



THE URS BUILDING

EXTERNAL CONCRETE REPAIR – CONDITION SURVEY

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1. INTRODUCTION

1.1. BRIEF

Purcell has been commissioned by The University of Reading to undertake a detailed visual inspection of the external concrete building elements at the Urban and Regional Studies Building (referred to henceforth as URS Building) on the University of Reading's Whiteknights campus and to prepare an accompanying report with recommendations for repair. These are to be reviewed and put forward as part of the ongoing negotiations with Wokingham Borough Council (WBK) in relation to the wider applications for the refurbishment of the building.

1.2. PURPOSE

Purcell were first engaged in late 2022 by the University of Reading to provide heritage advice in relation to the proposed refurbishment of the URS Building by Ayre Chamberlain Gaunt Architects. The proposals have been split into two separate but related applications for external and internal elements of the building. Jon Wright, C20 Heritage Consultant at Purcell, has been engaged in this process to provide a Heritage Statement and Heritage Impact Assessment in support of both applications.

The University is committed to putting the URS Building back at the heart of the campus both functionally and aesthetically and in terms of the latter, it has been important to address the concrete of the building as a key element of architectural significance and visual identity.

In order to achieve this, Purcell were commissioned to provide an outline condition assessment of the building exterior. This survey and report form key components of stages 3a (Assessment of Condition) and the initial steps for stages 4 (Development of Repair Strategy) of Purcell's URS Centre Concrete Strategy (Appendix A). Specifically, the purpose is to identify defects to the concrete building components in predefined areas, to assign priority ratings to defects depending on their condition and location. To accompany this, we have provided outline repair methodologies (Appendix G) which can be trialled and refined further as part of stage 3b and 4 of the Concrete Repair Strategy, prior to implementation of a package of works, and subsequent maintenance.

Over the previous 10 years, a number of programmes of intrusive investigation have been undertaken at the URS Building, in order to understand the condition of the reinforced concrete structure. The making good of trial holes and some other localised repairs have been completed with limited success and are deemed to have negatively impacted the appearance of the Grade II listed building. It is agreed that addressing some of these ill-conceived repairs along with any other areas of defective concrete would be recognised by the Council as a heritage benefit. This report is intended to identify prioritised repair types which may be presented to Wokingham Borough Council. The report aims to set out best practice for concrete repairs, to guide the scope of future repair packages and to satisfy the requirement to provide heritage benefits, proportionate to the impact of any wider development.

The report will consider inspection and maintenance activities, which fall partly under stage 6 of the Concrete Strategy, to ensure the longevity of the repairs and that future defects and deterioration are addressed in a timely manner.

The report will also identify other thematic issues and risks for consideration which may at this stage not relate directly to this scope but require action and consideration by the owner in the longer term in order to maintain the Grade II listed building in good repair and to reduce their liability risks.

1.3. STRUCTURE

Sections 1 and 2 of the report provide background information to the commission and the building respectively.

Section 3 sets out details of the inspections including but not limited to dates, weather conditions, personnel, limitations, definitions and further details to assist in the interpretation of the defects schedule, which can be found in Appendix F.

Section 4 of the report provides detailed analysis of the survey findings. This section is broken down into a general summary of condition, a section on specific defects and recommended repairs, together with other observations outside of the scope of this commission, as well as health and safety priorities.

Section 5 describes how the recommendations of the report may be implemented and provides next steps in order to progress works and negotiations with WBC.

The concluding **Section 6** provides an outline of further considerations for action by the client relating to repair works and ongoing management and maintenance of their asset.

The reported is supplemented by the following appendices:

<i>Appendix A:</i>	<i>Purcell Concrete Repair Strategy</i>
<i>Appendix B:</i>	<i>Statutory List Description</i>
<i>Appendix C:</i>	<i>Purcell Heritage Impact Assessment (HIA)</i>
<i>Appendix D:</i>	<i>Significance Drawings</i>
<i>Appendix E:</i>	<i>Key Drawings</i>
<i>Appendix F:</i>	<i>Defects Schedule</i>
<i>Appendix G:</i>	<i>Schedule of Defect and Repair Types</i>
<i>Appendix H1-H6:</i>	<i>Defect Drawings (with Priority Ratings)</i>
<i>Appendix J:</i>	<i>Photographic Record of Condition</i>
<i>Appendix K:</i>	<i>Health and Safety Items Schedule</i>

2. BUILDING DETAILS

2.1. LOCATION

The URS Building is located on the Whiteknights Campus of the University of Reading. The Whiteknights Campus is located to the south-east of the town centre of Reading, and is north-west of Earley, a historic village, now a suburb of Reading.

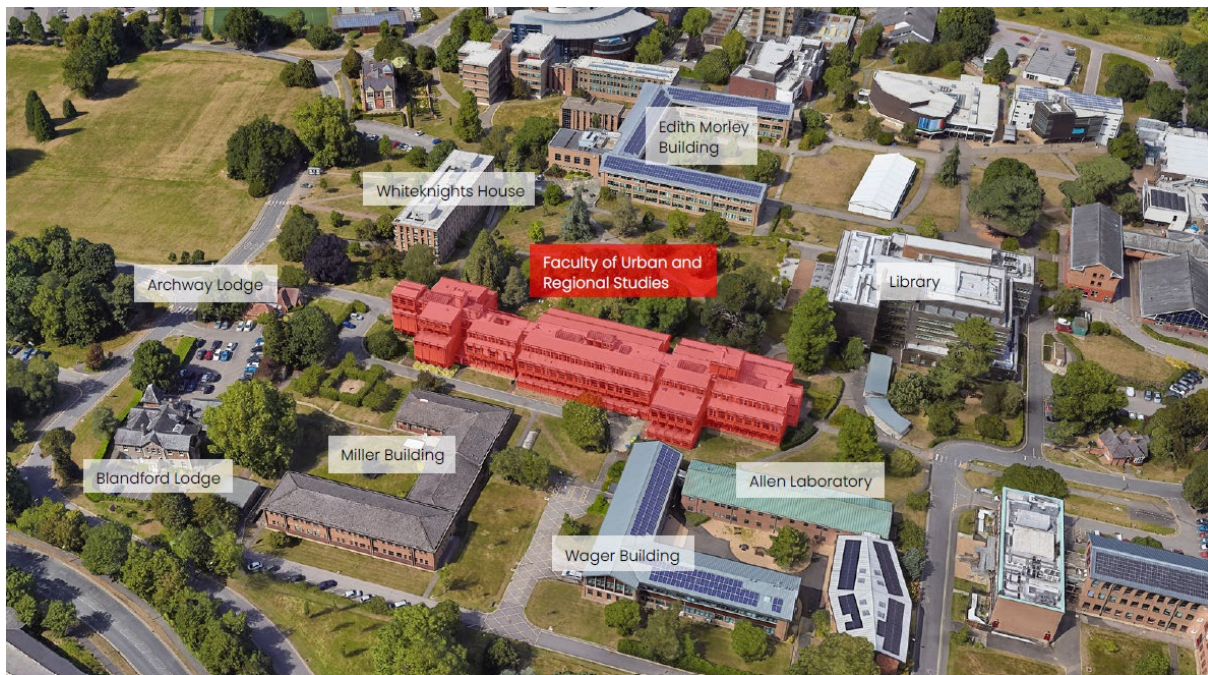
The building straddles Chancellor's Way, a historic route which traverses the historic Whiteknights Park on an east-west alignment. The URS Building is located in the western portion of the campus, where the teaching facilities are most densely concentrated.

Postcode:	WC1N 1BS
District:	Wokingham Borough Council
Ordnance Survey Grid Reference:	SU7332671728

The location of the URS Building is indicated on the aerial views below.



Location of URS Building within town of Reading



Location of URS Building on University of Reading Whiteknights Campus

2.2. STATUS AND OCCUPANCY

2.2.1. Building Occupancy

The URS Building is currently unoccupied. It was originally built to house the Faculty of Urban and Regional Studies and was used as a temporary studies centre from 2016 until 2019, while the main library building was undergoing a programme of refurbishment.

2.2.2. Tenure

The building tenure is a freehold to the University of Reading.

2.2.3. Maintenance Responsibility

Maintenance responsibilities lie with the University of Reading as the building owner/freeholder.

2.3. CONCRETE AS A BUILDING MATERIAL

Prior to discussing the specifics of the URS Building, it is felt pertinent to provide a brief summary of concrete as a building material to provide some context before discussing the issues identified.

Concrete is a porous composite material, composed of a mixture of cement, sand, aggregate and water. The nature and the type of each component will typically vary according to the desired appearance, performance and function of the material.

Concrete is used in two forms in construction, bulk concrete (un-reinforced) and reinforced concrete which includes some form of embedded steel, bars, mesh etc, to provide tensile strength. Each type of concrete has its place, but each is vulnerable to deterioration due to various factors, both environmental and as part of its original production and installation.

The factors affecting concrete include:

- the selection of the cement (binder)
- selection and grading of the aggregates (achieving a good variation in size of the particles, free from contaminants)
- the methods of mixing and batching the concrete (on site or off site and levels of consistency and quality control between batches)
- the methods of installing and finishing (relating to water content, compaction, eradication of air, sufficient cover, and careful placement)
- The use of chemical admixtures, which became commonplace at the height of concrete use in the mid/late 20th century to 'improve' and 'manage' the water content vs strength.

With this in mind, understanding that the makeup of the concrete will be unique to each building is critical and that it may even vary across that building depending on the batch and installer.

Since its use became commonplace from the late 19th century, there has been an ongoing conflict between the need to build fast whilst also requiring high quality construction. Innovations have been many, with the development and use of concrete through the 20th century but in many instances, innovation has been at the expense of something else, and industry standards have also struggled to balance these opposing issues, especially with regards to historic concrete and for buildings of high significance.

Skills have also slipped over the years, and it is only now as 20th century buildings are being valued for their historic and aesthetic significance that the area of concrete conservation is coming to the fore. In the late 1950s/early 1960s, Britain was known for its concrete craftsmen and for its high-quality pre-casting. By the early 1970s, when construction was underway at the URS Building, standards were known to have reduced significantly as concrete production struggled to keep pace with demand.

It was also becoming apparent at this time that the concept of concrete being a 'maintenance free' building material was a myth, and in fact concrete is as vulnerable to its environmental conditions as any other building material. The integration of two material components, where metal is also present in the form of reinforcement also poses significant issues, and so it became commonplace to apply coatings or surface treatments to resist water penetration.

One of the most frequent defects with concrete is the corrosion of the embedded reinforcement which causes the surface to spall and sections to detach from the building, presenting major safety risks but also permitting further water ingress into the fabric.

Concrete, when mixed, batched and installed has a high alkalinity (pH12-13). This high alkalinity of calcium hydroxide in fresh concrete provides and initiates a protective coating around the reinforcement, preventing it from deteriorating. However, when these hydroxides react with carbon dioxide (within the air and within rainwater), the alkalinity is reduced by a process of carbonation and hence the protective layer to the reinforcement is broken down (de-passivated).

If concrete is not maintained and/or water is allowed to get in, or compaction and air eradication has not been sufficient during construction, deterioration and corrosion of the embedded metal will occur. When metal oxidises as a result of contact with water (corrosion), it can increase up to 8 times its original size and push the surrounding fabric outwards. The result is cracking and/or spalling concrete and further exposure of the re-bar surface which then accelerates this form of decay and perpetuates a never-ending cycle.

The addition of chlorides (salts) can also accelerate this process further, whether as part of the original concrete mix (unwashed aggregates) or through later transmission (from de-icing roads or being physically located in a marine environment). Other environmental conditions, e.g.

temperature/humidity, ground movement can also affect rate and the nature of decay, but the corrosion of the reinforcement is by far the most common.

As these phenomena became apparent and better understood through the 20th century, ways to prevent the corrosion of reinforcement became more commonplace with the use of coatings, additives and concrete repair mortars. Concrete repair mortars come ready mixed and certified for strength. However, these mixes have nothing in common with the original concrete mix specification, being only concerned with strength, and therefore in conservation terms are inappropriate as they appear nothing like the original material and are unsuitable as like-for-like repairs. These later concrete repairs, which can be found across the URS Building, using premixed 'repair mortars' are also now showing significant signs of failure, for a variety of reasons, including being too shallow, not being properly bonded to the parent material and not addressing the underlying issues, thereby trapping or permitting further moisture ingress. As such, specialist understanding is required on, and developed through, an iterative process to provide a bespoke solution to concrete repair to historically significant buildings, alongside routine maintenance and repair.

2.4. GENERAL DESCRIPTION OF THE BUILDING

2.4.1. Building Description

The following descriptions are taken from the listing description (see Appendix B) and supplemented with observations made on site.

MATERIALS: the building is composed of an exposed reinforced concrete frame constructed with through-coloured ochre cement; the frame is infilled with pre-cast concrete cladding panels of brown Thames Valley aggregate and ochre-coloured cement, aluminium panels, and aluminium windows. The low-pitched roofs are also covered with aluminium sheet.

PLAN: the building forms the south side of an open space enclosed by Whiteknights House to the west, the Humanities & Social Studies Faculty to the north and the Library to the east. The building has a long, narrow, footprint, which runs broadly east to west; the north elevation faces out onto the open space. The building has four floors, plus a basement and a partial fifth floor with plant room over. The plan is centred on a 120m long top-lit spine, which forms the principal internal circulation space. Rooms, lecture theatres and teaching spaces, project irregularly out from the spine, and to the north they project over a wide double-height, brick-paved, pedestrian walkway known as Chancellor's Way.

The circulation spine takes the form of a double corridor sandwiching a central core of staircases, lobbies, lifts and light-wells. Lecture theatres and tutors' rooms are at first floor level with seminar and teaching rooms above. The ground floor is reserved for the printing and administration of the CEM's postal courses. With the exception of a small ground-floor infill extension, alterations are limited to minor internal rearrangements of partitions, to subdivide, or open up, rooms in discrete areas of the building.

EXTERIOR: the building's elevations are formed of irregular projections, bracing up its length with vertical and horizontal cut-aways to bring daylight into the corridors. The exposed structural frame creates a strong bay rhythm, and the joints of post and beam are exaggeratedly expressed, with the fork-ended beams resting on, or supporting, the shouldered ends of the columns, giving a playful emphasis to the building's rational construction.

The structure is made to work hard, with beams post-tensioned for large spans and cantilevers. The most dramatic projection is to the north, over Chancellor's Way; the supporting structural columns forming a colonnade. The principal entrances, each of which gives access to a stair, are arranged along the north elevation, but the heavy modelling is a feature of both north and south elevations. The two end elevations to east and west give the appearance that the building has been sliced like a stick of rock, to reveal the cross-section of the structure. At both ends there are also projections – to the east a service tower, and to the west the central spine advances forward at first, second and third floor, projecting out over a square, ornamental, pool.

The building's roofs are visible as shallow, mono-pitch gable ends from the east and west ends; built-in box gutters terminate in projecting spouts to carry water away from the building. The proportions and glazing pattern of the windows vary depending on the rooms they serve, and some are more architecturally expressed, forming shallow oriels.

Chancellor's Way, which runs along the north elevation of the building, is paved with brown brick paviours. The route steps up near the building, forming a continuous shallow podium along its length. To the west, the paviours wrap round to side of the building and form a raised edge to the square pool beneath the projecting end of the building.

The building's expressed structure is a typical feature of HKPA's work, recalling their interest in oriental timber construction. However here, the trabeated post-and-lintel aesthetic is translated to reinforced concrete and amplified to a monumental scale, creating a distinctive and extrovert aesthetic. It is a didactic building, showing how structural loads are transmitted; this was appropriate given that Construction Management was amongst the courses taught here.

2.5. BUILDINGS HISTORY AND SIGNIFICANCE

2.5.1. Building and Site History

A detailed history of the building and site is provided in Purcell's Heritage Impact Assessment (Appendix C). The following is a summary of the history.

The University of Reading

The origins of Reading University can be traced to the Reading Town Council's foundation of school of art and science within the town in the latter half of the 19th century. These schools were then converted into Reading College in 1892, as part of the Oxford University Extension Movement. This movement was aimed at bringing 'education of a university type within reach of those who cannot go to university', bringing with it a grounding in 'liberal' and technical education' and a means by which 'the chosen intellects of all classes may climb to the universities themselves.' Much of the college's teaching and administration occurred in the medieval former Hospitium of St John, part of the former Reading Abbey complex.

By 1906 Reading College's activities were largely focused on and around London Road where they leased five acres and series of five connected terraced houses for university use. In 1905 the Great Hall was erected on the London Road campus. In 1908 Wantage Hall was built. This quadrangular

building, which drew inspiration from medieval Oxbridge colleges, housed a grand hall, residences and was entered from Upper Redlands Road via a grand, crenelated gatehouse.

In 1926, the College successfully petitioned for the grant of a Royal Charter and had university status conferred the following year. The University remained on the existing London Road site, but it was considered that the site was significantly too small to accommodate the university's post-war growth.

New buildings were gradually erected in Whiteknights, the university's architectural approach seeking to ensure the 'great natural beauty of the Park must be preserved, and even enhanced, and that the buildings to rise on it shall be appropriate to their background in design, construction and material.'⁰⁶

Early construction on the campus was largely carried out by the firm of Easton and Robertson (later known as Easton and Roberston, Cusdin, Preston and Smith), who were selected as main campus architects in December 1948.⁰⁷ They designed the Faculty of Letters, a large U-plan building to the north of the URS building, which was completed in 1957. They also designed the library directly to the north-east of the URS building, which was completed in 1964 and overclad and altered substantially by Stride Treglown in the 2010s.



1994 Ordnance Survey map, approximate site of the URS building outlined in red

Howell, Killick, Partridge, and Amis

Bill Howell, John Killick and Stanley Amis met in 1948 at the Architectural Association in London. Howell, two years older than the others, had studied at Gonville and Caius, Cambridge before moving to the AA, where Amis and Killick were entering their 4th year.

The AA was a leading architectural school, playing a key role in post-war architectural culture, with roughly half of the leading British architects of the period passing through the institution.

Upon their graduation from the AA in 1950, Howell, Killick and Amis joined the architect's department of the London County Council. John Partridge arrived there via a different route, signing up to a part-time architectural training scheme administered by the L.C.C. and Regent Street Polytechnic in 1943 when he was working in the council's public health department.

In 1959 Howell, Killick and Partridge was established as an architectural practice, following the team's second place finish in the landmark competition for a college campus for the newly founded Churchill College at the University of Cambridge. The plans were worked up in Howell's basement and, although unrealised, represent the first of the firm's striking collection of university buildings. This was followed by commissions to design buildings at the University of Birmingham (Faculty of Commerce and Social Science, 1959–64), St Anne's College, Oxford (Wolfson & Rayne Buildings, and Gatehouse, 1960–6), St Anthony's College, Oxford (masterplan, 1960–1; Hilde Besse Building, 1966–70), the University of Cambridge (University Centre, 1963–7), Downing College, Cambridge (Senior Common Room and Kitchen Block, 1965–9), and the University of Warwick (Mathematics Research Centre houses (1966–70). All of the above projects, aside from the St Anne's Gatehouse, demolished in 2014, are on the National Heritage List for England. Amis joined the practice later, in 1961.

HKPA and the University of Reading

In 1969 Bickerdike, Allen, Rich & Partners (BAR) developed a masterplan for the campus which argued that the university should change its approach to its layout in line with shifting requirements.

'The policy of development in Whiteknights has been to spread buildings thinly, so that parkland rather than buildings dominates. This was apparently determined when people had in mind a small University of some 1,500–2,000 students, when it was practicable for landscape to flow freely among loosely located buildings. Today this has already changed [...] Our function has been to examine the implications of growth in respect of land, density, movement, landscape, and building forms, and the changes that may be needed not merely to deal with the problems foreseeable up to the 1980s, when the University will likely have some 8,000 students [...] but to peer beyond this period into the more distant future.'

The URS building formed part of BAR's proposed densification of the campus, terminating the southern side of a loose quadrangle, enclosed to the east by the library, west by Whiteknights House and north by the Faculty of Letters. This plan envisaged the concentration of teaching activities to the south-west of the Whiteknights site, with residential halls to be constructed to the extreme north and eastern fringes of the park, open parkland separating all three.

Structure and materials at URS

HKPA worked with Frank Newby of Felix Samuely and Partners. Newby had lead the practice since 1956 when the eponymous Felix Samuely had died; the latter was a pioneering engineer at the cutting edge of English architectural culture since he had left Nazi Germany in the early 1930s. Newby ensured that Samuely's practice retained its cachet, working on a series of highly significant post-war buildings, including James Stirling's acclaimed Red Trilogy (the History Faculty at the University of Cambridge, Engineering Building at the University of Leicester, and Florey Building for Queen's College, Oxford – the two former buildings are Grade II*, the latter is Grade II), Cedric Price's Snowdon Aviary at London Zoo (a Grade II* listed tensile structure), and the American Embassy by Eero Saarinen (Grade II).

The URS building moved beyond the subtler articulation of external structure evident in HKPA's earlier works. Where octagonal columns were revealed between splayed pre-cast panels at the Acland Burghley School and Hilde Besse building at St Anthony's College, the URS building more overtly demonstrates its structure to the viewer, representing, in one commentator's eyes, 'a major departure from previous practice' by HKPA.

The URS building has a load bearing concrete frame, with all of the structural members up to 2.5 tons in weight being pre-cast, with any heavier members cast in situ. Beams with longer spans were post-tensioned, in order to increase their rigidity, with the associated anchorage pockets visible in a number of beams ends visible across the building.²⁹ A heavily pigmented mix of concrete was used across these members, intended to blend the colour palette of the building with the neighbouring buildings on campus thanks to its red-tinged tan colour, which matches the stock brick of the Faculty of Letters and concrete cladding of Whiteknights House.

The concrete members all have a fair faced finish. They contrast with the infilling, pre-cast concrete spandrel panels, which are textured with Thames Valley gravel and tinted a less pronounced red. This speaks to HKPA's oft adopted differentiation between fair-faced structural members and roughly textured infill panels, evident at Acland Burghley. Otherwise, single-glazed windows set within metal frames, and metal infill panels (textured) and weathering details (flat) were used to clad the façade.

The roof of the building has been retained and is formed from sheets of aluminium with standing seams. The underside of the roofs was originally clad in wood wool or woolcrete panels. The partitions are formed from unplastered blockwork, which was originally left unpainted, as were most of the internally expressed columns and beams.



Standard beams (below) and post-tensioned beams, distinguished by the infilled anchorage pockets (above)

2.5.2. Building Significance

Purcell's Heritage Impact Assessment (Appendix C) provides a detailed assessment of significance and includes the following in its assessment of significance:

Significance of URS Building

Significance can be defined as the sum of the cultural values which make a building or site important to society. When making an assessment of significance numerous aspects are considered including architectural interest, historic interest, group value, social value, former uses and local distinctiveness. These aspects can be grouped under a series of four values outlined in

English Heritage's Conservation Principles, Policies and Guidance (2008): Evidential, Historic, Aesthetic and Communal. A description of each value is given under the headings for each section.

The significance of the URS Building is assessed using significance ratings from High to Detrimental.

This section addresses the intrinsic architectural, historic and communal qualities of the building and its landscape. To this end the building does have a range of heritage values that are here set out in more detail and expressed in a sequence of coloured plans which are given at the end of the section.

- High: A theme, feature, building or space which is important at national or international level, with high cultural value and important contribution towards the character and appearance of the heritage asset and its setting.
- Medium: Themes, features, buildings or spaces which are important at regional level or sometimes higher, with some cultural importance and some contribution towards the character and appearance of the heritage asset and its setting.
- Low: Themes, features, buildings or spaces which are usually of local value only but possibly of regional significance for group or their value. Minor cultural importance and contribution to the character or appearance of the heritage asset and its setting.
- Neutral: These themes, spaces, buildings or features have little or no cultural value but do not detract from the character or appearance of the heritage asset and its setting.
- Intrusive: Themes, features, buildings or spaces which detract from the values of the heritage asset, its setting, character and appearance. Efforts should be made to remove or enhance these features

Key Elements of Significance

- As a Grade II listed building designed by one of the leading practices of the Post-War Period, HKPA
- As a key building in the wider historic campus of Reading University
- For its impressive structural qualities derived from a variety of lines of architectural enquiry including Brutalism and Japanese methods of construction
- For its designed setting including the re-imagining of the historic carriageway and ornamental pond and the use of colour as a metaphor for the surrounding landscape
- For the contextual and rare use of pigmented concrete in two tones
- For the expression of 'vertebrate architecture' as a means of spatial planning and educational engineering in building design
- For the consistent use of materials on the interiors, including timber and steel, which give a coherence and unity across the building

Evidential

"The potential of a place to yield evidence about past human activity."

LOW SIGNIFICANCE

URS is a relatively recent building which has been well-documented since construction and is supported by recent scholarship. There is consequently little more to know about the construction techniques and skills that went into it that we do not already understand. Of note in terms of original archive material is the fact that this assessment has been unable to source the extensive RIBA archives of the HKPA practice as these are currently not accessible. There is the possibility to

understand more about the building's design genesis and construction within this archive, but this is not thought to be hugely significant – more an embellishment of what we already know.

Its use as an educational building for a specific subject meant it was a rather bespoke piece of architecture, the design of which was closely allied with functional requirements. This is a facet shared by a number of university buildings of the Post-War period and does have something to tell us about the way in which Post-War architects provided purpose-built spaces that were often client-led and programmatic in their design ethos. This is an important facet of URS and is manifest principally in the plan form of the ground and first floors mostly. This tells us about how the building was used for teaching and learning and expresses its social engineering, and this is a part of its ongoing evidential value.

For the above reasons the building's evidential value is considered to be low.

Historic

"The ways in which past people, events and aspects of life can be connected through a place to the present."

MEDIUM SIGNIFICANCE

The historic value of the URS Building rests principally on its association to HKPA. HKPA were a complex and interesting Post-War practice where support and collaboration were key to the output.

The four partners all worked closely together, overseeing each other's work. For such a practice, there was a remarkable degree of coherence in the aesthetic qualities of their architecture. Their key buildings – of which URS would be one – demonstrate a consistent expression of historic reference, focus on structural form and attention to detail with materials and finishes. URS expresses all these attributes and for its place in the canon of HKPAs work, has considerable historic value.

One of these attributes can loosely be termed contextualism and this is manifest in the use of colour which was designed to match the existing buildings on the campus at the time of construction and echoing and continuing, of the historic campus in the new building.

HKPA designed a number of important Post-War buildings and their work in the sphere of higher education – particularly at Oxford and Cambridge colleges – is well represented on the national list. Their work was widely published and has received consistent critical and scholarly attention, most recently as part of the C20 architects series published by the RIBA/C20 Society. Their largest and most notable project, Roehampton Lane (the Alton Estate) is one of the key works of Modern Movement architecture in Post War Britain and remains a touchstone for architects. Although there were a few private commissions, the legacy of the practice is largely either public or educational and this echoes the origins of the four men at the LCC Architects Dept in the early years of practice. Within the context of their work, the URS building stands as something of a culmination of their collective ideas but is not hugely noteworthy or pioneering as an expression of them. Ideas about structural expression are well-evidenced in their earlier work, which would include the Hilda Besse building at St Anthony's and the work at Downing College in Oxford and the boldness of form evidenced by Roehampton and St Annes had also been explored before. URS took the idea of structural timber forms in concrete – trabeation – to a logical and large-scale conclusion and for that, does hold historic value but it was not widely copied and inside their oeuvre was only continued in less successful projects like the Weston Estate.

There is also historic value attached to the history of the College of Estate Management, the life of which had begun immediately after the First World War having been founded by Sir William Wells in

1919. Three years later, the College was granted a Royal Charter which would detail the core purpose of the college, namely, to provide truly accessible, relevant and cost-effective education, enabling students to enhance careers, increase professionalism and contribute to a better built environment. The University College of Estate Management celebrated its centenary in 2019. The URS Building and the residential hall also designed by HKPA were purpose built for the College after it sought closer ties with Reading University in 1967.

For these reasons the historic value of the URS building is considered to be medium overall.

Architectural and Aesthetic

“The ways in which people draw sensory and intellectual stimulation from a place.”

BY ELEVATION

NORTH – HIGH

SOUTH – MEDIUM

WEST – HIGH

EAST – LOW

EXTERIORS – VARIED SEE PLANS

INTERIORS – VARIED SEE PLANS

LANDSCAPE VARIED SEE PLANS

Introduction

The architectural value of the URS Building rests on a number of interrelated values to do with its design, materiality and setting. These elements are below taken in turn as a prelude to significance judgements about the four principal elevations and their settings. Plan form and key interior spaces are then discussed. The values given in the text are then expressed in a series of coloured plans which are given at the end of the section.

Design

The URS building is architecturally distinctive and is a developmental expression of a number of sensibilities of the HKPA practice throughout their active years. Of primary value to the aesthetic of URS is HKPA's collective interest in expression of structure and the legibility of structural components in any given design. Although this is seen in a number of HKPA buildings, the scale and repetition of the beams at URS make it one of the most expressive of any of their major works and the trabeation is an important visual component in this regard. This element of the design also had an important relationship to Japanese architecture, which was a touchstone for a number of important architects Post-War, including the Smithsons. There is also value in the expression of 'vertebrate architecture' where functional sequences of spaces were designed as nodes off a main, central spine and where the movement of people was a considered element of the design. HKPA were concerned with this in most of their projects and it again echoed wider pre-conceptions of the period – particularly in higher education. Sir Denys Lasdun's Academic Teaching Wall at the University of East Anglia (UEA) was a larger version of this socially engineered solution for large-scale teaching spaces where laboratory, seminar and faculty accommodation was concentrated in repeating sequences off a central spine corridor that had a social function. Some of those ideas are expressed – albeit in a smaller way – at URS, with stairwells, corridors, atria and communal breakout spaces expressed centrally on plan as part of circulation.

Materiality

Concrete was the chosen material for HKPA on a number of their most important projects and the firm developed a high level of sophistication in using both in situ and precast types of the material. The firm's oeuvre has been widely characterised as Brutalist and this indeed holds true for many of their major, early works including Roehampton and Acland Burghley School, both of which rely on exposed concrete finishes for their aesthetic character. Acland Burghley is rather a pre-cursor to URS as the structure is a combination of pre-cast and in-situ concrete elements, clad with pre-cast panels with an exposed aggregate finish of Walley flints. At URS, the distinctive two-tone colouring does carry significance both as an interesting contextual design element and as an aesthetic choice.

Setting

The immediate setting of the building is part of its architectural design and there is a formal and designed relationship between some of the internal and external spaces. Most significant in this regard is the covered walkway to the northern side.

2.6. DESIGNATED HERITAGE ASSETS

2.6.1. Statutory Listing

The URS Building is Grade II listed, first listed in 2016 as *URS Building, including the paved surface of Chancellors Way and raised edges of the ornamental pool, University of Reading*.

The statutory list description (NHLE 1435127) is available on the National Heritage List for England and is reproduced in Appendix B.

2.6.2. Conservation Area Designations

The URS Building is not located within a Conservation Area.

2.7. REPAIR AND MAINTENANCE HISTORY OF THE BUILDING

There appear to have been very few examples of significant repair and maintenance activities to the building since construction was completed in 1973, and we have not been provided with any historic maintenance or repair records.

There are numerous small repairs or fills which appear to date to the time of construction and these include mortar fills to threaded sockets built into pre-cast concrete panels. Also noticeable are mortar repairs to the top edges of the concrete beams. Sometimes these are hardly distinguishable from the concrete of the beam itself but in other places the mortar does not match the concrete so well. In many locations, these repairs are beginning to fail with cracking along the junction of the repair to the concrete. The precise cause of the cracking has not been established but may be due to loading of the pre-cast panels onto the top outer edge of the beams, outward movement of the pre-cast panel pins or spalling of concrete due to corrosion of reinforcement to the top edge of the beams. Further research and investigation would be required to fully understand the history, cause and failure of these repairs. These repairs are reasonably discrete and would only require repair or replacement where they are failing.

A smaller number of recent repairs have been carried out, either to spalling concrete or where holes or openings have been formed as part of CRL's intrusive investigations in 2015, 2016 and 2019. These have generally been undertaken in a grey proprietary mortar which is not consistent with the original finish or colour of the concrete and are visually jarring. Some of these repairs are now failing due to the continued corrosion of the reinforcement. It is understood that these repairs were intended to be temporary in nature, with the purpose of preventing further deterioration, rather than as a permanent repair. There was at least one instance noted of the exposed reinforcement having been coated with a protective treatment but with no mortar covering. It is unclear what product was used to treat the reinforcement.

2.8. BACKGROUND DOCUMENTS AND ADDITIONAL INFORMATION ON PREVIOUS WORKS

2.8.1. Previous Survey/Inspection Reports

The University of Reading have kindly provided access to the following documents:

- 2014 AECOM: UoR URS: Structural Survey Report
- 2014 AECOM: UoR URS: Second Phase – Intrusive Survey Works Specification
- 2015 CRL: Limited Investigation Works at URS Building for University of Reading
- 2017 CRL: Limited Investigation Works at URS Building for University of Reading
- 2019 CRL Fixing Investigation to 2no. Pre-cast Panels
- 2021 CRL: Cladding Panel Investigation at URS Building for University of Reading
- 2022 Oakleaf: Condition Survey for University of Reading
- 2023 AECOM: UoR URS: Structural Survey Report
- 2023 AECOM: UoR URS: Structural Constraints Summary
- 2023 AECOM: UoR URS: Second Phase – Intrusive Survey Works Specification

These reports have been prepared to help understand the condition of the building and specifically the concrete components, in relation to the previous Hawkins/Brown scheme and the current Ayre Chamberlain Gaunt scheme.

A. 2014 AECOM UoR URS: Structural Survey Report and 2014 AECOM UoR URS: Second Phase – Intrusive Survey Work Specification

This initial structural survey undertaken by the project engineers identified a number of defects to the concrete structure which included:

- Poor previous repairs, generally to locations of previous survey work.
- Cracking due to deflection.
- Expansive corrosion to reinforcement bars resulting in spalling of the concrete.
- Carbonation of the concrete.
- Inadequate concrete cover.
- Poor concrete compaction.
- Potential presence of chlorides.

The report recommended monitoring of the structure in various locations in relation to movement around the pond feature, movement relating to nearby vegetation, deflection and associated cracking to the west end in particular. The report also recommended repairs to areas of cracking and spalling concrete due to expansive corrosion with consideration to installing some form of corrosion management system, to reduce risk of incipient anode effect, where corrosion of the

reinforcement adjacent to the repair site takes place. Further intrusive investigations were recommended to determine the current condition of the concrete and reinforcement, to identify the fixing detail for the pre-cast panels and to identify suitable remedial measures.

The AECOM report noted that the majority of the defects were aesthetic and did not have significant structural implications.

AECOM subsequently prepared a specification for intrusive investigations covering the following:

1. Tactile survey of high-level structural members – Access by cherry picker to survey a sample of high-level members to determine their condition and record common defects.

2. Intrusive testing of external concrete elements to determine residual design life and repair strategy

- Specification of half-cell potential surveying to determine whether corrosion is occurring to a sample of concrete members which do not yet exhibit external signs of corrosion.
- Specification of hammer testing of concrete elements to detect for signs of hollowness associated with reinforcement corrosion.
- Investigate condition of the embedded post tensioned cables and inspect post tensioned beam end repairs undertaken in 2011.
- Durability investigation of members to check reinforcement cover, record depth of carbonation and test for chlorides and sulphates.
- Transfer beam cracking investigation – opening up works to investigate cause of apparent shear cracking to concrete transfer beams

3. Survey of precast panel connections – opening up of corners of pre-cast panels to provide access to fixings and allow inspection using borescope or videoscope to identify connection type and condition.

B. Intrusive Investigations

Investigative works were undertaken by CRL with specialist testing by Sandburg in 2015 and 2017. The investigations and testing included the following:

- Visual condition survey of mainly the exterior facades
- Hammer testing
- Concrete cover measurements
- Chloride content analysis
- Carbonation tests
- Half-cell potential measurements and opening up/visual corroboration
- Concrete core specimen analysis – petrographic and concrete strength
- Reinforcement distribution and detailing
- Post-tensioned beam investigations – vacuum testing of ducts, grout sampling and analysis, visual inspections
- Cantilever deflection

Specific investigations to assess the fixing of the pre-cast cladding panels were undertaken by CRL in 2019 and 2021. On completion of the investigations, temporary making good was undertaken using proprietary mortars.

2015 Results of Testing and Analysis:

Defects observed included the following:

- The structure was visually deteriorated and exhibited distress in some areas.
- The exposed surfaces were variably weathered and discoloured, consistent with concrete of this age.

Concrete cover measurements

CRL reported that the depths of cover recorded in the investigated locations may have been considered as adequate when compared to the standards in force at the time of construction but would not be acceptable by those of today.

An average depth of minimum cover was not given, but in places it was found to be as little as 10–15mm. Reviewing the Ferroskan output in the tested areas, cover was mostly a minimum of 30mm with localised areas of reduced cover. Areas with least cover appeared to be to beam soffits.

Carbonation testing

Carbonation occurs when carbon dioxide in the atmosphere dissolves in the moisture present in the concrete and forms an acidic solution, this reduces the alkalinity of the concrete so that passivity around the steel is lost and corrosion can then occur. Where the depth of carbonation is the same or greater than the depth of cover to the reinforcement, there is a risk of corrosion.

In CRL's opinion, the depths of carbonation recorded were, in places, in excess of the expected range.

Not many values for carbonation depth were provided in the report and so it is hard to assess how extensive this issue was, but there were certainly instances where the carbonation front had extended to or beyond the reinforcements. From the data provided there was no particular pattern to variations in carbonation depth.

Chloride content

If chlorides of a significant % reach the depth of the reinforcement, the passivity around the bar is lost and corrosion can occur. The corrosion has a cutting effect through the bar and can result in loss of continuity.

Chloride ion contents as a percentage by weight of cement were consistently 0.1% in the tested areas. This is considered to be in the normal range. It is thought that in the case of the URB building the chlorides were cast into the original construction rather than entering the concrete through contamination.

CRL reported that for concrete of this age, i.e. probably approaching 50years-old, with the carbonation as recorded and containing 'cast-in' chlorides in the above proportions, BRE Digest 444 would suggest risk categories ranging from 'Negligible' to 'Moderate' in terms of the potential for steel reinforcement corrosion, depending on whether the concrete is damp or dry.

Sulphate content

Sulphate content was found to be within the normal range being less than 4%

The Relative Depths of Cover to the Reinforcement and Carbonation

According to CRL, the relative depths of cover to the reinforcement and carbonation indicated that in most of the areas tested the carbonation front had not yet encroached upon the reinforcement. However, where this had occurred there was evidence of expansive corrosion and spalling of concrete.

Corrosion of Reinforcement

CRL's findings from various investigations using electrochemical procedures indicated that the reinforcement, in the areas with shallower depths of cover, was probably actively corroding. The half-cell potential values indicated a corrosion risk of 10% or less, generally in the sheltered areas but a greater than 90% risk of corrosion generally in the areas of current spalling.

Limited direct inspection of the reinforcement at existing spalled and probed locations generally confirmed that the reinforcement was clean and uncorroded, with the passive film intact when

encapsulated within uncarbonated sheltered concrete. However, the steel exhibited variable evidence of deterioration and corrosion when encapsulated within carbonated and / or chloride contaminated concrete.

Post tensioned beams

The investigation of the post tensioned beams generally confirmed that the grouted tendons were in a good condition with no deleterious corrosion identified. Where there are voids in the grout then there was an increased risk of corrosion.

Conclusion

CRL concluded that on the basis of the investigation results, the concrete elements had deteriorated and become distressed mainly as a result of localised carbonation induced corrosion.

Using BRE tables for assessing corrosion risk and prognosis and taking into account BRE classifications of exposure conditions, the risk of further corrosion was likely to be negligible to moderate. The exposure conditions were assessed to be moderate to severe on the basis that the concrete surfaces were exposed to severe rain, alternate wetting and drying, or occasional freezing or severe condensation. Taking these two assessments together, CRL's prognosis was that continued corrosion of the reinforcement spreading from currently affected areas should be allowed for in considerations for repairs and remediations.

2015 Recommendations

CRL's report made the following specific recommendations:

- Conventional concrete patch repairs to replace existing patch repairs and to areas of spalled or spalling concrete.
- Application of an anti-carbonation coating with a view to minimising further deterioration.

With this approach they anticipated periodic maintenance and reapplication of coatings and minor, isolated repairs to new spalls. Periodic inspections and tactile make-safe surveys would be necessary to identify any new areas of expansive corrosion and spalling and to prevent the risk of falling material.

While the report described the process for electrochemical rehabilitation (i.e. cathodic protection), no specific approach is recommended.

Commentary

The report allows for general conclusions to be drawn, but the limited amount of sample data presented in a directly comparable manner, limits the ability to analyse and draw firm conclusions or develop a building wide strategy.

2017 Results of Testing and Analysis:

A further CRL report from 2017 is very similar in its purpose, although it presents comparable data for more sample areas (13no.).

Concrete cover measurements

The depth of cover in the test areas was generally found to be around 40-50mm, with two areas of shallower cover at 28mm and 21mm.

The Relative Depths of Cover to the Reinforcement and Carbonation

Generally, the relative depth of cover to the reinforcement and carbonation was approximately 30mm, with only 3 out of the 13 areas with notably less at 23mm, 18mm and 6mm. Only one of these areas was at significant risk of the carbonation front meeting the corrosion within the near future. Within the samples, there were no instances of carbonation extending to or beyond the reinforcement.

Chloride content

There were more instances of chloride levels exceeding the normal range, with 4no. samples in the range 0.2% to 0.5%.

Sulphate content

Sulphate testing was not undertaken as part of this investigation.

Corrosion of Reinforcement

No half-cell potential testing was undertaken.

Pre-cast panel condition

2no. openings were made from the interior to enable inspect of the rear of the pre-cast panels. In both locations the panels appeared to be in good condition.

2017 Conclusion and Recommendations

No specific recommendations were made in the report.

Commentary

A greater number of samples (13no.) were presented in a directly comparable way, making analysis and interpretation slightly easier than the previous intrusive investigation report. The report itself was purely factual with no analysis or recommendations. The sample data would suggest that there was adequate cover to the reinforcement to a greater extent of the building than was apparent from the first survey, that the depth of carbonation was generally less and the relative depths of cover to reinforcement and carbonation were greater than apparent from the 2015 investigation. While it would be possible to draw the conclusion from the 2017 investigation report that the risk of carbonation induced corrosion was less than previously thought, the samples were taken from a limited number of locations (east and west end elevations and 1no. north return elevation) and visual inspection shows more extensive shallow cover, corrosion and spalling.

It would have been helpful to aggregate all survey data from two intrusive investigations and to include a greater degree of analysis and interpretation to assist decision making on future repairs and protections.

2019 Fixing Investigation to 2no. Pre-cast Panels

In 2019, CRL were asked to identify the fixing details of 2no. pre-cast cladding panels located to either side of the south lecture theatre and establish the probable cause of apparent panel misalignment / movement.

The investigation took the form of non-destructive measurement, remote scanning to identify the location of fixings and breaking out to the lower front face of the panels to enable borescope / endoscopes inspection.

Both panels were found to be restrained by means of vertical pins / bars slotted into the pre-cast channels provided in the frame of the panels. Both pins / bars were found to exhibit a considerable amount of movement / play within the channels. No evidence of grout nor any chemical fixing was observed. Both bars were in a relatively good visual condition albeit with some minor surface corrosion.

2019 Recommendations

The report recommended further assessment of the adequacy of the specific fixings as well as further investigation of fixings to establish the potential for wider issues across the structure.

Commentary

The investigation only provided a partial picture of the configuration of fixings and of the specific issues relating to the specific misaligned panels. The investigation did not look at top fixings for the panels nor the configuration of the fixings to the post-tensioned beams. The investigation did not assess the adequacy of the fixings nor make recommendations for repair.

2021 Cladding Panel Investigation

A second fixing investigation was undertaken by CRL in 2021 which looked at 11no. panels across the building including both those that appears misaligned and those which appeared visibly 'sound'. The method of investigation was the same as in 2019 but investigations included the upper panel fixings.

The fixing detail at top and bottom of the panels was found to be consistent and via a steel pin and channel / slot at the bottom of the panel and beam interface. At the top, a stainless-steel angle plate, fixed into the RC frame, and pin system was noted. Where the top fixing detail was inspected, there was no auxiliary means of restraining the pin within the angle plate hole, was observed.

Pins / dowels to the bottom of the panels, displayed variable levels of surface corrosion. There was no apparent water ingress or staining around the fixing cavities / channels. Where visible displacement or misalignment of panels was observed, the fixing detail consistently exhibited a lack of grout infill to the channels / slots and movement was observed to the pins.

2021 Recommendations

In the short term, CRL recommended repeat make-safe and panel movement checks on a 6 monthly basis as well as movement monitoring to better understand the movement and behaviour of the panels. In the longer term, CRL recommended installation of a panel fixing system.

Commentary

Through the two fixing investigations, CRL have identified the basic configuration of fixings of the pre-cast panels. They have also identified the likely cause of movement and displacement of the panels, being the absence of grouting to the lower fixing pins, with some pins notably loose. The investigation raises the possibility that the fixity of the upper fixings may be compromised, although with only 2no. upper fixings inspected, it is not clear how extensive this problem may be. The report does not make any conclusions about the adequacy of the fixings and leaves this for further assessment, presumably by a Structural Engineer. There is also no assessment of the mechanisms causing damage to the arises of the beams below the panels. The recommendation to monitor movement of the panels has not been implemented.

C. 2023 AECOM UoR URS: Structural Survey Report and 2023 AECOM UoR URS: Second Phase – Intrusive Survey Work Specification

The building was listed by Historic England in 2016 and the previous Hawkins/Brown scheme was not pursued, in part due to objections by The Twentieth Century Society and the Local Planning Authority. In preparation for a new scheme developed by Ayre Chamberlain Gaunt, AECOM were commissioned to reassess the condition of the building. Based on the findings of previous intrusive investigations and reinspection, the Structural Engineers reidentified many of the same defects as in 2015 but also noted deterioration of the condition in some area. A number of defects to the concrete structure which included:

- Poor previous repairs, generally to locations of previous survey work, with reoccurrence of cracking and spalling including to areas around the repairs.
- Cracking due to deflection.
- Expansive corrosion to reinforcement bars resulting in spalling of the concrete, with deterioration in some areas.

- Carbonation of the concrete.
- Inadequate concrete cover, notably to pre-cast concrete panels.
- Poor concrete compaction.
- Presence of chlorides.
- Displacement of pre-cast panels.
- Lack of waterproofing to beam to column interfaces with tracking of water into the building fabric.

The report repeated recommendations for monitoring of the structure in various locations in relation to movement around the pond feature, movement relating to nearby vegetation, deflection and associated cracking to the west end in particular. The report restated recommendations to repair areas of cracking and spalling concrete due to expansive corrosion with consideration to installing some form of corrosion management system, to reduce risk of incipient anode effect, where corrosion of the reinforcement adjacent the repair site takes place. Further intrusive investigations were recommended again to determine the current condition of the concrete and reinforcement, to identify the fixing detail for the pre-cast panels and to identify suitable remedial measures.

AECOM subsequently prepared a specification for further intrusive investigations covering the following:

1. Tactile survey of high-level structural members – Access by cherry picker to survey a sample of high-level members to determine their condition and record common defects.
2. Intrusive testing of external concrete elements to determine residual design life and repair strategy
 - Specification of half-cell potential surveying to determine whether corrosion is occurring to a sample of concrete members which do not yet exhibit external signs of corrosion.
 - Specification of hammer testing of concrete elements to detect for signs of hollowness associated with reinforcement corrosion.
 - Investigate condition of the embedded post tensioned cables and inspect post tensioned beam end repairs undertaken in 2011.
 - Durability investigation of members to check reinforcement cover, record depth of carbonation and test for chlorides and sulphates.
 - Transfer beam cracking investigation – opening up works to investigate cause of apparent shear cracking to concrete transfer beams
3. Survey of precast panel connections – specification of intrusive surveys to provide access to fixings to confirm condition using a borescope or videoscope. Removal of cladding panel corners may be required to establish the condition of connections.

D. Intrusive Investigations

At the time of writing, a programme of intrusive investigations is being conducted by CRL. The type of investigations is the same as those undertaken in 2015 and 2017. The investigations take in additional areas not previously investigated, thereby providing evidence of condition to a more representative sample of locations. CRL has been asked to provide both a factual and interpretive report. It is intended that findings of the current investigations, when considered in relation to previous findings will inform decisions not only on the extent of defects and type of repairs required, but also on the suitability and potential extent of anti-carbonation coatings and cathodic protection.

E. Analysis of previous survey/inspection reports

The previous survey and inspection reports provide a useful but incomplete understanding of the building fabric and its condition. It is hoped that the outcome of the current phase of intrusive investigations will provide a more complete picture of the condition of the concrete structure.

The type of defects identified by AECOM in 2015 and 2017, remained the same in 2023 and on the basis of our own observations as well as those of the Structural Engineer, they have continued to this day and in some areas have deteriorated. Carbonation induced corrosion with associated cracking and spalling due to shallow concrete cover and rainwater exposure continues to pose the greatest risk to the structure. Based on the 2015 and 2017 findings, the presence of chlorides has only had a limited effect on the condition of the concrete and reinforcement.

Where testing has been undertaken, generally there appears to be adequate cover to the reinforcement and the carbonation front is mostly over 30mm from the reinforcement; however, a visual inspection shows that there are in fact many areas of shallow cover that have resulted in spalling of the concrete. Spalling most frequently seems to occur to high-level, exposed posts and to beam ends.

Review of the cover meter visual mapping shows that while there are extensive areas of adequate concrete cover to reinforcement, there are localised areas of shallow cover. The areas of shallow cover do not seem to follow a clear pattern, but rather are likely to be the result of localised poor detailing and workmanship, which can be seen elsewhere in the form of construction debris to underside of the beams.

Over time, in areas of low concrete cover there will be an increase in the instances of the carbonation front reaching the reinforcement. The passivity of the concrete will be reduced, and the risk of corrosion will be increased. In locations exposed to water, there is likely to be an increase in instances of corrosion of reinforcement and associated cracking and spalling of concrete. It is noted in our inspection and by AECOM that in areas where loose and spalling concrete has been removed and patch repaired, notably at high level to posts, there are already a significant number of new instances of loose and spalling material. CRL note in their various reports that their repairs are temporary, and it is likely that the repairs have addressed only those areas of visibly spalling concrete rather than the full extent of corroding reinforcement. Recurrence of defects and spalling around existing repairs also indicates the progression of the carbonation front and corrosion of reinforcement in those areas and as well as possible incipient corrosion, whereby, corrosion is initiated on steel in concrete immediately adjacent an area of repair.

In their 2023 structural report, AECOM identify particularly low concrete cover to the pre-cast panels together with instances of the carbonation front meeting or exceeding the depth of reinforcement. This is somewhat surprising considering that pre-cast panels were usually factory made and are often found to have deeper and more consistent cover than site poured concrete and the risk of carbonation is generally less. While there is not visual evidence of significant spalling to the pre-cast panels, there is some more minor cracking and spalling to the bottom corners of the pre-cast panels, which could relate either to the reinforcement or to displacement of the panels.

Both CRL and AECOM discuss the potential for anti-carbonation coatings to the concrete. While an anti-carbonation coating may arrest the progression of the carbonation front for a period of time where the carbonation front is not already close to the reinforcement, there are a number of considerations as to its suitability including the effects of preparatory cleaning on the appearance and performance of the concrete, the visual appearance of the coating both on application and over time with the risk of changes of colour, texture and finish, yellowing and peeling over time. Also, the implications of maintenance and renewal. These impacts have to be weighed against the technical benefits of applying a coating system.

Where the carbonation front has already reached the reinforcement and the concrete has lost its passivity, it will be important to reduce the potential for rainwater ingress which will cause corrosion of the reinforcement. Consideration should be given to the benefits of the application of a water repellent coating such as silane or siloxane coating. The benefits of such a coating should be weighed up against any possible risks as described above for anti-carbonation coatings.

Where the carbonation front has already reached the reinforcement, the process of corrosion may already have begun, and it should be anticipated that there will be increasing instances of cracking and spalling. Where there is existing evidence of these defects, then they can be addressed by localised repairs. For latent defects, it will be necessary to undertake periodic visual inspections to identify and remove spalling and loose material and to undertake localised repairs. This approach is critical in areas where falling material could be a health and safety risk, for example over public walkways.

At present, there is an incomplete and fragmented record of the survey findings, although this should be largely rectified by the current intrusive investigations, interpretation and reporting by CRL and Curtins, the new project Structural Engineers. The surveys and investigations should be incorporated into a Building File. It would be useful to bring together the survey and testing data into a single location. In particular, the results of cover meter testing and carbonation from 2015, 2017 and 2024, in order to create a comprehensive record. It may be possible to use this data to identify “at risk” areas and enable comparison with future surveys and inspections. Ideally this information would be amalgamated using BIM (Building Information Modelling) and would be a useful resource for future management and maintenance of the building.

2.8.2. Building plans

Building drawings have been provided by Ayre Chamberlain Gaunt Architects on behalf of the building owner. The drawings, which include elevations, plans and reflected ceiling plans, have been used as the basis for the survey, identifying and locating defects. Below is a representative selection of the drawings. A full set of drawings is provided in Appendix E.



North Elevation



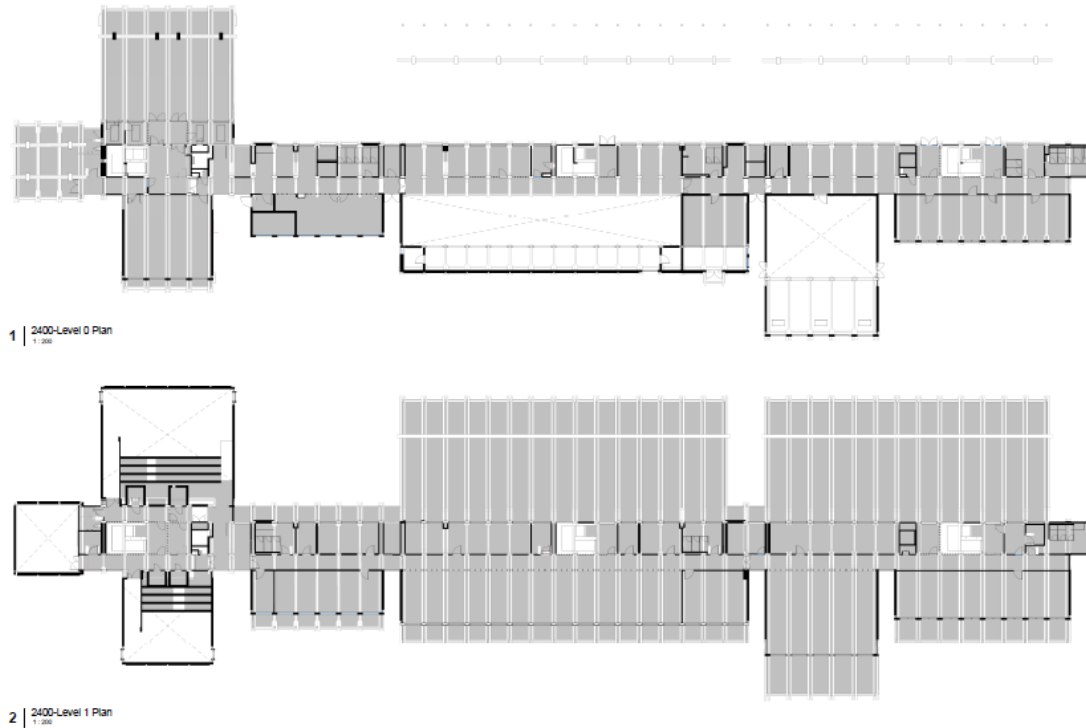
South Elevation



East Elevation



West Elevation



Example of reflected ceiling plans to ground and first floor

2.8.3. Asbestos Register

A copy of the asbestos register dated 2019 has been seen. Prior to and at the time of the inspection, extensive asbestos removal works were being undertaken. There was very limited entry into the building, comprising, accessing the entrance lobby to sign the site register. On one occasion, the asbestos removal contractor accompanied Purcell surveyors to the roof, to enable closer inspection of the external concrete at high level.

2.8.4 Fire Risk Assessment

A copy of the Fire Risk Assessment has not been seen.

2.8.5 Reinforced Autoclaved Aerated Concrete (RAAC)

Curtins, the project Structural Engineers, have assessed the building and have not identified any RAAC.

3. SURVEY DETAILS

3.1. SCOPE OF THE INSPECTION

3.1.1. Scope

All concrete components on the external elevations of the building were inspected. While outside of the scope of the inspections, observations are made on associated building components such as mastic seals, mortar joints, roof coverings and rainwater goods.

3.2. EXCLUSIONS AND LIMITATIONS

3.2.1. Non-invasive

The survey was non-invasive. No opening up works were carried out during the inspection. No fixings or covers were removed for the inspection. The survey was carried out by a visual inspection of surface finishes only. Parts of the building were covered up, unexposed or could not be inspected and it is therefore not possible to confirm that such parts are free from defects.

3.2.2. Survey from the ground

The report is based on the findings of an inspection made from ground level with the use of binoculars or from limited access to the main roof deck. Not all high-level defects will have been visible or apparent at the time of the inspection, due to the obscured sightlines. Some ground-level areas were obscured by dense planting. In both instances, the obscured areas will be subject to further investigation as part of any subsequent commissions and if a programme of works is undertaken.

3.2.3. Inaccessible Areas

There was limited access to the principal roof and no access to lower roofs, which limited inspection of the rear of the posts projecting above roof level.

Views of some areas of concrete soffit, walls and beams were restricted due to the nature of the elevations with various projections and setbacks. As the elevations were generally inspected from the ground, these views became increasingly restricted with each level and as such the level of detail provided to these parts as part of this commission is limited and requires further verification in due course.

Some areas were obscured by planting. This was the case to the parts of the ground floor on the south and east elevations.

3.2.4. Building services

This report does not comment on the functionality of building services.

There was no specific or detailed inspection of rainwater goods, but it was observed that the run of or blow back of water from outlets has caused algal staining and may be exacerbating corrosion of reinforcements and spalling of the concrete due to regular wetting of the fabric. It is anticipated that the rainwater goods will be renewed, and the detailing improved as part of the wider refurbishment scheme.

3.2.5. Structural assessment

This report does not constitute a structural survey. Structural assessments of the building have been undertaken by AECOM in 2015 and 2023. A further structural assessment is being undertaken at the time of writing by Curtins, the project engineers. The initial findings of Purcell's survey have been shared with Curtins and concerns over structural integrity or structural performance have been brought to their attention.

3.2.6. Asbestos

A copy of the 2019 Asbestos Register has been shared by the client. It is known that there are significant quantities of ACMs in the building and over recent months an extensive programme of asbestos removal has been undertaken. It is anticipated that asbestos removal will continue as further opening up works are carried out and during the early phases of the development on site.

No ACMs were knowingly encountered during the course of the concrete condition survey.

3.3. PERSONNEL AND AUTHORSHIP

The survey was undertaken by Alex Baldwin (conservation accredited Chartered Building Surveyor), Jess Gregory (Assistant Building Surveyor) and Henry Eyres (Assistant Building Surveyor).

The report was prepared by Alex Baldwin with assistance from Jess Gregory, Henry Eyres and Jon Wright (Heritage Consultant).

Purcell were kindly assisted by Claire Biggs of University of Reading, Yannis Kantzios and Alex Parry of Curtins, Richard Burgess of Ayre Chamberlain Gaunt Architects, Selene Orejon-Tejera of CRL as well as other operatives from CRL and European Asbestos Services Limited.

3.4. DATES OF INSPECTION AND WEATHER CONDITIONS

The survey was carried out on the following dates and under the given weather conditions:

2 June 2024 – dry and sunny.

7 June 2024 – dry and sunny

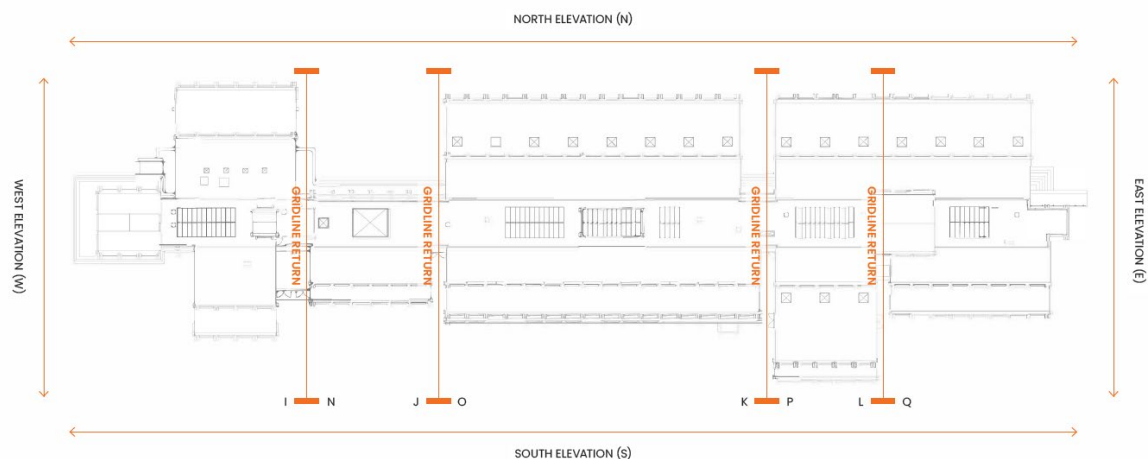
8 June 2024 – dry and sunny.

9 June 2024 – dry and sunny.

3.5. SURVEY METHODOLOGY & OUTPUT

3.5.1. Methodology

In order to best manage the conduct of the survey and the information required for output, a survey methodology was developed. The building was split into elevations as per the key plan below. Each elevation was overlaid with a grid and given associated reference nos. in order to be able to locate defects more easily on the repetitive elevations (refer to Appendix E).



A schedule template was also developed to record individual defects on with reference to the grid location in which the defects were found (refer to Appendix F).

A series of defect types were developed (refer to Appendix G) based on experience and having undertaken an initial walkaround of the building to understand the recurrent issues. Each defect was recorded on site and located on drawings and attributed a unique identification number (per elevation), a defect and repair type, quantity, unit, photographic reference. A record was made as to whether or not the defect was to a pre-cast panel. Priority ratings were also assigned as well as items which were felt to present a health and safety risk. Any relevant notes/details were also recorded where appropriate.

Through the course of the survey, it became apparent that a number of defects were found extensively across the building and in those instances an initial observation has been noted and assigned a defect number reference and the location has been marked on the defect drawings; however, subsequent occurrences have not been individually noted. More detail on the nature and extent of these defects is noted in Section 4.2 Specific Defect Types and outline repair specifications are included in Appendix G.

3.5.2. Survey Output

The following documents have been produced as part of the condition assessment and are appended to this report.

- **Key Drawings (Appendix E)** – in order to manage the elevations and locate defects for future reference, the elevations were all overlaid with a grid with each grid given a reference number. These act as a way to locate specifically on some very large and repetitive elevations where you are both as observer and also to locate the specific defects. This also helps with quantifying areas when you can refer to specific grid references.
- **Defects Schedule (Appendix F)** – this provides a complete list of defects This can be developed into a schedule of repair works for the building, with the ability to filter to different areas, priority items and repair types.
- **Schedule of Defect and Repair Type (Appendix G)** – identifies the various defect types observed across the building, together with outline methodologies for repair. These are not specifications. They provide guidance only as to the required works and will need further refinement and modification subject to future verification and trials, specific to the URS Building.

- **Defect Drawings (Appendix H1-H6)** – these show the overall elevations to provide a snapshot of each elevation and the defect quantity, their priority ratings and distribution. Each grid reference has its own drawing sheet to be able to accurately locate the defect within that area. The defects are colour coded according to priority with **red being high, blue medium** and **green low**. Priority rating descriptions are provided below.
- **Photographic Record of Condition (Appendix J)** – this provides photographs of each defect recorded for reference and to assist in pricing. It also acts as a future record and providing a snapshot of the building and its condition at this point in time, and can be viewed against, during and after works are completed.
- **Health and Safety Items (Appendix K)** – this provides a snapshot of all health and safety items on site. These will all have a high priority rating due to the risk posed. The content is discussed later in this document in section 4.4. This acts as a record for the items which should be regularly monitored until such time as works can be undertaken to repair and make safe.

3.6. DEFINITION OF PRIORITIES

3.6.1. Defect Priority

Defects are categorized as **low, medium** or **high**.

High priority: repairs required for legal or safety reasons or to prevent imminent damage or rapid deterioration and where there has been a significant impairment to the structural integrity of the structure/component. Generally, areas of spalled concrete and exposed reinforcement have been classed as high priority due to the potential for rapid deterioration with the potential for health and safety risks. ***These should be completed within 0-2 years.***

Medium priority: repairs are required to prevent deterioration and to avoid more significant damage which may incur increased costs and could pose safety or performance risks if left. ***These should be completed within 3-5 years.*** Where defects are visually very harmful, they have been assigned an M* rating. It is **strongly recommended that these works are completed within 3-5 years**; however, not all of these defects present a risk of deterioration or damage.

Low priority: repairs desirable to improve function or performance, or to enhance or reinstate features. These repairs may also cover periodic maintenance. ***These should be completed within 5-10 years.*** Some items categorised as Low priority may not need any action other than ongoing monitoring. A strategy for monitoring should be devised by the Structural Engineer.

3.6.2. Safety Priority Items

Where defects pose a health and safety risk, they have been identified in the H&S column of the defects schedule (Appendix F) with a Y. In many instances these will be listed as high priority items. A number of issues were identified across the building, principally in relation to loose or spalled sections of concrete at risk of detachment from a height. It is advised that these items are addressed as part of any works. If they cannot be, frequent and routine inspection should be undertaken and/or temporary protection measures put in place. A summary of these items is provided below in Section 4.4 and Appendix K.

3.7. RELEVANT STANDARDS AND USEFUL RESOURCES

The following guidance was taken into consideration when carrying out this survey:

*RICS Professional Standards and Guidance, Global Surveying Safely: Health and Safety
Principles for Property Professionals 2nd Edition, November 2018*

*RICS Professional Standards and Guidance, Surveying Assets in the Built Environment 1st Edition,
March 2017*

RICS Practise Standard, Historic Building Conservation, 1st Edition, September 2009

Historic England Practical Building Conservation: Concrete, Taylor & Francis Ltd, 2013

4. FINDINGS OF INSPECTION AND RECOMMENDATIONS

4.1. GENERAL SUMMARY OF CONDITION

Overall, the external elevations are in **FAIR** condition. However, there are defects noted across all of the elevations where the concrete is in poor repair and notably deteriorating. If left unaddressed, the overall building condition will worsen.

In total **710** individual defects were noted. A breakdown of their distribution in terms of areas/elevations is as follows:

Location Ref	Elevation	No. of Defects
NE	North Elevation	186
EE	East Elevation	36
SE	South Elevation	198
WE	West Elevation	65
RI	Gridline Return I	30
RJ	Gridline Return J	7
RK	Gridline Return K	23
RL	Gridline Return L	10
RN	Gridline Return N	16
RO	Gridline Return O	16
RP	Gridline Return P	24
RQ	Gridline Return Q	12
S	Soffits	97

The above demonstrates a fairly even and proportionate distribution of defects across the elevations. Proportionally, there are a slightly greater number of defects to the west elevation than the east. This could be due to a number of factors including the west elevation being more exposed to the prevailing weather and the west elevation having been the location for more intrusive investigations.

It is noted that the defects recorded are generally typical of this construction method, and with some indicative of areas of poorer quality construction e.g. construction debris in formwork. The repair and the ongoing maintenance of the building fabric is the only way to slow or arrest decay and ensure the building is safe and the significant fabric is preserved.

It can be stated that overall, there are defects everywhere. There is evidence of cracking to the transfer beams, which is being assessed by the Structural Engineer, but is not believed to be of particular concern. There is spalling across the building which is indicative of the underlying reinforcement corroding, due to poor cover and water penetration, as highlighted in the previous reports, and there is also evidence of previous failure, demonstrated by the array of proprietary mortar repairs. Other defects include redundant fixings, biological growths and staining.

North Elevation

Most defect types could be found to the north elevations, although there were fewer instances of health and safety risks compared to the south elevation. The north elevation, being the more sheltered and shaded, appeared to experience a greater degree of damp staining and accumulation of moss and algal growths, mostly to the pre-cast spandrel panels. Spalling and corrosion of reinforcement was noted to be worse to the more exposed elements, including the tops of the upper-most beams extending above the roof line and projecting beam ends, although spalling was also noted to the vertical posts, immediately below the projecting beam ends. These defects are likely to be due in part to the exposure to the elements and potentially also the accumulation of biological growths but may also be due to poor workmanship and specifically areas of lower concrete cover in these areas, although this is observational rather than being specifically demonstrated through intrusive testing.

The below-window, pre-cast spandrel panels have a slight dip to the upper face creating a channel which allows water to discharge off the sides. The water and algal staining to the upper front faces of the panels is thought to be the result of an accumulation of moss to these channels and it will be important to ensure that the tops of the panels are cleared of biological growths periodically to prevent the recurrence of algal staining.

There is a deep undercroft to the north supported on large structural posts. There appear to be issues of poor compaction and subsequently cracking and spalling concrete to the base of many of the posts and the Structural Engineer will need to assess to what degree these defects have compromised the strength of the posts. The north elevation to the ground and first floors is generally sheltered from the elements and few defects were noted to this area, apart from minor spalling to beam ends.

It was noted that the concrete has a stronger ochre colour in the sheltered areas of the undercroft, and this may be due to the concrete elsewhere experiencing greater UV exposure or washing away of the pigment. There are various types of staining to the concrete in these areas including mortar and adhesive staining.

East Elevations

The east elevation has a relatively low proportion of defects. Most defects to the East Elevation are classified as poor previous repairs and are the result of previous intrusive investigations which have been repaired with poorly matched proprietary mortars.

South Elevations

The defects observed to the south elevation are very similar to those of the north, although there is less of an accumulation of moss and algal growths than to the north, except to the more exposed beam ends and upper-most projecting posts. To some of the large pre-cast panels on this elevation there were areas of spalling and some uneven finishes. To the upper face of the ground floor pre-cast spandrel panels mortar filled socket holes were observed, the sockets having been used to lift the pre-cast panels into place during construction. In a few locations the mortar fills were cracked and coming loose. The upper face of these panels could not be inspected to upper floors, and it is anticipated that there will be more instances of loose mortar fills.

West Elevations

The west elevation shares many of the same defects as the other elevations although it is noted that there appears to have been extensive intrusive testing to this elevation with the investigation holes filled with a poorly matching proprietary mortar. These repairs have had a significant impact on the aesthetic qualities of the concrete and are in highly prominent locations. There are also some

notable areas of corrosion of reinforcement and spalling of concrete, in particular to the left-hand side of the forward projecting central block.

Gridline Elevations

There are numerous gridline/return elevations which comprise the long-exposed sides of the transfer beams at each floor with predominantly pre-cast panels interspersed with occasional windows. In a number of locations there was visible displacement of some of the pre-cast panels. In addition, there was cracking and spalling to some of the bottom corners of pre-cast panels. Failure of the mastic joints between panels and between panels and beams makes these parts of the panels vulnerable to water ingress, wetting and associated corrosion and spalling. It is possible that damage in these locations is also related to movement of the panels.

To the transfer beams there are areas of poor compaction, apparent either as vertical lines with more exposure of aggregate or blowholes. While these are generally quite minor, in a few locations they are more extensive. To the top edge of many of the beams there is a pattern of horizontal cracking which may in fact be the result of spalling fabric. In a few locations the concrete has spalled, exposing the steel reinforcement which appears to have minimal concrete cover. In many locations the top edge of the beam appears to have been repaired and the mortar repairs are now beginning to fail. It is not clear yet whether the failure of the top edge is due to the particular loading and possible movement of the pre-cast panels which are supported on the beams or whether it is due to expansive corrosion of the reinforcement to the upper edge of the beam or a combination of the two. Further investigation will be required to establish the detail and extent of repairs.

Soffits and Undercroft

The soffits comprise the painted, fair-faced underside of the reinforced concrete floor slabs of the first and second floors. A large proportion of the soffits are obscured by insulated panels. The soffits are subdivided by the post-tensioned concrete transfer beams. In various locations there are proprietary repairs which could be repairs to spalling due to expansive corrosion or could be temporary repairs where intrusive testing has taken place. There is a pattern of spalling due to expansive corrosion to the outer corners of the soffit adjacent the beams and this appears to be due to water tracking into the joints between the beams and the posts and wetting the adjacent soffits. This type of defect is most notable to the south of the building. There are areas of both exposed reinforcement and loose spalling concrete which poses a health and safety risk where it is over public areas or where it could ricochet off the building onto public areas.

To the west, over the pond, there is some fine cracking to the soffit that should be assessed by the Structural Engineer. In this same area and to the undercroft to the north there is a pattern of very fine diagonal cracking to the reinforced structural beams extending upwards and outwards from the connection of the supporting column to the beam. This shear cracking is identified in AECOM's reports as being due to deflection of the beams. This cracking requires assessment by the Structural Engineer.

It was noted that to the underside of the beams, including where they extend out beyond the elevation of the building, there is an accumulation of metal debris which is resulting in minor concrete spalls. There also appear to be water runs to the sides of the beams. The wide spread of this water staining across the undercroft would indicate that it is not related to a specific plumbing leak. It is possible that instead it is the result of condensation to the soffits.

Water Tower

Generally, the same defects noted elsewhere around the building were also observed to the water tower, although the water tower is more exposed and some notable spalling of concrete and exposure of corroding reinforcement was observed. Where there are outlets from the water tank through the soffits extensive water and algal staining was noted, including to adjacent beams, and this is likely to exacerbate issues of corrosion and spalling identified elsewhere.

4.2. SPECIFIC DEFECTS TYPES

The following are specific defect types found to the external concrete at the URS Building. Refer to Appendix G for recommended repair types for each of these defects.

4.2.1 A – Cracking

A1 & A2 – Small and Large Cracks

There are numerous small / fine cracks across the building together with some large cracks (classified in this report as being over 3mm wide). Cracking is a natural feature of concrete structures and in many cases will have little effect on strength and durability. Some of the cracks will be non-structural and will have developed during the construction process or be the result of thermal variation.

Much of the cracking appears to be the result of corrosion of the reinforcement and is a precursor to spalling. The cracks provide a route for water to ingress the structure and exacerbate the corrosion process. Many of the cracks were viewed from a distance and so should be assessed close up to establish whether they are a sign of more extensive spalling. Cracking along the top edge of transfer beams, as viewed to the gridline return elevations may be due to spalling of the upper reinforcement bars, although further investigation is required.

A lot of the cracking that has been observed is hairline cracking. Generally, this occurs to the large transfer beams to the undercroft, taking the form of diagonal cracks extending upwards and outwards from the bearings of the beams on the principal concrete piers. The Structural Engineer has assessed these cracks to be sheer cracking due to deflection. At present this cracking is not considered to be a cause for concern. With these very fine, hair line cracks, no action is recommended at this time, although the Structural Engineer may recommend ongoing monitoring.

Cracking across the building has been assessed by a Structural Engineer to identify anything that is a structural cause for concern. Where the Structural Engineer does consider cracking to be a structural concern, then a strategy for remedial works should be developed by the Structural Engineer, utilising components of the outline repair strategy proposed in this report, to ensure that repairs are visually acceptable and compatible with the existing fabric.

Where cracks appear to be the result of corrosion of reinforcement then they should be treated as for a spall with cutting out of the cracked and spalling material, removal of corroding material from the reinforcement and a concrete repair. Elsewhere a variety of repair strategies have been provided for filling cracks depending on their size and whether they are static or active.

Active cracks should not be repaired until the cause has been identified and progressive movement arrested, otherwise there is a risk of abortive work. On the basis of our inspection, it is not possible to identify which cracks are active and which are not and further investigation and monitoring of some of the cracks will be required. Repair of non-progressive cracks is by means of resin injection, to accommodate small amounts of movement but prevent water ingress.



Example of Defect Type A1



Example of Defect Type A2

4.2.2 B – Spalling/Damage

B1 & B2 – Spalling or damaged surface with and without reinforcement bar visible

Spalling of concrete occurs where the steel reinforcements have corroded, and the expansion of the metal exerts pressure on the surrounding concrete. The principal causes are shallow cover of concrete to the reinforcement bars, progress of carbonation to the depth of the concrete cover, or beyond, and water ingress. Spalling could be seen to all areas around the building and to both in situ and pre-cast concrete components. In some areas the loss of concrete has exposed the reinforcement bars. Spalling is more notable to exposed areas of concrete, including post and beam ends, and also to soffits where water has tracked into the structure via open construction joints.

In a few locations, where spalling concrete has previously been removed, the exposed reinforcement has received some form of protective coating, although the specification of the coating is unknown.

Some of the spalling material is at high level and over areas where contractors, consultants and other visitors to site may be and poses a considerable health and safety risk. In these areas loose material should be removed as a matter of urgency.

Areas of spalling concrete will require cutting out of the cracked and spalling material, removal of corroding material from the reinforcement and a concrete repair. The preferred approach to replacing spalled fabric is for a poured concrete repair, or a hand placed mortar repair, as these are most compatible with a conservation approach to repairs using like-for-like materials and achieving coloured and textured finishes to match the existing fabric.

Where spalling has occurred to originally painted soffits, the use of proprietary repair mortars may be appropriate. Careful replication of surface texture and overpainting will ensure that the proprietary repairs have limited visual impact on the appearance of the building.



Example of Defect Type B1



Example of Defect Type B2

B3 – Impact Damage

There are a very small number of instances of impact damage to both in situ and pre-cast concrete panels, where there is a small loss of concrete but with no exposure of reinforcement bars. There is no notable pattern to the impact damage and so there are no obvious management actions to avoid future mechanical damage. As noted above, where there has been a loss of concrete, this can reduce the amount of cover over steel reinforcement and pushes the carbonation front closer to the reinforcement, increasing the risk of corrosion and spalling. Localised concrete repairs should be undertaken to reduce the risk of more extensive damage.



Example of Defect Type B3

B4 – Concrete Compaction Issues

Honeycombing and voids are inherent problems relating to poor workmanship and the original construction materials. They are the result of poor compaction and are mostly found in corners where the presence of a concentration of reinforcement makes access for compaction difficult. The cement paste does not surround aggregate, so the particles are loosely bound. The consequence of honeycombing and voids can be enhanced rates of carbonation.

There are examples of honeycombing and voids across the building but most notably in the following locations. Firstly, to the sides of concrete beams where there is slight honeycombing in occasional vertical strips and also occasional individual voids. Secondly, to the base of the base of beams within the undercroft areas. There is corresponding spalling of concrete in these positions, potentially the result of honeycombing.

The honeycombing and voids to the sides of beams are relatively minor and are unlikely to be having a significant impact on the rates of carbonation and there is no evidence of cracking or spalling in these areas. The Structural Engineer has expressed no concerns regarding the structural integrity of these areas. Generally, no action is recommended, although deep voids can be filled with a colour matched mortar repair. Alternatively, coating the interior of the void with an anti-carbonation coating could provide some protection should this approach be taken to the building more generally.

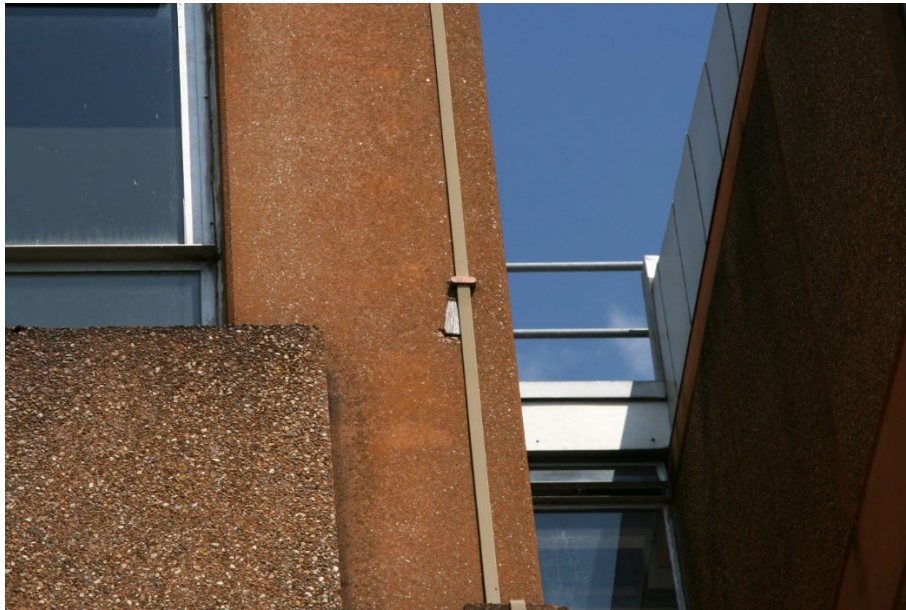
Where honeycombing is more extensive to the undercroft posts and cracking and spalling have been observed, cutting out the honeycombed concrete and undertaking a cast in situ concrete or hand-placed mortar repair is recommended and these defects should be assessed by the Structural Engineer.



Example of Defect Type B4

B5 – Timber inclusions in in situ concrete

In a number of locations, small pieces of timber were observed, embedded in the concrete. It is likely that these were used as spacers, not removed before the concrete was poured, or as fixing blocks installed after construction. In either case, the presence of the timber on the surface of the concrete is likely to enhance the rate of carbonation in a localised area and should be removed and replaced with a hand-placed mortar repair.



Example of Defect Type B5

B6 – Small pieces of corroding metal in underside of cast concrete

To all undercroft areas, numerous small pieces of metal debris were observed to the underside of the concrete beams and beam ends. These appear to be mostly steel wire off-cuts, which have been cut when tying the reinforcement and allowed to fall into the bottom of the formwork, subsequently being cast into the beams. The metal debris is now corroding and causing small amounts of concrete to spall from the underside of the beams. The presence of small amounts of corroding metal wire on the underside of the beams and minor spalls are unlikely to affect the overall integrity of the concrete structure and reinforcement. Removal is likely to be very disruptive for the limited benefits that it offers and so it is considered to be preferable to leave the metal debris in place and to remove any loose material. Removal of loose and spalling material will need to be undertaken periodically to ensure that falling material does not affect people using the building.

Due to the extensive nature of these defects, they have only been recorded once in the Schedule of Defects and Defect Drawings (Appendix F and Appendix H).



Example of Defect Type B6

B7 – Uneven finish to pre-cast panels

The building has two types of pre-cast panel. Smaller spandrel panels have a water-wash, exposed aggregate finish to the bottom and sides and an untextured upper face incorporating a shallow channel for drainage. These smaller panels are generally in good condition with few apparent defects. Larger walling panels also have a water-wash finish to the front face and generally have untextured chamfered edges and sides while a smaller number have a water wash finish to the sides without any chamfer. The aggregate is a Thames valley gravel, and the cement matrix has a slight reddish-ochre tint.

To some of the large pre-cast panels, to the south elevation in particular, the cement matrix in which the aggregate is embedded appears to have weathered away resulting in an uneven appearance and localised failure of the exposed aggregate with some loss of gravel/aggregate. This only appears to be a localised problem to a small number of panels and may be the result of poor original workmanship or the specification of the concrete and may even be an original construction defect of these panels.

A tactile inspection should be undertaken to assess to what extent the loss or absence of cement matrix has destabilised the aggregate or whether the impact is mostly superficial and whether the condition can be monitored for deterioration with only limited and localised repairs. The tactile inspection should be reviewed in conjunction with the outcome of intrusive investigations by CRL, to establish whether the loss of cement matrix and aggregate corresponds with a loss of cover to the reinforcement and evidence of associated corrosion.

Where the loss of matrix and aggregate is not extensive, then localised, cast in situ or hand-placed repairs can be undertaken with particular care being paid to the choice of aggregate and mortar mix, based on detailed investigation of the existing and on-site trials and samples.



Example of Defect Type B7

4.2.3 C – Previous Repairs

C1 – Poor Previous Repairs

Following previous programmes of intrusive concrete investigations, core drilled holes, opening up and areas of cracked or spalling concrete were repaired using proprietary repair mortars. These repairs were noted to both the in-situ and pre-cast concrete elements. While a reasonable number of the repairs are performing adequately, they are a poor match in terms of texture, colour, profile and overall appearance and are visually jarring.

A sizeable proportion of repairs are failing with cracking and spalling which appears to be the result, at least in part, of continued corrosion of the steel reinforcements. The failing repairs will require cutting out and replacement to prevent further corrosion of the reinforcement and more extensive damage.

Across the building, the poor previous repairs should be renewed with new in-situ concrete or hand-placed mortar repairs, designed to blend with the original concrete fabric.



Example of Defect Type C1

C2 – Construction phase making good

Across the building there are numerous small holes which have been filled with a mortar that matches reasonably closely to the structural components. Many of these filled holes are located in similar locations to the sides or tops of pre-cast panels and other pre-cast components and the mortar appears to fill threaded metal sockets cast into the components, presumably installed to facilitate transport and lifting. The sockets would have been filled as part of the original construction process. The mortar fills are not always a perfect colour match, but they are much better than more recent repairs and only require replacement if they are failing. Where the mortar has fallen out of the socket, there appears to be some light surface corrosion to the inside of the threaded socket. The extent of corrosion is unknown, but only a few loose or missing fills were noted and there were not obvious signs of cracking or spalling of the concrete components around the metal socket positions.

Where the mortar fills are cracked, loose or missing they should be refilled to reduce the risk of corrosion and associated cracking and spalling. Where the socket is heavily corroding, and this is causing damage to the concrete panel a more extensive repair will be required involving the removal of the socket and an in-situ concrete or hand-placed mortar repair to fill the void. Further investigation will be required to establish the relationship of the socket.

Due to restricted sightlines, only a small number of visible defects are recorded in the Schedule of Defects and Defect Drawings (Appendix F and Appendix H), but it is anticipated that more of these defects will be identified once close inspection to all parts of the elevations is available.

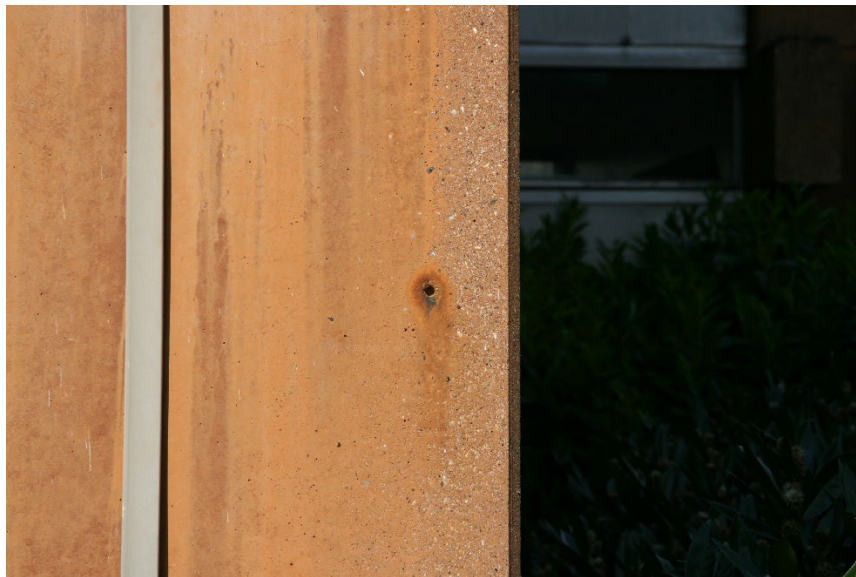


Example of Defect Type C2

4.2.4 D – Holes

D – Holes and Fixing Holes

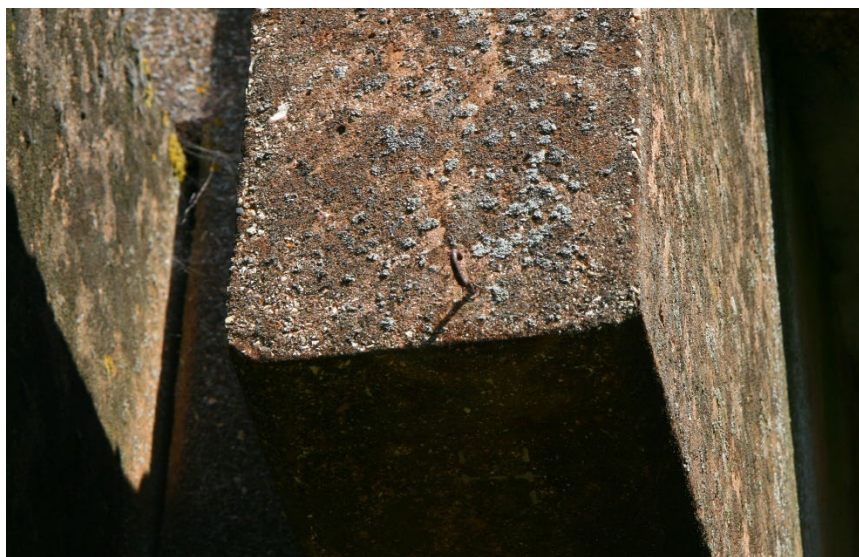
Holes in the concrete are vulnerable to water ingress which could result in corrosion of the steel reinforcements, they also increase the depth of carbonation within a localised area, which also increases the risk of reinforcement corrosion and associated spalling. Holes that are not required for a specific purpose should be filled with a suitable repair mortar and, where still required, holes should be provided with suitable weatherings to reduce the risk of water penetration.



Example of Defect Type D1

D2 – Redundant Fixings

There are numerous fixings around the building, many of which appear to be redundant. In some instances, the fixings are corroding with the potential to cause cracking and spalling of the concrete as well as more superficial rust staining to the surface. A review should be made of the fixings to ascertain which are still required and which are redundant. Where redundant, the fixings should be removed, and the hole filled with a suitable repair mortar. Where the fixings are still required, it may be necessary to change the fixings for a non-ferrous alternative.



Example of Defect Type D2

D3 – Testing/investigation holes made by contractors

Over the past 10 years there have been a series of intrusive concrete investigations undertaken by CRL, under the supervision of the Structural Engineers at the time. The investigations have involved drilling holes, taking core samples, opening up works to inspect reinforcement and fixing details, hammer testing and various other intrusive investigations, undertaken with the objective of understanding the composition and current condition of the concrete and reinforcements and to assess the extent and rate of deterioration since the previous investigations. The result has been the formation of numerous holes and openings in concrete components across the building. While the holes have generally been filled with proprietary mortars, at the time of the inspection, a new round of intrusive investigations were underway and a number of openings had been formed. It may be that these have subsequently been filled with proprietary repair mortars. In either case, the outline repair methodology for poor previous repairs should be applied.



Example of Defect Type D3

4.2.5 E – Concrete out of Plumb

E1 Pre-cast panels out of plumb / displaced

A number of pre-cast panels were noted to be out of plumb, either with the bottom edge appearing to have moved outwards beyond the concrete beam upon which it is supported, or with two adjacent panels moving outwards at their vertical meeting point. Previous intrusive investigations by CRL have established the nature of the pre-cast panel fixings. The bottom edge is secure by metal pins fixed into the bottom of the panels which are located and grouted into a channel on the top edge of the concrete beam and the top corners are secured by angle brackets. Investigations have shown that some of the pins are not securely grouted and this could be the cause of movement to the panels. It is also possible that outward movement of the bottom of the panels has caused the disturbance noted elsewhere to the top edge of the beams.

Investigations into the condition of the panel fixings and an assessment of their structural stability is in progress at the time of writing, with investigations carried out by CRL under the supervision of the Structural Engineers, Curtins. At this time it is anticipated that some grouting of the lower pins will be required, as well as some discrete additional fixings to the rear of the panels, where they have been displaced to ensure their stability. Details of these structural repairs will be prepared by the

Structural Engineer for submission as part of a subsequent planning and listed building consent application.

The Structural Engineer will review and advise on whether the extent of displacement requires the full replacement of any of the pre-cast panels. Replacement should be on the basis of like-for-like replacement with regard to form, colour, aggregate, and finish.



Example of Defect Type E1

4.2.6 G – Mastic sealants

G1 – Failure of mastic seals

There are mastic seals across the building. These are mostly found at junctions between different concrete sections. Depending on the type of sealant used and the specific conditions of the location applied, seals can last between 5 and 20 years. The condition of the seals will be affected by the quality of application, temperature and UV. All of the seals have reached the end of their service life with evidence of shrinkage, cracking and hardening to all parts.

Failure of the seals will affect the performance of the building envelope, potentially causing water ingress into the building and the building structure, accelerating decay. The seals should be renewed across the building.

Where corrosion and spalling were noted to the outer corners of soffits, to the south elevation in particular, it is thought that this is a result of water ingress via the junctions between concrete beams and posts. It may be that water ingress is due to the failure of mastic seals in these locations, although the actual weathering details could not be observed due to restricted sightlines. If on closer inspection it is found that there are failing mortar weatherings to these joints or no weatherings further consideration will be required to establish the best means of weathering these joints.



Example of Defect Type G1

4.2.7 H – Surface Deposits

H1 – Calcium deposits

Where water has penetrated through the concrete structure it has caused the calcium hydroxide in the concrete mix to dissolve and leach out of the structure. On contact with the atmosphere the calcium hydroxide reacts with carbon dioxide to form calcium carbonate. As the water evaporates on the surface, hard white deposits are left, which in places form stalactites. At the URS Building the calcium deposits can be found in several locations to the north undercroft. The cause of the water penetration is unknown and should be investigated and remedied.

While the deposits themselves are a cosmetic issue, the process of leaching can lead to durability problems. Water ingress through the structure also risks the corrosion of the steel reinforcements.



Example of Defect Type H1

H2 – Salt deposits

Salt deposits or efflorescence were observed in a number of locations across the building, but most notably as tide mark to the exposed beam ends which experience frequent cycles of wetting and drying. Water soluble salts migrate to the surface of the concrete and evaporate, leaving powdery white deposits. While generally a cosmetic issue, salts that evaporate below the surface can cause spalling of the concrete. Where practicable, water penetration issues should be addressed, and the salts brushed off.

Light efflorescence was observed to the sides of transfer beams in the undercroft to the north side of the building in particular. This was in the form of water runs. The wide spread of the staining across the undercroft would indicate that it is not related to a specific plumbing leak. It is possible that instead it is the result of condensation to the soffits. As the condensation has evaporated it leaves a pattern of white salt staining corresponding with the water runs. While the appearance of the water runs is relatively limited and brushing off the salts may be considered adequate, further consideration will be required as to how to reduce the future risk of condensation forming to the soffits.

Due to the extensive nature of these defects, they have only been recorded once in the Schedule of Defects and Defect Drawings (Appendix F and Appendix H).



Example of Defect Type H2

4.2.9 J – Coating and Surface Finishes

J1 – Cracking/crazing to render finishes

To the south side of the building there is a small area of cement render. The substrate to the rendered panel is unknown.

There is crazing and cracking to the render. The precise cause of the crazing and cracking is unknown but could relate to the quality of the materials and workmanship or the condition of the underlying substrate. Damaged render finishes should be cut back, the substrate inspected for defects, and the render coat renewed.



Example of Defect Type J1

4.2.10 K – Mortar

K1 – Damaged or missing mortar

Where mortar joints are visible between concrete components or between concrete components and windows many of these are cracked and loose. In a number of locations mortar is missing from joints altogether. Open and missing joints can allow water to penetrate the fabric/structure with the risk of damage and decay to adjacent fabric. This could be observed where water has tracked in above beam ends and has caused dampness and spalling to the adjacent soffits although it is not clear without close inspection whether this is due to defective mortar or mastic joints, or the absence of weatherings altogether. The defective mortar should be raked out and the joints repointed in a suitable mortar.

Due to the extensive nature of the cracking of mortar around windows, this defect has only been recorded a limited number of times in the Schedule of Defects and Defect Drawings (Appendix F and Appendix H). As the windows are due to be replaced it is anticipated that all mortar joints around windows will be renewed.



Example of Defect Type K1

4.2.11 Staining

S1 – Biological growths/staining

There is an accumulation of algal growths in various locations around the building, including to spandrel panels below windows, to beam ends and to the sides of concrete beams. The accumulations tend to be where the concrete is more exposed or where there is water run off down the concrete due to poor detailing of roofs and rainwater goods. In many of these locations there is also an accumulation of lichens, although these were also noted to high level concrete components more generally. Algal staining to vertical surfaces was seen in conjunction with an accumulation of moss to sky facing surfaces. The biological growths can contribute to the deterioration of the surfaces on which they colonise by the following means:

- causing water retention;
- producing organic acids; and
- for mosses and lichens, causing mechanical deterioration by anchoring to the surface with their rhizoids.

Mosses, algal staining and to a lesser degree lichens, should be removed to improve the appearance of the building and to reduce the risk of deterioration of the fabric. Where the algal staining is the result of poor detailing of roofs and rainwater goods, this should be addressed by the proposals for renewal.



Example of Defect Type S1

S2 – Pyrites and rust staining

Small mineral deposits in the concrete aggregate mix called pyrites (iron disulphide) can corrode and leave rust staining to the surface of the concrete. This staining is a cosmetic problem only and will not affect the long-term performance of the concrete structure but is visually obtrusive.

Elsewhere rust staining is the result of the corrosion of fixings or structures fixed to the building. There are a number of instances of redundant fixings which are corroding. As well as causing superficial staining, the expansion of the corroding fixings can cause cracking and spalling to the surrounding concrete which increases the risk of water ingress into the structure and corrosion of the metal reinforcements. The corroding fixings should be removed and the fixing holes made good in an appropriate mortar.



Example of Defect S2

S3 – Environmental dirt

As with algal staining, environmental dirt comprising heavy accumulations of dirt and pollution deposits can be found on high-level and exposed or sky facing concrete surfaces and immediately below sky-facing surfaces. The dirt is most notable to the podium boxes, the sloping sections of the towers and below ledges to the towers and flank return walls of the flats. Not only is the dirt unsightly but depending on the makeup, can also accelerate corrosion of the reinforcement and can cause gypsum and ettringite to form which can result in spalling of the concrete. The dirt should be removed together with associated algal staining.

In removing the dirt, it is likely that poor quality patch and plaster repairs to the concrete will become much more apparent and there will be a stronger justification to replace them for aesthetic reasons and not just where they are failing or defective.

4.3. OBSERVATIONS OUTSIDE OF SCOPE OF SURVEY

In the course of our survey, we observed a number of other defects or items of concern that fall outside of the scope of the current survey, but we think warrant mention here.

Mastic

Mastic seals and movement joints across the building, including between the pre-cast panels, are in poor and deteriorating condition. There was evidence of shrinkage of mastic and opening up of gaps which could allow water penetration into the building fabric. It is unlikely that the current seals are original, but it is unknown when they were installed and they appear to be coming to or have exceeded their service life. Mastic seals across the building now require renewal. The colour of the mastic will be critical to the success of any mastic renewal.

Roofs

The roofs did not form part of the inspection, although it was noted that in places algal staining to the gridline return elevations corresponded with the configuration of roof/fascia panels and that some of the algal staining is the result of water runoff from individual panels or joints between panels. It is proposed to renew the roof coverings and it is important that these are detailed to reduce the risk of water run off over the adjacent concrete surfaces.

Rainwater goods

Gutters overflows project out from the sides of the roofs and in places it appears that rainwater either discharges down the adjacent concrete surfaces or is blown back onto the walls below the overflows, resulting in some algal staining and potentially some wetting of concrete which exacerbates problems associated with corrosion of reinforcement and spalling. It will be important that renewed roofs and rainwater goods are detailed to ensure that rainwater is discharged away from the building.

Windows/glazing

It is proposed that all the windows will be renewed, and it is anticipated that all the defective mortar joints around windows will be renewed. It is important that the new mortar joints are in a carefully specified mortar mix. If it is proposed to replace mortar joints with mastic joints, then these will have to be carefully considered to ensure a good colour match.

Cleaning

There are various reasons why cleaning might be undertaken at the URS Building. The Schedule of Defect and Repair Types (Appendix G) includes outline specifications for cleaning to remove biological growths, rust staining and calcium deposits. Various cleaning methods are proposed.

If cleaning is to be undertaken, then it will require careful consideration and coordination, and be subject to trials. It would be undesirable to carry out the cleaning to individual defects without consideration of the wider impact on the appearance of the building this would result in an inconsistent appearance. Phasing of any cleaning also needs careful consideration. If the building is not to be cleaned as a single exercise, then it may be feasible to clean the external elevations separately where they are not visible and directly comparable within the same view. Cleaning will also present practical challenges, such as providing adequate protections to ensure that there is no water ingress into the building.

If coating of the building with an anti-carbonation coating is proposed, then more extensive cleaning may be required and consideration will need to be given to the appropriate extent of cleaning, the visual impact of comprehensive cleaning, the physical effects on the concrete surface including any effects on performance, and the impact on the appearance and significance of the building. This is particularly pertinent due to the nature of the concrete finish and its colour, which was designed to reflect the earlier building on the Whiteknights campus.

Coating

There are currently no coatings other than paint coatings to the concrete soffits. Application of protective coatings, such as anti-carbonation coatings would need to be carefully considered. If considered to be appropriate, subject to review of the Structural Engineer's report and the CRL intrusive investigations report, then application should be planned to ensure a coherent and uniform finish to the building, this would require either coating the whole building in one go or phasing the application of coatings to ensure that elevations with a visual relationship that are viewed at the same time are coated at the same time to ensure uniformity.

Bird nests and pigeon spikes

There are areas of pigeon spikes to ledges across the building, including to the undercroft. Despite this, a number of birds' nests were observed to the tops of beams. The bird deterrent strategy should be reviewed as it is not currently entirely effective.



Example of bird's nest to undercroft beams

4.4.HEALTH AND SAFETY PRIORITIES

Some of the defects described above pose a health and safety risk to contractors, consultants, university staff and anyone else within the current site compound. The greatest risk is of falling concrete where it has spalled and become loose due to corrosion of the reinforcement. The risk is increased where the loose fabric is at height. There is a risk that falling masonry which is close to but not immediately over a public area could hit a projection or other surface and ricochet into a public area, although the site compound is reasonably large and this risk was considered to be low. It is important that anyone entering the site compound should wear appropriate PPE, including hard hat and site boots and that they should be encouraged to stand away from the building wherever possible. It is highly recommended that obviously spalling fabric should be removed as a matter of urgency to prevent the risk of significant harm.

If someone is injured or killed by falling masonry the University of Reading is likely to be liable for damages, could potentially be found guilty of manslaughter and would suffer considerable and irreparable reputational damage.

Where defects pose a health and safety risk, these are identified as such within the survey schedules. 26no. health and safety related defects were identified across the building, (as identified in Appendix K).

Location Ref	Elevation	No. of H&S Defects
NE	North Elevation	5
SE	South Elevation	12

WE	West Elevation	1
RI	Gridline Return I	1
RK	Gridline Return K	1
S	Soffits	6

5. REPAIR OFFER AND NEXT STEPS

5.1. REPAIR OFFER

It is Purcell's understanding that the University intends to implement an initial package of concrete repairs focussing on high priority defects in specific locations as part of the refurbishment proposals and then to roll out the concrete strategy over the coming years through further packages of repairs. The detailed scope of these works will be agreed upon in consultation with WBC and other stakeholders including the Twentieth Century Society. The benefit of any repairs is to repair the fabric, address safety issues, and to improve the appearance of the building to the public benefit.

There are high priority defects across the building, with the greatest number on the south elevation.

Location Ref	Elevation	No. of High Priority Defects
NE	North Elevation	45
EE	East Elevation	6
SE	South Elevation	86
WE	West Elevation	19
R	Gridline Return Elevations	20
S	Soffits	33

The decision of where the University decides to undertake the first package of repairs will depend on a number of factors. The greatest number of high priority defects and H&S defects is to the south elevation, although this is probably the least visually prominent elevation, as it faces onto a service road and away from the main approaches to and views of the building. It may be possible to cordon off the area around the base of the walls on the south elevation where there is an ongoing risk of falling material, until the repair works can be undertaken. The north and west elevations are the most visually prominent and repairs to these elevations will have the greatest visual impact and consequently the greatest heritage and public benefit. The north elevation fronts directly onto Chancellors Way and so will have the greatest public footfall and consequently the greatest risk of injury from falling fabric with associated liability and reputational risk. Similarly, there is a risk of injury from falling fabric within the undercroft on the north side of the building.

It is recommended that all defects across all the priority ratings are undertaken as each elevation is repaired, to maximise the efficiencies in consistency of contractors and utilising access and to reduce the need to return to the area for lower priority repairs.

For those areas that are not included in the first round of repairs, it will be important to undertake a tactile, make-safe survey to ensure that loose material has been removed and to reduce the risk of falling fabric. Periodic make-safe surveys and visual inspection should continue in each area until such a time as a programme of repairs can be implemented. Where there is a risk of falling material that cannot be immediately removed by means of tactile survey then the area to the base of the wall should be secured, taking into account the potential for material to ricochet off projecting elements of the building.

5.2. NEXT STEPS

The information and findings provided as part of this report can be considered in relation to a number of strands of activity for the repair of the historic concrete at the URS Building, and the following is provided with reference to the Concrete Repair Strategy provided by Purcell, which should guide the process and is found in Appendix A.

Once the client has reviewed this report together with the accompanying information found in Appendices A-K, the following next steps are recommended. Where applicable the Concrete Repair Strategy Stage is noted in brackets after each item (refer to Appendix A). As discussed in the strategy document, this is an iterative and incremental process throughout, which will require input from stakeholders.

5.2.1. Current Planning Application and 'Offer' to Wokingham Borough Council

1. University of Reading to advise how they wish to proceed/preferred package(s) (1)
2. Purcell to prepare information for the 'offer' to WBC (1)
3. Presentation of preferred package to WBC for discussion/negotiation (1)

5.2.2. Implementation of 'Offer' (in line with concrete repair strategy)

1. Technical team and HC to undertake further and specific research into the material construction of the building and concrete properties (inc. original specification and subsequent alterations), and obtain any relevant missing information including: (2)
2. Technical team to undertake further investigation into the performance and compatibility of different coatings and consult suppliers (Keim/Sika etc) (3b)
3. Discussion on coatings and cleaning in relation to wider building strategy (1)
4. Engage contractor for enabling contract – and determine location in which to carry out tests and trials (3b/4)
5. Consents – gain consent from WBC for the trials/test (locations TBC) (3b/4)
6. Testing – testing of concrete to establish mix/properties, existing coatings etc (3b/4)
7. Trials – undertake samples of each repair type for sign off (3b/4)
8. Verification survey with contractor of chosen package area(s) including high level access (4)
9. Application for consent to implement programme of repairs to chosen package area (4)
10. Engage contractor for implementation of repairs (4)
11. Implement works with appointed contractor (5)

5.2.3. Wider concrete repair strategy

1. Develop a maintenance strategy – to be agreed by WBC and University of Reading (1/6)
2. Discussion on coatings and cleaning for longer term. (1)

6. FURTHER ACTIONS

6.1. REPAIR RELATED ACTIONS

6.1.1. Statutory Consents

The URS Building is a Grade II-listed building. Professional advice should be sought as to whether the recommended investigations, trials and repair works require listed building consent. If in doubt, the local planning authority (Wokingham Borough Council) should be consulted. It would also be the advice of this document that the Twentieth Century Society be consulted for guidance and planning support.

6.1.2. Asbestos

While extensive asbestos removal works have been undertaken in recent months at the URS building, it is possible that some Asbestos Containing Materials (ACM) remain, for example, within cavities and behind pre-cast panels. Prior to any works being carried out on the building a refurbishment/demolition survey should be undertaken to identify any ACMs that might be disturbed in the course of the works, to ensure that no one will be harmed by the work, and that the work is undertaken in accordance with the Control of Asbestos Regulations 2012.

6.2. RECOMMENDED MANAGEMENT AND MAINTENANCE ACTIONS

7.2.1 Summary of Existing Management and Maintenance Arrangements

As well as inherent defects in the design, specification and construction of the URS Building, poor maintenance has caused premature deterioration of the concrete structure. There has been a failure to undertake regular inspections of the building and to identify and address defects in a timely manner. This can be seen in the instances of spalling concrete in public areas. A failure to address cracks and spalls is resulting in continued corrosion of the reinforcement. In a number of cases, the lack of regular inspection and remedial repairs has resulted in considerable health and safety risks. Where repairs have been undertaken, they have not always been carried out in a way that is sympathetic to the character and appearance of the listed building, or in a way that is compatible with the characteristics and performance of the fabric.

7.2.2 Management and Maintenance Plan

As the building does not appear to have been subject to a holistic maintenance strategy at any point during its life, the commissioning and implementation of a Management and Maintenance Plan (MMP) is highly recommended.

The MMP would ensure the timely maintenance of the building fabric, reducing safety risks, slowing decay and reducing the need for more costly repair works and would ensure that short and long-term management decisions are based on an understanding of the building's significance.

Examples of MMPs for similar mid-C20 buildings include:

- UEA
- The National Theatre
- Alexandra Road Park

7.2.3 Management and Maintenance Activities

Maintenance and management activities are likely to include but are not limited to:

1. Maintenance of up-to-date records of construction, modification, maintenance and repair contracts, ideally including 'as built' reinforcement drawings. This information enables informed decisions to be made about maintenance and repair including suitable specifications and intervals for maintenance. If existing records are not held by the building owner, it may be necessary to approach former project architects and contractors and planning records. Existing and future records should be held in a Building File.
2. Building inspection. The building owner should ensure there is someone responsible for regular inspection of the building. This could be consultants or specialist contractors with a good understanding of concrete and its performance, to ensure good practice is followed. Regular inspection allows for early identification of deterioration, weakness and sensitive areas and enables pre-emptive action to be taken to slow deterioration and avoid more extensive and expensive repairs.

The inspection of the concrete structure may include periodic 'hands-on', make-safe surveys of the concrete in public areas, to manage the risk of continued deterioration and spalling of concrete in those areas.

3. Planned preventative maintenance. Planned maintenance activities carried out on established cycles relating to product service life may include redecoration/re-coating, cleaning, renewal of seals and movement joints, renewal of roof coverings, periodic inspection and maintenance of rainwater goods.
4. Reactive maintenance. Prompt reactive maintenance to address leakages and damp conditions as well as reports of spalling and loose material will prevent ongoing deterioration of the building.

APPENDICES

APPENDIX A PURCELL CONCRETE REPAIR STRATEGY

APPENDIX B STATUTORY LIST DESCRIPTION

APPENDIX C PURCELL HERITAGE IMPACT ASSESSMENT (HIA)

APPENDIX D SIGNIFICANCE DRAWINGS

APPENDIX E KEY DRAWINGS

APPENDIX F DEFECTS SCHEDULE

APPENDIX G SCHEDULE OF DEFECT AND REPAIR TYPES

APPENDIX H1-H6 DEFECTS DRAWINGS (WITH PRIORITY RATINGS)

APPENDIX J PHOTOGRAPHIC RECORD OF CONDITION

APPENDIX K HEALTH AND SAFETY ITEMS SCHEDULE
