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What Makes Durable Concrete?
A Cement/Admixture Perspective
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Understanding “Lisa G”

- Limestone
- Iron
- Silica
- Aluminum
- Gypsum
Cement Properties

CaO
MgO
C4AF
C3S
C3A
C2S
Gypsum

Essroc - Italcementi Group
C3A

- Gypsum added to control flash set

Reaction of tricalcium aluminate in gypsum solution
C3A Durability Concerns

- Subject to sulfate attack
- Potential DEF with high curing temperatures (above 158F)
Alkali Durability Concerns

- Responsible for ASR and ACR
- Water Soluble Alkalis are the culprit
Calcium Hydroxide

- Carbonation (lowers steel corrosion resistance)
- Easily reacts with acids
- Sulfate Attack

Approximately 25% of hydration product
What chemical is responsible directly or indirectly for the majority of concrete durability issues, including: ASR, sulfate attack, corrosion, freeze/thaw?
Chemical Admixtures

• Properties that decrease durability
  – Overdosing
  – High chloride content
How Chemical Admixtures Increase Durability

- Air Entrainers
- Lithium based
- Corrosion inhibitors
- Water reducers
- Water repellents
- Shrinkage Reducers
Mineral Admixtures

- Class F Fly Ash
- Slag
- Silica Fume
- Metakaolin
- Other Pozzolans
Benefits of SCM’s

• Consume Alkalies and Calcium Hydroxide
• Decreases Permeability
• Increases Strength
• Increases Durability
Use SCM’s and Admixtures whenever possible