

5 DISCUSSION

5.1 General

- 5.1.1 Harris Shopping Arcade was built around 1930 and consists of an L Shaped corridor with shops on either side. Access to the arcade is from Friar Street as well as Station Road.
- 5.1.2 There appears to have been more recent modifications, one of which is the construction of the office block at the corner of Friar Street and Station Road.
- 5.1.3 In the following sections, the more significant observations are discussed in more detail

5.2 Office Block - Spalling of concrete and reinforcement corrosion

- 5.2.1 The office block has concrete elements exposed on the external rear elevations. These exposed elements include lintols above windows and beams at floor levels. The beams are rendered.
- 5.2.2 In many cases, spalling of the concrete has occurred. The spalling of the concrete is due to the corrosion of the embedded reinforcement (or steel section), in turn occurring due to a process called 'Carbonation'. Carbonation occurs when the carbon dioxide in the atmosphere mixes with moisture and penetrates the concrete. When the carbonation front reaches the embedded reinforcement, the normal protective alkalinity of the concrete is neutralised. The reinforcement then corrodes, expands and causes the concrete cover to spall.
- 5.2.3 Below are sketches showing the carbonation process:

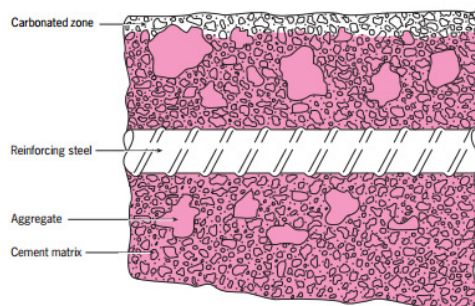


Figure 3 Diagrammatic view of steel protected from carbonation-induced corrosion in partially carbonated concrete

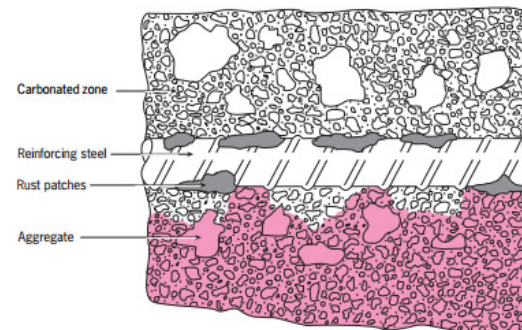


Figure 4 Diagrammatic view of steel corroding in carbonated concrete

- 5.2.4 The beams appear to have been rendered, but the render has suffered from extensive cracking. The cracking may be due to shrinkage of the render, but where vertical, the cracking may also be due to the corrosion of the reinforcement links in the beams. Where the concrete and/or render have been repaired, cracking has occurred again in certain locations. In certain locations, the spalled concrete appears loose and needs to be dealt with urgently.

5.2.5 It should be expected that cracking and spalling will be ongoing as the carbonation process is also ongoing. Therefore, repairs will be necessary from time to time. The repairs will involve the removal of loose concrete, treatment of the reinforcement and the application of a repair mortar such as Fosroc Renderoc HB. To match the existing, a cosmetic render can be applied thereafter.

5.2.6 We also recommend that concrete tests, to include carbonation, chlorides and measurement of cover are undertaken in order to inform the future maintenance regime.

5.3 **Cracking to pier at entrance of the Arcade**

5.3.1 The cracking to the pier is significant and it measures up to 8mm in width. We suspect that there is an embedded steel column which has been corroding.

5.3.2 The arcade building dates back to circa 1930. At that time, it was considered that a 100mm stone or brick gave adequate protection against moisture ingress. This was not the case and many buildings in the UK have suffered through corrosion of the steel frame. It was not until the 1952 London Building (Constructional) By-Laws which were amended in 1956 that any steelwork incorporated in external masonry needed better protection, such as 50mm concrete cover.

5.3.3 We recommend that the steel is carefully exposed and its condition assessed. Remedial works may be necessary, depending on the condition of the steelwork.

5.4 **Warehouse Building - Horizontal Cracking to the Retaining wall**

5.4.1 The warehouse building adjoins a newer development called Aquis House. The rear wall of the warehouse, which faces the car park of Aquis house, appears to have been lowered when Aquis House was constructed. This is evidenced by the corbelling (perhaps underpinning) at the bottom of the columns and the rendering to the lower part of the wall. This rendered lower part of the wall is likely to be a retaining wall with the ground on the internal warehouse side higher than the external car park side.

5.4.2 There is extensive random cracking to the render, which may be due to shrinkage. However, there is also well defined horizontal cracking which is unlikely to be due to shrinkage alone. This horizontal cracking may be due to movement of the retaining wall.

5.4.3 We recommend that any movement of the rendered wall is monitored. This could be undertaken either by putting tell-tales across the cracking or by measuring the outwards movement of the retaining wall. The measurements need to be taken over a period of time.

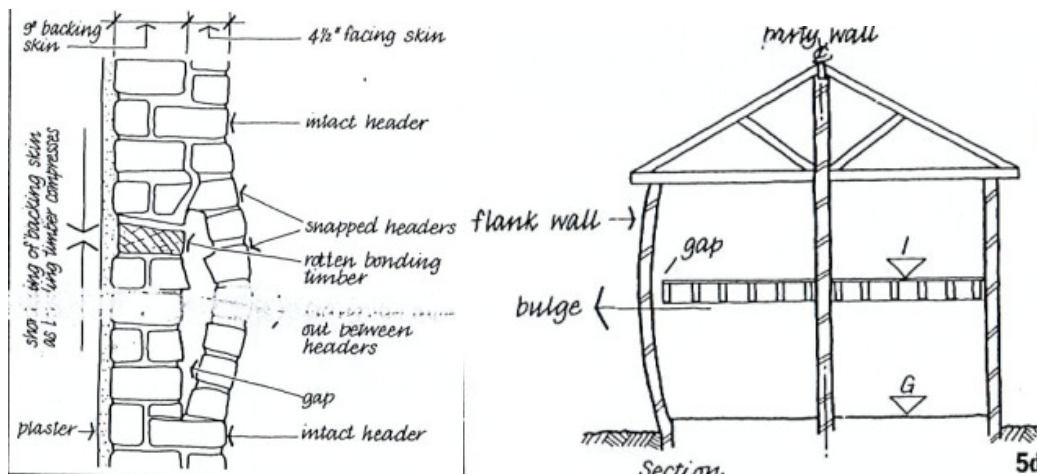
5.4.4 Should movement be found to be ongoing, it will be necessary to establish the nature of the wall and the reason for the movement. Remedial works may subsequently be necessary.

5.5 Rear Garage – Spalling of concrete and reinforcement corrosion

- 5.5.1 The rear garage is concrete framed, with the frame exposed externally. There are also concrete stubs that project beyond the roof, possibly intended for a future extension.
- 5.5.2 In many instances, the concrete has spalled to expose corroded reinforcement. In some of these instances, repairs have been undertaken but some of the repairs have cracked and spalled again.
- 5.5.3 As in Section 5.2 of the report, the cause of the concrete spalling and corrosion of the embedded reinforcement is likely to be carbonation attack. Therefore we recommend similar concrete tests, together with the application of the mortar repair, where spalling has occurred and loose concrete removed.

5.6 Building above the Friar St Arcade Entrance – Horizontal and Vertical Movement

- 5.6.1 This part of the building is occupied by a dental practice. The flank wall (east side) of the building at second floor and towards the front of the building has suffered from substantial outward movement.
- 5.6.2 We believe that there are two mechanisms in play:
- Firstly, there is a localised outward bulge at the level where the roof meets the wall. We believe that this distortion is due to the deterioration of the embedded timber wall plate supporting the roof. Below is a sketch which illustrates this movement, although the sketch shows a gap forming in the wall, which may not be the case here.
 - Secondly, a large portion of this wall has bulged out. We believe that this is due to a lack of tie or restraint to the wall. Below is a sketch which illustrates this movement – the gap shown between the wall and the floor may not be present here.
- 5.6.3 Sketches illustrating the wall movement:



- 5.6.4 The outward bulge of the wall and lack of tie / restraint may have resulted in the instability of the wall. We recommend that the condition of the timbers and tying provisions are investigated. This is likely to require intrusive investigations internally. The remedial works will depend on the findings of the investigation works.
- 5.6.5 The rear elevation of the same building has suffered from vertical and horizontal distortion.
- 5.6.6 The vertical distortion is consistent on the height of the elevation and therefore, it must have been caused by the downward movement of the supporting structure below. As the rear wall is above the arcade area, the wall is unlikely to extend to foundations, so must be sitting on some form of transfer structure. This transfer structure may be a steel beam or timber beam spanning between columns.
- 5.6.7 The reason for the deflection of the transfer structure needs to be investigated and it is likely that intrusive investigations will need to be undertaken internally to look at its condition. Remedial works, if necessary, will depend on the findings of the investigations.
- 5.6.8 The lateral movement of the rear wall is also likely to be due to a lack of tie or to rotting embedded timbers in the wall, similar to the flank wall. These should be investigated at the same time as the flank wall.
- 5.6.9 Lateral distortion is also visible on the other flank wall facing the office block. Again, this could be due to a lack of tie or rotten embedded timbers, which will need to be investigated.

5.7 Building above the Station Road Arcade Entrance – Spalling concrete and reinforcement corrosion

- 5.7.1 The rear elevation of this building has exposed concrete beams at floor and roof levels.
- 5.7.2 In a few instances, the concrete has spalled and corroded reinforcement exposed.
- 5.7.3 As in Section 5.2 of the report, the cause of the concrete spalling and corrosion of the embedded reinforcement is likely to be carbonation attack. Therefore we recommend similar concrete tests, together with the application of the mortar repair, where spalling has occurred and loose concrete removed.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1.1 There inspection of 17 Friar Street and Harris Arcade has noted a number of defects. These are described in the Observations Section of this report.

6.1.2 We recommend that the following measures are undertaken in the short term (locations as per Observation Section of report):

- (a) Address instances of loose render that can fall off and cause injury.
- (b) Address instances of spalled and loose concrete that can fall off and cause injury. Loose concrete to be removed, the reinforcement treated and a proprietary repair mortar used.
- (c) Secure dislodged coping stones that could be loose and fall off.
- (d) Investigate the large vertical crack at the Station Road entrance to the arcade.
- (e) Address the spalling brickwork on the Station Road elevation as loose pieces of brickwork can fall off and cause injury.
- (f) Secure loose pieces of stone, either by pinning the piece or replacing sections of stone.
- (g) Monitor the movement of the rear wall of the warehouse (facing the car park of Aquis House). Investigate if movement is ongoing.
- (h) Investigate the bulges in the wall of the building above the Friar Street entrance to the arcade. The bulges are believed to be due to rotten timbers and lack of restraint to the walls. Remedial works will depend on the findings of the intrusive works.
- (i) Investigate the vertical distortion of the rear wall of the building above the Friar Street entrance to the arcade. This will require intrusive investigations on the transfer structure beneath the wall.
- (j) Address the potential loose pieces of brickwork on the rear elevation of the building above the Friar Street entrance to the arcade. Loose pieces of brickwork can fall off and cause injury.
- (k) Remove the loose bricks to the rear plant deck of the office block. Reconstruct as necessary.

6.1.3 We recommend that the following measures are undertaken in the medium term, say within the next 5 years, but with regular monitoring (locations as per Observation Section of report):

- (a) Replace the lintols with the insufficient bearing in the plantroom of the office block.
- (b) Replace bricks that have suffered from frost damage.
- (c) Undertake repointing and replacement of localised cracked bricks generally.
- (d) Undertake crack stitching to localised cracks in masonry. Stitching can be undertaken with a proprietary system such as the Helifix crack stitching system.

- (e) Remove redundant fixings that can corrode and cause cracking.
 - (f) Infill service holes and replace missing bricks in brickwork walls
 - (g) Address cracked render.
 - (h) Address defective rainwater goods.
 - (i) Secure loose roof tiles and replace missing ones.
 - (j) Undertake concrete repairs with a proprietary repair mortar where concrete has spalled to reveal corroded reinforcement.
- 6.1.4 We recommend that the following measures are undertaken in the long term, say beyond the next 5 years, but with regular monitoring (locations as per Observation Section of report):
- (a) Undertake concrete tests, incl. carbonation, chlorides and reinforcement cover to concrete elements where exposed in order to inform the long term maintenance requirements.