

STUDIO ONE



65 Princess Street, Manchester
Structural Engineering Review – Rev. C
17 January 2020

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Studio One Job Number: 031_010

65 Princess Street, Manchester
Structural Engineering Review – Rev. C

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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 Guy Taylor Associates' (GTA) pre-application planning submission to Manchester City Council. Commentary on the proposed end-use is provided in a later section of the report, which responds to GTA's 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
- CCTV survey of the existing drainage to check for defects and inform consideration of suitability for re-use.
- Survey of existing roof coverings may be considered.
- Timber survey by specialist may be considered and may be advisable subject to the above strip out and further inspection.

Items requiring **action**:

1. Install basement **Tanking** to all areas in the basement (walls and floor surfaces below ground level).
2. **Remove deteriorating wall** (wall in very poor structural condition) within the basement adjacent to staircase, undertake structural works to suit wall removal so as to tie in with architectural proposals.
3. Replace **damaged brickwork** (ad-hoc brick replacement) in the basement.
4. Replace spliced **rotten timber beam** over opening in basement with new beam (steelwork advisable); remove existing timber prop.
5. **Protect timber joist ends** (or replace with new with suitable detailing) where embedded into external walls and affected by (or may be affected by) water ingress.
6. **Drainage** to adjoining properties currently discharging onto the site should be diverted.
7. Brickwork outrigger construction in very poor condition to be **taken down** (re-build and/or remodel) and address associated **damp issues** to rear corner of rear courtyard.

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

8. **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.
9. **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.
10. **Floor strengthening may be required in specific areas** (installation of steels to underside of floor joists. Floor at second floor is dished and may require strengthening; strengthening of further areas may be required).
11. Remove **debris** from the roof space to prevent any overloading of the ceiling structure.
12. **Survey roof coverings** and or consider re-roofing.
13. **Repointing and re-rendering** are not structural items but can help resist water penetration. Client may wish to carry out to both elevations
14. Consider **demolition of outrigger** that abuts The Waterhouse (subject to further consideration).
15. Below ground drainage may contain defects. **CCTV survey** of existing drainage is advisable to inform consideration of this aspect.

Items appearing **structurally adequate**

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

2. Introduction

Studio One Consulting Limited have been instructed to undertake a structural engineering inspection of 65 Princess Street, Manchester, M2 4EG and report on findings to support pre-planning dialogue. Studio One were instructed by email dated 09 May 2019 by Colin Shenton.

This report considers the existing condition of the building and works required to maintain structural robustness and condition, which is based on a limited site walkover dated 07 June 2019, and the works required for its intended use; a boutique hotel.

The visual inspection of the building was carried out with opening-up of the existing structure at positions agreed with Colin Shenton Ltd 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.

The proposed use is to be a boutique hotel with a small number of rooms. An extension is proposed to the rear of the property by increasing the height of an existing outrigger by a single storey. A separate existing outrigger is proposed to be demolished, and a new terrace and lightwell at ground floor to the rear of the property is proposed to be created.



Figure 1 – Front elevation of 65 Princess Street

3. Condition of Existing Structure

3.1. Basement

The general condition of the basement appears to be fair, however there is evidence of water ingress to the brickwork retaining wall along the front elevation of the building. Some bricks are suffering from efflorescence attributed to water causing crystalline salt deposits on the surface.

There is further evidence of deterioration of the brickwork in the basement along the rear retaining wall, party wall adjacent to the Waterhouse pub and internal wall adjacent to the staircase into the basement. Some of the brickwork was noted to crumble to touch.

Other loadbearing walls that were visible appeared to be in fair condition with some fairly minor cracking.

Where timber joists bear into the external retaining walls there is some evidence of timber degradation, most likely rot, to the joist ends. A spliced timber beam, supported by a timber prop from the existing basement floor, appears to be in poor condition.

The basement floor appears to be in fair condition. Tiled finishes were not removed during the inspection. The finishes appeared dry i.e. they were not suffering water ingress.

3.2. Ground Floor

There does not appear to be any significant signs of distress to the ground floor structure, including the floor joists and loadbearing walls.

Timber joists were visible from the basement to the underside of the ground floor and appeared to be in fair condition, with only a few areas noted that the joist ends are weak. Steelwork appeared ok where visible, however the full extent of the beams was not inspected.

No cracking was evident in the plaster to the loadbearing walls, however an independent stud has been created in front of the partition wall with The Waterhouse pub and the wall was not visible. The partition wall with the adjoining property was visible from the staircase and no sign of cracking was evident.

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.

3.3. First Floor

Most of the existing finishes were still intact to the first floor. 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, and suspended ceiling from below were removed in 5 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.



Figure 2 – Basement (top), underside ground floor (middle), first floor (bottom)

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.

It was noted that the room to the rear off the property had a dishing effect in the floor. This has occurred where joists have been trimmed around the fireplace where joists act as a transfer. The joist may be overloaded.

3.5. Roof

A brief view into the roof void was carried out, accessed via stepladder from the second floor through a loft hatch. Structure is timber roof trusses supported between the front and rear elevation loadbearing walls. It appears that some rafters have been replaced with new softwood timbers since they appear lighter in colour. There is a central walkway with a build-up of debris. Roof trusses appear to be in fair condition.

Roof coverings from the exterior of the building were not visible.

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. Rainwater goods appear to be in fair condition as viewed at street level.

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 the adjacent property on the opposite side to The Waterhouse, which is two storeys in height (ground + first floor) with mono pitch roof with high point on the adjacent property. 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.

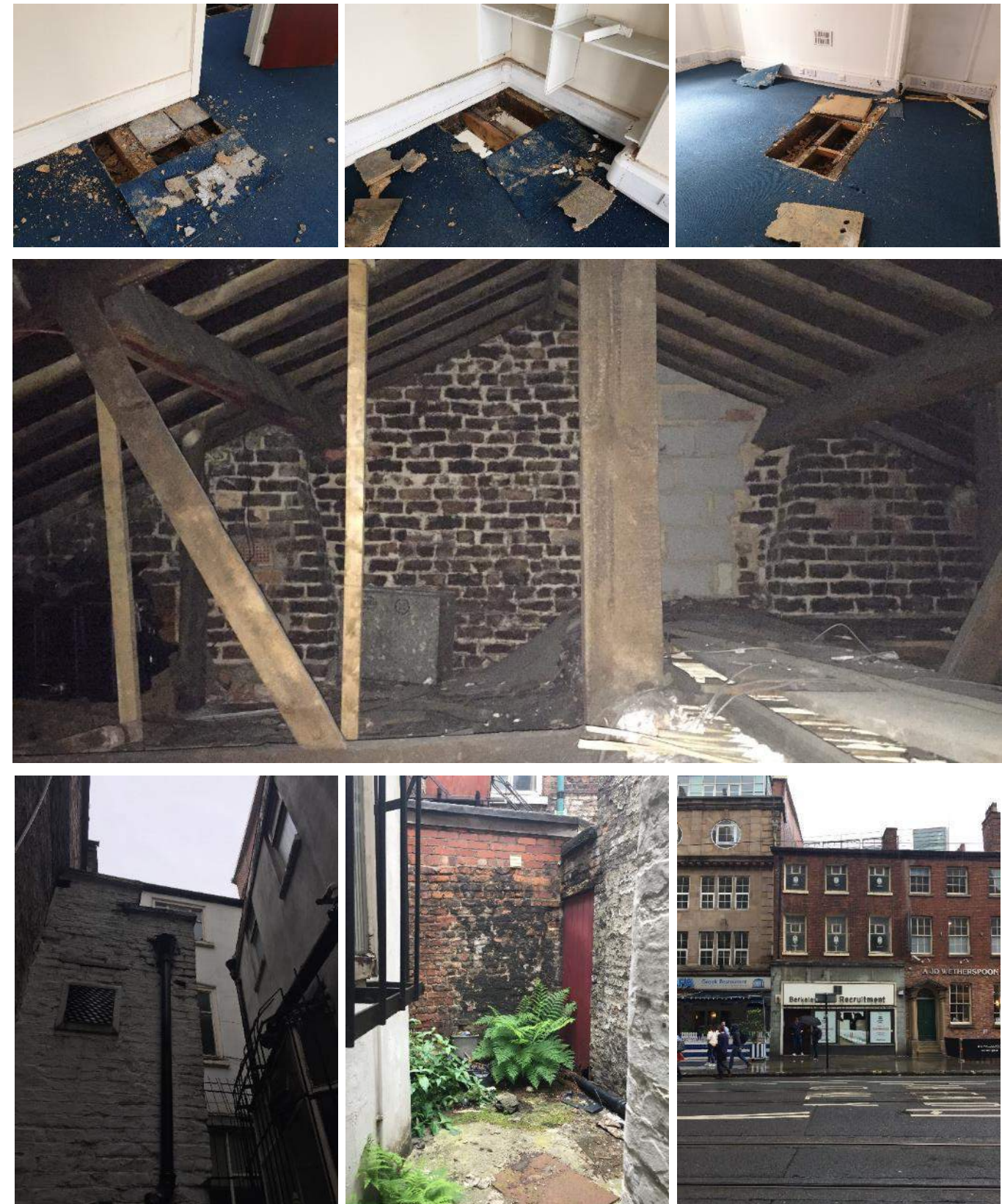


Figure 3 – Top – Second Floor Joists, Middle – Roof Void, Bottom – Rear and Front Elevations

4. Works Required in Response to Structural Condition

4.1. Basement

Where water ingress has been found on the front elevation wall it would be advisable to tank the wall to prevent further ingress and protect the wall from further deterioration. Further tanking should be undertaken to the remainder of walls and floors below ground floor levels, and also to suit the proposals that are discussed in Section 5 of this report. The partition walls are not expected to be earth retaining (it is understood the adjoining properties may have basements).

Where deterioration of the wall adjoining the staircase has occurred it would be advisable to remove the wall, which ties into the proposals discussed in Section 5.

Brickwork that has been found to be perished should be cut out and replaced with new, bedded on new mortar. There are localised instances of perished brickwork on the partition wall adjoining The Waterhouse.

4.2. Ground Floor

The water ingress adjacent to the entrance hallway should be addressed. It is not clear from the external elevation how the water is ingressing / precisely where it is leaking from.

Replace spliced timber beam with new steelwork beam allowing the timber prop to be removed. The prop does not appear to be original and may have previously installed to supplement the floor structure.

Wet floor joist ends may need to be treated in-situ or replaced and ends protected, subject to further timber investigation.

Remove wall coverings between ground floor and underside of first 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.

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.

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.

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. The Client may wish to re-point the brickwork and clean staining from the elevation if desired.

4.7. Rear Elevation

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. Moss growth within the courtyard should be cleared.

The outrigger abutting The Waterhouse should be demolished given its poor condition, as is also part of the architectural proposals.

The area of poor brickwork to the second outrigger will need taking down 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 may wish to be cleared of existing render and render reapplied, subject to architectural requirements.

5. Structural Works to Support Architectural Brief

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 C, which detail typical structural engineering details which can be found around the proposed building refurbishment.

There are significant works required that may affect the surrounding properties. It would be advisable to appoint a party wall surveyor at the earliest opportunity to provide advice to the requirements of the Party Wall Act 1996.

5.1. Change in Use

A load appraisal has been undertaken on the existing floors to determine the change in loads from the proposed development and the residual capacity for applying superimposed dead loads, such as finishes, services, ceilings and acoustic treatment. Calculations for the load appraisal is presented in the appendix of the report.

According to BS 6399-1, the following imposed loading is used in the existing and proposed uses:

- **Existing** - Office – 2.5 kN/m²
- **Proposed** - Hotel – 2.0 kN/m²

Each use would normally also make an allowance for moveable partitions, with area load of 1.0kN/m² in addition to the imposed load noted above. There are localised increases in loading to stairwells and corridors that are used for fire escapes.

Studio One attended site on 11 July 2019 following opening up of the floor structure in 9 no. locations across the various floor plates to determine the joist span, spacing and sizes. Jonathan McArdle, Senior Engineer 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:

- **Ground – 1.10 kN/m²**
- **First – 0.24 kN/m²**
- **Second – 0.69 kN/m²**

The residual load capacity above would be sufficient for light finishes, acoustic treatment and services. Local strengthening may be required if heavier finishes are required or local increases in loads are required, such as bathrooms with baths full of water.

5.2. Basement and Foundations

It is proposed to demolish the existing outrigger adjacent to The Waterhouse to facilitate the creation of a larger lightwell and terrace at ground floor. The outrigger will likely have shallow foundations that will need to be grubbed up as part of the works. Any interface with the existing buildings will need to be made good with any perished bricks replaced.

In creating the larger lightwell at basement/ground floor level, the second outrigger will likely require underpinning. It is not understood at this stage what the foundations are, however they will be below basement level as the outrigger walls extend into the basement and act as a retaining wall. Whilst the excavation is taking place, it would be prudent to externally tank the outrigger walls to prevent any further water ingress into the basement. Works will need to be coordinated with the existing drainage that is found within the courtyard and drainage may need to be temporarily or permanently diverted.

The existing area of poor condition brickwork found to the rear of the property is proposed to be demolished and new three storey structure built to accommodate bathrooms for the proposed hotel. New foundations will be required, which will need to be founded at the same depth as the existing foundations to prevent any surcharging on the existing foundations. Drainage in this area will need to be diverted. The new structure is to be a standalone structure of similar construction to the existing, which will need to be tied laterally to the existing structures surrounding it.

The existing wall found to be in poor condition within the basement is proposed to be demolished to create a larger opening. A further opening is proposed in the wall perpendicular to it. Steelwork beams will need to be installed over the openings bearing on padstones at the ends where bearing onto the existing brickwork walls. The bearing end walls will need to be prepared and made good, with any areas of poor condition brickwork replaced. Temporary works will need to be considered within the basement area. Long spanning beams may need to be spliced to assist in delivery and installation on site.

To the rear of the building a new steelwork beam has previously been installed built off pier on a footing. The beam is proposed to be lifted so that it is flush with the ceiling and the pier removed. The beam may be spliced (subject to assessment) or new beam installed in its place, with temporary works installed to support the ground floor joists. Padstone to be installed below the bearing of the beam. This beam will bear on/into the web of the new beam installed as part of the opening works. As previous, a new beam may be brought to site to be spliced so aid delivery and installation within the tight space in the basement.

Existing opening within the wall towards the front of the property is to be infilled either with new brickwork toothed into the existing, or with new wall starters.

A new service lift is proposed, extending from basement to second floor level. The service lift will need to be founded on a new reinforced concrete pit, which may require a sump and drainage. The lift shaft will need to be constructed from high density blockwork and be tied laterally to the existing wall construction.

5.3. Ground Floor

The existing floor to the front of the property is understood to not be original, therefore it is proposed to lift the level of this floor to match the level of the rear of the property. New steel beams may be required subject to assessment of the existing beams. Raised steel will need to bear on padstones at both ends on the brickwork walls at basement level. New joists will be installed on the raised beams. To access the raised portion of the property a new staircase will be required from the main entrance, which may be of a variety of construction methods e.g. timber, steelwork, glass etc.

To complement the proposed raised ground floor, the front elevation will be slightly altered with new windows and areas of infill. A canopy is proposed to be supported from the front elevation with signage.

In partitioning the large room at ground floor, the wall is to be reinstated in blockwork, timber stud or cold rolled stud.

Towards the staircase the wall to the right-hand side is proposed to be removed as it is understood not to be original. This wall is to be removed full height to reveal the handrails as per the architectural intent. Support for the stairs will need to be investigated as new support (by steel or timber) may be required.

Just beyond the staircase a new infill section of wall is proposed to match the existing wall line. This will align with the steelwork in forming the new opening in the basement, and construction can be in brickwork, timber stud or cold rolled stud.

One replacement bay window is proposed on the rear elevation and an existing bay window is to be removed in the two-storey outrigger. A new lintel may be required over the bay being removed. No structural works are anticipated with the replacement bay.

Joists around the proposed service lift will need to be trimmed and re-supported from the lift shaft via joist hangers. Temporary support to trimmed joists will need to be implemented during construction.

5.4. First Floor

No significant structural works are required at first floor level in response to the architectural brief beyond what is required as noted in Section 4.

Non-loadbearing walls are to be removed from the outrigger to the rear of the property. The wall to the staircase is also to be removed as previously noted.

Joists around the proposed service lift will need to be trimmed and re-supported from the lift shaft via joist hangers. Temporary support to trimmed joists will need to be implemented during construction.

5.5. Second Floor

It is proposed to construct a single storey extension to the outrigger to the rear of the property. The mono pitch roof is to be removed and replaced with new floor, with new walls constructed from the existing brickwork walls to form new roof level. In order to mitigate load increase to the structure it is proposed to use a lightweight form of construction such as loadbearing structural framing system (SFS) formed of cold rolled sections, timber stud and roof joists with finishes to suit architectural requirements. Materials would need to be manageable by hand for the construction so that materials can be carried up the stairs.

Underpinning may be required to the existing outrigger as previously noted due to the anticipated increase in load to the outrigger foundations. Other works associated with the extension is the creation of opening through brickwork wall to access the extension, which will require a new lintel (steel or precast concrete). Other works at second floor include small area of infill to partition between front and rear rooms and the installation of green wall from the wall forming the party wall with The Waterhouse.

Joists around the proposed service lift will need to be trimmed and re-supported from the lift shaft via joist hangers. Temporary support to trimmed joists will need to be implemented during construction.

5.6. Roof

No works are proposed to the roof.

5.7. External Elevations

Minor alterations to the front elevation are proposed. At ground floor, existing window openings are proposed to be blocked up and new window openings formed at a higher level that complement the proposed ground floor level.

5.8. Below Ground Drainage

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

Appendix A – Structural Sketches

BASEMENT FLOOR PLAN

NOTES

1. SOME BRICKWORK FOUND TO BE PERISHED / IN POOR CONDITION. CUT OUT + REPLACE WITH NEW ON BED OF MORTAR.

ALL FLOORS TO BE STRENGTHENED AS NECESSARY (STEELWORK TO UNDERSIDE OF JOISTS ETC.).

REMOVE EXISTING TIMBER BEAM + PROP AND REPLACE WITH NEW TIMBER / STEEL BEAM.

DEMOLISH EXISTING WALL IN POOR CONDITION. NEW BEAM OVER OPENING ON PADSTONES AT BEARING ENDS

WALL MAY REQUIRE UNDERPINNING WHERE INFIL OVER PROPOSED + NEW STEELWORK BEAM

SERVICE LIFT WITH SHAFT TUNNEL IN HIGH DENSITY BRICKWORK SUPPORTED ON REINFORCED CONCRETE BASE. SUMP + DRAINAGE MAY BE REQUIRED. ADJOINING WALL MAY REQUIRE UNDERPINNING SUBJECT TO LIFT PIT DETAILS.

EXISTING WALLS MAY NEED UNDERPINNING DUE TO 2 STOREY EXTENSION.

TREAT / REPLACE JOIST ENDS EMBEDDED IN WALLS + PROTECT AS NECESSARY.

INSTALL EXTERNAL TANKING DURING GROUNDWORKS.

NEW RETAINING WALL TO FORM LARGER LIGHTWELL, TANKED EXTERNALLY.

REMOVE PIER AND SPLICE EXISTING STEEL BEAM / REPLACE WITH NEW BEAM

REMOVE EXISTING WALL. NEW BEAM OVER OPENING ON PADSTONES AT BEARING END.

INFIL TO EXISTING WALL, TIED TO EXISTING WITH WALL STARTERS / TOOTHED BRICKWORK.

LOCATION OF OPENING UP AS VIEWED ON SITE 10.07.19 TO DETERMINE JOIST SPAN, DIMENSIONS + SPACING. TYPICAL ALL.

INTERNAL TANKING TO RETAINING WALL.



ORDNANCE SURVEY GRID

Scale Bar (m)



NOTES

1) ALL DIMENSIONS TO BE CHECKED ON SITE AND NOTED FROM THIS DRAWING.
2) ALL DIMENSIONS ARE IN METERS ONLY.
3) ALL DIMENSIONS ARE TO A CENTER LINE UNLESS OTHERWISE STATED.
4) ALL DIMENSIONS ARE TO A CENTER LINE UNLESS OTHERWISE STATED.
5) ALL DIMENSIONS ARE TO A CENTER LINE UNLESS OTHERWISE STATED.

KEY

1. 1st Floor	2. 2nd Floor	3. 3rd Floor	4. 4th Floor
5. 5th Floor	6. 6th Floor	7. 7th Floor	8. 8th Floor
9. 9th Floor	10. 10th Floor	11. 11th Floor	12. 12th Floor
13. 13th Floor	14. 14th Floor	15. 15th Floor	16. 16th Floor
17. 17th Floor	18. 18th Floor	19. 19th Floor	20. 20th Floor
21. 21st Floor	22. 22nd Floor	23. 23rd Floor	24. 24th Floor
25. 25th Floor	26. 26th Floor	27. 27th Floor	28. 28th Floor
29. 29th Floor	30. 30th Floor	31. 31st Floor	32. 32nd Floor
33. 33rd Floor	34. 34th Floor	35. 35th Floor	36. 36th Floor
37. 37th Floor	38. 38th Floor	39. 39th Floor	40. 40th Floor
41. 41st Floor	42. 42nd Floor	43. 43rd Floor	44. 44th Floor
45. 45th Floor	46. 46th Floor	47. 47th Floor	48. 48th Floor
49. 49th Floor	50. 50th Floor	51. 51st Floor	52. 52nd Floor
53. 53rd Floor	54. 54th Floor	55. 55th Floor	56. 56th Floor
57. 57th Floor	58. 58th Floor	59. 59th Floor	60. 60th Floor
61. 61st Floor	62. 62nd Floor	63. 63rd Floor	64. 64th Floor
65. 65th Floor	66. 66th Floor	67. 67th Floor	68. 68th Floor
69. 69th Floor	70. 70th Floor	71. 71st Floor	72. 72nd Floor
73. 73rd Floor	74. 74th Floor	75. 75th Floor	76. 76th Floor
77. 77th Floor	78. 78th Floor	79. 79th Floor	80. 80th Floor
81. 81st Floor	82. 82nd Floor	83. 83rd Floor	84. 84th Floor
85. 85th Floor	86. 86th Floor	87. 87th Floor	88. 88th Floor
89. 89th Floor	90. 90th Floor	91. 91st Floor	92. 92nd Floor
93. 93rd Floor	94. 94th Floor	95. 95th Floor	96. 96th Floor
97. 97th Floor	98. 98th Floor	99. 99th Floor	100. 100th Floor

FLOOR PLAN SYMBOLS

1. 1st Floor	2. 2nd Floor	3. 3rd Floor	4. 4th Floor
5. 5th Floor	6. 6th Floor	7. 7th Floor	8. 8th Floor
9. 9th Floor	10. 10th Floor	11. 11th Floor	12. 12th Floor
13. 13th Floor	14. 14th Floor	15. 15th Floor	16. 16th Floor
17. 17th Floor	18. 18th Floor	19. 19th Floor	20. 20th Floor
21. 21st Floor	22. 22nd Floor	23. 23rd Floor	24. 24th Floor
25. 25th Floor	26. 26th Floor	27. 27th Floor	28. 28th Floor
29. 29th Floor	30. 30th Floor	31. 31st Floor	32. 32nd Floor
33. 33rd Floor	34. 34th Floor	35. 35th Floor	36. 36th Floor
37. 37th Floor	38. 38th Floor	39. 39th Floor	40. 40th Floor
41. 41st Floor	42. 42nd Floor	43. 43rd Floor	44. 44th Floor
45. 45th Floor	46. 46th Floor	47. 47th Floor	48. 48th Floor
49. 49th Floor	50. 50th Floor	51. 51st Floor	52. 52nd Floor
53. 53rd Floor	54. 54th Floor	55. 55th Floor	56. 56th Floor
57. 57th Floor	58. 58th Floor	59. 59th Floor	60. 60th Floor
61. 61st Floor	62. 62nd Floor	63. 63rd Floor	64. 64th Floor
65. 65th Floor	66. 66th Floor	67. 67th Floor	68. 68th Floor
69. 69th Floor	70. 70th Floor	71. 71st Floor	72. 72nd Floor
73. 73rd Floor	74. 74th Floor	75. 75th Floor	76. 76th Floor
77. 77th Floor	78. 78th Floor	79. 79th Floor	80. 80th Floor
81. 81st Floor	82. 82nd Floor	83. 83rd Floor	84. 84th Floor
85. 85th Floor	86. 86th Floor	87. 87th Floor	88. 88th Floor
89. 89th Floor	90. 90th Floor	91. 91st Floor	92. 92nd Floor
93. 93rd Floor	94. 94th Floor	95. 95th Floor	96. 96th Floor
97. 97th Floor	98. 98th Floor	99. 99th Floor	100. 100th Floor

REVISIONS

REV	DATE	DESCRIPTION	BY

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION WITHOUT THE SIGNATURE OF THE DESIGNER.

DATE: 10.07.19

BY: J.M.

FOR: S.O.

PROJECT: 10.07.19

CLIENT: My Happy Place 2 Ltd

ADDRESS: 3 Oxford Street

CITY: Manchester

POSTCODE: M2 3WQ

PROJECT NAME: 65 Princess Street

CITY: Manchester

POSTCODE: M2 3FX

PROJECT NAME: 65 Princess Street

CITY: Manchester

POSTCODE: M2 3FX

PROJECT NAME: 65 Princess Street

CITY: Manchester

POSTCODE: M2 3FX

PROJECT NAME: 65 Princess Street

CITY: Manchester

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PROJECT NAME: 65 Princess Street

CITY: Manchester

POSTCODE: M2 3FX

PROPOSED BASEMENT

J.M. FOR S.O.
10.07.19

REV. A
16.01.20 P02

NOT FOR CONSTRUCTION

FIRST FLOOR PLAN

NOTES

- AS GROUND FLOOR

FLOOR JOIST KEY

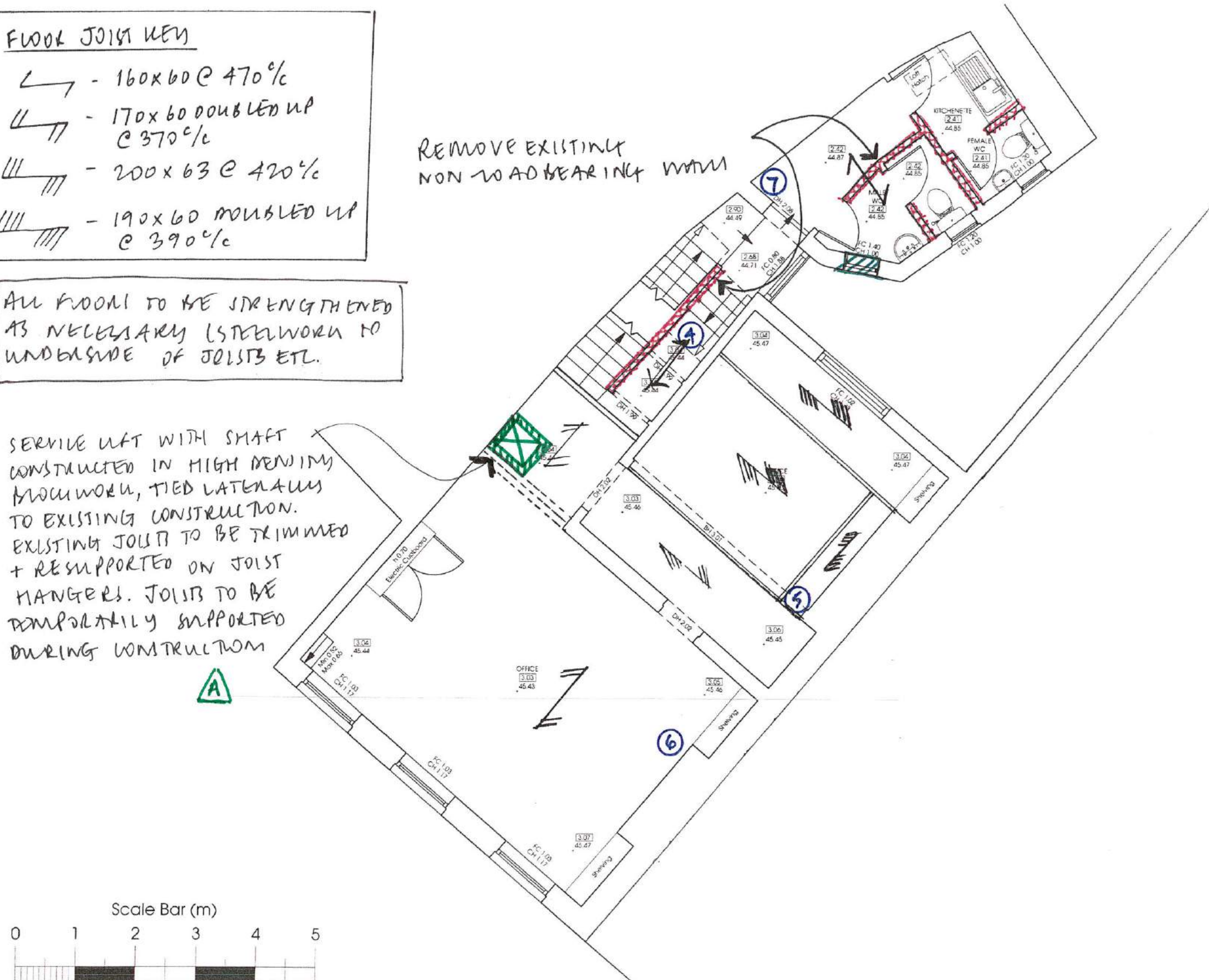
- 160x60 @ 470°c
- 170x60 DOUBLE UP @ 370°c
- 200x63 @ 420°c
- 190x60 DOUBLE UP @ 390°c

ALL FLOOR TO BE STRENGTHENED AS NECESSARY (STEELWORK TO UNDERSIDE OF JOISTS ETC).

SERVICE LIFT WITH SHAFT CONSTRUCTED IN HIGH DENSITY BLOCKWORK, TIED LATENTLY TO EXISTING CONSTRUCTION. EXISTING JOIST TO BE TRIMMED + RESUPPORTED ON JOIST HANGERS. JOISTS TO BE TEMPORARILY SUPPORTED DURING CONSTRUCTION

A

REMOVE EXISTING NON LOAD BEARING WALL



NOTES

1. ALL DIMENSIONS TO BE CHECKED ON SITE AND NOT SCALED FROM THIS DRAWING.
2. ALL DIMENSIONS TO BE GIVEN BY THE ARCHITECT WITHIN 24 HOURS OF THE DATE OF THE DRAWING.
3. ALL DIMENSIONS TO BE GIVEN BY THE ARCHITECT WITHIN 24 HOURS OF THE DATE OF THE DRAWING.
4. ALL DIMENSIONS TO BE GIVEN BY THE ARCHITECT WITHIN 24 HOURS OF THE DATE OF THE DRAWING.
5. ALL DIMENSIONS TO BE GIVEN BY THE ARCHITECT WITHIN 24 HOURS OF THE DATE OF THE DRAWING.

KEY

1. 160x60 @ 470°c	11. 170x60 DOUBLE UP @ 370°c
2. 200x63 @ 420°c	12. 190x60 DOUBLE UP @ 390°c
3. 160x60 @ 470°c	13. 170x60 DOUBLE UP @ 370°c
4. 200x63 @ 420°c	14. 190x60 DOUBLE UP @ 390°c
5. 160x60 @ 470°c	15. 170x60 DOUBLE UP @ 370°c
6. 200x63 @ 420°c	16. 190x60 DOUBLE UP @ 390°c
7. 160x60 @ 470°c	17. 170x60 DOUBLE UP @ 370°c
8. 200x63 @ 420°c	18. 190x60 DOUBLE UP @ 390°c
9. 160x60 @ 470°c	19. 170x60 DOUBLE UP @ 370°c
10. 200x63 @ 420°c	20. 190x60 DOUBLE UP @ 390°c

FLOOR PLAN SYMBOLS

1. 160x60 @ 470°c	11. 170x60 DOUBLE UP @ 370°c
2. 200x63 @ 420°c	12. 190x60 DOUBLE UP @ 390°c
3. 160x60 @ 470°c	13. 170x60 DOUBLE UP @ 370°c
4. 200x63 @ 420°c	14. 190x60 DOUBLE UP @ 390°c
5. 160x60 @ 470°c	15. 170x60 DOUBLE UP @ 370°c
6. 200x63 @ 420°c	16. 190x60 DOUBLE UP @ 390°c
7. 160x60 @ 470°c	17. 170x60 DOUBLE UP @ 370°c
8. 200x63 @ 420°c	18. 190x60 DOUBLE UP @ 390°c
9. 160x60 @ 470°c	19. 170x60 DOUBLE UP @ 370°c
10. 200x63 @ 420°c	20. 190x60 DOUBLE UP @ 390°c

REV	DATE	REVISIONS	BY

1. 160x60 @ 470°c	11. 170x60 DOUBLE UP @ 370°c
2. 200x63 @ 420°c	12. 190x60 DOUBLE UP @ 390°c
3. 160x60 @ 470°c	13. 170x60 DOUBLE UP @ 370°c
4. 200x63 @ 420°c	14. 190x60 DOUBLE UP @ 390°c
5. 160x60 @ 470°c	15. 170x60 DOUBLE UP @ 370°c
6. 200x63 @ 420°c	16. 190x60 DOUBLE UP @ 390°c
7. 160x60 @ 470°c	17. 170x60 DOUBLE UP @ 370°c
8. 200x63 @ 420°c	18. 190x60 DOUBLE UP @ 390°c
9. 160x60 @ 470°c	19. 170x60 DOUBLE UP @ 370°c
10. 200x63 @ 420°c	20. 190x60 DOUBLE UP @ 390°c

TITLE

First Floor Plan

Client

My Happy Place 2 Ltd
Shanton House
3 Oxford Street
Manchester, M2 3WQ

Project Name

65 Princess Street
Manchester
M2 3FX

malcolm hollis

The Lexicon
10-12 Mount Street
Manchester M2 5NT

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W malcolmhollis.com

DATE 20.12.2018

SCALE 1:50

PROJECT 74359

DATE 20.12.2018

PROJECT 74359

PROPOSED FIRST FLOOR

JM FOR S.O.
10.07.19

16.01.20
REV. A
P02.

NOT FOR CONSTRUCTION

Scale Bar (m)

Appendix B – Floor Joist Capacity Structural Assessment



65 Princess Street, Manchester
Floor Joist Capacity Structural Assessment

Studio One Job Number 031_010

12 July 2019

65 Princess Street
Floor Joist Capacity Structural Assessment

Contents

Page	Content
1 – 2	Introduction; Design considerations
J/1	Timber Joist Loadings
J/2	Superimposed Dead Load Capacities
J/3 – J/5	Joist Number Assignment
J/6 – J/35	Timber Joist Calculations

Calculations prepared by: SG
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 up 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 2.0 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 031/010

Sheet No 3/1

Project 63 PRINCESS STREET

Engineer SG

Date 11/07/19

Element TIMBER JOIST LOADING

Checked by JM

Date 12.07.19

EXISTING DEAD LOAD

LIGHT FINISHES	SAY = 0.10 kN/m ²
25mm BOARDS 7 8kN/m ²	0.25 x 8 = 0.20 kN/m ²
JOISTS (NOMINAL)	SAY = 0.20 kN/m ²
PLASTER	SAY = 0.25 kN/m ²
SERVICES	SAY = 0.05 kN/m ²
	<u>Σ = 0.80 kN/m²</u>

PROPOSED IMPOSED LOAD

HOTEL = 1.5 kN/m² 1.4kN POINT LOAD.

		Dimensions					Permissible	Applied			
Joist	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)	Status	DL Capacity (kN/m)
1	Ground Floor	70	90	400	1500	C16	6.656	2.438	4.218	Pass	1.10
2	Ground Floor	225	75	450	1930	C16	6.017	0.7	5.317	Pass	7.23
3	Ground Floor	150	75	420	2360	C16	6.292	2.164	4.128	Pass	1.67
4	Ground Floor	175	50	420	1860	C16	6.186	1.468	4.718	Pass	2.78
5	First Floor	160	60	470	2700	C16	6.247	3.45	2.797	Pass	0.79
6	First Floor	170	120	370	4570	C16	6.206	3.622	2.584	Pass	0.57
7	First Floor	200	63	420	4285	C16	6.096	4.8	1.296	Pass	0.24
8	First Floor	190	60	390	3430	C16	6.13	3.319	2.811	Pass	0.69
9	Second Floor	180	130	450	4570	C16	6.167	3.611	2.556	Pass	0.69
10	Second Floor	200	60	345	3500	C16	6.096	2.781	3.315	Pass	0.87

= doubled up joist

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

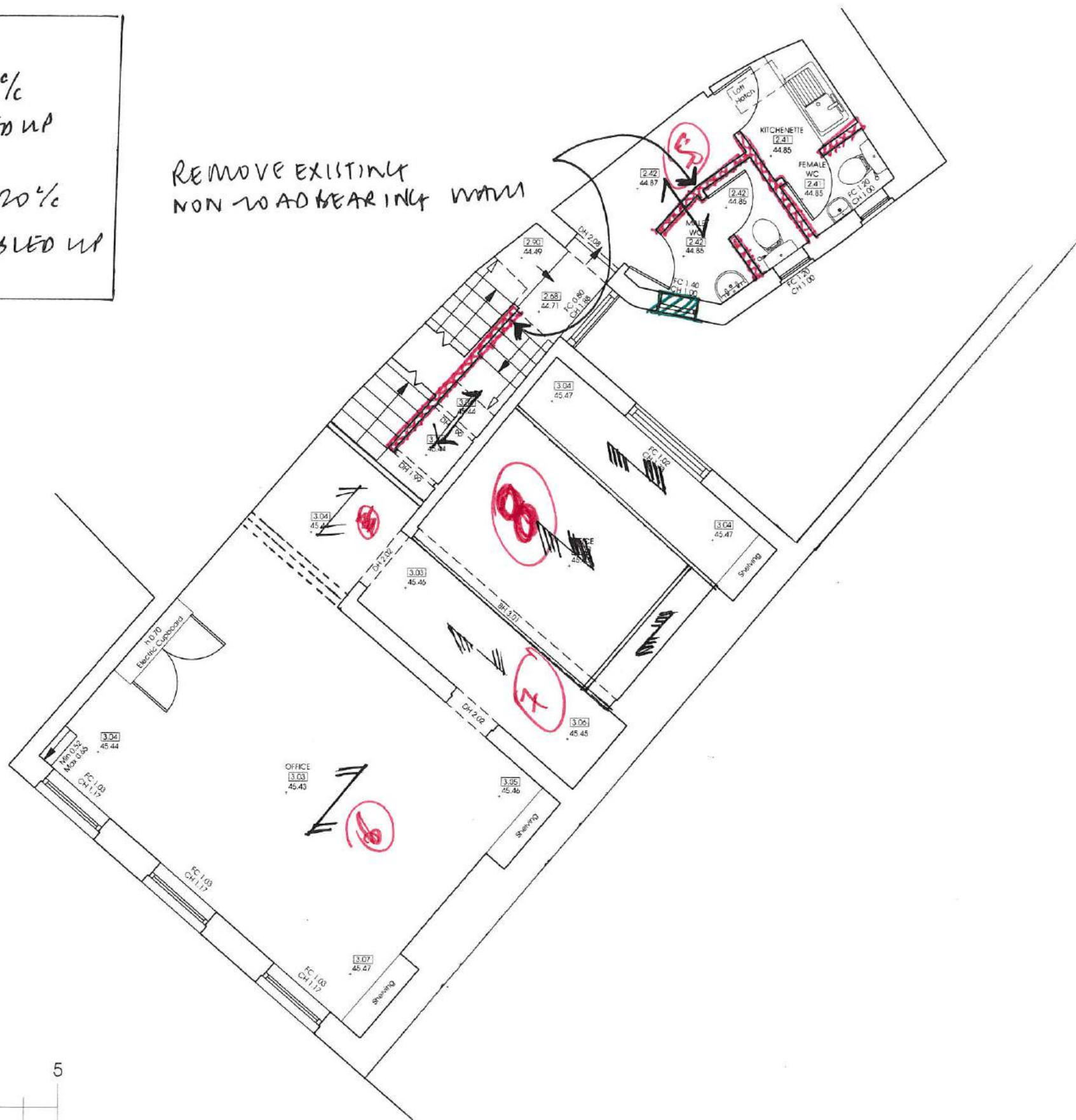
NOTES

- AS GROUND FLOOR

FLOOR JOIST NEN

-  - 160x60 @ 470°C
 - 170x60 DOUBLE UP @ 370°C
 - 200x63 @ 420°C
 - 190x60 DOUBLE UP @ 390°C

REMOVE EXISTING
NON-LOAD BEARING WALL



Scale Bar (m)



NOTES

- 1) ALL DIMENSIONS TO BE CHECKED ON SITE AND NOT SCALED FROM THE DRAWING
- 2) MAIN COLUMN-HOLDS SHALL BE FORMED IN WRITING OF ANY DISCREPANCIES
- 3) ALL DIMENSIONS ARE IN METRES ONLY
- 4) THE ORIGIN AND ORIENTATION OF THE SURVEY GRID RELATE TO A GPS RE TO ORDNANCE SURVEY GRID
- 5) ALL LEVELS ARE BASED ON A GPS RE TO OS LEVEL DATUM

KEY

[illegible]

FLOOR PLAN SYMBOLS

25.50 Soft Level
 19.20 Floor to Soft Height
 17.20 Floor to Outer Ceiling Height
 16.00 Soft Level
 13.20 Inner Ceiling Line
 → Show Angle (both up)
 → Structural Overhead Slope (point up)
 → Non-structural Overhead Slope (point up)
 → Roof Slope (point down)
 → Structural Ceiling (point not slope)
 → Non-structural Ceiling (point not slope)

REVISIONS

REV	DATE	AMENDMENTS	INITIALS
THIS DRAWING IS FOR THE FOLLOWING PURPOSE ONLY			
PRELIMINARY ☐	TRUCK ☐	CONSTRUCTION ☐	
SWITCH ☐	MEAS. FOR SUBMIT ☐	CONTRACT ☐	

7	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110
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45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140
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60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155
65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165
75	80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170
80	85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175
85	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180
90	95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185
95	100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190
100	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195
105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200
110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205
115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200		

First Floor Plan

CUEN*	
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My Happy Place 2 Ltd
Shenton House
3 Oxford Street
Manchester, M2 3WQ

PROJECT NAME	
--------------	--

65 Princess Street
Manchester
M2 3FX

malcolm hollis

The Lexicon
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Manchester M2 5NT

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W malcolmhollis.com

DATE	SPAN BY
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20.12.2018	DI
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1.50	@A2	PV
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FILE NO.	TO WHOM	FILE NO.	DATE	BY

74354	MHL	00	01	M2
74355	MHL	00	01	M2

G	10200	A7	—
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JM for S.O.
10.07.19

 $\frac{5}{4}$

NOT FOR CONSTRUCTION



SECOND FLOOR PLAN

NOTES

- AS GROUND FLOOR.

FLOOR JOIST KEY

↙ - 180x65 DOUBLED UP
C 450 %

↘ - 200x60 C 345 %



NOTES

1) ALL DIMENSIONS TO BE CHECKED ON SITE AND NOT SCALED FROM THIS DRAWING.
2) MALCOLM HOLLS SHALL BE RESPONSIBLE FOR WRITING TO ANY DISCREPANCIES.
3) ALL DIMENSIONS ARE IN METRES ONLY.
4) THE CURVE AND ORIENTATION OF THE SURVEYOR RELATE TO A CORRECTION TO ORDNANCE SURVEY GRID.
5) ALL LEVELS ARE BASED ON A GPS RE TO US LEVEL DATUM.

KEY

1. Wall	2. Floor	3. Ceiling	4. Staircase
5. Window	6. Door	7. Partition	8. External Wall
9. External Wall	10. External Wall	11. External Wall	12. External Wall
13. External Wall	14. External Wall	15. External Wall	16. External Wall
17. External Wall	18. External Wall	19. External Wall	20. External Wall
21. External Wall	22. External Wall	23. External Wall	24. External Wall
25. External Wall	26. External Wall	27. External Wall	28. External Wall
29. External Wall	30. External Wall	31. External Wall	32. External Wall
33. External Wall	34. External Wall	35. External Wall	36. External Wall
37. External Wall	38. External Wall	39. External Wall	40. External Wall
41. External Wall	42. External Wall	43. External Wall	44. External Wall
45. External Wall	46. External Wall	47. External Wall	48. External Wall
49. External Wall	50. External Wall	51. External Wall	52. External Wall
53. External Wall	54. External Wall	55. External Wall	56. External Wall
57. External Wall	58. External Wall	59. External Wall	60. External Wall
61. External Wall	62. External Wall	63. External Wall	64. External Wall
65. External Wall	66. External Wall	67. External Wall	68. External Wall
69. External Wall	70. External Wall	71. External Wall	72. External Wall
73. External Wall	74. External Wall	75. External Wall	76. External Wall
77. External Wall	78. External Wall	79. External Wall	80. External Wall
81. External Wall	82. External Wall	83. External Wall	84. External Wall
85. External Wall	86. External Wall	87. External Wall	88. External Wall
89. External Wall	90. External Wall	91. External Wall	92. External Wall
93. External Wall	94. External Wall	95. External Wall	96. External Wall
97. External Wall	98. External Wall	99. External Wall	100. External Wall

FLOOR PLAN SYMBOLS

20.00	Spot Level
21.00	Floor to Soffit Height
22.00	Floor to Under Ceiling Height
23.00	Soffit Level
24.00	Floor Ceiling Level
25.00	Base Anso (point to)
26.00	Structural Overhead Slope (point to)
27.00	Non-Structural Overhead Slope (point to)
28.00	Floor Slope (point to)
29.00	Structural Ceiling Vault (point to)
30.00	Non-Structural Ceiling Vault (point to)

REV	DATE	AMENDMENTS	NOTES

THIS DRAWING IS FOR THE FOLLOWING PROJECT ONLY:
DRAWING NO. 10.07.19
CONTRACT NO. 10.07.19
DRAWING NO. 10.07.19
CONTRACT NO. 10.07.19

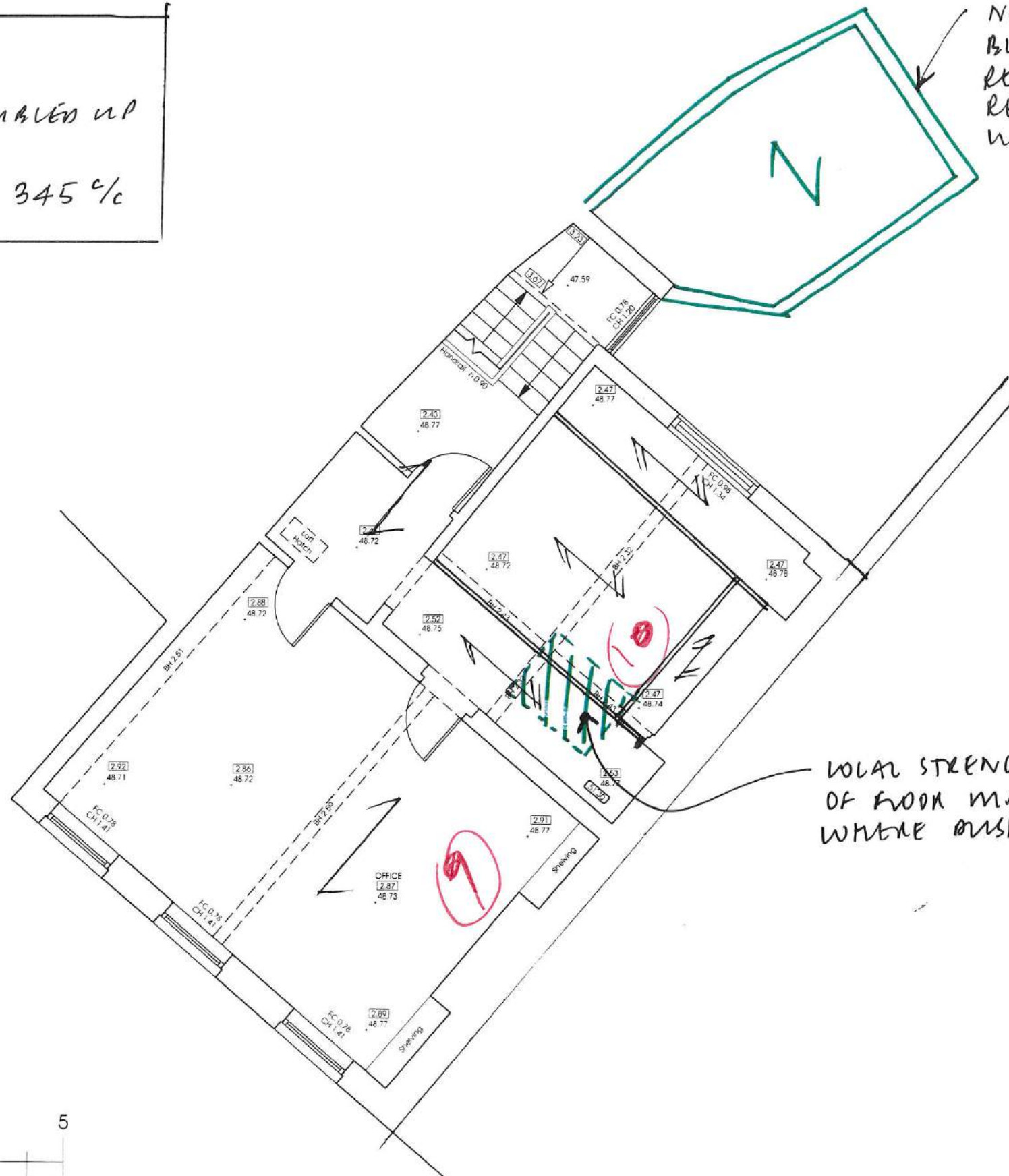
Second Floor Plan

My Happy Place 2 Ltd
Shenton House
3 Oxford Street
Manchester, M2 3WQ

65 Princess Street
Manchester
M2 3FX

malcolm holls
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DATE	20.12.2018	REVISION	D1
SCALE	1:50	APP. NO.	PV
APP. NO.	74359	APP. NO.	74359
APP. NO.	74359	APP. NO.	74359
APP. NO.	74359	APP. NO.	74359



NEW SINGLE STOREY EXTENSION
BUILT FROM EXISTING WALLS.
REMOVE MONOPITCH ROOF AND
REPLACE WITH FLAT.
UNDERPINNING MAY BE REQUIRED.

LOCAL STRENGTHENING / RAISING
OF FLOOR MAY BE REQUIRED
WHERE BUSTLING HAS OCCURRED.

Scale Bar (m)



JM FOR S.O.
10.07.19

J/S

NOT FOR CONSTRUCTION

 Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street		Job no. 031/010	
	Calcs for Joist 1		Start page no./Revision J/ 6	
	Calcs by SG	Calcs date 12-Jul-19	Checked by JM	Checked date 12/07/2019

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

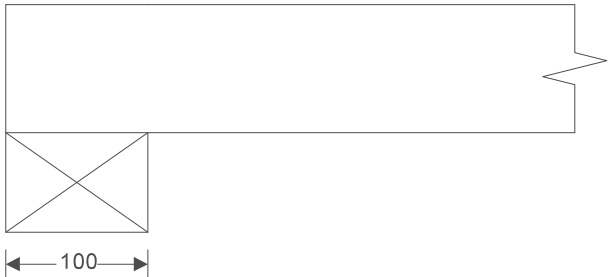
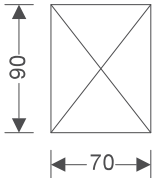
Joist details

Joist breadth	b = 70 mm
Joist depth	h = 90 mm
Joist spacing	s = 400 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} = 1500 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 4252500 mm ⁴
Section modulus	Z = b × h ² / 6 = 94500 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.02 kN/m
Dead load	F _{d_udl} = 0.00 kN/m ²
Imposed UDL(Long term)	F _{L_udl} = 2.00 kN/m ²
Imposed point load (Medium term)	F _{L_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 = 1.14
Load sharing factor	K ₈ = 1.10

 Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street		Job no. 031/010	
	Calcs for Joist 1		Start page no./Revision J/ 7	
	Calcs by SG	Calcs date 12-Jul-19	Checked by JM	Checked date 12/07/2019

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 0.230 kNm
Maximum shear force	V = 0.614 kN
Maximum support reaction	R = 0.614 kN
Maximum deflection	δ = 1.523 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 = 6.656 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 2.438 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) = 0.146 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) = 0.088 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 4.500 mm
Bending deflection (based on E _{mean})	δ _{bending} = 1.443 mm
Shear deflection	δ _{shear} = 0.080 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 1.523 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 0.680 kNm
Maximum shear force	V = 1.814 kN
Maximum support reaction	R = 1.814 kN
Maximum deflection	δ = 3.651 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 = 8.319 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 7.200 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) = 0.432 N/mm ²

PASS - Applied shear stress within permissible limits

Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project65 Princess Street				Job no.031/010	
	Calcs forJoist 1				Start page no./RevisionJ/ 8	
	Calcs bySG	Calcs date12-Jul-19	Checked byJM	Checked date12/07/2019	Approved by	Approved date

Check bearing stress

Compression perpendicular to grain (no wane)

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

Permissible bearing stress

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

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.259 \text{ N/mm}^2$

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 4.500 \text{ mm}$

Bending deflection (based on E_{mean})

$\delta_{bending} = 3.416 \text{ mm}$

Shear deflection

$\delta_{shear} = 0.236 \text{ mm}$

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 3.651 \text{ mm}$

PASS - Actual deflection within permissible limits

Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project65 Princess Street				Job no.031/010	
	Calcs forJoist 2				Start page no./RevisionJ/ 9	
	Calcs bySG	Calcs date12-Jul-19	Checked byJM	Checked date12/07/2019	Approved by	Approved date

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

Joist details

Joist breadth

b = 75 mm

Joist depth

h = 225 mm

Joist spacing

s = 450 mm

Timber strength class

C16

Service class of timber

1



Span details

Number of spans

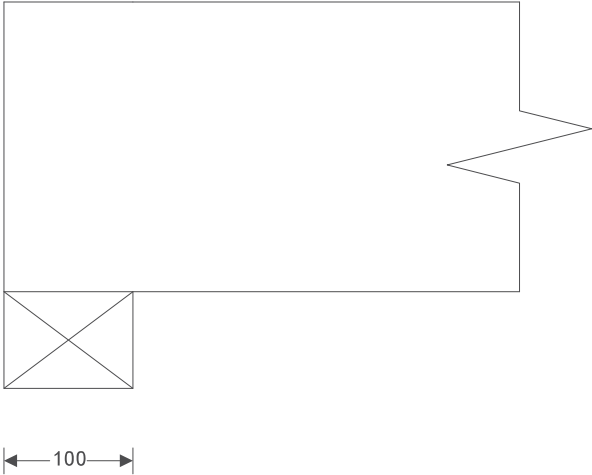
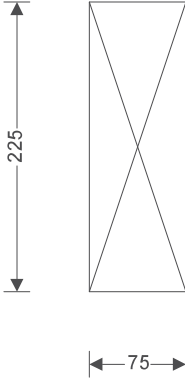
N_{span} = 1

Length of bearing

L_b = 100 mm

Effective length of span

L_{s1} = 1930 mm



Section properties

Second moment of area

I = b × h³ / 12 = 71191406 mm⁴

Section modulus

Z = b × h² / 6 = 632813 mm³

Loading details

Joist self weight

F_{swt} = b × h × ρ_{char} × g_{acc} = 0.05 kN/m

Dead load

F_{d_udl} = 0.00 kN/m²

Imposed UDL(Long term)

F_{i_udl} = 2.00 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

 Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street				Job no. 031/010	
	Calcs for Joist 2				Start page no./Revision J/ 10	
	Calcs by SG	Calcs date 12-Jul-19	Checked by JM	Checked date 12/07/2019	Approved by	Approved date

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

K_{2c} = **1.00**
K_{2s} = **1.00**
K_{2e} = **1.00**
K₇ = **1.03**
K₈ = **1.10**

Consider long term loads

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

K₃ = **1.00**
M = **0.443** kNm
V = **0.918** kN
R = **0.918** kN
δ = **0.332** mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

σ_m = **5.300** N/mm²
σ_{m_adm} = σ_m × K_{2m} × K₃ × K₇ × K₈ = **6.017** N/mm²
σ_{m_max} = M / Z = **0.700** N/mm²
PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress
Permissible shear stress
Applied shear stress

τ = **0.670** N/mm²
τ_{adm} = τ × K_{2s} × K₃ × K₈ = **0.737** N/mm²
τ_{max} = 3 × V / (2 × b × h) = **0.082** N/mm²
PASS - Applied shear stress within permissible limits

Check bearing stress

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

σ_{cp1} = **2.200** N/mm²
σ_{c_adm} = σ_{cp1} × K_{2c} × K₃ × K₈ = **2.420** N/mm²
σ_{c_max} = R / (b × L_b) = **0.122** N/mm²
PASS - Applied bearing stress within permissible limits

Check deflection

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

δ_{adm} = min(L_{s1} × 0.003, 14 mm) = **5.790** mm
δ_{bending} = **0.274** mm
δ_{shear} = **0.057** mm
δ = δ_{bending} + δ_{shear} = **0.332** mm
PASS - Actual deflection within permissible limits

Consider medium term loads

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

K₃ = **1.25**
M = **0.892** kNm
V = **1.850** kN
R = **1.850** kN
δ = **0.560** mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

σ_m = **5.300** N/mm²
σ_{m_adm} = σ_m × K_{2m} × K₃ × K₇ × K₈ = **7.522** N/mm²
σ_{m_max} = M / Z = **1.410** N/mm²
PASS - Applied bending stress within permissible limits

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	Calcs for Joist 2				Start page no./Revision J/ 11	
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Check shear stress

Shear stress
Permissible shear stress
Applied shear stress

τ = **0.670** N/mm²
τ_{adm} = τ × K_{2s} × K₃ × K₈ = **0.921** N/mm²
τ_{max} = 3 × V / (2 × b × h) = **0.164** N/mm²
PASS - Applied shear stress within permissible limits

Check bearing stress

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

σ_{cp1} = **2.200** N/mm²
σ_{c_adm} = σ_{cp1} × K_{2c} × K₃ × K₈ = **3.025** N/mm²
σ_{c_max} = R / (b × L_b) = **0.247** N/mm²
PASS - Applied bearing stress within permissible limits

Check deflection

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

δ_{adm} = min(L_{s1} × 0.003, 14 mm) = **5.790** mm
δ_{bending} = **0.445** mm
δ_{shear} = **0.115** mm
δ = δ_{bending} + δ_{shear} = **0.560** mm
PASS - Actual deflection within permissible limits

 Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street		Job no. 031/010	
	Calcs for Joist 3		Start page no./Revision J/ 12	
	Calcs by SG	Calcs date 12-Jul-19	Checked by JM	Checked date 12/07/2019
		Approved by	Approved date	

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

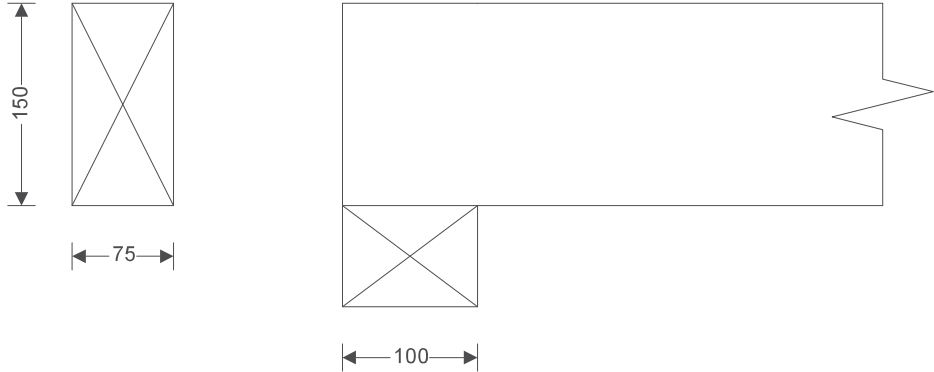
Joist details

Joist breadth	b = 75 mm
Joist depth	h = 150 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} = 2360 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 21093750 mm ⁴
Section modulus	Z = b × h ² / 6 = 281250 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.03 kN/m
Dead load	F _{d_udl} = 0.00 kN/m ²
Imposed UDL(Long term)	F _{l_udl} = 2.00 kN/m ²
Imposed point load (Medium term)	F _{l_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

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	Calcs for Joist 3		Start page no./Revision J/ 13	
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Section depth factor	K ₇ = 1.08
Load sharing factor	K ₈ = 1.10
Consider long term loads	
Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 0.609 kNm
Maximum shear force	V = 1.032 kN
Maximum support reaction	R = 1.032 kN
Maximum deflection	δ = 2.020 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 = 6.292 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 2.164 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) = 0.138 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) = 0.138 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 7.080 mm
Bending deflection (based on E _{mean})	δ _{bending} = 1.902 mm
Shear deflection	δ _{shear} = 0.118 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 2.020 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 1.086 kNm
Maximum shear force	V = 1.840 kN
Maximum support reaction	R = 1.840 kN
Maximum deflection	δ = 2.940 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 = 7.865 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.861 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) = 0.245 N/mm ²

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PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

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

Permissible bearing stress

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

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.245 \text{ N/mm}^2$

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 7.080 \text{ mm}$

Bending deflection (based on E_{mean})

$\delta_{bending} = 2.730 \text{ mm}$

Shear deflection

$\delta_{shear} = 0.211 \text{ mm}$

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 2.940 \text{ mm}$

PASS - Actual deflection within permissible limits

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	Calcs forJoist 4				Start page no./RevisionJ/ 15	
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TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

Joist details

Joist breadth

$b = 50 \text{ mm}$

Joist depth

$h = 175 \text{ mm}$

Joist spacing

$s = 420 \text{ mm}$

Timber strength class

C16

Service class of timber

1



Span details

Number of spans

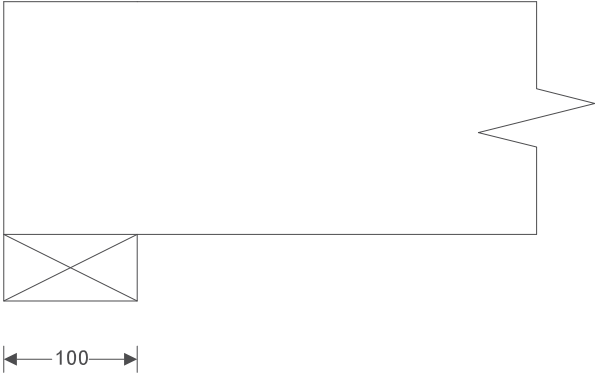
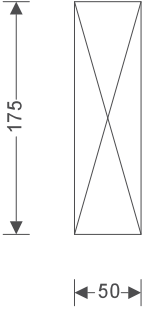
$N_{span} = 1$

Length of bearing

$L_b = 100 \text{ mm}$

Effective length of span

$L_{s1} = 1860 \text{ mm}$



Section properties

Second moment of area

$I = b \times h^3 / 12 = 22330729 \text{ mm}^4$

Section modulus

$Z = b \times h^2 / 6 = 255208 \text{ mm}^3$

Loading details

Joist self weight

$F_{swt} = b \times h \times \rho_{char} \times g_{acc} = 0.03 \text{ kN/m}$

Dead load

$F_{d_udl} = 0.00 \text{ kN/m}^2$

Imposed UDL(Long term)

$F_{l_udl} = 2.00 \text{ kN/m}^2$

Imposed point load (Medium term)

$F_{l_pt} = 1.80 \text{ kN}$

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

$K_{2e} = 1.00$

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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 $M = 0.375$ kNm
Maximum shear force $V = 0.806$ kN
Maximum support reaction $R = 0.806$ kN
Maximum deflection $\delta = 0.781$ mm

Check bending stress

Bending stress $\sigma_m = 5.300$ N/mm²
Permissible bending stress $\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = 6.186$ N/mm²
Applied bending stress $\sigma_{m_max} = M / Z = 1.468$ N/mm²

PASS - Applied bending stress within permissible limits

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 $\tau_{max} = 3 \times V / (2 \times b \times h) = 0.138$ 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 $\sigma_{c_max} = R / (b \times L_b) = 0.161$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection $\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 5.580$ mm
Bending deflection (based on E_{mean}) $\delta_{bending} = 0.687$ mm
Shear deflection $\delta_{shear} = 0.093$ mm
Total deflection $\delta = \delta_{bending} + \delta_{shear} = 0.781$ mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor $K_3 = 1.25$
Maximum bending moment $M = 0.849$ kNm
Maximum shear force $V = 1.825$ kN
Maximum support reaction $R = 1.825$ kN
Maximum deflection $\delta = 1.461$ mm

Check bending stress

Bending stress $\sigma_m = 5.300$ N/mm²
Permissible bending stress $\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = 7.733$ N/mm²
Applied bending stress $\sigma_{m_max} = M / Z = 3.325$ N/mm²

PASS - Applied bending stress within permissible limits

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 $\tau_{max} = 3 \times V / (2 \times b \times h) = 0.313$ N/mm²

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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 $\sigma_{c_max} = R / (b \times L_b) = 0.365$ N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection $\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = 5.580$ mm
Bending deflection (based on E_{mean}) $\delta_{bending} = 1.249$ mm
Shear deflection $\delta_{shear} = 0.212$ mm
Total deflection $\delta = \delta_{bending} + \delta_{shear} = 1.461$ mm

PASS - Actual deflection within permissible limits

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TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

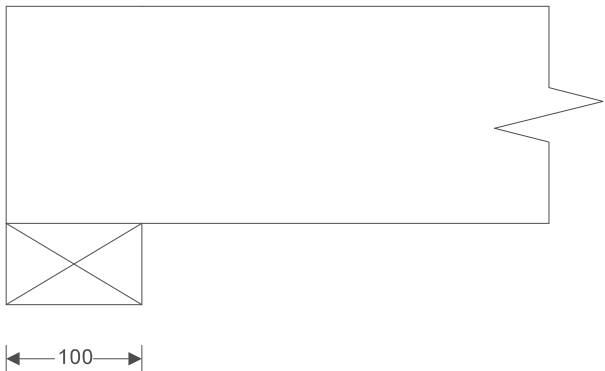
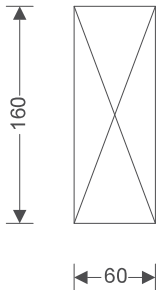
Joist details

Joist breadth	b = 60 mm
Joist depth	h = 160 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} = 2700 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 20480000 mm ⁴
Section modulus	Z = b × h ² / 6 = 256000 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.03 kN/m
Dead load	F _{d_udl} = 0.00 kN/m ²
Imposed UDL(Long term)	F _{L_udl} = 2.00 kN/m ²
Imposed point load (Medium term)	F _{L_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

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Section depth factor	K ₇ = 1.07
Load sharing factor	K ₈ = 1.10
<u>Consider long term loads</u>	
Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 0.883 kNm
Maximum shear force	V = 1.308 kN
Maximum support reaction	R = 1.308 kN
Maximum deflection	δ = 3.922 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 = 6.247 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.450 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) = 0.204 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) = 0.218 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 8.100 mm
Bending deflection (based on E _{mean})	δ _{bending} = 3.721 mm
Shear deflection	δ _{shear} = 0.201 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 3.922 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 1.242 kNm
Maximum shear force	V = 1.839 kN
Maximum support reaction	R = 1.839 kN
Maximum deflection	δ = 4.490 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 = 7.809 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 4.850 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) = 0.287 N/mm ²

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PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

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

Permissible bearing stress

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

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.307 \text{ N/mm}^2$

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

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

Bending deflection (based on E_{mean})

$\delta_{bending} = 4.208 \text{ mm}$

Shear deflection

$\delta_{shear} = 0.282 \text{ mm}$

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 4.490 \text{ mm}$

PASS - Actual deflection within permissible limits

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TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

Joist details

Joist breadth

$b = 120 \text{ mm}$

Joist depth

$h = 170 \text{ mm}$

Joist spacing

$s = 370 \text{ mm}$

Timber strength class

C16

Service class of timber

1



Span details

Number of spans

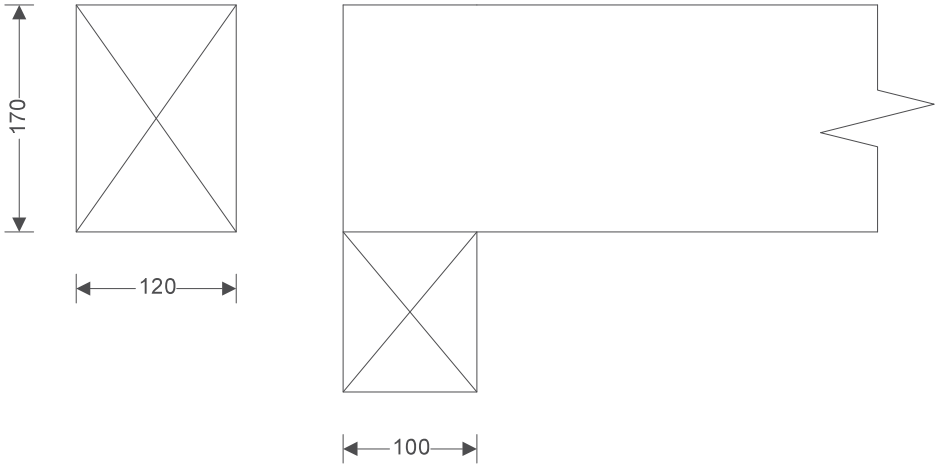
$N_{span} = 1$

Length of bearing

$L_b = 100 \text{ mm}$

Effective length of span

$L_{s1} = 4570 \text{ mm}$



Section properties

Second moment of area

$I = b \times h^3 / 12 = 49130000 \text{ mm}^4$

Section modulus

$Z = b \times h^2 / 6 = 578000 \text{ mm}^3$

Loading details

Joist self weight

$F_{swt} = b \times h \times \rho_{char} \times g_{acc} = 0.06 \text{ kN/m}$

Dead load

$F_{d_udl} = 0.00 \text{ kN/m}^2$

Imposed UDL(Long term)

$F_{l_udl} = 2.00 \text{ kN/m}^2$

Imposed point load (Medium term)

$F_{l_pt} = 1.80 \text{ kN}$

Modification factors

Service class for bending parallel to grain

$K_{2m} = 1.00$

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

K_{2c} = **1.00**
K_{2s} = **1.00**
K_{2e} = **1.00**
K₇ = **1.06**
K₈ = **1.10**

Consider long term loads

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

K₃ = **1.00**
M = **2.094** kNm
V = **1.833** kN
R = **1.833** kN
δ = **10.759** mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

σ_m = **5.300** N/mm²
σ_{m_adm} = σ_m × K_{2m} × K₃ × K₇ × K₈ = **6.206** N/mm²
σ_{m_max} = M / Z = **3.622** N/mm²

PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress
Permissible shear stress
Applied shear stress

τ = **0.670** N/mm²
τ_{adm} = τ × K_{2s} × K₃ × K₈ = **0.737** N/mm²
τ_{max} = 3 × V / (2 × b × h) = **0.135** N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

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

σ_{cp1} = **2.200** N/mm²
σ_{c_adm} = σ_{cp1} × K_{2c} × K₃ × K₈ = **2.420** N/mm²
σ_{c_max} = R / (b × L_b) = **0.153** N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

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

δ_{adm} = min(L_{s1} × 0.003, 14 mm) = **13.710** mm
δ_{bending} = **10.536** mm
δ_{shear} = **0.224** mm
δ = δ_{bending} + δ_{shear} = **10.759** mm

PASS - Actual deflection within permissible limits

Consider medium term loads

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

K₃ = **1.25**
M = **2.218** kNm
V = **1.942** kN
R = **1.942** kN
δ = **9.330** mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

σ_m = **5.300** N/mm²
σ_{m_adm} = σ_m × K_{2m} × K₃ × K₇ × K₈ = **7.757** N/mm²
σ_{m_max} = M / Z = **3.838** N/mm²

PASS - Applied bending stress within permissible limits

 Studio One 42 Edge Street Manchester M4 1HN	Project 65 Princess Street				Job no. 031/010	
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Check shear stress

Shear stress
Permissible shear stress
Applied shear stress

τ = **0.670** N/mm²
τ_{adm} = τ × K_{2s} × K₃ × K₈ = **0.921** N/mm²
τ_{max} = 3 × V / (2 × b × h) = **0.143** N/mm²

PASS - Applied shear stress within permissible limits

Check bearing stress

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

σ_{cp1} = **2.200** N/mm²
σ_{c_adm} = σ_{cp1} × K_{2c} × K₃ × K₈ = **3.025** N/mm²
σ_{c_max} = R / (b × L_b) = **0.162** N/mm²

PASS - Applied bearing stress within permissible limits

Check deflection

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

δ_{adm} = min(L_{s1} × 0.003, 14 mm) = **13.710** mm
δ_{bending} = **9.093** mm
δ_{shear} = **0.237** mm
δ = δ_{bending} + δ_{shear} = **9.330** mm

PASS - Actual deflection within permissible limits

Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project				Job no.	
	65 Princess Street				031/010	
	Calcs for				Start page no./Revision	
Joist 7				J/ 24		
Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date	
SG	12-Jul-19	JM	12/07/2019			

TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

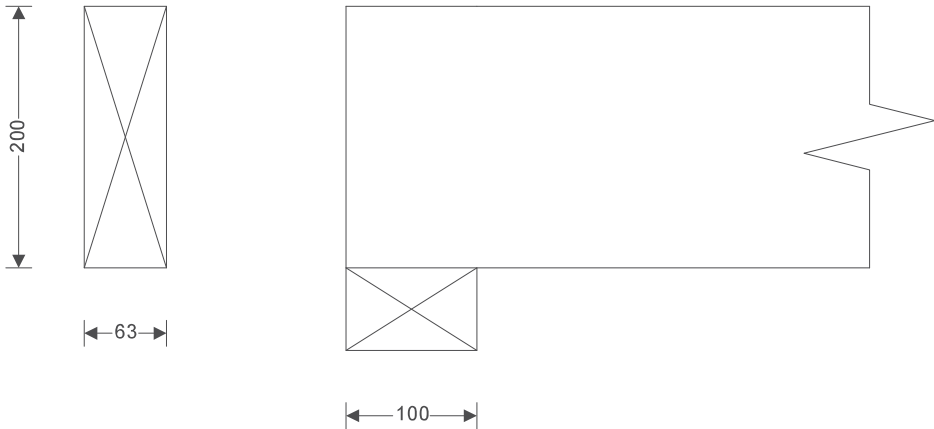
Joist details

Joist breadth	b = 63 mm
Joist depth	h = 200 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} = 4285 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 42000000 mm ⁴
Section modulus	Z = b × h ² / 6 = 420000 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.04 kN/m
Dead load	F _{d_udl} = 0.00 kN/m ²
Imposed UDL(Long term)	F _{l_udl} = 2.00 kN/m ²
Imposed point load (Medium term)	F _{l_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

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	65 Princess Street				031/010	
	Calcs for				Start page no./Revision	
	Joist 7				J/ 25	
	Calcs by	Calcs date	Checked by	Checked date	Approved by	Approved date
	SG	12-Jul-19	JM	12/07/2019		

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 = 2.016 kNm
Maximum shear force	V = 1.882 kN
Maximum support reaction	R = 1.882 kN
Maximum deflection	δ = 10.781 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 = 4.800 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) = 0.224 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) = 0.299 N/mm ²

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection	δ _{adm} = min(L _{s1} × 0.003, 14 mm) = 12.855 mm
Bending deflection (based on E _{mean})	δ _{bending} = 10.432 mm
Shear deflection	δ _{shear} = 0.349 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 10.781 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 2.016 kNm
Maximum shear force	V = 1.882 kN
Maximum support reaction	R = 1.882 kN
Maximum deflection	δ = 8.787 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 = 7.620 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 4.800 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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Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project65 Princess Street				Job no.031/010	
	Calcs forJoist 7				Start page no./RevisionJ/ 26	
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Permissible shear stress	$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = \mathbf{0.921 \text{ N/mm}^2}$
Applied shear stress	$\tau_{max} = 3 \times V / (2 \times b \times h) = \mathbf{0.224 \text{ N/mm}^2}$
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	$\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.299 \text{ N/mm}^2}$
PASS - Applied bearing stress within permissible limits	
Check deflection	
Permissible deflection	$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = \mathbf{12.855 \text{ mm}}$
Bending deflection (based on E_{mean})	$\delta_{bending} = \mathbf{8.438 \text{ mm}}$
Shear deflection	$\delta_{shear} = \mathbf{0.349 \text{ mm}}$
Total deflection	$\delta = \delta_{bending} + \delta_{shear} = \mathbf{8.787 \text{ mm}}$
PASS - Actual deflection within permissible limits	

Tekla Tedds Studio One 42 Edge Street Manchester M4 1HN	Project65 Princess Street				Job no.031/010	
	Calcs forJoist 8				Start page no./RevisionJ/ 27	
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TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

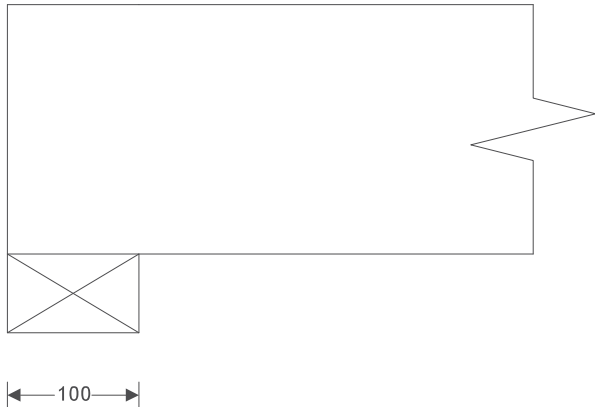
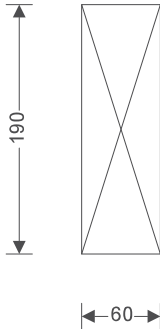
Joist details

Joist breadth	b = 60 mm
Joist depth	h = 190 mm
Joist spacing	s = 390 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 = 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} = 0.00 kN/m ²
Imposed UDL(Long term)	F _{i_udl} = 2.00 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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	Calcs for Joist 8				Start page no./Revision J/ 28	
	Calcs by SG	Calcs date 12-Jul-19	Checked by JM	Checked date 12/07/2019	Approved by	Approved date

Service class for modulus of elasticity	$K_{2e} = \mathbf{1.00}$
Section depth factor	$K_7 = \mathbf{1.05}$
Load sharing factor	$K_8 = \mathbf{1.10}$
Consider long term loads	
Load duration factor	$K_3 = \mathbf{1.00}$
Maximum bending moment	$M = \mathbf{1.198}$ kNm
Maximum shear force	$V = \mathbf{1.397}$ kN
Maximum support reaction	$R = \mathbf{1.397}$ kN
Maximum deflection	$\delta = \mathbf{5.094}$ mm
Check bending stress	
Bending stress	$\sigma_m = \mathbf{5.300}$ N/mm ²
Permissible bending stress	$\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = \mathbf{6.130}$ N/mm ²
Applied bending stress	$\sigma_{m_max} = M / Z = \mathbf{3.319}$ N/mm ²
PASS - Applied bending stress within permissible limits	
Check shear stress	
Shear stress	$\tau = \mathbf{0.670}$ N/mm ²
Permissible shear stress	$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = \mathbf{0.737}$ N/mm ²
Applied shear stress	$\tau_{max} = 3 \times V / (2 \times b \times h) = \mathbf{0.184}$ N/mm ²
PASS - Applied shear stress within permissible limits	
Check bearing stress	
Compression perpendicular to grain (no wane)	$\sigma_{cp1} = \mathbf{2.200}$ N/mm ²
Permissible bearing stress	$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = \mathbf{2.420}$ N/mm ²
Applied bearing stress	$\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.233}$ N/mm ²
PASS - Applied bearing stress within permissible limits	
Check deflection	
Permissible deflection	$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = \mathbf{10.290}$ mm
Bending deflection (based on E _{mean})	$\delta_{bending} = \mathbf{4.865}$ mm
Shear deflection	$\delta_{shear} = \mathbf{0.229}$ mm
Total deflection	$\delta = \delta_{bending} + \delta_{shear} = \mathbf{5.094}$ mm
PASS - Actual deflection within permissible limits	
Consider medium term loads	
Load duration factor	$K_3 = \mathbf{1.25}$
Maximum bending moment	$M = \mathbf{1.594}$ kNm
Maximum shear force	$V = \mathbf{1.859}$ kN
Maximum support reaction	$R = \mathbf{1.859}$ kN
Maximum deflection	$\delta = \mathbf{5.526}$ mm
Check bending stress	
Bending stress	$\sigma_m = \mathbf{5.300}$ N/mm ²
Permissible bending stress	$\sigma_{m_adm} = \sigma_m \times K_{2m} \times K_3 \times K_7 \times K_8 = \mathbf{7.663}$ N/mm ²
Applied bending stress	$\sigma_{m_max} = M / Z = \mathbf{4.417}$ N/mm ²
PASS - Applied bending stress within permissible limits	
Check shear stress	
Shear stress	$\tau = \mathbf{0.670}$ N/mm ²
Permissible shear stress	$\tau_{adm} = \tau \times K_{2s} \times K_3 \times K_8 = \mathbf{0.921}$ N/mm ²

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Applied shear stress	$\tau_{max} = 3 \times V / (2 \times b \times h) = \mathbf{0.245}$ N/mm ²
PASS - Applied shear stress within permissible limits	
Check bearing stress	
Compression perpendicular to grain (no wane)	$\sigma_{cp1} = \mathbf{2.200}$ N/mm ²
Permissible bearing stress	$\sigma_{c_adm} = \sigma_{cp1} \times K_{2c} \times K_3 \times K_8 = \mathbf{3.025}$ N/mm ²
Applied bearing stress	$\sigma_{c_max} = R / (b \times L_b) = \mathbf{0.310}$ N/mm ²
PASS - Applied bearing stress within permissible limits	
Check deflection	
Permissible deflection	$\delta_{adm} = \min(L_{s1} \times 0.003, 14 \text{ mm}) = \mathbf{10.290}$ mm
Bending deflection (based on E _{mean})	$\delta_{bending} = \mathbf{5.221}$ mm
Shear deflection	$\delta_{shear} = \mathbf{0.305}$ mm
Total deflection	$\delta = \delta_{bending} + \delta_{shear} = \mathbf{5.526}$ mm
PASS - Actual deflection within permissible limits	

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TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

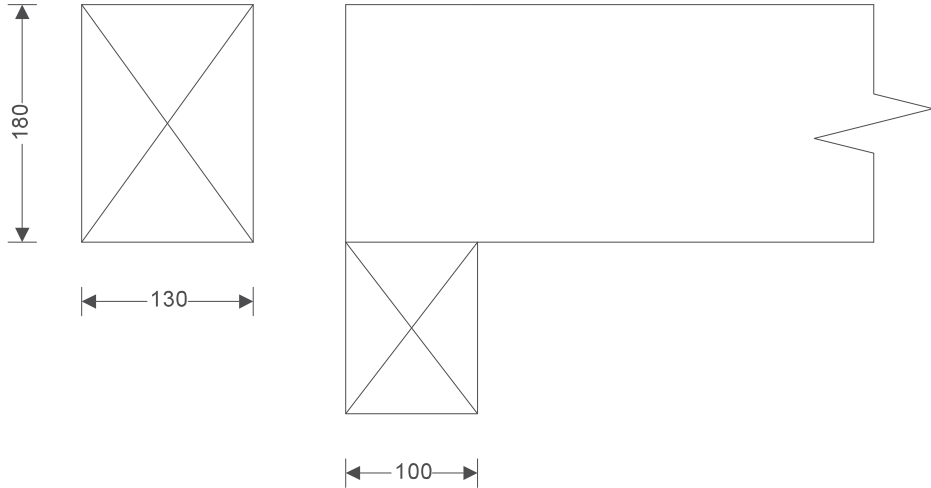
Joist details

Joist breadth	b = 130 mm
Joist depth	h = 180 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} = 4570 mm



Section properties

Second moment of area	I = b × h ³ / 12 = 63180000 mm ⁴
Section modulus	Z = b × h ² / 6 = 702000 mm ³

Loading details

Joist self weight	F _{swt} = b × h × ρ _{char} × g _{acc} = 0.07 kN/m
Dead load	F _{d_udl} = 0.00 kN/m ²
Imposed UDL(Long term)	F _{L_udl} = 2.00 kN/m ²
Imposed point load (Medium term)	F _{L_pt} = 1.80 kN

Modification factors

Service class for bending parallel to grain	K _{2m} = 1.00
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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 = 1.06
Load sharing factor	K ₈ = 1.10

Consider long term loads

Load duration factor	K ₃ = 1.00
Maximum bending moment	M = 2.535 kNm
Maximum shear force	V = 2.219 kN
Maximum support reaction	R = 2.219 kN
Maximum deflection	δ = 10.157 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 = 6.167 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.611 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) = 0.142 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) = 0.171 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} = 9.920 mm
Shear deflection	δ _{shear} = 0.236 mm
Total deflection	δ = δ _{bending} + δ _{shear} = 10.157 mm

PASS - Actual deflection within permissible limits

Consider medium term loads

Load duration factor	K ₃ = 1.25
Maximum bending moment	M = 2.242 kNm
Maximum shear force	V = 1.963 kN
Maximum support reaction	R = 1.963 kN
Maximum deflection	δ = 7.373 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 = 7.709 N/mm ²
Applied bending stress	σ _{m_max} = M / Z = 3.194 N/mm ²

PASS - Applied bending stress within permissible limits

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Check shear stress

Shear stress

$\tau = 0.670 \text{ N/mm}^2$

Permissible shear stress

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

Applied shear stress

$\tau_{max} = 3 \times V / (2 \times b \times h) = 0.126 \text{ N/mm}^2$

PASS - Applied shear stress within permissible limits

Check bearing stress

Compression perpendicular to grain (no wane)

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

Permissible bearing stress

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

Applied bearing stress

$\sigma_{c_max} = R / (b \times L_b) = 0.151 \text{ N/mm}^2$

PASS - Applied bearing stress within permissible limits

Check deflection

Permissible deflection

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

Bending deflection (based on E_{mean})

$\delta_{bending} = 7.164 \text{ mm}$

Shear deflection

$\delta_{shear} = 0.209 \text{ mm}$

Total deflection

$\delta = \delta_{bending} + \delta_{shear} = 7.373 \text{ mm}$

PASS - Actual deflection within permissible limits

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TIMBER JOIST DESIGN (BS5268-2:2002)

Tedds calculation version 1.1.04

Joist details

Joist breadth

$b = 60 \text{ mm}$

Joist depth

$h = 200 \text{ mm}$

Joist spacing

$s = 345 \text{ mm}$

Timber strength class

C16

Service class of timber

1



Span details

Number of spans

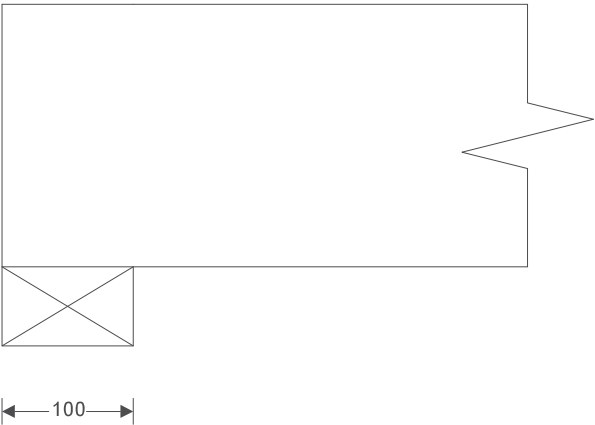
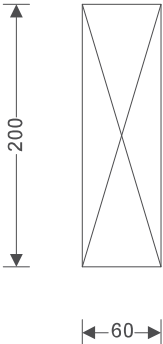
$N_{span} = 1$

Length of bearing

$L_b = 100 \text{ mm}$

Effective length of span

$L_{s1} = 3500 \text{ mm}$



Section properties

Second moment of area

$I = b \times h^3 / 12 = 40000000 \text{ mm}^4$

Section modulus

$Z = b \times h^2 / 6 = 400000 \text{ mm}^3$

Loading details

Joist self weight

$F_{swt} = b \times h \times \rho_{char} \times g_{acc} = 0.04 \text{ kN/m}$

Dead load

$F_{d_udl} = 0.00 \text{ kN/m}^2$

Imposed UDL(Long term)

$F_{l_udl} = 2.00 \text{ kN/m}^2$

Imposed point load (Medium term)

$F_{l_pt} = 1.80 \text{ kN}$

Modification factors

Service class for bending parallel to grain

$K_{2m} = 1.00$

Service class for compression

$K_{2c} = 1.00$

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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**
K₇ = **1.05**
K₈ = **1.10**

Consider long term loads

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

K₃ = **1.00**
M = **1.112** kNm
V = **1.271** kN
R = **1.271** kN
δ = **4.235** mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

σ_m = **5.300** N/mm²
σ_{m_adm} = σ_m × K_{2m} × K₃ × K₇ × K₈ = **6.096** N/mm²
σ_{m_max} = M / Z = **2.781** N/mm²
PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress
Permissible shear stress
Applied shear stress

τ = **0.670** N/mm²
τ_{adm} = τ × K_{2s} × K₃ × K₈ = **0.737** N/mm²
τ_{max} = 3 × V / (2 × b × h) = **0.159** N/mm²
PASS - Applied shear stress within permissible limits

Check bearing stress

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

σ_{cp1} = **2.200** N/mm²
σ_{c_adm} = σ_{cp1} × K_{2c} × K₃ × K₈ = **2.420** N/mm²
σ_{c_max} = R / (b × L_b) = **0.212** N/mm²
PASS - Applied bearing stress within permissible limits

Check deflection

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

δ_{adm} = min(L_{s1} × 0.003, 14 mm) = **10.500** mm
δ_{bending} = **4.033** mm
δ_{shear} = **0.202** mm
δ = δ_{bending} + δ_{shear} = **4.235** mm
PASS - Actual deflection within permissible limits

Consider medium term loads

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

K₃ = **1.25**
M = **1.631** kNm
V = **1.864** kN
R = **1.864** kN
δ = **5.067** mm

Check bending stress

Bending stress
Permissible bending stress
Applied bending stress

σ_m = **5.300** N/mm²
σ_{m_adm} = σ_m × K_{2m} × K₃ × K₇ × K₈ = **7.620** N/mm²
σ_{m_max} = M / Z = **4.077** N/mm²
PASS - Applied bending stress within permissible limits

Check shear stress

Shear stress

τ = **0.670** N/mm²

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Permissible shear stress
Applied shear stress

τ_{adm} = τ × K_{2s} × K₃ × K₈ = **0.921** N/mm²
τ_{max} = 3 × V / (2 × b × h) = **0.233** N/mm²
PASS - Applied shear stress within permissible limits

Check bearing stress

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

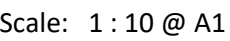
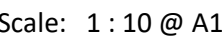
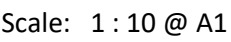
σ_{cp1} = **2.200** N/mm²
σ_{c_adm} = σ_{cp1} × K_{2c} × K₃ × K₈ = **3.025** N/mm²
σ_{c_max} = R / (b × L_b) = **0.311** N/mm²
PASS - Applied bearing stress within permissible limits

Check deflection

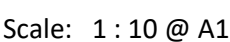
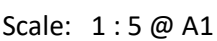
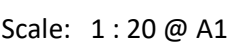
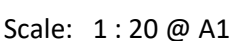
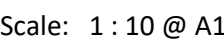
Permissible deflection
Bending deflection (based on E_{mean})
Shear deflection
Total deflection

δ_{adm} = min(L_{s1} × 0.003, 14 mm) = **10.500** mm
δ_{bending} = **4.770** mm
δ_{shear} = **0.297** mm
δ = δ_{bending} + δ_{shear} = **5.067** mm
PASS - Actual deflection within permissible limits

Appendix C – Structural Engineering Details



- Scale: 1 : 5 @ A1



P01	08.11.19	Issued for Information	PM	JA
Rev	Date	Description	By	Chn

STUDIO ONE

Client

My Happy Place 2 Ltd

Project

65 Princess Street, Manchester

Title

Structural Engineering Details Sheet 1

Status

FOR INFORMATION

Studio One Project Number	Revision	Scale @ A1
031-010	P01	As Shown

Drawing Number

031-010-SO-XX-ZZ-DR-S-0006

STUDIO ONE

Prepared by: JM
Reviewed by: JP

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