



Ultra-High Performance Concrete

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Concrete that acts like steel

One of the most exciting recent developments in concrete mix technology is the advent and growth in popularity of Ultra High Performance Concrete (UHPC). UHPC is concrete that is designed to act like steel in regards to strength-to-weight ratio, while still giving the benefits over steel associated with concrete such as corrosion resistance, versatility, and lower maintenance costs.

What's different about UHPC?

UHPC mix designs are crafted with very specific performance related goals in mind.

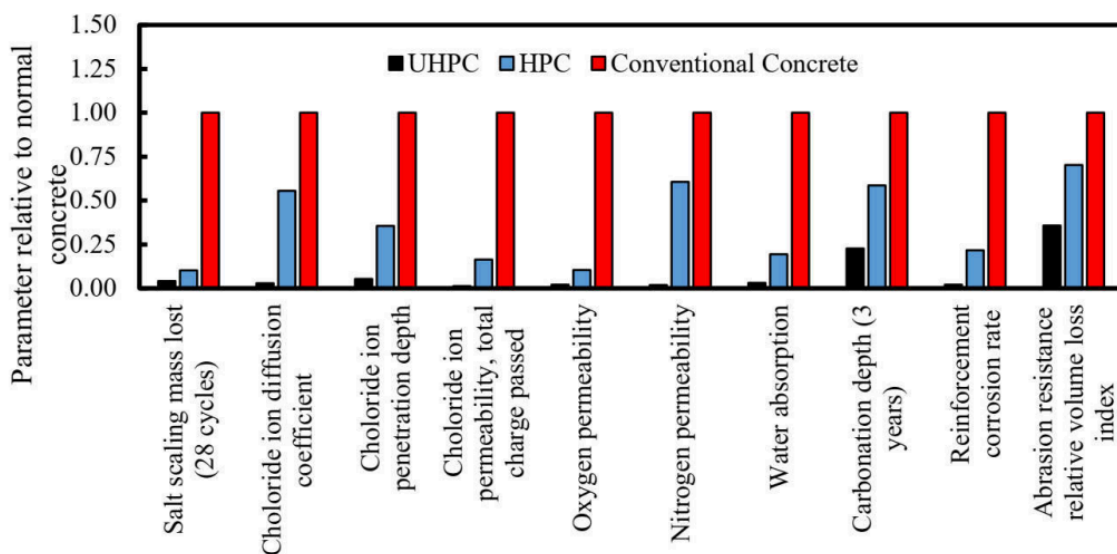
Compressive Strength: Definitions vary between 17,000 and 22,000psi on the low side, to 60,000psi on the very high end, although most applications run between 25,000-30,000psi. That's about 7 times stronger than the average conventional mix design!

Flexural Strength: 2200-5800psi. Most conventional mixes would only register around 500psi in flexural strength.

Abrasion and Wear Resistance: UHPC mixes are designed with spectacular abrasion resistance in mind. Most UHPC mixes will be more than 10x more resistant to wear than a conventional mix design.

Freeze-Thaw Resistance: UHPC are completely and utterly resistant to intrusion of liquids, meaning there is no water saturation inside the concrete and no possibility of freeze-thaw damage. Tests on UHPC have reported a 100% mass retention in a lab after 300 freeze-thaw cycles.

Corrosion Resistance: When used to replace steel, UHPC is obviously vastly superior in corrosion resistance. Even compared to conventional mixes with steel reinforcement, UHPC is 100x more resistant to corrosion, again because of the extreme watertightness. In a US Army Corps of Engineers test, UHPC with only 3/8" cover over rebar was placed in an oceanic tidal zone. After 21 years, there has been ZERO corrosion associated with that concrete. Due to the impermeability, chlorides have been unable to penetrate the concrete to the depth of the rebar, even in those extreme conditions.



How is UHPC made?

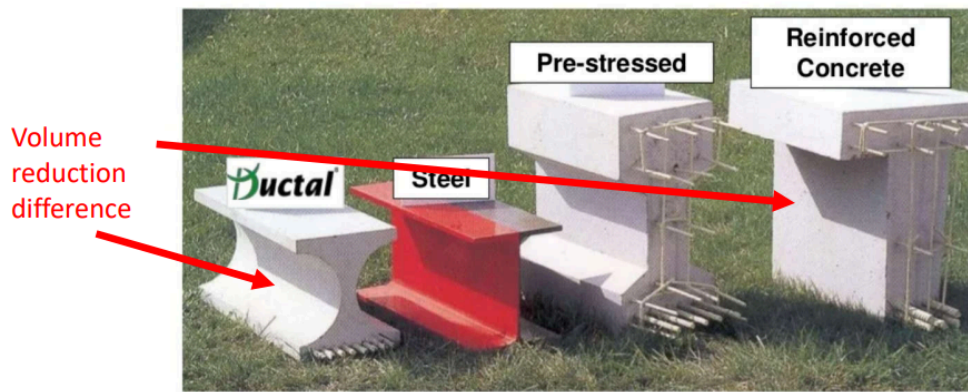
Although early UHPC elements were cast from bagged mixes or at precast plants, it's becoming more prevalent to produce UHPC from a ready mix plant. UHPC mixes utilize a very high amount of cementitious materials (1600-2000lbs) including silica fume. They also often include a ground quartz flour. Water contents are EXTREMELY low, with w/c ratios sub .20, normally around .16.

Often UHPC includes steel fibers or synthetic macrofibers, a boatload of superplasticizer and no air entrainment.



What is UHPC used for?

UHPC is most commonly used in bridge deck overlays and connections between precast members. It's also used in critical areas of high rise structures. Precast UHPC bridge beams are also becoming more common, and UHPC is being used in some incredible architectural precast building facades. The applications for UHPC continue to grow as designers and contractors look to leverage the unique properties of the material.



	<u>Mass (weight) of Beams</u>			
kg/lineal meter	140	112	467	530
lbs/lineal ft.	94	75	313	355

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What are some of the drawbacks of UHPC?

The major impediment to the use of UHPC is simply the cost. UHPC can cost 6x or more than conventional concrete. This is mostly due to the high material costs but also the challenge to successfully mix, control, and place this material. UHPC takes a VERY long time to mix, severely limiting placement speeds and pour sizes.

As one might imagine with such a low water content, UHPC can be very difficult to finish. The highly viscous material often flows and consolidates easily but is sticky and prone to drying and autogenous shrinkage.

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Hahn Ready Mix

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