:
1861,35 m**

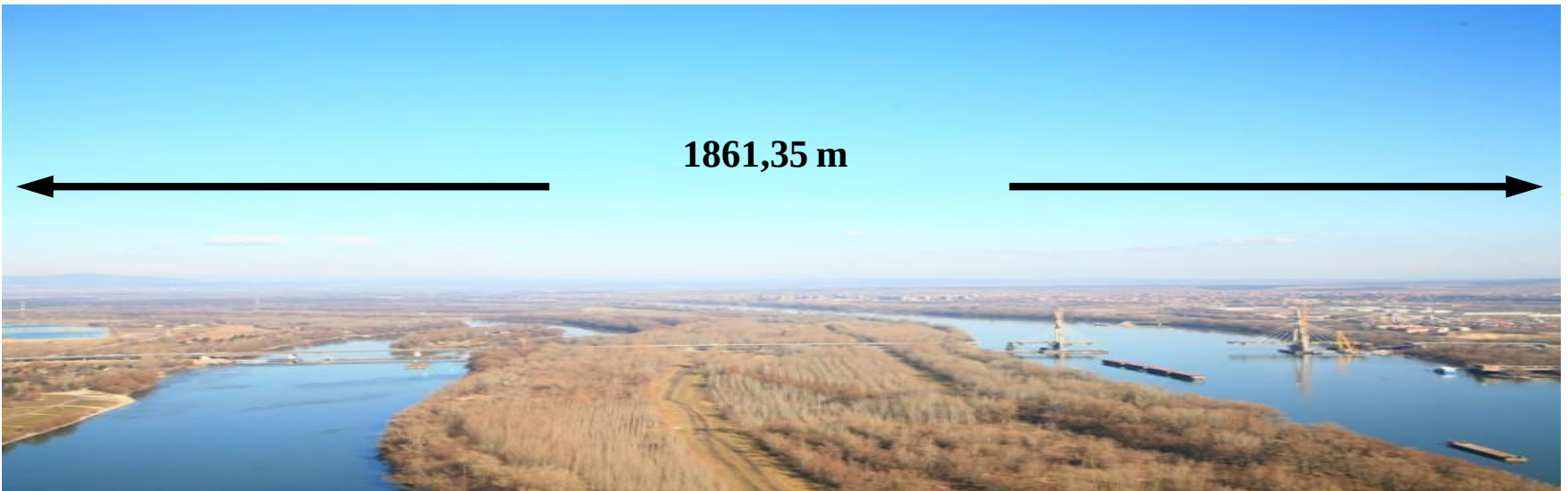
5 BRIDGE SECTIONS



**9 SEPARATE
SUPERSTRUCTURES**



1861,35 m



Deák Ferenc bridge



Thank you for your attention!

