QUIKRETE®

CEMENT & CONCRETE PRODUCTS™

TRAINING MODULE 2

Concrete & Mortar Mix Ingredients

What's in the Mix?

Standard concrete mixes contain approximately 13-15% cement and 85-87% aggregate (sand & gravel or stone). The cement acts as the "glue" that bonds the aggregate together.

What's in the Mix – Aggregate

The aggregate portion of a concrete mix is usually made up of approximately 50% fine and 50% coarse aggregate.

- **Fine aggregate** can be a natural or manufactured sand, ranging in size from 3/8" to 100 mesh (visualize 100 particles lined up to equal one inch) – just over 10,000 particles in 1" x 1" opening.

- **Coarse aggregate** can be crushed stone or round gravel, with a minimum size of ¼". Packaged concrete typically uses a coarse aggregate with a maximum size of ½".

What is Mortar?

The term Mortar typically refers to a cement mix that contains only fine aggregate. Mortars can be formulated for a variety of purposes from masonry mortars and stuccos to bridge deck and structural concrete repair.

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What are Masonry Mortar & Stucco?

Masonry mortar is a proportional blend of approximately 25% masonry cement (or a blend of portland cement & hydrated lime) and 75% graded fine sand. Stucco formulations are similar to masonry mortar, but use a coarser graded sand.

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Other Ingredients

Concrete mixes also are formulated with other ingredients or admixtures to enhance various performance characteristics.

1. **Fly ash:** Fly ash is a post-industrial byproduct of electrical generation by coal-fired power plants. Fly ash improves workability and can replace up to 30-40% of the Portland cement in a concrete mix. The use of fly ash is also considered a green product because it diverts unused fly ash from a landfill. *Note – With the reduction in coal-fired power plants, fly ash is becoming more and more scarce.*

2. **Air Entraining Admixture:** The use of an air entraining admixture improves the freeze/thaw durability of concrete and prevents scaling. Air entraining additives create billions of microscopic “bubbles” throughout the concrete. These air voids give water an area to fill as it expands as it freezes. Air Entrained concrete mixes will contain 5-7% air voids by volume. Non-air entrained concrete will typically contain about 3% entrapped air (from the mechanical mixing process). The addition of air entraining admixture will also significantly improve the workability and finishing characteristics of concrete.

Other Ingredients (Cont'd)

3. **Water-Reducing Admixture:** The use of a water-reducer makes concrete flow like it contains much more water than it actually does. This characteristic makes placement easier and keeps the water content low for improved concrete strength.

4. **Fiber:** The use of synthetic fibers (polypropylene, nylon, fiberglass) are used to reduce drying shrinkage cracking as the concrete cures. Fiber reinforced concrete can typically eliminate the need for wire mesh for concrete slabs. The fibers in concrete, however, do not replace structural steel such as rebar.

Setting the Standard – ASTM

The American Society of Testing and Materials (ASTM) has developed standards for coarse and fine aggregate gradations that establish proper ranges of aggregate particle sizes for use in concrete, mortars, stuccos and grouts.

The ASTM has also established performance standards for mortar, concrete and cement.

ASTM INTERNATIONAL
Standards Worldwide

Note: structural concrete is designed to meet 2500 psi (will withstand 4000 pounds of weight per square inch before failing) – water expands at 32,000 psi as it freezes.

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Measuring ASTM Standards – Compressive Strength

Concrete Mixes are formulated to achieve specific compressive strengths and to exhibit certain finishing characteristics.

Compressive Strength is presented in psi (Pounds per Square Inch) and represents the force in pounds per square inch that the concrete will withstand before if fails (cracks). Concrete designs are typically described by compressive strength in psi that will be achieved in 28 days (ie. 4000 psi).

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Concrete typically gains about 35% of its designed strength in 3 days and 60% of its strength in 7 days.

Concrete & Mortar Mix Ingredients Quiz

1. Concrete mix contains all but one of the following ingredients:
   a) Gravel
   b) Sand
   c) Lime
   d) Cement

2. Standard concrete mixes contain about 30% cement, by weight.
   a) True
   b) False

3. The term “mortar” typically refers to a cement mix that contains only fine aggregate.
   a) True
   b) False

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Concrete & Mortar Mix Ingredients Quiz

4. In addition to cement, fine aggregate and coarse aggregate, concrete mixes can also be formulated with what other ingredient.
   a) Fiber
   b) Fly Ash
   c) Water Reducing Admixture
   d) Air Entraining Admixture
   e) All of the Above

5. The use of synthetic fibers in concrete can eliminate the need for rebar in concrete slab.
   a) True
   b) False

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Concrete & Mortar Mix Ingredients Quiz

6. Adding air entraining admixture to concrete mix produces the following benefit.
   a) Denser Surface
   b) No Need for Curing
   c) Improved Color Consistency
   d) Improved Freeze-Thaw Durability

7. The testing organization that has developed and maintains concrete, mortar, stucco and grout performance and testing standards is…?
   a) ICRI
   b) ASTM
   c) ACI
   d) AIA

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Concrete & Mortar Mix Ingredients Quiz – ANSWERS

1. C - Lime
2. B - False
3. A - True
4. E - All of the Above
5. B - False
6. D - Improved Freeze-Thaw Durability
7. B - ASTM

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