The Influence of Prestressed Units on Perimeter Frames

The most significant project currently underway in the Civil Test Hall at the University of Auckland is an investigation considering the influence of diaphragms containing prestressed units on the behaviour of perimeter frames. Significant influence is expected as the prestressed floor components will restrain elongation of the beams, and in so doing increase their strength.

Post-tensioned concrete masonry continues to be considered. Creep and shrinkage tests are almost complete, and wall testing is now focused on the performance of multi-storey walls and walls with confinement plates, damping and penetrations.

Testing of masonry walls to obtain data supporting updated shear strength provisions for inclusion in a new version of NZS 4230 is continuing. Four walls have been tested to date, with a similar number still to be considered.

The performance of tilt-up concrete walls is also being considered, in conjunction with studies at BRANZ and the University of Canterbury. Attention at Auckland has been directed initially to consideration of the out-of-plane behaviour, in response to concerns expressed by Auckland designers. Parameters being considered include a variety of footing details, panel thicknesses, panel height/thickness ratios, and axial load ratios.

A study is underway considering the performance of lightweight (BST polystyrene bead) concrete diaphragms. Initially focus has been directed to consideration of the performance of shear studs in lightweight concrete, through correlation with concretes of different densities and strengths. At completion of this component of the study, attention will turn to structural aspects of the lightweight diaphragm.

Projects anticipated in the near future include further testing of reinforced concrete beams to establish the influence of loading history on their structural performance; the performance of nominally reinforced masonry walls with openings; the seismic performance of reinforcement couplers; performance of nominally reinforced concrete wall panels; aspects of structural performance using grade 500 reinforcement; and retrofit solutions for earthquake-risk masonry structures.

The State House Revisited

The supply of housing is a significant social, political and economic issue in New Zealand. This is recognised by the current Government, and through Housing New Zealand it is making efforts to correct the deficiencies that exist in the social housing stock. A research project begun in 2000 at the VUW School of Architecture has considered how a 50-year-old project can be modified to better meet the changing needs of owners and users.

The upgrading and modification of existing housing to meet current needs has largely been ignored in both research and practice. This existing stock represents a significant social and economic investment for the country. The research has identified that the needs and expectations of residents, managers and Housing New Zealand have changed. The research has also identified that the houses may have suffered through deterioration of the building fabric. Necessary replacement of elements and other maintenance brings the opportunity to incorporate changes.

A site in the Hutt Valley was identified in consultation with Housing New Zealand, which supports two three-storey buildings known as 'Star Flats'. This plan for a 12-unit building was repeated throughout the country during the 1950s, principally in the Auckland and Wellington regions. The research project has reached the point of making proposals as to how the buildings can be modified to meet today's needs. An aspect of the proposal includes the addition of a completely new concrete building on the site to take advantage of development potential and to add amenity. To date, all research and design work has involved considerable input from the stakeholders.

The research project is proposed to be ongoing, continuing with the implementation of the agreed design proposals and evaluation once completed to generate feedback to the client and designers of similar projects in the future. The design will be developed and costed to the point that it may be used to attract interest from the owner, perhaps in conjunction with a private developer, to implement the project. Implementation is seen as a critical requirement of the long-term success of this research project.

This research is complementary to other research projects currently being carried out at the School. Other academic staff and researchers are looking at unique aspects of housing such as affordability, desirability, sustainability, building performance, and health issues. Others, including the CCANZ Fellow, are also involved in housing research at a planning and urban design level. There is an abundance of information within the School of Architecture upon which the project has relied heavily. Funding for this first stage of the project has come from the School of Architecture.

Morten Gjerde, CCANZ Fellow, Schools of Architecture and Design, Victoria University of Wellington

Architectural Concrete: Innovation and Excellence

Victoria University has funded a research project carried out over the 2000 - 2001 summer research period that has established a database of the world's best uses of architectural concrete from the past five years. The objective of the research has been to provide architectural students, educators and practising architects with contemporary examples of excellence in the use of architectural concrete.

A comprehensive literature survey of recent architectural publications has identified approximately 50 such buildings built between 1996 and 2000. One New Zealand building is included. The six areas of innovation and excellence that stand out in the group of buildings are:

- Architectural form and space
- Detailing
- Craft
- Surface finish
- Environmental aspects
- Construction aspects.

Concrete's versatility as an architectural material emerges as one of the key issues. Using the group of buildings as a reference standard, the project is now poised to review New Zealand's approach to architectural concrete and suggest how it can be further developed.

Morten Gjerde, CCANZ Fellow, Schools of Architecture and Design, Victoria University of Wellington

Performance-Based Specification for Concrete

The designer of a structure generally intends that it will perform satisfactorily throughout its envisaged service life. Structural design ensures that the anticipated physical loads at any given time can be resisted. Durability design acknowledges that material properties will change with time, and makes appropriate allowances for the changes that might occur in different environments. As asset management practices increasingly demand long-term forecasts of performance, more owners of major structures will need to predict - if not minimise - life cycle costs at the design stage.

As recognition of the importance of durability design for concrete structures has grown, so has recognition that existing design rules are not sufficient to deliver an intended service life with an acceptable level of reliability for the wide range of concrete materials now available. Specification of concrete by a certain level of performance rather than by composition is generally believed to be the best solution.

This may seem a blessing to the designer, who now only has to specify the desired material performance and construction quality. But someone, usually the supplier, still has to work out how to deliver that performance and how to demonstrate that it will be achieved.

This involves identifying the properties of the concrete that are going to determine its durability in each particular structure; the mix design and materials that will deliver these properties; and methods of demonstrating that they do so, for a given period and level of reliability.

Three problems have meant that performance-based specification is only ever used in the simplest sense. First, concrete technology has yet to provide adequate test methods (and associated acceptance criteria) to assess resistance to all environmental factors. Second, current models of concrete behaviour cannot easily accommodate the variabilities in materials and construction quality that often determine durability. Third, design and construction standards are still based on long-standing assumptions about a limited range of materials.

Opus Central Laboratories has started a research programme that aims to address some of these shortcomings. Initially we will gather information on the behaviour of concrete in existing New Zealand structures so that we can model deterioration processes for variable materials and construction quality. We will also be initiating discussions to achieve an industry-wide understanding of what can and can't be achieved currently from performance-based design, an agreement on changes to New Zealand industry standards needed to facilitate it, and support for the developmental work needed before these changes can be implemented.

The scope of the problem has been outlined in a discussion paper available from the CCANZ library. An industry workshop is scheduled to be held in the middle of the year to discuss the above issues, and the outcome of this and of initial field investigations to ascertain the effectiveness of current durability guidelines in NZS3101 will be presented at the NZ Concrete Society conference later this year.

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