

MASTER'S LODGE, MARLBOROUGH COLLEGE
EXISTING STAIRS STRUCTURAL REPORT



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MASTER'S LODGE, MARLBOROUGH COLLEGE**EXISTING STAIRS STRUCTURAL REPORT****C O N T E N T S**

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1. INTRODUCTION

The existing Master's Lodge building at Marlborough College, Marlborough, Wiltshire, SN8 1PA is undergoing a conversion from a private residential property to use as a day school. The property is Grade II listed. SFK were appointed to carry out structural engineering services for the conversion work. Previous work carried by SFK has included an initial structural inspection (refer to SFK report 24167/R01 dated December 2024) and a trial pit investigation (refer to SFK report 24167/R02 dated March 2025).

This report has been prepared to structurally assess the three existing staircases in the building. Recommendations are made which need to be reviewed and agreed by the Client, design team, building control and Wiltshire Council.

2. EXISTING STAIRS

The building was constructed circa 1845 to 1865. There are three existing timber staircases referenced as Stair A, Stair B and Stair C, Fig. 2.1.

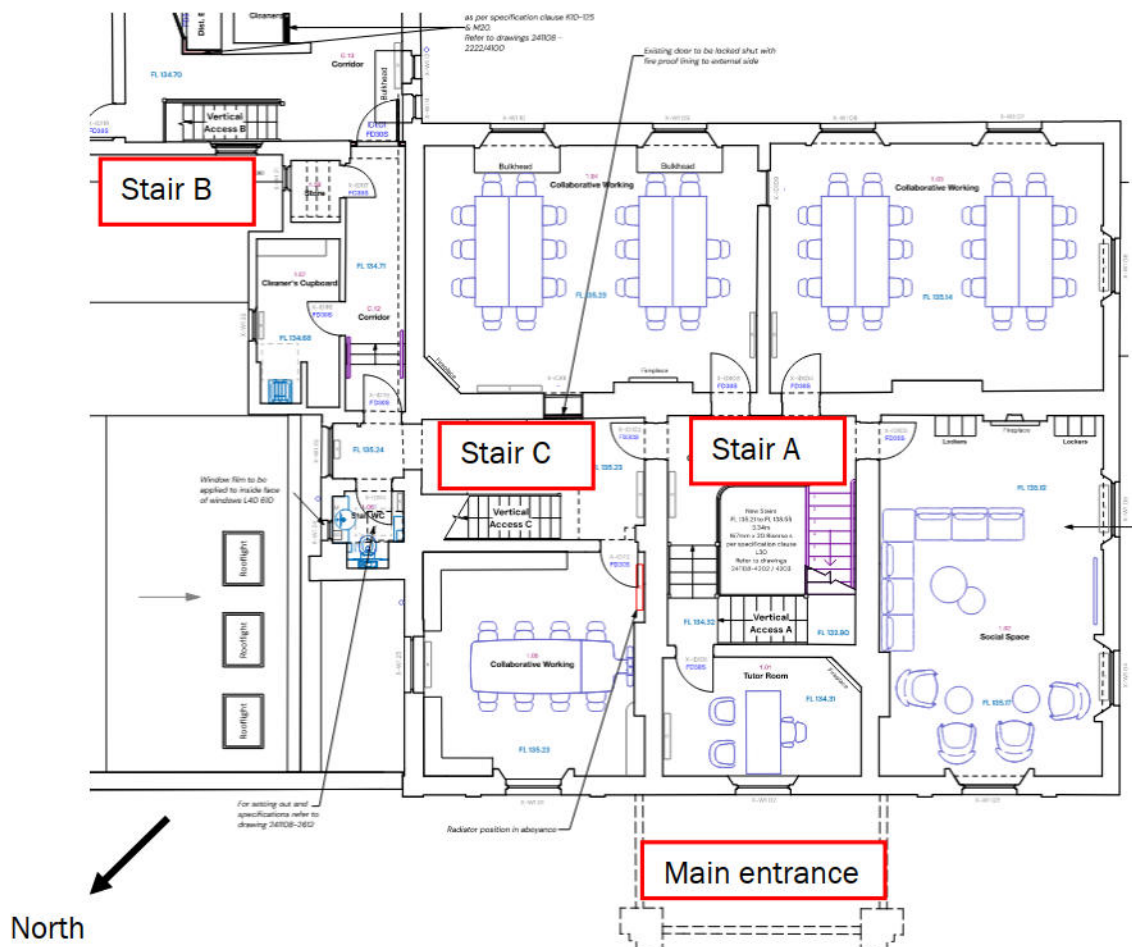


Fig. 2.1. Extract first floor plan showing staircase locations

3. STAIR LOADING AND REGULATIONS

For design of new buildings vertical and horizontal stair loadings are taken from Eurocode 1. Older British Standard BS6399: Part 1: 1996 essentially has the same loading values but will be used as more appropriate to the assessment of existing stairs. Loading is related to the use of the building. The existing use is domestic and residential while the proposed use is as an institutional type building. Extracts of the BS6399 code for vertical and horizontal loading are given in Tables 3.1 and 3.2 below. These are unfactored or characteristic loads. The uniformly distributed line load and the uniformly distributed and concentrated loads applicable to the infill are not additive and should be considered as three separate load cases. In design, the horizontal uniformly distributed line load should be considered to act at a height of 1.1 m above datum level, irrespective of the actual height of the element.

Table 3.1. Extract BS6399 Part 1 Table 1 vertical loads

Table 1 — Minimum imposed floor loads				
Type of activity/occupancy for part of the building or structure	Examples of specific use	Uniformly distributed load kN/m ²	Concentrated load kN	
A Domestic and residential activities (Also see category C)	All usages within self-contained ~~E1~~ single family ~~E1~~ dwelling units Communal areas (including kitchens) in blocks of flats with limited use (See note 1) (For communal areas in other blocks of flats, see C3 and below)	1.5	1.4	
C3 Areas without obstacles for moving people	Corridors, hallways, aisles, stairs, landings etc. in institutional type buildings (not subject to crowds or wheeled vehicles), hostels, guest houses, residential clubs, and communal areas in blocks of flats not covered by note 1. (For communal areas in blocks of flats covered by note 1, see A)	Corridors, hallways, aisles etc. (foot traffic only)	3.0	4.5
		Stairs and landings (foot traffic only)	3.0	4.0

Table 3.2. Extract BS6399 Part 1 Table 4 balustrade loads

Table 4 — Minimum horizontal imposed loads for parapets, barriers and balustrades, etc.				
Type of occupancy for part of the building or structure	Examples of specific use	Horizontal uniformly distributed line load (kN/m)	A uniformly distributed load applied to the infill (kN/m ²)	A point load applied to part of the infill (kN)
A Domestic and residential activities	(i) All areas within or serving exclusively one ~~E1~~ single family ~~E1~~ dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs (see C3 ix)	0.36	0.5	0.25
C3 Areas without obstacles for moving people and not susceptible to overcrowding	(viii) Stairs, landings, corridors, ramps	0.74	1.0	0.5
	(ix) External balconies and edges of roofs. Footways and pavements within building curtilage adjacent to basement/sunken areas	0.74	1.0	0.5

Additional design guidance for balustrades is also provided in BS 6180:2011 Barriers in and about buildings – Code of practice. This includes a horizontal deflection limit of 25mm under the loadings in Table 3.2.

The Building Regulations 2010, Approved Document K, Protection from falling, collision and impact includes geometric rules for stairs. These are usually applied by the project Architect.

4. EXISTING STAIR A

4.1 Description

Stair A is the main stair in the building; Fig. 3.1. It runs from ground to first floor with three flights and two quarter landings. As part of the conversion project, it is proposed to extend the stair from first to second floor. This will have a steel framed structure supported off existing brick walls.

Stair A is timber framed with a timber balustrade. It is historic and is probably original. The balustrade is decorative. The clear width of the stair is approximately 1000mm. The height of the balustrade on the stair flights is approximately 900mm. The height of the balustrade to the first floor is approximately 1000mm.

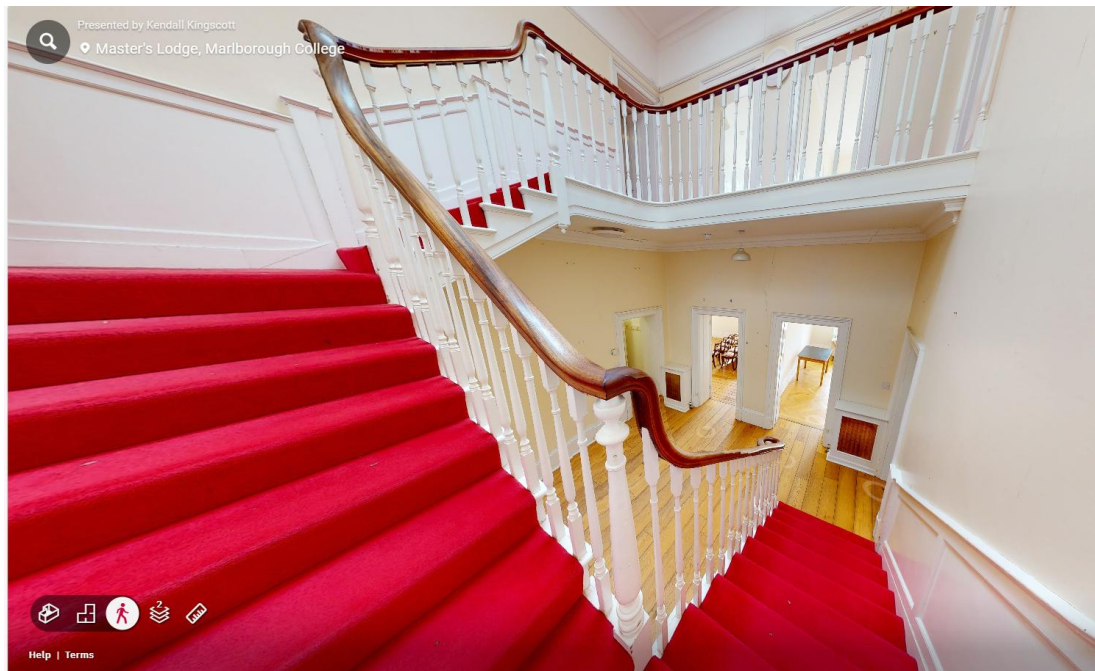


Fig. 3.1. Staircase A viewed from lower quarter landing

4.2 Assessment

4.2.1 Vertical loading

As Stair A is the main stair it is considered that it should be able to support institutional vertical load i.e. 3.0 kN/m^2 . Assessment of timber stairs by calculation can be complex and, in this case, not all details of the stair were known and could not be easily established without risk of damage to historic fabric. It was therefore decided to carry out a vertical load test of the stair. Full details of the test and results are shown on SFK drawing 25036-ZZ-1242 in Appendix A. In summary this showed that Stair A does have sufficient strength and stiffness to meet the vertical load requirement of 3.0 kN/m^2 .

4.2.2 Horizontal balustrade loading

The timber spindles to the stair are notably slender varying in thickness from 20mm to 35mm. The spindles can easily be bent by moderate hand force. Based on this it is considered the spindles would not meet horizontal load requirements for even domestic loading.

For assessment of the handrail and balusters assessment by calculation can be complex. It is difficult to account for jointing details (that are potentially unknown) between elements that can affect the overall capacity. It was therefore decided to carry out a horizontal load test applied to the handrail. The requirements for the test are given on SFK drawing 25036-ZZ-1243 in Appendix B. A specialist company, Sandberg, were employed under the supervision of SFK to carry out the test. Their report 81319/S/1 is also provided in Appendix B.

The intent was to test the handrail up to the institutional load of 0.74 kN/m which is equivalent to 74 kg/m . However, both lengths of handrail tested reached the deflection limit of 25mm at midspan at lower loads. For the middle flight this was 61 kg/m and for the lower flight this was 44 kg/m . The lower flight has a longer span length which is probably the main reason for the lower load.

The test was based on the design code requirements of applying the load at 1100mm height even though the actual height is 900mm. This was achieved by increasing the load to produce the same bending effect at the bottom of the balustrade. We would suggest for assessment purposes this approach could be relaxed. If loading were applied at the actual height, then the capacities would increase to 74 kg/m for the middle flight and 54 kg/m for the lower flight.

On this basis the middle flight complies with the handrail load requirement. The lower flight does not fully comply, but the load achieved 54 kg/m , is still considerable and lies midway between the code requirement for domestic, 36 kg/m

and institutional, 74kg/m. As a proportion of the required load this is $54/74 \times 100 = 73\%$.

In assessing the balustrade, it is also important to consider the code requirements for the infill loads. This is for 1.0 kN/m^2 (a uniform pressure) or a point load of 0.5 kN (50kg). It has already been established that the existing spindles are inadequate to support these loads. Assuming these are strengthened/protected for the moment, then for the uniform load the load that would be applied to the handrail is $1.0 \text{ kN/m}^2 \times 0.9\text{m}/2 = 0.45 \text{ kN/m}$ i.e. 45 kg/m . The handrail system as tested can comply with this and for the alternative 50kg point load.

Comparison of the load tests with the code requirements are illustrated in the highlighted table 4.1 below.

Table 4.1. Comparison of load test results with code requirements (assuming infill protected)

Table 4 — Minimum horizontal imposed loads for parapets, barriers and balustrades, etc.

Type of occupancy for part of the building or structure	Examples of specific use	Horizontal uniformly distributed line load (kN/m)	A uniformly distributed load applied to the infill (kN/m ²)	A point load applied to part of the infill (kN)
A Domestic and residential activities	(i) All areas within or serving exclusively one ^(E) single family ^(A) dwelling including stairs, landings, etc. but excluding external balconies and edges of roofs (see C3 ix)	0.36	0.5	0.25
C3 Areas without obstacles for moving people and not susceptible to overcrowding	(viii) Stairs, landings, corridors, ramps	0.74 *	1.0	0.5
	(ix) External balconies and edges of roofs. Footways and pavements within building curtilage adjacent to basement/sunken areas	0.74	1.0	0.5

Key:

Indicates compliance of handrail/baluster system

* If applied at actual height, middle section complies, lower section 0.54 kN/m

For the infill itself to comply it will be necessary protect the timber spindles. A concept for this has been considered to introduce glass vertical glass panels inside the spindles. These would be fixed with brackets to the timber treads at the bottom and to the underside of the handrail. The concept is illustrated on SFK sketch 090126-01 in Appendix B.

Although the lower section of handrail is not fully compliant with code loading, it is suggested that a risk-based approach is taken and to accept that the 54kg/m run capacity is sufficient for the managed use of the building. Loading to the stair flight

balustrades is predominantly along the line of the handrail rather than perpendicular to it (as tested) and the load of 54 kg/m is probably at the limit of what an adult male can push for a short duration. The width of the stair is limited and would prevent a crowd type situation pushing on the baluster.

If a risk-based approach is not considered appropriate, then strengthening would need to be considered. Strengthening the existing balustrade directly is unlikely to be feasible without significantly affecting the original historic fabric and appearance. Adding an independent barrier inside the existing might be feasible but there are two issues. Firstly width. There is currently only have about 1m clear. Adding an independent barrier would reduce this probably by 100-200mm. This may have implications for escape. Second issue is the structural support of the independent barrier. The timber treads are unlikely to be sufficient. At new post positions it is likely that steel members would need to be attached under the timber stair treads and run back to fix into the masonry wall with a moment connection, possibly requiring Cintec anchors. This is potentially feasible but would require significant removal of parts of the soffit to the stair.

4.2.3 First floor balustrade geometry

The first-floor balustrade height is approximately 1000mm. Building regulations require a minimum height of 1100mm. It is suggested this should be assessed for risk by the Client and project Architect. If the height requires to be raised, then any solution must consider the heritage aspects of the existing balustrade.

4.3 Conclusions and recommendations for Stair A

- Uniform vertical load complies with design code requirements for an institutional stair.
- The timber spindles do not comply with design code requirements for horizontal loads. It is proposed to add glass panels inside the spindles to protect them and support the design code loads. Details to be developed with design team.
- The handrail and baluster system fails to meet the horizontal design code loads. If modified for assessment, the middle section meets the code requirement and the lower section meets 73% of the load required.
- It is suggested the handrail and baluster system horizontal load capacity is accepted on a risk-based approach. This needs to be accepted by all parties including the Client.
- The first-floor balustrade height is marginally substandard in height and this needs to be risk assessed by the Client and project Architect.

5. EXISTING STAIR B

5.1 Description

Stair B has single flight from ground to first floor in the east wing of the building, Fig. 5.1. It is a timber stair with a modern timber balustrade. The clear width of the stair is approximately 800-900mm. The height of the balustrade to the first floor is approximately 1100mm. Spindles are 40mmx40mm reducing to 20mmx20mm and have 60mm gaps. Balustrade geometry appears to comply with code requirements, but this should be checked and confirmed by the project Architect.



Fig. 5.1. Staircase B viewed from first floor

5.2 Assessment

From site inspection the top newel post has movement at the base and requires further investigation for repair. The middle newel post is broken and requires repair. At the foot of the stair the newel post does not extend as far as the bottom of the stair and is likely to require extension.

The stair gives access to the first floor where there are two collaborative working rooms, a social space and two toilets. The working rooms are assumed to accommodate say 10-15 students along with office type furniture. Although code floor loadings would require 3.0 kN/m², actual floor loading is unlikely to exceed 1.5kN/m² in practice. Considering the number of students on the first floor and that the width of the stair would limit the number of students using it, it is proposed the stair only requires domestic load capacity for both vertical and horizontal loading. No calculation or load testing is proposed. Although requiring repairs, based on previous use, the stair is assessed as adequate for domestic loads.

5.3 Conclusions and recommendations for Stair B

- Project Architect to check stair geometry for code compliance.
- Structural repairs are required to the top and middle timber newel posts.
- Stair loading assessed as adequate for domestic loads based on previous use.
- Project Architect to consider extension of balustrade at foot of stairs.

6. EXISTING STAIR C

6.1 Description

Stair C has two flights and a half landing from the first to second floor of the west wing of the building, Fig. 6.1. It is timber framed with a timber balustrade. It is historic and is probably original. The balustrade is much plainer than Stair A. The clear width of the stair is approximately 900mm. The height of the balustrade on the stair flights and half landing is approximately 900mm. The height of the balustrade to the first floor is approximately 970mm. Spindles are 25mmx25mm and have 95mm gaps.

Balustrade geometry generally appears to comply with code requirements, except for the first floor which is under-height (1100mm required) but this should be checked and confirmed by the project Architect.

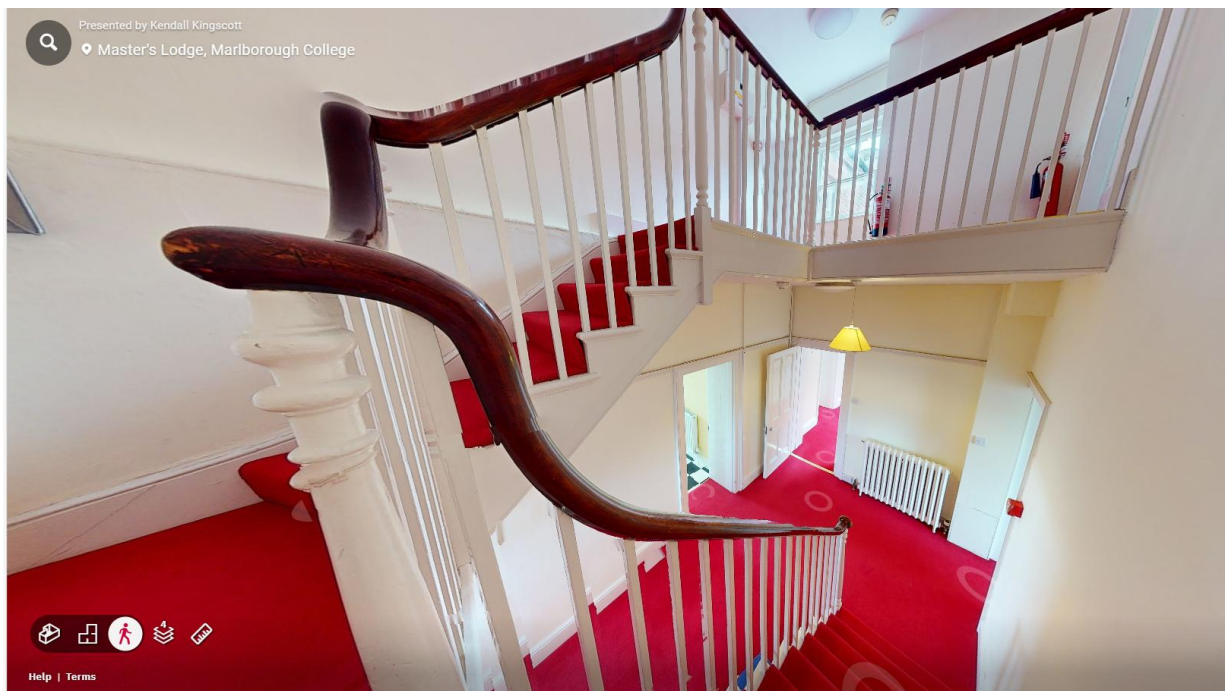


Fig. 6.1. Staircase C viewed from half landing

6.2 Assessment

The stair gives secondary access to the second floor, primary access being via Stair A. On the second floor there are three collaborative working rooms, a social space and small storerooms. The working rooms are assumed to accommodate up to say 10 students along with office type furniture. Although code floor loadings would require 3.0 kN/m², actual floor loading is unlikely to exceed 1.5kN/m² in practice. Considering the number of students on the first floor and that the width of the stair

would limit the number of students using it, it is proposed the stair only requires domestic load capacity for both vertical and horizontal loading.

The existing 25mmx25mm spindles have been assessed by calculation assuming they are a grade C24 softwood. On this basis they are inadequate for domestic infill load for bending strength. If the spindles were replaced with 30mmx30mm hardwood (D40 strength class) then they would be adequate in strength (and deflection) for domestic infill load.

The existing half landing has three timber beams (55dx110w) supporting it. Assuming these are C24 softwood and assessed for domestic load, they are adequate in bending strength but do not meet code deflection requirements. This is common in historic buildings for timbers to not meet code deflection requirements. The boarding may provide additional stiffness not accounted for in the calculation. As strength is more important than deflection, and as the stair has previously performed adequately under domestic loads it is recommended the landing is accepted with no further action.

The first-floor balustrade height is approximately 970mm. Building regulations require a minimum height of 1100mm. It is suggested this should be assessed for risk by the Client and project Architect. If the height requires to be raised, then any solution must consider the heritage aspects of the existing balustrade.

An SFK proposal for the handrail (assuming first floor height does need to be raised) is as follows;

1. Carefully remove existing handrail and set aside
2. Carefully remove existing spindles
3. Install new 30x30 hardwood spindles with raised height to first floor
4. Reinstall handrail with adjustments for new level to first floor.

Steps 2 and 3 may need a local trial to investigate the practicality of the proposal.

6.3 Conclusions and recommendations for Stair C

- Project Architect to check stair geometry for code compliance.
- The existing spindles are inadequate for domestic infill load by calculation.
- SFK proposal is to replace spindles with larger hardwood spindles. May require a local trial.
- The first-floor balustrade height is substandard in height and this needs to be risk assessed by the Client and project Architect.
- If the height to the first-floor balustrade is to be raised, then one approach would be to increase the height of the replacement spindles and adjust the existing handrail to suit. This option requires further review.

7. APPENDIX A – STAIR A VERTICAL LOADING

SFK drawing 25036-ZZ-1242 – Stair A Vertical Load Testing



PHOTO 1 - GROUND FLOOR INVESTIGATION BENEATH NEWEL POST

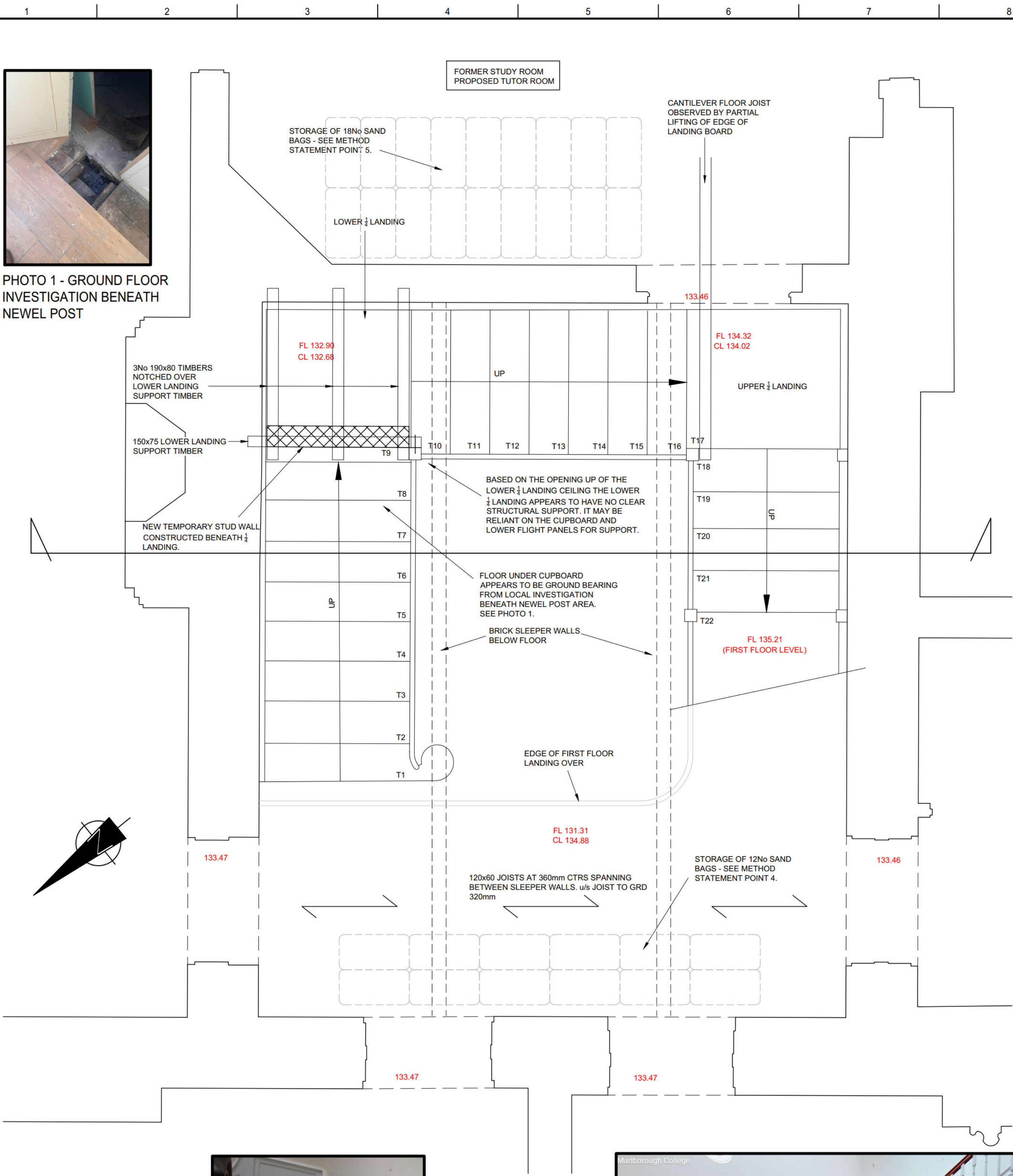


PHOTO 3 - LOAD STAGE 6 (FULLY LOADED)

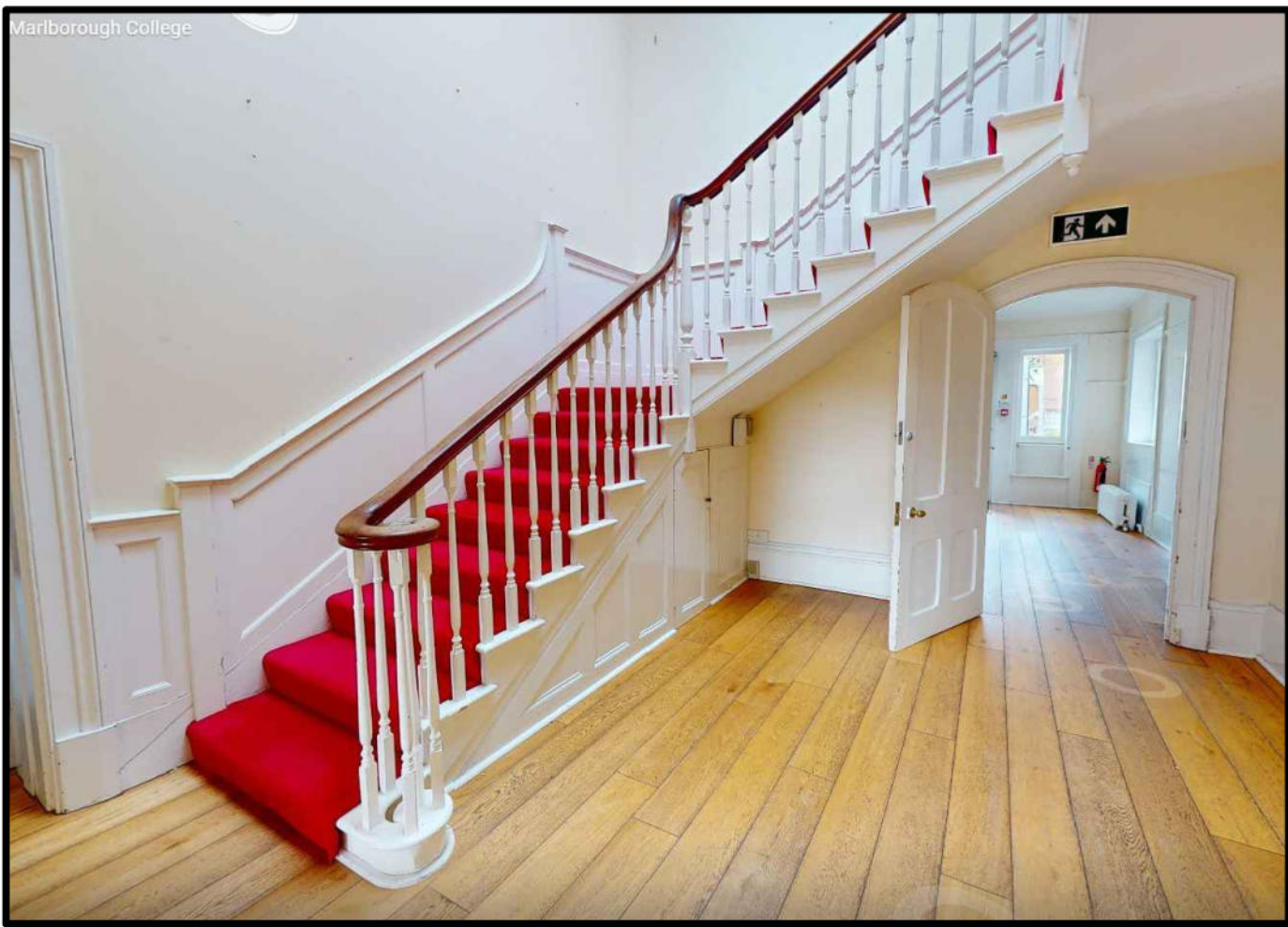
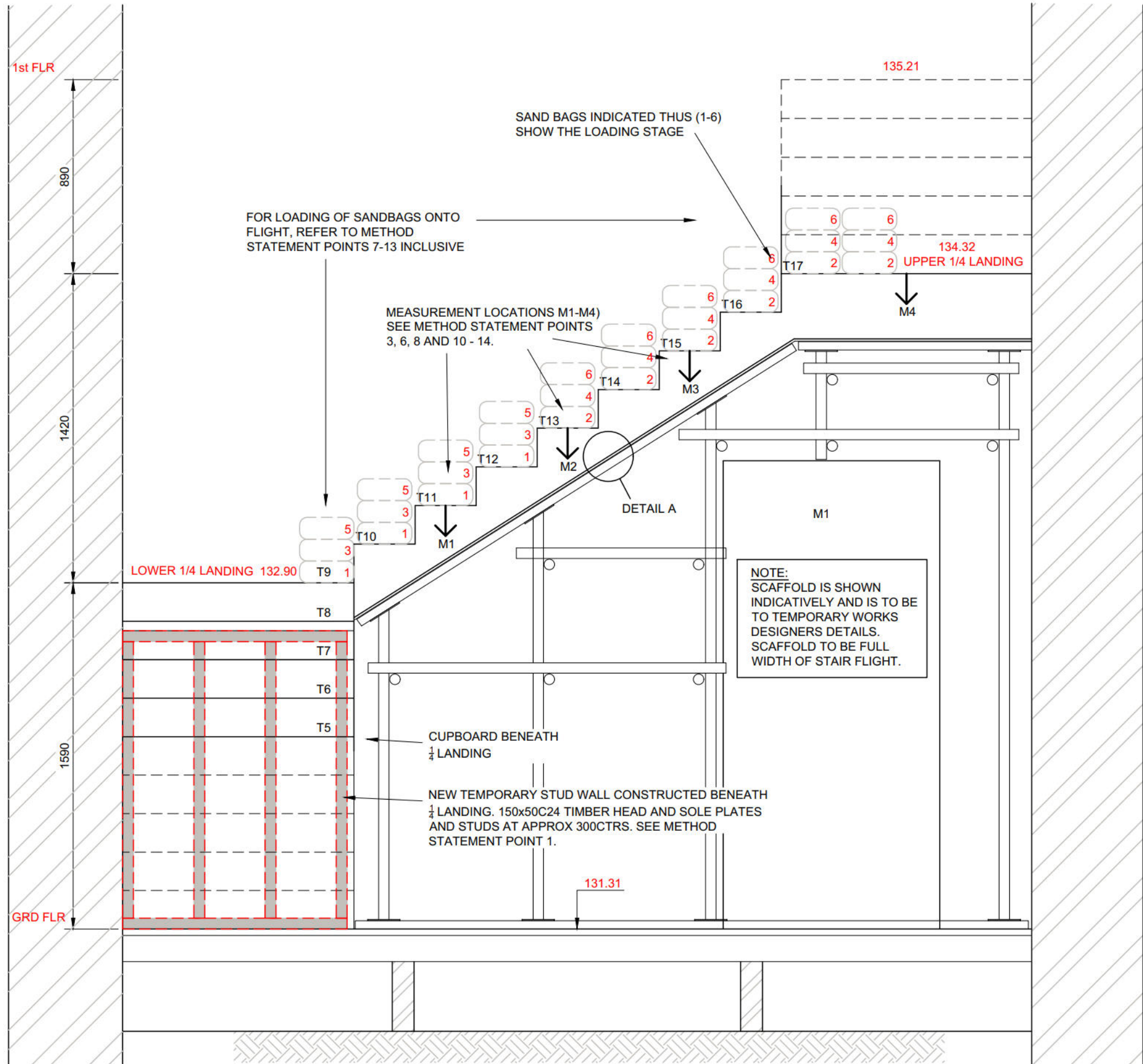
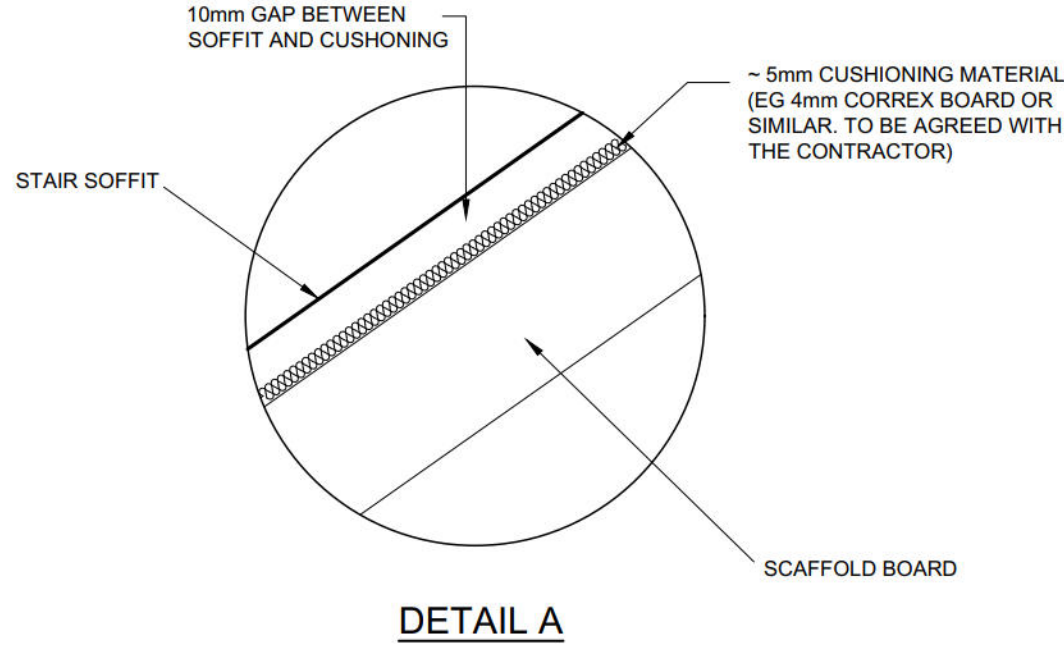


PHOTO 2 - VIEW OF STAIR AT GROUND FLOOR LEVEL



CROSS SECTION

LOAD TEST CARRIED OUT BY N WINTERBOTTOM (SFK) AND B MEES (RIGG CONST'N) ON 6th NOV 2025

STAIR A - VERTICAL LOAD TESTING RESULTS				
LOAD STAGE	M1 (mm)	M2 (mm)	M3 (mm)	M4 (mm)
SET UP	1848	2205	2557	2695
1	1847	2204	2557	2695
2	1847	2204	2557	2695
3	1848	2204	2557	2695
4	1847	2203	2557	2695
5	1847	2203	2557	2695
6	1847	2203	2556	2695
UNLOAD STAGE				
6	-	-	-	-
5	-	-	-	-
4	1847	2203	2257	2695
3	-	-	-	-
2	1847	2203	2257	2695
1	-	-	-	-
NO LOAD	1848	2204	2257	2695

APPROX SLOPE SPAN OF FLIGHT T10-T16 = 2200mm.
GUIDE TO ALLOWABLE VERTICAL DEFLECTION = $2200 \times 0.003 = 6.6\text{mm}$.
FROM LOAD TEST, DEFLECTION AT MIDSPAN UNDER FULL LOADING CONDITION ($\sim 2.7\text{kN/m}^2$) = 2mm.
THEREFORE CONCLUDE THAT STAIR HAS SUFFICIENT STRENGTH AND STIFFNESS TO MEET BS6399 VERTICAL LOAD REQUIREMENT OF NOMINAL IMPOSED LOAD OF 3.0kN/m^2 .
IT IS OUR RECOMMENDATION THAT THE TEMPORARY STUD WALL UNDER THE FIRST 1/4 LANDING IS LEFT AS A PERMANENT STRUCTURE. BLOCKS FOR LANDING JOISTS TO BE REINSTALLED MORE SECURELY FOR THE PERMANENT STATE.

NOTES

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND M&E DRAWINGS TOGETHER WITH THE SPECIFICATION.
- THE BASE INFORMATION ON THIS DRAWING HAS BEEN TAKEN FROM D. H. SURVEYS LTD (dated Sept '24) INFORMATION PROVIDED BY MARLBOROUGH COLLEGE.
- TYPICAL FILLED SANDBAG SIZE APPROX 500x250x100mm AND TO WEIGH 25kg.

OUTLINE METHOD STATEMENT FOR VERTICAL LOAD TESTING. FURTHER DETAILS TO BE DEVELOPED BETWEEN SFK CONSULTING AND THE CONTRACTOR AS REQUIRED.

- INSTALL TIMBER STUD WALL SUPPORT UNDER LOWER QUARTER LANDING ENSURING BOTH THE LOWER LANDING SUPPORT BEAM AND THE 1/4 LANDING JOISTS ARE FULLY SUPPORTED.
- ERECT SCAFFOLD SUPPORT UNDER LOWER 1/4 LANDING, STAIR FLIGHT AND UPPER 1/4 LANDING. SCAFFOLD TO BE SUPPORTED OFF SUSPENDED TIMBER GROUND FLOOR WITH SPREADER BEAMS SPANNING OVER THE SLEEPER WALLS. SCAFFOLD TO BE TAKEN TO UNDERSIDE OF FLIGHT AND 1/4 LANDINGS WITH NOMINAL GAP WITH CUSHIONING MATERIAL. SCAFFOLD TO BE DESIGNED FOR A NOMINAL 3.0kN/m^2 IMPOSED LOAD BY THE TEMPORARY WORKS CONTRACTOR.
- SET UP LASER LEVEL MONITORING SYSTEM TO MONITOR THE FLOOR LEVEL BENEATH THE CENTRAL FLIGHT.
- PREPARE AND STORE 12No 25KG SANDBAGS ON THE GROUND FLOOR NEAR THE FOOT OF THE STAIR AS INDICATED. STORE ONLY 1 BAG HIGH.
- PREPARE AND STORE 18No 25KG SANDBAGS ON 1ST FLOOR PROPOSED TUTOR ROOM AS INDICATED. STORE ONLY 1 BAG HIGH.
- TAKE VERTICAL READINGS FROM 4No SET LOCATIONS ON THE CENTRAL FLIGHT TO THE FLOOR LEVEL. (U/S OF NOSING SIDE OVERHANG TO T11, T13 AND T15 AND U/S OF UPPER 1/4 LANDING) USING A LEICA DISTO D1.
- ADD 1No SANDBAG TO LOWER 1/4 LANDING (T9) AND FLIGHT TREAD NUMBERS T10, T11, AND T12. (4No SANDBAGS).
- CHECK LEVELS.
- IF LEVELS ACCEPTABLE TO SFK CONSULTING ADD 2No SANDBAGS TO UPPER 1/4 LANDING (T17) AND 1No TO FLIGHT TREAD NUMBERS T16, T15, T14 AND T13. (6 No SANDBAGS IN PLACE = 10No SANDBAGS TOTAL. APPROX 0.9kN/m^2).
- CHECK LEVELS.
- IF LEVELS ACCEPTABLE TO SFK CONSULTING REPEAT ACTIONS 7-10(INCL) ADDING 2ND LAYER OF SANDBAGS ON TOP OF FIRST LAYER. TOTAL OF 20 No OF SANDBAGS IN PLACE = APPROX 1.8kN/m^2 .
- IF LEVELS ACCEPTABLE TO SFK CONSULTING REPEAT ACTIONS 7-10(INCL) ADDING 3RD LAYER OF SANDBAGS ON TOP OF FIRST TWO LAYERS. TOTAL OF 30 No OF SANDBAGS IN PLACE = APPROX 2.7kN/m^2 . THIS IS THE MAXIMUM LOAD TO BE APPLIED.
- UNLOAD 1/4 LANDINGS AND FLIGHT 1No SAND BAG ROW AT A TIME TAKING LEVELS AT EACH CORRESPONDING STAGE AS FOR LOADING.
- RECORD FINAL SET OF LEVELS WHEN FULLY UNLOADED.

rev	drawn	chkd	appd	date	description
P1	AD	NW	-	07/11/25	ISSUED FOR INFORMATION. Drawing updated to correct layout. Method statement updated to correspond to site operations. Measurements table and notes added. Photo 3 added showing the fully loaded stair.
	AD	NW	-	30/05/25	ISSUED FOR INFORMATION/COMMENT/COSTING

MASTERS LODGE Marlborough College

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DRAWING TITLE:

STAIR A VERTICAL LOAD TESTING

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SCALE:

1:20 @ A1

SFK REF:

25036-ZZ-1242

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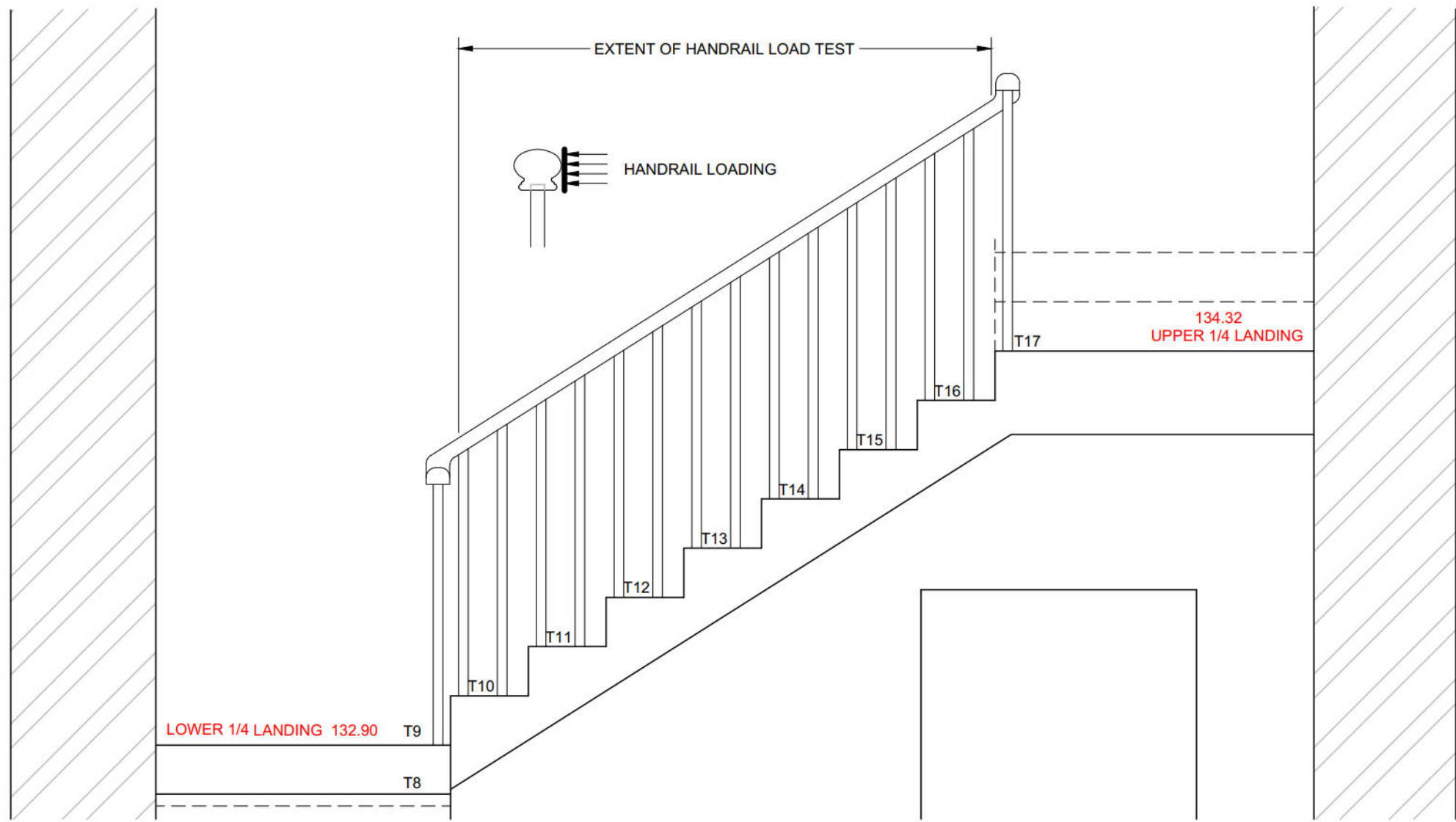
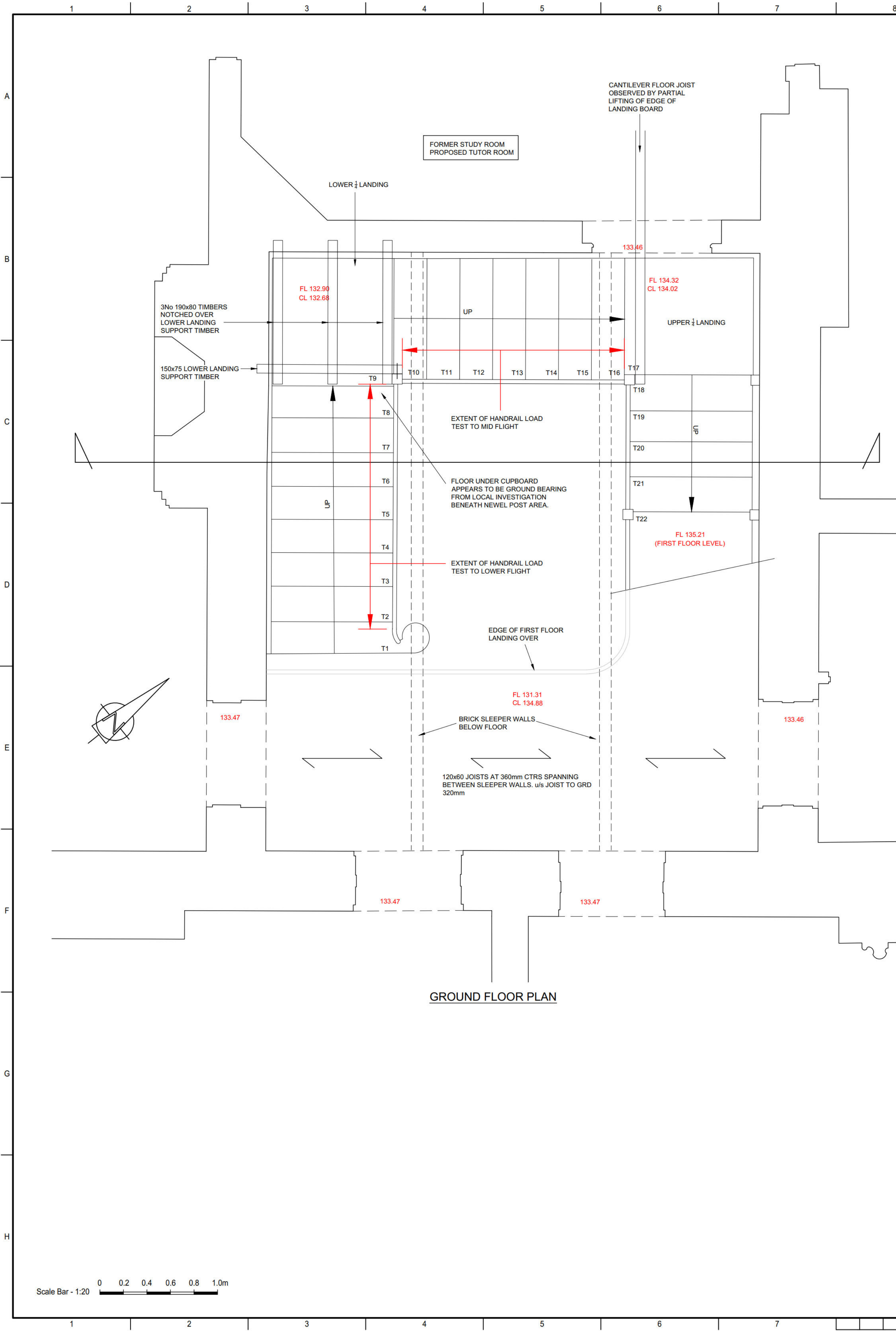
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8. APPENDIX B – STAIR A BALUSTRADE

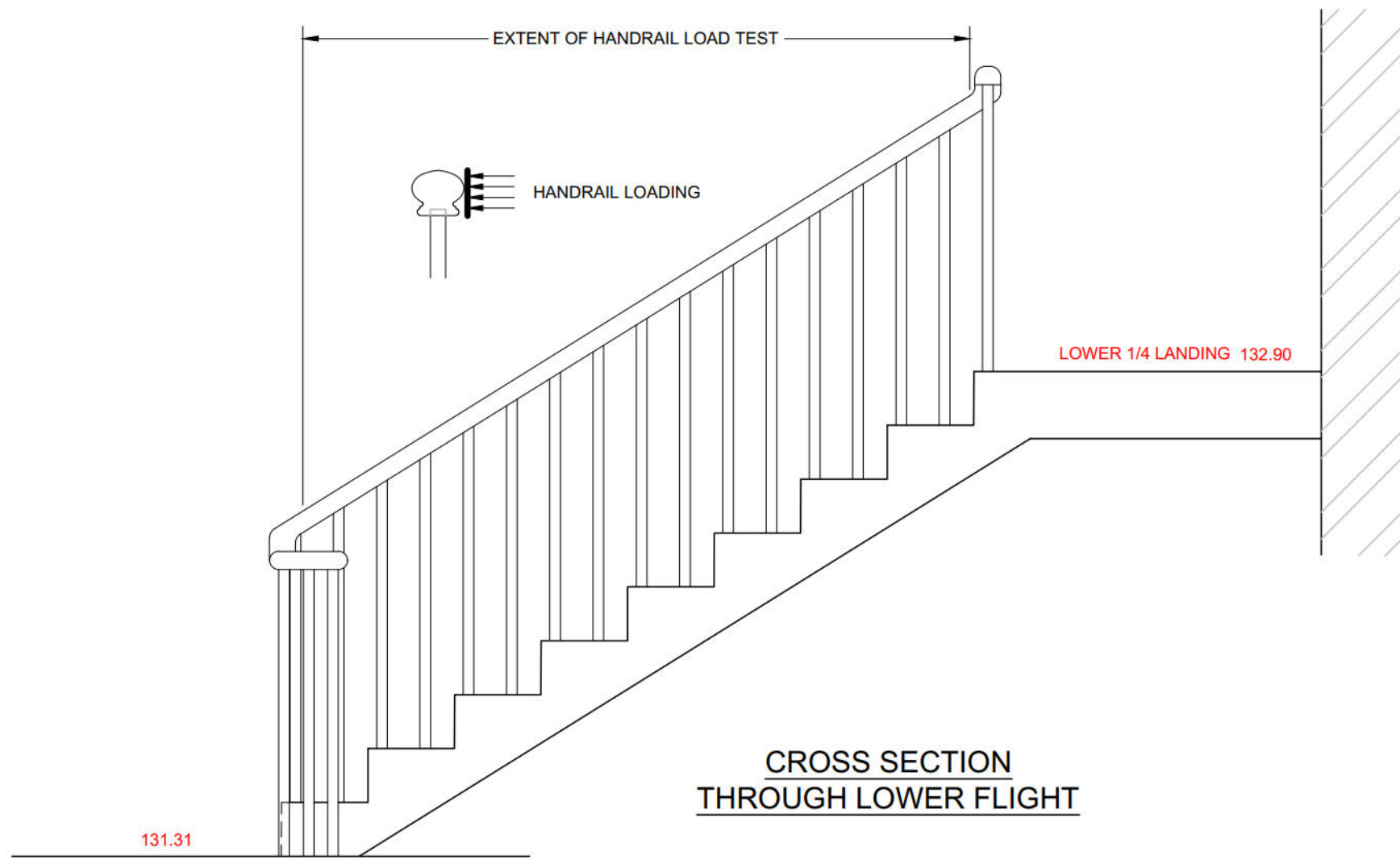
SFK drawing 25036-ZZ-1243 P2 – Stair A Handrail Load Test

Sanberg LLP Report 81319/S/1 Marlborough College, Master's Lodge, Testing of Stair Handrails. Dated 12 January 2026.

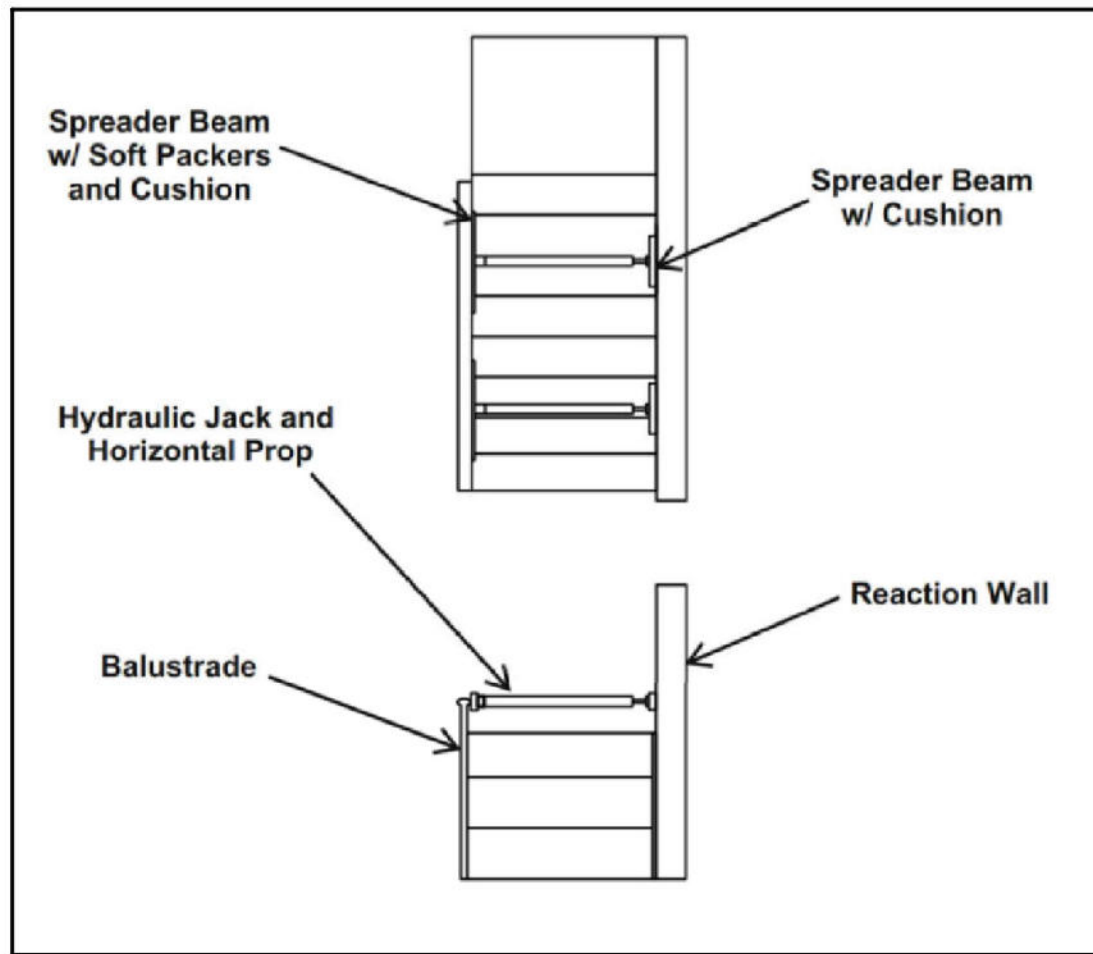
SFK sketch drawing 25036-SFK-SK-09012026-01 - Indicative glass balustrade elevation and section.



CROSS SECTION
THROUGH MIDFLIGHT



CROSS SECTION
THROUGH LOWER FLIGHT



SANDBERG PROPOSED LOAD TEST SET UP

NOTES

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THE BELOW METHODOLOGY HAS BEEN PRODUCED BY CURTIS FOGELBERG OF SANDBERG CONSULTING ENG'S ON 17.11.25

METHODOLOGY FOR BALUSTRADE TESTING AT MARLBOROUGH COLLEGE - MASTER LODGE - STAIR A

BACKGROUND -

SANDBERG LLP HAS BEEN INSTRUCTED TO CARRY OUT LINE LOAD TESTING ON SELECTED HANDRAILS ON STAIRWELLS IN MARLBOROUGH COLLEGE. LOAD TO BE APPLIED TO THESE HANDRAILS SHALL BE AT 0.74KN/M AT THE EXISTING HANDRAIL HEIGHT.

METHODOLOGY -

TESTING OF THE STAIRCASE BALUSTRADES AT MARLBOROUGH COLLEGE WILL BE CARRIED OUT BY APPLYING TWO TO THREE HORIZONTAL LINE LOADS TO THE HANDRAIL, EQUIVALENT TO 0.74 KN/M, AT THE EXISTING HANDRAIL HEIGHT. HYDRAULIC JACKS WILL BE USED TO APPLY THE TEST LOADS, WITH FORCES MONITORED USING 10 KN CALIBRATED LOAD CELLS. ALUMINIUM PROPS WILL SPAN THE WIDTH OF THE STAIRWELL AND BEAR AGAINST THE PARALLEL WALL OPPOSITE THE BALUSTRADE, WHICH WILL SERVE AS THE REACTION POINT. TO PREVENT DAMAGE TO THE WALL, TIMBER SPREADER BEAMS WITH FOAM CUSHIONING WILL BE POSITIONED BETWEEN THE PROPS AND THE WALL TO DISTRIBUTE THE APPLIED LOAD EVENLY.

TEST LOADS WILL BE GRADUALLY APPLIED AND MONITORED THROUGHOUT THE EXERCISE. IF ANY EVIDENCE OF DAMAGE IS OBSERVED OR DEFLECTION EXCEED 25MM LIMIT THE TEST WILL BE STOPPED IMMEDIATELY. IF NEEDED LOAD INCREMENTS WILL BE ADOPTED ON REQUEST.

THE LOAD WILL BE UNIFORMLY TRANSFERRED TO THE STAIRWELL BALUSTRADE BY POSITIONING TIMBER SPREADER BEAMS DIRECTLY TO THE SIDE OF THE HANDRAIL. DUE TO THE IRREGULAR HANDRAIL PROFILE, SOFT PACKERS WILL BE INSERTED TO ENSURE THE SPREADER BEAMS DISTRIBUTE THE LOAD EVENLY ACROSS THE SURFACE. AS WITH THE REACTION SETUP, FOAM CUSHIONING WILL BE APPLIED AT ALL CONTACT POINTS TO PREVENT MARKING OR DAMAGE TO THE BALUSTRADE HANDRAIL.

PROTECTIVE SHEETING WILL BE PLACED ALONG THE STAIRWELL TO ENSURE TREADS ARE FULLY PROTECTED THROUGHOUT TESTING. ALTHOUGH HYDRAULIC FLUID LEAKAGE FROM THE JACK IS UNLIKELY, THE SHEETING PROVIDES A PRECAUTIONARY BARRIER TO PREVENT ANY POTENTIAL CONTAMINATION OR DAMAGE.

DEFLECTIONS WILL BE MEASURED USING 50 MM RANGE LVDT TRANSDUCERS, MOUNTED ON INDEPENDENT FREESTANDING THESE POSTS WILL BE APPROPRIATELY BALLASTED TO ENSURE FULL STABILITY DURING TESTING. MEASUREMENTS WILL BE RECORDED AT THE WORST-CASE DEFLECTION LOCATIONS, WHICH WILL VARY DEPENDING ON THE SPECIFIC BALUSTRADE BEING ASSESSED.

REFER ALSO TO THE DIAGRAM OF THE TEST SET UP THAT IS PROPOSED -

P2	AD	NW	17.11.25	ISSUED FOR COMMENT / APPROVAL BY STANTEC
P1	AD	NW	17.11.25	ISSUED FOR DRAFT INFORMATION
REV	drawn	chkd	appd	date
				description

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STAIR A
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SCALE:

1:20 @ A1

SFK REF:

25036-ZZ-1243

25036-SFK-ML-ZZ-DR-S-1243

P2

REPORT 81319/S/1

**MARLBOROUGH COLLEGE
MASTER'S LODGE**

TESTING OF STAIR HANDRAILS

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REPORT 81319/S/1

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TESTING OF STAIR HANDRAILS

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This report comprises:
Cover sheet
This contents page
4 pages of text
Photographs 1 to 6
Back cover

For the attention of Nigel Winterbottom

12 January 2026

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REPORT 81319/S/1

MARLBOROUGH COLLEGE MASTER'S LODGE

TESTING OF STAIR HANDRAILS

Instruction: Instruction received by email from Nigel Winterbottom of SFK Consulting LLP on 24 November 2025.

1 INTRODUCTION

Marlborough College Master's Lodge, a Grade II listed building located in Bath Road, Marlborough, SN8 1PA, is being repurposed from residential accommodation to a teaching facility. As a result of this change, Stair A was required to undergo horizontal handrail load testing to verify compliance with BS 6180:2011.

Testing was limited to the handrail only and was carried out by applying a horizontal uniformly distributed line load, in accordance with the standard. The existing stair balusters had been assessed previously; they were found to be insufficient to meet modern loading requirements. Consequently, SFK Consulting will introduce new glass panels designed to resist the loads specified in BS 6180:2011.

The staircase balustrade comprised a continuous timber handrail supported by regularly spaced timber balusters along the stair flights and larger newel posts at each landing. The posts were fixed to the stair structure. The balustrade height was consistent throughout and measured approximately 900mm above the nosings of the stair treads. At the base of the stairwell, the balustrade transitioned into a grouped arrangement of balusters configured in a spiral pattern. The tested handrail sections are shown in Photographs 1 and 2.

In accordance with BS 6180, the applied test load was adjusted to account for the actual handrail height. The standard requires that where a handrail is installed below 1100mm, the applied load is increased such that the bending moment at the base of the balustrade is equivalent to that produced by the specified load acting at 1100mm.

As the handrail was located 900mm above the stair treads, the applied line load was increased from 0.74kN/m to 0.90kN/m.

The load testing was conducted on 18 December 2025, as required by the client.

2 TEST PROCEDURE

Testing was carried out by applying a horizontal uniformly distributed line load equivalent to 0.74kN/m acting at 1100mm, adjusted to 0.90kN/m in accordance with BS 6180:2011 to account for the actual handrail height of 900mm.

Two hydraulic jacks were used to apply the test load along the full length of each handrail section with two 900mm long steel spreader beams ensuring an even distribution of load. The hydraulic jacks reacted against the parallel wall alongside the staircase (Photographs 3 and 4). Applied forces were measured using a calibrated load cell (Equipment reference: E60.9) (Photograph 5).

Deflections were measured at a height of 900mm above the edge of the stair treads. Measurements were taken at the mid-span of each handrail section. Additional readings were taken at quarter-span locations on the middle stair section, and, on the lower section of the staircase, near the spiral baluster arrangement and at a quarter length from the top of the handrail.

Deflections were recorded using 50mm range LVDT transducers mounted on independent freestanding posts (Photograph 6). The posts were adequately ballasted to ensure stability.

3 RESULTS

3.1 Test 1 - Middle Stair Section

The middle stair section had a total span of 2.3m between the newel posts.

The following table summarises test 1 results:

Load stages	Max load applied per jack (kN)	Equivalent line load at 1100mm (kN/m)	Lower quarter span deflection (mm)	Mid-span of handrail deflection (mm)	Upper quarter span deflection (mm)
Initial	0	0	0	0	0
Maximum applied load	0.86 (Target 1.04)	0.61 (Target 0.74)	20.1	25.5	23.3
Unloaded after test	0	0	1.7	2.4	2.0

Comments - An audible cracking sound was heard at an equivalent uniformly distributed line load of 0.61kN/m. The test was terminated prior to reaching the target load, as the measured horizontal displacement of the handrail exceeded the 25mm deflection limit at 1100mm prescribed by BS 6180:2011. Termination prevented permanent damage to the balustrade.

3.2 Test 2 - Lower Stair Section

The lower stair section had a total clear span of 2.6m between the newel posts. As the previous test did not reach the target load of 0.74kN/m applied at 1.10m, the client requested that intermediate load increments of 0.4kN and 0.6kN per jack be applied, with corresponding displacements recorded.

The following table summarises test 2 results:

Load stages	Max load applied per jack (kN)	Equivalent line load at 1100mm (kN/m)	Deflection at baluster spiral (mm)	Mid-span of handrail deflection (mm)	Upper quarter span deflection (mm)
Initial	0	0	0	0	0
Increment 1	0.4	0.25	10.7	13.4	10.3
Increment 2	0.6	0.38	16.7	20.5	16.2
Maximum Applied Load	0.7 (Target 1.17)	0.44 (Target 0.74)	19.9	25.2	19.2
Unloaded after test	0	0	2.2	2.7	1.8

Comments - In order to prevent any permanent damage to the balustrade, this test was terminated prior to reaching the target load of 0.74kN/m at a height of 1100mm. The test ended at an equivalent uniformly distributed line load of 0.44kN/m, because the measured horizontal displacement of the handrail had already exceeded the 25mm deflection limit measured at 1100mm above the nosings as prescribed by BS 6180:2011.

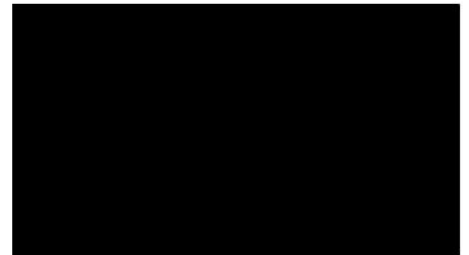
4. REMARKS

All tested balustrades failed to resist the equivalent uniformly distributed line load target of 0.74kN/m applied at 1100mm.

Based on the results of the tests undertaken, the balustrades do not meet the stiffness requirements of BS 6180:2011.

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For Sandberg LLP



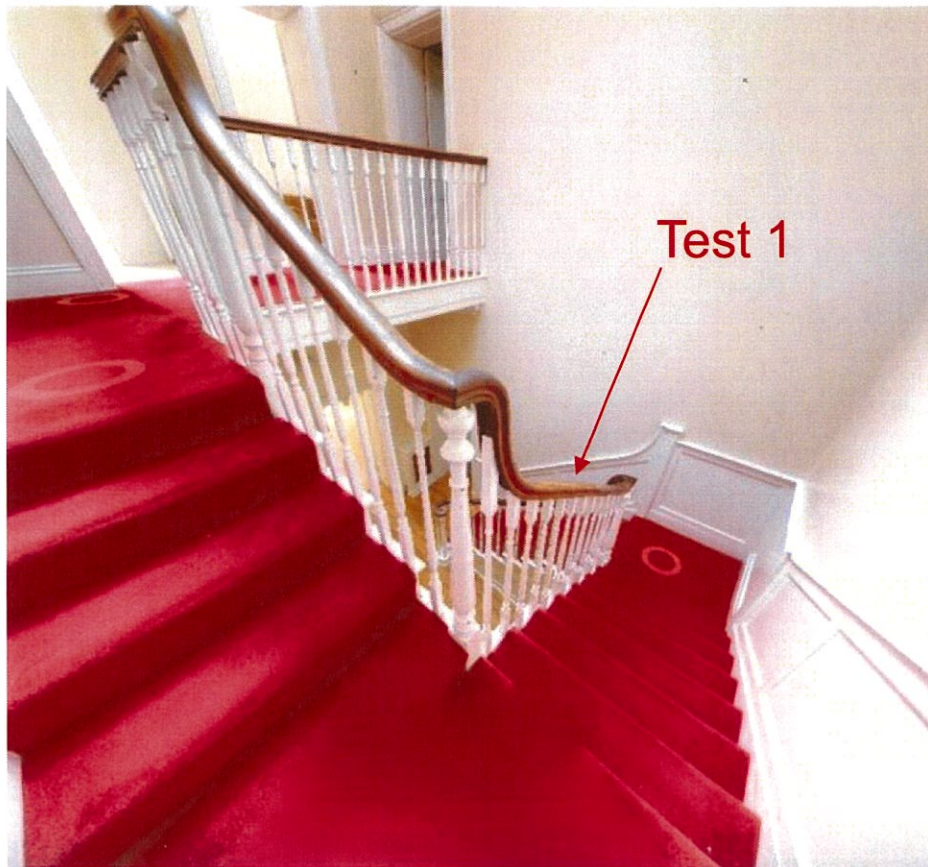
For the attention of Nigel Winterbottom

S M Pringle
Consultant

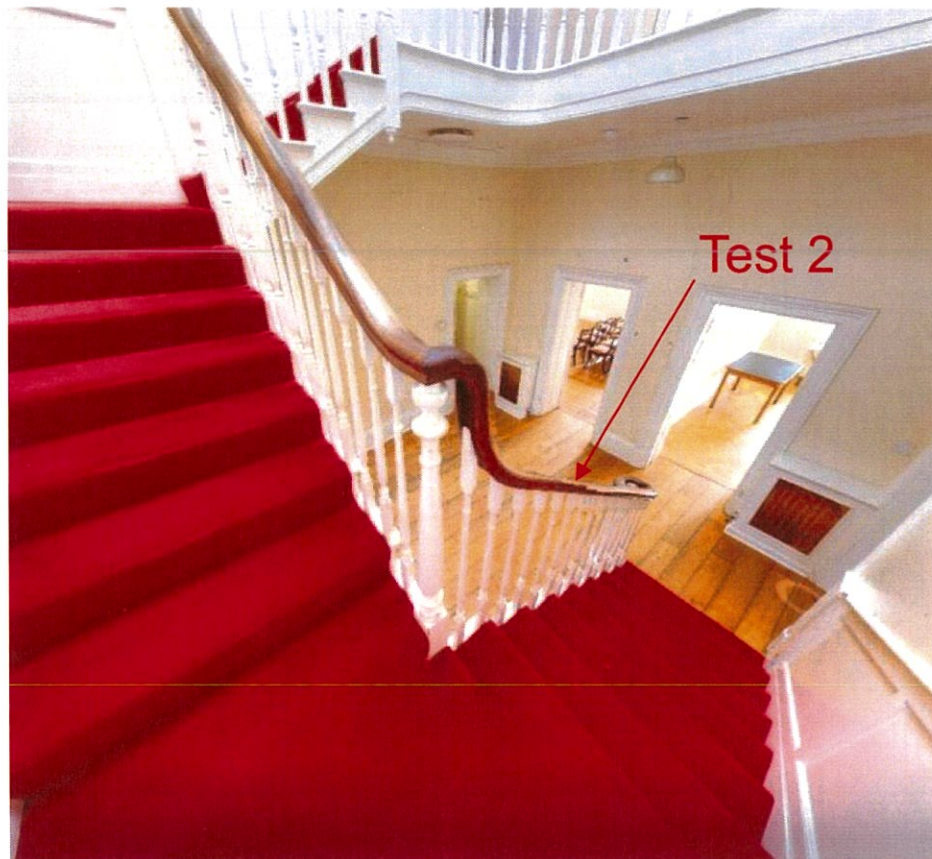
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12 January 2025

PHOTOGRAPHS



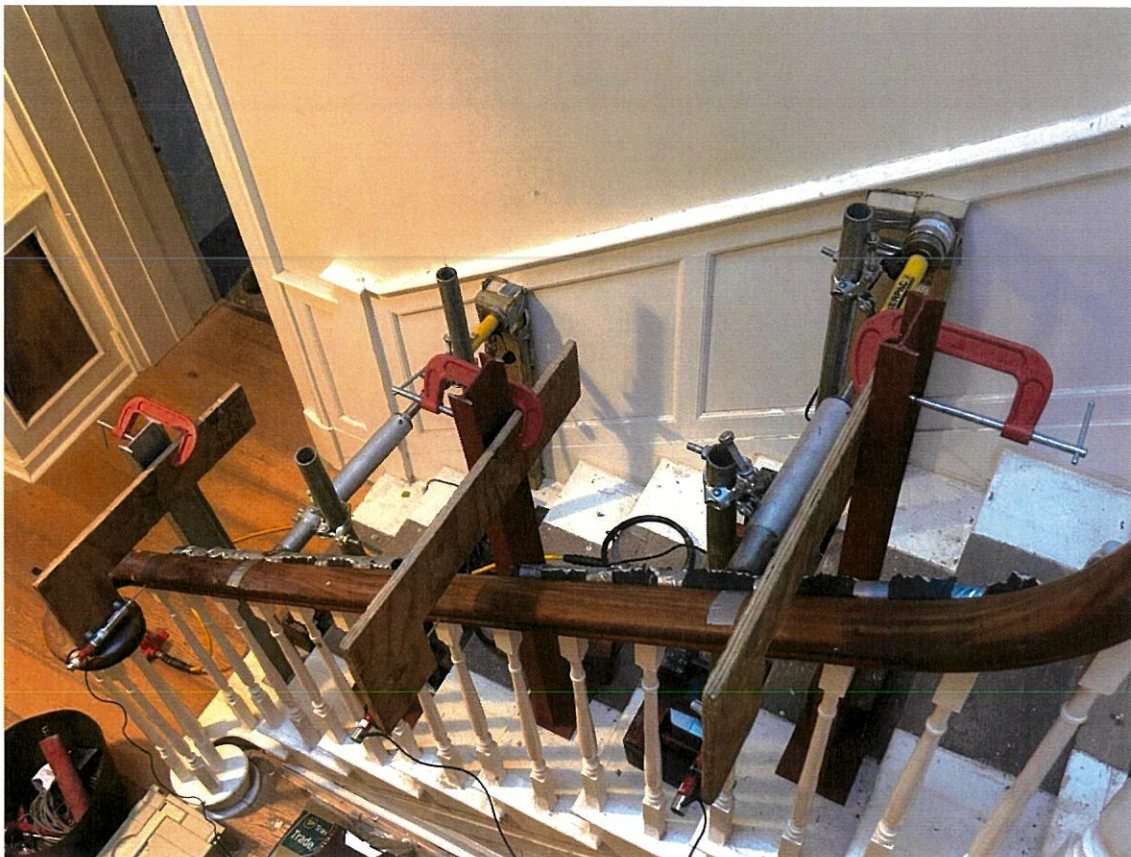
Photograph 1 Test 1 – Middle stair section balustrade



Photograph 2 Test 2 – Lower stair section balustrade



Photograph 3 Test setup for middle stair section



Photograph 4 Test setup for lower stair section



Photograph 5 Calibrated load cell reference E30.9



Photograph 6 50 mm range LVDT transducers

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Where test results are given, the results and our conclusions relate only to the samples tested and apply to the sample(s) as received, except where sampling has been conducted by Sandberg LLP.

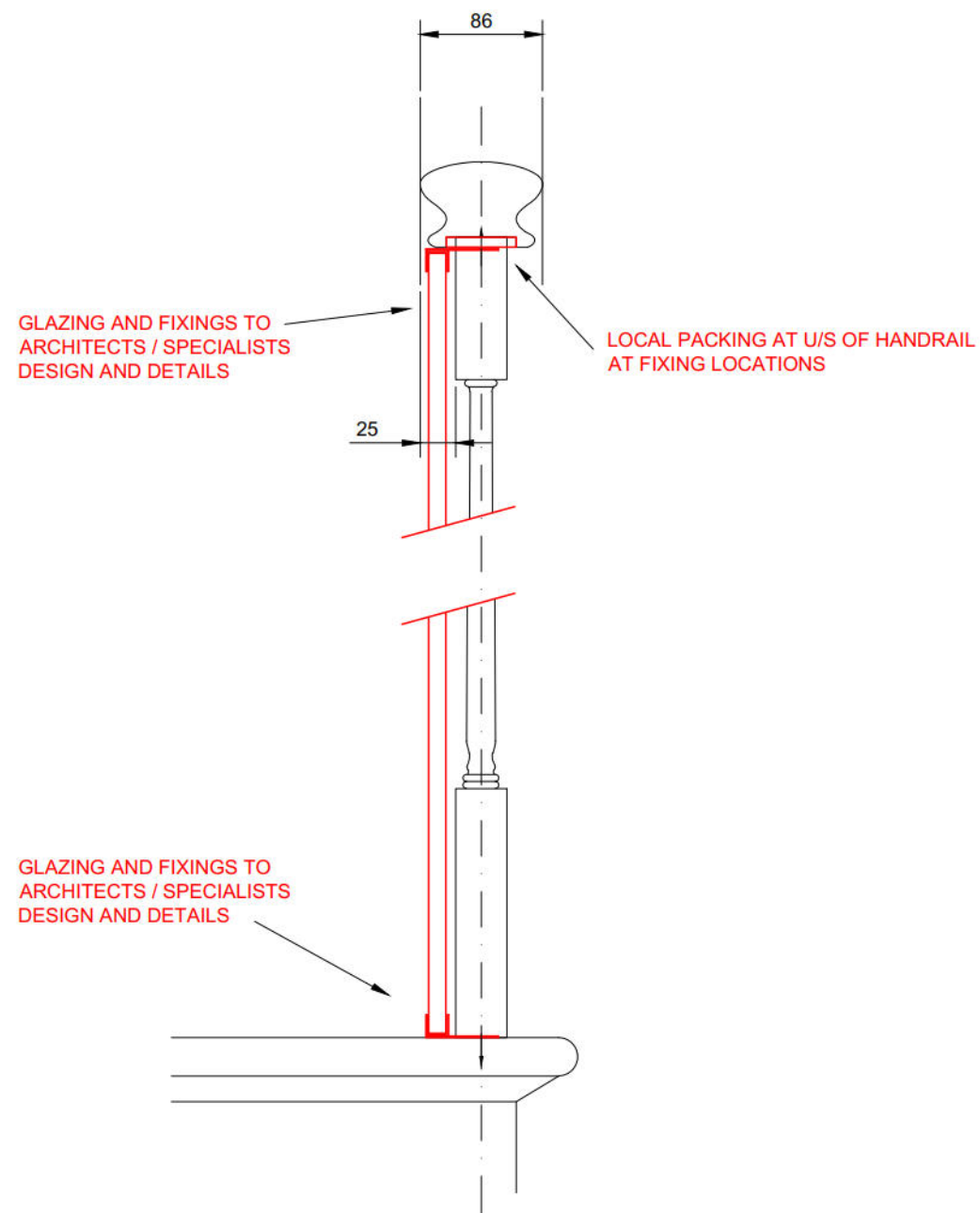
Materials, samples and test specimens are retained for a period of 2 months from the issue of the final report.

Tests reported on sheets not bearing the UKAS mark in this report/certificate are not included in the UKAS accredited schedule for this laboratory.

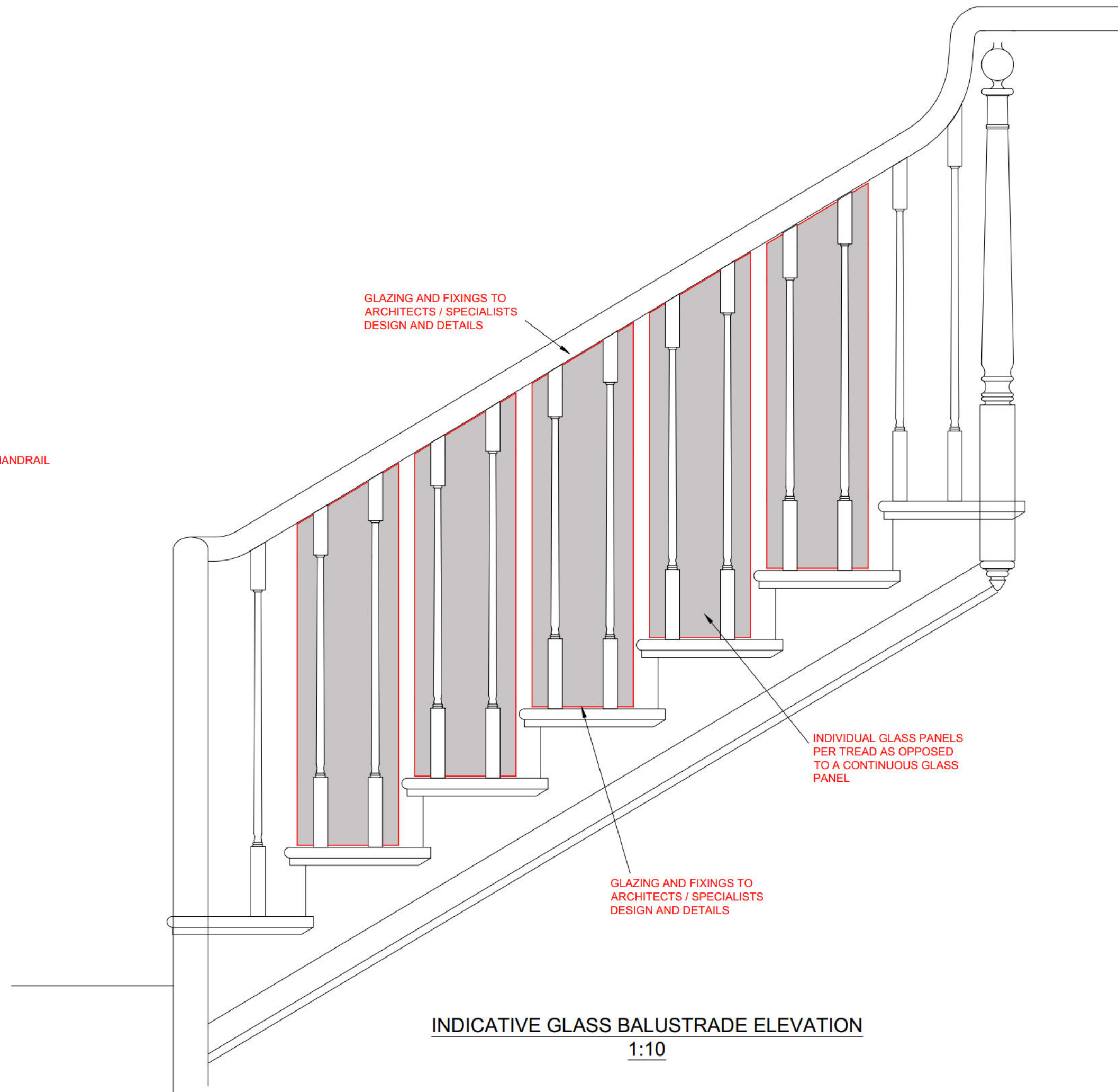
Opinions and interpretations expressed herein are outside the scope for UKAS accreditation.

End of report.





INDICATIVE GLASS BALUSTRADE SECTION
1:5



INDICATIVE GLASS BALUSTRADE ELEVATION
1:10