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FEB - 4 2010

ICC-ES Evaluation Committee

January 29, 2010

International Code Council - Evaluation Service (ICC-ES)
Los Angeles Business/Regional Office
5630 Workman Mill Road
Whittier, CA 90601

Attention: Mahmut EKENEL, Ph.D., P.E., Staff Engineer

Dear Mahmut,

Re: Support for the Proposed Revisions to the Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems, Subject AC125-0210-R1 (ME/BG)

ISIS Canada has been researching and providing guidance for the design and use of FRP Materials for construction in Canada for over 15 years. Much of this work has focused on the design, use, and durability of externally bonded Fiber-Reinforced Polymer (FRP) Composite Systems for strengthening structures. Many of the recommendation in this proposed revision is the same methodology that is included in the ISIS Design Guide Manuals.

We therefore support the proposed revision to the AC 125 Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems.

Thank you for your consideration. Should you wish to discuss this with us further or desire additional information please feel free to contact me at 204-474-8506.

Yours Truly,

Dr. Aftab Mufti, P.Eng.
President



Antonio Nanni, PhD, PE
Professor & Chair
Civil, Arch. & Env. Engineering

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January 28, 2010

Dr. Mahmut Ekenel
ICC Evaluation Service, Inc.
Los Angeles eBusiness/Regional Office
5360 Workman Mill Rd Whittier, CA 90601

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FEB - 4 2010

ICC-ES Evaluation Committee

RE: Acceptance Criteria - FRP strengthening (AC125) - Via e-mail

Dear Dr. Ekenel:

I would like to congratulate ICC-ES staff for proposing these urgently needed changes to AC125 "Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems."

I strongly agree with the proposed changes to AC 125 which are in line with the latest position of ACI Committee 440. The proposed changes to AC125 align its acceptance criteria with recently acquired knowledge in the design and performance of FRP repair and strengthening applications to concrete and masonry structures as established by ACI Committee 440 and published in ACI 440.2R-08 Design Guide (Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures).

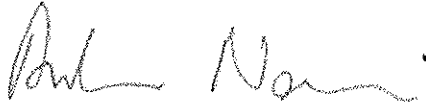
As an academician who has invested many years into the development, evaluation and verification of FRP performance and design limitations, and as a practicing engineer who uses FRP regularly for strengthening of concrete and masonry systems, I strongly believe it is in the public interest to make the proposed changes to AC125 permanent. Adopting the proposed changes would resolve the following shortcoming of the current version of AC125:

1. Even though AC 125 criteria states that "The design stresses and strains shall be based on a characteristic value approach verified by test data," the current criteria do not consider the FRP debonding failure mode that is greatly affected by FRP material stiffness and the use of multiple FRP plies. Available experimental results have shown that this approach can lead to overestimating the design strength, which in turn may lead to structural failure under service conditions.
2. I strongly agree with the introduction in AC 125 of the reliability approach of ACI 440.2R-08, since it allows for aligning the reliability of FRP repaired structures with that of the current building codes.
3. The proposed adoption of the design methodology of ACI440.2R-08 to determine the shear strength and axial strength enhancements will greatly improve AC 125 acceptance criteria. Proposed design methodologies account for the effect of concrete strength and the use of multiple FRP plies, thus better estimate the capacity of the strengthened

system. A recent reliability analysis for FRP shear strengthening that was performed by ACI Committee 440 indicated that the design methodologies adopted in ACI 440.2R-08 provide the required reliability to achieve safe and adequate performance.

One more time, I wish to thank you and ICC-ES for this effort in harmonizing technical documents related to FRP use. If you have any question, please feel free to contact me.

Sincerely,

A handwritten signature in cursive script, appearing to read "Paul Nam".



January 28, 2010

Mahmut EKENEL, Ph.D., P.E.
Staff Engineer
International Code Council - Evaluation Service (ICC-ES)
Los Angeles Business/Regional Office
Los Angeles, CA

Dear Dr. EKENEL:

I would like to commend the ICC technical staff on addressing the technical issues with the existing AC125 that are primary in nature and can affect the performance and safety of FRP composites strengthened structures.

As Director of the Composites Growth Initiative of the American Composites Manufacturers Association (ACMA) and past chairman of the American Concrete Institute (ACI) Committee 440 (FRP Reinforcement) from 2003 to 2009, I have seen the FRP design guideline published by my committee evolve from a design approach of basic material based on theories from 10 years ago, to a more advanced design procedure that account for all possible failure modes and design limits. The latest release of the ACI 440.2R-08 design guide was based on examining hundreds of tests carried out on members with different sizes, properties, shapes and reinforcement ratios.

I am proud to say that the collective minds of the more than 60 voting members of ACI Committee 440 who represent the wide spectrum of this industry including academia, manufacturers, designers, and end users, all with expertise with FRP repair and strengthening applications were able to examine the available large pool of test data and develop the most comprehensive, and accurate design guide. It is in my opinion that the recommended changes to AC125 will greatly improve these criteria and provide the proper alignment of the test requirements with the current state of the practice for FRP performance and design limits. Most importantly, the synergy of the changes to AC125 and ACI 440.2R will minimize confusion for the practicing engineer in the future which is important when designing for safety of occupants in buildings.

I strongly support these changes and the alignment of AC125 with the current ACI 440.2R.

Thank you for your consideration. If you have any questions, you can contact me at 914-961-8007 or jbusel@acmanet.org

Sincerely,

A handwritten signature in black ink, appearing to read 'John P. Busel', written in a cursive style.

John P. Busel
Director, Composites Growth Initiative



The FRP Retrofit Experts

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January 28, 2010

Mahmut EKENEL, Ph.D., P.E.
Staff Engineer
International Code Council - Evaluation Service (ICC-ES)
Los Angeles Business/Regional Office

RE: Acceptance Criteria - FRP strengthening (AC125)

Dear Dr. Ekenel:

As a company that specializes in repair and retrofit of structure with FRP products, we fully support your efforts in revising the Acceptance Criteria to bring it in compliance with the ACI 440 documents. I believe this is an undertaking that is overdue and I am sure it is welcome by a great majority of those involved in this industry.

I have asked some of the engineers in my office review the document and they have come up with the following corrections:

1. In Section 7.3.2.3 the aspect ratio of columns has been changed from 1.5 to 2 (similar to ACI 440) but in Section 7.3.2.4 reference is made to the old ratio of 1.5.
2. In Section 7.3.2.4.2 change "H" and "B" to "h" and "b" and change 1.5 to 2.0 to be consistent with Section 7.3.2.3.2
3. Eq. (13) should read " $\rho_s \geq \dots$ "
4. Eq. (16) should read " $l_s \geq \dots$ "
5. In Section 7.5 "CFRP" definition reads "Carbon fiber ...", which should be "Carbon fiber..."
6. Equations (11) to (16) should be "aligned" and formatted to facilitate visualization.

I hope you will find these comments helpful. We look forward to the approval of the revised document. If you have any questions or comments, please contact me.

Sincerely yours,

Mo Ehsani, PhD, P.E., S.E.
President, QuakeWrap, Inc. and
Professor of Civil Engineering, The University of Arizona



Department of Civil and Environmental Engineering

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January 28, 2010

Mahmut Ekenel, Ph.D., P.E.
ICC Evaluation Service, Inc.
5360 Workman Mill Road
Whittier, CA 90601

Dear Dr. Ekenel:

This letter is in response to your memo dated December 29, 2009, to parties interested in ICC evaluation reports on using externally-bonded FRP for strengthening concrete and masonry structures.

As an academician, who is also a member of ACI Committee 440 (Fiber Reinforced Polymer Reinforcement) and TRB AFF80 (Structural Fiber Reinforced Polymers), I found myself keen on writing this letter hoping that it would assist in your upcoming public hearing discussions.

Endorsing the proposed AC125 changes related to flexural strengthening of concrete structures is not a hard decision for me. My research in recent years focused on structural reliability of FRP-strengthened concrete beams. This research led to my assignment with the task of performing calibration of ACI 440.2R-08 guidelines. The work of the task group was adopted in ACI 440.2R-08 after lengthy discussions among committee members and friends. I can see that AC125's proposed provision changes are close to ACI 440.2R-08 provisions to a great extent. Therefore, I believe that these changes are a step forward in the right direction. What I found missing in the proposed changes is the general factored nominal moment equation for flexure $\phi M_n = \phi (M_s + \psi_f M_f)$ and a defined value for ψ_f . In my opinion it should be included like it was for the shear design (Eq. 17).

Should you need to contact me, please use the above address or call me at 225-578-7048. You may also contact me by fax at 225-578-8652 or via email at aokeil@lsu.edu.

Sincerely,

Ayman M. Okeil, Ph.D., P.E.



29 January 2010

Engineering of Structures
and Building Enclosures

Mahmut Ekenel
Staff Engineer ICC Evaluation Service, Inc.
Los Angeles eBusiness/Regional Office
5360 Workman Mill Rd Whittier, CA 90601

RE: AC125 "Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems".

Dear Dr. Ekenel:

We reviewed the proposed revisions to AC125 "Acceptance Criteria for Concrete and Reinforced and Unreinforced Masonry Strengthening Using Externally Bonded Fiber-Reinforced Polymer (FRP) Composite Systems".

For FRP strengthening of concrete, the revised AC 125 document includes design considerations developed by the American Concrete Institute (ACI) – Committee ACI 440 for strengthening of concrete structures, which are part of ACI 440.2R-08. These changes substantially improve the current AC 125 document.

For FRP strengthening of masonry, the proposed AC125 document also includes some design considerations developed by ACI 440, which will be published in the next few months. The design considerations are mainly for flexural strengthening due to out-of-plane loads. The revised AC 125 document does not include provisions for shear strengthening of masonry. Thus, Section 7.3.2.6 – Shear Strength Enhancement can be misleading since a design professional may use it for shear strengthening of masonry, when it obviously is only applicable to concrete strengthening. Therefore, we suggest you modify the section title to "Sections Strength Enhancement of Concrete Elements," or state in Section 1.2 – Scope that this document does not deal with shear strengthening of masonry with FRP.

In general, we suggest that the revised AC125 document should make reference to ACI 440 design guidelines for strengthening of concrete and masonry structures. In particular, ACI 440 provisions not included in the AC 125 document.

In essence, we agree with the proposed changes to AC 125. As practitioners who frequently use FRP systems in structural design including strengthening of concrete and masonry structures, we believed that AC 125 should include design recommendations provided by the American Concrete Institute (ACI) – Committee ACI 440 and reference documents produced by this ACI committee.

If you have any questions please feel free to contact us.

Sincerely yours,

J. Gustavo Tumialan, Ph.D., P.E.
Senior Staff II

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Wassim Naguib, Ph.D., S.E.
Senior Staff II

RAFAEL C. DISCIPULO, P.E.
Structural Engineer

January 29, 2010

Mahmut Ekenel, PhD, PE

Staff Engineer

International Code Council – Evaluation Service (ICC-ES)

Los Angeles Business/Regional Office

Tel: 562-699 0543 ext. 3721

Re: Proposed Changes to Acceptance Criteria AC125 – FRP Strengthening

Dear Mr. Ekenel:

This is to express my support to the proposed changes to AC125 – FRP Acceptance Criteria advanced by Structural Preservation systems as circulated in the ICC-ES letter dated December 29, 2009.

In my design practice, I have had exposure to applications of FRP in strengthening and upgrade of structures particularly between 2001 thru 2007 while working with a post-tensioning company in Washington DC. Now that I work for the Department of State Overseas Buildings Operations in Arlington, VA, I continue to follow the FRP industry trend. There have been opportunities when FRP could have provided a good solution to some projects. Acceptance Criteria became the question in some of them. I can see that coherence between ICC-ES and ACI440 will help push effective FRP solutions forward in future projects.

Thank you for considering this support letter.

Sincerely,



Rafael C. Discipulo, P.E.

CA/DC/DE/KY/MD/MI/NC/OH/PA/VA