

INSTALLATION GUIDE

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STOPDIGGING!
THE GROUND SCREW FOR SOLID FOUNDATIONS

CodeMark 
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PURPOSE

This document is intended for use by approved STOPDIGGING! Ground Screw installers only.

It describes the steps that must be taken when installing the STOPDIGGING! Ground Screw Foundation System (the system).

To ensure correct installation of the system the following documents must also be relied upon:

- › STOPDIGGING! Machine manual
- › Survey plan or datum set out
- › the building consent plans and specifications (including engineering where applicable) or STOPDIGGING! Groundscrew Foundation System Design Guide where building consent is not required (system design).

When installation of the system is finished the following completed documents must be provided to the customer or project manager.

- › STOPDIGGING! ground screw foundation system static ground screw test report (online app)
- › STOPDIGGING! ground screw foundation system record of installation (online app)

INSTALLATION

HEALTH AND SAFETY

Take all necessary steps to ensure your safety and the safety of others:

- › wear appropriate safety equipment, clothing and footwear
- › use all tools in accordance with relevant instruction manuals
- › clear the work area of any obstruction before work starts.

For further information refer to:

- › WorkSafe. [July 2018] Small Construction Sites, the Absolutely Essential Health and Safety Toolkit.
- › WorkSafe. [December 2016] Health and Safety at Work, Quick Reference Guide.

These documents are available at www.worksafe.govt.nz.

HANDLING AND STORAGE

Handle ground screws with care to ensure screws are not damaged when transporting, unloading, and storing.

SOIL SUITABILITY

Confirm soil suitability. Soil type may be used to confirm soil suitability.

MAJOR SOIL TYPE	SUITABILITY ¹	RATIONALE
SILT	Yes	Silt can generally be pre-drilled with a suitable soil auger, allowing for installation of the Ground Screws
SAND	Yes	Ground Screws can generally displace sands during installation.
Fine GRAVEL	Yes	Fine gravels are expected to behave in a similar fashion to sands.
Medium GRAVEL	Requires on-site confirmation	Medium gravels may become disturbed during installation, diminishing the bond strength between the ground screw and the soil. As such, the suitability of such soils will need to be confirmed with on-site testing.
Course GRAVEL	Requires on-site confirmation	Course gravels may become disturbed during installation, diminishing the bond strength between the ground screw and the soil. As such, the suitability of such soils will need to be confirmed with on-site testing.
COBBLES	No	Cobbles are expected to become disturbed during installation, or present installation all together due to penetration resistance. Disturbed cobbles would have a greatly diminished bond strength to the installed Ground Screw.
BOULDERS	No	It is unlikely that the pre-drilling process, or the ground screw installation will be able to penetrate through soil mediums comprising boulders as the main constituent.
CLAY	Yes	Clays can generally be augered, allowing the pre-drilling process to be completed successfully, and in most cases shall allow for the successful installation of the Ground Screw system.
PEAT	No	Peat is an organically dominated material that is unsuitable for most shallow foundation types.
TOPSOIL	No	Topsoil is an organically dominated material that is unsuitable for most shallow foundation types.
ROCK	No	Pre-drilling is generally un-successful into bedrock, and Ground Screws are unable to displace rock during installation.
Non-engineered FILL	No	Non engineered fills are inconsistent materials with unpredictable characteristics. Uncontrolled fill lacks the horizontal stratification that is common in naturally deposited materials. As such, localised soil and load testing cannot be used to infer the performance or the load carrying characteristics of the soil across and entire site.

Where the soil type falls outside the permitted soil types (whether by exclusion or reference) then testing is as below.

Shallow soil testing

No test required as this is confirmed as part of the static ground screw test procedure.

Soil pH testing

Carry out an indicative site test. If the pH <4 take a soil sample and have tested by a qualified laboratory.

Soil resistivity

If the site is adjacent to an area of potentially significant electrical activity, such as an electrified rail track, then obtain advice from STOPDIGGING!

¹ Assuming soil is sufficiently dense.

STATIC GROUND SCREW TEST

Purpose

The static ground screw test measures the response of a ground screw under an applied load and provides an accurate method for determining ground screw capacities and ability to support load without excessive or continuous displacement. It provides confirmation or the need for an amendment in respect of the size of ground screw and screw depth necessary to meet the foundation design.

Methodology

Two types of tests are required, one that establishes the compressive load capacity and the other the lateral load capacity. The number of tests to be undertaken is calculated as 5% of the total number of ground screws to be installed.

Load testing apparatus

COMPONENT	DESCRIPTION	COMPONENT	DESCRIPTION
1	Bolted plate and shackle with 56kN minimum capacity in tension.	9	The ground screw installed as per Installation , undergoing load proof-testing for either tensile, compressive or lateral demands.
2	Digital display for load cell with current calibration certificate 0.5kN minimum display resolution.	10	0.3 x 0.3m load distribution pads to limit vertical settlement of the tripod during tension testing.
3	50kN load cell with current calibration certificate 0.5kN minimum read accuracy.	11	Hydraulic pump compatible with chosen hydraulic pull-back ram. Shall be rated to cope with hydraulic pressures when ram loaded to 50kN
4	Tripod constructed with 50mm SHS 5mm thick steel sections.	12	Ground screws installed to provide a reaction force during compressive testing of the test screw. These screws shall be installed as deeply as the on-site conditions allow to minimise the risk of a tension failure during the test.
5	Hydraulic pullback ram with 50kN minimum capacity.	13	Hydraulic jack with 50kN minimum capacity.
6	Mechanical strain gauge with current calibration certificate and 0.01 mm minimum resolution.	14	Bolted plate and shackle with 20kN minimum capacity in shear.
7	Strain gauge support – Steel Y Post (Warratah) or similar. Support to be isolated from testing apparatus by placement at a distance of 0.5m minimum from any loaded ground screw or tripod load distribution pad.	15	Tension tendon with 20kN minimum capacity in tension. This tendon shall be regularly checked for any defects or fraying that may affect its capacity.
8	Bolted plate and shackle with 56kN minimum capacity in tension.	16	Reaction system for tension tendon. Shall be stable under loads of up to 20kN without undergoing significant displacement that could affect test results.

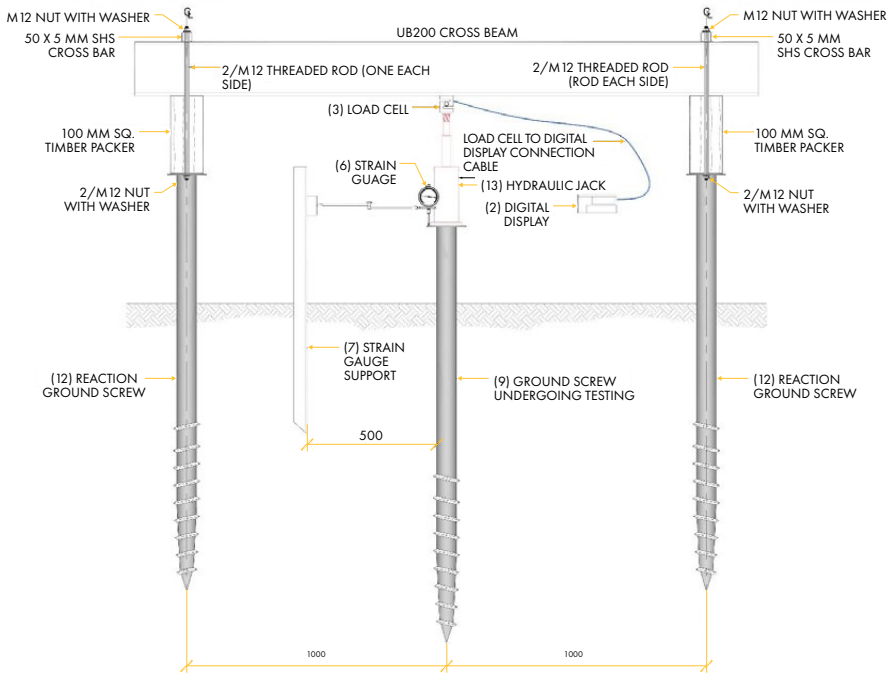
Establishing compressive load capacity

Either a Compression or Tension testing methodology may be used.

Compression test (Maintained load)

Installation of test rig

Install test screw vertically and in one drive within the footprint of the proposed structure or within close proximity to the footprint. Record distance of the screw from the footprint (if being tested outside the footprint).



▲ FIGURE 1. – COMPRESSION TEST TESTING

The height of the screw above ground shall be carefully monitored as this shall replicate the installed conditions while in-service.

Ensure the reaction screws are installed in line with the test screw and are spaced 1.0 m from the test screw as shown in Figure 01. The reaction screws are to be installed as deeply as on-site conditions allow. This minimises the risk of a tension failure during the test. The reaction screws must have a combined tensile capacity of 1.2 times the maximum compressive test load.

Install timber packers and crossbeam as shown in figure 1. Confirm that all bolted connections are tightly fastened.

Install the strain gauge support 0.5 m from the test and reaction screws. The purpose of the strain gauge support is to prevent undue movement of the support during testing that may affect recorded measurements. Ensure installation will achieve this including loosening the support after being driven to reposition the strain gauge.

Install loading and measuring apparatus as per figure 1. Confirm that the strain gauge is aligned with the test screw so that only vertical displacement in the direction of loading is measured.

Install the hydraulic jack vertically and fix directly to the top of the test screw. Check full contact through the load cell is made with the cross beam.

Testing

Confirm that the engineer has included safety factor in their calculations. If not, then a test of 150% of the design load must also be included.

Load the test screw (10%, 25%, 50%, 75%, 100%) of design load.

Ensure each of the target loads is maintained as accurately as possible for the 1 – 15 mins time. Minor ongoing adjustment of the hydraulic pump will be necessary while monitoring the digital display to ensure the target load is maintained.

Timing begins once the target load has been achieved. The target load shall not vary by more than 5% at each loading increment. Ensure that the target load is not significantly exceeded, even momentarily, while loading the screw. Overshooting the target load will skew the results, causing a failed result.

Record results

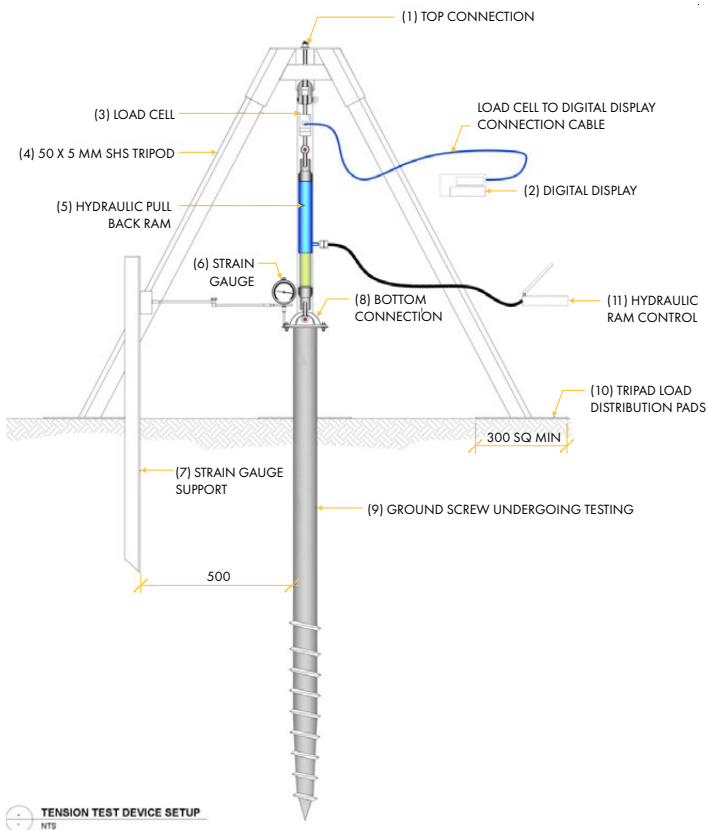
After each test, record the results.

Tension test (Maintained load)

Installation of test rig

Install test screw vertically and in one drive within the footprint of the proposed structure or within close proximity to the footprint. Record distance of the screw from the footprint (if being tested outside the footprint).

The height of the screw above ground shall be carefully monitored as this shall replicate the installed conditions while in-service.



▲ FIGURE 2. TENSION TEST TESTING RIG

Install the tripod as shown in figure 2 over the installed test screw. Position the top connection directly above the test screw to eliminate other forces from interfering with the recorded results.

Fasten bottom connection of the tripod to the top of the test screw, ensuring all bolts are securely tightened.

Install the strain gauge support 0.5 m from the test and reaction screws. The purpose of the strain gauge support is to prevent undue movement of the support during testing that may affect recorded measurements. Ensure installation will achieve this including loosening the support after being driven to reposition the strain gauge.

Install loading and measuring apparatus as indicated in figure 2. The strain gauge must be accurately aligned with the test screw so that only vertical displacement is measured.

The hydraulic pull-back ram must be installed vertically and directly above the bottom support so that only a vertical force is applied, and any undue lateral forces are avoided.

Testing

Confirm that the engineer has included safety factor in their calculations. If not then a test of 150% of the design load must also be included.

Load the test screw (10%, 25%, 50%, 75%, 100%) of design load. Ensure each of the target loads is maintained as accurately as possible for the 1 – 5 mins time. Minor ongoing adjustment of the hydraulic pump will be necessary while monitoring the digital display to ensure the target load is maintained.

Timing begins once the target load has been achieved. The target load shall not vary by more than 5% at each loading increment. Ensure that the target load is not significantly exceeded, even momentarily, while loading the screw. Overshooting the target load will skew the results, causing a failed result.

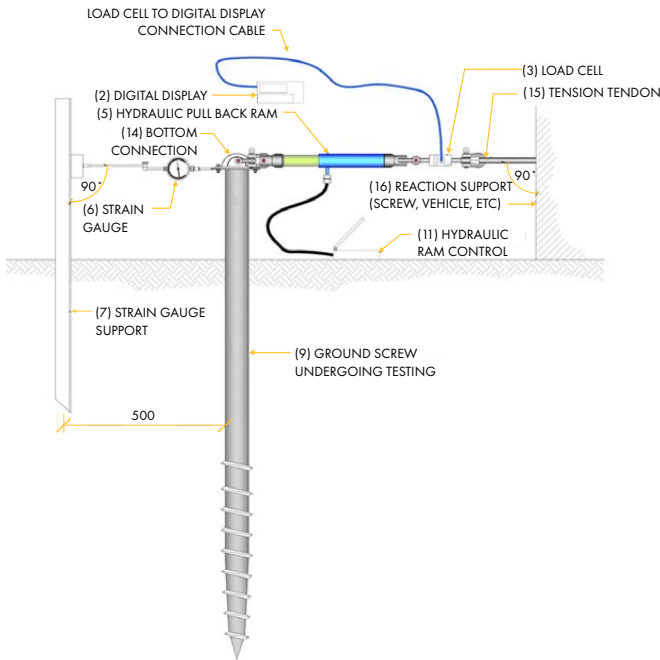
Record results

After each test, record the results. Displacements shall be recorded in millimetres and micrometres. Measurements shall be taken as close to the end of the load increment as possible. If displacement at a certain load increment is not stable, and has begun to creep, the load inducing this displacement shall be noted as resulting in failure.

Establishing lateral load capacity

Installation of test rig

Install test screw vertically and in one drive within the footprint of the proposed structure or within close proximity to the footprint. Record distance of the screw from the footprint (if being tested outside the footprint).



▲ FIGURE 3. LATERAL LOAD CAPACITY TEST RIG

The height of the screw above ground shall be carefully monitored as this shall replicate the installed conditions while in-service.

Install a reaction system at least 1.0 m away from the test screw. This reaction system may be another test screw, a heavy vehicle, arbitrary kentledge, or any other mass capable of providing the required reaction force.

Fasten the bolted connection to the top of the test screw and secure the tension tendon to the reaction system as shown in figure 3.

Install the strain gauge support 0.5 m from the test and reaction screws. The purpose of the strain gauge support is to prevent undue movement of the support during testing that may affect recorded measurements. Ensure installation will achieve this including loosening the support after being driven to reposition the strain gauge.

Install loading and measuring apparatus as indicated in figure 3. Ensure the strain gauge is accurately aligned with the tension tendon so that only horizontal displacement in the direction of loading is measured.

The hydraulic pull-back ram and tension tendon must be installed at 90° from the top of the test screw. Any variation from 90° in the tension tendon/hydraulic pull-back ram during loading and measurement will cause inaccurate measurements.

Testing

Confirm that the engineer has included safety factor in their calculations. If not then a test of 150% of the design load must also be included.

Load the test screw (10%, 25%, 50%, 75%, 100%) of design load. Ensure each of the target loads is maintained as accurately as possible for the 1 – 5 min time. Minor ongoing adjustment of the hydraulic pump will be necessary while monitoring the digital display to ensure the target load is maintained.

Timing begins once the target load has been achieved. The target load shall not vary by more than 5% at each loading increment. Ensure that the target load is not significantly exceeded, even momentarily, while loading the screw. Overshooting the target load will skew the results, causing a failed result.

Record results

After each test, record the results. Displacements shall be recorded in millimetres and micrometres. Measurements shall be taken as close to the end of the load increment as possible. If displacement at a certain load increment is not stable, and has begun to creep, the load inducing this displacement shall be noted as resulting in failure.

Failed test results

Where 100% of the compression load capacity is not achieved establish a new test rig with a larger diameter test screw or where the test screw is longer.

Where lateral load capacity testing fails consider the introduction of above ground diagonal bracing. Specification of this bracing must be carried out in consultation with the design engineer.

Complete static test report

When all testing is finished, complete the Static Ground screw Test Report and supply to the engineer (if required) and customer or project manager. The completed static test report must be submitted to council, with the Installation Declaration when application for a CCC is made.

GROUND SCREW FOUNDATION INSTALLATION

Pre-drilling

Pre-drilling holes prior to the installation of STOPDIGGING! ground screws. This enables installation in one drive.

Ensure that the drill bit is suitable for the specific soil conditions. For gravel soils, use a masonry style drill bit and for fine-grained soils such as silts and clays, use an auger-style drill bit.

Pre-drill to a depth of 100 mm less than the final installation depth for the ground screw.

Do not over-drill as this will decrease the compressive capacity of the installed ground screw.

Installation of Ground Screw

Ground screws must be installed vertically, and in one drive.

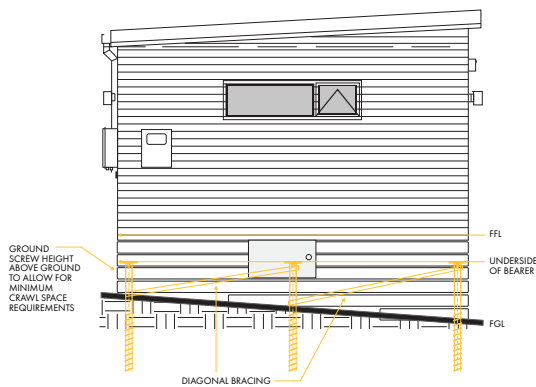
The heads of all ground screws that are to be installed as part of a foundation system, must finish at the same level after installation. Establish finished height with a laser level and a fixed datum.

Diagonal Bracing

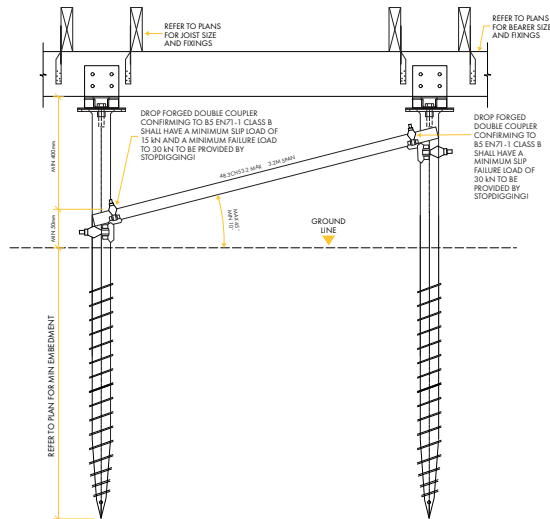
Install bracing units in accordance with engineer's design.

Use 48.3 x 3.2 CHS Grade 250 tube, maximum length 3.2 m installed at a brace angle between 10° and 45° to the horizontal.

Connect the bracing unit with a scaffolding coupler that has an established capacity of greater than 6kN. The bracing unit must be fixed at least 100 mm above ground level.



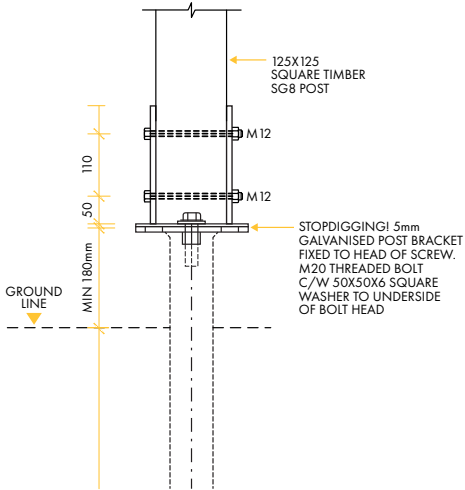
▲ FIGURE 4. DIAGONAL BRACING



▲ STEEL PIPE DIAGONAL BRACE DETAIL

Senton Pile

Where Senton piles are specified ensure that the ground screw has been installed to enable the installation of the timber post.



▲ FIGURE 5. BRACKET SGL125 FIXED TO THE SENTON PILE

COMPLETION

When all ground screws have been installed in accordance with the building consent plans and specifications or the system design, complete the STOPDIGGING! Installation Declaration and along with the completed static pile test provide to the project manager or customer as applicable..

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See www.stopdigging.co.nz for current version.