# CEMENTING AN EMPIRE

*This week Ben investigates one of the Romans’ most lasting innovations – concrete! Ben provides a solid introduction to Roman Concrete and its significance, even today!*

## A Concrete Jungle

The Romans are known for many things. Murder. Assassinations. War. Salad (Caesar – get it?). You can still see temples and other relics of the Ancient Roman world which have withstood the tests of time. But we must ask ourselves – why are these buildings still standing?

The answer is, arguably, one of the greatest innovations of the Roman Empire – an innovation that the modern world stabilises itself upon, and will continue to use as its foundations. What is this material? It is a material of strength and durability – it can withstand enormous pressure, hold firm against time and erosion, and underpins some of the greatest cities in the world. It is – CONCRETE.

Concrete is a material that is not specific to the Roman Empire. Archaeological studies point to the use of concrete or concrete-like materials spanning decades before the Romans, appearing in India, Asia-Minor and Greece [@GoldsworthyandMin: 934]. The difference, however, is the durability of the Roman concrete, and its physical properties [@Delatte: 109]. Concrete under the Roman hands would be moulded into something new.

Roman builders followed a standardised process when producing concrete [@Delatte: 112], a process which is largely detailed by the 1st Century BC Roman Architect, Marcus Vitruvius Pollio. Various studies, such as those conducted by [@Gotti], have attempted to follow the procedure set down by Vitruvius. What was found was that Vitruvius ([Vitr. 2.5.1](http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0073%3Abook%3D2%3Achapter%3D5%3Asection%3D1); [5.12.2](http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0073%3Abook%3D5%3Achapter%3D12%3Asection%3D2)) developed an “academic ideal” for concreting – a recipe which, when perfected, would create long-standing concrete structures.

Of course, this process was not perfect from the beginning. It developed and improved over the course of the Roman Empire – the biggest divide being between the Republican and Imperial stages of the Empire itself. This divide is evident in the structures hailing from each period – namely in their construction, innovation, symbolism, and general structure. Yet their differences are weak, compared to their similarities – concrete has always had many CONCRETE uses.

## The Foundations of Concrete

The history of concrete in Rome is traced through its use in the various epochs of Roman history. A basic recipe is developed quite early on – slaked limestone is mixed with sand and water to develop a “high-quality plaster” [@GoldsworthyandMin: 934]. To add strength, Romans would utilise various aggregates designed to provide extra stability within the mortar. During the Republic, these aggregates would be seemingly random – often tuff fragments, rubble from buildings and glass. These aggregates would reflect the “near-site geographical setting” and were generally haphazard [@Marra: 191].

Early Roman concrete structures reflect this method – the Porticus Aemilia (*fig. 1*), used as a warehouse and built in 193 BC, is the earliest known example of Roman concrete use [@Marra: 183-185]. These warehouses showcase an earlier version of Roman concrete – the mortar is mixed with “scrap material” as a base, with “volcaniclastic material” providing an adhesive [@Marra: 190]. At this time, the system of building using concrete is basic – the Romans want to build things, and don’t appear to care for how. This has largely to do with restrictive timeframes; due to the one year term of official positions.

In 111 BC, the Romans struck gold – or concrete [@Marra: 194]. Mortar is mixed with Pozzolana – volcanic ash deposits (*fig. 2*) first found at the town of Pozzuoli, north of Naples [@Delatte: 109]. This ash, when combined with lime, sand, and water, gains a cementitious value [@GoldsworthyandMin: 935]. This is because the ash undergoes a chemical reaction when mixed with the water, causing it to harden [@Jackson: 1669]. This addition would allow Republican leaders to develop larger feats of concrete-based infrastructure, as well as gaining the ability to be used in marine construction ([Vitr. 2.6.1](http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.02.0073%3Abook%3D2%3Achapter%3D6%3Asection%3D1)). This is an important development in the use of concrete, resulting in its active use hereafter.

Consider, for example, the Capitoline Hill. The Capitoline Hill itself is twin-peaked – a north and south summit, connected by an underlying substructure, the *Tabularium* [@Davies: 89] (*fig. 3*). A large concrete slab, complete with arches and vertical walls, bridged the gap between the summits to expand the ground for Roman infrastructure [@Davies: 89]. This is an amazing feat, considering it was built around 78 BC! The *Tabularium* still sits on this saddle and supports the *Piazza del Campidoglio* in modern Rome. Concrete thus not only ensured the longevity of the Roman world, but expanded it.

## ‘A Concrete Revolution’

Under Augustus (27 BC – 14 AD), we see a Golden Age of concrete. Political stability and a standardised process meant that Augustus and subsequent Emperors could build bigger and more permanent structures without worrying about shorter timeframes. During the Imperial Ages, older structures are restored using concrete bases, the process becomes streamlined [@Delatte: 112], and newer structures are designed with greater effects. Concrete wasn’t just a foundational base anymore – it was used in walls, domes, sea walls, and other areas. It became a symbol of progression and stability – a testament to time.

A case in point would be the Pantheon – a structure where concrete was more than just a base (*fig. 4*). The Pantheon was first built during the reign of Augustus by his friend Agrippa and was restored twice after that – the first time around 80 AD by Domitian, and then again by Hadrian in 126 AD [@Coarelli: 286]. The central focus of the building – the 43.4 metre concrete dome [@Delatte: 109] - is largely attributed to Hadrian’s restoration. The dome itself is a fantastic example of the versatility of Roman concrete – not only is it structurally sound, but the patterns and designs built into it reflect a durability otherwise unseen.

## Set in Stone (or Concrete)

Concrete gave the Empire more than just stronger structures, however. Concrete represents a multitude of things – stability, strength, durability, longevity – all of which reflect a strong government or presence in society [@Dumser: 137]. This advertisement of power and authority had its origins in the Republic. Buildings were commissioned by private individuals to selfishly strengthen their image through public dedications [@Dumser: 136]. This sentiment is true for concrete materials during the Republic as, since political stability was fleeting, patrons had to leave a lasting image of their presence to keep favour.

This sentiment is best reflected in the competition of infrastructure between Pompey and Caesar during the Republican years [@Davies: 97]. During these years “architecture and politics were inextricably intertwined” – to ensure longevity, leaders needed “rapid concrete construction” to solidify their position [@Davies: 99]. Pompey and Caesar would continuously battle for control in the Roman Republic (49–48 BC) – however, their battles were fought not just on the battlefield.

Both men were focused on gaining visibility by manipulating the public space of the City of Rome to match their desires. Since concrete “imposed symbolic and physical authority”, whichever man had more concrete structures, the more concrete their political position [@Davies: 84]. Pompey’s Theatre (*fig. 5*), for example, was a large complex built by Pompey in 55 BC to impose his presence on the city landscape with a concrete core. The theatrical complex included a theatre, gardens, a temple, a *portico*, and a *curia*. The theatre itself could accommodate for up to 20,000 people [@Temelini: 42]. Semi-circular in shape, the beautiful structure was a concrete example of Pompey’s presence in the city, and of the symbolic use of the material during this period. For more information on the Theatre of Pompey, see Ewan’s blog.

As mentioned previously, this symbolic value of concrete was not lost on Augustus or later Emperors either. Due to Augustus’ long time in power, and his persistence in ensuring stability, concrete development and use could be standardised through a stricter recipe and concentration of the process. This standardisation of building materials and techniques, and planning procedures, made building projects more systematic [@Delatte: 112]. They began to use scaffolds to provide a stronger structural outline [@Delatte: 113], which allowed them to design new structures to boost their image – e.g. the Pantheon’s Dome. Through Vitruvius, we see that this recipe was so important it was written down for future use to ensure the longevity of the practice.

Concrete was even employed in the building of the *Portus* at Ostia by Emperor Claudius, started in 42 AD, as a way to both provide a safe and nearby harbour for Rome, and to cement his legitimacy and rule [@HohlfelderandBrandon: 55]. The *Portus* proved an excellent place to utilise the enhanced strengthening of concrete by seawater, which is still resistant to seawater today [@Jackson: 1669]. The *Portus* was finished by Nero (*fig. 6a*) in 64 AD and is commemorated in his coinage (*fig. 6b*). It was later expanded by the addition of a hexagonal harbour by Trajan, finished in 112 AD [@HohlfelderandBrandon: 57], which still retains its shape, owing to its concrete construction.

Additionally, using concrete was the signpost of a smart leader. Concrete production and building boosted the economy – it was cheap, the aggregates could come from recycled rubble (as used by Nero after the 64 AD fire), and only required simple workmanship, boosting employment [@White]. Concrete meant jobs, which meant a stronger economy, a larger labour force, and a smart leader who only wanted the best for their City. Rome never looked better than when its people saw another concrete structure go up.

## Shine bright like some concrete…

The student of Ancient History is, no doubt, obsessed with the ‘cool’ topics – war, murder, political strife, etc. Yet, we never consider the nitty-gritty parts of Rome – what housed the Generals when they discussed these wars? When Caesar was assassinated, what material lay beneath his body? And when Rome eventually fell, what rubble coated its streets, and what stayed standing? The Romans use of concrete is nothing but exceptional – not only was it regularly used throughout the Republican and Imperial periods of Rome (until around the 3rd century AD) [@GoldsworthyandMin: 934], its value was more than structural. A concrete building meant a concrete leader – both would stay long after the people were gone

Augustus, it is said by Suetonius ([Suet. Aug. 28.3](http://penelope.uchicago.edu/Thayer/E/Roman/Texts/Suetonius/12Caesars/Augustus*.html#28)), left Rome a “city of marble” when he died. With all due respect, the truth of this statement is not clear enough. Augustus may have left a city built of marble, but the Roman legacy itself was built with concrete.

## Follow these links to CEMENT your Knowledge!

Platner & Ashby’s [*A Topographical Dictionary of Ancient Rome*](http://penelope.uchicago.edu/Thayer/E/Gazetteer/Places/Europe/Italy/Lazio/Roma/Rome/_Texts/PLATOP*/home.html) provides further detail into buildings mentioned here, as well as other buildings made of concrete

Vitruvius’ [*De Architectura*](http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:1999.02.0073) talks about a variety of building-related concepts of the Romans, as well as the theory behind concrete production.

Corporals Corner has produced a [video](https://www.youtube.com/watch?v=tOhAfaFboNU) on the actual process of creating “Roman” concrete, using more modern materials. Although he does follow the methods as set out by Vitruvius, it is important to note that Romans may not have even created concrete using the same methods and materials used in the video.