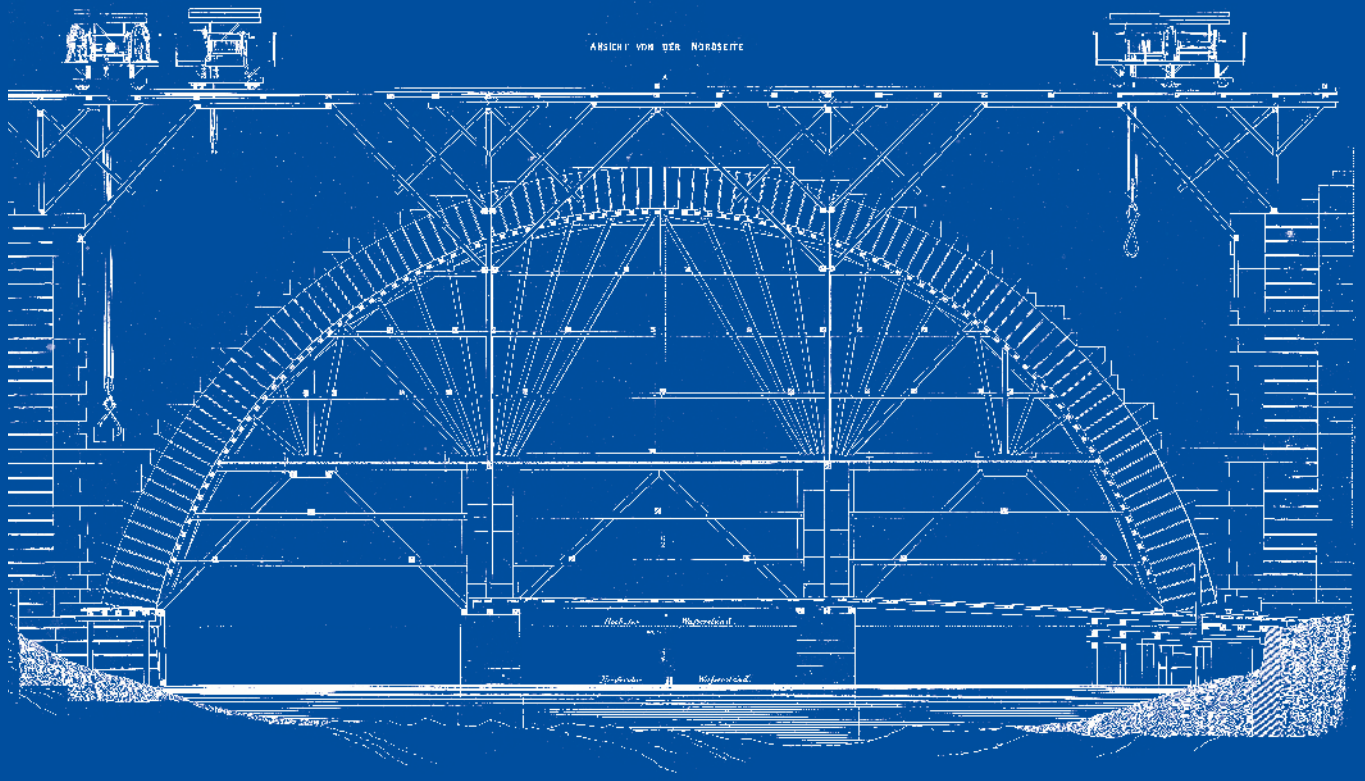
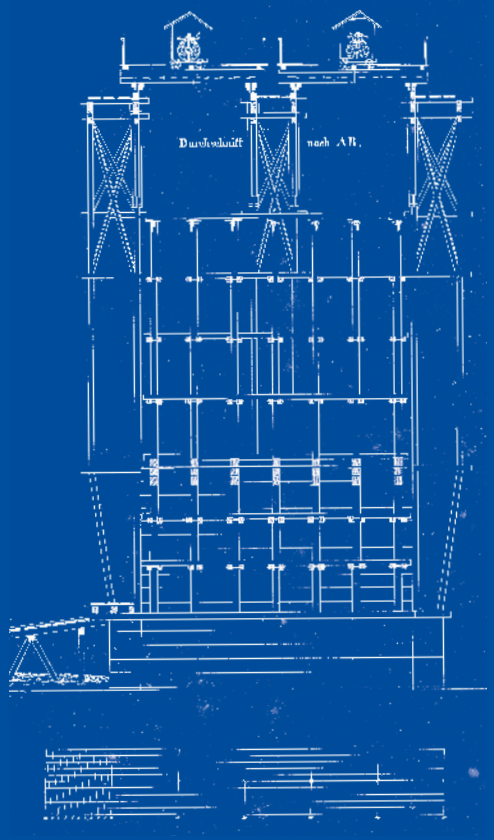
Proceedings of the 8th International Congress on Construction History
Stefan Holzer, Silke Langenberg, Clemens Knobling, Orkun Kasap (Eds.)



Construction Matters



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8th International Congress on Construction History – Zurich

The strange history of the bridge over the Adda in Trezzo: from Late Middle Ages Chronicles to Structural Medievalism

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Abstract: What is the biggest masonry bridge built before the twentieth century? Construction history has no doubt: it is the bridge over the Adda at Trezzo, an arch of about 72 m span, built in 1370 and destroyed in 1416.
All the most authoritative construction history texts mention it, often accompanied by graphic reconstructions that imagine it as humpbacked, with Ghibelline merlons and two turrets on each side.
How was it possible, in the middle of the fourteenth century, to build a bridge almost twice as span as its predecessors? A span that would be reached again only 420 years later, by a cast-iron bridge, while a new masonry bridge of similar span would not be built until 1903. Did that bridge really exist? Or is it a striking case of "structural medievalism", stimulated in the mid-nineteenth century by some engineers' hostility to iron and cast-iron structures and, conversely, their passion for the Middle Ages?
The paper aims to try to reconstruct the history of this record-breaking arch, among Latin chronicles and fanciful neo-Gothic reliefs, among parchments, codices and altarpieces, encountering dukes, condottieri, Augustinian friars and many engineers, without, however, being able to offer proof of the bridge's existence.

Introduction

What is the largest arch bridge made before the Industrial Revolution? That is, before cast iron and then wrought iron from the late eighteenth century completely changed the rules of the construction game? And before reinforced concrete twisted the dimensions of stone arches, even if the stone was artificial and reinforced?

Engineering histories agree. Such is the bridge over the Adda at Trezzo, built in 1370: a 72.25 m span arch, destroyed, however, shortly afterwards, in 1416, during a siege.

It is mentioned by just about everyone: it is present in bibliographical reviews that squeeze bridges between centuries, such as that of Leonardo Fernández Troyano (Fernández Troyano 2003, 93 and 116) or in precise historical essays, such as the recent one on the calculation of the limit arch by Santiago Huerta (Huerta Fernández, 2019, 579–592); it is authoritatively cited in very Italian encyclopedic entries (Castiglia 1935) but also in nineteenth- and twentieth-century manuals immune from possible accusations of parochialism, such as that of Canadian Henry Grattan Tyrrell (Tyrrell 1911, 46–47), who does not hesitate to offer the reader even a sketch of the bridge. It was spoken of with ill-concealed pride by twentieth-century Italian engineers who delighted in historical topics: Giuseppe Rinaldi (Rinaldi 1974, 21–22), Giuseppe Albenga (Albenga 1944, 290), Eugenio Miozzi (Miozzi 1935, 553–580), and Antonio Federico Jorini (Jorini 1905), all of whom were very knowledgeable about bridges for having designed very important ones or taught courses at the university for decades. They all admired medieval bridges that were essential, bare, spiritual, and imbued with constructive sincerity, capable of reaching bold spans.

No one seemed to wonder how it had been possible, in the middle of the fourteenth century, to build a masonry bridge of practically twice the span of its predecessors. A span that would be equaled only 420 years later by a cast-iron bridge, built in Sunderland by Rowland Burdon, while a higher span in masonry (84.65 m) would be achieved by Paul Séjourné with the Adolphe Bridge in Luxembourg, even in 1903.

About the Trezzo bridge we do not know much. But that is normal: about the late Middle Ages there are few sources, either to endorse or to disprove. The story, however, has all the hallmarks of a legend: it looks very much like an example of "medievalism," of "imagined" and "invented" Middle Ages during the nineteenth century, in a rather original sphere that we can call "structural medievalism" (Di Carpegna Falconieri 2020).

Let us then try to put together what we know around this story.

1. The "dark" sources

What are the sources attesting to the construction of this record-breaking bridge?

Going back through the citations one after another, the first trace seems to be preserved in the *Mediolanensium rerum historia*, written by the Augustinian Andrea Biglia (1395?–1435), in the last years of his life. Biglia reported that close to the castle of Trezzo, renovated by the villainous Bernabò Visconti, who would later be imprisoned and die

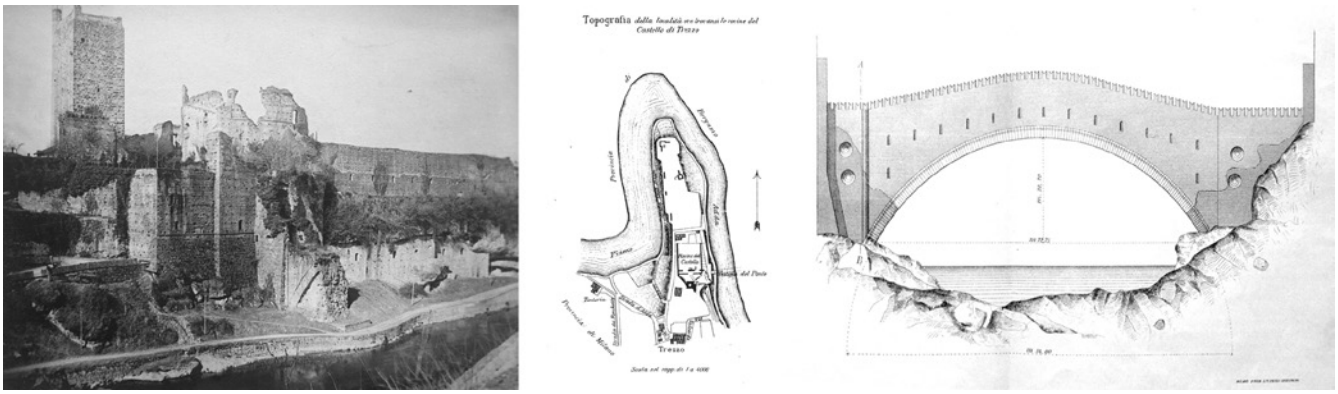


Figure 1. From left to right: Photo of the ruins of Trezzo castle and the bridge in the early twentieth Century; Plan of Trezzo castle and location of the bridge ruins, 1886 (Crivelli 1886); Fictional reconstruction of the Trezzo bridge, 1885 (Biadego 1885).

there, Visconti himself had a bridge built "like none of that kind before": "A single-arched link spanned very high over the whole width of the river, which although made of brick no iron could untie on account of the exceptional way in which the very strong lime connected it".

The bridge directly connected the castle with the Bergamo side of the Adda, at the end of that river meander that bordered the fortress on three sides (Fig. 1). Biglia was careful not to report the dimensions of the great archway and did not even write that he had personally seen it, although he could have (born in Milan, he had only left the city at the end of 1412 to study in Padua). In his chronicle, he mentioned the bridge only at the time of its destruction by the Count of Carmagnola. Francesco Bussone, in fact, sent by the Duke of Milan to reconquer the castle, occupied since 1404 by the Bergamasque Colleoni family, failing to prevent supplies from reaching the besieged from the part of the bridge controlled by Pandolfo III Malatesta, decided to destroy it. And Biglia said, "Carmagnola destroyed this bridge by demolishing the outer pylon", perhaps alluding to the pylon furthest from the fortress (Biglia 1831).

A few years later, Donato Bossi (1436–1502), in his Chronica, recorded that this destruction took place on December 21, 1416, when "of the arched stone bridge of Trezzo, an admirable work, several arches made of flint collapsed" (Bossi 1492). So: not the very tall brick arch described by Biglia but rather an unspecified sequence of stone arches.

Bossi did not explicitly write that Carmagnola was responsible for the collapse but, continuing the chronology, he reported that a few days later, between January 2 and 11, 1417, Trezzo returned under the Duke's control. Bossi then added that on February 14 Carmagnola celebrated a lavish wedding with Antonia Visconti in Milan. The accuracy of the dates suggests that Bossi consulted annals.

Shortly after the collapse, the deadly Wars of Lombardy (1423–1454) began, leading the Venetian Republic to conquer territories as far as the banks of the Adda River. Venice absolutely needed to know in detail the mainland it wanted to invade: and it had maps drawn up, with roads, rivers and distances. Two stylized images of the bridge date from this era: one found in the *Carte militaire du moyen âge représentant le théâtre de la guerre a l'époque des premières conquêtes de la République de Venise en terre ferme*, painted in color on parchment, long preserved at the National Library in Paris, in which the bridge is depicted as a single arch: but on widening one's gaze, one realizes that all bridges are depicted this way, as the unknown draughtsman distinguished only between wooden and masonry bridges. In Giovanni Pisato's map of Lombardy, on parchment, dated 1440, the bridge is instead depicted with three arches: but this time the other bridges were drawn well differentiated with one, two, three spans. What is certain is that a stable masonry structure is mentioned in these maps: evidently, the bridge destroyed in 1416 by Carmagnola had soon been repaired or rebuilt.

Technical manuals of the time never mentioned this admirable work, although the description of a strange bridge was included by Filarete in his *Trattato di architettura* (1460–1464), written while he was in the service of the new Duke of Milan, Francesco Sforza. Intended for the visionary city of Sforzinda, it was a bridge with two lowered arches of 40 fathoms each (about 36 m), on which rested a round arch of no less than 120 fathoms (108 m), encompassing the lower two. Filarete, who was well acquainted with the 11th-century covered bridges of Pavia and Mantua, and those of Florence built between the mid-13th and mid-14th centuries, and who imagined his utopian city located (perhaps) precisely on the Adda, not even for an imaginary bridge could he conceive of a clear span of more than 40 m (Filarete 1465).

But the arch of Trezzo may have been depicted in a very famous painting: the *Adoration of the Magi* (1423) by Gentile da Fabriano! In the central lunette, the turreted and crenellated castle where the procession is headed, high on the hill (which in the figuration represents Jerusalem), is connected with the other side of a river (where there is a tower) by a huge arch, with a covered passage like that of Pavia. Gentile's life is still mostly obscure to us, but it is known that between 1414 and 1419 he worked for Pandolfo III in Brescia (Anelli 1986, 31–54) and only later moved to Florence, where he made this altarpiece. And so perhaps he may indeed have made a ride to Trezzo, and perhaps to the other castles conquered by Malatesta: and been so impressed by the bridge that he included it years later in his masterpiece! (Fig. 3)

Continuing to look for sources, by now, however, those are no longer contemporary.

In 1503 the *Historia patria* by Bernardino Corio (1459–1519?) was published, written in the vernacular and later much cited (Corio 1503).

Corio reported, too, that "Bernabò began the rebuilding of the castle of Trezzo; and he also had the bridge over the river Adda made, which was cast with a single arch: which seemed a miraculous thing; on each side he had two towers erected,

and so great an edifice was completed in seven years and three months" (Corio 1503). The presence of the towers and the long construction time are new information, which was perhaps taken from a written document, perhaps a source now lost along with the Visconti Signorile archives, which Corio was able to consult in the castle of Pavia instead. To be sure, one would have to find the contents of cabinet No. 12 of that collection, the one with all the papers of Bernabò collected by Giangaleazzo (Meschini 1995; Leverotti 2008). It is very likely that the duration of the work for the "great building," referred to the castle and not to the bridge, as would later always be repeated instead.

In a later passage, when Corio recounted Carmagnola grappling with the siege of the fortress, he said: "Indi placed the army on each side of the river Adda, and made the admirable bridge ruin, built in five arches in the naked stone" (Corio 1503).

Here we go again: the arches are increased—five—well founded on the rock.

Could this many-arched bridge, readjusted after damage, have been seen by Leonardo when he stayed in Milan for the second time, between 1508 and 1513? Leonardo, passing through Vaprio, drew on a sheet of blue paper, dated January 5, 1513 (now in the *Windsor Codex*), the castle of Trezzo in plan, which at the time was under cannon fire from the Venetian siege during the War of the League of Cambrai. Leonardo strongly traced the continuous sign of the bridge. The drawing, discovered by Luca Beltrami in the late nineteenth century, is only a small sketch confused between anatomical studies of the diaphragm and lungs (Beltrami 1923). But perhaps that multi-arched bridge could be the famous one reproduced behind the Mona Lisa (but not even in jest here do we want to enter the unresolvable dispute about the actual location of that landscape behind the famous lady...).

More details of the structure were added in 1548 by Paolo Giovio, bishop of Nocera, in his *Vite dei dodici Visconti*, translated by Lodovico Domenichi the following year: "Among Barnaba's other noble works, most excellent was the bridge of the fortress of Treccio made with marvelous vaulted construction over the river of the Adda. The bridge rose so high that three different passages could be made there at the same time: in the lowest went the carts with equipment and baggage, in the middle one the men on horseback, in the upper one the pedestrians" (Giovio 1549).

Thus Giovio described a three-story bridge, with as many as two overlapping covered passages, compatible with Biglia's version, who told of Carmagnola's difficulties in stopping the coming and going of men and vehicles with arms during the siege; but this description is incompatible with the hypothesis of a single large arch, which would become too high.

Then the bridge, at some time, collapsed: and was never rebuilt. From the end of the seventeenth century, in the plans of the area (there are detailed ones dating back to 1687, 1707 and 1734) the ruins of the "double bridge" were indicated, an ambiguous definition that does not clarify whether the bridge was two-story or two arches.

Then in 1771 Giorgio Giulini, in his year-by-year *Continuazione delle Memorie di Milano ne' secoli bassi*, cited Biglia, Bossi and Corio and wrote that Bernabò built in 1370 "a beautiful bridge over the Adda of one arch, with two towers on either side. This great work was completed in seven years and three months; Corio asserted this, and there is no one to say otherwise!" (Giulini 1771). Instead, it was Corio who contradicted himself. But Giulini was greatly astonished at this "mistake", and similar astonishment he reserved for Bossi's mistake: only Biglia would have reported correctly, because he was contemporary with the events.

To sum up, in the few sources traced, the bridge was described as: one, two, three or five spans; with a turret on each bank; built of bricks cemented with very strong mortar or with stone blocks; equipped with two or three crossing levels; built in seven years and three months, but this time more likely referred to the whole castle. No trace, as yet, of that record-breaking size: 72.25 m.

2. "Structural" Medievalism

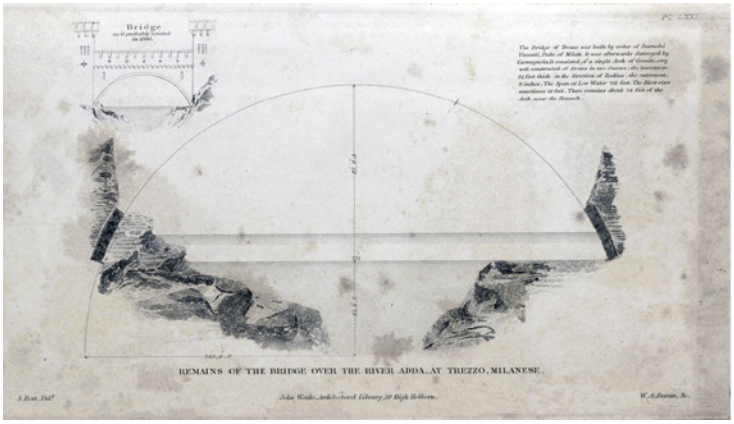
In the mid-nineteenth century everything changed. The contradictory and imprecise reports of more or less coeval chronicles became granitic certainties, to which were added details about dimensions, materials, decorations.

Of the bridge, meanwhile, practically nothing remained: in 1775, the last remnant of the arch (on the left bank? Or already in the water?) was destroyed because it hindered vessels ascending to Paderno (Ferrario 1867). The castle became a ruin, exploited as a material quarry. Il Ceppo, the local pudding that made up the elevated and buried structures, was recycled in the construction of monumental works in Milan. In the right bank, a small stump of the arch, about 7 m high and almost 5 m wide, survived, incorporated into a masonry block (whose originality no one later questioned). The footprint of the eventual remains of the left abutment, later attacked by quarry excavations and disappeared, is unknown.

The engineers became curious and from then on took over the narrative. Leaving words, dear to historians, in the background, they drew the bridge, as if it were a relief. But instead they reconstructed it from fantasy, starting from the few existing ruins, inventing its architectural features and adding to the perfect circle line the quintessential medieval requirements: battlements and embrasures.

As early as October 1842, the bridge was mentioned by William Hosking, an architect and civil engineer, in an essay included in a encyclopedia devoted to bridges (Hosking 1842). In 1823 Hosking had been in Italy for study. In 1827 he published a book of architectural details taken from buildings in many Italian cities (Jenkins 1827). Perhaps on that trip, he also visited Trezzo. On his return, he was first a bridge designer, then a forerunner of the Gothic Revival, and then, from 1840, a professor of the art of "building between engineering and architecture" at King's College, London.

In the essay for the encyclopedia, Hosking wrote that the now-lost bridge was made of hard granite and because of this had reached a span of 251 feet (76.5 m), with a radius of curvature of 134 feet. The thickness of the archivolt was only one-sixtieth of the span (but this measurement seems implausible). In the text, Hosking insisted repeatedly that stone was the material of choice for arch bridge construction: because it was strong, durable, monumental, and far more suitable than metal. As a fervent neo-Gothic, he blatantly detested metal. The Trezzo Bridge was used by Hosking as a pretext to point out how the ancients had achieved



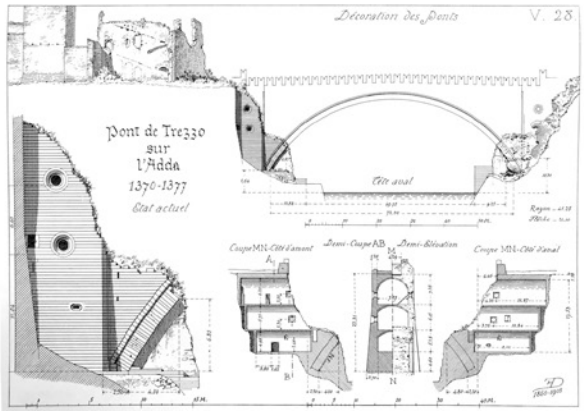


Figure 2. From left to right: Fictional reconstruction of the Trezzo bridge and hypothesis on the curve of the arch, 1842 (Hosking 1842); Survey of the ruins and fictional hypothesis of the bridge's appearance by Fernand De Dartein, 1860–1908 (De Dartein 2008).

grandiose results with stone: "these potentials have only been forgotten," he lamented.

In Table 71 appended to the second volume of the encyclopedia (Fig. 2), a drawing was finally published: the two abutments, the Adda backdrop, and the hatching of the outline of the arch, made by connecting the curves of the ruins, can be seen. In the upper left corner of the drawing, the bridge was depicted as it probably must have been in 1390: iconically medieval, with battlements, embrasures, crosses, and side turrets. But surprisingly, in the introduction to his essay, Hosking disclaimed the drawing, as from all those included by the editor to accompany the volume. But then: who drew up the design? The table states that "S. Best delineavit" and "W.A. Beever sculpsit." There is a long historical/technical caption, and in the commentary text, unsigned, details were added: in particular, the dimensions of the two concentric archivolt rings, one about 1 m and the second 22 cm (not corresponding, by the way, to what is measured on the ruin). It is very likely that the design was completely invented on the basis of some sketch by Hosking or who knows who else, at the behest of the unscrupulous editor and publisher of the volume, John Weale, who was intent on offering a well-illustrated and communicative product on the market.

But the die was cast and the story continued. The 1854 reprinting in booklets of Giulini's many volumes of Milan's history revived the affair of the "one fornix" bridge.

At this point in history a Frenchman intervened, a follower of Eugène-Emmanuel Viollet-le-Duc's (1814–1879) theories of restoration in style and even integral, invented reconstruction of medieval monuments. His name was Fernand de Dartein (1838–1912) and he was an engineer at Ponts and Chaussées. As soon as he graduated, Dartein spent a semester in Italy and became fascinated with Lombard art: he returned to Italy several times until he became an expert on that period. He taught architecture for decades at the École Politechnique (1867–1910) and, when charged at the École des Ponts and Chaussées with a course on bridge decoration, he was saddened by the lack of drawings to show his students: so he decided to redraw dozens of structures from all eras, after surveying them himself.

Thus he produced the most copied technical drawing of the Trezzo Bridge, which was to be published in his colossal work on masonry bridges, given to the presses between 1906 and 1912. But the fifth volume, devoted to foreign bridges, announced in the general index and ready in draft, did not see the light of day because Dartein died suddenly: it would be printed only in 2008 by scholars who found it in his private archive (De Dartein 2008).

In the pages devoted to Trezzo, the few historical facts, gleaned from the books written by Giulini, are the commentary introduction to the beautiful survey of the ruin, measured to the accuracy of the second decimal place. Dartein understood that the curvature of the arch was imperceptible, and starting from that to trace the arch would lead to a gross error. In the absence of visible ruins on the left bank, Dartein studied the remnants of the foundation and measured with a wire the distance between the two supposed shoulders: 72 m. In this he was aided by the presence of two brick foundations, 49.75 m apart, belonging to a railway bridge begun around 1840 but then never completed.

Then, having fixed three points, through graphic studies and with analytical calculations, he determined the connecting circle, with a radius of 41.25 m and an arrow of 21.10 m, thus very low. Dartein wondered, not without reason, how the builders had managed to make the centina to build the arch, in such deep and swift water and with the rocky seabed, and to stabilize an archivolt only 2.08 m thick, 1/35 of the span: it seems an incredible feat!

But surveying the ruins was not enough. Viollet-le-Duc taught that one had to present a complete image, possibly inventing it. For his "virtual reality," Dartein drew inspiration from another bridge of the period, which he had already redesigned: the Scaliger bridge of Castelvecchio over the Adige River in Verona, built in 1354, with three arches, the largest of which had a span of 48.31 m (a bridge at the time fairly well preserved).

In the graphic reconstruction, along the entire brick parapet, Dartein drew a sequence of dovetailed Ghibelline merlons, 2.35 m high and 1.63 m wide, also similar to those that surmounted the perimeter wall of the castle of Milan (Beltrami 1885). The two bull's-eye openings present on the right abutment illuminated storage rooms arranged on three superimposed floors: in the design these rooms were lengthened and ended up completely emptying the abutments, which were ventilated by 4 narrow slits. The bridge was then symmetrical, thus equal on the left bank. This is what is seen in the drawing found in the Dartein archive and published only recently: but many must have seen that drawing in draft, much earlier. (Fig. 2)

Meanwhile, in 1867, Luigi Ferrario, archivist of the Royal Archives of Milan and a corresponding member of the Royal Deputation of the Studies of National History, published a short historical text on Trezzo and its castle, dedicating it to his brother Giuseppe, who had had archaeological excavations carried out on the ruins.

It is a nimble booklet compared to Giulini's monumental volume, to which the new text added nothing but if anything took away. As for the historical narrative, Ferrario cited only the texts of Biglia and Corio (whose book he had revised and annotated for the 1856 reissue), omitting instead Bossi's text, which annoyed; he then recounted some more recent news but made no mention of the bridge's exceptional measurements (Ferrario 1967).

Among Italian engineers, however, the bridge was now of great interest. One need not be surprised: to better understand the reasons for this, one need only enter the cultural climate of the post-unification period, particularly the debate over the language of the new "Italian architecture".

By 1861 Italy was finally united: with the Second War of Independence, Lombardy had been conquered from the Austrians, and then with the Third War, in 1866, Venice was also annexed. Italy made, its architecture had to be made. Designers were in search of a style adhering to the new reality of nationhood. Students at the Schools of Fine Arts were advised by their professors to practice on the architecture of the past: but which architecture should they prefer? In the former Lombardy-Venetia Kingdom, a key role in defining a style suited to the Homeland was played by Camillo Boito, who occupied the chair of Architecture at the Brera Academy from 1860 to 1909 and who also taught Architecture at the Regio Istituto Tecnico Superiore in Milan (later the Politecnico) from 1865 to 1907. Boito had among his students, just to mention the main ones, Luca Beltrami and Gaetano Moretti. Boito suggested "tying the knot" in medieval architecture: the essence of a national language could only be found in Lombard architecture because other styles "could not be considered fully Italian" (Boito 1880; Zucconi 1997).

"In the Lombard style, which the first two centuries after the year 1000 extended from the provinces of Upper Italy to the central provinces and even to those of Naples, decorum could be associated with economy." Economy is a magic word that has always been destined for great fortune among engineers, guided by the principle of the minimum (the rationality of the solution is guaranteed by the minimum cost and the essentiality of beauty).

The style of the Middle Ages was considered unifying, as opposed to the classical styles of Imperial Rome and then later the Renaissance, which were divisive and "pagan." For this it was studied and imitated. Mostly, however, it was invented: architects devised a neo-Gothic language that was also suitable for building restorations and additions.

Italian engineers, too, became passionate about this era so steeped in constructive sincerity. Engineers also had another problem to solve in the second half of the nineteenth century: they could not excel in the experimentation with metal structures that was fashionable throughout Europe. Since they could say nothing original in this field, they decided to claim a leading role for Italian engineering at least in masonry construction.

Thus, around 1880, two influential engineers took an interest in the bridge affair: Celeste Clericetti (1835–1887) and Giovanni Battista Biadego (1850–1925).

Clericetti from 1864 taught Construction Science at the Milan Polytechnic and was remembered as one of the Italian pioneers of laboratory tests on the strength of materials. He was also an enthusiast of Lombard architecture, on which he wrote essays and then volumes (Clericetti 1862, 141–192; Clericetti 1869). Clericetti met Dartein; they wrote to each other (Bella 2009, 72–87).

In a letter dated July 30, 1879 written (in English, for practice) to his friend Luigi Cremona, among the most celebrated scientists of the period, first professor of Graphic Statics at the Polytechnic and then from 1873 director of the School of Engineering in Rome, Clericetti recounted having seen the ruins of the "greatest stone arch ever," called by contemporaries "the eighth wonder of the world" (Testi Saltini 2016). He invented some names and got others wrong: but he really visited the site and impressed him so much that he mentioned the bridge in the important lecture he gave at the 1881 National Exhibition in Milan, on the great structures built in Italy in recent years, before an attentive audience. Here, too, he repeated mistakes, multiplying them: Bernabò became Azzone; Carmagnola was already a general of the Venetian Republic when he destroyed the bridge; he changed, little, the dimensions noted by Dartein: 72.25 m span and 20.70 m arrow.

Even in his lecture, the bridge was used to issue a challenge: it became a limit that the masonry vaults ("kind of artifact that is a very old Italian glory") would have to overcome (Clericetti 1881, 196).

Then, on September 15, 1882, following a dispute between the Municipality of Trezzo and the owners of the castle, Clericetti was commissioned by the Royal Prefecture to comply with the desire expressed by the Royal Minister of Public Education to know the state of the remains of the building and the costs of possible maintenance. On the occasion he made a survey of the ruins, suggested worthy excavations and proposed a solution to safeguard it from further spoliation: in the report he included a mention of the bridge and attached a drawing he attributed to Dartein (but the report has not been traced).

Giovanni Battista Biadego, the other engineer who became interested in the Trezzo arch, was instead a designer of metal bridges, among the very few in Italy at that time: he directed for a long time the technical office of the prestigious Società Ferrovie Mediterranee, of which he later became deputy director. Of the bridge over the Adda he made mention in *Il Politecnico* as early as 1880, reporting the usual sources but also pointing out, first, the pair measuring 72.25 x 20.70 m, which Clericetti later cited in the lecture (Biadego 1880, 455).

In 1885 Biadego devoted a chapter to the bridge in the volume *Monografie tecniche*, in which he collected essays on his major works but also on a series of historical masonry bridges. And finally he published, on a large folded board, the drawing of the bridge, "drawn up long ago on the basis of measurements taken in situ." In addition, Biadego reported some notes from Zucconi, an "egregious" engineer from Milan: "In that locality the Adda River is very deep and very narrow and no evidence of piers can be found there". This

Figure 3. From left to right: Detail of "The Adoration of the Magi" by Gentile da Fabriano, 1423 (photo by the author); Fictional drawing of the Castle and Bridge of Trezzo by Pietro Brunati, 1898 (Private Archive).

statement was added to put to rest any possible doubt about the one large span.

In addition, Zucconi said: "The passage plane above the arch was all covered in the manner of a walled gallery" (Biadego 1885).

Dartein certainly did not know Giovio's version of the "three-level" bridge configuration, later also cited in *Il Politecnico* (A.C. 1886), nor did he know the eighteenth-century maps that described the "double bridge". Zucconi evidently knew them, and urged Biadego to edit the drawing drawn up by the Frenchman (who was never named, however) to adapt it to contain at least two levels: the bridge was raised a great deal in the central part, to give space to the covered gallery, illuminated by side slits along the entire length. Along the uncovered passage, however, the battlements were shrunk but increased in number (from 28 to 49). The radius of the circle, whose center is lower than the line of the shoulders, is set at 42 m.

"As Clericetti puts it, the grandest wall arch ever erected." (Fig. 1)

Meanwhile, in Trezzo the necessities of modern life arrived on the scene: building a new bridge became urgent. Years earlier, in 1835, a man named Charles Armand of Lyon had submitted a design for a wire suspension bridge (which would be one of the first in Italy, after the bridge over the Bacchiglione in Padua in 1828). Later, in April 1840, the Holzhammer firm of Bolzano, based on plans by engineers Krenzlin and Pirovano, had hastily laid the first stone of a railroad bridge to serve the Monza-Bergamo line, studied by Giulio Sarti, but the project had been shelved because it lacked a final concession from Vienna. In 1845, entrepreneurs Bernasconi and Biasini had presented a design for a "cast iron mirror" bridge-whatever this definition meant, it had also been exhibited at the Brera Exposition in 1846.

Eventually, just downstream from the castle, a metal bridge was built for the Milan-Bergamo road, made by Officine Savigliano, with a central span of 62.5 m. Clericetti was the tester. This was one of the first large metal arch bridges built in Italy. The choice of location was felt as an affront by some (A.C. 1886).

The new bridge, an arch of constant thickness throughout its development (thus of unrational geometry), had not even managed to break the record of the ancient Visconti bridge! Not much later, the beautiful arched bridge of San Michele in Paderno, with a span of no less than 160 m, was built, and the Adda made peace with metal bridges.

In 1886 Ariberto Crivelli, also an engineer, published a final little volume on the castle ruins, the old bridge and the new bridge (Crivelli 1886). Crivelli, incidentally, was accustomed to historical forgery: a "privilege" of Charlemagne and a diploma of Charlemagne III, on parchment, were found in his family archives, which Crivelli had forged in order to document an imaginative Crivelli genealogy. He married the last descendant of Giulini, from whom he inherited the archive. It was not difficult for him to summarize the events on the ancient bridge, adding the most recent notes taken from Ferrario and then corroborating the story with Biadego's drawing, attributing it to Dartein and saying he had found it in a Bertotti lithograph. Of his own, he added that the open-air passage over the bridge was subject to a toll while the covered route was reserved for the private use of the castellans, and went straight into the castle. In his description, the archivolt was correctly described as being of Mapello sandstone and he imagined that the gables were as well, ruling out the hypothesis of a brick bridge.

A final vision of the bridge ("dreamed and designed") was realized by Pietro Brunati, the engineer who designed in perfect "medieval style" the workers' village of Crespi d'Adda (1889–1898), around the cotton factory founded by Cristoforo Benigno Crespi, just north of the Adda River meander. Crespi in 1894 bought the castle and its land, where he built a factory and the magnificent Taccani Hydroelectric Power Plant, a neo-medieval masterpiece by Gaetano Moretti, built with beautiful local pudding.

Brunati in 1898 drew up a romantic color drawing for his patron in which he "reconstructed" the castle and the bridge in a bird's eye view: without a mount, the bridge is drawn in two levels and the gallery is lit by ox eyes. (Fig. 3)

Conclusion

An American military engineer, vacationing in Italy during the 1960 Olympics, took the opportunity to visit the ruins of the "famous single span bridge at Trezzo sull'Adda" and reported the news in a bulletin of his Society.

He attributed the design of the bridge to such "Viviani, an Italian military engineer," and stated that, it would turn

out from chemical analysis on a fragment of the ruin, that the solidity of the mixture had been ensured by having mixed the mortar with cow's milk, a natural additive in use in the Middle Ages and whose protein contribution would have functioned as a cementing agent (Robb 1960, 414–415). In short, a dash of alchemy completes the bridge narrative.

But then, did the greatest masonry bridge of all ever exist? Albenga warns us that "too willingly" a Frenchman (but who?) called it "presque légendaire." We would not like to be scolded like that Frenchman, but we certainly have many doubts.

Biglia's sentence is practically the only hook on which to keep the whole narrative hanging: the rest is a magnificent invention, based mostly on the engineers' passion for the Middle Ages.

One would need a book dedicated to the history of the construction of medieval bridges of great span: on the Magdalene Bridge over the Serchio River in Borgo a Mozzano (38 m), on the oldest bridges over the Arno River in Florence, on the Castelvecchio Bridge over the Adige River in Verona (48.70 m) to the Alidosi Bridge in Castel del Rio (42 m). "Bridge Stories. Hunting for Engineers in the Late Middle Ages" could be called.

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