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History of Concrete

A Timeline

- 12,000,000 BC** Reactions between limestone and oil shale during spontaneous combustion occurred in the region now known as Israel to form a natural deposit of cement compounds. The deposits were characterized by Israeli geologists in the 1960s and 70s.
- 3000 BC**
- Egyptians used mud mixed with straw to bind dried bricks. They also used gypsum mortars and mortars of lime in the pyramids.
- Chinese used cementitious materials to hold bamboo together in their boats and in the Great Wall.
- 800 BC** Greeks, Crete and Cyprus used lime mortars which were much harder than later Roman mortars.
- 300 BC** Babylonians and Assyrians used bitumen to bind stones and bricks.
- 300 BC - 476 CE** Romans used pozzolana cement from Pozzuoli, Italy near Mt. Vesuvius to build the Appian Way, Roman baths, the Coliseum and Pantheon in Rome, and the Pont du Gard aqueduct in south France. They used lime as a cementitious material. Pliny reported a mortar mixture of one-part lime to 4 parts sand. Vitruvius reported a 2 parts pozzolana to one-part lime. Animal fat, milk, and blood were used as admixtures (substances added to cement to increase the properties.) These structures exist today!
- 1200 - 1500** In the Middle Ages the quality of cementing materials deteriorated. The use of burning lime and pozzolan (admixture) was lost but reintroduced in the 1300s.



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| 1678 | Joseph Moxon wrote about a hidden fire in heated lime that appears upon the addition of water. |
| 1779 | Bry Higgins was issued a patent for hydraulic cement (stucco) for exterior plastering use. |
| 1780 | Bry Higgins published "Experiments and Observations Made with the View of Improving the Art of Composing and Applying Calcereous Cements and of Preparing Quicklime." |
| 1793 | John Smeaton found that the calcination of limestone containing clay gave a lime which hardened under water (hydraulic lime). He used hydraulic lime to rebuild Eddystone Lighthouse in Cornwall, England which he had been commissioned to build in 1756 but had to first invent a material that would not be affected by water. He wrote a book about his work. |
| 1796 | James Parker from England patented a natural hydraulic cement by calcining nodules of impure limestone containing clay, called Parker's Cement or Roman Cement. |
| 1802 | In France, a similar Roman Cement process was used. |
| 1810 | Edgar Dobbs received a patent for hydraulic mortars, stucco, and plaster, although they were of poor quality due to lack of kiln precautions. |
| 1812 -1813 | Louis Vicat of France prepared artificial hydraulic lime by calcining synthetic mixtures of limestone and clay. |
| 1818 | Maurice St. Leger was issued patents for hydraulic cement. Natural Cement was produced in the USA. Natural cement is limestone that naturally has the appropriate amounts of clay to make the same type of concrete as John Smeaton discovered. |
| 1820 - 1821 | John Tickell and Abraham Chambers were issued more hydraulic cement patents. |
| 1822 | James Frost of England prepared artificial hydraulic lime like Vicat's and called it British Cement. |



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- 1824** Joseph Aspdin of England invented Portland cement by burning finely ground chalk with finely divided clay in a lime kiln until carbon dioxide was driven off. The sintered product was then ground, and he called it Portland cement named after the high-quality building stones quarried at Portland, England.
- 1828** I. K. Brunel is credited with the first engineering application of Portland cement, which was used to fill a breach in the Thames Tunnel.
- 1830** The first production of lime and hydraulic cement took place in Canada.
- 1836** The first systematic tests of tensile and compressive strength took place in Germany.
- 1843** J. M. Mauder, Son & Co. were licensed to produce patented Portland cement.
- 1845** Isaac Johnson claims to have burned the raw materials of Portland cement to clinkering temperatures.
- 1849** Pettenkofer & Fuchs performed the first accurate chemical analysis of Portland cement.
- 1860** The beginning of the era of Portland cements of modern composition.
- 1862** Blake Stonebreaker of England introduced the jaw breakers to crush clinkers.
- 1867** Joseph Monier of France reinforced William Wand's (USA) flower pots with wire ushering in the idea of iron reinforcing bars (re-bar).
- 1871** David Saylor was issued the first American patent for Portland cement. He showed the importance of true clinkering.
- 1880** J. Grant of England show the importance of using the hardest and densest portions of the clinker. Key ingredients were being chemically analyzed.
- 1886** The first rotary kiln was introduced in England to replace the vertical shaft kilns.
- 1887** Henri Le Chatelier of France established oxide ratios to prepare the proper



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amount of lime to produce Portland cement. He named the components: Alite (tricalcium silicate), Belite (dicalcium silicate), and Celite (tetracalcium aluminoferrite). He proposed that hardening is caused by the formation of crystalline products of the reaction between cement and water.

- 1889** The first concrete reinforced bridge is built.
- 1890** The addition of gypsum when grinding clinker to act as a retardant to the setting of concrete was introduced in the USA. Vertical shaft kilns were replaced with rotary kilns and ball mills were used for grinding cement.
- 1891** George Bartholomew placed the first concrete street in the USA in Bellefontaine, OH. It exists today!
- 1893** William Michaelis claimed that hydrated metasilicates form a gelatinous mass (gel) that dehydrates over time to harden.
- 1900** Basic cement tests were standardized.
- 1903** The first concrete high rise was built in Cincinnati, OH.
- 1908** Thomas Edison built cheap, cozy concrete houses in Union, NJ. They exist today!
- 1909** Thomas Edison was issued a patent for rotary kilns.
- 1929** Dr. Linus Pauling of the USA formulated a set of principles for the structures of complex silicates.
- 1930** Air entraining agents were introduced to improve concrete's resistance to freeze/thaw damage.
- 1936** The first major concrete dams, Hoover Dam and Grand Coulee Dam, were built. They exist today!
- 1956** U.S. Congress annexed the Federal Interstate Highway Act.
- 1967** First concrete domed sport structure, the Assembly Hall, was constructed at The University of Illinois, at Urbana-Champaign.
- 1970s** Fiber reinforcement in concrete was introduced.



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1975	CN Tower in Toronto, Canada, the tallest slip-form building, was constructed. Water Tower Place in Chicago, Illinois, the tallest building was constructed.
1980s	Superplasticizers were introduced as admixtures.
1985	Silica fume was introduced as a pozzolanic additive. The "highest strength" concrete was used in building the Union Plaza constructed in Seattle, Washington.
1990	311S Wacker and Two Prudential Plaza in Chicago sets new height record at 920 ft.
1992	The tallest reinforced concrete building in the world was constructed at 311 S. Wacker Dr., Chicago, Illinois.
1996	Petronas Twin Towers, 1476 ft.
1999	HTC, originally a Swedish company, introduced concrete polishing to the United States. The first installation in the US was a 40,000-square-foot warehouse floor for the Bellagio in Las Vegas. The popularity of polished concrete has soared in just the few short years it has been around, it is now being used in retail locations and even residential homes.
Early 2000s	Portland-Limestone cement to reduce carbon footprint Concrete structures formed with 3D Printers Fiber-reinforced concrete Accelerated precast concrete construction Transparent concrete introduced in modern architecture

Sources:

<http://matse1.matse.illinois.edu/concrete/hist.html>

<http://www.concretenetwork.com/concrete-history/>