

BEHAVIOR OF NORMAL AND HIGH-STRENGTH CONCRETE FLEXURAL MEMBERS REINFORCED WITH FRP BARS

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Due to its noncorrosive properties, fiber reinforced polymer (FRP) reinforcement offers significant benefits for structures in a variety of applications where environmental exposure and potential for corrosion of steel reinforcement is a concern. Such applications include bridge decks exposed to deicing salts, bridge abutments, containment structures, piles, and sea walls. FRP materials are extremely high in strength, but differ from steel typically used for concrete reinforcement in that they are lower in stiffness and exhibit a linear-elastic stress-strain behavior to failure.

This experimental study involves the testing of a large number of concrete beams reinforced with fiber reinforced polymer bars. Several types of structural behavior are being studied, including flexural strength, shear strength, and deflections. Over fifty beams have been tested to date using glass fiber (GFRP) reinforcing bars, with the primary variables considered being quantity of reinforcement and concrete strength. Beams have been fabricated and testing using both normal strength concrete (5000 psi) and high strength concrete (11,000 psi). The latest phase of this ongoing research study involves the testing of fifteen high strength concrete beams with carbon fiber (CFRP) reinforcing bars.

Outcomes of this work focus on verifying design equations proposed in ACI Committee 440's *Guide for the Design and Construction of Concrete Reinforced With FRP Bars*, published in 2001. Modifications for shear strength and deflection prediction equations for beams with GFRP reinforcement have been suggested.

Publications Resulting from this Work:

- Yost, J.R., Gross, S.P., and Dinehart, D.W., "Shear Strength of Concrete Beams Reinforced with Deformed GFRP Bars," *ASCE Journal of Composites for Construction*, Vol. 5, No. 4, Nov. 2001, pp. 268-275.
- Yost, J.R. and Gross, S.P., "Flexural Design Methodology for Concrete Beams Reinforced With Fiber-Reinforced Polymers", *ACI Structural Journal*, Vol. 99, No. 3, May-June 2002, pp. 308-316.
- Yost, J.R. and Gross, S.P., "Proposed Load Factors for Bridge Decks Reinforced with FRP," *Proceedings of the Sixth International Conference on Short & Medium Span Bridges - Vancouver, Canada*, Canadian Society for Civil Engineering, 2002, awaiting final publication.
- Gross, S.P., Yost, S.P., Dinehart, D.W., Svensen, E.C., and Liu, N., "Shear Strength of Normal and High Strength Concrete Beams Reinforced With GFRP Bars," *Proceedings of the 2001 United Engineering Foundation International Conference on High Performance Materials in Bridges and Buildings, Kona, Hawaii*, American Society of Civil Engineers, 2003, awaiting final publication.
- Yost, J.R., Gross, S.P., and Dinehart, D.W., "Flexural Stiffness of High Strength Concrete Beams Reinforced With GFRP Bars," *ACI Special Publication SP-XXX* (title to be determined), American Concrete Institute (ACI), 2003, awaiting final publication.
- Yost, J.R., Gross, S.P., and Dinehart, D.W., "Effective Moment of Inertia for GFRP Reinforced Concrete Beams", submitted to *ACI Structural Journal* in July 2002, under review.

