UNITED GRAND LODGE OF ENGLAND – REGENT STREET DISEASE WORK PHASE 4

CATHODIC PROTECTION CONCEPT DESIGN REPORT

For

UNITED GRAND LODGE OF ENGLAND

DOCUMENT NUMBER: CN22-028-J946-R1777, REV 01

DOCUMENT CONTROL

CONTRACT TITLE:

UNITED GRAND LODGE OF ENGLAND – REGENT STREET DISEASE WORK PHASE 4

DOCUMENT TITLE:

CATHODIC PROTECTION CONCEPT DESIGN REPORT

DOCUMENT TYPE:	Technical Report					
DOCUMENT NUMBER:	CN22-028-J946-R1777					
REVISION DETAILS:	**REVISION:**	01	**STATUS:**	For Information		
	AUTHOR:	C. Wozencroft	**CHECKED:**	T. Robinson	**APPROVED:**	R. Edwards
	DATE OF ISSUE:		24 March 2025			
DISTRIBUTION:	1 copy to UGLE. 1 copy to Baily Garner 1 copy to CES Archive.					
CLIENT:	United Grand Lodge of England 60 Great Queen Street London WC2B 5AZ					
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CORROSION ENGINEERING SOLUTIONS

REVISION RECORD:

REVISION:	STATUS:	REVISION NOTES:					
00	I	First issue.					
		AUTHOR:	C. Wozencroft	**CHECKED:**	T. Robinson	**APPROVED:**	R. Edwards
		DATE OF ISSUE:		14 March 2025			
01	I	Location of TR cabinet moved to improve serviceability/safety.					
		AUTHOR:	C. Wozencroft	**CHECKED:**	T. Robinson	**APPROVED:**	R. Edwards
		DATE OF ISSUE:		24 March 2025			

CORROSION ENGINEERING SOLUTIONS

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1 INTRODUCTION

Corrosion Engineering Solutions [CES] have been commissioned by United Grand Lodge of England to produce a concept design [roughly equivalent to Stage 3 of the Royal Institute of British Architects [RIBA] project guidance] for a Cathodic Protection [CP] system. The CP system is to arrest on-going corrosion of the steelwork embedded in the glazed brick façades of the Large Connaught Room Lightwell & the Air-handling Plantroom, which sits at one end of the lightwell.

The purpose of this document is to describe the context of the project and to communicate the concept design via text and sketches in sufficient detail to allow for planning and coordination in the context of the wider repair works. The other main purpose is to provide details of the CP design to inform listed building consent, as the structure is on the National Heritage List of England.

The intention of the CP is to protect and preserve the structure for a period of 50 years, but it is predicted that the major components of the system will last 100+ years.

The document has been prepared such that the principal concepts are accessible by anyone with a basic understanding of buildings and engineering. The nature of CP does, however, require an understanding of some specific technical concepts and it is expected that any persons using this document for pricing or planning purposes have an understanding commensurate with that expected of persons certificated to BS EN ISO 15257:2017, Level 3 in the reinforced concrete application sector.

1.1 PROJECT PARTICULARS

1.1.1 THE PROJECT

Below is a list of the parties involved in the refurbishment project at the design stage:

1.1.2 CLIENT

United Grand Lodge of England
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Main Contact: Mr Paul Turner

1.1.3 Project Manager

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Main Contact: Mr Chris Wozencroft

1.2 TERMS OF REFERENCE

The design of this scheme has been carried out in accordance with the following contract documents, standards and guidance notes:

i. BS EN ISO 12696:2022, *"Cathodic Protection of Steel in Concrete"* – N.B. although this structure is not universally constructed of concrete, this standard/sector can be applied to masonry clad early 20th Century Buildings.
ii. BS EN ISO 15257:2017 *"Cathodic Protection – Competence levels and certification of* cathodic protection personnel".
iii. BS 7671:2018 "Regulations for Electrical Installations – The IET Wiring Regulations 18th Edition" and associated guidance notes.

1.3 SCOPE OF CONCEPT DESIGN PACKAGE

The concept design work for the CP system is intended to provide:

i. A description of the structure and elements requiring protection.
ii. The scope and extents of the proposed CP scheme.
iii. Reasoning in support of the selected system and materials and identification of any which may be inappropriate.
iv. An outline of the proposed CP scheme.

The CP concept design does not include detailed drawings, calculations, or materials specifications as these will need to be developed as part of the detailed design and in conjunction with the wider project team.

2 CONSTRUCTIONAL DETAIL & BACKGROUND

Freemasons' Hall, also known as *The Masonic Peace Memorial London,* is the home of the *Grand United Lodge of England,* who are the governing body for Freemasonry. The building is a four-storey steel frame structure, which is clad in Portland Stone. It was designed by Ashley and Newman Architects and was constructed between 1927 and 1933 as a memorial to the Freemason's who died during World War I. It consists of 26 temples around the central *Grand Temple* and is also home to a museum, gift shop, and a bar/café. In addition the building also has basement levels, a loft/service space above the *Grand Hall/Temple*, and a Grand Entrance upon which a tower of approximately four more storeys sits.

The whole structure is Grade II* listed. This particular listing is understood to include internal and external fittings. Therefore, significant care must be taken to avoid impacting these.

Various investigations and assessments have been carried out over the past 20 years which have identified widespread expansive corrosion of the embedded steel frame. This expansive corrosion has caused extensive damage to the masonry cladding in the form of cracking & displacement. This is often referred to as Regent Street Disease [RSD].

Different parts of the building have had this problem addressed in different phases. Phase 1 addressed the issue in the southern half of the main lightwell, and Phase 2 included treatment of the parapet beams in that area.

Both of these phases used extensive masonry removal, surface treatment of the steel and replacement of masonry using new glazed bricks. Crucially, this work was not just limited to those areas that were extensively cracked and displaced, but extended to all areas that were at risk [i.e. every beam & column]. The result is that the treated areas are reasonably obvious, and extensive damage was caused to the heritage fabric of the building. The area covered by Phase 1 & 2 is shown in Photograph 1.

Photograph 1 - Phase 1 & 2 repairs

In 2023 the upper sections of the main entrance [down to datum 66m] and the tower that sits above this was treated in Phase 3 of the RSD work. This part of the structure is clad with Portland stone and CP was used to address the RSD risk as this drastically reduced the damage to the historic cladding and disruption to the building occupants, comparted to traditional measures. This system was commissioned in autumn 2023. This installation included a fully automated and remotely controllable electronic control system in the form of a single Transformer Rectifier [TR] cabinet at the base of the Tower Room.

In parallel with Phase 3 works, the building's owners commissioned a study to categorise the different areas of the building that might be affected by RSD and to prioritise the intervention. This was summarised in a CES report titled Freemason's Hall Façade Asset Management [reference CN22-028-J733-R1292 REV01].

The Grand Superintendent of Works at that time, and the building's maintenance team, had identified that the structures associated with the two lightwells that neighbour the Connaught Rooms to the north-east were in significant distress. The larger of the two lightwells, and the Air-handling Plantroom that sits above it were prioritised to be Phase 4 of the work. These areas are shown in sketch SK001 [an extract from the CES report] in Appendix A.

3 SCOPE OF SYSTEM

The scope of the CP system is to protect the embedded steel beams and columns in the façades of the larger of the two Connaught Room Lightwells, and the Air-handling Plantroom that sits between them. The elevations are numbered 23, 25, 26 & 27 according to a wider survey of all of the façades [completed by Spatial Dimensions land surveyors]. Presently, there is some confusion as to whether these numbers are correct, and this is being investigated separately.

Both the Large Connaught Room Lightwell and the Air-handling Plantroom are entirely clad in white colour glazed brick. Generally, the façades on the Freemason's Hall façade of the lightwell are flat wall/ashlar but the Connaught Room wall has buttressed brickwork around the columns. There is also a large corbel jutting out from the wall at 3rd floor beam level.

It is understood that the Connaught Room elevation of the lightwell was built at the same time as Freemason's Hall, and thus shares similar construction details. Whereas the majority of the Connaught Rooms is a 19th Century building.

Presently, the details of the embedded members are not known. As discussed above, there are plans to undertake limited surveys Before the detailed design is complete, it is planned that scaffold will be erected and additional investigations [using metal detectors, narrow stitch drilling of bed joints and limited opening up work] will be undertaken to ascertain the minimum information required.

Although it is possible that only the upper parts of the lightwell will require protection, this concept design has assumed the worst case and all members in all four façades have been included.

Equally, it is possible that the damage to the Air-handling Plantroom is so great that the extensive rebuilding that is required will render CP redundant, as direct treatment of the steel will be possible.

It should be noted that CP is a reasonably intense treatment and should only be undertaken where the damage caused by the installation drastically outweighs the damage that RSD will cause over the medium to long-term, or the damage that traditional approaches to treating RSD would cause [e.g. Phase 1 & 2].

The plantroom to the south-east of the large lightwell is not expected to be included. This is referred to as 'The Lift Motor Room' on CN22-028-J733-SK001 and is shown in Photograph 2.

Photograph 2 – Lift Motor Room to south-east of lightwell

It is likely that this building does not contain any embedded steel members. This is because the building does not appear to be original. It is only one storey tall, the brickwork is visually slightly different, it has been built in front of the neighbouring building's extract louvre and it appears to have a reinforced concrete slab roof.

Although the structure is not part of the scope, it has been identified as the location for the Phase 4 control cabinet.

4 OUTLINE DESIGN

The structure should be protected by the impressed current form of CP. Alternative systems such as galvanic and hybrid anodes have been considered but dismissed as inappropriate. Galvanic and hybrid anodes are generally much larger than the impressed current anodes being proposed and, because they are proprietary products, they are often vastly more expensive for a much reduced capacity/functionality.

The system will likely utilise titanium mesh ribbon anodes. An image of a segment of typical ribbon anode is given in Figure 1. These anodes will likely be 10/20 mm wide and 1 mm thick. The required lengths will be cut to suit the situation. The titanium is coated in mixed metal oxide [MMO]. The benefits of this material are that it is flexible to fit into the masonry joints, it can be used to form rod anodes installed into drilled holes, and, when properly managed, is robust and long-lasting with an extensive track record. These anodes have a design life of 100 years.

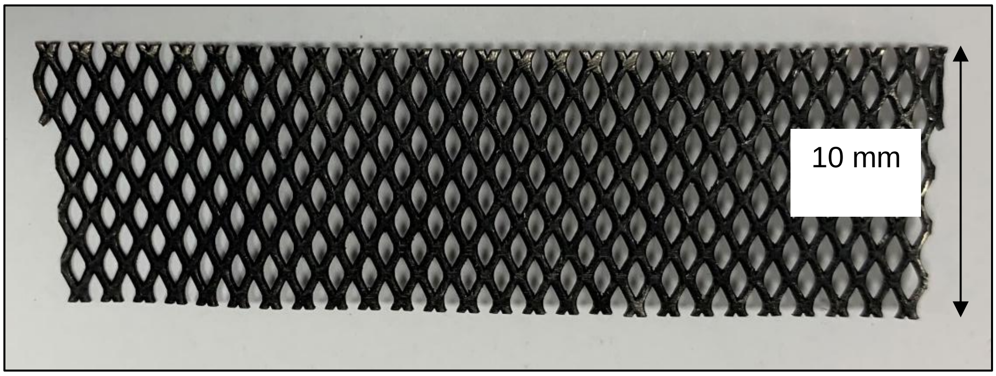


Figure 1 - Typical segment of MMO titanium ribbon anode.

Correctly installed and properly managed impressed current CP systems have been found to be the cheapest and most effective CP option for masonry structures. They are typically designed for a 50–60-year design life but with proper maintenance could function for 100+ years.

Based on the design life, impressed current CP is also likely to be a more environmentally friendly option for the structure as it does not require the mining and refining of high purity zinc. If properly managed, it is likely that an impressed current CP system will also require less maintenance with only monitoring sensors and control systems needing to be replaced within the service life, as opposed to the entire system.

Typically, Ag/AgCl reference electrodes [monitoring sensors] will need replacement every 10 to 15 years and the control equipment will require replacement approximately every 20 years.

4.1 ANODE ARRAY & INSTALLATION

It is envisaged that the system be installed predominantly externally as this limits disruption, noise, and mess to the occupants and listed internal features. In the case of the wall of the Connaught Rooms [south-west facing elevation], the work would almost certainly need to be done externally, as this is presently occupied by a third-party leaseholder. The other walls are in the domain of the owner [UGLE] but cannot easily accommodate an internal installation due to all the internal listed walls and disturbance this would cause the occupants.

The south-east facing elevation is a mostly an air-handling duct with little internal access. The north-west and north-east facing elevations are part of the 'front of house' space within Freemason's Hall [offices, corridors and stairwells], and most of these areas/finishes are listed.

Elements such as cable management and infrastructure will mostly be installed externally also, behind the parapet at roof level and/or within the Air-handling Plantroom at roof level. It is possible that some small amount cabling will need to be installed within risers, the internal soffits and walls, but none is envisaged at this stage. If required, this may require some out of hours work.

It is very likely that an ethernet cable connection between the existing TR unit in the Tower Room and the new Phase 4 TR unit [location to be confirmed] will be required.

As the CP system will have anode ribbons chased into the masonry joints of the facades, the joints will need to be widened from 5mm to 6mm, to 6mm to 8mm, the CP components grouted in place, and the joint over-pointed with an appropriate heritage lime-based mortar. Figure 2 shows an example of the proposed installation.

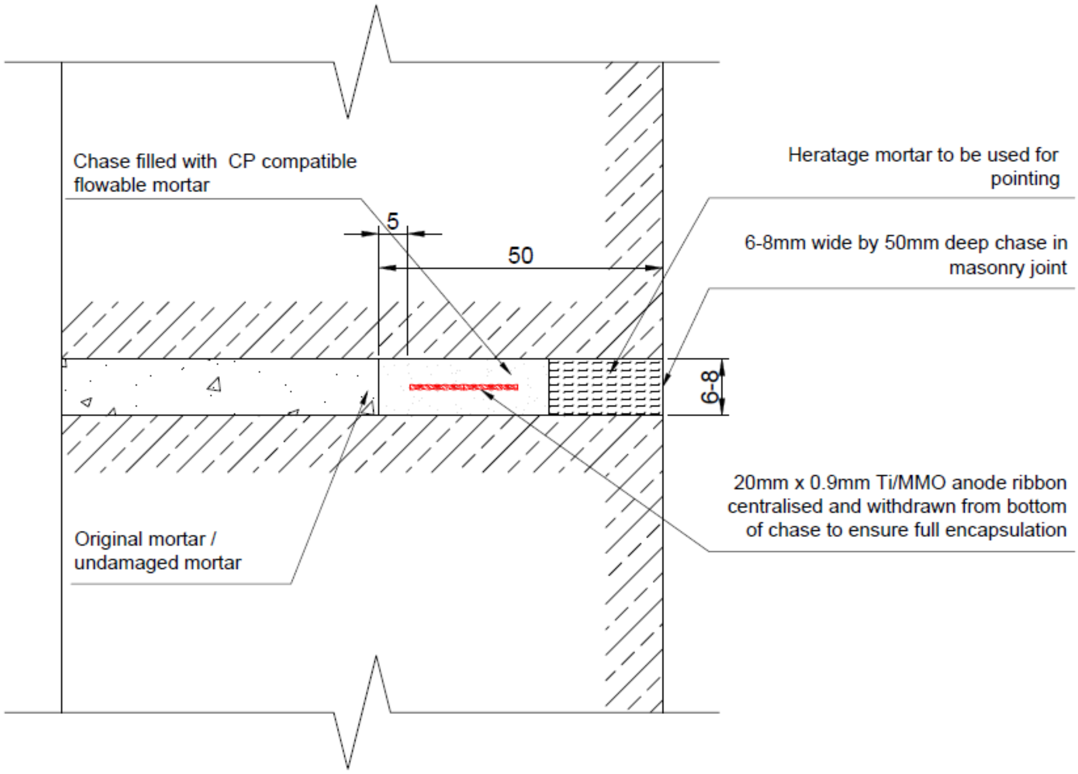
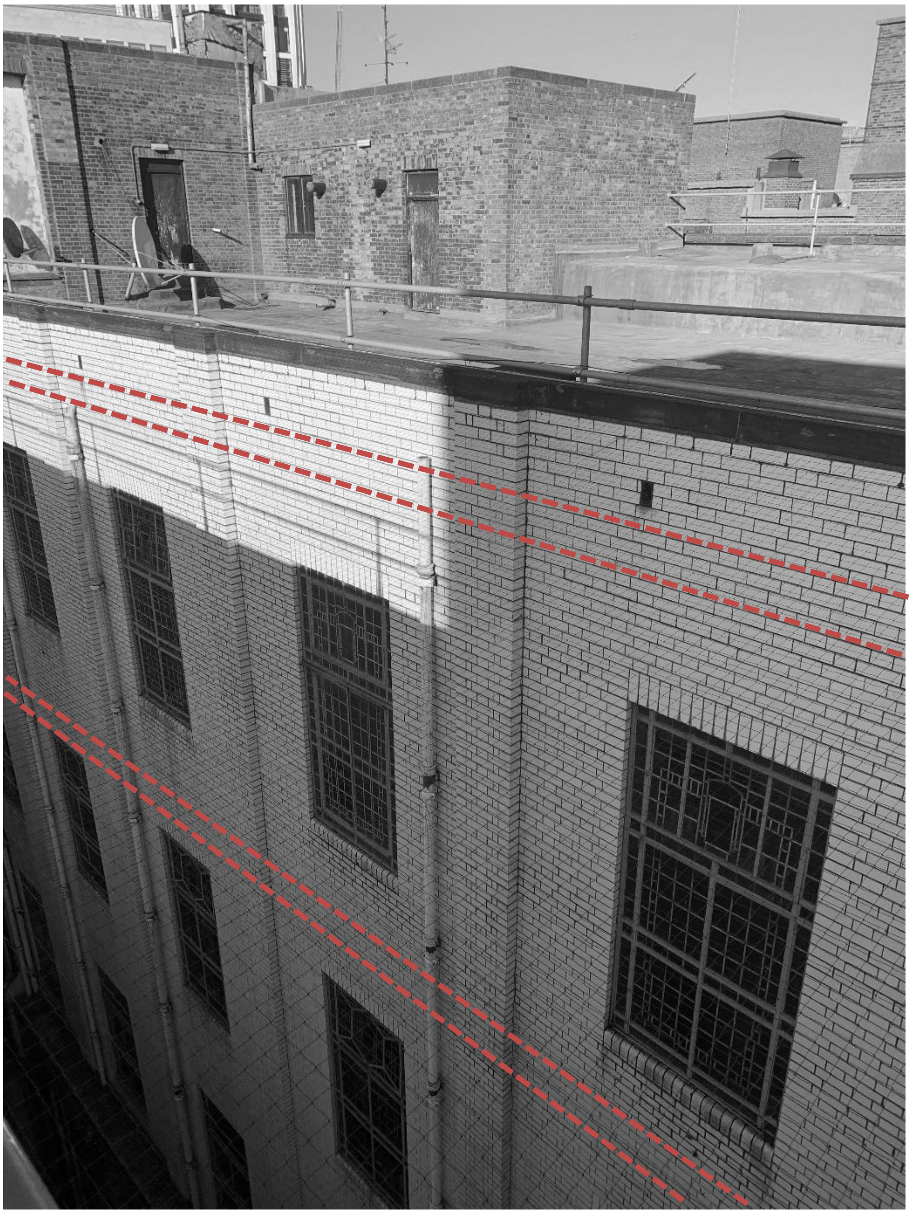


Figure 2 - Cross-section showing proposed anode installation

4.1.1 BEAMS

It is likely that all beams will be protected using a series [probably two] runs of horizontal anode ribbons installed in joints slightly above and below the beam. An example is shown in the red lines marked on Photograph 3.



Photograph 3 - Position of anode ribbons for beam protection.

This is a well-establish standard method for CP of embedded steel members.

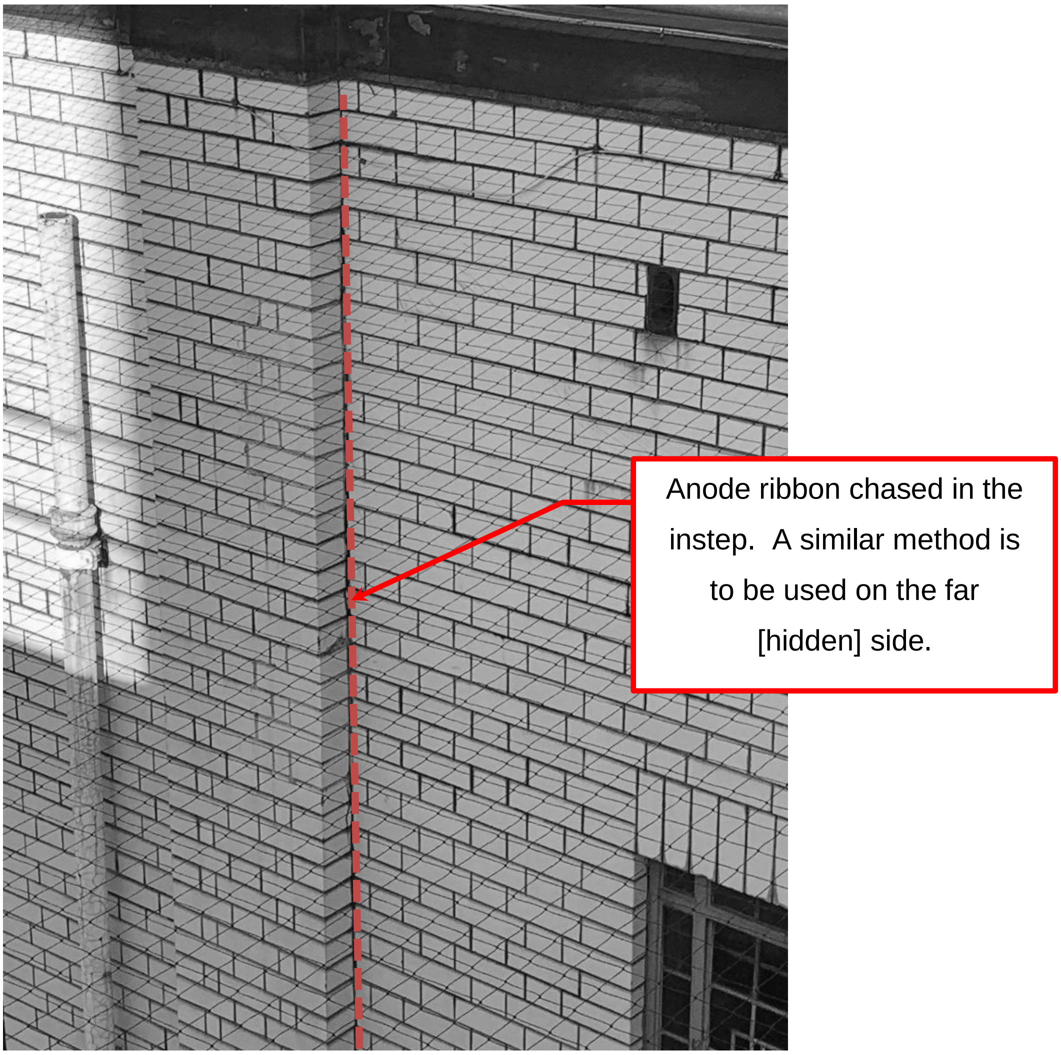
The existing bed joints are approximately 4mm to 6mm wide presently, although the width varies considerably, even across a relatively small area. This requires a small widening of the joint to approximately 8mm.

Previous projects on other buildings have established that diamond blade cutting discs and multi-tools risk damaging the edges of the glazed bricks as the joint is enlarged. Instead, a carbide cutting disc can be used to 'sand' the edges gently, which results in almost no damage to the glazing of the bricks.

No details are presently known of the size or orientation of the members. In the case of the beams, the orientation is given, and it is likely that the beams at each level are a similar size [as the expected loadings and geometry is similar]. It is possible that the large flat accessible roof will have deeper beams, because of snow-loading risks.

4.1.2 BUTTRESSED MASONRY COLUMNS

On the south-east side of the of the lightwell [Connaught Rooms wall], the columns are encased in buttressed brickwork – whereas the rest of the lightwell's columns are not. The reason for this change in design is not known but it offers an opportunity to embed the anodes vertically up the instep of the buttress. This is shown the red lines marked on Photograph 4.



Photograph 4 - Proposed position of anode ribbon in buttressed brickwork.

This is also a well-establish standard detail for CP of embedded steel members.

In most cases, the insteps of these buttresses are showing signs of previous damage and repair. This is particularly apparent at the upper levels. This means that the cables and anodes can be installed in chases without further damage to the brickwork.

As discussed above, there are no details available for the size of these columns but the brickwork suggests the stanchions are encased in the buttresses, and this gives a maximum limit to the overall dimensions.

4.1.3 FLAT-WALL COLUMNS

Where columns are not behind buttressed brickwork [three of the four lightwell elevations], they are to be protected using a series of horizontal strips of anode ribbon, installed every fourth or fifth brick course. This is shown in Figure 3.

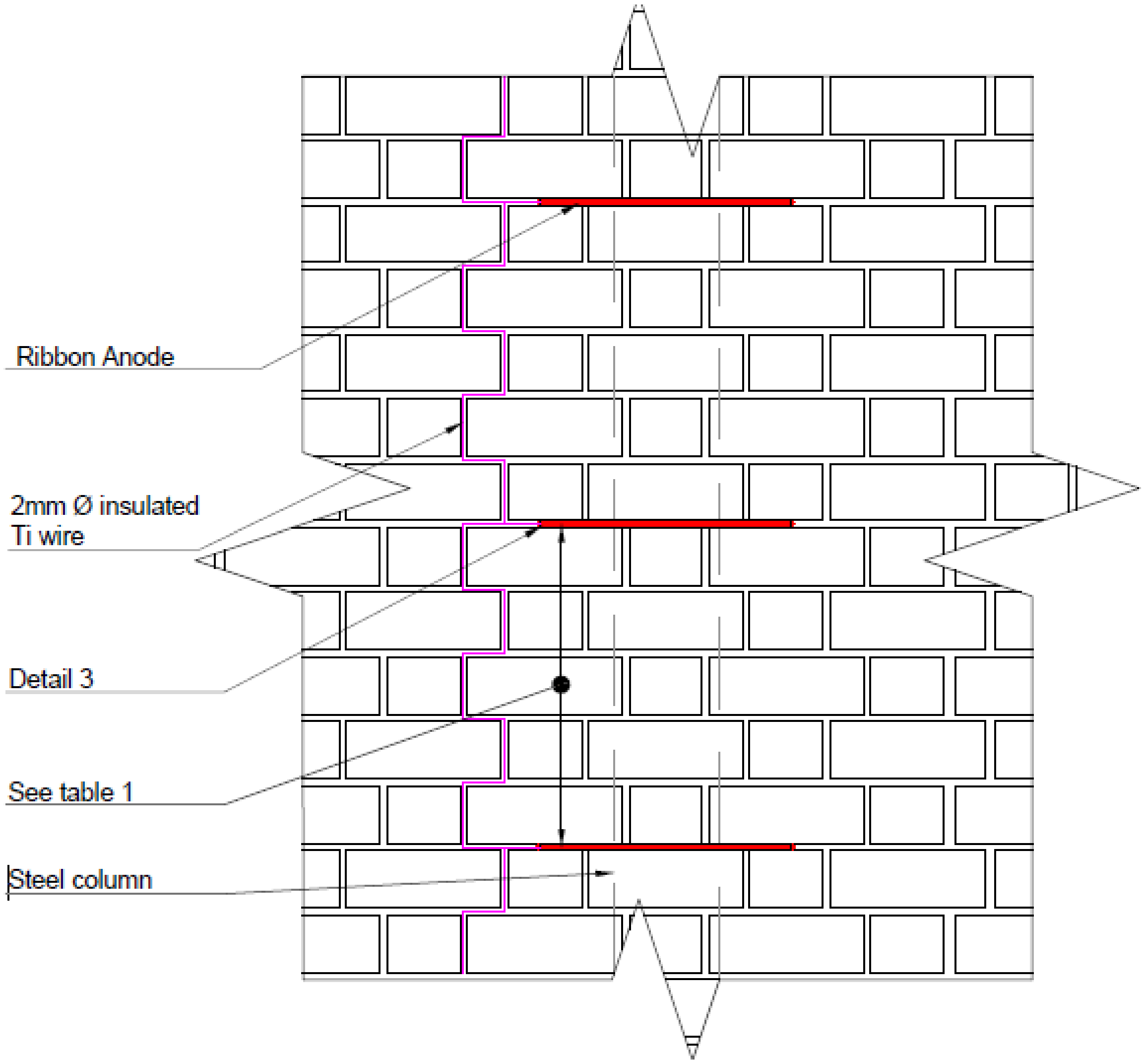


Figure 3 - Column anodes at flat-wall positions.

The exact length of each ribbon anode and the spacing required between them shall be determined during detailed design and is dependent on factors such as the size of the member to be protected and the cover depth.

This is also a well-establish standard detail for CP of embedded steel members.

As discussed above, there are no details available for the size or orientation of the embedded steel members but they are not expected to be excessively large due to the original intended use of the structure [office building].

4.1.4 CORNER COLUMNS

The nature of this part of the building means that there are few external corner columns. The only corner columns that might be included are on the Air-handling Plantroom and, as discussed above, this part of the structure may not be included in the scope.

Any corner columns that do require protection, more of the embedded member is at risk as it is exposed on two faces. For these situations a similar arrangement to that described in Section 4.1.3 is proposed, with flat strips of ribbon running horizontally across the face of the member. The difference is that two strips will be required, one for each face of the column, slightly offset from the corner arris, and they are to be linked with titanium conductor wire.

This is shown in Figure 1Figure 4.

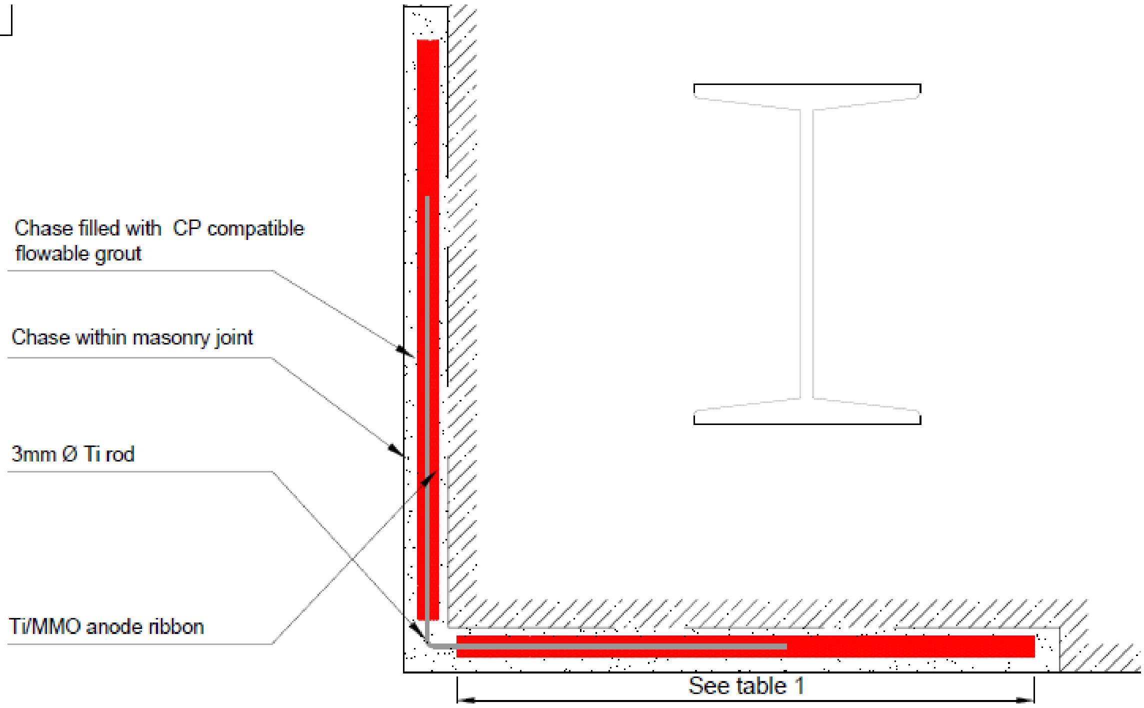


Figure 4 - Example horizontal section through corner column showing proposed anode arrangement.

This is also a well-establish standard detail for CP of embedded steel members.

The size and orientation of the members in the Air-handling Plantroom are also not know but the extensive amount of masonry repair/rebuilding that is required means that these details can be confirmed before details are finalised. The nature of the proposed layout is such that the length and/or the spacing of the horizontal strips can be easily adjusted, at short-notice to accommodate the actual as-found dimensions of the member.

4.2 SYSTEM ZONING

For the CP system to run as effectively as possible, the structure shall be divided into a series of zones. CP zoning is usually based on the perceived exposure conditions in each part of the building/façade, the size of the steel members and the façade material.

The lightwell & Air-handling Plantroom have been divided into five zones. The proposed zoning is shown on drawing CN22-028-J946-SK101. The zone numbering continues from the seven zones of Phase 3.

Zones 8 and 9 cover the upper storey and parapet/roof level beam of the lightwell. These are the areas that are almost certainly going to be included in the scheme. Zones 10 and 11 protect the areas below this and can easily be removed from the scheme should the survey results suggest that is possible. Finally, Zone 12 will protect the Air-handling Plantroom.

The zones have also been separated into the part of the structure that is UGLE's direct responsibility and the single elevation which is under The Connaught Room's control. This is to allow easy distribution of installation, maintenance and monitoring costs if required.

In reference to the distribution of maintenance responsibility discussed above, the concept design proposes dedicated junction boxes and multicore cables to serve each part of the structure. This will allow relatively easy separation of the system in the future, should the properties become fully independent.

It should also be noted that there remains scope for further division of the structure into more zones or changes to zone boundaries to account for specific details – i.e. more detailed information on the size/orientation of the embedded members after the surveys planned for early April 2025. The precise zoning shall be determined during detailed design.

4.3 CONTINUITY

For a CP system to function, it is essential that all components intended to be protected, are electrically continuous. Given the construction approach/standard in the 1930s, it is highly likely, that the steel frame is electrically continuous within the lightwell and any given zone. The Phase 3 works confirmed good continuity of the frame on the Tower [a separate part of the structure], which increases confidence for Phase 4.

Externally mounted metallic components, within 0.5m of any anode, e.g. window fixings/mountings will require a protection strategy to prevent the CP from damaging these components. These items could be bonded directly to the steel frame [or the D.C. negative terminal at the TR] or be isolated from the system via the use of non-metallic mountings or surrounding their mountings in electrically resistive resin. A further option is to earth the metallic components.

4.4 NEGATIVE AND TEST NEGATIVE CONNECTIONS

The relevant standards require a minimum of two of each type of connection per zone. However, the nature of a steel frame and need to minimise disruption to the façade means that a more pragmatic and considered approach can be accommodated.

A new control cabinet, also referred to as a TR, is required for this part of the system and it is proposed that it have its own negative and test negative connections. These connections shall be made internally and in close proximity to the control cabinet, so as to minimise the need for excessive cabling. A minimum of two negative and two test negatives will be required for this new control cabinet.

A similar approach was taken for the Phase 3 work and that has been proven to be effective.

4.5 MONITORING SENSORS

It is envisioned that monitoring of the CP system will be performed by both reference electrodes and decay probes. Reference electrodes, while giving a precise measure of the potential of the steel structure, tend to lose their accuracy after 10-15 years in service and at this point, they may require replacement. To address this potential vulnerability, decay probes will also be specified. Decay probes do not lose their accuracy and can report valid results to the end life of a CP system.

In order to offer additional redundancy an equal number of two types of reference electrode shall be used these will be located in different zones to maintain an equal distribution:

i. Silver/silver chloride [Ag/AgCl 0.5M KCl].
ii. Manganese/manganese Dioxide [Mn/MnO_2]

No other reference electrode chemistries shall be accepted.

The decay probes shall be made from short lengths of MMO coated titanium ribbon anode or repurposed MMO coated titanium rod anodes.

4.6 CONTROL EQUIPMENT AND CABLE MANAGEMENT

4.6.1 CONTROL EQUIPMENT

Impressed current CP systems require electronic control equipment to supply DC protection current, control the outputs, log monitoring data, report faults, and to allow remote control/monitoring. Modern control cabinets/TRs contain a variety of equipment including transformers, rectifiers, analogue-digital convertors, data-loggers, data-storage, modem-routers and human-machine interface controls.

As discussed in Section 4.4, a single new TR cabinet is envisaged. The existing system installed during Phase 3 [Zones 1 through 7] is served by a single TR cabinet in the base of the Tower that contains all of the required equipment. There is not sufficient room in that cabinet to accommodate the additional equipment and the location is too far removed from the lightwell to be efficient. A new TR cabinet is required.

This new/additional TR will require its own 230V power supply.

The exact location of the TR will be confirmed during the detailed design and will need to be carefully coordinated with the building's existing mechanical and electrical system. Presently, the inside of the lift-motor room to the south-east end of the lightwell is being proposed. The Air-handling Plantroom was originally proposed but the air pressures in this space make it a difficult environment to work in when the plant is running.

The TR shall be housed in suitable GRP IP65 rated cabinets, with all cabling entering the bottom of the cabinet. The cabinet should be of suitable size and weight to allow for installation without additional lifting equipment.

The TR cabinet that serves Phase 3 [Zones 1 through 7] is shown in Photograph 5.

Photograph 5 - Phase 3 TR cabinet located in the base of the Tower.

Quantities of terminations for the TR will be stated in the detailed design.

Each zone shall have a minimum output of 12V and 500 mA. The equipment shall allow the output current to be set in 1 mA increments with an accuracy of +/- 1 mA in constant current control. Each output channel shall be capable of having its output independently adjusted without affecting the output of any other output channel.

The equipment may provide functionality to arbitrarily limit the output via current or voltage.

The new TR cabinet shall act as a 'slave' unit to the existing TR cabinet, which will also be the interface/control, for the Phase 4 parts of the system. This is important as it is likely to keep costs to a minimum and maximise the efficiency of monitoring and maintenance.

It is currently envisioned that the control cabinet shall have the following dimensions 1400 × 1000 × 400 mm.

4.6.2 CABLE MANAGEMENT, INFRASTRUCTURE AND ROUTING.

4.6.2.1 MULTICORE CABLING & JUNCTION BOXES

Multicore cabling will be required from the TRs to the junction boxes. It is anticipated that the zones to each elevation will have a dedicated junction box and multicore, as will the zone that serves the Air-handling Plantroom [if included].

Multicore cables shall likely be 2.5mm^2 with either PVC or XLPE insultation, coloured black. The conductors shall be Class 2 or Class 5 stranded / flexible copper conductors. Appropriate cable management shall be utilised, for instance flexible conduit.

The size of the junction boxes shall be confirmed during detailed design, however, shall be IP65 rated. At this stage the project should assume that all junction boxes will be approximately will be 250 x 250 x 200mm.

Figure 5 below shows an example of the proposed arrangement.

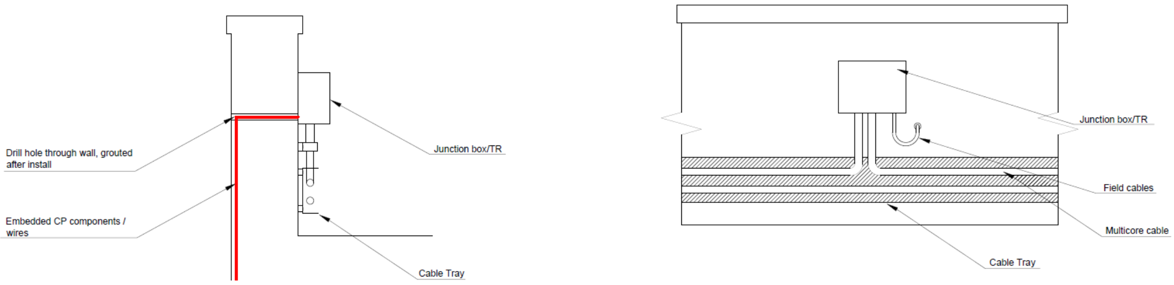


Figure 5 - Example of junction boxes & penetrations mounted to rear face of parapets.

The precise route and form of the multicore cable management utilised will need to be determined at detailed design stage and coordinated with the existing M&E management. The CP cabling should be independent of other services and must be separated or otherwise protected from mains and high voltage AC sources.

It is presently envisaged that the junction boxes will be mounted to the rear face of the parapet wall and that multicore cables will run along the roof or back face of the parapets to the required position.

It may be that the detailed design opts for multiple small junction boxes along the parapet of each elevation, to minimise the number of cables that must be grouped and run in the joints near the penetration points.

4.6.2.2 SINGLE CORE CABLING [FIELD CABLES]

The single core cabling shall penetrate into the façade from the junction box and serve each zone. These penetrations should be located as close as possible to the junction box positions. A small number of holes shall be drilled during this installation to facilitate cable penetrations through the façade.

Field cabling shall **not be visible externally**, all external cables shall be chased into masonry joints of the facades.

Cabling routes are subject to change during the detailed design.

4.6.3 CABLE PENETRATIONS

At various positions [yet to be agreed], the cabling that is installed/hidden in the external masonry joints will need to be connected to the internal junction boxes.

The system will be designed such that the number of cables at any one penetration will be limited, thus reducing the width of the masonry joint required and disruption to the façade. It is important that these penetration points are disguised, and that their impact on the building's aesthetic is minimised.

The proposed detail will be to drill a small [approximately 18mm Ø] hole through the masonry at the intersection of a bed and perp joint. The cables will pass through this hole and be laid into the masonry joints. The edges of the blocks around the hole will then be repaired.

If a larger penetration is needed, then the face of a brick [preferably in a location where repair is required regardless] will be locally removed to create a larger aperture [up to 50mm x 50mm]. This will then be repaired using matched materials in the same manner that the existing damaged bricks are to be repaired.

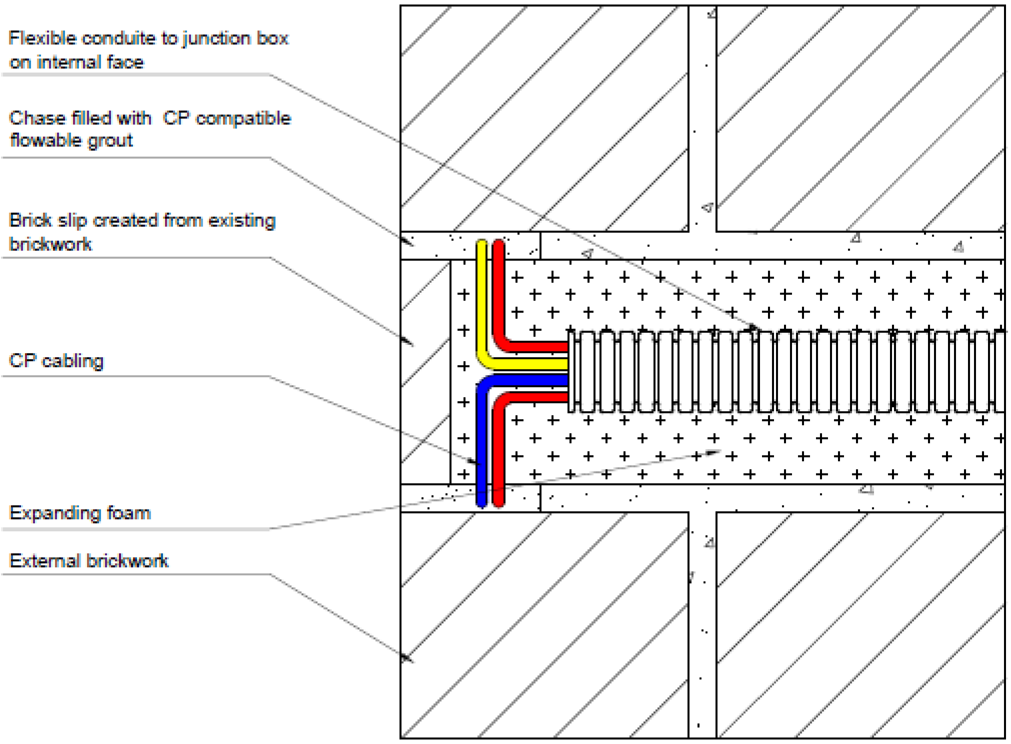


Figure 6 - Example of cable penetration detail.

This method shall result in repairs at these locations that are indistinguishable from other, incidental repairs.

5 DETAILS REQUIRED FOR DETAILED DESIGN

Before the detailed design can be progressed, more information is required.

5.1 HERITAGE APPROVAL

The building is a listed monument and heritage approval/listed building consent is required from Camden Borough Council to undertake the repairs and install the CP system.

It is understood that this concept design shall form a major part of the listed building consent application. Baily Garner are managing the application on behalf of the project.

It is likely that heritage trials will be required to manage the rebuilding work, and the CP installation. This should be considered, discussed with Camden's heritage team and programmed into the work at the earliest opportunity.

5.2 CONFIRMATION OF SCOPE

As discussed above, CP may be the least intrusive and most heritage compliant approach to controlling RSD but it is still a relatively intrusive technique and the scope of the system [and indeed any destructive repair methods] should be confined to only those areas where it is necessary.

Presently, there is no information to inform the assessment of scope other than visual clues that can be seen from the roof. A thorough, and largely non-destructive, investigation is planned for the first week of April 2025 once the scaffolding is in place.

This survey will use non-destructive techniques such as visual assessment, hammer-tap, half-cell potential mapping, metal-detector and resistivity measurement to determine the corrosion risk to the façades, and thus define the extent of the system.

It is also proposed that localised opening up work is done in areas of existing damage and/or areas where poor quality repairs have been carried out previously. These sites will be used to determine the actual corrosion condition, calibrate the more extensive non-destructive test values, and to obtain information on structural details.

There is no proposal presently to formally present this information or the analysis. Instead, CES proposes to organise a design meeting/workshop where recommendations can be presented and discussed, alongside the proposals for masonry repair. Following this, CES will write to the owner formally recommending which parts of the façade should be included in the system extension.

5.3 EXISTING STRUCTURAL DETAILS

As discussed above, extensive [and largely non-destructive] surveys are planned for early April 2025 once the scaffold is in place. These surveys will gather information on the existing structure, sufficient for the detailed design to progress.

The proposed surveys will include a limited number of intrusive investigations to calibrate the non-destructive testing but also to confirm member sizes, orientation and cover. It is proposed that one beam and one column are exposed in areas that have had poor quality repairs previous and are showing signs of repeat cracking. A third exposure is proposed on a beam or column on the Freemason's Hall side of the lightwell. This is to determine if construction details change between the different parts [there is a strong likelihood that they do] and to obtain a calibration point for steel that is not corroding.

5.4 MECHANICAL & ELECTRICAL SERVICES COORDINATION

The building's Facilities Manager should provide information on the existing M&E scheme in this area. Although minimal cable routes are required, and only a single additional power supply is required for the new TR cabinet, these details should be discussed and carefully coordinated as soon as possible.

6 SUMMARY

Full details of the proposed CP system are yet to be determined, however, the following summary provides a framework for the detailed design to begin:

i. The lightwell shall be protected by an Impressed Current Cathodic Protection [CP] system.
ii. The scope of the protection is yet to determined but may include the beams and columns on all the façades of the lightwell & the Air-handling Plant Room walls.
iii. Survey work is planned for early April 2025 to gather information that will allow the scope to be properly determined. For now the worst case [total coverage of all elevations] has been assumed.
iv. Some intrusive work will be required prior to the installation to confirm details of the steel arrangement and sizes. Two of three of these will be limited to areas which require substantial repair works [due to the impact of steel corrosion].
v. The Phase 4 system will be divided into five separate CP zones as shown in sketch CN22-028-J946-SK101.
vi. The beams and columns will likely be protected by lengths of 10 or 20mm wide MMO ribbon anode embedded in external masonry joints.
vii. Many of the masonry joints will need to be widened to accommodate the CP installation which will be embedded in the mortar. The joints will then be over-pointed with heritage matched mortar to conceal the CP installation.
viii. Each zone shall be monitored by a series of Ag/AgCl 0.5M KCl or Mn/MnO_2 reference electrodes and MMO decay probes.
ix. A new control cabinet shall be installed and positioned in an appropriate plant room in the building to enable servicing without disruption to the daily operations of the building.
x. The new control equipment shall be connected to the existing equipment installed in Phase 3.
xi. Multicore cabling will be installed between the new control cabinet and junction boxes at roof level – probably along the rear faces of the parapet wall.
xii. Heritage, M&E and masonry repair design coordination is required before the detailed design can progress.

7 QUALITY STATEMENT

We confirm that we have exercised reasonable skill and care in the preparation of this report, which has been produced for and on behalf of Corrosion Engineering Solutions Ltd.

The opinions contained within this report are based upon information available at the time of writing. If further information becomes available, we reserve the right to review our comments and revise our opinions.

APPENDIX A. CONCEPT DESIGN SKETCHES

Presented separately as PDFs