الجامعة التكنولوجية

قسم هندسة البناء والإنشاءات

المرحلة الأولى

العـدد :

التاريخ : 13 /6/ 2015

الى / السيد معاون رئيس القسم

م/ الاجابة النموذجية لمادة (تكنولوجيا مواد البناء 2)

تحية طيبة .....

نرفق لكم طياً نسخة من الأسئلة الخاصة بمادة تكنولوجيا مواد البناء 2 و للإمتحان النهائي للفصل الدراسي الثاني – الدور الأول و للعام الدراسي 2014 – 2015 و الذي تم اجراءه بتاريخ 2015/6/13 مع الاجابة النموذجية الخاصة بها.

مع التقدير

أ.م.د. قيس جواد فريح

مسؤول المرحلة الأولى

13 /6/ 2015

نسخة منه الى/

- ملف اللجنة الامتحانية

University of Technology
Building and Construction Engineering Department
Final Exam 2014-2015

Subject: Material Technology 2
Class: All
Examiner: -

Year: First
Time:3 hours
Date: 13 / 06 /2015

Note: Answer only four questions

Q1/ Data shown below are obtained during tensile test for shaft sample. If the original diameter of the bar is 17mm, its diameter at breaking is 11.5mm, and the gauge length is 200mm, determine the followings:

1. Modulus of elasticity.
2. Modulus of toughness.
3. Maximum load that the shaft can carry without failure.
4. Ductility of the shaft.
5. Yield point

(25%)

Stress, N/mm^2	75	150	225	300	375	450	525	600	450
Strain,mm/mm	0.003	0.006	0.01	0.0125	0.015	0.018	0.05	0.075	0.225

Q2/The following data were obtained during the tensile strength test of mild steel circular bar 13mm diameter:

a. Stress at the point specified maximum permanent deformation =265 N/mm^2
b. Max. load = 65000 N
c. Diameter of the bar at the section where failure occurred = 8.1mm
d. Stress at failure = 350 N/mm^2
e. Maximum elastic strain = 0.0015

Determine:

1. Modulus of elasticity
2. Modulus of resilience
3. Ultimate Strength
4. Percentage reduction in cross sectional area
5. The true breaking strength of the material

(25%)

Q3/ Complete these sentences:

a. The operation of burning in manufacture of clay bricks divided into the followings stages:
b. Composition of cast iron is
c. The raw materials of concrete bricks are:
d. During the manufacture of clay bricks most of the free moisture is removed during
e. The main uses of aluminum in civil engineering works are:

(25%)

Q4/ Differentiate between the followings:

a. Properties of Keen cement and properties quick lime
b. Hardness test and Izod test
c. Creep damage and creep failure
d. The effect of percentage of silicon and manganese on properties of steel
e. Properties of concrete bricks and properties of clay bricks.

Enhance your answers with required drawings

(25%)

Q5/A/ Explain briefly what is meant by:

a. Gypsum rock.
b. Stainless steel.
c. Manufacture of lime.
d. Excess of lime in clay bricks.

(15%)

Q5/B/ Explain briefly the manufacture of:

a. Sand lime bricks.
b. Lime.

(10%)

Typical answers

Q1/

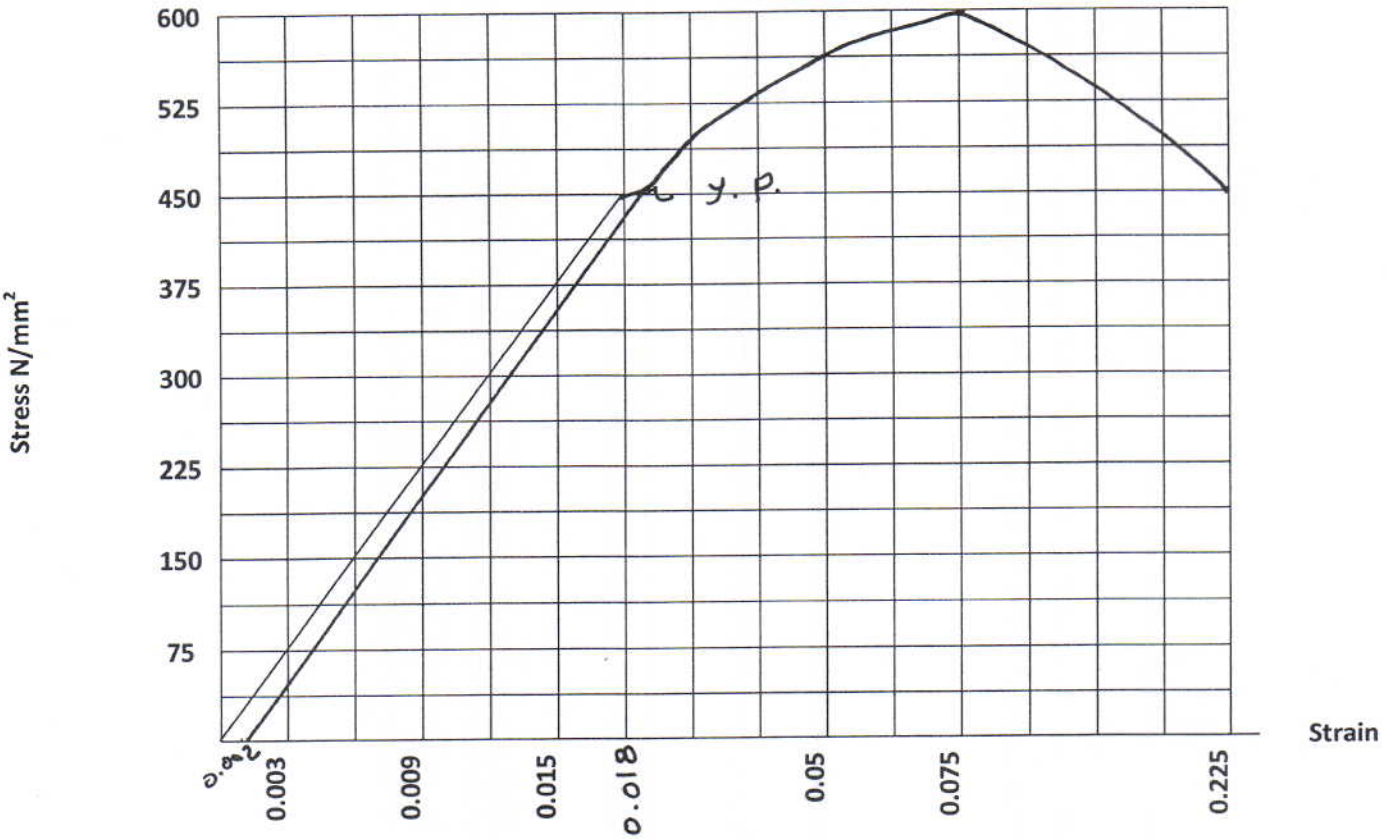


Fig. 1

a. Modulus of elasticity= $(\sigma_2-\sigma_1)/(\epsilon_2-\epsilon_1)=(450-0)/(0.018-0)=25000$ N/mm^2
b. Modulus of toughness $\angle$ 2/3 (ϵ_f * σ_f) $\angle$ (2/3)*450*0.225=67.5 N/mm^2
c. $A_0= \pi D^2/4= \pi*17*17/4= 227.3708$ mm^2
   So, Maximum load that the shaft can carry without failure = 600*227.3708 = 136422.5 N
d. % of elongation = 0.225*100% = 22.5%
   % reduction in area = $\{(A_0 - A_f)/ A_0\} * 100=$ (227.3708-104.0477)/227.3708*100% = = 54.2%
e. Yield point (0.019, 460)

Q2/

a. Modulus of elasticity= 265/0.0015= 176666.7 N/mm^2
b. Modulus of resilience = 1/2 ($\epsilon_{P.L.}$ * $\sigma_{P.L.}$) = ½(265*0.0015) = 0.19875 N/mm^2
c. Ult. Str. For apparent stress – strain curve = max. Load/ A_0
   A_0= π*13*13/4= 132.96 mm^2
   So, Ult. Str.= 488.86 N/mm^2
d. % reduction in area = {($A_0 - A_f$)/ A_0} * 100= (132.96-51.618)/132.96*100%
   =61.17%
e. True breaking strength = 65000/51.618 = 1259.25 N

Q3/

a. water smoking , dehydration, and oxidation
b. iron – 92-95%, Carbon – 2- 4.5 %, Silicon- 1-3 %, sulpher, phosphorus and manganese in varying proportions
c. Portland cement and aggregate. Typical aggregate include sand, gravel, crushed stone and blast furnace slag.
d. drying stage.
e.

1) It is most suitable for making door and window frames, railings of shops and corrugated sheets for roofing system.
2) Aluminum sheets are used over doors in bathrooms to protect them from getting rot and for stamping into a variety of shapes.
3) Aluminum powder is used for making paint.
4) Aluminum is extensively used in making parts of internal combustion engine, airplanes, utensils and packing's for medicines, chocolates, etc.

Q4/

a.

Properties of keen cement:

a. Its set is extremely slow, usually between 1-7 hours.
b. It gains in strength very gradually, but ultimately attains a great degree of hardness and a strength exceeding that of any ordinary gypsum plaster.
c. Its plasticity is high.
d. Its resistance to water is higher than ordinary plaster.

Properties of quick lime:

1. Plasticity:

The term "plasticity "is commonly used to describe the spreading quality of the material of the material in plastering. If it spreads easily and smoothly, it is plastic, if it sticks under the trowel, or cracks, and drops behind the trowel, it is non plastic.

2. Sand- carrying capacity:

Practically all lime used structurally is made up in the form of mortar by the addition of sand to lime paste for the following reasons:

a. Sand is cheaper than lime.
b. To diminish the great shrinkage which accompanies the setting and hardening of lime, and to prevent the consequent cracking.
c. To counteract the extreme stickiness' of some high- calcium limes.

It is important that the "sand- carrying capacity" of the lime be properly established. If too little sand is used, excessive shrinkage will cause a weakening of bond between the plaster or mortar and the masonry materials or plastered surface. On the other hand, too much sand produces a non plastic and weak mortar.

3. Setting time:

The setting of lime and lime mortar is a chemical process involving the evaporation of the large excess of water used in forming the lime paste, followed by the gradual replacement of the water of hydroxide by CO2 in the atmosphere, causing the lime hydrate to revert to the original calcium carbonate.

$$CaO + H2O \rightarrow Ca(OH)2$$

$$Ca(OH)2 + CO2 \rightarrow CaCO3 + H2O$$

4. Tensile and compressive strength of lime mortars:

The physical properties of lime mortar vary with the:

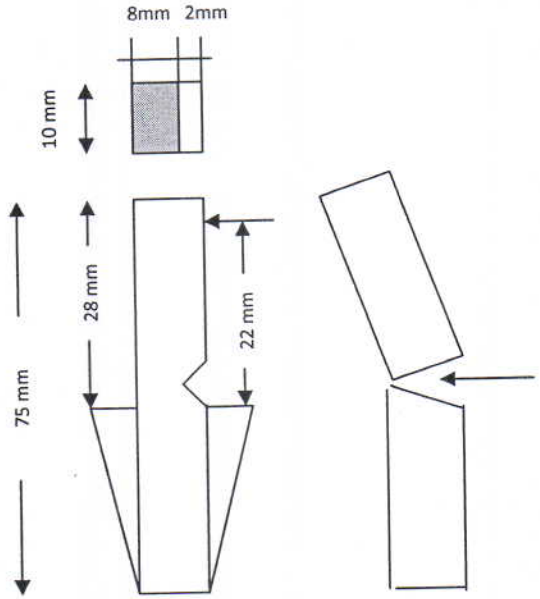
a. Chemical composition of the lime: Magnesia lime makes it stronger than calcium limes.
b. Character of the sand: Fine sand makes stronger mortar than coarse sand.
c. The amount of water: Suitable amount of water produces stronger lime mortar.

d. The conditions under which the mortar sets: The humidity and amount of CO2 in the atmosphere influence the rate of setting of lime drying the air and charging it with carbon dioxide, greatly accelerating the setting process.

b.

Izod method

For tough metals the notched Izod type of specimen tested as a cantilever is used. For extremely brittle metal that test specimen requires no notched, because the first suddenly applied stress causes a brittle failure.



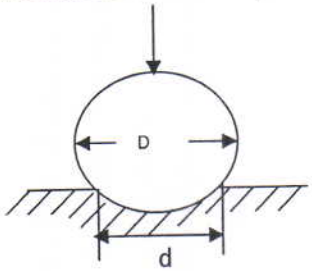
Fracture surface

Hardness

Hardness is resistance to plastic deformation. Thus a hard material may have a high elastic limit. Other meanings are given to term, however, such as resistance (1) to abrasion, (2) to scratching, or (3) to indentation of a cone or ball.

Hardness of metals is determined by measuring the resistance to penetration of a ball, cone, or pyramid. The brinell method is based upon determining the resistance offered to indentation by a hardened sphere that is subjected to a given pressure. The pressure used in testing steel is 3000 kg and a diameter of the ball is 10mm. When softer materials a pressure of 500 kg is used. Brinell numbers can be computed by the formula:

$$BHN = 2P/\pi D(D - (D^2 - d^2))$$



Where P- pressure in kg

D- Diameter of the ball

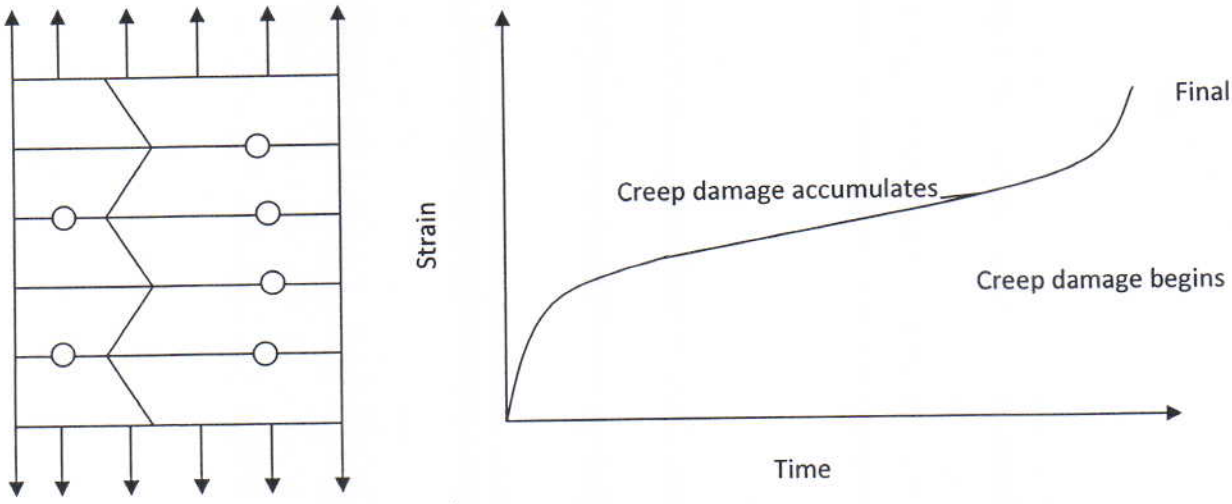
d- Diameter of the impression, mm

The harder the steel, the smaller the indentation under the load and the greater the BHN.

c.

Creep damage and creep fracture:

During creep, damage, in the form of internal cavities, accumulates. The damage first appears at the start of the tertiary stage of the creep curve reflects this as the holes grows. The section of the sample decreases and (at constant load) the strains goes up and the creep rate goes up even faster than the stress does.



d.

The effect of silicon:

If percentage of silicon is less than 0.2%, it has no appreciable effect on physical properties of steel, but when silicon content is between 0.3-0.4%, the strength and modulus of elasticity are increased without decreasing ductility.

The effect of manganese:

When the manganese content is between 0.3-1 %, it helps to improving the strength of mild steel, but when it's content exceeds 1.5%, the steel becomes brittle and losses it's structural value.

e.

Properties of concrete bricks:

a. The using of these bricks save time and effort as brick are light in weight and big in size.
b. These bricks give good bonding with plastering materials used in their construction.
c. These bricks have accurate size and shape.
d. These bricks can produced with various bearing capacity according to the cement content used in their production.
e. The weight of bricks can be controlled by varying the size of openings.

Properties of clay bricks:

The raw materials and the manner and degree of burning influence the physical properties greatly and therefore wide ranges in values are to be expected for each property.

Q5/A

a.

Pure gypsum is a hydrous lime sulfate ($CaSO_4 . 2H_2O$), the composition of which by weight is:

Lime sulfate

- Lime CaO – 32.6%
- Sulfur trioxide SO_3 – 46.5%

Water H_2O – 20.9

Total = – 100 %

Natural deposit of gypsum are very seldom pure, the lime sulphated being adulterated with silica, alumina, iron oxide, calcium carbonate and magnesium carbonate. The total of all impurities varies from a very small amount up to a maximum of about 6%.

b.

Stainless steel:

Stainless steel is a very common alloy with approximately 10-20% chromium, and less than 1% nickel. The chromium protects the steel from oxidation. Stainless steel can be sterilized in high pressure steam without deforming, making it very useful for food and medical applications.

Properties:

1) low carbon steel (0.2-2.1) %
2) high strength and elongation
3) good welding
4) non-magnetic, G.S = 8
5) long time shiny surface
6) low thermal expansion

Uses:

7) kitchen tools
8) for architectural uses
9) all structural works with rust attack
10) does not need surface finish

c.

Manufacture of lime – Theory of calcinations:

The burning or calcinations of lime accomplishes three objects:

a. The water in the stone is evaporated.
b. The lime stone is heated to the request temperature for chemical dissociation.
c. The CO_2 is driven off as a gas, leaving the oxides of calcium and magnesium.

d.

Excess of lime:

Excess of lime makes the colure of the brick yellow instead of red. Lumps of limestone remaining in the finished brick are undesirable because, when such a brick comes in contact with water, lime will begin to slake. During slaking, lime expands and also generates heat. Due to this, stresses will be produced, which will result in producing cracks in bricks.

Q5/B

a.

Manufacture of sand lime bricks:

a. Sand, lime and pigment are taken in suitable proportions and they are thoroughly mixed with a required quantity of water.
b. The material is then molded in the shape of the bricks under mechanical pressure (150-200 kg/cm^2).
c. Bricks are then placed in closed chamber and subjected to saturated steam pressure of about 8.5-16 kg/cm^2 for 6-12 hours to speed up the interaction between lime and sand. The process is known as autoclaving.

$CaO + H_2O + SiO_2 \rightarrow CaO.SiO_2.H_2O$ " Tobermorite " " Hydrous calcium silicate "

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

b.

Manufacture of lime – Theory of calcinations:

The burning or calcinations of lime accomplishes three objects:

d. The water in the stone is evaporated.
e. The lime stone is heated to the request temperature for chemical dissociation.
f. The CO_2 is driven off as a gas, leaving the oxides of calcium and magnesium.