

Example problem of analyzing the combined aggregate gradation of an optimize concrete mix:

MIX DATA:

Concrete use: Bridge Sub-structure (Class B w/Air)
 Cement amount: 479 pounds (5.1 sacks/ cubic yard)
 Sand type: Class A (Natural Sand)

Sieve Size	Percent Passing			
	Fine Agg.	Coarse Agg.	Intermediate Agg.	Combined Agg.
2"	100.0	100.0	100.0	100.0
1 1/2"	100.0	100.0	100.0	100.0
1"	100.0	100.0	100.0	100.0
3/4"	100.0	95.0	100.0	97.4
1/2"	100.0	47.0	100.0	72.5
3/8"	100.0	23.0	99.0	60.0
#4	97.0	8.5	9.0	43.1
#8	81.0	4.5	4.0	34.3
#16	77.0	3.9	3.6	32.4
#30	42.0	3.2	3.2	18.3
#50	7.0	2.6	2.6	4.3
#100	0.6	1.9	2.4	1.4
#200	0.2	1.3	2.0	0.9
% Used	39.0	51.8	9.2	

1) Check each aggregate fraction to ensure it complies with Section 501.3 of the Standard Specification.

Do the fine, coarse and intermediate aggregates have 100 percent passing the 1" sieve? YES

Do the coarse and intermediate aggregates have less than 2.5 percent passing the No. 200 sieve? YES

Does the fine aggregate have less than 2.5 percent passing the No. 200 sieve? YES

2) Determine the Coarseness Factor¹.

$$\text{Coarseness Factor} = \frac{(\% \text{ Total Aggregate Retained above the } 3/8" \text{ Sieve})}{(\% \text{ Total Aggregate Retained above the No. 8 Sieve})} \times 100$$

$$\% \text{ Total Aggregate Retained above } 3/8" \text{ Sieve} = 100 - 60.0 = 40.0\%$$

$$\% \text{ Total Aggregate Retained above No. 8 Sieve} = 100 - 34.3 = 65.7\%$$

$$\text{Coarseness Factor} = \frac{(40.0)}{(65.7)} \times 100$$

Coarseness = 60.9
Factor

3) Determine the Workability Factor¹.

Workability Factor = % Total Aggregate Passing the No. 8 Sieve

% Total Aggregate Passing the No. 8 Sieve = 34.3%

The Coarseness Factor Chart¹ is based upon 6.0 sacks (564 pounds) of cementitious materials per cubic yard. Will need to adjust the Workability Factor in order to account for different cementitious amounts. When the amount of cement exceeds 6.0 sacks, the Workability Factor is adjusted plus 2.5 percent per sack of cement equivalent. When the amount of cement is below 6.0 sacks, the Workability Factor is adjusted minus 2.5 percent per sack of cement equivalent.

Adjusted = Workability Factor + $\frac{((\text{Amount of cementitious materials}) - (564)) \times 2.5}{94}$

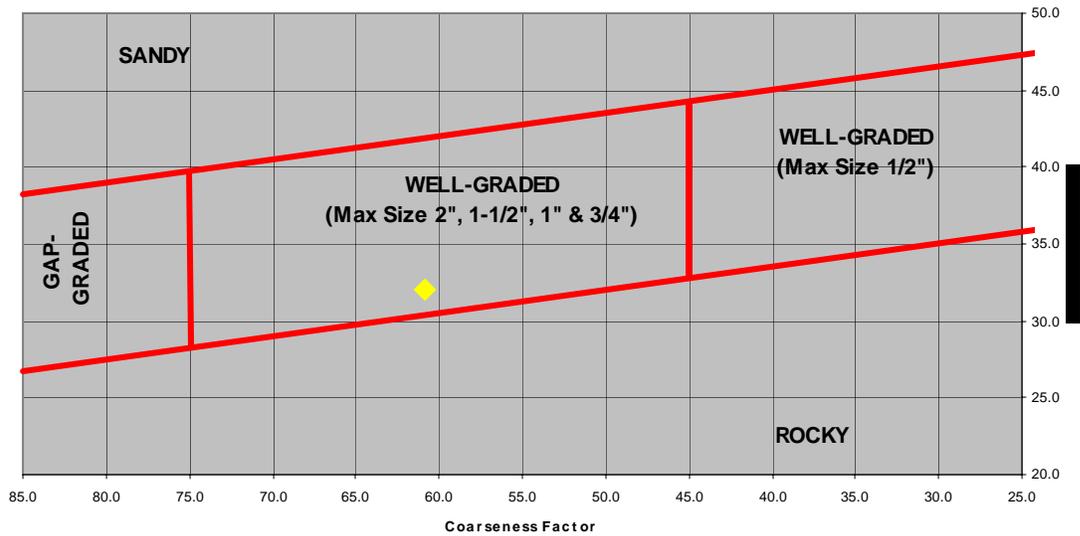
Adjusted = Workability Factor + $34.3 + \frac{((479) - (564)) \times 2.5}{94}$

Adjusted = Workability Factor + $34.3 + \frac{(-85) \times 2.5}{94}$

Adjusted = Workability Factor + 32.0

4) Plot the Coarseness Factor and adjusted Workability Factor on the Coarseness Factor chart to determine if the combined aggregate gradation is considered optimized.

Coarseness Factor Chart¹



When the point is located in the area entitled, " Well-Graded (Max Size 2", 1 ½", 1" & ¾)", " the combined aggregate gradation is considered suitable for use in an optimized concrete mix. When the point is located outside this area, the mix needs to be evaluated by the Materials Field Office.

Appendix References:

¹Shilstone, J. Sr., "Concrete Mixture Optimization", Concrete International, June 1990