



What are Horizontal Soil Mixed (HSM) beams?

Horizontal Soil Mixed (HSM) beams are made from the soil present under an existing house and introduced grout (a mixture of water and cement) which is mechanically mixed together, creating cylindrical-shaped, horizontal beams of cement-stabilised soil.

How do HSM beams improve the ground?

HSM beams are significantly stiffer and stronger than the natural ground that surrounds them. The beams are constructed at the uppermost ground elevation where there is liquefiable soil, typically near to the groundwater surface. The HSM beams are non-liquefiable and do not lose their strength during earthquake shaking. Testing has shown that at lower and moderate levels of shaking, the soil between the beams also does not liquefy. The net result is that the house has a thicker and stiffer 'crust' of non-liquefying soil to support it during an earthquake. This means the improved ground and house foundations are likely to suffer less damage during earthquakes.

Testing showed that a double row of beams provided significantly better protection against uneven ground surface subsidence than a single row of beams.

By preventing liquefied soils ejecting from the ground, the likelihood of localised ground surface depressions occurring is reduced. Such localised depressions can cause damage to house foundations.

HSM beams decrease the vulnerability of the existing building to liquefaction-related damage. However, in the event that future building work is done for an extension or rebuilding of the existing house, further assessment and work may be required to ensure resilience of the extension or new building to liquefaction-related damage.

How are HSM beams constructed?

To construct an HSM beam, directional drilling equipment is used to pilot a horizontal borehole beneath an existing house. This equipment 'day-lights' in a receiving trench on the opposite side of the house.

A 500mm diameter mixing tool is then attached to the end of the drill. This is progressively dragged back along the alignment of the horizontal borehole. Grout is pumped through the drill rods to the mixing tool, which mixes grout into the surrounding soil.

This process leaves a horizontal beam of cement-stabilised soil in the ground. The beam-formation process is repeated to make layers of HSM beams below the house.

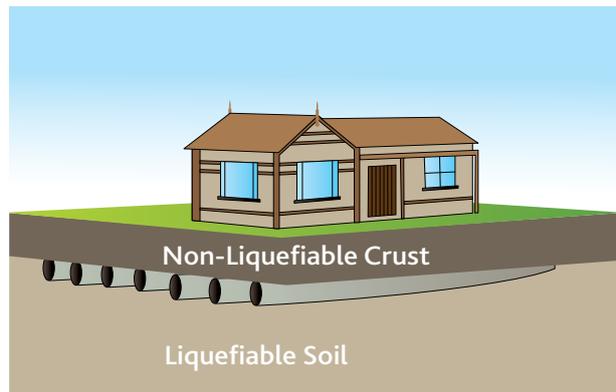
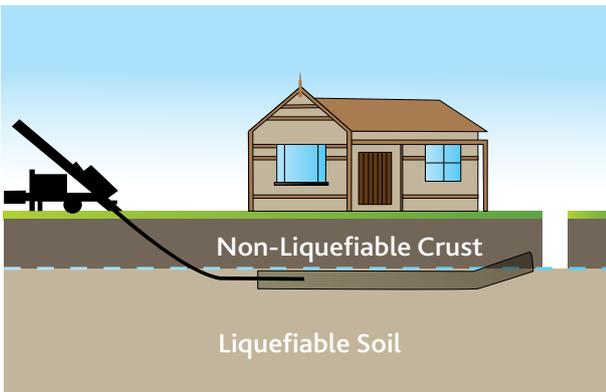
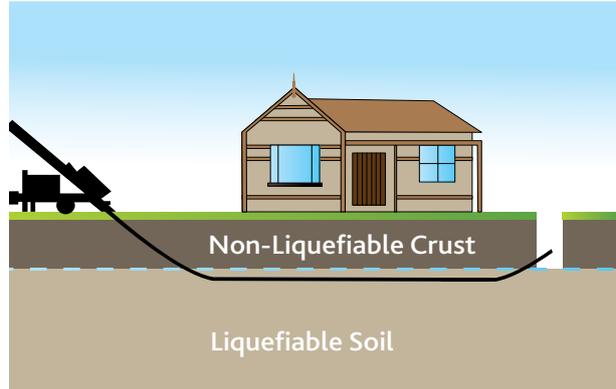
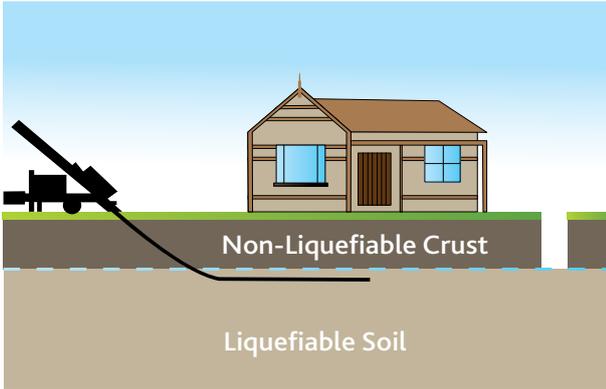
What soils suit HSM beams?

HSM beams can be constructed in silty and sandy soils but not in peat/organic soils. Construction of HSM beams in gravels has not been trialled.

Not every house on suitable soils can have HSM beams constructed. The construction method requires space around a house for equipment and some small excavation trenches.



The improved ground and house foundations are likely to suffer less damage during future earthquakes



Construction methodology of Horizontal Soil Mixed beams

The positioning of the beams in the ground is typically determined by the depth of the groundwater surface. Where this is too high, the beams would need to be constructed too close to the house foundations, which could cause damage. Where it is too low, construction becomes difficult or unachievable because of the depth at which the beams would need to be formed.

HSM beams are considerably more expensive compared to cleared-land solutions that can be constructed on properties without houses. HSM beams are considered suitable for improving the resilience of an existing house in future earthquakes. However, while they will improve the performance of the existing houses, they are unlikely to provide the same level of performance as cleared-land ground improvement methods.

This stabilised soil is much stiffer and stronger than the surrounding soil



Constructed HSM beams beneath a house



Exposed HSM beam