ICC INTERNATIONAL CODE COUNCIL®

REIMAGINING THE ICC PERFORMANCE CODE

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EXECUTIVE SUMMARY

In May 2021, the International Code Council (ICC) embarked on a research effort to explore concepts and obtain stakeholder input on a reimagined ICC Performance Code for Buildings and Facilities (ICCPC). The aim of the research effort was to understand how perspectives and experience on the use of the ICCPC, on performance-based codes in general, and with performance-based design, have evolved since 2000. The effort looked to understand what might be needed / improved in order to expand the adoption and use of a reimagined ICCPC that incorporates best practice elements.

The specific research objectives were threefold:

- Explore background, current approaches, and emerging trends for performance-based building codes
- Identify and engage with stakeholders on current state of practice and wants and needs for a 'reimagined' ICC Performance Code
- Develop a working outline for a 'reimagined' ICC Performance Code

The primary purpose of the background research was to understand how the concepts and structure of performance-based building codes, and performance-based design, have developed since the ICCPC was first developed in the later 1990s. The reason for this was to understand whether there might be some areas missing from the ICCPC, which have emerged during this period, and if so, what some approaches for addressing those areas might be in a reimagined ICCPC. A secondary reason was to provide this information for stakeholders in the research process, so that they could have somewhat of a common basis for discussing future issues to be addressed within a reimagined ICCPC.

As a resource for informing the community about information gathered through the research effort, an ICCPC web portal for the project was established and populated with a substantial amount of content. The content was made available in three forms: media resources, online resources, and useful websites. A LinkedIn discussion forum was also established to help facilitate discussion, and a dedicated email address was created for correspondence performance@iccsafe.org. In the initial stage, the web portal provided resources that were developed as part of the background research. As the research effort progressed, the web portal was used to post information that was obtained from stakeholders via roundtable discussions and the stakeholder workshop.

Information from stakeholders was collected via three primary mechanisms:

- Surveys
- Roundtable discussions with small groups of stakeholders
- A stakeholder workshop in 2022, which was held in two sessions: February 2 and 16

Surveys were used to obtain initial perceptions (in the beginning of project) and to test ideas and concepts (at the project's conclusion). The roundtable discussions were used to take a 'deeper dive' into specific issues, concerns and desires of the various stakeholder groups. The stakeholder workshop aimed to reach a level of common understanding, and, to the extent practicable, consensus on major areas of agreement and items that need to be addressed going forward.

Summaries of the outcomes of each of the above efforts are presented in this report. Additional information can be found on the ICCPC web portal. Several of the key outcomes are reflected below:

- There is clear understanding that performance-based design is increasingly being used, in part because it is needed to address emerging design methods, technologies and concepts, that do not readily fit within the prescriptive codes (e.g., the International Building Code (IBC)).

- While codes such as the IBC provide for the use of alternate methods and materials of construction, there is little uniformity and less structure in its approach and widely varying levels of knowledge about the methods on both the design and approval.
- While performance-based codes have challenges, there is a clear need for a robust performance-based code, and for appropriate application of performance-based design.
- There is broad support for a reimagined ICCPC.
- Views on the purpose and use of a reimagined ICCPC are split. While many favor a document that could be adopted and used in conjunction with the other I-Codes in much the same way as the current ICCPC, some others view a reimagined ICCPC as a document which could facilitate making performance objectives, criteria and methods more explicit in the other I-Codes.
- If a project to develop a reimagined ICCPC goes forward, the resulting document should contain objectives, functional requirements, and performance requirements. More specificity and more quantification than in the existing ICCPC are desired by many. To the extent practicable, quantified measures should be included in a reimagined ICCPC, while maintaining the flexibility that a performance code should permit. Clear linkages between quantified performance measures and tools of analysis and verification are desired. Peer review should be considered for all safety-related performance-based design.
- A reimagined ICCPC should encompass areas currently addressed, and should also include sustainability, energy performance, indoor air quality, and mechanisms to facilitate community resilience.
- Consideration of requirements for assessing building performance in use (outcomes) as well as at the design stage should be explored and incorporated where appropriate (e.g., outcome-based performance standards, as are already in use in some jurisdictions).
- The concept of functional recovery, as a means to support community resilience, should be explored and incorporated if sufficiently robust.
- While performance-based design is not needed for all aspects of a building, those undertaking, and reviewing/approving, should have the appropriate competency in the methods.
- There is support for requiring peer review for safety issues / key buildings (components), as long as it does not create an undue burden for jurisdictions (e.g., paid by other than jurisdiction).

Based on the reimagining the ICCPC research effort, it is suggested that ICC move forward with a new project to develop a reimagined ICCPC.

- In advance of the effort, the ICC should make a clear decision on purpose and scope of the document. The most flexible approach would be development of a document that is much like the current ICCPC – a self-contained code (that works with the other I-Codes) that would be available for adoption, or which could be used administratively to guide performance-based designs that are developed under the alternate materials and methods clause of the other I-Codes. This would allow for the most flexibility in adoption and use within and outside of the USA.
- It is suggested that the development effort would be best served by a set of committees rather than by existing committees or a single development committee. It is suggested that a structure could be:
    - A 'top level' development or correlating committee, with broad expertise and stakeholder representation, that would have responsibility for the overall document, making sure that it functions holistically and appropriately across the specific content areas (e.g., structural, energy, fire, indoor air quality, …).

- Content-focused committees (subcommittees) that are largely responsible for development of specific aspects of the ICCPC that rely on subject matter expertise, such as performance-based structural engineering, performance-based and/or outcome-based performance standards for energy usage, performance-based design for indoor air quality, and performance-based design for fire. It should also be considered to form a committee (subcommittee) on embodied carbon, and one on functional recovery, to assist with those areas. It would be important that each of these committees (subcommittees) is working closely with the professional association related to the topic (e.g., ASCE, ASHRAE, SFPE, etc.). It is proposed that this should in effect be a joint effort (and at a minimum, needs to be a collaborative one).

- It is suggested that peer review and competency of involved professionals is critical to successful use of performance-based codes and design. As such, an effort associated with defining how a peer-review approach could (should) work for use with the ICCPC, without imposing an undue burden on jurisdictions, and in a way that can be adopted by any jurisdiction that wants, should be pursued. Furthermore, it is suggested that educational programs, consideration of competency frameworks, and consideration of certification schemes for professionals involved in performance-based design and review should be explored.
- It is suggested that support materials be developed upon completion of the ICCPC.

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1. INTRODUCTION AND CONTEXT

The *ICC Performance Code for Buildings and Facilities* (ICCPC) was developed during the period 1996-2000. At the time, it largely reflected international best practice, incorporated performance concepts envisioned in the Structural Engineers Association of California (SEAOC) Vision 2000 report and reflects performance-based approaches for fire as presented by the Society of Fire Protection Engineers (SFPE). However, some areas, such as sustainability and resilience, were not addressed in much detail or at all.

In the years since there have been developments in many areas of the built environment, including the emergence of broad societal concepts of sustainability and community resilience, the introduction of new and innovative technologies, the emergence of performance-based design for areas not considered in 2000, and advancements / rethinking about performance-based design for those areas that were considered. A few developments over the past 20 years include:

- Energy design is significantly performance-based, with energy demand and consumption outcome criteria embodied in performance-based standards.
- Concepts of sustainability are embodied within the International Green Construction Code (IgCC), which did not exist at the time.
- ASHRAE and other standards-development organizations (SDOs) have produced many standards that are performance-based, including performance criteria.
- Community resilience has become a focus, and the concept of functional recovery is being promoted as a means to help design buildings to reflect community resilience needs.

Arguably, the idea of 'demonstrating performance' has significantly been adopted and performance criteria and methods have found their way into the IBC and referenced standards. In addition, other entities have moved in this direction as well (e.g., NIBS / high performance buildings). Recently the American Institute of Architects (AIA), in their 'Commitment 2030', has stated an aim to move regulation and design to become more performance-based. This suggests much wider acceptance of 'performance-based' approaches than 20 years ago in the USA.

During this same period, more countries have developed, or are in the process of developing, functional-, objective- or performance-based (PB) building codes. Furthermore, those which have had PB building codes for some time now have evolved their thinking and are focusing on factors such as 'quantification of performance' in the codes. Also, some of the concepts built into the ICCPC have been adopted by other countries, in part driven by discussions and publications through the Interjurisdictional Regulatory Collaboration Committee (IRCC). Increasingly, this includes low- and middle-income countries (LMICs), where detailed specification-based codes and regulations are difficult to implement, and flexibility in terms of 'compliance documents' (e.g., design codes, test standards) is desirable.

However, until recently, few code change proposals have been submitted for the ICCPC. In addition, there have been few adoptions, with the ICCPC being used more as an 'administrative' guide. In order, then, to better embrace performance-based or even outcome-based design, the timing seemed right for the ICC to engage in research to understand current thinking about performance-based codes and performance-based design, and if appropriate, 'reimagine' the structure and approach to the ICCPC, with the aim to develop a model code that has relevance and appeal inside and outside of the US. In particular, it was felt that the research should consider where we are in the US, what advancements have been made at home and abroad, what is needed for broad acceptance and implementation, who the key players are, and what is needed to achieve the objectives.

Meacham Associates was engaged to lead this research effort. The specific research objectives were threefold:

- Conduct background research regarding history, current approaches and emerging trends for performance-based building codes
- Identify and engage with stakeholders on current state of practice and wants and needs for a 'reimagined' ICC Performance Code
- Develop a working outline for a 'reimagined' ICC Performance Code

The primary purpose of the background research was to understand how the concepts and structure of performance-based building codes, and performance-based design, have developed since the ICCPC was first developed in the late 1990s. The reason for this was to understand whether there might be some areas missing from the ICCPC, which have emerged during this period, and if so, what some approaches for addressing those areas might be in a reimagined ICCPC. A secondary reason was to provide this information for stakeholders in the research process, so that they could have somewhat of a common basis for discussing future issues to be addressed within a reimagined ICCPC.

The primary aims of identifying and engaging stakeholders were to (a) understand the level of interest in performance-based codes, and in the ICCPC in particular, (b) understand the situation with performance-based design, in various disciplines, and from the review and approval perspective, and (c) develop a sense of interest in pursuing a reimaged ICCPC.

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2. OVERVIEW OF BACKGROUND RESEARCH

Background research was conducted in the form of 'desk research' that considered the history of performance-based codes and design, how they developed in the US and internationally, and what some of the emerging topics and trends are in the performance-based code and design space for buildings.

As a means to bound the extent of the background research, Meacham Associates was asked to draw heavily on their experience, and not undertake any in depth studies. This approach was implemented, and a number of documents were identified that helped to provide historical context and address current considerations. Many of these resources were posted to the ICCPC web portal, a dedicated web location established for communication with stakeholders about the project. This web portal, and some of the resources posted, is discussed below.

In addition, various other resources were collected and used in framing the problem and discussion points forward. Not all of these were posted, so as to not provide 'information overload' to stakeholders. Rather, in some cases, websites of organizations, with information that reflects developments in performance-based codes and design were provided. These too are available via the project website.

Finally, while not specifically background information, it was believed to be very important that stakeholders be kept informed of progress on the research and on outcomes of the various activities, particularly the roundtable discussions and stakeholder workshop.

Therefore, as a resource for informing the community about the Reimagining the ICCPC research effort, and to provide a resource to share information gathered throughout the effort, an ICCPC web portal for the project was established and populated with a variety of content. Content was made available in three forms: media resources, online resources, and useful websites. A LinkedIn discussion forum was also established. A dedicated email address was created as well, performance@iccsafe.org.

On the media resources page, content includes the following:

- An overview presentation about the research effort.
- A presentation on background and trends in performance-based codes.
- A presentation that summarizes the initial 'stakeholder perceptions' survey.
- Recordings from each of the eight roundtable sessions (and summary outcomes for each session in PDF format).
- Recordings from the stakeholder workshop (and summary outcomes from breakout groups and the overall workshop).

On the online resources page, several reports and papers identified as part of the background research phase were made available, including:

- Current ICCPC basics (which is also available from ICC)
  - ICCPC flowchart
  - ICCPC users guide extract
- Performance code history
  - 1968 HUD Operation Breakthrough report
  - 1968 NIST report on measurement of performance

- 1978 Nordic building code (NKB) committee report on structure of performance-based building codes
- 1997 report from CIB TG11 committee on performance-based building codes

- Concept documents
  - 2021 NIST-FEMA report on functional recovery
  - Various papers on performance-based design, risk and performance, etc.
- Survey 1 (initial perceptions) outcomes

The useful websites page was used to provide links to a range of applicable web resources, including:

- The Inter-jurisdictional Regulatory Collaboration Committee (IRCC)
- The American Institute of Architects (AIA)
- The National Institute of Building Sciences (NIBS)
- The U.S. Department of Energy (USDOE)
- National Fire Protection Association (NFPA)
- The U.S. National Institute of Standards and Technology (NIST)
- National Research Council (Canada) – Construction Research Centre
- BRANZ
- Research Institutes of Sweden
- ICC resources on
  - Functional Recovery Resources
  - Resilience Toolkit
  - Sustainability & Energy Efficiency

In total, the ICCPC web portal provides stakeholders with the fundamental background material, survey outcomes, roundtable outcomes, and workshop outcomes.

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3. INITIAL SURVEY

Before embarking on reimagining the ICCPC, it was deemed important to understand current experience with and perceptions of performance-based codes (including the ICCPC) and performance-based design. It was also deemed important to identify and engage with stakeholders from the start. As a means to both understand current perspectives and perceptions on performance, and to begin engaging with interested stakeholders, a first step in the research effort was to undertake a survey.

The aim of this survey was to collect perceptions / perspectives / opinions about performance-based building codes (regulations) and performance-based design methods. The survey covered a broad range of topics, from general perceptions, to structure of performance-based building codes, to demonstration of compliance. It also asks for some comparison to prescriptive building regulations.

The initial survey had 30 questions. Many were structured as multiple choice or fixed response (i.e., strongly agree, agree, disagree...) to assist in assessing the results. However, there were some options to add comments and items to consider. Participants were told to expect that this survey may take 30-60 minutes to complete. Comments were received that more time was required by some.

The survey was structured into five Parts: (1) Overview, (2) Demographics, (3) Performance-Based Code (Regulation) Structure and Components, (4) Performance-Based Design Components, and (5) Additional Information. Participants were told that it did not matter whether they had experience with performance-based building codes (regulations) and design or not, since it was important to have perspectives from those with and without experience.

For the purpose of this survey, a few terms were defined to try and get some level of common benchmarking. This includes:

- "Performance-based codes" encompass those codes (regulations) which are primarily limited to stating objectives, functional requirements and performance requirements that a building should achieve, without specifying (prescribing) how (e.g., maintain stability when subject to expected loads; limit energy usage to X kWhr/m2 of floor area).
- "Prescriptive-based codes" encompass codes (regulations) which provide a great deal of specification and detail on how a building and its systems are to be designed (e.g., size of a structural member; travel distance to an exit). While "prescriptive-based codes" may have some performance requirements, generally "performance-based codes" do not prescribe specific required solutions.
- "Performance-based design" reflects the process of designing to specific performance objectives and criteria, without the need to demonstrate "equivalency" to a prescribed solution.
- "Prescriptive-based design" reflects design that makes use of highly-specified parameters within the code (e.g., minimum width of a corridor; maximum travel distance to an exit; required fire resistance rating) that set a benchmark. If all design parameters are limited by the code (as a benchmark), that is considered "prescriptive-based design", even if engineering calculations are required.

The survey was particularly interested in perspectives from the USA, but welcomed and encouraged perspectives from around the world as well, and sought input from all sectors in the built environment, e.g., designers, engineers, regulators, enforcement officials, manufacturers, insurance, etc. The demographic data will help us compare perspectives across sectors and countries. Participants were advised that if they would like to follow progress on this project, and find survey outcomes, updates and future survey information, that it would be posted on the ICCPC web portal.

A Powerpoint presentation and recording of the initial survey (Survey 1) outcomes can be found on the media resources page. A few interesting outcomes and key summary points are provided below.

For the survey there were 194 total responses, but for several questions, only about 130 responses were provided. In the presentation of results, the number of people responding for each question noted (N = _). Note that percentages for each specific question are based on number responding to that question, not a percentage of the overall respondents.

Responses were quite similar for respondents from both within and outside of the US. Only a little more than half think that the current building regulatory system works well or very well (performance or prescriptive) in their country, with more than 80% believing that a robust performance-based building code system can be developed and implemented.

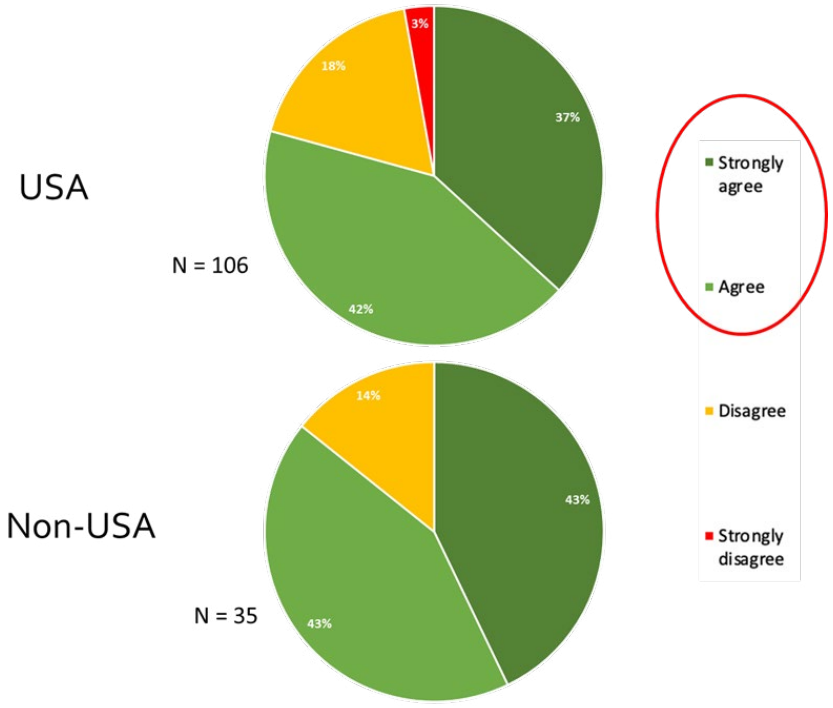

Figure 1. Surevy responses – can a robust performance-based regulatory system be developed?

Regarding specific components of performance-based codes and design, some of the key survey outcomes are that:

- Quantification of performance, with strong linkage to methods of design and verification / compliance, are critically important issues.
- Work needed in all disciplines, on all areas of design and verification methods.
- Engineers have more harsh view of their capabilities than architects and enforcement officials
- Engineers want to have more development of standards and guidelines
- General sense that we are currently doing poor job with sustainability and resilience
- Qualifications, competency, ability to innovate, increasing confidence in verification are key issues.
- Peer review, investment in training and education, are essential.

Again, a full set of survey outcomes can be found on the media resources page.

4. ROUNDTABLE DISCUSSIONS

Based on the background research and initial survey, a number of items were identified that warranted consideration. These included the following:

- What is the most appropriate structure for performance-based codes?
- What societal- (policy-) level goals and objectives should be included in the code?
  - Should sustainability objectives be added to the building code?
  - Should resilience objectives be added to the building code?
  - Should environmental justice / equity objectives be added to the building code?
- What is the most appropriate way to define goals, objectives and performance requirements?
- Should there be different approaches to defining goals, objectives and performance requirements for different areas (e.g., energy performance, structural performance, etc.)?
- To what extent should risk be used as a basis for establishing performance requirements?
- To what extent should performance requirements have associated, quantified performance criteria (metrics, measures)?
- To what extent should quantified performance metrics be included in the code?
- To what extent should quantified risk metrics be included in the code?
- To what extent should engineering (performance-based) design and verification methods be mandated by (required to be referenced by) the code as compared to being a professional decision?
- To what extent is it required to have mandated (referenced) acceptable solutions (compliance documents) as compared to allowing these to be developed in the market?
- What is an appropriate balance between governmental control / oversight and market mechanisms?
- To what extent should regulation lead (creating market pull – i.e., if you build it they will come)?
- To what extent should compliance decisions and accountability be left to the market?
- To what extent should private sector building control options be used and how to control?
- To what extent does consumer protection play a role in the regulatory system?
- To what extent does practitioner competence and qualifications play a role?
- What is the right balance between simplicity and robustness of the regulatory system?

While impossible to address all of these topics in a time-limited research effort with stakeholders, it was believed important to obtain input on as many of these topics as possible, at least at a high level, from different stakeholder perspectives. To accomplish this, it was decided to form a series of diverse 'roundtable' discussion groups, each comprised of persons from a specific stakeholder groups, to explore these concepts.

The roundtable discussion groups were comprised of 8-16 persons from eight different stakeholder groups: architects, building code officials, energy/MEP engineers, facility owners / manager representatives, fire protection engineers, fire

service officials, persons working in the resilience space, and structural engineers. While there was some overlap between groups, each group largely came to the discussions from their unique perspectives. Not all interests could be included in the roundtables due to timing, but all stakeholders, including those who did not participate in a roundtable, were invited to participate in Workshop to add their contributions.

The invitation list for each roundtable group was developed from interested parties who signed up through ICCPC web portal and through the Reimagining the ICCPC LinkedIn forum, as well as from a list of ICC-suggested parties (there was much overlap between the three sources). The groups were largely US focused, but also had participation from Canada and England to provide some international perspectives. About 120 persons were invited to participate, and more than 90 were able to join the roundtable sessions.

The roundtable participants were notified in advance that the discussions were primarily intended to be information gathering, or learning sessions, in which the participants are invited to provide their perspectives on a set of topics associated with performance-based building codes and performance-based design. They were advised that it was not intended to go person-by-person to seek input, but rather, to have a welcoming environment where all engage at a level that they feel appropriate. Participants were notified that the sessions would be recorded and posted for others to view.

It was hoped to have two roundtable sessions, but time only allowed for one. Participants were advised that the focus was on overall perceptions of and perspectives on performance-based building codes and performance-based design, and key aspects of each that need to be addressed for successful implementation and use. To facilitate discussion, a set of initial discussion points was distributed:

1. What is your view of performance-based building codes and performance-based design?
2. How familiar / experienced are you with working with/under a performance-based building code (regulation)?
3. How familiar / experienced are you with performance-based design?
4. Do you think that the ICCPC sufficiently 'meets the need' from your perspective, in terms of clearly defining goals, functional expectations, performance requirements, performance criteria (measures), acceptable guidance for design, and acceptable guidance for demonstration of compliance / verification of performance?
5. How do you view the 'state of readiness' of the profession / discipline (of the roundtable participants) with respect to the ability to undertake or review performance-based design, including adequacy of criteria and design and compliance / verification standards or guidance?
6. What do you see as the biggest challenges currently faced in gaining broad acceptance of performance-based building codes and performance-based design?
7. What do you see as the biggest opportunities currently being missed (if you do not think the current approach adequately meets the needs)?
8. What do you see as critical aspects of any reimagined ICCPC that may come in the future, and the supporting regulatory infrastructure, that must be considered going forward?
9. What are your 'top three' items that must be addressed for a successful reimagined ICCPC, and,
10. How do you see the ability of your profession / discipline (of the roundtable participants) to contribute to successful development, implementation and use of any reimagined ICCPC?

It was noted that if other topics arise, which the group believed important to discuss, that these will be considered within the time constraints. The roundtable sessions were set at 90 minutes each.

Table 1 summarizes key outcomes of the roundtable series across the groups. A more complete summary of each group's roundtable outcomes is included on the ICCPC web page.

Key: Arc = Architects; BO = Building Officials; E/M = Energy / MEP Engineers; F/O = Facility / Owners Reps; FPE = Fire Protection Engineers; FS = Fire Service; Res = Resilience; SE = Structural Engineers; PB = Performance-Based; PBC = performance-based code; PBD = performance-based design; AMM = Alternate Materials & Methods; AHJ – Authority Having Jurisdiction

Table 1 – Summary of Key Outcomes from Roundtable Discussions

Issue / Observation / Outcome / Need	Arc	BO	E/M	F/O	FPE	FS	Res	SE
While PB approaches have challenges, there is a need for a robust & usable PBC, and appropriate use of PBD	✓	✓	✓	✓	✓	✓	✓	✓
PB approaches are helpful because not all buildings / building features fit prescriptive provisions	✓	✓		✓	✓	✓		✓
PBC & PBD are not needed for all buildings - particularly helpful for complex buildings and for existing buildings	✓	✓		✓				✓
PBC can provide helpful and uniform guidance for undertaking AMM approaches in prescriptive codes	✓	✓	✓	✓		✓		
Clear and agreed definition of terms needed	✓	✓	✓	✓				
Clarity is needed on performance-based versus outcome-based: if outcome-based, how incorporate lifetime needs	✓		✓					
Current structure largely OK, but more detail needed and more of a holistic, whole of building, and whole of building lifecycle approach is needed	✓	✓		✓			✓	✓
Objectives need updating, e.g., sustainability, functional recovery, health (IAQ), community resilience	✓			✓			✓	✓
More specific performance requirements needed	✓		✓			✓		
Performance should be based on tolerable risk / impact where possible / feasible					✓			✓
Quantified performance / design criteria required where performance is used, and clarity needed where performance not required (e.g., electrical)		✓	✓			✓		
In addition to risk/performance levels/criteria for safety and health, risk/performance levels/criteria needed for functional recovery to meet community resilience needs							✓	✓
For hazards, quantified loads needed						✓		✓
Widely agreed and referenced PBD and verification / compliance methods and tools are needed, which tie directly to agreed performance / design criteria		✓		✓		✓		
Challenges currently exist with lack of adequate education / training in PB approaches (engineering / design communities, and review / approval by AHJs)	✓	✓	✓	✓	✓	✓		

Challenges exist with lack of capacity in many jurisdictions (for review and approval)	✓	✓			✓	✓		
Peer-review, paid by client/project/design team, but picked by & reporting to AHJ, a helpful/needed approach	✓	✓						
Guidance / handbooks for AHJs helpful/necessary		✓			✓			
Need to understand / accept risk of using PBC/PBD	✓	✓						
Education, training, competency, ethics essential	✓	✓	✓	✓	✓	✓	✓	✓
Cost and audience are important factors to consider		✓		✓		✓	✓	✓

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5. STAKEHOLDER WORKSHOP

Following the successful roundtable discussions, a broader stakeholder workshop was held over the course of the two-week period from February 2-16, 2022. The purpose of the workshop was to discuss issues, frameworks, and strategies for a reimagined ICCPC, building off of insights gained from the survey, roundtable discussions and related research. Due to restrictions associated with COVID-19 restrictions, the workshop was held virtually, using the Zoom meeting framework. As a virtual workshop, it was structured with two 'in-person' sessions, and 'homework' as follows:

- February 2, 1pm-5pm EST, introductory presentations and initial breakout sessions
- February 3 – 11, breakout sessions as organized within breakout groups
- February 16, 1pm-5pm EST, reporting back on breakout sessions and planning forward

Interested participants were asked to make a commitment to participate in the two large group workshop sessions, as well as in some offline work with smaller groups between the first and second sessions., with a total time commitment anticipated to be 2-days (the same as for a full, 2-day, in person workshop with break-out sessions).

Given that workshops function best when all participants are able to actively participate, and that this was a virtual event, the number of participants was limited, and advance registration was required. In the end, there were more than 60 participants, which allowed for 5 breakout groups (A-E) with about 12 participants each. This turned out to be good numbers for the working (breakout) sessions.

As with the roundtable sessions, there are many items to discuss around the reimagining of the ICCPC, so the workshop topics were by necessity limited to focus discussion and feedback. For several of the topics, associated background papers were produced (2-3 pages). These include definitions, possible structure of the reimagined ICCPC, performance groups and levels, and quantified criteria and design / verification methods. These background papers were provided, and it was highly recommended that participants read the background papers in advance of the workshop.

Discussion on each topic was limited to 30 minutes. For each topic, a brief introduction and set of three questions was developed. These are presented below. Topics 1 and 2 were addressed in Session 1, when the full group was together, and outcomes were reported back to the whole group. During the period in between Session 1 and 2, Topics 3-6 were discussed by the breakout groups. When the workshop was reconvened in Session 2, the groups reported out on Topics 3-6, and then addressed Topic 7.

Topic 1: Initial Revised Framework for ICCPC and Components

It has been suggested that a reimagined ICCPC might have a structure and contents that differ from the current ICCPC (see Overall Structure document). This includes adding the concepts of changing 'performance groups' to 'risk groups' for design compliance, and potentially adding 'operational performance' groups and 'functional recovery' groups. It also suggests moving quantitative criteria into the body of the code, and requiring peer review, among other items.

Based on whatever knowledge / experience level that you have about performance codes, including the current ICCPC:

1. Does the suggested framework seem to appropriate in terms of aspects considered, location of specific components (e.g., performance criteria), and requirements to help facilitate appropriate performance-based design and approval?
2. If the structure and components do not seem adequate, what structure and components would you suggest as being more appropriate?
3. If the structure seems OK, but components / connections do not seem adequate, what components / attributes would you suggest adding, and where would you suggest they be located?

Topic 2: Design, Operational & Functional Recovery Risk/Performance Levels Concepts

In the existing ICCPC, performance groups and performance levels are used to group buildings of different uses for the purpose of reflecting the general performance expectations. As currently structured, however, the focus is on safety to life (risk to life) from fire and natural hazards, and the performance group / level concept is not applied to different types of safety or health hazards, operational expectations (e.g., energy use), or functional recovery performance expectations. Discussion to date suggests that (a) the performance group / level concept is helpful and should be maintained, and (b) expanded where appropriate to address other performance expectations that can be applied to groups of buildings. It is further suggested that in some cases, the term 'performance group' might be modified to 'risk group'. It is important to explore these concepts further.

1. It has been suggested that the term 'performance groups' change to 'risk groups' for natural hazards and fire. It has also been suggested to modify the grouping to 'risk groups' to reflect performance expectations for design compliance verification. Does this seem appropriate? If not, what is suggested?

2. It has been suggested that 'operational performance groups' could be added for in-use operational issues, such as energy performance, indoor air quality, and so forth, or perhaps more broad sustainability or climate impact performance indicators (e.g., energy/square foot/year, or …). In such a framing, it may be that 'moderate' impacts are the norm, and 'mild' or 'zero' impacts reflect aspirational levels (e.g., net zero energy building). Does it seem appropriate to explore some form of 'operational performance' group and level approach for a reimagined ICCPC? If so, what specific items might be considered?

3. It has been proposed that 'functional recovery' performance groups and levels be added, much like the design performance groups and levels in the current ICCPC for life safety, use group allocations to performance groups and resultant performance levels may be required based on expected time to functional recovery and the magnitude of event pairings. Does it seem appropriate to explore some form of 'functional recovery' performance group and performance level approach for a reimagined ICCPC? If so, what specific items might be considered?

Topic 3: Attributes for Use Group Designation for Performance Group Allocation

It has been suggested that a reimagined ICCPC might, in addition to retaining design performance groups (which may be changed to risk groups), consideration be given to adding 'operational performance' groups and 'functional recovery' groups, with potential different performance expectations. However, Use Groups are expected to remain, and Use Groups need to be assigned to different Performance Groups based on expected use of the building, risk to life, and other attributes. Based on the background paper on Use Groups:

1. When considering aspects of building uses as related to establishing performance design/risk performance criteria (for safety), performance groups, and performance levels, are the attributes (factors) identified in the current ICCPC still appropriate? If not, what should be changed (added / deleted)?

2. When considering aspects of building uses as related to establishing operational performance criteria (for design compliance or in-use outcome-based performance), performance groups, and performance levels, are there specific attributes (factors) that should be considered? If so, what attributes should be considered? (E.g., if there is an operational performance for energy usage, or indoor air quality, should there be an occupant load target, or building area/volume for different uses, or…?)

3. When considering aspects of building uses as related to establishing functional recovery performance criteria, performance groups, and performance levels, are there specific attributes (factors) that should be considered? If so, what attributes should be considered? (E.g., importance to community resilience, and if so, how; importance to community welfare, …)

Topic 4: Quantified Design / Operational / Functional Recovery Criteria

It has been suggested that for a reimagined ICCPC, quantitative criteria for measurement / calculation / verification of performance be included in the code

1. Is it appropriate to state quantified performance metrics in the code document to help clarify the designs / analysis understanding and verification (compliance) process?
2. If so, should these be required for all performance areas (e.g., energy, fire, structural) where this approach is feasible (i.e., it may not be feasible for some areas, such as electrical safety)? If so, which areas to you see as being feasible / requiring quantified performance metrics?
3. If you do not think quantified performance metrics should be in the code document, where should they be, and how should they be cited, to assure better connection to performance requirements as stated in the code?

Topic 5: Design / Verification Methods

It has been suggested that for a reimagined ICCPC, there should be clear linkages between quantitative criteria for measurement / calculation / verification of performance stated in the code, and the methods (tools, computational models) used for analysis / verification of design to the code-stated performance requirements.

1. Is it appropriate to state in the code, by reference (or by reproduction in the code), the acceptable design / verification methods that are linked to quantitative performance criteria to help clarify the designs / analysis and verification (compliance) processes?
2. If so, should stated / referenced methods be required for all performance areas (e.g., energy, fire, structural) where this approach is feasible (i.e., it may not be feasible for some areas, such as electrical safety)? If so, which areas to you see as being feasible / requiring specific design / verification methods (documents) to be referenced?
3. If you do not think specific design / verification methods (documents) should be in the code document / referenced by the code document, where should they be, and how should they be cited, to assure better connection to performance requirements as stated in the code?

Topic 6: Design Verification / Peer Review (Compliance) and Performance Outcomes Reporting

It has been suggested that there are different performance requirements – those for design, those to be demonstrated for the building in use (outcome-based criteria), and for functional recovery. Each may have a different compliance pathway, but there is support for peer review by qualified and competent entities which are independent of the design process (i.e., not paid by designer's client).

1. Is it necessary and appropriate to provide a pathway for required peer review by qualified and competent entities which are independent of the design process (i.e., not paid by designer's client)? If so, for what areas is this required (e.g., fire, structural, …), and are there specific qualifiers to consider (e.g., any high-risk, or complex, or innovate building or system, or any and all buildings and systems)?
2. Should there be some form of certification for qualified and competent entities to be certified as 'approved' peer reviewers (or other classification)? If so, how might this be set up and managed?
3. Should there me some form of certification for providers of in-use compliance with performance outcomes (e.g., energy performance in use)? If so, how might this be set up and managed?

Topic 7: Top 5 Items for a Successful Reimagined ICCPC

Please identify your 'top 5' items that must be successfully addressed / implements for widespread adoptions, implementation and use of a reimagined ICCPC?

The discussion within the breakout groups was robust, as one might expect, did not result in 100% consensus within or between the groups. However, there were many areas of commonality in terms of the discussion topics. A high-level summary of outcomes from each of the breakout groups (A-E) is presented below. A more complete comparison of outcomes, as well as PDFs of each group's summary points, is available on the ICCPC web portal.

It should be noted again that these are summary items from the breakout groups and does not necessarily represent consensus. However, there are clear areas of consensus around the desire for a reimagined ICCPC, the need for clarity, and careful consideration of the components that should be in a performance-based code and how they should be linked.

Table 2 – Summary of Key Outcomes from Workshop Breakout Groups

GROUP	A	B	C	D	E
Structure					
How ICCPC relates to other I-Codes needs to be be very clear going forward	✓	✓	✓	✓	✓
Unclear whether I-Codes 'deemed to comply' with ICCPC or ICCPC an 'AMM" for I-Codes	✓	✓	✓	✓	✓
Performance requirements (goals, objectives) at 'top-level' regardless of where located (ICCPC or I-codes)	✓	✓	✓	✓	✓
ICCPC should accommodate the reality that PBD is often only for parts of the building	✓	✓	✓	✓	✓
Should be clear that there is a requirement for peer review above the line (in the code, as is now)	✓	✓	✓	✓	✓
Risk, Operational Performance, and Functional Recovery					
Changing performance groups to risk groups good (and in alignment with code change proposals)	✓	✓	✓	✓	✓
Including operational performance could be OK, but requires a lot of work / coordination / education		✓	✓	✓	✓
Including functional recovery largely agreed, but requires a lot of work / coordination / education		✓	✓	✓	✓
Use Groups					
Should be evaluated in some depth, especially with risk, operational and functional recovery aims	✓	✓	✓	✓	✓
Should consider different hazards for risk groups, different performance for functional recovery	✓	✓	✓	✓	✓
Not much consensus on operational performance, mixed on functional recovery - both new to many	✓	✓	✓	✓	✓
Quantification of Performance Metrics					
Absolutely essential (where appropriate) in the code	✓		✓	✓	
Need for some in the code - may not be appropriate (or may not have) for others		✓			✓
Critical for safety (e.g., fire, natural hazards)	✓	✓	✓	✓	✓
General consensus on need - diversity of views on specified versus reference, and if referenced, who decides	✓	✓	✓	✓	✓
Linkages to Design / Verification Methods					
No referenced standards in code	✓	✓			
Appropriate to have reference standards, but make clear there may be other options (standards, guides, ...)			✓	✓	✓
Needs to be clear linkage / criteria for determining 'acceptable' design and verification methods somewhere	✓	✓	✓		
Verification of Design Compliance and Outcome Achievement					
Peer review is required for all PBD	✓			✓	✓
Framework for determining when/what peer reviewed helpful - e.g., threshold / complex / high risk buildings	✓	✓	✓		✓
Different pathways to peer review helpful	✓	✓	✓		
Competency more important than certification	✓	✓	✓		
Should require engineers and AHJ to have same competencies for design & review of PBD				✓	
Certification for peer reviewers is needed					✓
If looking at performance in use (outcome-based), need new mechanisms				✓	
Top 5 'Must Haves'					
Clear scoping statement, with clarity on when/where applicable, and decision on 'code' or 'AMM' guidance	✓	✓			
Needs to be part of I-Code family, working in concert	✓			✓	✓
ICCPC should be 'top level' governing document as per diagram			✓	✓	✓
ICCPC need performance expectations and metrics, quantitative where appropriate	✓		✓	✓	✓
Goal / objective / intent statements should align with other I-Codes to extent practicable		✓		✓	
Guides / flowcharts / handbooks / assessment tools needed	✓				✓
Adequacy of / framework for peer review / appropriate competencies / what is appropriate vs not		✓	✓	✓	✓
Should set out minimum performance	✓			✓	
Multiple levels of performance should be possible		✓	✓		
Operational performance and functional recovery to be considered		✓		✓	
Education and training			✓		✓

A significant item that was discussed and not fully resolved was around the purpose and use of a reimagined ICCPC. While many favor a document that could be adopted and used in conjunction with the other I-Codes in much the same way as the current ICCPC, some others view a reimagined ICCPC as a document which could facilitate making performance objectives, criteria and methods more explicit in the other I-Codes. For those who favor a document that might be more of a guide to the other I-Codes (in terms of objectives, functional statements, performance requirements), it was suggested that criteria and linkages to design / verification methods would be found in other documents (either existing or created as supplements), rather than embedded within the ICCPC.

Regardless of this open question, which does need to be answered, a brief poll was provided at the end of the workshop to gauge views on moving forward. In addition, a draft outline was tabled for consideration, which includes potential contents if a reimagined ICCPC is developed to be a document that could be adopted and used in conjunction with the other I-Codes in much the same way as the current ICCPC. The poll questions and outcomes are below. There we 33 poll respondents.

1. The ICC should proceed with a code development project on a reimagined ICCPC.
2. The material developed during this research phase provides a reasonable starting point.
3. While a decision needs to be made on exact relationship between the ICCPC and other I-codes, and whether the ICCPC is a code, guide or other mechanism, starting the ICCPC as its own document is appropriate (just as the current ICCPC is its own document).
4. Regardless of final form of the ICCPC and the interaction between the ICCPC and other I-Codes, this effort can help clarify when, where and how to use PBD methods, and how to review and verify, as PBD or AMM.
5. Education and training on the ICCPC and PBD is needed – starting now – and advancing as the reimagined ICCPC takes form.
6. Competency and qualifications in PBD will be important for all involved in PBD or review of PBDs.

It should be understood that any such poll / outcomes reflect variability in participant interpretation of questions and views on the importance or relevancy of issues. In particular, it should be understood that views related to the exact structure, relationship and use of a reimagined ICCPC are diverse, which is reflected in responses to Question 3. It is also appreciated that responses to other questions may be closely tied to which specific direction a reimagined ICCPC might take.

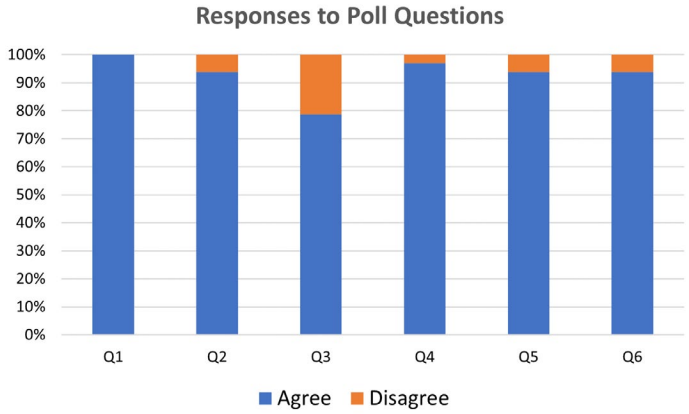

Figure 2. Workshop participants response to poll questions.

Overall, the poll provides further indication of support for moving forward with a reimagined ICCPC, and that the background work to this point is a useful starting point.

6. SUGGESTED STEPS FORWARD

Based on the reimagining the ICCPC research effort, it is suggested that ICC move forward with a new project to develop a reimagined ICCPC. While there remain some key issues that need to be addressed, there is strong support for embracing more expressly performance-based design, developing / modifying code structure(s) to facilitate this in a competent and reliable manner, while maintaining the flexibility needed to adjust to the needs of emerging areas. A development effort for a reimagined ICCPC can accomplish this. The following are suggested to help facilitate the next step forward.

- In advance of a document development effort, the ICC should make a clear decision on purpose and scope of the document. The most flexible approach would be development of a document that is much like the current ICCPC – a self-contained code (that works with the other I-Codes) that would be available for adoption, or which could be used administratively to guide performance-based designs that are developed under the alternate materials and methods clause of the other I-Codes. This would allow for the most flexibility in adoption and use within and outside of the USA.
- It is suggested that the development effort would be best served by a set of committees rather than by existing committees or a single development committee. It is suggested that a structure could be:
    - A 'top level' development or correlating committee, with broad expertise and stakeholder representation, that would have responsibility for the overall document, making sure that it functions holistically and appropriately across the specific content areas (e.g., structural, energy, fire, indoor air quality, …).
    - Content-focused committees (subcommittees) that are largely responsible for development of specific aspects of the ICCPC that rely on subject matter expertise, such as performance-based structural engineering, performance-based and/or outcome-based performance standards for energy usage, performance-based design for indoor air quality, and performance-based design for fire. It should also be considered to form a committee (subcommittee) on embodied carbon, and one on functional recovery, to assist with those areas. It would be important that each of these committees (subcommittees) is working closely with the professional association related to the topic (e.g., ASCE, ASHRAE, SFPE, etc.). It is proposed that this should in effect be a joint effort (and at a minimum, needs to be a collaborative one).
- It is suggested that peer review and competency of involved professionals is critical to successful use of performance-based codes and design. As such, an effort associated with defining how a peer-review approach could (should) work for use with the ICCPC, without imposing an undue burden on jurisdictions, and in a way that can be adopted by any jurisdiction that wants, should be pursued. Furthermore, it is suggested that educational programs, consideration of competency frameworks, and consideration of certification schemes for professionals involved in performance-based design and review should be explored.
- It is suggested that support materials be developed upon completion of the ICC PC.