Revised seismic standard for building services

The soon to be published NZS 4219:2009 covers all engineering systems necessary to ensure compliance with the Building Code, but its writers faced some challenges during its development.

By Roger Shelton, BRANZ Senior Structural Engineer

Standards New Zealand is about to publish NZS 4219:2009 to replace NZS 4219:1983 *Specification for seismic resistance of engineering systems in buildings*, which is well past its 'use by' date. The review included an update to reflect the change in the loading standard from NZS 4203 to the AS/NZS 1170 series (on which NZS 4219:2009 is based), as well as incorporating changes in technology and practice for engineering systems.

NZS 4219:1983 is cited in New Zealand Building Code Clauses B1 *Structure*, G10 *Piped services*, G12 *Water supplies* and G14 *Industrial liquid waste*. It is expected that the revision will be cited instead in due course. The standard is also referenced by a wide array of other standards dealing with building services, and its publication in revised form will bring all these into line with the intent of AS/NZS 1170 and the Building Code.

Engineering systems covered in NZS 4219

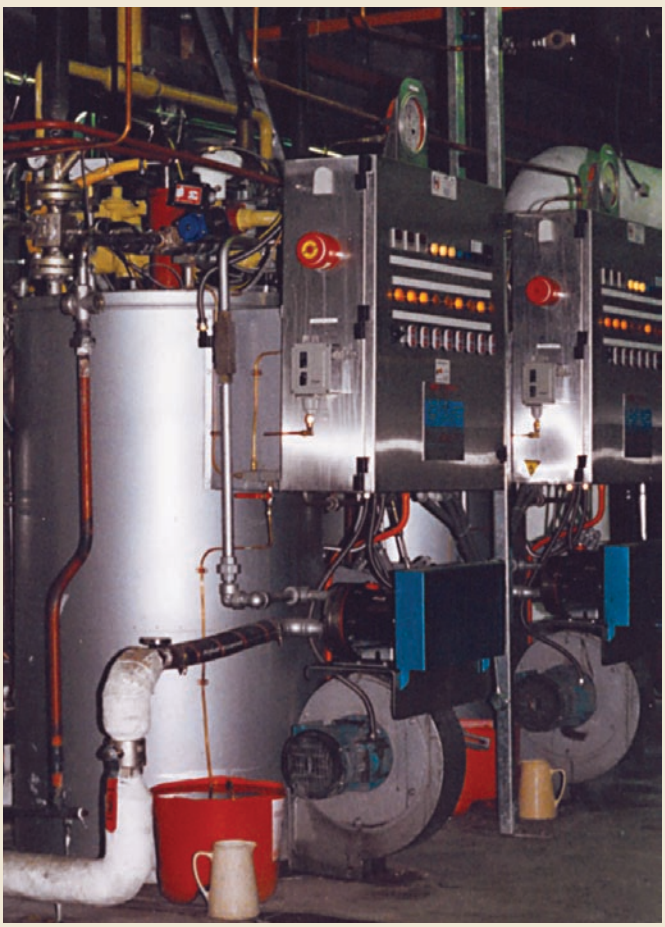
The revised standard will cover all engineering systems necessary to ensure compliance of the building with the Building Code (including compliance schedule items) and those systems required for the normal functioning of the building – in other words, building services.

The standard excludes lifts and fire sprinkler pipework, as the design and installation of these systems are covered by their own specific standards. NZS 4219:2009 also excludes contents or items not attached to the building structure, such as portable appliances, process plant and so on.

Particularly large items (those weighing more than 20% of the building itself) are also excluded. This is because such a large mass will almost certainly modify the dynamic characteristic of the main structure. Thus, the assumptions made in the loading standard about building configuration and seismic performance would not apply, and the heavily loaded structure would require a special study.

Components classified on expected performance

NZS 4219:2009 sets out general objectives and performance requirements for components of engineering systems. This requires the designer to classify all components on the basis of their expected performance under earthquake actions. Examples of classifications are those components that are:



The revised standard NZS 4219:2009 will cover building services.

- representing a risk to human life (for example, falling, hazardous contents and so on)
- required for emergency evacuation or fire suppression
- essential for the continuing functioning of the building (especially if the building itself has a post-disaster function, for example, a hospital).

Performance demands are weighted in acknowledgement of these classifications.

The detailed provisions of the standard follow two main streams:

- A non-specific design process that allows mechanical engineers and building systems designers who don't have a detailed knowledge of seismic engineering to use a range of ready-made solutions for standard situations. This is, in effect, a self-contained Acceptable Solution that provides a means of compliance with Building Code Clause B1.
- A specific design section, or Verification Method, that allows an experienced structural engineer to design the installation using standard structural engineering rationale and calculations, based on the loading standard and the relevant materials standards.

The technical and performance criteria are based on the provisions for non-structural parts in the loading standards NZS 1170.0 and 1170.5 and draw heavily on performance-based earthquake engineering principles being developed primarily in the United States.

Conundrums for the writers

The drafting committee faced two conundrums during the course of the review. One was how to deal with off-the-peg proprietary items manufactured overseas, and the other was the lack of a direct link between calculated seismic force and actual damage.

OFF-THE-PEG ITEMS FROM OVERSEAS

Engineering components differ from many other elements of a building. The larger items in particular, are frequently standard items of equipment designed primarily to process engineering, not seismic criteria. Many may be of New Zealand origin, but a significant number are designed and manufactured overseas, where there may be no earthquake loading standards.

This issue resulted in vigorous discussion among the committee members. It was acknowledged that these items are generally robust by virtue of their functionality and being designed to be transported long distances and handled many times.

In the standard, all such components require the same verification as any other engineering components, and the attachment to the building structure must be in accordance with New Zealand standards. Guidance is provided for design professionals on the verification required.

CALCULATED SEISMIC FORCE AND ACTUAL DAMAGE

The issue of lack of a positive link between calculated earthquake forces on the component and observed damage to similar items in previous seismic events is an international problem. It probably reflects the lack of research in this area (and the absence of 'convenient' earthquakes and well instrumented buildings).

The provisions in the standard are based on research done at BRANZ some years ago that simulated seismic ground motion loading on several representative buildings, but the inability to test actual components in a real building under realistic earthquake actions hampers the quantification of damage.

This situation may be about to change, with full-scale building tests in California and Japan either underway now or due to begin within a year. To overcome this uncertainty, a table of factors was included that makes an allowance for the difference between predicted and observed behaviour. Structural engineers will recognise this table as similar in principle to the S_p factors in the loading standard NZS 1170.5.

NZS 4219 drafting committee member Roger Shelton has been appointed as New Zealand representative on an International Standards Organisation (ISO) working group that is writing a new ISO standard on non-structural components. The working group is part of technical committee TC98 Actions on structures. The scope of this standard includes architectural components as well as engineering systems. Many of the concepts developed in New Zealand and used in NZS 4219 are expected to be incorporated into that document.