SECTION 8 - FLEXURAL MEMBERS (BEAMS)

Table of Contents

SECTION 8

FLEXURAL MEMBERS (BEAMS)

Look for this blue line in the left margin of the Design Manual documents. This line shows you where the latest update has been made.

SYMBOLS FOR FLEXURAL MEMBERS (BEAMS)

A_w	Cross-sectional area of web or webs (in^2)
B	Derived constant for use in Eq. B-5
C_1	Lateral buckling coefficient from Table B-1
E	Modulus of Elasticity about X-X or Y-Y axis (psi)
F_b	Allowable flexural stress (psi)
F_b'	Allowable flexural stess-laterally unsupported beams (psi)
F_u	Ultimate flexural stress-laterally supported beams (psi)
F_u'	Ultimate flexural stress-laterally unsupported beams (psi)
F_v	Allowable shear stress (psi)
G	Shear modulus (psi)
I_x I_y	Moment of inertia about X-X or Y-Y axis (in^4)
J	Torsional constant (in^4)
K_x K_y	Effective length factor for buckling about X-X or Y-Y axis
K_b	Coefficient for flexural deflection
K_v	Coefficient for shear deflection
L	Length of beam (center to center of supports) (ft)
L_u	Unbraced length of beam (center to center of lateral braces) (ft)
M	Bending moment from applied loads (lb-in)
N	Derived constant for use in Eq. B-5
P	Concentrated load on beam (lbs)
S_x	Section Modulus about X-X axis (in^3)
V	Shear from applied load (lbs)
W	Uniform beam load (lbs/ft)
Wt	Weight of section (lbs)
b	Outside dimension of square tube (in)
b_f	Width of flange (in)
d	Full depth of section (in)
f_b	Flexural stress from applied loads (psi)
f_v	Shear stress from applied loads (psi)
l	Length of beam (center to center of supports) (in)
l_u	Unbraced length of beam (center to center of lateral braces) (in)
t	Thickness of section (in) Wall thickness of tubes (in)
t_f	Thickness of flange (in)
w	Uniform beam load (lb/in)
Δ	Deflection (in)

FLEXURAL MEMBERS (BEAMS)

INTRODUCTION

The load carrying capability of **EXTREN®** beams may be limited by considerations of strength, stability or deflection. The strength capacity is characterized by an allowable working stress; the stability of the beam is characterized by its resistance to twisting or buckling laterally; and the deflection of the beam is usually limited by architectural or functional requirements.

STRENGTH

For beams sufficiently supported laterally to prevent lateral buckling, beam selection for a given work load will depend upon the flexural stress f_b, the shear stress f_v, or the amount of deflection resulting from the load.

The allowable flexural stress, F_b for W and I shapes, is usually governed by local buckling of the outstanding flange. Equation B-3, developed from extensive product testing, provides values for the ultimate flexural stress F_u, for open shapes. The ALLOWABLE LOAD tables are generated with a **factor of safety of 2.5**. Loads controlled by bending stresses are indicated with asterisks (*).

At points of concentrated loads and at supports, it may be necessary to insert stiffeners between the flanges of open structural shapes. If stiffeners are **not provided**, the compression flange of the beam will buckle at a lower stress than that predicted by Equation B-3. The designer is referred to *Structural Plastics Design Manual* — Reference 2 for further information relative to the flange buckling and web crippling effects.

Loads on beams of relatively short span may be limited to the allowable shear stress, F_v. For **EXTREN®** 500, 525 and 625 beams, F_v = 1,500 psi. The ALLOWABLE LOAD tables designate which loads are limited by shear stress. This represents a **factor of safety of 3.0** against the ultimate short beam shear stress as listed in Section 3 — **PROPERTIES OF EXTREN®**.

STABILITY

A beam which is not restrained laterally may deflect and/or twist out of the plane of the load at considerably less load than the same member would carry with adequate lateral support. The degree of lateral support for some beams may be obvious in many cases. In some cases, however, it is difficult to accurately assess the restraint to lateral displacement of a beam provided by adjacent members of bracing. Generally, if the compression flange of a beam is attached at frequent points along its length to a floor or roof system, it may be considered to be laterally supported (this section contains a more complete discussion of lateral bracing).

The ALLOWABLE LOAD tables list the uniformly distributed loads (in pounds per foot) at the given unsupported lengths. Generally, the W shapes and rectangular shapes will carry the same load whether laterally supported or unsupported. I shapes will carry reduced loads if laterally unsupported. Equation B-6 can be used to determine the allowable flexural stress for laterally unsupported open symmetrical shapes.

It is strongly recommended that only **EXTREN®** beams with geometrical symmetry in the plane of the load be used in a laterally unsupported condition. Before nonsymmetrical shapes are used, the designer should consult *Steel Structures* — Reference 1 or *Structural Plastics Design Manual* — Reference 2.

DEFLECTION

The deflection of **EXTREN®** beams results from both flexural and shear stresses. In long beams, deflections are primarily due to flexural stresses, but in short beams, the shear stresses may account for a significant portion of the total deflection. For typical applications of **EXTREN®** products as beams, Equations B-13 & B-14 will predict the deflections of **EXTREN®** beams to acceptable values. For unusual applications in which beam deflections are a critical factor, the designer is referred to *Mechanics of Materials* — Reference 7 or any contemporary mechanics book.

The load tables at the end of this section were based on the LIMITING stress for the particular structural shape, span and deflection requirements. **The designer is CAUTIONED that when the equations are used in lieu of the tables, one should confirm the lateral support characteristics of a beam.**

BEAM EQUATIONS FOR LOADS APPLIED IN THE PLANE OF THE WEB

STRESSES FROM APPLIED LOADS

Flexural stress:

$$f_b = \frac{M}{S_x} \qquad \text{(B-1)}$$

Shear stress:

$$f_v = \frac{V}{A_w} \qquad \text{(B-2)}$$

ULTIMATE AND ALLOWABLE FLEXURAL STRESSES

Laterally Supported EXTREN® W & I Shapes

Ultimate: $$F_u = \frac{.5E}{(b_f / t_f)^{1.5}} \leq \begin{cases} 30{,}000 \text{ psi } (\textbf{EXTREN}^{®}\ 500/525) \\ 30{,}000 \text{ psi } (\textbf{EXTREN}^{®}\ 625 > 4") \\ 33{,}000 \text{ psi } (\textbf{EXTREN}^{®}\ 625 \leq 4") \end{cases} \qquad \text{(B-3)}$$

Allowable: $$F_b = \frac{F_u}{2.5} \qquad \text{(B-4)}$$

Laterally Unsupported EXTREN® W & I Shapes

Ultimate: $$F_u' = \frac{C_1}{S_x}\sqrt{N^2 + \frac{d^2B^2}{4}} \leq F_u \qquad \text{(B-5)}$$

Where: $$N = \frac{\pi}{K_y l_u}\sqrt{E\, I_y G J}$$

And: $$B = \frac{\pi^2 E\, I_y}{(K_y l_u)^2}$$

Allowable: $$F_b' = \frac{F_u'}{2.5} \qquad \text{(B-6)}$$

K_y and C_1 are taken from Table B-1 and reflect the beam end conditions in the Y-Y Axis and loading on the beam.

Laterally Supported or Laterally Unsupported EXTREN® Square and Rectangular Tubing:

Ultimate: $$F_u = \frac{E}{16(b/t)^{0.85}} \leq \begin{cases} 30{,}000 \text{ psi } (\textbf{EXTREN}^{®}\ 500/525) \\ 33{,}000 \text{ psi } (\textbf{EXTREN}^{®}\ 625) \end{cases} \qquad \text{(B-7)}$$

Allowable: $$F_b = \frac{F_u}{2.5} \qquad \text{(B-8)}$$

BEAM EQUATIONS FOR LOADS APPLIED IN THE PLANE OF THE WEB

Laterally Supported EXTREN® Channels

Ultimate: $F_u = \frac{E}{27(b_f / t_f)^{.95}} \leq \begin{cases} 30{,}000 \text{ psi (EXTREN® 500 \& 525)} \\ 33{,}000 \text{ psi (EXTREN® 625)} \end{cases}$ (B-9)

Allowable: $F_b = \frac{F_u}{2.5}$ (B-10)

It must be stressed that a non-symmetrical shape such as a channel should only be used when the flanges are adequately laterally supported. Current industry experience has shown that satisfactory performance from channels has been achieved when the compression flange was laterally supported with connecting members at the following spacings:

— 24" maximum for 3" and 4" channels
— 36" maximum for 5" and 6" channels
— 48" maximum for 8" channels and larger

ALLOWABLE SHEAR STRESSES

EXTREN® structural shapes:

$$F_v = \frac{4500}{3.0} = 1500 \text{ psi} \qquad \text{(B-11)}$$

EXTREN® large rectangular shapes:

$$F_v = \frac{4000}{3.0} = 1333 \text{ psi} \qquad \text{(B-12)}$$

DEFLECTIONS

EXTREN® structural shapes with uniform loads, w:

$$\Delta = K_b \frac{wl^4}{EI_x} + K_v \frac{wl^2}{A_wG} \qquad \text{(B-13)}$$

EXTREN® structural shapes with concentrated loads, P:

$$\Delta = K_b \frac{Pl^3}{EI_x} + K_v \frac{Pl}{A_wG} \qquad \text{(B-14)}$$

K_b is taken from Table B-2 and reflects the beam end conditions.

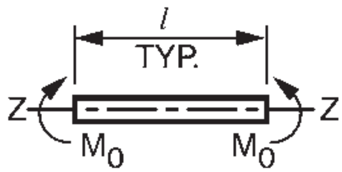
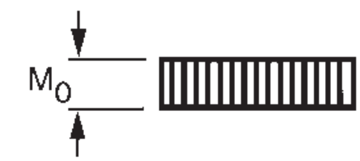
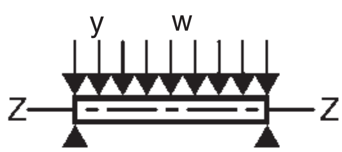
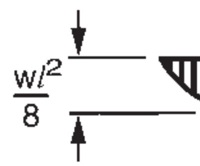
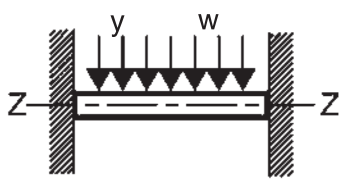
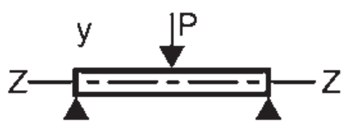
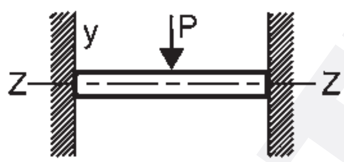
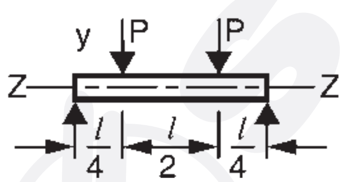
K_v = 0.35. This value actually varies slightly depending on load distribution, end constraints and Poisson's Ratio, but the given value will be adequate for most cases with supports at both ends of the beam.

K_v = 1.2 for cantilever beams.

For additional information, see *Mechanics of Materials* by Timoshenko & Gere.

TABLE B-1

LATERAL BUCKLING COEFFICIENTS FOR BEAMS WITH VARIOUS LOAD AND SUPPORT ARRANGEMENTS

Loading and end restraint * about X-axis	Bending Moment diagram	End Restraint about Y-axis	K_y	C_1*
		None	1.0	1.0
		None Full	1.0 0.5	1.13 0.97
		None Full	1.0 0.5	1.30** 0.86**
		None Full	1.0 0.5	1.35 1.07
		None Full	1.0 0.5	1.70 1.04
		None	1.0	1.04

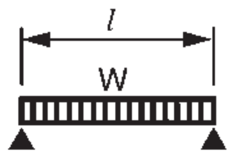
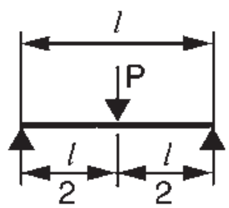
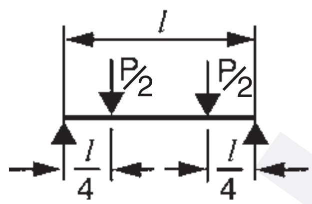
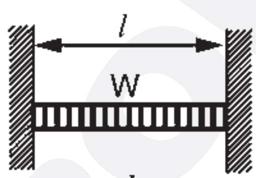
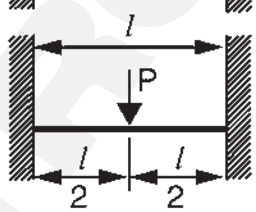
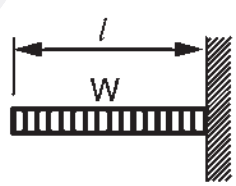
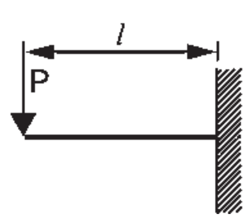
* All beams are restrained at each end against rotation about the X-axis and displacement in the Y and Z directions. Loads applied at beam centroidal axis.

** Critical Stress based on center moment ($wl^2/24$).

Table taken from *Structural Plastics Design Manual* - Reference 2.

TABLE B-2

COEFFICIENTS K_b - FOR FLEXURAL DEFLECTION

END SUPPORT	TYPE OF LOADING	DEFLECTION AT:	K_b
Simple Support @ Both Ends		Midspan	0.013
		Midspan	0.021
		Midspan Quarter Pts.	0.029 0.021
Fixed Support @ Both Ends		Midspan	0.003
		Midspan	0.005
Cantilever		Free End	0.125
		Free End	0.333

EXAMPLES OF BEAM SELECTION USING THE TABLES

PROBLEM #1

Select an **EXTREN**® 525 W-shape for a clear span of 18'-0", capable of supporting 250 pounds per foot of load (including beam weight) with a maximum deflection not to exceed $l/150$. The beam is laterally supported and is simply supported at each end.

From the applicable ALLOWABLE LOAD table shown in this section, it can be seen that a 10 x 10 x 3/8 W-shape will support a load of 254 pounds per foot (which is greater than 250 pounds per foot required) and produce a maximum deflection of $l/150$.

♦ **Use a 10 x 10 x 3/8 EXTREN® 525 W-Shape**

PROBLEM #2

An **EXTREN**® 625 I-shape must be used to carry 1450 pounds per foot of load over a clear span of 7'-0" and not produce a deflection greater than $l/150$. Again, the beam will be laterally supported and is simply supported.

From the applicable table shown in this section, a 10 x 5 x 3/8 I-shape, for a 7'-0" span, lists no value. This indicates that the load required to produce a deflection of $l/150$ is theoretically greater than the maximum allowable uniform load, in this case 1,487 pounds per foot, shown to be controlled by F_v (shear). Therefore, the I-shape will support 1,450 pounds per foot load and meet the deflection criteria. (From Eq. B-13, it can be shown that the maximum deflection is about 1/2" which is an $l/170$ ratio.)

♦ **Use a 10 x 5 x 3/8 EXTREN® 625 I Shape**

PROBLEM #3

A laterally unsupported **EXTREN**® 525 W-shape, spanning 10'-0", is required to carry 250 pounds per foot of load. Deflection must be kept to a maximum of $l/360$ for architectural reasons. Choose a W-shape adequate for this application. The beam will be simply supported.

Although the applicable table shows that a 6 x 6 x 3/8 W-shape will support 266 pound per foot for a 10'-0" laterally unsupported span, the deflection column shows that a 122 pound per foot load will produce a deflection of $l/360$. A 8 x 8 x 3/8 W-shape in the laterally unsupported condition will support a load of 724 pounds per foot and requires a 263 pound per foot load (greater than 250 pound per foot service load) to produce a deflection of $l/360$.

♦ **Use an 8 x 8 x 3/8 EXTREN® 525 W-Shape**

PROBLEM #4

A simply supported **EXTREN**® 625 W-shape, spanning 20'-0", is required to carry 130 pounds per foot, including beam weight. The beam will be laterally supported only at the ends and at the middle. What W-shape will work if the maximum deflection allowed is $l/100$?

The allowable load table for the 8 x 8 x 3/8 W-shape shows that a laterally supported beam, 20'-0" long, is capable of carrying 150 pounds per foot and meet the deflection criteria. The beam is laterally supported at 10'-0". Therefore, the actual flexural stress f_b' must be checked against the allowable flexural stress, F_b' at L_u = 10'-0".

From TABLE B-1

$$M = \frac{wl^2}{8} = \frac{(130/12)(20 \times 12)^2}{8} = 78{,}000 \text{ lb-in}$$

Therefore, $f_b = 78{,}000/S_x = 78{,}000/24.80 = 3145$ psi (Eq. B-1)

From the ALLOWABLE LOAD table, the allowable stress for the 8 x 8 x 3/8 W-shape when laterally unsupported at 10'-0" is 4,379 psi. Since 4379 psi allowable > 3,145 psi actual, the W-shape is adequate.

Using the equations, the procedure yields the same results, but is slightly more involved!

Using Eq. B-5: $F_u' = \frac{C_1}{S_x}\sqrt{N^2 + \frac{d^2 B^2}{4}} < F_u$

with $E = 2.5 \times 10^6$ psi, $G = 0.425 \times 10^6$ psi (Section 3—**PROPERTIES OF EXTREN®**)
$d = 8$ in, $S_x = 24.80$ in^3, $I_y = 32.03$ in^4, $J = 0.409$ in^4 (Section 6—**ELEMENTS OF SECTIONS**)
K_y=1.0, C_1=1.13 (TABLE B-1)

$$B = \frac{\pi^2 E I_y}{(K_y l_u)^2} = \frac{\pi^2 (2.5 \times 10^6)\, 32.03}{[1.0 \times (10 \times 12)]^2} = 54{,}883 \text{ lbs}$$

and

$$N = \frac{\pi}{K_y l_u}\sqrt{E I_y G J}$$

$$= \frac{\pi}{1.0 \times (10 \times 12)}\sqrt{(2.5 \times 10^6) \times 32.03 \times (0.425 \times 10^6) \times 0.409}$$

$$= 97{,}673 \text{ lb-in}$$

Therefore:

$$F_u' = \frac{1.13}{24.80}\sqrt{97{,}673^2 + \frac{8^2\,(54{,}883)^2}{4}} = 10{,}948 \text{psi}$$

and from Eq. B-6: $F_b' = \frac{F_u'}{2.5} = \frac{10{,}948}{2.5} = 4{,}379$ psi

Again, since 4,379 psi allowable > 3,145 psi actual, the 8 x 8 x 3/8 W-shape is adequate.

♦ **Use an 8 x 8 x 3/8 EXTREN® 625 W-Shape**

INTRODUCTION TO FLEXURAL MEMBER (BEAM) LOAD TABLES

The following are the allowable load tables for **EXTREN®** W and I shapes, **EXTREN®** channels, and **EXTREN®** square, rectangular and large rectangular tubes when used as flexural members (beams).

These allowable load tables are based upon:

1. Ambient temperature
2. A safety factor of 2.5 for flexural stresses
3. A safety factor of 3.0 for shear stresses
4. Beams uniformly loaded in the plane of their webs and simply supported at each end.

Controlling values for the LATERALLY SUPPORTED condition governed by stress are limited by flexural stress, F_b, when preceded with an asterisk (*) or limited by shear stress, F_v, without an asterisk.

For W and I shapes, the LATERALLY UNSUPPORTED allowable uniform load value is generated using the controlling allowable stress as predicted by Eq. B-6 or B-4 and B-11.

The LATERALLY UNSUPPORTED stresses listed are the allowable stresses for the respective length as predicted by Eq. B-6. The use of this column to the designer is illustrated in Example Problem #4.

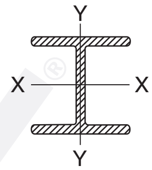
NOTE: All load table data is based on single (simple) span calculations. The effect on strength of notches, copes or other stress concentrations must be considered.

STRONGWELL

BEAMS

W-SHAPES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

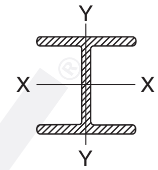


SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 1/4									
w = 1.69 lb/ft	3	8,419	630	630	—	—	553	414	276
b_f/t_f = 12.0	4	5,211	458	473	—	337	281	211	141
F_b = 12,000 psi	5	3,689	208	378	286	191	159	119	80
A_w = 0.63 sq. in.	6	2,834	111	315	176	117	98	73	49
I_x = 3.17 in.^{4}	7	2,296	66	270	115	77	64	48	32
S_x = 2.11 in.^{3}	8	1,929	42	236	79	53	44	33	22
I_y = 1.13 in.^{4}	9	1,665	29	*208	56	38	31	23	16
J = 0.044 in.^{4}	10	1,465	21	*169	42	28	23	17	12
4 x 4 x 1/4									
w = 2.22 lb/ft	3	8,125	880	880	—	—	—	793	529
b_f/t_f = 16.0	4	7,462	660	660	—	—	582	436	291
F_b = 8,125 psi	5	5,007	528	528	—	416	347	260	173
A_w = 0.88 sq. in.	6	3,664	269	440	397	265	220	165	110
I_x = 7.94 in.^{4}	7	2,846	154	377	266	177	148	111	74
S_x = 3.97 in.^{3}	8	2,307	95	330	185	124	103	77	52
I_y = 2.67 in.^{4}	9	1,932	63	*265	134	89	75	56	37
J = 0.060 in.^{4}	10	1,657	44	*215	100	67	56	42	28
	11	1,450	32	*178	76	51	42	32	21
	12	1,288	24	*149	60	40	33	25	17

STRONGWELL

BEAMS

W-SHAPES — EXTREN® 625
E = 2.8 x 10^6 psi



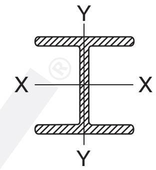
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 1/4									
w = 1.69 lb/ft	3	8,979	630	630	—	—	578	433	289
b_f/t_f = 12.0	4	5,532	473	473	—	356	297	222	148
F_b = 13,200 psi	5	3,900	219	378	304	203	169	127	84
A_w = 0.63 sq. in.	6	2,986	117	315	187	125	104	78	52
I_x = 3.17 in.^{4}	7	2,412	69	270	123	82	68	51	34
S_x = 2.11 in.^{3}	8	2,023	44	236	84	56	47	35	23
I_y = 1.13 in.^{4}	9	1,743	30	210	60	40	34	25	17
J = 0.044 in.^{4}	10	1,532	22	*186	45	30	25	19	12
4 x 4 x 1/4									
w = 2.22 lb/ft	3	8,750	880	880	—	—	—	820	547
b_f/t_f = 16.0	4	7,985	660	660	—	—	608	456	304
F_b = 8,750 psi	5	5,344	528	528	—	438	365	274	183
A_w = 0.88 sq. in.	6	3,900	287	440	420	280	233	175	117
I_x = 7.94 in.^{4}	7	3,021	163	377	282	188	157	118	78
S_x = 3.97 in.^{3}	8	2,443	101	330	198	132	110	82	55
I_y = 2.67 in.^{4}	9	2,041	67	*286	143	96	80	60	40
J = 0.060 in.^{4}	10	1,748	46	*232	107	71	59	45	30
	11	1,526	33	*191	82	54	45	34	23
	12	1,354	25	*161	64	43	35	27	18

BEAMS

W-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

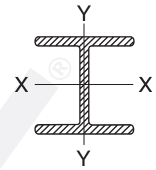
Allowable Uniform Loads in Pounds Per Foot



SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
6 x 6 x 1/4									
w = 3.52 lb/ft	5	4,253	828	828	—	—	—	662	441
b_f/t_f = 24.0	6	4,253	690	690	—	—	597	448	299
F_b = 4,253 psi	7	4,253	546	*546	—	503	419	314	209
A_w = 1.38 sq. in.	8	3,761	369	*418	—	364	303	227	152
I_x = 28.28 in.^{4}	9	3,031	235	*330	—	270	225	169	113
S_x = 9.43 in.^{3}	10	2,508	158	*267	—	205	171	128	86
I_y = 9.00 in.^{4}	11	2,119	110	*221	—	159	133	100	66
J = 0.091 in.^{4}	12	1,823	80	*186	—	126	105	79	52
	13	1,591	59	*158	152	101	84	63	42
	14	1,407	45	*136	123	82	69	51	34
	15	1,257	35	*119	102	68	57	42	28
6 x 6 x 3/8									
w = 5.13 lb/ft	5	7,813	1,182	1,182	—	—	—	943	628
b_f/t_f = 16.0	6	7,200	985	985	—	—	850	638	425
F_b = 7,813 psi	7	5,460	844	844	—	715	596	447	298
A_w = 1.97 sq. in.	8	4,327	604	739	—	517	431	323	216
I_x = 40.17 in.^{4}	9	3,545	391	657	576	384	320	240	160
S_x = 13.40 in.^{3}	10	2,982	266	591	438	292	243	183	122
I_y = 13.52 in.^{4}	11	2,561	189	537	340	227	189	142	94
J = 0.303 in.^{4}	12	2,238	139	*485	269	179	149	112	75
	13	1,983	105	*413	216	144	120	90	60
	14	1,778	81	*356	175	117	97	73	49
	15	1,611	64	*310	145	96	80	60	40

BEAMS

W-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

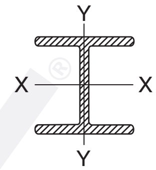
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	$*F_b$ or F_v	$l/100$	$l/150$	$l/180$	$l/240$	$l/360$
8 x 8 x 3/8									
w = 6.97 lb/ft	6	5,076	1,360	1,360	—	—	—	1,209	806
b_f/t_f = 21.3	7	5,076	1,166	1,166	—	—	—	885	590
F_b = 5,076 psi	8	5,076	1,020	1,020	—	—	884	663	442
A_w = 2.72 sq. in.	9	5,076	907	907	—	810	675	506	338
I_x = 99.18 in.^{4}	10	4,379	724	816	—	630	525	394	263
S_x = 24.80 in.^{3}	11	3,681	503	*694	—	498	415	311	208
I_y = 32.03 in.^{4}	12	3,150	362	*583	—	400	333	250	167
J = 0.409 in.^{4}	13	2,735	268	*497	487	325	271	203	135
	14	2,405	203	*428	401	267	223	167	111
	15	2,138	157	*373	333	222	185	139	93
	16	1,919	124	*328	280	186	155	116	78
	17	1,736	99	*290	237	158	132	99	66
	18	1,582	81	*259	202	135	112	84	56
	19	1,451	66	*232	174	116	97	72	48
	20	1,339	55	*210	150	100	84	63	42
	21	1,242	47	*190	131	87	73	55	36
	22	1,157	40	*173	115	77	64	48	32
	23	1,082	34	*159	101	67	56	42	28
	24	1,016	29	*146	90	60	50	37	25
**** 8 x 8 x 1/2**									
w = 9.23 lb/ft	6	7,813	1,750	1,750	—	—	—	1,552	1,035
b_f/t_f = 16.0	7	7,813	1,500	1,500	—	—	—	1,136	757
F_b = 7,813 psi	8	7,202	1,313	1,313	—	—	1,134	850	567
A_w = 3.5 sq. in.	9	5,826	1,167	1,167	—	1,039	866	650	433
I_x = 127.06 in.^{4}	10	4,839	1,025	1,050	—	808	674	505	337
S_x = 31.76 in.^{3}	11	4,106	719	955	—	639	533	399	266
I_y = 42.74 in.^{4}	12	3,546	521	875	769	513	427	320	214
J = 0.958 in.^{4}	13	3,108	389	808	625	417	347	260	174
	14	2,758	298	750	514	342	285	214	143
	15	2,473	233	700	427	285	237	178	119
	16	2,239	185	*646	358	239	199	149	100
	17	2,042	150	*572	303	202	169	126	84
	18	1,876	123	*511	259	173	144	108	72
	19	1,734	102	*458	223	149	124	93	62
	20	1,611	85	*414	193	129	107	80	54
	21	1,504	72	*375	168	112	93	70	47
	22	1,411	62	*342	147	98	82	61	41
	23	1,328	53	*313	130	86	72	54	36
	24	1,254	46	*287	115	77	64	48	32

** Non-stock size subject to mill run requirements.

BEAMS

W-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

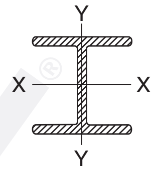


SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
10 x 10 x 3/8									
w = 8.78 lb/ft	6	3,630	1,735	1,735	—	—	—	—	1,241
b_f/t_f = 26.7	7	3,630	1,487	1,487	—	—	—	1,411	941
F_b = 3,630 psi	8	3,630	1,301	1,301	—	—	—	1,089	726
A_w = 3.47 sq. in.	9	3,630	1,157	1,157	—	—	1,138	854	569
I_x = 198.82 in.^{4}	10	3,630	961	*961	—	—	905	679	452
S_x = 39.70 in.^{3}	11	3,630	794	*794	—	—	729	547	364
I_y = 62.54 in.^{4}	12	3,630	667	*667	—	—	594	445	297
J = 0.514 in.^{4}	13	3,630	569	*569	—	—	489	367	245
	14	3,352	453	*490	—	488	407	305	203
	15	2,950	347	*427	—	410	341	256	171
	16	2,620	271	*375	—	347	289	217	144
	17	2,346	215	*332	—	296	246	185	123
	18	2,117	173	*297	—	254	212	159	106
	19	1,923	141	*266	—	220	183	137	92
	20	1,756	116	*240	—	191	159	119	80
	21	1,613	97	*218	—	167	139	105	70
	22	1,488	81	*199	—	147	123	92	61
	23	1,380	69	*182	—	130	108	81	54
	24	1,284	59	*167	—	115	96	72	48
	25	1,199	51	*154	—	103	86	64	43
	26	1,124	44	*142	138	92	77	58	38
	27	1,057	38	*132	124	83	69	52	34
	28	996	34	*123	112	75	62	47	31
	29	942	30	*114	101	68	56	42	28
	30	893	26	*107	92	61	51	38	26

BEAMS

W-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot



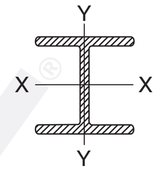
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 10 x 10 x 1/2									
w = 11.64 lb/ft	6	5,590	2,250	2,250	—	—	—	—	1,606
b_f/t_f = 20.0	7	5,590	1,929	1,929	—	—	—	1,825	1,216
F_b = 5,590 psi	8	5,590	1,688	1,688	—	—	—	1,407	938
A_w = 4.5 sq. in.	9	5,590	1,500	1,500	—	—	1,471	1,103	735
I_x = 256.2 in.^{4}	10	5,590	1,350	1,350	—	—	1,169	877	584
S_x = 51.20 in.^{3}	11	5,590	1,227	1,227	—	1,129	941	706	471
I_y = 83.42 in.^{4}	12	4,813	1,125	1,125	—	920	767	575	383
J = 1.208 in.^{4}	13	4,162	841	1,038	—	758	631	473	316
	14	3,644	635	964	945	630	525	394	262
	15	3,226	489	*848	793	529	441	330	220
	16	2,882	384	*745	671	447	373	280	186
	17	2,597	307	*660	572	382	318	238	159
	18	2,357	248	*589	492	328	273	205	137
	19	2,154	204	*529	425	283	236	177	118
	20	1,979	169	*477	370	247	205	154	103
	21	1,829	142	*433	324	216	180	135	90
	22	1,697	120	*394	285	190	158	119	79
	23	1,582	102	*361	251	168	140	105	70
	24	1,481	88	*331	223	149	124	93	62
	25	1,391	76	*305	199	133	111	83	55
	26	1,310	66	*282	178	119	99	74	49
	27	1,238	58	*262	160	107	89	67	44
	28	1,174	51	*243	144	96	80	60	40
	29	1,115	45	*227	131	87	73	54	36
	30	1,062	40	*212	118	79	66	49	33

** Non-stock size subject to mill run requirements.

BEAMS

W-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

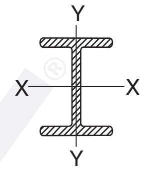


SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 12 x 12 x 1/2									
w = 13.98 lb/ft	6	4,253	2,750	2,750	—	—	—	—	2,212
b_f/t_f = 24.0	7	4,253	2,357	2,357	—	—	—	—	1,719
F_b = 4,253 psi	8	4,253	2,063	2,063	—	—	—	2,038	1,358
A_w = 5.5 sq. in.	9	4,253	1,833	1,833	—	—	—	1,632	1,088
I_x = 452.7 in.^{4}	10	4,253	1,650	1,650	—	—	—	1,322	881
S_x = 75.50 in.^{3}	11	4,253	1,500	1,500	—	—	1,444	1,083	722
I_y = 144.10 in.^{4}	12	4,253	1,375	1,375	—	—	1,193	895	597
J = 1.458 in.^{4}	13	4,253	1,267	*1,267	—	1,195	996	747	498
	14	4,253	1,092	*1,092	—	1,005	837	628	419
	15	4,240	948	*951	—	852	710	532	355
	16	3,761	739	*836	—	727	606	454	303
	17	3,364	586	*741	—	625	521	390	260
	18	3,031	471	*661	—	540	450	338	225
	19	2,749	383	*593	—	470	392	294	196
	20	2,507	316	*535	—	411	342	257	171
	21	2,300	262	*485	—	361	301	226	150
	22	2,119	220	*442	—	319	266	199	133
	23	1,962	187	*405	—	283	236	177	118
	24	1,823	159	*372	—	252	210	157	105
	25	1,700	137	*342	338	225	188	141	94
	26	1,591	118	*317	303	202	169	126	84
	27	1,494	103	*294	273	182	152	114	76
	28	1,407	90	*273	247	165	137	103	69
	29	1,328	79	*255	224	149	124	93	62
	30	1,257	70	*238	203	136	113	85	57
	31	1,193	62	*223	185	124	103	77	52
	32	1,134	56	*209	170	113	94	71	47
	33	1,080	50	*197	155	104	86	65	43
	34	1,031	45	*185	143	95	79	59	40
	35	986	41	*175	131	88	73	55	36
	36	944	37	*165	121	81	67	50	34
	37	906	33	*156	112	75	62	47	31
	38	870	30	*148	104	69	58	43	29
	39	837	28	*141	96	64	53	40	27
	40	806	25	*134	89	60	50	37	25

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



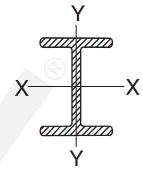
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	$l/100$	$l/150$	$l/180$	$l/240$	$l/360$
3 x 1-1/2 x 1/4									
w = 1.11 lb/ft	3	2,771	240	630	—	444	370	277	185
b_f/t_f = 6.0	4	1,920	94	473	317	211	176	132	88
F_b = 12,000 psi	5	1,473	46	*374	173	115	96	72	48
A_w = 0.63 sq. in.	6	1,198	26	*260	103	69	57	43	29
I_x = 1.75 in.^{4}	7	1,012	16	*191	67	44	37	28	18
S_x = 1.17 in.^{3}	8	876	11	*146	45	30	25	19	13
I_y = 0.14 in.^{4}	9	774	7	*116	32	21	18	13	9
J = 0.029 in.^{4}	10	693	5	*94	24	16	13	10	7
4 x 2 x 1/4									
w = 1.48 lb/ft	3	3,516	573	880	—	—	769	577	384
b_f/t_f = 8.0	4	2,252	206	660	—	469	391	293	195
F_b = 12,000 psi	5	1,639	96	528	398	265	221	166	111
A_w = 0.88 sq. in.	6	1,287	52	440	244	163	136	102	68
I_x = 4.4 in.^{4}	7	1,060	32	*359	160	106	89	66	44
S_x = 2.20 in.^{3}	8	902	21	*275	110	73	61	46	30
I_y = 0.34 in.^{4}	9	786	14	*217	78	52	44	33	22
J = 0.039 in.^{4}	10	697	10	*176	58	39	32	24	16
	11	627	8	*145	44	29	24	18	12
	12	569	6	*122	34	23	19	14	9

BEAMS

I-SHAPES — EXTREN® 625
E = 2.8 x 10^6 psi

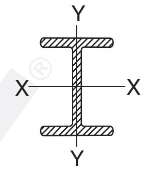
Allowable Uniform Loads in Pounds Per Foot



SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 1-1/2 x 1/4									
w = 1.11 lb/ft	3	2,913	252	630	—	468	390	293	195
b_f/t_f = 6.0	4	2,009	98	473	337	225	187	140	94
F_b = 13,200 psi	5	1,538	48	378	184	123	102	77	51
A_w = 0.63 sq. in.	6	1,249	27	*286	111	74	61	46	31
I_x = 1.75 in.^{4}	7	1,053	17	*210	71	48	40	30	20
S_x = 1.17 in.^{3}	8	912	11	*161	49	32	27	20	13
I_y = 0.14 in.^{4}	9	804	8	*127	34	23	19	14	10
J = 0.029 in.^{4}	10	720	6	*103	25	17	14	11	7
4 x 2 x 1/4									
w = 1.48 lb/ft	3	3,735	609	880	—	—	804	603	402
b_f/t_f = 8.0	4	2,379	218	660	—	495	413	309	206
F_b = 13,200 psi	5	1,725	101	528	422	282	235	176	117
A_w = 0.88 sq. in.	6	1,350	55	440	260	173	145	108	72
I_x = 4.4 in.^{4}	7	1,110	33	377	170	114	95	71	47
S_x = 2.20 in.^{3}	8	943	22	*303	117	78	65	49	33
I_y = 0.34 in.^{4}	9	820	15	*239	84	56	47	35	23
J = 0.039 in.^{4}	10	727	11	*194	62	41	34	26	17
	11	653	8	*160	47	31	26	20	13
	12	593	6	*134	37	24	20	15	10

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi



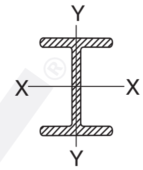
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
5-1/2 x 2-1/2 x 1/4									
w = 1.95 lb/ft	3	4,080	1,221	1,250	—	—	—	1,098	732
b_f/t_f = 10.0	4	2,473	416	938	—	—	800	600	400
F_b = 12,000 psi	5	1,718	185	750	—	569	474	356	237
A_w = 1.25 sq. in.	6	1,299	97	625	541	360	300	225	150
I_x = 11.12 in.^{4}	7	1,039	57	536	361	241	200	150	100
S_x = 4.04 in.^{3}	8	864	36	469	252	168	140	105	70
I_y = 0.62 in.^{4}	9	739	25	*399	182	121	101	76	50
S_y = 0.50 in.^{3}	10	646	17	*323	135	90	75	56	38
J = 0.055 in.^{4}	11	574	13	*267	103	69	57	43	29
	12	517	10	*224	80	54	45	34	22
	13	470	7	*191	64	43	35	27	18
	14	432	6	*165	52	34	29	21	14
	15	399	5	*144	42	28	23	18	12

STRONGWELL

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi



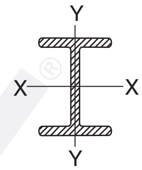
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
**** 6 x 3 x 1/4**									
w = 2.31 lb/ft	5	2,307	327	828	—	752	627	470	313
b_f/t_f = 12.0	6	1,694	167	690	—	485	404	303	202
F_b = 12,000 psi	7	1,320	96	591	492	328	274	205	137
A_w = 1.38 sq. in.	8	1,073	59	518	347	231	193	144	96
I_x = 15.92 in.^{4}	9	901	39	460	252	168	140	105	70
S_x = 5.32 in.^{3}	10	775	27	414	189	126	105	79	52
I_y = 1.13 in.^{4}	11	679	20	*352	145	96	80	60	40
J = 0.060 in.^{4}	12	604	15	*296	113	75	63	47	31
	13	544	11	*252	90	60	50	38	25
	14	495	9	*217	73	49	40	30	20
	15	454	7	*189	60	40	33	25	17
**** 6 x 3 x 3/8**									
w = 3.39 lb/ft	5	2,868	568	1,182	—	1,060	884	663	442
b_f/t_f = 8.0	6	2,177	300	985	—	683	569	427	285
F_b = 12,000 psi	7	1,747	177	844	692	462	385	288	192
A_w = 1.97 sq. in.	8	1,457	113	739	487	325	271	203	135
I_x = 22.3 in.^{4}	9	1,250	76	657	354	236	197	148	98
S_x = 7.43 in.^{3}	10	1,095	54	591	265	177	147	110	74
I_y = 1.71 in.^{4}	11	974	40	*491	203	135	113	85	56
J = 0.198 in.^{4}	12	878	30	*413	159	106	88	66	44
	13	800	23	*352	126	84	70	53	35
	14	735	19	*303	102	68	57	43	28
	15	680	15	*264	84	56	46	35	23

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10⁶ psi



Allowable Uniform Loads in Pounds Per Foot

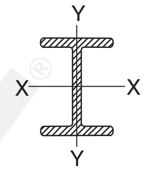
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
8 x 4 x 3/8									
w = 4.61 lb/ft	6	2,932	752	1,360	—	—	1,174	880	587
b_f/t_f = 10.7	7	2,257	425	1,166	—	987	823	617	411
F_b = 12,000 psi	8	1,815	262	1,020	—	714	595	446	298
A_w = 2.72 sq. in.	9	1,508	172	907	796	530	442	331	221
I_x = 55.45 in.^{4}	10	1,285	119	816	605	403	336	252	168
S_x = 13.85 in.^{3}	11	1,117	85	742	469	313	261	196	130
I_y = 4.03 in.^{4}	12	987	63	680	371	247	206	155	103
J = 0.268 in.^{4}	13	883	48	628	298	198	165	124	83
	14	799	38	*565	242	161	135	101	67
	15	730	30	*492	200	133	111	83	55
	16	672	24	*433	166	111	92	69	46
	17	622	20	*383	140	93	78	58	39
	18	580	17	*342	119	79	66	49	33
	19	543	14	*307	102	68	56	42	28
	20	510	12	*277	88	58	49	37	24
**** 8 x 4 x 1/2**									
w = 6.03 lb/ft	6	3,383	1,106	1,750	—	—	1,501	1,125	750
b_f/t_f = 8.0	7	2,655	638	1,500	—	1,262	1,051	789	526
F_b = 12,000 psi	8	2,174	400	1,313	—	912	760	570	380
A_w = 3.5 sq. in.	9	1,835	267	1,167	1,015	677	564	423	282
I_x = 70.62 in.^{4}	10	1,586	187	1,050	772	515	429	322	214
S_x = 17.65 in.^{3}	11	1,397	136	955	599	399	333	249	166
I_y = 5.41 in.^{4}	12	1,248	102	875	473	315	263	197	131
J = 0.625 in.^{4}	13	1,127	79	808	379	253	211	158	105
	14	1,029	62	*720	309	206	172	129	86
	15	946	49	*628	254	170	141	106	71
	16	877	40	*552	212	141	118	88	59
	17	817	33	*489	178	119	99	74	50
	18	764	28	*436	151	101	84	63	42
	19	719	23	*391	130	86	72	54	36
	20	678	20	*353	112	74	62	47	31

** Non-stock size subject to mill run requirements.

STRONGWELL

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

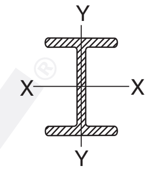
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 10 x 5 x 3/8									
w = 5.78 lb/ft	6	4,062	1,680	1,735	—	—	—	1,451	967
b_f/t_f = 13.3	7	3,055	928	1,487	—	—	1,402	1,052	701
F_b = 10,274 psi	8	2,400	558	1,301	—	1,250	1,042	781	521
A_w = 3.47 sq. in.	9	1,950	358	1,157	—	949	791	593	395
I_x = 111.67 in.^{4}	10	1,626	242	1,041	—	734	612	459	306
S_x = 22.33 in.^{3}	11	1,386	170	946	867	578	482	361	241
I_y = 7.85 in.^{4}	12	1,201	124	868	693	462	385	289	192
J = 0.338 in.^{4}	13	1,057	93	801	561	374	312	234	156
	14	941	72	744	460	307	256	192	128
	15	847	56	*680	382	255	212	159	106
	16	769	45	*597	320	213	178	133	89
	17	704	36	*529	270	180	150	113	75
	18	649	30	*472	231	154	128	96	64
	19	601	25	*424	198	132	110	83	55
	20	560	21	*382	171	114	95	71	48
	21	524	18	*347	149	99	83	62	41
	22	493	15	*316	131	87	73	54	36
	23	465	13	*289	115	77	64	48	32
	24	440	11	*266	102	68	56	42	28
	25	417	10	*245	90	60	50	38	25

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

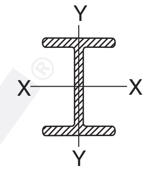


SPAN IN FEET		LATERALLY UNSUPPORTED F_b' (psi)	LATERALLY UNSUPPORTED W	LATERALLY SUPPORTED--GOVERNED BY: Stress $*F_b$ or F_v	Deflection $l/100$	Deflection $l/150$	Deflection $l/180$	Deflection $l/240$	Deflection $l/360$
** 10 x 5 x 1/2									
w = 7.58 lb/ft	6	4,435	2,250	2,250	—	—	—	1,872	1,248
b_f/t_f = 10.0	7	3,381	1,320	1,929	—	—	1,809	1,357	904
F_b = 12,000 psi	8	2,692	805	1,688	—	1,612	1,343	1,007	672
A_w = 4.5 sq. in.	9	2,216	524	1,500	—	1,223	1,019	764	510
I_x = 143.48 in.^{4}	10	1,873	358	1,350	—	946	788	591	394
S_x = 28.70 in.^{3}	11	1,615	255	1,227	1,116	744	620	465	310
I_y = 10.51 in.^{4}	12	1,417	188	1,125	892	594	495	372	248
J = 0.788 in.^{4}	13	1,261	143	1,038	722	482	401	301	201
	14	1,134	111	964	592	395	329	247	165
	15	1,031	88	900	491	327	273	205	136
	16	944	71	844	411	274	229	171	114
	17	871	58	794	348	232	193	145	97
	18	808	48	*709	296	198	165	124	82
	19	754	40	*636	255	170	141	106	71
	20	707	34	*574	220	147	122	92	61
	21	665	29	*521	192	128	106	80	53
	22	628	25	*474	168	112	93	70	47
	23	596	22	*434	148	98	82	62	41
	24	566	19	*399	131	87	73	54	36
	25	539	17	*367	116	77	65	48	32

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

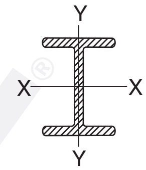
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 12 x 6 x 1/2									
w = 9.24 lb/ft	6	5,878	2,750	2,750	—	—	—	2,715	1,810
b_f/t_f = 12.0	7	4,408	2,357	2,357	—	—	—	2,024	1,349
F_b = 12,000 psi	8	3,452	1,521	2,063	—	—	2,053	1,539	1,026
A_w = 5.5 sq. in.	9	2,795	973	1,833	—	—	1,589	1,192	795
I_x = 254.1 in.^{4}	10	2,324	655	1,650	—	1,500	1,250	938	625
S_x = 42.30 in.^{3}	11	1,974	460	1,500	—	1,197	998	748	499
I_y = 18.11 in.^{4}	12	1,706	334	1,375	—	968	806	605	403
J = 0.958 in.^{4}	13	1,496	250	1,269	1,188	792	660	495	330
	14	1,329	191	1,179	982	655	546	409	273
	15	1,193	150	1,100	820	547	456	342	228
	16	1,080	119	1,031	691	461	384	288	192
	17	986	96	971	587	392	326	245	163
	18	907	79	917	503	335	279	210	140
	19	839	66	868	434	289	241	181	120
	20	780	55	825	376	251	209	157	105
	21	728	47	*767	329	219	183	137	91
	22	683	40	*699	288	192	160	120	80
	23	644	34	*640	254	170	141	106	71
	24	608	30	*588	226	150	125	94	63
	25	576	26	*541	201	134	112	84	56
	26	548	23	*501	180	120	100	75	50
	27	522	20	*464	161	107	90	67	45
	28	498	18	*432	145	97	81	60	40
	29	477	16	*402	131	87	73	55	36
	30	457	14	*376	119	79	66	50	33
	31	439	13	*352	108	72	60	45	30
	32	423	12	*330	99	66	55	41	27
	33	407	11	*311	90	60	50	38	25
	34	393	10	*293	83	55	46	34	23
	35	-	-	*276	76	51	42	32	21
	36	-	-	*261	70	47	39	29	19
	37	-	-	*247	65	43	36	27	18
	38	-	-	*234	60	40	33	25	17
	39	-	-	*222	55	37	31	23	15
	40	-	-	*212	51	34	29	21	14

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot



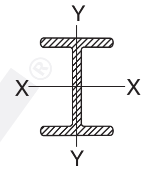
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 18 x 3/8 x 4-1/2 x 1/2									
w = 8.34 lb/ft	5	3,874	3,825	3,825	—	—	—	—	3,354
b_f/t_f = 9.0	6	2,727	2,880	3,188	—	—	—	—	2,548
F_b = 12,000 psi	7	2,035	1,579	2,732	—	—	—	—	1,978
A_w = 6.375 sq. in.	8	1,586	942	2,391	—	—	—	2,340	1,560
I_x = 513.25 in.^{4}	9	1,277	600	2,125	—	—	—	1,872	1,248
S_x = 57.03 in.^{3}	10	1,056	402	1,913	—	—	—	1,515	1,010
I_y = 7.67 in.^{4}	11	892	280	1,739	—	—	1,652	1,239	826
J = 0.674 in.^{4}	12	767	202	1,594	—	—	1,365	1,023	682
	13	669	151	1,471	—	1,365	1,137	853	569
	14	591	115	1,366	—	1,147	956	717	478
	15	528	89	1,275	—	972	810	607	405
	16	476	71	1,195	—	829	691	518	345
	17	432	57	1,125	1,068	712	593	445	297
	18	396	46	1,063	923	615	513	385	256
	19	365	38	1,007	802	535	446	334	223
	20	338	32	956	702	468	390	292	195
	21	314	27	911	616	411	342	257	171
	22	294	23	869	544	363	302	227	151
	23	276	20	832	483	322	268	201	134
	24	260	17	*792	430	287	239	179	119
	25	246	15	*730	384	256	213	160	107
	26	233	13	*675	345	230	192	144	96
	27	221	12	*626	311	207	173	129	86
	28	211	10	*582	281	187	156	117	78
	29	201	-	*542	254	170	141	106	71
	30	193	-	*507	231	154	128	96	64
	31	185	-	*475	211	140	117	88	59
	32	177	-	*446	193	128	107	80	53
	33	171	-	*419	176	118	98	73	49
	34	164	-	*395	162	108	90	67	45
	35	159	-	*372	149	99	83	62	41
	36	153	-	*352	138	92	76	57	38
	37	148	-	*333	127	85	71	53	35
	38	143	-	*316	118	78	65	49	33
	39	139	-	*300	109	73	61	45	30
	40	135	-	*285	101	68	56	42	28

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot



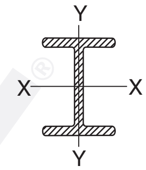
SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 18 x 1/2 x 8 x 3/4									
w = 17.11 lb/ft	5	14707	47355	4950	17087	11391	9493	7120	4746
b_f/t_f = 10.67	6	10296	23022	4125	13373	8916	7430	5572	3715
F_b = 12,000 psi	7	7635	12544	3536	10694	7129	5941	4456	2971
A_w = 8.25 sq. in.	8	5908	7431	3094	8685	5790	4825	3619	2413
I_x = 1086.76 in.^{4}	9	4723	4694	2750	7139	4760	3966	2975	1983
S_x = 120.75 in.^{3}	10	3875	3119	2475	5927	3951	3293	2470	1646
I_y = 62.50 in.^{4}	11	3247	2160	2250	4962	3308	2757	2068	1378
J = 3.134 in.^{4}	12	2769	1548	2063	4187	2791	2326	1744	1163
	13	2396	1141	1904	3557	2371	1976	1482	988
	14	2100	862	1768	3041	2027	1690	1267	845
	15	1860	665	1650	2616	1744	1453	1090	727
	16	1663	523	1547	2263	1509	1257	943	629
	17	1500	418	1456	1968	1312	1093	820	547
	18	1363	339	1375	1720	1146	955	717	478
	19	1246	278	1303	1510	1007	839	629	419
	20	1146	231	1238	1332	888	740	555	370
	21	1060	193	1179	1180	786	655	492	328
	22	984	164	1125	1049	699	583	437	291
	23	918	140	1076	936	624	520	390	260
	24	860	120	1031	839	559	466	350	233
	25	808	104	990	754	503	419	314	209
	26	762	91	952	680	453	378	283	189
	27	721	80	917	615	410	342	256	171
	28	683	70	884	558	372	310	233	155
	29	649	62	853	508	338	282	212	141
	30	619	55	825	463	309	257	193	129
	31	591	49	798	423	282	235	176	118
	32	565	44	773	388	259	216	162	108
	33	542	40	750	356	238	198	149	99
	34	520	36	728	328	219	182	137	91
	35	500	33	707	303	202	168	126	84
	36	481	30	688	280	187	155	117	78
	37	464	27	669	259	173	144	108	72
	38	448	25	651	240	160	134	100	67
	39	433	23	*635	223	149	124	93	62
	40	419	21	*604	208	139	116	87	58

** Non-stock size subject to mill run requirements.

BEAMS

I-SHAPES — EXTREN® 500, 525 & 625
E = 2.5 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

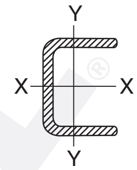


SPAN IN FEET		LATERALLY UNSUPPORTED		LATERALLY SUPPORTED--GOVERNED BY:					
				Stress	Deflection				
		F_b' (psi)	W	*F_b or F_v	$l/100$	$l/150$	$l/180$	$l/240$	$l/360$
** 24 x 3/8 x 7-1/2 x 3/4									
w = 16.1 lb/ft	5	12,000	5,058	5,058	—	—	—	—	—
b_f/t_f = 10.0	6	8,724	4,215	4,215	—	—	—	—	4,139
F_b = 12,000 psi	7	6,443	3,613	3,613	—	—	—	—	3,393
A_w = 8.43 sq. in.	8	4,962	3,161	3,161	—	—	—	—	2,826
I_x = 1903.44 in.^{4}	9	3,946	2,810	2,810	—	—	—	—	2,382
S_x = 158.62 in.^{3}	10	3,220	2,529	2,529	—	—	—	—	2,027
I_y = 52.83 in.^{4}	11	2,682	2,299	2,299	—	—	—	—	1,738
J = 2.510 in.^{4}	12	2,273	1,669	2,108	—	—	—	—	1,500
	13	1,954	1,223	1,945	—	—	—	—	1,302
	14	1,701	918	1,806	—	—	—	1,703	1,135
	15	1,497	704	1,686	—	—	—	1,492	995
	16	1,330	549	1,581	—	—	—	1,313	875
	17	1,191	436	1,488	—	—	—	1,160	773
	18	1,075	351	1,405	—	—	1,371	1,028	685
	19	976	286	1,331	—	—	1,220	915	610
	20	892	236	1,265	—	—	1,089	817	545
	21	819	196	1,204	—	1,171	976	732	488
	22	756	165	1,150	—	1,052	877	657	438
	23	700	140	1,100	—	948	790	592	395
	24	652	120	1,054	—	857	714	535	357
	25	609	103	1,012	—	776	647	485	323
	26	571	89	973	—	705	588	441	294
	27	537	78	937	—	642	535	401	268
	28	506	68	903	879	586	489	366	244
	29	478	60	872	805	536	447	335	224
	30	453	53	843	738	492	410	307	205
	31	431	47	816	678	452	377	283	188
	32	410	42	790	624	416	347	260	173
	33	391	38	766	576	384	320	240	160
	34	374	34	744	532	355	296	222	148
	35	358	31	723	493	329	274	205	137
	36	343	28	703	457	305	254	191	127
	37	329	25	684	425	283	236	177	118
	38	317	23	666	395	264	220	165	110
	39	305	21	648	368	246	205	153	102
	40	294	19	632	344	229	191	143	96
	41	284	18	617	321	214	179	134	89
	42	274	-	602	301	201	167	125	84
	43	265	-	588	282	188	157	117	78
	44	257	-	575	264	176	147	110	73
	45	249	-	562	248	166	138	104	69
	46	242	-	550	234	156	130	97	65
	47	235	-	538	220	147	122	92	61
	48	228	-	527	207	138	115	86	58
	49	222	-	516	196	131	109	82	54
	50	216	-	506	185	123	103	77	51

** Non-stock size subject to mill run requirements. *** Using F_b, F_b' or F_v

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
**** 3 x 7/8 x 1/4**							
w = 0.77 lb/ft	3	620	479	319	266	199	133
b_f/t_f = 3.5	4	*376	220	147	122	92	61
F_b = 11,717 psi	5	*241	118	79	65	49	33
A_w = 0.62 in.^{2}	6	*167	70	47	39	29	19
I_x = 1.15 in.^{4}	7	*123	45	30	25	19	12
S_x = 0.77 in.^{3}	8	*94	30	20	17	13	8
I_y = 0.06 in.^{4}	9	*74	21	14	12	9	6
J = 0.020 in.^{4}							
**** 3 x 1 x 3/16**							
w = 0.68 lb/ft	3	*396	—	279	232	174	116
b_f/t_f = 5.3	4	*223	194	130	108	81	54
F_b = 7857 psi	5	*142	104	70	58	44	29
A_w = 0.49 in.^{2}	6	*99	62	41	34	26	17
I_x = 1.03 in.^{4}	7	*73	40	27	22	17	11
S_x = 0.68 in.^{3}	8	*56	27	18	15	11	7
I_y = 0.07 in.^{4}	9	*44	19	13	11	8	5
J = 0.010 in.^{4}							
**** 3-1/2 x 1-1/2 x 3/16**							
w = 0.88 lb/ft	3	*431	—	—	386	289	193
b_f/t_f = 8.0	4	*243	—	224	187	140	93
F_b = 5,342 psi	5	*155	—	123	103	77	51
A_w = 0.586 in.^{2}	6	*108	—	74	62	46	31
I_x = 1.91 in.^{4}	7	*79	72	48	40	30	20
S_x = 1.09 in.^{3}	8	*61	49	33	27	20	14
I_y = 0.19 in.^{4}	9	*48	35	23	19	14	10
J = 0.013 in.^{4}	10	*39	26	17	14	11	7

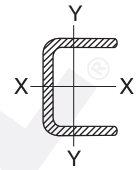
** Non-stock size subject to mill run requirements.

STRONGWELL

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot



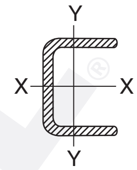
SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 7/8 x 1/4							
w = 0.77 lb/ft	3	620	508	339	282	212	141
b_f/t_f = 3.5	4	*405	235	157	131	98	65
F_b = 12,618 psi	5	*259	126	84	70	53	35
A_w = 0.62 in.^{2}	6	*180	75	50	42	31	21
I_x = 1.15 in.^{4}	7	*132	48	32	27	20	13
S_x = 0.77 in.^{3}	8	*101	32	22	18	14	9
I_y = 0.06 in.^{4}	9	*80	23	15	13	10	6
J = 0.020 in.^{4}							
**** 3 x 1 x 3/16**							
w = 0.68 lb/ft	3	*426	—	295	246	185	123
b_f/t_f = 5.3	4	*240	207	138	115	86	58
F_b = 8,462 psi	5	*153	112	74	62	47	31
A_w = 0.49 in.^{2}	6	*107	67	44	37	28	18
I_x = 1.03 in.^{4}	7	*78	43	28	24	18	12
S_x = 0.68 in.^{3}	8	*60	29	19	16	12	8
I_y = 0.07 in.^{4}	9	*47	20	14	11	9	6
J = 0.010 in.^{4}							
**** 3-1/2 x 1-1/2 x 3/16**							
w = 0.88 lb/ft	3	*465	—	—	406	305	203
b_f/t_f = 8.0	4	*261	—	238	198	149	99
F_b = 5,753 psi	5	*167	—	131	109	82	55
A_w = 0.586 in.^{2}	6	*116	—	79	66	50	33
I_x = 1.91 in.^{4}	7	*85	77	51	43	32	21
S_x = 1.09 in.^{3}	8	*65	53	35	29	22	15
I_y = 0.19 in.^{4}	9	*52	37	25	21	16	10
J = 0.013 in.^{4}	10	*42	27	18	15	11	8

** Non-stock size subject to mill run requirements.

STRONGWELL

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

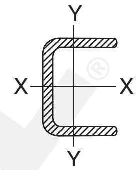
SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
** 4 x 1-1/16 x 1/8							
w = 0.58 lb/ft	3	*291	—	—	—	234	156
b_f/t_f = 8.5	4	*164	—	—	151	113	76
F_b = 5,043 psi	5	*105	—	100	83	62	42
A_w = 0.47 in.^{2}	6	*73	—	60	50	38	25
I_x = 1.55 in.^{4}	7	*54	—	39	32	24	16
S_x = 0.78 in.^{3}	8	*41	40	26	22	17	11
I_y = 0.06 in.^{4}	9	*32	28	19	16	12	8
J = 0.004 in.^{4}	10	*26	21	14	12	9	6
4 x 1-1/8 x 1/4							
w = 1.11 lb/ft	3	880	—	696	580	435	290
b_f/t_f = 4.5	4	*550	505	337	281	210	140
F_b = 9,228 psi	5	*352	277	185	154	116	77
A_w = 0.88 in.^{2}	6	*244	167	111	93	70	46
I_x = 2.87 in.^{4}	7	*180	108	72	60	45	30
S_x = 1.43 in.^{3}	8	*137	74	49	41	31	20
I_y = 0.13 in.^{4}	9	*109	52	35	29	22	15
J = 0.030 in.^{4}	10	*88	38	26	21	16	11
4 x 1-3/8 x 3/16							
w = 0.94 lb/ft	3	*563	—	—	503	377	251
b_f/t_f = 7.3	4	*317	—	297	248	186	124
F_b = 5,805 psi	5	*203	—	165	137	103	69
A_w = 0.68 in.^{2}	6	*141	—	100	83	63	42
I_x = 2.62 in.^{4}	7	*103	97	65	54	41	27
S_x = 1.31 in.^{3}	8	*79	66	44	37	28	18
I_y = 0.19 in.^{4}	9	*63	47	32	26	20	13
J = 0.014 in.^{4}	10	*51	35	23	19	15	10

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10[6] psi

Allowable Uniform Loads in Pounds Per Foot



SPAN IN FEET			LATERALLY SUPPORTED--GOVERNED BY:					
			Stress	Deflection				
			*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
** **4 x 1-1/16 x 1/8**								
w =	0.58 lb/ft	3	*314	—	—	—	247	164
b_f/t_f =	8.5	4	*177	—	—	160	120	80
F_b =	5,431 psi	5	*113	—	106	89	66	44
A_w =	0.47 in.^{2}	6	*78	—	64	54	40	27
I_x =	1.55 in.^{4}	7	*58	—	42	35	26	17
S_x =	0.78 in.^{3}	8	*44	43	28	24	18	12
I_y =	0.06 in.^{4}	9	*35	30	20	17	13	8
J =	0.004 in.^{4}	10	*28	22	15	12	9	6
4 x 1-1/8 x 1/4								
w =	1.11 lb/ft	3	880	—	733	611	458	305
b_f/t_f =	4.5	4	*592	536	357	298	223	149
F_b =	9,938 psi	5	*379	296	197	164	123	82
A_w =	0.88 in.^{2}	6	*263	179	119	99	74	50
I_x =	2.87 in.^{4}	7	*193	116	77	64	48	32
S_x =	1.43 in.^{3}	8	*148	79	53	44	33	22
I_y =	0.13 in.^{4}	9	*117	56	37	31	23	16
J =	0.030 in.^{4}	10	*95	41	28	23	17	11
4 x 1-3/8 x 3/16								
w =	0.94 lb/ft	3	*607	—	—	528	396	264
b_f/t_f =	7.3	4	*341	—	315	262	197	131
F_b =	6,252 psi	5	*218	—	176	146	110	73
A_w =	0.68 in.^{2}	6	*152	—	107	89	67	45
I_x =	2.62 in.^{4}	7	*111	104	69	58	43	29
S_x =	1.31 in.^{3}	8	*85	71	48	40	30	20
I_y =	0.19 in.^{4}	9	*67	51	34	28	21	14
J =	0.014 in.^{4}	10	*55	37	25	21	16	10

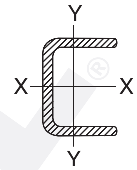
** Non-stock size subject to mill run requirements.

STRONGWELL

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

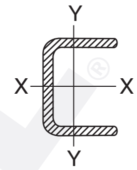


SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
5 x 1-3/8 x 1/4							
w = 1.4 lb/ft	5	*470	—	346	289	216	144
b_f/t_f = 5.5	6	*326	319	213	177	133	89
F_b = 7,626 psi	7	*240	209	139	116	87	58
A_w = 1.12 in.^{2}	8	*184	144	96	80	60	40
I_x = 5.78 in.^{4}	9	*145	103	68	57	43	29
S_x = 2.31 in.^{3}	10	*117	76	51	42	32	21
I_y = 0.25 in.^{4}	11	*97	58	38	32	24	16
J = 0.040 in.^{4}	12	*82	45	30	25	19	12
	13	*69	35	24	20	15	10
	14	*60	28	19	16	12	8
	15	*52	23	15	13	10	6
**** 5-1/2 x 1-1/2 x 3/16**							
w = 1.19 lb/ft	3	*835	—	—	—	703	469
b_f/t_f = 8.0	4	*470	—	—	—	366	244
F_b = 5,342 psi	5	*301	—	—	280	210	140
A_w = 0.96 in.^{2}	6	*209	—	209	174	130	87
I_x = 5.8 in.^{4}	7	*153	—	137	114	86	57
S_x = 2.11 in.^{3}	8	*117	—	95	79	59	39
I_y = 0.22 in.^{4}	9	*93	—	68	57	42	28
J = 0.018 in.^{4}	10	*75	—	50	42	31	21
	11	*62	57	38	32	24	16
	12	*52	44	30	25	19	12
	13	*44	35	23	20	15	10
	14	*38	28	19	16	12	8
	15	*33	23	15	13	10	6

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	$l/100$	$l/150$	$l/180$	$l/240$	$l/360$
**** 5 x 1-3/8 x 1/4**							
w = 1.4 lb/ft	5	*506	—	368	306	230	153
b_f/t_f = 5.5	6	*351	340	227	189	142	94
F_b = 8,213 psi	7	*258	223	149	124	93	62
A_w = 1.12 in.^{2}	8	*198	154	102	85	64	43
I_x = 5.78 in.^{4}	9	*156	110	73	61	46	31
S_x = 2.31 in.^{3}	10	*126	81	54	45	34	23
I_y = 0.25 in.^{4}	11	*105	62	41	34	26	17
J = 0.040 in.^{4}	12	*88	48	32	27	20	13
	13	*75	38	25	21	16	11
	14	*65	31	20	17	13	8
	15	*56	25	17	14	10	7
**** 5-1/2 x 1-1/2 x 3/16**							
w = 1.19 lb/ft	3	*899	—	—	—	733	489
b_f/t_f = 8.0	4	*506	—	—	—	385	257
F_b = 5,753 psi	5	*324	—	—	297	223	149
A_w = 0.96 in.^{2}	6	*225	—	222	185	139	92
I_x = 5.8 in.^{4}	7	*165	—	146	122	91	61
S_x = 2.11 in.^{3}	8	*126	—	101	84	63	42
I_y = 0.22 in.^{4}	9	*100	—	73	61	45	30
J = 0.018 in.^{4}	10	*81	81	54	45	34	22
	11	*67	61	41	34	26	17
	12	*56	48	32	27	20	13
	13	*48	38	25	21	16	11
	14	*41	30	20	17	13	8
	15	*36	25	17	14	10	7

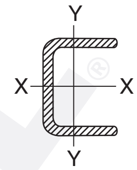
** Non-stock size subject to mill run requirements.

STRONGWELL

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

Allowable Uniform Loads in Newtons Per Meter



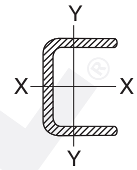
SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
5-1/2 x 1-1/2 x 1/4							
w = 1.55 lb/ft	3	1,250	—	—	1,241	931	621
b_f/t_f = 6.0	4	*828	—	779	649	487	325
F_b = 7,021 psi	5	*530	—	449	374	280	187
A_w = 1.25 in.^{2}	6	*368	—	278	232	174	116
I_x = 7.78 in.^{4}	7	*270	—	183	153	115	76
S_x = 2.83 in.^{3}	8	*207	190	127	106	79	53
I_y = 0.33 in.^{4}	9	*164	136	91	76	57	38
J = 0.042 in.^{4}	10	*132	101	67	56	42	28
	11	*109	77	51	43	32	21
	12	*92	60	40	33	25	17
	13	*78	47	31	26	20	13
	14	*68	38	25	21	16	11
	15	*59	31	21	17	13	9

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi

Allowable Uniform Loads in Newtons Per Meter

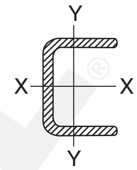


SPAN IN FEET			LATERALLY SUPPORTED--GOVERNED BY:					
			Stress	Deflection				
			*F_b or F_v	$l/100$	$l/150$	$l/180$	$l/240$	$l/360$
5-1/2 x 1-1/2 x 1/4								
w =	1.55 lb/ft	3	1,250	—	—	—	970	646
b_f/t_f =	6.0	4	*892	—	819	683	512	341
F_b =	7,562 psi	5	*571	—	475	396	297	198
A_w =	1.25 in.^{2}	6	*396	—	296	247	185	123
I_x =	7.78 in.^{4}	7	*291	—	196	163	122	81
S_x =	2.83 in.^{3}	8	*223	203	135	113	85	56
I_y =	0.33 in.^{4}	9	*176	146	97	81	61	41
J =	0.042 in.^{4}	10	*143	108	72	60	45	30
		11	*118	82	55	46	34	23
		12	*99	64	43	36	27	18
		13	*84	51	34	28	21	14
		14	*73	41	27	23	17	11
		15	*63	33	22	19	14	9

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



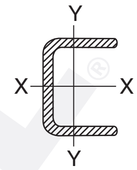
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
6 x 1-5/8 x 1/4							
w = 1.68 lb/ft	5	*592	—	565	471	353	236
b_f/t_f = 6.5	6	*411	—	355	296	222	148
F_b = 6,507 psi	7	*302	—	235	196	147	98
A_w = 1.38 in.^{2}	8	*231	—	163	136	102	68
I_x = 10.22 in.^{4}	9	*183	176	118	98	73	49
S_x = 3.41 in.^{3}	10	*148	131	87	73	55	36
I_y = 0.43 in.^{4}	11	*122	100	66	55	42	28
J = 0.050 in.^{4}	12	*103	78	52	43	32	22
	13	*88	62	41	34	26	17
	14	*75	50	33	28	21	14
	15	*66	41	27	23	17	11
**** 6 x 1-11/16 x 3/8**							
w = 2.46 lb/ft	5	1,182	—	806	671	503	336
b_f/t_f = 4.5	6	*829	758	505	421	316	210
F_b = 9,228 psi	7	*609	503	335	279	209	140
A_w = 1.97 in.^{2}	8	*466	349	232	194	145	97
I_x = 14.55 in.^{4}	9	*368	251	167	139	105	70
S_x = 4.85 in.^{3}	10	*298	186	124	104	78	52
I_y = 0.54 in.^{4}	11	*247	142	95	79	59	39
J = 0.150 in.^{4}	12	*207	110	74	61	46	31
	13	*177	88	58	49	37	24
	14	*152	71	47	39	29	20
	15	*133	58	38	32	24	16

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi



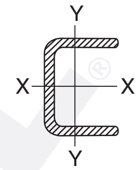
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
6 x 1-5/8 x 1/4							
w = 1.68 lb/ft	5	*637	—	597	498	373	249
b_f/t_f = 6.5	6	*443	—	376	314	235	157
F_b = 7,008 psi	7	*325	—	250	209	157	104
A_w = 1.38 in.^{2}	8	*249	—	174	145	109	73
I_x = 10.22 in.^{4}	9	*197	188	126	105	79	52
S_x = 3.41 in.^{3}	10	*159	140	93	78	58	39
I_y = 0.43 in.^{4}	11	*132	107	71	59	44	30
J = 0.050 in.^{4}	12	*111	83	55	46	35	23
	13	*94	66	44	37	28	18
	14	*81	53	35	30	22	15
	15	*71	44	29	24	18	12
**** 6 x 1-11/16 x 3/8**							
w = 2.46 lb/ft	5	1,182	—	851	709	532	355
b_f/t_f = 4.5	6	*893	804	536	447	335	223
F_b = 9,938 psi	7	*656	535	357	297	223	149
A_w = 1.97 in.^{2}	8	*502	372	248	207	155	103
I_x = 14.55 in.^{4}	9	*397	268	179	149	112	75
S_x = 4.85 in.^{3}	10	*321	199	133	111	83	55
I_y = 0.54 in.^{4}	11	*266	152	101	84	63	42
J = 0.150 in.^{4}	12	*223	118	79	66	49	33
	13	*190	94	63	52	39	26
	14	*164	76	51	42	32	21
	15	*143	62	41	34	26	17

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

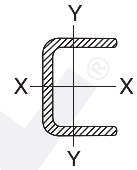
SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 8 x 2-3/16 x 1/4							
Wt/ft. = 2.32 lb/ft	6	*573	—	—	—	474	316
b_f/t_f = 8.8	7	*421	—	—	—	324	216
F_b = 4,906 psi	8	*322	—	—	307	230	153
A_w = 1.88 in.^{2}	9	*255	—	—	224	168	112
I_x = 25.22 in.^{4}	10	*206	—	202	169	127	84
S_x = 6.31 in.^{3}	11	*171	—	156	130	97	65
I_y = 1.10 in.^{4}	12	*143	—	122	102	76	51
J = 0.060 in.^{4}	13	*122	—	97	81	61	41
	14	*105	—	79	66	49	33
	15	*92	—	65	54	40	27
	16	*81	—	54	45	34	22
	17	*71	68	45	38	28	19
	18	*64	57	38	32	24	16
	19	*57	49	33	27	20	14
	20	*52	42	28	23	18	12
8 x 2-3/16 x 3/8							
w = 3.41 lb/ft	6	*1,195	—	1,081	901	676	450
b_f/t_f = 5.8	7	*878	—	738	615	462	308
F_b = 7,216 psi	8	*672	—	524	436	327	218
A_w = 2.72 in.^{2}	9	*531	—	383	319	239	160
I_x = 35.75 in.^{4}	10	*430	—	288	240	180	120
S_x = 8.94 in.^{3}	11	*355	332	221	184	138	92
I_y = 1.42 in.^{4}	12	*299	260	173	145	108	72
J = 0.200 in.^{4}	13	*254	208	138	115	86	58
	14	*219	168	112	93	70	47
	15	*191	138	92	77	57	38
	16	*168	114	76	64	48	32
	17	*149	96	64	53	40	27
	18	*133	81	54	45	34	23
	19	*119	69	46	39	29	19
	20	*108	60	40	33	25	17

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

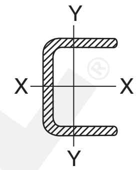


SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 8 x 2-3/16 x 1/4							
w = 2.32 lb/ft	6	*617	—	—	—	499	332
b_f/t_f = 8.8	7	*454	—	—	—	343	228
F_b = 5,284 psi	8	*347	—	—	325	244	163
A_w = 1.88 in.^{2}	9	*274	—	—	239	179	119
I_x = 25.22 in.^{4}	10	*222	—	216	180	135	90
S_x = 6.31 in.^{3}	11	*184	—	166	139	104	69
I_y = 1.10 in.^{4}	12	*154	—	131	109	82	54
J = 0.060 in.^{4}	13	*132	—	104	87	65	43
	14	*113	—	85	70	53	35
	15	*99	—	69	58	43	29
	16	*87	87	58	48	36	24
	17	*77	73	48	40	30	20
	18	*69	62	41	34	26	17
	19	*62	53	35	29	22	15
	20	*56	45	30	25	19	13
8 x 2-3/16 x 3/8							
w = 3.41 lb/ft	6	*1,287	—	1,138	949	712	474
b_f/t_f = 5.8	7	*945	—	781	651	488	325
F_b = 7,771 psi	8	*724	—	556	463	347	232
A_w = 2.72 in.^{2}	9	*572	—	408	340	255	170
I_x = 35.75 in.^{4}	10	*463	460	307	256	192	128
S_x = 8.94 in.^{3}	11	*383	354	236	197	148	98
I_y = 1.42 in.^{4}	12	*322	278	185	155	116	77
J = 0.200 in.^{4}	13	*274	222	148	123	93	62
	14	*236	180	120	100	75	50
	15	*206	148	99	82	62	41
	16	*181	123	82	68	51	34
	17	*160	103	69	57	43	29
	18	*143	87	58	49	36	24
	19	*128	75	50	41	31	21
	20	*116	64	43	36	27	18

** Non-stock size subject to mill run requirements.

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

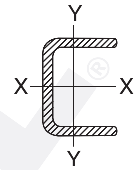


Allowable Uniform Loads in Pounds Per Foot

	SPAN IN FEET	LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
10 x 2-3/4 x 1/2							
w = 5.5 lb/ft	6	2,250	—	—	1,998	1,499	999
b_f/t_f = 5.5	7	*1,919	—	1,687	1,406	1,054	703
F_b = 7,626 psi	8	*1,469	—	1,223	1,019	764	510
A_w = 4.5 in.^{2}	9	*1,161	—	910	759	569	379
I_x = 92.46 in.^{4}	10	*940	—	693	578	433	289
S_x = 18.49 in.^{3}	11	*777	—	539	449	337	224
I_y = 3.99 in.^{4}	12	*653	639	426	355	266	177
J = 0.600 in.^{4}	13	*556	513	342	285	214	143
	14	*480	418	279	232	174	116
	15	*418	345	230	191	144	96
	16	*367	287	191	160	120	80
	17	*325	242	161	134	101	67
	18	*290	205	137	114	86	57
	19	*260	176	117	98	73	49
	20	*235	152	101	84	63	42
	21	*213	132	88	73	55	37
	22	*194	115	77	64	48	32
	23	*178	101	67	56	42	28
	24	*163	89	60	50	37	25
	25	*150	79	53	44	33	22

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi

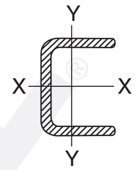


Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	$l/100$	$l/150$	$l/180$	$l/240$	$l/360$
10 x 2-3/4 x 1/2							
w = 5.5 lb/ft	6	2,250	—	—	2,089	1,566	1,044
b_f/t_f = 5.5	7	1,929	—	1,772	1,477	1,108	739
F_b = 8,213 psi	8	*1,582	—	1,290	1,075	807	538
A_w = 4.5 in.^{2}	9	*1,250	—	964	803	602	402
I_x = 92.46 in.^{4}	10	*1,012	—	736	613	460	307
S_x = 18.49 in.^{3}	11	*837	—	573	477	358	239
I_y = 3.99 in.^{4}	12	*703	681	454	378	284	189
J = 0.600 in.^{4}	13	*599	547	365	304	228	152
	14	*517	446	298	248	186	124
	15	*450	368	246	205	153	102
	16	*395	307	205	171	128	85
	17	*350	259	173	144	108	72
	18	*312	220	147	122	92	61
	19	*280	188	126	105	79	52
	20	*253	163	108	90	68	45
	21	*230	141	94	78	59	39
	22	*209	123	82	69	51	34
	23	*191	108	72	60	45	30
	24	*176	96	64	53	40	27
	25	*162	85	57	47	35	24

BEAMS

CHANNELS — EXTREN® 500 & 525
E = 2.6 x 10^6 psi



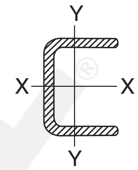
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
12 x 3 x 1/2							
w = 6.3 lb/ft	6	2,750	—	—	—	2,096	1,398
b_f/t_f = 6.0	7	*2,274	—	—	2,000	1,500	1,000
F_b = 7,021 psi	8	*1,741	—	—	1,470	1,102	735
A_w = 5.5 in.^{2}	9	*1,375	—	1,327	1,106	829	553
I_x = 142.8 in.^{4}	10	*1,114	—	1,019	850	637	425
S_x = 23.80 in.^{3}	11	*921	—	798	665	499	332
I_y = 5.07 in.^{4}	12	*774	—	634	529	396	264
S_y = 2.20 in.^{3}	13	*659	—	512	427	320	213
J = 0.750 in.^{4}	14	*568	—	418	349	262	174
	15	*495	—	346	288	216	144
	16	*435	434	289	241	181	121
	17	*385	366	244	203	153	102
	18	*344	312	208	173	130	87
	19	*309	267	178	148	111	74
	20	*279	231	154	128	96	64
	21	*253	201	134	111	84	56
	22	*230	175	117	97	73	49
	23	*211	154	103	86	64	43
	24	*193	136	91	76	57	38
	25	*178	121	81	67	50	34
	26	*165	108	72	60	45	30
	27	*153	97	65	54	40	27
	28	*142	87	58	48	36	24
	29	*132	79	52	44	33	22
	30	*124	71	47	40	30	20

BEAMS

CHANNELS — EXTREN® 625
E = 2.8 x 10^6 psi

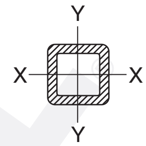
Allowable Uniform Loads in Pounds Per Foot



SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
12 x 3 x 1/2							
w = 6.3 lb/ft	6	2,750	—	—	—	2,182	1,455
b_f/t_f = 6.0	7	2,357	—	—	2,093	1,570	1,047
F_b = 7,562 psi	8	*1,875	—	1,854	1,545	1,159	773
A_w = 5.5 in.^{2}	9	*1,481	—	1,400	1,167	875	583
I_x = 142.8 in.^{4}	10	*1,200	—	1,079	899	674	450
S_x = 23.80 in.^{3}	11	*992	—	846	705	529	353
I_y = 5.07 in.^{4}	12	*833	—	674	562	421	281
S_y = 2.20 in.^{3}	13	*710	—	545	454	341	227
J = 0.750 in.^{4}	14	*612	—	446	372	279	186
	15	*533	—	369	308	231	154
	16	*469	464	309	258	193	129
	17	*415	391	261	217	163	109
	18	*370	333	222	185	139	93
	19	*332	286	191	159	119	79
	20	*300	247	165	137	103	69
	21	*272	215	143	119	90	60
	22	*248	188	125	105	78	52
	23	*227	166	110	92	69	46
	24	*208	146	98	81	61	41
	25	*192	130	87	72	54	36
	26	*177	116	77	64	48	32
	27	*165	104	69	58	43	29
	28	*153	93	62	52	39	26
	29	*143	84	56	47	35	23
	30	*133	76	51	42	32	21

BEAMS

SQUARE TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi
Allowable Uniform Loads in Pounds Per Foot



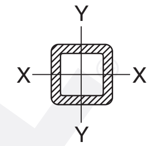
SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 1/4							
w = 2.2 lb/ft	3	1,250	—	885	738	553	369
b_f/t_f = 12.0	4	*763	633	422	352	264	176
F_b = 7,863 psi	5	*489	345	230	192	144	96
A_w = 1.25 sq. in.	6	*339	207	138	115	86	57
I = 3.5 in.^{4}	7	*249	133	89	74	55	37
S_x = 2.33 in.^{3}	8	*191	90	60	50	38	25
J = 5.913 in.^{4}	9	*151	64	43	36	27	18
	10	*122	47	31	26	20	13
**** 3-1/2 x 3-1/2 x 1/4**							
w = 2.57 lb/ft	3	1,500	—	1,343	1,119	839	560
b_f/t_f = 14.0	4	*963	—	663	552	414	276
F_b = 6,898 psi	5	*616	552	368	307	230	153
A_w = 1.5 sq. in.	6	*428	335	223	186	140	93
I = 5.86 in.^{4}	7	*314	217	145	121	91	60
S_x = 3.35 in.^{3}	8	*241	149	99	83	62	41
J = 8.582 in.^{4}	9	*190	106	71	59	44	29
	10	*154	78	52	43	32	22
4 x 4 x 1/4							
w = 3.08 lb/ft	5	*724	—	531	442	332	221
b_f/t_f = 16.0	6	*503	489	326	272	204	136
F_b = 6,158 psi	7	*369	320	213	178	133	89
A_w = 1.75 sq. in.	8	*283	219	146	122	91	61
I = 8.82 in.^{4}	9	*223	157	105	87	65	44
S_x = 4.41 in.^{3}	10	*181	116	77	64	48	32
J = 14.937 in.^{4}	11	*150	88	59	49	37	24
	12	*126	68	45	38	28	19
	13	*107	54	36	30	22	15

** Non-stock size subject to mill requirements.

BEAMS

SQUARE TUBES — EXTREN® 625
E = 2.8 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

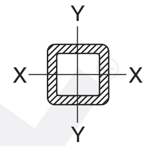


SPAN IN FEET		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 1/4							
w = 2.2 lb/ft	3	1,250	—	934	779	584	389
b_f/t_f = 12.0	4	*822	673	449	374	280	187
F_b = 8,468 psi	5	*526	368	245	204	153	102
A_w = 1.25 sq. in.	6	*365	221	147	123	92	61
I = 3.5 in.^{4}	7	*268	143	95	79	59	40
S_x = 2.33 in.^{3}	8	*206	97	65	54	40	27
J = 5.913 in.^{4}	9	*162	69	46	38	29	19
	10	*132	51	34	28	21	14
**** 3-1/2 x 3-1/2 x 1/4**							
w = 2.57 lb/ft	3	1,500	—	1,410	1,175	881	588
b_f/t_f = 14.0	4	*1,037	—	702	585	439	292
F_b = 7,428 psi	5	*664	588	392	327	245	163
A_w = 1.5 sq. in.	6	*461	358	239	199	149	99
I = 5.86 in.^{4}	7	*339	233	155	129	97	65
S_x = 3.35 in.^{3}	8	*259	159	106	88	66	44
J = 8.582 in.^{4}	9	*205	113	76	63	47	32
	10	*166	84	56	46	35	23
4 x 4 x 1/4							
w = 3.08 lb/ft	5	*780	—	564	470	352	235
b_f/t_f = 16.0	6	*542	521	347	289	217	145
F_b = 6,631 psi	7	*398	341	228	190	142	95
A_w = 1.75 sq. in.	8	*305	235	157	130	98	65
I = 8.82 in.^{4}	9	*241	168	112	93	70	47
S_x = 4.41 in.^{3}	10	*195	124	83	69	52	35
J = 14.937 in.^{4}	11	*161	94	63	52	39	26
	12	*135	73	49	41	30	20
	13	*115	58	39	32	24	16

** Non-stock size subject to mill run requirements.

BEAMS

SQUARE TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

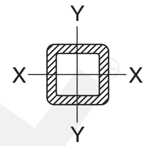


Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 3/8							
w = 3.09 lb/ft	3	1,690	—	1,159	966	724	483
b_f/t_f = 8.0	4	1,268	825	550	458	344	229
F_b = 11,099 psi	5	*894	448	299	249	187	125
A_w = 1.69 sq. in.	6	*621	268	179	149	112	75
I = 4.53 in.^{4}	7	*456	173	115	96	72	48
S_x = 3.02 in.^{3}	8	*349	117	78	65	49	33
J = 6.780 in.^{4}	9	*276	83	55	46	35	23
	10	*223	61	41	34	25	17
	11	*185	46	31	26	19	13
	12	*155	36	24	20	15	10
	13	*132	28	19	16	12	8
4 x 4 x 3/8							
w = 4.28 lb/ft	3	2,440	—	—	2,099	1,575	1,050
b_f/t_f = 10.7	4	1,830	—	1,277	1,064	798	532
F_b = 8,689 psi	5	*1,379	1,081	721	601	450	300
A_w = 2.44 sq. in.	6	*957	663	442	368	276	184
I = 11.9 in.^{4}	7	*703	433	288	240	180	120
S_x = 5.95 in.^{3}	8	*539	297	198	165	124	82
J = 17.860 in.^{4}	9	*426	212	141	118	88	59
	10	*345	157	104	87	65	43
	11	*285	119	79	66	49	33
	12	*239	92	61	51	38	26
	13	*204	73	49	40	30	20
	14	*176	59	39	33	24	16
	15	*153	48	32	27	20	13
	16	*135	39	26	22	16	11
	17	*119	33	22	18	14	9
	18	*106	28	19	15	12	8
	19	*95	24	16	13	10	7
	20	*86	20	14	11	8	6

BEAMS

SQUARE TUBES — EXTREN® 625
E = 2.8 x 10^6 psi

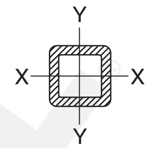


Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
3 x 3 x 3/8							
w = 3.09 lb/ft	3	1,690	—	1,224	1,020	765	510
b_f/t_f = 8.0	4	1,268	878	585	488	366	244
F_b = 11,953 psi	5	*963	479	319	266	200	133
A_w = 1.69 sq. in.	6	*668	287	192	160	120	80
I = 4.53 in.^{4}	7	*491	185	123	103	77	51
S_x = 3.02 in.^{3}	8	*376	126	84	70	52	35
J = 6.780 in.^{4}	9	*297	89	60	50	37	25
	10	*241	66	44	36	27	18
	11	*199	50	33	28	21	14
	12	*167	38	26	21	16	11
	13	*142	30	20	17	13	8
4 x 4 x 3/8							
w = 4.28 lb/ft	3	2,440	—	—	2,196	1,647	1,098
b_f/t_f = 10.7	4	1,830	—	1,348	1,123	842	562
F_b = 9,357 psi	5	1,464	1,148	765	638	478	319
A_w = 2.44 sq. in.	6	*1,031	706	471	392	294	196
I = 11.9 in.^{4}	7	*758	462	308	257	193	128
S_x = 5.95 in.^{3}	8	*580	318	212	177	132	88
J = 17.860 in.^{4}	9	*458	227	152	126	95	63
	10	*371	168	112	93	70	47
	11	*307	127	85	71	53	35
	12	*258	99	66	55	41	27
	13	*220	78	52	43	33	22
	14	*189	63	42	35	26	17
	15	*165	51	34	29	21	14
	16	*145	42	28	24	18	12
	17	*128	35	24	20	15	10
	18	*115	30	20	17	12	8
	19	*103	26	17	14	11	7
	20	*93	22	15	12	9	6

BEAMS

SQUARE TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

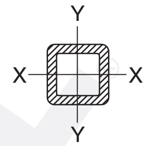


Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
6 x 6 x 3/8							
w = 6.46 lb/ft	2	5,910	—	—	—	—	5,015
b_f/t_f = 16.0	3	3,940	—	—	—	3,839	2,559
F_b = 6,158 psi	4	2,955	—	—	2,890	2,167	1,445
A_w = 3.94 sq. in.	5	*2,322	—	2,105	1,754	1,316	877
I = 42.41 in.^{4}	6	*1,612	—	1,355	1,129	847	564
S_x = 14.14 in.^{3}	7	*1,185	—	915	762	572	381
J = 66.740 in.^{4}	8	*907	—	643	536	402	268
	9	*717	701	468	390	292	195
	10	*580	524	350	291	219	146
	11	*480	402	268	223	167	112
	12	*403	314	209	174	131	87
	13	*343	250	167	139	104	69
	14	*296	202	135	112	84	56
	15	*258	165	110	92	69	46
	16	*227	137	91	76	57	38
	17	*201	115	77	64	48	32
	18	*179	97	65	54	41	27
	19	*161	83	55	46	35	23
	20	*145	71	48	40	30	20

BEAMS

SQUARE TUBES — EXTREN® 625
E = 2.8 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

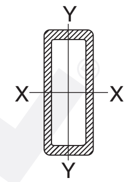
SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
** 6 x 6 x 3/8							
w = 6.46 lb/ft	2	5,910	—	—	—	—	5,105
b_f/t_f = 16.0	3	3,940	—	—	—	—	2,639
F_b = 6,631 psi	4	2,955	—	—	—	2,258	1,506
A_w = 3.94 sq. in.	5	2,364	—	2,211	1,842	1,382	921
I = 42.41 in.^{4}	6	*1,736	—	1,431	1,192	894	596
S_x = 14.14 in.^{3}	7	*1,276	—	970	809	606	404
J = 66.740 in.^{4}	8	*977	—	684	570	428	285
	9	*772	748	498	415	312	208
	10	*625	560	373	311	233	156
	11	*517	430	286	239	179	119
	12	*434	336	224	187	140	93
	13	*370	268	178	149	112	74
	14	*319	217	144	120	90	60
	15	*278	177	118	99	74	49
	16	*244	147	98	82	61	41
	17	*216	123	82	69	51	34
	18	*193	104	70	58	44	29
	19	*173	89	59	50	37	25
	20	*156	77	51	43	32	21

** Non-stock size subject to mill run requirements.

BEAMS

RECTANGULAR TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

Allowable Uniform Loads in Pounds Per Foot

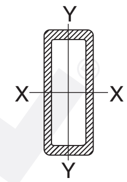


SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
4 x 1/8 x 2 x 1/4							
w = 1.52 lb/ft	5	564	403	269	224	168	112
b_f/t_f = 8.0	6	*454	247	165	137	103	69
F_b = 11,099 psi	7	*334	161	107	89	67	45
A_w = 0.94 sq. in.	8	*256	110	74	61	46	31
I_x = 4.41 in.^{4}	9	*202	79	53	44	33	22
S_x = 2.21 in.^{3}	10	*164	58	39	32	24	16
I_y = 1.10 in.^{4}	11	*135	44	29	24	18	12
J = 2.640 in.^{4}	12	*114	34	23	19	14	9
**** 6-1/2 x 1/4 x 2 x 1/2**							
w = 3.77 lb/ft	5	1,650	—	1,307	1,089	817	544
b_f/t_f = 4.0	6	1,375	1,246	831	692	519	346
F_b = 12,000 psi	7	1,179	834	556	463	348	232
A_w = 2.75 sq. in.	8	*960	583	389	324	243	162
I_x = 24.97 in.^{4}	9	*759	422	281	234	176	117
S_x = 7.68 in.^{3}	10	*614	314	209	175	131	87
I_y = 2.79 in.^{4}	11	*508	240	160	133	100	67
J = 8.020 in.^{4}	12	*427	187	125	104	78	52
	13	*364	149	99	83	62	41
	14	*313	120	80	67	50	33
	15	*273	98	65	55	41	27

** Non-stock size subject to mill run requirements.

BEAMS

RECTANGULAR TUBES — EXTREN® 625
E = 2.8 x 10^6 psi



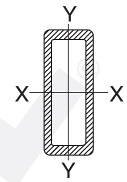
Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY: Stress	Deflection				
		*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
4 x 1/8 x 2 x 1/4							
w = 1.52 lb/ft	5	564	429	286	238	179	119
b_f/t_f = 8.0	6	470	263	175	146	110	73
F_b = 11,953 psi	7	*359	172	115	96	72	48
A_w = 0.94 sq. in.	8	*275	118	79	66	49	33
I_x = 4.41 in.^{4}	9	*217	84	56	47	35	23
S_x = 2.21 in.^{3}	10	*176	62	42	35	26	17
I_y = 1.10 in.^{4}	11	*146	47	32	26	20	13
J = 2.640 in.^{4}	12	*122	37	24	20	15	10
**** 6-1/2 x 1/4 x 2 x 1/2**							
w = 3.77 lb/ft	5	1,650	—	1,376	1,147	860	573
b_f/t_f = 4.0	6	1,375	1,319	879	733	550	366
F_b = 13,200 psi	7	1,179	887	591	493	369	246
A_w = 2.75 sq. in.	8	1,031	621	414	345	259	172
I_x = 24.97 in.^{4}	9	*834	450	300	250	188	125
S_x = 7.68 in.^{3}	10	*676	336	224	187	140	93
I_y = 2.79 in.^{4}	11	*559	257	171	143	107	71
J = 8.020 in.^{4}	12	*469	201	134	111	84	56
	13	*400	159	106	89	66	44
	14	*345	129	86	72	54	36
	15	*300	105	70	59	44	29

** Non-stock size subject to mill run requirements.

BEAMS

RECTANGULAR TUBES — EXTREN® 500 & 525
E = 2.6 x 10^6 psi

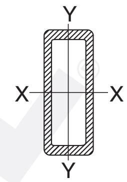


Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	*l*/100	*l*/150	*l*/180	*l*/240	*l*/360
7 x 4 x 1/4							
w = 4.1 lb/ft	3	3,250	—	—	—	3,134	2,089
b_f/t_f = 16.0	4	2,438	—	—	2,351	1,763	1,175
F_b = 6,158 psi	5	*1,601	—	—	1,423	1,068	712
$A_{w(x\text{-}x)}$ = 3.25 sq. in.	6	*1,112	—	1,097	914	686	457
I_x = 34.14 $in.^4$	7	*817	—	740	617	463	308
S_x = 9.75 $in.^3$	8	*625	—	520	433	325	217
J = 30.500 $in.^4$	9	*494	—	378	315	236	157
	10	*400	—	282	235	176	118
	11	*331	324	216	180	135	90
	12	*278	253	169	141	106	70
	13	*237	201	134	112	84	56
	14	*204	163	109	90	68	45
	15	*178	133	89	74	56	37
	16	*156	111	74	61	46	31
	17	*138	93	62	51	39	26
	18	*124	78	52	44	33	22
	19	*111	67	45	37	28	19
	20	*100	58	38	32	24	16
4 x 7 x 1/4							
w = 4.1 lb/ft	3	1,750	—	—	—	1,491	994
b_f/t_f = 28.0	4	*1,121	—	—	1,077	808	538
F_b = 3,827 psi	5	*717	—	—	635	476	317
$A_{w(y\text{-}y)}$ = 1.75 sq. in.	6	*498	—	480	400	300	200
I_y = 14.06 $in.^4$	7	*366	—	320	266	200	133
S_y = 7.03 $in.^3$	8	*280	—	222	185	139	93
	9	*221	—	160	134	100	67
	10	*179	179	119	99	75	50
	11	*148	136	91	76	57	38
	12	*125	106	71	59	44	30

BEAMS

RECTANGULAR TUBES — EXTREN® 625
E = 2.8 x 10^6 psi



Allowable Uniform Loads in Pounds Per Foot

SPAN IN FEET		LATERALLY SUPPORTED--GOVERNED BY:					
		Stress	Deflection				
		*F_b or F_v	l/100	l/150	l/180	l/240	l/360
7 x 4 x 1/4							
w = 4.1 lb/ft	3	3,250				3,233	2,155
b_f/t_f = 16.0	4	2,438				1,838	1,225
F_b = 6,631 psi	5	*1,724			1,495	1,122	748
$A_{w(x\text{-}x)}$ = 3.25 sq. in.	6	*1,197		1,159	966	725	483
I_x = 34.14 in.^{4}	7	*880		785	654	491	327
S_x = 9.75 in.^{3}	8	*673		553	461	346	230
J = 30.500 in.^{4}	9	*532		403	336	252	168
	10	*431		301	251	188	126
	11	*356	347	231	193	144	96
	12	*299	271	181	151	113	75
	13	*255	216	144	120	90	60
	14	*220	175	116	97	73	48
	15	*192	143	95	79	60	40
	16	*168	119	79	66	49	33
	17	*149	99	66	55	41	28
	18	*133	84	56	47	35	23
	19	*119	72	48	40	30	20
	20	*108	62	41	34	26	17
4 x 7 x 1/4							
w = 4.1 lb/ft	3	1,750	—	—	—	1,546	1,030
b_f/t_f = 28.0	4	*1,207	—	—	1,128	846	564
F_b = 4,121 psi	5	*773	—	—	670	502	335
$A_{w(y\text{-}y)}$ = 1.75 sq. in.	6	*537	—	509	424	318	212
I_y = 14.06 in.^{4}	7	*394	—	340	283	213	142
S_y = 7.03 in.^{3}	8	*302	—	237	198	148	99
	9	*238	—	171	143	107	71
	10	*193	191	128	106	80	53
	11	*160	146	97	81	61	41
	12	*134	114	76	63	47	32

BEAM DIAGRAMS AND FORMULAS

The beam diagrams and formulas that follow represent frequently occurring beam loadings and beam end conditions found in civil/structural applications. They are included herein for the convenience of those engineering and designers who have relatively infrequent use for such formulas and hence may find them necessary.

Though formulas for Δ_{max}, Δ_a, Δ_x, and Δ_{x1} are shown, the engineer and designer of fiberglass flexural members is reminded that it represents only **maximum flexural deflection**. To obtain the true total deflection, the effects of **shear deflection** must be added. Please refer to equations B-13 and B-14 as applicable to your particular loading condition.

EFFECTIVE LATERAL BRACING SYSTEMS

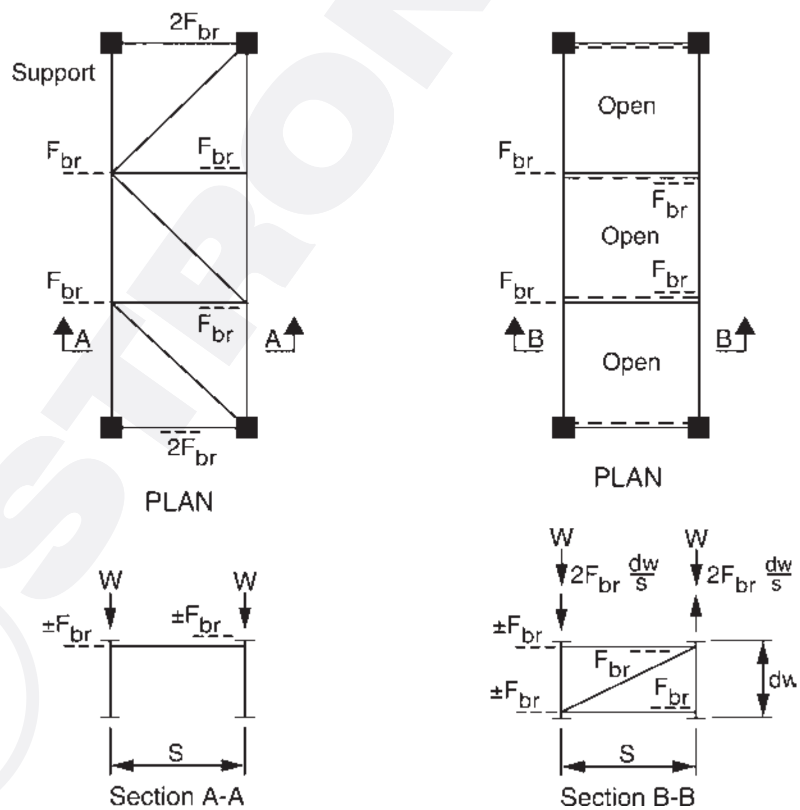
Lateral support must be effective in preventing lateral deflection of the beam compression flange and must limit the laterally unsupported length of the beam to obtain the required level of stress.

Two common methods for the lateral support of the compression flange are shown below.

TYPE 1 supports the compression flange by a lateral bracing system that prevents significant lateral deflection. Each lateral support should be designed for two percent (2%) of the total compression force at that brace point in the laterally braced beam.

TYPE 2 prevents twisting of the entire cross section at the brace points. Rigid diaphragms are provided between two parallel beams. Each diaphragm should be designed for 2% of the total compression flange force at the brace points. Note that this system produces small upward and downward loads on the adjacent beams.

For additional discussion on lateral buckling and lateral bracing systems, the designer is referred to the *ASCE Structural Plastics Design Manual*.



Type 1
Top Chord Braced Against Lateral Bending

Type 2
Bracing Prevents Rotation at Brace Points

BEAM DIAGRAMS AND FORMULAS

NOMENCLATURE

E	Modulus of Elasticity of steel at 29,000 ksi
I	Moment of Inertia of beam (in.^{4})
L	Total length of beam between reaction points (ft.)
M_{max}	Maximum moment (kip in.)
M_1	Maximum moment in left section of beam (kip in.)
M_2	Maximum movement in right section of beam (kip in.)
M_3	Maximum positive moment in beam with combined end moment conditions (kip in.)
M_x	Moment at distance x from end of beam (kip in.)
P	Concentrated load (kips)
P_1	Concentrated load nearest left reaction (kips)
P_2	Concentrated load nearest right reaction, and of different magnitude than P_1 (kips)
R	End beam reaction for any condition of symmetrical loading (kips)
R_1	Left end beam reaction (kips)
R_2	Right end or intermediate beam reaction (kips)
R_3	Right end beam reaction (kips)
V	Maximum vertical shear for any condition of symmetrical loading (kips)
V_1	Maximum vertical shear in left section of beam (kips)
V_2	Vertical shear at right reaction point, or to left of intermediate reaction point of beam (kips)
V_3	Vertical shear at right reaction point, or to right of intermediate reaction point of beam (kips)
V_x	Vertical shear at distance x from end of beam (kips)
W	Total load on beam (kips)
a	Measured distance along beam (in.)
b	Measured distance along beam which may be greater or less than "a" (in.)
l	Total length of beam between reaction points (in.)
w	Uniformally distributed load per unit of length (kips per in.)
w_1	Uniformly distributed load per unit of length nearest left reaction (kips per in.)
w_2	Uniformly distributed load per unit of length nearest right reaction and of different magnitude than w_1 (kips per in.)
x	Any distance measured along beam from left reaction (in.)
x_1	Any distance measured along overhang section of beam from nearest reaction point (in.)
Δ_{max}	Maximum deflection (in.)
Δ_a	Deflection at point of load (in.)
Δ_x	Deflection at any point x distance from left reaction (in.)
Δ_{x1}	Deflection of overhang section of beam at any distance from nearest reaction point (in.)

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS

FREQUENTLY USED FORMULAS

The formulas given below are frequently required in structural designing. They are included herein for the convenience of those engineers who have infrequent use for such formulas and hence may find reference necessary.

BEAMS

Flexural stress at extreme fiber:

$f = Mc/I = M/S$

Flexural stress at any fiber:

$f = My/I$ y = distance from neutral axis to fiber.

Average vertical shear (for maximum see below):

$v = V/A = V/dt$ (for beams and girders)

Horizontal shearing stress at any section A-A:

$v = VQ/I\,b$ Q = statical moment about the neutral axis of the entire section of that portion of the cross section lying outside of Section A-A,

b = width at Section A-A

(Intensity of vertical shear is equal to that of horizontal shear acting normal to it at the same point and both are usually a maximum at mid-height of beam.)

Slope and deflection at any point:

$$EI\frac{d^2y}{dx^2} = M$$

x and y are abscissa and ordinate respectively of a point on the neutral axis, referred to axes of rectangular coordinates through a selected point of support.

(First integration gives slopes; second integration gives deflections. Constants of integration must be determined.)

CONTINUOUS BEAMS (THE THEOREM OF THREE MOMENTS)

Uniform load:

$$M_a\frac{l_1}{I_1} + 2M_b\left(\frac{l_1}{I_1} + \frac{l_2}{I_2}\right) + M_c\frac{l_2}{I_2} = -\frac{1}{4}\left(\frac{w_1 l_1^{\,3}}{I_1} + \frac{w_2 l_2^{\,3}}{I_2}\right)$$

Concentrated loads:

$$M_a\frac{l_1}{I_1} + 2M_b\left(\frac{l_1}{I_1} + \frac{l_2}{I_2}\right) + M_c\frac{l_2}{I_2} = -\frac{P_1 a_1 b_1}{I_1}\left(1 + \frac{a_1}{l_1}\right) - \frac{P_2 a_2 b_2}{I_2}\left(1 + \frac{b_a}{l_2}\right)$$

Considering any two consecutive spans in any continuous structure:

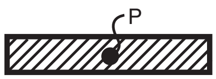
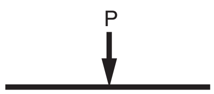
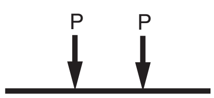
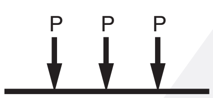
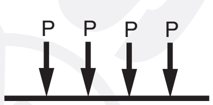
- M_a, M_b, M_c = moments at left, center and right supports respectively, of any pair of adjacent spans.
- l_1 and l_2 = length of left and right spans respectively, of the pair.
- I_1 and I_2 = moment of inertia of left and right spans respectively.
- w_1 and w_2 = load per unit of length on left and right spans respectively.
- P_1 and P_2 = concentrated loads on left and right spans respectively.
- a_1 and a_2 = distance of concentrated loads from left support in left and right spans respectively.
- b_1 and b_2 = distance of concentrated loads from right support in left and right spans respectively.

The above equations are for beams with moment of inertia constant in each span but differing in different spans, continuous over three or more supports. By writing such an equation for each successive pair of spans and introducing the known values (usually zero) of end moments, all other moments can be found.

STRONGWELL

BEAM DIAGRAMS AND FORMULAS

Table of Concentrated Load Equivalents

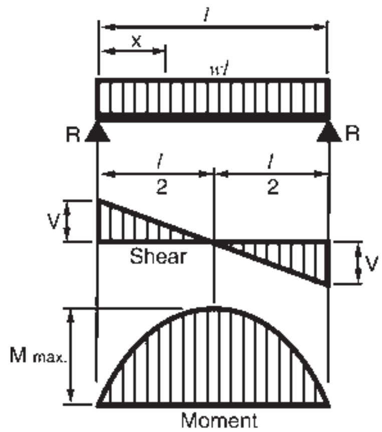
n	Loading	Coeff.	Simple Beam	Beam Fixed One End Supported at Other	Beam Fixed Both Ends
					
∞		a	0.1250	0.0703	0.0417
		b	–	0.1250	0.0833
		c	0.5000	0.3750	–
		d	–	0.6250	0.5000
		e	0.0130	0.0054	0.0026
		f	1.0000	1.0000	0.6667
		g	1.0000	0.4151	0.3000
2		a	0.2500	0.1563	0.1250
		b	–	0.1875	0.1250
		c	0.5000	0.3125	–
		d	–	0.6875	0.5000
		e	0.0208	0.0093	0.0052
		f	2.0000	1.5000	1.0000
		g	0.8000	0.4770	0.4000
3		a	0.3333	0.2222	0.1111
		b	–	0.3333	0.2222
		c	1.0000	0.6667	–
		d	–	1.3333	1.0000
		e	0.0355	0.0152	0.0077
		f	2.6667	2.6667	1.7778
		g	1.0222	0.4381	0.3333
4		a	0.5000	0.2656	0.1875
		b	–	0.4688	0.3125
		c	1.5000	1.0313	–
		d	–	1.9688	1.5000
		e	0.0495	0.0209	0.0104
		f	4.0000	3.7500	2.5000
		g	0.9500	0.4281	0.3200
5		a	0.6000	0.3600	0.2000
		b	–	0.6000	0.4000
		c	2.0000	1.4000	–
		d	–	2.6000	2.0000
		e	0.0630	0.0265	0.0130
		f	4.8000	4.8000	3.2000
		g	1.0080	0.4238	0.3120

Maximum positive moment (kip-ft.): a x P x L
Maximum negative moment (kip-ft.): b x P x L
Pinned end reaction (kips): c x P
Fixed end reaction (kips): d x P
Maximum deflection (in.): e x Pl^3/EI
Equivalent simple span uniform load (kips): f x P
Deflection coeff. for equivalent simple span uniform load: g
Number of equal load spaces: n
Span of beam (ft.): L

Reprinted with permission of American Institute of Steel Construction

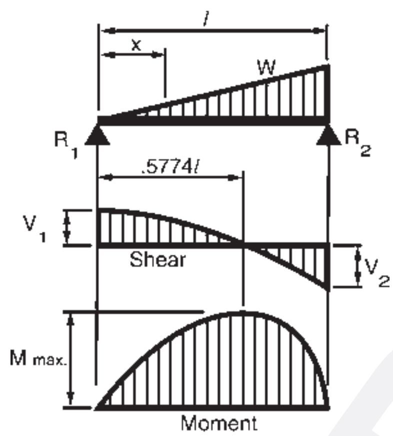
BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

1. SIMPLE BEAM — UNIFORMLY DISTRIBUTED LOAD



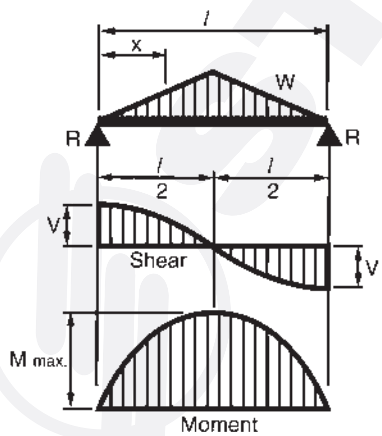
Total Equiv. Uniform Load	$= wl$
$R = V$	$= \frac{wl}{2}$
V_x	$= w\left(\frac{l}{2} - x\right)$
M max.(at center)	$= \frac{wl^2}{8}$
M_x	$= \frac{wx}{2}(l - x)$
Δmax.(at center)	$= \frac{5wl^4}{384EI}$
Δ_x	$= \frac{wx}{24EI}(l^3 - 2lx^2 + x^3)$

2. SIMPLE BEAM — LOAD INCREASING UNIFORMLY TO ONE END



Total Equiv. Uniform Load	$= \frac{16W}{9\sqrt{3}} = 1.0264W$
$R_1 = V_1$	$= \frac{W}{3}$
$R_2 = V_2$ max.	$= \frac{2W}{3}$
V_x	$= \frac{W}{3} - \frac{Wx^2}{l^2}$
M max. (at $x = \frac{l}{\sqrt{3}} = .5774l$)	$= \frac{2Wl}{9\sqrt{3}} = .1283\,Wl$
M_x	$= \frac{Wx}{3l^2}(l^2 - x^2)$
Δmax. (at $x = l\sqrt{1 - \sqrt{\frac{8}{15}}} = .5193l$)	$= .01304\frac{Wl^3}{EI}$
Δ_x	$= \frac{Wx}{180EI\,l^2}(3x^4 - 10l^2x^2 + 7l^4)$

3. SIMPLE BEAM — LOAD INCREASING UNIFORMLY TO CENTER

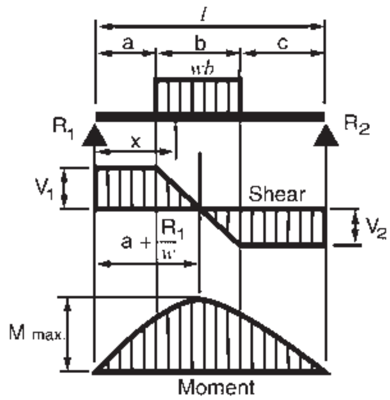


Total Equiv. Uniform Load	$= \frac{4W}{3}$
$R = V$	$= \frac{W}{2}$
V_x (when $x < \frac{l}{2}$)	$= \frac{W}{2l^2}(l^2 - 4x^2)$
M max. (at center)	$= \frac{Wl}{6}$
M_x (when $x < \frac{l}{2}$)	$= Wx\left(\frac{1}{2} - \frac{2x^2}{3l^2}\right)$
Δmax. (at center)	$= \frac{Wl^3}{60EI}$
Δ_x (when $x < \frac{l}{2}$)	$= \frac{Wx}{480\,EI\,l^2}(5l^2 - 4x^2)^2$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

4. SIMPLE BEAM — UNIFORM LOAD PARTIALLY DISTRIBUTED



$R_1 = V_1$ (max. when a < c) $= \frac{wb}{2l}(2c + b)$

$R_2 = V_2$ (max. when a > c) $= \frac{wb}{2l}(2a + b)$

V_X (when x > a and < (a + b)) $= R_1 - w(x - a)$

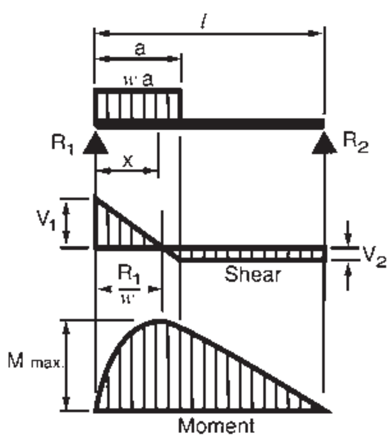
M max. (at $x = a + \frac{R_1}{w}$) $= R_1\left(a + \frac{R_1}{2w}\right)$

M_x (when x < a) $= R_1 x$

M_x (when x > a and < (a + b)) $= R_1 x - \frac{w}{2}(x - a)^2$

M_x (when x > (a + b)) $= R_2(l - x)$

5. SIMPLE BEAM — UNIFORM LOAD PARTIALLY DISTRIBUED AT ONE END



$R_1 = V_1$ max. $= \frac{wa}{2l}(2l - a)$

$R_2 = V_2$ $= \frac{wa^2}{2l}$

V_x (when x < a) $= R_1 - wx$

M max. (at $x = \frac{R_1}{w}$) $= \frac{R_1^2}{2w}$

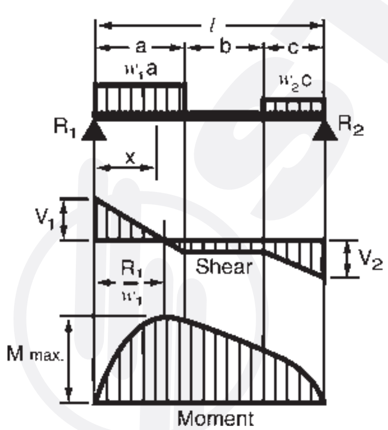
M_x (when x < a) $= R_1 x - \frac{wx^2}{2}$

M_x (when x > a) $= R_2(l - x)$

Δ_x (when x < a) $= \frac{wx}{24EIl}(a^2(2l-a)^2 - 2ax^2(2l-a) + lx^3)$

Δ_x (when x > a) $= \frac{wa^2(l - x)}{24EIl}(4xl - 2x^2 - a^2)$

6. SIMPLE BEAM — UNIFORM LOAD PARTIALLY DISTRIBUTED AT EACH END



$R_1 = V_1$ $= \frac{w_1 a(2l - a) + w_2 c^2}{2l}$

$R_2 = V_2$ $= \frac{w_2 c(2l - c) + w_1 a^2}{2l}$

V_x (when x < a) $= R_1 - w_1 x$

V_x (when x > a and < (a + b)) $= R_1 - w_1 a$

V_x (when x > (a + b)) $= R_2 - w_2(l - x)$

M max. (at $x = \frac{R_1}{w_1}$ when $R_1 < w_1 a$) $= \frac{R_1^2}{2w_1}$

M max. (at $x = l - \frac{R_2}{w_2}$ when $R_2 < w_2 c$) $= \frac{R_2^2}{2w_2}$

M_x (when x < a) $= R_1 x - \frac{w_1 x^2}{2}$

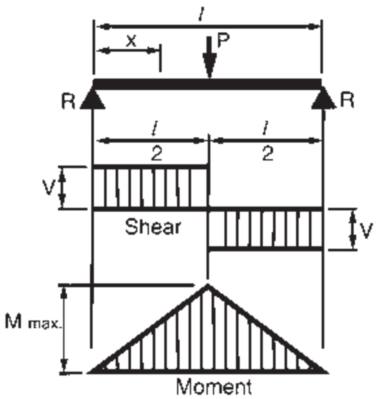
M_x (when x > a and < (a + b)) $= R_1 x - \frac{w_1 a}{2}(2x - a)$

M_x (when x > (a + b)) $= R_2(l - x) - \frac{w_2(l - x)^2}{2}$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

7. SIMPLE BEAM — CONCENTRATED LOAD AT CENTER



Total Equiv. Uniform Load $= 2P$

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

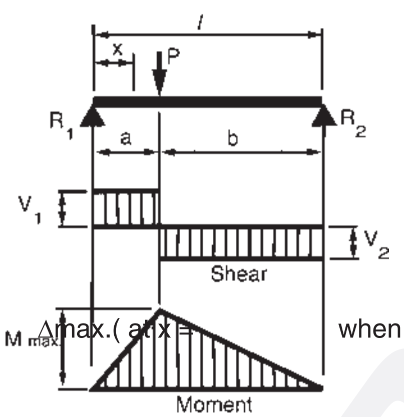
M max. (at point of load) $= \frac{Pl}{4}$

M_x (when $x < \frac{l}{2}$) $= \frac{Px}{2}$

Δmax. (at point of load) $= \frac{Pl^3}{48EI}$

Δ_x (when $x < \frac{l}{2}$) $= \frac{Px}{48EI}(3l^2 - 4x^2)$

8. SIMPLE BEAM — CONCENTRATED LOAD AT ANY POINT



Total Equiv. Uniform Load $= \frac{8Pab}{l^2}$

$R_1 = V_1$ (max. when a < b) $= \frac{Pb}{l}$

$R_2 = V_2$ (max. when a > b) $= \frac{Pa}{l}$

M max.(at point of load) $= \frac{Pab}{l}$

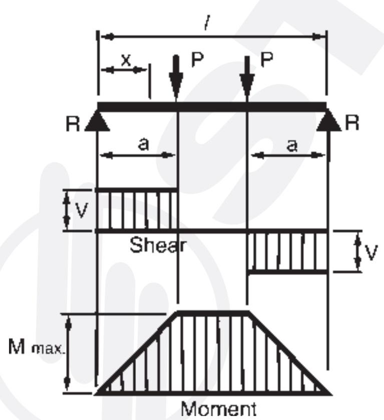
M_x (when x < a) $= \frac{Pbx}{l}$

Δmax.(at $x = \sqrt{\frac{a(a+2b)}{3}}$ when a > b) $= \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$

Δa(at point of load) $= \frac{Pa^2b^2}{3EIl}$

Δ_x (when x < a) $= \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$

9. SIMPLE BEAM — TWO EQUAL CONCENTRATED LOADS SYMMETRICALLY PLACED



Total Equiv. Uniform Load $= \frac{8Pa}{l}$

$R = V = P$

M max. (between loads) $= Pa$

M_x (when x < a) $= Px$

Δmax.(at center) $= \frac{Pa}{24EI}(3l^2 - 4a^2)$

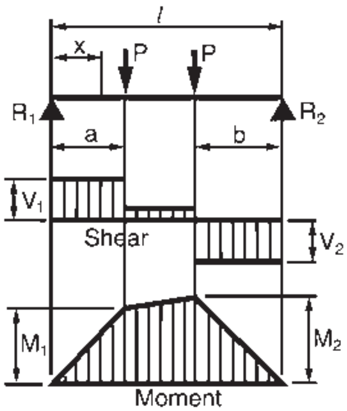
Δ_x (when x < a) $= \frac{Px}{6EI}(3la - 3a^2 - x^2)$

Δ_x (when x > a and < (l – a)) $= \frac{Pa}{6EI}(3lx - 3x^2 - a^2)$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

10. SIMPLE BEAM — TWO EQUAL CONCENTRATED LOADS UNSYMMETRICALLY PLACED



$R_1 = V_1$ (max. when a < b) $= \frac{P}{l}(l - a + b)$

$R_2 = V_2$ (max. when a > b) $= \frac{P}{l}(l - b + a)$

V_x (when x > a and < (l – b)) $= \frac{P}{l}(b - a)$

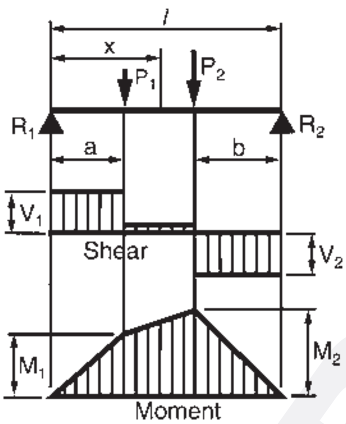
M_1 (max. when a > b) $= R_1 a$

M_2 (max. when a < b) $= R_2 b$

M_x (when x < a) $= R_1 x$

M_x (when x > a and < (l – b)) $= R_1 x - P(x - a)$

11. SIMPLE BEAM — TWO UNEQUAL CONCENTRATED LOADS UNSYMMETRICALLY PLACED



$R_1 = V_1 = \frac{P_1(l - a) + P_2 b}{l}$

$R_2 = V_2 = \frac{P_1 a + P_2(l - b)}{l}$

V_x (when x > a and < (l – b)) $= R_1 - P_1$

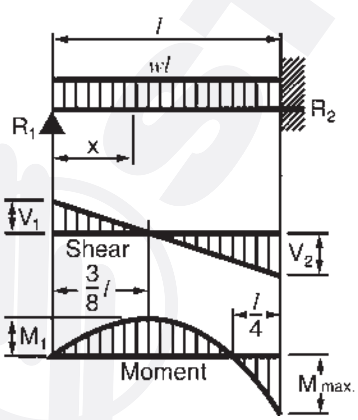
M_1 (max. when $R_1 < P_1$) $= R_1 a$

M_2 (max. when $R_2 < P_2$) $= R_2 b$

M_x (when x < a) $= R_1 x$

M_x (when x > a and < (l – b)) $= R_1 x - P_1(x - a)$

12. BEAM FIXED AT ONE END, SUPPORTED AT OTHER — UNIFORMLY DISTRIBUTED LOAD



Total Equiv. Uniform Load $= wl$

$R_1 = V_1 = \frac{3wl}{8}$

$R_2 = V_2$ max. $= \frac{5wl}{8}$

$V_x = R_1 - wx$

M max. $= \frac{wl^2}{8}$

M_1 (at x = 3/8 l) $= \frac{9}{128} wl^2$

$M_x = R_1 x - \frac{wx^2}{2}$

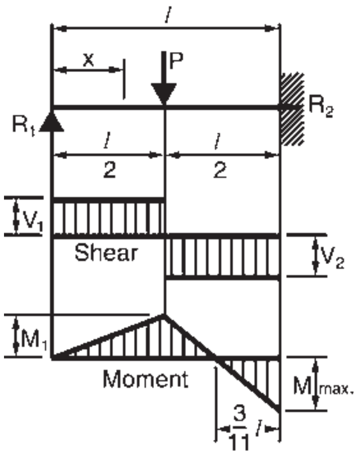
Δmax. (at $x = \frac{l}{16}(1 + \sqrt{33}) = .4215l$) $= \frac{wl^4}{185EI}$

$\Delta_x = \frac{wx}{48EI}(l^3 - 3lx^2 + 2x^3)$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS
FOR VARIOUS STATIC LOADING CONDITIONS

13. BEAM FIXED AT ONE END, SUPPORTED AT OTHER — CONCENTRATED LOAD AT CENTER



Total Equiv. Uniform Load $= \frac{3P}{2}$

$R_1 = V_1 = \frac{5P}{16}$

$R_2 = V_2$ max. $= \frac{11P}{16}$

M max. (at fixed end) $= \frac{3Pl}{16}$

M_1 (at point of load) $= \frac{5Pl}{32}$

M_x (when $x < \frac{l}{2}$) $= \frac{5Px}{16}$

M_x (when $x > \frac{l}{2}$) $= P\left(\frac{l}{2} - \frac{11x}{16}\right)$

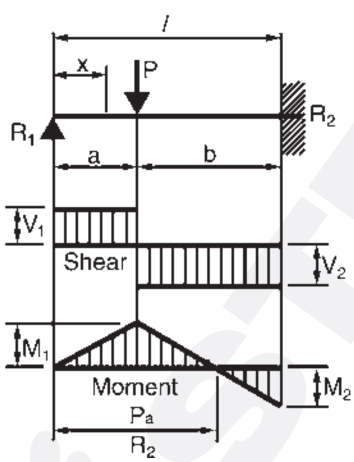
Δmax. (at $x = l\sqrt{\frac{1}{5}} = .4472l$) $= \frac{Pl^3}{48EI\sqrt{5}} = .009317\frac{Pl^3}{EI}$

Δ_x (at point of load) $= \frac{7Pl^3}{768EI}$

Δ_x (when $x < \frac{l}{2}$) $= \frac{Px}{96EI}(3l^2 - 5x^2)$

Δ_x (when $x > \frac{l}{2}$) $= \frac{P}{96EI}(x-l)^2(11x - 2l)$

14. BEAM FIXED AT ONE END, SUPPORTED AT OTHER — CONCENTRATED LOAD AT ANY POINT



$R_1 = V_1 = \frac{Pb^2}{2l^3}(a + 2l)$

$R_2 = V_2 = \frac{Pa}{2l^3}(3l^2 - a^2)$

M_1 (at point of load) $= R_1 a$

M_2 (at fixed end) $= \frac{Pab}{2l^2}(a + l)$

M_x (when $x < a$) $= R_1 x$

M_x (when $x > a$) $= R_1 x - P(x - a)$

Δmax. (when $a < .414l$ at $x = l\frac{l^2 + a^2}{3l^2 - a^2}$) $= \frac{Pa}{3EI}\frac{(l^2 - a^2)^3}{(3l^2 - a^2)^2}$

Δmax. (when $a > .414l$ at $x = l\sqrt{\frac{a}{2l+a}}$) $= \frac{Pab^2}{6EI}\sqrt{\frac{a}{2l+a}}$

Δa (at point of load) $= \frac{Pa^2b^3}{12EIl^3}(3l + a)$

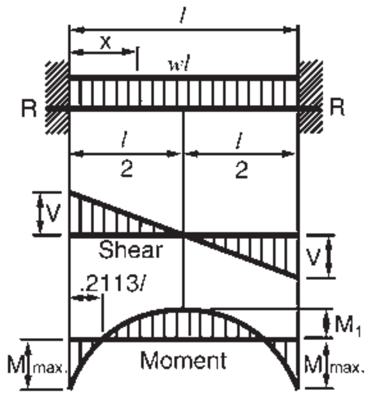
Δ_x (when $x < a$) $= \frac{Pb^2x}{12EIl^3}(3al^2 - 2lx^2 - ax^2)$

Δ_x (when $x > a$) $= \frac{Pa}{12EIl^3}(l - x)^2(3l^2x - a^2x - 2a^2l)$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

15. BEAM FIXED AT BOTH ENDS — UNIFORMLY DISTRIBUTED LOADS



Total Equiv. Uniform Load $= \frac{2wl}{3}$

$R = V = \frac{wl}{2}$

$V_x = w\left(\frac{l}{2} - x\right)$

M max. (at ends) $= \frac{wl^2}{12}$

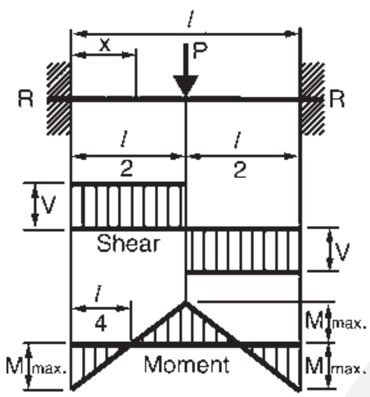
M_1 (at center) $= \frac{wl^2}{24}$

$M_x = \frac{w}{12}\left(6lx - l^2 - 6x^2\right)$

Δmax. (at center) $= \frac{wl^4}{384EI}$

$\Delta_x = \frac{wx^2}{24EI}(l - x)^2$

16. BEAM FIXED AT BOTH ENDS — CONCENTRATED LOAD AT CENTER



Total Equiv. Uniform Load $= P$

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

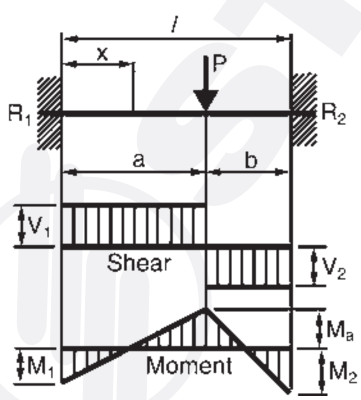
M max. (at center and ends) $= \frac{Pl}{8}$

M_x (when $x < l/2$) $= \frac{P}{8}\left(4x - l\right)$

Δmax. (at center) $= \frac{Pl^3}{192EI}$

Δ_x (when $x < l/2$) $= \frac{Px^2}{48EI}\left(3l - 4x\right)$

17. BEAM FIXED AT BOTH ENDS — CONCENTRATED LOAD AT ANY POINT



$R_1 = V_1$ (max. when $a < b$) $= \frac{Pb^2}{l^3}\left(3a + b\right)$

$R_2 = V_2$ (max. when $a > b$) $= \frac{Pa^2}{l^3}\left(a + 3b\right)$

M_1 (max. when $a < b$) $= \frac{Pab^2}{l^2}$

M_2 (max. when $a > b$) $= \frac{Pa^2b}{l^2}$

M_a (at point of load) $= \frac{2Pa^2b^2}{l^3}$

M_x (when $x < a$) $= R_1x - \frac{Pab^2}{l^2}$

Δmax. (when $a > b$ at $x = \frac{2al}{3a + b}$) $= \frac{2Pa^3b^2}{3EI\,(3a + b)^2}$

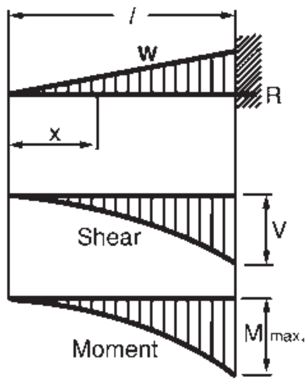
Δa (at point of load) $= \frac{Pa^3b^3}{3EIl^3}$

Δ_x (when $x < a$) $= \frac{Pb^2x^2}{6EIl^3}\left(3al - 3ax - bx\right)$

Reprinted with permission of American Institute of Steel Construction

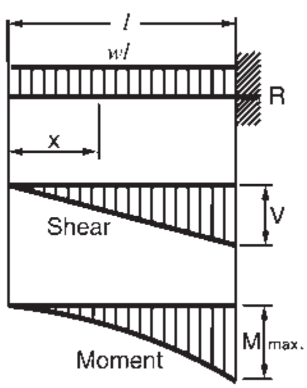
BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

18. CANTILEVER BEAM — LOAD INCREASING UNIFORMLY TO FIXED END



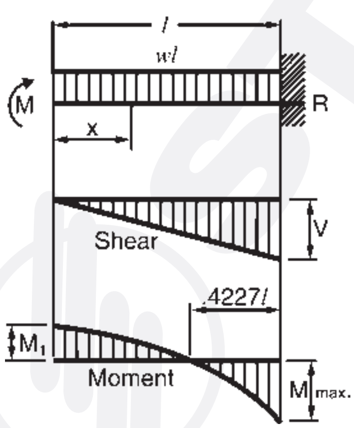
Total Equiv. Uniform Load	=	$\frac{8}{3}W$
R = V	=	W
V_x	=	$W\frac{x^2}{l^2}$
M max. (at fixed end)	=	$\frac{Wl}{3}$
M_x	=	$\frac{Wx^3}{3l^2}$
Δmax. (at free end)	=	$\frac{Wl^3}{15EI}$
Δ_x	=	$\frac{W}{60EI\,l^2}(x^5 - 5l^4x + 4l^5)$

19. CANTILEVER BEAM —UNIFORMLY DISTRIBUTED LOAD



Total Equiv. Uniform Load	=	$4wl$
R = V	=	wl
V_x	=	wx
M max.(at fixed end)	=	$\frac{wl^2}{2}$
M_x	=	$\frac{wx^2}{2}$
Δmax.(at free end)	=	$\frac{wl^4}{8EI}$
Δ_x	=	$\frac{W}{24EI}(x^4 - 4l^3x + 3l^4)$

20. BEAM FIXED AT ONE END, FREE TO DEFLECT VERTICALLY BUT NOT ROTATE AT OTHER UNIFORMLY DISTRIBUTED LOAD

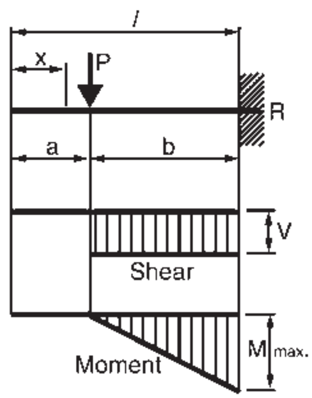


Total Equiv. Uniform Load	=	$\frac{8}{3}wl$
R = V	=	wl
V_x	=	wx
M max. (at fixed end)	=	$\frac{wl^2}{3}$
M_1 (at deflected end)	=	$\frac{wl^2}{6}$
M_x	=	$\frac{w}{6}(l^2 - 3x^2)$
Δ max. (at deflected end)	=	$\frac{wl^4}{24EI}$
Δ_x	=	$\frac{w(l^2 - x^2)^2}{24EI}$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

21. CANTILEVER BEAM — CONCENTRATED LOAD AT ANY POINT



Total Equiv. Uniform Load $= \frac{8Pb}{l}$

R = V $= P$

M max. (at fixed end) $= Pb$

M_x (when x > a) $= P(x - a)$

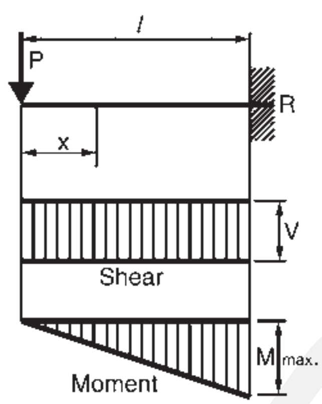
Δmax. (at free end) $= \frac{Pb^2}{6EI}(3l - b)$

Δa (at point of load) $= \frac{Pb^3}{3EI}$

Δ_x (when x < a) $= \frac{Pb^2}{6EI}(3l - 3x - b)$

Δ_x (when x > a) $= \frac{P(l - x)^2}{6EI}(3b - l + x)$

22. CANTILEVER BEAM — CONCENTRATED LOAD AT FREE END



Total Equiv. Uniform Load $= 8P$

R = V $= P$

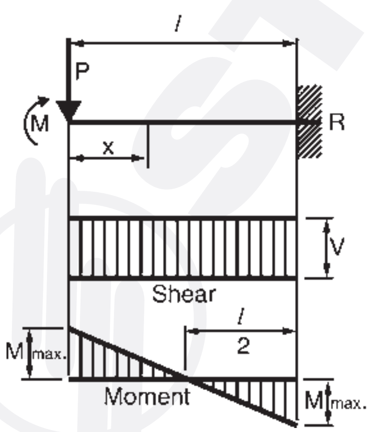
M max. (at fixed end) $= Pl$

M_x $= Px$

Δmax. (at free end) $= \frac{Pl^3}{3EI}$

Δ_x $= \frac{P}{6EI}(2l^3 - 3l^2x + x^3)$

23. BEAM FIXED AT ONE END, FREE TO DEFLECT VERTICALLY BUT NOT ROTATE AT OTHER CONCENTRATED LOAD AT DEFLECTED END



Total Equiv. Uniform Load $= 4P$

R = V $= P$

M max. (at both ends) $= \frac{Pl}{2}$

M_x $= P(\frac{l}{2} - x)$

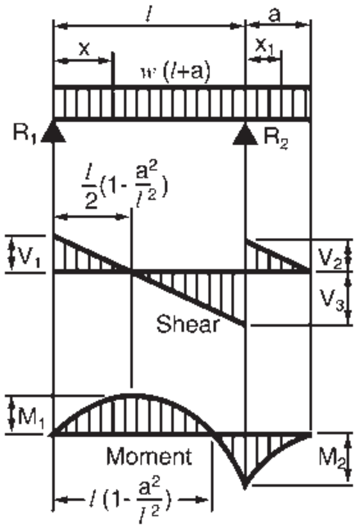
Δmax. (at deflected end) $= \frac{Pl^3}{12EI}$

Δ_x $= \frac{P(l - x)^2}{12EI}(l + 2x)$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

24. BEAM OVERHANGING ONE SUPPORT — UNIFORMLY DISTRIBUTED LOAD



$R_1 = V_1 \quad = \frac{w}{2l}(l^2 - a^2)$

$R_2 = V_2 + V_3 \quad = \frac{w}{2l}(l + a)^2$

$V_2 \quad = wa$

$V_3 \quad = \frac{w}{2l}(l^2 + a^2)$

V_x (between supports) $\quad = R_1 - wx$

V_{x_1} (for overhang) $\quad = w(a - x_1)$

M_1 (at $x = \frac{l}{2}\left[1 - \frac{a^2}{l^2}\right]$) $\quad = \frac{w}{8l^2}(l + a)^2(l - a)^2$

M_2 (at R_2) $\quad = \frac{wa^2}{2}$

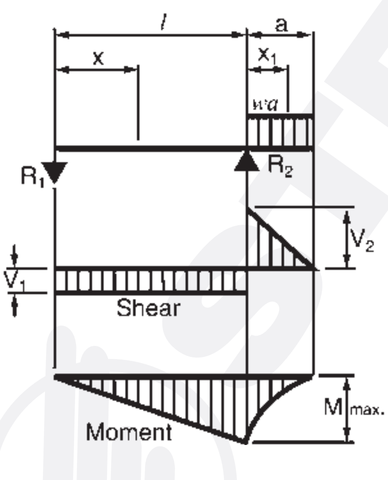
M_x (between supports) $\quad = \frac{wx}{2l}(l^2 - a^2 - xl)$

M_{x_1} (for overhang) $\quad = \frac{w}{2}(a - x_1)^2$

Δ_x (between supports) $\quad = \frac{wx}{24EIl}(l^4 - 2l^2x^2 + lx^3 - 2a^2l^2 + 2a^2x^2)$

Δ_{x_1} (for overhang) $\quad = \frac{wx_1}{24EI}(4a^2l - l^3 + 6a^2x_1 - 4ax_1^2 + x_1^3)$

25. BEAM OVERHANGING ONE SUPPORT — UNIFORMLY DISTRIBUTED LOAD ON OVERHANG



$R_1 = V_1 \quad = \frac{wa^2}{2l}$

$R_2 = V_1 + V_2 \quad = \frac{wa}{2l}(2l + a)$

$V_2 \quad = wa$

V_{x_1} (for overhang) $\quad = w(a - x_1)$

M max. (at R_2) $\quad = \frac{wa^2}{2}$

M_x (between supports) $\quad = \frac{wa^2x}{2l}$

M_{x_1} (for overhang) $\quad = \frac{w}{2}(a - x_1)^2$

Δmax.(between supports at $x = \frac{l}{\sqrt{3}}$) $= \frac{wa^2l^2}{18\sqrt{3}EI} = .03208\ \frac{wa^2l^2}{EI}$

Δmax.(for overhang at $x_1 = a$) $\quad = \frac{wa^3}{24EI}(4l + 3a)$

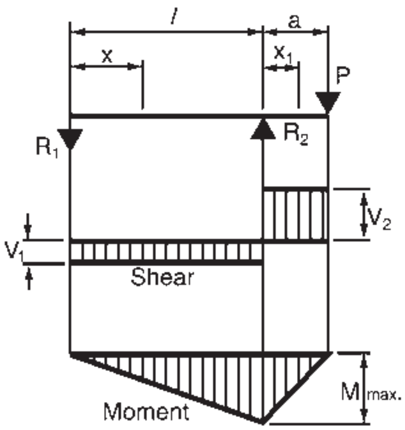
Δ_x (between supports) $\quad = \frac{wa^2x}{12EI\,l}(l^2 - x^2)$

Δ_{x_1} (for overhang) $\quad = \frac{wx_1}{24EI}(4a^2l + 6a^2x_1 - 4ax_1^2 + x_1^3)$

Reprinted with permission of American Institute of Steel Construction

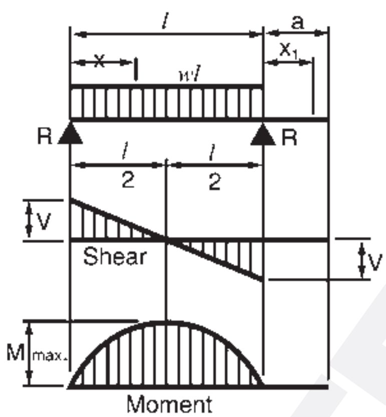
BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

26. BEAM OVERHANGING ONE SUPPORT — CONCENTRATED LOAD AT END OF OVERHANG



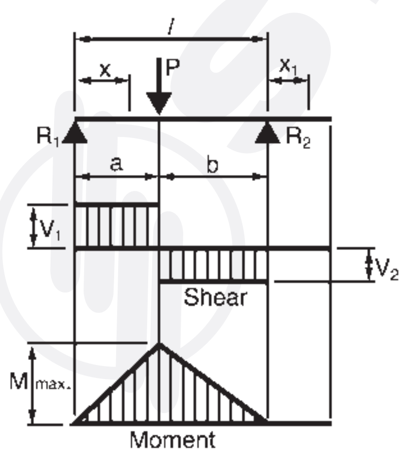
$R_1 = V_1$	$= \frac{Pa}{l}$
$R_2 = V_1 + V_2$	$= \frac{P}{l}(l + a)$
V_2	$= P$
M max. (at R_2)	$= Pa$
M_x (between supports)	$= \frac{Pax}{l}$
M_{x_1} (for overhang)	$= P(a - x_1)$
Δmax. (between supports at $x = \frac{l}{\sqrt{3}}$)	$= \frac{Pal^2}{9\sqrt{3}EI} = .06415\frac{Pal^2}{EI}$
Δmax. (for overhang at $x_1 = a$)	$= \frac{Pa^2}{3EI}(l + a)$
Δ_x (between supports)	$= \frac{Pax}{6EIl}(l^2 - x^2)$
Δ_{x_1} (for overhang)	$= \frac{Px_1}{6EI}(2al + 3ax_1 - x_1^2)$

27. BEAM OVERHANGING ONE SUPPORT — UNIFORMLY DISTRIBUTED LOAD BETWEEN SUPPORTS



Total Equiv. Uniform Load	$= wl$
$R = V$	$= \frac{wl}{2}$
V_x	$= w\left(\frac{l}{2} - x\right)$
M max. (at center)	$= \frac{wl^2}{8}$
M_x	$= \frac{wx}{2}(l - x)$
Δmax. (at center)	$= \frac{5wl^4}{384EI}$
Δ_x	$= \frac{wx}{24EI}(l^3 - 2lx^2 + x^3)$
Δ_{x_1}	$= \frac{wl^3x_1}{24EI}$

28. BEAM OVERHANGING ONE SUPPORT — CONCENTRATED LOAD AT ANY POINT BETWEEN SUPPORTS

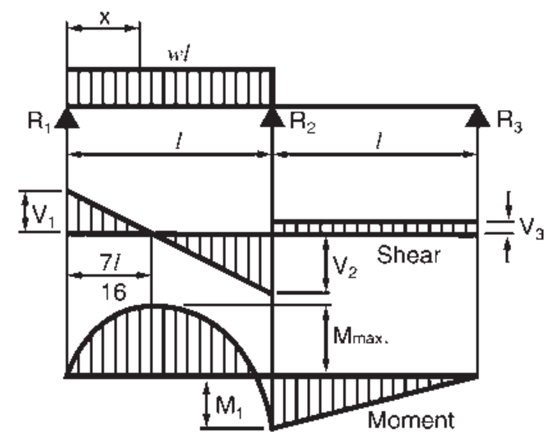


Total Equiv. Uniform Load	$= \frac{8Pab}{l^2}$
$R_1 = V_1$ (max. when $a < b$)	$= \frac{Pb}{l}$
$R_2 = V_2$ (max. when $a > b$)	$= \frac{Pa}{l}$
M max. (at point of load)	$= \frac{Pab}{l}$
M_x (when $x < a$)	$= \frac{Pbx}{l}$
Δmax. (at $x = \sqrt{\frac{a(a+2b)}{3}}$ when $a > b$)	$= \frac{Pab(a+2b)\sqrt{3a(a+2b)}}{27EIl}$
Δa (at point of load)	$= \frac{Pa^2b^2}{3EIl}$
Δ_x (when $x < a$)	$= \frac{Pbx}{6EIl}(l^2 - b^2 - x^2)$
Δ_x (when $x > a$)	$= \frac{Pa(l - x)}{6EIl}(2lx - x^2 - a^2)$
Δ_{x_1}	$= \frac{Pabx_1}{6EIl}(l + a)$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

29. CONTINUOUS BEAM — TWO EQUAL SPANS — UNIFORM LOAD ON ONE SPAN



Total Equiv. Uniform Load $= \frac{49}{64} wl$

$R_1 = V_1 = \frac{7}{16} wl$

$R_2 = V_2 + V_3 = \frac{5}{8} wl$

$R_3 = V_3 = -\frac{1}{16} wl$

$V_2 = \frac{9}{16} wl$

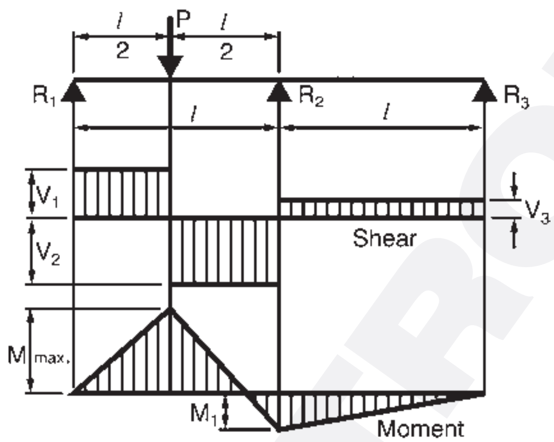
M max. (at $x = \frac{7}{16} l$) $= \frac{49}{512} wl^2$

M_1 (at support R_2) $= \frac{1}{16} wl^2$

M_x (when $x < l$) $= \frac{wx}{16} (7l - 8x)$

Δmax. (0.472 l from R_1) $= 0.0092\ wl^4/EI$

30. CONTINUOUS BEAM—TWO EQUAL SPANS—CONCENTRATED LOAD AT CENTER OF ONE SPAN



Total Equiv. Uniform Load $= \frac{13}{8} P$

$R_1 = V_1 = \frac{13}{32} P$

$R_2 = V_2 + V_3 = \frac{11}{16} P$

$R_3 = V_3 = -\frac{3}{32} P$

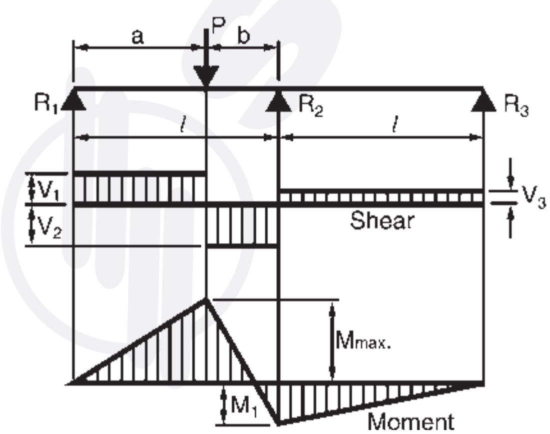
$V_2 = \frac{19}{32} P$

M max. (at point of load) $= \frac{13}{64} Pl$

M_1 (at support R_2) $= \frac{3}{32} Pl$

Δmax. (0.480 l from R_1) $= 0.015\ Pl^3/EI$

31. CONTINUOUS BEAM — TWO EQUAL SPANS — CONCENTRATED LOAD AT ANY POINT



$R_1 = V_1 = \frac{Pb}{4l^3} \left(4l^2 - a(l + a) \right)$

$R_2 = V_2 + V_3 = \frac{Pa}{2l^3} \left(2l^2 + b(l + a) \right)$

$R_3 = V_3 = -\frac{Pab}{4l^3} (l + a)$

$V_2 = \frac{Pa}{4l^3} \left(4l^2 + b(l + a) \right)$

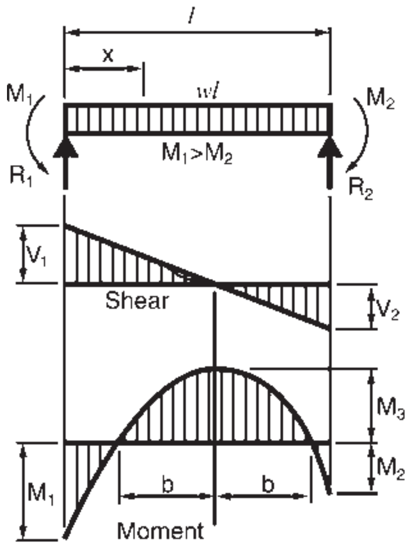
M max. (at point of load) $= \frac{Pab}{4l^3} \left(4l^2 - a(l + a) \right)$

M_1 (at support R_2) $= \frac{Pab}{4l^2} (l + a)$

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS STATIC LOADING CONDITIONS

32. BEAM — UNIFORMLY DISTRIBUTED LOAD AND VARIABLE END MOMENTS



$R_1 = V_1 = \frac{wl}{2} + \frac{M_1 - M_2}{l}$

$R_2 = V_2 = \frac{wl}{2} \quad \frac{M_1 - M_2}{l}$

$V_x = w\left(\frac{l}{2} - x\right) + \frac{M_1 - M_2}{l}$

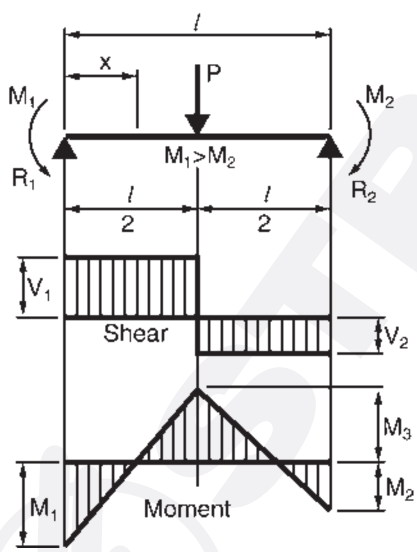
$M_3 \left(\text{at } x = \frac{l}{2} + \frac{M_1 - M_2}{wl}\right) = \frac{wl^2}{8} - \frac{M_1 + M_2}{2} + \frac{(M_1 - M_2)^2}{2wl^2}$

$M_x = \frac{wx}{2}(l - x) + \left(\frac{M_1 - M_2}{l}\right)x - M_1$

b (To locate inflection points) $= \sqrt{\frac{l^2}{4} - \left(\frac{M_1 + M_2}{w}\right) + \left(\frac{M_1 - M_2}{wl}\right)^2}$

$$\Delta_x = \frac{wx}{24EI}\left[x^3 - \left(2l + \frac{4M_1}{wl} - \frac{4M_2}{wl}\right)x^2 + \frac{12M_1}{w}x + l^3 - \frac{8M_1 l}{w} - \frac{4M_2 l}{w}\right]$$

33. BEAM — CONCENTRATED LOAD AT CENTER AND VARIABLE END MOMENTS



$R_1 = V_1 = \frac{P}{2} + \frac{M_1 - M_2}{l}$

$R_2 = V_2 = \frac{P}{2} - \frac{M_1 - M_2}{l}$

M_3 (at center) $= \frac{Pl}{4} - \frac{M_1 + M_2}{2}$

$M_x \left(\text{when } x < \frac{l}{2}\right) = \left(\frac{P}{2} + \frac{M_1 - M_2}{l}\right)x - M_1$

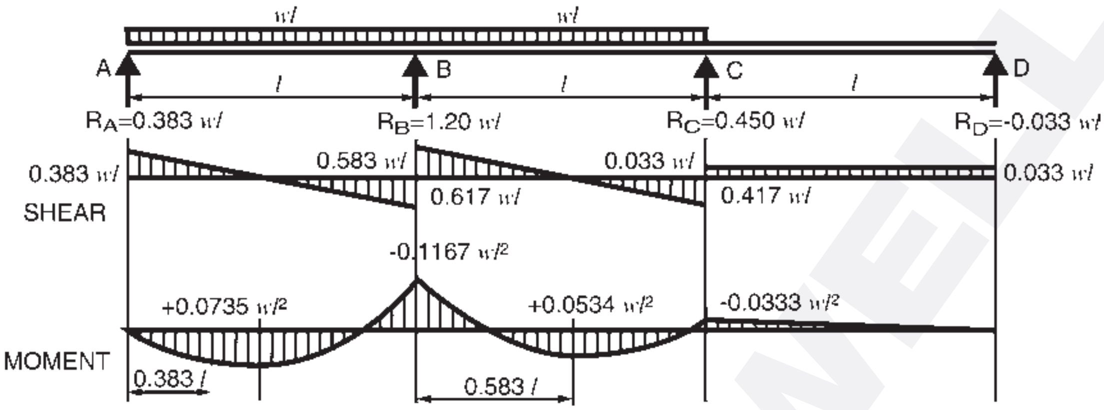
$M_x \left(\text{when } x > \frac{l}{2}\right) = \frac{P}{2}(l - x) + \frac{(M_1 - M_2)x}{l} - M_1$

$$\Delta_x \left(\text{When } x < \frac{l}{2}\right) = \frac{Px}{48EI}\left(3l^2 - 4x^2 - \frac{8(l - x)}{Pl}\left[M_1(2l - x) + M_2(l + x)\right]\right)$$

Reprinted with permission of American Institute of Steel Construction

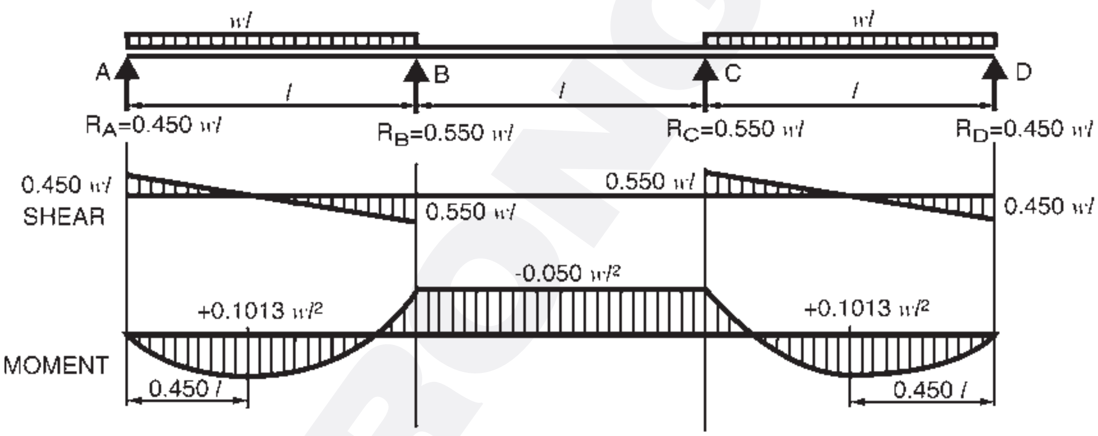
BEAM DIAGRAMS AND DEFLECTIONS
FOR VARIOUS STATIC LOADING CONDITIONS

34. CONTINUOUS BEAM — THREE EQUAL SPANS — ONE END SPAN UNLOADED



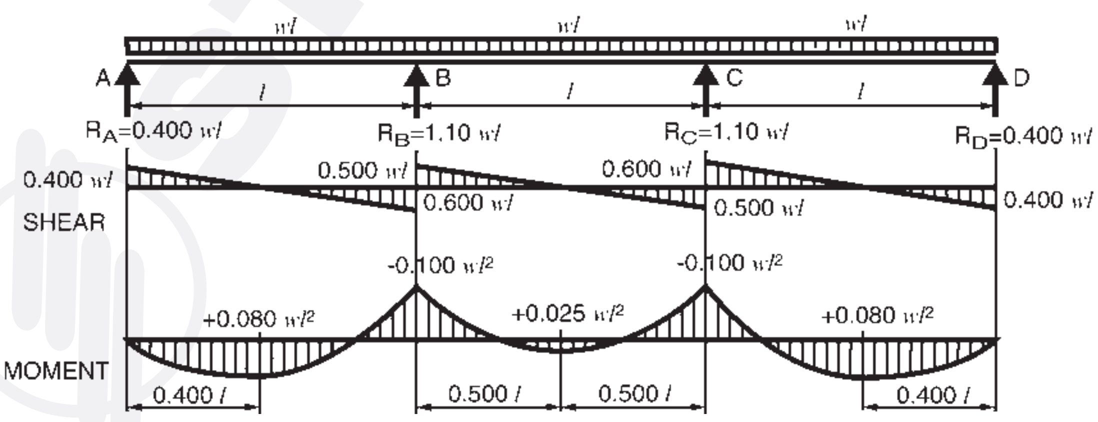
Δ Max. (0.430 l from A) = 0.0059 wl^4/EI

35. CONTINUOUS BEAM — THREE EQUAL SPANS —END SPANS LOADED



Δ Max. (0.479 l from A or D) = 0.0099 wl^4/EI

36. CONTINUOUS BEAM — THREE EQUAL SPANS —ALL SPANS LOADED

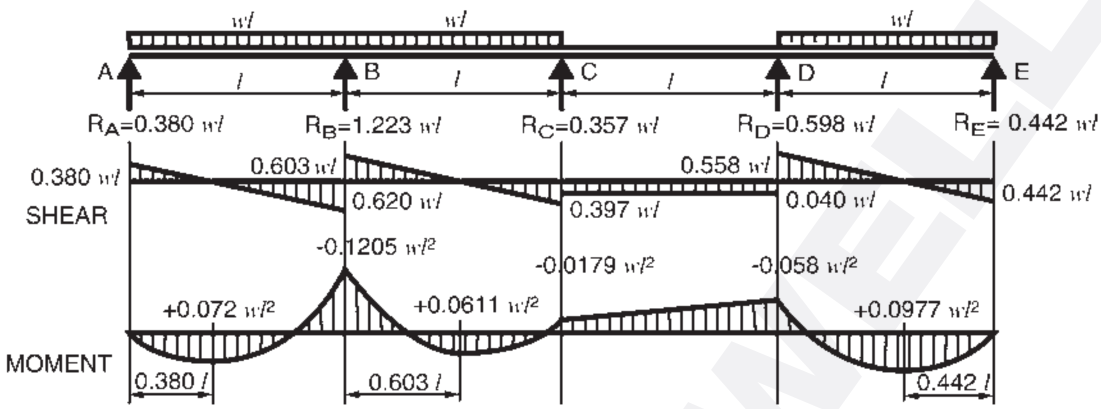


Δ Max. (0.446 l from A or D) = 0.0069 wl^4/EI

Reprinted with permission of American Institute of Steel Construction

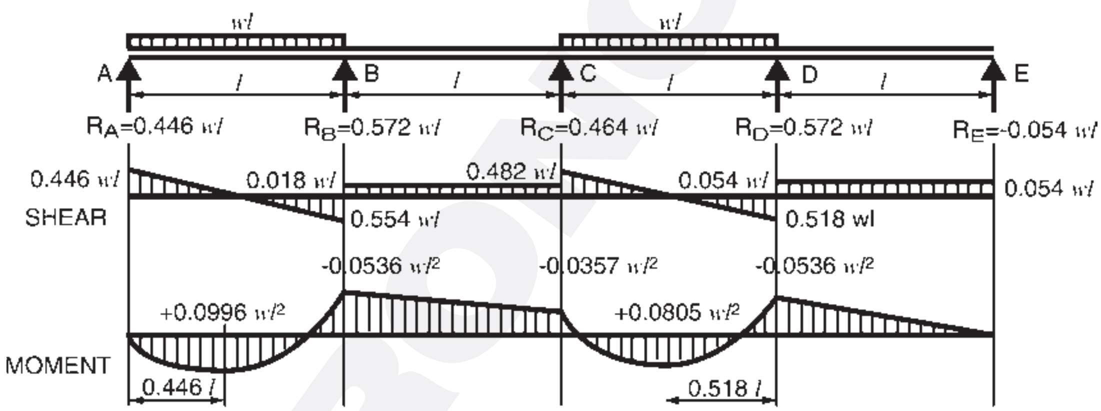
BEAM DIAGRAMS AND DEFLECTIONS FOR VARIOUS STATIC LOADING CONDITIONS

37. CONTINUOUS BEAM — FOUR EQUAL SPANS — THIRD SPAN UNLOADED



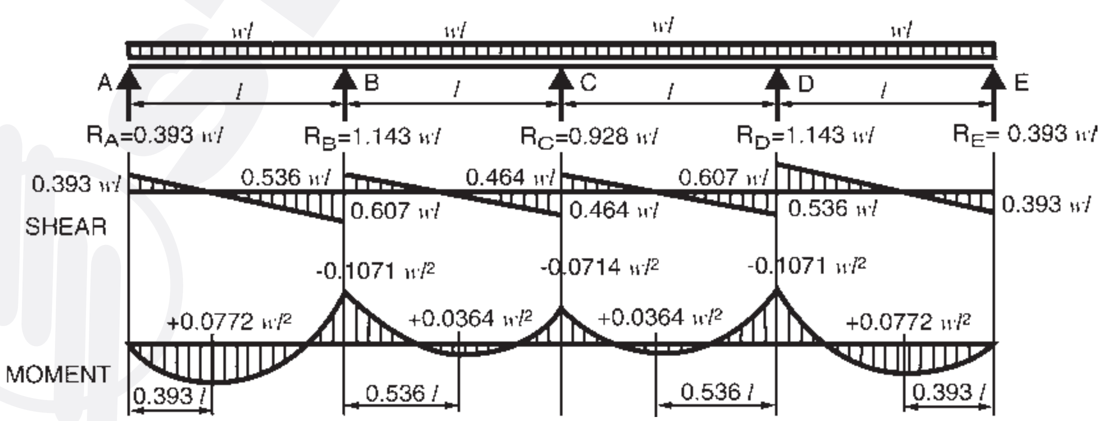
Δ Max. (0.475 l from E) = 0.0094 wl^4/EI

38. CONTINUOUS BEAM — FOUR EQUAL SPANS — LOAD FIRST AND THIRD SPANS



Δ Max. (0.477 l from A) = 0.0097 wl^4/EI

39. CONTINUOUS BEAM — FOUR EQUAL SPANS — ALL SPANS LOADED



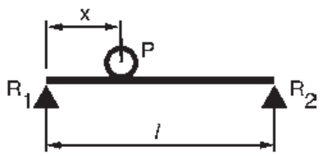
Δ Max. (0.440 l from A and E) = 0.0065 wl^4/EI

Reprinted with permission of American Institute of Steel Construction

BEAM DIAGRAMS AND FORMULAS FOR VARIOUS CONCENTRATED MOVING LOADS

The values given in these formulas do not include impact which varies according to the requirements of each case.

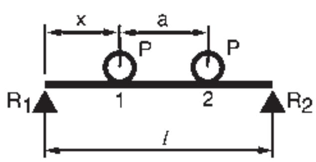
40. SIMPLE BEAM — ONE CONCENTRATED MOVING LOAD



R_1 max. = V_1 max. (at x = o) .... = P

M max. (at point of load, when $x = \frac{l}{2}$) .... = $\frac{Pl}{4}$

41. SIMPLE BEAM — TWO EQUAL CONCENTRATED MOVING LOADS

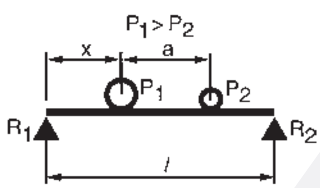


R_1 max. = V_1 max. (at x = o) .... = $P\left(2 - \frac{a}{l}\right)$

M max.

- when $a < (2-\sqrt{2})\,l = .586l$, under load 1 at $x = \frac{1}{2}\left(l - \frac{a}{2}\right)$ $= \frac{P}{2l}\left(l - \frac{a}{2}\right)^2$
- when $a > (2-\sqrt{2})\,l = .586l$, with one load at center of span (case 40) $= \frac{Pl}{4}$

42. SIMPLE BEAM — TWO UNEQUAL CONCENTRATED MOVING LOADS

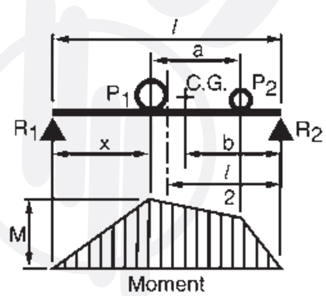


R_1 max. = V_1 max. (at x = o) .... = $P_1 + P_2 \frac{l - a}{l}$

M max.

- under P_1, at $x = \frac{1}{2}\left(l - \frac{P_2 a}{P_1 + P_2}\right)$ $= (P_1 + P_2)\frac{x^2}{l}$
- M max. may occur with larger load at center of span and other load off span (case 40) $= \frac{P_1 l}{4}$

GENERAL RULES FOR SIMPLE BEAMS CARRYING MOVING CONCENTRATED LOADS



The maximum shear due to moving concentrated loads occurs at one support when one of the loads is at that support. With several moving loads, the location that will produce maximum shear must be determined by trial.

The maximum bending moment produced by moving concentrated loads occurs under one of the loads when that load is as far from one support as the center of gravity of all the moving loads on the beam is from the other support.

In the accompanying diagram, the maximum bending moment occurs under load P_1 when x=b. It should also be noted that this condition occurs when the center line of the span is midway between the center of gravity of loads and the nearest concentrated load.

Reprinted with permission of American Institute of Steel Construction