What's in your Concrete Specification, and what does it mean?

Opening Comments

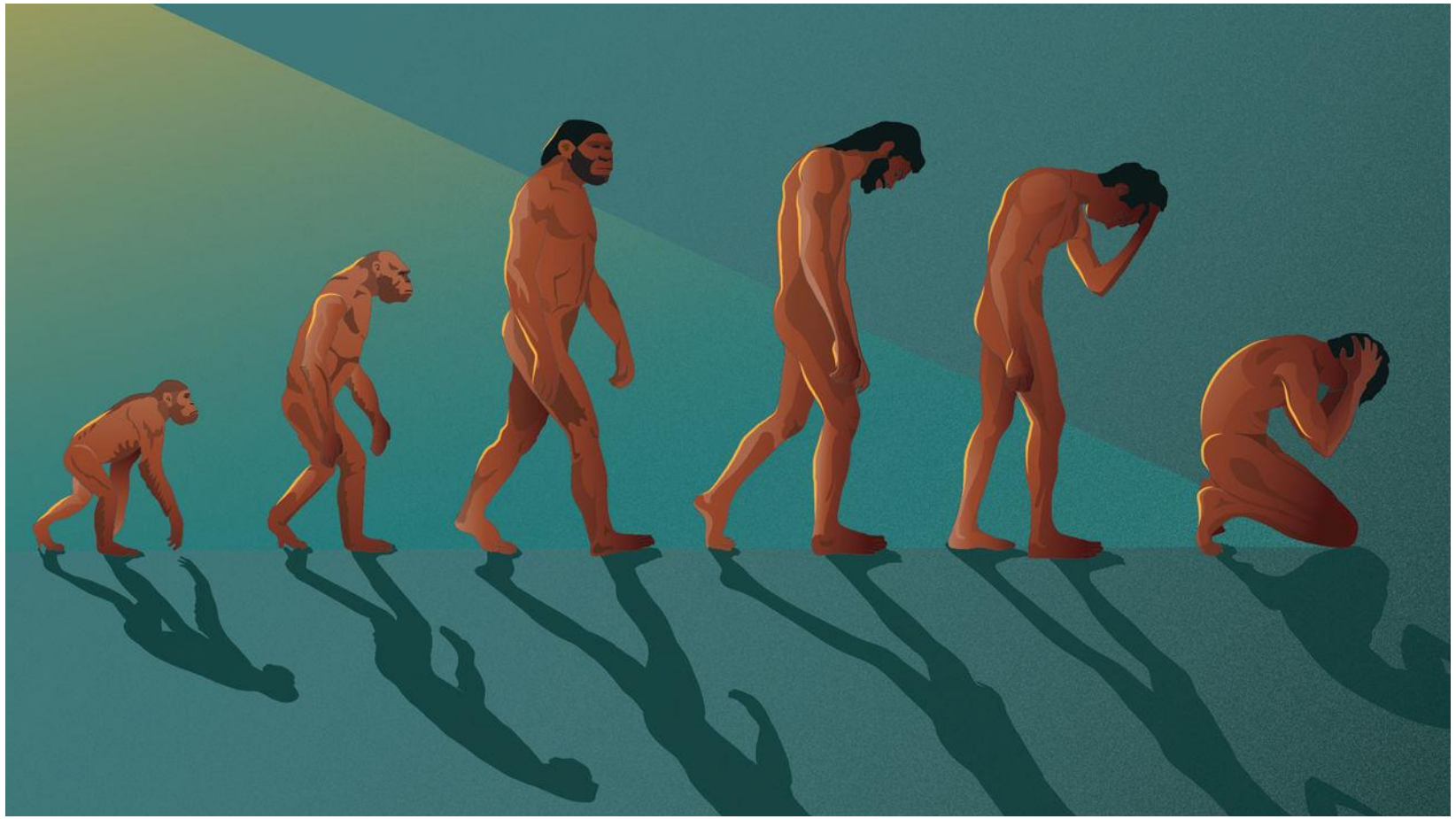
- Anti-Trust Statement
- Recording this webinar
- IRMCA website www.irmca.org

Webinar Sponsors

Today's Speakers

- Scott Kelly - Ozinga Director of Technical Services
- Gary Hall - Prairie Material Technical Services

Evolution of the Specification



Reference Standards and Specifications

- ACI 301-20, Specifications for Structural Concrete
- ACI 318-19, Building Code Requirements for Structural Concrete
- ASTM C94/C94M-21, Standard Specification for Ready-Mixed Concrete
- IDOT SSRBC (2016) and Supplemental Special Provisions (2021)
- AASHTO – FHWA Standard Specifications for Construction of Roads and Bridges for Federal Highways

Is your specification current?

- Are the standards you have listed still active? Have they been updated or withdrawn?
- Is there redundancy or conflict in your specification?
- Are there prequalification requirements that could be satisfied by allowing existing results from agencies such as IDOT?

Does your specification reference codes or standards which aren't enforced?

- Concrete Field Curing Boxes (ASTM C31)
- Testing for Density of Concrete (ASTM C138)
- Concrete Curing and Protection in hot and cold weather

Prescriptive Specifications

Examples:

- Minimum cement or cementitious contents
- Maximum water to cementitious ratios
- Limits on Slump
- Aggregate ratios or minimum contents

Undesirable Risks:

- Increased risk of shrinkage and curling
- Increased crack risk
- Decreased workability and placement issues
- Decrease in durability
- Increased cost

Guide to Compressive Strength vs. Water to Cementitious Ratios[1]

Compressive Strength	w/c+p Ratio	Notes
3000	0.60	
3500	0.55	
4000	0.50	Maximum 0.45 in F/T applications
4500	0.45	
5000	0.40	

[1]https://www.nrmca.org/association-resources/research-and-engineering/specification-in-practice-sip/

Limits for Supplementary Cementitious Materials

Supplementary cementitious material	Maximum percent of total cementitious material by mass*
Fly ash or natural pozzolans conforming to ASTM C618	25
Slag cement conforming to ASTM C989/C989M	50
Silica fume conforming to ASTM C1240	10
Total of fly ash or natural pozzolans, slag cement, and silica fume	50†
Total of fly ash or natural pozzolans and silica fume	35†

*Total cementitious material also includes ASTM C150/C150M, C595/C595M, and C1157/C1157M cement. The maximum percentages above shall include:

(a) Fly ash or natural pozzolans present in ASTM C1157/C1157M or C595/C595M Type IP blended cement.

(b) Slag cement present in ASTM C1157/C1157M or C595/C595M Type IS blended cement.

(c) Silica fume conforming to ASTM C1240 present in ASTM C1157/C1157M or C595/C595M Type IP blended cement.

†Fly ash or natural pozzolans and silica fume shall constitute no more than 25 percent and 10 percent, respectively, of the total mass of the cementitious materials.

Class F3 Exposure Class Only!

Performance Specifications

- Allows designer to target specific performance criteria
- Considers means and methods of placement
- Allows use of more sustainable and locally sourced materials
- Promotes new technologies in concrete materials and production

Concrete Admixtures ASTM C494/C260

- Type A Water Reducing
- Type B Retarding
- Type C Accelerating
- Type D Water Reducing and Retarding
- Type E Water Reducing and Accelerating
- Type F Water Reducing, high range
- Type G Water reducing, high range, and retarding
- Type S Specific Performance
- ASTM C260 Air Entrainment

Concrete Admixtures C494 Type S

- Shrinkage Reducers
- Corrosion Inhibitors
- Viscosity/Rheology Enhancing
- Anti-Washout
- Permeability Reducing
- Moisture Vapor Reducing
- Water Proofing
- Integral Sealing
- Carbon Mineralization
- Strength Enhancing
- Slump Retention

Fiber Reinforcement ASTM 1116

- Monofilament
- Fibrillated
- Macro Synthetic
- Steel

Jobsite Acceptance of Concrete

- Verify mix on delivery ticket
- Sampling of fresh concrete ASTM C172
- Slump/Flow ASTM C143/C1611
- Temperature ASTM C1064
- Air Content Pressure Method/Volumetric ASTM C231/C173
- Density (Unit Weight) ASTM C138
- Casting/Storage of cylinders/beams ASTM C31

Concrete Field Testing Equipment

Jobsite testing and cylinders: ACI 301&318 ASTM C31, C39, C172

- Basics of cylinder casting and storage prevent major problems for all participants on a project
- ACI 301 states contractors must provide space and electricity onsite for initial curing of concrete specimens
- Ensure suitable ambient conditions: protection from temps, sunlight, and wind
- Ensure ground is level
- Ensure cylinders are transported safety within 48 hours to lab
- During pre-construction create distribution list for all parties

Acceptable Jobsite Cylinder Storage

Poor Cylinder Storage and Transport

Low Concrete Cylinder Strengths

- Verify cylinder results
  - Check accompanying testing data
  - Type of cylinder fracture
  - Improper casting, handling, and curing
  - Excessive water addition
  - Adherence to ACI and ASTM prevent these issues
- Verify in-place strength
  - Create a process to verify in-place strength and responsibility
  - Determine strength of needed structure
  - Penetration Resistance Test
  - Core Test
  - Petrography

ACI 305R and 306R Hot and Cold Weather

- Hot Weather concerns
  - Concrete cooling predominant concern
  - Address controllable jobsite conditions
    - Wet subgrade
    - Wind blocks
    - Use admixtures to assist placement
    - Adequate labor to place and finish
    - Protect test cylinders
- Cold Weather concerns
  - Concrete heating predominant concern
  - Address controllable jobsite conditions
    - Manage site ambient temperatures
    - Wind blocks, tarping, walls
    - Use admixtures to assist placement
    - Adequate labor to place and finish
    - Protect test cylinders

In both hot and cold weather, storage of concrete specimens must be within 60 to 80 °F.

Production Of Concrete In Hot Weather

- Sprinkling/misting of aggregate stockpiles (Evaporative Cooling)
- Chilled Water
- Addition of ice to replace portion of batch water
- Liquid Nitrogen systems
- Use of retarding/hydration stabilizing admixtures to control setting time
- Night time placement of concrete

Liquid Nitrogen Systems

Production Of Concrete In Cold Weather

- Hot water
- Steam pads for sand
- Steam systems in aggregate silos
- Use of accelerating admixtures to control set time

Hot Water/Steam Systems

Do Your Specifications Allow All Cements?

Cement Types available for all concrete mixes:

- ASTM C150 / AASHTO M 85 (prescriptive)
- ASTM C1157 (performance)
- ASTM C595 / AASHTO M 240 (blended)

Portland-Limestone Cement (PLC)

- 1:1 replacement and performance
- Same durability and resilience
- 10% carbon footprint reduction
- www.greenercement.com

plc
portland-limestone cement

Allowing Portland-Limestone Cement is Easy

Look in the ”Cement” section of your specifications

- Include ASTM C595 and C1157 Type IL alongside ASTM C150
- Include AASHTO M 240 Type 1L alongside AASHTO M 85

Accepted nationally

- American Concrete Institute (ACI) Building Code
- Federal Highway Administration (FHWA) specifications
- Federal Aviation Administration (FAA) specifications
- American Institute of Architects (AIA) MasterSpec

Accepted locally

- IDOT and CDOT
- Illinois Tollway

Fly Ash – ASTM C618

Supplementary cementitious material

- Byproduct from burning coal in power generating plants
- Two types – Class C and Class F

Advantages

- Increased workability
- Reduced permeability
- Improved sulfate resistance
- Improved ASR mitigation

Typical amounts in concrete mixes

- Class F used at dosages between 15 and 25 percent
- Class C used at dosages between 15 and 40 percent

Slag – ASTM C989

Supplementary cementitious material

- Byproduct of iron and steel-making from a blast furnace
- Three types – Grades 80, 100, and 120

Advantages

- Increased workability
- Reduced permeability
- Improved sulfate resistance
- Improved ASR mitigation

Typical amounts in concrete mixes

- Direct replacement for portland cement up to 95 percent
- 40 to 50 percent replacement is most commonly used

E-Ticketing

- E-Ticketing has become an increasing request within DOTs due to safety factor of COVID 19 and data management
- Pilot programs being created to refine and implement E-ticketing
- Electronic delivery ticket and batch weight
- Simple distribution list established at pre-pour
- Eliminates paper copies and “lost” tickets so all relevant parties have documentation
- ASTM finally removed the provision within C94 that mandated paper tickets

Closing Comments

- Concrete Specifications Review
- Next Webinar is on June 2nd 12:00 PM CST

Concrete 101 – The Basics of Concrete

- Theron Tobolski Assistant Executive Director Illinois Ready Mixed Concrete Association
- Registration Opens on Monday May 24th 2021
- Free Engineering Assistance

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