

Figure 1
Cores representing concrete with low and expected compressive strength, respectively

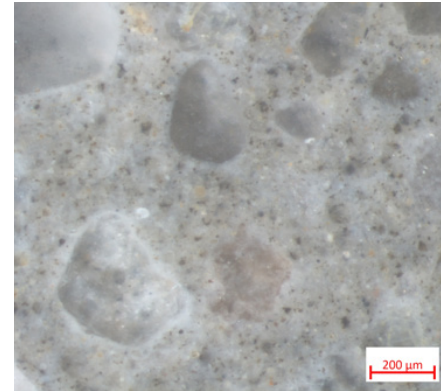
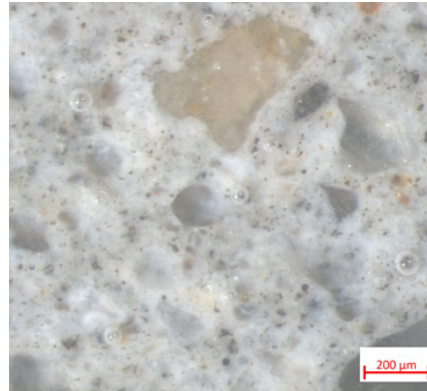


Figure 2
Cut, polished surface of each core as viewed under the stereomicroscope. Notice that, overall, the paste in the low strength core on the left is lighter in color compared to the darker colored paste in the core with expected strength on the right. On a micro scale, some areas in the low strength concrete are almost white in color compared to other areas that are gray.

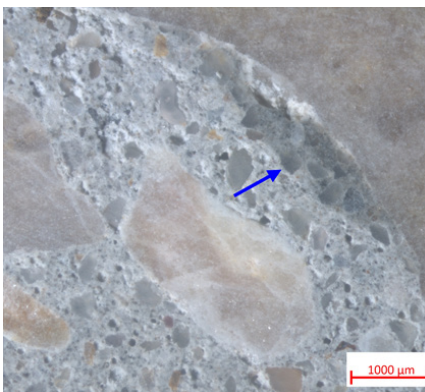
Low Compressive Strength

Determining the cause of low compressive strength of concrete

A common reason for a concrete petrographic examination is to determine the cause of low compressive strength. There are many causes of low concrete strength that can be diagnosed by examining a sample using ASTM C856. These include incorrect mixture proportions such as fly ash overdose, high water-to-cementitious content, and high air content. One example that was diagnosed as retempering after an examination is described below. The core on the left in Figure 1 was reported to have low strength and the core on the right had the expected compressive strength.

Observations indicating retempering with water has occurred

Under the microscope, it was observed that the paste in the low strength core was lighter in color compared to the core that met compressive strength requirements (Figure 2), indicating a relatively higher water-cement ratio (w/c). Many factors influence paste color (w/c, pozzolans, curing, etc.). In comparing two concrete samples of the same mix design, generally a lighter colored paste indicates a higher w/c compared to darker colored paste. When concrete is retempered, the paste sometimes appears to be inhomogeneous on a microscale. Some areas are lighter in color and softer and other areas are darker and harder (Figure 2).



Veneers were observed adjacent to coarse aggregate particles in the low strength core (Figure 3). Veneers are a characteristic that commonly develop in aggregate concavities when water is added to a concrete mix sometime after initial batching. Veneers are darker, harder paste or mortar that represent the original concrete as batched. When water in excess of the design is added after initial batching, this results in an elevated w/c of the bulk concrete. A petrographer can observe the darker veneers compared to the lighter colored, softer bulk concrete indicating a retempering procedure has occurred. The elevated w/c can result in low compressive strength.

Figure 3
Cut, polished surface of the low strength core viewed under the stereomicroscope. A blue arrow points to a discontinuous veneer of darker mortar adjacent to a coarse aggregate particle. Notice how the bulk paste is lighter in color compared to the paste in the veneer.