224319

April 25

STRUCTURAL CALCULATIONS

For

ALTERATIONS

At

10 PARADE STREET
PENZANCE
TR18 4BU

For

MUSIC ABILITY FOUNDATION

Banbury 01295 279719 Cheltenham 01242 323389 Cornwall 01736 317877 Leamington Spa 01926 885287
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Job Name	**10 Parade Street Penzance**		
Date	**April 25**	**By IGH**	**Scale**
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1. DESIGN PRINCIPLES

The following list summarises the main structural principles and assumptions used in the design:

- The existing building has been used for its current purpose in the recent past and was originally built as a library. It is judged that there no net increase in floor loading.

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2. GENERAL NOTES

Notes: TO BE ISSSUED TO AND READ BY PRINCIPAL CONTRACTOR (PC)

General

- PC to comply with all H&S requirements and CDM regulations.
- The General Notes are to be issued to and read by the PC. The General Notes are to be read in conjunction with the structural calculations and drawings, where available.
- Where structural CAD drawings have not been produced with the calculations and markups/sketch details, it is essential that the PC use their expertise to complete structural details in accordance with usual good building practice.
- All dimensions in the structural calculations/drawings are for design purposes only and in many cases scaled from the Principal Designer's (PD) or other available drawings. These dimensions are not to be used for setting out, establishing cut length for beams or other works on site. They must be measured on site and/or agreed by the Client/PD. Site measurements can vary slightly from those indicated.
- All setting out dimensions and levels must be checked and confirmed on site, by site measurements before ordering/cutting any material.
- If any details vary on site from those assumed in these calculations to an extent that it may affect or alter the design, refer back to Engineer.
- The Client and/or Principal Designer (PD) if appropriate, should ensure that the PC/Fabricator is competent to carry out the works specified in the calculations.
- The Client and/or PD if appropriate, should find out if the Party Wall Act applies to the proposed works. HRCE can provide further advice on this, if requested.
- Unless specifically noted otherwise, the production of fabrication drawings for structural steel, engineered timber and timber structural elements, glass, grp or other structural materials - including the steel connection details, bar bending schedules and reinforcement layout drawings - is by the PC/Fabricator/Manufacturer
- The PC must contact us to resolve any queries or element of work not fully understood.

Works to Existing Buildings

- This design is based on the information provided by others (PD/Client/PC) and/or a site inspection limited to the inspection of visible elements of the existing structure at the time. The PC should expose the building structure and make sure that any unforeseen arrangements and details are reported to the Engineer for comment.
- Design and implementation of temporary support of all walls and other associated structural elements by the PC. Ensure supporting floors or ground can carry the temporary loads. The PC should seek the advice of the Engineer or scaffolding and shoring specialist, if in any doubt.

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- The removal of loadbearing walls will lead to cracking of the structure and finishes above. This can be reduced by the correct application of temporary support, but this risk cannot be entirely eliminated.

Trench Fill Foundation

- Any existing foundations encountered are to be grubbed out locally at new foundation positions, to 300mm below the depth of the existing foundation level, and the new foundation formation level is to be at this depth, with stepping to adjoining foundations accordingly.
- All trench fill foundations are to be min. 450mm wide, unless noted otherwise. Minimum thickness of concrete foundation shall be half the foundation width or 300mm, whichever is greater.
- All foundations shall be central about the gridlines unless noted otherwise. The setting out of the foundation in relation to the masonry is as shown on the relevant sections.
- New trench fill foundation, min. 1.0m below external ground level or to suitable strata. All foundation depths are to be measured from the lower of existing or proposed levels. All foundation depths are for initial guidance only – depths should be agreed on site with the Building Inspector, subject to ground conditions and proximity of trees.
- Foundations adjacent to pipe runs or manholes are to have their formation level set above the invert level no higher than the equivalent of the horizontal distance between the pipe/excavation trench and the foundation, minus 500mm.
- Drains passing through foundations to be sleeved to provide min. 50mm clearance all round and masked both sides with vermin proof board. Foundation within 1m of and above drains to be taken down to invert of the drain.
- Construction joints and steps in foundations are to be in accordance with NHBC Standards Chapter 4.4
- All excavations shall be kept free from water, loose material and rubbish etc. The formation level shall not be exposed until the day of the concrete pour.
- Concrete specification:
    - Designation: FND 2.
    - Fibres: Not required.
    - Aggregates:
        - Size (maximum): 20 mm.
        - Coarse recycled aggregates: Not permitted.
        - Consistence class: PC's choice.
        - Additional mix requirements: None
- Concrete sampling and testing shall be carried out in accordance with BS 1881.

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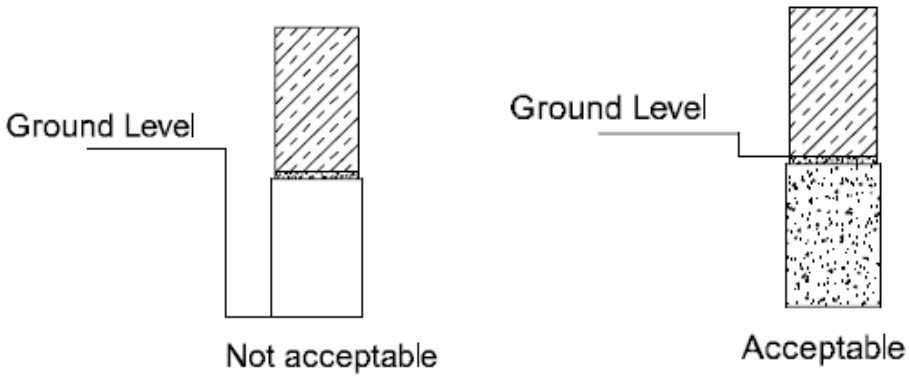
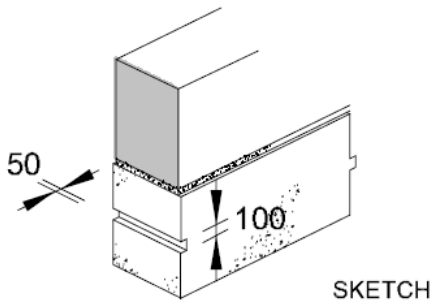
Underpinning

- Extent: as shown on sketches.
- Standards: Mass concrete underpinning to BS EN 1997-1 and BS 8004.
- Assumed bearing strata: 1m below ground level.
- Give notice if:
    - The bearing formation is not as assumed,
    - The formation contains hard or soft spots or highly variable material.
- The underpinning pits and associated concrete works are to be constructed in the following sequence 1, 2, 3, 4, 5.
- All pits to be approximately 1.0m in length, unless noted otherwise.
- The underpinning is to be constructed from the outside, unless noted otherwise.
- A preliminary excavation may be taken down to the whole underside of the existing foundations for the length of the affected wall, but under no circumstances any deeper, see sketches below:



- Allowance must be made for all temporary planking and strutting and any other propping deemed necessary to safely undertake the work.
- Chases or pockets are to be left in vertical stop-ends between underpinning pours, see sketch below. Alternative proposals for the use of dowel bars will be considered.



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- Concrete specification:
    - Designation: RC25/30.
    - Aggregates:
        - Size (maximum): 20 mm.
        - Coarse crushed concrete aggregates (CCA): PC's choice.
        - Consistence class: PC's choice.
        - Additional mix requirements: Temperature limitations for concrete; 30°C (maximum) and 5°C (minimum). Do not place against frozen or frost covered surfaces.
- The mass concrete for the underpinning is to be placed to 75mm below the underside of the existing foundations. After a minimum period of 24 hours the remaining 75mm gap should be packed with 1:3 cement:coarse washed sand (dry pack mortar) of a semi dry consistency.
- Vertical face of the adjacent section of the underpinning concrete is to be scabbled and then soaked with neat cement grout before casting the next underpinning section.
- A period of at least 72 hours must elapse between inserting the dry packed mortar and commencing the excavation of an adjoining section of underpinning.
- All surplus soil and waste to be removed from site and damaged surfaces restored to the present style and standard.

Masonry Walls

- Bricks used for construction should:
    - Be frost resistant (class FL or FN),
    - have a characteristic compressive strength of minimum 20 N/mm^2, unless specified otherwise.
- Blocks used for construction internally, including inner leaf of cavity walls, should:
    - have a characteristic compressive strength of minimum 7 N/mm^2, unless agreed in writing otherwise,
    - be at least 100mm thick using solid, medium density blocks.
- Blockwork below DPC or as outer leaf of cavity walls should have a density of at least 1500 kg/m^3, or a characteristic compressive strength of 7 N/mm^2.
- Mortar mixes are to be Class (iii) M6 (1:1:6 / cement:lime:sand) above DPC and Class (i) M2 (1:1/4:3 / cement:lime:sand) below DPC, unless noted otherwise.
- Cavity wall ties to be stainless steel embedded minimum 50mm in each leaf.
- Ties should be spaced:
    - Horizontally: at 900 mm centres for cavities up to 75mm and 750 mm for cavities over 75 mm
    - Vertically: at 450 mm centres staggered in general and at 225 mm centres at ends or openings
- Vertical movement joints should ideally be provided in all blockwork walls at maximum 6 m centres and at all corners and returns of greater than 550mm in length.
- Where new walls butt up to existing walls, provide:

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  - stainless steel wall starters screw fixed to the masonry with M6 bolts/screws at 450 mm vertical centres,
  - stainless steel sliding ties at 225 mm vertical centres to secure blockwork to wall starter.
- Where internal blockwork abuts steel column, provide:
  - galvanised wall starters screw fixed to steelwork with M6 bolts/screws at 450 mm vertical centres,
  - galvanised sliding ties at 225 mm vertical centres to secure blockwork to wall starter.
- PC to ensure all walls supporting padstones are sound and re-build ends if necessary.
- All opening reveals to be checked for soundness of brickwork and re-built in semi engineering brick if cracked or poorly constructed masonry uncovered.
- All walls to have lateral restraint straps at floor and roof level and wall plates have vertical restraint straps, all straps @ 1.2m c/c unless noted otherwise.

Lintels, Padstones, Precast Concrete

- All lintels should be provided with bearing length equal to their structural depth where possible or to supplier's requirements.
- Lintel calculations for heavy or point load loading situations will be provided, otherwise use:
  - prestressed precast concrete lintels in internal masonry walls,
  - Catnic or similar proprietary cavity wall lintels in external cavity walls.
- All padstones should be placed central under the beams where possible.
- Padstones can be:
  - Precast concrete (minimum 30 N/mm^2) padstones cast to the specified dimensions (min. size 215x215x215 unless noted otherwise),
  - Precast concrete lintel (100mm wide and 145 or 220 mm deep, as specified) cut to the specified length,
  - Brickwork using Class B solid engineering bricks laid in 1:3 (cement:sand) mortar and built to specified dimensions or nearest greater brick size.
- All pre-cast concrete elements to be specialist supplier designed.

Steelwork

- All steel to be grade 355, unless otherwise noted.
- Minimum end bearing of beam 100mm onto concrete padstones, when padstones are perpendicular and 150mm when padstones are in line.
- All steel to be bolted to padstone with 2 no. M12 resin anchors.
- Slate and dry pack to be installed between beams and underside of walls before releasing temporary support.
- All steel members should be blast cleaned and shop primed as a minimum requirement.
- All external steels or steel members within external walls to be galvanised.

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- All steels embedded in concrete or masonry to have 2 coats of bitumastic paint applied to the embedded section plus 150 mm beyond embedment.
- All beams made up of two or more members to have diaphragm connections at maximum 1.0m centres.
- All connections to be formed from 10mm plate or at least the thickness of the flange of the largest member forming the connection.
- All welds to be buff or fillet, full strength full penetration all round profile. Fillet welds to be 6mm all-round profile, unless otherwise specified.
- Where cranked beam is specified, this should be shop fabricated with full strength weld to maintain full structural continuity of member.
- Site welding of any structural steel member is not recommended unless absolutely necessary.
- 4no. M16 8.8 bolts minimum to be used for all UB, UC and PFC connections, and 2no. M20 8.8 bolts minimum for all CHS, SHS and RHS connections, unless otherwise noted.
- Torqued HSFG bolts to be used in close tolerance holes for beam and columns splice connections.
- Steel purlins or ridge beams to have a continuous 50 mm deep timber plate fixed to the top flange of the beam with M10 bolts at 500 mm centres, staggered each side of the web.
- If chemical or expanding anchors are specified in these calculations, they are to be installed in accordance with the manufacturer's recommendations.

Structural Timber

- All new timber to be:
    - C24 softwood, unless otherwise specified,
    - sound and free from any defects or decay,
    - well-seasoned and dry with a moisture content not exceeding 20% in individual pieces at time of construction.
- Rafters to be bird mouthed on to purlins or wall plates and fixed with truss clips nailed through every hole with 9 SWG x 32mm long, square twisted sherardized nails.
- Rafters to be doubled up around rooflights, unless otherwise specified.
- Where new ridge runs into existing roof and is appropriate, the new rafters can be constructed on layboards fixed to the top face of the existing rafters. Layboards to be 25x150 mm unless otherwise specified, double skew nailed to the existing rafters crossed.
- Where timber purlins bear onto supporting walls, they should be connected with traditional splices and jointing methods or using vertical halving joint, minimum 150mm long, bolted with at least 2no. M12 bolts.
- Where timber purlins connect at right angles, use suitably sized heavy duty proprietary joist hangers.
- Purlins, joists and lintels to have min. 100mm bearing on masonry or proprietary joist hangers, unless noted otherwise.
- Provide herringbone strutting or full depth noggins between joists for all spans over 2.5m;
    - Joist spans of 2.5 to 4.5 m: One row at centre span,

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- Joist spans over 4.5 m: Two rows equally spaced.

- Double up all floor joists in bathrooms with a bath.
- All trussed rafters to have 25 x 100 mm K bracing.

Design Codes

All relevant and latest British Standards, in particular:

- BS6399: Part 1 and Part 3 for imposed loading
- BS6399: Part 2 for wind loading
- BS5268: Part 2 and Part 3 for timber
- BS5628: Part 1 to Part 3 for masonry
- BS5950: Part 1 for steelwork
- BS8110: Part 1 to Part 3 for concrete

Part A of Building Regulations

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3. LOADS

Within the building, principle loads arise from the installation of a beam to support a new folding partition.

Outside the building it is proposed to construct a new timber ramp to provide wheelchair access.

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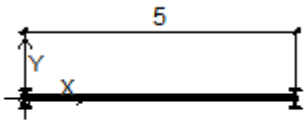
4. BEAM DESIGN

Partiton Support beam as UC

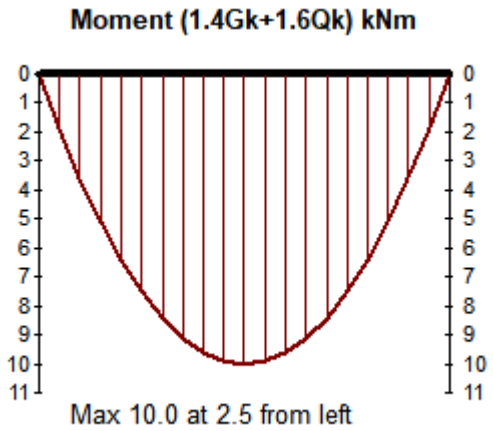
UB / UC bending check

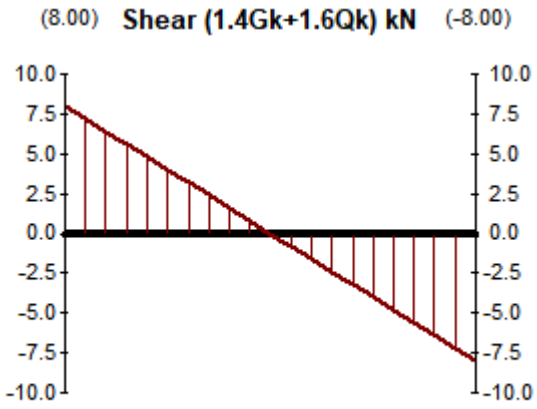


Calculations in accordance with BS5950:Part1:2000 and the SCI 'Steelwork Design Guide to BS5950'

Span		= 5 m
Section size		- 152x152x23 UC
Section class		- 3 (Semi-compact)
Steel grade		- S 355
Design strength of steel		= 355 N/mm2
Design forces	- maximum span moment	= 10 kNm
	- left support reaction	= 8 kN
	- right support reaction	= 8 kN

Load Description	**Type**	**A**	**B**	**C**	**Gk**	**Qk**
Partition	UDL	0	5.0	0.0	2.0	





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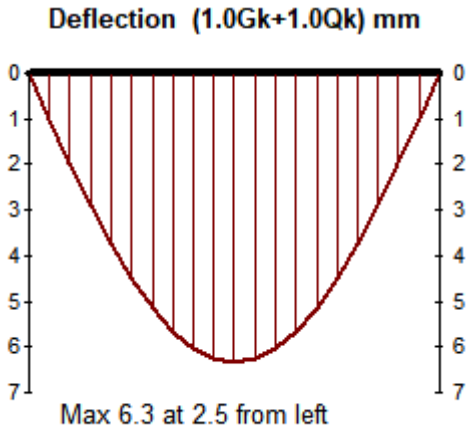

End restraint type: (As defined in Table 13)
Left hand end - Compression flange laterally restrained. Nominal torsional restraint against rotation about longitudinal axis, as detailed in 4.2.2. Both flanges free to rotate on plan.
Right hand end - Compression flange laterally restrained. Nominal torsional restraint against rotation about longitudinal axis, as detailed in 4.2.2. Both flanges free to rotate on plan.

Section unrestrained over its length.
Beam subject to destabilising loads.

Determine capacity of the section

Shear capacity

In accordance with clause 4.2.3.

Pv = 0.6*py*Av

where Av = D*t
= 882 mm2

and hence Pv = 0.6*py*Av/103
= 187.9 kN

The maximum applied shear force is less than 0.6*Pv, hence section subject to LOW SHEAR.

Moment capacity

The section capacity for low shear in accordance with clause 4.2.5 is

Mcx = py*Zxx/106
= 58.2 kNm

As the effective plastic modulus, calculated in accordance with clause 3.5.6, exceeds the section modulus the section capacity can be increased to

Mcx = py*Sxxeff/106
= 60.5 kNm

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Lateral torsional buckling

Determine effective length of beam

Effective length for left hand restraint condition
Le left = 1.2*span
and for the right hand restraint condition
Le right = 1.2*span
the average of this giving the effective length of the beam as
Le = 6000 mm

Check lateral torsional buckling of the section, where in accordance with clause 4.3.6.2, the following condition should be satisfied
Mx <= Mb / mLT

where Mx - the maximum major axis moment of the segment
Mb - the lateral torsional resistance moment
mLT - the equivalent uniform moment factor

In accordance with clause 4.3.6.6. and the equation in Table 18:

Sub-beam subject to destabilising loads - mLT = 1

Lateral torsional resistance moment

Based on the equivalent slenderness, to clause 4.3.6.7:
lLT = u * v * l * (bw)^0.5
where l = Le/ryy
= 162.16
u = 0.84
and from Table 19, based on n = 0.5 and l/x = 7.83
v = 0.7
and from clause 4.3.6.9. for a class 3 section
bw = 0.937

hence lLT = u*v*l*(bw)0.5
= 92.30
and using Appendix B.2.1 Mb = 26.7 kNm
(Note: Mb can never be greater than Mcx)

Mb / mLT = 26.7 kNm and is not exceeded by the maximum major axis moment 10 kNm, section OK.

Deflection

The maximum deflections for E = 205000 N/mm2
Ixx = 1250 cm4

for total load dtot = 6.3 mm

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and for imposed load $\frac{(span / 794)}{dimp} = 6.3\ mm$

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Partition Beam as SHS

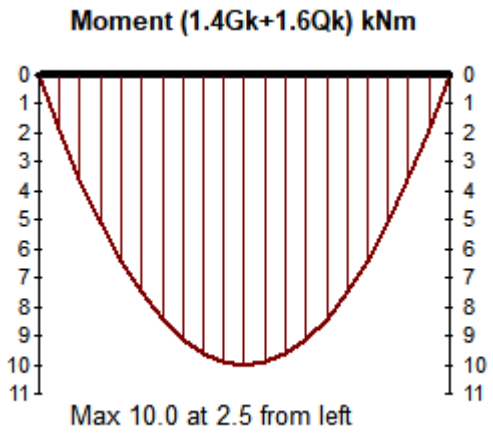
SHS/RHS bending check (Hot rolled sections only)

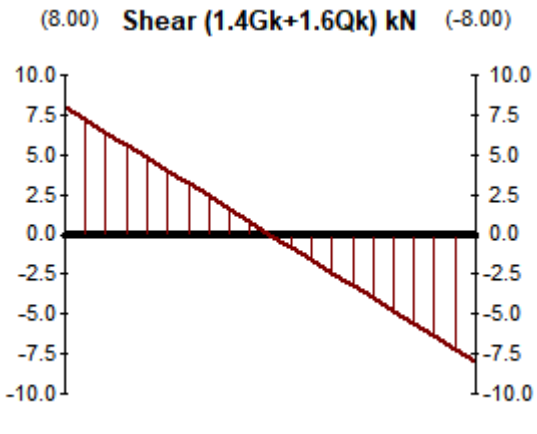
Calculations in accordance with BS5950:Part1:2000 and the SCI 'Steelwork Design Guide to BS5950'

Span = 5 m
Section size - 150x150x5.0 RHS
Section class - 2 (Compact)
Steel grade - S 355
Design strength of steel = 355 N/mm2

Design forces - maximum span moment = 10 kNm
- left support reaction = 8 kN
- right support reaction = 8 kN

Load Description	Type		A	B	C	Gk	Qk
Partition	UDL	0	5.0	0.0	2.0		





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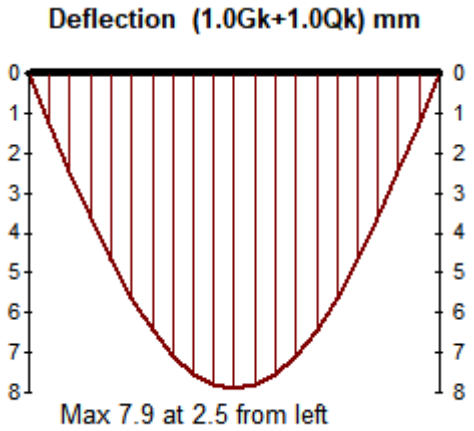

End restraint type: (As defined in Table 13)
Left hand end - Compression flange laterally restrained. Nominal torsional restraint against rotation about longitudinal axis, as detailed in 4.2.2. Both flanges free to rotate on plan.
Right hand end - Compression flange laterally restrained. Nominal torsional restraint against rotation about longitudinal axis, as detailed in 4.2.2. Both flanges free to rotate on plan.

Section unrestrained over its length.
Beam subject to destabilising loads.

Determine capacity of the section

Shear capacity

In accordance with clause 4.2.3.

Pv = 0.6*py*(D/D+B)*A

hence Pv = 0.6*py*(D/(D+B))*A/103
= 305.7 kN

The maximum applied shear force is less than 0.6*Pv, hence section subject to LOW SHEAR.

Moment capacity

The section capacity for low shear in accordance with clause 4.2.5 is

Mcx = py*Sxx/106
= 55.4 kNm

Lateral torsional buckling

Determine effective length of beam

Effective length for left hand restraint condition

Le left = 1.2*span

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and for the right hand restraint condition

Le right = 1.2*span

the average of this giving the effective length of the beam as

Le = 6000 mm

The limiting slenderness ratio for an RHS section with a depth to breadth ratio of 1 from table 15 is unrestricted.

The actual slenderness ratio 101.695 is not greater than the limiting slenderness ratio and in accordance with clause 4.3.6.1. no check is required for lateral torsional buckling.

Deflection

The maximum deflections for E = 205000 N/mm2

Ixx = 1000 cm4

for total load dtot = 7.9 mm

(span / 633)

and for imposed load dimp = 7.9 mm

(span / 633)

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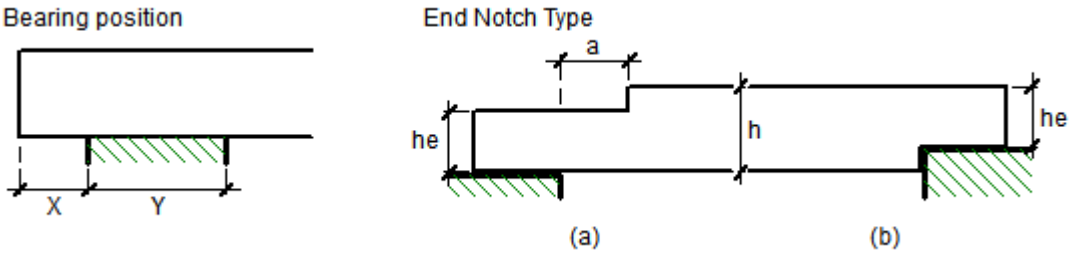
External Ramp Deck Joists

Joist section design



Calculations for timber joists are in accordance with BS5268:Pt 2:2002

Joist size - 47 wide x 200 deep
Timber type - Sawn Softwood as Table NA.2 of BS EN 336

Span of joist = 2.3 m
Span type - Simple

End bearing - left hand end X = 0 mm
Y = 50 mm
- right hand end X = 0 mm
Y = 50 mm
End notches - left hand end - none specified
- right hand end - none specified

Joist centres = 400 mm
Strength class from Table 8 (service classes 1 & 2) - C24

Service class - 2 (Covered and heated or unheated)

Maximum design moment = 3.64 kNm/m
Design shear force at left hand support = 6.33 kN/m
Design shear force at right hand support = 6.33 kN/m

Load Description	**Type**	**A**	**B**	**C**	**Gk**	**Qk**
Floor	UDL	0	2.3	0.5	5.0	

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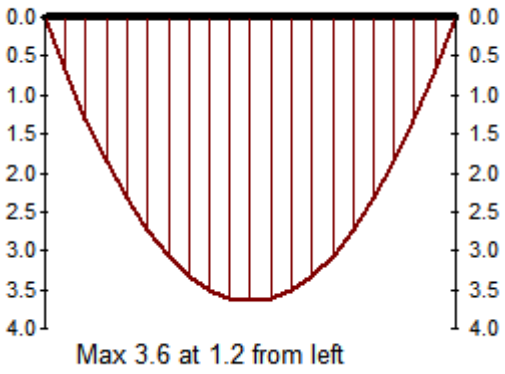
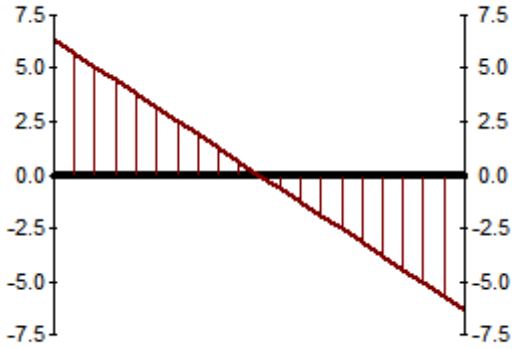
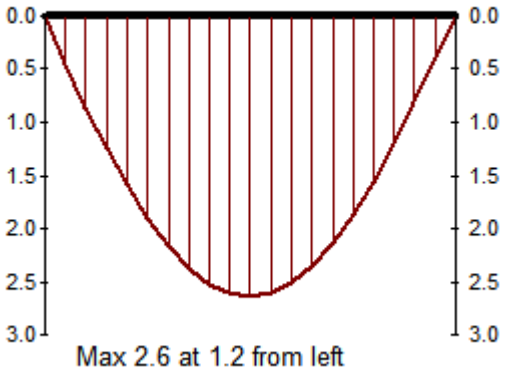
Moment (1.0Gk+1.0Qk) kNm



(6.33) **Shear (1.0Gk+1.0Qk) kN** (-6.33)



Deflection (1.0Gk+1.0Qk) mm



Grade stresses - from Tables 8 and 9

Bending parallel to grain = 7.5 N/mm2
Shear parallel to grain = 0.71 N/mm2
Compression perpendicular to grain = 2.4 N/mm2
(wane prohibited at bearing areas)

Modification factors

For service class 2	- moment	K2M	= 1
	- shear	K2V	= 1
	- bearing	K2B	= 1
	- Youngs mod	K2E	= 1
	- Shear mod	K2E	= 1
For load duration	- long	K3	= 1
For end bearing	- left end	K4l	= 1
	- right end	K4r	= 1
For no end notch	- left end	K5l	= 1
For no end notch	- right end	K5r	= 1
For depth between 72 and 300mm		K7	= (300/h)0.11

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= 1.05

For load sharing system K8 = 1.1

Bending Design

The allowable bending stress is

sbpall = sbp*K2M*K3*K7*K8
= 8.66 N/mm2

The moment per metre width of floor is 3.64 kNm/m. Hence, the moment per joist is

Mj = M*jcc/1000
= 1.46 kNm

giving the required section modulus per joist as

zreqd = Mj*106/sbpall
= 168591 mm3

The section modulus of the joist chosen is 313000 mm^3.

Shear Design

Left hand support

The allowable shear stress is

scpaall = scpa*K2V*K3*K5l*K8
= 0.78 N/mm2

The shear per metre width of floor is 6.33 kN/m. Hence, the shear per joist is

Rlj = Rl*jcc/1000
= 2.53 kN

giving the required cross sectional area per joist as

Alreqd = 3*Rlj*103/(2*scpaall)
= 4865 mm2

The cross sectional area of the joist chosen is

Alprov = b*h
= 9400 mm2

Right hand support

The allowable shear stress is

scpaall = scpa*K2V*K3*K5r*K8
= 0.78 N/mm2

The shear per metre width of floor is 6.33 kN/m. Hence, the shear per joist is

Rrj = Rr*jcc/1000
= 2.53 kN

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giving the required cross sectional area per joist as

Arreqd = 3*Rrj*103/(2*scpaall)
= 4865 mm2

The cross sectional area of the joist chosen is

Arprov = b*h
= 9400 mm2

Bearing Design

Left hand support

The allowable bearing stress is

scpeall = scpe*K2B*K3*K4l*K8
= 2.64 N/mm2

The shear per joist is 2.53 kN, giving the required bearing area as

Ablreqd = Rlj*103/scpeall
= 958 mm2

The bearing area of the joist chosen is

Ablprov = b*Yl
= 2350 mm2

Right hand support

The allowable bearing stress is

scpeall = scpe*K2B*K3*K4r*K8
= 2.64 N/mm2

The shear per joist is 2.53 kN, giving the required bearing area as

Abrreqd = Rrj*103/scpeall
= 958 mm2

The bearing area of the joist chosen is

Abrprov = b*Yr
= 2350 mm2

Deflection check

The deflection calculated includes for shear deflection and is based on the following

- For a loadsharing system
- Youngs modulus - E = 10800 N/mm2
- Shear modulus - G = 675 N/mm2
- Shape factor - F = 1.2 (for rectangular sections)

and section properties of

- Area - A = 94 cm2
- Mom. of inertia - I = 3130 cm4

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The maximum calculated deflection is 2.6 mm.

The allowable deflection in accordance with clause 2.10.7 is 6.9 mm (0.003*span).

The section PASSES all checks

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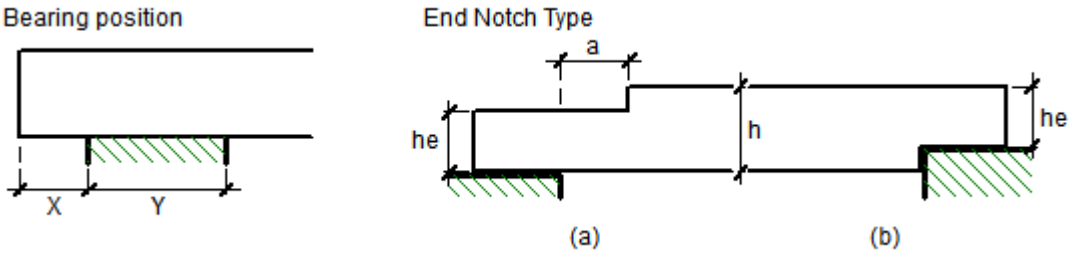
Trimmers to deck changes of direction

Beam/lintel section



Calculations for timber beams/lintels are in accordance with BS5268:Pt 2:2002

Number of parallel pieces making up beam/lintel = 2
Section size of each timber - 47 wide x 200 deep
Timber type - Sawn Softwood as Table NA.2 of BS EN 336

Span of beam/lintel = 1.4 m
Span type - Simple

End bearing - left hand end X = 0 mm
Y = 50 mm
- right hand end X = 0 mm
Y = 50 mm
End notches - left hand end - none specified
- right hand end - none specified
Strength class from Table 8 (service classes 1 & 2) - C24

Service class - 2 (Covered and heated or unheated)

Maximum design moment = 2.88 kNm
Design shear force at left hand support = 8.23 kN
Design shear force at right hand support = 8.23 kN

Load Description	**Type**	**A**	**B**	**C**	**Gk**	**Qk**
Bearer	UDL	0	1.4	1.0	10.75	

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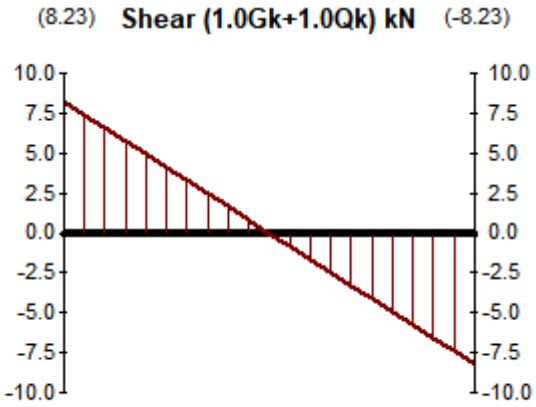

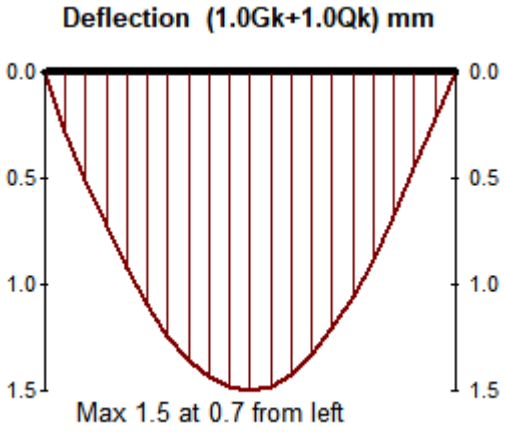

Grade stresses

Bending parallel to grain = 7.5 N/mm2
Shear parallel to grain = 0.71 N/mm2
Compression perpendicular to grain = 2.4 N/mm2
(wane prohibited at bearing areas)

Modification factors

For service class 2	- moment	K2M	= 1
	- shear	K2V	= 1
	- bearing	K2B	= 1
	- Youngs mod	K2E	= 1
	- Shear mod	K2E	= 1
For load duration	- long	K3	= 1
For end bearing	- left end	K4l	= 1
	- right end	K4r	= 1
For no end notch	- left end	K5l	= 1
For no end notch	- right end	K5r	= 1
For depth between 72 and 300mm		K7	= (300/h)0.11

DO NOT ORDER MATERIALS BEFORE REMOVING FINISHES AND TAKING SITE DIMENSIONS.
THESE CALCULATIONS MUST NOT BE USED FOR ORDERING OF MATERIALS.

= 1.05

For load sharing system K8 = 1.1

For 2 pieces of softwood K9 = 1.14

The section is checked assuming that all the pieces of the beam/lintel act together as a load sharing system. The pieces must be connected together in such a manner to ensure this is achieved.

Bending Design

The allowable bending stress is

sbpall = sbp*K2M*K3*K7*K8
= 8.66 N/mm2

The required section modulus is

zreqd = M*106/sbpall
= 332564 mm3

The section modulus of the beam/lintel chosen is 626000 mm^3.

Shear Design

Left hand support

The allowable shear stress is

scpaall = scpa*K2V*K3*K5l*K8
= 0.78 N/mm2

The required cross sectional area is

Alreqd = 3*Rl*103/(2*scpaall)
= 15827 mm2

The cross sectional area of the beam/lintel chosen is

Alprov = Ntim*b*h
= 18800 mm2

Right hand support

The allowable shear stress is

scpaall = scpa*K2V*K3*K5r*K8
= 0.78 N/mm2

The required cross sectional area is

Arreqd = 3*Rr*103/(2*scpaall)
= 15827 mm2

The cross sectional area of the beam/lintel chosen is

Arprov = Ntim*b*h
= 18800 mm2

DO NOT ORDER MATERIALS BEFORE REMOVING FINISHES AND TAKING SITE DIMENSIONS.
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Bearing Design

Left hand support

The allowable bearing stress is
scpeall = scpe*K2B*K3*K4l*K8
= 2.64 N/mm2

The required bearing area is
Ablreqd = Rl*103/scpeall
= 3117 mm2

The bearing area of the beam/lintel chosen is
Ablprov = Ntim*b*Yl
= 4700 mm2

Right hand support

The allowable bearing stress is
scpeall = scpe*K2B*K3*K4r*K8
= 2.64 N/mm2

The required bearing area is
Abrreqd = Rr*103/scpeall
= 3117 mm2

The bearing area of the beam/lintel chosen is
Abrprov = Ntim*b*Yr
= 4700 mm2

Deflection check

The deflection calculated includes for shear deflection and is based on the following material properties which incorporate modification factors K2 and K9 as appropriate.

- Young's modulus - E = 8208 N/mm2
- Shear modulus - G = 513 N/mm2
- Shape factor - F = 1.2 (for rectangular sections)

and section properties of

- Area - A = 188 cm2
- Mom. of inertia - I = 6260 cm4

The maximum calculated deflection is 1.5 mm.

The allowable deflection in accordance with clause 2.10.7 is 4.2 mm (0.003*Span).

The section PASSES all the checks.

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Job Name	**10 Parade Street Penzance**		
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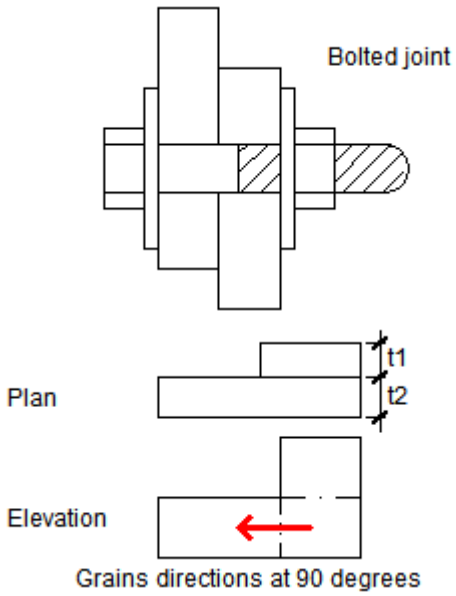
Connection of timber to wall

Bolted timber connection



Calculations are done in accordance with BS5268-2:2002
Bolts should conform to BS EN 20898-1 and have a minimum tensile strength of 400 N/mm2
Washers should conform to BS 4320.
Bolt holes should be drilled to diameters as close as practicable to the nominal bolt diameter.
In no case should they be more than 2 mm larger than bolt diameter.
Bolts should protrude a minimum of one complete thread from the nut.
Nominal diameter of washer is 3d (60 mm)
Nominal washer thickness is d/4 (5 mm)

Input details

Axial load carried by the joint	F	=	2 kN
Duration of loading		-	Long term
Timber 1 - strength class		=	C24
Timber 2 - strength class		=	C24
Joint made in service class 1			
Joint type		-	Two member timber to timber joint
Connection type		-	Grains at 90 degrees to each other
Thickness of member 1	t1	=	50 mm
Thickness of member 2	t2	=	100 mm
Angle between grain and load for member 1			
	a1	=	0 degrees
Angle between grain and load for member 2			
	a2	=	90 degrees
Fastener type		-	Bolt
Bolt grade		-	G4.6
Fastener spacing parallel to grain			

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apar = 80 mm
Fastener diameter d = 20 mm

Design results
Permissible bolt load = 5.96 kN
Number of bolts required = 1

Loaded end distance parallel to grain = 140 mm (7d)
Loaded end distance per. to grain = 80 mm (4d)
Unloaded end distance (parallel & per.) = 80 mm (4d)
Loaded edge distance parallel to grain = 30 mm (1.5d)
Loaded edge distance per. to grain = 80 mm (4d)
Unloaded edge distance (parallel & per.) = 30 mm (1.5d)
Distance between bolts or bolt rows = 80 mm (4d)

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5. STRUCTURAL LAYOUT

See mark up drawings as follows:

224319 SK01 to SK05

DO NOT ORDER MATERIALS BEFORE REMOVING FINISHES AND TAKING SITE DIMENSIONS.
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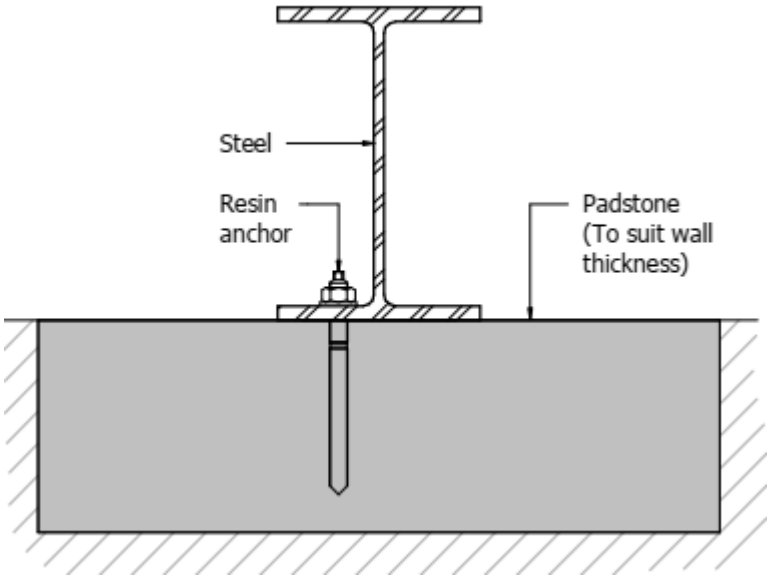
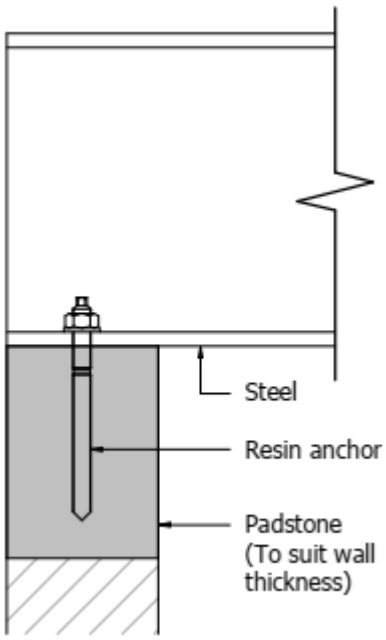
6. DETAILS

TYPICAL DETAIL – PADSTONE PERPENDICULAR WITH BEAM





Note
Detail is generic, steel section may differ from UB, shown. The relevant issued drawings should be followed with a similar fixing detail used for other steel sections

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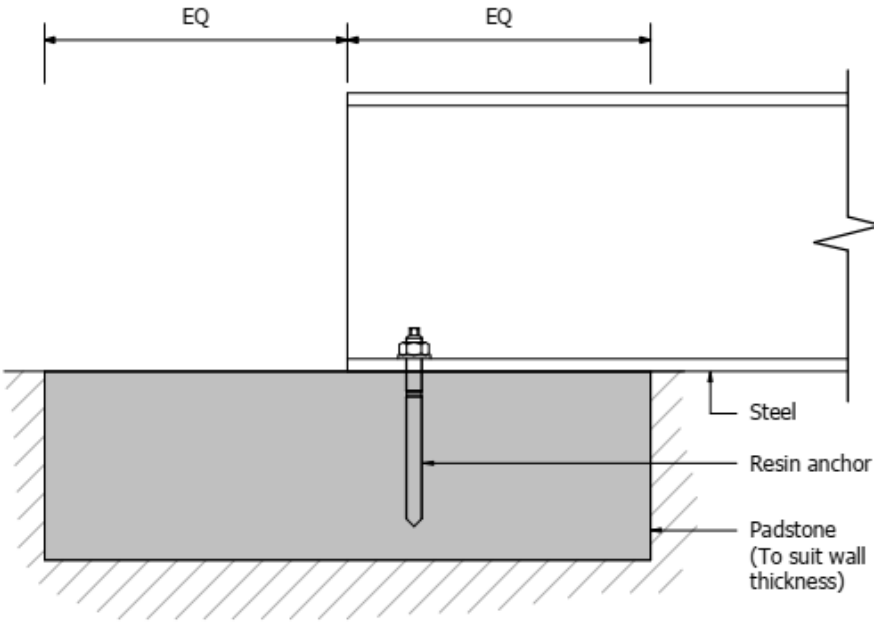
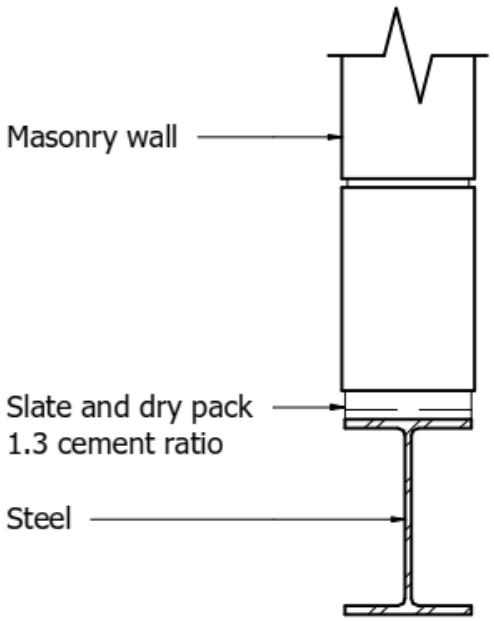
TYPICAL DETAIL – PADSTONE PARALLEL WITH BEAM



Note
Detail is generic, steel section may differ from UB shown. The relevant issued drawings should be followed with a similar fixing detail used for other steel sections

TYPICAL DETAIL – STEEL BEAM UNDER WALL SUPPORT



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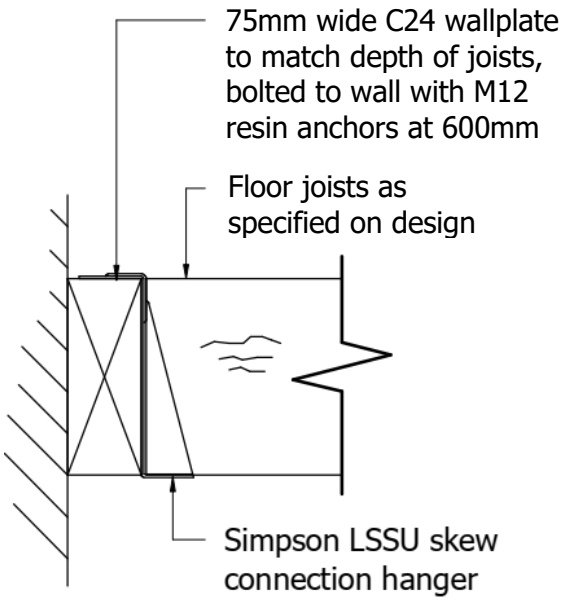
TYPICAL DETAIL – WALLPLATE DETAIL



DO NOT ORDER MATERIALS BEFORE REMOVING FINISHES AND TAKING SITE DIMENSIONS.
THESE CALCULATIONS MUST NOT BE USED FOR ORDERING OF MATERIALS.

Harban
Redwood
Consulting Engineers