Acland Burghley School, Theatre London

Structural and Civil Engineering Planning Report

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Reviewed by: **Paul Batty MIStructE MICE**

Job Number: **28851**

Date	Revision	Notes/Amendments/Issue Purpose
March 2021	1	Draft for comment
March 2021	2	For Planning Submission

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Contents

1 Project Description

A refurbishment and extension to the existing theatre at Acland Burghley School. The school is located on Burghley Road near Tufnell Park underground station. The theatre is a single storey structure with an irregular hexagonal shape on plan located in the centre of the school grounds, a site plan is shown in Figure 1. The school was designed by Howell, Killick, Partridge and Amis between 1960 and 1966. The school was Grade 2 listed in 2016.

The proposed refurbishments include increasing the toilet facilities and improving the theatre specification creating a more versatile space in terms of seating and technology.

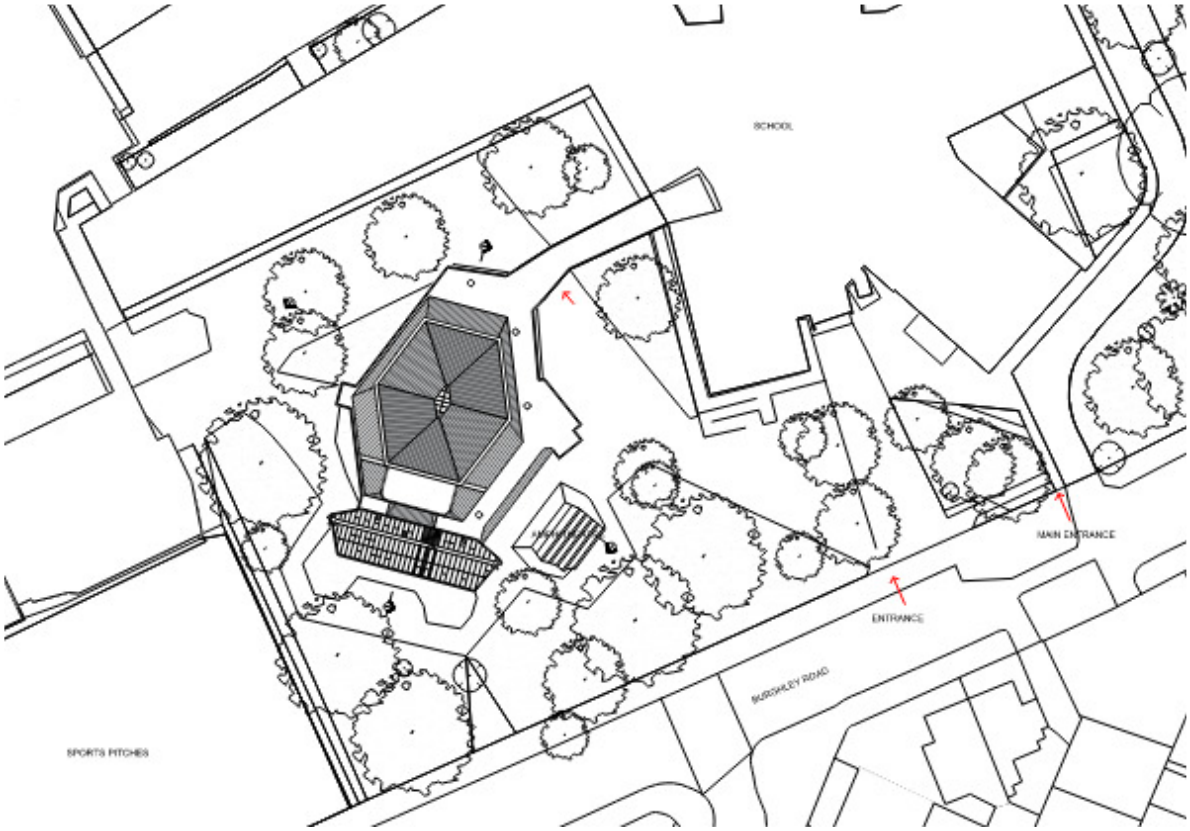


Figure 1 Site Plan

2 Ground Conditions

The British Geological Survey records the ground conditions as London Clay. This is confirmed by local borehole records in the area.

The publication "Lost Rivers of London" has a map indicating subterranean watercourses [Figure 2]. There are tributaries of the river Fleet to the west of the site.

Figure 2 Extract from Lost Rivers of London Map

The Northern Line tunnel of the London Underground is nearby to the east of the site [Figure 5]. The tunnel is at a sufficient distance to be unlikely to cause any interference with the substructure of the building, which is shallow.

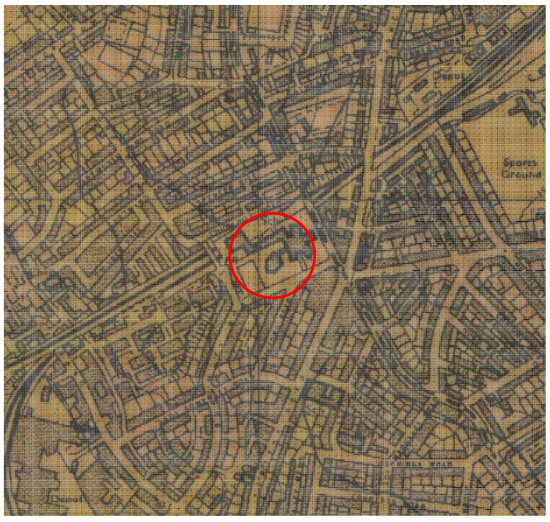


Figure 4 Extract from geological map showing Acland Burghley School. British Geological Survey © All Rights Reserved [2018]

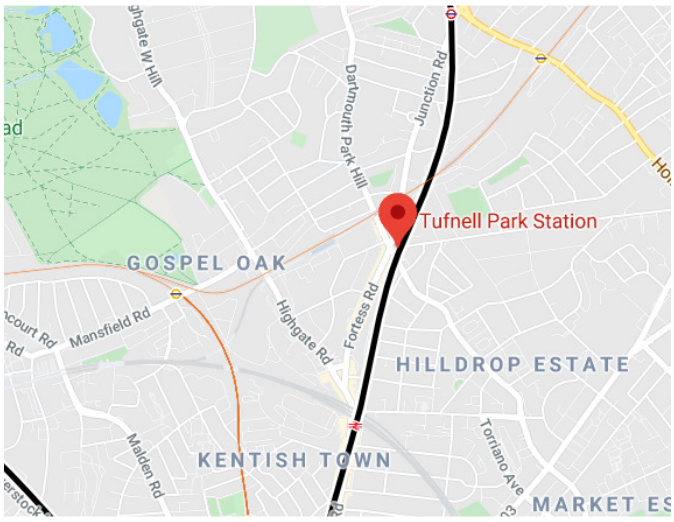


Figure 5 Map showing London Underground Northern Line

3 Existing Structure

Drawings of the building were obtained from the RIBA archive, a section showing the structure is shown in Figure 6. The foundations are a 150mm thick ground bearing slab with thickenings at wall and column locations.

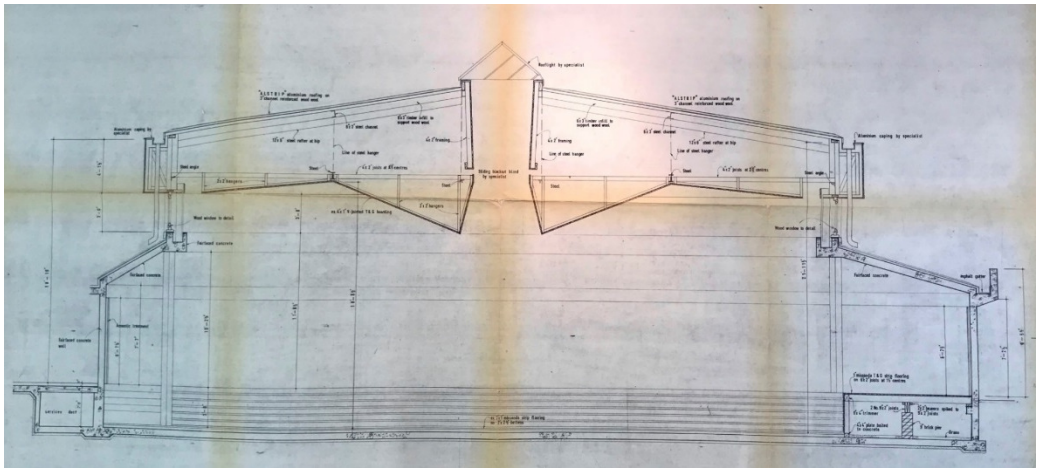


Figure 6 Short Section from RIBA Archive

The superstructure has perimeter reinforced concrete walls to both sides all exposed fair faced concrete with an inner row of RC columns within the theatre space one side of the hexagon has a corridor with an additional RC wall. The RC structure extends to form a lower level roof slab to a RC ring beam to the underside of a row of windows at clerestory level. Above this a lightweight steel and timber structure forms the roof. The roof structure has two main steel trusses either side of the central rooflight. There are secondary steels forming the hips which are steel 'I' sections spanning from the truss to the RC columns. The shaped profile of the roof and ceiling is formed in timber.

Figure 7 Archive photographs of the theatre

4 Proposed Structure

The main area of structural engineering work to the theatre is the proposed extension to the south-east edge. Other aspects of the project requiring engineering input are also discussed in this section. Structural drawings are included in Appendix A.

Extension

The extension (see in Figure 8) to the building is to increase the toilet and storage facilities. The space is created by pushing the corridor out, placing new toilets and storage in the existing corridor and creating a new walkway. To connect the new extension to the existing building a few new openings are to be diamond wire or caw cut into the RC wall. The cut concrete will be left exposed in some areas or framed to form new doorways.

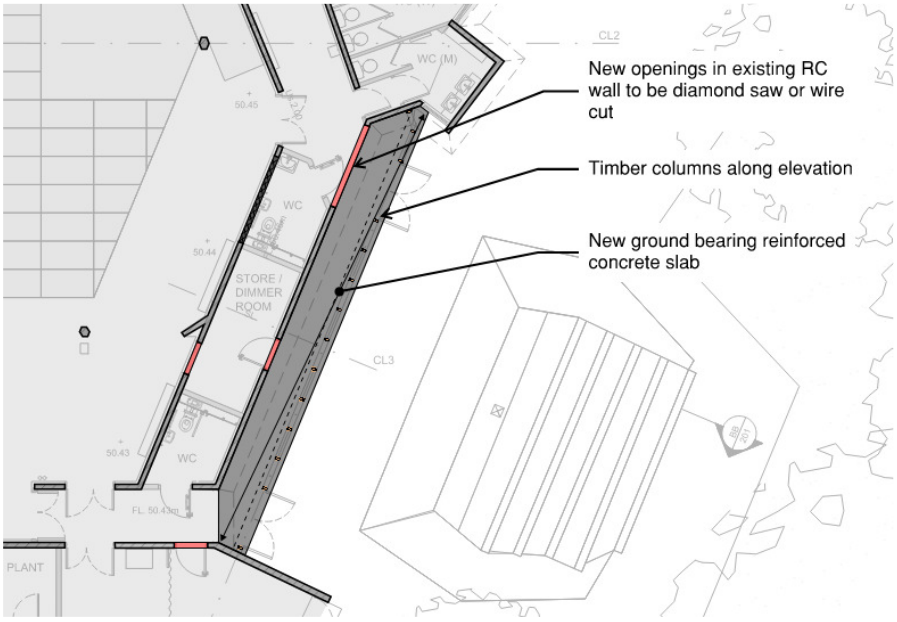


Figure 8 New extension along southeast edge

Early stages of the design looked at a steel frame for the extension structure. With keeping the embodied carbon of the structure as low as possible being a focus of the project we have settled on a timber frame for the extension with columns at closer centres. The embodied carbon assessment of a steel versus timber frame is included in Appendix C. The roof of the extension will be timber rafters and ceiling joists spanning onto timber beams which are fixed back to the existing RC wall with steel flitch plates resin anchored to the wall.

Figure 9 Photograph looking southwest where the extension is proposed

The substructure of the extension will be a ground bearing slab to the depth of the existing slab with an edge thickening under the new columns. The ground is London Clay which has a high volume change potential due to changes in moisture content. Foundations are usually put to a minimum depth of 900mm to avoid seasonal changes in moisture content close to the surface. Deeper foundations are required if there is planting and the likelihood of tree roots extracting moisture from the ground under the foundations and causing subsidence. Leaking drains can be another cause. The existing foundations in the vicinity of the extension are quite shallow at about 500mm. There are no obvious signs of distortion or cracking in the existing building in the area close to the proposed extension, so the existing external paving has prevented any significant seasonal movement in the clay and that trees are sufficiently far away for their roots to have extended under this side of the building.

Elsewhere around the building there appear to be varying depths of foundation ranging from around 500mm to around 1.2m and there are trees at varying distances and ground finishes vary from paving to bare soil. There is the potential for future ground movement and cracking of the existing structure as the trees grow and due to seasonal effects where the foundations are shallow. It would be worth considering providing a strip of hard landscaping alongside areas where the foundations are shallow and instituting a regime of planned pruning of the trees to try to limit the spread of roots. Unfortunately, once roots have spread under a foundation pruning is unlikely to be effective. Any future planting should also be carefully considered and planned.

Lighting

New lighting is proposed to upgrade the technical equipment in the theatre. A survey was undertaken of the existing trusses which support the roof. It has been assumed that access into the roof area will not be required going forward as this would need modification to make it safe. Instead, maintenance of the new lighting layout will be accessed from below ceiling level inside the theatre.

The new lighting will be supported off the existing roof structure, this will involve installing new timber joists to support the lighting bars. New equipment is required above the stage area which will need additional steel beams for support.

Ventilation

Richie and Daffin have proposed a new buried earth duct approximately 70m long and 1m in diameter in the ground surrounding the building to improve the ventilation of the theatre space. The earth duct will feed into the theatre at low level via a new buried concrete chamber constructed next to the building. To avoid underpinning the existing foundations the base of the concrete chamber needs to be outside a 45-degree line from the edge of the existing footings. The chamber and duct will need to be waterproofed and drained. The high-level extract equipment will be in the roof above the stage area. Additional steel framing is required to support the extract plenum, this is shown on drawing 28851/1110 in Appendix A.

Drainage

The below ground drainage design has been carried out in accordance with BS EN 752, Part H of the Building Regulations and best practice guidance.

The utilities survey carried out by Greenhatch Group shows that the site comprises of an existing combined water drainage network that serves the existing performing arts building and surrounding areas. Thames Water asset maps were not available at the time of writing, however it is assumed that this private drainage network ultimately outfalls to the Thames Water public sewers.

A new private combined drainage system is proposed to serve the additional rainwater downpipes that serve the new extension and the foul water stacks that serve the new W/C's and sink in the refurbished areas of the existing building. The new combined manhole C1 (shown in drawing 28851-6000) is proposed to connect to the existing 150mm diameter combined drain that runs adjacent to the proposed extension. An allowance should be made to re-build the existing manholes where new incoming connections are proposed.

A foul pumping chamber is proposed to serve the foul flows from the proposed Earth Duct (designed by the M&E Engineer). It is proposed to connect the rising main from the foul pump onto the closest existing manhole that discharges to the combined drainage system located to the south of the site.

The below ground drainage drawings are included in Appendix B.

5 Design Criteria

Codes and Standards

The proposed structure will be designed in accordance with the relevant Eurocodes with reference made where appropriate to historic design guides.

Below ground drainage will be designed in accordance with Building Regulations Part H, BS EN 752 "Drains and Sewer systems outside Buildings".

Design Life

Standard practice of 50 years for new elements.

Loadings

To be assessed in accordance with the following Codes of Practice:

BS EN 1991 Part 1-1 (2002)	General actions
BS EN 1991 Part 1-3 (2003)	Snow loads
BS EN 1991 Part 1-4 (2005)	Wind actions

Imposed Loads:

Theatre	4.0 kN/m^2
Corridors	3.0 kN/m^2
Roof	0.6 kN/m^2

Design Fire Periods

A fire rating of 60 minutes will be provided for the proposed works. Fire protection shall be provided in the form of appropriate cover to reinforcement for RC construction and cladding to other structural elements to the Architect's specification. As the classification of the building has not changed, no changes to the fire protection of the existing building are envisaged.

Disproportionate Collapse

The theatre is a single-storey educational building and is therefore a Class 2a building according to Table 11 of Part A3 of the Building Regulations. This classification requires effective horizontal ties or effective anchorage of suspended floors to walls. The proposed works will provide ties where necessary.

Embodied Carbon and Sustainability

Areas in which the specification of the structure will contribute to the sustainability of the building include the substitution of a proportion of the portland cement for ground granulated blast furnace slab (ggbs) in the concrete mixes, ensuring that all timber for shuttering and any other purposes during construction is obtained from FSC or PEFC accredited sources, and the use of recycled aggregates for all fill materials.

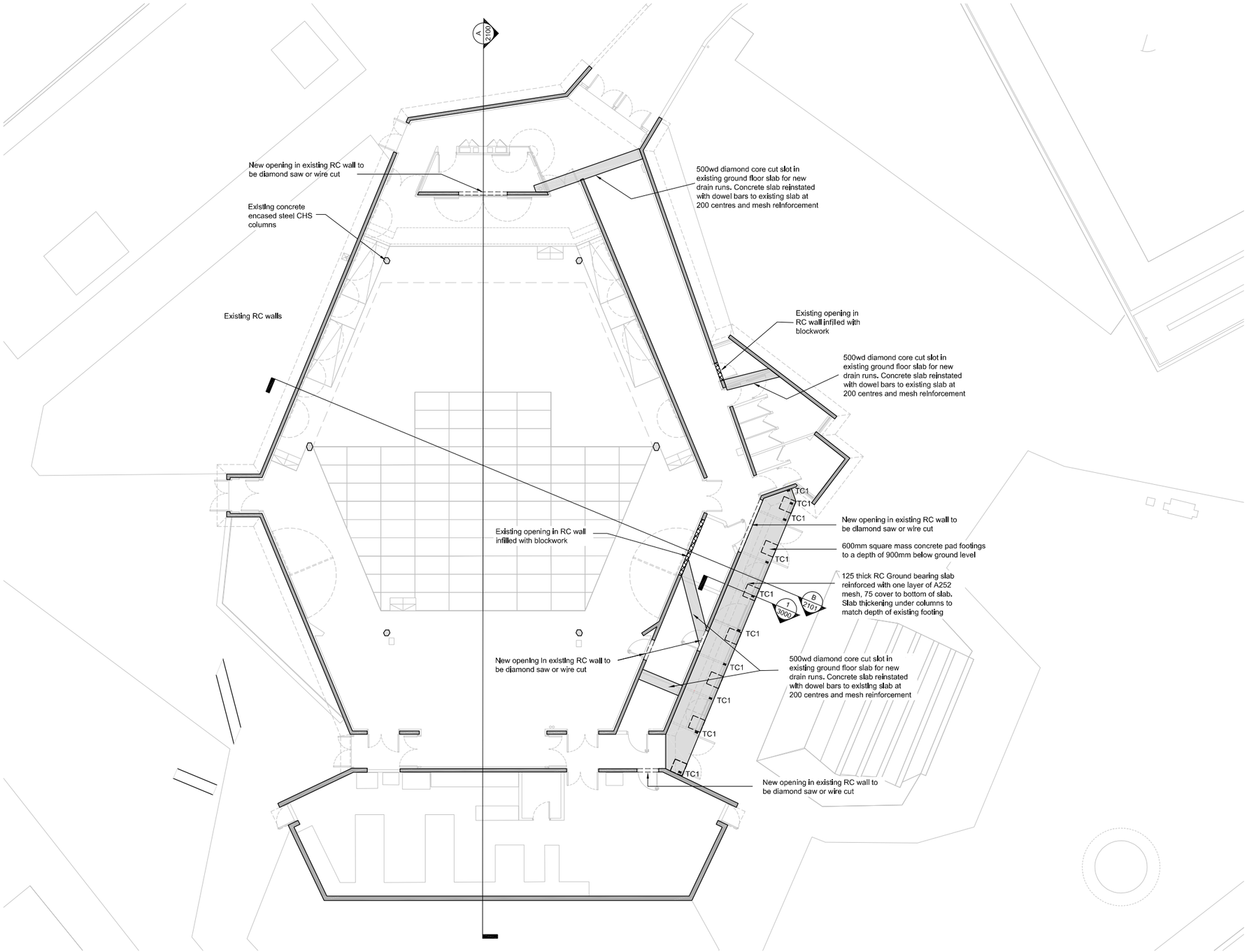
6 Surveys and Investigations

To aid the design process some investigations into the existing structure have been undertaken. This includes a survey of the existing roof structure to assess the capacity of the roof trusses to support new lighting equipment. Trial pits were dug on the site to confirm details, form, and depth of existing foundations. These were also done to assess if there was any ground contamination on the site. In the two trial pit locations there was no immediate signs of contamination.

The following surveys and investigations are required before construction:

- Cover survey for reinforcement in RC walls.
- A CCTV drainage survey to establish the condition and level of the existing below ground drainage system.

Appendix A
Structural Drawings



NOTES :

1. This drawing is to be read in conjunction with all relevant Architect's, Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check that this drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety :
   All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".
4. For general notes refer to Drawing No. 28851-0001

COLUMN SCHEDULE
TC1 125 x 75 C25 Timber column

Rev	Date	Drawn	Eng	Amendment
P01	26.03.21	MM	GH	Issued for Stage 3

ACLAND BURGHLEY SCHOOL THEATRE

GROUND FLOOR PLAN

Status
STAGE 3
NOT FOR CONSTRUCTION

Drawn MM	Eng GH
Scales 1:100 at A1	1:200 at A3
Drawing No 28851-1100	Rev P01

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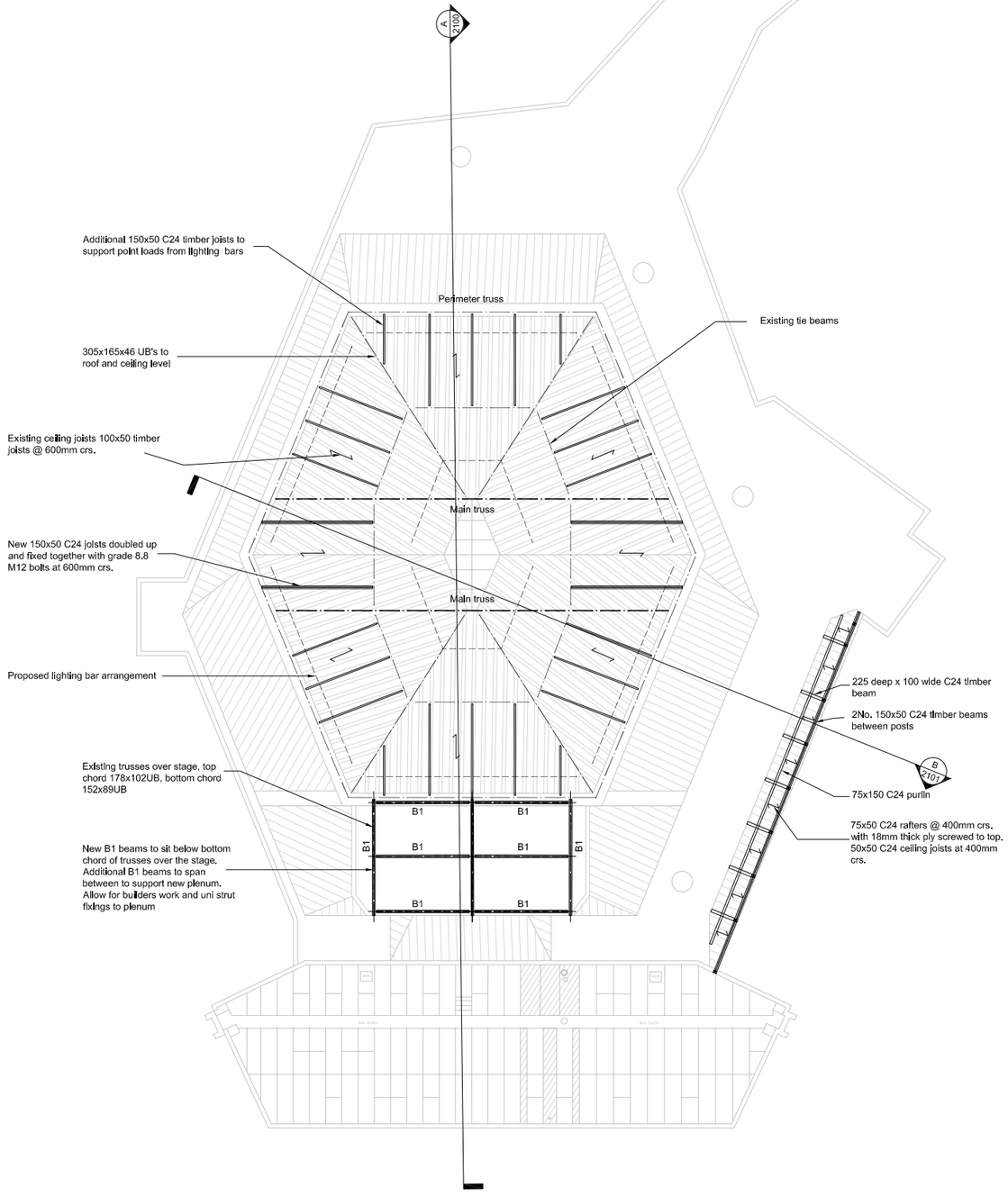

NOTE:
Allow for new vertical hangers to support new lighting bars to the roof over the centre of the hall. Hangers to be fixed to existing beams with Lindapter clamps and support brackets

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BEAM SCHEDULE	
B1	152 x 89 x 16 UB

Rev	Date	Drawn	Eng	Amendment
P01	26.03.21	MM	GH	Issued for Stage 3

ACLAND BURGHLEY SCHOOL
THEATRE

ROOF STRUCTURE PLAN

Status
STAGE 3
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Scales 1:100 at A1	1:200 at A3
Drawing No 28851-1110	Rev P01

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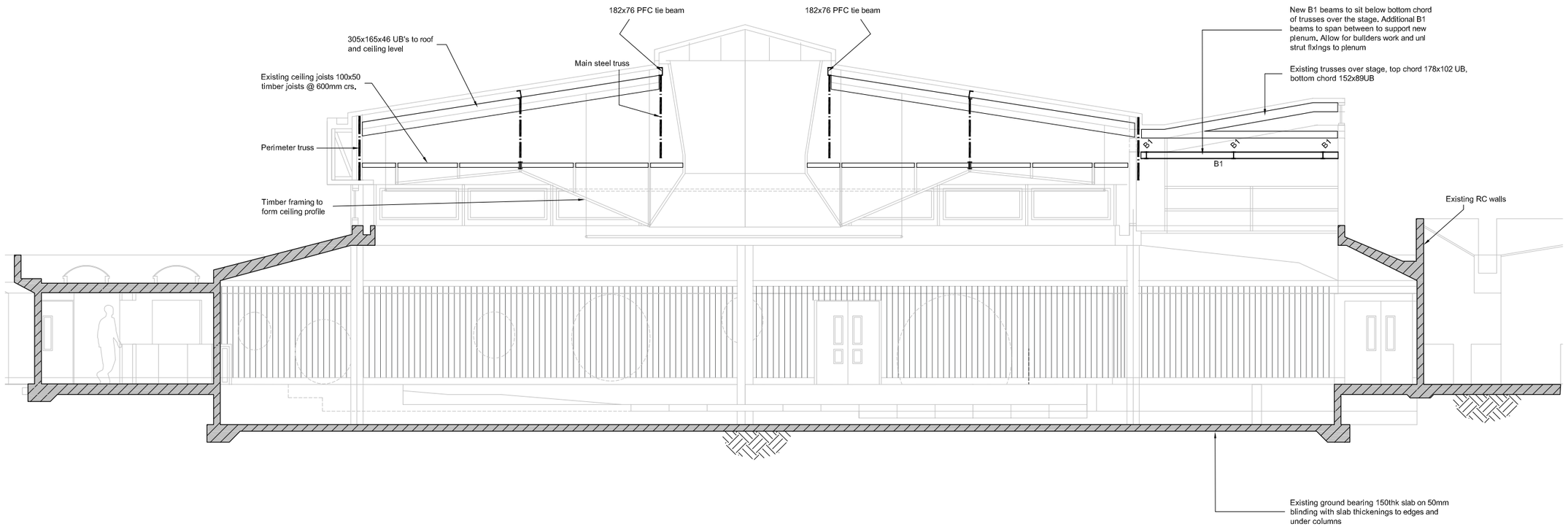

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BEAM SCHEDULE	
B1	152 x 89 x 16 UB

Rev	Date	Drawn	Eng	Amendment
P01	26.03.21	MM	GH	Issued for Stage 3

ACLAND BURGHLEY SCHOOL
THEATRE

SECTION A-A

Status
STAGE 3
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Drawn MM	Eng GH
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Drawing No 28851-2100	Rev P01

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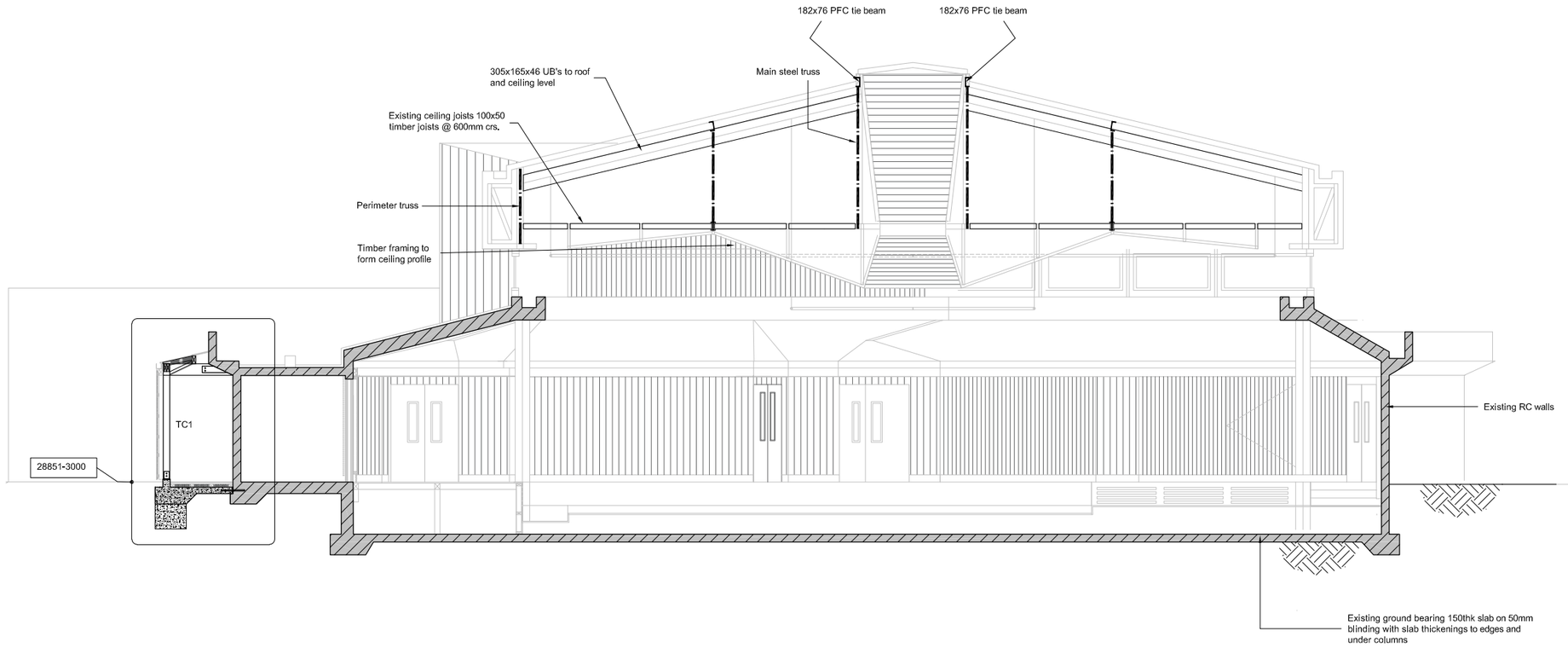

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4. For general notes refer to Drawing No. 28851-0001

COLUMN SCHEDULE
TC1 125 x 75 C25 Timber column

Rev	Date	Drawn	Eng	Amendment
P01	26.03.21	MM	GH	Issued for Stage 3

ACLAND BURGHLEY SCHOOL
THEATRE

SECTION B-B

Status
STAGE 3
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Drawn MM	Eng GH
Scales 1:50 at A1	1:100 at A3
Drawing No 28851-2101	Rev P01

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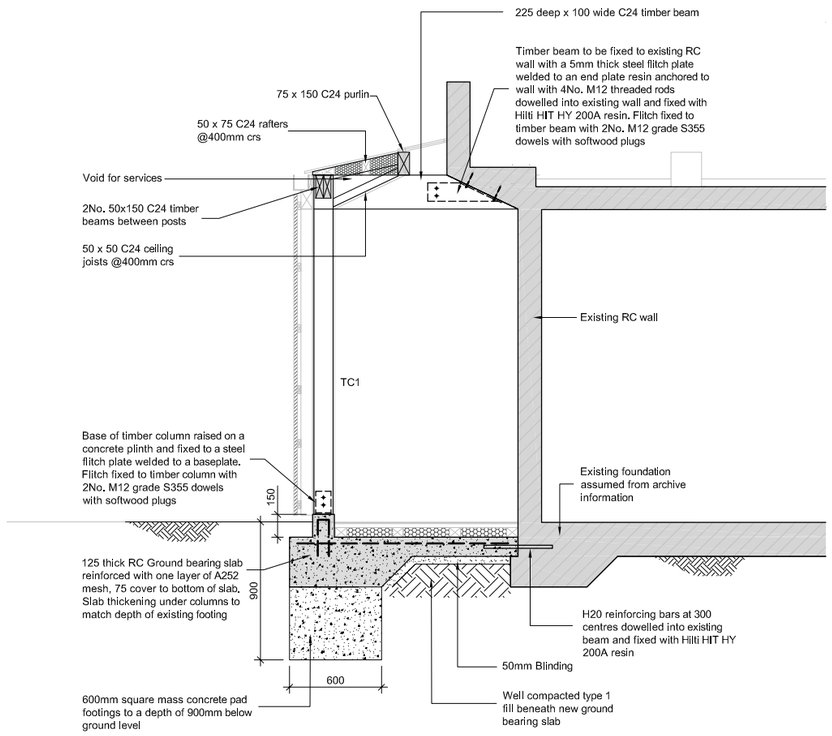

SECTION 1-1
SCALE 1:20

NOTES :

1. This drawing is to be read in conjunction with all relevant Architect's, Engineer's and specialists' drawings and specifications.
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COLUMN SCHEDULE
TC1 125 x 75 C25 Timber column

Rev	Date	Drawn	Eng	Amendment
P01	26.03.21	MM	GH	Issued for Stage 3

ACLAND BURGHLEY SCHOOL
THEATRE

DETAILS
SHEET 1

Status
STAGE 3
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Drawn MM	Eng GH
Scales 1:20 at A1	1:40 at A3
Drawing No 28851-3000	Rev P01

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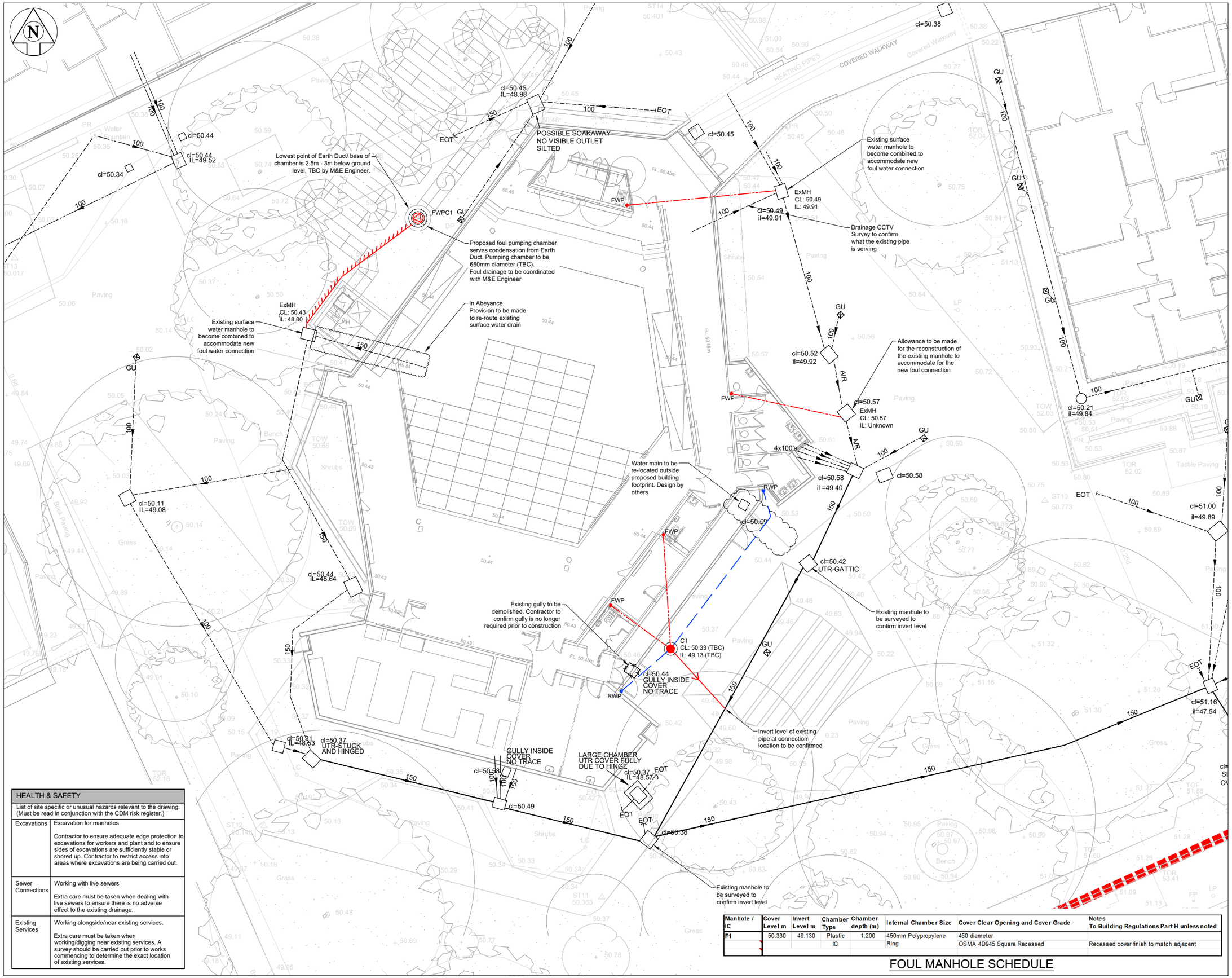
Appendix B
Below Ground Drainage



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3. Health & Safety :
   All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".
4. All proposed RWP's and FWP's shown indicatively only, to be confirmed by the Architect and M&E Engineer.
5. It is assumed that all rainwater downpipes are retained and drain as existing.
6. All proposed pipework to be vitrified clay.
7. All pipework to be 100mm in diameter unless stated otherwise
8. Provision to be made to rebuild existing manholes with new drainage connections.
9. All disused pipework to be abandoned/demolished.
10. Existing drainage and utilities information taken from survey drawing by Greenhatch Group ref: 36874_01_P.
11. Earth Duct layout design by the M&E Engineer.

DRAINAGE LEGEND	
Site Boundary	
New FW Drain	
New SW Drain	
New Combined Drain	
New Foul Rising Main	
Existing SW Drain	
Existing FW Drain	
Existing Combined Drain	

DRAINAGE KEY	
FWP	Foul Waste Pipe
RWP	Rainwater Downpipe
C1	Combined Water Manhole Chamber
FWPC1	Pumping Station Manhole Chamber

ABBREVIATIONS	
IL	- Invert Level
CL	- Cover Level

HEALTH & SAFETY	
List of site specific or unusual hazards relevant to the drawing: (Must be read in conjunction with the CDM risk register.)	
Excavations	Excavation for manholes Contractor to ensure adequate edge protection to excavations for workers and plant and to ensure sides of excavations are sufficiently stable or shored up. Contractor to restrict access into areas where excavations are being carried out.
Sewer Connections	Working with live sewers Extra care must be taken when dealing with live sewers to ensure there is no adverse effect to the existing drainage.
Existing Services	Working alongside/near existing services. Extra care must be taken when working/digging near existing services. A survey should be carried out prior to works commencing to determine the exact location of existing services.

Manhole / IC	Cover Level m	Invert Level m	Chamber Type	Chamber depth (m)	Internal Chamber Size	Cover Clear Opening and Cover Grade	Notes To Building Regulations Part H unless noted
F1	50.330	49.130	Plastic	1.200	450mm Polypropylene	450 diameter	
			IC		Ring	OSMA 4D945 Square Recessed	Recessed cover finish to match adjacent

FOUL MANHOLE SCHEDULE

Rev	Date	Drawn	Eng	Amendment
P02	26.03.21	TP	YA	Issued for Stage 3
P01	28.01.21	WS	YA	Issued for Stage 3

ACLAND BURGHLEY SCHOOL

BELOW GROUND DRAINAGE LAYOUT

Status
STAGE 3 ISSUE
NOT FOR CONSTRUCTION

Drawn	WS	Eng	YA
Scales	1:100 at A1		1:200 at A3
Drawing No		Rev	
28851/6000		P02	

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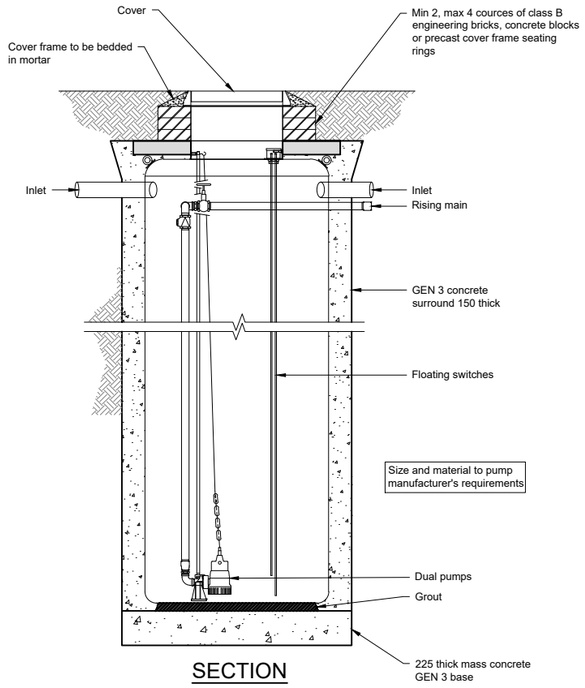
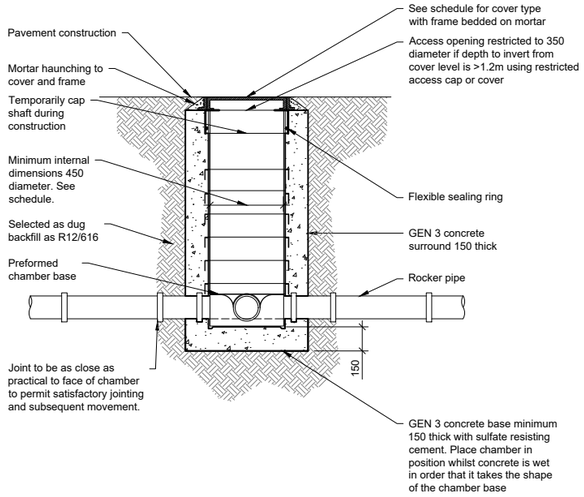


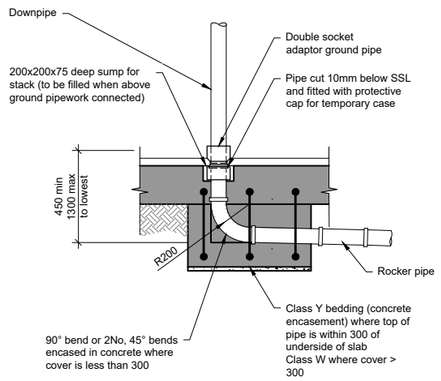
SECTION



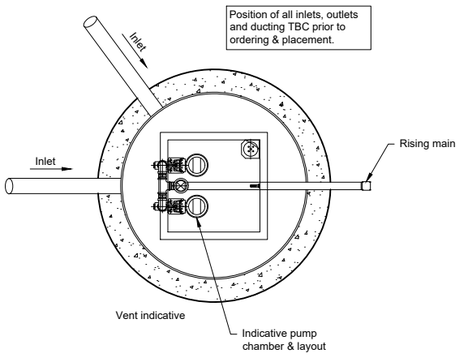
PLASTIC INSPECTION CHAMBER

FOR 450 DIAMETER CHAMBERS IN :-

- SOFT LANDSCAPING, PEDESTRIAN (A15) AREAS UP TO 3.0m DEEP
- DOMESTIC DRIVEWAYS (B125) AREAS UP TO 1.0m DEEP



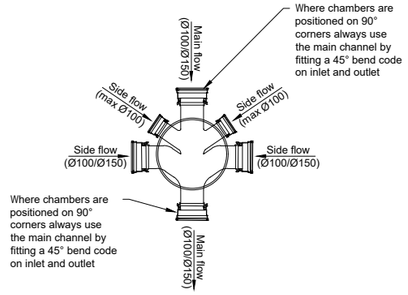
TYPICAL FOUL STACK DETAIL



GRP PUMP CHAMBER - PLAN VIEW

REFER TO NEW HADEN PUMP QUOTE (TBC)

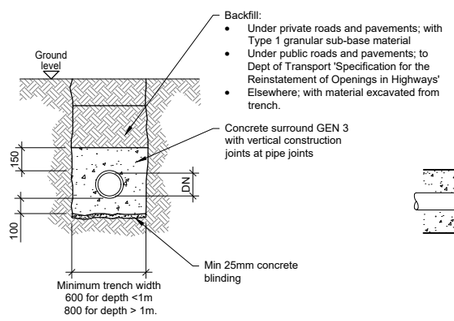
PRE-PACKAGED PUMP CHAMBER FOR EXTERNAL USE



Ø450 WAVIN PPIC PLAN

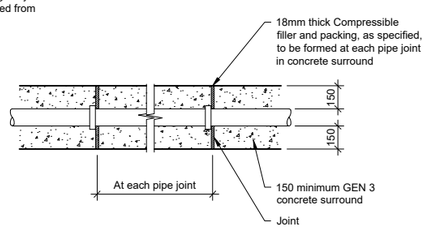
Ø150 MAIN CHANNEL, MAX 2 NO. (Ø100 & Ø150)
SIDE CONNECTIONS ON EACH SIDE
(50mm step height for all branch connections)

PPIC PLAN DETAIL



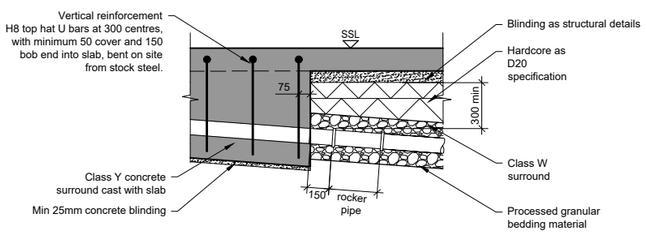
CLASS Z SURROUND

COMPLETE CONCRETE SURROUND (WHERE COVER IS LESS THAN 1200MM IN VEHICULAR AREAS AND LESS THAN 600MM IN AREAS NOT SUBJECT TO VEHICULAR LOADING)

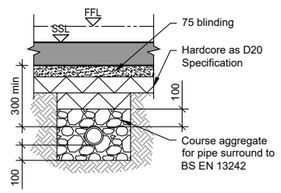


CLASS Z SURROUND

FLEXIBLE JOINTS IN CONCRETE SURROUND

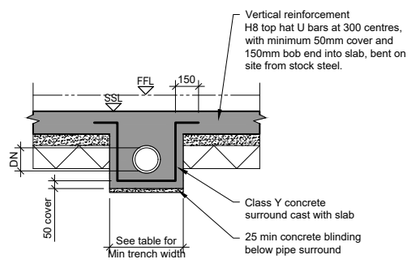


TYPICAL DETAIL FOR PIPELINES UNDER SLABS: CLASS Y AND W SURROUND



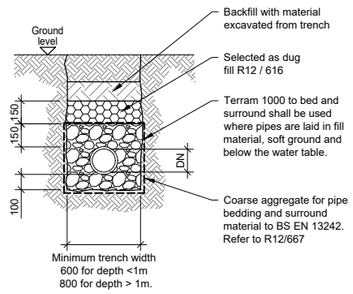
CLASS W SURROUND

FOR PIPES WITH CROWN >300 UNDER BUILDING



CLASS Y SURROUND

FOR PIPES WITH CROWN < 300 UNDER BUILDING



CLASS S SURROUND

GRANULAR SURROUND & BACKFILL FOR SOFT OR HARD LANDSCAPING AREAS NOT SUBJECT TO VEHICLE LOADING (MINIMUM 600 MM COVER)

NOTES :

1. This drawing is to be read in conjunction with all relevant Architect's, Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check that this drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety :
   All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".

Rev	Date	Drawn	Eng	Amendment
P02	26.03.21	TP	YA	Issued for Stage 3
P01	28.01.21	WS	YA	Issued for Stage 3

ACLAND BURGHLEY SCHOOL

BELOW GROUND DRAINAGE DETAILS

Status
STAGE 3 ISSUE
NOT FOR CONSTRUCTION

Drawn	WS	Eng	YA
Scales	1:20 at A1		1:40 at A3
Drawing No		Rev	
28851/6100		P02	

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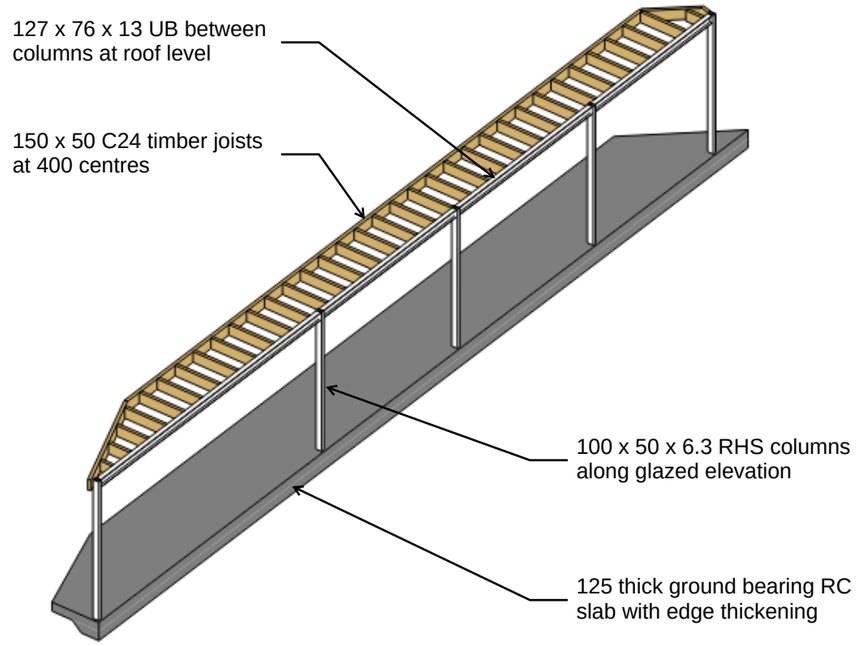
Appendix C
Embodied Carbon Assessment

PRICE & MYERS

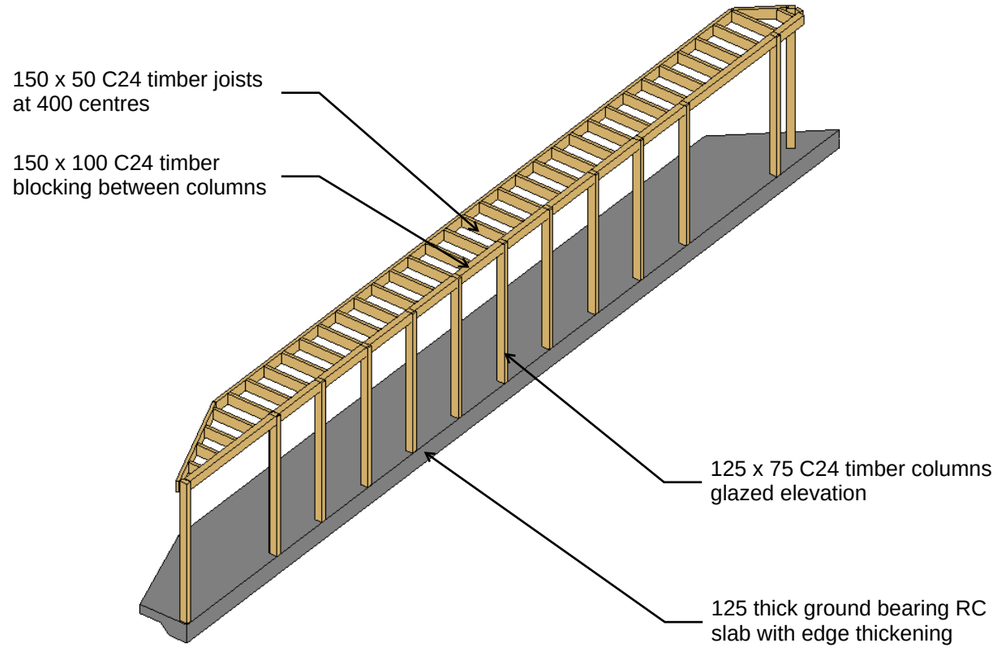
Job No.	28851	Page	SK 09	Rev	1
Date	Jan 2021	Eng	GH	Chd	PB
Job	Acland Burghley School, Theatre				

EXTENSION STRUCTURE OPTIONS - Embodied Carbon Assessment



OPTION 1 - Steel frame with timber infill

		Quantity (kg)	Value	Total CO2 (kgCO2e)	Weighting	
CONCRETE	Ground bearing slab	6600	0.120	794.3	40	%
STEEL	Steel sections	314	1.550	486.7	24	%
	Reinforcing steel	344	1.990	684.6	34	%
TIMBER	Timber joists	105.4	0.263	27.7	2	%
			Total embodied carbon	**1993.3 kgCO2e**		
			Gross internal floor area	**18.4 m²**		
			TOTAL EMBODIED CARBON (RATE)	**108.3 kgCO2e/m²**		



OPTION 2 - Timber frame

		Quantity (kg)	Value	Total CO2 (kgCO2e)	Weighting	
CONCRETE	Ground bearing slab	6600	0.120	794.3	51	%
STEEL	Reinforcing steel	344	1.990	684.6	44	%
TIMBER	Timber joists	105.4	0.263	27.7	2	%
	Timber framing	155	0.263	40.8	3	%
			Total embodied carbon	**1547.4 kgCO2e**		
			Gross internal floor area	**18.4 m²**		
			TOTAL EMBODIED CARBON (RATE)	**84.0 kgCO2e/m²**		