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Dear Sirs

FAO Graeme Todd

Bishops Waltham Depot – foundation and retaining wall options appraisal

Introduction

Scott White Hookins have been instructed to provide a report on the likely foundation options to the proposed new development at the above. Specifically advising on alternative foundation options for the proposed new building and external retaining walls.

The site comprises currently of an existing light industrial unit of brick walls and corrugated asbestos roof covering. It is proposed to demolish the existing brick built industrial unit and replacement with modern steel framed building.

It is proposed to increase the hardstanding area by cutting into the embankments and providing retaining walls to the perimeter, where currently embankments.

The Site

The central section of the site is relatively level, a cutting having been historically formed sufficiently level to construct the current building. There is a gradual rise in ground level / hardstanding towards the rear. The existing units are terraced to follow the profile of the slope. The floor / roof level of the units stepping up towards the rear.

There are embankments of varying heights to the perimeter of the site, ranging in height from approximately 1.5m to 4.5m. The height of embankments increased towards the rear the rise in ground level appears to extend beyond the boundary. The embankments are heavily wooded; the majority of trees are young semi-mature, occasional trees have reached full maturity.

Geology

The ground investigation report for the site indicates the underlying soil to be of weathered low density DM grade chalk, extending to approximately 3m below ground level. DM chalk typically of weak putty-like constituency.

The site is in close proximity to a small river, which is a tributary of the River Hamble. Over geological time the site will have been within the flood plain of the river and subject to weathering of the chalk to the weakened condition observed today.

The geotechnical report recommends construction the new building on piled foundations. In this case the floors of the units would be suspended, with the associated additional foundations to support the ground floor slab or the floor could be constructed as a piled raft slab.

Construction

The proposed building is likely to be steel portal frame with steel roof and wall cladding, with blockwork perimeter walls to 2.0m height. Frame loading will be concentrated at column locations.

It is proposed to provide mezzanine / first floor accommodation to the new commercial units. There are two primary options for the first floor elements:

1) Provide lightweight "temporary" mezzanine construction of standalone steel frame; typically the floor is constructed using cold rolled metal purlin floor joist, with chipboard deck. This type of mezzanine construction is typically built off the ground floor slab.
2) Construction of steel frame connected to the main building frame and supported on the building foundations. This is typically considered permanent construction; the floor is usually precast concrete floor units, but could be constructed using timber joists and boarding to reduce loading.

Proposed foundations.

We have reviewed the ground investigation report. The recommendation for piled foundations is due to a combination of issues including; potential for dissolution features giving variable ground bearing pressure and local soft spots giving differential settlements. Also the non-cohesive nature of the ground, creates the risk of instability / collapse of deep excavations for foundations. For piled foundation option CFA piles would be recommended. These piles are augured piles so eliminates impact vibration experienced with driven piles.

The chalk subsoil at the site is considered a vitally important aquifer. Driven piles create a path for water to penetrate between the pile and the ground so will not be acceptable. CFA piles are concrete filled during withdrawal of the auger so the concrete forms a full seal against the soil preventing water penetration. Considering the sensitivity of the aquifer the Environment Agency may require sleeved piles.

The ground floor slab under these proposals would need to be suspended spanning between piled ground beams or a piled raft slab.

Alternative foundation options

Raft foundation

There is the possibility that a raft foundation could be adopted if the deflection can be controlled within acceptable limits. The current ground investigation report does not include allowable ground bearing pressure figures for shallow foundations. Therefore this option will be subject to

further ground investigation, including plate bearing tests to allow calculation of allowable ground bearing pressure potential settlements.

The steel portal frame concentrates loads at column positions; the closely spaced frames shown on OB architecture will assist in distributing the loads. A modest perimeter ground beam would be suitable for the proposed frame spacing shown on OB architecture drawings.

Ground improvement

The use of a soil stabilisation could be used to say 600mm depth to improve the ground bearing pressure of near surface layers, to avoid removing large volumes of natural soils to provide deep sub-base for both the external hardstanding's and the building floor slab. There is the potential to use this method under a raft slab; again to avoid removing large volumes of natural soils. Alternatively this could be used for a ground bearing slab in combination with piled superstructure.

We have been in discussion with Beach Ground Engineering Ltd, who are specialists in ground improvement. Following those discussions we would recommend a cement stabilisation, rather than a lime, as this would provide a more rigid platform on which to build. Cement stabilisation would be suitable for the floor slab but is not considered suitable to support building foundations, as all the weak materials would need to be treated to whatever depth the weak material extends in this instance greater than three metres depth. The final specification for any ground improvement would be subject to specialist detailed design.

Vibro-compaction stone columns.

We have reviewed the potential to use vibro-compaction stone replacement. The Vibro-compaction process uses replacement stone filled and vibrated into augured boreholes or using a specialist vibrating bore driven in an utilising air jets to penetrate to the design depth. The process can improve the ground bearing pressure but essentially provides a confined stone column; the new foundations span between the stone columns taking the loads through the depth of weak / poor ground onto the underlying bedrock. The process is not well suited to chalk soils and more commonly used with loose granular soil. The project is also relatively small for this type of ground improvement and there is a risk that the vibration will raise concerns with owners of nearby properties. Dilapidations surveys may be required to properties in close proximity to the site, this may outweigh any cost benefits of this option.

External retaining walls

The scheme drawings indicate traditional masonry type retaining walls. The ground slope is indicated to extend above the wall at a slope angle of approximately 70 degrees. The weathered weak chalk will not remain stable to this steep angle. Also cutting back the embankment to provide construction space will excavate the soil beyond this steep slope and the backfill cannot be installed to such a steep slope angle. Therefore the retaining walls are likely to be higher than indicated on the architectural sections.

Several of the mature / semi-mature trees on top of the embankment will be very close to the wall excavation. It is likely that a significant proportion of the tree roots will be cut and the bowl of the

tree undermined by the cutting / excavation. It is recommended to seek specialist advice from an arboriculturalist on the viability of retaining trees above the cutting.

Traditional masonry retaining walls will not be practical or cost effective on this site; partly due to the tree / embankments and partly due to the depth of weak chalk and reaching a foundation strata for traditional foundations. It is recommended to provide a flexible retaining wall that does not require engineered foundations.

External retaining wall options:

1) Criblock wall: these can be timber or concrete interlocking ribs, generally laid to a slight incline and infilled with excavated material. These can be installed on a flexible shallow sub-base foundation. Over time plant growth will establish to the infill material providing a natural finish.
2) Stone filled gabions: these can be installed on a shallow flexible sub-base foundation.
3) Sheet pile wall: this will avoid any excavation beyond the cut line so reducing the impact on the trees. However the finish is not athletically pleasing so will likely require cladding. There will be a similar requirement for deep foundation for traditional masonry walls cladding, precluding this. An option may be to provide timber or other cladding fixed to the sheet pile wall.
4) A potential option is for steep embankments with soil nailing / ground anchors with surface mesh or geotextile membrane. This could allow minimal excavation so avoid undermining of trees and avoid extensive engineered walls. Aesthetically this is not a good finish but over time will be increasingly obscured by undergrowth.

The disadvantage to options 1 and 2 is that there are gravity retaining walls so require a great deal of space to construct.

Drainage

The chalk should be suitable for soakaway construction. As mentioned above the chalk subsoil at the site is considered a vitally important aquifer. The Environment Agency and local authority must be consulted when planning soakaway installations where chalk lies below the site even where it is mantled with superficial deposits. It is very likely that a petrol interceptor will be required for the external hardstanding drainage.

Further investigation:

It is recommended to undertake an arboricultural assessment of the trees on the embankment specifically considering the proposed retaining wall excavation including likely excavation for construction space and batter angle for safe working.

The ground investigation was undertaken using window sampling. Weathered chalk has a tendency to liquefy when disturbed; the writer has previous experience where the disturbance caused by the window sampling process, indicated an apparent poor quality chalk; but when work commenced the chalk was found to have significantly greater integrity than indicated within the soils report. Therefore it is recommended to undertake additional ground investigation to advise of allowable ground bearing pressure for shallow foundations for external works and possible raft foundation.

Investigation to include an excavated trial pit to verify chalk condition and to undertake the plate bearing tests to confirm the actual ground bearing pressure.

Summary

The building is most suited to a steel portal with cold rolled steel purlins and metal cladding. The frame spacing proposed on the architects drawing appears the most suitable to suit the structural / foundation requirements.

The piled foundation option may prove the most effective solution although a shallow raft may be suitable, subject to further ground investigation.

The installation of a standalone mezzanine or more permanent construction will be influenced by the further ground investigation and foundation option proposed. If piled foundations with suspended floors are used then connection to the main frame would be recommended. If a raft is adopted the mezzanine option may distribute the loads to the slab more evenly. In any event considering the poor ground a lightweight option would be beneficial.

It is recommended to provide flexible external retaining walls to the new excavation, or slope stabilisation using soil nailing.

It is recommended to undertake soil stabilisation to improve the near surface ground condition to limit the depth of excavation and soil removal from site and to limit sub-base depth under external hardstandings and possibly under floor slab / raft.

It is unlikely that permeable paving will be acceptable to the environment agency due to the important aquifer. A petrol interceptor will likely be required.

If you have any questions regarding the content of this report please contact the writer.

Yours sincerely

Michael Lakey
Scott White and Hookins LLP