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For the attention of Rob Tulloch

Dear Sir,

16A Lyndhurst Gardens- Audit of documents received post BIA to address comments given in Arup letter to Camden, dated June 2012, on further work required

Introduction

In June 2012 we provided a letter to Camden giving our recommendations with regards to the BIA prepared for planning permission for 16A Lyndhurst Gardens. In that letter we listed aspects that in our view needed to be addressed more fully in later stages of design. We recommended that a condition of Planning Approval should be to review the further work required in our letter prior to construction proceeding.

In the decision notice for the grant of planning permission, Condition 4 states:

"The development (including both excavation and construction) hereby approved shall not commence until further details relating to the basement construction (including further investigations, condition surveys, construction methodology and detailed design, mitigation measures, monitoring methods, etc), as itemised in Arup's letter dated 27.6.12 titled 'Audit of revised BIA June 2012', have been submitted to and approved by the Council. The development shall thereafter be constructed and monitored in accordance with such approved details and with the Basement Impact Assessment report dated June 2012 by Michael Chester and Partners."

Since then the applicant has prepared further information to address the planning condition. This information describes design intent, as the project is not yet at detailed design stage. The information is contained in the following documents/communications:

- Supplied through Vabel drop box Jonathan Been to Dinesh Patel, 6 Nov 2014**,** "FA17725 16a LYNDHURST GARDENS, LONDON. NW3. PROPOSED 2 STOREY BASEMENT TO SUPPORT NEW HOUSE & GARDEN. BASEMENT

IMPACT ASSESSMENT – RIBA PLAN OF WORK 2013 STAGE 3." Abbey Pynford.

- Email Nicola Pinkstone of Abbey Pynford to Hilary Shields dated 29/1/15 including Abbey Pynford letter dated 29/1/15 to Arup, bearing pile design calculations, updated sketch showing indicative temporary propping to the southern garden wall and underpin below, borehole information (also seen in the previous BIA documents)

As confirmed by email from Rob Tulloch to Hilary Shields dated 13 February 2015, Arup were instructed to assess the additional information supplied by the applicant and advise the Council whether this complies with all the requirements stipulated in the Arup letter of June 2012. However, the email also states that it is not required for us to review the detailed design.

This letter therefore provides our comments on the design intent information provided. We assume that the detailed design will comply with the stated intent.

As in all BIA review work for Camden, our role has been to review and comment on the documents, and does not constitute a formal independent design check.

Technical Response

In the following, our numbering will follow the numbering given in the Arup letter of June 2012. We list each of our points in that letter in turn in italics and then discuss to what extent the applicant has fulfilled the requirements.

2. Topic: Site Investigation.

Further work required prior to construction

- *Additional trial pits to investigate the foundations of the adjacent properties*
- *Further boreholes to investigate the ground conditions, depending on choice of piling method*

Comments following further information post BIA

It is stated that negotiations with adjoining owners are continuing to gain permission to dig the trial pits to investigate the foundations of adjacent properties.

A further ground investigation using CPTs has been carried out and the previous borehole lab test data revisited. The further CPT ground investigation has been interpreted as Made Ground over London Clay. We have observed to Abbey Pynford that there are clearly granular horizons at the top of the "London Clay". The lab test data from the boreholes has been revisited by Abbey Pynford to show that this stratum is consistent with London Clay. The boreholes were dry during construction.

The proposed wall appears to consist of 450mm diameter piles at 650mm centres so there will be gaps for water and soil to flow through perhaps after heavy rain and we have made this comment to Abbey Pynford. Abbey Pynford accept that this possibility cannot be excluded but do not think the risk is such that a secant piled wall or advance grouting is

justified. In the event that such a problem arises they propose to grout between the piles as necessary.

In principal their proposed mitigation is acceptable. Given that no method statements are yet available, we are unable to comment further on this aspect.

3. Topic: Drainage pathway

Further work required prior to construction

- *Design of drainage pathway behind walls and maintenance requirements*
- *Ensure that drainage behind the walls does not provide a pathway for water ingress through the piled wall.*

Comments following further information post BIA

Abbey Pynford are happy to construct a land drain around the existing basement as proposed in the previous BIA. No details have yet been proposed. In designing the drain they will need to consider that the previous groundwater level monitoring showed a rise in ground water level at the top of the London Clay of up to 1.2m following heavy rain, with a maximum measured level of 74.4mOD. Therefore it should be ensured that groundwater cannot potentially rise significantly above the maximum level currently monitored.

Abbey Pynford have confirmed that in the permanent condition the retaining wall will be faced so that there is not a pathway for water ingress in the permanent condition. If the drain is in place in the temporary condition consideration needs to be given so that it does not create a pathway for water inflow into the basement excavation.

In principal the proposed mitigation is acceptable. Given that no details of the drain are yet available, we are unable to comment further on this aspect.

6. Topic: Construction Sequence.

In the following list, our response is shown in bold adjacent to the point concerned.

Further work required prior to construction

Some details need to be clarified/ considered at later stages of design. These include:

- *The design depth of excavation needs to be specified and clearly shown on the drawings. We are assuming that it will not be significantly deeper than the maximum 9.2m analysed in the preliminary wall movement calculations.* **Abbey Pynford have clarified that the maximum excavation level is +67.475mOD, i.e. 9.225m below the general site level of +76.7mOD.**
- *Precise distances to neighbouring buildings need to be clearly shown on the drawings.* **This has been done**.
- *Details of the propping to restrain the boundary wall with No. 16 need to be developed.* **Abbey Pynford have provided a sketch which shows indicatively the temporary propping proposed to laterally restrain the wall and the proposed new underpin beneath.**

- *Some main bearing piles are constructed initially prior to construction of the ground floor slab. These piles are shown extended to ground level to support the ground bearing slab during construction. No support method for the basement and sub-basement slabs is shown on the drawings. The calculations in Appendix F say that the basement and sub-basement slab are hung off the floors above. No mention is made of plunge columns. Attention needs to be given to how these slabs will be supported.* **Abbey Pynford are proposing a top-down methodology in which the ground slab is supported on mini piles, and the first basement level slab and liner wall beneath are hung off the ground slab. They state that this is their usual top-down construction technique and the piles will be designed as free standing columns between the basement slab levels. Arup have expressed concern to Abbey Pynford that the piles could be subject to lateral loads due to out-of –balance forces across the basement from north to south. Abbey Pynford aim to demonstrate at detailed design that through the diaphragm action of the slabs, this out of balance will be transmitted to the perpendicular retaining walls which will act in longitudinal shear. Therefore the piles will not be a primary means of resisting horizontal loading.**
- *As shown, the piles installed adjacent to the south boundary wall will need to be broken down at the stage when the underpinning and the sacrificial retaining wall are constructed. This needs some thought within the sequence. An alternative would be to install the piles from ground level and backfill the bore above pile cut-off, although this would preclude the use of CFA piles.* **The proposed construction sequence at the south wall has been changed so that there is no longer a sacrificial retaining wall and the piles do not need to be broken down until the permanent liner wall is in place.**
- *Excavation below the basement slab to just below the temporary prop level will be carried out prior to construction of the remaining bearing piles. No level is given for the temporary prop. The wall movement calculations in Appendix F show the prop level 2.8m below the basement slab centreline. Therefore a piling mat and piles will need to be constructed in about 3m of headroom. This may be difficult and advice needs to be sought from piling contractors at detailed design stage. Again, an alternative would be to install the piles from ground level and backfill the bore above pile cut-off.* **This comment is no longer applicable due to the change in construction methodology.**
- *The maximum depth of excavation needs to be clarified. It has been assumed in the wall movement calculation in Appendix F to be 9.2m. This appears to be an upper bound from the available drawings.* **Abbey Pynford have clarified that the maximum excavation level is +67.475mOD, i.e. 9.225m below the general site level of +76.7mOD. This has been taken into account in the new retaining wall calaculations.**
- *The method of drainage of the cavity below the base slab needs to be specified.* **The new basement scheme incorporates a ground bearing slab so this comments is no longer applicable.**

Summary of Comments following further information post BIA

The proposed scheme appears to have been carefully thought through and we agree that with appropriate design, the proposed solution should be possible. We have expressed our observation of the slender nature of the mini piles used for temporary vertical support of the ground slab and structures below, and queried whether additional bracing measures may be required. Abbey Pynford do not think this will be an issue because the piles will

not take any significant lateral load and will be supported against buckling by the intermediate slab. Given that detailed design has yet to be carried out, we are unable to comment further on this aspect.

7. Topic: adequate support system to the excavation on the south side

Further work required prior to construction

- *The dimensions of the sacrificial retaining wall have yet to be determined and may impact on the final design of the geometry of the permanent basement wall and basement slab shown on the drawings.*

Comments following further information post BIA

This comment no longer applies with the new proposed construction sequence.

8. Topic: Calculations of movement of the contiguous piled wall

Further work required prior to construction

- *In detailed design, calculations will need to be carried out for the final design depths of excavation and wall toe level and at different sections around the excavation, including the design of any temporary propping scheme.*
- *Consideration will need to be given to the effects of potential sway across the basement due to the higher ground level to the north, as noted in the geotechnical assessment report. The surcharge loadings from the adjacent buildings will also need to be confirmed for detailed design.*

Comments following further information post BIA

Detailed calculations have been carried out at different sections of the wall for wall movement, bending moment and shear force for the top-down construction sequence. Analysis of reinforcement requirements has been carried out. These calculations lead to proposed pile diameter and spacing (consisting of 450mm diameter piles at 650mm centres). We understand that detailed design has yet to be carried out.

We have expressed our concern to Abbey Pynford that 450mm diameter piles are small for a 9m excavation depth. The calculations show small movements and bending moments that are reasonable to reinforce for. On examination of the calculations we observe that minimum equivalent fluid pressures (mefp) have not been applied behind the wall, as recommended in CIRIA design guidance report C580. This would increase bending moment, leading to bigger cages which might present construction difficulties, and predicted wall deflection. We suggest that in detailed design mefp should be incorporated and consideration given to adoption of larger 600mm diameter piles.

In relation to the imbalance of lateral load, Abbey Pynford reasonably consider that this will be taken out to the side retaining walls through diaphragm action, and will also be taken down to the base slab through internal shear walls, where it will be resisted in sliding. Because of the ground bearing nature of the base slab in the new proposal, they have demonstrated that there will be sufficient vertical pressure to give the required

resistance in sliding. In the short term we would comment that since the piled walls are contiguous rather than secant, then behaviour in shear will need some thought since there is a row of piles, rather than a wall. Abbey Pynford state that in detailed design the paths for the imbalance of lateral load will be analysed in both the temporary and permanent conditions, so we consider that they should be able to achieve a robust design. Given that detailed design has yet to be carried out, we are unable to comment further on this aspect.

10. Topic: bearing pile design.

Further work required prior to construction

- *Detailed pile design still needs to be carried out, including considerations of construction sequence (see 6.)*
- *The pile design will need to consider the effects of heave adjacent to the pile shafts.*

Comments following further information post BIA

Abbey Pynford have provided reasonable charts for bearing pile design for 300mm and 450mm diameter piles. The loads, pile layout and toe levels have yet to be designed.

Heave effects on the piles will be considered in detailed design.

Given that detailed design has yet to be carried out, we are unable to comment further on this aspect.

11. Topic: Damage assessment of adjacent buildings.

Further work required prior to construction

- *The predicted ground movements will need to be checked during detailed design with the final construction sequence of temporary/permanent propping.*
- *The distances of the adjacent buildings from the excavation will need to be shown clearly in order to fully understand where the buildings are positioned with regard to predicted ground movements and whether there is any significant curvature arising from their positions relative to the settlement trough behind the walls.*
- *The assessment of "damage" should be reviewed in regard to future condition surveys and surveys of the existing foundations, including investigation of the garden wall to No. 16.*

Comments following further information post BIA

A revised ground movement assessment for the proposed construction methodology has been carried out by Donaldson Associates.

The distances to adjacent buildings have now been marked on a plan. Contour plans have been provided in the ground movement report superimposed on plans showing the locations of the adjacent structures.

Donaldson assess the corresponding damage to adjacent properties as negligible, though suggest that this finding is further reviewed when greater information on the building foundations is available.

We would point out that the Donaldson vertical movements shown in plan are on the small side in comparison with movements that might be anticipated based on the empirical data in CIRIA report C580. Possibly, as we suggested for the wall calculations, this may be because of the undrained behaviour modelled, with no potential for water to fill tension cracks, leading to small wall and hence ground movements. In addition, the vertical movements shown in plan, and upon which the damage assessment appears to be based, do not include the ground movements due to wall installation, which Donaldson do quantify separately. Nevertheless, the predicted damage given is well within the Category 1 "very slight" damage that was proposed in the BIA, so that there is some scope for variation in the movement prediction during detailed design. We appreciate that the predicted ground movements are not yet finalised as detailed design has yet to be carried out.

The Donaldson report has not taken into account differential in ground level across the basement. Donaldson and Abbey Pynford have provided an extra comment that the top-down sequence will act to minimise movement, with the lateral load being taken out to the perpendicular piled walls by the diaphragm action of the slabs. We understand that this is going to be addressed fully in detailed design.

In summary, detailed consideration is clearly being given to understanding of ground movements associated with the proposed new construction methodology. It is clear that since detailed design has yet to be carried out and any investigation of neighbours' foundations yet to be undertaken, the predicted ground movements cannot be finalised at this stage.

12. Topic: Monitoring.

Further work required prior to construction

- *A full monitoring specification with trigger levels and contingency measures will need to be developed during detailed design.*
- *A detailed method statement for the basement construction needs to be developed alongside the monitoring so that each element of activity can be assessed with respect to movements.*

Comments following further information post BIA

Abbey Pynford agree that these actions are required and will be developed during detailed design and agreed with all relevant parties.

The proposal is to fix tell tales to the walls of adjacent structures as the only means of monitoring likely to be of any use. On this point we disagree. Monitoring of the basement walls is the primary means of understanding whether wall movements are conforming with expected behaviour. In addition, in the event of an unexpected movement of an adjacent

structure it helps to provide understanding of the cause. We therefore recommend that monitoring of the basement is also considered in developing the monitoring proposals.

13. Topic: ground related risk assessment

Further work required prior to construction

- *We note that in relation to piles, it is advised that the piling contractor should allow for temporary casings if necessary to protect the sides of the bore and that he should ensure the bore is clean before filling with concrete. This is therefore worded with bored piles in mind. Although no rig details are given in this submission, the previous submission indicated that the proposed piling method would use a minipile Klemm 709 rig (essentially a segmental auger CFA method of piling). If a CFA rig is finally proposed then a statement needs to be made in regard to the risks of using cfa rigs next to buildings and the controls and mitigation measures to be put in place during construction to ensure installation of piles has no detrimental effects to buildings. Also, the cfa method also requires controls to avoid flighting, avoiding contaminating the concrete as short segmental casings (1-2m)are removed during concreting, and risks of plunging steel cages to the bottom of a slim 450mm diameter pile into fresh concrete from the ground surface.*

Comments following further information post BIA

Abbey Pynford state that they intend to use a Klemm 702 machine which constructs bored piles, cased through Made Ground, with concrete placed through a tremmie pipe after insertion of cage. We have no further comments on this.

Summary

The project is not yet at detailed design. Our brief was to comment on a level of design that is not yet at detailed design stage. The applicant has provided design and construction proposals/ intentions to address the requirements stipulated in the Arup letter of June 2012. We consider that these have been addressed in a reasonable manner commensurate with this stage of design.

Yours faithfully

Dinesh Patel

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