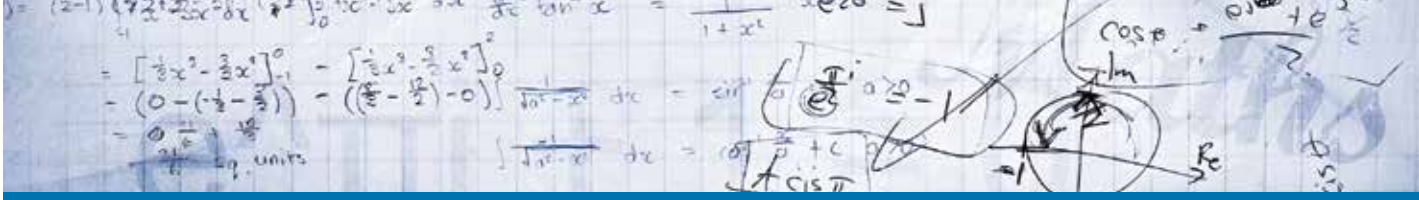

Discussion

New Generation of Precast Concrete Double Tees Reinforced with Carbon-Fiber-Reinforced Polymer Grid

The authors of "New Generation of Precast Concrete Double Tees Reinforced with Carbon-Fiber-Reinforced Polymer Grid"[1] still do not get it. A beam flange that is unreinforced, or acts like it is unreinforced, is not acceptable under ACI 318-14,[2] regardless of how high its load capacity might happen to be.

There is a second strange comparison made in the sentence, "However, for FRP, significant differences exist between the statistically guaranteed tensile strength typically specified for design and the strength actually exhibited by the materials at rupture." Counting on this difference is no different from my learning that the average yield stress of Grade 60 (410 MPa) steel is actually 72 ksi (500MPa) (to pluck a number from the air) and then basing my designs on this higher value.

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Reference

1. Lunn, Dillon, Gregory Lucier, Sami Rizkalla, Ned Cleland, and Harry Gleich. 2015. "New Generation of Precast Concrete Double Tees Reinforced with Carbon-Fiber-Reinforced Polymer Grid." *PCI Journal* 60 (4): 37–48.
2. ACI (American Concrete Institute) Committee 318. 2014. *Building Code Requirements for Structural Concrete (ACI 318-14)* and Commentary (ACI 318R-14). Farmington Hills, MI: ACI.

Authors' response

The authors would like to thank the reader for his continued interest in this topic. Currently, ACI 318-14[1] does not consider design of reinforced concrete members using fiber-reinforced polymer (FRP) material and its unique properties. Similarly, ACI Committee 440 has developed design guidelines for FRP bars as reinforcement in concrete structures (ACI 440.1R-06);[2] however, these guidelines do not specifically address carbon-fiber-reinforced polymer (CFRP) grid as reinforcement. In the absence of well-established design provisions for the use of new and innovative materials, engineers are permitted to consider experimental evidence as the basis for developing new design approaches. While the reader has stated that load capacity is irrelevant in this case, the authors respectfully disagree. The lowest ratio of measured failure load to service load was 3.7 for a full-thickness test specimen with a 2.7 in. (69 mm) grid spacing.[3] The authors consider this factor of safety to exceed the range of acceptable design practice. Furthermore, the authors have proposed significant strength reduction factors to guard against brittle failure due to FRP rupture and concrete cracking.

The difference between the statistically guaranteed tensile strength typically specified for FRP design and the average measured rupture strength can be significant, and is one of several factors relevant to the development of the minimum reinforcement and for the overstrength design recommendations discussed previously. The design tensile strength of carbon grid used in the research program was the minimum measured rupture strength.

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References

1. ACI (American Concrete Institute) Committee 318. 2014. *Building Code Requirements for Structural Concrete (ACI 318-14)* and Commentary (ACI 318R-14). Farmington Hills, MI: ACI.
2. ACI Committee 440. 2006. *Guide for the Design and Construction of Structural Concrete Reinforced with FRP Bars*. ACI 440.1R-06. Farmington Hills, MI: ACI.
3. Lunn, Dillon, Gregory Lucier, Sami Rizkilla, Ned Cleland, and Harry Gleich. 2015. "New Generation of Precast Concrete Double Tees Reinforced with Carbon-Fiber-Reinforced Polymer Grid." *PCI Journal* 60 (4): 37–48.

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