

ICC Public Comments of 1st Draft of ICC 1150-202X Standard for Automated Construction Technology for 3D Printing Walls

#	Name and Affiliation	Section	Comment and Revised Language/Proposed Resolution	Committee Response	Committee Meeting Notes
1	David Langefeld, P.E. ICON	101 PURPOSE	The standard includes more than just design. Suggest the committee be more descriptive: “...to establish design, <u>qualification, inspection, and acceptance</u> provisions...”	Approve – Minor Edits	Motion to accept as revised by Werner, Doug second, approved unanimously.
2	Mahmut Ekenel, Ph.D., P.E. ACI	101.1 Purpose.	Suggest adding <u>material specifications and...</u> 101.1 Purpose. The purpose of this standard is to establish <u>material specifications and</u> design provisions for <i>3D printed walls</i> and their connections where the walls are built using 3D automated construction technology.	Approve – Minor Edits	Motion to accept as revised by Werner, Doug second, approved unanimously.
3	Mahmut Ekenel, Ph.D., P.E. ACI	102 SCOPE	This standard does not mention fire performance limitations. At least a statement such as “ <u>Fire & smoke prevention features, where required, must comply with IBC Chapter 7 and local building code requirements</u> ” can be added.	Approve – Minor Edits	Motion to accept as revised by Adil, Bing second, approved unanimously.
4	David Langefeld, P.E. ICON	102.1 Scope.	The section describes a number of types of wall systems. Suggest the committee exclude this description in Chapter 1 and allow Chapter 4 to cover what is possible/permissible. Recommend striking: “ The walls are to be constructed by printing (extruding) the 3D printing material in layers to create wall configurations including, but not limited to, a wall with two printed outer face shells with a core fill grout poured between the shells to form a solid wall, a wall with two printed outer face shells and composite action achieved through a printed web and/or reinforcement, and multiple shell walls with shells without integral cores that are considered veneer, where the out-of-plane load is transferred to a structural shell. ”	Approve – Minor Edits	Motion to accept as revised by Adil, Bing second, approved unanimously.

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5	Mahmut Ekenel, Ph.D., P.E. ACI	103.1 Compliance alternatives.	<p>Instead of starting with negativity, it is suggested to include language similar to 2024 IBC Code Section 104.2.3 language, such as:</p> <p>103.1 Compliance alternatives. <u>The provisions of this standard are not intended to prevent the use of...</u></p>	Approve – Minor Edits	Motion to accept as revised by Werner, Maryam second, approved unanimously.
6	Mahmut Ekenel, Ph.D., P.E. ACI	104 TESTING LABORATORIES AND REPORTS	<p>This section 104 contradicts with Section 406.2. Section 406.2 requires labs to be accredited under 17025; whereas Section 104 only requires results to be reported per ISO 17025. These sections have two different languages with different meanings. Suggest Section 406.2 language is used in Section 104.</p> <p><u>Also see my comment below about Section 406.2.</u></p>	Disapprove	The comment was not applicable for this section.
7	David Langefeld, P.E. ICON	104.1	<p>Chapter 1 does not clearly reference testing, except through special inspections. Suggest the committee update the reference to “laboratory tests specified in this chapter.” Also, does the lab need the certifications listed? IBC and IRC do not reference ASTM E329, C1077, or ISO 17025. Suggest the committee revisit this and align with current requirements in IBC and other Codes.</p> <p>Refer to definition of “Approved Agency” in 2024 IBC, and Section 1703.1 to see if the references are necessary.</p>	Approve – Minor Edits	Motion to accept as revised by Gabriel, Werner second, approved unanimously.

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8	Mahmut Ekenel, Ph.D., P.E. ACI	105.1 Special Inspection.	<p>This section is narrow in content, and I do not think it satisfies the intent of IBC Chapter 17. Because there is no 3D printing in the IBC, especially in Section 1705.3, Section 105.1 needs to be more specific. Suggest the following:</p> <p>105.1 Special Inspection. Special inspection shall be provided in accordance with Sections 1705.1.1 <u>and applicable parts of Section</u> 1705.3 of the IBC during the mixing, printing, and placing of the <i>3D printing material</i> shells and <i>core fill grout</i>. The inspection shall include verification that the concrete compressive strength is in compliance with the minimum compressive strength specified in the construction documents. <u>Applicable requirements of Sections 501 and 502 determined by registered design professional in responsible charge may also apply.</u></p>	Approve – Major Edits.	<p>Tabled for additional work by the structures working group. Motion by Werner, second by Adil, unanimously approved.</p> <p>Motion to approve the changes as discussed in March 21, 2025 meeting: Paul 1st, Eric 2nd, unanimously approved.</p>
9	Mahmut Ekenel, Ph.D., P.E. ACI	106.1	<p>Does the language in Section 106.1 contradict with Section 501.7 language about what is mandated? See underlined.</p> <p>501.7 Submittal Requirements. Upon completion of the field prequalification, <u>a submittal shall be provided to the licensed design professional</u> that demonstrates suitable properties for workability, structural performance, and durability for the intended construction project.</p>	Disapprove	Resulted in a minor change to Section 501.7. Section 501.7 is related to prior to construction while 106.1 is during construction.
10	David Langefeld, P.E. ICON	108.1 General.	<p>The “weight of the structure considered” is unclear. Suggest the committee reword the item.</p> <p>Replace “weight of the structure considered” with “<u>...unit weight of the 3D printing material or the service dead load of the 3D-ACT wall system in psf...</u>”</p>	Approve – Minor Edits	Motion by Adil, second by Rory, unanimously approved.

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11	David Langefeld, P.E.	202 DEFINITIONS 2-COMPONENT (2K) 3D PRINTING MATERIAL	<p>The definition of 2K 3D printing material needs more clarity. Suggest the committee reword and consider adding a definition for 1K 3D printing material.</p> <p><u>“2K 3D printing material-a 3D printing material consisting of a base and an admixture package, where one or more of the admixtures is dosed and introduced downstream of the initial batching, likely close to the nozzle extrusion point. Most commonly, 2K materials serve to closely control workability/consistency and set time.”</u></p> <p><u>“1K 3D printing material- a 3D printing material where all consistent materials, including any admixtures, are dosed and mixed during batching prior to delivery.”</u></p>	Minor editorial changes – Chair approved.	Not applicable.
12	ICON	202 DEFINITIONS 3D AUTOMATED CONSTRUCTION TECHNOLOGY (3D-ACT)	<p>The definition of 3D Automated Construction Technology should emphasize the automation aspect of the technology. Suggest the committee reword the definition as</p> <p>“Construction-scale additive manufacturing technique, also known as additive manufacturing or layer-by-layer automated construction technology, for the construction of buildings or building components using automated, computer-controlled robotics to extrude and deposit cement-based materials layer-by-layer in a predefined print path. The system consists of 3D Printer Software, 3D Printer, and Material Batching and Delivery System.”</p>	Minor editorial changes – Chair approved.	Not applicable.
13	David Langefeld, P.E.	202 DEFINITIONS 3D PRINTING WALLS	<p>An alternative definition for 3D printed wall may be more flexible for future editions. Suggest the committee reword the definition as:</p> <p>“A variable configuration of components, constructed of 3D Printable Materials with 3D Automated Construction Technology that taken together are used for structural and non-structural walls, either interior and exterior and with or without structural steel reinforcing. The system includes connections to the foundation, floors, and roof.”</p>	Minor editorial changes – Chair approved.	Not applicable.

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14	David Langefeld, P.E. ICON	202 DEFINITIONS 3D PRINTER	In the future, if not currently, the material batching and delivery system may not be unique to the 3D printer. It may be good to separate this machinery from the 3D printer definition. See also comment 15. Suggest the committee reword the definition as: “3D Printer-Computer-controlled robotics equipment used to support and control the position and orientation of a print nozzle, used to construct 3D Printing Walls by extruding 3D Printing Materials layer-by-layer following a predefined print path.”	Minor editorial changes – Chair approved.	Not applicable.
15	David Langefeld, P.E. ICON	202 DEFINITIONS 3D PRINTING MATERIALS	In the definition of 3D printing materials, it says “and/or coarse aggregate.” It is highly unlikely that a printable material would contain only coarse aggregate. Suggest the committee reword. Replace “ fine and/or coarse aggregate ” with “ <u>fine aggregate, coarse aggregate, or both</u> ”	Minor editorial changes – Chair approved.	Not applicable.
16	David Langefeld, P.E. ICON	202 DEFINITIONS 3D PRINTING MATERIAL MIX DESIGN	The definition of 3D printing material mix design appears to reference itself. Suggest the committee reword. Replace definition with “ <u>Proprietary or non-proprietary formula and associated documentation for 3D printing materials that specify the constituent materials and their proportions usually in weight or volume fractions.</u> ”	Minor editorial changes – Chair approved.	Not applicable.
17	David Langefeld, P.E. ICON	202 DEFINITIONS CORE FILL GROUT	The term “Core fill grout” should be more general. Refer to 401.3.2. See Comments 22 (core) and 23 (effective structural contact width). Suggest the committee strike this definition “core fill grout.”	Minor editorial changes – Chair approved.	Not applicable.

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18	David Langefeld, P.E. ICON	202 DEFINITIONS FIBERS	<p>It is understood that the definition for Fibers was taken from ACI CT. Suggest the definition provide more information. Suggest the committee reword.</p> <p>Replace definition with “<u>Short, slender filaments, generally with a length at least 100 times their diameter, and made of glass, steel, or plastic, which may be added to 3D printing material for structural integrity and crack control.</u>”</p>	Minor editorial changes – Chair approved.	Not applicable.
19	David Langefeld, P.E. ICON	202 DEFINITIONS FIELD MIX 3D PRINTING MATERIAL	<p>The definition for Field mix 3D printing material needs more clarity to distinguish it from pre-package 3D printing materials. Suggest the committee reword.</p> <p>Replace definition with “<u>Printing material mixture, either mortar or concrete, where constituent materials are stored separately at the jobsite and are batched and mixed at the jobsite.</u>”</p>	Minor editorial changes – Chair approved.	Not applicable.
20	David Langefeld, P.E. ICON	202 DEFINITIONS PRE- PACKAGED 3D PRINTING MATERIAL	<p>The definition for Pre-packaged 3D printing material appears to reference itself and needs more clarity. It lacks any information about what makes it “pre-packaged.” Suggest the committee reword.</p> <p>Replace definition with “<u>printing material mixture, either mortar or concrete, where the dry constituent materials are combined at a factory or plant into containers such as bags, totes, or supersacks, and shipped to the jobsite ready to be mixed with water and liquid admixtures, if applicable.</u>”</p>	Minor editorial changes – Chair approved.	Not applicable.
21	David Langefeld, P.E. ICON	202 DEFINTIONS	<p>Admixtures, Aggregates, Cement, Supplementary Cementitious Materials, and Water/Mixing Water do not need to be defined unless there is something specific that applies to 3D-ACT.</p> <p>Suggest the committee delete these definitions for Admixtures, Aggregates, Cement, Supplementary Cementitious Materials, and Water/Mixing Water.</p>	Minor editorial changes – Chair approved.	Not applicable.

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22	David Langefeld, P.E. ICON	202 DEFINITIONS	<p>It might be helpful to have a definition of the mixing and batching system for 3D-ACT since the entire system requires pre-qualification. Suggest the committee add this definition.</p> <p><u>“Mixing and delivery system-machinery or assembly that performs some or all of the following functions: material batching, material mixing, and material pumping.”</u></p>	Editorial – Chair approved.	Not applicable.
23	David Langefeld, P.E. ICON	202 DEFINITIONS	<p>Suggest the committee define “bead”.</p> <p><u>“Bead-Singular, variable-height extrusion of plastic 3D Printing Materials created by the 3D Printer following designated print path and added layer-by-layer.”</u></p>	Editorial – Chair approved.	Not applicable.
24	David Langefeld, P.E. ICON	202 DEFINITIONS	<p>Suggest the committee define “core”.</p> <p><u>“Core-Bounded vertical space printed by the 3D Printer that is later reinforced and filled with 3D Cementitious Printable Materials that may or may not differ from the material used in the shells or filled with mortar, grout, or concrete. Serves as the primary vertical structural component of 3D Printed Wall Systems and may or may not be visible in the final structure.”</u></p>	Editorial – Chair approved.	Not applicable.
25	David Langefeld, P.E. ICON	202 DEFINITIONS	<p>Suggest the committee define “effective structural contact width”.</p> <p><u>“Effective Structural Contact Width-The portion of a shell’s width where different layers are in continuous contact with one another.”</u></p>	Editorial – Chair approved.	Not applicable.
26	David Langefeld, P.E. ICON	202 DEFINITIONS	<p>Suggest the committee define “effective side face contact”.</p> <p><u>“Effective Side Face Contact-The portion of a bead’s height where adjacent beads alongside are in continuous contact with one another.”</u></p>	Editorial – Chair approved.	Not applicable.

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27	David Langefeld, P.E. ICON	202 DEFINITIONS	Suggest the committee define “cavity”. <u>“Cavity-Interstitial space between the shells of a 3D Printing Wall that may or may not be filled completely or partially with insulation, concrete, mortar, or grout.”</u>	Editorial – Chair approved.	Not applicable.
28	David Langefeld, P.E. ICON	202 DEFINITIONS	Suggest the committee define “print path”. <u>“Print Path-Computer-generated and -controlled, systematic directional route repeatedly followed by the 3D Printer to construct a structure layer-by-layer.”</u>	Editorial – Chair approved.	Not applicable.
29	David Langefeld, P.E. ICON	202 DEFINITIONS	Suggest the committee define “shell.” <u>“Shell-Combined stack of multiple layers of one or more beads making up the inner and outer and possibly intermediate vertical surfaces of the 3D printing wall.”</u>	Editorial – Chair approved.	Not applicable.
30	David Langefeld, P.E. ICON	202 DEFINITIONS	Suggest the committee define “engineered design guidelines report”. <u>“Engineered Design Guidelines Report-Report summarizing full-scale testing and alternative design provisions that calibrate, substantiate, and demonstrate the design of the specific 3D printing wall complies with the intent of this standard and the building code adopted by the administrative authority adopting this standard as applicable for the intended use of the structure.”</u>	Editorial – Chair approved.	Not applicable.
31	David Langefeld, P.E. ICON	202 DEFINITIONS	The use of the word “printing” is awkward in places. Suggest that materials and its derivatives be referred to as “3D Printable Materials”. Suggest that walls be referred to as “3D Printed Wall System.” Suggest the committee discuss the terminology. For materials and its derivatives, replace “ Printing ” with “ <u>Printable</u> ”. For walls and its derivatives, replace “ Printing Walls ” with “ <u>Printed Wall Systems</u> ”	Non-persuasive. No changes made.	Not applicable.

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32	David Langefeld, P.E. ICON	302.4 Density (unit weight)	<p>The reference to ASTM C138 for mortar includes a lot of other information not related to unit weight. Suggest the committee simplify the test standard reference.</p> <p>Allow both 3D printed mortars and concretes to use ASTM C138 for unit weight, and delete the reference to ASTM C185. ASTM C138 references, among others, the container used in the air test from ASTM C231, which is consistent with the requirements for air content given in Section 302.3.</p>	Approve – Minor Edits	Motion by Werner, second by Paul, unanimously approved.
33	David Langefeld, P.E. ICON	302.5	<p>It states that a specific set time may be required for material performance. A user of the standard may not know when this is required, unnecessarily specifying it. Suggest the committee clearly make set time testing optional and provide guidelines on when it may be an important consideration.</p> <p>Propose the committee clearly make set time testing optional and provide guidelines on when it may be an important consideration.</p>	Approve – Minor Edits	Motion by Werner, second by Eric, unanimously approved.
34	David Langefeld, P.E. ICON	303.2 Compressive strength	<p>Compressive strength of 3D printed mortars should have the option for using cylinders. Suggest the committee add a reference. This is consistent with Chapter 5.</p> <p>Add “...or cylinder specimens in accordance with ASTM C39.”</p>	Approve – Minor Edits	Roll call for cylinder testing for mortar: 8 yes (two email votes), 4 no.

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35	David Langefeld, P.E. ICON	303.3 Shrinkage	<p>ASTM C157 does not consider the benefits of shrinkage-compensating admixtures. Suggest the committee add a means for testing the shrinkage that allows for the benefits of shrinkage-compensating admixtures to be realized.</p> <p>Add a reference to ASTM C878 in addition to C157.</p>	Disapproved (comment withdrawn)	<p>Table until the materials working group develops a recommendation for the main committee.</p> <p>Motion by Werner, second by Gabriel, unanimously approved.</p> <p>Werner 1st, Maryam 2nd, unanimously approved.</p>
36	David Langefeld, P.E. ICON	304 LONG TERM DURABILITY TESTING METHODS AND PERFORMANCE SPECIFICATIONS	<p>Suggest the committee consider referring to ACI 318 table for durability and forego the requirements of ASTM C666, which is overly aggressive for exposures consistent with vertical walls.</p> <p>Strike Section 304.1 and 304.3 and refer to ACI 318-19 Tables 19.3.1.1 and 19.3.2.1 for commercial projects and ACI 332-20 Tables 5.1.1 and 5.3.2 for residential projects. Section 304.2 on ASR may remain.</p>	Disapproved.	<p>The comment was withdrawn.</p> <p>Unanimously approved.</p>
37	David Langefeld, P.E. ICON	CHAPTER 4 STRUCTURAL DESIGN	<p>Chapter 4 uses the term "3D-ACT Wall Systems," which differs from elsewhere. Suggest the committee align terminology.</p> <p>Suggest "3D-ACT Wall Systems" or "3D-Printed Wall Systems" be used throughout the entire standard.</p>	Editorial – Chair approved.	Not applicable.

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38	David Langefeld, P.E. ICON	401.3 Construction Systems	<p>Add Chapter 5. Suggest the committee require compliance with both Chapter 3 and 5 and reword slightly.</p> <p>Replace “The provisions of this chapter govern the construction of 3D-ACT wall systems. Materials used in the construction shall conform to Chapter 3.” With “<u>The provisions of this chapter govern the construction of 3D-ACT wall systems. 3D-Printable Materials used in the construction shall conform to Chapters 3 and 5.</u>”</p>	Approve – Minor Edits	No vote. Chair approved editorial change.
39	David Langefeld, P.E. ICON	401.3.3.2 Multi-Shell Walls	<p>Section mentions that walls w/o integral cores are permitted. Suggest the committee also reference Section 401.3.5.</p> <p>“Multi-shell walls with or without integral cores shall be permitted. <u>See also Section 401.3.5.</u>”</p>	Disapproved	<p>The comment was withdrawn.</p> <p>Unanimously approved.</p>
40	David Langefeld, P.E. ICON	401.3.4.2 Multi-Shell Walls	<p>Add testing as an option also. Suggest the committee add testing language.</p> <p>“Multi-shell walls shall be classified as non-composite unless a rational analysis <u>or physical test results are</u> is provided to verify that cross ties and webbing are adequate to transfer between shells the horizontal shear stresses developed from the design loads being considered.”</p>	Disapproved	<p>The comment was withdrawn.</p> <p>Unanimously approved.</p>
41	David Langefeld, P.E. ICON	403.4 Minimum Connections Between Cores and Shells	<p>Cross ties need more definition. For example, as written, no hook is required. Suggest the committee add minimum detailing requirements for cross ties.</p> <p>Require cross ties have at least a 90 deg. hook with a 3 in. extension at each end.</p>	Approve – Minor Edits.	Eric 1 st , Werner 2 nd , unanimously approved.

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42	David Langefeld, P.E. ICON	403.6 Minimum Connections Between Beads in Multi-Bead Shells	<p>Consider adding language that cross ties fulfill this requirement and that effective side face contact negates this requirement. Suggest the committee revise the language.</p> <p>“Where the shell consists of multiple beads that are assumed to be composite, cross ties consisting of 0.01 sq. in. per sq. ft. (69.4 sq. mm per sq. m) of wall area shall connect the two beads. <u>Cross-ties connecting multiple shells as described in Section 403.5 fulfill this requirement. Cross ties shall not be required if a rational analysis shows that the horizontal shear demands between the beads is less than 80 psi (550 kPa).</u>”</p>	Approve – Minor Edits	Motion by Gabriel, 2 nd by Eric, unanimously approved
43	David Langefeld, P.E. ICON	Table 403.7.1 Minimum Concrete Cover for Reinforcement	<p>The Bar Sizes and “Horizontal Reinforcement” is confusing. Suggest the committee revise the table to ensure clarity.</p> <p>Add callout for vertical reinforcement in some rows.</p> <p>“No. 6 and larger <u>vertical bars</u>”</p> <p>“No. 5 and smaller <u>vertical bars</u>”</p> <p>“All Bar Sizes (<u>vertical bars</u>)”</p>	Approve – Minor Edits	Motion by Gabriel, 2 nd by Doug, unanimously approved
44	David Langefeld, P.E. ICON	Table 403.7.1 Minimum Concrete Cover for Reinforcement	<p>If not exposed to weather or in contact with the ground, stainless/HDG is not necessary. Delete ** for cross ties and horizontal reinforcement. Suggest the committee revisit table.</p> <p>Strike corrosion requirements from horizontal reinforcement not exposed to weather.</p>	Approve – Minor Edits	Motion: Werner 1 st , Maryam 2 nd , unanimously approved.
45	David Langefeld, P.E. ICON	403.11 Structural Integrity	<p>This requirement overrides the minimum vertical reinforcement requirement in 403.2. Suggest the committee review this. Change 8 ft. to 10 ft.</p>	Editorial – Chair approved.	

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46	David Langefeld, P.E. ICON	Table 404.11 Strength Reduction Factors for 3D-ACT Wall Systems	Additional testing has revealed that the design axial capacity could be unconservative. Suggest the committee reduce the 3D phi-factor or further discuss the design method for axial load. Change axial phi_3D from 0.80 to <u>0.60</u> .	Approve – Minor Edits	Motion: Paul 1 st , Maryam 2 nd , unanimously approved.
47	Mahmut Ekenel, Ph.D., P.E. ACI	406.4 Anchor Testing.	IBC referenced ACI Code 318 refers to anchor testing as specified in ACI 355.2 and ACI 355.4. Suggest committee also add references to ACI codes: <u>The capacity of anchors in 3D printing materials may be determined in accordance with ACI 355.2, ACI 355.4, AC01, AC58...</u>	Approve – Minor Edits	Motion: Werner 1 st , Maryam 2 nd , unanimously approved.
48	Mahmut Ekenel, Ph.D., P.E. ACI	406.2 Alternative Design Qualification Approach	Suggest the following revisions below. This is crucial because “complying with” does not mean they need to be operating under ISO 17025. They must be accredited. Also add “for the scope of tests” to make sure lab has the test in their scope. “.....shall be performed by a qualified testing agency complying with <u>accredited in accordance with</u> ISO/IEC Standard 17025 <u>for the scope of tests</u> by any accreditation body that is a signatory to the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA).” FYI: ILAC and IAF are merging to form GLOBAC late 2025.	Approve – Minor Edits	Motion: David 1 st , Eric 2 nd , unanimously approved.

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49	David Langefeld, P.E. ICON	Chapter 5	<p>Change title to be more aligned with Chapter 3 and contents of Chapter 5. There are no performance requirements given in Chapter 5. See comment 58 about moving final acceptance criteria to Section 105.</p> <p>Change title to “<u>3D Printing Material Field Prequalification – Testing Methods</u>”</p>	Addressed as a part of Comment #8.	Voted as a part of Comment 8 and approved.
50	David Langefeld, P.E. ICON	Chapter 5	<p>The results of the field prequalification would be useful for the structural design in Chapter 4. Suggest the committee consider moving Chapter 5 ahead of Chapter 4.</p> <p>Reorder what is currently Chapter 5 to be before what is currently Chapter 4.</p>	Disapproved.	<p>The comment was withdrawn.</p> <p>Werner 1st, David 2nd, unanimously approved.</p>
51	David Langefeld, P.E. ICON	501.1 General.	<p>Section refers to the 3D printing system. Suggest the committee define this term in Chapter 2.</p> <p>In Chapter 2, add definition for “<u>3D printing system-consists of the entirety of the equipment needed for 3D-ACT, namely, the material batching and delivery system, the 3D printer, and the 3D printing software.</u>”</p>	Editorial – minor revisions. Chair approved.	Not applicable.
52	David Langefeld, P.E. ICON	501.1 General.	<p>Suggest the committee reword the last sentence of the first paragraph to be more in line with the contents of Chapter 3.</p> <p>Replace “The 3D printing material and 3D printing material mix design shall meet the requirements of Chapter 3 of this standard prior to performing the field prequalification testing.” with “<u>The 3D printing material and mix design shall have been prequalified in accordance with Chapter 3 of this standard prior to performing the field prequalification testing.</u>”</p>	Clarification related comment addressed.	No vote. Chair approved.

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53	David Langefeld, P.E. ICON	501.2 Material Source and Storage Requirements.	<p>The phrase “unaccounted for moisture” is awkward. Suggest the committee revise.</p> <p>Replace “such as the introduction of unaccounted for moisture prior to mixing and batching” with “<u>such as addition moisture not accounted for prior to mixing and batching</u>”</p>	Clarification related comment addressed.	No vote. Chair approved.
54	David Langefeld, P.E. ICON	501.3 Prequalification Elements.	<p>The phrase “If 3D printing concrete is used for construction” is incorrect since this chapter is about field prequalification. Suggest the committee revise.</p> <p>Replace “If 3D printing concrete is used for construction” with “<u>If prequalifying 3D printing concrete</u>”</p>	Clarification related comment addressed.	No vote. Chair approved.
55	David Langefeld, P.E. ICON	501.4 Printing Process.	<p>Reference to early-age protection and curing is good but should be defined. Suggest the committee add a time associated with early age.</p> <p>Suggest early age refer to the first 72 hours after extrusion</p>	Approve – Minor Edits	Motion: Werner 1st, Doug 2nd, unanimously approved.
56	David Langefeld, P.E. ICON	501.4.1	<p>The sentence “During construction, there shall be no application of bonding agent or special surface preparation between printing layers.” is confusing. Suggest the committee revise.</p> <p>Replace “During construction” with “<u>During prequalification</u>”</p> <p>Replace “between printing layers” with “<u>between printing layers 8 and 9 and 10 and 11.</u>”</p>	Clarification related comment addressed.	No vote. Chair approved.
57	David Langefeld, P.E. ICON	501.6.1 Fresh Properties. 501.6.1.4 Strength Test Specimens.	<p>It is confusing whether the three samples are being collected from each element or just one element. Suggest the committee add clarifying language.</p> <p>In Section 501.6.1.4, replace “each prequalification element” with “<u>each of the three samples specified in 501.6.1</u>”</p>	Disapproved.	<p>The comment was withdrawn.</p> <p>Werner 1st, David 2nd, unanimously approved.</p>

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#	Name and Affiliation	Section	Comment and Revised Language/Proposed Resolution	Committee Response	Committee Meeting Notes
58	David Langefeld, P.E. ICON	501.6.2.1 Air Content.	<p>Clarifying language is needed regarding the curing of the molded (cast) samples and the prequalification elements. Suggest the committee add more language.</p> <p>Replace first paragraph of 501.6.2.1 with the following: “<u>Cast specimens shall be subjected to standard curing according to ASTM C31/C31M. Cast specimens consisting of 3D printing mortar shall be tested in accordance with ASTM C109/C109M for cubes and ASTM C39/C39M for cylinders. Cast specimens consisting of 3D printed concrete cylinders shall be tested according to ASTM C39/C39M.</u>”</p> <p>In the start of the second paragraph, replace “In addition, a minimum of 24 specimens” with “<u>In addition to cast specimens, a minimum of 24 printed specimens</u>”</p>	Clarification related comment addressed.	No vote. Chair approved.
59	David Langefeld, P.E. ICON	501.6.2.1 Compressive Strength.	<p>The 2% dimensional tolerance in C42 can be difficult and expensive to chase when cutting small cubes. Suggest the committee consider increasing the tolerance perhaps with the requirement that actual, not nominal, dimensions be used to report compressive strength. It also may be worth mentioning that large sections can be cut first and fine tuned in the laboratory.</p> <p>Replace mandatory language with guideline to achieve 2% tolerance in ASTM C42 and require actual measurements be used when computing compressive strength.</p>	Approve – Minor Edits	Motion: Eric 1st, Gabriel 2nd, unanimously approved.

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#	Name and Affiliation	Section	Comment and Revised Language/Proposed Resolution	Committee Response	Committee Meeting Notes
60	David Langefeld, P.E. ICON	501.6.2.1 Compressive Strength.	<p>No guidance is given on age when sawing or subsequent curing of specimens after early ages. Suggest the committee add some language for consistency.</p> <p>Add language that saw cutting not be done prior to 7 days after the conclusion of printing.</p> <p>Add language that once sawn, specimens should be standard cured.</p>	Approve – Minor Edits	Motion: Eric 1st, Gabriel 2nd, unanimously approved.
61	David Langefeld, P.E. ICON	501.7.b Submittal Requirements.	<p>Proprietary mix designs should be excluded from the submittal. Instead, a mixture ID or product ID could be provided. Suggest the committee discuss this.</p> <p>Strike item b or provide provisions for proprietary products.</p>	<u>Approve – Minor Edits</u>	Motion: Werner 1st, Adil 2nd, unanimously approved.
62	David Langefeld, P.E. ICON	501.7.g Submittal Requirements.	<p>This seems out of place in Chapter 5. Suggest the committee include this in Chapter 4 and strike it here.</p> <p>Strike item g from Chapter 5.</p>	<u>Approve – Minor Edits</u>	Motion: David 1st, Werner 2nd, unanimously approved.
63	David Langefeld, P.E. ICON	502 FINAL ACCEPTANCE TESTING	<p>Move Section 502 to the Special Inspections Section in Chapter 1.</p> <p>Move Section 502 to Section 105.</p>	Disapproved.	<p>The comment was withdrawn.</p> <p>Werner 1st, David 2nd, unanimously approved.</p>
64	David Langefeld, P.E. ICON	502.2 Workability. 502.3 Air Content.	<p>Daily could be unclear. Does it refer to a 24-hour period? It can be hard to know how long printing will happen, so halfway through the day is not the best specification. Suggest the committee define better.</p> <p>Replace “additional tests shall be performed halfway through daily printing” with “<u>additional tests shall be performed at least every 8 hours of print time.</u>”</p>	Addressed as a part of Comment #8.	Voted as a part of Comment 8 and approved.

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65	David Langefeld, P.E. ICON	502.4 Compressive Strength.	<p>The molding, handling, and curing of compressive strength specimens should be aligned to a standard. Suggest the committee reference ASTM C31.</p> <p>Replace “followed by demolding at 24 hours and subsequently wet curing in laboratory conditions until testing ages (7 days and 28 days).” with <u>“with the molding, handling, and curing following ASTM C31. Specimens shall be tested at 7 and 28 days.”</u></p>	Addressed as a part of Comment #8.	Voted as a part of Comment 8 and approved.
66	David Langefeld, P.E. ICON	502.4 Compressive Strength.	<p>The need for additional sawn samples is unnecessary in light of the prequalification and cylinders being molded and tested. Suggest the committee remove this requirement.</p> <p>Strike “In addition, a minimum of five specimens shall be sawn once a week from either the walls of actual printed structures or a mock-up wall with similar characteristics. Samples may be extracted from any suitable location. Testing shall be performed in accordance with ASTM C109/C109M with the samples tested perpendicular to the interface and print direction. Each cube shall include at least one interface. The specimen weight, dimensions, compressive strength, and failure modes shall be reported.”</p>	Addressed as a part of Comment #8.	Voted as a part of Comment 8 and approved.
67	David Langefeld, P.E. ICON	502.4.a Compressive Strength. 502.4.b Compressive Strength.	<p>Rather than reference specified design strength it should reference compressive strength specified in the contract documents. Suggest the committee revise the language.</p> <p>Replace “specified design strength used in Chapter 4 of this standard” with <u>“compressive strength specified in the contract documents.”</u></p>	Addressed as a part of Comment #8.	Voted as a part of Comment 8 and approved.

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68	David Langefeld, P.E. ICON	502.4.b Compressive Strength.	<p>The individual strength test requirements should be aligned with ACI 318. Suggest the committee revise the language.</p> <p>Replace b with “<u>No strength test shall falls below the compressive strength specified in the contract documents by more than 500 psi if the specified compressive strength is 5000 psi or less; or by more than 10 percent if the specified compressive strength exceeds 5000 psi.</u>”</p>	Addressed as a part of Comment #8.	Voted as a part of Comment 8 and approved.

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69	David Langefeld, P.E. ICON	105.1	<p>The reference to IBC Section 1705.3 is insufficient and given the differences between 3D-ACT and traditional CIP concrete construction will cause confusion and perhaps unnecessary regulation. Suggest the committee provide more guidance on Special Inspections specific to 3D-ACT.</p> <p>Propose the committee discuss what tasks and deliverables are needed specifically for 3D Printed Walls.</p>	Discussion addressed with comment #8.	No Action Required.
70	David Langefeld, P.E. ICON	202	<p>It's understood that the definitions are in alphabetical order, however, some terms fit well together. Is it possible to have "sub definitions" under a main item so all definitions of like items are together in one place?</p> <p>For example, 3D printing material can be the main definition and the following can be sub-definitions: 3D printing mortar, 3D printing concrete, 2-Component 3D printing material, 1-Component 3D printing material, Field mix 3D printing material, Pre-packaged 3D printing material. Another example is 3D automated construction technology can be the main definition and the various components and technology can be sub-definitions: 3D printer, 3D printer software.</p>	Discussion addressed with definitions.	No Action Required.
71	David Langefeld, P.E. ICON	501.6.2.1	<p>Guidance should be provided for the statistical variability. Suggest the committee discuss what is appropriate.</p> <p>Include specification of required average compressive strength from ACI 301, Sections 4.2.3.3. Number of compression tests from pre-qualification elements may need to be increased to reduce the fcr or give manufacturer's the option of printing additional pre-qualification elements with additional testing to reduce their fcr.</p>	Discussion addressed with comment #60.	No Action Required.

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72	David Langefeld, P.E. ICON	404.3.1.2	<p>The language about the specimen geometry in Section 501 and the requirement to be representative of the bead and shell geometry being designed could be confusing. Suggest the committee develop requirements for verifying effective structural contact width.</p> <p>Include an additional pre-qualification element that is specific to the wall system being pre-qualified and perform sawcuts to measure both effective structural contact width and effective side face contact if applicable.</p>	Discussion addressed with comment #60.	No Action Required.
73	David Langefeld, P.E. ICON	404.3.2.2	Refer to comment 40.	Discussion addressed with comment #40.	No Action Required.

#	Name and Affiliation	Section	Comment and Revised Language/Proposed Resolution	Staff Comment
74	David Langefeld, P.E. ICON	404.6.5	<p>Numbering is off. Should be 404.5.1</p> <p>Change 404.6.5 to <u>404.5.1</u>.</p>	<p>Corrected.</p> <p>Staff Editorial.</p>
75	David Langefeld, P.E. ICON	501.6.2 Hardened Properties.	<p>The term mortar should be in italics to be consistent with the remainder of the standard.</p> <p>Make “mortar” be italics.</p>	<p>Corrected.</p> <p>Staff Editorial.</p>