SPARK
STRUCTURES.

Structural Report
Apartment 3.10 St Pancras Chambers, Euston Road, London, NW1 2AR

Document: 2304-R01
Date: 06 December 2023
Revision: 00

SPARK **STRUCTURES.**

Client:
Nathan Roberts

Project Address:
Apartment 3.10 St Pancras Chambers
Euston Road
London
NW1 2AR

Revisions:

Revision	Date	Description
00	06/12/23	First issue

Prepared by:

L. EVANS

Lloyd Evans MEng CPEng MIE(Aust)

Notes:
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1.0 Introduction

Spark Structures was appointed by the Client to carry out a structural inspection and evaluation of the existing structure at apartment 3.10 St Pancras Chambers in relation to the proposed alterations to the existing bathroom partition wall and ceiling. The proposed works are shown on the architectural drawings by Pick Our Brains.

An inspection of the property was carried out on 23 November 2023 by Lloyd Evans (Spark Structures).

The purpose of this report is to assess the existing structural arrangement of the apartment and offer recommendations to accommodate the proposed alterations.

This report is based upon a non-intrusive visual inspection of the property. This report describes the findings and draws conclusions of a general nature and is not a detailed structural appraisal of the building. Whilst comments are made to satisfy the requirements of the brief, the report has, of necessity, not been exhaustive and cannot therefore constitute a warranty as to the soundness or otherwise of the property in areas hidden from visual inspection or not part of the brief.

This report has been prepared for the sole use of the Client.

2.0 Overview

The apartment is located within the former Midland Grand Hotel building, with the conversion completed in 2009. The Grade I listed building falls within the Kings Cross St Pancras conservation area.

The third floor apartment comprises three former hotel rooms. The main dividing walls between the former hotel rooms running north west to south east in the apartment appear to be solid masonry, and studwork partitions have been installed within two of the three main spaces to form a separate hallway and bathroom.

All of the rooms have approximately 3.98m floor to ceiling height apart from the bathroom which has a false ceiling installed to form a storage and service void above. This storage and service void above the ceiling can be accessed via a ceiling hatch in front of the bathroom door.

The proposed works are indicated on the architectural drawings by Pick Our Brains and can be summarised as follows:

- Removal of the existing upper portion of the partition wall between the bedroom and bathroom, and installation of a new paddle stair to improve access to a loft storage void located above the bathroom false ceiling.

This report should be read in conjunction with all architectural drawings and reports produced by Pick Our Brains.

3.0 Observations and Discussion

Following the inspection the following items were noted regarding the existing structure and the proposed alterations:

1. Both the existing main building structure and the infill partitions and ceilings appear to be in good condition with no noticeable signs of structural distress or deterioration.
2. All of the proposed alterations are to non-structural partitions and false ceilings, and will have no impact on the structural stability and integrity of the main building. Refer to figure 1 and 4 below.
3. The proposed alterations would improve access to the space above the bathroom however due to the limited clearance to the main building ceiling above, the classification of the space as a ceiling void would remain the same, as would the 0.25kN/m2 design imposed loading for such a space as stipulated by BS6399 and EN1991. Therefore the overall design imposed load on the main building would remain unchanged.
4. It is proposed to install a new paddle stair to improve access to the ceiling void. Due to its lightweight nature and the spatial constraints imposed on the main floor space below the paddle stair could be considered akin to a moveable item of furniture. As such, the loading of the stair would account for a minor portion of the residential design imposed floor load allowance of the apartment and would not contribute to an increase in the overall design loading on the existing floor structure.
5. Removal of the hot water cylinder, and replacing of the existing partition wall above the false ceiling level with an open balustrade structure would contribute to a net reduction in design dead load on the existing floor structure. Refer to figure 1 and figure 3 below. A detailed breakdown of the loading calculations is provided in appendix B.
6. The false ceiling is exposed on top and as such this detailing is not suitable for access as it is unsafe to directly stand on. Replacement of the lightweight steel joists and installation of new boarding would cause a nominal increase in the ceiling dead load, but is still part of a net reduction in loading when considered as part of the whole works. Refer to the detailed breakdown of the loading calculations in appendix B.
7. The partition wall appears to be constructed from lightweight steel studs that are continuous from floor to ceiling. Removal of the top part of the partition would require some minor strengthening/modifications to retain its stability for the altered layout.
8. It is unclear whether the existing partition wall studs would be suitable for fixing and supporting the proposed timber paddle stair and balustrade. Although designed for the ceiling design imposed load noted in point 3, the robustness of the existing connection between the ceiling and partition wall studs is unknown. Replacing the partition with a lightweight timber framed partition would be preferable to allow a more robust fixing between the ceiling and partition and to accommodate the install of the paddle stair and balustrade.
9. Although the proposed works are not likely to exceed the current design loading condition of the main building structure, it should be noted that the building was previously operational as a hotel which has a much higher allowance for design imposed floor load compared with the typical domestic/residential use category. As a result it is likely that the main building structure could accommodate notable increases in design loading if required.

4.0 Conclusion and Recommendations

1. No modifications or strengthening works are required to the main building structure.
2. The lightweight steel ceiling and partition wall should be replaced with a lightweight timber stud partition and ceiling to allow top boards to be added, improved access, and fixing of the paddle stair/balustrade.

Please refer to the drawings in Appendix B for details of the proposed structural specification and details.

Fig. 1: Photograph of the existing ceiling void viewed from the access hatch facing west with the exposed top surface of the ceiling visible, the top part of the partition wall on the right and the main building masonry party wall on the left.

Fig. 2: Photograph of the existing ceiling void viewed from the access hatch facing south with the services visible, the main building masonry corridor wall on the left and the main building masonry party wall on the right.

Fig. 3: Photograph of the existing hot water cylinder and support bracket within the ceiling void supported on the main building masonry corridor wall.

Fig. 4: Photographs of the existing partition wall viewed from the bedroom looking towards the bathroom/hallway. The proposed works include the removal of the upper portion of the partition.

Appendix A - Loading Calculations

The total relevant loads have been distributed over the plan area of the ceiling void to allow the existing and proposed load conditions on the main building structure to be assessed.

Ceiling void plan area = 6.8m^2

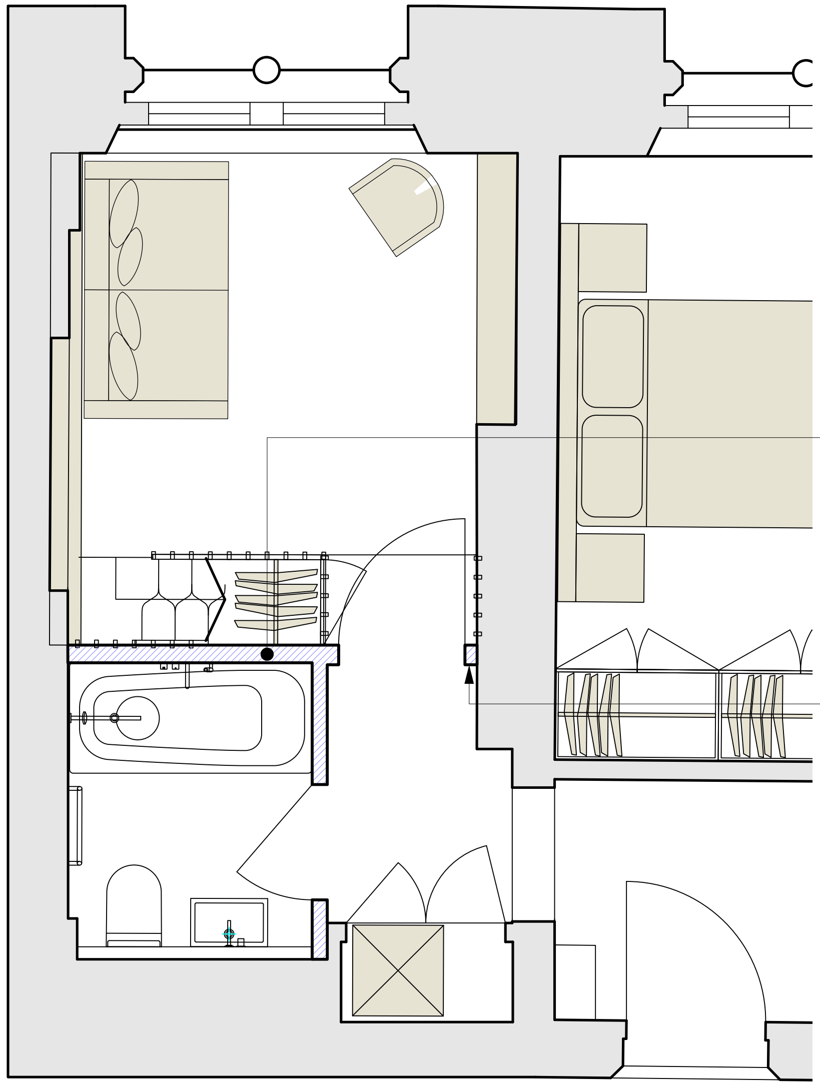
Existing load

Element	[kN/m^2]	Notes
Ceiling:	0.20	Lightweight I joists with no top boarding
Services:	0.20	Includes 109kg hot water cylinder and framing
Partition:	0.25	Upper portion of lightweight partition
Imposed:	0.25	Eurocode standard for ceiling voids
TOTAL:	**0.90**	

Proposed load

Element	[kN/m^2]	Notes
Ceiling:	0.40	Increased to allow for top boarding/finishes
Services:	0.05	Reduced following removal of hot water cylinder
Balustrade:	0.15	Replacing upper portion of partition
Imposed:	0.25	Eurocode standard for ceiling voids
TOTAL:	**0.85**	

Appendix B - Structural Drawings



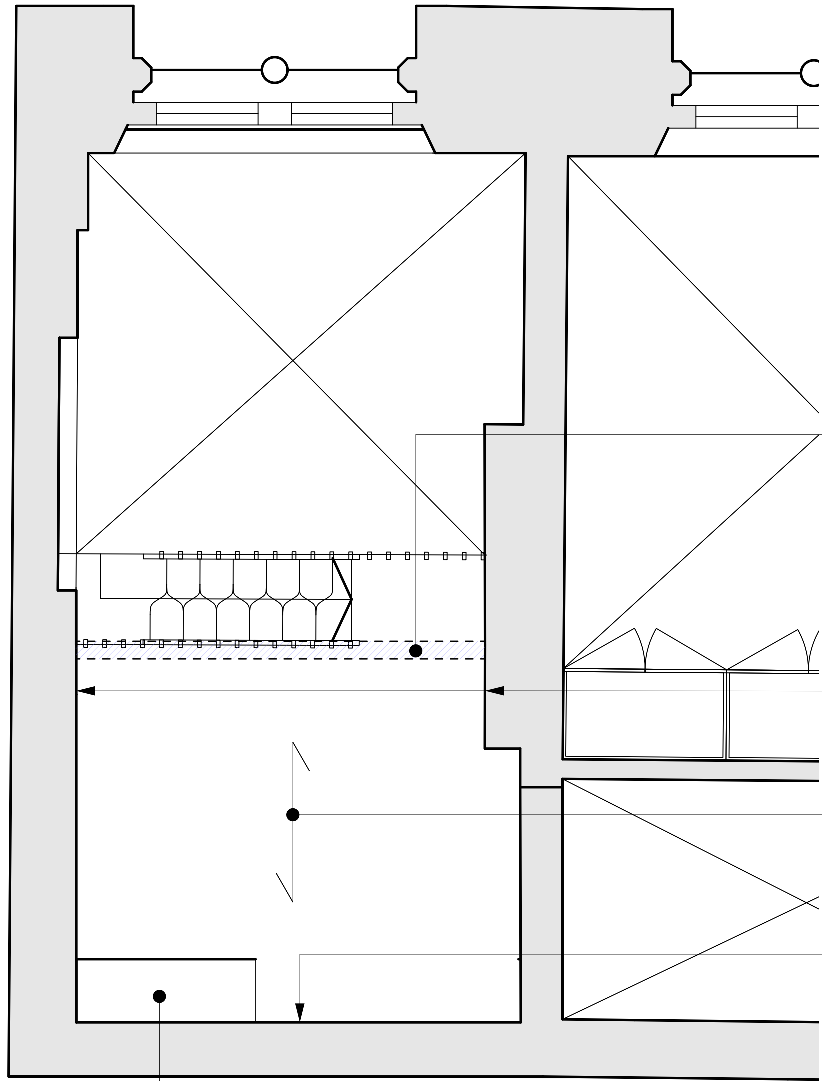
EXISTING FULL HEIGHT PARTITION REMOVED AND REPLACED WITH 75x50 C16 TIMBER STUDS AT 400 C/C WITH NOGGINS AT MAX 1200 C/C.

WALL TO BE SHEATHED IN 12THK PLYWOOD ON BEDROOM SIDE OR INSTALL ADDITIONAL NOGGINS TO SECURELY FIX THE PADDLE STAIR AND TIMBER BALUSTRADE MEMBERS.

LAST STUD AT EACH END OF WALL INSTALLED TIGHT TO MASONRY WALL AND NYLON PLUGGED AND SCREWED AT MAX 300 C/C.

PROPOSED PLAN

SCALE 1:50



PROVIDE DOUBLE HEAD PLATE ALONG FULL LENGTH OF WALL TO ALSO ACT AS LINTEL OVER DOORWAY UNDER. FLOOR JOISTS TO CANTILEVER OVER WALL TO FORM SMALL LANDING PLATFORM AT TOP OF PADDLE STAIR.

LAST JOIST INSTALLED TIGHT TO EXISTING WALL AND NYLON PLUGGED AND SCREWED AT MAX 300 C/C.

EXISTING FALSE CEILING REMOVED AND REPLACED WITH 100x50 C16 TIMBER JOISTS AT 400 C/C. CEILING VOID FLOOR TO BE SHEATHED IN MOISTURE RESISTANT 12THK PLYWOOD OR 15THK PARTICLEBOARD FLOORING.

PROVIDE NEW 100x50 C16 LEDGER BOARD ALONG FULL LENGTH OF WALL FIXED WITH M10 RESIN ANCHORS AT 400 C/C WITH 100 EMBEDMENT.

NEW JOISTS TO BE INSTALLED BETWEEN SERVICE RUNS AS PER EXISTING CEILING JOIST ARRANGEMENT. ALLOW TO BOX OUT AS NECESSARY.

PROPOSED CEILING LEVEL PLAN

SCALE 1:50

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Project:	Apartment 3.10 St Pancras Chambers, Euston Road, London, NW1 2AR
Drawing:	PROPOSED PLANS
Stage:	PRELIMINARY
Scale:	NOTED @ A3
Date:	06/12/23
Drawn:	LE
Checked:	LE
Revision:	P1
Drawing No:	2304-S-201

Notes:
1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS ARE IN MILLIMETRES U.N.O
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM U.N.O
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS
5. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE BY THE CONTRACTOR PRIOR TO PREPARING AND WORKING DRAWINGS OR COMMENCING ON SITE.
6. THE CONTRACTOR MUST ENSURE AND WILL BE HELD RESPONSIBLE FOR THE OVERALL STABILITY OF THE BUILDING/STRUCTURE/EXCAVATION AT ALL STAGES OF THE WORK.
7. ALL WORK BY THE CONTRACTOR MUST BE CARRIED OUT IN SUCH A WAY THAT ALL REQUIREMENTS UNDER THE HEALTH AND SAFETY AT WORK ACT ARE SATISFIED.
8. ALL WORK IS TO BE CARRIED OUT IN COMPLIANCE WITH THE REQUIREMENTS OF THE RELEVANT STATUTORY AUTHORITIES AND REGULATIONS.
9. ALL EXISTING STRUCTURE IS ASSUMED ONLY. ARRANGEMENT, SIZE AND CONDITION TO BE CONFIRMED BY CONTRACTOR ON SITE AND PRESENTED TO SPARK STRUCTURES FOR REVIEW.

Appendix C - Structural Calculations

TIMBER STUD ANALYSIS & DESIGN (EN1995-1-1:2004)

In accordance with EN1995-1-1:2004 + A2:2014 incorporating corrigendum June 2006 and the UK national annex

Tedds calculation version 1.0.07

Stud details

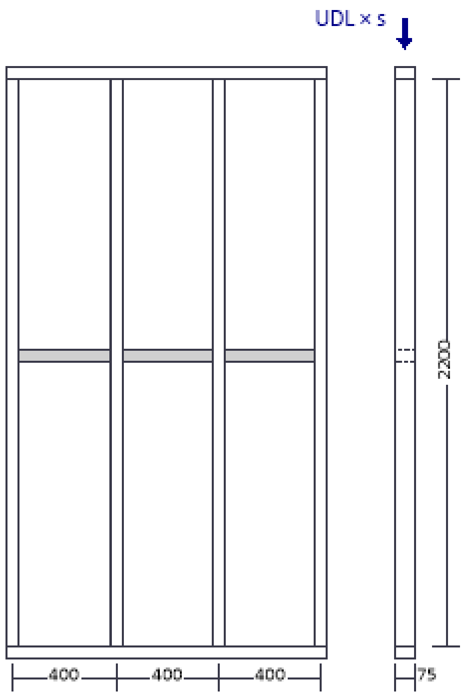
Description 47 x 75 C16 timber studs

Restraint in plane of panel Dwangs (x 1)

Stud spacing s_{Stud} = **400** mm

Stud height l_{Stud} = **2200** mm

Panel height $l_{Panel} = l_{Stud} + 2 \times b$ =**2294** mm



Forces input on Stud

Permanent distributed load on top rail L_{G_Stud}= **0.60** kN/m

Imposed distributed load on top rail L_{Q_Stud}= **3.60** kN/m

Stud loading details

Point loads

Total vertical permanent point load (2200 mm) $P_{G\_1} = L_{G\_Stud} \times s_{Stud}$= **0.24** kN

Total vertical imposed point load (2200 mm) $P_{Q\_1} = L_{Q\_Stud} \times s_{Stud}$= **1.44** kN

Member results summary	Unit	Capacity	Maximum	Utilisation	Result
Compressive stress	N/mm^2	12.9	0.7	0.055	PASS
Column stability check				0.169	PASS

ANALYSIS

Tedds calculation version 1.0.37

Loading

Self weight included (Permanent x 1)

Load combination factors

Load combination	Permanent	Imposed	Snow	Wind
1.35G + 1.50Q (Strength)	1.35	1.50	0.00	0.00
1.00G + 1.00Q (Service)	1.00	1.00	0.00	0.00

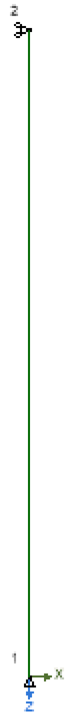
Member Loads

Member	Load case	Load Type	Orientation	Description
Member	Permanent	Point load	GlobalZ	0.24 kN at 2.2 m
Member	Imposed	Point load	GlobalZ	1.44 kN at 2.2 m

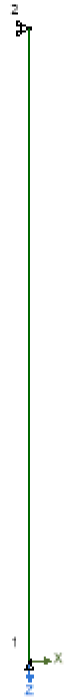
Results

Total deflection

1.35G + 1.50Q (Strength) - Total deflection



1.00G + 1.00Q (Service) - Total deflection



Node deflections

Load combination: 1.35G + 1.50Q (Strength)

Node	Deflection X (mm)	Deflection Z (mm)	Rotation (°)	Co-ordinate system
1	0	0	0	
2	0	0.2	0	

Load combination: 1.00G + 1.00Q (Service)

Node	Deflection X (mm)	Deflection Z (mm)	Rotation (°)	Co-ordinate system
1	0	0	0	
2	0	0.1	0	

Total base reactions

Load case/combination	Force FX (kN)	Force FZ (kN)
1.35G + 1.50Q (Strength)	0	2.5
1.00G + 1.00Q (Service)	0	1.7

Element end forces

Load combination: 1.35G + 1.50Q (Strength)

Element	Length (m)	Nodes Start/End	Axial force (kN)	Shear force (kN)	Moment (kNm)
1	2.2	1	-2.5	0	0
		2	0	0	0

Load combination: 1.00G + 1.00Q (Service)

Element	Length (m)	Nodes Start/End	Axial force (kN)	Shear force (kN)	Moment (kNm)
1	2.2	1	-1.7	0	0
		2	0	0	0

Forces

Strength combinations - Moment envelope (kNm)

Member results

Envelope - Strength combinations

Member	Position (m)	Shear force (kN)		Moment (kNm)	
Member	0	0		0	

Tedds calculation version 2.2.20

<u>Member - Span 1</u>

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3 γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2 Short-term

Service class - cl.2.3.1.3 1

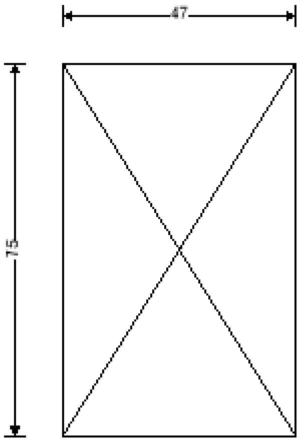
Timber section details

Number of timber sections in member N = **1**

Breadth of sections b = **47** mm

Depth of sections h = **75** mm

Timber strength class - EN 338:2016 Table 1 **C16**



47x75 timber section
Cross-sectional area, A, 3525 mm^2
Section modulus, W_y, 44062.5 mm^3
Section modulus, W_z, 27613 mm^3
Second moment of area, I_y, 1652344 mm^4
Second moment of area, I_z, 648894 mm^4
Radius of gyration, i_y, 21.7 mm
Radius of gyration, i_z, 13.6 mm
Timber strength class C16
Characteristic bending strength, $f_{m,k}$, 16 N/mm^2
Characteristic shear strength, $f_{v,k}$, 3.2 N/mm^2
Characteristic compression strength parallel to grain, $f_{c.0.k}$, 17 N/mm^2
Characteristic compression strength perpendicular to grain, $f_{c.90.k}$, 2.2 N/mm^2
Characteristic tension strength parallel to grain, $f_{t.0.k}$, 8.5 N/mm^2
Mean modulus of elasticity, $E_{0,mean}$, 8000 N/mm^2
Fifth percentile modulus of elasticity, $E_{0.05}$, 5400 N/mm^2
Shear modulus of elasticity, G_{mean}, 500 N/mm^2
Characteristic density, ρ_k, 310 kg/m^3
Mean density, ρ_{mean}, 370 kg/m^3

Span details

Bearing length L_b = **100** mm

<u>Consider Combination 1 - 1.35G + 1.50Q (Strength)</u>

Modification factors

Duration of load and moisture content - Table 3.1 k_{mod} = **0.9**

Deformation factor - Table 3.2 k_{def} = **0.6**

System strength factor - cl.6.6 k_{sys} = **1.1**

Check compression parallel to the grain - cl.6.1.4

Design axial compression P_d = **2.516** kN

Design compressive stress $\sigma_{c,0,d} = P_d / A =$ **0.714** N/mm^2

Design compressive strength $f_{c,0,d} = k_{mod} \times k_{sys} \times f_{c.0.k} / \gamma_M =$ **12.946** N/mm^2

$\sigma_{c,0,d} / f_{c,0,d} =$ **0.055**

PASS - Design parallel compression strength exceeds design parallel compression stress

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending $L_{e,y} = 0.9 \times 2200$ mm = **1980** mm

Slenderness ratio $\lambda_y = L_{e,y} / i_y =$ **91.452**

Relative slenderness ratio - exp. 6.21 $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **1.633**

Effective length for z-axis bending $L_{e,z}$ = **1100** mm

Slenderness ratio $\lambda_z = L_{e,z} / i_z =$ **81.075**

Relative slenderness ratio - exp. 6.22 $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{(f_{c.0.k} / E_{0.05})} =$ **1.448**

Both $\lambda_{rel,y}$ > 0.3 and $\lambda_{rel,z}$ > 0.3, column stability check is required

Straightness factor β_c = **0.2**

Instability factors - exp.6.25, 6.26, 6.27 & 6.28 $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2) =$ **1.967**

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2) =$ **1.663**

$k_{c,y} = 1 / (k_y + \sqrt{}(k_y^2 - \lambda_{rel,y}^2)) = \mathbf{0.326}$

$k_{c,z} = 1 / (k_z + \sqrt{}(k_z^2 - \lambda_{rel,z}^2)) = \mathbf{0.403}$

Column stability checks - exp.6.23 & 6.24 $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) = \mathbf{0.169}$

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) = \mathbf{0.137}$

PASS - Column stability is acceptable

Check columns subjected to either compression or combined compression and bending - cl.6.3.2

Effective length for y-axis bending $L_{e,y} = 0.9 \times 2200$ mm $=$ **1980** mm

Slenderness ratio $\lambda_y = L_{e,y} / i_y = \mathbf{91.452}$

Relative slenderness ratio - exp. 6.21 $\lambda_{rel,y} = \lambda_y / \pi \times \sqrt{}(f_{c.0.k} / E_{0.05}) = \mathbf{1.633}$

Effective length for z-axis bending $L_{e,z} =$ **1100** mm

Slenderness ratio $\lambda_z = L_{e,z} / i_z = \mathbf{81.075}$

Relative slenderness ratio - exp. 6.22 $\lambda_{rel,z} = \lambda_z / \pi \times \sqrt{}(f_{c.0.k} / E_{0.05}) = \mathbf{1.448}$

Both $\lambda_{rel,y} > 0.3$ and $\lambda_{rel,z} > 0.3$, column stability check is required

Straightness factor $\beta_c = \mathbf{0.2}$

Instability factors - exp.6.25, 6.26, 6.27 & 6.28 $k_y = 0.5 \times (1 + \beta_c \times (\lambda_{rel,y} - 0.3) + \lambda_{rel,y}^2) = \mathbf{1.967}$

$k_z = 0.5 \times (1 + \beta_c \times (\lambda_{rel,z} - 0.3) + \lambda_{rel,z}^2) = \mathbf{1.663}$

$k_{c,y} = 1 / (k_y + \sqrt{}(k_y^2 - \lambda_{rel,y}^2)) = \mathbf{0.326}$

$k_{c,z} = 1 / (k_z + \sqrt{}(k_z^2 - \lambda_{rel,z}^2)) = \mathbf{0.403}$

Column stability checks - exp.6.23 & 6.24 $\sigma_{c,0,d} / (k_{c,y} \times f_{c,0,d}) = \mathbf{0.169}$

$\sigma_{c,0,d} / (k_{c,z} \times f_{c,0,d}) = \mathbf{0.137}$

PASS - Column stability is acceptable

TIMBER JOIST ANALYSIS & DESIGN (EN1995-1-1:2004)

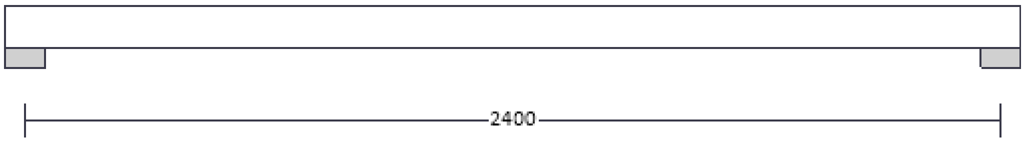
In accordance with EN1995-1-1:2004 + A2:2014 incorporating corrigendum June 2006 and the recommended values

Tedds calculation version 1.0.07

Joist details

Description 47 x 100 C16 timber joists

Joist spacing s_{Joist} = **400** mm



Forces input on Joist

Vertical permanent load on joist F_{G_Joist}= **0.35** kN/m^2

Vertical imposed load on joist F_{Q_Joist}= **0.25** kN/m^2

Joist loading details

Distributed loads

Vertical permanent load on joist $p_G = F_{G\_Joist} \times s_{Joist}$= **0.14** kN/m

Vertical imposed load on joist $p_Q = F_{Q\_Joist} \times s_{Joist}$= **0.10** kN/m

Member results summary	Unit	Capacity	Maximum	Utilisation	Result
Bearing stress	N/mm^2	1.7	0.1	0.068	PASS
Bending stress	N/mm^2	13.2	3.3	0.249	PASS
Shear stress	N/mm^2	2.4	0.2	0.084	PASS
Deflection	mm	6.7	5.0	0.750	PASS

ANALYSIS

Tedds calculation version 1.0.37

Loading

Self weight included (Permanent x 1)

Load combination factors

Load combination	Permanent	Imposed	Snow	Wind
1.35G + 1.50Q (Strength)	1.35	1.50	0.00	0.00
1.00G + 1.00Q (Service)	1.00	1.00	0.00	0.00
1.00G + $\psi_2$1.00Q (Quasi)	1.00	0.30	0.00	0.00

Member Loads

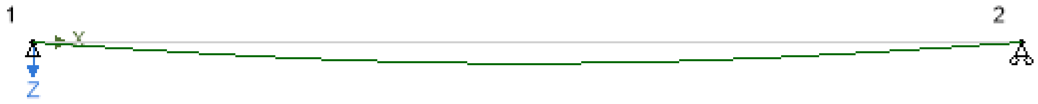
Member	Load case	Load Type	Orientation	Description
Member	Permanent	UDL	GlobalZ	0.14 kN/m at 0 m to 2.4 m
Member	Imposed	UDL	GlobalZ	0.1 kN/m at 0 m to 2.4 m

SPARK STRUCTURES. 21 Court Road South Caerphilly	Project Apartment 3.10 St Pancras Chambers, Euston Road, London,				Job no. 2304	
	Calcs for Partition Wall Studs				Start page no./Revision 8	
	Calcs by LE	Calcs date 06/12/2023	Checked by LE	Checked date 06/12/2023	Approved by LE	Approved date 06/12/2023

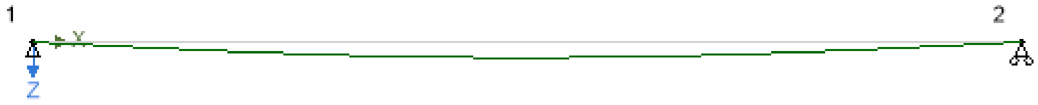
Results

Total deflection

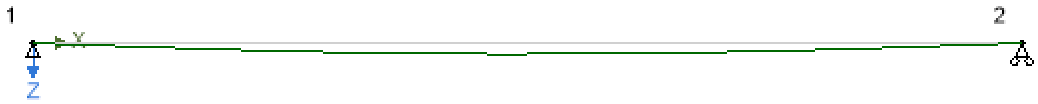
1.35G + 1.50Q (Strength) - Total deflection



1.00G + 1.00Q (Service) - Total deflection



1.00G + $\psi_2$1.00Q (Quasi) - Total deflection



Node deflections

Load combination: 1.35G + 1.50Q (Strength)

Node	Deflection		Rotation	Co-ordinate system
	X (mm)	Z (mm)	(°)	
1	0	0	0.37737	
2	0	0	-0.37737	

Load combination: 1.00G + 1.00Q (Service)

Node	Deflection		Rotation	Co-ordinate system
	X (mm)	Z (mm)	(°)	
1	0	0	0.26783	
2	0	0	-0.26783	

Load combination: 1.00G + $\psi_2$1.00Q (Quasi)

Node	Deflection		Rotation	Co-ordinate system
	X (mm)	Z (mm)	(°)	
1	0	0	0.1941	
2	0	0	-0.1941	

Total base reactions

Load case/combination	Force	
	FX (kN)	FZ (kN)
1.35G + 1.50Q (Strength)	0	0.9
1.00G + 1.00Q (Service)	0	0.6

SPARK STRUCTURES. 21 Court Road South Caerphilly	Project Apartment 3.10 St Pancras Chambers, Euston Road, London,				Job no. 2304	
	Calcs for Partition Wall Studs				Start page no./Revision 9	
	Calcs by LE	Calcs date 06/12/2023	Checked by LE	Checked date 06/12/2023	Approved by LE	Approved date 06/12/2023

Load case/combination	Force	
	FX (kN)	FZ (kN)
1.00G + $\psi_2$1.00Q (Quasi)	0	0.4

Element end forces

Load combination: 1.35G + 1.50Q (Strength)

Element	Length (m)	Nodes Start/End	Axial force (kN)	Shear force (kN)	Moment (kNm)
1	2.4	1	0	-0.4	0
		2	0	-0.4	0

Load combination: 1.00G + 1.00Q (Service)

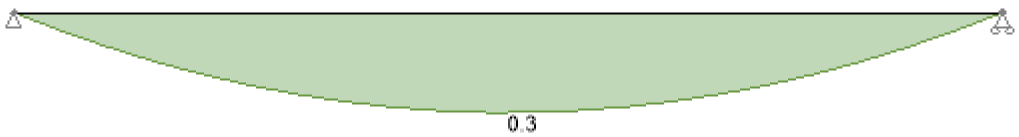
Element	Length (m)	Nodes Start/End	Axial force (kN)	Shear force (kN)	Moment (kNm)
1	2.4	1	0	-0.3	0
		2	0	-0.3	0

Load combination: 1.00G + $\psi_2$1.00Q (Quasi)

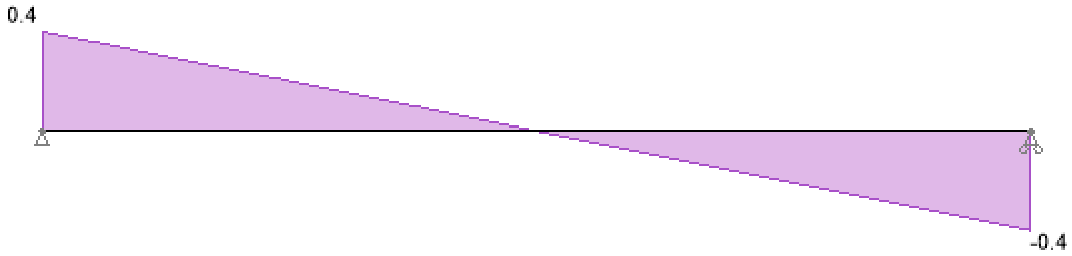
Element	Length (m)	Nodes Start/End	Axial force (kN)	Shear force (kN)	Moment (kNm)
1	2.4	1	0	-0.2	0
		2	0	-0.2	0

Forces

Strength combinations - Moment envelope (kNm)



Strength combinations - Shear envelope (kN)



Member results

Envelope - Strength combinations

Member	Position (m)	Shear force (kN)		Moment (kNm)	
Member	0	0.4 (max abs)		0 (min)	
	1.2	0		0.3 (max)	
	2.4	-0.4		0 (min)	

Tedds calculation version 2.2.20

Member - Span 1

Partial factor for material properties and resistances

Partial factor for material properties - Table 2.3 γ_M = **1.300**

Member details

Load duration - cl.2.3.1.2 Short-term

Service class - cl.2.3.1.3 1

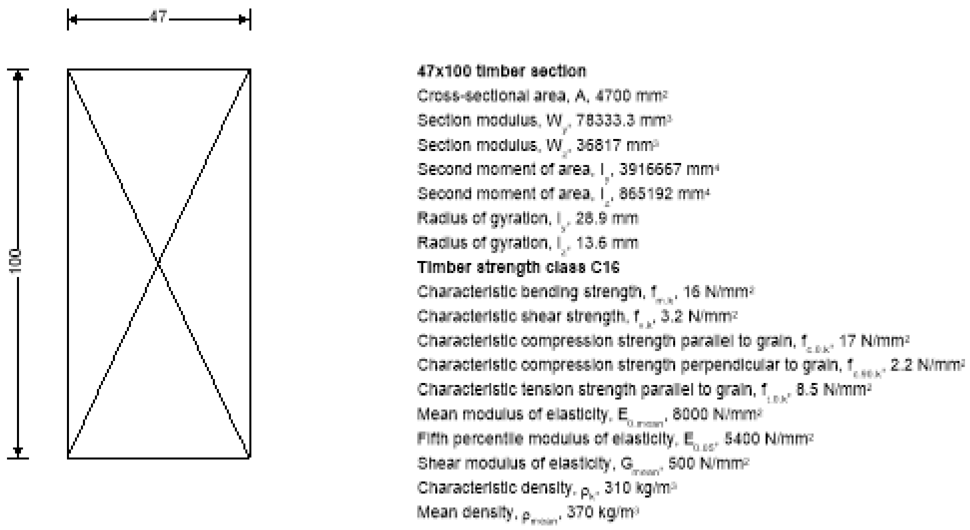
Timber section details

Number of timber sections in member N = **1**

Breadth of sections b = **47** mm

Depth of sections h = **100** mm

Timber strength class - EN 338:2016 Table 1 **C16**



Span details

Bearing length L_b = **50** mm

Consider Combination 1 - 1.35G + 1.50Q (Strength)

Modification factors

Duration of load and moisture content - Table 3.1 k_{mod} = **0.9**

Deformation factor - Table 3.2 k_{def} = **0.6**

Depth factor for bending - Major axis - exp.3.1 $k_{h,m,y} = \min((150 \text{ mm} / h)^{0.2}, 1.3)$ = **1.084**

Bending stress re-distribution factor - cl.6.1.6(2) k_m = **0.7**

Crack factor for shear resistance - cl.6.1.7(2) k_{cr} = **0.67**

System strength factor - cl.6.6 k_{sys} = **1.1**

Check design at start of span

Check compression perpendicular to the grain - cl.6.1.5

Design perpendicular compression - major axis $F_{c,y,90,d}$ = **0.43** kN

Effective contact length $L_{b,ef} = L_b + \min(L_b, 30 \text{ mm})$ = **80** mm

Design perpendicular compressive stress - exp.6.4 $\sigma_{c,y,90,d} = F_{c,y,90,d} / (b \times L_{b,ef})$ = **0.114** N/mm^2

Design perpendicular compressive strength $f_{c,y,90,d} = k_{mod} \times k_{sys} \times f_{c.90.k} / \gamma_M$ = **1.675** N/mm^2

$\sigma_{c,y,90,d} / (k_{c,90} \times f_{c,y,90,d})$ = **0.068**

PASS - Design perpendicular compression strength exceeds design perpendicular compression stress

Check shear force - Section 6.1.7

Design shear force $F_{y,d}$ = **0.43** kN

Design shear stress - exp.6.60 $\tau_{y,d} = 1.5 \times F_{y,d} / (k_{cr} \times b \times h)$ = **0.205** N/mm^2

Design shear strength $f_{v,y,d} = k_{mod} \times k_{sys} \times f_{v.k} / \gamma_M$ = **2.437** N/mm^2

$\tau_{y,d} / f_{v,y,d}$ = **0.084**

PASS - Design shear strength exceeds design shear stress

Check design 1200 mm along span

Check bending moment - Section 6.1.6

Design bending moment $M_{y,d}$ = **0.258** kNm

Design bending stress $\sigma_{m,y,d} = M_{y,d} / W_y$ = **3.293** N/mm^2

Design bending strength $f_{m,y,d} = k_{h,m,y} \times k_{mod} \times k_{sys} \times f_{m.k} / \gamma_M$ = **13.214** N/mm^2

$\sigma_{m,y,d} / f_{m,y,d}$ = **0.249**

PASS - Design bending strength exceeds design bending stress

Consider Combination 2 - 1.00G + 1.00Q (Service)

Check design 1200 mm along span

Check y-y axis deflection - Section 7.2

Instantaneous deflection δ_y = **3.6** mm

Quasi-permanent variable load factor ψ_2 = **0.3**

Final deflection with creep $\delta_{y,Final} = 0.5 \times \delta_y \times (1 + k_{def}) + 0.5 \times \delta_y \times (1 + \psi_2 \times k_{def})$ = **5** mm

Allowable deflection $\delta_{y,Allowable} = L_{m1\_s1} / 360$ = **6.7** mm

$\delta_{y,Final} / \delta_{y,Allowable}$ = **0.75**

PASS - Allowable deflection exceeds final deflection