

URS Building

Structural Repair Strategy Report

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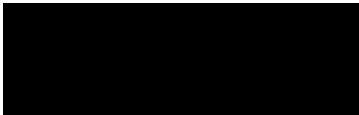
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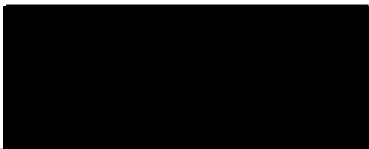
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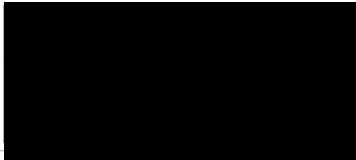
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1.0 Introduction

Curtins were instructed by the University of Reading (UoR) to undertake an intrusive structural survey of the URS Building. The URS building is an unoccupied grade II listed building constructed in the early 1970's and has an expressed concrete frame structure. The externally exposed concrete of the building is in poor condition and deteriorating. The intrusive structural survey will assess the condition of the concrete structure and provide recommendations for repairs and protection measures.

The brief is to preserve, strengthen and repair the 50-year-old structure, whilst also assessing the implications on the wider redevelopment works. The wider works introduce new shared teaching spaces, café/support facilities and reintroducing construction management and estates department (CME) within the building. Other upgrades such as Mechanical, Electrical, fire escape, access and fabric works are necessary to improve the original 1970's performance and bring the building into the 21st Century.

This document is a summary of the Curtins Interpretative Structural Survey report 085282-CUR-XX-XX-T-Z-00001. The aim of this report is to briefly summarise the condition of the concrete structure from the recent survey findings and provide a detailed structural repair strategy for Wokingham Council and Twentieth Century Society to review.

2.0 Existing Structure

2.1 History

Originally designed by Architect's HKPA and Structural Engineer's Felix Samuely, the URS building is a four-storey building built in the early 1970's. Due to the building's architectural interest and expressive use of structure with reference to traditional Japanese construction, the building received grade II listed status in 2016.

As the building is of architectural and historical interest, the expressed structure which includes the ochre-coloured concrete beams, columns and cladding panels has special protection. Therefore, any alterations, extensions and repairs require careful consultation with the heritage stakeholders. Refer to Purcell's Heritage Impact Assessment report for further details on the listed building description and statement of significance. Any repairs to the concrete structure are therefore to be carefully considered to mimic the existing appearance.

The brief is to preserve, strengthen and repair the 50-year-old structure, which is nearing the end of its initial intended design life. Whilst this does not necessarily mean the structure is no longer fit for purpose, but it does affect the future performance and maintenance requirements.

The original Structural Engineer's Felix Samuely record drawings were recovered shortly after the survey phase was completed. The information on the archive drawings along with the intrusive survey information has led to a detailed appraisal of the existing structure.

2.2 Description

The structure is a 120m long reinforced concrete (RC) frame, where the building layout has a long circulation spine corridor along the east west axis (see figure 1). The concrete framed superstructure is split into three independently stable structures (each approx. 40m in length) with two structural movement joints located along its length.

The buildings's structure is stabilised in the north south direction through RC shear walls with two walls within each 3 No. independent structures. At this stage it is assumed that the RC blade columns provide moment resisting frame action to stabilise the east west direction. Rigid connections between the floor plate and concrete columns provide this rigid sway frame action.

Diaphragm action is assumed to be provided via the in-situ and precast RC slabs at the upper floors to distribute lateral wind pressures to the RC shear walls and columns.

A review of the structural record drawings during Stage 3 found the two 25mm structural movement joints on grid lines 18 & 35, provide vertical shear transfer and discontinuous longitudinal movement.

Typically, on internal floor slabs, a non - structural 50mm screed has been installed with an allowance for data cable routing within the screed depth.

The sub structure comprises of shallow foundations with RC pad foundations located beneath the RC columns and strip footings/ground beams to support the ground floor slab and external cladding panels. The existing plant room located in the basement is formed with a reinforced concrete basement box with retaining walls. A half-height crawl duct basement extends the length of the building and is formed with masonry retaining walls and a concrete base slab.



Figure 1 Aerial image of URS Building (Google Earth)

The superstructure consists of a RC frame with a mixture of in-situ and precast RC beams, columns and slabs. The long span overhang and cantilevers above the external paved colonnade (Chancellor's Way) to the North are formed with post tensioned (PT) beams. Other long span and cantilever beams to the south are also formed with PT beams. From the record drawings, the concrete frame beams predominately span in the north-south axis. Floor slabs are either precast

planks or in situ reinforced concrete, assumed to be 150mm thick spanning between beams typically spaced at 2.4m centres.

The building is four storeys in height with structural floor to soffit heights of 2.6m typically. Historical drawings indicate an average building height of 18m above ground level. Glazing and precast cladding panels form the external façade. A water tower is located on the fifth-floor roof.

The existing roofs consist of a mixture of lightweight mono pitched woodwool slab roofs, woodwool flat roofs and glazed roof lights over the stair cores.



Figure 2 East Elevation External

2.3 Previous Structural Surveys

Between 2015 and 2023, previous Structural Engineers AECOM and Concrete Repairs Limited (CRL) undertook visual and intrusive structural surveys. Lab testing was undertaken by Sandbergs acting as a subcontractor to CRL. The AECOM and CRL survey reports found the buildings to be in reasonable condition given its age and unoccupied state. The AECOM reports do refer to localised deterioration of the external concrete frame elements and cladding panels.

Interestingly, The Hawkins Brown Design & Access Statement document submitted during the previous 2018 planning application, proposed an anti-carbonation coating applied to all external concrete to extend their working life.

The previous survey information made available to us for review is listed below:

1. CRL Reports

- CRL Limited investigations works May 2015 - SUR151846
- CRL Limited investigations 2nd report Jan 2017 - SUR162720
- CRL Precast Cladding Panel investigations April 2019 - SUR193837
- CRL Precast Cladding Panel investigations April 2021 - SUR217744

2. AECOM Reports

- Structural Survey report - Oct 2014
- Intrusive Survey Works Specification - Nov 2014
- Structural Survey report - Oct 2023 - 60717568-ACM-XX-XX-RP-00001
- Intrusive Survey Works Specification Dec 2023 - 60717568-ACM-XX-XX-SP-00001

2.4 Previous Heritage Surveys

During 2024, Purcell were commissioned to undertake a detailed visual inspection of the external concrete building elements with recommendations for repairs. The *Purcell URS Building External Concrete Repair - Condition Survey* report identified defects and prioritised them based on condition and location. An outline repair methodology has been developed which is to be trialled prior to the main contract works and any subsequent maintenance.

The Purcell concrete condition survey report also commented on the previous poor quality concrete repairs, which have negatively affected the building's external appearance.

3.0 Visual Inspections

3.1 Previous Repairs

Previous poor quality concrete patch repairs have also negatively affected the building’s external appearance. These conventional concrete repairs have used a grey pigmented product which does not resemble the surrounding ochre-coloured concrete (see figure 3).

The condition and durability of these previous repairs appears to be intact with no delamination or further spalling at these locations. However, the removal of these grey patch repairs is to be considered based on their heritage impact. Reinstatement with a suitable repair that matches the colour and texture of the original structure is recommend, in line with Purcell’s recent Concrete Repair Strategy.



Figure 3 Poor quality previous concrete repairs on east elevation façade

3.2 Types of Defects

Curtins undertook a visual inspection of the structure both internally and externally from ground level to determine its current condition. The visual inspection was first undertaken on the 26th February 2024 by Mat McNab and Yannis Kantzios from Curtins. Subsequent inspections were carried out during May and June when CRL were mobilised on site to undertake the instructive investigation work.

Whilst the structural survey work was being carried out, Purcell undertook a detailed visual inspection of the external concrete building elements with recommendations for repairs. It is recommended that the reader refers to Purcell’s *URS Building External Concrete Repair - Condition Survey* report for a detailed survey highlighting defects on the external fabric.

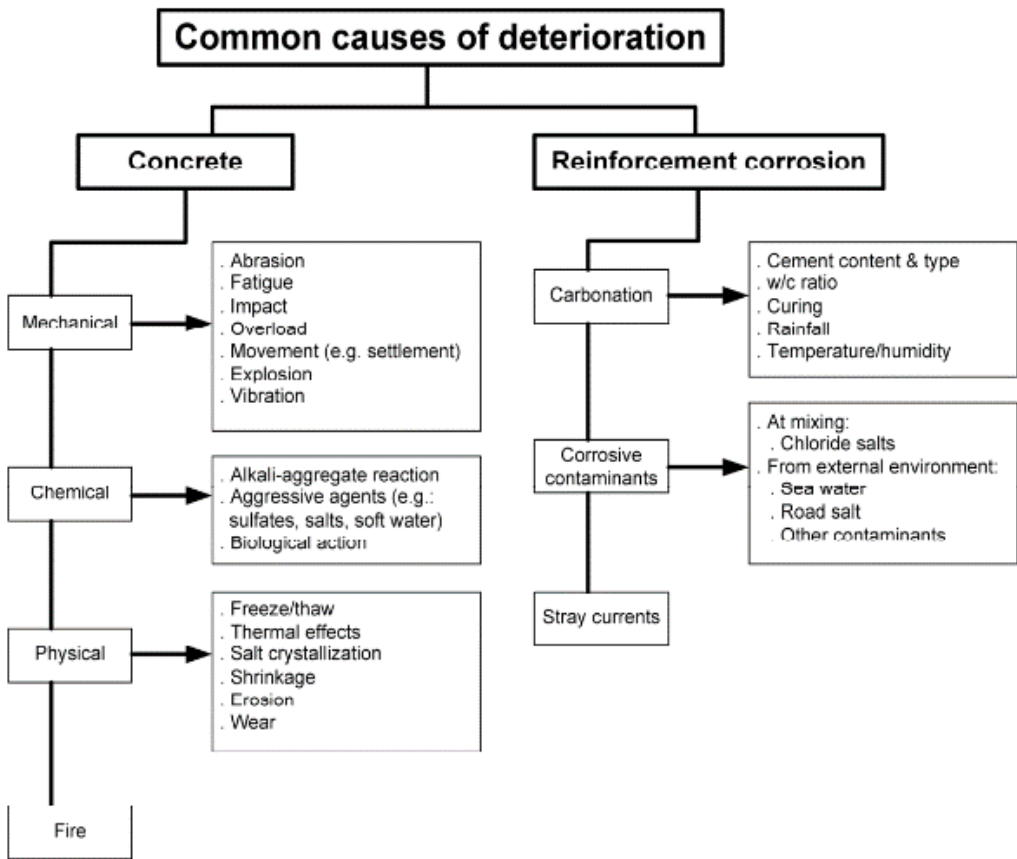


Figure 4. Common causes of defects of typical building structures (extract from BS EN 1504-9:2008)

No signs of ground induced movement were identified on the building e.g. settlement cracks. Therefore, specific trial pits investigations were not deemed necessary.

A summary of common causes of concrete defects in typical building structures is summarised in figure 4. For the URS building, the deterioration is to both the concrete and reinforcement. From our visual inspection, a list of observed defects has been provided below:

- a) Spalling of external RC elements (see figure 5). The possible causes for this defect are as follows:
- Carbonation of external exposed concrete elements which eventually cause the embedded reinforcement to corrode and expand.
 - Freeze thaw action due to weathering.



Figure 5 Spalling of exposed post-tensioned beam end

- b) Corrosion of embedded steel reinforcement within concrete (see figure 6)

- This is suspected due to carbonation of the concrete, where carbonation depths exceed the reinforcement cover.
- Possible areas of localised low cover which are less than the required cover. This is caused by poor workmanship during the original concrete pour.



Figure 6 Steel reinforcement exposed on Post Tensioned RC beam end

- c) Honeycombing of concrete faces particularly columns and basement walls.
- This is caused by poor concrete mix design and workmanship issues during the original build. Refer to figure 7 below.



Figure 7 Honeycombing on internal face of basement RC retaining wall

- d) Visible deflections and diagonal hairline cracking on some RC transfer beams. Refer to figure 8 below.



Figure 8 Diagonal cracking and honeycombing on RC transfer beam near external pond

- e) A number of precast cladding panels are noticeably out of plumb with failed mastic seals (see figure 9). Cracking and spalling to the bottom edge of the cladding panels was also evident.
- Cracking and spalling damage evident on cladding panel edges.



Figure 9 Out of plumb cladding panel above PT beam with hairline cracking at panel bottom edge.

4.0 Intrusive Survey Findings

4.1 Summary of Results

CRL completed their survey work in late August 2024 and their latest survey report (SUR231838 Rev 01) was issued to Curtins on 14th October 2024. This section of the report summarises the survey data and findings.

The most significant finding of the survey was the lack of grouting of the PT beams tendon ducts, despite the archive record drawings specifying the ducts to be fully grouted. Air pressure tests also found air leakage and a drop in air pressure within some tendon ducts, indicating the ducts are not sealed air-tight. Furthermore, the visual inspection of the tendon cables within the ducts found surface corrosion on two out of six of the PT beams.

Other significant findings include the results of the carbonation depth and half-cell potential tests. The carbonation test data found a sample of external concrete elements (beams, columns and cladding panels) to have carbonation depths within 5mm of the reinforcement cover. The high half-cell potential (mV) test also identified a number of areas of the concrete structure with medium to high risk of corrosion occurring at the time of measurement.

The findings mentioned above signify a medium to high risk of ongoing and future corrosion of embedded steel reinforcement bars. If no action was taken, this could lead to a reduction of section sizes, inadequate reinforcement and weakening of the structure. It can also cause more frequent concrete spalling and loose debris falling from a height.

Whilst only a few areas showed visible defects such as cracking and spalling to the external concrete face, this only paints half the picture. It is possible that concealed defects such as carbonation induced corrosion of the hidden reinforcement is occurring. The problem is exacerbated in localised areas of low reinforcement cover on external structural columns and beams. The substandard concrete cover due to workmanship issues during the original build increases the probability of accelerated deterioration.

4.2 Summary of Diagnosis

From the overall diagnosis the following key points are:

- The quality of concrete is largely in good condition. Although there are some areas of honeycombing likely due to poor workmanship, petrographic analyses confirm the concrete has voids in line with the water: cement ratio of the mixes used and minimal microcracking.
- Carbonation depths in all external elements are close to approaching or have reached the first layers of steel reinforcement of concrete elements. Without appropriate intervention, carbonation will provide the conditions necessary for steel reinforcement to corrode. This will lead to widespread spalling of concrete and reduction in effective section of reinforcing bars, thereby reducing the capacity of structural members.
- Chloride content within the original mix of the concrete is low and is deemed to be unlikely to cause corrosion.
- The external precast panels have defects beyond the reinforced concrete including degraded mastic and ungrouted connections. Mastic will need to be replaced to prevent moisture ingress and joints are to be grouted to ensure sufficient connection back to the structure.
- Further testing is required to satisfy that the strength characteristics of the concrete mixes used. It is recommended that Schmidt hammer testing is used on structural members to identify if there are weak spots.
- Additional input from CRL is required to diagnose the results from deflection testing.

The tested post tensioned beams have been improperly grouted in the tendon ducts leading to voids. Whilst this does not affect the structural performance of the beams, the presence of voids puts the tendons at higher risk of corrosion which has been noted in 33% of the tested PT beams. Further investigation is required to determine whether the issue is widespread

5.0 Concrete Repairs and Protection Measures

5.1 Summary

A summary is provided below on the suggested repair strategy and additional protection coatings required to extend the lifespan of the building. All repair and protection options mentioned are subject to further trial test samples during the next design stage, RIBA Stage 4.

- a) **Removal of existing poor quality concrete repairs**, priority is to be based on heritage impact defined by Purcell.
- b) **Clean and prepare** external concrete surfaces for application of protection measures. Cleaning requirements will be defined by the product manufacturer and Purcell.
 - *Possible Option: Jet wash of all external concrete columns and beams. Steam clean of the potentially fragile concrete cladding panels may be necessary to avoid risk of damage.*
- c) **Patch concrete repairs** to areas of spalled, cracked concrete and previous repair reinstatement.
 - Repairs with exposed reinforcement should be primed with a protective coating to reduce further corrosion and enable re-passivation of the reinforcement steel.
 - *Possible Option: Apply SikaTop Armatec 110 Epo Cem primer (or similar)*
 - Patch repairs to be made using either hand applied concrete repair mortars or using poured concrete. Either option is to ensure the colour and textured finish match the existing concrete.
 - *Possible option: Apply Sika MonoTop-225 Colour Match repair mortar (or similar)*
- d) **Apply a corrosion inhibitor coating** to all external faces of structural concrete that will diffuse through pores and protect reinforcement steel that has started to corrode and delay the onset of corrosion in unaffected reinforcement.
 - *Possible option: Apply Sika Ferrogard 903+ Corrosion Inhibiting Impregnation coating (or similar)*

- e) **Apply a further anti-carbonation coating or hydrophilic impregnation protection** to all external faces of structural concrete and PC cladding panels. The product will need to be a water based and transparent with a matt finish and UV resistant to match the existing condition.
 - *Possible option: Apply Sika Siloxane based water repellent impregnation coating (or similar)*
- f) **Re-grout the dowel connection joints internally behind the out-of-plumb PC cladding panels**
 - Local removal of the inner blockwork walls internally behind the PC cladding panels to provide access to connection joints.
 - The failed mastic joints will also need to be replaced to prevent future water ingress.

At the next design stage, RIBA Stage 4, it is recommended that further trial testing and samples are carried out on site to review coating and repair options. The testing will either be on a mock-up rig or undertaken directly on the structure itself. The latter will require listed building consent. An outline of the testing process is summarised below:

- Arrange for a test clean on a sample of external concrete elements (beams, columns and cladding panels).
- Apply various coating protection options on a test area. Sample areas to include at least 1 beam, 1 column and 1 cladding panel.
- Compare results of hand-applied concrete repair mortar and shuttered poured concrete. Colour matching and pigmentation of repairs to match existing is to be carefully considered. Refer to Figure 10 for the existing colour scheme.

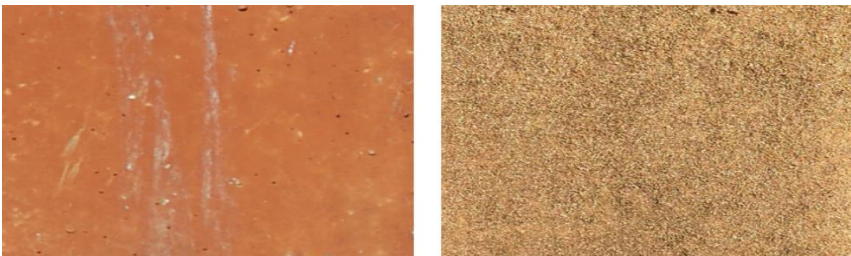


Figure 10 Pigmented concrete (ochre) and concrete cladding panels finished with exposed Thames Valley aggregate

5.2 Options and Factors

The various defects and deterioration processes affecting the structural members of the building have been documented and can summarised in the following 3 groups:

- Corrosion of reinforcement with either visible or hidden damage or non-visible and potential defects.
- Corrosion of post-tensioned strands within ducts, unlikely to result in visible damage prior to failure.
- Damage to the concrete either in the form of cracking, spalling, staining or chemical attack (chlorides).

5.2.1 Options

Prior to choosing the repair and maintenance strategy for the building, the six options and associated factors as presented in BS EN 1504-9:2008 are considered:

- a) do nothing for a certain time but monitor.
- b) re-analyse the structural capacity, possibly leading to downgrading in function.
- c) **prevent or reduce further deterioration.**
- d) **strengthen or repair and protect all or part of the concrete structure.**
- e) reconstruct or replace all or part of the concrete structure.
- f) demolish all or part of the concrete structure.

Given that the structure is a Grade II listed building and further deterioration could lead to health and safety problems to its users and the public, options *c* and *d* are relevant.

Options *a* and *b* have been disregarded as a large number of the existing defects must repaired to prevent further degradation of members, and also, the project brief requires the building to return to its original capacity and glory.

Options *e* and *f* have also been disregarded because none of the records of defects and damages indicate the necessity to reconstruct, demolish, or rebuild any parts of the building.

5.2.2 Factors

Several factors have been accounted for the selection of the repair strategy of each defect, including notably:

Health and Safety

- The consequences of structural failure.
- The effect on occupiers or users of the structure and on third parties.

Environmental

- The need or opportunity to protect part or all of the concrete structure from weather

Structural

- Actions (Loads) during and after implementation of the strategy

Basic

- The intended use and remaining service life of the structure.
- The required performance of the structure.
- The likely service life of the protection and repair works.
- The required availability of the structure, permissible interruption to its use and opportunities for additional protection, repair and monitoring work.
- The number and cost of repair cycles acceptable during the design life of the concrete structure.
- Possible methods of preparation of the existing substrate.
- The appearance of the protected and repaired structure.

As discussed in the following sections, the highest priority of repairs involves all these that pose a threat to the users of the building and the general public (falling debris, spalling concrete, etc.), followed by those aiming to arrest the further degradation of elements.

5.3 Principles and Methods

To meet the requirements of the client, the proposed repairs need to meet the objectives of preventing or reducing further deterioration and strengthen or repair & protect all or part of the concrete structure.

To ensure that the diagnosed issues highlighted in the section above are addressed, the following principles set out in BS EN 1504-9:2008 Section 6 are suggested to be used in the repair of the structure.

The principles and methods are divided into two groups: the first deals with defects in the concrete as a material; the second addresses defects caused by corrosion of reinforcement. The principles and methods adopted for this project are listed in Table 3 below.

Table 1 Excerpt of principles and methods for concrete repair

Principle	Methods based on principle	Relevant part of EN BS 1504 (where applicable)
Principles and methods related to defects in concrete		
1. Protection against ingress	1.1 Hydrophobic impregnation	2
	1.2 Impregnation	2
	1.3 Coating	2
	1.5 Filling of cracks	5
2. Moisture control	2.1 Hydrophobic impregnation	2
	2.2 Impregnation	2
	2.3 Coating	2
3. Concrete restoration	3.1 Hand-applied mortar	3
	3.2 Recasting with concrete or mortar	3
4. Structural strengthening	4.4 Adding mortar or concrete	3,4
	4.5 Injecting cracks, voids or interstices	5
	4.6 Filling cracks, voids or interstices	5
5. Increasing physical resistance	5.1 Coating	2
	5.2 Impregnation	2

	5.3 Adding mortar or concrete	3
6. Resistance to chemicals	6.1 Coating	2
	6.2 Impregnation	2
	6.3 Adding mortar or concrete	3
Principles and methods related to reinforcement corrosion		
7. Preserving or restoring passivity	7.3 Electrochemical realkalisation of carbonated concrete	
	7.4 Realkalisation of concrete by diffusion	
8. Increasing resistivity	8.1 Hydrophobic impregnation	2
	8.2 Impregnation	2
	8.3 Coating	2
11. Control of Anodic Areas	11.3 Applying corrosion inhibitors in or to the concrete	

(For full table refer to BS EN 1504-9:2008, Table 1)

The fundamental structural defect of the URS building is the corrosion of the reinforcement in the concrete. Corrosion of steel in concrete can be seen to be a two-stage process, namely initiation and propagation.

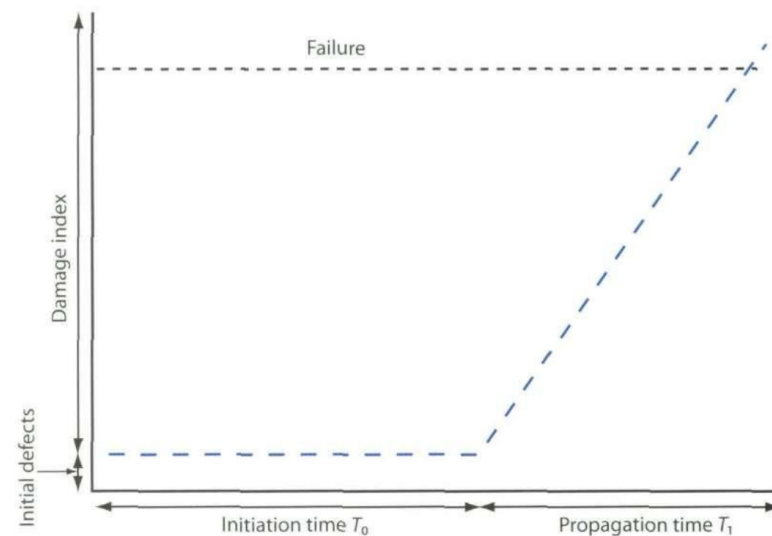


Figure 11 Graph of corrosion process in steel reinforcement

Further to the investigations and tests carried out on-site, it becomes apparent there are concrete elements within the *Initiation* stage and others in the *Propagation* stage where corrosion has been initiated.

The 1st principle (1.1 hydrophobic impregnation, 1.2 impregnation etc.) will assist in keeping the contaminants and moisture out. The same applies to the 2nd principle. The 3rd principle is required for the cases where the propagation phase has started. The 4th principle will protect damaged parts of the concrete and principles 5 and 6 intend to futureproof the concrete structure.

The second half of Table 2 relates to the reinforcement corrosion, i.e. the propagation phase. Upon the rehabilitation of the reinforced concrete elements, principles 7, 8 and 11 intend to arrest the steel's degradation and control or eliminate the cause of the de-passivation of the steel.

5.4 Repair And Protection Measures

The following repairs are recommended to meet the requirements of the overall repair strategy for each area of the building.

5.4.1 External Structural Elements (columns, in situ beams, transfer beams, PT beams)

- External structural elements are to be cleaned to the manufacturers' specification for the application of coatings that meet the requirements of the principles outlined in BS EN 1504 or to the heritage consultants' requirements (whichever is more onerous).
- Areas of spalled concrete to be repaired with mortar either hand applied or recast to the principles 3 and 4, meeting the specifications outlined for each in BS EN 1504. New mortar to also meet the requirements of the heritage consultant. This will control moisture, carbon dioxide and chloride ingress, increasing the durability of the concrete.
- Areas of spalled concrete with exposed reinforcement to be cleaned to manufacturer's specification before priming with a coating according to principle 7, meeting the specifications outlined in BS EN 1504. This will help to repassivate the steel reinforcement and protect against corrosion. Concrete is to be repaired with mortar either hand applied or cast to principles 3 and 4, meeting the specifications outlined in BS EN 1504. New mortar to also meet the requirements of the heritage consultant. This will control moisture, carbon dioxide and chloride ingress, increasing the durability of the concrete.
- Structural elements to be applied with a coating of corrosion inhibitor to principle 11, meeting the specifications outlined in BS EN 1504 across all external faces of structural concrete. This will diffuse through pores and protect reinforcement steel that has started to corrode and delay the onset of corrosion in unaffected reinforcement. The inhibitor helps to control cathodic areas of reinforcement and reduce the ability for corrosion to occur. Coating to also meet the requirements of the heritage consultant.
- All external faces to be coated with a hydrophobic impregnation or impregnation or coating that follows the principles 1, 2 and 7, meeting the specifications outlined for each in BS EN 1504. The coating must bridge across cracks to aid with durability. Following principles 1 and 2 will increase the durability of the concrete by protecting against moisture, chloride and external compounds. Following principle 7 will greatly reduce the ability for carbon dioxide to permeate through the concrete and therefore reduce the rate of increase of carbonation depth. Coating to also meet the requirements of the heritage consultant.

5.4.2 Precast Concrete (PC) Cladding panels

From the record drawings the first layer of reinforcement is galvanised steel. Therefore, the steel is resistant to corrosion even in conditions created by carbonation. Given the galvanised steel and that the precast panels are not structural elements, it has been deemed economical to not be applied with a corrosion inhibitor. Due to spalling likely to freeze thaw it is necessary to protect the concrete using a coating that will reduce moisture ingress without affecting vapour diffusion to manage the risk of falling concrete from spalling.

- PC cladding panels to be cleaned to the manufacturers' specification for the application of coatings that meet the requirements of the principles outlined in BS EN 1504 or to the heritage consultants' requirements (whichever is more onerous).
- Areas of spalled concrete to be repaired with mortar either hand applied or recast to the principles 3 and 4, meeting the specifications outlined for each in BS EN 1504. New mortar to also meet the requirements of the heritage consultant. This will control moisture, carbon dioxide and chloride ingress, increasing the durability of the concrete.
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5.4.3 Internal Structural Elements (columns, beams, slabs, shear walls)

Internal structural elements have not been exposed to the same conditions as external elements that make reinforcement susceptible to corrosion. Therefore, no additional repairs are recommended.

5.4.4 Roof (build-up, condition)

As the roofs are being replaced with metal decking concrete repair and protection measures are not applicable.

5.5 Test and quality control

Further testing of repair and protection strategies will be needed to meet the requirements of BS EN 1504 of the heritage consultant.

It is recommended test panels are created to test the performance of crack-bridging tests, colour, texture, cleanability etc.

Adverse effects of using multiple protection and repair methods should be considered. This includes increased rate of carbonation due to hydrophobic impregnation and reduced frost resistance from surface coatings entrapping moisture. Consultation with the manufacturer is required to ensure any adverse effects are mitigated.

5.6 Health and Safety

Due to concerns of spalled concrete falling from the URS building, the area is segregated with heras fencing. CRL have surveyed the external envelope to identify and report any areas where concrete has delaminated or become dislodged from the main structure, posing a risk of falling. This report and the CRL report is to be shared with University of Reading Health & Safety Advisor for appropriate action.

6.0 Maintenance Strategy

6.1 Plan

The need for maintenance is primarily determined by two key factors, Loss of functionality and aesthetic considerations. Recent advancements in technology have led to the development of modern repair mortars and surface treatments. When applied correctly, these materials can provide effective performance for many years, often lasting 10 years or more. However, like all materials, they will eventually deteriorate and require maintenance

Life to first major maintenance of protection coatings and concrete repairs is likely to be within the range of 5-15 years. The maintenance plan is to be agreed at the next design stage with the client and discussions with potential product suppliers regarding their repair system warranties. For instance, Sika can provide a high-performance concrete repair system, which carries a 10-15-year guarantee.

6.2 Scope

6.2.1 Seasonal Housekeeping.

To ensure proper maintenance and functionality of the building, the following tasks need to be addressed.

- Cleaning of the drainage systems and roof gutters to prevent blockages. Ensure rainwater is free to flow off the building and does not pool/pond for prolonged periods.
- Periodically remove any bird nests or residues that may obstruct airflow or drainage. (Consultation with an Ecologist may be required)
- Inspect and test rainwater outlets and associated chambers to check for damage or signs of wear.
- Remove any soiling and dirt retention that can cause any blockages or discolouration of the building. Ensure this task is carried out head of the annual visual inspection and in areas that might require inspection or maintenance.

6.2.2 Regular Visual Inspections

Once all repairs and protective measures have been completed, an annual visual inspection regime should be implemented.

The inspections should be carried out by suitably qualified personnel who are familiar with the repair history of the building and aware of all the protective treatments/measures and repair techniques that have been applied.

The objective of the inspection is to have a walk-around of the structure at the ground level and inspect every vertical and horizontal surface of the elevations, with the aid of binoculars for the higher points.

For the areas where previous repairs or surface treatments have been applied, some of the defects to look for include:

- Chalking (the formation of white, powdery residue on the surface of concrete)
- Colour changing
- Flaking (either of concrete laitance, or cover, or the surface coating)
- Cracking of concrete, crazing
- Loss of adhesion
- Blistering (small, round and raised areas formed by entrapped water vapour in surface-treated areas)
- Efflorescence
- Spalling
- Lime leaching (similar to 'chalking')
- Freeze-thaw damage (similar to 'spalling')
- Biological growth, algae,

A detailed logbook is essential for documenting all identified defects and the subsequent repairs performed. This log should include the following information:

- The date of each inspection conducted, noting who performed it.
- Description of each defect found, including its specific location and nature.
- Detailed accounts of the repairs carried out and methods used to address each issue.
- Dates when the repairs were completed, along with any follow-up inspections to ensure the effectiveness of the repairs.
- Specifications of the materials utilized in the repairs, including brand names, quantities, and any relevant safety or compliance information.

Maintaining a detailed logbook will provide a clear record of the condition and maintenance history of the equipment or facility, ensuring accountability and aiding in future maintenance planning.

Appendix

Appendix A Curtins Photographic Record



Photograph 1 - North Elevation overhangs



Photograph 2 - Concrete surveys on south elevation



Photograph 3 - North & West Elevations



Photograph 4 - South and East Elevations



Photograph 5 - South elevation PT beams cantilever



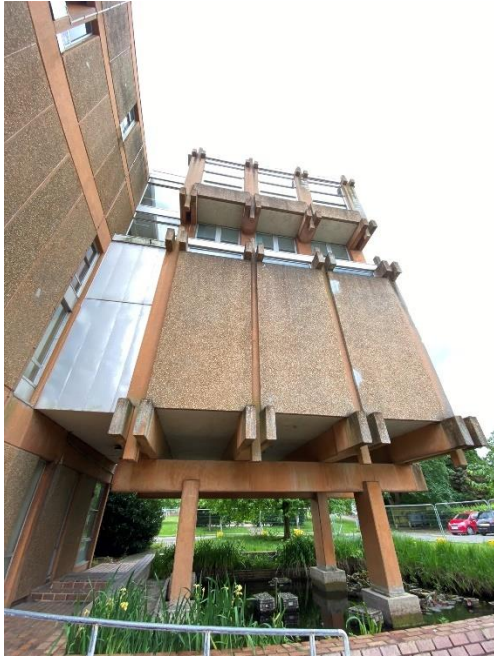
Photograph 6 – South elevation



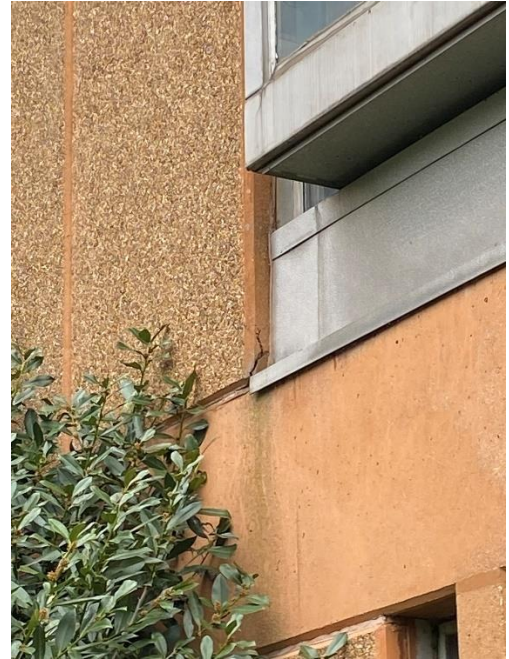
Photograph 7 - Concrete spalling on PT beam ends on south elevation level 1.



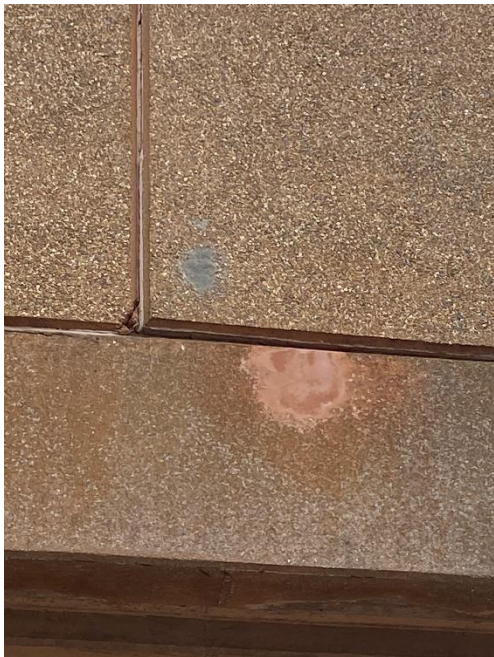
Photograph 8. Concrete spalling on concrete column located on southeast corner



Photograph 9 - West elevation above garden pond



Photograph 10 – Horizontal displacement of precast cladding panel at base. Concrete cracking also evident. Panel located on south elevation



Photograph 11 – Horizontal displacement of precast cladding panel at base. Concrete cracking also evident. Panel located on south elevation



Photograph 12 – Water damage to insulation cladding panel boards located on overhang soffits.



Photograph 13 – Walkway known as Chancellor's Way along North Elevation. The supporting structural columns forming a colonnade



Photograph 14 – Level 2 Transfer beam along north elevation.



Photograph 15 – Moss and algae growth on beam and cladding panels (general comment).



Photograph 16 – Previous concrete repair mortar repairs to concrete PT beam (level 3) on south elevation.



Photograph 17 – Diagonal hairline cracking on level 1 transfer beam above garden pond.



Photograph 18 – Moss and algae growth on concrete PT beam ends (level 1) on south elevation.



Photograph 19 – Vegetation growth on top surface of beam end tips (south elevation)



Photograph 20 – Failed mastic seals on precast cladding panels with daylight visible.



Photograph 21. Internal inspection of precast cladding panel fixings (top and bottom)



Photograph 22 – Detailed inspection of precast cladding panel fixings at top



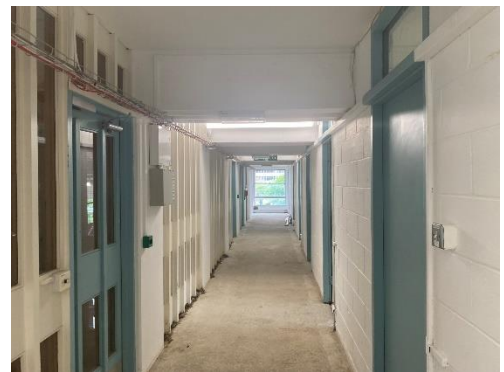
Photograph 23. Detailed inspection of precast cladding panel fixings at base to PT beam below



Photograph 24 – 50mm thick concrete block wall forming inner leaf behind precast cladding panels.



Photograph 25. – Damage to floor screed (50mm) on upper floor slabs



Photograph 26 – Typical corridor with non-loadbearing block walls between concrete columns



Photograph 27. Non-loadbearing block walls between concrete columns



Photograph 28 – Concrete shear wall along north-south direction between columns



Photograph 29. Concrete shear wall within lift shaft



Photograph 30 – Diagonal concrete block wall



Photograph 31. External light well with non-loadbearing block walls between concrete columns



Photograph 32 – vegetation growth on level 2 roof surface within light well.



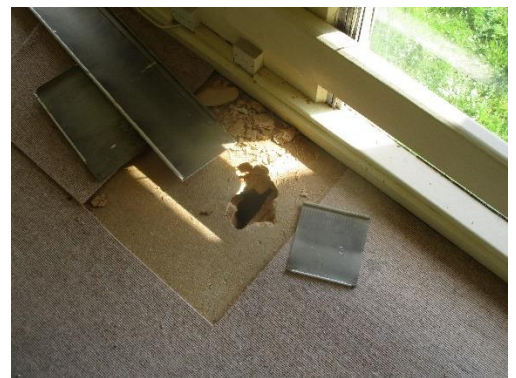
Photograph 33. Grazing cracks and peeling paint on level 2 columns within light well



Photograph 34 – Extraction of floor slab core samples by CRL



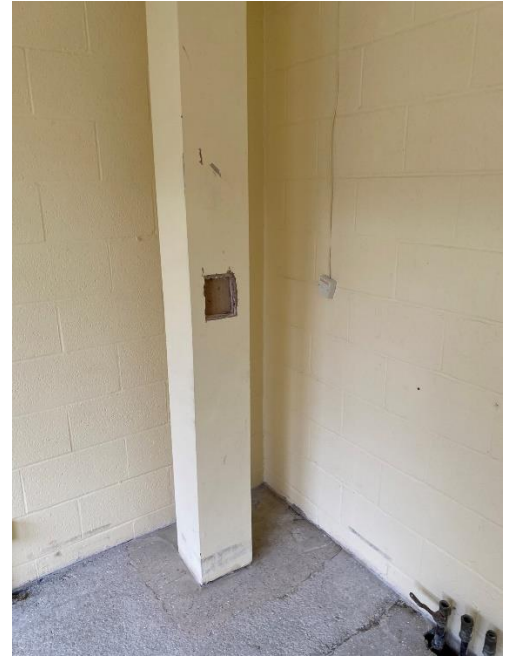
Photograph 35. 1990's Ground floor infill. Props installed on site.



Photograph 36 –Level 01 Top surface of infill floor. Timber boarding on joists.



Photograph 37. 1990's Ground floor infill. Steel beam and timber joist floor construction. Supported on new steel columns or Props installed on site.



Photograph 38 –Existing steel column (not original) to support new floor infill



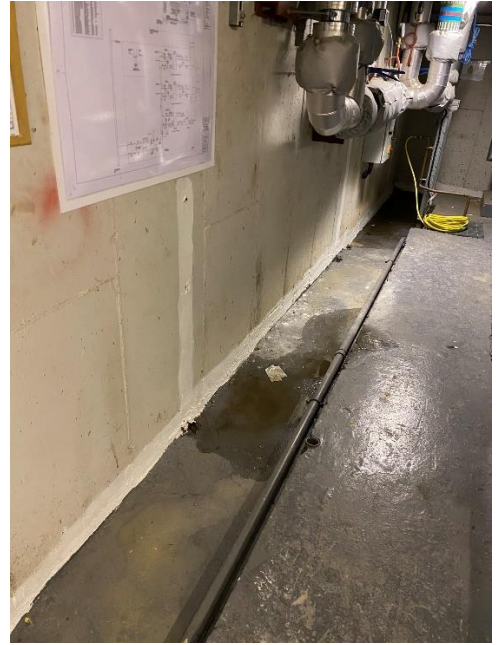
Photograph 39. Timber joists supported on steel beam (PFC) fixed back to existing structure.



Photograph 40 – East stair core with visual concrete.



Photograph 41. Honeycombing on basement retaining wall



Photograph 42 – Water leak from pipework above. Basement space notably humid.



Photograph 43 - Poor compaction and honeycombing issues on slab soffit between PT double beams.



Photograph 44 – Poor compaction and honeycombing issues on slab soffit between PT double beams.



Photograph 45. Level 4 roof (looking east)



Photograph 46 – Level 4 roof (looking west)

