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To: ICC-ES Evaluation Committee
From: Mahmut Ekenel, Brian Gerber, ICC-ES Staff
Date: January 28, 2010
Subject: Proposed Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer, Subject AC125-0210-R1 (ME/BG)

MEMO

In response to the request for public comments in our December 29, 2009, staff letter on the subject criteria, the following items were received:

1. A letter from Dominique Deschamps (Freyssinet, Inc.), dated January 19, 2010.
2. An e-mail from Scott F. Arnold (Fyfe Co. LLC), dated January 19, 2010.
3. A letter from Kent A. Harries (University of Pittsburgh), dated January 26, 2010.
4. A letter from Garth Fallis (Vector Construction Group), dated January 26, 2010.
5. A letter from Owen Rosenboom (WJE), dated January 26, 2010.
6. A letter from Michael W. Lee (WJE), dated January 27, 2010.
7. A letter from Hakim Bouadi (Walter P. Moore), dated January 28, 2010.
8. A letter from Sami H. Rizkalla (NC State University), dated January 27, 2010.
9. A letter from Tarek Alkhrdaji, PhD, PE, Nestore Galati, PhD and Silvia Rocca, dated January 27, 2010.

ICC-ES staff reviewed these letters and would like to clarify the following issues about the proposed AC125. The reason for development of this criteria is to provide the requirements to qualify use of FRP laminates under the 2009 and 2006 *International Building Code*[®], the 2009 and 2006 *International Residential Code*[®] and the 1997 *Uniform Building Code*[™], including structural strength and compatibility, fire safety, and durability. Section 7.3 of AC125 (Design Criteria Section) sets the critical thresholds for certain design aspects that cannot be exceeded. The analysis of structural tests, as conducted under AC125, must show compliance with these design aspects.

ICC-ES staff reviewed the submitted letters and proposes the following revisions to the proposed AC125 draft:

1. Revise Section 7.3.2.1 as follows:

The nominal effective stress level in the FRP reinforcement shall be calculated in accordance with Equation 1b.

$$f_{fe} = \underline{0.85} \cdot E_f \cdot \varepsilon_{fe} \quad (1b)$$

where $\varepsilon_{fe} \leq \varepsilon_{fd}$.

Checks must be done to ensure that the strain in the member is at least as high as what is assumed in design. Fibers shall not have a misalignment of more than 5 degrees.

Dependable flexural design strengths shall be determined by multiplying the nominal flexural strength, including the effects of fiber according to Equation (1b), by the appropriate flexural strength reduction factor according to the IBC or UBC ~~and an additional strength reduction factor of 0.85 that applies to the flexural strength contribution of the FRP reinforcement only.~~

2. Add ε_{fd} to Section 7.5 (Nomenclature):

ε_{fd} = debonding strain of externally bonded FRP reinforcement

The following ICC-ES staff comment is based on the information submitted by Dominique Deschamps (Freyssinet, Inc.): Section 10.2.8 of ACI 440.2R-08 (Serviceability) requires compressive stress in concrete under service load to be limited to 45 percent of the compressive strength ($f_{c,s} \leq 0.45f'_c$) in addition to the stress limit in the reinforcing steel ($f_{s,s} \leq 0.80f_y$). Staff seeks input whether compressive stress limit in concrete should also be considered in Section 7.3.2.1.1 of proposed AC125.