Concrete slump test

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The test measures consistency of concrete in that specific batch. It is performed to check the consistency (also known as workability, or fluidity) of freshly made concrete, and therefore the ease with which concrete flows.

The slump test can therefore be used on site to check a mix of concrete has the expected fluid properties and degree of wetness. In general, wetter mixes are more workable than drier mixes, but concrete of the same consistency may vary in workability. The test is also used to determine consistency between individual batches.

The test is popular due to the simplicity of apparatus used and simple procedure. Unfortunately, the simplicity of the test often allows a wide variability in the manner in which the test is performed. The slump test is used to ensure uniformity for different batches of concrete under field conditions,[1]:127,128 and to ascertain the effects of plasticizers on their introduction.[1]:134 In India, this test is conducted as per IS specification.

A separate test, known as the flow table, or slump-flow, test, is used for concrete that is too fluid (workable) to be measured using the standard slump test, because the concrete will not retain its shape when the cone is removed.

Contents

Principle

The slump test measures the resulting behavior of a compacted inverted cone of concrete under the action of gravity. It indicates the consistency or wetness of the concrete.[1]:128

Procedure

Slump cone

Tamping procedure

Removing cone

Height measurement

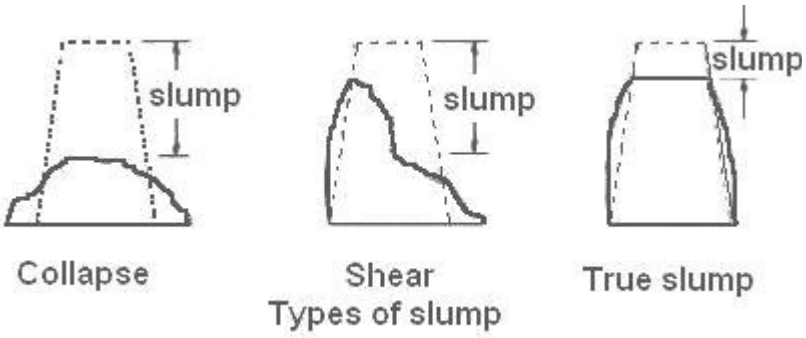
The test is carried out using a metal mould in the shape of a conical frustrum known as a slump cone or **Abrams cone** that is open at both ends and has an attached handle. The tool typically has an internal diameter of 4 in (100 mm) at the top and of 8 in (200 mm) at the bottom with a height of 1 ft (300 mm).The cone is placed on a hard non-absorbent surface. This cone is filled with fresh concrete in three stages. Each time, each layer is tamped 25 times with a 2 ft (600 mm)-long bullet-nosed metal rod measuring $\frac{5}{8}$ in (16 mm) in diameter.[2] At the end of the third stage, the concrete is struck off flush with the top of the mould. The mould is carefully lifted vertically upwards with twisting motion, so as not to disturb the concrete cone.

The concrete then subsides. This subsidence is termed as slump, and is measured to the nearest 5 mm if the slump is <100 mm and to the nearest 10 mm if the slump is >100 mm.[1]:128[3]

Interpretation of results

The slumped concrete takes various shapes, and according to the profile of slumped concrete, the slump is termed as true slump, shear slump or collapse slump. If a shear or collapse slump is achieved, a fresh sample should be taken and the test repeated. A collapse slump is an indication that the mix is too wet.

Only a true slump is of any use in the test. A collapse slump will generally mean that the mix is too wet or that it is a high workability mix, for which the slump test is not appropriate.[1]:128[3] Very dry mixes; having slump 0 – 25 mm are used in road making, low workability mixes; having slump 10 – 40 mm are used for foundations with light reinforcement, medium workability mixes; 50 - 90 for normal reinforced concrete placed with vibration, high workability concrete; > 100 mm.[4]:68



Types of slump

Collapse	Shear	True
In a collapse slump the concrete collapses completely.[3]	In a shear slump the top portion of the concrete shears off and slips sideways.[3]	In a true slump the concrete simply subsides, keeping more or less to shape.[3]

European classes of slump

According to European Standard EN 206-1:2000 five classes of slump have been designated, as tabulated below.[4]:69

Slump	Slump in mm
S1	10 - 40
S2	50 - 90
S3	100 - 150
S4	160 - 210
S5	≥220

Limitations of the slump test

The slump test is suitable for slumps of medium to high workabiity, slump in the range of 5 – 260 mm, the test fails to determine the difference in workability in stiff mixes which have zero slump, or for wet mixes that give a collapse slump. It is limited to concrete formed of aggregates of less than 38 mm (1.5 inch).[1]:128

Differences in standards

The slump test is referred to in several testing and building codes, with minor differences in the details of performing the test.

United States

In the United States, engineers use the ASTM standards and AASHTO specifications when referring to the concrete slump test. The American standards explicitly state that the slump cone should have a height of 12-in, a bottom diameter of 8-in and an upper diameter of 4-in. The ASTM standards also state in the procedure that when the cone is removed, it should be lifted up vertically, without any rotational movement at all.[5] The concrete slump test is known as "Standard Test Method for Slump of Hydraulic-Cement Concrete" and carries the code (ASTM C 143) or (AASHTO T 119).

United Kingdom and mainland Europe

In the United Kingdom, the standards specify a slump cone height of 300 mm, a bottom diameter of 200 mm and a top diameter of 100 mm. The British Standards do not explicitly specify that the cone should only be lifted vertically. The slump test in the British standards was first (BS 1881–102) and is now replaced by the European Standard (BS EN 12350-2).[6] The test should be carried out by filling the slump cone in three equal layers with the mixture being tamped down 25 times for each layer...

Other tests

There are many tests for evaluating slump in concrete: one example is the K-Slump Test (ASTM International C1362-09 Standard Test Method for Flow of Freshly Mixed Hydraulic Cement Concrete).[7] Other tests evaluating consistency are the British compacting factor test,[8] the Vebe consistometer for roller-compacted concrete (ASTM C1170),[9] and the flow table test (DIN 1048-1).[10]

Another way of determining slump is to use an automated slump meter. Sensors and controls enable the meters to measure and display slump. Their reliability has by now earned them acceptance in various standard codes such as ASTM International. Some automated slump meters, such as the one by Verifi (http://verificoncrete.com/) also can add water to the concrete mix in the delivery truck while in transit. In 2013 ASTM C94/C94M (http://www.astm.org/Standards/C94.htm) was revised to allow water additions during transit for trucks equipped with automated slump monitoring and measurement systems.

See also

- Plasticity (physics)
- Flow table test

References

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