

PERFORMANCE-BASED SPECIFICATIONS FOR FIBER-REINFORCED CONCRETE (FRC)

What is the difference between ARS (from C1399) and R_{e3} (from C1609)?

The addition of macro fibers to the concrete mix provides different residual strength values. This parameter shows how much load (or stress) can be provided after the concrete has cracked.

When flexural tests are performed according to ASTM C1609, the parameter R_{e3} is used to characterize the flexural toughness of fiber-reinforced concrete.

R_{e3} (or RT_{150} in the current C1609 version) is used to characterize the flexural toughness of fiber-reinforced concrete. This parameter is called “equivalent flexural strength ratio” and is expressed as a percentage. This indirectly shows the ratio of the flexural loads that can be carried by the fibers once the section is cracked and compared to the peak load (or modulus of rupture). The value of R_{e3} can be calculated from either the existing steel reinforcement or the details of the loads and sub-base properties. It should also be noted that the value of R_{e3} can vary between concrete mixes and the determination of the appropriate fiber dosage should always be tested with known materials and conditions. Once established, an example specification may read: FRC design shall provide a minimum R_{e3} value of 35%; For this example, a TUF-STRAND SF dosage rate of 5 lb/yd³ (3 kg/m³) would be used based on internal test results.

While both ASTM C1609 and C1399 measure the load to deflection response in a post-crack state, these two tests can yield different results due to the configuration of the testing method. C1609, due to its more complicated equipment requirements, can be more expensive and difficult to conduct but the results are typically more accurate and conservative towards establishing a required fiber dosage by design. C1399 is an easier and less expensive test and more laboratories can conduct it, therefore, ARS is also acceptable and is currently used in many specifications. It is the responsibility of the design professional to determine which test method to specify and determine the appropriate spreadsheets and materials once R_{e3} or ARS values have been determined.

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