DS10 – Natural Hazards and Earthworks

Contents

DS10 Natural Hazards and Earthworks

10A Earthworks & Land Stability

10A.1 Introduction

This section of the Code sets out the requirements for undertaking the assessment of land stability and the design of earthworks to ensure that the development provides a suitable platform for the construction of buildings, roads and other structures in order to comply with the outcome requirements of the District Plan

Geotechnical assessments and design will require the engagement of a geotechnical engineer, whose engagement will include observation and quality control of the works, including a completion report and certification of building sites as suitable for the development of buildings. The Councils have adopted a system of classification of geotechnical works into 3 categories and a parallel system for registration of geotechnical engineers with 3 tiers as detailed later in this section of the Code.

A good guide to the various aspects that should be addressed as a means of compliance with this section of the Code of Practice, is provided in the Part 2 'NZS 4404:2004 - Code of Practice for Urban Land Subdivision'. That document sets out the areas in which the rational processes of engineering appraisal and design (site investigation) are necessary, and which requires the involvement of a geotechnical engineer.

Engineering appraisal and design are required:

- Prior to detailed planning, which may involve some form of subsurface investigation.
- During the review of and advice on design concepts.
- During construction to ensure the adequacy of the bulk filling and the execution of the earthworks design.

Observation, quality assurance and review of the earthworks design during the construction phase are covered in DS 1 of this Code.

10A.2 General Requirements

i. Every completed lot or development site shall provide at least one designated safe building platform suitable for the erection thereon of building types appropriate to the zoning of the land and meet the following:

   - Upon issue of the s224 certificate, the designated safe building platforms on each lot or development site are able to be developed without further geotechnical input being required, except where either approved by Council or covered in a consent notice.

- The safe building platform shall be certified as meeting the performance criteria of the New Zealand Building Code and s2 of NZS 4404 by the Geotechnical Engineer.

As a minimum, completed slopes should possess a factor safety against slope failure of 1.5 (static condition) unless a risk assessment based on probabilistic analysis or other methods is undertaken and a lesser factor of safety proposed by the practitioner.

For differential settlement no more than 25mm settlement over 6m shall be adopted. Any expected differential settlement exceeding this range shall be specifically identified within the geotechnical completion report along with building development recommendations to manage the exceeded differential settlement.

- The geotechnical completion report shall provide a plan showing all designated safe building platforms.

ii. To achieve the above performance requirements and to ensure each lot or development site has at least one designated safe building platform work may be required to be undertaken by the Consent Holder to comply with this requirement.

iii. All applications for resource consent for land subdivision, multiple residential or commercial units or any other type of development where land stability of one form or another needs to be addressed to ensure that the requirements of 10A.2 above can be met, shall be accompanied by a Development Evaluation Report relevant to the site in a format similar to the one shown in the Drawings. The report should also utilise the criteria outlined in Part 2 of NZS 4404 in its compilation.

iv. After review of the Development Evaluation Report, Council may request that a fully detailed geotechnical investigation and evaluation be undertaken to prove the suitability of the site for its intended purpose.

v. The Consent Holder shall appoint a Category 1 or 2 Chartered Professional Engineer to undertake the responsibilities of the Geotechnical Engineer.

vi. Only persons who are appropriately qualified and experienced in geotechnical engineering and are accredited in accordance with the requirements of this Code are approved to prepare development evaluation reports, geotechnical investigation reports and geotechnical completion reports and undertake the role of the geotechnical engineer within the sub-regional area.

vii. The Person referred to in (i) above shall possess Professional Indemnity Insurance meeting the minimum requirements of this Code. Council may request a copy of the Professional Indemnity Insurance for particularly complex or high risk land.

viii. The Consent Holder's Representative may act as the geotechnical engineer where they meet the requirements below.

ix. The Consent Holder may not act as the geotechnical engineer.

x. It is expected that all development evaluation reports, geotechnical investigation reports or geotechnical completion reports relating to Category 1 and 2 landforms are internally peer reviewed by the company preparing the report. The peer review should be undertaken by someone with the appropriate expertise as the geotechnical engineer.

xi. All development evaluation reports, geotechnical investigation reports or geotechnical completion reports within a Category 1 area should be assessed for the following matters:

- Geomorphic features
- Historic land stability and landform processes
- Landform stability
- Engineering issues

In undertaking the assessment the expertise of both a geotechnical engineer and engineering geologist may be required to ensure a full understanding of the site is known.

Council may request that a peer review of the report be undertaken.

When a peer review is required Council will notify the Consent Holder's Representative in writing of the requirement and outline why the review has been requested.

Peer reviews will follow the process outlined in this section.

The cost of the peer review will be met by the Consent Holder.

xii. A lot which has specific geotechnical requirements may be approved subject to conditions which will be registered on the certificate of title by way of consent notice and the information relating to the requirement held within Council's Land Feature Management Module which forms part of the lot's property file.

xiii. The Resource Consent issued by Council for a subdivision may include a condition that a Geotechnical Completion Report and a certificate in a format similar to the one shown in this Code shall be submitted in respect of every lot/building site whether it as been affected by earthworks, contract civil works or not.

xiv. Where the Development Evaluation Report or supporting geotechnical advice recommends works to be undertaken to ensure the creation of safe building platforms, these works will form a condition of resource consent.

xv. Where it is proposed to locate designated safe building platforms within the 4:1 runout zone then these building platforms shall be protected by way of an earth bund. The earth bund must possess the bulk and geometry to absorb the impact of any upslope failure and effectively deflect away from or around the designated safe building platform. The earth bund shall be able to be accessed by machine for maintenance should this be required.

10A.3 Geotechnical Engineer

10A.3.1 Background

Site investigations for land development projects require the exercising of considerable geotechnical skills, experience and judgment depending on the nature and complexity of the project.

The nature of many of the soils and landforms in the Western Bay of Plenty District is very complex and often prone to slippage in extreme weather and other events.

In order to have confidence in the geotechnical assessments and designs that accompany an application for land subdivision Tauranga City and Western Bay of Plenty Councils have formed and administer a "Register" of approved geotechnical practitioners.

The register incorporates three levels of expertise based on the complexity of the landform matched to the relevant qualifications, training, experience in the Western Bay of Plenty environment and internal support network available to the practitioner within the company environment.

10A.3.2 Responsibilities

The role of the "geotechnical engineer" is as follows:

- Provide expert advice and supervision where land development involves undertaking bulk earthworks, the assessment of slope stability or bearing capacity, the detailed evaluation of the suitability of natural ground for the foundations of buildings, streets, services or other works.

- Ensure an appropriate site investigation and evaluation is undertaken to determine the geological model for the subject site, what effect the geology has on the proposed development and how to avoid, remedy or mitigate the issues found.

- Provide expert advice on the issues involved with development of land in complex geotechnical areas and how that land may be developed safely.

- Before construction commences review the drawings and specifications outlining the earthworks proposed and their design or other works required above, and submit, at the time of development plan approval, a written statement or report to the Council confirming that the proposed earthworks and/or works will be appropriate to manage the issues identified above and to provide safe completed landforms and building platforms.

- Before work commences and during construction to determine the extent of further specialist soils engineering services required (including investigation and geological work).

- Before and during construction determine and review the methods and frequency of construction control tests to be carried out, determine the reliability of the testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work.

- During construction provide regular inspection as deemed appropriate to certify the completed earthworks and landform as being suitable for building development and long term stability.

- On completion submit to Council the required geotechnical completion report and associated as-built plans.

- Ensure the investigation and evaluation of a site, earthwork design and reporting on the constructed and completed geotechnical landform and matters conform to this Code and Part 2 of NZS 4404.

10A.3.3 Three Tier Accreditation System

i. The three tiers that apply to a professional's ability to undertake geotechnical work within the region are:

Category 1 A Chartered Professional Engineer or Engineering Geologist who is acknowledged by the Accreditation Panel as possessing the appropriate qualifications, skills and relevant experience in the Western Bay of Plenty Region to provide advice on all geotechnical issues found within the region.

Category 2 A Chartered Professional Engineer or Engineering Geologist who is acknowledged by the Accreditation Panel as possessing appropriate qualifications, skills and relevant experience in the Western Bay of Plenty Region to provide advice on a limited number of less complex geotechnical issues found in the region.

Category 3 A Chartered Professional Engineer or an Engineering Geologist with an appropriate level of supervised work experience in a related field. Typically those professionally qualified and practicing engineers not listed on Tauranga City Council's Register.

ii. Admittance to either category 1 or category 2 status on the "Register" is by way of an interview by an independent panel of specialists (Accreditation Panel) convened by Tauranga City Council.

iii. Accreditation on the register is for a period of 5 years. At completion of the 5 year period the practitioner is required to be re-interviewed by the Accreditation Panel.

iv. A application fee is payable by the charged to the applicant for the accreditation process.

10A.3.4 Categories of Geotechnical Work for Development Evaluation and Geotechnical Reports

As a minimum the following are the various areas where the three different categories of engineer are required to be utilised.

Studies have been undertaken through parts of the Western Bay Region i.e. Tonkin and Taylor Ltd's work on the Minden and at Omokoroa. These other studies should be utilised as reference documents.

It is clear however from the above report that the 2:1 and 4:1 failure zones be utilised as a minimum for category definition in all parts of the Western Bay Region.

Category 1

- Where a building platform is proposed to be located within the 2H:1V upslope zone or the 4H:1V downslope zone. (Both sets of zones are defined on Council's GIS system for Tauranga City only).
- Where a building platform is proposed to be located within the 2H:1V and 3H:1V upslope zones but where combined with various other factors – i.e. relic geomorphic features.
- Where sites include possible slope movement feature with:
  - clearly or poorly defined headscarp
  - indications of recent or current instability, or
  - hummocky debris
- Where difficult settlement problems exist in either:
  - low lying areas
  - areas subject to old uncertified filling and/or horticultural fills, or
  - estuarine silts and compressible soils
- Seismic ground hazard including soil liquefaction and mitigation of effects
- Lateral spread issues
- Seepage issues from slopes of any height or slope angle
- Low strength soils

- Where a soakage method for stormwater disposal is proposed within the areas defined as "Specific Design" for stormwater disposal and/or within 150m of a relic geomorphic feature or from the outer extent of the displayed 2H:1V zone.
- Specific design of foundations where large depths/extents of compressible soils or uncertified / horticultural filling exist. ("large depths/extents" is defined as being greater than 4 m in depth).

Category 2

- Where a site exhibits no evidence of relic geomorphic features within or in close proximity to the proposed development, and
- Where proposed structures are to be located outside of the 2H:1V upslope and 4H:1V downslope zones.
- Areas not covered by Categories 1 or 3.
- Where a soakage method for stormwater disposal is proposed within the areas defined as "Specific Design" but is outside of the distance of 150m from a relic geomorphic feature or from the outer extent of the displayed 2H:1V zone.
- Specific design of foundations where limited extents of compressible soils or uncertified / horticultural filling exist. ("Limited" is defined as being in the order of 2 – 4 m in depth where the extent of poor bearing capacity soil is easily determined).

Category 3

- Minor soils work
- Proving bearing capacity for foundations not included in Category 1 or 2 areas
- Soakage reports where the surrounding ground stability does not need to be proven

10A.3.5 Landforms not Defined

Where a site lies within an area undefined by the three categories above then the developer shall request that Council confirm which category the site shall be managed under.

10A.3.6 Sites outside a Level of Expertise/ Professional Development

A practitioner may undertake work in a category one step above their classification by engaging an appropriately classified Category 1 practitioner to carry out a peer review on their investigation approach/report and completion report.

This provides a mechanism for a practitioner to demonstrate that they are suitably qualified and becoming experienced enough to be reclassified to the next level of expertise.

The following requirements apply:

Category 2 Practitioner to Category 1 Practitioner, or
Category 3 Practitioner to Category 2 Practitioner

i. A category 2 practitioner may undertake work on a Category 1 area subject to the following requirements:

- Prior to commencing any site investigation the practitioner engages a Category 1 practitioner as a peer reviewer. The peer reviewer undertakes a review of the methodology for the investigation and agrees the approach being proposed for the subject site. The site investigation is then undertaken in accordance with the agreed approach. Regular communication between the two practitioners shall be undertaken to ensure professional coaching about key findings, assumptions and approach occurs.
- The completed geotechnical report submitted to Council shall be peer reviewed by the nominated Category 1 practitioner who shall confirm the findings of the report as being appropriate.
- The cost for the peer review shall be met by the consent holder/developer.

ii. In special circumstances the Category 2 practitioner may seek approval to engage an appropriately qualified and experienced person who is not on the "Register" as the peer reviewer. Such application shall be made in writing to Council stating clearly the qualifications and experience of the proposed reviewer. Council's decision shall be final. It should be noted that approval will be given only in exceptional circumstances.

Peer Reviewer Costs

The peer reviewer costs shall be met by the consent holder/developer or their geotechnical practitioner.

10A.4 Peer Reviews

Where a peer review is required by Council or the accreditation process above the following shall requirements shall be met:

i. The peer review shall be undertaken by a Category 1 practitioner or an appropriately qualified and experienced person acceptable to Council. The peer review shall include the legal description and address of the site and clear reference to the report being peer reviewed.

ii. The peer review shall ensure the investigations, geological assumptions and conclusions, engineering modelling and analyses, including seismic and stormwater components, meet the requirements and intent of this Code.

iii. The peer reviewer may recommend or request additional investigations and/or analyses to clarify or confirm any concerns, and these shall be addressed by the practitioner in writing to both Council and the reviewer.

iv. The peer reviewer shall provide a written report to Council confirming the following:

- The advice provided in the report meets the requirements of this Code
- The report compiled has been compiled in accordance acceptable industry practice
- In general the peer reviewer agrees with the advice/recommendations/conclusions reached within the report
- Confirm that in the reviewer's opinion Council may rely on the advice/ recommendations/conclusions contained within the report when issuing further resource or building consents or PIMs and LIMs
- Any other pertinent matters.

v. The cost of peer review shall be met by the Consent Holder.

10A.5 Design of Earthworks and Observation of Construction

10A.5.1 Appoint Geotechnical Engineer

The Consent Holder's Representative shall appoint and retain a Geotechnical Engineer to design, supervise and certify all earthworks and landform development and undertake the responsibilities of the "geotechnical engineer".

10A.5.2 Requirements of the Earthworks Design

i. The following topics shall be included in the matters considered when designing the earthworks for a development:

- Completed landform gradients (reduction of overland flow velocity and concentration of overland flow).
- Permanent management of overland flow across landforms (contour drains, cut-off drains, formalised overland flowpaths not forming accessways etc).
- The place of man-made structures in the construction of safe landforms and building platforms.
- Debris protection devices.

ii. The design of earthworks shall be undertaken in accordance with this Code and shall take account of the requirements of NZS4402, NZS4404 and NZS4431.

iii. The design of the earthworks shall also take into account the requirements shown in the associated specification section of this Code relating to standards, supervision and inspection and general requirements.

iv. The following matters shall be included in the documentation provided with the application for engineering plan approval:

- The design parameters to be set for the fill materials
- The suitability of the on-site materials for placement as fill materials
- The method of placement of fill materials and the compaction methodology to be utilised to construct the fill
- The method to be used to measure for acceptability of the earthfill during construction
- Dust and erosion management measures
- A contour plan displaying existing and proposed landform contours
- Design certificate for earthworks design. See the drawings

10A.6 Geotechnical Completion Reports

10A.6.1 Compilation of the Geotechnical Completion Report

A geotechnical completion report shall be submitted to Council and shall address, as a minimum, the following:

a. **Purpose**

To report on all geotechnical aspects of the development after completion of the works with a view to recording:

- The construction methods, supervision and inspections undertaken and test results
- Additional investigations
- Statements of suitability of the land for building development for all lots

The emphasis of the report shall be on stating what occurred during construction, supported by detailed field notes, test results, and construction reports to provide an accurate detailed 'As Built' record of the development.

b. **Scope**

The report shall include:

- The earthworks design and fill parameters;
- Test results and extent of engineering supervision undertaken;
- Variations to the original earthworks design and specifications and why these occurred;
- Compaction plant and techniques employed ;
- Extent of certified and un-certified fill;
- 'As Built' drawings;
- The lot and deposited plan numbers covered by the contents of the report;
- Statement of Professional Opinion in a format similar to that shown in the Drawings;
- A lot summary sheet similar to that shown in the Drawings for inclusion on PIM reports;
- Any other comment or recommendations pertinent to individual lots or building platforms within the development; and
- The completed report should display how the requirements of the Development Evaluation Report, NZS4431 and the conditions of subdivision consent were met.

c. The report should include description of the earthworks, sufficient test results, site inspection data, and other information to enable an independent assessment to be made as to the suitability of the development from the report. i.e, the report should be a document that remains relevant for the life of the landform developed.

d. **'As Built' Drawings**

'As Built' drawings shall include:

- Site plan showing borehole and test positions
- Site plans showing:
  i. the lot boundaries as submitted to LINZ
  ii. a contour plan of the completed landform, displayed in 1m contours and in Moturiki Datum
  iii. the extent and depth of all certified and uncertified fills displayed in 1m contours and in Moturiki Datum
  iv. the positions of any Building Restriction Lines and all Designated Safe Building Platforms
  v. Extent, positions and depth of all permanent subsoil, contour, cut off drains, overland flowpaths etc
  vi. any other relevant engineering features

e. A lot summary report of the individual lots and safe building platforms in a format shown in the Drawings This summary report will detail subsurface data, foundation recommendations and comments for the individual building platforms established on each lot, topsoil depths etc. (This information will be used by Council to form part of each PIM/LIM report for individual building projects).

f. A summary of all recommendations/restrictions and/or conditions should be made within the summary sheet and geotechnical completion report.

g. A statement in a format similar to that shown in the Drawings shall be submitted.

h. Report Format:
All reports shall be submitted at the time of either building or resource consent or at the time of application for s224 as follows:

- 1 paper copy; and
- 1 electronic copy in "pdf" format

i. Plan Format:
As-built plans and final contour plans shall be submitted:

- in accordance with the requirements of this Code
- 1 electronic copy in Council's Digital Data Transfer Standard, and
- 1 electronic copy in "pdf" format

Council reserves the right to have any geotechnical completion reports peer reviewed if it deems this to be necessary. Council will notify the applicant and outline the reasons why this course of action has been undertaken.

Peer reviews will be undertaken in accordance with this Code.

10B. Natural Land Hazards

10B.1 Performance Criteria

i. Every lot shall contain a safe building platform suitable for the erection thereon of building types appropriate to the zoning of the land that is not subject to damage from a natural land feature.

ii. Works maybe required to be undertaken to ensure this criteria is met.

iii. The building platform shall be deemed safe when the performance criteria in the New Zealand Building Code are met.

10B.2 Minimum Requirements

i. All resource consent applications for subdivisions, multiple residential, industrial or commercial units or any other type of development that is the subject of a natural land feature which may cause damage to any proposed structures or buildings shall be accompanied by a development evaluation report that displays:

- The extent of the natural land hazard that exists on the site.
- The effect of the natural land hazard.
- How to avoid, remedy or mitigate the effects of the natural land feature so that any buildings or building platforms located on the subject site shall not be the subject of damage due to the land feature.

ii. Natural land features that need to be addressed by a Development Evaluation Report are:

- Land located below Council's known minimum building platform levels. (These levels are available from Council's Customer Service's Centres).
- Land that is displayed as requiring "specific design for stormwater disposal".
- Coastal flooding (storm wave run up).
- Coastal erosion.
- Harbour inundation not assessed as part of minimum building platform criteria above.
- Flood prone and stormwater sensitive land or land outside of Council's minimum building platform zones that has a known maximum flood level.
- Land possessing localised depressions that have no overland flow outlet.
- Land subject to overland flows.
- Sites where the intensification of development of the site creates an off site effect.
- Other.

iii. A suitably qualified and experienced person in the field of expertise of the specific land feature shall undertake a detailed investigation of the natural feature and provide advice/recommendations on the appropriate solutions to avoid remedy or mitigate the land feature.

The investigation and advice/recommendations shall be provided in the development evaluation report to ensure the above criteria is met.

iv. A site for which specific works are required to avoid, remedy or mitigate the effect of a natural land feature may be approved subject to conditions requiring that work to be undertaken and also restrictions which may be registered on the certificate of title for the land by way of a consent notice or covenant and recorded in Council's land management systems.

v. Any specified works required by the development evaluation report and/or resource consent shall be undertaken prior to the release of the s224 certificate or commencement of the activity or issue of code compliance for the structure.

10B.3 Natural Land Feature Completion Report

i. A natural land feature completion report shall be provided to Council and is required to cover, as a minimum, the following:

The report shall certify that the works required by the development evaluation report and/or the resource consent required to manage the effects of the natural land feature have been completed:

- In accordance with that advice provided in the development evaluation report and the resource consent.
- A statement of opinion that the land is now suitable for building development with respect to the natural land feature.
- Have effectively managed the issues relating to the natural land feature.
- Any recommendations or restrictions relating to the site.
- Any ongoing maintenance matters required undertaken to ensure the mitigation measures remain effective.
- Any other comment or recommendations pertinent to individual lots or building platforms within the development or their ongoing development .

Report Format:

All reports shall be submitted at the time of either building or resource consent or at the time of application for s224 as follows:

- 1 paper copy
- 1 electronic copy in "pdf" format

Plan Format:

As-built plans and final contour plans shall be submitted:

- In accordance with the requirements of DS 1 and this Code
- 1 electronic copy in Council's Digital Data Transfer Standard
- 1 electronic copy in "pdf" format

Council reserves the right to have any natural land feature completion reports peer reviewed if it deems this to be necessary. Council will notify the applicant and outline the reasons why this course of action has been undertaken.

Peer reviews will be undertaken in accordance with this Code.