



## Restrained-Shrinkage Testing (ASTM C 1581 / C 1581 M)

### Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained-Shrinkage

#### What is Restrained-Shrinkage testing?

Restrained-shrinkage testing is performed to assess the cracking potential of concrete when its shrinkage is restricted.

#### How is the Cracking Potential of Concrete Evaluated?

Concrete is placed in a circular mold around an instrumented steel ring and, shortly after it hardens, permitted to dry from only the circumferential surface. The steel ring restrains the shrinkage of the concrete, invariably, causing cracking to occur. The age at cracking and the rate of tensile stress development can be determined from the measured compressive strains and are indicators of the material's resistance to cracking under restrained shrinkage.

#### What are the concerns about Cracking on durability and serviceability?

Cracking of concrete is of critical concern because cracks permit a faster ingress of deleterious materials leading to premature deterioration and increased maintenance costs in order to maintain the design service life of a structure.

#### Where should I be concerned about Restrained-Shrinkage?

Cracking occurs when concrete shrinkage is restrained such that the induced tensile stresses exceed the tensile strength of the concrete. In slabs-on-ground, restraint is typically due to friction with the subbase or subgrade. Heavy amounts of steel reinforcement such as that present in bridges, water tanks and other heavily-reinforced concrete structures provide a significant amount of restraint making these structures more prone to cracking.

#### How is this standard used in the industry?

This test is used to develop concrete mixtures with high resistance to cracking under restrained shrinkage for use in heavily reinforced concrete structures, particularly bridges and liquid containment structures. The cracking potential of concrete can be minimized significantly by using either conventional shrinkage-reducing admixtures or a crack-reducing admixture.

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