

PCA

Concrete Technology and Codes

Concrete Specifications





Standards and Specifications

- Standards - used for methods, procedures, practices,... step-by-step instructions...
- Specifications - manuals, codes, requirements...
- Performance specifications - specify end results... how it will perform
- Prescriptive specifications - specify exactly what to use



Standard Organizations

- American Society for Testing and Materials (ASTM) - all types of materials including concrete
- American Concrete Institute (ACI) - specifications and codes only... no standards!
- American Society of State and Local Highway Transportation Officials (AASHTO) - bridge and highway standards



Why use standards and specifications?

- Convenience - I need a concrete mix with C618 ash instead of... I need a concrete mix with fly ash that has an LOI of x% and a maximum carbon content of y% and reference compressive strength of z%, etc., etc., etc.



Clarity

- ASTM C150 Portland Cement means the same thing whether you're placing concrete in Anchorage, Alaska or West Palm Beach, Florida or Kandahar, Afghanistan



Safety

- These are consensus standards... they represent the current state-of-the-industry so, if they're used correctly, they can help us build safer structures
- Since they're consensus standards... so, if they're used correctly, they also help limit the designer's liability



What does it mean to meet the standard?

- You've met certain minimum requirements
- Concrete can meet the minimum requirements and still be bad concrete if the workmanship is bad



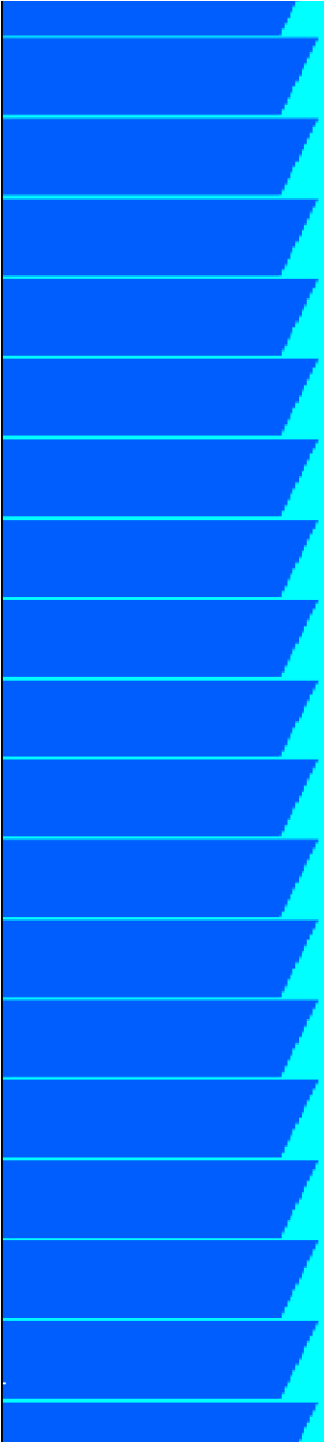
Who's Responsible?

- Architect - Design Issues... the building should look like this and use these materials
- Engineer - Takes the architect's design from finished concept to practice... here are the design loads, member sizes, size, spacing, and amount of rebar, etc.
- Contractor - Decides the means and methods to build the structure



Who's Responsible? Part II

- Subcontractor - responsible for a specific portion of the structure... electrical, mechanical, HVAC, plumbing, dry wall, painting, concrete
- Owner - pays for everything... approves the architects design along with the contract documents... gives authority to his representative



Q/A & Q/C Responsibilities

- Owner - Develop the plan and review/approve the contract documents
- A/E - Creates a design to meet the owner's requirements and regulatory requirements
 - ◆ prepares contract documents
 - ◆ helps choose contractor
 - ◆ accepts/rejects workmanship and materials
 - ◆ evaluates testing/inspection results



Q/A & Q/C Responsibility Part II

- Contractor - comply with the contract documents and schedule inspections
- Suppliers - make sure the materials supplied meet the requirements of contract documents

ACI 301





ACI 301

- Is the standard specification for cast-in-place structural concrete
- You should know that if this specification is used, then more than 70 other standards and specifications are referenced... 301 is an “umbrella” specification
- You should know that designers can either use 301 or individually list 70 specifications

ASTM C143

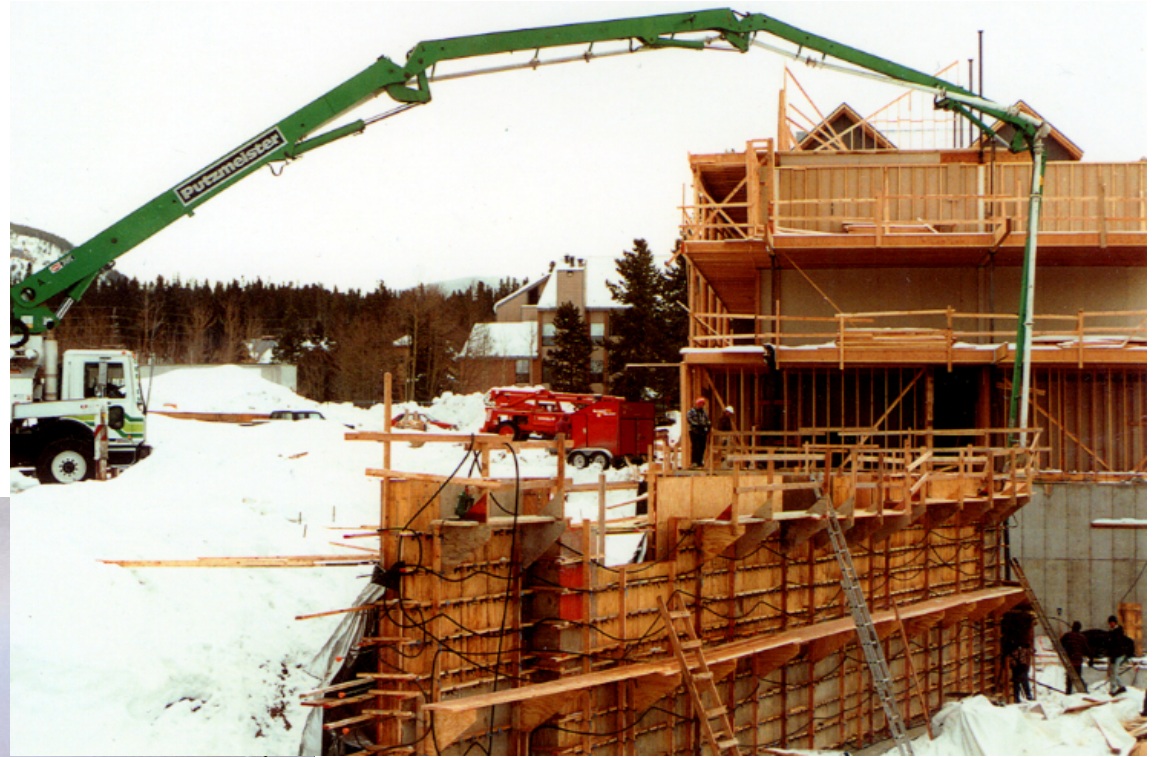




Slump Test for Concrete

- Details the test procedure for slump test for portland cement concrete
- You should know that the test is the most basic test of fresh concrete available but doesn't tell you anything about the quality of the concrete

ACI 305/306





ACI 305/306

- Specifies what is cold and hot weather
 - ◆ cold is 3 consecutive days where the adt is 40°F or less and the temperature doesn't go above 50°F for more than 12 hours
 - ◆ hot weather can mean... high ambient temperature, high concrete temperature, low relative humidity, high wind, or solar radiation
- You should know that certain weather conditions will require that certain precautions must be taken

ACI 211.1





ACI 211.1

- Specifies how a concrete mixture is proportioned
- You should know that concrete mixtures are designed for strength and durability concerns and any changes will impact the strength and durability of the concrete

ACI 318





ACI 318/349

- Provides the building code requirements used for concrete construction
- You should know that these requirements give specific guidance on what to do if the concrete doesn't meet the specified strength



ASTM C31

- Making and curing test specimens in the field
- You should know the difference between initial curing, final curing, and field curing

ASTM C33





ASTM C33

- Defines the grading and quality requirements for concrete aggregates
- You should know that;
 - ◆ not all aggregates are created equally
 - ◆ aggregates can meet C33 and yet give gap-graded or poorly graded concrete mixtures

ASTM C39





C39

- Defines testing procedures for compressive strength concrete test cylinders
- You should know that there are rigid requirements that testing machines need to meet

ASTM C 94





C94

- Covers all aspects of ready mixed concrete
- You should know that this specification gives information on;
 - ◆ ordering options
 - ◆ air content tolerances
 - ◆ scale and weight tolerances
 - ◆ required batch ticket information
 - ◆ sampling procedures



More C94...

- ◆ Batch-to-placement time limitations
- ◆ Batch-to-placement mixing revolution limitations
- ◆ information on the addition of water at the job site

ASTM C 150





C150

- Covers the physical and chemical requirements for portland cement used to produce concrete
- You should know that producers won't sell portland cement that doesn't meet C150



C595

- Specification for Blended Cements
- Covers portland blast furnace slag cement (Type IS) and portland-pozzolan cement (Type IP)
- You should know this is a prescriptive spec



C1157

- Performance specification for hydraulic cements
- Physical performance test requirements
- No prescriptive restrictions on ingredients or cement chemistry



Material Specifications for SCMs

- ASTM C618 - Fly ash and natural pozzolan
- ASTM C989 – Slag cement
- ASTM C1240 – Silica fume

ASTM C172





C172

- Sampling procedures for fresh concrete
- You should know that;
 - ◆ composite samples are required
 - ◆ all material must be sampled within a 15 minute period
 - ◆ tests must be performed within 5 minutes after the last portion of the sample is obtained
 - ◆ cylinders must be cast within 15 minutes after...

ASTM C173





C173

- Air content by volumetric method
- You should know that;
 - ◆ this method can be used with any type of concrete aggregate
 - ◆ this method doesn't tell you how much air is entrapped or entrained
 - ◆ it does tell you the total air content

ASTM C231





C231

- Air content by pressure method
- You should know that
 - ◆ only used for concrete with relatively dense aggregates
 - ◆ requires that the apparatus be calibrated
 - ◆ requires an aggregate correction factor

ASTM C309





C309

- Curing compounds
- You should know that
 - ◆ these compounds should be sprayed, rolled, or brushed in temperatures above 40°F
 - ◆ they should be non-reactive
 - ◆ they should restrict the loss of water to 0.55 kg/m² in 72 hours
 - ◆ they should have a daylight reflectance of at least 60%



More on C309

- ◆ They should be dry to the touch in 4 hours
- ◆ they can be either Type 1 - clear or translucent and with or without a fugitive dye
- ◆ Type 2 - white pigmented

ASTM C470





C470

- Molds for forming concrete vertically
- You should know that molds have to meet specific requirements and that not all molds are reusable



C511

- Moist cabinets, moist rooms, water storage tanks
- You should know that compressive strength test cylinders need to be stored in a moist condition once they reach the laboratory until they are tested



Summary

- ASTM Vol 04.01
- ASTM Vol 04.02
- ACI MCP