

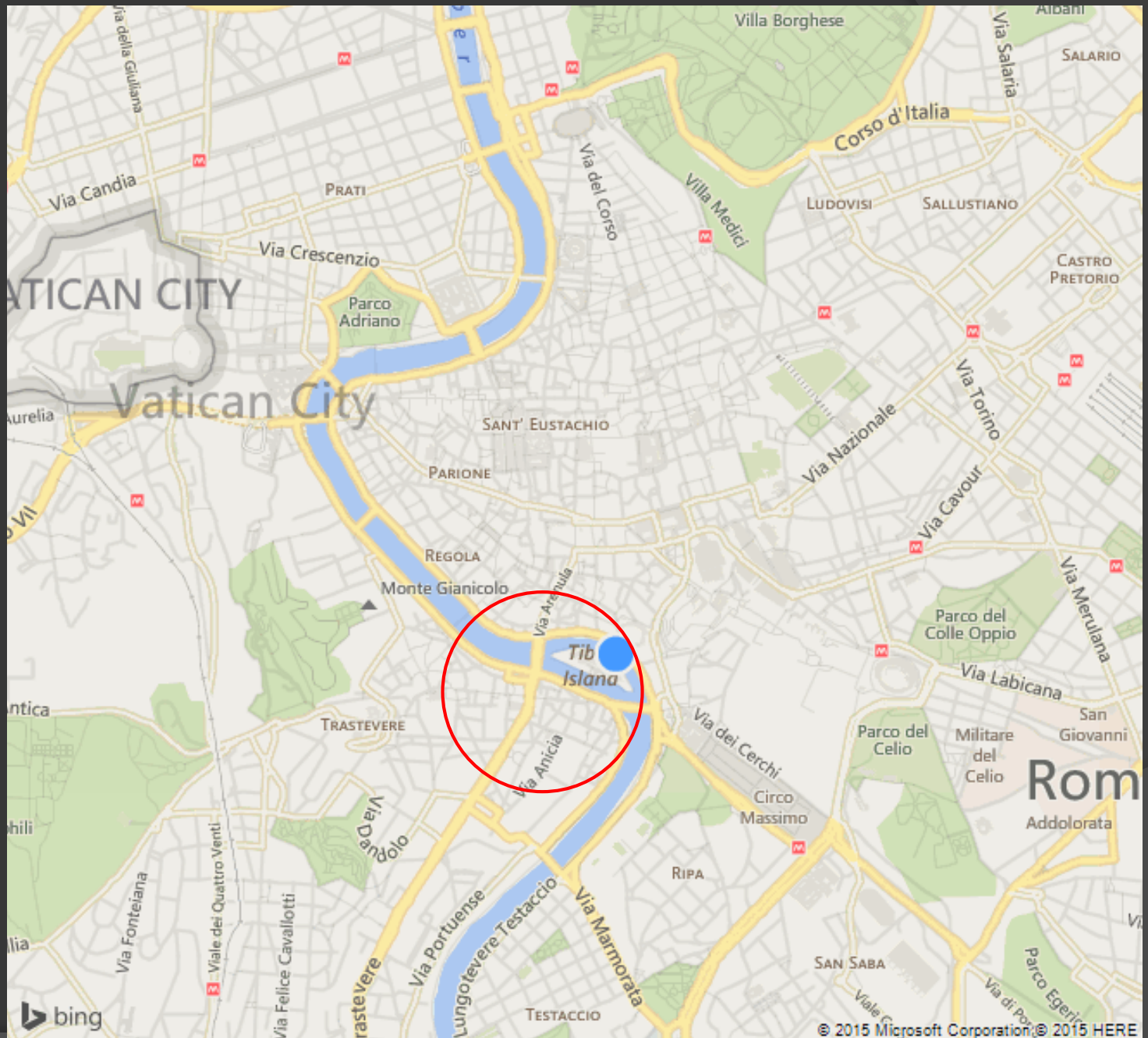
History of the oldest bridge Pons Fabricius

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Outline of the Presentation

- ⦿ History
- ⦿ Design – Geometry, Loading, Architectural
- ⦿ Materials
- ⦿ Construction Methods
- ⦿ Improvements

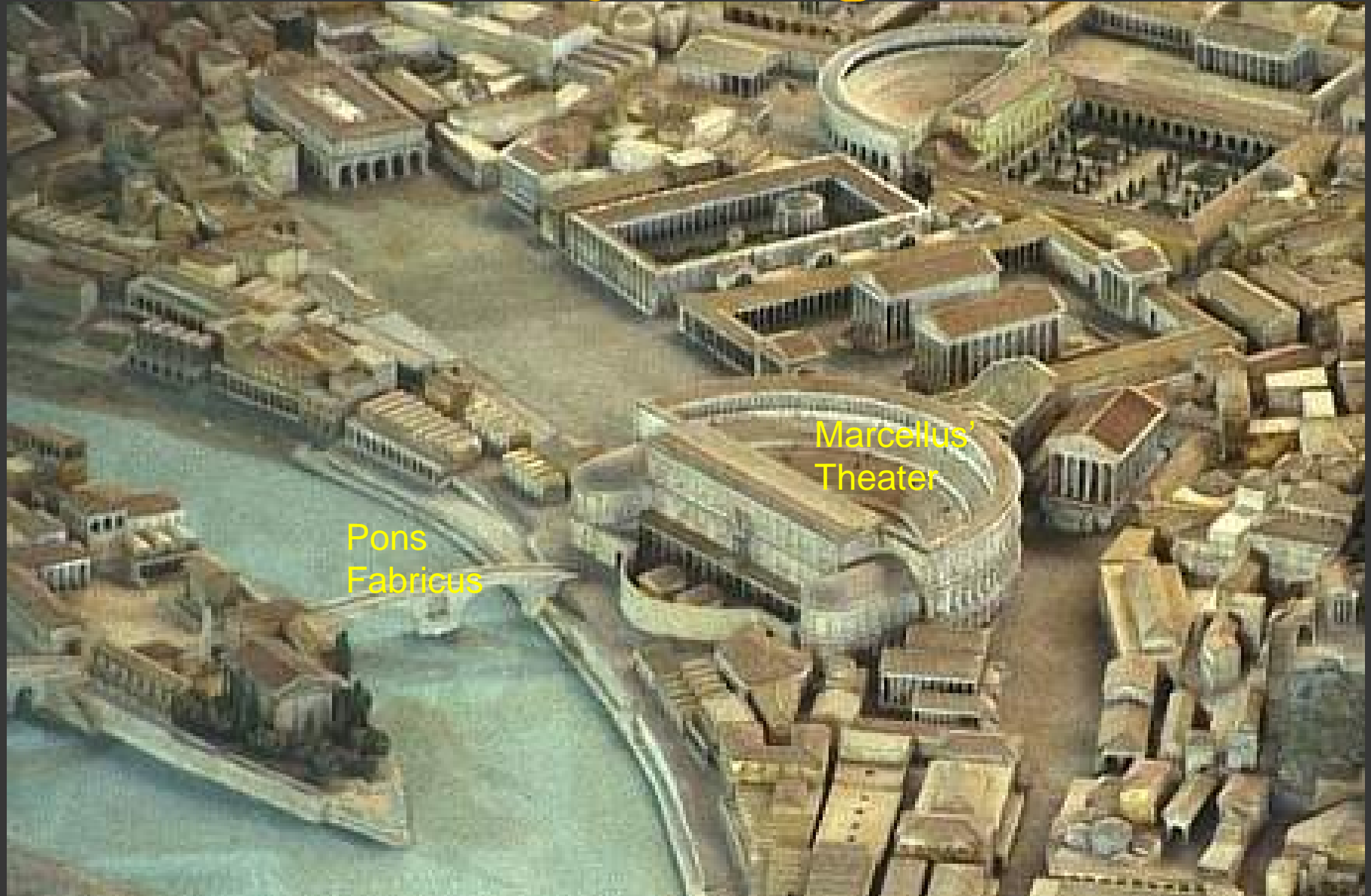
Location



Arial Map



Rome 2000 years ago



Pons
Fabricius

Marcellus'
Theater

A detailed model of ancient Rome, showing a dense urban landscape with numerous buildings, streets, and public structures. The model is made of a light-colored material, possibly wood or plaster, and is set against a dark background. The Colosseum is a prominent feature in the upper center, and the Circus Maximus is a large, oval-shaped structure in the lower right. The Tiber River is visible in the bottom left corner, with the Pons Fabricius bridge crossing it. The overall scene depicts the grandeur and complexity of the Roman Empire's capital city.

Colosseum

Circus Maximus

Marcellus'
Theater

Pons
Fabricius

History Facts

- ⦿ Built in 62 BC by Lucius Fabricius, curator of Rome at that time – in replacing the wooden bridge.
- ⦿ The bridge went under repair after major flood in 23 BC by Lepidus and M. Lolius.
- ⦿ Outside face tiles were replaced with travertine in 1679.
- ⦿ Walls were built along the Tiber river in 1875 to stop the flooding in the city.

Challenges - Design and construct a bridge structure for the flooding river



How the Roman engineers handled the Flood and Scour

◎ Flood

- Built a heavy gravity bridge with stone or rocks that sturdy, strong, and durable to stand the river flow
- Provided enough opening for the water channel

◎ Scour

- Constructed a deep foundation
- Designed for hydrology of the river
- Provided heavy riprap around the pier

Design and Construction

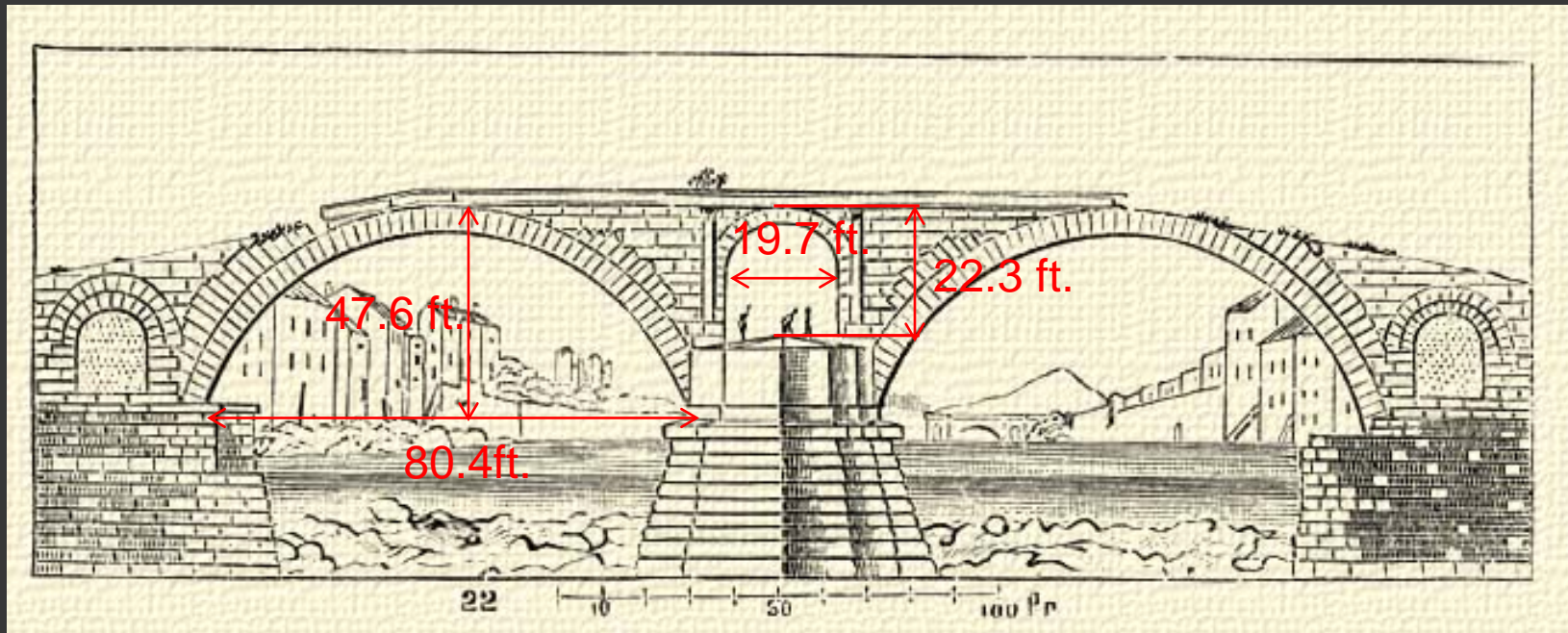
◎ Design

- **Dead** and Live
- **Flood**
- **Scour**
- Others

◎ Construction

- **Cofferdam system**

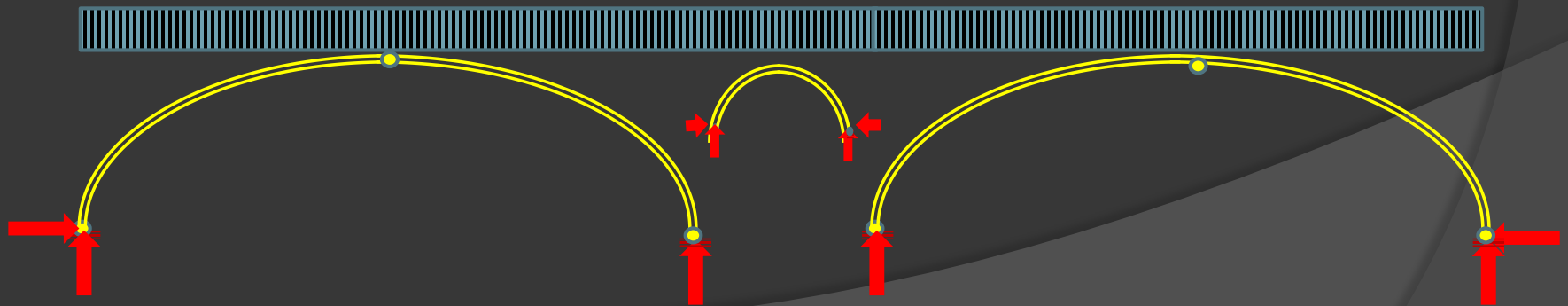
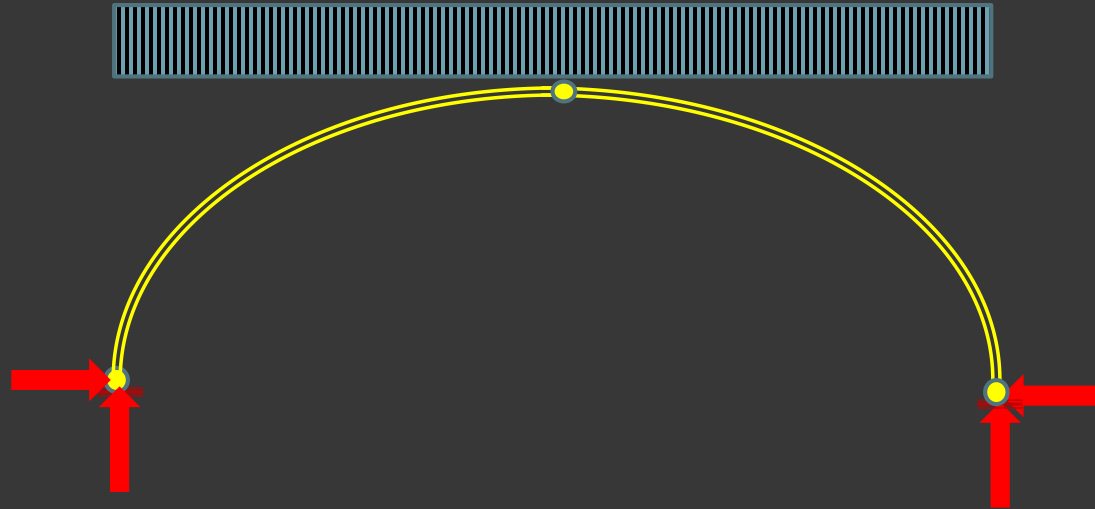
Design Facts



Geometric Data

- Height = 14.5 m (47.6 ft.)
- Arch Width = 24.5 m (80.4 ft.)
- Rdwy. Width = 5.5 m (18.1 ft.)
- Span/Height Ratio = 1.7

Arch Loading (3-hinges)

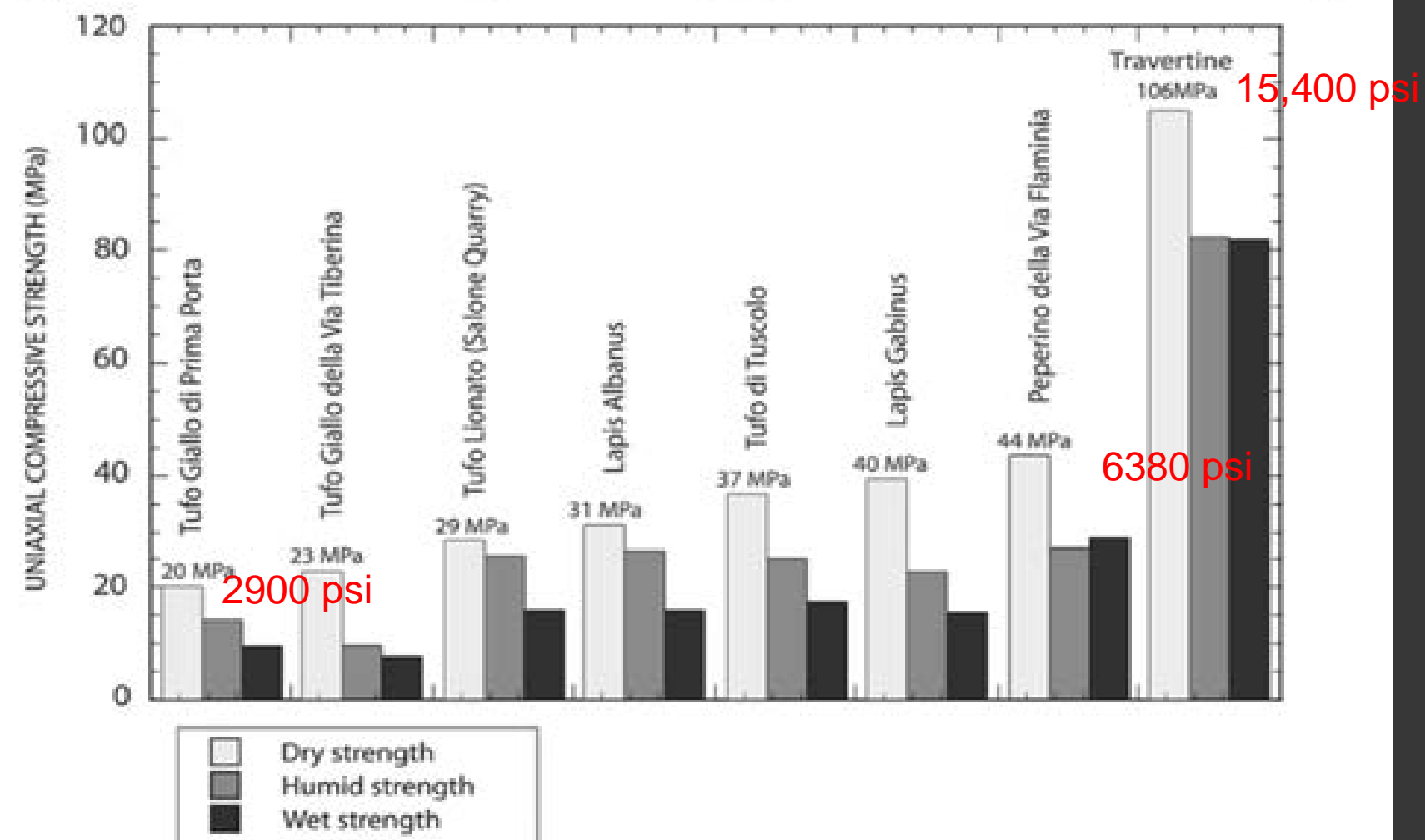


Tuff and Travertine Compressive Strength

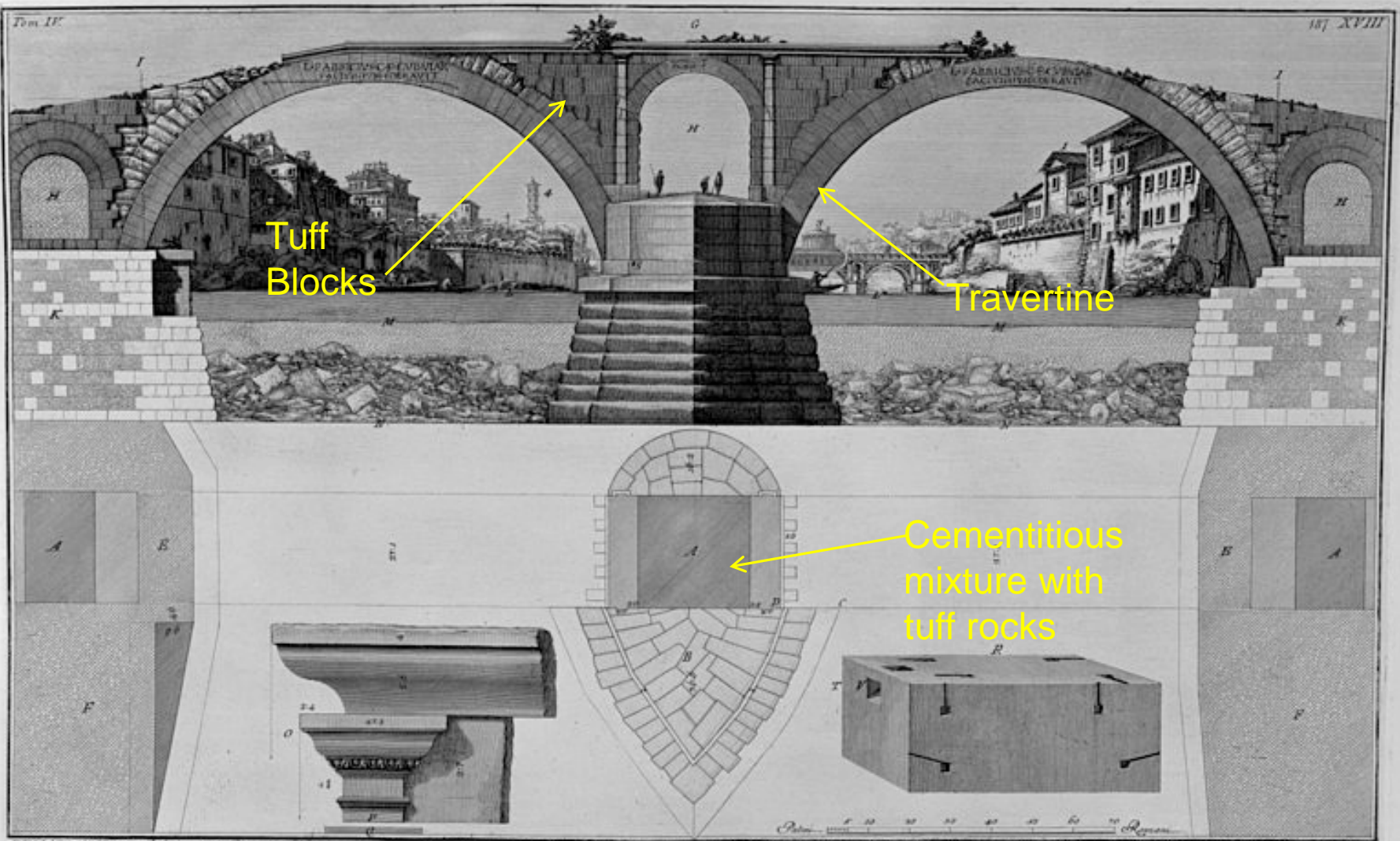
2006]

ROMAN STONE MASONRY

23



Construction Drawing



Tuff
Blocks

Travertine

Cementitious
mixture with
tuff rocks

Dimostrare nella sua pianta la forma ed elevazione del Ponte, ogni detto Quattro Cap. Coli è architettonico, e chiamarà l'edifizio da G. Fabrice il reatino delle strade, che lo fabbrica nel fine della Repubblica Augustana per quell'occasione che fece erigere il tempio di Giove la gloriosa maggiore sotto il pontificato di M. Aureo, e a quella l'edifizio verso del suo Imperio, e quattoro quattro dopo la di lui edificazione. A. Spina R. Spina, il quale rappresenta in C. del lato degli Archi. E. e quello dei due Cornici. B. Arco di sopra, fatto da Cornici, il quale si uniscono alle Spine E. e sono frangibili in caso degli Archi del Ponte. e l'elevazione M. Archi, il quale servono per scartare delle fondazioni. F. sono a essere senza parte del Ponte, e degli Archi non interviene nelle moderne Spine. K. spaccato delle Spine a luogo di Spina soprapposti, i quali servono al Ponte dell'Arco da onde le parti. G. quello dell'acqua in tempo di Arco. M. detto moderno. Ponte che si pone sopra il capo e mobile, perché le spaccature di ogni anno ora si portano dell'acqua che se lo tirano. N. è il arco ricevuto di riviera. O. l'edifizio di Cornici dell'Arco di mezzo col suo Cornice, e l'edifizio del Ponte. P. e quello degli Archi da piedi. Q. il quale porta senza base. R. l'edifizio fatto nel di sopra delle Spine in S. la cui base è. T. è in fuori. U. l'edifizio sono quattoro di base per il Ponte, e comestono interviene nelle altre Spine della Spina. F. sono nel mezzo sopra fatto a bella posta per levare le Spine. Altri simili si vedono quasi, ed in altri Ponte. I. Chiesa di S. Bartolomeo all'Isola. 2. Chiesa di S. Tomaso. 3. Tempio di Giove, ora di S. Maria del Sole. 4. Compagnie di S. Maria in Spina. 5. Ponte del Ponte di S. Maria del Sole.

Materials (The invention of first concrete)

◎ Arch

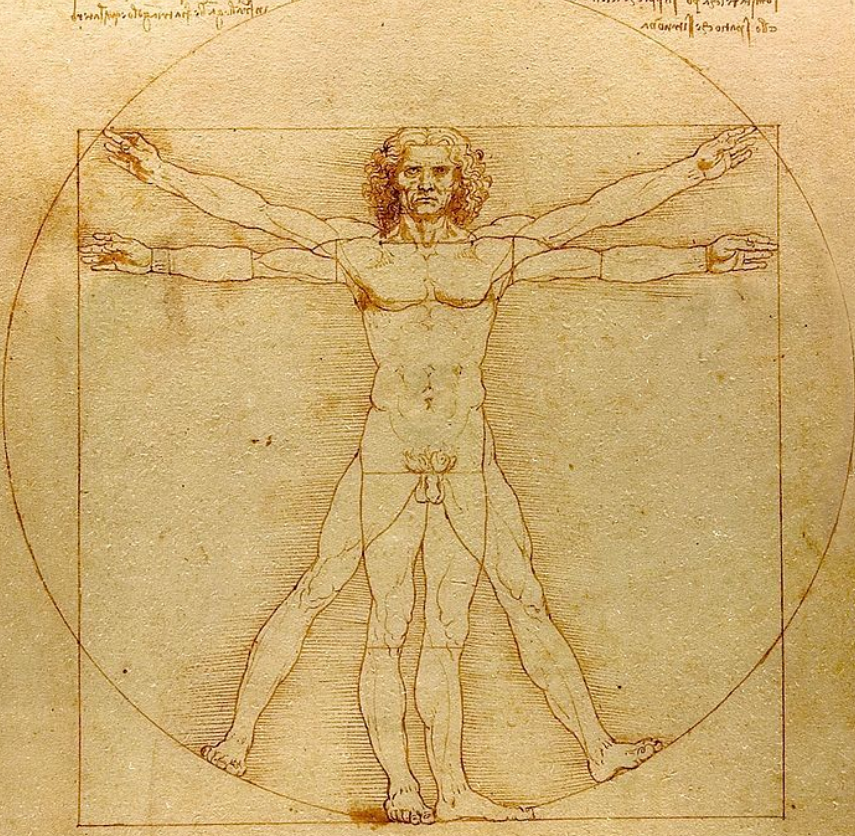
- Arch – tuff blocks, tuff rocks mixing cementitious mixtures of pozzolanic ash, lime, and water. (1:3 ratio of lime to pozzolan)
- Arch fascia – bricks and travertine

Foundation

- Cofferdam – Timber piles
- Inside Cofferdam – tuff rocks mixing with cementitious mixtures of pozzolanic ash, lime, and water.
- Footing – tuff blocks, tuff rocks mixing with cementitious mixtures of pozzolanic ash, lime, and water. (1:2 ratio of lime to pozzolan)

[Ten Books on Architecture by Vitruvius](#)

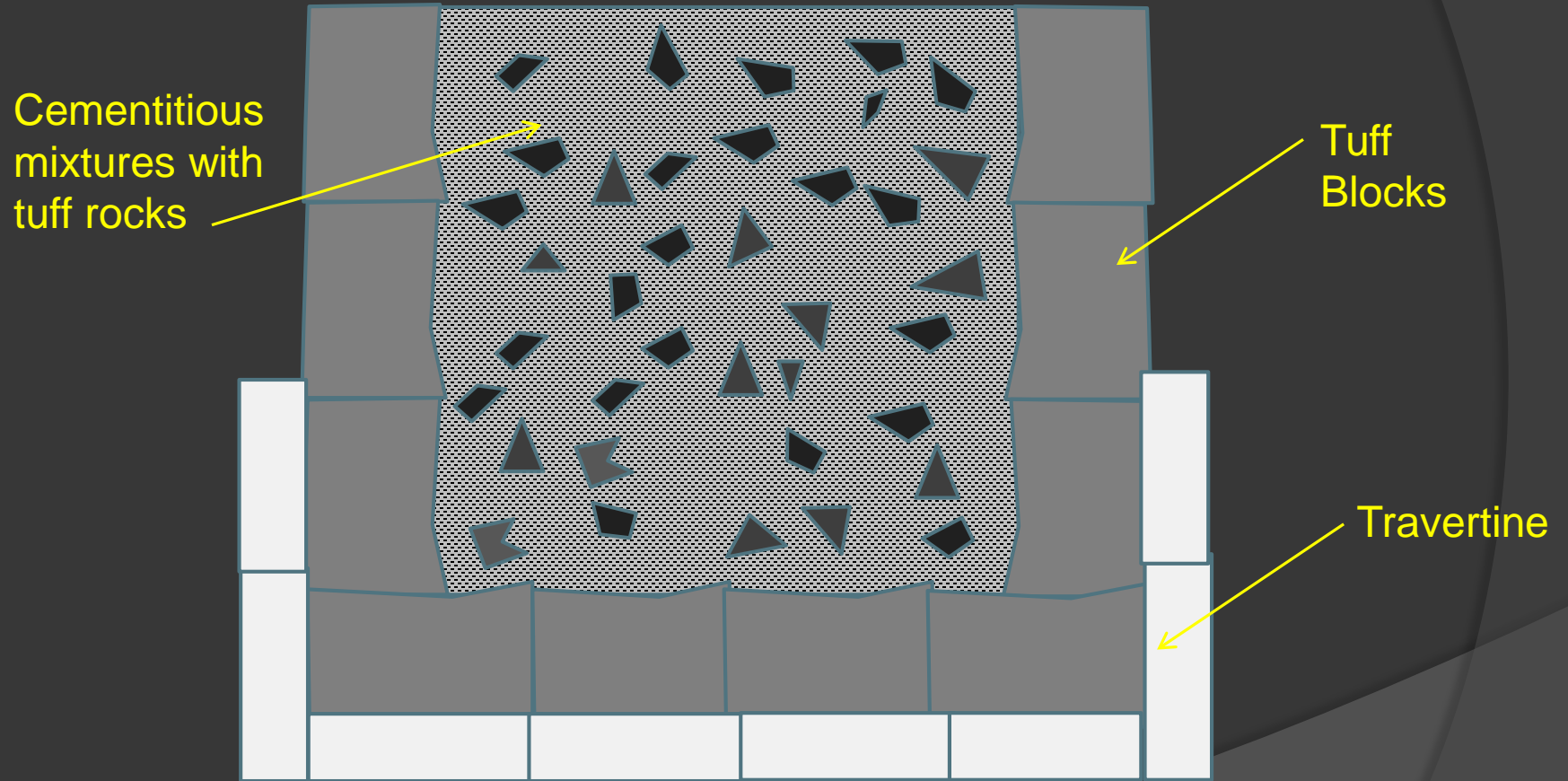
Handwritten text in a cursive script, likely a Latin translation of Vitruvius's text, located at the top of the page.



Handwritten text in a cursive script, likely a Latin translation of Vitruvius's text, located at the bottom of the page.

Vitruvian man
by Leonardo
da Vinci, in
1409

Cross Section of Arch





Travertine

Bricks



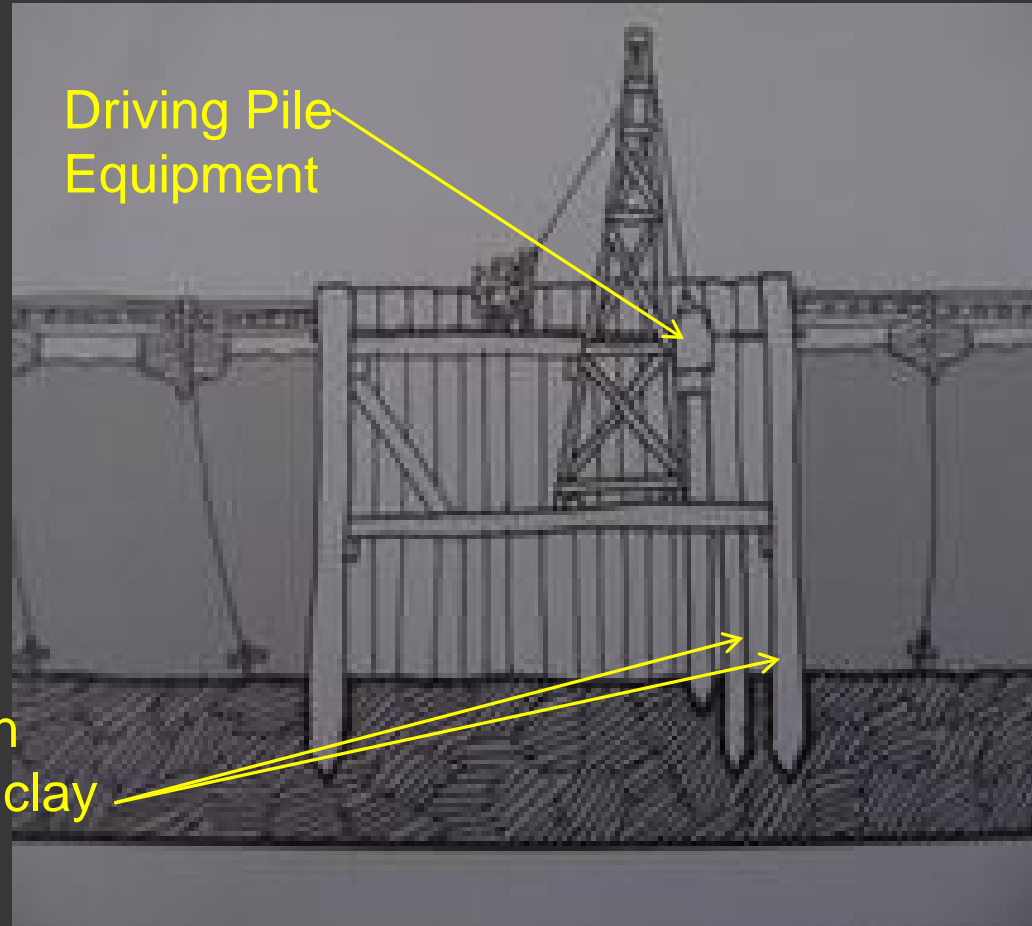
Cementitious mixtures fill with tuff

Tuff blocks

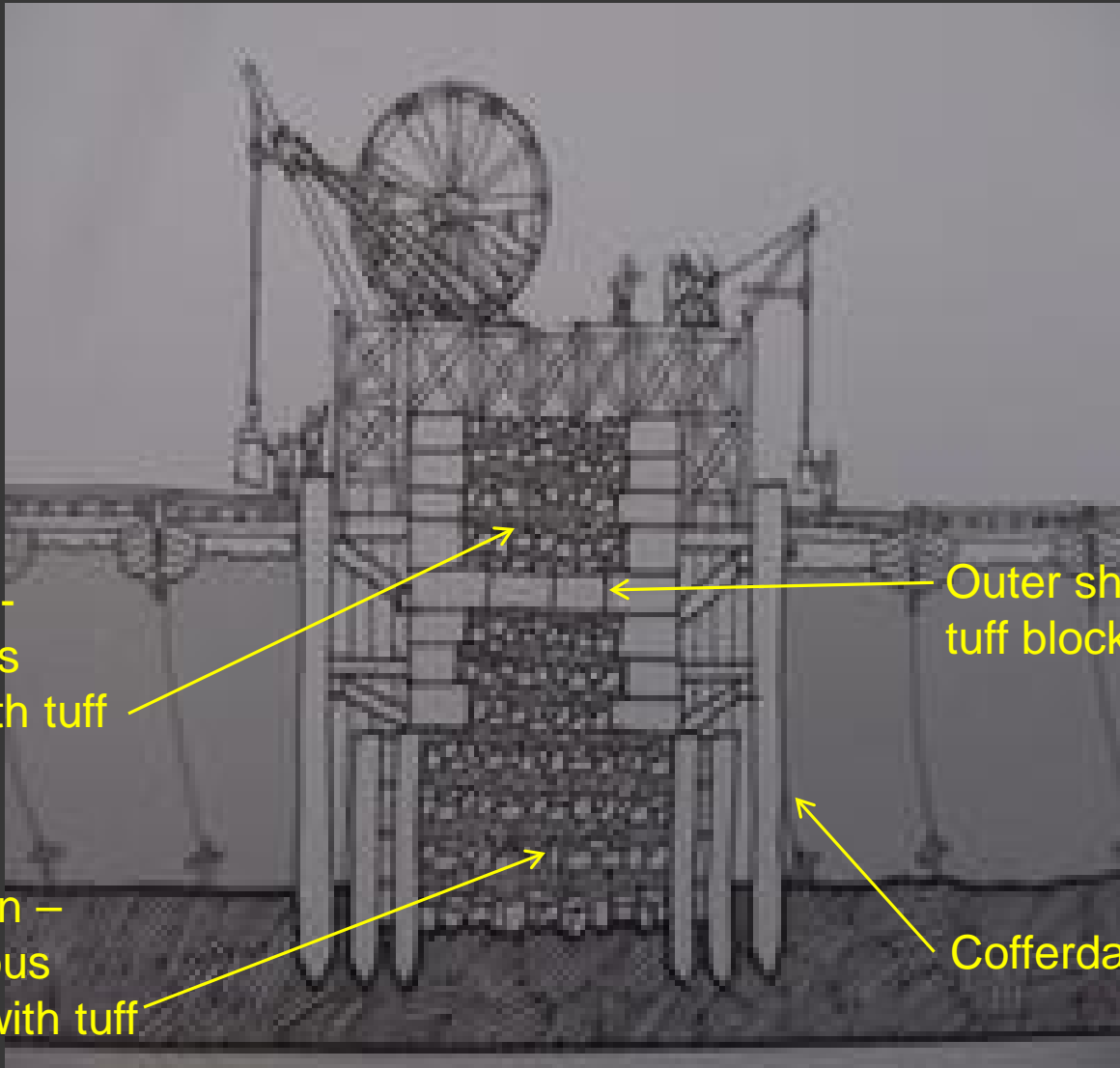
Foundation Construction



Two layers of wooden
cofferdam, filled with clay



Foundation Construction



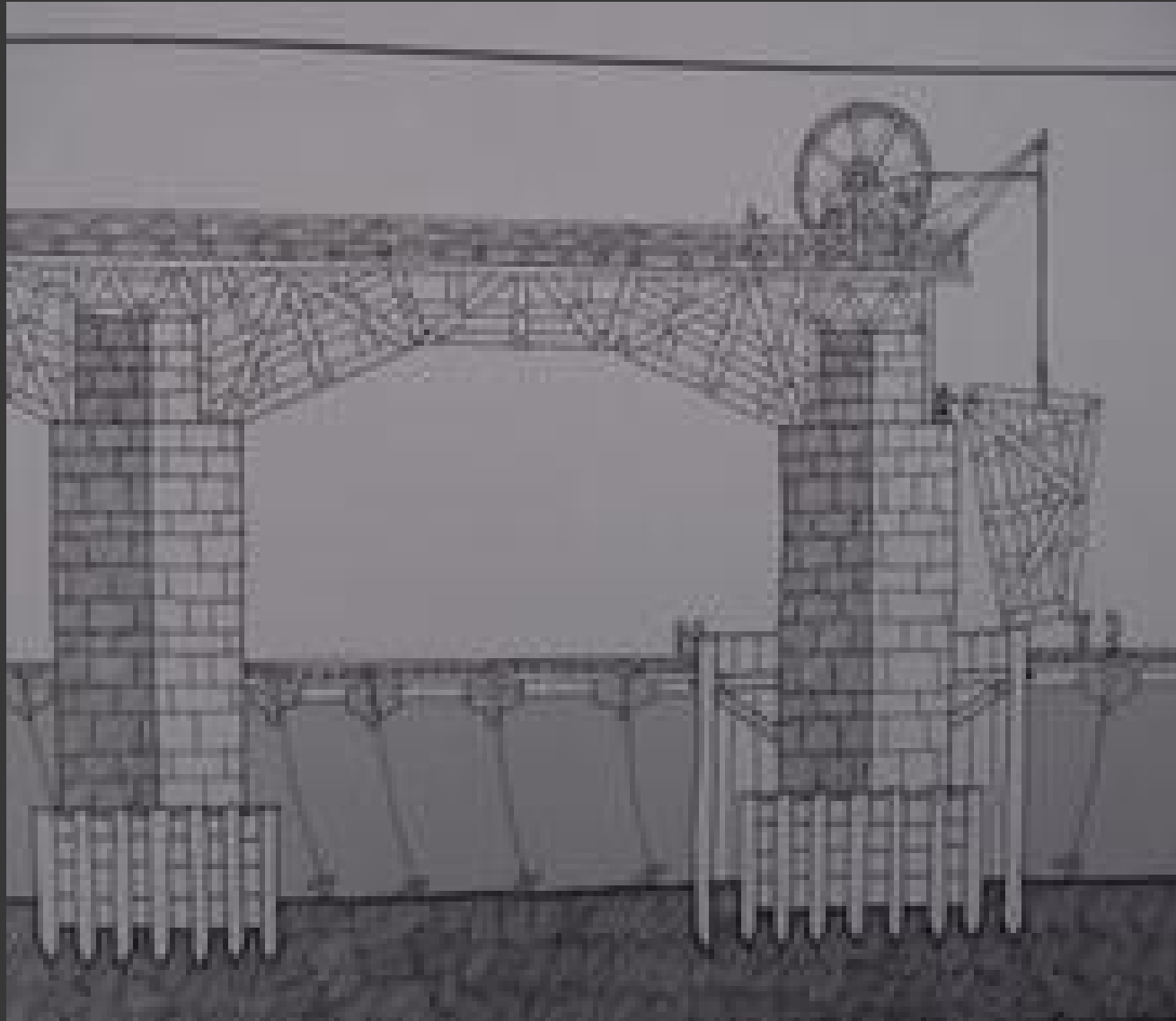
Inside arch -
cementitious
mixtures with tuff

Outer shell -
tuff blocks

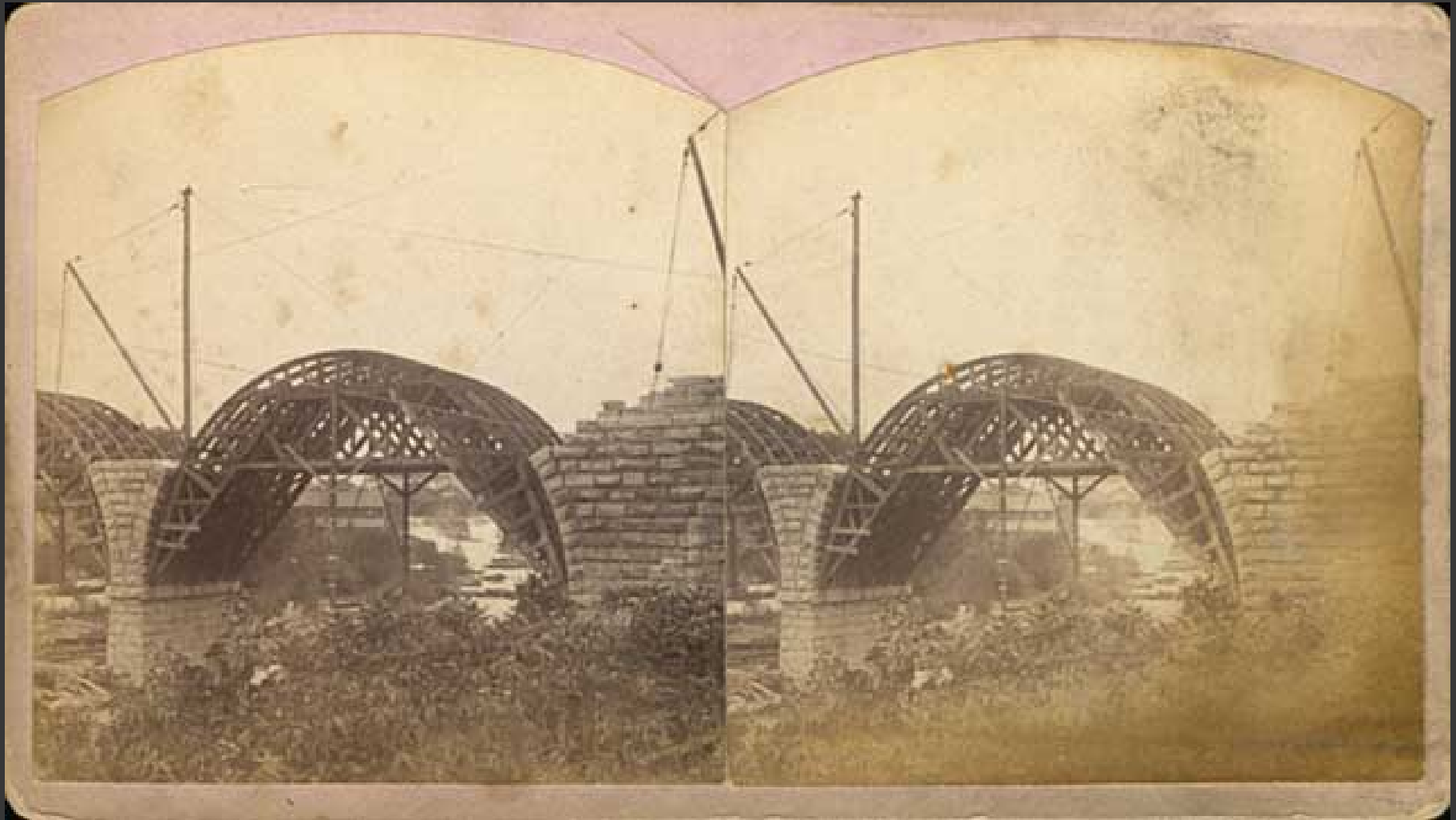
Foundation -
cementitious
mixtures with tuff

Cofferdam

Arch Construction



Arch Construction in earlier 1900

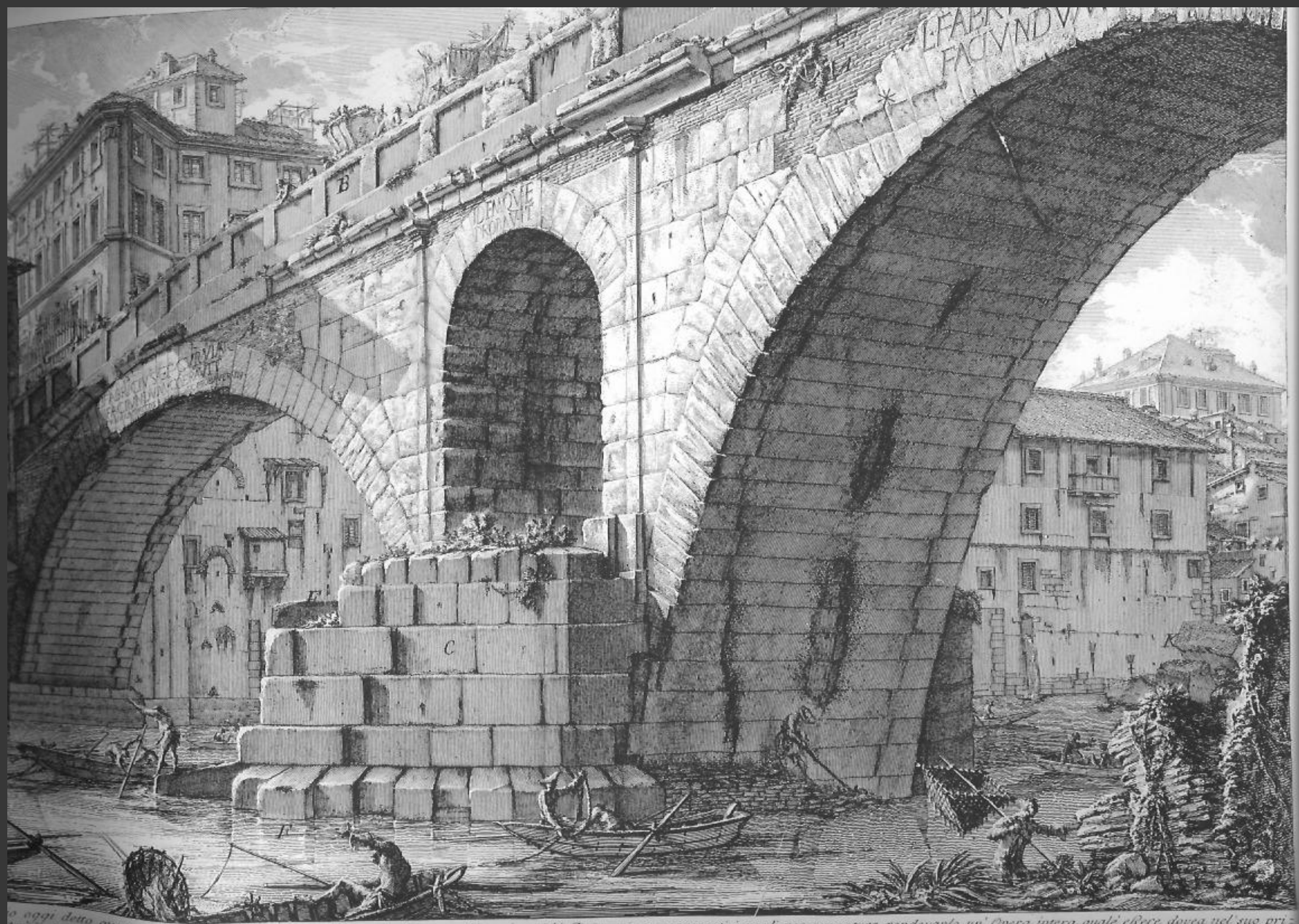


Arch Construction in early 1900

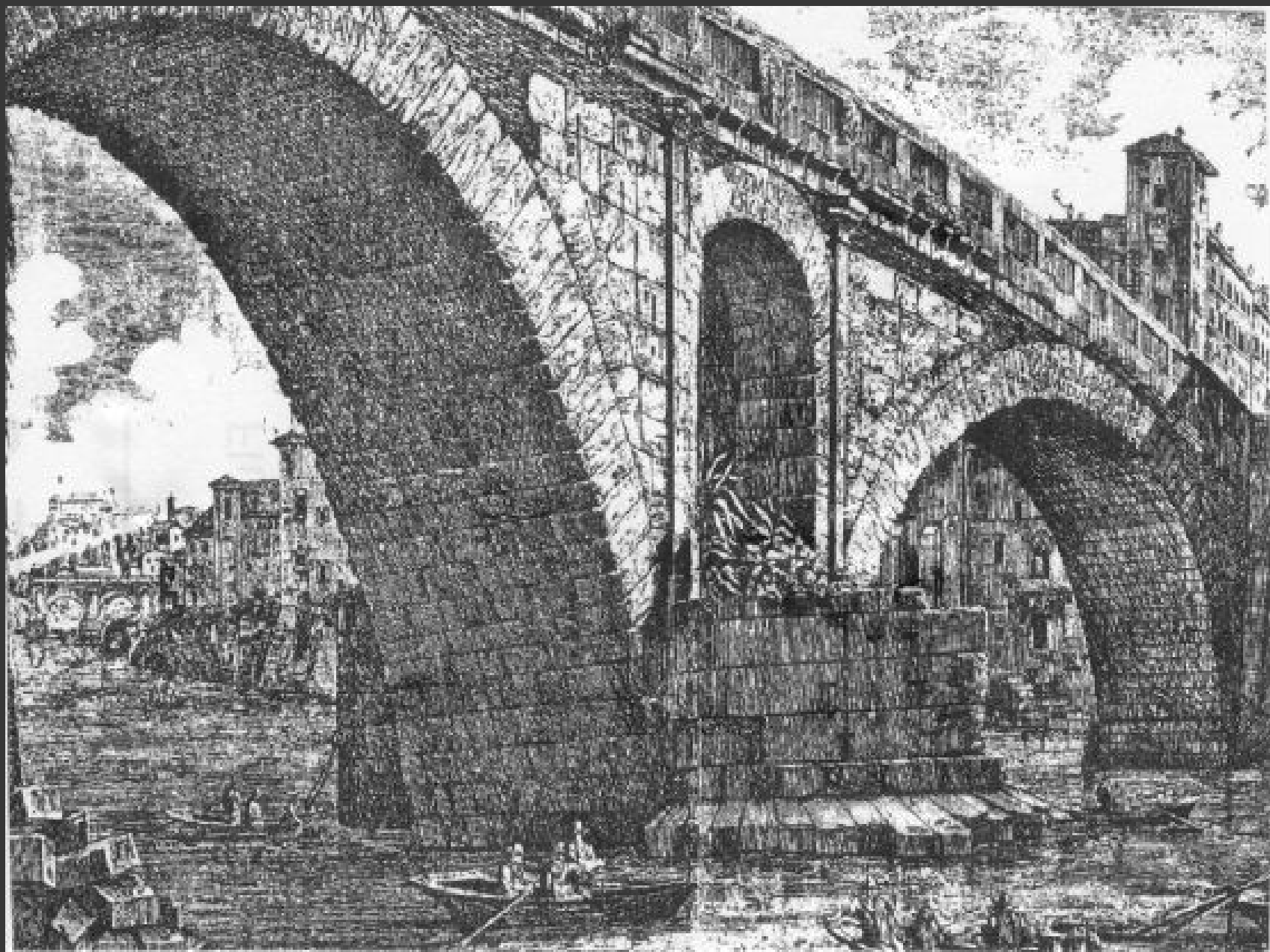


Pons Fabricius in 1600?





Il Ponte Sisto, detto anche Ponte di Sisto, fu fatto costruire da papa Sisto IV nel 1472. È un ponte a tre archi, in stile rinascimentale, che collega il centro storico di Roma con il quartiere di Trastevere. Il ponte è stato restaurato nel 1980 e nel 1990. Oggi, detto anche Ponte Sisto, è uno dei ponti più importanti e belli di Roma, e per avventura renderlo un'Opera intera, quale essere doveva nel suo pri-



P. Fabricius in 1900



Roma - Isola Tiberina

P. Fabricius at the present date









Architectural elements and Preservation

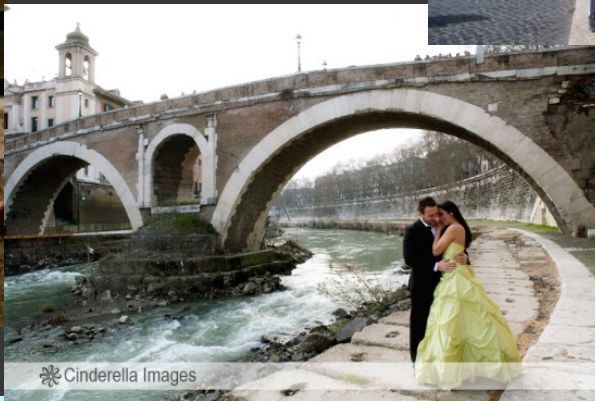


2077 Years Later

Pons Fabricius bridge has went through

- ⦿ Thousand floods
- ⦿ Earthquakes
- ⦿ Wars
- ⦿ Millions of horse carriages and pedestrians
- ⦿ Millions of tourists













Conclusion

Pons Fabricius reveals to us the ingenuity and marvel of the ancient Roman engineers – the first to develop the expertise in design and construction bridges.

- ⦿ Designing for the environments
- ⦿ Understanding the functions of forces and forms
- ⦿ Selecting the materials that last
- ⦿ Developing well-thought construction techniques
- ⦿ Preserving the structure

Pons Fabricius gives us the senses of wonder that we can build bridges to last...



Questions (Quaestiones)?