

I'm not robot!

A concrete mixer truck.

Composite construction material
This article is about the construction material. For other uses, see Concrete (disambiguation).
Not to be confused with cement, grout, mortar (masonry), or plaster.
A vast concrete structure - The Hoover Dam
Concrete is a composite material composed of fine and coarse aggregate bonded together with a fluid cement (cement paste) that hardens (cures) over time. Concrete is the second-most-used substance in the world after water,[1] and is the most widely used building material.[2] Its usage worldwide, ton for ton, is twice that of steel, wood, plastics, and aluminum combined.[3] Globally, the ready-mix concrete industry, the largest segment of the concrete market, is projected to exceed \$600 billion in revenue by 2025.[4] This widespread use results in a number of environmental impacts. Most notably, the production process for cement produces large volumes of greenhouse gas emissions, leading to net 8% of global emissions.[5][6] Other environmental concerns include widespread illegal sand mining, impacts on the surrounding environment such as increased surface runoff or urban heat island effect, and potential public health implications from toxic ingredients. Significant research and development is being done to try to reduce the emissions or make concrete a source of carbon sequestration, and increase recycled and secondary raw materials content into the mix to achieve a circular economy. Concrete is expected to be a key material for structures resilient to climate disasters,[7] as well as a solution to mitigate the pollution of other industries, capturing wastes such as coal fly ash or bauxite tailings and residue. Concrete being poured into rebar
When aggregate is mixed with dry Portland cement and water, the mixture forms a fluid slurry that is easily poured and molded into shape. The cement reacts with the water through a process called concrete hydration that hardens over several hours to form a hard matrix that binds the materials together into a durable stone-like material that has many uses.[8] This time allows for the placement of concrete in forms but also has a variety of other uses. Hydration process is exothermic, which means ambient temperature plays a role in how long it takes concrete to set. Often, additives (such as pozzolans or superplasticizers) are used to improve the physical properties of the wet mix, delay or accelerate the curing time, or otherwise change the finished material. Most concrete is poured with reinforcing materials (such as rebar) embedded to provide tensile strength, yielding reinforced concrete. In the past, lime based cement binders, such as lime putty, were often used but sometimes with other hydraulic cements, (water resistant) such as a calcium aluminate cement or with Portland cement to form Portland cement concrete (named for its visual resemblance to Portland stone).[9][10] Many other non-cementitious types of concrete exist with other methods of binding aggregate together, including asphalt concrete with a bitumen binder, which is frequently used for road surfaces, and polymer concretes that use polymers as a binder. Concrete is distinct from mortar. Whereas concrete is itself a building material, mortar is a bonding agent that typically holds bricks, tiles and other masonry units together.[11] Etymology[The word concrete comes from the Latin word "concretus" (meaning compact or condensed), [12] the perfect passive participle of "concrecere", from "con-" (together) and "crescere" (to grow). History Ancient times
Mayan concrete at the ruins of Uxmal is referenced in Incidents of Travel in the Yucatan by John L. Stephens. "The roof is flat and had been covered with cement". "The floors were cement, in some places hard, but, by long exposure, broken, and now crumbling under the feet." "But throughout the wall was solid, and consisting of large stones imbedded in mortar, almost as hard as rock." Small-scale production of concrete-like materials was pioneered by the Nabatean traders who occupied and controlled a series of oases and developed a small empire in the regions of southern Syria and northern Jordan from the 4th century BC. They discovered the advantages of hydraulic lime, with some self-cementing properties, by 700 BC. They built kilns to supply mortar for the construction of rubble masonry houses, concrete floors, and underground waterproof cisterns. They kept the cisterns secret as these enabled the Nabateans to thrive in the desert.[13] Some of these structures survive to this day.[13] Classical era
Exterior of the Roman Pantheon, finished 128 AD, the largest unreinforced concrete dome ever built in the world.[14] Interior of the Pantheon dome seen from beneath. The concrete for the coffered dome was laid on moulds, mounted on temporary scaffolding. Opus caementicium exposed in a characteristic Roman arch. In contrast to modern concrete structures, the concrete used in Roman buildings was usually covered with brick or stone. In the Ancient Egyptian and later Roman eras, builders discovered that adding volcanic ash to the mix allowed it to set underwater. Concrete floors were found in the royal palace of Thyrns, Greece, which dates roughly to 1400–1200 BC.[15][16] Lime mortars were used in Greece, Crete, and Cyprus in 800 BC. The Assyrian Jerwan Aqueduct (688 BC) made use of waterproof concrete.[17] Concrete was used for construction in many ancient structures.[18] The Romans used concrete extensively from 300 BC to 476 AD.[19] During the Roman Empire, Roman concrete (or opus caementicium) was made from quicklime, pozzolana and an aggregate of pumice. Its widespread use in many Roman structures, a key event in the history of architecture termed the Roman architectural revolution, freed Roman construction from the restrictions of stone and brick materials. It enabled revolutionary new designs in terms of both structural complexity and dimension.[20] The Colosseum in Rome was built largely of concrete, and the Pantheon has the world's largest unreinforced concrete dome.[21] Concrete, as the Romans knew it, was a new and revolutionary material. Laid in the shape of arches, vaults and domes, it quickly hardened into a rigid mass, free from any of the internal thrusts and strains that troubled the builders of similar structures in stone or brick.[22] Modern tests show that opus caementicium had as much compressive strength as modern Portland-cement concrete (ca. 200 kg/cm2 [20 MPa; 2,800 psi]).[23] However, due to the absence of reinforcement, tensile strength was far lower than modern reinforced concrete, and its mode of application also differed.[24] Modern structural concrete differs from Roman concrete in two important details. First, its mix consistency is fluid and homogeneous, allowing it to be pumped to forms rather than requiring hand-laying together with the placement of coarse aggregate, which means that concrete assemblies grow in tension, whereas Roman concrete could depend on the strength of the concrete bonding to resist tension.[25] The mixture of coarse aggregate and cementitious binder in concrete structures has been found to be due to its use of pyroclastic (volcanic) rock and ash, whereby the crystallization of strätlingite (a specific and procalcic calcium aluminosilicate hydrate)[26] and the coalescence of this and similar calcium-silicate-hydrate cementing binders helped give concrete a greater degree of fracture resistance even in seismically active environments.[27] Roman concrete is significantly more resistant to erosion by seawater than modern concrete; it used pyroclastic materials which react with hydrate to form Al-tobromerite crystals over time.[28][29] The widespread use of concrete in many Roman structures ensured that many survive to the present day. The Baths of Caracalla in Rome are just one example. Many Roman aqueducts and bridges, such as the magnificent Pont du Gard in southern France, have masonry cladding on a concrete core, as does the dome of the Pantheon. After the Roman Empire collapsed, use of concrete became rare until the technology was redeveloped in the mid-18th century. Worldwide, concrete has overtaken steel in tonnage of material used.[30] Middle Ages
After the Roman Empire, the use of burned lime and pozzolana was greatly reduced. Low kiln temperatures in the burning of lime, lack of pozzolana, and poor mixing all contributed to a decline in the quality of concrete and mortar. From the 11th century, the increased use of stone in church and castle construction led to an increased demand for mortar. Quality began to improve in the 12th century through better grinding and sieving. Medieval lime mortars and concretes were non-hydraulic and were used for binding masonry, "hearting" (binding rubble masonry cores) and foundations. Bartholomaeus Tylosius first printed the recipe for mortar in 1249 during the Crusades. The word "concrete" was first used in 1324, in the second volume of the 13th-century French treatise *Le Livre des Propriétés des Choses*, written by Bartholomaeus Tylosius. The Cambridge Dictionary of English defines the word as "the process of making concrete". 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