Moments & Reactions

The Newsletter of the Structural Engineers Association of Ohio (SEAoO)

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Grassroots SEAoO Takes Shape & Moves Forward

Ohio Structural Engineers Uniting

Robert C. Rogers, PE

Now that spring has sprung and summer is approaching, many of us will be busy with family, fun, and all those miscellaneous summer activities. Spring is always a time of growth and how fitting it is that SEAoO has had such a positive response signaling the beginning of what we hope will be a long growth spurt.

Applications for charter membership have totaled over 50 and the articles of incorporation as a nonprofit association have been filed. My personal vision for the SEAoO is one which truly provides a forum for practitioners within the State of Ohio. Not just another organization offering courses, books, etc. for fees. On that note, I would like to thank David MacGregor for his excellent article contained herein regarding the impact of the IBC on the Ohio Building Code. I would also encourage comments / responses to the articles herein. E-mail me your thoughts ! Remember, this is our forum! We need to collectively use it for the betterment of our profession! ❖

Inside This Issue

Practical Application of the 2002 Ohio Building Code

Are You Applying the New Code Provisions in Your Design Efforts ?

David C. MacGregor, PE

The impact of the IBC on the practice of structural engineering in Ohio has been significant. There were a number of relevant changes due to the adoption of the 2002 Ohio Building Code (OBC) in July 2002. The changes to past design and detailing practices discussed herein are based on a literal application of the OBC. Also, bear in mind this is one engineer's perspective of a firm's evolving understanding after applying the new Ohio provisions for well over a year. The experience base is also based on other IBC based codes such as the 2002 Kentucky Building Code. Some of these provisions merely modify previous design values while others create design and construction circumstances not previously encountered in Ohio.

It is hoped, by pointing out the number of changes and some of their implications (to fellow structural engineers, architects, contractors and owners) the need for a SEAoO Code Committee will be evident. The Code Committee will need to work with the Ohio Board of Building Standards and other professional organizations to make a positive change for all involved. The SEAoO Code committee can also promote industry-friendly and technically correct modification suggestions both within and outside Ohio. Many of the progressive changes to the Kentucky Building Code were made at the suggestion of the Structural Engineers Association of Kentucky (SEAOK). The SEAOK interaction is an example of the positive contributions that can be made. Positive contributions include a less conservative

continued on page 2

way to determine a structure's Seismic Design Category and raising the threshold at which special inspection is required, essentially exempting smaller structures from the increased requirements.

There are many areas in the OBC-02 where changes in practice are required:

- the load combinations have been revised, making the use of the 1/3 stress increase for wind impractical (OBC 1605.3.2),
- the minimum roof snow has been modified, resulting in an increase from the BOCA-based OBBC-98, and additional snow drift and sliding snow cases are defined (ASCE 7-98, Chapter 7),
- a number of changes have been made to wind design, including a change from "fastest-mile" to "3-second gust" wind speeds, modifications to wind exposure, changes to the internal pressure, and additional component and cladding design cases (OBC 1609 and ASCE 7-98),
- seismic requirements have been changed in ways that dramatically increase the design forces, detailing requirements and design effort required (OBC 1613 through 1623),
- special inspection plan submittal by the design professional has been made mandatory on all but minor projects (OBC 1704),
- geotechnical investigations have been mandatory where assuming default Site Class D results in a Seismic Design Category of C or more severe (OBC 1802),
- masonry provisions have been increased to require dramatically increased bar lap lengths (OBC 2107.2.3), reinforcing non-structural partitions at Seismic Design Category C or D (OBC 2106.4.1.3), and consideration of their impact on the lateral force resisting system (OBC 2106.4.1.2),
- additions and particularly modifications to existing buildings have been made more complicated by changes in the OBC language (Chapter 34).

The Basic ASD Load Combinations eliminate the 1/3 stress increase in favor of reducing loads when two or more transient loads are present → → (OBC 1605.3.1.1). The basis of this approach is that it is unlikely that two or more separate loads will simultaneously reach their maximum design value. The Alternate ASD Combinations allow the 1/3 stress increase but require a wind load amplification of 1.3 and remove the directionality reduction of 0.85 in ASCE 7, making it inefficient to use the stress increase. The effects of this are most evident in strength-controlled elements such as reinforced masonry walls and metal roof deck diaphragms, whereas stiffness-controlled systems such as brick veneer on metal stud backup would probably still be controlled by deflection criteria.

The minimum roof snow is defined by I*pg, resulting in an increased design snow load when compared to OBBC-97. New drift requirements particularly affect large, low slope structures (ASCE 7-98).

The change from the "fastest-mile" 80 mph wind speed to the "3-second gust" 90 mph wind speed results in a small reduction in wind pressures. Of greater interest is the ability to use a different wind exposure from each direction and to use Exposure B for component and cladding design where the building height is less than 60 feet, resulting in a significant reduction in wind pressure. The OBC-02 also provides more guidance for open structures.

Seismic design has become much more involved and complicated. There are a number of new design provisions:

- determination of a Site Class based on the average properties of the top 100 ft. of a site (OBC 1615.1),
- significant increased seismic bedrock accelerations based on a change from a 10% to a 2% probability of exceedance in 50 years,
- amplification of the increased bedrock accelerations based on soft soils (OBC 1615.1.2),which are very prevalent in current or previous river valleys,
- increased importance factors for projects such as schools, fire houses, and police stations OBC Table 1604.5),
- The Seismic Performance Category from

continued on page 3

OBBC-98 has been replaced with a Seismic Design Category (SDC) based on Site Class, Building Use, and ground accelerations. The SDC is the most important factor in determining many detailing and design requirements for structural, architectural, mechanical and electrical elements,

- AISC seismic detailing requirements can be avoided when the SDC is less severe than SDC D by using the "Structural Steel Systems Not Specially Detailed for Seismic" category, but this results in increased design forces (OBC Table 1617.6),
- an increased likelihood that overall seismic forces will govern over wind or checks like seismic story drift will govern member design even if wind forces are larger than the seismic forces. Because of this, it is necessary in some areas of Ohio to do complete wind and seismic designs rather than stopping the seismic design should it be determined that the wind forces exceed the seismic forces,
- design forces defined for connections such as diaphragm/wall connections, seismic force collector elements, and architectural/mechanical components can be significant (OBC 1620.1, 1621).

One area in the OBC-02 that appears to be inconsistent and conservative is the determination of SDC for short structures. Designers are required to select the more severe SDC based on either the short 0.2 second spectral response or the long 1.0 second spectral response (OBC 1616.3) even if the structure's calculated building period is well below T_s (OBC Figure 1615.1.4). This requires many short, rigid structures to be designed as though they are tall, flexible structures and often requires using the detailing requirements in SDC C or D. IBC-2003 allows the SDC to be determined using the short period provided that all diaphragms are rigid, which is unlikely for any structure using metal roof deck. SEAOK successfully proposed a change to the KBC-02 allowing all structures with building periods sufficiently below T_s to determine the SDC based on the short period.

Detailing and connection requirements can be significant for SDC C and D and may include items such as pile cap and/or shallow footing restraint, non-bearing partitions, and architectural and mechanical equipment. The goal of the OBC-02 for SDC C and D is to require a ductile load path, and masonry elements seem to be particularly affected.

OBC 3403.2 states "additions or alterations to an existing structure shall not increase the force in any existing structural element by more than 5 percent, unless the increased forces on the element are still in compliance with the code for new structures, nor shall the strength of any structural element be decreased to less than that required by this code for new structures." There is a similar provision in the OBBC-98, but the new seismic requirements make it difficult or impossible for an existing steel roof deck with new HVAC openings to meet the OBC-02 requirements when it must be checked with additional seismic loading and without the 1/3 stress increase used in the original design. Similarly, it will be difficult for an existing unreinforced masonry shear wall with new openings to satisfy the new seismic requirements.

Conditions such as these were frequently designed using OBBC 3408.4.1, which allowed modifications to existing building elements as long as the live load requirements of OBBC 1606 were satisfied. However, a change in the wording in OBC 3410 removes this option.

OBC 3410.1 states that it is "intended to maintain or increase the current degree of public safety…while permitting repair, alteration, addition, and change of occupancy without requiring full compliance with Chapters 2 through 33…". However, 3410.4.1 states "The owner shall have a structural analysis of the existing building made to determine the adequacy of structural systems for the proposed alteration, addition or change of occupancy. The existing building shall be capable of supporting the minimum load requirements of Chapter 16". OBBC-98 required that the existing building only be adequate to support the live load requirements of Chapter 16, but the OBC-2002 requires that the existing building be adequate to support all of the loads in Chapter 16, including wind and

continued on page 4

Practical Application of the 2002……Continued From Page 3

seismic, in order to not be required to comply with Chapter 16. This obvious contradiction was unfortunately not remedied in the IBC-2003.

There is a newly written International Existing Building Code-2003 that is much clearer than the IBC or OBC-02 provisions, but it has not been adopted by Ohio, although it has been adopted by West Virginia.

The IBC-2000 and the OBC-02 contain many changes from the BOCA-based OBBC-97 and previous Codes that will affect all facets of the construction industry. It is important to be aware of these changes and implement them in a cost effective, technically correct manner. One of the advantages of having a statewide SEA chapter is that it will allow structural engineers to influence building codes at both the national and state levels. ❖

Uniform Requirements for Structural Engineers

The Effort for Uniformity Continues to Gain Credence Among the Professional Community

Robert C. Rogers, PE

I would urge each of you to take time to read the articles regarding structural engineering that are contained within NCEES' publication, Licensure Exchange – April 2003, located at http://www.ncees.org/licensure/licensure_exchange/le_2003_04.pdf)

There is no doubt that our profession is changing for the better. Once we all agree on the minimum requirements to practice the art / science of structural engineering within the United States, we can devote more time educating the public about our responsibilities, and its direct correlation to the general health and welfare of all.

Be part of the movement ! Recommend to your structural engineering colleagues to join SEAoO today and start making an effort to change the profession ! ❖

A Practitioner's Perspective

Technicians or Professionals, We Decide ! Communication is the key !

Robert C. Rogers, PE

I am continually reminded of the perception that other's have regarding the practice of our profession. On many occasions I have heard the familiar quote:

"*No big deal….you can just go back and change your spreadsheet / computer model and quickly revise your calculations….right…..no big deal…plug and chug….right* ?"

In some situations, this argument may have credence (we should never make "mountains out of molehills…it reduces our credibility), but in many instances nothing could be farther from the truth. Changes in a building's lateral system layout, introduction of vertical or plan irregularities, or other "unique" changes require more than just a "*plug and chug*". Worse yet, once calculations / assumptions are redone, it is formidable task to try and explain why the change can't happen exactly the way envisioned by others.

We must become better at being able to discuss / illustrate these issues so that others understand the ramifications / implications of the change requested. The work involved on the structural engineer's behalf to reevaluate assumptions, methodology, and code checks needs to be understood by the party making the request. They don't necessarily have to understand all the details but it must be clear to them the level of effort involved. Communication is the key; succinct, clear and direct communication that does not linger in the world of technical details ! Others must understand that knowledge, judgment and flat-out hard work are required to provide solutions for changes. Once this is understood, our probability to evolve from perceived "technicians" or "number crunchers" to respected professionals will increase. ❖

