Physical Properties and Characteristics Affecting The Sensitivity To Cracking of Concrete Repair Materials

ACI 364.16T

Honoring the Contributions of Fred Goodwin

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Beauty of a technote

- Condensed information

Overall, the requirement for long-lasting monolithic behavior is that the repair materials have properties and dimensional behavior that will make them compatible with the existing concrete substrate for the application considered. Dimensional compatibility is defined as a balance of strains between a repair material and the existing substrate, such that the composite repair system withstands all stresses induced by the various volume changes without distress and deterioration over a designed period of time.

- If your repairs do this – you will be fine

Why do cracks matter?

- Open pathway for water and aggressive agents
  - Corrosion
  - Freeze-thaw
  - Salt attack
  - Sulfates
  - Etc.
- They look nasty
  - Confidence in a structure
  - Contractor call backs

Concrete materials – why do they crack?

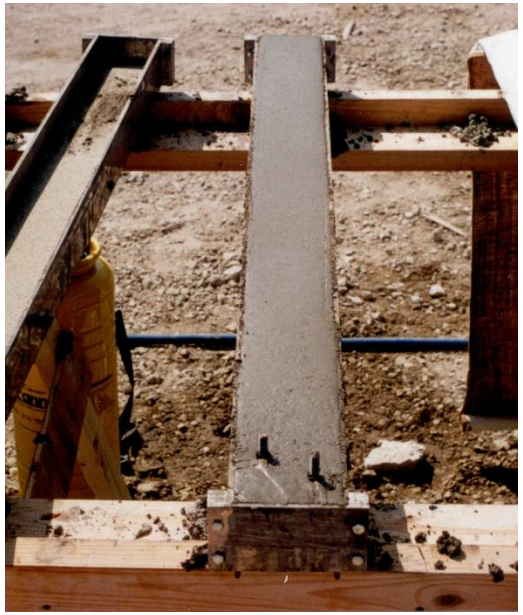
- All cementitious materials can crack
  - Yes, this is true
- Tensile strain capacity is exceeded
  - Load
  - Structural displacement
  - Restraint of shrinkage
  - Etc.
- Restraint of shrinkage
  - Shrinkage due to:
    - Loss of water (drying shrinkage):
      - Evaporation prior to initial set
      - Evaporation after initial set
    - Chemical shrinkage

How to control cracking – New construction?

- Locate the cracks where we want them
  - Joints
    - Contraction
    - Expansion
    - Isolation
- Provide mechanisms shrinkage dissipation
  - Checkerboard placement
  - Limit placement sizes
- Precompression / expansive materials
  - Post-tensioned members
  - Type K cements

Concrete repair materials – ACI 364.16T

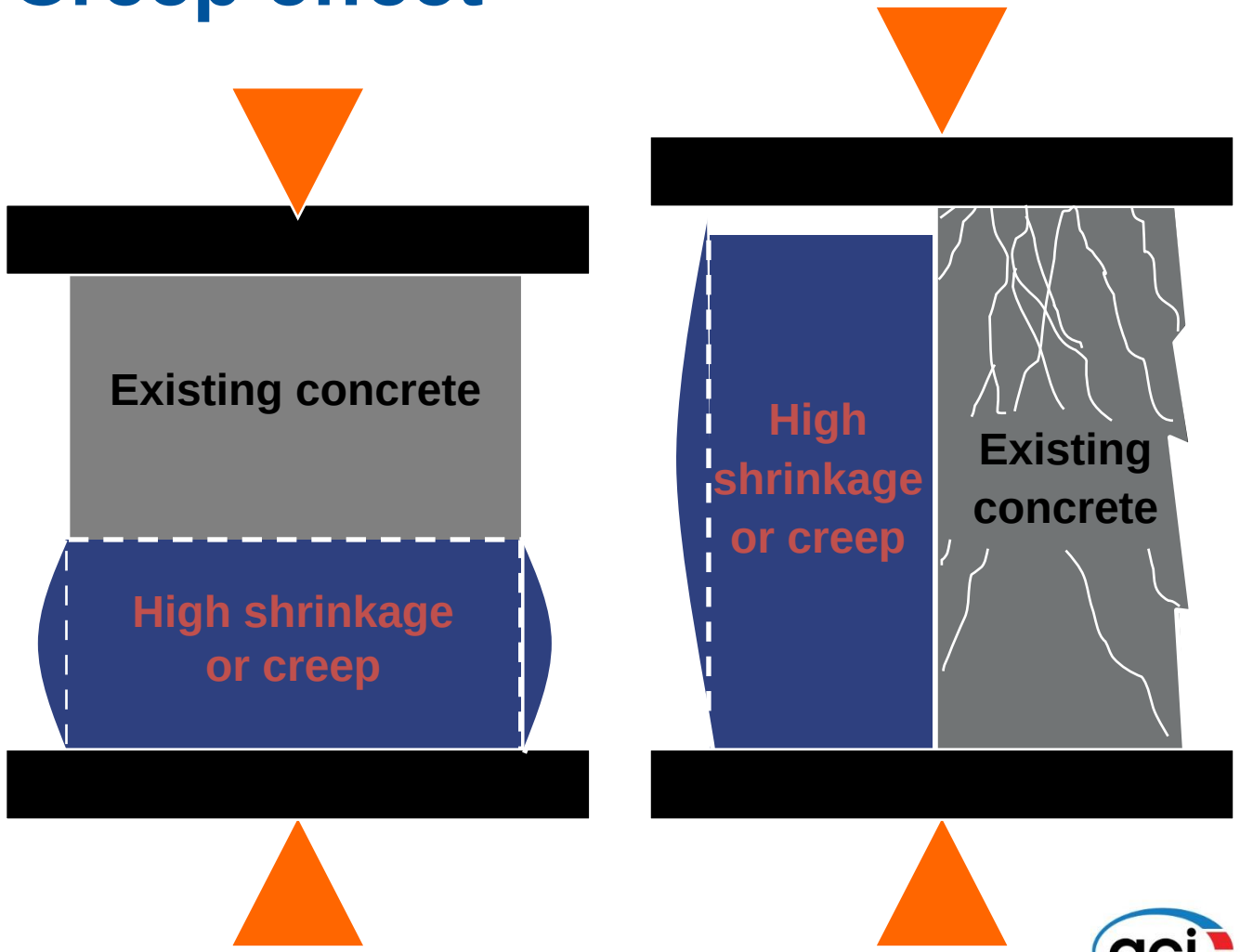
- Repairs are more sensitive than new construction
  - Repair = existing structure = more restraint
  - Faster strength gain = more shrinkage (in general)
- More restraint = more cracking potential



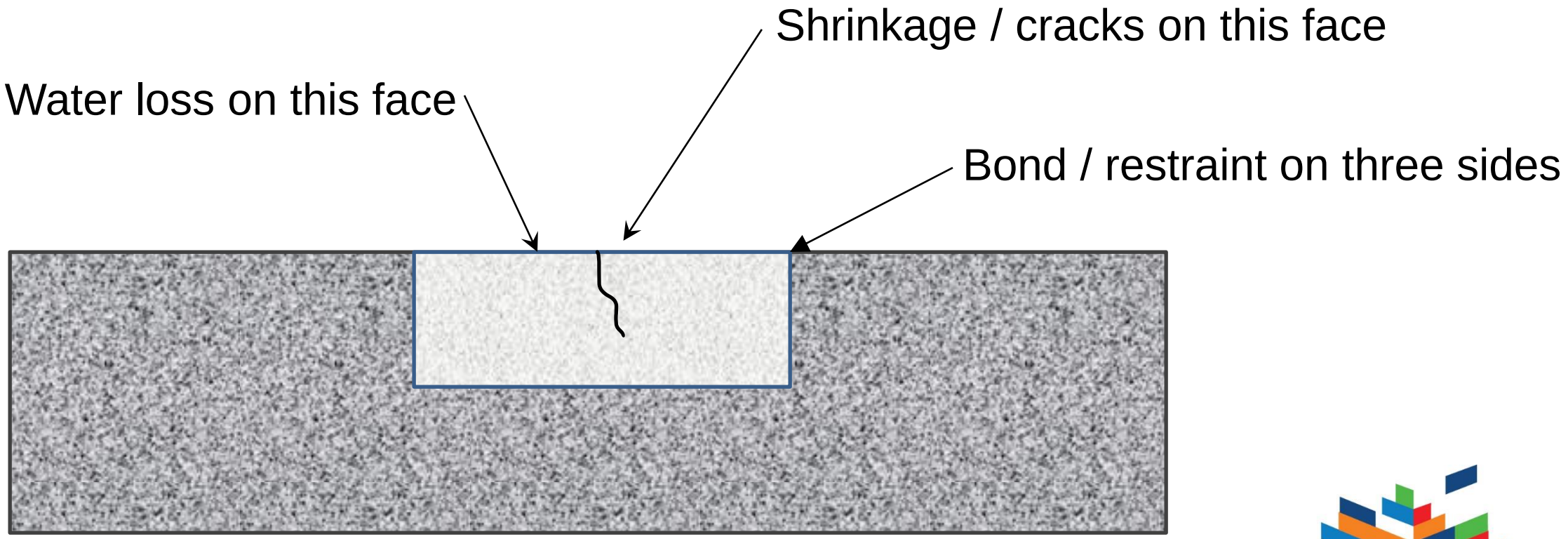
Dimensional compatibility

- Repair materials
  - Restrained shrinkage potential
    - Why not just “drying shrinkage”
  - Modulus of elasticity
  - Creep – tensile and compressive
  - Note that all of these properties vary with time as curing occurs
- Existing structure
  - Where does the water go?
  - Restraint based upon repair geometry
  - Movement in response to loads
  - Movement in response to temperature

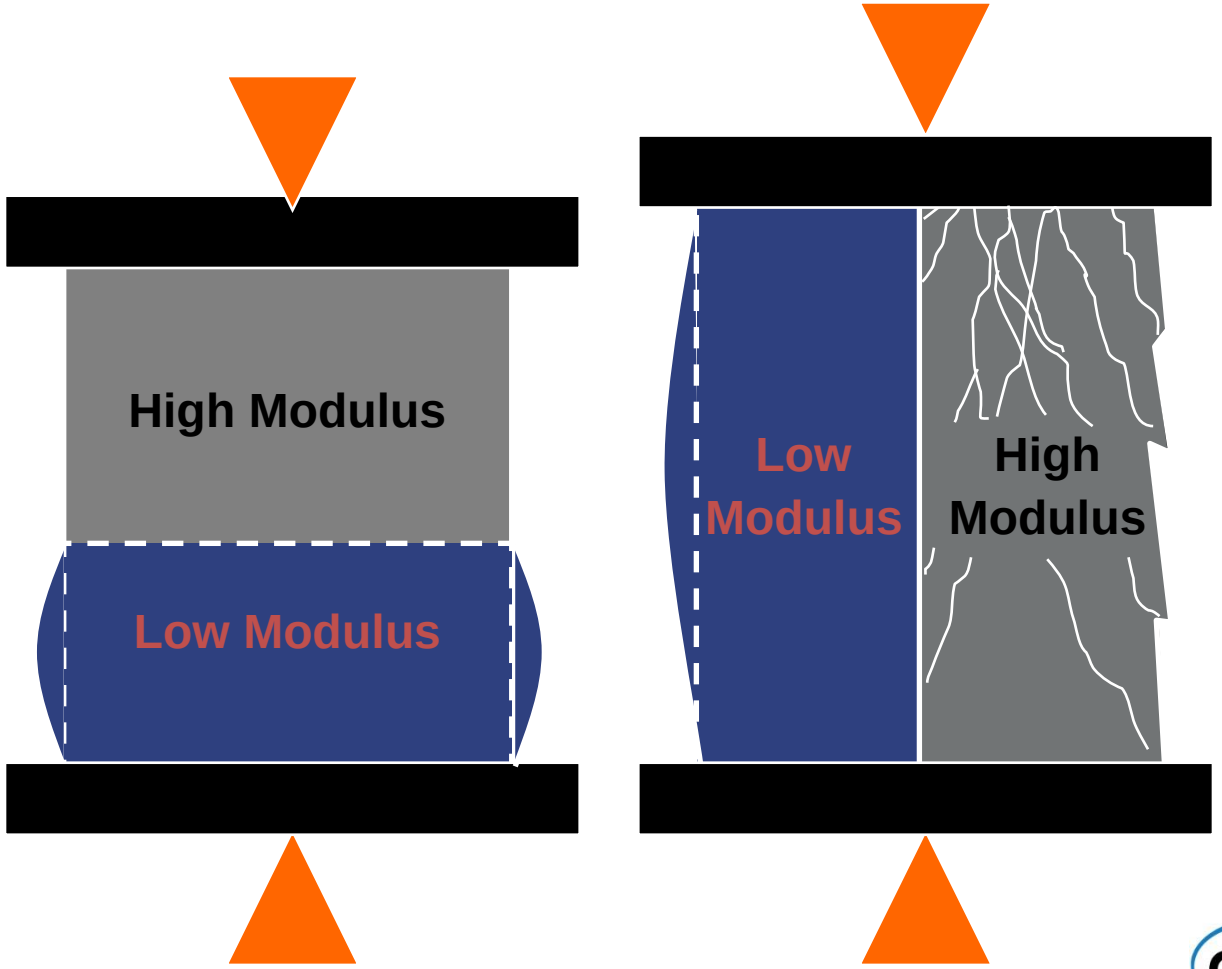
Shrinkage / Creep effect



Shrinkage - restraint

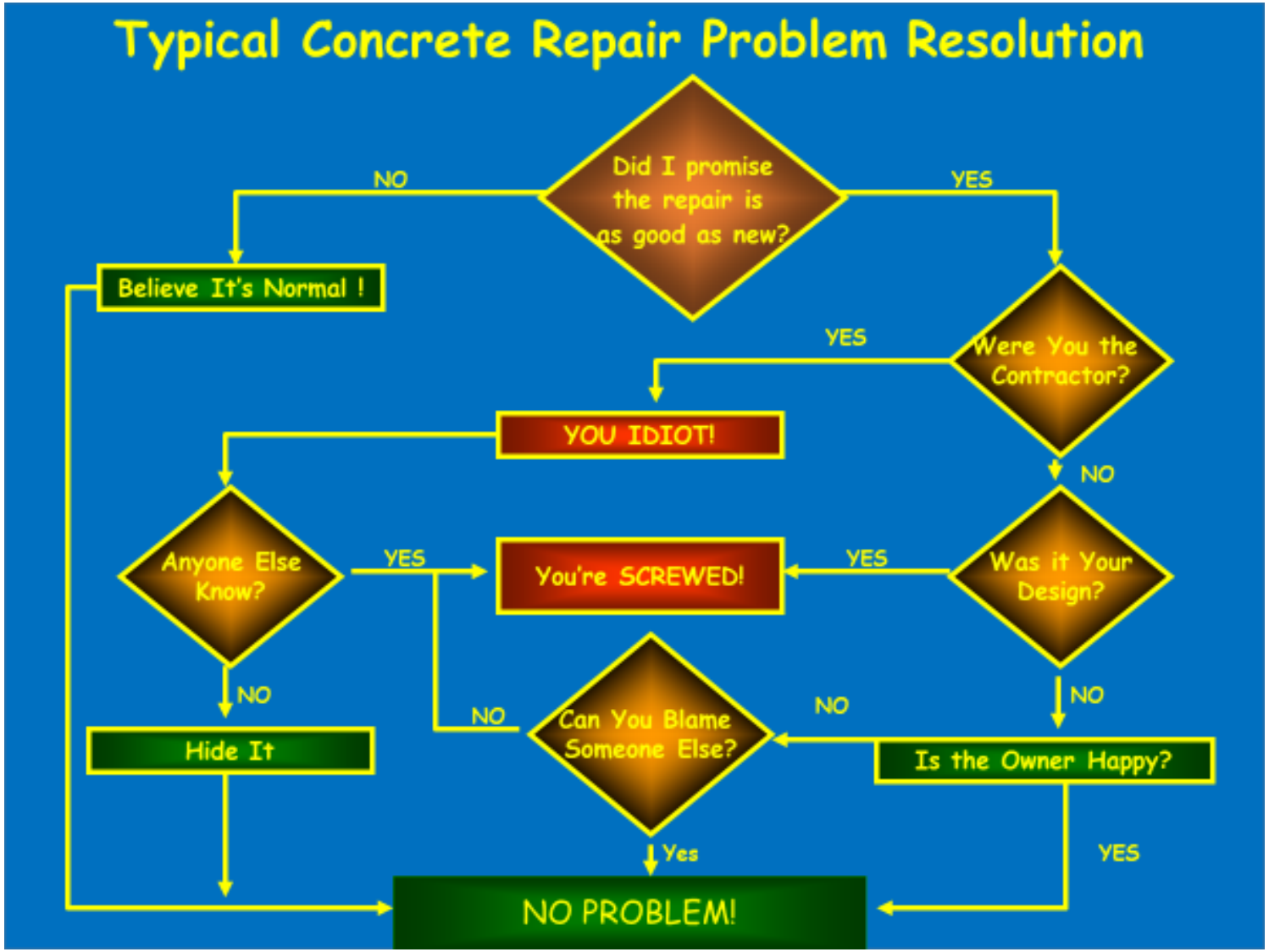


Modulus of elasticity



Limiting cracking in repair materials

- Evaluate “extensibility”
  - Hard to do
- Restrained shrinkage
  - Coutinho ring - ASTM C1581
  - Plate test
- Material properties
  - Match to substrate (if possible)
  - Minimize drying shrinkage
  - Curing



Wisdom of Fred Goodwin

Impact of Fred Goodwin

- Industry
  - Tremendous technical resource
  - Advanced concept of repair as a distinct practice from new construction
- As an ACI committee chair
  - Documents, documents, documents
  - Leadership
- As an ACI TAC member
  - Made sure you followed the rules
  - All committees were important

Impact of Fred Goodwin on ACI

- He made it okay to change firms
- He made it okay to use ~~goofy~~ fun slides
- He made everyone welcome at ACI
- Thank you from all of us