

DYNE HOUSE REVIEW OF BUILDING DAMAGE ASSESSMENT REPORTS

REPORTS REVIEWED

1. Expedition: Highgate School Dyne House and Island Site Basement Impact Assessment EXP-REP-404-001Rev 00 Parts 1 to 6.
2. Expedition: Highgate School Dyne House and Island Site. Basement Impact Assessment EXP-REP-XXX-001. Rev 03

These documents are subsequently referred to as the BIA. The approach to assessing building damage is the same.

PREVIOUS REVIEW

1. Appendix A contains the comments that were made when reviewing the documents in October 2024. These comments remain relevant.
2. In the following sections of this document, some additional comments have added along with points of clarification.

HYDROGEOLOGY

3. The BIA (Rev 00) states the following:

6.1.3 The maximum head increase of approximately 2.0m is observed to be coincident with the flow obstruction (i.e. the upstream basement wall). In the areas surrounding the proposed basement, the extent of the groundwater head rise is lesser. As flow is permitted around the basement, this effect reduces with lateral offset from the basement perimeter.

6.1.4 Indicatively, the range of increase in groundwater head in the vicinity of the neighbouring properties is between 0.5m and 0.9m. Considering the nature of the existing buildings, anticipated foundations, and depths to the groundwater table, the change to the local groundwater regime is expected to have a limited effect on the neighbouring properties.

4. The parameters used in the analysis are not stated nor are the boundary conditions applied. The behaviour of the ground will depend on whether or not the basement is drained.
5. It should be noted that the anticipated displacements are additive to the displacements obtained from the retaining wall analysis when assessing building damage.

BUILDING DAMAGE ASSESSMENTS

6. The BIA has been undertaken using industry standard pieces of software (WALLAP, XDisp and PDisp.) which are commonly used for the design of retaining structures and the assessment of ground conditions assuming that the ground has a linear elastic response

which in this case is a simplification. However, these programs do not directly provide ground movements behind the wall and are only appropriate for level ground.

7. A methodology, described in CIRIA 760 (see Appendix B), has been used to assess ground movements remote from the excavation and to derive potential building damage. However, there are limitations on when this approach should or should not be used and it is not always appropriate for assessments of this form.
8. Appendix B of this document contains an extract from CIRIA C760 which includes the following statement in relation to the methodology used in the BIA to assess building damage:

“For walls embedded in competent (stiff) ground back analysis of case study data relating to excavations at the YMCA (16m deep) and New Palace Yard (18m deep) in London, using FREW yields the approximate relationship shown in Figure 6.17. This relationship is based on the case studies that comprise a top-down construction sequence with diaphragm walls embedded in stiff clay retaining up to 10m thickness of coarse-grained soils overlying the stiff clay. The relationship shown in Figure 6.17 should only be applied in comparable ground conditions with similar support stiffness. Caution should be exercised if this relationship is applied to situations that differ significantly from those applicable to the case studies that it is based on.”

9. It is apparent that the proposed scheme at Dyne House differs somewhat from the case histories that this procedure was based on (the YMCA on Tottenham Court Road and the New Palace Yard in Westminster) and as CIRIA C760 suggests, caution should be exercised. Further, the ground is sloping from one side of the new basement to the other and is not level as the BIA assumes. As such the approach adopted is not appropriate.
10. CIRIA C760 describes other forms of analysis (finite difference and finite element) which can account for the level changes across the site and how these impact on the behaviour of the retaining structures. With appropriate representation of the ground response, these methods of analysis account for the overall sway of the basement from upslope to downslope. They can directly give displacements remote from the excavation that can be used to assess potential building damage although, depending on the detail of the analysis, displacements caused by changes in the groundwater regime may need to be added. Such methods of analysis do not rely on the procedure described in Appendix B.
11. As previously noted, an approach has been adopted for the BIA (Revisions 00 & 03) which is not appropriate in this case. Suitable forms of analyses (finite difference and finite element) are routinely undertaken by geotechnical engineers and there is no reason why these approaches could not have been adopted in this instance.
12. These analyses (finite difference and finite element) model the actual construction sequence, and the results of the analyses are sensitive to it. Much will depend on the stiffness of the retaining structures, the method of supporting the walls and the sequence of excavation (top-down or bottom up).
13. It is unlikely that the level of support assumed so far can be achieved. For the reasons given, at present the results of the BIA are speculative. Until the details of the proposed scheme

are finalised it is not possible to say what the effects of the proposed works will be on adjacent properties.

14. Based on sensitivity studies it is possible to define constraints that can be imposed on the way the basement is constructed and to provide reassurance that acceptable levels of building damage can be achieved. Because the analyses undertaken so far are inappropriate, they cannot be used to provide the necessary guidance or reassurance.
15. It appears that the hydrogeological assessments and basement impact assessments have not progressed from Revision 00 to 03. In terms of ground movement, as previously noted, a lot depends on the stiffness of the support system for the training walls. The analysis undertaken so far have assumed that this is “stiff” however, it has not been demonstrated so far that this is case.

REFERENCE

CIRIA C760. Guidance on embedded retaining wall design. CIRIA 2017. ISBN 978-0-8617-764-7.

Appendix A

October 2024 Review.

1. Hydrogeological assessment
 - a. Please provide a diagram showing the boundary conditions applied to the analysis and a dimensioned illustration of the model.
 - b. Please provide the parameters (permeability) used in the analyses indicating if the various strata are isotropic or anisotropic. We know that the Claygate beds are highly anisotropic and this will affect how pore water pressures change with time.
 - c. We assume that the results of the analyses represent a long term steady state following equalisation of porewater pressures throughout the ground. Is there a transient condition that is more critical in terms of groundwater affecting the properties? Information on the groundwater rise for each property would be of assistance.
2. Building Damage Assessment.
 - a. The ground is generally sloping and there is an imbalance from one side to the proposed basement to the other. How has this been accounted for?
 - b. If the props are supported off the sidewalls, how have the stiffnesses used in the analyses been derived given that the ground is supported by sheet piling which will have little longitudinal stiffness?
 - c. How has the inclination of the props been accounted for?
 - d. How does the retaining wall analysis used in the BIA account for the asymmetric nature of the excavation?
 - e. Please provide tensile strains and deflection ratios for each property. These should also be plotted on the appropriate interaction diagram along with the Burland damage categories.
 - f. The displacements of the buildings will be dependent on the propping arrangements and the stiffness of the walls. Will the BIA be repeated once the chosen contractor has prepared proposals? Will this become a condition?
 - g. We believe that under these circumstances a 3D finite element model should be prepared and reported to confirm, or otherwise, the results of the BIA. The proposed basement is complex and we are of the view that ‘standard’ approaches are not necessarily appropriate.
3. Monitoring
 - a. When will a monitoring plan with trigger levels and actions be produced?
 - b. How will the results of the monitoring be communicated to the residents.

Appendix B

Extract from CIRIA C760

6.2.2 Semi-empirical methods

Where SLS calculations are carried out (Section 7.3.2) using sub-grade reaction or pseudo-finite element software packages such as WALLAP and FREW (see Websites) for Category 2 walls, these provide estimates of wall deflections only. Users of these software packages typically adopt parameters that have been determined from the back analysis of well-instrumented and reliably monitored case studies of comparable walls and excavations in similar ground conditions, using the same software. In such instances, there is a need to develop an understanding of how the computed lateral wall deflections correspond to associated ground movements behind the wall. However, only limited information is available for such correlations.

Websites

WALLAP: www.geosolve.co.uk/wallap1.htm

FREW: www.oasys-software.com/products/engineering/frew.html

For walls embedded in competent (stiff) ground, back analysis of case study data relating to excavations at the YMCA (16 m deep) and New Palace Yard (18 m deep) in London, using FREW yields the approximate relationship shown in Figure 6.17. This relationship is based on the case studies that comprise a top-down construction sequence with diaphragm walls embedded in stiff clay retaining up to 10 m thickness of coarse-grained soils overlying the stiff clay. The relationship shown in Figure 6.17 should only be applied to excavations in comparable ground conditions with similar high support stiffness. Caution should be exercised if this relationship is applied to situations that differ significantly from those applicable to the case studies it is based on.

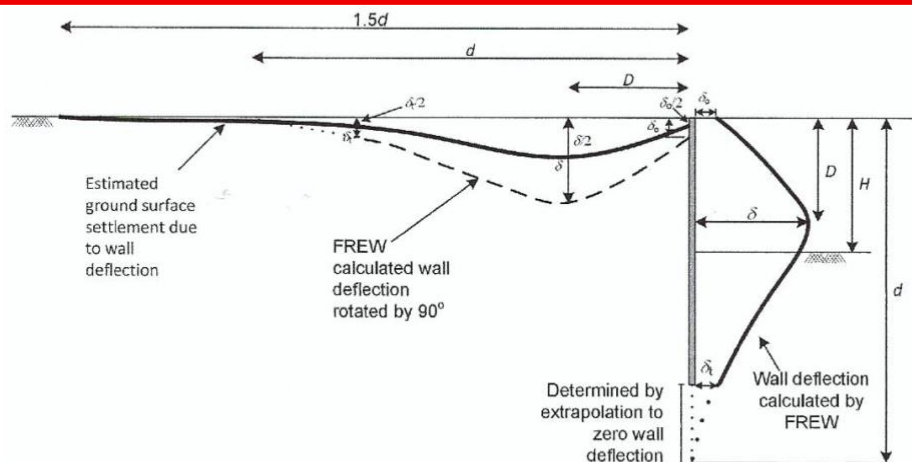


Figure 6.17 Relationship between analysed lateral (propped) wall deflections and predicted ground surface settlements in stiff ground

A number of other methods have been proposed to relate the settlement of the ground behind an excavation to the lateral movement of the embedded wall retaining that excavation, for example, Caspe (1966), Kane (1966), Bauer (1984), and Bowles (1988). A good discussion of these methods is provided in GEO (1990), to which the reader is referred for more details.

The literature contains insufficient high-quality data on the performance of walls. There is an urgent need to obtain more reliable case study data to provide high-quality measurements of the actual behaviour of different types of retaining wall installed in various ground conditions under well understood circumstances.

Short-term and long-duration measurements of the vertical and horizontal movements of the wall and the ground around the wall are particularly required. Such measurements would help establish appropriate relationships between wall deflections, depth of excavation and ground movements behind and in front of the wall – not only at ground surface level, but also with depth and its location from the wall. Until reliable measurements of this kind are available, relationships such as that shown in Figure 6.17 can only be estimates and limited to very specific applications.