السعودية للخرسانة الجاهزة
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Features

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CMA Tower Raft Foundation

Photo © Peter Bogaczewicz

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In November 2011, Saudi Ready mix completed one and a half day continuous ready-mixed concrete for the raft foundation of the Capital Market Authority (CMA) Tower located at the King Abdullah Financial District (KAFD) in Riyadh. It was one of the largest concrete pours to take place in KSA.

Saudi Ready mix supplied 11,700m3 of concrete in a continuous flow of mobile truck mixers, arriving on-site at an average of one every 90 seconds. The company used six of its plants located in different areas in Riyadh, including it's on- site factory at the King Abdullah Financial District project, in total 150 truck mixers were mobilized. Although the estimated time to execute the task was 42 hours, it was completed smoothly and in only 36 hours.

The Challenges

- Complexity of the mix and the special materials that had to be used.
- The temperature of concrete for the whole quantities below 26 °C.
- The logistics and scheduling of pouring from 12 batching plants in different locations in the very crowded city of Riyadh.
- Monitoring and checking all mixers with followability 600±100 MM and temperature below 26°C by Five check points from ACTS laboratory.
- The maximum hydration heat temperature was specified to be notmore than 70°C.

Preparations and precautions

- The huge pour was preceded by substantial preparations. Special precautions were taken to avoid cracks and cold joints. The concrete mix design was reviewed and tuned properly to permit fast placing, pumping and flow.
- Cement was partially substituted with imported GGBFS and silica fume to reduce heat of hydration and for smooth workability.
- Several sample mixes were cast for verification.

• Preparations included sun shades and fog sprays to limit solar radiation and heat, and to increase humidity and cool down steel, formwork and the environment for workers.

• On-site nine pumps (plus standby) were used for pouring concrete and a sequence of pumping was developed to avoid cold joints.

• Saudi Ready mix used a poly carboxylate admixture to achieve the high workability of the concrete.

• Ice and chilled water were used to cool the concrete through- out the whole pour which involved six ice plants and six chillers.

• Curing system and isolation of the raft were implemented to avoid differential temperatures. Polystyrene sheets were used to avoid thermal shock. The thickness of the raft foundation reaches 5m in some areas and the heat of hydration of concrete was monitored using stations of thermocouples distributed over the surface of the raft, at different depths (surface, middle, bottom and in between).

12 Months in Advance

In order to meet with the strict technical requirements and quality standards of this massive project, keeping in mind all the design, testing and delivery challenges, we started working on this pour almost 12 months prior to the day of pouring.

Technical department in Saudi Readymix and in order to meet the optimum concrete mix design running several tests of mockups to simulate the raft foundation and to measure the expected heat of hydration to ensure its compliance with the project requirements.

We are proud to high- light that the ingredients used for this special concrete were mostly produced from recycled materials, which makes the final product **'green'**.

Concrete Throughout the Ages

Reinforced Concrete

The idea of reinforced concrete was first mentioned in the "Encyclopedia of cottage farm and village architecture" in the 1830s which suggested that a lattice of iron tie rods could be embedded in concrete to form a roof.

As early as 1830 the idea of reinforced concrete was first mentioned in the "Encyclopedia of cottage farm and village architecture" which suggested that a lattice of iron tie rods could be embedded in concrete to form a roof. In 1848 the world's first reinforced concrete boat was built in France by Jean-Louis Lambot. He plastered a layer of fine concrete or mortar over a network of iron rods and mesh to produce what is now known as Ferro-cement. It created quite a sensation when shown at the Paris exhibition of 1855.

The man generally credited with the invention of reinforced is a little-known Newcastle builder, William Wilkinson. In 1854 he took out a patent for embedding a network of flat iron bars or wire rope in floors and beams of flat or arched concrete. This appears to be the first use of reinforced concrete as a composite structure as opposed to the French idea of metalwork encased in concrete. Wilkinson has thus come to be regarded as the first person to understand the basic structural principles of reinforced concrete.

One of the earliest uses of reinforced concrete was in a pair of cottages built in 1866 by Joseph Tall at Bexleyheath in Kent. A lattice of hoop iron was embedded in the original flat roofs and he used his patent method of formwork for casting the monolithic walls.

A pair of cottages built in 1866 by Joseph Tall

1848 Jean-Louis Lambot reinforced concrete boat

The first widespread use of Portland cement concrete in buildings occurred under the direction of the French builder, Francois Coignet. He built several large houses of concrete in England and France in the period 1850-1880, at first using iron rods in the floors to keep the walls from spreading, but later using the rods as flexural elements.

The fire-resisting quality concrete was soon realized and became a major selling point, particularly for industrial buildings. At first it was used chiefly for reinforced concrete floors, especially in cotton and woolen mills where, in the squalid working conditions that prevailed, the incidence of fire was high.

The first landmark building in reinforced concrete was built by an American mechanical engineer, William E. Ward, in 1871-1875. The house stands today in Port Chester, NY. It is well-known because of the diligence with which Mr. Ward conducted all of his business, researching and documenting everything. He desired a concrete house because his wife was terribly afraid of fire and commissioned architect Robert Mook for the design in 1870. Like Coignet's buildings, it was made to resemble masonry to be socially acceptable. Mr. Ward handled all technical and construction issues himself, conducting long-term load tests and other experiments. He used the French word for concrete, beton, and in 1883 delivered a paper on the house to the American Society of Mechanical Engineers entitled "Beton in Combination with Iron As a Building Material." His audience, by definition, was far more interested in the unique water supply and heating systems, which he had designed, than in reinforced concrete.

William E. Ward house

In the 1870s Ernest L. Ransome was managing a successful stone company (producing concrete blocks as artificial stone) in San Francisco. He first used reinforcing in 1877, and in 1884 he patented a system using twisted square rods to help the development of bond between the concrete and reinforcing). His largest work of the time was the Leland Stanford, Jr. Museum at Stanford University, the first building to use exposed aggregate. He was also responsible for several industrial buildings in New Jersey and Pennsylvania, such as the 1903-1904 construction of the Kelly and Jones Machine Shop in Greensburg, Pennsylvania.

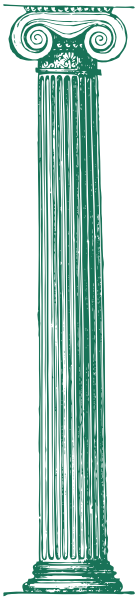
In 1879 G. A. Wayss, a German builder, bought the patent rights to Monier's system and pioneered reinforced concrete construction in Germany and Austria, promoting the Wayss-Monier system). (Many of these buildings were built in France as well).

The late nineteenth century saw the parallel development of reinforced concrete frame construction by G. A. Wayss in Germany/ Austria, by Ernest L. Ransome in the United States, and by Francois Hennebique in France.

In Europe, Francois Hennebique, a successful mason turned contractor in Paris, had started to build reinforced concrete houses in the late 1870s.
He took out patents in France and Belgium for the Hennebique system of construction and proceeded to establish an empire of franchises in major cities. He promoted the material by holding conferences and developing standards within his own company network. Most of his buildings (like Ransome's) were industrial.

When the far-flung company was at its' peak, Hennebique was fulfilling more than 1500 contracts annually! More than any other individual he was responsible for the rapid growth of reinforced concrete construction in Europe.

Leland Stanford, Jr. Museum, Stanford University



Concrete Through The Ages; British Cement Association