W O R K S H E E T			
Client	CGL Summary Worksheet		
Job Title	Pile Installation Case Studies		
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SHEET No. 1

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1. Introduction

The purpose of this summary report is to provide evidence to support the estimation of piled wall installation movements with regards to basement projects on urban sites.

Current guidance[1] suggests that horizontal and vertical movements induced by the installation of secant piled walls should be modelled as 0.08% and 0.05% of the total length of the piles in the wall, respectively. These recommendations are based on a limited historical set of case study data. In CGL's experience horizontal and vertical movements actually caused by the installation of secant and contiguous piled walls are generally substantially lower than these values. CGL has found that that assuming horizontal and vertical installation movements to be 0.02% of the pile lengths is an appropriate and conservative approximation for the estimation of ground movements caused by the installation of piled walls adjacent to monitored structures. These values are in line with monitoring movement data acquired for recent basement developments in the London area, constructed using up to date piling methods and technology. These data are more current than the historical case studies used to derive the recommendations in the current CIRIA guidance[1] and supplement the data set reported in that document. CGL has historically published case study data[2] demonstrating a safe application of the reduced estimation of installation movements.

This worksheet is a brief review of case studies in which CGL has been directly involved. Installation movements are evaluated for four basement development projects with similar ground conditions in central London. For confidentiality reasons, these projects have been anonymised.

2. Project A – Secant piled wall, rotary bored piles.

As part of Project A, a three-storey basement was constructed within a secant piled box. The secant wall piles were rotary bored cased secant piles, with 850/750mm diameter at 1100mm spacing c/c, within 1m distance from the relevant party walls, which were supported on shallow strip foundations. The wall was constructed in accordance with conventional ICE SPERW specifications[3].

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[1] *CIRIA C760. Guidance on embedded retaining wall design*

[2] *Ball, R.J., Creighton, M., & Langdon N.J., Prediction of party wall movements using Ciria report C580, Ground Engineering, September 2014.*

[3] *ICE Specification for Piling and Embedded Retaining Walls*

The ground conditions across site typically comprised cohesive Made Ground, directly underlain by Lynch Hill Gravels and London Clay at depth. Groundwater was encountered within the Lynch Hill Gravel Member.

Based on a review of the monitored movement of the neighbouring properties (façade monitoring targets at multiple levels) during the period when the secant piled wall was being installed parallel to the party wall structures, vertical and lateral movements recorded were of the order of 1mm and 3mm, respectively. Taking into account the as-built bored pile length, the percentage of lateral and vertical movement was between 0.005% and 0.014%, with an overall typical value of 0.01%. These findings are summarised in Table 1 below.

The results of the assessment suggest that the monitored movements are significantly less than those predicted using current guidance[1].

Table 1. Monitored party wall movements during secant piled wall installation – Project A.

Party wall ID	*Lateral movement (mm) [a]*	*Vertical movement (mm) [a]*	*Bored pile length (mm) [b]*	*Lateral movement % of pile length*	*Vertical movement % of pile length*
Façade A1	2	2.5	22000	0.009	0.011
Façade A2	3	3	22000	0.014	0.014
Façade A3	1	2.5	22000	0.005	0.011
Façade B1	2.5	2	19500	0.013	0.010
Façade B2	1	1	19500	0.005	0.005
Façade B3	2.5	2	19500	0.013	0.010

Notes:

a. Average value across all targets on façade. Lateral movement is towards site and vertical movement is settlement.

b. Rotary bored cased (to formation level) secant piles - 850/750mm diameter at 1100mm spacing. Piling offset typically 1m from party wall.

3. Project B – Secant piled wall, CFA piles.

As part of project B, to enable the construction of an additional basement level, a hard-hard secant pile wall with 525mm reinforced male piles spaced at 450mm c/c was constructed using a cased CFA system along the northern, eastern and southern boundaries of the site. The secant piling was undertaken within just 0.2m to 1.5m from the neighbouring party wall footings. The wall was constructed in accordance with the ICE SPERW specification[3] in a hit and miss approach.

The ground conditions across site typically comprised granular Made Ground, directly underlain by Lynch Hill Gravels and London Clay at depth. It should be noted that Alluvium was locally identified along the northern boundary of the site. Groundwater monitoring

results indicated the presence of a shallow groundwater body within the Lynch Hill Gravel Member on site.

Monitoring targets were installed on the existing shallow footings at existing B1 level to the south and east of the site. Based on a review of the monitored movements during the specific period when the secant piled wall was being installed, average typical vertical and lateral movements recorded across all targets ranged between just 1mm and 2mm. Taking into account the as-built bored pile lengths, the average lateral and vertical movement across all targets evaluated is 0.016% and 0.008%, respectively. These findings are summarised in Table 2 below.

The results of the assessment suggest that the monitored movements are generally substantially less than those predicted using current guidance[1].

Table 2. Monitored party wall movements during secant piled wall installation – Project B[e].

Monitoring Target Ref	*Lateral movement (mm)*	*Vertical movement (mm)*	*Bored pile length (mm)[b]*	*Lateral movement % of pile length*	*Vertical movement % of pile length*
MAP2[a]	4	2	10000	0.040	0.020
MAP3[b]	1	0.5	10000	0.010	0.005
MAP5[b]	1.5	0.5	11000	0.014	0.005
GPC2[c]	1	1	11500	0.018	0.009
GPC4[d]	1	~0	11500	0.009	Below 0.005

Notes:

a. Piles installed between 6th and 20th May 2021.
b. Piles installed between 5th and 15th May 2021.
c. Piles installed between 15th and 20th May 2021.
d. Piles installed between 19th and 21st May 2021.
e. Lateral movement is towards site and vertical movement is settlement.

4. Project C – Secant piled wall, CFA piles

Project C comprised the excavation of a 9m excavation on the Isle of Dogs. The ground conditions comprised of Made Ground and Alluvium to a depth of typically 6m below ground level. These soils were underlain by river terrace gravels, Lambeth Group soils at 11m depth, with the Thanet Sand present at 19m below ground level.

The secant wall was constructed of 750mm piles at centres of between 1060mm to 1216mm using a cased CFA rig. The wall was constructed in accordance with ICE SPERW specifications[3]. The retaining was constructed some 2m in front of a single storey listed brick structure, this structure was monitored with targets on facades during the pile installation

and subsequent excavation of the basement. The secant piles in this location were approximately 21m long, taken to a toe level of -15.5mOD.

Monitoring records over the installation period of the secant piled do not show a consistent pattern of settlement, with a worst case of 4mm settlement recorded. Lateral displacements of the monitored points closest to the secant wall recorded similar displacements of up to 4mm.

These values equate to an installation movement of 0.019% of the installed piled length.

5. Project D – contiguous piled wall – CFA piles

Project D was constructed in the city of London, 2m from a Grade 1 listed church building. The ground conditions comprised of Made Ground over Alluvium, River Gravels, and London Clay. The piles on the elevation adjacent to the church were installed using a CFA rig following the ICE SPERW specification[3] in a hit and miss approach.

The church wall was monitored during construction to an accuracy of +/- 2mm horizontally and vertically. Movements reported in the monitoring were 2mm to 3mm during the installation of the piles. The maximum normalised movements of the party wall after the pile wall installation including a -2 mm measurement error was 0.029% of the pile length (21 m). With a +2mm measurement error the normalised movement is as low as 0.010% of the pile length. The results are generally considered to be considerably more optimistic than the guidelines set out in the CIRIA Reports C580[4] and C760[1], which suggest a value of 0.040% of the pile wall depth.

6. Conclusions

- Monitored movements for piling projects across the London basin have been found to record displacements consistent with 0.02% of installed pile length. This observation is consistent with much of the data reported within CIRIA C760[1].
- The assumption made in the Preliminary Basement Impact Assessment Report with regards to installation movements being 0.02% of the pile lengths is therefore considered reasonable and moderately conservative.

[4] *CIRIA C580. Embedded retaining walls – guidance for economic design.*