engineering new zealand
te ao rangahau

DISCIPLINARY COMMITTEE – UPHELD COMPLAINTS

LESSONS TO BE LEARNT

CASE STUDY
APRIL 2023 – SOUTHLAND STADIUM

INTRODUCTION

Engineering New Zealand receives around 50 concerns and complaints about Chartered Professional Engineers and members each year.

Not all complaints are upheld, but they typically relate to:

- miscommunication,
- inattention to client care,
- a misunderstanding over what the engineer has been engaged to do (or what they can't do),
- serious issues of competence, or
- ethical conduct.

Reflections on past complaints that an Engineering New Zealand Disciplinary Committee has upheld can offer valuable lessons for engineers.

We will review an upheld complaint from a past Disciplinary Committee decision every two months. The purpose of this project is not to name and shame, but to provide information so we can learn and grow. Wherever possible, we have anonymised the case.

We invite you to reflect on the lessons to be learnt.

Background

The engineer was engaged to undertake the structural engineering design of Southland Stadium. No formal contract was signed between the project's engineer and the client. A peer reviewer was not engaged for the project.

While the stadium was under construction, excessive deflections were observed in the roof trusses erected over the Community Courts area. The original design was peer-reviewed and found errors; at least ten items were under code strength and/or serviceability limits. They also found the contractor had been making unapproved variations eg using SHS with 6mm rather than 9mm wall on the chords.

Modifications had to be made at a late stage of construction to address these problems. The building was completed in 2000. On 18 September 2010, the stadium roof structures collapsed following a snowstorm.

Key issues

1. Were the designs authorised (by signing the PS1) or subsequently provided by the engineer, including the initial, amended, and final designs, adequate?
2. Was the level of construction monitoring adequate?
3. Did the engineer meet the competency standards expected of a reasonable engineer in providing engineering services for the design and construction monitoring?

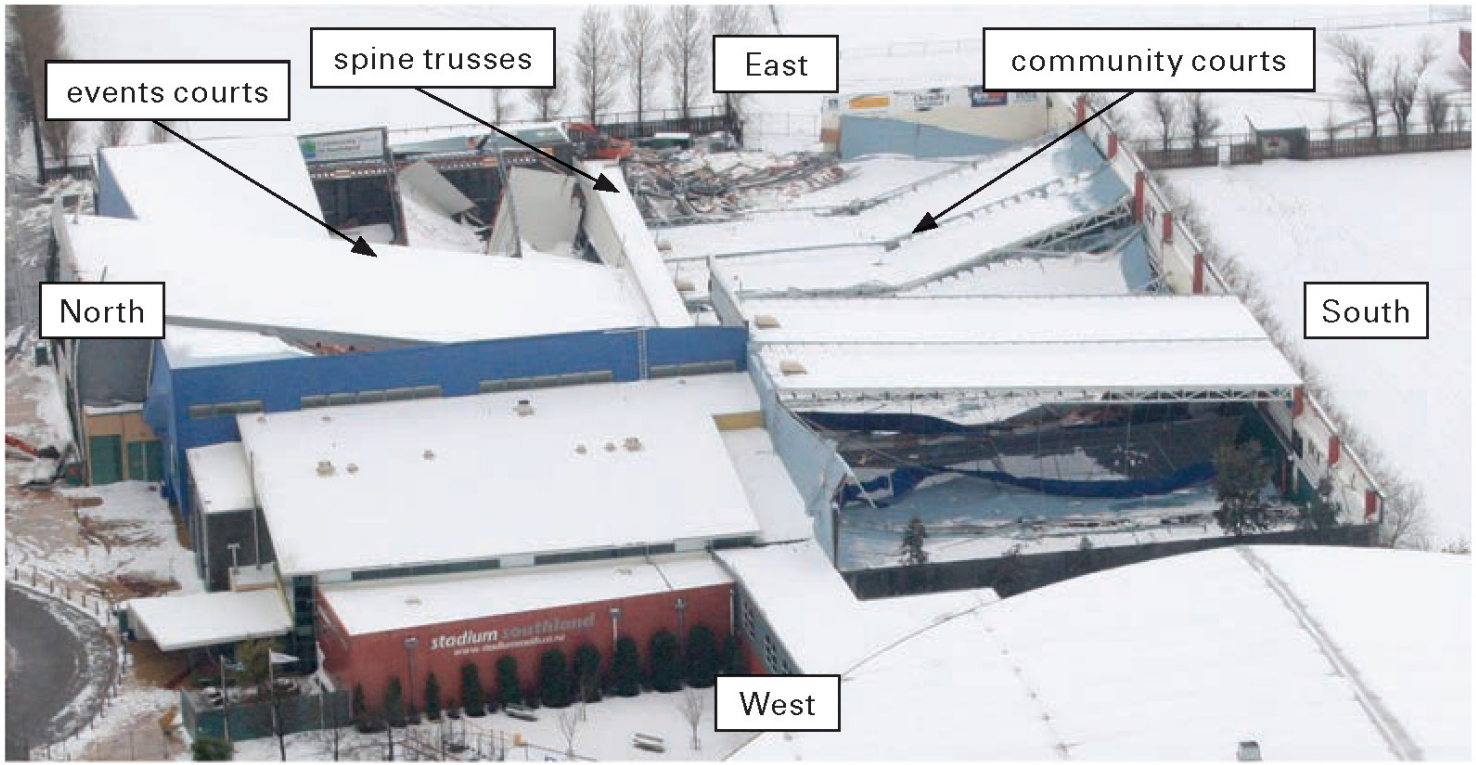
Decision

The Disciplinary Committee found the respondent engineer did not recognise the special nature and risks inherent in a project of this size and type and acted outside his level of competence. He did not meet the standards expected of a reasonable engineer in providing engineering services for the stadium's design or construction monitoring.

Drawings

Figure 1: Stadium following collapse[1].

Figure 2 Stadium Southland following collapse – 19 September 2010
(copyright The Southland Times)



1 www.mbie.govt.nz/dmsdocument/100-southland-stadium-technical-investigation-pdf

Figure 2: Collapse sequence diagram[2].

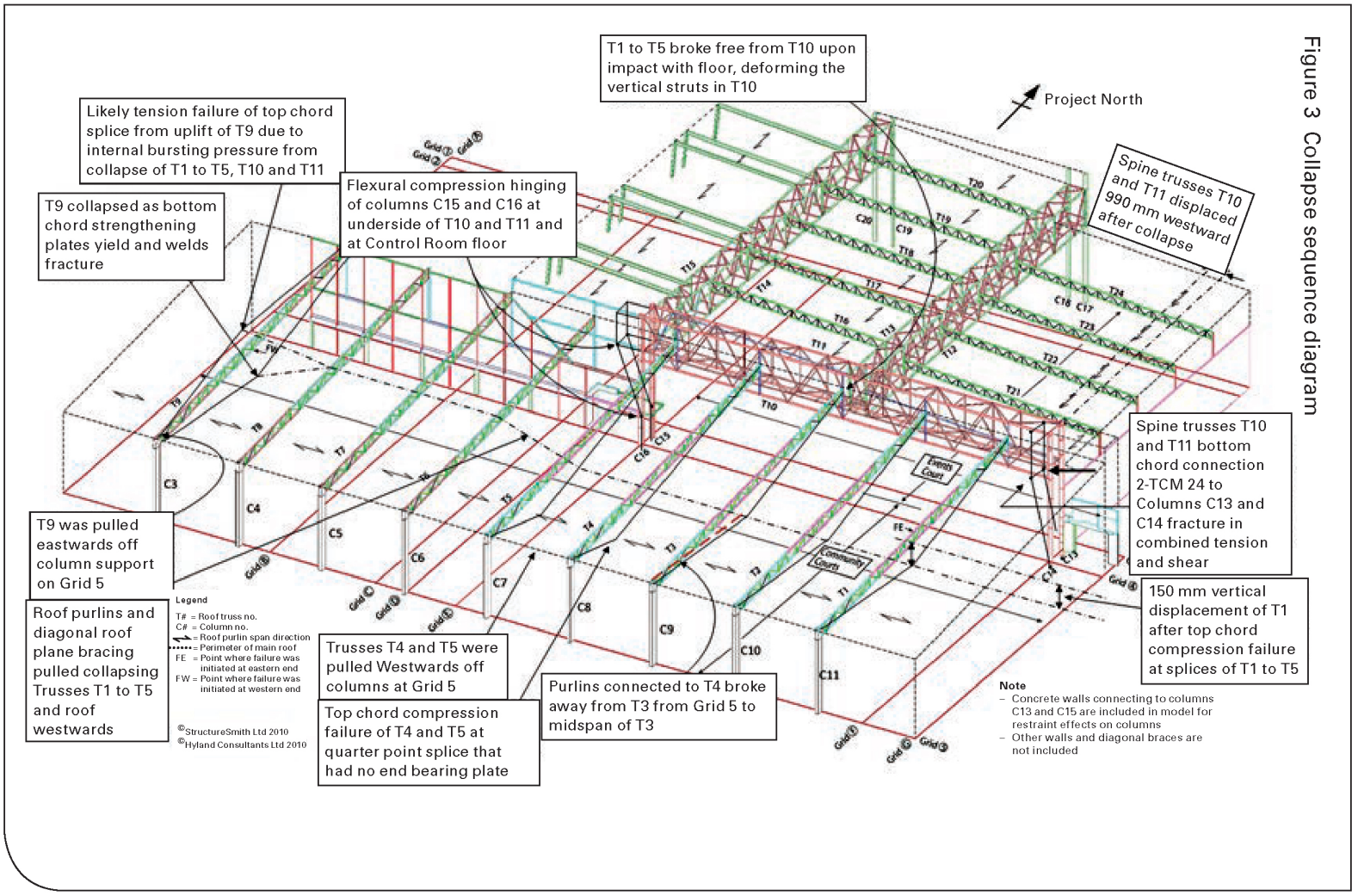


Figure 3 Collapse sequence diagram

2 www.mbie.govt.nz/dmsdocument/100-southland-stadium-technical-investigation-pdf

PROCESS FAILURE

This case study focuses on the engineer's lack of quality assurance and control process because that is the root of the failure and subsequent disciplinary action. In the report provided to the Council after construction problems became apparent, the reviewing engineer concluded that:

"The problems that have arisen are design problems and appear to be due to the following reasons:

1. *Lack of checking.*
2. *Failure to carry out sufficient seismic analysis.*
3. *Insufficient detailed design input into connections and member slenderness.*
4. *Failure to follow design codes.*
5. *Pressure to reduce structure costs without detailed re-analysis[3]."*

Contract

The Disciplinary Committee could not find evidence of a contract or scope of work between the client and the engineer.

Engineering New Zealand recommends having a contract for every job you undertake so both parties understand their obligations. You can download contracts for free from our website.

Competence

Working within our bounds of competence is a fundamental part of work. The Disciplinary Committee found the engineer acted outside his competence. For example, they found he did not have robust, clearly defined load paths through the structure.

"The significance of restraint to resist lateral torsional buckling actions was apparently misunderstood by Mr Major and his assumption that the full section capacity could be effective did not appear to be consistent with his approach to provision of bracing. From the limited design details available to the DC it is apparent that in some cases the bracing failed to achieve a full load path, as it terminated some distance from the restraining panel. This would require gravity resisting members to resist lateral loads in potentially significant bending about their weak axis.[4]"

There was evidence he wasn't familiar with the appropriate Standards. For example, when questioned about the construction monitoring of steel fabrication and erection work (NZS 3404:1997 cl 1.6), the engineer replied *"he was not familiar with the New Zealand Standard and relied on the requirements of his materials and workmanship specification to ensure that the fabricator provided his own quality assurance without reference to the design engineer"*.

3 SOUTHLAND INDOOR LEISURE CENTRE CHARITABLE TRUST vs Invercargill City Council, 2015
4 Southland Stadium Disciplinary Decision (d2rjvl4n5h2b61.cloudfront.net)

Quality Assurance and control

DISCIPLINARY COMMITTEE FINDINGS

The Disciplinary Committee found the engineer's process to be inadequate. They said, *"a high level of quality assurance could have been expected for the design and construction components of the project*[5]*."* They felt that:

- a formal peer review of the design should have been conducted
- a construction monitoring schedule for on-site and off-site work
- when defects and unconsented variations were discovered, the engineer should have raised the level of construction monitoring accordingly
- construction monitoring reports that fully documented the work done, for signing-off purposes, should have been provided.

However, the engineer did not undertake any of these items.

FROM THE ENGINEER

In correspondence with Invercargill City Council regarding their continued acceptance of his producer statements, the engineer said:

"From now on, I intend to:

1. *only accept commissions where adequate time is allowed for the design and documentation phases*
2. *be rather more pedantic where savings in the structural content are requested*
3. *prepare calculations to a standard that will allow an independent check to be carried out*
4. *engage an independent engineer to carry out a full peer review, covering design philosophy and arithmetical check, for any major projects, or those which involve difficult or novel solutions*[6]*."*

The implication is that the engineer normally did not use that process.

Engineering New Zealand recently published a Quality Control system developed by the Waikato Group. It is available for engineers to download and adapt to their needs.

5 IPENZ, 2014.
6 SOUTHLAND INDOOR LEISURE CENTRE CHARITABLE TRUST vs Invercargill City Council, 2015

YOUR REFLECTION

As is seen in this case, having a robust quality management system is critical. A good system is flexible and fit for purpose. It should not be unwieldy or difficult to use. You could use Word templates or Excel spreadsheets. There are also software packages you can buy.

A sole trader or small business company will have different processes than one with 1,000 employees, but you should have a system that covers the principles. The questions below have been adapted from www.business.govt.nz [7]

- How do you measure the quality characteristics your customers care about and any legal requirements?
- How do you ensure your quality specifications are easy to measure and give useful results?
- What processes and controls help you eliminate repeat problems and catch new problems early?
- How do you control processes inside and outside your business (such as at suppliers, eg construction monitoring)?
- How do you ensure the final product or service meets your customer's needs?
- How do you provide good support for any quality problems your customers encounter?
- Relying on lowest-cost bidding doesn't ensure long-term viability or allow for robust QA and QC. How do you make the most of your quality to market your business?

ISO9000 – QUALITY MANAGEMENT AND CONTROL

The ISO9000 series are the International Standards for quality assurance and quality control. There are set principles that they recommend following. How you follow those principles should fit the scale of your company.

The principles stated in the ISO9000 series are:

- **Engagement of people** – openly discussing issues, sharing knowledge and experience with your team, and ensuring everyone in your company understands their role and feels valued for their contribution.
- **Customer focus** – developing a strong customer focus and gathering customer feedback.
- **Leadership** – ensuring your team works towards common goals provides motivation. What is your vision for the company's future? How are you deciding and communicating your goals?
- **Process approach** – you should have established processes for common tasks. How do you identify hazards and manage the risks on a company and project level? For example, hiring and retaining staff, assessing project pricing and scope, and ensuring the finished design is fit for purpose.
- **Improvement** – continuous improvement is crucial to incorporate lessons learnt. How do you do that? You need information from internal project reviews and customer feedback. How are you gathering it?
- **Evidence-based decision making** – if there's a problem, you must identify it correctly. To do so, you need a good process. You can use these steps:
  - What is the problem, and what is its history?
  - Where did it occur?
  - When did it happen, and when was it reported?
  - How big is the problem, how frequent is it, and how are you measuring it?
- **Relationship management** – your relationships with suppliers, contractors, customers, investors, and employees, can significantly influence the performance of your business. How do you make sure you're working effectively with these stakeholders?

7 Quality checklist – Operations strategy (business.govt.nz)

Do your company procedures cover these principles? If so, how?

What are the quality assurance and quality control procedures in your company? How have you recorded them?

How would you have stopped this from occurring in your own company?

AN EXPERT'S VIEW

We share some tips on approaching the principles of QA and QC from the owner of a small company, who's worked both as a sole practitioner and employed other engineers.

Engagement of people

Openly discuss issues, share knowledge and experience with your team, and ensure everyone in your company understands their role and feels valued for their contribution.

In a small practice, this can be difficult! Ensuring employees understand their employers are there to produce high-quality work, listening to their ideas for improvement and implementing them where applicable is key to ongoing employee engagement.

Participation in local small engineer groups, Engineering New Zealand branches, and technical groups can help compensate for the lack of fellow workers. You need a network of people to discuss problems with, and bounce ideas off.

Customer focus

Customer focus is vital in any organisation. It's important to actively seek feedback, listen to customers, and record that feedback. Look for patterns, good and bad. Do something about the patterns you see and keep gathering feedback to see if your solution worked.

Leadership

Ensure your team works towards common goals provides motivation. What is your vision for the company's future? How are you deciding and communicating your goals?

For a small organisation, this could be as simple as your reasons for being in practice. Be passionate about providing good quality engineering solutions. Your team should know that providing quality engineering for our customers is the most important driver.

Process approach

You should have established processes for common tasks. How do you identify hazards and manage the risks on a company and project level? For example, hiring and retaining staff, assessing project pricing and scope, and ensuring the finished design is fit for purpose.

Check my work using these principles:

- Make sure the fee is adequate for the size of the job.
- Set aside time to review work before it is issued.
- Take a little time to sit back and review load paths down to the ground without doing calculations Look at potential failure modes or collapse mechanisms.
- Mentally try to build the structure to anticipate construction problems.
- Carry out simple checks on the structure, including checking actions.
- Use 'ballpark' order of magnitude loads.
- Do simple capacity checks on the structure.
- Check restraints to ensure they match capacity assessments.
- Make sure failure modes are ductile. You don't want bolts popping or pulling out of concrete. Check bolts aren't only in cover concrete!
    - If it doesn't look right, it probably isn't.
    - During construction, make sure checks are carried out on critical parts of the structure. Ensure that durability requirements are met. Record construction monitoring information with notes and photographs. Engineering New Zealand has construction monitoring templates you can download and use.
- Treat requests for changes carefully. Consider the implications for the rest of the project.
- Don't rush – follow the process.

Engineering New Zealand has published a Quality Management System, developed by the Waikato Group. You can download and adapt this for your own business.

Improvement

Continuous improvement is crucial to incorporate lessons learnt. How do you do that? You need information from internal project reviews and customer feedback. How are you gathering it?

Learn from your own mistakes and those others make. Have a simple checklist to record mistakes yourself or others have made. You can download a simple structural checklist from the Engineering New Zealand website.

Record items from seminars and webinars that relate to the type of work you do. Last year's SESOC seminars on '10- tips for designing low-rise structures' is especially useful for structural engineers. Learnings from discussion groups can be useful for all disciplines.

Evidence-based decision making

If there's a problem, you must identify it correctly. To do so, you need a good process. You can use these steps:

1. What's the problem, and what's its history?
2. Where did it occur?
3. When did it happen, and when was it reported?
4. How big is the problem, how frequent is it, and how are you measuring it?

Write these questions down and work through them when resolving issues. This applies to both the design and construction phases. Importantly, keep a record of them and incorporate them into your in-house checks.

Relationship management

Your relationships with suppliers, contractors, customers, investors, and employees, can significantly influence the performance of your business. How do you make sure you're working effectively with these stakeholders?

- Open courteous communication is vital.
- Listen carefully.
- Be careful not to ignore criticism.
- Actively and continuously seek feedback. Look for patterns in the feedback and find solutions for any issues.

LESSONS TO BE LEARNT

What lessons can be learnt after reflecting on this upheld complaint?

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