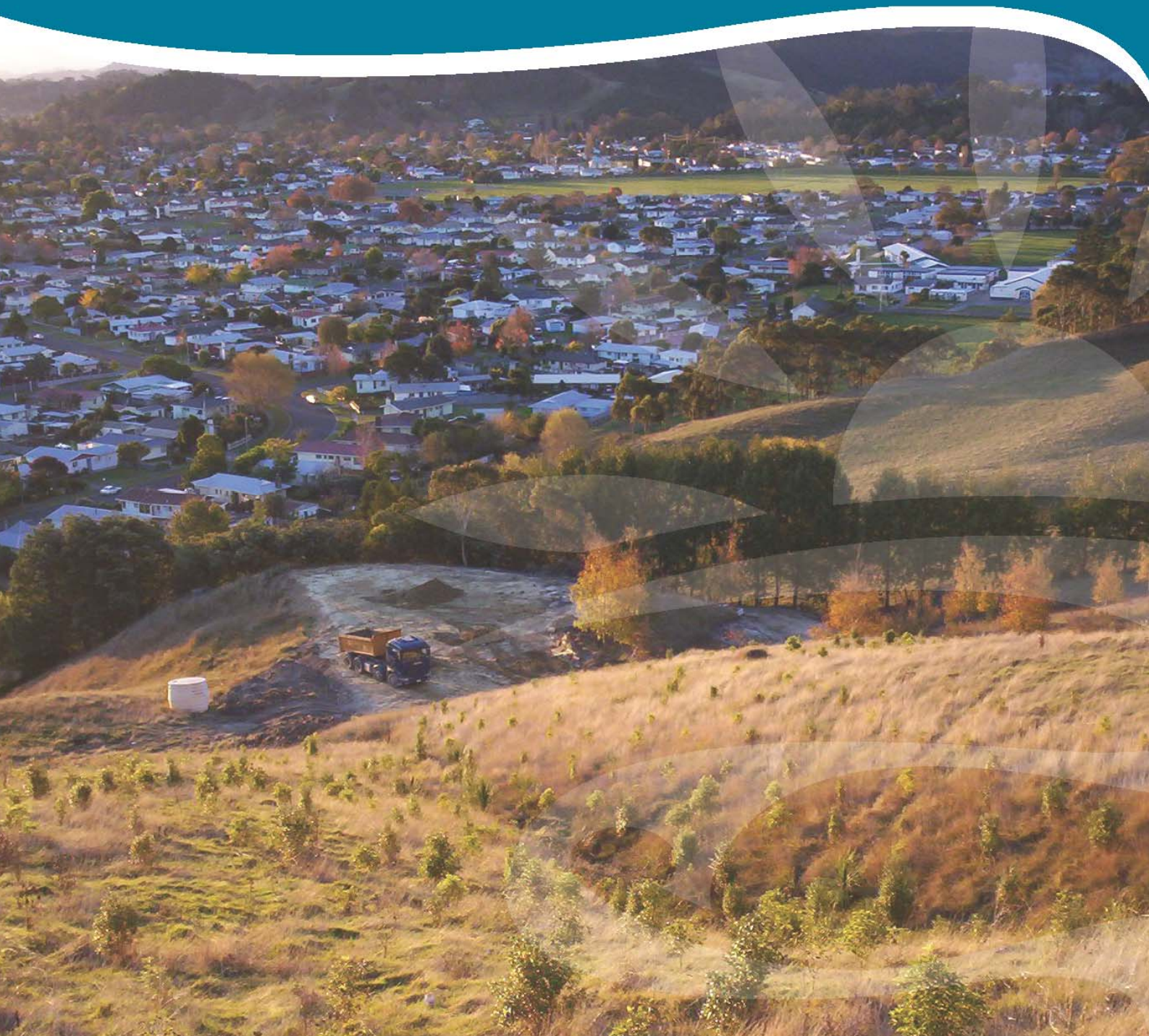


# Bearing Capacity and Geotechnical Investigation Requirements for Buildings

New Zealand Building Code Requirements

November 2011



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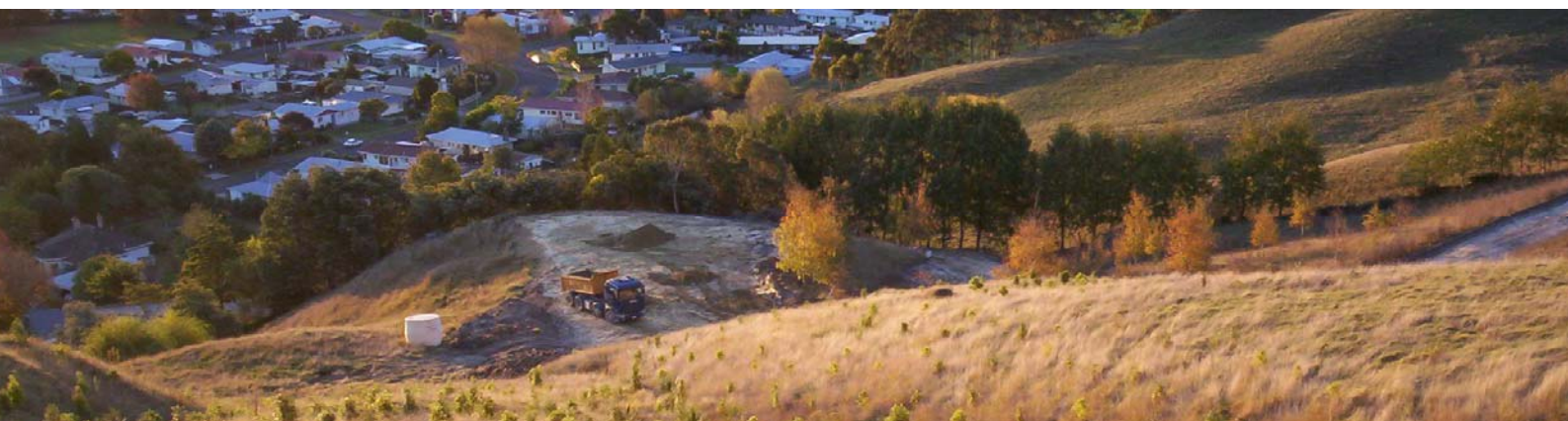
Requirements outlined in this pamphlet are intended to apply generally to buildings (up to 2 storeys high) such as domestic dwellings, and most residential and most commercial/industrial buildings.

**Please Note:** Gisborne District Council reserves the right to request further information for any building irrespective of the following requirements, depending on the nature of the site and building.

### Contact:

Gisborne District Council  
Building Services or Soil Conservation

PHONE: (06) 867-2049 • FREEPHONE: 0800 653 800 • FAX (06) 867-8076 •  
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## INTRODUCTION

New Zealand Standard 3604 – Light Timber Framed Buildings requires a ground ‘strength’ of 100kpa for foundation support, termed ‘good ground’ in the standard. Potentially compressible ground, expansive soils/shrink-swell soils and ground that can experience more than 25mm of movement is excluded from the definition of good ground. Ground ‘strength’, usually termed ‘bearing capacity’, is required so that buildings are supported adequately and don’t suffer differential settlement through their lifespan. Differential settlement is when one end or part of a building sinks more than the other, leading to uneven or cracked floors. Commercial buildings, whether large or small, require the same consideration. Most engineers will qualify this on their producer statements (a document which guarantees their work) with the assumption of 100kpa or ‘good ground’. If the ground does not meet the 100kpa requirement the building will require specific foundation design, usually deeper and/or bigger foundations. There is little ‘good ground’ in the Gisborne region and as a consequence testing is required on all sites.

## RECENT SUBDIVISIONS

If you are intending to build on land which has recently been part of a subdivision, check to see if a ***‘Consent Notice’*** is on the ***Certificate of Title***. A ***‘Consent Notice’*** may dictate the level of subsurface investigations and instability remedial measures required at the building consent stage. Alternatively, ‘advice notes’ on the subdivision consent may give an indication of the level of testing required. The Council’s Development Control Planners can help you with identifying consent notices.

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## GROUND BEARING CAPACITY

The minimum investigation required by Council involves testing the bearing capacity of the supporting ground beneath a proposed building. This must be undertaken by a **suitably qualified professional**, approved by the Council, prior to designing the foundations. The method of testing varies depending on the subsurface conditions. For example if it is a sandy soil as in the Te Hapara area a 'penetrometer' is used, or a clay soil like that found in Kaiti a 'shear vane' is used. The type of ground and its bearing capacity determines the foundation requirements.

Generally, if the ground beneath your proposed building has an 'allowable bearing' pressure of 100kPa, as required by the Building Code, then foundations can be constructed in accordance with NZS3604:2011. This means they can be constructed without the need for specific engineering design.

However, where the 'allowable ground-bearing capacity' is less than 100kPa OR the ground consists of expansive soils (shrink – swell), soft soils (clays) or loose gravels, the foundations (*not necessarily the remainder of the building*) must be specifically engineer designed.

For areas and/or buildings where liquefaction or lateral spreading testing is required, electronic cone penetrometer tests (CPT's) are necessary, and foundations will be required to be designed to allow for any settlement or lateral spreading.

## BUILDINGS NEEDING SITE INVESTIGATIONS

### Residential buildings

The following buildings will require subsurface investigations:

- ▶ All new habitable buildings (including sleep outs)

- ▶ All relocated houses
- ▶ Substantial additions > 50% of original area
- ▶ Large (generally over 110m<sup>2</sup>) ancillary buildings (sheds, garages etc). See exemptions for pole sheds.
- ▶ All buildings in **areas of natural hazards**, including sheds, garages, retaining walls with surcharges and swimming pools. Areas of natural hazard include (but are not limited to):
  - On or at the base of sloping land or on ridge tops.
  - Mangatuna Formation geology (commonly found in hills around the District).
  - Fill material.
  - Coastal environment.
  - Wheatstone Road/Sponge Bay area.
  - Te Puia landslide.
  - Adjacent to watercourses, drains or rivers.
  - Areas with high or moderate liquefaction potential.
- ▶ **Note:** Two storey buildings on sand soils will require liquefaction analysis.

## Requirements:

### a) Flat Sites

On a generally flat site, a '**Geotechnical Bearing Capacity Report**' **MUST** be submitted as part of the building consent application. This report must be prepared by a suitably qualified professional and contain:

1. A site plan (to scale) showing the position of the proposed building 'on the lot' and accurate locations of the investigation sites (re-siting of the building may require a whole new series of investigations).

2. Auger profiles and ground bearing capacity test results (see specifications below).
3. A description of the landscape and an interpretation of the results, including recommendation for bearing capacity plus depth of good-ground and reasoning how this was derived. Confirmation that the potential for differential (uneven) settlement and liquefaction is either a low or high risk and mitigation measures must also be included.
4. Recommendations for any foundation design (engineered) requirements i.e. for clays, expansive soils or loose gravels or due to low bearing capacity.

**b) Areas of natural hazards**

A detailed **'Geotechnical Report'** **MUST** be included with a building consent application where a proposed building site is to be located:

- ▶ On or at the base of sloping land (including ridge tops).
- ▶ In close vicinity to a watercourse, drains or rivers.
- ▶ On fill material.
- ▶ In an area of natural hazard (see above).

The investigations and report must be undertaken by a suitably qualified professional with appropriate geotechnical experience, such as an engineering geologist or geological engineer. The report shall include the requirements outlined for “flat sites” and include stability analysis and recommendations for appropriate foundation design and development options (stability measures). Council can supply the minimum requirements of a detailed geotechnical investigation and report.

**Exemptions**

Ancillary buildings less than 110m<sup>2</sup> and pole sheds with dirt floors that have engineer designed foundations will be assessed by

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Council on a case by case basis depending on location and proposed use.

For ***Small to Medium Additions*** to an existing building, which shows no sign of previous movement and depending on location, it may be possible to construct the foundations to the same dimensions as the existing foundations or to that required by the New Zealand Standard – NZS3604:2011 *Timber Framed Buildings* NZS3604 whichever is the greater, without the need for subsurface investigations.

### **Commercial/industrial buildings needing site investigations**

In addition to the requirements for residential buildings (bearing strength and stability analysis), all building consents for commercial/industrial buildings greater than 110m<sup>2</sup> and all tilt slab buildings regardless of size, shall include liquefaction testing in the form of electronic cone penetrometer tests (CPT's) and, if required, engineer designed foundations or mitigation measures to account for settlement or movements (lateral spreading). Commercial/industrial buildings (not including tilt slab) less than 110m<sup>2</sup> shall be in accordance with the same requirements as residential buildings.

**Note:** Allowance for consolidation settlement of soils from building loading and floor loadings shall be considered in the foundation/floor slab design for all industrial/commercial buildings.

### **Exemptions**

- Pole sheds without concrete floor.
- Pole sheds with concrete floor but not attached to foundation.

- Portal frame tin sheds <math> < 401\text{m}^2 </math> (this does not apply to any tilt panel buildings).

## TESTING SPECIFICATIONS

1. If your building platform is  $200\text{m}^2$  or less and generally rectangular in shape:
    - Five auger holes and five ground-bearing capacity tests
    - One in each corner of the building platform and one in the centre.
  2. To a minimum depth of:
    - a) 2m below the underside of the proposed strip or bored pile footings; or
    - b) 600mm beneath short driven timber piles or 2m in depth, whichever is the deeper; or
    - c) until refusal (justification for refusal must be given).
- Note:** Where foundation depth may need to be deeper than the required testing depth, testing will need to be extended to allow for this.
3. A penetrometer must be used in sandy soils and a shear vane in cohesive, expansive or clay soils. Shear vane readings are to be taken every 200mm in depth in each bore.
  4. If the building platform is greater than  $200\text{m}^2$  or an irregular shape additional test(s) will be required - 1 extra test site per additional  $50\text{m}^2$ .

## ENGINEER DESIGN SOLUTIONS

Where the ground-bearing capacity does not meet the requirements for NZS3604, i.e. allowable bearing of 100kpa, or if the ground consists

of clays, expansive soils or loose gravels, highly liquefiable soils, or if slope stability remedial measures are required then the foundations and any remedial measures (e.g. a retaining wall) must be designed by a suitably qualified engineer or suitably qualified person with at least an NZCE [Civil] and/or REA [Civil]).

The consulting engineer is also required to give a professional guarantee through a 'Producer Statement' (PS1) which must also be supplied with the building consent application.

## **ASSOCIATED EARTHWORKS**

Depending on the location of your proposed building site you may require earthworks (cut and fill) to form the building platform and associated areas. This may trigger a requirement for a building consent for 'site works' or resource consent for land disturbance, particularly if you are on a hill slope. Please contact the Soil Conservation Section of Council if earthworks are required as part of the development. Resource Consents for land disturbance are issued by the Soil Conservation Section of Council. In some cases when a land disturbance consent is not required you may still require a building consent before undertaking any earthworks. **Please ask first.**

## **Definitions**

**Liquefaction:** This is the process where a saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid. This process is most often observed in saturated, loose (low density or uncompacted) sandy soils.

Areas susceptible are often found along riverbeds, beaches, dunes and areas where windblown silt and sand have accumulated.

**Liquefaction-induced Lateral Spreading:** Lateral displacement of gently sloping ground as a result of liquefaction during an earthquake. Affects areas in close proximity to rivers and streams. The displacement appears as parallel cracks and the surface of the land can drop.

**Differential Settlement:** Uneven, downward movement of the foundation of a structure, usually caused by varying soil or loading conditions and resulting in cracks and distortions in the foundation.

**Cone Penetrometer Test (CPT):** CPT is an in-situ testing method used to determine the geotechnical engineering properties of soils, delineating soil stratigraphy and gather pore water pressure data. CPT data is used for determining liquefaction and lateral spreading potential.

**Slope Stability:** Defined as the resistance of an inclined surface to failure by sliding or collapsing. The main objectives of slope stability analysis are finding endangered areas, investigation of potential failure mechanisms, determination of the slope sensitivity to different triggering mechanisms, and designing possible remedial measures, e.g. barriers, stabilisation and building setbacks restriction.

**PLEASE NOTE:** Gisborne District Council reserves the right to seek independent peer review of any Building Consent application at the owner/client expense.

**If you require further information we recommend you contact Building Services or Soil Conservation staff before committing to any major project.**

**Contact:**

Gisborne District Council

Building Services or Soil Conservation

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