STRUCTURAL CALCULATIONS

LOCATION: 9 Portway Woking Surrey GU24 9AJ

PROPOSED WORKS: Part single storey, part two-storey side extension and, single storey rear extension following demolition of existing garage.

JOB REF: 22-973

PREPARED FOR: Hannah & Hugo Cavalier

REVISION:

DATE: 29/11/2022

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Project Summary

The existing building is a left side semi-detached 2 storey family dwelling built circa 1950/60 in construction comprising,

External Walls: Traditional cavity construction with outer brick, cavity width = 60/70 approx. and inner skin using concrete aggregate blocks (as seen in loft space only)
Party Wall: Cavity construction (both skins in blockwork).
Internal Grd Fr Walls: 108 Wide masonry (75 blocks)
Internal First Fr Walls: Same as grd walls.
First Fr: Grd Fr: Boarded timber joists spanning front to back.
Main Roof: Combination of hand made timber trusses, purlins and rafters.

JOB. 9 Portway Woking Surrey GU24 9AJ 19/11/2022

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Proposals:

- Building enlargement scope as per report cover page. External walls in cavity construction with brick outer leaf to match existing. Ground floor will be suspended beam-and-block bearing on traditional trench-fill footings. First floor in boarded timber joists. There are two large Oak trees (heights 20 & 22m) beyond the front garden perimeter within the head of the cul-de-sac and a further Oak tree (22m ht.) at back of the rear garden. Because of the potential of local subsoils being shrinkable, a site investigation was undertaken by Albury S.I. Ltd on 16th September 2022 to ascertain engineering properties of underlying soils and to assist in designing a safe and economical foundation solution.

  The investigation comprised three boreholes using hand-held window sampling techniques and a hand-dug trial pit to expose the existing foundations (also extended by window sampling). Soil samples were recovered for further examination and laboratory testing. In addition, several in situ hand shear vane tests were also performed. The soil report – Ref 22/12463/KJC is appended.

NHBC Design Guide Chapter 4.2 – Building Near Trees, will be followed in appointing details for new building foundations.

Ground Report Overview

Ground Make-up: Made Ground varying in thickness 0.5/0.6 & 0.7m deep (in bh's 1 2 3 & TP4) overlying sandy clay/clayey sand or silt to depths between 1.2 to 1.8m deep proved for the full depth of 3.1m and representative of expected local geology. Short term ground water first encountered at depths of 2.7/2.8 & 2.6m – therefore water not likely to be encountered during building work.

In Situ Testing Method: In brief, the soil report gives 100kPa as an allowable bearing capacity to work with when calculating concrete foundation widths.

Existing House Foundations: From TP no. 4 = 700 deep to u/side of conc. measured from GL. Outstand = 200mm giving an estimated 700mm overall trench width.

Lab. Testing & Results Interpretation:

Plasticity Range: Samples tested indicate Low to Intermediate plasticity (See penultimate column 'IPc' on Page 23 of 31/Main soil report). Because an IPc values of less than 10% is classified as non-shrinkable, this means the rear extension can adopt 1.0m deep foundations (see bh's 1 and 2). Towards the front of the site (bh 3 + TP4) the soils in upper region are above 10% (ie 13% & 26%) and so their classification is in range of 'low' (10% - 20%) to 'intermediate' (20% - 40%) based upon NHBC guidelines and therefore foundations need to be taken down deeper on to the non-shrinkable classified sand (see bh 4) so depth needs to be 1.5m approx. The change-over from 1.0 to 1.5m deep must be determined from looking at the excavations being during construction.

Ground Floor Construction: This needs to be 'suspended' construction. (See Section 5.4/Report). Beam and block will be adopted.

Chemical Testing: Soils are low in sulphates in conjunction with slightly acidic or near neutral pH values.

In Summary, adopt conventional foundations ranging from 1 to 1.5m deep together with suspended ground floor.

References

LOADING

- BS 6399 PART 1 1984: LOADING FOR BUILDINGS - CODE OF PRACTICE FOR DEAD & IMPOSED LOADS
- BS 6399 PART 2 1997: LOADING FOR BUILDINGS - CODE OF PRACTICE FOR WIND LOADS
- BS 6399 PART 3 1988: LOADING FOR BUILDINGS - CODE OF PRACTICE FOR IMPOSED ROOF LOADS
- BS 648 1964: SCHEDULE OF WEIGHTS OF BUILDING MATERIALS

MATERIALS

- BS 449 PART 2 1969 (AMD DEC. 1989): THE USE OF STRUCTURAL STEEL IN BUILDING
- BS 5268 PART 2 1996: CODE OF PRACTICE FOR PERMISSIBLE STRESS DESIGN, MATERIALS & WORKMANSHIP.

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- BS 5628 PART 1 2005: STRUCTURAL USE OF MASONRY (UNREINFORCED)
- STRUCTURAL USE OF GLASS IN BUILDINGS (THE INSTIITUTION OF STRUCTURAL ENGINEERS).

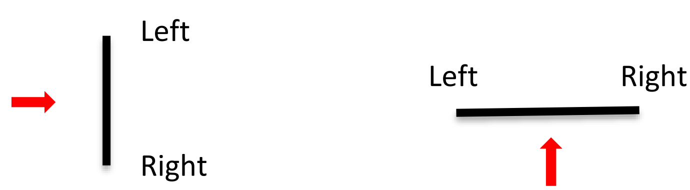
Notes

1. Calculations are to be read in conjunction with Engineer's drawing nos. 22-963/1 & 2. (Sheet size A1 & A3 respectively).

2. Unless noted otherwise steel beams are designed for a deflection limit ≤ span ÷ 250 for dead + imposed gravity loads – new construction & a deflection limit ≤ span ÷ 450 for steelwork inserted below temporarily supported existing construction.

3. Abbreviations used in Superbeam loadings: # = Kn per Sq. M. L = dim/length on plan. H = dim/Height.

4. In the Superbeam design program, the orientations below distinguish the left and right beam ends (ie alignment of beams on drawing sheet).



Contents

Basic Unit Loads (# Denotes Kn/m^2)

Unless specified differently in the calculations the basic loads below have been adopted

1. Flat roof:	0.6 Snow + 0.7 Dead = 1.3#
2. Tiled pitched rafters (without flat ceiling) (on plan):	0.6 Snow + 1.1 Dead = 1.7#
Tiled pitched rafters (with flat ceiling) (on plan):	0.6 Snow + 1.7 Dead = 2.3#
3. Internal timber floors:	1.5 Imposed + 0.5 Dead = 2.0#
4. Internal timber stud wall (Dead):	0.5# (elevated)
5. 103 Solid brick walls with plaster finishes (Dead):	2.3# (elevated)
6. 215 Solid brick walls without finishes (Dead):	4.0# (elevated)
7. 215 Solid brick walls and existing cavity walls with finishes (Dead):	4.5# (elevated)
8. Brick + light wt block cavity wall + int. finishes (Dead):	2.7# (elevated)
9. External tile clad timber stud wall (Dead):	1.2# (elevated)

SECTION 1

SuperBeam 7 Project Summary

Site address: 9 Portway, Woking, Surrey GU24 9AJ
Job: Side & Rear Enlargement
Client: Hannah Cavalier & Hugo Cavalier
Job number: 22-973

ITEMS:

1: Beam: Flat Roof Joist - Max Span
Span: 3.6 m.
Reactions (unfactored/factored): R1: 1.12/1.12 kN; R2: 1.12/1.12 kN
Use 47 x 170 C24

2: Beam: R1 - Flat RoofLight Trimmer.
Span: 1.3 m.
Reactions (unfactored/factored): R1: 1.43/1.43 kN; R2: 1.43/1.43 kN
Use 2x47 x 170 C24

3: Beam: R2 - Flat RoofLight Trimmer.
Span: 1.3 m.
Reactions (unfactored/factored): R1: 0.71/0.71 kN; R2: 0.71/0.71 kN
Use 2x47 x 170 C24

4: Beam: R3 - Flat RoofLight Trimmer.
Span: 3.6 m.
Reactions (unfactored/factored): R1: 1.65/1.65 kN; R2: 2.41/2.41 kN
Use 2x47 x 170 C24

5: Beam: R4 - Flat RoofLight Trimmer.
Span: 3.6 m.
Reactions (unfactored/factored): R1: 1.81/1.81 kN; R2: 2.57/2.57 kN
Use 2x47 x 170 C24

6: Beam: G2.
Span: 3.4 m.
Reactions (unfactored/factored): R1: 1.70/1.70 kN; R2: 1.70/1.70 kN
Use 2x47 x 145 C24

7: Beam: 1st Fr Joists Over Bike/Storage.
Span: 3.2 m.
Reactions (unfactored/factored): R1: 1.44/1.44 kN; R2: 1.44/1.44 kN
Use 47 x 170 C24

8: Beam: G3.
Span: 2.6 m.
Reactions (unfactored/factored): R1: 4.36/4.36 kN; R2: 4.28/4.28 kN
Use 178 x 102 x 19 UB S275
Bearing R1: 300 x 100 mm padstone
Bearing R2: 200 x 100 mm padstone

9: Beam: Fafters to 1st Fr Vaulted Rf.
Span: 1.6 m.
Reactions (unfactored/factored): R1: 1.12/1.12 kN; R2: 1.12/1.12 kN
Use 47 x 95 C24

10: Beam: R9. Ridge Beam Over 1st Fr Vaulted Ceiling.
Span: 3.4 m.
Reactions (unfactored/factored): R1: 6.55/6.55 kN; R2: 6.55/6.55 kN
Use 3x47 x 195 C24

11: Beam: G1. Top of Box Frame.
Span: 5.2 m.
Reactions (unfactored/factored): R1: 64.93/64.93 kN; R2: 61.27/61.27 kN
Rear Wall in cavity Brick: W Kn/m = 4.5# [(14.5) - (2.3+1.2)] /6.1m = 8.1 Kn/m. Say 8.5
Use 254 x 254 x 73 UC S275

Beam: Flat Roof Joist - Max Span **Span: 3.6 m.**

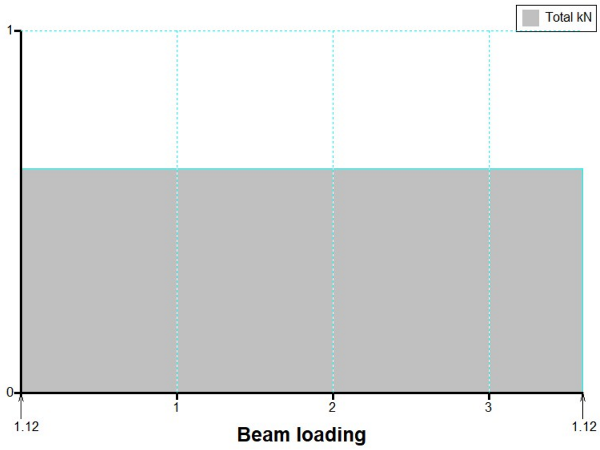
	Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
O D	o.w.	0.1	0		L	0.18	0.18	0.22
U T	Roof:1.3#x0.4L	0.52	0		L	0.94	0.94	1.14
			Total load (unfactored):		**2.23 kN**	**1.12**	**1.12**	1.36

Load types: O:Beam o.w.; U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

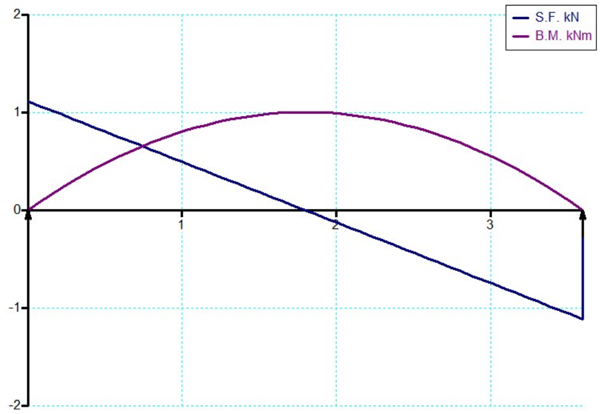
Maximum B.M. = 1.00 kNm (unfactored (all loads applied)) at 1.80 m. from R1

Maximum S.F. = 1.12 kN (unfactored) at R1

Total mid-span deflection: 1.36 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 47 x 170 C24 *3.4 kg/m approx*

z = 226 cm^3 I = 1,924 cm^4

Timber grade: C24 Load sharing system: K_8 = 1.1 [§2.10.11]

K_3 (loading duration factor) = 1.25 (medium term)

K_7 (depth factor) = $(300/170)^{0.11}$ = 1.06 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 10,800 N/mm^2 (E_{mean})

Bending

Permissible bending stress, $s_{m,adm} = s_{m,g}.K_3.K_7.K_8$ = 7.5 x 1.25 x 1.06 x 1.1 = 10.98 N/mm^2

Applied bending stress, $s_{m,a}$ = 1.00 x 1000/226 = 4.44 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm,//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 1.12 x 1000 x 3/(2 x 47 x 170) = 0.21 N/mm^2 OK

Deflection

Bending deflection = 1.36 x 10^8/(10,800 x 1,924) = 6.5 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 1.00 x 10^6/((10800/16) x 47 x 170) = 0.2 mm

Total deflection = 6.5 + 0.2 = 6.7 mm (0.0019 L) <= 0.003L OK

Beam: R1 - Flat RoofLight Trimmer. **Span: 1.3 m.**

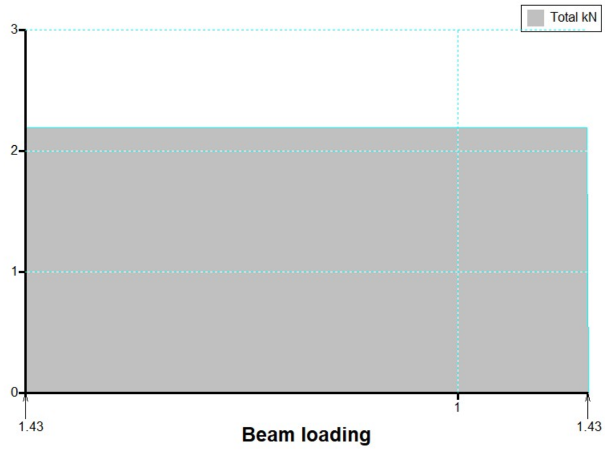
	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp	Defl.
O D	o.w.	0.1	0		L	0.06	0.06	0.004
U T	Roof:1.3#x1.6L	2.1	0		L	1.36	1.36	0.078
			Total load (unfactored): **2.86 kN**			**1.43**	**1.43**	0.082

Load types: O:Beam o.w.; U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

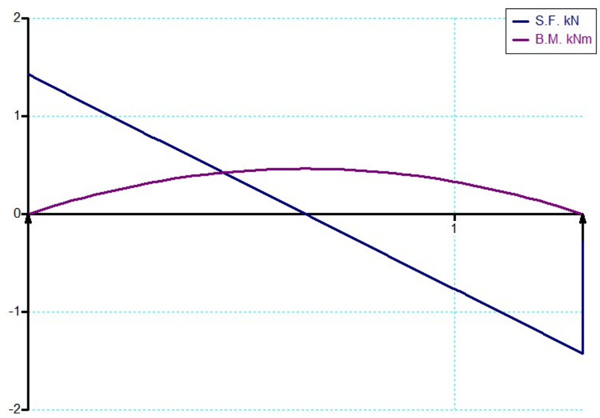
Maximum B.M. = 0.465 kNm (unfactored (all loads applied)) at 0.65 m. from R1

Maximum S.F. = 1.43 kN (unfactored) at R1

Total mid-span deflection: 0.082 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 2x47 x 170 C24 *6.7 kg/m approx*

z = 453 cm^3 I = 3,849 cm^4

Timber grade: C24 2 members acting together: K_8 = 1.1 [§2.9]

K_3 (loading duration factor) = 1.25 (medium term)

K_7 (depth factor) = $(300/170)^{0.11}$ = 1.06 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 7,200 x 1.14 = 8,208 N/mm^2 ($E_{min}.K_9$)

Bending

Permissible bending stress, $s_{m,adm} = s_{m,g}.K_3.K_7.K_8$ = 7.5 x 1.25 x 1.06 x 1.1 = 10.98 N/mm^2

Applied bending stress, $s_{m,a}$ = 0.465 x 1000/453 = 1.03 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm,//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 1.43 x 1000 x 3/(2 x 94 x 170) = 0.13 N/mm^2 OK

Deflection

Bending deflection = 0.082 x 10^8/(8,208 x 3,849) = 0.3 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 0.465 x 10^6/((8208/16) x 94 x 170) = 0.1 mm

Total deflection = 0.3 + 0.1 = 0.3 mm (0.0003 L) <= 0.003L OK

Beam: R2 - Flat RoofLight Trimmer. **Span: 1.3 m.**

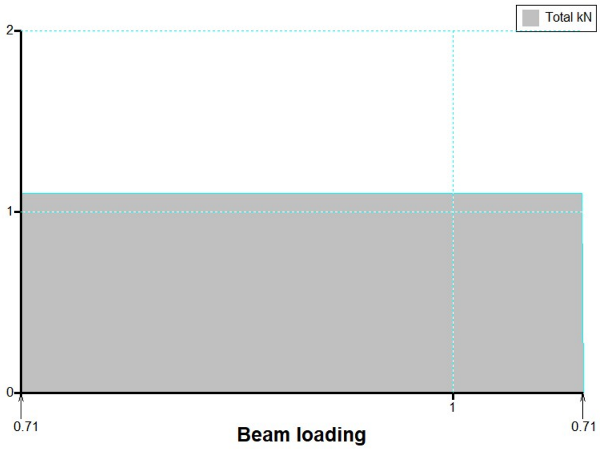
	Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
O D	o.w.	0.1	0		L	0.06	0.06	0.004
U T	Roof:1.3#x0.8L	1.0	0		L	0.65	0.65	0.037
			Total load (unfactored):		**1.43 kN**	**0.71**	**0.71**	0.041

Load types: O:Beam o.w.; U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

Maximum B.M. = 0.232 kNm (unfactored (all loads applied)) at 0.65 m. from R1

Maximum S.F. = 0.715 kN (unfactored) at R1

Total mid-span deflection: 0.041 x 10^8/EI *(E in N/mm², I in cm⁴)*



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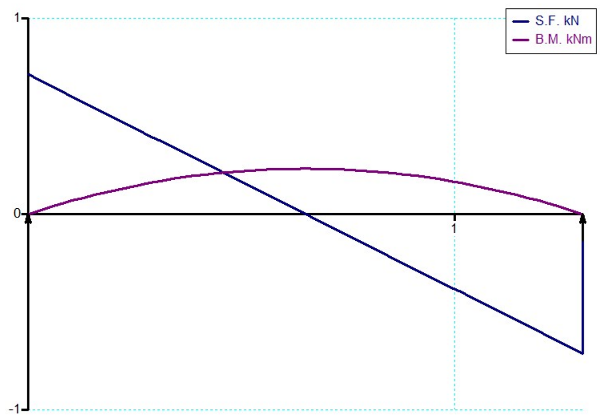


Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 2x47 x 170 C24 *6.7 kg/m approx*

z = 453 cm^3 I = 3,849 cm^4

Timber grade: C24 2 members acting together: K_8 = 1.1 [§2.9]

K_3 (loading duration factor) = 1.25 (medium term)

K_7 (depth factor) = $(300/170)^{0.11}$ = 1.06 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 7,200 x 1.14 = 8,208 N/mm^2 (E_{min}.K_9)

Bending

Permissible bending stress, $s_{m,adm}$ = $s_{m,g}$.K_3.K_7.K_8 = 7.5 x 1.25 x 1.06 x 1.1 = 10.98 N/mm^2

Applied bending stress, $s_{m,a}$ = 0.232 x 1000/453 = 0.51 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm,//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 0.71 x 1000 x 3/(2 x 94 x 170) = 0.07 N/mm^2 OK

Deflection

Bending deflection = 0.041 x 10^8/(8,208 x 3,849) = 0.1 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 0.232 x 10^6/((8208/16) x 94 x 170) = 0.0 mm

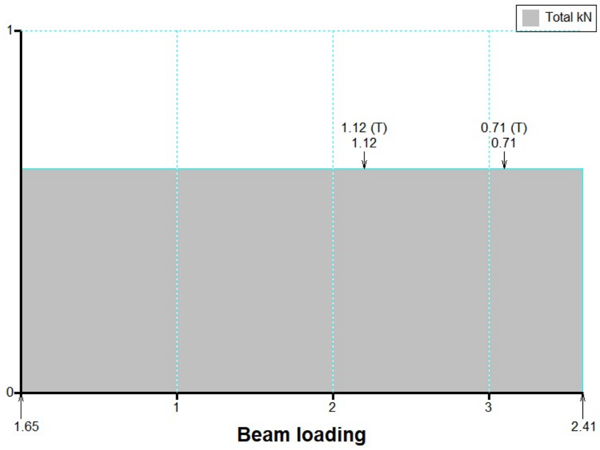
Total deflection = 0.1 + 0.0 = 0.2 mm (0.0001 L) <= 0.003L OK

Beam: R3 - Flat RoofLight Trimmer. **Span: 3.6 m.**

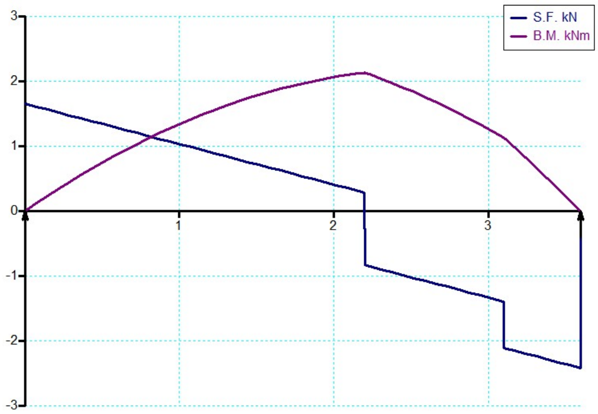
	Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
O D	o.w.	0.1	0		L	0.18	0.18	0.22
U T	Roof:1.3#x0.4L	0.52	0		L	0.94	0.94	1.14
P T	Bm: Flat Roof Joist : R1	1.12 [B/F]	2.2			0.43	0.68	1.01
P T	Beam: R2 - Flat : R1	0.71 [B/F]	3.1			0.10	0.62	0.28
			Total load (unfactored): **4.06 kN**			**1.65**	**2.41**	2.65

Load types: O:Beam o.w.; U:UDL; P:Point load; Load positions: m. from R1
Load durations: D: Dead; L: Live

Maximum B.M. = 2.13 kNm (unfactored (all loads applied)) at 2.20 m. from R1
Maximum S.F. = -2.41 kN (unfactored) at R2
Total mid-span deflection: 2.65 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 2x47 x 170 C24 *6.7 kg/m approx*

z = 453 cm^3 I = 3,849 cm^4
Timber grade: C24 2 members acting together: K_8 = 1.1 [§2.9]
K_3 (loading duration factor) = 1.25 (medium term)
K_7 (depth factor) = $(300/170)^{0.11}$ = 1.06 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]
E = 7,200 x 1.14 = 8,208 N/mm^2 ($E_{min}.K_9$)

Bending

Permissible bending stress, $s_{m,adm}$ = $s_{m,g}.K_3.K_7.K_8$ = 7.5 x 1.25 x 1.06 x 1.1 = 10.98 N/mm^2
Applied bending stress, $s_{m,a}$ = 2.13 x 1000/453 = 4.70 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 2.41 x 1000 x 3/(2 x 94 x 170) = 0.23 N/mm^2 OK

Deflection

Bending deflection = 2.65 x 10^8/(8,208 x 3,849) = 8.4 mm

Mid-span shear deflection = $1.2M_0/GA$ (G=E/16) = 1.2 x 1.96 x 10^6/((8208/16) x 94 x 170) = 0.3 mm

Total deflection = 8.4 + 0.3 = 8.7 mm (0.0024 L) <= 0.003L OK

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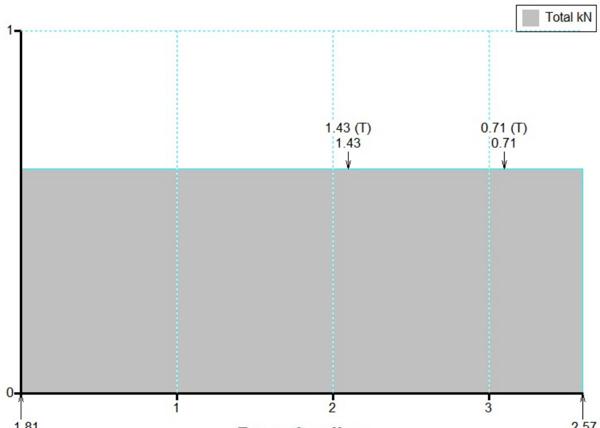
Beam: R4 - Flat RoofLight Trimmer. **Span: 3.6 m.**

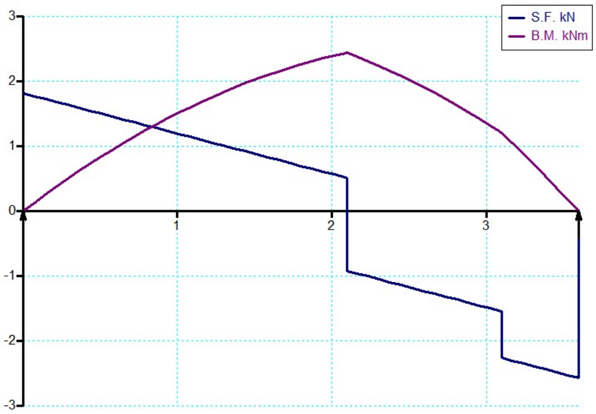
	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp	Defl.
O D	o.w.	0.1	0		L	0.18	0.18	0.22
U T	Roof:1.3#x0.4L	0.52	0		L	0.94	0.94	1.14
P T	Beam: R1 - Flat : R2	1.43 [B/F]	2.1			0.60	0.83	1.34
P T	Beam: R2 - Flat : R2	0.71 [B/F]	3.1			0.10	0.62	0.28
			Total load (unfactored): **4.38 kN**			**1.81**	**2.57**	2.97

Load types: O:Beam o.w.; U:UDL; P:Point load; Load positions: m. from R1
Load durations: D: Dead; L: Live

Maximum B.M. = 2.44 kNm (unfactored (all loads applied)) at 2.10 m. from R1
Maximum S.F. = -2.57 kN (unfactored) at R2
Total mid-span deflection: 2.97 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 2x47 x 170 C24 *6.7 kg/m approx*

z = 453 cm^3 I = 3,849 cm^4
Timber grade: C24 2 members acting together: K_8 = 1.1 [§2.9]
K_3 (loading duration factor) = 1.25 (medium term)
K_7 (depth factor) = $(300/170)^{0.11}$ = 1.06 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]
E = 7,200 x 1.14 = 8,208 N/mm^2 (E_{min}.K_9)

Bending

Permissible bending stress, $s_{m,adm}$ = $s_{m,g}$.K_3.K_7.K_8 = 7.5 x 1.25 x 1.06 x 1.1 = 10.98 N/mm^2
Applied bending stress, $s_{m,a}$ = 2.44 x 1000/453 = 5.38 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 2.57 x 1000 x 3/(2 x 94 x 170) = 0.24 N/mm^2 OK

Deflection

Bending deflection = 2.97 x 10^8/(8,208 x 3,849) = 9.4 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 2.26 x 10^6/((8208/16) x 94 x 170) = 0.3 mm

Total deflection = 9.4 + 0.3 = 9.7 mm (0.0027 L) <= 0.003L OK

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Site address: 9 Portway, Woking, Surrey GU24 9AJ
Job: Side & Rear Enlargement
Client: Hannah Cavalier & Hugo Cavalier

Side & Rear Extensions.sbw Printed 29 Nov 2022 15:25

Beam: G2. **Span: 3.4 m.**

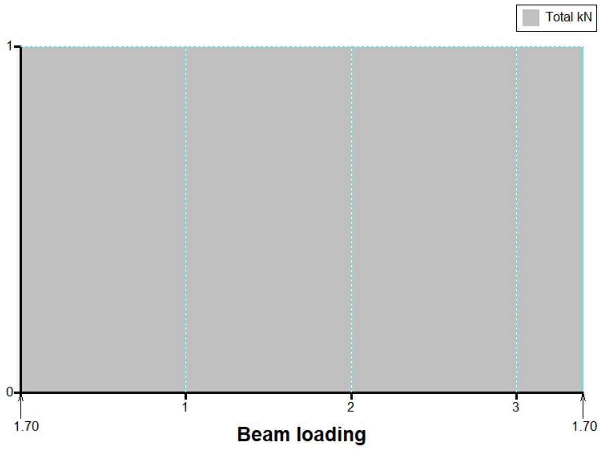
	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp	Defl.
U T	roof: Load=1.0 kn/m	1.0	0		L	1.70	1.70	1.74
			Total load (unfactored):	**3.40 kN**		**1.70**	**1.70**	1.74

Load types: U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

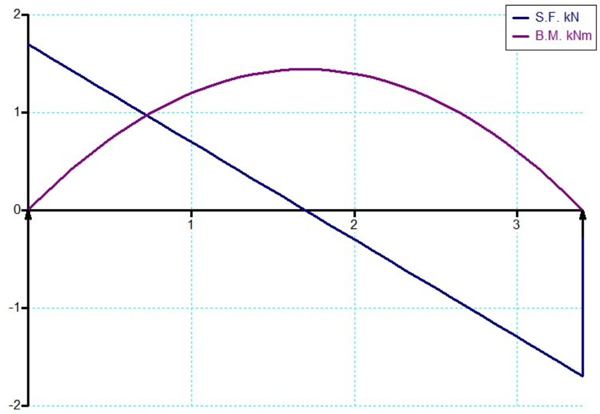
Maximum B.M. = 1.45 kNm (unfactored (all loads applied)) at 1.70 m. from R1

Maximum S.F. = 1.70 kN (unfactored) at R1

Total mid-span deflection: 1.74 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 2x47 x 145 C24 *5.7 kg/m approx*

z = 329 cm^3 I = 2,388 cm^4

Timber grade: C24 2 members acting together: K_8 = 1.1 [§2.9]

K_3 (loading duration factor) = 1.25 (medium term)

K_7 (depth factor) = $(300/145)^{0.11}$ = 1.08 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 7,200 x 1.14 = 8,208 N/mm^2 (E_{min}.K_9)

Bending

Permissible bending stress, $s_{m,adm}$ = $s_{m,g}$.K_3.K_7.K_8 = 7.5 x 1.25 x 1.08 x 1.1 = 11.17 N/mm^2

Applied bending stress, $s_{m,a}$ = 1.45 x 1000/329 = 4.39 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm//}$ = $t_{g,//}$.K_3.K_8 = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 1.70 x 1000 x 3/(2 x 94 x 145) = 0.19 N/mm^2 OK

Deflection

Bending deflection = 1.74 x 10^8/(8,208 x 2,388) = 8.9 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 1.45 x 10^6/((8208/16) x 94 x 145) = 0.2 mm

Total deflection = 8.9 + 0.2 = 9.1 mm (0.0027 L) <= 0.003L OK

Jatinder Tamrat. M:+44 7810 370470. E: Jatinder.t@outlook.com

Site address: 9 Portway, Woking, Surrey GU24 9AJ
Job: Side & Rear Enlargement
Client: Hannah Cavalier & Hugo Cavalier

Side & Rear Extensions.sbw — Printed 29 Nov 2022 15:25

Beam: 1st Fr Joists Over Bike/Storage. **Span: 3.2 m.**

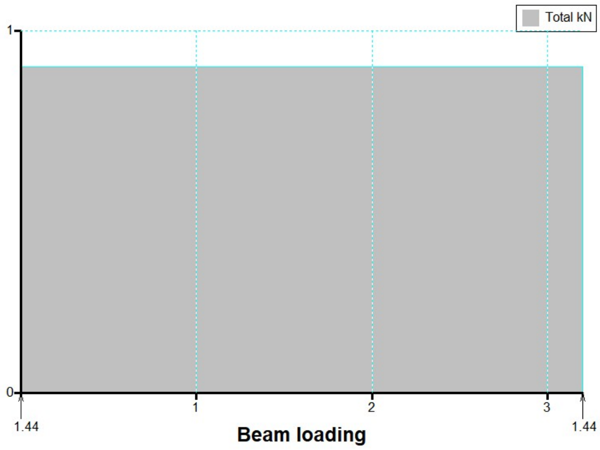
		Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
O	D	o.w.	0.1	0		L	0.16	0.16	0.14
U	T	Floor:2.0#x0.4L	0.8	0		L	1.28	1.28	1.09
				Total load (unfactored):	**2.88 kN**		**1.44**	**1.44**	1.23

Load types: O:Beam o.w.; U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

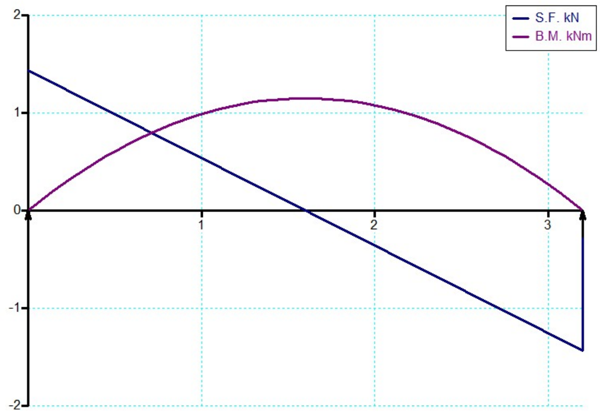
Maximum B.M. = 1.15 kNm (unfactored (all loads applied)) at 1.60 m. from R1

Maximum S.F. = 1.44 kN (unfactored) at R1

Total mid-span deflection: 1.23 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 47 x 170 C24 *3.4 kg/m approx*

z = 226 cm^3 I = 1,924 cm^4

Timber grade: C24 Load sharing system: K_8 = 1.1 [§2.10.11]

K_3 (loading duration factor) = 1.00 (long term)

K_7 (depth factor) = $(300/170)^{0.11}$ = 1.06 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 10,800 N/mm^2 (E_{mean})

Bending

Permissible bending stress, $s_{m,adm}$ = $s_{m,g}$.K_3.K_7.K_8 = 7.5 x 1.00 x 1.06 x 1.1 = 8.78 N/mm^2

Applied bending stress, $s_{m,a}$ = 1.15 x 1000/226 = 5.09 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.00 x 1.1 = 0.78 N/mm^2

Applied shear stress, t_a = 1.44 x 1000 x 3/(2 x 47 x 170) = 0.27 N/mm^2 OK

Deflection

Bending deflection = 1.23 x 10^8/(10,800 x 1,924) = 5.9 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 1.15 x 10^6/((10800/16) x 47 x 170) = 0.3 mm

Total deflection = 5.9 + 0.3 = 6.2 mm (0.0019 L) <= 0.003L OK

Beam: G3. **Span: 2.6 m.**

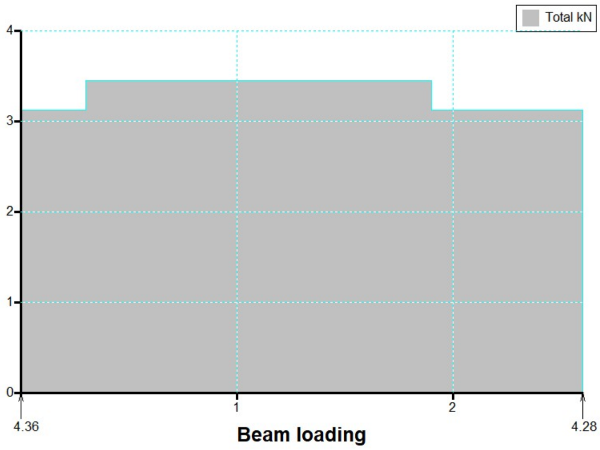
	Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
O D	o.w.	0.2	0		L	0.26	0.26	0.12
U T	Flat rf:2.2#x2.3L/2	2.5	0		L	3.25	3.25	1.49
R T	JB doors:	0.75	0.3		1.9	0.69	0.51	0.36
R T	Outer leaf	0.42	0		0.3	0.12	0.01	0.01
R T	Outer leaf	0.42	1.9		L	0.04	0.25	0.04
			Total load (unfactored): **8.64 kN**			**4.36**	**4.28**	2.01

Load types: O:Beam o.w.; U:UDL; R:Part UDL; Load positions: m. from R1
Load durations: D: Dead; L: Live

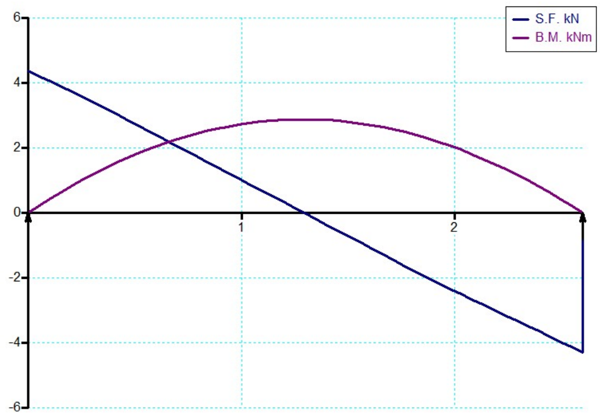
Maximum B.M. = 2.87 kNm (unfactored (all loads applied)) at 1.29 m. from R1

Maximum S.F. = 4.36 kN (unfactored) at R1

Total mid-span deflection: 2.01 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Steel beam calculation to BS449 Part 2 using S275 steel

SECTION SIZE : **178 x 102 x 19 UB** S275

D=177.8 mm B=101.2 mm t=4.8 mm T=7.9 mm I_x=1,360 cm^4 r_y=2.37 cm Z_x=153 cm^3

Bending

L_E/r_y = 2.60 x 100/2.37 = 110 D/T = 22.5

Permissible bending stress, p_{bc} = 124 N/mm^2 (Table 3a)

Actual bending stress, f_{bc} = 2.87 x 1000/153 = 18.7 N/mm^2 OK

Shear

Permissible shear stress, p_s = 110 N/mm^2 [Table 11]

Maximum shear in web, f_s = 4.36 x 1000/(4.8 x 177.8) = 5.1 N/mm^2 OK

Beam web

Check unstiffened web capacities with loads of 4.36 kN and 4.28 kN

Bearing: p_b = 210N/mm^2 (Table 9); C1 = 27.1 kN [27.e] C2 = 1.01 kN/mm
Buckling: p_c = 141N/mm^2 (Table 17a); C1 = 60.2 kN; C2 = 0.677 kN/mm

R1: Minimum required stiff bearing length, L_b = 0mm
Bearing capacity, P_w = C1 + L_b.C2 = 27.1kN ¬ OK
Buckling capacity, P_x = C1 + L_b.C2 = 60.2kN

R2: Minimum required stiff bearing length, L_b = 0mm
Bearing capacity, P_w = C1 + L_b.C2 = 27.1kN ¬ OK
Buckling capacity, P_x = C1 + L_b.C2 = 60.2kN

Deflection

Total deflection = 2.01 x 1e8/(205,000 x 1,360) = 0.7 mm (L/3599) OK

Combined bending and shear check (14.c)

Check $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2$ = 0.023 + 0.000 = 0.023 at 1.30 (<=1.25 OK) [14.c]

Bearings

178 x 102 x 19 UB stiff bearing length, b_1 = t + 1.6r + 2T = 32.8 mm

Factored reactions = unfactored reactions x 1.50 (user selected value)

R1: 300 x 100 mm Padstone

Factored reaction = 1.50 x 4.36 = 6.54 kN

Masonry: 100mm 2.9N/mm^2 solid block (SF>2.0), class (iii) mortar, normal const/normal mfr, Class 2 bearing

Local design strength (factored) = 2.8 x 1.5/3.5 = 1.20N/mm^2 (BS5628-1:2005 Table 2d/2e)

Factored stress under padstone = 6.54 x 1000/300 x 100 = 0.22 N/mm^2 OK

R2: 200 x 100 mm Padstone

Factored reaction = 1.50 x 4.28 = 6.42 kN

Masonry: 15N/mm^2 brick, class (iii) mortar, normal const/normal mfr, Class 2 bearing

Local design strength (factored) = 4.3 x 1.5/3.5 = 1.84N/mm^2 (BS5628-1:2005 Table 2a)

Factored stress under padstone = 6.42 x 1000/200 x 100 = 0.32 N/mm^2 OK

Beam: Fafters to 1st Fr Vaulted Rf. **Span: 1.6 m.**

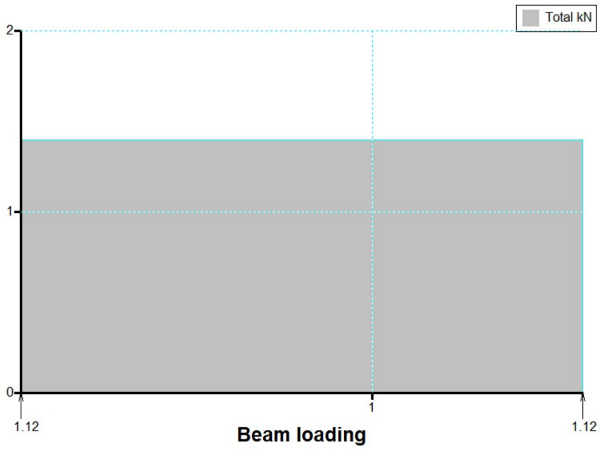
	Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
U T	1.7#x1.65L/2	1.4	0		L	1.12	1.12	0.12
			Total load (unfactored):	**2.24 kN**		**1.12**	**1.12**	0.12

Load types: U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

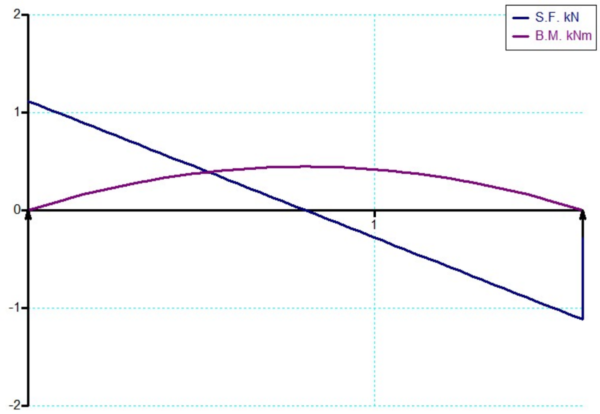
Maximum B.M. = 0.448 kNm (unfactored (all loads applied)) at 0.80 m. from R1

Maximum S.F. = 1.12 kN (unfactored) at R1

Total mid-span deflection: 0.12 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 47 x 95 C24 *1.9 kg/m approx*

z = 70.7 cm^3 I = 336 cm^4

Timber grade: C24   Load sharing system: K_8 = 1.1 [§2.10.11]

K_3 (loading duration factor) = 1.25 (medium term)

K_7 (depth factor) = $(300/95)^{0.11}$ = 1.13 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 10,800 N/mm^2 (E_{mean})

Bending

Permissible bending stress, $s_{m,adm} = s_{m,g}.K_3.K_7.K_8$ = 7.5 x 1.25 x 1.13 x 1.1 = 11.70 N/mm^2

Applied bending stress, $s_{m,a}$ = 0.448 x 1000/70.7 = 6.34 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 1.12 x 1000 x 3/(2 x 47 x 95) = 0.38 N/mm^2 OK

Deflection

Bending deflection = 0.119 x 10^8/(10,800 x 336) = 3.3 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 0.448 x 10^6/((10800/16) x 47 x 95) = 0.2 mm

Total deflection = 3.3 + 0.2 = 3.5 mm (0.0022 L) <= 0.003L OK

Beam: R9. Ridge Beam Over 1st Fr Vaulted Ceiling. **Span: 3.4 m.**

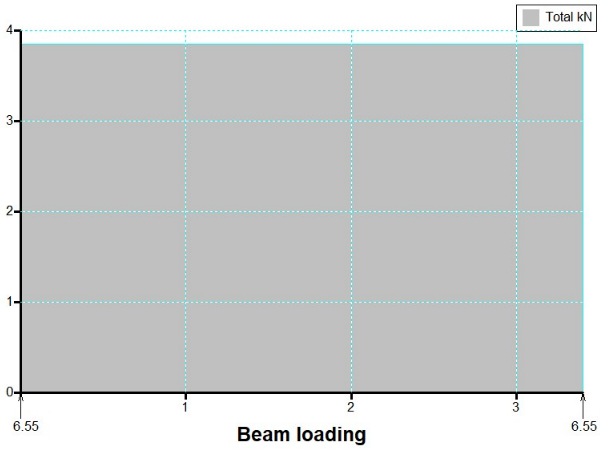
	Load name	Loading w1	Start x1	Loading w2	End x2	R1comp	R2comp	Defl.
O D	o.w.	0.25	0		L	0.43	0.43	0.44
U T	Roof:1.7#x4.2L/2	3.6	0		L	6.12	6.12	6.26
U T		0	0		L	0.00	0.00	0.00
			Total load (unfactored):		**13.09 kN**	**6.55**	**6.55**	6.70

Load types: O:Beam o.w.; U:UDL; Load positions: m. from R1; Load durations: D: Dead; L: Live

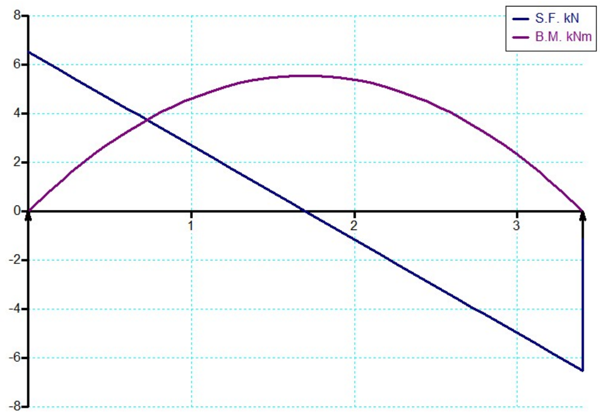
Maximum B.M. = 5.56 kNm (unfactored (all loads applied)) at 1.70 m. from R1

Maximum S.F. = 6.55 kN (unfactored) at R1

Total mid-span deflection: 6.70 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Timber beam calculation to BS5268 Part 2: 2002 using C24 timber

Use 3x47 x 195 C24 *11.5 kg/m approx*

z = 894 cm^3 I = 8,712 cm^4

Timber grade: C24 3 members acting together: K_8 = 1.1 [§2.9]

K_3 (loading duration factor) = 1.25 (medium term)

K_7 (depth factor) = $(300/195)^{0.11}$ = 1.05 [§2.10.6] K_8 (load sharing factor) = 1.1 [§2.9,2.10]

E = 7,200 x 1.21 = 8,712 N/mm^2 (E_{min}.K_9)

Bending

Permissible bending stress, $s_{m,adm}$ = $s_{m,g}$.K_3.K_7.K_8 = 7.5 x 1.25 x 1.05 x 1.1 = 10.81 N/mm^2

Applied bending stress, $s_{m,a}$ = 5.56 x 1000/894 = 6.23 N/mm^2 OK

Shear

Permissible shear stress, $t_{adm//} = t_{g,//}.K_3.K_8$ = 0.71 x 1.25 x 1.1 = 0.98 N/mm^2

Applied shear stress, t_a = 6.55 x 1000 x 3/(2 x 141 x 195) = 0.36 N/mm^2 OK

Deflection

Bending deflection = 6.70 x 10^8/(8,712 x 8,712) = 8.8 mm

Mid-span shear deflection = 1.2M_0/GA (G=E/16) = 1.2 x 5.56 x 10^6/((8712/16) x 141 x 195) = 0.4 mm

Total deflection = 8.8 + 0.4 = 9.3 mm (0.0027 L) <= 0.003L OK

Beam: G1. Top of Box Frame. **Span: 5.2 m.**

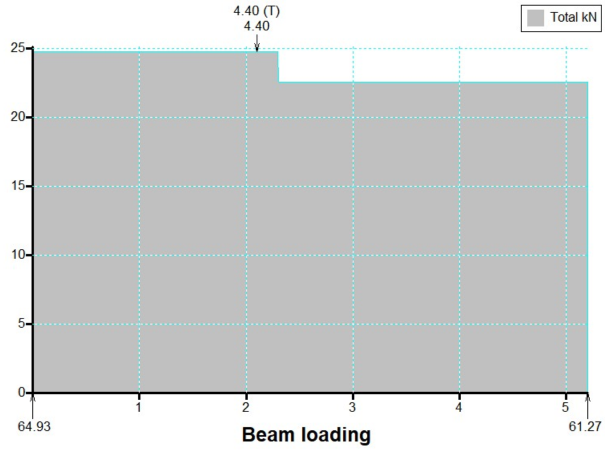
	Load name	*Loading w1*	*Start x1*	*Loading w2*	*End x2*	*R1comp*	*R2comp*	*Defl.*
O D	o.w.	1.15	0		L	2.99	2.99	11
U T	Wall: See below: W=8.5	8.5	0		L	22.10	22.10	81
U T	1st Fr:2.0#x2.8L/2	2.8	0		L	7.28	7.28	27
U T	Dormer wall:1.2#x2.6H	3.1	0		L	8.06	8.06	30
U T	Dormer Rf:1.3#x3.7L/2	2.4	0		L	6.24	6.24	23
U T	Dormer fr:1.9#x2.0#L/2	1.9	0		L	4.94	4.94	18
U T	1st fr ceiling	0.5	0		L	1.30	1.30	5
U T	Ext. roof:1.3#x3.3L/2	2.1	0		L	5.46	5.46	20
R T	1st fr wall:1.0#x2.2H	2.2	0		2.3	3.94	1.12	9
P T	1st fr wall:1.0#x2.2Hx2L	4.4	2.1			2.62	1.78	12
			Total load (unfactored): **126.2 kN**			**64.93**	**61.27**	235

Load types: O:Beam o.w.; U:UDL; R:Part UDL; P:Point load; Load positions: m. from R1
Load durations: D: Dead; L: Live

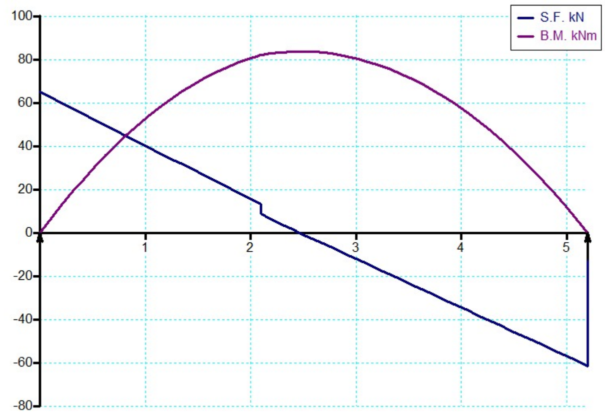
Maximum B.M. = 83.6 kNm (unfactored (all loads applied)) at 2.47 m. from R1

Maximum S.F. = 64.9 kN (unfactored) at R1

Total mid-span deflection: 235 x 10^8/EI *(E in N/mm², I in cm⁴)*



Beam loading



Bending moment and shear force

Rear Wall in cavity Brick: W Kn/m = 4.5# [(14.5) - (2.3+1.2)] /6.1m = 8.1 Kn/m. Say 8.5

Steel beam calculation to BS449 Part 2 using S275 steel

SECTION SIZE : **254 x 254 x 73 UC** S275

D=254.1 mm B=254.6 mm t=8.6 mm T=14.2 mm I_x=11,400 cm^4 r_y=6.48 cm Z_x=898 cm^3

Bending

L_E/r_y = 5.20 x 100/6.48 = 80 D/T = 17.9

Permissible bending stress, p_{bc} = 155 N/mm^2 (Table 3a)

Actual bending stress, f_{bc} = 83.6 x 1000/898 = 93.1 N/mm^2 OK

Shear

Permissible shear stress, p_s = 110 N/mm^2 [Table 11]

Maximum shear in web, f_s = 64.9 x 1000/(8.6 x 254.1) = 29.7 N/mm^2 OK

Beam web

Check unstiffened web capacities with loads of 64.9 kN and 61.3 kN

Bearing: p_b = 210N/mm^2 (Table 9); C1 = 84.1 kN [27.e] C2 = 1.81 kN/mm
Buckling: p_c = 150N/mm^2 (Table 17a); C1 = 164 kN; C2 = 1.29 kN/mm

R1: Minimum required stiff bearing length, L_b = 0mm
Bearing capacity, P_w = C1 + L_b.C2 = 84.1kN ¬ OK
Buckling capacity, P_x = C1 + L_b.C2 = 164kN

R2: Minimum required stiff bearing length, L_b = 0mm
Bearing capacity, P_w = C1 + L_b.C2 = 84.1kN ¬ OK
Buckling capacity, P_x = C1 + L_b.C2 = 164kN

Deflection

Total deflection = 235 x 1e8/(205,000 x 11,400) = 10.0 mm (L/518) OK

Combined bending and shear check (14.c)

Check $(f_{bc}/p_{bc})^2 + (f_s/p_s)^2$ = 0.359 + 0.000 = 0.359 at 2.50 (<=1.25 OK) [14.c]

APPENDIX

REPORT ON A SITE INVESTIGATION

Site

9 PORTWAY, BISLEY, WOKING, SURREY GU24 9AJ

Client

HANNAH AND HUGO CAVALIER

Consulting Engineer

JATINDER TAMRAT

Report Ref

22/12463/KJC

Issued

SEPTEMBER 2022

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DOCUMENT CONTROL			
Report Title	Report on a Site Investigation		
Contract	Portway, Bisley		
Report Reference	22/12463/KJC		
Client	Hannah and Hugo Cavalier		
Prepared by	**K J Clark** BSc Hons Director		
Approved by	**G C D Owens** BSc MSc FGS MIEnvSc Director		
Revision No.	Status	Date of Issue	Final Issue Check
0	Final	29/09/2022	

This Report is prepared for the specific purpose stated and in relation to the development proposals or usage indicated to Albury S.I. Limited at the time of preparation. The recommendations should not be used for adjacent schemes and may not be appropriate for alternative proposals.

The recommendations made and opinions expressed in this Report are based on the strata conditions revealed by the fieldworks as indicated on the exploratory records, together with an assessment of the data from in situ and laboratory tests. No liability can be accepted for conditions which have not been revealed by the fieldworks, for example, between exploratory positions. While this Report may offer opinions on the possible configuration of strata, both between the excavations and below the maximum depth achieved by the investigation, these comments are for guidance only and no liability can be accepted for their accuracy. The data obtained relate to the conditions which are relevant at the time of the investigation.

The groundwater observations entered on exploratory records are those noted at the time of the investigation. The normal rate of progress does not usually permit the recording of any equilibrium water level for any one water strike. It should be noted that groundwater levels are prone to seasonal variation and to changes in local drainage conditions. The word 'none' indicates that groundwater was sealed off by the borehole casing or that no water was observed in the exploratory hole upon completion.

REPORT REF: 22/12463/KJC
CONTRACT: PORTWAY, BISLEY

TABLE OF CONTENTS

1 INTRODUCTION

The Client proposes to construct a single rear and two storey side extension following the demolition of the existing garage structure at 9 Portway, Bisley, Woking ("the site"). Consequently, a site investigation has been undertaken in order to ascertain the nature and engineering properties of the soils underlying the proposed development site and to obtain data which will assist in the formulation of a safe and economical foundation solution. At the time of the site works, the site was occupied and the existing garage building was still present.

The programme of this investigation comprised the construction of three boreholes using hand-held window sampling techniques. A trial pit was also constructed using manual techniques to expose the existing foundations of the property. This excavation was extended by window sampling. During this work samples were recovered for further examination and laboratory testing. In addition, a number of in situ hand shear vane tests were also performed.

This report describes the work undertaken, presents the information obtained and discusses the ground conditions with respect to foundation design and construction.

2 FIELDWORKS

The boreholes and trial pit were constructed on 16th September 2022 at locations as shown on the site plan, drawing no. 22/12463/1, which is presented as Figure 1. The exploratory positions were located in order to provide adequate site coverage taking into account the extent of the proposed extensions. The proposed layout is presented on drawing no. 22/12463/2, included as Figure 2.

The depths and descriptions of the strata encountered in the boreholes and trial pit are given on the records which comprise Appendix 1 to this report. These records note the depths at which samples were taken, the results of in situ tests and the groundwater observations noted at the time of the fieldworks.

Photographs which give a general impression of the site at the time of the fieldworks are included below.

3 GROUND CONDITIONS

3.1 Geology

Reference has been made to the published 1:50,000 scale British Geological Survey (BGS) mapping of the area. The site is indicated as being underlain by the Windlesham Formation of Eocene age.

3.2 Stratigraphy

Consideration of the exploratory records indicates that made ground varying from block paving over sand and crushed limestone to greeny-brown sandy clay with rare brick fragments was encountered at the investigatory locations and was proved to depths of 0.50m, 0.60m and 0.70m.

Green-grey/brown to orange-brown/light grey sandy clay/clayey sand or silt was exposed upon penetration of the made ground and was exposed to depths of between 1.20m and 1.80m. Grey/light grey silty sand was observed beneath the sandy clay/clayey sand and was shown to extend to the full depth of this investigation at 3.10m. These soils are representative of the Windlesham Formation.

3.3 Groundwater

During the construction of the exploratory positions groundwater strikes were encountered at 2.70m and 2.80m. Short-term standing water levels upon completion of the boreholes and trial pit of 2.40m, 2.50m and 2.60m were recorded.

3.4 In Situ Testing

Hand shear vane tests were conducted using the Geonor Shear Vane test equipment in the more cohesive soils encountered. Shear strengths ranging from 140kPa to in excess of 250kPa have been established, which represent a stiff to very stiff in situ condition for a purely cohesive soil.

3.5 Existing Foundations

The existing foundation exposed in the trial pit is depicted on the sectional drawing no. 22/12463/3, presented in Figure 3 to this report. The excavation revealed that the existing foundation comprises brickwork, which extended to 0.38m. At this depth concrete was exposed, which extended out from the building a distance of 0.20m. The depth to the base of the concrete was proved at 0.70m. A photograph of the trial pit excavation is included on the sectional drawing.

4 LABORATORY TESTING

A programme of laboratory testing has been undertaken and the results are presented as Appendix 2 to this report. Each type of test is summarised below and the results obtained have been used to assist in the formulation of the discussion.

4.1 Water Content

The water contents of samples of the soils encountered at this site have been determined. Water contents within the range 13.4% to 26.9% have been recorded.

4.2 Index Properties

The liquid and plastic limits of samples of the clay soils have been determined. The results of this work indicate that the samples tested can generally be described as inorganic clays and silts of low to intermediate plasticity. The soils also exhibit variable shrinkage potential ranging from non-shrinkable to medium shrinkage potential.

4.3 Particle Size Distribution

Samples of the soils encountered at this site have been subjected to sieve analysis in order to determine the soils' particle size distribution. The results of this work are presented in the form of grading curves, which confirm that the soils tested can be described as silty fine to medium sands that are non-shrinkable.

4.4 Chemical Testing – Soluble Sulphates & pH

Samples of the soils and groundwater encountered at this site have been subjected to chemical analyses in order to determine their soluble sulphate contents and pH values. Under the conditions of this work low concentrations of soluble sulphate have been recorded in association with slightly acidic or near neutral pH values.

5 GEOTECHNICAL DISCUSSION

5.1 Foundations

The Client proposes to construct a single storey rear and two storey side extension to the existing house. The proposed layout is shown in Figure 2. At the time of the preparation of this report no information had been provided with regard to the anticipated structural loads.

It cannot be recommended that major structural foundations be located within the made ground revealed by this investigation. Soils of this origin are frequently present in a weak and variable condition such that unacceptable settlement could occur even under the action of light loading intensities. Therefore, it will be necessary to continue foundation excavations through these undesirable materials where they are of less than 1.00m in thickness to this minimum depth in order to avoid that zone of soil which is subject to normal seasonal moisture variation or frost action. The above precautions need not necessarily be applied to light ancillary structures, which will be formed structurally discrete from the main development and in which a greater degree of settlement can be tolerated.

It is known that a number of trees, including mature oaks, are present in the vicinity of the proposed structure. A discussion of the causes, effects and classification of desiccation in clay soils is included in Appendix 3 to this report. Consideration of the results of the laboratory testing indicates that moisture deficiency is not generally present within the near surface soils that have been shown to be of a shrinkable nature.

Interpretation of the data derived from this investigation indicates that both non-shrinkable and shrinkable soils will be present at a nominal depth of 1.00m. Therefore, in order to eliminate the risk of unacceptable differential settlement, it is recommended that all foundations are constructed within soils that are non-shrinkable. It is considered that a nominal depth of 1.00m can be adopted in the areas of boreholes 1 and 2. Where the cohesive and shrinkable soils have been encountered in borehole 3 and trial pit 4, it will necessary to locate foundations at 1.50m depth. Strip or spread foundations can be designed to apply a maximum increase in load of 100kPa. At this loading intensity a factor of safety of 3 against general shear failure will be operative. Moreover, settlements should remain within tolerable limits for the type of structure proposed. These movements are likely to be sensibly complete during a normal construction period due to the free draining nature of the underlying soils.

It would be prudent to incorporate a flexible construction joint between the new extension and the existing house. This will allow any small differential movement between the two elements to be accommodated without inducing structural distress.

5.2 Stability of Excavations

Excavations of less than 1.00m depth should not require temporary support to their sides. However, where foundation excavations are extended below this level, then adequate temporary support or shoring should be provided in order to comply with current statutory safety regulations and to maintain the stability of the excavation sides.

5.3 Groundwater

The groundwater observations noted at the time of the fieldworks suggest that this phenomenon should not represent an engineering problem in respect of shallow depth excavations. Any slight seepages or surface water run-off entering excavations is likely to dissipate through the bases.

5.4 Ground Floor Slabs

The thickness of made ground revealed by this investigation, commonly in excess of 0.60m, infers that a system of fully suspended floor slabs should be incorporated within the proposed structure in accordance with NHBC criteria.

5.5 Buried Concrete

The information obtained from this investigation has been compared with the criteria proposed in BRE Special Digest 1, 2005 Edition, Concrete in Aggressive Ground. Using the information in Table C1 (natural ground) of this publication the Aggressive Chemical Environment for Concrete Classification (ACEC) is AC-1, which coincides with a Design Sulphate Class DS-1. The ACEC Class above can be used to determine the Design Chemical Class for concrete for general cast-in-situ use as required Part D of the Digest.

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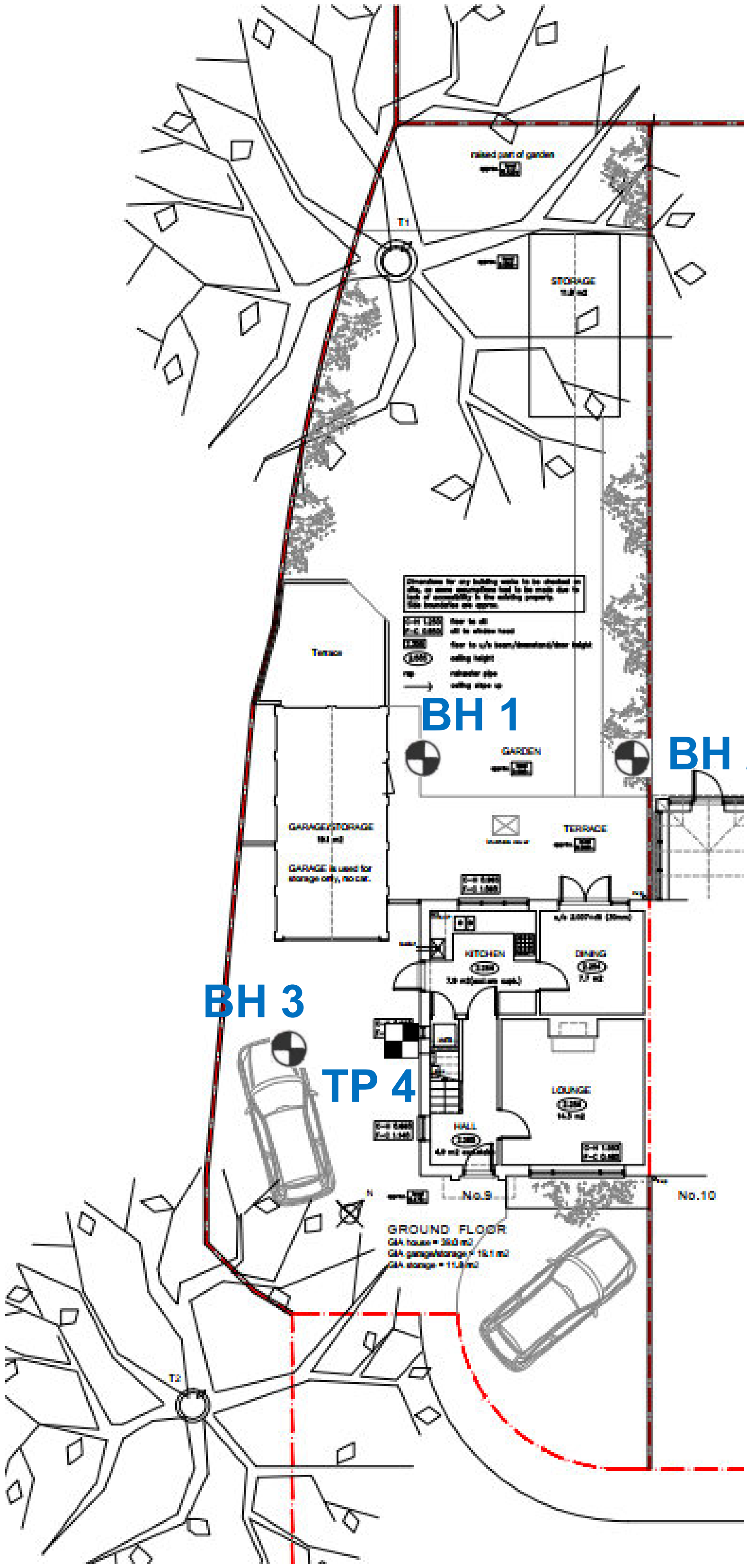
LIST OF ABBREVIATIONS

AOD	-	Above Ordnance Datum
ACM	-	Asbestos-containing Material
AST	-	Above-ground Storage Tank
BGS	-	British Geological Survey
BH	-	Borehole
BRE	-	Building Research Establishment
BSI	-	British Standards Institution
BS	-	British Standard
C4SL	-	Category Four Screening Level
CIRIA	-	Construction Industry Research and Information Association
CP	-	Cable Percussive
DPH	-	Dynamic Probing Heavy
DPSH	-	Dynamic Probing Super Heavy
EA	-	Environment Agency
GAC	-	Generic Assessment Criteria
LL	-	Liquid Limit
mAOD	-	Metres Above Ordnance Datum
mBGL	-	Metres Below Ground Level
mOD	-	Metres Ordnance Datum
OS	-	Ordnance Survey
PAH	-	Polycyclic Aromatic Hydrocarbons
PCB	-	Polychlorinated Biphenyl
PID	-	Photo Ionisation Detector
PL	-	Plastic Limit
PSD	-	Particle Size Distribution
SGV	-	Soil Guideline Value
SOM	-	Soil Organic Matter
SPT	-	Standard Penetration Test
SPZ	-	Source Protection Zone
SVOC	-	Semi-volatile Organic Compounds
TPH	-	Total Petroleum Hydrocarbon
UST	-	Underground Storage Tank
UXB	-	Unexploded Bombs
UXO	-	Unexploded Ordnance
VOC	-	Volatile Organic Compound

FIGURE 1

SITE LAYOUT PLAN - EXISTING



Title:	Site Layout Plan - Existing
Dwg No:	22/12463/1
Client:	Hannah and Hugo Cavalier
Contract:	Portway, Bisley
Job Ref:	22/12463/KJC
Scale:	NTS
Revision:	0
Issue Date:	29/09/2022

Legend:

- Borehole Location
- Trial Pit Location
- Site Boundary

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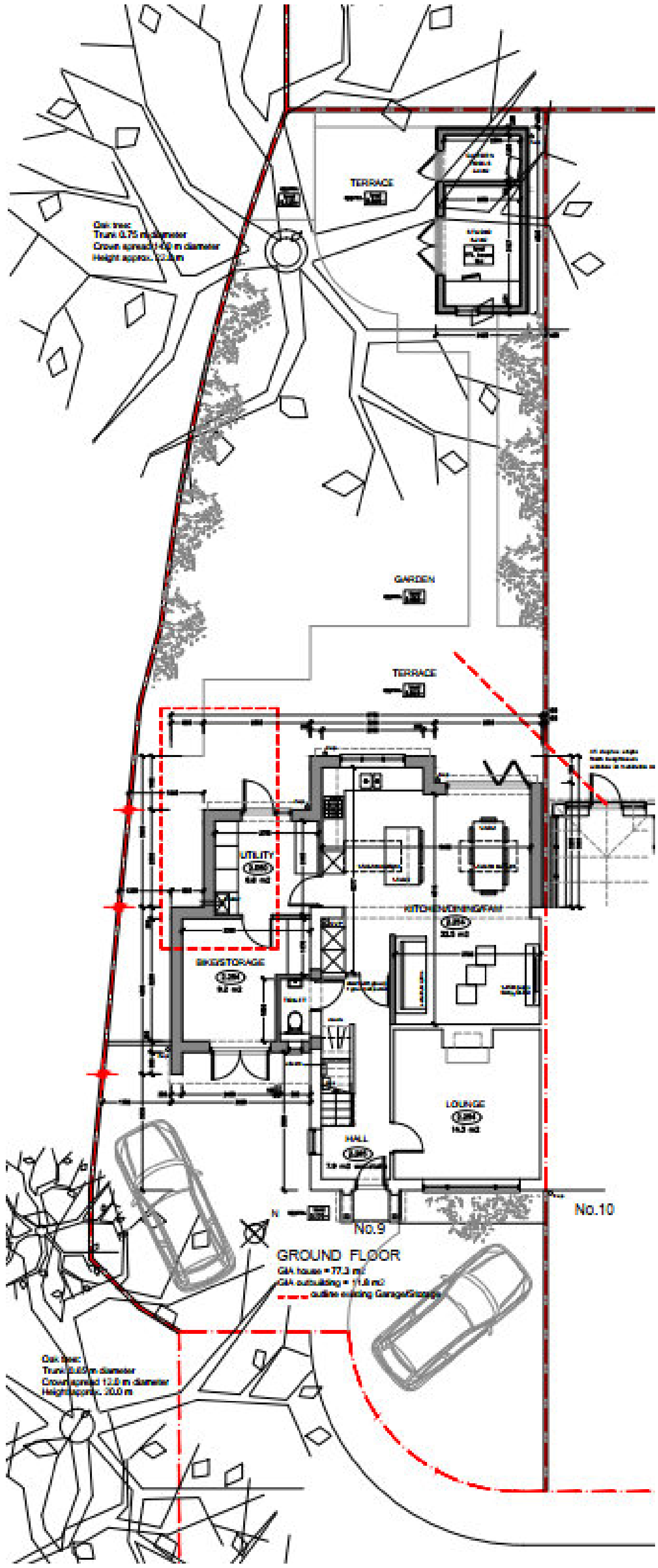
FIGURE 2

PROPOSED LAYOUT



Title:	Proposed Layout
Dwg No:	22/12463/2
Client:	Hannah and Hugo Cavalier
Contract:	Portway, Bisley
Job Ref:	22/12463/KJC
Scale:	NTS
Revision:	0
Issue Date:	29/09/2022

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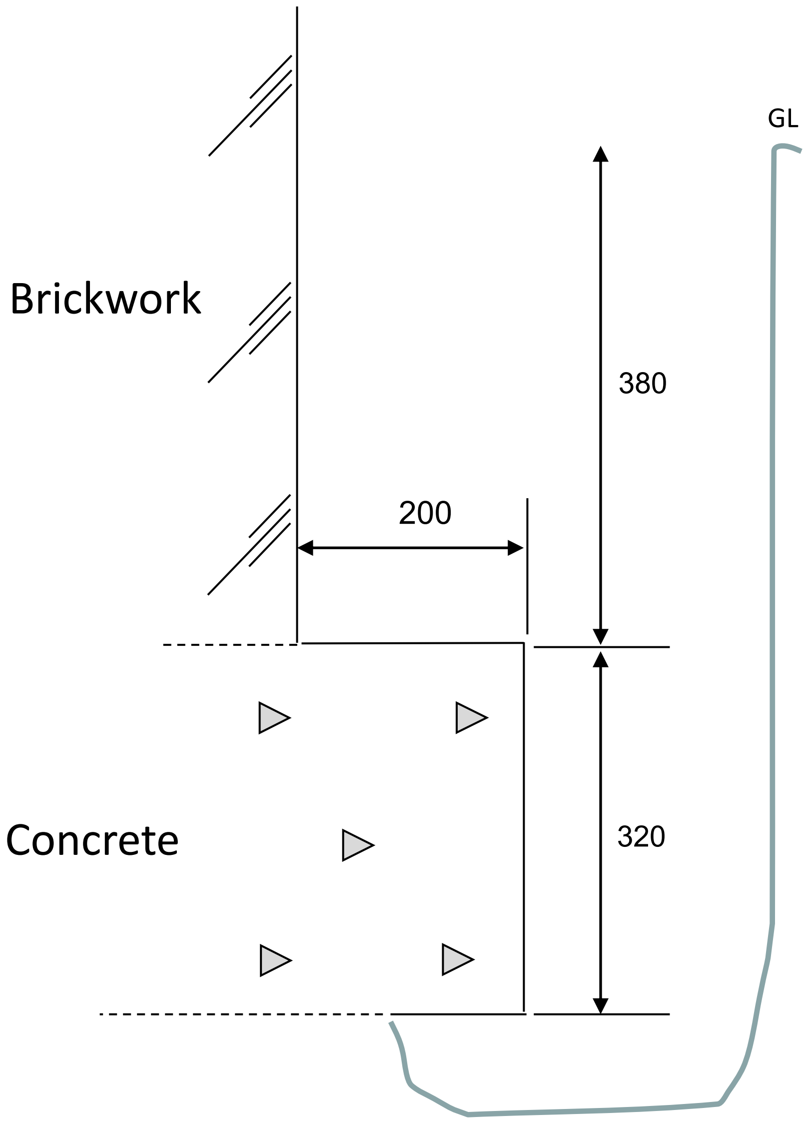
FIGURE 3

TRIAL PIT SECTIONAL DRAWING



Title:	Trial Pit 4 Section
Dwg No:	22/12463/3
Contract:	Portway, Bisley
Scale:	NTS – all dimensions in mm
Revision:	0
Issue Date:	29/09/2022

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APPENDIX 1

EXPLORATORY RECORDS

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		BOREHOLE	1
Contract	Portway, Bisley	**Report Ref**	22/12463/KJC
Client	Hannah and Hugo Cavalier	**Date**	16/09/2022
Site Address	9 Portway, Bisley, Woking, Surrey GU24 9AJ	**Ground Level**	

Type of excavator	Window Sampler	**Water level after completion, m**	2.50

Water strikes, m		**Dimensions, m**		**Ease of excavation, m**			
1	2.80	Diameter	0.06	Very easy		Difficult	0.50-0.80
2				Moderate	GL-0.50, 0.80-3.10	Very hard	

Remarks

Samples or tests		**Shear Strength kPa**	**Depth**	**Legend**	**Strata Description**
Type	**Depth, m**				
D	0.10				MADE GROUND (grass over dark brown silty SAND with brick fragments)
D	0.30		0.30		MADE GROUND (grey/brown very sandy CLAY with gravel, brick particles and roots)
D	0.50		0.50		Brown/grey very sandy CLAY
D	0.75		0.80		Green-grey/brown clayey sandy SILT (very stiff)
D	1.00	230			
D	1.50	250			
			1.70		Green-grey/brown silty SAND
D	2.00				
D	2.50		2.50		Grey/light grey silty SAND
D	3.00				
			3.10		END OF BOREHOLE
W	(2.50)				

Sample Code: B - Large Disturbed D - Small Disturbed W - Water Sample R - Root Sample T - Tube Liner

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BOREHOLE	**2**		
Contract	Portway, Bisley	**Report Ref**	22/12463/KJC
Client	Hannah and Hugo Cavalier	**Date**	16/09/2022
Site Address	9 Portway, Bisley, Woking, Surrey GU24 9AJ	**Ground Level**	

Type of excavator	Window Sampler	**Water level after completion, m**	2.50

Water strikes, m		**Dimensions, m**		**Ease of excavation, m**			
1	2.80	Diameter	0.06	Very easy		Difficult	1.00-3.10
2				Moderate	GL-1.00	Very hard	

Remarks

Samples or tests		**Shear Strength kPa**	**Depth**	**Strata Description**
Type	**Depth, m**			
D	0.10		0.20	MADE GROUND (dark brown clayey SAND with occasional brick fragments and roots)
D	0.30			MADE GROUND (greeny-brown sandy CLAY with occasional brick fragments)
D	0.50		0.50	Orange-brown/light grey sandy CLAY with very occasional gravel
D	0.75		0.90	
D	1.00	200		Green-grey/brown clayey SAND (very stiff)
D	1.50		1.80	
D	2.00			Grey/light grey silty SAND
D	2.50			
D	3.00		3.10	
				END OF BOREHOLE

Sample Code: B - Large Disturbed D - Small Disturbed W - Water Sample R - Root Sample T - Tube Liner

ALBURY S.I. LTD Miltons Yard, Petworth Road, Witley, Surrey GU8 5LH		**BOREHOLE**	**3**
Contract	Portway, Bisley	**Report Ref**	22/12463/KJC
Client	Hannah and Hugo Cavalier	**Date**	16/09/2022
Site Address	9 Portway, Bisley, Woking, Surrey GU24 9AJ	**Ground Level**	

Type of excavator	Window Sampler	**Water level after completion, m**	2.60		
Water strikes, m	**Dimensions, m**	**Ease of excavation, m**			
1 2.70	Diameter 0.06	Very easy		Difficult	GL-1.50
2		Moderate	1.50-3.10	Very hard	

Remarks

Samples or tests		**Shear Strength kPa**	**Depth**	**Legend**	**Strata Description**
Type	**Depth, m**				
			0.20		MADE GROUND (block paving over sand and crushed limestone)
D	0.25		0.40		MADE GROUND (dark brown silty SAND with tile and brick fragments)
D	0.50		0.60		MADE GROUND (greeny-brown clayey SAND with occasional gravel and brick fragments)
D	1.00	>250	1.00		Green-grey/brown clayey SAND
			1.20		Very stiff green-grey/brown very sandy CLAY
D	1.25				Green-grey/brown clayey SAND
D	1.50		1.80		
D	2.00				Grey/light grey silty SAND with rare fine gravel
D	2.50				
D	3.00		3.10		
					END OF BOREHOLE

Sample Code: B - Large Disturbed D - Small Disturbed W - Water Sample R - Root Sample T - Tube Liner

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		TRIAL PIT	**4**
Contract	Portway, Bisley	**Report Ref**	22/12463/KJC
Client	Hannah and Hugo Cavalier	**Date**	16/09/2022
Site Address	9 Portway, Bisley, Woking, Surrey GU24 9AJ	**Ground Level**	
Type of excavator	Manual/Window Sampler	**Water level after completion, m**	2.40

Water strikes, m		**Dimensions, m**		**Ease of excavation, m**			
1	2.70	Diameter	0.06	Very easy		Difficult	GL-3.10
2				Moderate		Very hard	

Remarks
Trial pit extended by window sampling techniques

Samples or tests		Shear Strength kPa	Depth	Legend	Strata Description
Type	**Depth, m**				
			0.20		MADE GROUND (block paving over sharp sand over crushed limestone)
D	0.30		0.40		MADE GROUND (dark brown clayey SAND with occasional brick fragments and roots)
D	0.50		0.70		MADE GROUND (green-grey/brown sandy CLAY with occasional brick fragments and roots)
D	1.00	140	1.40		Stiff green-grey/brown sandy CLAY
D	1.50				Grey/brown silty SAND
D	2.00				
D	2.50				
D	3.00		3.10		END OF BOREHOLE

Sample Code: B - Large Disturbed D - Small Disturbed W - Water Sample R - Root Sample T - Tube Liner

APPENDIX 2

LABORATORY TEST RESULTS

INDEX PROPERTIES AND WATER CONTENTS

BS 1377 : Part 2 : 1990

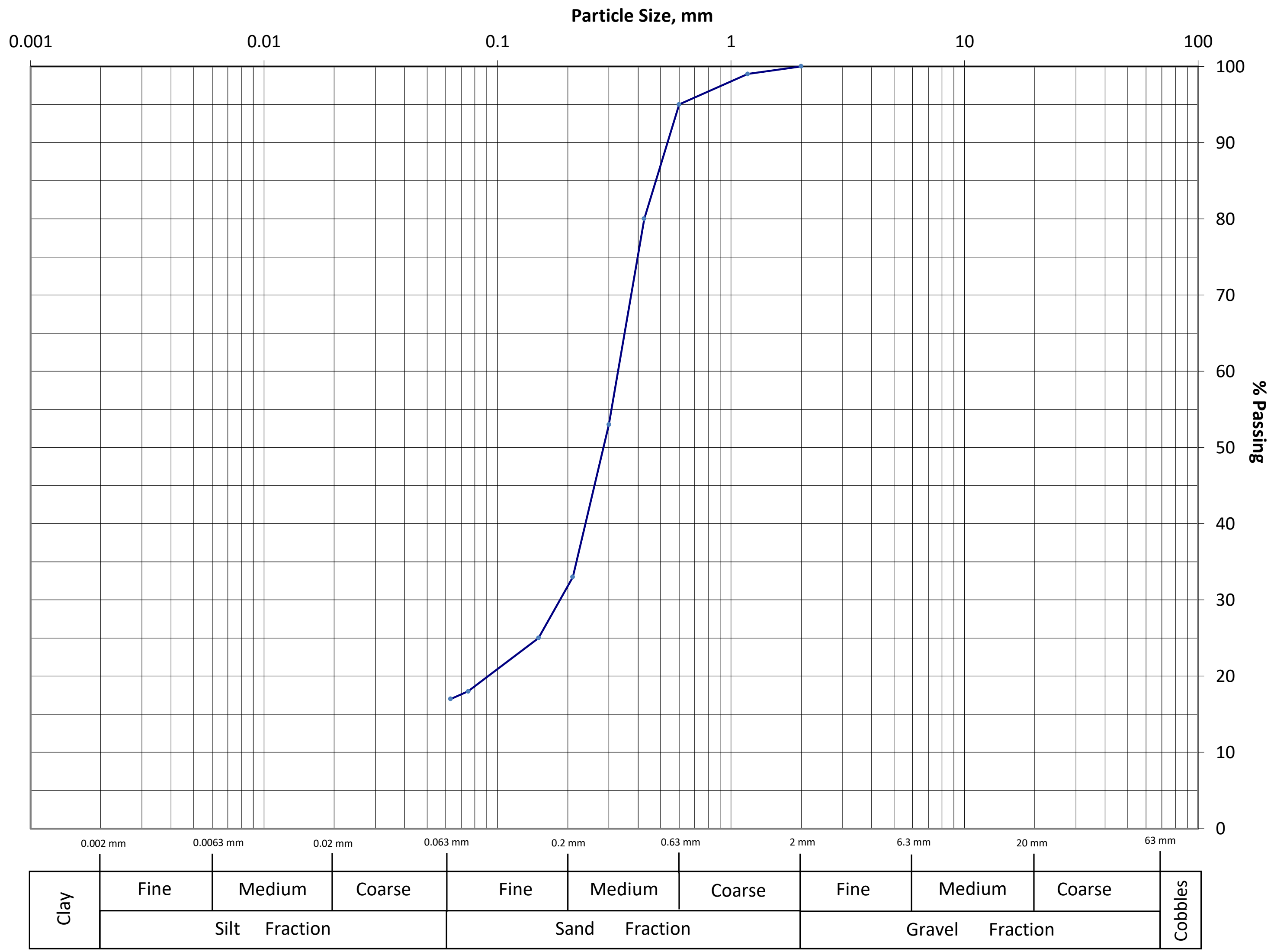
Report Ref	22/12463/KJC	**Contract**	Portway, Bisley

BH/TP No.	Sample		Water Content W %	Liquid Limit W_L %	Plastic Limit W_P %	Plasticity Index IP %	% Passing 425 Micron Sieve	Corrected Plasticity Index IPc %	Soil Classification	Remarks
	Depth m	Description								
1	1.00	Green-grey/brown clayey sandy silt	22.0	30	24	6	97	6	ML	
	1.50	Green-grey/brown clayey sandy silt	16.9	27	22	5	98	5	ML	
2	1.00	Green-grey/brown clayey sand	23.0	30	21	9	98	9	CL	
	1.50	Green-grey/brown clayey sand	14.5	28	20	8	98	8	CL	
3	1.00	Green-grey/brown very sandy clay	16.6	35	22	13	98	13	CL/CI	
	1.50	Green-grey/brown clayey sand	13.4	26	20	6	98	6	ML/CL	
4	1.00	Green-grey/brown sandy clay	26.9	49	23	26	99	26	CI	

KEY: *Soil Type:* **C** - Clay **M** - Silt **O** - Organic **NP** - Non Plastic
Plasticity: **L** - Low **I** - Intermediate **H** - High **V** - Very High **E** - Extremely High

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	
50	
37.5	
25	
20	
13	
9.5	
6.3	
4.75	
3.35	
2	100
1.18	99
0.6	95
0.425	80
0.3	53
0.21	33
0.15	25
0.075	18
0.063	17

Particle Proportions (%)	
Cobbles	0
Gravel	0
Sand	83
Silt & Clay	17

BH/TP No.	**1**	**Depth, m**	2.00	**Report Ref**	22/12463/KJC
Visual Description	Grey/light grey silty sand			**Contract**	Portway, Bisley

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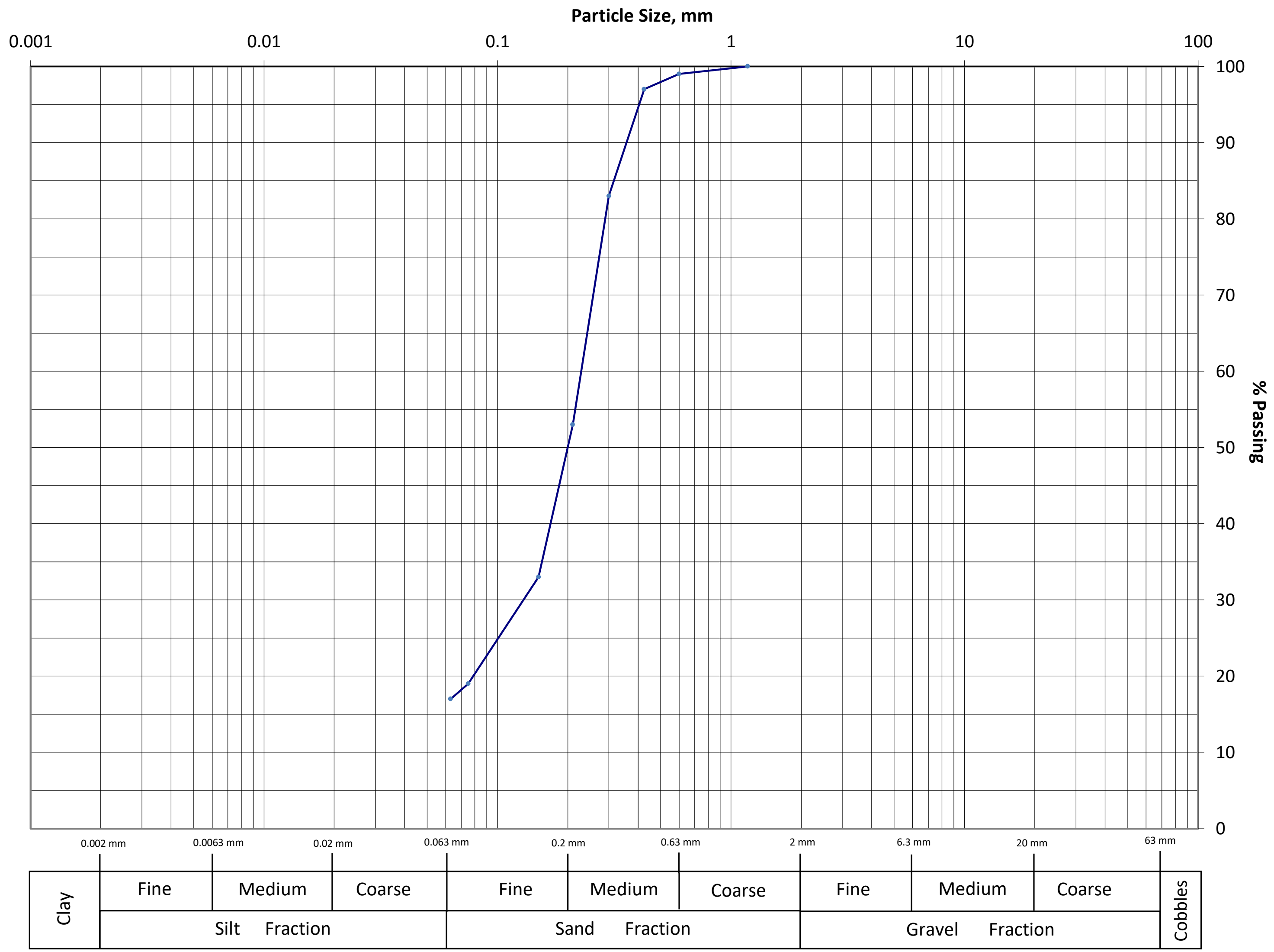
PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	
50	
37.5	
25	
20	
13	
9.5	
6.3	
4.75	
3.35	
2	
1.18	100
0.6	99
0.425	97
0.3	83
0.21	53
0.15	33
0.075	19
0.063	17

Particle Proportions (%)	
Cobbles	0
Gravel	0
Sand	83
Silt & Clay	17

BH/TP No.	**2**	**Depth, m**	2.00	**Report Ref**	22/12463/KJC
Visual Description	Grey/light grey silty sand			**Contract**	Portway, Bisley

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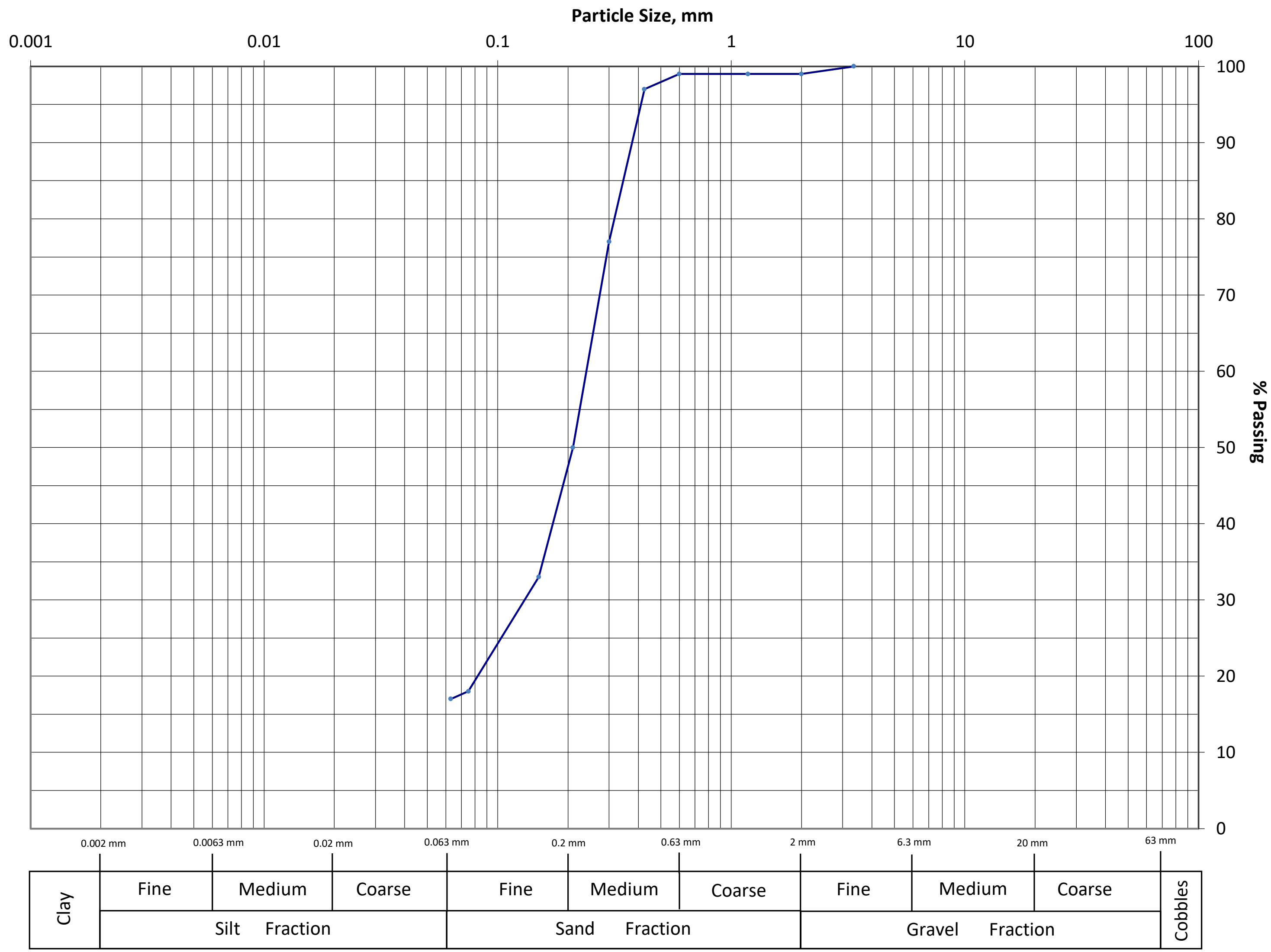
PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



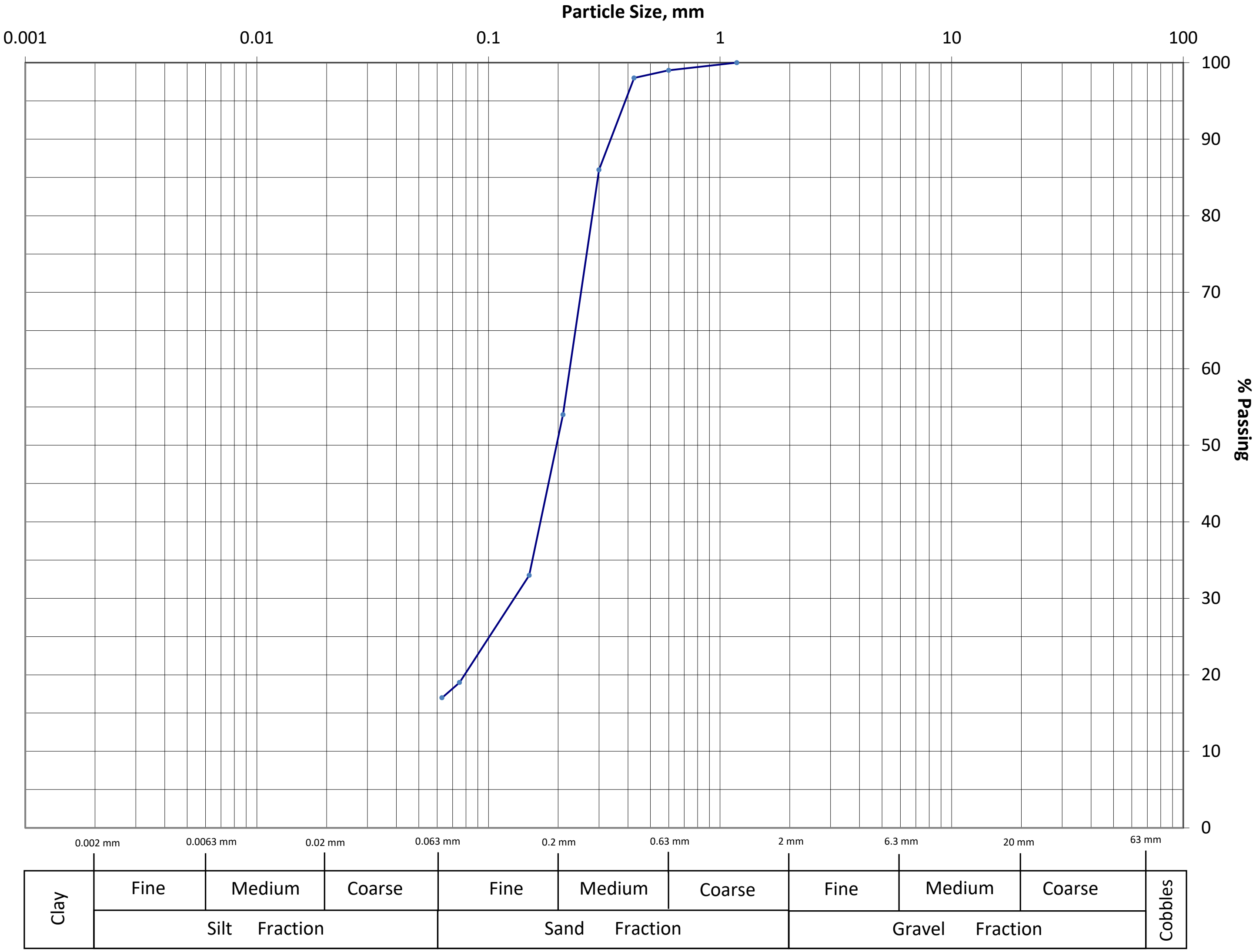
BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	
50	
37.5	
25	
20	
13	
9.5	
6.3	
4.75	
3.35	100
2	99
1.18	99
0.6	99
0.425	97
0.3	77
0.21	50
0.15	33
0.075	18
0.063	17

Particle Proportions (%)	
Cobbles	0
Gravel	1
Sand	82
Silt & Clay	17

BH/TP No.	3	Depth, m	2.00	Report Ref	22/12463/KJC
Visual Description	Grey/light grey silty sand with rare fine gravel			Contract	Portway, Bisley

PARTICLE SIZE DISTRIBUTION TEST

BS 1377 : Part 2 : Clauses 9.2, 9.3 : 1990 Particle Size Distribution by Wet/Dry Sieving Method



BS Test Sieve Aperture Size (mm)	Percentage Passing
75	
63	
50	
37.5	
25	
20	
13	
9.5	
6.3	
4.75	
3.35	
2	
1.18	100
0.6	99
0.425	98
0.3	86
0.21	54
0.15	33
0.075	19
0.063	17

Particle Proportions (%)	
Cobbles	0
Gravel	0
Sand	83
Silt & Clay	17

BH/TP No.	**4**	**Depth, m**	1.50	**Report Ref**	22/12463/KJC
Visual Description	Grey/brown silty sand			**Contract**	Portway, Bisley

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SUMMARY OF CHEMICAL ANALYSES

Determination of Soluble Sulphate Contents of Soil and Groundwater, Organic Matter Content and pH Value

Report Ref	22/12463/KJC	**Contract**	Portway, Bisley

BH/TP No.	**Sample**			**Concentration of Sulphates expressed as SO_4**		**pH Value**	**Organic Content %**
	Depth m	Soil Type	% passing 2mm sieve	2:1 Water:Soil Extract mg/l	Groundwater mg/l		
1	1.00	Clayey sandy silt	100	<250		4.2	
	2.50	Water	-		<80	4.5	
2	0.30	Made ground	100	<250		6.4	
	1.50	Clayey sand	99	<250		4.1	
3	1.00	Clayey sand	96	<250		4.5	
4	0.25	Made ground	100	<250		7.7	

APPENDIX 3

DESICCATION

DESICCATION

Classification

The removal of moisture from a soil as a result of external influences with a constant stress regime, results in shrinkage or settlement of the soil. The magnitude of shrinkage is dependent upon the geological stress history of the soil, its clay content and the composition of the clay minerals. Under normal climatic conditions, there is a seasonal cyclic variation in soil moisture and, hence, volume change, which extends to depths of approximately 1m. When the soil moisture deficit attains a critical value, the shrinkage of the soil can become significant. In these circumstances, the soil can be regarded as being present in a desiccated state.

Causes

A common cause of desiccation consists of the reduction in soil moisture by tree root action. In the absence of a water table at shallow depth, root action of trees will reduce the soil moisture level in order to maintain growth. In general terms, the increase in rainfall which occurs during winter periods will allow for some replacement of the moisture content of the soil, particularly where isolated or immature trees are concerned.

However, when drought summer conditions or limited winter rainfall occurs, desiccated zones will develop within the zone of influence of tree roots. In woodland, desiccation develops as it is not possible for rainfall to overcome the soil moisture deficit. Other causes of desiccation, which have created problems to structures, include incorrectly installed and insulated heating pipes or ducts and industrial processes, ie furnaces or brick kilns.

Effects

The development of desiccation in clay soils will result in an increase in strength of the material. In addition, negative pore water pressure or soil suction will develop. Any foundation system located within soil which is subject to a reduction in soil moisture can experience structural distress, which results from the loss in volume or shrinkage of the ground. Also, if the source of the desiccation is removed, there will be heave of the soils as a result of an increase in equilibrium water content

It is evident, therefore, that foundation systems founded in soils which are actively experiencing an increase or decrease in soil moisture, will be subject to either heave or settlement, which can induce stresses within the structure. It should also be appreciated that a desiccated soil, which is experiencing an increase in equilibrium water content, will attempt to increase its volume in a horizontal as well as vertical plane. It is important, therefore, to ensure that horizontal movements do not apply differential stresses to structural elements, by incorporating collapsible membranes within remedial works.

Identification

A soil in a state of equilibrium is present in a semi-solid state. At the onset of desiccation, the condition of the soil moves towards the boundary between a solid and semi-solid state, this boundary being defined as the plastic limit of the soil. It follows, therefore, that when the natural water content of a soil lies close to, or falls below, the value of the plastic limit, the soil can be considered to be desiccated.

An alternative proposal was made by Driscoll (1983), who related the soil suction induced by desiccation to a function of the liquid limit of the soil. In general terms, desiccation is assumed to be present when the moisture content falls below a level of 40% liquid limit. The arbitrary factor of 0.4 relates to a soil suction value proposed by Croney (1977) and may vary with the composition and mineralogy of different soil types. This approach is only considered to be valid over a limited depth range as the overburden effect will result in a natural reduction in soil moisture and result in the development of negative pore pressures.

A further approach, which considers the shear strength of the clay, Pugh et al (1995), recognises the fact that a reduction in soil moisture will result in an increase in undrained shear strength as well as the development of negative pore pressures. Whilst this approach has a considerable amount of merit, care is required in establishing the value of the soil's in situ shear strength, particularly if it is not possible to obtain representative "undisturbed" samples from cable percussion boreholes. The proposal made in the Pugh paper that the simple pocket penetrometer will provide accurate consistent results should be treated with care, as the pocket penetrometer can take no account of the effects of disturbance and remoulding that are inevitable when completing a trial pit with a mechanical excavator. It is for this reason that this Company attempts to establish the shear strength of clay soils by using the Geonor Field Vane. With this test equipment the appropriate-sized vane is pushed into the side of the pit, through the thin disturbed zone which is caused by the teeth of the bucket during excavation. Furthermore, by use of the 'blank' probe, it is possible to take account of any skin friction which builds up on the shaft of the vane and thus provide a more accurate assessment of the shear strength of the soils.

Hence, a combination of the methods discussed above should be considered in order to confirm whether the development of soil moisture reduction to achieve a desiccated state has occurred within a particular site. The data for affected areas should, where possible, be compared with soils which lie outside the influence of tree root bulbs and may, therefore, be considered to be present in a stable and equilibrium state.

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