

Supplementary Information

Investigating the Bond Performance of FRP Bars and Concrete Under Dynamic Loading Conditions

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Table S1. Comparative Properties of Glass fiber, Basalt Fiber, and Carbon Fiber.

Sample	Tensile Strength (MPa)	Elastic Modulus (GPa)	Application Temperature (°C)	Elongation at Break (%)	Density (g/cm ³)
Glass fiber	3000 - 3800	70 - 75	-50 ~ 300	2 ~ 3	2.54
Basalt fiber	3000 - 4800	80 - 100	-260 ~ 700	2 ~ 3	2.8
Carbon fiber	3000 - 6000	230 - 600	-50 ~ 600	1 ~ 2	1.78

Table S2. Chemical Composition of Glass fiber, Basalt Fiber, and Carbon Fiber.

Sample	SiO ₂	Al ₂ O ₃	CaO	MgO	Fe ₂ O ₃	C	H
Glass fiber	50 - 75%	10 - 15%	5 - 15%	2 - 5%	1 - 5%		
Basalt fiber	45 - 55%	10 - 20%	10 - 12%	5 - 7%	10 - 15%		
Carbon fiber						90 - 95%	90 - 95%

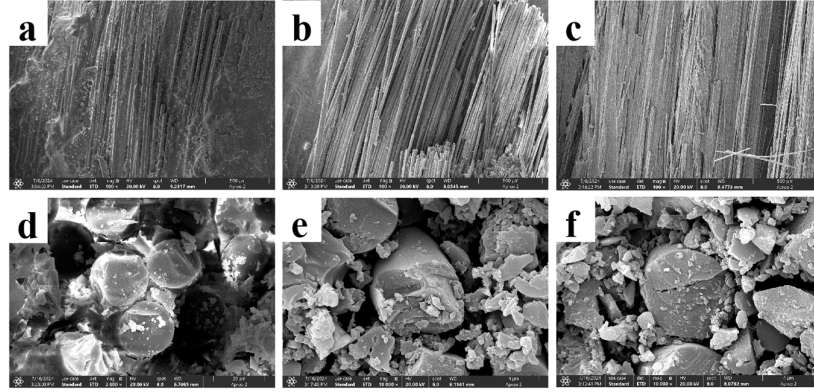


Figure S1. The SEM images of the surfaces and cross-sections of (a, d) GFRP, (b, e) BFRP, (c, f) CFRP, respectively.

As shown in Figure S2, the scanning electron microscopy (SEM) results reveal the surface morphology of the FRP bars after being pulled out from the concrete. The fibers on the surface of the pulled-out GFRP bars remain aligned in a parallel orientation, with no obvious gaps observed between them, and they still exhibit good bonding with the resin (Fig. S2d). A small number of fiber fractures are visible on the surface of the GFRP bars, and residual concrete is unevenly attached to the outer surface of the fiber layer, indicating that the material may have experienced localized damage or contamination during loading or demolding (Fig. S2a). In Fig. S2e, a small amount of residual concrete remains on the surface of the BFRP bars. The concrete layer is very thin and is located within the grooves between the fibers (Fig. S2b). Figure S2f shows the surface morphology of the CFRP bars after being pulled out, where the surface fibers are completely covered by unevenly distributed concrete. The concrete layer appears relatively dense, with localized agglomeration causing surface protrusions, and a few defect-induced delaminations are also observed (Fig. S2c).

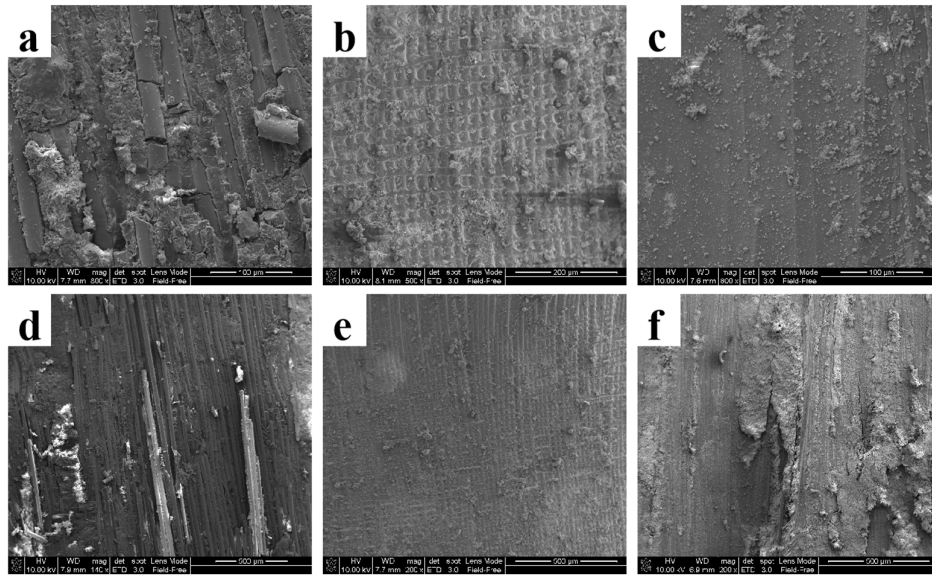


Figure S2. The SEM images of the FRP bars surfaces after pulled out from the concrete (a, d) GFRP, (b, e) BFRP, (c, f) CFRP, respectively.

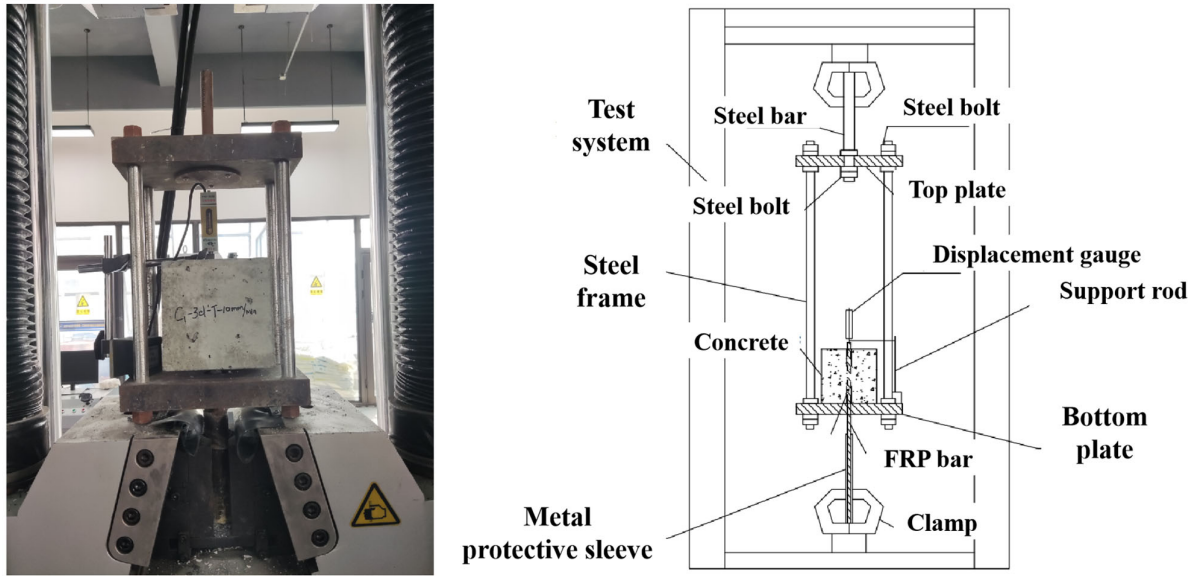


Figure S3. Photograph of the physical test setup and schematic of the loading device mechanism.



Figure S4. Photographs of the specimen preparation process.



Figure S5. Photograph of the test system.



Figure S6. Photograph of the test specimen after pull-out.

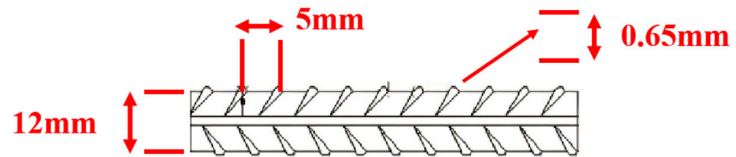


Figure S7. Photographs of the four types of bars and a schematic diagram illustrating the geometric parameters of the deformed steel bar.

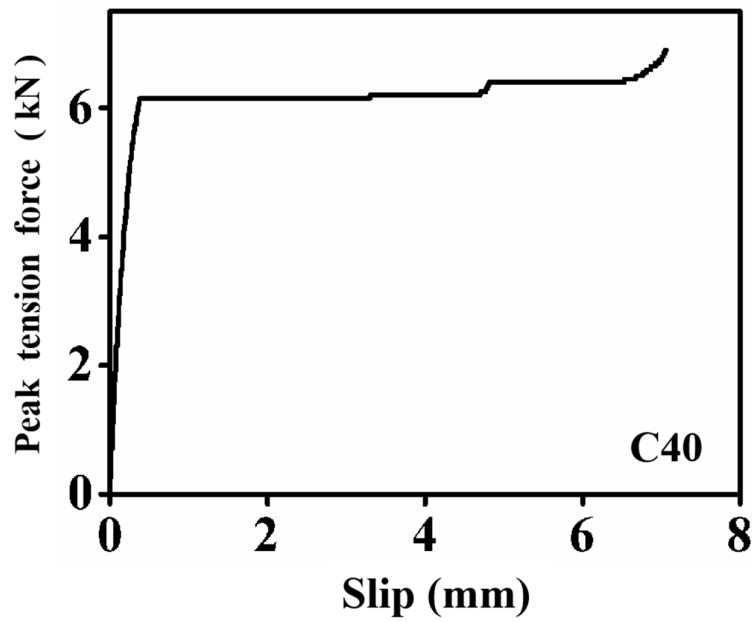


Figure S8. Pull-out test results of the bond performance between deformed steel bars and C40 concrete under a loading rate of 5 mm/min.