











## Misconceptions on requirements for repair overlays to concrete structures



Nicholas Jarratt







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## Contents

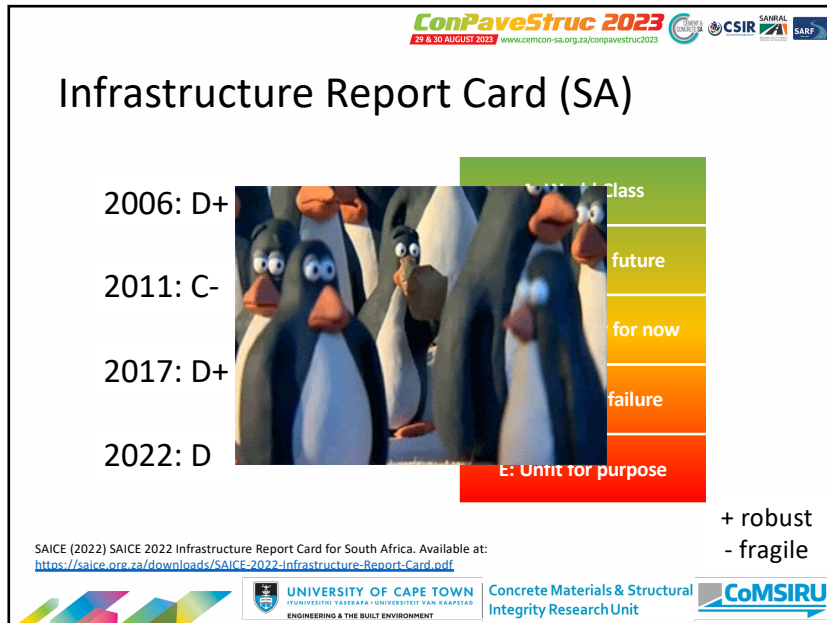
- The need for repairs
- How are repairs performing?
- Causes of concrete damage and the consequences.
- The need for high strength repair materials...really?
- Surface conditions of the substrate. Is saturated surface dry really beneficial?



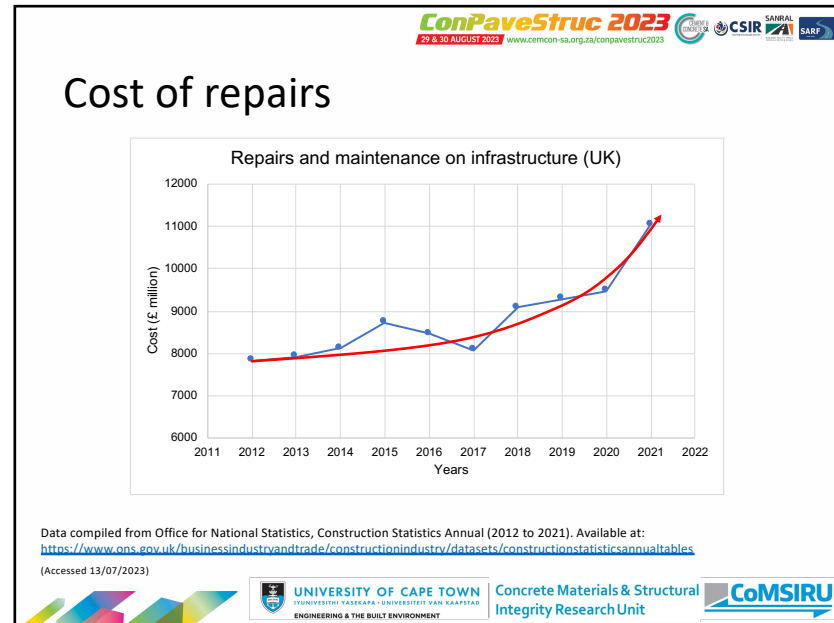




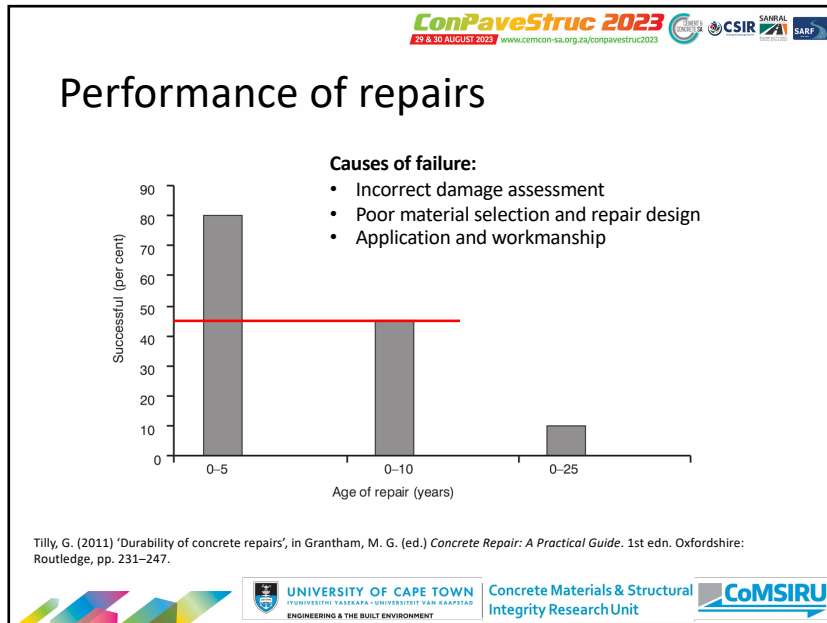
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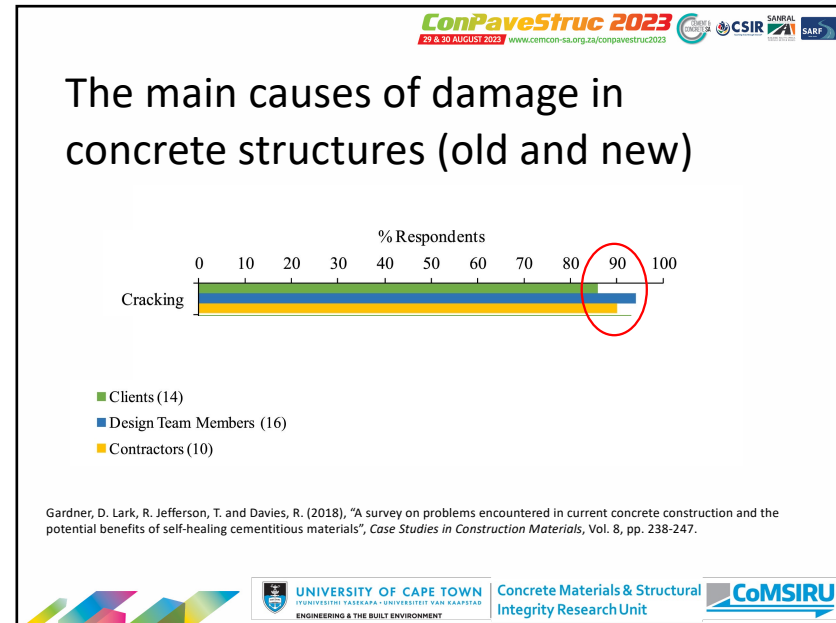
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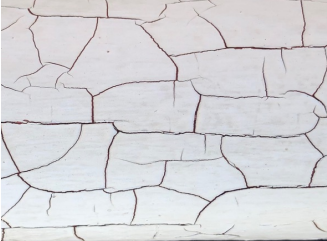
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### Cracking in repairs

- Aesthetics
- Penetrability
- Debonding



Cause: 

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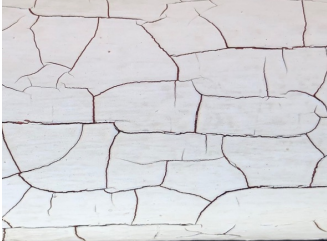
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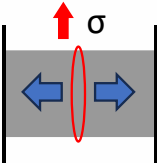
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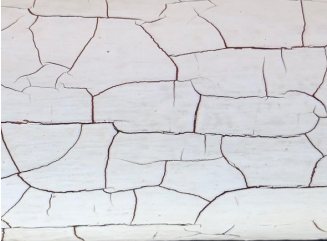
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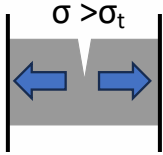
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## Cracking in repairs

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## Strength of repair mortars

- Tensile strength  $\approx$  10% of compressive strength.
- Often used as an index of quality.

High strength  $\equiv$  High quality

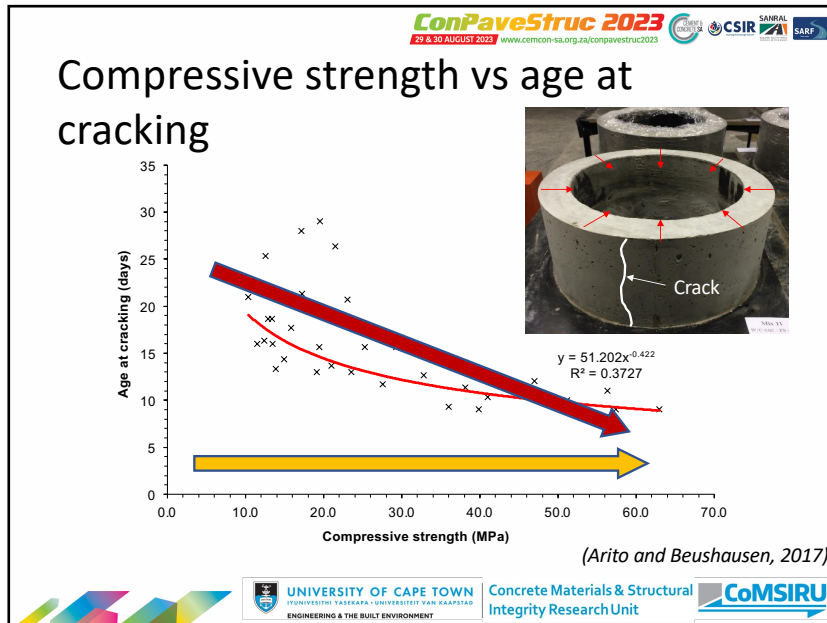


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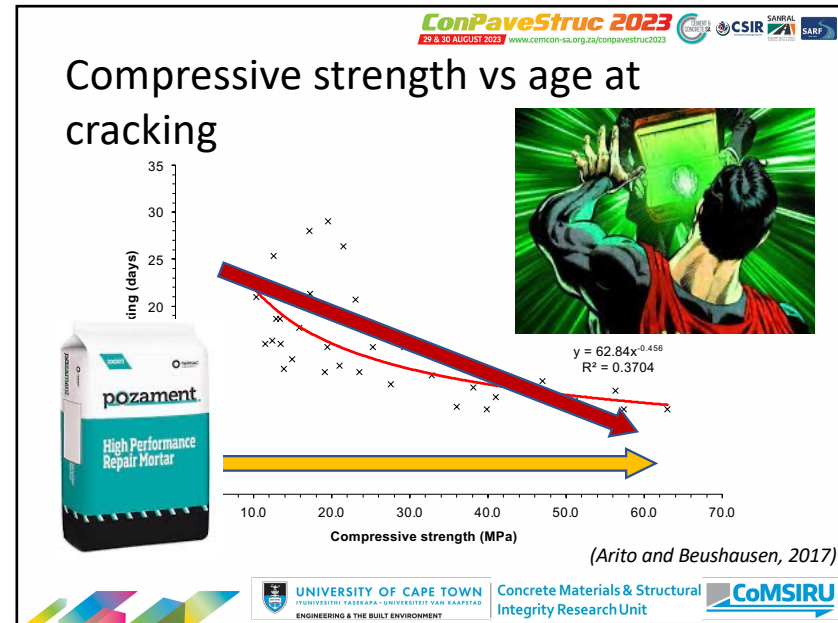
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## Consequences of high strength in repair mortars

Stronger the material → Higher elastic modulus → Higher tensile stresses

forces at time of repair

anisole forces build as materials mature

cracking at bond

cracking within substrate concrete

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## Solution

- What we in most cases don't need are high-strength repair mortars.

- What we need are low-strength repair mortars with good bond, crack resistance, and suitable electrochemical properties.

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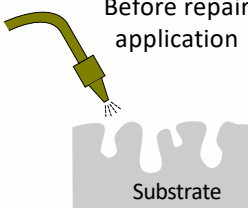
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## Substrate surface preparation

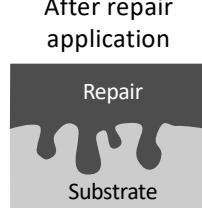
- Concrete substrate condition:
  - Sound (no microcracks)
  - Clean (free of dust, particles, etc.)
  - Rough profile (not smooth)
  - Moisture condition

Before repair application




Substrate

After repair application



Repair  
Substrate



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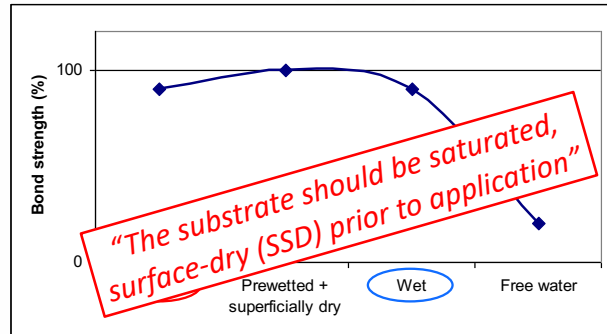
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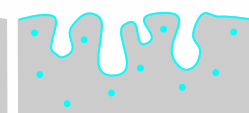
"The substrate should be saturated, surface-dry (SSD) prior to application"

*(Silfverbrand, 2005)*

↓ Hydration

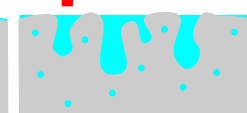


Dry



SSD

↑ w/c ratio



Wet

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## What is SSD?

- Definition of *SSD* (ACI & ICRI)
  - *“Condition of an aggregate particle or other porous solid when the permeable voids are filled with water and no water is on the exposed surfaces”*
- What does it mean?
  - Aggregates: Particles are fully saturated, with no film of water over their surface
  - Concrete: Porosity immediately under the surface is saturated, with no film of water at the surface


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## ICRI No. 030130 (Guide Specifications for Structural Concrete Repairs)

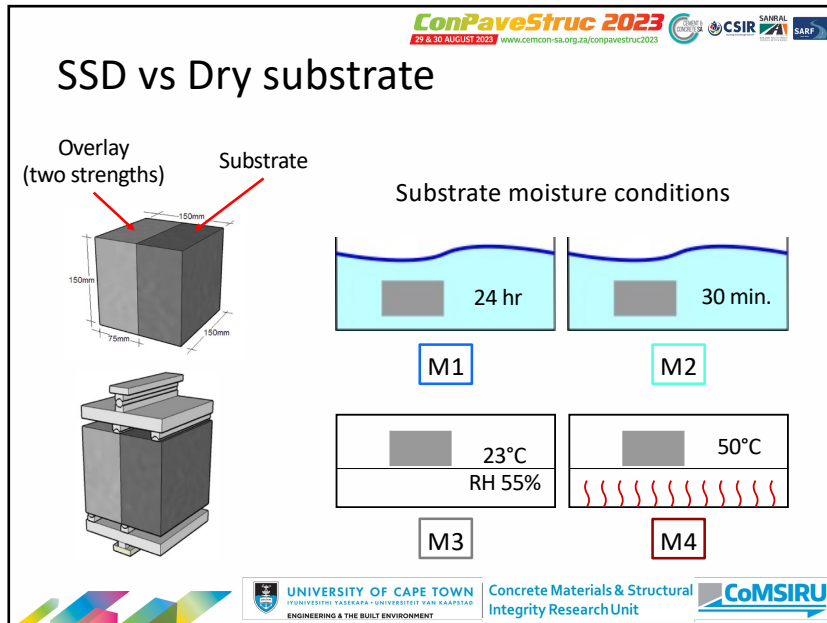
- Par. 3.4:
  - *Predampen concrete substrate surfaces to saturated surface-dry condition immediately prior to placement.*
- *Commentary* (par. 3.4)
  - *“The repair area must be properly dampened with water prior to the application of the mortar scrub coat or other bonding agents...”*
  - *“It may be necessary to wet the repair substrate more than once or for periods 2 hours or longer in order to achieve proper dampening....”*

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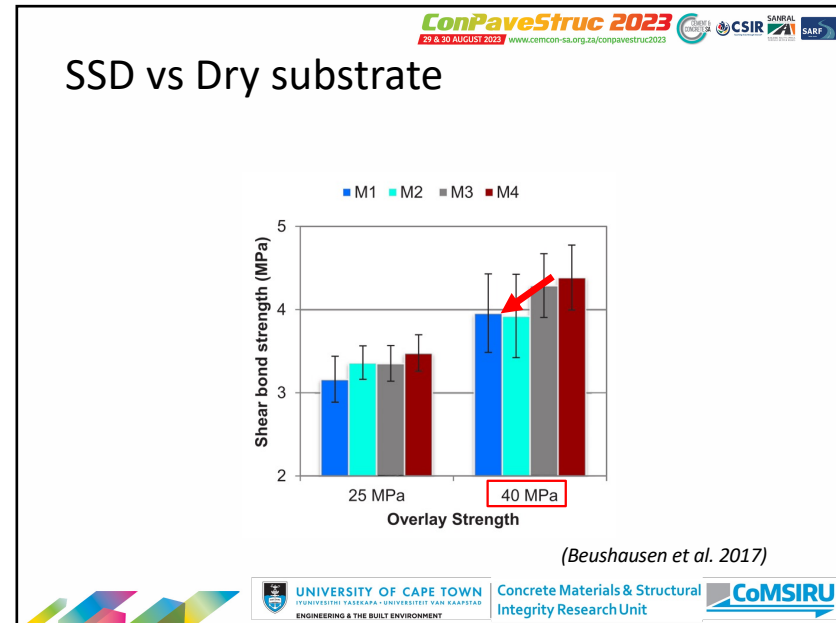
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## Conclusion

- Need for improved guidance on material performance and repair practice.
- Strength
  - Value is still considered a measure of “quality”. However, higher strength suggests poorer performance.
  - Need for low-strength repair mortars with good bond, crack resistance, and suitable electrochemical properties.
- Substrate surface conditions
  - Need for improved guidance regarding moisture conditioning prior to repair (definitions, specifications, assessment).
  - Pre-wetting the substrate surface prior to application of the overlay provides no added benefit towards bond strength.
  - In some cases, pre-wetting can negatively affect bond.





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