Workshop on PCE Candidates: Technical Paper (Civil)

Presented by:

Ir. Wong Loo Min

Member of WG on PCE (Civil)

Workshop 3: 23rd August 2023

Miami 1,
MATRADE Exhibition & Convention Centre

PART B – Civil Paper 1 (MCQ) & 2 (Essay)	
Category	Weightage
Geotechnical	Approximatel1 20%
Infra-structural	Approximately 40%
Structural	Approximately 40%
Regulations, submission and Contract administration	In Part A

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

- Paper 1 – 40 MCQ – Need to answer all
  – 1 ½ hours duration

- Paper 2 – 5 essay questions – Need to answer 3
  – 1 ½ hours duration

- Not like university exam but practical orientated
- The syllabus is wide
- PCE mimics work environment. Open book
- Difficult but largely unnecessary to study
- Understand what and why you do
- Be familiar with your handbooks and texts
- Know where to find things
- No time to search from scratch, only time to refer
- Calculations not heavy duty but easy, straightforward to demonstrate understanding
- Level of difficulty is similar to hand check or preliminary sizing/design

- Questions relates to practical matters commonly encountered in work
- Time constraints? Exam is open book!
- Sufficient time to refer but not enough time to search
- Sufficient time to check but not enough time to learn
- Subject matter covered by syllabus
- In design work, major sub-disciplines such as civil infrastructure, geotechnical and structures are inter-related
- Candidate need to understand and be conversant with basic Civil Engineering design matters for all major sub-disciplines

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

What do examiners expects from you?

- Know what to expect from examiners. Know what the examiners expect from you.
- “PEPC should not endorse plans for design that he/she is not familiar with”.
- Engineer must know what he is doing and know what he does not know. How?
- Reached a level a competency to have sufficient understanding of the major sub-disciplines of Civil Engineering and to know his/hers limitation and to realise things he does not know. Allowed to sign for all and so need to know all.
- Demonstrate an understanding of design processes.
- Multi-disciplinary understanding required e.g. soil~structure interaction.
- Marking liberal. Examiners mindful that multiple correct answers.
- No single correct answer but multiple correct solutions.
- Need to convince examiners that you know and understand.

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

- MCQ questions range from easy to moderate to hard. Approximately 40%, 40% and 20%
- Limited time, tackle easy part first
- Don’t leave questions or parts of questions unanswered
- Look at the marks allocated and apportion time spend appropriately.
- Passing marks is 50%. Both Papers 1 and 2 must achieve at least 50% each to pass.

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

- Answers should preferably be made using black ink
- Answers in both English and Bahasa Melayu are acceptable
- Answer in answer booklet only. DO NOT write in question booklet

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

Geotechnical Works

Generally including but not limited to:

- Soil investigation for earthworks, footings and piled foundations and basements
- General knowledge of different soil and rock formations
- Types of laboratory tests for earthworks and foundation
- Interpretation of test results
- Retaining wall, pile and footing design

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

- PEPC acting as PSB on industrial building

Earthworks

Generally including but not limited to:

- Suitable filling materials and tests
- Construction control at site
- Hill side development, slope stability
- Settlement analysis
- Slope stabilisation and soft ground treatment
- Selection of subsoil/rock design parameters
- Erosion control
- Ground monitoring

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

Structures

- Design of pads, raft, pile caps
- Earth retaining structures
- Temporary works for excavation
- Structural analysis
- Concrete and steel structures design
- Pre- stressed concrete
- Composite design

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

Water and Sewerage

- Acts and design guidelines
- Water, reticulation design and sewerage system design
- Net work analysis, hydraulic calculations
- Master planning requirements

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

Road and Drainage

- Arahan Teknik JKR and MSMA
- Vertical and horizontal alignment
- Acceleration, deceleration, and junction
- Superelevation
- Road pavement design
- Hydrological and hydraulic calculations
- Drainage design
- Storage pond

Disclaimer: This slide is property of BEM and the information cannot be used as official statement from BEM. The information is only valid on the date of its establishment and you may refer to BEM for new update.

PART B: Civil Paper 1 - SAMPLE QUESTION

Q1. Which of the following statements is true for circular columns?

A. Minimum no. of bars is 8, size of bar is not less than 10 mm

B. Minimum no. of bars is 8, size of bar is not less than 12 mm

C. Minimum no. of bars is 6, size of bar is not less than 10 mm

D. Minimum no. of bars is 6, size of bar is not less than 12 mm

E. None of the above

[Code of Practice]

PART B: Civil Paper 1 - SAMPLE QUESTION

Q2. What is the minimum residual pressure head for an external hydrant system required by Bomba.

A. 3.0 m

B. 7.5 m

C. 12.5 m

D. 10.0 m

E. 9.0 m

[Bomba requirements]

PART B: Civil Paper 1 - SAMPLE QUESTION

Q3. What is the fire resistance requirement for a concrete structure of an underground basement car-park?

A. One hour

B. Half an hour

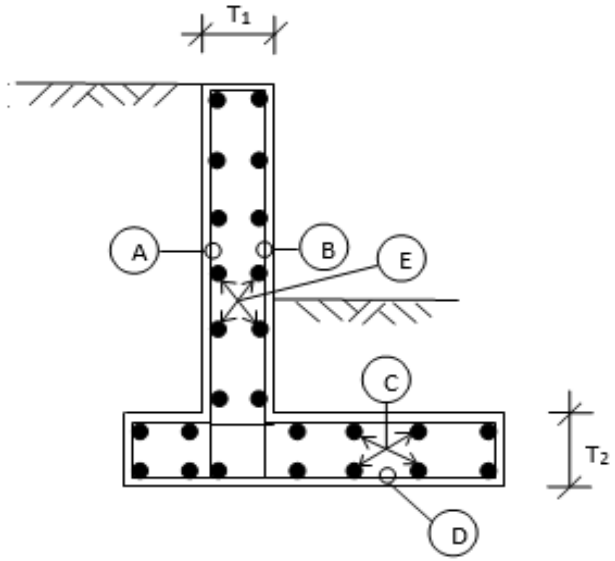
C. Two hours

D. Four hours

E. One & half hours

[UBBL/SBO]

PART B: Civil Paper 1 – ACTUAL QUESTION



In the above section of a retaining wall, where $T_2 > T_1$, the reinforcement bars are labelled A to E. If the yield stresses and cover for all the bars are identical, which of the bars have the highest area A_{st}/m width?

A. A
B. B
C. C
D. D
E. E

PART B: Civil Paper 2 - SAMPLE QUESTION

Q1. A 3-storey basement car park is to be built with an excavation of approximately 15.0 m from the existing ground level. The water table is 1.0 m below the existing ground level. You are required to provide a solution on the structural system for the retaining walls of the basement.

Note:

This question can be answered in ½ hr. if it is expected that the answer is only descriptive in nature.
However if a plan of basement & sections are provided with the soil properties then this question will take at least 1 hr where it is expected that sketches and typical details are to be produced with supporting calculations.

[Retaining structures & safeguarding public interest]

PART B: Civil Paper 2 - SAMPLE QUESTION

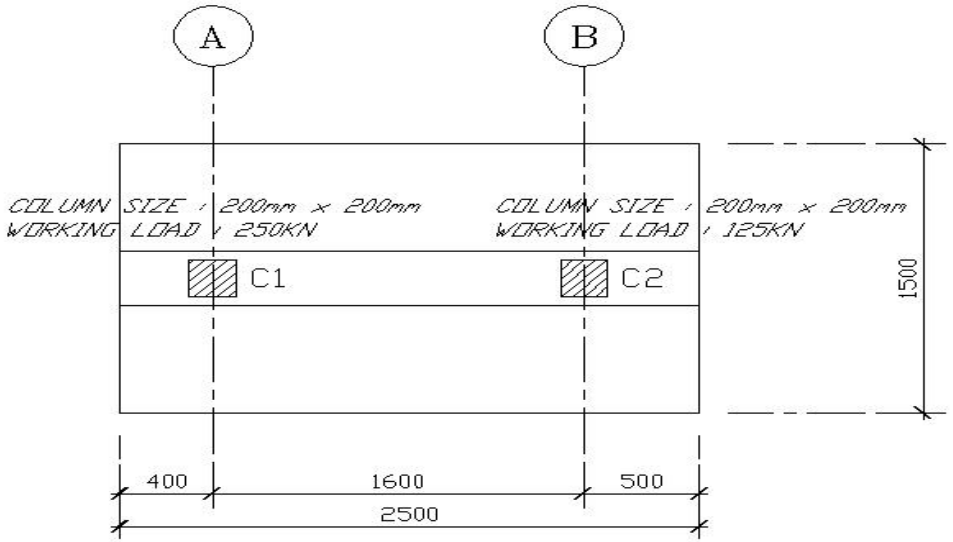
Q2. You are the infrastructure engineer for a housing development scheme for a 500-acre project. What is your advice to the Developer, Planner and Architect in terms of requirements for drainage, sewerage, water reservoirs, retention ponds and earthwork for the application for master plan?

Note:

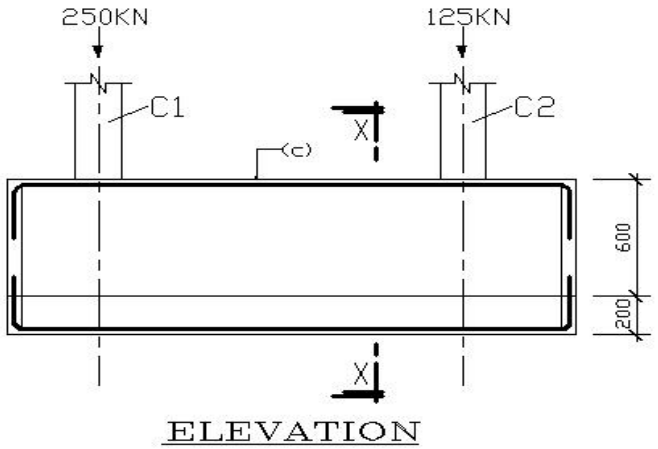
Question can be answered in ½ hr provided that the answer is descriptive in nature. The layout plan of the housing scheme with contours is provided and rough estimate of sizes and areas where these services should be located. It tests a candidate's knowledge in master planning.

[Acts and submission]

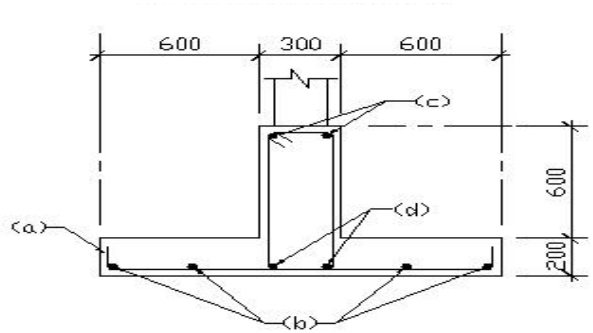
PART B: Civil Paper 2 – ACTUAL QUESTION



PLAN



ELEVATION



SECTION X–X

FIGURE 1

C21 OF 15(26th September 2022)

Figure 1 shows the plan, elevation and cross-section of a combined footing supporting two (2) columns C1 and C2 at gridlines A and B .

The working loads of the columns C1 and C2 are 250 kN and 125 kN respectively.

i. Calculate the bearing pressure imposed by the footing on the ground and show clearly how the bearing pressure varies and state the maximum and minimum values. (35 marks)

Ans: ***Self weight*** = ***[(2.5m x 1.5m x 0.2m) + (2.5m x 0.3m x 0.6m)] x 24 kN/m³***

= ***28.8 kN***

Sum of load ΣN = ***250 kN + 125 kN + 28.8 kN = 403.8 kN***

Moment of load about a-a = 250 x 0.4 + 125 x 2.0 + 28.8 x 1.25 kNm = 386 kNm

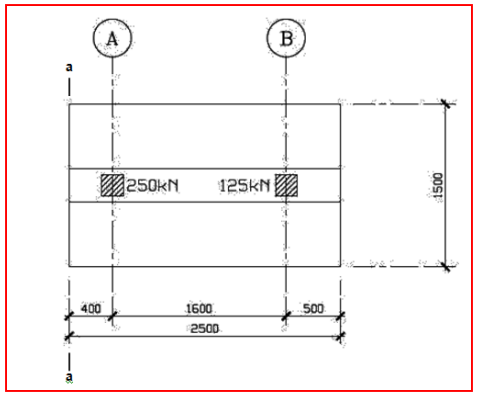
CG from a-a = $\frac{386\ kNm}{403.8\ kN}$

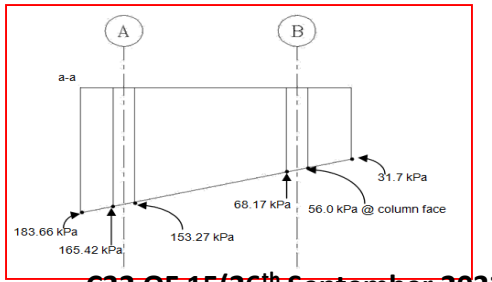
= ***0.956m***

Bearing pressure = $\sum \frac{N}{A} \pm \frac{M}{Z}$

= ***107.68 kPa ± 75.98 kPa***

= ***183.66 / 31.7 kPa***





ii. Calculate the ultimate bending moments that should be used to design the reinforcement marked (a) and (b) in the cross-section X-X. (5 marks)

Ans:

Maximum ultimate slab transverse cantilever moments =

$$M_u = 1.5 \times 183.66\ kPa \times \frac{0.6m^2}{2}\ kNm/m$$

$$= 49.6\ kNm/m$$

$$A_{st}\ (transverse) = 546\ mm^2/m$$

$$A_{st}\ (longitudinal) = 0.13\%\ bd$$

$$= \frac{0.13}{100} \times 1000 \times 250$$

$$= 325\ mm^2/m$$

iii. Using the bearing pressures obtained in (i) above, sketch the bending moment diaphragm (BMD) for the footing beam in the longitudinal direction.

Draw the bending moment on the tension side and estimate the magnitude of the moments.

(30 marks)

Ans:

Cantilever slab moments at column C1

$M_o = 1.5 \times (183.66\ kPa \times 1.5m) \times \frac{0.3^2}{2}\ m^2$

$= 18.6\ kNm$

Cantilever moments at column C2

$M_o = 1.5 \times (56.0\ kPa \times 1.5m) \times \frac{0.4^2}{2}\ m^2$

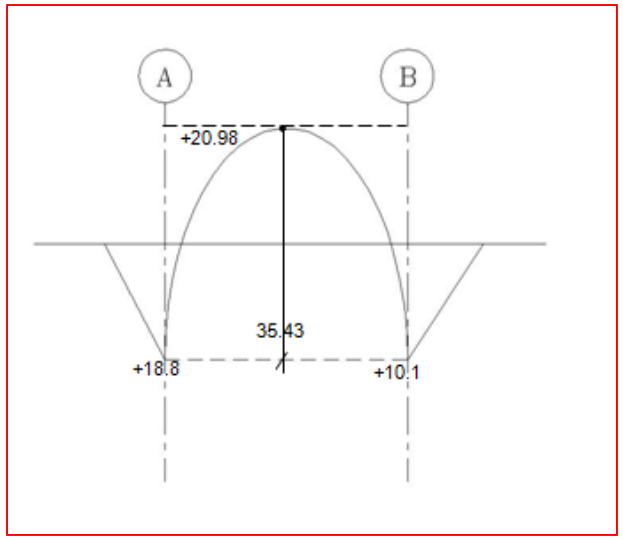
$= 10.1\ kNm$

Between columns, w $= \frac{1.2}{2}(153.27 + 68.17)$

$= 110.72\ kN/m$

$\frac{wl^2}{8} = \frac{110.72 \times 1.6^2}{8}$

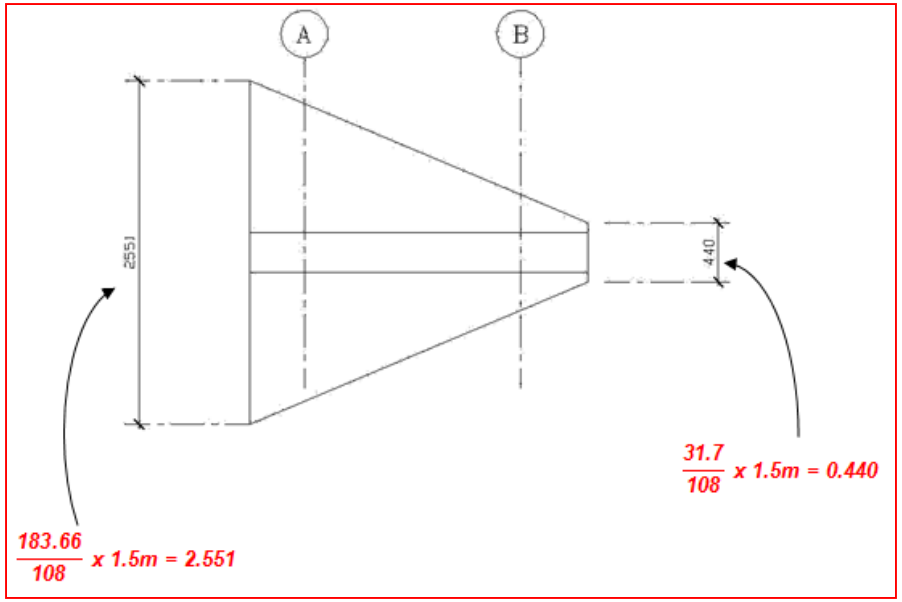
$= 35.43$



iv) If the maximum allowable bearing pressure was determined to be 108 kPa, does the maximum applied footing bearing pressure exceed this?

If it does, suggest two (2) ways to reduce the applied bearing pressure to be within the allowable bearing pressure without increasing the plan area of the footing. (30 marks)

Ans: ***(a) Vary the width of footing***



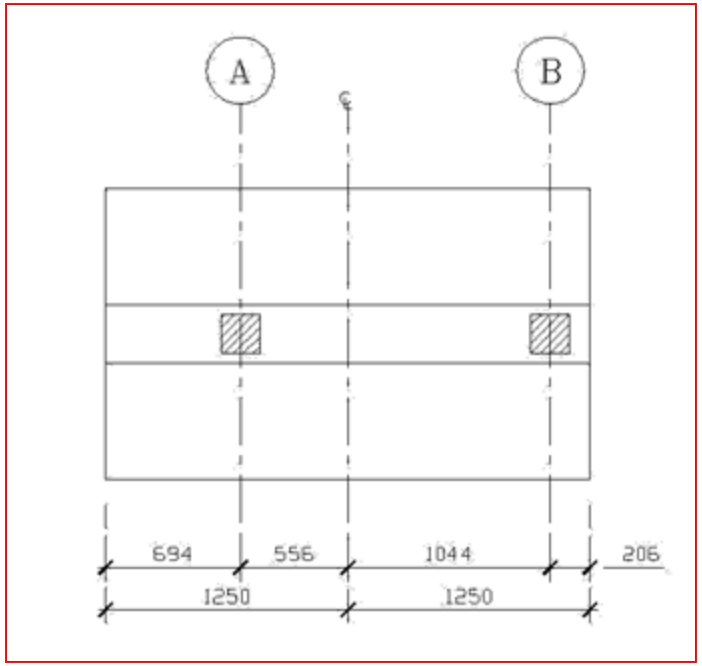
Check average = 1496 mm

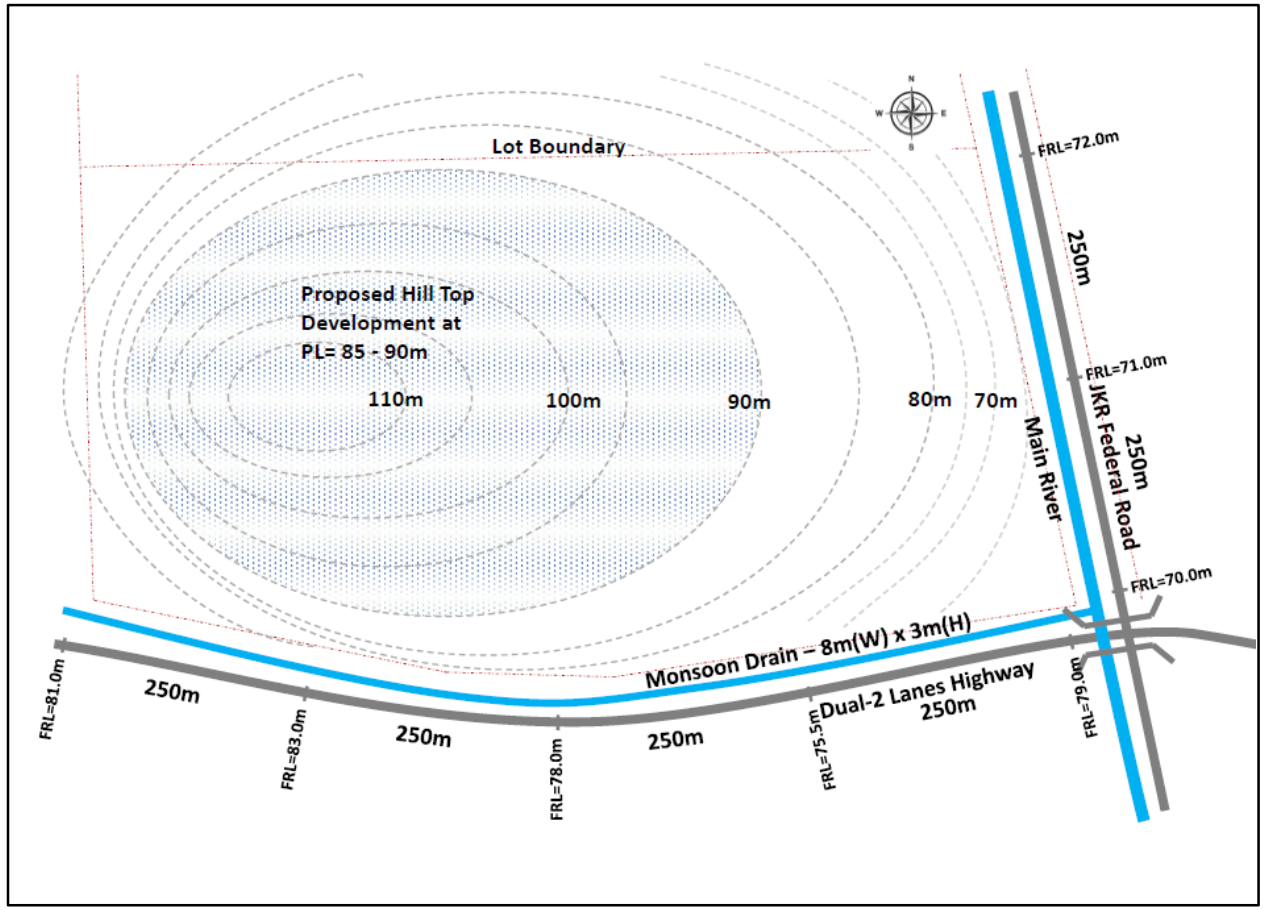
Use 2555/445

iv) If the maximum allowable bearing pressure was determined to be 108 kPa, does the maximum applied footing bearing pressure exceed this?

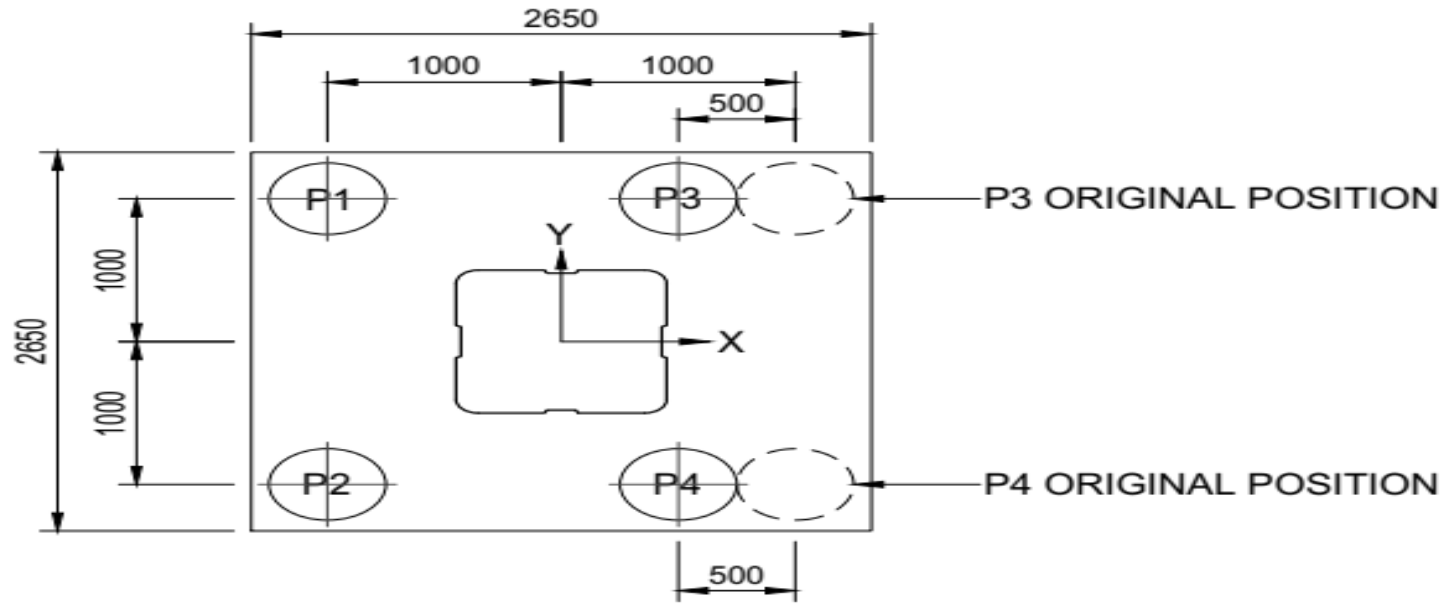
If it does, suggest two (2) ways to reduce the applied bearing pressure to be within the allowable bearing pressure without increasing the plan area of the footing. (30 marks)

Ans: ***(b) Shift footing centre to load centre***





B. A pile cap with dimension of 2.65m x 2.65m and thickness of 1m consists of 4 numbers of 500 mm diameter spun piles as shown in the following Figures. The design working load of the spun pile is 2000kN. Subsoil information below the existing ground surface and the results of the Standard Penetration Test (SPT-N) are shown in the following Table 1. Due to the survey errors, it was found that two piles (P3 and P4) had deviated from the original design position by 500mm in x-direction but no deviation in y-direction.


2650
1000
1000
500
P1
P3
P3 ORIGINAL POSITION
Y
X
2650
1000
1000
P2
P4
P4 ORIGINAL POSITION
500

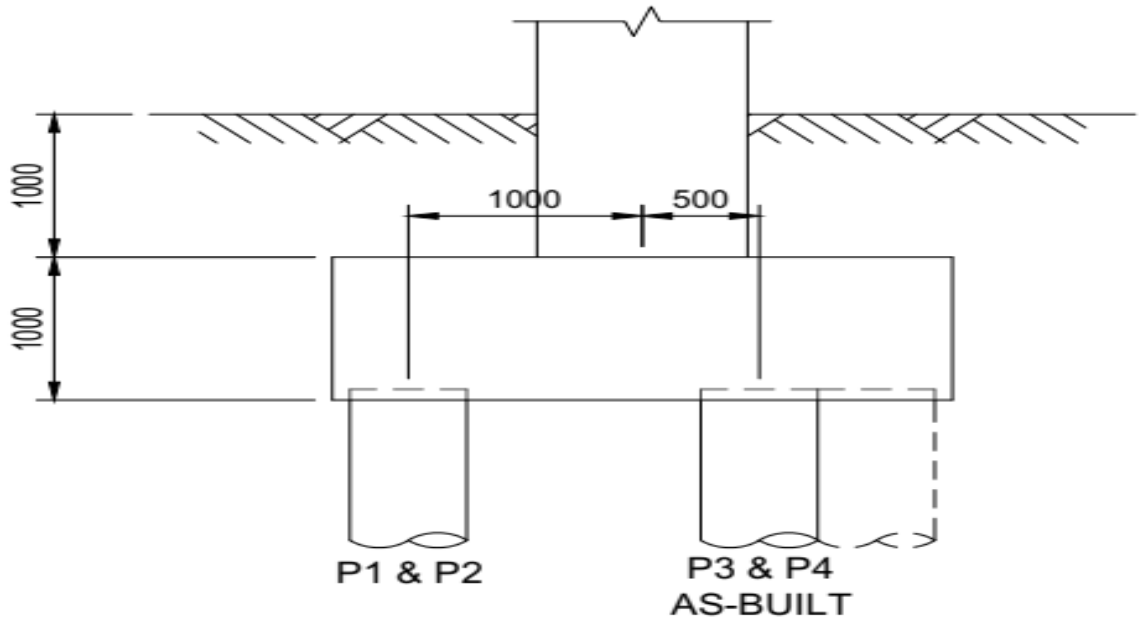

1000
1000
500
1000
P1 & P2
P3 & P4
AS-BUILT

Table 1. Subsoil profile and SPT-N values

Depth (m)	Soil Type	Average SPT-N (blows/300mm)
0m to 7m	Clayey silt	12
7m to 14m	Medium dense sand	20
14m to 30m	Sandy clay	30
>30m	Very dense sand	50

(b) The column load is 7500kN. If all piles were installed to the design positions, what is the maximum load on pile(s)

*note: ignore the weight of pile cap and soil weight above pile cap)

(10 marks)

(c) The unit shaft friction (fs) and end resistance (fb) of the spun pile can be estimated using empirical equation as follow:

fs = 2 N

fb = 250 N

With Factor of Safety (FS) of 2 for friction and for end resistance, what is the estimated minimum required pile length if the pile design capacity is 2000kN (pile length shall be calculated below cut-off level)?

(30 marks)

(d) Since two piles (P3 and P4) had deviated from the design positions, please evaluate the maximum load on pile(s) in this case and compare with the maximum load on pile(s) if all piles were installed at the design positions without deviation. Is the maximum load on pile(s) still the same or will it be different?

(4 marks)

(e) Please justify your answer for the above question (d). You shall show calculation to demonstrate/substantiate your answer

(35 marks)

(

(f) Based on your findings from the above questions (d) and (e), please assess whether the pile design (pile capacity) still acceptable or remedial/strengthening method to be proposed? If remedial/strengthening is required, please provide a Sketch to illustrate your proposal. (please note that the column position is not allowed to be shifted)

(15 marks)

Q & A

THANK YOU

"Committed To Engineering Excellence"

BOARD OF ENGINEERS MALAYSIA

Tingkat 11 & 17, Blok F Ibu Pejabat JKR
Jalan Sultan Salahuddin, 50580 Kuala Lumpur
http://www.bem.org.my
enquiry@bem.org.my or complaint@bem.org.my.
Tel: 03-26912090; Fax: 03-26925017