Observations from reviewing consent applications

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ABSTRACT

Building control authorities use producer statements throughout the building consent and certification process. When it comes to geotechnical matters, acceptance of a producer statement may not be a reliable indication that the works comply with the building code. There is often a lack of consideration to site works and compliance with the building code beyond the envelope of the main building. Building practices have changed and flat sites are now desired, timber retaining is preferred, but are their long term consequences? Although the geotechnical earthquake engineering modules have been released, it is not a simple matter to implement them. This paper discusses some of the challenges that councils face with geotechnical matters and suggests some enhancements.

1 INTRODUCTION

At two stages of my career I have worked for different councils processing geotechnical and civil engineering reports and designs that have accompanied resource consents and building consents. Working at councils provides access to information and examples of where things have gone wrong and you work to prevent it recurring in the future. Councils are not companies and may be caught up in litigation years after the design firm has been disestablished, so it is therefore important to reduce the risk of legacy issues developing. This paper provides a snapshot of some of my experiences at both councils, and includes some comments based on my dealings with other councils when representing clients.

2 GEOTECHNICAL REPORTING DURING SUBDIVISION

During the land development process, several geotechnical reports are often provided to councils. The first is to demonstrate the suitability of the land for the proposed development. The purpose of this report is to address natural hazards and demonstrate to councils that the land can be developed to meet the requirements of the Resource Management Act and District Plan.

If the site is to be modified then a geotechnical design report is often needed. The purpose of this report should be to confirm the suitability of the proposed landform and provide any specific assessments needed to support the detailed design of the subdivision and landform. This is a detailed design stage, however it is not always completed and I have had experiences where the development works have been approved without the input recommended in the suitability report. In these cases we have had to tell the clients that we need to satisfy ourselves that the works are suitable before we can supervise them, and in some instances modify the works and have the new design approved by the council.

The final report for each stage of a development should be a Geotechnical Completion Report or GCR. This report summarises the works undertaken and provides the recommendations for the building consent phase. Some GCRs provide recommendations for additional investigation and assessment. Other GCRs state that buildings can be built in accordance with NZS3604, provide an ultimate bearing capacity or recommend liquefaction resistant foundation design. In my experience some councils have issued building consents without requiring the subsequent

assessment that was recommended by the GCR, or validating that the assessment has addressed the issues flagged in the GCR. When this occurs the council exposes itself to liability should any issue arise in the future.

Sometimes the GCR for new sections on sloping land states that the site is suitable for standard foundations in accordance with NZS3604. The recommendation has often been provided on the basis of a test between 1.5 and 2 metres deep. While the GCR is technically correct that the site is suitable for *some types of foundations* in accordance with NZS3604 it does not address construction of the single level concrete floor.

3 SLOPE STABILITY

Both of the councils I worked at have areas where the topography and geology is prone to deep seated instability and flow failures have previously occurred. One of the councils had zoned a significant area of steep unstable land for lifestyle sections with a minimum size of 5000m^2. I was frequently provided with geotechnical reports with 2 metre deep hand augers and statements such as "the slope is less than 25 degrees and considered stable". On more than one occasion while undertaking my site check or checking the aerial photos in the GIS system, I identified active or past instability. There was no mention of the wider geomorphology or recognition of the geohazards in documents that were described as geotechnical reports. While a house was under construction on one of these sites, a deep seated slip occurred metres from the house that resulted in a flow that had enough momentum to travel 5-6 metres up the adjacent ridge. Fortunately I had not been involved in either the subdivision or building consent process for that site.

Having a suitable geotechnical report is no guarantee that the recommendations will be followed. I once reviewed a building consent for a house adjacent to the crest a steep 35 m high slope. The house was entirely located downslope of the established building restriction line. The consent included an engineer designed raft and a PS1 (Producer Statement – Design) that was issued subject to confirmation of ground conditions. The engineer had signed the plans showing where the house was in relation to the building restriction line. On another site where most of a debris protection bund was removed to create a building platform, the engineer who provided the PS1 did not considering the purpose of the bund and the impact forces that could occur. In a third example for a house on a slope, the engineer who provided the PS1 designed piles to extend through deep fill and an underlying buried topsoil layer, to be founded with only 300mm embedment into the natural soil. No assessment or calculations were provided for the possible lateral forces on the piles.

4 PRODUCER STATEMENTS

An engineer must provide sufficient information with an application to satisfy the council on reasonable grounds that the proposed works would comply with the Building Code if the works are completed in accordance with the plans and specifications that accompanied the application (BA04 - S49). Many councils request PS1s at the time consent is lodged. At the end of the building process PS4s (Producer Statement - Construction Review) may also be requested.

IPENZ, 2014 refers to the recommended practice when producer statements are used to support building consent applications:

> *"… a BCA (Building Consent Authority) that relies wholly on a producer statement, without providing some level of assessment, audit or review of the work, is not taking reasonable steps to satisfy itself as to the design or construction's adequacy. BCAs should also satisfy themselves, on reasonable grounds, that the author of the producer statement is suitably competent to have carried out the work described."*

Multiple determinations also refer to the role of the producer statement as part of the documentation, however the BCA still had sole responsibility to determine that the documents and built work complied with the building code.

In Section 3, I provided three examples where the designs did not have sufficient information to demonstrate compliance with the building code and yet PS1s were issued. Unfortunately this is common.

Many engineers also supply PS4's without any additional information or a summary providing the basis for issuing the PS4. I have seen PS4s for retaining walls that were later shown to be factually incorrect. PS4s issued for earthfills have not had test records or the testing used incorrect methods. Earthfills are building works if associated with a building (BA04 - S7 & S8) and must comply with Clause B1 of the Building Code (BA04 - S17),

In some instances, supporting information has been requested and not supplied, even though record keeping is very important and councils need to be the keeper of records. One company told a council they don't keep testing records and provide their recommendations on site. Years down the track when someone wants to know what has happened, the companies involved may no longer exist, but the councils will (in one form or another).

5 COMMERCIAL BUILDING FOUNDATIONS

It is common for structural engineers to supply producer statements for commercial buildings assuming ground conditions are in accordance with NZS3604 or an ultimate bearing capacity of 300kPa subject to on-site verification. BA04-S49 requires that it is reasonable to accept that construction in accordance with the ***plans submitted*** will comply with the building code. The B1 compliance document states that 300kPa can be assumed if testing with a Scala Penetrometer indicates 5/blows per 100mm to a depth equal to twice the width of the foundation. This is seldom established and commercial buildings often have large pads, which would require testing deeper than most structural engineers would undertake during construction. Where sedimentary soils are present the ground conditions can also be variable horizontally and vertically.

Several buildings have required the foundations to be redesigned following requests for assessment by a geotechnical engineer. One of the more extreme examples I have been involved with was a 2-storey office building that had a shallow investigation by the designer of shallow pad foundations. The investigations showed saturated loose sand and organic soil to the base of the testing. I requested a geotechnical peer review. The reviewer required several drill holes and CPT tests to be undertaken with the resulting report recommending a raft foundation for liquefaction and settlement mitigation. When the designer only increased the size of the pads I requested the geotechnical engineer sign the plans. A new design for a raft was subsequently supplied.

6 SITE WORKS

Site works associated with the construction of a building are building works (BA04 – S7 & S8) and all building works must comply with the building code, (BA04 - 17). Of interest in this section are provisions B1.2 and B1.3 of the building code which requires buildings and sitework to withstand the combination of loads that they are likely to experience and have a low probability of rupturing, becoming unstable, losing equilibrium or collapsing during construction or alteration and throughout their lives.

In the past, buildings were designed to fit the land. Free-standing garages, basements and upper floor garages are common sights in the hilly older suburbs of many cities. Today, single level concrete floor construction makes up the vast majority of new buildings within greenfield subdivisions. Most building companies do not have standard plans offering split level buildings,

basements or pole construction. As a result, the building company will need to undertake further earthworks to create the level site that they need. This will often involve the construction of retaining walls on or near boundaries.

Many architectural designers misrepresent the site works on plans. The elevations tend to show the site to be level and they do not extend the ground beyond the boundaries. Contours or levels on plans frequently do not match subdivision as built contours. Those that got it right would have deep excavations adjacent to boundaries to construct retaining walls or large fills. It wasn't just the designers; many engineers gave no thought to the stability of cuts during construction. Although some soils will often stand vertically unsupported for some time, there have been cases where other property was adversely affected by temporary works in these soils.

Fills for single house sites are frequently poorly controlled. Engineers have certified deep fills that went beyond building restrictions lines imposed by a geotechnical engineer without any additional assessment. Cohesive fills have been tested with a Scala penetrometer, or only tested in the upper metre. I have seen cases where building inspectors could push their 'T' probes up to the handle in "tested" fill. When we began requesting earthworks specifications that showed compliance with NZS4431, a number of structural and civil firms were unable to show that they had an understanding of soil compaction and current practice.

Scala penetrometer testing is presented in a variety of non-standard ways. It is not uncommon to see Scala penetrometer testing presented as a bearing capacity with depth or a California Bearing Ratio with depth, without the site data. One engineer was generally presenting penetration per 10 blows but on some data lines they indicated a different number of blows. Once I had confirmed with them what the document was showing I needed to make a check sheet for the council staff so that they could readily confirm that the test results provided reasonable grounds to be accepted as good ground, as described in NZS3604.

7 RETAINING WALLS

Retaining walls are buildings (BA04 - S7 & S8), although not all retaining walls require a building consent (BA04 - Schedule 1). Regardless of whether a building consent is required; they must comply with the building code (BA04 - S17). It has been common place to show some retaining walls on plans as "landscaping walls"

For a wall to be a landscaping wall, there needs to be no surcharge throughout the life of the wall. I also think it is also reasonable that for any retaining wall that is shown on plans that a council approves to have sufficient information to show how it complies with the Building Code, as the council is confirming that the documents comply with the building code when the plans are approved, and at the end of the process the building works are signed off with a Code of Compliance Certificate (CCC). If the applicant does not want to demonstrate that the wall complies with the Building Code, they need to show how they can develop the site without the need for the wall, and build their non-compliant wall once they have received their (CCC).

7.1 Timber pole retaining walls

The most common type of retaining wall is the timber pole retaining wall. At both councils, compliance of a retaining wall with the building code was assessed by the Building Consent Officer (BCO). The wall was accepted as compliant if there was design by an engineer with a PS1 and the BCO recorded "PS-1 from XX CPEng No. YY".

The first retaining wall design I reviewed for a council was designed by a CPEng and it had an accompanying set of calculations, a PS1 producer statement and a hand sketch of the wall. The wall appeared undersized and an independent calculation check indicated that the wall poles were at least 2 sizes too small and embedment was not sufficient. The documentation was also

insufficient to demonstrate compliance with the building code. The omissions and errors are listed in **Table 1**.

Table 1 - Timber pole retaining wall design omissions / errors

No geotechnical investigation*	No design description of the site and boundary conditions*	Did not allow for sloping ground above and below the walls
No comment on seismic requirements*	Did not consider long term drained soil failure*	Increased the undrained shear strength for the highest wall height without explanation
Bending moment taken at ground level*	Superseded timber bending strength used*	Multiple calculation errors
Global stability not addressed*	Missing elevations of the walls*	Safety in design not considered*

*Denotes items that were commonly omitted by designers

The sketch detail was basic and didn't include the key assumptions from the design calculations such as the rail span and strength grade, the treatment of timber wasn't specified and drainage was simply referred to as free draining backfill. By not supplying a reasonable detail that was consistent with the design, there was not sufficient grounds to accept that it would comply with B1 and B2 when built.

It soon became apparent that it was common practice for structural and civil engineers to present a set of calculations with a PS1 without any reasonable supporting documentation. The PS1 would often state ground assumed to be as per NZS3604, and more than often the wall was designed from the plans and the engineer had not been to the site or verified the topography.

In contrast designs received from geotechnical engineers always included a site investigation, a design summary and generally addressed the other matters. This leads to the question *what do the structural engineers know about highly variable soil and ground water conditions that the geotechnical specialists don't?*

Some firms gave inspection schedules that only required them to inspect the holes to issue a PS4 or recommended that Council inspect the wall. They were taking aggressive design approaches such ignoring groundwater, adopting the maximum pole taper, requiring rails to be strength tested timber and have multiple spans. In my opinion, a building inspector is unlikely to see these and is even more unlikely to understand the basis of the design based on a rudimentary detail and several pages of calculations.

7.2 Stacked or terraced retaining walls

If multiple building companies are developing sites within a subdivision it is likely that they don't know what is happening on the adjacent site until it happens. This has led to consents being issued for retaining walls that are influenced by other retaining walls which then needed to be dealt with during the construction phase. There are at least two ways that this can be prevented. Retaining walls can be constructed as part of subdivisional work, so single walls are built near the boundaries that are suitable for the future building consents. Alternatively, the BCA needs to keep records of the levels shown on plans that are already in the system or approved.

Terraced retaining walls are also problematic as there is no code or design note for how to assess the force interactions. Some engineers can present reasonable interpretations while others simply try to ignore it.

7.3 Masonry retaining walls

Masonry walls are often designed by structural engineers using the vertical bearing capacity from a geotechnical completion report or an assumed bearing capacity if there is no GCR. From the bearing capacity equation in B1/VM4, the associated worked example and more recently Module 6 (MBIE, 2017) it is apparent that load inclination factors adversely affect the bearing capacity. There is normally no specific check on the bearing capacity. Several design firms did not check sliding until requested and free standing walls are routinely not checked for global stability.

7.4 Pool retaining walls

Pools are often submitted with generic producer statements and assumed ground conditions. One pool company uses an engineer in Australia and the site assumptions relate to expansive soil conditions. Council building inspectors are very unlikely to understand the Australian expansive soil references. Pools are big investments. In my opinion generic producer statements that are not based on site specific ground conditions should not be accepted.

7.5 Potential legacy issues

In my opinion, the prevalence of timber retaining walls to create level building sites may well be the next "leaky building crisis". The preferred construction material is soft pine that has been chemically treated to prevent rot. The H5 treated timber poles are rated for structural ground contact with a design life of 50 years. The lagging between the poles is routinely constructed with H4 timber as permitted by NZS3603. It is not clear how the lagging (or poles) on a 4-metre-high retaining wall supporting someone else's property can be adequately replaced without a large excavation extending into that property. More concerning is that on many properties it will not be possible to access the walls with the machinery necessary to replace them. Strengthening work such as soil anchors may also not be possible.

Another point to ponder is whether a retaining wall that is constructed as part of a subdivision with a design life of 50 years remains suitable to support a building if the consent for the building is lodged 10 years later.

8 SECTION 72

One of the requirements of both the councils I worked for is the identified building sites shown on subdivision plans can have a building consent issued without reference to S72 of the Building Act 2004 (BA04). There are varying interpretations within councils and also between different councils, as to how S72 should be applied and in what situations. New titles have been created on land that floods or is prone to settlement, without imposing consent notices informing the buyers that a S72 would be required.

An interesting example of how S72 can be interpreted is a house that cantilevers over a building restriction line. The house has been mitigated yet the land under the house and towards the slope crest has been assessed as potentially subject to a natural hazard. Some believe the house is supported on stable ground and S72 is not applicable. Alternatively, EQC considers the land within 8 metres of the dwelling as contiguous with the dwelling and would cover a claim on that land.

Should S72 be applicable for a palisade wall within a zone of instability? The wall is designed to protect the upslope land. The ground downslope of the wall remains unstable and it's possible that strengthening works would be required once the land in front slips. The same could also be true for a house that is piled beyond the building restriction line.

9 LIQUEFACTION

Taylor, 2012 discussed a historical environment in Christchurch where developers, relied on engineers, engineers needed to keep costs down to win work and would do the minimum to get it through council. This meant that if the council didn't ask for liquefaction to be assessed it wasn't undertaken and the cycle continued.

In 2016, Modules 2 and 3 of the geotechnical earthquake engineering series were released (MBIE, 2016a and 2016b). The intent was to standardise the assessment requirements nationally. Despite the modules, it is still common for engineers to prepare geotechnical reports in areas where liquefaction assessment should be undertaken, without doing an assessment. When a council started to ask for liquefaction to be addressed, the majority of geotechnical engineers supported this approach. Building designers, structural and civil engineers protested. One rang MBIE several months after the modules were published and was told that the guidelines were for Canterbury only. Complainants focused on time delays and additional cost, not the long term resilience of the community, costs of displacement and repair nor the risk exposure to the organisation by issuing building consents in an area with a mapped hazard.

10 PRESSURES ON COUNCIL STAFF

Councils have statutory time frames that need to be met for resource consents and building consents. This is a key audit metric in a BCA's accreditation. At both councils; resource consents and building consents submitted were lacking supporting information or with inadequate supporting information. By the time they are reviewed and information is requested, the majority of the days have lapsed. This applies pressure in responding to further information received.

In some instances, designs take several iterations between council and the designers. As they solve one issue, they create another. Significant staff time is tied up dealing with consents that are not in a state that can be approved. This can entail emails, phone calls and meetings. Some applicants or their representatives automatically escalate matters to elected members or senior management. Complaints often focus on timeframes and costs. Again this impedes the ability of staff to focus on the good consents as their time is spent justifying decisions to several layers of management.

While councils can use peer reviews, their use is contentious. The applicant or their agent complains that they have already used a "highly qualified member of IPENZ". They object to the additional costs and delays. The peer reviewer then ends up having the same discussions as council with the originator and having to resolve the design. When a council has had a number of such reviews they lose confidence in the designer. While complaints can be lodged with IPENZ they are time consuming to resolve and in the interim council can't advise the public against the use of the engineer. They therefore have to continue to accept their work when submitted and review it for compliance.

11 BUILDING CONTROL OFFICERS

Building Control Officers (BCO's) and inspectors have a history of focusing on "the building". The interaction of building works outside of the main building envelope is often not assessed by the BCO. However, the compliance of the building works also requires that the following building code clauses are addressed, safe and functional access for vehicles and persons (Clause D1), site works (Clause B1), retaining walls (Clauses B1 and B2), on-site stormwater management (Clause E1) and on-site wastewater management (Clause G13). In my experience these are not things that BCOs and inspectors are trained to assess.

Both councils I was involved with used had historically used Project Information Memorandum Officers (PIM officers) that sat outside of the BCA to review geotechnical and environmental

engineering. The PIM officers did not have an engineering background, and their primary function was to confirm that producer statements had been supplied or would be supplied. This is inconsistent with the requirements of the Building Act and IPENZ, 2014.

12 CONCLUSIONS

There are a number of good engineers supplying a high standard of work. Unfortunately the market dictates that the cheaper engineers, who will undertake geotechnical design without investigation and provide minimal supervision, will undertake the greater portion of the work, particularly in the residential building market.

In my opinion councils and the wider industry would be assisted if the following suggestions were adopted by MBIE, IPENZ and NZGS:

- Review extent that producer statements are relied on and how BCA's determine if the works referred to in a producer statement comply with the building code. This should be undertaken as part of the BCA's compliance audits.
- Develop a mandatory competency standard for anyone who assesses the compliance of site works and geotechnical information. The standards would also include the triggers for specialist review.
- Further development of Module 6 for the design of residential retaining walls including minimum investigation and documentation requirements, durability requirements and safety in design considerations.
- Development of a design methodology for the design of terraced timber pole retaining walls.
- Promote greater integration between geotechnical and structural disciplines with an IPENZ practice note on the design of foundations. Include geotechnical review of the final design.
- Develop guidance on the use of S72 of the Building Act, with examples of when it should and should not be applied.
- Recognise the recommendations of the Earthquake geotechnical engineering practice Modules 1 to 6 in the building code.

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