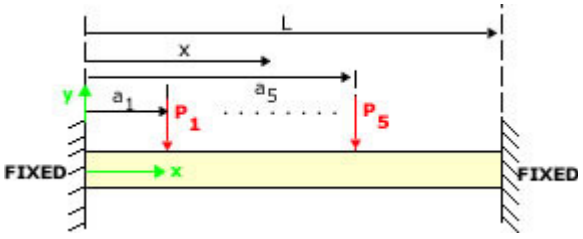
Advanced Mechanical Engineering Solutions

FIXED STRUCTURAL BEAM DEFLECTION AND STRESS CALCULATOR FC MULTIPLE LOADS AND MOMENTS

Following calculator has been developed to find forces, moments, stresses, deflections and slopes in a fixe Multiple point loads, distributed loads and concentrated moments can be defined as input loading for s beam. This calculator has been developed by using formulas given in the "Fixed Beam with Concentrated any Point", "Fixed Beam with Concentrated Intermediate Moment" and "Fixed Beam with Partially Distribute calculator pages.

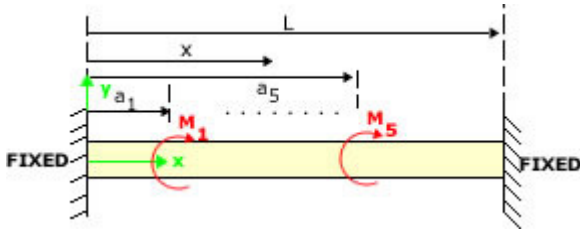
Note: For more information on shear, moment, slope and deflection calculations for different end constraints refer to "Beams; Flexure of Straight Bars" chapter of Roark's Formulas for Stress and Strain.

Calculator:

INPUT PARAMETERS			
POINT LOADS			
			
Parameter	Symbol	Magnitude	Distance
		N	mm
Load 1 *	P_1	1225.6	3400
Load 2 *	P_2	573.5	4000
Load 3 *	P_3	1225.6	4600

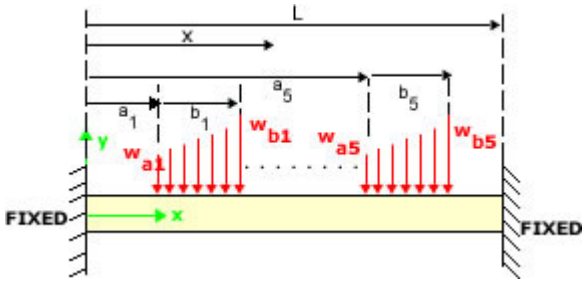
Load 4 *	P_4	0	0
Load 5 *	P_5	0	0

CONCENTRATED MOMENTS



Parameter	Symbol	Magnitude	Distance
		lbf*ft	ft
Moment 1 *	M_1	0	0
Moment 2 *	M_2	0	0
Moment 3 *	M_3	0	0
Moment 4 *	M_4	0	0
Moment 5 *	M_5	0	0

DISTRIBUTED LOADS



Parameter	Symbol	Magnitude		Distance	
		lbf/in		ft	
		wa	wb	a	b
Distributed Load 1 *	w_1	0	0	0	0
Distributed Load 2 *	w_2	0	0	0	0
Distributed Load 3 *	w_3	0	0	0	0
Distributed Load 4 *	w_4	0	0	0	0
Distributed Load 5 *	w_5	0	0	0	0

STRUCTURAL BEAM PROPERTIES

Parameter	Symbol	Value	Unit
Structural Beam Length	L	8000	mm

Distance x	x	0	
Modulus of Elasticity	E	12.15	GPa
Distance from neutral axis to extreme fibers	c	100	mm
Second moment of area **	I	32000000	mm^4
Calculate			

Note : Use dot "." as decimal separator.

Note * : P is positive in downward direction as shown in the figure and negative in upward direction. M is positiv in clockwise direction as shown in the figure. w_a and w_b are positive in downward direction as shown in the figu and negative in upward direction.

Note ** : For second moment of area calculations of structural beams, visit " Sectional Properties Calculators".

INPUT LOADING TO FIXED BEAM

POINT LOADS

No.	Location	Magnitude
1	3400 mm	1225.6 N
2	4000 mm	573.5 N
3	4600 mm	1225.6 N

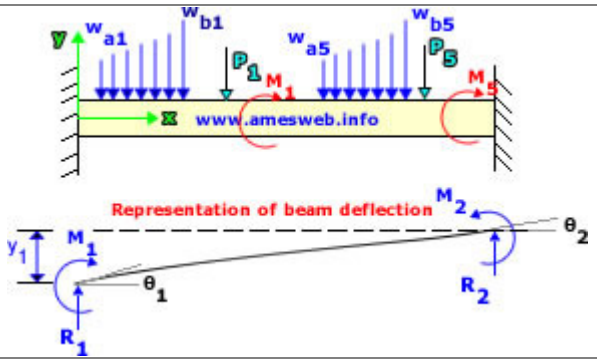
CONCENTRATED MOMENTS

No.	Location	Magnitude

DISTRIBUTED LOADS

No.	Start Location	Magnitude	End Location	Magnitude

RESULTS

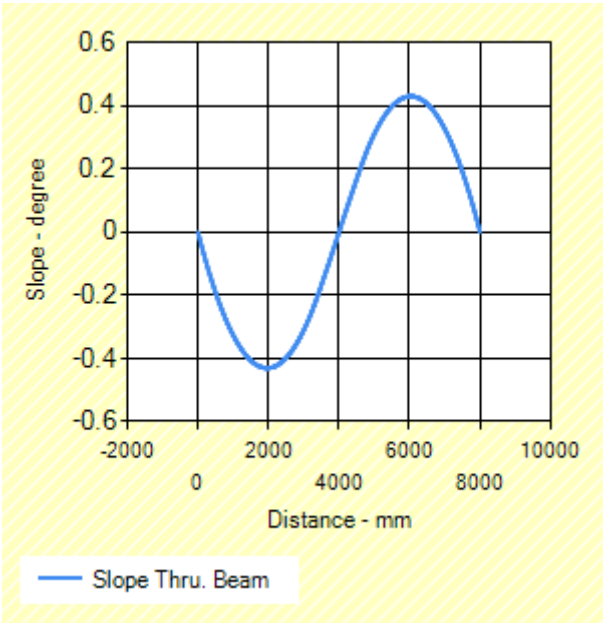


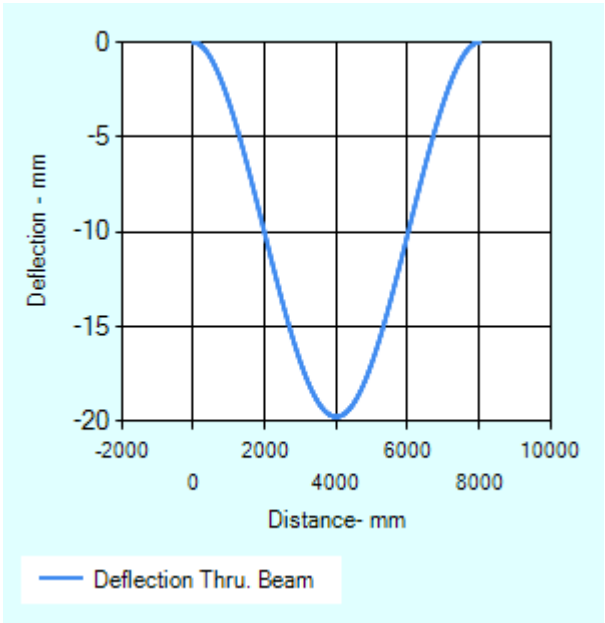
Parameter	Symbol	Value	Unit
Reaction Force 1	R_1	1512.3	N
Reaction Force 2	R_2	1512.3	
Transverse Shear Force @ distance x	V_x	1512.3	
Maximum Transverse Shear Force	V_{max}	1512.3	

Reaction Moment 1	M_1	-2969.5	N*m
Reaction Moment 2	M_2	-2969.5	
Moment @ distance x	M_x	-2969.5	
Maximum Moment	M_{max}	-2969.5	
Slope 1	θ_1	0.000	degree
Slope 2	θ_2	0.000	
Slope @ distance x	θ_x	0.000	
Maximum Slope	θ_{max}	-0.430	
End Deflection 1	y_1	0.000	mm
End Deflection 2	y_2	0.000	
Deflection @ distance x	y_x	0.000	
Maximum Deflection	y_{max}	-19.724	
Bending Stress @ distance x	σ_x	9.3	MPa
Maximum Bending Stress	σ_{max}	9.3	

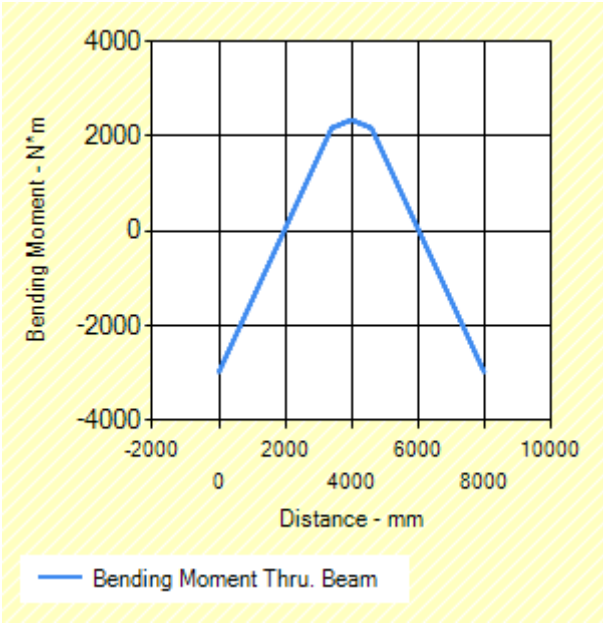
Note * : R_1 and R_2 are vertical end reactions at the left and right, respectively, and are positive upward. Shea forces and deflections are positive in upward direction and negative in downward direction. M_1 and M_2 are th reaction end moments at the left and right, respectively. All moments are positive when producing compressic on the upper portion of the beam cross section. All slopes are positive when up and to the right.

Note: Stresses are positive numbers, and these are stress magnitudes in the beam. It does not distinguis between tension or compression of the structural beam. This distinction depends on which side of the beam neutral plane c input corresponds.

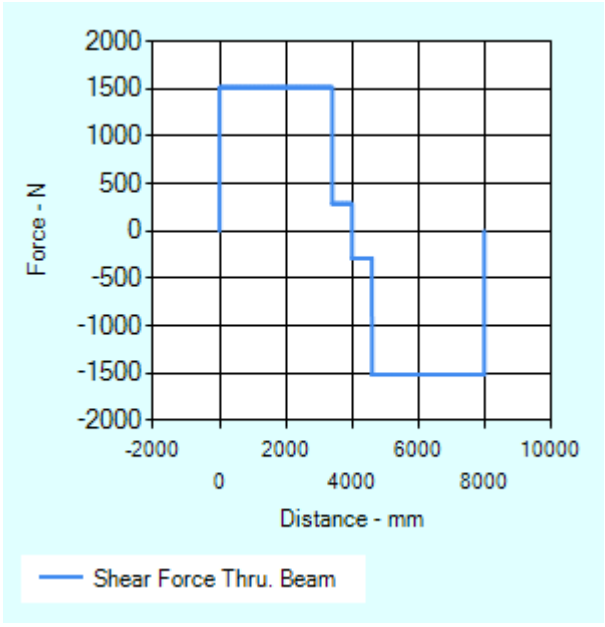




Slope **Deflection**



Moment



Shear Force

Definitions:

Distributed load: A load which acts evenly over a structural member or over a surf supports the load.

Fixed support: Fixed supports can resist vertical and horizontal forces as well as a Since they restrain both rotation and translation, they are also known as rigid supports.

Pin support: A pinned support resist both vertical and horizontal forces but not a mome will allow the structural member to rotate, but not to translate in any direction. A connection could allow rotation in only one direction; providing resistance to rotatio other direction.

Roller support: Roller supports are free to rotate and translate along the surface upon w roller rests. The resulting reaction force is always a single force that is perpendicular to the surface. Roller are commonly located at one end of long bridges to allow the expansion and contraction of the structur temperature changes.

Fixed beam: A beam which is fixed at both ends.

Structural beam: A structural element that withstands loads and moments. General shapes are rectangular I beams, wide flange beams and C channels.

Supplements:

Link	Usage
Sectional Properties Calculator of Profiles	Sectional properties needed for the structural beam stress analysis can b calculated with sectional properties calculator.

List Of Equations:

"Fixed Beam with Concentrated Load at any Point", Fixed Beam with Partially Distributed Load" and Fixe with Concentrated Moment at any Point" calculators have been used for the calculation of forces, m stresses, deflections and slopes with superposition principal.

Reference:

- Young, W. C., Budynas, R. G.(2002). Roark's Formulas for Stress and Strain . 7nd Edition, McGraw-Hill, Chapt 125 - 267
- Oberg.E , Jones.D.J., Holbrook L.H, Ryffel H.H., (2012) . Machinery's Handbook . 29th edition. Industrial Press 236 - 261
- Beer.F.P. , Johnston.E.R. (1992). Mechanics of Materials , 2nd edition. McGraw-Hill, Chapter 4-5-7-8-9