

create

ENGINEERING IDEAS INTO REALITY



ENGINEERS
AUSTRALIA

DEEP CLEAN

WHAT IT TAKES TO
BRING NEW LIFE
TO AN OLD PETROL
STATION SITE



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WILD RIDE
ENGINEERING A THEME PARK

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SYDNEY MODERN
TURNING AN OIL TANK INTO A GALLERY

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GREEN INFRASTRUCTURE
CLIMATE SMART ENGINEERING 2023



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THE JOURNAL FOR ENGINEERS AUSTRALIA

VOL. 9 | NO. 9 | OCTOBER 2023



IMAGE: JESSE BOWSER ON UNSPLASH

THE PRICE OF PETROL

As the world moves on from fossil fuels, it turns to the question of what to do with decommissioned service stations. The clean-up work is neither simple nor cheap.



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MECHANICAL

Balancing safety and excitement in a theme park ride requires careful engineering.

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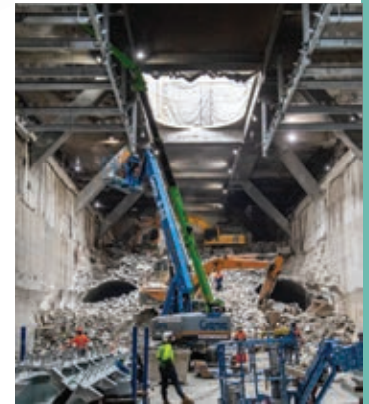
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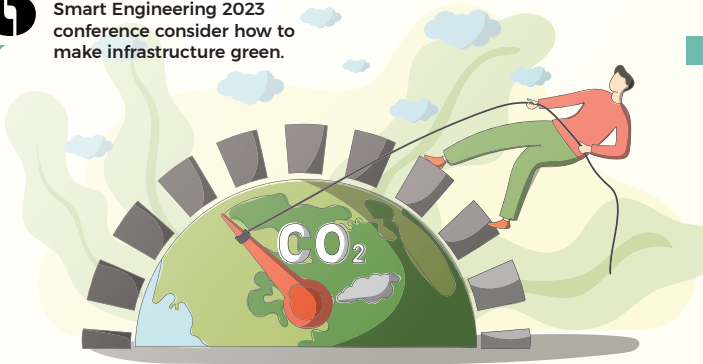
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Engineers Australia celebrates a wide range of cutting-edge projects from around Australia.

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createdigital.org.au

Check out the *create* website — your best resource for the latest engineering news and information from Australia and the world.



Excellence now – and in the future

FLAGSHIP ENGINEERS AUSTRALIA EVENTS PUT THE SPOTLIGHT ON THE ACHIEVEMENTS OF ENGINEERS TODAY – AND LOOK TO HOW THEY CAN MAKE A MORE SUSTAINABLE WORLD FOR TOMORROW.

WELCOME TO the October edition of *create*.

As the end of the year approaches, so are two of Engineers Australia's exciting and impactful events: the Excellence Awards and Climate Smart Engineering 2023 (CSE23).

In this month's magazine, you will learn more about the outstanding contributions of our state and territory Excellence Awards 2023 winners.

These engineers will be in the running for a prestigious National Award in their respective categories at our gala Excellence Awards event in Melbourne next month.

They are deserving of this recognition for the outstanding

They shine a spotlight on the best of engineering.

CSE23 is also happening in November.

A packed program will bring climate leaders together with industry, business and policymakers to debate – among a plethora of topics – solutions to climate change, boosting the circular economy and insights into what sustainable infrastructure means to engineering.

The "Building Green" article in this edition previews some of what is in store.

Stories of the breadth and creativity of the profession are canvassed throughout this month's magazine.

validations and proper encryptions are in place can make this engineering job an adrenalin rush.

And as more people purchase electric cars, is the end of the petrol pump era looming? What will it take to prepare service stations for a second life?

Remediation of sites is not straightforward, and engineers are helping by designing and facilitating monitoring programs at high-risk sites to detect leaks, reduce petrol contamination and assist in clean-ups.

The result in one instance is a café, co-working space and a museum.

We hope to see you at the Excellence Awards and CSE23.

"The awards play an important role in promoting engineering excellence and the significant contribution engineers make to the community."

contributions they have made to the engineering profession.

The Excellence Awards have a long history. Established more than a century ago, the awards honour the outstanding achievements of the country's engineers across the categories of people and projects, and play an important role in promoting engineering excellence and the significant contribution engineers make to the community.

They are an opportunity to celebrate the innovators and thank the problem-solvers. They provide a platform for our winners and finalists to be advocates for the profession and inspire the next generation of talent.

create speaks to the engineers charged with bringing theme park rides to life.

Safety is always the bottom line, but maximising innovation, the thrill of the experience and combining diverse technologies within a single ride are constant and evolving challenges.

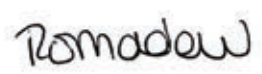
It's all about the technology for the engineers trying to thwart cybercrime.

According to the Australian Cyber Security Centre, 164 cybercrime reports are made every day. "White hat" or ethical hackers are cyber security engineers who are charged with testing system vulnerabilities.

Simulating real-world attacks while racing against the clock to test input




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Keeping current

I found the article about wave energy ("Catching a wave", *create*, August 2023) very interesting. It reminded me about an article on water energy I read many years ago that discussed using the strong and regular sea currents flowing down the east coast, and a proposal to suspend turbines in the sea to enable these currents to generate electricity.

Since then I have not read any more about this concept. Presumably, there were practical difficulties in developing the concept to working models.

I am wondering if this former concept could be updated considering the current proposals to erect marine wind farms off the NSW coast.

The wind turbines could provide anchorage for the current generators and cables installed to connect the wind turbines to the mainland grid.

Is it my wishful dreaming or is there some group working on this concept?

DOUG CRAWFORD

"I've found it to be incredibly effective at channelling the creativity of engineers towards problems that matter in ways that can have real impact."

In praise of product management

There's some great coverage in *create* on the interesting and fantastic things engineers are doing with technology.

These inventions can have real impact if effectively commercialised and scaled; however, this can be challenging for many engineers who are masters

of their technical domains but struggle with the other aspects of making innovations truly successful.

Product management is a discipline that embodies design thinking, lean approaches and agile delivery to discover the right problems to solve and harness the creativity of engineers to deliver solutions that create great value for customers as well as the business.

As a mechanical engineer who has worked extensively in the innovation space and has now been practising product management for over five years, I've found it to be incredibly effective at channelling the creativity of engineers towards problems that matter in ways that can have real impact.

Yet I rarely hear about product management in engineering circles within Australia.

At its heart, product management works to reduce risk in four key areas:

- Desirability risk: does the invention solve a real problem and in such a way that people will want to pay for it?
- Technical feasibility risk: can the invention be designed in a way that makes it safe, secure, performant and scalable?
- Viability risk: can value be created and delivered to customers through a business model that generates revenues that exceed costs?
- Ethical risk: should it be built? What is the potential for misuse and what are the impacts on people and the planet?

This makes product management a great fit for engineers in many technical domains and sectors – not just software.

Not every product manager is an engineer, but many engineers make fantastic product managers.

**AIDAN DEPETRO CPENG
DIRECTOR OF PRODUCT
DELOITTE SOFTWARE GROUP**



create

welcomes
feedback from
the community

Do you know of an exciting project we should write about? Is there an outstanding engineer in your midst? Are you working on an innovative technology that you'd like to share with your fellow members? Are there engineers out there doing their bit to help the community? Do you want to comment on an article you've read in *create*?

Email letters@engineersaustralia.org.au and we'll be pleased to consider your suggestions.

Bollard Anchoring in a Rail Tunnel

When it comes to tunnel construction projects, the importance of reliable and durable anchoring systems cannot be overstated.

Our CS-DZ dynamic studs and EF500R+ chemical anchor were employed to anchor the track-bearing bollards down to the tunnel floor because of the ETA certification we could provide for both fatigue loading and 100-year design life. Thus, providing a secure and stable anchor solution for the project's railway track system.

Designed for areas of high attenuation these bollards were installed in penetrations within the suspended track floor segment and anchored to the tunnel floor. Holding the track floor segment from moving latitudinally or longitudinally.

In addition to our studs and anchors, we also provided an innovative solution: an aluminium drilling template. This tool ensured that our studs and anchors were installed perfectly in place, guaranteeing their effectiveness and longevity. These items played a critical role in anchoring the track-bearing bollards to the tunnel floor, ensuring the stability and success of the railway system.

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Best of the best

A PRESTIGIOUS GALA DINNER HELD IN MELBOURNE NEXT MONTH WILL SEE AUSTRALIA'S FINEST ENGINEERING PROJECTS CELEBRATED WITH THE 2023 ENGINEERS AUSTRALIA EXCELLENCE AWARDS.

AMONG THE cutting-edge projects in the running for the 2023 Engineers Australia Excellence Awards are urban redevelopments in Adelaide and Brisbane, an agricultural robot developed by Monash University and educational facilities in Western Australia and the Australian Capital Territory.

The finalists were announced at regional ceremonies across the country last month.

A redevelopment of Central Station was awarded the prize for the Sydney region in what judges described as an "impressive example of enhancing both the economic and social outcomes from a project having national prominence and significance".

Comprising the most significant upgrades to the station in decades, the project was praised for a novel top-down construction approach that led to efficiencies in project implementation in a live rail environment.

Other major urban projects also received recognition, with Queensland's award going to Heritage Lanes at Brisbane's 80 Ann Street.

A 35-storey premium office tower spread across 74,000 m², Heritage Lanes was noted for being one of Australia's most sustainable commercial buildings.

"Heritage Lanes is considered a new benchmark for the Australian building industry, setting a high standard for achieving a Green Star-rating incorporating sustainable development principles including solar



CLOCKWISE FROM TOP LEFT: Heritage Lanes, Brisbane; Monash University's apple-picking robot; the Adelaide Festival Centre; Sydney's Central Station.

"ENGINEERS SOLVE PROBLEMS. AND THAT IS EXACTLY WHAT THE MONASH UNIVERSITY TEAM HAS DONE IN DEVELOPING THEIR MONASH APPLE RETRIEVING SYSTEM."

power, beehives, and community gardens," the judges said.

In South Australia, the Adelaide Festival Plaza redevelopment was seen as a transformational project that connected six major buildings and revitalised a landmark precinct.

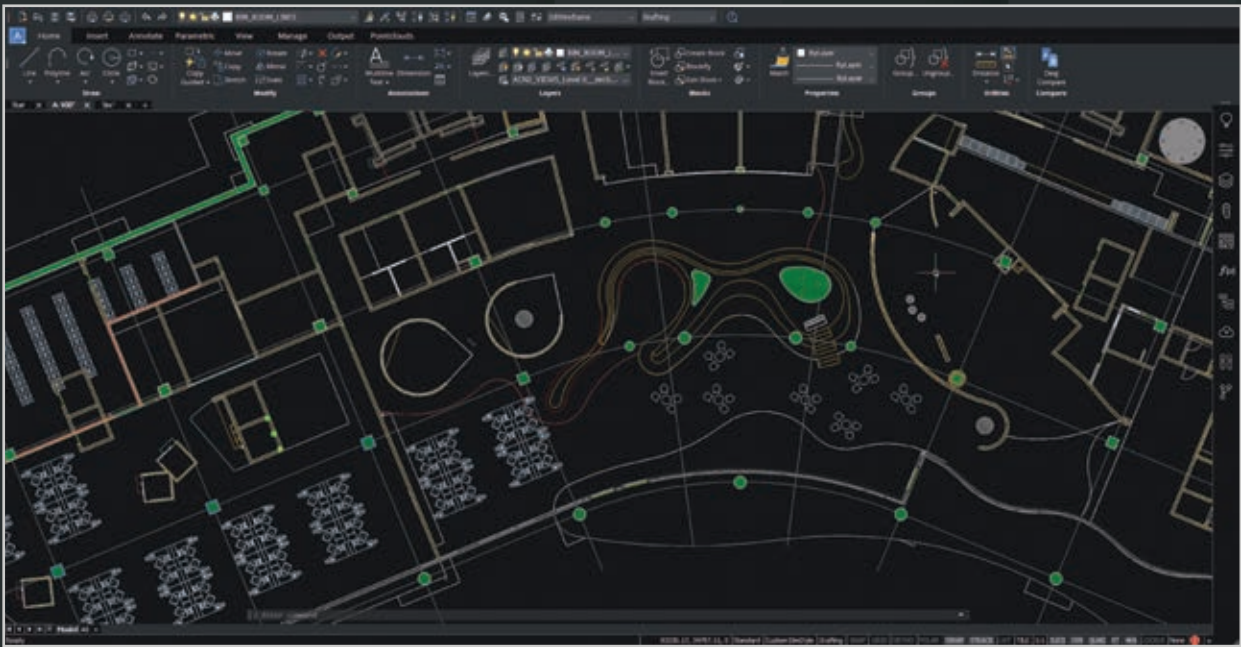
"The Adelaide Festival Centre Project is an outstanding example of the manner in which a range of carefully considered and innovative engineering solutions can come together to ensure a creative, playful and functional architectural vision can be realised in such a high-profile public space," the judges observed.

Victoria is represented by a Monash University team responsible for developing an apple-harvesting robot that can identify and pick ripe fruit before depositing it in a collection box.

"Engineers solve problems. And that is exactly what the Monash University team has done ►

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in developing their Monash Apple Retrieving System (“MARS”) apple harvesting robot,” said the judges.

“By reducing reliance on manual labour, MARS solves several problems for the apple-growing industry.”

Academia is also represented in the awards by Murdoch University’s Boola Katitjin, the largest mass-engineered timber building in Western Australia, which will accommodate large-scale collaborative teaching-learning spaces.

Commending the potential for the project to be an “engineering influencer”, the judges noted that Boola Katitjin is “already attracting global attention for its contribution to advancing the sustainable, renewable and circular approaches required by the construction industry to assist economies to reach their net-zero carbon goals”.

In Canberra, the Australian National University Research School of Physics is nominated for its transformation of an elite scientific facility into a collaborative workspace fostering creativity and a sustainable future.

“This project will be key in assisting the research school to meet its objective of being one of the top 20 institutions of its kind in the world,” the judges said.

“The clean rooms, low-vibration acoustics, AMF and RF isolation enable advances in quantum physics, photonics and nanotechnology as well as on many other fronts.”

The winner of the Newcastle district was a biological leachate remediation program by ENV Solutions in response to environmental contamination in the Lismore region of New South Wales after heavy rainfall and flooding in early 2022.

Combining physical, biological, polishing and disinfection water treatment stages to effectively manage the complex composition of the leachate, the effort was praised by judges as an innovative and novel approach



“THE PROJECT REPRESENTS A SUPERB BLEND OF TECHNICAL EXACTITUDE, INNOVATION, SAFETY AND ENVIRONMENTAL SENSITIVITY IN THE DELIVERY OF A CRITICAL COMMUNITY ASSET.”



ABOVE:
Boola Katitjin,
Western Australia.
LEFT (from top):
ANU’s Research
School of
Physics; leachate
remediation
in Lismore;
Tasmania’s Bruny
Island pipeline.

that demonstrated the ecologically sustainable and cost-effective nature of the technology.

Significant energy infrastructure projects form the regional winners from Tasmania and the Northern district.

The unanimous winner in its region, the Northern Territory’s Jabiru Hybrid Renewable Power Station is able to supply the Jabiru community with 100 per cent solar power on most days, and features a 3 MW/5 MWh solar battery that has reduced diesel consumption by an estimated 1.7 million litres per year.

“This power system solution demonstrated community and cultural engagement in design, construct and operational phases, and innovative optimised control systems maximising solar and battery use with the security of diesel backup,” the judges said.

In Tasmania, the Bruny Island submarine cable replacement project received top honours for its role in repairing a damaged cable that provides essential electricity and fibre optic connectivity to the community.

“The Bruny Island power cable replacement project represents a superb blend of technical exactitude, innovation, safety and environmental sensitivity in the delivery of a critical community asset,” the judges said.

“It stands as a testament to problem-solving, adaptability, and the high standard application of engineering principles.”

Along with the Project of Year winners, the Excellence Awards will also celebrate individual entrants in the Engineer of the Year and Emerging Engineer of the Year categories. •

JONATHAN BRADLEY

The winning project will be announced at the national Excellence Awards in Melbourne on 29 November.

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WORDS BY ELLE HARDY

GUARD DUTY



ACCORDING TO THE AUSTRALIAN CYBER SECURITY CENTRE, 164 CYBER CRIME REPORTS ARE MADE BY AUSTRALIANS EVERY DAY. *CREATE* MEETS THE ENGINEERS TRYING TO THWART THESE ATTACKS.

H **EAVYWEIGHT BOXER**
Mike Tyson famously said that “everybody has plans until they get hit for the first time”.

That’s the reality of the digital world when it comes to cyber security and data protection, a rapidly growing industry that the Australian government projects will be worth \$7.6 billion by 2024.

Even with all eyes on the online crooks, so far in 2023 there have been 39 large corporate data breaches.



**“YOU HAVE TO
LEARN TO THINK
LIKE AN ATTACKER,
AND INFORMATION
IS GOLD TO THEM.”**

Victims include major banks and state governments as well as giants in health, telecom and retail.

In the Optus network breach alone, cybercriminals believed to be working for a state-sponsored operation may have accessed data of up to 9.8 million customers – accounting for about 38 per cent of Australians.

The Medibank attack similarly saw the sensitive information of 7.8 million national and 1.8 million international customers leaked.

Combating cybercrime requires robust prevention and response, but a number of leading cyber engineers say that's only the beginning.

THINK LIKE A HACKER

For large corporations, trying to get ahead of the bad guys is key to maintaining good cyber defences.

“White-hat” or ethical hackers, are cyber security engineers who test system vulnerabilities. Kat Ramos is one such hacker for ANZ.

Just one day after winning two gold medals for archery at the World Dwarf Games, Ramos sat down with *create* to explain how penetration testing helps engineers to prepare for an attack.

“We test our web and mobile applications by simulating a real-world attack,” she said.

“Then we can advise our applications team on what we did, and the best way to prevent a similar attack in future.”

Ramos said that testing is done using checklists in a timebox manner – racing the clock to see where they find vulnerabilities in a way that sounds a bit like a Hollywood film.

“We might only have one week to test input validations and proper encryptions are in place,” she said.

That's because white-hat hackers like her are always trying to expose weaknesses and have them patched up before

bad actors can step in, so they're operating under time constraints, just like cyber criminals.

“There's always a new attack, so we can't rely on replicating the ways that systems have been attacked in the past,” Ramos said.

“Technology keeps changing and hackers keep improving, so it's really important to continue learning.”

She points out that criminal hackers have more time to learn than engineers playing defence.

“You have to learn to think like an attacker,” she said.

“And information is gold to them.”

“UNSEXY” SECURITY

For Alex Tilley, Secureworks' head of threat intelligence, Asia-Pacific and Japan, private companies have to work hand-in-hand with governments to combat online crime.

Prevention is the hard part, he told *create*, because “if bad guys want to get in, they'll find a way to get in”.

Tilley, who has worked in cybercrime operations for online casinos, banking,

security and law enforcement, maintains a government security clearance, which means he can't go into specifics about state-sponsored cybercrime.

But no matter who is attacking systems, he said, “prevention is about things like patching, configuration and restriction of access, and secure coding practices”.

Equally, it's important to be able to spot when a breach occurs.

“A lot of places don't have the visibility to spot the breach as it's happening, or at least quickly after it's happened,” he said.

A number of recent “name-and-shame” ransomware attacks have also seen the “bad guys control the narrative around the breach”.

Spotting a breach, even if it is a day later or a week later, allows businesses to exert more control over the situation.

“You can't form a good risk-based approach if it's a bad guy who comes to you saying, ‘we've just taken all your data’ – and you do not know if that is true,” Tilley said. ▶

BELOW
(from top): Kat Ramos, ANZ; Alex Tilley, Secureworks.





SUSTAINABLE RECYCLED TOOLS FOR A QUIETER RAILWAY

Noise pollution is an insidious issue, which is why Strailastic has developed recyclable mini sound walls and dampers to curb the problem at its source.

High levels of rail noise and vibration emitted by railways and tunnels have a detrimental impact on communities located close to railways.

Up until now, new projects erected imposing high concrete walls with high embodied energy, loss of views and graffiti.

But there is another way with STRAILastic's environmentally effective 70% recycled noise toolbox, with its alternative mini noise walls. They are erected close to the noise source for a third of the cost, according to Rod Pomroy, Managing Director of STRAILastic Australia.

These high-absorbing low walls can reduce noise by up to 11 dBA. They don't create a large visual barrier, thereby granting residents and passengers an unobstructed view with significant noise reduction.

STRAILastic's noise attenuation toolbox includes walls, acoustic panels, vibration pads and ballast mats, all designed to trap and reduce noise and vibration where it is generated within the railway corridor – as close to the source as possible.

Mini sound protection wall in action

Oberwesel, located in Germany's Middle Rhine Valley, is famous for its well-preserved town along the Rhine River. Between the wall and the left bank of the Rhine is a railroad embankment with a heavy freight double-track railway where noisy rail freight traffic used to impact Oberwesel residents and affected public life.

To combat this problem, Deutsche Bahn (German Railways) contracted Kraiburg Strail GmbH & Co. KG to install Strailastic_IP infill panels to successfully reduce the noise. In another site at Nordhorn northern Germany an old industrial site was allowed to be redeveloped for housing once combinations of IP, mSW360 walls and Inox2.0 dampers had been installed on the adjacent rail corridor.

These combinations provided effective sound insulation due to a highly diffusible surface on the front of each IP and mSW element. Further the dead weight of the rubber compound panels provides an additional damping effect when retro fitted using the existing safety structures.

STRAILastic's mini sound walls are being installed across Europe with either the new high absorbing panel or earlier panel. Recent projects have been completed in Germany Spain and Italy with planning completed for a major rail junction near Budapest, as part of a major push to quieten existing railway lines and build more sustainable communities.

"Our noise walls are being widely used in areas where engineers want to reduce noise whilst communities want to minimize the visual impact on often heritage areas," said Pomroy.

"Houses are often located close to train tracks so we want to provide an aesthetic noise reduction solution."

Driving home the benefits

STRAILastic mini sound walls can be easily retrofitted into existing tracks with steel sleeper extensions or attached to screw pile foundations or fixed direct to existing concrete walls.

There is no fatigue of material due to the passing train push pull forces or vibration upto 160km/hr. The material is fire, graffiti and UV resistant.

"The product has proven to be long-lasting and effective with low embedded energy," said Pomroy.

"Noise is one of the worst polluters. Reduce the noise without blocking the views, all helps to green our neighbourhoods and create healthier communities."





That means getting what he calls the “unsexy security” right in the first place, through secure coding practices and secure development practices, as well as regular internal and external reviews.

One common problem is constantly adding to systems without going back to check that the fundamentals are still in place.

“Companies will have an authentication scheme, but it might have been implemented 12 years ago,” he said.

The way to get visibility, he said, is through the practice of logging, which is a record of the events – such as failures or changes to an application – occurring within a company’s IT systems and networks.

“Everyone hates it, but what we find when we do incident response engagements is that they often involve someone making a

“YOU CAN’T FORM A GOOD RISK-BASED APPROACH IF IT’S A BAD GUY WHO COMES TO YOU SAYING, ‘WE’VE TAKEN ALL YOUR DATA’ – AND YOU DO NOT KNOW IF THAT IS TRUE.”

decision five years ago that is no longer best practice,” he said.

Reviewing web and database servers ensures that the logging of activity and actions or strange activity can filter out the normal from the malicious.

“The worst day to find out that your data logging hasn’t been up to date is the day of an attack,” Tilley said.

Even if logging history is stored on a USB drive, he said, it’s better than nothing.

Modern attacks require sorting through a lot of logging data to find out what has happened.

Creating meaningful data visibility is the aim of the game, as hackers tend to use web shells to gain access to systems.

“Web shells are where someone finds a mistake, or security flaw, in a web application that lets them upload malicious code and tricks the web server to run it, and they can use that to execute commands on your internal network,” Tilley said.

Not logging extra details of what the web application is doing – such as the commands it is running on the web server, who is connecting to the web server, and what they are sending or receiving – means that “in the event that an attacker is trying to extort you, you can’t see how much data was stolen.” ▶

Tilley points out that engineers of all stripes often work in highly regulated environments, and that requires them to know what has actually happened in the event of a security breach.

“You can’t reconstruct the log from nothing,” he said.

“No one likes to be in a situation where you’re trying to infer what happened.”

Not only do firms want to have the actual data, but third parties such as regulators and stock markets will expect you to as well.

“The last thing you want to say is ‘we don’t know’ – and that puts the bad guys in charge of the narrative,” Tilley said.

When it comes to responding to an attack, Tilley said that he’s a realist. Having a proper action plan in place, which covers everything from insurance, communications and even what to do with staff makes a stressful day a little bit easier.

“I’ve been involved in a lot of crisis situations, and they tend to involve people sitting around a table yelling at each other,” he said.



“HAVING AGREED WAYS OF DEALING WITH CERTAIN ISSUES UPFRONT CAN HELP YOU FOCUS ON WHAT MATTERS MOST.”

“That’s not helpful, and it slows down responses. Having agreed ways of dealing with certain issues upfront can help you focus on what matters most.”

ENGINEERING SOLUTIONS
Shireane McKinnie, chair of Engineers Australia’s Cyber Engineering Working Group,



BIG BREAKS

LATITUDE

March 2023
Impact: 14 million customers in Australia and New Zealand

The personal loan provider’s defences were breached by stealing a set of employee credentials. The data obtained, largely driver’s licence numbers with identifying information, went back to 2005 – well beyond the required seven-year timeframe for holding customer data.

Better cyber-security controls, including encryption and key management for sensitive data, multi-factor authentication, and controls limiting third-party access to data could have helped to prevent the attack.



MEDIBANK

December 2022
Impact: 9.7 million customers

Believed to have been orchestrated by a well-known Russian ransomware gang, the hack originated through the theft of credentials belonging to an individual with privileged access to Medibank’s system. Their credentials were then sold on the dark web, with the buyer using them to gain access to customer data. The insurer’s security team was alerted after the hackers had already extracted some 200 GB of information.

It is likely that the hackers obtained the employee’s access via phishing. Best practice credential management to try to prevent such attacks includes



has worked on cyber security at the highest level.

Specialising in electronic warfare in the defence industry, she has worked to secure assets including ships and submarines, as well as sensitive surveillance and telecommunications systems.

McKinnie said that engineers – and not only those working in cyber – have a broad role to play in both preventing and responding to online attacks.

“Engineers need to work across the full lifecycle from the initial planning and understand the requirements for the system to designing, implementing and transitioning it into service,” she said.

When it comes to building systems that shore up electronic defences, McKinnie said engineers need to be “constantly looking at the threat environment”, and understand what implications that environment has for a system.

“We must be designing around that threat environment but constantly reviewing and modelling the threat environment, because it is changing all the time,” she said.

The terrain is always shifting, as bad actors continue evolving and sharing new ways to exploit systems.

Assume that you’re going to have an incident, McKinnie advised, so that you already have a plan in place.

“The quicker you can respond, then the more likely you are to protect your data,” she said.

ALL HANDS ON DECK

The Australian Cyber Security Centre (ACSC), run by the Australian Signals Directorate, has platforms and networks that everyone from individuals to large enterprises can join.

There, tech professionals can find out about threats detected



ABOVE: Shireane McKinnie, Chair of Engineers Australia's Cyber Engineering Working Group.

by the ACSC, and information on how to patch systems to defend against them.

McKinnie said that the Engineers Australia working group is also putting together a career development roadmap and competency framework for cyber engineers, and coordinating a number of continuing professional development events as well as developing guidance on standards for use in the field.

Last year, Engineers Australia delivered a comprehensive submission to the federal government's national data security action plan discussion paper.

“As digital transformation takes hold across many sectors, and control systems are used in a whole range of applications, everyone has a part to play in keeping them secure,” McKinnie said.

“Engineers need to bear in mind these very real threats as they develop solutions to a wide range of problems.” •

“AS DIGITAL TRANSFORMATION TAKES HOLD ACROSS MANY SECTORS, EVERYONE HAS A PART TO PLAY IN KEEPING THEM SECURE.”

limiting each employee's account access to the minimum level required to perform their job, segmenting the network to limit access, and using multi-factor authentication.

OPTUS

September 2022

Impact: 9.8 million customers



State-sponsored criminals were said to be behind the breach that took data dating back to 2017 of almost 40 per cent of Australians. The attackers gained access through an unauthorised API endpoint, which was used for testing and did not require authentication to connect to the system and access customer information. Optus also

stored customer records without unique identifiers.

Risk of API-based attacks can be reduced by ensuring that all APIs are secured with an authentication protocol, as well as by joining the OWASP API Security Project, which regularly updates a public database of known API security risks.

AUSTRALIAN NATIONAL UNIVERSITY

November 2018

Impact: 200,000 students



Undertaking a cyber-attack of “unprecedented sophistication” believed to have originated from China, hackers spent weeks trawling the university's system, which was not detected until months later.

Deploying four spear-phishing campaigns – that is a targeted, rather than broad, attempt to gain information – to harvest staff credentials, it began with an email to a senior staff member that was “previewed” and quickly deleted without being clicked on. From there, the infected staff member's breached email sent invites to prominent school members for a fake event.

Spear-phishing campaigns use social engineering and rely on poor OPSEC, gathering information from social media and other online sources. Ways to prevent it include limiting personal information online, as well as rigorous controls such as multiple sign-offs for wire transfers and alternate ways to confirm requests from seemingly trusted sources.



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DOLRE bridge traffic barriers can play a significant role in extending the serviceable life of many existing bridges - delivering AS5100 and AS3845 compliant protection without the need for expensive deck strengthening works or additional reinforcement.

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 SCAN ME

COMING CLEAN

IMAGE: JESSE BOWSER ON UNSPLASH

WORDS BY **NADINE CRANENBURGH**

AS ELECTRIC CAR SALES REACH AN ALL-TIME HIGH, THE ERA OF THE PETROL PUMP IS DRAWING TO A CLOSE. WHAT WILL IT TAKE TO PREPARE SERVICE STATIONS FOR A SECOND LIFE?

OVER THE first half of this year, 45,000 electric vehicles (EV) were snapped up by Australian drivers, accounting for 8.4 per cent of new car sales across the nation.

And as the transition to electric transport continues over the coming decade, up to 80 per cent of service stations could lose their profit margins and close.

This is not a new phenomenon. According to figures compiled by AECOM, there were more than 25,000 petrol stations across Australia in the 1970s. Today, there are about 7000.

“This is something the industry’s been dealing with for some time,” said Sally Stevenson, Associate Director in AECOM’s Geoscience and Remediation team.

The greatest challenges in repurposing service stations are the cost and time required for full remediation, which can stretch to more than \$1 million per site and take between two and five years.

Converting valuable sites to high or medium-density housing or commercial office buildings can be a profitable exercise for both the landowner and developer – even with the cost of remediation.

For example, in 2019, Caltex sold 25 service station sites in desirable locations across the country for a total of \$136 million.

Lower-value sites might leave the tanks in place and become car washes or used car yards.

There is also potential to convert them to green spaces or walking paths.

Some sites still need a lot of work. According to the most recent New South Wales Environment Protection Authority (EPA) State of the Environment Report, service stations and other petrol industry installations accounted for 53 per cent of significantly contaminated sites between 2018 and 2020.

In July, the NSW EPA list of significantly contaminated

that the PSR is not a full list of contaminated sites.

According to geological engineer and site contamination specialist Patrick Baldwin, there could also be a number of former service station sites that have slipped through the cracks and not been reported to the state EPAs.

“Some landowners might not know that they have service station sites which still have tanks in the ground,” Baldwin said.



“THESE SITES AREN’T BEING REPORTED, MANAGED OR REGULATED. THEY ARE JUST SITTING THERE IDLE.”

sites included 892 service station sites.

About 130 of these sites are no longer used for refuelling. This includes one site in the Sydney suburb of Alexandria that has since been converted into residential apartments.

The Victorian EPA’s Priority Sites Register (PSR) includes 21 service stations, with eight no longer in use. But the EPA notes

“These sites aren’t being reported, managed or regulated. They are just sitting there idle.”

In the past three years, Victoria and South Australia have joined NSW and Western Australia in introducing mandatory reporting of contaminated sites.

“The legacy of derelict service stations is only going to increase once regulators become more vigilant about ensuring owners ▶



“SOMETIMES THOSE CHEMICALS MAKE THEIR WAY INTO THE ENVIRONMENT. MANAGING THE RISK APPROPRIATELY IS KEY TO CREATING A BRIGHTER FUTURE FOR GENERATIONS TO COME.”

report ex-service stations,” Baldwin said.

While the prospect of hundreds of contaminated ex-servos around the nation is alarming, once the sites are identified, the risk can be managed.

Matt Tendam, Associate Environmental Engineer at Aurecon and a board member of Engineers Australia’s Environmental College, explained that engineers can turn the risks of contaminated sites into opportunities.

TOP: A fuel storage tank is removed from a decommissioned service station. **RIGHT:** Geological engineer Patrick Baldwin.



“Our modern lives are dependent on the use of tens of thousands of chemicals,” he said.

“Sometimes those chemicals make their way into the environment. Managing the risk appropriately in line with beneficial land uses and other engineering considerations is key

to creating a brighter future for generations to come.”

CONTAMINATION AND REMEDIATION

According to EPA Victoria, underground petrol storage systems (UPSS) at petrol stations are a major source of both land and groundwater contamination.

This can lead to environmental damage, a hefty clean-up bill and risks to people’s health.

Tendam explains that historically, petrol and diesel leaking from UPSS have caused contamination of soil, soil vapour and groundwater.

“The potential risks are dependent on the location of a service station in relation to sensitive human or ecological receptors,” he said. “For example, use of groundwater for potable or non-potable purposes, potential for inhalation of vapours, direct ▶

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contact with soil or proximity to a surface water body.”

Soil vapour can also travel upwards and affect the indoor air quality of basements onsite or in neighbouring residences.

Tendam believes that most subsurface contamination is due to legacy issues from old UPSS that have since been replaced.

“Once petroleum is released to the ground, it takes many years or decades to remediate,” he said.

“Often, it is not technically or economically viable to remediate the impacted soil, soil vapour or groundwater to non-detectable concentrations.”

Modern UPSS systems with leak-control devices and monitoring have greatly reduced the issue. But even small petrol leaks can lead to significant contamination.



“If you are pushing 100,000 litres into a tank and you have a very minor leak, you might lose 500 or 600 litres each time,” Baldwin said. “But if you multiply that by one load a week over a 30-year lifespan that adds up to a lot of leaked fuel.”

Some elements of fuel, including benzene, a carcinogen, can also be dissolved in groundwater and travel a significant distance from the site.

ABOVE (clockwise from top): An abandoned petrol station in remote Western Australia; Matt Tendam, Aurecon; refuelling an underground fuel tank.

So how can these sites be cleaned up?

In Australia, remediation is usually tackled on a site-specific basis, which uses a risk assessment approach to balance the available budget and time with factors such as the technology used, extent of remediation, site geology and size, and intended land use.

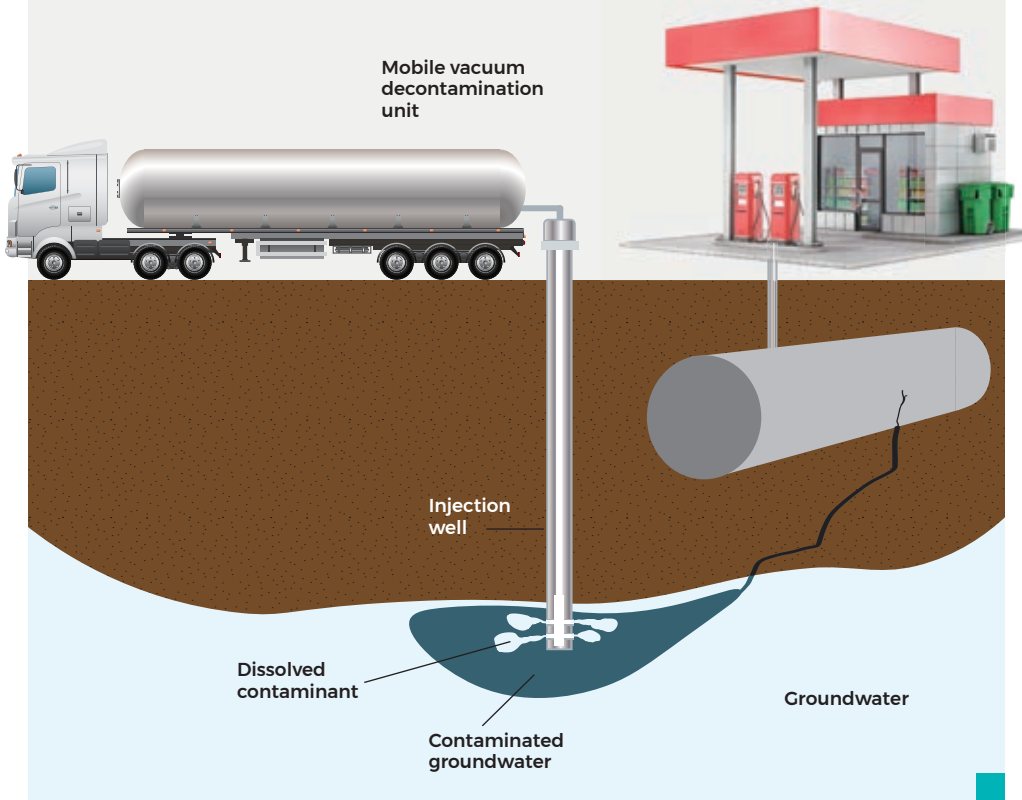
For example, a site slated for residential development or

childcare would require a higher level of remediation than an industrial development.

To do this, engineers and other remediators need to understand the known and unknown sources of chemical contamination on a site, how chemicals travel through the environment, and the ways people and landscapes can be exposed to them.

For example, petrol leaking from a UPSS could travel through

In-situ chemical oxidation



“IF YOU ARE PUSHING 100,000 LITRES INTO A TANK AND YOU HAVE A VERY MINOR LEAK, YOU MIGHT LOSE 500 OR 600 LITRES EACH TIME. BUT IF YOU MULTIPLY THAT BY ONE LOAD A WEEK OVER A 30-YEAR LIFESPAN THAT ADDS UP TO A LOT OF LEAKED FUEL.”

the groundwater as a liquid and come up through a bore water well to be drunk as potable water, or used in irrigation. This is usually summarised in a conceptual site model.

Contaminated sites are regulated in each state by the local EPA, under state environment legislation. The EPAs also provide guidelines for engineers and other contaminated-land professionals.

The National Environment Protection (Assessment of Site Contamination) Measure 1999 (revised 2013) contains screening levels for contaminants based on residential use, and explains the risk assessment process.

There is also a National Remediation Framework produced by the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment.

ABOVE: Remediation using an in-situ chemical oxidation process.

AMERICAN ADVANCES

The US's Environmental Protection Agency has reported that there are about 60,000 contaminated service station sites awaiting remediation, with more yet to be identified.

According to geological engineer Patrick Baldwin, the US is streets ahead of Australia in adopting innovative remediation technology that makes monitoring more cost-effective.

Remediation technologies such as in-situ chemical oxidation are one example.

Aurecon Associate Environmental Engineer Matt Tendam, who worked in the US for the first 11 years of his career, said the US clean-up effort is largely driven by the need to protect groundwater, which makes up half of the national potable water supply, with even more used for crop irrigation.

While Australian use of groundwater is on the rise, it is still much lower than surface water consumption.

One lesson Australia could learn from the US is the need to set aside a government fighting fund to remediate contaminated ex-service station sites when the owners cannot or will not pay, and mandate insurance for service stations to cover the \$1 million clean-up bill.

REGIONAL REMEDIATION

In country towns, the cost of remediation is a barrier that is hard to overcome.

For around a decade, a disused service station at the entrance to the historic town of Beaufort in western Victoria was a graffiti-covered eyesore.

Thanks to the efforts of a local community group, the site now boasts a café and coworking space. It's also home to a museum ▶

What can filmmakers learn from engineers?

The future of 'design and make'

Autodesk is involved in everything in the world that gets designed and made, whether that's buildings, rockets, electric vehicles, or media and entertainment. It wants to unite those industries on a single Design and Make Platform.

"There's no other company that does that," said Haresh Khoobchandani, Autodesk Vice President APJ. "A common thread across all those industries is the intersection of digital and physical worlds, and how these worlds come together."

Sharing knowledge across industries

But what can manufacturers learn from, for example, the media and entertainment industry? Khoobchandani and Andy Cunningham, ANZ Senior Regional Director at Autodesk, are interested in the cross-pollination of ideas.

"Our media and entertainment products are useful as visualisation tools for manufacturing and construction," said Cunningham. "Not everyone can read a plan, but they can watch a movie of a digital model."

On the other hand, the production of any film or TV show involves the management of thousands of individual assets. The lessons learned on a movie set also apply to the built environment.

Cunningham said insights can be taken from manufacturing and applied to construction, and vice versa.

"Buildings account for around 30 per cent of the waste on our planet; what can we learn from manufacturing pre-made structures?" he asked.

"And what can manufacturing learn from construction about producing one-offs? Customisation is a manufacturer's nightmare without the application of technology."




"If we can connect the data across the value chain, and bring collaborators together using the cloud, we will be able to unlock insights," added Khoobchandani.

"We can improve operational efficiency in ways no one else can."

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State of Design and
Make 2023 report



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Using Autodesk for large-scale coral restoration

Coral Maker and Autodesk have partnered to bring the best insights from manufacturing, robotics, and artificial intelligence to rapidly design, prototype, and test technologies for scaling coral reef restoration.

Using the Design and Make platform, Coral Maker produces premade stone skeletons from reclaimed construction waste. These armatures accelerate the process of coral calcification, allowing the corals to reach adult size much faster than in the wild. The coral can then be reintroduced to reefs.

that celebrates the life and legacy of chemist and food technologist Cyril Callister, who invented iconic spread Vegemite.

Full remediation of a former service station site typically involves assessing the contamination, removing underground tanks and cleaning up the soil and groundwater.

"This can cost from \$500,000 to over \$1 million if significant work is required," Baldwin said.

Liza Robinson is President of the Beaufort Progress Association, which now leases the revamped site, dubbed Servo@23. The 1950s building is rich in local history, but its land value does not make a full remediation effort worthwhile.

"The cost of remediation is pretty much out of the ballpark



"IT'S VERY HARD FOR THE REGULATORS TO FORCE CLEAN-UP, BECAUSE CLEAN-UP IS EXPENSIVE. QUITE OFTEN THOSE LEGACY SITE OWNERS DON'T HAVE THE FUNDS TO MANAGE THE CLEAN-UP."

which treat the contamination sources in place without excavation, and ex-situ solutions, which require excavation of contaminated materials.

"Globally, the industry has generally moved away from large-scale mechanical and electrical systems for remediation to 'in-situ' technologies," Tendam said.

Tendam said one of the more interesting in-situ strategies he has used is injection of a sulphate source – such as gypsum – to stimulate the natural biodegradation process, and monitor its process.

Called monitored natural attenuation, this involves bacteria eating the spilt fuel. Although it takes many years to complete, it is one of the most cost-effective remediation techniques.

Baldwin has also used in-situ technologies in several of his petrol station remediation projects. One of these technologies is in-situ

chemical oxidation (ISCO). This involves injecting chemicals into the ground to destroy the petrol or diesel hydrocarbons.

"The chemicals are designed to break down into non-toxic, environmentally friendly by-products once they have done their job," Baldwin said.

Another, more aggressive, technology used in petrol station remediation is multiphase vacuum extraction, or MPE.

This involves installing extraction wells where spilled petroleum hydrocarbons have leaked into groundwater.

Remediators use a high-powered vacuum to remove the hydrocarbon as both a liquid and as vaporised droplets, which speeds up the extraction process.

"Speed is money, so a lot of people remediating these ▶



for a tiny little town like Beaufort," Robinson said.

"They couldn't sell it for the amount of money it would take to fix it."

This is not uncommon in regional towns, according to Baldwin.

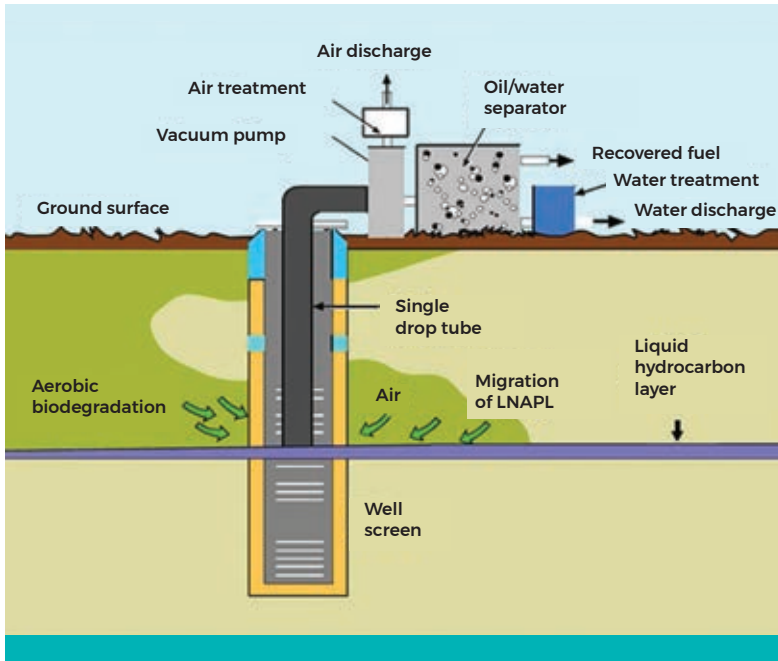
"It's very hard for the regulators to force clean-up, because clean-up is expensive," he said.

"Quite often those legacy site owners don't have the funds to manage the clean-up or even the contamination."

TECHNOLOGY SELECTION

Remediation technologies can be divided into in-situ solutions,

ABOVE: A decommissioned service station in Beaufort, Victoria, has been transformed into a site with a café, coworking space and a museum.



LEFT: This example of multiphase extraction at a contaminated site involves total fluid removal using a drop tube and vacuum blower.

“IT’S A BALANCING ACT BETWEEN THE TYPE OF ATTENUATION, THE SIZE OF THE CONTAMINATION PLUME, AND HOW MUCH TIME YOU HAVE.”

sites want to do it as quickly as possible,” Baldwin said, adding that even aggressive remediation technologies take months to work.

It’s important to select the right technology for the site geology and type of spill.

If the spill is large and complex and has spread quite a long way, Baldwin explained, he might use one of the more aggressive technologies.

On legacy sites, the contamination plume in groundwater is usually quite old, and may have soaked into the soil. This means that aggressive technologies won’t work, and a natural attenuation solution will be a better fit.

“It’s a balancing act between the type of attenuation, the size of the contamination plume, and how much time you have,” Baldwin said.

Soil vapour on redeveloped sites – which can contain compounds such as benzene – can also be

controlled with membranes and soil vapour extraction systems.

MONITORING THE PROBLEM

Over the past three decades, petroleum companies have prioritised remediation of their higher-risk sites, but ongoing monitoring is needed to detect and prevent future issues.

“Engineers can help by designing and facilitating a routine monitoring program to detect leaks early and monitor any known impacted sites,” Tendam said.

When leaks are detected, environmental engineers evaluate, recommend and design appropriate remediation technologies and strategies to reduce the amount of petrol contamination and reduce the risk.

Other engineering disciplines are also involved in petrol station clean-ups.



ABOVE: Sally Stevenson, AECOM.

For example, civil engineers might oversee the installation of new UPSS, along with leak prevention and detection equipment; geological and geotechnical engineers specialise in underground rock formations; and process engineers might be involved in the design of remediation systems.

Modern UPSS at operating service stations are made from corrosion-resistant fibreglass and have double walls to prevent leaks.

This can be combined with leak monitoring using devices to draw samples from monitoring wells, and electronic inventory monitoring to track fuel entering and leaving the system.

Decommissioned and redeveloped sites may also be monitored to track soil vapour and soil or groundwater contamination.

“All of these measures have greatly reduced the potential for leaks or that leaks will be detected as early as possible to address them as soon as practicable,” Tendam said. •

Health check

AECOM’s Sally Stevenson said that rather than mandated clean-up limits, Australia has nationally consistent health-screening levels to measure soil and groundwater against to ensure that they meet land-use threshold levels.

Australia’s National Environment Protection (Assessment of Site Contamination) Measure includes four types of land use: low-density residential, high-density residential, commercial and industrial, or recreational (for parks and ovals, for instance).

“You can also develop site-specific remediation criteria depending on the specific site conditions,” Stevenson said.

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THRILL

FOR THE ENGINEERS CHARGED WITH BRINGING THEME PARK RIDES TO LIFE, IT'S VITAL TO BALANCE INTENSITY AND SAFETY.

HOW DOES an engineer create excitement, danger and fun?

And, more importantly, how does an engineer ensure these thrills are actually safe, meeting all regulations, even as the end user is speeding through the sky, gliding across water or perched hundreds of metres in the air?

These are just a few of the challenges faced by Australia's amusement park designers and engineers, who work hard to bring some of the safest "danger" you can experience across the country.

There are currently 35 operating roller coasters around Australia, with more than half of them in Queensland, as well as a raft of other amusement park rides across the country designed to entertain people.

Each one has required a unique design and engineering approach to suit Australian conditions and regulations.

But who are the people building fun from the ground up?

DESIGNING "DANGER"

The creative mind behind Australian design and strategy firm Atomiq is creative director Philip Drake. For him, the amusement and tourism industry has truly been a roller-coaster ride.

Drake's journey to become a major creative mind behind Australia's rides started during the construction of one of the country's largest theme parks.

Beginning his career as a production designer in the film industry, Drake got his first taste of designing for amusement parks when the original Movie World began construction on the Gold Coast. For that project, film designers were asked to come on board to make the site look like the sets on a studio backlot.

"I spent about six months working on Movie World and became very interested in theme park design," Drake said.

"About five years later when I was ready for a career change, I started looking for theme park design projects as a freelancer, eventually forming Atomiq Design - which has led me to working on large projects across Australia, New Zealand and Asia."

These projects include The Claw, Tower of Terror II and the horror-themed Buzzsaw at Dreamworld, as well as the globe's tallest and steepest Tornado slide at Perth's Adventure World.

multiple types of engineers to create something completely new," he said. "The challenges are many and varied as you go through the process. Firstly, translating an abstract experience concept into physical objects and movements is a big step. We have to start by conceiving the ride experience and then figuring out how it can be achieved

"A big challenge, especially for the engineers, is making

PICTURED:
The Abyss
roller coaster
at Perth's
Adventure
World.



"WE MIGHT START WITH AN EXISTING RIDE DESIGN IN MIND OR WORK WITH MULTIPLE TYPES OF ENGINEERS TO CREATE SOMETHING COMPLETELY NEW."

Drake describes his job as creating problems so that engineers can create the solutions. Over his career, he has developed a number of these problems, and evolving technology has enabled him to take different approaches to the rides.

Walking through his creative process for designing a ride, Drake said he starts with a conception of the overall ride experience.

"We might start with an existing ride design in mind or work with

whatever crazy stuff we designers come up with consistently repeatable every three minutes, 10 hours a day, 364 days a year. We need to work closely together and often think outside the box."

He said that while the foundations for creating fun are the same, he is increasingly combining diverse technologies within a single ride.

"While many of the core principals have stayed the same, ►

such as setting out to engage, entertain and thrill, there is definitely a larger toolkit now to consider,” Drake said.

“In the early days, this was mainly scenery, physical effects and perhaps simple mechanics – and that is often still the right way to go for some rides.”

Designers today, however, incorporate virtual reality into roller coasters, or use trackless ride vehicles with story choice options.

“Also, rides that have multiple experiences built in, either through variable routes, variable media, or other customisable aspects,” Drake added.

“There will always be a place for keeping it simple and telling a good story; however, now we consider if we can, or need to, integrate more impactful elements such as large media screens, lighting effects, movement

simulation, animatronics, or even complex ride movements.”

One increasingly important aspect in designing for Australian theme parks is water usage on rides, particularly aquatic experiences. Drake said engineers have adjusted their thinking on water-based experiences.

One technique uses reticulating systems rather than an inbound source to minimise water. Another approach works closely with engineers to control and manage run-off and rainwater to minimise loads on filtration systems.

“IN THEME PARK DESIGN, CORE SAFETY TRUMPS ALL OTHER CONCERNS, AND SOMETIMES THINGS ARE JUST NOT POSSIBLE DUE TO PRACTICAL AND SAFETY MATTERS.”



BELOW:
WhiteWater World
is part of Gold
Coast theme
park Dreamworld.

“I don’t know of any water park these days who is not extremely conscious of water wastage and upgrading systems all the time to minimise their use,” he adds.

STAYING SAFE

Amusement park rides are intricate pieces of infrastructure – machinery that operates on a number of different systems and requires all the elements working in conjunction – there are multiple potential points of failure.

The likelihood of unsafe incidents is low; the International Association of Amusement Parks and Attractions puts the odds of serious injury on fixed-site rides at US amusement parks at about one in 15.5 million. Even so, injuries and even fatal accidents occur.

Between 2001 and 2016, there were 111 serious amusement >



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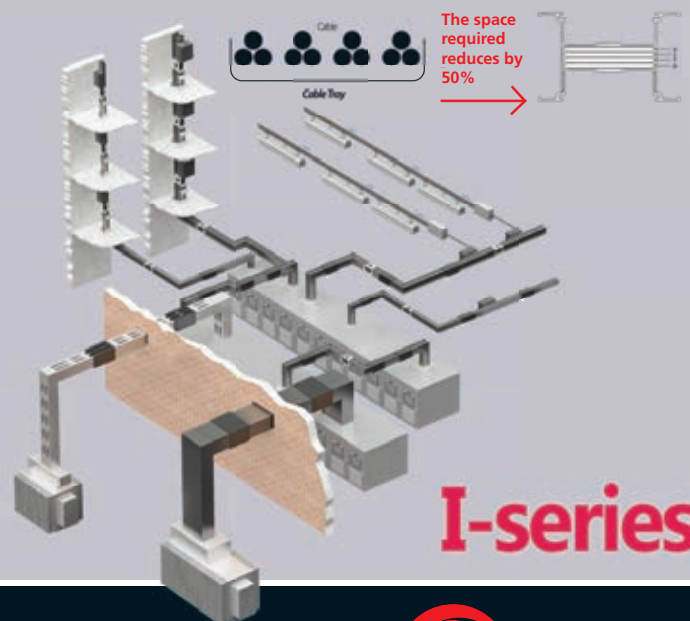
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- Circuit Breaker Selection
- Time/Current Co-ordination Curves
- Co-ordination Curve On Screen CB OCR Adjustment (dynamic)
- User Defined Time/Current Co-ordination Curves
- Selectivity/Cascading
- Maximum Demand
- Cable Thermal Stress
- Let Through Energy
- Cable Sizing
- Conduit Sizing
- Fault-loop Impedance
- Fault Level Calculations
- ARC Fault Check
- ARC Flash calculations
- Harmonic Analysis
- Network Resonance Check
- Harmonic Mitigation
- Power Factor Correction
- Active Harmonic Filter Sizing
- Passive Harmonic Filter Sizing
- Substation Sizing
- Standby Generator Sizing
- Single Line Diagram Display
- Single Line Diagram Export to AutoCAD®
- L.V. Distribution Network Modelling
- Bus-Tie modelling
- Check metering modelling
- Automatic Mains and Submains Cable Selections
- Automatic Final Subcircuit Cable Sizing
- Variable Speed Drives
- Display Load Starting Current Profile
- AutoCAD® Interface for Loads Input
- Light Fitting and Motor Libraries
- Reports with Print Preview
- Direct Online Support
- Standards AS/NZS, IEE, BS, CP5, SAS and IS (India)

Compliance Checking

- ✓ **clause 2.5.5.3 arcing fault clearing capacity of protective devices for feeds of 800amps and above**
- ✓ **clause 2.5.7.2.3 supply circuit discrimination with option for checking protective devices less than 250amps**
- ✓ **clause 5.3.3.1.1 protective earth conductor thermal stress check**
- ✓ **clause 5.7.4 earth system impedance check at 0.4s and 0.5s disconnect times**



I-series



ride incidents in Australia, most caused by operator error.

In 2014, there was a fatal incident at the Royal Adelaide Show and four people died on a ride at Dreamworld in 2016.

As recently as January, Movie World shut two rides – Doomsday and the Green Lantern – after issues were uncovered. A week earlier, riders had been briefly stuck on Sea World’s Leviathan ride after it stalled.

The Leviathan incident came after the ride closed temporarily only days following its opening.

Australia’s – and in particular Queensland’s – amusement park ride safety standards have since been overhauled.

Following a best-practice review in Queensland, new rules were introduced, comprising mandatory major inspections for amusement devices, such as rides.

The people operating specified amusement devices are now required to be properly trained, qualified or experienced, and details of statutory notices are to be recorded in log books. Theme parks must also apply a licensing regime and prepare safety cases similar to the regulatory models of major hazard facilities.

MITIGATING RISK

“In theme park design, core safety trumps all other concerns,” Drake said. “Sometimes things are just not possible due to practical and safety matters.”

He said when it comes to the design phase, if there is a potential

“I KNOW THAT NO MATTER WHAT FANTASTIC RIDE EXPERIENCE WE COME UP WITH, THERE’S A LINE THAT CANNOT BE CROSSED.”

for machinery that is properly operated to cause significant injury, the design and engineering are altered to mitigate the risk or the project will not go ahead.

This may include safety barriers, slower speeds, greater clearances for the ride, or multiple sensors and control systems.

Drake said that these control systems have become a lot more sophisticated and this allows everything to be deployed in a far more tightly orchestrated experience, further aiding safety.

“As a designer, I know that no matter what fantastic ride experience we come up with, there’s a line that cannot be crossed and, apart from simple common sense, we rely on the engineers to interrogate, refine and challenge what can be done, and then to let us know exactly where that line is,” he said.

“As far as I know, most companies in Australia adopt the highest possible standards anywhere in the world.

“If there’s no specific Australian code or standard for something in a theme park, we would often be looking at British, US or German standards, then mirroring the one with the higher levels.” ●

WILD RIDE

Atomiq’s Phillip Drake said making a good theme park ride is about the whole-of-park experience – just having the “tallest”, the “longest”, or the “newest” is not enough.

Drake said Atomiq has designed iconic rides that have resonated with theme park guests. Some of the most recognisable and exciting rides that the company has worked on include:

- The Claw at Dreamworld
- The horror-themed Buzzsaw at Dreamworld
- The Kraken at Adventure World
- The Abyss at Adventure World
- The new Big Dipper at Luna Park, Sydney
- Ice Age: Expedition Thin Ice at Genting SkyWorlds in Malaysia

Drake said what sets these rides apart is that they often have managed to create a narrative that is clear and finds synch with the actual ride movement and experience.

And it is not just theme parks where the company’s designs and engineering cut through for the tourism and leisure industry.

ABOVE: The Kraken, Adventure World. RIGHT: Atomiq installed a giraffe in Federation Square as part of a 2014 Australian Centre for the Moving Image exhibition.



Atomiq has also:

- Designed onboard experiences for cross-continental trains *The Ghan* and the *Indian Pacific*
- Redeveloped Tiger Island for Dreamworld
- Put a giant giraffe into Federation Square in Melbourne



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MINIMALISM AND ELEGANCE WERE THE GOALS OF THE ENGINEERS RESPONSIBLE FOR TAKING WORLD WAR II-ERA INFRASTRUCTURE AND TRANSFORMING IT INTO A 21ST-CENTURY EXHIBITION SPACE.

AT SYDNEY'S Domain, in a cavern deep beneath the ground, great gnarled masses loom out of the black, illuminated by slowly shifting spotlights before winking back into the void.

The forms resist attempts at categorisation; from one angle they look like machinery, as if dinosaurs had been reborn as metal and mechanics. But from other angles, they seem eerily organic, like alien life had begun to metastasise in the gloom.

The setting is a disused fuel bunker: built in the 1940s to serve ships fighting in the Pacific Theatre of World War II, decommissioned 50 years later, and today home – at least temporarily – to the strange monuments that form Argentine-Peruvian artist Adrián Villar Rojas's exhibit *The End of Imagination*.

Villar Rojas was the first artist commissioned to use the space known as the Tank gallery, a major new attraction in Sydney Modern, the \$344 million expansion of the Art Gallery of New South Wales, which opened in December last year.

But before Villar Rojas had even seen the space with which he would fill his unsettling constructions, it was the project's engineers who were tasked with descending into the darkness of the decommissioned fuel tank.

"We looked down into that space and it was all covered in water," recalled Arup structural engineer Andrew Phillips. "We had to go down a temporary scaffold – the gallery had kindly



THE ART OF THE ENGINEER

WORDS BY JONATHAN BRADLEY

ABOVE: The empty tank in 2018, with residual water reflecting the light from above ground.

erected scaffolds so we didn't have to dangle down a rope – but we all had to wear gumboots because it was filled with water."

Acoustic engineer Harvey Yang described the future gallery in otherworldly terms – "a feeling of magic".

"It was very dark; it's not like how at the moment you have lights or you know where the exit is," he said. "When you first step on to the floor, the water starts

making a sound and the tank itself echoes. It felt really amazing – this echo from history."

BUILDING ON BRIDGES

The tanks were first installed when, during the lead-up to World War II, the British navy requested that Australia build a dry dock on Garden Island to ready for potential conflict in the Pacific.

That required fuel tanks for ships arriving in the facility,



IMAGE: BEN JOHNSON

and two were constructed by excavating massive pits in the hillside, which were enclosed with concrete gravity walls and finished with precast columns and a flat slab laid across the top.

Years later, the Art Gallery of NSW turned its attention to the space, looking to integrate it into an expansion that would double its floor space to 40,000 m². Of the two tanks, the south one would become the Tank gallery,

while the other would be used for back-of-house purposes, such as loading and storage.

Adding to the complexity was the Eastern Distributor, a highway running through a tunnel directly to the original gallery's north – exactly where the Sydney Modern wing was to be built.

The entry to Sydney Modern would not be built on solid earth, but rather on a land bridge spanning 11 lanes of traffic.

“The art gallery wanted the new wing to be not too far away from the old wing; some of it had to be on top of that land bridge. It’s not every day that you build a building on top of a bridge, but that was the challenge,” Phillips said. “We had to do some very detailed analysis of that land bridge structure. We analysed every part of it [and] we designed the structure to be as light as possible and then to spread its loads as widely as possible to minimise the impact on that land bridge.”

The engineers also had to consider potential seismic activity, and sought to minimise the horizontal loading the building would impose on the land bridge.

“We designed the new structure to be able to slide across the top surface of the land bridge, so that in an earthquake, they could move independently of each other,” Phillips said.

“WHEN YOU FIRST STEP ON TO THE FLOOR, THE WATER STARTS MAKING A SOUND AND THE TANK ITSELF ECHOES. IT FELT REALLY AMAZING – THIS ECHO FROM HISTORY.”

HISTORICAL ANALYSIS

Although Arup was able to draw on recent and relatively detailed information for its work with the land bridge, this wasn’t the case with the new gallery’s oil tanks.

“Because at the start, we didn’t have a lot of information about that 1940s structure; we didn’t have any drawings of it that we could use to analyse it, so we had to do a lot of the investigation ourselves,” Phillips said. ▶



ABOVE: Andrew Phillips, Arup.



“THE ART GALLERY WANTED THE NEW WING TO BE NOT TOO FAR AWAY FROM THE OLD WING; SOME OF IT HAD TO BE ON TOP OF THAT LAND BRIDGE. IT’S NOT EVERY DAY THAT YOU BUILD A BUILDING ON TOP OF A BRIDGE.”

“We had no idea how strong it would be, how much capacity it would have to have with a new building built on top of it, and so we did a lot of investigation into it.

“There were geometric surveys done and then material testing on the concrete, scanning of the concrete to find what the reinforcement was inside the concrete, strength testing of the reinforcement through taking samples of it.”

They also tested for any damage the oil stored in the tank might have done to the concrete.

“There was that challenge of knowledge – or the lack of knowledge that we had – and how we overcame that,” Phillips said.

“And then the challenge of, once we did have information about it, working out where we could put the new structure over the top of it, and how we could spread the loads to minimise the impact on it.”

In working with the original materials, the team sought to retain the vast majority of the 125 columns within the tank.

“We analysed every single one, effectively. We did a load analysis of all the structures coming down on the top, plugging it into a model, to work out where all the forces were going to trickle down,” Phillips said.

“So we knew exactly what was going to happen in the future in terms of loads on each column,

and then worked out that we could spread the new loads sufficiently to only have to replace 10 of the 125.”

LISTENING SESSION

While the structural engineers dealt with the physical challenges, Yang fine-tuned visitors’ aural experience by drawing on his deep knowledge of the acoustic demands of gallery spaces.

People walk through these buildings in particular ways, and it is important to ensure the sounds of footfalls and quiet conversation don’t resonate unpleasantly throughout the vast rooms. ▶

ABOVE: Part of the Sydney Modern gallery had to be built over a bustling highway. **BELOW:** The building’s design of interlocking blocks.

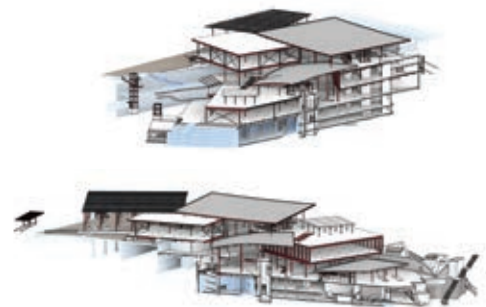


IMAGE: AERIAL VIEW OF THE ART GALLERY OF NEW SOUTH WALES. NEW SANAA-DESIGNED BUILDING, 2022. PHOTO © IWAN BAAN

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The West Gate Bridge Project

Dulux® Protective Coatings is proud to have partnered with McElligotts on one of Australia's largest steel maintenance projects – the West Gate Bridge.

Built in the 1970's, this Melbourne icon was coated with Dulux Protective Coatings and now 40 years on it was time for a remediation project.

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BLAST: The 800m long steel deck had a total of 60,000 square meters to repaint. The underside of the steel deck was abrasive blast cleaned.

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SECOND COAT: The second coat of surface tolerant epoxy Durebild® STE was then applied.

THIRD COAT: Durebild® STE MIO added a layer of surface tolerant micaceous iron oxide, working as a barrier coat for protection against water ingress.

FINISH: A final topcoat of Weathermax® HBR MIO ensured a high build finish.



5 reasons to choose Quadshore™ 150 over conventional propping systems

Designed by engineers at Coates and Monash University, Quadshore 150 is the lightest, heavy-duty propping solution in the world. Here's why you should consider hiring it for your next project.

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Conventional propping systems are often costly and inefficient due to their low capacity-to-weight ratio and bolted module-to-module connections. Quadshore 150 uses lightweight, high-strength steel elements to provide extra-high load-bearing support of up to 170 tonnes. The working load limit-to-weight ratio of a 3m assembly is at least 1.7 times higher than conventional systems.

2. Faster and easier to install and de-install

Quadshore's patented boltless connectivity eliminates the need for consumables. As a result, assembly and disassembly time is at least 60% quicker than conventional systems with the same capacity. A range of end sections means adjustments are faster and easier, too. These include an unloading jack that enables the screw jack to be disengaged with zero manual effort.

3. Safer due to less manual handling

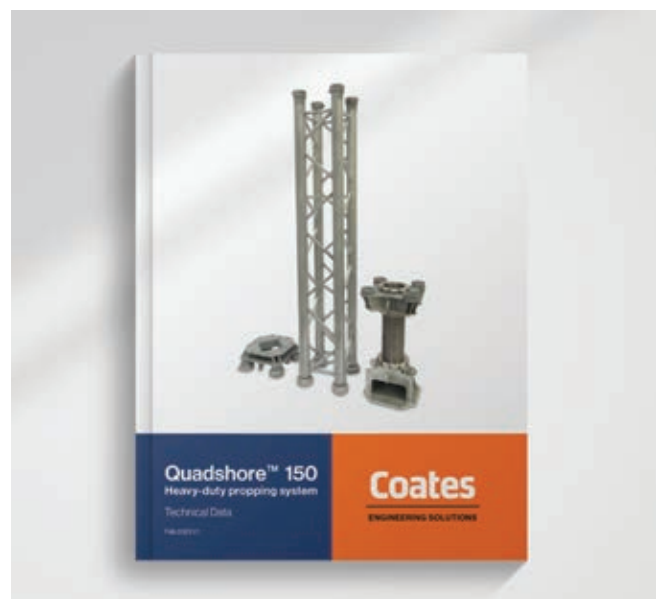
Conventional propping systems pose challenges around safety due to the need for manual handling and heavy machinery or equipment to unload and install it. As Quadshore 150 is considerably lighter with no bolted connections between its modular beams and a smaller site footprint, Coates expects the number of lost time injuries reported by customers will be dramatically reduced.

4. Reduced costs for labour, transport and consumables

Compared with a conventional propping system, Coates estimates that Quadshore 150 will reduce transport costs due to its lighter weight and higher capacity, which means less equipment, machinery and labour are required on site. The boltless design will also result in significant cost savings on consumables throughout the entire lifecycle of the product.

5. Lower carbon footprint due to less transport

Quadshore 150 is more environmentally sustainable than conventional propping systems in a number of ways. As it is made with higher-grade steel, there is less material used in its manufacture and less energy is required for its transportation. Boltless connections mean less waste of any kind of steel componentry.



Learn more

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But the Tank gallery required a different approach to other projects Yang has overseen, such as Hong Kong's M+ gallery or his subsequent work on the new Powerhouse Museum in the Sydney suburb of Parramatta.

For the Tank, Yang pursued what he described as a "do nothing" tactic.

"Traditionally, acoustic design is always about trying to control something - we control noise, we control reverberance to make it sound comfortable," he explained.

"But this type of building is basically an empty space shell for the artworks to fill in. There's no right or wrong [approach] to it."

And for a gallery like Sydney Modern's Tank, it was more important to retain the distinctive qualities of the space and the experiences it offers to visitors.

"The unique experience, as part of the history of that [space] and the origin of the building, should be kept," Yang said.

"It's understanding that space and communicating how to use the space and the limitations and consideration of what needs to be done [to exhibit there]."

To measure the properties of the Tank, Yang needed to gather data about how sounds behaved.

That meant recording a variety of sounds, including a French horn



"THE UNIQUE EXPERIENCE, AS PART OF THE HISTORY OF THAT SPACE AND THE ORIGIN OF THE BUILDING, SHOULD BE KEPT."

being played and a balloon being popped - all before construction even began on the gallery.

"We have this technique to record the signature of a room, which we call the impulse response of the space," Yang said. "[We] generate an impulse signal in the room, and how it reflects that sound back into your microphone gives you a signature of the room's acoustic characteristics corresponding to that point in space."

ABOVE (from top): A spiral steel staircase brings visitors into the Tank; constructing the original fuel tanks.

Yang then created a digital representation of the space with that recording, which could be used for later analysis or to model changes.

The model created from that data could then be replayed in Arup's SoundLab, helping the engineers further understand how sound interacts in the room. More than 90 recordings were used for the Tank gallery, allowing Arup to model five different operational situations for various acoustic treatment options.

The situations modelled were: a conversation in the space, a static exhibition, an event with more than 800 people, a formal speech and a musical performance.

This work showed that certain flexible and low-impact additions, such as acoustic curtains or baffles, might be necessary to hold certain events in the gallery.

BEAUTIFUL WORK

The minimalist approach was not restricted to the sound engineering. Arup Principal Andrew Johnson, the technical director on the project, said the engineers, the gallery and architectural firms Sanaa and Architectus agreed on the "do nothing" approach from the outset.

"Everyone saw it as a space that should be just left as it was, and so, from a functional point of view, it was all about the minimal amount of invasiveness or intervention to make it a space that could be used," he said. "And that was from not just acoustics and structural, that was from a services point of view as well, and then from a curatorial perspective. How could we leave this space alone, and still curate it and use it?"

Phillips affirmed that the team sought to intervene as little as it could.

"The idea was to keep that structure as intact as possible and have as little impact as you could while making use of the space," he said.

"We wanted to minimise the impact on heritage, minimise the structural work we had to ▶



do to make it work, and minimise servicing.”

But when intervention was necessary, the quality the team sought to accentuate in its contribution was – fittingly for an art gallery – beauty.

“For instance, there had to be a way of getting people into the tank, so Sanaa came up with this concept of the spiral stair that comes down through a hole in the roof,” Phillips explained.

“Which is obviously a very clear intervention, but the thinking being, well, if we have to intervene, let’s make it beautiful and elegant.

“And so we helped them design this stair that’s really a monolithic piece of steel that’s quite a beautiful structure in itself.”

This ability to focus on the aesthetic qualities of the project, the engineers said, was the result of strong collaboration with the architect and the gallery.

“Listening to the architects, listening to what’s important to



them, and then trying to bring our skills to realise that vision,” Phillips explained.

For Arup, that meant understanding the level of complexity underlying Sanaa’s streamlined style. The team focused on getting the details right.

“There’s a lot of visible steel structure in the building, and where the pieces of steel connect to each other, there are dozens of different ways to design a connection between a steel beam and a steel column, and a lot of them are not very elegant,” Phillips said. “We could detail those

ABOVE: The entry to the gallery makes use of a modest column grid.
BELOW: Harvey Yang, Arup; Andrew Johnson, Arup.



“WE CAN MAKE THE BUILDING ELEGANT FROM AN ENGINEERING AND ARCHITECTURAL POINT OF VIEW BY MAKING IT TRUE IN THE WAY IT PERFORMS.”

FOUND ART

By seeking to work with the site’s existing material in its construction of Sydney Modern, Arup delivered a number of sustainability benefits for the project.

“It’s that re-use, recycle idea,” structural engineer Andrew Phillips said.

“The more that you can reuse – the less new stuff we have to build – the lower our carbon emissions are.”

It also meant that, by retaining existing material rather than removing and rebuilding, the project sent less waste to landfill.

According to Phillips, approximately 75 per cent of the new building is founded on existing structures, including the 1940s oil bunkers constructed of reinforced concrete and the land bridge over the Eastern Distributor.

The adaptive reuse of the fuel bunkers alone saved more than 2500 m³ of concrete and 250 t of reinforcement – the equivalent of more than 3000 t of carbon dioxide emissions.

connections to be as minimalist as possible and minimise the bolts and plates – more welding than bolting and plating and make those welds as minimalist as possible.”

The beauty extended to the engineering itself, Johnson said.

“We can make the building elegant from an engineering and architectural point of view by making it true in the way it performs,” he explained.

“The column grid is relatively modest, other than the large-span gallery, and that allows us to use an elegantly slender column diameter for its height.

“The roofs of the entry pavilion and what we call the café roof, which is that curved roof over the atrium space ... have a two-way beam structure that is slightly unusual – but it’s very effective and efficient structurally on a square grid.” ●

INTERIOR VIEW OF THE ART GALLERY OF NEW SOUTH WALES; NEW SANAA-DESIGNED BUILDING, FEATURING WORKS BY (LOWER WALL) LINDY LEE AND STANLEY WHITNEY AND (UPPER WALL) ISA REIHANA, 2022. PHOTO © IWAN BAAN; INTERIOR VIEW OF THE ART GALLERY OF NEW SOUTH WALES; NEW SANAA-DESIGNED BUILDING, 2022. PHOTO © IWAN BAAN

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AT CLIMATE SMART
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GLOBAL THOUGHT
LEADERS WILL
PROVIDE INSIGHT AND
GUIDANCE AROUND
WHAT SUSTAINABLE
INFRASTRUCTURE MEANS
TO ENGINEERING.

WORDS BY **CHRIS SHEEDY**

BUILDING

GREEN

WHEN WE discuss the idea of climate smart infrastructure, we're actually talking about several aspects of engineering, said ACT Chief Engineer Adrian Piani FIEAust CPEng.

Engineers ultimately design to optimise variables, he said. And there are numerous variables those in the profession must consider, including safety, robustness, level of service, community needs, asset life and environmental impact.

"The engineer's bread and butter is to find solutions that optimise all of those variables," said Piani, who is speaking at Engineers Australia's Climate Smart Engineering 2023 (CSE23) conference next month.

"Carbon is just a new variable that we need to focus on in our design process.

"In infrastructure, that means that in the next 15 or 20 years, we have to get carbon out of our infrastructure cycle. We create a lot of carbon emissions when manufacturing concrete and steel. We can't do that 15 to 20 years from now. We have to be as near to zero as possible."

Removing carbon from supply chains, then, is one major element of climate smart engineering and infrastructure – and it is no longer a choice.

If Australia is to meet its carbon emissions targets, Piani said, removing carbon from the supply chain is not negotiable.

"That's 25 years to get carbon out of our processes, systems and solutions," he said.

"In infrastructure engineering terms, that isn't very long away."

But the removal of carbon is just one element. Another, Piani said, is designing infrastructure that is fit for our future climate.

"Climate variables – wind speed, rainfall intensity, hottest day of the summer, amount of hot days you get, amount of days you get below zero – these are all straightforward engineering inputs: assumptions in our infrastructure design.

"But when we design infrastructure, what temperature and what wind load are we now designing for? What rainfall intensity do we need to manage? What is the highest temperature we need to deal with? Those variables are changing."

The challenge for engineers in designing climate smart infrastructure concerns those variables, he said.

It is infrastructure that will need to deliver an acceptable level of service and safety 100 years from now.

And with the current rate of climate change, the weather conditions of the future will be very unlikely to match current models.

BEYOND ECONOMICS

Climate smart infrastructure is sustainable infrastructure, and sustainability focuses on more than just the environment, said Lara Parsons, Senior Associate Infrastructure Delivery and Strategic Advisory with Jacobs.

Until recently, sustainability focused on environmental outcomes, she said, but a rethinking considers sustainability as a discipline in its own right,

and considers the tension between environmental, social and economic outcomes in realistic terms.

It is no longer reasonable to look at project or business outcomes as surface-level compliance exercises.

"We are moving towards an integrated discipline," Parsons, who will also present at CSE23, said.

"Sustainability is something we all need to think of and take responsibility for, much like health and safety culture has transformed the way we work in the past 20 years. We're now at a point where we're starting to integrate sustainability into the way we do our business – as we should be."

The challenge, Parsons said, is that the decisions around design, materials and processes for most infrastructure projects are largely driven by what can be measured economically in the short term, rather than looking at projects through a longer-term, climate-smart and resilient asset outcome.

"We're in a hybrid situation where we've got a formal process against which we assess our projects, which is a very economics-based evaluation. This is entirely appropriate because you're spending the public's money and we need to be able to compare projects under a common framework," Parsons said.

"But there is also a growing understanding of the importance of qualitative and non-monetised ▶



ABOVE (from top): ACT Chief Engineer Adrian Piani; Lara Parsons, Jacobs.



"THE ENGINEER'S BREAD AND BUTTER IS TO FIND SOLUTIONS THAT OPTIMISE ALL OF THOSE VARIABLES. CARBON IS JUST A NEW VARIABLE THAT WE NEED TO FOCUS ON IN OUR DESIGN PROCESS."

sustainability outcomes. We haven't quite worked out how to value that in the public realm when making these major infrastructure decisions."

PEOPLE AND PURPOSE

CSE23 speaker Ruby Heard CPEng, Director of Alinga Energy Consulting, said getting sustainable, climate-smart infrastructure right will also involve more just and equitable approaches, particularly in terms of energy.

Look, for example, to the way remote Indigenous communities are not only disproportionately impacted by climate change, being in hotter regions and subject to weather events such as fires and floods, but are also contributing directly to climate change through no fault of their own.

"A lot of them are powered 100 per cent by diesel generators," Heard said.

"That's not up to them. That's what the monopolistic utilities originally set up and what remains across most communities."

Heard said a fairer distribution of ownership of renewable energy infrastructure, particularly a local community ownership model, will require a fundamental change in approach compared to what we've been accustomed to in the past – the centralised-generation model.

The upcoming transition to renewables, to climate smart infrastructure, offers an opportunity to make that paradigm shift, Heard said.

"Not only that, but it gives these communities the opportunity to move back towards living in line with their value systems, towards being in harmony with the planet and living sustainably," she said.



ABOVE:
Ruby Heard,
Alinga Energy.

"They are living in conflict with that right now.

"We'd like to think that the clean energy transition is going to be a fantastic win for the environment. But in this idea of the just transition, we're saying that it should also be equitable and fair for everybody involved."

Climate smart infrastructure means so much more than simply fire-proofing or flood-proofing a physical system.

It is about ensuring the infrastructure delivers a vital service to its community through increasingly challenging weather conditions, but also is being designed, constructed and maintained in a way that is carbon neutral.

It is about ensuring builds come in on budget and that public money is spent efficiently and wisely, while also understanding and providing full consideration to the sometimes immeasurable value of sustainable aspects of a design.

Finally, climate smart infrastructure is about people, particularly the support of individuals and the empowerment of communities. ●

"WE'D LIKE TO THINK THAT THE CLEAN ENERGY TRANSITION IS GOING TO BE A FANTASTIC WIN FOR THE ENVIRONMENT. BUT WE'RE SAYING THAT IT SHOULD ALSO BE EQUITABLE AND FAIR FOR EVERYBODY INVOLVED."



CLIMATE SMART ENGINEERING 2023

Take a deep dive into climate smart infrastructure at Climate Smart Engineering 2023. Now in its third year, the conference will explore the latest in world-leading views and engage in debate on solutions to address climate change, responding to extreme events, biodiversity loss, boosting the circular economy and upholding the principles of sustainable practices in engineering.

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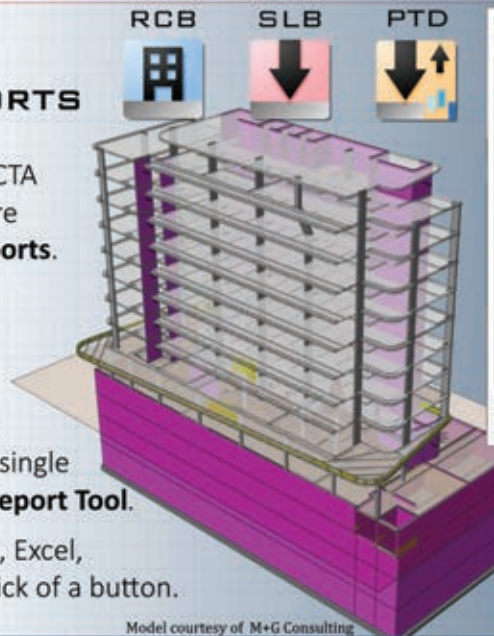
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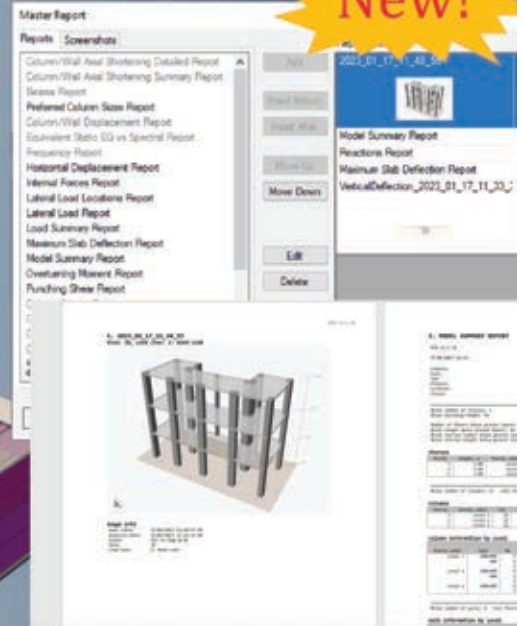
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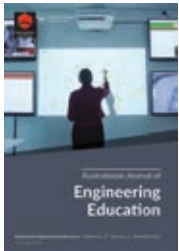
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STAY CURRENT

HIGHLIGHTS FROM AUSTRALIA'S MOST UP-TO-DATE ENGINEERING RESEARCH



BEYOND SKILLS: BUILDING RESEARCH CAPACITY THROUGH COGNITIVE APPRENTICESHIP AND SOCIAL CAPITAL

Journal: *Australasian Journal of Engineering Education*
Authors: K.J. Jensen, I. M. Miller, D. E. Suresh & J. P. Martin

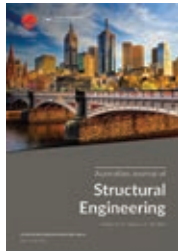
Calls for building capacity in engineering education research (EER) as a discipline have led to the development of workshops, training programs and resources for scholars to learn and practise EER. This study looks at how established researchers help new engineering education researchers build social capital for EER through mentoring relationships.



RESEARCH ON AN IMPROVED CONVOLUTIONAL NEURAL NETWORK FAULT DIAGNOSIS METHOD FOR EXCITER SYSTEM

Journal: *Australian Journal of Electrical and Electronics Engineering*
Authors: J-M. Weng, X. Chen, H. Liu, Y. Qiu, H. Yang & W. An

China's power grid has entered a new stage of ultra high voltage, long-distance, large-capacity, large-unit, AC and DC hybrid interconnection grids, and the generator excitation system is important to the stability of the power system. The exciter is vital to the safe operation of the excitation system. This paper proposes an improved conventional neural network exciter fault diagnosis research method.



SERVICEABILITY PERFORMANCE OF BUILDINGS FOUNDED ON RUBBER-SOIL MIXTURES FOR GEOTECHNICAL SEISMIC ISOLATION

Journal: *Australian Journal of Structural Engineering*
Authors: H-H. Tsang, D-P. Tran & E. F. Gad

Base isolation is a low-damage seismic design strategy that can be used for constructing resilient structures. Geotechnical seismic isolation (GSI) is a new category of emerging base-isolation techniques that has attracted global interest over the past decade. This paper presents the first study on the serviceability performance of buildings constructed with a GSI rubber-soil mixture system.

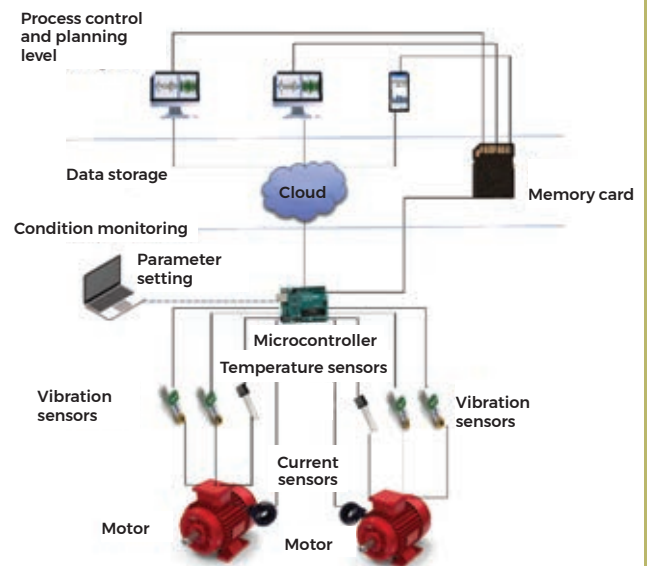


Online condition monitoring system for rotating machine elements using edge computing

Journal: *Australian Journal of Mechanical Engineering*
Authors: N. D. Pagar, S. S. Gawde & S. B. Sanap

For any manufacturing company, industrial equipment maintenance and effective functioning are crucial, so a systematic plan is needed. Misalignment, imbalance, induced vibrations and noise in rotating machines must be identified early using condition monitoring and signal-processing techniques. If these are not detected early, a machine's reliability will suffer, potentially resulting in a catastrophic failure of the machine components. In this study, a web application for real-time fault detection was designed and built using the novel approach of edge computing and the Internet of Things.

BELOW RIGHT: Overall connections of the setup.





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Senior Designer Civil Infrastructure (WSP)

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Senior Civil Designer (MWH)

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<p>07-09 NOV 2023 IMC INTERNATIONAL MARITIME CONFERENCE</p>	<p>Location: in-person <i>Sydney</i> Website: indopacificexpo.com.au/IMC2023 Conference delegates will be involved in discussions concerning the latest developments in naval architecture, marine engineering and maritime technology in the areas of defence and commercial shipping. Register now</p>
<p>12-15 NOV 2023 HYDROLOGY AND WATER RESOURCES SYMPOSIUM 2023</p>	<p>Location: in-person <i>Sydney</i> Website: engineersaustralia.org.au/hwrs2023 Innovation, collaboration and engineering excellence come together for HWRS 2023, with this year's theme "Living with extremes". Topics cover the spectrum of engineering hydrology and the progress made in understanding the uncertainties facing water resources managers now and in coming decades. Register now</p>
<p>07-09 FEB 2024 11TH AUSTRALASIAN CONGRESS ON APPLIED MECHANICS (ACAM 2024)</p>	<p>Location: in-person <i>Brisbane</i> Website: engineersaustralia.org.au/acam2024 ACAM 2024 aims to bring together engineers, academics, postgraduate scholars and industry managers to share research and development in all aspects of applied mechanics. Early-bird registrations close 22 December 2023</p>



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Location: in-person *Melbourne*
Website: engineersaustralia.org.au/cse

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Eytan Lenko, Chief Executive Officer, Boundless Earth
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Dr Larry Marshall, former CEO of CSIRO
Lisa McLean, CEO, Circular Australia
Kane Thornton, Chief Executive, Clean Energy Council
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- INTERNATIONAL WOMEN'S DAY **5-8 MARCH 2024**
- ELEVATION CAREERS EXPO **MARCH 2024**
- AUSTRALASIAN STRUCTURAL ENGINEERING CONFERENCE **28-29 AUGUST 2024**

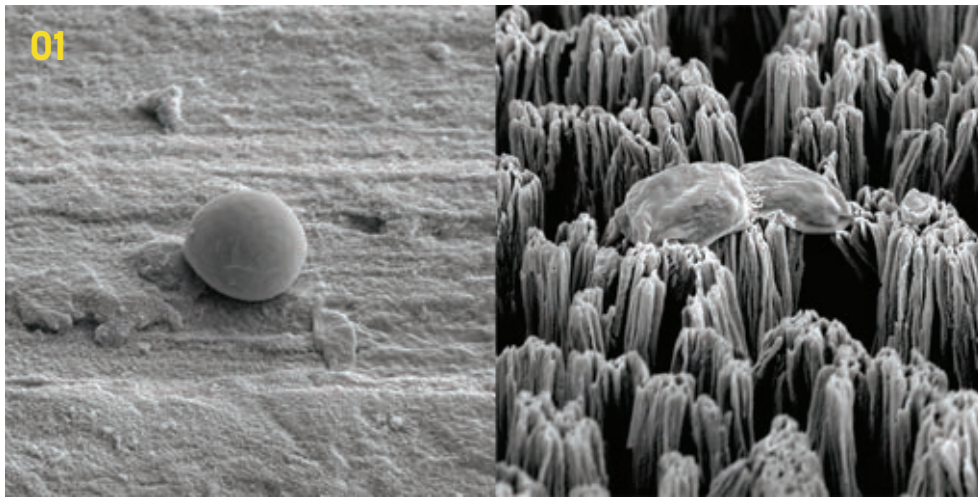
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29 November 2023

Location: Crown Towers, Melbourne
Website: engaus.org/excellenceawards

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THE LATEST DEVELOPMENTS FROM AROUND THE WORLD.



01

Antibacterial micro-spikes

A cell of candida fungus intact on polished titanium (left) and ruptured on micro-spiked titanium (right). Image: RMIT

Researchers at RMIT University are using hostile surfaces to attack increasingly drug-resistant infections. Inspired by bacteria-killing barbs on insect wings, the RMIT team has etched microscopic spikes on to the surface of titanium implants to help prevent infections from being carried on medical devices. Testing the spikes on a strain of drug-resistant candida, a potentially deadly fungus, the team found that the surface killed half of the cells, with the other half damaged to a point where they were unable to cause harm. "The candida cells that were injured underwent extensive metabolic stress, preventing the process where they reproduce to create a deadly fungal biofilm, even after seven days," said Dr Denver Linklater. "They were unable to be revived in a non-stress environment and eventually shut down in a process known as apoptosis, or programmed cell death." Previous studies have shown that the spikes are also effective against pathogenic bacteria such as golden staph.



02

AI timber

Rather than cut logs to size, artificial intelligence was able to fit irregular shapes tightly together. Image: Reed Photographic

Start-up construction technology company Maestro has developed a new method of cross-laminated timber production that uses artificial intelligence to fit together irregularly shaped boards. Rather than wasting wood by cutting felled trees into standardised blocks, the technology scans raw logs, saws them into boards, then identifies the best way to fit the disparate forms together. The process is useful not just because it saves waste, but also because wood offers the construction industry an alternative to carbon-intensive concrete. "Timber isn't just a substitute for concrete; it unlocks new possibilities for prefabricated construction," said Maestro co-founder Mykola Murashko. "Because engineered wood products are lightweight, renewable and dimensionally stable, we can design an entire building in our factory, then ship the flatpack of its components to construction sites around the world." The company's proof-of-concept triangular pavilion was displayed at Shanghai's DigitalFutures conference earlier this year.

03

HADAR imaging

Heat-assisted detection and ranging is a form of passive machine perception. Image: Purdue University

Engineers at the US's Purdue University have developed an advanced form of machine vision named HADAR, or heat-assisted detection and ranging. Designed to augment robots and other autonomous machines, the technology combines infrared imaging with machine learning to improve upon existing LiDAR and heat-sensing approaches to mapping, which have limitations in terms of scale and loss of information and texture. "Our work builds on the information theoretic foundations of thermal perception to show that pitch darkness carries the same amount of information as broad daylight," said Associate Professor Zubin Jacob. "Evolution has made human beings biased toward the daytime. Machine perception of the future will overcome this long-standing dichotomy between day and night." The researchers are looking to improve the technology by making it lighter and faster so it can be used by robots or self-driving cars.

04

Turtle robot

A robot inspired by hatchling turtles digs its way through sand. Image: "Gravish Tolley AIS Sandworm", UC San Diego Jacobs School of Engineering, <https://www.flickr.com/photos/jsoe/53092211984/in/album-72177720309859207/>, CC BY 2.0

Roboticians at the University of California San Diego have created a device that can make its way through sand and detect obstacles

as it moves. Inspired by the flipper-like limbs of baby turtles, the robot has a tapered body and a nose shaped like a shovel. "We needed to build a robot that is both strong and streamlined," said PhD student Shivam Chopra. The robot's flippers allow it to negotiate the unusual properties of sand, which sometimes acts as a solid and other times more like a liquid. Sensors on

the machine's flippers detect changes in torque generated by its movement, allowing it to locate obstacles above its body, while terrafoils on either side of its nose help to control its lift. The team hopes the technology will be useful in such activities as seafloor digging, grain silo inspection or extra-terrestrial exploration.

ENGINEERS AT THE PINNACLE OF THE PROFESSION

Peter Moore

CPEng, CEO Monford Group

CIVIL ENGINEER PETER MOORE IS GRATEFUL TO ENGINEERING FOR SHOWING HIM THE WORLD – AND ALLOWING HIM TO HELP IT IN RETURN.

CEO OF the engineering, procurement and construction company Monford Group Peter Moore grew up in South Wales, in the UK, and that, he told *create*, is where his appreciation for engineering developed.

"It was quite an industrial part of the world," he said.

"I was always surrounded by large infrastructure projects, whether that be ports, steelworks, freeways or building structures."

But it was engineering that took him away from home too – one of the projects he is most proud of from his early career is the second bridge crossing of the River Severn, which divides Wales from England.

"It was an exciting challenge to have, because you are building a piece of infrastructure that millions of people are going to use in the years to come," he said.

"I can remember the day that the project opened, I watched a flood of traffic disappear down the road over the bridge. It's quite a rewarding experience to say that you were part of that."

Moore would go on to projects in Dubai, New Zealand and Perth, where he is based today.

"I look back with fondness at what engineering has done for me," he said.

"It's enabled me to live and work in many different parts of

05 TIPS FOR SUCCESS

1 Engineering teaches you how to make decisive decisions, and those principles will ready you for management positions.

2 Work hard at your craft.

3 Stay open to new technologies.

4 Listening is important; don't go into a room thinking you already have the answer.

5 Keep an open mind.



the world; it's one of those vocations that is easily transferable into different places."

Having recently concluded a four-year stint as CEO Melchor Contracting, he's taken on a new challenge leading the Monford Group, and he's excited to help the company solidify its national presence in Australia.

"From my perspective, it's about making sure that we cement that national footprint, take advantage of the opportunities in the renewable sector, and to grow the business around that," he said.

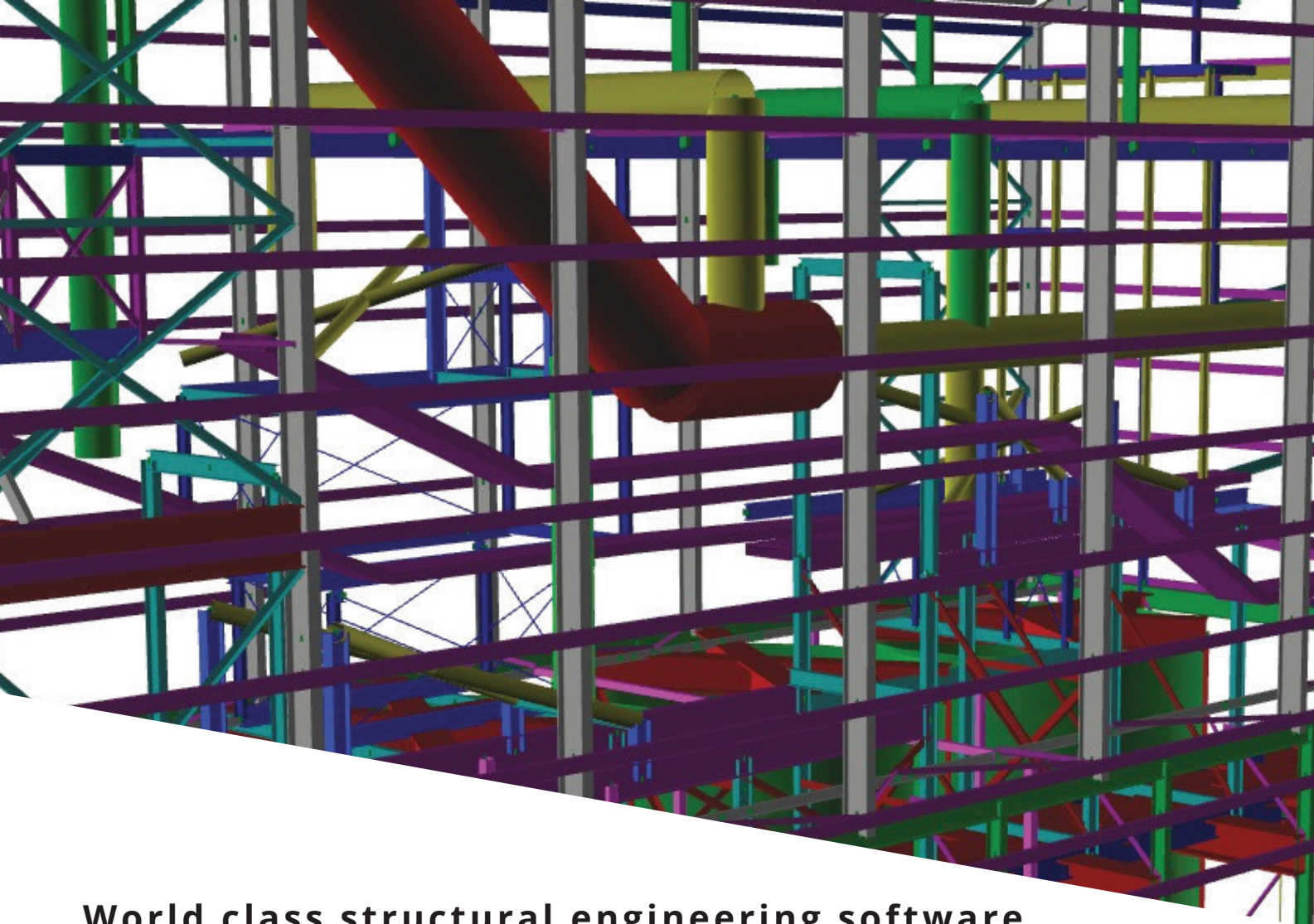
"Monford Group has actually done more megawatts in renewables [projects] on the east coast than it's done on the west coast."

Moore also wants to see the business capitalise on its opportunities in the renewables sector.

"From an industry perspective, there is a real drive ... to expand the renewables capabilities of various different government entities and the private sector," he said.

Moore is a Chartered engineer, and he says the accreditation reflects the importance of career-long learning.

"You've always got to challenge yourself to consistently improve, and to consistently improve, you must continually learn," he said. "If you have Chartered status, it proves to the industry and your colleagues that you are dedicated to continuing to learn in your discipline." ●



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