

What is Flexural Strength in Concrete?

Flexural strength of concrete is a measure of its ability to resist bending and is commonly referred to as the modulus of rupture. It represents the tensile stress at failure of a concrete beam subjected to bending. Because concrete is weak in direct tension, flexural strength provides an indirect indicator of tensile performance under loading conditions similar to slabs and pavements.

Why Test Flexural Strength?

Flexural strength is tested because many concrete elements such as slabs on grade, pavements and industrial floors are governed by bending rather than compression. Owners often specify flexural strength when crack control, load carrying capacity and performance under wheel loads are critical. It is frequently used for acceptance and quality control in pavement construction where bending behavior is more relevant than compressive strength.

How is Flexural Strength Measured?

Flexural Strength on concrete is measured in accordance with CSA A23.2-8C, Flexural Strength of Concrete by Third-Point Loading. Concrete is cast into prisms and loaded until failure.

How Flexural Strength is Used?

Flexural strength is used in pavement and slab design to estimate allowable loads, joint spacing and slab thickness. It may also be used to compare mix designs or monitor production consistency when it is a specified performance parameter. While correlations to compressive strength exist, flexural strength should only be used directly for design or acceptance when it is explicitly specified and appropriate for the structural application.

Problems and Limitations with Flexural Strength?

Flexural strength testing exhibits higher variability than compressive strength testing. Results are highly sensitive to specimen preparation, curing surface condition, beam geometry and testing alignment. Small differences in casting handling or testing setup can significantly influence results. Because of this variability, flexural strength is less reliable as a general strength indicator and is not recommended as a substitute for compressive strength except in applications where bending performance clearly governs behavior.

Three Rules to Consider:

1. Ensure testing is performed in accordance with CSA A23.2-8C or as required.
2. Ensure proper beam preparation, curing, and alignment during testing
3. Confirm results with additional tests if variability is high

References

1. CSA A23.1 A23.2 2024. *Concrete materials and methods of concrete construction Test methods and standard practices for concrete.* CSA Group
2. *Design and Control of Concrete Mixtures.* 9th Edition. Cement Association of Canada
3. *How Should Strength be Measured for Concrete Paving?* Richard C. Meininger, NRMCA TIL 420, and Data Summary, NRMCA TIL 451, NRMCA, Silver Spring, MD.
4. *Concrete Strength Testing*, Peggy Carrasquillo, Chapter 14, ASTM STP 169C, *Significance of Tests and Properties of Concrete and Concrete-Making Materials*, American Society for Testing and Materials, West Conshohocken, PA.
5. "Studies of Flexural Strength of Concrete, Part 3, Effects of Variations in Testing Procedures," Stanton Walker and D. L. Bloem, NRMCA Publication No. 75, NRMCA, Silver Spring, MD.

6. *Variation of Laboratory Concrete Flexural Strength Tests*, W. Charles Greer, Jr., ASTM Cement, Concrete and Aggregates, Winter, 1983, American Society for Testing and Materials, West Conshohocken, PA.
7. "Concrete Mixture Evaluation and Acceptance for Air Field Pavements" Richard C. Meininger and Norm Nelson, NRMCA Publication 178, September 1991, NRMCA, Silver Spring, MD.
8. *Compression vs. Flexural Strength for Quality Control of Pavements*, Steve Kosmatka, CTT PL 854, 1985, Portland Cement Association, Skokie, IL.
9. *Time to Rein in the Flexure Test*, Orrin Riley, ACI Concrete International, August, 1994, American Concrete Institute, Farmington Hills, MI.

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