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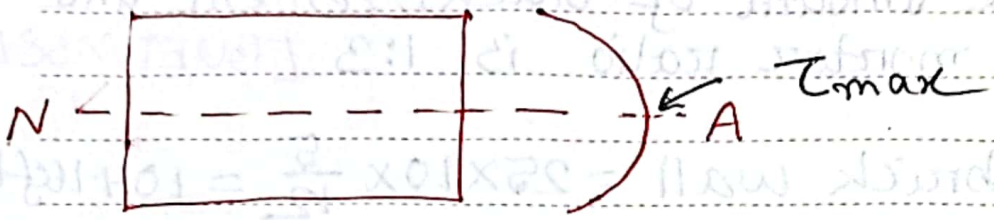
BSCIC AE 2023
MCQs (IBA)

(১)# নিরপেক্ষ অক্ষের কাছে stress কত থাকে?

Ans: সর্বোচ্চ (maximum)



(2) 1000 Sq.ft গাঁথুনির জন্য ইট লাগে?

Ans: volume $= 1000 \times \frac{5}{12} = 416.67$ cft

No of brick required $= \frac{416.67}{\frac{10 \times 5 \times 3}{12 \times 12 \times 12}} = 4800$ Nos

(৩) Spiral Column এ কতগুলো bar reinforcement bar থাকে?

Ans: 6 bars

(৪) BNBC 2020 অনুযায়ী earthquake zone?

Ans: 4টি

(৫) How many blows are in a standard Proctor test?

Ans: 25 blows

(১) প্রথম শ্রেণীর ইটের পানি শোষণ ক্ষমতা কত?

Ans: 15-20% of self weight

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~~(7) প্রথম শ্রেণীর হিসাব~~

(7) প্রাথমিক সেটিং টাইম কত- এর কম হওয়া উচিত নয়?

Ans: 45mins

(8) লিকুইড লিমিট কিসের সাহায্যে পরীক্ষা করা হয়?

Ans: Casagrande apparatus

(9) Tri-axial Test কোন ধরনের জিনিসের জন্য করা হয়?

Ans: soil

(10) স্লাবের প্রধান reinforcement এর maximum spacing কত?

Ans: 18inch or 3h

(11) এক বস্তা সিমেন্টের জন্য 0.50 হিসাবে কতটুকু পানি দরকার?

Ans: 50kg x 0.5 = 25kg

(12) Inflection Point কী?

Ans: যেই point এ BMD এর value zero. এবং curve positive থেকে negative হয় & vice-versa

(13) Laminer flow তে Reynould's Number কত?

Ans: less than 2000

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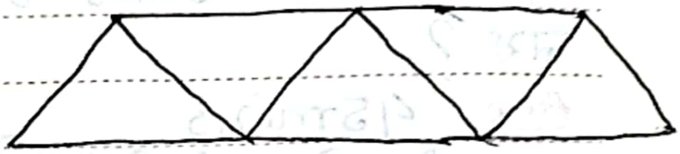
(14) যমুনা সেতুতে কী ধরনের ট্রাস ব্যবহার করা হয়েছে?

Ans: Warren Truss



(15) সার্ভেয়র চেইনের দৈর্ঘ্য কত?

Ans: 66ft

(16) Plinth লেভেলের উপরের structure কে কী বলে?

Ans: Superstructure

*** The portion of a structure between surface of ground and floor surface, immediately above the ground is known as Plinth.

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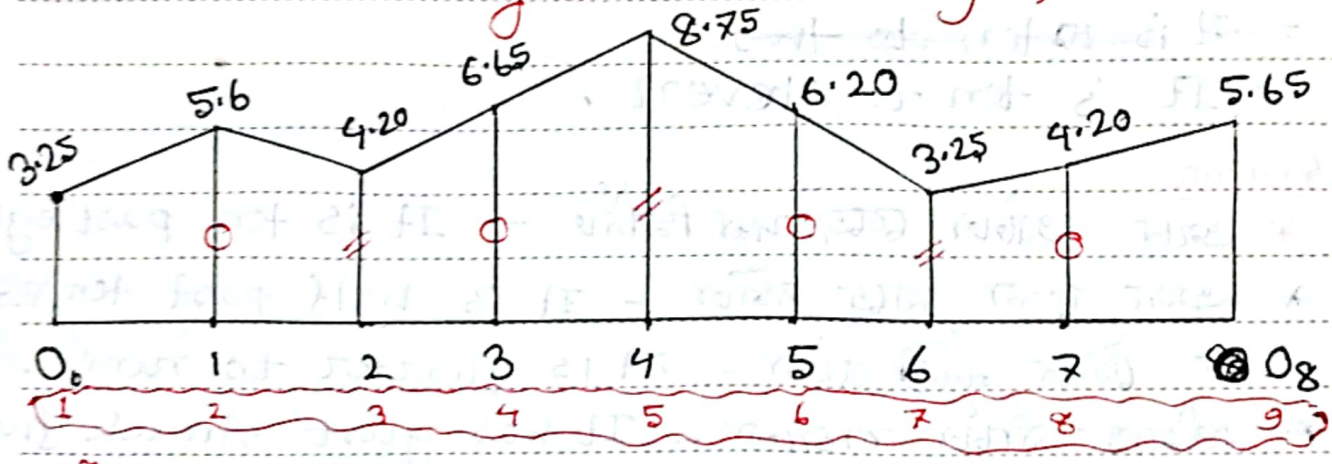
Non-25
(B, E, M, Gk)
Depth 45
Total 70 marks

* The following perpendicular offsets were taken at 10meters' intervals from a survey line to an irregular boundary line.



Sol^{n}: Area calculation by simpsons 1/3 rule -

$$A = \frac{d}{3}\left[(\text{first} + \text{last}) + 4*(\text{even sum}) + 2(\Sigma \text{odd})\right]$$

$$= \frac{10}{3}\left[(3.25 + 5.65) + 4(5.6 + 6.65 + 6.20 + 4.20) + 2(4.20 + 8.75 + 3.25)\right]$$

$$= 439.6767\ m^2$$

simpson's 1/3 rule apply করার সময় 9 টি ordinate থাকবে।

9 টি ordinate থাকলে 2 টি করে Trapezoidal rule.

$$\text{Area} = d\left[\frac{\text{first} + \text{last}}{2} + \text{বাকীগুলো}\right]$$

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* Calculate the critical depth and the corresponding specific energy for a discharge of $5.0 m^3/sec$ for rectangular channel of $B = 2.0 m$. Define froude's number.

Ans:

critical depth, $y_c = \left(\frac{Q^2}{gb^2}\right)^{1/3} = \left(\frac{5^2}{9.81 \times 2^2}\right)^{1/3}$

$= 0.86$

specific energy at critical depth $= (1.5 \times 0.8\ b)m$

$= 1.29\ m$

Froude Number:

The Froud Number is the ratio between fluid inertial forces and fluid gravitation forces.

Froude number is a dimensionless value that describes different flow regimes of open channel flow.

$$Fr = \frac{V}{\sqrt{gD}}$$

V = velocity
D = hydraulic depth

When, $Fr = 1 \rightarrow$ critical flow

$Fr > 1$ supercritical flow

$Fr < 1$ subcritical flow

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PSI unit ⇒ $V_{all} = \frac{4.8\sqrt{f'c}}{D}$

$f'c = \frac{fc}{0.45}$

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* A simply supported beam of rectangular size of L = 6m and carrying uniform load is 34.34KN including its own weight if b = 250mm and effective depth d = 500mm, reinforcement 3-25mm ϕ rebar. Show whether it is safe at Bond stress Given, n = 10; fc = 9.26MPa, fs = 140MPa

Sol^n

Maximum shear force in the beam, $V = \frac{wL}{2}$

$V = \frac{34.34 \times 6}{2}$

$= 103.02KN$

$= 103.02 \times 10^3 N$

Bond stress, $U = \frac{V}{n\pi D \times jd}$

$= \frac{103.02 \times 10^3}{3\pi \times 25 \times 0.862 \times 500}$

$= 1.008MPa$

D = bar dia
d = effective depth of beam

n = no. of bar

$k = \frac{n}{n + \frac{fs}{fc}}$

$= \frac{10}{1 + \frac{140}{9.26}}$

$= 0.398$

$j = 1 - k/3$

$= 1 - 0.398/3$

$= 0.862$

Allowable bond stress, U_{all}

$= \frac{10.12\sqrt{f'c}}{D}$

$f'c = \frac{fc}{0.45}$

$= \frac{9.26}{0.45}$

$= 20.578$

$= \frac{10.12 \times \sqrt{20.578}}{25}$

$= 1.836MPa > 1.008MPa$

∴ This beam is safe at bond stress (Ans)

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Short Questions

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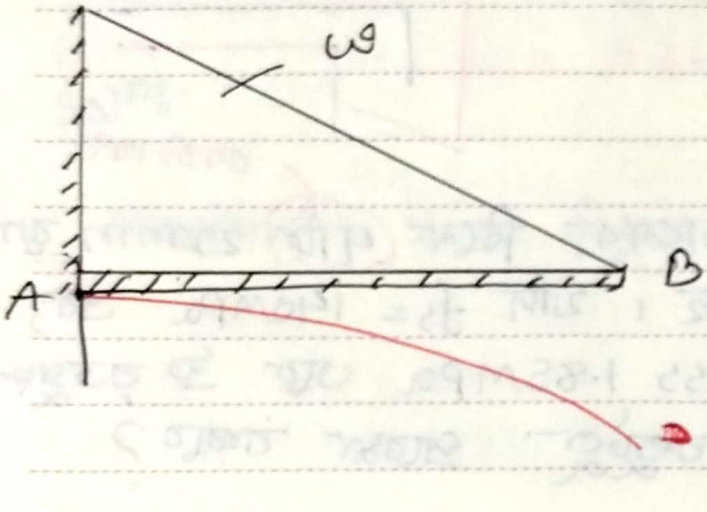
1 mark

* A cantilever beam of length l carries a gradually varying load from zero at the end and w per unit length at the fixed end. What would be the maximum deflection and where?



maximum deflection $\frac{WL^4}{30EI}$ and it occurs at free end.

$$y_B = \frac{WL^4}{30EI}$$

* Write down advantages of plane table surveying.

⇒ Plane table Surveying :

→ Plane table surveying is one of the most rapid methods of surveying. The plane table is an instrument used for surveying by a graphical method in which the fieldwork and plotting are done simultaneously.

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→ The main advantage of plane table surveying is that the topographic features to be mapped are in full view. It is most suitable for small and medium-scale mapping. (1:10000 to 1:250000)

Advantages of Plane Table Survey:

→ The observations and plotting are done simultaneously, hence there is no risk of omitting necessary details.

→ The errors in plotting can be checked by drawing check lines.

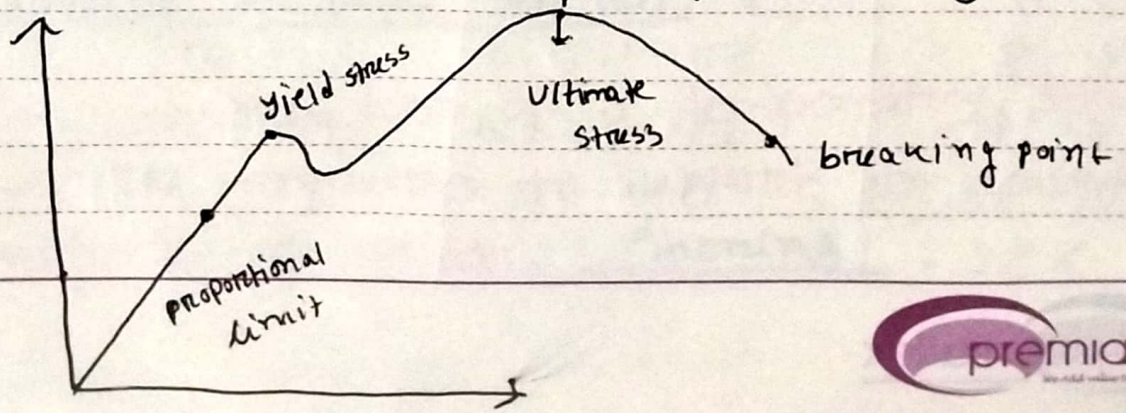
→ Irregular objects can be plotted accurately

→ It is one of the most rapid methods of surveying.

→ less costly.

*What are the sequences of stress-strain diagram for a mild steel under tensile test?

Ans: Proportional limit > elastic limit > yield stress point > Ultimate stress point > breaking point.



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* A partially saturated soil V = 700cc and weight w = 854g. Dry weight 765gm. specific gravity of dry soil 2.67. Find void ratio, porosity, water content and percent saturation.

Soln:

$$\gamma_d = \frac{765}{700} = 1.09 \text{ gm/cc} \qquad \gamma_w = 1 \text{ gm/cc}$$

again, $\gamma_d = \frac{G_s \gamma_w}{1+e}$

$$\Rightarrow e = \frac{G_s \gamma_w}{\gamma_d} - 1 = \frac{2.67 \times 1}{1.09} - 1$$

$$= 1.45$$

water content, $w = \frac{W_s - W_d}{W_d} = \frac{854 - 765}{765} = 0.116$ A

$$n = \frac{e}{1+e} = \frac{1.45}{1+1.45} = 0.59 \quad \text{A}$$

$Se = wG_s$

$$\Rightarrow S = \frac{wG_s}{e} = \frac{0.116 \times 2.67}{1.45} = 0.21 \quad \text{A}$$

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* What effects seen in Bricks when excess of alumina presents in the clay fore making bricks.

→ Alumina imparts plasticity to the earth so that it can be molded.

→ If excess amount of alumina presents in brick, it may causes shrinkage and warp during drying and burning.

→ good brick earth should contain 20-30% of Alumina.

Good to Know:(Silica)

→ Good brick earth should contain 50-60% of- silica.

→ It prevents cracking, shrinking and wrapping of raw bricks

→ Silica imparts uniform shape to the bricks

→ Excess of silica makes the bricks brittle.

* Shape factor depends on only on the geometry of the section.

* The construction of a temporary structure structure required to support an unsafe structure is called Shoring.

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* An under reinforced section means yield strain of the steel occurs at loads lower than the load at which the failure strain of the concrete occurs.

* No treatment of sewage is done if the dilution factor is more than 500.

* CPM (critical Path Method) ৭ critical activity ৫০ total float ৫০ মান ২৫০ zero.

* একটি rectangular beam ৫০ maximum shear stress ৫০; এবং shear stress ৫০ অনুপাত 1.5:1 হলে।

* Very soft clay ৫০ unconfined compressive strength less than 25 KPa.

Good to know:

N value	S. Cu	type
<2	<25 KPa	very soft
2-4	25-50 KPa	soft
4-8	50-100 KPa	medium
8-16	100-200 KPa	stiff
16-32	200-400 "	very stiff
>32	>400 "	Hard

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* The depressions and undulations in the pavement are caused due to —

→ improper compaction of subgrade
→ impact of heavy wheel loads
→ punching effect
→ flexible gears

* একটি channel section কিসের সমন্বয়ে গঠিত হয় ?

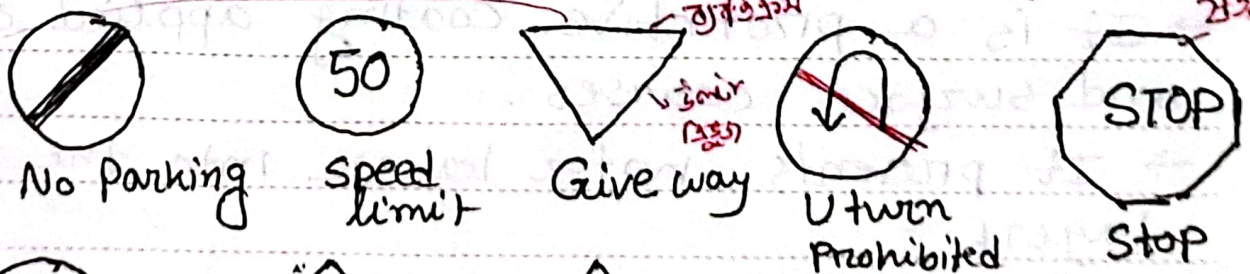
Geometric elements of open channels —

1) flow depth
2) depth of flow section
3) Side slope
4) Top width
5) wetted perimeter
6) Flow area
7) hydraulic depth
8) hydraulic radius
9) Bottom slope

* একটি slab এর gross sectional area এর minimum 0.18% reinforcement ব্যবহার করতে হয়,

* limit 0.18% to 1%

* Draw 5 mandatory traffic sign



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* information sign △
* Prohibition sign ○

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Differences between Prime coat, tack coat, seal coat.

Ans:

Prime Coat:

→ The coat of suitable bituminous binder applied over a non bituminous granular base as a preliminary treatment before the application of bituminous surfacing.

→ It provides adhesion between bituminous and granular course.

Tack Coat:

→ It is a thin layer of liquid bituminous binder of low viscosity ~~to ensure~~ between existing and new asphalt layer.

→ It provide adequate interface bond between the existing pavement surface and new asphalt layer.

Seal Coat:

→ It is a protective coating applied on base and surface courses.

→ It prevents water leakage into the pavement layers.

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* 7 মিটার প্রস্থের একটি সড়কে গাড়ির সর্বোচ্চ ডিজাইন গতিবেগ 80 কিমি./ঘন্টা নিরাপদ সীমিত ব্যাসার্ধ 400 মিটার ব্যাসার্ধের বাঁকের জন্য সুপার এলিভেশনের পরিমাণ নির্ণয় করুন। (ঘর্ষণ সহগ বিবেচ্য নয়)

Sol^n: $e = \frac{v^2}{gR}$

$\Rightarrow e = \frac{(22.22)^2}{9.81 \times 400}$

$= 0.126$

$V = 80 \text{ kmph}$
$= 22.22 \text{ m/s}$

$\therefore$ Total superelevation $= (0.126 \times 7)\text{m}$
$= 0.882\text{m}$ A

CPGCBL-2023

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Tech-40, Non Tech-60

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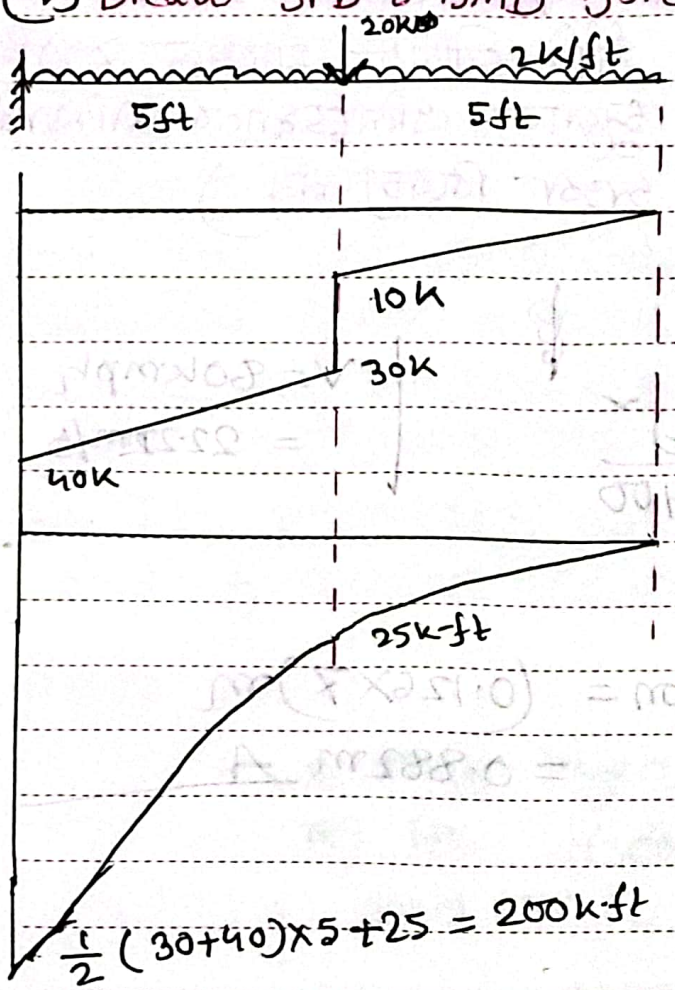
(1) Draw SFD & BMD for the following beam -



(2) Write down ACI code specifications for the minimum thickness of non-prestressed one way slabs, and the minimum ratios of temperature and shrinkage reinforcement in slabs based on gross concrete area.

Soln: Minimum thickness for one-way slabs —

(i) Simply supported = $\frac{l}{20}$

(ii) one end continuous = $\frac{l}{24}$

(iii) both end continuous = $\frac{l}{28}$

(iv) Cantilever = $\frac{l}{10}$

l = length of slab

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Minimum ratios of temperature and shrinkage reinforcement in slabs based on gross concrete area —

(i) for 40 grade bar = 0.0020

(ii) for 60 grade bar = 0.0018

(iii) for greater than 60 grade bar = $\frac{0.0018 \times 60{,}000}{f_y}$

(3) Calculate the volume of each ingredients to make 15 cft concrete having cement : sand : Stone Chips = 1 : 1.75 : 3.50

see my Engineering materials note.

(4) State Darcy's Law. A 12m thick layer of stiff saturated clay (density = 1920 kg/m3) is underline by a saturated sand layer (density 1845 kg/m3). The sand layer is under artesian pressure of 7m of water. Determine the maximum depth of cut that can be made in the clay layer.

Soln:

Darcy's Law: The discharge velocity (v) through saturated soil mass is proportional to the hydraulic gradient (i)

$v \propto i$

$\Rightarrow v = ki$; where k = hydraulic conductivity

Maximum depth of Cut = $12 - \frac{7 \times 1000}{1920}$

$= 8.354$ m

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(5) Draw a neat cross section of a flexible pavement. ~~Name the effects of~~

Soln: See Transportation note.

(6) Name the effects of highway and traffic on the environment.

Ans:

→ Greenhouse effect & climate change
→ Global warming through emission of carbon dioxide
→ Air pollution by producing nitrous oxide and particulate matters.
→ Noise pollution from horn.
→ land consumption & landscape damage
→ Ecological degradation.

(7) What are the drinking water standard for each of the parameters - Arsenic, Iron, Manganese, chlorine & faecal coliform. Draw a neat sketch of the longitudinal section of a septic tank.

See Environmental Note

As - 0.05ppm
Fe - 0.3 ~ 1.0ppm
Mn - 0.1 ppm ***
Cl - 0.2mg/l
FC - 0N/100mL

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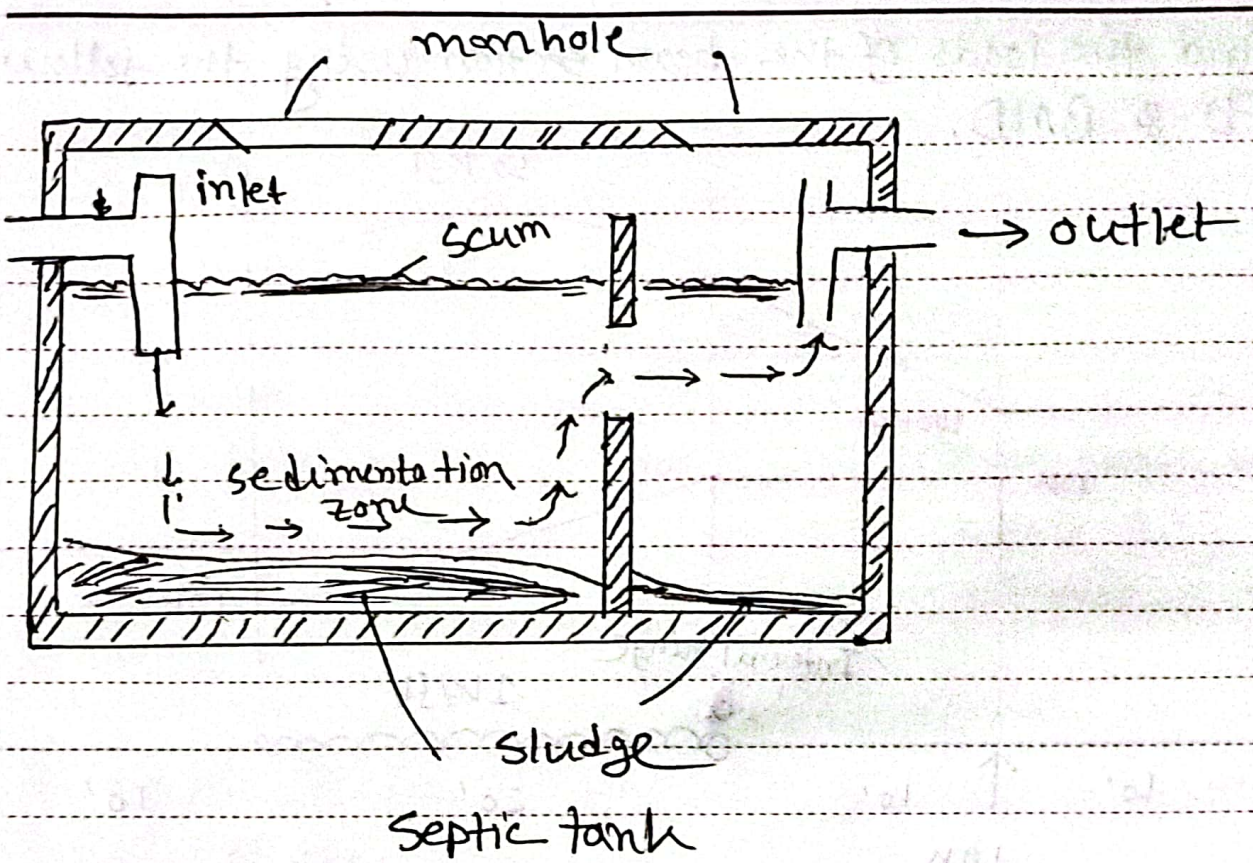

Septic tank

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WARPO

Tech – 70

Non-Tech – 20

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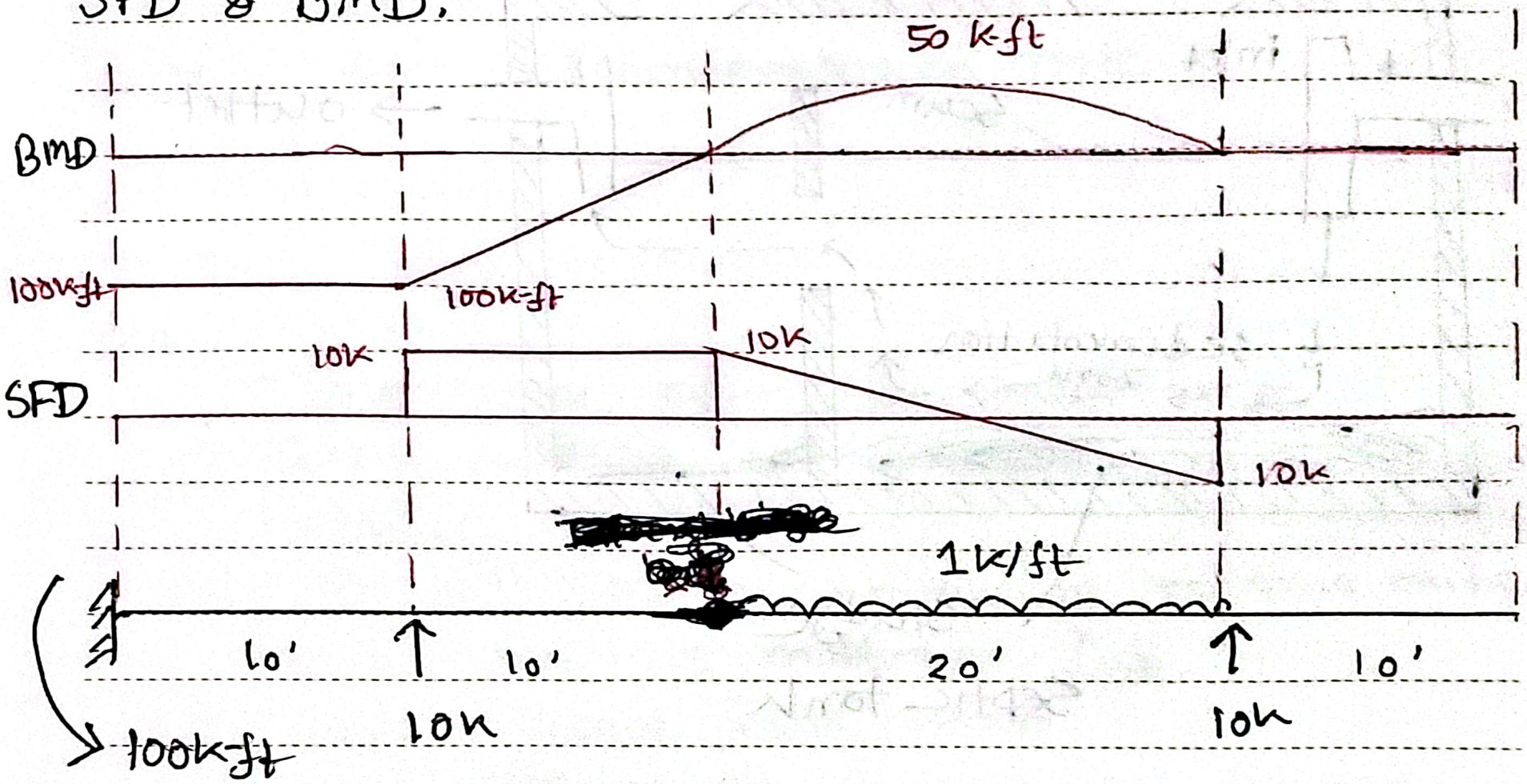
* Find the loads of the beam section using the following SFD & BMD.



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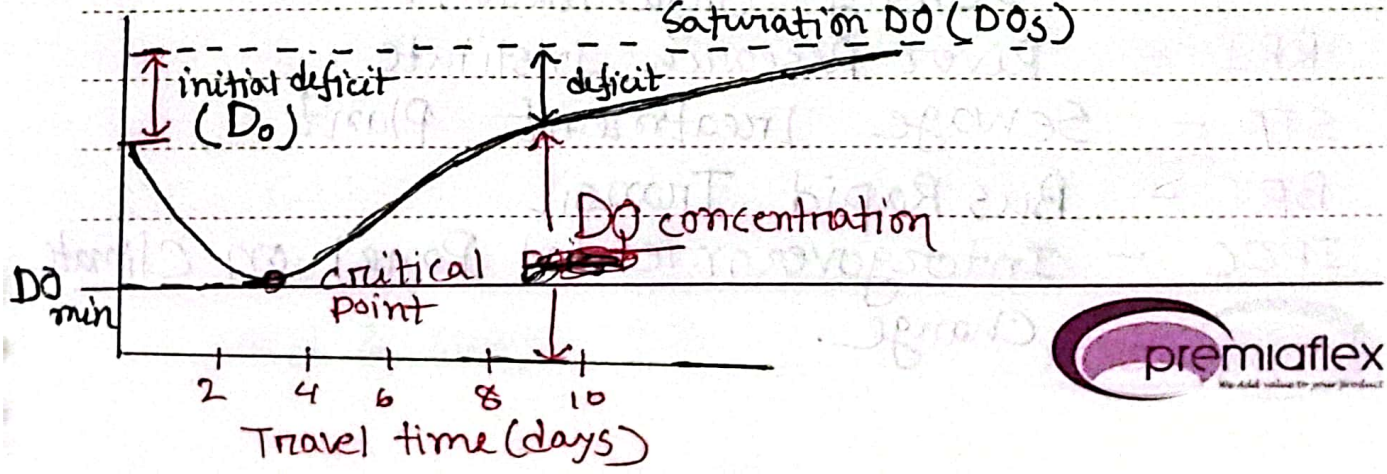
* Write down the clear covers of the following structural elements considering BNBC 2020.
(1) Beam (2) column (3) Footing (4) Retaining wall

Element	Clear cover
Beam	1.5"
Column	1.5" (above grade beam)
	3" (below GB)
Footing	3"
Retaining wall	2.5"

* Write down six laboratory tests to assess the quality of bituminous materials.
⇒ see my Transportation note.

* Draw contours with arbitrary values for a pond and a hill.
⇒ see my Surveying Note.

* Draw qualitative Dissolved oxygen variation curve in a flowing water body from a particular source of pollution.



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* The areas enclosed by the contours in a lake are as follows :

Contour (m)	270	275	280	285	290
Area (m^2)	2050	8400	16300	24600	31500

Calculate the volume of water between the contours 270m & 290m using the Prismoidal formula.

Soln: Contour interval, d = 275 - 270 = 5m

Volume by prismoidal formula

$$= \frac{5}{3}[2050 + 31500 + 4(8400 + 24600) + 2(16300)]$$

$$= 330250 m^3$$

* Simpson 1/3 এর Prismoidal সূত্রের formula

* Write the following abbreviated terms:

(a) ~~FFWC~~ -

FFWC - Flood Forecasting & Warning Centre

SPARRSO - Bangladesh Space Research & Remote Sensing Organization.

RRI - River Research Institute.

STP - Sewage Treatment Plant

BRT - Bus Rapid Transit

IPCC - Intergovernmental Panel on Climate Change.

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Write four major problems of using ground water as a source of water supply in Bangladesh.

→ Drying up of wells
→ groundwater becoming saline due to evaporatio
→ reduction of water in streams & lakes
→ land subsidence
→ decreasing ground water level

Write the expressing unit of the following parameters : (i) salinity (ii) Turbidity (iii) Hardness (iv) TDS

Soln:
(i) Salinity — µmhos/cm
(ii) Turbidity — NTU
(iii) Hardness — mg/L
(iv) TDS — mg/L

In a sieve analysis, 5% of the sample passe through 0.075mm sieve and 25% passes through 4.75mm sieve ; Determine the % of coarse and fine aggregates as well as silt and clay materials.

Ans: coarse aggregate = (100-25) % = 75%

Fine aggregate = (25-5) % = 20%

Silt & clay = 5%

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Draw qualitative gradation curves for a well-graded and a gap-graded aggregate sample

See my Engineering Materials note.

~~# Draw qualitative~~

During a soil test, SPT value was found to be 20, explain its meaning. As a site engineer, at what stage will you stop the SPT test ?

SPT N value 20 means, the number of blows required for 30cm (12 inch) penetration is 20.

I will stop the SPT test if →

(i) 50 blows are required for ~~300mm (12in)~~ any 150mm (6in) increament.

(ii) 100 blows are obtained for 300mm (12in) penetration.

(iii) 10 successive blows produce no advancement.

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Write the names of the test to be performed to obtain the gradation or texture of fine grained soils?

→ Sieve Analysis

→ Hydrometer analysis

Write three basic governing equations applicable for open channel flow as well as pipe flow.

→ ~~Continuity~~ Continuity equation ($A_1V_1 = A_2V_2 = \text{constant}$)

→ Bernoulli's equation

$$\left(\frac{p}{\rho g} + \frac{v^2}{2g} + h = \text{constant}\right)$$

$\frac{p}{\rho g}$ ↙ Pressure head

$\frac{v^2}{2g}$ ↘ Velocity head

h ↘ Potential head

→ Momentum equation,

Force = ~~Rate~~ rate of change of momentum

$F = \rho Q(V_2 - V_1)$

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What is rating curve ? Write the equation of a typical rating curve

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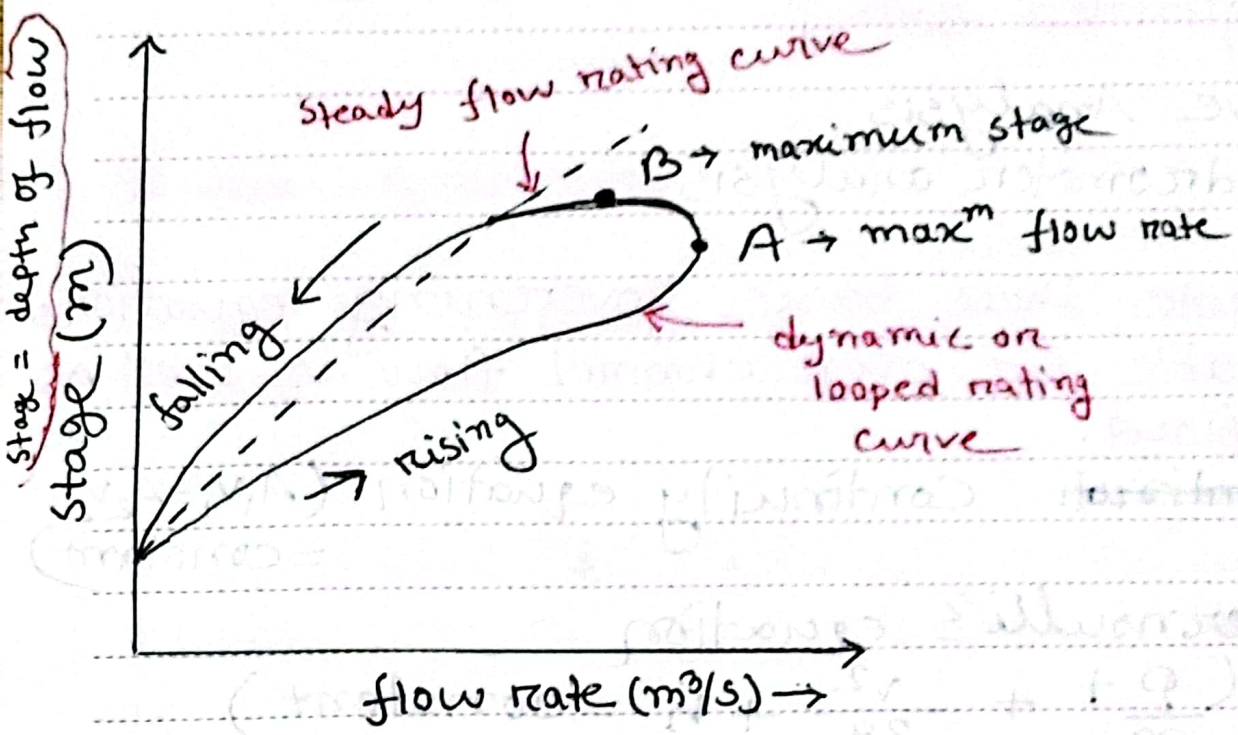
~~# Draw a typical flood hydrograph and a unit hydrograph for rivers of Bangladesh~~



Rating curve equation, $Q = C(h+a)^n$

Q = flow rate

a = stage as zero flow

h = stage height

C, n = constants

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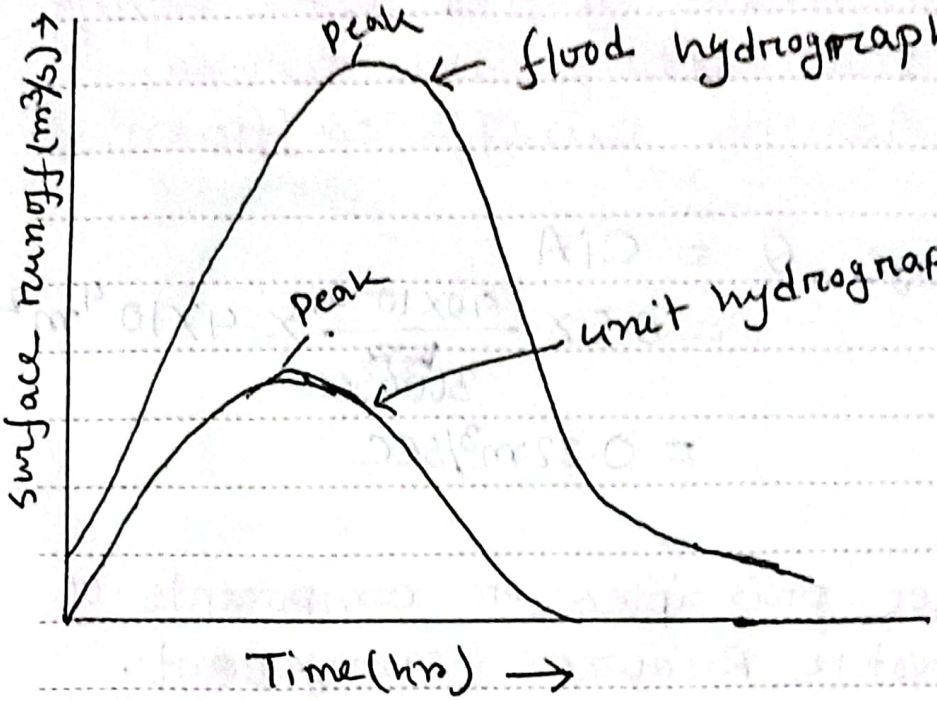
Draw a typical flood hydrograph and a unit hydrograph for rivers of Bangladesh.



Water requirement of a crop is 5mm/day and the growing period of the crop is 100 days. Calculate the total water requirement of the crop for an area of 2 ha considering water application and conveyance efficiency of 75% and 50%, respectively.

Soln: Total water requirement = $\frac{\frac{5}{1000} \times 100 \times 2 \times 10^4}{0.75 \times 0.50}$ m^3

$= 26666.67\ m^3$ water

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Calculate the drainage discharge in m^3/s to dispose the runoff generated from a catchment of 4 ha after having a 40mm/hr rain using the rational formula. Assume runoff coefficient of 0.5

Soln: discharge, $Q = CiA$

$$= 0.5 \times \frac{40 \times 10^{-3} m}{3600 sec} \times 4 \times 10^4 m^2$$

$$= 0.22 m^3/sec$$

Write three principles or components of Integrated Water Resources Management.

Soln:

→ Stormwater management
→ Wastewater treatment
→ Water supply
→ Conservation of existing water sources

Draw the qualitative stress-strain diagram of mild steel showing all its components.

See my RCC note

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The flow in (m^3/s) of a stream at a section in nine consecutive years are given below — 100, 110, 90, 75, 115, 120, 105, 95, 125. Calculate the 80% dependable flow of the stream.

Sol^n:

Flow(m^3/s)	Rank(m)	Probability, $P = \frac{m}{1+n}$
125	1	0.1
120	2	0.2
115	3	0.3
110	4	0.4
110	5	0.5
100	6	0.6
95	7	0.7
90	8	0.8
75	9	0.9

$n = 9$

$\therefore$ 80% dependable flow = $90 m^3/sec$ Ans

Write four names of the policies, plans, or acts related to water resources management of Bangladesh.

→ Bangladesh Water Act 2013
→ Bangladesh water Rules 2018
→ National water Management Plan (NWMP)
→ Flood Action Plan (FAP)
→ Integrated Coastal Zone Management Plan

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Write the major causes of riverbank failures in Bangladesh.

→ Geological factor : The low laying delta lands of Bangladesh offer little resistance to the hydraulic forces of its rivers during high flow period.

→ Sedimentation in the River beds : our rivers carry more than 1 billion tons of sediment every year and are responsible for the prevalence of flooding which eventually leads to riverbank failure.

→ Groundwater seepage also causes riverbank failure.

→ mature Stage of River : When rivers enter the mature stage (Ganges, Brahmaputra, Meghna) they become meander or braided. These oscillations cause massive riverbank failure.

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Non-24, Dept -36

Write short notes on (a) Standard Proctor Test (b) Curing on concrete (c) Rigid pavement (d) Flash point.

See my note. (Transportation)

Define BOD & COD - Which one is greater and why? If the BOD_5 at 20° of a sewage sample is 320 ppm, calculate ultimate BOD.

⇒ See environment note.

Take, $k_{20} = 0.2/day$

Determine ultimate pile capacity of clay soil when pile length is 30' and dia 15", $\alpha = 0.52$ with unconfined compressive strength 30kip/in^2.

$Q_u = \alpha C_u A_s + 9 C_u A_b$ (Nc)

$= 0.52 \times \frac{30}{2} \times \pi \times 15 \times 30 \times 12 + 9 \times \frac{30}{2} \times \frac{\pi}{4} \times 15^2$

$= 156180.35$ kip

CN_cA_b

Calculate the settlement of 2.5m clay layer due to increase of 30KN/m^2 pressure (Given $P_o = 130$ KN/m^2, $e = 0.80$ & $C_c = 0.28$)

$S = \frac{C_c}{1+e_o} H \log\left(\frac{\sigma + \Delta\sigma}{\sigma}\right)$

$= \frac{0.28}{1+0.8} \times 2.5 \times \log\left(\frac{130+30}{130}\right)$

$= 0.035m$

$= 35mm$ A

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Calculate the working moment capacity of a beam with dimension 12"×20" and 4 #7 bars in one row. $f'_c = 3.5$ksi & $f_y = 60$ksi.

$$n = \frac{E_s}{E_c} = \frac{29\times10^6}{57000\times\sqrt{3500}} \approx 9$$

Steel ratio, $\rho = \frac{A_s}{bd} = \frac{4\times\frac{\pi}{4}\times\left(\frac{7}{8}\right)^2}{12\times18.5}$

effective depth, $d = (20-1.5)"$
$= 18.5"$

$= 0.011$

$A_s = 4\times\frac{\pi}{4}\times\left(\frac{7}{8}\right)^2$
$= 2.405$

$\rho n = 0.011\times9 = 0.099$

$\therefore k = \sqrt{(\rho n)^2 + 2\rho n} - \rho n$

$= \sqrt{(0.099)^2 + 2\times0.099} - 0.099$

$= 0.357$

$j = 1 - k/3 = 1 - \frac{0.357}{3} = 0.881$

$f_s = 0.4 f_y$

If steel controls,

$M_s = A_s f_s j d = 2.405\times0.4\times60\times0.881\times18.5$

$= 940.75$ k-in

If concrete controls,

$f_c = 0.45 f'_c$

$M_c = \frac{1}{2} f_c k j b d^2$

$= \frac{1}{2}\times0.45\times3.5\times0.357\times0.881\times12\times(18.5)^2$

$= 1017.23$ k-in $\quad \because M_c > M_s$

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$\therefore$ working moment capacity $= 1017.23$ k-in

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#1 Design a simply supported rectangular beam for a bending moment of 1500k-in where concrete strength $f'_c = 3500$psi and steel strength $f_y = 60{,}000$psi following WSD method. (Consider $n=9$ & $d=2b$)

Ans:

$$k = \frac{n}{n+r} = \frac{9}{9 + \frac{0.4 \times 60}{0.45 \times 3.5}} = 0.371$$

$$j = 1 - \frac{0.371}{3} = 0.876$$

Now, $M_c = \frac{1}{2} f_c k j b d^2$

$\Rightarrow 1440 = \frac{1}{2} \times 0.45 \times 3.5 \times 0.371 \times 0.876 \times bd^2$

$\Rightarrow bd^2 = 5626.44$

$\Rightarrow \frac{d}{2} \times d^2 = 5626.44$

$\Rightarrow d^3 = 11252.89$

$\therefore d = 22.4$

≈ 24inch

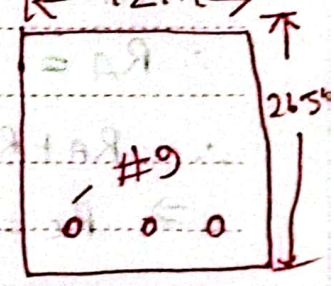
$b = 12$inch $\quad \therefore h = 24 + 2.5 = 26.5$inch

Again, $M_s = A_s f_s j d$

$\Rightarrow 1440 = A_s \times 0.4 \times 60 \times 0.876 \times 24$

$\Rightarrow A_s = 2.85 in^2$

use 3#9 bar ($3in^2$)



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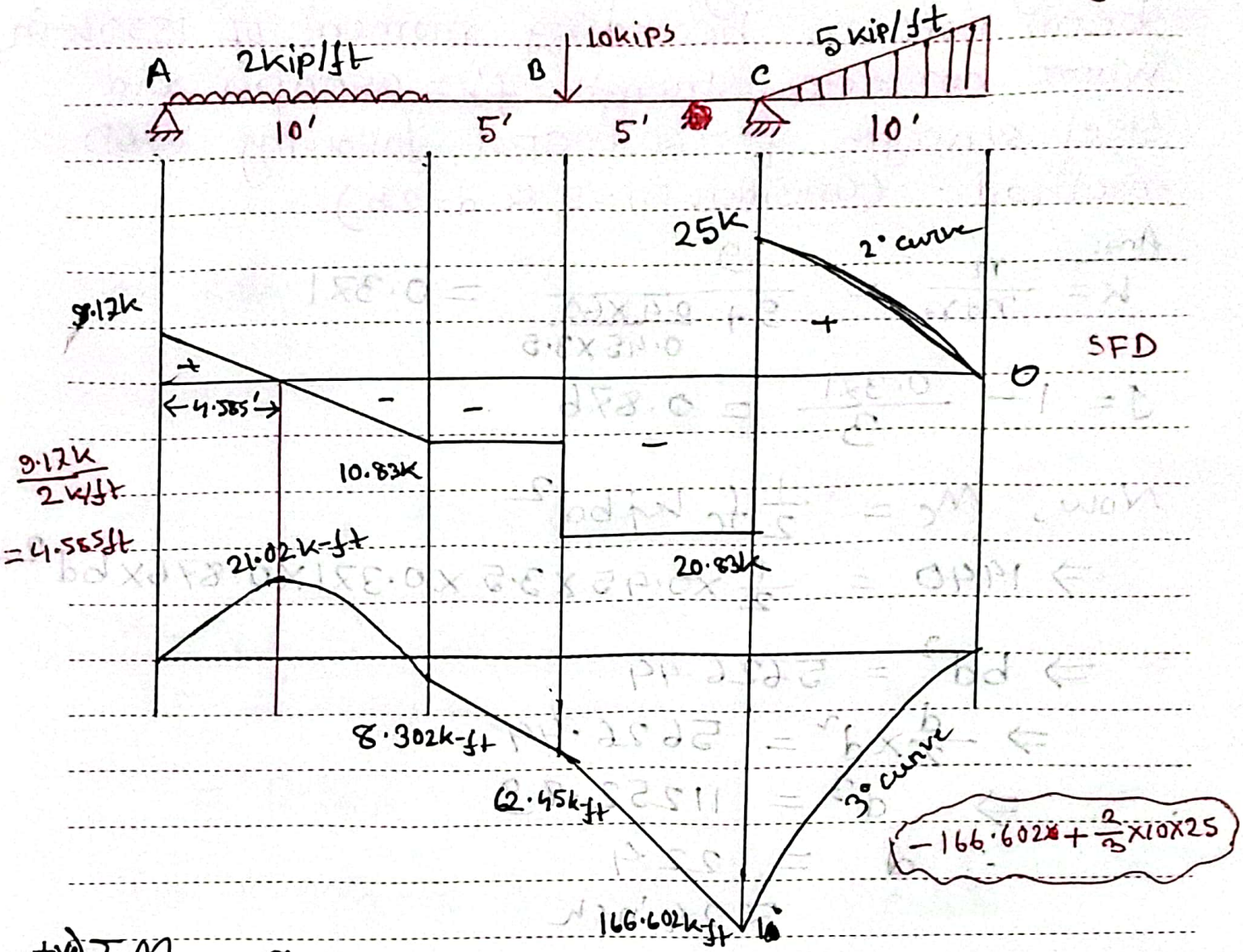
Sketch the SFD & BMD of the following:



+ve $\circlearrowleft \Sigma M_C = 0$

$\Rightarrow \frac{1}{2} \times 10 \times 5 \times \frac{2}{3} \times 10 - 10 \times 5 - 10 \times 2 \times 15 + R_A \times 20 = 0$

$\Rightarrow R_A \times 20 = 189.33$

$\therefore R_A = 9.17k$

$\therefore R_A + R_C = 2 \times 10 + 10 + \frac{1}{2} \times 10 \times 5$

$\Rightarrow R_C = 45.83k$

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