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TechNotes

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Concrete Anchors

This issue of TechNotes has been written by Victoria Valentine, P.E., NFSA's Director of Product Standards and member of the NFPA Technical Committee on Hanging and Bracing of Water-Based Fire Protection Systems.

Concrete anchors have been a point of discussion since the major seismic revisions to NFPA 13 starting with the 2007 Edition of the standard. The concerns of strength capacities in the concrete anchors following an earthquake have caused modifications to the requirements in NFPA 13.

Under earthquake forces, concrete struggles to maintain its strength capacity. The most common result is to find cracks in the concrete, which do reduce the loads the concrete structure can carry. Relating this to fire sprinkler systems, if the concrete anchors supporting the system, either for hanging or seismic protection purposes, are in or near a crack, the load from the sprinkler system may not be properly supported.

The International Building Code (IBC) has had requirements for many editions that in seismic areas concrete anchors need to be pre-qualified for the seismic forces. This is done under the International Code Council Evaluation Service (ICC ES) AC 193, *Mechanical Anchors in Concrete Elements*. This standard is used to determine the strength of the concrete anchors. However, the results need to be read carefully as AC 193 can be used for seismic and/or non-seismic applications. In addition, the testing is done using ultimate strength design, whereas, NFPA 13 uses actual stress design.

However, NFPA 13 has provided criteria including load capacities for different styles of anchors in Figure 9.3.5.12.1 in the 2013 Edition, with similar information in earlier editions. The loads in this figure are based on generic anchors and reasonable worst case assumptions. Yet there are many products on the market that have been tested with the seismic pre-qualifications and can support more load than what is listed in the figure. These products are acceptable to use as long as

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they have been listed. Yet the listed loads cannot be directly applied for use under NFPA 13.

Following the order in which the rules are adopted legally, the model building codes refer to ASCE/SEI 7, *Minimum Design Loads for Buildings and Other Structures*. ASCE 7-10 states that NFPA 13 is a "deemed to comply" standard (see Section 13.6.8.2). This means that the capacities for concrete anchors that are in NFPA 13 are acceptable to use in place of the calculations in ASCE 7-10. It is important to note that the requirements in NFPA 13 and those in ASCE 7 are not directly interchangeable. Therefore, the information in NFPA 13 is acceptable, even if it is not equitable on a line-by-line basis.

Concrete anchors that are listed under structural provisions such as AC 193, need to adjust the load capacities by calculating them in accordance with the equations and safety factors found in ASCE 7. Depending on the anchor used and the conditions of the installation, the load will be determined. This load will also need to be presented for actual stress design, the calculation method used in NFPA 13. At this time a simplified correlation for use with NFPA 13 does not exist.

Supplement 1 to ASCE 7-10 was published after the 2013 Edition of NFPA 13. The NFPA 13 Technical Committee on Hanging and Bracing of Water-Based Fire Protection Systems is updating the document in preparation for the 2016 Edition. During these revisions a task group is looking at the proper correlation of the newest ASCE 7 information (ASCE 7-10 Supplement 1 and the proposed revisions for ASCE 7-16) for concrete anchors. As part of this, the loads in Figure 9.3.5.12.1 are being reviewed including the process used to determine those values. It is too early to definitively say what the results will be, but a simplified method of correlating the results from AC 193 and other test standards is being sought.

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