8 Pilgrims Lane – Ground Movement Assessment (2013)
CGL Comments & RKD Responses

Item	CGL Comment	RKD Response	CGL Review
(1) **S 2.2**	"heave..should be considered within the analysis"	Heave has been fully considered. From conventional linear-elastic modelling (PDISP) small heave movements occur at the Party Walls on excavation and marginally beyond. Analytical heave movements may be inspected in detail [attached PDISP 'unloading assessment'] but are of the order of 3 to 5mm at the PWs on excavation with little change in the long-term on net loading with the base slab alone included. RKD's historic survey measurement data between underpinning and bulk excavation for approx. 4m excavations in London and on these kinds of projects do not tend to support a clear and definitive measurable upward movement of underpins during the excavation stage. For this reason it was not presented as a sub-part within the pin movement assumption.	PDISP input parameters are not consistent with stated Cu profiles. Claygate Beds are much stiffer than stated (based on Cu design line stated in PDISP calcs.) and LC appears to be less stiff. Cu multiplier of 750 is high for vertical loading/unloading of CG Beds and LC. Note that heave movements are actually of the order of 6mm to 10mm when short-term and long-term movements are summed – how does this affect the settlement profile around the perimeter of the basement with regard to building damage?
(2) **S 2.3**	"no mention of multi-stage underpinning" and "two vertical stages" predicted.	Certainly we agree that a two-stage process is possible and it would not presently be unusual for Consulting Engineers' to specify this for a deep underpinning requirement. We are aware that such a scheme would involve a temporary prop to the bottom of stage 1 after a stage 1 dig; re-bar shear reinforcement pushed down to stage 2 and completion of stage 2 propped across at toe/blinding level before removing the referred prop. We are not proposing this for reasons described further below. As is rightly observed, 2-stage pinning has the potential to increase ground movements particularly as the available bearing area at the base of the first pin level in the Clay may introduce a temporary softness in the wall response with associated movement risk. Traditionally, pins in Clay throughout and for these depths have been done in single stage pins and RKD have previously consulted on this point with a large and experienced Groundworks Contractor for whom we carry out designs across London and also separately with one of London's most respected Party Wall Engineers who have confirmed. It seems to us likely that 2-stage pinning in these circumstances and at present times are driven mainly by a Consulting Engineer's CDM regulation 11 perceptions: in relation to shorter pit depths being safer and with an associated lack of familiarity with pit temporary works. In fact, we are calling for	We accept that a one-stage process is better in terms of analysis and construction if a safe method is available to excavate in one stage this is beneficial and the construction methodology/contract should ensure that a single stage construction is adopted.

		close boarding of underpinning pits with continuous propping (and pumping as required) in a manner that is proven to be safe by an experienced and competent Contractor. This traditional method is not intrinsically unsafe and over the required depths. RKD and Greig-Ling concluded that were the ground profile different, say being gravels with a thin zone at the bottom clearly in groundwater where the pin was to be founded, then this approach would have its merits. This is not the case in this instance. As a final note, the maximum pin depth is less than 5m. A total maximum perimeter pin depth of 4.4m [i.e. pin formation level at +75.75mOD and existing floor level at +80.1mOD: boundary wall to 6 PL]. The internal bathroom area pins and those against 8 PL's lightwell would be no more than this as the bathroom has a false floor. Therefore, we are certainly considering 'single storey' underpinning by its scale.	Underpinning will be taken to a depth at least 5.5m below ground level in the courtyard of No. 6.
(3) **S 2.3**	".. underpinned footing structure in the Car Port area" and impact on 10 PL column foundation & susceptibility of 10 PL locally to ground movements.	The column will have underpinning using minipiles as per Greig-Ling's attached sketch. This will not add to movements already considered. Otherwise #10 PL movements are considered in full.	Outline methodology for southern column appears reasonably considered and appropriate for planning stages. Detailed construction plan/temporary works design required for construction. There is also a northern column beneath No 10 adjacent to Pilgrim's Lane that will be undermined by the excavations in this area. Please advise proposals for this foundation as well.
(4) **S 2.3**	Shallow Section underpin & road surcharging effect.	At the nearest part of the bay window underpinning and for the one pin at this point, the nearest part of the road is 1.2m away. This part of the road is pavement for a further 1.2m. The depth of the pin excavation here is from +79.7mOD (existing) to +78.6mOD, a distance of 1.1m. So even for this single nearest pin there will be no de-stabilising effect from pavement surcharge. The original FREW graphic and full in/output is appended [8 PL Front].	What is the purpose of the vertical 7.6kN/m loads in the FREW analysis? Groundwater in BHA1 was recorded at 1.5m depth. The effect of this should be included in the FREW analysis.
(5) **S 2.3**	Deep Section underpin & 6 PL and Downshire Studios surcharging effect.	In the case of the #6 wall surcharge, the effect was not considered significant at the time of the original work. This FREW model has now been re-run with the wall surcharge included on the following reasonable assumptions: 8m high & 220 thick brick giving 38 kN/m; and carrying the half span of 3.8m(total) for upstairs floor and roof both equally assumed at 9.5 kN/m, giving a total 57 kN/m run modelled on 0.9m wide footing at 1.7m offset from u/pin centreline. This load	What is the purpose of the vertical 7.6kN/m loads in the FREW analysis? Groundwater is taken as below excavation level, please provide justification for this.

		inclusion had a negligible effect on both prop loads (answer within 2%) and pin movement (answer also within 2%). The FREW graphic and full in/output is appended [6 PL Rear]. The floor level in the Downshire Studios area has not been made available. However, in the case of the underpinning analysis the very cautious view has been taken that it can be no higher than the +81.3mOD level of the rear of #6 and therefore is adequately represented by this same analysis. In the case of the piled wall section, the level of +80.5mOD has been taken which is known to be representative of the rear of #10 and so is certainly representative there. From inspection of this wall in the garden it would not appear that the Downshire Studios wall is retaining to any significant level above the garden level, i.e. no dampness, salts, growth, cracking or bulging, and it is also known that the Downshire Hill properties are all markedly downhill of the Pilgrim Lane properties. Therefore the assumption of +80.5mOD, being 500 to 600mm of ground above the #8 garden level is deemed to be cautious and appropriate. The Downshire studios structure and footing load are small and calculated as: 4m high (above +80.5mOD) & 220 thick brick giving 19 kN/m; and carrying the half span of 4.2m(total) for a roof structure at 5 kN/m2 or 21 kN/m and giving a total 40 kN/m run, say 44 kN/m2 on a 900mm wide footing. Clearly in the case of the underpinning analysis the additional continuous UDL from the extra high ground level assumed, an additional 0.8m of ground, more than compensates for this. The effect on the piled wall is addressed in the next point below.	Analysis allows for excavation to +77mOD then installation of structural blinding as prop. This sequence will need to be carried forward into detailed temporary works design. Analysis for 6 PL rear taken as conservative estimate for Downshire studios, comments as above apply.
(6) **S 2.3**	Piled Wall area & surcharging effect.	In the case of the piled wall analyses, the footing load as described above has been included. The result shows a very small prop load increase of less than 3% and max wall deflection increase of less than 1 % (or within 0.1mm.) The FREW graphic and full in/output data is appended [Piled Wall].	OK
(7) **S 2.4**	Workmanship & groundwater pumping/loss of fines/ pin excavation stability.	The Contractor will be expected to provide small pumps suitable for maintaining dry underpinning excavations and in addition such excavations will be close boarded to ensure full face stability at all times as the excavation progresses. Without belittling the risk of groundwater issues, the SI boreholes at this location do not describe either seams of fine sands or extensive zones of partings in the Claygate Member which are locally commonly associated with these problematic groundwater issues. Pockets of fine sand are seen but these are naturally less continuous. Furthermore grey gleying is seen in the fissures of the Claygate Member and this is typically the product of a chemically reducing environment where groundwater in	Noted. Noted, however ground conditions can vary considerably over short distances and as such the temporary works design/construction method statement/contractor should provide a methodology for controlling groundwater ingress and subsidence at the basement

		contact is not significantly aerated, i.e. this is unlikely to be an environment where groundwater is moving quickly through the ground at these points. It seems highly likely that the permeability assessments made are indeed very cautious (conservative) for the site given these actual observations in an SI which has very good coverage by the standards of BS 5930.	perimeter should such be encountered during construction.
(8) **S 3.2**	Analytical assessment of pin movement under load to new formation level.	The effect of underpin loading has been combined in PDISP with the heave analysis undertaken for the short-term condition as described in Item 1 [see PDISP 'Pin Settle & Unloading Assessment' appended.] Graphical output and input appended. The heave is reduced by 1 to 2mm in consequence at the location of the underpinning [seen for #10 PL side, front & rear #6 PL and Downshire Studios].	OK
(9) **S 3.3**	Assuming 0.05% rather than 0.04% for settlement due to wall installation. Assuming 0.08% lateral ground movement rather than 0.04%.	The 0.04% (as CIRIA reports for contiguous walls) is still appropriate as the dominant effect here is from pile casing in the case of the secant pile database and in contrast to the contiguous piled wall database. On this site there will not be a significant effect of casing as existing structures are founded on cohesive material. Similar comment applies to lateral ground movement assessment.	This is not stated in CIRIA C580, and the fact that the secant wall case studies include Hard/Soft CFA piles that would not have used a casing suggests that this is not the case. A greater volume of soil is excavated from secant piled wall than a contiguous, causing greater 'relaxation', contributing to greater observed installation movements.
(10) **S 4.1**	Lateral movement results for various walls and using FREW.	Full details of the FREW inputs/ouputs are attached and as referenced above. Parameters chosen use entirely typical methodology.	Received and reviewed with comments as previous.
(11) **S 4.1**	PLAXIS analysis details.	The footing pressure bulb in this area, or as considered by a 45 degree cut line, will not be appreciably affected. The wall here is not underpinned for the short excavation depth and the footing stability is entirely maintained. Qualitatively the movements from the excavation, at best lateral to the footing, are always likely to be very small. However, this was demonstrated analytically using PLAXIS. A programme-generated report from PLAXIS is presented to illustrate the work undertaken (inputs & outputs) and it can be seen that for a 150 kN/m2 footing pressure on 800mm wide strip the settlement on excavation is determined as 0.63mm [Note that Soil Model #2 (Terrace Gravels) was not actually used in this analysis].	We have reviewed the PLAXIS model and note the very small movements calculated. It is not clear whether this includes drained, long-term movements as well as undrained.

(12) **S 4.1**	Ground Movement Contours & Building Damage Assessment.	The answers given above aim to address all the stated input concerns in relation to the methodology for these elements which in any case has been followed using accepted practice.	The answers provided require additional clarification as noted above.