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Job title	Job number	Sheet number	Revision
ASTOR COLLEGE	6775	16/1	
Calculation/Sketch title	**Date**	**Author**	**Checked**
SOLAR PANELS	JULY 17	JC	

INTRODUCTION

46 NO SOLAR PANELS ARE PROPOSED ON THE ROOF OF THE EXISTING 1960S AND 1970S BLOCKS.

THE LOADING OF THE PANELS IMPOSED ON THE EXISTING ROOF IS CALCULATED BY MICHAEL AUBREY PARTNERSHIP. REFER TO THEIR CALCULATION SHEETS NO'S C3105, 1-13.

THE EXISTING 1970S ROOF IS CONSTRUCTED FROM WOODWOOL SLABS SUPPORTED BY TIMBER JOISTS AND METSEC TRUSSES AS SHOWN IN SECTION 15.

THE WEIGHT OF THE PANELS, ASSOCIATED BALAST AND WIND LOAD EXCEEDS THE GENERAL LOAD CAPACITY OF THE ROOF.

THE FOLLOWING CALCULATIONS PROPOSE AN ARRANGEMENT FOR THE PANELS THAT DOES NOT EXCEED THE CAPACITY OF THE ROOF STRUCTURE. THE ARRANGEMENT DIFFERS FROM THAT PROPOSED BY PHOTON ENERGY, THE PANEL SUPPLIERS

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ASTOR COLLEGE	6775	16/2	
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SOLAR PANELS	JULY 17	JC	

ROOF LOADINGS TO 1960S BUILDING

WIND LOADS

FROM TEDDS

MAX DOWN LOAD = 0.43 kN/m², ZONE D, CASE 4

MAX SUCTION = -1.67 kN/m², ZONE A, CASE 1

SNOW LOADS

FROM TEDDS = 0.27 kN/m²

ACCESS LOADS

0.6 kN/m² WHERE NO ACCESS, ON PANELS OR GUTTERS (ACCESS TO MAINTAIN ONLY)

1.5 kN/m² WHERE ACCESSIBLE

SELF WEIGHT EXCLUDING JOISTS

G_k = 0.5 kN/m² (REFER TO SECTIONS)

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UCL ASTOR COLLEGE	6775	16/3	
Calculation/Sketch title	**Date**	**Author**	**Checked**
SOLAR PANELS	JULY 17	JC	

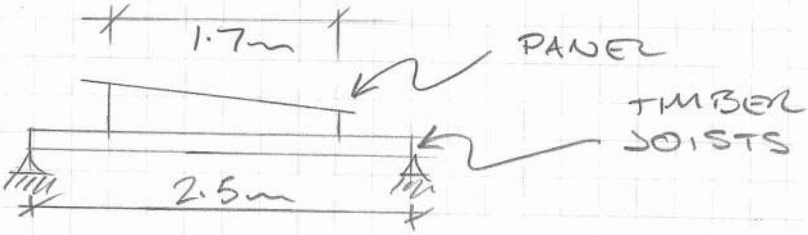
SOLAR PANEL LOADS ON TIMBER ROOF JOISTS

FROM MICHAEL AUBREY CALCULATIONS:

TOTAL SLS DOWN LOAD PER/m^2 ON PANEL
= 2.37 kN/m^2 INCLUDING WIND + BALLAST

PANELS ARE 1.7m LONG x 1.1m WIDE (TRAY SIZE)

PANELS ARE ORIENTATED AS FOLLOWS ON ROOF JOISTS



PANEL LOAD / JOIST, ω_1

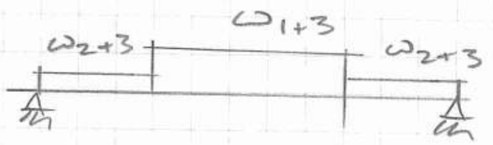
ω_1 = 0.9 x 2.37 = 2.13 kN/m

LOAD TO SIDES OF PANELS, ω_2

Q_{kr} = ACCESS ONLY = 0.6 kN/m^2 x 0.9 = 0.54 kN/m

EXISTING ROOF DEAD LOAD, ω_3

G_{kr} = 0.5 kN/m^2 x 0.9 = 0.45 kN/m



CHECK JOISTS USING TEDDS, SHEET 16/5-6

LOADING CONSIDERED CONSERVATIVELY AS MEDIUM TERM. JOISTS OK

NOW CONSIDER LONG TERM CONDITION

PANEL DEAD LOAD AND ROOF DEAD LOAD ONLY

PANEL LOAD + BALLAST

$= (3 + 0.24)/(1.7 \times 1.1) = 1.73\ kN/m^2$

LOAD/m $= 1.73 \times 0.9 = \underline{1.56}\ kN/m$

CHECK JOISTS USING TEDDS FOR LONG TERM LOADS. JOISTS OK. SHEET 16/7-8.

COMPARE JOIST END REACTION TO UNIFORM IMPOSED LOAD OF $1.5\ kN/m^2$

REACTION FOR $1.5 kN/m^2$ $= (2.5/2) \times (1.5 + 0.7) \times 0.9$

$= 2.5\ kN$

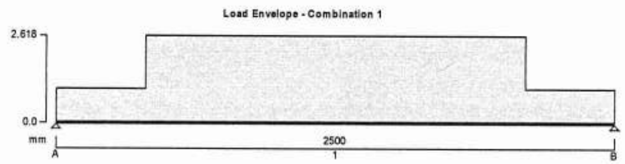
THAT IS COMPARABLE TO THE JOIST REACTION FOR THE PANELS WITH ACCESS ONLY TO THE SIDES = 2.6 kN

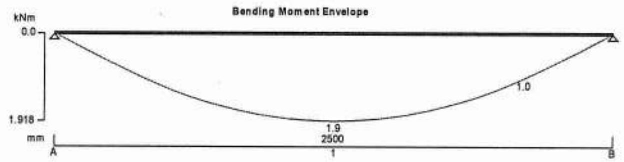
ADOPT $1.5\ kN/m^2$ OK FOR CHECKING THE EDGE TRUSS, WHICH INCLUDES THE GUTTER AND BALUSTRADE.

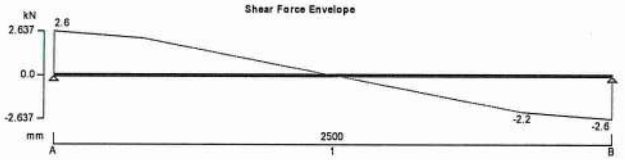
1615

TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002 , MEDIUM TERM

TEDDS calculation version 1.5.07







Applied loading

Beam loads

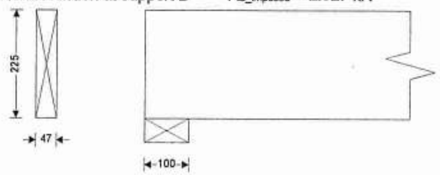
	Dead self weight of beam × 1
w3	Dead full UDL 0.450 kN/m
w1	Imposed partial UDL 2.130 kN/m from 400 mm to 2100 mm
w2	Imposed partial UDL 0.540 kN/m from 0 mm to 400 mm
w2	Imposed partial UDL 0.540 kN/m from 2100 mm to 2500 mm

Load combinations

Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00

Analysis results

Maximum moment	M_{max} = **1.918** kNm	M_{min} = **0.000** kNm
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **1.918** kNm	
Maximum shear	F_{max} = **2.637** kN	F_{min} = **-2.637** kN
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **2.637** kN	
Total load on beam	W_{tot} = **5.274** kN	
Reactions at support A	R_{A_max} = **2.637** kN	R_{A_min} = **2.637** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **0.610** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **2.027** kN	
Reactions at support B	R_{B_max} = **2.637** kN	R_{B_min} = **2.637** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **0.610** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **2.027** kN	



Timber section details

Breadth of sections	b = **47** mm
Depth of sections	h = **225** mm
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **47** mm
Timber strength class	**C16**

Member details

Service class of timber	**1**
Load duration	**Medium term**
Length of bearing	L_b = **100** mm

Section properties

Cross sectional area of member	A = N × b × h = **10575** mm^2
Section modulus	Z_x = N × b × h^2 / 6 = **396563** mm^3
	Z_y = h × (N × b)^2 / 6 = **82838** mm^3
Second moment of area	I_x = N × b × h^3 / 12 = **44613281** mm^4
	I_y = h × (N × b)^3 / 12 = **1946681** mm^4
Radius of gyration	i_x = √(I_x / A) = **65.0** mm
	i_y = √(I_y / A) = **13.6** mm

Modification factors

Duration of loading - Table 17	K_3 = **1.25**
Bearing stress - Table 18	K_4 = **1.00**
Total depth of member - cl.2.10.6	K_7 = (300 mm / h)$^{0.11}$ = **1.03**
Load sharing - cl.2.9	K_8 = **1.00**

Lateral support - cl.2.10.8

No lateral support

Permissible depth-to-breadth ratio - Table 19 **2.00**

Actual depth-to-breadth ratio $h / (N \times b) = \mathbf{4.79}$

FAIL - Lateral support is inadequate

Compression perpendicular to grain

Permissible bearing stress (no wane) $\sigma_{c\_adm} = \sigma_{cp1} \times K_3 \times K_4 \times K_8 = \mathbf{2.750}$ N/mm²

Applied bearing stress $\sigma_{c\_a} = R_{B\_max} / (N \times b \times L_b) = \mathbf{0.561}$ N/mm²

$\sigma_{c\_a} / \sigma_{c\_adm} = \mathbf{0.204}$

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress $\sigma_{m\_adm} = \sigma_m \times K_3 \times K_7 \times K_8 = \mathbf{6.838}$ N/mm²

Applied bending stress $\sigma_{m\_a} = M / Z_x = \mathbf{4.838}$ N/mm²

$\sigma_{m\_a} / \sigma_{m\_adm} = \mathbf{0.707}$

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress $\tau_{adm} = \tau \times K_3 \times K_8 = \mathbf{0.838}$ N/mm²

Applied shear stress $\tau_a = 3 \times F / (2 \times A) = \mathbf{0.374}$ N/mm²

$\tau_a / \tau_{adm} = \mathbf{0.447}$

PASS - Applied shear stress is less than permissible shear stress

Deflection

Modulus of elasticity for deflection $E = E_{min} = \mathbf{5800}$ N/mm²

Permissible deflection $\delta_{adm} = \min(14 \text{ mm}, 0.003 \times L_{s1}) = \mathbf{7.500}$ mm

Bending deflection $\delta_{b\_s1} = \mathbf{4.769}$ mm

Shear deflection $\delta_{v\_s1} = \mathbf{0.601}$ mm

Total deflection $\delta_a = \delta_{b\_s1} + \delta_{v\_s1} = \mathbf{5.370}$ mm

$\delta_a / \delta_{adm} = \mathbf{0.716}$

PASS - Total deflection is less than permissible deflection

16/6

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Job title	Job number	Sheet number	Revision
UCL ASTOR COLLEGE	6775	16/7	
Calculation/Sketch title	**Date**	**Author**	**Checked**
SOLAR PANELS	JULY 17	JC	

EXISTING TRUSSES

THERE ARE TWO TRUSS TYPES:

- EDGE TRUSS BETWEEN GRIDS G AND F
- CENTRAL TRUSSES BETWEEN ON GRIDS E AND D

EACH TRUSS TYPE IS CHECKED FOR THE PROPOSED LOAD

THE TRUSSES HAVE BEEN MEASURED ON SITE AND APPEAR TO BE, BASED ON DATA SHEETS 16/13 TO 19 FROM METSEC, AS FOLLOWS

- EDGE TRUSS, TYPE 1W 14, 356 DEEP

  MOMENT CAPACITY = 29 kNm

  PERMISSIBLE LINE LOAD = 5 kN/m FOR A 6.5 m SPAN

- CENTRAL TRUSS, TYPE 1W 16

  MOMENT CAPACITY = 34 kNm

  PERMISSIBLE LINE LOAD = 6.3 kN/m FOR A 6.5 m SPAN

EDGE TRUSS CHECK

LOAD BASED ON ALL $Q_K = 1.5 kN/m^2$
> PANEL LOAD WITH ACCESS ONLY TO SIDES

$= (0.7 + 1.5) \times (2.5/2 + 0.8/2)$

$= 3.6 kN/m$

$M = 3.6 \times 6.1m^2 / 8 = 16.7 kNm < 29 kNm$

$\omega = 3.6 kN/m < 5 kN/m$

CENTRAL TRUSS CHECK

BASED ON PANEL LOAD WITH $1.5 kN/m^2$ ON CANTILEVER JOIST REACTION FROM TEDDS, SHEET 9.1 - 9.2

$= 5.9 kN / JOIST$ OR $6.55 kN/m$

$M = 6.55 \times 6.1m^2 / 8 = 30.5 kNm < 34 kNm$

$\omega = 6.55 kN/m > 6.3 kN/m$ FOR A 6.5m SPAN BUT SPAN IS 6.1m SO OK AS CAPACITY AT 6.0m IS 7.37 kN/m

SO TRUSSES ARE ADEQUATE BUT HEAVILY LOADED

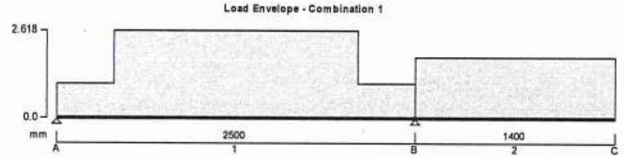
RECOMMEND INCREASING SPACING TO 1.5m TO REDUCE LOAD ON TRUSSES BY CIRCA 20%.

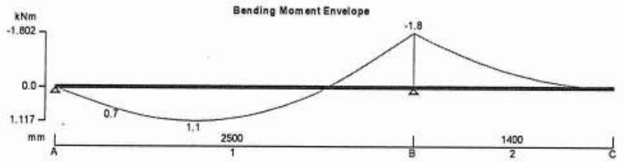
TEKLA Tedds MBP 105-109 Strand London WC2R0AA	Project				Job Ref.	
	Section				Sheet no./rev. 1	
	Calc. by J	Date 07/07/2017	Chk'd by	Date	App'd by	Date

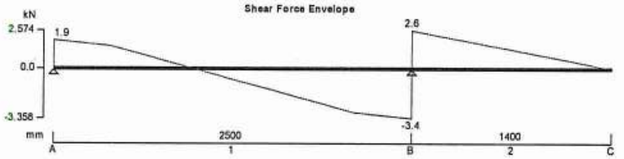
TIMBER BEAM ANALYSIS & DESIGN TO BS5268-2:2002

LOADS ONTO CENTRAL TRUSS

TEDDS calculation version 1.5.07







Applied loading

Beam loads

	Dead self weight of beam × 1
w3	Dead full UDL 0.450 kN/m
w1	Imposed partial UDL 2.130 kN/m from 400 mm to 2100 mm
w2	Imposed partial UDL 0.540 kN/m from 0 mm to 400 mm
w2	Imposed partial UDL 0.540 kN/m from 2100 mm to 2500 mm
w4	Imposed partial UDL 1.350 kN/m from 2500 mm to 3900 mm

Load combinations

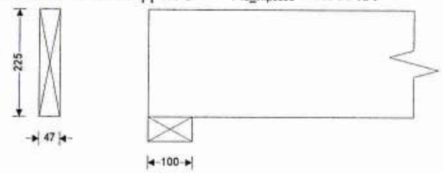
Load combination 1	Support A	Dead × 1.00
		Imposed × 1.00
	Span 1	Dead × 1.00
		Imposed × 1.00
	Support B	Dead × 1.00
		Imposed × 1.00

TEKLA Tedds MBP 105-109 Strand London WC2R0AA	Project				Job Ref.	
	Section				Sheet no./rev. 2	
	Calc. by J	Date 07/07/2017	Chk'd by	Date	App'd by	Date

Span 2	Dead × 1.00
	Imposed × 1.00
Support C	Dead × 1.00
	Imposed × 1.00

Analysis results

Maximum moment	M_{max} = **1.117** kNm	M_{min} = **-1.802** kNm
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **1.802** kNm	
Maximum shear	F_{max} = **2.574** kN	F_{min} = **-3.358** kN
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **3.358** kN	
Total load on beam	W_{tot} = **7.848** kN	
Reactions at support A	R_{A_max} = **1.916** kN	R_{A_min} = **1.916** kN
Unfactored dead load reaction at support A	R_{A_Dead} = **0.419** kN	
Unfactored imposed load reaction at support A	$R_{A\_Imposed}$ = **1.497** kN	
Reactions at support B	R_{B_max} = **5.931** kN	R_{B_min} = **5.931** kN
Unfactored dead load reaction at support B	R_{B_Dead} = **1.486** kN	
Unfactored imposed load reaction at support B	$R_{B\_Imposed}$ = **4.446** kN	
Reactions at support C	R_{C_max} = **0.000** kN	R_{C_min} = **0.000** kN
Unfactored dead load reaction at support C	R_{C_Dead} = **0.000** kN	
Unfactored imposed load reaction at support C	$R_{C\_Imposed}$ = **0.000** kN	



Timber section details

Breadth of sections	b = **47** mm
Depth of sections	h = **225** mm
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **47** mm
Timber strength class	**C16**

Member details

Service class of timber	**1**
Load duration	**Medium term**
Length of bearing	L_b = **100** mm

Section properties

Cross sectional area of member	A = N × b × h = **10575** mm²
Section modulus	$Z_x = N \times b \times h^2 / 6$ = **396563** mm³
	$Z_y = h \times (N \times b)^2 / 6$ = **82838** mm³
Second moment of area	$I_x = N \times b \times h^3 / 12$ = **44613281** mm⁴
	$I_y = h \times (N \times b)^3 / 12$ = **1946681** mm⁴
Radius of gyration	$i_x = \sqrt{(I_x / A)}$ = **65.0** mm

1619.1

$i_y = \sqrt{(I_y / A)} = \mathbf{13.6}$ mm

Modification factors

Duration of loading - Table 17	$K_3 = \mathbf{1.25}$
Bearing stress - Table 18	$K_4 = \mathbf{1.10}$
Total depth of member - cl.2.10.6	$K_7 = (300 \text{ mm} / h)^{0.11} = \mathbf{1.03}$
Load sharing - cl.2.9	$K_8 = \mathbf{1.00}$

Lateral support - cl.2.10.8

No lateral support

Permissible depth-to-breadth ratio - Table 19	**2.00**
Actual depth-to-breadth ratio	$h / (N \times b) = \mathbf{4.79}$

FAIL - Lateral support is inadequate

Compression perpendicular to grain

Permissible bearing stress (no wane)	$\sigma_{c\_adm} = \sigma_{cp1} \times K_3 \times K_4 \times K_8 = \mathbf{3.025}$ N/mm^2
Applied bearing stress	$\sigma_{c\_a} = R_{B\_max} / (N \times b \times L_b) = \mathbf{1.262}$ N/mm^2

$\sigma_{c\_a} / \sigma_{c\_adm} = \mathbf{0.417}$

PASS - Applied compressive stress is less than permissible compressive stress at bearing

Bending parallel to grain

Permissible bending stress	$\sigma_{m\_adm} = \sigma_m \times K_3 \times K_7 \times K_8 = \mathbf{6.838}$ N/mm^2
Applied bending stress	$\sigma_{m\_a} = M / Z_x = \mathbf{4.543}$ N/mm^2

$\sigma_{m\_a} / \sigma_{m\_adm} = \mathbf{0.664}$

PASS - Applied bending stress is less than permissible bending stress

Shear parallel to grain

Permissible shear stress	$\tau_{adm} = \tau \times K_3 \times K_8 = \mathbf{0.838}$ N/mm^2
Applied shear stress	$\tau_a = 3 \times F / (2 \times A) = \mathbf{0.476}$ N/mm^2

$\tau_a / \tau_{adm} = \mathbf{0.569}$

PASS - Applied shear stress is less than permissible shear stress

Deflection

Modulus of elasticity for deflection	$E = E_{min} = \mathbf{5800}$ N/mm^2
Permissible deflection	$\delta_{adm} = \min(14 \text{ mm}, 0.003 \times L_{s2}) = \mathbf{4.200}$ mm
Bending deflection	$\delta_{b\_s2} = \mathbf{3.080}$ mm
Shear deflection	$\delta_{v\_s2} = \mathbf{0.000}$ mm
Total deflection	$\delta_a = \delta_{b\_s2} + \delta_{v\_s2} = \mathbf{3.080}$ mm

$\delta_a / \delta_{adm} = \mathbf{0.733}$

PASS - Total deflection is less than permissible deflection

1619.2

CONCLUSION

THE PROPOSED PANEL ARRANGEMENT IS SHOWN ON THE FOLLOWING SHEETS, 11-12

THE ARRANGEMENT IS TO BE FINALISED, BUT AIMS TO LIMIT THE LOADS ON THE ROOF TRUSSES BY SPACING THEM AT 1.5m C/C AS OPPOSED TO 1.1m C/C ASSUMED IN THE DESIGN

PANELS ARE ALSO PERMITTED ON THE CENTRAL PART OF THE 1960'S ROOF WHICH IS AN R.C SLAB. THE OUTER PART BETWEEN GRIDS 18 TO 19 AND 20 TO 21 IS NOT TO BE LOADED AS THESE SLABS ARE CANTILEVER STRUCTURES OR SUPPORTED BY CANTILEVERS.

TIMBER BLOCKING IS PROPROSED BELOW THE PANELS TO STRENGTHEN THE WOOD WOOL SLABS AND PROVIDE LATERAL RESTRAINT TO THE JOISTS.

16/11

SOLAR PANELS

PANELS TO BE IN SINGLE ROWS, MAXIMUM NO OF PANELS PER ZONE IS AS FOLLOWS:

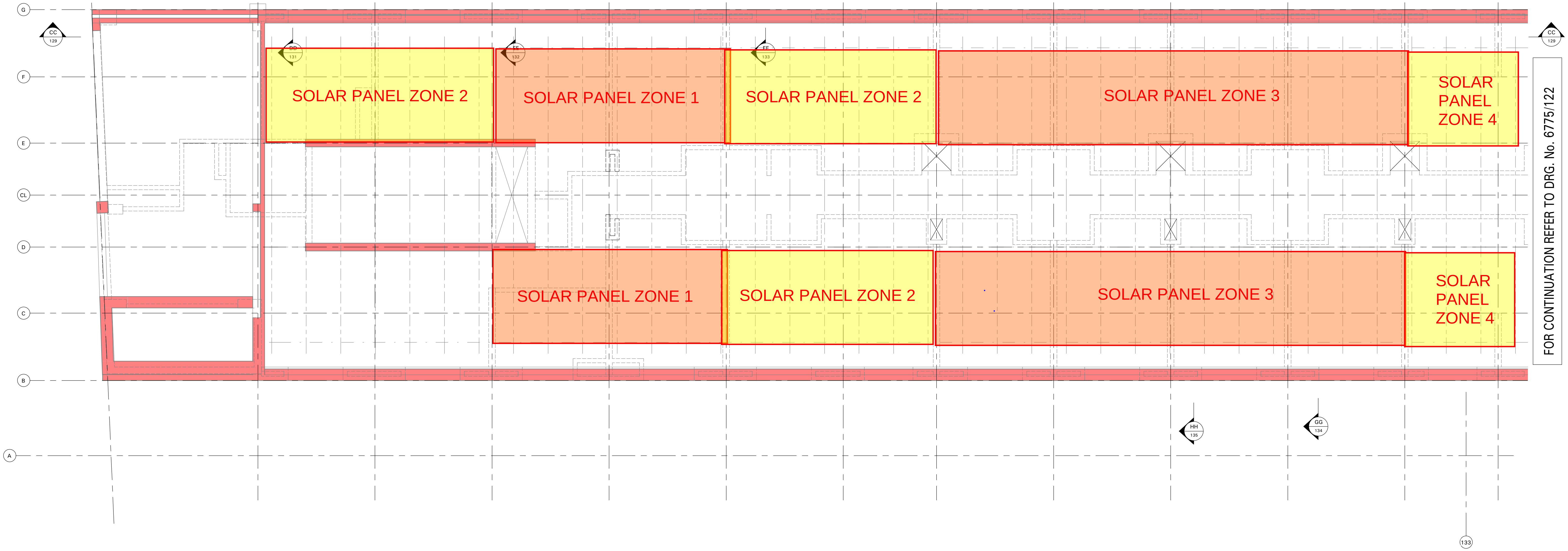
ZONE 1. 4 AT 1.5M C/C
ZONE 2. 4 AT 1.5M C/C
ZONE 3. 8 AT 1.5M C/C
ZONE 4. 2 AT 1.5M C/C
ZONE 5 4 EQUALLY SPACED SAY AT 1.5 M C/C
TOTAL PERMITTED = 32+28+8 = 68
TOTAL REQUIRED = 46

THE LAYOUT SHOWN IS NOT A CONSTRUCTION DRAWING AND IS FOR INFORMATION ONLY

CONTRACTOR TO SUBMIT CO-ORDINATED ROOF PLAN SHOWING LAYOUT OF ALL PLANT, WALKWAYS, GUARDINGS ETC AND ASSOCIATED LOADS.

NOTES FOR CONTRACTOR

1. ADDITIONAL TIMBER BLOCKING 150 DEEP X 50 WIDE TO BE INSTALLED BELOW EDGES AND CENTRE OF SOLAR PANELS TO SUPPORT THE EXISTING WOODWOOL SLAB. BLOCKING TO BE IN THREE ROWS PER PANEL FIXED TIGHT BETWEEN THE EXISTING TIMBER JOISTS. BLOCKING TO BE FIXED WITH PAIRS OF SIMPSON A35 FRAMING ANGLES TO THE EXISTING JOISTS IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.



FOR CONTINUATION REFER TO DRG. No. 6775/122

NOTES:

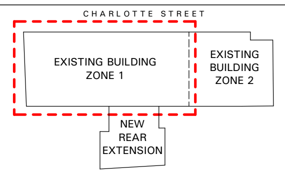
1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.

2. FOR SETTING OUT REFER TO ARCHITECT'S DRAWINGS.

3. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS NOTED OTHERWISE.

4. DO NOT SCALE FROM THE DRAWING OR THE COMPUTER DIGITAL DATA. ONLY FIGURED DIMENSIONS TO BE USED.

5. REFER TO ZONE 2 DRAWING FOR LEGEND AND SCHEDULES.



KEY PLAN

09/12/2016 16:15:49

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Rev	Date	Description	By
C2	09/12/16	AREA BETWEEN GRIDLINES "B" TO "G" AND "6" TO "14" ISSUED FOR CONSTRUCTION AT 1st FLOOR AND ABOVE	JL
C1	25/11/16	AREA BETWEEN GRIDLINES "B" TO "G" AND "6" TO "14" ISSUED FOR CONSTRUCTION AT 1st FLOOR AND ABOVE	JL
T3	01/11/16	ISSUED FOR TENDER	JL
T2	14/09/16	ISSUED FOR TENDER	JL

Job
Astor College, UCL
Charlotte Street, W1T 4QB

Drawing Status
CONSTRUCTION

Title
EIGHTH FLOOR PLAN
EXISTING BUILDING - PROPOSED
ZONE 1

Scale @ A1	Date	By	Checked
1 : 50	06/2016	JL	JC

Drawing Number: 6775 / 121
Revision: C2

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16/12

SOLAR PANELS

PANELS TO BE IN SINGLE ROWS, MAXIMUM NO OF PANELS PER ZONE IS AS FOLLOWS:

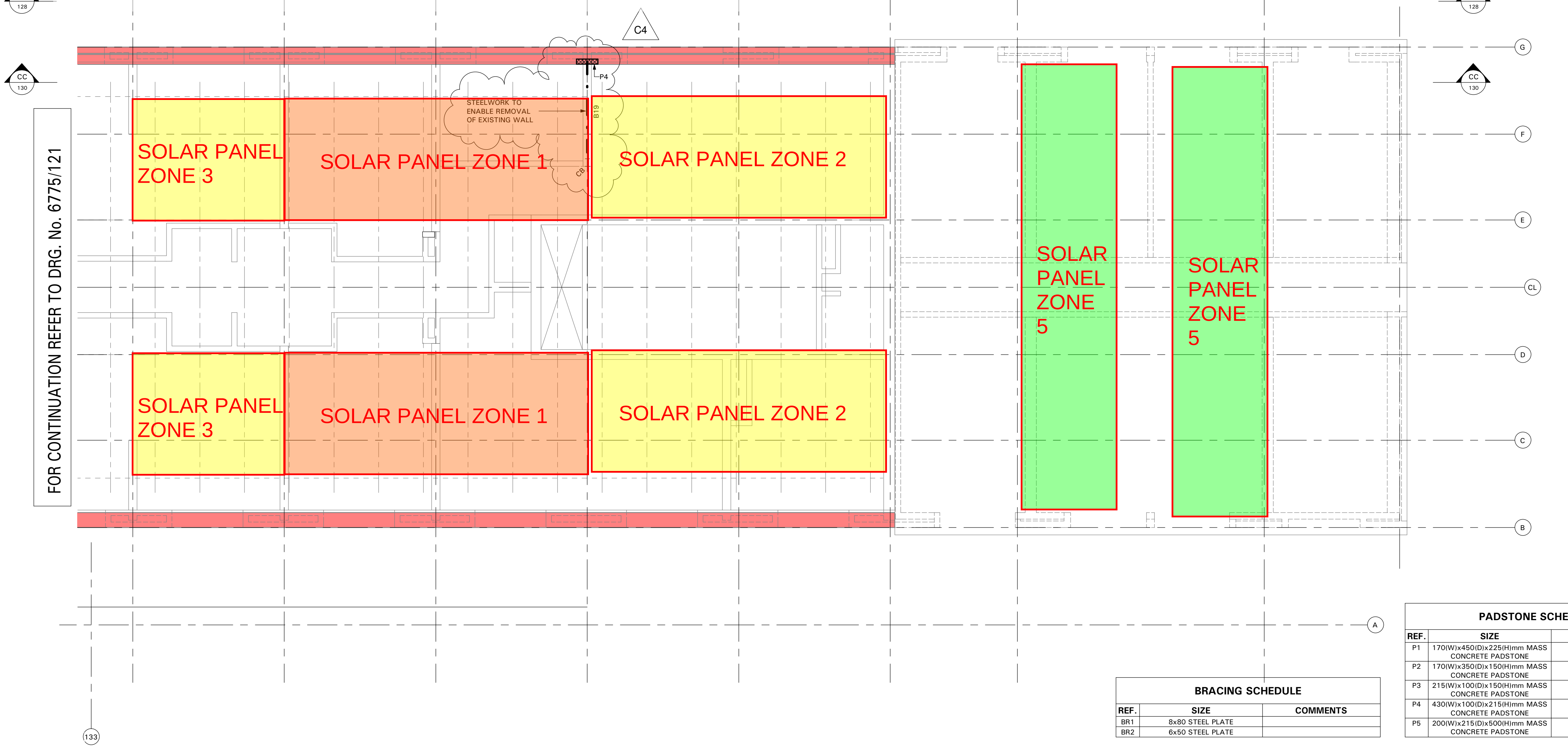
ZONE 1. 4 AT 1.5M C/C
ZONE 2. 4 AT 1.5M C/C
ZONE 3. 8 AT 1.5M C/C
ZONE 4. 2 AT 1.5M C/C
ZONE 5 4 EQUALLY SPACED SAY AT 1.5 M C/C
TOTAL PERMITTED = 32+28+8 = 68
TOTAL REQUIRED = 46

THE LAYOUT SHOWN IS NOT A CONSTRUCTION DRAWING AND IS FOR INFORMATION ONLY

CONTRACTOR TO SUBMIT CO-ORDINATED ROOF PLAN SHOWING LAYOUT OF ALL PLANT, WALKWAYS, GUARDINGS ETC AND ASSOCIATED LOADS.

NOTES FOR CONTRACTOR

1. ADDITIONAL TIMBER BLOCKING 150 DEEP X 50 WIDE TO BE INSTALLED BELOW EDGES AND CENTRE OF SOLAR PANELS TO SUPPORT THE EXISTING WOODWOOL SLAB. BLOCKING TO BE IN THREE ROWS PER PANEL FIXED TIGHT BETWEEN THE EXISTING TIMBER JOISTS. BLOCKING TO BE FIXED WITH PAIRS OF SIMPSON A35 FRAMING ANGLES TO THE EXISTING JOISTS IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.



LEGEND:

EXISTING RC STRUCTURE TO BE RETAINED
EXISTING BRICKWORK TO BE RETAINED
NEW REINFORCED CONCRETE STRUCTURE
NEW BRICKWORK
NEW LOADBEARING BLOCKWORK
NEW LOADBEARING PARTITIONS
B1 — NEW STEEL BEAM AND REFERENCE. REFER TO SCHEDULE FOR TYPE AND SIZE
EX-B1 — EXISTING STEEL BEAM AND REFERENCE. REFER TO SCHEDULE FOR TYPE AND SIZE
L1 — NEW LINTEL AND REFERENCE REFER TO SCHEDULE FOR TYPE AND SIZE.
NEW TIMBER MEMBER; JOIST/RAFTER ETC.
P1 OR P1 — NEW PADSTONE AND REFERENCE. REFER TO SCHEDULE FOR TYPE AND SIZE.
C1 — COLUMN REFERENCE. REFER TO SCHEDULE FOR TYPE AND SIZE
CB — COLUMN BELOW SYMBOL
TWO-WAY SPAN OF RC SLAB. REFER TO LAYOUT FOR DEPTH.
ONE-WAY SPAN OF RC SLAB. REFER TO LAYOUT FOR DEPTH.
SPAN OF PRECAST CONCRETE FLOOR
SPAN OF COMPOSITE DECKING
SPAN OF 50x200 GRADE C24 TIMBER JOISTS AT 350mm c/c WITH 1No. LAYER OF 18mm PLY SHEATHING TOP
SPAN OF 50x200 GRADE C24 TIMBER JOISTS AT 400mm c/c WITH 1No. LAYER OF 18mm PLY SHEATHING TOP
SPAN OF 50x150 GRADE C24 TIMBER JOISTS AT 400mm c/c WITH 1No. LAYER OF 18mm PLY SHEATHING TOP
STEP IN LEVEL SYMBOL

ABBREVIATIONS:

FL - FORMATION LEVEL
SSL - STRUCTURAL SLAB LEVEL
FFL - FINISHED FLOOR LEVEL
TOF - TOP OF FOUNDATION
TOB - TOP OF BEAM
TOPC - TOP OF PILECAP
TOS - TOP OF STEEL
TOW - TOP OF WALL
L/L - LOW LEVEL
H/L - HIGH LEVEL
CR - CRANKED STEEL BEAM
J - JOINT

BEAM SCHEDULE

REF.	SIZE	COMMENTS
B1	UKC152x152x30	
B2	UKC203x203x46	
B3	UB457x191x74	
B4	PFC150x90x24	
B5	UKC254x254x89	
B6	UKC203x203x60	
B7	UC152x152x23	
B8	RHS300x200x8	
B9	UKC152x152x37	
B10	PFC200x90x30	
B11	UKB203x133x30	
B12	RHS150x100x6.3	
B13	PFC430x100x64	
B14	UKB152x89x16	
B15	UKB254x102x28	
B16	PFC230x90x32	
B17	UB305x165x54	
B18	UKC254x254x132	
B19	UB152x89x16	
RCB1	250x1000mm DEEP RC SPANDREL BEAM	
RCB2	250x350mm DEEP RC DOWNSTAND BEAM	
RCB3	250x780mm DEEP RC SPANDREL BEAM	

C4

COLUMN SCHEDULE

REF.	SIZE	COMMENTS
C1	250x500mm RC COLUMN	
C2	UKC203x203x46	
C3	PFC230x90x32	
C4	PFC200x90x30	
C5	UKC254x254x89	
C6	PFC150x90x24	
C7	UKC203x203x60	
C8	UKC152x152x23	
C9	SHS60x60x5	
C10	UKC152x152x30	
C11	RHS150x100x6.3	
C12	UB254x102x28	
C13	RHS300x200x8	
C14	UB152x89x16	

C4

PADSTONE SCHEDULE

REF.	SIZE	COMMENTS
P1	170(W)x450(D)x225(H)mm MASS CONCRETE PADSTONE	
P2	170(W)x350(D)x150(H)mm MASS CONCRETE PADSTONE	
P3	215(W)x100(D)x150(H)mm MASS CONCRETE PADSTONE	
P4	430(W)x100(D)x215(H)mm MASS CONCRETE PADSTONE	
P5	200(W)x215(D)x500(H)mm MASS CONCRETE PADSTONE	

BRACING SCHEDULE

REF.	SIZE	COMMENTS
BR1	8x80 STEEL PLATE	
BR2	6x50 STEEL PLATE	

NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.

2. FOR SETTING OUT REFER TO ARCHITECT'S DRAWINGS.

3. ALL DIMENSIONS ARE IN MILLIMETRES (mm) UNLESS NOTED OTHERWISE.

4. DO NOT SCALE FROM THE DRAWING OR THE COMPUTER DIGITAL DATA. ONLY FIGURED DIMENSIONS TO BE USED.

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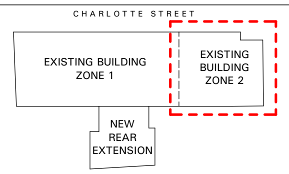

KEY PLAN

Rev	Date	Description	By
C4	09/06/17	BEAM & COLUMN ADDED	JL
C3	21/12/16	ISSUED FOR CONSTRUCTION	JL
C2	09/12/16	AREA BETWEEN GRIDLINES "B" TO "G" AND "6" TO "14" ISSUED FOR CONSTRUCTION AT 1st FLOOR AND ABOVE	JL
C1	25/11/16	AREA BETWEEN GRIDLINES "B" TO "G" AND "6" TO "14" ISSUED FOR CONSTRUCTION AT 1st FLOOR AND ABOVE	JL

Job
Astor College, UCL
Charlotte Street, W1T 4QB

Drawing Status
CONSTRUCTION

Title
EIGHTH FLOOR PLAN
EXISTING BUILDING - PROPOSED
ZONE 2

Scale @ A1	Date	By	Checked
1 : 50	06/2016	JL	JC

Drawing Number: 6775 / 122
Revision: C4

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Physical Properties

Imperial

Joist Type	Overall Depth ins	Distance between Neutral Axes of Booms ins	Moment of Inertia Ixx in^4	Moment of Inertia Iyy in^4	Radius of Gyration ryy ins	Maximum Permissible Moment Mxx lb in
1W 14	14	12.162	75.5	2.95	1.21	252,118
2W 14	14	12.250	103.1	5.00	1.36	340,207
1W 16	16	14.162	102.0	2.95	1.21	293,578
2W 16	16	14.250	139.1	5.00	1.36	395,751
3W 16	16	14.378	154.2	6.97	1.54	436,027
1W 18	18	16.162	132.5	2.95	1.21	335,032
2W 18	18	16.250	180.6	5.00	1.36	451,295
3W 18	18	16.378	199.6	6.97	1.54	496,679
4W 18	18	16.478	229.3	10.89	1.81	565,475
2W 20	20	18.250	227.4	5.00	1.36	506,839
3W 20	20	18.378	251.0	6.97	1.54	557,331
4W 20	20	18.478	288.0	10.89	1.81	634,109
5W 20	20	18.526	349.6	15.36	1.95	765,457
3W 22	22	20.378	308.3	6.97	1.54	617,983
4W 22	22	20.478	353.3	10.89	1.81	702,743
5W 22	22	20.526	428.8	15.36	1.95	848,093
4W 24	24	22.478	425.4	10.89	1.81	771,377
5W 24	24	22.526	516.0	15.36	1.95	930,729
4W 26	26	24.478	504.2	10.89	1.81	840,011
5W 26	26	24.526	611.4	15.36	1.95	1,013,365
5W 28	28	26.526	714.9	15.36	1.95	1,096,001

Metric

Joist Type	Overall Depth mm	Distance between Neutral Axes of Booms mm	Moment of Inertia Ixx cm^4	Moment of Inertia Iyy cm^4	Radius of Gyration ryy cm	Maximum Permissible Moment Mxx kg cm
1W 14	356	309	3,141	123	3.07	290,471
2W 14	356	311	4,293	208	3.45	391,960
1W 16	406	360	4,244	123	3.07	338,238
2W 16	406	362	5,791	208	3.45	455,954
3W 16	406	365	6,417	290	3.90	502,357
1W 18	457	411	5,515	123	3.07	385,998
2W 18	457	413	7,515	208	3.45	519,948
3W 18	457	416	8,309	290	3.90	572,236
4W 18	457	419	9,545	453	4.60	651,497
2W 20	508	464	9,465	208	3.45	583,941
3W 20	508	467	10,447	290	3.90	642,114
4W 20	508	469	11,986	453	4.60	730,572
5W 20	508	471	14,552	639	4.94	881,901
3W 22	559	518	12,831	290	3.90	711,993
4W 22	559	520	14,707	453	4.60	809,647
5W 22	559	521	17,847	639	4.94	977,108
4W 24	610	571	17,708	453	4.60	888,722
5W 24	610	572	21,479	639	4.94	1,072,315
4W 26	660	622	20,987	453	4.60	967,797
5W 26	660	623	25,449	639	4.94	1,167,522
5W 28	711	674	29,756	639	4.94	1,262,730

16/14

Load Tables Metric

Maximum applied loads in kilogrammes per linear metre (ignoring deflection)

Loads in kilogrammes per linear metre to give a deflection of $\frac{\text{SPAN}}{360}$

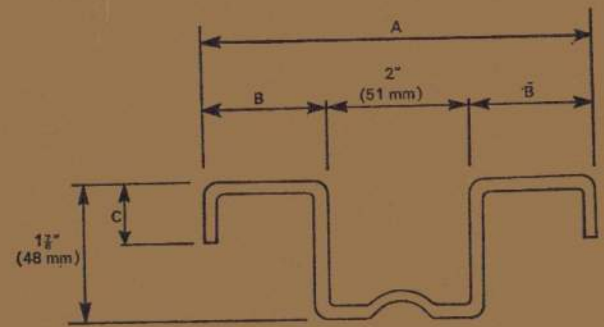
N = Standard Bracing System
H = Heavy Bracing System

SPAN IN METRES		6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0
DEFLECTION = $\frac{\text{SPAN IN mm}}{360}$		17	18	19	21	22	24	25	26	28	29	31	32	33	35	36	38	39	40	42	43	44
Joist Type	Wt per metre Steel only																					
1W 14 N	13.5	631	536	460	399	349	307	272	243	218	196	178	161	147	134	123						
H	*14.0*	*631*																				
1W 14			497	398	323	266	222	187	159	136	118	102	89	79	70	62						
2W 14 N	17.0	674	621	575	536	472	416	369	329	295	266	241	219	199	182	167	154	142	131	121		
H	*17.5*	*853*	*724*	*622*	*539*	*472*																
2W 14			680	544	442	364	304	256	217	186	161	140	122	108	95	85	75	68	61	55		
1W 16 N	13.5	737	626	538	467	408	360	320	285	256	231	209	190	173	159	146	134	124	114	106		
H	*14.0*	*737*																				
1W 16				538	437	360	300	253	215	184	159	138	121	106	94	84	75	67	60	54		
2W 16 N	17.0	768	707	656	611	552	486	432	386	346	312	283	257	235	215	197	182	168	155	144	133	124
H	*18.0*	*995*	*845*	*726*	*630*	*552*																
2W 16					597	491	410	345	293	251	217	189	165	145	129	114	102	91	82	74	67	61
3W 16 N	18.5	772	711	658	613	574	536	476	425	381	344	312	283	259	237	217	200	185	171	158	147	137
H	*19.5*	*1096*	*931*	*800*	*694*	*608*	*536*															
3W 16					661	545	454	382	325	279	241	209	183	161	142	127	113	101	91	82	75	68
1W 18 N	15.0	842	716	615	534	467	412	366	327	293	265	240	218	199	182	167	154	142	131	122	113	105
H	*15.0*	*842*																				
1W 18							390	329	279	239	207	180	157	138	122	109	97	87	78	71	64	58
2W 18 N	18.5	854	786	729	679	631	556	494	441	397	358	324	295	269	247	227	209	193	178	165	154	143
H	*18.5*	*1136*	*965*	*829*	*720*	*631*																
2W 18							532	448	381	326	282	245	215	189	167	148	132	119	107	96	87	79
3W 18 N	19.5	858	790	732	682	638	599	545	487	437	395	358	326	298	273	250	231	213	197	183	170	158
H	*20.0*	*1251*	*1063*	*914*	*793*	*695*	*613*	*545*														
3W 18							588	495	421	361	312	271	237	209	185	164	146	131	118	107	97	88
4W 18 N	21.5	862	794	735	685	640	601	567	536	498	449	407	371	339	310	285	263	243	224	208	194	180
H	*22.5*	*1345*	*1210*	*1040*	*903*	*791*	*698*	*620*	*554*	*498*												
4W 18							676	569	484	415	358	312	273	240	212	189	168	151	136	123	111	101
2W 20 N	19.0	937	863	800	745	697	626	556	497	447	403	366	333	304	279	256	236	218	202	187	174	162
H	*20.0*	*1277*	*1085*	*933*	*810*	*710*	*626*															
2W 20									480	411	355	309	270	238	210	187	167	150	135	122	110	100
3W 20 N	20.0	935	861	798	743	696	653	612	547	491	444	402	366	334	306	282	259	240	222	206	191	178
H	*21.5*	*1405*	*1193*	*1026*	*891*	*780*	*689*	*612*														
3W 20									530	454	392	341	298	263	232	206	184	165	149	134	122	111

Each timber fillet weighs approximately 1.3 kg per metre

Design Details

Boom Section



Imperial Boom	A ins	B ins	C ins	Thickness ins
1W	4	1	9/16	0.124
2W	4½	1¼	¾	0.157
3W	5¼	1⅝	¾	0.157
4W	6	2	1	0.157
5W	6½	2¼	1	0.187

Metric Boom	A mm	B mm	C mm	Thickness mm
1W	102	25	14	3
2W	114	32	19	4
3W	133	41	19	4
4W	152	51	25	4
5W	165	57	25	5

Contents

This brochure contains information regarding the Metsec range of short and intermediate span open web joists, together with information on Metsec structural steel frames. Each main section is clearly tabulated, but the following index may be of assistance in locating detailed items of information.
No prices are given in this brochure but quotations will be quickly made against specific enquiries sent either direct to the Company or through its regional sales offices.

Introduction 16/17

General
In conformity with Metal Sections' policy of reviewing its products in the light of modern requirements and manufacturing techniques, the Company has rationalised its short and intermediate span open web beam ranges in order to produce (at competitive prices) a fully co-ordinated modular range of components for the building industry.
Metal Sections' intermediate span joists are now brought into line with the short span range in that they incorporate solid bar bracing. The use of this form of bracing has facilitated the introduction of modern manufacturing techniques and has increased the load carrying capacity. It has also led the way to the more efficient use of the short and intermediate span joists in complete structural frames.

Metric
In keeping with national plans for the change over to the metric system, load tables are given in both imperial and metric units.

Service
Metal Sections' beam range continues to be backed by a free and comprehensive technical design service which can be made use of through technical representatives from the regional sales offices or through specialised design engineers based at the Company's head office.
In conjunction with the supply of components and of complete structural frames, Metal Sections offer an erection service with fully qualified supervision.
The improved production techniques enable quicker deliveries to be effected and facilitate the maintenance of continuous quality control by technical supervision at all stages in production.

Applications
Metal Sections' joists can be used for floor and roof construction in conjunction with steelwork, brickwork and concrete, or any combination of these materials. The short span range is intended for use in spans up to 40 feet with beam depths of 7, 8, 10, 12, 14 inches, and the intermediate range, for spans of between 20 feet and 60 feet with beam depths ranging between 14 inches and 28 inches, in 2 inch increments.

Advantages
Economies in the design of structural supports and foundations are made possible because :

(*a*) The light weight of Metal Sections' joists reduces the dead load.

(*b*) The open web design facilitates the installation of electrical, plumbing and heating services.

(*c*) The steel construction ensures that the joists will not shrink or warp, thus distortion to ceilings and floors is avoided.

(*d*) Erection costs are reduced because all joists are tailored to the job in question and are simple and quick to erect.

(*e*) Ease of handling on site, combined with simple end fixings and well designed accessories, reduce site labour to a minimum.

(*f*) The stoved primer finish ensures greatly reduced maintenance costs.

(*g*) All necessary connecting and holding down bolts are included in the supply.

Lateral Restraint

TRUSSES HAVE RESTRAINT EVERY 4TH JOIST BY CLEATS, 2.7M C/C

(i) The figures given in the load tables assume that the top chord is fully restrained laterally. This restraint must be obtained from a positive connection between the top chord and the roof or floor slab.
(ii) During the erection period bridging is required to enable the joists to support construction loads and to assist in lining up. The recommended spacing of this bridging is given in table A.
The spacing of lateral restraints shown have been calculated for an l/r (unsupported length divided by the radius of gyration about the vertical axis of the chord) of 120.
Joists up to 26 in (660 mm) deep: Roof joists—lateral support to be provided by straight angle bridging to top chord only. Floor joists—lateral support to be provided by straight angle bridging connecting to top and bottom chords.
Joists over 26 in (660 mm) deep: Lateral stability to be provided by angles cross braced from top to bottom chords. When the centres of joists exceed 3 ft 6 in the crossed angles should be connected together by a single bolt at their intersection.
Recommended sizes of bridging angles for various centres of joists are shown in tables B and C.

A

Chord Size	Maximum Spacing of Lateral Restraint ft ins	Maximum Spacing of Lateral Restraint mm	
1W	12′ 0″	3680	C
2W	13′ 6″	4110	D
3W	15′ 0″	4670	E
4W	18′ 0″	5510	F
5W	19′ 6″	5920	G

B

Centres of Joists ft	Size of Bridging Angle ins
0 – 5	$1\frac{1}{4} \times 1\frac{1}{4} \times 0.100$
over 5 – 8	$2 \times 2 \times 0.124$
over 8 – 10	$2\frac{1}{2} \times 2\frac{1}{2} \times 0.157$
over 10 – 12	$3 \times 3 \times 0.25$

C

Centre of Joists mm	Size of Bridging Angle mm
0 – 1550	32 x 32 x 2.5
1550 – 2450	50 x 50 x 3
2450 – 3110	64 x 64 x 4
3110 – 3740	76 x 76 x 6