Basement Impact Asesessment

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September 2014

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Job ref	93 Hillway
Sheet	: Design Output
Made By	: RAS
Date	**: 24-3-14**
Checked	**: PZ**
Approved	: **27.3.14**

93 Hillway Structural proposals and design

The following issues have been considered and addressed in the initial design assessment for construction of this swimming pool

- Existing Structure
- Ground conditions
- Drainage
- New swimming pool structure
- Structural design and calculations
- Structural drawings
- Construction Method Statement and Sequence of work

Initial appraisal

Existing structure

Number 93 Hillway is a two storey self contained terraced house plus a loft room. The main walls are generally solid brick masonry walls on traditional step footings. Timber floor construction on the uppers floors supported by the external solid and internal spine walls. There is an existing swimming pool at the rear of the house elevated from the ground in the exact location. The proposals are to reconstruct and remodel this pool. Therefore the local ground in this area will not be subjected to any additional load as the new excavation will remove the overburden pressure of the earth from its current location.

Ground conditions

Full trial pit and ground investigations have been carried out and data collected has been discussed in detail in the Impact assessment report carried out bu Southern Testing.

Drainage

Full CCTV survey of the existing drainage has been carried out and this data will be used for the design of a new underground drainage system as part of the main refurbishment of the house. The details of the new drainage design will be incorporated with the main construction and refurbishment package for the house after design offered by specialist pool consultant which will include the design of the pumps.

New swimming pool structure

Having assessed the ground conditions we have concluded that the most appropriate method of construction for this pool will be a conventional reinforced concrete retaining wall and raft box construction.

In order to minimise disturbance to the adjoining property the construction will be formed in stages like an underpinning format and each pin and excavation will be propped in all directions using trench sheeting and flying shores.

Structural Design & Calculations

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Structural Design and calculations

Design in accordance with:

Imposed Loadings	**BS 6399 : 1996**	**Part 1**
Dead Loads	**BS 648 : 1964**	
Foundations	**BS 8004 : 1986**	

Materials to be used are:

Concrete C35 Cement content 330 kgm-3

Design process

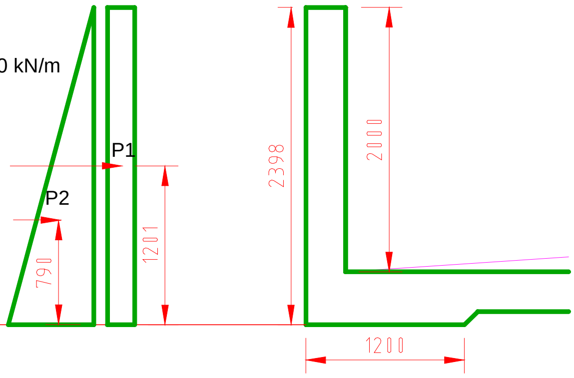
The structural design process involves calculating the ultimate loading on the walls and the base of the retaining wall structure both in saturated and dry conditions. This will include all the surcharges and loads influenced by the surrounding area. Design will consider both temporary and permanent condition and consideration will be given to propping in the temporary condition to neutralise all loads on the new construction. Ultimately the retaining wall will be designed as a cantilever.

DRY

Horizontal forces

P1 surcharge = 1.5 x 2.398 x 0.27 = 0.97 kN/m

P2 Pressure from ground 18 x 2.4x2.4/2 x 0.27 = 14.0 kN/m



Overturning moment about base

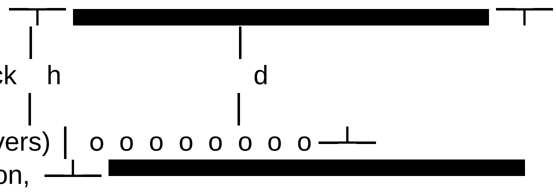
0.97 x 1.2 + 14 x 1.2 = 18 kNm

Design moment = 18 x 1.6 = 29 kNm

Design of RC retaining wall as a cantilever

Design of solid r.c. slabs reinforced in tension only.

Calculations for singly-reinforced
slabs using formulae in Cl.3.4.4.4,
i.e. assuming rectangular stress block
and restricting n.a. depth to 0.4*d at
supports (except supports to cantilevers)
and 0.5*d near midspan (redistribution,
if any, limited to 10%).



Design to BS8110(1997) with partial safety factor for steel gammaS=1.15
Section location: At support of cantilever.
Ultimate moment (after redstrb.) M=29 kNm per metre width
Characteristic concrete strength fcu=35 N/mm¬2
Characteristic strength of steel fy=400 N/mm¬2

fy has been set to less than the characteristic strength in order to achieve a design which satisfies span/effective-depth requirements.

Diameter of tension bars dia=12 mm

Minimum nominal cover to all steel is 20 mm
Nominal concrete cover cover=75 mm
Overall thickness of slab h=300 mm

Maximum effective depth dmax=h-cover-dia/2=300-75-12/2
=219 mm

Effective depth of section d=219 mm

Longitudinal reinforcement

At support of cantilever:
assuming no redistribution betab=1
and resistance-moment factor K'=0.156
Actual resistance-moment factor K=M*10^6/(1000*d^2*fcu)
=29*10^6/(1000*219^2*35)
=0.017276
As this does not exceed K'(i.e. 0.156) comp.steel is not needed
and lever arm z=d*(0.5+SQR(0.25-K/0.9))
=219*(0.5+SQR(0.25-0.017276/0.9))
=214.71 mm
but as this must not exceed a maximum value of 0.95*d=208.05 mm,
adopt a value of lever-arm z of 208.05 mm

Area of tension steel required As=M*10^6/(fy/gammaS*z)
=29*10^6/(400/1.15*208.05)
=400.75 mm2/m
Cold-worked bars; thus min.permissible area is 0.13% of gross section.
As 3*d<750 mm, maximum clear distance between bars
for tension steel maxcl=3*d=3*219=657 mm, and
maximum spacing (c.to c.of bars) pchmx=3*d+dia=669 mm
Calculated c.to c.spacing for tension bars

pch=1000*PI/4*dia^2/As
=1000*3.1416/4*12^2/400.75
=282.22 mm
As this does not exceed maximum permissible spacing of 669 mm,
employ this value.
Round spacing (c.to c.of bars) to 280 mm (rounded).
Chosen spacing of tension bars pch=100 mm
Area of tension steel provided Aspr=1000/pch*PI*dia^2/4
=1000/100*3.1416*12^2/4
=1131 mm2/m

Spacing and proportion of tension steel (see Clause 3.12.11.2.7)

Tension steel provided per=Aspr/(10*h)=1130/(10*300)
=0.37667 % of gross section.
As this falls within Code limits of 0.13% and 4%, this is satisfactory.

Basic clear distance allowed between tension bars (see Cl.3.12.11.2.4)
is given by cdist=47000*3*Aspr*betab/(2*fy*As)
=47000*3*1130*1/(2*400*400.75)
=496.98 mm
As this exceeds permitted limit of 300 mm, take cdist=300 mm
As the amount of tension steel provided is less than 1%, Clause
3.12.11.2.7(b) permits the maximum bar spacing to be increased to
300÷percentage; i.e. 796.46 mm, but as this then exceeds (pchmx-dia);
i.e. 657 mm, final maximum value for bar spacing cdist=657 mm

As max.allowable pitch of cdist+dia=669 mm exceeds the rounded
value determined above (i.e. 100 mm), the above pitch is satisfactory.

Minimum distribution steel required

Minimum steel area (Table 3.25) Asmin=0.0013*1000*h=0.0013*1000*300
=390 mm2/m width.
Diameter of distribution bars diamn=8 mm

As 3*d does not exceed 750, max.permiss.clear spacing of bars is 3*d
and thus maximum permiss.pitch pchmx=3*d+diamn=3*219+8=665 mm
Max.pitch for distribution steel pchmn=1000*PI/4*diamn^2/Asmin
=1000*3.1416/4*8^2/390
=128.89 mm,
which is O.K. as it does not exceed the limit pchmx (i.e. 665. mm)
=125 mm (rounded).
Spacing of distribution bars pchDA=200 mm
Value used (200) exceeds expected maximum value of 128.89
Area of dist.steel provided Asmpr=1000*PI/4*diamn^2/pchDA
=1000*3.1416/4*8^2/200
=251.33 mm2/m

TENSION REINFORCEMENT SUMMARY

Characteristic strength 400 N/mm¬2
Diameter of bars 12 mm
Spacing of bars 100 mm
Effective depth 219 mm
Area of steel required 400.75 mm2/m
Area of steel provided 1130 mm2/m
Percentage provided 0.37667 %
Weight of steel provided 8.87 kg/m¬2

DISTRIBUTION REINFORCEMENT SUMMARY

Characteristic strength 400 N/mm¬2
Diameter of bars 8 mm
Spacing of bars 200 mm
Depth to bar centres 209 mm
Area of steel required 390 mm2/m
Area of steel provided 251 mm2/m
Percentage provided 0.083667 %
Weight of steel provided 1.97 kg/m¬2

Check on span/effective-depth ratio

Basic ratio for cantilever slab bs'd=7 (see Table 3.9)
Area of tension steel provided Aspr=1130 mm¬2
Service stress in this steel fs=2*fy*As/(3*Aspr)
=2*400*400.75/(3*1130)
=94.571 N/mm¬2
As applied-moment factor M'bd2=M*10^6/(1000*d^2)
=29*10^6/(1000*219^2)
=0.60466
From equation 7 modf1=0.55+(477-fs)/(120*(0.9+M'bd2))
=0.55+(477-94.571)/(120*(0.9

+0.60466))
=2.668
but this cannot exceed 2, so modf1=2
Mod.factor for tension steel modf1=2
Mod.factor for no comp.steel modf2=1.0
Maximum permissible
span/effective-depth ratio ps'd=bs'd*modf1*modf2=7*2*1
=14
Effective span of slab span=2 m
True span/effective-depth ratio as'd=1000*span/d=1000*2/219
=9.1324

As this does not exceed 14, this is Acceptable.

Saturated condition

SATURATED

Horizontal forces

P1 surcharge = 1.5 x 2.398 x 0.27 = 0.97 kN/m

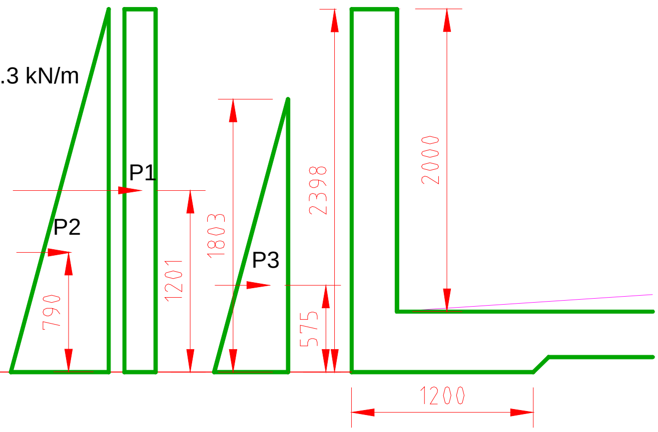
P2 Pressure from ground 10.8 x 2.4x2.4/2 x 0.27 = 8.3 kN/m

P3 hydraulic pressure 10 x 1.8 x 1.8/2 = 16.2 kN/m

Overturning moment about base

0.97 x 1.2 + 8.3 x 0.79 + 25 x 0.575 = 22 kNm

Design moment = 22 x 1.6 = 36 kNm



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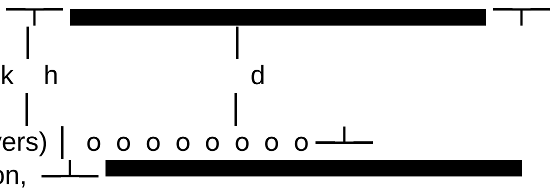
Design of RC cantilever

Location: Typical continuous slab reinforced with high-yield steel

Design of solid r.c. slabs reinforced in tension only.

Calculations for singly-reinforced
slabs using formulae in Cl.3.4.4.4,
i.e. assuming rectangular stress block
and restricting n.a. depth to 0.4*d at
supports (except supports to cantilevers)
and 0.5*d near midspan (redistribution,
if any, limited to 10%).



Design to BS8110(1997) with partial safety factor for steel gammaS=1.15
Section location: At support of cantilever.
Ultimate moment (after redstrb.) M=36 kNm per metre width
Characteristic concrete strength fcu=35 N/mm¬2
Characteristic strength of steel fy=400 N/mm¬2

fy has been set to less than the characteristic strength in order to
achieve a design which satisfies span/effective-depth requirements.

Diameter of tension bars dia=12 mm

Minimum nominal cover to all steel is 20 mm
Nominal concrete cover cover=75 mm
Overall thickness of slab h=300 mm

Maximum effective depth dmax=h-cover-dia/2=300-75-12/2
=219 mm
Effective depth of section d=219 mm

Longitudinal reinforcement

At support of cantilever:
assuming no redistribution betab=1
and resistance-moment factor K'=0.156
Actual resistance-moment factor K=M*10^6/(1000*d^2*fcu)
=36*10^6/(1000*219^2*35)
=0.021446
As this does not exceed K'(i.e. 0.156) comp.steel is not needed
and lever arm z=d*(0.5+SQR(0.25-K/0.9))
=219*(0.5+SQR(0.25-0.021446/0.9))
=213.65 mm
but as this must not exceed a maximum value of 0.95*d=208.05 mm,
adopt a value of lever-arm z of 208.05 mm

Area of tension steel required As=M*10^6/(fy/gammaS*z)
=36*10^6/(400/1.15*208.05)
=497.48 mm2/m
Cold-worked bars; thus min.permissible area is 0.13% of gross section.

As 3*d<750 mm, maximum clear distance between bars
for tension steel maxcl=3*d=3*219=657 mm, and
maximum spacing (c.to c.of bars) pchmx=3*d+dia=669 mm
Calculated c.to c.spacing for tension bars

Office: 6245
pch=1000*PI/4*dia^2/As
=1000*3.1416/4*12^2/497.48
=227.34 mm
As this does not exceed maximum permissible spacing of 669 mm,
employ this value.
Round spacing (c.to c.of bars) to 225 mm (rounded).
Chosen spacing of tension bars pch=100 mm
Area of tension steel provided Aspr=1000/pch*PI*dia^2/4
=1000/100*3.1416*12^2/4
=1131 mm2/m

Spacing and proportion of tension steel (see Clause 3.12.11.2.7)

Tension steel provided per=Aspr/(10*h)=1130/(10*300)
=0.37667 % of gross section.
As this falls within Code limits of 0.13% and 4%, this is satisfactory.

Basic clear distance allowed between tension bars (see Cl.3.12.11.2.4)
is given by cdist=47000*3*Aspr*betab/(2*fy*As)
=47000*3*1130*1/(2*400*497.48)
=400.35 mm
As this exceeds permitted limit of 300 mm, take cdist=300 mm
As the amount of tension steel provided is less than 1%, Clause
3.12.11.2.7(b) permits the maximum bar spacing to be increased to
300÷percentage; i.e. 796.46 mm, but as this then exceeds (pchmx-dia);
i.e. 657 mm, final maximum value for bar spacing cdist=657 mm

As max.allowable pitch of cdist+dia=669 mm exceeds the rounded
value determined above (i.e. 100 mm), the above pitch is satisfactory.

Minimum distribution steel required

Minimum steel area (Table 3.25) Asmin=0.0013*1000*h=0.0013*1000*300
=390 mm2/m width.
Diameter of distribution bars diamn=8 mm

As 3*d does not exceed 750, max.permiss.clear spacing of bars is 3*d
and thus maximum permiss.pitch pchmx=3*d+diamn=3*219+8=665 mm
Max.pitch for distribution steel pchmn=1000*PI/4*diamn^2/Asmin
=1000*3.1416/4*8^2/390
=128.89 mm,
which is O.K. as it does not exceed the limit pchmx (i.e. 665. mm)
=125 mm (rounded).
Spacing of distribution bars pchDA=200 mm
Value used (200) exceeds expected maximum value of 128.89
Area of dist.steel provided Asmpr=1000*PI/4*diamn^2/pchDA
=1000*3.1416/4*8^2/200
=251.33 mm2/m

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TENSION REINFORCEMENT SUMMARY

Characteristic strength 400 N/mm¬2
Diameter of bars 12 mm
Spacing of bars 100 mm
Effective depth 219 mm
Area of steel required 497.48 mm2/m
Area of steel provided 1130 mm2/m
Percentage provided 0.37667 %
Weight of steel provided 8.87 kg/m¬2

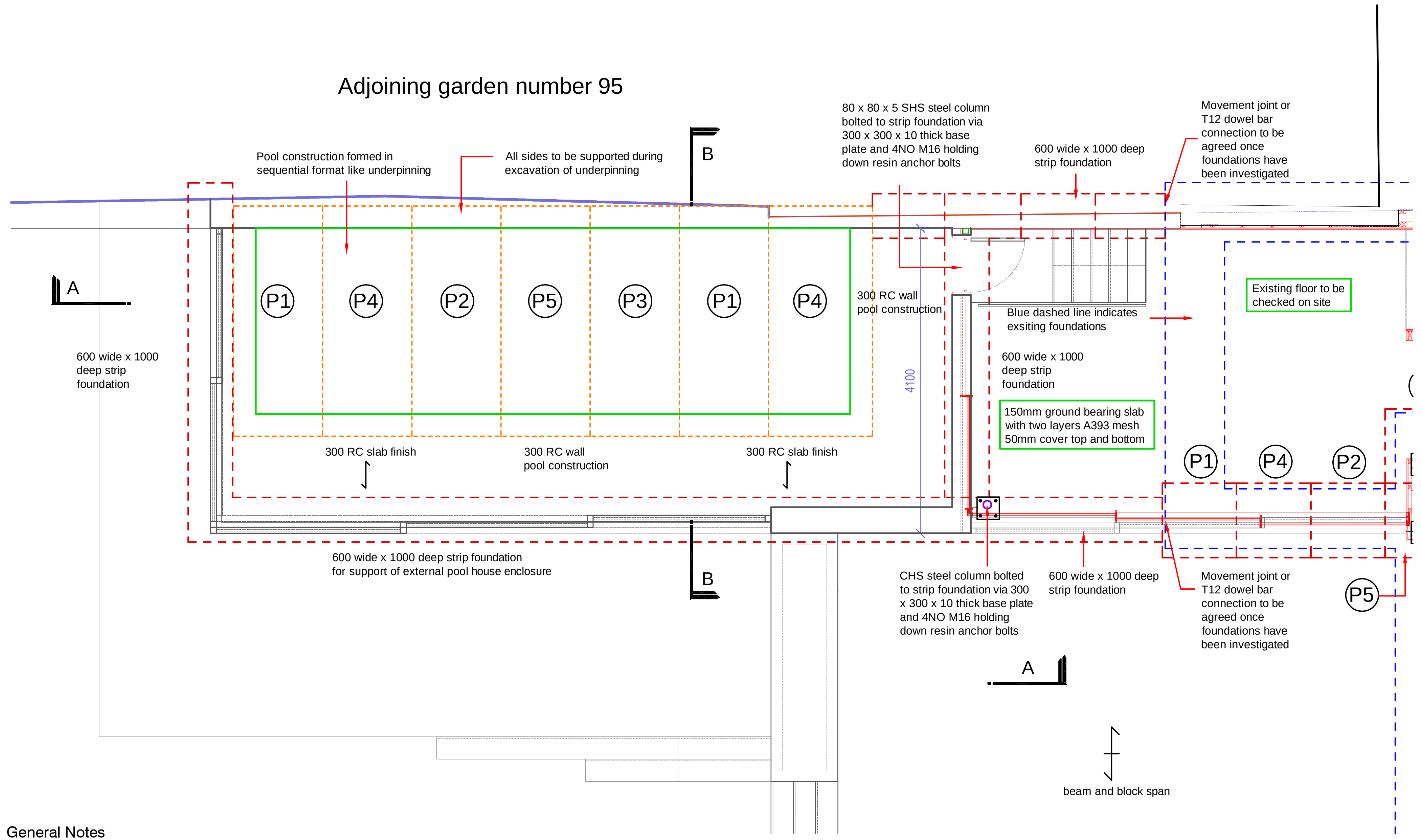
DISTRIBUTION REINFORCEMENT SUMMARY

Characteristic strength 400 N/mm¬2
Diameter of bars 8 mm
Spacing of bars 200 mm
Depth to bar centres 209 mm
Area of steel required 390 mm2/m
Area of steel provided 251 mm2/m
Percentage provided 0.083667 %
Weight of steel provided 1.97 kg/m¬2

Check on span/effective-depth ratio

Basic ratio for cantilever slab bs'd=7 (see Table 3.9)
Area of tension steel provided Aspr=1130 mm¬2
Service stress in this steel fs=2*fy*As/(3*Aspr)
=2*400*497.48/(3*1130)
=117.4 N/mm¬2
As applied-moment factor M'bd2=M*10^6/(1000*d^2)
=36*10^6/(1000*219^2)
=0.75061
From equation 7 modf1=0.55+(477-fs)/(120*(0.9+M'bd2))
=0.55+(477-117.4)/(120*(0.9
+0.75061))
=2.3655
but this cannot exceed 2, so modf1=2
Mod.factor for tension steel modf1=2
Mod.factor for no comp.steel modf2=1.0
Maximum permissible
span/effective-depth ratio ps'd=bs'd*modf1*modf2=7*2*1
=14
Effective span of slab span=2 m
True span/effective-depth ratio as'd=1000*span/d=1000*2/219
=9.1324
As this does not exceed 14, this is Acceptable.

Structural Drawings



General Notes

Do not scale this drawing. All dimensions as shown on drawing are approximate. All dimensions for fabrication to be taken from site by the Contractor checked with the architect. Any differences including site ambiguities reported.

1. All ground for foundations and ground bearing slabs must be inspected and approved by the Building Inspector.

2. Mass concrete for foundations to be grade C20 with 40mm max aggregate size. Use sulphate resisting unless otherwise directed. Reinforced concrete is to be grade C35 with 20mm max agg. size. Provide 35mm min cover, except for reinforcement placed in the ground that has 75mm cover elsewhere. Concrete for padstones to be 1.11/2.3 nominal mix with 12mm max aggregate size.

3. "Hardcore" is to be a compactable well graded granular material, free from timber, vegetable matter, steel or other deleterious materials. It may include broken bricks or crushed concrete but may not contain general demolition material. It is to be compact in layers not thicker than 150mm on approved ground.

4. All damp proofing treatment is to be carried out to the architects requirements.

5. All internal steelwork to be thoroughly wire brushed to remove all loose rust and scale and painted with two coats of high build zinc phosphate primer with touch up on site after erection. Concrete encased steel to be left unpainted. All structural steelwork is to be fire protected to the architects requirements and to the satisfaction of the Building Inspector.

6. All welds to be 6mm full profile fillet welds U.N.O. All welding to be carried out in the fabrication works. In the event that site welding becomes necessary, weld testing is to be carried out by an independent testing house to the satisfaction of the building inspector and engineer.

7. Load bearing masonry to be laid in 1:1:6 mortar except where otherwise specified. Cavity wall ties to be stainless steel at 900 c/c horizontally, 450 c/c vertically and 225 c/c around the openings. New masonry is to be tied to existing using propriety steel wall starter, plugged and screwed to the existing masonry in accordance with the manufacturers recommendations. Seal joint with a flexible silicone joint sealant internally, mastic sealant externally.

8. All new timber in works to be grade C 24 or better in accordance with BS5268 and to be pressure impregnated (tanalised) with cut ends thoroughly treated before fixing.

9. All temporary works and stability of the building during construction work is the responsibility of the contractor.

10. All structural work is to be carried out to the satisfaction of the Building Inspector.

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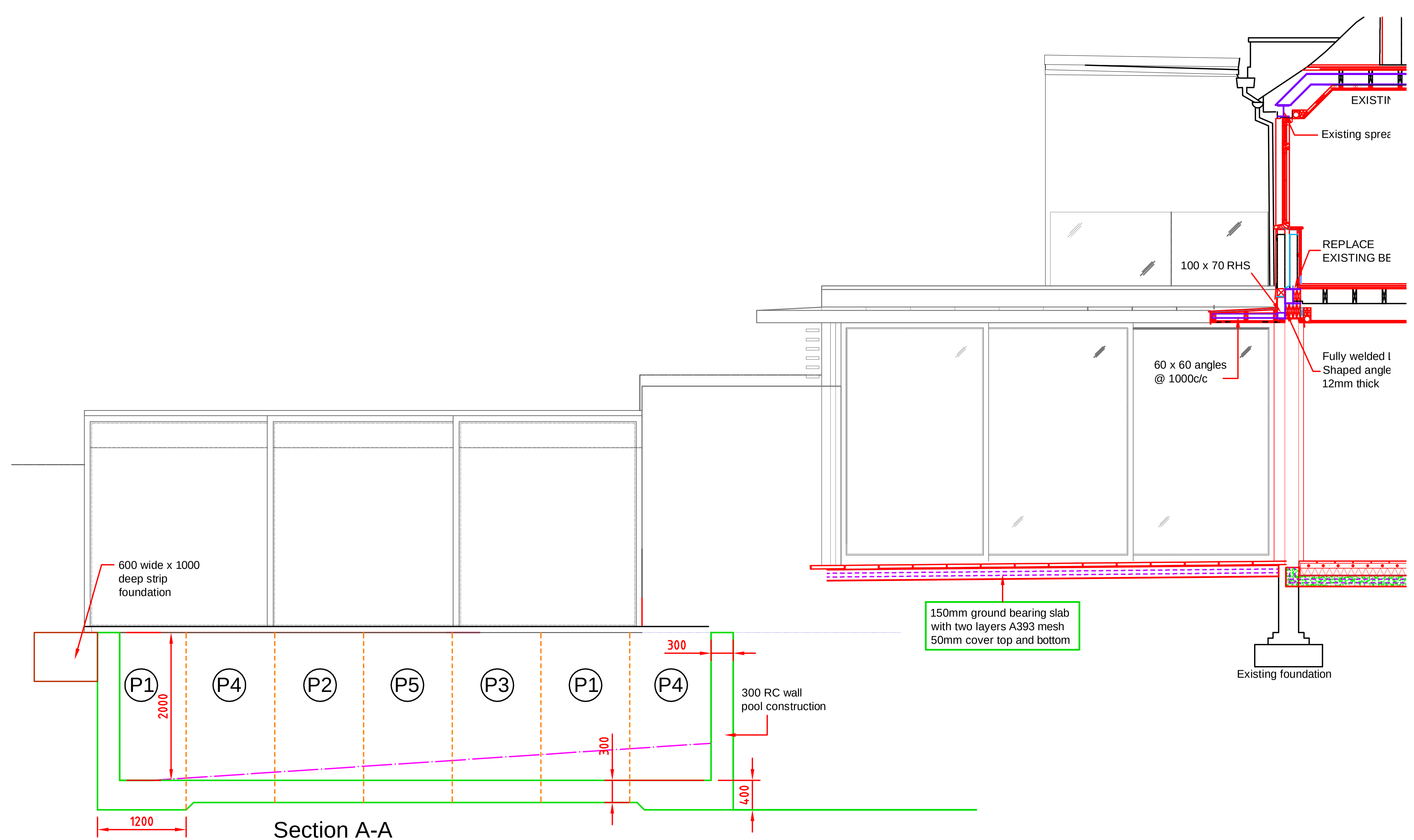
Amendment	Date	Rev
PRELIMINARY/FOR COMMENTS		

Project: 93 Hillway

Title: Proposed Ground

Drawing No: L/9913-SP-01

1:50 **Date:** September 2014



Section A-A

PRELIMINARY/FOR COMMENTS

General Notes

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1. All ground for foundations and ground bearing slabs must be inspected and approved by the Building Inspector.

2. Mass concrete for foundations to be grade C20 with 40mm max aggregate size. Use sulphate resisting unless otherwise directed. Reinforced concrete is to be grade C35 with 20mm max agg. size. Provide 35mm min cover, except for reinforcement placed in the ground that has 75mm cover elsewhere. Concrete for padstones to be 1.11/2.3 nominal mix with 12mm max aggregate size.

3. "Hardcore" is to be a compactable well graded granular material, free from timber, vegetable matter, steel or other deleterious materials. It may include broken bricks or crushed concrete but may not contain general demolition material. It is to be compact in layers not thicker than 150mm on approved ground.

4. All damp proofing treatment is to be carried out to the architects requirements.

5. All internal steelwork to be thoroughly wire brushed to remove all loose rust and scale and painted with two coats of high build zinc phosphate primer with touch up on site after erection. Concrete encased steel to be left unpainted. All structural steelwork is to be fire protected to the architects requirements and to the satisfaction of the Building Inspector.

6. All welds to be 6mm full profile fillet welds U.N.O. All welding to be carried out in the fabrication works. In the event that site welding becomes necessary, weld testing is to be carried out by an independent testing house to the satisfaction of the building inspector and engineer.

7. Load bearing masonry to be laid in 1:1:6 mortar except where otherwise specified. Cavity wall ties to be stainless steel at 900 c/c horizontally, 450 c/c vertically and 225 c/c around the openings. New masonry is to be tied to existing using propriety steel wall starter, plugged and screwed to the existing masonry in accordance with the manufacturers recommendations. Seal joint with a flexible silicone joint sealant internally, mastic sealant externally.

8. All new timber in works to be grade C 24 or better in accordance with BS5268 and to be pressure impregnated (tanalised) with cut ends thoroughly treated before fixing.

9. All temporary works and stability of the building during construction work is the responsibility of the contractor.

10. All structural work is to be carried out to the satisfaction of the Building Inspector.

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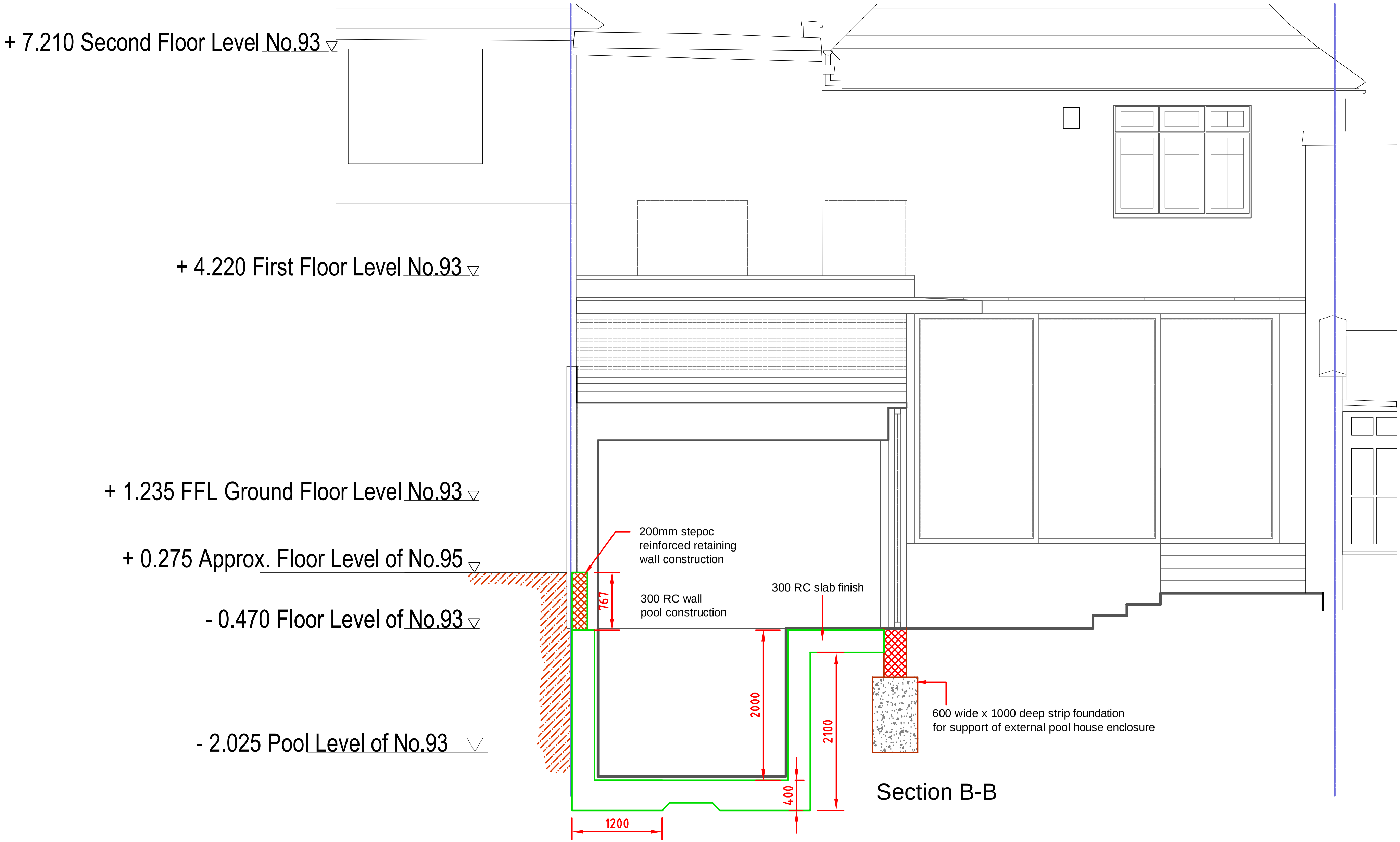
PRELIMINARY/FOR COMMENTS		
Amendment	Date	Rev

Project: 93 Hillway

Title: Proposed Section A-A

Drawing No: L/9913-SP-02

1:50 **Date:** September 2014



Section B-B

General Notes

Do not scale this drawing. All dimensions as shown on drawing are approximate. All dimensions for fabrication to be taken from site by the Contractor checked with the architect. Any differences including site ambiguities reported.

1. All ground for foundations and ground bearing slabs must be inspected and approved by the Building Inspector.

2. Mass concrete for foundations to be grade C20 with 40mm max aggregate size. Use sulphate resisting unless otherwise directed. Reinforced concrete is to be grade C35 with 20mm max agg. size. Provide 35mm min cover, except for reinforcement placed in the ground that has 75mm cover elsewhere. Concrete for padstones to be 1.11/2.3 nominal mix with 12mm max aggregate size.

3. "Hardcore" is to be a compactable well graded granular material, free from timber, vegetable matter, steel or other deleterious materials. It may include broken bricks or crushed concrete but may not contain general demolition material. It is to be compact in layers not thicker than 150mm on approved ground.

4. All damp proofing treatment is to be carried out to the architects requirements.

5. All internal steelwork to be thoroughly wire brushed to remove all loose rust and scale and painted with two coats of high build zinc phosphate primer with touch up on site after erection. Concrete encased steel to be left unpainted. All structural steelwork is to be fire protected to the architects requirements and to the satisfaction of the Building Inspector.

6. All welds to be 6mm full profile fillet welds U.N.O. All welding to be carried out in the fabrication works. In the event that site welding becomes necessary, weld testing is to be carried out by an independent testing house to the satisfaction of the building inspector and engineer.

7. Load bearing masonry to be laid in 1:1:6 mortar except where otherwise specified. Cavity wall ties to be stainless steel at 900 c/c horizontally, 450 c/c vertically and 225 c/c around the openings. New masonry is to be tied to existing using propriety steel wall starter, plugged and screwed to the existing masonry in accordance with the manufacturers recommendations. Seal joint with a flexible silicone joint sealant internally, mastic sealant externally.

8. All new timber in works to be grade C 24 or better in accordance with BS5268 and to be pressure impregnated (tanalised) with cut ends thoroughly treated before fixing.

9. All temporary works and stability of the building during construction work is the responsibility of the contractor.

10. All structural work is to be carried out to the satisfaction of the Building Inspector.

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PRELIMINARY/FOR COMMENTS		
Amendment	Date	Rev

Project: 93 Hillway

Title: Proposed Section B-B

Drawing No: L/9913-SP-03

1:50 Date: January 2014

Construction Method Statement
Sequence of Work

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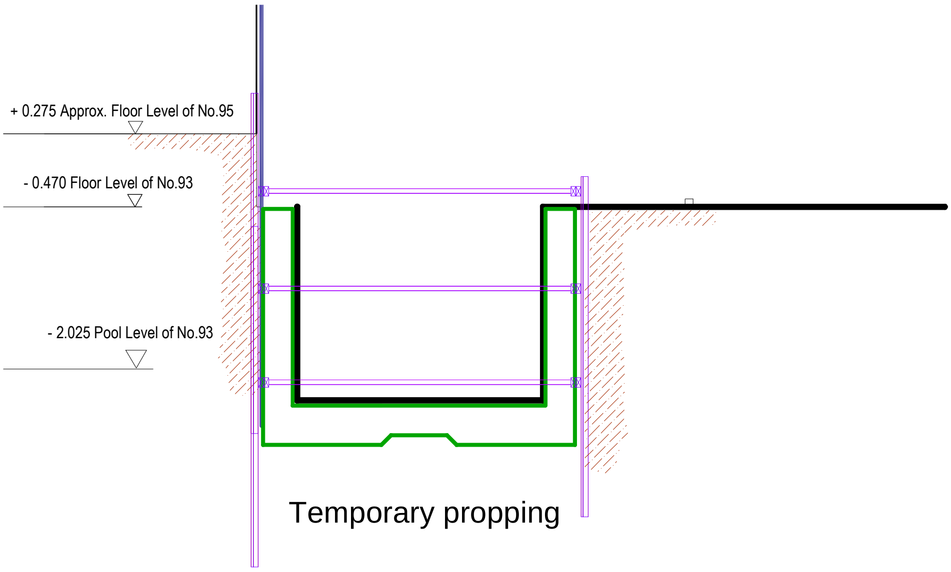
Construction Method Statement & Sequence of work

The construction format and sequence of forming the pool structure has been illustrated in the following stage sketches below.

All excavations will be supported with trench sheeting and flying shores as it has been demonstrated in the attached sketch in order to maintain the stability of the ground along the line of the neighbouring garden. The details of this work will be discussed with the contractor in more detail and will form part of the party wall award that needs to be signed with the adjoining owner.



Temporary propping

zussmanbear © Consulting Structural Engineers	Job No	Detail Title	Rev
395 St Margarets Road, Richmond, TW7 7BZ	L/9913-TP01	Pool construction sequence	P

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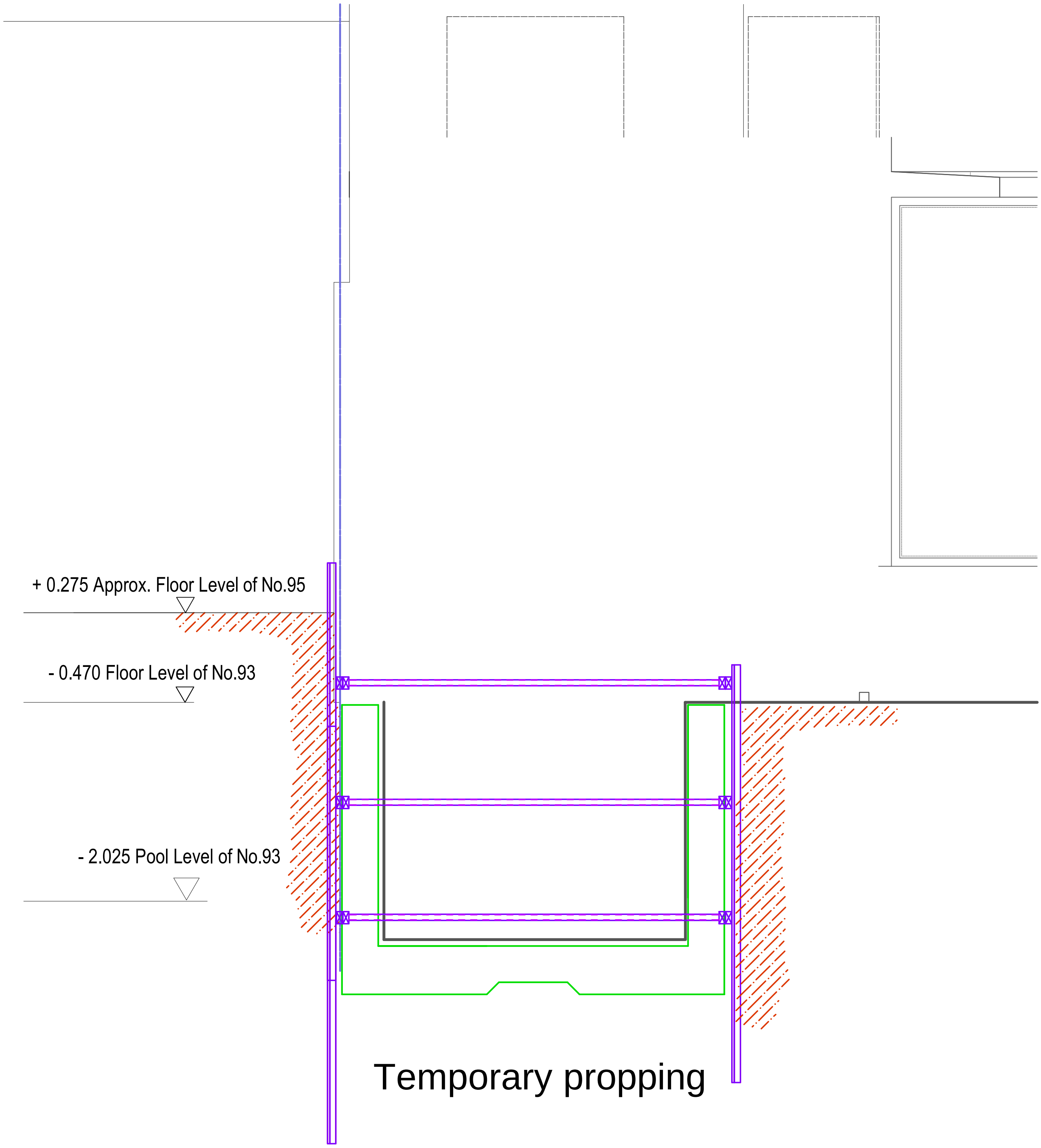
Project

93 Hillway temporary propping



Temporary propping

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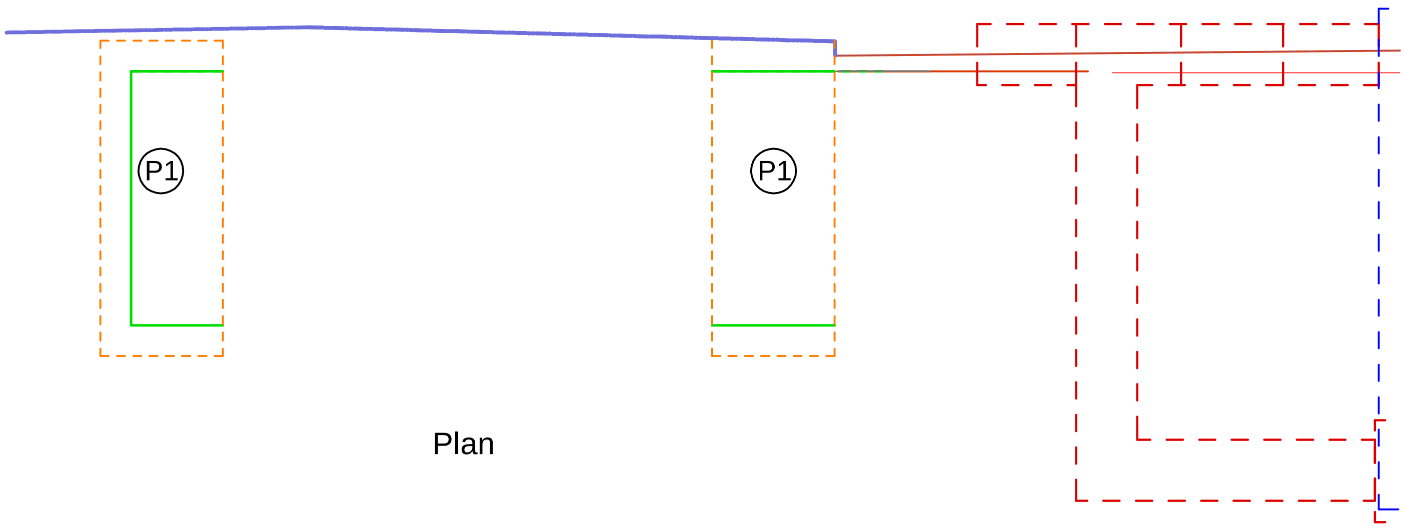
Job No	Detail Title	Rev
L/9913-sq01	Pool construction sequence	P

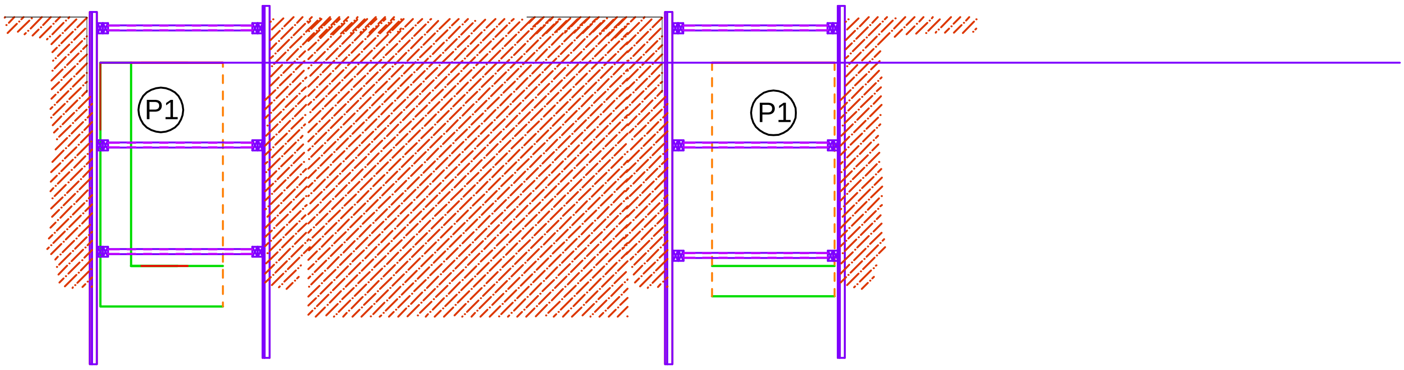
Project

93 Hillway construction sequence

Adjoining garden number 95



Plan



Section

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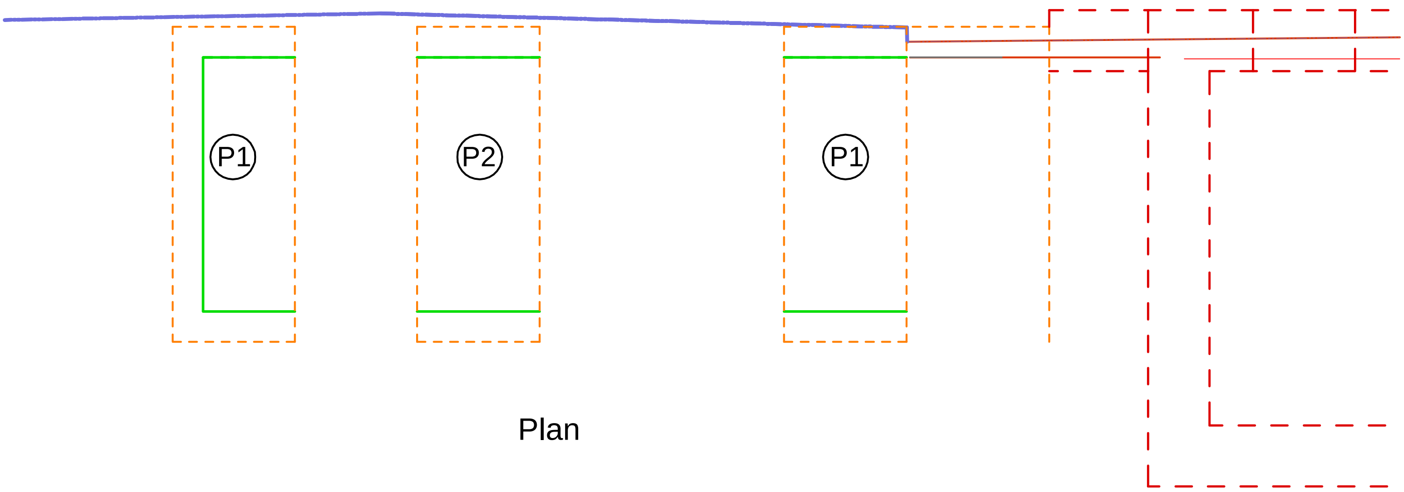
Job No: L/9913-sq02

Detail Title: Pool construction sequence

Rev: P

Project: 93 Hillway construction sequence

Adjoining garden number 95



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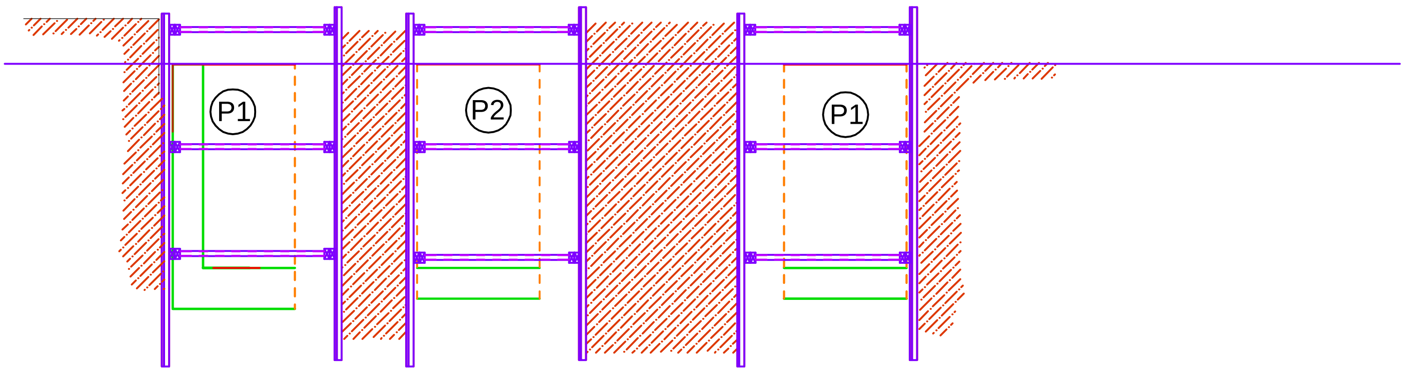

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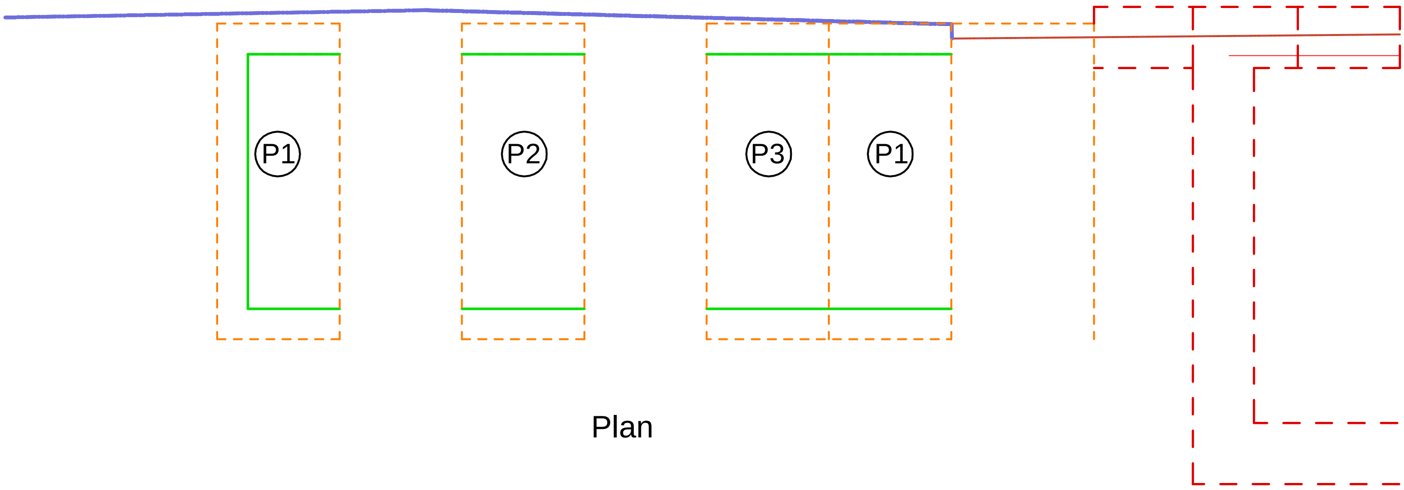
Job No	Detail Title	Rev
L/9913-sq03	Pool construction sequence	P

Project

93 Hillway construction sequence

Adjoining garden number 95



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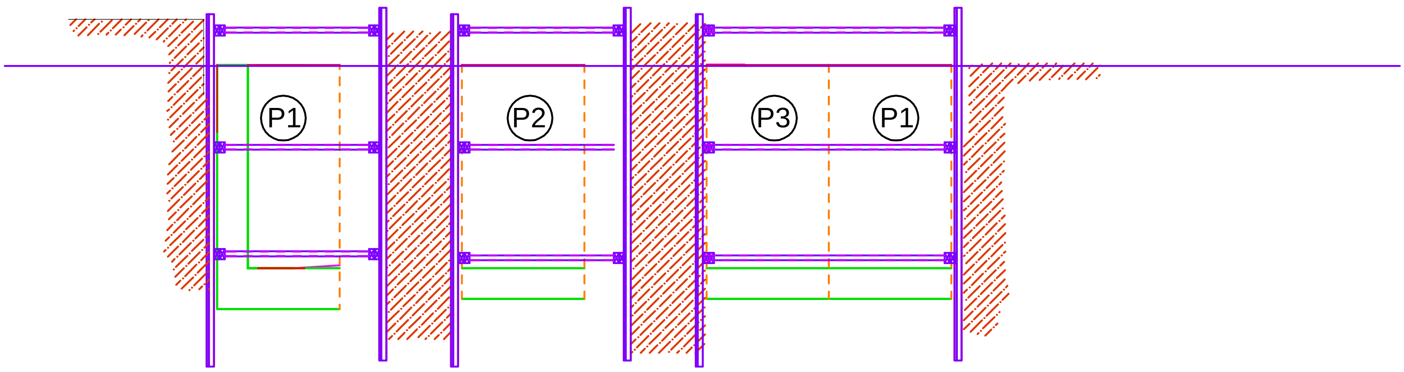

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STAGE -3

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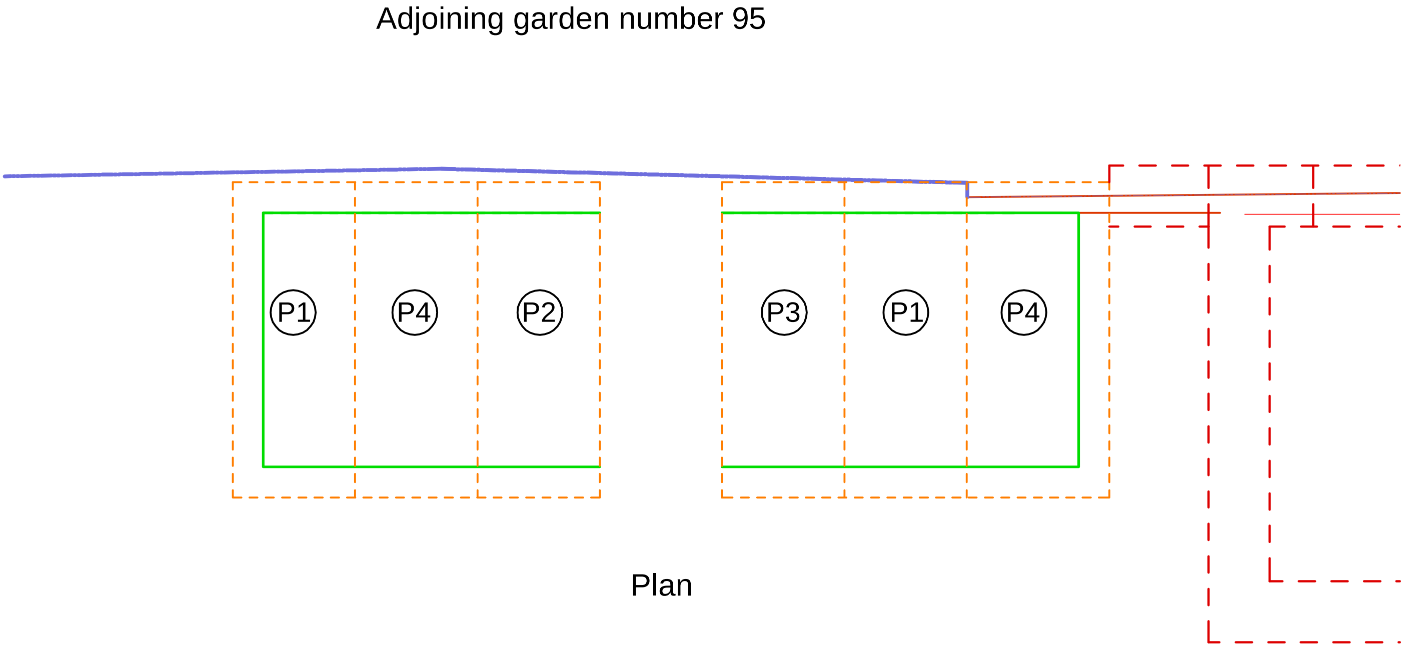
Job No	Detail Title	Rev
L/9913-sq04	Pool construction sequence	P

Project

93 Hillway construction sequence



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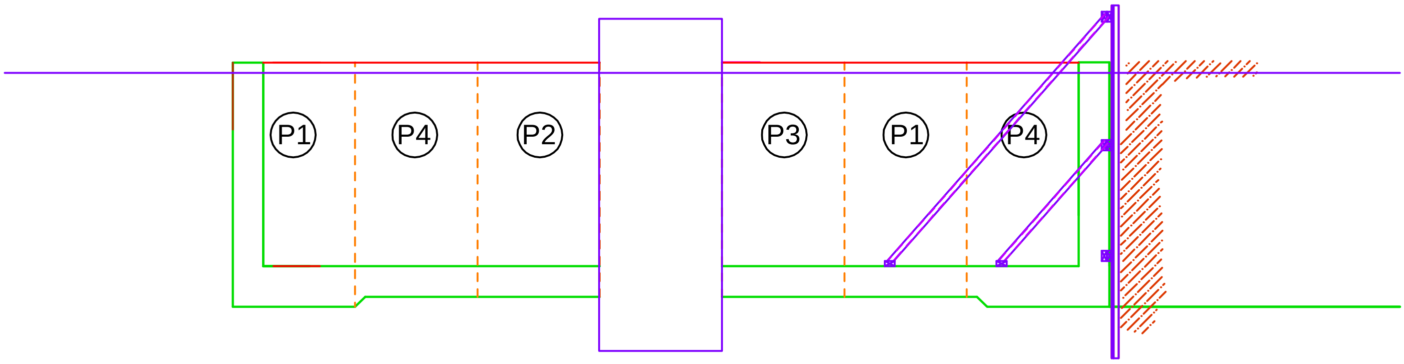

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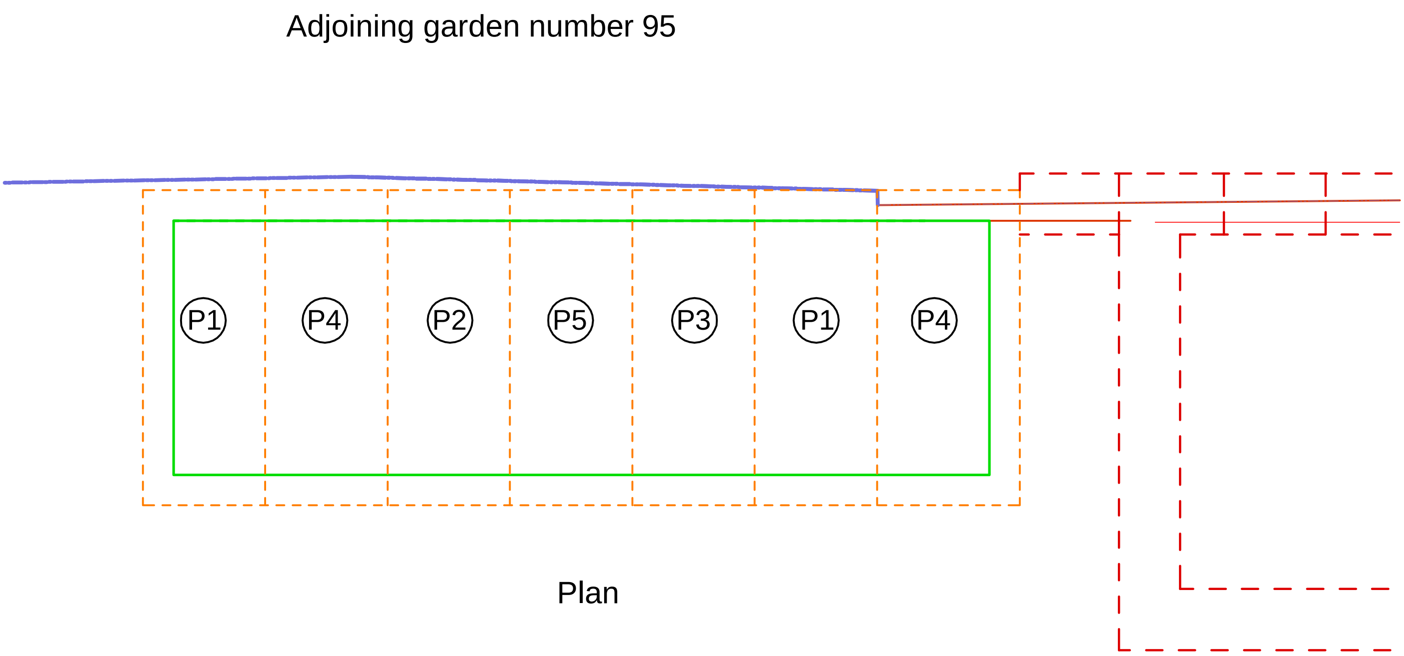
Job No	Detail Title	Rev
L/9913-sq05	Pool construction sequence	P

Project
93 Hillway construction sequence



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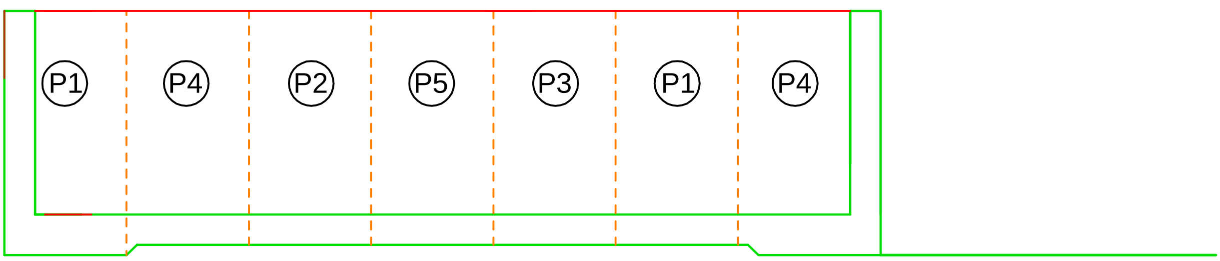

Section

STAGE -5