

Example 2.2 Pad foundation with inclined eccentric load on boulder clay

The square pad foundation shown in Figure 2.2a, with an embedment depth of 0.8 m, which is below any topsoil and disturbed ground, is required to support the following characteristic loads:

Permanent:	Vertical	$G_{v,k} = 1000 \text{ kN}$, excluding weight of foundation
	Horizontal	$G_{h,k} = 0$
Variable:	Vertical	$Q_{v,k} = 750 \text{ kN}$
	Horizontal	$Q_{h,k} = 500 \text{ kN}$, at 2m above the top of the foundation
Concrete weight density		$\gamma_c = 25 \text{ kN/m}^3$

The variable loads are independent of each other. Assume the variable loads are repeated several times at this magnitude.

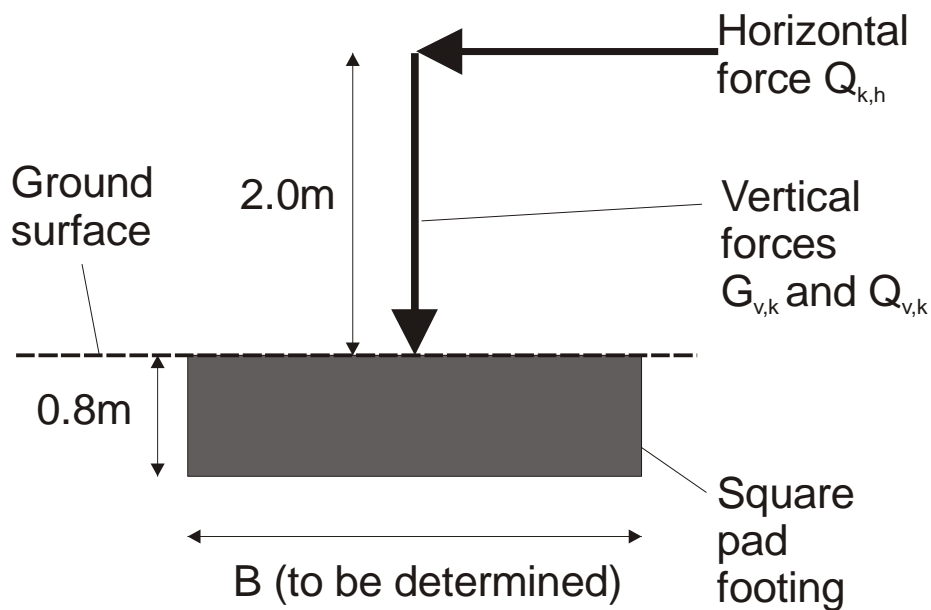


Figure 2.2a: Pad foundation (square on plan)

The soil consists of boulder clay. A site plan showing the location of the foundation and the locations where five SPT tests were carried out is given in Figure 2.2b. N values obtained from SPT tests are plotted in Figure 2.2c, the water contents and index tests determined from samples are presented in Figure 2.2d. The soil has a bulk weight density of 21.4 kN/m^3 and the ground water level is 1.0 m below the ground level. The width of the foundation when designed to Eurocode 7 is to be determined, assuming the foundation is for a conventional concrete framed structure. There is no need to consider any effects due to frost or vegetation. The foundations' design working life is 50 years.

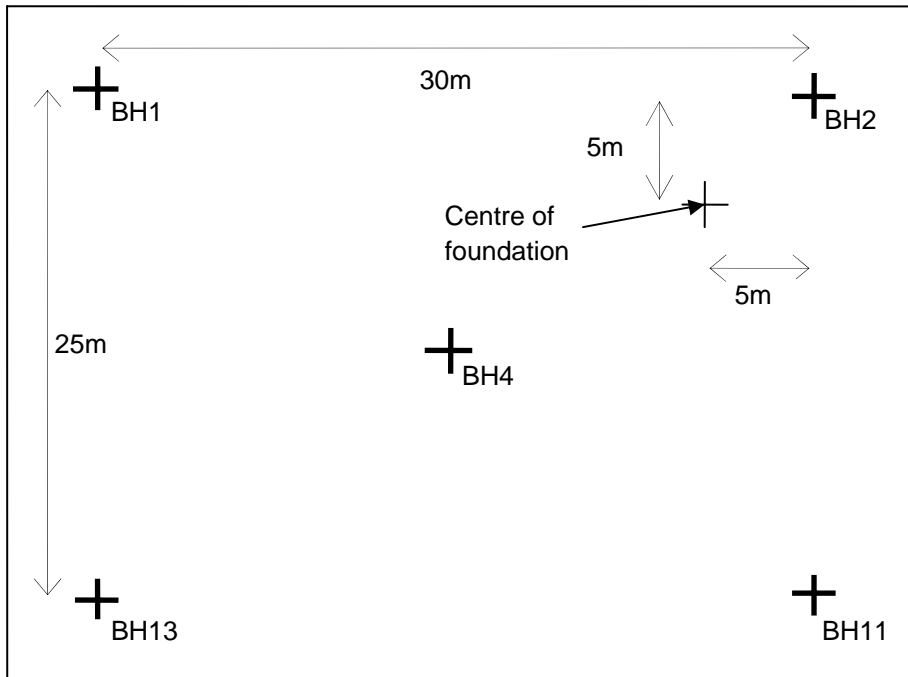


Figure 2.2b: Example 2.2 Site plan and location of SPT tests

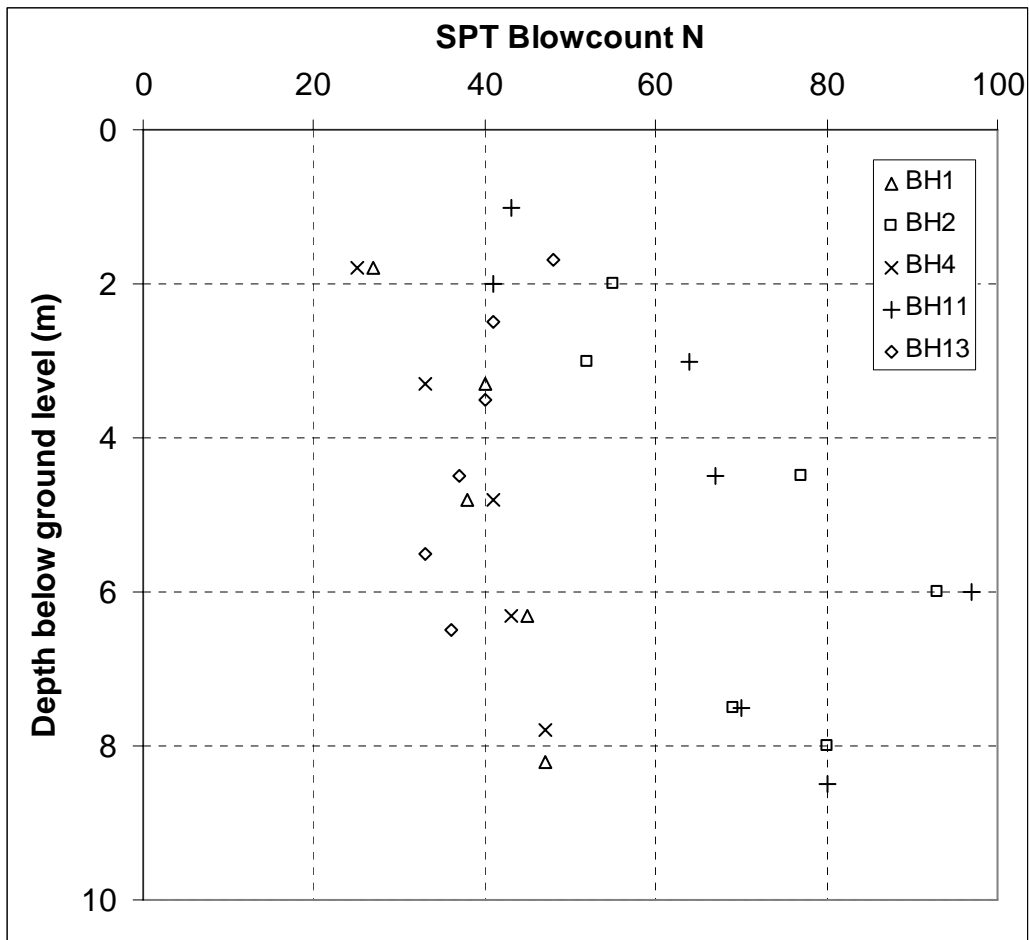


Figure 2.2c: SPT N values recorded at the site

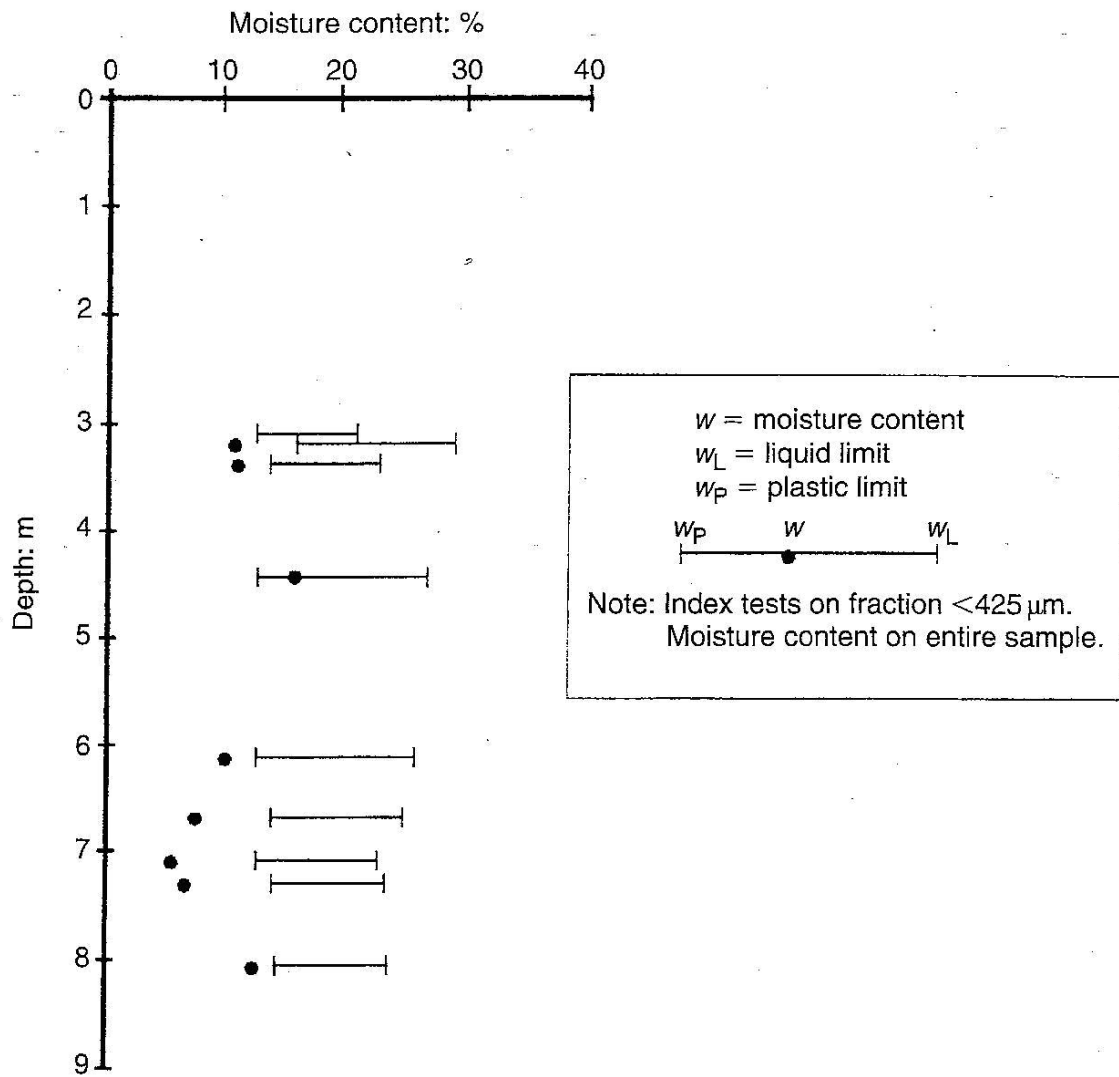















Figure 2.2d: Measured water contents and index values

Design Example 2.2

BOREHOLE No. 1

Type and Dia. of Boring		SHELL & AUGER - 200mm DIAMETER									
Water Strikes		Water Levels Recorded During Boring									
1. None	Hole Depth										
2.	Casing Depth										
3.	Water Level										
Remarks											
Description		Scale		Samples & S.P.T.							
		Depth	Legend	Ref. No.	Type	Depth	N				
TOP SOIL		0.30									
Very stiff brown sandy gravelly CLAY with cobbles (Boulder Clay)				9998	U	1.00					
				9351	D	1.50					
				9905	D	2.00	(1.80)	27			
				9352	D	2.50					
				9997	D	3.00					
							(3.30)	40			
											
				9920	D	5.00	(4.80)	38			
				9923	D	6.00					
							(6.30)	45			
Very stiff black silty sandy gravelly CLAY with cobbles and boulders (Boulder Clay)				9921	D	7.50					
				9924	D	8.00	(7.80)	47			
		8.00									

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Figure 2.2e: Borehole Log 1

Design Example 2.2

BOREHOLE No. 2







Type and Dia. of Boring		SHELL & AUGER - 200mm DIAMETER							
Water Strikes		Water Levels Recorded During Boring							
1.	2.0	Hole Depth	5.00	8.00	8.00				
2.		Casing Depth	5.00	7.40	Nil				
3.		Water Level	Nil	Nil	3.00				
Remarks Chiselling total of 4 hours PVC pipe installed.									
Description		Scale		Samples & S.P.T.					
		Depth	Legend	Ref. No.	Type	Depth	N		
TOPSOIL		0.20							
Firm brownish grey mottled silty sandy CLAY (some organic flecks at upper levels)				10088	U	0.50			
				10089	D	0.50			
				10090	U	1.50			
				10091	D	1.50			
				10092	D	2.20	(2.00)	55	
							(3.00)	52	
				10093	D	3.80			
							(4.50)	77	
				10093	D	5.00			
				10094	D	5.20			
Stiff to hard black sandy very silty gravelly CLAY containing cobbles and boulders (Boulder Clay)									
				10095	D	7.10			
					(7.50)	69			
		10096	D	8.00	(8.00)	80			
Borehole completed at		8.50							

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Figure 2.2f: Borehole Log 2

Design Example 2.2

BOREHOLE No. 4






Type and Dia. of Boring		SHELL & AUGER - 200mm DIAMETER							
Water Strikes		Water Levels Recorded During Boring							
1.	3.20	Hole Depth							
2.		Casing Depth							
3.		Water Level							
Remarks Seepage at 3.20 metres. Sealed off in Black Boulder Clay.									
Description		Scale		Samples & S.P.T.					
		Depth	Legend	Ref. No.	Type	Depth	N		
TOPSOIL		0.30							
Firm to stiff brown sandy gravelly CLAY (Boulder Clay)				9914	D	1.50 (1.80)	25		
		3.20		9202	D	3.20 (3.30)	33		
Very stiff black silty gravelly CLAY with cobbles and boulders (Boulder Clay)						(4.80)	41		
				9989	D	6.00 (6.30)	43		
		8.00		9990	D	(7.80) 8.00	47		

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Figure 2.2g: Borehole Log 4

Design Example 2.2

BOREHOLE No. 11












Type and Dia. of Boring						
SHELL & AUGER - 450mm DIAMETER						
Water Strikes		Water Levels Recorded During Boring				
1. 2.80	Hole Depth	6.30	8.50	8.50		
2.	Casing Depth	6.30	7.30	--		
3.	Water Level	Nil	Nil	3.50		
Remarks						
Total - 3 hrs. chiselling PVC pipe installed.						
Description	Scale		Samples & S.P.T.			
	Depth	Legend	Ref. No.	Type	Depth	N
TOPSOIL	0.30		10096	U	0.50	
Stiff brown silty very stony CLAY, some cobbles	1.00		10097	D	0.50	
					(1.00)	43
Stiff brown sandy gravelly CLAY with cobbles (Boulder Clay)	3.00		10098	D	1.50	
					1.50 (Abortive)	41
Very stiff black sandy silty gravelly CLAY, cobbles and some boulders (Boulder Clay)	9.00		10099	D	3.00	(3.00) 64
Borehole completed at	9.00		10100	D	4.50	(4.50) 67
			10101	D	6.50	(6.00) 97
			10102	D	7.80	(7.50) 70
					(8.50)	80

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Figure 2.2h: Borehole Log 11

Design Example 2.2

BOREHOLE No. 13

Type and Dia. of Boring		SHELL & AUGER - 250mm DIAMETER					
Water Strikes		Water Levels Recorded During Boring					
1.	2.50	Hole Depth	3.00	8.00			
2.		Casing Depth	3.00	8.00			
3.		Water Level	--	4.50			
Remarks		Chiselling boulders - total 3½ hrs. PVC pipe inserted					
Description		Scale		Samples & S.P.T.			
		Depth	Legend	Ref. No.	Type	Depth	N
TOPSOIL, stony		0.50					
Stiff brown sandy gravelly CLAY with cobbles and boulders (Boulder Clay)				10063	U	1.20	
				10062	D	1.50	
						(1.70)	48
						(2.50)	41
		2.90		10064	D	3.00	
Stiff black sandy silty gravelly Boulder Clay with cobbles and boulders and thin layers of sand and gravel						(3.50)	40
				10079	D	4.50 (4.50)	37
						(5.50)	33
				10080	D	6.00	
						(6.50)	36
						(7.50)	42
Borehole completed at		8.00		10081	D	8.00	

Code: U—Undisturbed Sample D—Large Disturbed Sample J—Jar Sample W—Water Sample

Figure 2.2i: Borehole Log 13