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January 21st, 2010

Dr. Mahmut Ekenel, PhD, PE
Staff Engineer
ICC Evaluation Service, Inc.
5360 Workman Mill Road
Whittier, CA 90601

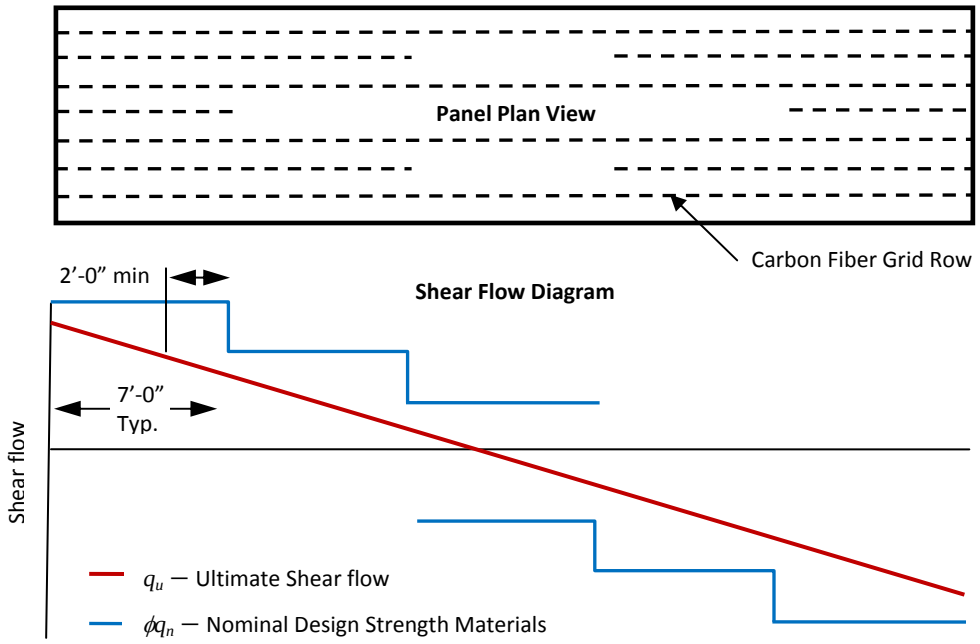
RE: Staff Letter dated December 29th, 2009 written by ICC Evaluation Service's Staff Engineer, Dr. Mahmut Ekenel

Dear Dr. Ekenel,

I hope this letter finds you well. The following is in response to the above referenced letter.

The specimen size of 7 feet (2.1m) by 4 feet (1.2m) as outlined in the proposed acceptance criteria AC422 was established to better represent full scale conditions of the products that this combination of materials (concrete, insulation, carbon fiber grid) would be used in. Typical insulated wall panel sizes are 8 feet, 10 feet, 12 feet and 15 feet wide and range in heights from 20 feet to 50 feet. Typical horizontal panels (spandrels) range in lengths from 15 feet to 45 feet and are 4 feet to 7 feet high.

From a design perspective the carbon fiber grid is used to resist internal shear flow, q_u. This shear flow is not constant from one end of the member to the other, based on forces and connections there is typically a maximum shear flow at the ends and zero shear flow in the center of the span. In typical designs the quantity or rows of grid will be reduced as you approach zero shear flow. The 7 foot length is a good representation of this decrease while adding some redundancy to the design as our normal procedure would be to taper off rows in about 5 foot tp 7 foot increments as shown in the following figure.



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If you have any additional questions please do not hesitate to contact me. For reference my contact information is:

Jason P. Lien
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1660 Lincoln St, Suite 1800
Denver, Colorado 80264
303.298.1900

Thank you once again.

Sincerely,

Jason P. Lien, P.E.

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RE: Letter dated January 18th, 2010 written by Thermomass's Director of Engineering, Venkatesh Seshappa

Dear Dr. Ekenel,

I hope this letter finds you well. The following is in response to the above referenced letter. I will review each numbered item in addition to a reply for both Mr. Seshappas introduction and concluding paragraphs.

I would also like to take this opportunity to remind you that the intent of AC422 is to develop an Acceptance Criteria (AC) and Evaluation Service Report (ESR) for the interaction of carbon fiber grid, concrete, and insulation. The results of any ESR related to AC422 would be specific for a given specimen based on the material properties of the insulation, insulation thickness, material properties of the concrete, spacing of the grid strips, and grid properties including spacing, orientation, and strength. In addition, the AltusGroup® is comprised of a number of individual company members under confidentiality. These member companies have access to proprietary research and design information specific to our group. The intent was never to expose this information but develop an accepted method to determine specific design properties that are most crucial the behavior of some of some of our proprietary designs. There are a number of tests that Mr. Seshappa request be included in AC422 that have already been completed within our group's R&D program, however, releasing this content and developing procedures for these tests exposes much of our proprietary data and theory. Since this is not an AC document to define a completed building component we believe his requested test additions are not required. I refer you to numbered items 19, 20, and 21.

Introduction Paragraph

I too am a member of a number of committees for PCI and AltusGroup, as well as having many professional design years in the business of precast concrete. Our AltusGroup's Technical Committee has hundreds of combined years in the design and development of precast concrete as well and as you know this AC was developed as an AltusGroup Technical Committee. We have leveraged this experience to develop in an effort to ascertain from AC422, the most critical aspects of our system design; shear flow, q, and shear modulus, G. The primary reason for not using AC320 is twofold:

- AC320 was written for a discrete connector
- The design model in AC 320 for the connector does not follow a truss analogy.

Numbered Items

1. Although wall panels are subjected to multiple loading combinations, AC422 was only written to formalize a procedure and develop consistency for determining the two values critical to wall panel design; shear flow, q, and shear modulus, G.
2. The intent of section 6.4, lines 301 and 302 should be rewritten to clarify that shear grid alone is not to be used as the primary mechanism for the support of sustained loading.
3. AC422 was written to test the system of concrete, insulation, and grid connectors. The title should be rewritten to describe the same.

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4. AC422 was written as a procedural method to test a specific system of a specific concrete, a specific insulation type and thickness, and grid connectors. The results of testing are specific to the constituents of the sample.
5. There is a misunderstanding – the panel is under combined shear and bending and the grid connection mechanism is used to resist shear flow in a unidirectional manner. Should forces normal to the weak direction of the grid exist, additional grid would need to be added to resist these forces. This additional grid would be placed in a direction where the force was collinear to the added grids strong direction.
6. As noted in 5, any forces induced the in panel, spandrel or otherwise, would need grid with the strong axis placed in the same direction as those forces.
7. As noted in 5 and 6. Should transportation forces or erection forces require additional grid then the additional grid would be placed with the strong axis collinear to the direction of those forces.
8. AC422 is for the determination of continuous and semi-continuous grid as we have defined. If required, a second set of samples can be made to highlight and test the semi-continuous definition. There is no lap splicing of the grid in a panel which is why there is a semi-continuous definition.
9. See item 8.
10. Based on previous observations and tests, we do not feel that this statement is accurate and thus there is only one set of results for a given sample set.
11. See item 4.
12. Section 4.2 of line 113 and 121 should be rewritten to reference section 4.4 not 4.2.
13. See item 1. In addition, AC422 is not indented to be used as a design guide, engineering guide, or as a prescriptive method to panel design. One final note in relationship to the same, the capacity calculations of section 3.3 for the determination of *Nominal Strength* follows the ACI recommended 5% fractile method and no additional factor of safety should be placed in AC422. Within the AltusGroup Design Guide which is not part of this document, we apply appropriate Strength Reduction Factors, ϕ to determine *Design Nominal Strength.*
14. Agree 7 ft (2.1) should be rewritten as 84 in (2133 mm).
15. See item 13.
16. The shear modulus, G does not have a direct correlation to the number of grid segments but is directly correlated to the total surface contact area of the specimen, $2Lw$.
17. Agree the units for G should be rewritten as lbs/in^2 or kN/mm^2
18. See item 14.
19. See introduction.
20. See introduction.
21. See introduction.
22. ASTM D3039 is intended to be used to test an individual group of fibers and matrix that the grid is made from. It is not intended to test a full grid sample.
23. See item 22.
24. See item 22.
25. We disagree and believe that the test procedure and outline as noted section 4.4 provides enough detail to the end user.
26. The sentence indicating that a single row of connectors may be tested should be removed and the sentence should be rewritten as such.
27. We agree to modify the sentence as recommended "…. can be interpolated for results of other insulation thicknesses provided all other connection design alternatives are the same."
28. See item 13.
29. We understand that the quality procedures outlined in AC10 will be implemented as we have written in section 5.2.
30. Agree.
31. Agree.
32. Section 1.4.3.3 should be deleted as the results for AC422 are specific to grid spacing, concrete, insulation type and thickness, etc.
33. The results for AC422 are specific to grid spacing, concrete, insulation type and thickness, etc.

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Concluding Paragraph

Altus Group is a proprietary system and set of manufacturers. It is not the intent of AC422 to deliver this intellectual property only to determine specific parameters required in the precast component design.

In addition, based on some of Mr. Seshappa'a recommendations, I believe the following should be changed for consistency within the document. I have listed these based on line numbers.

153	Add the following sentence: *A semi-continuous grid segment is considered a full segment as if it were continuous.*
178 – 179	The *4 feet (1.2)* should be changed to *48 inches (1219 mm)*.

I would like to conclude and thank Mr. Seshappa for his thorough review of AC422. I trust that our explanation clears the path for acceptance and reduces confusion regarding the intent of the criteria. If you have any comments or wish to pass this on the Mr. Seshappa please do not hesitate.

For reference my contact information is:

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Thank you once again.

Sincerely,

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