Swiss Cottage Library

Fin inspection

London Borough of Camden

22 April 2022

5206133-ATK-XX-XX-RP-SE-000001

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Contents

Executive Summary

Atkins conducted a high-level qualitative inspection of the fins on the 13th of April in order to examine a badly damaged fin, and more generally to assess the general condition of the concrete fins on the building façade, following reports by the contractor of existing cracking being observed during the current works.

Whilst the fins appear to be in good visual condition given the age of the structure and the exposure conditions, there are obvious signs of deterioration.

Many of the fins have horizontal cracks both internally and externally and it is likely that this is due to the fins being restrained by the structure as they undergo heating and cooling due to thermal effects and also the long-term shrinkage of the concrete.

Whilst previous attempts appear to have been made to address the external cracking, in some cases the cracks have reopened giving rise to a risk of corrosion due to water ingress.

It is likely that cracks will continue to open, and form, and that the risk of corrosion will increase because of this.

In several locations at the bottom of the fins, there is significant cracking and corrosion that may lead to large pieces of concrete spalling at some point in the future that would present a risk to public safety.

At roof level, whilst the tops of the fins appear to be in good condition, the fact that a large piece of concrete became detached during the inspection, and the apparent low cover to the reinforcement, suggests that there is a risk of further pieces spalling that would be a significant risk to public safety should they fall onto the footpath, or road, below.

Given the apparent lack of adequate cover to the reinforcement in the fins, it is not possible to use current crack width limits as a guide to ongoing durability in this Report.

In addition to the issues of the fins acting as a cold bridge across the façade line, the cracks that bridge this line may also lead to water ingress into the building.

Considering the above, it is therefore recommended that:

- To fully assess the condition of the fins, and develop a building maintenance and remedial strategy, a detailed survey of every fin should be conducted, including testing to assess the corrosion risk such as for carbonation, chloride presence, half-cell potential, and cover-meter surveys.
- Mitigation measures should be taken to address the risk of spalling at roof level before the current scaffolding and its sheeting is removed. Similarly, at ground level the boundary fencing should be retained until the risk of spalling at the bottom of the fins is addressed.
- The two fins where fixing points had failed should be assessed structurally to develop a suitable remedial solution; they cannot be left in their current condition.
- The fixing detail between fins and cladding panels should be reviewed generally due to two instances of this detail having failed.
- Several the scaffolding boards were noted to be warped and these should be replaced as a matter of urgency as they present a significant trip hazard.

1. Introduction

Swiss Cottage Library is a Grade II Listed Building dating from 1963 and is notable for the concrete fins around its perimeter as shown in Figure 1.1.

Figure 1.1 – Swiss cottage library; photograph courtesy of Historic England website.

During the current internal, non-structural, fit-out works, the contractor reported various cracks in the concrete fins, both internally and externally. Additionally, one fin was reported to have significant damage on its inside face giving rise to the concern that it would be unable to support the cladding panels attached to it.

Therefore, Atkins carried out a high-level qualitative inspection of the fins on the 13th of April in order to examine the badly damaged fin and more generally to assess the general condition of all fins and to provide a recommendation as to what next steps should be taken by the Council.

It should be noted that the purpose of the inspection carried out was to allow a view to be taken as to the general condition of the fins. The inspection and report do not constitute a detailed structural survey of every fin and no structural assessment work has been carried out as part of the current brief.

2. Fin inspection

The fins were inspected internally from within the library, externally through the library windows, and also from the scaffolding, roof level and from ground level.

In all instances, references to cracking relate to horizontal cracks unless noted otherwise.

2.1. Internal condition

A global assessment of the internal fin condition is given in Section 2.1.1 whereas the badly damaged fin highlighted by the contractor is addressed in Section 2.1.2.

2.1.1. Fins – general comments

With respect to the examination of the internal fins, the key plan shown in shows the zone numbering used in the descriptions that follow with directional notation being as per the compass arrow; note that this is for reference purposes only with the actual longitudinal axis of the library running in a north-northwest to south-southeast direction.

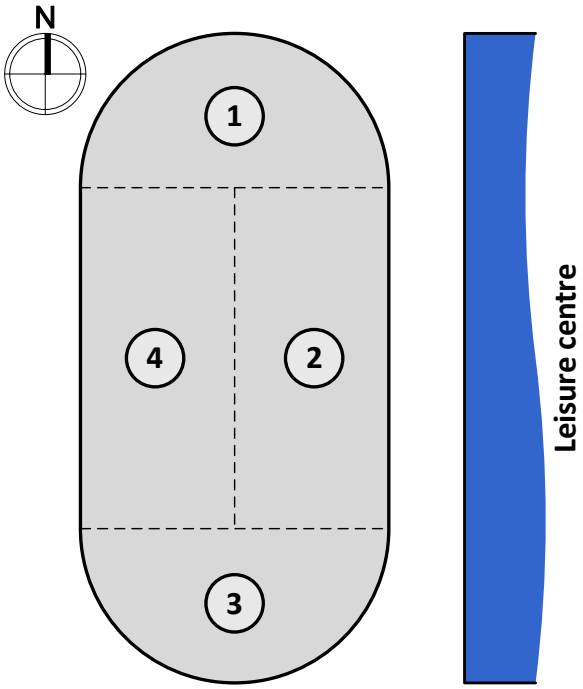


Figure 2.1 – Key plan with zone references

At both first and second floor levels it was noticeable that in Zones 1 and 2, cracking was infrequent and where it did occur on a given fin, the spacing was large, e.g. greater than 1m. By contrast, in the other zones the cracking was seen on most fins and at close centres, e.g. 250mm; spot checks of crack widths were in the order of 0.3mm in all zones.

It is thought likely that the incidence of cracking reflects both the exposure of a given elevation, and the orientation of the respective building faces. The latter point on facing relates to the exposed nature of the fins, the heating and cooling cycles they will undergo, and also the differential temperature between the external portion of the fins and that which is inside the building.

It is not known how the fins are attached to the primary structure, but no expansion joints were noted. Combined with the attachment of the cladding panels to both the fins and the structural frame, it is likely that there is a significant level of restraint to movement of the fins as they heat up and cool down generally and also relative to the other internal vertical elements. This is likely to be the main cause of the cracking observed. Long-term shrinkage of the restrained concrete fins is also likely to be a contributing factor to the level of cracking seen.

Whilst in the majority of cases, no evidence of rust staining was seen on the internal fins—which would suggest corrosion—some rust discolouration of the concrete around cracks was noted in a number of places.

The photographs that follow are representative of the observed defects. A brief description of what each photo illustrates is set out below together with a preliminary evaluation of its significance. In all cases the presence of external cracks (including those that continue internally) present a corrosion risk.

Figure 2.2 illustrates cracking over the full fin width. As these bridge the window line, this may provide a path for water ingress into the building.

Figure 2.3 is an example of one of the few internal vertical cracks seen on the rear of the fins. The horizontal crack that intersects it also continues through the window line and appears to have been patched at some point. Whilst there is no clear cause of the vertical crack, the general damage in this area requires further investigation to determine if corrosion of the reinforcement in the fin is a contributing factor.

Figure 2.4 illustrates where something has been fixed to the rear of a fin and a crack that coincides with it. Whilst this is clearly an old fixing, it may have been the instigating factor for the crack to appear at this point.

Figure 2.5 shows regular cracking on a south facing fin and rust staining. This suggests that the crack continues to the external face and is wide enough to allow water to penetrate to the inner face of the section to allow corrosion to occur.

Figure 2.2 – Wide cracks bridging window line and likely to allow water ingress in addition to corroding the fin reinforcement

Large internal crack and the external repair

Rear face of fin with vertical crack

Figure 2.3 – Vertical and horizontal cracking

Figure 2.4 – Fixing to rear of fin may have instigated cracking

Regular cracking on fin

Rust staining indicating corrosion of bars

Figure 2.5 – Cracking and rusting of fin

2.1.2. Badly damage fin

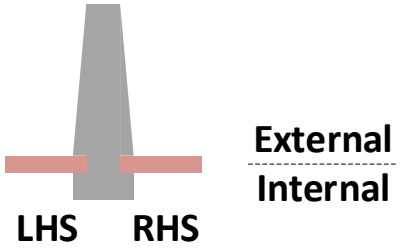
The badly damaged fin highlighted by the contractor is in Zone 3 on the 2nd floor and is shown in Figure 2.6.

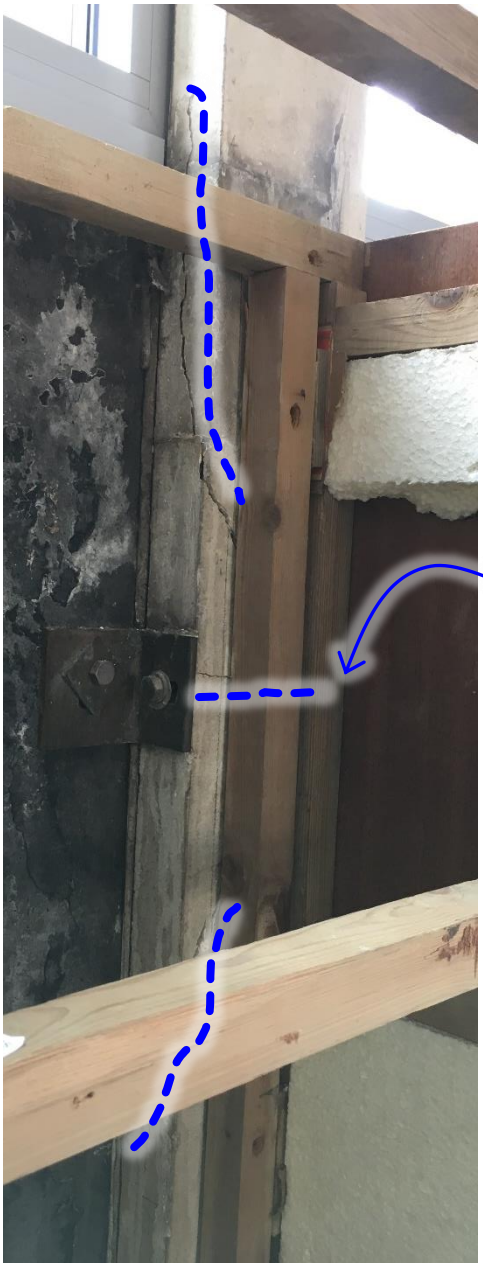
This has occurred at lateral restraint connection to a cladding panel with each panel being restrained at two points on each fin. There is considered to be a low risk of the cladding panel falling away as whilst the severe cracking is likely to make one connection ineffective, the other three lateral fixings to the panel appear undamaged with the nibs on the back of the panel, providing vertical support, are soundly grouted in place.

With respect to the figure, whilst the failure zone on the left-hand side (LHS) of the fin (when viewed from the inside) appears to be a localised cone failure; the cracking on the right-hand side (RHS) is not. The bulging/cracking seen on the RHS of the fin suggests that it may have been used as a fulcrum in prying out the existing window or that the cladding panel is bowing outwards at this corner causing the observed deformation as the fixing rotates.

This fin cannot be left as-is and a structural investigation is required as to its soundness and in order to develop a suitable repair solution.

Note that one other location in Zone 2 exhibited the cone type failure of a cladding panel fixing and is shown in Figure 2.7 and Figure 2.8. This suggests that there may be a recurring issue with this detail, amplified by the relatively small edge distance from the fixing to the concrete surface and should be investigated further.



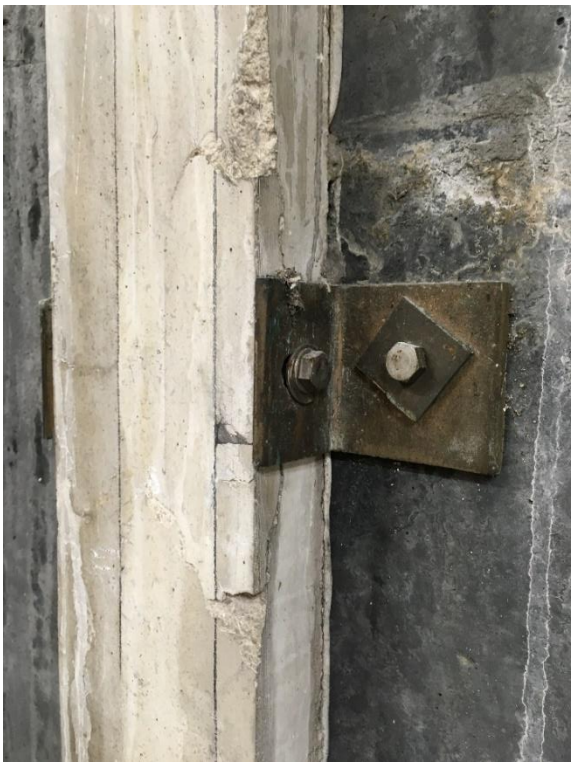


LHS

RHS; the crack width is in the order of 1.5mm at the corner. Note also the bow of the concrete.

Figure 2.6 – Damaged fin

Figure 2.7 – Cladding panel fixing; failure zone circled



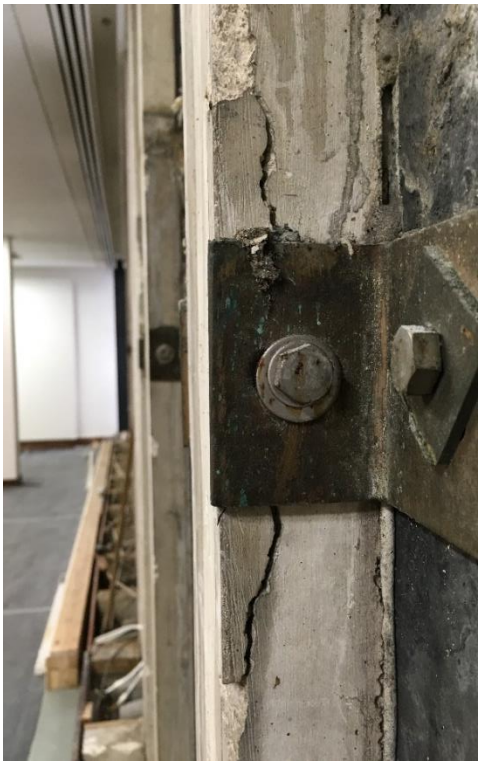


Figure 2.8 – Close-up of failure zone

2.2. Roof level

The tops of the fins at roof level were examined.

Whilst visually they appear to be in good condition, whilst measuring a noticeable crack, a fist sized lump of concrete broke away as shown in Figure 2.9 and Figure 2.10.

Figure 2.11 is a close-up view of this area and shows that in addition to the horizontal reinforcing bar being close to the surface, a vertical bar protrudes past the top concrete surface. Exposure and hence corrosion of the latter is likely to have been the root cause of this fracture.

This arrangement may be indicative of systematic quality control issues with the fin construction. This would relate to low levels of concrete cover to the reinforcement in an external environment.

With the scaffolding, and its associated sheeting, in place, the risk of spalling has some mitigation but clearly once the scaffolding is removed, this would have presented a significant danger to the public if a similar piece were to fall onto the footpath or road.

A detailed inspection of the tops of all fins is required, including cleaning the tops in order to facilitate this and consideration should be given to applying a cap to the tops of all fins (such as metal flashing or a high strength grout) to protect the exposed top surface.

Figure 2.9 – Spalling at top of fin with location indicated on plan

Figure 2.10 – Close-up of broken concrete piece

Figure 2.11 – Reinforcing bar projecting to surface and low cover

2.3. External elevation

The external elevation of the fins was examined through the library windows and from the external scaffolding.

It was noted that the scaffolding has been fixed to the fins at regular intervals and has caused significant damage in a number of locations, for example Figure 2.12**.** If this is not suitably repaired, for example by breaking back to a sound substrate, and patched with a suitable repair mortar, it is likely that these areas will be a point of weakness, as can be seen with older patch repairs to the fins. Furthermore, it is not known if the contractor's temporary works designer has assessed the strength of the fins to be adequate for restraint of the scaffolding.

Figure 2.12 – Damage to fins due to scaffold fixings

In other locations, older cracking could clearly be seen as could associated patch repairs. Examples are shown in Figure 2.13, Figure 2.14, and Figure 2.15. The repairs have not always been successful with cracking again being seen that these points. Where cracking is unpatched, signs of minor rust staining were noted suggesting corrosion of the reinforcement. Elsewhere, the horizontal white staining seen on the fins at crack positions appears to be a sign of efflorescence which is described by the Concrete Society as:

> 'Lime weeping is caused by water leaking through the concrete and dissolving calcium hydroxide from the matrix. On contact with the atmosphere the calcium hydroxide reacts with carbon dioxide to form calcium carbonate, which is precipitated on the surface when the water evaporates, generally at cracks or joints. Serious leakage of water through joints can lead to the formation of stalactites. Significant leakage may be symptomatic of a more severe problem and can lead to durability problems.'

Further investigation, including testing, would be required to assess the significant of this with respect to the soundness of the fins.

Note the continuation of the cracks from external to internal parts of the fins

Figure 2.13 – Repairs to fins, open cracks, and possible efflorescence

Note the crack adjacent to top of cladding panel

Figure 2.14 – Repairs to fins, open cracks, and possible efflorescence

Figure 2.15 – Open cracks with some rust staining

An issue of low cover, rusting, and spalling was also noted on one fin at first floor level as shown in Figure 2.16. and, as with the observations at roof and ground level, this suggests there to be an issue with low cover and bar placement in the fins that increase their risk of deterioration.

Figure 2.16 – Rusting and spalling; rust spot at top appears to be the end of a reinforcing bar

2.4. External elevation at bottom of fins

The bases of some of the fins show the highest levels of deterioration observed during the inspection. Considering the clear signs of corrosion and significant horizontal and vertical cracking at the base of the fins, there is a high risk of sections of concrete spalling in the future if action is not taken to address this. Whilst the visible damage is at the south end of the building, the bases of all fins should be inspected.

Examples of the damage are shown in Figure 2.17 to Figure 2.23 inclusive.

Figure 2.17 – Bursting of previously patched concrete and rust staining

Figure 2.18 - Vertical crack in previously patched area with rust staining

Figure 2.19 – Reinforcement bars clearly exposed and rusting.

Failure of existing patch repair

Significant spalling is likely due to corrosion of reinforcement

Figure 2.20 – Spalling and corrosion of vertical bars

Figure 2.21 – Significant horizontal fracture and bursting

Figure 2.22 – Rebar at surface hence rust spots, evidence of previous patching, appears to be tow significant cracks (vertical and inclined to the horizontal)

Figure 2.23 – Spalling due to rusting of near surface reinforcement appears to have instigated cracking; risk of corner spalling

2.5. Other

It was noted that a number of scaffolding boards were warped and my present a trip hazard.

Figure 2.24 – Warped scaffolding board

3. Summary and recommendations

Summary

Whilst the fins appear to be in good visual condition given the age of the structure and the exposure conditions, there are obvious signs of deterioration.

Many of the fins have horizontal cracks both internally and externally and it is likely that this is due to the fins being restrained by the structure as they undergo heating and cooling due to thermal effect and long-term shrinkage of the concrete.

Whilst attempts appear to have been made to address the external cracking, in many cases the cracks have reopened giving rise to an increased risk of corrosion.

In several locations at the bottom of the fins, there is significant cracking and corrosion that may lead to large pieces of concrete spalling and present a risk to public safety.

At roof level, whilst the tops of the fins appear to be in good condition, the fact that a large piece of concrete became detached during the inspection, and the apparent low cover, suggests that there is a risk of further pieces spalling that would be a significant risk to public safety should they fall onto the footpath, or road, below.

It is likely that cracks will continue to open, and form, and that the risk of corrosion will increase because of this.

Given the apparent lack of adequate cover to the reinforcement in the fins, it is not possible to use current crack width limits as a guide to ongoing durability.

In addition to the issues of the fins acting as a cold bridge across the façade line, the cracks that bridge this line may also lead to water ingress into the building.

Recommendations

To fully assess the condition of the fins, and develop a building maintenance and remedial strategy, a detailed survey of every fin should be conducted, including testing to assess the corrosion risk such as for carbonation, chloride presence, half-cell potential, and cover-meter surveys.

Mitigation measures should be taken to address the risk of spalling before the current scaffolding and its sheeting, and boundary fencing at ground level, is removed.

The two fins where fixing points have failed should be assessed structurally to develop a suitable remedial solution; they should not be left in their current condition.

The fixing detail between fins and cladding panels should be reviewed due to two of these details having failed.

Several the scaffolding boards were noted to be warped and these should be replaced as a matter of urgency as they present a significant trip hazard.

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