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Queenstown Commercial Limited
PO Box 15084
Tauranga

Attention: Brent Mitchell

Sanderson Development – Kawarau Heights
Preliminary Review - Residential Building Foundations

1 Introduction

As requested, this letter has been provided to provide a summary and review of the foundation options for residential buildings in the Kawarau Heights residential development.

2 Ground Soil Conditions

In the ground conditions present at the site are not unusual in the Queenstown area. Across the subdivision the ground conditions are relatively consistent and comprise:

- 0.15 to 0.5 m of Topsoil, overlying.
- 0.6 to 1.6 m of Loess, overlying;
- Deltaic Silt, Sand and Gravel, which extend to depths of many metres.

The loess materials directly underlie the topsoil and are described as a “firm silt,” however can be “Stiff” were they are drier. Beneath the loess, deltaic materials (sand and gravels) are present and are typically described as “loose” or “medium dense.”

3 Foundation Discussion

Once topsoil has been removed from beneath the building footprint, as per requirements of the Building Code (required for any home in New Zealand regardless of where the site is located), loess material will be present at typical foundation depths.

Loess materials are weaker than “good ground” as described in NZS3604 and standard foundations constructed as per this standard will not be suitable. Specific foundation design will therefore be required and well-established foundation options are available, as outlined below.

4 Foundation Options

The following three options are commonly used across the Queenstown Lakes District. Your architect and engineer will determine which is best for your type of build during the design process. Specific engineering design will be required, however, the ground conditions present at the site are not unusual in the Queenstown area and well-established foundation options are available, as outlined below.

4.1 Waffle Raft

Waffle rafts e.g. Max Raft of Rib raft, are commonly used. These types of foundation systems can cope with reduced ground strengths and are frequently constructed with a layer of granular fill underneath to provide a suitable base for construction. Minimum gravel fill depths of approximately 400 mm beneath foundation areas will be sufficient to allow a standard waffle raft to be constructed.

Figure 1 below shows a typical Waffle raft solution, note the 400 mm is approximate only and final depths will require confirmation by specific testing on a lot-by-lot basis.

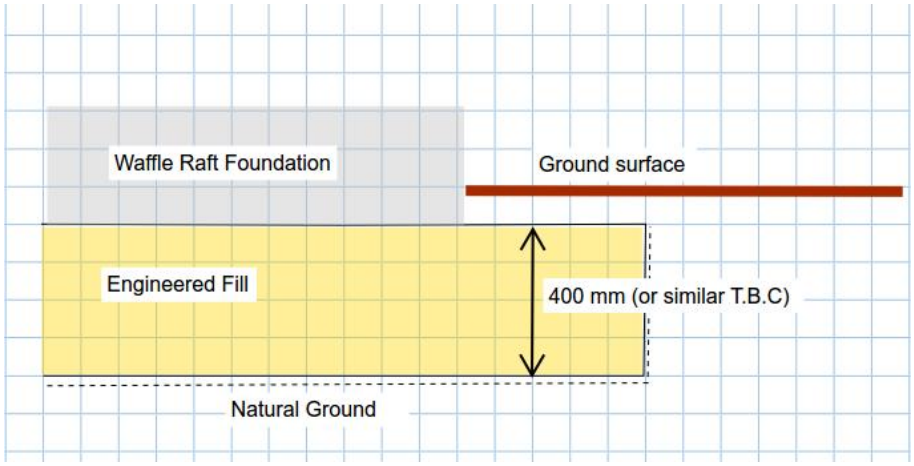

Figure 1. Schematic cross-section showing a typical waffle raft solution with engineered fill.

Suitable gravel materials to form the engineered fill layer are available locally.

4.2 Strip and Pad Foundations

For strip and pad foundations local excavation, approximately 0.3 m depth under foundation areas (to be confirmed on a lot-by-lot basis), assuming a 0.4m embedment, will provide good bearing.

Note the key difference between the waffle raft and the strip and pad foundation is that, for the waffle raft, the entire building footprint area is excavated to depths of 400 mm (approximate) and replaced with engineered fill, whereas only the foundation areas and key structural locations below the floor are excavated and filled in the “strip and pad foundation” method.

As for the waffle raft, suitable locally sourced gravels are available for the engineered fill.

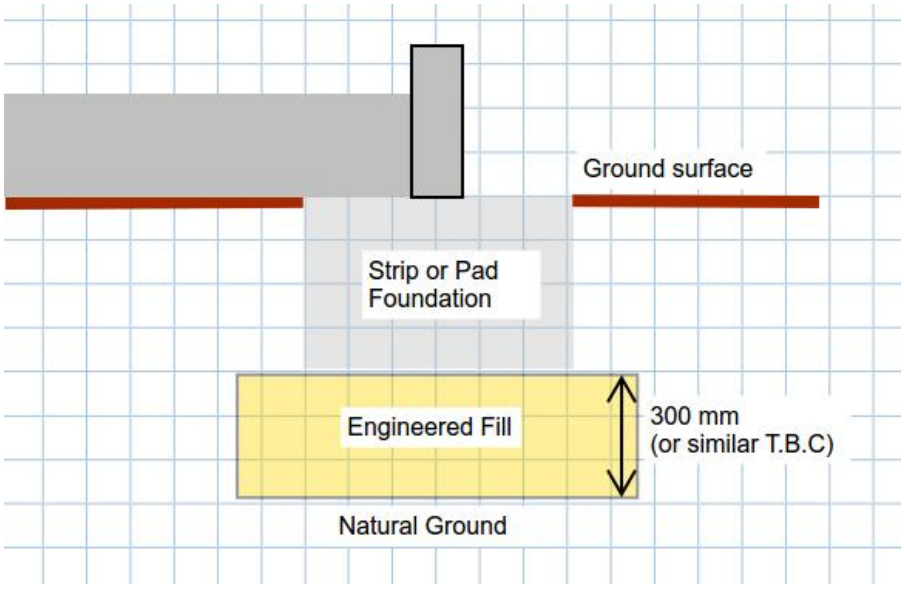

Figure 2. Schematic cross-section showing a typical strip footing solution using engineered fill.

All engineered fill beneath foundation areas will need to be constructed in accordance with NZS4431. The standard requires the fill to be to be compacted and density tested to ensure it meets the correct design criteria.

4.3 Timber Pile Foundations

Other foundation options, such as timber piles, will be suitable and the ground is well suited for this type of solution. It is expected that pile lengths and spacing will need to be adjusted for the ground conditions which will need to be confirmed on a lot-by-lot basis.

5 Slope Stability.

Lots located on the eastern side of the subdivision will need to consider the stability of the adjacent slope. The lot numbers affected are 1 to 3 and 6 to 24 inclusive. Drawings completed by Paterson Pitts Group, provided separately, identify a set-back zone from the slope crest. Construction outside of this zone will not require slope stability to be considered. Construction in the zone will require slope stability to be considered. For buildings in the zone additional foundation engineering, and associated costs, may be required in some cases to ensure long term stability, e.g. for the seismic case, is acceptable. As a general rule, the further into the zone and nearer the crest of the slope the building is, then the more engineering and costs will be required to ensure the performance of the building is acceptable.

6 Summary

In summary, the general soil conditions are not suitable for standard foundation construction and specific engineering design will be required. However, the ground conditions are not uncommon in Queenstown and readily available foundation solutions

are available. For lots 1-3 and 6-24 a zone at the slope crest defines an area that if encroached by future building, slope stability will require consideration, and additional engineering is expected to be required in most cases.

7 Applicability

This report has been prepared for the benefit of Queenstown Commercial Limited with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Yours faithfully,

Paul Faulkner
Senior Engineering Geologist