



ENGINEERS
AUSTRALIA

Building Confidence: How to use engineers to improve building and construction

Summary

Engineers Australia convened a building industry working group to develop a paradigm for good practice of engineers across the building sector.

The paradigm proposed is to introduce two key professional engineering roles into the delivery and approval of a building project:

- Engineer of Record
- Proof Engineer

Introduction

The building and construction industry has been plagued by poor building practice leading to a loss of confidence in the building sector as evidenced by high profile cases such as Opal Tower, Mascot Towers, Neo 200 and Lacrosse. The rise of design-and-construct as a delivery method has also seen the industry lapse into poor building practices with a driver to maximise profits by shortening the design-construction period and sidelining input from professional engineers.

The Building Confidence report by Shergold and Weir which was commissioned by the Building Ministers Forum in 2017, makes 24 recommendations towards improving the effectiveness of compliance and enforcement systems for the building and construction industry across Australia. Building controls can only go so far to improve practices, a significant paradigm shift is called for.

The implication of evidence considered by and conclusions reached by the Report is that the contribution of professional engineers to the design and construction of buildings has become compromised.

Purpose

“The building and construction industry needs to actively participate in lifting standards, competency and integrity if it is to produce safe and reliable buildings...”¹

As a response to this call, Engineers Australia convened a building industry working group to develop a paradigm for good practice of engineers across the building sector. Members of the working group came from various sectors and jurisdictions within the building industry.

This paradigm supports many of the Building Confidence report recommendations and is intended to:

- Improve the likelihood that the building production system (design, fabrication, construction) gets it right every time. Sign off by an Engineer of Record; and
- Improve the likelihood that the building approval process (verification) gets it right every time. Verification by a Proof Engineer.

1 P. Shergold and B. Weir, *Building Confidence*, 2018, p. 4

Making the case

Poor design documentation and ineffective enforcement of compliance was identified as a contributing factor to the diminishing public confidence in the building industry by the Building Confidence report. While the Report aims to support delivery of compliant and safe buildings, a key concern is the confused roles, responsibilities and accountabilities of different parties in the industry.

Parties involved in the building industry are:

- The building owner or developer
- The building approval authority
- The building surveyor/certifier
- Engineers in various areas of practice
- The builder/head contractor
- Subcontractors
- Project managers
- The architect/building designer

Traditionally the architect, building owner, design professionals and builders all knew the structure of their relationships and could settle information on building requirements.

With an apparent lessening role of the project architect and the greater use of design-and-construct contracts directly with the builder, the work of design professionals has become more focused on minimising costs and meeting deadlines. Poor design documentation has gone unchecked and forced builders to “improvise, making decisions on matters which affect safety, ... exacerbate disputes about quality and compliance and ... result in inadequate information to guide the future maintenance of safety systems in buildings.”² At the extreme, underfunded and ineffective enforcement of standards on complex commercial building projects has left those involved in high-rise construction largely to their own devices.³

There is an ever increasing complicated building environment to be navigated. With this comes risks of error or omission associated with the design of related engineering systems.

The concept design for a building project is usually based on a design brief provided by the building owner and is influenced by many of the parties involved in the building industry. Often the design brief will evolve as opportunities and challenges emerge during the design and construction phases, so the concept design needs to be flexible enough to accommodate change. In this context, change management is crucial and risk management processes need to be robust to appropriately manage the complexity of the building project’s engineering systems.

In a design-and-construct building project, design work and construction often run concurrently, designs being delivered just in time for construction. Compressed project delivery times increase the risk of poor-quality documentation due to errors or omissions on the part of the design engineer or engineers involved in construction. Process improvement is necessary to manage and mitigate these risks. Engineers Australia’s paradigm for good practice in the building industry introduces enhanced coordination of engineering systems and design verification to support a better project outcome.

2 *ibid.*

3 *ibid.*, p. 11, p. 29, p. 30, p. 33

A Paradigm for Engineers

Significant improvement to engineering processes are necessary to lift standards and lead a paradigm shift in the building construction industry.

The engineer supports the architect or building designer with specialist advice and develops the concept for and details of engineering systems. The engineer supports the builder with specialist advice on how to construct engineering systems efficiently and effectively. The engineer supports the building surveyor with specialist advice on the compliance of engineering systems with the National Construction Code (NCC).

No matter who commissions professional engineering services, the engineer must exercise their ethical responsibility, serving the community above all. In doing so, the engineer is to demonstrate integrity, practice competently, exercise leadership, and promote sustainability, all of which requires the engineer to communicate honestly and effectively with all stakeholders who rely on their engineering expertise.

The paradigm proposed is to introduce two key professional engineering roles into the delivery and approval of a building project:

- Engineer of Record
- Proof Engineer

These professional engineers should have at least fifteen years' experience and be registered in a relevant area of engineering as required by jurisdictional law. If there is no statutory requirement to be registered then the engineer should, at a minimum, be registered on Engineers Australia's National Engineering Register (NER).

Engineer of Record

The Engineer of Record for an engineering system is a senior professional engineer who is engaged by the owner to endorse drawings, reports, or documents for a project. Endorsement means review and assessment for compliance with the performance objectives and compatibility with the concept design.

There are many engineering systems in a building project. For each engineering system the Engineer of Record should:

- plan, monitor and coordinate professional engineering service delivery to ensure that the documentation of their engineering systems meet the contractual and regulatory requirements
- be satisfied that the professional engineers engaged on the engineering system are aware of the National Construction Code (NCC) and have the required competency and capacity to deliver the required services
- help determine when independent checking or enhanced verification is justified
- liaise with the builder concerning planning, management and monitoring of the construction phase especially concerning design changes initiated during construction
- coordinate regulatory certification of the engineering system and advise on the inspection of engineering systems and implementation of building safety during the construction phase
- interact with the responsible building surveyor over concerns about non-compliant construction work
- advise the building owner on meeting statutory approval requirements

Proof Engineer

Proof engineers are specifically engaged by the building approval authority to verify the integrity of complex engineering systems for compliance with the NCC. In the context of the building environment, verification means review of calculations and design documentation prepared by others and may also involve checking by independent calculation.

The ABCB provides a definition of a building's complexity⁴. The level of a building's complexity should drive the basis for engagement of a Proof Engineer.

The Proof Engineer is a senior professional engineer who verifies that each engineering system is coherent and meets the applicable standards. The Proof Engineer must not be part of the engineering design team, is entirely commercially independent and carries out third party certification for a project.

Where the level of building complexity requires a Proof Engineer, the Proof Engineer should:

- have in-depth knowledge and understanding of the NCC and the supporting Australian Standards
- identify the Performance Requirements from all sections and parts of the NCC that may be relevant to any aspect of Performance Solutions for critical systems
- verify that the engineering system, if constructed as intended, will comply with all relevant Performance Requirements of the NCC
- verify that the engineering system as constructed complies with all relevant Performance Requirements of the NCC
- certify that verification has been made and provide supporting documentation that identifies applicable sections and parts of the NCC to the building approval authority or the relevant Engineer of Record
- report to the building approval authority on non-compliance of design or construction of critical systems
- raise issues with building approval authority where Performance Solutions have been used inappropriately to approve non-compliant construction work

Conclusion

Professional engineers have an important role in the successful delivery of engineering systems. The paradigm for engineers engaged in the building industry, as presented here, will support a number of the recommendations from the Building Confidence Report.

The **Engineer of Record** will provide assurance on the integrity of the engineering system.

The **Proof Engineer** will provide assurance of compliance with the NCC.

4 Australian Building Codes Board, *Definition: Building Complexity Exposure Draft*, 2020

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