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The engineering of ancient Roman roads

29th of September 2015 - h. 17:30 BRUSSELS



The Roman Bridges

Mario P. Petrangeli

1. Finitura
2. Campidoglio
3. Parapetto
4. Pavimentazione

Mario Paolo Petrangeli

The importance of the bridges at roman time: (i) to facilitate the troop movements



The bridge (21 wooden arches spanning 51 m each) built by Traiano (53-117 AC) to cross the Danube and conquer the Dacia (the Balcan area)

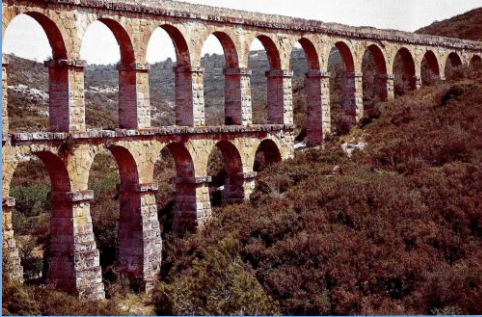


The right abutment still in place

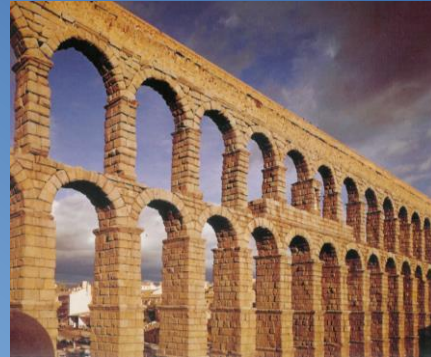
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The importance of the bridges at roman time: (ii) to cross deep valleys with aqueducts

Tarragona (11+25 arches)



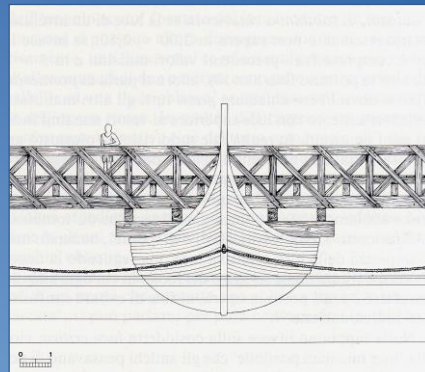
Segovia (119 arches)



3

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Bridge of ships

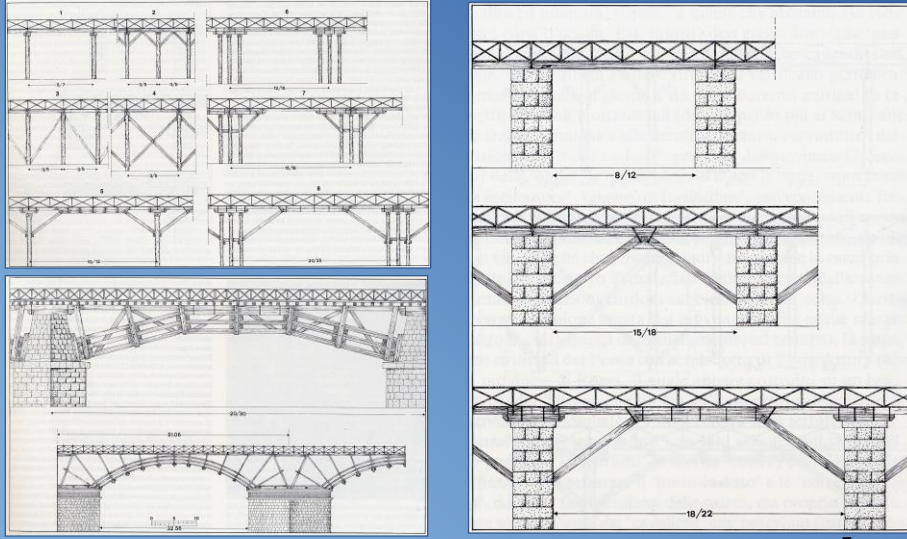


- Marco Varrone (116-27 BC) planned to cross the Adriatic sea from Otranto to Apollonia (Albania) (about 50 km)
- Caligola (1° century AC) built a bridge of ships about 5000 m long crossing the sea from Baia to Pozzuoli (Naples).

4

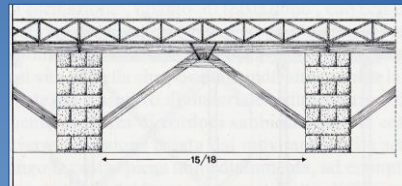
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Wooden bridges



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A modern italian railway bridge

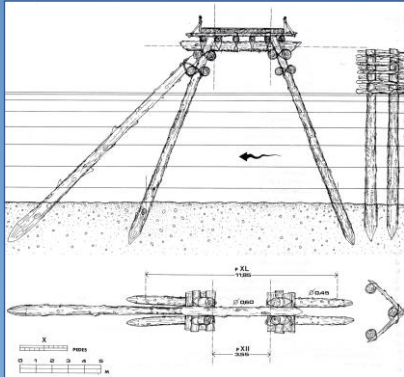


Linea Rome-Bari, Ponte Sisto, Cosenza
Ponte Sisto, Linea Sesto-Cosenza, Napoli
Linea Rome-Bari, Ponte Sisto, Cosenza

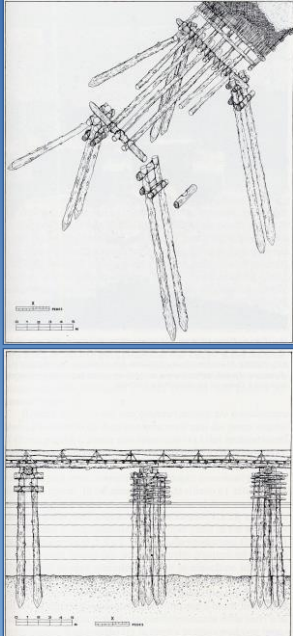
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**Pontes tumultuarii
(Temporary bridges)**



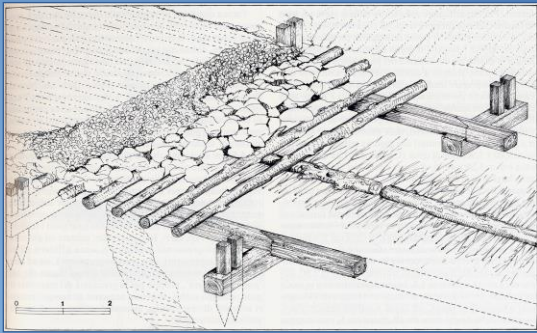
Wooden trestle bridge, 400m long,
crossing the Rhine river
built by Caesar (55 BC) in 10 days



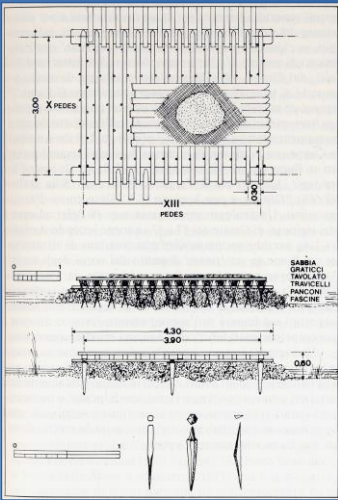
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**Pontes longi
(Long Bridges)**



To cross marshes or very soft
soils



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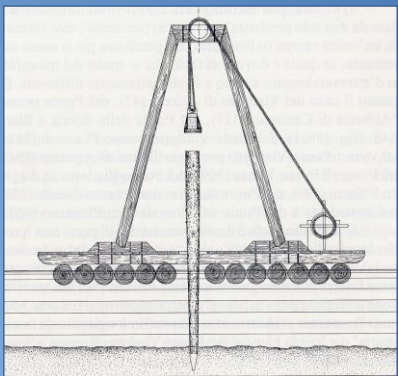
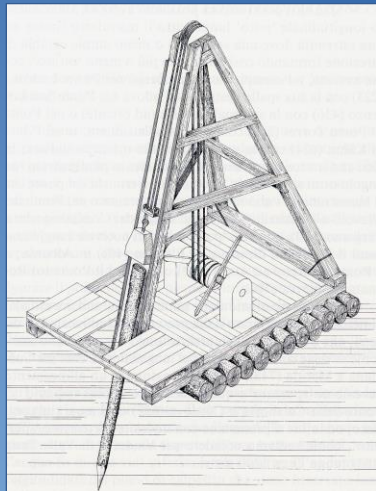
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1 The main arch
 2 Secondary arch
 3 Lateral retaining wall
 4 Pier
 5 Foundation

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Pile-drivers

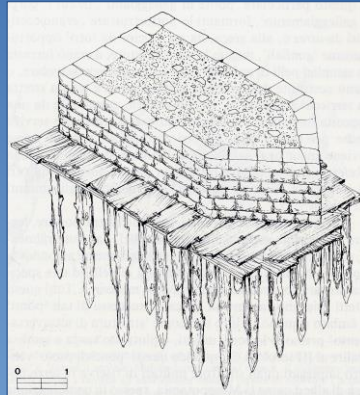
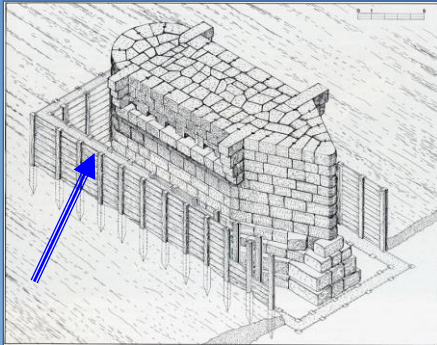



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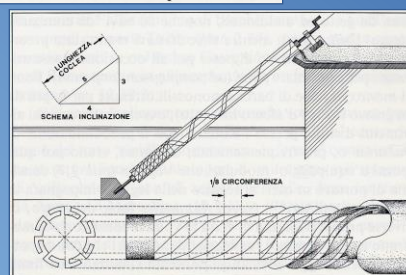
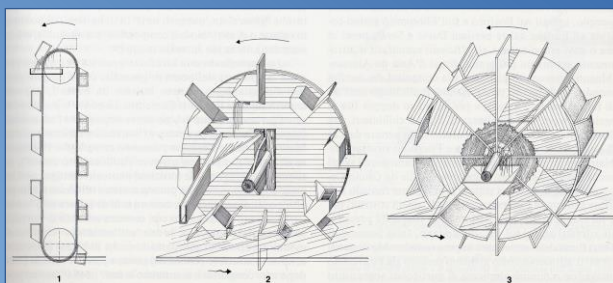
Foundations



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Water-scooping machines

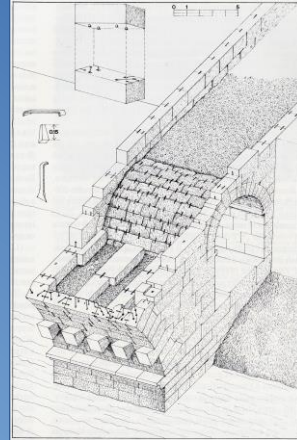


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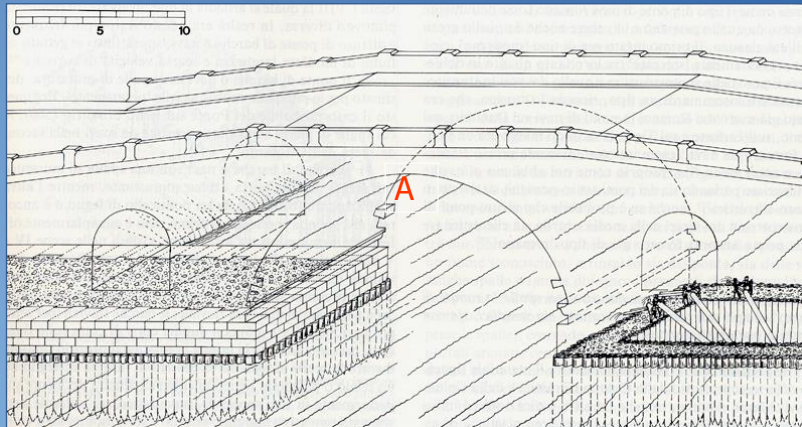
Ponte Cestio



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Scheme of the original single arch CESTIO bdg foundations



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Ponte Emilio

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Piers shape

Upstream face: mainly with cutwater, sometime circular
 Downstream face: circular or plane

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Type of walls: ***grande apparecchio*** (large dimension blocks)



Arcaic polygonal work



"Third generation"
 polygonal work



Square units work

17

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A Roman bridge widened and still in service for a national road
 (Tiburtina)



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Type of walls: ***piccolo apparecchio*** (small dimension blocks)



Opus incertum

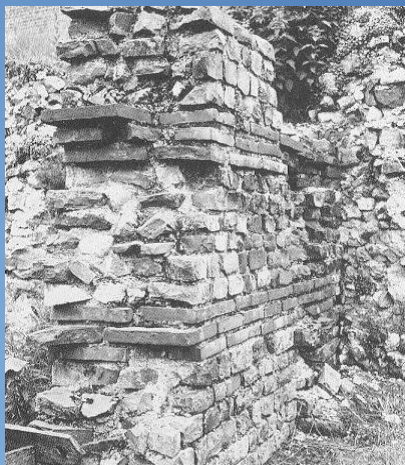


Opus reticulatum

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Type of walls: ***piccolo apparecchio*** (small dimension blocks)



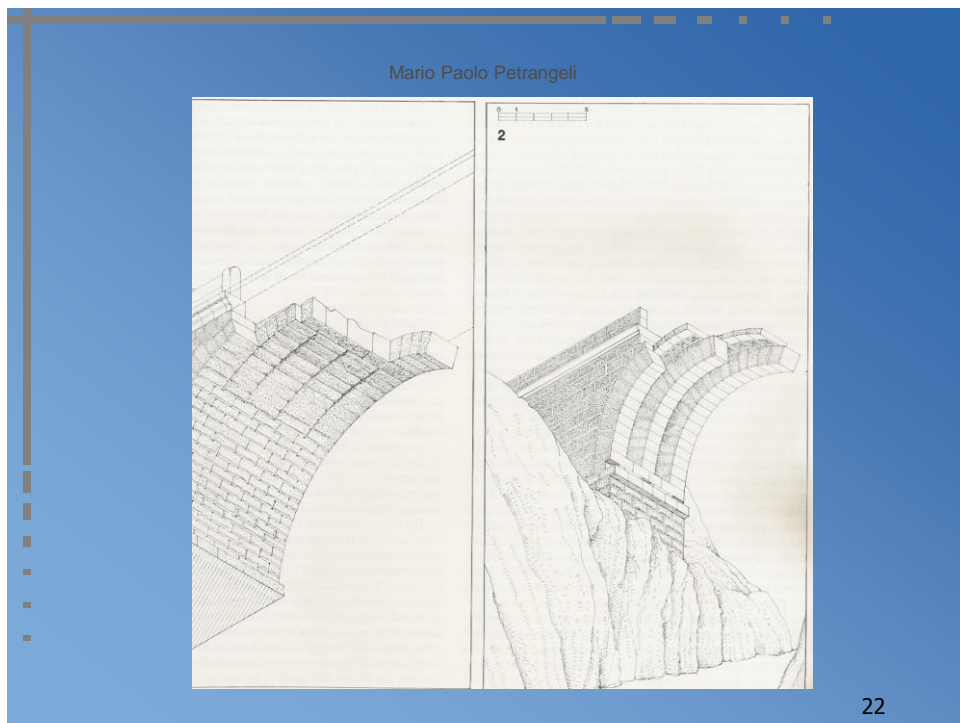
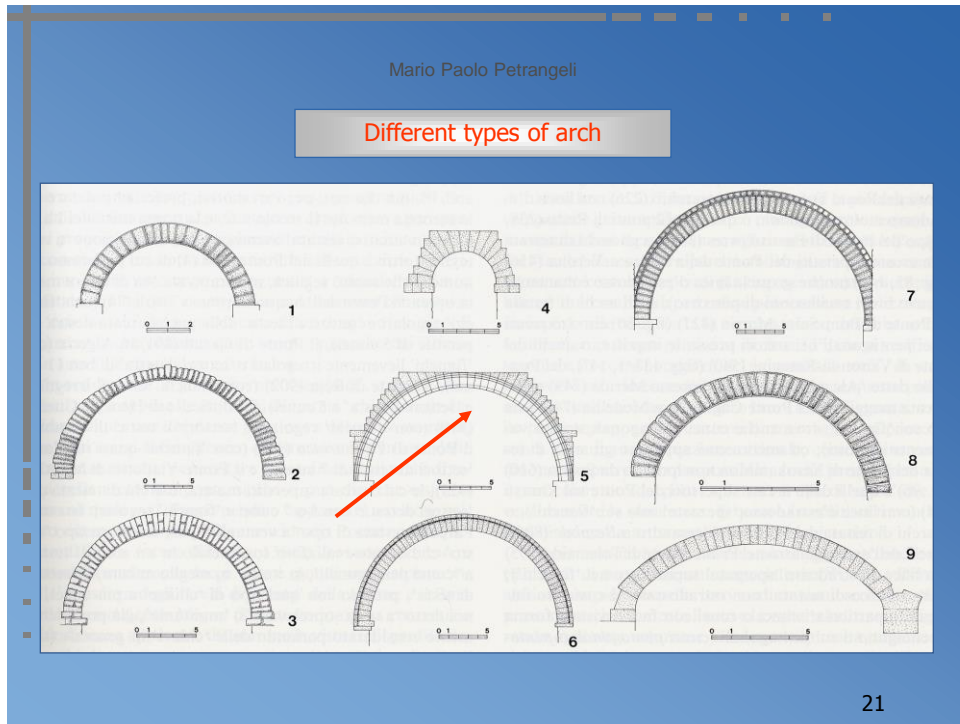
Opus mixtum



Opus vittatum

20

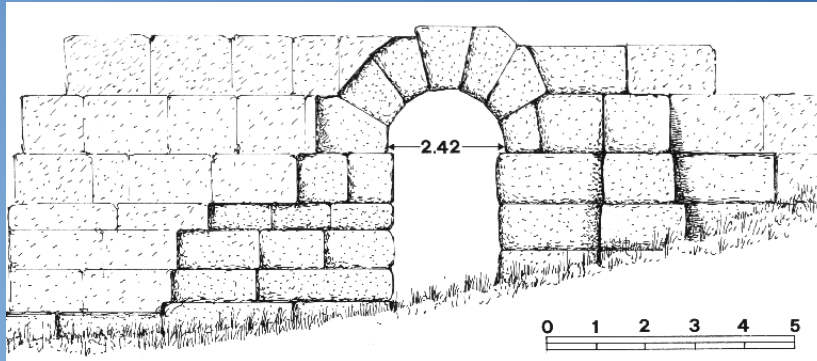
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One of the oldest example of Etrurian Bridge
 (Ponte Camillario) near Viterbo

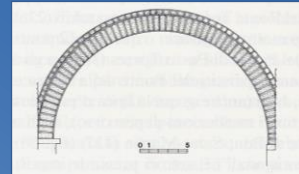


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Alcàntara

Spain- 103-104 A.C.

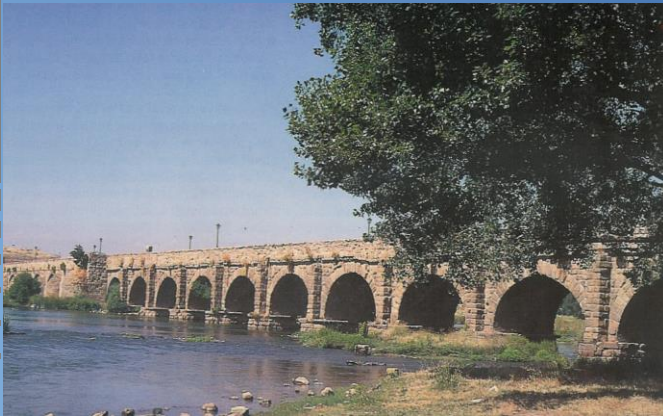
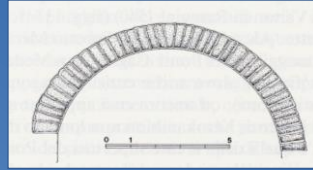


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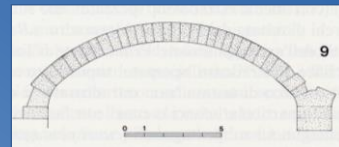
Salamanca



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Alconétar

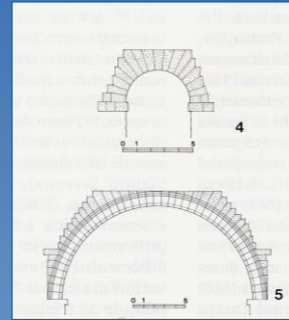


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A modern version of an ancient shape

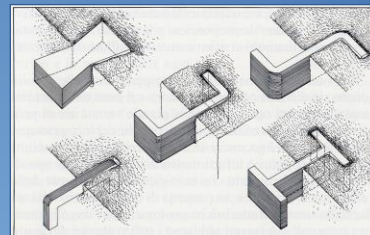
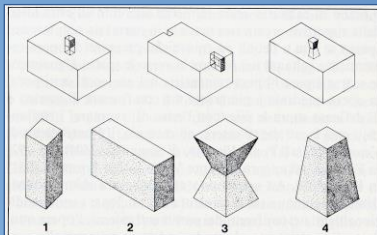
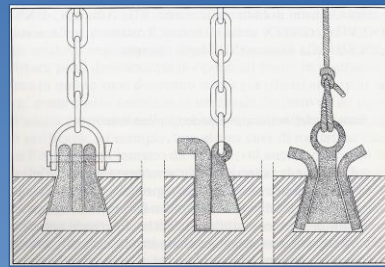
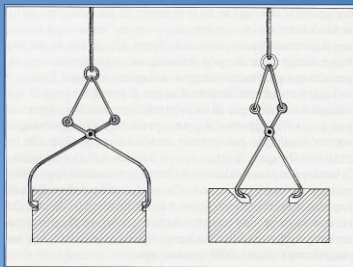


The central part of the arch supports directly the road

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Details to handle and to connect stone blocks

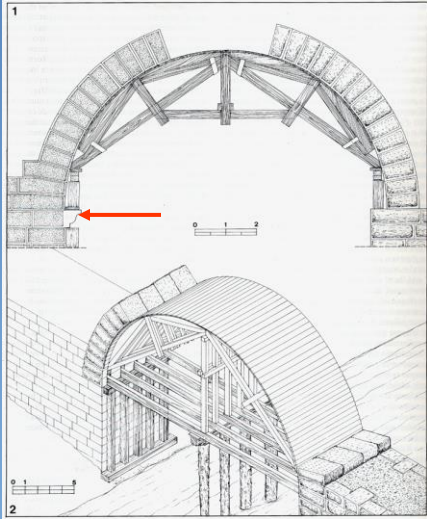


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Types of centreing



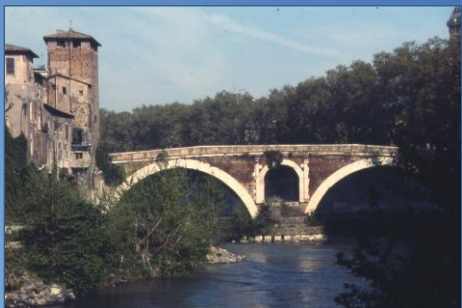
The diagram shows two types of bridge centreing. Figure 1 is a plan view of a semi-circular arch with a wooden truss structure supporting the masonry. A red arrow points to the central support. Figure 2 is a perspective view of a similar arch, showing the wooden framework and the masonry arch. Both figures include scale bars.

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Ponti Fabricio e Cestio on the back; the ruins of ponte Emilio on the left



Ponte Fabricio

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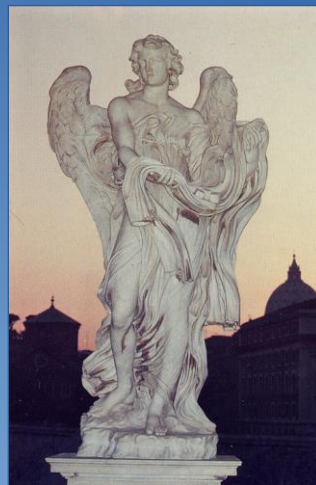
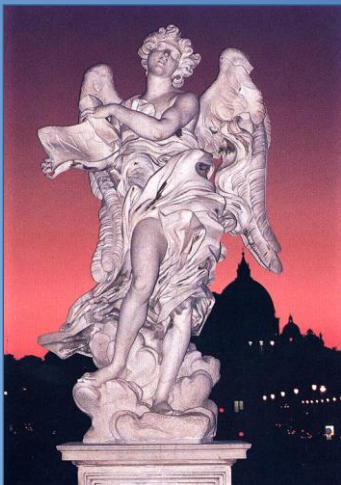
Ponte S. Angelo



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Ponte S. Angelo



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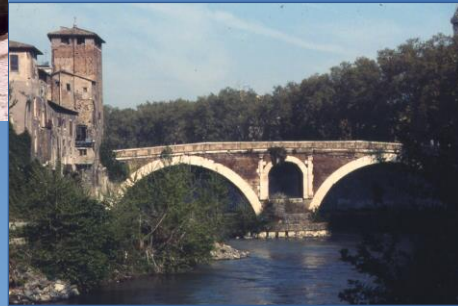
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A fascinating history lasting more than two thousands years



Ponte sul PO

Ponte Fabricio



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