CROSS AUS
COLLABORATIVE REPORTING FOR SAFER STRUCTURES

The Institution of Structural Engineers

CROSS Newsletter

CROSS-AUS Newsletter 9 | **April 2023**

Editorial

Welcome to CROSS-AUS Newsletter No. 9, our first for 2023. This newsletter is being prepared in the aftermath of the devastating earthquake in Turkey and Syria. There is much to learn from this, ranging from the magnitude of the event, design assumptions made, behaviour of structures, and quality of construction. This disaster serves as a reminder of the need for continued learning in our profession, and the sharing of knowledge to increase structural safety.

The four reports in this newsletter cover a range of topics, all with a common theme of how we can do better by following correct procedures and learning from each other's knowledge and experience.

Behind the scenes, CROSS-AUS has been working on some strategic growth. This includes streamlining our systems, alongside our international partners in the UK and USA.

Delivering on the Australasian remit of CROSS-AUS, we welcome Michelle Grant as a Director of CROSS-AUS Ltd. Michelle is Director of LGE Consulting, based in Masterton NZ, the immediate Past President of SESOC, and brings a direct connection to our NZ colleagues to the inner workings of CROSS-AUS. We look forward to working with Michelle and hearing more from our NZ friends 'across the ditch', and their reports being published in future newsletters.

In November last year, I was privileged to represent CROSS-AUS, as part of a wider international CROSS contingent, at the American Society of Engineers (ASCE) Forensic Engineering conference in Denver, USA. This conference was a gathering of some of the brightest minds, and industry leaders, in Forensic Engineering. As part of the Plenary session, I presented our journey of rolling out CROSS-AUS since its inception in 2018 and why CROSS can form a key part of industry knowledge sharing across international boundaries.

Later this year, September will mark CROSS-AUS' 5th year in operation and much ground has been covered in that time, sharing insights and knowledge around structural safety. We have seen some recurring themes present themselves, including insufficient reviews of design, lacking quality of analysis models, seismic design, precast concrete, punching shear, and quality of construction. These recurring themes indicate areas of our industry where there are shortcomings in understanding and, by way of example with punching shear, that we as an industry can be slow to learn from past mistakes in some areas. This only serves to reinforce the role that CROSS can play as a tool for sharing knowledge.

As a not-for-profit group, we rely on continuous support from Industry and to this end we request that:

- If you find these reports useful, please forward them to your network and recommend they subscribe for **CROSS-AUS email updates>**
- You consider submitting a report and sharing the insights you have experienced. If you are not sure if you have a worthwhile report, please submit what you have and our Designated People will be in contact if more information is needed. All information is treated with utmost confidentiality. For more information, please visit **Reporting to CROSS-AUS>**
- If you feel a presentation from CROSS-AUS may be useful to your organization or group, or if you would like to play a direct role with CROSS-AUS, please contact us at **team.aus@cross-safety.org>**

Please read this newsletter and reports, and share with your networks.

Phil Latham

Director, CROSS-AUS Ltd

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Reporting to CROSS

Your report will make a difference. It will help us to create positive change and improve safety.

Find out more

Visit:
www.cross-safety.org/aus

Email:
team.aus@cross-safety.org

Defects found in precast (prefabricated) concrete façades

CROSS Safety Report   Report ID: 995

The reporter found several issues when inspecting or reviewing buildings with precast concrete façades, particularly on older buildings, due to a lack of attention to durability and poor workmanship. Defects included the failure of connections due to corrosion, the breakdown of veneered layers of concrete, and the corrosion of reinforcement due to lack of cover and poor workmanship resulting in spalling concrete. In some instances, the reporter found precast concrete façades were in danger of falling off the building.

Key Learning Outcomes

For structural and civil design engineers:

- Pay close attention to the detailing of precast (prefabricated) concrete elements
- Specify hot-dipped galvanized dowels and inserts as a minimum, and consider specifying stainless steel items where elements are exposed to aggressive environments
- Ensure non-load-bearing panels are detailed and constructed in such a manner that no unintentional loads are transferred in either horizontal or vertical planes
- Include periodic inspections in the fabrication yard (or on site in the case of tilt-up construction) as part of the inspection regime for quality control
- Pay careful attention to the design of grouted joints, and specify accordingly

For contractors:

- Utilise suitably skilled labour for the grouting of load-bearing joints
- Grout joints to load-bearing elements as the work proceeds
- Do not allow any loading to load-bearing elements until grouting is complete and the grout has reached the specified strength

For asset owners and managers:

- Inspect precast panels during the building life, particularly on older buildings, taking account of those subject to potentially accelerated degradation.

R Full Report

The reporter wishes to draw the attention of structural engineers to several issues when inspecting or reviewing buildings with precast concrete façades, particularly on older buildings. The reporter has inspected, or is aware of, several precast concrete façades which have been in danger of falling off the building, often due to the effects of corrosion.

Get Involved with CROSS-AUS

CROSS is your safety community and CROSS-AUS is seeking expressions of interest from individuals who would like to assist in its further development.

By creating a non-judgmental community, we want to encourage as many professionals as possible to share safety information and learn from each other's experiences. This will enable us to create positive change and improve safety.

If you have an interest in structural safety and would like to become a member of the CROSS-AUS team, please send an email with a brief resume to **team.aus@cross-safety.org>**.

Feedback on CROSS-AUS reports

If you have had similar experience to any of our reports, we encourage you to share your experience by simply completing the form at the end of each report or by email to **team.aus@cross-safety.org>**.

Some recent examples of feedback include:

- **Report 956 - Inspection and maintenance of Super-T bridge girders>**
- **Report 1056 - Production of as-constructed drawings>**

Significant failures of precast concrete panels

The period 1960-1980 was an era of significant change to building envelope construction as designers in Australia and elsewhere developed precast concrete façades. With the improvements in craneage equipment both in the factory and on site, there was a substantial shift to using both load-bearing and non-load-bearing precast concrete panels for external walls in multistorey buildings.

Unfortunately, as is often the case with advances in technology, a lack of understanding of the behaviour of the overall structure and the durability of the precast cladding elements has resulted in some significant failures. This includes the effects of axial shortening in the main vertical structural elements (resulting in load being transferred to non-load-bearing precast panels), corrosion failure of connections due to poor durability, the breakdown of veneered concrete layers, spalling of concrete and the corrosion of reinforcement due to lack of cover and poor workmanship.

The failure of veneer construction involving an outer layer of more durable, and therefore more expensive, concrete and the underlying layer of lower grade concrete became evident in some precast concrete panels exposed to the weather. This form of construction requires care to be taken to ensure that the veneer concrete is poured before the base concrete has fully set, and that the two concretes have similar properties. Most of the early problems occurred because of significant time differences between the pouring of the two types of concrete used in veneer construction.

Other significant issues the reporter found included using ungalvanized ferrules, ungalvanized dowel bars, and ungalvanized J-bar lifting inserts (usually located in the top and sides of the prefabricated concrete for lifting purposes and for connections). In many cases, sealants were never replaced which allowed water to enter the façade causing corrosion in the ferrules and dowels. This led to local failures of the panels and possible failure of restraint, usually requiring expensive repairs. Proprietary lifting inserts, dowel bars and ferrules are now hot-dipped galvanized as a minimum and stainless steel should be considered for aggressive environments. However, proprietary lifting inserts are not readily available in stainless steel.

From the late 1970s, concerns were raised about the durability of concrete as the Concrete Code (Australian Standard AS1480-1974) provided little guidance to designers, and the required covers to reinforcement were generally inadequate. In 1979, Beresford and Ho identified the extent and cost of durability failures - approximately 10% of the expenditure of new buildings. In 1987, Marosszeky et al. studied 95 buildings in Sydney involving significant corrosion (indicating inadequate cover) as well as poor detailing and workmanship.

The Concrete Institute of Australia (CIA) also published *Practice Note No 12* in March 1983, setting out some of the factors affecting durability using information from the draft AS3600. The Cement and Concrete Association of Australia (CCAA) published *Technical Note TN57 on Durable Concrete Structures* in 1989 and, in 1990, the CIA published *Recommended Practice Durable Concrete*.

> **Structural engineers … need to be aware of these durability issues and … need to understand the causes of cracking**

Structural engineers need to be aware of these durability issues when inspecting precast concrete façades and, where cracking is found, they need to understand the causes of the cracking. This can often mean significant investigations to determine the reasons for cracking, the extent of corrosion and failure of connections, and the formulation of a suitable repair procedure.

References

Peyton J.J. and Wynhoven J.H., "Symposium on Concrete, Towards better concrete structures - Design and construction aspects of precast concrete façades, the evolution of the system", 1981.

News & Information

"Celebrating Structural Engineering" is the theme for the **SESOC 2023 Conference>** to be held in Christchurch, NZ, 21-23 June 2023.

SESOC> (Structural Engineering Society New Zealand) is a valued **CROSS-AUS Supporter>**.

"Creating a sustainable future: the challenges and opportunities" is the fire safety theme for the **AFAC23 Conference & Exhibition>** to be held in Brisbane, Australia, 22-25 August 2023.

AFAC> is the Australian and New Zealand National Council for fire and emergency services and AFAC23 will incorporate the **Australian Disaster Resilience Conference>**, the **Institution of Fire Engineers (Australia) National Conference>** and the **Women and Firefighting Australasia (WAFA) Conference>**.

Registration

Engineers Australia has prepared **two guides>** on national registration, the case for registration and minimum registration requirements. These guides outline Engineers Australia's position and expertise in engineering registration.

National Construction Code

NCC 2022 is now available on **NCC Online>** and will be adopted by the states and territories on 1 May 2023. Until then, NCC 2019 Amendment 1 remains in-force.

For those who wish to use the new provisions, refer to the ABCB's **Using NCC 2022 prior to 1 May 2023>**.

Campbell-Allen D. and Roper H., "Towards better concrete structures - Durability of Precast Façades", University of Sydney Symposium on Concrete, 1981.

Beresford F.D. and Ho DWS, "The repairs of concrete structures - a scientific assessment", Concrete Institute of Australia, Biennial Conference, Concrete 79, Canberra.

Marosseky, M., Griffiths, D., Sade, D., "Site study of factors leading to a reduction in durability of reinforced concrete", ACI SP-100, page 1703–1726, 1987.

CIA, "Durable Concrete, How to Specify and Construct", Note 12, March 1983.

CCAA, "Durable Concrete Structures", Technical Note TN57, March 1989.

CIA, "Recommended Practice Durable Concrete", February 1990.

C Expert Panel Comments

The reporter describes a systemic problem with precast concrete façades in older buildings.

Issue not limited to older buildings

The issue, however, is not limited to older buildings. We have seen more recently constructed apartments with precast panels experiencing problems such as poor joint control, lack of fire seals, inadequate panel support, corrosion, and water damage from leaks. All of these have the potential to lead to substantial future repair costs. It would appear that we have not learned from the failures of façades of apartment blocks in Europe and the USA in the 1960s.

Durability is a critical factor in building performance that requires detailed attention to product selection and specification to ensure that documentation adequately considers the design life of the building and the severity of its exposure conditions. This is of particular importance for external façade panels. With the current emphasis on sustainability where the extended life of buildings is being encouraged, a design life in excess of 50 years should be considered.

As noted by the reporter, lifting inserts, dowel bars and fasteners should be specified as hot-dipped galvanized as a minimum. In addition, stainless steel items should be used where building elements are exposed to aggressive environments, noting that lifting inserts may not be available in stainless steel. In accordance with good practice, connection of dissimilar metals should be detailed to avoid galvanic corrosion. Responsibility for durability requirements lies with the designer.

Attention should be given to the **New Zealand Building Code, clause B2>** which states: *'...building materials, components and construction methods are required to be sufficiently durable. They must ensure that the building, without reconstruction or major renovation, continues to satisfy the other functional requirements of the Building Code throughout its life.'.* Compliance in New Zealand is typically required to **SNZ TS 3404-2018, Durability requirements for steel structures and components>**.

For new panel construction, consideration should be given to conducting periodic inspections at production facilities to confirm conformance with documented materials, inserts, cover and the like. Checking the cover on delivery to site can also be conducted by means of cover meters.

All parties involved with the design, manufacture and erection of precast concrete should be familiar with:

- Safe Work Australia's **Guide to managing risk in construction: Prefabricated Concrete>**, published in 2019. This guide replaces the *National Code of Practice for Precast, Tilt-up and Concrete Elements in Building Construction*, which was published by the Australian Safety and Compensation Council in 2008
- **The Precast Concrete Handbook (2009)>**, being mindful that the handbook is out of date with respect to design matters relating principally to the updated Concrete Structures Standard AS3600
- National Precast Concrete Association Australia's guide entitled **Understanding Grouted Precast Joints: A guide for engineers and building contractors (2020)>**

Press Roundup

In every interval between CROSS Newsletters, failures of some kind or incidents related to structural and fire safety are reported in the press. Here are some accompanied by a brief comment:

1. **Turkey-Syria Earthquake >**

In February a massive earthquake struck Turkey and Syria. Hundreds of dramatic building failures occurred. The death toll (largely from these collapses) has exceeded 50,000. There can be no stronger example of the demands on building safety.

2. Fire risk from lithium batteries. **Waste fires> House fire>**

The fire risk from lithium batteries continues to be in the news. Domestic fires initiated from scooters and electric bikes have been reported and discarded batteries have been a hazard causing numerous waste fires.

3. **Hotel aquarium collapse>**

A major collapse illustrating links between modes of failures, consequences and design standards occurred in Berlin. The world's largest freestanding aquarium collapsed 'instantly' within a hotel lobby releasing a million litres of water and all the fish. The mode (instant and total) was highly undesirable, and the financial consequences would be very significant.

4. **Importance of temporary works>**

The dangers of instability during construction were once again highlighted by the collapse of a wall which killed a site worker.

5. **Risk of collapse in older buildings>**

All structures deteriorate and safety requires proper and prompt maintenance. A UK government report has raised the risk level of school buildings collapsing to "very likely", after an increase in serious structural issues being reported – especially in blocks built in the years 1945 to 1970. Previous reports have raised similar concerns over hospitals.

- AS3850, *Parts 1 and 2: Prefabricated Concrete Elements, which introduce the concept of In-service Designer and Erection Designer.* They are referenced via the Australian Standard AS3600 to the National Construction Code, thus requiring designer compliance.

Notwithstanding the differentiation between In-service Designer and Erection Designer as noted above, it is important for the In-service Design Engineer of the structure to be aware of any temporary measures, such as lifting points, and their potential effect on the long term function of the concrete.

Load-bearing considerations

The reporter has drawn attention to the importance of correct detailing to ensure that panels are not subject to loading other than that for which they were designed. This applies equally to non-load-bearing panels, where the provision of isolation joints should prevent any load transfer into the panels in both horizontal and vertical planes. Deformations of buildings due to shrinkage, post-tensioning forces, temperature movements and the like should be taken into account. Some dowelled connections loaded by such movements can produce slip/stick noises if the connections cannot carry the imposed loading. The cost of addressing such noises can be very high.

Connections, fasteners and fixings

Connections, fasteners and fixings are particularly important in prefabricated concrete, and they have many roles which must be considered in design. Light-duty cast-in ferrules should not be used for structural connections between concrete elements other than fixing for lightweight steel structures or similar. Only headed anchors complying with AS3600:2018 should be used for structural connections between adjoining concrete members. Exposed connections require the same fire rating as adjoining prefabricated concrete elements. **CROSS-AUS report 993 - The use of cast-in ferrules as structural connections>** highlights several problems that can arise with this type of connection.

Importance of grouting procedures

Recent experience has highlighted the critical nature of grouting procedures. Highly stressed load-bearing joints can have complex stress patterns depending on joint configuration, they need to be correctly designed, detailed and specified. It should be noted that the effective width of the joint resisting loads will be reduced by the fact that compressive stresses cannot occur at the edges of the joint. Typically, the width of the joint resisting compression is reduced by at least the depth of the joint on either side or by the presence of concrete chamfers. Packers should be removed after grouting. **CROSS-AUS report 961 - Grouting of joints between load-bearing prefabricated concrete members>** covers this important procedure in more detail.

Inspection and checks

It is also important to remember that, even with a theoretical design life of 50 years, some repairs and maintenance may be required during the life of a structure. Sufficient periodic inspections are required to be able to identify such requirements.

When inspecting structures, the condition of all parts resisting load needs to be assessed. Regarding façade panels, these parts are often hidden from view and assessment may require additional effort and cost. It is important that asset owners appreciate the need for this and make provision for inspection and timely repairs, especially with older structures and structures subject to accelerated degradation. Examples include coastal high rise buildings and buildings subject to higher exposure to chemical attack, perhaps from industrial or vehicle emissions.

For an American perspective on similar issues dating back to the 1970s and 80s, the paper by Jenna Cellini **The Development of Precast Exposed Aggregate Concrete Cladding: The Legacy of John J. Earley and the Implications for Preservation Philosophy>** again stresses the importance of learning from the past.

Submit Report

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Newsletters from other CROSS regions

The UK published their latest Newsletter in March and CROSS-US will do so soon. Make sure to **take a look>** for applicable lessons learned from these international safety reports.

More from CROSS

Request a CPD talk from CROSS-AUS

The CROSS Team is available to give presentations to firms and organisations. These give insight into the work of CROSS and include examples of failures and the lessons that can be learned. To request a talk, please email us and we will be in touch to organise: **team.aus@cross-safety.org>**

Inadequate modelling of existing building

CROSS Safety Report   Report ID: 1082

An existing building suffered damage while being upgraded, which led to a more detailed inspection of the existing building's condition. The report highlights the importance of conducting a thorough investigation and assessment of an existing building structure to ensure an understanding of how it will perform under the applied design loads, rather than relying on assumptions that may be unrealistic.

Key Learning Outcomes

For structural and civil engineers:

- Conduct a thorough on site inspection to confirm whether assumptions about the structure of an existing building are accurate, prior to making an assessment of its loadbearing capability
- Carefully consider whether it is suitable to use existing brick panels to contribute to the seismic resistance of an existing building
- A quality assurance system that includes internal checking, or peer review, of calculations and design assumptions can help prevent safety issues from arising during the design process

R Full Report

The reporter's work includes numerous projects involving older structures. In many cases, these structures are found not to comply fully with modern standards, design practices and construction techniques. In the reporter's experience, many such buildings have also been modified, not always with the input of a suitably qualified builder or engineer.

One particular project comprised a framed structure with large non-loadbearing brickwork infill panels as the exterior walls. The brickwork suffered significant damage during the reconstruction. Design criteria for the structure required it to resist wind and seismic events as prescribed in current design codes.

An on site investigation found that the wall panels were not connected to the structural framing along their top edges (joints were filled with compressible filler foam), nor at their vertical edges in the corners of the building at the wall-column interfaces. Some brick panels also had door and window openings which limited their capacity to resist lateral forces.

Building assessment

An assessment of the out-of-plane capacities of the wall panels, based upon conditions of edge restraint observed on site, determined they could not sustain the design wind loading condition.

The reporter notes the panels had previously been assessed as being adequate for the purposes of the project. They are of the opinion that the previous modelling, when considering the capacity of the brickwork panels, failed to take into account the actual connections between the panels and the structural building frame. The modelling also did not appear to consider the effects of door and window penetrations which had a substantial negative effect on the structural behaviour of the wall panels.

The reporter suggests many designers fall into the trap of applying the same set of assumptions to an existing structure that they might apply to a 'clean sheet' design – in this case the assumption of full lateral support to all edges of the panels.

In conclusion, the reporter suggests adequate site investigation of brickwork panels should be conducted to confirm details of fixings, and therefore edge support conditions, for all loading conditions.

> **never assume anything until conditions have been fully inspected on site**

This experience reaffirmed the belief within the reporter's company that previous work which states something complies with a specific standard should not be relied on when a quick visual assessment suggests otherwise. It is important, particularly when dealing with older structures, to never assume anything until conditions have been fully inspected on site.

C Expert Panel Comments

The reporter has drawn attention to an extremely important aspect of any refurbishment works, namely the full and detailed assessment of the condition of the existing building. When assessing any existing structure, it is critical to match design assumptions with the details and conditions of the building as determined on site.

There is no substitute for a detailed inspection by an experienced structural engineer with a good background in the relevant materials. In some cases, confirmation of whether assumptions adopted in the design are valid, through more extensive site investigation, will be appropriate. This is all the more important when the as-built documentation of the building is unavailable. This report confirms that, in the example given, assumptions were made that did not match the reality on site.

assumptions were made that did not match the reality on site

Implicit in the report is the importance of internal checking and/or peer review processes, which play an important role in helping identify erroneous assumptions in subsequent modelling performed in the design process.

When considering stability within the design process, it may be necessary to make conservative assumptions to account for any unknowns (for example, assuming no ties exist unless it can be verified there are in fact ties present).

A source of recommended design parameters for assessment of existing construction is the previously withdrawn (but still available) AS3826 – *Strengthening Existing Buildings for Earthquake*. However it is important to note that, in addition to its withdrawn status, this code was not gazetted in the National Construction Code. Accordingly, it has never been a deemed-to-satisfy solution in the Building Code of Australia for compliance during a refurbishment.

Submit Report

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Inadequate design and procurement of large steel roof structure

CROSS Safety Report   Report ID: 1123

This report demonstrates the importance of following the correct process for project procurement, including preparing a detailed design and project specification, and certificating compliance with the relevant building codes. It also covers the potential consequences when shortcuts are taken.

In the example raised by the reporter, a contractor procured the steelwork for a large span roof from overseas, based on a concept design supplied for pricing, without seeking construction documentation from the original design engineer. Construction proceeded without correctly specified design and construction drawings. As a result of concerns raised by the steelwork erector, an independent review found many deficiencies in the steelwork design and detailing which, combined with a steel grade lower than that indicated in the initial design, resulted in significant delays to the project and increased costs to the contractor.

Key Learning Outcomes

For civil and structural design engineers:

- Carefully consider your involvement with contractors who do not follow the correct procedure for design and construction
- Ensure all important design parameters (such as steel grade) are noted on the shop drawings prior to checking
- Either certify, or require competent third party certification, for connection details designed by the shop detailer
- Ensure that all quality control (including third party certification of steel and steelwork fabrication as required) has been satisfactorily carried out prior to issuing final certification, paying particular regard to overseas fabrication and supply

For contractors:

- Do not commence fabrication without recourse to certified and approved construction drawings
- Carry out the requisite quality control at all stages of construction to ensure compliance of materials and fabrication with Australian Standards (including third party certification as required), particularly when these are procured abroad

For certifiers:

- Withhold the issue of Building Approval until satisfactory receipt of adequate design documentation and a Declaration of Design Compliance with the National Construction Code (NCC)

For asset owners and managers:

- Review the risk profile associated with the delivery method, and consider adopting the traditional method of engaging a project engineer for the full design documentation prior to any contractor involvement

R Full Report

The reporter describes what happened when shortcuts were taken in the procurement process and construction proceeds without detailed design, project specification and certification. In their example, an engineer *(Engineer 1)* provided a concept design, for pricing purposes, for structural steelwork to be procured from overseas for a large single storey steel-framed building. The importer (contractor) won the project tender and ordered the steelwork to be detailed and fabricated overseas without seeking construction documentation from Engineer 1.

During the erection of the steelwork, concerns were initially raised by the installer over some member deflections and poor details, as well as poor fabrication and welding. As a result, a peer review was undertaken by another engineer

(Engineer 2) appointed by the contractor. During the peer review by Engineer 2, several structural issues were noted and Engineer 2 consulted a specialist steel design engineer (Engineer 3) for advice. Engineer 3 found the structural design to be inadequate and undersized. This design was the preliminary design that had been prepared for pricing by Engineer 1, and had been used for fabrication and construction without further input from Engineer 1. Most steel connections were designed by the overseas steel detailer. The steel grade was also questioned and tested. The design was based on grade Q345 steel, but it was found that grade Q235 steel had been supplied.

The design required significant modifications to strengthen the RHS/SHS open web trusses in order to suit the supplied steel grade, as well as additional end wall bracing and modified roof and side wall bracing. Further concerns regarding the welding quality and paint system were reviewed separately. This resulted in delays to the project and increased costs that had to be borne by the contractor.

> **delays to the project and increased costs … had to be borne by the contractor**

The reporter notes that this exemplifies the importance of following the correct design, project specification and certification procedure- three processes that are generally the responsibility of engineers to complete successfully. If the design is not correct, problems may arise during the construction phase of the project or potentially lead to failures. The supply and performance of materials, fabrication and corrosion protection rely upon the adequacy of the design and construction drawings.

Importance of checking processes

The reporter recommends checking processes at all stages of project delivery, and that any connection details designed by steel detailers should be checked and approved by the responsible design engineer.

The reporter draws attention to the following initiatives of the Australian Steel Institute (ASI) which provide independent third party auditing and certification for structural steelwork projects:

- **Steelwork Compliance Australia>** provides independent third party auditing and certification of fabricators who have the capability to fabricate structures to the specified standards
- **ShedSafe>** is an independent third party shed design certification scheme that can further enhance confidence in the engineering, steel products and specification for steel sheds and other large buildings

C Expert Panel Comments

This report highlights a failure to follow due process, which always involves increased risk for the parties concerned - in this case the risks related to safety, as well as delays and costs to the contractor. It also suggests a lack of appropriate contractual arrangements between parties.

Seeking an alternative design and utilising overseas fabrication is now commonplace in the industry and is not, in itself, the issue. However, in the case highlighted in this report the fabrication proceeded without any approved design, on the basis of a preliminary unproven design submitted for costing only. This raises the question of why construction was permitted to proceed without the certifier having possession of the engineer's approved and certified steel designs.

The adequacy of documentation was one of the issues raised in the **Shergold Weir Building Confidence Report>** (BCR). Under recommendations 13 to 17 the BCR states: *'We recommend that there be a statutory duty on design practitioners to prepare documentation that demonstrates that proposed buildings will comply with the NCC. We recommend a more robust approach to third party review of designs and to the documentation and approval of performance solutions and variations.'*

In response to the BCR, the Australian Building Codes Board Implementation Team has produced a **series of guidance documents>** for consideration by State and Territory Governments, including **Design acceptance: Model guidance on BCR recommendations 13-16>**. This is a comprehensive document and includes eight Principles for Design Acceptance.

Principle 2 - Declarations of Design Compliance states: *'That each design practitioner, as listed in the National Registration Framework for building practitioners (the NRF), declare in writing that, to the best of their knowledge, their design complies with the NCC and other prescribed requirements. The declaration will be known as a Declaration of Design Compliance.'*

Overseas manufacture causing risks?

Another issue raised by the report is the increased risk of non-compliance with Australian Standards introduced by overseas design and fabrication. This issue has garnered much attention in recent years following a significant increase in non-conformance problems within the construction industry, as reported over the years by the ASI. These issues have come at great cost to the industry.

Where structural steel and components (e.g. bolts) are imported from overseas it is essential to ensure that they comply with Australian Standards in terms of their mechanical and chemical properties. Non-conforming steel may be non-ductile, fail in a brittle manner in an overload situation, and may not be weldable. As a result, overseas design and fabrication deserves close scrutiny by all parties to ensure compliance.

The ASI has committed significant resources to developing a body of documentation to address the problem. These include guidelines for testing in Australia to verify material composition and performance as specified. The Australian and New Zealand Standard *AS/NZS 5131: Structural Steelwork – Fabrication and Erection* is a case in point. Additional guidance on **Steelwork Quality and Compliance>** can be found on the ASI website.

The situation is no different in New Zealand, where the sourcing and procurement of large quantities of steelwork can be even more difficult to find locally. Importantly, the Australasian Certification Authority for Reinforcing and

Structural Steels' (ACRS) **Product Certification Scheme>** certifies steel construction products are manufactured to Australian and New Zealand Standards. It provides users with certainty that steel manufacturers and producers of fabricated materials adhere to the relevant Standards. The requirement for ACRS certification should be written into the relevant specifications.

A further issue raised in the report relates to the development of structural connection details. The report example indicates such details were provided by the shop detailer. This is considered a non-standard situation. If it were to be adopted, the certifying design engineer would have to be prepared to verify the design during a review stage of shop drawings, prior to fabrication.

Submit Report

Submit Feedback

The misuse of standard details and notes on structural drawings

CROSS Safety Report   Report ID: 1133

This report draws attention to the excessive and incorrect use of standard details and notes on structural drawings, as well as the assumption that the builder/contractor will somehow work out the designer's intention of these on site. Inadequate or conflicting design and documentation can potentially lead to failures.

Key Learning Outcomes

For structural and civil design engineers:

- Design in accordance with up to date versions of the correct Standards, and apply the same to the nomination of Standards in specifications
- Provide contract specific details and applicable selected standard details, sufficient to ensure there is adequate information to safely build the structure
- Delete all irrelevant and conflicting details, which create information overload and confusion
- Apply the same approach to drawing notes and to specifications
- Identify limitations, if any, on circumstances for the application of standard details

R Full Report

The reporter has become concerned about the excessive and incorrect use of standard details and notes on structural drawings, as well as the assumption that the builder/ contractor will somehow interpret the intention of these on site. Inadequate or conflicting design and documentation can potentially lead to failures.

This report follows the review of the structural drawings for a housing project, where the reporter encountered several issues. In this particular project, the notes referred to items that were not part of the project such as fabricated timber trusses, Y bar (out of date reinforcement rolled from about 1984 to 2001 in Australia), and covers to reinforcement in concrete footings not in accordance with AS3600. On checking the overall height of the project, the reviewer also noted the building was greater than 8.5 metres in height. This required it to be designed in accordance with the Australian Standard AS1170.4, an issue which may have been overlooked by the structural engineer. It appeared to the reporter that the structural drawings had not been checked or coordinated.

On another recent project, the reporter was advised that there were about ten sheets of standard details which were supposed to cover most of the sections for the project. However, there were no specific details and sections that related to the project itself. In addition, the reporter has often seen specifications referring to Standards that are out of date and, in some cases, incorrect Standards are specified.

Standard details and notes on structural drawings evolved many years ago and were intended to cover the general detailing that would occur on sites, such as lapping of reinforcement, arrangement of reinforcing bars and the like. They also cover standard details such as bolted connections for steelwork. The reporter has found that it is now not unusual to have two or more drawings of standard notes on any large project. However, having standard notes for materials that are not used on a project introduces unnecessary complications.

> **too much reliance on 'copy and paste' and not enough emphasis on 'real' engineering design**

Standard details save on production time and labour costs, and have their place on projects, but must be used with caution, especially when they are not relevant or specific to the project. It is the reporter's opinion that there is too much reliance on 'copy and paste' and not enough emphasis on 'real' engineering design and drawing capability, to the detriment of the profession. The reporter's view is that structural engineers should provide sufficient information for the builder/contractor to understand how the structure is to be built.

The reporter believes that it is due to cost restraints and a lack of understanding that leads to structural engineers not drawing details and sections to show how the structure fits together. In the case of the drawings for the housing project reviewed by the reporter, it was fortunate that the building certifier had required the structural engineer to draw a section through the edge of the building. This identified that underpinning was required to the footing to the building on the adjacent property.

C Expert Panel Comments

The reporter has raised the concern that there is a tendency for standard details to be overused in structural documentation. It has been noted that, for small projects, the total number of standard notes and details can sometimes outnumber the project specific plans and details sheets. Whilst it is incumbent on the engineer to ensure drawings convey all the important information required to construct the building in a safe manner, the use of blanket standard details conveying superfluous and irrelevant information can be confusing, and will often result in a reduced focus on the critical information required for construction.

> **superfluous information … will often result in a reduced focus on the critical information required for construction**

Standard details that are not relevant, out of date and/or conflicting should be removed from documentation, and notes should be concise and relevant. Care should be taken to update standard notes for project specific locations (e.g. corrosion requirements, wind speeds, seismic accelerations, geotechnical conditions and the like), and to keep track with revisions to official construction codes and practices.

Where appropriate use of standard details is made, they should clearly specify to the designer and contractor the circumstances in which they are appropriate if there are limitations on their adoption. Examples, where this practice has not been followed, include:

- A typical construction joint detail in a post-tensioned (PT) slab appropriate for use at the slab quarter-span point where moments were close to zero. The detail was used away from the quarter-span point resulting in significant strength shortfalls in PT slabs which then required remedial action
- A standard multi-floor propping and back-propping diagram that assumed all floors were supported at columns. In this case, a construction joint at 3/4 span meant a different distribution of loads from that envisaged in the standard detail, contributing to the collapse of four levels of back-propping
- A contractor following a general note requiring a '6mm fillet weld all round unless otherwise noted' instead of applying the full penetration welds and commensurate NDT quality control specific to a particular connection detail

Third party audits and checking processes should include an assessment of the relevance and adequacy of standard details.

It is worth noting, with respect to the economic driver behind the overuse of standard details, that low fees are not a defensible reason for inadequate detailing, and fees should be structured accordingly.

As highlighted by the reporter, the above comments on details apply equally to the nomination of Australian and New Zealand Standards, with experience indicating that out of date, and at times even inappropriate, Standards are sometimes specified. This of course extends even further, to the need to ensure that the correct and up to date Standards are used in the design as well.

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