FLORIDA DEPARTMENT OF TRANSPORTATION
State Materials Office
5007 NE 39th Avenue
Gainesville, Florida 32609

April 18, 2022

Florida Method of Test for Optimizing Aggregate Gradation for Portland Cement Concrete

Designation: FM 5–621

1. SCOPE

1.1. This method covers procedures for Optimizing Aggregates Graduation (OAG) for Portland Cement Concrete.

2. REFERENCES

2.1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

2.2. FM 1–T 084 – Florida Method of Test for Specific Gravity and Absorption of Fine Aggregate.

2.3. FM 1–T 085 – Florida Method of Test for Specific Gravity and Absorption of Coase Aggregate.

2.4. ASTM C29/C29M – Standard Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate.

2.5. ASTM C136/C136M – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

3. MATERIALS

3.1. Coarse Aggregates: The Coarse Aggregates consist of the combination of two sizes of aggregates meeting the requirements of Standard Specifications Section 901 Table 901–1.

3.2. Fine Aggregate: Use only silica sand meeting Standard Specifications Section 902 or screenings as provided in 902–5.2.3.

3.3. Cementitious Materials: Meet the requirements of Standard Specifications Section 921 for Portland Cement and Blended Cement, and Standard Specifications Section 929 for Supplementary Cementitious Materials.

3.4. Admixtures: Provide admixtures meeting the requirements of Standard Specifications Section 924.

4. MIX DESIGN

Each OAG mix design shall contain information about aggregate sources, aggregate gradations for each source, mix components proportions, Coarseness Factor (CF), Adjusted Workability Factor (WF_{adj}), and 28–day specified compressive strength.

5. METHOD

5.1. Provide information about the cementitious materials content for OAG mix design, mix components material properties, and aggregate sieve analysis results.

Calculate the Coarseness Factor (CF) – Equation 1, Workability Factor (WF) – Equation 2, and Adjusted Workability Factor (WF_{adj}) – Equation 3.

5.1.1. The coarseness factor (CF) is defined as follows:

$$\text{Equation 1:} \quad CF = \left(\frac{Q}{Q + I}\right) 100$$

where:

Q = Percent of combined aggregates retained on the 3/8 in. sieve,

I = Percent of combined aggregates passing the 3/8 in. sieve and retained on the No. 4 and No. 8 sieves.

5.1.2. The workability factor (WF) is defined as follows:

$$\text{Equation 2:} \quad WF = \left(\frac{W}{Q + I + W}\right) 100$$

where:

Q = Percent of combined aggregates retained on the 3/8 in. sieve,

W = Percent of combined aggregates passing the No. 8 sieve

5.1.3. When the cementitious material content of a concrete mix is other than 564 lb/ft^3 (equivalent to six bags of cement), WF must be adjusted by plus or minus 2.5% per bag of cement (94 lb.) that is over or under 564 lb.

$$\text{Equation 3:} \quad WF_{adj} = \left(\frac{W}{Q + I + W}\right) 100 + 2.5\left(\frac{W_{cm}}{94} - 6\right)$$

where:

WF_{adj}= Adjusted Workability Factor, percent

W = Percent of combined aggregates passing the No. 8 sieve.

W_{cm} = Mass of total cementitious material content in lb/yd^3

5.2. Plot the WF_{adj} versus CF in **Figure 1**. The plot of the WF_{adj} versus CF should be located within Well Graded Zone.

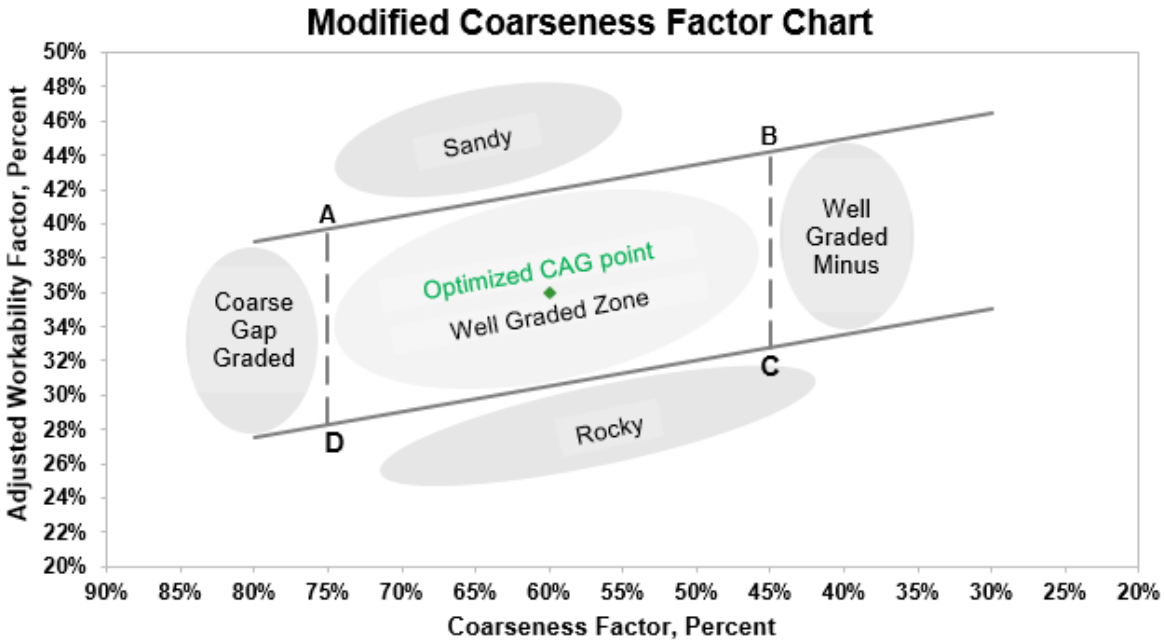

Fig. 1 Modified Coarseness Factor chart shows the Well Graded Zone and Optimized Coarse Aggregate Gradation (CAG) Point

6. PROCEDURE

6.1. Aggregates: Combine two or more coarse aggregate sizes and fine aggregate for OAG mix design. The plot of the WF_{adj} versus CF should be located within Well Graded Zone – **Figure 1**.

6.2. Cementitious Materials Content: Select the types and amounts of cementitious materials contents of the mix for the specified concrete strength and durability properties.

6.3. Admixtures: Select the types and amounts of admixtures needed for the design mix.

6.4. Water: Determine the amount of water of the design mix.

6.5. Perform the laboratory trial batch of the design mix and submit the test results for review and approval process.

7. Precision and Bias

7.1. Precision and bias statements have not been established for this test procedure.

8. Reporting

8.1. Report all calculated values from **Section 5** of this method along with all pertinent mix design information in accordance with Materials Manual Volume 2, Section 9.2.