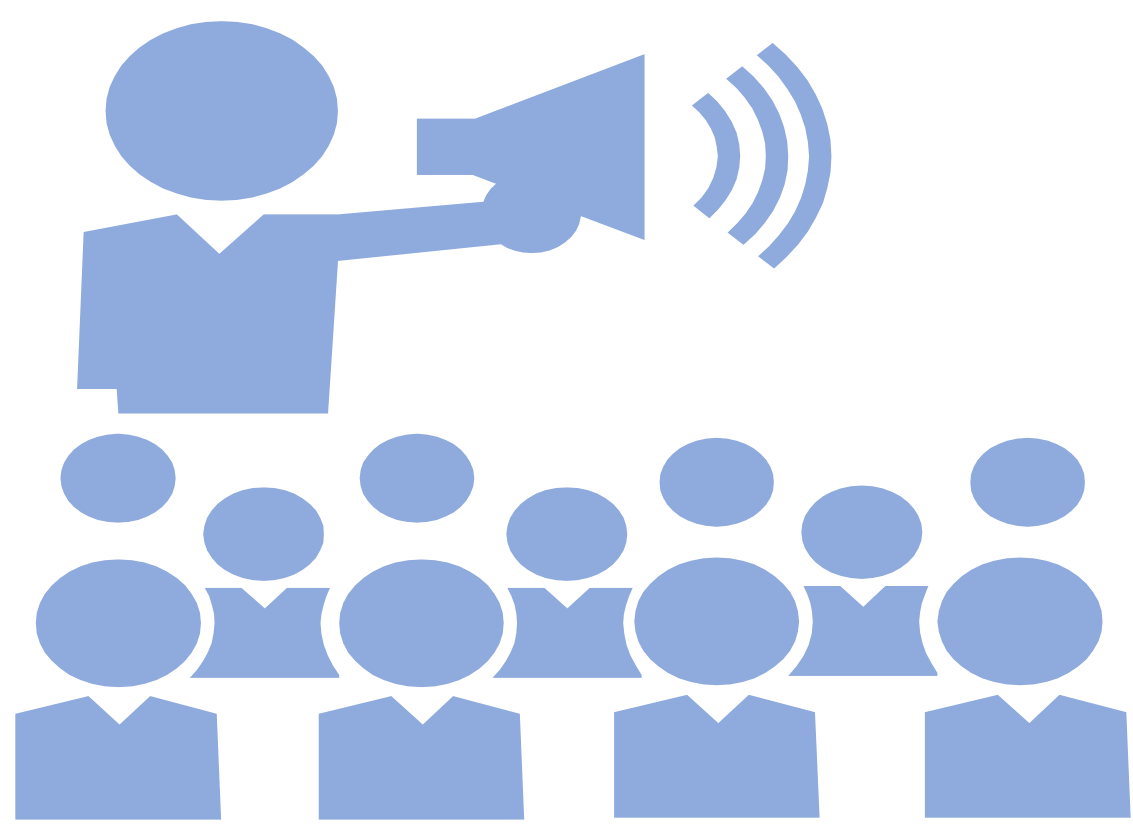


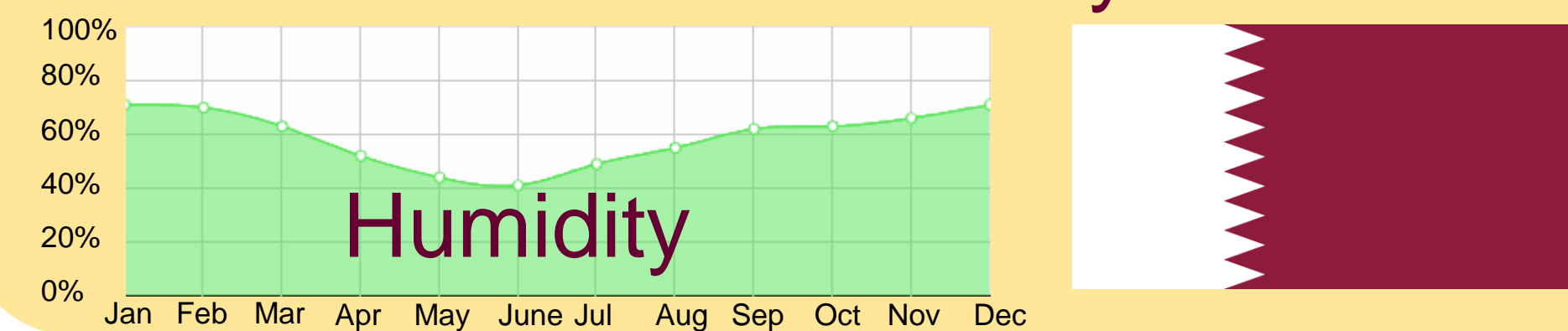
Presented by: Abdulrahman Abushanab¹, PhD candidate
Supervised By: Dr. Wael Alnahhal¹, Associate Professor

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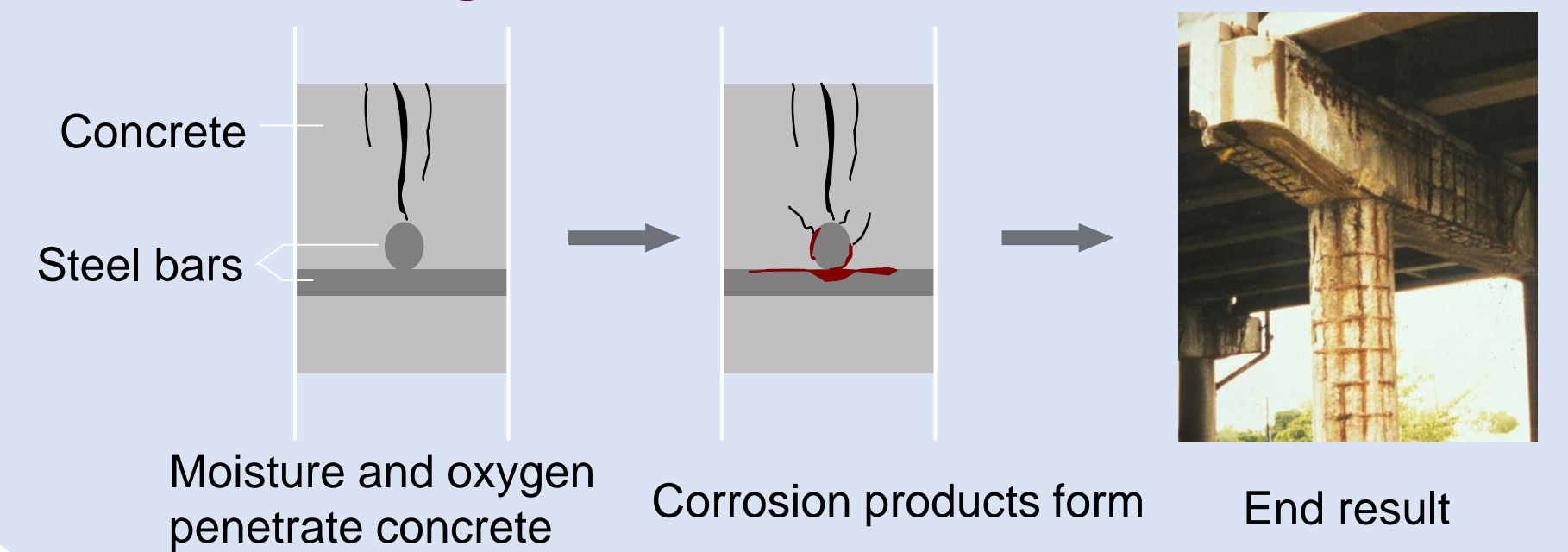
Background



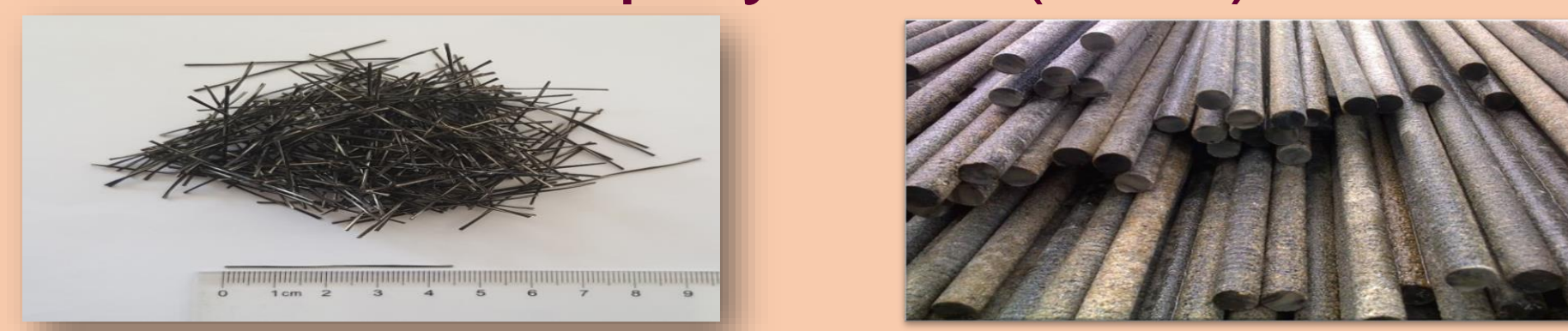
The State of Qatar is suffering from its harsh environment and coastal condition, which stand for most of the year



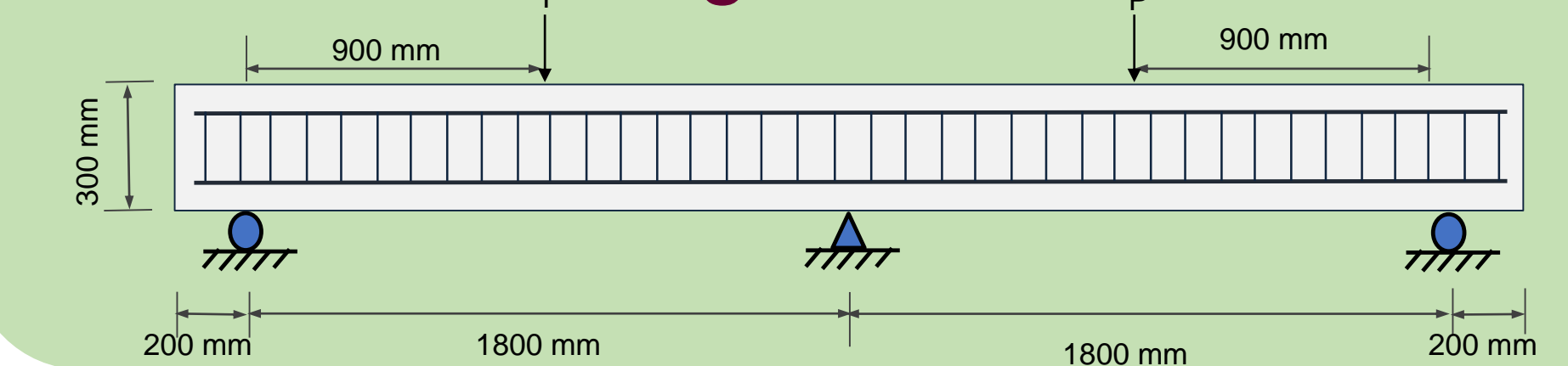
RC degradation due to corrosion



Therefore, there is a necessity to replace the conventional steel reinforcement by fiber-reinforced polymers (FRP)



Moment redistribution enhance the ductility of continuous beams and reduce their congested rebar



Objective



To conduct a parametric study, using a validated finite element model, to investigate the moment-redistribution in concrete continuous beams reinforced with Basalt FRP (BFRP) bars which include volume fractions of Basalt macro fibers of 0.75 and 1.5% and stirrups spacing of 80, 100 and 120 mm

Methods



1 The experimental program consists of eleven concrete continuous beams over two spans of 1800 mm each and a rectangular cross-section of 200 x 300 mm

2 Different flexural reinforcement materials (steel and BFRP) with steel stirrups were considered

3 Different flexural reinforcement ratios (0.3-3.9pfb) were considered in both top and bottom sections to allow for moment redistribution of 0 or 20%

4 Volume fractions of Basalt-macro fiber (BMF) of 0.75 and 1.5% were used to enhance the concrete shortcoming properties such as the tensile strength

5 A FEM modeling was conducted using ABAQUS software, release 14. The produced model was utilized to perform a parametric study

6 A linear regression analysis was performed using Minitab 17 software. A formula ($R^2=87.28\%$) that predict moment redistribution was generated

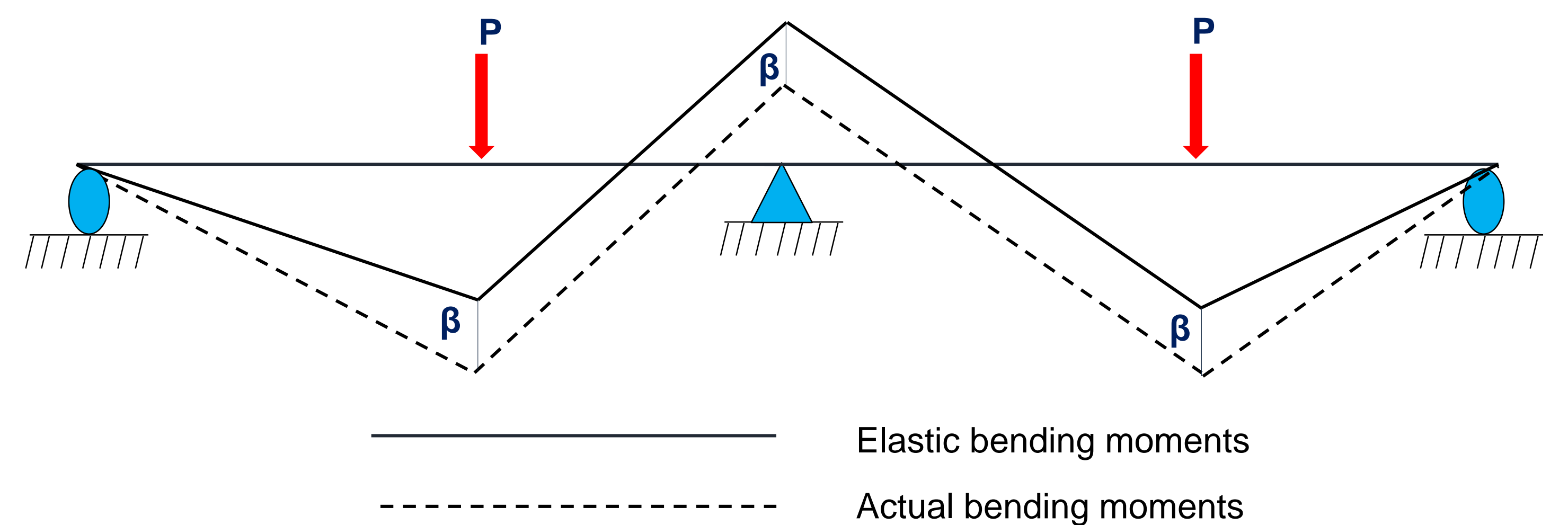


Figure 1. Elastic and actual bending moments of the beams



Figure 2. Experimental test setup and loading pattern

$$\text{Mid-span Moment} = R_A \times \left(\frac{L}{2}\right)$$

$$\text{Mid-Sup. Moment} = \left(P \times \left(\frac{L}{2}\right)\right) - R_A \times L$$

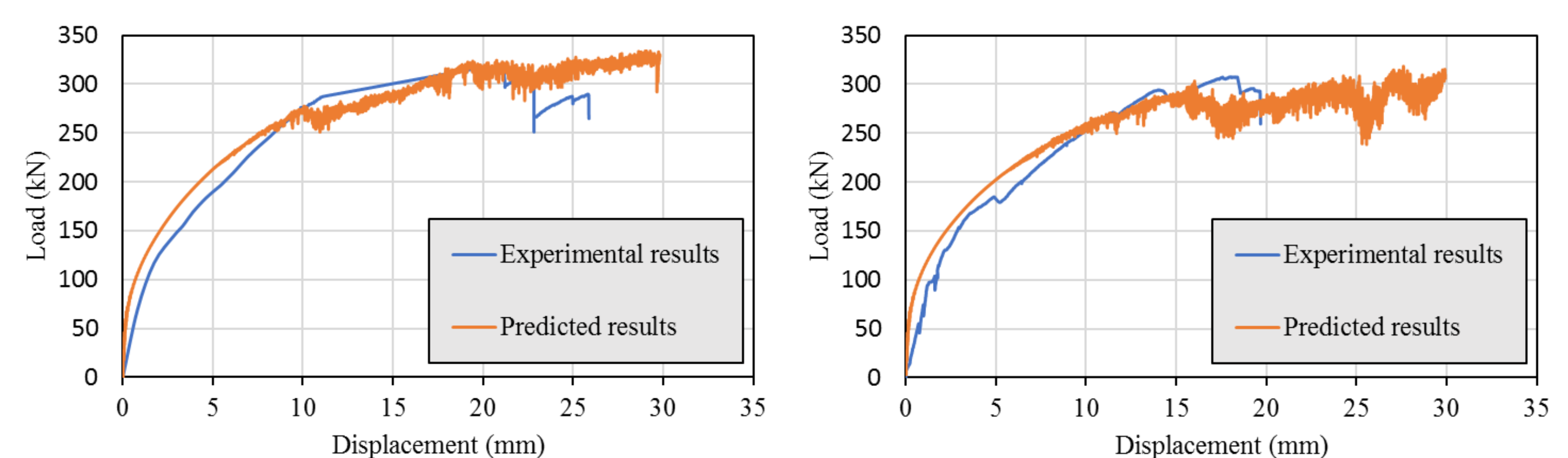
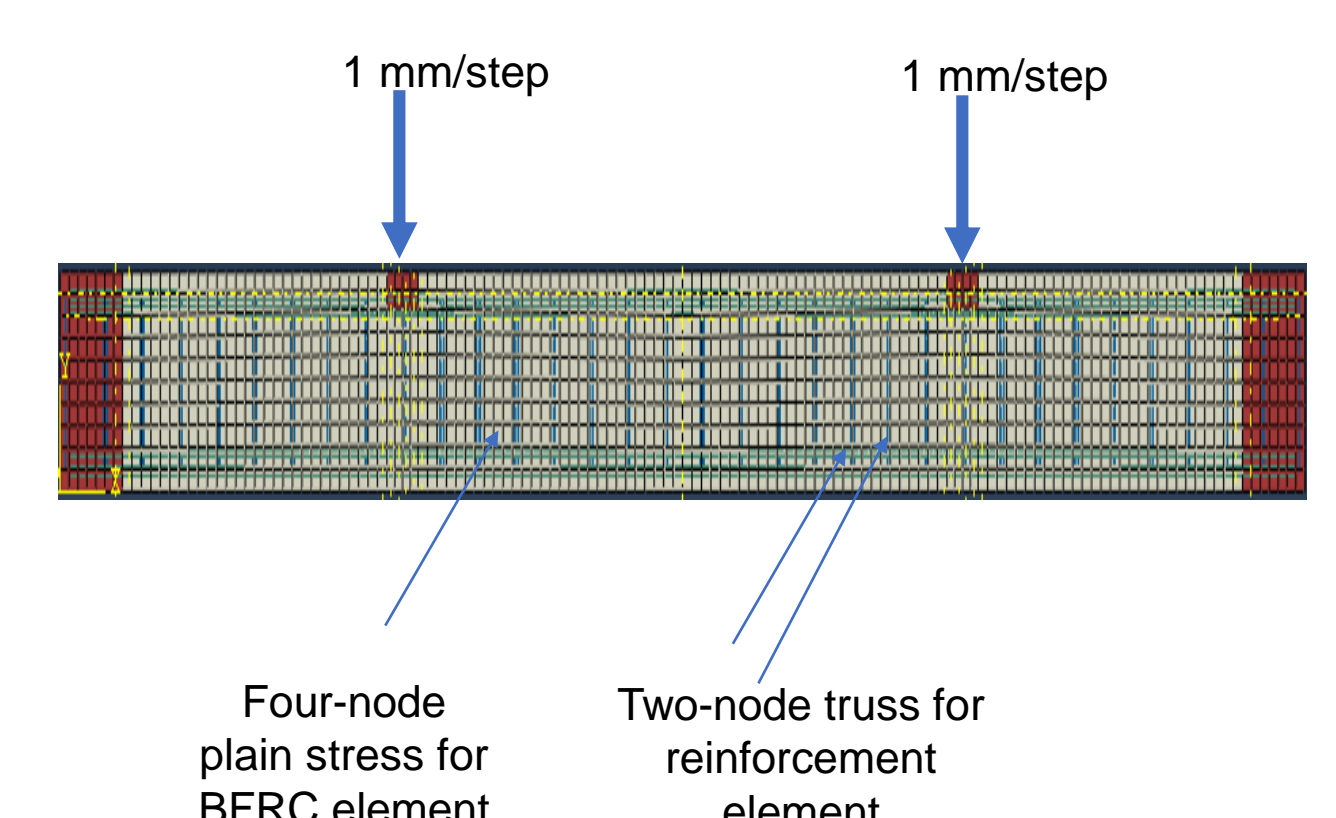


Figure 3. Experimental and predicted load-displacement diagrams for test beams

Table 1. FEM matrix

Top Reinforcement	Bottom Reinforcement			
	R0	R1	R2	R3
R0	R0R0	R0R1	R0R2	R0R3
R1	R1R0	R1R1	R1R2	R1R3
R2	R2R0	R2R1	R2R2	R2R3
R3	R3R0	R3R1	R3R2	R3R3



During loading, forces were transferred from the low-stiffness section to high-stiffness section. This behavior was observed in the beams that have higher bottom reinforcement

The ratio between bottom reinforcement to top reinforcement should be more than 0.3 to redistribute forces between the critical sections

$$\% \text{Moment redistribution} = 3.72 + 0.444 (\text{volume fractions of BMF}) + 0.0212 \text{ stirrups spacing} - 0.02505 \text{ top reinforcement} + 0.04102 \text{ bottom reinforcement}$$

Conclusion

This study is the first of its kind that evaluated the moment redistribution in continuous concrete beams with BFRP bars. Moment redistribution occurs in beams that have at least a ratio of bottom to top reinforcement of 0.3

Acknowledgement

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