



# FLEXURAL STRENGTH OF CONCRETE

## WHAT IS FLEXURAL STRENGTH?

It is the ability of a beam or slab to resist failure in bending. It is measured by loading unreinforced 150x150 mm concrete beams with a span three times the depth (usually 450mm). The flexural strength is expressed as "Modulus of Rupture" (MR) in MPa. Flexural Strength is about 12 to 20% of compressive strength. However, the best correlation for specific materials is obtained by laboratory tests.

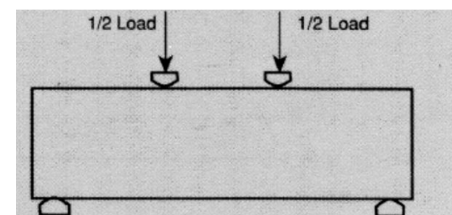
## WHY TEST FLEXURAL STRENGTH?

Designers of pavements use a theory based on flexural strength. Therefore, laboratory mix design based on flexure may be required, or a cement content may be selected from past experience to yield the needed design MR. Some also use MR for field control and acceptance of pavements. Very few use flexural testing for structural concrete. Agencies not using flexural strength for field control generally find the use of compressive strength convenient and reliable to judge the quality of the concrete as delivered.

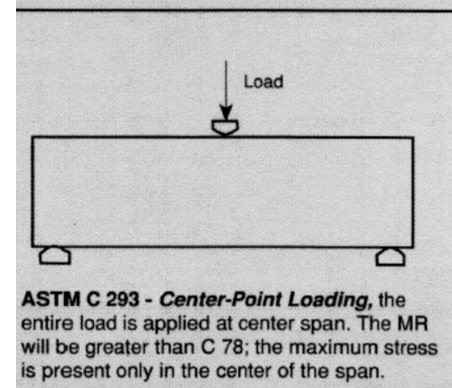
## HOW TO USE FLEXURAL STRENGTH:

Beam specimens must be properly made in the field. Consolidate by vibration in accordance with CSA A23.23C and tap sides to release bubbles. For higher slump, after rodding, tap the molds to release bubbles and spade along the sides to consolidate. Never allow the beam surfaces to dry at any time. Immerse in saturated lime water for at least 20 hours before testing.

Specifications and investigation of apparent low strengths should take into account the higher variability of flexural strength results. Standard deviation for projects with good control range from about 0.30.5 MPa. Values over 0.7 MPa indicate testing problems, and there is a high likelihood that testing problems, or moisture differences within a beam, will cause low strength.



**ASTM C 78 - Third - Point Loading**, half the load is applied at each third of the span length. MR so measured is lower than by C 293. Maximum stress is present over the center 1/3.



**ASTM C 293 - Center-Point Loading**, the entire load is applied at center span. The MR will be greater than C 78; the maximum stress is present only in the center of the span.



Where a correlation between flexural and compressive strength has been established, core strengths by CSA A23.2-14C can be used for compressive strength to check it against the desired value using the CSA 85 percent criteria. It is impractical to saw beams from a slab for flexural testing. Sawing beams will greatly reduce measures flexural strength and should not be done. Some use has been made of measuring indirect tensile strength of cores by CSA A23.2-13C, but experience is lacking on how to apply the data.

Another procedure for in-place strength investigation uses compressive strength of cores calibrated by comparison with acceptable placements on either side of the concrete in question.

## WHAT ARE THE PROBLEMS WITH FLEXURE?

Flexural tests are extremely sensitive to specimen preparation, handling, and curing procedure. Beam specimens are very heavy, and allowing a beam to dry will yield lower strengths. Beams must be cured in a standard manner, and tested while wet. A short period of drying can produce a sharp drop in flexural strength.

The concrete industry and inspection agencies are much more familiar with traditional cylinder compression tests for control and acceptance of concrete. Flexure can be used for design purposes, but the corresponding compressive strength should be used to and accept the concrete. Any time trial batches are made, both flexural and compressive tests should be made so that a correlation can be developed for field control.