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CET Engineering Services Newsletter

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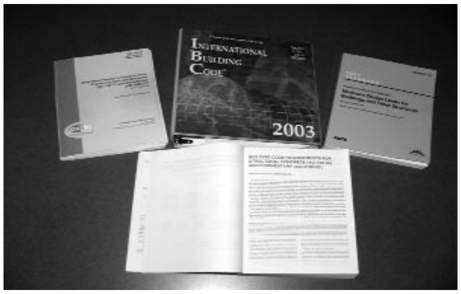
STRUCTURAL DESIGN CONSIDERATIONS RESULTING FROM IMPACTS OF THE NEW UNIFORM CONSTRUCTION CODE: MASONRY STRUCTURES

In 2004, the Commonwealth of Pennsylvania adopted the Uniform Construction Code (UCC), which essentially established the 2003 International Building Code (IBC) as the governing regulation for the design and construction of some residential and virtually all commercial, industrial, and public buildings and facilities throughout the State. A major benefit from a structural engineering standpoint is that, where engineers previously had to deal with multiple older and, at times, outdated codes on a municipality by municipality basis, engineers now have uniform design parameters to apply to projects throughout Pennsylvania. In addition, it is intended that the new code provide a more uniform level of review of design and construction drawings for code compliance purposes, and a more uniform monitoring of critical portions of the construction process. This has allowed engineering and construction work in Pennsylvania to catch up with what was being done in most surrounding States where the IBC had already been adopted as the standard.

Like most other engineers who provide structural engineering services, at CET we are constantly updating our design procedures and methods, and evaluating and improving our details of construction and specifications to comply with changing technology and improved understanding of materials performance and design procedures.



As a result, the mandated move to use IBC 2003 did not require wholesale modifications to our thought process and the way we approach the structural design phase of projects. However, in spite of the advance publicity, the implementation of this code and the implications related to structural design, detailing, and construction do appear to have taken some engineers and many contractors and owners by surprise.

One particular area where there appears to be a lack of understanding is related to the design of load bearing masonry structures and the need for what is often perceived as unnecessary and expensive masonry reinforcing. The need for reinforced masonry is essentially driven by two issues, seismic design and lateral wind loadings.

Seismic Design

There is a steady increase in knowledge due to constant research resulting in better understanding of issues related to seismic activity and the effects of such activity on masonry structures. The IBC requires that all buildings constructed under the code must be assigned a seismic design category ranked A through F with A being the lowest risk and F the highest. The category for a particular building or facility is based upon a complex combination of factors which can simply be described as the building or facility seismic use group classification, maximum ground acceleration anticipated in the geographic area where the project is located, and soil and subsurface properties in the immediate vicinity of the building foundation.

All areas of the continental United States, as well as Hawaii, Alaska, and selected territories, have been mapped and ground acceleration contours have been developed for selecting the appropriate design value. There is no such thing as a "0" value, meaning all areas are subject to some seismic activity. The IBC requires that, even in the lowest design category, all components of buildings and facilities must be designed to resist a minimal lateral force, and all components of the structure must be interconnected to physi-

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cally transmit the seismic force from one component to the other without danger of separation and to reduce the possibility of catastrophic collapse.

When designing using load bearing masonry, the ability to resist the lateral loads due to seismic forces is provided by grouting vertical reinforcing steel into the cores of the hollow core masonry. This reinforcing is connected into the concrete strip footing and hooked into the masonry bond beam capping the wall. By anchoring the roof or floor system into the bond beam, we are able to provide positive connection between components, thereby meeting the code requirements.

As the seismic design category steps up from an A to a B and so on, the complexity of design and detailing increases. Contrary to popular notions, while the ground acceleration values in the mid-Atlantic region are not large compared to some areas of the continental United States, they are higher than expected. For the design of water and wastewater treatment and conveyance facilities, when the various factors, including facility function, are considered, we are immediately in the B or C category and at times as high as a D category. Again, the higher the design category, the greater the design loadings and the complexity of design and detailing increase dramatically.

Lateral Wind Loadings

The second issue pertaining to load bearing masonry pertains to lateral loadings due to wind. The IBC allows engineers to defer to another document, ASCE 7 - "Minimum Design Loads for Buildings and Other Structures", by the American Society of Civil Engineers, for determining design values due to wind. Again, due to ongoing research, there are constantly increasing complexities related to the determination and applications of lateral loads due to wind.

Some of this is driven by relatively recent climatic events involving wind, where, among other issues, there are well documented cases of roof structures lifting due to uplift created by wind, and the resulting collapse of unreinforced masonry walls, which were dependent upon a roof load for lateral stability.

For years, the engineering profession tended to apply empirical principles and to use unreinforced masonry in building construction. But, within the last 20 years there have been increasing restrictions in the application of empirical methods, in favor of analytical design based upon specific site conditions and building materials. While the loadings for masonry design are developed following ASCE 7, the application of these loadings and actual masonry design are governed by another document, ACI 530 - "Building Code Requirements for Masonry Structures", which is provided by the American Concrete Institute.

Given the increasing restrictions in the use of empirical design methods, combined with the need for positive connection due to seismic loadings, there are very few structures which do not require analytical design and which therefore require vertical reinforcing to resist lateral wind loads.

New IBC 2006

The new IBC 2006 will become the governing code starting January 1, 2007.

One important additional item to note is that, at times, it seems just as we start to get a feeling of comfort with the contents of a governing code, the code is updated and the current edition often is superseded. This is exactly what is happening in Pennsylvania, since the new IBC 2006 will become the governing code starting January 1, 2007. However, any projects under contract by December 31, 2006 will still be done by the existing IBC 2003 edition.

Need More Information?

While the information provided in this article is basic and is not intended to be comprehensive in nature, we do hope that it sheds light on some of the issues that are driving the need for reinforced masonry structures. Should you have any questions, or be interested in obtaining further information or in finding out how you can obtain any of the noted design references, do not hesitate to contact our engineering staff.

We welcome inquiries from owners and contractors related to our design assumptions and procedures in general and on specific projects. We are prepared to provide technical backup and explanations to insure that the end result is developed in accordance with governing design codes in all geographic areas and states where CET provides design services.

Written by Kenneth T. Grubb, P.E., senior structural engineer with CET Engineering Services

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