November
2014

CONCRETE CONNECTIONS

WWW.ACRASSOC.COM.AU

Concrete Connections

Editorial contributions are welcomed.
Please contact the ACRA (02) 9654 3692
Email: info@acrassoc.com.au
Postal: PO Box 452, Chester Hill NSW 2162
www.acrassoc.com.au

Publisher/Editor
Nicole Raymond

Publications Committee
Matthew Ball
Grant Dowling

Cover Photo – Freyssinet Australia Pty Ltd, Geraldton Grain Silos Remediation

On the inside

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Welcome to the November 2014 Edition Of Concrete Connections.

Presidents AGM Report

Welcome to our last newsletter for 2014

I would like to start by thanking all our members, both individual and corporate, for their continued support for the Australasian Concrete Repair Association. I would especially like to thank the board members in NSW and ever growing number of sub-committee members throughout Australia who give up their own time to see ACRA continue its fantastic growth year on year. Special thanks to Andrew Dickinson (6 years' service), Dianne Soliman and Farhana Jesmina who are taking a break from the board this year. In taking over this role from Andrew Dickinson last year I commented on how lucky I was to come into this role in a time when so much hard work from the board and ACRA community was coming to fruition.

The growth in our sub-branches around the country has contributed greatly to our on-going success and growth during the year. We now have sub-branches in Western Australia, Queensland and Victoria with our first international sub-branch in New Zealand in the pipeline for next year. Each of our sub branches have been driving seminars, supporting the ACRA one-day training course and helping drive ARCRA to a larger National audience.

Membership has continued to grow in 2014 with an additional seven corporate members following on from the six in 2013. It's especially rewarding to see the growing number of asset owners now in the Association. For me this really completes the suite of parties with a vested interest in setting the standards for excellence in concrete repair in the industry.

The ACRA one-day course has continued to be well supported around the country. With the course delivered in QLD, WA, VIC, NT, Wollongong and courses still to be run in both QLD and ACT, we are expecting close to 100 attendees from the industry. The success of the course and the financial contribution it provides to the Association, is a credit to all involved. With the technical sub-committee working on a rewrite of the two day course the next step in the evolution of this training provided by the Association is not far away.

Supporting this progression in training, a review of the HB84-2006 Guide to Concrete Repair & Protection has been approved by Standards Australia. With the advances in technology and changes in industry practices it is timely for this review to get underway. An independent industry committee will be bought together in the near future to begin undertaking this challenge.

With all of this action underway it would be great to see more of our members around the country take an active involvement in the Association. Your contribution can be as simple as sharing our updates to your LinkedIn network, to getting more of your people along to seminars and training, right through to speaking up and taking an active involvement in a sub-branch. Many hands make for light work and new faces are always welcome. And a final thanks to Nicole for all her work over the year. Her ongoing hard work behind the scenes has been invaluable, especially with regards to driving our social media campaign, courses and seminars so diligently.

Lastly, from myself and all on the ACRA Board, we wish you, your staff and your families a very merry Christmas and prosperous 2015.

~ Daniel Rowley, President.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

ACRA AWARDS

Recently ACRA held its biannual Awards night in the field of excellence. This was held at the lovely La Aqua venue overlooking Cockle Bay. The new was well attended and all in attendance had a great evening of looking through all the entries as well as networking with their peers. The ACRA Awards program acknowledges outstanding achievement in remedial concrete diagnosis and repair.

The judges this year consisted of David Ferguson of Strata Plus, Strata Community Australia, Grahame Vile of BAAM Consulting and David Mahaffey of Mahaffey Associates. All 3 judges had admitted to this year's awards entries being one of the toughest they have had to agree on, so much so that 3 weeks prior to the awards night the judges were still struggling to choose a winner as all were deserving of an award.

And the entries were….

There were eight categories judged this year, with the following outcomes:

Water and Sewer Projects: Won by Water Infrastructure Group for the Penrith WRP Overhaul Grit Vortex & Flow Distribution Chamber.

Project Background/History:

"The Penrith ST0046 Water Recycling Plant is owned and operated by Sydney Water and located on Castlereagh Rd, Penrith. SASTTI Joint Venture was engaged by Sydney Water to carry out an inspection and condition assessment of the Inlet Works, Grit Removal Tank and Flow Distribution Chamber. It was identified that the grit removal area has exposed concrete surfaces which are experiencing up to 30mm of biogenic acid attack and in the flow distribution chamber areas generally lost 55 mm of concrete cover. This required urgent repairs to both the Grit Removal Tank and the Flow Distribution Chamber to ensure the structural integrity on these critical operational assets.

Sydney Water decided to deliver this rehabilitation project through its new NFRP procurement program. The $890,000 project was awarded to WI Group in February for completion in June 2014. The majority of the repairs consisted of UHP water blasting to prepare the surface for the application of a minimum 50 mm thickness of Calcium Aluminate Cement (CAC). The major challenges of this project were:

It was essential that all works were performed whilst the WRP remained fully operational.

Concrete Connections

Therefore a fully automated 730 L/s bypass system was required to circumvent both structures and a16 m long 1350 mm diameter large siphon;

The access to both the grit removal vortex and the flow distribution chamber was difficult and required substantial and complex scaffolding structure to provide a safe working area and access & egress. Additionally the configuration and size of the structures made if very onerous to complete the repairs.

Other ACRA members involved: BASF Construction Chemicals

Final Project Value: $895,512.00

Building & Remedial Projects up to $2M: Won by Duratec Australia Pty Ltd for the Old Treasury Building balcony remediation project, Perth WA

Project Background/History:

The Old Treasury Building, is located in one of the most significant heritage precincts in Perth's CBD.

Built in 1878, the building has a rich history spanning more than 135 years.

The building had been left vacant for the past seventeen years and in 2013 FJM Properties commenced restoration of the building into an exciting mix of hotel, hospitality and retail uses. Built NSW Pty Ltd was the selected main building contractor to manage the works and in turn they selected specialist restoration sub-contractor Duratec Australia Pty Ltd to undertake the remediation and restoration of the external balconies. The building balconies were in a very poor condition prior to commencement of the works.

Well-developed cracking was evident on the balcony corbels, convex spandrel beam, floor slabs, longitudinal and transverse beams and columns. Slight structure movement over time had caused cracking of the outer cementitious encasement allowing the ingress of moisture and carbon dioxide. This resulted in sections of the coke breeze concrete becoming carbonated and the pH lowing to a level that supported steel corrosion.

In addition many of the ornate heritage architectural features were cracked, damaged or broken off completely. Two handrails were completely destroyed as a consequence of building settlement. Fortunately in all cases there were sufficient undamaged features to enable accurate moulding, and recasting to be performed using similar cementitious materials and traditional methods.

Other ACRA members involved: Parchem, SIKA, Infracorr Consulting

Final Project Value: $1.7m

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Building & Remediation Projects Over $2M: Won by Structural Systems Remedial for the Midtown Plaza – Façade Remediation in Melbourne, VIC project

Project Background/History:

Midtown Plaza is a commercial development located in the heart of Melbourne's CBD. The development is comprised of two adjoining buildings, namely—

· Main tower building-on the corner of Bourke and Swanston Streets, consisting of a 7 storey office building, over a ground floor corporate foyer, a separate retail mall, and single level basement mall.

· Little Bourke Street building—an adjoining older 2-storey building to the north and with frontage on Little Bourke Street. A restaurant currently occupies this building.

The main tower building was originally built in 1934, with an additional 3 storeys added in the 1970s. It is of reinforced concrete construction, with the façade being mostly of rendered cast in situ concrete, with some decorative mouldings. The rendered concrete surface was painted on the south and west elevations and unpainted on the north and east elevations. The upper 3 storeys (later addition) are of concrete encased steel construction, with blockwork infills. The Little Bourke Street Building is largely of brick construction with the exception of a rendered concrete north elevation facing Little Bourke Street. After reports of spalled concrete and detached render, the building manager (Knight Frank), on behalf of Building owners (ISPT Pty Ltd), engaged Hyder Consulting Pty Ltd to inspect and report on the condition of both buildings. This was followed by make safe works and the preparation of tender documents to address observed building issues.

Other ACRA members involved: Hyder Consulting Pty Ltd, BASF

Final Project Value: $3.42M

Mega Projects over $10M: Won by Freyssinet Australia Pty Ltd for their Geraldton Grain Silos Remediation project

Project Background/History:

The CBH Group is one of Australia's leading grain organisations, a co-operative with operations including grain storage, handling and transport, to marketing shipping and processing, based in Western Australia, it has been established for over 80 years and is owned and controlled by more than 4500 grain growers. In more recent years evidence of extensive vertical cracking was noted throughout the walls of these silos and this lead to various investigations and structural assessments.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

As is typically found for circular grain storage facilities of this type and age, it was concluded that the original design understanding was inadequate to cater for the peak loads occurring during grain outflow. The resulting structural cracking reflected this structural inadequacy, and given the marine environment in which the silos are located, also raised concern in regard to the long term durability of this structure.

After failed remedial works, Freyssinet were called upon to provide a complete design & construction solution. With a history of similar strengthen & repair projects throughout Europe & the Middle East, Freyssinet not only executed the project allowing the terminal to continue operating without significant loss of capacity, but the overall finished product is set to provide an additional 40 years service life.

Other ACRA members involved: Parchem

Final Project Value: $30M

Historical Structures: Won by Marine & Civil Maintenance for the Cape Don Lighthouse Rehabilitation project

Project Background/History:

In late 2012 the Australian Maritime Safety Authority (AMSA) awarded Marine & Civil Maintenance Pty Ltd (MCM) the design & construct contract to repair and protect the heritage listed Cape Don Lighthouse, located 170km northeast of Darwin.

Built in 1916, the lighthouse consists of a reinforced concrete tower 28m high with a circular barrel and an octagonal base. There is a reinforced concrete balcony at the top of the barrel, immediately below the light.

Despite proving its strength by withstanding many cyclones and at least one earthquake, the concrete structure has deteriorated over the years as a result of corrosion of its reinforcing steel.

AMSA's rehabilitation contract required the repair of the external damage, design and installation of a cathodic protection system including monitoring and maintenance for a fixed period, and coating of the entire structure, all with due regard for the important heritage nature of the lighthouse. Carried out over one dry season, the remote project presented a variety of challenges to MCM.

Other ACRA Members Involved: Infracorr Consulting Pty Ltd, Parchem Construction Supplies Pty Ltd

Final Project Value: $2.4M

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Marine Infrastructure: Won by Duratec Australia Pty Ltd for their Bunbury Port Authority Wharf Remediation Project

Project Background/History:

The Bunbury Port Authority (BPA) has engaged Duratec Australia in a Design and Construct contract for the staged maintenance and repairs of Berths 1 & 2 at the Outer Harbour—Bunbury Port.

Berth 1 and Berth 2 are adjoining berths located in the Bunbury Outer Harbour. These two berths were designed and constructed during the 1960s and remain in service as general purpose berths with facilities for the offload of methanol from tankers via discharge piping. The berths consist of conventionally reinforced two-way spanning concrete suspended decks 184m long x 15.8m wide (Berth 1) and 16.6m wide (Berth 2), supported by three rows of 1067mm diameter reinforced concrete piles which have been installed within a rock protected embankment forming a conventional 'land back' berth system. The piles are 'pin' supported onto the Bunbury Basalt formation. The height of the deck is 3.6 metres above datum level. Given the berth age is in the order of 40 years, it has exceeded the original theoretical design life hence requiring appropriate levels of management including consideration of future berth plans, condition assessment and maintenance repair efforts. The repair of berths (1 &2) will take place over a staged five year design and construct maintenance contract, broken down into repairs to piles, approach slab subsidence, general concrete, steelwork and joint repairs to Berths 1 and 2, with Berth 2 piles and approach slabs taking priority.

The Berth 2 piles, particularly through the inter-tidal and splash zone above low water, are suffering from varying degrees of deterioration including significant cracking, delamination of cover concrete and in one case; fully exposed rebar where total spalling loss of the cover concrete has occurred. The approach slabs and hardstand to the rear of the Berth 2 deck are also suffering varying degrees of subsidence requiring remediation for safe use of the berth.

Other ACRA members involved: Parchem, Infracorr Consulting

Final Project Value: $3.5m

Long Term Performance: Won by Water Infrastructure Group for the Rehabilitation of the Main Western Carrier at Wolli Creek & West Botany, NSW project

Project Background/History:

Rehabilitation of the Main Western Carrier was one of the first major spiral wound Panel Lok projects in Australia.

This project involved the lining of approximately 3x1800m of the triple barrel of the Main Western Carrier at Arncliffe. The Panel Lok lining is a uPVC spiral wound lining which was developed 30 years ago by

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Danby (now Water Infrastructure Group) and has been installed ever since within man-entry sewers to provide structural and biogenic acid attack protection to concrete and brick stormwater and sewers.

This specific project was executed in 1999-2000 and two recent inspections were carried out by two different engineering consultants:

· Sewer Traverse Report, Main Western Carrier, KBR, 9 November 2009

· Main Western Carrier Surveillance Report No 1, SAS-TTI, 10 May 2013

Sydney Water personnel joined the engineering consultants on both occasions and the feedback from Sydney Water was that the Panel Lok was still in excellent condition. WI Group are currently installing Panel Lok, spiral wound uPVC liner for Sydney Water's Narrabeen Submain rehabilitation project which further reinforces the reputation that the Panel Lok system has gained from its track record as an excellent, value for money option for the rehabilitation of critical sewer and stormwater conduits assets. This award submission is to highlight the long term performance of Panel Lok as a proven rehabilitation technology.

Final Project Value: $2,500,000

And the big winner of the night of the ***ACRA Repair Industry Excellence Award for 2014*** was won by **Freyssient Australia Pty Ltd** for the **Geraldton Grain Silos Remediation Project**. Well done to all at Freyssient Australia Pty Ltd.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Other entries that are worth mentioning but unfortunately didn't win on the night were from:

Andersal Pty Ltd and their Warragamba Radial Gates 1, 2, 4 & 5 at Warragamba Dam project.

National Concrete Solutions and their Prince Henry Hospital-Little Bay redevelopment, NSW project.

Duratec Australia and their restoration project at Parmelia House Façade, Perth, WA.

Duratec Australia and the International School of WA, concrete repair project.

RM Watson's project for 48a Queenscliff Rd, Queenscliff project.

Australian Concrete Repair Group for their Magnetic Island historic WWII Fort Complex Refurbishment project.

Preservation Technologies culvert remediation project at Blacktown Creek, NSW.

Andersal Pty Ltd for the ATP Channel 7 project at Australian Technology Park, NSW

A big thank you to all ACRA members who attended and who continue to support the ACRA Awards for Excellence program and an even bigger thank you to our 3 judges David Miller, David Mahaffey and Grahame Vile who took time out of their busy weeks to go through all the entries and to come the decisions of who won each award.

We encourage all corporate members to submit entries in 2016.

The night was proudly sponsored by:

KENNARDS HIRE

parchem

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

SUB BRANCH COMMITTEES NEED YOU!

EXPRESSIONS OF INTEREST FOR SUB BRANCH COMMITTEE MEMBERS VIC, WA, QLD and NZ

Our current Sub Branch Committees are always looking for ACRA Corporate members who are interested in being a part of ACRA in your state. We would also be looking to start sub branches in SA, NT and Tassie also if anyone is interested.

The purpose and mission of the State Committees is to provide within their respective states:

a. Support and Communication to Association Members
b. Industry related seminars, courses and other learned society activities of this type, including site visits and academic programs
d. Member relationships - Individual and Corporate.

If you are interested please get in touch with the National Office info@acrassoc.com.au and we would be more than happy to provide you with more information as to what is required.

IT'S CHRISTMAS TIME!!
ACRA Member Christmas Drinks – NSW, VIC & WA

ACRA invites all its members to join in on one of our Christmas Networking Drinks which are being held in NSW, VIC and WA.
3 per corporate membership per state and individuals only, **can attend for FREE** but if either would like to bring more it would only cost an extra $40.00 per person.
Send an email with the names of your attendees and which state Christmas drinks you will be attending.
For those in Perth there is an added bonus of a Forum on Managing Expectations for All Parties prior to your drinks. *info@acrassoc.com.au*

☐*SYDNEY CHRISTMAS DRINKS*

Date: 20 November 2014
Venue: Paragon Hotel, Circular Quay, Sydney, NSW
Start Time: 6.30pm

☐*MELBOURNE CHRISTMAS DRINKS*

Date: 11 December 2014
Venue: Woolshed Pub, Shed 9 T18/161 Harbour Esplanade, Docklands VIC
Start Time: 6.30pm

Got something to say?
If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

☐*PERTH FORUM AND* ☐*DRINKS*

Managing Expectations for All Parties

Unlike new construction, the performance of concrete repair is more difficult to define due to pre-existing conditions, site limitations and other uncertainties. Despite the formal technical specifications and contract documents, all the involved parties including the client, consultant, contractor, supplier and other stakeholders have different expectations based on their own objectives. This forum provides a platform for the attendees to discuss and express their opinions on how to manage different expectations. Some keynote speakers will be invited to provide a brief overview followed by an open forum discussion.

***Date:* 3 December 2014**
Venue: 43 Below, 43 Barrack St, Perth WA
Start Time: Forum 4.30pm
Drinks 6.30pm

All 3 of these are great networking events in a relaxing environment. The last for 2014.
Email us today your RSVP to info@acrassoc.com.au

Concrete Connections

MEET YOUR NEW ACRA BOARD MEMBERS FOR 2014-2015

Greg Zambesi – GHD (consultant)

Greg is a Snr Materials Scientist with extensive experience in infra-structure inspection and assessment, material selection, diagnostic investigation and asset management of concrete, steel and timber. He has over 20 years' experience with Civil, Road, Maritime, Port and Rail infrastructure projects throughout Australia and New Zealand.

Peter Johnsson – Hyder Consulting (consultant)

Peter Johnsson is a Principal Engineer in Hyder Consulting's Diagnostic & Remedial Engineering group. He has been President of ACRA on two occasions and a Director since 1994. His is a presenter of ACRA's 1 day course in Concrete Repair and Protection and current secretary of the Association.

Matthew Ball- Buildcorp Asset Solutions (contractor)

Matthew Ball is the Operations Manager at Buildcorp Asset Solutions, a division of Buildcorp Group Pty Ltd. The division specialises in remedial construction, predominantly concrete repair. Matthew is a B.Eng (hons) Civ/Struct graduate and has 17 years of construction experience.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Henk van den Heuvel – Andersal (contractor)

Henk is a Charted Professional Engineer who manages Andersal & contracting business that specialises in remedial repairs to buildings and structures. Henk has been a board member of ACRA since 2001 and has been active in many areas of their activities including past president and current treasurer. Henk is also on the MBA, NSW Waterproofing Technical Committee and has recently been made a Fellow of the Institute of Engineers Australia.

Peter Reed – Port Authority of NSW (Asset Service)
General Manager of Assets for the Port Authority of NSW and is responsible for the strategic management of some of the most critical marine assets in the Port Jackson area including wharves, buildings and other key structures.

A fitter and turner by trade and with a Masters Degree in Engineering Peter has 25 years' experience in Asset Management on major infrastructure and is and believer in the longer term management of key assets in harsh environments.

Huber Madrio – Roads and Maritime Services (NSW) (Asset Service)

Huber is a Project Engineer within Roads and Maritime Bridge Engineering - Technology and Practice - Durability Group. The group conducts studies in materials technology and provides specialist knowledge to Roads and Maritime Services in maintaining its concrete assets including use of self-compacting concrete, sacrificial anode cathodic protection trials, concrete durability investigations and concrete repair. Huber completed his BSc in Civil Engg in the Philippines and attained his MES in Civil Engg at The University of Sydney.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Theo Combis – Parchem Construction Supplies (Supplier)

Theo Combis is part of the Engineering Specification team at Parchem (a division of the Dulux Group). He has completed studies in Civil Engineering and has been working within the construction industry for nearly 20 years predominately in concrete protection and repair.

Grant Dowling – SIKA Australia (Supplier)

Grant has been a board member of ACRA since 2012 is also a NSW Committee Member for ACA. Grant has a Dip in Marketing Management and is the Target Market Manager – Refurbishment & Strengthening for SIKA Australia. His previous experience has been a technical remedial consultant where he conducted Diagnostic inspection and analysis of concrete structures, Defect liability inspections and reports, Remedial project management, Remedial Specifications

Konrad Stempniak - Kennards Hire (Supplier)

Konrad has been involved in the construction industry for over ten years with a special interest in the remedial and concrete repair industries. In his current role as NSW State Sales Manager at Kennards Hire and in his previous role as National Product Manager at Kennards Concrete Care, Konrad has focused on providing equipment hire solutions and specialist advice to the remedial concrete repair industry. Konrad regularly draws on his previous experience as a Senior Project Manager at one of Australia's leading remedial construction companies, where he managed major projects across Australia for blue chip companies such as Rio Tinto and a range of Government Agencies. During this time Konrad specialised in cathodic protection systems in concrete and steel structures, structural strengthening, concrete repair and technical remedial solutions. Konrad has previously served as an ACRA Board Member and returns with a breadth of new experience. Konrad is a Graduate of the University of New South Wales and Management Consultancy International.

We have some returning board members as well as some new board members. Fresh ideas have already been raised to improve upon your association.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

AECOM

Managing the durability of existing assets

Rob Kilgour, Principal Engineer – Strategic Asset Management & Advanced Materials - AECOM

With tightening financials constraints for asset owners and operators, there is greater pressure for asset managers to extend the service life of existing assets. This is particularly true for organisations who manage large vertical and linear infrastructure assets where corridor restrictions, limited opportunity for service interruption, heritage values and demolition & construction costs constrain the opportunities for complete asset replacement.

Reliance on existing structures, however, creates uncertainty for the asset manager with regards to the residual service life of the asset; the as-built structural capacity of the asset; and the magnitude of service life extension that is economically feasible.

For owners of reinforced concrete assets, managing these uncertainties requires a holistic assessment that considers past and future exposure environments, past and future loading patterns and uses, and appropriate remedial technologies.

Understanding residual service life

Residual service life, particularly for concrete structures, is influenced by various factors as shown in Figure 1.

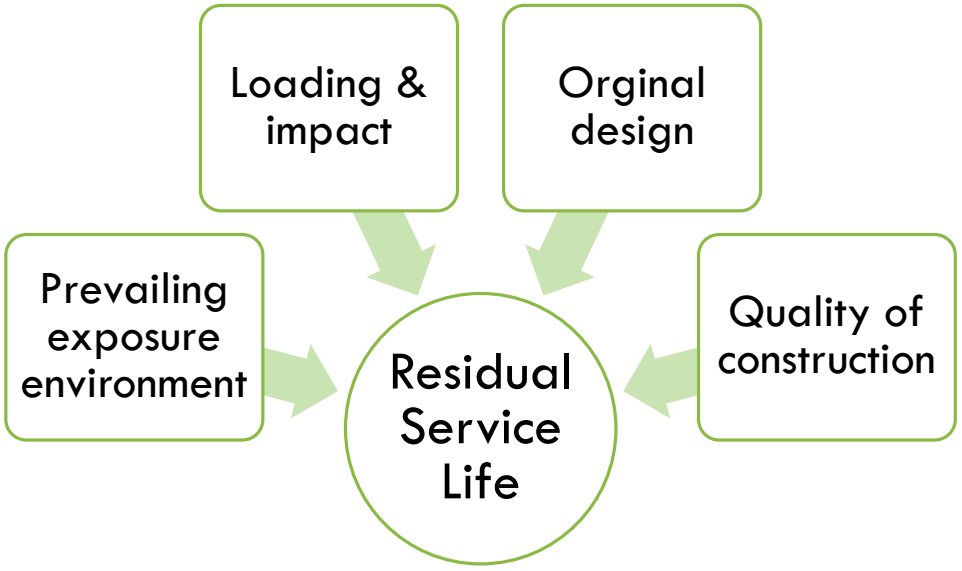

Figure 1 Factors influencing residual service life

Concrete Connections

Reducing the uncertainty around residual service life requires the collection of data relating to the condition of the asset. While this typically would include visual assessment data (and the assignment of a condition grade), understanding the performance of the materials of construction over time is also required. In the case of reinforced concrete assets, this can include; resistivity, proximity & concentration of aggressive species (such as chlorides) to the reinforcement, depth of carbonation and electrochemical potential gradients.

Analyses using this data are critical to providing greater certainty around the residual service life (assisting asset managers to determine the priority for assigning renewals budgets).

Additionally, the outputs enable assessment of the underlying cause of deterioration and thus the most appropriate remedial techniques that can be used to extend the service life of the asset, while minimising the lifecycle cost of this extension.

Managing durability design risks for life extension projects

As with new construction, managing durability performance requires the design team to consider the selection of materials, detailing and construction methods appropriate to the expected exposure conditions and level of maintenance anticipated during the extended service life.

For repair and rehabilitation projects, durability risks can include:

- residual contamination on concrete leading to incipient anode formation and premature repair failure;
- insufficient repair preparation leading to premature failure;
- the repair method not addressing underlying causes of deterioration; and
- remedial methods not considering the future use of the asset.

These are common examples and explain why the use of specialist materials engineers and scientists to advise design teams on the durability aspects of significant rehabilitation projects is becoming more commonplace, particularly where infrastructure is critical (e.g. ports, tunnels, bridges), or where it is installed in aggressive environments.

Typically for reinforced concrete structures, the causes of deterioration are influenced by prevailing exposure conditions leading to either corrosion of the reinforcement, sulphate attack of the cement matrix, or alkali-aggregate reaction. Overloading of the structure can also result in cracking that leads to corrosion of the reinforcement.

Depending on the complexity of the project, a number of approaches to mitigating durability performance risk can be adopted. For simple projects (or in the very early design stages of more complex projects), a high-level durability risk review may be sufficient to highlight areas of the design considered to be inadequate for the proposed design life. The outcomes of such a review could be expected to provide guidance for the design team to modify its specifications and details to address issues identified.

For more complex projects, mitigating the risks associated with durability performance (such as inflated maintenance costs, premature repair failure, loss of structural integrity, and ultimately a reduction in the level of service provided by the asset) typically requires the development of a durability management plan. More common for development of new assets, a similar approach can be adopted for existing assets where service life extension may be equivalent to the original design life of the asset. It could be argued that adopting this

process is more important for life extension projects, as identifying the full the extent of deterioration of an asset, understanding its causes and adopting appropriate remedial measures are critical to overall project success.

While the production of such plans is an important step towards achieving target service lives, Blin et al [1] notes that simply addressing durability through the development of a plan is unlikely to achieve the desired outcomes. To truly manage durability-related risks associated with design, a durability management process must be adopted that accounts for durability risks and ensures that durability requirements are embedded into the design and construction process. Successful outcomes require design teams to consider future maintenance requirements to achieve an asset's target design life, the provision of adequate technical support during the design phase, and for construction phase inspection and repair requirements to be outlined prior to construction commencing.

Mitigating construction risks

A holistic durability management process can be also be used to mitigate construction-related durability risk. This is considered equally important for repair and remediation projects as it is for asset development projects.
While good construction quality control processes are integral to delivering durable assets, the technical approach taken to resolve non-conformances, construction defects and materials substitution can expose asset owners to durability performance risks if sufficient rigour is not applied. Blin et al suggest the involvement of durability specialists during the construction phase of a project using a process-based approach that places less reliance on informed opinion, provides greater transparency, facilitates more effective verification of the outcomes by industry peers. Ultimately this approach provides more confidence to project stakeholders that the solutions adopted will not compromise the durability of the asset.

Adopting a whole-of-life durability management process should mitigate construction-related durability risk by requiring:

- durability input into the assessment of vendor durability data;
- durability responses to construction requests for information and non-conformance reports;
- verification that assets are rehabilitated in accordance with the repair durability management plan and design package requirements;
- in-situ materials quality to be verified for compliance to durability requirements during construction;
- repair procedures are clearly defined by the durability designers;
- inspection and maintenance procedures are clearly defined; and
- as-built asset registers are developed or updated as required.
-

Mitigating future operational risks

Up to 80 percent of an asset's lifecycle cost is realised during its operation [2]Further unplanned expenditure on repairs and maintenance of a rehabilitated asset are just two examples of operational risks that can be mitigated at the design stage by adopting a holistic durability management plan. Expected deterioration rates, mechanisms and consequences of degradation may be defined in the durability plan. Complementary

measures include implementing a live asset register (containing condition information), having durability input into the review of inspection and maintenance procedures, and defining condition assessment guidelines.

Works Cited

[1] F. Blin, S. Furman and A. Mendes, "Durability design of infrastructure assets – Working towards a uniform approach," in *18th International Corrosion Congress*, Perth, 2011.

[2] J. Doran, "Broader aspects for consideration in managing assets," in *ICOMS Asset Management Conference Proceedings*, Gold Coast, 2011.

This article is adapted from "Durability management – a design response to risk" that was published in Consult Australia's National Outlook, March 2012.

Other relevant articles prepared by members of the wider AECOM community you may be interested in include:

a) Blin F., Law D., Dacre, M.C., op't Hoog C.J., Gray, B., Newcombe, R. (2008) Extension of design life of existing maritime infrastructure – a durability perspective, # 068 Proceedings of Corrosion & Prevention 2008

b) Christodoulou, C et al (2011) A new approach for the patch repair of car parks using galvanic anodes, Concrete Solutions, CRC Press

c) Aziz, A; Blin, F and Dacre, M. Extension of Asset Life for Melbourne's Swanson Dock [online]. Australian Journal of Civil Engineering, Vol. 9, No. 1, 2011: 35-46

d) Tanner, P., Davison, N., Pritchard, J., Kilgour, R., (2014) Reducing the maintenance costs and extending the life of reinforced concrete structures using hybrid corrosion protection systems – examples from United Kingdom, Australia and New Zealand, Proceedings of The New Zealand Industry Concrete Conference 2014

Concrete Connections

Project Profile by Max Build
1 Beach Rd, Bondi Beach-Concrete Repairs

We've come a long way in advances in concrete construction. Opening up Bondi Beach's Berkeley Court is one of the best reminders of that.

At the stately 1 Beach Road, built in 1926, MAX Build tackled the structural repair of the reinforced concrete frame, clad behind bricks.

Aside from the quality of the original steel reinforcement, MAX Build's team discovered over the course of the six-month project that all other materials and building processes were substandard when contrasted with today's techniques. If the original builders had known what we do, a sizable component of the concrete spalling and cancer could have been prevented.
Nowadays we are judicious about the quality of sands, purity of water and sizes of aggregates, being especially wary of salts and sulphurs because of their detrimental effects on any reinforcement.

It was clear that the concrete mixed for this building was inconsistent. Large seashell particles from the dredging process were clearly visible on the concrete surface, which made the likelihood of salts fairly high.

The aggregate size was too large, in the 30mm to 40mm category, as opposed to the 25mm in modern mixes. We now know that the aggregate needs to be small enough to get a good, dense fit of concrete around reinforcement.

The distribution of aggregates, along with sand and slurry was also overlooked. From what MAX Build exposed, the original mix needed a bit longer in the mixer and a stir once settled in the formwork.

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

If this residential block had been erected in 2014 all of these elements would have been carefully monitored at the concrete batching plant and tested for peak performance.

For additional insurance, an engineer would have carefully laid out the mix criteria of sand, cement and water ratios plus aggregate sizes allowable. In this case David Wright of Strata Remedial Engineers lent his expertise to the job.

For Wright, the stand out on this repair was working with the coke-breeze concrete, which is “weak and porous as was typical during that era of construction in the 1920s”. It allowed for the easier passage of chlorides to the steel reinforcement. Coke-breeze concrete was also used on the Sydney Harbour Bridge. “And it’s still standing!” adds Wright.

The placement of the concrete was also below current standards with large concentrations of air holes apparent on the surface and honeycombing on the corners, reducing the concrete’s strength. We would today construct formwork tight enough to prevent leeching during the pour, and set period so that cement isn't carried out of the form with any water run-off. Also the concrete is mechanically compacted to remove any air holes and ensure a dense, tight-packed concrete around any reinforcement bar.

All of the reinforcing that was corroding and spalling the concrete, was too close to the surface, this allowed moisture and air to start the corrosion process that then self-perpetuated until all recognisable strength from the steel was lost. Today we would employ plastic bar chairs or wagon wheels to hold the reinforcement in a minimum distance from the concrete surface, especially during the initial moments when the force of pouring concrete can move the steel cages.

Despite all of these advances in knowledge and technique, we might have lost one thing along the way. Quality steel. The exposed steel behind the brickwork façade looked like it had come straight off the merchant’s floor. Only where there were signs of water egress, either from poor flashings or roof leaks, did the original steel corrode. Would today’s reinforcement cope with that scenario as well as the old had? We suspect that with or without leaking water as a catalyst, modern reinforcement would have rusted.

View from rooftop

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Did you know…..

- Berkeley Court is one of the first buildings in Sydney constructed using reinforced concrete. A lot of corrosion and concrete spalling could have been prevented with modern techniques.

- Berkeley Court is one of Bondi's earliest high-rise buildings. When the first bricks were laid in 1926, its main neighbours were cows, pigs and poultry.
- In spite of being born out of the Great Depression era, Berkeley Court began life as serviced holiday apartments, with a few shops below.
- During World War II Berkeley Court chipped in to the war effort and transformed one shop into a venereal disease clinic for the armed forces.

Above the existing shopfront awning, was once a thriving, albeit illegal, casino and club. But its less than salubrious life finally caught up with it, and a police raid led to its closure in 1966.

Contact Max Build
Phone: 02 8033 4725
Email: info@maxbuild.com.au
Web: www.maxbuild.com.au

INDUSTRY NEWS……..

ACRA Corporate Member BAAM Consulting have a new website
www.baam.com.au
Phone: 1300 763 319
Email: mail@baam.com.au

Check out their services, projects, resources and case studies.

Duratec Australia have two new offices, one in NSW and the other in VIC.

Melbourne: Unit 1/5 Redland Drive, Mitchem VIC 3132
Phone: 03 9873 2300 Fax: 03 9873 1454

Parramatta: Suite 608, level 6, 91 Phillip St, Parramatta NSW 2150
Phone: 02 9893 1824

ACRA's Executive Officer Nicole, has had the pleasure of meeting the new Duratec staff in their new office in Parramatta, NSW.
Thank you for the invite and she looks forward to visiting other corporate member offices soon.

Got something to say?
If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Concrete Spalling

An introduction on why attention to detail matters in reinforced concrete design and construction.

As with building and construction generally, the erection of concrete structures is a cost intensive process. Those funding reinforced concrete projects deserve maximal return on their expenditure by way of a build quality that withstands the onslaught of the elements and is for the long haul. This requires attention to detail that, without proper supervision, can fall by the wayside.
Concrete spalling, also called "concrete cancer" generally refers to the deterioration of steel reinforced concrete either by oxidisation, chemical ingress, or fire. Unfortunately, the cost associated with rectification of concrete spalling is usually a burden brought about by poor building design and construction process which proper attention to detail should otherwise avoid. Early intervention is required to ensure deterioration does not proceed beyond what might otherwise be a rectifiable situation.

What is Concrete Spalling?
Spalling is a word that refers to a process of either external or beneath the surface activity causing obvious surface failure and visible breaking away of something.
Concrete spalling is the deterioration of reinforced concrete characterised by cracking, rust and breaking away of sections of concrete. It usually has a relatively minor cause, and then progresses in stages, which unchecked may lead to serious structural problems. The end stage of unchecked concrete spalling may include actual structural failure and the need for demolition and substantial rectification works.
Concrete Spalling An introduction on why attention to detail matters in reinforced concrete design and construction.

What are the causes of Concrete Spalling?
Concrete spalling is generally caused by disturbances to steel embedded within concrete by way of oxidation or chloride ion ingress. Usually the affected steel members are the steel reinforcement bars used to give the structure strength. However, other steel objects such as beams windows or pipes, either completely or partially embedded in the concrete that comprise part of or the whole structure can be affected.

Oxidation and Corrosion
Naturally, one might wonder why steel in concrete doesn't begin to rust at the time of concrete pour, given that concrete is part comprised of water. A key principle of reinforced concrete is that concrete has a high alkaline content which means that chemically speaking, under normal circumstances, the steel is protected from corrosion. This protective property of concrete does not permit the oxidation that begins the rusting process on steel, and will last so long as the concrete retains its high alkalinity. The way to ensure that this is the case is to ensure that the concrete area is maintained by way of maintenance in good condition and repair.

This is necessary as concrete is porous making it liable to absorb water and contaminants present in the atmosphere generally.

The problem with such absorption is that the protective alkalinity of concrete may be compromised due to acidic process that neutralizes alkalinity and then creates an environment conducive to oxidation. This process is known as carbonation and commences on the outside of the concrete, moving inwards towards steel reinforcement inside the concrete.

The onset of oxidation leads to corrosion. When steel reinforcement inside concrete corrodes, it is well documented that the corrosion products can take up many more times the volume of the original steel. This hidden expansion exerts forces on the concrete that it is unable to

Got something to say?
If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

handle resulting in cracking and damage around oxidized steel. These cracks expose the interior of the concrete and steel further to the elements, which if unchecked, leads to progressive breakdown of the concrete.

Chloride Ion Ingress — Another process, found particularly in areas close to the sea, is linked with seawater salt introducing chloride ions to concrete. This ingress may lead to outcropping of rust nodules forming on steel reinforcement bar. This can cause cracks in concrete when the formation of such nodules unduly stresses the concrete from within. As with carbonation outlined earlier, the process is degenerative as cracks results in further chloride ion attack and concrete dilapidation.

In light of the above, much like the human disease of cancer, concrete spalling in concrete structures originates through insidious microscopic process leading to mutation that causes dysfunction. Left unchecked, it is a process that leads to total failure and destruction.

One should also note that spalling of concrete can be caused by fire.

In this context the spalling can be classified in terms of the following:
• Aggregate spalling — the bursting of the concrete's aggregate near the surface of the concrete;
• Corner Spalling — the spalling of concrete originating at the corner of a structure such as a beam or column;
• Explosive spalling — which is the complete failure of heated concrete.

Depending on the intended use of a concrete structure and the conditions it is exposed to, certain measures can be implemented to guard against fire spalling. An Engineer specialising in this field can advise you of guarding in respect of spalling by fire. A more extensive commentary can be read in the work of Dr Raymond Connolly (1997) noted at the end of this article.

Naturally, the questions that arise are, how can concrete spalling be identified, and what can be done about it?
Given that spalling originates with microscopic process not entirely visible to the naked eye, there will usually be a delay between the time that concrete spalling problems commence, and the time they become evident on physical assessment. Generally speaking in the context of oxidative process, the problem has its first visible symptom in rust staining in the area affected.

Another tell tale sign of concrete spalling is visible cracking and deterioration of sheaths of concrete in affected areas arising from the inability of concrete to contend with sheer forces caused by the internal expansion of steel surface changes whilst embedded in concrete. Diagnostically speaking, it should be noted that not all apparent rust staining is necessarily a symptom of concrete spalling.

A chartered professional engineer who has the necessary skill, qualification or experience to advise you about the affected areas in question should determine whether concrete spalling is in fact a problem at your site.

How it can be prevented/treated?
It is impractical to suggest that because spalling seems to commonly originate with steel becoming affected by degenerative process, that steel should not be used in concrete structures. Concrete has a relatively high compressive strength but low tensile strength. Steel, on the other hand has a high tensile strength. Combining these two materials together can lead to the construction of the primary structure of breath taking building structures such as the Beirj Khalifa skyscraper in Dubai, at 828m tall. Despite this, concrete cancer is the Achilles heel of reinforced concrete structures. Concrete and steel work very well together, and much can be done to prevent or treat the problem of concrete spalling such that the problem is arrested and eliminated.

The first line of defence against concrete spalling is attention to detail in the construction phase. It is the writer's experience that cost pressures, time pressures, lack of experience, a lack of education or sheer ignorance can lead to mistakes that cause unacceptable rectification work costs down the road for building owners. Proper supervision and intervention as necessary will avoid these undesirable costs arising. Reinforced steel must be suitably covered by the concrete at the time of pour. Whilst different sites, conditions and requirements may necessitate different minimum levels of cover one good rule of thumb is to ensure that concrete covers steel reinforcement by no less than 25mm. A perusal of, and compliance with the Australian Standard AS 3600 "Concrete Structures", current edition, will be considered by your Structural Engineer in relation to your project.

One should ensure that supervision is effected such that proper coverage is achieved, and that suitable curing techniques are

Concrete Connections

affected to achieve maximal concrete strength. One might contemplate and implement a system that aims to prevent causative agents at the genesis of the concrete spalling affecting embedded reinforced steel. Several reputable manufacturers of appropriate coatings exist. They offer products that aim to prevent the ingress of moisture and harmful agents into concrete to protect your building.

In the instance of established concrete spalling requiring repair one might consider retaining a Structural Engineer to advise on the extent of damage and to implement a solution. Typically, this will involve a removal of deteriorated steel and concrete, the imposition of remedial measures to rectify and structural defects arising as a result of the spalling, the application of any relevant coatings to steel, the application of binding agents, and the careful repair of spalled areas.

Finally, concrete spalling is a problem that arises due to exposure of concrete structures to the forces and dynamism of nature. Whilst an eye for detail and excellence under the watchful

eye of a professional can largely ensure that it is entirely avoided by way of superior construction technique, concrete spalling may originate at a microscopic level. When left unchecked, it may become progressively worse. Fortunately, early intervention can restore a concrete structure to a good condition and without major ongoing concern for building owners.

By Nicholas Abelas,
Principal at Sydney Engineers.

References: Connolly R., The Spalling of Concrete, Fire Engineers Journal, January 1997, p38
About the author: Nicholas Abelas -40 is a chartered professional Structural Engineer. His experience is in the structural design and documentation of building structures and the provision of advice and reports for all manner of projects in Sydney, Illawarra and Greater NSW region. He is the principal at Sydney Engineers — www.sydneyengineers.com.

Article from Master Builders Magazine March 2014

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

CORROSION & PROTECTION OF REINFORCED CONCRETE
A 2 DAY ACA/ACRA COURSE

Melbourne - April 28-29 2015
Adelaide - August 20-21 2015
Perth - September 1-2 2015

Participants will receive a solid body of knowledge on the mechanisms of corrosion associated with reinforced concrete and the best preventive and remedial methods available today, so they can offer more effective solutions to combat this costly problem in the construction industry.

For more information and to register click here or phone +61 3 9890 4833

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

NEW CORPORATE MEMBERS.....

MAX Build offers the full remedial and refurbishment service
- MAX Build assigns a full-time supervisor to each project
- MAX Build construction projects are sized from $55,000 to $3,000 000
- Engineers and building consultants, strata managers, Owners Corporations, insurers and local government seek our specialist remedial knowledge
- Our jobs are situated in Sydney's eastern suburbs, northern beaches, Sydney city and the inner west
- MAX Build delivers permanent solutions with its Defects Prevention Policy

Services include: Concrete Repairs, Structural Repairs, Facade Refurbishment, Brickwork Repairs, Dry-Wall Ties and Lintel Replacement, Window and Door Replacement, and Waterproofing

www.maxbuild.com.au
Phone: 02 8033 4725
Email: info@maxbuild.com.au

http://www.begavalley.nsw.gov.au
Phone: 02 6499 2222
Email: council@begavalley.nsw.gov.au

Kennards Hire Concrete Care is one of the specialist branches within Kennards Hire network. The equipment available for hire provides contractors a range of options and solutions for; Surface Preparation, Cutting, Sawing, Drilling, Dust Control, Demolition, Concrete Break Out, Mixing, Pumping, Spraying and a market leading range of diamond consumables. The trained staff are committed to discussing any scope of works or project requirements, and deliveries are available throughout Australia and NZ.

Kennards Hire Concrete Care branches are located in QLD, NSW, WA, NT, SA, VIC and NZ with support available 24/7.

For all enquiries please contact 135 135 within Australia and (09) 274 8418 within New Zealand
http://www.kennards.com.au - Australia
http://www.kennardshire.co.nz – New Zealand

Got something to say?
If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au

Concrete Connections

Magnatex is a leading provider of concrete spalling (concrete cancer) investigation and repair services to the Strata Industry. Our services include concrete spalling investigation & repair, magnesite removal and cemenititious toppings.
Magnatex offers a responsive professional service, thorough investigation and appropriate repair methodologies. The benefit is asset protection. All residential structural repairs carry a 6 year warranty.
Maanatex does it right ....the first time!
Phone: 0413 125 525 http://www.magnatex.com.au

http://www.colacotway.vic.gov.au
Phone: 03 5232 9400
Email: ing@colacotway.vic.gov.au

ARDEX - First choice for reliability and quality

For more than 60 years, ARDEX has been the quality leader for an entire industry, offering excellent building chemicals with supreme processing reliability – the brand of choice for installers and wholesalers. ARDEX today is still an independent family-owned business. This means that in our permanent efforts to achieve market-shaping innovations, we have been able to retain our most important tradition: uncompromising quality. This is something we guarantee by applying the latest rigidly enforced quality assurance procedures. It's no coincidence that ARDEX is regarded as the premium partner in the buildings chemicals sector.

www.ardexaustralia.com

Phone: 1300 788 780

Technical Support Hotline: 1800 224 070

Concrete Connections

Introducing the New Concrete Crack Repair Range

The ARDEX Concrete Crack Repair Range uses a high strength, rapid setting two-part system to repair concrete damage from hairline cracks right through to structural repairs. These products are ideal for repairing holes, spalls and cracks in concrete, in internal as well as external situations where heavy duty vehicle traffic is anticipated. Once cured, the repaired concrete cracks will be two to three times stronger than the original concrete, guaranteeing a long lasting and durable crack repair solution.

ARDEX RA 88 is a two component, high performance ceramic blend epoxy. No-drip, non sag, repair adhesive perfect for horizontal, vertical and overhead use (trowelable). Fast cure time (approx. 2 hours) and when cured, over twice as strong as standard concrete.

Ideal for use as a repair adhesive for almost any material, including metal, concrete, brick, wood, stone, block and other substrates. It can also be used for repairing holes, spalls and cracks in concrete, repairing rotted wood, installing anchor bolts and repairing hand rails.

ARDEX RA 54 is used to fill interior control joints or new construction saw joints on horizontal concrete surfaces. Designed for industrial floor applications receiving heavy duty vehicle traffic. Can be used in exterior applications, when minimal (10% to 12%) joint movement from thermal cycling will occur. With a very rapid cure time, repaired joints can be opened to traffic in 90 minutes.

ARDEX RA 56 is an ultra-low viscosity, 2-component hybrid polyurethane adhesive. It is a rapid curing concrete repair material used when minimal down time is crucial. Its low viscosity offers deep penetration into hairline cracks for a structural repair. The addition of dry, bagged aggregate makes a quality spall repair product that is ready for grinding and open to traffic in less than 1 hour.

Phone: 1300 788 780

Got something to say?

If you want to feature a story in our newsletter, email us now at info@acrassoc.com.au