

EARTH

STRUCTURES

SRE Construction Requirements & Technical Data 2019

1 Site Construction Requirements

- Reasonable access to site for delivery of equipment via semi-trailer – including 3 tonne skid-steer loader.
- Reasonable access for delivery of 10m³ gravel **trucks with trailers**.
- Adequate space in which to store earth and palletised cement bags.
- 10m by 10m area to mix earth etc. Note mixing can be done on the concrete slab provided it is not polished or similar.
- Provision of good pressure water to a ¾" fitting near the site.
- Power source for tools etc. during construction.
- Access to one face of each wall for skid-steer loader, scissor lift and telehandler.
- Rubbish skip for cement bags

2 Compressive Strength

NBTC Bulletin 5 Earth Wall Construction requires an adjusted characteristic compressive strength for all earth walls of at least 2Mpa. Current practice for a 200mm load bearing monolithic stabilised earth wall is to design to a minimum compressive strength of 2.5 Mpa.

In the Report it was clearly demonstrated that the increase in cement content caused a corresponding (almost linear) increase in the unconfined compressive strength.

Table 1: EFFECT OF CEMENT CONTENT ON COMPRESSIVE STRENGTH

Cement Content (%)	2	5	10	15
Moisture Content (%)	9.1	8.2	8.9	10
Dry Density (t/m ³)	2.08	2.13	2.14	2.13
7 Day Compressive Strength (Mpa)	3.22	6.70	8.99	13.50

Earth Structures Group members use a mix design of 8% cement content for load bearing stabilised earth walls.

Further tests were carried out to determine the effect of moisture content on the compressive strength of monolithic stabilised earth walls. In these, a constant 5% cement sample was combined with:

- A. 4% below optimum moisture content
- B. Optimum moisture content
- C. 4% above optimum moisture content
- D. Very wet (a consistency similar to concrete)

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Table 2: EFFECT OF MOISTURE CONTENT ON COMPRESSIVE STRENGTH

SAMPLE	A	B	C	D
Cement Content (%)	5	5	5	5
Moisture Content (%)	6.7	10.8	12.8	14.8
Dry Density (t/m ³)	2.05	2.07	1.97	1.86
7 Day Compressive Strength (Mpa)	4.56	4.02	2.67	1.76

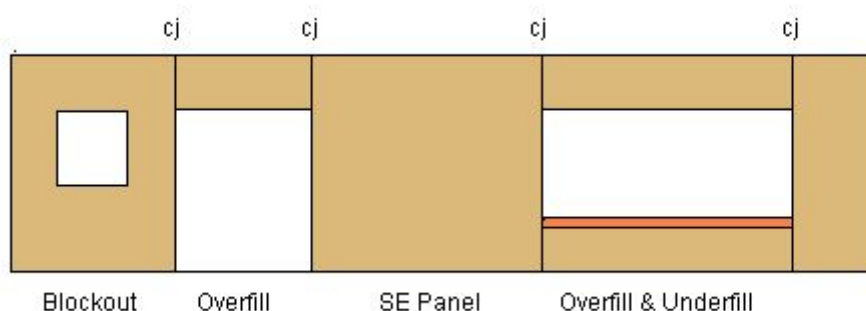
The system used to manufacture the Earth Structures Peninsula Pty Ltd walls uses optimum moisture levels (10%) for most granite, limestone, sandstone and other road base materials.

1. Control Joint Placement

Maximum wall lengths are 3800mm between control joints (CJ). Smaller openings up to 1200mm wide can be cast into the centre of a stabilised earth panel using demountable timber “block-outs”.

Larger openings can have articulated stabilised earth panels above them, using steel tee lintels bolted to the stabilised earth walls on either side.

The following diagrams are examples of various door and window openings.



2. Tensile Strength

The study carried out ‘Brazilian’ tensile strength tests and were performed on two 5% added cement samples. These resulted in Tensile strength performances of 0.56 and 0.58 Mpa.

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3. Density

Tests on two field samples, taken at random from a larger sample using the wax/buoyancy method calculated to 2.06 t/m³ and 2.09 t/m³, giving an average of 2.07 t/m³. This corresponds to 98% of relative standard compaction.

To investigate the effect of compaction on strength, 5 samples were prepared at 5% cement and optimum moisture content. Compaction was varied to obtain densities ranging from the 1.97 t/m³ “poorly compacted state” to 2.19 t/m³ “very well compacted”. The average dry density in on previous tests had been 2.05 t/m³.

Table 3: EFFECT OF COMPACTIVE EFFORT

SAMPLE	1	2	3	4	5
Cement Content (%)	5	5	5	5	5
Moisture Content (%)	10	9.8	9.5	9.3	8.3
Dry Density (t/m ³)	1.97	2.07	2.11	2.16	2.19
28 Day Compressive Strength (Mpa)	5.73	6.43	7.26	8.01	8.49

The Earth Structures Peninsula Pty Ltd system of manufacture for most stabilised earth walls will achieve a very constant 2.10 t/m³. The nature of the modified compaction system allows for greater uniformity of density than was allowed for the purposes of these tests.

4. Durability

While the tests on a lateritic soil showed that the required compressive strength could be achieved with less than 2% cement, a minimum of 6% cement is now specified for most soils, and 8% to 10% cement specified for soils with very low clay contents. This is firstly structurally prudent and secondly, it provides a concrete like surface hardness and durability.

5. Seismic Design

Stabilised Earth walling can be engineered to Earthquake Code AS 2121, suitable for Seismic Zone 2 in Eastern Australia.

6. Wind Loading

Stabilised Earth walling can be engineered to Australian Wind Code AS 1170 which allows for a Permanent Windspeed of 70 m/sec.

7. Acoustic Properties

Stabilised earth walls are an effective device for the reduction of airborne sound transmission and impact sound vibration. Mass walls provide an efficient barrier to sound transmission. The rating system used for sound insulation is the sound transmission class (STC).

An STC of 57 was derived from a 1986 NBTC test of a 300mm stabilised earth specimen. As a comparison a 140mm solid concrete block wall has an STC of 45.

8. Fire Resistance

A 1986 NBTC Fire Resistance test carried out to AS 1530.4-1985 on a 300mm thick stabilised earth wall sample resulted in a four hour fire rating.

Subsequent to this test we have performed further fire resistance testing through an independent company based in Dandenong. We undertook these tests for a specific project (Port Phillip Estate Winery) where up-to-date verification of the fire resistance ability of the walls was required. The walls maintained the 4 hour fire rating at extreme heats. In addition, the temperature of a steel beam in the stabilised earth wall was monitored throughout the test, the results showed that the temperature of the steel beam increased by no more than 3 degrees Celsius which demonstrated the added benefit of radiant heat control the stabilised earth walls have in extreme fire conditions.

Stabilised earth walls at their minimum thickness of 300mm are compliant with the most recent changes to the building standards as a result of bushfires.