Term Project

CEEN 3145_100 Thursday 2:00 p.m. - 4:50 p.m.

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Purpose	Joshua Sepulveda
Significance and Use	Michael Herrera
Apparatus	Mohammad Alajmi
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Section One:

Methods:
Group 5 was tasked with creating a new ASTM Standard Test Procedure for Hydraulic Mortar Flow. The current standard uses a specially designed flow table that drops a sample of formed hydraulic mortar the height of 1 inch 25 times in 15 seconds of operation. In order to replicate similar results of this experiment the hydraulic cement needs to be dropped in a similar matter in order to produce a flow, but the difference can be in the materials used, mass of the drop table, or even changing the height of the drop. There are many ways that this experiment can be conducted, but the results need to be adjusted in order to produce similar results when completing multiple tests.

Theories:
The original flow table operates under the Energy Wave Theory developed by Isaac Newton in the late 1600s. The current theory is applied to this test standard by using a mass, in this case the brass flow table, and acceleration, in this case the 1 inch standardized drop. These two numbers results in the force generated by the tables repeated rapid deceleration over a short period of time. In order to get consistent results group 5 can create a table that operates similarly to the current table, but by decreasing the weight of the table and increasing the standardized drop height will allow for a similar result of flow that can be related to the ASTM C 1437 – 07 typically used for this testing.

Analysis:
The new test standard will use the same principles of the original test standard, but will change the equipment and procedure of the test. The scope of the project will remain the same as the goal of this project is to still be able to determine the flow of a hydraulic mortar. The significance and use of the test method will not change as understanding the flow of the test will allow for an engineer or technician to understand the workability and water content of the sample. The apparatus and equipment used will be specially designed in order to replicate the results of the original test, but will be a compact stand alone box that can be operated easily in the field as specifiecd by the prompt. The temperature and humidity of the air in the location being tested will not be in accordance with specification C 511. As this experiment is meant to be performed on the job site away from the lab, the environmental conditions may not be guaranteed. The materials used in the test for testing will not be changed as the hydraulic mortar should be the same as used in the original procedure. The procedure will change and be listed specifically in the lab report section of this term project report. The calculations will have to be adjusted, but the same equation can be used, the mold diameter is the only variable that should change for our new test procedure. Lastly, the experiment should be able to be performed by someone with no lab experience, the purpose of this new test procedure is to make the hydraulic flow test be able to be performed in the field. If this new test procedure is not able to replicate results similar to the ASTM C 1437 - 07 then it is a failure.

Development Process:
For this experiment group 5 decided to design a sliding box out of wood and aluminum foil that will drop, impact the base, and cause the mortar to flow. ⅜” plywood sheets were used along with 4- 1’ 2” X 2” boards with sanded edges that would come in contact with the sliding tray. The sliding tray was made of ⅜” plywood cut into a square 10” X 10”. All 4 of the sides had a 2 opposite sides were offset by 1 1/2 “ so that the box was contained in the rails and would guide the tray 12.5 cm as it dropped onto the base. The tray was then lined with aluminum foil in order to create an impervious barrier that would not absorb the moisture from the mortar during testing. Also a measurement web was measured and drawn on the aluminum foil because it would allow for the ring mold to be centered and provide the scale for the flow of the mortar. The base was made up of horizontally oriented 2” X 4” boards in order to create a solid continuous surface that the tray would impact. On the top of the finished apparatus a thin piece of wood approximately 1 foot long was stapled to the top and could roate in order to create a drop height that was consistent throughout the experiment, overall the construction was meant to be a prototype and if constructed in better quality materials would allow for a consistent and effective testing method in the field.

Lab # 9: Mortar Mix, Mortar Flow ASTM C270, C230, C1437

Purpose:
The purpose of this lab is to create a new set of procedures to be used on a jobsite to determine an acceptable mortar flow range (105-115) without using the flow table.

Significance and Use:

By determining mortar flow, we can determine if the mortar sample is within the acceptable criteria for mortar. If so, we can mold the mortar and use it to determine the compressive strength in mortar cubes since it is proportional to that of concrete cylinders.

Apparatus:
Using Flow table
- 500g of mortar
- 100 mm diameter mold
- Flow table
- 100 ml of water
- Bowl for mixing
- Scale

Using new procedure
- 650 g of mortar
- 77.3 mm diameter mold
- Structure built to determine mortar flow
- 108ml of water
- Bowl for mixing
- Scale

Test Specimens:
- Thoroughly Mixed Mortar

Test Procedure:
Flow Table

1. Gather materials
2. Weigh out 100 g of mortar
3. Pour 150ml of water into mixing bowl with mortar and mix
4. Mix mortar until the sample feels like play-do
5. Once done mixing pour mix into a 100mm (4 inch) diameter mold (M). Pour 2 layers and at each layer tamp 20 times until full and then take excess mortar off of the mold.
6. Once the mold is done place mold onto the flow table and then pull the mold off. Once the mold is off begin to turn the lever to drop the flow table 1 inch. Do this 25 times in 15 seconds.
7. After dropping the flow table get 4 diameter measures and take the average (A)
8. Use the average diameter (A) and plug into formula Flow = [(A-M)/M]*100

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1. Gather the framed apparatus and pvc mold.
2. Weigh out 650 g of mortar and mix it with 108 mL of water in a bowl.
3. Place the pvc mold on top of the stand inside the frame.
4. Fill in the pvc mold with mortar in two layers. Rod each layer 20 times with a rod.
5. Smooth out the top surface of the pvc mold.
6. Remove the pvc mold.
7. Lift the stand until it touches the top wood barrier.
8. Drop the stand and lift it up again to the wood barrier. The drop height will be 12.5 cm.
9. Drop the stand 15 times in 30 seconds.
10. Measure and record the diameter of the mortar after step 9 is achieved.

Analysis and Results:

Original Flow Table Results

Diameter # (mm)				Mold Diameter (mm)	Flow (%)
1	2	3	4	Inside Diameter	Nearest %
213	205	206	214		
Average Diameter	209.5			100	110

New Flow Table Results

Diameter # (mm)				Mold Diameter (mm)	Flow (%)
1	2	3	4	Inside Diameter	Nearest %
205	205	210	215		
Average Diameter	208.75			77.3	131

Conclusion:
In conclusion the project was a success with a slight error in calculation. The purpose of this lab is to create a new set of procedures to be used on a jobsite to determine an acceptable mortar flow range (105-115) without using the flow table. Our procedures and our structure that we built to replicate the flow table results were good but the mold we had used was a bit smaller than the mold used for the flow table and we overlooked that this would affect our calculation. Our structure produced an adequate diameter of mortar once dropped 15 times for 30 seconds giving us an average diameter of 209.5 which is still within the acceptable criteria of 205mm - 215mm for the flow table to produce an adequate morar flow. Using our average diameter and mold size we came out with a 131% mortar flow which is higher than the acceptable criteria of 105% - 115%. If we had used a mold that was 100 mm rather than 77.3 mm our results would have come out to 110% which is within the acceptable criteria. Therefore our purpose was achieved but we have to adjust the mold size to put us within the acceptable criteria.

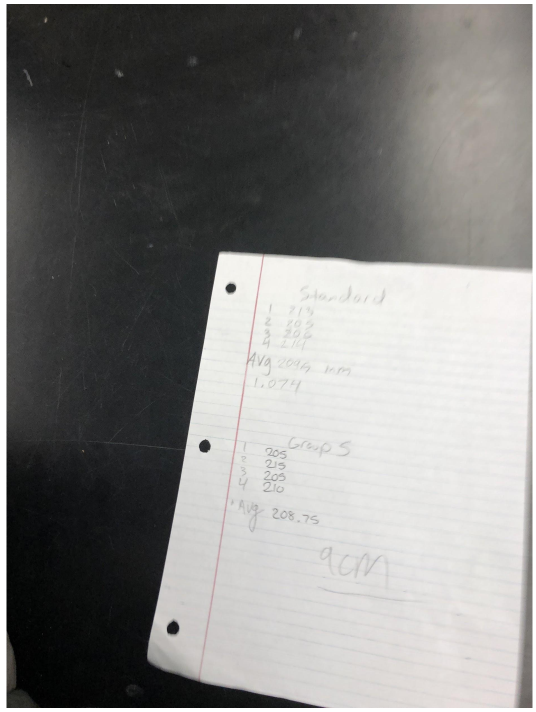
References:

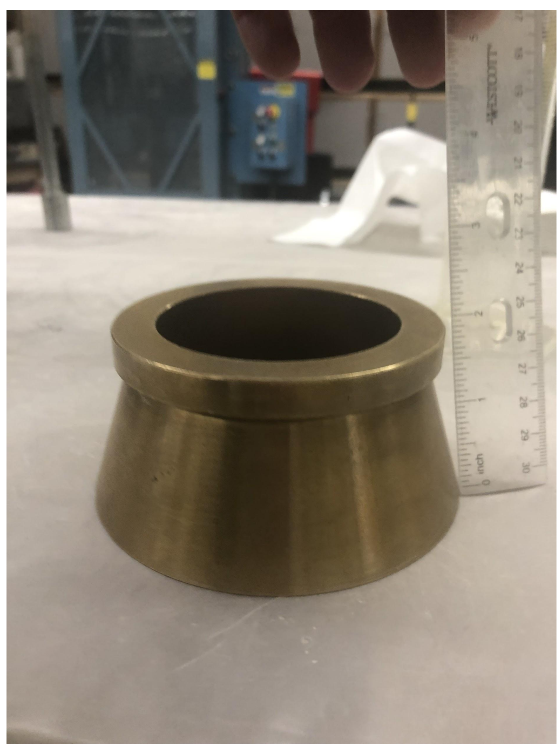
ASTM Standard C270, 2009, “Specification for Mortar for Unit Masonry”

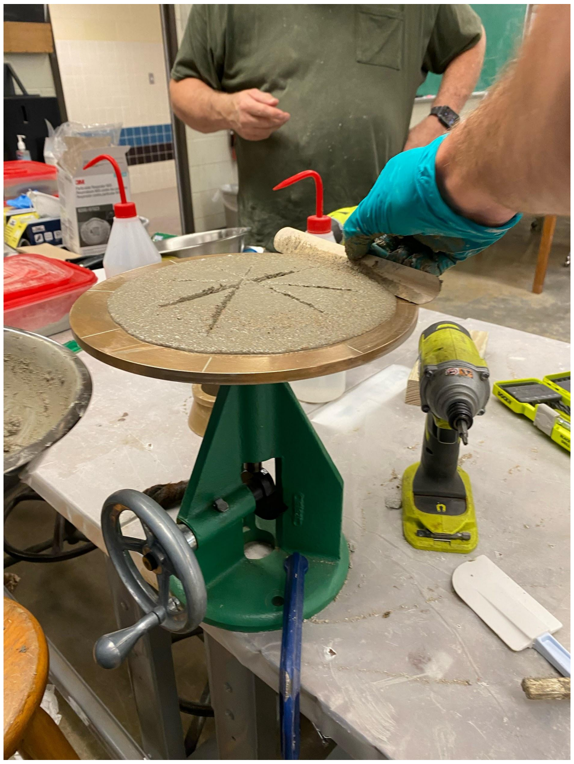
ASTM Standard C230, 2014, “Specification for Flow Table for Use in Tests of Hydraulic Cement”

ASTM Standard C1437, 2015, “Standard Test Method for Flow of Hydraulic Cement”

Appendix:







Designation: New C 1437 – 07

New Standard Test Method for Flow of Hydraulic Cement Mortar [1]

1. Scope*

1.1 This new test method was created to determine the flow of a hydraulic cement mortar.

1.2 The values used in this experiment should be SI units are used in ASTM standards.

1.3 This new standard serves to categorize a batch by flow, it does not address the dangers encountered when mixing a batch of hydraulic cement mortar, or how to dispose of the tested sample.

2. Referenced Documents

2.1 ASTM Standards:

C 230/C 230M Specification for Flow Table for Use in Tests of Hydraulic Cement

3. Significance and Use

3.1 This test method is intended to be used to determine the flow of hydraulic cement mortars, and of mortars containing cementitious materials other than hydraulic cements.

3.2 Understanding the flow of the mortar, while not necessary, helps the engineer or technician in charge of the mix to approximate the water content of the mix and determine the workability as well in the field.

4. Apparatus

4.1 Constructed Wood Flow Table, PVC Flow Mold, Conforming to the requirements of Specification C 230.

4.2 Metric Ruler, a metric ruler is used to divide the flow of a sample into 4 sections and measure the diameter to nearest mm

4.3 Tamper, made of impervious material conforming to the requirements of Test Method C 109.

4.4 Metal Spoon, metal spoon will ensure that the surface is impervious to moisture and will not affect the moisture content of the mortar when placing the ample into the PVC ring mold.

4.5 Straightedge, made of steel, in this case a metal blade wood handled icing knife.

5. Temperature and Humidity

5.1 The temperature and relative humidity of the air in the field cannot be guaranteed, the test needs to be performed in a dry location protected from the elements.

6. Materials

6.1 Hydraulic Cement Mortar— mortar that will be used in determining the flow of a design mix specifications. Approx. 550 grams of Mortar and 118 ml of water.

7. Procedure

7.1 Determination of Flow:

7.1.1 Clean the flow table and ensure there is no moisture on the impervious metal surface. Clean the PVC flow mold, ensuring to remove all points of moisture and debris that may affect the results. Place the first lift of hydraulic cement mortar into the mold, tamp 25 times using a rod to evenly spread the mortar throughout the mold. Perform a second lift filling the mold to the top and tamp 20 times again. Add the remaining mortar and tamp accordingly until the mold is completely full, screet off the excess mortar and clean all surfaces that may have mortar on the table, bottom mold, or any surface of the testing apparatus. Immediately raise the flow table to the top of the apparatus, a board will ensure the correct height the sample will be dropped from to ensure a standardized impact. Remove the mold swiftly in one motion and drop the table, proceed to raise, and drop the table 15 times in 30 seconds. The impact of which will cause the hydraulic cement mortar to spread out and illustrate the flow of the design mix.

7.1.2 Use a metric ruler provided in the apparatus,
Measure the flow of the spread using the 4 transcribed lines on the flow table. The average of the 4 measured diameters needs to exceed 205mm. Record each diameter to the nearest mm, the mortar should spread evenly, but if it does not you may need to remix the batch of hydraulic cement mortar.

8. Calculation

8.1 The flow of the hydraulic cement mortar is described by the inner diameter of the lower section of the PVC form mold and the average diameter of the flow table.

8.2 For the calculation the average diameter value is subtracted by the inner diameter of the PVC form mold. Then the value from this step is divided by the average dimeter and multiplied by 100 to display the flow as a percent of the original diameter of the sample.

where:
A = The average of the four diameters measured, minus the inside diameter of the PVC ring mold used for the sample.
Report the flow % to the nearest %

9. Precision and Bias

9.1 Precision— This method was developed in order to have replicate the results of C 1437 – 07, test is performed by 2 users, one will only remove the ring mold as the other performs the drop tests of the experiment, 1 test should be within 4% and 2 tests within 11% standard deviation.

9.1.1 Results from 2 different laboratories should not exceed more than 31% of the standard deviation of 11%

9.2 Bias—This is a prototype standard, a lot of the details probably need to be changed, but the results do produce a similar result, except that the mold needs to be accounted for when performing flow % calculations.

10. Keywords

10.1 flow; hydraulic cement; screet, PVC, mortar

SUMMARY OF CHANGES

The sections of this New ASTM C 1437 – 07 that were changed and edited in this document were Scope, Significance and Use, Apparatus, Temperature and Humidity, Materials, Procedure, Calculations, and Precision and Bias. Basically, everything or as much as possible.