The 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 & Cyprus	Used lime mortars which were much harder than later Roman mortars.

300 BC

Babylonians & As Syrians	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 1 part lime to 4 parts sand. Vitruvius reported a 2 parts pozzolana to 1 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

The Middle Ages — The quality of cementing materials deteriorated. The use of burning lime and pozzolan (admixture) was lost, but reintroduced in the 1300s.

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.

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 & Fuches 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 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.

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/