

HIGHLIFE

ROPE ACCESS

BURY FUSILIERS MUSEUM - VENTILATION TOWER INSPECTION REPORT

Inspection conducted on: 18-19 May 2023

Inspection conducted by: Ben Silvestre, Will Oates, Alex Haslehurst

Report written by: Ben Silvestre

Project overseen by: Rob Chambers at Chambers Conservation

Specification:

Highlife Rope Access (HLRA) was approached by Chambers Conservation to conduct an inspection of the ventilation tower at Bury Fusiliers Museum, to enable the planning of future works on the roof areas for which some funding has already been agreed. This historic tower is now functioning as an elevator shaft, however still suffers from water ingress, with reports that this water ingress is at times extensive. The specification was therefore to conduct a thorough inspection of the tower roof and four elevations to find any faults which might be causing this water ingress, and to assess the general condition of the tower so as to determine whether or not more extensive repair works than anticipated will be required.

Overview of the inspection:

In general the tower is in good condition, with the lead roof covering holding up very well. Where visible, the original mortar is in good condition, if not slightly recessed, with only occasional perpend joints open on the bricked areas. In some places there is relatively recent cementitious face pointing covering the original lime mortar, which may still be contributing to water ingress. The stone elements such as the cills and the cornice also have open perpend, with some of these likely to be some of the larger causes of water ingress. On all four elevations there is a lightning conductor running

down the face and into the roof below, with these joints generally poor and likely tracking water into the building. The step flashings at the bottom of the tower are generally in good condition, but the sealant used to point them in is growing tired and is likely to be leaking in places.

There are numerous ferrous scaffolding ties embedded in both the stone and brick work, some of these have corroded significantly and shattered the masonry surrounding them. At around half height on the arched stone details below the cornice there is a ferrous band embedded in the masonry. This runs the length of the four elevations, and on the north elevation has corroded significantly, which has jacked the entire structure above by around 10mm. The metal cage/ armature around this section of the tower was possibly installed in an effort to combat this movement, but ultimately the issue will progress until either the corrosion can be stopped or the embedded metal work can be removed. The latter is made more complicated by ferrous dowels joining the stone mullions at this level, which may make extraction of the embedded metal more awkward. These dowels have also caused some spalling of the stone mullions, some of which have had historic mortar repairs performed on them.

Photographic Report:

North Elevation:



No.	Location	Description	Proposed Solution
N1	Brickwork above cornice level	Poor quality cementitious face pointing on 100% of brickwork above cornice level	Repoint using a suitable lime mortar if deemed high enough priority
N1	Photos		
N2	Brickwork above cornice level	Unpointed joints/ hole behind the lightning conductor, likely causing water ingress	Repoint using a suitable lime mortar
N2	Photos		

N3	Brickwork above cornice level	Large hole next to wooden wedge	Remove wedge and point using a suitable mortar
N3	Photos		
N4	Cornice	Open skyward facing perpend joints	Rake out joints and repoint using a suitable mortar. A lead covering on the cornice may be desirable as this could also be used to create a drip - currently there is no drip detail on the bottom edge of the cornice which may cause water to track down the masonry below, and may also be contributing to minor exfoliation on the corbels
N4	Photos		



N5	Corbels supporting cornice	Open joints above corbels on either side of the NW arete	Repoint using a suitable lime mortar
N5	Photos		
N6	String course below corbels	Open skyward facing perpend joints and deterioration of stone	Rake out joints and repoint with a suitable lime mortar. It may be preferable to perform minor mortar repairs to help the string course to shed water
N6	Photos		



N7	Mullions of arched stone details	Deteriorating mortar repairs, stable at the time of inspection	Remove and reinstate mortar repair if high enough priority
N7	Photos		
N8	Halfway down mullions of arched stone details	Embedded iron bed reinforcement has corroded significantly, jacking up the structure above in the region of 10mm. Possibly the metal cage/ armature boxing in this area was installed to combat this, but the issue will persist until either the corrosion can be stopped or the metalwork removed. Following conversation with architect Rob Chambers an investigation was performed by removing a brick to assess the depth of the bed reinforcement - this was 60mm. A sample of the metal was taken so that it can be assessed	Given the heavily corroded nature of the metal work, our recommendation would be to remove and replace the bed reinforcement. Following our close investigation we feel that this would be fairly straightforward given that it is only one brick deep. This would likely require the temporary removal of a course of bricks. Given that the dowels in the mullions have caused some of the mullions to spall, it may be desirable to also remove these at the same time, which would make removing and replacing the bed reinforcement more straightforward. The solution for removing the dowels would likely involve cutting out a section spanning the joint with the dowel, and indenting some new stone with stainless dowels to secure

N8

Photos







N9	Lower mullion section on NW arete	Deteriorating mortar repairs, stable at the time of inspection. Some of these illustrate that the spalled mullions are likely caused by dowels at joints in mullions.	Remove and reinstate mortar repair if high enough priority. It may be necessary to remove dowels as mentioned in N8. This might be achieved by cutting out a section encompassing the dowel and indenting some new stone following installation of the bed reinforcement, with new stainless dowels to secure.
N9	Photos		

N10	Lower mullion section	Long vertical cracks in the mullion have been repointed. Cracks approx 10mm wide	The pointing is in fairly good condition, however if some of the mullions do wind up being indented it may make sense to replace this section.
N10	Photos		
N11	Sill at base of mullions	Large open perpend joint	Clean joint and repoint with a suitable lime mortar

N11	Photos		
N12	Sill at base of mullions	Hole in perpend joints	Rake out joint and repoint with suitable lime mortar
N12	Photos		
N13	Brickwork between sill and stone string course	6no. Ferrous scaffold fixings. Some of these have corroded and caused the neighboring bricks to split, with cracks as wide as 10mm in places	Replace broken bricks and repoint with a suitable lime mortar. Where bricks are not broken, core out ferrous fixings and point

N13

Photos



			
N14	Brickwork between sill and stone string course	Photos showing the condition of the pointing, which is mostly in acceptable condition if not slightly recessed, with occasional open perpend joints. Some poor quality cementitious face pointing	Repoint open joints with a suitable lime mortar. Investigate beneath poor quality loose cementitious face pointing

N14

Photos



			
N15	Stone string course	4no. Ferrous scaffold fixings. The central pair have caused the surrounding masonry to crack	Where a fixing has cracked a brick, replace and repoint the brick. The other 3 will need to be cored out and repointed, including the crack in the stone

N15

Photos





N16	Brickwork below stone string course	Photo showing particularly poor area of pointing	Rake out and repoint with a suitable mortar
N16	Photos		
N17	Brickwork below stone string course	Photos showing the condition of the pointing, which is mostly in acceptable condition if not slightly recessed, with occasional open perpendicular joints. Some poor quality cementitious face pointing	Repoint open joints with a suitable lime mortar. Investigate beneath poor quality loose cementitious face pointing

N17

Photos



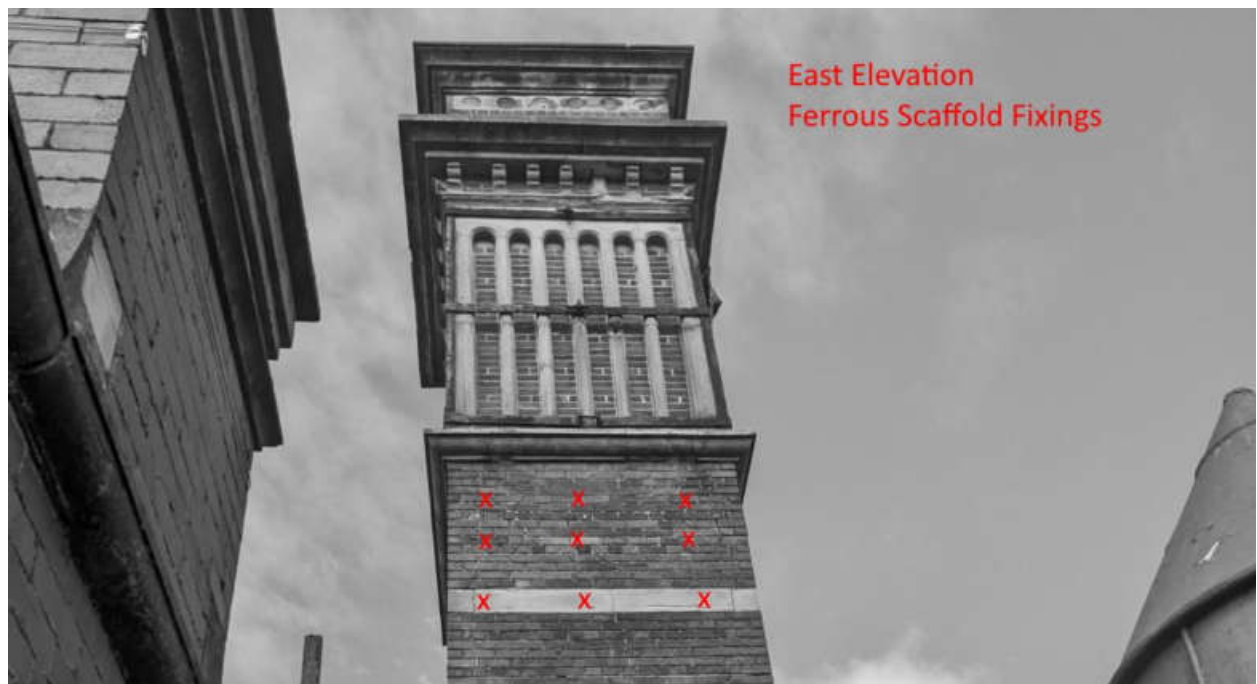


N18	Lower brick work	Crack along full length of bed appears to be bed lift, which may indicate further ferrous bed reinforcement, however we could not find evidence of any embedded metal	Given that the damage caused in this instance of bed lift is currently much less consequential than the bed lift further up the tower, it is unlikely that removal would be necessary, and a lower impact method such as cathodic protection might prove adequate if further investigation can prove that there is indeed embedded metalwork
N18	Photos	 The image contains two photographs of a brick wall. The top photograph shows a horizontal crack in the mortar bed joint between two courses of red bricks. A white scale with 'HIGH LIFE ROPE ACCESS' and 'N18' in blue is held against the crack for measurement. The bottom photograph shows a similar crack, but with a small, irregular piece of brick missing from the right side of the joint, creating a jagged opening. The same 'HIGH LIFE ROPE ACCESS N18' scale is held against the crack for reference. A gloved hand is visible holding the scale in both photos.	

			
N19	Bottom of lightning conductor	Poorly sealed joint where the lightning conductor enters the roof below	Apply sealant to seal the joint. Point open perpend joint to the left with a suitable lime mortar
N19	Photos		
N20	Bottom of brick work	Approx 26no. Drill holes in the masonry	Point/ fill holes with a suitable filler/ lime based mortar

N20	Photos	 A close-up photograph of a brick wall. A white tag with a ruler scale is held against the bricks. The tag has a logo with the letter 'H' inside a circle, followed by the text 'HIGHLIFE ROPE ACCESS'. Below this, 'N20' is written in large blue letters, and 'x 26' is written in smaller blue letters. The tag also features a ruler with markings in inches and centimeters. The bricks are reddish-brown and show signs of wear and mortar.
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East Elevation:



No.	Location	Description	Proposed Solution
E1	Brickwork above cornice	Drill holes in brick works with plastic plugs in could be tracking water into the masonry	Repoint the open one if deemed necessary
E1	Photos		
E2	Cornice	Perpend joints are starting to deteriorate	Rake out joints and repoint using a suitable mortar. A lead covering on the cornice may be desirable as this could also be used to create a drip - currently there is no drip detail on the bottom edge of the cornice which may cause water to track down the masonry below, and may also be contributing to deterioration of the corbels (see E3).

E2

Photos



E3	Corbels	Heavy deterioration of the corbels on this face, with one missing entirely. This does not seem to be a consequence of corroding metalwork. The cornice above does not have a drip detail and the lip of the cornice is also visibly weathered, therefore it seems likely that water erosion plays a significant role in this weathering	Indenting a new corbel where one is missing may be desirable, however preventing further deterioration of the others may be more pressing. Installation of some sort of drip detail would be a good start, either by installing a lead covering on the cornice above, or cutting a slot into the bottom of the cornice.
E3	Photos	 The top photograph is a close-up of a single, rectangular stone corbel set into a red brick wall. A white tag with the text 'HIGH LIFE ROPE ACCESS' and a blue 'E3' is held next to it for scale. A gloved hand is visible holding the tag. The bottom photograph shows a wider view of the corbel structure, with multiple corbels visible. A similar 'HIGH LIFE ROPE ACCESS' tag with 'E3' is placed on the right side for scale. The brickwork is red with grey mortar.	

E4	Mullions of arched stone details	Some delamination of the stone, loose parts were removed. Historic mortar repairs suggest this is an ongoing issue	Further mortar repairs may be desirable. The old mortar repairs on this face are currently stable
E4	Photos		



			
E5	Mullions	Drill holes filled with plastic plugs	
E5	Photos		

E6	Mid height on the mullions	Bed lift from ferrous bed reinforcement as per N8. Photos show that the bed lift decreases from north to south. One photo also shows one of the ferrous dowels in the mullions, which has spalled a large section off the mullion.	As per N8
E6	Photos		

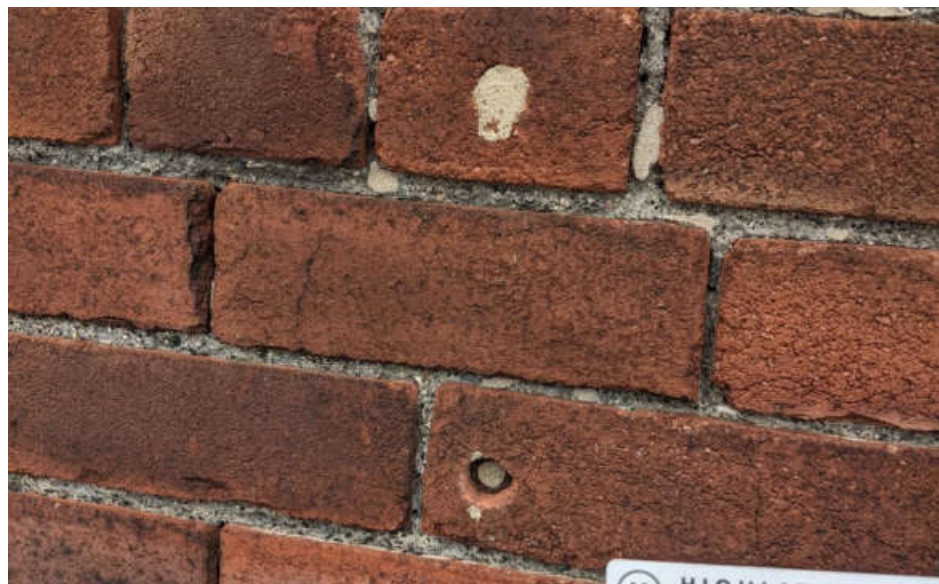
			
E7	Lower section of mullions	Photos to illustrate the condition of lower sections of mullions, one of which has had some long cracks pointed. Also showing condition of the pointing in the brickwork which is acceptable despite being pointed with cementitious mortar	No action needed
E7	Photos		

			
E8	Sill below mullions	Hole in a perpend joint on the sill is likely accepting water	Rake out joint and repoint with a suitable lime mortar
E8	Photos		

E9	Sill below mullions	Open perpend joint on the underside of the sill is potentially tracking water back into the masonry	Rake out joint and repoint using a suitable lime mortar
E9	Photos		
E10	Brickwork between mullions and stone string course	6no. Ferrous scaffolding fixings. Some of these have corroded badly and cracked the surrounding bricks. On the NE arete this has caused significant displacement of several bricks which may compromise the structural integrity of the arete.	Where the bricks are not broken core out the fixings and point with a suitable lime mortar. On the NE arete it may be necessary to replace around 7no. Bricks which have been moved by the corroded ties, or to simply replace the broken bricks and use stainless bed reinforcement to tie the other bricks back into the structure

E10

Photos



E11	Stone string course	Open perpend joints and ferrous scaffolding fixings in the string course	Rake out and repoint perpend joints with a suitable lime mortar. Core out ferrous fixings and repoint. Where the stone has broken a small mortar repair may be desirable
E11	Photos		



E12	Lower brickwork	Photos showing the condition of the pointing which is better than the other faces though still slightly recessed and with occasional open perpend joints. Also approx. 20no. open drill holes which may be tracking water into the building	Point open perpends and drill holes with a suitable lime mortar.
E12	Photos	 The image contains two photographs of a brick wall. The top photograph shows a close-up of the brickwork with several small, dark, circular drill holes visible in the mortar joints. A white tag with the text 'HIGH LIFE ROPE ACCESS' and 'E12' in green is placed against the wall for scale. The bottom photograph shows a similar section of the brick wall, also with drill holes and a 'HIGH LIFE ROPE ACCESS' tag with 'E12' written on it.	

			
E13	Step flashings at roof	Some of the sealant is growing tired and the point where the lightning conductor meets the roof is likely a small leak	Renew tired sealant and seal lightning conductor joint, or repoint it all with a suitable lime mortar

E13

Photos





South Elevation



No.	Location	Description	Proposed Solution
S1	Decorative stone work below roof	Failing pointing	Rake out joints and repoint with suitable lime mortar
S1	Photos		
S2	Cornice	Pointing is starting to deteriorate in perpendicular joints	Rake out and repoint with a suitable lime mortar. As per E2 a lead covering may be desirable
S2	Photos		

			
S3	Cornice	Spalling masonry on lip of cornice, stable at the time of inspection	If a lead covering is installed on the cornice as proposed elsewhere that would likely stop this fault from progressing to failure
S3	Photos		
S4	Mullions of arched stone details	Large mortar repair is starting to fail, stable at the time of inspection	Remove masonry repair and possibly replace, although if this fault is caused by a ferrous dowel then the issue may well continue

S4	Photos		
S5	Half height on mullions	Photo showing that there does not appear to be any bed lift on the south face where the ferrous bed reinforcement is	Potentially no action needed however if the bed reinforcement is being removed elsewhere it may make sense to give this elevation the same treatment
S5	Photos		

S6	Lower section of mullions	Large spall starting to appear, stable at the time of inspection, plus horizontal crack	It may be adequate to try and point this horizontal crack however the cause of this issue is unknown - it could potentially be a consequence of the jacking occurring on the other side of the tower as it seems an unlikely location for a ferrous dowel
S6	Photos		
S7	Sill at base of mullions	Open perpend joint in sill	Rake out and repoint with a suitable lime mortar
S7	Photos		

S8	Sill/ offset course below mullions	Open perpend joints	Rake out and repoint with a suitable lime mortar
S8	Photos	 The image contains two photographs documenting the repair of open perpend joints in a stone wall. In the top photograph, a gloved hand holds a white identification card with the text 'HIGH LIFE ROPE ACCESS' and 'S8' next to a vertical joint in the stone masonry. The bottom photograph shows a similar joint, but includes a red brick course at the base of the frame, providing context for the location of the repair.	

S9	Brickwork between sill and stone string course	Photos illustrating condition of pointing which is generally acceptable if not recessed in the region of 10/12mm with occasional open perpend joints	Repoint open perpend joints with a suitable lime mortar
S9	Photos		

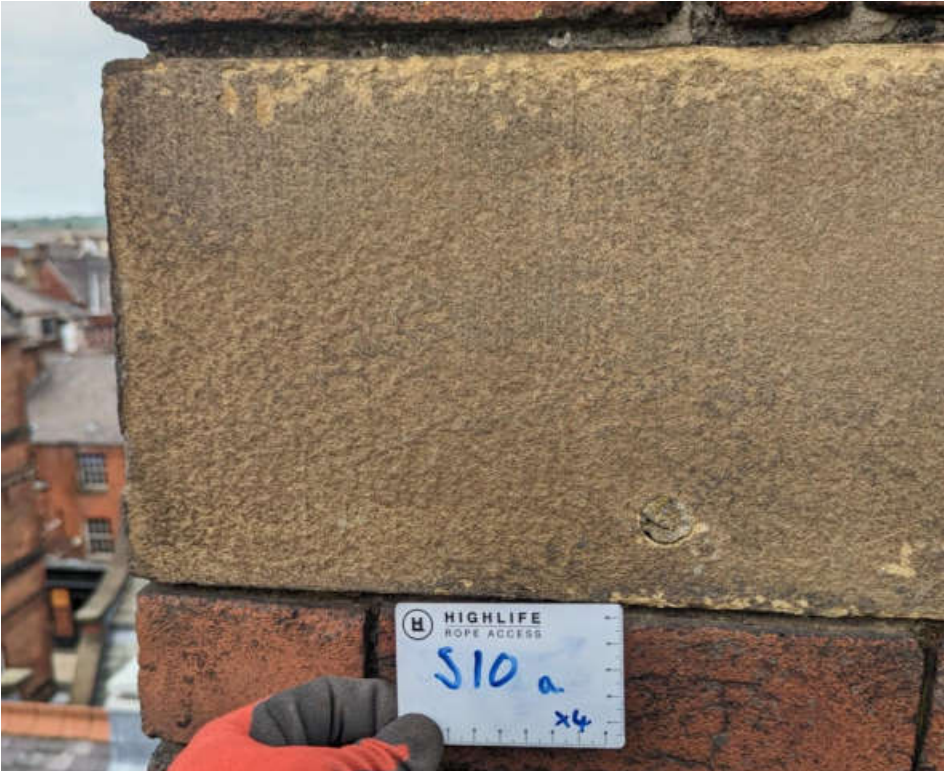
S10	Brickwork between sill and stone string course	6no. Ferrous scaffold fixings. Some have caused the surrounding bricks to crack	Remove and replace broken bricks and repoint with a suitable lime mortar
S10	Photos	 The photographs show two views of a brick wall. In both, a white scale card is held against the bricks. The card has the text 'HIGHLIFE ROPE ACCESS' at the top, 'S10' written in blue marker in the center, and 'x6' written in blue marker at the bottom right. The bricks are red and show signs of wear and damage, including missing mortar and cracked bricks. A gloved hand is visible holding the scale card in both photos.	

			
S10 a	Stone string course	4no. Ferrous scaffold fixings, the central pair have caused minor cracking	Core out fixings and point with a suitable lime mortar

S10
a

Photos



			
S11	Brickwork below string course	As for S12	
S11	Photos		
S12	Brickwork below string course	Photos illustrating condition of the pointing which is generally acceptable if not slightly recessed, with occasional open perpend joints	Rake out and repoint open perpend joints
S12	Photos		



S13	Brickwork below string course	Photos illustrating condition of the pointing which is generally acceptable if not slightly recessed, with occasional open perpend joints	Rake out and repoint open perpend joints
S13	Photos		
S14	Brickwork above roof	Large area of cementitious pointing. Given evidence elsewhere there is good reason to assume that this is poor quality face pointing and may still be contributing to water ingress	This may not be high enough priority but under a belt and braces approach it would be preferable to investigate why this area has had such extensive treatment and potentially repoint with lime mortar. The poor application of cementitious pointing elsewhere suggests that maybe a great job hasn't been done of this area

S14

Photos



			
S15	Step flashings	Sealant is growing tired with small cracks which will be accepting water	Remove old sealant and reseal or point with a suitable lime mortar
S15	Photos		

S16	Parapet	Where a parapet wall joins the tower there is a poor mortar filet which is loose and likely accepting water behind	Rake out joint and repoint with a suitable lime mortar
S16	Photos		

West Elevation

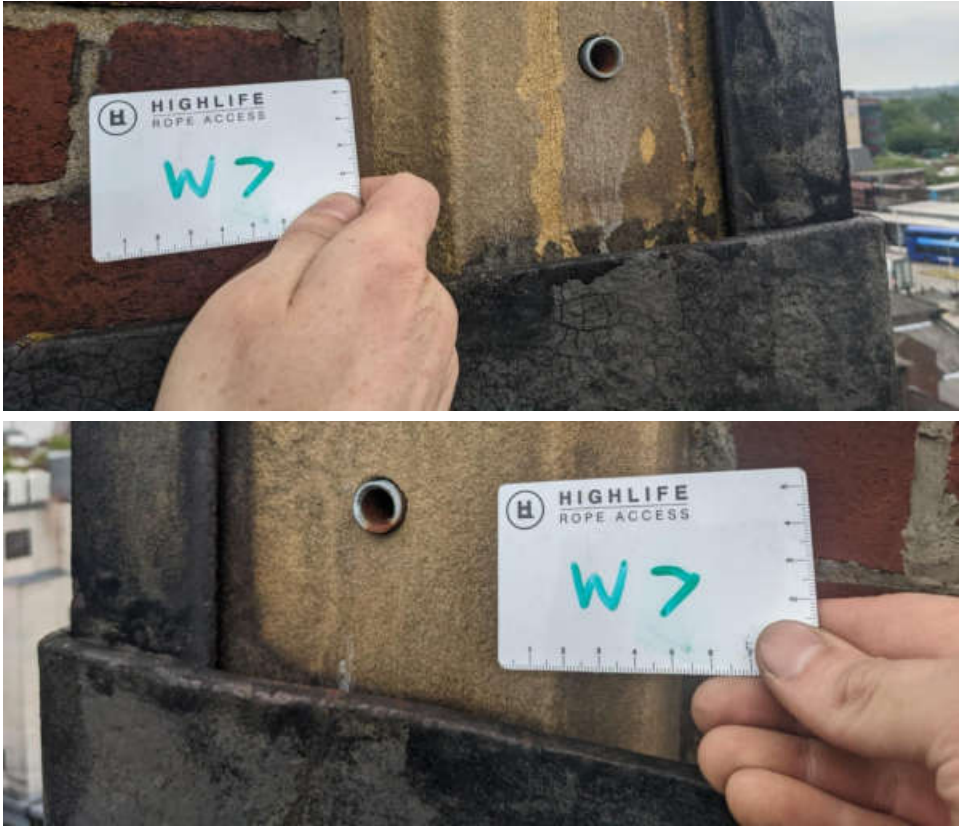


No.	Location	Description	Proposed Solution
W1	Decorative stone work below roof and brickwork above cornice	A crack in the stonework leads into a stepped crack in the brick work. It is unclear what has caused this	The cracks aren't particularly bad so raking out and repointing may be adequate, alternative some stainless bed reinforcement such as helibar may be used to stitch the crack to prevent further spreading
W1	Photos		

W2	Cornice	Large open perpend joints in the cornice likely accepting a large amount of water	Rake out and repoint with a suitable lime mortar. As mentioned previously a lead covering may be preferable to help form a drip on the cornice.
W2	Photos		

W3	Corbels	Open joints on top of the corbels on the NW arete as per N5	Repoint using a suitable lime mortar
W3	Photos		
W4	Sill above arched stone details	Open joint certainly accepting water	Rake out and repoint with a suitable lime mortar
W4	Photos		
W5	Top of mullions	Historic mortar repair starting to fail, likely caused by ferrous dowel. Stable at time of inspection	It may be adequate to replace the mortar repair, however the issue may persist if caused by a corroding dowel
W5	Photos		

W6	Top of arched stone detail	Open joints, and historic mortar repair suggesting further evidence of corroding dowels	Rake out and repoint joints with a suitable lime mortar
W6	Photos		
W7	Mullions	2no. Ferrous scaffold fixings	Core out fixings and repoint with a suitable lime mortar

W7	Photos	 The top photograph shows a hand holding a white tag with 'HIGH LIFE ROPE ACCESS' and 'W7' in green marker against a rusty metal mullion. The bottom photograph shows the same tag and mullion from a slightly different angle, with a hole visible in the metal above the tag.	
W8	Mid height on the mullions	Bed lift from ferrous bed reinforcement as per N8. Photos show that the bed lift decreases from north to south. One photo also shows that one of the ferrous dowels in the mullions is spalling a large section off the mullion. This was stable at the time of inspection	As per N8
W8	Photos	 The photograph shows a brick wall with a white tag labeled 'W8' held against it. The tag also has 'HIGH LIFE ROPE ACCESS' printed on it. The brickwork is made of red bricks with some mortar visible.	

			
W9	Brickwork between the mullions	Photos showing the condition of the brickwork between the mullions which is generally sound, the pointing is cementitious face pointing and is acceptable	No action needed

W9	Photos		
W10	Mullion on NW arete	Open bed at the bottom of the mullion may well be tracking water into the building	Rake out and repoint with a suitable lime mortar

W10	Photos		
W11	Sill/ offset course below mullions	Open perpend and bed in the offset course likely tracking water into the building	Rake out and repoint with a suitable lime mortar
W11	Photos		

			
W12	Brickwork between sill and stone string course	6no. Ferrous scaffold fixings, some of which have broken the surrounding bricks	Replace broken bricks and repoint with a suitable lime mortar. Where bricks are not broken core out fixings and repoint
W12	Photos		

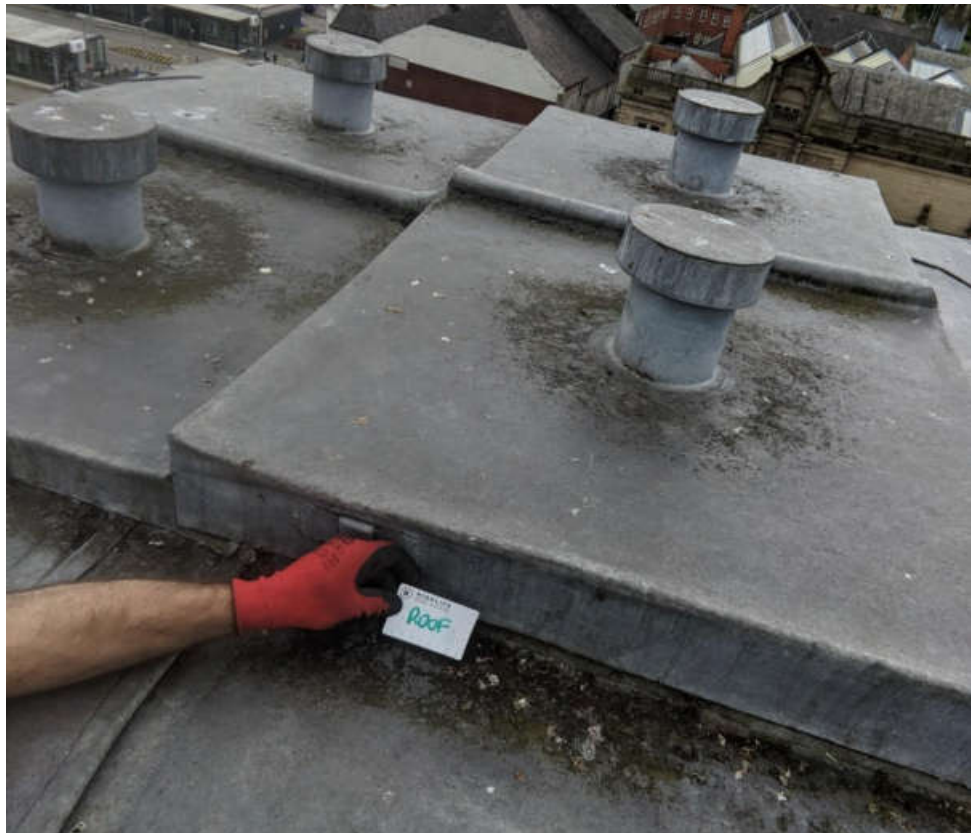


W13	String course	3no. Ferrous scaffold fixings, one of which has caused minor cracking of the stone	Core out fixings and point with a suitable lime mortar
W13	Photos		

W14	String course	Open perpend joints in string course	Rake out and repoint with a suitable lime mortar
W14	Photos	See photos for W13	
W15	Step flashings	Some of the sealant used to seal the step flashings is growing tired and is likely tracking water into the building	Remove old sealant and reseal or point with a suitable lime mortar
W15	Photos		
W16	Lightning conductor	Point where the lightning conductor joins the roof is poorly sealed and likely accepting water	Seal hole with sealant or repoint
W16	Photos		

Roof:

No.	Location	Description	Proposed Solution
	Roof	The lead roof covering is in very good condition, with no obvious flaws or defects. The only thing that could possibly be considered an issue is that the lead stops around 50mm short of the edge of the roof, however it is highly unlikely that this is actually causing any leaks	No action needed
	Photos		





Mortar:

Where there is no cementitious face pointing the original mortar is still well visible. This appears to be a hot mixed ash mortar; the numerous coal flecks suggest that coal ash was used as the primary aggregate, with only a small amount of silica aggregate and some visible flecks of brick, likely from the kilning process. The mortar was very soft beneath a tool, suggesting only a minor pozzolanic effect from the brick.



Conclusions:

Overall the tower is in fairly good shape, with the issues tending to be isolated and minor, with the exception of the ferrous bed reinforcement, which is causing significant jacking of the upper portion of the tower. Given that the original specification was to ascertain what can be done to prevent water ingress, we feel that there are a lot of easy gains to be made in this respect, namely repointing the cornice, sills, and string course, as well as potentially doing some isolated repointing of the open perpendicular joints in the brick work, and resealing the flashings and lightning conductor entry points.

Beyond this the structural repairs will require a more directed approach, with removal of the embedded ferrous material being a priority. Unless removed the ferrous dowels in the mullions are likely to continue spalling the mullions, however given the constraints of funding it may be preferable to repair these on a case by case basis,

which may be acceptable given that the solution to removing these dowels is likely to involve indenting a new section of stone.

Given the difficulty of scaffolding this tower over the complex roof structure, a rope access approach may be considered for these repair works, which we feel would be perfectly achievable. The suitability of this option might be ascertained after receiving a quotation for scaffolding. Given that the bed reinforcement only spans a single skin of brick, we do feel that all of the work can be achieved externally, without needing access to the internal elevator shaft.