Proportioning Concrete

- Concrete mix designs are often given by a ratio:

  - Crushed rock : Sand : Cement

- Usually the ratio is in terms of weight of the components

Proportioning Concrete

- The cylinders for Project 2 are always 6 inches in height and 3 inches in diameter

Proportioning Concrete

- Concrete mix designs are often given by the following ratio:

  - 1:2:2

  - Coarse Aggregate – crushed rock
  - Fine Aggregate – sand
  - Cement

- In this case, the ratio implies 1 part (by weight) of cement to 2 parts coarse aggregate to 2 parts fine aggregate

Proportioning Concrete

- Part of your design for this project is to develop mix ratios that lead to high compression stresses at failure.

- The two criteria for a successful mix ratio are:
  1. High compressive stress
  2. Adequate workability

Proportioning Concrete

- Once a mix ratio is selected, you need to compute the amounts of cement, water, and aggregates required.

- To start, we need to estimate the volume of concrete required for the job.

- In your work, we used cylinder molds to form our concrete specimens

Proportioning Concrete

- The volume of a cylindrical mold is:

  \[ V_{cylinder} = \frac{\pi h D^2}{4} \]

  where \( D \) is the diameter of the cylinder and \( h \) is the height

- The cylinders for Project 2 are always 6 inches in height and 3 inches in diameter

Proportioning Concrete

- How much concrete do we need to make 5 cylinders?

  \[ V_{cylinder} = 5 \left( \frac{\pi (6 \text{ in.}) (3 \text{ in.})^2}{4} \right) = 212 \text{ in.}^3 \]

  We need 5 cylinders

  \[ V_{total} = 212 \text{ in.}^3 \]
Proportioning Concrete

Next, we need to convert this volume to cubic feet and account for any errors

\[
Volume_{\text{total}} = 212 \text{ in.}^3 \times \left( \frac{1 \text{ ft.}^3}{(12 \text{ in.})^3} \right) = 212 \text{ in.}^3 \times \frac{1 \text{ ft.}^3}{1,728 \text{ in.}^3}
\]

Make sure you have enough factor

\[
Volume_{\text{total}} = (0.123 \text{ ft.}^3) \times MSYHEF
\]

\[
Volume_{\text{total}} = (0.123 \text{ ft.}^3) \times 2 = 0.25 \text{ ft.}^3
\]

Proportioning Concrete

Next, we need to convert this volume to an equivalent weight of concrete

\[
Weight_{\text{concrete}} = 0.25 \text{ ft.}^3 \times \left( \frac{150 \text{ lb.}}{\text{ft.}^3} \right) = 37.5 \text{ lb.}
\]

To compute the amount of each component required for this mix, use the ratio of the each component to the sum of all components

For a 1:2:2 mix, the weight of cement required is 1/5 of the total weight

\[
Weight_{\text{cement}} = \left( \frac{1}{5} \right) \times 37.5 \text{ lb.} = 7.5 \text{ lb.}
\]

To compute the amount of each component required for this mix, use the ratio of the each component to the sum of all components

For a 1:2:2 mix, the weight of fine aggregate required is 2/5 of the total weight

\[
Weight_{\text{fine aggregate}} = \left( \frac{2}{5} \right) \times 37.5 \text{ lb.} = 15 \text{ lb.}
\]

To compute the amount of each component required for this mix, use the ratio of the each component to the sum of all components

For a 1:2:2 mix, the weight of coarse aggregate required is 2/5 of the total weight

\[
Weight_{\text{coarse aggregate}} = \left( \frac{2}{5} \right) \times 37.5 \text{ lb.} = 15 \text{ lb.}
\]

Proportioning Concrete

Next, we need determine the amount of water required

The weight of water is specified by the w/c ratio

In this example, the w/c = 0.45

For this mix, the weight of cement is 7.5 lb. Therefore, the weight of water required is:

\[
Weight_{\text{water}} = 7.5 \text{ lb.} \times (0.45) = 3.4 \text{ lb.}
\]

Proportioning Concrete

In summary, the weight of each component in 1:2:2 mix with \( w/c = 0.45 \) is:

- Cement: 7.5 lb.
- Fine aggregate: 15.0 lb.
- Coarse aggregate: 15.0 lb.
- Water: 3.4 lb.
Proportioning Concrete

- Typical mixing procedure:
  1. Clean mixer
  2. Add aggregates and mix for 2 minutes
  3. Add cement and mix for 2 minutes
  4. Add ½ of the mixing water and mix for 2 minutes
  5. Add remaining mixing water and mix for 5 minutes

(pay close attention to the concrete in the back of the mixer and make sure that all the materials are well mixed and as homogeneous as possible)

The End