THE UNIVERSITY OF ZAMBIA

SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

2020/2021 ACADEMIC YEAR

CEE 3111 – CIVIL ENGINEERING MATERIALS AND PRACTICES

QUIZ 1

MONDAY 20th MARCH 2023

TIME: 10 MINUTES

CLOSED BOOK

Name: ..... Student ID.....

The following data were recorded during the tensile strength test of a mild steel rod. The gauge length was 50 mm.

Load (kN)	0.0	6.3	12.6	18.8	25.1	31.3	37.9	40.1	41.6	46.2	52.4	58.4	68.0	59.0	67.8	65.0	65.5
Elongation (mm)	0.000	0.010	0.020	0.030	0.040	0.050	0.060	0.163	0.433	1.250	2.50	4.50	7.50	12.50	15.50	20.00	Fracture

The stress strain diagram for this steel rod is given below. Figure 1 shows the Stress Strain Diagram that zooms into the elastic region while Figure 2 shows the entire stress strain diagram.

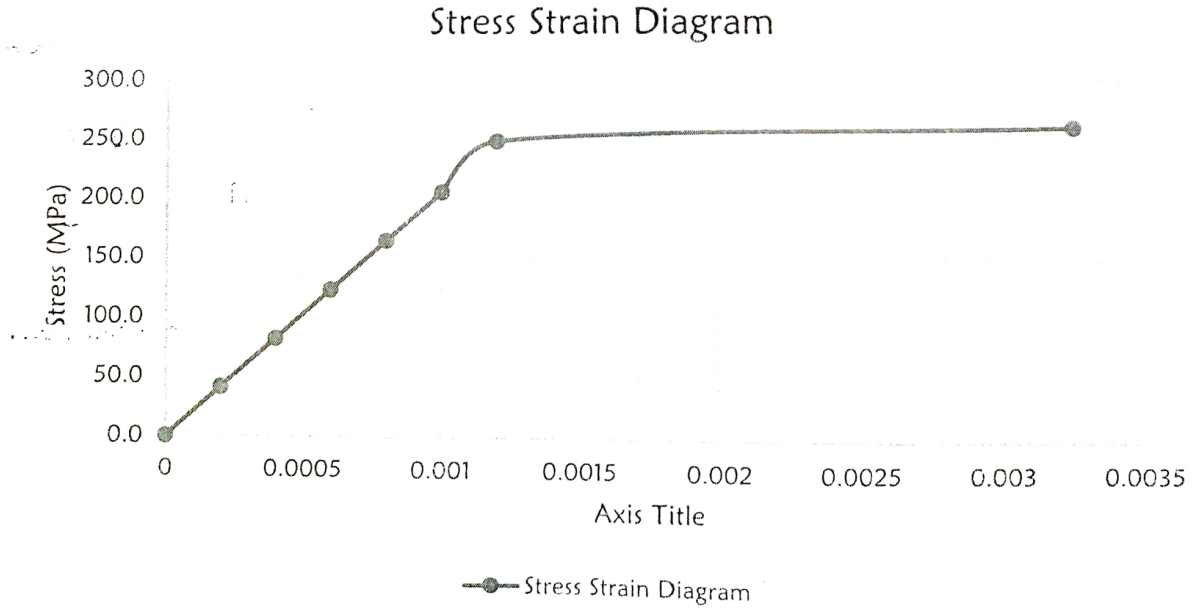

Figure 1: Zoomed in Stress Strain Diagram

10

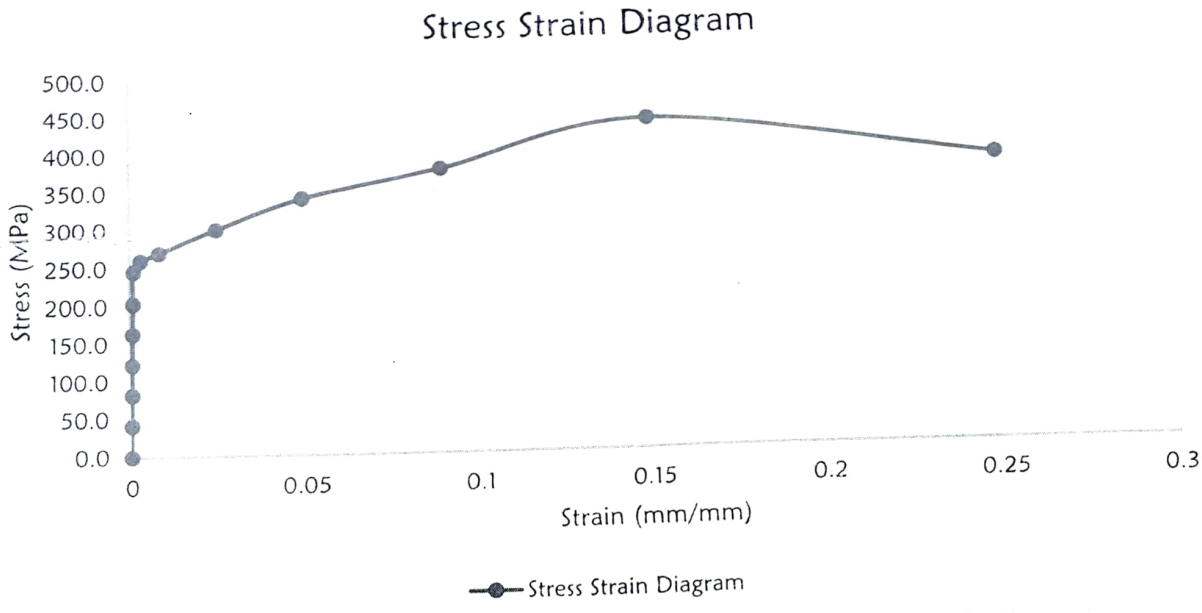

Figure 2: Entire Stress Strain Diagram of the Steel Rod

Determine approximately to the nearest 10, the modulus of elasticity and yield point;

(1) $E = \frac{\sigma}{\varepsilon} = \frac{200 \times 10^6 \text{ N/m}^2}{0.001} = 200 \text{ GPa}$

(2) Yield Point = 250 MPa

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QUIZ 2

6-12 = 8

MONDAY 17th APRIL 2023

TIME: 20 MINUTES CLOSED BOOK

Name: .... Student ID..... .....

During the pothole patching activity by RDA on Twin Palm Road, the base coarse aggregate used has a target dry density of 1917 kg/m³ in place. During the activity, the students cut and compacted a combined rectangular repair area of 600 m * 15 m * 0.15 m. The aggregate in the stockpile contains 3.1% moisture. If the required compaction is 95% of the target, **how many tons** of aggregate from the stockpile will be needed?

Volume = $600m \times 15m \times 0.15m = 1350m^3$ (2)

~~3x~~ $M.C = \frac{W_{moist} - W_{dry}}{W_{dry}} \times 100$

$0.031 = \frac{W_{moist} - (0.95 \times 1917)}{(0.95 \times 1917)} \times 1350$ (2)

$W_{moist} = 2584773.5 kg$

1ton — 1000 kg

~~8x~~ x → 2584773.5

$W_{moist} = 2534.77 tons$ (2)

CEE 3111 QUIZ 4

MONDAY 6TH JUNE 2022

TIME: 1 HOUR CLOSED BOOK

Name: ..... Student ID.....

The table below shows results obtained during a field compaction test for a soil sample.

i. Complete the table (highlighted sections)

ii. Given that the minimum required field compaction is 93%, how many test holes meet the minimum density requirements?

IN-SITU DENSITY (SAND REPLACEMENT METHOD)

QF 7502 QC-09 (AASHTO T-196,ASTM D-1556, BS-1377-9)

Location/Chainage	: **Ch-1+750 To 1+840**	Date of Testing	19.07.2018
Description of Layer	: **Embankment Fill**	Bulk Density of Sand (Gs)	1.235
Layer No	: **1st**	Weight of Sand in Cone (w3)	2629
Source of Material	: **Oriental B/Pit**	M.D.D (gm/cc) (y_{dmax})	2.053
		O.M.C (%)	8.5
		Compaction Required (%)	

A	Test hole No	1	2	3	4	5	6
B	Location of Test	LHS	CENTER	RHS	CENTER		
C	Depth of Hole, (mm)	200MM	150MM	150MM	150MM		
D	Weight of Wet Sample from Hole, (gm) (w_w)	9298	9870	8889	8971		
E	Weight of Cylinder filled with Sand before Pouring, (gm) (w_1)	23800	23800	23800	23800		
F	Weight of Cylinder filled with Sand after Pouring, (gm) (w_2)	15812	15453	16023	16121		
G	Weight of Sand in Hole, (gm) ($w_s = w_1-w_2-w_3$)	5359	5718	5148	5050		
H	Volume of Hole, (cc) $v = w_s/G_s$	4339	4630	4168	4089		
I	Wet Density of Sample, (gm/cc) $y_d = w_w/v$	2.143	2.132	2.133	2.194		
J	Rapid Moisture Container ID	C1	C2	C3	C4		
K	Weight of wet soil+ container	274	436	432	432		
L	Weight of dried soil + container	269	423	415	418		
M	Weight of container	161	203	197	197		
N	Weight of dry soil	108	220	218	218		
O	Moisture Content (%) (w)	4.6	5.9	7.8	6.4		
P	Dry density of sample (gm / cc) $y_d = y_b/1+w$	2.05	2.01	1.98	2.06		
Q	Relative Field Degree of Compaction (%) = y_d/y_{dmax}	99.9	97.9	96.4	100.34		

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2021/2022 ACADEMIC YEAR

CEE 3111 – CVIL ENGINEERING MATERIALS AND PRACTICES

MID-TERM TEST

TUESDAY 25TH APRIL 2023

TIME: TWO (2) HOURS **CLOSED BOOK**

INSTRUCTIONS TO CANDIDATES

1. **THERE ARE FOUR QUESTIONS IN THIS PAPER; ANSWER ALL THE QUESTIONS**
2. MARKS WILL BE LOST FOR ILLEGIBLE, UNTIDY AND UNORGANISED ANSWERS

QUESTION 1 [35 Marks]

a) Why is reinforcing steel used in concrete? (2 Marks)
b) What are the typical uses of structural steel? (2 Marks)
c) Name three mechanical tests used to measure properties of steel. (3 Marks)
d) Name the **two primary factors** that make aluminium an attractive structural engineering material. (2 Marks)
e) Discuss two different desirable characteristics of aggregate used in each of the following works:
   i. Portland cement concrete. (2 Marks)
   ii. Asphalt concrete. (2 Marks)
f) Define the fineness modulus of aggregate. What is it used for? (2 Marks)
g) The following laboratory tests are performed on aggregate samples:
   i. Specific gravity and absorption
   ii. Soundness
   iii. Sieve analysis test

What is the significance and use of each of these tests? (1+1+1 Marks)

h) Discuss the effect of water–cement ratio on the quality of hardened concrete. (2 Marks)
i) What do we mean by curing concrete? What will happen if concrete is not cured? (3 Marks)
j) Discuss five different methods of concrete curing. (5 Marks)
k) State five types of admixtures and discuss their applications. (5 Marks)
l) What is mortar made of? What are the functions of mortar? (2 Marks)

QUESTION 2 [22 Marks]

Students in the materials class prepared three mortar mixes with water to cement ratios of 0.50, 0.55, and 0.60. Three 50-mm mortar cubes were prepared for each mix. The cubes were cured for 7 days and then tested for compressive strength. The test results were as shown in the table below.

Mix No.	w/c Ratio	Cube No.	Maximum Load (kN)	Compressive Strength (MPa)	Average Compressive Strength (MPa)
1	0.50	1	89.4		
		2	90.1		
		3	91.9		
2	0.55	1	84.7		
		2	84.5		
		3	82.5		
3	0.60	1	75.8		
		2	79.3		
		3	81.2		

Determine the following:

v. The compressive strength of each cube. (9 Marks)
vi. The average compressive strength for each mix. (6 Marks)
vii. Plot the average compressive strength versus w/c ratios for all mixes. (5 Marks)
viii. Comment on the effect of increasing w/c ratio on the compressive strength of the mortar cubes. (2 Marks)

QUESTION 3 [25 Marks]

A sieve analysis test was performed on a sample of coarse aggregate and produced the results in the table below.

Sieve Size (mm)	75	50	37.5	25	19	12.5	9.5	4.75	Pan
Mass Retained (g)	0.0	0.0	1678.0	7212.0	5443.0	6124.0	12111.0	4581.0	590.0

vi. Calculate the percent passing through each sieve. (7 Marks)
vii. What is the maximum size? (1 Mark)
viii. What is the nominal maximum size? (1 Mark)
ix. Plot the percent passing versus sieve size on a semilog gradation chart. (10 Marks)
x. Referring to ASTM C33, what is the closest size number and does it meet the gradation for that standard size? (6 Marks)

QUESTION 4 [18 Marks]

c) A concrete masonry unit is tested for compressive strength and produces the following results: Failure load = 726 kN; Gross area = 0.081 m^2; Gross volume = 0.015 m^3; Net volume = 0.007 m^3

iv. Calculate the gross area compressive strength of the masonry unit. (3 Marks)
v. Calculate the net area compressive strength of the masonry unit. (5 Marks)
vi. Does the compressive strength satisfy the ASTM requirements for load bearing units? (2 Marks)

d) Coarse aggregate is placed in a rigid bucket and rodded with a tamping rod to determine its unit weight. The following data are obtained: Volume of bucket = 9.44 L

Weight of empty bucket = 8.39 kg

Weight of bucket filled with dry rodded coarse aggregate:

Trial 1 = 25.03 kg

Trial 2 = 26.82 kg

Trial 3 = 24.23 kg

iii. Calculate the average dry-rodded unit weight. (4 Marks)
iv. If the bulk dry specific gravity of the aggregate is 2.630, calculate the percent voids between aggregate particles for each trial. (4 Marks)

REFERENCE MATERIALS

Table 1: Minimum Compressive Strength of Masonry Units Based on Net Area Compressive Strength – ASTM Requirements

	Minimum Compressive Strength Based on Net Area MPa	
Type	**Average of Three Units**	**Individual Units**
Load bearing	13.1	11.7
Non–load-bearing	4.1	3.5

Table 2: Coarse Aggregate Grading Requirements for Concrete based on ASTM C33

		Amounts Finer Than Each Laboratory Sieve (Square Openings), Weight Percent												
Size No.	**Nominal Size**	**100 mm**	**90 mm**	**75 mm**	**63 mm**	**50 mm**	**37.5 mm**	**25.0 mm**	**19.0 mm**	**12.5 mm**	**9.5 mm**	**4.75 mm**	**2.36 mm**	**1.18 mm**	**0.3 mm**
1	90 to 37.5 mm	100	90 to 100	...	25 to 60	...	0 to 15	...	0 to 5	...	...	...	...	...	...
2	63 to 37.5 mm	...	...	100	90 to 100	35 to 70	0 to 15	...	0 to 5	...	...	...	...	...	...
3	50 to 25.0 mm	...	...	...	100	90 to 100	35 to 70	0 to 15	...	0 to 5	...	...	...	...	...
357	50 to 4.75 mm	...	...	...	100	95 to 100	...	35 to 70	...	10 to 30	...	0 to 5	...	...	...
4	37.5 to 19 mm	...	...	...	...	100	90 to 100	20 to 55	0 to 15	...	0 to 5	...	...	...	...
467	37.5 to 4.75 mm	...	...	...	...	100	95 to 100	...	35 to 70	...	10 to 30	0 to 5	...	...	...
5	25.0 to 12.5 mm	...	...	...	...	...	100	90 to 100	20 to 55	0 to 10	0 to 5	...	...	...	...
56	25.0 to 9.5 mm	...	...	...	...	...	100	90 to 100	40 to 85	10 to 40	0 to 15	0 to 5	...	...	...
57	25.0 to 4.75 mm	...	...	...	...	...	100	95 to 100	...	25 to 60	...	0 to 10	0 to 5	...	...
6	19.0 to 9.5 mm	...	...	...	...	...	...	100	90 to 100	20 to 55	0 to 15	0 to 5	...	...	...
67	19.0 to 4.75 mm	...	...	...	...	...	...	100	90 to 100	...	20 to 55	0 to 10	0 to 5	...	...
7	12.5 to 4.75 mm	...	...	...	...	...	...	...	100	90 to 100	40 to 70	0 to 15	0 to 5	...	...
8	9.5 to 2.36 mm	...	...	...	...	...	...	...	...	100	85 to 100	10 to 30	0 to 10	0 to 5	...
89	9.5 to 1.18 mm	...	...	...	...	...	...	...	...	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5
9*	4.75 to 1.18 mm	...	...	...	...	...	...	...	...	...	100	85 to 100	10 to 40	0 to 10	0 to 5

*Size number 9 aggregate is defined in Terminology C 125 as a fine aggregate. It is included as a coarse aggregate when it is combined with a size number 8 material to create a size number 89, which is a coarse aggregate as defined by Terminology C 125.