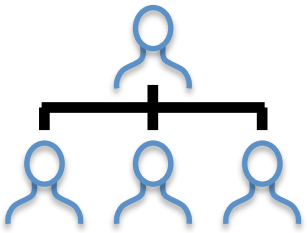


Ian Smith Consulting

http://www.profiansmith.com

Sample Exam questions – by Professor Ian Smith
Downloaded from www.profiansmith.com

The solutions are provided in a separate downloadable file.

The following sample questions are given in this file. The “Year” aligns to the Scottish 4-year long honours degree system.

Q1. Soil classification & physical relationships (Year 2 Geotechnics)

Q2. Vertical stress increments (Year 3 Geotecnics)

Q3. Retaining wall check to Eurocode 7 (Year 4 Geotecnics (Honours year))

Q1. (a) An oven dried sample of soil of mass 165.4g was tested in a sieve analysis. The results are given in Table Q.1.

Sieve Size (mm)	Mass Retained on Sieve (g)
37.5	0.0
20.0	2.0
14.0	5.4
10.0	6.2
6.3	28.3
3.35	32.5
1.18	54.0
0.60	21.0
0.212	10.2
0.063	1.6
pan	4.2

Table Q.1

Using the PSD Chart provided, plot the particle size distribution of the soil.

(10 marks)

(b) Determine the coefficient of uniformity of the soil.

(2 marks)

(c) A specimen of soil was fully contained in a sampling tube of internal volume $1.05 \times 10^{-3} m^3$.

The complete sample of soil was removed from the tube for moisture content determination and the following results were obtained:

Mass of wet soil = 2.035 kg
Mass of dry soil = 1.85 kg

over/

If the specific gravity of the soil was $G_s = 2.70$, calculate:

(i) the bulk density of the soil, ρ_b,

(2 marks)

(ii) the moisture content of the soil, w,

(3 marks)

(iii) the dry density of the soil, ρ_d,

(2 marks)

(iv) the void ratio of the soil, e,

(3 marks)

(v) the degree of saturation of the soil, S_r.

(3 marks)

(Total 25 marks)

(Note: The density of water may be taken as $\rho_w = 1$ Mg/m^3)

Q2. A 30 m long by 8 m wide warehouse storage unit is to be built using a flexible rectangular raft foundation constructed using small concrete blocks place on a compacted sand bed. The foundation will place a uniform pressure of 40 kPa on the soil beneath, which is a deep deposit of saturated clay with Modulus of Elasticity, E = 5 MPa, ν = 0.5.

A sewer runs along the longer axis of the foundation at a depth of 3m, as shown in the plan of the site in Figure Q2(a).

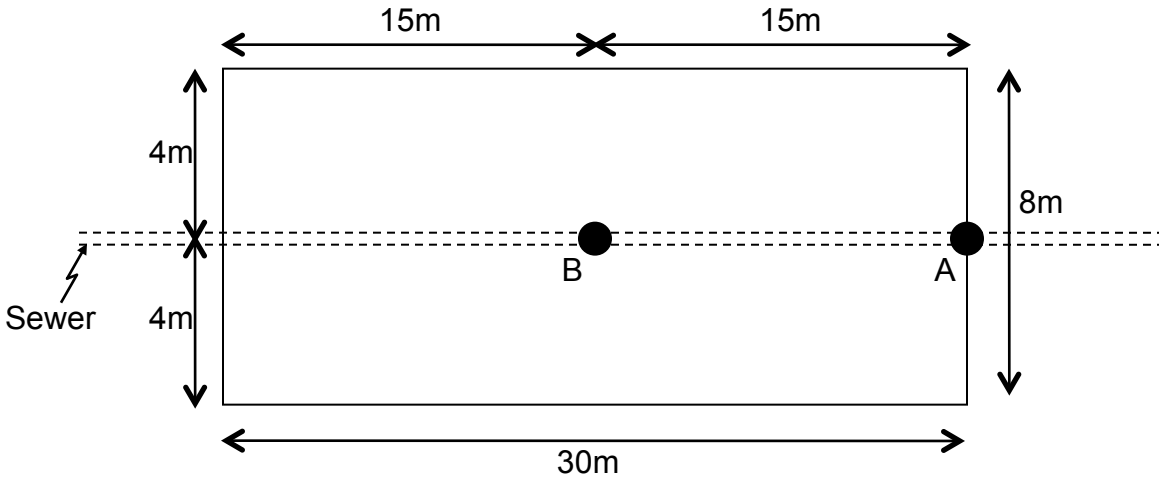


Figure Q2(a)

(a) Using Fadum's chart, calculate the increase in vertical stress acting on the sewer;

under point A;
under the centre, point B

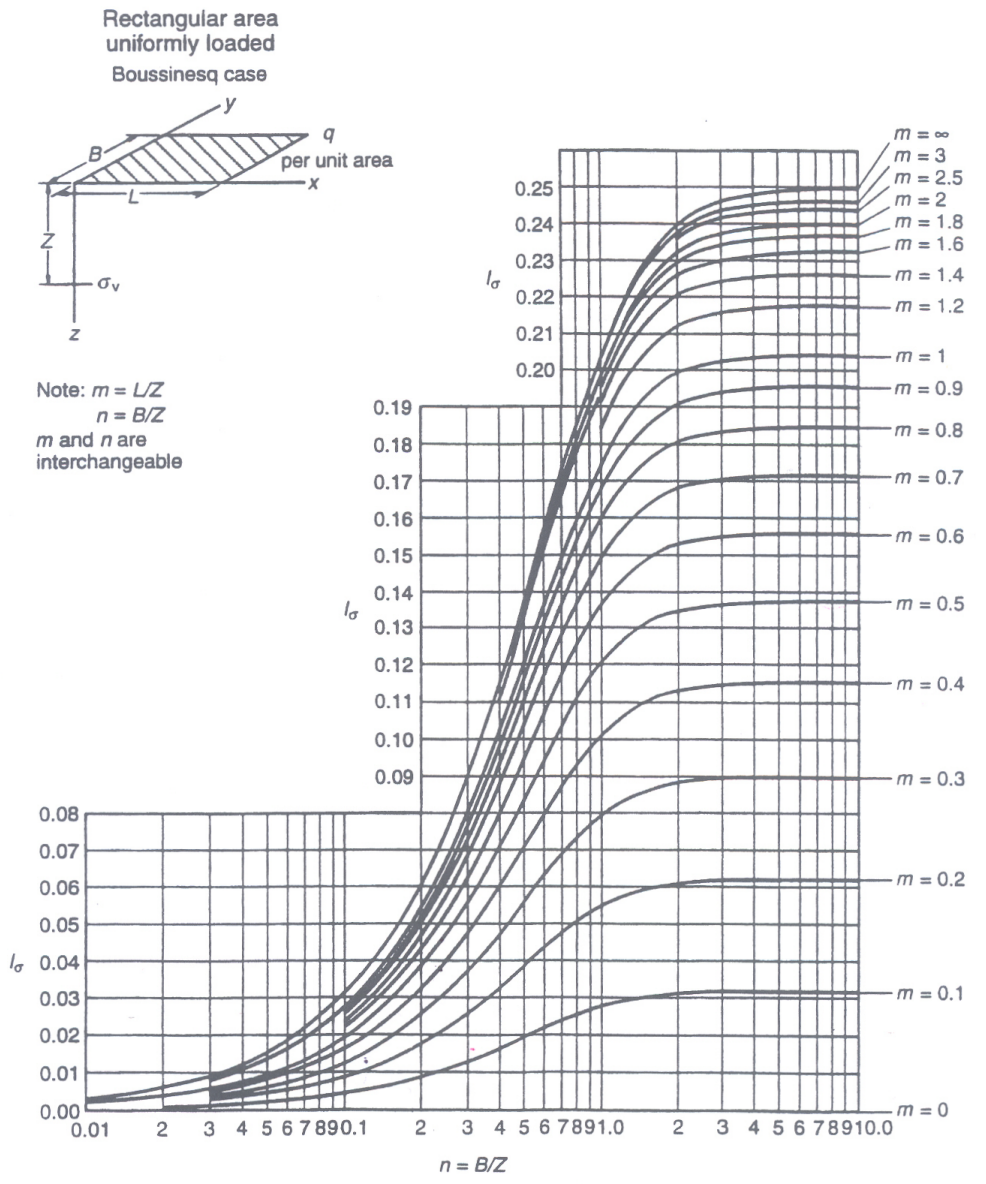
(15 marks)

(b) Estimate the elastic settlement, under one corner of the foundation, using the table of Np values given below:

L / B	**N_p**
1	0.56
2	0.76
3	0.88
4	0.96
5	1.00

(5 marks)

(Total 20 marks)



Influence factors for the increase in vertical stress below the corner of a uniform rectangular surcharge. (Redrawn from Fadum, 1948.)

Fadum's Chart: for use in Q2.

Q3. a) Using Eurocode 7, Design Approach 1, determine the magnitudes of the over design factors for both sliding and overturning for the wall shown in Fig Q3.1. You may assume that the friction between the wall and the soil, $\delta = \phi'$ and that the unit weight of concrete is equal to 24 kN/m^3. The same soil exists both behind and beneath the wall.

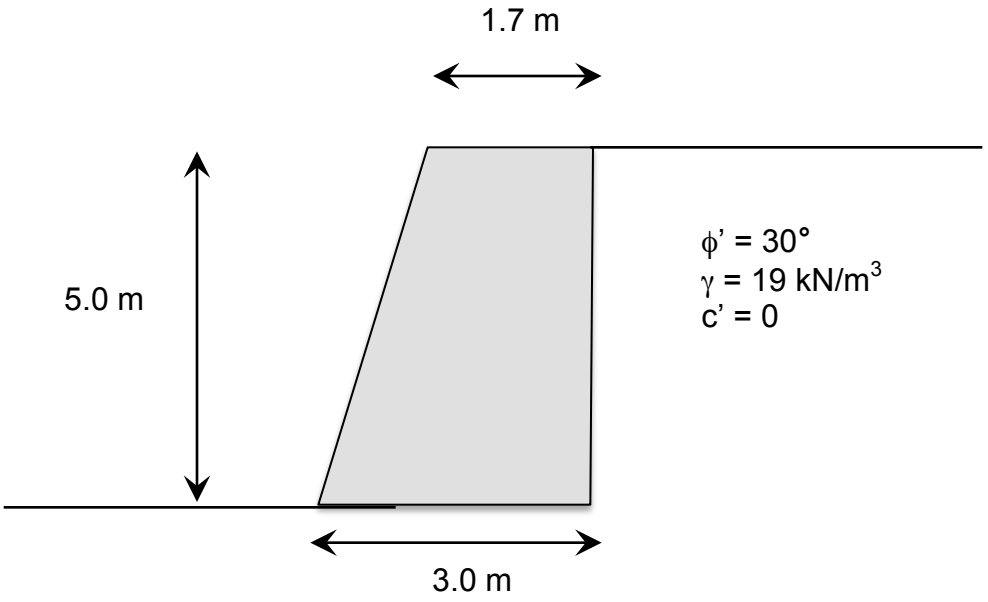


Fig Q3.1

Note 1: The chart of Coefficients K_a (horizontal component) for horizontal retained surface is provided.

Note 2: The table of partial factors is provided.

Sliding	**(15 marks)**
Overturning	**(15 marks)**

(Total 30 marks)

Data sheets for use in Q3.

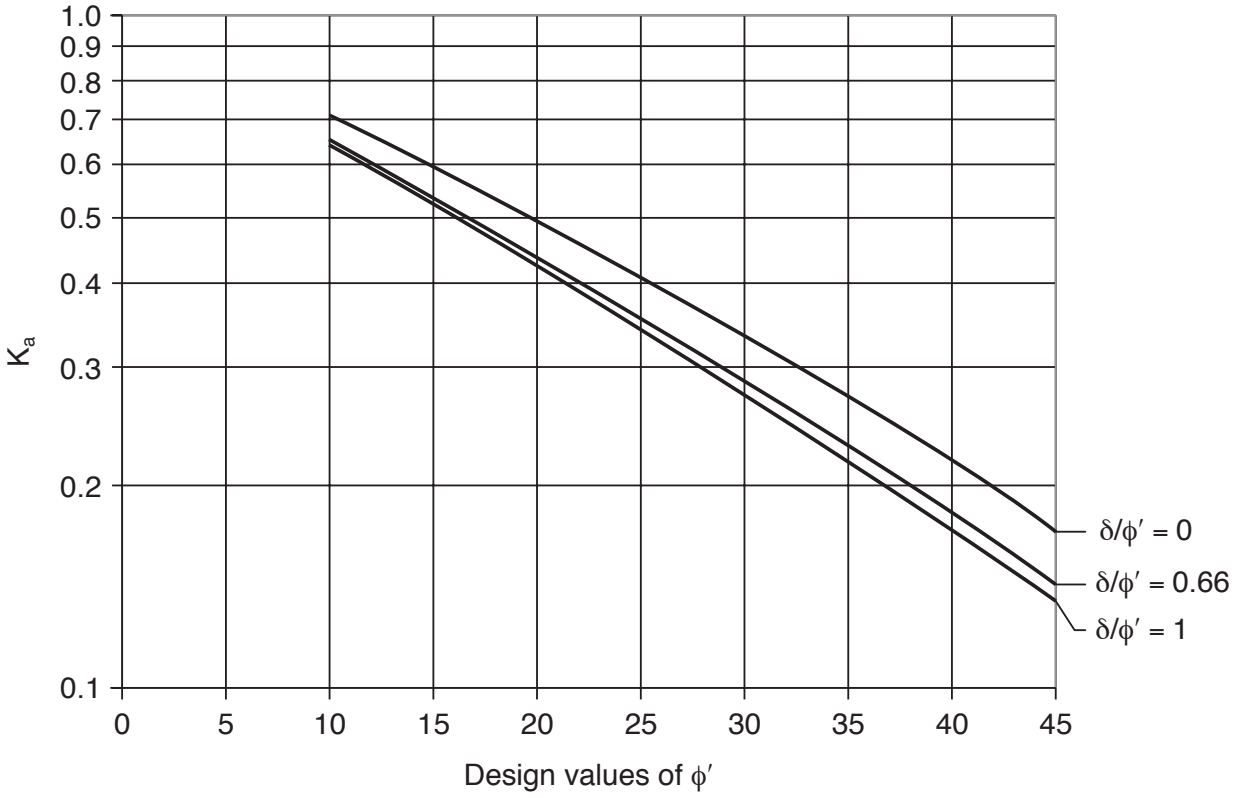


Figure Q3. Coefficients K_a (horizontal component) for horizontal retained surface.

Partial Factor sets:

Design Approach 1:

Combination 1: A1 + M1 + R1
Combination 2: A2 + M2 + R1

Table Q3 Partial factor sets for EQU, GEO and STR limit states.

Parameter		Symbol	GEO/STR – Partial factor sets						
			A1	A2	M1	M2	R1	R2	R3
Permanent action (G)	Unfavourable	$\gamma_{G;dst}$ / $\gamma_{G;unfav}$	1.35	1.0					
	Favourable	$\gamma_{G;stb}$ / $\gamma_{G;fav}$	1.0	1.0					
Variable action (Q)	Unfavourable	γ_Q	1.5	1.3					
	Favourable	–	–	–					
Accidental action (A)	Unfavourable	γ_A	1.0	1.0					
	Favourable	–	–	–					
Coefficient of shearing resistance (tan ϕ')		$\gamma_{\phi'}$			1.0	1.25			
Effective cohesion (c′)		$\gamma_{c'}$			1.0	1.25			
Undrained shear strength (c_u)		γ_{cu}			1.0	1.4			
Unconfined compressive strength (q_u)		γ_{qu}			1.0	1.4			
Weight density (γ)		γ_{γ}			1.0	1.0			
Bearing resistance (R_v)		γ_{Rv}					1.0	1.4	1.0
Sliding resistance (R_h)		γ_{Rh}					1.0	1.1	1.0
Earth resistance (R_e)		γ_{Re}					1.0	1.4	1.0

Note: weight density ≡ unit weight