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Connection

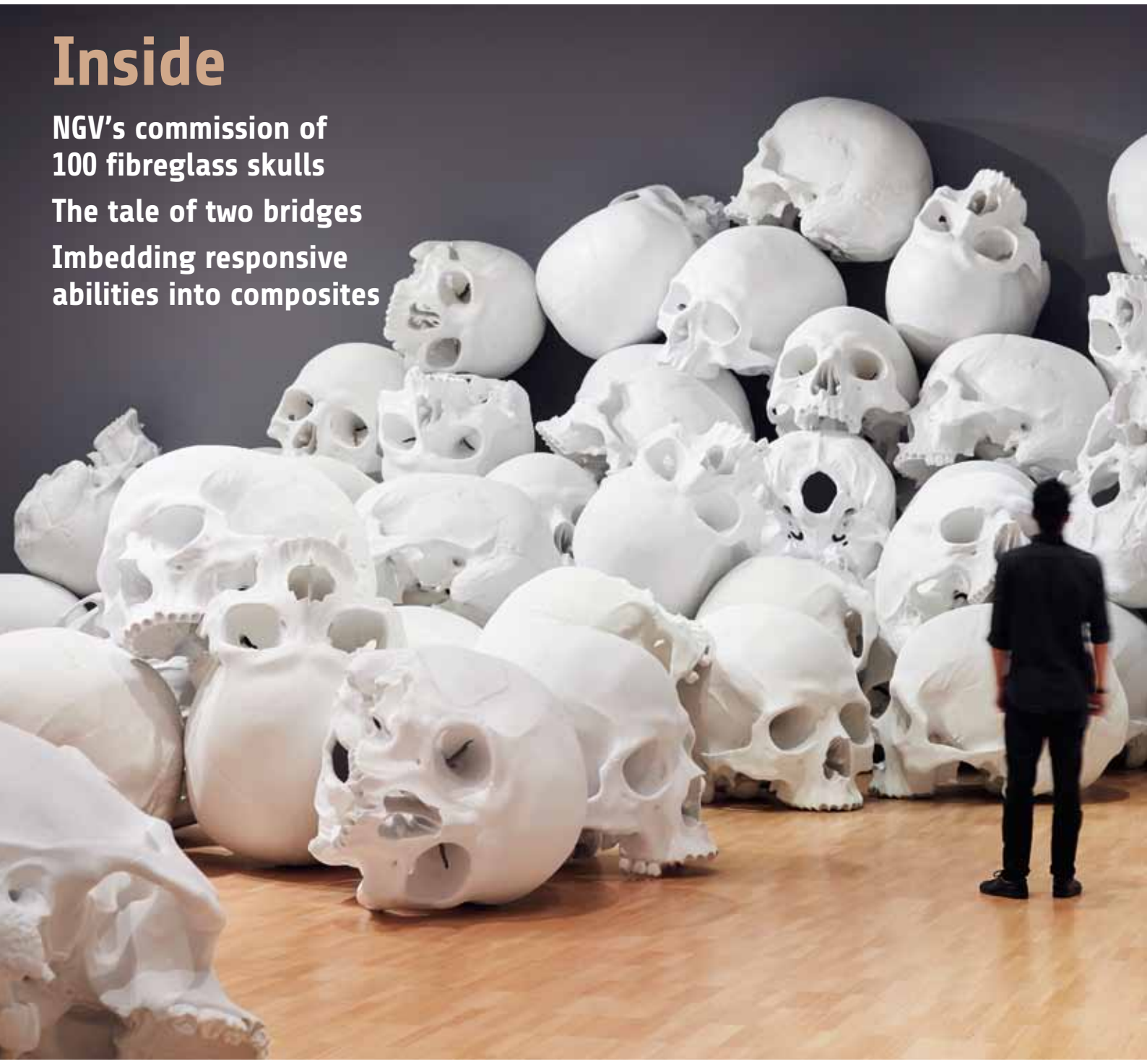
The official magazine of Composites Australia

Inside

NGV's commission of 100 fibreglass skulls

The tale of two bridges

Imbedding responsive abilities into composites



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President's letter

It is my pleasure to issue this edition of the Composites Australia *Connection* magazine. The stories within its pages are profound examples of the versatility of advanced composites and of the people behind the science and innovation. From art insulations to bridges, the productivity and adaptability of composites continue to grow.

For anyone in Melbourne or travelling there over the next few months, I urge you not to miss the first hand experience of walking among the Ron Mueck skulls at the National Gallery of Victoria, fabricated in Melbourne by King's Fibreglass. What an amazing project and a proud achievement for Australian manufacturing.

In November last year, our annual AGM was held at Ryman Composites' new manufacturing facility at Milperra, Sydney, and 80 attendees enjoyed a tour of the modern 2500m2 production facility. We were made very welcome by owner and CEO, Chris Ryman and members of his staff, who showed us examples of the company's diverse composite products and each stage of production. For those who missed this great networking event, there are photos and details in this edition.

This edition also features articles on two innovative bridges that use pioneering composites technology, demonstrating commendable penetration/acceptance into the field of critical infrastructure. While both are using composite technology, the contrast in each application demonstrates the versatility of our sector. When I read about the pedestrian bridge built by Composites Engineering at the Banyo train station in Brisbane, I went straight over to see it for myself, as I can't resist seeing composites in action.

The 2018 Advancing Composites Innovation Conference (ACI-18), Australia's biggest networking and knowledge sharing event for the Australasian composites industry, will be held on Wednesday 18th and Thursday 19th April 2018, at the Australian Synchrotron in Clayton, Victoria. As a composites fabricator, I am excited that the event will bridge the gap between theory and practical application by showcasing several demos, including a live demo of bonding and sealing using three adhesives and a myriad of materials. The Light Resin Transfer Moulding demo will prove quick curing and fast mould turnaround for automotive components. Other demonstrations include methods for achieving consistent fibre to resin volume ratio during fabrication.

On behalf of the Board, I wish you all a productive 2018 and I look forward to seeing you at the Advancing Composites conference in April.

Leona Reif
President

Talent, design, advanced materials & engineering converge to create public art

Good public art is said to have far-reaching cultural, social, and economic benefits by adding meaning to our cities and uniqueness to our communities.

Advanced composites technology is increasingly enabling the realisation of ambitious, beautiful and dynamic public art commissions that embody cultural spirit and atmosphere. The most recent of these is 'Convergence', which stands proudly at the main entrance to the new Perth Stadium. Created by artist Dr Jonathan Tarry (and team), having been commissioned by Westadium Consortium through public art consultants FORM, "Convergence' generates an interactive space, inviting people to engage with its sweeping forms. Tarry says it is intended to embody the flow of the nearby Swan River and the "fearless energy of a football game".

At over 12-metres high, the structure is a hollow carbon fibre shell with 14mm thick walls and a 6mm foam core for robustness and to prevent print-through and dimpling. The final sections were coated with a textured finish and a coat of metallic grey.

The artwork reflects the surface of Western Australia's many water bodies and the environment. Its atmosphere is further enhanced with a 16-channel programmable advanced light system, which illuminates the piece at night, making the form breath, sway and sparkle.

The structure was fabricated by long-term Composites Australia member, Composite Constructions. Managing Director, Steven Campbell said that, "while the shape was complex and complicated to build and required the lateral thinking of a boat builder for issues such as windage, we're very happy with the results."

Brian Nelson of Capital House Australasia, specialist FRP engineering consultants for the project, said that carbon fibre composite was the material of choice. It facilitated the complexity of form while satisfying the high degree of torsional effects induced by wind and self-weight, and also from people climbing on the work. The structural behaviour called for the combined properties of stiffness, durability, formability and strength that could only be satisfied with a lightweight carbon fibre composite solution.

Above & below. Two views of 'Convergence', standing proudly at the main entrance to the new Perth Stadium.

Design considerations for the structure were considerable, such as the ability to transport it across the Nullarbor Plain and erect it on the building site. The team at Composites Constructions built the structure in sections, within which stainless steel plate connectors were bonded. Travel cradles were also engineered for the journey. It took the team, a crane, eight people and a full day to load the sections onto two trucks.

Realising ambitious creative outcomes requires strategic partnerships and collaboration across many disciplines working with artists. For 'Convergence', more than 50 skilled people contributed to the creation of the project over a nine-month period. In particular, Jon Tarry sees Steve Campbell's role as pivotal in the collaboration between artist, engineer and fabricator. The result is a proud testimony to talent, design and advanced materials and engineering.

Ron Mueck's 'courageous' composites commission

Internationally acclaimed Australian-born sculptor Ron Mueck is a purist, spending hundreds of hours perfecting the shape and form of each of his works down to the finest detail.

Distinctive resin odours permeate his UK studio, where he controls every step of the creative process, from the clay moulds to the fibreglass and resin lay-up; from the minutiae of the finishing touches to the pores of the skin and single strands of hair, using a mix of media including silicone and ceramic.

So, it was with some trepidation that Mueck accepted the National Gallery of Victoria's commission to create the artwork, MASS 2017, for acquisition through the Alfred Felton Bequest, for the gallery's current NGV Triennial exhibition.

Made up of 100 skulls, each 1.2 metres high, Mueck had to hand over two critical phases of his creative process – the mould-making and fabrication of the skulls – to people in Australia he had never met, let alone worked with.

Mueck designed and made the silicone patterns for two moulds, which he brought with him from London. Mueck then made three additional moulds in collaboration with Weining Lin, Director of Idea Productions Pty Ltd in Altona, Melbourne. Working closely with Idea Productions, these subsequent moulds were modified for efficiency and usability.

After demonstrating the company's capabilities with photographs of diverse projects, followed by a telephone interview, the NGV and Mueck assigned the fabrication of 100 blank skulls to King's Fibreglass in Bayswater, Melbourne.

For four weeks, Director Glen King, Mueck and the NGV bounced around thoughts and opinions on the production process, in what Glen calls the R&D phase of production.

"Ron worked with us for two months on the project, visiting us regularly to check on progress. He taught us the art and craft of fibreglass and we taught him the commercial side," says Glen.

Mueck's input in the production phase included several techniques he had developed through experimentation, such as the insertion of thousands of

Kings Fibreglass was transformed during the time it took to fabricate 100 skulls.

expandable glass beads between the layers of fibre to render the bone structure as anatomically correct as possible. In all, there were 20 parts in each two-piece mould, to be laid-up for each of the 100 skulls, plus dozens of teeth.

The project so excited Glen's fibreglass technicians that one voluntarily gave up scheduled annual leave to be part of the project. The other three on the team willingly gave up their weekends, working seven days a week to complete the skulls in the required timeframe.

"Each skull took 25 to 26 hours to glass. Each one took over an hour to get out of the mould," says Glen. "Ron was a fabulous client. He was pleased for us to contribute to something like this and so appreciative of our work and skills, he would hug the guys each time he visited to check on progress."

Every week a batch of fibreglass skulls was delivered to a dedicated NGV workshop where a team of NGV technical staff, under Mueck's direction, added another 25 hours of labour to provide the detail that completed the artistic vision for each piece. The resulting piece - MASS 2017 - is a major feature of the NGV's Triennial exhibition and is unlike any of Mueck's previous work.

Mueck says he referenced Cambodia's killing fields, Paul Cezanne's Pyramid of Skulls and the Paris catacombs in his research.

Chairman of the Felton Bequest Committee, Sir Andrew Grimwade CBE, described MASS 2017 as "a most valuable, brave and courageous work. It is the NGV's 'Blue Poles' moment as it is sure to confound, confront and exhilarate visitors in equal measure."

NGV Triennial is a free exhibition and will be open until 15 April 2018 at NGVI, St Kilda Rd, Melbourne.

Australian-born sculptor Ron Mueck spent hundreds of hours perfecting the shape and form of each of his works down to the finest detail.

Composites enabling innovation in bridge technology

The HCB composites bridge installed over a creek prone to flooding in a new rural subdivision estate, Wyndham Ridge in the Hunter Valley.

During the 60-year period between 1860 and 1920, over 400 timber truss bridges were built in NSW. At the time, iron and steel were expensive imports and the Indigenous hardwoods were readily available, three to five times stronger and far more durable. But those days are long gone. New materials and innovative engineering concepts are readily available to the inherently conservative decision makers in critical public infrastructure. While materials are still debated, the increasing need for Accelerated Bridge Construction (ABC) is not. Public safety and the uninterrupted movement of people and goods is of paramount concern.

Long-term Composites Australia members A.C. Whalan Composites Pty Ltd joined forces with New Tech Beams Pty Ltd and the US firm, Hillman Composite Beams (HCB), to build a composites bridge solution over a creek that was prone to flooding in a new rural subdivision estate, Wyndham Ridge in the Hunter Valley. A.C. Whalan is an Australian family-owned firm that has been engineering and fabricating industrial composite solutions for the mining, industrial and civil industries throughout Australia since 1939. A much younger company, HBC is a technology company based on the east coast of North America.

The licensing construction agreement between the firms was secured for the intellectual property to make lightweight structural bridge members using three components, including an FRP shell, compression reinforcement and tension reinforcement.

- The FRP Shell is a fibreglass box that is VARTM-infused using an epoxy vinyl ester resin matrix reinforced with balanced quad-weave fabric with fibres that are horizontal (00), vertical (900) and (±450).

- The compression reinforcingis 41MPa (6,000 psi) self-consolidating concrete that is pumped into an internal arch-shaped conduit formed within the beam.

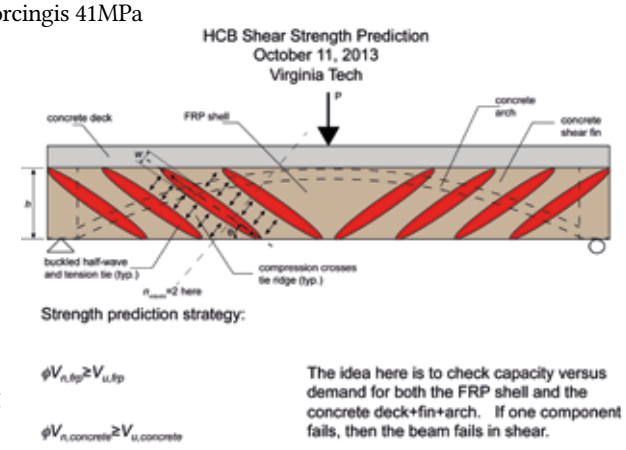
- The tension reinforcing running along the bottom of the beam is 1,860 MPa (270 ksi) galvanised prestressing steel strand.

The eight 16-metre skewed end HCBs were supplied by New Tech Beams. Each beam derives most of its strength and stiffness from the high modulus concrete and steel components in order to comply with code-specified deflection criteria.

The beam technology was originally developed for heavy axle freight railroad loadings, although it is able to be adapted to accommodate the same loads as any conventional beam.The HCB, complete with concrete arch, weighed in at 2 tonnes as opposed to a concrete member, which would weigh 20 tonnes. The lightweight design also provided added benefits for shipping and erection, while using standard construction equipment and methods.

Ben Whalan, General Manager for A.C. Whalan says, “The beams may appear unconventional, but under the guidance and training of Mike Zicko, CEO of HCB, our team was able to master the design, fabrication and construction processes within our existing skill set and production facilities.”

The company maintains that the strength capacity of the beams consistently exceeds code requirements by a significant margin. Couple this inherent safety with corrosion-resistant properties and bridges made using the HBC technology last longer with less maintenance.



Composites pedestrian footbridge constructed over live power lines

Isaac Newton's laws of motion, formulated in the 18th century, are three physical laws that describe the relationship between a body and the forces acting upon it, and its motion in response to those forces. It is safe to bet that Newton would not have anticipated that his laws would be used, centuries later, in a composites truss pedestrian footbridge over Banyo Station in the shadow of the Brisbane airport.

Alarmed by the knowledge that the site had the highest rate of illegal rail crossing (track jumping) across its entire network, Queensland Rail commissioned the design of the composites footbridge in 2016.

The engineering and installation challenges that this crucial piece of infrastructure posed were significant. Not least of these challenges were the 25,000-volt live power lines over which the bridge had to be built, with as little inconvenience as possible to the approximately 600 boarding passengers each week day. Other considerations included the need for light-weight design, corrosion resistance, off-site construction, low maintenance and minimal whole-of-life cost.

A platform-to-platform, non-conductive solution was designed and manufactured by the Melbourne structural composites company Composites Engineering Pty Ltd. The resulting footbridge measures over nine metres tall and 16 metres end-to-end, with the main horizontal element at 2.9 metres high with three metres of internal clearance, permitting the highest pedestrian traffic volume across the network.

Co-directors of Composites Engineering David Barrie and Troy Beros were thrilled when the structure performed exactly as predicted by the FEA modelling, satisfying the stringent load requirements set by the client.

Troy Beros said that, "Utilising light-weight composite components, we designed the main bridge span (fully fitted) to tip the scales at just six tonnes, which offered our client significant weight savings compared to the cumbersome 21 tonnes for a similar steel bridge span previously installed within the rail network."

The pedestrian bridge is a high traffic area where the safety of and convenience for commuters is paramount. This is why the repairs and maintenance system, of simply unbolting and replacing components without the need for hot work or any other special work permits, appealed to the client. The modular design also allows for retrofitting lift structures in the future, with minimal alterations.

The composites truss pedestrian footbridge over Banyo Station in Brisbane showing the 25,000-volt live power lines over which the bridge had to be built.

Below: View showing custom structural profiles and hollow beam-style stair tread.

The job required the development of several custom structural profiles utilising various roving and quadraxial cloth arrangements. The hollow beam-style stair tread used on the footbridge for example, could be used in applications over four metres wide (unsupported). The firm performed all the preliminary FEA testing in-house, including testing of the bespoke structural profiles that were required to meet the flame spread or surface burning characteristics rating ASTM E84 and self-extinguishing requirements of ASTM D-635.

Fitted out with LED lighting with emergency back-up, the bridge also features safety screens that were installed using tamper-proof fixings and full CCTV coverage, both inside and out. Lockable (transparent) storage areas under each set of stairs have also been incorporated into the design, allowing maximum utilisation of space on each platform. The innovative composite bridge was opened to the public by Queensland Rail in December 2017.

Events Roundup

Ryman Composites – a positive market outlook

Some 80 Composites Australia members enjoyed their visit to Ryman Composites' new manufacturing facility at Milperra, Sydney, at the end of November.

Guests had the opportunity to tour each stage of the modern 2500m2 production facility to see examples of the company's diverse range of high quality composite products and view each stage of production, including design, lamination, mould making and finishing.

Among the highlights of the display was the opportunity for delegates to experience the award-winning SynFlyt 3DOF (degrees of freedom) outdoor flight motion simulator in a composite pod that was developed for both large and small pilot training schools.

Owner and CEO, Chris Ryman, along with members of his staff, proudly shared some insights into the company's journey, from its beginnings in the 80s when the focus was on the development, manufacture and distribution of over 40,000 NoseCone® wind deflectors into the transport industry.

Delegates enjoying the Ryman manufacturing facility

Chris believes strongly that there is room in the market if you are prepared to manufacture professionally.

He shared salient advice gained from his experience running a composites business for over 40 years. Lessons he has learnt — more often than not, the hard way — include: run with a good thing; don't undermine your suppliers; pay bills on time; share your success; and carry good people with you.

He has learnt to be cautious of people and apparent opportunities that can distract you from your business, warning to be wary of customers that may attempt to run your business and inventors who may "never give birth". One of Chris' mantras is to "do it yourself and not buy other's ideas".

While business will always be challenging, it is best done on the foundation of good supplier relationships and customer partnerships, according to Chris.

Composites Australia and delegates are grateful for Chris and his team's generous hospitality.

10-Year Anniversary Celebration of UQ Composites

On Friday 2nd of February, The University of Queensland Composite Group (UQ Composites) celebrated its 10-year anniversary. The celebrations were organised to coincide with the NETZSCH seminar – "Characterising and optimising the curing of thermosetting resins and composite materials" – hosted by the group.

Both the seminar and the anniversary celebrations were well attended by industry partners, academic colleagues and group members. Stephan Knapp from the NETZSCH head office in Germany and Andrew Gillen from NETZSCH Australia provided a comprehensive seminar on the different analytical approaches available for resin cure analysis. Of particular interest to the participants was the comparison of different techniques, the many practical examples, and the demonstration of dielectric resin cure analysis.

As part of the anniversary celebrations, Assoc. Prof. Martin Veidt and Dr Michael Heitzmann reflected on the 10-year history of the group and key milestone events. Particular note was made of the importance of the Cooperative Research Centre for Advanced Composite Structures in establishing the group and the focus on product development and integration of mechanical, chemical and civil engineering, which was responsible for the recent strong growth of the group. The event was concluded with a tour of the laboratory facilities that was enhanced by an impromptu performance on a composite guitar.

Steber International showcases advanced manufacturing in regional NSW

Over 40 people travelled to Taree, a town on the Mid North Coast of NSW, to celebrate advanced composite manufacturing at the commercial and recreation boat builder, Steber International Pty Ltd.

A family owned business that was founded in 1946, Steber International originally produced timber clinker hull boats, transitioning to fibreglass (FRP) construction in 1959. It is now considered as one of the pioneers in the construction of fibreglass vessels in Australia.

The Steber manufacturing plant is on a four-acre site with approximately two acres under cover. Generous host and General Manager, Alan Steber shared salient advice gained from his experience running a composites business for over 40 years. His strong belief in networking was demonstrated by the calibre of invited speakers, including the Federal Member for Lyne, Dr David Gillespie, and State Member for Myall Lakes, Stephen Bromhead, both of whom outlined their commitment to manufacturing in the region.

Alan also explained that an active R&D program is critical for continued innovation and growth in regional areas. "Given the distance from key decision makers, we simply have to stay ahead of the pack by knowing more and offering innovative solutions and products," Alan said. One area of concern is the perception that passenger safety is compromised by the use of composite materials. "Although the benefits of using advanced composites in transport vehicles and vessels are well known, an obstacle to their wider adoption is uncertainty over their fire performance. We have a responsibility to inform procurement agencies about the benefits of composites." says Alan.

Left. State Member for Myall Lakes, Stephen Bromhead with Steber International Managing Director, Alan Steber. Right. Dan Naiker of allnex demonstrating fire retardancy properties of a composite panel.

To demonstrate, Dan Naiker of allnex Composites provided delegates with a demonstration of fire retardant performance on a panel.

Trent Jennison, CEO of Valley Industries, a not-for-profit organisation providing support and employment opportunities for people with disabilities in the Manning Valley, encouraged delegates to consider partnering with an Australian Disability Enterprise (ADE). Trent explained that while the National Disability Insurance Scheme (NDIS) is a once in a generation reform that will improve many lives, it is also a significant opportunity for manufacturers to outsource cost-effective labour solutions, particularly for repetitive routine tasks.

Robert Dane, founder and CEO of OCIUS Technology, provided delegates with an inspirational presentation on the highly innovative Bluebottle unmanned surface vessel project. The drones feature rigid FRP opening sails and hybrid marine power technology and provide a low-cost, persistent, wide area ocean surveillance for defence, security, oceanographic, hydrographic and oil and gas applications. By harvesting wind, wave and solar energy, the Bluebottle is self-propelled, self-deployable and retrievable. Though still in its startup phase, OCIUS could not have made progress if it weren't for the collaboration between Steber's advanced manufacturing capability and support from Government, which is providing grants to assist further development, including extensive sea trials.

Bianca Adimari and Wayne Thompson of Vero Insurance also provided a colourful presentation on developing strategies to mitigate risk to ensure manufacturing companies, their employees and commercial interests are protected.

Alan proudly led a tour of the factory covering a $2m export vessel, 43ft navy vessel, 4380 sports cruiser, 34ft commercial fishing vessel and a host of other projects under construction. (An article on the company in the previous edition of Connection Magazine describes current contracts.) Alan explained that it takes on average 43 mouldings to make one Steber commercial and/or recreational composite vessel.

Guests were also showered with the rich tradition of country hospitality – Steber style. Composites Australia and delegates are grateful for Alan and his wife, Debbie's, generous hospitality.

Front row: Kerryn Caulfield, Composites Australia; Federal Member for Lyne, Dr David Gillespie and Steber International Managing Director, Alan Steber.

Composite Engineer's Viewpoint
By Rik Heslehurst PhD, MEng, BEng (Aero) FIEAust, FRAeS, CPEng

Part 11 B–The Operational Environment
Defects and Damage in Composite Sandwich Structures

In this article we examine operational environmental effects, with a specific focus on defects and damage in composite-skinned sandwich structures. An understanding of the defect/damage type will assist in determining why the anomaly has occurred; what effect the anomaly has on the structural and/or behavioural performance; steps that can be taken to ensure the issue does not happen again; and how to restore the structural and/or behavioural performance of the sandwich structure.

A definition of what constitutes a defect and failure for primary load bearing sandwich structures is given as follows:

Defects: also known as a discontinuity, non-conformity, flaw or damage, a defect, is defined as *'any unintentional local variation in the physical state or mechanical properties which may affect the structural behaviour of the component'* (Heslehurst, 2014).

Failure: defined as '*when a component or structure is unable to perform its primary function adequately*' (Heslehurst, 2014).

Defect types and classifications

There are 74 separate defect types to which composite materials and sandwich structures are prone. They range from microscopic fibre faults to large, gross impact damage. This list of defects can be found in the full article on the Composites Australia website.

Defects can be grouped into specific categories according to when they arise during the life of the structure; their relative size; their location or origin within the structure; and those that produce a similar effect to a known stress state in the component.

Defect Occurrence. Defects occur during materials processing, at the component manufacture stage, or in-service use. The following table list those defects peculiar to manufacturing (materials processing and component manufacture) and those sustained during service life.

Materials Processing defects occur during the production and preparation of the constituent materials or the prepreg. Defects could occur because of improper storage of materials or inadequate quality control and batch certification procedures. Both can lead to material property variations.

Component Manufacture induced defects occur during lay-up or cure (component fabrication) or during machining and assembly of the components.

In-Service Use defects will occur in components through mechanical action or contact with hostile environments, such as impact and handling damage, local overloading, local heating, chemical attack, ultraviolet radiation, battle damage, lightning strikes, acoustic vibration, fatigue or inappropriate repair action.

The size of a defect has significant bearing on its criticality. We therefore categorise them as either microscopic or macroscopic (see Heslehurst 2014 for more details).

Defects may present in isolation, originating from structural features such as cutouts and bolted joints, or as a random accumulation resulting from interaction amongst them, however they tend to concentrate at geometric discontinuities. The defects can be classified under the headings of geometric discontinuities, free edges, projectile impact and heat damage (see Heslehurst 2014 for more details).

Reference: Heslehurst R.B., *Defects and Damage in Composite Materials and Structures,* ISBN 9781466580473, 2014 CRC Pre

Generalisation of Defect Types

The results of an extensive literature survey indicate that defects can be listed in terms of developing a common stress state. These common stress states are delaminations, transverse matrix cracks, holes or fibre fracture and core damage.

Listing of Manufacturing and In-Service Defects

MATERIALS PROCESSING	COMPONENT MANUFACTURE	IN-SERVICE
Contamination	Bearing Surface Damage	Bearing Surface Damage
Damaged Filaments	Condensed Core	Blistering
Fibre Distribution	Contamination	Blown Core
Fibre Faults	Corner Radius Delaminations	Contamination
Fibre Fracture	Crushed Cure	Core Filler Cracks
Fibre Kinks	Crushing	Corner Crack
Fibre Misalignment	Cut Core	Corner Radius Delaminations
Fibre/Matrix Disbonds	Distorted Core	Corner/Edge Splitting
Marcelled Fibres	Excessive Ply Overlap	Cracks
Miscollination	Fibre Misalignment	Creep
Moisture	Fibre/Matrix Disbonds	Crushed Cure
Node Debond	Improper Cure	Crushing
Pills or Fuzz Balls	Inclusions	Cut Core
Prepreg Variability	Lack of Adhesive	Cuts and Scratches
Variation in Density	Lack of Filler	Debonds
Variation in Fibre	Microcracks	Delaminations
Volume Ratio	Miscollination	Dents
Variation in Thickness	Mismatched Parts	Edge Damage
Wrong Materials	Missing Core	Erosion
	Missing Plies	Fastener Holes
	Over/Under Cured	Fibre Fracture
	Overaged Prepreg	Fracture
	Pills or Fuzz Balls	Heat Damage
	Ply Underlap or Gap	Holes and Penetration
	Porosity	Impact Damage
	Reworked Areas	Inclusions
	Thermal	Macrocracks
	Stresses	Matrix Cracking
	Unbond or Disbond	Matrix Crazing
	Variation in Fibre Volume Ratio	Moisture
	Variation in Thickness	Porosity
	Voids	Reworked Areas
	Warping	Surface Damage
	Water in Core	Surface Oxidation
	Weak Bonds	Surface Protrusions
	Wrinkles	Surface Swelling
	Wrong Materials	Thermal Stresses
		Water in Core

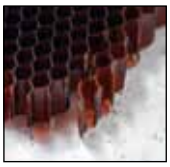
Composite Skin Failure. Details of the failure modes of composite skins in sandwich structures have been addressed in a previous newsletter. More details can be found in Heslehurst, 2014.

Generalised Defect Types

DELAMINATIONS	MATRIX CRACKS	HOLES	CORE DAMAGE
Bearing Surface Damage	Bearing Surface Damage	Crushed Core	Blown Core
Blistering	Blistering	Crushing	Condensed Core
Corner Radius Delaminations	Corner Crack	Cut Core	Core Filler Cracks
Corner/Edge Splitting	Corner Radius Delaminations	Cuts and Scratches	Crushed Core
Debonds	Corner/Edge Splitting	Edge Damage	Crushing
Delaminations	Cracks	Fastener Holes	Cut Core
Dents	Crushing	Fibre Fracture	Debonds
Edge Damage	Cuts and Scratches	Fracture	Dents
Heat Damage	Dents	Holes and Penetration	Distorted Core
Holes and Penetration	Edge Damage	Impact Damage	Edge Damage
Impact Damage	Fibre/Matrix Disbonds	Inclusions	Fastener Holes
Inclusions	Fracture	Reworked Areas	Heat Damage
Lack of Adhesive	Heat Damage	Surface Damage	Holes and Penetration
Lack of Filler	Holes and Penetration	Surface Protrusions	Impact Damage
Ply Underlap or Gap	Impact Damage		Inclusions
Reworked Areas	Inclusions		Lack of Adhesive
Surface Damage	Interfacial Cracks		Lack of Filler
Surface Protrusions	Macrocracks		Missing Core
Surface Swelling	Matrix Cracking		Moisture
Thermal Stresses	Matrix Crazing		Moisture Pick-up
Unbond or Disbond	Microcracks		Node Debond
Warping	Pills or Fuzz Balls		Reworked Areas
Wrinkles	Porosity		Thermal Stresses
	Reworked Areas		Unbond or Disbond
	Surface Damage		Variation in Density
	Surface Protrusions		Variation in Thickness
	Thermal Stresses		Water in Core
	Translaminar Cracks		Weak Bonds
	Voids		Wrong Materials
	Warping		

Honeycomb Core Failure. The core will have several potential failure modes. These core failure modes are:

Core crushing



Core node debonding

Core-skin separation

Core fatigue failure

Core shear failure

Foam core damage will be shown in the next article.

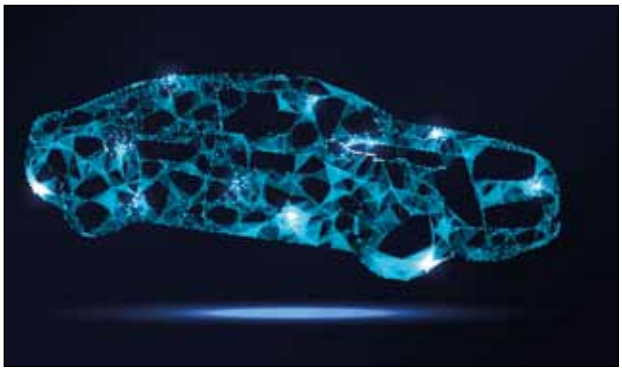
In the next article we will continue in the operational environment theme with a short commentary of fatigue and damage growth in composite skinned sandwich structures

All articles published in Engineer's Viewpoint are available on the Composites Australia website (www.compositesaustralia.com.au/industry). Rik welcomes questions, comments and your point of view by email to rikheslehurst@gmail.com

ATLAS launched at RMIT for lightweight automotive structures

More than $3 million in Australian Research Council funding has been awarded to RMIT to establish a new training centre in lightweight automotive structures. ATLAS will host 31 world-leading scientists and industrial engineers from 16 organisations in Australia, Germany, the UK and the USA, who will collectively develop new lightweight materials, advanced manufacturing processes, energy storage designs, and rapid non-destructive evaluation techniques, which are keys to reducing carbon dioxide (CO2) emissions in transportation.

ATLAS is led by RMIT University in close partnership with Deakin University and the Australian National University. The Ford Motor Company is the lead industry partner, alongside CSIRO and 11 additional local and international partner organisations.The Victorian firm CME (Composite Materials Engineering), which has been a Tier One supplier of advanced composites to the automotive sector for over 40 years, is a key partner in the new centre. Managing Director Brian Hughes says, "I look forward to the new industry-focused research centre supporting the transformation from local vehicle production to the export of our engineering services and locally manufactured high-value products and components,"ATLAS will take on 13 PhD candidates and five postdoctoral research fellows.



A major new research centre aims to transform Australia's automotive industry by developing new lightweight materials and manufacturing technologies.

The 2018 experiential Advancing Composites Innovation Conference

Set aside the dates in your diary. The 2018 Advancing Composites Innovation Conference (ACI-18), Australia's biggest networking and knowledge sharing event for the Australasian composites industry, will be held on Wednesday and Thursday 18 and 19 April, 2018 at the Australian Synchrotron, in Clayton, Victoria.

The event will **bridge the gap between theory and practical application** by showcasing several demos, including a live demo of bonding and sealing using three adhesives using a myriad of materials. The Light Resin Transfer Moulding demo will prove quick curing and fast mould turnaround for automotive components. Other demonstrations include methods for achieving consistent fibre to resin volume ratio during fabrication. **Come and watch composite materials and technologies perform.**

"Come and be apprenticed, if only for two days, to masters with a wealth of experience in their trades, products and processes." says Kerryn Caulfield, Executive Manager of Composites Australia.

The conference is fortunate to have the continued support of SAMPE and the Advanced Composites Structures Society (ACSS), an Engineers Australia technical group that is again providing the $500 Best Paper Prize for the presenting author of the outstanding Peer Reviewed paper.

The welcome reception and conference dinner are opportunities to network, advance your career or business and identify opportunities for collaboration in the relaxed and friendly environment.

This year the dinner will be held at the Clayton Lawn Bowls Club where guests will enjoy a great meal, a round of bowls and beer on tap.

The 2018 Advancing Composites Innovation Conference (ACI-18), Australia's biggest networking and knowledge sharing event for the Australasian composites industry, will be held on Wednesday and Thursday 18 and 19 April, 2018 at the Australian Synchrotron, in Clayton, Victoria.

Details for the conference and accommodation options are all on the conference website: www.compositesconference.com.au

The venue for ACI-18: the Australian Synchrotron, Clayton, Victoria.

ACI 18

ADVANCING COMPOSITES INNOVATION CONFERENCE

17-19 April 2018, Australian Synchrotron
Melbourne, Australia

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Renewable energy targets unlock opportunities for local supply

The Victorian Government's commitment to local content targets that have been built into the broader renewable energy targets and auction scheme evaluation criteria has been somewhat of a boon for local industry with many potential operators searching for capable local suppliers.

"The Government took a great first step by recognising the need to implement the renewable energy targets of 25% by 2020 and 40% by 2025. It is now vital that we ensure they are achievable by optimising investment, jobs and local economic value from renewable energy projects and supporting participation by local supply chains," said Don Matthews, ICN Executive Director.

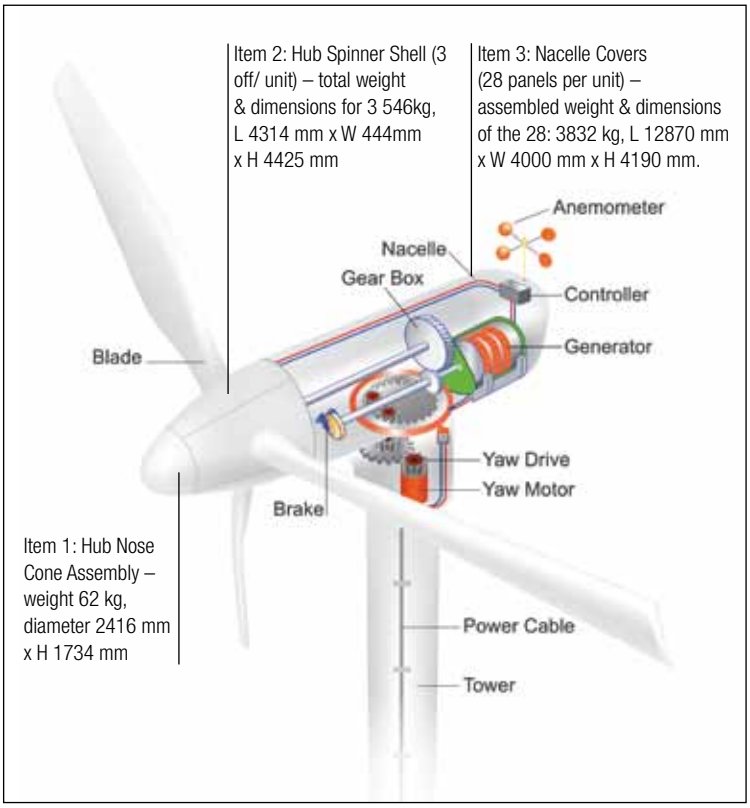
The 2017 Victorian Renewable Energy Targets (VRET) Reverse Auction called for bids from renewable energy projects, submitted under formal Request for Proposal (RFP). This included bids up to 550MW of large scale, technology neutral renewable energy and up to 100 MW of large scale solar-specific renewable energy.

Companies involved in the auction scheme proposals are committed to providing full, fair and reasonable opportunity for capable local industry to participate across its supply chain opportunities and reflect our commitment to local industry participation and local content.

"We know that potential operators are searching for capable local businesses that can provide materials and manufactured components that can support the construction and ongoing operations of wind and solar farms," said Don.

"We can also reveal that major OEM equipment suppliers are seeking to engage with capable, local suppliers/subcontractors to manufacture or value-add to various components including hub and tower components, TCI and maintenance, balance of plant construction, nacelle components including covers and blade materials."

A distinct pathway to opportunities exists by engaging with ICN who provide consultancy services around LIDP/VIPP requirements, Gateway webpages that facilitate expressions of interest, and ICN Supply Chain expertise and knowledge in both Solar & Wind Renewables via State Government and Industry sponsored supply chain mapping.



ICN
Industry Capability Network

More information can be found on the ICN Gateway at www.vicrenewables.icn.org.au. Log into the ICN Gateway for further information: http://gateway.icn.org.au/

Advanced Composites – a perfect medium for the Industrial Internet of Things

There is no doubt that the world is only going to become more digitally connected to the point where each object or component will become a source of data and interaction that informs users, makers, customers and stakeholders. Most understood is IoT – the acronym for the "Internet of Things" - in terms of connectivity of consumer devices and products such as iPhones. The Industrial Internet of Things - or IIoT - is the connection of devices, objects or components over the internet, but with a focus to transfer, command and control critical industrial information and responses to a given technological environment. It is the process of collecting "big data" on an industrial scale.

The company worked with Yarra Trams and Vicroads to install antennas in pits between the tracks and to install fibreglass composite lids and access covers.

Imbedding a sensing or responsive ability into a composite product or component provides customers with the classical properties of composites - less weight, stiffness and strength - in addition to creating unprecedented direct customer and stakeholder engagement and interaction.

The Industrial Internet of Things is providing a multitude of new generation of smart devices that can do everything from monitoring water quality and flow to directing trams. RTUs (Radio Transmission Units) can utilize GSM (Global System for Mobile Communications) technology and also, newer Low Power Wide Area Network (LPWAN) systems such as the LoRa Alliance protocol and Sigfox. Even though Radio Frequency Identification (RFID) has a long history, it still offers significant connectivity; asset tracking and data capture capabilities for industrial applications. Given that radio waves travel efficiently through most non-metallic materials, fibre reinforced polymers offer a perfect medium.

Melbourne firm, Terra Firma Industries, Australia's leading manufacturer and supplier of fibreglass composite lids and access covers, specializes in using a number of technologies to capture data for its customers. Ashley Reid, the firm's Managing Director who previously worked in telecommunications throughout Europe and Asia, believes that providing connectivity is critical for all client/customer relationships in today's world. "Thinking and planning like a technology company is the greatest challenge for companies in adapting to IIoT," says Ashley.

The company worked with Victoria's City West Water to install composite covers in and around Melbourne CBD to allow the transmission of data logged from flow metres via RTUs installed underground, inside manholes. The pit covers needed to be transparent in order to allow radio signals to

pass through; gas and water tight; strong enough to withstand heavy vehicle traffic yet sufficiently lightweight enough to allow easy inspection. Conventional ductile iron or concrete infill covers do not allow radio signals to pass through them and require costly trenching, cabling and external transmitters for RTUs.

Another project utilizing the RFID tags already fitted in Melbourne trams, required a safe place to house the equipment to read the tags and transmit the information to the control system, the TransCore AA3233-004 915 MHz Heavy Rail Antenna. The company worked with Yarra Trams and Vicroads to install antennas in pits between the tracks. However, traditional metal or concrete pit covers could not be used as they interfere with the transmission of the radio signals. The composite structure allows radio waves to pass through them allowing transmission of signals between the ID antennas mounted on trams and the readers in the pits below.

A significant hurdle in imbedding sensors into composites materials is the prerequisite for a precision curing process including the exothermic nature of the reaction, the thermal diffusivity of the material and the geometry of the part.

Terra Firma is now working with Composites Australia and Standards Australia to update legacy

The pit covers are transparent in order to allow radio signals to pass through; gas and water tight; strong enough to withstand heavy vehicle traffic yet sufficiently lightweight enough to allow easy inspection.

standards which have been developed over many years for legacy materials such as cast iron. "We need to work collectively to allow new materials and a new generation of smart devices to collect data that informs ourselves, our customers and their customers to enable smart decisions on safety and efficiencies" says Ashley.

Hear more about Ashley's view on the future of imbedded sensors in composites and the challenge to think and plan like a technology company at the ACI18 conference on 17 and 18 April

Events Schedule 2018

Now

December 15 to April 15
National Gallery of Victoria, Melbourne

The Triennial Exhibition
Premiers sculptor Ron Mueck's largest work to date, Mass 2017, created using resin, fibreglass, silicone among other materials. Supported by King's Fibreglass and commissioned by the NGV with funding from the Fenton Bequest.
Free entry

March

Monday 19 & Tuesday 20
Waurn Ponds, Geelong, VIC

One day Industry symposium
Collaboration on Lightweight Structures: Workshop aims is to encourage a collaborative research network to become a globally recognized competence partnership for lightweight structure technologies

April

Tuesday 17
Clayton, Melbourne, VIC

Pre-conference Workshop
With international trainer and composites engineer Dr Rik Heslehurst

Wednesday 18 & Thursday 19
Clayton, Melbourne, VIC

2018 Advanced Composites Innovation Conference
An experiential program combining knowledge sharing on the latest developments in materials and processes with live demonstrations of the latest developments in material technologies, processes and systems.

May

Thursday 24
Sydney, NSW

Full-day workshop on methylacrylates

July

Thursday 26
Canning Vale, Perth WA

Tanks site visit and networking
Tanks West produces moulded FRP tanks, designed to meet the needs of agriculture, mining, industrial and domestic customers.

July 29 to August 1
Cairns, QLD

11th Asian-Australasian Conference on Composite Materials
A three-day program with a divergent range of composite research themes, including additive manufacturing and cement-based composites.

August

Thursday 30
Tomago, NSW

Compass Pools site visit and tour
At this morning networking event, members have the opportunity to hear the story behind one of the most innovative and successful pool manufacturers in Australia and enjoy a guided tour of the manufacturing facility.

October

Wednesday 10
VIC

Knowledge forum on Intellectual Property

December

Wednesday 5
QLD

Workshop and end of year networking function
Technology workshop on latest developments in FRP reinforced concrete structures followed by end of year networking function.

For full details and to register go to. www.compositesaustralia.com.au/events

Disclaimer: This schedule was current at time of going to print but is subject to change. Composites Australia is not liable for any loss or expenses incurred due to changes in the program.

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