

concrete

VOLUME 58 ISSUE 2



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2015 Concrete³ Awards Open

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Heavyweight Concrete Basement

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IN UNDERWATER ENVIRONMENT

Rain, Rain, Go Away...

WHAT CAN BE DONE FOR CONCRETE FLOORS
THAT HAVE BEEN AFFECTED BY RAIN



NEW AQUATIC CENTRE A FAST-LANE TO THE FUTURE





THE NEW ASHBURTON INDOOR SPORTS AND LEISURE CENTRE, NAMED 'EA NETWORKS CENTRE', AND DESIGNED BY ARCHITECTS WARREN AND MAHONEY SETS THE PRECEDENT FOR THE SHAPE OF SPORTING FACILITIES TO COME. COMBINING MULTIPLE SPORTS FACILITIES IN A STATE-OF-THE-ART BUILDING, THE CENTRE IS A ONE-STOP SHOP FOR INDOOR SPORTS AND LEISURE.

Project Architect Alex Head says, "Clustering a diverse range of sporting disciplines under one roof allows efficiencies in staffing, support services and maintenance." A critical mass of activities encourages participation and the centre's design maximises these opportunities by creating visual connections between the indoor courts and swimming pools.

Situated on an old river terrace along the Ashburton River, the 8,000m² facility is the first step to developing a recreation precinct complete with outdoor cricket, hockey and rugby pitches. "The Ashburton District Council had the vision to provide a sports facility to not only meet the needs of the local community, but to serve as a centre of excellence for the wider Mid Canterbury region," says Alex. "The linear form is designed to allow the expansion of the indoor courts, aquatic and fitness centres, so the building can grow with the needs of the community."



Sustainability is at the core of the Warren and Mahoney design. Ventilation via louvre windows in the foyer and administrative areas lessens the load on air-conditioning, rainwater collected from the roof feeds the hydrotherapy pool make-up water system and an efficient heat recovery system minimises waste heat. The gymnasium is designed with roof-lights to provide natural light while daylight sensors dim the artificial light according to the user's needs.

In the foyer, a material palette of concrete, timber and glass sets up the public interface while a restrained use of colour (yellow and green) lends an element of fun and assists the public to find their way through the facility.

Using local materials was a priority and the centre is clad in precast concrete sandwich panels with an exposed aggregate greywacke pattern. Designed by Alex, the patterning was inspired by the local braided rivers that created the Canterbury plains. The fresh water gives life to the farms that are the backbone of the Ashburton and Mid Canterbury region.

The concrete panels were manufactured by McIntosh Precast in Ashburton. "We worked closely with John McIntosh to refine the design and develop an efficient pattern module that could be repeated along the main façade," says Alex.

"The panels provide a timeless quality to the new community facility. The pattern is abstracted internally to continue the theme through the foyer and café. We are really pleased with the quality of the concrete panels. They give permanence and solidity to the community building that would have been difficult to achieve with other materials."

The Thermomass precast concrete sandwich panel system was selected for its efficient thermal envelope, speed of erection and durable, low-maintenance finish. XPS insulation is sandwiched between a 150mm-thick structural panel and a 100mm architectural wythe providing a contiguous thermal envelope. Fibre composite panel connectors support the external architectural wythe panel from the inner structural panel.

Peter Marshall, Managing Director, Warren and Mahoney says, "The building will be a magnet for human interaction that meets its brief to motivate more widespread participation in sport - a facility that will inspire people to get active and nurture our next generation of top athletes. Projects like these, for regional centres such as Ashburton, are significant developments that demonstrate a confidence in, and commitment to, the future."



UPFRONT

Having arrived at the mid-point of the year the weather has certainly taken a turn for the worse. The drop in temperatures across the country will definitely be posing a few challenges to concrete placers.

Concrete quality has recently been in the news as Firth Industries, New Zealand's largest ready mixed concrete supplier, inadvertently supplied low strength concrete to a number of customers / projects, owing to an isolated plant malfunction in Auckland.



Although a very difficult incident for Firth to manage there are aspects that reflect positively on them as a responsible company, as well as the wider concrete industry.

For instance, the manner in which Firth 'front-footed' communications with their customers (and the media) should be applauded, as should their implementation of a testing regime to detect and rectify affected sites.

This in turn acts as an endorsement of the NZ Ready Mixed Concrete Association's (NZRMCA) Plant Audit Scheme, under which Firth's quality control mechanisms are certified.

The plant in question has now undergone a new audit by the Scheme to reaffirm its certification after remedial actions. The incident, remedial actions and audit have been reported to the Ministry of Business Innovation and Employment (MBIE) by the Scheme's Chairman in accordance with protocols agreed between the NZRMCA Council and MBIE.

This shows that the industry's checks and balances are effective, and that the customer can have confidence in the 3.8 million cubic metres of concrete placed annually.

The NZRMCA is not resting on its laurels however, and will undertake an evaluation to determine learning opportunities for the industry around communication, production practices and training.

The importance of training cannot be overstated. Those making crucial material, design and construction decisions must be fully informed.

Over recent years CCANZ has endeavoured to bolster our industry's education, training and research capabilities through the appointment of a dedicated staff member to implement a targeted plan.

A component of this work has been the recent development of the CCANZ Concrete Construction Course (see pages 16-17), a 2-day classroom based course designed to promote quality concrete outcomes amongst those working on-site.

It is critical that as an industry we engage with the contracting community, who are ultimately responsible for handling our product in its final phase.

That is not to say CCANZ is reducing its training focus on the engineering and design disciplines. In fact, we are thrilled that in partnership with BRANZ our annual ArchEng student workshop will adopt a new materials neutral pan-industry approach in July this year.

Since 2012 the workshop has brought together final year students studying structural engineering and architecture at various universities around the country, to promote collaboration under a pressured deadline.

The vision for ArchEng was always to position itself as the premium annual student workshop for the construction sector. For that reason, CCANZ has agreed to allow BRANZ to take the lead on the event and to become one of three construction material supporters of the event, along with steel and timber.

While we are inevitably protective of our concrete patch, we must remember that success in the construction industry is based on collaboration – between service providers and their customers, across professional disciplines and amongst the material supply chain.

Rob Gaimster
CCANZ, CEO

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NEW ZEALAND COATINGS & CORROSION CONFERENCE & EXHIBITION OCCURRING JULY

Building on the success of the inaugural event in 2014, Conferenz will again host a Coatings & Corrosion conference and exhibition in July at the Ellerslie Events Centre in Auckland.

The consequences of the corrosion process have become a problem of worldwide significance. Corrosion can cause plant shutdowns, waste valuable resources, contaminate products, reduce efficiency, and cause costly maintenance and expensive overdesign. It can also jeopardise safety.

It is well known that the corrosion of reinforcing steel and other embedded metals is the leading cause of deterioration in concrete. When steel corrodes, the resulting rust occupies a greater volume than the steel, and it is this expansion that creates tensile stresses in the concrete, leading eventually to cracking, delamination and spalling.

The two day conference on 29 & 30 July offers advanced topics and case studies from a wide range of speakers to cater to the trade, management and technology providers in the field of combatting corrosion and protective solutions.

This event attracts a wide range of professionals from both the public and private sectors, including those involved with utilities maintenance, horizontal infrastructure and engineering.

Come and hear case studies such as Phillip Island: San Remo Bridge Protective Coatings Case History and take part in an interactive session on differences in opinions within industry for how to prepare and coat aged galvanising. Asset owners can glean from hearing ICS Inspection & Consultancy Services on methodologies for coating performance, how far applications should go when it comes to surface preparation and retaining warranties for work completed.

This event is strongly supported by sponsoring exhibitors – such as Sika, Altex Coatings and Applied Polymers – offering excellent advice and knowledge on new products and services. To read the conference programme - see the website www.conferenz.co.nz/corrosion



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INTRODUCING BCITO'S INDUSTRY ADVOCATE FOR CONCRETE

In 2015 BCITO brought together all services that engage directly with industry into a new Stakeholder Engagement Group, which includes research, marketing, and communications functions. Importantly, this group includes a new team of Industry Advocates.

Industry Advocates are the primary contact for, and will manage strategic relationships with key industry stakeholders and BCITO. Tasked with making sure the strategic goals of industry are well understood and achieved by our wider organisation, it's the industry advocates' role to liaise and consult directly with industry leaders in each industry they look after.

ANGELA LEWES

Angela has worked within the construction industry for the last nine years as a project manager. She is looking forward to being part of a team within the BCITO whose role is to listen, and help provide the best possible educational pathways for apprentices from various trades.

In her busy life she tries to find time to squeeze in some travel combined with volunteer work to assist people in less fortunate situations in our global community.

Angela is the Industry Advocate covering Brick & Block Laying, Masonry, Exterior Plastering and Concrete.

"I look forward to building on our close relationships with associations and groups to further support and enhance the educational goals of your industry. Please get in touch with me to discuss any aspect of BCITO's specific initiatives for your industry in 2015 and beyond," says Angela.

You can contact Angela on 0800 422 486 or by email – angela.lewes@bcito.org.nz.



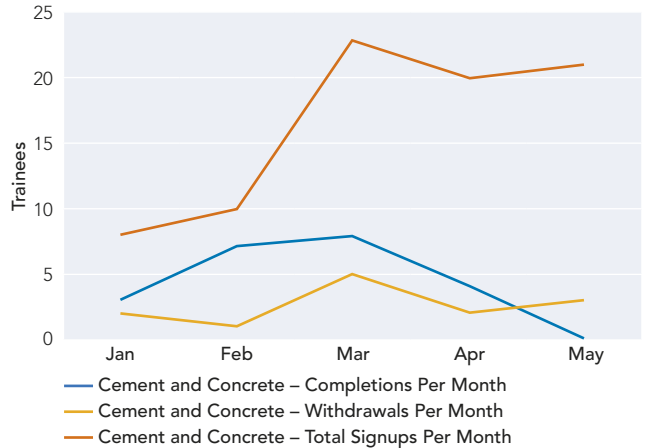
Angela Lewes

CURRENT APPRENTICE STATISTICS IN THE CONCRETE INDUSTRY

Month 2015	Total Trainees YTD	Signups per month	Completions per month	Withdrawals per month
January	155	8	3	2
February	157	10	7	1
March	167	23	8	5
April	181	20	4	2
May	199	21	0	3



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NZS 3121 FULL REVISION

The scheduled amendment to *NZS 3121 Specification for Water and Aggregate for Concrete* has become a revision due to the large number of changes required to make it fit for purpose and to reflect current best practice.

The Committee established to review this Standard recommended to Standards New Zealand that to account for advances in current practice as well as changes over the past decade to the NZ Building Act and to *NZS 3101 Concrete Structures Standard*, NZS 3121 should be revised rather than amended.

The Standard gives essential requirements for water and aggregates, other than lightweight aggregates, suitable for use as materials for making concrete to meet normal structural and durability requirements.

This expansion in scope has pushed out the timetable; however a draft for public comment is now available from the Standards New Zealand website – www.standards.co.nz.



Image: PCA

CONSULTATION ON RESPIRABLE QUARTZ (CRYSTALLINE SILICA)

Worksafe New Zealand is proposing to modify the Workplace Exposure Standard for respirable quartz (crystalline silica).

Worksafe proposes to adopt an 8 hour time weighted average (WES-TWA) of 0.025mg/m³ (measured as respirable fraction).

A review was performed recently to recommend this proposed WES value. This review was carried out by Toxicology Excellence for Risk Assessment (TERA) in the United States.

CCANZ will review the document to assess its relevance to the concrete industry. Individual companies may wish to do the same.

The deadline for response is 5pm Friday 7th August 2015. The document can be downloaded from the Worksafe New Zealand website - www.business.govt.nz/worksafe.

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SUSTAINABILITY AWARDS

CCANZ IS DELIGHTED TO ANNOUNCE THAT THE 2015 CONCRETE³ SUSTAINABILITY AWARDS ARE NOW OPEN FOR ENTRIES. THE AWARDS PROVIDE ARCHITECTS, DESIGNERS, ENGINEERS AND/OR INDUSTRY WITH THE OPPORTUNITY TO SUBMIT A CONCRETE BASED PRODUCT, PROJECT OR INITIATIVE, SUBSTANTIALLY COMPLETED WITHIN THE PAST THREE YEARS, THAT DEMONSTRATES SUSTAINABILITY IN EITHER THE PRODUCTION OR USE OF CONCRETE.

Previous winners have included The Pride, Lion Nathan's integrated manufacturing and warehousing facility in East Tamaki, which made extensive use of recycled glass as aggregate in concrete, and the Northern Gateway Toll Road, of which every aspect, from design through to operation, considered ways in which to contribute to New Zealand's sustainable development.

In 2010 the Fletcher Construction Company took home the Award for the Tauranga Harbour Link's "Mix M", while in 2011 Peddle Thorp Architects' conversion of 21 Queen Street into a modern and vibrant office/retail complex received the highest honour.

2012 saw Athfield Architects collected the top prize for its extensive refurbishment of the new Christchurch Civic Building on Hereford Street - a transformation of what was the New Zealand Post Building into an architectural statement that adds tremendous value to Christchurch. In 2013 Nauhria Precast was recognised for its stunning use of precast concrete throughout the redevelopment of Hurstmere green in Takapuna.

Sustainability embraces environmental, economic and social considerations. Each concrete based product, project or initiative entered may relate to any of the following areas:

- Lean production less waste
- Managing natural resources
- Minimising energy use
- Protecting against pollution
- Respect for people
- Setting performance targets

HOW WILL ENTRIES BE JUDGED?

Within each Award category entries will be judged by a panel of New Zealand and international industry experts, using an environmental, economic and social sustainability set of criteria. Extra credit will be given to unique factors and entries that cover more than one facet of sustainability (e.g. both environmental and social sustainability).

AWARD CATEGORIES

The 2015 Concrete³ Sustainability Supreme Award winner will be selected from the following categories:

- Excellence in Residential Concrete Construction
- Excellence in Commercial Concrete Construction
- Excellence in Civil Concrete Construction
- Excellence in Concrete Innovation
- Excellence in Concrete for the Community

HOW TO ENTER & CLOSING DATE

For entry information and an entry form visit www.sustainableconcrete.org.nz. You have until Friday 4 September 2015 to submit your entry.

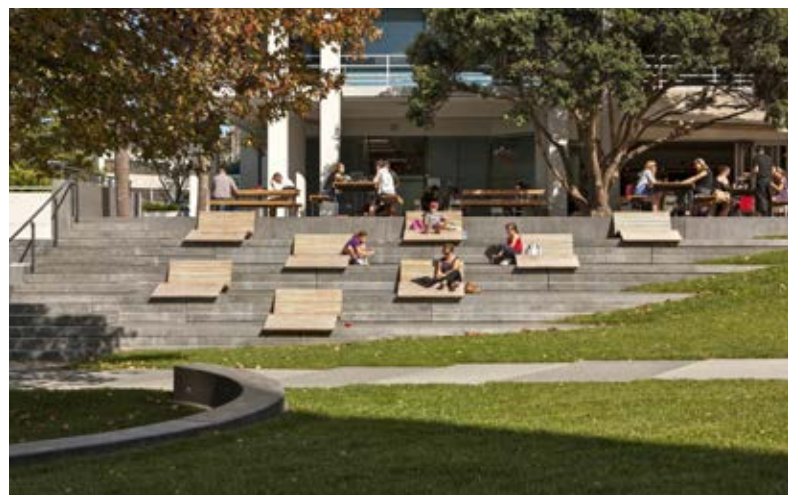
ANNOUNCEMENT OF RESULTS

The Supreme Award winner will be announced at a presentation at the New Zealand Concrete Conference, October 2015. The December 2015 issue of *Concrete* magazine will include a detailed report on the Awards, based on the material submitted by the entrants. The winner of the Concrete³ Sustainability Supreme Award will be presented with the 2015 Concrete³ Sustainability Award trophy.

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Images: Simon Devitt

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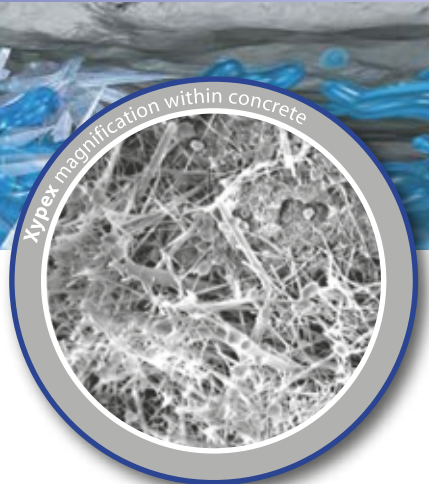
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THE LAST PRE-CAST CONCRETE PIECE IN THE GIANT WATERVIEW TUNNEL PUZZLE CAST

A PURPOSE-BUILT FACTORY IN EAST TAMAKI, HAS CAST THE LAST OF 24,000 SEGMENTS WHICH ARE BEING USED TO LINE THE MOTORWAY TUNNELS FOR THE NZ TRANSPORT AGENCY'S WATERVIEW CONNECTION PROJECT.

Brett Gliddon, the NZ Transport Agency's Auckland State Highways Manager says now that the final pre-cast segment is completed, it marks another exciting milestone and real progress in the Waterview project.

"The linings have been a key component in the design and construction of the twin-tunnels and this factory has done a first rate job consistently delivering such a big quantity on time. This has made a significant contribution to keeping us well on target for the project to be completed in December 2016, and the planned opening to traffic in early 2017."

The segments are delivered to the project site in Owairaka where 'Alice' the Tunnel Boring Machine (TBM) has been installing the segments at a rate of six linings every 24 hours that the TBM is operating.

The East Tamaki facility was built by a partnership between the tunnel project's Well Connected Alliance and Wilson Tunnelling, using some of the most up to date concrete batching and moulding equipment.

"The linings for these tunnels have needed to be extremely precise with to-the-millimetre precision so they fit perfectly together inside the tunnels. They're also incredibly strong, durable enough to withstand 100 years of traffic use," says Mr Gliddon.

The remaining 65 workers at the factory have celebrated their achievement in completing the final segment. The facility will now progress to a deconstruction phase.

With the skills developed at East Tamaki, many of those working there have been able to find new jobs in a booming construction industry, says the Alliance Project Manager John Burden.

"The team at the precast factory can be very proud of the job they have completed," Mr Burden says.

"In addition to producing the tunnel segments on time and under budget, the team have worked hard with the local community to hire, train and develop a workforce that is now able to move on to higher skill jobs. The skill development within the local community is something that I'm personally very pleased about."

New Zealand COATINGS & CORROSION

29 & 30 July 2015 | Ellerslie Events Centre, Auckland

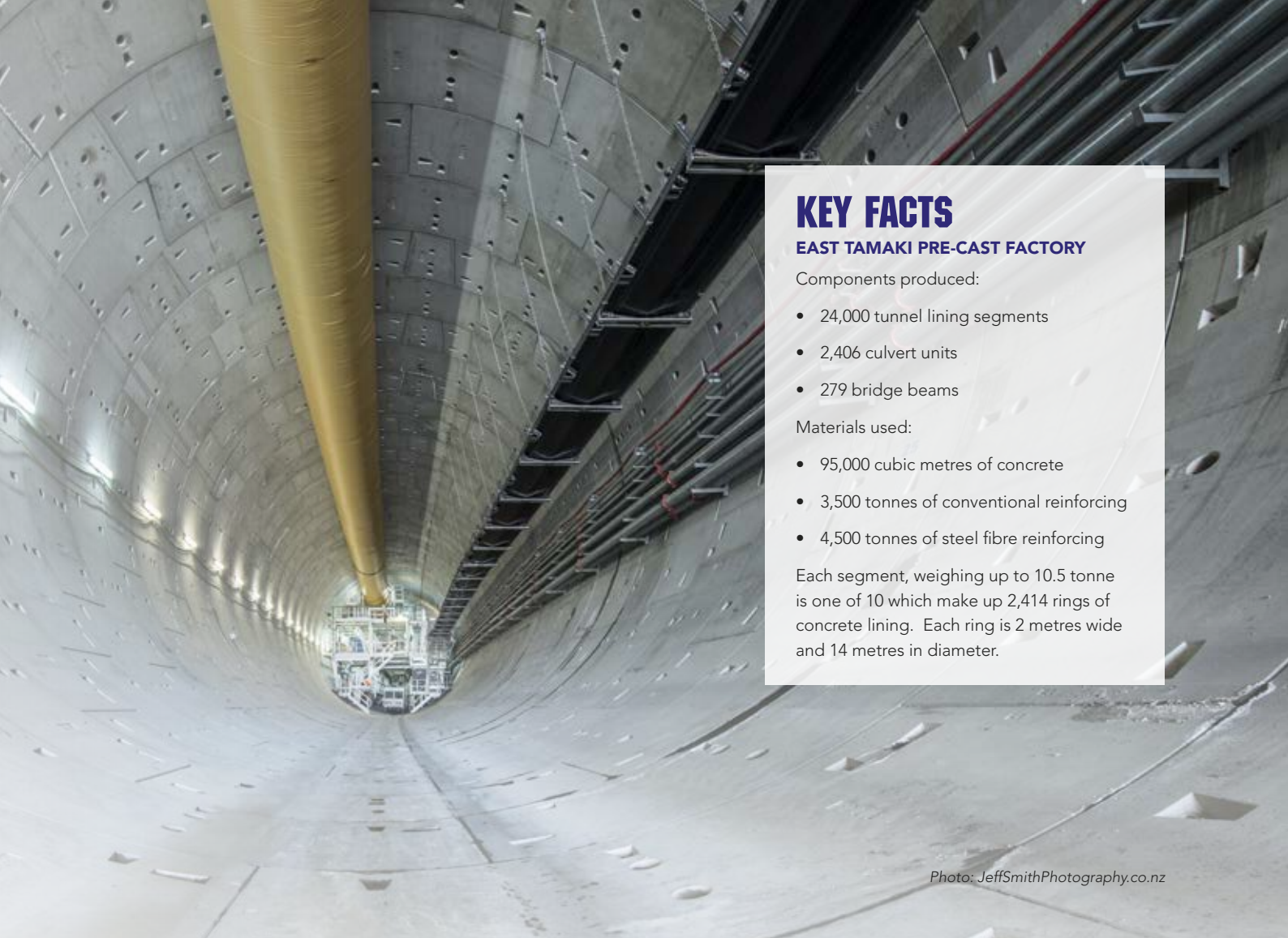
Two day conference:

- The impact of corrosion on the NZ economy
- Legal aspects of corrosion
- The impact of corrosion on Health & Safety
- Corrosion from the environmental point of view



Supporting Publications





KEY FACTS

EAST TAMAKI PRE-CAST FACTORY

Components produced:

- 24,000 tunnel lining segments
- 2,406 culvert units
- 279 bridge beams

Materials used:

- 95,000 cubic metres of concrete
- 3,500 tonnes of conventional reinforcing
- 4,500 tonnes of steel fibre reinforcing

Each segment, weighing up to 10.5 tonne is one of 10 which make up 2,414 rings of concrete lining. Each ring is 2 metres wide and 14 metres in diameter.

Photo: JeffSmithPhotography.co.nz

CORROSION

ALL THE EXPERTS



LES BOULTON



MIKE BOARDMAN



SEAN RYDER



WAYNE THOMSON



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CCANZ CONCRETE COURSES 2015

UNTIL THE END OF 2015 CCANZ HAS SCHEDULED A RANGE OF TRAINING COURSES DESIGNED TO MEET CONCRETE TESTING, TECHNOLOGY AND (WEATHERTIGHT) CONSTRUCTION NEEDS. CONTACT CCANZ NOW TO SECURE YOUR PLACE OR EXPRESS INTEREST IN AN UPCOMING COURSE.

CONCRETE TECHNICIAN'S COURSE

INTRODUCTION TO THE CONCRETE INDUSTRY

DAY 1

The CCANZ *Introduction to the Concrete Industry Course* is a single day course that provides an overview of the important areas of the wider cement and concrete sectors.

The course is comprised of the following modules:

1. Properties of Concrete - Materials used in concrete - cement, aggregates, water and admixtures.
2. Concrete Production - Important aspects of *NZS 3104 Specification for Concrete Production*.
3. Concrete Construction - Construction practice issues from *NZS 3109 Concrete Construction*.
4. Concrete Testing - Fresh and hardened concrete testing *NZS 3112 Methods of Test for Concrete*.

Venue / Date

Auckland and Christchurch annually. The next scheduled course is on 20 October / 9.00 am to 5.00 pm in Christchurch.

Instructors

Dr Joe Gamman and Dr Alistair Russell.

Registration Fee

- Price on enquiry.

To register your place or interest in future courses call CCANZ on (04) 499 8820 or email admin@ccanz.org.nz.

CONCRETE LABORATORY TESTING COURSE

DAY 2 (NZQA UNIT STANDARDS – 26053 & 26063)

The CCANZ *Concrete Laboratory Testing Course* is a single day course covering the major routine laboratory tests performed at batching plants.

The course emphasises how testing is directly related to the Building Act and the relevant NZ Standards. The teaching and assessment is a mixture of theory, practice and group discussion.

The course is comprised of the following modules:

1. Tests on Fresh Concrete
 - a. Testing and Sampling Fresh Concrete
 - b. Slump Test
 - c. Yield and Air Content Tests Air Content Test
 - d. Spread Test
2. Tests on Hardened Concrete
 - a. Making Cylinders
 - b. Hardened Density
 - c. Compressive Strength
 - d. Splitting Tensile Strength
 - e. Flexural Tensile Strength

Venue / Date

Auckland and Christchurch annually. The next scheduled course is on 21 October / 9.00 am to 5.00 pm in Christchurch.

Instructors

Dr Joe Gamman and Dr Alistair Russell.

Registration Fee

- Price on enquiry.

To register your place or interest in future courses call CCANZ on (04) 499 8820 or email admin@ccanz.org.nz.



WEATHERTIGHT CONCRETE CONSTRUCTION COURSE

This one day course covers the requirements of weathertight concrete construction based on the CCANZ publication *Code of Practice for Weathertight Concrete and Concrete Masonry Construction (CP 01:2014)*.

The theory that underpins the policies and practice of being a Building Control Officer which is one component of the *Diploma in Building Control Surveying - Small Buildings* is also addressed.

The course is comprised of the following modules:

1. Scope
2. General
3. Wall Construction
4. Wall Weathertightness Systems
5. Flashings
6. Concrete Roofs and Decks
7. Concrete Slab-On-Ground and Footings
8. Construction Moisture

Venue / Dates

Whangarei	Tauranga
12 August 2015	15 October 2015
New Plymouth	Christchurch
17 September 2015	12 November 2015

Instructor

Ralf Kessel, Architect (Deu).

Registration Fee

- BOINZ and CCANZ Members - \$535 plus GST (\$615.25)
- Non-BOINZ Members - \$735 plus GST (\$845.25)

To register your place call CCANZ on (04) 499 8820 or email admin@ccanz.org.nz.

CCANZ can schedule and locate this course to suit individual councils.

CONCRETE TECHNOLOGY COURSE

DAY 3 (NZQA UNIT STANDARDS – 12020)

The CCANZ *Concrete Technology Course* extends the concepts introduced in the *Concrete Laboratory Testing Course*.

There is more detail on the interplay of NZ Standards and the construction industry. The basic chemistry of cement is introduced and its influences on the final properties of concrete is explained.

Participants will learn how mix proportions affect the properties of the hardened concrete.

The course is comprised of the following modules:

1. Introduction to NZ and Australian Standards
2. Admixtures for Concrete
3. Concrete Mix Design Principles
4. Test for Concrete Raw Materials

Venue / Date

Auckland and Christchurch annually. The next scheduled course is on 22 October / 9.00 am to 5.00 pm in Christchurch.

Instructors

Dr Joe Gamman and Dr Alistair Russell.

Registration Fee

- Price on enquiry.

To register your place or interest in future courses call CCANZ on (04) 499 8820 or email admin@ccanz.org.nz.

The *Concrete Technician's Course* can be taken as a 3-day block or as individual day courses.

CONCRETE CONSTRUCTION COURSE

(NZQA UNIT STANDARDS - 13008, 13009, 13010 & 13029)

The CCANZ *Concrete Construction Course* is designed for those responsible for supervising the receipt and placement of fresh concrete on-site.

The aim of the course is to promote *quality* concrete construction.

Built around *NZS 3109 Concrete Construction*, the curriculum for the two day classroom based course meets both industry needs and the relevant NZQA standards.

The course is comprised of the following modules:

1. Introduction to Concrete
2. Properties of Fresh and Hardened Concrete
3. Reinforcement
4. Formwork
5. Site Practice

Venue / Date

Auckland and Christchurch annually. The next scheduled course is on 8–9 September 2015 / 9.00 a.m. to 5.00 p.m. in Auckland.

Instructors

Dr Joe Gamman and Dr Alistair Russell.

Registration Fee

- Price on enquiry.

To register your place or interest in future courses call CCANZ on (04) 499 8820 or email admin@ccanz.org.nz.



HEAVYWEIGHT CONCRETE: TÄBY CITY HALL SWEDEN

By Dave Parker



Vital ingredients: MaganDense magnetite aggregates

SUPER DENSE CONCRETE HAS SOLVED A TRICKY BASEMENT CHALLENGE IN SWEDEN. DESIGNERS OF DEEP BASEMENTS EXTENDING BELOW THE LOCAL WATER TABLE HAVE ALWAYS HAD TO CONSIDER HYDROSTATIC PRESSURES, IN PARTICULAR THE VERTICAL FORCES GENERATED BY THE BASEMENTS' INHERENT BUOYANCY. THESE CAN GENERATE ENOUGH UPLIFT TO THREATEN THE OVERALL STABILITY OF THE BUILDING ABOVE. IF ENOUGH OF THE DEADWEIGHT OF THE BUILDING IS CARRIED BY THE BASEMENT STRUCTURE, THIS RISK CAN BE NULLIFIED - BUT THAT WAS NOT THE CASE AT THE NEW SEVEN STOREY CITY HALL IN TÄBY, SWEDEN.

Heavily fissured granite had to be blasted and sawn to create space for a two storey basement car park measuring 53m by 36m in plan. The lower storey is entirely below normal groundwater level. Uplift, however, is not cancelled out by the building's deadweight, as main contractor Sweco engineering project manager Peter Hniopek explains.

"The office above has a wider span than the car park levels, which means there isn't enough deadweight on two column lines on the lower floor.

"Without special measures, at high groundwater levels, the foundation pad would lift along these two lines."

Originally Sweco had proposed to solve the problem with rock anchors, but the need to drill wells for ground-source cooling below the basement would have complicated installation and probably added significant extra costs.

Luckily, a member of the Sweco project team had previous experience of heavyweight concrete. The alternative of adding high density ballast to the basement looked increasingly attractive, the more it was evaluated.

Left: Smooth operator: The heavyweight concrete flowed well and was easy to compact

"We realised that heavy concrete would give us the extra deadweight needed without excessive volume," says Hniopek. "Furthermore, it would be much quicker than rock anchoring, meaning we could meet our agreed delivery time."

The laws of physics also endow high density concretes with another crucial advantage in what is effectively an underwater environment. Archimedes' Principle states that a body immersed in water will be subject to an uplift equal in weight to the volume of water displaced.

Thus a cubic metre of concrete will lose around 1t of deadweight when immersed.

Sweco was aiming for a density of 3,700kg/m³, which in effect meant that the high density concrete would have an effective deadweight of 2,700kg/m³ when immersed, more than twice that of normal concrete in a similar situation.

This was based on the choice of magnetite (iron ore) as aggregate. LKAB Minerals could supply magnetite in zero to 2mm, zero to 8mm and 2mm to 20mm fractions from its mine at Kiruna in Sweden, understood to be the largest underground iron mine in the world. A density of 3,700kg/m³ was easily achievable and compressive strengths equivalent to normal mixes would have been no problem.

However, on the Täby city hall project, compressive strength was not an issue and was not specified. The normal concrete basement slab was designed to take all loading.

Basement subcontractor Skanska production manager Daniel Kedland says that constructing the basement is "like casting a large boat." He adds: "We calculated that by casting two 'loaves' under the base slab we could create the deadweight we needed."

These "loaves" measure 3m wide by 550mm deep, and extend across the 53m length of the basement. The concrete arrived ready mixed and could be placed with the truckmixers' chutes. Kedland admits he had some concerns before placing began.

"I had never worked with heavy concrete before. I was worried that it would be very stiff and difficult to compact. But it was like normal concrete, and there were no real problems."

Overall the verdict on the super dense concrete was very positive. It was much easier to work with than some feared, and was quicker and simpler than the rock anchoring alternative. It was also significantly cheaper as well.

HEAVYWEIGHT CONCRETE'S HISTORY

Heavyweight concretes first appeared on the large scale in the 1950s and 1960s, paralleling the growth of the nuclear power industries in the UK and United States.

Their much greater density made them a realistic option for radiation shielding, reducing the thickness and volume of concrete needed to contain deadly ionizing gamma rays.

Later the booming offshore oil industry also took advantage of the higher densities to ballast pipelines and seabed installations. Most major hospitals now have radiotherapy treatment centres, where heavyweight concrete is usually the radiation shielding solution. It has also found uses in counterweights on cranes.

Ultimately, concrete density is determined by aggregate density. Options include barites or barytes (barium sulphate), the iron ore magnetite, iron shot, or even lead shot. Barites concretes have a density of around 3,500kg/m³, 45% greater than normal concrete, and are non-magnetic. With magnetite a density of 4,000 kg/m³ is possible, more than 60% higher than normal.

Should even higher densities be required, iron shot concretes can offer 5,900kg/m³, while lead shot aggregate can yield a density of 8,900kg/m³. Such concretes are very expensive and difficult to handle.

All heavyweight concretes suffer from similar drawbacks. Truckmixers and skips can only carry a significantly smaller volume than normal, and formwork pressures will be higher.

Heavyweight concretes can be successfully pumped, but wear and tear on pumps and mixers will be greater. And more energy is usually needed to achieve full compaction unless plasticising admixtures are used, so poker vibrators have to be inserted at closer centres.

Compressive strengths equivalent to normal density concretes are readily achievable.

A typical C25/30 mix with a wet density of 3,900kg/m³ using magnetite aggregates would have a cement content of 290kg/m³ and a water/cement ratio of 0.55. A plasticiser would be included.

Swedish magnetite aggregates in a range of sizes are available in the UK from LKAB Minerals. Barites (barytes) aggregates are produced from mines in Scotland and to a lesser extent in England, although the primary use of UK barytes is to increase the density of drilling fluids for oil and gas exploration. Barytes production and hence the availability of barytes aggregates for concrete is influenced directly by the fortunes of the oil and gas industries.

Durability of magnetite and barytes concretes is similar to that of mixes using other types of natural aggregates. Durability and compressive strength can be enhanced by the inclusion of condensed silica fume (microsilica) and modern high range water reducing admixtures (superplasticisers).

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ASK ALISTAIR

CCANZ STRUCTURAL ENGINEER ALISTAIR RUSSELL
EXPLORES THE SYMPTOMS, MECHANISMS, PROTECTION
METHODS AND REMEDIES FOR CONCRETE FLOORS
THAT HAVE BEEN AFFECTED BY RAIN.



IT'S RAINING AGAIN

AFTER A VERY WET SUMMER IT IS NOT SURPRISING THAT CCANZ HAS ONCE AGAIN RECEIVED A NUMBER OF ENQUIRIES ABOUT RAIN-DAMAGED CONCRETE.

SYMPTOMS

The symptoms are dependent upon when in the placing process the rain arrived. If the concrete has been floated and trowelled, and is nearing setting, the damage may be limited to some marking of the surface.

If the rain arrives prior to trowelling, there is a real risk that the surface will, at a later date, start to dust. The image shows a driveway where rain occurred during the finishing process and a dusty surface has resulted. Over a period, the dusting surface was abraded in the wheel tracks, exposing the aggregate.

WHY DUSTING OCCURS

The strength of concrete is directly related to the water/cement ratio. The higher the ratio (i.e. the more water added), the weaker the concrete. When water, either from rain or the bleed water, is mixed into the surface during the finishing process, a very weak concrete layer is created.

Typically this weak layer is 3-5mm thick and the concrete below is usually sound. It is this weak surface layer that is the source of the dust which is created by surface abrasion.

WHAT CAN BE DONE TO PREVENT IT?

The simplest answer is to avoid placing concrete when there is a threat of rain. However, there are times when rain occurs despite the forecasts for good weather. In these instances it pays to have a contingency plan. Under clause 7.1.3.2 of *NZS 3109 Concrete Construction*, the contractor has a responsibility to protect freshly cast concrete from the effects of rain.

For trowelled surfaces, one option is to lay polythene over the concrete surface as soon as the rain starts, and then wait for it to cease. When the rain has stopped the polythene should be rolled back from a small area at a time and then finished. Use the moisture in the slab to finish and avoid the addition of any water to the surface during the finishing process.

This process is repeated until the entire slab has been finished. Do not pull the polythene off the entire surface in one go as invariably the surface will dry and become unfinishable. It is important to ensure that any water sitting on the top of the polythene is not discharged onto the concrete. Start the curing process as soon as possible after finishing.

If a prolonged period of rain has occurred, better results can be achieved by using a "rotating plate compactor" to bring the fat up



Image: PCA

to the surface then machine finish as normal. Pan floating may help if a rotating plate is not available.

For decorative concrete, particularly stamped concrete, the potential practical contingency plans are limited as there is only a relatively small window of opportunity to conduct the stamping process.

YOU HAVE A DUSTING SURFACE – WHAT CAN BE DONE?

The answer depends on the severity of the problem and how quickly remedial action is taken.

For situations where the dusting problem is not severe, and the problem is addressed early, the surface may be saved using a “dustproofer and surface hardener”. These are typically clear silicate-based solutions that are poured and broomed/squeegeed into the surface.

These solutions may not save a moderate to severe dusting surface, but as the cost is modest compared to other options it may be worth trialling. If the surface has been left for a period of time, and wear has exposed the aggregate, this solution is no longer available as it will not hide the aggregate, so it is important to both acknowledge the problem and take action early.

Another remedial solution is to grind off the weak surface layer. This can create a rather attractive terrazzo effect. However, given that the floor was not intended to be ground, it would be unreasonable to expect an even distribution of the aggregate.

If a terrazzo appearance is not desired, then the weak surface layer can be removed by grinding, and a cementitious topping placed over the surface. These toppings can often be coloured and textured.

In some instances the only practical solution is to rip the concrete up and start again.

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THROUGH-LIFE CARE AND MANAGEMENT OF CONCRETE STRUCTURES: ASSESSMENT, PROTECTION, REPAIR AND STRENGTHENING BY STUART MATTHEWS

Most concrete structures provide satisfactory performance over many decades but a significant number experience premature deterioration and require repair, especially in aggressive environments. Existing structures represents not only a huge

economic investment that cannot easily be replaced, but also a large and important investment in embodied carbon.

This book seeks to give an appreciation of the issues associated with the management, assessment, maintenance and repair of concrete structures. It also aims to reflect recent and evolving developments and give an up to date overview.



THE ISSUES AND DISCUSSION OF MODERN CONCRETE SCIENCE BY WENKE YANG

This book is devoted to two primary objectives. The first is to present the errors, inadaptability and mistakes arising when the current theory on concrete is applied to explaining practical construction of concrete; the second is to put forward viewpoints in modern concrete science.

The results include: corrections to several one-sided views on concrete construction in the field and a new theory that can be adopted to improve the durability of concrete projects, to control and improve the implementation quality of concrete projects and to guide teaching in universities.

LIBRARY QUIZ

To go in the draw to win a copy of *The Issues and Discussion of Modern Concrete Science* by Wenke Yang answer the following simple question:

What industry saw the large scale growth of heavyweight concrete in the 1950s and 1960s?

Email your answer to library@ccanz.org.nz. Entries close Friday 28 August 2015.

Congratulations to Alex Vierhout of Frontier Engineers, who correctly answered the Vol 58 Iss 1 Library Quiz to receive a copy of *Improving Concrete Quality* by Karthikeyan H Obla.

APARTMENT DESIGN GUIDE



The CCANZ *Apartment Design Guide* sets out key considerations, and provides recommendations on size, daylight and interior climate requirements, along with effective soundproofing and fire protection.

Email admin@ccanz.org.nz to request your FREE copy of the *Apartment Design Guide*.



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NEWS FROM THE ASSOCIATIONS



NEW ZEALAND CONCRETE SOCIETY (NZCS)

CONFERENCE BRINGS PLENTY OF VARIETY

Planning for this year's Conference is almost complete and the organisers say the new venue is perfectly geared to the diverse range of activities scheduled for the three-day event.

The conference (Thursday 8th to Saturday 10th October) is to be held at Rotorua's Sir Howard Morrison Performing Arts Centre (previously the Rotorua Convention Centre).

Conference organising chairman Jeff Matthews says the event's programme has been designed to maximise the technical content but also to provide networking opportunities. These include a casual party on the Thursday evening and social activities on Friday afternoon – and the formal conference dinner and awards night on Friday evening.

"The technical presentations in particular are generating enormous interest. We've received nearly 50 papers for consideration and selecting those that will be delivered is one of our more difficult tasks. I can confirm that the topics are remarkably diverse." One paper that's sure to be of interest is a reflection on the lives of three world leaders in *Reinforced Concrete Design – Professors Paulay, Park and Priestley*.

Sustainability and environmentally-sound construction products/techniques are prominent themes. One paper, for example, explores 'natural green engineered cementitious composites', while another analyses the 'easiest way to achieve a sixstar Homestar home.'

Other authors have focussed on seismic issues: *Seismic Responses to a Steel Cable Connection Between Precast RC Panel and Foundations*, *Seismic Performance of Existing NZ Shear Wall Structures* and *Triumphal Arch Seismic Strengthening*.

The sensitivity demanded of heritage restorations is explored in a keynote paper about Christchurch's Arts Centre. The Centre comprises 22 Category One heritage buildings – many of which suffered significant damage in the 2010/2011 earthquakes.

Author John Trowsdale discusses the extensive use of concrete and cement materials in both the original construction and strengthening works, as well as glass fibre reinforced polymers and post tensioning techniques.

Says Jeff: "I urge industry to attend the conference. I am confident it represents some of the best technical material we've ever assembled, and the new venue will deliver excellent opportunities for exhibitors and delegates alike."

THE VENUE

The Sir Howard Morrison Performing Arts Centre is located in Rotorua's downtown business and retail area. Hotels, shops, bars, restaurants and the lakefront are only minutes away. Specifically designed for conferences, exhibitions and trade shows, the Centre features a 686-seat auditorium, a fully-acoustic concert chamber, a banquet room (728m²), mezzanine floor area, a multifunctional foyer and four breakout rooms.

TRADE EXHIBITION

As in previous events, this year's event incorporates an extensive trade exhibition over the three days. Exhibitors are hosting all the morning/afternoon teas, the lunches and the pre-dinner drink functions. In effect, says Jeff, the conference gives companies an excellent opportunity to present their products and services to some 400 decision makers.

REGISTRATION AND ACCOMMODATION

Registration for the conference is now open. As in past years, the conference has made block bookings at hotels, all within easy distance of the conference venue. These will be available to book as part of your online registration.

Visit the Conference website for more details – www.theconcreteconference.co.nz.



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