

Free research paper on roman aqueducts synthesis of form and function

[Environment](#), [Water](#)



Roman Aqueducts: Synthesis of Form and Function

Rome's aqueducts have long been a subject of debate over what constitutes architecture and what amounts to engineering. Howard Crosby Butler's article on aqueducts as monuments examines the nature of architecture itself. Butler writes that "architecture is distinctively the 'art of design' or of composition, and the term may be applied to structures which, though they may have no claim to beauty of detail, give evidence that their builders had a care for appearances, and an effect of dignity" ¹ While aqueduct design may indeed belong in the category of form versus function, there are those who have insisted that Rome's elegant water conduits render the debate inconsequential, and that these feats of Roman ingenuity are worthy of consideration free of strict classifications. In other words, their effectiveness, beauty and longevity practically demand that they be treated on their own terms.

But can a practical solution to a basic societal challenge truly be considered in aesthetic terms? This is a valid question considering the magnitude of the problem that Roman engineers faced and surmounted. Most aqueducts that the Romans constructed featured long, flat sections mitigated by a series of short drops. ² Roman engineers had to develop a response to the problem of heavy flows which short, steep drops facilitated. Their solution revolutionized engineering principles while leaving behind a legacy of design simplicity that manifests an undeniably intrinsic aesthetic beauty. As Butler reminds us, "wherever stone is dressed and laid" there exists an underlying design concept which exhibits a beauty that reflects the immutable laws of nature.

3 When such a design duplicates the functions of nature, the result is a unique triumph of balance and beauty. Such is the case with Roman aqueducts.

It is remarkable that aqueducts, which are a result of this balancing, were themselves directly responsible for the creation of other examples of function and architectural beauty. “ The Roman habit of bringing water, often over considerable distances, to cities and towns through aqueducts from higher points made fountains commonplace.” 4 Aqueducts also made possible public baths and other treasured examples of Roman architectural design. As such, this balancing of presentation and purpose fostered further examples of Roman architectural genius. Had aqueducts been simple, stripped-down products of convenience and efficiency, it is interesting to speculate as to whether other Roman design elements would have been so striking. Aqueducts, it seems, were destined, both practically and aesthetically, to contribute to the creation of other magnificent architecture.

First and foremost, aqueducts were lifelines of Roman civilization. They were critically important to the survival of millions, who depended on their ability to provide a non-stop supply of drinking water for Roman urban centers throughout the ancient world, and the means to produce crops. Like the fountains and baths they supplied, aqueducts were marvels of design, products of “ pragmatism and the desire to impress.” 5 In Rome itself, the demand for water was overwhelming, exceeding anything that had been seen in the ancient world. By the second century A. D., eleven aqueducts that carried hundreds of millions of gallons of water each day to

approximately 1 million inhabitants in the capital of the empire. They were statements “ of a city’s power, grandeur, and influence in an age when such things mattered greatly.”⁶ Considering the scope of their purpose, Roman aqueducts were truly a marvel of engineering.

They were also important as physical legacies, which mattered greatly to the emperors who sponsored their construction and for whom they sometimes were named. One such example was the Aqua Traiana (Aqueduct of Trajan), constructed during the second century A. D. during the reign of the Emperor Trajan. It was one of the largest of the aqueducts that supplied the city, spanning more than 25 miles between the springs on the northwestern side of Lake Bracciano, running southeasterly to Rome. Traversing such a distance across the varying features of the Italian landscape forced Roman engineers to adapt and invent as they went. In the case of Trajan’s aqueduct, the ground had to be carefully surveyed to make sure that the flow followed an acceptable gradient along its entire length. If the gradient was too steep, it could cause scouring that would damage the conduit itself; if it were not constructed at a sufficiently steep angle, the water would pool and eventually become stagnant. It was a matter of following the grade of the landscape and making careful, often subtle adjustments along the way.

If engineers encountered a hill or some other physical obstacle, they would simply tunnel through it to the other side. If a valley intervened, the Romans would construct a bridge, or devise some other means of transporting the water across, sometimes with a specially constructed pipe system that was reminiscent of modern technology. In order to ensure water was safe to use,

filtration systems were set up at various points along the route. Engineers faced such challenges in constructing the massive Aqua Claudia, which covered more than 40 miles (the Aqua Marcia was the longest of the aqueducts at Rome, covering 56 miles). ⁷ Begun by the Emperor Caligula in 38 A. D., it was completed in 52 A. D. by the Emperor Claudius. ⁸ But covering such a long distance was only one part of the process - engineers had to first gain access to the water's source.

Aqueducts could convey water originating from different sources. If it came from a river, engineers would construct an intake, or access point, for the aqueduct. This could take the form of a dam, or reservoir of some kind, so that the aqueduct would not go dry. Often, an aqueduct carried water from a spring, or series of springs. ⁹ Engineers constructed a springhouse or catch basin where the water issued from the ground, and flowed along various channels downhill until they came together at the entrance to the main aqueduct. Once the water had reached its destination, it was routed into a distribution tank called a castellum. From here, the water was routed to various districts throughout the city via a system of smaller, "mini" aqueducts. At that point, the water was stored in another castellum, from which water was distributed through pipes to various locations throughout the area.

In terms of material, the great majority of aqueducts were constructed of concrete, brick and stone, which indicates that most were built during the imperial period. Nine of the 11 aqueducts that served Rome were completed during the Empire, as were most of those built in the provinces¹⁰ More than

700 miles of Roman aqueducts were built in France, Germany, Turkey, Italy, Africa, Spain and Switzerland, and four at Lyon. Together, they comprise the most widespread monument to Roman ingenuity. More importantly, they are one of civilization's most important early examples of the convergence of art and science. Perhaps more than any other ancient society, the Romans synthesized design and invention in ways which showed that functionality could be aesthetically pleasing and artistically influential.

Butler, Howard C. “ The Roman Aqueducts as Monuments of Architecture.” *American Journal of Archaeology*. 5(2), 1901.

Butler's article is an important consideration of the confluence of architecture and engineering. The thrust of his argument is that just because a structure has a practical, functional purpose doesn't mean it can't also be qualified as architecture. That this article appeared in the *American Journal of Archaeology* is significant and lends considerable credibility to Butler's contention. There has been considerable debate over this issue.

Chanson, H. “ Hydraulics of Roman Aqueducts: Steep Chutes, Cascades, and Dropshafts.” *American Journal of Archaeology*. 104(1), 2000.

Chanson's article considers the particulars of aqueduct design. Specifically, he is concerned with the details of how the Romans were able to manage a consistent downgrade over such long stretches. This article provides a more technical view of aqueduct design and function. This is important as a counterpoint to an aesthetic consideration of these massive water conduits.

MacDonald, William L. *The Architecture of the Roman Empire: An Urban Appraisal*. New Haven, CT: Yale University Press, 1986.

Strickland, Michael. *Roman Building Materials, Construction Methods, and Architecture: The*

Identity of an Empire. Thesis, Clemson University, 2010.

This study considers the particulars of various elements of Roman architecture. Strickland's interest with aqueducts is focused on construction methods and building materials. This thesis offers highly useful information about the numbers of Roman aqueducts, their geographic dispersal and the period in which they were begun and completed.

Taylor, Rabun. "How a Roman Aqueduct Works." *Archaeology*. 65(2), 2012.

This article provides an understandable overview of how an aqueduct was surveyed, designed and constructed. Taylor includes information about the largest (longest) aqueducts, and particulars about their construction. It is useful and important in that it offers clear, sequential detail about how the Romans approached aqueduct construction projects.

Taylor, Rabun. "Rome's Lost Aqueduct." *Archaeology*. 65(2). 2012.

This article studies the Aqua Traiana, an aqueduct with design components that have been lost to time. Taylor chronicles the archaeological efforts to locate these components, and to reconstruct how engineers overcame the particular challenges this project presented. It is an illuminating

consideration of the way emperors saw aqueducts and other monuments as personal tributes.