

Civil Engineering Materials | (2nd Edition)

Problem

Mix design calculations show a dry mix of 1C :2FA :3.5CA :0.55W by weight. The moisture content and absorption of coarse aggregate are 3 percent and 1 percent, respectively, and of fine aggregate, 8 percent and 3 percent, respectively. Find the field mix proportions.

Step-by-step solution

Step 1 of 8

Calculate the weight of the cement by using the following formula:

Consider the mix design as following below:

$$\text{mix} = 1C : 2FA : 3.5CA : 0.55W$$

Consider the following formula:

$$V_{\text{conc}} = \frac{W_c}{62.4} \left(\frac{1}{3.15} + \frac{2}{2.65} + \frac{3.5}{2.7} + \frac{0.55}{1} \right) + \frac{3 \times 1}{100}$$

Consider 1 yd³ volume

Substitute 1 yd³ for concrete volume.

$$1 = \frac{W_c}{62.4} \left(\frac{1}{3.15} + \frac{2}{2.65} + \frac{3.5}{2.7} + \frac{0.55}{1} \right) + \frac{3 \times 1}{100}$$

$$1 - 0.03 = \frac{W_c}{62.4} (2.9185)$$

$$0.97 = W_c \times 0.046771$$

$$W_c = 20.74 \text{ lb}$$

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Step 2 of 8

Calculate the weights for the fine aggregates, coarse aggregates, and water as following below:

Calculate the weight of the fine aggregates by using the following relation:

$$W_{FA} = 20.74 \times 2$$
$$= 41.48 \text{ lb}$$

Calculate the weight of the coarse aggregates by using the following relation:

$$W_{CA} = 20.74 \times 3.5$$
$$= 72.59 \text{ lb}$$

Calculate the weight of the water by using the following relation:

$$W_w = 20.74 \times 0.55$$
$$= 11.407 \text{ lb}$$

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Step 3 of 8

Calculate the required weight of coarse aggregates by using the following relation:

$$W_{CA(\text{moist})} = W_{CA} + (m_{CA} \times W_{CA})$$

Here, the weight of the coarse aggregates is W_{CA} , and the moisture content of the coarse aggregates is m_{CA} .

Substitute 72.59 lb for W_{CA} , and 3% for m_{CA} .

$$W_{CA(\text{moist})} = 72.59 + (3\% \times 72.59)$$
$$= 72.59 + (0.03 \times 72.59)$$
$$= 72.59 + 2.1777$$
$$= 74.77 \text{ lb}$$

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Step 4 of 8

Calculate the required weight of fine aggregates by using the following relation:

$$W_{FA(\text{moist})} = W_{FA} + (m_{FA} \times W_{FA})$$

Here, the weight of the fine aggregates is W_{FA} , and the moisture content of the fine aggregates is m_{FA} .

Substitute 41.48 lb for W_{FA} , and 8% for m_{FA} .

$$W_{FA(\text{moist})} = 41.48 + (8\% \times 41.48)$$
$$= 41.48 + (0.08 \times 41.48)$$
$$= 41.48 + 3.3184$$
$$= 44.79 \text{ lb}$$

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Step 5 of 8

Calculate the free moisture in coarse aggregates as following below:

$$\text{Free moisture in CA} = m_{CA} - \text{absorption capacity of CA}$$

Substitute 3% for m_{CA} and 1% for absorption capacity of CA.

$$\text{Free moisture in CA} = 3\% - 1\%$$
$$= 2\%$$

Calculate the free moisture in fine aggregates as following below:

$$\text{Free moisture in FA} = m_{FA} - \text{absorption capacity of FA}$$

Substitute 8% for m_{FA} and 3% for absorption capacity of FA.

$$\text{Free moisture in FA} = 8\% - 3\%$$
$$= 5\%$$

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Step 6 of 8

Calculate the net reduction in water as following below:

$$W_{w(\text{net reduction})} = \text{free moisture in CA} \times W_{CA(\text{moist})} + \text{free moisture in FA} \times W_{FA(\text{moist})}$$

Substitute 2% for free moisture in CA, 74.77 lb for $W_{CA(\text{moist})}$, 5% for free moisture in FA, and 44.79 lb for $W_{FA(\text{moist})}$.

$$W_{w(\text{net reduction})} = (2\% \times 74.77) + (5\% \times 44.79)$$
$$= (0.02 \times 74.77) + (0.05 \times 44.79)$$
$$= 1.4954 + 2.24$$
$$= 3.735 \text{ lb}$$

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Step 7 of 8

Calculate the net mixing water required by using the following relation:

$$\text{net mixing water required} = W_w - W_{w(\text{net reduction})}$$

Substitute 11.407 lb for W_w and 3.735 lb for $W_{w(\text{net reduction})}$.

$$\text{net mixing water required} = 11.407 - 3.735$$
$$= 7.67 \text{ lb}$$

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Step 8 of 8

Consider the filed mix quantities as following below:

$$\text{weight of the cement} = 20.74 \text{ lb}$$

$$\text{weight of the fine aggregates} = 44.79 \text{ lb}$$

$$\text{weight of the coarse aggregates} = 74.77 \text{ lb}$$

$$\text{weight of the water} = 7.67 \text{ lb}$$

Calculate the filed mix proportions as following below:

$$\text{Field mix design} = 20.74C : 44.79FA : 74.77CA : 7.67W \dots\dots (1)$$

Divide the equation (1) with 20.74

$$\text{Field mix design} = \frac{20.74}{20.74} C : \frac{44.79}{20.74} FA : \frac{74.77}{20.74} CA : \frac{7.67}{20.74} W$$
$$= 1C : 2.16FA : 3.6CA : 0.37W$$

Therefore, the filed mix proportions are 1C : 2.16FA : 3.6CA : 0.37W.

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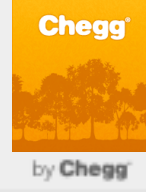
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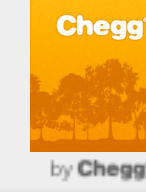
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