The durability of building products is significantly influenced by the climatic conditions to which they are exposed. Retention of desirable properties, such as structural integrity and an attractive appearance, can depend as strongly on the local environment as the choice of constituent materials.

New Zealand presents a challenging environment for building components. Metallic items suffer from corrosion due to a relatively warm moist maritime climate and our fondness for building in salt-laden coastal locations. Paints, plastics and other materials based on organic polymers are susceptible to degradation from ultraviolet (UV) radiation. Our radiation intensity is generally higher than in equivalent Northern Hemisphere latitudes, because of ozone depletion and a comparatively less polluted atmosphere. So it is crucial that both building researchers and product manufacturers fully understand the effects of the local climate on the durability of building materials.

Many factors affect the durability of building materials (see Table 1). Moisture, temperature and light, particularly in external environments, can result in significant damage to building elements. Such damage can include colour changes, corrosion, chalking, cracking, embrittlement, and loss of strength.

The use of accelerated weathering techniques has become an integral part of assessing the durability of building materials. These techniques are widely used for research and development, quality control and material certification, providing relatively fast and reproducible results.

Building Code requirements

The purpose of the Durability Clause (B2) of the New Zealand Building Code is to ensure that building materials, components and construction methods are sufficiently durable that they meet the requirements of other relevant NZBC clauses for the life of the building, without needing reconstruction or major renovation.

The actual durability requirement largely depends on the specific application and location of the building element. For example, building elements that give stability to the building (floors, walls, fixings) or are difficult to access or replace require a 50-year durability, whereas building elements that are moderately difficult to access or replace (the building envelope, exposed plumbing in the sub-floor space, and in-built chimneys and flues) have a 15-year requirement. Elements that are easy to access and replace (services, linings and fixtures) require a durability of 5 years.

Assessing building product durability

The Verification Method within the NZBC (B2/VM1) states that proof of performance should take into account in-service history, laboratory testing and comparable performance of similar building elements. But assessing the durability of building elements and components is not always possible through history of use and by comparison with existing materials. Therefore laboratory testing is often used to evaluate how a building element will perform within a specific environment.

Natural exposure of materials has many advantages, being relatively inexpensive and giving realistic results, but the length of time required is often a drawback. Hence accelerated methods are frequently used.

Accelerated weathering facilities

An increasing number of facilities are routinely used to evaluate and predict the durability of building materials.
of various building materials. These facilities include salt spray equipment to accelerate the effects of moisture on metal substrates, environmental chambers to assess the effects of a combination of humidity and temperature, heat rain facilities for thermal shock studies and several accelerated UV weathering chambers.

BRANZ uses two accelerated UV techniques: fluorescent ultraviolet/condensation equipment using both UVA or UVB fluorescent tubes, and the xenon arc lamp weathering apparatus. Both give essential information and improved understanding of the durability and weathering of polymeric materials, such as plastics, coatings, membranes and sealants.

**UV techniques**

The two techniques are based on different approaches. The xenon arc lamps have an output closely resembling that of the solar spectrum (see Figure 1). The QSUN 3100S can simulate the effects of UV radiation, rain and elevated temperatures through the use of xenon arc lamps and a water spray facility. The QUV does not reproduce sunlight, but replicates the short wave UV spectral region that causes most weathering damage. The fluorescent UVA lamps within the QUV give an excellent simulation of sunlight between 295 and 370 nm. The similar fluorescent UVB lamps have an output at the higher energy, lower wavelength region of the UV spectrum and so give quicker results.

Coating manufacturers often use the UVB lamps for accelerated weathering. The lamps generally give satisfactory results, but some substrates may be affected by the UVB output below the solar cut-off of 290 nm and unrealistic results can sometimes occur.

The QUV apparatus simulates the effect of rain and moisture through a condensation cycle, during which a water reservoir is heated and vapour is formed. The increased temperature maintains the relative humidity at 100%. As one side of the specimen forms the wall of the chamber and the reverse side is exposed to ambient room temperature, the cooling effect results in the vapour condensing on the samples.

There is no direct relationship between the accelerated and natural weathering of building products, owing to so many variables within the natural exposure of materials. Both the above techniques are useful in assessing the durability of materials in the presence of UV radiation. Lamps with differing intensities and distributions are available and, with continual developments on control of the environment within the exposure chamber, we can get results more consistent with natural weathering.

**Q-Fog salt spray chamber**

The Q-Fog salt spray chamber at BRANZ is important in assessing the performance of metallic-based materials. It currently provides one of the most effective methods of simulating natural corrosion. Specimens can be exposed to a programmed cyclic series of different environments to replicate outdoor conditions. The Q-Fog facility is useful for comparative testing of coated and uncoated metal substrates, as well as assessing the performance of metals within marine environments.

The combination of the conditions generated through Q-Fog, QUV and environmental chambers can also be useful for assessing the long-term durability of high performance coating systems, such as on the Auckland Harbour Bridge (see **Build** 92, February/March 2006, pages 76–77).

BRANZ’s experience and knowledge allows appropriate accelerated exposure methods to be selected for a wide combination of potential degradation agents and building materials, and the results correlated to expected in-service performance.

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