



International Code Council

ICC IS-3DACT Committee Agenda – Meeting #11

August 9, 2024 – 10:00 AM PT

1. Welcome and opening remarks

Staff Secretariat, Melissa Sanchez called the meeting to order at 10:02 am PDT and welcomed all committee members, invited parties, and ICC staff. Ms. Sanchez announced that Mr. Jared Brewe has taken a different position and due to a conflict of interest will no longer be a committee member moving forward. This meeting will be his last day of voting. He will stay on as an interested party member. Mr. David Langefeld will become the new leader for the Structures Working Group.

Ms. Sanchez then went on to note the committee must adhere to the ICC Code of Ethics, which states that those participating in ICC activity must adhere to the highest ethical conduct, with the purpose of the protection of the health, safety and welfare of the public by creating safe buildings and communities. In addition, Section 5.1.10 in Council Policy #7 is in effect and any committee member with a conflict of interest must withdraw from participating in discussion or vote on the matter in which they have an undisclosed interest. Lastly, Council Policy #50 outlines ICC Antitrust guidelines, which indicates the committee meetings are not intended for discussion of pricing and marketing topics.

2. Quorum and Attendance

Ms. Sanchez called the roll of the IS-3DACT with the following members registering attendance. Ms. Sanchez noted there was enough for a quorum.

2024 IS-3DACT COMMITTEE MEETING						
NAME	#8 5/10/24	#9 6/7/24	#10 7/12/24	#11 8/9/2024	#12 9/13/24	#13 TBD
Jared Brewe [A]	X	x	X	X		
Gabriel Carrera [D]	X	x	X	X		
Bora Gencturk [C]	X	x	X	X		
Rory Hamaoka [H]	X	x	-	-		
Werner Hellmer[H]	X	-	X	X		
Maryam Hojati [D]	-	x	X	X		
Berok Khoshnevis [D]	X	-	-	-		
Jeff Martin [A]	-	x	X	-		
Doug Mayer [H]	X	x	X	X		
Paul Messplay [H]	X	-	X	-		
Adil Tamimi [D]	X	x	X	-		
Bing Tian [A]	X	x	X	X		
David Langefeld [B]	X	x	X	X		
Eric Kreiger	-	-	-	X		
TOTAL	11/13	10/14	11/14	9/14		

Interested parties in attendance included Abdul Peerzada (Quikcrete), Daniel Galvez Moreno (ICON), Robert Devine (Wiss, Janney, Elstner Associates), Stephan Mansour (ASTM), Mahmut

Ekenel (ACI), Muhammed Shakeel Akhtar (Parsons), Sean Monkman (ICON), Chris Kaufmann (Parsons)

3. Approval of Agenda

Chair Mr. Bora Gencturk asked for a motion of approval for the agenda. Mr. Bing Tian motioned, and Mr. Werner Hellmer seconded. The agenda was unanimously approved.

4. Approval of Previous Meeting Minutes

Mr. Gencturk asked for a motion of approval for the previous meeting minutes. Mr. Hellmer motioned, and Mr. Tian seconded. The previous meeting minutes were unanimously approved.

5. Update on Work Groups

a. Materials Work Group (Bing Tian)

Mr. Gencturk shared the draft of Chapter 5. He then opened the floor for any last discussion on Chapter 5. Mr. Hellmer had a comment on the title of Chapter 5 – 3D Printing Material and Structural Field Prequalification – Testing methods, Performance Requirements and Final Acceptance with regards to the last section of the chapter, 502 Field Quality Control and Final Acceptance Testing. He suggested to remove the term field quality control as it is an ambiguous term. Mr. Gencturk and Mr. Tian agreed with this suggestion. Mr. Mahmut Ekenel requested to keep the term field. Mr. Gencturk and Mr. Tian agreed with this request. Section 502 reworded to Field Final Acceptance Testing.

Mr. Eric Kreiger had a comment on Section 502.4 regarding the compressive strength testing. He commented that the requirement for cut samples to be tested once a week was taken out and suggested to include it again. He remarked that this requirement was included for safety because the compressive strength from cast samples may be different than from printed samples, and that while the pre-qualification testing was good, not everyone can test with field conditions. Mr. Gencturk responded that the pre-qualification testing was required and no longer optional. Mr. Tian shared that during the materials meeting there was a 7 to 3 vote on removing the cut-out, however, he agreed with Mr. Kreiger about the importance of a cut-out in the field. Mr. Gencturk countered that the reason that the cut-out was removed was because it would add repetitive testing. Mr. Kreiger expressed concern for when the environmental field conditions were outside the prequalification environmental settings. He referenced shotcrete as an example of when on-site mock-up walls are required. Mr. Gencturk commented that it was already included that the pre-qualification testing would need to be repeated if the field conditions fell outside the initial pre-qualification range but opened the discussion to the committee for their opinion. Mr. Tian agreed with Mr. Kreiger that a mock-up wall was necessary for the jobsite. However, he said that only compressive strength testing was needed since compressive strength is the most important parameter considered in design. Mr. Robert Devine was also in favor of cut cube samples at least once a week and/or twice a project. He agreed with Mr. Tian that compressive strength should be enough. Mr. Gencturk suggested to cut the specimens out from the printed walls but leave in the option for a mock-up wall for those who do not want to cut from the walls. Mr. Tian liked this suggestion. Mr. Devine agreed with this suggestion too and added the suggestion to include that the cut samples should include an overnight delay. Mr. Gencturk commented that this was already considered in the pre-qualification testing.

August 9, 2024

Mr. Devine commented that it was not specified in Figure 501.6.2.1 where the cubes were to be taken from. Mr. David Langefeld commented that at ICON they had not seen any statistical difference in strength between cubes taken from layers with a long print stop and layers without delay. Mr. Kreiger added that cut samples taken from a long delay convey more information about the interlayer bond strength than the compressive strength and thus agreed with Mr. Langefeld that the location of the cut cubes did not matter.

Mr. Gencturk asked about the frequency of taking the cut samples, the number of specimens to take at a time, and the location of where to take them. Mr. Kreiger suggested once a week as long as a cast sample was also done at the same time; five samples; a printed wall or mock up wall would be acceptable; and the location anywhere on the wall.

Mr. Gencturk then moved the discussion to Chapter 4. He added that he would make the changes to Chapter 5 while Chapter 4 was being presented and the vote on Chapter 5 would be the last item on the meeting's agenda.

b. Structural Work Group (Jared Brewe / David Langefeld)

Mr. Jared Brewe started the discussion on Chapter 4 by presenting the first Section 401 – General Design Requirements. He explained Section 401.2.1 – Engineered Design was for conventionally reinforced planar walls while Section 401.2.2 – Structural Testing was for other types of walls. Both sections require the detailing requirement of Section 403 and the connection requirements of Section 405. Section 406 contains the testing taken from AC509. Section 401.3 – Construction Systems included the wall composition and wall classification. Mr. Brewe pointed out that language consistency (e.g. wythe versus shell) will be addressed. He also noted that Section 401.3.4 – Stay-in-Place Formwork would be added to the construction documents.

For Section 402-Design Criteria, Load and Resistance Factor Design (LRFD) was agreed to be used for the structural design as the concrete industry uses LRFD, even though established resistance factors are lacking for 3D-ACT wall systems. The standard will also be limited to Seismic Design Categories A and B.

For Section 403-Detailing Requirements, the minimum reinforcement was presented. Mr. Brewe commented that wires often used for horizontal reinforcement have strengths higher than 60 ksi. So, the issue of allowing this or not will need to be resolved. Mr. Brewe pointed out that the development and splicing of reinforcement will need to be discussed more.

For Section 404-Structural Wall Design Provisions, in Section 404.5-Out-of-plane Loads, Mr. Brewe posed the question to the committee whether the shell and core should be separated into two different sections or be kept together as the current draft shows. The shell spans horizontally and is a plain unreinforced element and the core spans vertically and is a reinforced element. Mr. Brewe stated a figure is planned to clarify the differences between the shell and core. Mr. Gencturk asked if this was just for flexural capacity calculations. Mr. Brewe replied that it was for out-of-plane loads and the strength of the shell and core. Mr. Gencturk commented that it all depended on whether or not the shell was reinforced. Mr. Brewe stated that the default for the wall was for the shell to be unreinforced, and that the wall had some reinforcement for temperature and shrinkage control, but not for strength. Mr.

Langefeld added that there could be horizontal reinforcement for multiple beads for structural capacity. Mr. Kreiger agreed and commented he mostly agreed that the shells could be analyzed for flexural capacity for the purpose of transferring the flexural capacity to the cores which transfer the loads to the foundation. Mr. Langefeld made the argument for keeping them together because of the duplication of the writing of the flexural equations. He commented that if a shell spanned horizontally from core to core, it could be unreinforced or reinforced. The cores which are vertical, must be reinforced. Thus, the flexural equations apply both for the horizontal and vertical spans. Mr. Devine commented that if a figure was provided it could lessen the density of the writing and thus there would be no need separate them. Mr. Kreiger agreed that a figure showing the load transfer would be helpful.

The next point of discussion Mr. Brewe brought up was on Section 404.12-Strength Reduction Factors. He commented that strength reduction factors were hard to change once set in a standard and thus asked for the committee's opinion on the proposal of using two strength reduction factors— one a traditional strength reduction factor and another an additional reduction factor for 3D printed elements. He used the flexural strength reduction factor as an example – the traditional strength reduction factor is 0.9 and the 3D reduction factor could be around 0.90 – 0.95. Mr. Gencturk was in favor of using two strength reduction factors. Mr. Kreiger was also in favor but suggested the 3D factor be called an uncertainty factor since it's not based on reliability. Mr. Devine asked if there was a good Greek letter for uncertainty. Mr. Brewe suggest psi (Ψ).

Mr. Brewe then briefly gave an overview of the remaining sections. Mr. Langefeld commented there were about 5-6 things to work on and the need for a structural working group meeting to discuss 2-3 things in more depth.

6. Additional Discussion of Initial Draft

Mr. Gencturk shared the edits he made to Chapter 5 including the cut-out samples for Section 502.4. He asked what the size of the cut-out samples should be and whether concrete specimens could be cubes. Mr. Devine commented that for aggregates 3/8-inches or less, cubes would be okay. He stressed that if the cubes could not be 2-inches then it should be specified that they need to be 90% of the effective structural contact width and have the loading rate be adjusted to within the stress rate specified in ASTM C109. Mr. Gencturk asked what to do with larger aggregates. Mr. Kreiger suggested a using a specimen that was a minimum dimension of four times the maximum aggregate size. Mr. Gencturk agreed with this. Mr. Devine suggested that dimensional tolerances of the samples meet the requirements of ASTM C42/C42M for sawn beam specimens. Mr. Gencturk agreed.

Mr. Devine had one additional comment on Section 501.4 regarding bonding agents being used during the print stop. He noticed it had been taken out and suggested to include it again. Mr. Gencturk agreed and edited the section.

Mr. Gencturk then moved to vote on Chapter 5. Mr. Brewe motioned to vote on Chapter 5. Mr. Tian seconded the motion. The vote count was 8/14. Mr. Gencturk approved the motion.

7. Next Meeting

The next meeting is set for September 13, 2024, at 10am Pacific Time.

8. New Business

August 9, 2024

There was no new business.

9. Action Items & Summary

The action items from the meeting were summarized as follows:

<i>Structures working group to meet in next two week and circulate the documents to the entire committee at least 1 week before next committee meeting.</i>	<i>Mr. Langefeld</i>
---	----------------------

With no other questions or comments before the committee Mr. Gencturk moved to adjourn the meeting. Mr. Brewe motioned for adjourning and Mr. Gabriel Carrera seconded. The meeting adjourned at 12:06pm Pacific Time.