IMPROVING NEW ZEALAND CONSTRUCTION INDUSTRY PRODUCTIVITY

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Contents

Executive Summary

The nature and extent of the problems in the construction industry are generally recognised. The industry has taken some measures in response, one of which is the Construction Sector Accord (CSA). However, there are concerns that many of the proposed changes are narrowly focused and consequently may not significantly improve productivity or lower costs. There are also concerns that some changes may increase compliance costs without yielding commensurate improvements in quality and efficiency.

The construction industry's difficulties are long-standing and their causes are complex. Behaviours and practices entrenched over many years have resulted in poor performance and low productivity. All sectors and participants share responsibility for the industry's current state. The entire construction industry — central and local government, contractors and subcontractors, architects, engineers, project managers, quantity surveyors and building owners — must work together to construct better buildings in an efficient, cost-effective manner.

We have to profoundly rethink how we deliver buildings. In order to improve productivity, the entire construction process — design, regulation, procurement, building — requires critical examination, as do the roles and responsibilities of all of the industry's participants.

As a positive contribution to this endeavour, a group of cross-discipline industry practitioners, with decades of experience in successfully delivering building projects across New Zealand, have worked together to find answers to the pressing question: How do we build better? Our group, the Construction Productivity Group (CPG), has focussed on vertical construction as we consider this is to be the industry sector in which changes are most urgently required. At the same time, we recognise that many of the issues we have identified, and the solutions we offer, are relevant across the whole industry, including the infrastructure sector.

The purpose of the CPG is to develop practical solutions that can have a direct effect in increasing construction industry productivity. The group is independent of existing industry bodies, such as the CSA, New Zealand Construction Industry Council (NZCIC) and New Zealand Institute of Building (NZIOB). Our intention is not to dissipate the effort of these bodies, but to offer them, and the wider industry, solutions for consideration.

In the past year we have met with many key industry groups, including the CSA, NZCIC, NZIOB, Engineering New Zealand (EngNZ), Te Kāhui Whaihanga New Zealand Institute of Architects (NZIA), New Zealand Master Builders Federation and Auckland City, to discuss our recommendations and gather feedback. We are now in a position to more clearly define our recommendations and connect and communicate with the wider New Zealand construction industry.

The CPG has focused on 6 inter-related areas:

1. **Construction Procurement Guidelines**

Creating guidelines that define standard construction procurement methods and align conditions of contract, risk allocation, tender design documentation and integration of sub-contractors for each delivery method.

2. **Regulatory Process Changes**

Aligning the processes for building consent with those for design documentation and construction procurement.

3. **Project Management Services Guidelines and Accreditation**

Creating guidelines defining standard Project Management (PM) services, including design management, and advocating for the regulation and licensing of PM services.

4. **NZCIC Design Documentation Guidelines Revisions**

Updating CIC guidelines to reflect changes in the industry over the last four years, and including in the guidelines Building Consent and construction tender design documentation, in line with the initiatives defined in this paper.

5. **Technology and Building Information Modelling (BIM) Use in Construction**

Fostering collaboration between designers, contractors and building owners to promote the use of BIM in construction, and developing standard contracting arrangements to address liability and responsibility issues hindering BIM use.

6. **Training and Education**

After the guidelines and initiatives outlined above have been developed and finalised, we recommend a series of training seminars/webinars explaining the purpose and use of the guidelines are organised across the country. We also urge that education and training programmes to address significant skills shortages and deficits are developed in consultation with tertiary education providers, together with in-house and on-the-job training. These programmes need to be aligned across the industry, with the hands-on involvement experienced practitioners.

Some of the initiatives we offer align with those currently under development within the industry. Where our recommendations or proposals complement existing initiatives, we seek to work with and the relevant industry group(s). Where our initiatives and guidelines break new ground, we wish to engage with industry representatives to realise the proposals. At this stage, we see the CSA, NZCIC, NZIOB, NZIA and EngNZ as the appropriate groups to bring about the necessary changes in the construction industry.

The CPG has identified starting points and developed directions for change. The entire construction industry must unite to drive this change, and work together to create a stronger industry that delivers better buildings.

1.0 Introduction

Senior leaders in the New Zealand construction industry say the condition of the industry is the worst it has ever been. Major construction companies continue to fail. For several years the industry's endemic problems have been a staple item in local media. *The New Zealand Herald*, for example, has reported on: poor construction industry productivity (26 August 2017); the lack of a large pool of financially strong contractors (1 October 2018); the huge cost of defective buildings, much of it falling on Councils (30 April 2019); and company failures (5 December 2019). On 17 October 2021 *The New Zealand Herald* warned of another 'leaky building crisis' in the making as 'cowboy' builders and developers rush into the Auckland housing market. Recent surveys of the construction sector by BDO and ANZ indicate an industry characterised by squeezed margins, a shortage of trained staff, rising compliance costs and inconsistent cash flow.

In *Rottenomics: The Story of New Zealand's Leaky Building Disaster (*2019), Peter Dyer explains the most significant construction industry failure of the last three decades. Dyer estimates the total cost of leaky buildings at around $47 billion (to date). Beyond the figures, the 'leaky building crisis' brought huge personal stress to thousands of people whose life savings evaporated in the face of costly repairs and protracted settlement disputes. The crisis has also precipitated the collapse of many construction companies, some of significant scale.

The reality is that we are confronting a dismal situation in the construction sector, even after a decade of a strong market with, prior to the Covid-19 lockdowns, three-to-five years of committed forward workload.

New Zealand continues to have one of the lowest construction sector productivities in the OECD. The nature and extent of the problems in the construction industry are now better recognised, and steps towards improvement are being contemplated. However, too often proposed actions and recommendations focus have too narrow a focus. They cannot be game-changing. Furthermore, many of the measures under consideration, or being enacted, will only serve to add significant compliance costs without commensurate improvements in quality and productivity.

In April 2019, the Government announced it was partnering with some of New Zealand's largest construction companies to address the industry's biggest issues. However, many senior industry leaders considered that the introduction of the joint strategy formalised in the Construction Sector Accord (CSA) would not be effective in tackling many of the problems facing the industry. Meetings between central government, represented by the Ministry of Business, Innovation and Employment (MBIE), and CEOs of large construction companies, representing the CSA, have been useful in highlighting the causes of the collapse of construction companies, the poor quality of buildings and the shortage of skills. We now have to move beyond an appreciation of the problems to the realisation of solutions.

The need is urgent, as problems with the design and construction process appear to be worsening. Construction contracts provided by clients and project managers are often based on incomplete and uncoordinated design documentation. Key project risks are placed unfairly onto parties — often contractors or subcontractors — who are unable to manage such risks. The Territorial Authority (TA) building consent process is often compromised in an effort to remove or limit TA

liability for defective buildings. Such behaviour adversely impacts, in particular, the procurement of commercial buildings through excessive time delays and onerous and ill-considered consenting impositions.

We are continuing to construct defective buildings, albeit to a much lesser extent than a decade ago. The cost of resolving protracted construction disputes continues to plague the industry, tying up much-needed resource, and adversely impacting on productivity. As well, there appears to be an increasing willingness to resort to costly litigation to resolve construction disputes. Unfortunately, one of the few productivity gains generated by the New Zealand construction industry has been in the area of dispute resolution services.

In recent years, the government has encouraged offshore construction contractors and suppliers into the industry. The construction industry does need competition which can introduce critical expertise into the task of developing better ways of delivering better buildings. However, the industry has strong concerns that MBIE is not taking proper steps to ensure compliance with New Zealand standards and regulations. In some cases, foreign compliance certificates have been found to be fraudulent.

The reasons for the construction industry's dismal rate of productivity are numerous, and failure has become entrenched over decades. Things must change. In order to significantly improve productivity, we must rethink the delivery of buildings through a critical examination of the entire process of design, approval, procurement and construction. This scope of this examination must include the roles and responsibilities of all participants in the construction industry. The CSA was established to improve the performance of the construction industry. However, we have not yet seen any evidence of the fundamental changes needed to deliver better buildings more productively. The Construction Productivity Group (CPG) has been formed to help achieve this goal by contributing an independent and critical perspective.

The cross-disciplinary group comprises practitioners with decades of experience delivering building projects across New Zealand. (*See Appendix 1 for CPG member details*). Many of our members have had leadership positions in key industry professional bodies and continue to participate in the industry. We were inspired to create the CPG by the late Bruce Connor, a construction industry leader, who 20 years ago brought together a similar group of senior cross-discipline practitioners to find solutions to the problem of poor design documentation. That collaboration led to the creation of the NZCIC Design Documentation Guidelines, issued in 2003. We have focussed on complex vertical construction as we consider this sector is most in need of change. However, we recognise that many of the principles relevant to this sector apply across the industry, including to the infrastructure sector.

The objectives of the CPG are to identify ways to improve the delivery of vertical construction residential / commercial / institutional buildings, create outlines and guidelines for proposed changes, and communicate proposed initiatives to key construction industry participants. We seek straight-forward, pragmatic solutions.

In 2020 the CPG met regularly to consider how to improve the vertical construction sector. We identified and pursued six workstreams:

1. Construction Procurement

2. Regulatory Process
3. Project Management Services
4. Design Documentation
5. Technology and BIM Use in Construction
6. Education and Training

Subgroups were created for each of the workstreams, with each working separately to develop initiatives and then consulting with the full CPG membership. The CPG did not wish to act or be perceived as a splinter group confusing the discussion around industry improvement. Our members met with representatives of the CSA, Auckland City, NZIA, EngNZ, NZCIC, NZMB, NZIOB and MBIE to ensure alignment with the industry.

This paper provides recommendations for a process that will deliver better buildings. The paper outlines initiatives, proposed by our six workstreams, to improve productivity in the areas of multi-storey commercial, institutional, and residential buildings.

2.0 Construction Procurement Guidelines

2.1 Introduction

The CPG's Procurement Group focussed on procurement processes. It examined how good practice in this area would establish a solid foundation that enables a successful project. This work must be considered in the wider context of the entirety of the construction life cycle that comprises the establishment of the client brief and budget, legal and consenting processes, procurement of consultants and contractors, design, project management, application of the relevant BIM strategy, consenting processes, construction and hand-over of the completed building, on time and within budget.

With very few exceptions, each construction project is bespoke. It has its unique set of drivers, challenges and risks. Construction procurement strategies must be tailored to a project's demands; adopting the right procurement process is critical to a project's success.

2.2 Consultant Procurement

In this section the term "consultant" includes not only architects and engineers but also the other professional experts engaged to design, provide cost analysis and management of a project. As with choosing the right building contractor for a specific project, engaging an appropriate consultant team is critically important. To maximise a project's success, not only is it necessary to engage an experienced and highly competent design professional or professionals for each aspect of the building's design, but it is also important that there is good synergy between the designers and all other consultants, project managers and contractor. On complex projects, previous success in delivering a similar project is, of course, advantageous.

The engagement of consultants based on low price or through a competitive tender process without regard to relevant experience and teamwork is usually detrimental to a project from the start. Selecting the right members of the consultant team and enabling their early contribution usually leads to significant enhancements to a project. To achieve this from-the-start collaboration, it is necessary to adopt a fee strategy that allows the consultant the necessary licence to challenge the client's assumptions and provide appropriate options.

A major consideration is establishing the nature of the consultant's engagement. That is, the extent to which the consultant is involved in providing the brief and the necessary design details, and the consultant's responsibilities for design coordination, construction observation and post-construction tasks through the defect liability period.

Rigorous design coordination is critical. Poor coordination inevitably leads to design omissions, errors, or inconsistencies. The resultant rectification work negatively impacts a building's cost, quality, and completion date. Often it also leads to disputes and their attendant expense. A critical omission in complex projects is the allowance of the time required to integrate and coordinate contractor design, particularly in specialist areas such as structural elements, façades, and mechanical services.

As buildings have become more complex there is also an increasing need to integrate and coordinate the specialist contractor design for other elements, including fire resistance and roof membranes and safety systems. The responsibilities of the consultant during pre-construction, such as interaction with contractors or subcontractors during the design and tender or contractor engagement period, must be considered and allowed for in planning the consultant procurement process.

The consultant's conditions of contract, which set out its obligations, particularly in respect of design, must take account of and align with those of the contractor. In a 'traditional' design-then-build contract, typically based on NZS 3910:2013, the contractor, and subcontractors, have limited design responsibilities, generally those confined to temporary works. However, the design of mechanical services, fire protection and lifts are often based on a performance-type specification from the design consultant. In many projects, significant triggers for variations are the gaps where the full design details necessary for the project are either missing or not obvious and are not the responsibility of the contractor.

The complexity of modern buildings often necessitates contractor-led design for critical elements such as large bespoke façade systems, sophisticated mechanical systems, and complex foundations. Inevitably, there must be close coordination between the lead contractor, subcontractor, and the design team. Sufficient time and budget must be allowed for this, and these responsibilities, schedules and costs must be properly provided for in the relevant contracts to ensure a properly coordinated design, budget, and programme. The engagement, at the start of project, of a professional cost consultant and project manager with the requisite design management expertise is essential.

Summary of key procurement-related issues to be taken into account when determining consultant procurement methodology:

- Size and complexity of project
- Client experience in a project of a similar nature
- Does the client have sufficient commercial and legal experience? If not, has the client enlisted external advice?
- Has the client provided a clear and complete list of strategic objectives to guide the briefing process?
- Will the consultant/s be required to assist with the defining of project objectives?
- Business case requirements, if any
- What experienced staff resources will the client provide for briefing, and during the ensuing stages of design, procurement, and construction?
- Nature of client user group interactions with the briefing and concept design process
- The market availability of experienced consultants covering all project phases, e.g., briefing, concept, design, and project trade sections, as necessary to meet programme requirements
- Consultants' ability to work together as an effective project delivery team
- Formal consultant processes required by the client or government.

2.3 Project Objectives

A project's objectives are generally established by the client, but they may incorporate consultant advice on the important issues of scheduling, cost, and quality. The objectives might be very simple, e.g., "build a new Call Centre", or more detailed, e.g., "build a new Science Centre with generic chemistry laboratories capable of accommodating other science-related activities in the future." The client will normally have already provided a 'strategic brief' stipulating, at a high level, key project objectives and the budget, and may also have provided draft budgets encompassing operational and maintenance costs over the life of the project. The budgets may be derived from a project business case approved by a board or other governing body, often without thorough examination of construction costs, or may be subject to a business case when more details are available. In some cases, the client might call on outside assistance to formulate this strategic brief. However the project objectives are established, it is critical that they are signed off by the client in advance of the establishment of the project brief, and that they provide sufficient detail to enable the development of a robust design brief.

Summary of specific project objective issues:

- A description of the business purpose driving the project
- An assessment of how the project will contribute to the corporate strategy
- An analysis of the high-level options, e.g., do something, do nothing, new build, extend, refurbish, relocate, change the way the organisation works
- A description of the nature of the client, and its history
- A description of the client's operations
- Information about existing premises and likely future requirements
- The assumed budget, and the basis for the budget
- The assumed programme
- An assessment of the potential for future changes.

2.4 Design Brief

The project brief is the final stage in the process of defining the client's requirements for a building. It is the key document on which the design will be based. The criticality of a fully detailed design brief which is formally approved by the client cannot be over-emphasised. Unless the client is proficient in briefing its requirements and/or has done this before, it is usual to get assistance from professional architects or engineers, generally in association with experts within the client's organisation. The engagement of a professional design manager and/or cost manager throughout the lifespan of a construction project is invaluable in keeping the process moving smoothly and providing costing information during the brief development stage.

The over-arching requirement is that the brief ensures the building is fit for the purpose for which it is intended, now and in the future, and that it meets the client's objectives in areas such as budget, programme and, construction quality, and that it satisfies criteria such as spatial requirements, sustainability, safety, maintenance, and adaptability. A robust, high-quality brief is the foundation stone for a successful project. The composition of the briefing team will vary, but for a major project, particularly a complex building, it is vital that experienced professionals lead the project. It is also fundamentally important to include in the process a client team with the relevant knowledge and understanding of a project's requirements and who can work effectively with the consultants who will distil information and translate it into the design brief.

Allowing sufficient time in the project programme for the establishment of a robust design brief is essential. The duration of this exercise varies with the type and complexity of each building. The client needs to understand that the briefing process may be time-consuming for the staff who are involved; their normal work commitments must be considered when agreeing the programme. It is also important that staff understand that what is being sought, for the purpose of concept design, is their knowledge in the areas of their expertise; a client's staff are not being asked to design the building.

The project/design brief is the key document for commencing the design process. Generally, it will be frozen at the end of the concept design stage. Any changes thereafter should be subject to standard project control procedures.

When appointing the consultant briefing team it is important that team members understand whether they will be part of the project team engaged for the design and construction of the building, or whether they are to be engaged solely for preparing the brief. Where the client intends to move immediately into project design phases following the establishment of an approved brief, it is strongly recommended that the same team becomes part of the design team. The project brief will typically evolve from the statement of client needs through the appointment of consultants, and then during early stages involving user and stakeholder inputs. On a complex project, the brief is often coordinated by the lead consultant, usually the lead architect on a commercial building project or the lead consulting engineer on an infrastructure project.

Summary of specific project brief requirements:

- Statement of needs, including details of client requirements

- Objectives and priorities of the project
- Business case
- Contextual and user information
- Site information and user, spatial and technical requirements
- Legislative and regulatory constraints
- Design principles including sustainability requirements
- Statement of Design Intent.

2.5 Project Challenges and Risks

The assessment of the challenges and risks of a project is an ongoing process. It should start in the pre-project and business case phases and continue, in one form or another, throughout the project until completion. It must be a vital component in the client's decision to commence the project be inherent in governance and management decision-making and the preparation of business cases, and continue through each stage of the project. The client must maintain responsibility for the business risks associated with the project, and for establishing the project objectives and outcomes, all of which need to be taken account when establishing the project brief.

The assumption of responsibility becomes especially important when assessing the various requirements and outcomes against the project brief. An assessment that should be undertaken at regular intervals during the briefing, concept design and developed design stages. An appropriate methodology is the establishment of a series of formal 'value management' and risk workshops at appropriate intervals during the various briefing and design stages. This can continue through the construction phase, a usual forum being the regular project control group (PCG) meetings, but could also continue in site and programme meetings.

A major and too frequently experienced risk during the construction phase is incomplete design or a lack of design details in the tender and detailed design drawings. The greater the complexity of the building and the larger the number of subcontractor trades involved, the higher the risk. Detailed design failure is often the major cause of contract variations and can have a significant impact on time and cost, and can lead to contract disputes. Even with the provision of fully detailed Issued For Construction (IFC) drawings, it is very unusual for the design documentation to fully cover all the required details for construction.

A further complicating factor impacting design coordination when design is incomplete is the trend to the early engagement of subcontractors in critical trades such as piling, structure, façades and mechanical services. This engagement can be informal or formal, with the latter split into either a contract for specialist trade design services only, or for design and build with the subcontractor being named in the head contract as a nominated subcontractor. This process requires a higher degree of design coordination by the lead consultant, normally the architect responsible for design coordination.

Excellent design coordination is important in mitigating the risk of programme and budget blowouts caused by incomplete or poor design coordination. Such mitigation can be difficult to achieve on large, complicated buildings and requires that all design consultants have regular access to the same digital platform. Another element in the mitigation of risk is the provision in the construction

tender documents of a detailed statement of design intent. [*Appendix 3 sets out the risks associated with each of the five more commonly used construction contract types*.]

Summary of Major Risks

Client:

- Inexperienced, or lacks understanding of project requirements
- Poor consultant selection
- Poor client briefing
- Lack of expert advice
- 'Low cost' mentality driving project
- Financial instability
- External consultant influencers dictating material selection
- Unreasonable risk transfer to contractor.

Design:

- Incomplete design
- Poor and uncoordinated design
- Inaccurate design information
- Design errors by principal and/or contractor or subcontractor.

Documentation:

- Poor or inadequate tender information
- Poor or inadequate contract documentation
- Use of inappropriate type of contract
- Unreasonable special conditions
- Unreasonable allocation of risks
- Inadequate programme time.

Pricing:

- Inadequate tendering period for pricing
- No full Schedule of Quantities (SoQ) or only a summary schedule
- Inaccurate SoQs
- Inadequate / low pricing.

Construction:

- Inexperienced contractor
- Inadequate pricing
- Inadequate management
- Financial instability

- Inexperienced subcontractors.

2.6 Construction Procurement Overview

The procurement of the head contractor under an even-handed and equitable construction contract is critical to a project's success. The failure to fully understand and make proper allowance for the areas of risk identified above sets the scene for subsequent, often expensive problems and may lead to costly disputes. The appropriate allocation of project risks to the party best able to control/manage and allow for each risk is fundamentally important, particularly when a contractor is not in control of the design process and design consultants.

The allocation of risks for each project will depend on the type of contract, the nature of the construction contract, the quality of the tender and contract documentation and the time available for a contractor to price and submit its tender. Particular emphasis must be placed on avoiding the addition to the contract document of special conditions which favour one or other party. For example, under a NZS 3910:2013 Lump Sum contract, a contractor should not be responsible for design errors or omissions unrelated to its own design responsibilities. Conversely, under an NZS 3916:2013 design-build contract, the principal should not be responsible for design errors or omissions which are the responsibility of the contractor, nor for poor workmanship.

The nature of each contract should determine the most appropriate contract conditions. For example, the traditional tendered contract with the principal providing the full design will differ in certain areas from a partial or full design-build contract, as will an early contractor engagement type of contract. A "when and why" guide to contract types should always include the fundamental attributes of communication and delivery that will, above all, be the measure of success. Depending on the type of contract, schedules of quantities prepared by the client-appointed project quantity surveyor/cost manager should be provided in all traditional full design-then-build projects as part of the tender documentation and then be incorporated into the agreed final schedule of quantities. This avoids the expense incurred when each tenderer measures its own quantities, often on the basis of incomplete design information, and avoids disputes around which items are or are not included, and/or measurement disputes.

The contractor's margin — unless defined otherwise under the construction contract — should allow for expenses or losses not incurred on the site which are required for the general overall running of the contractor's business, and which are not required for the carrying out of the contract works or for off-site manufacturing or fabrication work by the contractor, i.e., general administrative, financial, and overhead expenses incurred in the contractor's head office or other established offices. Contingency and risk are not included in the contractor margin, nor is any part of a client's contingency which is part of the overall budget. Risk and contingency should be addressed separately and sit outside the margin component which only allows for offsite overheads and profit. The attached discussion paper on contractor's margins [*Appendix 2*] provides further description of what the margin should cover.

2.7 Outline of Key Delivery Methods

General

The nature and extent of design documentation must be aligned with the project delivery method and the type of contract being used. Compliance with NZCIC Design Documentation Guidelines is to be encouraged. A schedule of each party's design and construction roles and responsibilities is critical. Key assumptions held by inexperienced clients, and perhaps by their advisors and some contractors, many of which may be embedded in the construction contract, can include the following:

- The client knows what it requires from the project and has provided an accurate detailed brief of its requirements
- The design consultants are properly briefed on the client's requirements and fully understand that brief
- The design consultants are able to translate the client's brief into documents which correctly interpret the client's brief
- Those design documents in themselves contain all details and information necessary for the tenderers to be able to accurately understand, price and construct the project, and where necessary tight design change control is implemented
- There is sufficient time allowed to complete all phases of the design process in order to provide the necessary contract design and documentation
- Selection of tenderers is based on their known capabilities, including financial status, previous performance on similar projects, satisfactory resources including labour, supervision, experienced and capable subcontractors, and the necessary plant required for the project
- Tenderers are given sufficient time to adequately prepare their tender price, taking into account the often-large numbers of subcontract trades pricing on which the contractors' tenders are based, including meeting preferred subcontractors to agree methodology and programme, and get alignment on addressing key project risks
- There is a clear, unambiguous set of tender plans and specifications and contract conditions which are fair to all parties, being client, contractor, and subcontractors, and which fairly allocate risks to those who are best able to manage them and allow for them in pricing
- The successful contractor and its subcontractors have understood the project requirements as provided in the tender documents and priced them with the necessary skill and attention required for that particular project
- The contractor fully understands the nature of the work to be carried out, even where many or all trade packages are to be subcontracted
- The tender price falls within the client's budget or is accepted by the client as being reasonable or is able be acknowledged as reasonable for the project and can be accommodated within the client's financial resources without undue financial stress
- The contractor and subcontractors have the necessary skills and resources to translate the project design into permanent structure/ structures within the contract programme and the contract price

- There are minimal if any design changes through the construction period and any such changes are fairly assessed as to cost and programme issues at the time
- There is strong teamwork between the designers, other consultants, contractors, subcontractors, independent suppliers, and contractors with all parties fully resourcing the project team
- The client carries out its duties as required under the contract including giving the necessary decisions and directions, avoiding design changes which impact on project delivery, and providing all payments by due date.

Needless to say, this Utopian situation rarely exists. Nevertheless, industry contract documents, including general and special conditions of consultant, contractor, and subcontractor conditions of contract are in the main relied on as though such certainty can be achieved. This is particularly the case with 'design then build' contracts, but such (misplaced) reliance permeates all types of contracts including design and build where the design is solely the responsibility of the contractor, other than for standard simple designs not requiring significant client brief input.

In almost all projects the design is incomplete at the commencement of construction.

The six types of Contracts reviewed are:

1. Traditional Lump Sum Tender
2. Design and Build
3. Novated Design and Build
4. P&G and Margin with progressive subcontract tendering and procurement
5. P&G and Margin converted to lump sum prior to construction
6. Alliancing.

The following provides summary comments on these six common types of construction contract, and the standard general conditions of contract more commonly used in the New Zealand for non-residential construction industry, including vertical and horizontal projects.

Traditional Lump Sum Tender: Measure & Value

This contract type is mostly used for civil and building work where the design is completed to detailed design and Building Consented stages and provided to contractors to submit a tender price for the completed project, albeit with the inclusion of some provisional items or sums, comprising only a relatively minor portion of the overall price.

The scope of the work should be well defined and preferably scheduled with the tenderers pricing a client-provided full schedule or quantities. It is more applicable to completely designed infrastructure projects and building works which are not of a highly complex nature, requiring further significant client or contractor design. Contractor design is traditionally limited to temporary work and specialist work items such as lifts and building services items. Tenders are submitted for a lump sum price with contract provisions providing for variations where instructed by an Engineer to the Contract acting as agent to the client, on the basis of tendered rates or agreed costs.

The New Zealand standard NZS 3910:2013 is the most used general conditions of contract, with NZIA SCC1 2018 also quite common. For clarity, this paper focuses on the NZS set of general conditions. It is not uncommon for special conditions to be added by clients which, in many cases, unfairly shifts risk onto the contractor. Several provisions such as contractor design, programme requirements and events beyond the contractor's control, such as the current Covid-19 pandemic lockdowns, in the NZS and NZIA standards also may not fairly allocate risk and responsibility between client and contractor.

The traditional lump sum contract conditions also have a strong underlying assumption that the contract includes all information and details necessary for the contractor to construct the project in accordance with the client's requirements as provided in the design intent. The standard conditions also fail to provide adequately for the increasing trend, particularly in larger commercial construction projects, for most trades to be subcontracted, and for large slices of the work such as unitised façades, mechanical and electrical services and lift supply and installation to be designed and constructed by specialist subcontract trades.

Design and Build

Contracts in which the whole design is undertaken by the contractor occur mainly for non-complex commercial (or residential) construction and major mechanical plant installations where proprietary design is held by large, often overseas, specialist plant suppliers and erectors such as packaged mechanical energy or oil installations. Such one-off projects are often governed by bespoke contract conditions negotiated between the client and the plant supplier or based on specialist FIDIC or NEC conditions of contract. For less specialised projects the NZS 3916:2013 general conditions may be used.

It is critical that the client's brief is comprehensive and fully understood by the contractor, in particular, what is required to ensure "fitness for purpose" of the project. To ensure this, the client must be given the opportunity to properly interrogate and understand a design before signing it off.

Novated Design and Build

Novating the design responsibility and team to the construction contractor is not unusual where the client requires a building, including significant repetition of design elements, but where it wishes only to establish the design elements and standards whilst leaving the detailed design and construction documentation to the contractor. Under the right circumstances this arrangement can lead to a better collaborative design approach between the designers, contractor and supply chain. However, a novated design and build contract should only be used where the contractor has the necessary skills to manage the design process once novated, and the contract conditions should fairly address the associated design risks. This approach should not be used to pass additional and unwarranted risk onto the contractor but instead to enhance relationships between the various parties.

Examples are large industrial complexes, warehouses and accommodation buildings. The consultants may be initially engaged by the client and concept design is generally completed to the stage where it is "frozen", i.e., the design intent is established and detailed, and sometimes further

developed to a stage where the contractor takes over from the consultants at partial developed design stage and becomes responsible to the client for completing the design and constructing the building. The contractor contracts directly with the consultants.

In these projects the consultants' engagement needs to clearly express the terms of the novation, including at which stage the design responsibility will pass to the contractor, who is responsible for "fitness for purpose", and for all further design and construction stages, including construction observation and post-construction defects liability responsibilities.

Consultants may resist entering into such novated contract situations, particularly where they might foresee problems with consultant–contractor relationships, the contractor's design management ability, its financial strength and other potential insurance and liability issues. Clients wishing to proceed on a novated design and build basis need to provide for this in the consultants' and contractor's contracts and must understand that they cannot, contractually, issue design and other instructions directly to the consultants following the novation without the contractor's express consent.

Contractors likewise need to be wary about such contracts, being sure that they have the necessary capacity and capability to manage the design process as well as the inevitable administration of contractor Requests For Information (RFIs) and Consultant Advice Notices (CANs) and client requests/instructions. NZS and NZIA standard conditions can be used with suitable special conditions, or bespoke consultant and construction contracts negotiated. Where separate subcontractors have been engaged prior to the main contractor and have inputted into the design at the concept or early developed design stages, this situation will need to be accommodated in the main contractor contract.

Both NZS 3910:2013 and NZS 3916:2013 general conditions of contract may be used for a novated design and build project but will require special conditions governing the consultant novation and the contractor's responsibilities.

P&G and Margin with progressive Subcontract Tendering and Procurement

There is an increasing tendency for larger, complex projects to be awarded to a main contractor on the basis of a tendered or negotiated contract, based on a fixed P&G lump sum and affixed margin, either lump sum or percentage. All trade packages are subsequently tendered. It is becoming less usual for the main contractor to undertake even the historical self-performed trades of concrete and carpentry, which are now generally subcontracted during the post main contract award.

A benefit of the "post contract" subcontractor tender process is the ability for the main contractor to work with the client and its consultants in finalising some design details but also choosing appropriate subcontractors to tender for the various trades, having regard to a main contractor's experience, commonly called Early Contractor Involvement (ECI). It is not unusual for some key subcontractors to have been involved with the consultant design process prior to the main contract award, and either be a nominated subcontractor or be placed on the tender list by the client. NZS 3910:2013 standard conditions of contract and the NZIA equivalent are appropriate.

P&G and Margin converted to Lump Sum prior to Construction

Input into the client design process being informed by a contractor and selected subcontractors is generally the same as that for a contract based on ECI but where a tender is only awarded on the basis of a lump sum price including most or all trade prices. Although this might seem to provide more certainty of price for the client on which to base its decision, it also might not provide the depth of contractor and subcontractor input into the client design and subcontractor selection process.

Alliancing Contract

As mentioned earlier, this type of contract is used primarily in New Zealand on very large and complex civil engineering infrastructure projects. Alliancing contracts enable strong teamwork between client, consultants, and contractor/contractors to be developed from the onset of the design process with all parties having a stake in the project outcome. The form of contract is generally bespoke around the nature of the project and requires significant effort to determine key aspects of the contract including Total Outturn Cost (TOC), and Pain & Gain share, Break-even Cost and Normal Profit Margin for all members of the Alliance.

2.8 Head Contractor Management Responsibilities

Given that, on average, between 80%–85% of the physical work is delivered by subcontractors, particularly on larger vertical construction projects, it is fundamental that the following areas of responsibility are addressed while procuring projects:

- Contractor management responsibilities identified within the various contract types
- Head office offsite and onsite management and supervision capability
- Design management — across all disciplines
- Relationship management
- Ability to support the overall team.

In addition to the above responsibilities, tender documentation should clearly set out head contractor management responsibilities, to assist in the procurement and selection of contractors and ensure the required range of disciplines, such as commercial awareness, risk management, programming, quality and delivery are covered. There is also the technical aspect of the head contractor's responsibilities for managing the interface between the construction design and shop drawings of the sub-contractors and the client's design consultants, including the design management responsibility for specialist trades e.g., façades, services, and structure.

2.9 Subcontractor Selection and Integration

Procurement of subcontractors is varied and inconsistent throughout the industry. A major contributor to project failures is poor planning and programming with too heavy a reliance placed on the specified start and end dates compared to what actually can be achieved. Subcontractor input at the planning phase is crucial to overall project success as specialist trade input informs the actual construction timeframes for both procurement and construction. Typically, with limited tender

time, the ability to prepare a comprehensive programme is often unrealistic. Also, it may not be possible to develop a comprehensive programme within the first two months following contract award. Many complexities related to the integration of specialist subcontractor works are not defined through the tender period, but are required to be incorporated once there is an in-depth understanding of project demands.

2.10 Construction Procurement Summary

General

Successful projects rely on teamwork and a strong “best for project” culture, as is exemplified in some alliancing contracts. The failure to understand and achieve this critical element has been evident in many project failures. However, the procurement process from consultant through to contractor engagement does not, in general, allow for ensuring selection based on team dynamics, especially in tender situations. Excessive emphasis on strict interpretation of tight probity requirements can be at the expense of building a strong compatible team. A balanced assessment that achieves the intent of probity requirements is often required.

In vertical construction the design of key design elements such as façades, mechanical and sometimes piling is often carried out by a specialist subcontractor, either solely or in collaboration with the consultant design team. This can mean that such subcontractors may be employed in advance of the head contractor, who may therefore have little or no say in the subcontractor’s design advice to the consultants, engagement terms and conditions. There may be incompatibility between the two entities but even without that there can be resourcing and programming issues which create problems. Therefore, the project team should resolve potential incompatibilities on a “best for project” basis before finalising the formal contracts for delivering the projects.

Key Procurement Issues

The following are key construction procurement issues that need to be considered in developing the *best* construction procurement for a project:

- A fixed price lump sum contract, based on a competitive tender, particularly on large, complex projects, may result in increased costs, delays, and significant contract variations
- Tender and contract documents should provide a clear outline of the project risks, which should lie with those parties best able to manage the risk
- Procurement methodologies should take into account the nature of each individual contract type and market conditions at the time
- Clients should accept that the contractor’s price needs to include a realistic margin covering overheads and profit
- The appropriate standard and other contract documents should be used for the particular contract type, with minimal special conditions
- Contract conditions should reflect the nature of the project and its design status. Allowance should be made in the contract for recovery of costs and time for incomplete client design or missing design details through provisional or contingency sums

- Contract documents need to take into account the design responsibilities of all parties, including consultants, designers, contractor, and subcontractors, and allocate contract responsibilities accordingly
- Selection of tenderers should be based on experience and track record
- Tender evaluation should consider experience, track record, quality of proposed project team and subcontractors, financial stability, and price evaluation
- Tenderers should be allowed adequate time to prepare their tenders
- The contract time allowances should fairly reflect the nature of all parts of the work.

Conditions of Contract

Appropriate conditions of contract should be adopted for different types of projects. For instance, where the project brief is clear and includes a full statement of design intent, and there is a complete, fully coordinated design provided with minimal contractor or subcontractor design requirement, a standard NZS 3910:2013 Conditions of Contract based on a lump sum price may be appropriate. The same contract conditions are also appropriate in cases when not all the work can be priced by incorporating provisional sums for such work or applying day-work rates. Where the project is to be designed and constructed by the contractor, NZS 3916 can be used, provided that the client brief is all-encompassing and is unlikely to be changed or varied. In addition, the NZIA form of contract is often use, albeit generally on small-to-medium projects.

NZS 3915:2005 can be used where there is no Engineer to the Contract, however it is not widely used. Alliancing-type contracts may be used where the design requires significant contractor or subcontractor input or where the project is based on joint client/contractor design with significant “unknowns”, more often used in major infrastructure projects in New Zealand. The UK-originated NEC suites of standard conditions do provide for more specialist projects such as major mechanical plant but have not been widely used for vertical construction in New Zealand. However, the industry is beginning to see an increase in the use of the NEC conditions of contract.

Irrespective of what form of contract is used, there should be minimal special conditions significantly varying the standard conditions. A raft of special conditions significantly distorting the fair and appropriate allocation of risks does not engender the strong work relationships between the numerous parties that need to work collaboratively together to create successful projects.

2.11 Conclusion

In all cases, the employment of appropriate procurement methods that best suit the particular project should reduce the risk of budget and time overruns and disputes.

The whole construction process depends on a well-functioning ecosystem, including the proper connections with the regulatory regime, the principal’s understanding of what it is contracting for, integration of the design team with other consultants such as quantity surveyors and project managers, inclusion of contractors, subcontractors and suppliers where their input is not only

desirable but sometimes necessary, and, above all, contract conditions which fairly and reasonably allocate the project risks across the parties.

The successful delivery of building projects requires that the entire project team works in concert to a common game plan. Each project will have its unique set of drivers and project team structure. Therefore, the right ‘game plan’ needs to be developed to suit the specific project requirements, within an ever-changing construction industry. However, there is a set of key construction procurement principles that are immutable in leading to project success.

The CPG has set out some of these key principles, and strongly recommends that the construction industry develop a set of guidelines for construction procurement that will guide project teams to create the best ‘game plan’ to sucessfully deliver better buildings.

3.0 Regulatory Process Changes

3.1 Introduction

The regulatory process was identified at the genesis of the CPG as being fundamental to achieving the delivery of better buildings, and a subgroup was formed to investigate the process in greater depth.

The building consent process is a fundamental component in the chain of building delivery. It is one of the few opportunities to critically review the design for compliance to the Building Code, independent of the project team. Therefore, it is a key opportunity to get things right in creating a building fully compliant with the Building Code that can meet owner and user requirements across the full life of the building.

3.2 Current Building Consent Process

General

The New Zealand regulatory/legal regime makes the obtaining of a Building Consent one of the key financial risks in the building process. Failings across the building delivery process over recent years have resulted in the regulatory process administered by the Territorial Authorities (TAs) becoming the scapegoat for failure, and TAs becoming the 'pockets of last resort' for claims related to defective buildings. As a result, ratepayers have had to fund pay-outs over leaky, structurally inadequate, and substandard buildings. TAs' regulatory departments are regarded as ambulances at the bottom of the cliff, thanks primarily to New Zealand's 'joint and several' liability regime. They have become the target for all substantial building claims, while others in the building delivery chain manage to avoid liability.

The vast majority of claims and subsequent pay-outs for defective buildings relate to apartment buildings. Commonly, a developer has sought to maximise profit, on-selling the units to owners who were not involved in the design and construction process and who are unaware of potential underlying building performance risks. The owners are largely reliant on the TAs to ensure a building, throughout its design life, meets Building Code requirements. In many recent claims and subsequent settlements developers, construction contractors and subcontractors and designers have either disappeared, or have limited capacity to respond to settlement decisions. TAs end up shouldering responsibility for the majority of claim settlements.

The Building Act 1991 and its related performance-based Building Code were applauded when they were introduced. However, the regulatory systems/processes associated with the Act were, and have remained, woefully inadequate to deal with the performance-based issues that are enshrined in the Building Code. Because of this, most designers have defaulted to expediency, endeavouring to comply with the explicit exemplar compliance documents associated with the Building Code, often to the detriment of developing the most appropriate building design solution.

In addition, new technologies, materials and processes are continually being developed and used in buildings. New Zealand's current regulatory process is not flexible enough to adequately assess them and ensure their appropriate performance before permitting their use.

There has also been a tendency to focus on new buildings in the regulatory process. However, changes/enhancements in our regulatory process need to apply equally to major alterations to existing buildings. The most beneficial areas of focus are likely to be seismic performance, weather tightness and fire upgrade.

When the CPG met with members of Auckland Council's (AC) regulatory team we discovered many areas of agreement. Given that AC deals with more complex buildings than any other TA, an approach that works for/with Auckland is most likely to achieve the desired changes to the consenting process.

In the discussions with AC, Andrew Minturn outlined the paper he produced for MBIE which proposes a regulatory process in which registered professionals take more direct responsibility for their building designs. This process follows the Canadian building regulatory regime. Overall, the CPG supports registered professionals assuming greater responsibility for their designs. However, there are significant differences between the New Zealand and Canadian building industries' regulatory regimes and professional registration systems. Therefore, the CPG has deep concerns over directly importing a foreign system. (Recent experience also suggests that the Canadian regulatory regime may not be the panacea some have suggested.) There are also significant questions about the functioning of New Zealand designers' professional indemnity (PI) insurance if the Canadian regime were followed.

Online Consenting Processes

Some jurisdictions, e.g., Singapore and many New Zealand TAs, have adopted online consenting processes in recent years. While it is hoped online consenting will increase consistency between TAs across New Zealand, the drivers for its adoption here appear to be a lack of staff to deliver the TAs' regulatory responsibilities and the availability of online technology, rather than any desire to achieve the consistency and excellence that will result in better buildings.

The extent to which an effective, consistent, nationwide regulatory overview process will contribute to the desired 'better buildings' outcome is questionable. Many of the online systems adopted thus far appear to relate to the lodgement and on-screen reviewing of documentation, which is then handled traditionally, rather than truly enabling the streamlining or automating of the consenting/regulatory process.

However, an effective online Building Consent process is a positive step towards the desired consistency of process and provision of technical oversight. It is desirable that whatever system or process is put in place it is future-proofed, allowing for the increasing use and involvement of digital technology.

Building Consent Experience Across New Zealand

A recent experience in applying for Building Consents to seven different TAs in three regions, using the same documentation resulted in the raising of quite different TA's Response For Information (RFIs). Generally, the RFIs were raised near the end of the 20-working day statutory period. A significant number of these RFIs were redundant — the response would refer the TA's reviewer to a drawing or detail already supplied.

Another recent experience with Auckland Council's "Premier Team" — a group of senior regulatory personnel focused on progressing 'important' building consents as rapidly as possible for 'special clients'— was similarly unhelpful. Despite the 20-working day statutory requirement, the Premier Team said it was unlikely a consent application would be processed in under 40 days. It was clearly indicated that providing as many PS2s (Producer Statements–Peer Review) as possible would quicken the consent process. However, no quantification of this speeding up was forthcoming.

TAs habitually request construction shop drawings for trusses and façade systems as part of Building Consent applications before a main contractor and/or façade subcontractor(s) have been appointed. This is out of step with the normal design and construction process for most buildings. The NZIA recently surveyed its members on the Building Consent process. Survey responses indicated a lack of consistency in the interpretation of the national Building Code by TAs across the country.

Reliance on Producer Statements

As noted, most TAs have significantly increased their reliance on Producer Statements (PSs), in particular PS2 Design Reviews and PS4 Construction Reviews, to the point where there appears to be greater interest in getting the paperwork in place than on reviewing or checking key technical details. The placing of near full reliance on PSs appears to be directed by legal advisors as a way for TAs to avoid responsibility for the construction of buildings. However, in a review of the settlement of many leaky building disputes, PSs in many cases, were found wanting in shielding TAs from responsibility.

The CPG believes that independent reviews and PSs have important roles to play in the building process. But reviews provided by design and construction reviewers selected by the building owner, frequently on the basis of low fees, cannot be considered to be adequate independent reviews. It is clear we are still building leaky, seismically risky, poorly ventilated buildings that lack adequate fire protection, even if in fewer numbers than a decade ago.

Summary

Despite the best efforts of TAs, the Building Consent process remains anything but interactive. TAs are increasingly overwhelmed by the demands of the Building Consent process. The CPG has concluded that the current Building Consent process is not an appropriate means to achieve buildings that are well constructed and enduring, and that can engender owners' confidence in their lifetime performance.

3.3 Key Reasons to Change the Building Consent Process

The CPG focused on the development of common regulatory systems for complex buildings. The following key principles informed the discussions and recommendations for change:

- Avoidance of rework across the building delivery process
- Development of an approach or system — possibly mandated — that is most likely to achieve the desired outcome: better and more enduring buildings
- Integration and streamlining of the various design processes into a seamless design and approval process, rather than leaving design elements to be part of the construction process
- Avoiding holding ratepayers, through TAs, financially responsible for inadequacies in the construction industry
- Dissemination through professional bodies of lessons learned about failures in processes and construction
- Development of a Building Consent process that effectively addresses buildings of increasing and varying complexity and risk; the current one-size-fits-all process is an impediment for most complex construction projects. Strengthening the Building Consent process is pivotal to achieving better buildings as it may provide the only touch point for the independent assessment of compliance.

An overarching conclusion of the CPG is that a far more collaborative approach, with clearly defined responsibilities, needs to be pursued much earlier in the regulatory process. Access to and dialogue with appropriate TA personnel needs to be on an outcome-focused, continuous basis, rather than the ‘drop it and run’ approach. All involved need to focus on compliance with the Building Code/laws, and agree on approaches and methods to develop confidence that a building will be constructed to the required and agreed standards. When members of a team sign off their respective parts of the building design and review process they all need to have greater certainty that the building will meet all statutory and professional requirements.

In summary, the CPG group believe that the Building Consent process/system must change for the following reasons:

1. Contemporary buildings are technically much more complex
2. The building design process is more complex and involves a greater number of design specialists
3. The building construction procurement process is also more complex and generally requires the construction contractor to take on more design responsibility
4. TAs have lost technical expertise and have not been able to keep pace with increases in the complexity of buildings. As a result, the building review process — apparently because of legal liability — relies on Producer Statements for many aspects of design; in addition, TAs do not seem to be getting adequate support from the government (MBIE)
5. The amount of design documentation required by TAs to accompany building consent submissions is inconsistent across the country and across sectors

6. The statutory timeframe within which TAs are required to assess detailed documentation submitted for building consents is not appropriate for complex buildings and hence is rarely achieved.

Russell Hawken, the chair of the CPG's subgroup on Regulatory Process, met with John Sneyd, MBIE General Manager Building System Performance in April 2021. Mr Sneyd expressed interest in and support for the CPG's work as there seem to be many areas of alignment between the activities of the MBIE regulatory group and the issues raised in this paper. Mr Sneyd considered the CPG to be working in parallel with other initiatives, such as those pursued under the Construction Sector Accord, and wished to work together to deliver better buildings.

3.4 Recommendations for Changes to the Building Consent Process

Key Principles

We consider the following key principles should guide the proposed changes to the building consent system:

1. Alignment of the building consent process with the building design and construction processes that deliver building projects
2. Identification of potential problems at the earliest possible stage and putting in place appropriate risk mitigation strategies
3. Definition of appropriate levels of documentation, with appropriate technical support, in support of Building Consent submissions, and identification of appropriate time frames
4. Provision of appropriate technical support for territorial authorities from MBIE, NZIA and EngNZ.

Proposed Changes

We propose the following five steps to achieve better buildings:

Step 1: Develop Building Consent Framework

MBIE, TAs and professional bodies within the building industry work together to develop a Building Consent framework in which the Building Consent approval process aligns with the processes by which buildings are generated, designed, documented and constructed. The framework should support a structure that identifies, assesses, mitigates and manages key building design and construction risks. It should recognise that the interfaces between design stages and the construction procurement process selected can considerably alter a building's risk profile, and effect the likelihood of a successful outcome.

Step 2: Develop Staged Building Consent Process

A staged building consent process, starting with preliminary design and leading to a Code Compliance Certificate (CCC).

i) Preliminary Design Features Review: A formal process with the relevant TA undertaken after the preliminary design has been completed, in which the parties identify key risks, e.g., weathertightness, seismic, fire and ventilation, and define the steps required to mitigate risk and validate the proposed design and construction details to meet the requirements of the Building Code. The review will encompass key components of the design and construction of the proposed building, including procedures that address construction design, shop drawing documentation, and review, and design changes during construction. The review should identify the key points where specialist expertise and independent reviews are required, so that the life-time performance of the building can be evaluated. For particularly complex building elements, the team may agree that key building components should be independently reviewed by MBIE or by reviewers appointed by NZIA/EngNZ.

Currently, many TAs hold pre-lodgement meetings with project team members. However, the issues addressed at these meetings vary greatly between TAs, and the agenda can be arbitrary. Pre-lodgement meetings often address only procedural issues regarding the staging of building consent documentation. The proposed Preliminary Design Features Review differs significantly from existing pre-lodgement meetings.

ii) Building Consent Review: Generally, the current formal process should be followed. However, the design documentation required for the Building Consent Review should be defined and consistent across the building industry [*see Step 3 below*]. In addition, the process should be better structured and more interactive, with a prime focus on key building risks and addressing the issues agreed in the Preliminary Design Features review.

For building components where detailed design is completed by construction contractors in the construction phase, e.g., precast flooring, curtain walls and glazing systems, the building consent documentation should define the generic design details and requirements that will form the basis of the procurement of ‘design-build’ elements. It should also define the extent of design reviews required by the designer to ensure that the ‘design-build’ elements meet the project requirements, in particular the Building Code requirements.

The Building Consent documentation should also define the key critical elements of the design that require particular attention and inspection during the construction phase.

iii) Construction Inspections and Design through Construction: To ensure a building is constructed correctly a detailed construction inspection plan, defining the extent of construction inspections to be carried out by TA staff, project designers [*see step 4 below*] and industry specialists, needs to be finalised and agreed before construction commences. Some large complex buildings may require a role akin to a Clerk of Works to carry out and coordinate all the requisite inspections.

The inspections currently carried out to satisfy Building Code requirements are inadequate for large complex buildings. Such buildings require additional inspections and reviews to ensure that departures from agreed documentation and construction details are addressed in a manner consistent with the intentions of the designers.

As outlined above, under Building Consent Reviews the detailed design of some specialist elements and shop drawings are commonly completed in the construction phase. Therefore, systems and procedures need to exist that ensure that the additional design documentation meets project team design and Building Consent requirements.

Design changes inevitably occur throughout the construction phase. Where changes impact on Building Consent issues/requirements, the design changes need to be documented and submitted for TA approval and recorded in the final set of ‘as-built’ documentation provided at the completion of construction. Importantly, in reference to the ‘as-built’ documentation required for the Building Consent process, there will need to be industry agreement on what constitutes a design change.

iv) Code Compliance Certificates (CCC): As noted above, prior to and throughout the construction stage the supplementary and revised detailed design documentation should be compiled along with inspection records and Producer Statements. There will then be a complete record of the building construction and the reviews completed by the various technical authorities to ensure that all requirements of the building consent process have been satisfactorily completed.

After all of the required documentation has been completed, the TA will be in a position to issue the CCC.

Step 3: Define Building Consent Design Documentation

As outlined above, under Building Consent Review, the building industry, across the country, needs clear definitions of the extent of design documentation required for each step of the building consent process.

Currently, the extent of design documentation varies widely between and within TAs. In many legal claims against TAs the design documentation that forms the basis of Building Consent approval and CCCs has been shown to be inadequate and not reflective of the building as actually constructed. Often, the consequence is significant ratepayer/TA pay-outs.

To change this, MBIE, TAs, NZIA, EngNZ and other industry bodies need to work together to define the design documentation required for the Buildings Consent process throughout New Zealand, and align it with NZ Construction Industry Council (NZCIC) Design Documentation Guidelines.

In addition, the incorporation of digital data, i.e., 3D computer Building Information Modelling (BIM) into any new Building Consent process should be given serious consideration. Technology and BIM design and construction has the potential to significantly improve the performance of the building industry, as outlined in Section 6 of this paper.

Step 4: Design Knowledge and Expertise through the Construction Phase

The Building Consent system should also ensure the presence of key design expertise across the full building delivery process. Designers must be involved in monitoring construction to ensure Building Consent requirements are met. Where design continuity cannot be achieved, steps must be taken to ensure construction meets the key design assumptions.

Step 5: Capture and Disseminate Lessons Learnt

The entire building industry needs to learn how to deliver good buildings, and how to avoid problems, including in the Building Consent process. Accordingly, industry feedback needs to be gathered through peak industry bodies — MBIE, TAs, NZIA and EngNZ. Over the last two decades, there have been numerous claims against TAs, design consultants, and construction contractors for defective buildings, in particular ‘leaky buildings’. However, the vast majority of these claims are settled out of court with strict confidentiality agreements. Consequently, the lessons from these building failures are not available. Professional bodies are unaware of the performance of its members and therefore are not in a position to provide guidance to those members. There also appears to be no system for TAs to assess performance and share any lessons. A reporting system that captures and disseminates lessons to key players across the building industry is important in improving the Building Consent process.

3.5 Conclusions

The basic Building Consent process has not changed over the past 30 years, despite changes introduced by the Building Act 1991, significant changes in building products and materials, and new ways of designing and constructing buildings. Accordingly, the process is no longer fit for purpose. The industry needs to work together to revise the regulatory process so that it is seen as a positive component in the delivery of buildings and reduces ratepayers’/TAs’ exposure to defective building claims. The government, through MBIE and TAs, needs to provide the leadership to achieve this goal.

The Building Consent processes outlined in this paper have been proposed to start a dialogue and to signal a direction for the Building Consent process that will lead to the construction of better buildings, more productively.

4.0 Project Management Services Guidelines and Accreditation

4.1 Background

Project Management (PM) in the vertical construction industry is a professional service which provides skilled resources to clients focused on the efficient delivery of projects. Generally, PM services start from the initial receipt of a project brief, including key objectives, design and functional requirements from the client, and then continues through design, consenting, procurement, construction and commissioning phases, then to Practical Completion, handover, defects liability period and final account resolution.

PM services normally exclude development management, cost management, construction management, facilities management, asset management, tenancy co-ordination, and property management.

PM should provide structure and process to a project through a combination of problem solving, options analysis, recommendations, decisions and approvals. The key to delivering a successful project is to work collaboratively in a trusted team environment to achieve the client's objectives within key constraints to optimise the balance between the competing factors of time, cost, quality, form, function and risk. Good PM should provide leadership and direction to the team and make decisions on a best for project basis.

A major problem with the PM services consultancy sector in New Zealand is that it is unregulated, and no qualifications are required to call yourself a project manager. Also, there is no clear definition of the minimum standard of the PM services which a client could reasonably expect. Until recently there were no formal tertiary education courses where one could study and achieve formal qualifications as a project manager. There are a few short-term certificate courses, but these do not offer sufficient knowledge or experience to then go out and run a major project on behalf of a client.

Since the PM service in New Zealand is unregulated and there is no set standard for services, the selection of PM consultants varies widely, with some firms offering 'full' services and some offering basic contract administration services. As the companies offering 'limited' services, such as solely contract administration, will be significantly cheaper than one offering a 'full' service, they generally win most Government and Local Government work with poor project outcomes often resulting.

The Project Manager and PM services provided on a project have a pivotal impact on the success of the delivery of vertical construction/building projects. The Project Manager critically links the design team, through the project tendering and execution phases, and the construction contractors; provides advice on risk identification, mitigation and management; sets key project programme target dates and durations for the design, tendering and construction phases; establishes the construction procurement methodology; manages the construction tendering process; administers all construction contracts; and, manages the interfaces between all project parties and the construction contractors, including incorporating all contract changes, through to contract completion.

Several problems and disputes in delivering building projects can be traced back to shortcomings in the PM services commissioned by the client or provided by the consultant. Improving construction productivity for building projects across the industry will need a corresponding improvement in the management of projects.

A key first step is to define and clarify the Project Manager role(s) and PM services.

4.2 Project Management Services

General

All projects, regardless of their size or complexity go through similar processes. The larger projects will of course require more resources and more stringent approval processes. On very large projects the typical role of a project manager may be split up and provided by different people or companies, typically with design management, BIM management, programming and programme management, and the Engineer to the Contract roles being split out. The splitting up of PM services inevitably leads to greater gaps and interface issues between the various parties providing the services and opens up questions around who is responsible or accountable for the gaps between them.

PM services related to construction tendering and contract administration are reasonably well understood within the industry. However, the level and quality of PM services and responsibilities through the design and consenting phases are highly variable, largely because the design process is not well understood by many in the industry. Highlighted below are some points related to design and BIM management and the delivery of PM services.

Design and BIM Management

To achieve a successful project outcome, it is important for the design team to receive a complete design and functional brief from the client and for the contractor to have a complete, accurate and well-co-ordinated set of tender and construction documents to price and build from. However, design processes are evolutionary; when a design team starts with the client brief the final form and building details are unknown, unlike the construction process where there is a set of plans to sequentially build from. In addition, the design process, involving numerous specialist consultants and ever-increasing building complexity, is further complicated when key elements of the design are subdivided into subcontractor ‘design-build’ packages. Also, it appears that many Project Managers do not have the requisite experience and knowledge to effectively manage the design process on complex building projects.

There is a growing recognition of the need for specialist design managers to successfully deliver complex building projects. The design manager’s role can be fulfilled by either the Project Manager, an independent expert, the lead design consultant or the contractor, in some cases. In recent years several major projects have run over time and budget due to poor design management on both the client and contractor’s part. The industry needs to upskill in this area. Irrespective of who takes responsibility for design management, the person(s) needs to have an in-

depth understanding of the design process and must understand how the design programme fits within the overall project delivery programme.

Also, the design manager's role versus the BIM manager's role needs to be clearly considered and defined. Design team management of the 3D BIM model needs to be tightly controlled and is considered a separate management task from design management.

Engineer to the Contract

On many projects the PM services include the NZS3910 role of Engineer to the Contract and/or engineer's representative. However, there have been conflicts of interest between the Project Manager and Engineer to the Contract roles that have led to costly disputes on building projects. The industry generally understands the issues around the Engineer to the Contract role [*see Peter Fehl's paper prepared for the Master Builders Federation Conference, August 2020 — attached in Appendix 4*] and the CPG understands that steps are being taken to clarify the role.

Selection of Construction Procurement Plan

One of the key responsibilities of a Project Manager is to establish the procurement structure and programme for selecting construction contractor(s). Determining the 'best' procurement methodology/plan to successfully deliver a building project requires in-depth knowledge and experience of the client's key objectives of cost, time/programme and quality; the design team's ability to deliver the requisite design tender and 'For construction' documentation; construction industry/contractor capacity and capability; and key project risks, mitigation and management plans. Following a procurement plan, often put together by a procurement 'specialist', that doesn't address all these key factors generally leads to building projects that struggle to achieve their objectives. The procurement plan needs to be tailored to suit the demands, challenges and objectives of specific projects.

Summary

Overall, the building industry needs to improve the quality/level of PM services, in particular in the area of design management. Currently there are good Project Managers delivering successful projects. However, there are too many projects where Project Managers are selected based on the provision of limited services. Also, there many projects where the Project Managers have limited expertise across the width breath of skills and knowledge required to deliver specific projects. To provide a 'level playing field' for the project management sector to fairly compete, and to set a benchmark for the industry, the CPG strongly recommends that the industry establishes a "Guidelines for Project Management services" document, like the NZCIC Design Documentation Guidelines.

In addition, the CPG recommends additional project management training and education programmes to address key shortcomings, generally improve project delivery, and ultimately leading to accreditations of the training, skills, and knowledge required to be a professional project manager.

Productivity should improve significantly if the quality of design documentation is improved and issued to the contractor in a timely manner, to meet a well-defined achievable procurement delivery programme that aligns to the clients brief, objectives and risk profile. The Project Manager and PM services are pivotal to achieving this goal.

4.3 Project Management Guidelines

The current NZCIC Guidelines, issued in 2016, define many PM roles and responsibilities, generally where PM services impact on the design process. However, the PM services outlined do not represent the full suites of 'standard' PM services required to deliver typical building projects, and there are areas of apparent conflicts with the extent of PM services consultants are usually engaged to deliver. The group responsible for revising the original NZCIC Design Documentation Guidelines into the 2016 NZCIC Guidelines should be congratulated for addressing issues well beyond the narrower 'design' focus of the original guidelines, including project management, cost control, regulatory compliance, and other areas of project delivery — a mammoth task.

However, the CPG is of the firm view that the industry needs to separate out PM services guidelines for the delivery of buildings. The full extent of PM services required on most typical projects should be defined but must recognise that these management services are integrally linked and interwoven with the design documentation process. Therefore, we recommend that the PM services guidelines follow the same format as the design guidelines, so that the services across the project can be interlinked; in the end, a full team approach is required to successfully deliver building projects. Having separate guidelines, but following a common interconnection format, will allow for simpler updates/revisions of the separate parts.

The CPG has had discussions with five separate PM consultants and found full support for the proposed PM Services Guidelines and believes that the best vehicle for developing and promoting the guidelines is through the NZCIC, similar to the existing NZCIC Guidelines.

4.4 Project Management Training and Accreditation

As previously noted, universities in New Zealand offer limited courses in construction management and project management in addition to the traditional engineering, architecture and quantity surveying courses. Many Project Managers have a professional qualification, generally in specific technical areas. However, many lack the breadth of experience and knowledge to effectively manage the delivery of building projects from initiation to project 'close out'. A good foundation for Project Managers is a trade background followed by a move into a site management and then a project management role. However, often Project Managers who come through the tradesperson route lack the in-depth knowledge required to manage the complex interfaces that exist throughout the design process. Also, some people who sell themselves as Project Managers have absolutely no qualifications or training, and only limited experience.

The industry needs to establish the minimum levels of training, education and experience required to define the skills and knowledge a Project Manager should have to undertake PM services. Where there are discrepancies between what the tertiary education institutions currently provide for project management services and what the industry consider is required, new training and

education programmes will need to be developed. We understand that BRANZ is currently doing research with AUT on how to improve design management in the industry and the CPG strongly supports such steps towards improving design management services.

Also, the CPG believes there is a need to regulate or license the PM sector so that clients, and all involved in delivering buildings, are protected from poor project management practice and receive a defined standard level of service and in particular adherence to a code of ethics. In several countries overseas Project Managers are required to be registered, just like Master Builders in New Zealand, and they are only permitted to work on certain sizes or values of projects, based upon their relevant experience, qualifications and training.

4.5 Summary and Recommendations

The PM services provided are pivotal to the successful delivery of building projects. However, too many building projects are delivered well beyond the required completion dates and budgets, due to significant levels of 're-work' and poor productivity, often as a direct result of project management actions and decisions, or/and Project Managers working on projects without the necessary knowledge and experience. Everyone involved in poor projects suffers losses. Good project management services generally lead to successful building projects.

Therefore, the CPG recommends the following three steps to improve the level of PM services for building projects in New Zealand. Starting with Step 1, each of the recommendations below could be progressively implemented.

Step 1: Establish Project Management Services Guidelines

Develop an industry guideline defining 'standard' full PM services for buildings projects, through the NZCIC. A starting point should be the current 2016 NZCIC Guidelines, where the PM services should be separated out and developed into a full list of PM services. An effective way to develop the guidelines is for a group of leading consultants providing PM services to work together to create an initial outline of 'standard' PM services, then bring together wider group of industry and MBIE/government representation to finalise the guidelines. The CPG recommends the development of the PM Guidelines is undertaken in concert with the proposed revisions of the NZCIC Design Documentation Guidelines outlined in the next section of this paper. Based on recent discussions with several of New Zealand's larger PM consultants there seems to be a recognition of the challenges facing the industry and a willingness to work together to define and set an appropriate standard of service and a common playing field.

Step 2: Define Project Management Training and Education Programmes

The industry needs to critically assess the shortcomings in the training and education programmes currently provided by the tertiary sector for construction projects within New Zealand; compare New Zealand programmes with project management training and education overseas; and consult with New Zealand tertiary education providers to define the training and education programmes needed to improve the quality of PM services for the delivery of building projects. To this end, the CPG recommends that the industry leads an investigation study, through either the Construction

Sector Accord or NZCIC, to determine what extensions and changes are appropriate to the current programmes, to better prepare project managers to deliver successful building projects.

Step 3: Establish Accreditation Structure for Project Management Services

The CPG recommends that PM services for the construction industry are regulated or licensed. This registration and licensing could be done in the short term by existing industry associations such as NZIOB, IPENZ, NZIA or MBIE. However, in the long term a Project Management Association could be established which could set standards and update best practice guidelines as techniques and new technologies develop over time.

5.0 CIC Design Documentation Guidelines Revisions

5.1 Background

The CPG includes members who led and contributed to the development of the original (2003) and revised (2016) NZCIC Design Documentation Guidelines. The key objective in formulating of the Guidelines was to establish a consistent industry standard that defines the scope and responsibilities of the design team engaged to create the documentation.

Accordingly, the Guidelines focussed on the design process from concept design through to the construction design documentation required to build buildings, irrespective of which party completes the design.

A decade after the development of the Design Documentation Guidelines it was recognised that they needed to be updated to reflect changes in technology and the increasing complexity and variety of delivery processes used for building projects. Through a NZIA-led initiative, the Guidelines were revised and also extended beyond the design process to address wider project delivery issues including project management services, regulatory consents, and construction procurement. The Guidelines issued in 2016, while still largely focussed on the design process, became an omnibus for project delivery and for that reason 'Design Documentation' was dropped from the title of the Guidelines.

As outlined in the previous sections of this report good design documentation is critical to delivering successful building projects, including through the regulatory, procurement tendering and construction stages. The design process is ongoing and intertwines throughout project and design management services on projects.

A sub-group of the CPG has undertaken a preliminary review of the Guidelines. This review has been in the context of the other CPG workstreams. It is clear the industry wants and needs a 'single source' suite of documents that communicate across all aspects of building delivery effectively, that influences sound decision-making by all participants, and directs users/readers easily to other relevant documents and guidelines.

5.2 Review of Current Guidelines

The 2016 Guidelines define two types of **Tasks**:

1. ***Generic Tasks* —** Management, H&S, BIM, ESD, etc.
2. ***Discipline Specific Tasks* —** Architectural, Structural, Mechanical, etc.

There are also a number of **Objectives** the Guidelines set out to achieve:

a) The design phase that is expected a design task will be undertaken, or the production of documentation with a certain level of detail will be completed.
b) When responsibility for a task passes from one participant to another
c) Where multiple people input into a task, who are the contributors and who is leading it?

d) Where a task could potentially be undertaken by multiple parties, confirming who is responsible for it.

The 2016 Guidelines structure is very good at achieving **Objectives** "b, c and d" for "type 1" **Tasks**. It is not as effective as the 2003 format in achieving **Objective** "a" for "type 2" **Tasks**.

The following are some of the key concerns identified in our review:

- Some tasks are listed in both the "generic" and in the "discipline specific" sections; in reviewing the structure this potential confusion should be addressed
- Linked to the structure, there is a need to better define the inputs required to produce the required design documentation; this can be inferred from the 2016 Guidelines but not as clearly as in the 2003 Guidelines
- In moving from the 2003 to the 2016 Guidelines a lot of repetition was removed (this was a good thing); however, some useful information was lost
- Neither format of the Guidelines addresses the areas in complex projects that regularly cause problems/ issues; these are often at the interface points between trades/disciplines. e.g., protective coatings to steel — structural, architectural and fire engineering responsibilities — or, where two parties have different but supplementary responsibilities for the same item, e.g., architect responsible for reflected ceiling plan, electrical engineer responsible for lighting performance
- More guidance is needed on the required/expected level of documentation required for Building Consent submissions
- The Guidelines only define some project management services — related to project delivery — and there is concern that the PM services defined could be inconsistent with the definition of the full extent of PM services for building projects
- Architectural design services are separated into two different headings; Architect and Designer/LBP — possibly due to how NZRAB/MBIE/NZIA define the two levels of technical capability.

In summary, the 2016 Guidelines were a step forward from those developed in 2003. However, buildings produced by the industry are now far more complex and the framework within which they are delivered has changed significantly.

Therefore, it is now time to revise the Guidelines to correct inconsistencies in the document and to align it with changes/developments across the wider building industry.

5.3 NZIA-Led Guideline Review

It is our understanding that the NZIA is currently leading a review/update of the 2016 document, through the NZCIC. The first stage of this review is surveying the industry for comments on the effectiveness of the current Guidelines document and suggestions for further development.

The CPG is very supportive of the proposed survey and review and believes that, in conducting the review, it is essential that a wide and true pan-industry approach be taken. The base purpose of the Guidelines is to build greater understanding between all parties delivering buildings. It would be

very disappointing if the Guidelines became too focussed on addressing issues within a single sector.

The CPG would be pleased to be consulted on the review process and has a number of suggestions as to appropriate people/organisations to involve. While the review process should be "sponsored" by the various (involved) industry bodies (NZIA, ENZ, NZIOB, etc.), the success of the review will be contingent on the individuals involved, the commitment they are able to provide and the sector acceptance that they represent, and the input they have brought from across their wider communities.

5.4 Other Industry Guidelines

Section 2 of this paper — Construction Procurement Guidelines — outlines the need for clarity and consistency in design documentation for tendering across the various procurement delivery methods. Section 3: Regulatory Process Changes outlines the need to define the design documentation TAs require for the Building Consent process. Section 4: Project Management Services Guidelines and Accreditation outlines the need for the industry to define design management, project management and contract administration services. The CPG believes there is now a great opportunity for the industry to develop each of the proposed separate guidelines using a common format that enables electronic interlinking. Having separate guidelines linked through a common format will allow each guideline to be revised and updated without impacting on other parts.

The successful delivery of building projects is a fully integrated team effort and interlinking common sourced guidelines will be a significant step towards achieving this goal.

5.5 Recommendations

The CPG makes the following recommendations in the hope that the next iteration of the Guidelines will be a further step up and will achieve even wider acceptance and impact across the industry.

Overall, we recommend restructuring the NZCIC Guidelines into four interlinked parts:

1. Design Documentation
2. Construction Procurement
3. Building Consent
4. Project Management

all addressing the following points:

- The focus of the original 2003Guidelines was on aligning expectations around design documentation. The Guidelines were not intended to be a "how to guide" for specific disciplines. We do not think this intent has changed.
- We recommend that the naming reverts to that of the original, that is, "NZCIC Design Documentation Guidelines" (from NZCIC Guidelines).

- The “Design Documentation Guidelines” must sit within a wider suite of documents that provide consistent and clear guidance to the wider industry. Some of these documents already exist e.g., the New Zealand BIM Handbook. Others are still to be created: e.g., Project Management Guidelines, Construction Procurement Guidelines and Building Consent Documentation Requirements.
- It is not recommended/proposed that this suite of documents replace documentation currently developed and held by the various industry bodies, where these documents are specific to that industry group. The NZCIC suite of documents should focus on documentation that is pan-industry.
- We recommend that the basic structure of the document be revised: We note that with an “electronic paper”-type document it is not easy to achieve all “objectives” across both types of “tasks” within in a single structure. Therefore, it may be necessary to move to a more data-driven, smart forms-style document where the same information can be displayed in a variety of formats (e.g., by discipline, by phase, by task).

6.0 Technology and BIM Use in Construction

6.1 Background

General

BIM is the generic term for the design ‘drawing’ software packages/tools/information sharing processes used throughout design and construction processes for the creation of design and construction information. The model is a 3D representation of the building; significant data embedded within the model can be used in the design, construction and maintenance of a building.

The use of Building Information Modelling (BIM) and technology in the construction industry has increased over the past six years, as evidenced by the NZ BIM Benchmark Survey 2020. However, BIM has not yet delivered the promised productivity or quality improvements.

Over the past 12 months, key infrastructure providers, e.g., KiwiRail, Auckland Airport and Waka Kotahi, have started asking their supply chains for compliance with ISO19650-2 (Organisation and digitization of information about buildings and civil engineering works, including building information modelling (BIM) — Information management using building information modelling — Part 2: Delivery phase of the assets).

While this standard provides a consistent framework for the management and control of the creation and sharing of asset information, it cannot drive better outcomes unless other challenges raised within this paper are also addressed.

Barriers to using BIM

The 2020 EBOS survey lists the following factors as key barriers to the greater uptake of BIM in New Zealand:

- Not all parties aligned, on board, or at the same level (cited by 28% of survey respondents)
- Client preparedness, alignment, and knowledge (23%)
- Training and experience of staff (20%)
- Platform and file-type issues (15%)
- Cost and value perceptions around using BIM (10%)

As noted, the availability and cost of technology were seen as minor barriers compared to the clear alignment and preparedness of key project participants.

Investment in R&D within the New Zealand construction industry is a small fraction of that of other industries/sectors, as documented in “Callaghan Innovations Workshop on Understanding Innovation for the Construction Section, February 2019”. The lack of investment in innovation handicaps the significant productivity gains that could be achieved, particularly in the light of the ever-increasing complexity of building projects.

BIM Use in Design

The use of 3D modelling in the design process has significantly ramped up over the last decade to a point where the majority of larger building projects are now fully modelled by the design teams and used by the main technical design disciplines (architecture/structure/building services). The main improvement over the last several years is the level of collaboration between the various design parties. Much of this improvement can be credited to the work of the BIM Acceleration Committee (BAC), initially formed in 2014 as a collaboration between tertiary education institutes and design consultants, with subsequent participation by a few contractors.

BAC has created the New Zealand BIM handbook and manages BIM in New Zealand. The organisation has helped create some standard methodologies and has advanced the use of and training in BIM. The annual review https://static1.squarespace.com/static/57390d2c8259b53089bcf066/t/5fd713ebdca2215260599bc5/1607930887111/BIM-Benchmark-Survey-2020.pdf(previously referenced) provides feedback on the utilisation and effectiveness of BIM from a high-level, industry-wide perspective. Some insights into the benefits of BIM, extrapolated from the surveys, together with subjective interpretation are:

- Better coordination (cited by 35% of survey respondents)
- Identifying issues or clashes before they get to site (23%)
- Streamlining time, costs, and workflows (20%)
- Better understanding of projects, what's required and design decisions (13%)
- Building better relationships (10%)

The increase in utilisation/productivity is starting to taper off. Getting BIM used more widely throughout the construction industry is the next step in leveraging a well-understood tool.

BIM Use in Construction

Further work is required to continue improving the use of BIM throughout the design process. However, the significant gains in productivity that the industry needs can only be achieved through improving the transfer of BIM from the design process into the construction process and full-life building operation and maintenance.

Design teams on most building projects are using BIM and integrated 3D design models to coordinate respective design discipline models and identify/mitigate clashes. However, the significant project BIM information contained within the design model is generally not formally/contractually transferred through tender/procurement to the construction contractor(s). On most projects the BIM information is reduced to 2D design documentation and included in construction contract tender and 'For Construction' documentation for each design discipline. BIM information is often passed onto the construction contractor(s) on an 'information only' basis, with the designers not prepared to further their contractual responsibility within that transfer arrangement.

As a result, construction contractor(s), if they are to use BIM in their construction process, need to effectively rebuild the entire BIM model. Much effort is expended and valuable information lost

within that responsibility transfer arrangement, with a consequent reduction in productivity. It has been estimated that 25%–30% of the effort of the model's creation is lost to the industry in the current contractual transfer arrangement.

Many enlightened building owners, generally larger institutional clients responsible for operating and maintaining their buildings, recognise the 'whole of life' value of integrating BIM throughout the design, construction, operation, and maintenance of their buildings. Many larger construction contractors and sub-contractors are also beginning to improve their use of BIM. However, there are many real and perceived barriers for the effective transition of BIM from the design process into construction, and on to building operation.

Many in the industry have attributed poor performance to factors such as ineffective contracting frameworks and the lack of specialised resources. Other issues or concerns include:

- The large number of participants on a project makes coordination difficult
- The scale of many projects does not warrant the complexity and challenges of fully integrating BIM
- A wide range of clients with many different requirements and stakeholders
- Varying levels of design/construction complexity on building projects
- Uncertainty around changing regulatory requirements
- The general risks and uncertainty of fully embracing BIM.

The size — by staffing levels/revenue — of the majority of participants In the New Zealand construction sector, particularly sub-contractors, has generally not been acknowledged as a key issue in BIM adoption and use. Of the respondents in a recent construction industry survey:

- 95% worked in a company of five people or less
- 2% worked for a company employing more than 50 staff

It is not difficult to understand why the investment in technology, BIM and R&D necessary to improve construction productivity is so inadequate. Simply put:

1. Notwithstanding the medium/long term benefits of BIM, small organisations cannot afford the technology
2. Main contractors rely on their subcontractors for doing work; investment in training and the use of technology is sacrificed in the 'race to the bottom' approach to margins
3. Many small businesses have an aging ownership; the risk of investment is seen as too high compared to the remaining tenure of ownership.

6.2 Opportunities to Improve Technology/BIM Utilisation on Building Projects

A research report prepared for the BIM Acceleration Committee in 2017 outlined the following means to mitigate barriers limiting the use of BIM:

- Education

- Increased communication
- Compulsory early contractor involvement and constant collaboration
- All expenses and time associated with BIM are realised and paid for
- Clarity on the ownership of the process and model
- Keep BIM up-to-date and relevant as project requirements change
- Empower project teams with the required technology
- Mind-shift away from the New Zealand ‘no. 8 wire’ approach.

The CPG supports these approaches. However, the industry needs to work well beyond the mitigation of the barriers identified in the BIM Acceleration Committee’s report. The industry needs to create an environment to unleash the use of technology, of which BIM is just one component, in construction.

At present, a significant issue impeding the full use of technology in construction is the liability for the use/transfer of the data associated with technology/BIM. Essentially, the contracting and liability issues around the breadth of information defined in the models create roadblocks. However, there is an opportunity to develop standard frameworks defining the base information where the designers can take responsibility with appropriate conditions of contract, for the transfer of the BIM information as a contract document. Therefore, it is critical that the procurement of design consultants and contractors includes the appropriate contracting arrangements to utilise the productivity benefits of the current technology.

To achieve the goal of integrating the designers’ BIM documentation into the construction of buildings requires alignment right across project delivery, including the definition of handover points at construction contract award. The high-level issues to clarify include:

- How design changes are incorporated into the BIM models throughout construction
- How contractor/sub-contractor designs are integrated in the BIM models
- How and what ‘as-built’ information is incorporated into the contract and project documentation.

To effectively use technology/BIM to its full potential and lift productivity requires building projects to have a technology/BIM plan in place at the commencement of the project. In many smaller projects it is likely there will be limited resources available to apply the required plan. Developing bespoke technology/BIM plans for individual building projects could be costly exercises, heavily influenced by lawyers, yielding many divergent plans that complicate and impede the use of technology/BIM.

Therefore, the CPG supports alignment across the industry to develop standard industry framework/guidelines for the integration/utilisation of technology/BIM in the construction of building projects. Promoting compliance with ISO19650 may be a starting point in the search for a solution. Section 6.4 below outlines CPG views on aligning technology/BIM across the building industry.

As previously highlighted, to realise the full potential of technology/BIM requires that extensive in-depth information/data be brought together through the design and construction phases and incorporated into a building’s operation and maintenance throughout its life.

There are a few publicised exemplars of technology making life easier on construction sites. The use of the following technologies has been accelerated by the challenges caused by the current pandemic, and include the following:

- Remote site inspection technologies integrated into BIM (commercial platforms are available including Artisan and ZYTE)
- Virtual Reality Health and Safety training for site inductions
- Augmented Reality, e.g., Microsoft HoloLens, for 'remote expert' site inspections or international experts virtually visiting sites
- 360 degree photogrammetry to assist with remote site briefings
- Point cloud scanning for mm-accuracy 3D measurements.

There is a wide range of other fields in which the use of technology/BIM could be explored for improving productivity. However, the suggested way forward is to target near-term, 'low hanging fruit' and so provide exemplars for the industry. Attributes for any preferred areas to be progressed might include:

- A wide range of users, by geography and scale of business/project
- Low entry cost
- Identifiable and measurable efficiency gains.

In addition to establishing industry guidelines, it is imperative to increase education and training across the industry, including across client/owner/operator groups. The following section outlines steps that could be taken to develop the requisite knowledge and skills across the industry.

6.3 Education and Training

General

Many owners and contractors cannot recognise the benefits of embracing technology/BIM use and see only barriers. While there is significant knowledge and experience in the industry, much of it is confined to small pockets. The industry needs education and training programmes tailored at specific sectors, including client/owner/operator, construction contractors/subcontractors, project management and technical user groups, to realise the advantages and productivity gains available. These sector groups do exist in various forms. However, given the extent of construction sector groups — estimated at 140 associations, organisations and institutions — the sector needs to foster some consolidation to advance the use of technology/BIM.

The following section outlines ways to develop education and training programmes.

Tertiary Education Polytechnical Institutes

Currently, there is reasonable alignment in the tertiary education sector. However, the consolidation of the various Institutes of Technology and polytechnics across New Zealand into a single governance organisation (NZIS&T) affords the opportunity to focus a national effort into training in technology. This step would be useful; however, it still requires the thousands of

construction contractor firms to invest in the tools and then leverage the training. This will take some time and will require much joined-up thinking/work between a newly formed national organisation and a wide range of lowly capitalised and geographically diverse participants.

Client/Owner/Operator User Groups

Under the overall governance of the Building Owners and Managers Association of New Zealand (BOMA), a specific education and training group could be created. Leaders from large organisations would share their knowledge and experience with the wider group to develop industry standards. Technological literacy varies widely across owner-type groups around New Zealand. A collective effort to improve capability in this area will likely have a multiplying effect with:

1. Pull factor with the construction industry as suppliers, and
2. Push factor towards growing the use of the technology in facility operations.

In addition, a client/owner/operator user group could develop guidelines for the use of the systems and software tools available, and improve the effectiveness of these tools within the industry, e.g., DfMA, QA systems using technology, and collaborative construction planning tools.

Construction Contractor and Subcontractor Groups

As previous highlighted, there is significant technological disparity across the industry. Many larger contractors and subcontractors have reasonable capability in the use of technology/BIM; most smaller contractors and subcontractors, which make up the majority of construction companies, have a very limited capability and understanding in this area. Therefore, to provide a step change in performance and a level playing field across industry, education and training programmes specifically targeted at general contractors and subcontractors are needed.

In addition to education and training to set industry standards, contractors and subcontractors should be encouraged to develop in-house and on-the-job training to further the use of technology/BIM.

Technical User Group

BAC is currently leading the role of technical user group for BIM use and should continue the good work undertaken since 2014. However, many in the industry are unaware of BAC. The various Construction Sector Accord groups could elevate awareness, e.g., via road shows and a Construction Technology Week, to generate additional focus across a greater number of industry players and the integration of other technologies.

6.4 Industry Alignment of Technology/BIM Use Across Building Projects

To improve the effectiveness of the use of technology/BIM across the life of a building, from conception through design and construction and into operation and maintenance requires alignment right across the industry, and a set of industry guidelines. As previously outlined, many

of the larger complex building projects for larger institutional clients require the use of technology/BIM. However, on these projects systems/procedures/protocols are being developed on a project-by-project basis. And even then the handover of the BIM data/models from the design team to the contractors is fraught with problems. Therefore, all projects should develop and implement a BIM utilisation and management plan at project commencement. The plan should set out how the BIM digital information is managed and transferred through each phase of the project, from the design team through to the construction contractors and ultimately to the building owner.

The industry needs to establish guidelines addressing key impediments, and setting standards. Some of the issues that need to be addressed and the solutions that require alignment, are:

1. BIM ownership: As it is the building owner/developer who engages the design team and construction contractors, the owner generally should take fundamental ownership of the BIM; standard conditions of contract should be established to align with this ownership
2. Transfer of design BIM information to construction contractors as a contract document; standards to be defined for the level of design information that the designer(s) can take responsibility/liability for and transfer to the construction contractors
3. Establish standard set of conditions of contract for the engagement of design consultants and construction contracts, these to be related to liability issues in the development and handover of BIM digital information
4. Set out standard procedures for updating the BIM throughout construction to incorporate design changes from client and design team-initiated changes and construction changes, including as-built details.

As stated in section 5 of this report, NZCIC is currently looking to set up a committee to revise and update the NZCIC Design Documentation Guidelines. This will provide a good opportunity to develop a set of guidelines for utilising technology/BIM throughout the lifecycle of building projects.

6.5 Summary and Key Recommendations

Utilising the full potential of technology and BIM on building projects can significantly lift the construction industry's productivity. Most participants in the industry can see the opportunities that the effective use of technology and BIM presents. However, due to the numerous barriers impeding progress the use of BIM in construction has been very poor in New Zealand. Improving the use of technology/BIM in construction can be achieved through education, training and aligning the industry be means of a set of guidelines.

A central theme within the previous sections of this report is the importance of developing a team approach to creating buildings, with the owner(s), designers, project managers, cost consultants, construction contractors and subcontractors working together to achieve common objectives. An aspect of this need for collaboration is successfully employing technology/BIM and setting a framework and guidelines for team members to work within.

The CPG recommends that the following actions are taken to lift productivity and the use of technology/BIM in construction:

1. ***Establish Industry guidelines and frameworks.*** Bring together an industry group through NZCIC, in parallel with revising/updating the NZCIC Design Documentation Guidelines. This group to be charged with setting guidelines and frameworks for transferring digital information between design consultants, construction contractors and other project participants and avoiding rework and the loss of information. A key outcome would be to develop an outline for a standard BIM utilisation and management plan that individual project teams can use to create project specific plans.
2. ***Make BIM and other relevant digital information Contract Documents on Construction Contracts for projects.*** To achieve this critical step will require resolving issues related to ownership, responsibility, and liability, with standard conditions of contract clauses that fairly represent the roles and responsibilities of the various contractual parties. The additional value that the information transfer delivers should allow any additional effort in verification and detail to offset designers' costs.
3. ***Set up education and training programs targeted at relevant sectors of the industry.*** Following an industry-wide survey into education and training needs, put together targeted education and training programmes. Consolidated industry groupings that can set up education and training sessions would be an owner/operator user group, possibly through BOMA, as well as construction groups. In addition to education and training programmes, industry support groups could be set up to assist with in-house and on-the-job training, possibly sponsored by government agencies.
4. ***Extend the mandate and scope of the BIM Acceleration Committee.*** To align the use of technology/BIM across the construction industry and to continue to address impediments to technology/BIM, leading to better use of available software tools.

7. 0 Training and Education

To realise potentially significant improvements in construction productivity requires education and training for all participants in the industry to understand the fundamentals of how to deliver better buildings. Therefore, after the guidelines and initiatives outlined in this paper have been developed and finalised, we recommend that a series of podcasts and training seminars/webinars, explaining the purpose and use of the guidelines, are organised across the country. We are confident the industry will recognise the value of the guidelines as a framework for creating successful building projects, improving productivity, and generating a stronger construction industry.

The CPG has also identified many areas in the industry in which significant shortcomings in skill levels lead to ‘re-work’ and corresponding reductions in productivity. The skill shortage problem is well recognised across the industry and is the result of under-investment, over decades, in trade apprenticeships and construction companies’ in-house training programmes. At present there appears to be considerable effort within the tertiary education industry to increase apprenticeship training and education in construction management. We support this greater focus on improving education and training. However, we recommend the tertiary education programmes include a greater involvement of ‘hands on’ experienced practitioners and on-the-job construction co-op training. It would take decades to build up skills by relying largely on bottom-up apprenticeships and tertiary education training programmes. Therefore, we recommend, in parallel, more targeted ‘in-house’ and ‘on-the job’ training.

Many of the shortcomings of in-house training programmes are the direct result of ‘the race to the bottom’ of reduced contractor margins. Therefore, contractor margins should include a component recognising the need for investment in ‘on-the-job’ and ‘in-house’ training. To promote contractor ‘in-house’ training we recommend government assistance for NZQA-accredited training modules.

Throughout the previous sections of this paper many industry skill shortcomings have been highlighted, including problems in project and design management and regulatory processes. There are also many other areas of skill shortages that the CPG has discussed in committee meetings but which are not specifically articulated in this paper. For example, an area of particular concern is the generally poor coordination of the numerous interfaces between the head contractor, subcontractor’s designers, client’s designers and project/design managers. Also, integrating technology and BIM use in construction will require new protocols and further industry training. We recommend targeted ‘in-house’ and ‘on-the-job training to improve the skill levels in defined problem areas.

In summary, the construction industry needs to come together to define the key problem areas that are adversely impacting on construction productivity and identify a suite of training seminars/webinars and education programmes to improve the industry. We see the NZCIC and NZIOB, supported by the Construction Sector Accord, as the best forums for developing a framework for such training and education programmes. Through discussion and alignment on training and education needs, the industry should liaise with the various tertiary education and training organisations across the country.

8.0 Summary and Next Steps

The CPG has examined the challenges facing the New Zealand construction industry afresh, unhindered by narrow sector pressures, and has developed a series of interlinked initiatives aimed at improving construction productivity in the vertical construction industry sector and delivering buildings better.

The initiatives described in the previous sections of this report are largely a set of guidelines for the industry to follow to create successful projects and ultimately better buildings. The CPG has set a framework, a blueprint, and a direction for the industry. The industry now needs to 'pick up the ball' and lead the requisite change, bringing together wider representation to further develop the framework. As stated in the introduction to this paper, all parties across the construction industry have had a hand in creating the current dire state of the construction industry, over many decades. Therefore, the entire industry needs to work together to find appropriate solutions.

The constant theme that has permeated CPG discussions, and reflected in this paper, is that building projects are becoming increasing complex and challenging, and that an integrated team approach is therefore required to deliver successful projects. Strong project teams, working to common sets of objectives, deliver successful building projects. The entire 'ecosystem' of delivering building projects needs to be considered and a game plan established to allow the multitude of industry players to effectively work together to create better buildings.

To achieve the significant improvement in construction productivity the industry is seeking requires integrated actions across all the areas outlined in this paper. Working to find solutions to only limited parts of the problem may be beneficial to an extent but will not achieve the step change necessary to significantly lift the industry.

The construction industry can develop the proposed guidelines without input from the government and MBIE, similar to how the construction sector developed the original NZCIC Design Documentation Guidelines. However, the proposed changes to the regulatory/building consent process clearly need the leadership of MBIE and TAs. For the procurement guidelines to be effective it will require government procurement groups, through MBIE, to participate in developing best practice procurement procedures and guidelines with the industry, and then actively following the guidelines in the procurement of contracts to build government buildings.

Over the last year CPG members have met with many senior industry leaders to discuss the proposed initiatives, and generally have found alignment and support. However, in that time, and over the past decade, we have seen little action towards implementing the fundamental changes required to improve the industry.

In this paper we have captured our collective knowledge and experience on how to improve construction productivity in New Zealand. It's now time for the government, through MBIE, and all players in the industry to provide the leadership required to achieve the change New Zealand desperately needs and wants. CPG members would be pleased to participate and work with industry groups to lead the challenge to create enduring change

Appendix 1: Construction Productivity Group Members

1. Terry Buchan
2. Peter Fehl, *Procurement Subgroup Chair*
3. Richard Harris
4. Russell Hawken, *Regulatory Subgroup Chair*
5. David Hayes
6. Lindsay Mackie, *Design Guidelines Subgroup Co-Chair*
7. Peter Neven
8. Mike Quirk, *BIM/Technology Subgroup Chair*
9. Dale Turkington, *CPG Chair*
10. Waren Warfield, *Project Management Subgroup Chair*
11. Jon Williams, *Design Guidelines Subgroup Co-Chair*

Appendix 2: Discussion Paper on Contractor Margins

The predominant New Zealand standard General Conditions of Contract is NZS 3910:2013 which rolls up the many items related to contractor margins into one category, being Off-Site Overheads and Profit. These are defined as:

"The following expenses or losses not incurred on the Site which are required for the general overall running of the Contractor's business, and which are not required for the carrying out of the Contract Works or for off-site manufacturing or fabrication work by the Contractor:

a) General administrative, financial, and overhead expenses incurred in the Contractor's head office or other established offices
b) Executive direction and supervision by principal officers of the Contractor not assigned in the ordinary way to the Contract
c) Profit, other than return on investment on Plant which would normally be recovered in hire rates for Plant."

This definition has not changed since the 2003 edition of NZS 3910 and even earlier editions. As part of the 3910 Committee over many editions I can attest that, as in the whole document, this is a definition established through consensus of the Committee, comprising among its members the New Zealand Contractors Federation and Roading New Zealand Inc., Registered Master Builders' Federation and New Zealand Specialist Trade Contractors' Federation, whose delegates all had an equal voice. It is noteworthy that no such definition was provided in the first standard Conditions of Contract sometime around the late 1950s, and its revised edition, NZSS 623:1964.

The absence of reference to "*contingency*" and "*risk*" in this definition should be noted, as these are two areas which cause the most financial problems across all construction contracts. Whereas most experienced clients or their advisors will add an overall contingency to their total project budget to cover unknowns, scope changes through the course of the project, and physical risks such as ground conditions where such risks are not included in the contractor's price, contingency and risk are treated differently by contractors across the construction industry and are often under-costed or not allowed for at all.

When finalising a tender for submission for a project, most contractors look at the total cost as estimated and decide what "*margin*" should be applied to arrive at the Tender Sum. This "*margin*" is then treated as Off-Site Overheads and Profit when filling out Schedule 1 of the Special Conditions and Schedule of Prices (or Rates). On very large projects, including Joint Ventures or Alliances, and particularly where there is a profit share arrangement between contractor, consultants and client, there might be a requirement to break down the "*margin*" or "*profit*" component into its constituent parts to achieve visibility for all parties. However, this is not the norm for most New Zealand building and civil engineering contracts.

The increasing employment of quantity surveyors over the decades has tended to emphasise that the schedule allowance for Off-Site Overheads and Profit is where the "*margin*" should be inserted. But the allowance for the margin in any one contract is not always to be found either in whole or in part under the Schedule Item "Off-Site Overheads and Profit". In earlier times and particularly in

civil engineering projects, the "*margin*" might be spread evenly or unevenly over different sections of the work, particularly where those parts of the work were self-performed by the head contractor. This was particularly the case in civil engineering construction where large sections of the work were more likely to be self-performed. An element of "gaming" was sometimes employed. For example, when a tenderer believed a particular item of work, such as unsuitable material or concrete formwork was under-measured in a schedule, it might provide a higher rate to that item, and vice versa.

In recent times head contractors in both civil and building projects have tended to move to a more outsourced model where part or all of the physical works are subcontracted. In these situations the Contract Price is likely to include several layers of margin, including margins on directly and indirectly sourced materials, second. third or fourth tier subcontractors, their individual suppliers, and the head contractor's margin. As a result the often-large discrepancy between head contractors' and subcontractors' margins, for example say 5% versus 10% to 15%, is justified by the fact that the margin of the head contract is spread over 100% of the Contract Cost whereas that of the subcontractor is applied to that portion of the subcontractor cost.

This paper deals predominantly with the makeup of the head contractor's margin but is also generally applicable to subcontractor's margins.

In theory, all contractors engaged in construction should have adequate accounting and financial records, a good understanding of the construction activities in which they are engaged and the contract conditions which they sign up to, in order that they can properly estimate the cost of the Contract Works and the inherent risks. A good understanding of their overhead costs is essential to properly evaluate the margin to be applied to each tender or estimate.

The costs of general "head office" administrative functions necessary for the continuing operation of the business are usually known and quantified for each business, even if only in the statutory accounts required by the Companies Office and the IRD. But other costs not necessarily included in this category also need to be included, such as management costs of the whole business, one off and ongoing offsite staff training, and all tendering and business marketing costs of the business. Good tendering records are essential to establish the ongoing tender success rate, so that costs can be analysed and allocated to each tender to allow for the cost of unsuccessful tenders.

In recent years the increasingly competitive construction market, which has led to tight margins, has seen head office experienced support personnel reduced to save costs, to the detriment of the whole industry as reflected in lower levels of productivity, a reduction in quality, lack of good programming skills with its attendant completion date delays, and an outflow of skills across the industry. This results from the lowering of industry margins to the extent where companies are unable to retain good staff during downturns in their workloads and cannot employ and train good people who will become future leaders and managers.

It has also discouraged companies from carrying out a proper risk assessment on tendered projects and making sufficient allowance for this in their tenders through a margin which makes allowance for such risks. This can be seen particularly in major commercial projects entered into in

the previous and current decades and has had a detrimental effect on the industry as a whole. Continuing to operate on margins which do not reflect costs of running the business or providing for the future in terms of retention and upskilling of competent staff through good times and bad and maintaining a core of experienced and skilled management in the business to lead, train, upskill staff and deal with contingent events as they occur, will continue the present downwards spiral.

Aligned to this is an increasing lack of capability, often in larger head contractors, to self-perform core trades, such as concrete and carpentry. Because of this, such companies are losing their ability to estimate those trades based on internal cost records, thereby increasing the risk of various subcontractors under-pricing and going out of business. This is a risk area which is increasing and therefore requires a higher risk margin on the head contractor's tender price.

Anecdotally, it seems that construction contractors continue to under-price their Offsite Overheads and Profit. To accommodate this they may have trimmed their overhead management structure, failed to invest in skills and medium and long term training, are becoming less knowledgeable regarding the complexities of modern complex buildings which they build, and may not make adequate allowance in their price ("margin") for risk.

Before this can be improved the industry needs to work with its members to understand the issue and to train its members to improve these factors. Of course, due to the competitive nature of the industry, not all players will understand this, or will make the choice to forgo some short-term market share so as they can win work at higher margins in the future.

It is absolutely necessary that industry not only educates its own members but also campaigns for a realistic level of margins through all industry participants, including consultants, the legal profession involved in advising industry clients and local and central government. Part of such a campaign must be to demonstrate the benefits of realistic project margins through greater industry skills, ongoing skills training, contractors who can work more closely with consultants and clients through having highly skilled industry professionals able to contribute through the project design and construction phases, and improvements in quality and project delivery.

Peter Fehl

9 August 2020

Appendix 3: Project Risk Allocation

The key elements of risk associated with typical vertical construction building projects are summarised in the following table. There should be always alignment between the key projects, as outlined in the example table, describing who 'owns' each of the risks and to what extent, and the relevant provisions of the construction contract conditions for the project.

	Risk	**Who owns the risk and to what extent?**			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
1	**Design Quality: Plan + Specs**				
	Traditional Tender: Measure & Value	None	None Other than where design is by the Contractor, Subs or suppliers	All	
	Design and Build	For the Design and Build elements as defined in the Contract	All for D&B elements	None, other than where previous design limitations in the Contract and/or Principal's Requirements	For the Design and Build elements as defined in the Contract
	Novated Design and Build		Subject to contract	Subject to contract	
	Tender; Margin & P&G; plus, subs progressively	For the Design and Build elements as defined in the Contract	None Other than where design is by the Contractor, Subs or suppliers	All	For the Design and Build elements as defined in the Contract
	Tender; Margin & P&G; LS	For the Design and Build elements as defined in the Contract	None Other than where design is by the Contractor, Subs or suppliers	All	For the Design and Build elements as defined in the Contract
2	**Competence & suitability of**				

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	design – "Fitness for Purpose"				
	Traditional Tender: Measure & Value	None		All	
	Design and Build	All for Contracted Design elements		Subject to contract	For the Design and Build elements as defined in the Contract
	Novated Design and Build	Subject to contract	For the Design and Build elements as defined in the Contract	For the Design and Build elements as defined in the Contract	For the Design and Build elements as defined in the Contract
	Tender; Margin & P&G; plus, subs progressively	None	None Other than where design is by the Contractor, Subs or suppliers	All – other than where design is by the contractor, Subs or Suppliers	None
	Tender; Margin & P&G; LS	None	None Other than where design is by the Contractor, Subs or suppliers	All – other than where design is by the Contractor, Subs or suppliers	For the Design and Build elements as defined in the Contract
3	**Design Quality: Other Contract Docs**				
	Traditional Tender: Measure and Value	None, Subject to Contract	None, other where design is by the Contractor, Subs or Suppliers	All – other than where design is by the Contractor, Subs or Suppliers	For the Design and Build elements as defined in the Contract
	Design and Build	All, subject to Contract	All, subject to Contract	Subject to Contract	For the Design and Build elements as defined in the Contract
	Novated Design and Build	All, subject to Contract	All, subject to Contract	Subject to Contract	For the Design and Build elements as defined in the Contract

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Tender; Margin & P&G; plus, subs progressively	Subject to Contract	None, other where design is by the Contractor, Subs or Suppliers	Subject to contract, All – other than where design is by the Contractor, Subs or Suppliers	For the Design and Build elements as defined in the Contract
	Tender; Margin & P&G: LS	Subs or suppliers	None, other where design is by the Contractor, Subs or Suppliers		
4	**Errors of omissions in the design documentation**				
	Traditional Tender: Measure & Value	Co-ordination role of documentation and shop drawings		Payment of actual reasonable costs incurred in resolving errors or omissions excluding P&G and Margin.	Co-ordination role as define in the Contract.
	Design and Build	All		None	
	Novated Design & Build	All form when design documentation passed from Principal		None, other than where previous design limitations in the Contract and/or Principal's Requirements	
	Tender; Margin & P&G; plus subs progressively	Co-ordination role of documentation and shop drawings		Payment of actual reasonable costs incurred in resolving errors or omissions excluding P&G and Margin	
	Tender; Margin & P&G; LS				
5	**Construction Quality: Buildability, workmanship, Suitability of materials where not specified**				
	Traditional Tender: Measure & Value	All	All	None	Design Specific
	Design and Build	All	All	None	Design Specific

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Novated Design and Build	All	All	None	Design Specific
	Tender; Margin & P&G; plus subs progressively	All	All	None	Design Specific
	Tender; Margin & P&G; LS	All	All	None	Design Specific
6	**Testing**				
	Traditional Tender: Measure & Value	All	All	None	Design Specific
	Design and Build	All	All	None	Design Specific
	Novated Design and Build	All	All	None	Design Specific
	Tender; Margin & P&G; plus subs progressively	All	All	None	Design Specific
	Tender; Margin & P&G; LS	All	All	None	Design Specific
7	**Additional Testing: Required by the Engineer to ascertain if the product is defective;**				
	Traditional Tender: Measure & Value	All	If work is defective or Engineer has reasonable grounds to consider the Works may be detective	All, if work tested as instructed by the Engineer is not defective unless the Engineer has reasonable grounds to consider the Works may be defective	If work is defective or Engineer has reasonable grounds to consider the Works may be detective
	Design & Build	All	If work is defective or Engineer has reasonable grounds to consider the Works may be detective	All, if work tested as instructed by the Engineer is not defective unless the Engineer has reasonable grounds to consider the Works may be defective	If work is defective or Engineer has reasonable grounds to consider the Works may be detective
	Novated Design & Build		If work is defective or Engineer has reasonable	All, if work tested as instructed by the	If work is defective or

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	Contractor/Subcontractor	Principal	Subcontractor Specific
	Quality				
			grounds to consider the Works may be detective	Engineer is not defective unless the Engineer has reasonable grounds to consider the Works may be defective	Engineer has reasonable grounds to consider the Works may be detective
	Tender; Margin & P&G; plus, subs progressively		If work is defective or Engineer has reasonable grounds to consider the Works may be detective	All, if work tested as instructed by the Engineer is not defective unless the Engineer has reasonable grounds to consider the Works may be defective	If work is defective or Engineer has reasonable grounds to consider the Works may be detective
	Tender; Margin & P&G, LS		If work is defective or Engineer has reasonable grounds to consider the Works may be detective	All, if work tested as instructed by the Engineer is not defective unless the Engineer has reasonable grounds to consider the Works may be defective	If work is defective or Engineer has reasonable grounds to consider the Works may be detective
8	**Testing required by design docs, quality plan**				
	Traditional Tender: Measure & Value	All	All	None	All
	Design and Build	All	All	None	All
	Novated Design and Build	All	All	None	All
	Tender; Margin & P&G; plus, subs progressively	All	All	None	All
	Tender; Margin & P&G, LS	All	All	None	All
9	**Financial:** **Adequacy of construction sum (other than provisional sums)**				

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Traditional Tender: Measure & Value	All	All	None	All
	Design and Build	All	All	None	All
	Novated Design and Build	All	All	None	All
	Tender; Margin & P&G; plus, subs progressively	All	All	None	All
	Tender; Margin & P&G, LS	All	All	None	All
10	**Adequacy of on Site Overheads**				
	Traditional Tender: Measure & Value	All	All	None	All
	Design and Build	All	All	None	All
	Novated Design and Build	All	All	None	All
	Tender; Margin & P&G; plus, subs progressively	All	All	None	All
	Tender; Margin & P&G, LS	All	All	None	All
11	**Adequacy of Off Site Overheads**				
	Traditional Tender: Measure & Value	All	All	None	All
	Design and Build	All	All	None	All
	Novated Design and Build	All	All	None	All
	Tender; Margin & P&G; plus, subs progressively	All	All	None	All
	Tender; Margin & P&G, LS	All	All	None	All
12	**Adequacy of provisional sums**				
	Traditional Tender: Measure & Value	None	None	All	None
	Design and Build	All, depending on contract	All, depending on contract		Subcontract Specific
	Novated Design and Build	All, depending on contract	All, depending on contract	None, depending on contract	Subcontract Specific

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Tender; Margin & P&G; plus, subs progressively	None	None	All	None
	Tender; Margin & P&G, LS	None	None	All	None
13	**Suitability of Subcontractors**				
	Traditional Tender: Measure & Value	All	All		
	Design and Build	All	All		
	Novated Design and Build	All			
	Tender; Margin & P&G; plus, subs progressively	Joint		Joint	
	Tender; Margin & P&G, LS	Joint		Joint	
14	**Management of Subcontractors**				
	Traditional Tender: Measure & Value	All	All	None	
	Design and Build	All	All	None	
	Novated Design and Build	All	All	None	
	Tender; Margin & P&G; plus, subs progressively	All	All	None	
	Tender; Margin & P&G, LS	All	All	None	
15	**Protection of Works and Site**				
	Traditional Tender, Measure & Value	All	All	None	Subcontract Specific
	Design and Build				Subcontract Specific
	Novated Design and Build				Subcontract Specific
	Tender; Margin & P&G; plus, subs progressively	Joint		Joint	Subcontract Specific
	Tender; Margin & P&G; LS	Joint		Joint	Subcontract Specific
16	**Health & Safety**				

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Traditional Tender, Measure & Value	All as PCBU	All as PCBU	None, other than HSE requirements as owner of Site and as Defined under the Health and Safety Act	Responsible as per the Act
	Design and Build	All as PCBU	All as PCBU	None, other than HSE requirements as owner of Site and as Defined under the Health and Safety Act	Responsible as per the Act
	Novated Design and Build	All as PCBU	All as PCBU	None, other than HSE requirements as owner of Site and as Defined under the Health and Safety Act	Responsible as per the Health and Safety Act
	Tender; Margin & P&G; plus, subs progressively	All as PCBU	All as PCBU	None, other than HSE requirements as owner of Site and as Defined under the Health and Safety Act	Responsible as per the Health and Safety Act
	Tender; Margin & P&G; LS	All as PCBU	All as PCBU	None, other than HSE requirements as owner of Site and as Defined under the Health and Safety Act	Responsible as per the Health and Safety Act
17	**Damage to the work**				
	Traditional Tender, Measure & Value	All	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None, except for damage caused by Separate Contractors or Client	
	Design and Build	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None, except for damage caused by Separate Contractors or Client	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Novated Design and Build	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None, except for damage caused by Separate Contractors or Client	
	Tender; Margin & P&G; plus, subs progressively	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None, except for damage caused by Separate Contractors or Client	
	Tender; Margin & P&G; LS	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None, except for damage caused by Separate Contractors or Client	
18	**Injury to persons (to the Construction site)**				
	Traditional Tender, Measure & Value	All	All	None	
	Design and Build	All	All	None	
	Novated Design and Build	All	All	None	
	Tender; Margin & P&G; plus, subs progressively	All	All	None	
	Tender; Margin & P&G; LS	All	All	None	
19	**Damage to property other than the works**				
	Traditional Tender, Measure & Value	All (but without limiting the Contractor's entitlement to claim indemnity	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
		under any applicable policy of insurance)			
	Design and Build	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None	
	Novated Design and Build	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None	
	Tender; Margin & P&G; plus, subs progressively	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None	
	Tender; Margin & P&G; LS	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	All (but without limiting the Contractor's entitlement to claim indemnity under any applicable policy of insurance)	None	
20	**Adequacy of services serving the site**				
	Traditional Tender, Measure & Value	None	None	All	
	Design and Build	None	None	All	
	Novated Design and Build	None	None	All	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Tender; Margin & P&G; plus, subs progressively	None	None	All	
	Tender; Margin & P&G; LS	None	None	All	
21	**Unanticipated sub surface conditions including rock, poor ground, demolition material or archaeology**				
	Traditional Tender, Measure & Value	None	None	All	
	Design and Build	All – subject to contract	All – subject to contract	None	
	Novated Design and Build	Subject to contract	Subject to contract		
	Tender; Margin & P&G; plus, subs progressively	None	None	All	
	Tender; Margin & P&G; LS	None	None	All	
22	**Hazardous Substances Cross Contaminating the Site and/or neighbouring spaces with Asbestos**				
	Traditional Tender: Measure and Value	All – depending on contract	All – depending on contract	None – depending on contract	
	Design and Build	All – depending on contract	All – depending on contract	None – depending on contract	
	Novated Design and Build	All – depending on contract	All – depending on contract	None – depending on contract	
	Tender; Margin & P&G; plus, subs progressively	All – depending on contract	All – depending on contract	None – depending on contract	
	Tender; Margin & P&G; LS	All – depending on contract	All – depending on contract	None – depending on contract	
23	**Dealing with hazardous substances**				

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Traditional Tender: Measure and Value	None – depending on contract	None – depending on contract	All – Pay actual reasonable verified costs or lump sum as agreed – depending on contract	
	Design and Build	None – depending on contract	None – depending on contract	All – Pay actual reasonable verified costs or lump sum as agreed – depending on contract	
	Novated Design and Build	None – depending on contract	None – depending on contract	All – Pay actual reasonable verified costs or lump sum as agreed – depending on contract	
	Tender; Margin & P&G; plus, subs progressively	None – depending on contract	None – depending on contract	All – Pay actual reasonable verified costs or lump sum as agreed – depending on contract	
	Tender; Margin & P&G; LS	None – depending on contract	None – depending on contract	All – Pay actual reasonable verified costs or lump sum as agreed – depending on contract	
24	**Access for Principal, its agents and Separate Contractors**				
	Traditional Tender: Measure and Value	Protocol to be agreed depending on Contract		All – Contractor to provide safe environment – depending on Contract Specific	
	Design and Build	Protocol to be agreed depending on Contract		All – Contractor to provide safe environment –	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
				depending on Contract Specific	
	Novated Design and Build	Protocol to be agreed depending on Contract		All – Contractor to provide safe environment – depending on Contract Specific	
	Tender; Margin & P&G; plus, subs progressively	Protocol to be agreed depending on Contract		All – Contractor to provide safe environment – depending on Contract Specific	
	Tender; Margin & P&G; LS	Protocol to be agreed depending on Contract		All – Contractor to provide safe environment – depending on Contract Specific	
25	**Changes to legislative requirements in respect of the Contact Works which could not be reasonably foreseen**				
	Traditional Tender: Measure and Value	None – other than Health & Safety, Tax, etc. The contractor must take steps to mitigate the extent of the delay		All – but not Health& Safety, Tax, etc	
	Design and Build	None – other than Health & Safety, Tax, etc. The contractor must take steps to mitigate the extent of the delay		All – but not Health & Safety, Tax, etc	
	Novated Design and Build	None – other than Health & Safety, Tax, etc. The contractor		All – but not Health & Safety, Tax, etc	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
		must take steps to mitigate the extent of the delay			
	Tender; Margin & P&G; plus, subs progressively	None – other than Health & Safety, Tax, etc. The contractor must take steps to mitigate the extent of the delay		All – but not Health & Safety, Tax, etc	
	Tender; Margin & P&G; LS	None – other than Health & Safety, Tax, etc. The contractor must take steps to mitigate the extent of the delay		All – but not Health & Safety, Tax, etc	
26	**Programme: Contact – Time for Completion**				
	Traditional Tender: Measure and Value	None		All	
	Design and Build	All		None	
	Novated Design and Build	Depends on specific contract		Depends on specific contract	
	Tender; Margin & P&G; plus, subs progressively	None		All	
	Tender; Margin & P&G; LS	None		All	
27	**Practical Completion of the works, separate projects and separable portions by the contract dates**				
	Traditional Tender: Measure and Value	All		None	
	Design and Build	All		None	
	Novated Design and Build	All		None	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Tender; Margin & P&G; plus, subs progressively	All		None	
	Tender; Margin & P&G; LS	All		None	
28	**Delays due to weather**				
	Traditional Tender: Measure and Value	All, except for extreme weather event covered by insurance, or specific contract requirements		None, except for extreme weather event covered by insurance or specific contract requirements	
	Design and Build	All, except for extreme weather event covered by insurance, or specific contract requirements		None, except for extreme weather event covered by insurance or specific contract requirements	
	Novated Design and Build	All, except for extreme weather event covered by insurance, or specific contract requirements		None, except for extreme weather event covered by insurance or specific contract requirements	
	Tender; Margin & P&G; plus, subs progressively	All, except for extreme weather event covered by insurance, or specific contract requirements		None, except for extreme weather event covered by insurance or specific contract requirements	
	Tender; Margin & P&G; LS	All, except for extreme weather event covered by insurance, or specific contract requirements		None, except for extreme weather event covered by insurance or specific contract requirements	
29	**Construction Programme**				
	Traditional Tender: Measure and Value	All		None	
	Design and Build	All		None	
	Novated Design and Build	All		None	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Tender; Margin & P&G; plus, subs progressively	All		None	
	Tender; Margin & P&G; LS	All		None	
30	**Delays due to industrial action**				
	Traditional Tender: Measure and Value	All		None	
	Design and Build	All		None	
	Novated Design and Build	All		None	
	Tender; Margin & P&G; plus, subs progressively	All		None	
	Tender; Margin & P&G; LS	All		None	
31	**Timely performance of provisional sum work**				
	Traditional Tender: Measure and Value	All, subject to timely information provision by Principal		None, subject to timely information provision by Principal	
	Design and Build	All, subject to timely information provision by Principal		None, subject to timely information provision by Principal	
	Novated Design and Build	All, subject to timely information provision by Principal		None, subject to timely information provision by Principal	
	Tender; Margin & P&G; plus, subs progressively	All, subject to timely information provision by Principal		None, subject to timely information provision by Principal	
	Tender; Margin & P&G; LS	All, subject to timely information provision by Principal		None, subject to timely information provision by Principal	
32	**Delay caused by the Principal, or others controlled by them**				

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
	Traditional Tender: Measure and Value	None, provided the Contractor strictly complies with contract notice and claims requirements		All, provided the Contractor strictly complies with contract notice and claims requirements	
	Design and Build	None, provided the Contractor strictly complies with contract notice and claims requirements		All, provided the Contractor strictly complies with contract notice and claims requirements	
	Novated Design and Build	None, provided the Contractor strictly complies with contract notice and claims requirements		All, provided the Contractor strictly complies with contract notice and claims requirements	
	Tender; Margin & P&G; plus, subs progressively	None, provided the Contractor strictly complies with contract notice and claims requirements		All, provided the Contractor strictly complies with contract notice and claims requirements	
	Tender; Margin & P&G; LS	None, provided the Contractor strictly complies with contract notice and claims requirements		All, provided the Contractor strictly complies with contract notice and claims requirements	
33	**Delay caused by unanticipated sub surface conditions**				
	Traditional Tender: Measure and Value	None		All	
	Design and Build	Contract Specific		Contract Specific	
	Novated Design and Build	Contract Specific		Contract Specific	
	Tender; Margin & P&G; plus, subs progressively	None		All	
	Tender; Margin & P&G; LS	None		All	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
34	**Delay in obtaining any building consents**				
	Traditional Tender: Measure and Value	All, where under the Contract the Contractor is responsible under the Contract for timely lodging of Building Consent documentation to suits its programme of works		None, unless where under the Contract the Principal is responsible for timely lodging of building consent documentation to suit its programme of work	
	Design and Build	All, where under the Contract the Contractor is responsible under the Contract for timely lodging of Building Consent documentation to suits its programme of works		None, unless where under the Contract the Principal is responsible for timely lodging of building consent documentation to suit its programme of work	
	Novated Design and Build	All, where under the Contract the Contractor is responsible under the Contract for timely lodging of Building Consent documentation to suits its programme of works		None, unless where under the Contract the Principal is responsible for timely lodging of building consent documentation to suit its programme of work	
	Tender; Margin & P&G; plus, subs progressively	All, where under the Contract the Contractor is responsible under the Contract for		None, unless where under the Contract the Principal is responsible for timely lodging of building consent	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
		timely lodging of Building Consent documentation to suits its programme of works		documentation to suit its programme of work	
	Tender; Margin & P&G; LS	All, where under the Contract the Contractor is responsible under the Contract for timely lodging of Building Consent documentation to suits its programme of works		None, unless where under the Contract the Principal is responsible for timely lodging of building consent documentation to suit its programme of work	
35	**Delay or default by sub-contractors or supplier**				
	Traditional Tender: Measure and Value	All		None	
	Design and Build	All		None	
	Novated Design and Build	All		None	
	Tender; Margin & P&G; plus, subs progressively	All		None	
	Tender; Margin & P&G; LS	All		None	
36	**Earthquake or other natural disaster**				
	Traditional Tender: Measure and Value	None		All	
	Design and Build	None		All	
	Novated Design and Build	None			
	Tender; Margin & P&G; plus, subs progressively	None		All	
	Tender; Margin & P&G; LS	None		All	

	Risk	Who owns the risk and to what extent?			
		Contractor Specific	**Contractor/Subcontractor**	**Principal**	**Subcontractor Specific**
	Quality				
37	**Suspension caused by Contractor**				
	Traditional Tender: Measure and Value	All		None	
	Design and Build	All		None	
	Novated Design and Build	All		None	
	Tender; Margin & P&G; plus, subs progressively	All		None	
	Tender; Margin & P&G; LS	All		None	
38	**Suspension caused by the Principal**				
	Traditional Tender: Measure and Value	None		All	
	Design and Build	None		All	
	Novated Design and Build	None		All	
	Tender; Margin & P&G; plus, subs progressively	None		All	
	Tender; Margin & P&G; LS	None		All	

Appendix 4: The Role of Engineer to the Contract

A paper prepared for the Master Builders Federation by Peter Fehl August 2020

NZS 3910 Definition and requirement for Engineer to be named in the tender documents so a contractor can assess its impartiality at time of deciding to tender. Need not be a qualified engineer

"The professional engineer, architect, surveyor, or other one natural person named or identified in the Special Conditions or such other one natural person as may be subsequently appointed by the Principal under 6.1 to act as Engineer to the Contract. The Engineer shall not be a body corporate or a firm."

The NZIA conditions are very similar, except that they replace the term "Engineer" with "Architect". That difference does, however, lead to an inference that the named "Architect" is in fact a professionally qualified architect, a significant difference from NZS 3910. And unlike NZS 3910 NZIA Standard Conditions of Contract do not expand the definition to other professionals or "natural persons".

There is no provision for the Contractor to object to the Engineer who is the person named in the tender documents and who has not been challenged by the Contractor in the Contractor's tender. The naming of the person engaged as the Engineer in the Special Conditions was not required in earlier 3910 conditions but was added in later additions to provide transparency and for a prospective tenderer to either make special allowances in its tender based on its impression of the capability of the natural person so named, or to decide not to submit a tender.

Once awarded the contract, the Contractor cannot require the Principal to get rid of the Engineer. However, if there is a change of Engineer by the Principal the Principal must notify the Contractor of the proposed change, consider any representations the Contractor may make on the suitability of the proposed Engineer. Once the Principal has decided to appoint the replacement it must notify the Contractor of the new Engineer's replacement – 6.1.4.

It is notable that the various contractor representatives on the present and previous NZS 3910 committees did not call for a major change in the Engineer role.

The Engineer to the Contract has two roles, to assist in the management of the project on behalf of the client and to make fair and impartial decisions on matters such as approval of progress and final payments, variations, EOT applications, etc.

Duality of Roles

As expert advisor to and representative of the Principal, give directions to the Contractor on behalf of the Principal; act as Principal's agent in receiving Payment Claims and providing Payment Schedules on behalf of the Principal. To fairly and impartially make the decisions required of it under the Contract, value the work and issue certificates independently of both the Principal and the Contractor.

Role of Engineer's Representative

The Engineer may appoint an Engineer's Representative to assist with its duties.

Such appointment is often the PM, or a member of the PM's team. It must be a natural person and not a company or firm.

The Engineer's Representative has very wide powers – perhaps too many, in my view.

What it cannot do unless authorised in writing by the Engineer: s.6.3.3

1. The reviewing of matters in dispute
2. The valuing of Variations, provision of Payment Schedules, issuing of PC or Final Completion Certificate, granting of EOT, any changing of Drawings or Specs
3. Any other powers excluded by the Engineer

Possible Problem Areas

Perception: Is the Engineer seen as being too close to the Client, by being paid by the Client?

Are the Special Conditions of Contract heavily weighted in Client's favour?

Consultants or project managers being Engineer to the Contract [e.g., recent lockdown decisions]

Engineers' poor understanding of their role – "client capture"

Unfamiliarity, lack of training in contract conditions

Lack of understanding of natural justice and procedural fairness

Lack of understanding of the project design

Lack of construction knowledge

Unnecessary delays in making decisions

Giving the Engineer's Representative too many powers

I suggest that the following prerequisites are essential for appointments of persons to the role of Engineer along with specific training in construction contract conditions and relevant legal concepts including natural justice. New and current practitioners would need to demonstrate the following:

- Good general understanding of construction work including design
- Good understanding of their powers and responsibilities — generally as set out in 3910 s.6 and throughout the document
- Scrupulously adhere to principles of reasonableness and fairness; be very aware of those decisions that require it to be independent of the wishes of the Principal, such as valuing

the work, issuing certificates, issuing Variation orders, completion certificates, ruling on extension of time claims

- Acting without undue delay — s 6.2.2 3910. Note that delay which impacts the Contractor's progress of the work may be treated as a Variation for which the Contractor is entitled to payment. This may lead to disputes where the Engineer is also part of the design team, or the PM team which has fallen behind in its responsibilities
- Maintain a regular understanding of the progress of the project and be prepared to listen to the parties involved
- Note that the Engineer's contract is solely with the Principal, not the Contractor. If the Engineer is also a consultant on the project it must put on a different hat when acting in its role as Engineer. This is particularly important when deciding on matters around design problems and issues
- The Engineer should not also be the Project Manager, particularly if a member of the PM team is the Engineer's Representative
- Conflict of interest — paid by Principal: How can Engineer be neutral? Note longstanding role of Engineer in MOWD projects.

How do I operate when in that position, as an employee of the University of Auckland? Involved in all project phases from before concept until post completion. Stay close to all parties during the contract — Principal, consultants and contractor. Understand issues, seek solutions prior to disputes arising by keeping in touch through all contract phases. Ensure independent PMs meet required timeframes, when necessary, especially when they supply the Engineers Representative. Likewise, QS's. Have a good understanding and knowledge of civil and vertical construction from a contractor perspective. Principles of natural justice; my legal training and arbitration and adjudication practice helps.

Times have changed, e.g., on the construction of Auckland's Starship Hospital, the contractor not allowed to speak with Engineer!

Role of Engineer Summary

Dual Roles: Principal's agent and impartial decision maker

Paid by the Principal and acts as Principal's representative and expert advisor. Can be on Principal's staff or a consultant employed by the Principal

Must be a "natural person" — NOT a company. Does not have to be an engineer

Is there any difference when the Engineer is employed by the Project Manager or other companies employed by the Principal?

Must act fairly and impartially independently of both Principal and Contractor when making decisions under the contract, such as valuing the work, issuing certificates, giving decisions under the contract such as completions certificates, instructing and valuing variations, instructing extensions of time

The Engineer must have a good knowledge of the type of work undertaken under the contract

It is essential that the Engineer fully understands the contract conditions and its powers under the contract

It is helpful to have training in issues such as fairness, impartiality, the principles of natural justice.