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Technical matters for concern arising from the excavations proposed for the Pears Building on Rowland Hill Street Application 2014/6845/P (Part 2)

Introduction

1. Part 1 concluded that the slope upon which St. Stephen's church and Church Hall are founded has a history of ground movement that has cracked and damaged these buildings, and that this damage has been associated with development of the Royal Free Hospital and its forerunners at the foot of the slope.

2. The Conclusions in Part 1 are as follows.

2.1 St Stephen's has a history of movement associated with engineering work downhill that can be traced back to 1901.

- 1901 when excavation of the basement for the Hampstead General Hospital was in progress.
- 1948/49 approximately, associated with the extension of the Hampstead General Hospital.
- 1968-70 in clear response to the excavation for the foundations of the Royal Free Hospital.
- 2015 during and following the demolition works for the LINAC centre of the Royal Free Hospital.

This 114 year history of movement associated with and in two cases in clear response to work downhill has been ignored.

2.2. The progressive movements that must have occurred in the ground beneath St. Stephen's over the years **will have had a cumulative effect upon the strength of the ground** and its present ability to withstand further deformation arising from excavations downhill, which should be assessed.

2.3. **Ground investigations were commissioned that appear not to have required the contractors to consider the St Stephen's estate.** For this reason two Basement Impact Assessments assure Camden that their requirements for approving the application to build the Pears Building have been satisfied.

2.4. **Camden have been misinformed by these BIAs.** St Stephens appears not to have been considered yet it literally casts a shadow across the site; the ground on which St Stephen's sits is a major component of that which should be considered in the design for the extension of the Royal Free Hospital towards its boundary.

2.5. Fortunately the independent review by LBH raised the question of St Stephen's and a prediction of ground movement was requested – no movement was predicted to occur from an excavation much closer to St Stephens than those before, even though all those works before have been linked to movement at St Stephens. **Movements following the demolition of the LINAC in early 2015 show how wrong that prediction of ground movement is and thus the fallacy of the assurances given to Camden at the time of the application**.

2.6. **This is not the only prediction that did not work;** the groundwater specialist ESI attempted to predict ground water pressures and failed to do so.

2.7. **The history of St Stephen's estate does not conflict with the geology of the slope on which it sits**, on the contrary, it is readily explained by St Stephen's sitting on a slope that has moved in the geological past and is able to move when conditions are right; **it behaves as if its factor of safety against shearing is hovering around 1.0.**

2.8. **The ground investigation for the Pears Building needs to be extended to include the St Stephen's estate and for the ground on which it sits to be seen as part of the ground for which a response should be known to the works proposed.** This may take time as it will be crucial for groundwater pressures and their response to be known.

2.9. **Failure to incorporate St Stephen's into the design of the works for the Pears Building runs a very high risk of initiating ground movements beneath the church, its tower and its hall (a school) that could be beyond control.**

3. Further to the documentary evidence upon which the above conclusions were based it was also known that a Condition Survey of St. Stephen's and its Hall had been commissioned by the Royal Free Hospital, that the results of this were awaited and that when the survey arrived there would be time to analyse the data it contained. Those results would be crucial evidence against which the conclusions from Part 1 could be judged and details of possible movements **in the ground** confirmed. It is emphasised that the **analyses of the survey data is to support an understanding of how the ground has moved**; it is not analysing the structure as such.

4. The Survey took 11 days to produce, was released on the 30th September and became available to for use by this report in late October. It contains a very considerable quantity of factual data that is unique; such data is neither reproduced nor duplicated in any other way elsewhere in the documents considered in the Application considered by Camden. The data is amongst the best presented in the Application and the facts it contains far exceed in numbers relevant factual data provided elsewhere in the ground investigations.

5. Some measure of the quantity of this data may be gained from the following crude statistics.

- The survey presents 34 x A3 drawings
- Each drawing contains at least 10 cracks and other defects, recording their
  - Position
  - Inclination
  - Extent
- Each crack and defect has been photographed (there are approximately 500 photos) recording their
  - Aperture or other character
  - Sense of movement
  - Relationship to other cracks
- This total data is in excess of 3000 items of factual information.

6. The time required to analyse these data has not been provided as supposed and this morning it was made known that Part 2 is required by the end of today, 16th November 2015.

7. Part 2 therefore provides nothing more than an overview of the data that has been presented and a description of the conclusions which are missing as a consequence of the data not being considered.

Findings

8. At least three families of failure surfaces transect the main body of the church, one trending approximately N-S another trending approximately E-W and a third approximately horizontal. It should be noted that the Tower was not fully accessed during the survey.

- The N-S trending set is inclined at around 60° to the horizontal and sloping downhill with its plane, seen in plan, oriented normal to a line that points directly towards the Royal Free Hospital.

- The E-W trending set is inclined almost vertically with its plane seen in plan oriented normal to a line that points towards Rosslyn Hill and Hampstead Green to the south and Pond Street to the north.

- The horizontal set define horizontal planes whose normal is vertical.

9. In general terms the N-S and E-W families seem most likely to be related to downhill movement of the ground whereas the horizontal families could easily be the consequence of consolidation (settlement). It is more than likely that they are inter-related rather than separate incidences, especially as the survey depicts the cumulative damage of over 100 years of recorded movement. Thus some of the horizontal surfaces may have originated from early settlement (the church was built in almost a year) but downslope movements would also have generated vertical components of movement.

10. Exactly such an inter-relationship occurred this year when the ground around the Hall settled and extensional cracks opened in the Hall.

11. With regard to the cracks cutting the church, there is evidence from their spacing to suggest it may be possible to reveal the sequence in which they occurred, first one then another, possibly starting from the point nearest the base of the slope; lack of time has prevented this from being done. Such an insight would help reconstruct the way in which ground movement may have occurred in the slope.

12. There is also evidence from the many photos that some of these movements were mainly extensional – just a pulling apart of masonry on brick courses rather in a plane strain mode, whereas other movements have been dominated by compressive shear. These modes of movement need to be mapped to show whether the ground on which all this sits was moving essentially laterally or subsiding as well; all the data is there for this to be attempted.

13. The photos also furnish invaluable information on the magnitude of these movements (some of which are Burland Scale 3; cracks 5mm – 15mm wide or a number of cracks greater than 3mm) and that is something of considerable value to a reconstruction of how the ground has responded to excavation down slope. Much is known about when the ground moved but almost nothing is known about how much it has moved. Although damage can be repaired in the superstructure and some strength thus restored, movements in the ground are cumulative and inaccessible; they are carrying the soil there through a stress-strain or strength-displacement relationship that could include a stage at which strength is lost with further displacement. From then on further displacement weakens the ground.

Conclusions

14. The Conclusions in Part 1 demonstrate that attention must be paid to the ground upon which St Stephen's and its hall are founded.

- A 114 year history of movement associated with and in two cases in clear response to work downhill, that has been ignored.

- Progressive movements that must have occurred in the ground beneath St. Stephen's over the years and which will have had a cumulative effect upon the strength of the ground and its present ability to withstand further deformation arising from excavations downhill.

- A campaign of Ground Investigations that did not consider the ground beneath St Stephen's and as a consequence delivered two Basement Impact Assessments (BIA) that assured Camden their requirements for approving the application to build the Pears Building have been satisfied. As a result Camden has been misinformed by these BIAs.

- No movement was predicted to occur to the Hall yet movements around St. Stephen's Hall and abutting the church following the demolition of the LINAC in early 2015 show how wrong in practice that was, and that was the most recent prediction of ground movement delivered as part of the BIA.

15. The history of St Stephen's estate does not conflict with the geology of the slope on which it sits, on the contrary, it is readily explained by St Stephen's sitting on a slope that has moved in the geological past and is able to move when conditions are right; it behaves as if its factor of safety against shearing is hovering around 1.0.

16. The factual data in the Condition Survey support this conclusion and add clarity to the outcomes it describes. The survey provides a unique body of data that should not be ignored as it reflects better than any written word or theoretical prediction, or learned opinion just what has happened at this site and to this ground.

17. There is no doubt in my mind that in the light of what is now known about St Stephen's a decision to approve the excavations proposed runs the risk of taking the ground beneath St Stephen's to failure, so promoting further displacements of a structure that has already been displaced. Such movements could be rapid and also dangerous if part of the structure was to collapse under such strain. A structural engineer would certainly be able to use the data in the Condition Survey to advise further on the structural stability of the church and its hall under these circumstances.

18. Best practice for achieving stability starts with a design based on a proper understanding of the ground. The current proposals manifestly fail in that respect and attempt to redress that ignorance with Conditions that can never be properly policed. The Condition Survey shows repeatedly by its weight of factual evidence that extreme caution is now required.

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