Emmanuel Denarié
EPF Lausanne

Exercise 4: Mix-design of Self-Compacting Concretes

We're looking at a concrete to be used for the curbs of a road bridge in the Alps. In the tender, the engineer specified the concrete as follows, according to SN EN 206:

C 35/45
XC4, XD3, XF4
D_{max} = 16 mm
Cl 0.10
SF2

The company plans to produce this concrete using the following recipe: Self-compacting concrete, 350 kg/m^3 of CEM I 42.5 N, 70 kg/m^3 of Fly Ash, W/C = 0.43, with superplasticizer admixture (10 kg/m^3), without air entrainer, placed by pumping.

1. On the basis of the particle size analyses given in Appendix 1, propose a mix of the 3 classes of aggregate (% of each component in relation to the total) suitable for a SCC.

2. Determine the composition of the concrete (components in kg/m^3) - the entrained air content is assumed to be 1.5%.

3. The amount of water added during mixing is 151 l/m^3. The concrete obtained shows marked segregation. Can you explain it?

4. Propose a modified composition for the concrete. Recalculate it in detail.

5. Check that the concrete meets the original requirements.

Appendix 1: Concrete components

Table 1: Sieve size analysis - Swiss plateau semi-rolled aggregates

	Cumulative sieves		
Sieve [mm]	0/4 [%]	4/8 [%]	8/16 [%]
0.05	2.3	0.8	3.4
0.063	2.3	0.8	3.4
0.125	5.2	0.8	3.4
0.16	9.5	0.8	3.4
0.25	16.7	0.8	3.4
0.4	26.3	0.8	3.4
0.63	36.5	0.8	3.4
1	47.6	0.8	3.4
1.6	60.3	0.8	3.4
2.5	76.2	1.3	3.4
4	95.6	8.6	3.4
5	99.7	31.1	3.4
6.3	100	63.6	4.3
8		96.3	19.6
10		100	55.1
12.5			93.3
16			100
20			
25			
31.5			

NB: Bulk sand moisture content = 6 % mass

Table 2: Densities

Component	Mass kg/m^3
Cement	3150
Fly ash	2200
Filler Limestone	2700
Superplasticizer	1050
Sand	2690
Gravel	2690

Superplasticizer solid content: 26.2 % mass

ED/ed - 10.2024