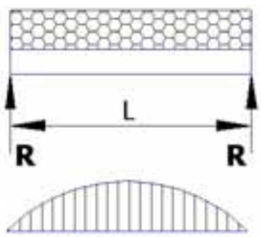
$$\text{Deflection}_{max.} = \frac{5WL^3}{384EI}$$



mm3
4161.4211
9317.2881
11731.356

Engineering Data

MECHANICAL SUPPORT SYSTEMS
salesinfo@mechanicalsupport.co.nz PO Box 204336 Highbrook Auckland www.mechanicalsupport.co.nz

Engineering Data - Beams and Columns

Structural Data

1. Section Properties

Section properties have been derived from ‘as formed’ shapes and are based on nominal dimensions and nominal base steel thickness. The product mass is either taken from actual product weights or calculated from the cross sectional area data based on a steel density of 7850kg per cu.m . All calculations are on a dead load basis (ie static loading).

2. Beam and Column Load Tables

Ultimate load values have been calculated from the section properties as permitted by AS/NZS 4600 Cold Formed Steel Structures code. The guaranteed minimum yield stress has been taken from manufacturer’s specifications as 230 Mpa (unless otherwise stated) for plain channels, and the increase allowed resulting from cold forming has been ignored. All beam and column working loads have been derived from yield load and reduced by a 1.5 FOS.

2.1 Span or Column Length

Listed value is to be taken as the distance between centres of supports.

2.2 Beam Load at Maximum Permissible Stresses

In order to establish the table of working loads that can be carried by the corresponding section, the ultimate limit state loads that could be permitted by the code were first determined. These were divided by 1.5 to provide ‘conservative’ working loads. The load is considered to be uniformly distributed along the span and orientated with respect to the section, as defined by the diagrams to cause bending about X-X axis only. The webs of the beams are assumed to be un-stiffened and have been checked for end bearing in accordance with clause 3.3.6 or AS/NZS4600:1996. Where this is critical the working loads have been appropriately reduced. This assessment has been based on a rigid support with the beam bearing on each support for a length equal to at least the straight length of web-depth of the basic section.

2.3 Beam Loads

The loads and deflections shown are based on simply supported beams uniformly loaded.

2.4 Beam Deflection

Beam deflection has been calculated by using the calculated working load in the standard formula shown below;

$$\delta udl = \frac{5\ \omega\ l3}{384\ E\ I}$$

Where;

δudl	= max beam deflection	mm
ω	= working load	N
l	= span between support centres	mm
E	= Young’s Modulus of Elasticity	N/mm^2
I	= Second Moment of Area	mm^4

As maximum working load (and thus maximum deflection) will not be visually acceptable ‘on the job,’ it will need to be factored in when selecting the product and support span to be used. A basic guideline is that beam deflections generally be limited to the smaller of the *span divided by 180*, or *10mm*, and loads restricted accordingly.

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3.0 Point Loads

For point loads at midspan, the working loads are half the values shown in the tables i.e. max working UDL = 2 x max working midspan point load. The deflection for the point load is obtained from:

$\delta p = 0.80\ \delta udl$

Where δudl is the deflection for a uniform load, which is double the value of the point load.

Example:
The application requires a 10kN point load to be carried, thus the value required from the table will need to be at least double that value (ie 20kN and above). So if this value is found on the table, the corresponding deflection value will need to be multiplied by 0.8, thus reducing the deflection value.

Using for this example the first table line for EM1000 (span of 250mm);

> Maximum working UDL value is 20.41kN, thus:
> 20.41 / 2 = 10.2kN
>
> Deflection at maximum working load is 0.22mm, thus the deflection for a point load of 10.2kN would be:
> 0.22 x 0.8 = 0.176mm

Table Notes

Note 1: Loads have been determined by calculation, FEA, and/or mechanical testing.

Note 2: Asymmetric sections are required to be adequately braced to prevent rotation and twist.

Note 3: UDL = Uniformly Distributed Load

Engineering Data - EM1000 Channel and Combinations

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
250	EM1000	20.4124	0.22
“	EM1001	45.7042	0.12
“	EM1001A	57.5492	0.12
“	EM1001B	57.5492	0.12
“	EM1001C	50.2217	0.12
500	EM1000	10.1967	0.87
“	EM1001	22.8332	0.48
“	EM1001A	28.7556	0.48
“	EM1001B	28.7556	0.48
“	EM1001C	25.0919	0.47
750	EM1000	6.7873	1.95
“	EM1001	15.2010	1.08
“	EM1001A	19.1494	1.09
“	EM1001B	19.1494	1.09
“	EM1001C	16.7069	1.06
1000	EM1000	5.0794	3.46
“	EM1001	11.3787	1.93
“	EM1001A	14.3399	1.93
“	EM1001B	14.3399	1.93
“	EM1001C	12.5080	1.87
1250	EM1000	4.0522	5.40
“	EM1001	9.0802	3.00
“	EM1001A	11.4492	3.00
“	EM1001B	11.4492	3.00
“	EM1001C	9.9837	2.92
1500	EM1000	3.3652	7.75
“	EM1001	7.5437	4.31
“	EM1001A	9.5178	4.32
“	EM1001B	9.5178	4.32
“	EM1001C	8.2966	4.20

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
1750	EM1000	2.8727	10.50
“	EM1001	6.4425	5.84
“	EM1001A	8.1347	5.86
“	EM1001B	8.1347	5.86
“	EM1001C	7.0879	5.69
2000	EM1000	2.5018	13.65
“	EM1001	5.6135	7.60
“	EM1001A	7.0941	7.63
“	EM1001B	7.0941	7.63
“	EM1001C	6.1782	7.41
2250	EM1000	2.2119	17.18
“	EM1001	4.9659	9.57
“	EM1001A	6.2820	9.62
“	EM1001B	6.2820	9.62
“	EM1001C	5.4679	9.33
2500	EM1000	1.9787	21.08
“	EM1001	4.4453	11.75
“	EM1001A	5.6298	11.82
“	EM1001B	5.6298	11.82
“	EM1001C	4.8971	11.47
2750	EM1000	1.7868	25.34
“	EM1001	4.0171	14.13
“	EM1001A	5.0939	14.24
“	EM1001B	5.0939	14.24
“	EM1001C	4.4278	13.80
3000	EM1000	1.6257	29.94
“	EM1001	3.6581	16.71
“	EM1001A	4.6452	16.85
“	EM1001B	4.6452	16.85
“	EM1001C	4.0346	16.32

Engineering Data - EM2000 Channel and Combinations

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
250	EM2000	14.1311	0.22
“	EM2001	31.4267	0.12
“	EM2001A	38.8443	0.12
“	EM2001B	38.8443	0.12
“	EM2001C	34.2102	0.12
500	EM2000	7.0589	0.88
“	EM2001	15.7001	0.48
“	EM2001A	19.4089	0.48
“	EM2001B	19.4089	0.48
“	EM2001C	17.0918	0.47
750	EM2000	4.6986	1.97
“	EM2001	10.4520	1.08
“	EM2001A	12.9245	1.09
“	EM2001B	12.9245	1.09
“	EM2001C	11.3798	1.06
1000	EM2000	3.5162	3.49
“	EM2001	7.8235	1.92
“	EM2001A	9.6779	1.93
“	EM2001B	9.6779	1.93
“	EM2001C	8.5193	1.88
1250	EM2000	2.8050	5.44
“	EM2001	6.2428	3.00
“	EM2001A	7.7264	3.00
“	EM2001B	7.7264	3.00
“	EM2001C	6.7995	2.93
1500	EM2000	2.3293	7.81
“	EM2001	5.1861	4.31
“	EM2001A	6.4224	4.32
“	EM2001B	6.4224	4.32
“	EM2001C	5.6500	4.20

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
1750	EM2000	1.9884	10.59
“	EM2001	4.4288	5.84
“	EM2001A	5.4885	5.86
“	EM2001B	5.4885	5.86
“	EM2001C	4.8264	5.70
2000	EM2000	1.7315	13.77
“	EM2001	3.8586	7.60
“	EM2001A	4.7858	7.62
“	EM2001B	4.7858	7.62
“	EM2001C	4.2065	7.42
2250	EM2000	1.5308	17.33
“	EM2001	3.4131	9.57
“	EM2001A	4.2373	9.61
“	EM2001B	4.2373	9.61
“	EM2001C	3.7224	9.35
2500	EM2000	1.3693	21.26
“	EM2001	3.0550	11.75
“	EM2001A	3.7968	11.81
“	EM2001B	3.7968	11.81
“	EM2001C	3.3333	11.48
2750	EM2000	1.2363	25.55
“	EM2001	2.7604	14.13
“	EM2001A	3.4347	14.22
“	EM2001B	3.4347	14.22
“	EM2001C	3.0134	13.82
3000	EM2000	1.1248	30.18
“	EM2001	2.5134	16.70
“	EM2001A	3.1315	16.83
“	EM2001B	3.1315	16.83
“	EM2001C	2.7453	16.34

Engineering Data - EM3000 Channel and Combinations

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)	Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
250	EM3000	6.0109	0.39	1750	EM3000	0.8260	18.26
“	EM3001	16.5292	0.22	“	EM3001	2.2958	10.71
“	EM3001A	39.3239	0.12	“	EM3001A	5.5522	5.85
“	EM3001B	39.3239	0.12	“	EM3001B	5.5522	5.85
500	EM3000	2.9983	1.55	2000	EM3000	0.7138	23.56
“	EM3001	8.2503	0.90	“	EM3001	1.9909	13.86
“	EM3001A	19.6476	0.48	“	EM3001A	4.8403	7.61
“	EM3001B	19.6476	0.48	“	EM3001B	4.8403	7.61
750	EM3000	1.9909	3.47	2250	EM3000	0.6254	29.39
“	EM3001	5.4843	2.01	“	EM3001	1.7517	17.36
“	EM3001A	13.0825	1.09	“	EM3001A	4.2844	9.60
“	EM3001B	13.0825	1.09	“	EM3001B	4.2844	9.60
1000	EM3000	1.4848	6.13	2500	EM3000	0.5538	35.70
“	EM3001	4.0965	3.56	“	EM3001	1.5584	21.19
“	EM3001A	9.7952	1.93	“	EM3001A	3.8379	11.79
“	EM3001B	9.7952	1.93	“	EM3001B	3.8379	11.79
1250	EM3000	1.1793	9.50	2750	EM3000	0.4944	42.42
“	EM3001	3.2600	5.54	“	EM3001	1.3985	25.30
“	EM3001A	7.8189	3.00	“	EM3001A	3.4707	14.19
“	EM3001B	7.8189	3.00	“	EM3001B	3.4707	14.19
1500	EM3000	0.9740	13.56	3000	EM3000	0.4440	49.46
“	EM3001	2.6992	7.93	“	EM3001	1.2636	29.68
“	EM3001A	6.4983	4.31	“	EM3001A	3.1632	16.79
“	EM3001B	6.4983	4.31	“	EM3001B	3.1632	16.79

Engineering Data - EM4000 Channel and Combinations

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
250	EM4000	3.9714	0.41
“	EM4001	10.4385	0.24
500	EM4000	1.9810	1.63
“	EM4001	5.2099	0.95
750	EM4000	1.3155	3.65
“	EM4001	3.4629	2.13
1000	EM4000	0.9812	6.46
“	EM4001	2.5863	3.77
1250	EM4000	0.7794	10.02
“	EM4001	2.0579	5.85
1500	EM4000	0.6438	14.30
“	EM4001	1.7035	8.37

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
1750	EM4000	0.5460	19.26
“	EM4001	1.4486	11.31
2000	EM4000	0.4720	24.85
“	EM4001	1.2559	14.63
2250	EM4000	0.4137	31.02
“	EM4001	1.1046	18.33
2500	EM4000	0.3664	37.69
“	EM4001	0.9824	22.36
2750	EM4000	0.3272	44.79
“	EM4001	0.8812	26.69
3000	EM4000	0.2939	52.24
“	EM4001	0.7959	31.30

Engineering Data - EM5000 Channel and Combinations

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
250	EM5000	31.0573	0.15
"	EM5001	90.6620	0.08
"	EM5001A	77.2046	0.12
"	EM5001B	77.2046	0.12
500	EM5000	15.5157	0.59
"	EM5001	45.3052	0.32
"	EM5001A	38.5765	0.48
"	EM5001B	38.5765	0.48
750	EM5000	10.3295	1.34
"	EM5001	30.1747	0.72
"	EM5001A	25.6889	1.09
"	EM5001B	25.6889	1.09
1000	EM5000	7.7320	2.37
"	EM5001	22.6009	1.29
"	EM5001A	19.2366	1.93
"	EM5001B	19.2366	1.93
1250	EM5000	6.1701	3.69
"	EM5001	18.0497	2.01
"	EM5001A	15.3583	3.00
"	EM5001B	15.3583	3.00
1500	EM5000	5.1260	5.30
"	EM5001	15.0099	2.88
"	EM5001A	12.7670	4.32
"	EM5001B	12.7670	4.32

Beam Span (mm)	Section Type	UDL (kN)	Deflection (mm)
1750	EM5000	4.3777	7.19
"	EM5001	12.8336	3.91
"	EM5001A	10.9112	5.86
"	EM5001B	10.9112	5.86
2000	EM5000	3.8144	9.35
"	EM5001	11.1971	5.10
"	EM5001A	9.5150	7.62
"	EM5001B	9.5150	7.62
2250	EM5000	3.3743	11.78
"	EM5001	9.9205	6.43
"	EM5001A	8.4252	9.61
"	EM5001B	8.4252	9.61
2500	EM5000	3.0205	14.46
"	EM5001	8.8957	7.91
"	EM5001A	7.5500	11.82
"	EM5001B	7.5500	11.82
2750	EM5000	2.7295	17.40
"	EM5001	8.0542	9.53
"	EM5001A	6.8308	14.23
"	EM5001B	6.8308	14.23
3000	EM5000	2.4855	20.57
"	EM5001	7.3500	11.29
"	EM5001A	6.2285	16.84
"	EM5001B	6.2285	16.84

Engineering Data - Channel Sectional Properties

EM1000	Mass	Area of Section	Axis X-X			Axis Y-Y		
			I	Z	r	I	Z	r
	kg/m	mm²	mm⁴	mm³	mm	mm⁴	mm³	mm
EM1000	2.7004	344	95463	4161.4211	16.66	76331.6	3696.4455	14.90
EM1001	5.4008	688	384804	9317.2881	23.65	190927	9245.8596	16.66
EM1001A	5.4008	688	484505	11731.356	26.54	152663	6654.8823	14.90
EM1001B	5.4008	688	484505	11731.356	26.54	152663	7392.8814	14.90
EM1001C	5.4008	688	434500	10237.983	25.13	171700	7879.7614	15.80

EM2000	Mass	Area of Section	Axis X-X			Axis Y-Y		
			I	Z	r	I	Z	r
	kg/m	mm²	mm⁴	mm³	mm	mm⁴	mm³	mm
EM2000	1.8055	230	65511.2	2880.8786	16.8769	53100.74	2571.4644	56.0923
EM2001	3.611	460	264597	6406.7056	23.9836	131022.36	6344.9085	73.9122
EM2001A	3.611	460	327032	7918.4453	26.6634	106201.48	5722.0625	63.1113
EM2001B	3.611	460	327032	7918.4453	26.6634	108203.17	5239.863	63.7033
EM2001C	3.611	460	295314	6973.9979	25.3375	119112.34	6075.6103	68.5641

EM3000	Mass	Area of Section	Axis X-X			Axis Y-Y		
			I	Z	r	I	Z	r
	kg/m	mm²	mm⁴	mm³	mm	mm⁴	mm³	mm
EM3000	1.9468	248	15779	1226.0295	7.97653	59471	2879.9516	15.4856
EM3001	3.8936	496	74828.8	3370.6667	12.2827	118943.17	5759.9598	15.4856
EM3001A	3.8936	496	331074	8016.3247	25.8358	31558.26	2452.0793	7.97656
EM3001B	3.8936	496	331074	8016.3247	25.8358	33123.12	2984.0649	8.17193

EM4000	Mass	Area of Section	Axis X-X			Axis Y-Y		
			I	Z	r	I	Z	r
	kg/m	mm²	mm⁴	mm³	mm	mm⁴	mm³	mm
EM4000	1.2659	161.26	9890.26	431.13601	24.33	39327.5	1904.4794	21.76
EM4001	2.5319	322.53	44702	1082.3738	34.54	78654.99	78654.99	24.33

EM5000	Mass	Area of Section	Axis X-X			Axis Y-Y		
			I	Z	r	I	Z	r
	kg/m	mm²	mm⁴	mm³	mm	mm⁴	mm³	mm
EM5000	3.5108	447.23	212418	9259.7088	14.61	134282.43	6502.7811	13.06
EM5001	7.021	894.4	1143963	27698.868	20.74	268564.86	13005.562	14.61
EM5001A	7.021	894.4	649986	15738.151	23.27	424835.43	18519.417	13.06
EM5001B	7.021	894.4	649986	15738.151	23.27	430861.44	20864.961	13.06

Note:
I = Moment of Inertia
Z = Section Modulus
r = Radius of Gyration

Engineering Data - Spring Nuts

Slip and Pull-Out Performance - Zinc Plated

Pull-out load data is primarily mechanical testing with the balance of the data being calculated from basic mechanical principles. The bolting system chosen using the data provided in the tables will perform as specified when design, fabrication and erection are carried out in accordance with MSS Mechanical Support Systems recommendations and accepted building practice.

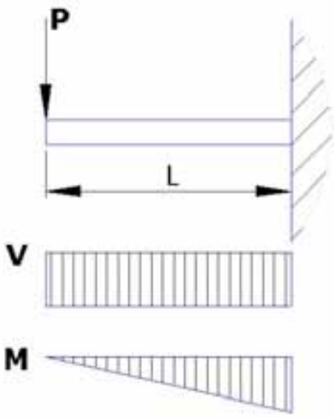
Note:
To simplify the table, channel nuts with springs only are shown. MSS Mechanical Support Systems nuts without springs will have identical performance.

All data obtained from actual mechanical testing, with presented data derived from complete failure less a 1.5 FOS. All tests carried out using 4.8 grade threaded rod.

Spring Nut Pull-Out Loads		
Channel Type:	**Nut Size:**	**Pullout (N):**
EM1000	M6	5800.0
“	M8	11666.7
“	M10	12920.0
“	M12	13613.3
EM2000	M6	5800.0
“	M8	8733.3
“	M10	8733.3
“	M12	8733.3
EM3000	M6	5800.0
“	M8	11666.7
“	M10	12920.0
“	M12	13613.3
EM4000	M6	5800.0
“	M8	8733.3
“	M10	8733.3
“	M12	8733.3
EM5000	M6	5800.0
“	M8	11666.7
“	M10	12920.0
“	M12	13613.3

Engineering Data - Reference Tables and Data

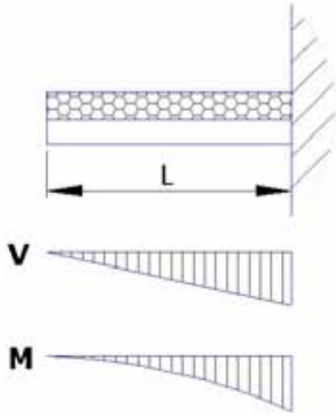
Cantilever Beams



$V_{max.} = P$

$M_{max.} = PL$

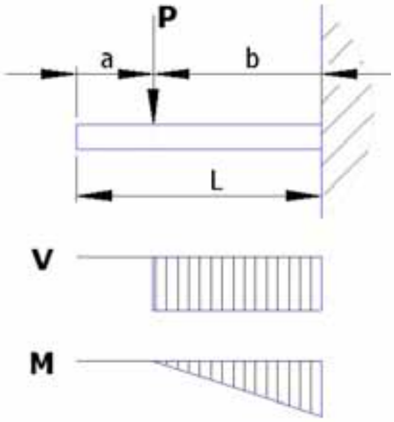
$\text{Deflection}_{max.} = \frac{PL^3}{3EI}$



$V_{max.} = W$

$M_{max.} = \frac{WL}{2}$

$\text{Deflection}_{max.} = \frac{WL^3}{8EI}$

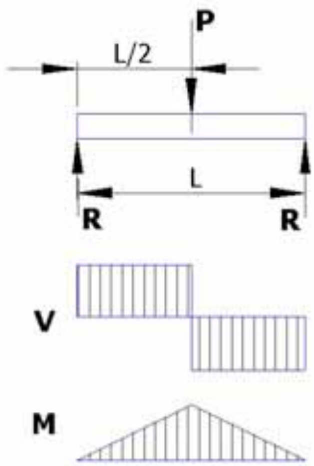


$V_{max.} = P$

$M_{max.} = Pb$

$\text{Deflection}_{max.} = \frac{Pb^2(3L-b)}{6EI}$

Simple Beams

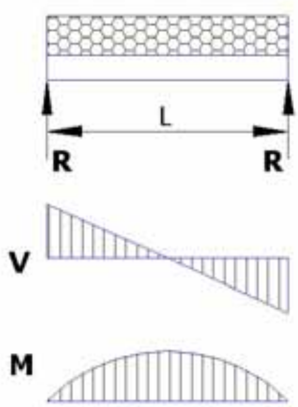


$R = \frac{P}{2}$

$V_{max.} = \frac{P}{2}$

$M_{max.} = \frac{PL}{4}$

$\text{Deflection}_{max.} = \frac{PL^3}{48EI}$

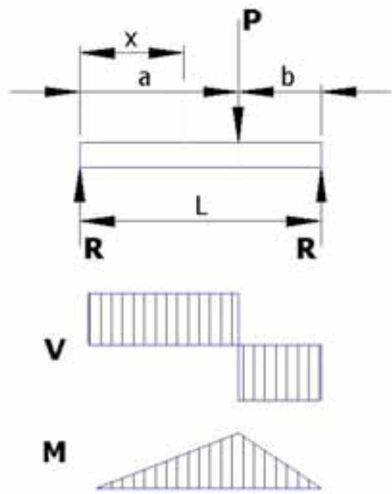


$R = \frac{W}{2}$

$V_{max.} = \frac{W}{2}$

$M_{max.} = \frac{WL}{8}$

$\text{Deflection}_{max.} = \frac{5WL^3}{384EI}$



$R1 = \frac{Pb}{L}$ L

$R2 = \frac{Pa}{L}$

$V_{max.} = \frac{Pa}{L}$

$M_{max.} = \frac{Pab}{L}$

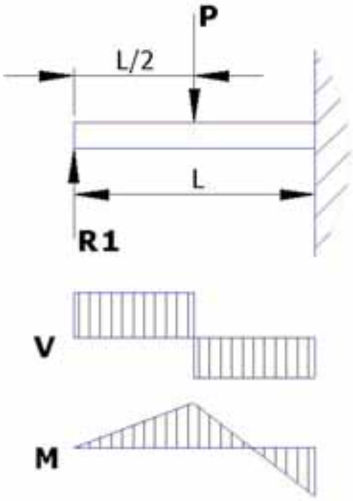
$\text{Deflection}_{max.}$ at $x = \sqrt{\frac{a(a+2b)}{3}}$

$\text{Deflection}_{max.} = \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27\ EIL}$

Note:
R = Reaction
M = Moment (Nmm)
E = Modulus of Elasticity (MPa)
L = Length (mm)
W = Total uniform load (N)
V = Shear
P = Concentrated Load (N)
I = Moment of Inertia (mm⁴)

Engineering Data - Reference Tables and Data

Beams Fixed One End, Supported at Other



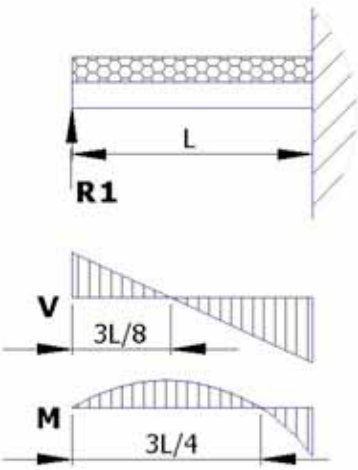
R1 $= \frac{5P}{16}$

Vmax. $= \frac{11P}{16}$

Mmax. $= \frac{3PL}{16}$

Deflectionmax. at x = 0.447L

Deflectionmax. $= 0.009317 \frac{PL^3}{EI}$



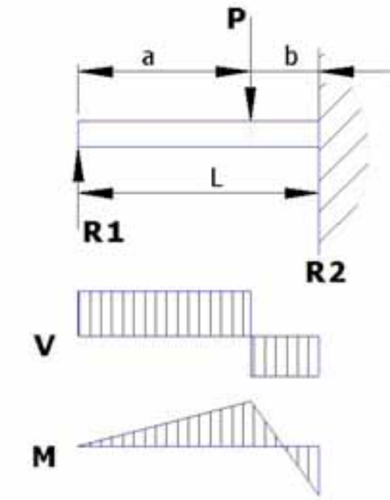
R1 $= \frac{3W}{8}$

Vmax. $= \frac{5W}{8}$

Mmax. $= \frac{WL}{8}$

Deflectionmax. at x = 0.4215L

Deflectionmax. $= \frac{WL^3}{185EI}$



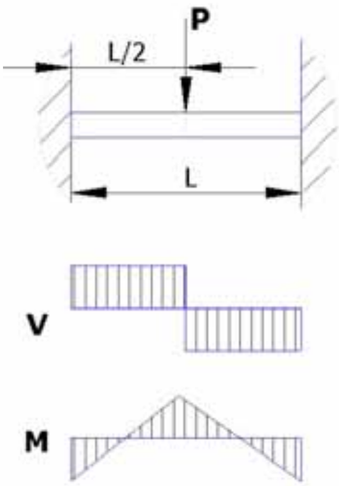
R1 $= \frac{Pb^2}{2L^3}(a+2L)$

R2 $= \frac{Pa}{2L^3}(3L2 - a^2)$

M at point of load(P) = R1a

M at fixed end $= \frac{Pab}{2L^2}(a+L)$

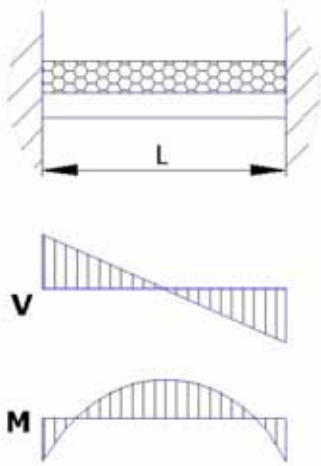
Beams Fixed at Both Ends



Vmax. $= \frac{P}{2}$

Mmax. $= \frac{PL}{8}$

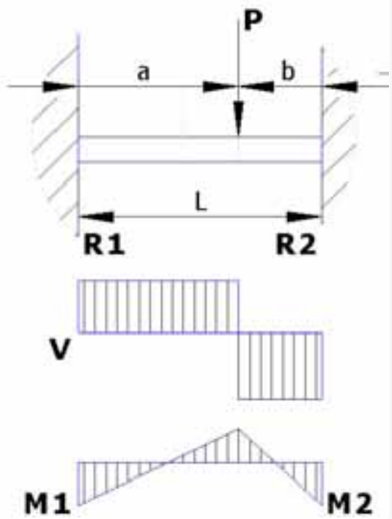
Deflectionmax. $= \frac{PL^3}{192EI}$



Vmax. $= \frac{W}{2}$

Mmax. $= \frac{WL}{12}$

Deflectionmax. $= \frac{WL^3}{384EI}$



R1 $= \frac{Pb^2}{L^3}(3a+b)$

R2 $= \frac{Pa^2}{L^3}(a+3b)$

M1 $= \frac{Pab^2}{L^2}$

M2 $= \frac{Pa^2b}{L^2}$

Note:

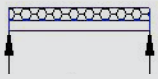
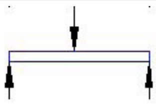
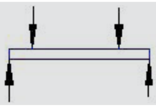
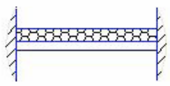
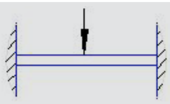
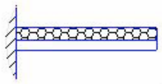
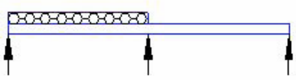
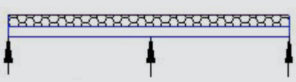
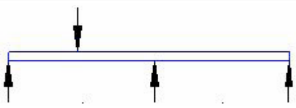
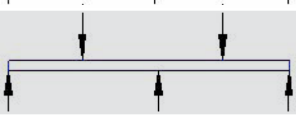
R = Reaction
M = Moment (Nmm)
E = Modulus of Elasticity (MPa)
L = Length (mm)
W = Total uniform load (N)
V = Shear
P = Concentrated Load (N)
I = Moment of Inertia (mm^4)

Conversion Factors For Beams With Various Static Loading Conditions

Load tables in this catalogue are for 41mm channel width series for single span beams, supported at the ends. These can be used in the majority of cases. There are times when it is necessary to know what happens with other loading and support conditions. Some common arrangements are shown in the below table. Simply multiply the loads from the Beam Load Tables by the load factors given in the below table. Similarly, multiply the deflections from the Beam Load Tables by the deflection factor given in the below table.

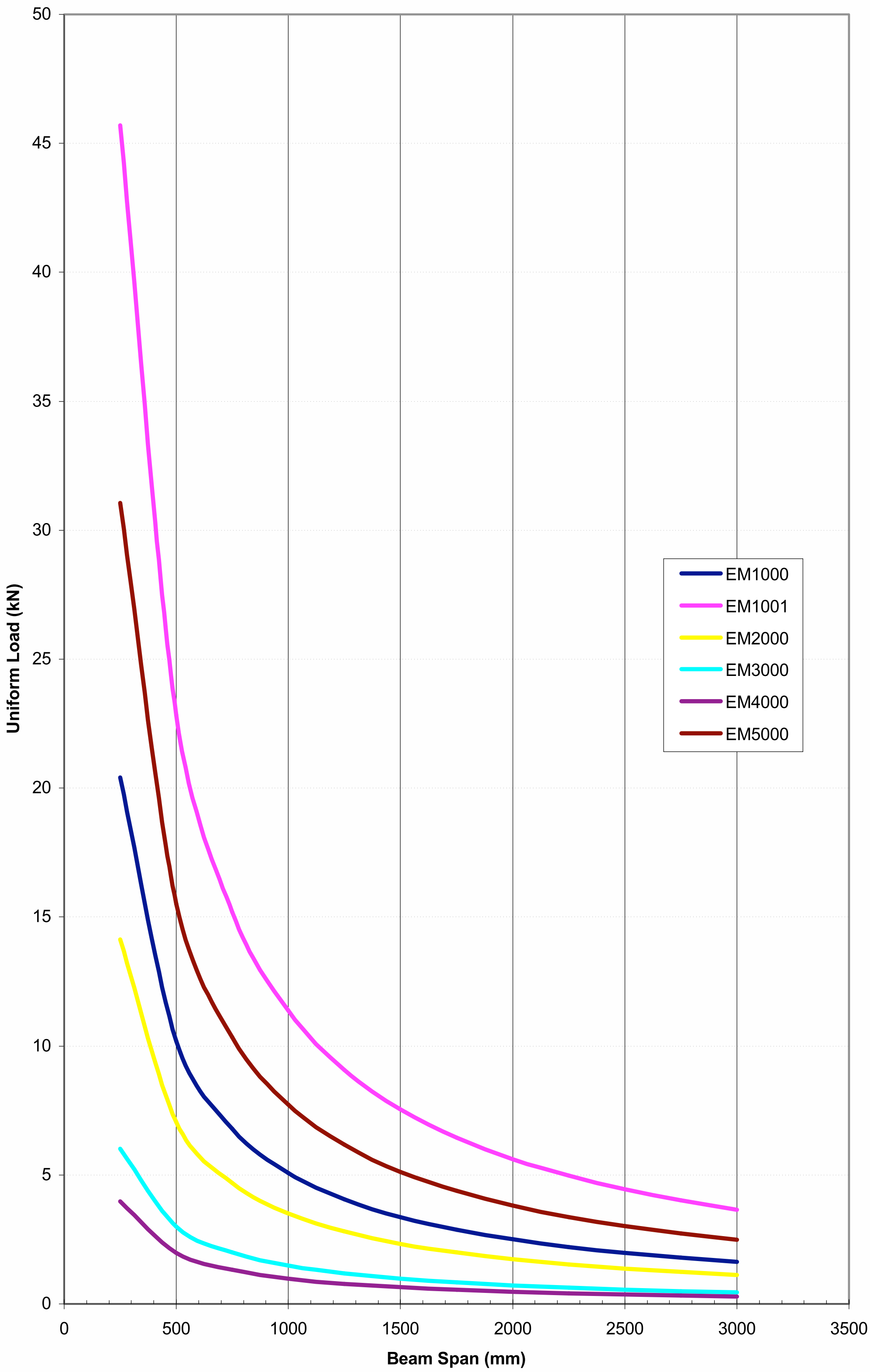
Note: *The multiplication factors shown are only to be used as a guide.*

Multiplication Factor Table

Load and Support Condition:	Diagram:	Load Factor:	Deflection Factor:
Simple Beam – Uniform Load		**1.0**	**1.0**
Simple Beam – Concentrated Load at Centre		0.5	0.8
Simple Bean – Two Equal Concentrated Loads at ¼ Points		1.0	1.1
Beam Fixed at Both Ends – Uniform Load		1.5	0.3
Beam Fixed at Both Ends – Concentrated Load at Centre		1.0	0.4
Cantilever Beam – Uniform Load		0.25	2.4
Cantilever Beam – Concentrated Load at End		0.12	3.2
Continuous Beam – Two Equal Spans – Uniform Load on One Span		1.3	0.92
Continuous Beam – Two Equal Spans – Uniform Load on Both Ends		1.0	0.42
Continuous Beam – Two Equal Spans – Concentrated Load at Centre of One Beam		0.62	0.71
Continuous Beam – Two Equal Spans – Concentrated Load at Centre of Both Spans		0.67	0.48

Engineering Data - Mass Charts

MSS Channel Working UDL



Engineering Data - Mass Charts