

The Physical Testing Laboratory of CMC provides the following services:

- Compressive, flexural, tensile strength, and modulus of rupture of construction materials
- Freeze-thaw durability and resonance frequency tests of concrete samples
- Accelerated weathering tests (wetting-drying, freezing-thawing, and heating-cooling cycles)
- Density, Absorption, Specific Gravity, and Volume of Permeable Voids
- Length change measurements for:
  - Drying Shrinkage Tests
  - Alkali-Silica Reactivity Tests
  - Alkali-Carbonate Reactivity Tests
  - Moisture Expansion Tests

**Strength and Freeze-Thaw Durability** - Measurements of compressive strengths of concrete cylinders, cores, masonry blocks, prisms, mortar cubes, bricks, dimension stones, and other materials are the regular services of various local testing laboratories in Western Pennsylvania. CMC, on the other hand, has highly specialized laboratories for characterization, quality assurance, and forensic investigation of construction materials through microscopy and chemical analysis. Occasionally, various strengths and freeze-thaw durability tests, when required for a particular project are done in collaboration with the local laboratories. In such cases, the sample preparations steps required for these tests are done by the CMC technicians. In a comprehensive failure investigation, microscopical examinations and chemical analyses are often supplemented with strength and durability tests. Results obtained from strength and durability tests, if unusual or questionable, are often verified by the microscopical and chemical methods. ASTM C 39, C 42, C 67, C 109, C 78, C 99, C 170, C 293, and C 880 are the various strength tests for mortar, concrete, dimension stone, and brick, and C 666 is the freeze-thaw durability test for concrete that can be provided upon request.

**Alkali-Silica Reactivity** - ASTM C 227 (mortar bar test), ASTM C 1260 (mortar bar test), and ASTM C 1293 (hardened concrete test) are the three ASTM tests related to expansion of laboratory prepared mortar bars or field concrete samples due to alkali-silica reactivity in which the prism or cylindrical samples are measured for the change in length by a digital length comparator. Length change measurements are done at various intervals since molding or sample preparation, and during the test period the samples are kept in water (in C 1293 test), above water in a sealed container (in C 227 test), or in a water bath in water and sodium hydroxide solutions at 80 degrees centigrade (for C 1260 test). Length change measurements are plotted for the percent expansion (compared to a reference bar and reference day) at various days since in the test condition.



**Alkali-Carbonate Reactivity** - There are two tests on alkali-carbonate reactivity related to length change measurements—one involves measurements of change of length of potentially reactive aggregate prisms in alkali hydroxide solution (rock cylinder test, ASTM C 586) and the other involves length change measurements of hardened concrete containing potentially alkali-carbonate reactive carbonate aggregates (ASTM C 1105 test). The rock cylinder test is done by using a special small length comparator shown here, whereas the ASTM C 1105 test is done by using the digital length comparator used for ASR tests.



**Shrinkage and Other Moisture Expansion Tests** - Measurement of drying shrinkage of concrete and mortar prisms by ASTM C 157 is a common length change measurement done by using the digital length comparators. Concrete or mortar prisms are casts in stainless steel molds, cured in air, and then measured at various time periods. Length change measurements of various expansive grout mixtures are done by preparing the mixtures in prism molds, curing for a period, and then measuring the length change while the bars are completely immersed in water.