OR iii. Draw the S.F. and B.M. diagrams for the beam which is loaded as shown in fig.4. Determine the points of contraflexure with in the span AB. **8**

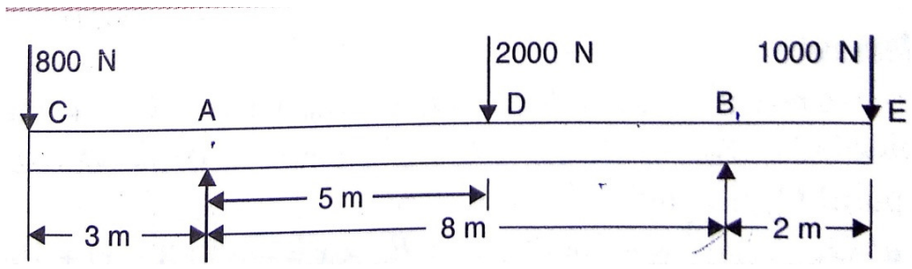


Fig:4

******

Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No.....

Faculty of Engineering

End Sem (Odd) Examination Dec-2018

EN3ES01 Basic Civil Engineering

Programme: B.Tech. Branch/Specialisation: All

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. In what form should lime be present in brick earth? **1**
(a) Paste (b) Lump (c) Clinker (d) Powder

ii. The accumulation of water on outer surface of concrete is **1**
(a) Transpiration (b) Bleeding (c) Segregation (d) Ponding

iii. The maximum and minimum magnitude of resultant forces is 1000N and 500N at point. What are the values of two forces acting on it? **1**
(a) 500N,500N (b) 450N,550N
(c) 300N,700N (d) 250N,750N

iv. Forces passing through a common point are known as____ **1**
(a) Collinear forces (b) Co-planer forces
(c) Concurrent forces (d) None of these

v. The bearing capacity of soil is calculated in _____units. **1**
(a) Gm/cc (b) Kg/m^3 (c) KN/m^2 (d) N/m

vi. The vertical portion between each tread on stair is called **1**
(a) Going (b) Nosing (c) Winder (d) Riser

vii. The line in which the plane passing through the given point and the north and south poles intersects the surface of the earth, is called **1**
(a) Arbitrary meridian (b) Magnetic meridian
(c) True meridian (d) None of these

viii. An axis about which the telescope can be rotated in a horizontal plane, is called: **1**
(a) Trunnion axis (b) Vertical axis
(c) Axis of the level tube (d) Line of collimation

ix. Bending moment at supports in case of simply supported beam is always **1**
(a) Zero (b) Positive
(c) Negative (d) Depends upon loading

x. At the point of contraflexure **1**
(a) B.M is minimum (b) B.M is maximum
(c) B.M is either zero or changes sign (d) None of these

Q.2 i. Enlist the factors affecting workability. **2**

ii. List out the Bogue's compounds of cement. Explain the importance of each. **3**

iii. Describe the method used to test the fresh concrete. **5**

OR iv. Define hydration of cement. Explain any three types of cement and its uses. **5**

Q.3 i. Explain condition of equilibrium. **2**

ii. Determine the direction and magnitude of resultant force for the system of forces shown in fig. 1. By Analytical method. **3**

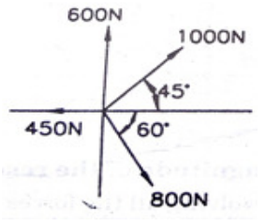


Fig:1

iii. State and proof Lami's theorem. **5**

OR iv. Two identical rollers each of weight, 500 N are supported by an inclined plane and a vertical wall as shown in fig. 2. Assuming smooth surfaces find the reactions at the points of support A, B and C. **5**

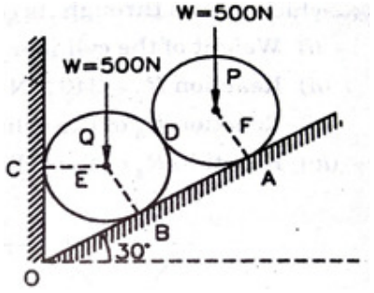


Fig:2

Q.4 i. Why Black cotton soil is taken as problematic? **3**

ii. What are the different types of foundations? What are the causes of failure of foundations? **7**

OR iii. Define floor. Discuss various types of floors and their suitability. **7**

Q.5 i. What do you understand by contour? Explain various characteristics of contour in detail with neat sketches. **4**

ii. The following staff were taken consecutively with a level. The instrument was shifted after fourth and seventh readings. Make the following data entered in a page of level field book and find out R.L. of all points by any rise and fall method. Apply arithmetical check to verify the results. 1.785, 1.595, 1.475, 1.300, 1.095, 1.955, 1.285, 1.050, 1.115, 0.775. The first reading was taken on a bench mark of reduced level 500.00m **6**

OR iii. The following bearings were taken in running a compass traverse. At what stations do you suspect local attraction? Find the correct bearing of the lines and also compute the included angles. **6**

LINE	F.B.	B.B.
AB	74°20′	256°00′
BC	107°20′	286°20′
CD	224°50′	44°50′
DA	306 °40′	126°00′

Q.6 i. Enlist types of supports along with diagram and respective live examples. **2**

ii. A simply supported beam of length 10 m carries the uniformly distributed load and two point loads as shown in fig.3. Draw a S.F. and B.M. diagram for the beam. Also calculate the maximum bending moment. **8**

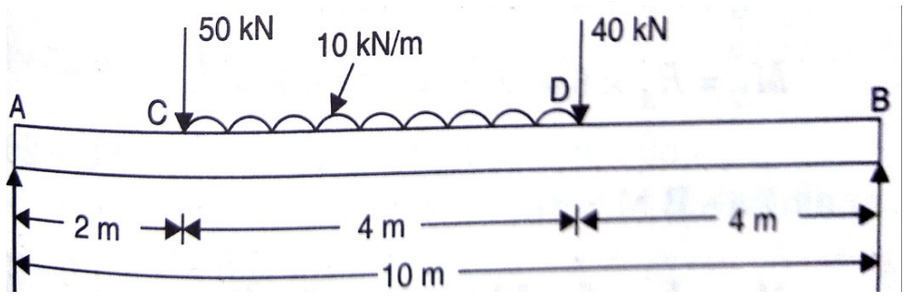


Fig:3

P.T.O.

Marking Scheme
EN3ES01 Basic Civil Engineering

Q.1	i.	In what form should lime be present in brick earth? (d) Powder		**1**
	ii.	The accumulation of water on outer surface of concrete is (b)Bleeding		**1**
	iii.	The maximum and minimum magnitude of resultant forces is 1000N and 500N at point. What are the values of two forces acting on it? (d)250N,750N		**1**
	iv.	Forces passing through a common point are known as____ (c)concurrent forces		**1**
	v.	The bearing capacity of soil is calculated in _____units. (c)KN/m²		**1**
	vi.	The vertical portion between each tread on stair is called (d) Riser		**1**
	vii.	The line in which the plane passing through the given point and the north and south poles intersects the surface of the earth, is called (c) true meridian		**1**
	viii.	An axis about which the telescope can be rotated in a horizontal plane, is called: (b) vertical axis		**1**
	ix.	Bending moment at supports in case of simply supported beam is always (a)Zero		**1**
	x.	At the point of contraflexure (c)B.M is either zero or changes sign		**1**
Q.2	i.	Each factor 0.5 mark (mini.4)	(0.5 mark * 4)	**2**
	ii.	Each 0.75 mark with explanation.	(0.75 mark *4)	**3**
	iii.	Diagram Explanation.	1 mark 4 marks	**5**
OR	iv.	Define hydration of cement. Types with explanation. Uses.	1 mark 3 marks 1 mark	**5**
Q.3	i.	2 mark explanation. (3 condition)		**2**

ii.

Sol. (*i*) **Analytical Method :**

Algebraic sum of horizontal components,

i.e., $\Sigma H = 1000 \cos 45^\circ + 0 - 450 + 800 \cos 60^\circ$

$\Sigma H = 707.1 + 0 - 450 + 400$

$= 657.1$ N

Now, Algebraic sum of all vertical components,

i.e., $\Sigma V = 1000 \sin 45^\circ + 600 + 0 - 800 \sin 60^\circ$

$\Sigma V = 707.1 + 600 + 0 - 692.8$

$= 614.3$ N

Now, magnitude of resultant force,

$$R = \sqrt{(\Sigma H)^2 + (\Sigma V)^2}$$

$$= \sqrt{(657.1)^2 + (614.3)^2}$$

≈ 900 N **Ans.**

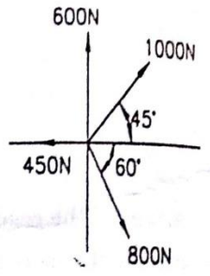


Fig. 12.20(*a*)

Direction of resultant force,

$$\tan \alpha = \frac{\Sigma V}{\Sigma H}$$

$$= \frac{614.3}{657.1}$$

$$= 0.9349$$

$\therefore \quad \alpha = \tan^{-1}(0.9349)$

$= 43.07^\circ$ **Ans.**

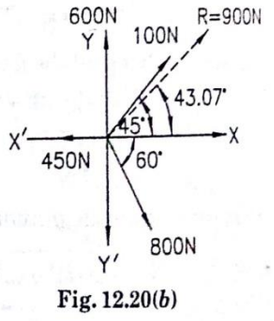


Fig. 12.20(*b*)

Resultant will act from the point of concurrency as shown in Fig. 12.20(*b*).

1mark for horizontal & vertical component
1 marks for resultant & direction of resultant force
1 mark for diagram

iii. Lami's theorem is used to find out the unknown forces, when three cuncurrent forces are acting on a body and body is in equilibrium. **5**

It states, "if three coplanar forces acting at a point are in equilibrium, then each force is proportional to the sine of angle between the other two forces."

If three forces P, Q and R are acting at a point as shown in Fig. 12.63, then according to Lami's theorem

$$\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}$$

Proof. Consider three forces P, Q and R acting at a point Q as shown in Fig. 12.63. Now construct a parallelogram $OABC$ as shown in Fig. 12.63. Consider ΔOAB,

Now from geometry of the Fig. 12.63, we have

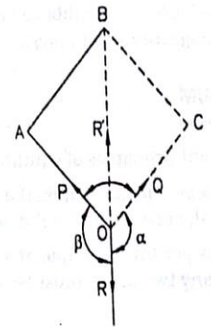


Fig. 12.63. Lami's theorem

$\angle AOB = 180 - \beta$, $\angle OBC = 180 - \alpha$

$\angle ABO = \angle BOC$

$= 180 - \alpha$

and $\angle ABC = 180° - (180° - \beta + 180° - \alpha)$

$= \beta + \alpha - 180°$

But $\alpha + \beta + \gamma = 360°$

So $\angle OAB = 180 - \gamma$

Now is ΔOAB using sine formula, we have

$$\frac{AB}{\sin\angle BCA} = \frac{BC}{\sin\angle CAB} = \frac{CA}{\sin\angle ABC}$$

or $$\frac{P}{\sin(180°-\alpha)} = \frac{Q}{\sin(180°-\beta)} = \frac{R}{\sin(180°-\gamma)}$$

or $$\boxed{\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}}$$

This proves the Lami's theorem.

1 mark for statement.
3 mark for apply sine rule
1 mark for diagram.

OR iv.

Sol. Given, weight of each roller = 500 N.

As both the rollers are identical so they will exert an identical reaction at each other. Let this reaction is R_D. Reactions at supports A, B, and C can be assumed R_A, R_B and R_C respectively.

Now consider the equilibrium of the roller P, first. It is in the equilibrium under the action of following forces :

(*i*) Weight 500 N acting vertically downwards.

(*ii*) Reaction R_D at point D, parallel to OA.

(*iii*) Reaction R_A at point A normal to OA.

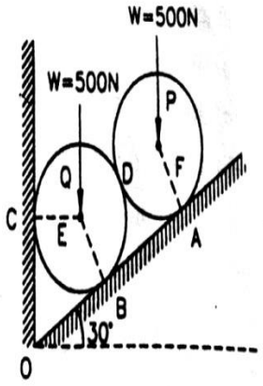
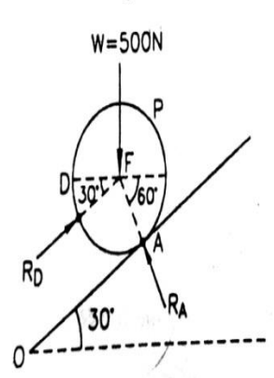
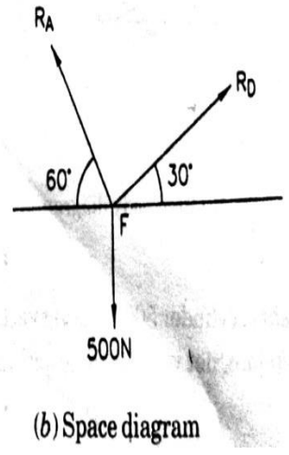


Fig. 12.86

Free body diagram of roller P is shown in Fig. 12.87(a) and system of forces acting at its centre F is shown in Fig. 12.87(b).



(a) Free body diagram



(b) Space diagram

Applying Lami's equation at F

$$\frac{500}{\sin 90°} = \frac{R_A}{\sin 120°} = \frac{R_D}{\sin 150°}$$

$$\therefore \quad R_A = \frac{500}{\sin 90°} \times \sin 120° = 433 \text{ N}$$

and

$$R_D = \frac{500}{\sin 90°} \times \sin 150° = \mathbf{250\ N} \quad \textbf{Ans.}$$

Now considering equilibrium of roller Q. It is in the equilibrium under the following forces :

(*i*) Weight 500 N acting vertically downwards.

(*ii*) Reaction R_D at point D, parallel to OB.

(*iii*) Reaction R_B at point B, normal to OB.

(*iv*) Reaction R_C acting horizontally.

As there are more than three forces, so Lami's method will become tedious. We can solve this problem by resolving the forces, horizontally and vertically.

$= 0$

Resolving forces vertically, and apply

$$\Sigma V = 0$$

$$-500 - R_D \sin 30° + R_B \sin 60° = 0$$

$$-500 - 250 \times \frac{1}{2} + R_B \times \frac{\sqrt{3}}{2} = 0$$

$$\therefore \quad R_B = \frac{625 \times 2}{\sqrt{3}}$$

$$= 721.7 \text{ N} \quad \textbf{Ans.}$$

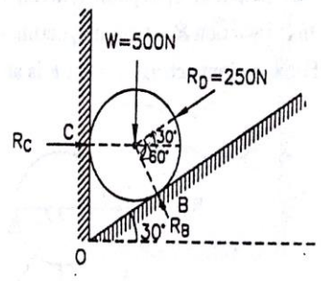


Fig. 12.88.

Now apply $\Sigma V = 0$

Resolving the forces horizontally,

$$R_C - R_D \cos 30° - R_B \cos 60° = 0$$

So $$R_C = 250 \times \frac{\sqrt{3}}{2} + 721.7 \times \frac{1}{2} = 577.35 \text{ N} \quad \textbf{Ans.}$$

1 mark for free body diagram.
1 mark for each reaction .(Ra, Rb, Rc, Rd)

Q.4 i. 3 mark explanation in detail. **3**

ii. 3.5 mark for types (each 0.5 mark) (0.5 mark *7) **7**
3.5 mark for failure (each 0.5 mark). (0.5 mark *7)

OR iii. 1 mark for define floor. **7**
3 mark for suitability.(each 0.5 mark) (0.5 mark *6)

3 mark for types of floor. (each 0.5 mark)

Q.5 i. 1 mark for define contour. **4**
3 mark for characteristics (each 0.5 mark) (0.5 mark *6)

ii. . **6**

Solution.

Station	*B.S.*	*I.S.*	*F.S.*	*H.I.*	*R.L.*	*Remark*
A	1.785			501.785	500	BM
B		1.595			500.19	
C		1.475			500.31	
D	1.095		1.300	501.58	500.485	CP1
E		1.955			499.625	
F	1.050		1.285	501.345	500.295	CP2
G		1.115			500.23	
H			0.775		500.57	
	3.93		3.36			

Arithmetic Check :

$$\Sigma B.S. - \Sigma F.S. = \text{Last R.L.} - \text{First R.L.}$$

$$3.93 - 3.36 = 500.57 - 500$$

$$0.57 = 0.57$$

Hence Checked

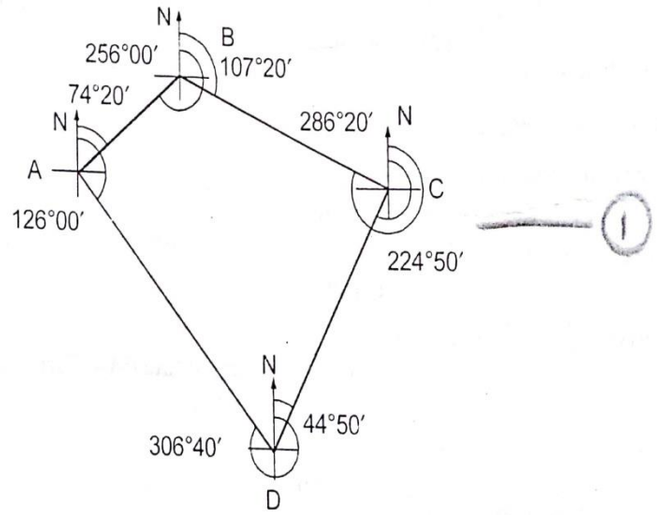
1 mark for filling correct table.
4 marks for calculation.
1 mark for arithmetical check.

OR iii.

Line	*Fore Bearing*	*Back Bearing*
AB	*74° 20′*	*256° 00′*
BC	*107° 20′*	*286° 20′*
CD	*224° 50′*	*44° 50′*
DA	*306° 40′*	*126° 00′*

[RGPV, Jan./Feb. 2008. Dec. 2(

Solution : (Refer Fig. 6.18)



Step 1 : Calculation of Included Angles

$\angle A$ = Bearing of line AB – Bearin of line AD
= 74° 20′ – 126° 00′
= 51° 40′ (Anticlockwise) (–ve)

$\angle B$ = Bearing of line BC – Bearing of line BA
= 107° 20′ – 256° 00′
= 148° 40′ (Anticlockwise) (–ve)

$\angle C$ = Bearing of line CD – Bearing of line CB
= 224° 50′ – 286° 20′
= 61° 30′ (Anticlockwise) (–ve)

$\angle D$ = Bearing of line DA – Bearing of line DC
= 306° 40′ – 44° 50′
= 261° 50′ (Clockwise)

∴ Corrected Angle = 360° – 261° 50′
= 98° 10′ (Anticlockwise)

Step 2 : Check for Included Angles

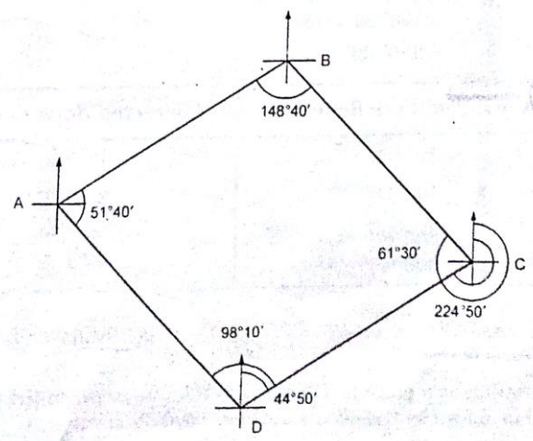
The sum of included angles should be equal to
$= (2n - 4)\ 90°$
$= (2 \times 4 - 4)\ 90°$
$= 360°$

$\angle A + \angle B + \angle C + \angle D$ = 51° 40′ + 148° 40′ + 61° 30′ + 98° 10′
= 360° 00′

As sum of included angles is equal to theoretical sum, hence there is no need to apply corrections to included angles.

Step 3 : Find out the Line which is Free from Local Attraction

Here, we find that fore and back bearings of line CD are differ exactly by 180°. Hence stations C and D are free from local attraction. That means bearings of line CD are the corrected bearings.



Step 4 : Calculation of Bearings ——— (3)

Corrected fore bearing of line CD = **224° 50′** **Ans.**

Corrected back bearing of line CD = **44° 50′** **Ans.**

Corrected fore bearing of line DA

= Bearing of line $DC + \angle D$

= 44° 50′ + (–)98° 10′

= – 53° 20′

⇒ = 360° – 53° 21′

= **306° 40′** **Ans.**

Corrected back bearing of line DA

= Fore bearing of DA – 180°

= 306° 40′ – 180°

= **126° 40′** **Ans.**

Corrected fore bearing of line AB

= Bearing of line $AD + \angle A$

= 126° 40′ + (–) 51° 40′

= **75° 00′** **Ans.**

Corrected back bearing of line AB

= Fore bearing of line AB + 180°

= 75° 00′ + 180°

= **255° 00′**

Corrected fore bearing of line BC

= Bearing of line $BA + \angle B$

= 225° + (–) 148° 40′

= **106° 20′** **Ans.**

Corrected back bearing of line BC

= Fore bearing of line BC + 180°

= 106° 20′ + 180°

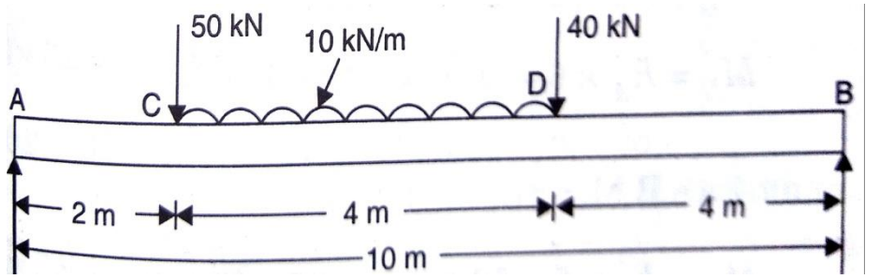
= **286° 20′** **Ans.**

Line	*Corrected Fore Bearing*	*Corrected Back Bearing*
AB	75° 00′	255° 00′
BC	106° 20′	286° 20′
CD	224° 50′	44° 50′
DA	306° 40′	126° 40′

1 mark for diagram.
1 mark for included angle
1 mark for detection of local attraction
3 mark for calculation of corrected bearings.

Q.6 i. 1 mark for types **2**
1 mark for live example.

ii.



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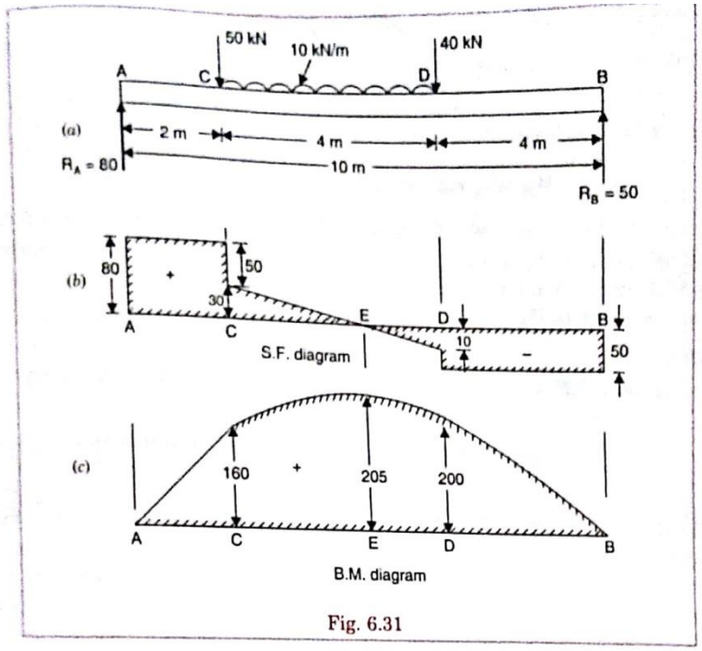


Fig. 6.31

S.F. Diagram

The S.F. at A, $F_A = R_A = +80$ kN

The S.F. will remain constant between A and C and equal to + 80 kN

The S.F. just on R.H.S. of $C = R_A - 50 = 80 - 50 = 30$ kN

The S.F. just on L.H.S. of $D = R_A - 50 - 10 \times 4 = 80 - 50 - 40 = -10$ kN

The S.F. between C and D varies according to straight line law.

The S.F. just on R.H.S. of $D = R_A - 50 - 10 \times 4 - 40 = 80 - 50 - 40 - 40 = -50$ kN

The S.F. at $B = -50$ kN

The S.F. remains constant between D and B and equal to – 50 kN

The shear force diagram is drawn as shown in Fig. 6.31 (b).

The shear force is zero at point E between C and D.

Let the distance of E from point A is x.

Now shear force at $E = R_A - 50 - 10 \times (x - 2)$

$= 80 - 50 - 10x + 20 = 50 - 10x$

But shear force at $E = 0$

$\therefore \quad 50 - 10x = 0$ or $x = \dfrac{50}{10} = 5$ m

B.M. Diagram

B.M. at A is zero

B.M. at B is zero

B.M. at C, $M_C = R_A \times 2 = 80 \times 2 = 160$ kNm

B.M. at D, $M_D = R_A \times 6 - 50 \times 4 - 10 \times 4 \times \dfrac{4}{2}$

$= 80 \times 6 - 200 - 80 = 480 - 200 - 80 = 200$ kNm

At E, $x = 5$ m and hence B.M. at E,

$$M_E = F_A \times 5 - 50(5 - 2) - 10 \times (5 - 2) \times \left(\frac{5 - 2}{2}\right)$$

$= 80 \times 5 - 50 \times 3 - 10 \times 3 \times \frac{3}{2} = 400 - 150 - 45 = 205$ kNm

The B.M. between C and D varies according to parabolic law reaching a maximum value at E. The B.M. between A and C and also between B and D varies according to linear law. The B.M. diagram is shown in Fig. 6.31 (c).

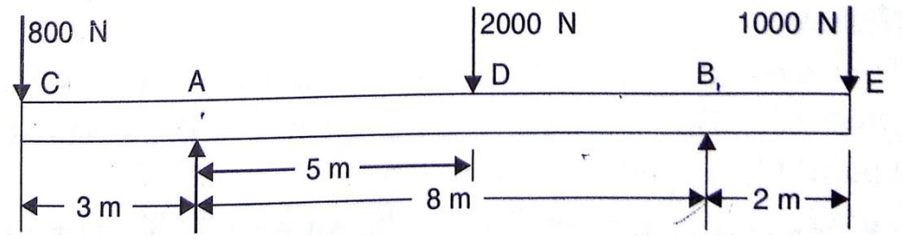
Maximum B.M.

The maximum B.M. is at E, where S.F. becomes zero after changing its sign.

$\therefore$ Max. B.M. = M_E = **205 kNm.** Ans.

1 mark for calculate reaction.
2 mark for calculate S.F.
2 mark for calculate B.M.
1 mark for S.F.D.
1 mark for B.M.D
1 mark for calculate max .B.M.

OR iii.



8

Sol. First calculate the reactions R_A and R_B.

Taking moments about A, we have

$$R_B \times 8 + 800 \times 3 = 2000 \times 5 + 1000(8 + 2)$$

or $$8R_B + 2400 = 10000 + 10000$$

$$\therefore \quad R_B = \frac{20000 - 2400}{8} = \frac{17600}{8} = 2200 \text{ N}$$

and $$R_A = \text{Total load} - R_B = 3800 - 2200 = 1600$$

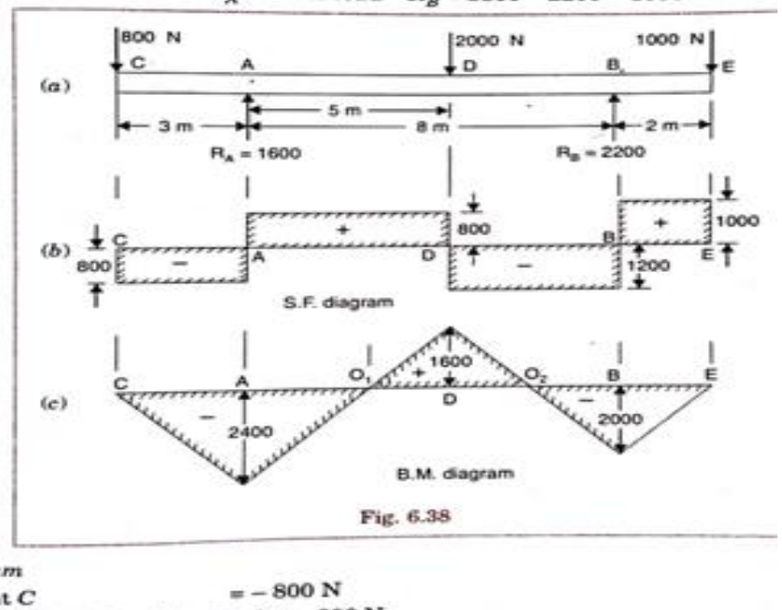


Fig. 6.38

S.F. Diagram

S.F at C $= -800$ N

S.F. between C and A remains -800 N

S.F. at A $= -800 + R_A = -800 + 1600 = +800$ N

S.F. between A and D remains $+800$ N

S.F. at D $= +800 - 2000 = -1200$ N

S.F. between D and B remains -1200 N

S.F. at B $= -1200 + R_B = -1200 + 2200 = +1000$ N

S.F. between B and E remains $+1000$ N

S.F. diagram is shown in Fig. 6.38.

B.M. Diagram

B.M. at C $= 0$

B.M. at A $= -800 \times 3 = -2400$ Nm

B.M. at D $= -800 \times (3 + 5) + R_A \times 5$

$= -800 \times 8 + 1600 \times 5$

$= -6400 + 8000 = +1600$ Nm

B.M. at B $= -1000 \times 2 = -2000$ Nm

B.M. at E $= 0$

The B.M. diagram is drawn as shown in Fig. 6.38 (*c*).

Points of Contraflexure

There will be two points of contraflexure O_1 and O_2, where B.M. becomes zero after changing its sign. Point O_1 lies between A and D, whereas the point O_2 lies between D and B.

(*i*) Let the point O_1 is x metre from A.

Then B.M. at O_1 $= -800(3 + x) + R_A \times x = -800(3 + x) + 1600x$

$= -2400 - 800x + 1600x = -2400 + 800x$

But B.M. at O_1 is zero

$\therefore \quad 0 = -2400 + 800x$ or $x = \frac{2400}{800} = 3$ m. Ans.

(*ii*) Let the point O be x metre from B.

Then B.M. at O_2 $= 1000(x + 2) - R_B \times x = 1000x + 2000 - 2200 \times x = 2000 - 1200x$

But B.M. at O_2 $= 0$

$\therefore \quad 0 = 2000 - 1200x$

$\therefore \quad x = \frac{2000}{1200} = \frac{5}{3} = 1.67$ m from B. Ans.

1 mark for calculate reaction.
2 mark for calculate S.F.
2 mark for calculate B.M.
1 mark for S.F.D.
1 mark for B.M.D
1 mark for determine the points of contra flexure.

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