Section 10 Solutions to Sections 8 & 9

WMTC Concrete Training & Certification Seminar

W Tare = 6.78 lbs **Container Vol. = 0.251 cuft**
W Total = 43.00 lbs (Container & Fresh Concrete)
T = 153.7 lbs/cuft (Theoretical or Air Free Unit Weight)
Total Batch Weight = 35,066 lbs **Batch Designed to Produce = 9.0 cy**

1. Compute measured unit weight (D).

   D = (43.0 – 6.78)/0.251 = 144.3 lbs/cuft

2. Compute yield (Y_f) in both cuft & cy.

   Yf = 35,006/144.3 = 243.0 cuft 243 cuft/27 cuft/cy = 9.0 cy

3. Compute relative yield (Ry).

   Ry = 9.0/9.0 = 1.0

4. Compute gravimetric air content (A).

   A = [(153.7 – 144.3)/153.7] x 100 = 6.1%

Wt. Net or Free Water = 296 lbs
Cement = 705 lbs
Silica Fume = 60 lbs

5. Compute the w/cm ratio.

w/cm ratio = 296 lbs/765 lbs = 0.39

6. If the contractor added 20 gals of water to adjust the slump on a 9.0 cuyd load, what is the new w/cm ratio? Compare to maximum w/cm allowed by WYDOT?

added water = 20 gal x 8.34 lbs/gal = 166.8 lbs of water added to load

166.8 lbs/9.0 cuyd = 18.53 lbs of water per yard of concrete

w/cm = (296 + 18.53)/765 = 314.53/765 = 0.41

new w/cm ratio is less than WYDOT's max w/cm of 0.45, OKAY

Moisture Problems

DRY Aggregate Weight = 7784 lbs
Moisture Content = 2.0%
Absorption = 1.48%

7. What is the percent (%) Free or Net moisture?

2.0 – 1.48 = 0.52%

8. Calculate the SSD aggregate weight.

7784 x 1.0148 = 7899 lbs

or

7784 x 1.48% = ABS water

(7784) x 0.0148 = 115.2 lbs

7784 + 115.2 = 7899 lbs

9. How much water is absorbed in the aggregates?

115.2 lbs from #8 above or 7899 – 7784 = 115 lbs

Check

(115.2/7784) x 100 = 1.479%

10. Calculate the total water content in pounds.

7784 x 2.0% = 7784 x 0.020 = 155.7 lbs

11. Calculate the Net or Free water content.

%Net = %Total – %ABS

Total ABS Net

7784 x (2.0% – 1.48%) = 7785 x (0.52%) = 7785 x 0.0052 = 40.5 lbs

12. What amount of water contributes to the mixing water?

40.5 lbs

13. Compute how much water can be added on-site?

Mix Design

590 lbs Cement	Max w/c ratio = 0.45	Max Water Allowed 590 x 0.45 = 265.5 lbs
1200 lbs Sand (dry)	1.482 % Absorption 2.5% Moisture Content	
1180 lbs Rock (dry)	0.831% Absorption 1.8% Moisture Content	
Batch Water Added:	27.0 gal/cy or 225.18 lbs/cy	

Sand

2.5% - 1.482% = 1.018% (% Net water)

1200 x 1.018% = 1200 x 0.01018 = 12.22 lbs

Rock

1.8% - 0.831% = 0.969%

1180 x 0.00969 = 11.43 lbs

265.5 lbs (max allowed water)

- 12.22 lbs (water from sand)

-11.43 lbs (water from rock)

-225.18 lbs (batch water)

16.68 lbs/cuyd (water to add)

16.68/8.34 = 2 gallons/cuyd

14. For a fresh concrete temperature of 75°F, what is the maximum placing time in minutes?

90 – 2 x (75-70) = 80 minutes

15. For a Level II paving project, determine the following:

	Testing	Frequency
	QC	**QA**
Strength Test	NA	1 set per sublot
Air Content	At start-up & 1 min. per 1000 SY	1 per sublot
Slump Test	At start-up & 1 min. per 1000 SY	NA
Yield/Unit Weight	NA	NA
Temperature	NA	NA
Number of Cylinders	NA	1 set (3 cyl.) per sublot

a. What is the maximum concrete lot size for QA?

6,000 SY max

b. What is the maximum concrete sublot size for QA?

Min: 3 sublots per lot 6,000 SY/3 = 2000 SY

c. If the total concrete placement consist of 45,000 SY, design a QC and QA testing program:

QC: air 3 (start-up) + 45,000 SY/1000 SY = 48 tests (min)

slump 3 (start-up) + 45,000 SY/1000 SY = 48 tests (min)

QA: 45,000 SY/6,000 SY = 7.5 lots = 8 lots Lot size = 45,000/8 = 5,625 SY

8 lots x 3 sublots/lot = 24 total sublots each sublot = 5,625/3 = 1,875 SY

strength	air	thickness
3 cyl per sublot	1 per sublot	1 per sublot
3 x 24 = 72 cylinders	24 air tests	24 cores

d. How many QA cylinders are required to represent 45,000 SY of pavement?

1 set (3 cyl) per sublot

3 x 24 = 72 total cylinders

16. Correlate the following slump, air content & unit weight test results: (PCCP Concrete)

Correlation of Field Testing					
Test	**Contractor's Tester**	**WYDOT's Tester**	**Difference**	**Pass/Fail**	Max Allowed
Slump	3.25"	3.50"	0.25	Pass	0.5 in.
Air Content	5.2%	4.5%	0.7	Fail	0.4%
Unit Weight	142.5 pcf	143.1 pcf	0.6	Pass	1 pcf

17. For a Level I structural concrete project, determine the following:

	Testing	Frequency
	QC	**QA**
Strength Test	Optional	1 set per sublot
Air Content	1st load & 1 per 25 CY	1 test per sublot
Slump Test	1st load & 1 per 25 CY	1 test per sublot
Yield/Unit Weight	1st load & 1 per 25 CY	NA
Temperature	1st load & 1 per 25 CY	NA
Number of Cylinders	Optional	3 per set or 3 per sublot

For a one day concrete placement of 135 cubic yards, compute the following for QC and QA:

a. Minimum number of air content and slump test?

QC	QA
135/25 = 5.4 = 6	5 sublots for 135 CY placement (see pg. 7-9)
Air & Slump = 1 + 6 = 7 min	Air & Slump = 5 (1 per sublot)

b. Minimum number of 4" x 8" strength cylinders?

QC	QA
Option	3 per set x 5 sublots = 15 cylinders

Section 9 WYDOT Sample Exam *Solution*

1. *b* min = ½ cuft
2. *c*
3. *d*
4. *a*
5. *e*
6. *d*
7. *e*
8. *a*
9. *b* (43.0-6.75)0/249 = 145.58 = 145.6 lbs/cuft
10. *a*
11. *b* at least 3 sublots per lot
12. *b*
13. *a*
14. *a*
15. *b* need additional 30 revolutions at mixing speed
16. *b* 71.5 - 6.78 = 0.37 lbs
17. *a* [(7.75 – 7.15)/6.78] x 100 = 8.85%
18. *d* 90F – 2 min/F(79F – 70F) = 72 minutes
19. *c* 237/564 = 0.42
20. *d* 0.45 x 517 lbs = 232.65 lbs 232.65 - 32.5 = 200.15 lbs

    200.15 lbs x 5 CY = 1,001 lbs
21. *a*
22. *e* computed: 0.42 lbs per sqft per hr
23. *b*
24. *b*