



# CS10 – Land Stability & Earthworks

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## CS10 Land Stability and Earthworks

### 10.1 Scope

The construction, supervision and testing of the earthworks shall be undertaken in accordance with the requirements of this section of the Development Code and in accordance with NZS4402, BZS4404 and NZS4431.

All earthworks shall be undertaken in a manner that ensures that nuisance is minimised and, where necessary, the effects are mitigated.

### 10.2 Definitions

Definitions are set out in Section 1 of the Development Code: Design, unless otherwise described.

Where the word “Contractor” or “Developer” is used below, it shall mean either work undertaken by the Consent Holder’s Representative (i.e. works undertaken by the Applicant) or Council’s appointed contractor (i.e. where works are undertaken by Council).

### 10.3 Related Documents

The following Drawings and other documents form part of this contract Document as listed:

Design Standard DS10:	Land Stability and Earthworks
Drawing Number: .....	Name: .....
Construction Standard DS10:	
???	

### 10.4 Materials

Materials shall be as listed in the appropriate section of the Development Code: Construction, or as defined in this document.



## **10.5 Supervision and Inspection**

### **10.5.1 Geotechnical Engineer**

The Geotechnical Engineer shall ensure an adequate level of supervision, inspection and testing is undertaken to ensure the proper evaluation of the quality of the finished work, make any corrective measures required and the associated rework and re-testing and compliance testing to enable the preparation and provision of the completion report as to the compliance with all specifications and reports.

It is the responsibility of the Consent Holder's Representative to ensure all compaction tests for bulk earthworks as required by the Geotechnical Engineer are undertaken.

## **10.6 General Requirements**

### **10.6.1 Application**

The requirements of this specification apply to the general earthworks involved in a development or a project. The compaction, filling and testing requirements apply to the general earthworks on the site. Where there are roads to be constructed the specifications for the road sub-base shall be those set out in section CS 4 Transportation of this Code.

### **10.6.2 Preparation for Earthworks**

Before any earthworks are commenced areas of cut and fill should be clearly defined.

The following general specifications shall apply to all earthworks:

- i. All rubbish, vegetation and debris shall be removed from earthworks areas prior to the commencement of topsoil stripping. Areas on which fill is to be placed, or from which cut material is to be removed, and haul road alignments shall be stripped of all topsoil and such other unsuitable soft or organic materials. Special care shall be taken to ensure that organic materials and areas of old uncompacted filling are not overlooked through being overlaid by other soils.
- ii. Any open-air burning of vegetation shall be supervised at all times and carried out in such a manner as to prevent smoke nuisance to neighbouring areas.

The burning of materials that may generate toxic emissions is prohibited.



Burning of vegetation can result in a large number of complaints to Council. Any costs resulting from abatement action carried out by Council will be charged to the Contractor or as a default, to the owner of the land.

- iii. 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 land beyond any current cutting or filling operation. Particular care shall be taken to ensure that overspill is not left in an uncompacted state anywhere on the site when constructing temporary haul roads.
- iv. 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, engineered fills.
- v. Where a fill abuts against sloping ground (greater than 3H: 1V), benches shall be cut into the ground to prevent the development of a continuous surface of low shear strength.
- vi. The perimeter of all sealed areas to be excavated shall be cut with suitable cutting equipment to a sufficient depth to ensure that the pavement and sealed surface outside the ripped or excavated area is not disturbed.
- vii. Pervious drains or similar subsoil seepage control systems shall be installed (as necessary) to lead seepage away from all springs and potential areas of ground water, tomors, or other voids, under or adjacent to fills in order to:
  - Prevent saturation of the fill before construction of the fill is completed.
  - Prevent internal erosion (piping).
  - Prevent internal ground water pressures which would detrimentally reduce shear strengths.
- viii. Subsoil drains should discharge via flexible jointed pipes to an outlet approved by the Geotechnical Engineer, preferably a stable watercourse or a piped stormwater system. The position of all subsoil drains shall be recorded on the "as-built" plans.
- ix. The stripped ground surface shall be prepared and then inspected by the Geotechnical Engineer before any fill is placed thereon. Confirmation of this inspection having occurred is required as part of the geotechnical completion report.

### **10.6.3 Protection of Trees or Other Features**

Where necessary, sufficient fencing or barriers should be provided around trees or other features that are required to be protected. Protection shall be in accordance with Construction Standard 2:



Streetscape. All site activities including clearing, storage, cutting and filling must be kept away from the root zone of trees (often defined as the extent of the canopy). If there is any doubt then the advice of an arboriculturalist shall be sought.

#### **10.6.4 Placement of Fills**

The method for placement of fills and the method of compaction shall be specified by the Geotechnical Engineer.

Fill material shall be placed in a systematic and uniform manner to the compaction standards and methods specified. Departures from the compaction standards and methods may only occur where approved by the Soils Engineer.

#### **10.6.5 Temporary Drainage and Erosion Control**

During the construction period, measures shall be taken to prevent excessive water-logging of surface materials yet to be excavated or compacted or both and to prevent fill material from being eroded and re-deposited at lower levels.

All dust, sediment, erosion control and temporary stormwater discharge shall be undertaken in accordance with Environment Bay of Plenty's "Erosion and Sediment Control for Land Disturbing Activities".

#### **10.6.6 Regional Consents**

Where required under the Regional Plan the developer shall obtain an earthworks consent from Environment Bay of Plenty and shall comply with all conditions specified in that consent. A copy of the consent shall be submitted to Council as part of the application for development or, if not available at that time, before any work commences on the site.

### **10.7 Compaction Requirements and Standards**

#### **10.7.1 Compaction Standards**

The minimum standard of compaction to be met for any fill material shall be as follows except where specified differently by the Geotechnical Engineer. The Geotechnical engineer shall specify means of compaction control, required standard and testing frequency. The means of compaction control shall generally be one of the options listed in NZS 4431.



Where the following criteria are not applicable for the materials encountered or being used, then the criteria to be adopted shall be those outlined in NZS 4431.

#### i. Cohesive Soils

The maximum dry density of the fill material shall be established using the standard compaction test presented in NZS4402.

For compaction tests a site specific optimum moisture content / dry density curve is required. After the curve has been established, then either:

- a. Fill material should be compacted to a minimum dry density which is not less than 95% of the value of the maximum dry density obtained in the laboratory sample; or
- b. The compacted fill material shall obtain minimum undrained shear strength of 150kPa and a maximum voids ratio of 10%. The shear strength of the fill material shall be determined using a hand shear vane test as prescribed in the New Zealand Geotechnical Society Guidelines. The use of scala penetrometer results to measure shear strength in cohesive soils will not be accepted.

**Note:** Steps should be taken to ensure that cohesive fills are not too wet or over-compacted to such an extent that “weaving” of the fill occurs.

#### ii. Cohesionless Soils

The maximum and minimum dry densities shall be obtained from laboratory testing as prescribed in NZS4402. Then either:

- a. The dry density of the fill material is expressed as a relative density in terms of the laboratory tests. This can be done by using a Scala Penetrometer calibrated adjacent to a test bed as follows:
  - Prior to commencement of earthworks establish the dry density of the cohesionless soil.
  - After completion of a portion of the earthworks prepare a test bed and re-measure the dry density and establish the percentage compaction.
  - The Scala penetrometer can then be calibrated adjacent to the test bed and using test results.

**Notes:**

- This test should not be used as a substitute for the maximum density and percentage compaction tests unless they are correctly calibrated.
- This method is for use on cohesionless soils only.
- Monitoring of dry density by using a Clegg Hammer can also provide acceptable results if calibrated in a similar manner.



Or:

- b. The dry density of the compacted fill material shall not be less than 95% of the maximum dry density from the standard compaction test of the fill material obtained from testing required by NZS4402.

### 10.7.2 Density Acceptance Criteria

The minimum acceptance criteria for test results shall be as follows:

- For less than 10 tests
- All tests shall meet or exceed the specified minimum standard
- For more than 10 tests
- The average of 10 consecutive tests shall exceed the specified minimum standard
- Only 1 test / 10 test results may be less than 90% of the minimum standard

## 10.8 Fill Testing Requirements

Fills shall be tested in accordance with these specifications or with the particular specifications where applicable:

- i. For fills of volume  $<10,000\text{m}^3$ 
  - 1 set of tests for every 750mm lift of fill
  - 1 set of tests for every  $800\text{m}^3$  of fill.

Or

- ii. For fills of volume  $>10,000\text{m}^3$  and  $<50,000\text{m}^3$ 
  - 1 set of tests for every 1.5m lift of fill
  - 1 set of tests for every  $4,000\text{m}^3$  of fill

The frequency of testing shall be increased above the minimum specified where the following apply:

- For the final layer of fill of not less than 1.0m depth the minimum frequency of tests shall be 3 sets of tests for every  $3,000\text{m}^3$ .
- When relatively small volumes of fill are concentrated in localised areas and placed discontinuously over an extended period of time the Soils Engineer shall specify the revised frequency.

All tests of fills shall be as prescribed in NZS4402.