

# Enhancing 3D-Printed Elements with Alkali-Resistant Glass Textile Reinforcement

Kayla Lee, Civil Engineering

Mentor(s): Dr. Narayanan Neithalath, Fulton Professor of Structural Materials & Dr. Avinaya Tripathi, Assistant Research Scientist  
School of Sustainable Engineering and the Built Environment



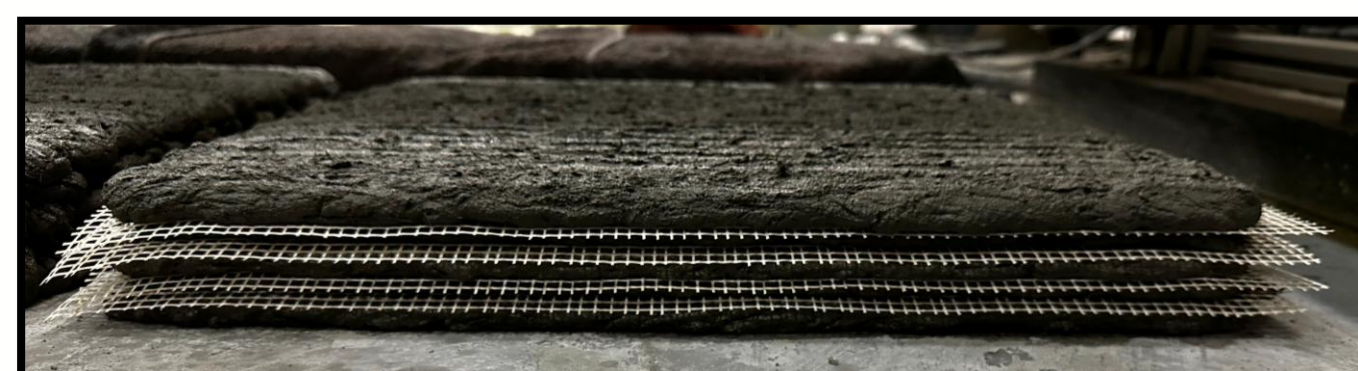
## Background

- 3D-printed concrete faces challenges related to weak interlayer bonding and cracking.
- These issues lead to reduced mechanical performance.
- This research investigates the incorporation of alkali-resistant glass textiles into 3D-printed elements.
- AR glass fibers contain added zirconium oxide to help resist alkalinity in concretes' highly alkaline environment.
- Goal: Enhance strength and durability in 3D printing.

## Objectives

- Improve interlayer adhesion in 3D-printed concrete using textile reinforcement.
- Assess the mechanical performance of the reinforced concrete under flexural test.
- Compare the effects of textile orientation on flexure behavior.

## Printing Process



## Results

- Test beams have been printed and are curing to meet the 28-day strength requirement.
- Preliminary data from similar studies were analyzed to anticipate outcomes.
- The figure below shows sample load-displacement curves from similar studies, comparing both unreinforced and textile-reinforced 3DPC specimens.

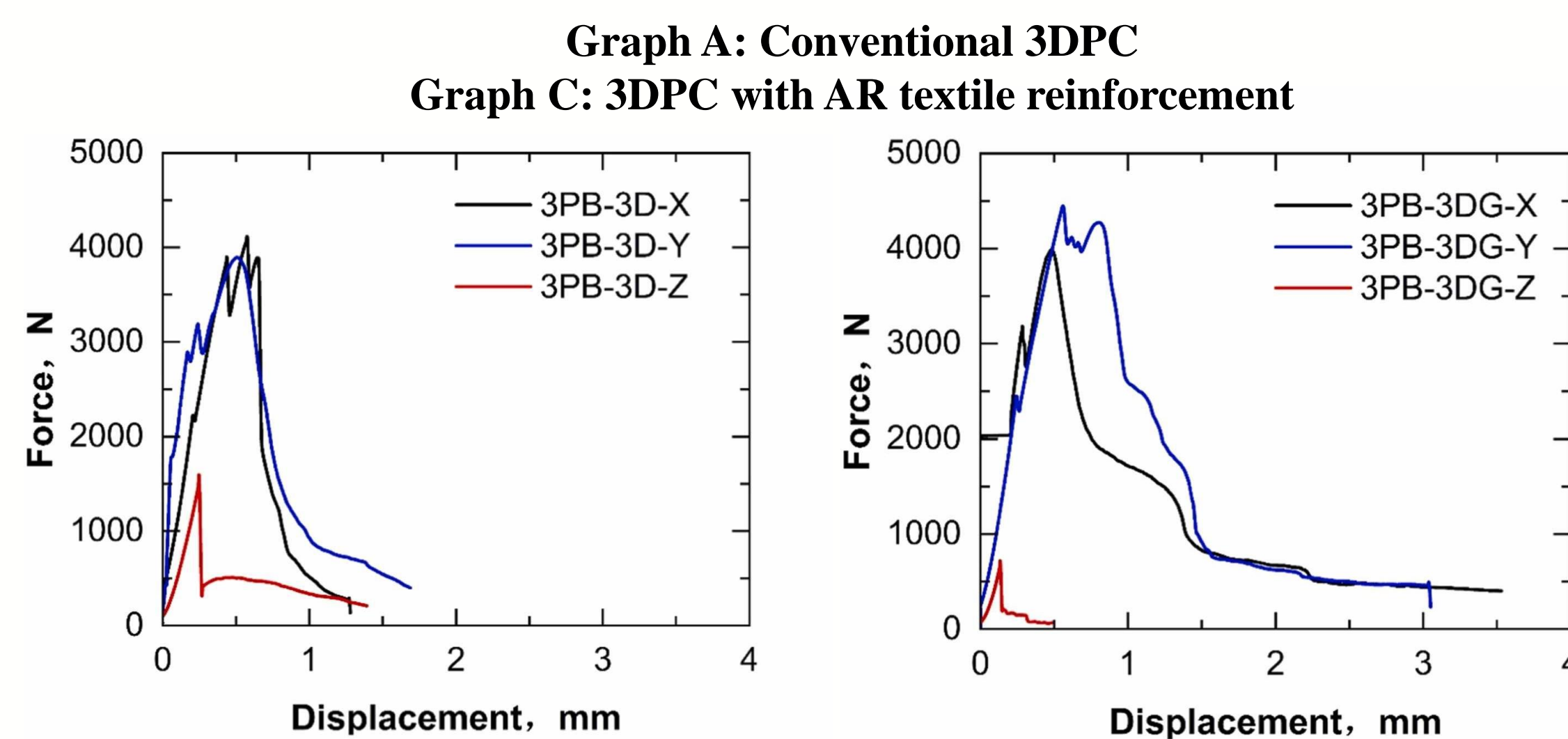
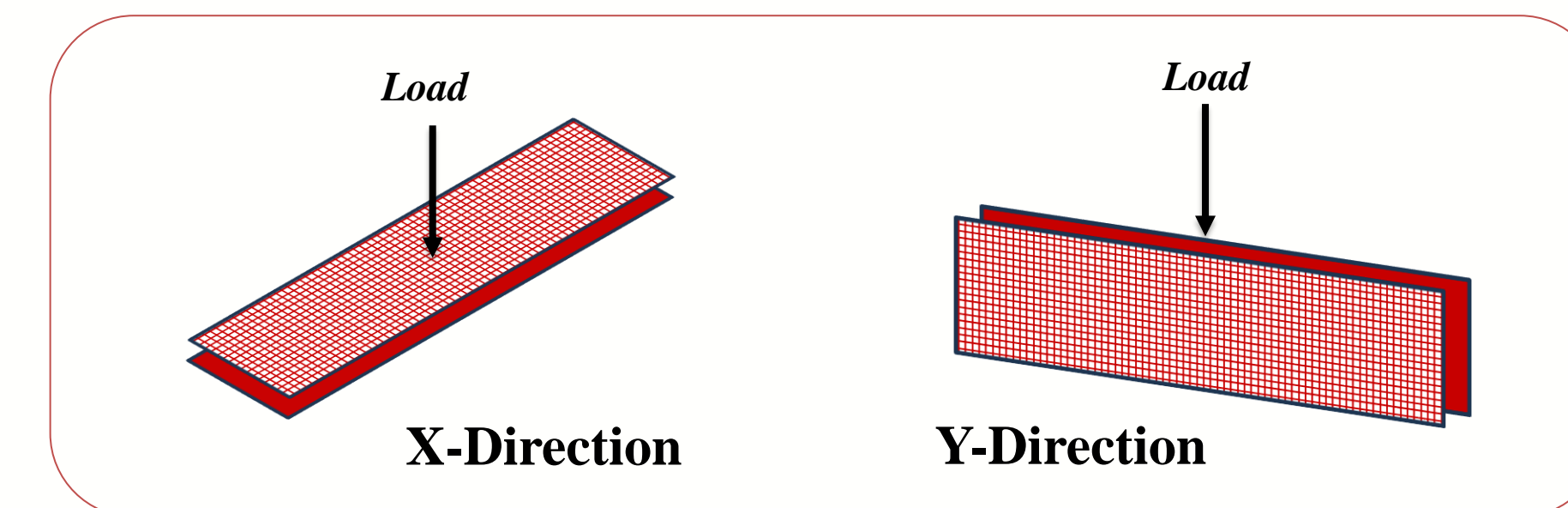


Figure 1: (Yao et. al., 2024)

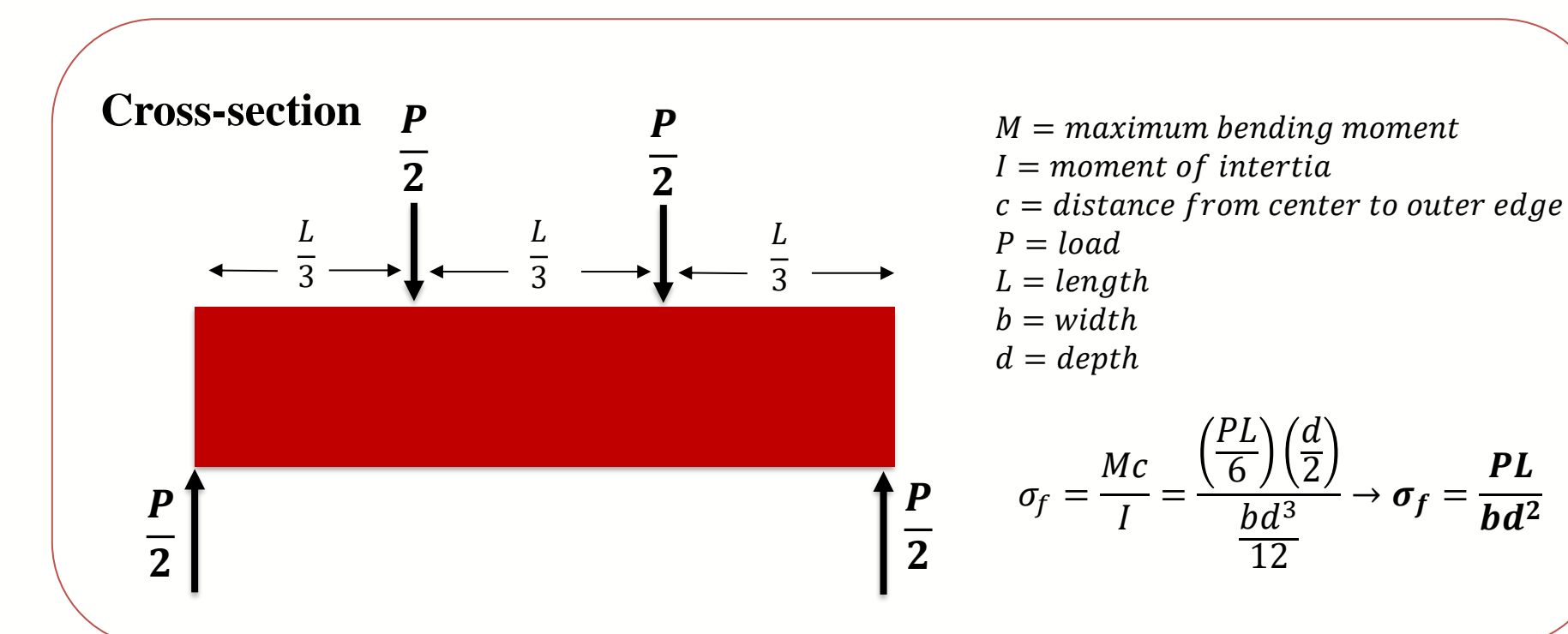
- The conventional 3DPC is shown in Graph A and the 3DPC with AR textile reinforcement is shown in Graph C.
- Both were tested across all three orientations.
- Conventional 3DPC in the X and Y directions showed a similar peak force.
- The addition of AR textile reinforcement to 3DPC displays improved ductility and post-peak behavior, especially in the Y-direction.
- These results support the hypothesis that AR textile reinforcement enhances the mechanical performance of 3DPC.

## Methodology

- AR glass textiles were embedded in 3DPC specimens in two orientations:



- Flexure test: Four-point bending



## Conclusion

- Preliminary data suggests that AR textile reinforcement can help to enhance strength and durability of 3DPC.
- Findings demonstrates the potential for enhanced structural performance in the built environment.
- Supports the use of advanced reinforcement strategies in 3D concrete printing.

Special thanks to the Neithalath Lab.