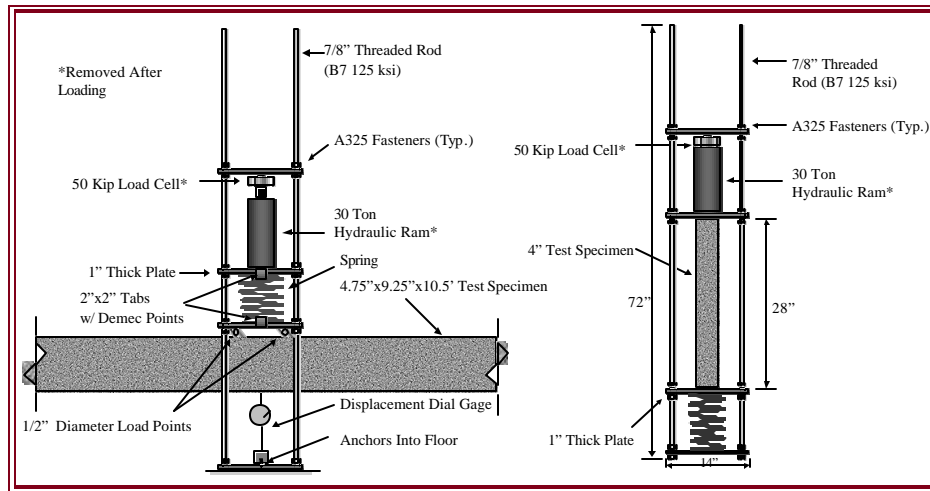


# TIME-DEPENDENT DEFLECTIONS OF NORMAL AND HIGH-STRENGTH CONCRETE BEAMS REINFORCED WITH GFRP BARS

Dates: April 2000 - May 2002  
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*This research is sponsored through a grant from the Villanova University Office of Research and Sponsored Projects, material donations from Hughes Brothers, Inc., JDM Materials, and SIKA Corporation, and faculty startup funds.*



Fiber reinforced polymers (FRP) offer significant strength-related and durability-related benefits for use as structural reinforcement in reinforced concrete structures. These materials generally are higher in strength than the steel typically used for reinforcement, but exhibit linear-elastic stress-strain behavior to failure. Furthermore, the stiffness of most FRP's is

significantly lower than that of steel. For example, glass fiber (GFRP) reinforcement typically has a stiffness only about one-fifth that of mild steel. This reduced stiffness often causes serviceability criteria (deflections and crack widths) to control the design of FRP-reinforced concrete members.

This experimental study involves the testing of twelve GFRP-reinforced concrete beams, six of which utilized normal strength concrete (5000 psi) and six of which utilized high strength concrete (10,000 psi). Beams were loaded under a sustained service-level load for a period of year. Heavy-duty railroad springs were utilized to maintain the load over time. For comparison, four additional beam samples were constructed and left unloaded in the same environmental conditions. Companion cylinder samples were also placed under sustained load to determine the time-dependent material properties (creep and shrinkage) of the concrete. After one year, the beams were unloaded and tested to failure.

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. Preliminary modifications related to time-dependent deflection predictions for beams with GFRP reinforcement have been suggested.

## **Publications Resulting from this Work:**

Gross, S.P., Yost, J.R., and Kevgas, G.J., "Time-Dependent Behavior of Normal and High Strength Concrete Beams Reinforced With GFRP Bars Under Sustained Loads," *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.