DEPARTMENT OF PUBLIC WORKS

PARLIAMENTARY PRECINCT: OLD ASSEMBLY BUILDING: CAPE STORES: STRUCTURAL REPAIR WORK

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REFERENCE NO: 3/12/20/2/6

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CONCEPT & VIABILITY REPORT

MAY 2016

PREPARED FOR:

DEPARTMENT OF PUBLIC WORKS
PRIVATE BAG X9027
CAPE TOWN
8000

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ISSUE & REVISION RECORD

QUALITY APPROVAL

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This report has been prepared in accordance with BVi Consulting Engineers Quality Management System. BVi Consulting Engineers is ISO 9001: 2008 registered and certified by NQA Africa.

REVISION RECORD

Revision Number	Objective	Change	Date
0	Issue to Clients for comments		

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SECTION 1- INTRODUCTION

BVi Consulting Engineers have been appointed by the Department of Public Works to provide Professional Engineering services. The project brief as per the appointment is as follows:

- Sealing of cracks
- Granite walkway on top of workshop to be removed, cleaned, replaced and re-grouted.
- Underpinning of some of the foundations in the Cape Stores basement.
- Permanent reinforcement of the Cape Stores soffit.
- Proper waterproofing, sealing, painting and proper defects repair work will have to be applied to remedy defects such as cracks, damage and dampness.
- The restoration of inadequate rainwater conveyance, expansion joints and grouting.
- Repair work of boundary and retaining walls.
- Repair to aprons and hard surfacing surrounding and effected buildings , and
- Repairs to underground and above ground stormwater systems and watercourses
- Refurbish existing electrical & mechanical services in basement area where required, while ensuring all key service aspects remain operational during the building works.

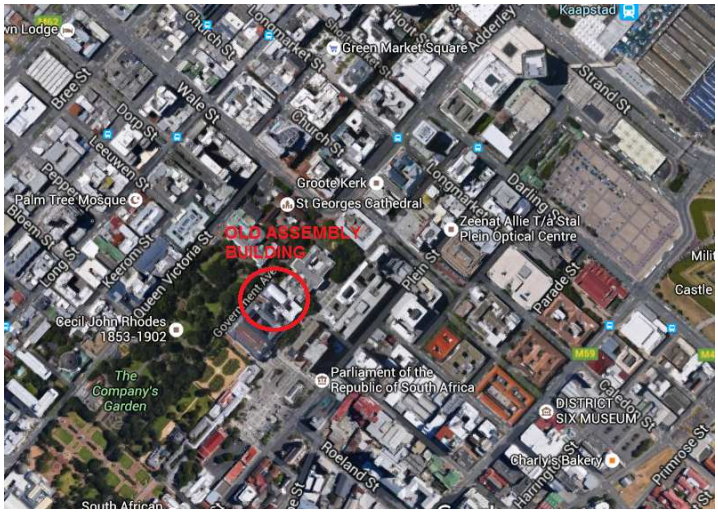


Photo 1.1: Arial photo of Cape Town CBD, indicating position of Old Assembly building

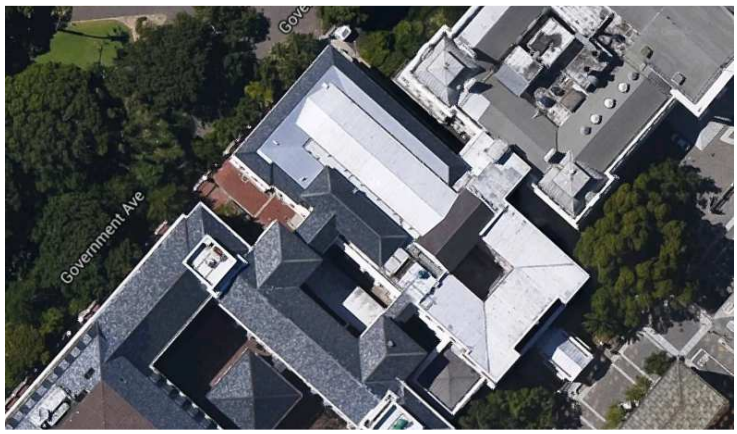


Photo 1.2: Close up aerial photo of Old Assembly building, at the Parliamentary Precinct

SECTION 2- EXECUTIVE SUMMARY

A 12 month construction timeframe and a budget estimate for the construction works of +/-R13m (ex. VAT), has been provided as a guideline.

The extent of works entails the structural repair & refurbishment of the Cape stores basement structure and upgrade of the storm water and ground water drainage system to drain water away from the building. Internal and external waterproofing is also to be implemented in the basement. The upgrade of the facilities infrastructure and services to adhere to the latest South African National standards will also be undertaken.

Addressing all the items on the scope of works mentioned in the introduction will ensure that the basement is able to function as a grade 4 basement (habitable ventilated basement with higher performance levels for ventilation & dehumidification than for a level 3 habitable basement). The List of scope of works items defined at tender stage and a brief explanation of each item as follows.

Scope of works	Outcome
1. Sealing of cracks	Cracks in soffit +/- 400m = plaster cracks to be repaired to look more acceptable with a movement joint that is sealed with a product that will look acceptable, while also increasing the durability of the structure.
	Cracks in beams and walls = +/- 50m structural cracks to be repaired to ensure the structure is safe and waterproof.
2. Granite walkway on top of workshop	Remove granite and waterproof the slab below and reroute rain water down pipe and connect to new storm water system.
3. Underpinning of some of the foundations in the Cape Stores basement.	No visible signs of differential settlement, so foundations appear in order. Size of footings and founding material to be verified during excavation for sub-soil drains. Based on the preliminary investigation no foundation underpinning is envisaged.
4. Permanent reinforcement of the Cape Stores soffit.	The steel beams inside the slab are the main structural elements. 3 locations occur where the steel beams are to be replaced and slab repaired. Applying a migratory corrosion inhibitor (MCI) and a waterproofing product in the concrete mix of the slab repairs (like Xypex or similar approved) to seal the slab will increase its durability. There are numerous old and outdated services on the soffit of the roof slab of the basement. Some of these are redundant and should be removed. Some are out dated and do not meet the latest SANS standards of safety and serviceability. Upgrading the infrastructure in the basement, while keeping all services running through the basement operational is also very important. Some of the outcomes will be more energy efficient services

	And meeting the latest fire protection regulations and Health and safety regulations.
5. Proper waterproofing, sealing, painting and proper defects repair work will have to be applied to remedy defects such as cracks, damage and dampness.	The basement needs to function as a class 4 basement, and inside and outside waterproofing with an additional storm water and sub-soil drainage system around the perimeter is to be implemented.
6. The restoration of inadequate rainwater conveyance, expansion joints and grouting.	New storm water system around the basement with the 3 rainwater down pipes leaking water into the basement to be connected with serviceable catch pits.
7. Repair work of boundary and retaining walls.	Once the sub-soil drain and storm water system is installed and tested to confirm to functions as required, the boundary wall cladded with granite will be repaired.
8. Repair to aprons and hard surfacing surrounding and effected buildings	Reinstate the existing finishes (granite copings & red brick pavers) and make good the surrounding buildings. As the area is next to a tourist route all the works will also have to be hoarded off to meet acceptable security and safety standards.
9. Repairs to underground and above ground stormwater systems and watercourses	New paving below lower area to match red bricks elsewhere and proper slopes and new storm water system to drain water effectively. Investigation is limited to Cape Stores and surrounds only.

SECTION 3- BACKGROUND

3.1 HISTORIC BACKGROUND OF ARCHIVES AT PARLIAMENT

Photo 3.1: Original Houses of Parliament building, completed in 1886

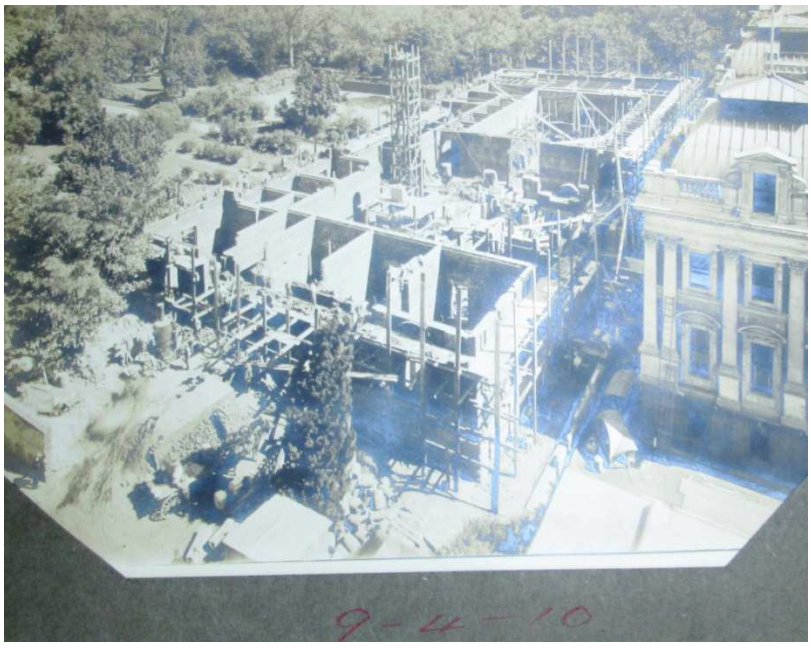


Photo 3.2: Old Assembly building built next to the Houses of Parliament, built in 1910

After the unification of South Africa in 1910, the basement in the Houses of Parliament became known as the Cape Archives Office and contained approximately 25,000 manuscript volumes of official documents.

In 1929 a faulty water drainpipe burst, which caused a large number of documents to be damaged.

It was finally decided to purchase the University Building (the present-day Centre of the Book) in Queen Victoria Street in 1934.The imposing building, known as the Cape Archives Depot (later known as the Cape Town Archives Repository), would be in use until 1989 when, again due to lack of accommodation, the archives needed to be transferred.

The premises of the former Roeland Street Prison were selected for the construction of a purpose-built ultramodern archives repository in which the records are presently stored.

3.2 HISTORIC BACKGROUND OF FILLER JOIST SLAB CONSTRUCTION

Filler joist' as an early form of floor slab construction, which was commonly used between about the 1880s and 1920s. These filler joist floor construction was widely used in offices and blocks of flats, notably the 'mansion blocks' of Edwardian times and later where its high mass gave good resistance to air-borne sound. Timber flooring laid on battens (particularly when carpeted) also gave good structure-borne sound resistance, resulting in excellent acoustic insulation between dwellings.

Filler joist slabs are formed from iron or steel joists spaced up to about 1 m apart and in-filled with unreinforced concrete. Loads applied to the concrete were transferred to the joists, with the concrete acting as a shallow arch. The soffit of the slab was flat, unlike the type of construction using 'jack arches'.

Filler joists have historically been widely used as a method of constructing reinforced concrete floors on multi floor buildings, in particular those constructed from concrete or structural steel frames. In some cases there are now quality problems associated with inadequate concrete compaction and poor cover around the embedded steel resulting in possible loss in fire protection and strength.

As is often the case with this method of construction, around the steel joists the concrete cover is low and there is often poor compaction resulting in advanced carbonation of the concrete.

The loading capacity of the slabs and fire protection of the floors are items to take note off, when reviewing an existing slab.

A problem often found with clinker concrete in such construction arises when the floor or roof becomes wet, as in neglected bathrooms or kitchens, or on flat roofs with degraded waterproofing. The clinker contains compounds of sulphur and also of nitrogen and chlorine, which in wet conditions can severely aggravate corrosion of the iron or steel joists. This leads to spalling of adjacent concrete. Repairs can be expensive and disruptive.

Furthermore, the clinker would usually contain particles of unburnt, or partially burnt coal with substantial proportions of sulphur in them. As the concrete was porous, this sulphur would slowly oxidize to sulphur dioxide: SO_2. If moisture is present, the sulphur dioxide will form sulphurous acid H_2SO_3, which in turn will oxidize further to sulphuric acid: H_2SO_4. This is of course a very strong acid and where such floors have been left open to the weather for any length of time, severe corrosion of the embedded iron- or steelwork may have resulted.

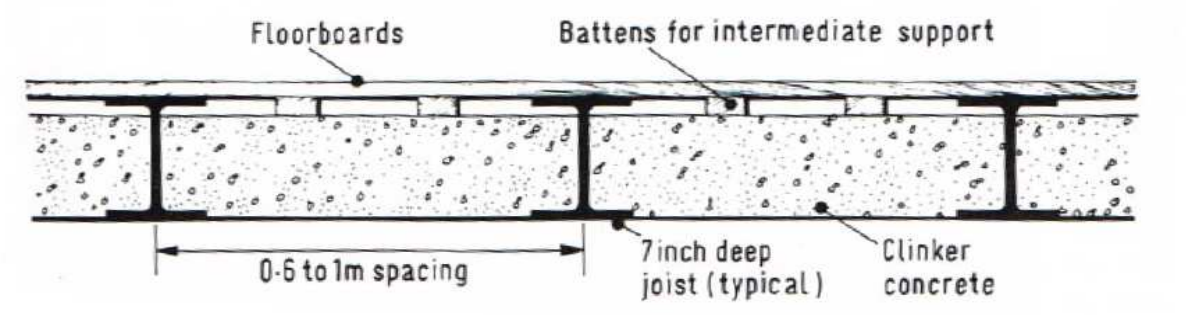


Figure 3.1: Typical section of filler joist floor construction

Treatment of these floors is typically done as follows:

- Identify and eliminate, as far as possible, the source of the water that is causing the corrosion.
- All surfaces must be cleaned down to bright metal.
- A 'zinc-rich' priming paint must be applied immediately.
- This priming coat must be protected with several coats of water-and air-excluding paint.

Cleaning is most effectively carried out by grit blasting, but even this cannot reach into the narrow gaps and other crevices. These can only be cleaned by disassembling the whole structure, which may also be rivetted at joints, which is not a 'live'trade any more. Radical remedial treatment is therefore rarely practicable and generally it is not justified. An alternative may be to treat the concrete with a migratory corrosive inhibator and to seal the gaps and crevices with a cementitious waterproof compound.

SECTION 4- OBSERVATIONS

4.1 STRUCTURAL OBSERVATIONS OF SEVERE CORROSION

In section 4 the site observations are summarized. The recommendation and conclusions follow in sections 5 & 7.

The steel beams in the slab functions as the main structural element, with the concrete acting as a secondary structural element spanning between the beams and also protects the steel beams from corrosion.

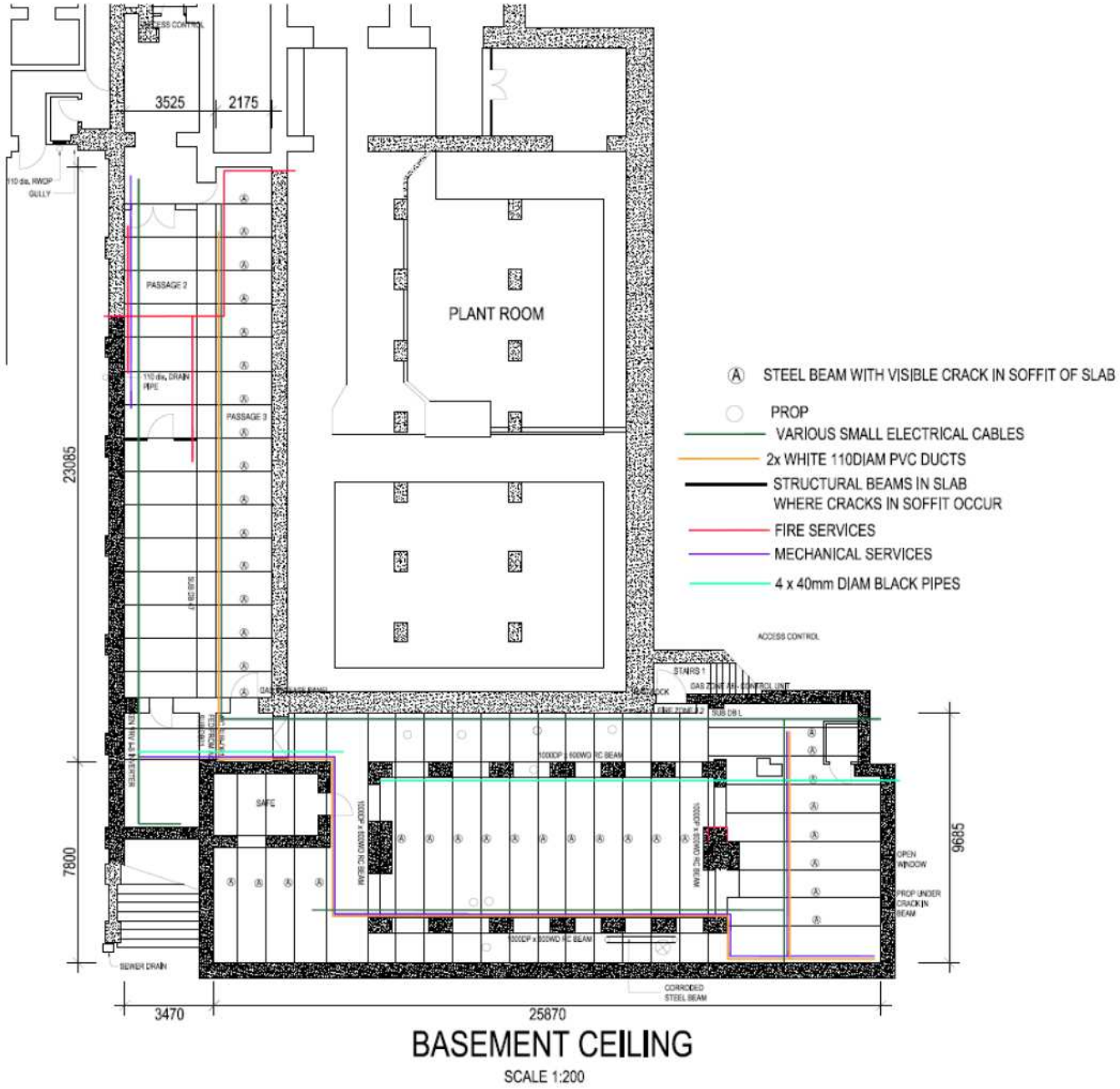


Figure 4.1.1: Layout drawing of basement with some of the service routes and approximate layout of the steel beams in the slab, based on the plaster cracks visible in the soffit of the slab.

3 locations in the basement were identified where very acute corrosion of the steel beams were visible. Only about 2mm of steel material (a 3rd of the original steel beam) remains in some instances.

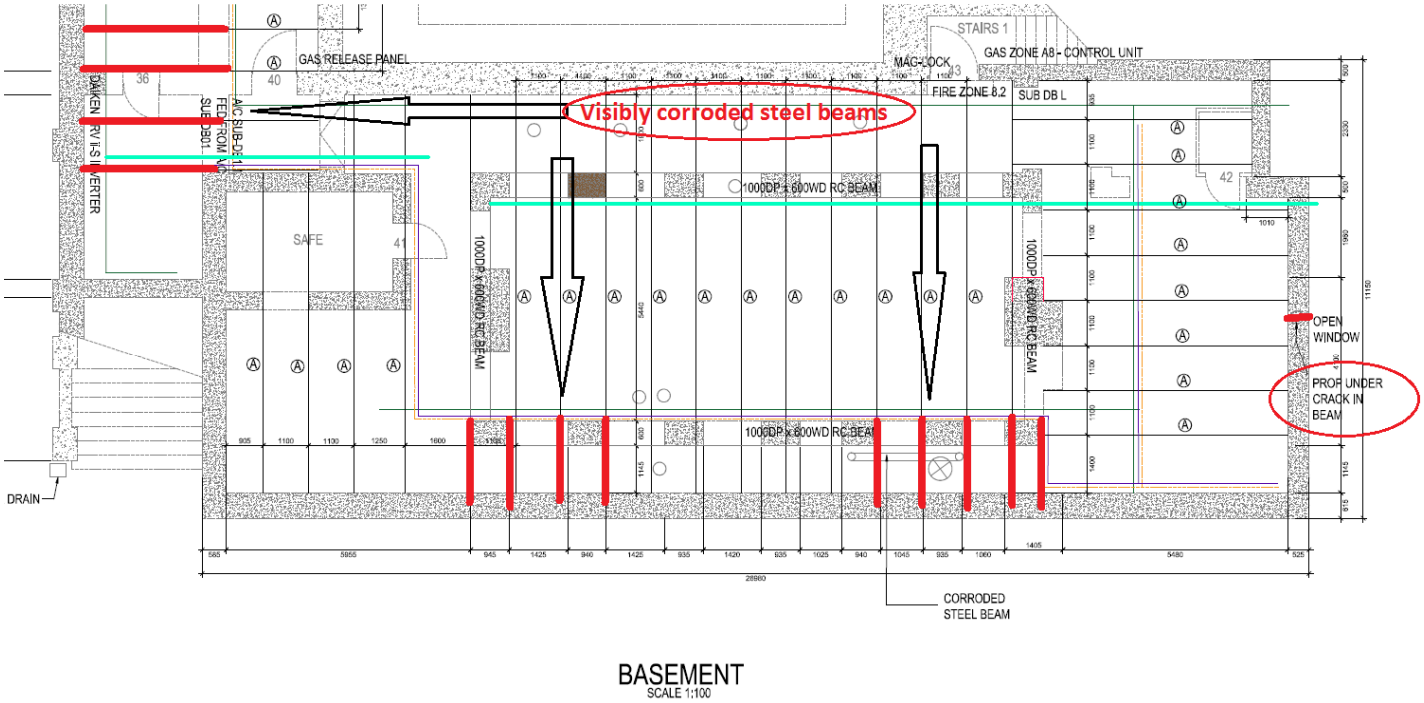


Figure 4.1.2: Location of severely corroded steel beams inside the concrete slab in the basement identified on site.

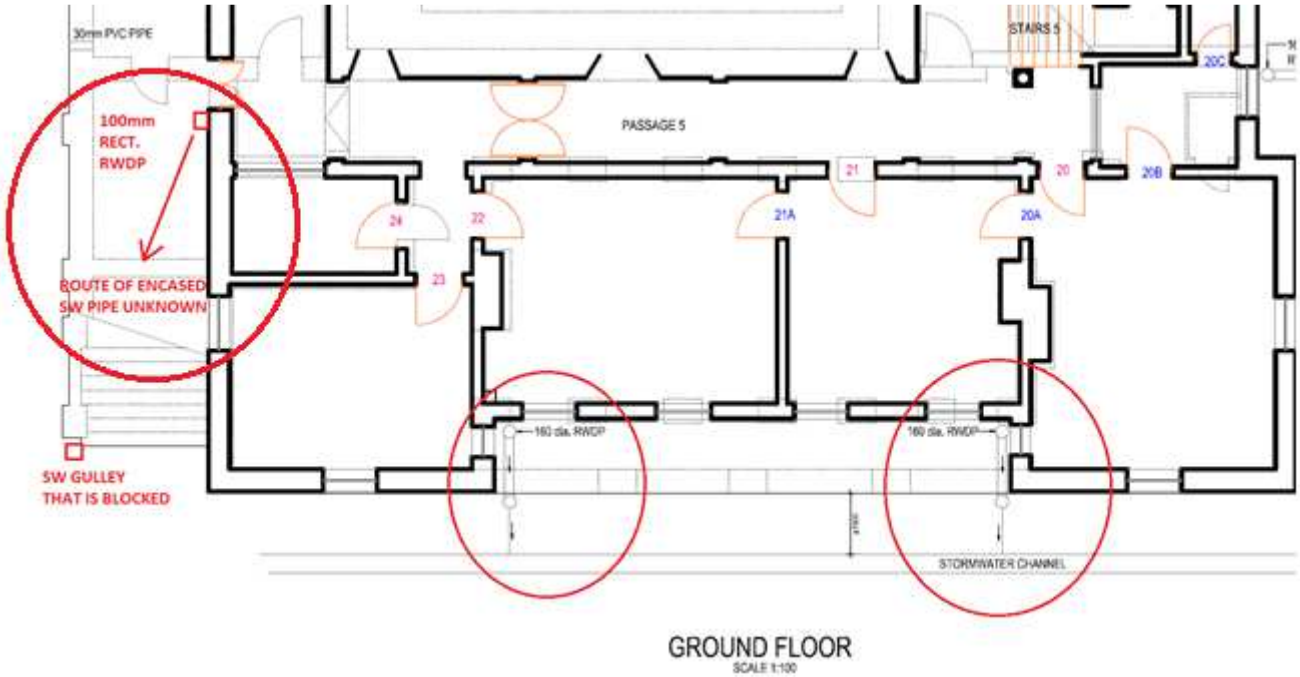


Figure 4.1.3: Location of rainwater down pipes from the roof, which are routed sub-surface, which most probably are related to the observed corrosion.

4.2 INSIDE OF BASEMENT ARCHIVES – CRACKS IN CONCRETE SLAB

Photo 4.2.1: Existing props and spreader beams in basement

Photo 4.2.2: Typical cracks in plastered finish of slab overhead

Photo 4.2.3: Portion of slab against far wall below outside balcony that is 500mm lower than rest of the slab

Photo 4.2.4: Services in cable trays with cracks in floor above

Photo 4.2.5:Steel beam inside concrete floor that is severely corroded

Photo 4.2.6: Another visibly corroded steel beam

Photo 4.2.7:Crack in slab with bottom flange of steel beam visible, no visible corrosion

Photo 4.2.8: Another steel beam with little to no corrosion some with reinforcing mesh visible

4.3 INSIDE OF BASEMENT ARCHIVES – CRACKS IN CONCRETE BEAMS

Downstand beams between most of the internal and external piers are visible. The reinforcing in these elements and also the characteristics of the concrete in these beams had to be checked, to better understand the cause and implications of the cracks that were observed.

Photo 4.3.1: Crack along slab/beam interface

Photo 4.3.2: Vertical cracks through down stand beam, following line of crack through slab

Photo 4.3.3 &4.3.4: Downstand Reinforced Concrete Ring beam inside basement (700dp x 600 wide)

4.4 INTRUSIVE SITE INVESTIGATION – EXPOSING STEEL BEAMS TO CHECK CORROSION

The make up of the slab consists of steel beams separating the concrete fill material, with a plaster finish on the soffit of the slab. The plaster cracks are deemed a side effect of the nature of these slabs, and are as such not of structural concern. The severe corrosion identified on site is however of structural concern, and must be rectified as a matter of urgency.

During the site investigation 3 areas were identified where corrosion of the steel beams was severe. The observed corrosion elsewhere was only nominal, so the driving factor at these 3 locations was not present elsewhere. Below herewith are site photo's indicating the various site observations.

Photo 4.4.1: Exposed Steel beam edge with slight surface discolouration visible

Photo 4.4.2: Another Exposed Steel beam with slight surface discolouration visible

Photo 4.4.3: Exposed steel beam with almost no visible corrosion

Photo 4.4.4: Exposed steel beam with sever surface corrosion visible

Photo 4.4.5: Portion of corrosion chipped off of beam

Photo 4.4.6: Bottom flange of beam that has almost no visible corrosion (+/- 6mm thick steel flange)

Photo 4.4.7: Bottom flange of beam that has extensive surface corrosion (+/- 4mm thick steel remaining)

Photo 4.4.8: Bottom flange of beam that has extensive pitting corrosion (1-2mm rusted material remaining)

4.5 INTRUSIVE SITE INVESTIGATION – EXPOSING CRACKS IN BEAM TO CHECK FOR REINFORCING

The structural make-up of the beams had to be verified, to understand the behaviour of these beams better. No reinforcing steel which would typically be found in modern day construction was observed. These beams are subsequently resisting the downward force by means of flexural resistance of the concrete which is about 1/10th as strong as the compressive resistance of the concrete. When a crack forms in these elements, the applied load from the weight of the building above needs to find an alternative route. This results in higher tensile stresses in the un-cracked section of the structure above, which may also result in further crack propagation, until localized collapse could occur.

Photo 4.5.1: Crack in beam that is propped, after a couple of blows with a hammer – some small cracks formed

Photo 4.5.2 More blows - Large portion of plaster broke off

Photo 4.5.3 More blows – Plaster fell off exposing some large aggregate covered with a some intermediate cement

Photo 4.5.4 More blows – some of the aggregate falls out, with no visible reinforcing steel in the beams

Photo 4.5.5 No more blows – size of exposed beam visible from below

Photo 4.5.6 Exposed beam, with crack from slab visible propagating through beam

Photo 4.5.7 Aggregate size of 75mm was used during construction of the beams. Modern day concrete used in concrete beams is made up of 19mm stone. 75mm aggregate is normally only used in mass concrete fill underneath foundations.

Photo 4.5.8 40mm thick cementitious plaster

Photo 4.5.9: Horizontal crack in wall element next to plant room of Assembly chamber

4.6 INSIDE OF BASEMENT ARCHIVES – EXISTING SERVICES

4.6.1 AIR CONDITIONING AND VENTILATION

4.6.1.1 EXISTING INSTALLATION

- The existing archive store is not ventilated by natural or mechanical means.
- No air conditioning or humidity control is installed for the preservation of stored documentation.
- Refrigerant piping to assembly area above is run in the archive stores area. The insulation of piping has been damaged and requires repair.
- The condensate drainage from above air conditioning units is also run in the archive store. The condensate drainage piping is not adequately supported with incorrect falls, increasing the risk of water damage to stored documentation.
- Sections of insulated redundant chilled water piping is installed in the archive store.

4.6.1.2 REQUIREMENTS

- Outside air supply is required as per SANS 10400 Part O.
- Active de-humidification must be provided for document preservation.
- All risk of future leaks from condensate and refrigerant piping must be avoided at all costs.

Photo 4.6.1: Open window behind supporting prop

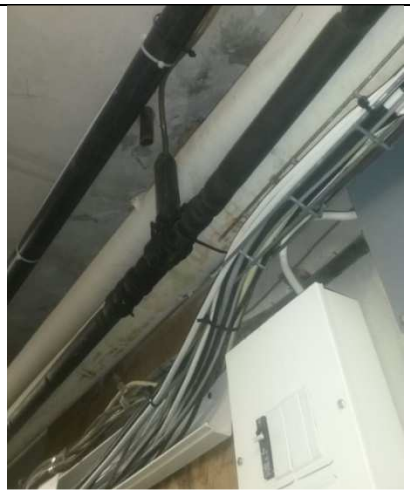


Photo 4.6.2: Overhead Mechanical services where water is leaking from

Photo 4.6.3:Standing water inside basement next to existing prop

Photo 4.6.4:Water mark from previous water leak elsewhere in basement

Photo 4.6.5 & 6: Passage 2 - Inverter at far end of basement underneath outside staircase cladded with granite, servicing airconditioner units on the floor above the basement

4.6.2 FIRE SERVICES

4.6.2.1 EXISTING INSTALLATION

- Fire extinguishers which have been well maintained.
- Fire detection (refer to electrical section of report)
- Sprinkler installation. The installation was extended to the main store area, however this installation is incomplete and should be stripped in storage area.
- The existing sprinklers in the back area and passages of the store is in fair condition and requires service only if retained. (sprinklers only where no storage of documents is to be done)
- A fire suppression system is installed in the main store area. The operation of the system is unknown and service of the system was last carried out in 2013.

- Access doors to the archive store are normal doors only.
- Numerous horizontal and vertical penetrations are thru the walls and floor of the archive stores with no fire stopping provided.

4.6.2.2 REQUIREMENTS

The archive store is to be adequately treated for fire as per SANS 10400 Part T.

Below herewith find site photo's indicating fire related infrastructure.

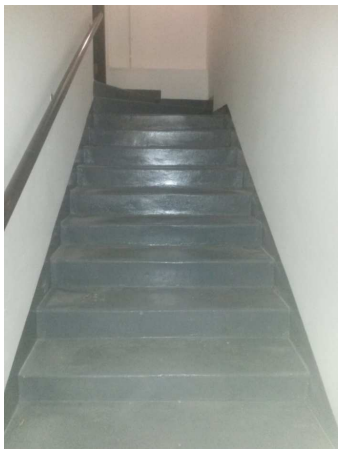


Photo 4.6.7: Steps down from Old Assembly building down to basement entrance door

Photo 4.6.8: Gas Control Unit on outside of basement entrance door

Photo 4.6.9 & 10: Basement entrance door with Mag lock on top & fire alarm & DB on either sides

Photo 4.6.11: Fire suppression units in basement

Photo 4.6.12: Passage 3 – View towards basement door -Yellow fire water line and other services

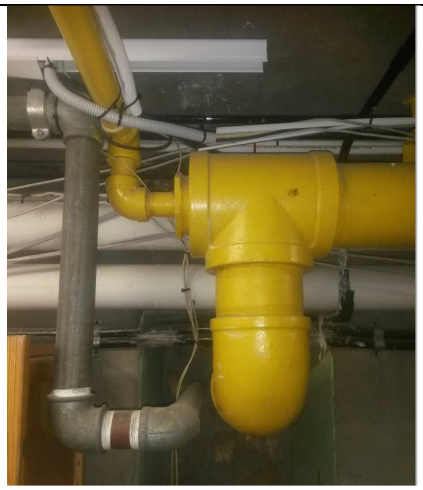
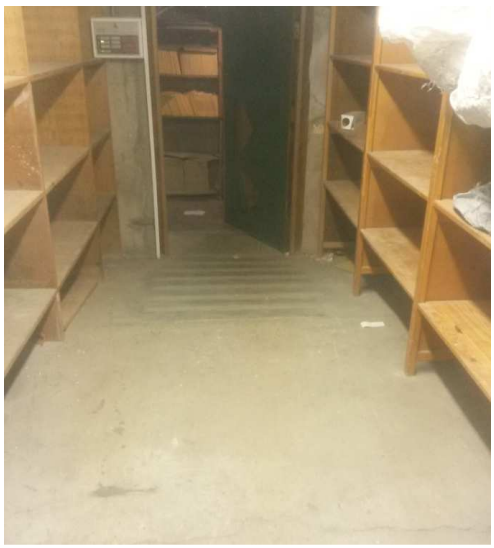


Photo 4.6.13: Fire water system reducer and other services

Photo 4.6.14: Passage 3 – View towards Passage 2 door - Yellow fire water line entering and exiting the passage with fire escape signage

Photo 4.6.15: Passage 3 – View with basement door behind. Note fire suppression units

Photo 4.6.16: Passage 3 – Basement timber door



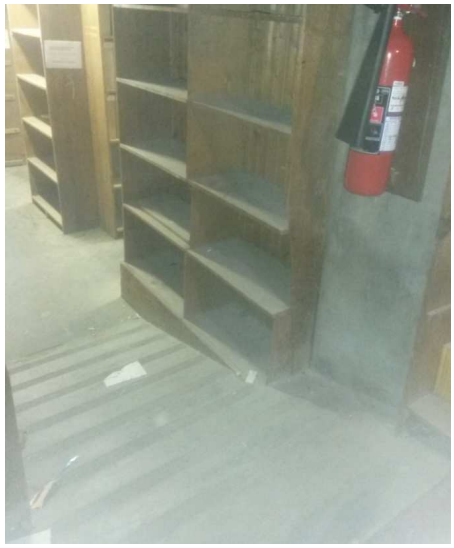


Photo 4.6.17 & 18: Passage 3 – Basement entrance door with ramps down either sides of doorway

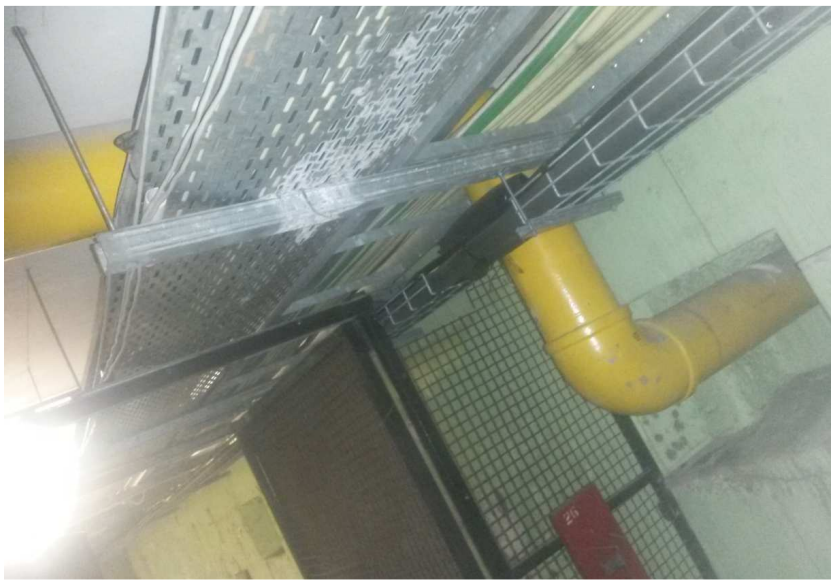


Photo 4.6.19: Passage 2 - Yellow fire water line exiting basement with cable tray below

4.6.3 ELECTRICAL & ELECTRONIC (E&E) SERVICES

4.6.3.1 SITE ASSESMENT AND OBSERVATIONS

During the site assessment the electrical and electronic services were investigated as well in order to establish what services are installed, how many are still active and what impact it will have during the refurbishment process of the basement and passage area.

- There are considerable E&E services running through the area, servicing mainly the offices above the basement area and also linking the various buildings surrounding the Old Assembly Building.
- Various E&E bulk supply cables were identified, running through the area and also some servicing the basement area itself. All bulk supply cables are installed on cable ladders or cables trays, running mainly along the passage area.
- Conduits and smaller cable trays are installed reticulating the E&E services within the basement area.
- Generally seen the cable work did not look very neat, especially when passing from the one area into another area. Refer to pictures taken showing the evidence found on site.

4.6.3.2 ELECTRICAL & ELECTRONIC **EQUIPEMENT** FOUND IN THE BASEMENT AND PASSAGE AREA:

- Distribution Boards feeding the area (4 x larger and couple smaller ones),
- Surface mounted open channel fluorescent light fittings,
- Wall mounted socket outlets,
- Isolator points for various equipment,
- Cable ladders and trays for electrical and mechanical (HVAC) services,
- Intercom, evacuation speakers and fire detection related equipment,
- Cable junction boxes,
- Surface mounted galvanized conduit,
- Fire suppression system.

4.6.3.3 ELECTRICAL & ELECTRONIC **CABLES & WIRING SERVICES** FOUND IN THE BASEMENT AND PASSAGE AREA:

- Bulk Electrical supply cables,
- Electrical distribution cables,
- Electrical wiring to various supply points (mainly lighting),
- Bulk Telecommunication cables,
- ICT cabling (Data / network and telecommunication),
- Fire detection system,
- Evacuation system,

4.6.3.4 TV CABLES (RG 59) AND SPLITTERS FOUND IN THE BASEMENT AREA:

As the basement area is mainly used as a document archive, the area itself actually does not require as much electrical and electronic services, however, the basement gets used as a pass through and distribution area to the building above the basement area and the surrounding buildings. As the Parliament is an active facility, these services cannot be deactivated, removed or relocated. Therefore most of these services, especially the E&E bulk infrastructure shall remain in place during the refurbishment process.

4.6.3.5 IRREGULARITIES AND NON COMPLIANCE ITEMS

Various installations and connections on E&E services were identified and found as non-compliant, which is not in line with the SANS 10142 code. Amongst others, the following were identified during the site assessment:

- Electrical and ICT cabling installed next to each other or installed inside the same wire way. This causes mainly disturbance on the ICT cabling.
- Some electrical connections were found and regarded as inappropriate or irregular connections.
- Not all socket outlets are protected by an earth leakage protection device.
- Untidy installation of some electrical and especially ICT cabling.
- Wrong cable type used for the Fire detection and evacuation system. Ripcord cable was found, which is not a fire rated cable.

These irregularities and non-compliance items will have to be resolved as part of this construction process as the basement will have to be eventually fully functional and compliant

Photo 4.6.20: Passage 2 - Internal Distribution board at far end of basement corridor

Photo 4.6.21: Passage 2 - Services inside of basement

Photo 4.6.22: Passage 2 - More services inside basement

Photo 4.6.23: Passage 2 - Numerous Service sleeves in the basement floor

Photo 4.6.24: Passage 2 - Security related services just outside basement passage

Photo 4.6.25: Passage 2 – Timber door to adjacent plant room with biometric control

Photo 4.6.26: Basement - Sub DB at Passage 3 doorway

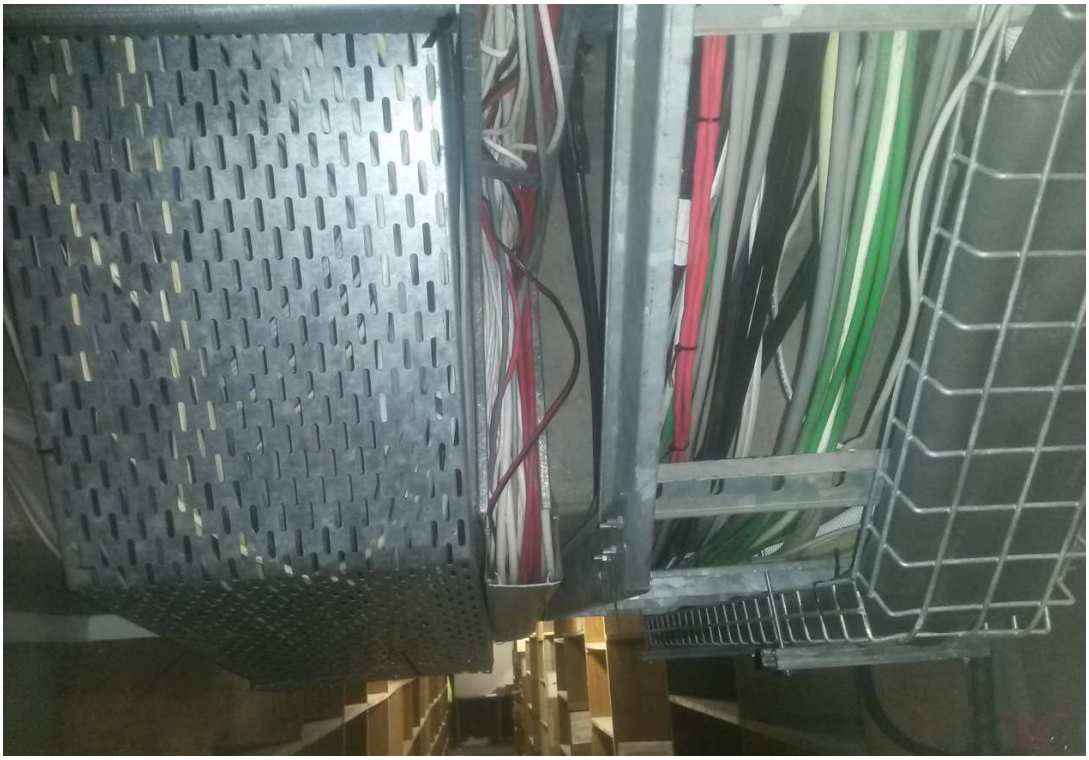


Photo 4.6.27: Basement viewed from Passage 3 doorway - Cable trays with electrical and mechanical services

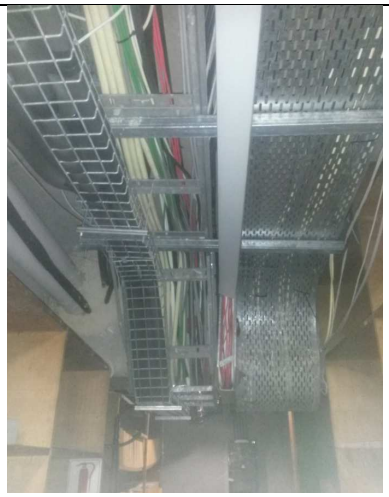


Photo 4.6.28: Basement looking onto Passage3 doorway with Sub DB against the back wall - Cable trays with electrical and mechanical

Photo 4.6.29 & 30: Basement safe area with overhead services

Photo 4.6.31 & 32: Services at far right corner of basement (close to safe)


Photo 4.5.33 & 34: Overhead services closer to entrance of basement (far left corner)

Photo 4.5.35: Overhead services with cracks in beam visible


Photo 4.5.36 & 37: 4x Black PVC conduits entering the basement on the near left corner of the basement

Photo 4.5.38 & 39: Numerous electrical cables entering the basement at the near left corner of the basement

Photo 4.5.40: DB at Basement entrance with numerous switches and services

Photo 4.5.41: Notice on basement door to Cape Stores, for getting keys from Key Office.

4.7 OUTSIDE OF BASEMENT ARCHIVES

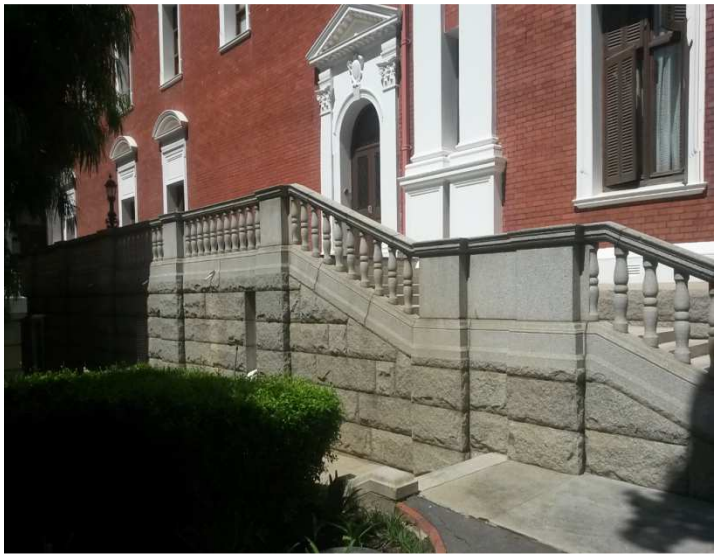


Photo 4.6.1: Granite cladded wall at side entrance staircase to external balcony

Photo 4.6.2: Rainwater downpipe going into staircase structure, probably resulting in observed corrosion due to water leaking out from encased pipe.

Photo 4.6.3: Granite cladded steps with grooves either sides for rainwater run-off

Photo 4.6.4: Joint sealing damaged on edges of granite step

Photo 4.6.5: Joints between steps with visible gaps

Photo 4.6.6: Damaged granite panel on balcony

Photo 4.6.7: Blocked storm water drain at bottom of steps

Photo 4.6.8: Blocked drain at back corner of balcony

Photo 4.6.9: Close-up of blocked drain

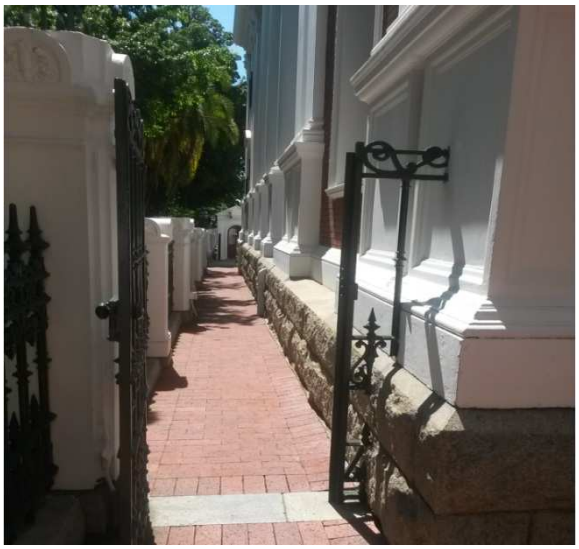


Photo 4.6.10: Side of building on Government Avenue with rainwater down pipes going underground next to granite cladding

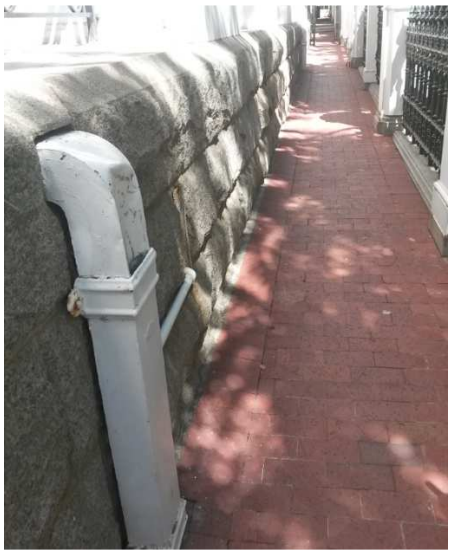


Photo 4.6.11: Position of Rainwater downpipe from roof correlates with position of severe corrosion of steel beams in basement.

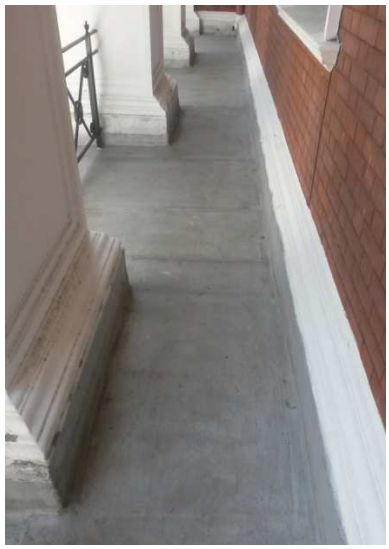


Photo 4.6.12: Balcony over basement archive next to Government Avenue

Photo 4.6.13: Rain water downpipe on other side of building Where stormwater is diverted via a surface channel.

Photo 4.6.14: Storm water manhole close to basement

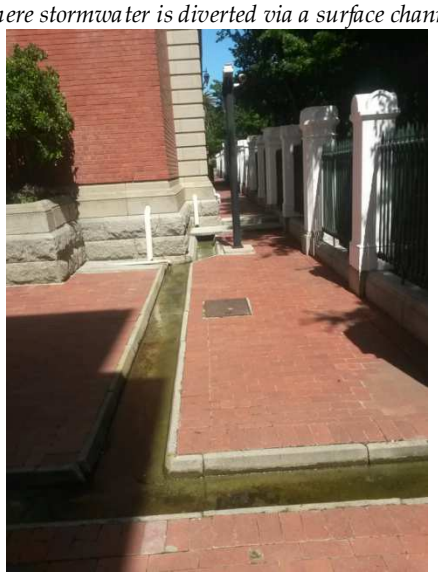


Photo 4.6.15: Water canals in the vicinity of the basement archive

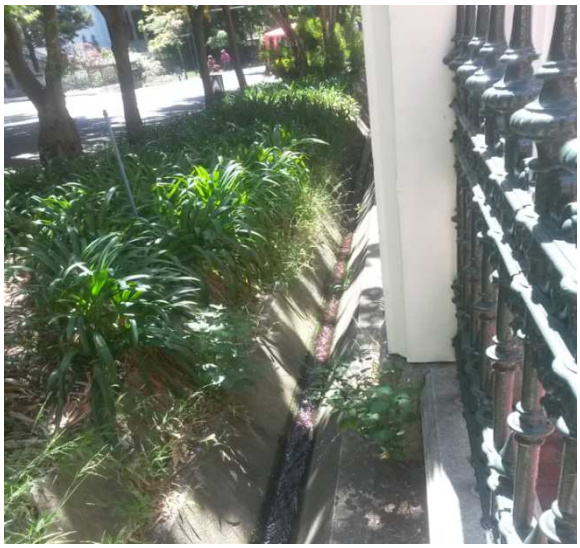


Photo 4.6.16: Water canal next to Government Avenue

Photo 4.6.17, 18 & 19: Potential basement access points during the construction works

SECTION 5- RECOMMENDATIONS

The following remedial measures to the basement and surrounding infrastructure is proposed:
(See attached Appendix A for remedial method statement for concrete repair products.)

5.1 STRUCTURAL / SITE WORKS

Scope of works	Remedial measures
1. Sealing of cracks 1.1 Cracks in slab	The majority of the +/-400m of cracks in the soffit of the slab are not of structural concern, as the steel beams are the main structural elements, spanning between brickwork supports. The concrete between the webs of the steel beams act as a simply supported elements spanning between the steel beams. As there is no continuity of the concrete, these separate elements behave independently under loading and other varying influences like humidity and temperature. As the plaster at the soffit of the slab was applied continuously, the independent behaviour of the concrete slabs resulted in stress cracks in the plaster. Treating these areas by introducing a straight joint in the plasterwork underneath each beam which must also be sealed with a polysulphide sealant, will reduce the visibility of these unsightly cracks in the plasterwork. Dehumidification of the air in the basement will also retard the rate of corrosion on the existing beams in future.
1.2 Cracks in beams	The down stand beams in the basement appear to be unreinforced concrete and brick beams with aggregate up to 70mm in size and concrete poorly compacted. As there is no observed steel reinforcing in these beams they must act as flexural beams spanning between the supporting walls, contrary to modern-day reinforced concrete beams that function structurally in bending. Some of the plaster cracks in the slab propagates into these beams, and as such these minor cracks are now causing cracks which is undermining the structural stability of the building. Propose that these cracks in the beams be filled with high pressure epoxy repair system, and that steel support beams be introduced underneath these beams where head height clearances are not required.
2. Granite walkway on top of workshop	Remove granite and waterproof the slab below and reroute rain water down pipe and connect to new storm water system.
3. Underpinning of some of the foundations in the Cape Stores basement	Check size of existing foundations and founding conditions to verify adequate founding. Ensure that the drainage system functions in such a manner as to drain ground water away from the foundations. At this stage underpinning of foundations do not seem to be necessary.

4. Permanent reinforcement of the Cape Stores soffit.	Repair of the corroded steel beams will be very difficult and laborious, as they are encased in the concrete. The 3 area's that have severely corroded steel beams to be propped and the corroded beams to be replaced with galvanized elements, and the concrete to be made good. Application of a migratory corrosion inhibitor to limit the future corrosion of the existing steel beams is also to be done. The services in these area's to be temporarily diverted and reinstated afterwards, where possible.
5. Proper waterproofing, sealing, painting and proper defects repair work	The following measures will have to be applied to remedy defects like cracks, damage and dampness. The basement needs to function as a class 4 basement, and inside and outside waterproofing with an additional storm water and sub-soil drainage system around the perimeter is to be implemented. Installing a sub-soil agricultural drain around the perimeter of the basement slab which is to be connected to the existing underground storm water system, to drain the ground water from the area. (awaiting surveyors data to verify final levels) Waterproofing on the outside of the basement walls that are exposed during the excavations for the new underground services. Rainwater down pipes running underground next to basement to get serviceable storm water catch pits which are to be connected to the new storm water system. Lifting of granite and waterproofing of concrete structure underneath. Resealing of all granite joints. Re- applying a waterproofing membrane on the balcony area's above the basement and also waterproofing the inside surfaces of the basement (floors and walls & ceiling)
6. The restoration of inadequate rainwater conveyance, expansion joints and grouting.	There is currently a mixed approach to handling of storm water on the site. At some locations it is surface run-off and at some locations it is downpipes without catch pits for servicing. We propose to improve the drainage around the basement by installing an agricultural drain around the perimeter of the basement to drain all the ground water. All of the downpipes around the basement are also to be connected to an underground 300mm diameter concrete storm water pipe to run toward the existing storm water drainage system, identified on site. During the installation of the underground drainage pipes, the outside walls of the basement are also to be waterproofed with an approved membrane system with durable characteristics. These measures should ensure that the area is properly drained to limit the risk of moisture ingress through the basement walls.

7. Repair work of boundary and retaining walls.	Take good record of the existing infrastructure, as this is a heritage site and the repair work must be done in such a manner as to restore the structure so that it is visibly not affected by the repair works.
8. Repair to aprons and hard surfacing surrounding and effected buildings	Reinstate the existing finishes (granite copings & red brick pavers) and make good the surrounding buildings. As the area is next to a tourist route all the works will also have to be hoarded off to meet acceptable security and safety standards.
9. Repairs to underground and above ground stormwater systems and watercourses	See outcome of item 6 on page 36.
10. Handling of services during the refurbishment works	See chapter 5.1 & 5.2 on page 38.
11. Shelfing	Carefully remove for re-use. Storage over construction period and reinstall where shelfs are re-useable. Treat existing shelfing with a timber rejuvenation product, that will not stain documents. Install new timber shelfing, where existing shelfing is too badly damaged due to water damage.

5.2 HANDLING MECHANICAL SERVICES

The overhead services in general will have to be stripped to allow access during the refurbishment works and reinstated afterwards. The main run of the bulk electrical, data & mechanical services which run through the basement from other buildings will have to be made safe in-situ during the construction works, while all redundant services on the secondary routes gets removed to allow access for structural repairs.

As the infrastructure needs to comply with all building regulations, it will not be feasible to reinstall the existing infrastructure as is, and then issue a certificate of compliance, as out dated infrastructure does not comply.

As such the only solution would be to replace all of the stripped services with new modern replacements. The following replacement of services are envisaged:

AIR CONDITIONING AND VENTILATION

- Introduce ventilation to the archive store.
- Install system to provide for active humidity control.
- Repair all existing refrigerant and condensate drainage piping and introduce support brackets to correct falls of piping.
- Remove redundant existing chilled water piping.

FIRE INSTALLATIONS

- Service all existing fire extinguishers and fire suppression systems.
- Fire detection (refer to electrical section of report)
- Remove incomplete sprinkler installation in main store area.
- Service the existing sprinklers in the back area and passages of the store as it is in fair condition and requires service only if retained.
- Test and service existing fire suppression system installed in the main store area.
- Introduce fire doors to archive store.
- Install fire stopping to all horizontal and vertical penetrations that are thru the walls and floor of the archive stores.

5.3 HANDLING ELECTRICAL & ELECTRONIC SERVICES

- It is proposed to strip all electrical and electronic services feeding the basement and passage areas. This entails all surface mounted light fittings, surface mounted conduit, Distribution Boards, socket outlets and temporary installations. As the refurbishment work in the basement area is extensive, which involves work to be done along long surfaces no E&E related services should hamper the process to do so.
- The E&E bulk supply services, mainly installed on the cable ladder and trays along the passage area shall remain in place as these are essential services that shall remain active. However, these bulk services shall be protected by being wrapped and sealed as considerable moisture and dust will be generated during the refurbishment process, which again can be removed when done.
- After the structural refurbishment process is complete, new electrical and electronic services shall be installed in the area. It is proposed installing new vapour proof type LED fittings onto a suspended cable tray system running between the new shelve layout. Other services like the fire detection system, evacuation system, etc. can also be installed on the cable tray, leaving the area neat and aesthetic appealing.

SECTION 6- COST ESTIMATES AND TIME FRAMES

6.1 CONSTRUCTION COSTS PRELIMINARY ESTIMATE

6.2 PROFESSIONAL FEES

SECTION 7- CONCLUSION

Presently the structural defects, waterproofing defects, non-compliance of services affect the functionality of the Cape Stores basement. Improving the underground drainage around the basement, waterproofing of the basement, general repairs, refurbishment & upgrade of services of the basement area and its immediate surrounds are the main outcome of this report.

The majority of plaster cracks in the bottom of the slabs at the location of the internal steel beams are deemed not of a immediate structural concern, but they appear unsightly and undesirable.

Where these cracks however propagate to the unreinforced concrete downstand beams, they impact on the structural durability of the structure. These beams act like mass concrete arches, spanning between the supporting columns and a shear failure of these arches could result in localized structural collapse.

Where severe corrosion of the steel beams have been observed, a direct correlation with rainwater down pipes going sub-surface has been identified as the potential driving factor of the corrosion. Installing lined rainwater catchpits that are serviceable at the bottom of the rainwater down pipes should reduce the risk of water ingressing into the basement slab. Ensuring proper drainage to the newly installed storm water system, should alleviate the problem in future.

A sub-soil drainage system around the perimeter of the basement floor slab which is to be connected to the storm water system is also deemed a very important measure to mitigate future ground water related moisture ingress into the basement.

Applying a waterproofing membrane on the inside and outside of the basement structure will ensure that the future use of the basement for storage of important documents can be done will be ensured.

General repairs of the infrastructure around the basement and improving the facilities will also require upgrade of some of the electrical and mechanical services, as these services are out dated in some instances.

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SECTION 8- APPENDIX A – CONCRETE REPAIR SPECIFICATION

A1. PREPERATION – CONCRETE/PLASTER REPAIR

- Thoroughly inspect and hammer test all concrete/plaster surfaces to locate and expose defective concrete/plaster which is not readily visible.
- All concrete/plaster area's to be broken out are to have rebated perimeter of at least 10mm deep. Break out all defective concrete/plaster by approved mechanical means.
- Thoroughly clean down all exposed steel that is still in a fair condition by abrasive blast cleaning to remove all rust and to expose clean bright steel.

A2. REPAIRS TO CONCRETE

- Immediately after cleaning down the steel beams, apply a coat of 1mm thick anti corrosive coating to the beams.
- Allow to dry for 2-3hours before applying a 2nd coat to the steel and surrounding concrete.
- Allow to dry for another 2-3hrs before applying patching repair mortar in layers not more than 70mm thick.
- All mortar repairs are to be suitably cured and protected by approved means.

A3. REPLACE SEVERELY CORRODED STEEL BEAMS

- Area's where severe corrosion of existing steel beams occurs should be propped, and the rusted beams should be replaced with new galvanized steel beams, and the concrete reinstated.
- The area's to be repaired are mainly accessible from the outside balconies, so propping and shuttering in the basement to be installed and concrete and steel beams to be installed from above down into the slab.
- Anchor fix chemicals to be used for the dowel bars on the steel beam to bind all the elements together.
- A wet to dry bonding agent to be used, on all existing concrete surfaces.

A4. PROTECTIVE COATINGS TO REINFORCED CONCRETE

MIGRATORY CORROSION INHIBATOR - MCI

- It is a migratory corrosion inhibitor to help re-passivate the exposed steel surfaces. This also stops the formation of incipient anodes forming next to new patch repairs. Corrosion inhibitors only work properly if the chloride levels are below 2%.
- All surfaces must be thoroughly cleaned down by any approved means so as to remove all surface contamination and existing paint.
- Porosity of the concrete will dictate the number of coats to be applied.
- Wash down with water 2 days after application to help the migration process.
- High pressure clean surfaces if a protective coating is going to be applied.

A5. WATERPROOFING OF SLAB ABOVE

Applied in 2 coats of 1mm thickness per coat of a waterproofing product and finishing product.

A6. WATERPROOF TANKING TO FLOOR AND BRICK WALLS INSIDE OF BASEMENT

SECTION 9- APPENDIX B – CONCEPT & VIABILITY INFORMATION – A0 DRAWING