

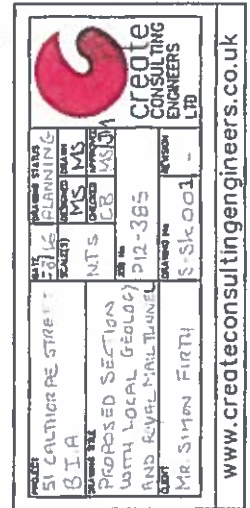


APPENDIX P

CALCULATION SHEET



Project: 51 Calthorpe Street BIA	Sheet no. of Calc. no: P/1	Job No: P12-385 Checked by:
Subject: CLASSIFICATION OF VISIBLE DAMAGE ASSESSMENT	Made by: PMO REV. MARCH Date: 2017	Date:
Ground Movement Calculations for Proposed Basement at 51 Calthorpe Street Ground movement estimates have been made using the guide CIRIA C580 Embedded Retaining Walls Guidance for Economic Design, Gaba et al., CIRIA, 2003. Some tables and graphs are reproduced in the calculations. GROUND COMPRISES SANDY CLAYS & GRAVELS. PILES ARE EMBEDDED INTO FIRM SANDY CLAY AND GRAVEL LAYERS. GROUND IN EXCAVATED ZONE MADE - GROUND-MORE SANDY. GROUND MOVEMENTS LIKELY BETWEEN THOSE IF STIFF CLAY ASSUMED AND FULL SAND CONDITION ASSUMED.		



Project: 51 Calthorpe Street BIA	Sheet no. of	Job No: P12-385
	Calc. no: <u>P13</u>	
Subject: CLASSIFICATION OF VISIBLE DAMAGE ASSESSMENT	Made by:	Checked by:
	PMO REV. <u>MARCH 17</u> Date: 09/09/16	

Horizontal Movement Due to Bored Piles (Secant Piled Wall)

Depth of bored Piles = 10m

Table 2.2 Ground surface movements due to bored pile and diaphragm wall installation in stiff clay

Wall type	Horizontal movements		Vertical movements	
	Surface movement at wall (per cent of wall depth)	Distance behind wall to negligible movement (multiple of wall depth)	Surface movement at wall (per cent of wall depth)	Distance behind wall to negligible movement (multiple of wall depth)
Bored piles				
Contiguous	0.04	1.5	0.04	2
Secant	0.08	1.5	0.05	2
Diaphragm walls				
Planar	0.05	1.5	0.05	1.5
Counterfort	0.1	1.5	0.05	1.5

Notes

- Maximum surface movement occurs close to the wall and is calculated as a percentage of the pile depth/diaphragm wall trench depth, as appropriate.
- Extent of movement is calculated non-dimensionally by dividing by the pile depth/diaphragm wall trench depth, as appropriate

Table 2.3 Support stiffness categories (Carder, 1995)

Support stiffness	Description/examples
High	Top-down construction, temporary props installed before permanent props at high level
Moderate	Temporary props of high stiffness installed before permanent props at low level
Low	Cantilever walls, temporary props of low stiffness or temporary props installed at low level

Table 2.4 Ground surface movements due to excavation in front of bored pile, diaphragm wall and sheet pile walls wholly embedded in stiff clays

Movement type	High support stiffness (high propped wall, top-down construction)		Low support stiffness (cantilever or low-stiffness temporary props or temporary props installed at low level)	
	Surface movement at wall (per cent of max excavation depth)	Distance behind wall to negligible movement (multiple of max excavation depth)	Surface movement at wall (per cent of max excavation depth)	Distance behind wall to negligible movement (multiple of max excavation depth)
Horizontal	0.1 0	4	0.4	4
Vertical	0.1 - CONSERVA-3.5 TLVE		0.35	4

- ALSO SEE
FIG. 2.12
- MOVEMENTS IN
SAND

- DUE TO RIGID
LG SLAB - HORIZ.
MOVEMENT AT GROUND
LEVEL = 0 / NEG.

Project:	ST CALTHORPE STREET	Sheet no. of	Job No:
Subject:	GROUND MOVEMENT	Calc. no: P/36	Checked by:
		Made by: PMO	Date:
		Date: MARCH 2017	

FOR EXCAVATING IN SAND

P/36

MAX EXCAVATION DEPTH = 3m

@ 1.5m = 0.5

@ 17.5m = 5.8 → 0

@ 5m = 1.67

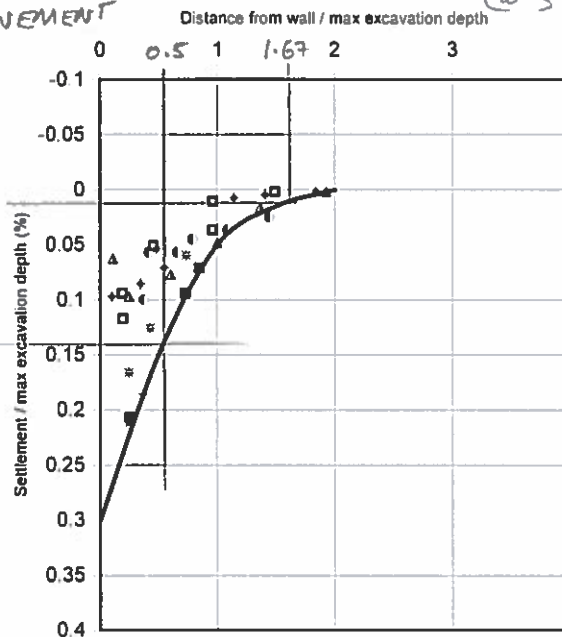
DIST. TO NEG. MOVEMENT
= 2 × 3 = 6m

0.02

0.14%

$$\frac{8}{3} = 0.14\%$$

$$S = 4.2 \text{ mm}$$



Key

Site | Wall Type

SHP: Sheet pile wall

KP: King post wall

DW: Diaphragm wall

See Appendix 2 for details of case histories

□ 7th & G Sts | KP

■ 8th & G St | KP

* Bergshamra | SHP

△ Chater Station | DW

□ G St Test Site | KP

♦ Hatfield | SHP

◀ OCC Bldg | KP

Figure 2.12 Ground surface settlement due to excavation in front of wall in sand

GROUND MOVEMENTS CONSERVATIVELY CAN ASSUME SAND CONDITION WHEN CHECKING SURFACE SETTLEMENTS DUE TO EXCAVATION IN FRONT OF WALL

Project:	51 CALTHORPE STREET	Sheet no. of	Job No: P12-385
		Calc. no: P/4	Checked by:
Subject:	GROUND MOVEMENT	Made by: PMO	Date:
		Date: REV. MARCH 2017	

HORIZONTAL MOVEMENT - CIRCA C580
EMBEDDED RETAINING WALLS -

GROUND SURFACE MOVEMENT DUE TO BORED PILES

PROPOSED BASEMENT DEPTH = m BELOW GROUND LEVEL (E.T.),
DEPTH = 3.0m BELOW EXISTING BASEMENT / NEW LOWER GROUND LEVEL.
DEPTH OF PILES = 10m APPROX.

TABLE 2.2

SECANT WALL

HORIZ. SURFACE MOVEMENT = 0.04%

$$S_h = 4.0 \text{ mm}$$

DIST. TO NEG. MOVEMENT = $1.5 \times 10 = 15 \text{ m}$

VERT. SURFACE MOVEMENT = 0.04%

$$S_v = 4 \text{ mm}$$

DIST. TO NEG. MOVEMENT = $2 \times 10 = 20 \text{ m}$

POTENTIAL MOVEMENT DUE TO WALL EXCAVATION

TABLE 2.3

HIGH SUPPORT STIFFNESS - TOP DOWN CONSTRUCTION

DEPTH OF EXCAVATION = 3m

FIG. 2.12

HORIZONTAL

SURFACE MOVEMENT = 0 DUE TO RIGID SLAB

VERTICAL

SURFACE MOVEMENT AT 1.5m = $0.14\% \times 3 = 4.2 \text{ mm}$

DIST. TO NEG. MOVEMENT = 6m

↳ CONSERVATIVE, SINCE DEFLECTION AT TOP
OF WALL $\triangle 0$.

Ground Surface Movement due to Installation of Piles

Contiguous Piles
Depth of Piles

	10 m	At 1.5 m		At 17.5 m	
		Horizontal	Vertical	Horizontal	Vertical
Horizontal surface movement Distance to neg. movement	0.04% 1.5 m 0.27 mm/m 4 mm 20 m 0.20 mm/m	3.60 mm		0 mm	
Vertical surface movement Distance to neg. movement	0.04% 2		3.70 mm		0.50 mm

Table 2.2

Ground Surface Movement due to Excavation in front of Wall

Depth of Excavation

3. m

Horizontal surface movement Distance to neg. movement	0.00% 4	0 mm 13.6 m 0.00 mm/m 3.4 mm 6 m
Vertical surface movement Distance to neg. movement	0.10%	

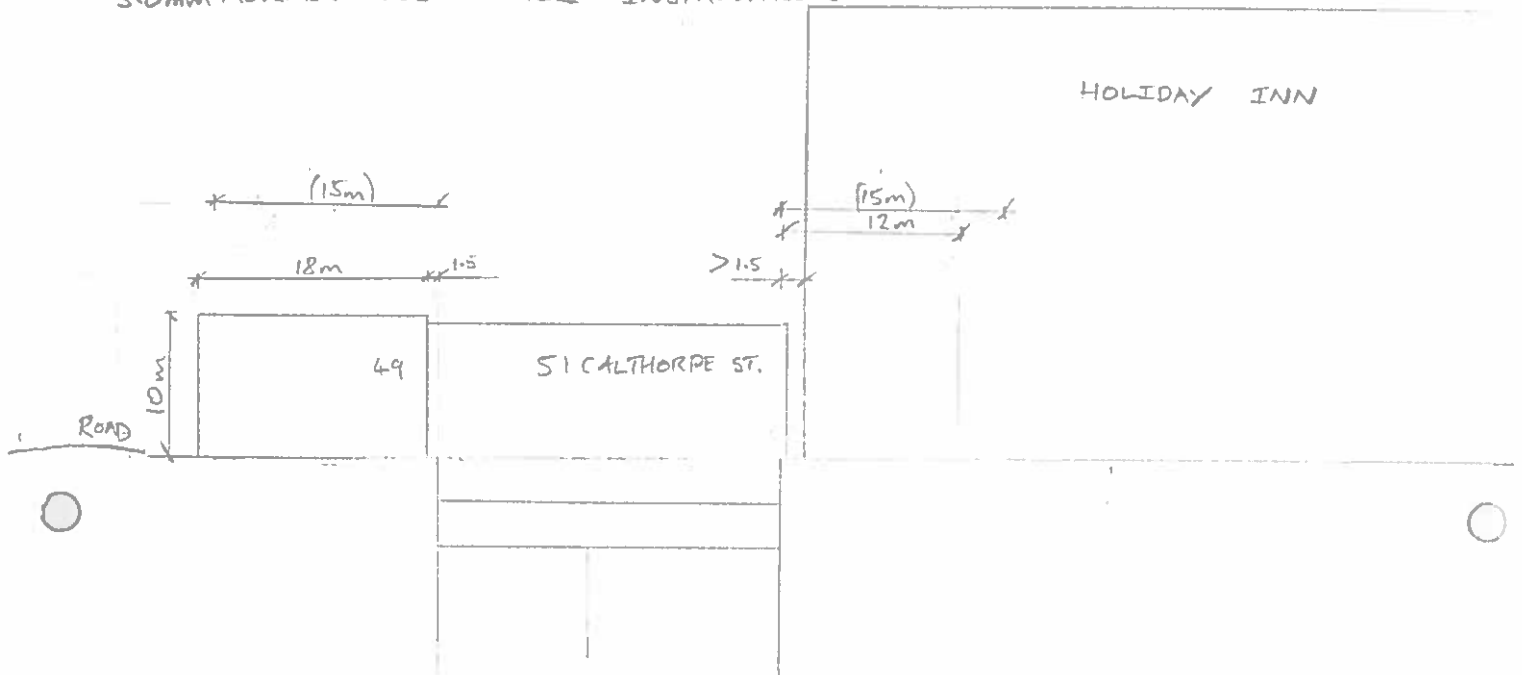
6 m

6 m

HORIZONTAL MOVEMENTS

AFFECTED BY CONSTRUCTION ONLY SINCE TOP-DOWN CONSTRUCTION PROVIDES RIGID PROP AT TOP OF PILES. $\therefore$ HORIZONTAL MOVEMENT NEG.

3.6mm MOVEMENT DUE TO PILE INSTALLATION

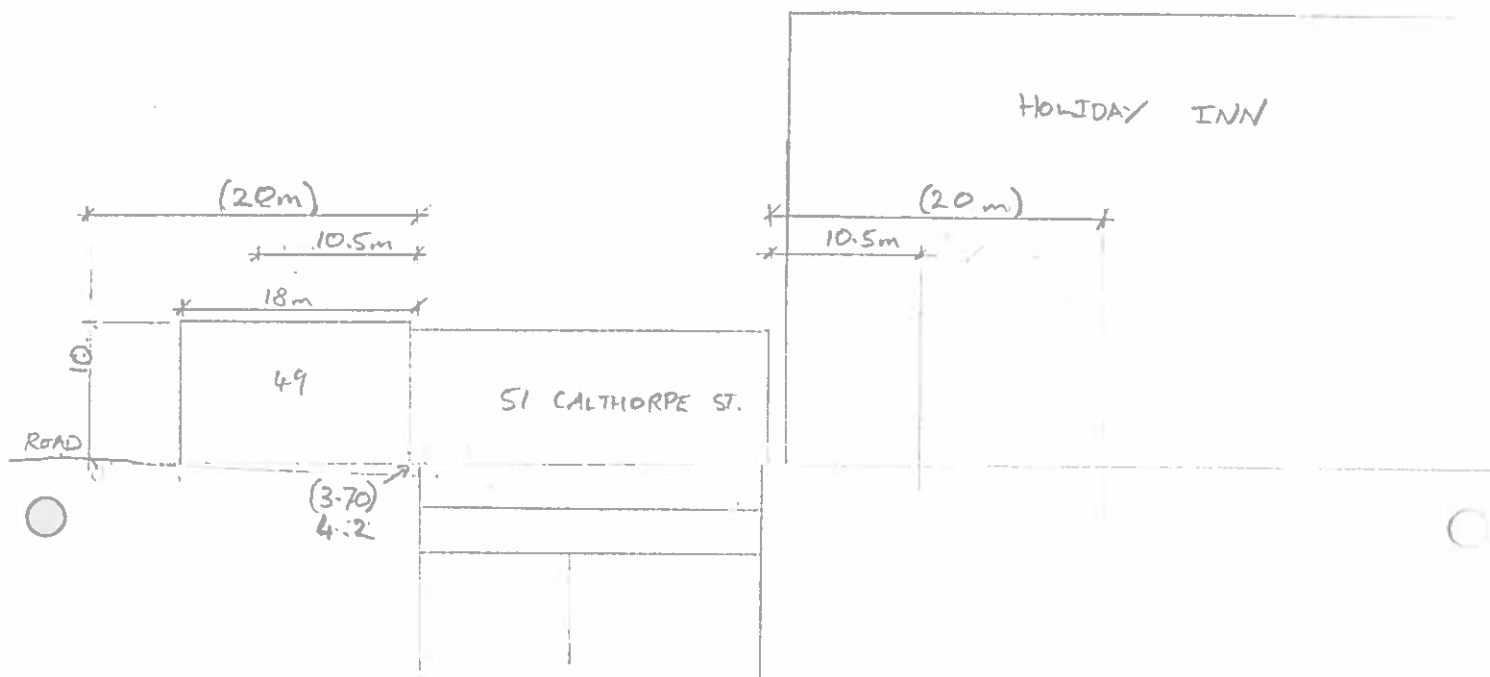


TOTAL = 3.6mm!

AFFECTED ZONE = ~15m FROM PILES

= 13.5m INTO BUILDING ON EITHER SIDE

CONSTRUCTION RELATED MOVEMENTS



TOTAL CONSTRUCTION RELATED MOVEMENTS : 3mm

AFFECTED ZONE $\approx$ 20m

BUILDINGS > 1.5m FROM PILES :

DISPLACEMENTS AT 1.5m = 7.9mm

Stage 1

Ground movements behind the retaining wall should be estimated as described in Section 2.5.2 assuming greenfield conditions, ie ignoring the presence of the building or utility and the ground above foundation level. Contours of ground surface movements should be drawn and a zone of influence established based on specified settlement and distortion criteria. All structures and utilities within the zone of influence should be identified.

Stage 2

A condition survey should be carried out on all structures and utilities within the zone of influence before starting work on site. The structure or utility should be assumed to follow the ground (ie it has negligible stiffness), so the distortions and consequently the strains in the structure or utility can be calculated. The method of damage assessment should adopt the limiting tensile strain approach as described by Burland *et al* (1977), Boscardin and Cording (1989) and Burland (2001); see Table 2.5 and Figure 2.18.

Table 2.5 Classification of visible damage to walls (after Burland *et al*, 1977, Boscardin and Cording, 1989, and Burland, 2001)

Category of damage	Description of typical damage (ease of repair is underlined)	Approximate crack width (mm)	Limiting tensile strain ϵ_{tm} (per cent)
0 Negligible	Hairline cracks of less than about 0.1 mm are classed as negligible.	< 0.1	0.0–0.05
1 Very slight	<u>Fine cracks that can easily be treated during normal decoration.</u> Perhaps isolated slight fracture in building. Cracks in external brickwork visible on inspection.	< 1	0.05–0.075
2 Slight	<u>Cracks easily filled. Redecoration probably required.</u> Several slight fractures showing inside of building. Cracks are visible externally and <u>some repointing may be required externally</u> to ensure weathertightness. Doors and windows may stick slightly.	< 5	0.075–0.15
3 Moderate	<u>The cracks require some opening up and can be patched by a mason. Recurrent cracks can be masked by suitable linings. Repointing of external brickwork and possibly a small amount of brickwork to be replaced.</u> Doors and windows sticking. Service pipes may fracture. Weathertightness often impaired.	5–15 or a number of cracks > 3	0.15–0.3
4 Severe	<u>Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows.</u> Windows and frames distorted, floor sloping noticeably. Walls leaning or bulging noticeably, some loss of bearing in beams. Service pipes disrupted.	15–25 but also depends on number of cracks	> 0.3
5 Very severe	<u>This requires a major repair involving partial or complete rebuilding.</u> Beams lose bearings, walls lean badly and require shoring. Windows broken with distortion. Danger of instability.	usually > 25 but depends on number of cracks	

Notes

1. In assessing the degree of damage, account must be taken of its location in the building or structure.
2. Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

CALCULATION SHEET



Project:	SI CALTHORPE STREET	Sheet no. of	Job No:
		Calc. no: P/9	Checked by:
Subject:	GROUND MOVEMENT MIXED-USE SCHEME	Made by: P.M.O. REV. MAY 2017	Date:
		Date: 07/16	

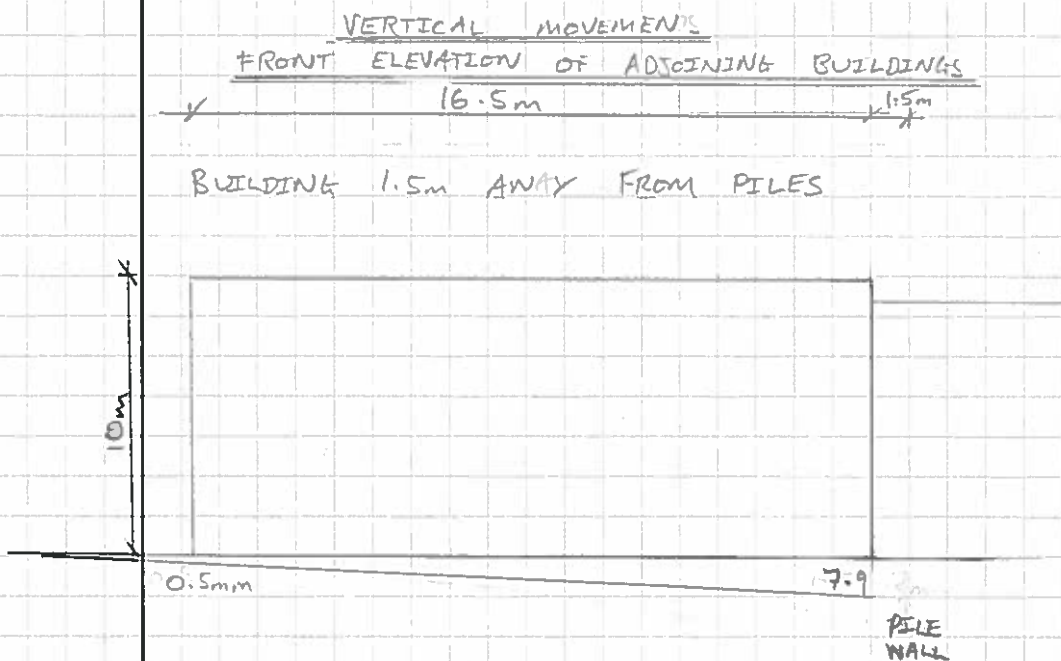


FIG. 2.18

$$\frac{\Delta}{L} = \frac{7.4mm}{16.5m} = 0.045\%$$

HORIZONTAL MOVEMENTS

At 1.5m : $\Delta_h =$

$$\frac{\Delta}{L} = \frac{3.6mm}{16.5m} = 0.022\%$$

TABLE 2.5

FOR SLIGHT CATEGORY

$$E_{lim} = 0.075 - 0.15\%$$

FIG. 2.18

$$\frac{L}{H} = \frac{16}{10} = 1.6$$

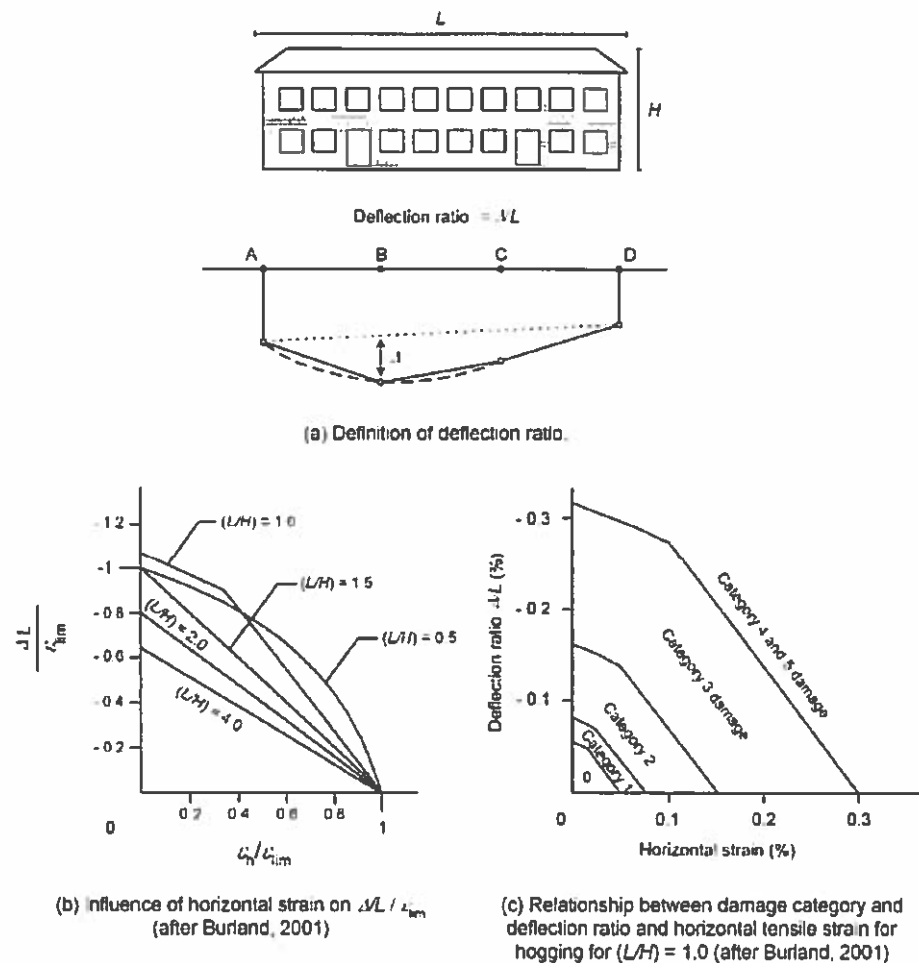
$$\frac{E_h}{E_{lim}} = \frac{0.022}{0.15} = 0.15$$

$$\frac{\Delta/L}{E_{lim}} = \frac{0.045}{0.15} = 0.30$$

VERY SLIGHT

$$\frac{E_h}{E_{lim}} = \frac{0.022}{0.075} = 0.29$$

$$\frac{\Delta/L}{E_{lim}} = \frac{0.045}{0.075} = 0.6$$



By adopting values of ϵ_{lim} associated with the various damage categories given in Table 2.5, Figure (b) can be developed into an interaction diagram showing the relationship between ΔL and ϵ_h for a particular value of L/H . Figure (c) shows such a diagram for $(L/H) = 1.0$.

Figure 2.18 Relationship between damage category, deflection ratio and horizontal tensile strain (after Burland, 2001)

Reinforced concrete-framed structures are more flexible in shear than are masonry structures and are consequently less susceptible to damage. Nevertheless, for the purposes of a stage 2 assessment of potential damage, all structures should be treated as masonry structures.

Box 2.5 Procedure for stage 2 damage category assessment

The following steps should be undertaken in making a stage 2 assessment of the damage to a structure:

- (i) establish L and H for the structure (see Figure 2.18(a) for definitions of L and H)
- (ii) determine (L/H)
- (iii) determine relationship between (Δ/L) and ϵ_h for the required (L/H) from Figure 2.18(b) for ϵ_{lim} values from Table 2.5
- (iv) estimate vertical and horizontal ground surface movements in the vicinity of the structure from Figure 2.14
- (v) determine (Δ/L) and $\epsilon_h (= \delta_h/L)$ where δ_h is the horizontal movement
- (vi) estimate damage category from the relationship between (Δ/L) and ϵ_h established from step (iii) above.

BUILDINGS JOINING WEST OF 51 CALTHORPE ST
(49 CALTHORPE ETC.)

EAST OF 51 CALTHORPE ST. = HOLIDAY INN = - - -

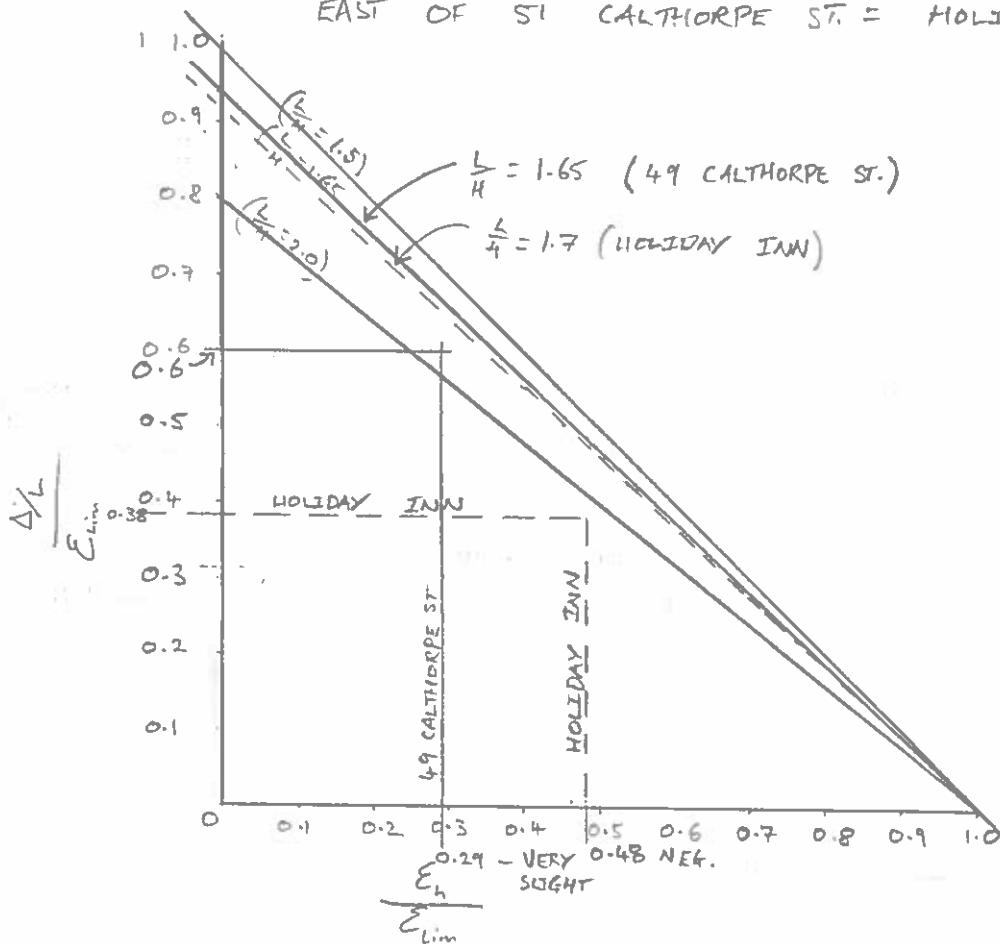


FIG. 2.18 (b)

49 CALTHORPE ST. $\therefore$ DAMAGE CATEGORY = 1-VERY SLIGHTHOLIDAY INN

DAMAGE CATEGORY = 0-NEGLIGABLE

CALCULATION SHEET



Project:	S1 CALTHORPE ST BIA	Sheet no. of	Job No: P12-325
		Calc. no: P/12	Checked by:
Subject:	CLASSIFICATION OF VISIBLE DAMAGE CHECKS MIXED USE SCHEME	Made by: REV. MAR 2017 HMO	Date:
		Date: 9/9/16	

CHECK ON HOLIDAY INN

HOLIDAY INN HAS A BASEMENT OF SIMILAR SIZE / DEPTH TO THAT PROPOSED AT S1 CALTHORPE ST.
 $\therefore$ NO GROUND MOVEMENT DUE TO EXCAVATION WOULD BE EXPECTED.

CHECK INSTALLATION MOVEMENTS

= AS PREVIOUS = 3.6 mm HORIZONTAL
 3.7 mm VERTICAL

DAMAGE CATEGORY

LENGTH OF BUILDING = 52 m

TAKING STRAIN ONLY OVER : 15m HORIZ.
 20m VERT.

$\frac{L}{H} = \frac{52}{30} = 1.73$

HORIZONTAL STRAINS :

$E_h = \frac{3.6}{15000} = 0.024\%$

FOR V. SLIGHT CATEGORY : $\frac{0.024}{0.075} = 0.32$
 FOR NEG. : $\frac{0.024}{0.05} = 0.48$

VERTICAL

$\frac{3.7}{20m} = 0.019\%$

FOR V. SLIGHT : $\frac{0.019}{0.075} = 0.25$
 NEG. : $\frac{0.019}{0.05} = 0.38$

SEE PREVIOUS = NEGLIGABLE CATEGORY

Project: SI CALTHORPE ST BIA	Sheet no. of Calc. no: P/13	Job No: Checked by:
Subject: CLASSIFICATION OF VISIBLE DAMAGE ASSESSMENT	Made by: REV. MARCH 2017 Date: 09/09/16	Date:

EFFECTS ON ROAD

MIN DISTANCE TO ROAD = AT S/E CORNER
= 15m

AT 5m FROM PILES, ^{VERT.} MOVEMENTS $\approx 0.02\%$
= 0.6mm

HORIZONTAL = 2.67mm

VERTICAL = 3.00mm + 0.6mm = 3.6mm

CARRIAGEWAY IS AT GRADE. THIS SORT OF MOVEMENT (MAX.) WOULD ONLY GENERATE VERY LOW STRAINS, WELL WITHIN WHAT CAN BE TOLERATED BY A HIGHWAY.

∴ NEGLIGABLE EXPECTED EFFECT ON ROAD

P/36

APPENDIX Q

NOTES

- THIS DRAWING TO BE READ WITH THE SPECIFICATION AND BILL OF MATERIALS AND ALL OTHER RELEVANT DRAWINGS.
- THIS DRAWING MUST NOT BE SCALED.
- ALL DIMENSIONS TO BE CHECKED WITH ARCHITECT'S DETAILS.

Pile No	Cut Off Level
1-4, 10-20, 30-40, 50-60, 70-80, 90-100, 110-120, 130-140, 150-160, 170-180, 190-200, 210-220, 230-240, 250-260, 270-280, 290-300, 310-320, 330-340, 350-360, 370-380, 390-400, 410-420, 430-440, 450-460, 470-480, 490-500, 510-520, 530-540, 550-560, 570-580, 590-600, 610-620, 630-640, 650-660, 670-680, 690-700, 710-720, 730-740, 750-760, 770-780, 790-800, 810-820, 830-840, 850-860, 870-880, 890-900, 910-920, 930-940, 950-960, 970-980, 990-1000	11.275
5-9, 135-138, 304-308, 323-327, 337-341, 343-347, 351-355, 359-363, 367-371, 375-379, 383-387, 391-395, 399-403, 407-411, 415-419, 423-427, 431-435, 439-443, 447-451, 455-459, 463-467, 471-475, 479-483, 487-491, 495-499, 503-507, 511-515, 519-523, 527-531, 535-539, 543-547, 549-553, 557-561, 565-569, 573-577, 581-585, 589-593, 597-601, 605-609, 613-617, 619-623, 627-631, 635-639, 643-647, 649-653, 657-661, 665-669, 673-677, 679-683, 687-691, 695-699, 703-707, 709-713, 717-721, 725-729, 733-737, 739-743, 747-751, 755-759, 763-767, 771-775, 777-781, 785-789, 793-797, 799-803, 807-811, 815-819, 823-827, 829-833, 837-841, 845-849, 853-857, 859-863, 867-871, 875-879, 883-887, 891-895, 897-901, 905-909, 913-917, 919-923, 927-931, 935-939, 943-947, 949-953, 957-961, 965-969, 973-977, 979-983, 987-991, 995-999, 1003-1007, 1011-1015, 1019-1023, 1027-1031, 1035-1039, 1043-1047, 1049-1053, 1057-1061, 1065-1069, 1073-1077, 1079-1083, 1087-1091, 1095-1099, 1103-1107, 1111-1115, 1119-1123, 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