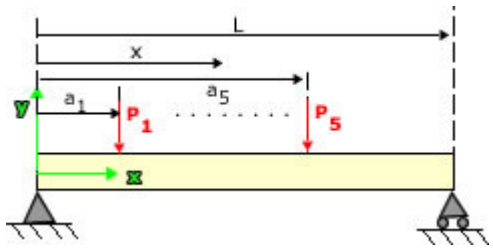
Advanced Mechanical Engineering Solutions

SIMPLY SUPPORTED STRUCTURAL BEAM STRESS AND DEFLECTION ANAL

Following calculator has been developed to find forces, moments, stresses, deflections and slopes in a supported beam. Multiple point loads, distributed loads and concentrated moments can be defined as input This calculator has been developed by using formulas given in the "Simply Supported Beam with Concentrat at any Point", "Simply Supported Beam with Concentrated Intermediate Moment" and "Simply Supported Be Partially Distributed Load" calculator pages.

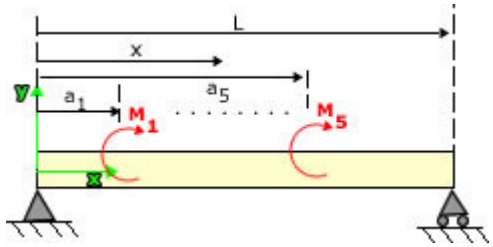
Note: For more information on shear, moment, slope and deflection calculations for different end constraints refer to "Beams; Flexure of Straight Bars" chapter of Roark's Formulas for Stress and Strain.

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

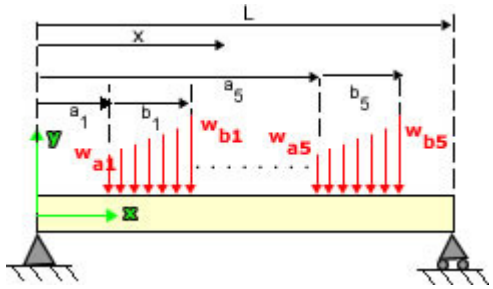
Load 5 *	P_5	0	0

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
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 SIMPLY SUPPORTED BEAM

POINT LOADS

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

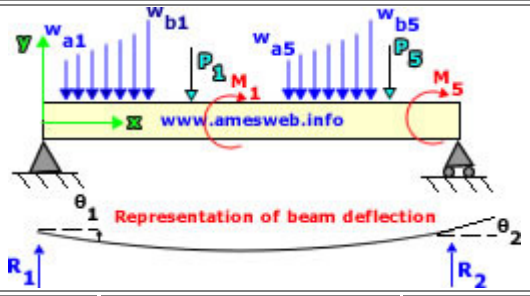
CONCENTRATED MOMENTS

No.	Location	Magnitude

DISTRIBUTED LOADS

No.	Start Location	Magnitude	End Location	Magnitude

RESULTS

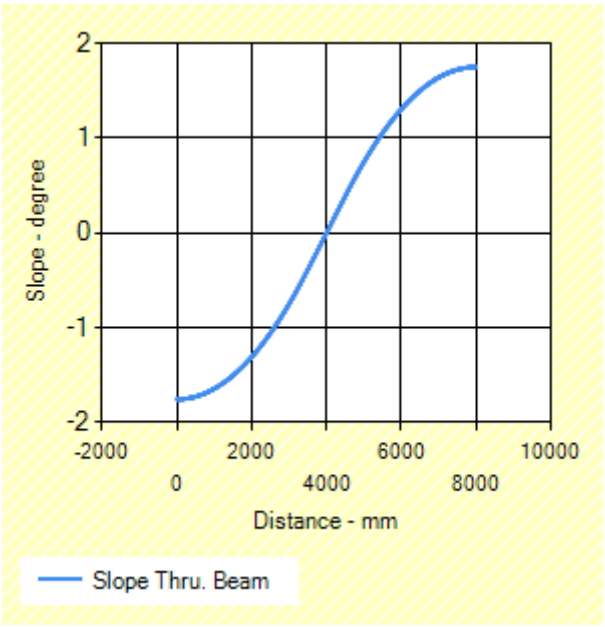


Parameter	Symbol	Value	Unit
Reaction Force 1	R_1	1512.3	N
Reaction Force 2	R_2	1512.3	
Transverse Shear Force @ distance x	V_x	1512.3	
Maximum Transverse Shear Force	V_{max}	1512.3	
Moment @ distance x	M_x	0.0	N*m
Maximum Moment	M_{max}	5314.0	

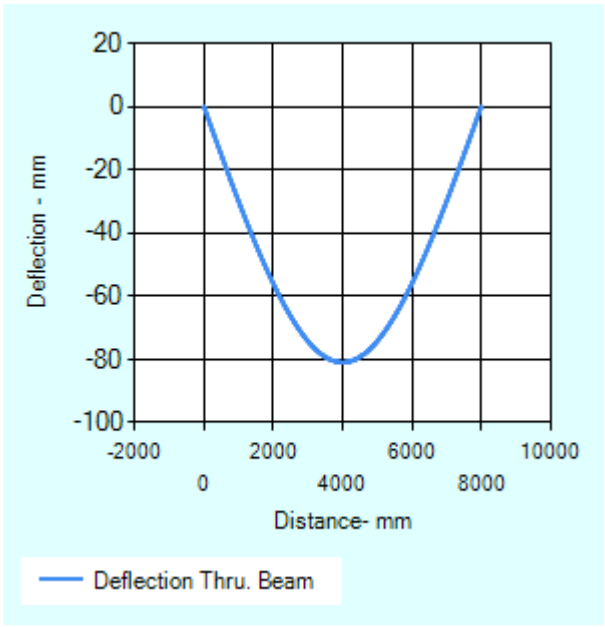
Slope 1	θ_1	-1.750	degree
Slope 2	θ_2	1.750	
Slope @ distance x	θ_x	-1.750	
Maximum Slope	θ_{max}	1.750	
Deflection @ distance x	y_x	0.000	mm
Maximum Deflection	y_{max}	-80.826	
Bending Stress @ distance x	σ_x	0.0	MPa
Maximum Bending Stress	σ_{max}	16.6	

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. All moments ar positive when producing compression on the upper portion of the beam cross section. All slopes are positiv when up and to the right.

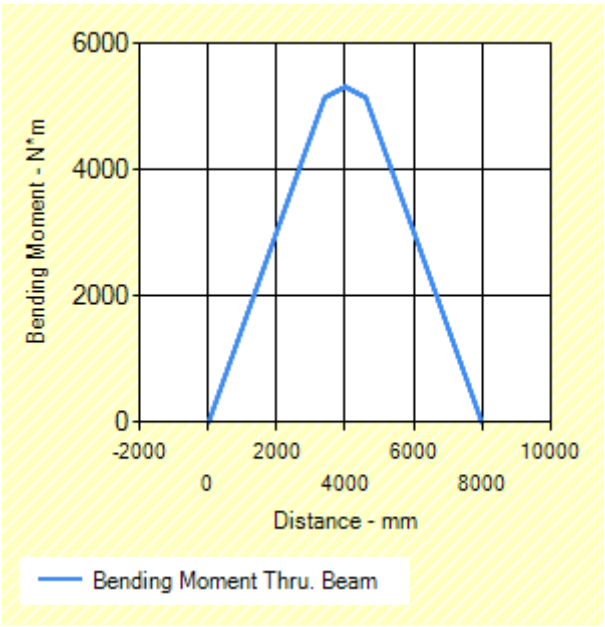
Note: Stresses are positive numbers, and these are stress magnitudes in the beam. It does not distinguis between tension or compression of the structural beam. This distinction depends on which side of the beam neutral plane c input corresponds.



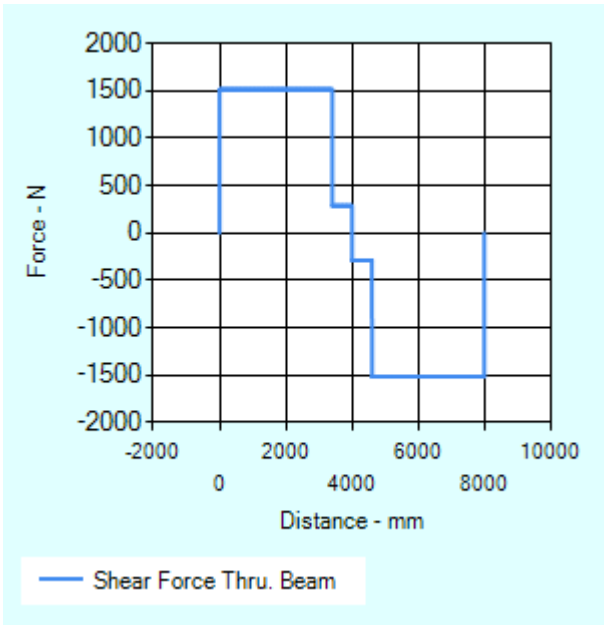
Slope



Deflection



Moment



Shear Force

Definitions:

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

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

Pin support: A pinned support resist both vertical and h forces but not a moment. They will allow the structural me rotate, but not to translate in any direction. A pinned co could allow rotation in only one direction; providing resis rotation in any other direction.

Roller support: Roller supports are free to rotate and along the surface upon which the roller rests. The reaction force is always a single force that is perpendicul surface. Roller supports are commonly located at one en bridges to allow the expansion and contraction of the struc to temperature changes.

Simply supported beam: A beam which is free to rota supports, and also to expand longitudinally at one end.

Structural beam: A structural element that withstands lo moments. General shapes are rectangular sections, I bea 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.
Simply Supported Beam Deflection Calculation Example	An example on calculation of max. deflection, max. shear force, max. bending moment and mid-span slope/deflection of a simply supported beam under multiple point loads and a distributed load.

List Of Equations:

"Simply Supported Beam with Concentrated Load at any Point", Simply Supported Structural Beam with Distributed Load" and Simply Supported Beam with Concentrated Moment at any Point" calculators have be for the calculation of forces, moments, 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