FIRST FLOOR, UNIT 6
UNION PARK
PACKET BOAT LANE
UXBRIDGE UB8 2GH

TEL: 01895 430700
FAX: 01895 430550

MMP DESIGN

Project No. 4467

Proposed Extension of Existing Lower Ground Floor and Upper Ground Floor Alterations at;

31 Heath Drive, London, NW3 7SB

Structural Design Calculations

S. R. MASTERS
B.Sc.(Hons).,C.Eng.,M.I.Struct.E.,M.B.Eng.

May 2015

Contents

INTRODUCTION TO MMP DESIGN

MMP Design Limited was formed as a private limited company in 1988 by one of the current Directors. Since then it has developed into it's present form as a firm of consulting engineers with expertise in Structural and Civil Engineering Services.

Within the Company experience has been gained in a range of projects from structural surveys through refurbishment to multi-million pound developments and the Directors have experience in residential, retail, commercial, community care and educational projects. The Company also has commitment to all types of work including Design and Construct projects.

The Company philosophy is to provide the fullest and most cost effective service to Clients. The Directors have a direct involvement with each project taking on the day to day control in order to provide the best possible service and the experience of the principals in the construction processes ensures that the objectives of buildability and cost effectiveness are met.

With regard to the Company's association with retro-fit basements, we have been working within this field since 1999 and during that time have had a direct involvement in the design of more than 700 such schemes.

MMP DESIGN DIRECTORS

Steven R. Masters - BSc(Hons).,C.Eng.,M.I.Struct.E.,M.B.Eng.
Philip Seastram - BSc(Hons).
Andrew J. Stone - BSc(Hons).,C.Eng.,M.I.C.E.,M.I.H.T.,Eur.Ing.

EVIDENCE OF COMPETENCE & RESOURCES

Details of Organisation

Name: MMP Design
Address: First Floor Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

Contact: S. R. Masters

Nature of Organisation

Consulting Civil, Structural and Highway Engineers

Incident/Accident Record

None recorded

Membership of Professional Bodies

S. R. Masters - BSc(Hons).,C.Eng.,M.I.Struct.E.,M.B.Eng.
A. J. Stone - BSc(Hons).,C.Eng.,M.I.C.E.,M.I.H.T.,Eur.Ing.

Professional Indemnity/Liability Insurance

PI is in place to cover our duties under CDM with cover limited to £1,000,000 and the liability period limited to 6 years. Details are available upon request.

Details of Persons to be Employed

S. R. Masters & A. J. Stone – Chartered Engineers & Project Leaders
P. Seastram – Project Leader & Designer
L. Gibson – Designer
S. Barrow – Technician
N. King & R. Shapland – CAD Operators

Familiarity with Construction Processes

The Directors have extensive experience in underpinning and retro-fit basement construction and have been instrumental in the development of some of the working practices adopted by the leading basement constructors.

Awareness of Relevant Health & Safety and Fire Regulations

Within the Company we have documentation relating to these matters which are regularly updated and circulated among the Directors and members of staff.

Health & Safety Practices

A copy of the Company's Health & Safety Policy is available upon request.

Management Systems

A Project Director is responsible for the design and resourcing of the project. Generally projects are undertaken in house with occasional external draughting only where necessary. Communications are by way of verbal and/or written instructions. All work is checked before leaving the office.

Resources

The Company comprises three working Directors together with full time and part time technical assistance sufficient to meet the design requirements for this project.

Technical Facilities to Support the Designer(s)

SCALE Structural Design suite
Staad/QSE Structural Analysis suite
Members of BSI
Members of TRADA
Members of BRE

Method of Communication Design Decisions

Design decisions are communicated verbally and confirmed in writing or by drawing revisions. All drawings are issued to relevant parties as required by the Lead Consultant and/or the Client.

Remaining Risks

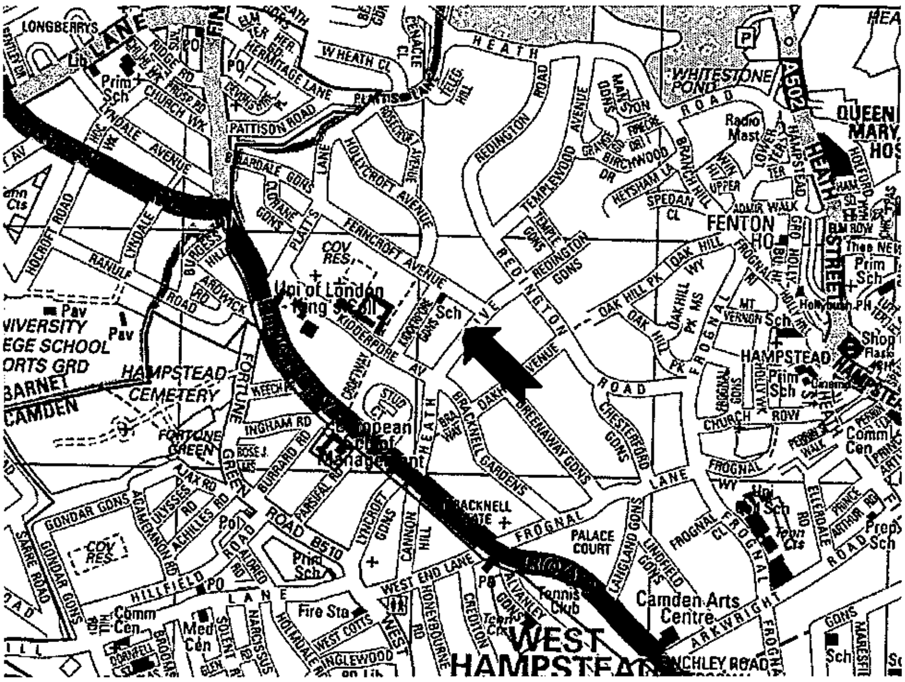
Remaining risks will be communicated in writing to the appropriate Authority.

THE SITE

Heath Drive runs in a north easterly direction climbing up from the A41 Finchley Road and the site is located on the south eastern side of the road. The site slopes up from the road as well as up from right to left with the road.

The property shares a party wall with No.32 Heath Drive which is a property of similar age and general arrangement. No. 32 to the right and downhill of No.31 when viewed from the road.

The footprint of the existing upper ground floor is approximately 12.6m wide between the party wall and the side flank wall by 24.0m deep between the external faces of the rear extension and front bay walls.



EXISTING STRUCTURE

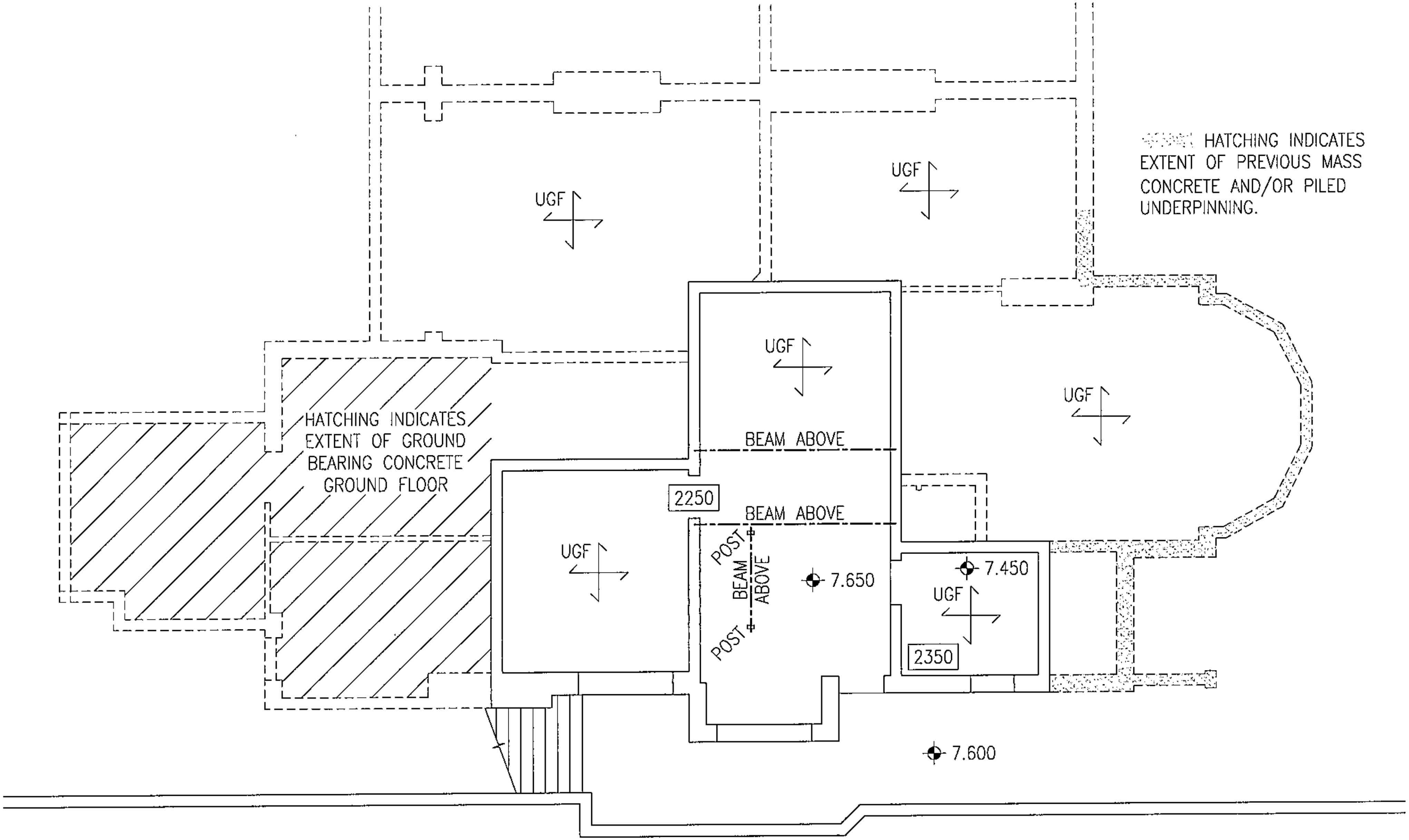
The existing structure is an early 20th century semi-detached property originally comprising three storeys beneath a tile covered pitched roof and with a small lower ground floor area beneath the front entrance hall and study.

The roof space has subsequently been converted to form additional habitable space, a single storey extension has been added to the rear and the property has been converted to form 3 private dwellings. A small lift was also installed to provide access to the upper floors.

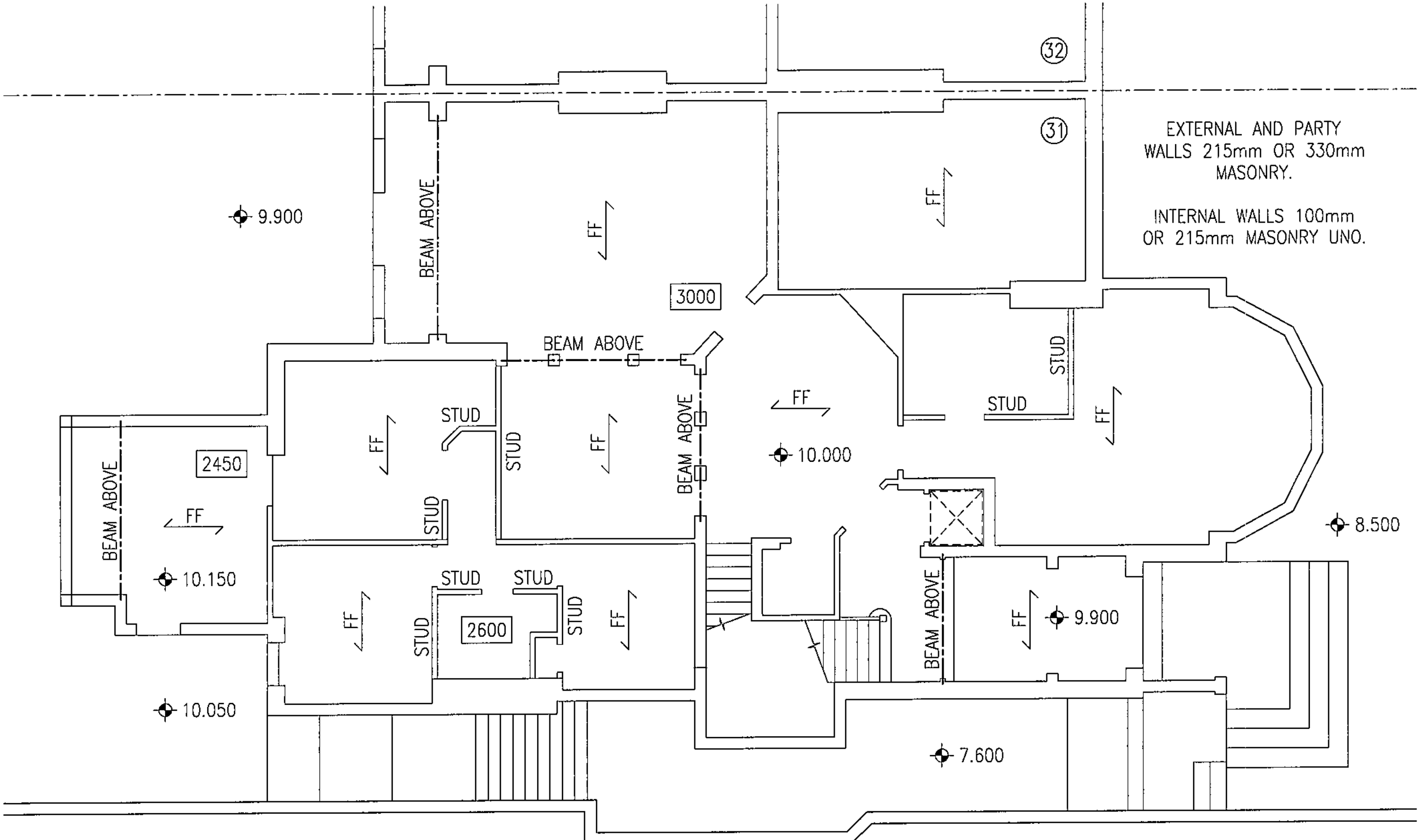
In 2008 the front entrance and porch and the front bay window were underpinned following subsidence which was attributed at the time to tree root activity.

The external and party walls are of solid masonry which extend down to a concrete strip foundation which are believed to be at approximately 1.8m below ground level. The internal load bearing walls are also of masonry at ground, first and second floor levels but are of timber studwork at the third floor level.

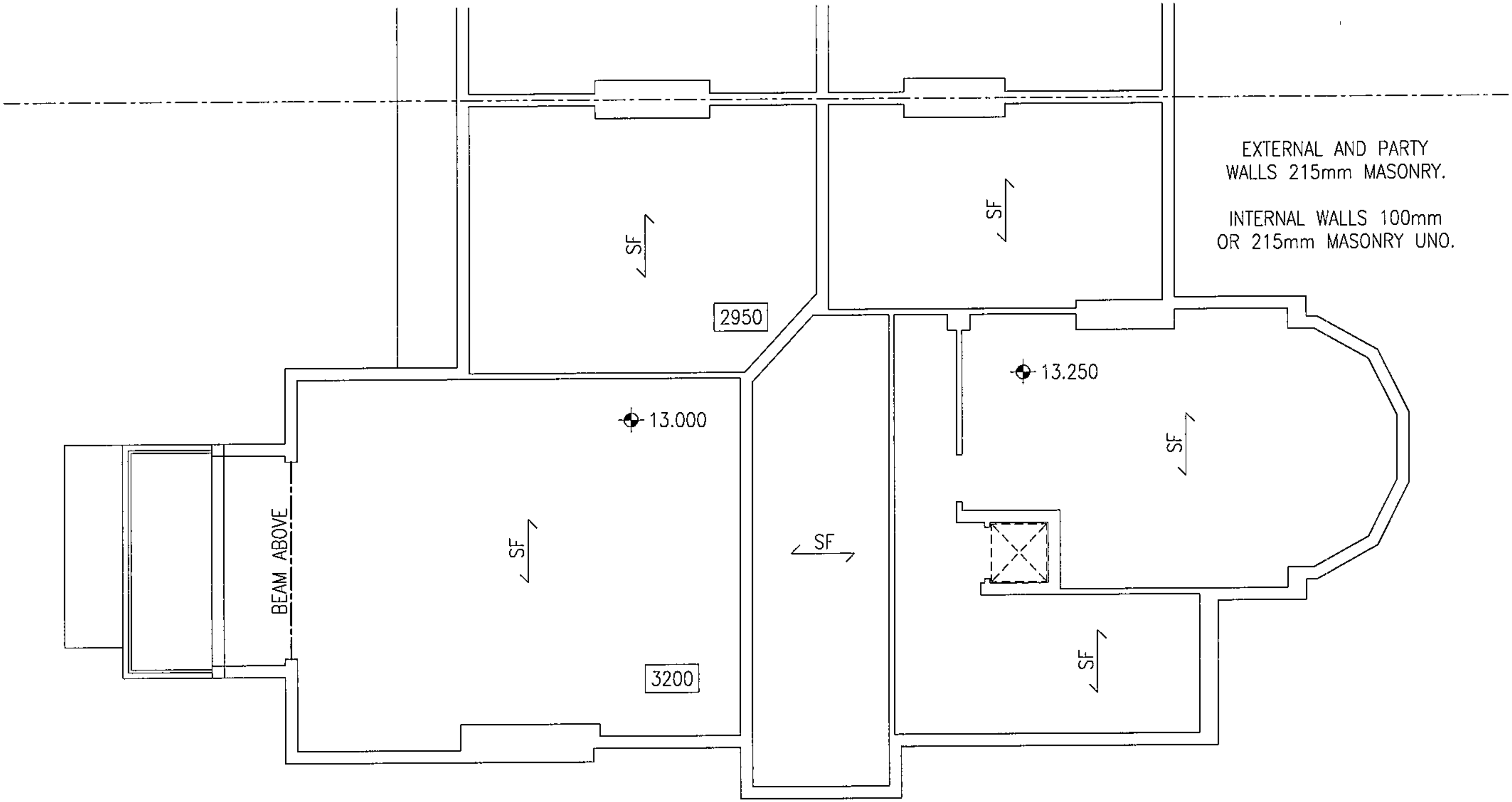
In addition to the alteration previously described other alterations to the layouts have been made over the years and simple plans showing the structural layout are attached.



EXISTING LOWER GROUND FLOOR PLAN



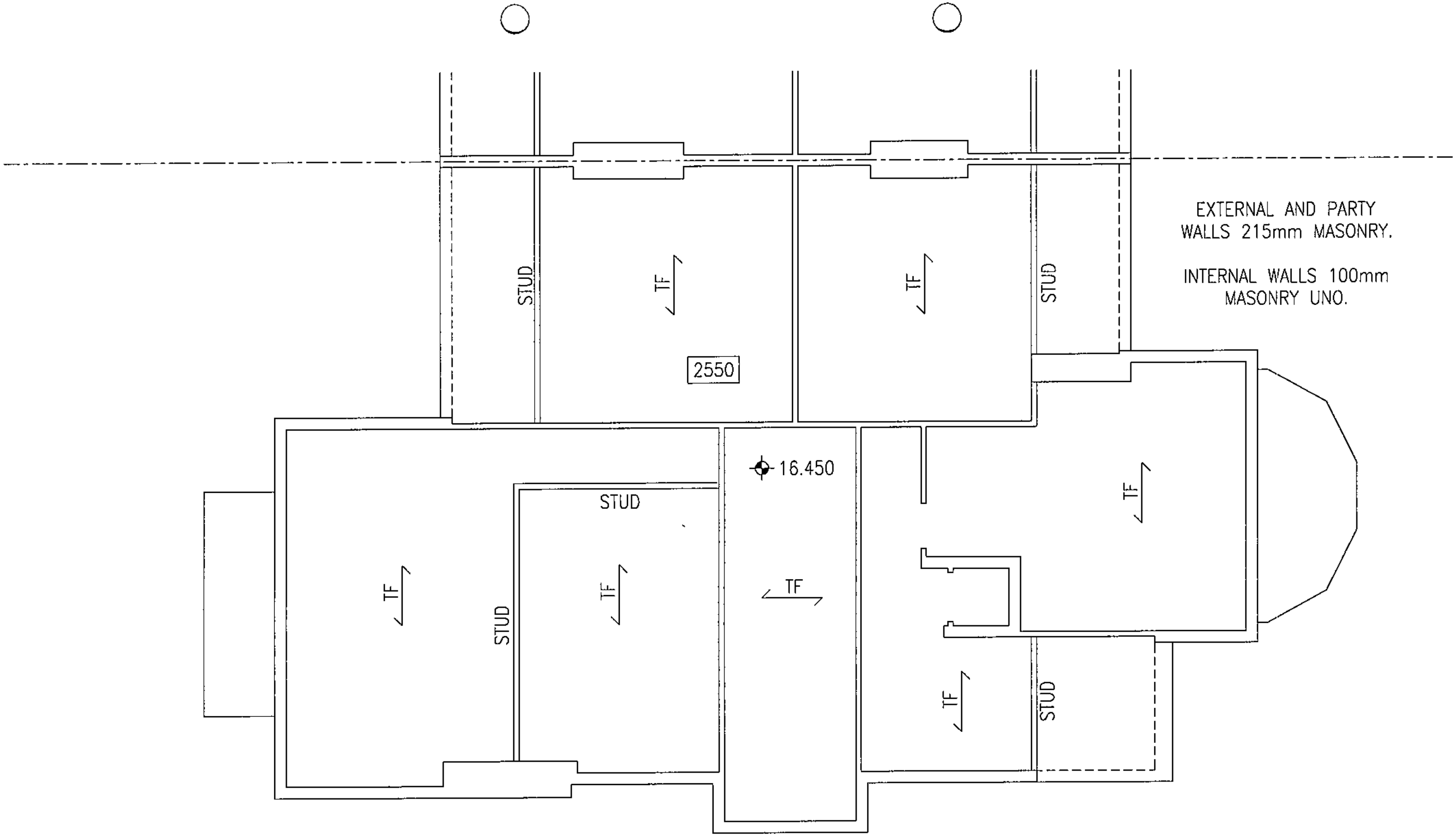
EXISTING UPPER GROUND FLOOR PLAN



EXTERNAL AND PARTY WALLS 215mm MASONRY.

INTERNAL WALLS 100mm OR 215mm MASONRY UNO.

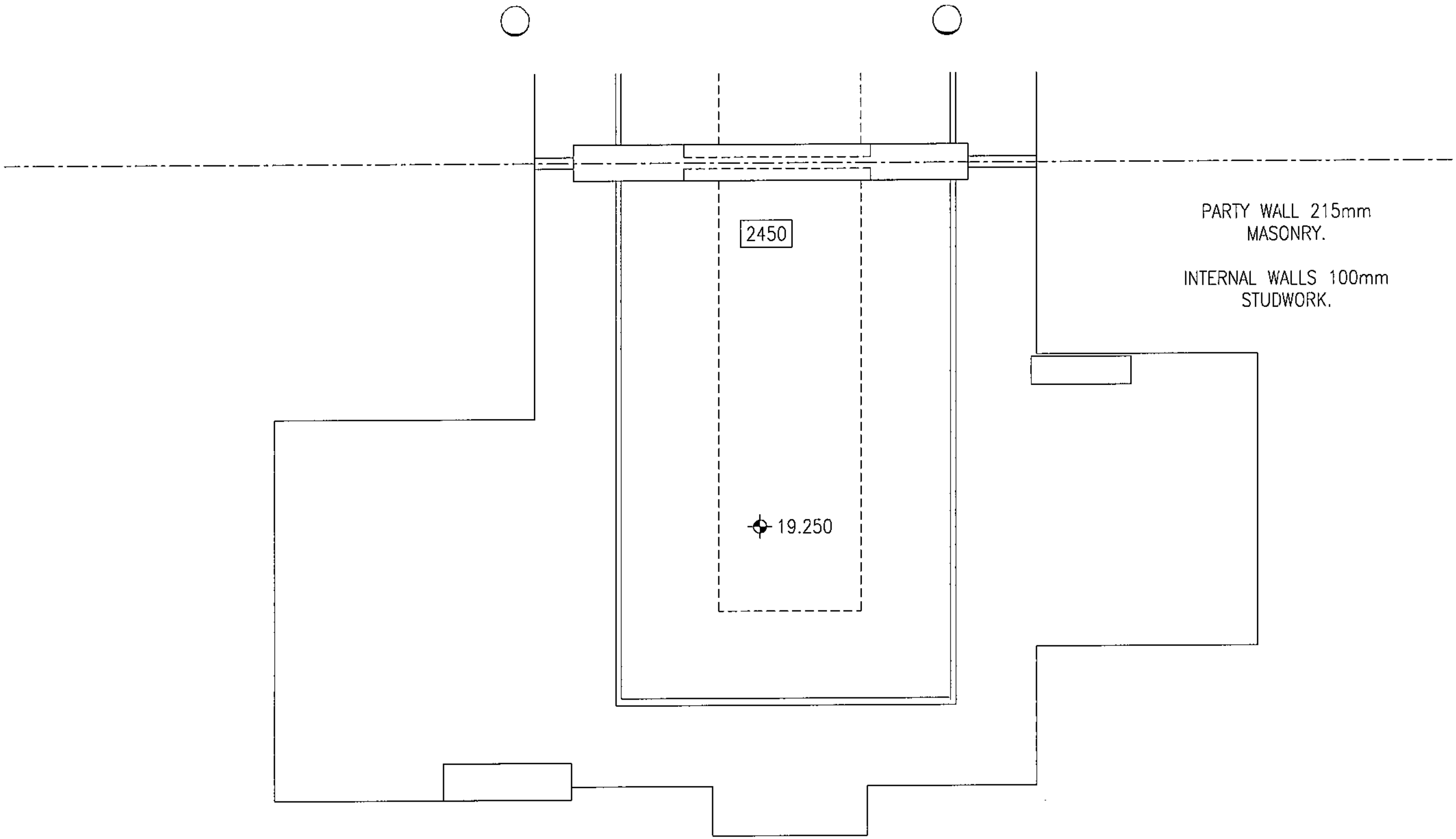
EXISTING FIRST FLOOR PLAN



EXTERNAL AND PARTY WALLS 215mm MASONRY.

INTERNAL WALLS 100mm MASONRY UNO.

EXISTING SECOND FLOOR PLAN



EXISTING THIRD FLOOR PLAN

PROPOSED DEVELOPMENT

It is proposed to extend the existing lower ground floor to provide additional habitable space as proposed on the drawings prepared by Callender Howorth Architects.

The new lower ground floor will extend to approximately 3.5m below the level of the existing upper ground floor and no lightwells are proposed.

Waterproofing of the existing and new lower ground floor will take the form of drained cavities with sumps and pumps to collect and discharge any waste into the existing drainage system.

SOIL CONDITIONS & FOUNDATIONS

Limited investigations were carried out when the subsidence occurred and these revealed the presence of a stiff Clay and this was proved to 5m below the front garden ground. The Clay was found to be highly shrinkable and no significant water was encountered.

Reference to the British Geological Survey supports these findings.

In the absence of any laboratory testing we have looked to BS.8002, BS.8004 and the Reinforced Concrete Designers Handbook (by Charles E. Reynolds and James C. Steedman) for a suggested range of parameters to be adopted for the design. For the soil profile previously described the guidance suggests an Angle of Internal Friction of 20-40° and an allowable Net Bearing Pressure (with no addition for depth of embedment) of 75-150 kN/m2.

Hence the following parameters will be adopted.

> $\phi = 30^\circ$ (so Ka = 0.333) and $\delta = 18$ kN/m3
> Allowable bearing stress at GL = 75 kN/m2
> Allowable bearing at Basement Level = 75 + soil removed, say = 125 kN/m2

These parameters have been confirmed by previous testing regimes carried out over a period of more than 15 years and are accepted by the checking authorities of at least 13 London Boroughs. They represent the long term condition which when combined with the design being based on active earth pressures results in a much simplified but rather conservative approach.

WATER

Although no significant water presence is anticipated at the site, the provisions of clause 3.4 (BS.8102) are considered but with an existing lower ground floor level at ground level along the side of the property it is clear that applying such onerous design requirement on what is simply an extension to the existing lower ground floor would be unreasonable.

Added to this, neither the new nor the existing lower ground floor structure is water retaining and both will adopt a drained cavity liner system to remove any water which enters.

However, even though the Clay in essence presents an almost complete barrier to water there can be some permeation albeit extremely slowly and there is also the possibility of some faster flow through fissures or localised zones of more granular material which can cause an occasional build up against the new lower ground floor walls.

It is for this reason that the basement design includes for the water table to be at the level of 0.75 x the average retained depth, ie. 1.2m above the existing lower ground floor level.

HEAVE & SETTLEMENT

The underpinning process involves transferring the foundation loads to a lower level and inevitably this leads to some settlement. Some movement will also be caused by the sequential transfer of load between different parts of the structure but the careful control of the underpinning process and sequence will keep such movements to a practicable minimum. Particular care will be taken in the vicinity of the more vulnerable parts of the existing fabric.

The depth to the London Clay and the modest dimensions of the site are such that the heave of the Clay is unlikely to exceed a few millimetres or to have any discernible effect outside the site boundaries. Any movement that does occur will be further mitigated by the necessarily slow rate of the excavation and construction.

At the lower level the lower ground floor slab will be used to resist these heave forces and by supporting the slab with the deeper underpinning and the internal wall and column foundations, the resulting upward movement effectively counteracts the increased settlements expected due to the increased dig depth.

SLOPE INSTABILITY

Although the property occupies a sloping site, the gradient of the slope when taken into consideration with the relative robustness of the existing and proposed foundation is such that we feel slope instability will not be initiated as a result of these works.

EFFECTS ON ADJACENT STRUCTURES

Outside of the basement area the change of vertical stresses in the ground may result in limited upward movements but since there is no underpinning of the party walls proposed any settlements and horizontal movements towards the new basement will be very minor.

In addition the excavating operations may cause localised settlements of the party wall which might result in cracks forming at the junctions of the walls of the adjacent properties where they abut the party wall. It should be stressed however that any anticipated movements are expected to be minimal the party wall itself is not to be underpinned and they are generally suppressed by the stiffness of the structures above and those adjoining.

It is our experience that the potential for damage will be limited to the party wall but this can be further mitigated by appointing a suitably experience Contractor familiar with propping techniques and sequential operations and by the Designer giving the necessary consideration to the risk by specifying measures to ensure that significant damage is avoided. This would typically be in the form of transitional underpins where we consider the structure above to be particularly vulnerable but otherwise by ensuring that the foundation transitions occur at inherently strong intersections of the more robust load bearing walls.

As a result we anticipate that should any damage occur it will be classified as Category 0 in the Category of Damage Chart, CIRIA C580. Category 0 is Negligible; hairline cracks of less than 0.1mm.

However, there will always be some movement as it can never be completely avoided and there are occasions where unforeseen conditions beneath the property which were not or could not be detected by the pre-construction investigations will result in more extensive damage. From our experience of designing more than 700 retro-fit basement the chance of such an occurrence is less than 2% and even then the damage would be classified as Category 1 in the Category of Damage Chart. Category 1 is Very Slight, fine cracks less than 1mm that can be easily treated during normal decoration.

IMPACT ON DRAINAGE AND SURFACE WATER

We understand that there is no statutory drainage within the area of influence of the proposed lower ground floor works.

With regard to surface water, the proposed extension is below the existing building and so we do not foresee any significant impact on the surface water courses.

It is commonly accepted that increasing the size of an existing subterranean floor as we are proposing has little or no effect on the flow of local water in relation to adjoining properties. In fact even if mobile water was forced to find an alternative route as a consequence of the construction, any increase in the level of that water is likely to be significantly less than the natural variations associated with seasonal changes and rises in levels from extreme rainfall events. We concur with these views.

DESIGN PRINCIPLES

Ground Floor Structure

Where the existing internal below ground floor level load bearing structure is to be removed, replacement will be by the use of steel and/or timber beams supported by the existing load bearing walls or new load bearing brick piers and/or steel posts.

To ensure the continued stability of the structure without reliance from the adjoining properties, the existing and any new load bearing basement walls are strapped to the structural ground floor deck using 30mm x 5mm galvanised mild steel straps placed at 2m centres.

New beams are not considered 'restrained' unless there is a mechanical connection to the top flange (or within 75mm of it). Hence timber floor joists do not restrain the compression flange unless they are notched into the web or nailed/screwed to a timber flange plate.

In order to restrict any possible damage to the existing structure, the deflection in the new beams is restricted to 1/360th of the overall span, under the total characteristic load condition.

Timber

The exact structural layout of any existing ground floor joists is often unknown although sometimes the general direction of the span of the joists is. There will almost certainly be a foundation under each load bearing and/or masonry ground floor level wall; it also likely that there are numerous sleeper walls supporting nominal floor joists and experience would suggest that these are likely to be only 50mm x 100mm joists spaced at little more than 400mm centres. The spacing of the sleeper walls is also likely to be little more than 2.0m.

The new ground floor support structure will therefore need to replicate this arrangement. However, since the exact location of the sleeper walls is unknown, the main beam layout will be created first with a beam provided under each load bearing and/or masonry wall. It will then be necessary to provide additional beams to replace each sleeper wall. Hence sleeper wall beams will be designed to span up to various lengths and support at least 2.0m width of floor and ceiling. All main beams will then be designed assuming the worst ground floor loading case.

For DL of (2 x 0.6)+0.5 = 1.70 kN/m and IL of (2 x 1.5) = 3.00 kN/m,

Provide 152x152 UC.23 for spans up to 4.5m,
152x152 UC.30 for spans up to 5.0m,

Lower Ground Floor Slab

The new lower ground floor will be a 250mm thick reinforced concrete ground bearing slab formed on a structural void former. In terms of potential ground heave the slab will span onto and connect with the perimeter underpins and the internal wall and column foundations.

Any upward water pressure will also be resisted by the slab and there is sufficient loading to the underpinned walls and the lower ground floor structure to resist any floatation' effects.

Lower Ground Floor

The remaining load bearing structure will be underpinned in a traditional 'hit and miss' method to achieve the increased headroom required. The underpins comprise a vertical stem which is immediately beneath the existing wall and a base which usually has a toe and a nominal heel. The heel size is determined by ignoring the earth pressure and considering the maximum vertical load on the wall only, using this to find a minimum foundation width based on the soil bearing capacity.

The toe of the base is then determined by considering the minimum vertical dead load on the wall along with the maximum pressure from the retained soil and with the wall assumed to be acting as a cantilever. In calculating the toe size, the maximum allowable bearing pressure is not exceeded and a minimum factor of safety against overturning of 2.5 is achieved.

The toe and/or stem will only be reinforced when the underpin stem is subjected to tensile stresses due to the pressures from the retained material. This usually only occurs where the London Clays are present or where the retained depth of soil is large.

To check the stresses in the underpin stem, the overturning moment taken about the basement slab is used. However, the design of the toe and the overall stability is based on the overturning moment taken about the underside of the underpin base.

We assume the soil/stem interface to be friction free as ultimately this provides the most onerous design.

Ground Water

No ground water was encountered during the previous exploration works but if any local ground water is found during construction it water will be locally removed from the excavations by local pumping from the excavated area to a sump area.

Water and moisture will generally be excluded from the permanent structure by the reinforced concrete walls/slab and the provision of an internal drained cavity system on the inside face of the walls/slab. Any water from the cavity system will drain to a sump and be pumped into the house surface water drainage system. The concrete walls/slab will prevent the migration of large quantities of water or soil particles and therefore the drained cavity will only need to deal with a limited quantity of ground water.

DESIGN CRITERIA

General

The detailed structural design of the proposed works will be carried out in accordance with current British Standards, Building Regulations and appropriate Guidance Documents published by CIRIA, ICE, IStructE etc.

The design and drawings will be submitted to the local Building Control for approval and the construction inspected by the Building Inspector on site.

Existing Brickwork

Assuming 7N stock bricks in a cement mortar, from CP.111 the basic compressive strength = 0.7 N/mm^2

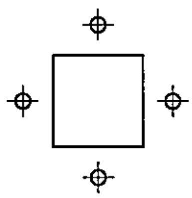
Hence under a concentrated load, bearing strength = 1.5 x 0.7, say 1.0 N/mm^2

Typical Underpinning Sequence

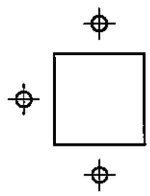
6	1	4	7	2	5	8	3	6	1	4	7

Materials

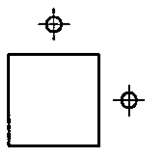
Concrete is grade C35 N/mm^2 using Sulphate Resisting cement unless otherwise directed.
Reinforcement is grade 500 N/mm^2
Mortar is Class (iii).



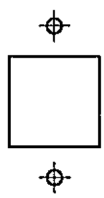
Le = 1.0 x L



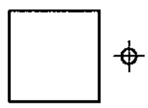
Le = 1.0 x L



Le = 1.5 x L



Le = 1.5 x L



Le = 2.0 x L

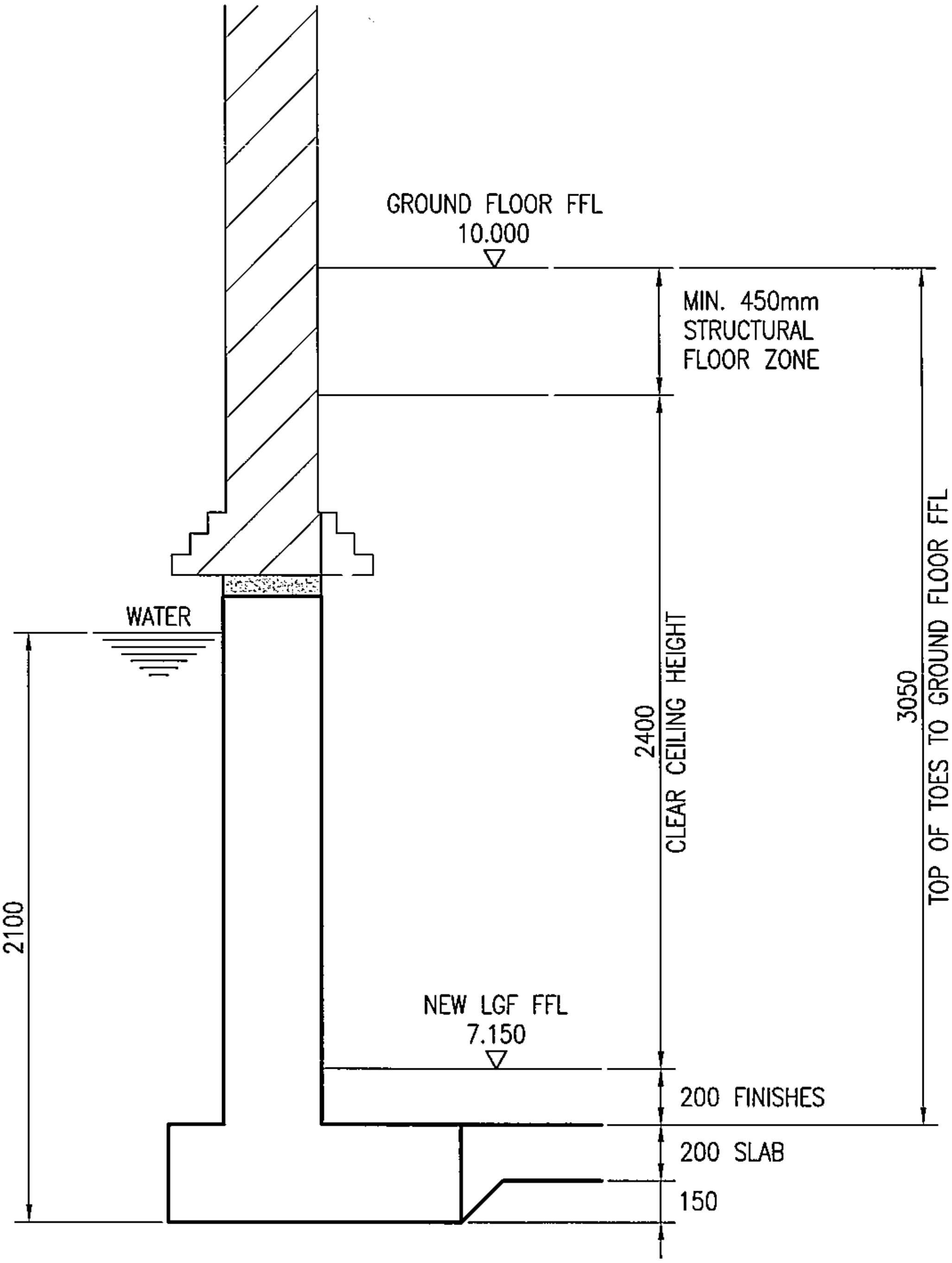
EFFECTIVE LENGTH OF BASEMENT POSTS

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550
Email: mail@mmpdesign.co.uk

The Institution of Structural Engineers

Client: CROWNWELL BASEMENTS	Drawing Status: CALCULATIONS		
Project: 31 HEATH DRIVE, NW3	Date: MAY/15	Drawn by: AFB	
	Scales: 1:25	Checked:	
Title: COLUMN EFFECTIVE LENGTHS	Job No. 4467	Drg. No. SK1	Rev.



TYPICAL UNDERPINNING DETAIL

SCALE 1:25

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550
Email: mail@mmpdesign.co.uk

The Institution of Structural Engineers

Client	CROWNWELL BASEMENTS
Project	31 HEATH DRIVE, NW3
Title	TYPICAL UNDERPIN SECTION
Drawing Status:	CALCULATIONS
Date:	MAY/15
Drawn by:	AFB
Scales:	1:25
Checked:	
Job No.	4467
Drg. No.	SK2
Rev.	

DESIGNERS RISK ASSESSMENT

Excavations

Care must be taken to prevent sides of excavations from collapsing.

Suspended Floors

The use of suspended insitu reinforced concrete ground slabs is expensive and impractical due to the extent of formwork required and the thickness of slab required.

Precast beam and block floors provide reduced weight and quick installation with holes and cutting for designed services carried out on site at the time of installation. However, during installation, and indeed before the floor is screeded, safety netting or air bags shall be provided to prevent injury due to operatives falling between the joists.

In-situ concrete slabs cast onto a profiled steel permanent shuttering provides a suitable alternative to the beam and block and removes the need for the netting or air bags. However, the manufacturer should always be consulted about temporary span propping that may be required prior to the concrete achieving it's design strength.

Masonry Walls

A 150mm minimum thickness is required for design load resistance and height to thickness ratios. However the blocks tend to be too heavy to manhandle and so load bearing blockwork walls will be specified as 215mm thick and formed from 100mm thick blocks laid on their side.

Steel Beams

Where possible, large span beams will be spliced to minimise manhandling. Other ways of minimising the weight of steel sections is to specify two channels bolted back to back in lieu of a single UB or UC section. However, there will be occasions where neither option will be practical and/or possible and the Contractor will be made aware of such situations.

Hazards & Risks Which Cannot be Designed Out

Potential Hazards	Action Required	Risk Assessment
Falls from Height	Works being carried out - provide hand rails and access scaffolding to all openings.	Medium
Falling Debris	Works carried out above public access - provide toe boards, netting and protection fans.	High
Materials Storage	Existing roofs and floors are not to be used for storage of materials without reference to the Engineer or for supporting access scaffolding.	High

Potential Hazards	Action Required	Risk Assessment
Lifting of Steelwork	Steel sections to be lifted using mechanical means where unable to be manually lifted.	High
Erection of Steelwork	Contractor responsible for providing method statement for erection procedure, including any temporary bracing.	Medium
Lifting of Timber	Timber rafters and joists to be lifted using mechanical means where unable to be manually lifted.	High
Fixing of Timber	Timbers to be fixed in accordance with good building practice.	Medium
Reinstate Existing Roof Finishes	Method statement to allow for temporary waterproofing if required.	Low
Use of Cutting Equipment – Flame or Disc.	Fire risk - use suitable protective methods – remove inflammable materials.	High
Painting	Touch up steelwork with primer – take precautions against vapour inhalation, eye and skin contact and fire. Wear protective clothing.	Low
Excavation	Take precaution against collapse of excavation and hazards of persons falling in.	High
Precast Concrete units	Lift into position using mechanical assistance. Storage at ground level in a safe manner.	Medium
Insitu Concrete Construction	Take precautions to prevent skin/eye contact. Protect public and site staff from falling objects and spillage. Ensure adequate care when fixing reinforcement.	Medium

Potential Hazards	Action Required	Risk Assessment
Formwork/Falsework	Design temporary works in a manner that makes allowances for all loadings, including accidental loads. Ensure adequate vertical and diagonal bracing. Supports not to be removed until period specified.	Medium
Forming new Openings in Walls	Provide temporary works to support wall and loads above opening. Install new support lintel and reinstate prior to removal of temporary supports.	Medium

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

UNIT LOADS in kN/m^2	**DEAD**	**IMPOSED**
Pitched Roofs		
Pitched roof with tiles and battens over felt, lined but excluding ceiling below	1.20	0.65
Flat Roofs		
Flat roof of lead, access for maintenance only	1.00	0.75
Flat roof of lead and full access	1.50	1.50
Suspended floors		
Timber upper floor including ceiling	0.50	1.50
Timber ground floor including services and suspended ceiling	1.00	1.50
200mm Concrete in-situ ground floor including services and suspended ceiling	6.00	1.50
Allowance for lightweight partitions if position not known	0.00	1.00
External walls		
215 mm solid masonry, plastered one side	4.80	0.00
330 mm solid masonry, plastered one side	7.20	0.00
Internal walls		
100 mm solid masonry, plastered both sides	2.60	0.00
215 mm solid masonry, plastered both sides	5.00	0.00
100 mm timber studwork, plasterboard and skim both sides	0.60	0.00

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

MMP DESIGN
Consulting civil and Structural Engineers

Project	31 HEATH DRIVE, NW3	Job No.	4467
CALCULATION SHEET	Title: ALTERATIONS	Date	MAY/15
	By: SM / Checked:	Sheet No.	FF/1	Rev

BEAMS AT FIRST FLOOR LEVEL

BEAM FB2 - SPAN 2000

ROOF	1.50 x 1.20	=	1.80	
	0.65	=		1.00
TF+SF	2 x 3.8 x 0.5	=	3.80	
	1.5	=		11.40
FF	2.80 x 0.50	=	1.40	
	1.50	=		4.20
WALL	6.00 x 2.60	=	15.60	
O/W	SAY	=	0.50	
			23.10	16.60

FROM FFC/1, PROV. 152UC23

BEAM FB1 - SPAN 1100

LOADS AS FB2

BY INSPECTION, PROV. 152UC23

(REACTIONS DL = 12.7, IL = 9.1)

BEAM FB3 - SPAN 4400

FF	3.30 x 0.50	=	1.65	
	2.50	=		8.25
O/W	SAY	=	0.50	
			2.15	8.25

FROM FFC/2, PROV. 152UC37

BEAM FB4 - SPAN 3600

LOADS AS FB3

BY INSPECTION, PROV. 152UC37

(REACTIONS DL = 3.9, IL = 14.9)

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

MMP DESIGN
Consulting civil and Structural Engineers

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

Project: 31 HEATH DRIVE, NW3			Job No. 4467	
CALCULATION SHEET	Title: ALTERATIONS		Date: MAY/15	
	By: SM	Checked	Sheet No. FF/2	Rev

BEAM FB5 - SPAN 2800

FF 1 2.00 x 0.50 = 1.00
1 2.50 = 5.00
O/W 1 SAY = 0.50
1.50 5.00

POINT LOAD FB3 = 4.7
= 18.2

FROM FFC/3, PROV. 152UC37

BEAM FB6 - SPAN 950

FF 1 1.70 x 0.50 = 0.85
1 1.50 = 2.55
WALL 1 0.95 x 4.80 = 4.56
O/W 1 SAY = 0.50
5.91 2.55

BY INSPECTION, PROV 152UC23
(REACTIONS DL = 2.8, IL = 1.2)

BEAM FB7 - SPAN 1400

FF 1 1.80 x 0.50 = 0.90
1 1.50 = 2.70
WALL 1 3.20 x 2.60 = 8.32
O/W 1 SAY = 0.50
9.72 2.70

BY INSPECTION, PROV. 152UC23
(REACTIONS DL = 6.80, 1.9)

FIRST FLOOR, UNIT 6
UNION PARK
PACKET BOAT LANE
UXBRIDGE UB8 2GH

MMP DESIGN
CONSULTING CIVIL AND STRUCTURAL ENGINEERS

TEL: 01895 430700
FAX: 01895 430550
WWW.MMPDESIGN.CO.UK
MAIL@MMPDESIGN.CO.UK

PROJECT: 31 HEATH DRIVE, NW3		JOB NO. 4467	
CALCULATION SHEET	TITLE: ALTERATIONS	DATE: MAY/15	
	BY: SM / CHECKED:	SHEET NO. FF/3	REV

BEAM FB8 - SPAN 2650

FF 1 0.50 x 0.50 = 0.25
1 1.50 = 0.75
o/w 1 SAY = 0.50
0.75 0.75

POINT LOAD FB7 = 6.8
= 1.9

FROM FFC/4, PROV. 152UC23

BEAM REF.	LHS DL	LHS IL	RHS DL	RHS IL
FB1	12.7	9.1	12.7	9.1
FB2	23.1	16.6	23.1	16.6
FB3	4.7	18.2	4.7	18.2
FB4	3.9	14.9	3.9	14.9
FB5	5.0	18.4	3.9	13.8
FB6	2.8	1.2	2.8	1.2
FB7	6.8	1.9	6.8	1.9
FB8	5.1	2.2	3.7	1.8

BEAM REF.	LHS DL	LHS IL	RHS DL	RHS IL

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

BEAM BEARINGS

Allowable bearing stresses beneath concentrated loads such as beam bearings are;

For existing brickwork, 1.0 N/mm^2 (EXB)

For new 27.5N brickwork, 2.0 N/mm^2 (NWB)

CP denotes Concrete Padstone; EB denotes single Engineering Brick.

All loads are un-factored.

BEAM	END	LOAD	TYPE	BEARING
FB1	RH	21.8	NWB	EB
FB2	LH	39.7	EXB	215x200x150 CP
	RH	39.7	NWB	215x150x150 CP
FB4	RH	18.8	EXB	EB
FB5	LH	23.4	EXB	300x100x150 CO
	RH	17.7	EXB	EB
FB6	LH	4.0	EXB	EB
	RH	4.0	EXB	EB
FB7	LH	8.7	EXB	EB
FB8	LH	7.3	EXB	EB
	RH	5.5	EXB	EB

MMP DESIGN
Consulting Civil & Structural Engineers

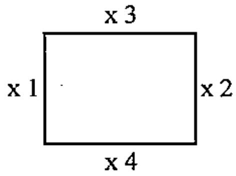
First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET			
Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
Title: ALTERATIONS		Date: MAY/15	
By: SM	Checked:	Sheet No.: FF/6	Rev:

BENDING MOMENTS IN NEW COLUMN GC1

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2	FB1	12.70	9.10
at x3			
at x4			
		12.70	9.10



Total Load = **21.80** kN
Total Ultimate Load = **32.34** kN

Enter Column Height = **3.00** m

Total Ultimate Sway (x1-x2) say = **0.44** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **0.00** kN

Net DL (x1-x2) = **12.70** kN
Net DL (x3-x4) = **0.00** kN

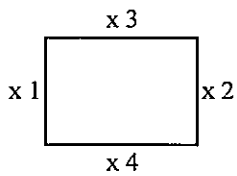
Max. LL (x1-x2) = **9.10** kN
Max. LL (x3-x4) = **0.00** kN

Total Ultimate Moment (x1-x2) say = **4.57** kN.m
Total Ultimate Moment (x3-x4) say = **0.00** kN.m

BENDING MOMENTS IN NEW COLUMN GC2

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1	FB3	4.70	18.20
at x2	FB4	3.90	14.90
at x3			
at x4			
		8.60	33.10



Total Load = **41.70** kN
Total Ultimate Load = **65.00** kN

Column Height = **3.00** m

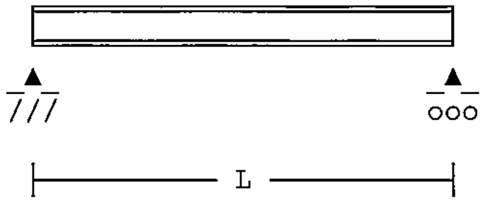
Total Ultimate Sway (x1-x2) say = **0.30** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **0.00** kN

Net DL (x1-x2) = **0.80** kN
Net DL (x3-x4) = **0.00** kN

Max. LL (x1-x2) = **18.20** kN
Max. LL (x3-x4) = **0.00** kN

Total Ultimate Moment (x1-x2) say = **3.93** kN.m
Total Ultimate Moment (x3-x4) say = **0.00** kN.m

Location: FIRST FLOOR LEVEL BEAM FB1



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.0 m
152 x 152 x 23 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.0 m
Dead load (unfactored)	Gku(1)=23.1 kN/m
Imposed load (unfactored)	Qku(1)=16.6 kN/m
Maximum span bending moment	29.45 kNm
Design shear force	Fv=58.9 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =219.2 N/mm^2

UNIVERSAL COLUMN DESIGN SUMMARY

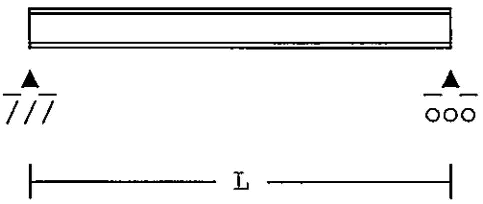
152 x 152 x 23 UC Grade S 275

	Maximum shear force	58.9 kN
	Shear capacity	145.85 kN
	Max. applied moment	29.45 kNm
	Moment capacity	45.112 kNm
	Buckling resistance	35.959 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	35.959 kNm
	Unfactored DL defln	1.878 mm
	Unfactored LL defln	1.3496 mm
	Limiting deflection	5.5556 mm
Unfactored end shears	DL shear at LHE	23.1 kN
	LL shear at LHE	16.6 kN
	DL shear at RHE	23.1 kN
	LL shear at RHE	16.6 kN

No408

Office: 5831

Location: FIRST FLOOR LEVEL BEAM FB3



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=4.4 m
152 x 152 x 37 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=4.4 m
Dead load (unfactored)	Gku(1)=2.15 kN/m
Imposed load (unfactored)	Qku(1)=8.25 kN/m
Maximum span bending moment	39.228 kNm
Design shear force	Fv=35.662 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =159.74 N/mm^2

UNIVERSAL COLUMN DESIGN SUMMARY

152 x 152 x 37 UC Grade S 275

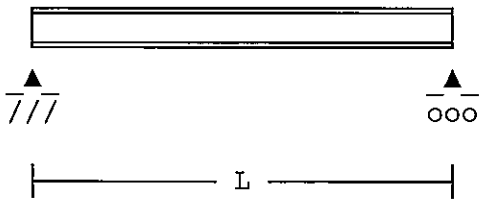
	Maximum shear force	35.662 kN
	Shear capacity	213.58 kN
	Max. applied moment	39.228 kNm
	Moment capacity	84.975 kNm
	Buckling resistance	49.361 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	49.361 kNm
	Unfactored DL defln	2.316 mm
	Unfactored LL defln	8.887 mm
	Limiting deflection	12.222 mm
Unfactored end shears	DL shear at LHE	4.73 kN
	LL shear at LHE	18.15 kN
	DL shear at RHE	4.73 kN
	LL shear at RHE	18.15 kN

No408

Location: FIRST FLOOR LEVEL BEAM FB5

Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.



Beam span	L=2.8 m
152 x 152 x 37 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=1.05 m
Dead load (unfactored)	Gkc(1)=4.7 kN
Imposed load (unfactored)	Qkc(1)=18.2 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.8 m
Dead load (unfactored)	Gku(1)=1.5 kN/m
Imposed load (unfactored)	Qku(1)=5.0 kN/m
Maximum span bending moment	32.708 kNm
Design shear force	Fv=36.453 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =202.53 N/mm^2

UNIVERSAL COLUMN DESIGN SUMMARY

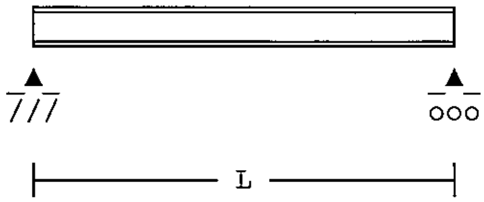
152 x 152 x 37 UC Grade S 275

	Maximum shear force	36.453 kN
	Shear capacity	213.58 kN
	Max. applied moment	32.708 kNm
	Moment capacity	84.975 kNm
	Buckling resistance	62.581 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	62.581 kNm
	Unfactored DL defln	0.69865 mm
	Unfactored LL defln	2.5626 mm
	Limiting deflection	7.7778 mm
Unfactored end shears	DL shear at LHE	5.0375 kN
	LL shear at LHE	18.375 kN
	DL shear at RHE	3.8625 kN
	LL shear at RHE	13.825 kN

No408

Office: 5831

Location: FIRST FLOOR LEVEL BEAM FB8



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.65 m
152 x 152 x 23 UC.	
Young's Modulus	$E=205\ kN/mm^2$
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=1.05 m
Dead load (unfactored)	Gkc(1)=6.8 kN
Imposed load (unfactored)	Qkc(1)=1.92 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.65 m
Dead load (unfactored)	Gku(1)=0.75 kN/m
Imposed load (unfactored)	Qku(1)=0.75 kN/m
Maximum span bending moment	9.829 kNm
Design shear force	Fv=10.584 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) $=252.33\ N/mm^2$

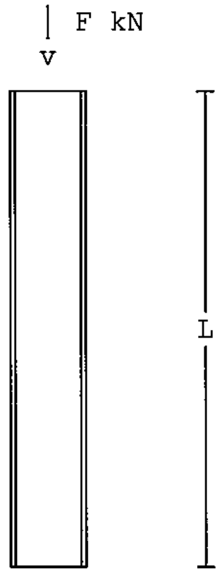
UNIVERSAL COLUMN DESIGN SUMMARY

152 x 152 x 23 UC Grade S 275

	Maximum shear force	10.584 kN
	Shear capacity	145.85 kN
	Max. applied moment	9.829 kNm
	Moment capacity	45.112 kNm
	Buckling resistance	41.393 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	41.393 kNm
	Unfactored DL defln	1.1549 mm
	Unfactored LL defln	0.46096 mm
	Limiting deflection	7.3611 mm
Unfactored end shears	DL shear at LHE	5.0994 kN
	LL shear at LHE	2.153 kN
	DL shear at RHE	3.6881 kN
	LL shear at RHE	1.7545 kN

No408

Location: GROUND FLOOR LEVEL COLUMNS GC1 & GC2



SHS column in 'simple' construction

Calculations are in accordance with BS5950 and 'SHS Design Examples to BS5950' published by British Steel General Steels.

The column is part of simple constr -uction and in accordance with 4.7.7 it is not necessary to consider the effect of pattern loading. All beams supported by the column are assumed to be fully loaded.

It is assumed that all elements of the column remain in compression.

Factored axial compressive load	F=65.0 kN
Factored BM about major axis x-x	Mx=0 kNm
Factored BM about minor axis y-y	My=4.57 kNm
Length between restraints	L=3000 mm

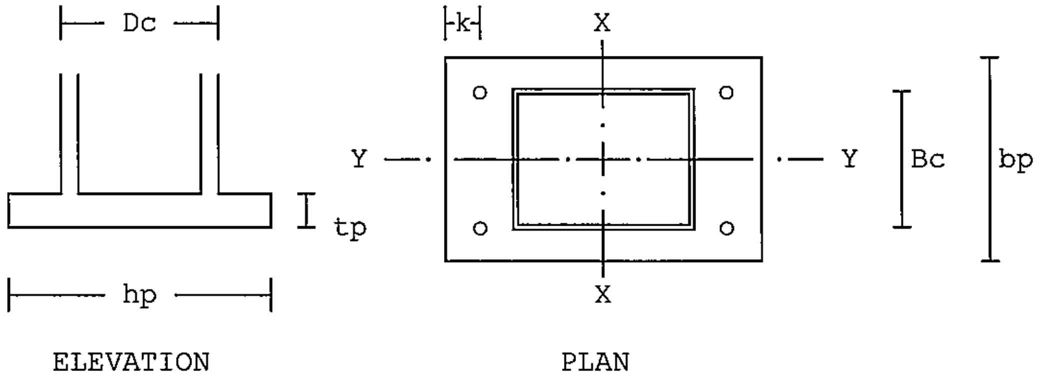
100 x 100 x 8 SHS - Hot finished.
Properties (cm): A=28.8 rx=3.73 Zx=79.9 Sx=98.2 Ix=400 J=646 C=116
Young's Modulus E=205 kN/mm^2

Effective length factor	ef=2
Compressive strength	pc=pe*py/(phi+(phi^2-pe*py)^0.5) =70.453 N/mm^2

HOT FINISHED	In accordance with EN 10210	
SQUARE HOLLOW SECTION	100 x 100 x 8 SHS Grade S 275	
SECTION SUMMARY	Section is satisfactory for axial load, buckling resistance and overall buckling check.	
DESIGN SUMMARY	Axial compressive load	65 kN
	Compressive resistance	202.9 kN
	Moment about minor axis	4.57 kNm
	Minor axis resistance	21.973 kNm
	Overall buckling check	0.52834 < 1

Location: BASEPLATE TO COLUMN GC1

Calculations are in accordance with 'Joints in Steel Construction Moment Connections' published by The Steel Construction Institute.



Axial load (+ve compression) N=32.34 kN
Moment about X-X axis M=4.57 kNm
Shear on the base in Y direction Fy=0.44 kN
100 x 100 x 8 SHS - Hot finished.
Properties (cm): A=28.8 rx=3.73 Zx=79.9 Sx=98.2 Ix=400 J=646 C=116
Length of baseplate hp=300 mm
Breadth of baseplate bp=300 mm
Edge distance to bolt centre line k=40 mm
Assumed fillet weld size sw=8 mm

Strength of concrete fcu=35 N/mm^2
Special control must be applied over the placing of the high strength bedding material.
Assumed weld size sw=8 mm
Selected baseplate thickness tp=12 mm

Number of bolts to be used n=4
Bolt diameter bd=16 mm
Selected fillet weld size sw=8 mm

SUMMARY

BASEPLATE REQUIREMENTS	Size 300 mm x 300 mm x 12 mm	
	Grade S 275 steel	
	Edge distance	40 mm
	Number of H.D. bolts	4
	Diameter of bolts	M 16
	Grade 4.6	
	Concrete/grout (fcu)	35 N/mm^2
WELDS	Fillet weld (all round)	8 mm
	Contact areas on the baseplate and column are machined to give a tight bearing contact.	

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

MMP DESIGN
Consulting Civil and Structural Engineers

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
CALCULATION SHEET	Title: BASEMENT	Date: MAY 15	
	By: SM / Checked:	Sheet No.: GF/1	Rev

BEAMS AT GROUND FLOOR LEVEL

BEAM GB1 - SPAN 2400

TF, SF + FF	3 x 1.0 x 0.50 =	1.50		
	1.50 =			4.50
GF	1.90 x 1.00 =	1.90		
	1.50 =			2.85
WALL	6.45 x 4.80 =	30.96		
WALL	2.80 x 2.60 =	7.28		
O/W	SAY =	1.00		
		42.64		7.35

FROM GFC/1, PROV. 203UC46

BEAM GB2 - SPAN 1700

TF, SF + FF	3 x 3.0 x 0.50 =	4.50	
	1.50 =		13.50
GF	1.60 x 1.00 =	1.60	
	1.50 =		2.40
WALL	6.45 x 4.80 =	30.96	
WALL	2.80 x 2.60 =	7.28	
O/W	SAY =	0.50	
		44.84	15.90

BY INSPECTION, PROV. 152UC23

(REACTIONS DL = 38.1, IL = 13.5)

BEAM GB3 - SPAN 1800

FF	1.60 x 0.50 =	0.80	
	1.50 =		2.40
GF	1.60 x 1.00 =	1.60	
	1.50 =		2.40
WALL	6.45 x 2.60 =	16.77	
O/W	SAY =	0.50	
		19.67	4.80

(REACTIONS DL = 17.7, IL = 4.3)

BY INSPECTION, PROV. 152UC23

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

MMP DESIGN
Consulting Civil and Structural Engineers

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

PROJECT: 31 HEATH DRIVE, NW3			JOB No. 1167
CALCULATION SHEET	TITLE: BASEMENT		DATE: MAY/15
	BY: SM	CHECKED	SHEET No. GF/2 · REV

BEAM GB4 - SPAN 3100

GF	1.50 x 1.00	=	1.50	
	1.50	=		2.25
O/W	SAY	=	1.00	
			2.50	2.25

TF, SF + FF	3 x 2.4 x 0.50	=	3.60	
	1.50	=		10.80
GF	2.80 x 1.00	=	2.80	
	1.50	=		4.20
WALL	9.25 x 2.60	=	24.05	
O/W	SAY	=	1.00	
			31.45	15.00

POINT LOAD GB1 = 51.2 GB2 = 38.1 GB3 = 17.7
= 8.8 = 13.5 = 4.3

FROM GFC/2, PROV. 203UC86

BEAM GB5 - SPAN 2700

TF, SF + FF	3 x 1.80 x 0.5	=	2.70	
	1.5	=		8.10
GF	1.20 x 1.00	=	1.20	
	1.50	=		1.80
WALL	12.00 x 2.60	=	31.20	
O/W	SAY	=	1.00	
			36.10	9.90

UDL 2 AS ABOVE		=	36.10	
		=		9.90
LESS WALL		=	-31.20	
ADD WALL	9.25 x 2.60	=	24.05	
			28.95	9.90

FROM GFC/3, PROV. 152UC37

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

MMP DESIGN
Consulting civil and Structural Engineers

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

PROJECT: 31 HEATH DRIVE, NW3			JOB NO. 4467
CALCULATION SHEET	TITLE: BASEMENT		DATE: MAY/15
	BY: SM	CHECKED	SHEET NO. GF/3 · REV

BEAM GB6 - SPAN 2700

TF,SF,FF	3x1.8x0.5 =	2.70		
	1.5 =		8.10	
GF	1.5x1.00 =	1.50		
	1.50 =		2.25	
O/W	SAY =	1.00		
		5.20	10.35	

TF,SF,FF	3x2.5x0.5 =	3.75	
	1.50 =		11.25
GF	1.5x1.00 =	1.50	
	1.50 =		2.25
WALL	12.00x2.60 =	31.20	
O/W	SAY =	1.00	
		37.45	13.50

FROM GFC/4, PROV. 152 UC 37

BEAM GB7 - SPAN 3800

TF,SF,FF	3x5.7x0.5 =	8.55	
	1.5 =		25.65
GF	2.40x1.00 =	2.40	
	1.50 =		3.60
WALL	3.25x4.80 =	15.60	
WALL	6.00x2.60 =	15.60	
O/W	SAY =	1.00	
		43.15	29.25

FROM GFC/5, PROV. 203 UC 86

BEAM GB8 - SPAN 3800

GF	1.00x1.00 =	1.00	
	1.50 =		1.50
O/W	SAY =	0.50	
		1.50	1.50

REACTIONS
DL = 2.9
IL = 2.9

BY INSPECTION, PROV 152 UC 23

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

MMP DESIGN
Consulting Civil and Structural Engineers

Project: 31 HEATH DRIVE, NW3		Job No. 4467	
CALCULATION SHEET	Title: BASEMENT	Date: MAY/15	
	By: SM / Checked:	Sheet No. GF/4	Rev

BEAM GB9 - SPAN 3850

FF	2.00 x 0.50 =	1.00	
	2.50 =		5.00
GF	2.00 x 1.00 =	2.00	
	2.50 =		5.00
WALL	3.25 x 2.60 =	8.45	
o/w	SAY =	0.50	
		11.95	10.00

FROM GFC/6, PROV. 203 UC46

BEAM GB10 - SPAN 2700

TF, SF, FF	3 x 2 x 0.5 =	3.00	
	2.5 =		15.00
GF	3.80 x 1.00 =	3.80	
	2.50 =		9.50
WALL	6.45 x 4.80 =	30.96	
WALL	2.80 x 2.60 =	7.28	
o/w	SAY =	1.00	
		46.04	24.50

POINT LOAD GB9 = 23.0 EXG BM SAY = 16.56 (WALL)
= 19.3

FROM GFC/7, PROV. 203 UC60

BEAM GB11 - SPAN 2600

UDL AS GB10 = 46.04
= 24.50

GF	2.10 x 1.00 =	2.10	
	2.50 =		5.25
o/w	SAY =	1.00	
		3.10	5.25

POINT LOAD GB8 = 2.9 GB7 = 82.0 GB2 = 38.1
= 2.9 = 55.6 = 13.5

FROM GFC/8, PROV. 203 UC86

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

MMP DESIGN
Consulting Civil and Structural Engineers

Project	31 HEATH DRIVE, NW3	Job No.	4467
CALCULATION SHEET	Title: BASEMENT	Date	MAY/15
	By: SM / Checked:	Sheet No.	GF/5

BEAM GB12 - SPAN 2850

TF,SF+FF	1	3x2x0.5	=	3.00	
	1	2.5	=		15.00
GF	1	3.30x1.00	=	3.30	
	1	2.50	=		8.25
WALL	1	9.25x2.60	=	24.05	
O/W	1	SAY	=	1.00	
				31.35	23.25

POINT LOAD GB3 = 17.7
= 4.3

FROM GFC/9, PROV. 203 UC 46

BEAM GB13 - SPAN 2350

GF	1	2.60x1.00	=	2.60	
		1.50	=		3.90
O/W	1	SAY	=	0.50	
				3.10	3.90

BY INSPECTION, PROV. 152 UC 23

(REACTIONS DL = 3.6, IL = 4.6)

BEAM GB14 - SPAN 4100

GF	1	1.90x1.00	=	1.90	
	1	2.50	=		4.75
O/W	1	SAY	=	0.50	
				2.40	4.75

POINT LOAD GC2 = 8.6
= 33.1

FROM GFC/10, PROV. 203 UC 46

BEAM	LHS		RHS	
REF.	DL	IL	DL	IL
GB1	51.2	8.8	51.2	8.8
GB2	38.1	13.5	38.1	13.5
GB3	17.7	4.3	17.7	4.3
GB4	84.3	27.9	94.9	34.4
GB5	39.9	13.4	44.0	13.4
GB6	10.8	14.3	29.0	16.1
GB7	82.0	55.6	82.0	55.6
GB8	2.9	2.9	2.9	2.9
GB9	23.0	19.3	23.0	19.3
GB10	82.9	48.4	79.0	37.0
GB11	86.0	48.3	135.2	77.8
GB12	50.0	34.4	57.1	36.1
GB13	3.6	4.6	3.6	4.6
GB14	7.9	21.0	10.6	31.5

BEAM	LHS		RHS	RHS
REF.	DL	IL	DL	IL
BEAM	LHS		RHS	RHS

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET	Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
	Title: BASEMENT		Date: MAY/15	
	By: SM	Checked:	Sheet No.: GF/7	Rev:

BEAM BEARINGS

Allowable bearing stresses beneath concentrated loads such as beam bearings are;

For existing brickwork, 1.0 N/mm^2 (EXB)

For new 50N brickwork, 3.1 N/mm^2 (NWB)

For new 35N concrete, 5.9 N/mm^2 (CON)

CP = Concrete Padstone; EB = single Engineering Brick; BC = Bearing onto new Concrete.

All loads are un-factored.

BEAM	END	LOAD	TYPE	BEARING
GB1	RH	60.0	CON	100mm BC
GB4	LH	112.2	EXB	203x203 UC46 x 600mm Long
GB5	RH	57.4	CON	100mm BC
GB6	RH	45.1	CON	100mm BC
GB7	LH	137.6	CON	150mm BC
GB8	LH	5.8	CON	100mm BC
GB9	RH	42.3	EXB	250x215x150 CP
GB13	LH	8.2	EXB	EB
	RH	8.2	CON	100mm BC
GB14	LH	28.9	EXB	350x100x150 CP
	RH	42.1	EXB	152x152 UC23 x 350mm Long

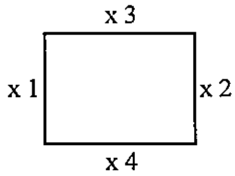
MMP DESIGN

Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
Project	31 HEATH DRIVE, NW3		Job No. 4467	
Title	BASEMENT		Date MAY/15	
By	SM	Checked	Sheet No. GF/8	Rev

BENDING MOMENTS IN NEW COLUMN BC1



Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1	GB4	94.90	34.40
at x2			
at x3			
at x4			
		94.90	34.40

Total Load = **129.30** kN — Enter Column Height = **2.80** m

Total Ultimate Load = **187.90** kN

Total Ultimate Sway (x1-x2) say = **3.32** kN (say 2.5% of Dead Load)

Total Ultimate Sway (x3-x4) say = **0.00** kN

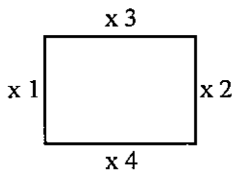
Net DL (x1-x2) = **94.90** kN — Max. LL (x1-x2) = **34.40** kN

Net DL (x3-x4) = **0.00** kN — Max. LL (x3-x4) = **0.00** kN

Total Ultimate Moment (x1-x2) say = **28.09** kN.m

Total Ultimate Moment (x3-x4) say = **0.00** kN.m

BENDING MOMENTS IN NEW COLUMN BC2



Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2	GB5	39.90	13.40
at x3			
at x4			
		39.90	13.40

Total Load = **53.30** kN — Column Height = **2.80** m

Total Ultimate Load = **77.30** kN

Total Ultimate Sway (x1-x2) say = **1.40** kN (say 2.5% of Dead Load)

Total Ultimate Sway (x3-x4) say = **0.00** kN

Net DL (x1-x2) = **39.90** kN — Max. LL (x1-x2) = **13.40** kN

Net DL (x3-x4) = **0.00** kN — Max. LL (x3-x4) = **0.00** kN

Total Ultimate Moment (x1-x2) say = **11.64** kN.m

Total Ultimate Moment (x3-x4) say = **0.00** kN.m

MMP DESIGN
Consulting Civil & Structural Engineers

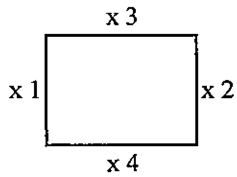
First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET			
Project	31 HEATH DRIVE, NW3	Job No.	4467
Title	BASEMENT	Date	MAY/15
By	SM	Checked	
Sheet No.	GF/9	Rev	

BENDING MOMENTS IN NEW COLUMN BC3

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2			
at x3			
at x4	GB12	57.10	36.10
		57.10	36.10



Total Load = **93.20** kN
Total Ultimate Load = **137.70** kN

Enter Column Height = **2.80** m

Total Ultimate Sway (x1-x2) say = **0.00** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **2.00** kN

Net DL (x1-x2) = **0.00** kN
Net DL (x3-x4) = **57.10** kN

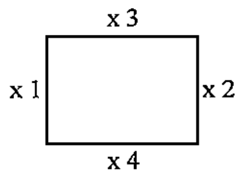
Max. LL (x1-x2) = **0.00** kN
Max. LL (x3-x4) = **36.10** kN

Total Ultimate Moment (x1-x2) say = **0.00** kN.m
Total Ultimate Moment (x3-x4) say = **19.37** kN.m

BENDING MOMENTS IN NEW COLUMN BC4

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2			
at x3	GB12	50.00	34.40
at x4			
		50.00	34.40



Total Load = **84.40** kN
Total Ultimate Load = **125.04** kN

Column Height = **2.80** m

Total Ultimate Sway (x1-x2) say = **0.00** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **1.75** kN

Net DL (x1-x2) = **0.00** kN
Net DL (x3-x4) = **50.00** kN

Max. LL (x1-x2) = **0.00** kN
Max. LL (x3-x4) = **34.40** kN

Total Ultimate Moment (x1-x2) say = **0.00** kN.m
Total Ultimate Moment (x3-x4) say = **17.40** kN.m

MMP DESIGN
Consulting Civil & Structural Engineers

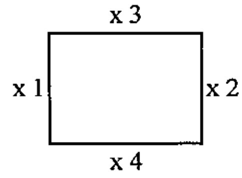
First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET	Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
	Title: BASEMENT		Date: MAY/15	
	By: SM	Checked:	Sheet No.: GF/10	Rev:

BENDING MOMENTS IN NEW COLUMN BC5

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2			
at x3			
at x4	GB11	135.20	77.80
		135.20	77.80



Total Load = **213.00** kN   Enter Column Height = **2.80** m
Total Ultimate Load = **313.76** kN

Total Ultimate Sway (x1-x2) say = **0.00** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **4.73** kN

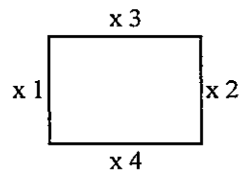
Net DL (x1-x2) = **0.00** kN   Max. LL (x1-x2) = **0.00** kN
Net DL (x3-x4) = **135.20** kN   Max. LL (x3-x4) = **77.80** kN

Total Ultimate Moment (x1-x2) say = **0.00** kN.m
Total Ultimate Moment (x3-x4) say = **44.63** kN.m

BENDING MOMENTS IN NEW COLUMN BC6

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2			
at x3	GB11	86.00	48.30
at x4			
		86.00	48.30



Total Load = **134.30** kN   Column Height = **2.80** m
Total Ultimate Load = **197.68** kN

Total Ultimate Sway (x1-x2) say = **0.00** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **3.01** kN

Net DL (x1-x2) = **0.00** kN   Max. LL (x1-x2) = **0.00** kN
Net DL (x3-x4) = **86.00** kN   Max. LL (x3-x4) = **48.30** kN

Total Ultimate Moment (x1-x2) say = **0.00** kN.m
Total Ultimate Moment (x3-x4) say = **28.20** kN.m

MMP DESIGN
Consulting Civil & Structural Engineers

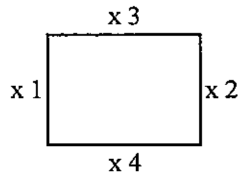
First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET	Project	31 HEATH DRIVE, NW3		Job No.	4467	
	Title	BASEMENT		Date	MAY/15	
	By	SM	Checked	Sheet No.	GF/11	Rev

BENDING MOMENTS IN NEW COLUMN BC7

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2			
at x3			
at x4	GB10	79.00	37.00
		79.00	37.00



Total Load = **116.00** kN Enter Column Height = **2.80** m
Total Ultimate Load = **169.80** kN

Total Ultimate Sway (x1-x2) say = **0.00** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **2.77** kN

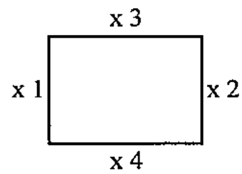
Net DL (x1-x2) = **0.00** kN Max. LL (x1-x2) = **0.00** kN
Net DL (x3-x4) = **79.00** kN Max. LL (x3-x4) = **37.00** kN

Total Ultimate Moment (x1-x2) say = **0.00** kN.m
Total Ultimate Moment (x3-x4) say = **24.72** kN.m

BENDING MOMENTS IN NEW COLUMN BC8

Enter the following:

	Beam Ref;	Char. DL	Char. LL
at x1			
at x2			
at x3	GB10	82.90	48.40
at x4			
		82.90	48.40



Total Load = **131.30** kN Column Height = **2.80** m
Total Ultimate Load = **193.50** kN

Total Ultimate Sway (x1-x2) say = **0.00** kN (say 2.5% of Dead Load)
Total Ultimate Sway (x3-x4) say = **2.90** kN

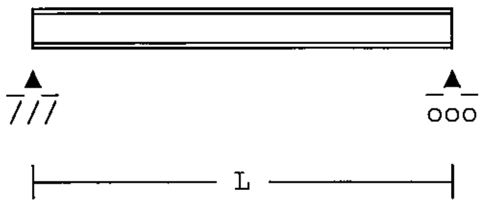
Net DL (x1-x2) = **0.00** kN Max. LL (x1-x2) = **0.00** kN
Net DL (x3-x4) = **82.90** kN Max. LL (x3-x4) = **48.40** kN

Total Ultimate Moment (x1-x2) say = **0.00** kN.m
Total Ultimate Moment (x3-x4) say = **27.47** kN.m

BASEMENT LEVEL COLUMN FORCES (ULTIMATE)

COL REF.	AXIAL LOAD	BENDING MOMENTS		SHEAR FORCES		OFFSET YES/NO	TYPE	REMARKS
		MAJOR AXIS	MINOR AXIS	MAJOR AXIS	MINOR AXIS			
BC1	187.9	0.0	28.1	0.0	3.3	Y	A	200 x 100 x 12.5 RHS
BC2	77.3	0.0	11.6	0.0	1.4	Y	B	150 x 100 x 8 RHS
BC3	137.7	0.0	19.4	0.0	2.0	Y	C	200 x 100 x 8 RHS
BC4	125.0	0.0	17.4	0.0	1.8	Y	C	200 x 100 x 8 RHS
BC5	313.8	0.0	44.6	0.0	4.7	Y	D	200 x 150 x 10 RHS
BC6	197.7	0.0	28.2	0.0	3.0	Y	A	200 x 100 x 12.5 RHS
BC7	169.8	0.0	24.7	0.0	2.8	Y	A	200 x 100 x 12.5 RHS
BC8	193.5	0.0	27.5	0.0	2.9	Y	A	200 x 100 x 12.5 RHS

Location: GROUND FLOOR LEVEL BEAM GB1



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.4 m
203 x 203 x 46 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.4 m
Dead load (unfactored)	Gku(1)=42.64 kN/m
Imposed load (unfactored)	Qku(1)=7.35 kN/m
Maximum span bending moment	51.448 kNm
Design shear force	Fv=85.747 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =230.31 N/mm^2

UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 46 UC Grade S 275

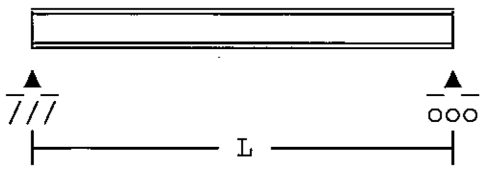
	Maximum shear force	85.747 kN
	Shear capacity	241.4 kN
	Max. applied moment	51.448 kNm
	Moment capacity	136.68 kNm
	Buckling resistance	114.46 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	114.46 kNm
	Unfactored DL defln	1.9662 mm
	Unfactored LL defln	0.33892 mm
	Limiting deflection	6.6667 mm
Unfactored end shears	DL shear at LHE	51.168 kN
	LL shear at LHE	8.82 kN
	DL shear at RHE	51.168 kN
	LL shear at RHE	8.82 kN

No408

Location: GROUND FLOOR LEVEL BEAM GB4

Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.



Beam span	L=3.4 m
203 x 203 x 86 UC.	
Young's Modulus	E=205 kN/mm2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=1.2 m
Dead load (unfactored)	Gkc(1)=38.1 kN
Imposed load (unfactored)	Qkc(1)=13.5 kN
Distance from left support	Lc(2)=1.35 m
Dead load (unfactored)	Gkc(2)=51.2 kN
Imposed load (unfactored)	Qkc(2)=8.8 kN
Distance from left support	Lc(3)=2.65 m
Dead load (unfactored)	Gkc(3)=17.7 kN
Imposed load (unfactored)	Qkc(3)=4.3 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=1.2 m
Dead load (unfactored)	Gku(1)=2.5 kN/m
Imposed load (unfactored)	Qku(1)=2.25 kN/m
Dist. from left support to start	Lau(2)=1.2 m
Distance from left support to end	Lbu(2)=3.4 m
Dead load (unfactored)	Gku(2)=31.45 kN/m
Imposed load (unfactored)	Qku(2)=15.0 kN/m
Maximum span bending moment	200.97 kNm
Design shear force	Fv=187.93 kN
Length of beam between restraints	LT=2.05 m
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =260.67 N/mm2

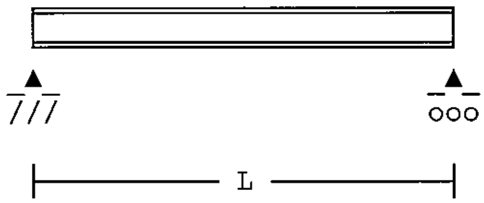
UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 86 UC Grade S 275

	Maximum shear force	187.93 kN
	Shear capacity	448.69 kN
	Max. applied moment	200.97 kNm
	Moment capacity	258.9 kNm
	Buckling resistance	254.68 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	254.68 kNm
	Unfactored DL defln	6.0328 mm
	Unfactored LL defln	1.9996 mm
	Limiting deflection	9.4444 mm
Unfactored end shears	DL shear at LHE	84.284 kN
	LL shear at LHE	27.89 kN
	DL shear at RHE	94.906 kN
	LL shear at RHE	34.41 kN

No408

Location: GROUND FLOOR LEVEL BEAM GB5



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.7 m
152 x 152 x 37 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=1.9 m
Dead load (unfactored)	Gku(1)=28.95 kN/m
Imposed load (unfactored)	Qku(1)=9.9 kN/m
Dist. from left support to start	Lau(2)=1.9 m
Distance from left support to end	Lbu(2)=2.7 m
Dead load (unfactored)	Gku(2)=36.1 kN/m
Imposed load (unfactored)	Qku(2)=9.9 kN/m
Maximum span bending moment	52.969 kNm
Design shear force	Fv=82.921 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =205.81 N/mm^2

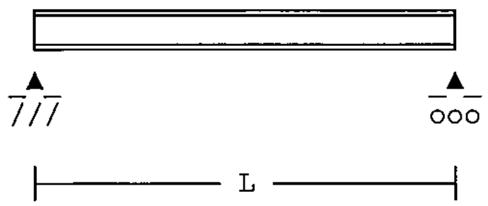
UNIVERSAL COLUMN DESIGN SUMMARY

152 x 152 x 37 UC Grade S 275

	Maximum shear force	82.921 kN
	Shear capacity	213.58 kN
	Max. applied moment	52.969 kNm
	Moment capacity	84.975 kNm
	Buckling resistance	63.595 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	63.595 kNm
	Unfactored DL defln	4.6384 mm
	Unfactored LL defln	1.5121 mm
	Limiting deflection	7.5 mm
Unfactored end shears	DL shear at LHE	39.93 kN
	LL shear at LHE	13.365 kN
	DL shear at RHE	43.955 kN
	LL shear at RHE	13.365 kN

No408

Location: GROUND FLOOR LEVEL BEAM GB6



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.7 m
152 x 152 x 37 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=1.9 m
Dead load (unfactored)	Gku(1)=5.2 kN/m
Imposed load (unfactored)	Qku(1)=10.35 kN/m
Dist. from left support to start	Lau(2)=1.9 m
Distance from left support to end	Lbu(2)=2.7 m
Dead load (unfactored)	Gku(2)=37.45 kN/m
Imposed load (unfactored)	Qku(2)=13.5 kN/m
Maximum span bending moment	30.492 kNm
Design shear force	Fv=66.388 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =205.81 N/mm^2

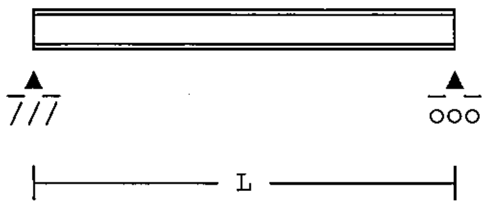
UNIVERSAL COLUMN DESIGN SUMMARY

152 x 152 x 37 UC Grade S 275

	Maximum shear force	66.388	kN
	Shear capacity	213.58	kN
	Max. applied moment	30.492	kNm
	Moment capacity	84.975	kNm
	Buckling resistance	63.595	kNm
	Moment factor (mLT)	1	
	Resistance (Mb/mLT)	63.595	kNm
	Unfactored DL defln	1.7714	mm
	Unfactored LL defln	1.6763	mm
	Limiting deflection	7.5	mm
Unfactored end shears	DL shear at LHE	10.842	kN
	LL shear at LHE	14.346	kN
	DL shear at RHE	28.998	kN
	LL shear at RHE	16.119	kN

No408

Location: GROUND FLOOR LEVEL BEAM GB7



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=3.8 m
203 x 203 x 86 UC.	
Young's Modulus	E=205 kN/mm²
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=3.8 m
Dead load (unfactored)	Gku(1)=43.15 kN/m
Imposed load (unfactored)	Qku(1)=29.25 kN/m
Maximum span bending moment	193.51 kNm
Design shear force	Fv=203.7 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =213.88 N/mm²

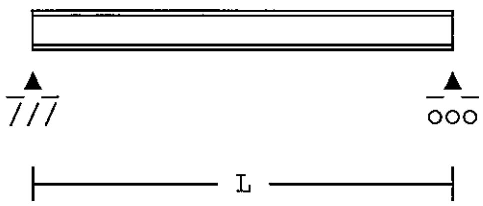
UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 86 UC Grade S 275

	Maximum shear force	203.7 kN
	Shear capacity	448.69 kN
	Max. applied moment	193.51 kNm
	Moment capacity	258.9 kNm
	Buckling resistance	208.96 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	208.96 kNm
	Unfactored DL defln	6.0474 mm
	Unfactored LL defln	4.0993 mm
	Limiting deflection	10.556 mm
Unfactored end shears	DL shear at LHE	81.985 kN
Unfactored end shears	LL shear at LHE	55.575 kN
Unfactored end shears	DL shear at RHE	81.985 kN
Unfactored end shears	LL shear at RHE	55.575 kN

No408

Location: GROUND FLOOR LEVEL BEAM GB9



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=3.85 m
203 x 203 x 46 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=3.85 m
Dead load (unfactored)	Gku(1)=11.95 kN/m
Imposed load (unfactored)	Qku(1)=10.00 kN/m
Maximum span bending moment	60.643 kNm
Design shear force	Fv=63.005 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =182.75 N/mm^2

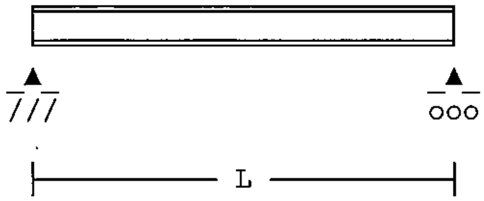
UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 46 UC Grade S 275

	Maximum shear force	63.005 kN
	Shear capacity	241.4 kN
	Max. applied moment	60.643 kNm
	Moment capacity	136.68 kNm
	Buckling resistance	90.829 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	90.829 kNm
	Unfactored DL defln	3.649 mm
	Unfactored LL defln	3.0536 mm
	Limiting deflection	10.694 mm
Unfactored end shears	DL shear at LHE	23.004 kN
	LL shear at LHE	19.25 kN
	DL shear at RHE	23.004 kN
	LL shear at RHE	19.25 kN

No408

Location: GROUND FLOOR LEVEL BEAM GB10



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.7 m
203 x 203 x 60 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=0.55 m
Dead load (unfactored)	Gkc(1)=23.0 kN
Imposed load (unfactored)	Qkc(1)=19.3 kN
Distance from left support	Lc(2)=2.25 m
Dead load (unfactored)	Gkc(2)=14.56 kN
Imposed load (unfactored)	Qkc(2)=0 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.7 m
Dead load (unfactored)	Gku(1)=46.04 kN/m
Imposed load (unfactored)	Qku(1)=24.50 kN/m
Maximum span bending moment	116.79 kNm
Design shear force	Fv=193.56 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =229.37 N/mm^2

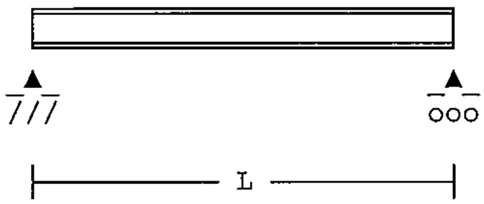
UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 60 UC Grade S 275

	Maximum shear force	193.56 kN
	Shear capacity	325.09 kN
	Max. applied moment	116.79 kNm
	Moment capacity	180.4 kNm
	Buckling resistance	150.47 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	150.47 kNm
	Unfactored DL defln	3.1972 mm
	Unfactored LL defln	1.7127 mm
	Limiting deflection	7.5 mm
Unfactored end shears	DL shear at LHE	82.895 kN
	LL shear at LHE	48.444 kN
	DL shear at RHE	78.973 kN
	LL shear at RHE	37.006 kN

No408

Location: GROUND FLOOR LEVEL BEAM GB11



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

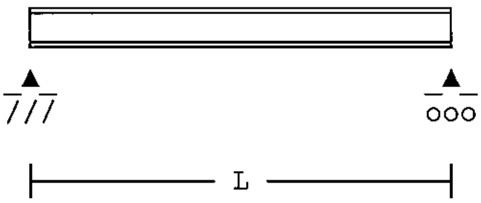
Beam span	L=2.6 m
203 x 203 x 86 UC.	
Young's Modulus	E=205 kN/mm2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=0.85 m
Dead load (unfactored)	Gkc(1)=2.9 kN
Imposed load (unfactored)	Qkc(1)=2.9 kN
Distance from left support	Lc(2)=2.0 m
Dead load (unfactored)	Gkc(2)=82.0 kN
Imposed load (unfactored)	Qkc(2)=55.6 kN
Distance from left support	Lc(3)=2.1 m
Dead load (unfactored)	Gkc(3)=38.1 kN
Imposed load (unfactored)	Qkc(3)=13.5 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.1 m
Dead load (unfactored)	Gku(1)=46.04 kN/m
Imposed load (unfactored)	Qku(1)=24.50 kN/m
Dist. from left support to start	Lau(2)=2.1 m
Distance from left support to end	Lbu(2)=2.6 m
Dead load (unfactored)	Gku(2)=3.1 kN/m
Imposed load (unfactored)	Qku(2)=5.25 kN/m
Maximum span bending moment	179.65 kNm
Design shear force	Fv=313.78 kN
Length of beam between restraints	LT=1.15 m

UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 86 UC Grade S 275

	Maximum shear force	313.78 kN
	Shear capacity	448.69 kN
	Max. applied moment	179.65 kNm
	Moment capacity	252.3 kNm
	Buckling resistance	258.9 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	258.9 kNm
	Unfactored DL defln	2.7378 mm
	Unfactored LL defln	1.5633 mm
	Limiting deflection	7.2222 mm
Unfactored end shears	DL shear at LHE	85.99 kN
	LL shear at LHE	48.303 kN
	DL shear at RHE	135.24 kN
	LL shear at RHE	77.772 kN

Location: GROUND FLOOR LEVEL BEAM GB12



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=2.85 m
203 x 203 x 46 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=2.0 m
Dead load (unfactored)	Gkc(1)=17.7 kN
Imposed load (unfactored)	Qkc(1)=4.3 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=2.85 m
Dead load (unfactored)	Gku(1)=31.35 kN/m
Imposed load (unfactored)	Qku(1)=23.25 kN/m
Maximum span bending moment	96.309 kNm
Design shear force	Fv=137.77 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =257.42 N/mm^2

UNIVERSAL COLUMN DESIGN SUMMARY

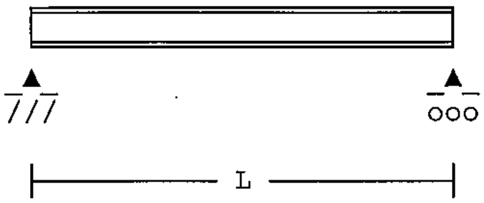
203 x 203 x 46 UC Grade S 275

	Maximum shear force	137.77 kN
	Shear capacity	241.4 kN
	Max. applied moment	96.309 kNm
	Moment capacity	136.68 kNm
	Buckling resistance	127.94 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	127.94 kNm
	Unfactored DL defln	3.5932 mm
	Unfactored LL defln	2.3065 mm
	Limiting deflection	7.9167 mm
Unfactored end shears	DL shear at LHE	49.953 kN
	LL shear at LHE	34.414 kN
	DL shear at RHE	57.095 kN
	LL shear at RHE	36.149 kN

No408

Office: 5831

Location: GROUND FLOOR LEVEL BEAM GB14



Simply supported steel beam

Calculations are in accordance with BS5950-1:2000.

Beam span	L=4.1 m
203 x 203 x 46 UC.	
Young's Modulus	E=205 kN/mm^2
Dead load factor	gamd=1.4
Imposed load factor	gami=1.6
Distance from left support	Lc(1)=2.7 m
Dead load (unfactored)	Gkc(1)=8.6 kN
Imposed load (unfactored)	Qkc(1)=33.1 kN
Dist. from left support to start	Lau(1)=0 m
Distance from left support to end	Lbu(1)=4.1 m
Dead load (unfactored)	Gku(1)=2.4 kN/m
Imposed load (unfactored)	Qku(1)=4.75 kN/m
Maximum span bending moment	80.107 kNm
Design shear force	Fv=65.273 kN
Bending strength	pb=(pey)/(phiLT+((phiLT^2-pey)^0.5)) =175.97 N/mm^2

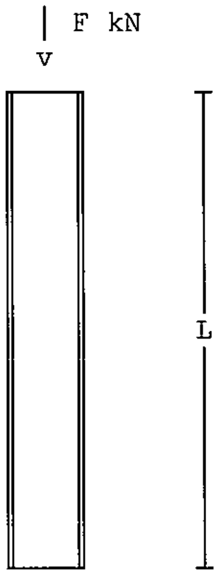
UNIVERSAL COLUMN DESIGN SUMMARY

203 x 203 x 46 UC Grade S 275

	Maximum shear force	65.273 kN
	Shear capacity	241.4 kN
	Max. applied moment	80.107 kNm
	Moment capacity	136.68 kNm
	Buckling resistance	87.455 kNm
	Moment factor (mLT)	1
	Resistance (Mb/mLT)	87.455 kNm
	Unfactored DL defln	2.0829 mm
	Unfactored LL defln	6.2544 mm
	Limiting deflection	11.389 mm
Unfactored end shears	DL shear at LHE	7.8566 kN
	LL shear at LHE	21.04 kN
	DL shear at RHE	10.583 kN
	LL shear at RHE	31.535 kN

No408

Location: BASEMENT LEVEL COLUMNS BC1 & BC6-BC8



SHS column in 'simple' construction

Calculations are in accordance with BS5950 and 'SHS Design Examples to BS5950' published by British Steel General Steels.

The column is part of simple constr -uction and in accordance with 4.7.7 it is not necessary to consider the effect of pattern loading. All beams supported by the column are assumed to be fully loaded.

It is assumed that all elements of the column remain in compression.

Factored axial compressive load	F=197.7 kN
Factored BM about major axis x-x	Mx=0 kNm
Factored BM about minor axis y-y	My=28.2 kNm
Length between restraints	L=2800 mm

200 x 100 x 12.5 RHS - Hot finished.
Properties (cm): A=67.1 rx=6.84 Zx=314 Sx=408 Ix=3140
J=2540 C=341 Zy=201 Sy=245 Iy=1000 ry=3.87
Young's Modulus E=205 kN/mm^2

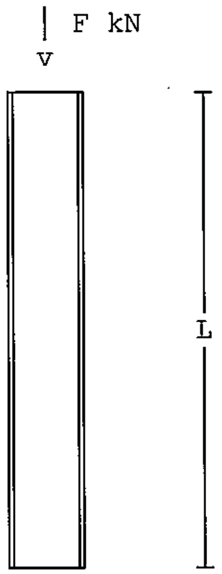
Effective length factor ef=2
Compressive strength pc=pe*py/(phi+(phi^2-pe*py)^0.5)
=85.505 N/mm^2

HOT FINISHED	In accordance with EN 10210
RECTANGULAR HOLLOW SECTION	200 x 100 x 12.5 RHS Grade S 275
SECTION SUMMARY	Section is satisfactory for axial load, buckling resistance and overall buckling check.

DESIGN SUMMARY

Axial compressive load	197.7 kN
Compressive resistance	573.74 kN
Moment about minor axis	28.2 kNm
Minor axis resistance	55.275 kNm
Overall buckling check	0.85476 < 1

Location: BASEMENT LEVEL COLUMN BC2



SHS column in 'simple' construction

Calculations are in accordance with BS5950 and 'SHS Design Examples to BS5950' published by British Steel General Steels.

The column is part of simple constr -uction and in accordance with 4.7.7 it is not necessary to consider the effect of pattern loading. All beams supported by the column are assumed to be fully loaded.

It is assumed that all elements of the column remain in compression.

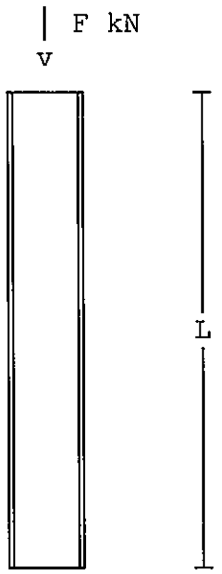
Factored axial compressive load	F=77.3 kN
Factored BM about major axis x-x	Mx=0 kNm
Factored BM about minor axis y-y	My=11.6 kNm
Length between restraints	L=2800 mm

150 x 100 x 8 RHS - Hot finished.
Properties (cm): A=36.8 rx=5.44 Zx=145 Sx=180 Ix=1090
J=1200 C=183 Zy=114 Sy=135 Iy=569 ry=3.94
Young's Modulus E=205 kN/mm^2

Effective length factor ef=2
Compressive strength pc=pe*py/(phi+(phi^2-pe*py)^0.5)
=88.312 N/mm^2

HOT FINISHED	In accordance with EN 10210	
RECTANGULAR HOLLOW SECTION	150 x 100 x 8 RHS Grade S 275	
SECTION SUMMARY	Section is satisfactory for axial load, buckling resistance and overall buckling check.	
DESIGN SUMMARY	Axial compressive load	77.3 kN
	Compressive resistance	324.99 kN
	Moment about minor axis	11.6 kNm
	Minor axis resistance	31.35 kNm
	Overall buckling check	0.60787 < 1

Location: BASEMENT LEVEL COLUMNS BC3 & BC4



SHS column in 'simple' construction

Calculations are in accordance with BS5950 and 'SHS Design Examples to BS5950' published by British Steel General Steels.

The column is part of simple constr -uction and in accordance with 4.7.7 it is not necessary to consider the effect of pattern loading. All beams supported by the column are assumed to be fully loaded.

It is assumed that all elements of the column remain in compression.

Factored axial compressive load	F=137.7 kN
Factored BM about major axis x-x	Mx=0 kNm
Factored BM about minor axis y-y	My=19.4 kNm
Length between restraints	L=2800 mm

200 x 100 x 8 RHS - Hot finished.
Properties (cm): A=44.8 rx=7.06 Zx=223 Sx=282 Ix=2230
J=1800 C=251 Zy=148 Sy=172 Iy=739 ry=4.06
Young's Modulus E=205 kN/mm^2

Effective length factor ef=2
Compressive strength pc=pe*py/(phi+(phi^2-pe*py)^0.5)
=93.183 N/mm^2

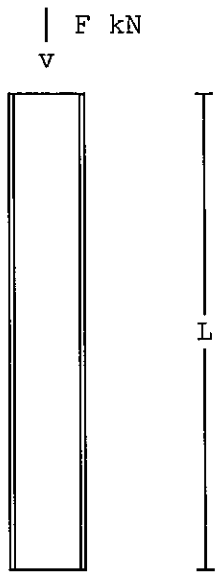
HOT FINISHED
RECTANGULAR HOLLOW SECTION
SECTION
SUMMARY

In accordance with EN 10210
200 x 100 x 8 RHS Grade S 275
Section is satisfactory for axial load, buckling resistance and overall buckling check.

DESIGN
SUMMARY

Axial compressive load	137.7 kN
Compressive resistance	417.46 kN
Moment about minor axis	19.4 kNm
Minor axis resistance	40.7 kNm
Overall buckling check	0.80651 < 1

Location: BASEMENT LEVEL COLUMN BC5



SHS column in 'simple' construction

Calculations are in accordance with BS5950 and 'SHS Design Examples to BS5950' published by British Steel General Steels.

The column is part of simple constr -uction and in accordance with 4.7.7 it is not necessary to consider the effect of pattern loading. All beams supported by the column are assumed to be fully loaded.

It is assumed that all elements of the column remain in compression.

Factored axial compressive load	F=313.8 kN
Factored BM about major axis x-x	Mx=0 kNm
Factored BM about minor axis y-y	My=44.6 kNm
Length between restraints	L=2800 mm

200 x 150 x 10 RHS - Hot finished.
Properties (cm): A=64.9 rx=7.41 Zx=357 Sx=436 Ix=3570
J=4410 C=475 Zy=302 Sy=356 Iy=2260 ry=5.91

Young's Modulus $E=205\ kN/mm^2$

Effective length factor ef=2
Compressive strength pc=pe*py/(phi+(phi^2-pe*py)^0.5)
$=169.32\ N/mm^2$

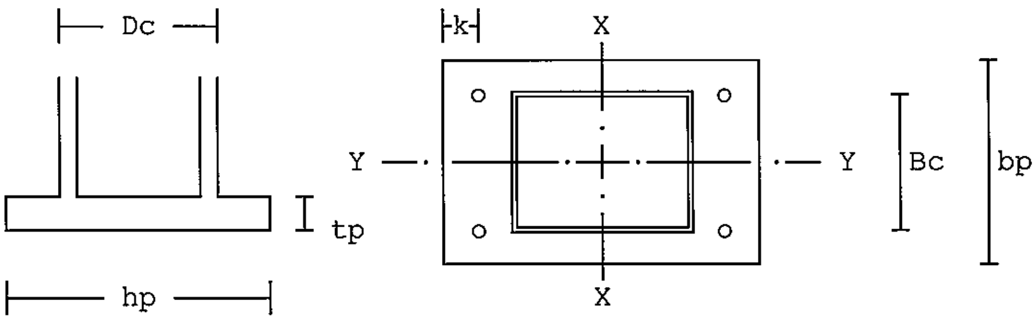
HOT FINISHED	In accordance with EN 10210
RECTANGULAR HOLLOW SECTION	200 x 150 x 10 RHS Grade S 275
SECTION SUMMARY	Section is satisfactory for axial load, buckling resistance and overall buckling check.

DESIGN SUMMARY

Axial compressive load	313.8 kN
Compressive resistance	1098.9 kN
Moment about minor axis	44.6 kNm
Minor axis resistance	83.05 kNm
Overall buckling check	0.82259 < 1

Location: BASEPLATE TO COLUMNS BC1 & BC6-BC8

Calculations are in accordance with 'Joints in Steel Construction Moment Connections' published by The Steel Construction Institute.



ELEVATION PLAN

Axial load (+ve compression) N=197.7 kN
Moment about X-X axis M=28.2 kNm
Shear on the base in Y direction Fy=3.0 kN
200 x 100 x 12.5 RHS - Hot finished.
Properties (cm): A=67.1 rx=6.84 Zx=314 Sx=408 Ix=3140
J=2540 C=341 Zy=201 Sy=245 Iy=1000 ry=3.87
Length of baseplate hp=400 mm
Breadth of baseplate bp=300 mm
Edge distance to bolt centre line k=40 mm
Assumed fillet weld size sw=8 mm

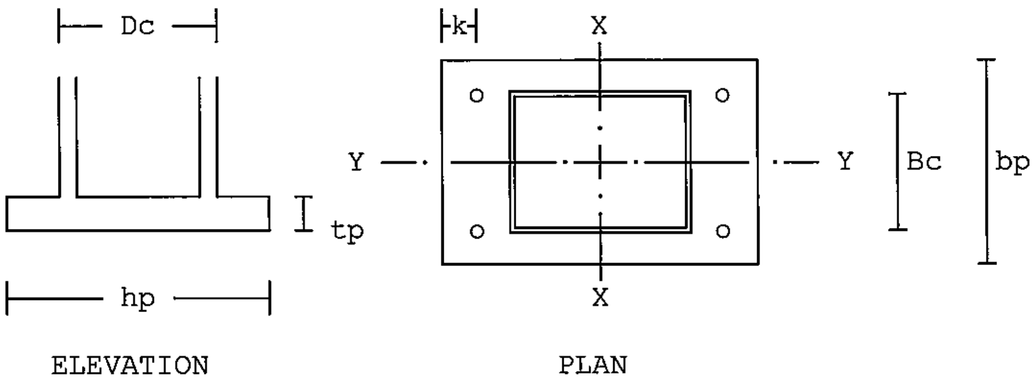
Strength of concrete fcu=35 N/mm2
Special control must be applied over the placing of the high strength bedding material.
Assumed weld size sw=8 mm
Selected baseplate thickness tp=20 mm

Number of bolts to be used n=4
Bolt diameter bd=16 mm
Selected fillet weld size sw=8 mm

SUMMARY		
BASEPLATE	Size 400 mm x 300 mm x 20 mm	
REQUIREMENTS	Grade S 275 steel	
	Edge distance	40 mm
	Number of H.D. bolts	4
	Diameter of bolts	M 16
	Grade 4.6	
	Concrete/grout (fcu)	35 N/mm^2
WELDS	Fillet weld (all round)	8 mm
	Contact areas on the baseplate and column are machined to give a tight bearing contact.	

Location: BASEPLATE TO COLUMN BC2

Calculations are in accordance with 'Joints in Steel Construction Moment Connections' published by The Steel Construction Institute.



Axial load (+ve compression)	N=77.3 kN
Moment about X-X axis	M=11.6 kNm
Shear on the base in Y direction	Fy=1.4 kN

150 x 100 x 8 RHS - Hot finished.
Properties (cm): A=36.8 rx=5.44 Zx=145 Sx=180 Ix=1090
J=1200 C=183 Zy=114 Sy=135 Iy=569 ry=3.94

Length of baseplate	hp=350 mm
Breadth of baseplate	bp=300 mm
Edge distance to bolt centre line	k=40 mm
Assumed fillet weld size	sw=8 mm

Strength of concrete fcu=35 N/mm^2
Special control must be applied over the placing of the high strength bedding material.

Assumed weld size	sw=8 mm
Selected baseplate thickness	tp=18 mm

Number of bolts to be used	n=4
Bolt diameter	bd=16 mm
Selected fillet weld size	sw=8 mm

SUMMARY
BASEPLATE
REQUIREMENTS

Size 350 mm x 300 mm x 18 mm
Grade S 275 steel

Edge distance	40 mm
Number of H.D. bolts	4
Diameter of bolts	M 16
Grade 4.6	
Concrete/grout (fcu)	35 N/mm^2

WELDS

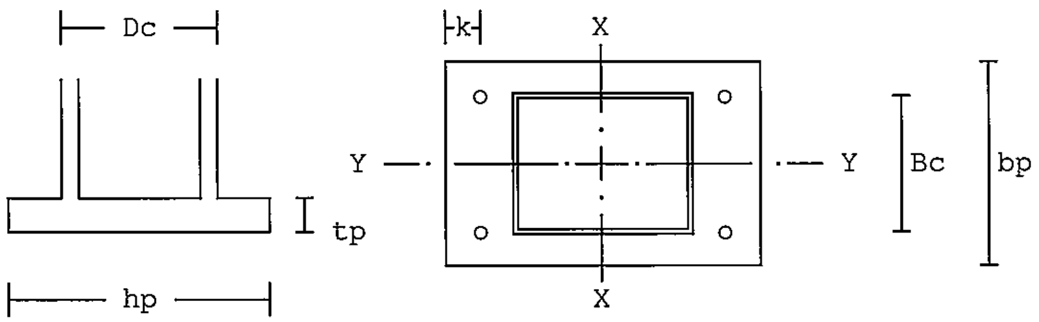
Fillet weld (all round) 8 mm
Contact areas on the baseplate and column are machined to give a tight bearing contact.

No396

Office: 5831

Location: BASEPLATE TO COLUMNS BC3 & BC4

Calculations are in accordance with 'Joints in Steel Construction Moment Connections' published by The Steel Construction Institute.



ELEVATION PLAN

Axial load (+ve compression)	N=137.7 kN
Moment about X-X axis	M=19.4 kNm
Shear on the base in Y direction	Fy=2.0 kN

200 x 100 x 8 RHS - Hot finished.
Properties (cm): A=44.8 rx=7.06 Zx=223 Sx=282 Ix=2230
J=1800 C=251 Zy=148 Sy=172 Iy=739 ry=4.06

Length of baseplate	hp=400 mm
Breadth of baseplate	bp=300 mm
Edge distance to bolt centre line	k=40 mm
Assumed fillet weld size	sw=8 mm

Strength of concrete fcu=35 N/mm^2
Special control must be applied over the placing of the high strength bedding material.

Assumed weld size	sw=8 mm
Selected baseplate thickness	tp=16 mm

Number of bolts to be used	n=4
Bolt diameter	bd=16 mm
Selected fillet weld size	sw=8 mm

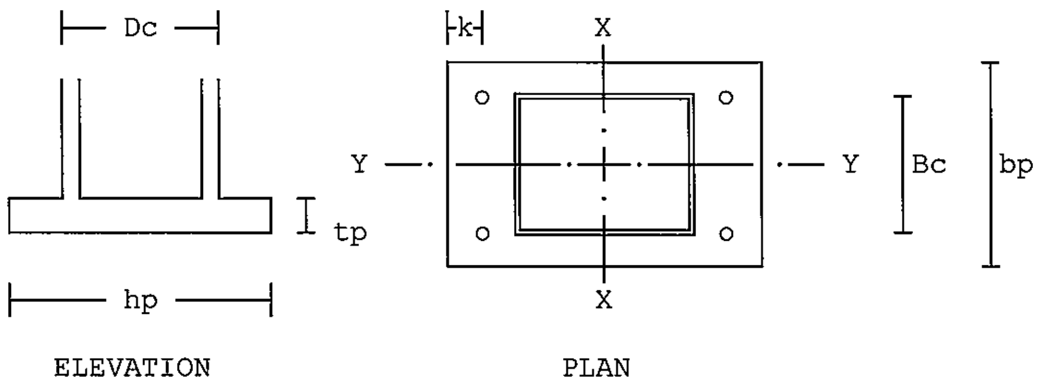
SUMMARY

BASEPLATE REQUIREMENTS	Size 400 mm x 300 mm x 16 mm	
	Grade S 275 steel	
	Edge distance	40 mm
	Number of H.D. bolts	4
	Diameter of bolts	M 16
	Grade 4.6	
	Concrete/grout (fcu)	35 N/mm^2
WELDS	Fillet weld (all round)	8 mm
	Contact areas on the baseplate and column are machined to give a tight bearing contact.	

No396

Location: BASEPLATE TO COLUMN BC5

Calculations are in accordance with 'Joints in Steel Construction Moment Connections' published by The Steel Construction Institute.



Axial load (+ve compression) N=313.8 kN
Moment about X-X axis M=44.6 kNm
Shear on the base in Y direction Fy=4.7 kN
200 x 150 x 10 RHS - Hot finished.
Properties (cm): A=64.9 rx=7.41 Zx=357 Sx=436 Ix=3570
J=4410 C=475 Zy=302 Sy=356 Iy=2260 ry=5.91
Length of baseplate hp=400 mm
Breadth of baseplate bp=350 mm
Edge distance to bolt centre line k=40 mm
Assumed fillet weld size sw=8 mm

Strength of concrete fcu=35 N/mm^2
Special control must be applied over the placing of the high strength bedding material.
Assumed weld size sw=8 mm
Selected baseplate thickness tp=24 mm

Number of bolts to be used n=4
Bolt diameter bd=16 mm
Selected fillet weld size sw=8 mm

SUMMARY

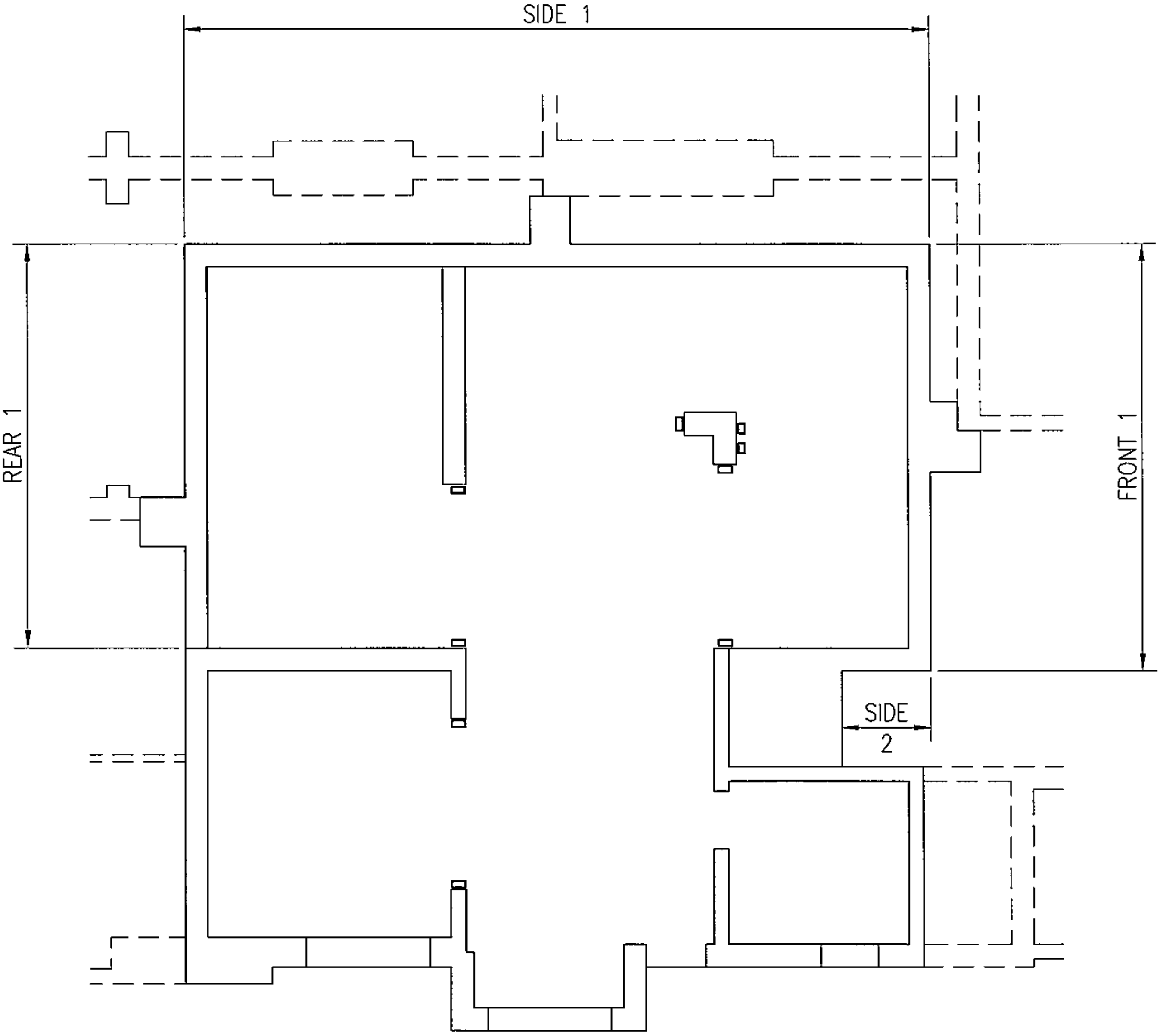
BASEPLATE REQUIREMENTS	Size 400 mm x 350 mm x 24 mm	
	Grade S 275 steel	
	Edge distance	40 mm
	Number of H.D. bolts	4
	Diameter of bolts	M 16
	Grade 4.6	
	Concrete/grout (fcu)	35 N/mm^2
WELDS	Fillet weld (all round)	8 mm
	Contact areas on the baseplate and column are machined to give a tight bearing contact.	

31 HEATH DRIVE, NW3

JOB. 4467

BASEMENT

PAGE. BS/1

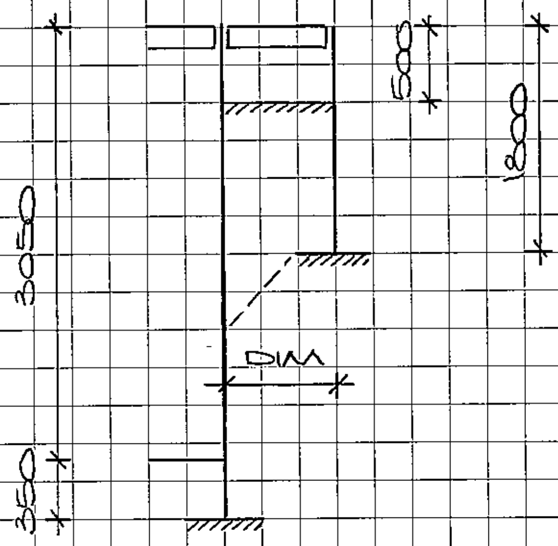


First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH

Tel: 01895 430700
Fax: 01895 430550
www.mmpdesign.co.uk
mail@mmpdesign.co.uk

MMP DESIGN
Consulting Civil and Structural Engineers

Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
CALCULATION SHEET	Title: BASEMENT	Date: MAY/15	
	By: SM / Checked:	Sheet No.: BS/2	Rev:



TYPICAL SECTION

WALL	DIM
REAR 1	2000
SIDE 1	950
FRONT 1	400
SIDE 2	1400

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
Project	31 HEAT DRIVE, NW3		Job No.	4467
Title	BASEMENT		Date	MAY/15
By	SM	Checked	Sheet No.	BS/3 Rev

FOUNDATION LINE LOADS OF EXISTING WALLS TO BE UNDERPINNED/SUPPORTED

WALL	Quantity	Unit load		Line Load		Total
		Dead	Imposed	Dead	Imposed	Load
MAIN PARTY WALL						
Pitched roof	2.00	1.20	0.65	2.40	1.30	3.70
Third floor	4.80	0.50	1.50	2.40	7.20	9.60
Second floor	4.10	0.50	1.50	2.05	6.15	8.20
First floor	4.10	0.50	1.50	2.05	6.15	8.20
Ground floor	4.10	1.00	1.50	4.10	6.15	10.25
First - eaves/roof wall	8.00	4.80	0.00	38.40	0.00	38.40
Foundation - first wall	4.80	7.20	0.00	34.56	0.00	34.56
		TOTALS (kN/m)		**85.96**	**26.95**	**112.91**
		WALL ONLY (kN/m)		**72.96**		
MAIN FRONT WALL						
Pitched roof	3.00	1.20	0.65	3.60	1.95	5.55
Second floor	1.00	0.50	1.50	0.50	1.50	2.00
First floor	2.90	0.50	1.50	1.45	4.35	5.80
Ground floor	2.90	1.00	1.50	2.90	4.35	7.25
First - eaves/roof wall	3.20	4.80	0.00	15.36	0.00	15.36
Foundation - first wall	4.80	7.20	0.00	34.56	0.00	34.56
		TOTALS (kN/m)		**58.37**	**12.15**	**70.52**
		WALL ONLY (kN/m)		**49.92**		
MAIN REAR WALL						
Pitched roof	3.00	1.20	0.65	3.60	1.95	5.55
Second floor	1.00	0.50	1.50	0.50	1.50	2.00
First floor	2.90	0.50	1.50	1.45	4.35	5.80
Ground floor	2.90	1.00	1.50	2.90	4.35	7.25
First - eaves/roof wall	3.20	4.80	0.00	15.36	0.00	15.36
Foundation - first wall	4.80	7.20	0.00	34.56	0.00	34.56
		TOTALS (kN/m)		**58.37**	**12.15**	**70.52**
		WALL ONLY (kN/m)		**49.92**		
INTERNAL ENTRANCE HALL WALL						
Pitched roof	4.00	1.20	0.65	4.80	2.60	7.40
Third floor	2.50	0.50	1.50	1.25	3.75	5.00
Second floor	3.80	0.50	1.50	1.90	5.70	7.60
First floor	3.80	0.50	1.50	1.90	5.70	7.60
Ground floor	3.80	1.00	1.50	3.80	5.70	9.50
First - eaves/roof wall	6.00	2.60	0.00	15.60	0.00	15.60
Foundation - first wall	4.80	4.80	0.00	23.04	0.00	23.04
		TOTALS (kN/m)		**52.29**	**23.45**	**75.74**
		WALL ONLY (kN/m)		**38.64**		

MMP DESIGN

Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
Project	31 HEATH DRIVE, NW3		Job No.	4467
Title	BASEMENT		Date	MAY/15
By	SM	Checked	Sheet No.	BS/4 Rev

MOMENT DUE TO RETAINED SOIL AND WATER - TYPICAL WALL

London Clay density = 18 kN/m^3 and angle of internal friction = 30 °

Hence Ka =	0.333	m	and Dd = dry density
Retained depth (Hr) =	2.90	m	Ds = saturated density
Depth of water (Hw) =	2.10	m	Dw = density of water
Surcharge (W) =	0.00	kN/m^2	

Now calculate the maximum pressures from the retained material;

	At u/s base			At top of base
Pressure due to dry soil, P1 =	4.80	kN/m^2	= Ka x Dd x (Hr - Hw)	4.80
Pressure due to dry soil surcharge, P2 =	4.80	kN/m^2	= Ka x Dd x (Hr - Hw)	4.80
Pressure due to submerged soil, P3 =	5.73	kN/m^2	= Ka x Ds x Hw	4.78
Pressure due to water, P4 =	20.60	kN/m^2	= Dw x Hw	17.17
Pressure due to surcharge, P5 =	0.00	kN/m^2	= Ka x W	0.00

Hence the forces acting on the wall due to the retained pressures are;

Force due to dry soil, F1 =	1.92	kN	= P1 x (Hr - Hw) x 0.5	1.92
Force due to dry soil surcharge, F2 =	10.08	kN	= P2 x Hw	8.40
Force due to submerged soil, F3 =	6.02	kN	= P3 x Hw x 0.5	4.18
Force due to water, F4 =	21.63	kN	= P4 x Hw x 0.5	15.02
Force due to surcharge, F5 =	0.00	kN	= P5 x Hr	0.00

and the overturning moments due to the forces acting on the wall are;

OTM due to dry soil, M1 =	4.54	kN.m	= F1 x (Hw + (Hr - Hw)/3)	3.87
OTM due to dry soil surcharge, M2 =	10.58	kN.m	= F2 x Hw x 0.5	7.35
OTM due to submerged soil, M3 =	4.21	kN.m	= F3 x Hw / 3	2.44
OTM due to water, M4 =	15.14	kN.m	= F4 x Hw / 3	8.76
OTM due to surcharge, M5 =	0.00	kN.m	= F5 x Hr x 0.5	0.00

Therefore, total force due to retained soil and water =	39.65	kN	29.52	kN
and total overturning moment due to retained soil and water =	34.48	kN.m	22.42	kN.m

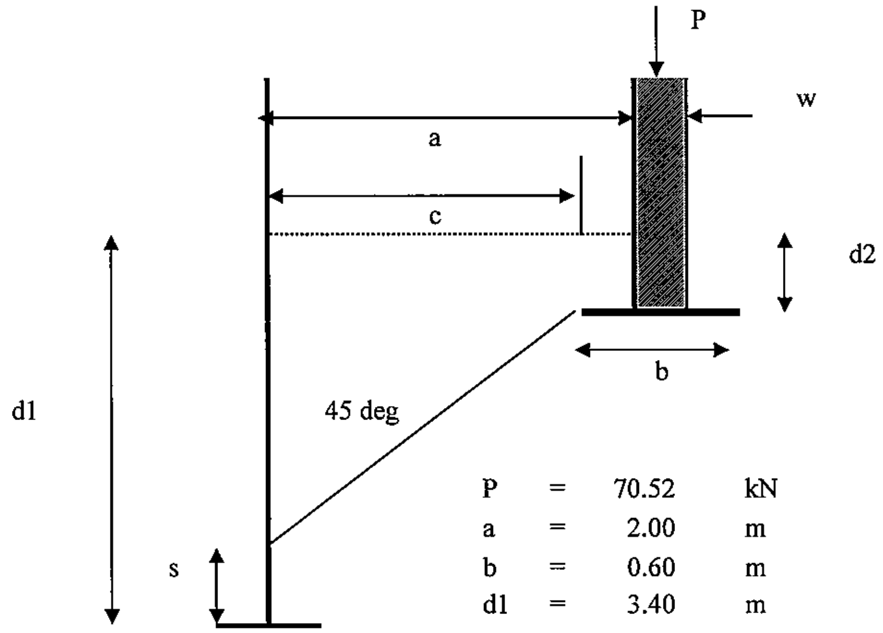
MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
Project	31 HEATH DRIVE, NW3		Job No.	4467
Title	BASEMENT		Date	MAY/15
By	SM	Checked	Sheet No.	BS/5	Rev

OVERTURNING MOMENTS FROM ADJACENT REAR WALL

REAR 1 WALL

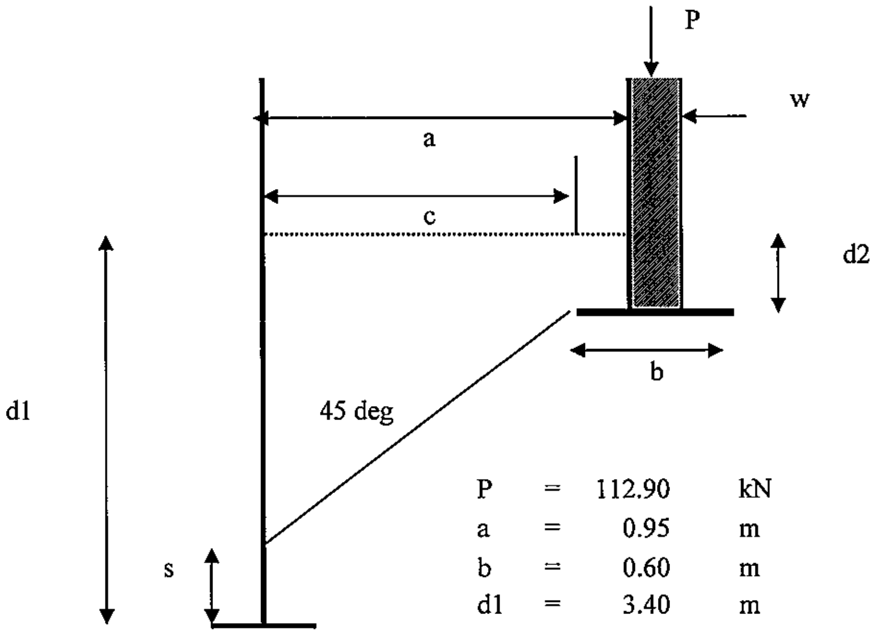


P	=	70.52	kN
a	=	2.00	m
b	=	0.60	m
d1	=	3.40	m
d2	=	1.80	m
w	=	0.33	m
k	=	0.333	
Soil density	=	18.00	kN/m3

	U/S OF BASE		TOP OF BASE	
c = edge of adjacent footing to wall =	1.87	m	1.87	m
Width of load spread at strike level =	4.33	m	4.33	m
s = Height of strike above base of wall =	-0.27	m	-0.62	m
Vertical surcharge pressure at strike level =	16.29	kN/m2	16.29	kN/m2
Horizontal surcharge pressure at strike level =	5.43	kN/m2	5.43	kN/m2
Horizontal force =	0.00	kN	0.00	kN
Lever arm =	-0.13	m	-0.31	m
OTM =	0.00	kNm/m	0.00	kNm/m

OVERTURNING MOMENTS FROM ADJACENT PARTY WALL

SIDE 1 WALL



P	=	112.90	kN
a	=	0.95	m
b	=	0.60	m
d1	=	3.40	m
d2	=	1.80	m
w	=	0.33	m
k	=	0.333	
Soil density	=	18.00	kN/m3

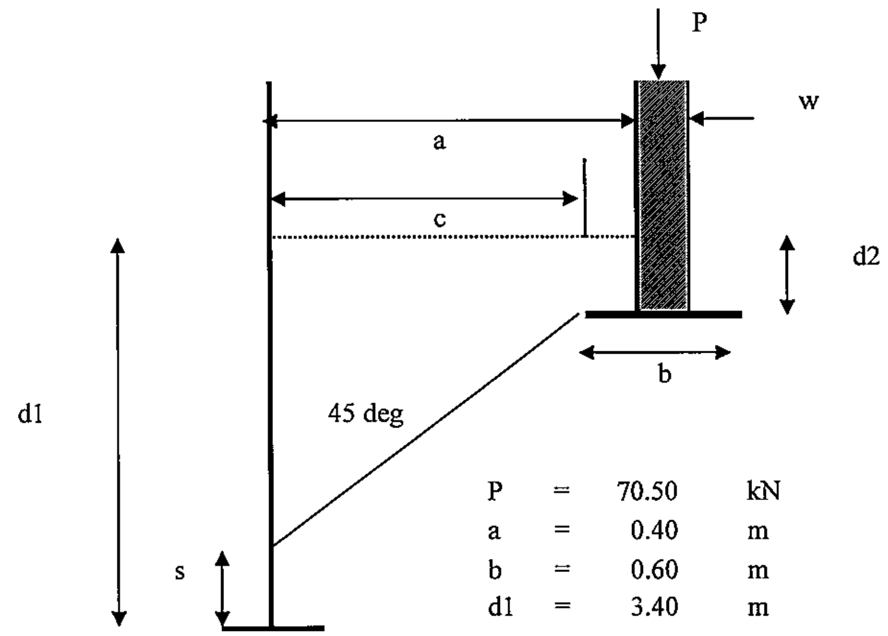
	U/S OF BASE		TOP OF BASE	
c = edge of adjacent footing to wall =	0.82	m	0.82	m
Width of load spread at strike level =	2.23	m	2.23	m
s = Height of strike above base of wall =	0.79	m	0.44	m
Vertical surcharge pressure at strike level =	50.63	kN/m2	50.63	kN/m2
Horizontal surcharge pressure at strike level =	16.88	kN/m2	16.88	kN/m2
Horizontal force =	13.25	kN	7.34	kN
Lever arm =	0.39	m	0.22	m
OTM =	5.20	kNm/m	1.60	kNm/m

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
	Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
	Title: BASEMENT		Date: MAY/15	
	By: SM	Checked:	Sheet No.: BS/7	Rev:

OVERTURNING MOMENTS FROM ADJACENT FRONT WALL

FRONT 1 WALL



P	=	70.50	kN
a	=	0.40	m
b	=	0.60	m
d1	=	3.40	m
d2	=	1.80	m
w	=	0.33	m
k	=	0.333	
Soil density	=	18.00	kN/m3

	U/S OF BASE		TOP OF BASE	
c = edge of adjacent footing to wall =	0.27	m	0.27	m
Width of load spread at strike level =	1.13	m	1.13	m
s = Height of strike above base of wall =	1.34	m	0.99	m
Vertical surcharge pressure at strike level =	62.39	kN/m2	62.39	kN/m2
Horizontal surcharge pressure at strike level =	20.80	kN/m2	20.80	kN/m2
Horizontal force =	27.76	kN	20.48	kN
Lever arm =	0.67	m	0.49	m
OTM =	18.53	kNm/m	10.09	kNm/m

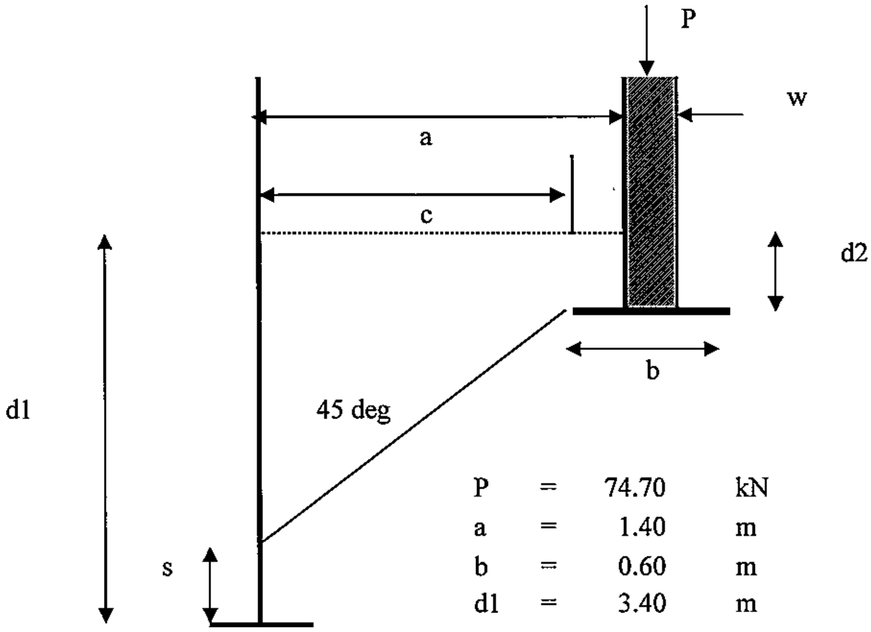
MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET	Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
	Title: BASEMENT		Date: MAY/15	
	By: SM	Checked	Sheet No.: BS/8	Rev

OVERTURNING MOMENTS FROM ADJACENT INTERNAL ENTRANCE HALL WALL

SIDE 2 WALL



P	=	74.70	kN
a	=	1.40	m
b	=	0.60	m
d1	=	3.40	m
d2	=	1.80	m
w	=	0.33	m
k	=	0.333	
Soil density	=	18.00	kN/m3

	U/S OF BASE		TOP OF BASE	
c = edge of adjacent footing to wall =	1.27	m	1.27	m
Width of load spread at strike level =	3.13	m	3.13	m
s = Height of strike above base of wall =	0.34	m	-0.02	m
Vertical surcharge pressure at strike level =	23.87	kN/m2	23.87	kN/m2
Horizontal surcharge pressure at strike level =	7.96	kN/m2	7.96	kN/m2
Horizontal force =	2.67	kN	0.00	kN
Lever arm =	0.17	m	-0.01	m
OTM =	0.45	kNm/m	0.00	kNm/m

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET	Project: 31 HEATH DRIVE, NW3		Job No. 4467	
	Title: BASEMENT		Date: MAY/15	
	By: SM	Checked:	Sheet No. BS/9	Rev:

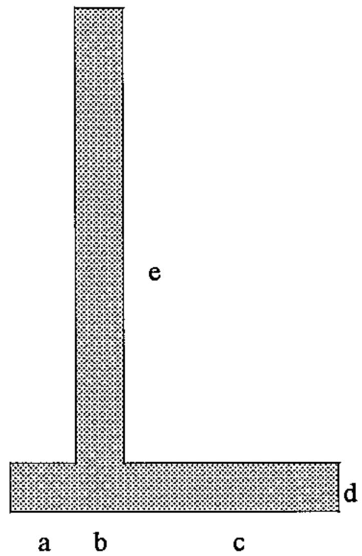
ECCENTRIC BASE DESIGN - SIDE & REAR WALLS

Enter the following:-

Dim. a =	0.000	m	
Dim b =	0.350	m	
Dim c1 =	0.000	m	
Dim c2 =	2.500	m	
Dim c3 =	2.500	m	
Dim d =	0.350	m	
Dim e =	2.850	m	
OTM =	39.70	kN.m	
Load 1 =	0.00	kN/m - maximum vertical load	
Load 2 =	0.00	kN/m - self weight of wall	

Note
Case 1 = maximum load from above, no OTM
Case 2 = Case 1 with OTM added
Case 3 = self weight of wall above with OTM

Take moments about the toe	Case 1	Case 2	Case 3
Retaining wall, stem weight =	23.94	23.94	23.94
Retaining wall, base weight =	2.94	23.94	23.94
Lever arm stem =	0.175	2.675	2.675
Lever arm base =	0.175	1.425	1.425
Lever arm vertical load =	0.175	2.675	2.675
Restoring moment =	4.70	98.15	98.15
Applied OTM =	0.00	-39.70	-39.70
Total vertical load =	**26.88**	**47.88**	**47.88**
Net total moment =	**4.70**	**58.45**	**58.45**



	Case 1	Case 2	Case 3	
Distance to load centroid =	0.175	1.221	1.221	m
Hence, eccentricity =	0.000	0.204	0.204	m
W/A =	76.80	16.80	16.80	kN/m^2
M/Z =	0.00	7.22	7.22	kN/m^2
Hence, max. pressure =	**76.80**	**24.02**	**24.02**	kN/m^2
and min. pressure =	76.80	9.58	9.58	kN/m^2
FoS v overturning =	**N/A**	**2.5**	**2.5**	

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
Project	31 HEATH DRIVE, NW3		Job No.	4467
Title	BASEMENT		Date	MAY/15
By	SM	Checked	Sheet No.	BS/10	Rev

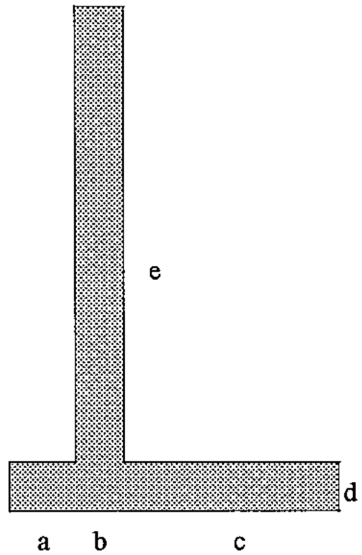
ECCENTRIC BASE DESIGN - FRONT WALL

Enter the following:-

Dim. a =	0.000	m
Dim b =	0.350	m
Dim c1 =	0.000	m
Dim c2 =	3.200	m
Dim c3 =	3.200	m
Dim d =	0.350	m
Dim e =	2.850	m
OTM =	53.00	kN.m
Load 1 =	0.00	kN/m - maximum vertical load
Load 2 =	0.00	kN/m - self weight of wall

Note
Case 1 = maximum load from above, no OTM
Case 2 = Case 1 with OTM added
Case 3 = self weight of wall above with OTM

Take moments about the toe	Case 1	Case 2	Case 3
Retaining wall, stem weight =	23.94	23.94	23.94
Retaining wall, base weight =	2.94	29.82	29.82
Lever arm stem =	0.175	3.375	3.375
Lever arm base =	0.175	1.775	1.775
Lever arm vertical load =	0.175	3.375	3.375
Restoring moment =	4.70	133.73	133.73
Applied OTM =	0.00	-53.00	-53.00
Total vertical load =	**26.88**	**53.76**	**53.76**
Net total moment =	**4.70**	**80.73**	**80.73**



	Case 1	Case 2	Case 3	
Distance to load centroid =	0.175	1.502	1.502	m
Hence, eccentricity =	0.000	0.273	0.273	m
W/A =	76.80	15.14	15.14	kN/m^2
M/Z =	0.00	7.00	7.00	kN/m^2
Hence, max. pressure =	**76.80**	**22.14**	**22.14**	kN/m^2
and min. pressure =	76.80	8.15	8.15	kN/m^2
FoS v overturning =	**N/A**	**2.5**	**2.5**	

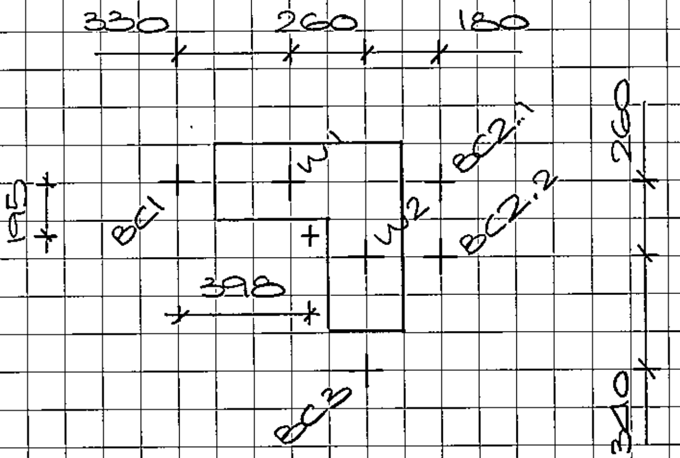
FIRST FLOOR, UNIT 6
UNION PARK
PACKET BOAT LANE
UXBRIDGE UB8 2GH

TEL: 01895 430700
FAX: 01895 430550
WWW.MMPDESIGN.CO.UK
MAIL@MMPDESIGN.CO.UK

MMP DESIGN
CONSULTING CIVIL AND STRUCTURAL ENGINEERS

PROJECT 31 HEATH DRIVE, NW3			JOB NO. 4467	
CALCULATION SHEET	TITLE BASEMENT		DATE MAY/15	
	BY SM	CHECKED	SHEET NO. BS/11	REV

PAD FOUNDATION - BC1 - BC3 + PIER/WALL



BC1 = 129.3

BC2.1 = 53.3

BC2.2 = 25.1

BC3 = 93.2

W_1 = 30.4

W_2 = 34.5

USE BC1 AS ORIGIN ABOUT WHICH TO TAKE MOMENTS.

SEE PAGE BS/12 FOR LOCATION OF CENTROID OF LOAD.

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET

Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
Title: BASEMENT		Date: MAY/15	
By: SM	Checked:	Sheet No.: BS/12	Rev:

LOCATION OF LOAD CENTROID

PAD FOUNDATION FPR COLUMNS BC1-BC3 & PIER/WALL

Enter Foundation Dimensions Length = **5.10** Width = **1.00** Depth = **0.55**

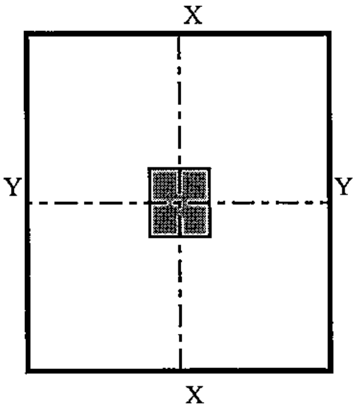
DESCRIPTION	Load	LA x-x	Moment x	Load	LA y-y	Moment y
BC1	129.30	0.000	0.000	129.30	0.000	0.000
BC2.1	53.30	0.770	41.041	53.30	0.000	0.000
BC2.2	25.10	0.770	19.327	25.10	0.260	6.526
BC3	93.20	0.590	54.988	93.20	0.600	55.920
W1	30.40	0.330	10.032	30.40	0.000	0.000
W2	34.50	0.590	20.355	34.50	0.260	8.970
	0.00	0.000	0.000	0.00	0.000	0.000
	0.00	0.000	0.000	0.00	0.000	0.000
	0.00	0.000	0.000	0.00	0.000	0.000
	0.00	0.000	0.000	0.00	0.000	0.000
	0.00	0.000	0.000	0.00	0.000	0.000
	0.00	0.000	0.000	0.00	0.000	0.000
	365.80		**145.743**	**365.80**		**71.416**

Origin to centroid x-x = **0.398** m
Origin to centroid y-y = **0.195** m

MMP DESIGN
Consulting Civil & Structural Engineers

First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550

CALCULATION SHEET				
	Project: 31 HEATH DRIVE, NW3		Job No.: 4467	
	Title: BASEMENT		Date: MAY/15	
	By: SM	Checked:	Sheet No.: BS/13	Rev:



Net allow. bearing pressure = 125 kN/m^2
(Basic allow. bearing pressure of 100 + weight of soil removed)

(All loads characteristic)

COLUMNS BC1-BC3 & WALL/PIER

Vertical Load from post = **365.80** kN
Moment about X-X = **30.97** kN.m
Moment about Y-Y = **13.20** kN.m

Pad width Y to Y =	**2.100** m	Pad area =	4.410 m^2
Pad length X to X =	**2.100** m	Pad modulus about X-X =	1.544 m^3
Pad depth =	**0.550** m	Pad modulus Y-Y =1.544	m^3

Hence weight of base = 58.212 kN

W/A =	96.148		
M/Zxx =	20.065	Hence max. pressure =	124.8 kN/m^2
M/Zyy =	8.552	Min. pressure =	67.5 kN/m^2

COLUMN BC4

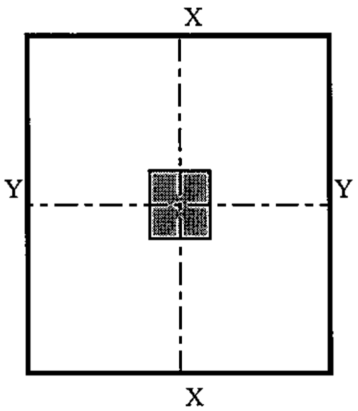
Vertical Load from post = **84.40** kN
Moment about X-X = **0.00** kN.m
Moment about Y-Y = **11.80** kN.m

Pad width Y to Y =	**1.200** m	Pad area =	1.440 m^2
Pad length X to X =	**1.200** m	Pad modulus about X-X =	0.288 m^3
Pad depth =	**0.550** m	Pad modulus Y-Y =0.288	m^3

Hence weight of base = 19.008 kN

W/A =	71.811		
M/Zxx =	0.000	Hence max. pressure =	112.8 kN/m^2
M/Zyy =	40.972	Min. pressure =	30.8 kN/m^2

MMP DESIGN
Consulting Civil & Structural Engineers
First Floor, Unit 6
Union Park
Packet Boat Lane
Uxbridge UB8 2GH
Tel: 01895 430700 Fax: 01895 430550



Net allow. bearing pressure = 125 kN/m²
(Basic allow. bearing pressure of 100 + weight of soil removed)

(All loads characteristic)

COLUMN BC5

Vertical Load from post = 213.00 kN
Moment about X-X = 0.00 kN.m
Moment about Y-Y = 30.35 kN.m

Pad width Y to Y =	1.700 m	Pad area =	2.890 m^2
Pad length X to X =	1.700 m	Pad modulus about X-X =	0.819 m^3
Pad depth =	0.550 m	Pad modulus Y-Y =	0.819 m^3

Hence weight of base = 38.148 kN

W/A =	86.902		
M/Zxx =	0.000	Hence max. pressure =	124.0 kN/m^2
M/Zyy =	37.065	Min. pressure =	49.8 kN/m^2

COLUMN BC6

Vertical Load from post = 134.30 kN
Moment about X-X = 0.00 kN.m
Moment about Y-Y = 19.20 kN.m

Pad width Y to Y =	1.400 m	Pad area =	1.960 m^2
Pad length X to X =	1.400 m	Pad modulus about X-X =	0.457 m^3
Pad depth =	0.550 m	Pad modulus Y-Y =	0.457 m^3

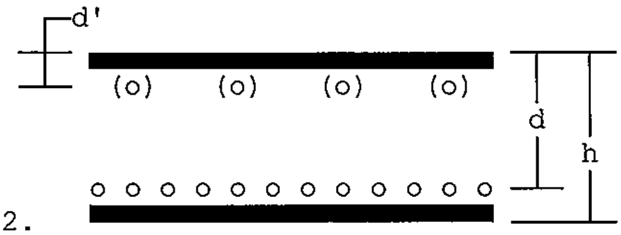
Hence weight of base = 25.872 kN

W/A =	81.720		
M/Zxx =	0.000	Hence max. pressure =	123.7 kN/m^2
M/Zyy =	41.983	Min. pressure =	39.7 kN/m^2

Location: NEW BASEMENT WALLS - CHARACTERISTIC MOMENT < 32.5 kN.m

Bending in solid slabs (with comp.steel if reqd.), designed per metre width, with checks on minimum steel and span/effective-depth ratio

Calculations are based on formulae in Clause 3.4.4.4 of BS8110: Part 1 and thus assume the use of a simplified rectangular concrete stress-block, and that the depth to the neutral axis is restricted to d/2.



Design to BS8110(1997) with partial safety factor for steel gammaS=1.15
Moment before redistribution Mbef=1.4*32.5=45.5 kNm per metre width
Slab containing section being analysed is considered as non-continuous.

Characteristic concrete strength	fcu=35 N/mm^2
Characteristic steel strength	fy=500 N/mm^2
Longitudinal reinforcement is high-yield steel.	
Diameter of tension bars	dia=10 mm
Nominal concrete cover	cover=75 mm
Overall thickness of slab	h=350 mm
Effective depth of section	d=270 mm
Area of tension steel required	As=M*10^6/(z*fy/gammaS) =407.99 mm2/metre width.
Chosen spacing of tension bars	pch=100 mm

TENSION (AND DISTRIBUTION) REINFORCEMENT SUMMARY

Characteristic strength	500 N/mm^2
Diameter of bars	10 mm
Spacing of bars	100 mm
Effective depth	270 mm
Area of steel required	455 mm2/m
Area of steel provided	785 mm2/m
Percentage provided	0.22429 %
Weight of steel provided	6.16 kg/m^2

Check on span/effective-depth ratio

Basic ratio for cantilever slab bs'd=7 (see Table 3.9)
Mod.factor for tension steel modf1=2
Diameter of compression bars diac=10 mm
Spacing of comp.bars provided pchCA=100
Compression steel provided As'pr=1000/pchCA*PI*diac^2/4
=785.4 mm^2 per m
Percentage of compression steel per'=100*As'pr/(1000*d)=0.29089 %
From Equation 9 of BS8110, with percentage of comp.steel=0.29089 %,
Mod.factor for compression steel modf2=1+per'/(3+per')=1.0884
Maximum permissible
span/effective-depth ratio ps'd=bs'd*modf1*modf2=15.237
Effective span of slab span=2.6 m
True span/effective-depth ratio as'd=1000*span/d=9.6296
As this does not exceed 15.237, this is Acceptable.