



Resilience

Hit with a one-in-100-year storm, fire, flood or even civil unrest, how effectively would our buildings withstand the impact and then recover from adversity? This question is being seriously asked of and by industry leaders as we seek to build the capacity for recovery into our built environment. Sean McGowan speaks to those leading the charge. On our panel are Lend Lease senior sustainability consultant Darryl Stuckey; Arup's Malin Lindblad, M.AIRAH; former GBCA COO Robin Mellon; grünconsulting principal consultant Clare Parry, M.AIRAH; A.G. Coombs strategic development director Bryon Price, M.AIRAH; and Atelier Ten's Paul Stoller, M.AIRAH.

Ecolibrium: We keep hearing the word "resilience" being used, but what does it really mean in the built environment?

Parry: If we think of a resilient person, we imagine someone strong and adaptable – unflappable. A resilient building is the same: something designed to stand the test of time. It's durable and flexible, appropriately designed to take into account internal factors such as occupant impacts, durability, requirements for flexibility and accessibility, rapidly changing



technologies and requirements of users, as well as external factors such as environment, climate, energy security, etc.

Mellon: Resilience means the ability to bounce back – whether that's buildings after floods, communities after bushfires or lawns after droughts. While it's not an exclusive term for the built environment industry, it is particularly relevant to how we design, construct and operate buildings that are flexible, adaptable and can bounce back from adversity.

Lindblad: When I hear resilience and building design, I link it to climate change and the required response from a building to withstand future unusual external conditions. Resilience in relation to new building design relates to understanding – or often trying to understand – how the threat of climate change may impact the way that we need to design our buildings today to ensure they are functional and useable in the future.

Price: From a whole-of-facility perspective, we think of resilience in terms of the building's ability to function adequately and fulfil its purpose in response to unusual external changes or threats. The physical attributes of the building, and this obviously involves design along with construction, are a very important determinant; however, just as important are the operational and management aspects of the facility.

Often, ongoing preparedness and effectiveness is dependent on a management response. For the activities in the facility to be resilient in concert with the building requires a management element that must be attuned to the building, its systems and its surroundings, and how they are expected to operate when under challenge.

Stuckey: Resilience and adaptation are key elements of our [Lendlease] global sustainability framework, and for the built environment it is really about building physical structures that facilitate and enhance the capacity of a community or individual to deal with external stresses.

A resilient built environment should also be sufficiently adaptive and able to easily evolve to respond to these stresses, safeguarding the future sustainability of their communities.

Ecolibrium: So what is a resilient building then?

Stoller: It is one capable of withstanding extreme events – cyclones or hailstorms, utility outages, bushfires – while providing shelter and essential services to people within, and reasonably returning to normal operation after such events.

A resilient building can also adjust to longer-term environmental, social and economic incremental changes and disruptions. Georgian terrace houses in London come immediately to mind.

Parry: A resilient building is designed and built with an eye to the future. Doing what we did last time, or the time before, is no longer going to cut it. Design needs to be iterative. The future is looking less and less certain, so our designs can no longer afford to use the standard mould. A truly resilient building is durable, flexible and energy-autonomous.

We are starting to design resilient buildings, but the word is so dynamic and in such a state of flux that we may

never truly hit the mark. Perhaps our best examples are those that are still around 200, 500 or more years later, and we are still using them.

Mellon: The house I grew up in, in England, is more than 400 years old. My mother tells the story of how once, during a great storm, her bed on wheels slid slowly across the room as the house bent and flexed but managed to withstand the severe winds.

Buildings that have stood the test of time – like my old family home – have usually been built to endure climate extremes and to be adaptable to the changing needs of occupants. The fact a building remains standing after 400 years is clearly testament to that fact.

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Ecolibrium: Is resilience simply a synonym for sustainability? After all, if our buildings are more resilient to extreme weather, for example, doesn't that make them more sustainable?

Lindblad: There are strong links between resilience and sustainability on many levels, particularly when talking about climate adaptation. I would argue, however, that there are additional aspects to sustainability as a concept that covers a range of sectors such as materials, transport, food, waste and water across areas such as biodiversity, cultural and social diversity, environmental flows and pollution that are generally not covered when considering resilience.

Stuckey: There are many people that would argue resilience is really about sustainability, or that resilience is just sustainability re-badged. I would agree that there can be parallels; however, for me



Darryl Stuckey



Malin Lindblad, M.AIRAH



Robin Mellon



Clare Parry, M.AIRAH



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Paul Stoller, M.AIRAH

sustainability is more about maintaining balance in the system – ensuring buildings during their life-cycle do not demand more resources or produce more waste than natural systems can support.

Resilience is more about the ability of buildings and their communities to resist, absorb and adapt to future shocks.

Price: In a big-picture, long-term-way definition of sustainability, a resilient building makes it more fit-for-purpose, and therefore you could argue more sustainable as a facility. On the other hand, making a building more resilient and keeping it so requires expenditure of resources that may or may not challenge other, perhaps more colloquial, definitions of sustainability.

Parry: Sustainability has become a dirty word mainly because of the way it's been realised in regulation – somewhere between a costly add-on and a huge sufferance. Those who have embraced and integrated it have quickly realised the benefits.

Resilience is more widely understood to be integral to design. No one would argue that they don't want a resilient building.

Stoller: Resilient design bears more resemblance to risk management. It is the intentional exploration of vulnerabilities and the development of pragmatic built and operational strategies to mitigate those risks.

“ If we are not thinking ahead, then we are just wasting time, energy and resources ”

Ecolibrium: How are building practices incorporating resilience?

Parry: Just asking “what if?” when undertaking a design is starting to talk about resilience.

What if the maximum temperature is 2°C higher due to climate change? What if flooding becomes a bigger issue in the area that we're building?

Then I need to adapt by systems design. I need to allow for the future, and my building therefore needs to become resilient.

Mellon: I am inspired by the work of Green Star project teams who are really challenging industry best practice.

For example, during the design stage of 480 Queen Street in Brisbane, the project team examined future climate predictions ... and looked at how the plant room might be upsized to ensure extra HVAC could be added or easily upgraded at a later date.

Stoller: Different design cultures have adopted different levels of resilience thinking. In places that have been recently or regularly affected by severe events – flooding in Brisbane or New York City, utility disruption in Mumbai – the design industry is incorporating more resiliency thinking into practice.



Buildings such as Georgian terraces, which have stood the test of time, have usually been built to endure climate extreme and with adaptability in mind.

For example, new buildings in Brisbane are more likely now to have critical electrical services located above 100-year flood levels rather than in basements. In New York City, it has become commonplace for new buildings to install quick connection points for external temporary power generators and boilers. In Sydney, there is more consideration given to locating rooftop equipment in penthouses or other shelter from hail and wind.

Price: One of the very positive things that the current conversation around resilience is doing is raising the awareness of many organisations to the level of preparedness they and their facility infrastructure need to have.

For existing facilities, more often than not when they scenario this out against possible and likely threats and assess how their facility would perform in providing their operational requirements, it comes up short. There is then a decision to be made around what to do, how to change the building and what needs to

be done to operational and management preparedness. We are helping a number of clients with this process, which is often triggered by a particular unexpected event that has significantly disrupted their business.

“ A resilient building is . . . designed to stand the test of time ”

New design is also beginning to take this into consideration. Large projects like Barangaroo South in Sydney have climate change and adaptation as a fundamental input to design, and these considerations have been integrated into the design responses.

Stuckey: As an industry we are really only just beginning to think about and

challenge typical design practices to consider future climate change impacts. Examples include taking steps to increase stormwater infrastructure in anticipation of more frequent heavier rainfall events, and better spatial planning in plant rooms to allow for additional HVAC infrastructure.

Building designers need to take a life-cycle perspective when evaluating different options. Looking at future climate projection data to help inform the design of systems is a good start. However, we need to be careful to ensure we get the balance right and don't end up just oversizing systems that may be replaced multiple times before any future climate scenario eventuates.

The design response really needs to be about questioning how the HVAC system can be easily adapted or augmented to accommodate the increased demands that may be placed on it. Are there ways to incorporate simpler, more passive and flexible systems into the building's HVAC systems to reduce climate change risks?

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Resilient design deepens the thinking required for good engineering. Image: A.G. Coombs.

Ecolibrium: So it's really about getting back to good engineering then?

Lindblad: For a lot of aspects this might be the case. However, some of the resilience aspects will potentially mean a requirement to withstand more extreme conditions, which wouldn't necessarily only come down to applying good engineering ... but result in additional engineering due to a climate threat.

Price: Increased consideration of facility resilience in response to a changing external environment and the need for buildings to support the functions within is adding to the increasing focus on the ability of the built and operational facility to actually perform.

This in turn is prompting changes to design thinking. Improvement in design is coming from a better and more complete understanding of the role of the facility in a more holistic sense – including the role of the building in the neighbourhood, and a more acute appreciation of the likelihood and possible effects of extraordinary – compared to previous experience – events in the external environment.

You could argue it is a necessary and even inevitable step in the evolution of our ability to design and create effective facilities that has been triggered by a changing climate. But it also reflects a growing sophistication in business management ... as businesses continually

look to understand and address the risks they perceivably face, and better understand the facility and its role in this.

Stoller: Building services engineering has traditionally relied on historical norms to determine the appropriate size and quality of systems. We know now that the norms are changing, and that the frequency of extreme weather is increasing. And we also appreciate more the magnitude of the complete costs for disrupted access to our built environment – and understand that risk mitigation often involves solutions that jump beyond the scale of the immediate building we are designing.

Because resilience thinking values risk mitigation differently than traditional, good engineering, resilient design broadens the skill-set and deepens the thinking required for good engineering.

While many of the systems will be designed as before, others many have higher levels of redundancy, greater capacity, additional access, unusual equipment locations, special service contracts and other departures from traditional practice.

Parry: The charge needs to be led by those in charge of realising projects. Engineers know what they need to do and want to do. Clients and architects must now allow the freedom – and budget – to look further into the future and make sure things are done right. Designing buildings for a 25-year life span is ludicrous. It's a new phenomenon that is extremely wasteful.

Ecolibrium: What can be done to build resilience into pre-loved buildings? And what pre-loved buildings are more resilient than others?

Mellon: It's true that some pre-loved buildings are more resilient than others. Some 400-year old buildings are remarkably resilient, while buildings from the 1980s tend to be less so.

Many of the principles for boosting resilience apply to both new and old buildings. Design them for disassembly, flexibility, maintainability and adaptability. Consider not just the smart HVAC systems, but how to engender sustainable behaviour and attitudes too.

Lindblad: There might be certain types of pre-loved buildings that are more resilient depending on the era that they were built, the materials used and the location or purpose of the building; however, it is difficult to point out one specific type. For example, pre-loved buildings may have some of the resilient features already, such as low-energy designs or natural ventilation; particular materials or certain structural features.

AIRAH'S RESILIENCE TASK GROUP

The Institute is taking the lead on creating more resilient buildings, communities and cities

"As part of our work to figure out what AIRAH's position on resilience can be, the AIRAH Resilience Task Group is developing a briefing paper to introduce the concept of resilience to AIRAH members and to outline how resilience thinking can inform the design, engineering, installation and maintenance of HVAC equipment and overall building systems," says Paul Stoller, M.AIRAH, one of the task group's members.

"This paper will provide basic strategies to make building equipment and systems design more resilient, and it will highlight related building resilience strategies."

Instead I would say that each individual building would need to be assessed against the resilience requirements for the specific location to truly understand the key risks for that particular building. Building for resilience is complex, and without a sound assessment as a basis it is difficult to achieve a good outcome.

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Parry: I'm a big believer in fabric first. If a building is designed well in terms of getting the envelope right, then resilience is a guarantee.

A well-designed building should have simple ventilation systems, very little need for AC, no predisposition to condensation or mould – or rot – and therefore is highly durable and low maintenance. Many of these aspects can be retrofitted, but not all, and for many buildings the economics of a retrofit won't stack up.

The Empire State Building underwent a retrofit project that has seen 40 per cent energy savings. Across 200,000 sq m and in an 85-year old building that is huge. Sometimes, however, a building is just not well designed and after its useful lifespan it may be necessary to start again. The assessment isn't just economic – it should encompass the social and environmental benefits as well.

Stoller: Pre-loved buildings are often still around precisely because they have been resilient to incremental changes in economic, social and climate norms, and because they have bounced back from extreme events.

A critical first step in adapting pre-loved buildings is to identify those qualities in

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A good operational and management understanding of HVAC is required to create resilient buildings. Image: A.G. Coombs.

a building that may make them inherently more resilient – climate-responsive facades that do a good job of passively heating, cooling and ventilation; narrower floorplates that allow them to be daylit; locations safely above high flood levels

or away from other threats; proximity to multiple utility; and so on. Then, the reuse strategy can preserve and enhance those inherently resilient features.

Price: A good operational and management understanding of the

building services including HVAC and energy plant, and its strengths and weaknesses, is very important, together with a good support infrastructure that can be called on – including maintenance and technical service providers.

These practical and real-world considerations often get overlooked when looking at new issues and challenges; however, they are fundamental to better outcomes when the chips are down. What do you do and who do you call?

Many of our acute-care hospital and other critical-facility clients already have a level of resilience thinking in place that is ahead of the broader industry and we can learn from this.

Stuckey: Pre-loved buildings represent a great opportunity. Green Cross Australia's "Build it Back Green" has a number of good strategies that can be applied to rebuilding post-disaster – many of which can be equally applied to pre-loved buildings.

Ecolibrium: Given extreme weather events are rarely localised, should we be seeking to build resilient cities? How would this differ from our current reality?

Price: Yes, absolutely. Buildings are part of a larger whole, and in effect part of the community infrastructure. This community element resonates particularly strongly in the Barangaroo South project.

Another aspect is that many major cities now have large-scale resilience plans. This leads to the questions like – how does your building’s plan coordinate with this plan, or your neighbour’s plan? Are you both evacuating to the same assembly point?

Stuckey: Resilient cities provide greater opportunities for collaboration, through connectivity, public transport and access, food security, cultural diversity and self-reliance.

Resilient cities are as much about infrastructure as they are about

community cooperation. Cities of the future will need to be constantly evolving, adaptable and efficient. Resilient cities by their nature are not static, but dynamic in their response to new challenges.

Stoller: We know from the experiences of places disrupted by extreme events communities that are highly socially connected are better able to withstand extreme events because people proactively help each other. Cities build in some of this social interaction inherently, which helps make them more resilient than low-density settlement.

We also know that there are existing communities at risk of events like flood or bushfire where the resilience strategy necessarily involves relocating lots of people. Resilient cities have facilities identified and ready to provide this shelter.

Lessons like this tell us that resilience should be considered at all scales – unit, building, neighbourhood, city and region – so that we can develop the right resilience strategies at the scale where

“ We know now that the norms are changing, and that the frequency of extreme weather is increasing ”

they are most effective and where we get the best value for the investment.

Parry: If we are not thinking ahead, then we are just wasting time, energy and resources. Putting up buildings that aren’t intended to cope with conditions 10, 20 or 50 years into the future is poor planning.

Mellon: We should definitely be thinking bigger picture – and many of the leaders in our industry are beginning to do so.

To return to Barangaroo as an example, Lend Lease's Climate Change Adaptation and Community Resilience framework predicts an increase in the number of extreme heat days.

The project team is addressing this through the selection of materials along boardwalks with a high solar reflectance index. Public realm areas have been modelled for sunlight exposure and wind movement to find the balance between winter and summer comfort, with tree-lined promenades, street awnings and drinking water fountains being integrated into the design.

Another inspiring example is found at Stockland's Caloundra South development in Queensland, which will feature the most advanced water reticulation, filtration, storage and treatment system ever installed in any Australian community.

These are just some examples of how we need to integrate adaptation and resilience into our big picture thinking.

Ecolibrium: Who is leading the charge in advocating resilience, and what role does AIRAH have to play?

Lindblad: This question would be answered very differently depending on which country it is being asked in.

In many countries, particularly in Europe, the governments are taking strong leadership in advocating resilience. It is also in those countries where we can see the biggest impact across countries or regions through a united approach.

In Australia this is not generally the case, and instead local governments as well as designers and not-for-profit organisations are. I believe it is extremely important that engineers and architects are active in pushing the boundaries for how to design for resilience, but strong advocacy from the government is also needed to get real traction in the industry.

Mellon: Australians want our communities to be more resilient and sustainable – and they are becoming ever-clearer in voicing this. Non-government organisations (NGOs) such as the Green Building Council of Australia have taken the lead for many years, but we are also seeing many local governments embrace sustainable, resilient building practices because they know their communities want them to invest wisely – not just for now, but for the future.



Sydney's Barangaroo has been designed with resilience in mind.

AIRAH and its members have an important role to play in educating people, showcasing best practice and changing mindsets, as well as designing and implementing the right technology and approaches.

Parry: The action must come from the ground up – consumers and clients need to demand it, while at the same time engineers and architects need to either educate clients or find ways to make resilient design the norm and with no premium to the client.

Savvy clients are definitely already looking for resilient designs. They're reassessing the cost-versus-value proposition and finding that they want something that's worth building. We've pushed through the consumerist period of the 80s and 90s and we're heading for traditional values of "built to last". Even the developers are taking note!

Stuckey: There is a broad range of people advocating resilient building. NGOs such as Green Cross Australia, local government and government departments such as the CSIRO are doing a lot of work to educate and promote the discussion around climate change adaptation and resilience.

The 100 Resilient Cities initiative pioneered by the Rockefeller Foundation is also helping to create a network of cities, private sector interests and NGOs engaged in sharing ideas and experiences, furthering the development of adaptation and resilience in cities globally.

Stoller: The federal government has funded research into coastal climate change adaptation, which AIRAH and ASBEC (Australian Sustainable Built Environment Council) are contributing

to through participation in industry engagement panels.

State and local governments are variously engaged with resilience too. For example, the NSW Office of Environment and Heritage has developed an extensive resource centre around climate change adaptation called AdaptNSW. Melbourne and Sydney are both part of the 100 Resilient Cities program, and they are involving the local government areas (LGAs) in their metro regions in that planning.

AIRAH has identified resilience as a strategic issue for the organisation, and we are working now with an internal task group to figure out what our role should be. Certainly, AIRAH's role will include raising awareness about resilience, and educating members on aspects of resilient design.

Price: There is an increasing level of interest and involvement in what is, in effect, an industry debate and discussion about resilience and what needs to be done.

And there is the need for some clear industry leadership and guidance material in this area.

AIRAH has an opportunity to foster the better and broader understanding of this issue both within our industry, the broader property and construction industry and the general community. Building services are a very important element in this area. A sound understanding of the relevant issues and implications around building services including HVAC and energy systems is essential for proper consideration and practical, effective and responsible outcomes.