

# Strength of High Reactivity Metakaolin Concrete

**DESIGNERS OF CONCRETE STRUCTURES** are often concerned with achieving high strengths. HRM concrete allows designers substantial flexibility in determining how high strengths are to be achieved.

**Compressive strength.** Strength gain contributed by portland cement occurs rapidly at early ages up to about seven days, after which the rate of strength gain slows markedly. Strength contribution of High Reactivity Metakaolin in concrete occurs through a chemical reaction of a purified calcined kaolinite with calcium hydroxide generated by the hydration of portland cement. This is called pozzolanic activity.

HRM concrete can be designed for equivalent strengths to conventional concrete, or to the high-early strengths associated with silica fume modified concrete. The pozzolanic reaction of HRM begins immediately (thus the term high reactivity) and continues to react over time to produce significantly higher strengths than can be achieved with conventional concrete at all ages.

**Flexural Strength.** In general, a relationship exists between the compressive and flexural strengths of concrete. Conventional concrete that has a higher

compressive strength will have a correspondingly higher flexural strength. This generally holds true for HRM concrete.

**High Strength Concrete.** When high strength is specified (typically above 7,000 psi), the strength benefit of additional portland cement can diminish. Typically added to concrete at rates of 5% to 10% by weight of portland cement, HRM addition consistently results in higher strengths than an equal amount of portland cement.

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*High Reactivity Metakaolin (HRM) concrete can be designed to achieve strength levels unattainable with conventional concrete containing only portland cement or portland cement and fly ash or slag blends.*  
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**Conventional Strength Concrete.** A variety of concrete performance conditions, including field performance and long term durability, can arise where the portland cement content in a concrete mix needs to be reduced, but where the strength performance of conventional concrete must be maintained. Moderate to high replacement rates of portland cement with HRM can be utilized to achieve concrete with comparable strengths to conventional concrete.

**Other Advantages.** The addition of HRM to concrete requires less water demand than silica fume; it is also less expensive and provides an aesthetically pleasing lighter color.

