Reimagining the ICCPC – Roundtable 1 Series – Summary of Key Points

The following table summarizes key outcomes of the Roundtable 1 series across the groups. More complete summaries of each group's roundtable outcomes are presented on the pages that follow.

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

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		✓		✓		✓	✓	✓

Architects

- Need to clarify whether any future incarnation of ICCPC will be performance-based, outcome-based or combination. Definitions important. Understood that current ICCPC is performance-based (compliance-focused) but new could be outcome-based (where appropriate).
- If move to outcome-based, better and more integrated attention must be given to buildings in use, maintenance, and related aspects for demonstrable achievement of performance targets / objectives (outcomes).
- Challenges exist with enforcement of performance approaches due to time and expertise required. Many jurisdictions, especially small ones, may lack capacity. May not be needed in all cases. Additional education, training and review resources may be needed. Where will this come from?
- Original ICCPC intended to help guide decisions for performance objectives not well addressed in prescriptive code at the time. Much has evolved in 20 years and the ICCPC has not been kept up to date. Prescriptive code is minimum baseline – need guidance for alternatives, for innovative materials, and when there is desire to go above minimums.
- Risk and liability are concerns for designers, authorities and owners. Prescriptive codes provide standard of care. Deviations by designers, and approval by authorities, can come with risks. With outcome-based requirements, owner have risks and liability concerns over achieving outcomes. (Outcome-based for energy becoming more and more adopted.) Need to be considered.
- There are costs to performance – both in design side and review side – need to be considered.
- To develop good designs using alternative methods and materials (AMM) clause, and performance design today, need to really understand bases for all prescriptive clauses before deviating. Burden on designers and authorities.
- Use of third-party peer review, self-certification, other approaches could perhaps help.
- Qualifications and competence important, especially with self-certification, but also peer-review. Experience with self-certification in Chicago was initial hesitancy, but then demand, and finally seems to work generally well.
- Transparency important. In current approach, if owners are setting performance requirements, can be hard to gain confidence of authorities. If performance measures / criteria are set out in code, can lead to higher confidence, trust and acceptability.
- Should be clear what buildings / situation performance code targeted for. Probably not small / simple buildings, but can be helpful for larger / complex buildings, where innovative materials, methods and approaches desired, and where prescriptions do not fit well to building concept.
- General agreement that code should needs to embody holistic approach that looks how a building is expected to performance, the criteria to measure that performance, and allows for various methods to demonstrate that.

Building Officials

- General support for performance-based codes (PBC) and performance-based design (PBD) within this group, but also several challenges and issues to be addressed.
- PBD requires certain level of expertise for design and review. Code officials in difficult situation with multiple responsibilities, limited resources, and often lack of expertise on staff. Situation is exasperated by the nature of PBC and PBD requiring judgments by code officials. Difficult without expertise, time and resources, and complicated further by liability concerns for making decision on items that differ from straightforward code compliance.
- Both PBD and alternative materials and methods (AMM) approaches suffer from lack of clear objectives (intents), measurable and broadly agreed criteria (what is acceptable, how is it measures), and clear connection to means of verification (for design and review). This is particularly a concern in fire – structural and energy are in better shape with these components. In general, confidence in data, tools, methods and those applying them relates to confidence in acceptance that PBD is appropriate. Need to actively decide what performance we want.
- PBD is not something that can be done by everyone, on the design or approval side, so consideration should be given to what knowledge / competencies are needed, by whom, and how to provide resources to address gaps.
- Education is important for all in the process.
- Guidance for how to review PBD would be helpful for code officials. This was done in England and helped significantly. When knowledge levels rise, support mechanism exist, and confidence in data, tools and methods exist, confidence in the system and application of PBD increases.
- Self-certification, third-party review, peer-review and private-sector building control are potential options to help with lack of knowledge and resource in jurisdictions. However, need to have mechanisms to control for the people doing the work, the same as in design and government approval (e.g., licensing, certification, accreditation). Need to be careful with licenses and certifications, both because those are often determined based on a test to some minimum level and do not reflect competency, and because it would require audits.
- PBD is not needed for every building, at least for many regulated areas (energy might be different). With respect to determining when PBD is appropriate, the concept of threshold buildings may be appropriate, as used in some states (e.g., CT, FL) for triggering peer review of primary structure design. This might be helpful in classifying what triggers PBD and the requirements to be associated with it.
- Need to make performance code usable, marketable and effective. At some point, though, must be aware that an aspect of performance is that the approach is used because some things have not been done before. In addition to upfront cost and documentation, need to bound the approval to the context of the analysis, and have continuous checking that bounding conditions are maintained.
- It is critical to have a good understanding the risk and the assumptions involved. In England, changed fire code to risk assessment and management approach. Requires documented risk assessment, with all assumptions, of what had been done. Then became a living document, with any alteration, change, maintenance included as update. Everyone becomes responsible party.
- This is a needed effort. Need to take the time to do it right.

Energy / MEP Engineers

- Need to develop set of definitions – performance-based, outcome-based, outcome-based performance standard, …
- Need to be clear if performance expectation is for compliance, in-use, or both – operational performance is much different that compliance with prescribed parameters
- Support of outcome-based performance codes which set performance targets to be achieved at design and in use
- Challenges with prescriptive approach are that
    - Performance not defined, so what is benchmark for alternative design?
    - Performance is not uniform – different MEP system types, different building construction, no consistency in performance
    - To use prescriptive code as deemed-to-satisfy, would need to narrow code
- Challenges for performance approach are that
    - Many enforcement officials do not have capacity or resources to assess model outcomes
    - Models currently benchmarked to specific prescriptive requirements to show compliance, and are not really performance assessment / prediction tools – can modify tools, but that comes with ability to clearly define parameters and targets
    - Not clear what performance requirements and criteria might be for some areas, such as electrical and some aspects of plumbing
    - Some areas, such as indoor air quality, might fit well in outcome-based performance code approach (maybe some plumbing too)
- Some states and jurisdiction have implemented laws that supersede the codes – Washington state, Boulder, CO, for example – if codes do not move to performance, could become less relevant
- Training, education, resources are key

Facilities / Owners Representatives

- Existing buildings present a big challenge for prescriptive codes - both for equivalency to current requirements – and to address future resilience and sustainability needs.
- Performance gap exists between how buildings are designed (performance based on design) and performance delivered in use. Need to find ways to narrow the gap.
- Prescriptive codes are based largely on looking backward (addressing concerns which have already arisen) and maybe not so good at looking forward, in particular around resilience and sustainability. Need to be able to predict and adapt and incorporate uncertainty in analyses.
- A performance-code differs from the alternate methods and materials clause in that, ideally, functional requirements, performance objectives, and performance criteria (measures) are stated, as well as appropriate means of demonstrating and verifying performance – none of which exists formally exists for undertaking or approving alternate methods and materials. It provides a basis to start a discussion on performance that is desired.
- Need clear statement of function that is expected, the performance expectation around system or material, how you measure, and tools to measure.
- Buildings with specific mission focus benefit from risk-informed approach, but many differing views on risk, risk acceptability, and how to use. Risk-informed performance-based approach could be beneficial if can reach consensus on terms and definitions.
- Clients often risk averse to performance approaches due to uncertainty in approval, and designers can be risk averse to using performance because not well defined and supported.

Fire Protection Engineers

- In England, which has had a PB regulatory system for 20 years, PBD is a legal option from the start, not as equivalency. This has created a lot of opportunities. However, has taken time to get actors up to speed, and still gaps. Educational preparation is lacking in some areas.
- Similar in USA, where some have been doing PBD for 20 years, but challenges with getting approvals, and peer review is a common approach. Lot of variability in approval. Need education and training, especially for code officials that may not have engineering backgrounds.
- We are caught up in a prescriptive environment, built in reaction to events, but for which now holistic performance is not readily known. Difficult to assess equivalencies to unknown performance levels. Without clearly defined goals of the current (prescriptive) code, it is hard to talk about performance. Would be helpful to move to performance, which can be informed by trying to extract performance objectives from IBC, similar to how Canada proceeded for 2005.
- Idea of 'acceptable' (tolerable) risk as a basis for performance has some attractiveness. Current challenge is that focus is often on 1-2 items and not overall building performance. This makes if difficult in coordinating with other disciplines as well.
- Some desire to move towards more probabilistic methods, but difficult to gain agreement based on current practice.
- Near-term approach seems to be continuing to focus largely on defining the process, giving guidance on scenarios, quantifying fires, and quantifying criteria, leaving decision to engineer.
- For future code, more scenarios and guidance helpful, and clearer objectives based on 'acceptable risk' or other holistic basis, to the extent possible, could help. Variability in solutions OK, as long as all end up meeting defined risk/safety/performance objectives.
- Need to find a way to develop confidence in system even when there will be variation.

Fire Service

- Most PBD for fire are not full performance, but part of AMM, and used when it is inconvenient for design professional to meet the code, or when the problem is outside of the bounds of code. It is often done in a piecemeal way, such that overall performances / impacts of AMM component not considered fully in design. Sometimes designs impose requirements that cannot be assured, like fire service response. Long-term assurance that performance is maintained / achieved is difficult.
- Most PBD for fire skips the way performance should be done according to the ICCPC – in particular Ch 3 and Ch 4 – setting / discussing design performance levels and reliability – and missing the initial discussions where jurisdiction and designer agree on the goals that the design should meet and provide measures to check against at end of design. Without this, nothing to compare to. Adopting the ICCPC as is could help. Upfront discussions / agreement essential.
- Challenges related to education level for both designers and code officials. More knowledge / expertise needed than just to apply prescriptions. Challenge for AHJs in time, resources, and confidence in making judgments.
- Dichotomy between fire and other areas, like structural and energy, in that for fire, engineers are trying to avoid something, where in energy or structure, trying to achieve something. In structure for example, innovations in structural design are driving PB analysis. No tall high-rise buildings in major cities with PBD for structure. End up with inspectable set of criteria. Have PBD, peer review, detailing of building structure and then can inspect – can check many points along the pathway.
- A major difference from structural and energy is that the inputs for analysis for fire and life safety is a bigger unknown than how to do the analysis. Egress time is supposedly based on time to egress theater 100 years ago where everyone got out in 3 minutes and that remains until today. Not clear this is appropriate. Lack of codified inputs for fire is a significant challenge. Chapters 3 and 4 are essential to address. A lot of work in needed quantified measures.
- Sometime solutions do not make sense. Bud Nelson, a grandfather of fire modeling and PBD for fire, once commented that *if the solution that is proposed defies the laws of physics or common sense the solution is just wrong*. It doesn't matter how many pages the computer spits out. Not enough time is spent on defining the problem, the means of analysis, validity of outputs, and effectiveness of proposed solution in meeting the need.
- Seems like we should be able to: sort of fire and life safety objectives in a way that can be measured, define loads that will test building from a societal perspective, define what the acceptance criteria are, and describe the quantitative process that must be robustly follow. If we can build this into the PBC, would that be a good first step.
- Quantification of performance good, but problem would exist if performance criteria are realistic, but not the same measures used in prescriptive: people would just default to prescriptive. Both codes / approaches need to move along in parallel. Measurable criteria would also help make more consistent in application. Also should have a performance statement associated with each clause, much like Canadian approach.
- Because we don't have that, every AMM approach is different, even if the problems and the buildings are the same. Also, all PBD / AMM should follow full performance approach – not that you have to engineer everything, but need to understand all performance expectations and show they are addressed.
- Need to keep in mind target audience and their needs.

Resilience

- Buildings are not resilient – communities are: the concept of designing buildings to support resilience is important – setting performance objectives and functional recovery objectives to meet community resilience is the key.
- Functional recovery is about maintaining basic intended function after some event, with project defining event and acceptable recovery time, against what hazard level, for buildings of different uses and importance to community (resilience).
- Community resilience in more than just buildings – lifelines are important – each are components in a system of systems that must work together to deliver resilience.
- FEMA P-2090 / NIST SP-1254 is important document to describe functional recovery, https://www.fema.gov/sites/default/files/documents/fema_p-2090_nist_sp-1254_functional-recovery_01-01-2021.pdf
- ICC Functional Recovery Portal has a link to that and other resources: https://www.iccsafe.org/advocacy/seismic-functional-recovery-resources/
- The categorization of performance groups in current ICCPC seems to be life safety based, but NIST-FEMA work suggests should be looked at from recovery performance as well. Might include functional recovery categories as well as risk categories. Note appendix in ICCPC that asks questions about community issues, but not reflect in the risk matrix. Need to bring in other aspects. Good place to start from.
- Important to note key components of resilient infrastructure that are not under purview of building codes. Might need to be a transition point where ICCPC is overarching document.
- Three key parts. Identify recovery objectives for different buildings / infrastructure, develop design criteria to meet those goals, and consider hazard levels. Need to have some metric to design against, but also need to identify what buildings those goals apply to, and to what hazard level. Some basics in ICCPC but need to go further.

Structural Engineers

- Several areas of structural engineering have well-developed performance-based design approaches, such as seismic and wind, but not all, and not necessarily approached in same way.
- Need to develop common set of definitions – performance-based, performance requirement, performance-based design, performance criteria, etc…
- Would be nice to have hazard-neutral framework but may not be possible.
- Helpful to look back to Performance Concept (HUD, 1970) and Operation Breakthrough, as well as NKB structure in Europe.
- Difference in expectations from society and engineers - need to pull back curtain and work to develop common understanding and expectations.
- Sustainability and resilience (and durability, lifecycle) objectives need to be included.
- Starting with comprehensive set of whole building, qualitative performance statements / objectives, would be a good start. Ultimately, quantification is needed, but may differ between disciplines, and approaches may differ.
- Risk as a basis for performance is important but needs to be balanced with cost. Need to define what risks. Cost to society, not just cost to developer / owner, which can be different. (Low cost of initial construction could mean high lifecycle cost if building a poor performer.) Also need to consider reliability of functionality. (Might be called maintaining performance in use.)
- Should have metrics for minimum performance – and how to demonstrate that. Can consider 'stretch code' idea to go beyond minimums if client or jurisdiction wants to.
- Big opportunity if approach allows for more specific design guidance for specific needs, and less 'one size fits all' approach. Can result in better designs, better cost optimization, better performance.
- Society has expectations for sustainability and resilience – need to match expectations better. Also, can use performance code as means to show how SEs are taking into account in designs.
- Training, education, competency important, but not everyone needs to conduct PBDs.