Portland Cement and Concrete
How Cement Works

Water mixes with Portland cement and starts a chemical reaction – Hydration

- Setting
- Heat
- Shrinking

Faster setting = higher heat = shrinkage cracking (in general)

Cement particles bond to each other over time. The longer they are kept moist, the stronger the bond.
Cement Types

Type I – normal or standard
Type II – Modified, slight sulfate resistance
Type III – High Early Strength, high heat, quick setting
Type IV – Low heat, slow setting
Type V – Sulfate Resistant
Air Entraining

Forms tiny bubbles in the mix
Resists freeze/thaw effects
It is often added at cement plant
IA, IIA, IIIA
Aggregate

Blend of varying sizes – **grading** important for economy of mix

Strength, durability, wear resistance critical

Chemical compatibility with cement and reinforcing steel
Water

Potable or drinkable
Admixtures

Accelerators
Retarders
Water reducers
Plasticizers

Never use admixtures unless they have been called for by the engineer!
Concrete Mixes

Sometimes specified by “sack”
One sack of Portland cement = 94 #
5 sack mix would have 470 # of cement
More precise method is by pounds of each ingredient
Cement
Water
Fine aggregate
Coarse aggregate
Major Tests for Concrete

**Slump test** – workability of the mix

**Air test** – determines the amount of air entraining in the mix

**Temperature** – may be critical in extreme conditions

**Cylinder test** – to determine the design strength at 3, 7, & 28 days

**Core test** – drilled cores from set concrete to test strength
Reinforcing (Rebar)

Reinforcing bars – provide tensile strength for the composite piece

Welded wire fabric – not considered reinforcing if made of light gage wire - reduces cracking and excess shrinkage in slabs
# Rebar Sizes

<table>
<thead>
<tr>
<th>Number</th>
<th>Diameter</th>
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<tbody>
<tr>
<td>#3</td>
<td>3/8”</td>
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<tr>
<td>#4</td>
<td>1/2”</td>
</tr>
<tr>
<td>#5</td>
<td>5/8”</td>
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<tr>
<td>#6</td>
<td>3/4”</td>
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Number is over 8.
Welded Wire Fabric

6x8  W1.4xW2.0

Longitudinal spacing

Transverse spacing

Transverse wire size

Longitudinal wire size
Formwork

Huge hydrostatic loads (150 pcf approx)
Bracing critical
Wall forms require ties through forms
Column forms
Release agent
Weight of Concrete

Consider concrete to weigh about 150 pounds per cubic foot
27 C.F. = about 4000 pounds/ CY
Trucks carry 10 yards = 40,000 #
Trucks weigh about 26,000 #
Total weigh = 66,000 #
Ready Mix Vs. Site Mix

Quality control is main concern
Access to site is a consideration
Small jobs may use sacked concrete @ 80# per sack (about ½ C.F.)
Placing Concrete

Forms braced and leveled. Clean of debris
Move concrete from truck to placing site
  Chute, buggy, pump, bucket, conveyor belt
Consolidate (beware of segregation)
Screed (slab)
Float (slab)
Trowel (slab)
Finish (slab)
Cure
Precast Concrete

Precast
Pre-stressed
  Pre-tensioned
  Post-tensioned