Winds of change

Wind power is increasingly looked to as the renewable energy source of the future. As outlined in a recent report by the Concrete Centre (UK), the inherent properties of concrete will allow the construction of taller and stronger wind towers resulting in greater energy production for the future.

As New Zealand's population and economy grows, so too does its demand for electricity. With an increased awareness of fossil fuels' environmental impact, the spotlight has fallen on renewable energy sources.

Hydro electricity is a well-established renewable energy source and contributes over 60% of New Zealand's electricity supply. However, due to a reliance on low rainfall patterns and limited development options, hydro production capacity is forecast to come under pressure. In addition, lower production from the depleted Maui gas field is expected. Diversification of energy generation is therefore vital to offset the predicted shortfall and ensure security of energy supply.

With an increased focus on sustainability, the government has recognised the need to address New Zealand's vulnerability to energy shortages. Policy documents setting the framework for stakeholder partnerships and a programme of action to promote renewable energy have been developed. The Energy Efficiency and Conservation Authority's (EECA) is currently planning the replacement of its National Energy Efficiency and Conservation Strategy. The drafting of the new strategy takes place within the wider strategic context of the Ministry for Economic Development's current development of a New Zealand Energy Strategy, and general climate change policy initiatives.

Wind power is emerging as a means to provide future energy supplies. It does not emit greenhouse gases, is one of the fastest forms of electricity generation to build and has a high public approval rating. New Zealand's strong winds also ensure an abundant and reliable source of wind energy.

By the end of 2005, rapid growth in the industry had increased the total capacity of wind turbines to 168.3 MW - enough capacity to generate electricity for 75,000 households. The energy sector has ambitious plans for the growth of wind power, and is planning developments around the country that will generate hundreds of Mega Watts of energy. Largest amongst the proposed developments is the Hawkes Bay Wind Farm and Meridian Energy's West Wind (Makara – Quartz Hill) wind farm. The capacity of these two sites alone is forecast to be over 400 MW.

With the anticipated growth in wind farms throughout New Zealand, increased emphasis will be placed on higher power outputs. To meet this demand, wind towers will have to become taller and stronger in order to gain access to more powerful wind currents and accommodate larger turbines and rotor spans. These requirements make concrete an ideal construction material, as outlined in a recent Concrete Centre (UK) report - Concrete Wind Towers.

As engineers strive to increase the height and strength of wind towers, concrete's durability will ensure reliability and low maintenance costs. Such durability is well suited to combat harsh environmental conditions, an attribute that makes offshore wind farms possible.

Concrete's mix design can also be modified to optimise performance. Through the use of chemical admixtures and...
Welcome to the September 2006 issue of Concrete. One of CCANZ’s prime objectives this year is to reinforce the value of concrete in promoting sustainable construction in the built environment – an issue which is becoming increasingly important to the sector.

With the introduction of new building regulations over the next few years and the shift in emphasis towards the principles of sustainable development in New Zealand’s built environment, CCANZ has been working with BRANZ and other partners in the industry to develop a report which aims to collate available data from around the world and provide more information to New Zealanders on the sustainable features of concrete.

In this issue of Concrete, we highlight various situations where concrete has been used to promote sustainability, discuss how concrete’s inherent properties contribute to sustainability, and look at the current environment of regulatory change and its focus on sustainable development.

As New Zealand’s population increases, so too does energy demand. As such, more emphasis is being placed on security of energy supply and higher power outputs. Wind power is frequently being seen as the renewable energy source of the future. We take a look at why concrete is being used to promote the principles of energy efficiency with the development of concrete wind towers in Europe.

The overall contribution of concrete to New Zealand’s goals of sustainable development is also looked at through an overview of the properties of durability, thermal efficiency, acoustic performance and fire resistance. The industry can raise awareness of these properties by actively engaging key decision makers.

We also highlight some new research for hollowcore detailing – the focus of which has moved from providing solutions for new buildings to providing tools for evaluating the performance of existing structures.

In other news, the Department of Building and Housing is consulting industry on changes to the Building Code. The Department has until 30 November 2007 to undertake the review and to present a report with its recommendations, and CCANZ is working hard with the Department to ensure industry needs are met.

Sustainability is becoming a hotly debated topic and CCANZ looks forward to realigning perceptions of concrete and also ensuring that its features are recognised for key elements of sustainability.

Continued from page 1

sophisticated reinforcement, properties such as strength, stiffness and corrosion resistance can be tailored to meet specific requirements. Concrete technology allows engineers a greater range of flexible design solutions and construction methods.

Depending on site conditions and accessibility, both in-situ and precast methods of construction are suitable for wind towers. In-situ construction can assist to overcome a problematic site, while also requiring minimal form and space. Precast techniques enable high quality sections to be produced under controlled conditions, as well as allowing for fast and efficient construction.

Flexibility of construction methods means concrete is suitable for demanding offshore installations. Gravity foundations can be constructed onshore and delivered for assembly using existing flat top barges. A similar procedure can be followed for the delivery of individual concrete sections of the pylon, which can be designed with ease of transportation in mind. The well-established practice of using caisson foundations provides another option. With the aid of a buoyancy device, the foundation and pylon can be constructed in protected shallow waters and towed to its permanent offshore position.

Concrete’s high dampening properties can help reduce noise emissions and structural fatigue in wind towers. The use of concrete in gravity foundations also improves dynamic response, while the wind tower’s in-service performance can be optimised further through pre-stressing.

The versatility of concrete in terms of technology, design and construction has the potential to offer significant cost savings. Concrete wind towers may incur a greater initial investment than using alternative materials, but could prove extremely economical over their prolonged life due to durability and higher power generation potential. Pre-stressed concrete wind towers can also accommodate multiple future-generation turbine retrofits, thereby increasing service life.

When constructing concrete wind towers, the levels of embodied energy and CO2 are significantly reduced in comparison with other materials, as is the period of operational time required to offset the energy consumed during their construction.

In summary, concrete is a durable and flexible construction material. It can facilitate taller and stronger wind towers which can help the New Zealand government meet its current renewable energy supply targets – a further 30 petajoules of consumer energy by 2012.

Industry News...

NZIA Award for Hannah Playhouse

Wellington’s iconic theatre venue made primarily of concrete, the Hannah Playhouse, has been given an Enduring Award as part of the New Zealand Institute of Architects Resene New Zealand Awards for Architecture 2006.

The Hannah Playhouse was built in 1973 for the Downstage Theatre Company. Constructed on the corner site of Courtenay Place and Cambridge Terrace, the foundation of the building is reinforced concrete. The building frame is also reinforced concrete, with suspended concrete floors. The second-floor auditorium is internally placed and has complete around-theatre circulation with a flexible stage and seating arrangement.

The use of concrete provides a strong sculptural presence in the city, and is an example of ‘Brutalist’ architecture that has been known as “the celebration of concrete”. Originally planned by Ron Parker, and reworked by James Beard in association with theatre designer Raymond Boyce, the Playhouse’s concrete exterior not only lends itself to the Brutalist architectural form, it provides valuable sound-proofing from Wellington’s busy city streets.

The Hannah Playhouse is a physical and cultural landmark. Its innovative stage and seating arrangement, as well as its theatrical contribution to the city, has led to two previous awards; a merit award from the Wellington branch of the NZIA in 1974 and a NZIA National Award in 1978.

Budget funding for home rating scheme

A new scheme designed to improve the energy efficiency of New Zealand houses has received funding in the 2006 budget. $1.7 million has been allocated for the 2006/07 year to develop a home energy rating scheme which will provide a star rating (or similar) to householders, based on the energy efficiency and energy performance of their houses.

Energy Minister David Parker said the Energy Efficiency and Conservation Authority would lead the work in consultation with the Department of Building and Housing, the Ministry for the Environment and other government agencies. For more information, visit the EECA website www.eeca.govt.nz

BCITO Building Careers Week

The second annual Building and Construction Industry Training Organisation (BCITO) Building Careers Week will run from 11-17 September to raise awareness of career opportunities in the building and construction industry.

The week will include the BCITO Build-Ability Challenge, a competition in schools where teams design and build dog kennels to be donated to their local SPCA shelter, as well as information sessions for the public and breakfasts for working builders and apprentices around the country.

BCITO is one of New Zealand's major building and construction training suppliers. There are currently 8,600 apprentices registered in training at the BCITO, 265 of those are doing the cement and concrete qualifications.

For more information, visit www.bcito.org.nz/events/buildingcareersweek

Consumers and architects benefit from new industry rules

Minister for Building Issues, Clayton Cosgrove, has announced that new rules governing the registration, ongoing training and discipline of architects will soon come into force, bringing significant benefits to the profession and consumers.

A new public register of registered architects overseen by a new board, established under the Registered Architects Act 2005, took effect on 1 July 2006.

Mr Cosgrove said the Act aims to maintain high standards in the profession, improve consumer protection and raise the status of registered architects by differentiating them from other design professionals, such as architectural designers.

NZ Concrete Industry Conference

Sustainability, safety, health and environmental awareness will be the focus of the 2006 New Zealand Concrete Industry Conference, to be held in Christchurch from 29 September to 1 October.

The conference will include seminars and workshop discussions about the construction of wind farms, bridge projects, the extension of Wellington Airport, infrastructure for the Rugby World Cup in 2011 and the Burj Dubai, the world’s tallest building which is currently under construction using concrete.

A feature presentation will showcase New Zealand’s first post-tensioned concrete masonry house, possibly the most earthquake-proof masonry house in the country.

For more information, visit www.concretesociety.org.nz or contact Alan Bluett, Secretary/Manager, (09) 536 5410.
Hollowcore research update

Chapter 18 of the Concrete Design Standard NZS3101 provides guidance for the seating and detailing of structures incorporating hollowcore.

The details and recommendations outlined have been tested and proven through research conducted by Lindsay and McPherson at the University of Canterbury.

The Standard requires that:
1. The hollowcore unit is no closer than 600mm to a parallel beam or that calculations performed demonstrate that deformation incompatibility will not cause failure
2. Unless shown by testing the seating depth should be 75mm, however, this can be reduced by 15mm if the seating is armoured
3. Units shall be seated on a low friction-bearing strip
4. It must be demonstrated, either by calculations or testing, that the hollowcore unit can accommodate rotations between the beam and supports. Alternatively, prescriptive details summarised in C18.6.7 of the commentary to NZS3101 can be used.

Adopting the recommendations outlined in NZS3101 will provide builders and engineers with confidence that flooring systems will satisfy the seismic performance requirements incorporated into the new loading standard (NZS1170.5). This standard requires a low probability of collapse in a maximum credible earthquake, generally taken as a 2500 year event.

Recently, there has been a shift in the focus of research into hollowcore systems from looking at solutions for new buildings to providing tools for evaluating the performance of existing structures. The University of Canterbury in association with Precast New Zealand is now exploring this issue.

The desired outcome of this research is a tool kit that will enable estimation of the probable performance of various seating details, and, if necessary, provide inexpensive performance enhancement solutions.

This research is part of a joint Foundation for Research, Science and Technology (FRST) funded programme at Auckland and Canterbury Universities. This wider study aims to develop generic retrofit solutions for buildings pre and post the 1970s and provide a manual incorporating tested and verified retrofit solutions.

University of Canterbury Masters student, James Jensen, is researching the influence of seating length on performance of hollowcore when subjected to rotation consistent with inter-storey drift in a structure, as part of his thesis. In his investigations, Jensen has been looking at the work of Dr Jeff Matthews, who completed extensive research into hollowcore units that were seated on a commercial grout with seating lengths of 25 and 35mm. To date, Jensen has tested three specimens in a two dimensional testing rig, and is expecting to test one more sample before completing his portion of the work and passing the research on to another student. Tested to date have been:

1. 35mm seating
2. 75mm seating
3. 50mm seating.

All units tested are 300mm deep hollowcore and each sits directly on a concrete ledge without a bearing strip or seating compound. The units are subjected to seating rotations and extensions consistent with outward movement due to beam elongation.

Although the results of the testing need evaluation, they do indicate that failure occurred when support was lost due to concrete spalling on the beam face and at the end of the hollowcore unit. The 35mm seating unit performed better than in the test conducted by Matthews, suggesting that the degree of adherence between the soffit of the hollowcore unit and the supporting beam is a performance variable. This finding reiterates the NZS3101 recommendation to seat the units on bearing strips.

The unit with 75mm seating performed best and sustained drifts in excess of three percent. The amount of spalling on the sample with the 35mm seating was less than that of the 50mm seating unit. The sample with the 35mm seating also withstood drifts of up to three percent, compared to two percent for the 50mm seating test.

Research is due to be completed in October. Results are likely to be released later in the year.
Concrete and Sustainable Development: An Overview

The cement and concrete industry is committed to the progression of New Zealand’s sustainable development, and believes that the intrinsic attributes of concrete will be a key element in achieving this goal.

Over the past five years the New Zealand Government has placed increasing importance on the sustainability of New Zealand’s infrastructure, economy and environment. A strong component of the Government’s strategy has been to promote its plan of action through collaborative partnerships with stakeholders, including the cement and concrete industry.

The inherent properties of concrete ensure the industry’s contribution to the sustainable development of the built environment is considerable. The industry will continue its positive approach to the achievement of sustainable development by working with key decision makers within the current regulatory environment.

Concrete’s Contribution to Sustainable Development

Durability
Concrete has extraordinary durability. It will not rot, rust or corrode. Concrete’s high resistance to wear and damage, including its ability to withstand earthquakes, tsunamis, and extreme weather conditions means minimal maintenance over a prolonged whole of life. Furthermore, robust concrete buildings contribute to communal well being by offering occupants an added feeling of security against the risk of intrusion.

Thermal Efficiency
As a key element of good passive solar design, concrete is crucial to the moderation of internal temperatures, particularly if the concrete used is an element of the building’s structure. At the core of passive solar design is concrete’s “thermal mass”. This is the ability to absorb and store heat throughout the day, and release it during the night, creating a thermally efficient and comfortable living environment all year round.

Acoustic Performance
Concrete has advantages over lightweight construction in various aspects of acoustic performance - specifically reducing airborne noise transmission, reducing noise from exterior sources and providing sound separation between adjoining rooms. The overall sustainability implications of concrete’s acoustic absorption properties lie in the potential to enhance building occupants’ health and well-being.

Fire Resistance
Concrete is non-combustible, non-flammable, and more robust in fire than other structural systems as it can absorb a greater amount of heat before reaching critical overload. Concrete is able to maintain sufficient strength over extended periods of exposure. This ensures its structural integrity is largely retained, therefore posing a lower risk to occupants and emergency personnel in the event of a fire. Consequently the need to rebuild is minimised, along with the associated financial and environmental costs.

Other
There are also favourable lifetime costs associated with durable concrete roading and cement stabilisation, the reduction of storm water through the use of pervious pavers and pavements, and the ability to recycle concrete either as fresh aggregate, roading metal or as complete building elements.

Current Activities
With the present emphasis on sustainability, the industry is continually engaged with government to ensure concrete’s key features are known and understood. A good example of this is the industry’s dialogue with the Department of Building and Housing (DBH) in relation to the current review of the Building Code, which requires that buildings be designed, constructed and can be used in ways that promote sustainable development.

The Energy Efficiency and Conservation Authority (EECA) has recently announced the development of a Home Energy Rating Scheme (HERS) and the replacement of the National Energy Efficiency and Conservation Strategy, both of which will involve industry input.

With industry assistance, Standards New Zealand is currently reviewing all cement and concrete standards ten years or older, central to which is the sustainable element of durability.

The industry is also engaged with the New Zealand Green Building Council regarding its assessment of various sustainable building rating schemes, and with the Ministry of the Environment about the Waste Minimisation (Solids) Bill.

While the current landscape of regulatory change is extremely challenging, it also offers the industry the opportunity to position itself strategically for long-term growth. An essential component of a successful outcome will be communicating concrete’s ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.
New innovation in Walled Paper

Concrete Blond, a UK architectural design company committed to material and process innovation, is successfully bridging the gap between construction and high-end design with its new concrete Walled Paper.

Walled Paper challenges the popular uses and associations of concrete in construction by providing a uniquely decorative material while still carrying all the benefits of concrete in its traditional form.

Initially designed as an entry into the London Design Festival in 2005, Walled Paper has created a major impact on the architectural and design industries for its innovation as a stunning decorative material that adds a new dimension to the use of concrete in construction.

Based in London, Concrete Blond produces unique and beautiful designs for architectural projects. The company has established itself through a series of original products that combine materials to create modern and textured effects in the domestic and commercial design environments. Some of Concrete Blonde’s most famous products include the integration of concrete and glass as internal flooring with inlaid lighting, and a glass, aluminium, water and steel table system in varying sizes for a range of different application situations.

Walled Paper is perhaps Concrete Blond’s most innovative concept yet, where the company resolved to create a product with the same graphic detail and visual appeal as patterned wallpaper. The result is a design feature that is as diverse as it is different, creating a visually stunning and tactile finish for designer interiors and exteriors on projects of all sizes. The product is made from a well mastered technique of fine casting concrete (by Concrete Blond), however the actual process used to make Walled Paper is a closely guarded secret.

With the increasing trend of using polished concrete on interior surfaces, Walled Paper adds texture and art to architectural spaces, and offers clients the opportunity to express a graphic and permanent statement in clad surfaces.

The product is available in many different sizes, patterns and continuous lengths, although only through private commission. It can be applied to both interior and exterior walls, floors, on flat or curved surfaces and has the possibility of use in various application situations including domestic and commercial properties. The product lends itself to the high-end design market, although its most successful application has been in the private home environment.

Walled Paper takes on the advantages that concrete offers, including durability, thermal and sound insulation, as well as fire resistance.

A commissioned private house in Highgate, north London, has given Concrete Blond the opportunity to establish the use of Walled Paper in the high-end design market, and a presence as an effective building and decorative material. The house uses concrete in the form of rotating hidden Walled Paper panels, to offset the polished white concrete floors.

With the success of Walled Paper, Concrete Blond now intends on returning to a process of research and development in order to build their reputation as a design company at the top of their field, that produces unique and innovative designs for the architectural and design markets.

The recent completion of the Highgate house has helped to establish Walled Paper as a beautiful decorative material, an effective building feature, and a means to add a subtlety and delicate quality never before associated with concrete. It has allowed concrete to be viewed in a new light. The traditional assumptions of the material as a solid form suited only to construction purposes have been challenged, creating new respect for concrete and its use in decorative and high-end design markets.
In the June issue of *Concrete*, Cook’s Clinic featured information on exposed aggregate floors, which generated some interesting discussion about exposing aggregates.

The Exposed Aggregate Floors article discussed several methods for exposing the aggregate. It stated:

*When the concrete has stiffened sufficiently to support a person whose footprints are no deeper than two millimetres, then surface cement paste can be washed off to expose the aggregate. A medium bristle broom and continuous water spray is used. The surface should not be over-broomed as this can result in dislodging the stones, and mixing water into the underlying cement paste can weaken the surface. Proprietary spray-on retarders can be used to prolong the available working time, and to give a consistent and predetermined depth of exposure. These retarders are applied with a backpack sprayer, typically with a long spray boom to reach the centre of the slab. After curing, a mild acid wash (5% hydrochloric acid) is sometimes applied to remove any remaining cement paste that may dull the appearance of the exposed aggregate. The surface is then thoroughly washed, and sealer applied if desired.*

Although exposing the aggregate without the use of spray on surface retarders is technically correct, it’s generally agreed that to use surface retarders is recommended best practice. This is due to the fact that when exposing the aggregate it is important that the concrete matrix has sufficient strength to ensure the aggregate is not dislodged when brooming occurs. This is best achieved by providing the maximum amount of time to start the washing off, which necessitates the use of surface retarders.

It may also be desirable to delay the acid washing process and sealing. Waiting four to six weeks before acid etching can mean that the etching will both clean the aggregate and remove any efflorescence which has occurred. (If your client is willing to wait!)

Also on the issue of floors, many of you will have attended the recent floors seminar run by the NZ Concrete Society and CCANZ. Here are a few questions to test your new knowledge.

**What is the difference between Normal concrete and Special concrete?**

The terms *Normal* and *Special* concrete are referred to in NZS3104 - *Specification for Concrete Production*. If the key performance requirement is 28 day compressive strength, then you would ask for *Normal* concrete. You would also specify the strength, maximum aggregate size and any workability requirements. The concrete supplier is then responsible for supplying a mix and ensuring that the quality control satisfies all requirements in NZS3104.

If you are looking for something a bit different then you should ask for *Special* concrete. The concrete supplier should then ensure that the specifications are aligned to the special requirements you may have. These include strengths greater than 50MPa, large aggregate sizes, the use of supplementary cementitious materials, special admixtures and specified shrinkage targets. When specifying special concrete you also need to nominate how the concrete will be tested to determine conformance with the specification.

**What is meant by flatness and levelness?**

The following figures best demonstrate these concepts.

![Figure 4.2: Flatness and levelness](image)

**What does a Certificate of Audit ensure in terms of NZS3104?**

For a concrete plant to obtain a Certificate the following is required:

- Audited by an independent engineer
- Monthly results monitored by a plant engineer
- Total alkali content is to be less than 2.5kg/m³
- Testing of aggregate - grading, cleanliness per 100-300m³
- Testing of sand per 50-150m³
- Concrete producer is responsible for the mix design and its properties
- Compressive test of one test (2-3 cylinders) per 75m³ up to 15,000m³ per 250m³

All specifications for concrete should require that the plant holds a current Certificate of Audit.
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2006 DIARY:
29th September – 1st October
The New Zealand Concrete Industry Conference, Christchurch

Concrete prizes revamped
The New Zealand Concrete Society has recently completed a review of its academic prizes in the tertiary sector and this month launches a more broadly focused Scholarship initiative to be known as the Concrete Prize of the New Zealand Concrete Society.

Eight prizes valued at $1,000 (plus travel and accommodation expenses) will be awarded in total. They will also include complementary attendance at the following year’s annual Concrete Industry or New Zealand Concrete Society Conference. The prizes will be awarded as follows:
- Two prizes will be available at the University of Auckland, School of Engineering
- Two prizes will be available at the University of Canterbury, School of Engineering
- One prize will be available at Victoria University, School of Architecture
- One prize will be available at the University of Auckland, School of Architecture
- One prize will be available at UNITEC and Massey University.

One further prize may be awarded at the discretion of Council for final year presentation or research projects.

The prizes will be awarded based on recommendations made to the Council of the New Zealand Concrete Society by academic staff from each institution.

The aim of these prizes is to encourage academic excellence and increasing knowledge in the use of cement and concrete. “We’re committed to working with students and their tutors to help ensure that developing generations of engineers, designers and construction professionals are well prepared for using concrete as a construction material of first choice,” says councillor Warren South.

Self-compacting concrete on show
Sheldon Bruce would like to hear about new self-compacting concrete (SCC) projects that might be suitable to showcase online in the SCC section of the NZCS website. This section of the site focuses on the growing applications of SCC and outlines to members the possibilities for this material in precast and cast-in-situ concrete. Feature projects include Auckland’s Lighter Quay Hotel and Apartments. For further information, contact: sheldon.bruce@opus.co.nz

NZRMCA Conference update
The NZRMCA has two concurrent sessions at the upcoming Combined Concrete Industry Conference. A range of excellent speakers has been confirmed including:

Friday 29 September:
1.30 pm - 3.00 pm, Session 2A: Chairman: Rob Green
"Drug & Alcohol Free Workplace" by Susan Nolan - ESR
"Human Resources in the Concrete Industry" by Janet Copeland - Janet Copeland Law.

3.30 pm - 5.00 pm, Session 3A: Chairman: Rob Green
"Competition Law and its Importance to the Concrete Industry" by Ian Mutton
"Basic Rheology Principles for New Zealand Concrete" by James Mackenzie - University of Canterbury.

NZRMCA publication
If you would like a copy of the recent publications on the management of wash water on site, you can visit the association’s website (which has just been re-vamped) where they can be downloaded for free - www.nzrmca.org.nz