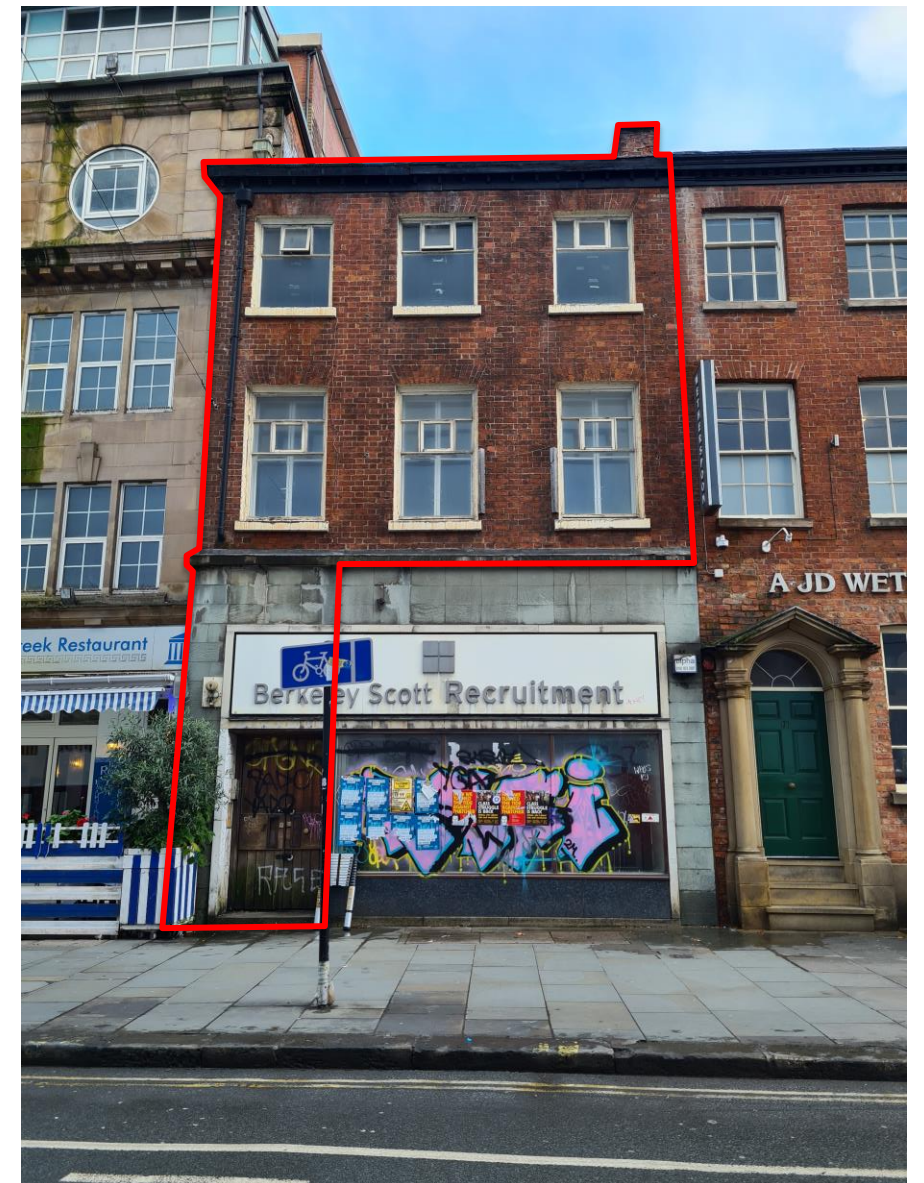




65 Princess Street, Manchester
Structural Engineering Review
23 February 2023

Jonathan McArdle CEng MICE

Studio One Job Number: 043_001

65 Princess Street, Manchester
Structural Engineering Review

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1. Summary

This summary gives an overview of the structural engineering walkover assessment carried out by Studio One Consulting Limited to support Paul Cox Design planning submission to Manchester City Council. Commentary on the proposed end-use is provided in a later section of the report, which responds to the architectural brief.

It should be noted that not all areas of the existing structure were exposed at the time of our site visit. Further works may be required (as may be informed by further areas of opening up and more structure exposed). The structural engineering walkover assessment was limited to that visible on the day of our inspection.

The summary opposite is presented on a 'traffic light' panel system:

- Red = key item requiring action
- Amber = Items presenting risk and requiring further consideration or treatment
- Green = items appearing structurally adequate

Further surveys are recommended, as follows, to inform the final scope of works:

- Further inspection pending full strip of existing fixtures and fittings, finishes to floors, walls and suspended ceilings that are not required for the proposed use
- Survey of existing roof coverings may be considered (we have reported on limited inspection of roof structure only)
- Timber survey by specialist may be considered and may be advisable subject to the above strip out and further inspection.

Items requiring **action**:

1. **Drainage** to adjoining properties currently discharging onto the site should be diverted.
2. Repair **flashing** to the outrigger monopitch roof to mitigate future structural issues.

Items presenting **risk** and requiring further consideration or treatment

3. **Given the age of the property further defects may be present and require attention.** Soft strip demolition of all existing finishes that are not being retained, such as suspended ceilings and wall linings, is advisable to inform this aspect.
4. **Lateral floor restraint straps** are unlikely to be present due to the age of the property and will require installing between the timber joists and perimeter loadbearing walls.
5. **Floor strengthening may be required in specific areas** (installation of supplementary joists and/or steels to underside of floor joists. Floor at second floor is dished and may require strengthening; strengthening of further areas may be required.
6. Remove **debris** from the roof space to prevent any overloading of the ceiling structure.
7. **Survey roof coverings and chimney** and / or consider re-roofing.
8. **Repointing and re-rendering** are not structural items but can help resist water penetration. Client may wish to carry out to both elevations.
9. **Risks relating to ground floor / basement** levels will need to be managed. Defects may be found and may require attention in the future. The basement should be dried and ventilated / kept dry.

Items appearing **structurally adequate**

10. Loadbearing structural walls appear reasonable condition.
11. Majority of timber floor joists appear reasonable where inspected.
12. Existing steelwork / floor strengthening has previously been installed in some areas.

2. Introduction

Studio One Consulting Limited has been instructed to undertake a structural engineering inspection of 65 Princess Street, Manchester, M2 4EG and report on findings to support planning dialogue. Studio One were instructed by email dated 17 October 2022 by Gian Wong (Anderton Gables) on behalf of Axis Property Consultancy LLP.

This report considers the existing condition of the building and works required to maintain structural robustness and condition, which is based on a site walkover dated 27 October 2022, and the works required for its intended use; an office at first and second floor.

The visual inspection of the building was carried out with opening-up of the existing structure at positions agreed with Axis Property Consultancy LLP (Client) and Studio One Consulting Ltd. Only structure that was visible was inspected. Further defects may be present, and may become apparent, once more of the structure is opened-up at a later date i.e. behind wall coverings.

The proposed use is to be an office at first and second floor. Minor structural alterations to internal structure are to be carried out to convert the current structural arrangement into a layout more suitable for the proposed end use.

The imposed load of 2.5 kN/m^2 is suitable for light office (office without storage or heavy items).

Corridors and circulation spaces (stairs) are expected to be suitable for imposed load up to 4.0 kN/m^2 . This has not been assessed.

This is a revised report version to consider defects and works in response to structural condition at first floor and second floor only.



Figure 1: Front elevation of 65 Princess Street

3. Condition of Existing Structure

3.1. Basement

The structural condition of the basement is not reported on in this report.

3.2. Ground Floor

The condition of the ground floor is reported on, however not all works are not understood to be carried out as part of this phase. We understand that only works to the entrance lobby are to be carried out.

From the visual inspection, there did not appear to be any significant signs of distress to the ground floor structure, including the floor joists and loadbearing walls.

No cracking was evident in the plaster to the loadbearing walls. There is evidence of water staining and mould growth adjacent to the entrance, adjoining Rozafa restaurant. It appears as though this is the intersection of a perished downpipe on the adjacent property, not attributed to 63 Princess Street. Refer to Figure 7.

The underside of the floor was viewed in 5 no. locations, with joist spacings, sizes and condition noted. There is typically a mix of existing joists and new joists installed to the ground floor with varying depths, widths and spacings dependent on span. Joists were found to be in fair condition. No notching of the joists was noted however this was based on limited inspection of the 5 no. locations. The span and joist dimensions are noted on the structural drawings found within the appendix.



Figure 2: View of water damage to party wall and perished downpipe on adjacent property

3.3. First Floor

Most of the existing finishes were still intact to the first floor. Targeted areas of the floor were opened up for inspection, primarily at external and party walls, and at joist centre spans. No movement in the loadbearing walls was noted from the interior of the building. Floor appeared to be level and was not suffering any excessive deflection (considered only by eye, floor structures have not been surveyed / measured for level by Studio One).

Floorboards from above were removed in 3 no. locations. The joists were found to be trimmed around previous fireplaces (continuous from basement foundations to roof). Some existing joists were doubled up with newer joists and some notching of the existing joists evident in places. Notches were typically narrow and shallow.

A steelwork beam (most likely paired) was visible at the front elevation over the existing window opening. It was in fair condition with no corrosion in the limited area inspected.

3.4. Second Floor

Similar construction as the first floor, with floorboards removed in 3 no. locations. The joists were found to be trimmed around previous fireplaces. Some existing joists were doubled up with newer joists and some notching of the existing joists evident in places. Notches were typically narrow and shallow (up to 25-30 mm approx.)

It was noted that there is dishing effect to the existing floor structure in the room on the front elevation and room on the rear elevation. Whilst the actual deflection was not measured, it appears (by eye) to be circa 20-30 mm. This is evident from the underside at first floor with cracking in the plasterboard ceiling in a cruciform pattern – refer to figure 8.

Dishing appears to be a historic issue. The new joists installed to the side of the existing have been installed level at the supports, with deflection evident in the existing joist where the level between tops of joists differs at mid-point.



Figure 3: First Floor looking towards front elevation with cracking to ceiling



Figure 4: Second Floor front room looking towards front elevation with dishing in floor plate



Figure 5: Second Floor rear room looking towards rear elevation with dishing in floor plate

3.5. Roof

Stepladder access was provided into the roof space from second floor. The roof is a single, central timber truss spanning between the front and rear elevation walls, with central support from the loadbearing wall. Timber purlins span between the truss and loadbearing party walls, with rafters over. It appears that most rafters (number not quantified) have been replaced with new softwood timbers since they appear lighter in colour. There is a central walkway with a build-up of debris. Further debris is evident across the ceiling finishes to second floor, including bricks.

Roof trusses appear to be in fair condition. Rafter and purlin ends appear to be dry.

A water tank is located on the party wall with The Waterhouse pub. It is not clear whether this is mounted on ceiling joists or the existing wall, due to limited access into the roof space.

Roof coverings from the exterior of the building were not visible. There did not appear to be 'daylight' coming through the main roof coverings.

3.6. Front Elevation

The front elevation appears to be fair condition. There is some staining on the elevation but it does not appear that any defects are attributed to it. Some water staining is evident where the rainwater pipe turns internal (left side) at first floor level.

Tiles at first floor over the entrance appear to be concealing the steel beams over the entrance. Condition of the steels is unknown.

3.7. Rear Elevation

The main property rear elevation appears to be in fair condition. There is some moss growth adjacent to the lightwell into the basement attributed to wet conditions. No cracking appears to be evident in the render on the external elevation from the visual inspection.

The outrigger adjacent to The Waterhouse appears to be a later addition add-on that is not in good condition. Brickwork in numerous areas appears to be in poor condition with vegetation growth at roof level. There is a large accumulation of debris within the mono pitch roof towards the gutter outlet.

A second outrigger is present that abuts Rozafa Restaurant, which is three storeys in height (basement + ground + first floor) with mono pitch roof with high point on the party wall. Behind the outrigger is an area of brickwork construction that is in poor condition. The property to the rear discharges its roof surface water through the construction into the manhole within the property's redline boundary. There is significant vegetation growth within this small construction area, which is likely to be attributed to presence of water; potentially from the adjacent property roof discharge, or collection within the corner of the construction. Further rainwater goods from adjoining properties discharge into the site. There is also 'daylight' seen through the existing roof finishes as observed through the roof hatch in the toilet at first floor level. It appears that the roof flashing has perished.



Figure 6: Top – Roof Void, Middle – Rear + Front Elevations, Bottom – Rear Elevations

4. Works Required in Response to Structural Condition

4.1. Basement

Works to the basement are not proposed. We are not aware of defects in the basement presenting significant risk that need to be addressed immediately. Defects may non the less be found to require attention in the future. The basement should be dried and ventilated / kept dry.

4.2. Ground Floor

The water ingress adjacent to the entrance hallway should be addressed. This may not be attributed to an issue from 63 Princess Street, it is likely to be from the adjacent property.

4.3. First Floor

Remove wall coverings between first floor and underside of second floor to determine whether any movement has occurred in the walls. Inspect and advise on any works required.

Install lateral restraint floor straps to joists at centres as required by the manufacturer. This is to tie the floor to the external walls for robustness.

Whilst not structural, it would be prudent to locally remove cracked ceiling plaster and replace with new. This could be integrated with any acoustic / thermal / fire treatment works as noted in Section 5.

4.4. Second Floor

Where dishing has occurred in the floor further assessment will need to be carried out of the existing joists. Floor loading capacity is covered in the next section of the report. It is likely that additional joists are to be installed to stiffen the floor plate and existing joists lifted to make the floor level.

Remove wall coverings between second floor and eaves level to determine whether any movement has occurred in the walls. Inspect and advise on any works required.

Install lateral restraint floor straps to joists at centres as required by the manufacturer. This is to tie the floor to the external walls for robustness.

Whilst not structural, it would be prudent to locally remove cracked ceiling plaster and replace with new. This could be integrated with any acoustic / thermal / fire treatment works.

4.5. Roof

Debris accumulating next to the walkway may cause overloading of the ceiling structure. Remove debris and discard.

Carry out inspection of the roof coverings from the exterior of the building. Advise on any works required.

4.6. Front Elevation

No structural works appear to be required as viewed during the visual inspection. If the tiles that cover the existing steelwork beam are removed, it would be advisable to inspect the steel and carry out any repairs / waterproofing treatment.

The Client may wish to re-point the brickwork (to mitigate water ingress) and clean staining from the elevation if desired.

4.7. Rear Elevation

Whilst not structural, it would be advisable to repair the flashing to the outrigger adjacent to Rozafa to mitigate any future structural issues with the monopitch roof.

It would be advisable to clean up the rear elevation to the main property by removal of the existing render and reapplying it as it will provide a degree of weatherproofing to the external walls. Inspect structure for cracking upon removal of render. Moss growth within the courtyard should be cleared.

The area of poor brickwork to the second outrigger adjacent to Waterhouse will need extensive masonry repairs and the damp addressing in the corner.

Drainage currently discharging into the property from the adjacent properties should be diverted to their own system.

The outrigger forming toilet/kitchen area may wish to be cleared of existing render and render reapplied, subject to architectural requirements.

5. Load Appraisal of Existing Floor Structure

The structural works described below, and also as noted on the sketches found in the appendix, respond to the architectural brief. For architectural requirements refer to the Architect’s information.

A suite of structural engineering details can be found in Appendix B, which detail typical structural engineering details which can be found around the proposed building refurbishment.

5.1. Proposed Use

A load appraisal has been undertaken to determine the residual capacity of the various timber joisted floor structures. The appraisal accounts for the proposed end use of the building and the applying of superimposed dead loads such as finishes, services, ceilings and acoustic/thermal/fire treatment.

According to BS 6399-1, the following imposed loading is to be adopted for the proposed uses and their respective areas:

- **Proposed First and Second** – Office – 2.5 kN/m²
- **Proposed First and Second** – Circulation – 4.0 kN/m²

The imposed load of 2.5 kN/m² is suitable for light office (office without storage or heavy items).

Moveable partition loading is not considered in the calculations. The proposed office is open-plan and it is envisaged that moveable partitions will not be used.

Further consideration should be given to circulation spaces at first and second floor for the localised enhanced loading. Ground floor area 1 has been considered for this load at the building entrance in principle based on the residual capacity available.

Studio One attended site on 27 October 2022 following opening up of the floor structure in 11 no. locations across the various floor plates to determine the joist span, spacing and sizes. Jonathan McArdle, Associate for Studio One, attended site to carry out the inspection.

The joists were a mix of existing timber joists and new timber joists, with varying depths and sizes according to their span length. Some joists were noted to be doubled up with new joists sitting alongside existing joists. The arrangements are shown on the structural sketches found within the appendix.

The load appraisal has found that the residual capacity of the joists in supporting superimposed dead load (finishes, ceiling + services and acoustic treatment) at the various floor levels is as follows:

- **First** – **-0.35 kN/m²** (deficit)
- **Second** – **+0.39 kN/m²**

The loading in the analysis considers joist dead load + superimposed dead load (from existing suspended ceiling & services + existing timber boarding) + imposed load (office). The residual capacity is the permissible loading available to new floor finishes and any thermal, acoustic and/or fire treatment to the existing floor structure in the proposed case.

At first floor, it appears that 2 areas (as defined in areas 2 and 4) would require structural enhancements (supplementary joists and/or steelwork beams) to meet requirements for any level of superimposed dead load. Area 3 may also require enhancements, subject to receipt of final floor treatment proposals.

At second floor, the joists have a residual capacity that may meet the requirements of new finishes. This is subject to receipt of final floor treatment proposals. This does not take into consideration the dishing effect that was noticed during site inspections.

Area	Location	Dimensions				Assumed Strength Class	Permissible		Applied		σ _{residual} (N/mm²)	Indicative Capacity for New Construction (kN/m²)	Indicative Capacity for New Construction (kg/m²)	Status
		h (mm)	b (mm)	Spacing	L (mm)		σ _p (N/mm²)	σ _{ll} (N/mm²)	σ _{ll} (N/mm²)	σ _{ll} (N/mm²)				
1	Ground Floor	175	75	420	1930	C16	6.186	2.347	3.839	3.16	321.74	Appears adequate		
2	First Floor	120	60	450	2700	C16	6.448	8.681	-2.233	-0.35	-35.97	Under capacity - Strengthening required		
3	First Floor	185	120	470	4570	C16	6.148	5.635	0.513	0.13	13.71	Appears adequate		
4	First Floor	200	60	350	4285	C16	6.096	6.234	-0.138	-0.02	-2.45	Under capacity - Strengthening required		
5	First Floor	200	60	350	3430	C16	6.096	3.994	2.102	0.57	58.28	Appears adequate		
6	Second Floor	190	130	440	4570	C16	6.13	4.656	1.474	0.44	45.02	Appears adequate		
7	Second Floor	190	60	340	3500	C16	6.13	4.474	1.656	0.39	39.80	Appears adequate		

= doubled up joist

Figure 7: Joist capacity summary

For the respective joist areas and assessment, refer to Appendix C for the GA plans and calculations.

6. Structural Works to Support Architectural + Fire Engineer's Brief

6.1. Basement Proposals

No works are proposed at basement in this phase.

6.2. Ground Floor Proposals

A 60 minute fire compartmentation is understood to be created between the Phase 1 and Phase 2 areas. This is not a structural requirement, however this may affect proposed loading to the existing structure at first floor.

6.3. First Floor Proposals

It is proposed to increase the opening width between the front and rear elevation rooms in the existing loadbearing masonry wall and install bi-folding doors. New precast / steel lintels to be provided over opening supporting floor load at second floor and any wall load above. Bearing to be provided in accordance with proprietary product supplier requirements, typically 150 mm at each end.

Non-loadbearing stud walls are to be removed and created within the existing kitchen / toilet area to create a revised layout. Would be advisable to install additional timber joist under the stud partition where the existing floor will need to be strengthened.

Non-loadbearing stud walls alongside the staircase are to be removed. This is non-structural.

6.4. Second Floor Proposals

It is proposed to increase the opening width between the front and rear elevation rooms in the existing loadbearing masonry wall and install bi-folding doors. New precast / steel lintels to be provided over opening supporting floor load at second floor and any wall load above. Bearing to be provided in accordance with proprietary product supplier requirements, typically 150 mm at each end.

Further non-loadbearing stud is to be removed at the stair landing.

6.5. Roof Proposals

Consideration of additional loading to the pitched roof (ceiling) to support additional thickness of insulation. Removal of debris at ceiling level may help to alleviate any unnecessary load.

6.6. External Elevations Proposals

No works are typically being carried out to the external elevations that require structural works.

6.7. Below Ground Drainage Proposals

Where possible, it is proposed to reuse the existing drainage that connects into the mains. The extent of the existing drainage is not yet understood therefore it would be advisable to have a CCTV survey carried out of the existing site into the mains. This will determine the condition and capacity of the existing system and whether it is suitable for reuse.

6.8. Fire Engineer's Comments

It has been noted that to satisfy the comments from the appointed Fire Engineer, *'The Client advised that their fire engineer has stated the floor joists need to be minimum 200 mm'*.

Not all areas of the floor structure meet the minimum 200 mm noted by the Fire Engineer – refer to sketches in appendix for existing floor joist depths.

Further fire treatment may be required, such as underboarding to the existing joists, to create the requisite fire resistance. Details are to be confirmed by the Fire Engineer.

Additional loading, including allowance for finishes, thermal and acoustic treatment must be taken into consideration for the respective areas based on the residual capacity noted above. Further structural strengthening may be required, subject to receipt of final proposals.

Appendix A – Structural Sketches

043_001-STU_ONE-XX-ZZ-SK-S-0001 – Ground Floor Proposed Works – Rev. P02

043_001-STU_ONE-XX-ZZ-SK-S-0002 – First Floor Proposed Works – Rev. P02

043_001-STU_ONE-XX-ZZ-SK-S-0003 – Second Floor Proposed Works – Rev. P02

043_001-STU_ONE-XX-ZZ-SK-S-0004 – Roof Proposed Works – Rev. P02

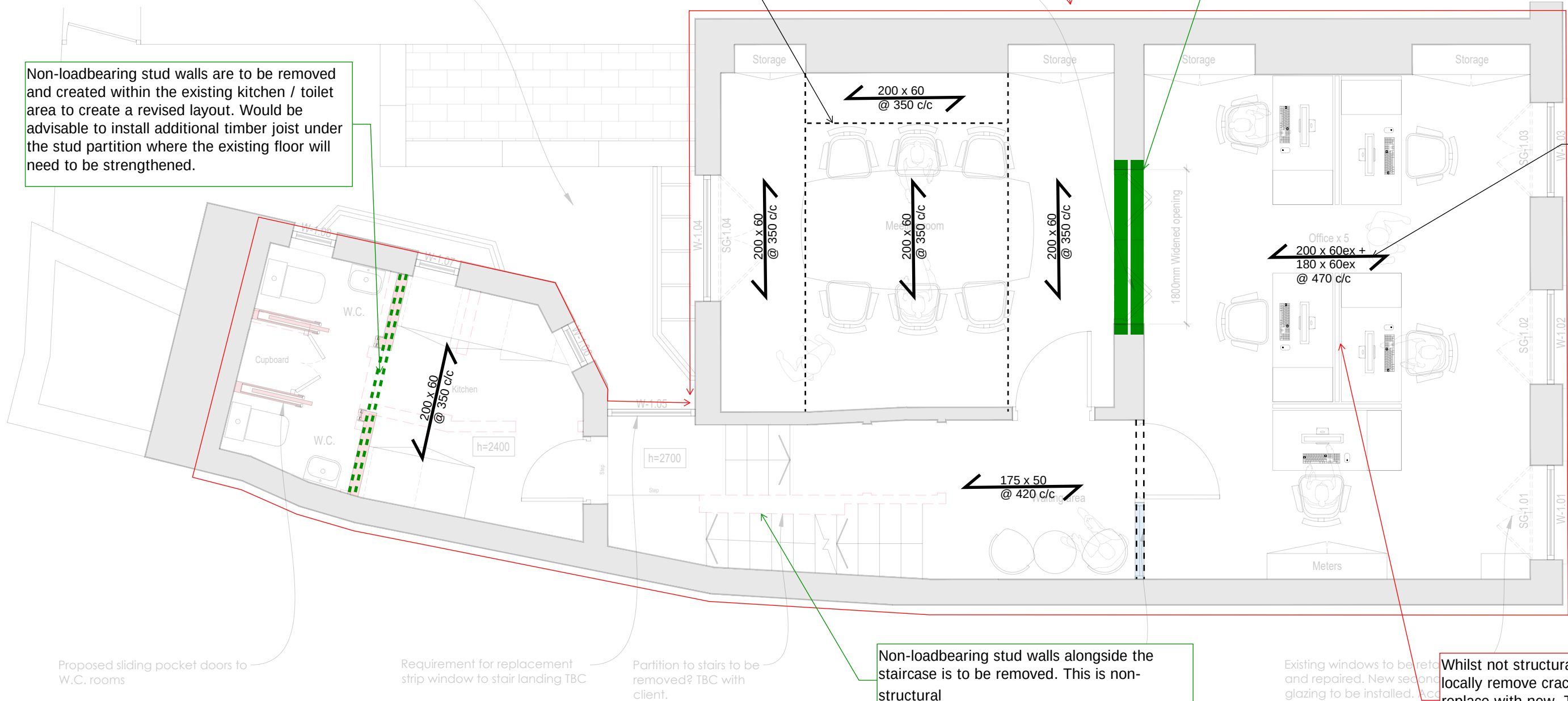


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P03 - For Information

All floors may need to be strengthened, subject to receipt of final finishes proposals. This will require supplementary floor joists placed alternately with existing floor joists to enhance the capacity of the floor to suit the final proposals, and / or steelwork beams under the floor. Steelwork beams may not be preferable, subject to Architect's final detailing.

The water ingress adjacent to the entrance hallway should be addressed. This may not be attributed to an issue from 63 Princess Street, it is likely to be from the adjacent property.



GENERAL NOTES

Do not scale from drawing, use figured dimensions only.

All dimensions must be checked and verified on site prior to commencement of work and architect to be notified of any discrepancies.

No works are to start on site prior to discharge of any / all pre-start planning conditions, the client is at risk if any works are started prior to approval by appointed building control body.

Party wall act: the owner has a duty to serve a party structure notice to any adjoining owner if works are to be carried out to a party wall, structure, or line of junction; or if works involve excavations lower than the foundations of a neighbouring building within 3m, or excavations cut through a 45° line from the foundations of a neighbouring building within 6m, a party wall agreement/award should be formalised before the commencement of the works.

Install lateral restraint straps to suspended timber joisted floor area. Refer to detail for further information.

It is proposed to increase the opening width between the front and rear elevation rooms in the existing loadbearing masonry wall and install bi-folding doors. New precast / steel lintels to be provided over opening supporting floor load at second floor and any wall load above. Bearing to be provided in accordance with proprietary product supplier requirements, typically 150 mm at each end.

Trimmer floor joists denoted thus.

Proposed bifold doors

External area TBC as part of phase 2 works

Repair / replace flashing to outrigger roof where found to be perished (not a structural issue).

Requirement for replacement strip window to stair landing TBC

Partition and doorway to landing lobby to be removed? TBC with client

Existing windows to be retained and repaired. New secondary glazing to be installed (SG). Acoustic consultant to advise on glazing specification

Whilst not structural, it would be prudent to locally remove cracked ceiling plaster and replace with new. This could be integrated with any acoustic / thermal / fire treatment works. Applies to both areas.

Notes:

1. Some masonry may need cutting and out replacing on an ad-hoc basis upon removal of wall finishes.
2. Lateral floor restraint straps to be installed to perimeter joists to 'tie' building together. Refer to details in Appendix C.
3. Extent of structural works subject to further opening up / assessment upon receipt of final proposals.
4. Works in **red** respond to structural condition.
5. Works in **green** respond to architectural requirements.

Floor Strengthening

All floors may need to be strengthened, subject to receipt of final finishes proposals. This will require supplementary floor joists placed alternately with existing floor joists to enhance the capacity of the floor to suit the final proposals, and / or steelwork beams under the floor. Steelwork beams may not be preferable, subject to Architect's final detailing.

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DESIGN.

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Rev No.

01 - Information Issue

02 - Information Issue

Project.

65 Princess Street,

Manchester, M2 3FX

Scale.

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Proposed
Second Fl

Drwg No.

105



STUDIO ONE

043_001-STU_ONE-XX-02-SK-S-0003

65 Princess Street

Second Floor Proposed Works

JM for SO

13.03.2023

P03 - For Information

4000
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GENERAL NOTES

Do not scale from drawing, use figured dimensions only.

All dimensions must be checked and verified on site prior to commencement of work and architect to be notified of any discrepancies.

No works are to start on site prior to discharge of any / all pre-start planning conditions, the client is at risk if any works are started prior to approval by appointed building control body.

Party wall act: the owner has a duty to serve a party structure notice to any adjoining owner if works are to be carried out to a party wall, structure, or line of junction; or if works involve excavations lower than the foundations of a neighbouring building within 3m, or excavations cut through a 45° line from the foundations of a neighbouring building within 6m, a party wall agreement/award should be formalised before the commencement of the works.

Thermal performance

In line with the Building Regulations Approved Document L Volume 2 (Buildings other than dwellings). The states in Table 4.2 Limiting U-values for existing elements in existing buildings the following U-values to be achieved. 2 options for location of insulation shown below;

Pitched roof – insulation at ceiling level to achieve a threshold U-Value of 0.35W/(m2K) and an improved U-Value of 0.16W/(m2 K). Suggest 300mm Rockwool between and over ceiling joists.

Pitched roof – insulation at rafter level to achieve a threshold U-Value of 0.35W/(m2k) and an improved U-Value of 0.16W/(m2 K). Suggest 50mm between rafters and 90mm under rafters. Note cross ventilation is to be maintained with continuous 25mm air gap.

Carry out chimney inspections to review condition and whether any structural works are required.

External area TBC as part of phase 2 works

All flashings to be inspected and repaired/replaced where appropriate.

All flashings to be inspected and repaired/replaced where appropriate.

Existing slate roof tiles and ridge tiles to be inspected and repaired/replaced where appropriate.

Remove debris from ceiling to mitigate any further ceiling deflection.



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Rev No.
01 - Information Issue

Project.

65 Princess Street,
Manchester, M2 3FX

Scale.

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Title.

Proposed
Roof

Drwg No.

107

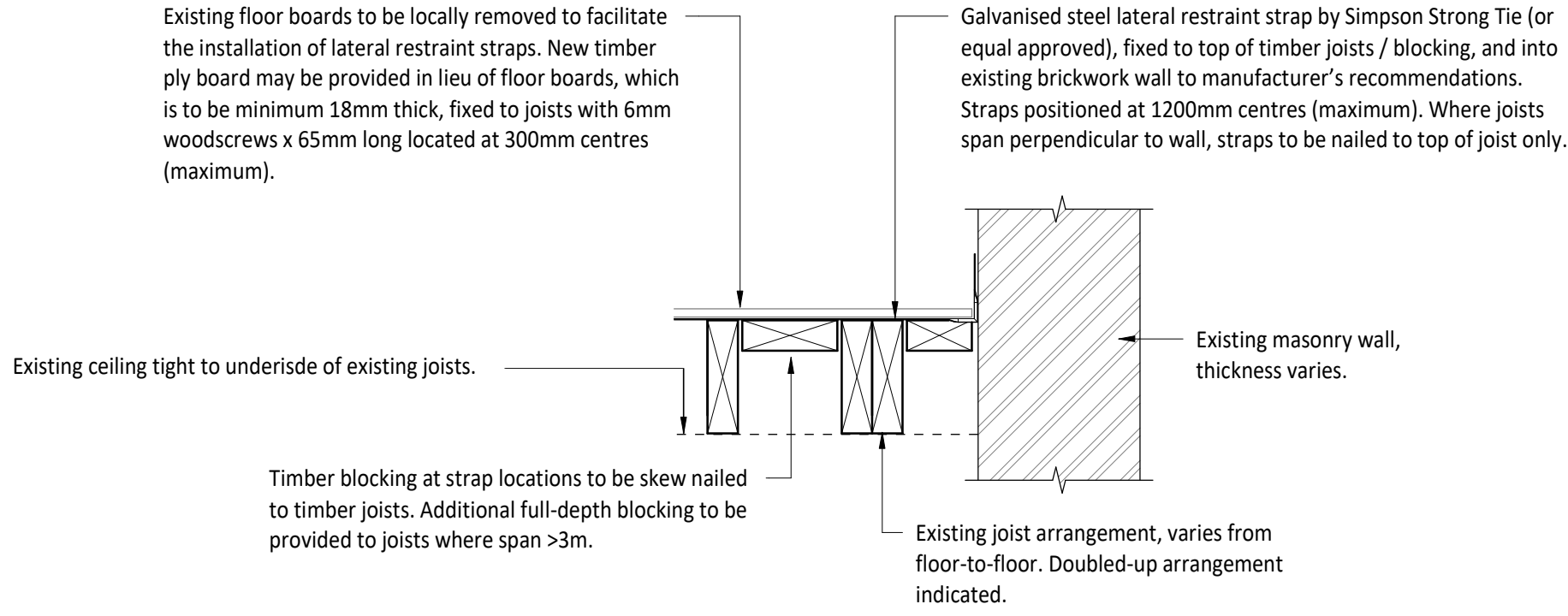


STUDIO ONE

043_001-STU_ONE-XX-RF-SK-S-0004
65 Princess Street
Roof Proposed Works
JM for SO
13.03.2023
P03 - For Information

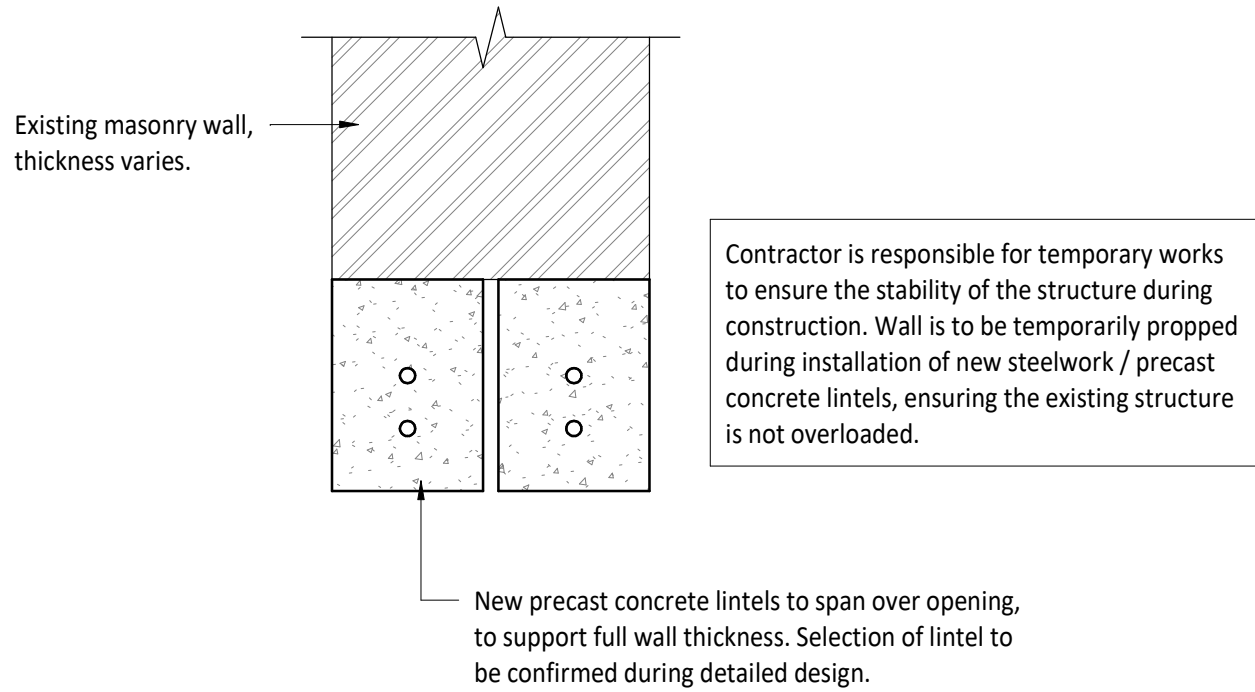
Appendix B – Structural Engineering Details

043_001-STU_ONE-XX-ZZ-DR-S-0005 – Structural Engineering Details Sheet 1 – Rev. P02



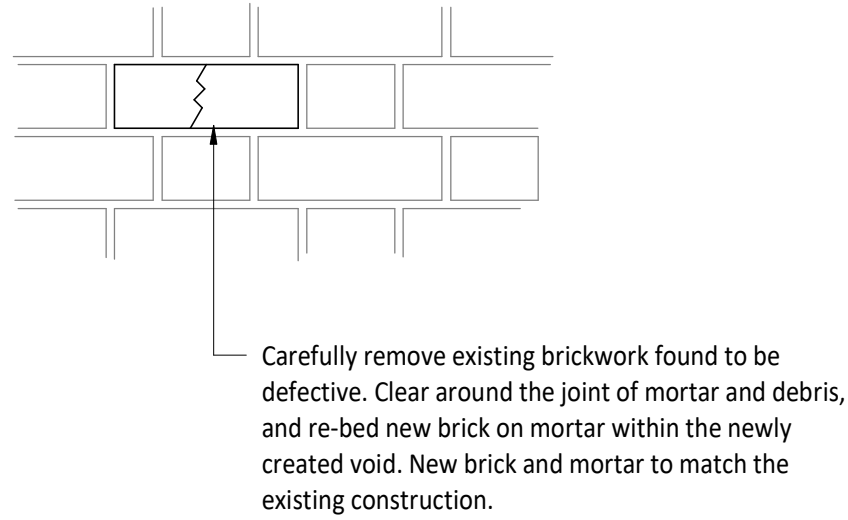
Detail 1 - Lateral Restraint Strap Detail (Joist Span Parallel to Wall)

Scale: 1 : 10 @ A1



Detail 2 - New Lintels to Proposed Opening

Scale: 1 : 5 @ A1



Detail 3 - Typical Brick Repair Detail

Scale: 1 : 10 @ A1

General Notes:

1. This Structural Engineering drawing is to be read in conjunction with all other relevant drawings, specifications and schedules, including all relevant Architect's drawings and other information.
2. All dimensions are in millimeters unless noted otherwise.
3. Do not scale from this drawing. Work to stated dimensions only.
4. All details and dimensions shown relating to the existing structure, existing drainage, ground and site conditions are indicative and are subject to confirmation on site as necessary.
5. All set out and levels are to be confirmed with reference to Architect's drawings.
6. The Contractor is responsible for the temporary stability of new and existing structures and the ground during the works.
7. The Contractor is to ensure that the works are undertaken in a manner so as to ensure that deflections, settlements or movements do not occur that would affect retained (or new) structures and ensure that unacceptable cracking or distress does not occur. The contractor is to allow for making good any such cracking or distress should it occur.
8. All works are to be in accordance with Building Regulation requirements.
9. The Builder is to ensure that all works are suitably weathered, and damp proofed so that damp and water ingress do not affect the works whilst in progress or after completion.

P02	23.02.2023	Issued for information	JM	-
P01	17.11.2022	Issued for information	JM	DS
Rev	Date	Description	By	Chkd

STUDIO ONE

Client
Axis Property Consultancy LLP

Project
65 Princess Street, Manchester

Title
Structural Engineering Details Sheet 1

Status
FOR INFORMATION

Studio One Project Number	Revision	Scale @ A1
043-001	P02	As Shown

Drawing Number
043_001-SO-XX-ZZ-DR-S-0005

Appendix C – Floor Joist Capacity Structural Assessment



65 Princess Street, Manchester
Floor Joist Capacity Structural Assessment

Studio One Job Number 043_001

22 February 2023

65 Princess Street
Floor Joist Capacity Structural Assessment

Contents

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Calculations prepared by: MN
Reviewed by: JM, JP

65 Princess Street
Floor Joist Capacity Structural Assessment

Introduction

These calculations appraise the structural capacity of existing timber floor joists at 65 Princess Street, Manchester. This appraisal is intended to inform an understanding of the capacity of the floors to support building fabric (finishes, partitions etc). Appraisal findings are presented as 'extra over capacity' above that required to support imposed (live) loads for the proposed boutique hotel use.

These calculations are based on assumed timber strength (actual timber grade has not been verified).

The appraisal has been informed by limited opening an inspection; it has been assumed that joists exposed at opening up positions are representative of the general condition and sizing of floor joists to floor plates.

This appraisal considers joist capacity only. Trimmers / beam capacities have not been considered. It is anticipated that historic trimmer joists to chimney breasts may be present and that these trimmers may have reduced structural capacity compared to that indicated by floor joists alone, as is normal. As such the capacities derived by this appraisal will not be representative of the full floor plate capacities unless strengthening works are first undertaken.

Imposed Design load

A proposed imposed load of 2.5 kN/m² has been adopted in accordance with BS 6399-1. Although some areas may have partitions, partition loading has not been considered.

Key design codes:

BS 6399: Part 1: Code of practice for dead and imposed loads
BS 5268: Part 2: Structural use of timber

Calculation sheet

Job No	043/001	Sheet No	J/1
Project	65 Princess Street	Engineer	MN
Element	Timber Joist Loadings	Checked By	JM
		Date	22.02.2023
		Date	23.02.23

Calculations			References
<u>EXISTING DEAD LOAD</u>			
Light Finishes	Say	=	0.10 kN/m2
25mm Boards γ 8kN/m3	0.025 x 8	=	0.20 kN/m2
Joists (Nominal)	Say	=	0.20 kN/m2
Plaster	Say	=	0.25 kN/m2
Services	Say	=	0.05 kN/m2
	Total	=	0.8 kN/m2
<u>PROPOSED IMPOSED LOAD</u>			
Office	=	2.5 kN/m2	1.8 kN Point Load
The first and second floors to be an office, subject to receipt of final proposals. The loads used in this back-analysis is therefore conservative since in the design, office use is adopted throughout.			

		Dimensions					Permissable	Applied				
Area	Location	h (mm)	b (mm)	Spacing	L (mm)	Assumed Strength Class	σ_p (N/mm ²)	σ_{II} (N/mm ²)	$\sigma_{residual}$ (N/mm ²)	Indicative Capacity for New Construction (kN/m2)	Indicative Capacity for New Construction (kg/m2)	Status
1	Ground Floor	175	75	420	1930	C16	6.186	2.347	3.839	3.16	321.74	Appears adequate
2	First Floor	120	60	450	2700	C16	6.448	8.681	-2.233	-0.35	-35.97	Under capacity - Strengthening required
3	First Floor	185	120	470	4570	C16	6.148	5.635	0.513	0.13	13.71	Appears adequate
4	First Floor	200	60	350	4285	C16	6.096	6.234	-0.138	-0.02	-2.45	Under capacity - Strengthening required
5	First Floor	200	60	350	3430	C16	6.096	3.994	2.102	0.57	58.28	Appears adequate
6	Second Floor	190	130	440	4570	C16	6.13	4.656	1.474	0.44	45.02	Appears adequate
7	Second Floor	190	60	340	3500	C16	6.13	4.474	1.656	0.39	39.80	Appears adequate

= doubled up joist

Note: Strength Class has been assumed based on limited visual inspection. Strength Class has not been verified.

Summary

The loading in the analysis considers joist dead load + superimposed dead load (suspended ceiling & services + timber boarding) + imposed load (office). The residual capacity is the permissible loading available to new floor finishes and any thermal, acoustic and/or fire treatment to the existing floor structure in the proposed case.

At ground floor, joists would have sufficient capacity for finishes and some thermal and acoustic treatment as necessary, subject to receipt of the final floor treatment requirements. A further planning application is understood to be submitted for works at ground floor and basement, which is outside of the current scope, however Area 1 (Sheet No. J/3) has been considered due to being the proposed office front entrance.

At first floor, it appears that two areas (area 2 and 4) would require structural enhancements (supplementary joists and/or steelwork beams) to meet requirements for any level of superimposed dead load. Area 3 may also require enhancements, subject to receipt of final floor treatment proposals.

At second floor, the joists have a residual capacity that may meet the requirements of new finishes. this is subject to receipt of final floor treatment proposals.

Area 1 is considered as circulation space. There is sufficient residual capacity to increase the imposed load to 4.0 kN/m2 to account for this load designation without having to strengthen.

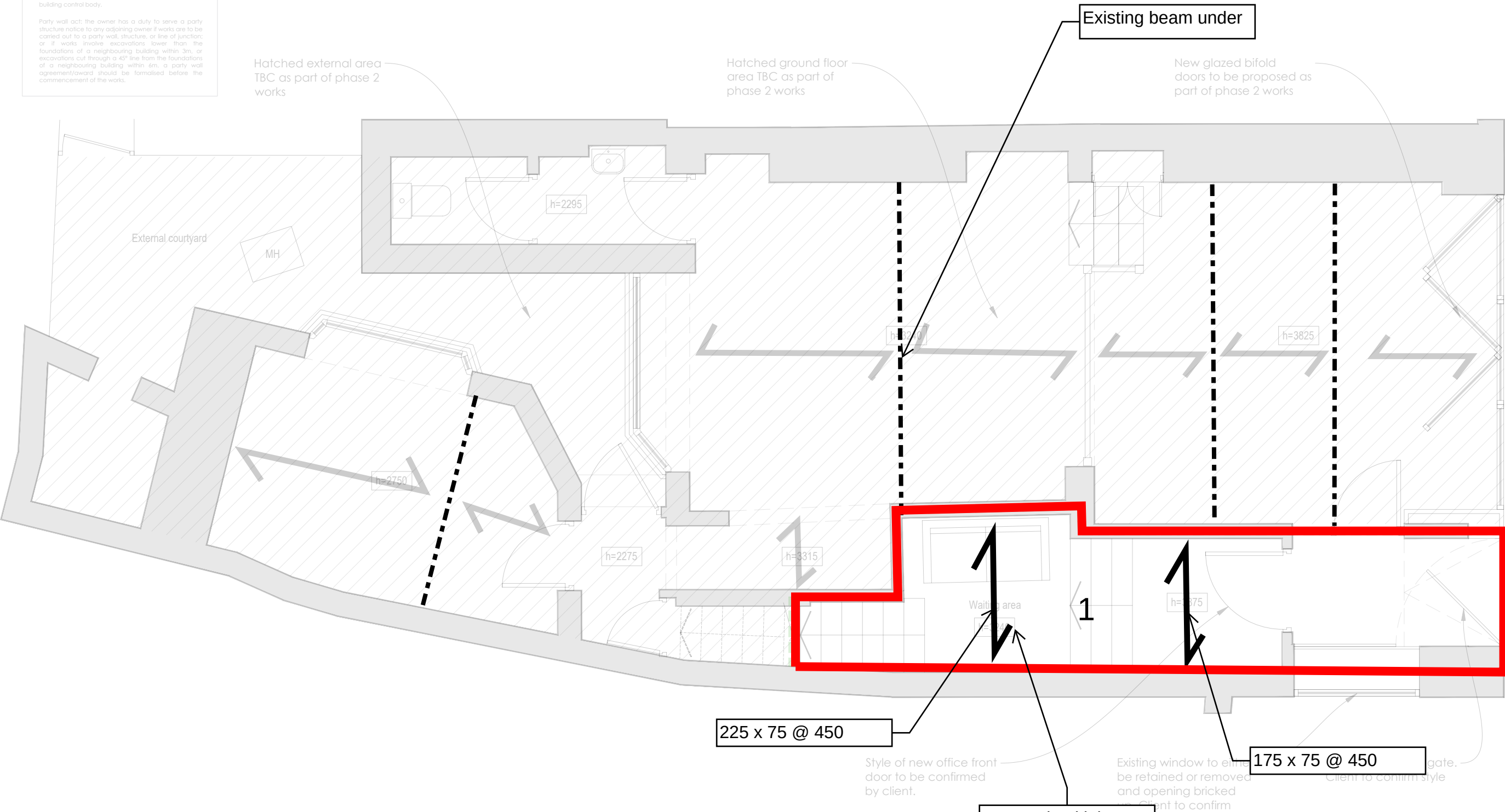
GENERAL NOTES

Do not scale from drawing, use figured dimensions only.

All dimensions must be checked and verified on site prior to commencement of work and architect to be notified of any discrepancies.

No works are to start on site prior to discharge of any / all pre-start planning conditions, the client is at risk if any works are started prior to approval by appointed building control body.

Party wall act: the owner has a duty to serve a party structure notice to any adjoining owner if works are to be carried out to a party wall, structure, or line of junction; or if works involve excavations lower than the foundations of a neighbouring building within 3m, or excavations cut through a 45° line from the foundations of a neighbouring building within 6m, a party wall agreement/award should be formalised before the commencement of the works.



External courtyard

MH

h=2295

h=2750

h=2275

h=3315

h=3315

h=3825

New glazed bifold doors to be proposed as part of phase 2 works

Existing beam under

Hatched ground floor area TBC as part of phase 2 works

Hatched external area TBC as part of phase 2 works

Waiting area

1

h=3375

225 x 75 @ 450

175 x 75 @ 450

Style of new office front door to be confirmed by client.

Existing window to either be retained or removed and opening bricked up. Client to confirm

Client to confirm style of gate.

Larger sized joists have sufficient capacity. This joist is ok by inspection

Wall type key

- Existing solid wall to be retained
- Existing internal wall to be removed
- New stud partition wall
- New glazed partition wall
- 60min fire compartmentation



1:50 Scale Bar

PAUL
COX
DESIGN.

paulcoxdesign@gmail.com

Rev No.

01 - Information Issue

02 - Information Issue

Project.

65 Princess Street,

Manchester, M2 3FX

Scale.

1:50 @ A3

Title.

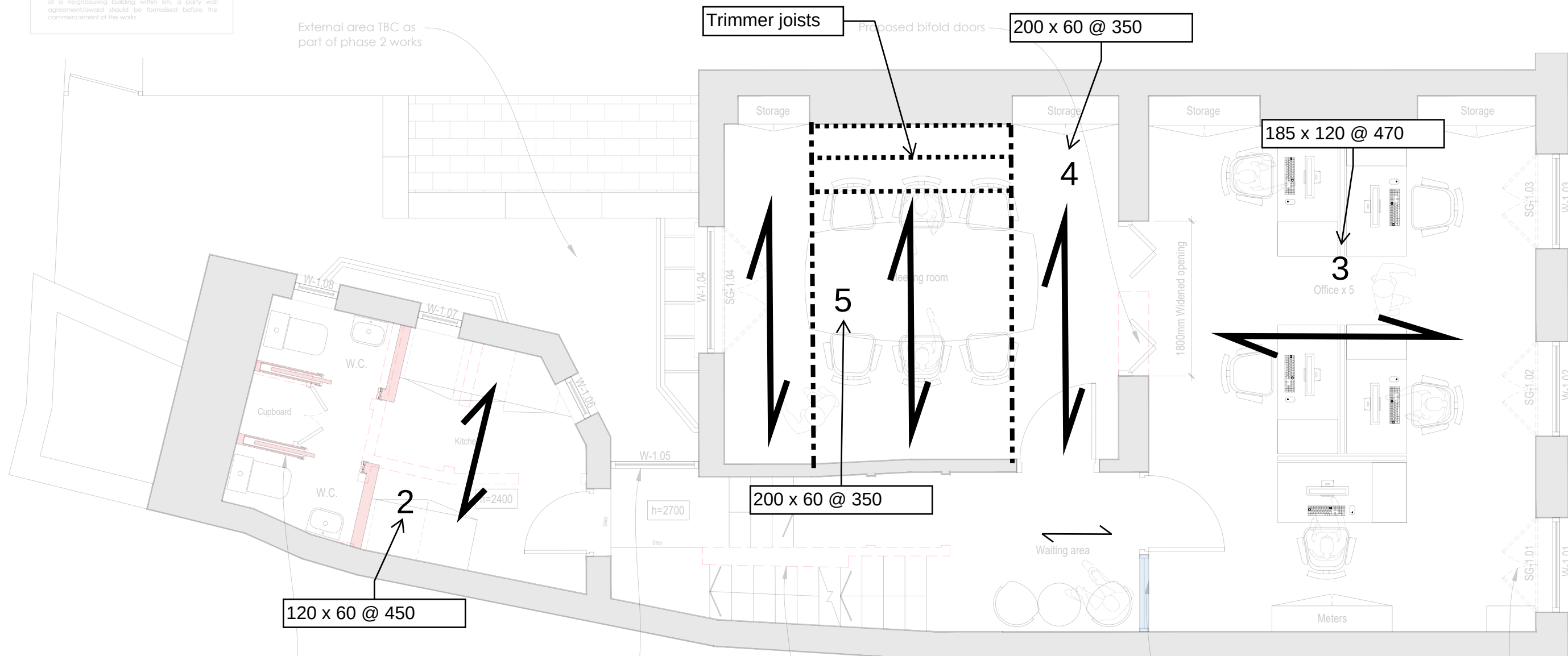
Proposed
Ground Fl

Drwg No.

103



A horizontal scale bar with a white background and a black border. It is divided into segments by vertical black lines. The segments are labeled with black numbers: 0, 200, 500, 1000, 2000, 3000, 4000, and 5000. The text "1:50 Scale Bar" is written in black at the bottom right of the bar.





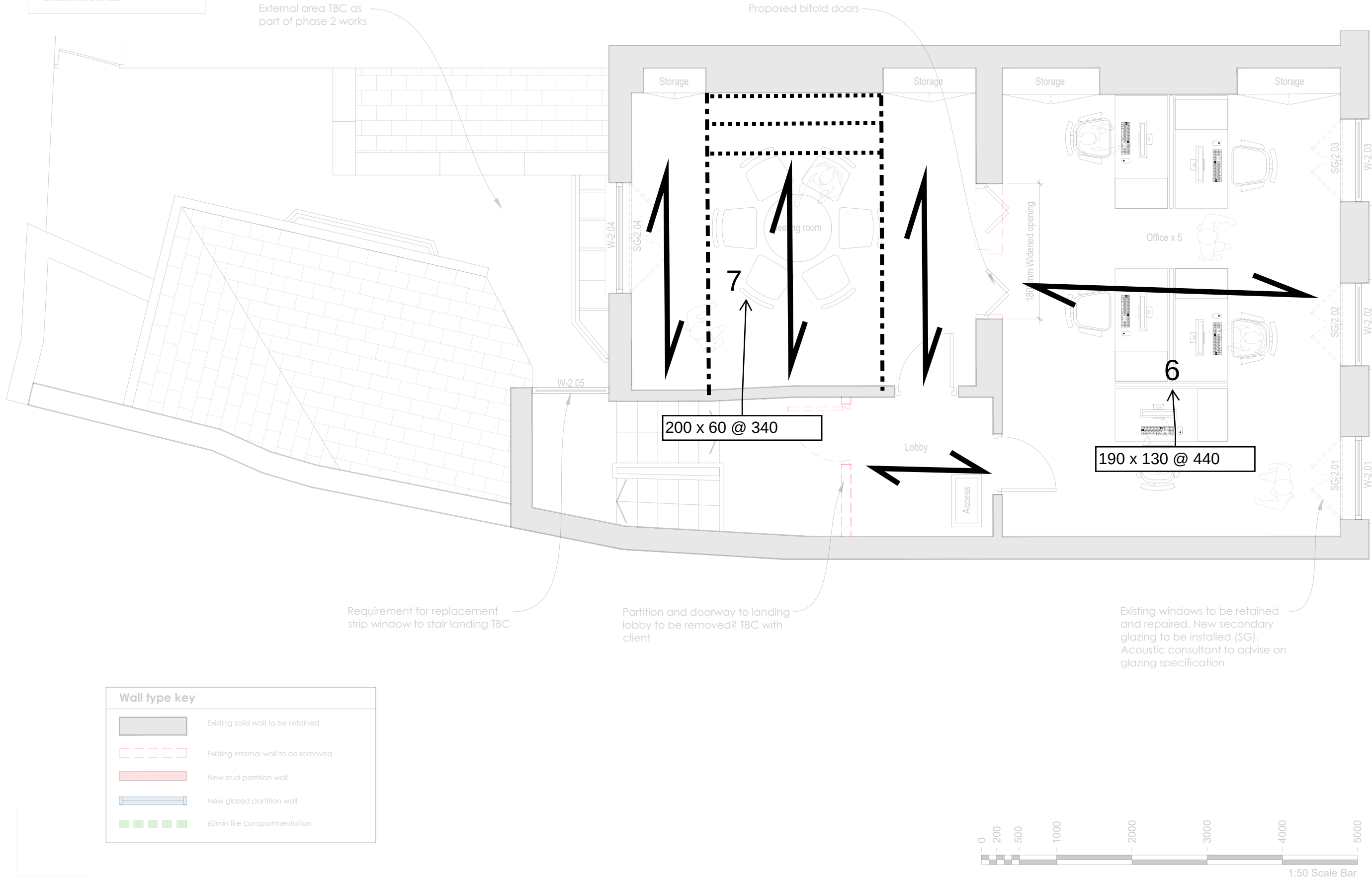
GENERAL NOTES

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Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 1				J/ 6		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	23/02/2023	JM	23.02.23			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

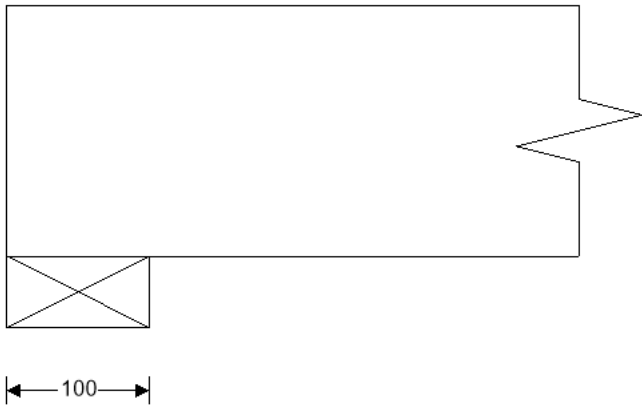
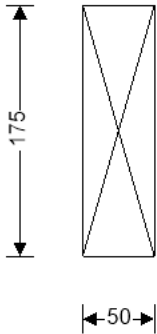
Joist details

Joist breadth	b = 50 mm
Joist depth	h = 175 mm
Joist spacing	s = 420 mm
Timber strength class	C16
Service class of timber	1



Span details

Number of spans	N _{span} = 1
Length of bearing	L _b = 100 mm
Effective length of span	L _{s1} = 1930 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 22330729 mm ⁴
Section modulus	Z = b × h ² / 6 = 255208 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.03 kN/m
Dead load	F _{d_udi} = 0.50 kN/m ²
Imposed UDL(Long term)	F _{i_udi} = 2.50 kN/m ²
Imposed point load (Medium term)	F _{i_pt} = 1.80 kN

Modification factors

Service class for bending parallel to grain	K _{2m} = 1.00
Service class for compression	K _{2c} = 1.00
Service class for shear parallel to grain	K _{2s} = 1.00
Service class for modulus of elasticity	K _{2e} = 1.00

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 1				J/ 7		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	23/02/2023	JM	23.02.23			

Section depth factor	K ₇ = 1.06
Load sharing factor	K ₈ = 1.10

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 0.599 kNm
Maximum shear force	V = 1.242 kN
Maximum support reaction	R = 1.242 kN
Maximum deflection	δ = 1.332 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 6.186 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 2.347 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.737 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.213 N/mm ²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)	σ _{cp1} = 2.200 N/mm ²
Permissible bearing stress	σ _{c_adm} = σ _{cp1} × K _{2c} × K ₃ × K ₈ = 2.420 N/mm ²
Applied bearing stress	σ _{c_max} = R / (b × L _b) = 0.248 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 5.790 mm
Bending deflection (based on E _{mean})	δ _{bending} = 1.183 mm
Shear deflection	δ _{shear} = 0.149 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 1.332 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 0.979 kNm
Maximum shear force	V = 2.028 kN
Maximum support reaction	R = 2.028 kN
Maximum deflection	δ = 1.833 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 7.733 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.835 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.921 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.348 N/mm ²

Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 1				J/ 8		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	23/02/2023	JM	23.02.23			

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane) $\sigma_{cp1} = 2.200$ N/mm²
Permissible bearing stress $\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = 3.025$ N/mm²
Applied bearing stress $\sigma_{c_max} = R / (b \times L_b) = 0.406$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection $\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 5.790$ mm
Bending deflection (based on E_{mean}) $\delta_{bending} = 1.589$ mm
Shear deflection $\delta_{shear} = 0.244$ mm
Total deflection $\delta = \delta_{bending} + \delta_{shear} = 1.833$ mm

PASS - Actual deflection within permissible limits

Table 17 — Modification factor, K_3 , for duration of loading

Duration of loading	Value of K_3
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads $K_3 = 1.00$ except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K_3 , may be taken as 1.5. ^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, exceeds 50 m. ^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

 Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 2				J/ 9		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Tedds calculation version 1.1.04

TIMBER JOIST DESIGN (BS5268-2:2002)

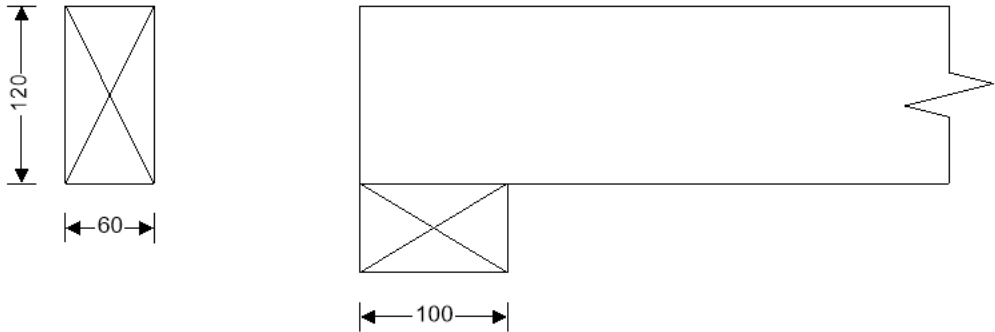
Joist details

Joist breadth $b = 60$ mm
Joist depth $h = 120$ mm
Joist spacing $s = 450$ mm
Timber strength class **C16**
Service class of timber **1**



Span details

Number of spans $N_{span} = 1$
Length of bearing $L_b = 100$ mm
Effective length of span $L_{s1} = 2700$ mm



Section properties

Second moment of area $I = b \times h^3 / 12 = 8640000$ mm⁴
Section modulus $Z = b \times h^2 / 6 = 144000$ mm³

Loading details

Joist self weight $F_{swt} = b \times h \times \rho_{char} \times g_{acc} = 0.02$ kN/m
Dead load $F_{d_udl} = 0.50$ kN/m²
Imposed UDL(Long term) $F_{i_udl} = 2.50$ kN/m²
Imposed point load (Medium term) $F_{i_pt} = 1.80$ kN

Modification factors

Service class for bending parallel to grain $K_{2m} = 1.00$
Service class for compression $K_{2c} = 1.00$
Service class for shear parallel to grain $K_{2s} = 1.00$
Service class for modulus of elasticity $K_{2e} = 1.00$
Section depth factor $K_7 = 1.11$

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street				Job no. 043/001	
	Calcs for Joist 2				Start page no./Revision J/ 10	
	Calcs by MN	Calcs date 22/02/2023	Checked by JM	Checked date 23.02.23	Approved by	Approved date

Load sharing factor

$K_8 = 1.10$

Consider long term loads

Load duration factor

$K_3 = 1.00$

Maximum bending moment

$M = 1.250$ kNm

Maximum shear force

$V = 1.852$ kN

Maximum support reaction

$R = 1.852$ kN

Maximum deflection

$\delta = 12.865$ mm

Check bending stress

Bending stress

$\sigma_m = 5.300$ N/mm²

Permissible bending stress

$\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = 6.448$ N/mm²

Applied bending stress

$\sigma_{m_max} = M / Z = 8.681$ N/mm²

FAIL - Applied bending stress exceeds permissible bending stress

Check shear stress

Shear stress

$\tau = 0.670$ N/mm²

Permissible shear stress

$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = 0.737$ N/mm²

Applied shear stress

$\tau_{max} = 3 \times V / (2 \times b \times h) = 0.386$ N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

$\sigma_{cp1} = 2.200$ N/mm²

Permissible bearing stress

$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = 2.420$ N/mm²

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.309$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 8.100$ mm

Bending deflection (based on E_{mean})

$\delta_{bending} = 12.486$ mm

Shear deflection

$\delta_{shear} = 0.379$ mm

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 12.865$ mm

FAIL - Actual deflection exceeds permissible deflection

Consider medium term loads

Load duration factor

$K_3 = 1.25$

Maximum bending moment

$M = 1.440$ kNm

Maximum shear force

$V = 2.133$ kN

Maximum support reaction

$R = 2.133$ kN

Maximum deflection

$\delta = 12.391$ mm

Check bending stress

Bending stress

$\sigma_m = 5.300$ N/mm²

Permissible bending stress

$\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = 8.060$ N/mm²

Applied bending stress

$\sigma_{m_max} = M / Z = 10.000$ N/mm²

FAIL - Applied bending stress exceeds permissible bending stress

Check shear stress

Shear stress

$\tau = 0.670$ N/mm²

Permissible shear stress

$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = 0.921$ N/mm²

Applied shear stress

$\tau_{max} = 3 \times V / (2 \times b \times h) = 0.444$ N/mm²

PASS - Applied shear stress within permissible limits

Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street				Job no. 043/001	
	Calcs for Joist 2				Start page no./Revision J/ 11	
	Calcs by MN	Calcs date 22/02/2023	Checked by JM	Checked date 23.02.23	Approved by	Approved date

Check bearing stress

Compression perpendicular to grain (no wane)

$\sigma_{cp1} = 2.200$ N/mm²

Permissible bearing stress

$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = 3.025$ N/mm²

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.356$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 8.100$ mm

Bending deflection (based on E_{mean})

$\delta_{bending} = 11.955$ mm

Shear deflection

$\delta_{shear} = 0.436$ mm

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 12.391$ mm

FAIL - Actual deflection exceeds permissible deflection

Table 17 — Modification factor, K_3 , for duration of loading

Duration of loading	Value of K_3
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads $K_3 = 1.00$ except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K_3 may be taken as 1.5. ^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, exceeds 50 m. ^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 3				J/ 12		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

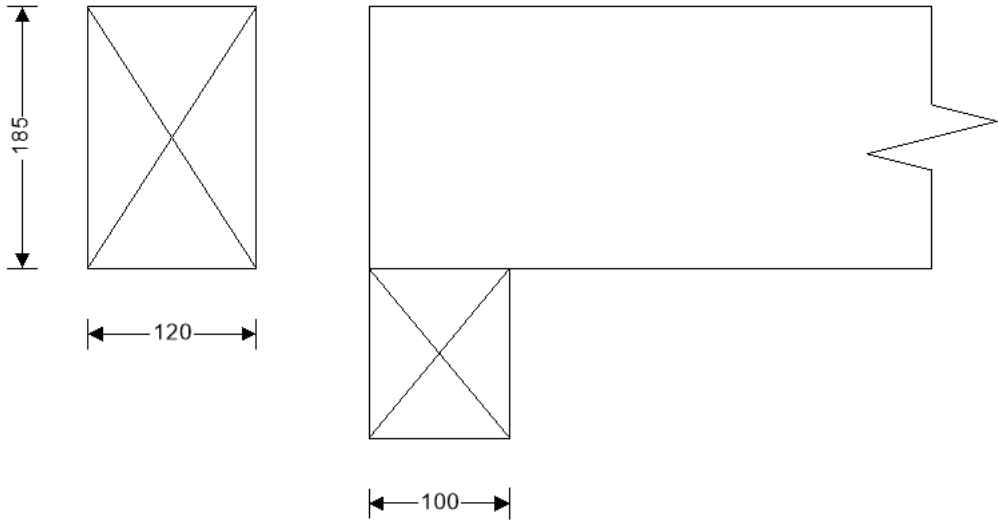
Joist details

Joist breadth	b = 120 mm
Joist depth	h = 185 mm
Joist spacing	s = 470 mm
Timber strength class	C16
Service class of timber	1



Span details

Number of spans	N _{span} = 1
Length of bearing	L _b = 100 mm
Effective length of span	L _{s1} = 4570 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 63316250 mm ⁴
Section modulus	Z = b × h ² / 6 = 684500 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.07 kN/m
Dead load	F _{d_udl} = 0.50 kN/m ²
Imposed UDL(Long term)	F _{i_udl} = 2.50 kN/m ²
Imposed point load (Medium term)	F _{i_pt} = 1.80 kN

Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 3				J/ 13		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Modification factors

Service class for bending parallel to grain	K _{2m} = 1.00
Service class for compression	K _{2c} = 1.00
Service class for shear parallel to grain	K _{2s} = 1.00
Service class for modulus of elasticity	K _{2e} = 1.00
Section depth factor	K ₇ = 1.05
Load sharing factor	K ₈ = 1.10

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 3.857 kNm
Maximum shear force	V = 3.376 kN
Maximum support reaction	R = 3.376 kN
Maximum deflection	δ = 15.439 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 6.148 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 5.635 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.737 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.228 N/mm ²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)	σ _{cp1} = 2.200 N/mm ²
Permissible bearing stress	σ _{c_adm} = σ _{cp1} × K _{2c} × K ₃ × K ₈ = 2.420 N/mm ²
Applied bearing stress	σ _{c_max} = R / (b × L _b) = 0.281 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 13.710 mm
Bending deflection (based on E _{mean})	δ _{bending} = 15.060 mm
Shear deflection	δ _{shear} = 0.379 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 15.439 mm

FAIL - Actual deflection exceeds permissible deflection

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 2.846 kNm
Maximum shear force	V = 2.491 kN
Maximum support reaction	R = 2.491 kN
Maximum deflection	δ = 9.787 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 7.686 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 4.158 N/mm ²

Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 3				J/ 14		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress $\tau = \mathbf{0.670}$ N/mm²

Permissible shear stress $\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = \mathbf{0.921}$ N/mm²

Applied shear stress $\tau_{max} = 3 \times V / (2 \times b \times h) = \mathbf{0.168}$ N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane) $\sigma_{cp1} = \mathbf{2.200}$ N/mm²

Permissible bearing stress $\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = \mathbf{3.025}$ N/mm²

Applied bearing stress $\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.208}$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection $\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = \mathbf{13.710}$ mm

Bending deflection (based on E_{mean}) $\delta_{bending} = \mathbf{9.507}$ mm

Shear deflection $\delta_{shear} = \mathbf{0.280}$ mm

Total deflection $\delta = \delta_{bending} + \delta_{shear} = \mathbf{9.787}$ mm

PASS - Actual deflection within permissible limits

Table 17 — Modification factor, K_3 , for duration of loading

Duration of loading	Value of K_3
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads $K_3 = 1.00$ except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K_3 , may be taken as 1.5.	
^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, exceeds 50 m.	
^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 4				J/ 15		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Tedds calculation version 1.1.04

TIMBER JOIST DESIGN (BS5268-2:2002)

Joist details

Joist breadth $b = \mathbf{60}$ mm

Joist depth $h = \mathbf{200}$ mm

Joist spacing $s = \mathbf{350}$ mm

Timber strength class **C16**

Service class of timber **1**

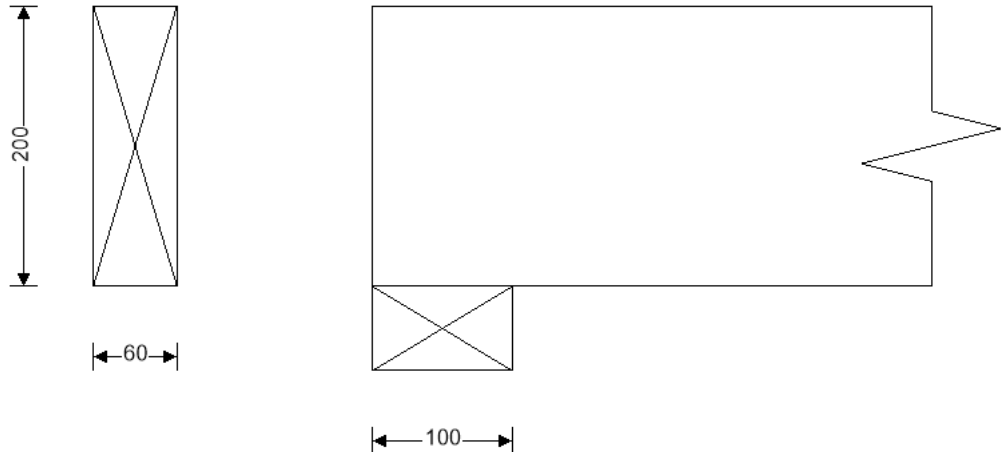


Span details

Number of spans $N_{span} = \mathbf{1}$

Length of bearing $L_b = \mathbf{100}$ mm

Effective length of span $L_{s1} = \mathbf{4285}$ mm



Section properties

Second moment of area $I = b \times h^3 / 12 = \mathbf{40000000}$ mm⁴

Section modulus $Z = b \times h^2 / 6 = \mathbf{400000}$ mm³

Loading details

Joist self weight $F_{swt} = b \times h \times \rho_{char} \times g_{acc} = \mathbf{0.04}$ kN/m

Dead load $F_{d_udl} = \mathbf{0.50}$ kN/m²

Imposed UDL(Long term) $F_{i_udl} = \mathbf{2.50}$ kN/m²

Imposed point load (Medium term) $F_{i_pt} = \mathbf{1.80}$ kN

Modification factors

Service class for bending parallel to grain $K_{2m} = \mathbf{1.00}$

Service class for compression $K_{2c} = \mathbf{1.00}$

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 4				J/ 16		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Service class for shear parallel to grain
Service class for modulus of elasticity
Section depth factor
Load sharing factor

$K_{2s} = 1.00$
 $K_{2e} = 1.00$
 $K_7 = 1.05$
 $K_8 = 1.10$

Consider long term loads

Load duration factor
Maximum bending moment
Maximum shear force
Maximum support reaction
Maximum deflection

$K_3 = 1.00$
 $M = 2.494$ kNm
 $V = 2.328$ kN
 $R = 2.328$ kN
 $\delta = 14.003$ mm

Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

$\sigma_m = 5.300$ N/mm²
 $\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = 6.096$ N/mm²
 $\sigma_{m_max} = M / Z = 6.234$ N/mm²

FAIL - Applied bending stress exceeds permissible bending stress

Check shear stress

Shear stress
Permissible shear stress
Applied shear stress

$\tau = 0.670$ N/mm²
 $\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = 0.737$ N/mm²
 $\tau_{max} = 3 \times V / (2 \times b \times h) = 0.291$ N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)
Permissible bearing stress
Applied bearing stress

$\sigma_{cp1} = 2.200$ N/mm²
 $\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = 2.420$ N/mm²
 $\sigma_{c_max} = R / (b \times L_b) = 0.388$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection
Bending deflection (based on E_{mean})
Shear deflection
Total deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 12.855$ mm
 $\delta_{bending} = 13.549$ mm
 $\delta_{shear} = 0.453$ mm
 $\delta = \delta_{bending} + \delta_{shear} = 14.003$ mm

FAIL - Actual deflection exceeds permissible deflection

Consider medium term loads

Load duration factor
Maximum bending moment
Maximum shear force
Maximum support reaction
Maximum deflection

$K_3 = 1.25$
 $M = 2.414$ kNm
 $V = 2.253$ kN
 $R = 2.253$ kN
 $\delta = 11.458$ mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

$\sigma_m = 5.300$ N/mm²
 $\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = 7.620$ N/mm²
 $\sigma_{m_max} = M / Z = 6.034$ N/mm²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress

$\tau = 0.670$ N/mm²

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 4				J/ 17		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Permissible shear stress

$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = 0.921$ N/mm²

Applied shear stress

$\tau_{max} = 3 \times V / (2 \times b \times h) = 0.282$ N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

$\sigma_{cp1} = 2.200$ N/mm²

Permissible bearing stress

$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = 3.025$ N/mm²

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.376$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 12.855$ mm

Bending deflection (based on E_{mean})

$\delta_{bending} = 11.019$ mm

Shear deflection

$\delta_{shear} = 0.439$ mm

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 11.458$ mm

PASS - Actual deflection within permissible limits

Table 17 — Modification factor, K_3 , for duration of loading

Duration of loading	Value of K_3
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads $K_3 = 1.00$ except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K_3 may be taken as 1.5. ^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, exceeds 50 m. ^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 5				J/ 18		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

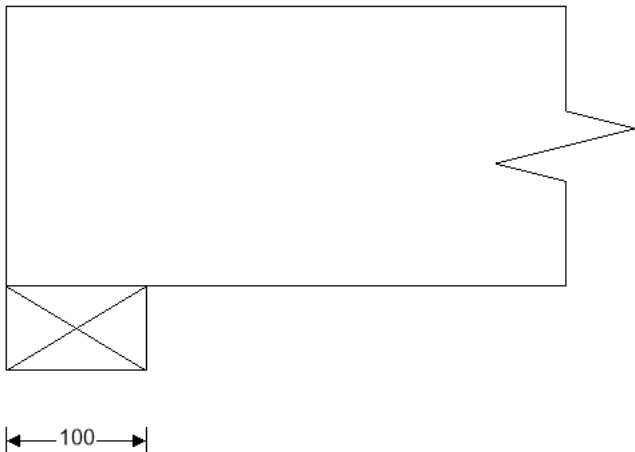
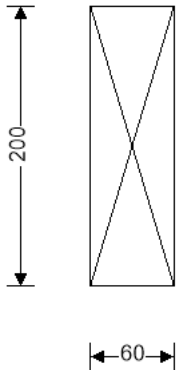
Joist details

Joist breadth	b = 60 mm
Joist depth	h = 200 mm
Joist spacing	s = 350 mm
Timber strength class	C16
Service class of timber	1



Span details

Number of spans	N _{span} = 1
Length of bearing	L _b = 100 mm
Effective length of span	L _{s1} = 3430 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 40000000 mm ⁴
Section modulus	Z = b × h ² / 6 = 400000 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.04 kN/m
Dead load	F _{d_udl} = 0.50 kN/m ²
Imposed UDL(Long term)	F _{i_udl} = 2.50 kN/m ²
Imposed point load (Medium term)	F _{i_pt} = 1.80 kN

Modification factors

Service class for bending parallel to grain	K _{2m} = 1.00
Service class for compression	K _{2c} = 1.00

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 5				J/ 19		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Service class for shear parallel to grain	K _{2s} = 1.00
Service class for modulus of elasticity	K _{2e} = 1.00
Section depth factor	K ₇ = 1.05
Load sharing factor	K ₈ = 1.10

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 1.598 kNm
Maximum shear force	V = 1.863 kN
Maximum support reaction	R = 1.863 kN
Maximum deflection	δ = 5.853 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 6.096 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.994 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.737 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.233 N/mm ²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)	σ _{cp1} = 2.200 N/mm ²
Permissible bearing stress	σ _{c_adm} = σ _{cp1} × K _{2c} × K ₃ × K ₈ = 2.420 N/mm ²
Applied bearing stress	σ _{c_max} = R / (b × L _b) = 0.311 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 10.290 mm
Bending deflection (based on E _{mean})	δ _{bending} = 5.563 mm
Shear deflection	δ _{shear} = 0.291 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 5.853 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 1.855 kNm
Maximum shear force	V = 2.163 kN
Maximum support reaction	R = 2.163 kN
Maximum deflection	δ = 5.719 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 7.620 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 4.636 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
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Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 5				J/ 20		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Permissible shear stress

Applied shear stress

$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = \mathbf{0.921 \text{ N/mm}^2}$

$\tau_{max} = 3 \times V / (2 \times b \times h) = \mathbf{0.270 \text{ N/mm}^2}$

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

Permissible bearing stress

Applied bearing stress

$\sigma_{cp1} = \mathbf{2.200 \text{ N/mm}^2}$

$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = \mathbf{3.025 \text{ N/mm}^2}$

$\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.360 \text{ N/mm}^2}$

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

Bending deflection (based on E_{mean})

Shear deflection

Total deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = \mathbf{10.290 \text{ mm}}$

$\delta_{bending} = \mathbf{5.382 \text{ mm}}$

$\delta_{shear} = \mathbf{0.337 \text{ mm}}$

$\delta = \delta_{bending} + \delta_{shear} = \mathbf{5.719 \text{ mm}}$

PASS - Actual deflection within permissible limits

Table 17 — Modification factor, K_3 , for duration of loading

Duration of loading	Value of K_3
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads $K_3 = 1.00$ except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K_3 may be taken as 1.5. ^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, exceeds 50 m. ^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 6				J/ 21		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

Joist details

Joist breadth

Joist depth

Joist spacing

Timber strength class

Service class of timber

b = 130 mm

h = 190 mm

s = 440 mm

C16

1



Span details

Number of spans

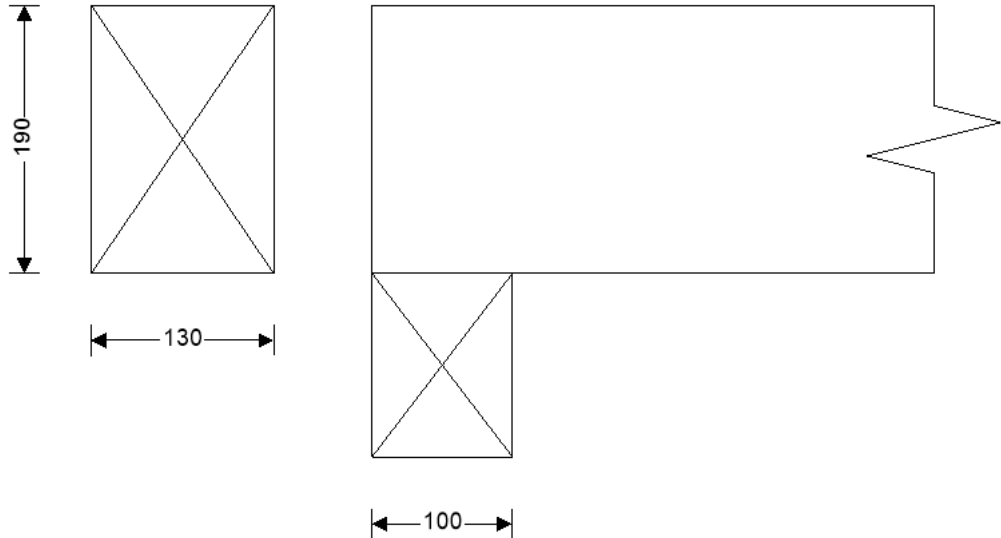
Length of bearing

Effective length of span

N_{span} = 1

L_b = 100 mm

L_{s1} = 4570 mm



Section properties

Second moment of area

Section modulus

Loading details

Joist self weight

Dead load

Imposed UDL(Long term)

Imposed point load (Medium term)

$I = b \times h^3 / 12 = \mathbf{74305833 \text{ mm}^4}$

$Z = b \times h^2 / 6 = \mathbf{782167 \text{ mm}^3}$

$F_{swt} = b \times h \times \rho_{char} \times g_{acc} = \mathbf{0.08 \text{ kN/m}}$

$F_{d_udl} = \mathbf{0.50 \text{ kN/m}^2}$

$F_{i_udl} = \mathbf{2.50 \text{ kN/m}^2}$

$F_{i_pt} = \mathbf{1.80 \text{ kN}}$

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street				Job no. 043/001	
	Calcs for Joist 6				Start page no./Revision J/ 22	
	Calcs by MN	Calcs date 22/02/2023	Checked by JM	Checked date 23.02.23	Approved by	Approved date

Modification factors

Service class for bending parallel to grain	K _{2m} = 1.00
Service class for compression	K _{2c} = 1.00
Service class for shear parallel to grain	K _{2s} = 1.00
Service class for modulus of elasticity	K _{2e} = 1.00
Section depth factor	K ₇ = 1.05
Load sharing factor	K ₈ = 1.10

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 3.642 kNm
Maximum shear force	V = 3.188 kN
Maximum support reaction	R = 3.188 kN
Maximum deflection	δ = 12.439 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 6.130 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 4.656 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.737 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.194 N/mm ²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)	σ _{cp1} = 2.200 N/mm ²
Permissible bearing stress	σ _{c_adm} = σ _{cp1} × K _{2c} × K ₃ × K ₈ = 2.420 N/mm ²
Applied bearing stress	σ _{c_max} = R / (b × L _b) = 0.245 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 13.710 mm
Bending deflection (based on E _{mean})	δ _{bending} = 12.117 mm
Shear deflection	δ _{shear} = 0.322 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 12.439 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 2.827 kNm
Maximum shear force	V = 2.474 kN
Maximum support reaction	R = 2.474 kN
Maximum deflection	δ = 8.286 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 7.663 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.614 N/mm ²

Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street				Job no. 043/001	
	Calcs for Joist 6				Start page no./Revision J/ 23	
	Calcs by MN	Calcs date 22/02/2023	Checked by JM	Checked date 23.02.23	Approved by	Approved date

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.921 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.150 N/mm ²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)	σ _{cp1} = 2.200 N/mm ²
Permissible bearing stress	σ _{c_adm} = σ _{cp1} × K _{2c} × K ₃ × K ₈ = 3.025 N/mm ²
Applied bearing stress	σ _{c_max} = R / (b × L _b) = 0.190 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 13.710 mm
Bending deflection (based on E _{mean})	δ _{bending} = 8.037 mm
Shear deflection	δ _{shear} = 0.250 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 8.286 mm

PASS - Actual deflection within permissible limits

Table 17 — Modification factor, K₃, for duration of loading

Duration of loading	Value of K ₃
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads K ₃ = 1.00 except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K ₃ may be taken as 1.5. ^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area <i>a</i> , as defined in BS 6399-2, exceeds 50 m. ^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area <i>a</i> , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

Tekla.Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 7				J/ 24		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

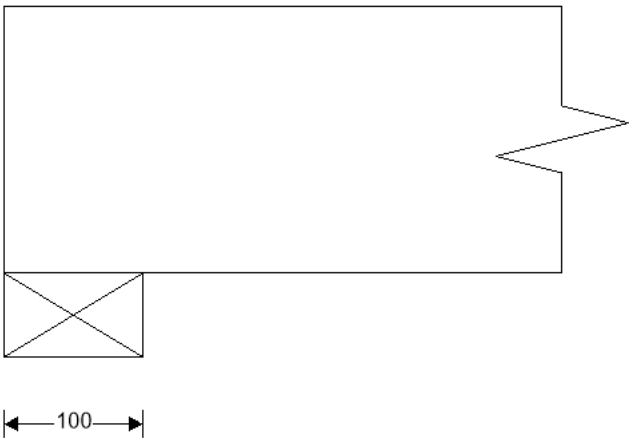
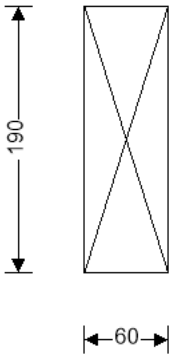
Joist details

Joist breadth	b = 60 mm
Joist depth	h = 190 mm
Joist spacing	s = 340 mm
Timber strength class	C16
Service class of timber	1



Span details

Number of spans	N _{span} = 1
Length of bearing	L _b = 100 mm
Effective length of span	L _{s1} = 3500 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 34295000 mm ⁴
Section modulus	Z = b × h ² / 6 = 361000 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.03 kN/m
Dead load	F _{d_udl} = 0.50 kN/m ²
Imposed UDL(Long term)	F _{i_udl} = 2.50 kN/m ²
Imposed point load (Medium term)	F _{i_pt} = 1.80 kN

Modification factors

Service class for bending parallel to grain	K _{2m} = 1.00
Service class for compression	K _{2c} = 1.00
Service class for shear parallel to grain	K _{2s} = 1.00

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	65 Princess Street				043/001	
	Calcs for				Start page no./Revision	
Joist 7				J/ 25		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
MN	22/02/2023	JM	23.02.23			

Service class for modulus of elasticity	K _{2e} = 1.00
Section depth factor	K ₇ = 1.05
Load sharing factor	K ₈ = 1.10

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 1.615 kNm
Maximum shear force	V = 1.846 kN
Maximum support reaction	R = 1.846 kN
Maximum deflection	δ = 7.137 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 6.130 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 4.474 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.737 N/mm ²
Applied shear stress	τ _{max} = 3 × V / (2 × b × h) = 0.243 N/mm ²

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)	σ _{cp1} = 2.200 N/mm ²
Permissible bearing stress	σ _{c_adm} = σ _{cp1} × K _{2c} × K ₃ × K ₈ = 2.420 N/mm ²
Applied bearing stress	σ _{c_max} = R / (b × L _b) = 0.308 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 10.500 mm
Bending deflection (based on E _{mean})	δ _{bending} = 6.828 mm
Shear deflection	δ _{shear} = 0.309 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 7.137 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 1.888 kNm
Maximum shear force	V = 2.158 kN
Maximum support reaction	R = 2.158 kN
Maximum deflection	δ = 7.014 mm

Check bending stress

Bending stress	σ _m = 5.300 N/mm ²
Permissible bending stress	σ _{m_adm} = σ _m × K _{2m} × K ₃ × K ₇ × K ₈ = 7.663 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 5.231 N/mm ²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress	τ = 0.670 N/mm ²
Permissible shear stress	τ _{adm} = τ × K _{2s} × K ₃ × K ₈ = 0.921 N/mm ²

Long term loading considered most onerous case due to the proposed use of the building. Refer to modification factor table for load duration types.

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Applied shear stress

$\tau_{\max} = 3 \times V / (2 \times b \times h) = \mathbf{0.284 \text{ N/mm}^2}$

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

$\sigma_{cp1} = \mathbf{2.200 \text{ N/mm}^2}$

Permissible bearing stress

$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = \mathbf{3.025 \text{ N/mm}^2}$

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.360 \text{ N/mm}^2}$

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = \mathbf{10.500 \text{ mm}}$

Bending deflection (based on E_{mean})

$\delta_{bending} = \mathbf{6.653 \text{ mm}}$

Shear deflection

$\delta_{shear} = \mathbf{0.361 \text{ mm}}$

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = \mathbf{7.014 \text{ mm}}$

PASS - Actual deflection within permissible limits

Table 17 — Modification factor, K_3 , for duration of loading

Duration of loading	Value of K_3
Long-term (e.g. dead + permanent imposed ^a)	1.00
Medium-term (e.g. dead + snow, dead + temporary imposed)	1.25
Short-term (e.g. dead + imposed + wind ^b , dead + imposed + snow + wind ^b)	1.50
Very short-term (e.g. dead + imposed + wind ^c)	1.75
^a For uniformly distributed imposed floor loads $K_3 = 1.00$ except for type C3 occupancy (see BS 6399-1:1996, Table 1) where for foot traffic on corridors, hallways, landings and stairs, K_3 may be taken as 1.5. ^b For wind, short-term category applies to class C (15 s gust) as defined in CP3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, exceeds 50 m. ^c For wind, very short-term category applies to classes A and B (3 s or 5 s gust) as defined in CP 3:Chapter V-2 or, where the largest diagonal dimension of the loaded area a , as defined in BS 6399-2, does not exceed 50 m.	

Modification factor table extracted from BS 5268-2-2002

STUDIO ONE

Prepared by: JM
Reviewed by: DS / MN

Rev. P03 – 13 March 2023
Rev. P02 – 23 February 2023
Rev. P01 - 18 November 2022

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