



CIVIL-709: New Concretes for Structures  
Doctoral school EDCE  
Teacher: Prof. Emmanuel Denarié



# Investigation of the shear performance of UHPFRC

Enrico Pinelli – Doctoral Assistant CONSTRUCT  
Elias Merhi – Doctoral Assistant CONSTRUCT

**Title:** Investigation of the shear performance of UHPFRC

## **MOTIVATION**

- RC shear has a mature experimental base, and RC dominates the built stock → upgrading shear-critical members long-term infrastructure challenge.
- UHPFRC is proven for strengthening, but shear-critical use is still limited by model/parameter uncertainty
- Many beam/squat-wall tests exist, but they mix bending–shear, arching, boundary/load-introduction effects
- Goal: **produce a clean dataset to support structural-level modeling** (shell/continuum) and future design calibration

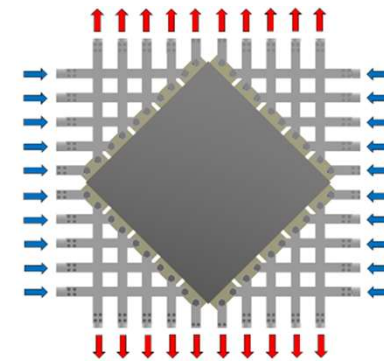
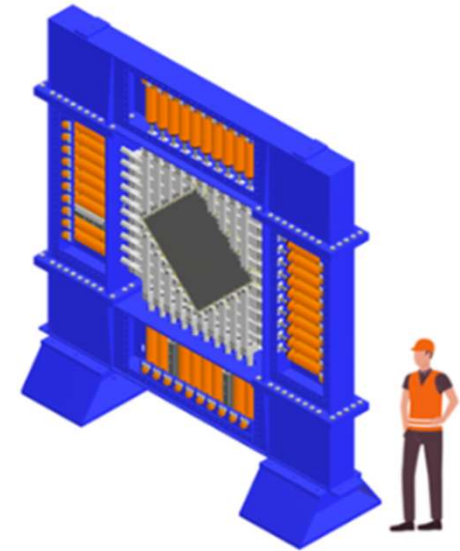
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### **RESEARCH GAP**

- Known: UHPFRC shear resistance strongly tied to post-cracking tensile behavior (fiber bridging)
- Models depend on effective tensile contribution that was not directly measured at membrane scale
- Missing: scarce panel evidence for:
  - Pure shear and biaxial tension data
  - Effect of reinforcement in a membrane

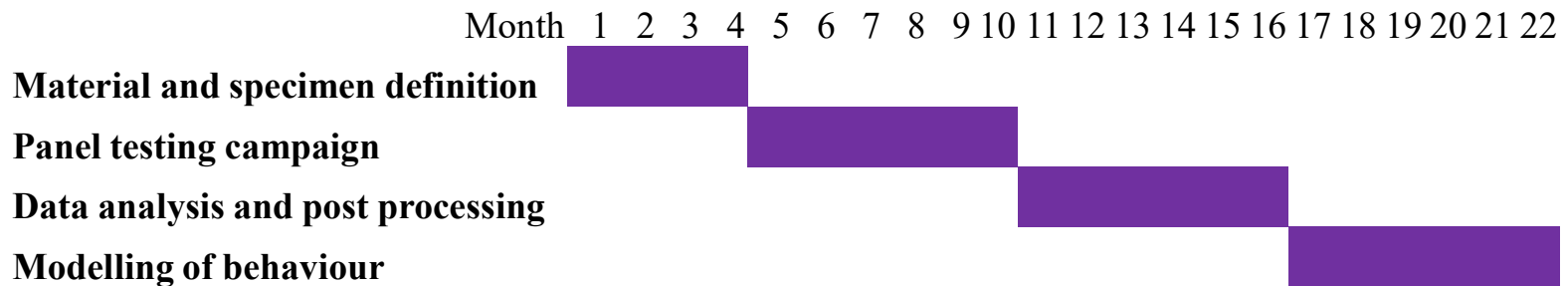
- **Project Overview:**
  - Method: experimental campaign using the Panel Element Tester (EPFL):  
**panel tests decouple mechanics from structural geometry**
    - Prescribed in plane stresses
    - Direct observation of membrane behaviour
  - Test program:
    - 10-20 panel elements
    - Pure shear, combined shear + axial loading, biaxial loading
    - Plain UHPFRC and R-UHPFRC
  - Instrumentation:
    - Digital Image Correlation (DIC)
    - Distributed Fiber Optic Sensing (DFOS)
    - LVDTs

- **Necessary equipment:**
  - EPFL Panel Element Tester
  - DIC system/ DFOS
  - Facilities to mix, cast and cure UHPFRC
- **Personnel:**
  - 1 PhD student
  - 1 Laboratory technician
- **Budget:**
  - Materials:
    - 10-20 panels 20-40 k CHF
  - Salaries:
    - PhD 250 k CHF
    - Technician 50 k CHF



Total about **350 k CHF**

- **Research plan & Schedule – 22-28 months**



- **Expected outputs:**

- Mechanism-resolved response in pure shear and biaxial tension
- Quantified effect of reinforcement on UHPFRC membrane behavior
- Calibration targets for membrane/shell-compatible modeling assumptions

- **Reference Experts:**
  - Frank J. Vecchio – Panel element testing, membrane mechanics
  - Benjamin A. Graybeal – FHWA’s UHPC bridge guidance
  - Viktor Mechtcherine – TU Dresden
  - Emmanuel Denarié
  - Eugen Brühwiler

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