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Home work 2 Concrete Mix Design Solutions. 2/13/08

1 Slump: Specified as 25 mm (1 in)

2 Maximum Agg. size = 1 inch (given)

nominal maximum size = 19 mm (3/4") ①

3 Mixing water and air content estimate.

Table 4.2 (9-5): 168 kg/m³ or 280 lb/yd³.

Volume of water: $\frac{168\ kg/m^3}{1000\ kg/m^3} = 0.168\ m^3/m^3$ ②

$\frac{280\ lb/yd^3}{62.4\ lb/ft^3} = 4.487\ ft^3/yd^3$

Volume of air (4.5%): $0.045\ m^3/m^3$

$0.045\ yd^3/yd^3 = \frac{0.045 \times 27\ ft^3}{yd^3} = 1.215\ ft^3/yd^3$ ②

4. Coarse agg. content:

table 9-4 (4.3) 62% of coarse agg.

$0.62 \times 1762\ kg/m^3 \times 1\ m^3 = 1092\ kg/m^3$

$0.62 \times 110\ lb/ft^3 \times 27\ ft^3/yd \times 1\ yd = 1841.4\ lb/yd^3$

Volume of coarse agg.:

$\frac{1092\ kg/m^3}{1000\ kg/m^3 \times 2.68} = 0.407\ m^3/m^3$ ②

$\frac{1841.4\ lb/yd^3}{62.4\ lb/ft^3 \times 2.68} = 11.011\ ft^3/yd^3$

5. Water - cement ratio

Table 9-3 specified $f'_c = 2500$ psi.

standard deviation = 250 psi (table in handout)

target $f'_c = 2500 + 400 = 2900$ psi. ②

from table 9-3 w/c = 0.605.

Also consider exposure condition (freeze-thaw), table 9-1

use: w/c = 0.45

①

6. Cement content.

$$\text{Cement content} = \frac{\text{water content}}{W/C} = \frac{168}{0.45} = 373\ kg/m^3$$

$$= \frac{280}{0.45} = 622\ lb/yd^3.$$

Minimum cement = $5 \times 94 = 470\ lb/cy < 622\ lb/yd^3$. (2)

Use $373\ kg/m^3$ or $622\ lb/yd^3$ cement weight.

Volume of cement: $\frac{373\ kg/m^3}{1000\ kg/m^3 \times 3.15} = 0.118\ m^3/m^3$

$$\frac{622\ lb/yd^3}{62.4\ lb/ft^3 \times 3.15} = 3.164\ ft^3/yd^3$$

7. fine agg. content:

Volume:	$1.0\ m^3$	$27\ ft^3$
- water	$0.168\ m^3$	$4.487\ ft^3$
- air	$0.045\ m^3$	$1.215\ ft^3$
- cement	$0.118\ m^3$	$3.164\ ft^3$
-) - Coarse agg	$0.407\ m^3$	$11.011\ ft^3$
= Volume of fine agg.	$0.262\ m^3$	$7.123\ ft^3$

(2)

Weight of fine agg. $= 0.262\ m^3 \times 1000\ kg/m^3 \times 2.50 = 655\ kg$. (per m^3)

or $= 7.123\ ft^3 \times 62.4\ lb/ft^3 \times 2.50 = 1111.188\ lb$. (per yd^3)

8. Adjustment for agg. moisture

Coarse agg. $1092 / (100\% - 1\%) = 1103.\ kg/m^3$

$1841.4 / (100\% - 1\%) = 1860\ lb/yd^3$.

Fine agg. $655 / (100\% - 4.5\%) = 685\ kg/m^3$

$1111.2 / (100\% - 4.5\%) = 1163.6\ lb/yd^3$.

(2)

(2)

Also, the amount of mixing water needs to be adjusted.

water from coarse agg → $1103 \times (1\% - 0.5\%) = 5.515$ kg/m³.

$1806 \times (1\% - 0.5\%) = 9.03$ lb/yd³

water from fine agg. $685 \times (4.5\% - 1\%) = 23.98$ kg/m³

$1163.6 (4.5\% - 1\%) = 40.726$ lb/yd³.

∴ the amount of water need to be added is:

$168 - 5.515 - 23.98 = 138.505$ kg/m³

$280 - 9.03 - 40.726 = 230.244$ lb/yd³.

9 Summary:

total materials required per unit volume (1m³ or yd³) are.

	(metric)	(English)
water	138.5 kg	230 lb
Portland cement	873 kg	622 lb
coarse agg.	1103 kg	1860 lb.
fine agg.	685 kg	1164 lb

(2)

specifically, to make one trial batch (0.03 m³ or 1 ft³), we need:

	(metric)	(English)
water	4 kg	8.5 lb
Portland Cement	11 kg	23 lb
coarse agg.	33. kg	69 lb
fine agg.	21 kg	43 lb.

(1)

final Solution.

IF No SI units, take off (2)
(or English)

(3)