Performance of Additively Manufactured Architectured Cement-based Materials

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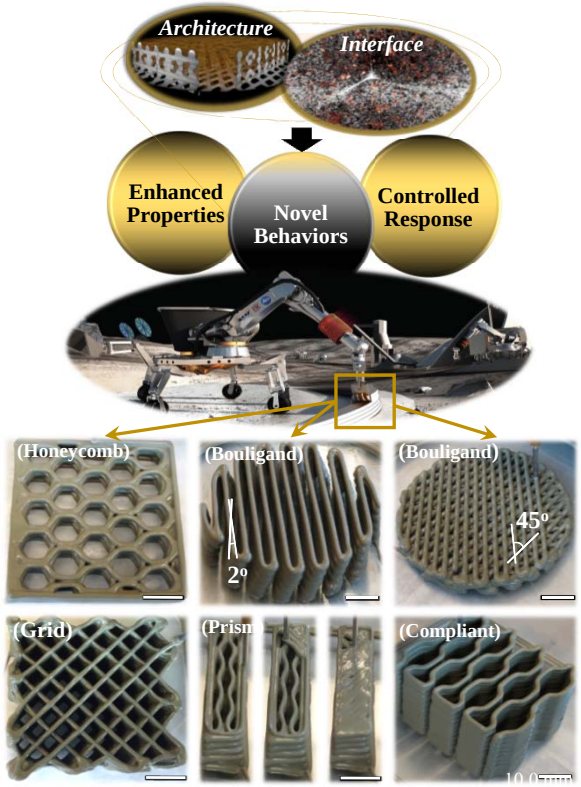
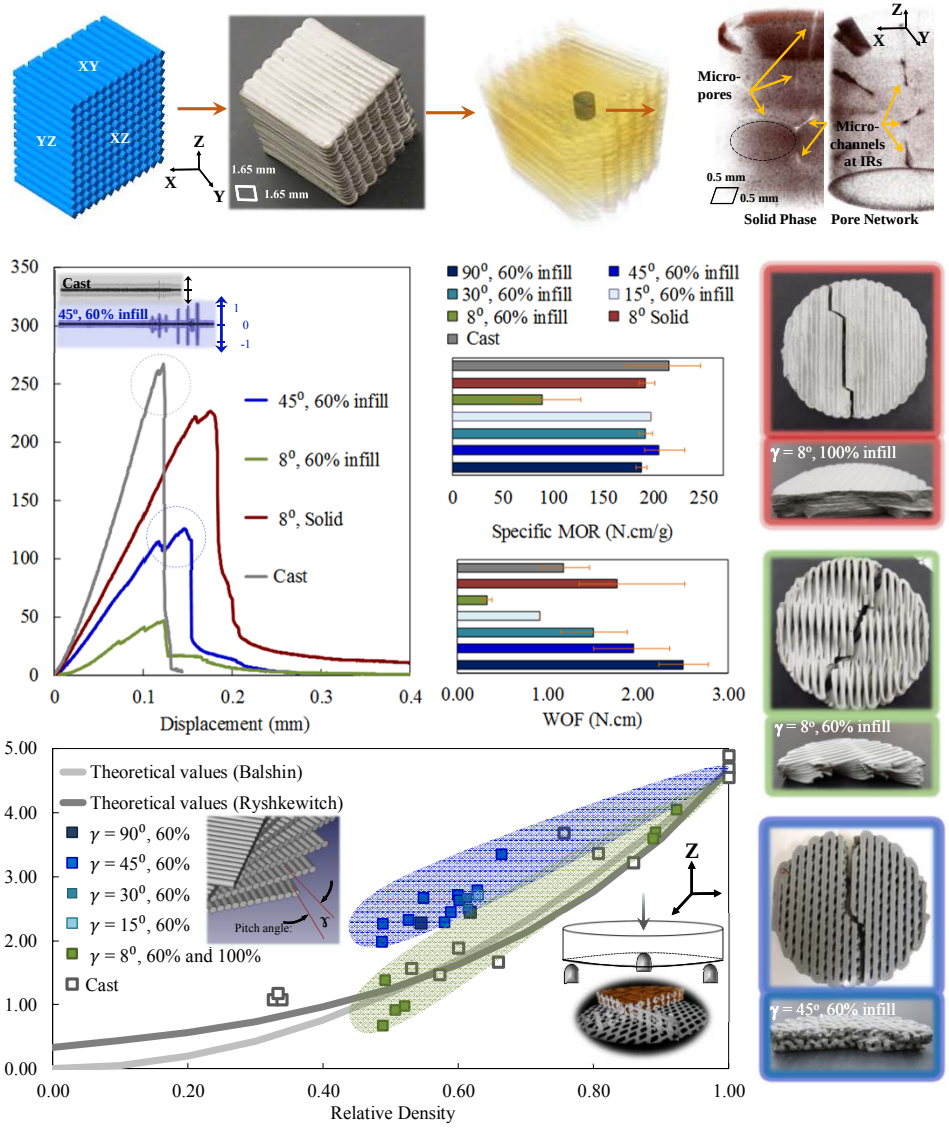
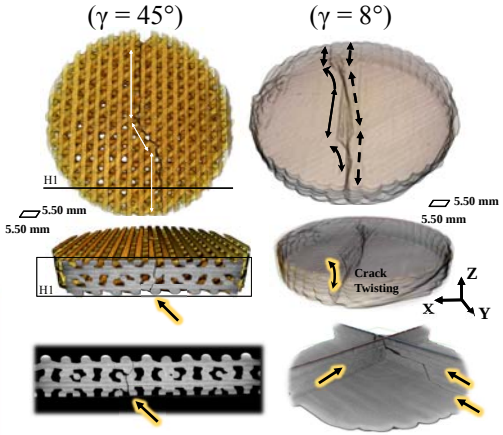
Objectives

The objective of this study was to:

- Examine the influence of interfacial heterogeneities on mechanical performance of 3D printed hydrated cement paste (HCP) elements.
- Employ bioinspired architectures as a mean to enhance mechanical response of brittle materials.







Findings

- Micro-pores and micro-channels were found at the interfacial regions (IRs), resulting in a weak and porous interface.
- Combining Bouligand architecture and weak interface leads to:
  - Interfacial damage delocalization
  - Quasi-brittle behavior
  - Enhanced work of fracture
  - Improved or similar flexural strength
  - Flaw-tolerant properties
- Trade off-between small (γ = 8°) and large pitch angles (γ = 45°) is the trade-off between crack growth at the interface and crack advancement through the solid material.
- Compliant architecture demonstrated novel bilinear stress–strain behavior, not attainable in cast elements.

References:

- Moini et. al.,***"Additive Manufacturing and Performance of Architectured Cement-based Materials"***, *Advanced Materials*, **2018**, https://doi.org/10.1002/adma.201802123.
- Moini et. al., "**Additive Manufacturing and Characterization of Architectured Cement-Based Materials via X-ray Micro-computed Tomography"**. In: First RILEM ICCDF, Digital Concrete 2018. DC 2018. RILEM Bookseries, vol 19. Springer, Cham, https://doi.org/10.1007/978-3-319-99519-9_16