

APPENDIX A

STRUCTURAL SURVEY REPORT BY DAVID SMITH ASSOCIATES

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CLIENT:

**UPPER HEYFORD GP LIMITED
AND UPPER HEYFORD
NOMINEE LIMITED FOR
UPPER HEYFORD LP**

**VISUAL STRUCTURAL
INSPECTION OF**

**HEYFORD PARK
UPPER HEYFORD
NR BICESTER**



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PREFACE

- a) This brief, preliminary report and/or opinion has been prepared for the specific purpose stated herein.

- b) The report has been prepared for the exclusive use of:-

Upper Heyford GP Limited and Upper Heyford Nominee Limited for Upper Heyford LP

- c) This document, or any part of this document, shall not be disclosed to any other persons except those specifically mentioned as follows:-
 - a) Local Authority Planning and Building Control Departments
 - b) Lambert Smith Hampton
 - c) Any other person with the express permission of Upper Heyford GP Limited and Upper Heyford Nominee Limited for Upper Heyford LP

- d) This document is issued only to the persons stated above and on the understanding that this practice is not held responsible for the actions of others who obtain any unauthorised disclosure of its contents, or place reliance on any parts of its findings, facts or opinions, be they specifically stated or implied.

- e) It is a condition of this report that we have not inspected all woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that such parts of the property are free from defect.

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1.0 INTRODUCTION

- 1.1 David Smith Associates have been requested by Lambert Smith Hampton to undertake a Visual Structural Inspection of the buildings denoted 1010 (Water Tank), UH49 (Brunswick Tower), 1011 (Ammo Store), 1050 (Fire Station) and UH50 (Boundary Observation Tower) all at Northern Bomb Stores. UH22 (Observation Tower) at QRA and provide comments on the building known as 299 Avionics at Heyford Park, Upper Heyford, Near Bicester.
- 1.2 We confirm having visited the site with George Moss of Lambert Smith Hampton on Tuesday 4th February 2014. The weather conditions during our inspection were cold but sunny.
- 1.3 The purpose of our visit was to inspect the structural elements described in Section 2.0 of the various buildings listed above and provide comment on Building 299 (Avionics).

2.0 RESULTS OF VISUAL STRUCTURAL INSPECTION

2.1 The Upper Heyford site was originally a disused British and then United States Military Site that is now owned by a private development company. The Conservation Authority have noted several of the buildings on the site hold historic significance and therefore should be maintained and future-proofed to ensure their subsistence for future generations.

2.2 We have been employed to provide structural advice and recommendations to ensure the structural elements within each building is maintained. For clarity within this report we will comment on each building individually.

2.3 1050 – FIRE STATION (NORTHERN BOMB STORES)

2.3.1 This is a single storey, flat roofed, reinforced concrete structure. The reinforced concrete walls were noted as approximately 350mm in width. Typical elevations can be seen in Photographs 1 to 4 in Appendix A.

2.3.2 The primary damage noted to the building was both spalling concrete and calcification noted on several of the elevations. (See Photographs 5 to 15 in Appendix A).

2.3.3 The spalling concrete is likely to have been caused by a combination of a lack of cover to the steel reinforcement and carbonation of the concrete.

- 2.3.4 In this type of environment it would usually be expected to find an absolute minimum of 25mm cover and for Military sites up to 50mm cover from the face of the concrete to the reinforcement. However, there only appears to be 10mm cover in areas where spalling was noted.
- 2.3.5 Carbonation of the concrete is a natural deterioration of the concrete caused by the reaction between the carbon dioxide in the air reducing the alkaline environment of the concrete. The speed of carbonation depends on the original concrete mix and its quality. A poor (weak) mix will carbonate much quicker than a good (stronger) mix. This therefore leads to cracking / shrinkage, which allows easy access to moisture and water to embedded steelwork. Such reaction leads to the corrosion of the reinforcement and subsequent cracking and spalling of the concrete.
- 2.3.6 When steel corrodes, the rust produced occupies many times the volume of metal oxidised, typically from three to five times. When steel corrodes within carbonated concrete, the pressure generated by the growing rust layer cracks and spalls the overlying concrete leading to even easier entry of air and water and more rapid corrosion of the steel. At this stage reinforced concrete appears to be in distress, however, it is still a long way from losing all its strength and ductility.
- 2.3.7 Calcification (efflorescence) of the concrete is caused by external moisture being present on the face of the concrete causing inherent chlorides and sulphates to leach out over time. This is not deemed to be a significant structural issue albeit may continue over time.

2.3.8 Whilst carrying out our inspection we noted the presence of pebble-dash effect to the concrete adjacent to the calcification near the entrance door. This is likely to have been caused by segregation of the aggregate and bleeding of the concrete during construction and is due to poor construction techniques and controls. (See Photographs 15 and 16 in Appendix A).

2.3.9 The current level of defect will not have a serious detrimental effect on the buildings status. However, if the problems noted become more widespread, the building will eventually need significant remedial repair works.

2.4 **UH49 – BRUNSWICK TOWER – NORTHERN STORES**

- 2.4.1 This is a steel tower with a wrap-around staircase and observation station located at the top. (See Photographs 17 to 20 in Appendix A).
- 2.4.2 Whilst a cherry picker was provided it was not able to get close to the tower due to the soft landscaping. Therefore our inspection was generally at a distance with the use of binoculars. (See Photographs 29 to 37 in Appendix A).
- 2.4.3 From our visual inspection, the tower has clearly been subject to various levels of steelwork corrosion. The most significant noted being the half landing staircase stringer at the top of the first flight. (See Photographs 20 and 21 in Appendix A).
- 2.4.4 Other less significant areas of corrosion were noted around the base of the tower. (See Photographs 22 to 28 in Appendix A).
- 2.4.5 Steel corrosion is caused by the presence of moisture and oxygen on unprotected steelwork, the lack of continued maintenance, painting / protection has allowed the corrosion to take place.
- 2.4.6 Clearly areas of significant corrosion noted in Item 2.4.3 above are a serious defect and could cause collapse of the staircase. This should be repaired as soon as possible to avoid this.

2.4.7 If the tower is to remain unprotected, corrosion will continue until principal members within the tower become defective which ultimately will lead to the collapse of the tower.

2.4.8 Due to the level of corrosion noted at the bottom of the principle steel columns, we recommend protection is provided within the next 6 months. If this is not carried out, the structure has a potential to become unstable and collapse.

2.5 **1010 – WATER TOWER (NORTHERN BOMB STORES)**

- 2.5.1. In principle this is a steel framed tower with a large steel constructed water tank positioned on top. The frame is constructed with a series of columns with primary and secondary beams which is fully braced. The steel tank is rectangular in shape and has a barrel roof. In addition to this, there is also a guard rail located around the top of the tank. (See Photographs 38 to 44 in Appendix A).
- 2.5.2 In general, the steelwork supporting the water tank is in a good condition with minor areas of corrosion noted. However, the maintenance platform which would service the pipeworks and mechanics below the tank has several areas of severe corrosion.
- 2.5.3 This has been caused by weathering and is not fit for purpose and in our opinion should be removed or replaced. (See Photographs 45 to 48 in Appendix A).
- 2.5.4 The main steelwork is in reasonable condition and has only minor areas of corrosion. We would, however, recommend that the columns and bracing that go below ground level are exposed for further inspection with the possibility of concrete encasement if required. (See Photograph 49 in Appendix A).
- 2.5.5 We were not able to inspect the water tank internally, although on general appraisal from the lifting platform, we were not able to see any major areas of defect.

2.6 **UH50 – OBSERVATION TOWER (NORTHERN BOMB STORES)**

- 2.6.1 The Observation Tower is constructed almost entirely from reinforced concrete. Reinforced concrete columns support a concrete slab which in turn support the concrete walled Observation Tower. (See Photographs 50 and 51 in Appendix A). The tower is located between the inner and outer fences of the Northern Bomb Stores and is exposed to the most severe of weather conditions.
- 2.6.2 This weathering has caused considerable deterioration of the concrete and several areas of reinforcement have been exposed and corroded down to a significant structural level. (See Photographs 52 to 57 in Appendix A).
- 2.6.3 The level of deterioration is such that the Tower should not be used or accessed and we would recommend that this Tower is cordoned off whilst remedial works take place.
- 2.6.4 The damage noted has been caused by the reinforced steelwork corroding. The rust produced occupies many times the volume of metal oxidised, typically from three to five times. When steel corrodes within carbonated concrete, the pressure generated by the growing rust layer cracks and spalls the overlying concrete leading to even easier entry of air and water and more rapid corrosion of the steel. At this stage reinforced concrete appears to be in distress, however, it will have some inherent strength exposure and ductility but this will reduce rapidly given the exposure.

- 2.6.5 It also appears that the platform does not drain very well and the water ingresses through the platform which has only added to the issues surrounding the weathering and ultimately the spalling of the concrete and corrosion of the steelwork.
- 2.6.6 Repair of the concrete can be expensive and difficult to perform reliably. When the reinforcement has entirely corroded, the structure becomes a mass concrete instead of a reinforced concrete one, incapable of reliably resisting tension or bending, and of low ductility. Therefore, protecting the reinforcement should be a priority in retaining this tower.
- 2.6.7 It should be noted that the process of carbonation followed by reinforcement corrosion produces no visible effect on OPC concrete until corrosion starts. Once cracking has been induced, corrosion damage is rapid and progressive. Thus it is wrong to consider that a small crack in a 40 year old component has taken 40 years to develop and should therefore take many decades to grow into a large crack.

2.7 **1011 – RENDER TO AMMO HOUSE ON NORTHERN BOMB STORE**

2.7.1 This is a brick built, fully reinforced Ammo Store, built off a concrete base with a duo-pitched roof covering. (See Photographs 58 to 64 in Appendix A).

2.7.2 The gable end of the building has been subjected to severe weathering and the render at the time had started to de-bond from the brickwork substrate.

2.7.3 Since our visit, the building has been subject to high winds and the delaminated render has completely fallen off around the main window on the gable end. (See Photographs 58 to 64 in Appendix A). This delamination is inherent throughout the structure and is likely to continue over the next 1 to 5 years until eventually all the render has fallen off.

2.7.4 The delaminating render is due to weathering and the presence of moisture in between the render and the brick substrate.

2.7.5 In our opinion, the render has failed as it has gone beyond its design life.

2.8 **UH22 – OBSERVATION TOWER IN QRA**

2.8.1 This is a steel tower with a wrap-around staircase and observation station located at the top. (See Photographs 65 to 75 in Appendix A).

2.8.2 From our visual ground inspection, the tower appears to be in good condition with only minor areas of steelwork corrosion noted.

2.9 **BUILDING 299 – AVIONICS (FLAT ROOF & SLOPING ELEVATIONS)**

- 2.9.1. Whilst on site we were also asked to comment on the roof of the above building. It is clear from the condition of the concrete reinforced roof structure that severe weathering has taken its toll on the finishes of the roof.
- 2.9.2 Whilst we did not carry out an internal inspection of the building, we could see that the primary damage had been caused by the presence of ponding water, frost damage and several attempts at previous repairs. (See Photographs 76 to 82 in Appendix A).
- 2.9.3 It is assumed that the flat roof and sloping elevations of this building may have been constructed by unskilled military labour, possibly using sub-standard materials and construction methods.

3.0 RECOMMENDATIONS

3.1 All recommendations are to be confirmed and agreed with The Conservation Authority prior to being carried out.

3.2 All repairs at this stage are related to preserving the structures as they are. These general repairs do not take into account buildings or structures being used as per their original purpose. Please see clauses specifically relating to this.

3.3 Please note, all prices quoted are allowances only. Exact quotes should be obtained from specialist contractors.

3.4 1050 – FIRE STATION – NORTHERN BOMB STORES

3.4.1 We would initially recommend that the calcification is scrapped off the building as and where it occurs.

3.4.2 All water drips and waterproofing / guttering etc should be maintained.

3.4.3 All concrete should be coated with an appropriate anti-carbonation paint.

3.4.4 Concrete patch repairs should be carried out using Sika Monotop-612. A copy of the Technical Data Sheet for this product can be seen in Appendix B of this report.

3.4.5 We would recommend an approximate allowance of £2,500.00 + VAT for the above repairs.

3.4.6 The above repairs are likely to enhance the life of the structure. It is difficult to say exactly by how long. Therefore, we would recommend that a visual inspection of the property be carried out every 12 months to enable specification of any ongoing repairs required.

3.5 **UH49 – BRUNSWICK TOWER – NORTHERN STORES**

3.5.1 All significant corrosion, i.e. mainly to the wrap around staircase, steel members should be strengthened or completely replaced on a like for like basis. (Allow an approximate sum of £1,500.00 + VAT).

3.5.2 Where light corrosion has taken place, the steelwork should simply be wire brushed / rubbed down or preferably sand blasted.

3.5.3 The whole structure should be painted with 2no. coats of Galvafruid or similar galvanising paint, to manufacturers recommendations. (Allow approximately £10,000.00 + VAT).

3.5.4 Where significant corrosion is noted, this should be reported to the Structural Engineer for further appraisal. (Allow approximately £2,000.00 + VAT for further advice).

3.5.5 The above repairs are likely to enhance the life of the structure. Exact details will be provided by specialist galvanized paint manufacturer. Therefore, we would recommend that a visual inspection of the property be carried out every 24 months to enable specification of any ongoing repairs required / repainting of the structure.

3.5.6 Should the Tower be recommended for re-commission as a Tourist Attraction or any other use where people will be climbing the staircase and sitting in the Tower, we would recommend that a full structural appraisal and analysis to current Codes of Practice take place to ensure that the structure is adequate to support this type of loading. (Allow approximately £4,000.00 + VAT for professional fees).

3.5.7 It is likely that some strengthening works will be required to facilitate the above repair works. (£TBC subject to full structural appraisal and analysis)

3.6 **1010 – WATER TOWER (NORTHERN BOMB STORES)**

3.6.1 We would recommend that the maintenance platform is simply removed or replaced on a like for like basis with galvanised steelwork. (Allow approximately £5,000.00 + VAT).

3.6.2 All existing steelwork to be wire brushed down / sandblasted and then painted with 2no. coats of Galvafruid or similar approved to manufacturers recommendations. (Allow approximately £3,000.00 + VAT). Please note this does not include the Water Tank itself.

3.6.3 The water tank should then be inspected and any patch repairs carried out as and where necessary. We would recommend that all hatches above the water tank and closed and made water-tight. The tank should then be drilled in several low points to allow for complete drainage of any water within the tank. This will reduce the dead loading and reduce the likelihood of further internal corrosion.

- 3.6.4 If, however, the tank is to be reused as a water tank, again we would recommend that the a full structural appraisal and analysis to current Codes of Practice take place to ensure that the structure is adequate to support this type of loading.
- 3.6.5 We would also recommend that any steelwork below ground is exposed for inspection and once deemed satisfactory, encased in concrete to protect it from further deterioration. (Allow £450.00 + VAT for a further inspection and advice plus £750.00 + VAT for the works).
- 3.6.6 The above repairs are likely to enhance the life of the structure. Exact details will be provided by specialist galvanized paint manufacturer. Therefore, we would recommend that a visual inspection of the property be carried out every 24 months to enable specification of any ongoing repairs required / repainting of the structure.

3.7 **UH50 – OBSERVATION TOWER (NORTHERN BOMB STORES)**

- 3.7.1 This structure is not suitable for any kind of use at present and significant structural remedial repairs will be required to maintain its current status. This will include concrete patch repairs in accordance with Sika Monotop-612. (See Technical Data Sheet in Appendix B) and fully coat the building with anti-carbonation paint. (Allow £2,500.00 + VAT).
- 3.7.2 The building will require the introduction of several galvanized structural steel members in order to strengthen the dilapidated concrete elements. (Allow approximately £3,000.00 + VAT)

3.7.3 We would recommend that exact details are confirmed following consultation with the Conservation Authority.

3.8 **RENDER TO AMMO HOUSE**

3.8.1 We recommend that the render is completely removed on all elevations of this building as it has become dangerous, as indicated by the falling of the render in the time between our visit and production of this report.

3.8.2 Once all the render has been removed, we would recommend that a new sand/cement render with appropriate bonding agent is applied. This should be suitably flexible and have appropriate shrinkage joints induced to enable an approximate life of a further 15 years protection to the building. (Allow approximately £10,000.00 + VAT)

3.8.3 On exposure of the brickwork substrate any spalling brickwork should be replaced on a like for like basis. (Allow approximately £750.00 + VAT).

3.8.4 The above repairs are likely to enhance the life of the structure and protect the brickwork substrate for another 10 years. However, we would recommend that a visual inspection of the property be carried out every 24 months to enable specification of any ongoing repairs required.

3.9 **UH22 – OBSERVATION TOWER IN QRA**

- 3.9.1 All significantly corroded members should be replaced or strengthened on a like for like basis and reported to the Structural Engineer for further appraisal.
- 3.9.2 Where light corrosion has taken place, the steelwork should simply be wire brushed / rubbed down or preferably sand blasted.
- 3.9.3 The whole structure should be painted with 2no. coats of Galvafroid or similar galvanising paint, to manufacturers recommendations. (Allow approximately £10,000.00 + VAT).
- 3.9.4 The above repairs are likely to enhance the life of the structure. Exact details will be provided by specialist galvanized paint manufacturer. Therefore, we would recommend that a visual inspection of the property be carried out every 24 months to enable specification of any ongoing repairs required / repainting of the structure.

3.10 **BUILDING 299 – AVIONICS (FLAT ROOF & SLOPING ELEVATIONS)**

- 3.10.1 We would initially recommend that an internal inspection is carried out with the exposure of the roof structure to identify cracking and any defects, along with a core/dust samples to be taken through the concrete for testing.
- 3.10.2 Testing of reinforced concrete that must be measured to assess structural condition and durability are (a) carbonation depth, (b) cover to reinforcement, (c) presence of HAC and Chloride content. (Allow approximately £10,000.00 + VAT).

4.0 CERTIFICATION

4.1 We trust that we have interpreted your instructions correctly and that this report is satisfactory for your present requirements. However, should you require any further information or clarification, please do not hesitate to contact the undersigned.

Signed: 

Steve Ainge B.Sc.Eng (Hons), I.Eng, A.M.I.Struct.E

Signed: 

Eur Ing **David Smith** B.Sc. (Hons), C. Eng., M.I.C.E., M.I. Struct E., RM.a.P.S., MFPWS

28th March 2014
Date.....

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