



What are reinforced soil-cement rafts?

Reinforced soil-cement rafts involve the construction of a 1.2m thick compacted crust made of cement-stabilised soil with reinforcing mesh called a geogrid.

Once constructed the raft provides a stable platform to build a house. These rafts can be used in areas vulnerable to liquefaction. The platform is designed to reduce the effects of liquefaction in a future earthquake.

Reinforced soil-cement rafts can only be constructed on land clear of buildings.

How do reinforced soil-cement rafts work?

Reinforced soil-cement rafts are designed to limit the consequences of liquefaction. They are designed to be stiff enough to limit undulations, tilt and uneven ground surface subsidence, therefore reducing damage to house foundations. A raft will also prevent the ejection of soils beneath the house foundations when the underlying soils are liquefied from earthquake shaking, therefore reducing the likelihood of localised ground surface subsidence.

How are reinforced soil-cement rafts constructed?

To form a reinforced soil-cement raft, soil is excavated to a minimum depth of 1.2m. Excavated topsoil is usually kept and later spread across other parts of the site, as it is unsuitable for cement stabilisation. The excavated suitable

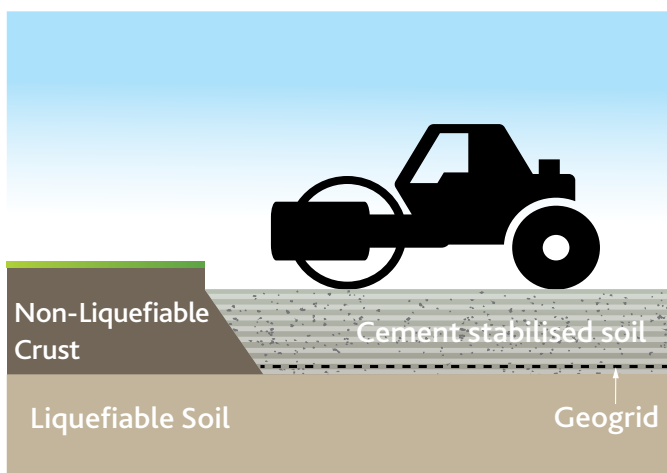
soil is progressively mixed with approximately 8% cement (by weight). This has traditionally been done using a machine called a pug mill but has also recently been done using a rotovated soil mixing method.

A pug mill is a specialist machine that mixes soil and cement, however, it is relatively expensive and often too large for use in residential areas. It is commonly used on commercial or road construction projects.

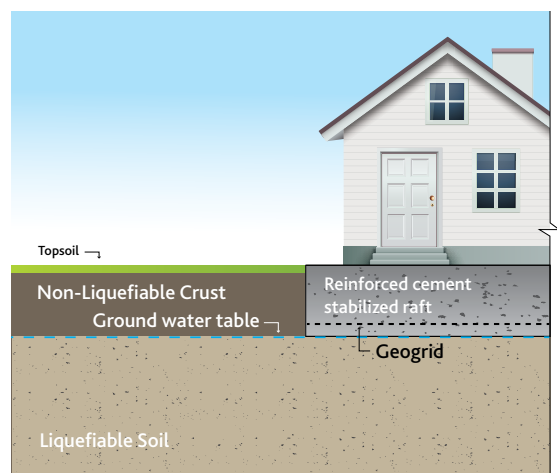
Rotovated soil mixing was trialed in the Ground Improvement Pilot Project. Rotovated soil mixing uses a small tractor with a rotovator (like a rotary hoe) attachment to mix cement spread on the ground into layers of placed soil.

To construct the raft, a layer of soil (typically no more than 200mm thick) is mixed and spread around the base of the excavated area and a roller compactor is used to compact the soil-cement mixture. Near the base of the raft one or two layers of geogrid are rolled out across the raft at different depths. Additional soil-cement layers are then put over the top and compacted to the ground surface.

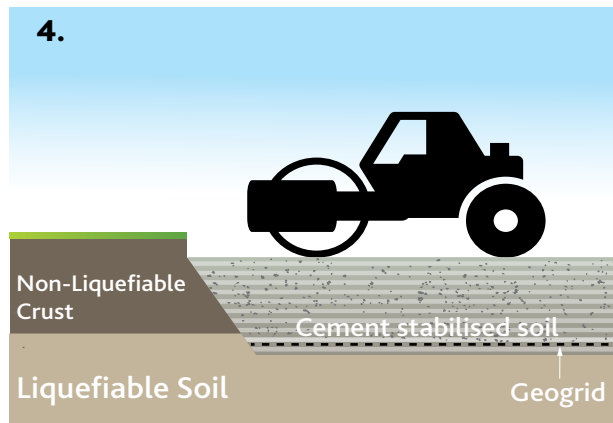
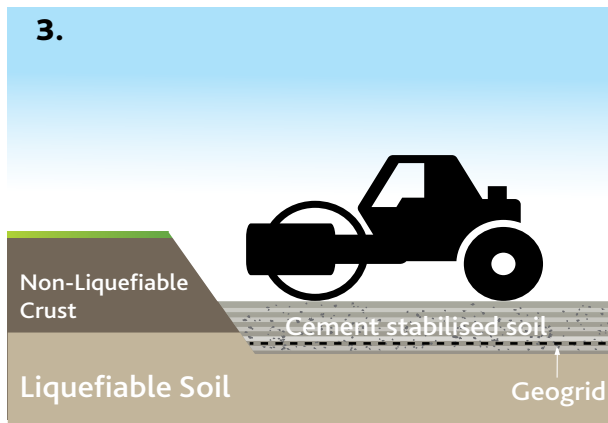
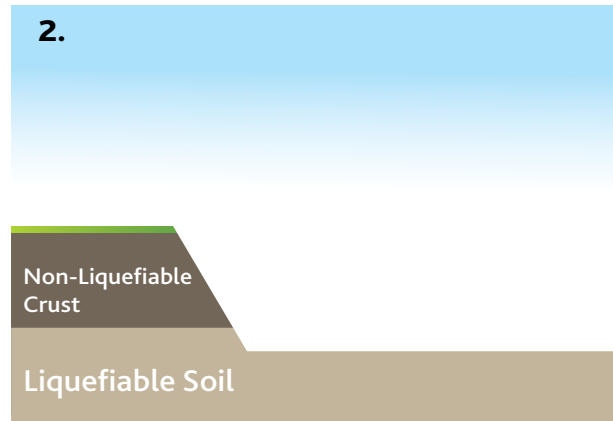
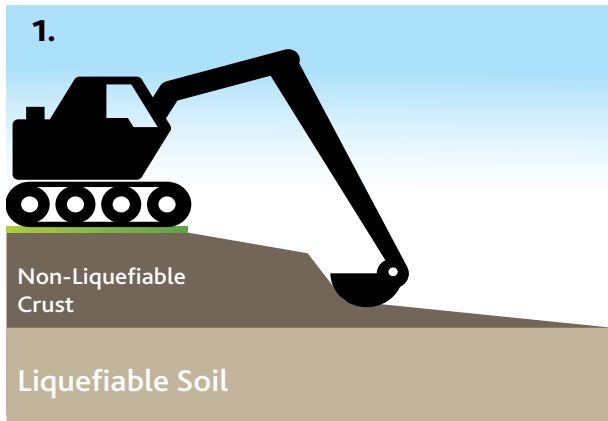
Construction in wet weather should generally be avoided, particularly when working at the upper layers of the raft. Delays from surface water ponding can result from heavy rainfall.



Soil-Cement Raft under construction



A Soil-Cement Raft beneath a rebuilt house



Soil-cement raft construction

What soils suit reinforced soil-cement rafts?

Reinforced soil-cement rafts are generally suitable for most soils found in Canterbury, including silts and sands. However, very weak and highly-compressible peat/organic soils are unsuitable for cement stabilisation or for founding a raft on. These unsuitable soils may be disposed of and more suitable soil for cement stabilisation used. An advantage of these rafts is that they can be used in areas with lateral spread vulnerability.

What about in-situ mixing?

An alternative method for constructing soil-cement rafts is 'in-situ mixing'. This method uses specialised machinery to mix cement into 'in-situ' soil, without having to excavate the soil.

The strength of a mixed in-situ raft relies almost entirely on the binding effect of the cement. The soil is not compacted (like it is in a mixed ex-situ raft) and does not have any installed geogrid. For this reason an in-situ mixed raft needs more cement and needs to be thicker (2m deep) to offset the expected lower strength/consistency. Experience has shown that high level of quality control is required to construct rafts with suitably well-mixed soil to the required strengths and consistency.



A pug mill as sometimes used to mix soil and cement together



A small tractor and rotovator attachment used to mix cement with soil



In-situ cement stabilisation