Faculty of Engineering and Technology

Civil Engineering Department

Construction materials Laboratory

ENCE215

Experiment # 1

"workability of fresh concrete"

Instructors :-

Dr. Nizar Assi.

Eng. Yasser saad

Done By Group #A :-

Mojahed Sabbah 1171996

Date of performing the experiment: 17-9-2019

Date of submitting the experiment: 24-9-2019

Table of contents:

- **Introduction:**

Concrete is considered to be one of the most vital materials used in the construction field, the compositio [1] ıcrete is usually known as a well distributed gradation of aggregates (coarse and fine) held together by a cementitious paste (cement and water), once these components are mixed the resulting material could be labeled as 'concrete'.

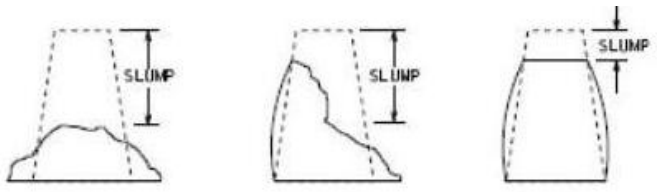
At the early stages after mixing (and before the mix has stiffened), the term 'fresh concrete' is usually used, that stage is of high importance and is directly correlated to a very important characteristic of fresh concrete called 'workability of concrete', which can be accurately defined as: the amount of work or mechanical energy needed to produce full compaction of a certain amount of concrete before sitting occurs and without segregation . However, since workability in this definition is very hard to be measured workability can be simply defined as the flowability and ease of performing operations of consolidation, compaction and finishing on fresh concrete without segregation.

Workability is affected by several factors mainly the water content, by increasing the water content workability is increased, on the other hand this has disastrous effects on the strength of concrete. Also, increasing the percentage of fines rises the amount of workability, but is not economical. Hence, a civil engineer's job is to produce the optimum mix that gathers strength, workability, durability and that is economic.

The main objective of this experiment is to try to determine the degree of workability of fresh concrete using empirical values and measurements obtained

by three tests which are: slump test, vee bee test, compacting factor test, each of the three tests expresses to some extent the consistency of the fresh concrete using different principles.

The slump test is mainly designed for concrete mixtures of moderate workability (neither too wet nor too harsh), its fundamental idea is to measure the decrease in elevation of the concrete pile under the influence of gravity. There are three phases of concrete slumps could be produced. first, a true slump and that is when the concrete pile subsides normally but still possesses cohesion. Second, shear slump which means an inclined failure (usually at 45^{o}) which splits the pile into two parts, this usually happens in mixes lacking cohesion or when the mixture is suffering from segregation and bleeading. Finally, collapse which as the name suggests a complete failure in the concrete resulted due to the very weak bonding of aggregates (mixture too wet or too dry). fig (1.10).



Type of concrete slump

The Vebe test is an empirical test that is related to the ability of concrete to be remolded, it is based on the measurement of time needed for concrete to take the shape of curtain mold (often a cylindrical container), it is obvious that the less the time measured the higher the workability of the concrete, and

vice versa. This test is valid for mixtures of low workability. However, flowable mixtures should not be tested using this test.

The compacting factor test reflects the degree of compaction of the fresh concrete, which in other words gives an overall idea of the voids content inside the mix, consequently some conclusions about other characteristics such as strength, durability…etc. could be driven. The compacting factor is defined as the ratio of the weight of concrete partially compacted (only using gravity and without manual interference) to the weight of concrete fully compacted (using mechanical vibrator), hence this ratio is always less than one. This test is commonly used for stiff mixes because of the presence of mechanical vibrations. Compacting factor = W.concrete partially compacted / W.concrete fully compacted.

- **Instruments:**
    1. Truncated cone (frustum of a cone) D_1 = 200mm , D_2 = 100m, h = 300mm. (fig 1.1)
    2. Tamping rod (steel) with length 60cm and cross sectional diameter 16mm. (fig 1.2)
    3. Steel trowel. (fig 1.3)
    4. Electronic balance. (fig 1.4)
    5. Graduated cylinder 1000ml (fig 1.5)
    6. Electric mixer. (fig 1.6)
    7. Vebe apparatus. (fig 1.7)
    8. Compacting factor apparatus. (fig 1.8)
    9. Digital Stopwatch (fig 1.9)

fig (1.1)

fig(1.2)

fig(1.3)

fig(1.4)

fig(1.5)

fig(1.6)

fig(1.7)

fig(1.8)

fig(1.9)

- **procedure:**

a) Preparing concrete

1. Aggregates were weighed using the electric balance as follows:

   Agg 20mm (30 kg).

   Agg 15mm (11 kg).

   Agg 5mm (10 kg).

2. Using the graduated cylinder 11 liters of water were filled.
3. Using the electric balance 18 kg of cement were weighed.
4. The electric mixer was cleaned by the addition of clean water and allowing it to complete 3 or 4 revolutions and then remove the cleaning water.
5. The components of concrete were fed gradually to the mixer starting with water (half the total amount), then the sands and the coarse aggregates and finally the remainig amount of water (the other half).

6. The mixture is then allowed to be agitated for an adequate amount of time.
7. When the mixture is observed to be homoginous the mixer was shut down and the fresh concrete was poured into a large container.

b) Slump test:

1. The truncated cone was lubricated using oil.
2. The truncated cone was filled at three layers such that each layer was tamped 25 times using the tamping rod (the rod should only reach the top of the previous layer).
3. Inorder to assure stability of the cone during filling it is important to secure it by standing on the plates of the cone.
4. After the cone is completely full the surfce was leveled using the trowel.
5. Then the cone was gently removed in the vertical direction, and the concrete was alowed to descend under its own weight.
6. The slump was measured by putting the cone next to the concrete and the tamping rod over it, and the vertical distance between the rod and the center of the concrete paste was measured and wirtten down (which represented the slump).

c) Vebe test:

1. The lubricated truncated cone was put inside the container of the Vebe machine.

2. The cone was filled at three layers with 25 gentle tamps for each layer (the end of the rod shouldn't exceed the top of the previous layer).
3. The cone was gentelly removed in the vertical direction.
4. After that the Vebe machine was turned-on to vibrate simultaneously with the stopwatch.
5. Once the concrete was clearly observed to take the shape of the container the stopwatch was paused and the ' Vebe ' time was recorded.

d) Compacting factor test:

1. A steel container is weighed before using it to contain the concrete.
2. Concrete was poured into the cylindrical steel container with the avoidance of any manual act causing compaction.
3. The container was put directly beneath the lower hopper.
4. Then the concrete was carefully poured into the upper hopper of the machine.
5. The trap-door of the upper hopper was removed allowing the concrete to fall into the lower hopper under the influence of gravity.
6. After that the lower hopper's trap door was removed and the concrete fell down again in the cylindrical container.
7. Excess concrete that is stick to the cylinder was removed to assure correct weighing.

8. The container and the concretre were weighed together using the balance (this concrete is said to be partially compacted).
9. The container was then placed over the vibrating table for about 5-7s (this concrete is said to be fully compacted).
10. The container holding the fully compacted concrete was then weighed using the balance.

The remaining concrete mix was used to prepare specimens of different shapes and sizes: small cubes, cylinders, big cubes and a prism.

- **Data and calculation:**

a) Slump test:

Slump = 20.0 ± 0.1 cm.

b) Vebe test:

The vebe time, t = 6.00 ± 0.01 s.

c) Compacting factor test:

Weight of Empty cylinder(W_0) = 5.75 ± 0.01 kg.

Weight of cylinder containing partially compacted concrete ($W_p + W_0$) = 17.00 ± 0.01 kg.

Weight of cylinder containing fully compacted concrete ($W_f + W_0$) = 17.50 ± 0.01 kg.

Wp = (Wp + W0) - W0 = 17.00 - 5.75 = 11.25 kg.

Wf = (Wf + W0) - W0 = 17.50 - 5.75 = 11.75 kg.

Compacting.Factor = W_p / W_f = 11.25 / 11.75 = 0.96

- **Results:**

- Conclusions:

  it was clearly observed that workability of concrete is a really important characteristic that controls the easiness of handling concrete especially for the workers who directly deal with concrete, it is also a good check to check in-site differentiations in batches of concrete.

- Explanation of results:

  The measured slump was 20.0 cm, according to the British Department of the Environment (DOE) Method the 20.0 cm falls in the range of **low slump** (10 – 30).

  Also by observation the concrete pile was having a cohesive shape that resembles **true slump.**

  for the Vebe test we measured 6.00 s which according to the (DOE) could be classified as **low** or **normal**.

  The compaction factor is calculated to be 0.96 which according to ASCE is considered a high degree of workability.

  The Slump test and the Vebe test gave kind of close results of low workability, while the Compacting factor test suggests a high workability, this might have occurred due to the invetable presence of errors, for example batch weighing might not be very precise. also, the

degree of mixing inside the drum might be a cause of segregation, the time of vibrating also affects the degree of compaction of concrete, errors in timing using the stopwatch also happened. All the previous sources of errors cause the measured values to deviate from the true values.