The Structural Engineer and the Changing Building Codes

IBC and NFPA

By Raymond T. Miller, S.E.

The structural engineer involved in buildings today is aware that the three nationwide codes have combined their resources; this includes the Standard Building Code (SBC), Building Officials Code Administrators (BOCA) and the Uniform Building Code (UBC). From these resources, the ICC Codes or the International Building Code (IBC) was formed. This change took place over a number of years and was, in the opinion of many, the answer with regards to enforcement. More recently a new player, the National Fire Protection Association (NFPA), came into the field with the *Building Construction and Safety Code*. As a result, the structural engineer is occasionally called upon to work with different codes. This often involves a detailed review of the different provisions of the two codes presently available, the IBC 2003 edition and the NFPA 5000, *Building Construction and Safety Code*, 2003 edition.

The following is a general review of differences between the two codes.

"Structural Design" (Ch. 16, IBC) vs. "Structural Design" (Ch. 35, NFPA)

The content and intent of these chapters is fairly consistent throughout. The impact on the structural engineer is minimal for the difference in the two codes.

The IBC provides its own values for basic load combinations in both strength and allowable stress design, but recommends review of additional requirements in the ASCE 7 for design criteria. For Building Categories, both codes use "Nature of Occupancy" for determination, but the NFPA provides additional definitions in the Occupancy categories.

The IBC includes requirements for special seismic load combinations that are found only in the NFPA commentary. Under the wind loads, the IBC and the NFPA both refer to Section 6 of the ASCE 7. However, there are several modifications to the seismic requirements in the IBC versus what is given in the NFPA and ASCE 7; *some of these modifications are in the following sections: Exception to Determination of Seismic Design, Additional Requirements to Simplified Analysis, Seismic Force-Resisting Systems, Structural Component Design and Detailing, Component Design, Non-Building Structures and Seismically Isolated Structures*.

"Structural Tests and Special Inspections" (Ch. 17, IBC) vs. "Quality Assurance during Construction" (Ch. 40, NFPA)

Under Chapter 17 of the IBC on "Special Inspection", there are criteria for verification and inspection for steel and concrete construction. Masonry has a Level 1 and Level 2 special inspection table. The NFPA requires a Quality Assurance Plan and Program as determined by the registered design professional. Special inspection for seismic resistance and special testing for seismic resistance are additional requirements of the IBC. Structural observations by the NFPA are determined by the Registered Design professional, whereas the IBC states when structural observation is required.

The IBC provides sections on Test Procedures, Test Safe Loads, IN-SITU Load Tests and Preconstruction Load Tests.

Under the IBC Special Inspection, verification and inspection is required whereas the NFPA requires a quality assurance program with scope and frequency determined by the registered design professional. Some of the items that are different under the section

"Quality Assurance Program" of the NFPA are (a) wood construction shop drawings or approved submittals are required for framing, details, and connections and (b) approved submittals are required for shear walls, diaphragms, and hold-downs. These same items are also required under quality assurance for light framed coldformed steel. The impact on the structural engineer can be significant depending upon the type of structure, location, and materials.

"Soils and Foundations" (Ch. 18, IBC) vs. "Soils, Foundations and Retaining Walls" (Ch. 36, NFPA)

The criteria between Chapter 16 of the IBC and Chapter 36 of the NFPA are basically the same. There is a little more information given on requirements for seismic consideration under the piling in the IBC, however, the impact is minimal to the structural engineer.

Under "Section for Reports" of the IBC, there are nine items required to be noted in the report depending on recommendations. There are no such requirements for reports in the NFPA. The NFPA does provide a "Soil Lateral Load" table that describes the backfill materials, unified soils classifications, and the design lateral load. The IBC provides a table for lateral sliding coefficient of friction value depending upon the class of materials; this is not provided in the NFPA.

In the IBC, under Retaining Walls, the factor of safety against lateral sliding and overturning is given; however in Chapter 36 of the NFPA, no factor of safety against lateral sliding and overturning is provided. The damp proofing and waterproofing section of the IBC has more criteria than the NFPA which covers above-grade, under floor spaces, floors, and walls for both dampproofing and waterproofing.

Under the section for Piers and Pile Foundations, the general requirements in the IBC give some investigation and report provisions with recommended items that should be included. Under the NFPA, no criterion for a minimum requirement of an investigation or report is listed. The IBC includes criterion for lateral support and different seismic design category requirements under the piling section. The NFPA and ASCE 7 does have some seismic and lateral considerations in Chapter 36, however, the IBC provides a far more in depth criteria of the different types of piles in relationship to lateral and seismic considerations.

"Concrete" (Ch. 19, IBC) vs. "Concrete" (Ch. 41, NFPA)

Both adopt the ACI 318 BuildingCode Requirements for Structural Concrete with modifications. The IBC modifies ACI 318 through section 1908. In addition, the section on Construction Documents in the IBC includes specific items which are to be noted on the plans. There are additional items noted beyond the ones referenced in the ACI 318. The IBC also has durability requirements that are not present in the NFPA.

"Masonry" (Ch. 21, IBC) vs. "Masonry" (Ch. 43, NFPA)

Both refer to the ACI/530/ASCE 5/TMS 402 publication. NFPA also defines the chapters, and references other publications for construction, seismic requirements, masonry, and concrete fireplaces and chimneys. In IBC, the first 10 sections are modifications of the referenced publication.

Although the two codes present information on fireplaces and chimneys in different ways (NFPA references the NFPA 211 document,

and the IBC has three sections which provide criteria and details for chimney construction and design), the impact to the structural engineer is minimal as the information is the same.

"Wood" (Ch. 23, IBC) vs. "Wood" (Ch. 45, NFPA)

Both codes reference the National Design Specification for Wood Construction (NDS).

The section "General Design Requirements for Lateral Force Resisting Systems" of the IBC provides general design requirements for lateral force resisting system. Provided under this section is deflection criteria for diaphragms and shear walls, the maximum shear wall aspect ratios, perforated shear walls, and anchorage for shear walls. The NFPA provides only reference to publications.

The IBC has sections on Heavy Timber Construction and conventional light-frame construction. The NFPA references the AF & PA and the Wood Framed Construction Manual for One and Two-Family Dwellings. The information provided in the IBC under "Wood" is of significant help to the structural engineer. However, the difference between the two codes is minimal.

Miscellaneous Differences

NFPA Chapters 4 and 8 contain items that impact the structural engineer which need to be considered.

Chapter Four, "General", refers to the goals and objectives of the NFPA. Two of the items that impact the structural engineer are under "Safety for Structural Failure Objectives" and "Safety during Building Use Objectives". Both of these sections pose questions such as, "What is damage?" and "Is the structural engineer responsible for job site safety?" However, the answers to these questions are not defined in the NFPA. (Chapter 4 of the NFPA is not included in the IBC.)

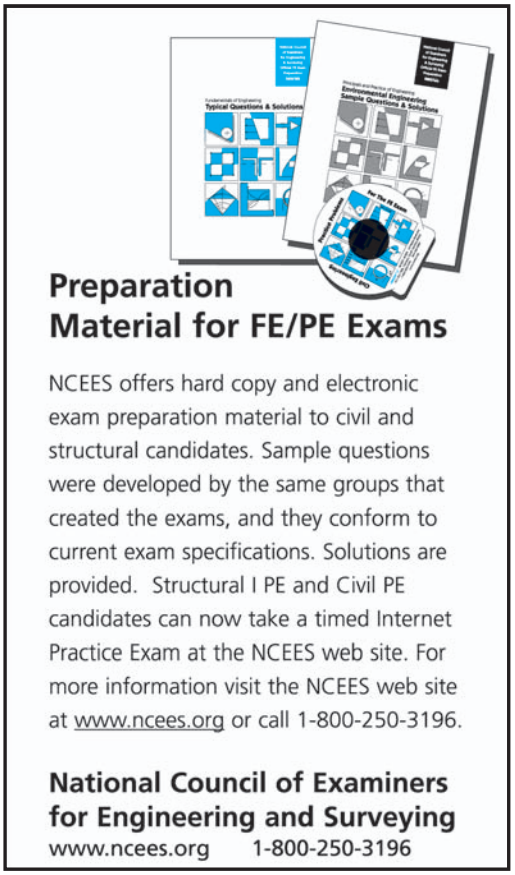
The section on "Mission Continuity", also in Chapter 4, requires reasonable assurance of continued function following a fire or an earthquake. Here, the structural engineer is given a second criterion that is in conflict with Chapter 35 of the NFPA.

Chapter 8, under "Structural Stability and Strength", requires the firewall to be stable after the collapse of the structure on either side of the wall. No definition of the load, impact load or load factor is provided to the structural engineer to meet this requirement.

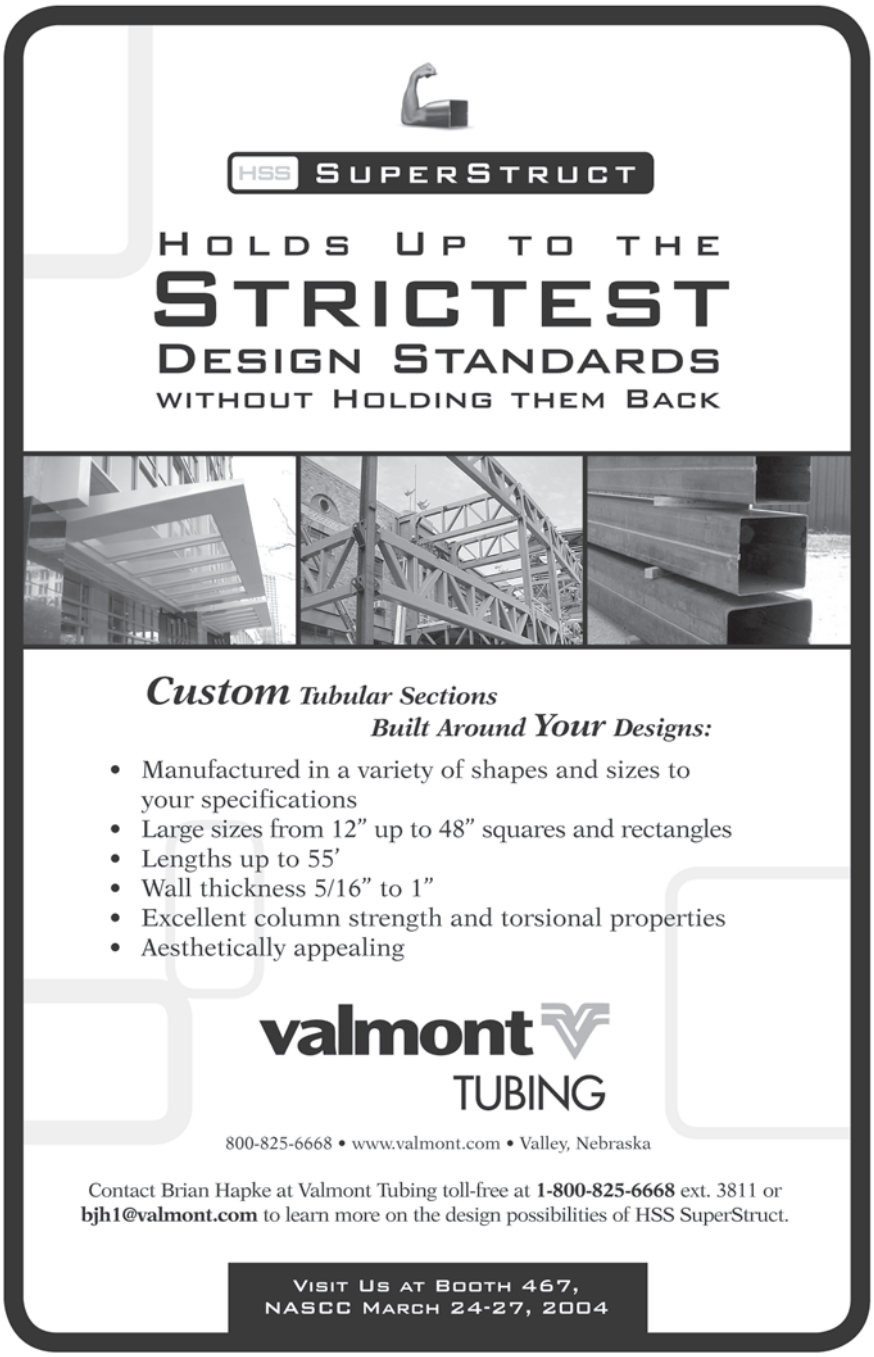
Summary

Engineers working in various jurisdictions should be aware of the code differences particular to the project. Not all national codes are "identical".■

Raymond T. Miller, P.E., is founder and president of Miller Consulting Engineers, Inc. Mr. Miller has over 40 years of structural engineering experience, and is a registered Professional Engineer in 14 states.



For Advertiser Information, visit www.structuremag.org



For Advertiser Information, visit www.structuremag.org