REPERTORY THEATRE

REPERTORY THEATRE ASSESSMENT

4 Ridgway Street, Whanganui

BPL Group
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Whanganui 4500, New Zealand
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Date: 29 November 2021
Job: E9718

1. Executive Summary

We have completed our structural assessment of the existing theatre building.

There are a number of building features which would comprise the likely performance of the building over the next 50+ years.

These include:

- Seismic performance
- Soil conditions
- General condition of the external walls and cladding
- The adjacent steep embankment to the rear of the theatre

We also note that there are functionality shortcomings within the building's architecture.

Accordingly, the remedial work to make good the facility and protect it for the next 50+ years would require significant building works which would include foundation improvements and reconstruction of the masonry end walls in light-weight materials.

2. Introduction

The building comprises of three wings and is constructed primarily of light-weight materials. We understand that the central part of the building was constructed as a library circa 1876. The outer two wings have been added subsequently. We have viewed photographs of the building indicating that the extensions were constructed between 1890 and 1913. The photographs suggest that the extensions took place whilst the building was still functioning as a library and that the large opening between the original portion of the building and the extensions were created as part of that building process, then further widened with the conversion to the theatre. The structure has remained a theatre since then and has a seating capacity of 114.

Apart from the two side walls, the building is constructed out of timber. The original timber floor structure has had a false floor added to it within the auditorium to create the slope that is apparent now. We do not know if the original flooring was removed. The walls are formed with conventional timber framing, clad with a combination of weatherboards and stucco. There is decay within some of the timber weatherboards. The roofing structure comprises of conventional pitched rafters supporting corrugated iron.

The two side walls have been constructed in solid two-skin unreinforced clay masonry. These walls would have been built with the first extensions around 1913 to create a fire separation with the neighbouring properties. Unreinforced clay masonry construction is known to perform poorly in earthquakes.

A mezzanine floor has been constructed above the foyer and dressing rooms. It is used for costume/prop storage and repairs.

When the building was constructed, it appears as though it was cut into the existing sand bank which runs up to Queens Park.

The main risks associated with the building, from a structural point of view, relate to its performance in a major earthquake. Buildings constructed prior to the Napier earthquake (1931) were designed with no consideration for the effects of earthquakes.

The main seismic risks associated with buildings of this age are:

1. The buildings do not have enough lateral load resisting capacity to prevent total collapse in a major earthquake.

2. The buildings do not have sufficient connections to heavy appendages to prevent them falling off the building during an earthquake, e.g., parapet walls.

Unreinforced clay brickwork was a common form of construction at this time. However, it is an undesirable form of construction from a seismic point of view. This is because its weight attracts seismic load, but it has minimal ability to resist these loads due to its lack of ductility.

Fortunately, the unreinforced brickwork on this building is limited to the two end walls. However, these walls do represent a risk to the building and its occupants as they **are not adequately** restrained by the remainder of the building.

At the rear of the theatre a steep sand bank extends up to the road around Queens Park. It is difficult to accurately determine the slope of this bank due to the vegetation, however we have approximately measured it using an Abney level. The maximum slope is around 33 degrees at the bottom of the embankment with the slope progressively reducing the higher you go.

We understand that Whanganui District Council (WDC) is currently investigating remediation of this slope including brick excavation to reduce the embankment slope and appropriate planting.

2. Deferred Maintenance

The building is suffering the effects of deferred maintenance. We have not competed a full assessment of the extent of defects but have noted:

1. Rotten weatherboards – particularly at the rear of the building.

2. Weathered mortar to the unreinforced masonry walls. There are mortar beds that can be easily scraped out with a soft stick.

3. At the rear of the property, an unreinforced masonry retaining wall has failed. It is leaning at in incline of approximately 20 degrees off vertical and propped to the external steps. Whilst we do not consider wall this poses an immediate risk to the building or its occupants, it will eventually need to be replaced. We understand that the bank remediation work will include a replacement retaining wall at the rear of the theatre, approximately 1.5m off the building.

3. Soil Conditions

Entering the theatre, it is immediately obvious that the floor is out of level.

We have carried out a level survey of the ground floor as a true indication of its performance over the life of the building.

We also carried out scala penetrometer and hand auger soil testing where access was possible.

The results of our level survey are attached in Appendix 1. These confirm significant variation in floor levels obviously ignoring the ramp construction associated with the auditorium flooring etc.

The floor plan can be broken into 3 areas for examining relative settlement.

1. Main entry, Super room, Green room. This area is the only section of floor that is at the original level. Both the stage and auditorium have been raised to connect the building to the theatre.

The differential settlement within this area is as much as 64mm between the box office and the external wall of the Green room.

2. Stage. The stage which sits nominally 1 metre above the common floor. However even within this platform, differential settlement of up to 70mm was recorded.

3. Auditorium. The auditorium comprises of a sloping floor from the stage to the control booth. Hence, it is difficult to measure differential settlement in that direction. However, there is significant settlement along a single row of seating which, presumably, would have been constructed at a uniform height above the original floor.

Scala penetrometer testing was carried out at the rear of the theatre where access permitted. The results were somewhat variable – see Appendix 2. The location of the tests is indicated on Appendix 1. However, soils with a bearing capacity of 200 kPa (ULS) were encountered at depths up to 900mm.

Modern construction would typically be founded on soils with a bearing capacity of 300 kPa (ULS), so whilst this soil is not at that level, 200 kPa soils would not typically result in the extent of differential settlement encountered here.

However, the test results at the rear of the building represent soil capacity of the ground that was excavated into to construct the building, so are likely to indicate better conditions than that under the building.

Hand auger testing indicated clean sand. This material would have been suitable for supporting the weight of a building if it was adequately compacted.

Soils with a bearing capacity of 200kPa can be built upon using appropriately enlarged foundations.

4. Structural Assessment

We have carried out a structural assessment of the building in its current form. We have assessed the design wind classification as “high” in accordance with NZS 3604:2011.

We have assessed the seismic performance of the building in accordance with the NZSEE Assessment Guidelines.

The seismic design parameter for the building are as follows:

- Importance Level 2 (IL2)
- Location Whanganui Z =0.25
- Site Sub-soil Class “D” Deep soils
- Ductility $\mu = 3.5$ Timber walls

The greatest seismic risk associated with the building comes from the two unreinforced masonry (URM) walls at each end of the theatre. We have assessed their connections to the building ceiling and floor, then their ability to span vertically between the ceiling and floor assuming the connections are or could be made adequate.

Results are as follows:

They are expressed as a percentage of new building standards (%NBS).

Feature	Ratings
URM Walls (Vertical Span)	30% NBS
URM Parapets (Cantilever)	25% NBS
Fixings	<10% NBS

We have carried out a global assessment of the building to assess the capacity of the existing bracing provisions.

The theatre is currently braced by its timber lined/clad walls. These walls resist the horizontal forces imposed by earthquake acceleration of the building mass. The URM walls contribute approximately 50% of the total building mass and therefore their seismic demand. Their removal and replacement with lightweight materials would have a commensurate improvement to the seismic performance of the building.

We have assessed the seismic capacity of the existing walls in accordance with Section C9 of the NZSEE Guidelines (Table C9.2) assuming fixings are at 300mm centres.

This results in a rating equivalent to 25% NBS. With URM walls replaced and no other improvements made, this figure becomes 40% NBS. Whilst this figure exceeds the NZBC building act threshold for earthquake prone buildings (34% NBS), we would recommend that the building be brought up to at least 67% NBS if a major renovation was planned.

The roof framing appears consistent with construction techniques at the time of construction. Inspection of the roof framing above the stage / backstage area was made. Thus, it does not meet current code provisions.

It is likely that some remedial work will be requested once refurbishment commences. This may be as simple as improving fixings between elements but would also require some additional elements/strengthening.

5. Proposed Upgrade

We have reviewed the architectural proposed prepared by Drawing Room Architecture.

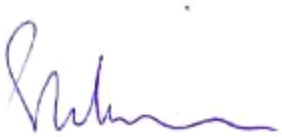
The proposal includes replacing the existing timber floor with a concrete slab to improve accessibility and address the current uneven floor issues. This would also provide opportunity to improve the compaction of the existing soils thus minimising future settlement. New reinforced concrete foundation walls would likely be required to achieve adequate a connection between the new timber shear walls and the floor slab.

A seismic upgrade will include removing the existing URM walls and rebuilding with lightweight materials. Other walls will need to be lined with bracing plywood to create shear walls.

Due to the current poor condition of the weatherboard cladding, it is likely that moisture damage has occurred with some of the wall framing. It is likely that sections of wall framing will require replacement.

The architectural proposal does not alter the existing roof geometry.

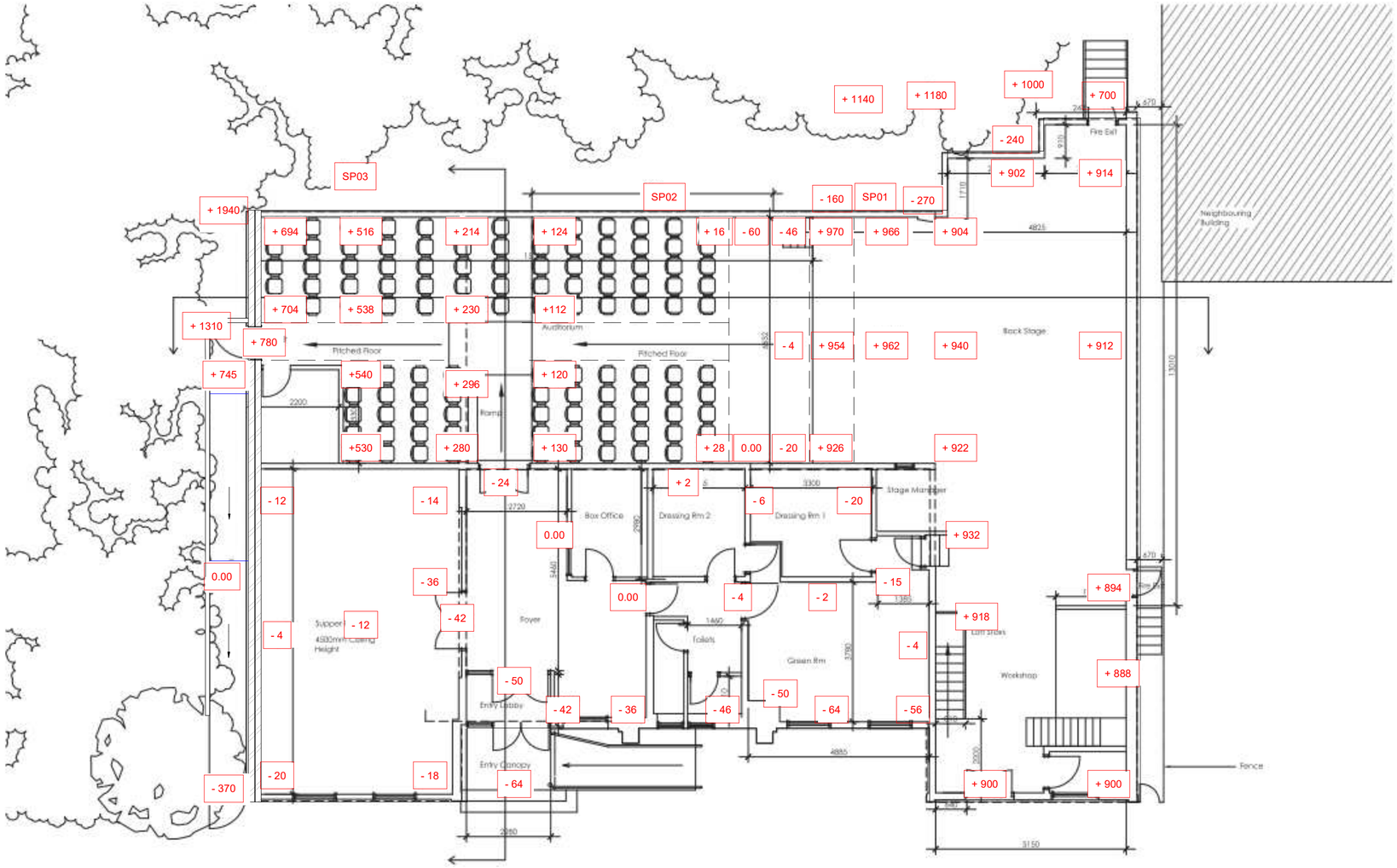
We trust that above is of assistance, however, should you wish to discuss any aspects of the above, please do hesitate to contact the writer.



STUART MACKINTOSH
CMEng CPEng

Encl.

APPENDIX A



LEVELS PLAN

1 : 100

CONSULTING ENGINEERS
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WHANGANUI DISTRICT COUNCIL

4 RIDGWAY STREET, WHANGANUI

REPERTORY THEATRE RETAINING WALL

LEVELS PLAN

ISSUE	REASON	DRAWN	DATE

Designed	SJM
Drawn	MPR
Checked	
Date	SEPTEMBER 2019
Job No.	9718
Scale	1 : 100
Sheet Size	A2
Sheet No.	S2.1
Issue	

APPENDIX B

BPL GROUP LTD
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Client: REPERTORY BOTTOM OF BANK		**Job No.** 9718	**Page** 1
Job: GROUND INVESTIGATION		**Date** Jul-21	**By** BPL

SCALA PENETROMETER TEST

Test Location: NORTH WEST

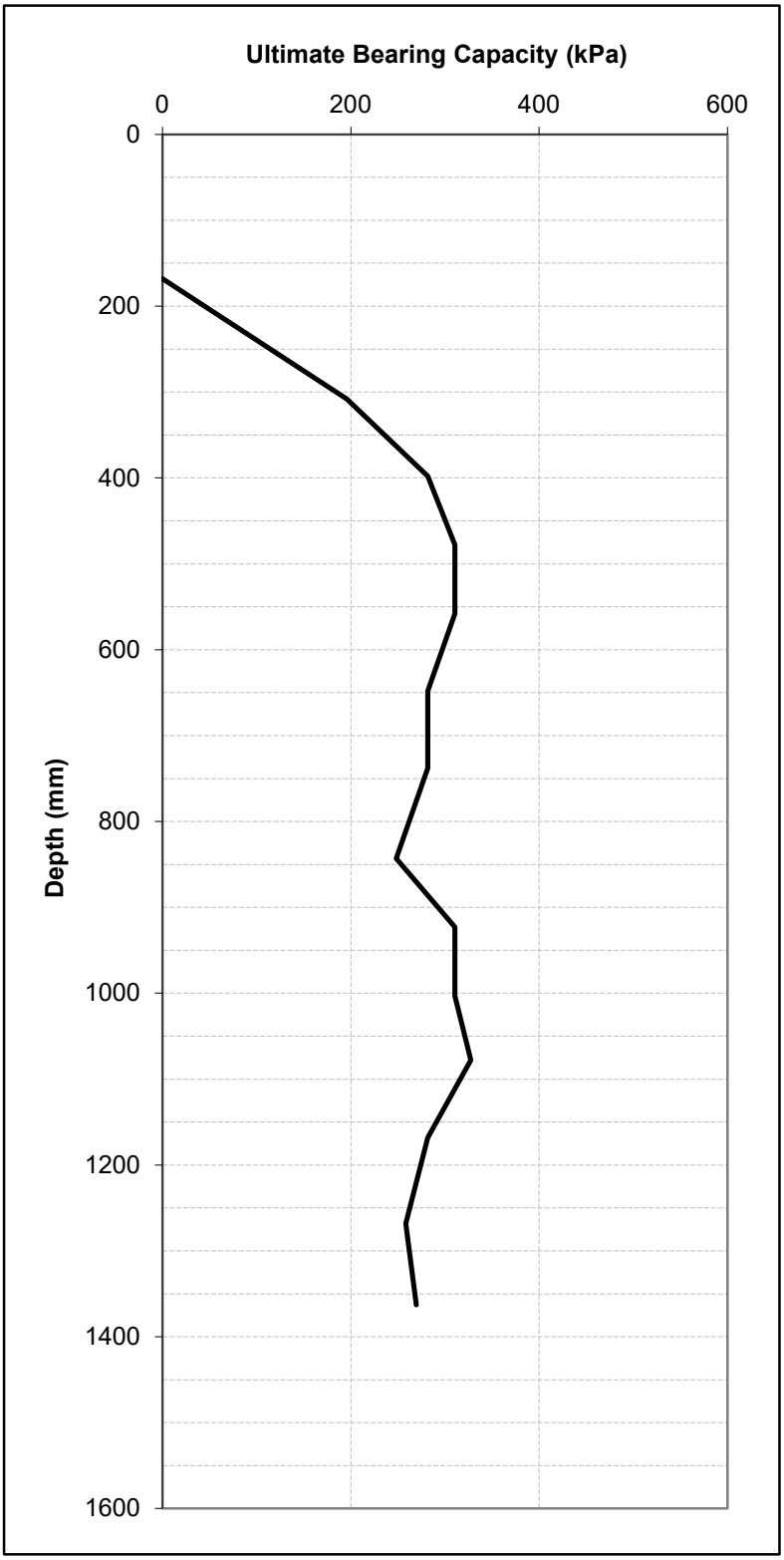
Site Description:

Test Number: SP01

LD: **GL:**

Starting Measurement
1330 mm
Depth of Excavation
168 mm

Blows (no.)	Depth (mm)	Soil Description
3	1190	
3	1100	
3	1020	
3	940	
3	850	
3	760	
3	655	
3	575	
3	495	
3	420	
3	330	
3	230	
3	135	



Probe Description:
9 kg Hammer falling 510 mm to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

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SCALA PENETROMETER TEST

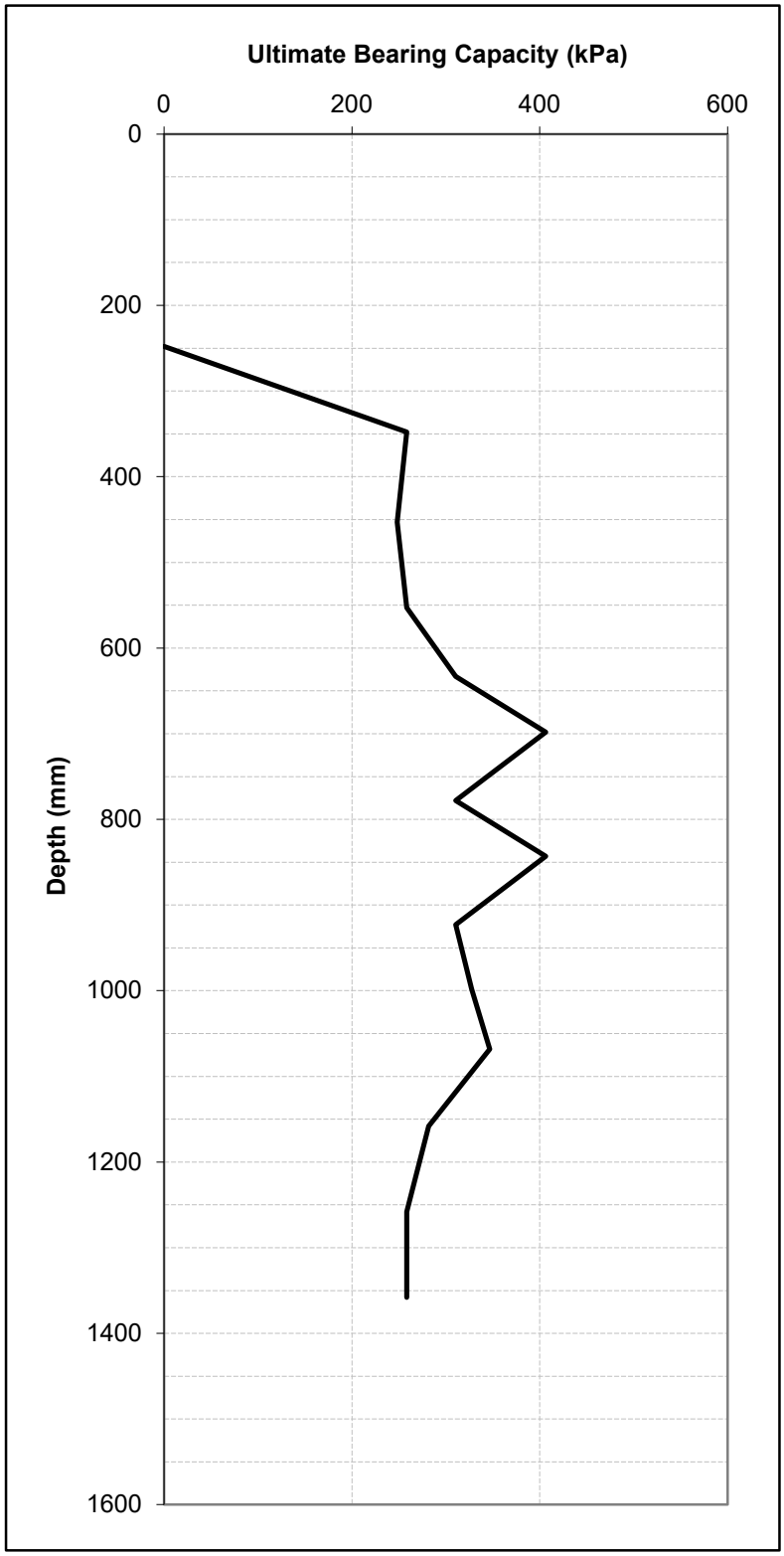
Test Location: NORTH WEST CENTRE OF HALL
Site Description:

Test Number: SP02

LD: **GL:**

Starting Measurement
1250 mm
Depth of Excavation
248 mm

Blows (no.)	Depth (mm)	Soil Description
3	1150	
3	1045	
3	945	
3	865	
3	800	
3	720	
3	655	
3	575	
3	500	
3	430	
3	340	
3	240	
3	140	



Probe Description:
9 kg Hammer falling 510 mm to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.

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Client: REPERTORY SLOPE OF BANK		**Job No.** 9718	**Page** 3
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SCALA PENETROMETER TEST

Test Location: SOUTH WEST

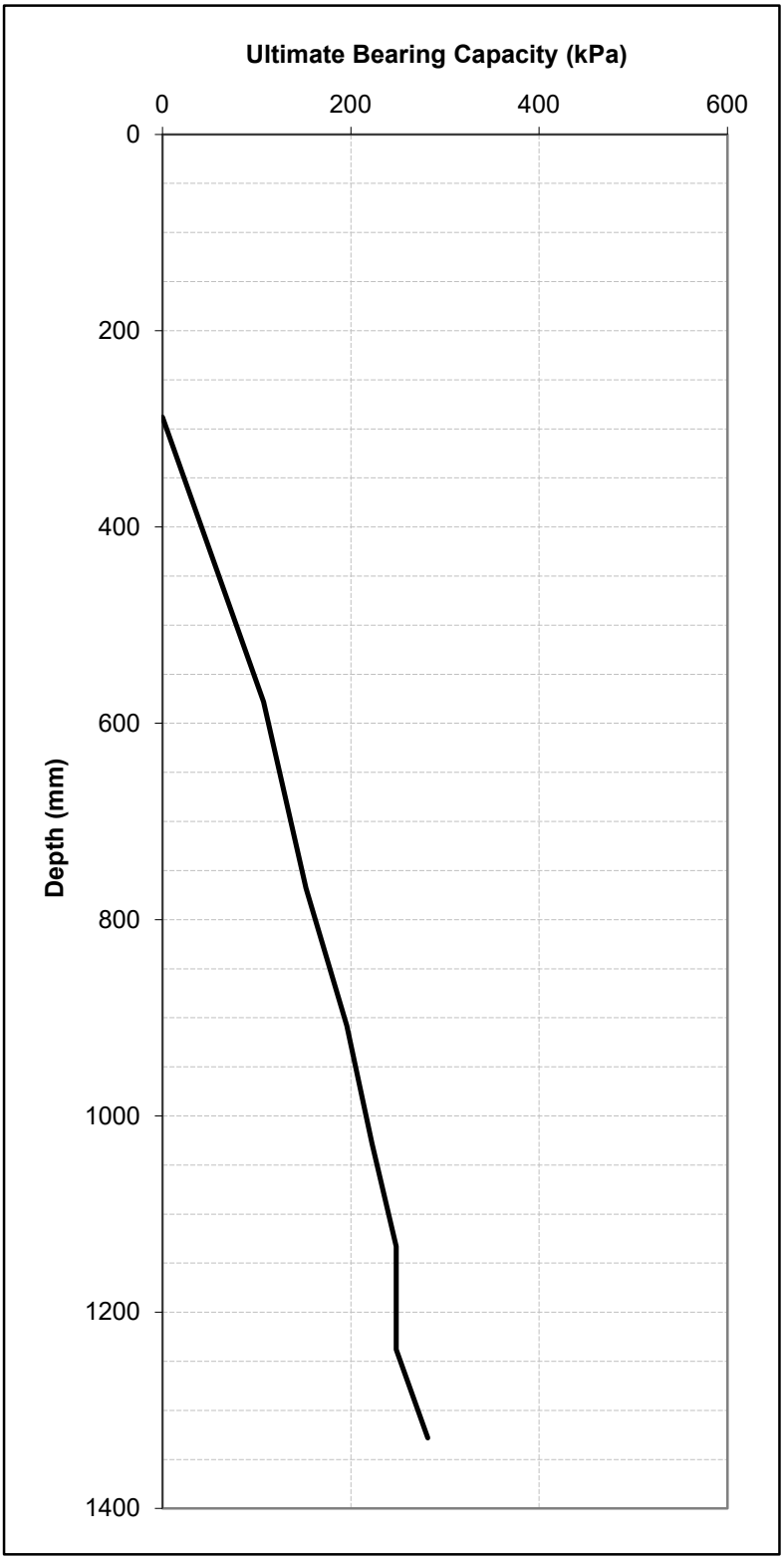
Site Description:

Test Number: SP03

LD: **GL:**

Starting Measurement
1210 mm
Depth of Excavation
288 mm

Blows (no.)	Depth (mm)	Soil Description
3	920	
3	730	
3	590	
3	470	
3	365	
3	260	
3	170	



Probe Description:
9 kg Hammer falling 510 mm to a steel anvil, driving a 16 mm diameter rod fitted with a 20 mm diameter cone.