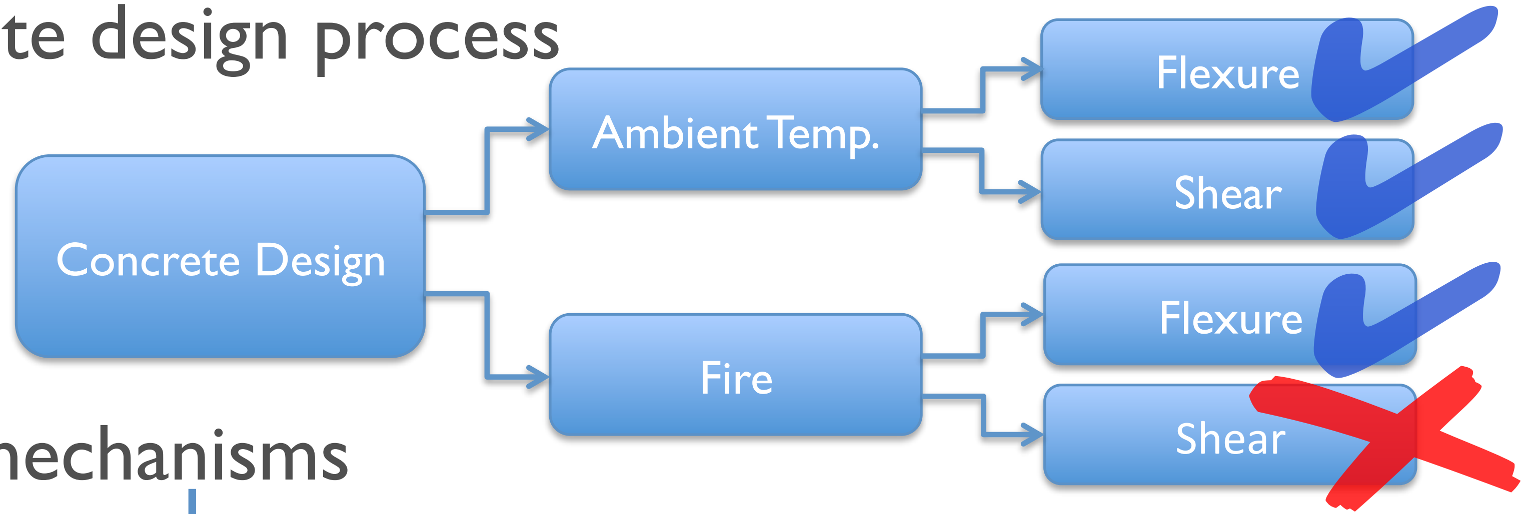
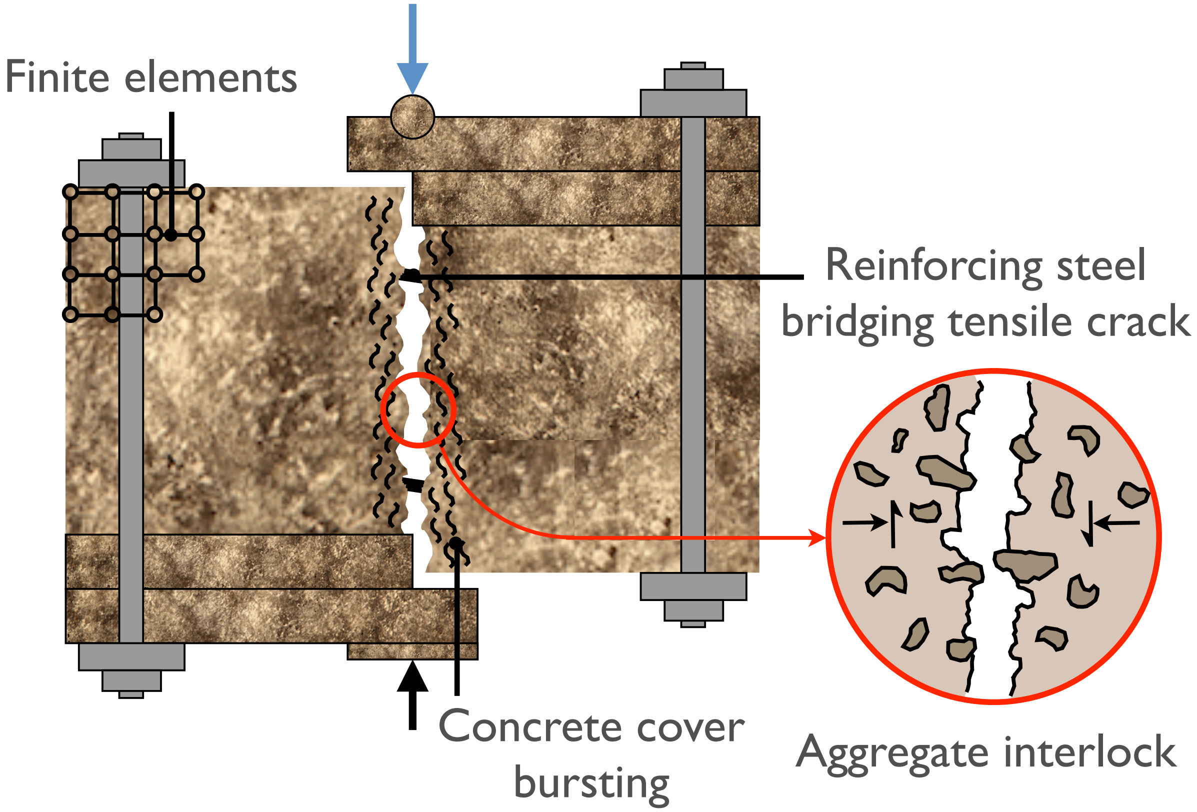
Shear Strength of Concrete at Elevated Temperature

BRE Centre *for* Fire Safety Engineering

Concrete design process



Shear mechanisms



Shear is carried in RC through the interaction of:

1. Compressive force paths
2. Concrete-steel bond
3. Dowel action
4. Aggregate interlock

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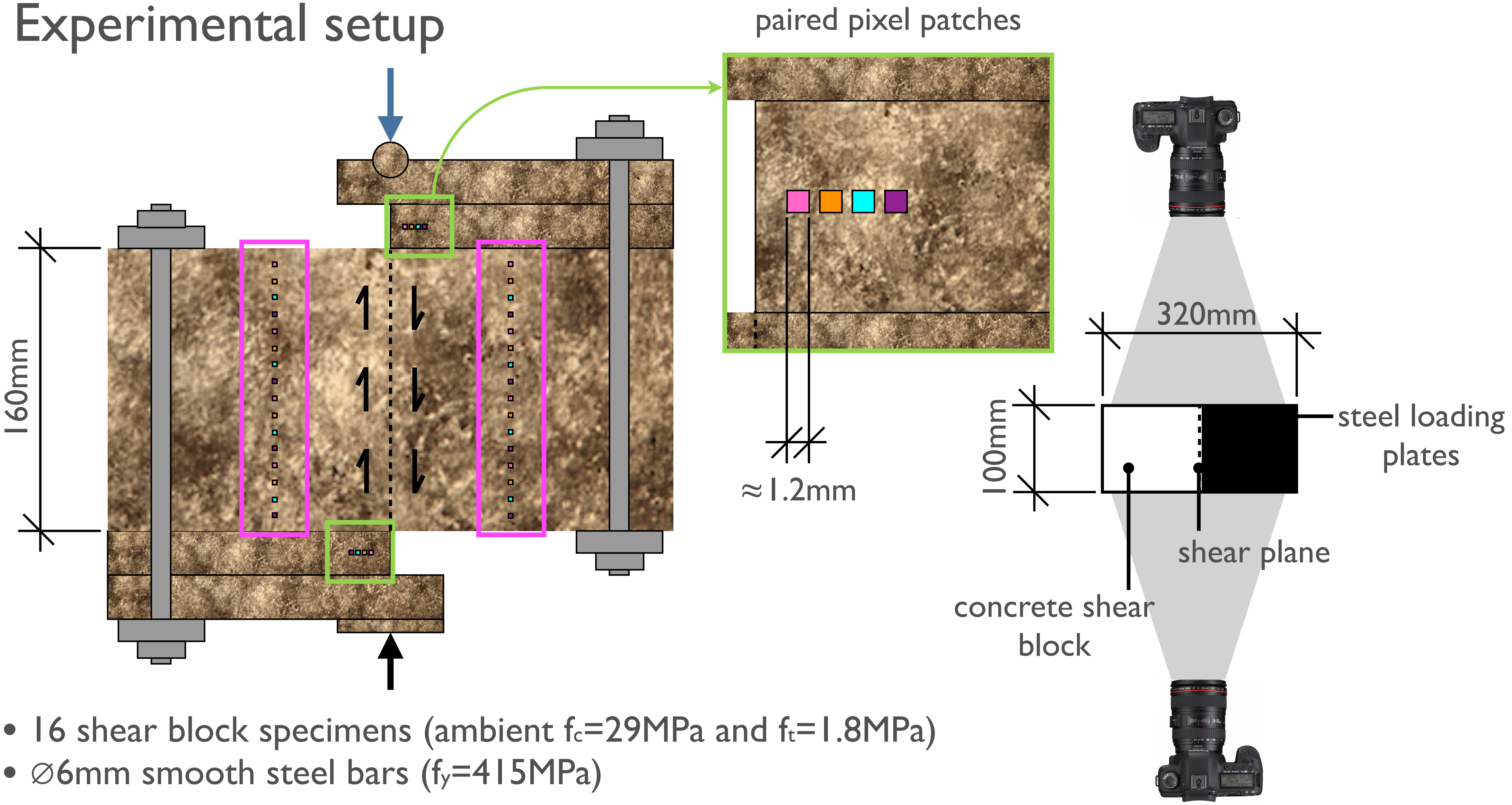
Experimental setup



- 16 shear block specimens (ambient f_c=29MPa and f_t=1.8MPa)
- ∅6mm smooth steel bars (f_y=415MPa)
- 2 shear stirrups crossed shear plane
- Specimen peak internal temperatures: 17°C, 112°C, 188°C, 390°C, 475°C, and 622°C

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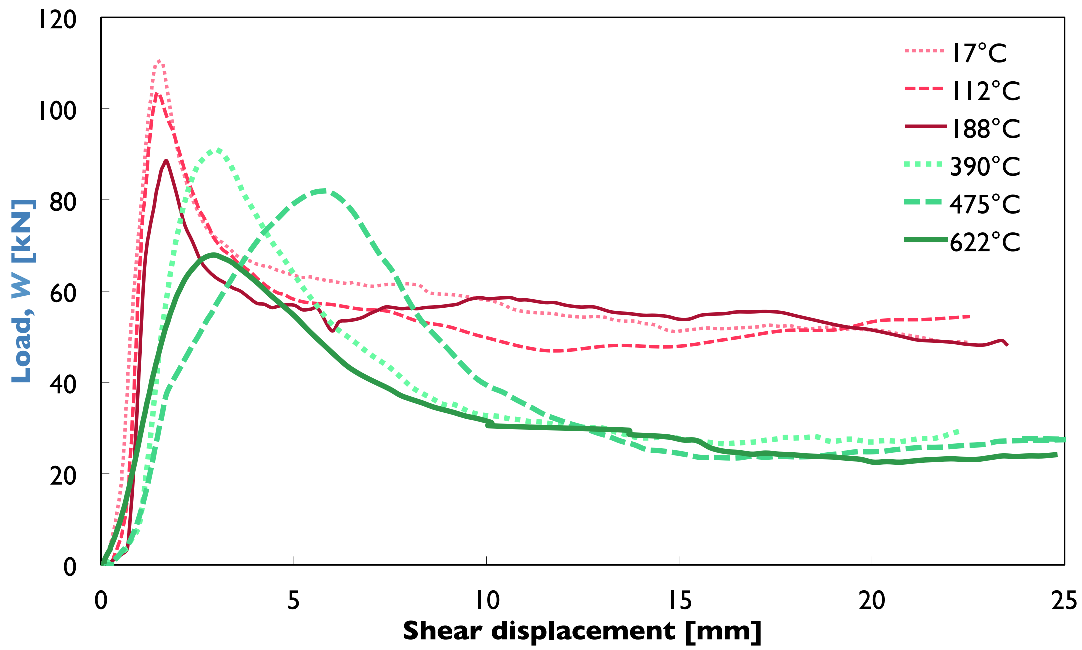
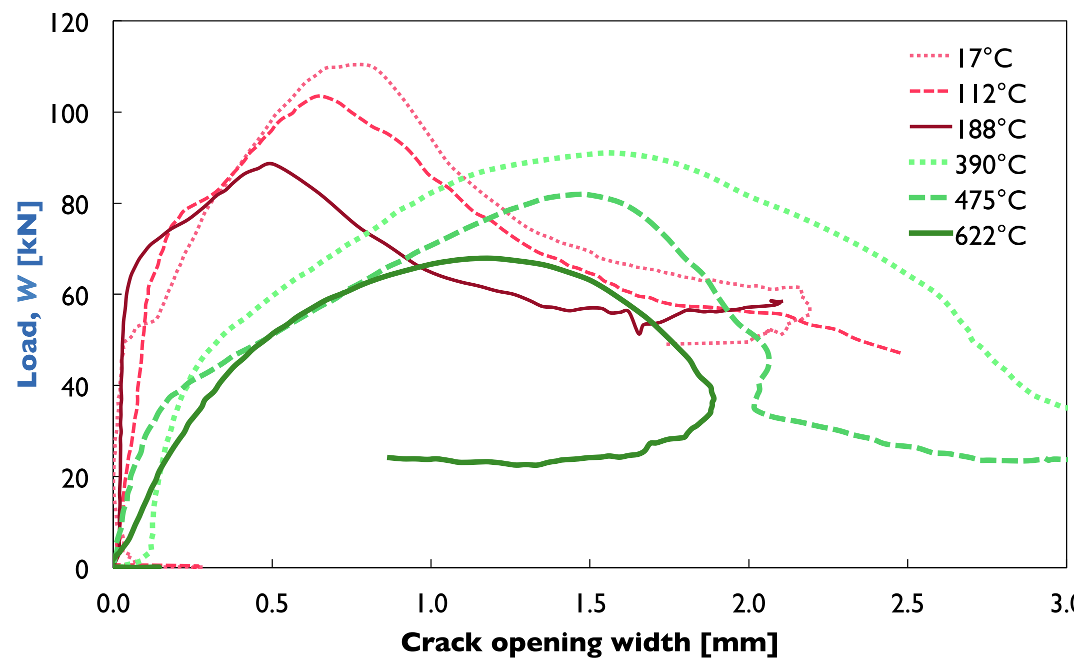
Results





- Shear crack fully forms at peak load
- Two groups of post-peak frictional strength
- Frictional strength governed by: concrete-steel bond, dowel action & aggregate interlock
- Initial stiffness & peak strength reduce with temperature, whereas peak strength displacement increases

- Again two clear groups:
  low temperatures ➜ low displacements
  high temperatures ➜ high displacements
- Low temperatures: diagonal tension cracks formed and then coalesced into a shear crack
- High temperatures: straight shear crack formed
- Extensive cover bursting at high temperature, leading to increased reinforcement debonding and decreased concrete confinement

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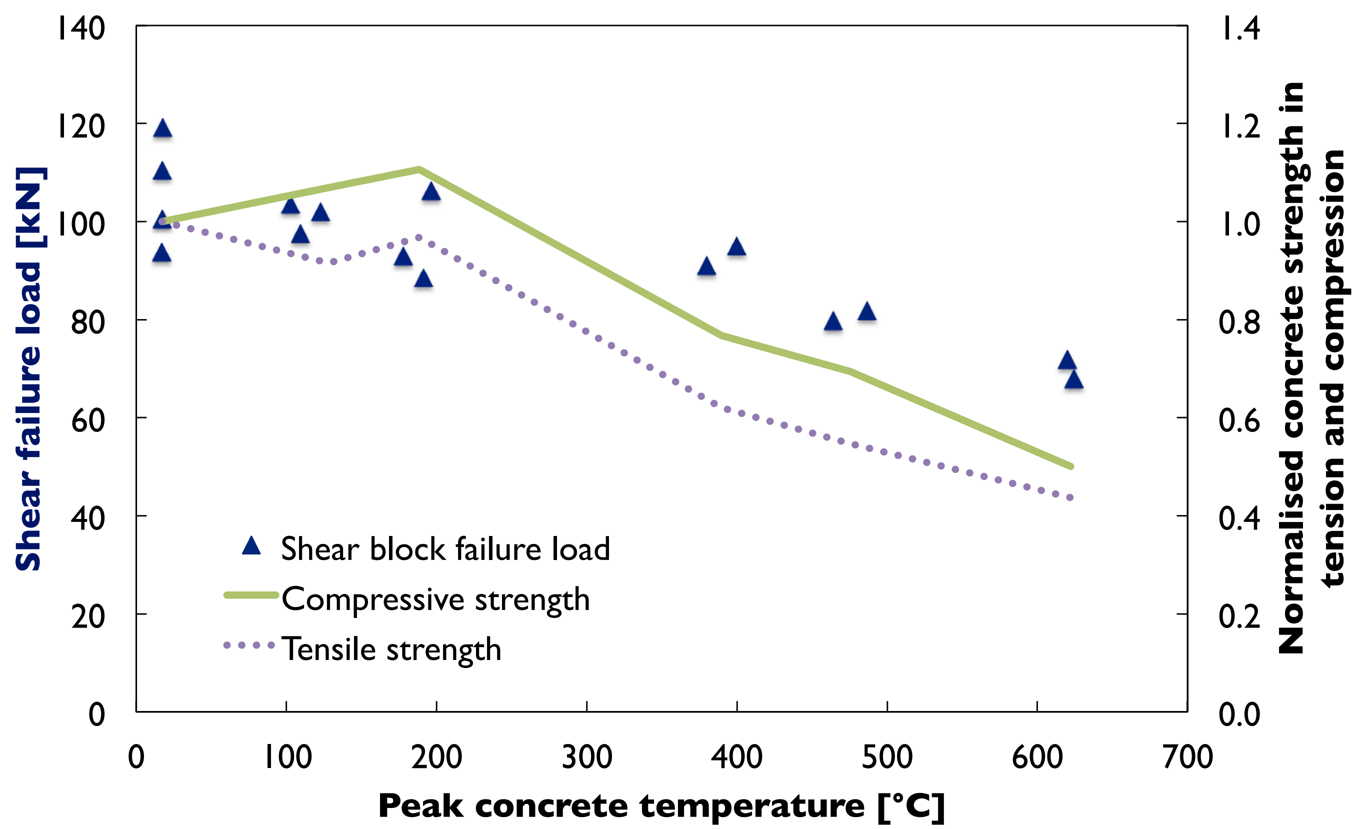
Summary



- Residual compressive and tensile concrete strengths decreased with temperature
- Less pronounced shear strength decrease with temperature, due to steel
- Residual shear strength of RC is:
  governed by interaction of concrete and steel through shear mechanisms

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