GREEN
STRUCTURAL
ENGINEERING

108 High Street Odiham

RG29 1LP

Structural Design Package

March 2022

J002241

Contents

GSE GREEN STRUCTURAL ENGINEERING	Project 108 HIGH STREET ODIHAM		Job Ref J002242	
	Drawing Ref	Calculations by PB	Checked by	Sheet C1
	Part of Structure DESIGN PHILOSOPHY		Date MARCH 2022	

1.0 Design Philosophy

The design of the structural elements will be carried out in such a way to limit the impact of the structural works on the existing building construction and that of the neighbouring properties.

Deflection Limits

Beams supporting existing masonry	= span/500 Total Load
Beams supporting new structure	= span/360 Live Load
	= span/200 Total Load

Scope of Works

The existing building is located within the High Street at Odiham, where the majority of buildings are listed

The premises is a Grade II Listed building, dating from the 18th and 19th century. Some architectural detailing internally is of the 20th century

There is a mixture of consented and unconsented works that appear to have occurred at various points in time

Current works will convert the current ground floor single retail unit into two units with central separating corridor. To the rear, the current ground floor retail (storage ?) is converted into a flat , and the first floor is reconfigured to provide two flats

Structural implications are as follows

1.Ground floor retail area, stripping back of casings to the two main support piers . Opening up has been carried out to verify the structural arrangement, and NO structural modifications proposed ; works are cosmetic only to reduce intrusion into corridor and retail unit 1

2.Timber beam, steel beam and flitch beam support at ground floor ceiling and 1st floor ceiling levels above various new openings in existing walls. The supporting beams bear onto either existing masonry walls or new timber support posts.

Bearing Pressures

Current works do not involve any new foundations , or changes that require foundation capacities to be checked , therefore the information presented below is 'for information' only

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An assumed conservative bearing pressure of 150 kPa will be used in any future foundation design or assessment.

From the BGS information the local geology is confirmed as being silt, silty chalky clay , and stiff weathered Grade IV chalk at approx. 2m below egl . Hence the current basement walls and foundations should be bearing onto the chalk.

Temporary Works

The temporary works for the project is the responsibility of the contractor.

Existing Masonry

Existing masonry is to be assessed in accordance with guidance given in CIRIA Report 111 ie, for UNFACTORED LOADS

i) Basic brick compressive strength = 0.42 N/mm2
ii) Enhancement under bearings = 1.5
iii) Therefore padstones to be sized on the basis of a bearing stress of (0.42 x 1.5 =) 0.63 N/mm2

GSE GREEN STRUCTURAL ENGINEERING	Project 108 HIGH STREET ODIHAM		Job Ref J002242	
	Drawing Ref	Calculations by PB	Checked by	Sheet c3
	Part of Structure DESIGN PHILOSOPHY		Date MARCH 2022	

Loadings (Service Loads SL)

Flat Roof

Dead Loads	
Felt and chippings	0.45 kN/m²
Boards and joists	0.20 kN/m²
Ceiling	0.20 kN/m²
Services	0.15 kN/m²
Total Dead Load	**1.00 kN/m²**
Imposed Load	**0.75 kN/m²**

Pitched Roof

Dead Loads	
Slate and felt	0.30 kN/m²
Boards and joists	0.25 kN/m²
Ceiling	0.25 kN/m²
Services	0.15 kN/m²
Total Dead Load	**1.00 kN/m²**
Imposed Load Roof (maintenance)	0.75 kN/m²
Imposed Load Ceiling	0.25 kN/m²
Total Imposed Loading	**1.00 kN/m²**

Timber Floors

Dead Loads	
Boards and joists	0.35 kN/m²
Ceiling	0.25 kN/m²
Services	0.20 kN/m²
Total Dead Load	**0.80 kN/m²**
Imposed Load	**1.50 kN/m²**
Partitions (on plan)	**0.60 kN/m²**

Beam & Block Floors

Dead Loads	
Screed	1.80 kN/m²
Floor swt	3.50 kN/m²
Services	0.30 kN/m²
Total Dead Load	**5.60 kN/m²**
Imposed Load	**1.50 kN/m²**

Walls Loads (on elevation)

Stud Partions	0.70 kN/m²
215 Brickwork + Plaster	5.30 kN/m²
330 Brickwork + Plaster	7.40 kN/m²
450 Brickwork + Plaster	10.10 kN/m²

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C4
	Part of Structure		Date	
	Soils		MARCH 2022	

SOILS CONDITIONS

- There is no 'site specific' soils investigation for the project
- Hence rely on information stored on the BGS website
- This confirms Seaford chalk formation
- The nearest bore hole is SU75SW188 in Keytiens View

this confirms silty clay over chalk (Slightly weathered) at 7m below ego

∴ the existing base mat & footings will be in the CHALK.

Allow 150 kN/m² safe bp in chalk

NOTE

Currently no works proposed which require foundations to be reviewed (or new ones provided).

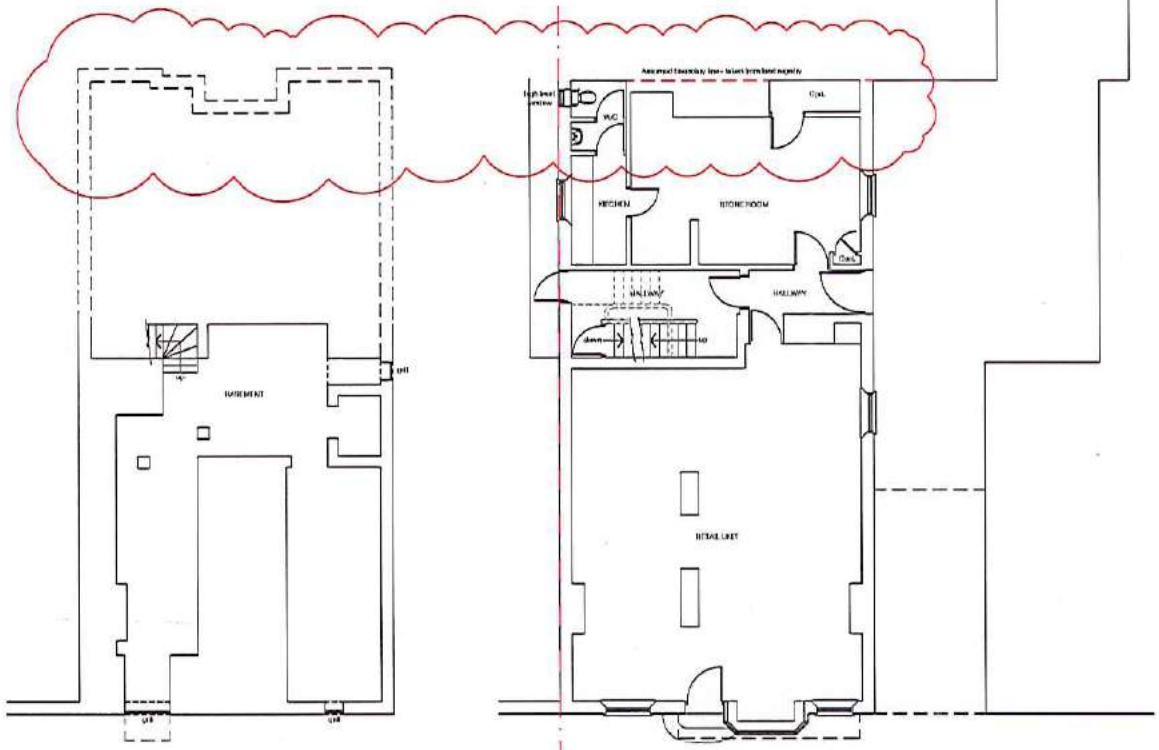
LOCATION: REYTIENS VIEW - ODIHAM | DATE: 28th Oct 1988 | **TRIALPIT : 3**

DESCRIPTION	REDUCED LEVEL m	DEPTH m	LEGEND	SAMPLE TYPE	SAMPLE DEPTH	THICKNESS m	SPT	REMARKS
		0.00						
TOPSOIL						0.20		The ho e remained dry.
Firm dark brown SILT		0.20						
						0.50		
Firm brown white mottled silty chalky CLAY		0.70						
				U38	1.00			--693 /3 / 1.00
						1.20		
				U38	1.70			--693 /3 / 1.70
Stiff weathered CHALK with some flints. Gracely chalk.		2.00						
						0.40		
		2.40						

TERRAMECH INVESTIGATIONS LIMITED
183 LONG LANE TILEHURST READING

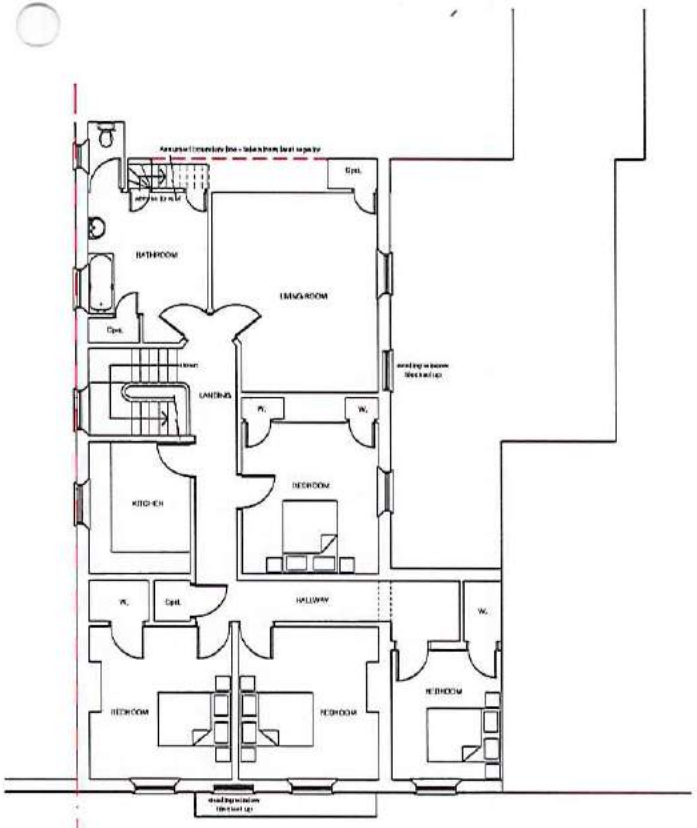
REMARKS :

J100 = 100mm dia. UNDISTURBED SAMPLE U38 = 38mm dia. UNDISTURBED SAMPLE
D = SMALL DISTURBED SAMPLE B = BULK SAMPLE W = WATER SAMPLE Page 1
SPT = STANDARD PENETRATION TEST CPT = CONE PENETRATION TEST



BASEMENT FLOOR PLAN

GROUND FLOOR PLAN



FIRST FLOOR PLAN

Revision A - Wall profile corrected 25.01.21

REV	DATE	DESCRIPTION	INITIAL	CHECKED

PLANNING

harding rose architects

CLIENT: LAMRON DEVTS (ODIHAM) LTD

PROJECT: 108 High Street, Odiham, RG29 1LP

TITLE: Existing Plans

SCALE	DATE	
1:100 @ A2	24.11.20	
DRAWN: JC	PROJECT NO: 19.767	P.02 A

North

0 1 2 3 4 5 10

FRONT ELEVATION (South)

SIDE ELEVATION (East)

Do not scale from this drawing, other than for Local Authority Planning purposes.

This drawing is to be read in conjunction with all relevant consultants, specialist manufacturers drawings and specifications.

Any discrepancies in dimensions or details on or between these drawings should be drawn to our attention.

All dimensions are in millimetres unless noted otherwise.

0 1 2 3 4 5 10

REV	DATE	DESCRIPTION	INITIAL	CHECKED

PLANNING

harding rose architects

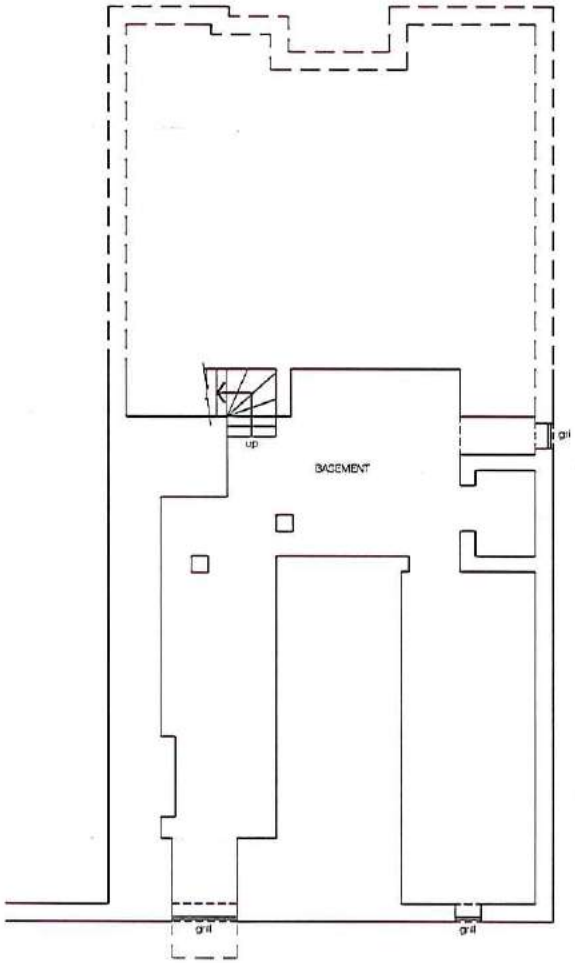
CLIENT: LAMRON DEVTS (ODIHAM) LTD

PROJECT: 108 High Street, Odiham, RG29 1LP

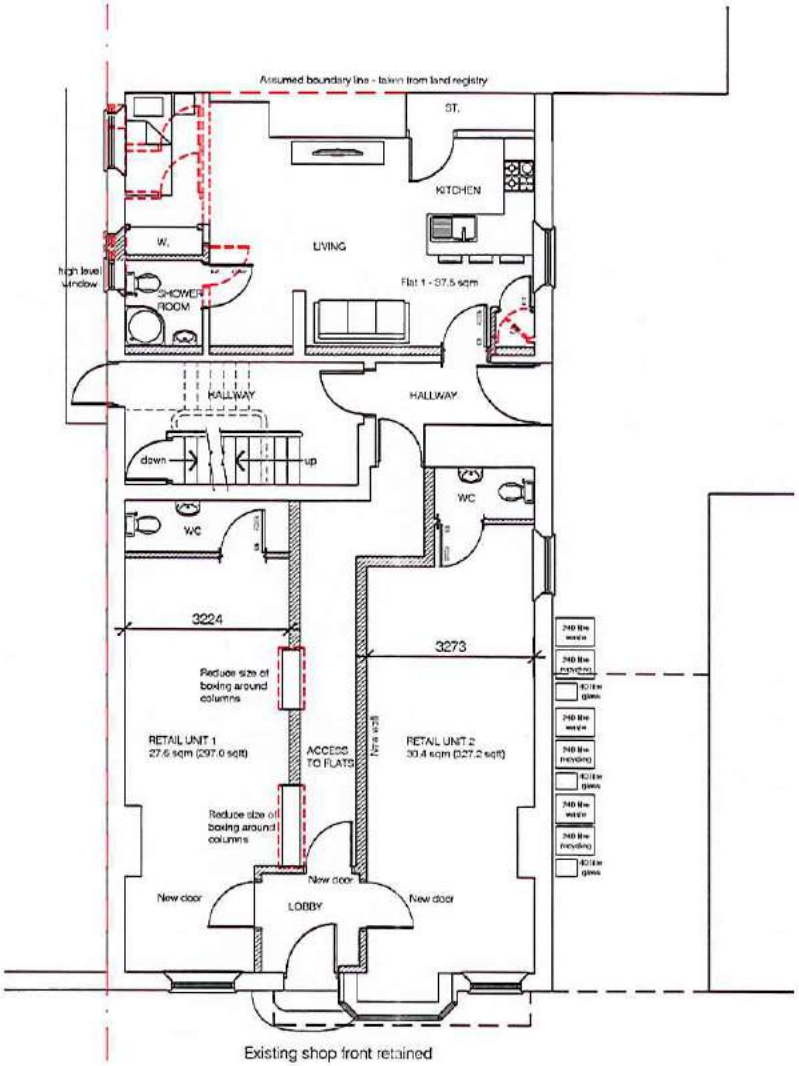
TITLE: Existing Elevations

SCALE	DATE	
1:100 @ A3	24.11.20	
DRAWN: JC	PROJECT NO: 19.767	P.03 -

67

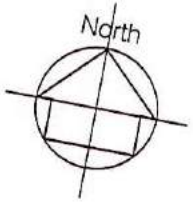


BASEMENT FLOOR PLAN



Existing shop front retained

GROUND FLOOR PLAN



REV	DATE	DESCRIPTION	INITIAL	CHECKED

PLANNING

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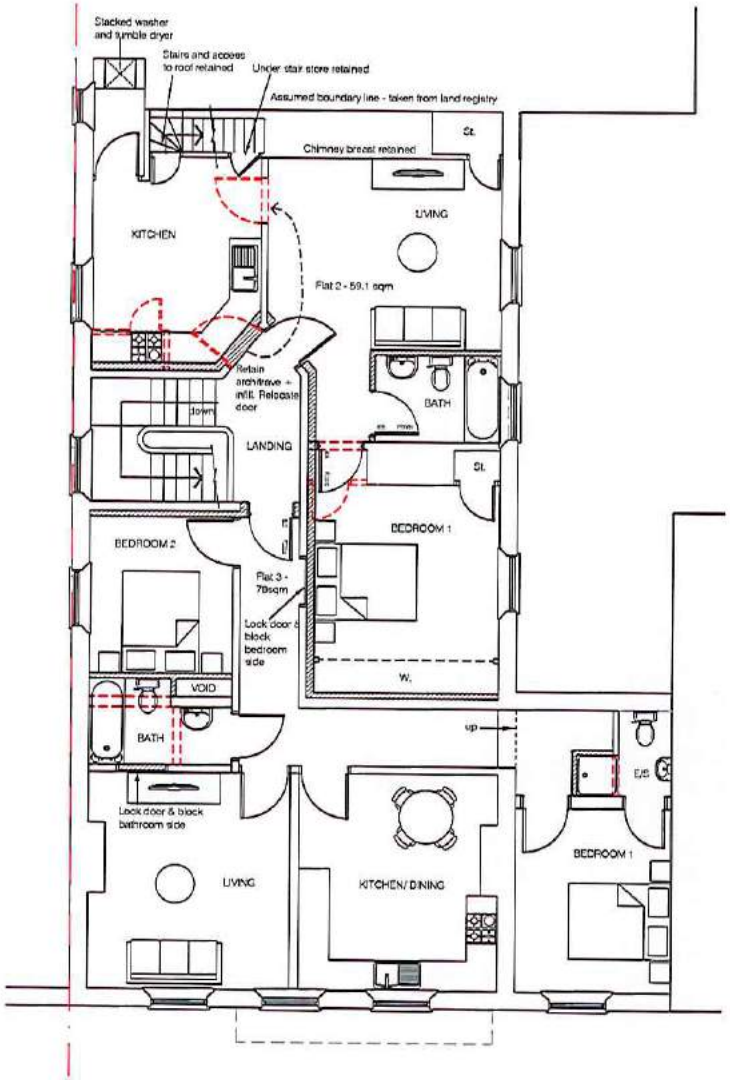
CLIENT: LAMRON DEVTS (ODIHAM) LTD

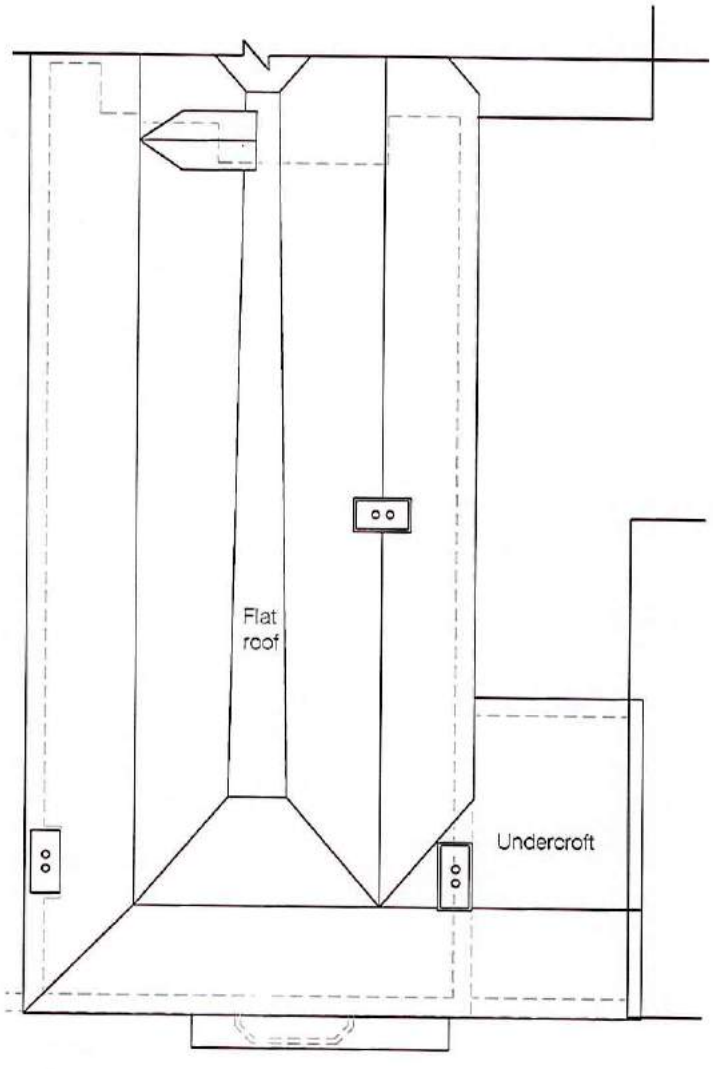
PROJECT: 108 High Street, Odiham, RG29 1LP

TITLE: Proposed Basement and Ground Floor Plans

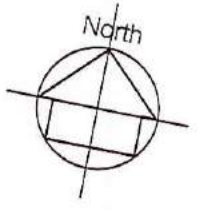
SCALE	DATE	
1:100 @ A3	21.01.22	
DRAWN: JC	PROJECT NO: 19.767	P.205



FIRST FLOOR PLAN



ROOF PLAN



REV	DATE	DESCRIPTION	INITIAL	CHECKED

PLANNING

harding rose architects

CLIENT: LAMRON DEVTS (ODIHAM) LTD

PROJECT: 108 High Street, Odiham, RG29 1LP

TITLE: Proposed First Floor and Roof Plans

SCALE	DATE	
1:100 @ A3	21.01.22	
DRAWN: JC	PROJECT NO.: 19.767	P.206

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	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C/O
	Part of Structure		Date	
	EXISTING STRUCTURE		MARCH 2022	

EXISTING STRUCTURE

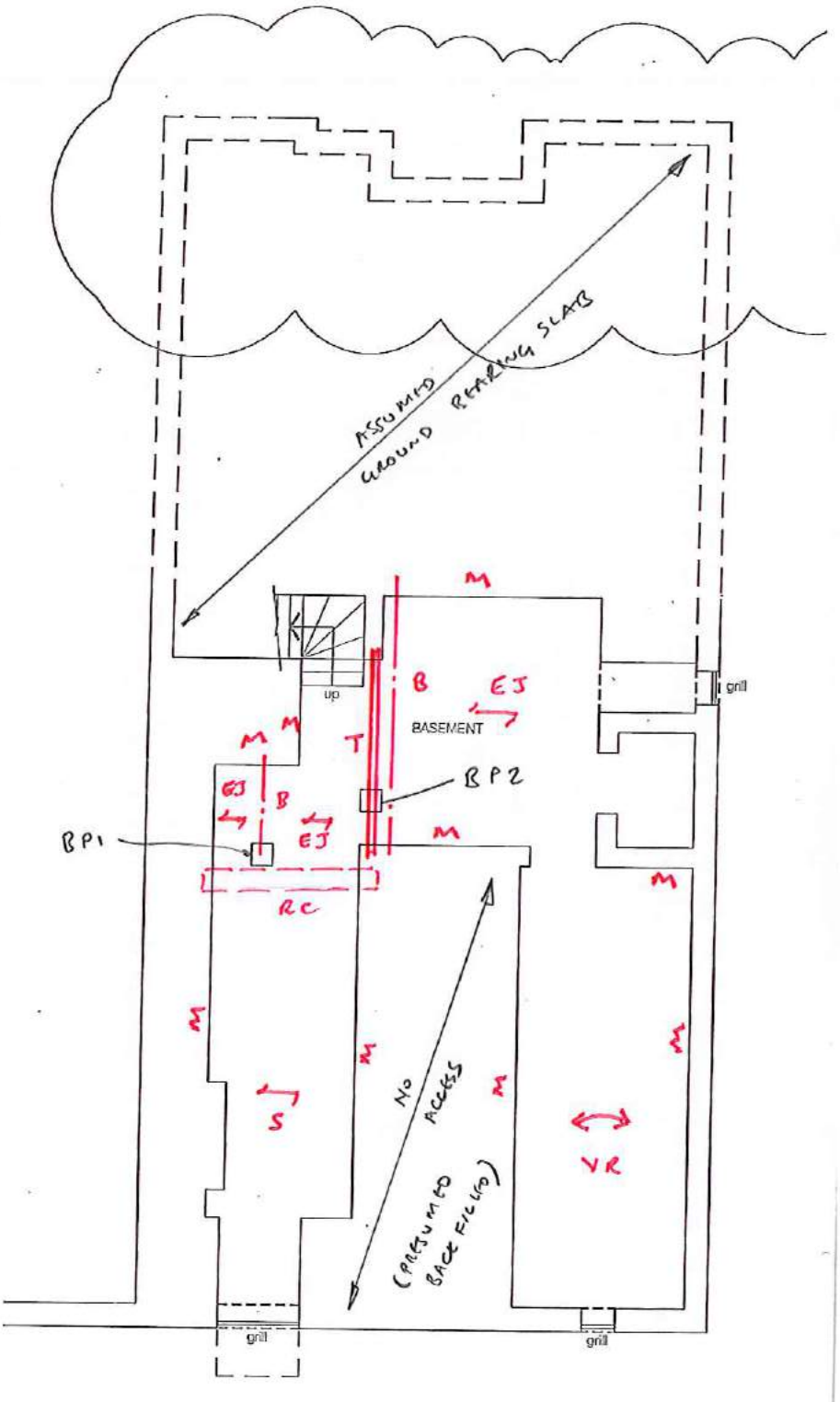
- The existing structure has timber roof and 1st floor supported on external masonry walls & selected internal walls, which are a mixture of masonry and loadbearing stud work, and timber beams.
- The ground floor is part suspended (with basement under) and part groundbearing (assumed) (with no basement under).
- On the left hand side of the building, the ground floor slab is mostly suspended rc slab supported on existing walls, with timber joists towards the main dividing wall. The central area is inaccessible. On the right hand side, there is a vaulted construction.
- The building has clearly been modified in the past, with new steel work introduced at ground & 1st floor levels to suit the current arrangements
- Selected photographs and marked up survey plans are included overleaf
- The current strategy is to minimise structural works to the existing building where possible.

C11

SCHEDULE

B	STEEL BEAM
RC	RC BEAM
T	TIMBER BEAM
EJ	EXISTING TIMBER JOISTS
M	MASONRY WALL
VR	VAULTED ROOF
S	CONCRETE SLAB

BP1	BRICK PIER 320 × 220
BP2	BRICK PIER 320 × 320



NOTE

BASEMENT FLOOR IS COBBLED

BASEMENT FLOOR PLAN

(STRUCTURE OVER)

108 HIGH ST, ODIHAM

J002242 / SK / SURV / 001

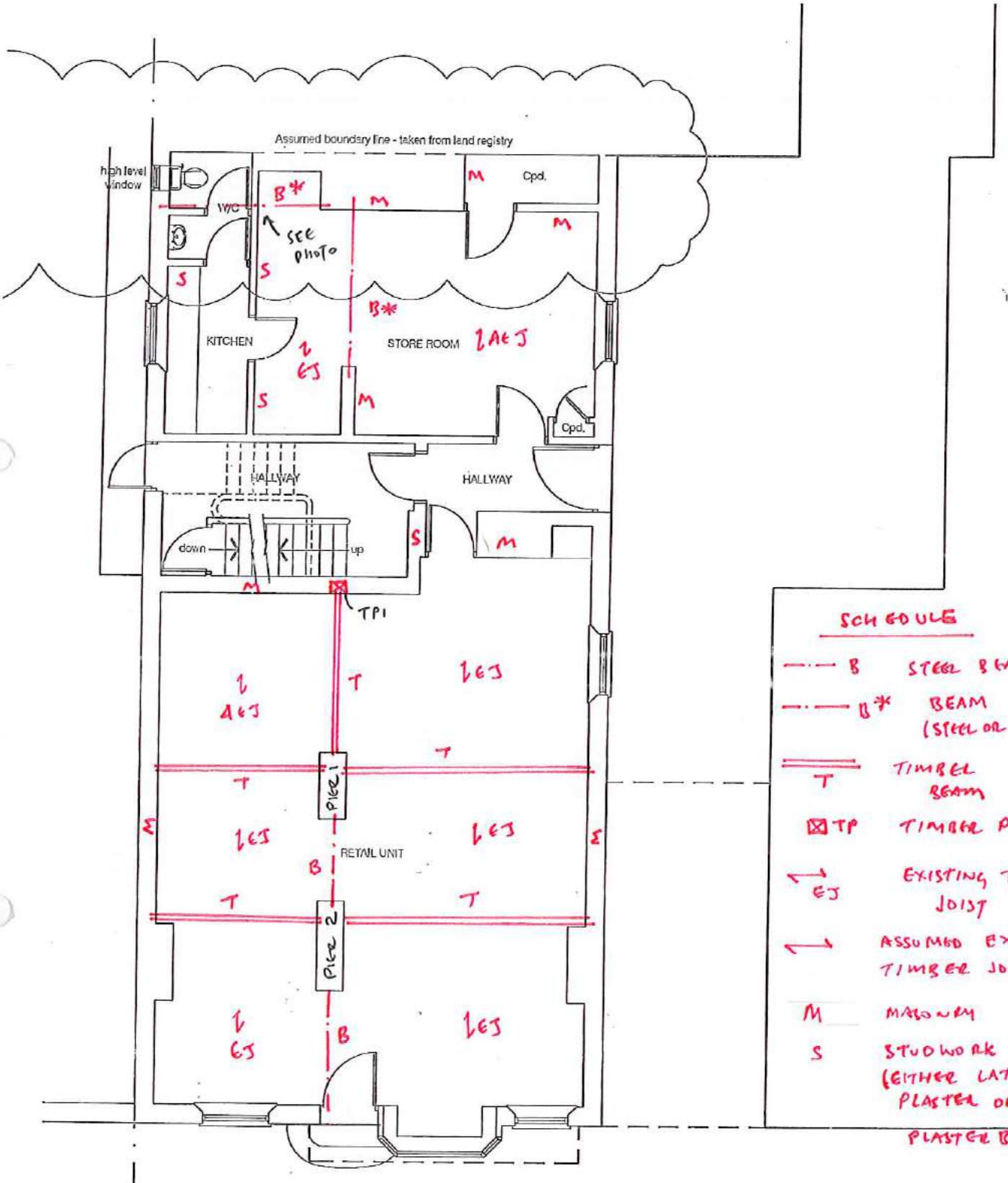
SURVEY NOTES (Sheet 1)

GSE GREEN STRUCTURAL ENGINEERING


RC BEAM + SLAB
TIMBER JOISTS
BRICK WORK
BASEMENT PIER
BP1


TIMBER JOISTS
STEEL BEAM
TIMBER BEAM
BRICK WORK
BASEMENT PIER
RPL


BASEMENT
VAULTED
CONSTRUCTION



GROUND FLOOR PLAN

(STRUCTURE OVER)

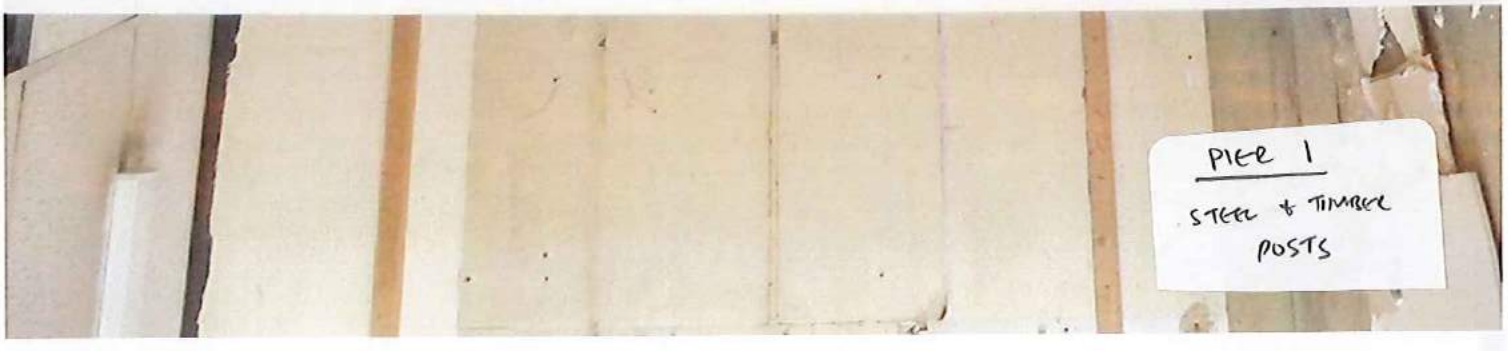
108 HIGH ST, ODIHAM

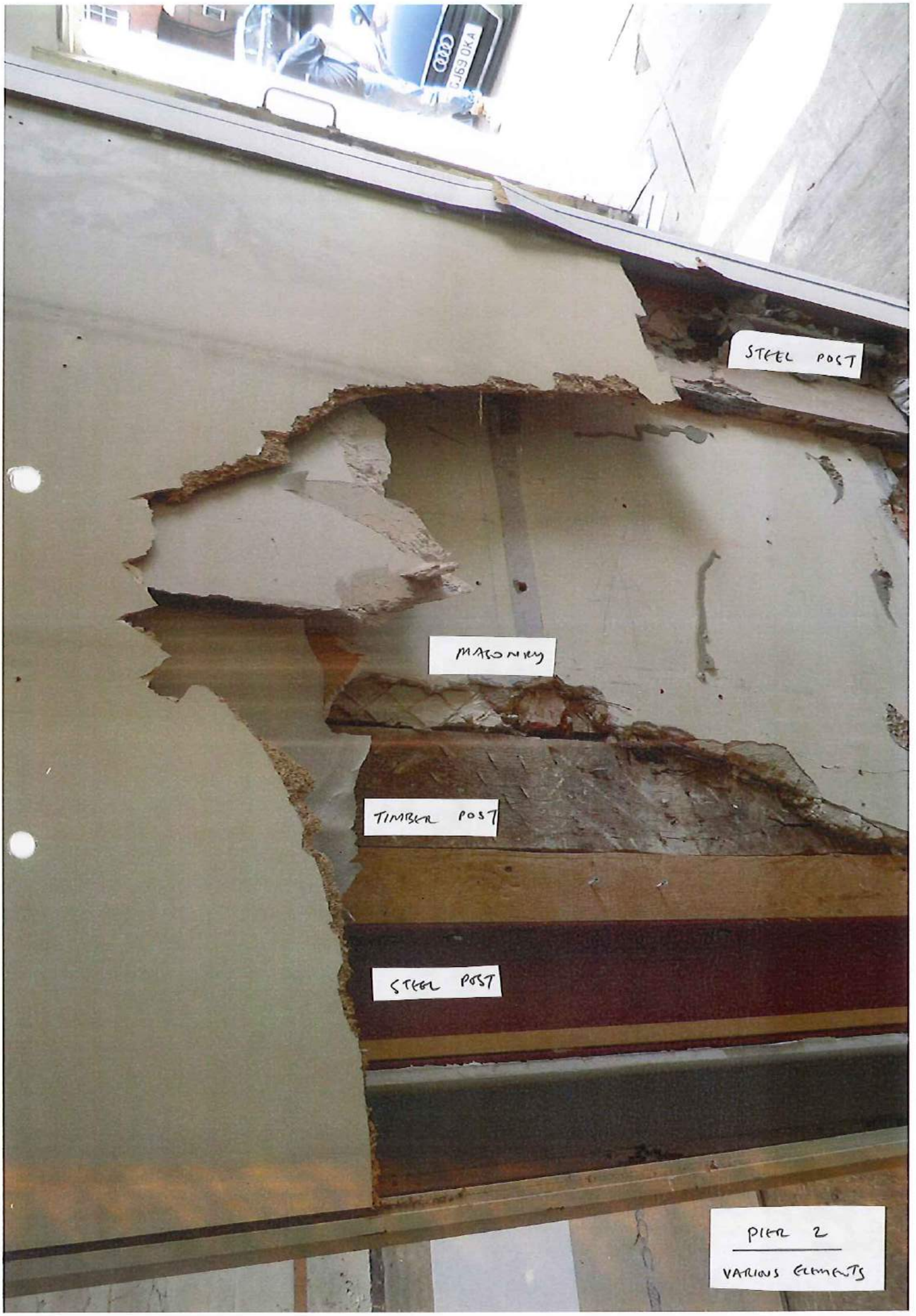
J002242/SK/SURV/002

SURVEY NOTES (Sheet 2)

GREEN STRUCTURAL ENGINEERING


TIMBER POST
STEEL COLUMN


PIER 1
STEEL & TIMBER
POSTS

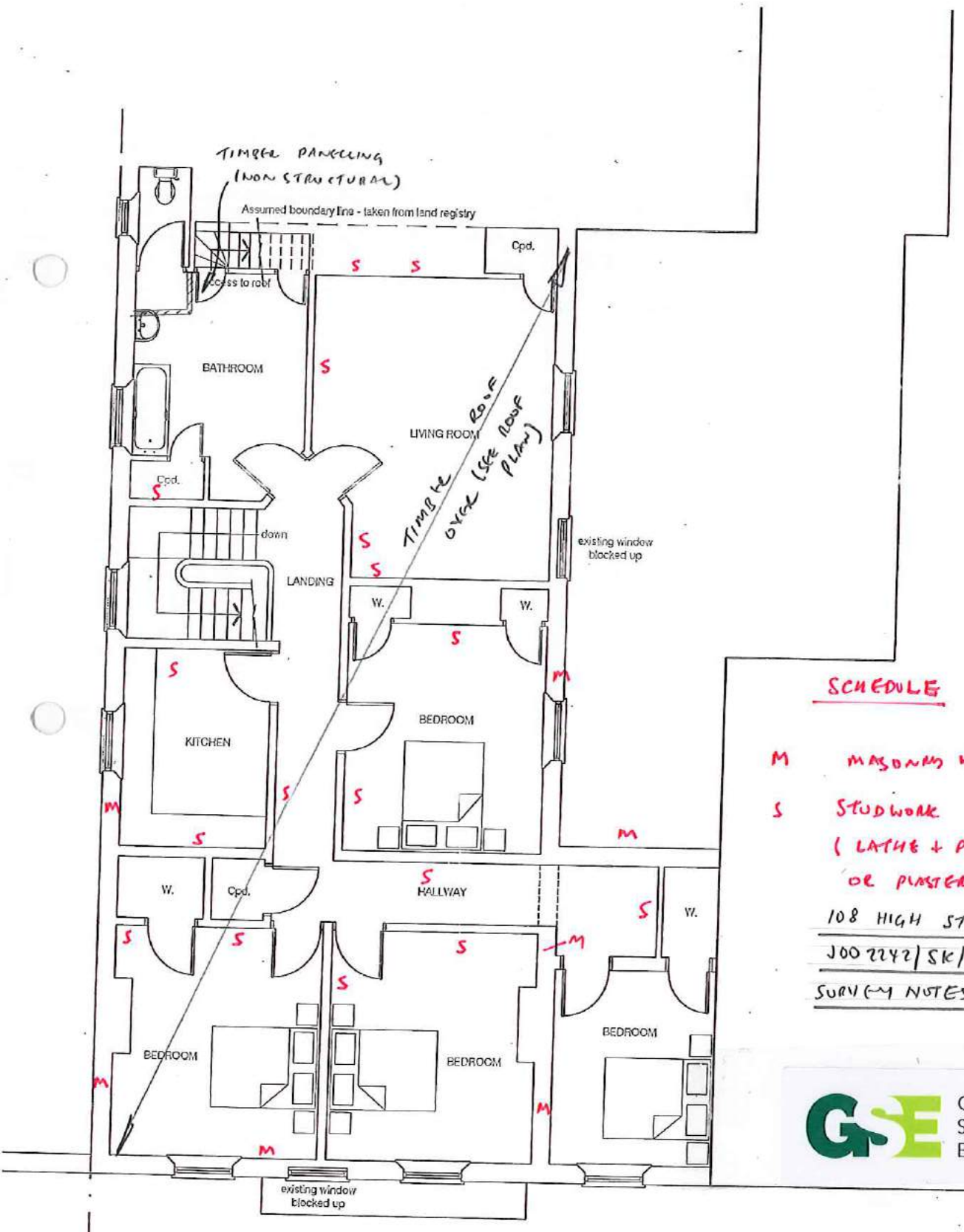

STEEL POST
MASONRY
TIMBER POST
STEEL POST
PIER 2
VARIOUS ELEMENTS


STEEL POST
PIER 2
'FRONT' STEEL POST


STEEL BEAM
STEEL COLUMN
CONNCTING BEAM
BETWEEN PIERS 1+2


GROUND FLOOR (REAR)
BEAM B*
CONTINUOUS
OVER PARTITION

C21



SCHEDULE

M MASONRY WALL

S STUDWORK (LATHE + PLASTER OR PLASTER BOARD)

108 HIGH ST, ODIHAM

J002242/SK/SURV/003

SURVEY NOTES (Sheet 3)

GSE GREEN STRUCTURAL ENGINEERING

FIRST FLOOR PLAN (STRUCTURE OVER)

TIMBER ROOF

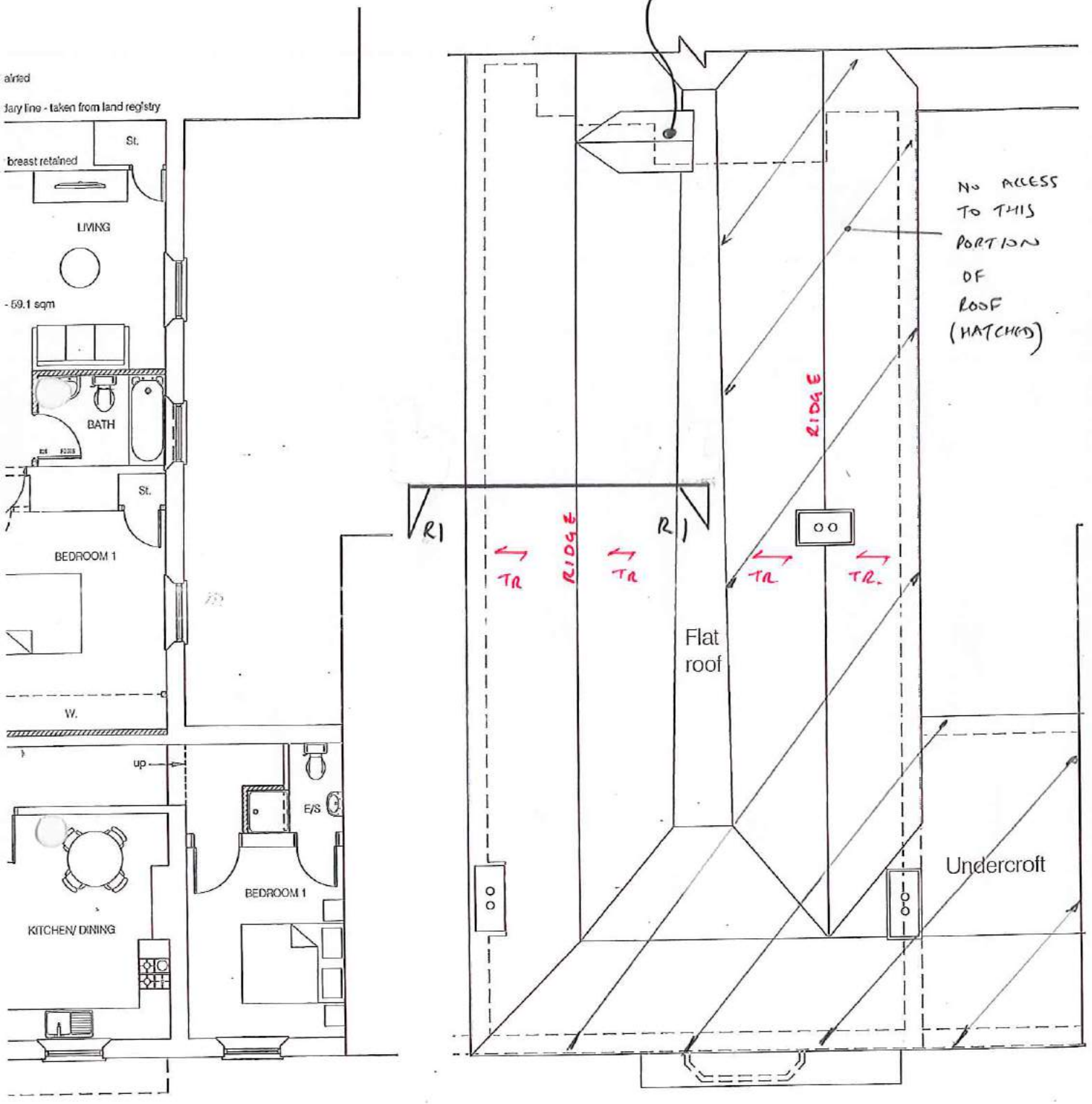
(LHS)

VIEWED FROM ONE END

TIMBER ROOF
(LHS)
ADJACENT TO
ACCESS POINT

NOTE

NO SAFE ACCESS TO ROOF - VISUAL SURVEY ONLY FROM THIS POINT



ROOF PLAN

SCHEDULE

⟷ TR TIMBER RAFTERS

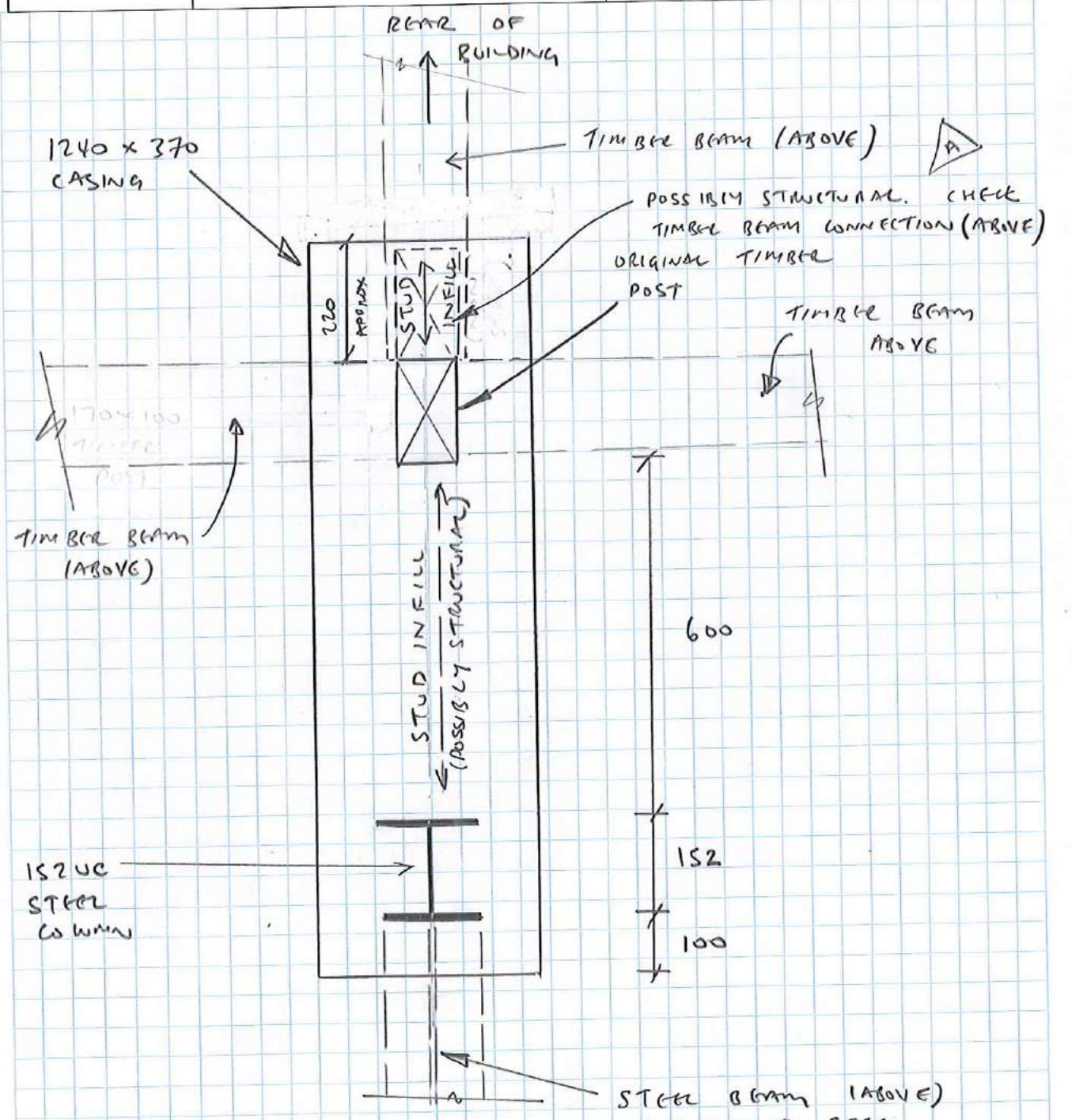
108 HIGH ST, ODIHAM

J002242/SK/SURV/004

SURVEY NOTES (Sheet 4)

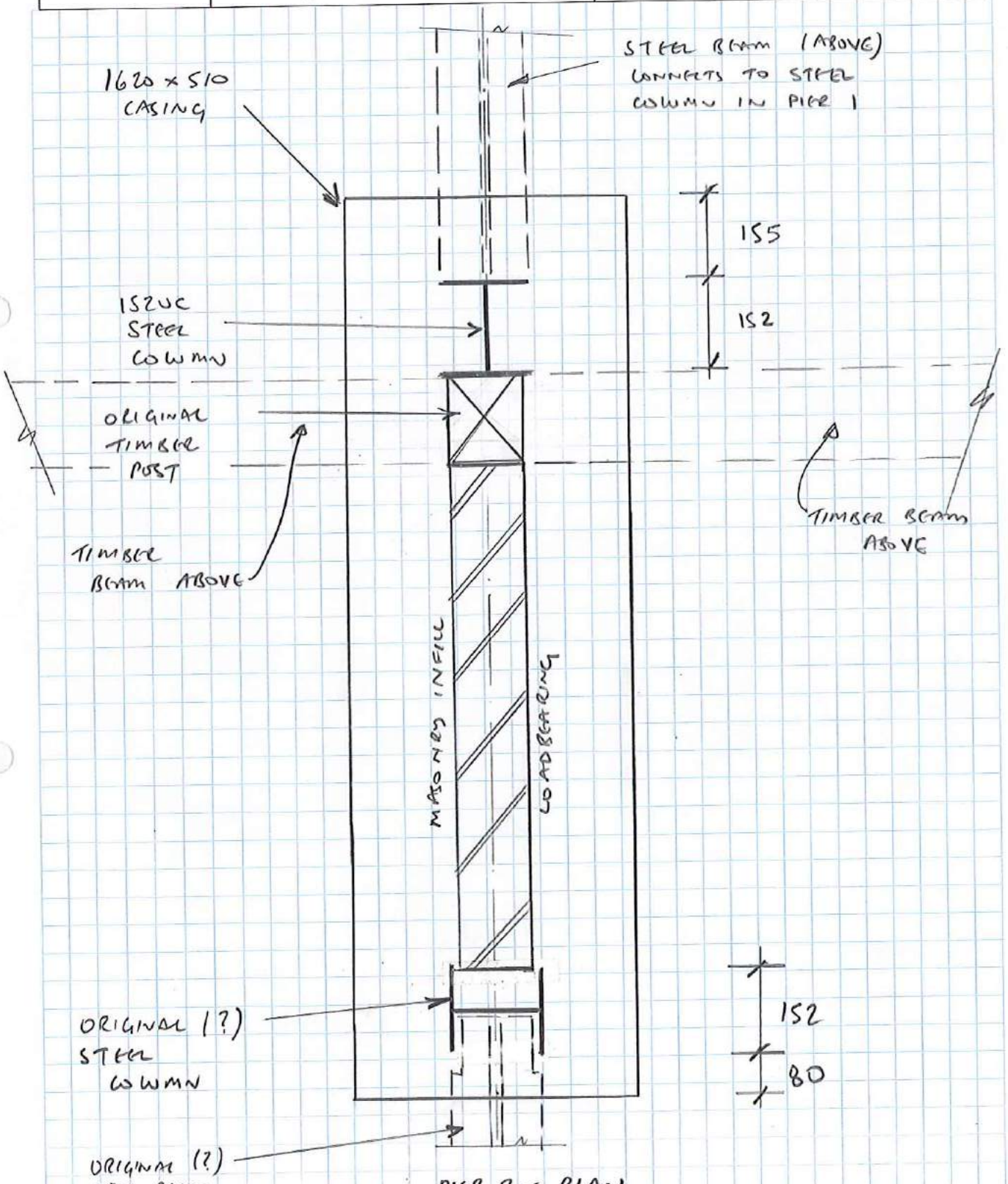
GSE GREEN STRUCTURAL ENGINEERING

GSE GREEN STRUCTURAL ENGINEERING	Project: 108 High St Odiham	Job Ref: Job 2242	
	Drawing Ref	Calculations by: PB	Checked by	Sheet No: SK/SURV/005 A
	Part of Structure: EXISTING PIERS	Date: March 2022	



SURVEY NOTES (Sheet 5)

GSE GREEN STRUCTURAL ENGINEERING	Project: 108 High St Odiham		Job Ref: J002242
	Drawing Ref:	Calculations by: PB	Checked by:
			Sheet No: SK) SURV) 006
	Part of Structure: EXISTING PIERS		Date: March 2022

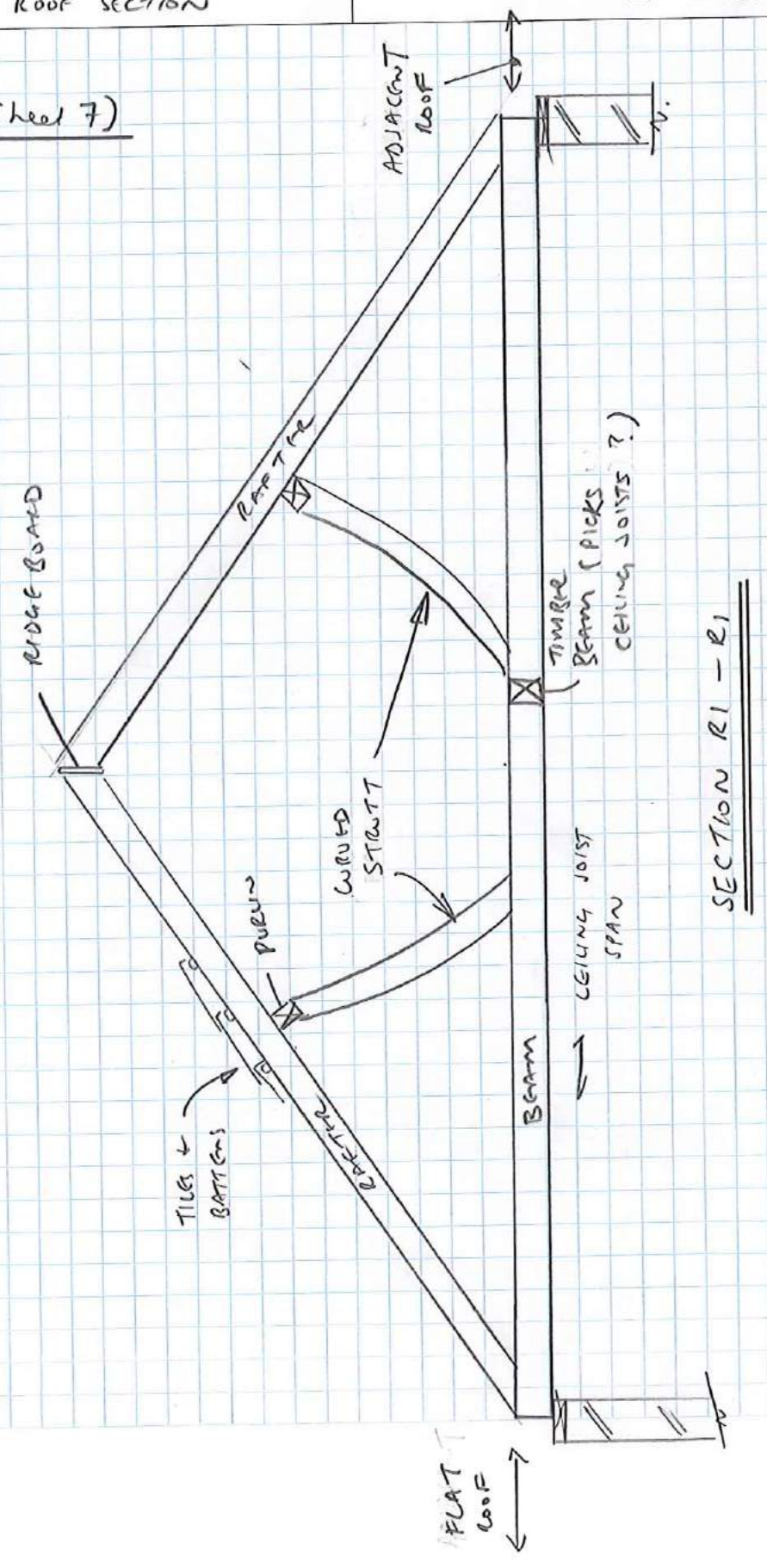


PIER 2 – PLAN

SURVEY NOTES (Sheet 6)

GSE GREEN STRUCTURAL ENGINEERING	Project: 108 High St Oadham		Job Ref: 3007242
	Drawing Ref:	Calculations by: PB	Checked by:
			Sheet No: SK/3007/007
	Part of Structure: ROOF SECTION		Date: March 2022.

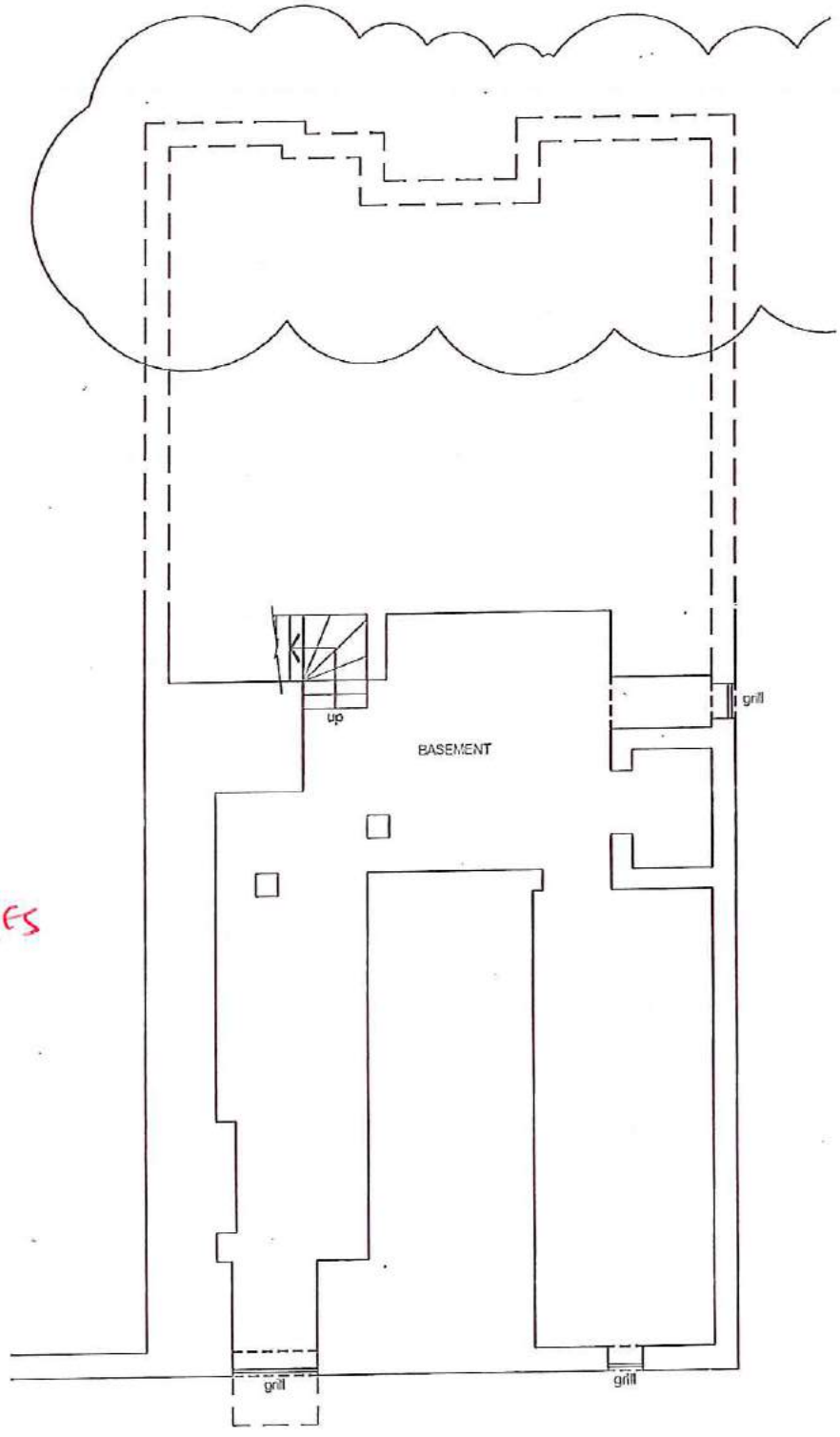
SURVEY NOTES (Sheet 7)



SECTION R1 – R1

NOTES

1. DUE TO LACK OF SUITABLE ACCESS ALL SIZES & SPACINGS ARE UNDETERMINED.
2. ALL MEMBERS ARE TIMBER

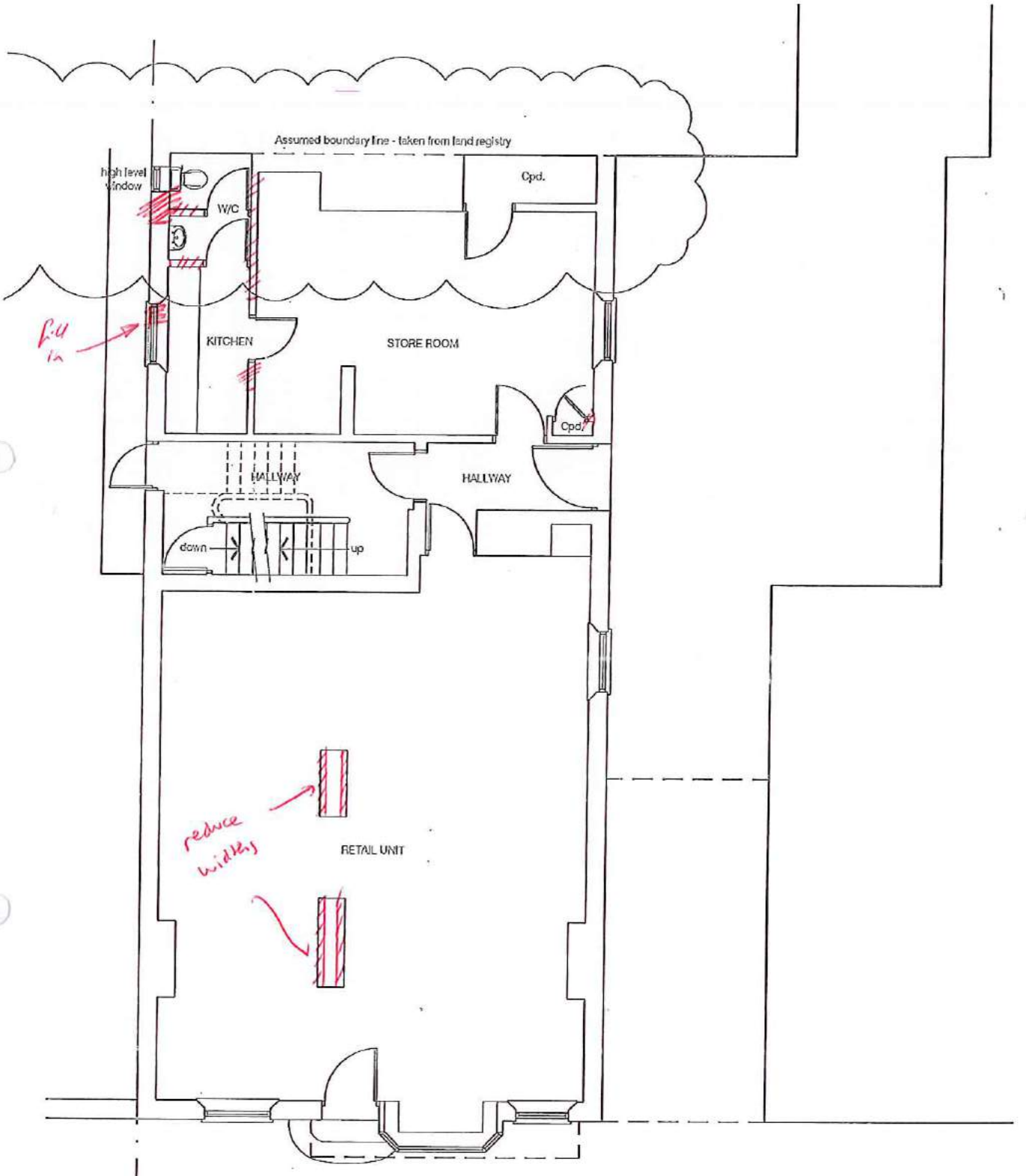


NO CHANGES

BASEMENT FLOOR PLAN

DEMOLITION

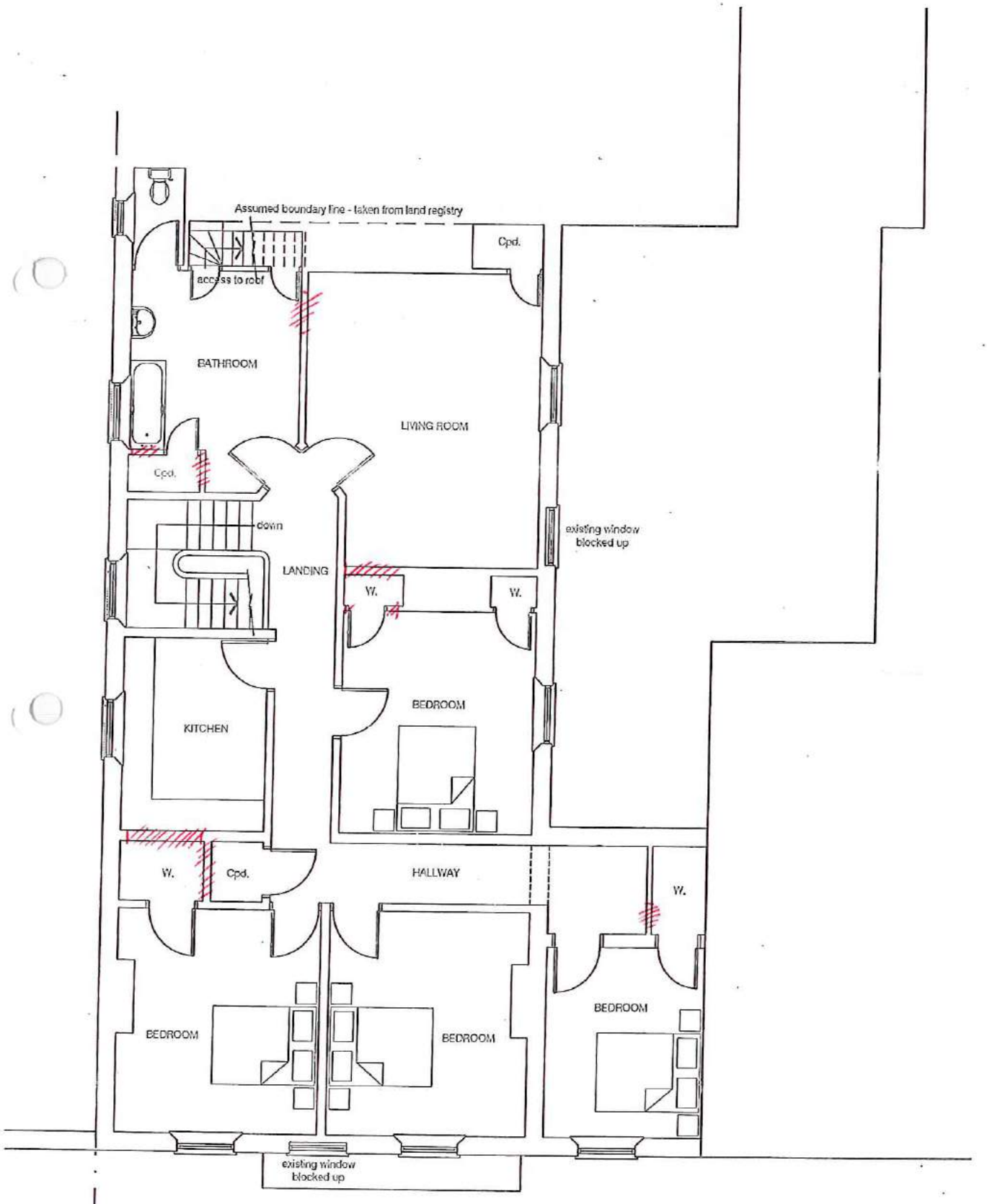
C19



GROUND FLOOR PLAN

DEMOLITION

C30



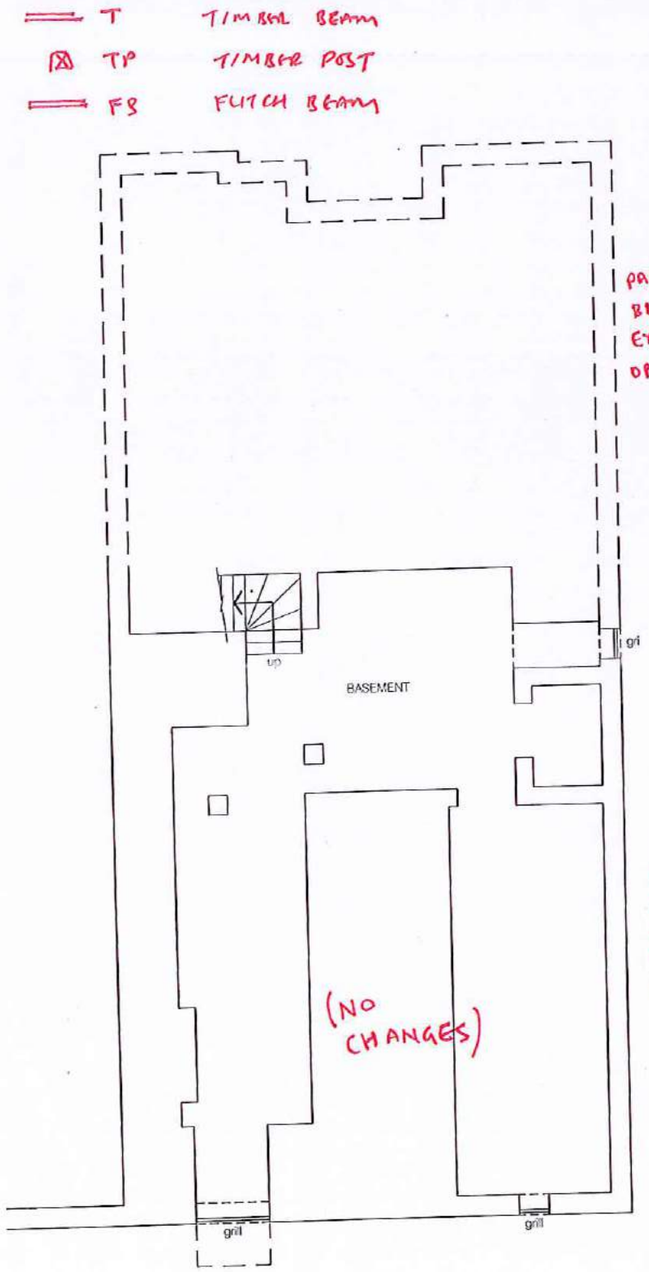
FIRST FLOOR PLAN (DEMOLITION)

LEGEND

B	STEEL	BEAM
EB	EXISTING	BEAM
T	TIMBER	BEAM
TP	TIMBER	POST
FB	FLITCH	BEAM

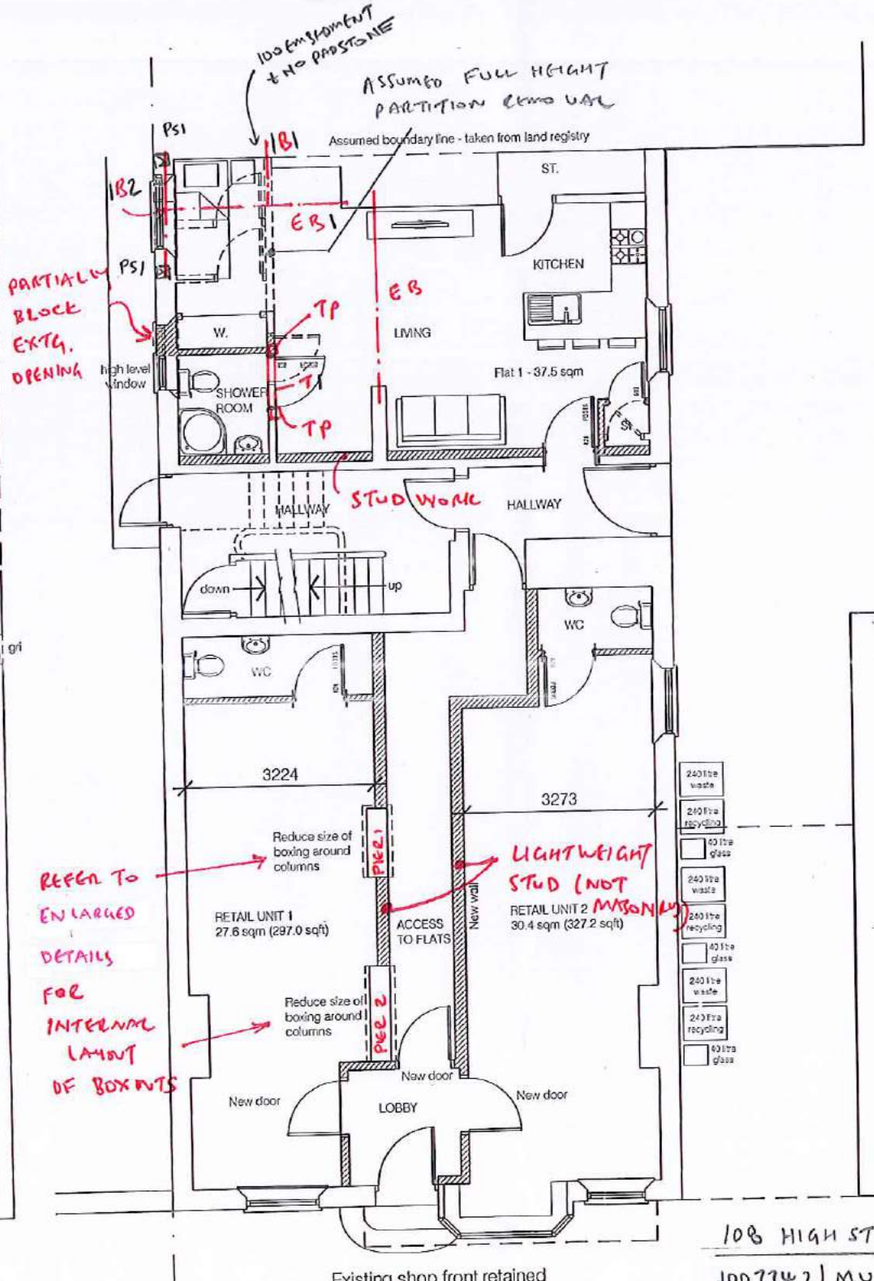
NOTES

1. ALL NEW WALLS/ PARTITIONS TO BE LIGHTWEIGHT STUD NOT MASONRY



(NO CHANGES)

BASEMENT FLOOR PLAN
(STRUCTURE OVER)



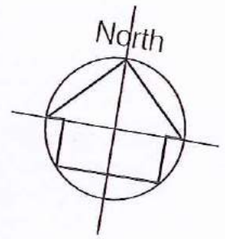
REFER TO ENLARGED DETAILS FOR INTERNAL LAYOUT OF BOXUTS

LIGHTWEIGHT STUD (NOT MASONRY)

Existing shop front retained

GROUND FLOOR PLAN
(STRUCTURE OVER)

C31



REV	DATE	DESCRIPTION	INITIAL	CHECKED

PLANNING

harding rose architects

CLIENT: LAMRON DEVTS (ODIHAM) LTD

PROJECT: 108 High Street, Odiham, RG29 1LP

TITLE: Proposed Basement and Ground Floor Plans

SCALE	DATE	
1:100 @ A3	21.01.22	
DRAWN: JC	PROJECT NO.: 19.767	P.205

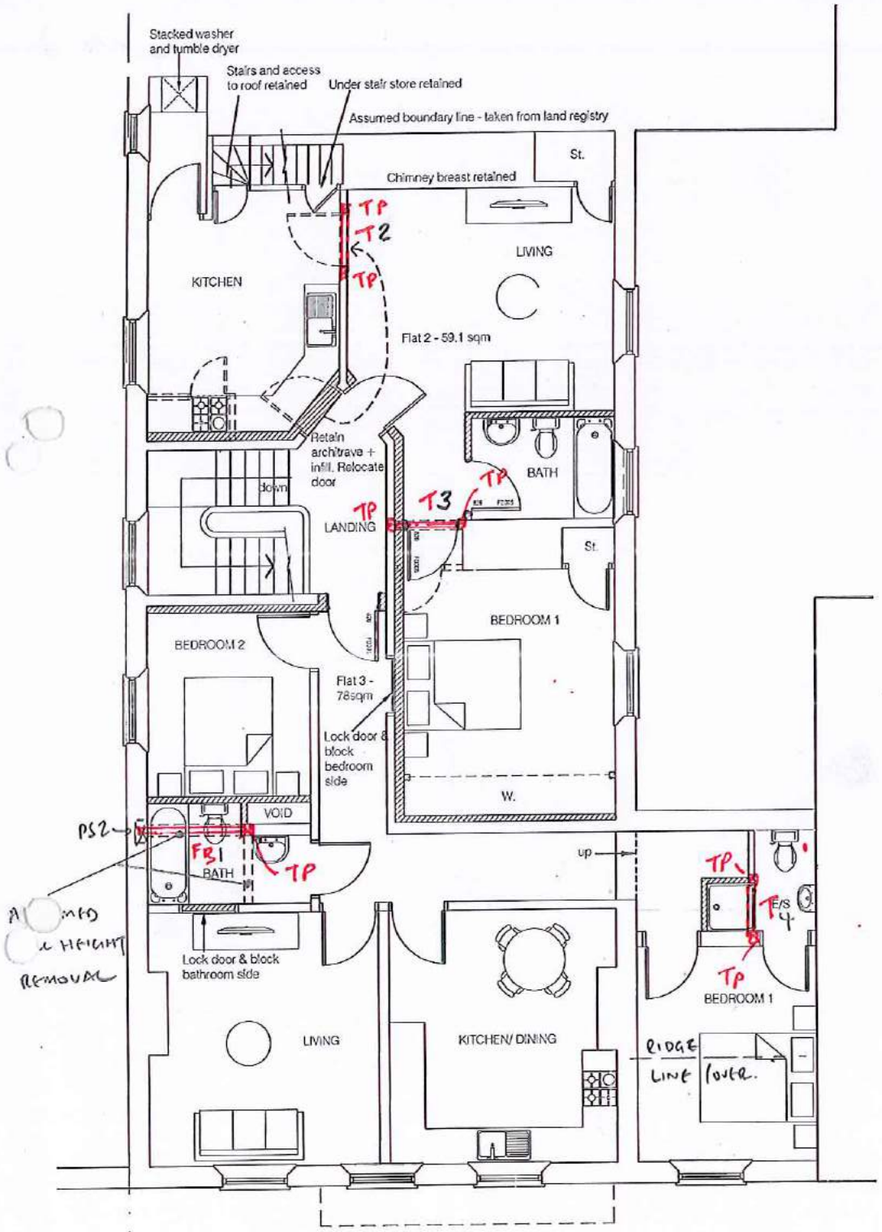
GSE GREEN STRUCTURAL ENGINEERING

108 HIGH ST, ODIHAM

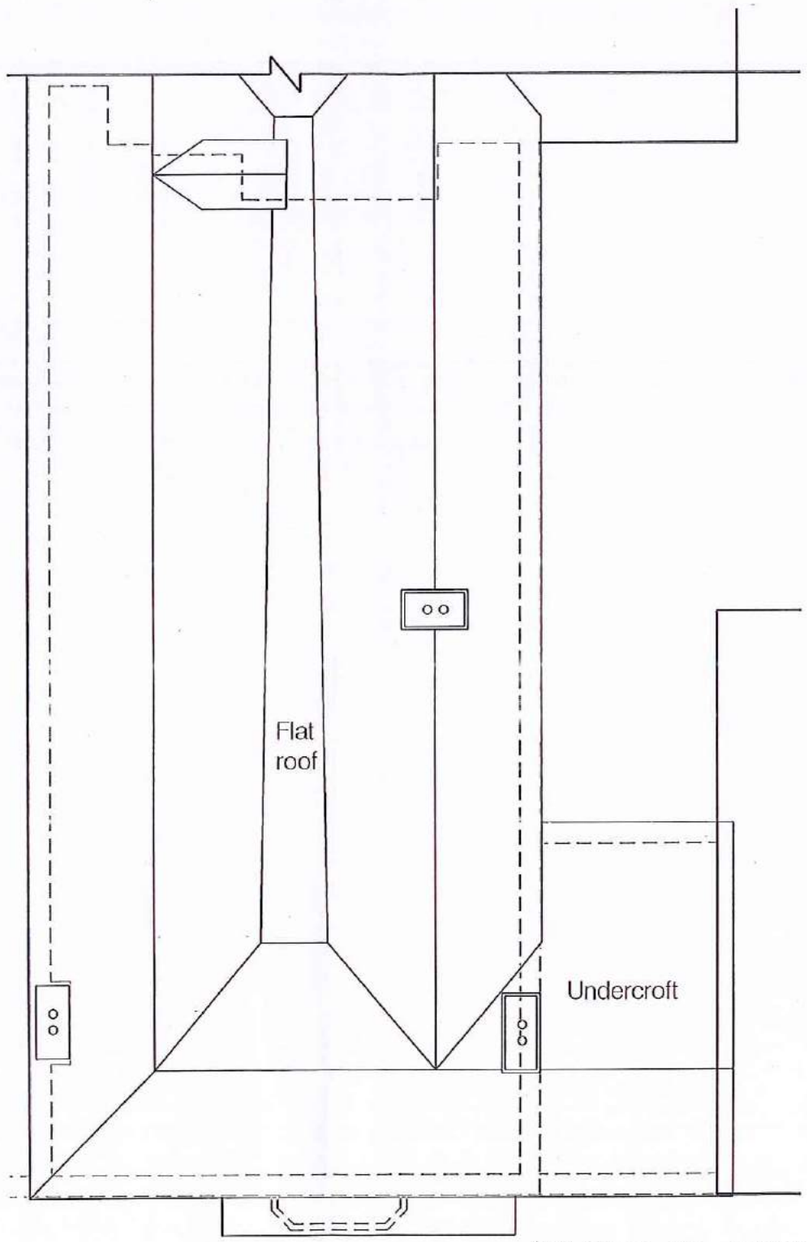
J002242/MU1/P1

FLOOR PLANS (Sheet 1)

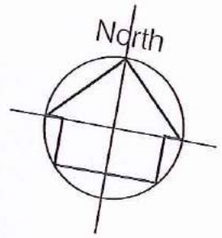
c32

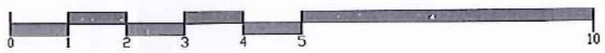


FIRST FLOOR PLAN
(STRUCTURE OVER)



ROOF PLAN





108 HIGH ST, ODIHAM

J007242/MU2/P1

FLOOR PLANS (Sheet 2)

GREEN STRUCTURAL ENGINEERING

REV	DATE	DESCRIPTION	INITIAL	CHECKED

PLANNING

harding rose architects

CLIENT: LAMRON DEVTS (ODIHAM) LTD

PROJECT: 108 High Street, Odiham, RG29 1LP

TITLE: Proposed First Floor and Roof Plans

SCALE	DATE	
1:100 @ A3	21.01.22	
DRAWN: JC	PROJECT NO.: 19.767	P.206

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C33
	Part of Structure	Schedule	Date	MARCH 2022

MEMBER SCHEDULE

IB1	178 × 102 UB 19 OR 2 N° 47 × 150 C24 TIMBERS
IB2	203UC46 + 10 PLATE
PS1	215 × 215 × 150 DP CONCRETE PADSTONE
PS2	215 × 100 × 150 DP —"—
T_1	2 N° 47 × 150 C24 TIMBERS
T_2	2 N° 47 × 225 C24 TIMBERS
T_3	2 N° 47 × 225 C24 TIMBERS
T_4	2 N° 47 × 175 C24 TIMBERS
FB1	2 N° 47 × 275 C24 TIMBERS + 8 × 200 STEEL PLATE.
	M20 BOLTS GRADE 8.8 — 2 AT EACH END, 3 IN SPAN.
TP	100 × 100 C16 POST.

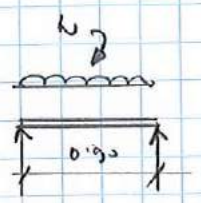
	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C34
	Part of Structure		Date	
	STEELWORK		MARCH 2022	

STEELWORK

- Steel beams are designed to BS 5950 using proprietary spreadsheets

1 B1

span = 0.90 m, supports wall load 1st + roof + CONSERVATIVELY assume ceiling load also supported.
note - floor spans parallel to wall, however assume 0.4 m loaded width for floor, 3.0/2 = 1.5 m for ceiling)



R_{DL} = 1.10 kN
R_{LL} = 0.44 kN
1.54 kN

			D (kN/m)	L (kN/m)
DL ceiling		1.5 × 0.25	0.38	
LL ceiling		1.5 × 0.25		0.38
5 kN partition	DL	2.6 × 0.6	1.56	
1st floor	DL	0.4 × 0.8	0.32	
	LL	0.4 × 1.5		0.60
			2.26	0.98

$f_c = 1.2P + 2d$. S_{req} = standard

USE 178×102 UB19

Consider a TIMBER alternative

USE 2 N = 47 × 150 C24 TIMBERS

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project No.: J002241
	Calculations by: PB	Checked by:	Sheet No.: C35
	Element: Beam 1- B1		Date: MARCH 2022

Analysis

Span (m)	0.900

Choose steel section: 178x102x19 ▼

◉ UB ○ UC ○ RSJ ○ PFC

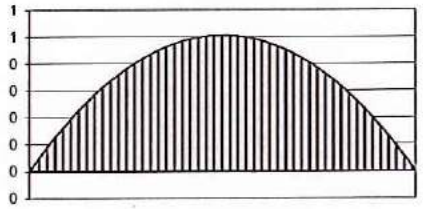
Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	1356

Simply supported beam

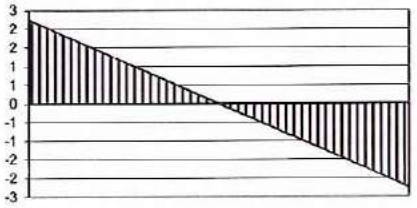
Design Status		capacity ratio
Vertical shear	PASS	0.02
Moment	PASS	0.01
Buckling	PASS	0.01
Deflection	PASS	0.00

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	2.26	0.98	-	-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				



Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Imposed only	Total load		kN	kN
kNm	kN			LHS	1.10	0.44
0.51	-2.25	0.00	-0.01	RHS	-1.10	-0.44



Shear Force Diagram

Design

Design Strength	
p_y N/mm²	275

◉ grade S275 ○ grade S355

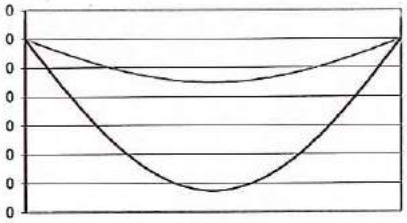
section classification
Plastic

Shear Capacity	
Area A_v	capacity P_v
mm²	kN
853.4	140.82

cl. 4.2.3

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	0.450	0.51	0.00	47.03	0.01
Critical section	0.450	0.51	0.00	47.03	0.01

* low shear



Deflection Diagram

Lateral torsional buckling

Equivalent Uniform Moment		kNm
Maximum moment	M_A	0.51
Uniform factor	m	1.00
Buckling moment	M_{bar}	0.51

cl. 4.3.7.2

Z_x (cm³)	153
S_x (cm³)	171

Slenderness Ratio				
Effective length			radius of gyration	slenderness
L	factor	L_E		
m		m	r_y (cm)	λ
0.900	1.2L+2D	1.436	2.37	60.57

cl. 4.3.7.5

cl. B.2.4	limiting slenderness	λ_{Lo}	34.31
cl. 4.3.7.6	correction factor	n	1.00
	buckling parameter	u	0.888
	torsional index	x	22.6
cl. B.2.5 (d)	slenderness factor	v	0.926
cl. B.2.5	equivalent slenderness	λ_{LT}	49.82
cl. B.2.3	Perry coefficient	η_{LT}	0.109
	Plastic moment capacity	M_p	47.03
cl. B.2.2	Elastic critical moment	M_E	139.41
	Buckling Index	ϕ_B	100.78
cl. B.2.1	**Buckling capacity**	M_b	40.77

Deflection

Deflection Limits		Allowable mm	
span/deflection ratios			
Imposed Loads	360	2.5	table 5
Total Loads	200	4.5	

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project N.: J002241
	Calculations by: PB	Checked by:	Sheet N.: C36
	Element: BEAM 1-B1 TIMBER ALTERNATIVE		Date: MARCH 2022

Span (m)	0.900
Bearing (mm)	75

Min. value to calculate L_{eff}

L_{eff} (m)	0.975
I_x (cm^4)	2644

N° sections	2	Class	C24
Depth h	150	Breadth b	47

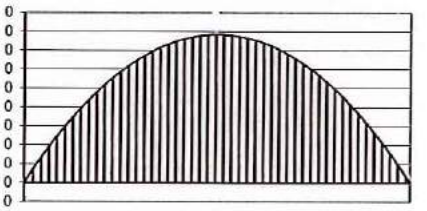
Service Class	Class 2
Load duration	Long-term
Load sharing system	No

Simply supported beam

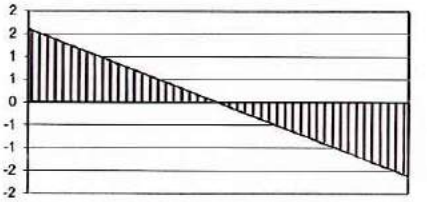
Design Status		Capacity ratio
Moment	PASS	0.12
Shear	PASS	0.22
Bearing	PASS	0.11
Deflection	PASS	0.08
Lateral stability	No Req.	N/A

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	2.26	0.98	-	-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				

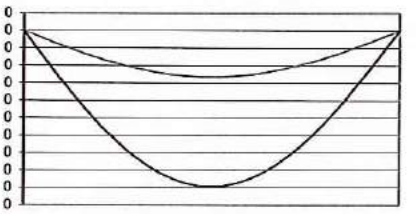
RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Bending	Shear		kN	kN
kNm	kN	Moment	Deflection	LHS	1.13	0.48
0.39	1.61	-0.18	-0.07	RHS	-1.13	-0.48



Bending Moment Diagram



Shear Force Diagram



Deflection Diagram
[Bending Deflection]

Design

K Modification Factors				
	K_2	Service class	Class 2	1.00
	K_3	Load duration	Long-term	1.00
	K_4	Bearing factor	N/A	1.00
	K_5	Notched end effect	N/A	1.00
	K_8	Form factor	Rectangular	1.00
	K_7	Depth factor	72 < h ≤ 300	1.08
	K_8	Load-sharing system	2 pieces	1.10
	K_9	Modulus mod. factor	2 pieces	1.14

Bending Stress		
Section Modulus	$Z\ (cm^3) = bh^2 / 6$	35.25
Applied bending moment	M_{max} (kN m)	0.39
Applied bending stress	$\sigma_{m.a.//} = M_{max} / Z$	**1.11**
Permissible bending stress	$\sigma_{m.adm.//} = \sigma_{m.g.//} K_2K_3K_6K_7K_8$	**8.90**
Capacity Ratio = $\sigma_{m.a.//} / \sigma_{m.adm.//}$		0.12

Shear Stress		
Applied shear force	$F_{v.max}$ (kN)	1.61
Applied shear stress	$\tau_a = 3/2\ (F_v / bh)$	**0.17**
Permissible shear stress	$\tau_{adm.//} = \tau_{g.//} K_2K_3K_5K_8$	**0.78**
Capacity Ratio = $\tau_a / \tau_{adm.//}$		0.22

Bearing Stress		
Applied load (MAX Reaction)	$F_{v.max}$ (kN) at either end	1.61
Applied bearing stress	$\sigma_{c.a.pp} = (F_v / b\ b_w)$	**0.23**
Permissible shearing stress	$\sigma_{c.adm.pp} = \sigma_{c.g.pp} K_2K_3K_4K_8$	**2.09**
Capacity Ratio = $\sigma_{c.a.pp} / \sigma_{c.adm.pp}$		0.11

Deflection				
Modulus of Elasticity		Non load sharing: use E.min * K9		8208
Deflection (mm)	Bending Moment	0.18	Δ_{total} =	**0.24**
	Shear Deflection	0.07		
Permissible deflection		$\Delta_{adm} = 0.3\ \%\ L_{eff}$		**2.93**
Capacity Ratio = $\Delta_{total} / \Delta_{adm}$				0.08

Lateral Stability		
Depth-to-breath	h / b	1.6
MAX applicable	From table	2

No lateral support required

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C37
	Part of Structure		Date	
	STEELWORK		MARCH 2022	

CONSIDER EXISTING BEAM EB1

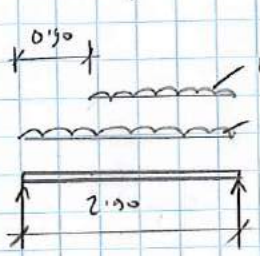
- This spans from EXISTING external wall to EXISTING chimney breast, & is NOT supported on internal dividing partition (confirmed by opening up).

Consider EXISTING LOADING

	D (kN/m)	L (kN/m)
loaded width = 5.0/2 = 2.50 m		
1st floor DL = 0.8 × 2.50	2.00	
LL = 1.5 × 2.50		3.75
w_1 =	2.00	3.75
(partial) partition load DL 2.6×0.6	1.56	

(assumed no other roof load supported on this partition)

Span = 2.90 m



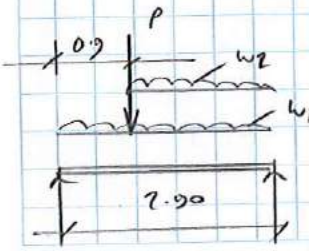
consider as a steel beam

$l_e = 1.2l + 2d$ f_{yk} = Standard

max. moment	=	11.4 kNm
shear	=	16.00 kN

ULS values

now check for 'P' point load from 1B1 (DL = 1.10 kN, LL = 0.44 kN)



eff. wall

max moment	=	12.39 kNm
shear	=	16.70 kN

DL = 5.00 kN
LL = 5.74 } SLS

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project No.: J002241
	Calculations by: PB	Checked by:	Sheet No.: C18
	Element: Beam EB1 - EXISTING LOADS		Date: MARCH 2022

Analysis

Span (m)	2.900

Choose steel section: 178x102x19 ▼

◉ UB ○ UC ○ RSJ ○ PFC

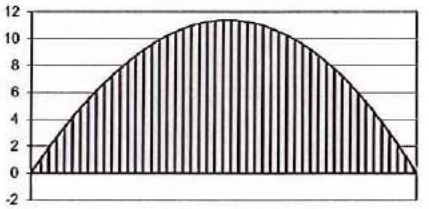
Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	1356

Simply supported beam

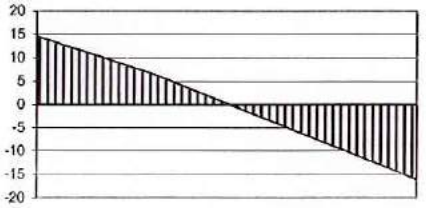
Design Status		capacity ratio
Vertical shear	PASS	0.11
Moment	PASS	0.24
Buckling	PASS	0.57
Deflection	PASS	0.16

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	2	3.75	-	-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL	1.56	0	0.900	2.000
Partial UDL				



Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Imposed only	Total load		kN	kN
kNm	kN			LHS	4.25	5.44
11.38	-16.00	-1.24	-2.37	RHS	-5.21	-5.44



Shear Force Diagram

Design

Design Strength	
p_y N/mm²	275

◉ grade S275 ○ grade S355

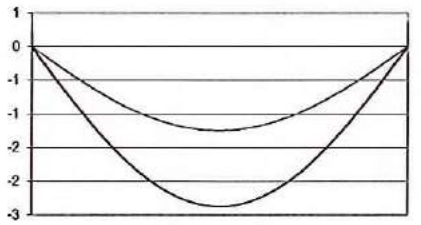
section classification
Plastic

Shear Capacity	
Area A_v	capacity P_v
mm²	kN
853.4	140.82

cl. 4.2.3

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	1.498	11.38	0.00	47.03	0.24
Critical section	1.498	11.38	-0.24	47.03	0.24

* low shear



Deflection Diagram

Lateral torsional buckling

Equivalent Uniform Moment		kNm
Maximum moment	M_A	11.38
Uniform factor	m	1.00
Buckling moment	M_{bar}	11.38

cl. 4.3.7.2

Z_x (cm³)	153
S_x (cm³)	171

Slenderness Ratio				
Effective length			radius of gyration	slenderness
L	factor	L_E		
m		m	r_y (cm)	λ
2.900	1.2L+2D	3.836	2.37	161.84

cl. 4.3.7.5

cl. B.2.4	limiting slenderness	λ_{LO}	34.31
cl. 4.3.7.6	correction factor	n	1.00
	buckling parameter	u	0.888
	torsional index	x	22.6
cl. B.2.5 (d)	slenderness factor	v	0.728
cl. B.2.5	equivalent slenderness	λ_{LT}	104.60
cl. B.2.3	Perry coefficient	η_{LT}	0.492
	Plastic moment capacity	M_p	47.03
cl. B.2.2	Elastic critical moment	M_E	31.62
	Buckling index	ϕ_B	47.10
cl. B.2.1	**Buckling capacity**	M_b	20.05

Deflection

Deflection Limits		Allowable mm
span/deflection ratios		
Imposed Loads	360	8.1
Total Loads	200	14.5

table 5

GSE GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project No.: J002241
	Calculations by: PB	Checked by:	Sheet No.: C39
	Element: Beam EB1 - REVISED LOADS		Date: MARCH 2022

Analysis

Span (m)	2.900

Choose steel section: 178x102x19 ▼

◉ UB ○ UC ○ RSJ ○ PFC

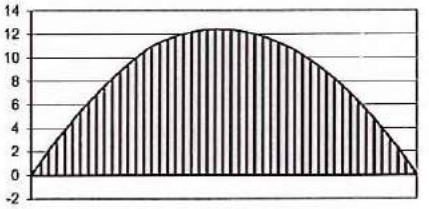
Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	1356

Simply supported beam

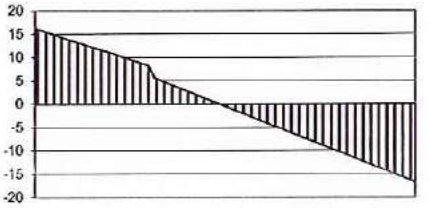
Design Status		capacity ratio
Vertical shear	PASS	0.12
Moment	PASS	0.26
Buckling	PASS	0.62
Deflection	PASS	0.18

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	2	3.75	-	-
Point load				
Point load	1.1	0.44	0.900	-
Point load				
Point load				-
Partial UDL	1.56	0	0.900	2.000
Partial UDL				



Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Imposed only	Total load		kN	kN
kNm	kN			LHS	5.00	5.74
12.39	-16.70	-1.31	-2.60	RHS	-5.56	-5.57



Shear Force Diagram

Design

Design Strength	
p_y N/mm²	275

◉ grade S275 ○ grade S355

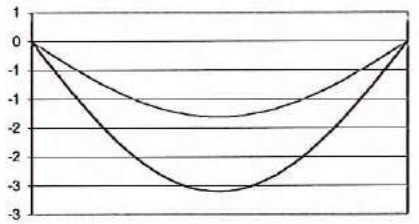
section classification
Plastic

Shear Capacity	
Area A_v	capacity P_v
mm²	kN
853.4	140.82

cl. 4.2.3

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	1.402	12.39	0.00	47.03	0.26
Critical section	1.402	12.39	0.15	47.03	0.26

* low shear



Deflection Diagram

Lateral torsional buckling

Equivalent Uniform Moment		kNm	cl.
Maximum moment	M_A	12.39	
Uniform factor	m	1.00	
Buckling moment	M_{bar}	12.39	cl. 4.3.7.2

Z_x (cm³)	153
S_x (cm³)	171

Slenderness Ratio					
Effective length			radius of gyration	slenderness	
L	factor	L_E			
m		m	r_y (cm)	λ	
2.900	1.2L+2D	3.836	2.37	161.84	cl. 4.3.7.5

cl. B.2.4	limiting slenderness	λ_{Lo}	34.31	
cl. 4.3.7.6	correction factor	n	1.00	
	buckling parameter	u	0.888	
	torsional index	x	22.6	
cl. B.2.5 (d)	slenderness factor	v	0.728	
cl. B.2.5	equivalent slenderness	λ_{LT}	104.60	
cl. B.2.3	Perry coefficient	η_{LT}	0.492	
	Plastic moment capacity	M_p	47.03	
cl. B.2.2	Elastic critical moment	M_E	31.62	
	Buckling index	ϕ_B	47.10	
cl. B.2.1	**Buckling capacity**	M_b	20.05	

Deflection

Deflection Limits span/deflection ratios		Allowable mm	
Imposed Loads	360	8.1	table 5
Total Loads	200	14.5	

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C40
	Part of Structure		Date	
	STEELWORK		MARCH 2022	

EB1 (cont)

hence % moment increase $= \left(\frac{12.39 - 11.40}{11.40}\right) \times 100 = 8.7\%$

% shear increase $= \left(\frac{16.70 - 16.00}{16.00}\right) \times 100 = 4.4\%$

THIS IS DEEMED ACCEPTABLE — no changes proposed to EB1

B2

required to West elevation external wall — existing window opening is enlarged.

Beam picks up roof load, external wall load, 1st floor load (1 storey only) & reaction from EB1

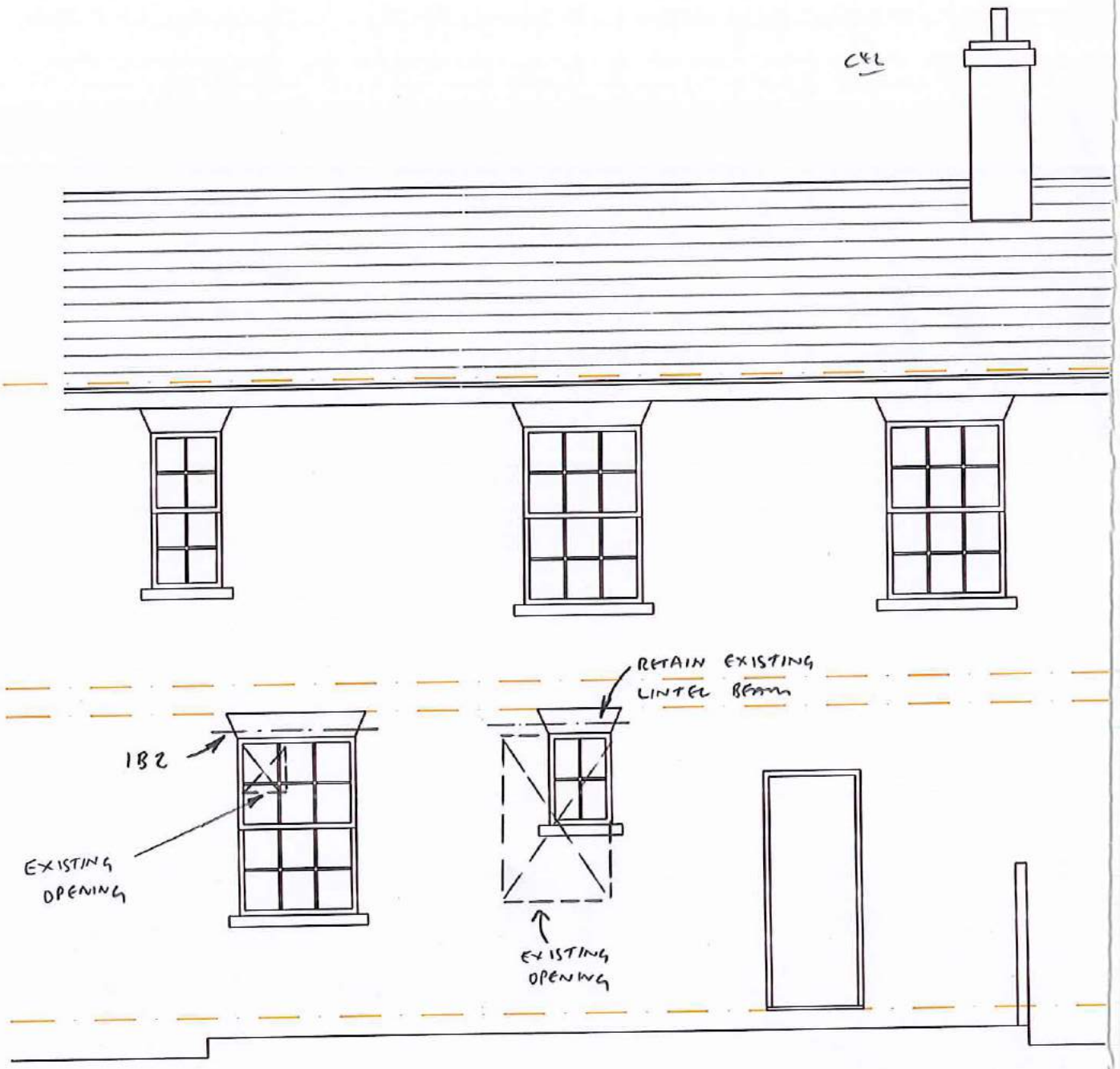
			D (kN/m)	L (kN/m)
roof/ceiling	DL	3.4/2 × 1.00	1.70	
	L	3.4/2 × 1.00		1.70
1st floor	DL	0.4 × 0.8	0.32	
	L	0.4 × 1.50		0.60
wall reg — 1st	DL	2.2 × 7.40	23.68	
			25.70	2.30

point load from EB1 DL = 5.00 kN
L = 5.74 kN

SIDE ELEVATION (West)

EXISTING WEST ELEVATION

(NTS)



SIDE ELEVATION (West)

PROPOSED WEST ELEVATION

(NTS)

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project No.: J002241
	Calculations by: PB	Checked by:	Sheet No.: C43
	Element: Beam 1- B2		Date: MARCH 2022

Analysis

Span (m)	1.350

Choose steel section: 203x203x46 ▼

○ UB ◉ UC ○ RSJ ○ PFC

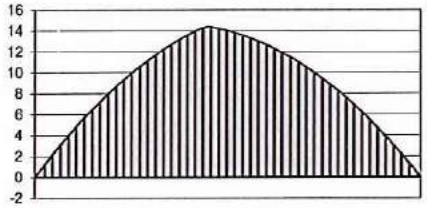
Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm⁴)	4568

Simply supported beam

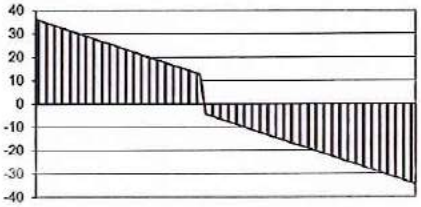
Design Status		capacity ratio
Vertical shear	PASS	0.15
Moment	PASS	0.11
Buckling	PASS	0.11
Deflection	PASS	0.07

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	25.7	2.3	-	-
Point load				
Point load				-
Point load	5	5.74	0.600	
Point load				-
Partial UDL				
Partial UDL				



Bending Moment Diagram

RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Imposed only	Total load		kN	kN
kNm	kN			LHS	20.43	4.74
14.43	36.19	-0.04	-0.19	RHS	-19.87	-4.10



Shear Force Diagram

Design

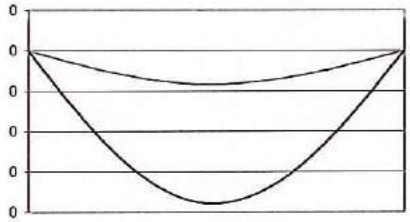
Design Strength	
p_y N/mm²	275

◉ grade S275
○ grade S355

section classification
Compact

Shear Capacity	
Area A_v	capacity P_v
mm²	kN
1463.0	241.40

cl. 4.2.3



Deflection Diagram

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	0.608	14.43	0.00	136.68	0.11
Critical section	0.608	14.43	-4.47	136.68	0.11

* low shear

Lateral torsional buckling

Equivalent Uniform Moment		kNm
Maximum moment	M_A	14.43
Uniform factor	m	1.00
Buckling moment	M_{bar}	14.43

cl. 4.3.7.2

Z_x (cm³)	450
S_x (cm³)	497

Slenderness Ratio				
Effective length			radius of gyration	slenderness
L	factor	L_E		
m		m	r_y (cm)	λ
1.350	1.2L+2D	2.026	5.13	39.50

cl. 4.3.7.5

Deflection

Deflection Limits		Allowable mm
span/deflection ratios		
Imposed Loads	360	3.8
Total Loads	500	2.7

table 5

cl. B.2.4	limiting slenderness	λ_{Lo}	34.31
cl. 4.3.7.6	correction factor	n	1.00
	buckling parameter	u	0.847
	torsional index	x	17.7
cl. B.2.5 (d)	slenderness factor	v	0.946
cl. B.2.5	equivalent slenderness	λ_{LT}	31.65
cl. B.2.3	Perry coefficient	η_{LT}	0.000
	Plastic moment capacity	M_p	136.68
cl. B.2.2	Elastic critical moment	M_E	1003.95
	Buckling index	ϕ_B	570.31
cl. B.2.1	**Buckling capacity**	M_b	136.68

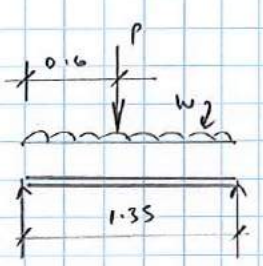
	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C44
	Part of Structure		Date	
	STEELWORK		MARCH 2022	

B7 (cont)

Beam span = 1200 + 150 = 1.35m

l_e = 1.7l + 2d

δ_{max} = l/500 (masonry)



R_A = 20.43 kN

R_B = 4.74

25.17 kN.

USE 203UC46 + 10 PLATE

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C45
	Part of Structure		Date	
	TIMBER		MARCH 2022	

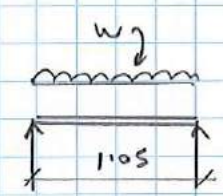
TIMBER BEAMS / POSTS

- designed to BS 5268 – beams using proprietary spreadsheets
  – posts – hand calculations

T1

Span = 900 + 150 = 1.050m

spans over door opening – supports stud work above door & also nominal floor load.



R_R = 0.52 kN
R_L = 0.37
} SLS

w_{DL} = (0.9 × 0.6) + (0.4 × 0.8)
wall + non floor
= 0.54 + 0.32 = 0.86 kN/m

w_{LL} = 0.4 × 1.5 = 0.60 kN/m

USE 2 No 47×150 C24 TIMBERS

T2

Span = 900 + 1050 = 1.05m

spans over door opening – supports stud work above door + roof loading.

Due to limited roof access, it was not possible to determine the exact setting out of main roof trusses; photographs show them to be at approx 2.5m c/c

∴ have conservatively design for WORST CASE, i.e. truss centre on span.

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project N.: J002241
	Calculations by: PB	Checked by:	Sheet N.: c46
	Element: TIMBER T1		Date: MARCH 2022

Span (m)	1.050
Bearing (mm)	75

Min. value to calculate L_{eff}

L_{eff} (m)	1.125
I_x (cm^4)	2644

N° sections	2	Class	C24
Depth h	150	Breadth b	47

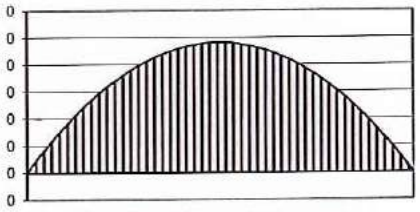
Service Class	Class 2
Load duration	Long-term
Load sharing system	No

Simply supported beam

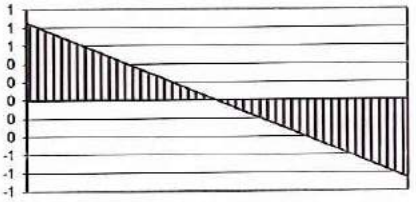
Design Status		Capacity ratio
Moment	PASS	0.08
Shear	PASS	0.12
Bearing	PASS	0.06
Deflection	PASS	0.06
Lateral stability	No Req.	N/A

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	0.86	0.6	-	-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				

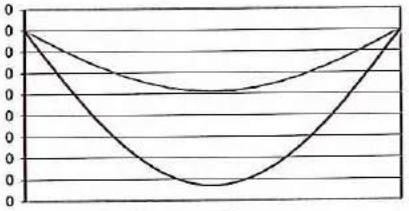
RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Bending Moment	Shear Deflection		kN	kN
kNm	kN			LHS	0.52	0.34
0.24	-0.85	-0.15	-0.04	RHS	-0.52	-0.34



Bending Moment Diagram



Shear Force Diagram



Deflection Diagram
[Bending Deflection]

Design

K Modification Factors				
	K_2	Service class	Class 2	1.00
	K_3	Load duration	Long-term	1.00
	K_4	Bearing factor	N/A	1.00
	K_5	Notched end effect	N/A	1.00
	K_6	Form factor	Rectangular	1.00
	K_7	Depth factor	72 < h ≤ 300	1.08
	K_8	Load-sharing system	2 pieces	1.10
	K_9	Modulus mod. factor	2 pieces	1.14

Bending Stress	Capacity Ratio = $\sigma_{m.a,//} / \sigma_{m.adm,//}$	0.08
Section Modulus	$Z\ (cm^3) = bh^2 / 6$	35.25
Applied bending moment	M_{max} (kN m)	0.24
Applied bending stress	$\sigma_{m.a,//} = M_{max} / Z$	**0.68**
Permissible bending stress	$\sigma_{m.adm,//} = \sigma_{m.g,//} K_2K_3K_6K_7K_8$	**8.90**

Shear Stress	Capacity Ratio = $\tau_a / \tau_{adm,//}$	0.12
Applied shear force	$F_{v.max}$ (kN)	0.85
Applied shear stress	$\tau_a = 3/2\ (F_v / bh)$	**0.09**
Permissible shear stress	$\tau_{adm,//} = \tau_{g,//} K_2K_3K_5K_8$	**0.78**

Bearing Stress	Capacity Ratio = $\sigma_{c.a.pp} / \sigma_{c.adm.pp}$	0.06
Applied load (MAX Reaction)	$F_{v.max}$ (kN) at either end	0.85
Applied bearing stress	$\sigma_{c.a.pp} = (F_v / b\ b_w)$	**0.12**
Permissible shearing stress	$\sigma_{c.adm.pp} = \sigma_{c.g.pp} K_2K_3K_4K_8$	**2.09**

Deflection		Capacity Ratio = $\Delta_{total} / \Delta_{adm}$		0.06
Modulus of Elasticity		Non load sharing: use E.min * K9		8208
Deflection (mm)	Bending Moment	0.15	Δ_{total} =	**0.19**
	Shear Deflection	0.04		
Permissible deflection		$\Delta_{adm} = 0.3\ \%\ L_{eff}$		**3.38**

Lateral Stability		
Depth-to-breath	h / b	1.6
MAX applicable	From table	2

No lateral support required

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project N.: J002241
	Calculations by: PB	Checked by:	Sheet N.: C47
	Element: TIMBER T2		Date: MARCH 2022

Span (m)	1.050
Bearing (mm)	75

Min. value to calculate L_{eff}

L_{eff} (m)	1.125
I_x (cm^4)	8923

N° sections	2	Class	C24
Depth h	225	Breadth b	47

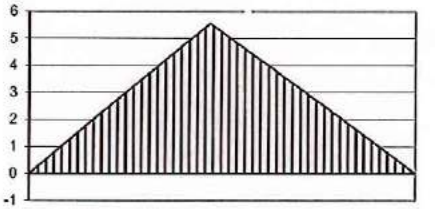
Service Class	Class 2
Load duration	Long-term
Load sharing system	No

Simply supported beam

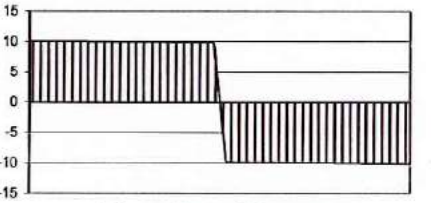
Design Status		Capacity ratio
Moment	PASS	0.82
Shear	PASS	0.92
Bearing	PASS	0.69
Deflection	PASS	0.42
Lateral stability	See Notes	N/A

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	0.54	0	-	-
Point load				
Point load	9.75	9.75	0.525	-
Point load				
Point load				-
Partial UDL				
Partial UDL				

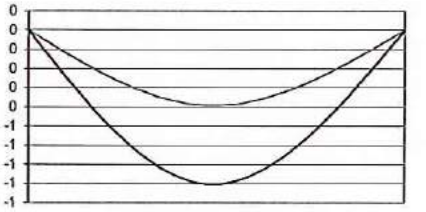
RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Bending	Shear		kN	kN
kNm	kN	Moment	Deflection	LHS	5.23	4.88
5.56	10.10	-0.80	-0.62	RHS	-5.23	-4.88



Bending Moment Diagram



Shear Force Diagram



Deflection Diagram
[Bending Deflection]

Design

K Modification Factors				
	K_2	Service class	Class 2	1.00
	K_3	Load duration	Long-term	1.00
	K_4	Bearing factor	N/A	1.00
	K_5	Notched end effect	N/A	1.00
	K_6	Form factor	Rectangular	1.00
	K_7	Depth factor	72 < h ≤ 300	1.03
	K_8	Load-sharing system	2 pieces	1.10
	K_9	Modulus mod. factor	2 pieces	1.14

Bending Stress	Capacity Ratio = $\sigma_{m.a.//} / \sigma_{m.adm.//}$	0.82
Section Modulus	$Z\ (cm^3) = bh^2 / 6$	79.31
Applied bending moment	M_{max} (kN m)	5.56
Applied bending stress	$\sigma_{m.a.//} = M_{max} / Z$	**7.01**
Permissible bending stress	$\sigma_{m.adm.//} = \sigma_{m.g.//} K_2K_3K_8K_7K_8$	**8.52**

Shear Stress	Capacity Ratio = $\tau_a / \tau_{adm.//}$	0.92
Applied shear force	$F_{v.max}$ (kN)	10.10
Applied shear stress	$\tau_a = 3/2\ (F_v / bh)$	**0.72**
Permissible shear stress	$\tau_{adm.//} = \tau_{g.//} K_2K_3K_5K_8$	**0.78**

Bearing Stress	Capacity Ratio = $\sigma_{c.a.pp} / \sigma_{c.adm.pp}$	0.69
Applied load (MAX Reaction)	$F_{v.max}$ (kN) at either end	10.10
Applied bearing stress	$\sigma_{c.a.pp} = (F_v / b\ b_w)$	**1.43**
Permissible shearing stress	$\sigma_{c.adm.pp} = \sigma_{c.g.pp} K_2K_3K_4K_8$	**2.09**

Deflection		Capacity Ratio = $\Delta_{total} / \Delta_{adm}$		0.42
Modulus of Elasticity		Non load sharing: use E.min * K9		8208
Deflection (mm)	Bending Moment	0.80	Δ_{total} =	**1.42**
	Shear Deflection	0.62		
Permissible deflection		$\Delta_{adm} = 0.3\ \%\ L_{eff}$		**3.38**

Lateral Stability		
Depth-to-breath	h / b	2.4
MAX applicable	From table	3

Ends to be held in position

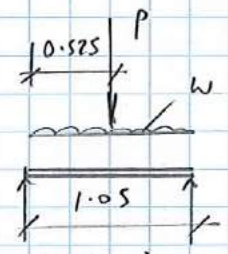
	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C48
	Part of Structure		Date	
	Timber		MARCH 2022	

∴ Loaded area for truss reaction = $2.5 \times 7.8/2 = 9.75\ m^2$

∴ $P_{DL} = 1.0 \times 11.7 = 9.75\ kN$

$P_{IL} = 1.0 \times 11.7 = 9.75\ kN$ } P

Std wall $w_{DL} = 0.6 \times 0.9 = 0.54\ kN/m \rightarrow w$



$R_{DL} = 5.73\ kN$
$R_{IL} = 4.88$ } SLS.

USE 2N° 47 × 225 C24 TIMBERS

T3 span = 0.90 + 0.15 = 1.05m

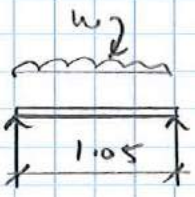
Supports std wall load + roof load from trusses.

conservatively assume similar loaded area to T2, however take this as a udl (as this timber T3 is parallel to span)

$w_{DL} = 0.54 + \frac{9.75}{1.05}$ (truss)
(SLS)

$= 0.54 + 9.29 = 9.83\ kN/m$

$w_{IL} = \frac{9.75}{1.05}$ (truss) $= 9.29\ kN/m$



$R_{DL} = 5.58\ kN$
$R_{IL} = 5.73\ kN$

USE 2N° 47 × 225 C24 TIMBERS

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project N.: J002241
	Calculations by: PB	Checked by:	Sheet N.: c49
	Element: TIMBER T3		Date: MARCH 2022

Span (m)	1.050
Bearing (mm)	75

Min. value to calculate L_{eff}

L_{eff} (m)	1.125
I_x (cm⁴)	8923

N° sections	2	Class	C24
Depth h	225	Breadth b	47

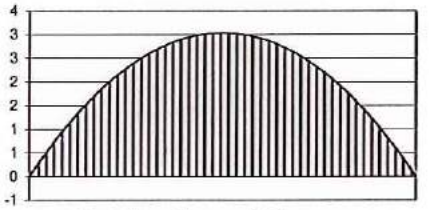
Service Class	Class 2
Load duration	Long-term
Load sharing system	No

Simply supported beam

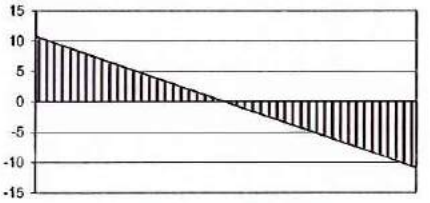
Design Status		Capacity ratio
Moment	PASS	0.45
Shear	PASS	0.98
Bearing	PASS	0.73
Deflection	PASS	0.26
Lateral stability	See Notes	N/A

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	9.83	9.29	-	-
Point load				
Point load				-
Point load				
Point load				-
Partial UDL				
Partial UDL				

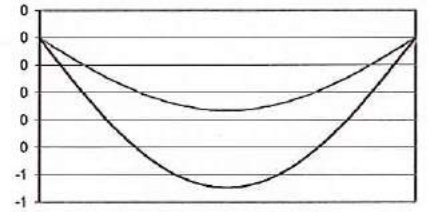
RESULTS				REACTIONS (UNFACTORED)		
M max	F_v max	Max. deflection (mm)			Dead	Imposed
		Bending	Shear		kN	kN
kNm	kN	Moment	Deflection	LHS	5.58	5.23
3.04	10.80	-0.55	-0.34	RHS	-5.58	-5.23



Bending Moment Diagram



Shear Force Diagram



Deflection Diagram
[Bending Deflection]

Design

K Modification Factors				
	K_2	Service class	Class 2	1.00
	K_3	Load duration	Long-term	1.00
	K_4	Bearing factor	N/A	1.00
	K_5	Notched end effect	N/A	1.00
	K_6	Form factor	Rectangular	1.00
	K_7	Depth factor	72 < h ≤ 300	1.03
	K_8	Load-sharing system	2 pieces	1.10
	K_9	Modulus mod. factor	2 pieces	1.14

Bending Stress	Capacity Ratio = $\sigma_{m.a.//} / \sigma_{m.adm.//}$	0.45
Section Modulus	$Z\ (cm^3) = bh^2 / 6$	79.31
Applied bending moment	M_{max} (kN m)	3.04
Applied bending stress	$\sigma_{m.a.//} = M_{max} / Z$	**3.83**
Permissible bending stress	$\sigma_{m.adm.//} = \sigma_{m.g.//} K_2K_3K_6K_7K_8$	**8.52**

Shear Stress	Capacity Ratio = $\tau_a / \tau_{adm.//}$	0.98
Applied shear force	$F_{v.max}$ (kN)	10.80
Applied shear stress	$\tau_a = 3/2\ (F_v / bh)$	**0.77**
Permissible shear stress	$\tau_{adm.//} = \tau_{g.//} K_2K_3K_5K_8$	**0.78**

Bearing Stress	Capacity Ratio = $\sigma_{c.a.pp} / \sigma_{c.adm.pp}$	0.73
Applied load (MAX Reaction)	$F_{v.max}$ (kN) at either end	10.80
Applied bearing stress	$\sigma_{c.a.pp} = (F_v / b\ b_w)$	**1.53**
Permissible shearing stress	$\sigma_{c.adm.pp} = \sigma_{c.g.pp} K_2K_3K_4K_8$	**2.09**

Deflection		Capacity Ratio = $\Delta_{total} / \Delta_{adm}$		0.26
Modulus of Elasticity		Non load sharing: use E.min * K9		8208
Deflection (mm)	Bending Moment	0.55	Δ_{total} =	**0.88**
	Shear Deflection	0.34		
Permissible deflection		$\Delta_{adm} = 0.3\ \%\ L_{eff}$		**3.38**

Lateral Stability		
Depth-to-breath	h / b	2.4
MAX applicable	From table	3

Ends to be held in position

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C50
	Part of Structure		Date	
	Timbers		MARCH 2022	

T4

This opening is remote from the main roof, however may be loadbearing.

Conservatively assume loaded area = $\frac{5.5}{2} \times \frac{3.3}{2}$ = 4.53 m²

Assume this is a purlin - point load central on span

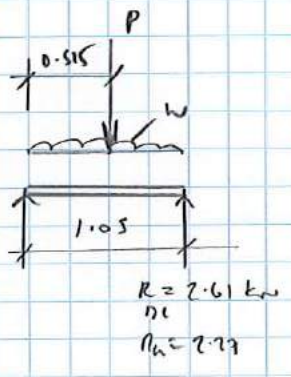
P_{DL} = 1.00 × 4.53 = 4.53 kN

P_{LL} = 1.00 × 4.53 = 4.53 kN

} P

also allow for 0.54 kN/m sundwork above door. (W)

Span = 1.05 m



R = 2.61 kN

R_h = 2.77

USE 2N° 47 × 175 C24 TIMBERS

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Project N.: J002241
	Calculations by: PB	Checked by:	Sheet N.: CS1
	Element: TIMBER T4		Date: MARCH 2022

Span (m)	1.050
Bearing (mm)	75

Min. value to calculate L_{eff}

L_{eff} (m)	1.125
I_x (cm⁴)	4198

N° sections	2	Class	C24
Depth h	175	Breadth b	47

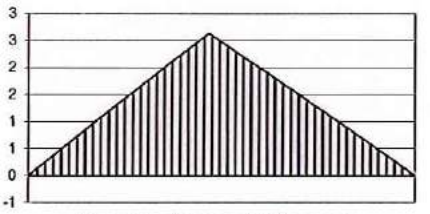
Service Class	Class 2
Load duration	Long-term
Load sharing system	No

Simply supported beam

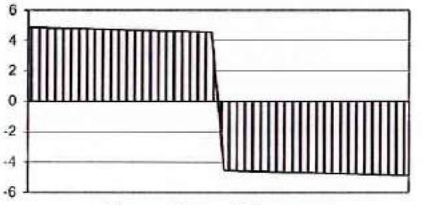
Design Status		Capacity ratio
Moment	PASS	0.63
Shear	PASS	0.57
Bearing	PASS	0.33
Deflection	PASS	0.35
Lateral stability	No Req.	N/A

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	0.54	0	-	-
Point load				
Point load	4.53	4.53	0.525	-
Point load				
Point load				-
Partial UDL				
Partial UDL				

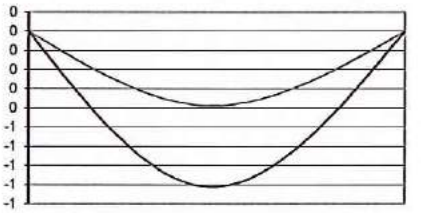
RESULTS				REACTIONS (UNFACTORED)		
M max	F_V max	Max. deflection (mm)			Dead	Imposed
		Bending Moment	Shear Deflection		kN	kN
kNm	kN			LHS	2.61	2.27
2.63	4.87	-0.81	-0.38	RHS	-2.61	-2.27



Bending Moment Diagram



Shear Force Diagram



Deflection Diagram
[Bending Deflection]

Design

K Modification Factors				
	K_2	Service class	Class 2	1.00
	K_3	Load duration	Long-term	1.00
	K_4	Bearing factor	N/A	1.00
	K_5	Notched end effect	N/A	1.00
	K_6	Form factor	Rectangular	1.00
	K_7	Depth factor	72 < h ≤ 300	1.06
	K_8	Load-sharing system	2 pieces	1.10
	K_9	Modulus mod. factor	2 pieces	1.14

Bending Stress		
	Capacity Ratio = $\sigma_{m.a,//} / \sigma_{m.adm,//}$	0.63
Section Modulus	$Z\ (cm^3) = bh^2 / 6$	47.98
Applied bending moment	M_{max} (kN m)	2.63
Applied bending stress	$\sigma_{m.a,//} = M_{max} / Z$	**5.49**
Permissible bending stress	$\sigma_{m.adm,//} = \sigma_{m.g,//} K_2K_3K_6K_7K_8$	**8.75**

Shear Stress		
	Capacity Ratio = $\tau_a / \tau_{adm,//}$	0.57
Applied shear force	$F_{v.max}$ (kN)	4.87
Applied shear stress	$\tau_a = 3/2\ (F_v / bh)$	**0.44**
Permissible shear stress	$\tau_{adm,//} = \tau_{g,//} K_2K_3K_5K_8$	**0.78**

Bearing Stress		
	Capacity Ratio = $\sigma_{c.a.pp} / \sigma_{c.adm.pp}$	0.33
Applied load (MAX Reaction)	$F_{v.max}$ (kN) at either end	4.87
Applied bearing stress	$\sigma_{c.a.pp} = (F_v / b\ b_w)$	**0.69**
Permissible shearing stress	$\sigma_{c.adm.pp} = \sigma_{c.g.pp} K_2K_3K_4K_8$	**2.09**

Deflection				
		Capacity Ratio = $\Delta_{total} / \Delta_{adm}$		0.35
Modulus of Elasticity		Non load sharing: use E.min * K9		8208
Deflection (mm)	Bending Moment	0.81	Δ_{total} =	**1.19**
	Shear Deflection	0.38		
Permissible deflection		$\Delta_{adm} = 0.3\ \%\ L_{eff}$		**3.38**

Lateral Stability		
Depth-to-breath	h / b	1.9
MAX applicable	From table	2

No lateral support required

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		C52
	Part of Structure		Date	
	FLITCH		MARCH 2022	

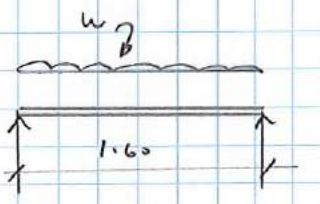
FLITCH BEAM FB1

Span = 1.60 m , ⊙ assume roof loading area is as per calculated for T_1

no SH/work above this beam as it will be located above bath/shower

$w_{DL} = \frac{9.75}{1.60} = 6.09$ kN/m

$w_{LL} = \frac{9.75}{1.60} = 6.09$ kN/m



$R_{D+L} = 9.74$ kN (SW)

USE 2N° 47 x 225 C24 TIMBERS
+
8 x 200 STEEL PLATE
+
7N° M20 BOLTS grade 8.8 → 2@ each end
+
3 in span.

Contract	108 HIGH STREET ODIHAM	CALCULATION
		Sheet No: c53 rev.0
Part of Structure	Flitch Beam FB1	Cont. No: J002241
		Date: 01-Mar-2022
		Designer: PB

Flitch Beam

Timbers
No. of 2
Width 47
x Depth 225
Grade C24

Steel Plate
Width 8
x Depth 200
$E_{(steel)}$ 205 E+3 N/mm2

Load Sharing Yes
Medium Term No
Span 1600

Loading:	DL	IL	Position	Length
W1	6.09	6.09	0	1600
W2	0	0	0	0
W3	0	0	0	0
P1	0	0	0	~~
P2	0	0	0	~~
P3	0	0	0	~~
P4	0	0	0	~~

Properties

Timber
z_{xx} = 793.1E+3 mm^3
I_{xx} = 89.2E+6 mm^4

Steel
z_{xx} = 53.3E+3 mm^3
I_{xx} = 5.3E+6 mm^4

Combined (in terms of timber)
m = 18.98
z_{xx} = 1.8E+6 mm^3
I_{xx} = 190.5E+6 mm^4

Loading Diagram

R_L = 9.74 kN R_R = 9.74 kN

Bending
BM = 3.90 kNm

Timber
$\sigma_{m,all}$ = 2.30 N/mm^2
$\sigma_{m,adm}$ = 8.52 N/mm^2
Okay

Shear (in timber)
$V_{(max)}$ = 4.56 kN
$\sigma_{v,a}$ = 0.32 N/mm^2
$\sigma_{v,adm}$ = 0.78 N/mm^2
Okay

Deflection
$\delta_{(bend)}$ = 0.66mm
$\delta_{(v)}$ = 0.20mm ☐ Ignore?
$\delta_{(max)}$ = 0.87mm
$\delta_{(adm)}$ = 4.80mm
Okay

Steel
$\sigma_{m,all}$ = 38.84 N/mm^2
$\sigma_{m,adm}$ = 275.00 N/mm^2
Okay

Bearing
$R_{(max)}$ = 9.74 kN
$\sigma_{c,adm}$ = 1.70 N/mm^2
Grade = C16

Is wane prohibited at bearing areas? ☐
=> min bearing = 60.98mm
actual bearing = 250 mm
Okay

Bolting

Total load = 19.49 kN
Proportion of load taken by steel plate = 10.36 kN = 53.2%

Bolt diameter = 20 mm
Allowable load per bolt = 1.53 kN
Enhance due to steel plate ☑
No reqd = 3
i.e. @ 400 crs

Reaction to be transfered at bearing = 5.18 kN => 2 No. bolts @ each bearing

Provide 2 No. 47mm x 225mm, grade C24 timbers with a 8mm x 200mm steel plate. To be jointed via 3 No. M20 Bolts equally spaced throughout the span (@ 400mm crs) and a further 2 No. at each bearing.

GREEN STRUCTURAL ENGINEERING	Project: 108 HIGH STREET ODIHAM		Job Ref: J002241	
	Drawing Ref	Calculations by: PB	Checked by	Sheet No: C54
	Part of Structure: TIMBER		Date: MARCH 2022	

TIMBER POSTS

worst case is T_2 with reaction 10.10 kN (SLS)

consider 100×100 C16 POST

Vertical load = 10.10 kN.

Height of post = 2900 mm

$l_e = 1.0 \times 2900 = 2900$ mm

$i = \sqrt{\frac{I}{A}} = \sqrt{\frac{b3d/12}{bd}} = \sqrt{\frac{b^2}{12}} = \frac{100}{\sqrt{12}} = 28.867$

$\therefore \lambda = \frac{2900}{28.867} = 100.5 \leq 180$ ✓ OK

for C16 timber

$\sigma_{c,0,k} = 6.8$ $E_{min} = 5800$ and $k_3 = 1.00$

$\frac{E_{min}}{\sigma_{c,k}} = \frac{5800}{6.8 \times 1.0} = 852.9$ } $k_{12} = 0.384$

$\lambda = 100.5$ }

$\therefore \sigma_{c,adm,\parallel} = 6.8 \times 1.0 \times 0.384 = 2.61$ N/mm²

$\therefore$ post capacity $= 2.61 \times 10^6 \times 10^{-3} = 26.1$ kN ≥ 10.1

HENCE 100 × 100 C16 POST ADEQUATE

	Project		Job Ref	
GSE GREEN STRUCTURAL ENGINEERING	108 HIGH STREET ODIHAM		J002241	
	Drawing Ref	Calculations by	Checked by	Sheet No
		PB		CSS
	Part of Structure		Date	
	PADSTONES		MARCH 2022	

PADSTONES

- to be sized on the basis of guidance given in CIRIA 111
  - ie basic stress onto brickwork = 0.42 N/mm²
  - enhancement under bearings = 1.5 x 0.42
- Hence padstones sized on the basis of 1.5 x 0.42 = 0.63 N/mm² (FACTORED LOADS)

1B1

reaction (SLS) = 1.54 kN.

area req'd = 1.54 x 10³ / 0.63 = 2444 mm²

if padstone is 100 wide, embedment = 2444 / 100 = 24.4 mm

USE 100 MIN EMBEDMENT — NO PADSTONE REQ'D.

1B2

reaction (SLS) = 25.17 kN

area req'd = 25.17 x 10³ / 0.63 = 39952 mm²

padstone = 215 x 215 (46,225 mm²) (x 150 DP)

FB1

reaction (SLS) = 9.74 kN

area req'd = 9.74 x 10³ / 0.63 = 15460 mm²

padstone = 215 x 100 (x 150 DP) (21500).