TUFF OZY CONCRETE SLEEPERS

Built tuff for Aussie conditions

SLEEPER RETAINING WALL TECHNICAL DESIGN GUIDE (REVISION A - MARCH 2020)

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1.0 INTRODUCTION

This brochure has been produced with the intent of providing design information and guidance for those wishing to install a sleeper retaining wall using Tuff Ozy Concrete Sleepers. User friendly design graphs have been compiled by Alta Projects, and can be found in section 5.0 of this document. The design assumptions used to assemble these graphs are discussed in detail throughout this brochure, and have been selected so that the advice given will be applicable to the majority of sleeper retaining wall applications throughout Queensland. If you are in any doubt as to whether your proposed retaining wall is covered by the recommendations contained within this document, please consult a registered engineer for further advice. An example of the appropriate selection procedure has also been provided in section 4.0 of this brochure for your convenience.

2.0 DESIGN ASSUMPTIONS

The following design assumptions have been used to produce the design graphs located in section 5.0 of this brochure. They have been selected from the relevant Australian Standards with the intent of covering the majority of sleeper retaining wall applications throughout Queensland. It is imperative that you ensure that **all** of the following design assumptions are suitable for your proposed sleeper retaining wall application, prior to using the provided design graphs. If in any doubt, or if your proposed sleeper retaining wall falls outside the scope of this document, please ensure that you seek expert advice from a registered engineer.

2.1 SLEEPERS

'Tuff Ozy' concrete sleepers are to be used within these retaining walls. We precast our sleepers in N40 concrete, and reinforce them with 2N12 longitudinal reinforcing bars, with 30mm minimum cover. Our standard sleepers are 80mm thick and 200mm high, and are typically made in 1000, 1200, 1500, 2000 and 2400mm lengths. Use packers under bottom row of sleepers to achieve horizontal alignment if required. Maximum retaining wall heights within this design guide are limited by the capacity of a single sleeper layer when posts are spaced at 2.4m centres. Double sleeper layers within larger posts will allow for larger retaining heights.

2.2 POSTS

The design graphs in section 5.0 of this brochure recommend the use of either 100UC15 or 150UC23 posts, depending on the proposed wall height. These

posts are to be Grade 300 and are to be hot-dipped galvanised to a system designation of HDG600. This will ensure 25+ years of post durability before first maintenance is required within atmospheric corrosion category C in accordance with AS/NZS 2312-2002. Sleeper retaining walls within this brochure are not permitted to be installed within 1km of the coastline, or a large body of salt water. Please seek expert advice from a registered engineer for sleeper retaining walls within this exclusion zone, or where proposed post sizes vary from the abovementioned.

2.3 FOOTINGS

100UC15 posts are to be cast into bored piers of 400mm minimum diameter, and 150UC23 posts are to be cast into bored piers of 450mm minimum diameter. Posts are to be embedded into the footings, and extend to 100mm from the base of the bored pier excavation (refer Figure 4 in section 5.0). Footings are to be cast in a minimum of N25 concrete, with 100mm minimum cover to post. Allow a minimum of 48 hours for the concrete footings to set prior to installing sleepers.

Please note that the footing depths recommended within the design graphs are to be considered as absolute minimum values. Footing depths are critical to the integrity of cantilever retaining walls, and hence a conservative approach should be adopted where possible. Ensure that no underground services will be affected by the installation of your sleeper retaining wall. Seek expert advice if the proposed bored pier footings are within the zone of influence of any nearby underground service.

2.4 FENCES

A fence up to 1800mm high is permitted to be installed on top of the proposed sleeper retaining wall, provided the appropriate design graph is used for the selection procedure. For example, the following 3 fence design options have been supplied within each subgrade category;

- **No Fence**: There will be no fence fixed to the top of the wall.
- **General Zone**: A maximum 1800 high fence that is *further than 3.6m away from a free end* may be installed on top of the wall. Fence posts located within this 'general zone' are subjected to only half the wind pressure of those within the 'end zone'.
- **End Zone**: A maximum 1800 high fence that is *within 3.6m away from a free end* may be installed on top of the wall. Fence posts located within this 'end zone' are subjected to twice the wind pressure of those within the 'general zone'.

The following **maximum** wind speed parameters have been adopted from AS/NZS1170.2-2011, and used to calculate the design graphs (with a fence allowance) in section 5.0 of this brochure;

- Wind Region = B
- Terrain Category = 2
- Importance Level = 1
- Design Life = 50 years

Please note that this design guide does not cover fences within cyclonic areas. If you are unsure whether these design wind speed assumptions are suitable for your proposed fence, or for areas of greater wind loading (e.g. cyclonic areas), please seek expert advice from a registered engineer. Proposed fences on top of sleeper retaining walls are to be designed and certified by others.

2.5 FOUNDATION

The design guidelines provided within this brochure assume that 'subgrade' and 'backfill' (refer Figure 4 in section 5.0) comprise of the same material (e.g. the foundation). It is also assumed that subgrade into which the footings are to be founded is in an undisturbed natural state. Backfill behind the retaining wall is to be placed as Controlled Fill – Class 1 as specified in AS4678-2002. This requires fill to be compacted in layers of 200mm maximum thickness at +/-2% of optimum moisture content, with compaction levels to achieve 98% of the soil's maximum dry density. Please note that care should be taken using heavy machinery within the immediate vicinity of the retaining wall.

The following **minimum** soil parameters have been assumed for the calculation of the design graphs in section 5.0 of this brochure;

Foundation	Density	Angle of Internal Friction	Cohesion
Sand / Gravel	1900kg/m³	30°	0kPa
Soft Clay	1900kg/m³	25°	25kPa
Stiff Clay	1900kg/m³	25°	75kPa

If you are unsure whether these design soil parameters are suitable for your proposed sleeper retaining wall, please seek expert geotechnical advice. Similarly, if the proposed foundation material is not covered by the above table (e.g. rock, silt, etc.), or if the soil parameters are less desirable than the assumed values, expert advice should be sought from a registered engineer.

2.6 SURCHARGE LOADS

This brochure assumes that the potential failure of the proposed sleeper retaining wall will result in only minimal damage and loss of access, and has hence been designed to structure classification 'A' in accordance with AS4678-2002. As such, a surcharge load of 2.5kPa acting at the top of the wall has been allowed for. If your proposed sleeper retaining wall requires a larger surcharge allowance, or is of a higher structure classification, please seek expert advice from a registered engineer.

House footings, or other heavily loaded foundations are to be founded below the angle of influence of the proposed sleeper retaining wall (refer Figure 1 below). If this is unavoidable, then expert advice from a registered engineer should be sought.

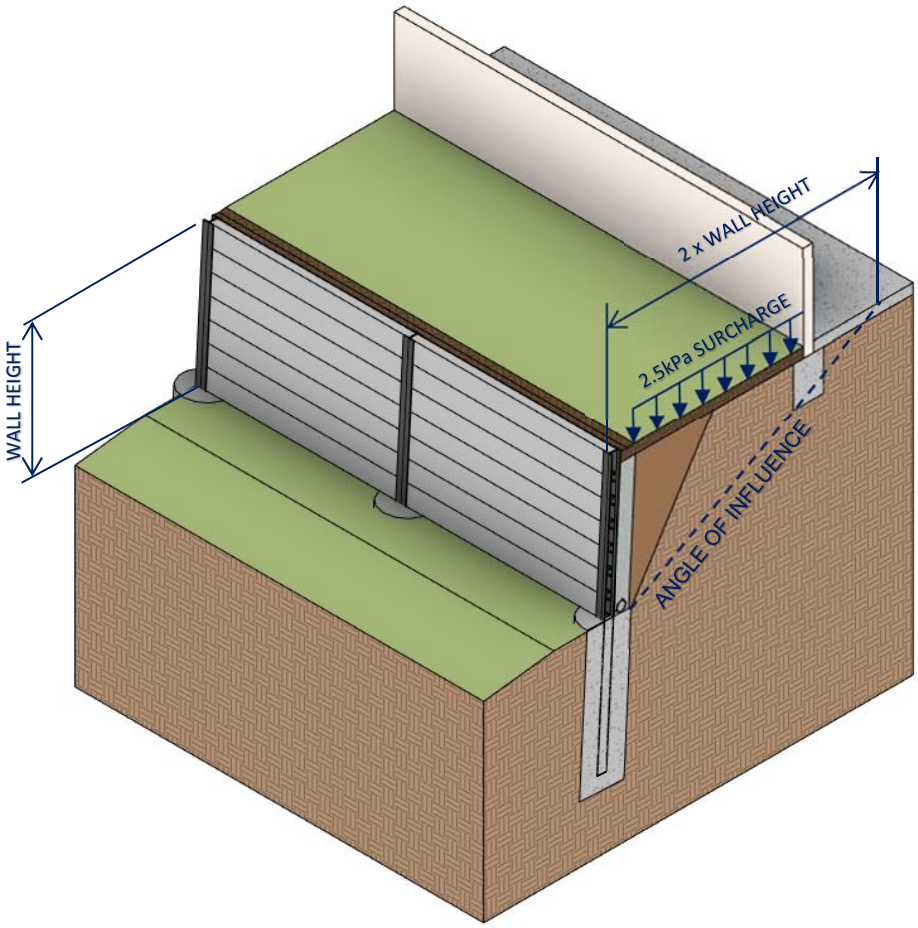

Figure 1 – Sleeper Retaining Wall Angle of Influence

2.7 DRAINAGE

The design graphs in section 5.0 of this brochure have made no allowance for hydrostatic loads (e.g. water pressure). As such, it is imperative that the wall builder implements an appropriate and effective drainage system behind the wall. It is

recommended that a 200mm wide drainage layer (e.g. gravel) be placed against the rear face of the sleepers, and be wrapped in a geofabric layer to separate it from the backfill material. A 100mm diameter slotted and sleeved agi-pipe is to be placed within the drainage layer at the base of the wall, and is to discharge to stormwater infrastructure (refer Figure 4 in section 5.0). An impermeable clay layer and/or cut-off drain should also be placed at the top of the wall to reduce the risk of any potential hydrostatic pressures acting on the wall.

2.8 BATTERING

It is important to consider the effect of post, subgrade, and backfill batters prior to installing a sleeper retaining wall. The following sub-sections discuss the design assumptions made regarding the abovementioned batters.

2.8.1 POST BATTER

Posts for sleeper retaining walls greater than 1000mm high are to be 'laid back' at a minimum batter of 1 in 20 (refer Figure 4 in section 5.0). Posts for walls less than 1000mm high may be installed vertically (e.g. no batter).

2.8.2 SUBGRADE BATTER

Subgrade shall remain flat (e.g. no batter) for a minimum of 500mm in front of the sleeper retaining wall, after which it may begin to slope away from the wall at a maximum batter of 1 in 5 (refer Figure 4 in section 5.0). Expert advice should be sought if this is not achievable.

2.8.3 BACKFILL BATTER

The design graphs in section 5.0 of this brochure have made no allowance for a battered backfill (refer Figure 4 in section 5.0). If the backfill behind the proposed wall will not be flat (e.g. horizontal), then please seek expert advice from a registered engineer.

2.9 WALL TERRACING

Terracing of multiple sleeper retaining walls is permitted, provided that the distance between the two walls is at least twice the height of the lower wall (refer Figure 2 over page).

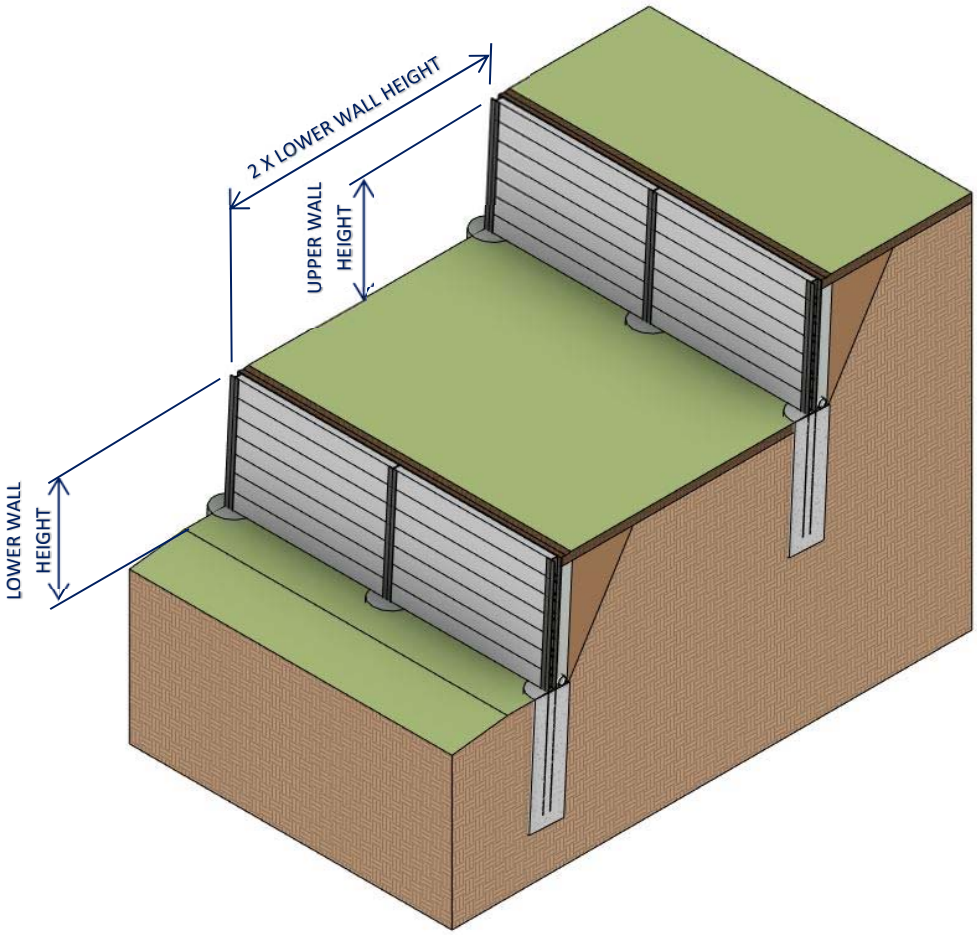

Figure 2 – Sleeper Retaining Wall Terracing

3.0 RELEVANT AUSTRALIAN STANDARDS

The following list of Australian Standards were referenced during the production of the design graphs in section 5.0 of this brochure;

- AS/NZS1170.0-2002 Structural Design Actions – Part 0: General Principals
- AS/NZS1170.0-2002 Structural Design Actions – Part 2: Wind Actions
- AS/NZS2312-2002 Guide to the Protection of Structural Steel Against Atmospheric Corrosion by the use of Protective Coatings
- AS3600-2009 Concrete Structures
- AS4100-1998 Steel Structures
- AS4678-2002 Earth Retaining Structures

4.0 PROCEDURE / EXAMPLE

The following is an example of the step by step procedure required to interpret the design graphs from section 5.0 of this brochure.

- Step 1: Select appropriate foundation material based on professional geotechnical advice

E.g. Foundation = Stiff Clay → Go to 'Stiff Clay' design graphs in section 5.3

- Step 2: Select appropriate fence design option based on proposed wall design

E.g. 1800 High Fence – General Zone → Go to the 'General Zone' design graph

- Step 3: Select appropriate sleeper retaining wall height based on site measurement/survey

E.g. Wall Height = 1400mm → Draw a horizontal line across the 1400 wall height axis

- Step 4: Select appropriate post spacing based on proposed wall design

E.g. Post Spacing = 2000mm → Draw a vertical line from intersection with graph

- Step 5: Read off the recommended post size and footing depth

E.g. Therefore adopt 100UC15 posts and a footing depth of 1450mm.

Refer to Figure 3 below for a diagrammatical explanation of the above design graph interpretation example.

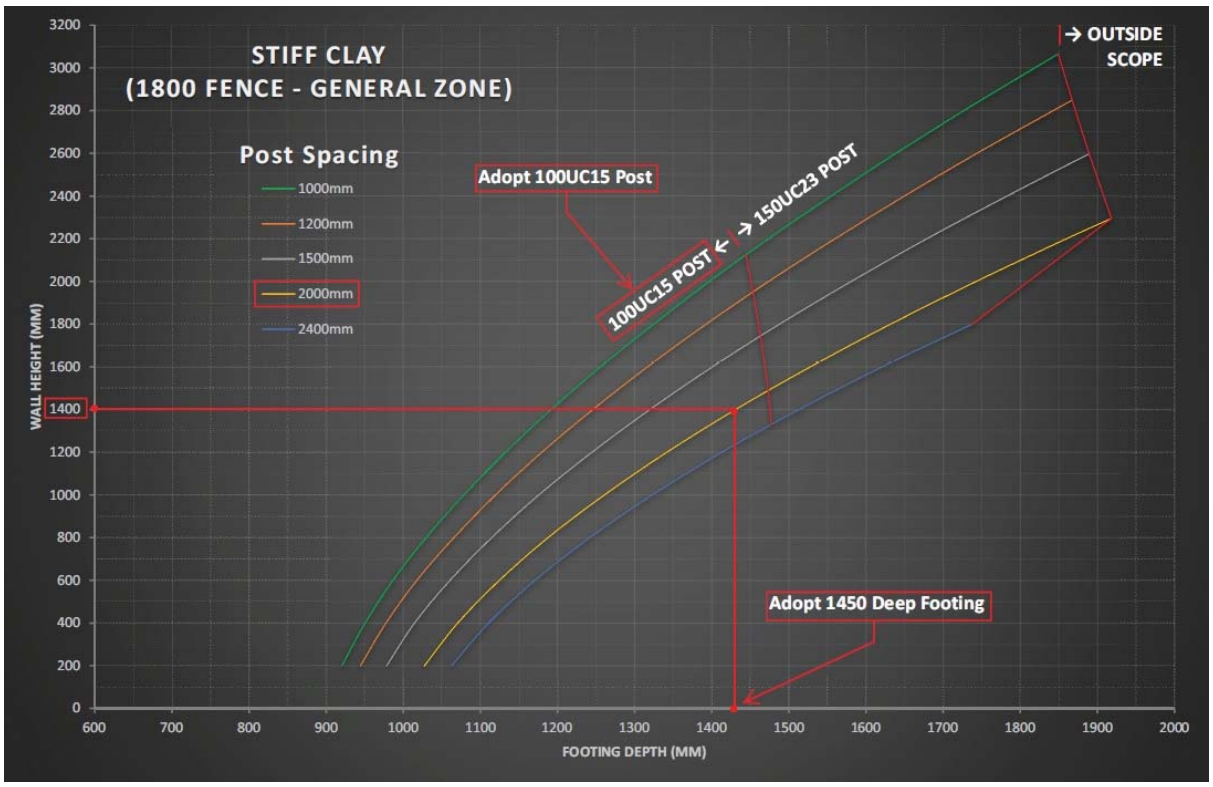

Figure 3 - Design graph procedure / example

5.0 DESIGN GRAPHS

The information provided in the graphs within this section is intended for design guidance purposes only. Ensure that all of the design assumptions listed in section 2.0 are reviewed, and that your proposed sleeper retaining wall satisfies all the necessary criteria before using the below design graphs. If in any doubt regarding interpretation of the information provided, or if your wall falls outside the scope of this brochure, please seek expert advice from a registered engineer. We highly recommend engaging a registered geotechnical engineer to confirm the soil conditions prior to using these design graphs. This is particularly important for walls greater than 2000mm high, as they generally have a larger consequence of failure.

Sleeper retaining walls designed using the following graphs are to be constructed in general accordance with the specifications listed throughout this brochure, and with the typical configuration diagram shown in Figure 4 below.

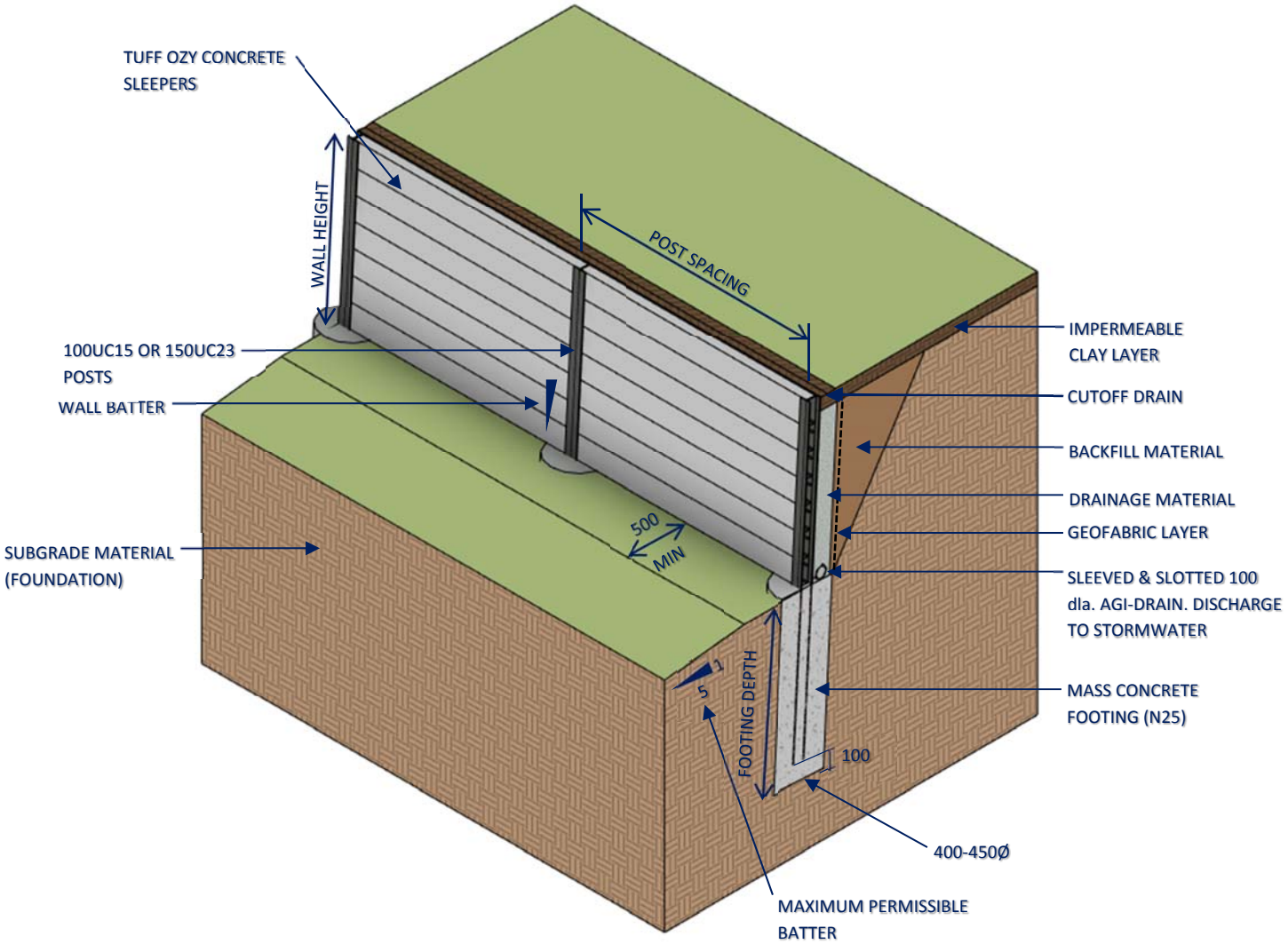

Figure 4 – Typical Sleeper Retaining Wall Configuration

5.1 SAND / GRAVEL FOUNDATION

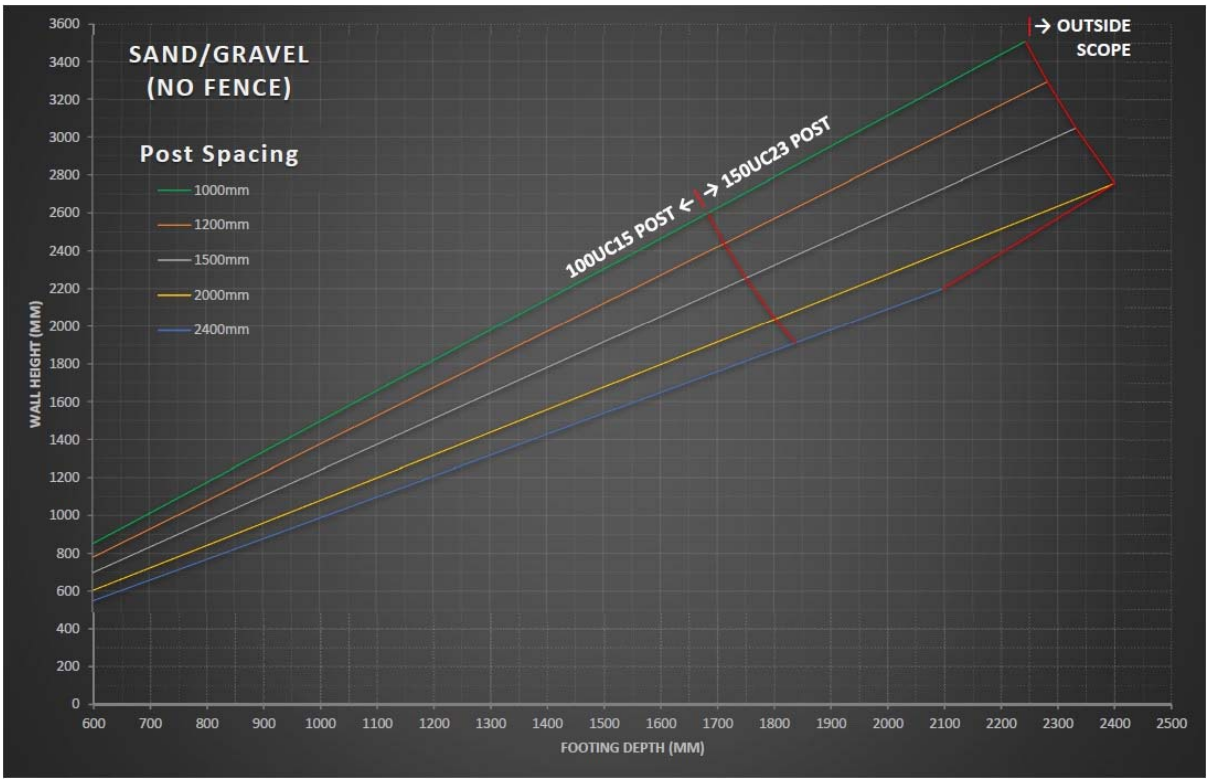

Figure 5 – Sand / Gravel (No Fence) Design Graph

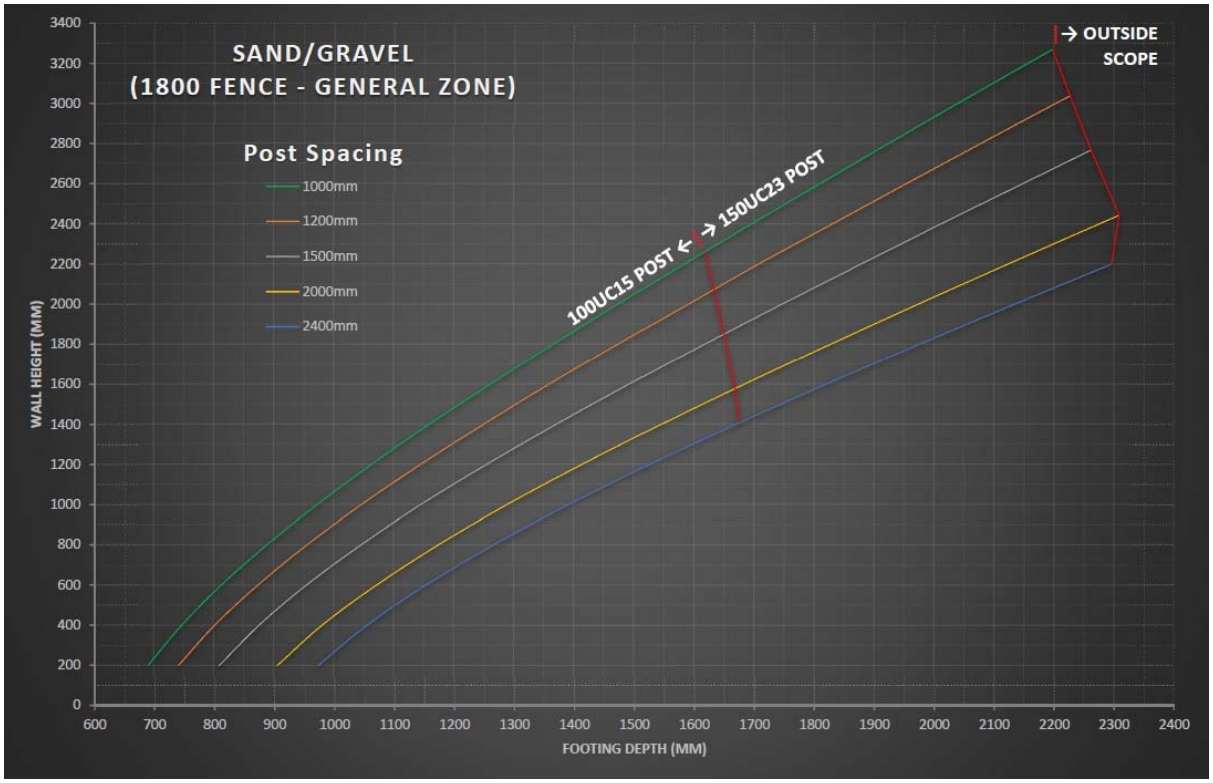

Figure 6 – Sand / Gravel (1800 Fence – General Zone) Design Graph

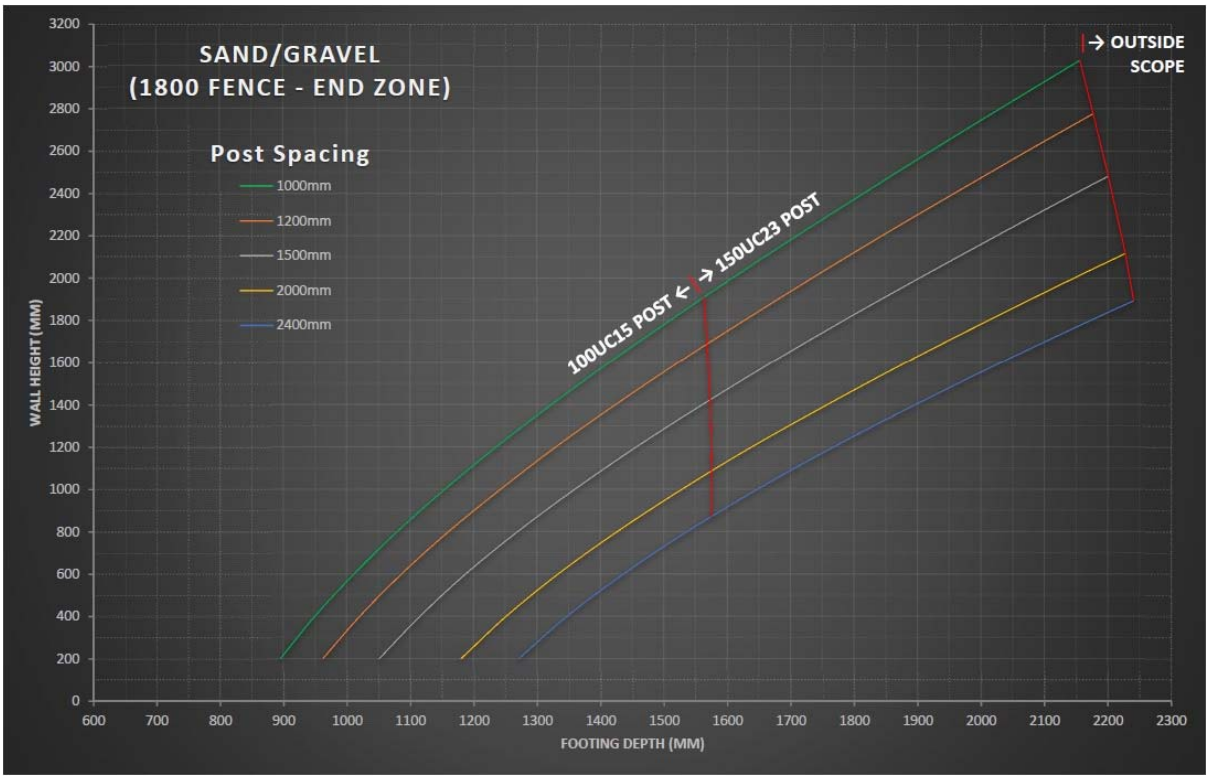

Figure 7 – Sand / Gravel (1800 Fence – End Zone) Design Graph

5.2 SOFT CLAY FOUNDATION

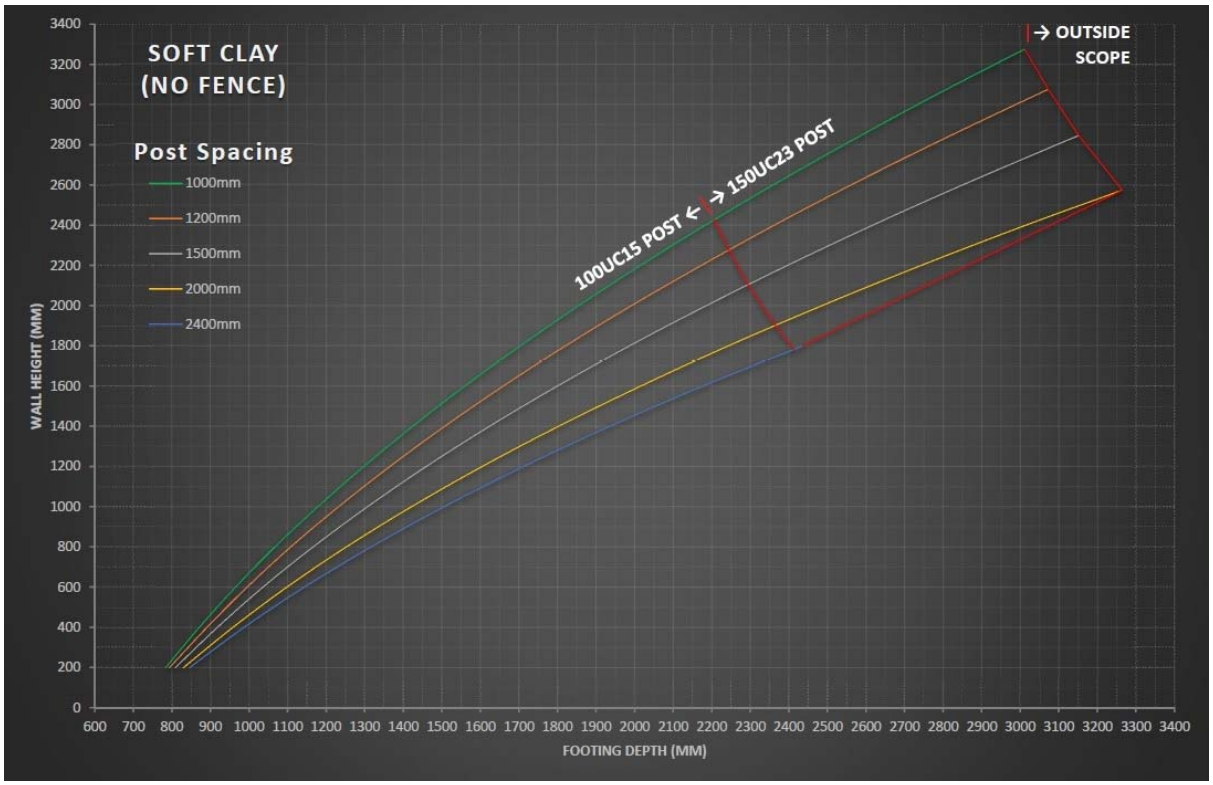

Figure 8 – Soft Clay (No Fence) Design Graph

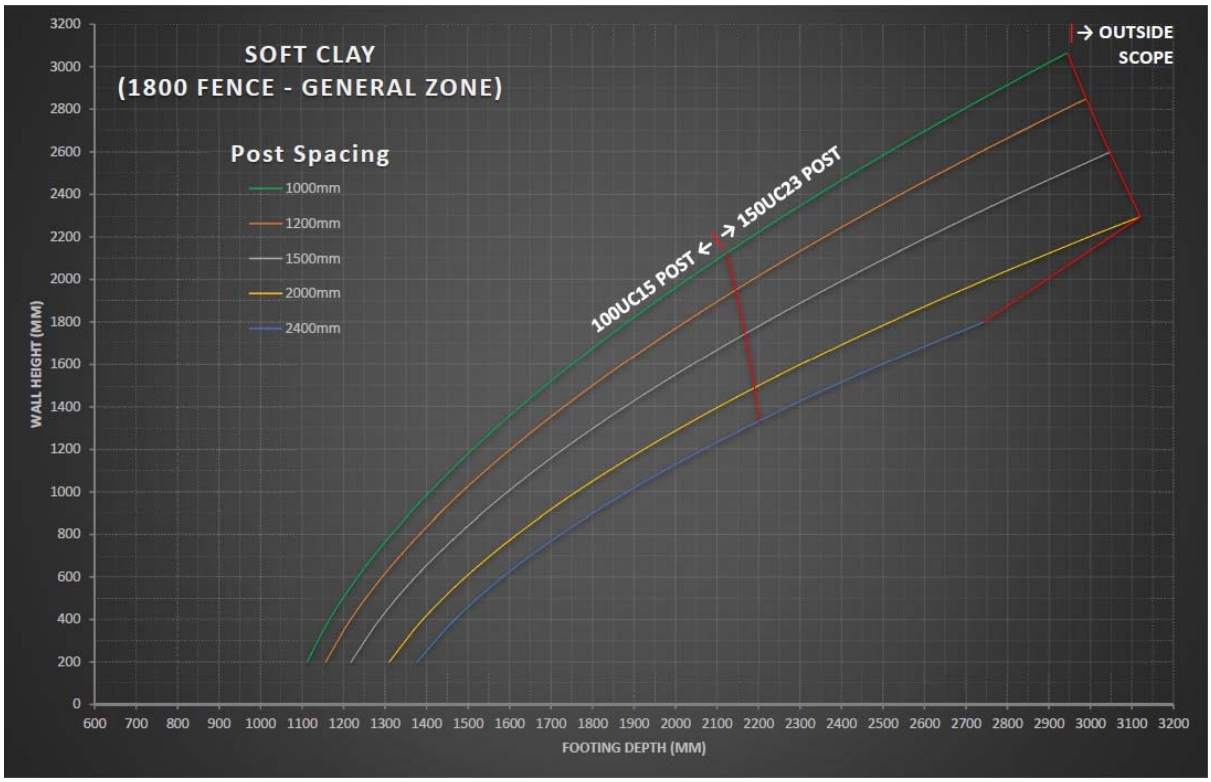

Figure 9 – Soft Clay (1800 Fence – General Zone) Design Graph

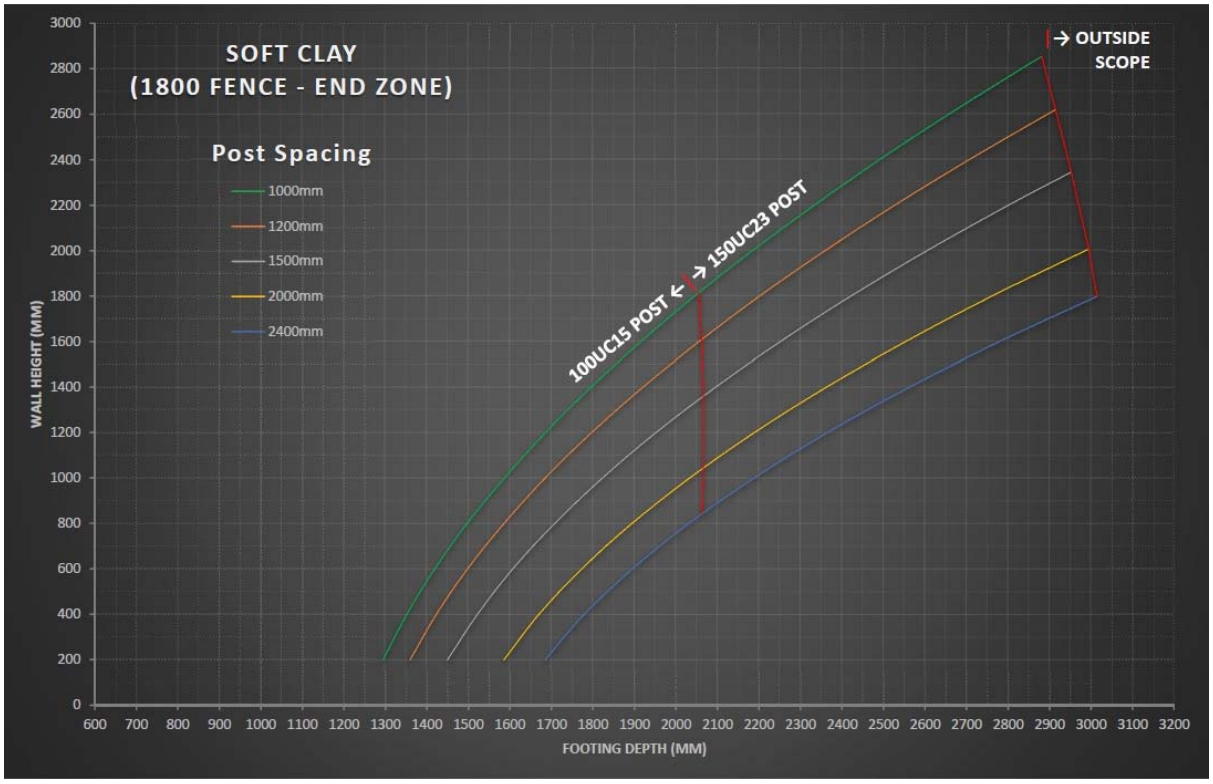

Figure 10 – Soft Clay (1800 Fence – End Zone) Design Graph

5.3 STIFF CLAY FOUNDATION

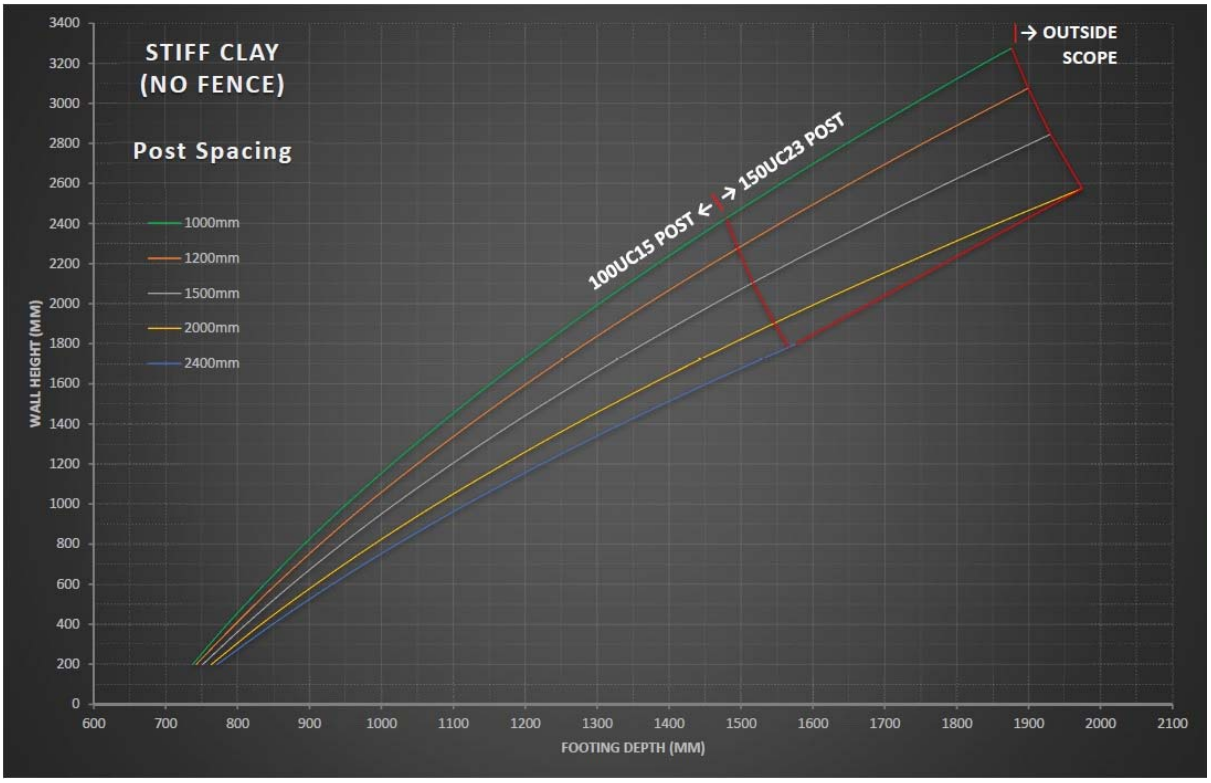

Figure 11 – Stiff Clay (No Fence) Design Graph

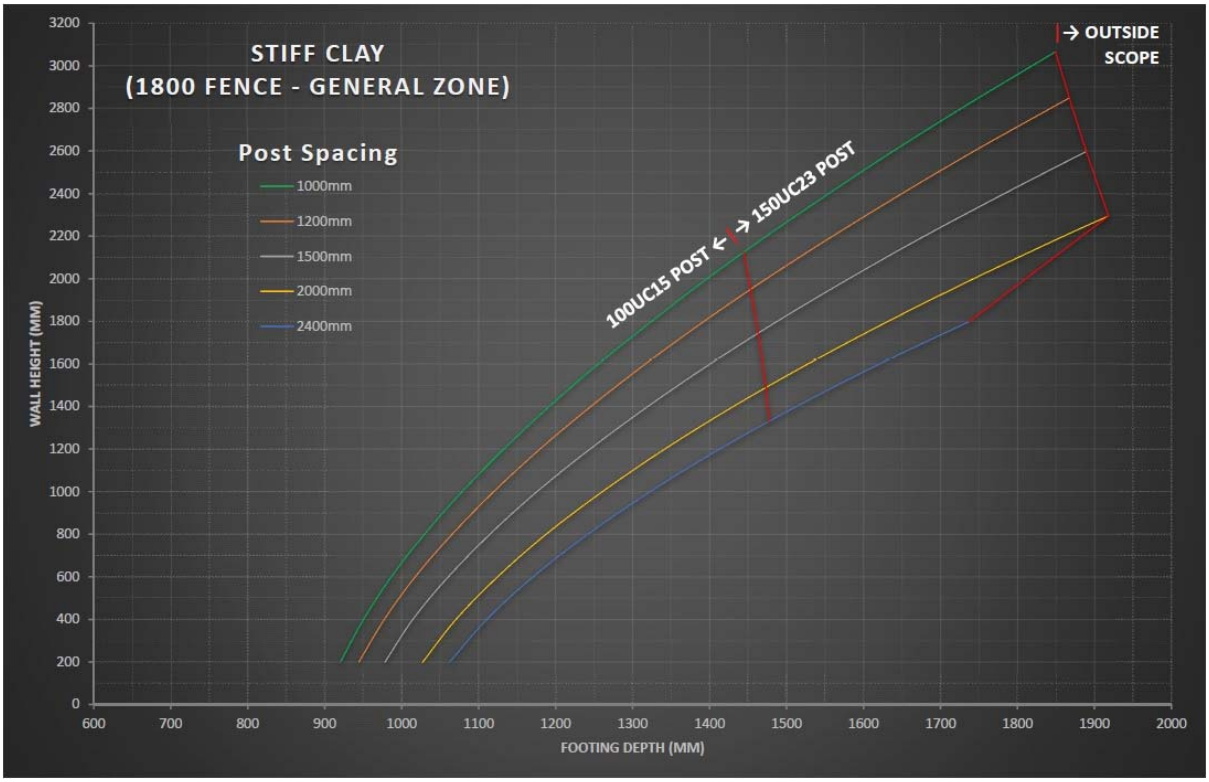

Figure 12 – Stiff Clay (1800 Fence – General Zone) Design Graph

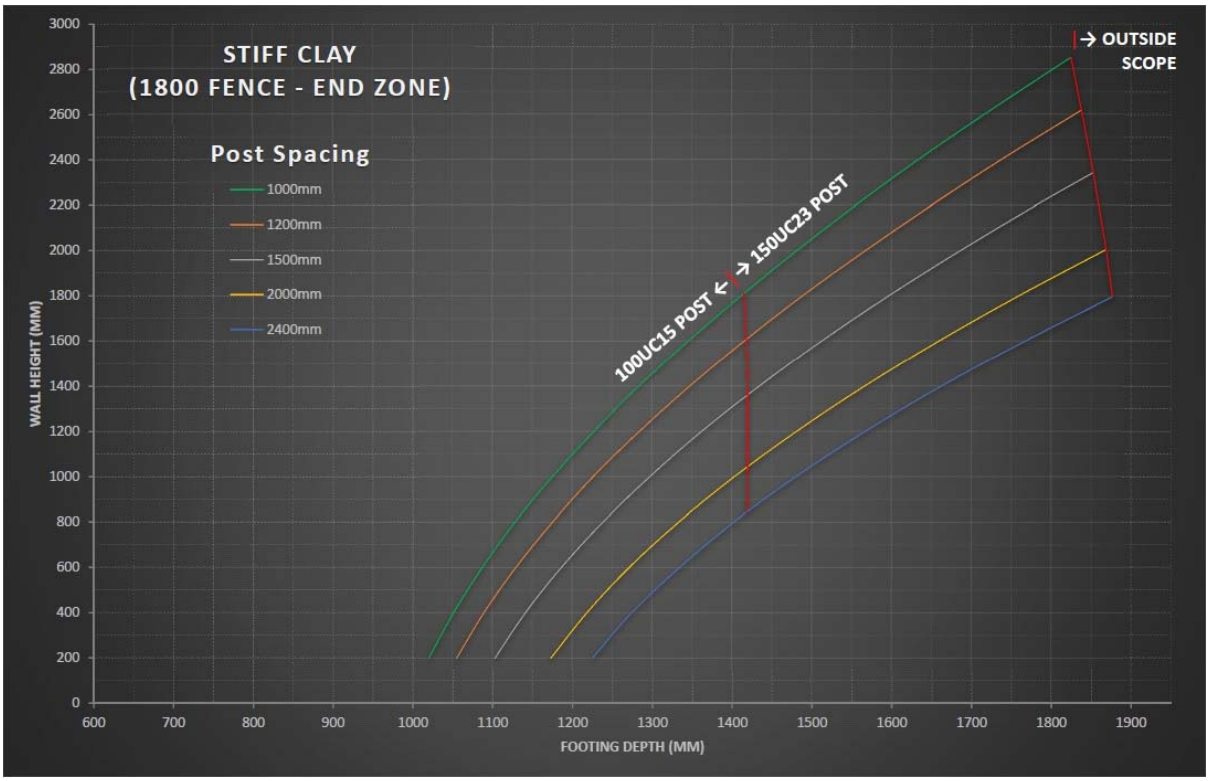

Figure 13 – Stiff Clay (1800 Fence – End Zone) Design Graph