MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

UPDATE:

Section 15.3 of the MBIE Guidance

Site Ground Improvement

The Guidelines have been updated.

Here's why…

New science from EQC research trials – GIT Report

‘T-Rex’…

explosive trials…

CPT testing..

shear wave testing..

lab testing..

analysis, analysis, analysis…

Why were the EQC trials carried out?

What did they show?

Why were the EQC trials carried out?

- Motivated by EQC's mandate for scientific research into natural hazards
- To gain a greater understanding of how ground improvement works function on a residential scale
- To explore the possibility of more affordable ground improvement solutions

What did the EQC research trials show (from MBIE's perspective)?

1. Satisfactory control of differential settlements can be achieved using 4m deep composite raft solutions (ie stone column or timber pile rafts) in conjunction with a TC2-type surface concrete raft component.
2. 'Solid raft' solutions can be made slightly shallower than the current 2m deep solutions in the guidelines, in some cases.
3. Competent design, and good quality control are crucial.

The Guidelines have been updated to reflect these findings.

What are the key changes to the Guidance?

The key changes…

Two parts…
- Section 15.3
- Appendix C4

It's **essential** to read and apply **both** side-by-side

1. Section 15.3 and Appendix C4 of the MBIE foundation guidelines have been updated – more complex
2. Most original methods remain available, apart from LMG
3. Original options were either shallow 2m deep 'raft' solutions (excavate and recompact, cement stabilisation), or 8m deep inclusions – stone columns, deep soil mixing etc)
4. Two shallower options (1.2m) are now available
5. New 'class' available – 'crust reinforced with inclusions' (a 4m deep raft of either stone columns ['RAP'], or driven timber piles)

What's in Section 15.3?

Section 15.3 is an overview.

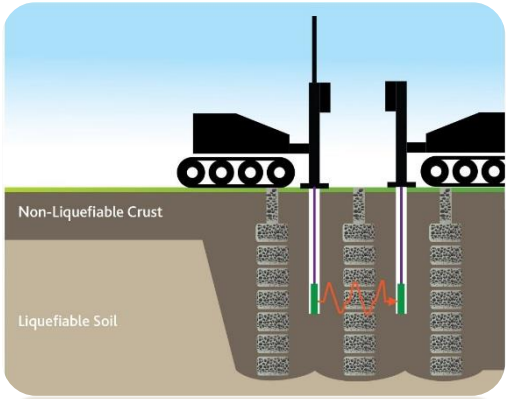
It covers…

- Background, objectives and scope
- Design approach / philosophy /strategy
- Investigation requirements
- Improvement types and options
- Selection considerations
- Applicability limitations
- High level specification, construction and verification issues

What's in Appendix C4?

Appendix C4…

- Still contains detailed method statements for each option as well as target Qc strength profiles
- There is a new section on construction quality control
- New information regarding shear wave velocity testing



What are we trying to achieve?

What are we trying to achieve?

- An integrated foundation solution, consisting of an ‘in-ground’ foundation component and a surface foundation component
- Control of **differential** settlements to the degree that acceptable foundation performance is maintained.
- In some cases, **total** settlements will also be important (e.g. flood zones).
- SLS – low level of damage (readily repairable)
- ULS – low probability of rupture
- Secondary benefit – foundations will not be the ‘weak’ link.

What are the options for Ground Improvement?

The options?

Now there are 10 different GI types to choose from.

Most of the previous options remain, however LMG as a shallow ground improvement option has been deleted.

A mixture of semi-prescribed outcomes, and options that require design input are included.

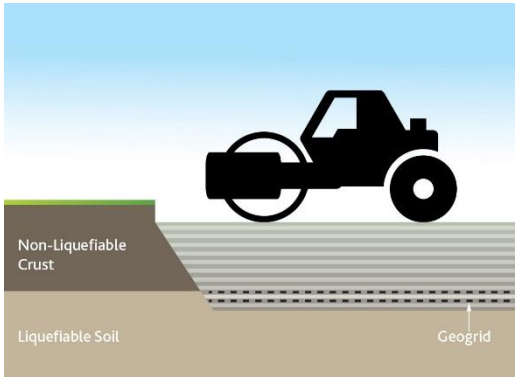
'Ex-situ' cement stabilised raft has been reduced in depth to 1.2m.

An additional 1.2m deep raft option (reinforced gravel raft) has been added.

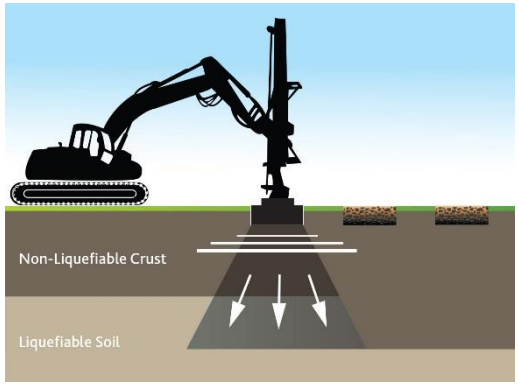
4m deep *'crust reinforced with inclusions'* options using either stone columns, RAP or timber piles have been added.

Let’s look at the 10 methods…

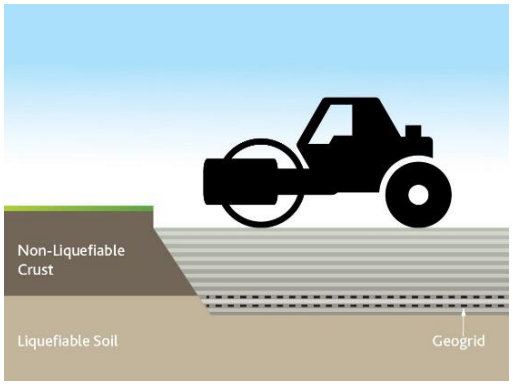
Shallow Options…



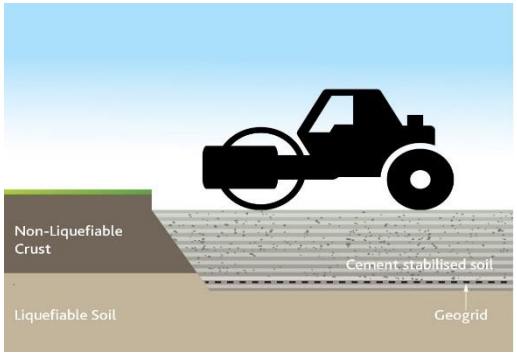
Excavate and recompact (2m)



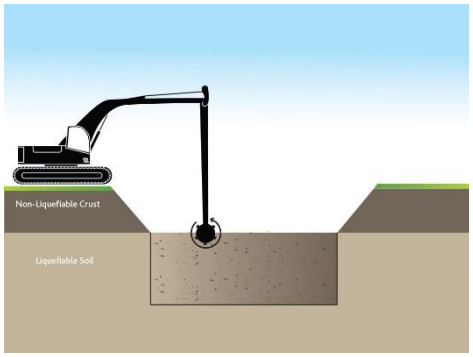
Rapid Impact Compaction/DC (not shown)

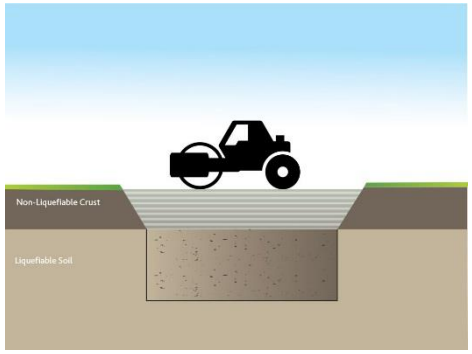


Reinforced Gravel Raft (1.2m)



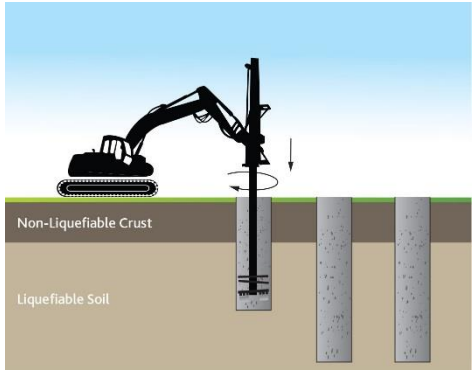
Cement Stabilised Raft (1.2m)



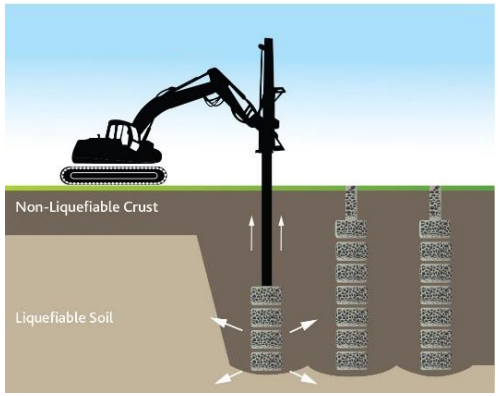


Cement Stabilised Raft (in-situ mixing) (2m)

Deep Options…

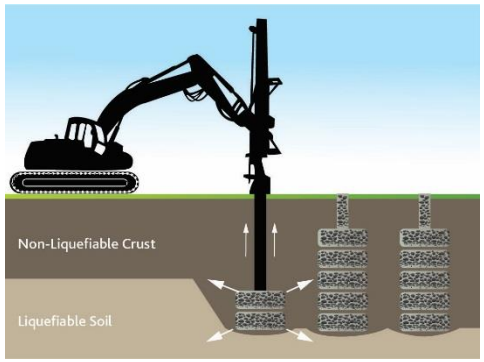


Deep Soil Mixing, Jet Grouting (8m)

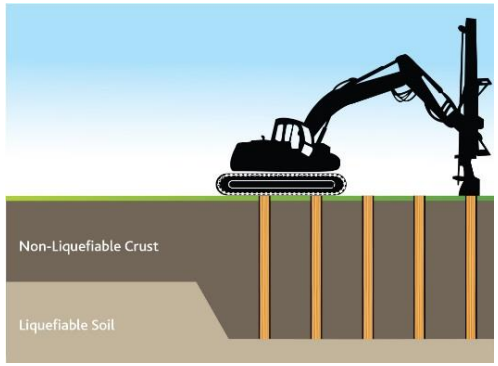


Deep Stone Columns (8m)

Crust reinforced with inclusions…



Shallow Stone Columns, Rammed Aggregate Piers (4m)



Driven Timber Piles (4m)

Key considerations for Subsurface Investigations

Key considerations for subsurface investigations…

Deep investigations required, as previously outlined in Section 13 of the guidelines.

Site specific investigations are needed, rather than relying on CGD data from nearby sites.

Lab testing for fines content and plasticity encouraged.

Can each method be used on any site?

Can each method be used on any site?

Each method has advantages and disadvantages

For example…

- *some methods are better on clean sands and some will work in silty sands*
- *some are more suitable for small sites*
- *some require specialist plant and equipment*
- *some require dewatering*
- *some give a better overall result than others*

There's a summary table (in Section 15.3) that outlines these

Table 15.4: Summary of ground improvement types covered by this guidance document' (grouped by construction methodology)

Group	Type	Description	Nominal depth of treatment below base of foundation	Refer Section	Advantages
G1 Shallow densified crust	G1a	Excavate and recompact	2m	15.3.10.1(a)	• Can be used in all soil conditions.[2] • Simple construction using typical earth works plant. • Can do on a single, small section (eg compared with G1b). • May be suitable for 'major' lateral stretch zones with additional geogrid.[3]
	G1b	Dynamic compaction	4m	15.3.10.1(a)	• Highly effective in clean sands.[4] • Results in thicker improvement zone than some other 'shallow' methods. • No dewatering required. • No stockpile area required.
	G1c	Rapid impact compaction	4m	15.3.10.1(a)	• Same as for Type G1b; and, • Faster and more efficient than dynamic compaction for shallow (≤ 4m deep) applications.
	G1d	Reinforced crushed gravel raft	1.2m	15.3.10.1(b)	• Same as for Type G1a; and, • Shallower excavation and less material handling. • Suitable for use in 'major' lateral stretch zones with additional geogrid.
G2	G2a	Reinforced	1.2m	15.3.10.2(a)	• Can be used in all soil condi[5]

Table 15.4
(Pages C15.8 - C15.9)

What are the technical selection criteria?

What are the technical selection criteria?

- Is SGI the right solution for this site?
- SLS settlements
- ULS settlements
- Lateral spread potential
- Soil type (sandy, silty, organic)
- Water table depth
- Location of untreated deposits in relation to proposed finished depth of treatment

What about practical considerations?

What about practical considerations?

Construction selection criteria include:

- Proximity issues – noise, vibration, batter stability, dewatering drawdown effects
- Availability of plant and materials
- Site contstraints – including access and stockpile requirements
- Costs

Who should be carrying out the selection, design and specification?

Who should be carrying out the selection, design and specification?

- Geotechnical Engineer
- CPEng
- Appropriate geotechnical earthquake engineering competence

REGISTRATION AUTHORITY
FOR CHARTERED PROFESSIONAL ENGINEERS

What questions do you have…