Proportioning Concrete

- ***Concrete*** mix designs are often given by a ratio:

:  : 

Cement Sand Crushed rock

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

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 fine aggregate to 2 parts coarse 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

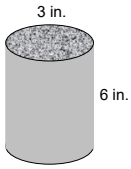
Proportioning Concrete

- The volume of a cylindrical mold is:

$$Volume_{cyclinder} = \frac{\pi h D^2}{4}$$

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



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

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

We need 5 cylinders

$$Volume_{Total} = 212\text{in.}^3$$

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

$$Volume_{Total} = 212\,\text{in.}^3\left(\frac{1\,\text{ft.}^3}{(12\,\text{in.})^3}\right) = \frac{212\,\text{in.}^3\text{ft.}^3}{1{,}728\,\text{in.}^3}$$

Make sure you have enough factor

$$Volume_{Total} = (0.123\,\text{ft.}^3) \times MSYHEF$$

$$Volume_{Total} = (0.123\,\text{ft.}^3) \times 2 = \boxed{0.25\,\text{ft.}^3}$$

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

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

- 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

$$Weight_{cement} = \left(\frac{1}{5}\right) \times 37.5\,\text{lb.} = \boxed{7.5\,\text{lb.}}$$

Proportioning Concrete

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

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

- 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 fine aggregate required is 2/5 of the total weight

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

Proportioning Concrete

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

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

- 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 coarse aggregate required is 2/5 of the total weight

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

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- 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:

$$Weight_{water} = 7.5\,\text{lb.}(0.45) = \boxed{3.38\,\text{lb.}}$$

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.

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- 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)

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Group Problem – 1:2:2 mix with w/c = 0.4 for 5 cylinders

1. What volume of concrete do you need if your MSYHEF = 1.5 — $V = 0.184\ ft^3$
2. What is the weight of concrete for your mix? — $W = 27.61$ lb.
3. What is the weight of cement? — $W_C = 5.50$ lb.
4. What is the weight of fine aggregate? — $W_{FA} = 11.05$ lb.
5. What is the weight of coarse aggregate? — $W_{CA} = 11.05$ lb.
6. For your mix in lab, what is the weight of water? — $W_{water} = 2.2$ lb.

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The End