Paleohydrology

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Company-sponsored paleohydrological research can pay good dividends. The research can take many forms, but for us, it focuses on archaeological sites that have a significant and unique water resources component.

Benefits resulting from field and office engineering research of ancient water development projects are many. Employees learn first-hand about scientific investigations; often by working next to experienced archaeologists who can teach them about focus, discipline, and documentation and that solid field evidence is necessary before drawing conclusions. It helps them become credible expert witnesses, as well as being better at their day-to-day work. There is no better way to understand sustainable design than to study ancient projects that have endured.

Research projects have taken our staff members to Mesa Verde National Park in Colorado, three sites in Peru, including Machu Picchu, and to Pompeii and Arles, France. A special honor for the Peru work was the 2007 receipt of Peruvian Presidential citations and decorations for contributions to Peru's cultural legacy.

Near Arles, France, not far from the Mediterranean Sea and the Rhone River, there is a 2nd Century Roman grain mill called Barbegal. The mill utilized 16 waterwheels, in two rows of 8 each, to turn 16 volcanic rock mill stones nearly 2,000 years ago. Water was delivered via two long Roman aqueducts. One aqueduct was fed with springs from the north side of the Alpilles Mountains and the other from the south side. The two aqueducts converged near the Barbegal mill. One branch supplied the mill and the other branch headed off to Arles to supply the Roman city with abundant clean water.

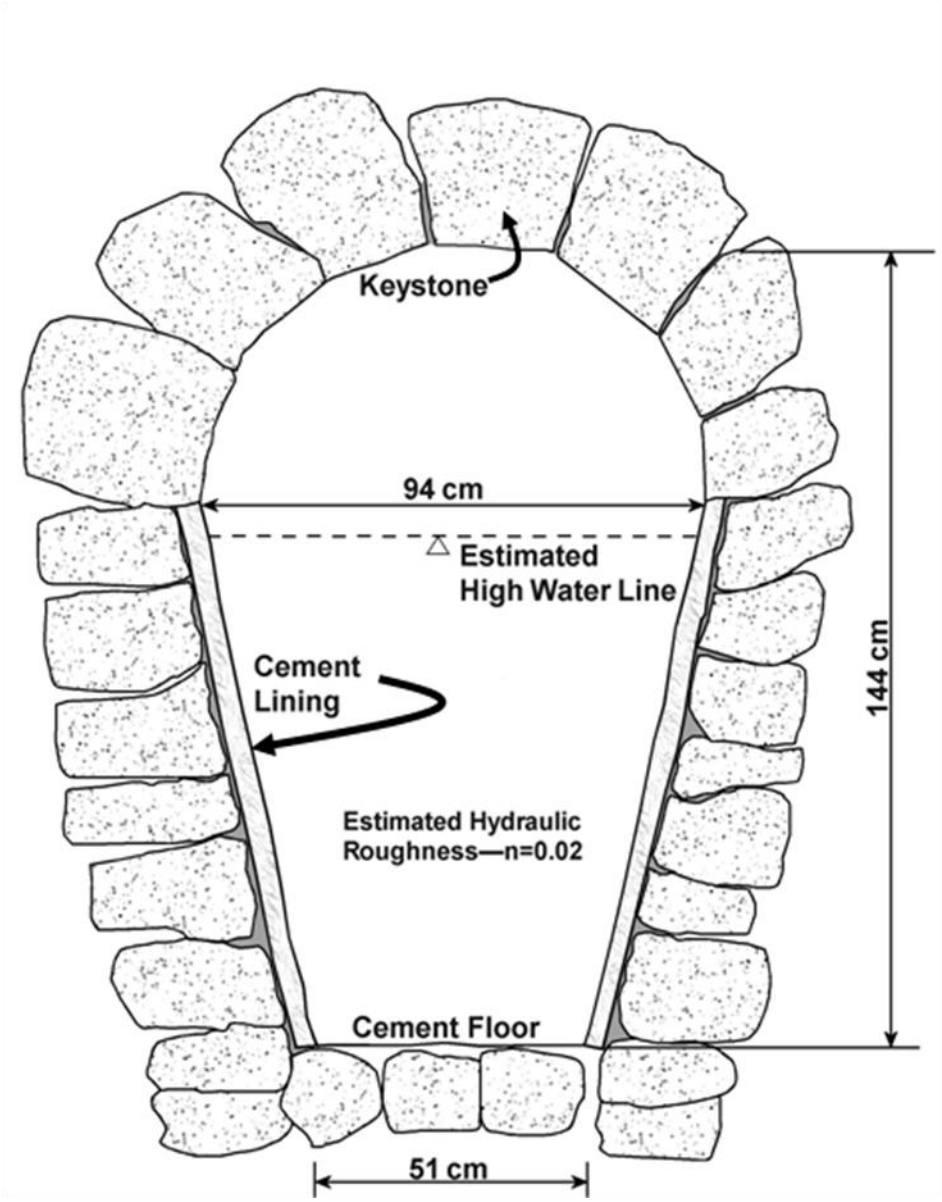
The north aqueduct is 24 miles long and the south is 7 miles long. Typical hydraulic gradients of the aqueducts are 0.1 percent, with likely roughness coefficients of n = 0.02. The north aqueduct had a capacity of about 17 cubic feet per second (cfs).

The waterwheels of Barbegal were of the overshot type with diameters of 7 feet and widths of 2.3 feet. With an estimated hydraulic efficiency of 75 percent, each waterwheel could have generated 2.5 horsepower to a shaft and gears to power millstones having a diameter of 2.5 feet and a weight of 900 pounds.

Our engineers networked with French, English, and American archaeologists and scientists to ensure a sound framework for our engineering findings. We concluded that the Roman mill could process up to 11,000 pounds of flour per day, enough to supply 10,000 people with daily nutrients.

Nearby agricultural fields still abound near Barbegal as they would have nearly 2,000 years ago. Even in 1888, the Dutch painter Vincent Van Gogh found the fields of grain so impressive that he recorded them in some of his most famous paintings that hang in the great museums of Europe.

It is well accepted that one must learn from history to avoid the same mistakes of early people did. By studying ancient civil engineering projects and water supplies, modern engineers can learn many lessons and be better able to serve society. For individual water resources engineers, the study of ancient civilizations and their water use and handling methods can be especially rewarding professionally. For engineering firms, such research efforts can be rewarding via an enlightened staff and the resulting appreciation by the public and clients who recognize the benefits of understanding long-ago civilizations and their water development.



Cross-section of Roman aqueduct that furnished water to power the Barbegal water wheels.

Roman aqueduct near Arles, France.