Tunnel Condition Report

S.1 Structural Condition Appraisal

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Revision: [01]

Issue Date: 04 March 2021

Client Name: Shenton Group

Client Address: 3 Oxford Court, Manchester, M2 3WQ

Site Address: Cuerden Hall, Shady Ln, Bamber Bridge, Preston PR5 6AZ

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00	Stage I Visual Structural Condition Appraisal	SJ	AR	04/03/2021

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1.0 Introduction

1.1 Curtins were commissioned by *Shenton Group*, the Client, to undertake a structural condition assessment of the Tunnel below the main access route to Cuerden Hall.

1.2 A structural engineer from this Practice visited the 4th February 2021 to undertake the appraisal.

1.3 The survey was largely based on visual appraisal only. It should be appreciated that opening up may reveal additional defects to those that were apparent at the purely visual inspection. All observations were made from ground level, and all observations were made with the naked eye.

1.4 Non-structural matters are not addressed unless they have a direct effect on the structure.

1.5 This report has been prepared on behalf of the Client, *Shenton Group*, and it must not 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 Executive Summary

2.1 The tunnel is in extremely poor condition and action is recommended. There is clear evidence of structural distress, and whilst the reinforced section of tunnel under the road appears to be working in practice, this cannot be guaranteed to continue without intervention.

2.2 It forms part of an existing pedestrian pathway running through the property boundary of Cuerden Hall.

2.3 The tunnel section is located directly below the main access road to Cuerden Hall.

2.4 Multiple strengthening measures appear to have been attempted on the tunnel in the past but these have now deformed, corroded and decayed respectively.

2.5 We cannot confirm the residual strength of this tunnel, so we recommend that the road over it should be closed to vehicles in excess of 3 tonnes until remedial work is undertaken. Regular monitoring should be put in place.

2.6 Action is required before refurbishment works start on the main hall.

2.7 Our recommended option is to remove the top of the tunnel and infill it. This is seen as the most cost effective and quickest solution.

3.0 Description of Building Structural Form

3.1 The tunnel forms part of an existing pedestrian pathway running in the north south direction to the west of Cuerden hall. A section of this pathway falls within the property boundary but does not appear on the Historic England listings.

3.2 The main access road to Cuerden Hall passes over a covered section of this pathway which forms a tunnel. It is not currently in use for pedestrian access which has previously been diverted.

3.3 This tunnel is ca 35m long and composed of a 240mm thick, 2 skinned masonry barrel vault with additional supporting ½ brick thick arches at ca 1.6m C/C.

Figure 1: Location of tunnel section of pathway within wider property.

Figure 2: Pathway looking north (left) and south entrance of tunnel (right).

4.0 Factual Survey Notes

4.1 The geometry of the masonry barrel vault is severely deformed. The walls on either side of the passage are leaning out and the arching vault has flattened.

4.2 The north section of the tunnel is partly collapsed and a hole is visible above. There is clear skin separation in this area.

Figure 3: Deformed masonry barrel vault (left), and collapsed sections of vault with loose masonry units (right).

4.3 Loose masonry units were observed throughout particularly around the open joints at the crown.

4.4 The arches are unbonded to the masonry walls and the bricks at the crown have been cut to suit a deformed shape.

Figure 4: Arches unbonded and thinner at crown as if cut to fit deformed shape (left), and filler joist below road (right).

4.5 The top section of the tunnel directly below the road has been replaced by a filler-joist system possibly with a concrete relieving slab (investigations required to prove) resulting in the hump in the road above.

4.6 The below the road section, acrow props are corroding and the timber beams they were bearing on are decayed.

Figure 5: Concrete spalled and joists corroded (left), acrow props are corroding and the timber beams decayed (right).

Figure 6: Filler joist section propped (left and centre), verticality of walls deformed (right).

4.7 No deformation or structural defects were noted in carriageway finishes above tunnel.

Figure 7: View of the hump in the road above tunnel looking west.

5.0 Principal Interpretive Findings

5.1 It appears that the section of tunnel was constructed in a cut and fill manner. The soil on either side of the tunnel masonry walls appears to have then deformed over time in response to the thrust from the arching structure.

5.2 This has resulted in the springing points of the arched masonry slowly being pushed further from each other and the span increasing significantly. The tunnel barrel vault and supporting arches have therefore formed a mechanism illustrated by the diagram below.

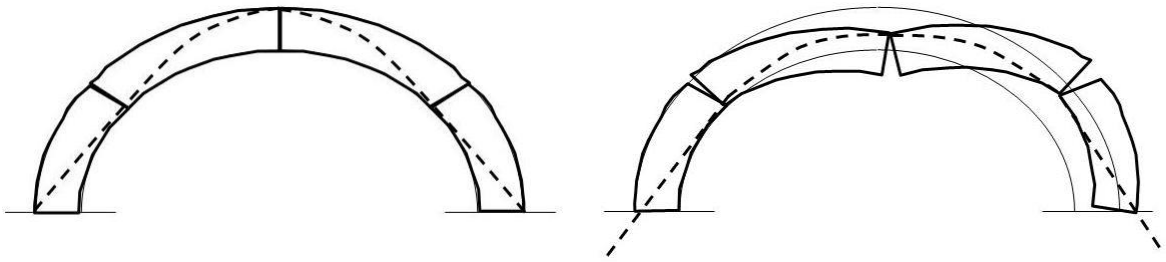


Figure 8: Thrust line through undeformed barrel vault (left), collapse mechanism created in deformed barrel vault (right)

5.3 Multiple alterations / strengthening measures appear to have been attempted on the tunnel in the past. The arches are unbonded to the masonry walls and appear to be a later addition as the bricks at the crown have been cut to suit a deformed shape.

5.4 The top section of the tunnel directly below the road has been replaced by a filler-joist system with concrete relieving slab resulting in the hump in the road above. The underside of the joists are corroding and have been propped with acrow props between timber spreader beams.

5.5 The acrow props are corroding and the timber beams have decayed to the point where these measures are no longer touching the filler-joist floor above rendering them ineffective.

5.6 The carriageway crossing over the bridge does not show signs of distress/ deformation. In this respect, engineering judgement suggests that the bridge is suitable for light vehicles i.e cars only.

6.0 Summary and Recommendations

6.1 The tunnel is in a very poor structural condition and sections of it are on the point of collapse.

6.2 It is located directly below the main access road to Cuerden Hall and as such needs to be able to support fire safety vehicles, supply vehicles and construction traffic among others.

6.3 Multiple strengthening measures appear to have been attempted on the tunnel in the past but these have now deformed, corroded and decayed respectively.

6.4 We cannot confirm to what extent these multiple measures are still effective, and consequently the residual strength of this tunnel, so we recommend that the bridge over the tunnel should be closed to vehicles in excess of 3 tonnes until repairs are undertaken.

6.5 The 3T limit is a pragmatic judgment based on the current use and lack of immediate deformation of the carriageway. No detail calculations have been undertaken and the condition of the structure is subject to change. Regular inspection is therefore recommended.

6.6 We recommend remedial works are undertaken before works start on the main hall. Below are some options to consider:

6.6.1 Do nothing – this will lead to the eventual collapse of the tunnel and road above and would present a safety hazard throughout the construction works at Cuerden Hall. We do not recommend this option.

6.6.2 Repair the existing tunnel – this option would require work to be undertaken within the tunnel. The inherent defect is the sub-optimal soil on either side so repairing the masonry of the tunnel would not solve the issue and would be potentially abortive or temporary at best considering the advanced state of deformation.

6.6.3 Bridge over it in precast concrete – this option would retain what's below in its current poor state as the traffic load would be taken by the new structure above. This would be a costly option but would be reversible if work was to be undertaken on the tunnel in the future.

6.6.4 Infill the tunnel in its existing state with a foam system – this would allow access above the tunnel to be made safe but there are environmental considerations.

6.6.5 Remove the top of the tunnel and infill it – **This is seen as the most cost effective and quickest solution**. It also leaves the option of the granular infill material to be removed and reconstruction to be undertaken at a later time when budget allows.

6.6.6 Full reconstruction – carefully remove the existing tunnel structure, build retaining walls on either side and/or consolidate the surrounding soil, and rebuild the tunnel using centring formwork and cross bond the arch piers into the surrounding masonry. Ensure the rebuilt design includes strengthening works over the barrel vault at the location of the road to allow for unrestricted access according to regulations.

6.7 If the tunnel is later designated as a heritage asset, the choice of option should satisfy the reversibility criteria to allow for the rebuild at a later time.

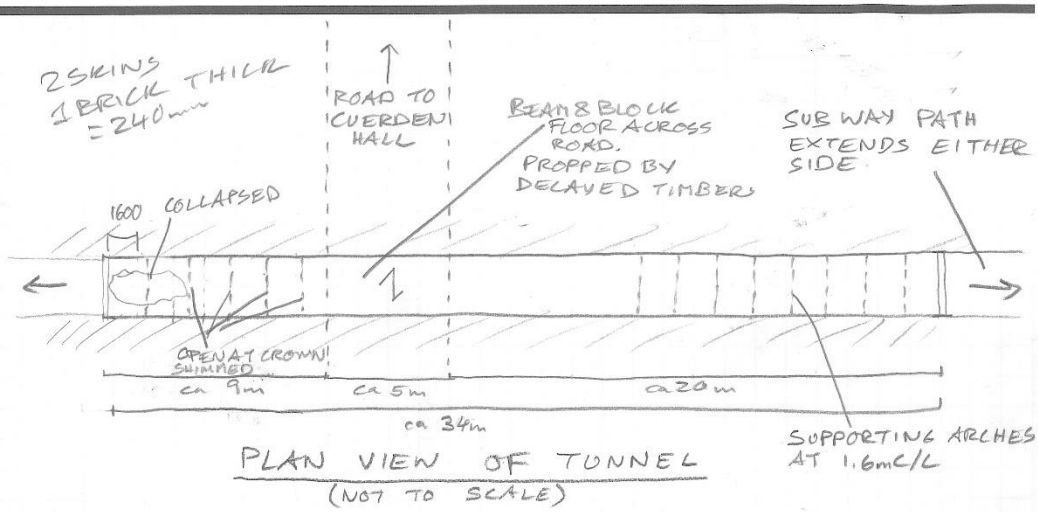
Appendix A: Survey Record Drawings

Job Title CUERDEN HALL

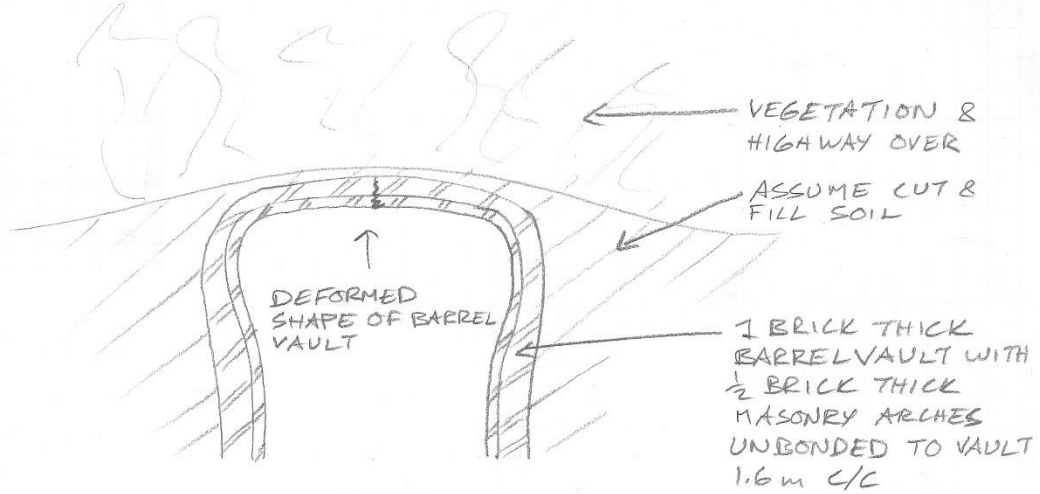
Job No: 077572 Date: 1/03/21

Made By: SJ Checked By: Sheet No:

curtins



PLAN VIEW OF TUNNEL
(NOT TO SCALE)



CROSS SECTION THROUGH TUNNEL. (NOT TO SCALE)

INTERPRETIVE NOTES:

- THIS TUNNEL IS IN A DANGEROUS CONDITION
- THE BARREL VAULT IS PARTIALLY COLLAPSED
- SOME OF THE ARCHES HAVE COLLAPSED, THE REMAINING ARCHES ARE UNBONDED.
- APPEARS TO BE A CUT & FILL PASSAGE WHERE THE SOIL ON EITHER SIDE WAS NOT COMPACTED/ STRONG ENOUGH TO RETAIN THE THRUST FROM THE ARCHING BARREL VAULT. THIS HAS LED TO ITS ARTICULATION TO THE POINT OF SUBSEQUENT COLLAPSE
- TOP DOWN INVESTIGATION REQUIRED OF REINFORCEMENT BELOW ROAD.
- CAREFUL DEMOLITION & EITHER REBUILD OR INFILL REQ.

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