

NATIONAL UNIVERSITY OF SINGAPORE
DEPARTMENT OF CIVIL ENGINEERING

DESIGN PROJECT
FOR
CE3116

PART B

INDIVIDUAL ASSIGNMENT

SEMESTER 2
YEAR 2023/2024

SHALLOW FOUNDATION

1. SCENARIO

Having designed the deep foundation of the apartment building, the client wishes to include the car porch at the front of the building. The reference borehole is provided in the Annex (as enclosed in this instruction sheet).

Design for the most economical shallow foundation configuration to support the loading provided below. Tender this project with your most competitive price.

2. SCOPE OF WORKS

The loadings acting on each column are as follow:

Vertical Permanent Action:	250 kN
Vertical Variable Action:	120 kN

Some useful information on soil:

Undrained Shear Strength:	5 times of SPT-N blow count
Drained Friction Angle:	35 degrees
Effective cohesion:	0 kPa

Details on the construction of the shallow foundation:

Shape of Shallow Foundation:	Square or Rectangular only
Thickness:	0.5 m
Maximum Depth at Base:	4 m
Density of Concrete:	2400 kg/m ³
Cost of Foundation:	\$ 100,000 per m ³ of concrete
	Additional % to the cost of foundation
	(i.e. Foundation Base at 0 to 1m depth --- 0%
	Foundation Base at 1.1 to 2m depth --- 5%
	Foundation Base at 2.1 to 3m depth --- 10%
	Foundation Base at 3.1 to 4m depth --- 15%)

3. TASK

- Design and compute the suitable dimensions of the shallow foundation for each column for ultimate limit state only. *Serviceability limit state not required.*
- Provide detailed workings deriving the cost of the construction of the shallow foundations.
- Give comments and reflection on the findings of the above tasks.

4. **SUBMISSION**

- a) The framework or style of the report shall be determined by the **individual student**. Presentation of the contents of the report must be clear and able to be understood by a layman.
- b) The **report (in pdf format)** must be submitted before **11:59pm on 17th April 2024** via Canvas.
- c) Submission through other unofficial channels will not be considered.
- d) Late submission penalty: Deduction of 2 mark per calendar day. Total marks for this assignment is 20 marks.
- e) This is an **INDIVIDUAL ASSIGNMENT**.

ANNEX

BOREHOLE:

FIELD & LABORATORY DATA & TESTS REPORTED ELSEWHERE										SPT N VALUE		SPT (N) / mm	WEATHERING GRADE	REDUCED LEVEL(m)	DEPTH (m)	SAMPLE TYPE	GRAPHIC LOG	THICKNESS(m)	GEOLOGICAL CLASSIFICATION	BS SOIL CLASSIFICATION	BOREHOLE NO. BH5	
DAILY WATER TABLE READING										SPT N VALUE											NORTHING	EASTING
DATE		READING (m.BGL)		10	20	30	40	50	60	70	80	90	100	DESCRIPTION								
2/24/2014		2.50																		Trial pit(1.0x1.0x1.0)m, Hand auger (1.0–3.0)m, Grey and reddish brown Sandy SILT with concrete fragmnets (Back fill)		
2/25/2014		2.80																		Stiff Reddish brown & yellowish brown Slightly gravelly sandy SILT (OLD ALLUVIUM FORMATION) TW1 (MC=23, BD=2.06, GRAVEL=4, SAND=55, SILT=24, CLAY=17, LL=67, PL=36)		
2/25/2014		4.50																				
2/28/2014		3.90																				
2/28/2014		4.20																				
3/1/2014		3.90																				

FIELD & LABORATORY DATA & TESTS REPORTED ELSEWHERE											SPT N VALUE										SPT (N) / mm	WEATHERING GRADE	REDUCED LEVEL(m)	DEPTH (m)	SAMPLE TYPE	GRAPHIC LOG	THICKNESS(m)	GEOLOGICAL CLASSIFICATION	BS SOIL CLASSIFICATION	BOREHOLE NO. BH5																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
											10	20	30	40	50	60	70	80	90	100										NORTHING 42013.45 m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
																					EASTING 32647.64 m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
																					REDUCED LEVEL 120.69 m																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
																					DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
																					50/300		99.69	21	21.00 SPT7 21.45		1.00	O(B)	MS	Hard Light greenish grey and yellowish brown Sandy SILT (OLD ALLUVIUM FORMATION)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
																							22		Dense Light greenish grey and reddish brown Silty fine to coarse SAND (OLD ALLUVIUM FORMATION)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
																						23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
																						24	24.00 SPT8 24.45		3.00	O(B)	SM	Very dense Light greenish grey and reddish brown Slightly gravelly silty fine to coarse SAND (OLD ALLUVIUM FORMATION)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
																					100/300		25																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
																						26																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
																						27	27.00 SPT9 27.45																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
																					65/300		28																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
																						29																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
																						30	30.00 SPT10 30.45		8.00	O(B)	SM	Hard Reddish brown and light greenish grey Slightly sandy CLAY (OLD ALLUVIUM FORMATION)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
																					60/300		31																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
																						32																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
																						33	33.00 SPT11 33.45																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
										73/300		34																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
											35																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
											36	36.00 SPT12 36.45																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
										97/300		37																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
											38																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
											39	38.00 SPT13 38.45																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
										100/290		40																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
												80.69																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					</

FIELD & LABORATORY DATA & TESTS REPORTED ELSEWHERE		SPT N VALUE										SPT (N) / mm	WEATHERING GRADE	REDUCED LEVEL(m)	DEPTH (m)	SAMPLE TYPE	GRAPHIC LOG	THICKNESS(m)	GEOLOGICAL CLASSIFICATION	BS SOIL CLASSIFICATION	BOREHOLE NO. BH5	
		10	20	30	40	50	60	70	80	90	100										NORTHING	42013.45 m
																					EASTING	32647.64 m
																					REDUCED LEVEL	120.69 m
																					DESCRIPTION	
												100/270			41							Hard Reddish brown and light greenish grey Slightly sandy CLAY (OLD ALLUVIUM FORMATION)
												100/240	75.32	42	SPT14	42.00	42.41					
														43							Borehole terminated at the depth 45.37m.	
														44								
														45	SPT15	45.00	45.37	5.37	O(B)	CS		
														46								
														47								
														48								
														49								
														50								
														51								
														52								
														53								
														54								
														55								
														56								
														57								
														58								
														59								
														60								

BORING TYPE
 ROTARY
 DIAMETER(mm)
 100

FRACTURE PER METRE
 RQD %
 SCR %
 TCR %

WEATHERING GRADE
 I II III IV V

SAMPLE
 PRESSURE METER TEST (PRM)
 CORE RUN
 VANE SHEAR TEST (VST) TW - THIN WALL PUSH IN

PERMEABILITY / PACKER TEST (PKT)
 SPT N VALUE
 Attempt TW,P,MZ,U
 P - PISTON SAMPLE
 TW - THIN WALL PUSH IN

MZ - MAZIER
 U - THICK WALL OPEN DRIVE
 CR - CORE RUN
 SPTLS - SPT LINER
 W - WATER
 TW+ - PUSH+HAMMER

PZS - CASAGRANDE PIEZOMETER
 WSP - WATER STANDPIPE