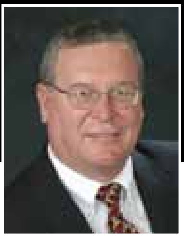
Editorial | *PBD: A Component in the Future of Structural Engineering*



By Stephen S. Szoke, P.E., F.SEI, F.ASCE, F.ACI

Performance-Based Design (PBD) has been practiced throughout history, dating back to the Code of Hammurabi, circa 1750 BCE. Today, the three most common applications of performance based design are:

- Use of innovative engineering technologies or products;
- Enhancement of project performance based on specific needs of the owners, such as design for special risk assessments like extreme loading conditions; and
- Economy, where more affordable design and construction options can demonstrate compliance with the intent of the building code.

Although PBD is already permitted in building codes, perhaps it is too infrequently practiced. Most building codes are based on the International Code Council *International Building Code* (IBC) which includes alternative means and methods to allow the use of materials, design techniques, or construction methods not specifically prescribed by the code. Many jurisdictions also adopt the *International Code Council Performance Code* (ICCPC) which permits innovation and deviations from the prescriptive criteria while maintaining the intent of the building code. The intent of the ICCPC is: "*To provide appropriate health, safety, welfare, and social and economic value, while promoting innovative, flexible and responsive solutions that optimize the expenditure and consumption of resources.*"

Today, the trend in structural engineering, often driven by the potential for litigation, is to exclusively follow the prescriptive design criteria for loads based on *Minimum Design Loads for Buildings and Other Structures* (ASCE/SEI 7) combined with prescriptive load resistance criteria as provided in documents like the American Concrete Institute's *Building Code Requirements for Structural Concrete*; American Institute of Steel Construction's Steel Design Manual; and American Wood Council's *ASD/LRFD Manual for Engineered Wood Construction*.

However, an unintended consequence of these prescriptive criteria is the ability to generate designs compliant with both load and resistance criteria via computer models. This method of structural design, while it may still require a stamp by an engineer, limits the freedoms related to innovation and creativity in structural design. The development of strategies and mechanisms to expand the acceptance of PBD tend to better reflect the interests of clients and jurisdictions while elevating structural engineers as design professionals. A new opportunity to increase use of PBD may be to encourage acceptance of emerging philosophies related to design and construction solutions that are associated with "enhanced resilience" or "community resilience."

The National Institute for Standards and Technology is in the final development stages of the *Community Resilience Planning Guide* which proposes new concepts for codes and standards related to the design of building and other infrastructure components. Another strategy could be related to transparency of consequences to owners and communities should a disaster occur. This might be in the form of multiple performance levels within each risk category to better allow owners and communities to select the appropriate performance levels. The National Institute of Building Sciences Building Seismic Safety Council is considering a menu of performance levels in lieu of single performance levels for respective risk classifications. This would differ from the current approach, where the standards development process dictates the acceptable performance level, such as 10% failure for the seismic design of most buildings, those classified in risk category II. This new approach may extend the role of the structural engineer in planning to help improve community resilience, the ability to rebound after disasters, seismic or otherwise.

To address historical and current applications of PBD and the role of PBD in future, the SEI Board of Governors has established a committee, not to develop criteria for PBD, but to investigate the role of PBD in the future of structural engineering. Their charge is to champion the trend toward performance-based design. This aligns with several aspects of SEI's *A Vision for the Future of Structural Engineering and Structural Engineers: A case for change*:

> *"…The drive to develop codes and specifications has led to the outcome that many of the tasks previously done by structural engineers could be and have been automated… …we must curb our tendency to codify our design decisions and leave those decisions in the province of qualified structural engineers. If we mandate how a structure must perform, but leave freedom to how the engineer provides that performance, we open the possibilities for amazing solutions to presently unsolvable problems."*
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> *"One avenue for change that has emerged in recent years is the notion of performance-based design… … performance-based design would increase the importance of sound engineering judgment in the design process, rely on better technical knowledge, require the use of more sophisticated technology in problem solving, result in more efficient structures, and place the structural engineer in a better position to drive technological change."*

The new PBD committee met during the 2015 Structures Congress. Many aspects and implications of PBD will be visited during the process of developing recommendations, including: development of a series of enabling documents to compliment current design criteria, possibly similar to Seismic Rehabilitation of Existing Buildings (ASCE/SEI 41); use PBD to serve as the documents in the public domain moving prescriptive compliance criteria to other documents maintained by standards developers; defining professional liability as a standard of care; and use of shelter-in-place performance levels for significant natural disasters. This effort, while invaluable, is a complex, multi-faceted and long-term project for the advancement of structural engineering as a profession.▪

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The National Institute for Standards and Technology *Community Resilience Planning Guide* can be found at **www.nist.gov/el/building_materials/resilience/guide.cfm**, last visited July 2015.