SHEET 1

PENANG SANGAM HIGH SCHOOL
P.O.BOX 44, RAKIRAKI
WEEK 21 WORKSHEET

Subject: Technical Drawing **Year/Level:** 12

Strand	**TD12.4 APPLIED MECHANICS**
Sub Strand	TD 12.4.1 FORCES
Content Learning Outcome	TD 12.4.1.1 Analyze and solve for coplanar and non-concurrent forces acting on individual structural members.

LESSON NOTES

Strand 4: Applied Mechanics

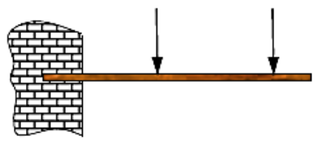
Forces and Moments

OUTCOME
By the end of this topic, students will:
a) Recall the different types of force systems and its impact in nature.
b) Identify the different types of member supports and their purpose.
c) Analyze and calculate resultant forces acting on beams graphically and analytically.
d) Determine the reactions at the supports.
e) Draw the shear force and bending moment diagram.
f) Calculate the shear force and bending moment.
g) Recall the definition of equilibrium and non-equilibrium conditions.
h) Analyze and calculate reactions on beams using moment equilibrium.

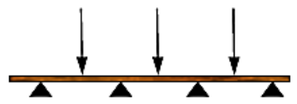
Forms of Beams

Some common forms of beams are as follows:

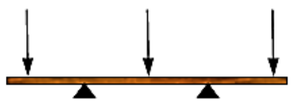
(1) Simple beam - a bar resting upon two supports, one near each end.



(2) Cantilever beam - a bar resting upon one support or fulcrum, or that portion of any beam projecting out of a wall or beyond a support.

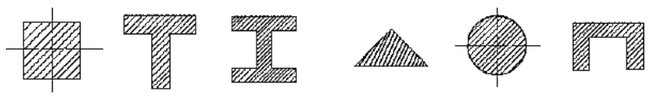


(3) Continuous beam - a bar resting upon more than two supports.



(4) Overhanging Beam – one or both sides hang over the support.

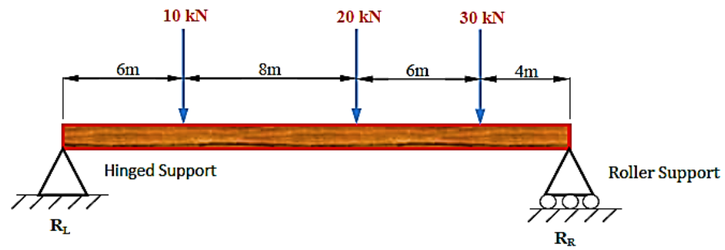
Beam Sections



Example 1

The space diagram of a beam is given with loads of 10 kN, 20 kN, and 30 kN arranged at intervals shown. Find: (a) the reactions at RL and RR graphically, the position and magnitude of resultant and equilibrant force graphically. (b) the reactions at RL and RR analytically. (c) the position and magnitude of resultant and equilibrant analytically. (d) Bending moment scale.

Space Diagram



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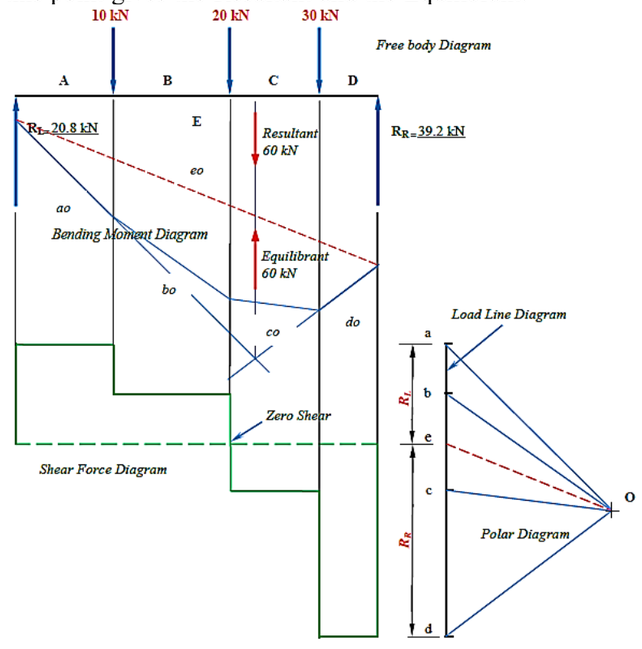
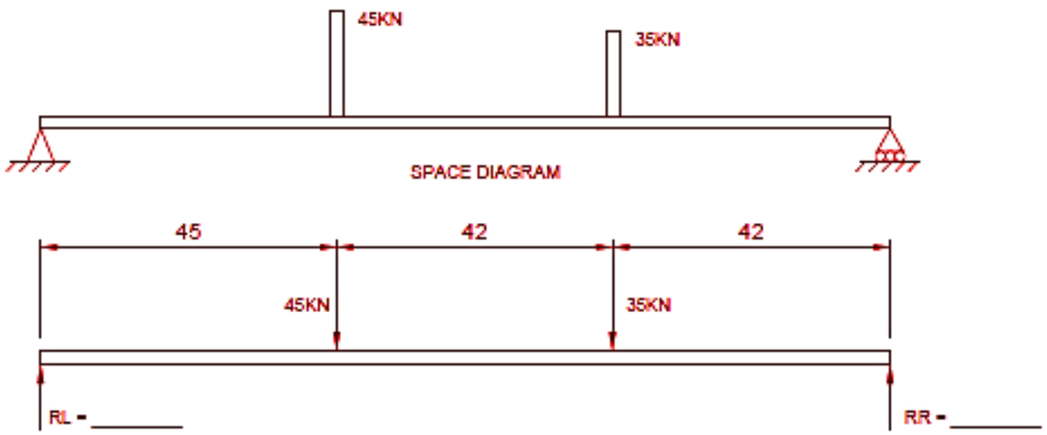
(a) Graphical Solution
i. Draw the free body diagram of the beam as shown to a suitable scale (say for example 10mm = 1m)
ii. Label Bow's Notation (Capital letters in clockwise direction)
iii. Draw the load line scale (say for example 10mm = 10kN), showing 10 kN a to b; 20 kN b to c; 30 kN c to d.
iv. Fix any pole 'o'.
v. Join abcd to pole o forming the polar polygon.
vi. Begin the link polygon by drawing ao parallel to ao in the polar polygon.
vii. Draw bo, co and do as shown to give y in the link polygon.
viii. Join xy with eo and draw eo in the polar polygon parallel to eo in the link polygon.
ix. The magnitude of RL and RR can be determined from the point where eo cuts the load line.
x. Extend the first (ao) and last line (do) from the link polygon to find the intersection. A line passing through this point gives the Resultant and the Equilibrant.



STUDENT ACTIVITY



Given: A beam drawn to a scale of 1:50 and a load line scale of 1mm : 1 kN.

Required: **Graphically and analytically:**

(i) Find the magnitude of the reactions.

RL _____ RR _____

(ii) (a) Draw the funicular polygon.

(b) Calculate the maximum bending moment of the beam. _____

(c) Locate the position of the resultant relative to RR

(iii) Draw a free- hand sketch of a typical beam to carry the loads.

(iv) Draw the shear force diagram and label zero shear.