Roman Baths

Roman baths were part of the day-to-day life in Ancient Rome. Bath in Somerset, contains one of the best examples of a Roman bath complex in Europe. There are two good examples at Pompeii.

Roman houses had water supplied via lead pipes. However, these pipes were taxed according to their size, so many houses had just a basic supply and could not hope to rival a bath complex. Therefore for personal hygiene, people went to the local baths. However, the local bath complex was also a gathering point and served a very useful community and social function. Here people could relax, keep clean and keep up with the latest news.

Taking a bath was not a simple chore. There was not one bath to use in a large complex such as the one at Bath. A visitor could use a cold bath (the frigidarium), a warm bath (the tepidarium) and a hot bath (the caldarium). A visitor would spend some of his time in each one before leaving. A large complex would also contain an exercise area (the palaestra), a swimming pool and a gymnasium. One of the public baths at Pompeii contains two tepidariums and caldariums along with a plunge pool and a large exercise area.

The building of a bath complex required excellent engineering skills. Baths required a way of heating up water. This was done by using a furnace and the hypocaust system carried the heat around the complex.

Water had to be constantly supplied. In Rome this was done using 640 kilometers of aqueducts - a superb engineering feat. The baths themselves could be huge. Those who built them wanted to make a statement - so that many baths contained mosaics and massive marble columns. The larger baths contained statues to the gods and professionals were on hand to help take the strain out of having a bath. Masseurs would massage visitors and then rub scented olive oil into their skin.

It was very cheap to use a Roman bath. A visitor, after paying his entrance fee, would do some exercising to work up a sweat before moving into the tepidarium which would prepare him for the caldarium which was more or less like a modern sauna. The idea, as with a sauna, was for the sweat to get rid of the body's dirt. After this a slave would rub olive oil into the visitor's skin and then scrap it off with a strigil. The more luxurious establishments would have professional masseurs to do this. After this, the visitor would return to the tepidarium and then to frigidarium to cool down. Finally, he could use the main pool for a swim or to generally socialise. Bathing was very important to the Ancient Romans as it served many functions.
Aqueducts

The first water supply to Rome was via the River Tiber and local natural springs. However the population of Rome greatly increased and the problem of water supply to all of the people of Rome was resolved through the development of aqueduct technology by the Roman engineers. The date of the first recorded aqueduct in Rome was in the year 312 B.C. A number of additional aqueducts were built conveying water from distant springs and streams to Rome.

People are still fascinated by how Roman aqueducts work. The water in the aqueducts ran gently through concrete channels. Multi-tiered viaducts were developed by Roman engineers to cross low areas. Water from the ancient Roman aqueducts passed into large, covered catch-basins in Rome designed to deposit their sediment. The water from the catch-basins were distributed through free-flowing canals, lead and terra-cotta pipes to storage reservoirs and then through lead pipes, called fistulae, to the people who inhabited the ancient city of Rome. A waste-water collection system discharged the waste into the drains or sewer system. The main outlet of the initial drainage system (Cloaca Maxima) was the Tiber River.

The Romans expended immense sums of money on the Ancient Roman aqueducts and baths. One of the most remarkable aqueducts was the Claudian aqueduct, which was completed by the emperor Claudius although started by Caligula. They featured high arches and beautiful and stately pillars. It is said that Rome was supplied with five hundred thousand barrels every twenty-four hours by means of these Ancient Roman aqueducts. The cloacae or sewers were constructed by undermining and cutting through the seven hills upon which Rome stood. The Cloaca Maxima was the main sewerage system of Ancient Rome.

The Colosseum Amphitheatre was provided with water via the Aqua Claudia aqueduct and distributed through free-flowing canals, lead and terra cotta pipes to storage reservoirs and then through lead pipes. A waste-water collection system discharged the waste into the drains or sewer system. The main outlet of the initial drainage system (Cloaca Maxima) was the Tiber River.

The importance of the ancient Roman aqueducts cannot be emphasized enough. The final destruction Rome occurred in 537 AD during a siege on Rome by the Goths. The aqueducts, which supplied Rome with water, were destroyed. The people of Rome could not survive without water and the population of Rome fell by 90%.
Road System

The Romans were famous for their roads. Some Roman roads exist to this day, nearly 2000 years after they were made. Roman roads were superbly made. Why did the Romans put so much effort into building roads?

Rome made a great deal of money from trade in Europe. Some of this trade involved transport by sea. More frequently, the Romans used roads. Also with so much of Western Europe conquered by the Romans, the Romans needed roads to move their troops around quickly. Poorly built roads would not help this. When the Romans arrived in England, they found no roads to use. Instead they had to make do with tracks used by the Britons. It was not unusual for these tracks to be in very poor condition as they were usually on high ground and open to all types of weather.

A good road system also made it easier for the emperors to control their empire as messages and orders could be sent quickly. Roman roads were famed for being straight and well made. However, the Romans usually built roads around a natural obstacle rather than go through it.

The Romans did not have a compass or maps to help them build roads. How did they manage it? Surveyors used a tool called a groma. This was an instrument that had two pieces of wood nailed together so that they formed a square cross with right-angles in all the corners. Each piece of wood had lead weights attached to the ends. When one lead weight from the same piece of wood lined up with the one in front of it, the surveyor knew that he had a straight line.

Once the surveyor was convinced that he had mapped out a straight line, wooden posts were dug into the ground to mark out the straight line. The road was built along this line. Ditches were dug either side of the road to allow for drainage. Roman roads tended to be built higher than the level of earth around them – this, again, helped drainage.

The bulk of the actual building was done by Roman soldiers. By doing this, the Romans could rely on the gained expertise of the soldiers. The authorities could also rely on the fact that the soldiers would do the best they could for Rome – by building excellent roads. Roman roads were well used throughout the empire. However, many of those who used them had to walk - including merchants - as chariots and horses were expensive. A wealthy merchant could afford a wagon pulled by horses. The roads were built so that two of these wagons could pass on both sides of the roads. They were so well built that they lasted for centuries.
Concrete & Arches

The Romans started making concrete more than 2,000 years ago, but it wasn’t quite like today’s concrete. They had a different formula, which resulted in a substance that was not as strong as the modern product. Yet structures like the Pantheon and the Colosseum have survived for centuries, often with little to no maintenance. Geologists, archaeologists, and engineers are studying the properties of ancient Roman concrete to solve the mystery of its longevity.

Roman concrete is approximately ten times weaker than modern day concrete, but it is assumed to have phenomenal resistance over time. That resistance, or durability against the elements, may be due to one of the concrete’s key ingredients: volcanic ash. Modern concrete is a mix of a lime-based cement, water, sand, and so-called aggregates such as fine gravel. The formula for Roman concrete also starts with limestone: builders burned it to produce quicklime and then added water to create a paste. Next they mixed in volcanic ash—usually three parts volcanic ash to one part lime, according to the writings of Vitruvius, a first-century B.C. architect and engineer. The volcanic ash reacted with the lime paste to create a durable mortar that was combined with fist-size chunks of bricks or volcanic rocks called tuff, and then packed into place to form structures like walls or vaults.

By the beginning of the second century B.C., the Romans were already using this concrete in large-scale construction projects, suggesting their experimentation with the building material began even earlier. Other ancient societies such as the Greeks probably also used lime-based mortars. But combining a mortar with an aggregate like brick to make concrete was likely a Roman invention.

In the earliest concretes, Romans mined ash from a variety of ancient volcanic deposits. But builders got picky around the time Augustus became the first Roman emperor, in 27 B.C. At that time, Augustus initiated an extensive citywide program to repair old monuments and erect new ones, and builders exclusively used volcanic ash from a deposit called Pozzolane Rosse, an ash flow that erupted 456,000 years ago from the Alban Hills volcano, 12 miles southeast of Rome. The ash’s unique mix of minerals appears to have helped the concrete withstand chemical decay and damage.

Through the use of concrete, Romans developed the arch, a supporting structure in building construction that could carry a lot of weight. An arch is a curved structure that is usually made of stone, brick, concrete, or, more recently, steel. Its purpose is to support or strengthen a building. Most arches consist of wedge-shaped blocks. The top center stone, called the keystone, is the last block to be inserted. During construction, arches are often supported by a wooden frame. When the frame is removed, both sides of the arch press against the keystone and thereby support the arch.

The Romans did not invent the arch. Indeed, arches have been used since prehistoric times. The ancient Egyptians, Babylonians, and Greeks all used it. The purpose of the arch in these cultures, however, was limited to supporting small structures. The ancient Romans created an arch that could support huge amounts of weight through the use of their unique mixture of concrete. As a result, Romans were able to build massive structures, such as aqueducts, which provided water to cities.

The Roman arch solved the problem of arches not being able to support large amounts of weight. The Roman arch also caused the Romans themselves to make further architectural developments. They combined arches to form ceilings or roofs called vaults. The Romans also used the principles of the arch to form a hemispherical ceiling or roof called a dome.
Roman Bridges

Connection between cities, ports, mines and neighboring civilizations brought the need of creating stable and permanent roads. For this purposes, many ancient civilizations started to leave their mark on history by leveling up uneven terrain, forging their way through wilderness and eventually, bridging rivers and extreme land formations with wood logs and stones. These early bridge building efforts finally received massive update in Greece, where builders and mathematicians discovered new ways of molding the weight of bridge material into structures that could remain strong enough to carry incredible weights.

With the arrival of Roman Empire, bridge building techniques were revolutionized with the introduction of arches. Rather than crudely covering entire surface below the deck of the bridge with the stone or wood, architects of that time built their bridges with the arching shapes, enabling downward force from the top of the bridge arch to meet the equal force that was pushed from the ground in the bridge foundations. Result of this design was an incredibly squeezed material and bridge structure that was very rigid and strong. The Roman stone arch bridges were so strong, that they had the potential to carry as much load as its own weight (or even more).

With such powerful knowledge in their hands, Roman road builders spread across the Europe, Asia and Africa, building over 900 bridges during the life of Roman Republic and Empire. They did not build bridges to carry pedestrians and cargo traffic, but also incredibly complex aqueducts and viaducts, which carried water and goods from all parts of Europe to Italy. All in all, original Roman bridge architecture reached 26 different modern countries, from Portugal on the west, to Turkey on the east. Testament of the building techniques of Ancient Rome can be witnessed even today, with hundreds and hundreds of their bridges still left standing in all across the world.

Roman stone arch bridges were semicircular, which offered greater protection from forces of flood waters and enabled builders to infuse less material into bridge itself, making it lighter. One of the best examples of the segmented arch bridges can be seen in Limyra Bridge in southwestern Turkey which features 26 segmental arches and in the Alcántara Bridge which is today viewed as one of the most impressive and best preserved masterpieces of ancient Roman architecture. 17 meter long Turkish Karamagara Bridge that was built in 5th or 6th century represents the oldest surviving Roman bridge that features pointed arch.

Construction of stone arch bridges was not an easy task. Builders first had to created wooden arches in exact measurements as a finished bridge, and then use that wooden construction as a contained for stones and another substance that enabled Roman Empire to become such an architectural force – mortar (they were the first civilization on earth which discovered that mortar did not dissolve in the rain). Stones that were used for building bridges were usually found locally, but mortar components had to be imported from far away (ground up volcanic rock).
Medical Tools

Even with many questionable doctors in the Roman civilization, they had a relatively advanced surgery system. The scientific knowledge of the body, gained largely from the Greeks, gave them the basis to perform many surgeries with the skill and success rate of today.

The Romans had several techniques to operate on eyes. One such operation helped minimize cataracts. They used a thin needle to push through the eye and break up the cataract. Then with the small hole in the needle the broken up pieces could be suctioned out. This procedure restored at least a moderate amount of sight for the patient.

Other operations involved plastic surgery. One report discusses an individual getting his earlobes repaired after years of wearing heavy earrings. The excess lobe was trimmed and the hole sewn together. Freed slaves prompted another common, but expensive, plastic surgery. The brandings and scars of the freed slave could be removed for a price. This would minimize the recognition and stigma of having been a slave in this ancient society.

Perhaps the most amazing operations were performed on the brain. Trepanation, the name of the procedure used, gave relief to those with incurable headaches and relieved pressure on the brain as a result of head injuries. The surgeon used a cylindrical drill bit to drill a circle in the skull. He would rotate the drill using a bow-like device, much like the ones used to rub sticks together in making a fire. Patients had a high survival rate and, amazingly, no anesthetic was needed.

The tools of surgery have given us an insight into the methods and advancement of surgery in Rome. Some of the best discoveries of these tools come from the remains of Pompeii, the city buried in AD 79 under the eruption of Mount Vesuvius. Archaeologists have uncovered the home of a surgeon. Within his house he had several tools that remained in pristine condition under the ash of the volcano. These included scalpels, scissors, and bone forceps, giving clues as to the process of surgery and treatment in Roman society. Much of what we know of Roman medicine is because of the "House of the Surgeon."

While the application of medicines and cures was a guessing methodology at best, with some undoubtedly dangerous use of elements such as toxic mercury, the Romans used very sophisticated medical tools. Among the items we know the Romans used were:

**Scalpels** made of bronze, iron and steel, and a wide variety of medical scissors were used.

**Intricate** and varying **hooks or probes**, were used in moving light tissues and for making the negotiation of the inner workings of the human body more manageable.

**Bone drills**, resembling the modern cork screw, were used to remove diseased bone tissue from various bones, or to drill holes to allow access to blocked parts of the body.

**Metal forceps** were used to extract small pieces of bone or other objects that would be otherwise difficult to remove with fingers.

The **bone saw** was used in amputation, which the Romans knew prevented gangrene.

**Bone levers** were used to put fractures back in place, or to remove teeth.
Ballista (Catapult)

The ballista's origins date back to ancient Greek civilization. The word ballista itself derives from the Greek word 'ballistes,' meaning 'to throw.' The Greeks were the first to discover torsion spring technology, the driving principle behind how a ballista works. The Romans took the Greek design and expanded upon it, creating both a small portable version that was easily carried into battle and a huge three-ton version for sieges. They also had some ballistae that hurled rocks instead of the traditional bolts.

Ballistae were constructed of different sizes for the various purposes of siege and field warfare. The largest ones could throw projectiles weighing up to fifty pounds as far as 400 yards! Similar to the working of a crossbow, the Ballista actually preceded the crossbow in western culture by over a thousand years and is where we get the word "Ballistic".

The ballista was used by attackers and defenders alike as an effective anti-personnel weapon. For defenders, the positioning of ballistae (ballistae) upon the walls of a fortification would afford additional range to the weapon, and some versions were built on a pivoting frame to allow for quickly repositioning a shot. For attackers, another version of the ballista was wagon mounted, the carro-ballista, allowing it great mobility in the field. The ballista could also be a powerful delivery system for the launching of flaming bolts over distant walls.

The Romans reputedly stole the concept of the catapult from the Greeks, but went on to perfect the machine as their own weapon of mass destruction. Ballistae were torsion-powered catapults, using pairs of rope springs to propel missiles, and as such had two horizontal arms, rather like a crossbow. The smallest type, called 'catapulta' or 'scorpio', shot a bolt or arrow, and were used as anti-personnel weapons. Each legion of the Roman Army had at least one small 'catapulta' to each century (100 men), and one ballista to each cohort (300-600 men). The larger ballistae were used to great effect in sieges, able to fire large rocks and spears from a range of 900-1200 feet at defending walls, doing considerable damage.

The early ballistae were made of wood, and held together with iron plates around the frames and iron nails in the stand. The main stand had a slider on the top, into which were loaded the missiles. Attached to this, at the back, were a pair of winches and a claw, used to ratchet the bowstring back to the armed firing position.

Ballistae and their like were introduced as a form of mobile artillery to the Roman Army by Julius Caesar, and used on his various campaigns to take over Gaul and Britain, and anywhere else that took his fancy. They became a mainstay of the Roman legions right up until the fall of Rome, and as such left a mark on ancient warfare - and numerous walls and bodies of Roman enemies. Proof of its use by the Roman military can be seen on Trajan's Column, which has carved reliefs of many Roman army ways of war. The ballista was a weapon that went on to be tweaked and redesigned over the ages, the medieval trebuchet becoming the ultimate in similar rock-throwing siege engines.
Sanitation Systems

In larger Roman towns, people often got sick or died from drinking water that had been contaminated with sewage. To fix this problem, many Roman towns built aqueducts to bring in fresh water from the hills outside of the towns. They also built public latrines and systems of sewage pipes to carry sewage out of the streets and dump it into the river. This was a big improvement on Greek sewage arrangements, where people just poured their waste into the street however they wanted.

There were also big public toilets that had room for lots of people at the same time. These sewers just dumped raw sewage into the river, which was better than leaving it lying around in the streets, but still did spread germs sometimes. The Romans didn't have any way of treating sewage to kill the germs, as we do today, and they didn't understand the need to do that.

In smaller towns, though - most of the towns in the Roman Empire - there weren't any sewers, and sewage collectors came through and got waste from each house and carried it off to sell to farmers to use as fertilizer on their fields, just like in ancient China at the same time. In small villages (where most people lived), they didn't have outhouses, and people just walked out to the fields every morning.

The first major public sewer, the Cloaca Maxima ("The Great Drain"), was originally built by Romans to drain the marshy areas which eventually became the Roman Forum. The Cloaca Maxima--a huge covered drain by the time of the Late Republic--functioned both as Rome's main storm sewer and means of sewage disposal. It emptied into the Tiber river.

The Romans integrated earlier sewer innovations into the cloaca maxima, first built around 800 BC. These open drains were designed to carry stormwater, but the rains also flushed away piles of waste and household rubbish thrown into the streets. During storms, these ditches were sources of a horribly revolting stench. Ancient Roman sewer designers also developed cesspools, forerunners of modern-day septic tanks. Sewage first flowed into a large stone or concrete tank where heavy solids settled to the bottom and lighter particles floated to the top. The partially cleaned liquid flowed into a nearby body of water. Collected sludge was either used as fertilizer or simply buried.

Roman water and sewage systems were the forerunners of the sanitation systems we have today that keep people's water clean and safe. Today the city of Rome has been joined by newer cities like London and New York City in maintaining healthy water supplies, and new street cleaning services keep the streets and buildings much cleaner than they were in Ancient Rome. But it all started with Roman aqueducts and sewers.