Part B: Long Answer Questions 1-8: 40 *points*

B1.

(a) What is the structural steel type is associated with "Weathering" steel. *1 mark*

Type C A, R

(b) What is the complete ASTM standard designation used to describe the material test for compression for concrete? *1 mark*

ASTM · C139 Compression test for concrete cylinders C-39

(c) What is the designation listing for the most common aluminium alloy for structural use? *1 mark*

AT-6061 – T6

(d) Steel is defined as containing what percentage of carbon? *1 mark*

0 → 2.11 % OH

(e) Is there a difference between cold working and strain-hardening? *1 mark*

There is no difference, both increase strength and lower ductility. OH

2

B2. Using the tables provided at the end of this mid-term, design an appropriate concrete mix to a target strength of 40 MPa and a target slump of 75 mm for seven cylinders of concrete with diameters 100 mm and a height of 200 mm. Your mix should satisfy the following properties;

Coarse Aggregate:
Maximum aggregate size of 10 mm
Specific Gravity = 2.675
Density = 1600 kg/m3

Fine Aggregate:
Specific Gravity = 2.618
Fine Modulus = 2.98

Cement Type:
Type = 10 / GU
Specific Gravity = 3.14

Water content adjustment due to the natural moisture in the aggregates is not required; therefore, you do not need the moisture content of aggregates. You will assume no air entraining admixtures will be added. And that the exposure class is inherent in the specified concrete strength. State all assumptions. You may continue your answer on the next page. *5 marks*

① Air & water
② strength
③ w/c ratio
④ weight cement
⑤ Coarse
⑥ Fine

① Table 12-5
Using Slump, non-air entrained, NMAS
water = 228 kg/m³ concrete
Air = 3%

② 12-11
over 35MPa so strength = 40+10 = 50 MPa

③ 12-3
know from 40→45 MPa
decrease by -0.04
ASSUME same decrease
from 45-50MPa
50: ratio = 0.34 water

④ $\frac{228\ kg}{0.34} = 670.588\ kg$ cement

⑤ Coarse using 12-4, NMAS, Fine Mod.
$\frac{0.44\ m^3\ coarse}{m^3\ concrete} \cdot \frac{1600\ kg}{m^3} = 704\ kg/m^3\ concrete$

⑥ $Fine = 1 - \frac{1}{1000}\left(\frac{704}{2.675} + \frac{670.588}{3.14} + \frac{228}{1}\right) - 0.03$
$= 0.265\ m^3$
Show? mass = 693

Tot Density Concrete
≈ 2300 kg/m³ ☑

Cylinder volume = $\pi r^2 \cdot h$
$= 0.01099\ m^3$

B2. ctd.	Final Volumes (m^3)	Volume for 7 cylinders (m^3)
Cement	0.21356	0.002347
water	0.228	0.002506
Coarse	0.26318	0.002892
Fine	0.265	0.002912

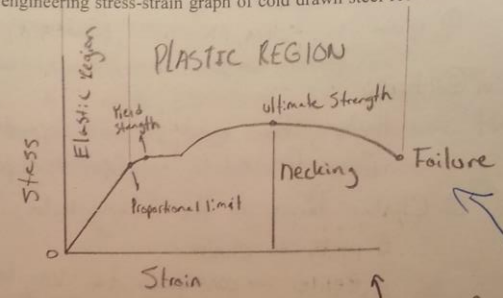
proportions? in mass? —1

$\frac{m^3 \text{ cement}}{m^3 \text{ concrete}}$

Some kind of stress/strain diagram ON FINAL

B3 Engineering stress-strain graphs are a way to characterize the mechanical performance of metallic materials.

(a) Draw a fully labelled engineering stress-strain graph of cold drawn steel rebar. *2 marks*

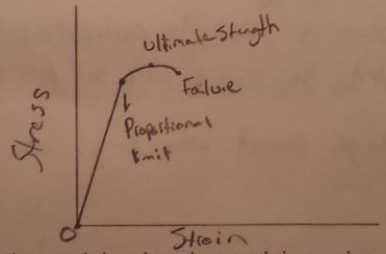


tch These

ys

This is for mild

(b) Draw a fully labelled engineering stress-strain graph of mild steel rebar. *2 marks*



OH.

← this is for cold drawn

(c) What might you do to these steels in order to improve their corrosion resistance? *1 mark*

Alloy them with copper b/c copper will oxidize, giving a thin "shield" on the outside of steel.

5

B4 Describe in detail the five steps of how Portland cement is fabricated? *5 Marks*

Cement

① quarry: Silica, Alumina, Limestone, Iron

② heat:
Heating the ingredients will separate Limestone into lime and CO_2. This is a very polluting process.

③ Clinker forms in the rotary kiln:
5 parts to clinker
i Belite → contributes to long term strength
ii Alite → contributes to high early strength
iii Aluminate → provides initial set, increases vulnerability to Sulphur at
iv Ferrite → Is not desired

④ Gypsum is added to control initial set reaction; if not added the cement will set as soon as water is added

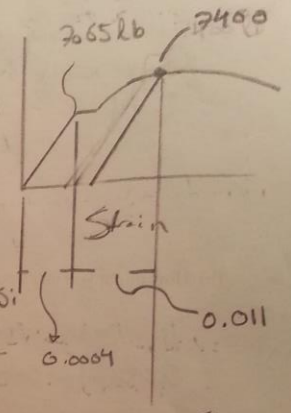
⑤ package cement into bags..etc and Shipped

/5

B6. A copper wire is 15.00 inches in length and 0.5 inches in diameter. Under tensile loading, it is noticed that plastic deformation starts when the load reaches 7,065 lbs. What is the yield strength of the copper? (in psi) When loaded to 7,400 lbs. the total (elastic + plastic) strain was 0.011 in/in. The wire was then unloaded. What is the length of the wire after unloading (in inches)? Assume Elastic modulus of copper = 16×10^6 psi. Assume engineering stress and strain. If you assumed true strain would your answer change? *5 points*

$L_o = 15''$, $r = 0.25''$ } Cross-sectional area $= \pi \cdot 0.25^2 = 0.01963\ in^2$

$E = \frac{\text{Stress}}{\text{Strain}}$ $E = 16 \times 10^6$ psi



@ 7065 lb

Strain $= \frac{\text{Stress}}{E} = \frac{7065}{16 \times 10^6} = 0.00044156\ in/in$

yield strength $= \frac{7065}{0.01963} = 35981.749\ psi = 3.60 \times 10^3\ psi$

$0.011 = 0.0004156 + \text{plastic strain}$

plastic strain $= 0.0104844$

$\text{Strain} = \frac{\Delta L}{L_o}$

$\Delta L = L_o \cdot \text{Strain}$

$= 15'' \cdot 0.0104844\ in/in$

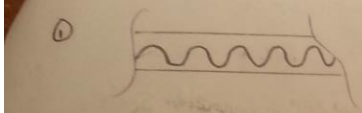
$= 0.157266''$

$\therefore$ new length of wire $= \Delta L + L_o = 15.16''$

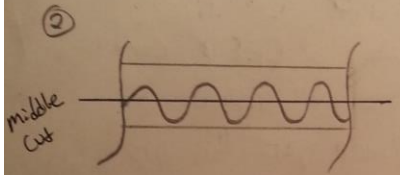
If true strain was assumed the answer would change b/c true strain and engineering strain are different at high stress

B7. How is a cellular steel beam manufactured? *5 Marks*

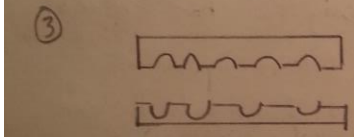
Cellular beam is made by: ① cutting a sinsoidal pattern down the center of one steel beam



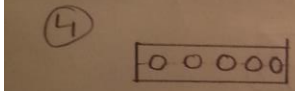
② Straight cut down centre of beam to create half circles in each piece



③ seperate and offset the two pieces



④ weld adjacent edges together



A

CIVE 2700B
Civil Engineering Materials
October 15th 2014
Midterm

Student ID Number: [redacted]
Student Section Numb...
Instructor: Dr. John Gales

Score 41 / 45

Time Allowed: 80 minutes
Only Materials Allowed: Pen/pencils, eraser, ruler, non-programmable calculator allowed. Answer all questions. Put your answer on this paper in the spaces provided.

Part A: Questions 1-5 worth one mark each: 5 *points*
For the following statements, circle the response that you think is correct. Circle **T** if you think the statement is TRUE or **F** if you think the statement is FALSE. If the statement is false, circle the false text and correct it in the space provided below.

		Q #	Statement water reducer
T	(F)	A1	A ~~thickener~~ admixture is specified for concrete casts where reinforcement is congested. ✓
(T)	F	A2	The most useful test in the Cardington series advanced our knowledge of concrete building behaviour in fire conditions. ✓
T	(F)	A3	They key to making a Portland cement mix that resists attack from sulfates is to ~~increase~~ decrease the ~~alite (C3S)~~ aluminate content of the Portland cement. ✓
(T)	F	A4	General use/purpose cement in Canada is called Type 10. In the United states it is called Type I. Type 10/GU ✓
T	(F)	A5	Post-tensioning of reinforcing steel bars or strands is performed ~~before~~ after concrete is in place. ✓

A 5
1 2
2 4
3 5
4 5
5 5
6 5
7 5
8 5
41