Bolsover Castle

Canopy Structural Appraisal

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Client Name: English Heritage (c/o Buttress Architecture Ltd)

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1.0 Introduction

1.1 Curtins were commissioned by the Client, English Heritage (c/o Buttress Architecture Ltd), to undertake a site visit to appraise the existing structure and produce an initial canopy roof feasibility study. Since this initial feasibility study, the structural intent has evolved and the remedial drainage works have been installed on site in preparation for the proposed canopy.

1.2 A preferred aesthetic option has been decided on by the client. This entails a single line of vertical support along the retaining wall upstand, running parallel to the existing North East elevation and connecting back into the existing fabric along this wall . This report discusses the methods for achieving this aesthetic and the various interventions that will be required to achieve this.

1.3 The proposed canopy will redirect rainwater which runs off the existing roof and prevent it from impacting the visitors experience, the conditions of the stairs and seek to reduce flooding in the basement space.

1.4 A site visit was undertaken on the 11th November 2020 to view the stairwell, adjacent historical building, and courtyard.

1.5 Third party report was obtained for the preliminary assessment of the existing rainwater storage tank which is located close to the proposed canopy.

1.6 No physical intrusive investigations have been carried out at this stage to prove hidden details. It should be appreciated that opening up may reveal additional defects to those that were apparent at the purely visual inspection.

1.7 This report has been prepared on behalf of the Client and their immediate advisors and it must be reproduced in whole or part, or relied upon by any third party without the express prior written authority of Curtins Consulting Ltd.

2.0 Existing Structural Context

2.1 Composition, Form & Geometry

Bolsover Castle was built by William Peverel in Derbyshire around the 12th Century. A number of repairs and alterations have been made throughout the extensive history of the property. The estate has a scenic view to the North and West, the escarpment can be seen in Figure 1, clearly indicating the level drop between the site boundary and the lower grounds.

The principal building which this report focusses on is denoted the 'Little Castle' and was built circa 1612 shown in Figure 2. It sits to the North-West area of the estate and it integrated with the castle wall. The façade is fine jointed ashlar and appears in reasonable condition. The 3-storey building has a basement accessible by a stairwell found around the North East elevation of the 'Little Castle,' adjacent to the courtyard. The stairwell is accessed from the courtyard level and walls are formed by a stone masonry retaining wall. The basement area parallel to the stairwell previously functioned as a kitchen which is believed to be connected to an existing rainwater tank in close proximity to the stairwell.

Figure 1 – Aerial view of site and escarpment

Figure 2 – External view of 'Little Castle'

2.2 Wider Constraints

- Existing rainwater tank is located in close proximity to the external stairwell. The tank is believed to be redundant and further discussions have determined that the tank should not be removed.
- The existing structure is Grade I listed and the courtyard which surrounds site is a scheduled ancient monument.
- The proposed canopy is to sit alongside the existing stairwell. If additional foundations are to be provided, then surcharge to the adjacent walls must be carefully considered and eliminated.
- Service water drainage is known to exist in proximity of site. It is believed that these are historic French drains, possibly Victorian and these transport water from site to the escarpment. Recent works have been undertaken to install a new drainage system around the location of proposed canopy.
- Curtins has previously advised that the relevant drainage is cleared by jetting. However, it has been highlighted that this approach is not possible as they are fully blocked, leading to a full replacement.
- Existing foundations are unknown at this stage but no formal foundations would be expected for a building of this age and are assumed to be boulder.

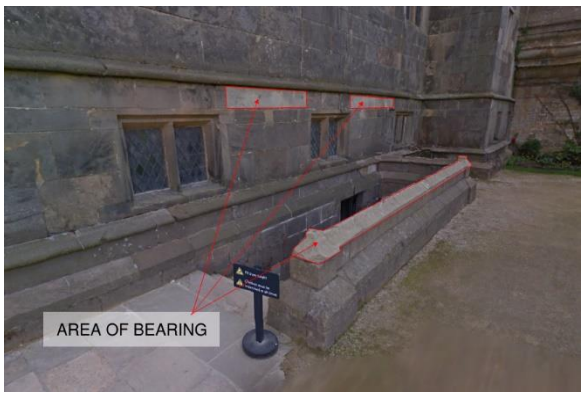


Figure 3 – Areas of bearing at external stairwell

Figure 4 – Stone retaining wall and rainwater tank

3.0 Conservation-Engineering Basis of Design

3.1 Our high level philosophy is based on the following considerations:

- Solution should be retreatable;
- Solution should be of minimal / low-stress interfaces with the masonry fabric;
- Solutions should work with the strengths of the existing structure and work around the weaknesses;
- Solution should be aesthetically appropriate.

4.0 Structural Design Intent

The design intent has been considered on reflection of previous feedback to provide a light touch connection approach between existing fabric and retaining wall upstand. The materiality is reflective of traditional construction and compliments the context of site.

Proposed Solution – Flitched Timber Canopy Structure

4.1 The proposed solution fixes at two points parallel to the 'Little Castle' fabric and retaining wall uptand. The general bearing areas have been highlighted in Figure 3.

4.2 Points of connection are minimal and the simplicity of this structural approach reduces the stresses applied to existing fabric.

4.3 The flitch structural frame provides a predominantly timber materiality while the inner steel plate facilitates an elegant and relatively discrete connection into the existing fabric.

4.4 Proposed connection between structural column and upstand is via discrete baseplate connection, indicated in Figure 6, sitting beneath the existing coping stones. The coping stones across the retaining wall upstand are in poor condition and will require due care when removing, however, the works provide the opportunity to undertake restorative works to the stone in this location.

4.5 The column baseplate will sit beneath the first course of coping stone, largely hidden from view, with an extruding steel plate extending above the stone. The extruding plate will run up between the timber sections to form the flitch column. Similarly, the steel plate will form connection between column and beam sections.

4.6 The canopy sits alongide existing external wall. In avoidance of more complicated and onerous moment connections to the sensitive fabric, the structural connections should sit tight to the underside of stringer course. The raised roof which has been proposed for this design offers the opportunity to maintain a suitable head height and aligns the canopy roof up to the stringer course while avoiding undue stresses to the existing fabric.

4.7 The raised roof plate will rest on steel sections running perpendicular to the primary flitch beams, required to reduce deflection of the roof plate. These elements are recessed back from the front of canopy to reduce their visibility. The roof plate itself is designed as a steel plate, which is required for structural integrity but can be covered with the preferred metal to give the desired appearance, such as copper.

4.8 Connection between beam and existing fabric face will be steel plate extruding from flitch beam into baseplate at fabric face. The space provided by the extruding steel plate gives breathing space between

the existing wall and timber. The proposed connections look to utilise a mechanical fastening to reduce intrusive works and the use of chemical adhesives.

4.9 Connection plates are to be located along wall face to avoid positioning above window lintels and within stone of suitable condition.

4.10 Rainwater from canopy surface will be carried over the long edge and allowed to naturally fall off to surface below. The rainwater will be carried away by the perforated drain running parallel to the long edge of canopy. To ensure that surface water is directed appropriately, gravel within this strip should be brought up to ground level to provide path for water flow and adequate maintenance to confirm the system works as intended. The perforated pipe then feeds back to the drainage system as designed for recent works shown on Curtin's drainage scheme site plan (Appendix A).

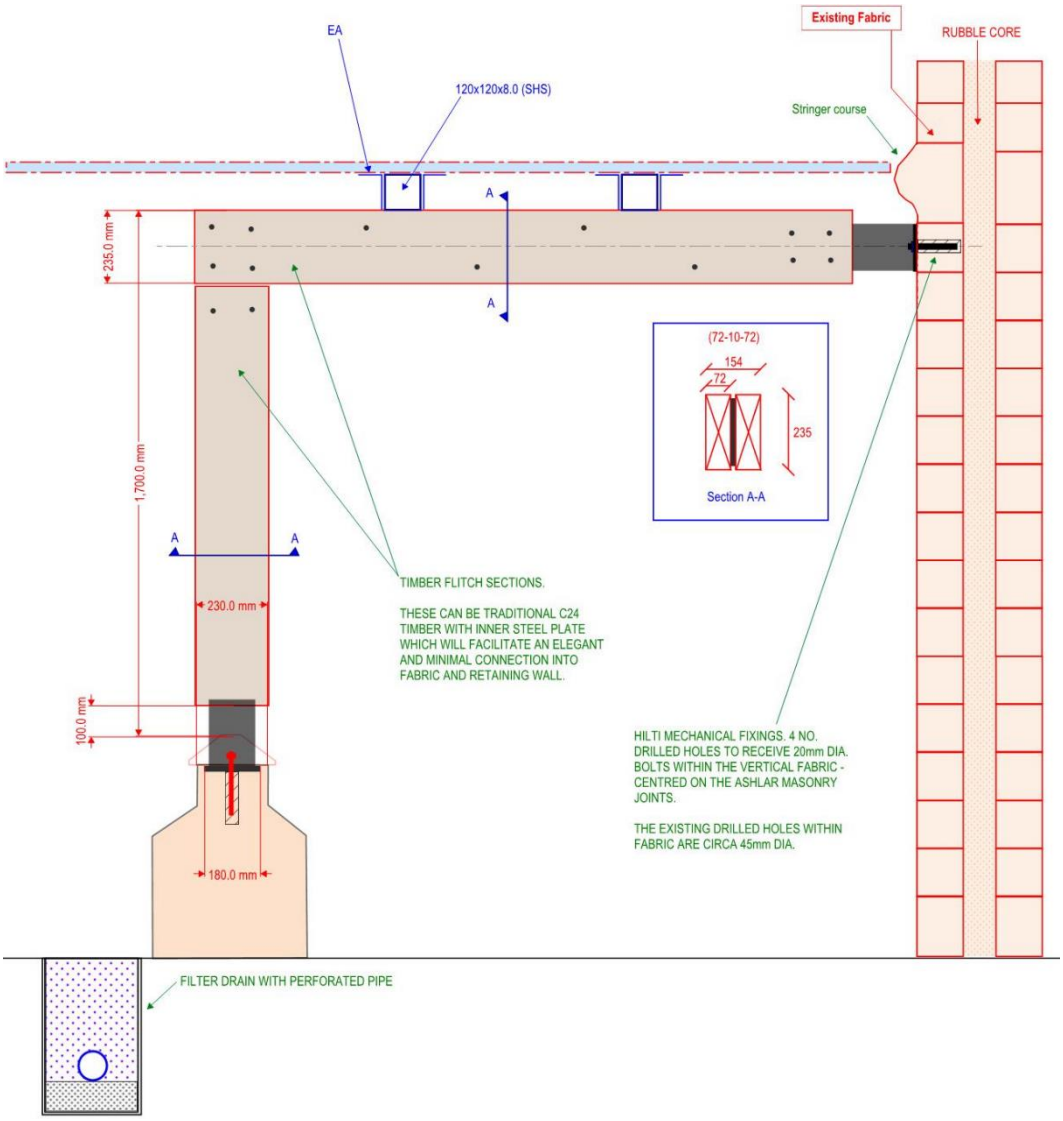


Figure 5 – Elevation of proposed canopy structure and connections

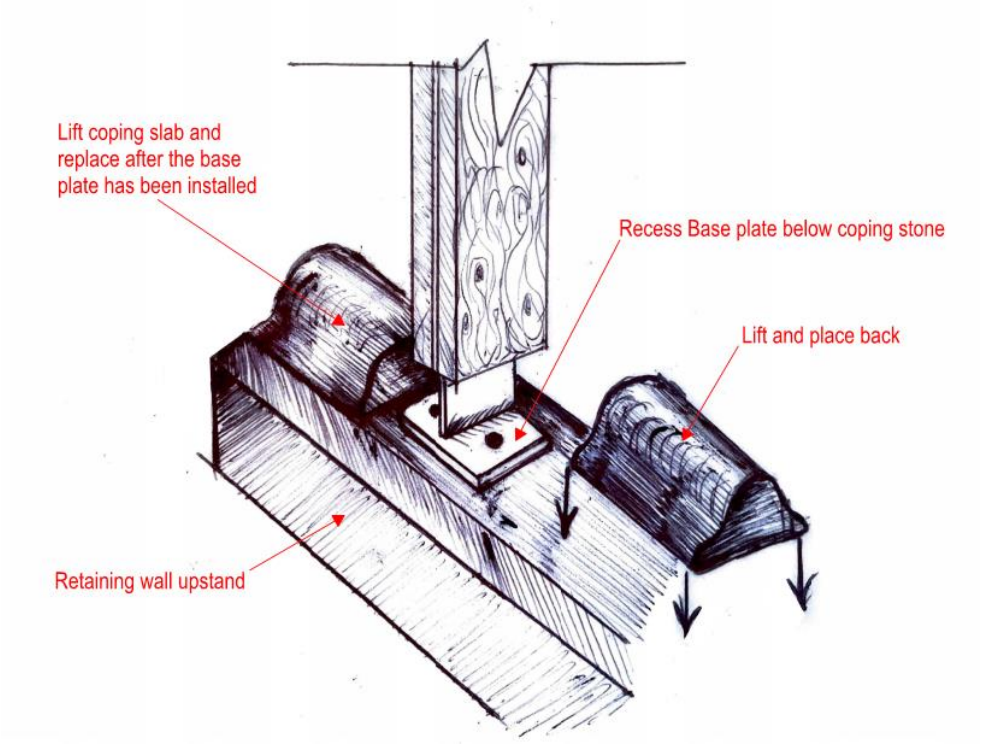


Figure 6 - Proposed connection to existing retaining wall

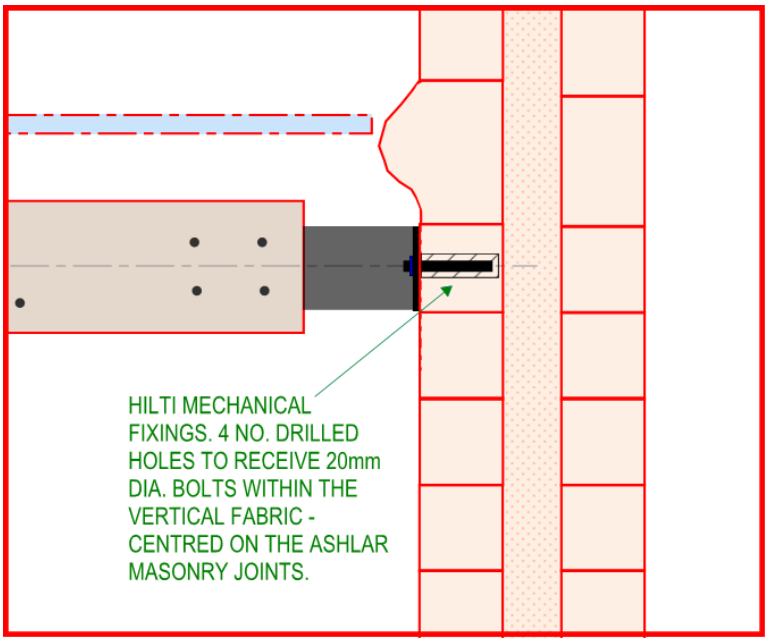


Figure 7 – Proposed connection to existing fabric

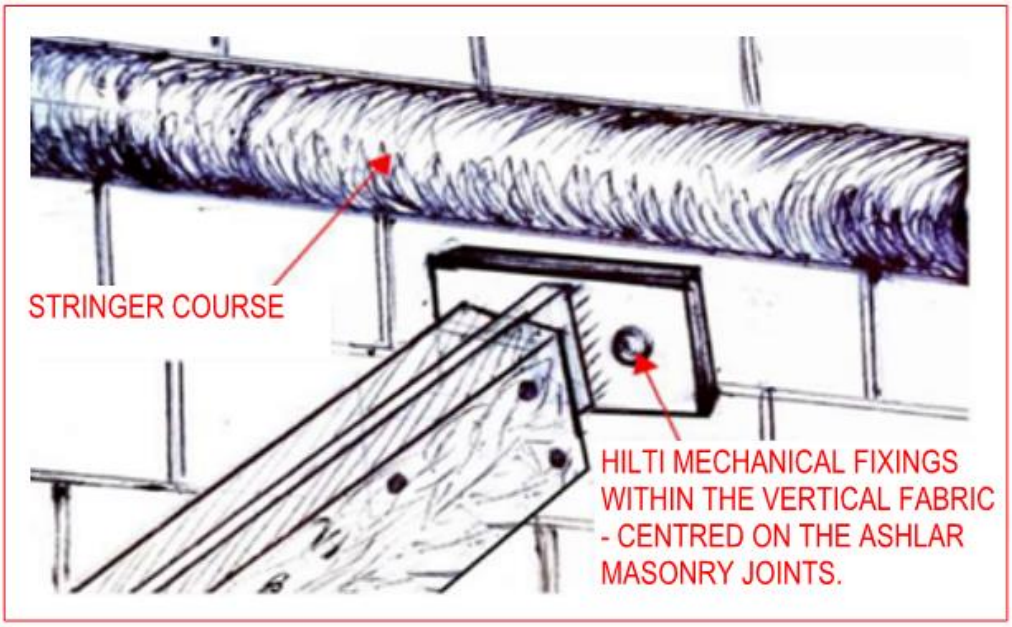


Figure 8 - Proposed connection to existing fabric in relation to stringer course

5.0 Summary

5.1 The flitch structure provides a discrete and minimalist design to compliment the historical context of 'Little Castle'. The timber materiality reflects traditional methods of construction while balanced with the internal steel plate which facilitates an elegant connection to existing fabric.

5.2 The connections will cause a degree of intrusion to the existing fabric, however this has been minimised as far as possible with the adoption of simple connections and reduced connection points along the elevation. The anticipated connection will involve 4 No. drilled holes to receive 20mm diameter bolts within the vertical fabric and centred on the ashlar masonry units.

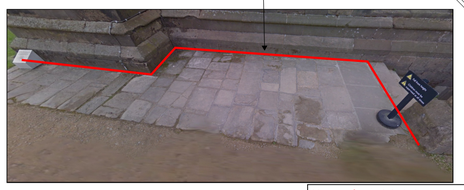
5.3 The proposed rainwater solution mirrors the current methods (roof rainwater directed to ground level through pipes concealed by stone gargoyles) for the 'Little Castle' which avoids any visually impacting interventions. The current proposal relies on the rainwater being directed by roof fall over the long canopy edge (Refer to section 4.10). Recent works have installed a perforated pipe within gravel trench along this edge which should be adequate in redirecting rainwater to the recently installed drainage system.

5.4 Although there is a potential for some wind driven rain into the stairwell, this is a consequence of the elevation being open to allow it to be visually uninterrupted from the adjacent courtyard. This level of wind driven rain would only be expected in severe weather conditions.

6.0 Appendix A

- Drainage Scheme Site Plan Drawing

PPIC Recessed Covers to Inpspection Chambers -
Stone infill in to match existing stone pacing in Courtyard
Gavel Fill to match path material around building



New Aco Hexdrain Brickslot installed between rear of top step and first paving flag.

Lead Pipe noted from Archaeology (TPA Report 012/2013) Trial Pit 02

New Catchpit (Typical Depth 500mm below Invert Level - may be reduced to accommodate archaeology)
CL 165.11
IL 164.640
Change in Direction and future maintenance requirements.

Proposed Canopy Location

New 100mm Dia Surface water drain at 1:70 fall

New Aco Hexdrain Brickslot installed between wall and edge of first paving flag.

New Catchpit (Typical Depth 500mm below Invert Level - may be reduced to accommodate archaeology)
CL 165.23
IL 164.400
Change in Direction and future maintenance requirements.

Cable noted from Archaeology (TPA Report 012/2013) Trial Pit 01

Existing pipe through wall to be repaired as advised as suitable for rehabilitation by Freeflow

Existing MH01
CL 164.709
IL 162.440

14.31m Outfall
Partially restricted

New 600mm dia PPIC
CL 164.659
IL 162.495
Change in Direction and future maintenance requirements.

New 600mm dia PPIC
GL 164.930
IL 163.710

New perforated drain in gravel strip to perimeter of building

New 600mm dia PPIC
CL 164.659
IL 162.870
Change in Direction and future maintenance requirements.

Potential clash zones with existing services as per external GPR survey (Approx.)

New 100mm Dia Surface water drain at 1:70 fall

New Catchpit (Typical Depth 500mm below Invert Level - may be reduced to accommodate archaeology).
CL 165.110
IL 164.030
Change in Direction and future maintenance requirements.

100mm Dia >>>
<<<100mm Dia
FOUNTAIN
flower bed
grass
compressed gravel

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

NOTE

NEW SYSTEM ESTIMATED AT 65m TO BE LAID, USING 100mm DIA TWINWALL PIPE.

MANHOLES TO BE CONSTRUCTED AS 600mm DIAMETER CATCHPIT CHAMBERS. FOR FUTURE MAINTENANCE AND INSPECTION. SOLID PIPEWORK TO BE USED FOR ROCKERS ON INLET AND OUTLET. SUMP DEPTH BELOW INVERT LEVEL MAY BE SET IN RELATION TO ARCHAEOLOGY. A MINIMUM

MINIMUM DISTANCE FROM FOUNDATION TO MEET REGULATIONS IS 5 METERS.

MANHOLE COVERS TO BE RECESSED TYPE WITH INFILL TO MATCH SURROUNDING SURFACE FINISHES

TRENCH WIDTHS AS SPECIFIED ON DRAWING 077684-CUR-00-00-DR-D-00001-C01 , SPECIFIC TO PIPE DIAMETER. FOR 100MM DIAMETER PIPES, TRENCH WIDTHS WILL BE MINIMUM OF 400MM

TRENCH DEPTHS ARE VARIABLE AND DETERMINED AS:
CL - IL - 1/16 Bc WHERE Bc = PIPE DIAMATER OR 150MM BELOW INVERT, WHICHEVER IS THE GREATER. REFER TO DRAINAGE DETAILS DRAWING 077684-CUR-00-00-DR-D-00001-C01 FOR BEDDING DETAILS

WHERE ARCHAEOLOGY IS FOUND, BEDDING DEPTH MAY REDUCED OR OMMITTED OVER SHORT LENGTHS TO PRESERVE ARCHAEOLOGY IN-SITU.

Services as identified by TPA GPR and Trial Pitting -Report ref 012/2013

100mm Diameter Twinwall Pipe

100mm Diameter Perforated Pipe in 300mm wide x 500mm deep gravel strip with permeable geotextile lining to sides and base

ACO Hexdrain Brick Slot drainage Channel

600mm Dia PPIC Inspection Chamber with B125 recessed cover to take surface finishes to match existing

G New 225mm diameter trapped gully, with 100mm diameter outlet

Rev:	Description:	Date:	By:	Chkd:
C02	1. DETAILS AND NOTES ADDEDED PERTAINING TO ARCHAEOLOGY 2. REVISIONS TO NUMBER OF CATCHPITS AND CONNECTIONS 3. REVISION TO REHAILITATION FROM REPLACMENT OF PIPE THROUGH WESTERN CURTAIN WALL 4. VISUAL DESCIPTION OF RECESSED COVERS ADDED	17/03/21	CS	CS
C01	SCOPE OF WORKS REVISED	11/03/21	CDG	CS
P04	REMEDIAL WORKS CLARIFIED	25/02/21	AMS	CDG
P03	PRELIMINARY	24/02/21	AMS	CHG
P02	PRELIMINARY	19/02/21	CHG	CS
P01	PRELIMINARY	11/02/21	AMS	AR

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Status: CONSTRUCTION A5

Project: BOLSOVER CASTLE

Drg Title: DRAINAGE SCHEME - SITE PLAN

Size:	Date:	Drawn By:	Designed By:	Checked By:
A1	24/02/21	AMS	CHG	AR
Scale: 1:100				

Project No:	Originator:	Volume:	Level:	Type:	Role:	Category / Number:	Rev:
077684	CUR	00	00	DR	D	00001	C02

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