HISTORIC ENGLAND

CIVIL & STRUCTURAL ENGINEERING TEAM

INTERNAL MEMO

Subject:	St Stephens, Rosslyn Hill, Hampstead, London		
To:	Ian Harper (HE, London Office)	**cc:**	
From:	Bridget Drake-Wilkes (Senior Engineer)	**Tel:**	07747 743 081
Date:	9th September 2015		

Figure 1. Location plan

1.0 Introduction

1.1 We visited site on 18 August 2015 with Michael Taylor, one of the trustees responsible for St Stephens, following his concerns that works to replace the linear accelerator on the adjacent Royal Free Hospital site earlier in the year may have caused damage to the church. With a new building at the Royal Free Hospital currently being considered by the local authority replacing the existing below ground car park and gardens to the south (Figure 1), the trustees of St Stephens are concerned that the listed building may experience further damage.

Photo 1. St Stephens South elevation

2.0 Building Description

2.1 St Stephens is a grade I listed masonry church constructed in the mid 19th century.

3.0 Observations

3.1 Generally the building is in reasonable structural condition.

3.2 There were signs of historic distortion to the north elevation (Photo 2 & 3). Cracking to the masonry was also observed on the south porch (Photo 4).

3.3 Deterioration of sandstone decorative columns beneath the limestone occurs in several locations with the worst observed on the north porch (Photo 5).

3.4 Some local vertical and horizontal cracking associated with embedded metalwork was observed in the tower staircase (Photo 6 & 7).

3.5 Vegetation was observed in gutters (Photo 4 & 8), suggesting some maintenance is outstanding, which if not attended to, could lead to local deterioration of the structure.

3.6 The lower roofs to the north and south aisles, were in good condition, although the mortar fillet to the south aisle roof is starting to fail (Photo 9).

3.7 On the main roof south elevation 54 slates had slipped (Photo 10). On the main roof north elevation a few slates had slipped adjacent to the tower (Photo 11).

4.0 Discussion of adjacent works undertaken early 2015

4.1 Michael described to us the scale of vibration experienced during replacement of the linear accelerator where percussive breakers were used. It should be noted that human beings are at least 50 times more sensitive than the threshold where cosmetic damage to buildings could occur.

4.2 I explained that to shield a linear accelerator to prevent the escape of scattered radiation thick reinforced concrete walls, ceilings etc were used and often cast following installation of the equipment. To renew the equipment, it would therefore be necessary to break out an area of concrete. This was confirmed by viewing from the top of St Stephens tower (Photo 13), where a section of the adjacent car park has been removed, presumably this was combined with an opening in a wall, which has subsequently been made good (and the application of the waterproof membrane currently visible).

4.3 On returning to the office and observing drawing A/RFMR/0002 Existing Level 00 plan on Camden Council's planning application 2014/6845/P this confirms the walls to the linear accelerator are approximately 900mm thick. This also identified that the nearest point of visible breaking out (observed from the tower) was approximately 58m from St Stephens.

4.4 Although the demolition associated with the renewal of the linear accelerator may not have required planning permission, it would not have been unreasonable to expect the contractor to follow Camden Council's "Guide for contractors working in Camden" to plan and use appropriate technology to avoid environmental disturbance.

4.5 Unfortunately without knowing what method was used I am unable to comment with certainty. It is likely that the linear accelerator was not in use during the breaking out, as the shielding would have been inadequate and it was about to be removed, hence the vibration requirements of the hospital would not have been onerous. If percussive breakers were used without isolating the area to be broken out first (e.g. by cutting), vibration would transmit easily through the concrete car park structure, and enter the ground at its nearest point approximately 33m from St Stephens.

4.6 BS5228-2[i] section B.3.1 notes that studies have shown that actual damage to structures or their finishes resulting solely from well controlled construction and demolition vibrations are rare. There are many other mechanisms which cause damage, especially in decorative finishes, and it is often incorrectly concluded that vibrations from construction and demolition sites are to blame. In some circumstances, however, it is possible for the vibrations to be sufficiently intense to promote minor damage, in this instance slipped slates.

4.7 The lower roofs to the north and south isles were reroofed and the slipped slates on the main roof reset with tingles in approximately 2008. You visited site in December 2013 when on the south elevation approximately 20 slates had slipped. On our site visit in August 2015 we observed 54 slates had slipped in the same section of roof. It is not known when the main roof was last (if ever) renewed. I believe that the main roof has suffered from corrosion of the nails (nail sickness), which manifests itself by means of slipped slates.

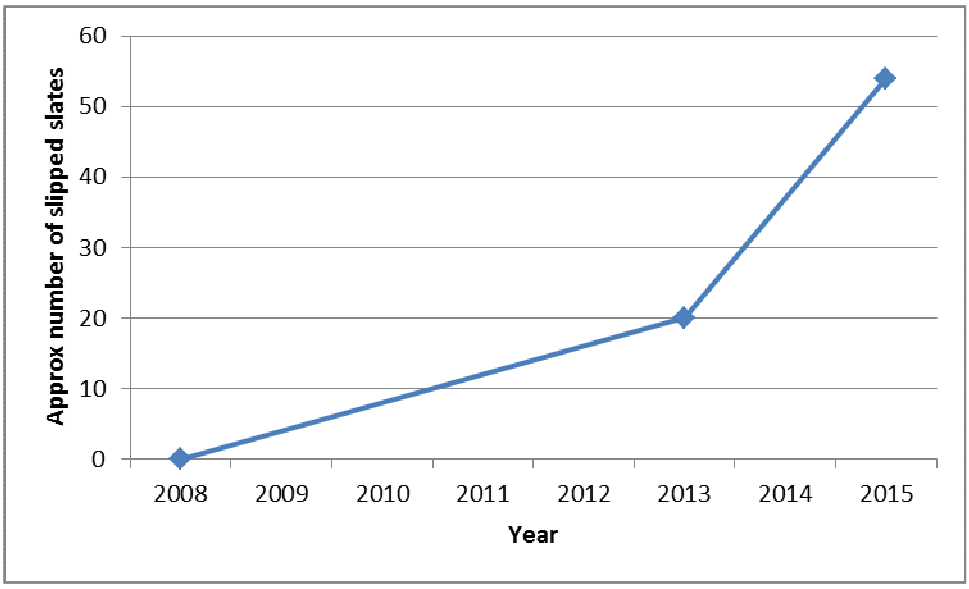

Figure 2. Slipped slates on main roof south elevation

4.8 Figure 2 shows the number of slipped slates observed graphically since it was last reset. It is possible that the vibration from the adjacent works may have accelerated the rate at which slates have slipped. Although exponential deterioration would be expected under normal environmental conditions as more of the roof structure becomes exposed.

5.0 Discussion of proposed adjacent works

5.1 The proposed works are to replace the existing below ground car park and gardens to the south with a new building, including 2 basement levels as outlined in Camden Council's planning application 2014/6845/P. I have not reviewed all the submitted documents, only those referenced below.

5.2 *Vibration*

5.2.1 Included in the planning application is a construction management plan, on p.26 it notes "*that there is sensitive medical equipment located adjacent to level 00* (basement level) *that may be susceptible to vibration caused by demolition and construction activity and so care must be taken to avoid any disruption to this. Previously vibration monitoring has been carried out during piling operations and no issues were encountered but suitable precautions and continued monitoring should still be undertaken during the forthcoming works. To this end, enabling works to separate the current car park from the hospital building to minimise any vibration transmission are being considered*."

5.2.2 This presumably refers to the linear accelerator, which is much closer to the proposed works and will have much more onerous constraints on vibration than the listed building.

5.2.3 On p.27 of the same document it states regarding St Stephens "*Primary concern of the church is potential damage that might result from by vibration caused by construction activity. It may therefore be necessary to adopt construction techniques that minimise vibration. In any event, robust monitoring will be required to ensure that vibration does not exceed predetermined levels."* Examples of best practice construction techniques to avoid vibration are;

- Demolition - by cutting the structure into sections to isolate it prior to removal
- Piling (and casings where appropriate) - the use of pressed or bored methods
- Temporary retaining walls - sheet piles pressed into position.

5.2.4 In the Building Design Partnership report p.8 it refers to a report RJ222801 undertaken by Vibration Specialists NVM which specifies the threshold levels. I have not had sight of this document to know whether an assessment of St Stephens for vulnerability of vibration induced damage in accordance with BS5228-2 is felt necessary or has been undertaken. Similarly without sight I am unable to comment on the proposed threshold levels or their justification.

5.2.5 I would recommend it is essential to set up continuous vibration monitoring on the church at low and high level, in advance of the works. Prior to installation, the proposals for monitoring should be understood and agreed by the trustees for St Stephens. The monitoring in advance would enable the report by Vibration Specialists NVM to be updated informed by the baseline vibration experienced from traffic etc. This in turn would better inform the proposed vibration thresholds; procedures and mitigation should thresholds be exceeded during the construction process. These proposals should be understood and agreed by ourselves and the trustees for St Stephens.

5.3 *Movement*

5.3.1 From drawing A/RFMR/2203 Proposed Cross Section DD the depth of the proposed excavation appears to be approximately 8.5m below the lowest floor level of St Stephens and from drawing A/RFMR/2000 Proposed Level 00 plan approximately 23m on plan. Therefore the angle from the lowest floor level to the base of the excavation is approximately 20° (1 in 2.7) and will be shallower when measured from the foundations of the church. This shallow angle combined with the two large trees (to be retained) between the church and the excavation is such that the risk of movement at the church associated with the excavation is in my opinion extremely low.

5.4 *Ground Water*

5.4.1 Whilst on site Michael advised that when the church was constructed the foundations had to be modified to pad foundations, rather than planned strip foundations to accommodate running water encountered below ground level. Michael also advised that when the work to extend the crypt was undertaken in the phase of work 2002-08 running water was observed under the church. On returning to the office I have checked the 1850 maps (prior to the church being constructed), modern contours and maps showing the approximate locations of the lost rivers of London and comment as follows;

- The River Fleet at its nearest point would have been approximately 280m from St Stephens.
- The River Tyburn at its nearest point would have been approximately 330m from St Stephens.
- The 1850 historical map shows no signs of a watercourse across or adjacent to the site.
- The contours (although admittedly modern) do not suggest that this would be the route of a water course.

5.4.2 With the scale of development that has occurred in the area surrounding St Stephens since it was built, the cause of the running water experienced during construction, maybe different to that experienced during the works undertaken in the early 21st century. It would be prudent to investigate to ensure the water currently flowing under the site is not related to a failed water main and I would recommend checking the size, proximity and condition of the nearest mains etc.

6.0 Conclusions

6.1 Given the distance of St Stephen's from the proposed redevelopment the risk of damage is in my opinion low, particularly as hospital equipment directly adjacent to the site is now switched on and sensitive to vibration and is likely to have more onerous requirements than St Stephen's.

6.2 It is unfortunate that a condition survey of St Stephen's and monitoring of vibration were not put in place prior to replacement of the linear accelerator.

6.3 It is difficult to say whether the works undertaken to date have accelerated the rate at which slates have slipped. The cause of the slates slipping; corrosion of nails fixing the slates predates the replacement of the linear accelerator.

7.0 Recommendations

7.1 Continuous vibration monitoring of St Stephens at low and high level should be set in place prior to redevelopment of the adjacent site to determine baseline levels of vibration that St Stephens experiences. This should be used by the developer to inform and agree with St Stephens vibration thresholds; together with procedures and mitigation should thresholds be exceeded during the proposed work.

7.2 A condition survey of St Stephens should be undertaken prior to commencement of the proposed works to provide a baseline should further defects become apparent during or shortly after the proposed works.

7.3 It would be prudent for the trustees to consider the timescale to undertake renewal of the main roof, particularly the south elevation as with more slates slipping, the risk of damage to the fabric of the building increases.

7.4 Investigation of water mains etc and their condition in proximity to St Stephens should be undertaken to understand whether this is the cause of the water observed under the church in the early 21st century or whether the underground river encountered during construction continues to flow under the site.

8.0 Reports and Documents Reviewed

Hopkins Architects Drawings

A/RFMR/0002, 0003 Relating to the existing building (all revision B)

A/RFMR/2000, 2001, 2002, 2203 Relating to the proposed building (all revision C)

Building Design Partnership

"Building Note on movements" Revision 1 (Jan 15)

P2005878(20)SP100 & 101 rev F & H Relating to proposed pilecap, foundation and level 00 plan

Institute of Immunity and Transplantation – Pears Building (Jan 15), pages 4, 8 – 13

[i] BS5228-2:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration

Photo 2. Distortion to the east end of the north aisle externally

Photo 3. Distortion to the east end of the north aisle internally

Photo 4. Cracking and vegetation to south porch

Photo 5. Sandstone decorative column to north porch.

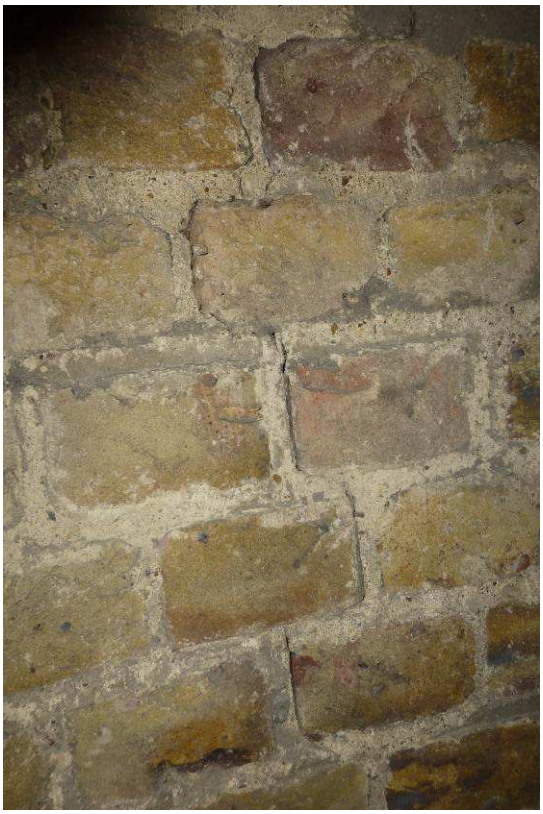

Photo 6. Vertical cracking to tower staircase

Photo 7. Horizontal cracking in the tower staircase

Photo 8. Vegetation and slipped tiles on north elevation adjacent to tower.

Photo 9. Failure of mortar fillet between south aisle roof and clerestory wall.

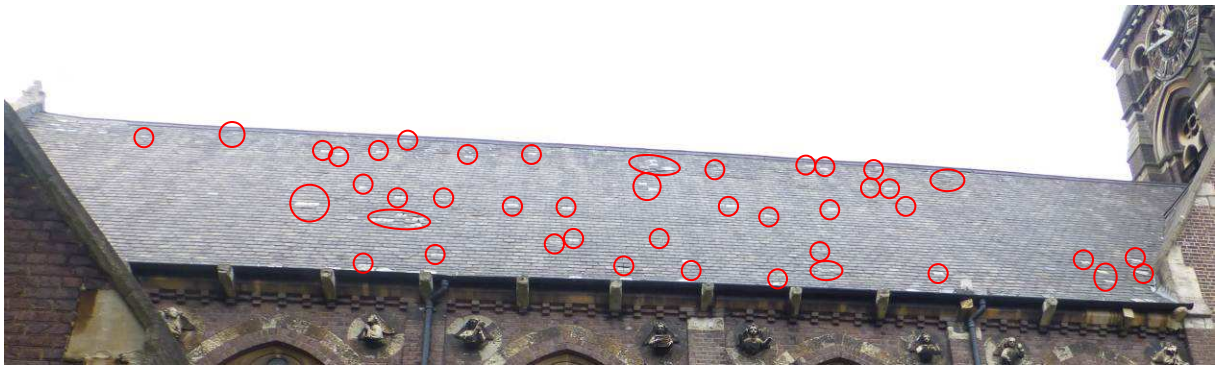

Photo 10. Main roof, south elevation areas of slipped slates.

Photo 11. Main roof, north elevation areas of slipped slates.

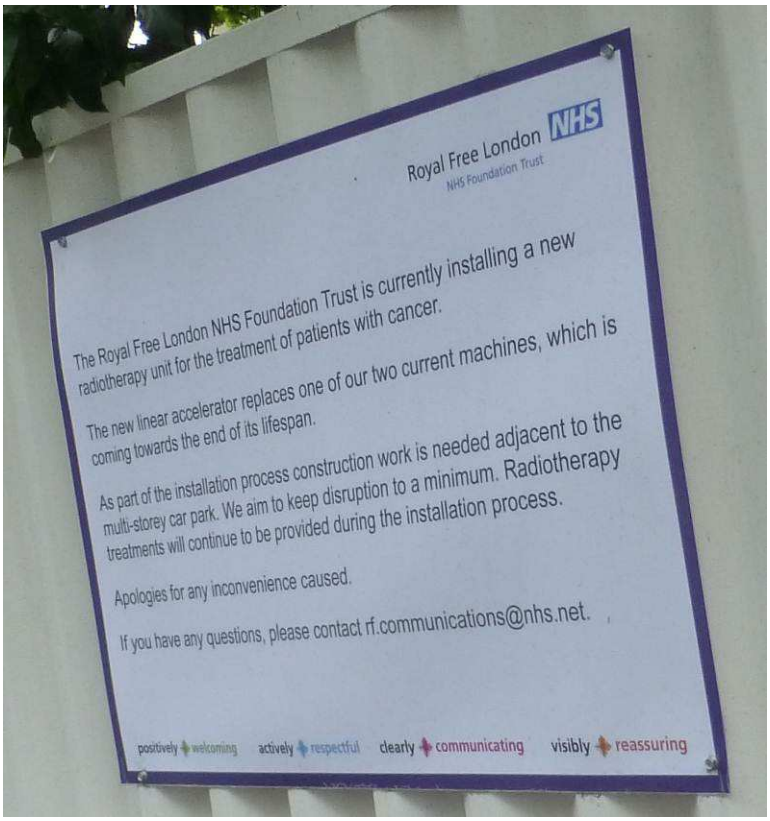

Photo 12. Signage on Royal Free Construction Site

Photo 13. View from St Stephens Tower of north end of linear accelerator.