

# **CHAPTER 2**

## **EARTHWORKS AND LAND STABILITY**



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### PART 1 GENERAL REQUIREMENTS

#### 2.1.1 INTRODUCTION

This chapter sets out the standards that are required to meet the performance criteria set out in the District Plan. It represents a preferred “Means of Compliance” with the District Plan and is the basis for all roading and infrastructure services work undertaken by or for Council.

It is acknowledged that the performance criteria in the District Plan may be achieved by adopting different design philosophies. If a Developer proposes to vary from this Design Guide then it is up to the Developer to prove that the performance criteria are met.

#### 2.1.2 EXISTING SERVICES

The Developer shall arrange for the searching of records to determine the existence and position of pipes, cables and other utilities on or about the site of the proposed works. The position or relocation of such utilities shall be taken into account when designing the works. Utilities shall include any permanent reference marks as defined in the regulations made under the Survey Act 1986 and which at any time have been set in the ground for the purposes of survey.

#### 2.1.3 HEALTH AND SAFETY

The developer shall give consideration during the design phase as to how the project will be constructed, so as to ensure that all aspects of the Health & Safety in Employment Act 1992 are fully complied with. The Developer shall also consider, and include all necessary information on how the work will be carried out in order to minimise the impact on the existing roading infrastructure.

## **PART 2      DESIGN REQUIREMENTS**

### **2.2.1      INTRODUCTION**

This part sets out the basic design requirements for earthworks that are to be carried out as a part of the development. Some construction information is included for completeness. Detailed information on construction standards is set out in Part 3 of this chapter.

### **2.2.2      STANDARDS**

The following NZ Standards shall be read concurrently with and apply to this section.

NZS 4431 : 1989 - "Code of Practice for Earth Fill for Residential Development".

NZS 4402 : 1986 - "Methods of Testing Soils for Residential Development"

### **2.2.3      SCOPE**

The requirements for the design of earthworks, or preparation for foundations, or both, include the following:

- The excavation and filling of land to form new contours
- The assessment and protection of slope stability
- The suitability of both natural and filled ground for the founding of roads, buildings, services and other works.

Because of the wide range of soil types, physical conditions and environmental factors to be found in different areas of the District, is not possible to lay down precise requirements which will be applicable in all cases. The criteria set out in this section will be subject to the judgement of the Developer's Representative, or the Soils Engineer.

### **2.2.4      TECHNICAL RESPONSIBILITIES**

Where any land development involves the carrying out of earthworks which require a Resource Consent, the assessment of slope stability, or the detailed evaluation of the suitability of natural ground for the foundations of buildings, roads, services or other works, then a Soils Engineer shall be appointed to carry out the following functions:

- Prior to detailed planning of any development, to undertake a site inspection and such investigations of sub-surface conditions as may be required
- Before work commences, to review the drawings and specifications defining the earthworks proposed, and submit a written report to the Engineer on foundation and stability aspects and any proposed departure from this Code and associated Standards
- 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, to determine 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

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- During construction to provide regular inspection (while a daily visit might be regarded as reasonable on earthwork construction on minor projects, inspection on a near full-time basis is often necessary for large projects)
- On completion to submit a written report to the Engineer attending to the compliance of the earthworks with these Standards and as to the suitability of the development for building construction.

The Developer's Representative may undertake the role of the Soils Engineer if he possesses suitable qualifications and experience.

The construction control testing shall be carried out by an organisation (preferably that of the Soils Engineer or under his control) with Telarc Registration in all relevant tests. (Minor testing using Scala Penetrometer or Pilcon Vane may be exempt from this requirement).

### **2.2.5 PRELIMINARY SITE EVALUATION**

Prior to any detailed planning or design, the Soils Engineer, where applicable, should undertake a preliminary evaluation of the general nature and character of the site in sufficient detail to determine the likely requirements for earthworks and/or the need for further investigations into the suitability of foundation conditions, and the stability of the natural ground. The preliminary evaluations should be carried out in the context of the total surroundings of the site and should not be influenced by details of land tenure, political or other boundary considerations. In simple cases, a visual appraisal may be sufficient, but in other cases, depending on the nature of the project, its locality, the scale of development proposed and individual site characteristics, particular attention may need to be given to the following matters.

### **2.2.6 SLOPE STABILITY**

Some natural slopes exist in a state of only marginal stability and relatively minor works such as trenching, excavation for roads or building platforms, removal of scrub and vegetation or the erection of buildings, can lead to failure.

Signs of instability include (but are not limited to) cracked or hummocky surfaces, crescent shaped depressions, crooked fences, trees or power poles leaning uphill or downhill, uneven road surfaces, swamps or wet ground in elevated positions, plants such as rushes growing on a slope and water seeping from the ground.

### **2.2.7 FOUNDATION STABILITY**

A study of the general topography of the site and its surroundings may indicate areas which have previously been built-up as a result of natural ground movement or by the deliberate placing of fill material. Unless such fill has been placed and compacted under proper control, long term differential settlement could occur causing damage to superimposed structures, roads, services or other development works.

### **2.2.8 SPECIALIST SERVICES**

Where a Soils Engineer has been appointed, that person shall submit to Council a written report setting out the particulars of any investigations carried out.

This shall include details of contours, natural features and modifications proposed thereto, and shall furnish to Council a statement of professional opinion as to the suitability of the land for its proposed use or subdivision with details of any special conditions that should be imposed. This statement is to be in the format given in Appendix 2.1 or 2.2.

## **PART 3 EARTHWORKS CONSTRUCTION**

### **2.3.1 GENERAL**

This part covers clearing, excavation, and fill operations, associated with all aspects of earthworks for subdivisions and developments.

### **2.3.2 STANDARDS**

Unless superseded by these specifications, the following standards shall apply:

NZS 4431 : 1989 - "Code of Practice for Earth Fill for Residential Development"  
TNZ Specification F/1 :- "Earthworks Construction"

### **2.3.3 PREPARATION FOR EARTHWORKS**

Before any earthworks are commenced, areas of cut and fill should be clearly defined. Where necessary, sufficient fencing or barriers should be provided around trees or other features which are to be retained or protected. All site activities including clearing, storage, cutting and filling must be kept away from the root zone of trees (best defined as the extent of the canopy). Adequate provision shall also be made for the control of erosion, surface water run-off and siltation. The following procedures shall be adhered to:

- Stripping shall be carried out as a specific operation with areas being stripped in large enough increments to ensure that there is an adequate margin of stripped ground beyond any current cutting or filling operation
- All stripped material shall be deposited in temporary stockpiles or permanent dumps, in locations where there is no possibility of the material being unintentionally covered by, or incorporated into, structural fills
- Where a fill is to be constructed on sloping ground, benches shall be cut into the ground to prevent the development of a continuous surface of low shear strength
- Pervious drains or similar subsoil seepage control systems shall be installed [where necessary] to lead seepage away from all springs and potential areas of ground water, under or adjacent to fills
- Subsoil drains shall be discharged via flexible jointed pipes to an outlet approved by the Engineer, preferably a stable water course or piped stormwater system
- The stripped ground surface shall be prepared and then inspected by the Soils Engineer before the commencement of fill placement.

### **2.3.4 FILL CONSTRUCTION**

The quality of fill material and the required testing shall be determined and specified before the placing of fill commences. Fill shall be placed in a systematic and uniform manner with near horizontal layers of uniform thickness [less than 225mm] of material being deposited and compacted progressively across the fill area.

Before any loose layer of fill is compacted, the water content of the fill should be suitable for the compaction required and as uniform as possible.

Any compacted layer which has deteriorated after an interruption in the earthmoving operation, shall be rectified before further material is placed over it.

Fill batter faces should be compacted as a separate operation, or alternatively, overfilled and cut back.

Where testing shows the compaction achieved in the field to be below the specified minimum, all material represented in the test shall be further compacted or removed as necessary. [Remediation measures specified by a Soils Engineer will be considered as an alternative to this method].

### **2.3.5 CONSTRUCTION MANAGEMENT PLAN**

Seven days prior to earthworks commencing on site, a management plan is to be submitted to the Engineer indicating the measures that will be applied in the event that site and weather conditions give rise to actual or potential adverse effects on adjoining properties brought about by the construction works.

The management plan shall describe the measures to be applied to minimise the effect of dust on adjoining properties, the intended sources of water, and named personnel to be contacted in the event of dust nuisances occurring. Earthworks shall not proceed until the consent holder's ability to control any dust nuisance has been demonstrated.

Due to the increased rate of run-off brought about by the denuding of the ground in mass earthworks, particular care shall be taken to control stormwater and to ensure that it is permitted free entry to stormwater culverts at all times. The developer shall be responsible for ensuring that adequate grids or similar approved traps are constructed and maintained during the construction period of the work, and until such time as the land becomes stabilised, to the satisfaction of the Engineer. Any of Council's stormwater infrastructures blocked or affected by silt shall be thoroughly cleaned by the developer or at the developer's expense.

Erosion and sediment control is to be carried out in accordance with Bay of Plenty Regional Council - Technical Report No 28- "Erosion and Sediment Control Guidelines for Earthworks".

The developer shall ensure that all erosion/sediment/stormwater controls are installed at all times during the works and afterwards where necessary, to the satisfaction of the Engineer. The developer shall carry out maintenance of erosion/sediment/stormwater controls where/when necessary and as directed by the Engineer or other authority.

Developers are also reminded of the requirements of the Regional Council with regard to excavation and the removal of ground cover. All necessary consents must be obtained prior to commencement of works.

### **2.3.6 INSPECTION AND QUALITY CONTROL**

The Soils Engineer shall provide an adequate level of inspection and testing in order to enable a proper evaluation of the general quality of the finished work and the furnishing of a report as to the compliance of the work with the specifications.



Visual inspection shall be made by the Soils Engineer at the following times:

- After any part of the existing ground has been stripped and prepared for the placing of fill
- After any drain has been installed and before the drain is covered by fill
- At such other times as the Soils Engineer considers necessary to enable the general standard of earthworks to be assessed.

During the construction of earth fills some or all of the following control tests should be made on the fill material:

- Tests to determine whether the moisture content is within the range for optimum compaction
- Insitu density tests to determine whether the degree of compaction is up to the specified minimum
- Where appropriate, tests to determine the maximum dry density for the soil tested in each insitu field density test
- Such other tests as may be specified by the Soils Engineer for control testing of fills or particular soil types. Such tests include shear strength tests, cone penetrometer tests and Proctor needle tests.

The locations of tests shall be decided by the Soils Engineer, who shall select them so as to test material likely to be furthest from the specified quality. In addition, a proportion of tests should be taken at random locations to check the average standard being obtained.

All field and laboratory test data should be recorded in a systematic manner that will allow the results to be identified and allow the calculations to be checked at a later date, if necessary. All control test results must have recorded the time, date, location and elevation. Test results relating to areas of fill that have been subsequently removed or reworked should be noted accordingly.

Where the volume of the fill does not exceed 50 cubic metres and the depth does not exceed 450mm, the requirements for testing as set out above will not be enforced.

### **2.3.7 NOISE CONTROLS**

The starting and operation of all earthmoving equipment shall be restricted to between the hours of 7.00 am and 7:00 pm Monday to Friday and 7:00 am to 12.00 am on Saturday. No earthmoving equipment shall be operated on Sundays and Public Holidays unless required for remedial or emergency works.

Construction equipment on the site shall be operated in a manner that ensures that the corrected noise level (based on  $L_{10}$  measurements) as measured at the boundary of any adjoining residential property does not exceed the levels as set out in NZS 6803 : 1999 - "Acoustics – Construction Noise"

The noise levels shall be measured and assessed in accordance with the requirements of NZS 6801 : 1991 - "Acoustics – Measurement of Sound", and NZS 6802 : 1991 - "Acoustics - Assessment of Environmental Sound".

The noise shall be measured with a sound level meter complying, at least, with IEC 60651 :- 1979 - "Sound Level Meters Type 2".

More restrictive hours or noise levels may be imposed as a result of the conditions of the Resource Consent.

To: The Engineer  
Whakatane District Council  
Private Bag 1002  
WHAKATANE 3120

**STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR  
SUBDIVISION**

<b>Subdivision:</b>	
<b>Owner/Developer:</b>	
<b>Location:</b>	

I, \_\_\_\_\_ of  
\_\_\_\_\_  
(Full name) (Name of Firm)  
\_\_\_\_\_  
(Address of Firm)

hereby confirm that:

1. I am a Chartered Professional Engineer who has pre-qualified with IPENZ with geotechnical accreditation and am experienced in the field of soils engineering and more particularly, land slope and foundation stability as applicable
2. I was retained by the owner/developer as the Soils Engineer on the above subdivision.
2. Site investigations have been carried out under my direction and are described in my report dated \_\_\_\_\_
3. I am aware of the details of the proposed scheme of subdivision and of the general nature of proposed engineering works as shown on the following drawings:  
\_\_\_\_\_  
(Insert reference to all drawings including dates of latest amendments)
4. In my professional opinion, not to be construed as a guarantee, I certify that the proposed works give due regard to land slope and foundation stability considerations and that the land is suitable for the proposed subdivision, provided that:
  - (a) \_\_\_\_\_
  - (b) \_\_\_\_\_
  - (c) \_\_\_\_\_
5. This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for further inspection during the course of the works.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_

To: The Engineer  
 Whakatane District Council  
 Private Bag 1002  
 WHAKATANE 3120

**STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR BUILDING DEVELOPMENT**

<b>Subdivision:</b>	
<b>Owner/Developer:</b>	
<b>Location:</b>	

I, \_\_\_\_\_ of \_\_\_\_\_  
 (Full name) (Name of Firm)  
 \_\_\_\_\_  
 (Address of Firm)

hereby confirm that:

1. I am a Chartered Professional Engineer who has pre-qualified with IPENZ with geotechnical accreditation and am experienced in the field of soils engineering.
2. I was retained by the owner/developer as the Soils Engineer on the above subdivision.
3. The extent of my inspections during construction, and the results of all tests carried out are described in my report dated \_\_\_\_\_
4. In my professional opinion, not to be construed as a guarantee, I certify that:
  - \*(a) That earth fills shown on the attached Plan No. \_\_\_\_\_ have been placed in compliance with the Code of Practice of the Whakatane District Council.
  - \*(b) The completed works give due regard to land slope and foundation stability considerations.
  - \*(c) The filled ground is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZ Building Act 1991 and NZ Building Regulations 1992, and related documents providing that:
    - (i) \_\_\_\_\_
    - (ii) \_\_\_\_\_
    - (iii) \_\_\_\_\_
  - \*(d) The original ground not affected by filling is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZ Building Act 2004 and NZ Building Regulations 1992, and related documents, providing that:
    - (i) \_\_\_\_\_
    - (ii) \_\_\_\_\_
    - (iii) \_\_\_\_\_
5. This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling.

**Signed:** \_\_\_\_\_

**Date:** \_\_\_\_\_