"How Did You Do That?"
Concrete Slump

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In 1992, the members of SEAOSC (So. Calif.) were asked to submit short technical papers of interest to Structural Engineers for their monthly newsletter. These papers were to be based upon some of their more interesting and practical job experiences. Three of these short papers on concrete fundamentals are being reproduced as part of a series in "STRUCTURE" magazine. Watch for articles on Concrete Shrinkage and Concrete Curing in future issues.

This installment of *From Experience* provides a limited discussion of concrete slump, and is more in the nature of a review of fundamentals. Many books have been written on the subject of concrete properties but a very limited amount has been devoted to slump. This supposedly simple property of fresh or plastic concrete is perhaps one of the least understood by engineers, and one of the most perplexing to contractors.

Let's start this discussion by saying: "The measurement of slump is probably **the most crude test** of all the tests that are performed on concrete." To make matters worse, it is performed in many

cases in a crude manner as well. It is specified as an authentic and precise number, but it may be of limited significance.

At the outset, it is assumed that engineers and construction personnel are familiar with the slump test. Those who may not be should by all means make a detailed study of ASTM C143 *Standard Method of Test for Slump of Portland Cement Concrete*. There are many aspects of this test which are not performed in the field in strict accordance with ASTM, yet frequently we put implicit faith in the results. There are numerous cases where the slump is measured by the "eyeball" method and recorded as an absolute number on the job records. There are even more cases where slump has been specified but is never measured or recorded on the job even though great pains are taken to obtain (and probably cure) the necessary compression test cylinders at the jobsite.

Slump is not a measure of the strength of concrete. At best, it is an approximation of the total water content of the mixture. In general, it serves as a comparison of the relative wetness or workability of a specific mixture. For a given combination of sand and gravel of a fixed size, **the slump is controlled by the total amount of water used per cubic yard of concrete.** For practical purposes this relationship holds true irrespective of the cement content between the usual range of 5 to 8 sacks per cubic yard. Laboratory and field experience indicates that, for most mixes, the addition of one gallon of water per cubic yard will add one inch to the slump of that particular mix within the usual accuracy of such measurements.

In addition to the slump, another very important concept in the proportioning of concrete mixtures has to do with the strength of the mix. Strength is controlled by the thickness or consistency of the paste or glue produced by mixing cement with water. If we use a thicker glue or paste, we produce a stronger concrete. If we produce a thinner glue or paste by the addition of water, we invariably reduce the strength of the concrete. This concept of the paste consistency is frequently referred to as the water/cement ratio. It is simply the ratio of the weight of water to the weight of cement. A low ratio such as 0.40 indicates 40 pounds of water per 100 pounds of cement, or approximately 4.5 gallons per 94-pound sack. This would be a relatively thick paste. On the other hand, a high water/cement ratio of 0.70 indicates 70 pounds of water per 100 pounds of cement, or approximately 8 gallons per sack. Obviously, this is a much thinner and weaker paste.

To summarize, **slump is controlled by the total water per cubic yard Strength is controlled by the total water per sack of cement**. It is entirely possible to produce a mix having a 6-inch slump and strength over 5000 psi or, conversely, a mix with only 1-inch of slump whose strength may fall below 2000 psi.▪

The author, Bob Tobin, is a retired Structural Engineer in Los Angeles. He has been involved with concrete since graduation in 1938. This now adds up to 65 years of "experience."