

# New ECCE book

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London 22nd Oct 2018



*dedicates this book to celebrate  
two important events in 2018*

## **2018 EUROPEAN YEAR OF CIVIL ENGINEERS**

*launched and organised by the  
European Council of Civil Engineers*

*and the*

## **200<sup>th</sup> ANNIVERSARY OF THE INSTITUTION OF CIVIL ENGINEERS, UK**

*founded in 1818 in London*

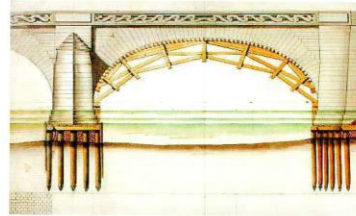


# Notes on the history of civil engineering

Authors

*Part I.*

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*Part II.*

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**Dome of the Church Santa Maria del Fiore,  
Florence, Italy  
Ground plan and cross section of the dome by Ludovico  
Cardi, detto il Cigoli, 1610, (Firenze, GDSU, 7980 Ar)**

# Some facts about the book

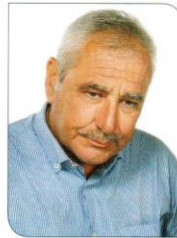
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- Weight: 383 gr.



*Part I.*

## Aristodimos Chatzidakis

### NOTES ON THE HISTORY OF CIVIL ENGINEERING A SMALL CONTRIBUTION TO A LONG TRADITION



The following notes are based on the material of the lectures I gave in the Seminars organised by the Greek Association of Civil Engineers (GACE) and the Technical Chamber – Department of Western Crete in 1991 – 1992.

Subsequently, this material was further enriched within the framework of the works of European Council of Civil Engineers made in the field of Engineering Heritage.

I was encouraged to unveil these texts again for the "ARCHIMIDES" magazine by my colleague Theodoros Voudiklaris, who at that time was the president of the GACE.

Since these notes were first written, there has been an upsurge in the literature about the history of structures and engineers. Therefore, let them be judged in relation to their own time frame and only as simple notes, without any claims to completeness.

The current digital capabilities have made possible the addition of full illustrations to the text, which helps in the understanding of the "climate" of each era.

I am happy that after so many years the European Council of Civil Engineers will print these notes. I believe that although brief, they give the essential steps of the historic evolution of civil engineers. I believe also that they are the common cultural heritage of European civil engineers, and could be a reference to our professional identity.

#### CHAPTERS

##### – THE ENGINEERS OF THE RENAISSANCE PERIOD

The birth of the Contemporary Engineer

##### – RESEARCH ON THE MECHANICAL PROPERTIES OF MATERIALS

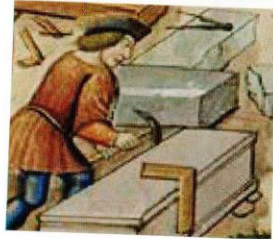
"The science of engineers" in the 18<sup>th</sup> century

##### – ARCHITECTS AND ENGINEERS IN THE AGE OF ENLIGHTENMENT

The organisation of knowledge

##### – THE EVOLUTION OF STRUCTURES DURING THE INDUSTRIAL REVOLUTION

The century of engineers



Dressing stone on a medieval construction site



Florence Dome of Santa Maria del Fiore

Thus labourers of different nationalities are found everywhere. The manning of large construction sites which causes these transfers and exchange of services, leads to the development of relations of solidarity and mutual assistance, and the establishment of the *compagnonnage*, a type of hospitality exchange that becomes a necessity within such a travelling profession.

An analogous situation, in terms of organisation and regulations, may be seen in the gaggle of artisans who, from Epirus and the Peloponnese, wandered across Greece and the Balkans in search of work.

Gradually the institution of *compagnonnage* becomes organised and gives birth to freemasonry. The immediate dissemination of these ideas tends to provide uniformity to methods and, finally, at the end of the 14<sup>th</sup> century we arrive at the creation of highly developed schools of thought. The masonic group of England has its own methods, as does that of Germany and so on. This centralisation leads to a stylistic unity, but also to standardisation and uniformity.

## The Renaissance

During the Renaissance period, the professions of the artist, architect and engineer were not clearly defined.

An artist could be commissioned by a municipality or a prince to create a statue, build a cathedral, drain a marsh or organise the siege of a city. The architect was expected to be familiar with the properties of materials and the techniques that would allow him to use them. The Renaissance artist had to know all this and, above all, be able to instil in his work the principles of geometry and engineering, consciously imitating antiquity. The diversity of talent and especially the fusion of art and science in one single person are seen as a unique characteristic of the Renaissance period.

However, the fact that artists possessed several different skills, the fact that Giotto, Orcagna, Brunelleschi, Benedetto da Maiano and Verrocchio were simultaneously painters, goldsmiths and engravers, that, despite the progress in specialisation, Raphael was still both a painter and an architect, while

Michelangelo was a sculptor and a painter as well as an architect – all this is linked more to the artisan nature of the visual arts than to the ideal of diversity in the Renaissance period.

Encyclopaedic education and practical diversity were in reality medieval ideals that were received by the 15<sup>th</sup> century along with the guild tradition of craftsmanship but were subsequently abandoned to the same degree as the spirit of craftsmanship was. In the late Renaissance period, painters who simultaneously practise different types of art become more and more rare. With the victory of the humanist concept of civilisation, the idea of *Homo universalis* (universal man) – an intellectual tendency opposed to specialisation – is once again brought to the fore and leads to the worship of a type of diversity that is more characteristic of the amateur than of the expert.

In contrast to the tendency for specialisation, we must above all mention the remarkable fact that of the most prominent architects of the later Renaissance period, only Antonio da Sangallo had prepared himself for this career: Bramante was initially a painter, Raphael and Peruzzi continued to combine painting with architecture, while Michelangelo was and remained primarily a sculptor.

The fact is that all these famous architects took up architecture relatively late in life, while many master architects received a predominantly theoretical education on the subject. This indicates, on the one hand, how quickly practical education had been sidelined by the more intellectual and academic kind and, on the other, how architecture became, to a certain extent, a hobby for the amateur. In all periods, in fact, we find examples of members of the nobility acting not only as sponsors but also as amateur architects.

It appears that the choice of architect, at least in the 14<sup>th</sup> and 15<sup>th</sup> centuries, was made by way of tender. Renowned architects would be invited from far afield, and it appears that French architects were in the Gothic period what Italians would become in the Renaissance.

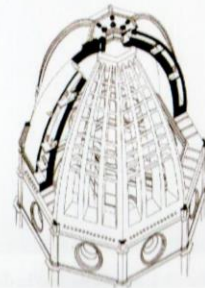
In the early period of the Renaissance the architect-engineer is a workman who stands out because of his talent and to whom, by way of tender or by election, the supervision of a construction site is assigned. On the expenses list, he does not appear to be



Filippo Brunelleschi



A reconstruction of the "centring" (scaffolding) designed by Brunelleschi for the construction of the Santa Maria del Fiore dome.



The structure of the dome



## Gorazd Humar

### NOTES ON THE HISTORY OF CIVIL ENGINEERING A SMALL CONTRIBUTION TO A LONG TRADITION



In my contribution to the history of civil engineering I wanted to draw attention to three notable stone bridges that hold a special place in this rich history. A special place because their construction made use of engineering procedures that were extremely important to the ongoing development of the profession. It was in the 16<sup>th</sup> century that engineering construction began to evolve from the merely architectural aspects of bridge building. And it is for this very reason that I have chosen to illustrate two remarkable stone bridges from the 16<sup>th</sup> century, which contain incredible engineering achievements, and elements that are less familiar to the public, and thus less admired. Their secrets are hidden to the untrained eye, but to us civil engineers they are fascinating and educational.

The first is the wonderful **Stari Most**, the Old stone bridge in Mostar, Bosnia and Herzegovina. A unique example of Ottoman know-how in bridge construction, it hid a secret for centuries, which consisted of the carefully designed hollows in the interior of the bridge, which master builder Mimar Hayruddin used to reduce the weight of the arch.

The second bridge illustrated is the **Rialto Bridge** in Venice, which has a special place in the history of bridge construction. With carefully planned foundations, its designer Antonio da Ponte succeeded in building a relatively large and shallow stone arch on the soft clays on which Venice stands. The engineering problems were overcome with a design that is extremely sensitive in architectonic terms. The Rialto Bridge is therefore probably one of the best-known and most-admired bridges in the world.

The third bridge- **Solkan bridge** over the Soča river in Slovenia features the world's largest stone arch in a bridge category. At the same time it is also the last great stone bridge built in human history. However, it also sketched out the method for the construction of large concrete arch bridges.

Numerous engineering technologies were used in the construction of Solkan Bridge that would prove significant to the ongoing evolution of the profession.

As the famous French bridge designer Paul Séjourné said:

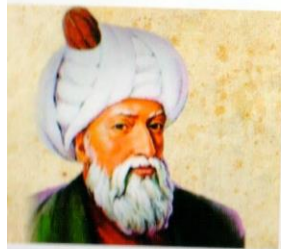
**RESPECT TO OLD BRIDGES!**

(Respect aux vieux ponts!)





Suleiman the Magnificent,  
Ottoman Sultan (1494-1566)



Mimar Sinan – the Grand Architect,  
(1488/1490?-1588)

usually passed along it. The Neretva, one of the most beautiful rivers of the Adriatic basin, is notable for its very changeable water levels, depending on the time of year. Human beings have always aspired to master the forces of nature, and the great desire to bridge the gorge of the Neretva with a single arch was undoubtedly the inspiration for the builder of the Old Bridge. The impossibility of building a central pier in the middle of the gorge, combined with the torrential character of the Neretva, represented a challenge for the builder, and at the same time an opportunity to build one of the most remarkable structures of the age: a bridge that joined the two banks of the Neretva in a single span.

By the sixteenth century the original wooden bridge structure was in a state of terminal disrepair, but traffic was growing and Mostar had begun to develop rapidly. The moment had clearly arrived to build a new, stronger bridge.

The order to build a new, solid, permanent bridge – as requested by the people of Mostar – was given by the Turkish sultan Suleiman the Magnificent. Construction of the bridge is believed to have begun in 1557 and was completed in 1566, the last year of Suleiman's reign. Much was written about the bridge by the seventeenth-century traveller Evliya Çelebi. His words are full of emotion and enthusiasm: *"This bridge, too, was built by the master architect Mimar Sinan, on the orders of Suleiman. Its appearance is that of a rainbow crossing from one bank to the other."* Later on he adds: *"Let it be known that I, Evliya, a poor servant of Allah, have journeyed across sixteen empires, but nowhere have I seen such a lofty bridge."* He also spoke enthusiastically of the fact that water pipes run across the bridge: *"In short, this is a bridge with water running both over and under it."*

The actual builder of the bridge was in fact Hayruddin, an apprentice of Mimar Sinan's. The latter, the chief builder of important structures across the Ottoman Empire, personally selected Hayruddin for the task.

## Travel writers and authors extol the beauty of the bridge

Evliya Çelebi's account is predated by that of a French traveller, Pouillet, who passed through Mostar in 1658: *"For five days we remained in this little town, in which we observed nothing of note with the exception of one bridge over the river Neretva, whose construction is without a doubt more daring and impressive than the Rialto Bridge in Venice, although the latter is spoken of as a true wonder."*

The Austrian writer Robert Michel, who dedicated a special monograph to the Old Bridge, also compared it to the Rialto Bridge. In his study, entitled *"Old Bridges in Bosnia and Herzegovina"*, he also refuted certain theories concerning the bridge's alleged Roman origin. *"If I had to say which was the most beautiful bridge in the world,"* wrote Michel, *"I would probably choose the Old bridge in Mostar. No built structure has ever affected me as profoundly as this bridge."* He compared the structure to a petrified crescent moon and to a gigantic gull turned to stone in mid-flight, at the very moment its wingtips touched the rocky banks of the Neretva. Be that as it may, until its destruction in



The Turkish travel writer Evliya Çelebi compared the Old Bridge in Mostar with the Rialto Bridge in Venice

Engraving of the Old Bridge  
(Ottomanic period)

