

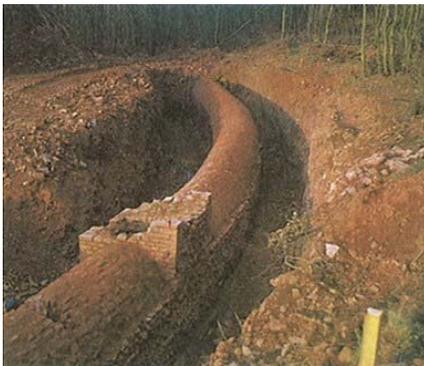
Concrete Evidence

Missing from the famous list in *“Life of Brian”* of what the Romans did for us was **concrete**. Not surprising really, since most of us regard concrete, and the soulless buildings which resulted, as a product of the 1950s. (Think Royal Festival Hall). But as always, the Romans were there long before. The great engineer, **Vitruvius**, writing in his **De Architectura** some 25 years before the birth of Christ was already suggesting various combinations of materials to produce the best results for the construction of buildings and, for example, sea walls. It is not always obvious that many Roman buildings are in fact made of concrete since they were often faced with stone. And it is also the large-scale stone structures such as the aqueduct at Segovia or Hadrian’s Wall which attract most attention.

Probably the most famous surviving Roman concrete building, and surviving in astonishing condition, is the Pantheon in Rome. After almost 2000 years its dome is still the world’s largest unreinforced concrete dome.



An equally spectacular Roman achievement in concrete, but very little known outside Germany, is the **Eifelwasserleitung** (pronounce *Eye-full-vasser-leitung*), the 100 kilometre long aqueduct which provided Roman Cologne with good quality spring water from the Eifel hills in the west for almost 300 years.



It is little known because it is invisible, being constructed one metre beneath ground level along most of its length. It also demonstrates the astonishing skills of the Roman surveyors. Gravity is the engine which drove the supply of water, so the Eifel aqueduct had to follow a down-hill path all the way from the source to Cologne, no mean feat of surveying and engineering, often through hostile territory.

Built in about 70AD, (i.e. at about the same time as Slack fort was being built) such a construction would even today be a major challenge. Unfortunately there is no documentary evidence surviving to tell us how the vast quantities of materials and the manpower needed were assembled and employed. At a rough estimate I reckon the amount of concrete used would today cost about £250 million from Readymix. Sections of the aqueduct are uncovered and excavated from time to time during building work etc. Approximately 50% of the aqueduct still survives.



But just why is Roman concrete “so darn tough”? This is a question that researchers at the University of Utah have recently put their minds to. Modern concrete, even when embedded with steel, starts to crumble away within decades, whereas the Roman version just seems to get stronger as the centuries pass, even when exposed to very challenging environmental conditions, such as sea water. Professor Marie Jackson of Utah University thinks she has found the answer. It is all to do with the very different materials used to make the Roman concrete.

Modern concrete is made from a mixture of Portland cement, sand, aggregate of small or large stones and water. Roman concrete is a mixture of volcanic ash, lime and perhaps surprisingly salt water. To this mixture would be added lumps of volcanic rock. This causes a chemical reaction called a pozzuolanic reaction, named after the city of Pozzuoli in the Bay of Naples, where presumably plenty of volcanic ash was available. This chemical blend results in a concrete which is virtually impenetrable. The water supply to Cologne, the Eifelwasserleitung, passes through a part of Germany where the landscape is dotted with long extinct volcanoes. Did these provide the vast quantity of ash required for the Roman concrete recipe?

More detailed information on this topic can be found on the University of Utah website:

unews.utah.edu/roman-concrete/



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