Lime & Cement Stabilisation Process

Introduction

Soil stabilisation, in pavement construction, is the process of pulverising, moisture conditioning, and mixing soil with selected binders, followed by compaction and trimming as required.

This improves key construction characteristics, including moisture content, density, strength (CBR%), permeability, plasticity index, and shrink-swell behaviour. Most materials, from clay to crushed rock, are suitable for stabilisation.

Seeking advice early from Furlong Ground Stabilisation during the design or feasibility stage supports efficient planning and effective use of stabilisation.

Lime Stabilisation and Modification

Lime and/or cementitious stabilisation is used to improve the properties of site-won materials. The excavated material can be reused in pavements, earthworks, capping layers, foundations, and similar applications.

Lime is particularly effective for wet or plastic cohesive soils, where it can improve workability, reduce plasticity, reduce swell potential. This will contribute to longer-term strength gain through pozzolanic reactions.

Cement or other hydraulic binders may be used alone or after lime treatment where additional strength or stiffness is required. Alternative binder blends, such as ground granulated blast-furnace slag (GGBS), pulverised fuel ash (PFA), or other approved materials, may also be suitable where supported by mix design and specification requirements.

Benefits of Soil Stabilisation

- Saturated or wet sites can be treated to provide a working platform within a day, supporting project continuation during wet periods or seasons.
- Furlong Ground Stabilisation can recycle suitable existing pavement or site-won material by pulverising it to the required grading before mixing with lime, cement, or other approved binders and water as necessary. Reducing imported material and disposal can improve programme, cost, and environmental outcomes.
- Strength improvement depends on soil type, binder selection, binder content, moisture condition, mixing quality, compaction, and curing. Any target CBR or strength value should therefore be confirmed by laboratory mix design and site testing rather than assumed.
- The plasticity index (PI) of cohesive materials can often be reduced significantly, but the achievable reduction depends on soil mineralogy, lime demand, binder content, moisture condition, and curing.

Stabilisation for Cohesive Material

- Reduce or eliminate the need for imported clay liner by stabilising in situ materials.
- Reduce permeability.
- Reduce shrink-swell behaviour and linear shrinkage, subject to material type, binder content, and verification testing.
- Environmental benefits include reduced reliance on geotextile, borrow-pit clay, and imported quarry material.
- Improved structural stability through realignment of soil particles by ionic exchange between clay and lime.
- Increase strength and durability.
- Reduced dispersion lowers the risk of piping failure and improves erosion protection.
- Pulverisation and mixing can improve material uniformity throughout the stabilised layer, reducing weak zones and preferential seepage paths where the treated material and construction process are suitable.

Lime

Several forms of lime are used in construction. Quicklime (calcium oxide, CaO) is commonly used for in situ treatment of wet cohesive soils because it reacts with soil moisture and produces heat, assisting drying and modification. Hydrated lime (calcium hydroxide, $Ca(OH)_2$) may also be used for some soil-treatment applications where specified, but product selection should be based on soil type, moisture condition, handling requirements, and project specification. Agricultural lime is calcium carbonate ($CaCO_3$) and is not a suitable substitute for soil stabilisation in pavement construction.

Hydrated lime (calcium hydroxide) is produced by reacting water with quicklime (calcium oxide): $CaO + H_2O \rightarrow Ca(OH)_2$ + heat. Because hydration is exothermic and involves mass gain from water addition, site handling, storage, and safety controls should follow the supplier's product data and the project specification.

Lime treatment initially causes cation exchange and flocculation-agglomeration of clay particles, which improve workability and reduce plasticity. In suitable reactive soils, longer-term pozzolanic reactions between calcium, silica, and alumina can form cementitious calcium silicate hydrates (CSH) and calcium aluminate hydrates (CAH), increasing strength and durability over time. The degree of improvement depends on soil mineralogy, binder content, moisture, compaction, curing, and quality control.

Lime demand is typically determined by laboratory testing and confirmed against the project specification. Where sufficient lime is present to maintain a high-pH environment, dissolved silica and alumina from suitable clay minerals can react with calcium to form cementitious hydrates. Indicative reaction products include:

$Ca^{2+} + OH^{-}$ + dissolved alumina → calcium aluminate hydrates (CAH)
$Ca^{2+} + OH^{-}$ + dissolved silica → calcium silicate hydrates (CSH)

Stabilisation Process & Machinery

Furlong Ground Stabilisation have suitable machinery to provide accurate binder dosage, uniform mixing, controlled treatment depth, and appropriate moisture conditioning.

Preparation

Before stabilisation begins, the surface should be prepared by trimming to approximate levels, shaping to shed water, and providing sufficient drainage to prevent ponding where possible. Some bulking may occur due to binder addition and density changes, although this may be offset by reduced moisture content or increased density of the underlying material during compaction. If necessary, the ground may need to be raked to the required depth to identify and remove unsuitable material, including obstacles, organics, and material too hard to stabilise.

Site Silo

Furlong Ground Stabilisation operates a range of purpose-built lime and cement Silos. The silo operates with an Independent Mounted engine and compressor for Pumping the Binder from the silo into the spreader under pressure. The silo works under pressure approx. 1bar to transfer the binder powder form silo to spreader.

Spreader

Furlong Ground Stabilisation operates a range of purpose-built lime and cement spreaders.

The spreader is pressure filled from the silo. Once the spreader is full the alarm sounds and filling operation is stopped.

Leading technologies are incorporated into the spreaders such as Radar Speed and Flow rate adjustment to ensure accurate binder spread rates at all times.

- On-board computers linked to load cells and Radar distance-measuring devices help ensure accurate spread rates.
- All spreader have sealed bulk bins to ensure the product does not start to react until it is on the ground ready to be mixed into the pavement. Spread rates (kg/m^2) must vary according to ground conditions.
- Additional spread rate tray weight testing can be carried out to confirm and adjust the spreading rate.

Stabilising Machine

Stabilising machines such as the Wirtgen WS250 Tractor Mounted mixer is capable of maintaining accurate treatment depth, homogeneous mixing, and effective binder and moisture incorporation.

Compaction

Compaction begins after mixing and moisture conditioning. Required density and compaction standard should be set by the project specification and verified by testing; 95% standard compaction is a common minimum. Layer thickness, binder type, moisture content, and equipment capability must be matched so density is achieved throughout the full treated depth. 13 – 16tn vibratory rollers are commonly used for compaction.

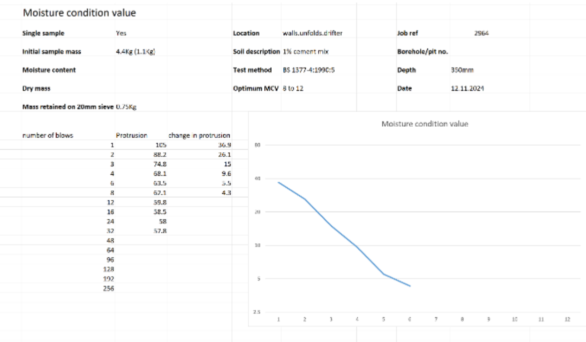
Testing

Furlong Ground Stabilisation have inhouse Testing Technicians on site to carry out regular Specified Testing as the works progress.

Laboratory testing is carried out on soil samples from the site to verify the binder dosage and to ascertain the MDD Max Dry Density of the soil. The MDD will be used to calibrate any NDG Nuclear Density Gauge tests on the completed works to validate Air Voids content are below 5.0% in Cohesive and 10% in Granular soils in accordance with the Design Specification.

Field Testing include the following:

- MCV Moisture Content Value. Essential for ensuring that required compaction will be achieved.

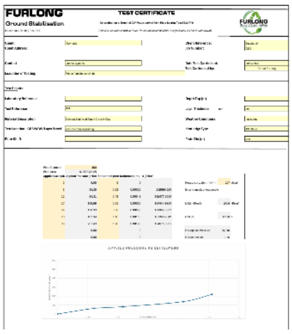


Moisture condition value

Single sample	Yes	Location	walls.unfolds.drifter	Job ref	2964
Initial sample mass	4.4Kg (1.1Kg)	Soil description	1% cement mix	Borehole/pit no.	
Moisture content		Test method	BS 1377-4:1990:5	Depth	350mm
Dry mass		Optimum MCV	8 to 12	Date	12.11.2024
Mass retained on 20mm sieve	0.75Kg				

number of blows	Protrusion	change in protrusion
1	105	36.9
2	88.2	26.1
3	74.8	15
4	68.1	9.6
6	63.5	5.5
8	62.1	4.3
12	59.8	
16	58.5	
24	58	
32	57.8	
48		
64		
96		
128		
192		
256		

- CBR California Bearing Ratio – Bearing Capacity of the treated soils



- LWD Light Weight Deflectometer – Stiffness and Structural Elastic Modulus of the treated soils

Considerations for Stabilisation

Furlong Ground Stabilisation offer early advice during development and design can maximise savings by optimising stabilisation methods, reducing double handling, and limiting the import and export of materials. Qualified engineers and project managers can provide practical guidance based on site conditions, specification requirements, and construction objectives.

To assess a site accurately for stabilisation, the following information should ideally be considered:

- Geotechnical data, including site conditions, material type and depth, subgrade, and existing pavement material.
- Construction conditions and loading.
- Proposed and existing geometric site layout.
- Proposed minimum area to be treated.
- Specification requirements, typically including density, CBR strength, or binder content where provided.
- Proposed award and commencement dates.

Technical Note / Disclaimer

Furlong Ground Stabilisation technical note:

The information in this document is provided as general guidance only and should not be relied on as a final design, specification, or site instruction. Binder selection, binder content, treatment depth, compaction requirements, curing periods, and performance targets must be confirmed through project-specific investigation, laboratory mix design, site trials where required, and compliance with the relevant contract specification, standards, and engineer's instructions. Furlong Ground Stabilisation accepts no responsibility for outcomes where materials, designs, construction methods, or quality-control procedures have not been assessed and approved for the specific site conditions.