1885

ompliments of

Pottsville Iron and Steel Co.,

Pottsville, Pa.

L. Schreiber and Sons

Please acknowledge receipt.

USEFUL INFORMATION

FOR

ARCHITECTS, ENGINEERS,

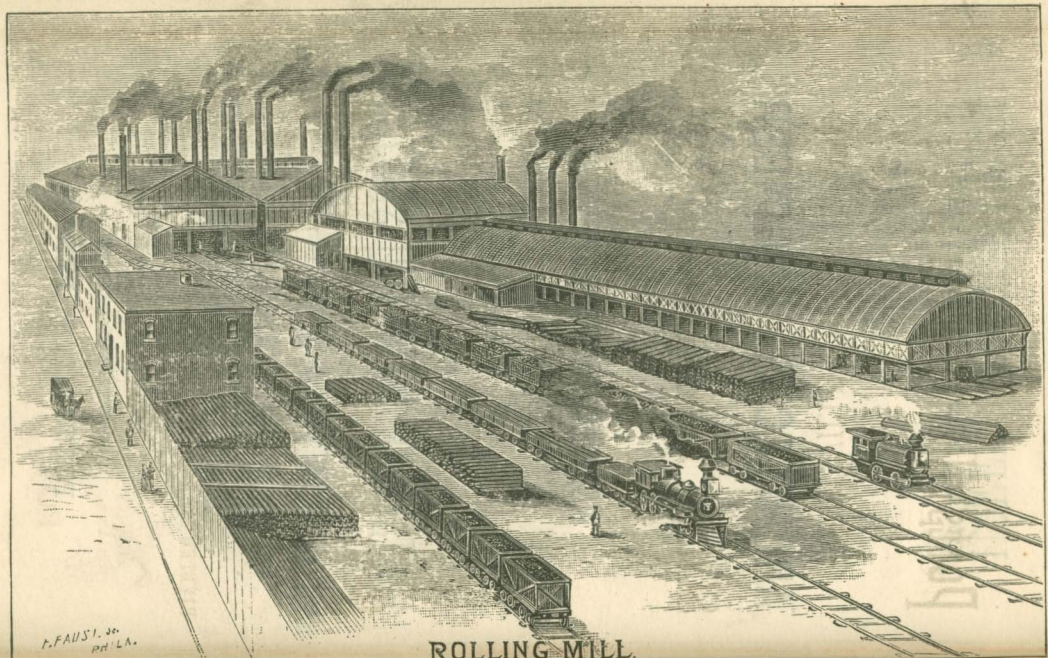
AND

WORKERS IN WROUGHT IRON,

BY THE

POTTSVILLE IRON AND STEEL CO.

GENERAL OFFICE,
POTTSVILLE, PENNA.



ROLLING MILL.

Pottsville Iron and Steel Co.

POTTSVILLE ROLLING MILLS,

MANUFACTURERS OF

SOLID ROLLED I BEAMS,

ANGLES, CHANNELS,

T IRON,

ROLLED OF EITHER IRON OR STEEL.

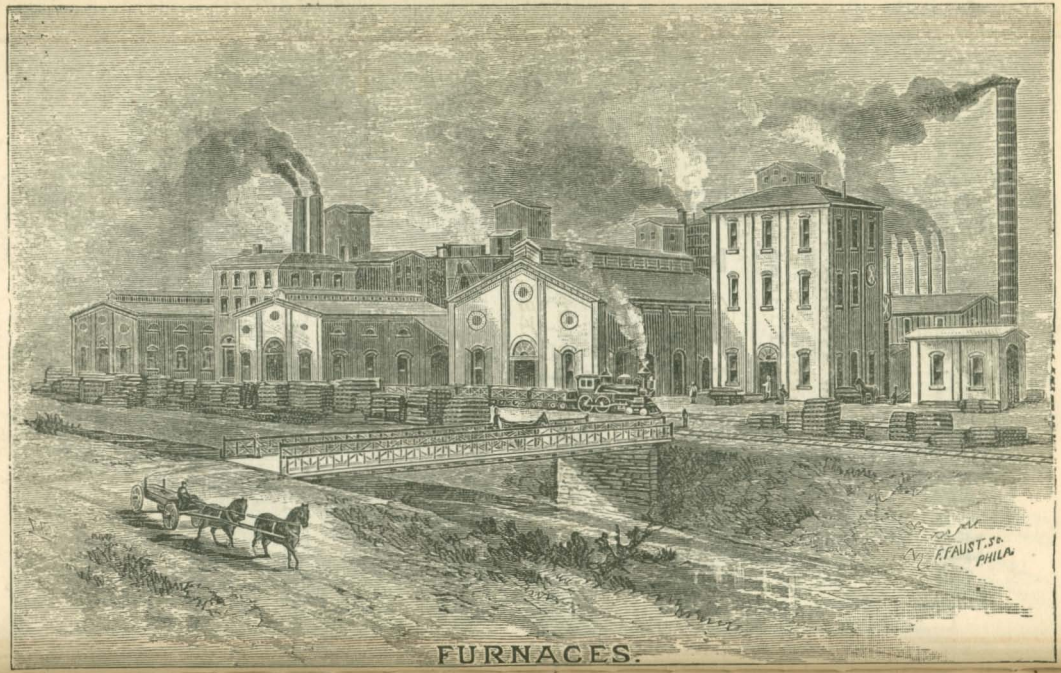
BEST REFINED MERCHANT BARS,

SHAFTING, BRIDGE IRON, ETC.

RIVETED GIRDERS AND COLUMNS OF EVERY DESCRIPTION.

GENERAL OFFICE,

POTTSVILLE, PENNA.



FURNACES.

OFFICERS.

C. M. ATKINS, President.
WILLIAM ATKINS, Treasurer.
C. H. DENGLER, Secretary.

WILLIAM ATKINS, General Manager.
WILLIAM BRAZIER, Sup't of Rolling Mills.
C. M. ATKINS, Jr., Sup't of Furnaces.
WM. H. KNOWLTON, Chief Engineer.
LEWIS W. SHARPLESS, Master Mechanic.

Correspondents will please address

POTTSVILLE IRON AND STEEL CO.
POTTSVILLE, PA.

AGENTS.

WM. H. WALLACE & CO.,
131 Washington St., New York.

J. F. BAILEY,
147 South Fourth St., Phila.

A. G. TOMPKINS & CO.,
8 Oliver St., Boston, Mass.

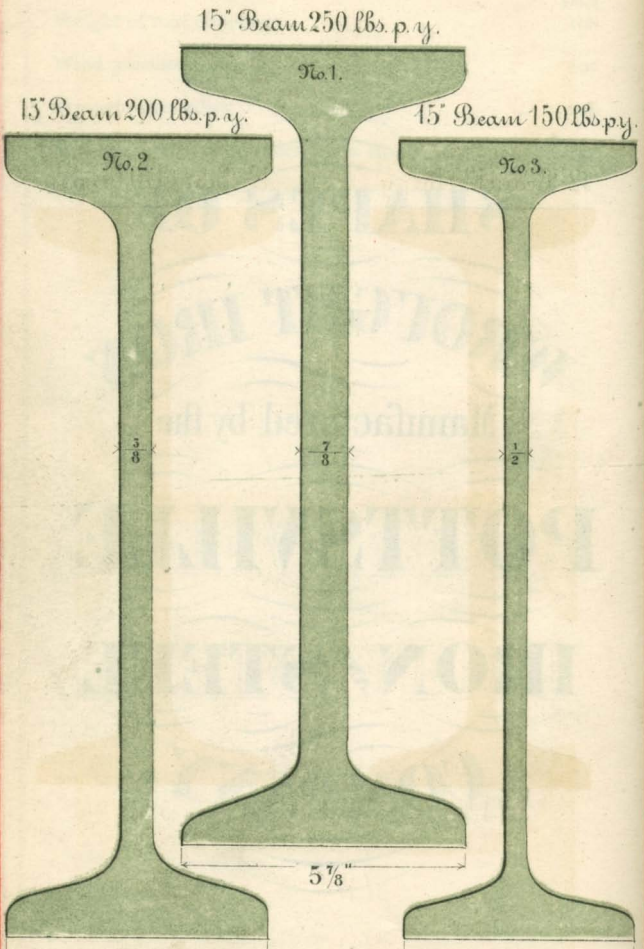
MACHINE SHOP AND FOUNDRY.

CONTENTS.

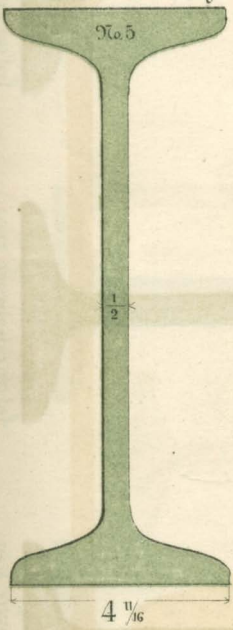
SHAPES OF WROUGHT IRON

Manufactured by the

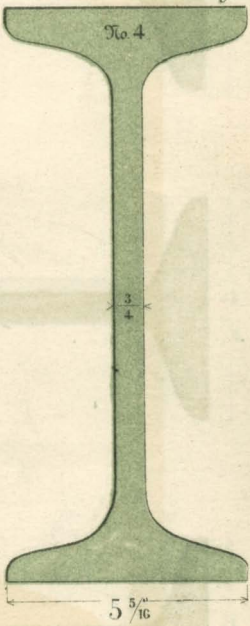
POTTSVILLE IRON AND STEEL COMPANY.


15" Beam 250 lbs. p. y.
No. 1.
15" Beam 200 lbs. p. y.
No. 2.
15" Beam 150 lbs. p. y.
No. 3.
3/8
7/8
1/2
5 7/8"
5 3/8"
5"

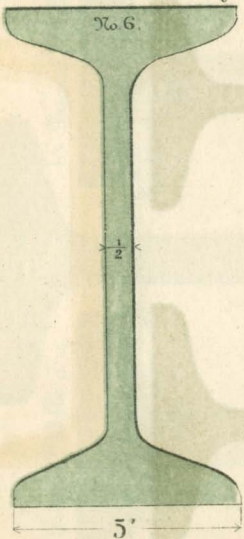
12" Beam 125 lbs. p. y.



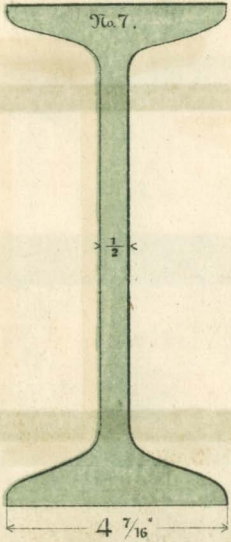
12" Beam 170 lbs. p. y.



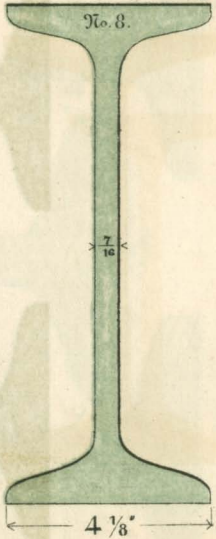
10½" Beam 135 lbs. p.y.



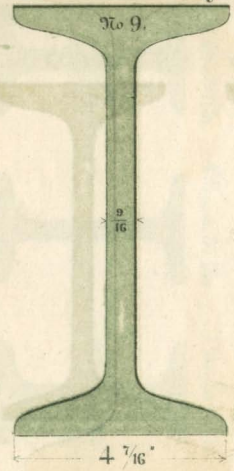
10½" Beam 105 lbs. p.y.



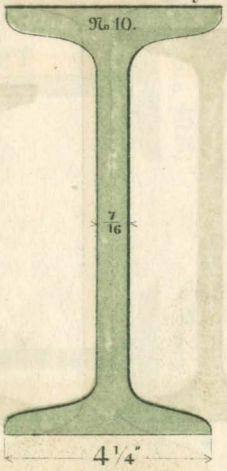
10½" Beam 90 lbs. p.y.



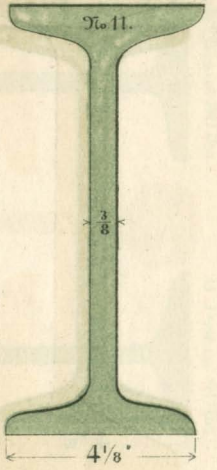
9" Beam 90 lbs. p.y.



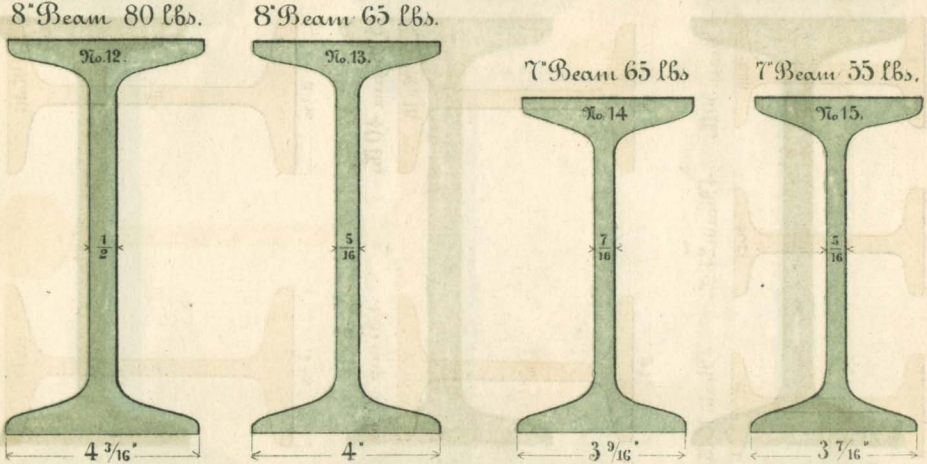
9" Beam 8 lbs p.y.



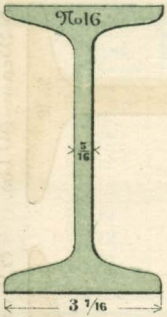
9" Beam 70 lbs. p.y.



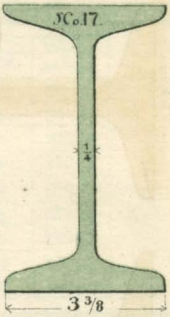
POTTSVILLE, PENNA., U. S. A.


8" Beam 80 lbs.
No. 12.
1/2
4 3/16"
8" Beam 65 lbs.
No. 13.
5/16
4"
7" Beam 65 lbs
No. 14
7/16
3 9/16"
7" Beam 55 lbs.
No. 15.
5/16
3 7/16"

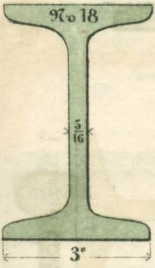
6" Beam 50 lbs.



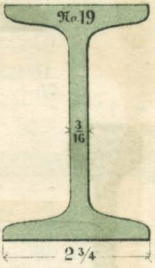
6" Beam 40 lbs



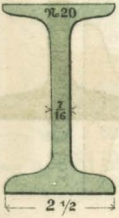
5" Beam 40 lbs



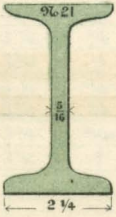
5" Beam 30 lbs.



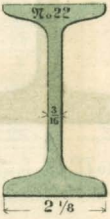
4" Beam 30 lbs.



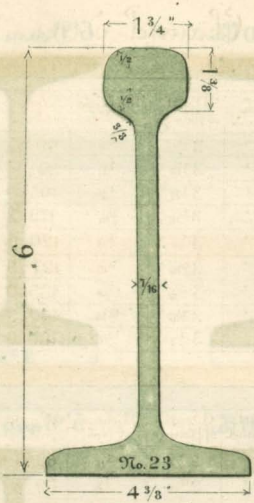
4" Beam 24 lbs



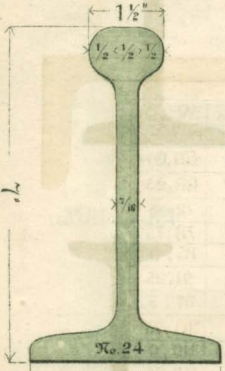
4" Beam 18 lbs.



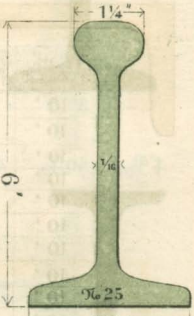
Deck-beams.



69 to 94 lbs per Yard.

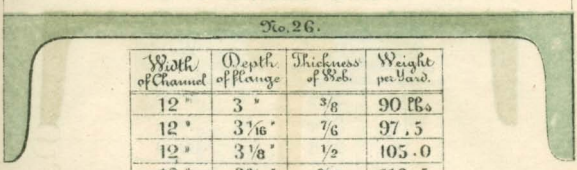


51 to 72 lbs p. yard.



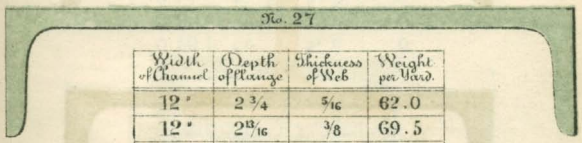
42 to 48 lbs. p. yard.

12" Channel Iron



No. 26.

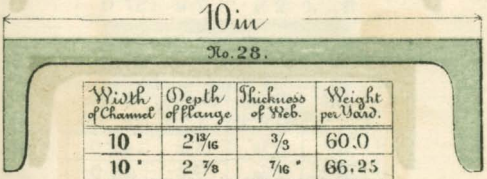
Width of Channel	Depth of Flange	Thickness of Web.	Weight per Yard.
12"	3"	3/8	90 lbs
12"	3 1/16"	7/16	97.5
12"	3 1/8"	1/2	105.0
12"	3 3/16"	9/16	112.5
12"	3 1/4"	5/8	120.0
12"	3 5/16"	11/16	127.5
12"	3 3/8"	3/4	135.0
12"	3 7/16"	13/16	142.5
12"	3 1/2	7/8	150.0



No. 27

Width of Channel	Depth of Flange	Thickness of Web	Weight per Yard.
12"	2 3/4	5/16	62.0
12"	2 13/16	3/8	69.5
12"	2 7/8"	7/16	77 0
12"	2 15/16	1/2	84.5

10in



No. 28.

Width of Channel	Depth of Flange	Thickness of Web.	Weight per Yard.
10"	2 13/16	3/3	60.0
10"	2 7/8	7/16"	66.25
10"	2 15/16	1/2	72.5
10"	3"	9/16	78.75
10"	3 1/16	5/8	85.0
10"	3 1/8	11/16	91.25
10"	3 3/16	3/4	97.5
10"	3 1/4	13/16	103.75
10"	3 5/16	7/8	110.0
10"	3 3/8	15/16	116.25
10"	3 7/16	1"	122.5
10"	3 1/2	1 1/16	128.75

10 in

No 29.

Width of Channel	Depth of Flange	Thickness of Web	Weight per Yard.
10	2 1/2	5/16	48.0
10	2 9/16	3/8	54.0
10	2 5/8	7/16	62.0

No. 30.

Width of Channel	Depth of Flange	Thickness of Web	Weight per Yard.
9	2 3/4	3/8	60.0
9	2 7/8	1/2	71.0
9	3	5/8	82.0
9	3 1/8	3/4	93 0

9 in

No 31

Width of Channel	Depth of Flange	Thickness of Web.	Weight per Yard.
9	2 1/2	5/16	46.0
9	2 5/8	7/16	57 0

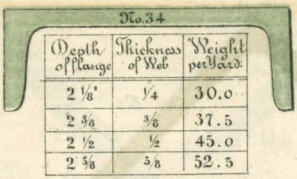
No. 32

Width of Channel	Depth of Flange	Thickness of Web.	Weight per Yard.
8	2 3/8	5/16	40 0
8	2 7/16	3/8	45 0
8	2 1/2	7/16	50 0
8	2 9/16	1/2	55 0
8	2 11/16	5/8	65 0

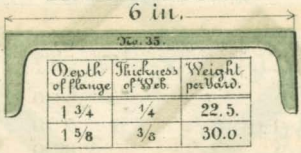
8 in.

No 33.

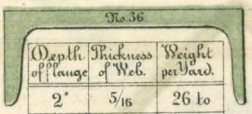
Width of Channel	Depth of Flange.	Thickness of Web.	Weight per Yard.
8	2 1/2	1/4	30 0
8	2 9/16	5/16	35 0



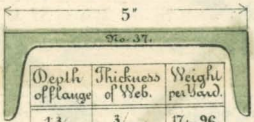
Depth of flange	Thickness of Web	Weight per Yard.
2 1/8"	1/4	30.0
2 3/8	3/8	37.5
2 1/2	1/2	45.0
2 5/8	5/8	52.5



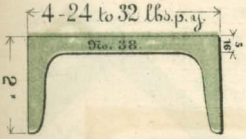
Depth of flange	Thickness of Web.	Weight per Yard.
1 3/4	1/4	22.5.
1 5/8	3/8	30.0.

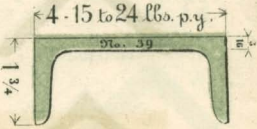


Depth of flange	Thickness of Web.	Weight per Yard.
2"	5/16	26 to
		40 lbs.



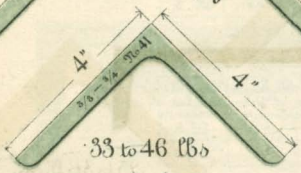
Depth of flange	Thickness of Web.	Weight per Yard.
1 3/4	3/16	17 to 26





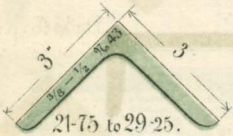
Angles with equal legs.

58 to 96 lbs p.y.

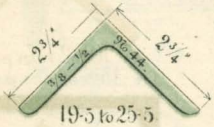


33 to 46 lbs

25-5 to 36 lbs.



21-75 to 29-25.



19-5 to 25-5

15 to 21. lbs.

12 75 to 18-75.

9 to 13.5.

6 to 10.5.

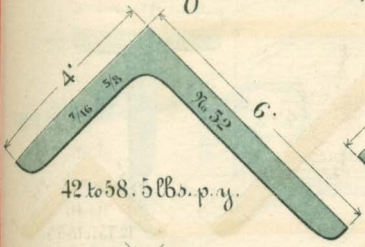
4.5 to 6.9.

2.7 to 4 2.

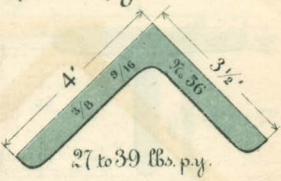
2 4 to 3.6.

In ordering give either weight or thickness, never both
Lenght of leg increases with the weight.

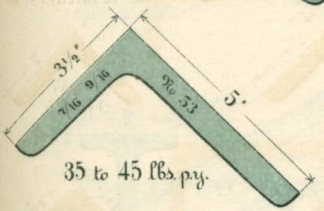
Angles with unequal legs.



42 to 58. 5 lbs. p. y.

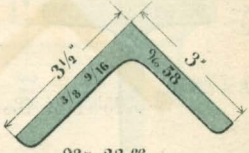


27 to 39 lbs. p.y.

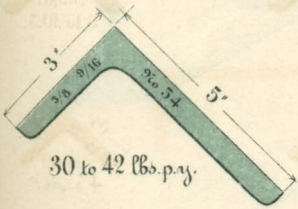


35 to 45 lbs. p.y.

25 to 36 lbs. p.y.

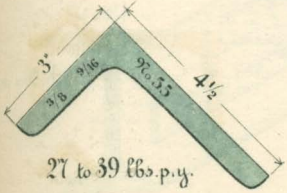


23 to 33 lbs. p.y.

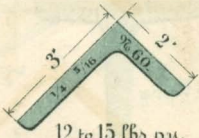


30 to 42 lbs. p.y.

16 to 25 lbs. p.y.



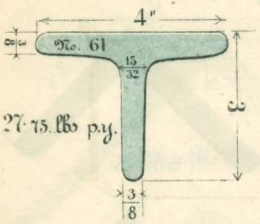
27 to 39 lbs. p.y.



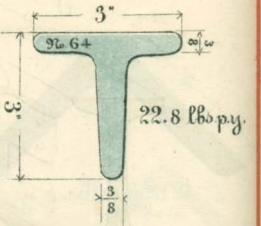
12 to 15 lbs. p.y.

In ordering give either weight or thickness, never both.
Lenght of leg increases with the weight.

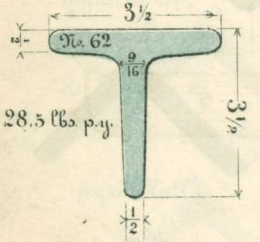
T Iron



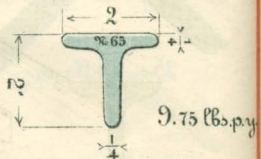
27.75 lbs p.y.



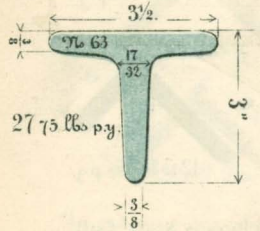
22.8 lbs p.y.



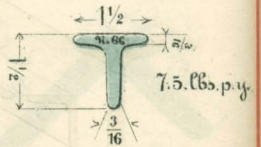
28.5 lbs p.y.



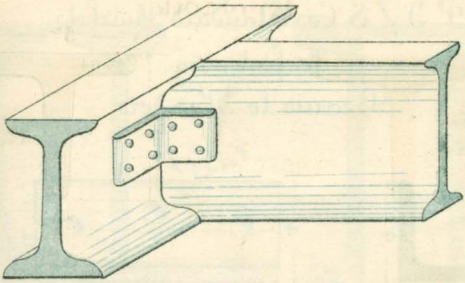
9.75 lbs p.y.

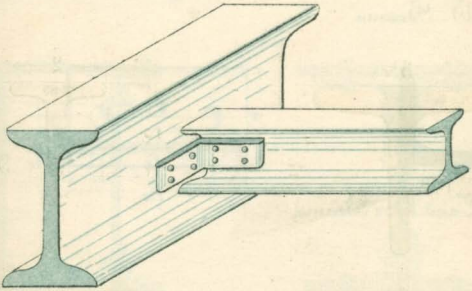


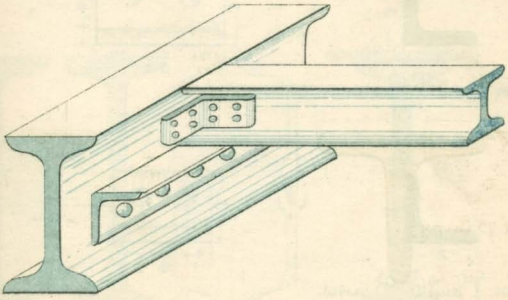
27.75 lbs p.y.



7.5 lbs p.y.

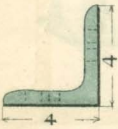


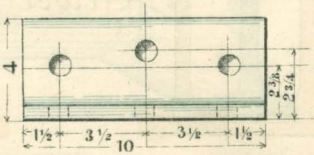




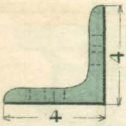
Beam-fittings

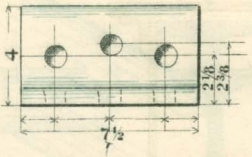
P. I. & S. Co's Standard Brackets for fastening Beams to Headers.



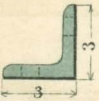


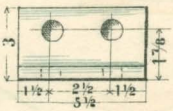
For 15" Beams.



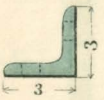


For 12" and 10½" Beams.





For 9" and 8" Beams.

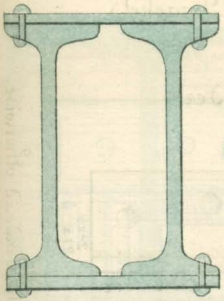


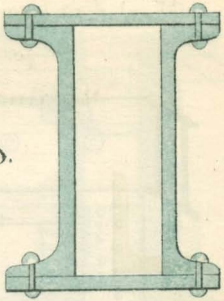
For 7" and 6" Beams.

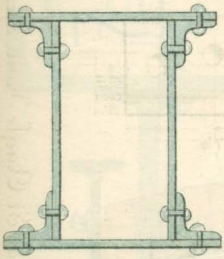
All Brackets are cut from St. Angle Iron, except when ordered otherwise.

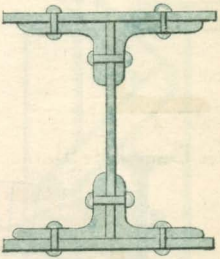
All holes are 13/16" diam for 3/4" bolts.

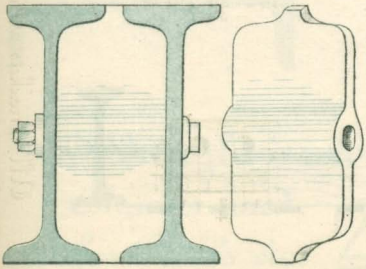
Girders.

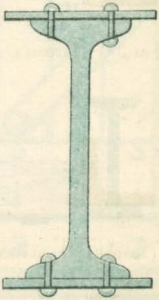


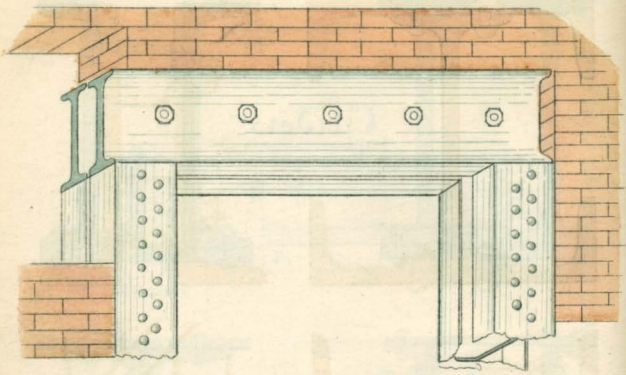


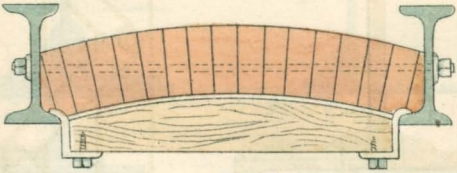


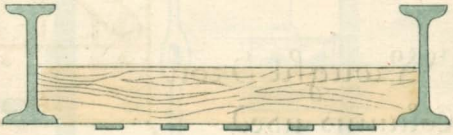


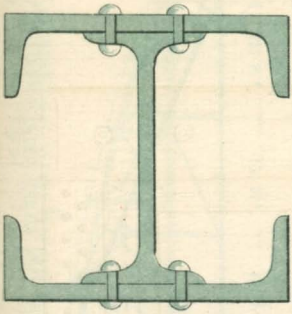


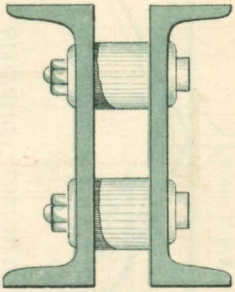


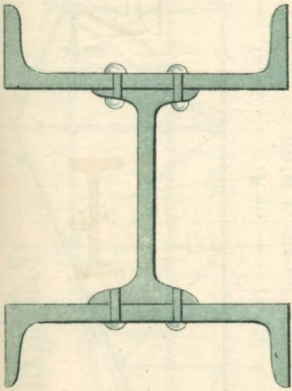


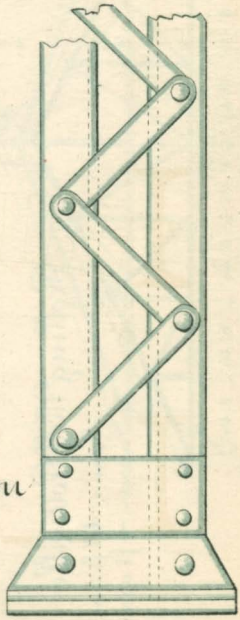






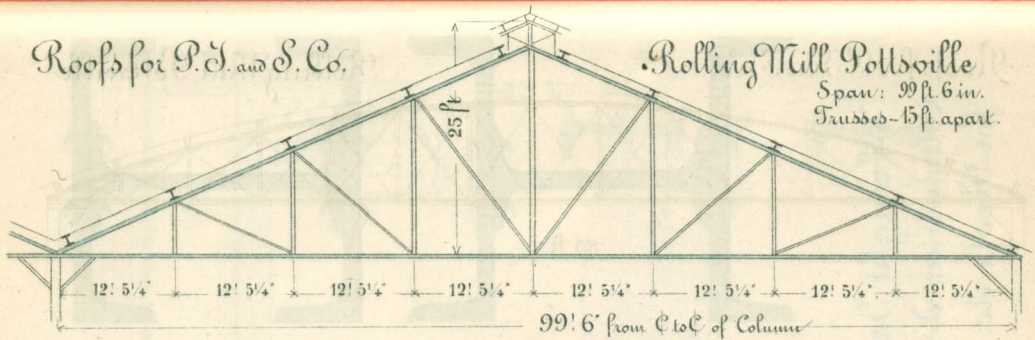






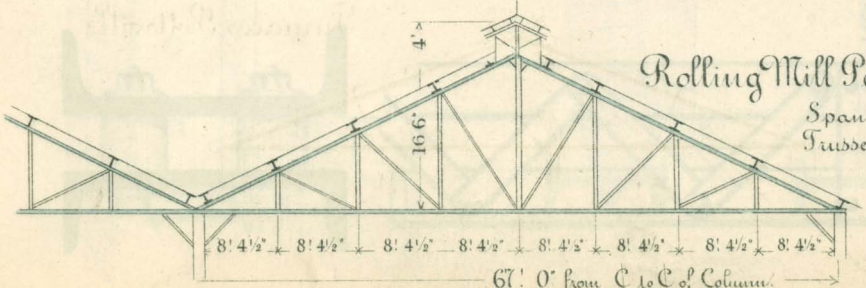
Wrought Iron Columns used for Roofs etc.

Roofs for P. D. and S. Co.



Rolling Mill Pottsville

Span: 99 ft. 6 in.
Trusses - 15 ft. apart.

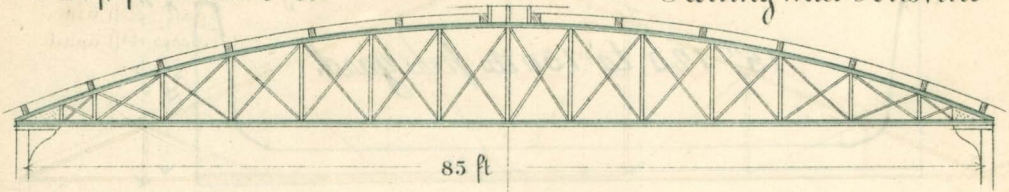


Rolling Mill Pottsville

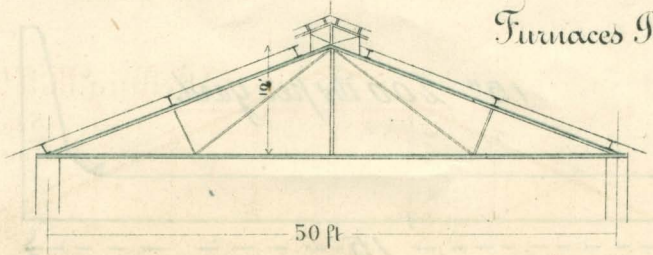
Span: 67 ft. 0 in.
Trusses: - ~ ft. apart.

Roofs for P. I. and S. Co.

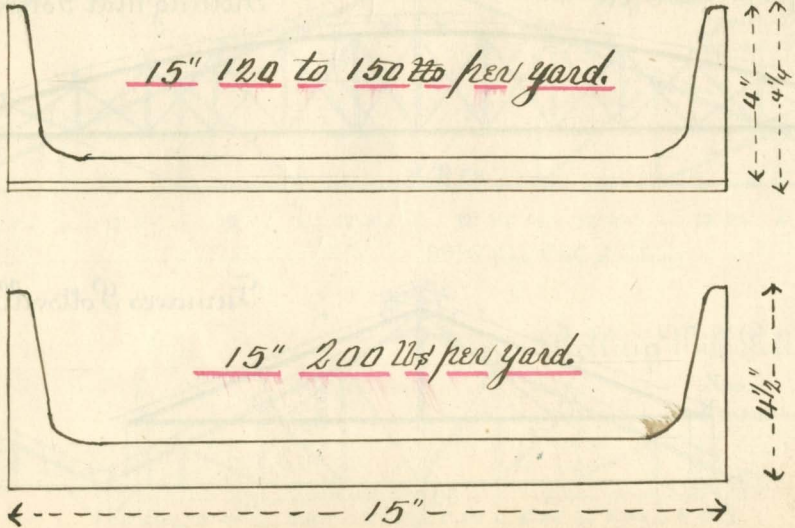
Rolling Mill Pottsville



Furnaces Pottsville.



POTTSVILLE IRON AND STEEL CO.,



POTTSVILLE, PENNA., U. S. A.

PRICE CURRENT.

SUBJECT TO CHANGES OF MARKET

WITHOUT NOTICE.

LIST OF REFINED BAR IRON

MADE BY

POTTSVILLE IRON AND STEEL CO.

ORDINARY SIZES—NO EXTRA.

ROUND AND SQUARE, $\frac{3}{4}$ to 2 inches.
FLAT IRON, 1 to 4 inches $\times$ $\frac{3}{8}$ to $1\frac{1}{2}$ inches.
" " $4\frac{1}{2}$ to 6 " $\times$ $\frac{3}{8}$ to 1 inch.

EXTRA SIZES—ROUND AND SQUARE.

$\frac{5}{8}$ and $\frac{11}{16}$	$\frac{1}{10}$c. per lb.	$2.24 per ton.
$\frac{1}{2}$ and $\frac{9}{16}$	$\frac{2}{10}$c. "	4.48 "
$\frac{7}{16}$	$\frac{4}{10}$c. "	8.96 "
$\frac{3}{8}$	$\frac{5}{10}$c. "	11.20 "
$2\frac{1}{8}$ to $2\frac{7}{8}$ ins.	$\frac{1}{10}$c. "	2.24 "
3 to $3\frac{1}{2}$ "	$\frac{3}{10}$c. "	6.72 "
$3\frac{5}{8}$ to 4 "	$\frac{5}{10}$c. "	11.20 "
$4\frac{1}{8}$ to $4\frac{1}{2}$ "	$\frac{6}{10}$c. "	13.44 "
$4\frac{5}{8}$ to 5 "	$\frac{8}{10}$c. "	17.92 "
$5\frac{1}{4}$ to $5\frac{1}{2}$ "	1 c. "	22.40 "
$5\frac{3}{4}$ to 6 "	$1\frac{5}{10}$c. "	33.60 "

EXTRA SIZES—FLATS.

1 to 6 ins. $\times$ $\frac{1}{4}$ and $\frac{5}{16}$	$\frac{2}{10}$c. per lb.	$4.48 per ton.
1 $\times$ $\frac{3}{16}$	$\frac{4}{10}$c. "	8.96 "
4 to 6 ins. $\times$ $1\frac{1}{8}$ to 2 ins.	$\frac{2}{10}$c. "	4.48 "
4 to 6 " $\times$ $2\frac{1}{8}$ to 3 "	$\frac{4}{10}$c. "	8.96 "
7 $\times$ $\frac{3}{8}$ to 1 in.	$\frac{2}{10}$c. "	4.48 "
7 $\times$ $1\frac{1}{8}$ to 2 ins.	$\frac{4}{10}$c. "	8.96 "
7 $\times$ $2\frac{1}{8}$ to 3 "	$\frac{6}{10}$c. "	13.44 "
8 $\times$ $\frac{3}{8}$ to 1 in.	$\frac{4}{10}$c. "	8.96 "
8 $\times$ $1\frac{1}{8}$ to $2\frac{3}{4}$ ins.	$\frac{6}{10}$c. "	13.44 "
9 $\times$ $\frac{3}{8}$ to 1 in.	$\frac{6}{10}$c. "	13.44 "
9 $\times$ $1\frac{1}{8}$ to 2 ins.	$\frac{8}{10}$c. "	17.92 "
10 $\times$ $\frac{3}{8}$ to 1 in.	$\frac{8}{10}$c. "	17.92 "
10 $\times$ $1\frac{1}{8}$ to $2\frac{1}{2}$ ins.	1 c. "	22.40 "
11 $\times$ $\frac{3}{8}$ to 1 in.	$\frac{9}{10}$c. "	20.16 "
11 $\times$ $1\frac{1}{8}$ to $2\frac{1}{2}$ ins.	$1\frac{1}{10}$c. "	24.64 "
12 $\times$ $\frac{3}{8}$ to 1 in.	$\frac{9}{10}$c. "	20.16 "
12 $\times$ $1\frac{1}{8}$ to $2\frac{1}{2}$ ins.	$1\frac{1}{10}$c. "	24.64 "

6 to 12 ins. wide, $\frac{1}{4}$ and $\frac{5}{16}$ thick = $\frac{2}{10}$ extra.
For cutting to specified lengths, from $\frac{1}{10}$ to $\frac{3}{10}$c. per lb.

REMARKS ON THE TABLES OF POTTSVILLE ROLLING MILLS' SHAPES.

TABLES OF BEAMS AND CHANNELS, SHOWING THE SAFE LOAD FOR VARYING SPANS, DEFLEXIONS UNDER SAFE LOAD, AND PROPER SPACING OF SHAPES FOR LOADS PER SQUARE FOOT OF 100 TO 230 LBS.

The first column gives the span in feet.

The second column gives the safe load in tons of 2000 lbs. uniformly distributed, which the shape will carry for the spans given in the first column; the fibre stress being 12,000 lbs. per square inch.

The third column gives the corresponding deflexion at centre of shape.

The fourth column gives the weight of the shape for a length equal to span.

The fifth to tenth columns give the maximum distance apart that the shapes can be placed to safely carry loads of

100 to 250 lbs. per square foot, the spans being as in the first column.

The safe loads given in the following tables include the weights of the shapes themselves, and assume that lateral deflexion cannot occur. Should the length of span exceed thirty times the width of flange, the fibre stress should be reduced, or else the shapes should be stayed together. In fireproof floors the filling in above the brick arches is a sufficient guard against lateral deflexion.

If the deflexion of a beam exceeds one-thirtieth of an inch per foot of span, there is danger of the plaster of the ceiling cracking. In the tables, this limit has been indicated by a heavy line. All beams beneath this line should not be used where there is a plaster ceiling.

ON THE USE OF THE TABLES.

Suppose the area of a floor surface be 20′ x 28′, and we desire to find the beams requisite to carry a total loading of 200 lbs. per square foot, and that we intend to use brick arches between the beams, above which and up to the level of top of beams we purpose filling in with concrete. The distances apart of beams will be limited to from 4′ to 5′ on account of using arches, and of course we should, if possible, set the beams the shorter length of floor area. Our span then will be about 21′ 0″. Looking then at our tables we find that Shape No. 5, 12″ I Beam 125 would answer, and that we can place the beams 4′ 8″ apart: the deflexion being less that $\frac{1}{30}$″ per foot of span, there will be no danger of cracking the ceiling when the floor is loaded to 200 lbs. per □′.

POTTSVILLE ROLLING MILLS

15″ I Beam, Shape No. 1, 250 Lbs. Per Yard.

Depth 15″. Width of Flange 5⅝″. Thickness of Web ⅞″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs per Square Foot.
10	43.2	0.09	833	86.4	69.1	57.6	49.37	43.2	34.5
11	39.27	0.11	917	71.4	57.12	47.6	40.80	35.7	28.56
12	36.00	0.14	1000	60.0	48.00	40.0	34.28	30.0	24.00
13	33.23	0.16	1083	51.12	40.89	34.08	29.21	25.56	20.44
14	30.85	0.19	1167	44.07	35.25	29.38	25.18	22.03	17.62
15	28.80	0.21	1250	38.40	30.72	25.60	21.94	19.20	15.36
16	27.00	0.24	1333	33.75	27.00	22.50	19.28	16.87	13.50
17	25.41	0.27	1416	29.89	23.91	19.92	17.08	14.94	11.95
18	24.00	0.30	1500	26.66	21.33	17.77	15.23	13.33	10.66
19	22.73	0.33	1583	23.92	19.14	15.95	13.67	11.96	9.57
20	21.60	0.37	1667	21.60	17.28	14.40	12.34	10.75	8.64
21	20.57	0.41	1750	19.59	15.67	13.06	11.19	9.79	7.83
22	19.63	0.45	1833	17.84	14.27	11.89	10.19	8.94	7.13
23	18.78	0.49	1917	16.33	13.06	10.88	9.33	8.16	6.53
24	18.00	0.53	2000	15.00	12.00	10.00	8.57	7.50	6.00
25	17.28	0.58	2083	13.82	11.09	9.21	7.89	6.91	5.54
26	16.61	0.63	2167	12.77	10.23	8.51	7.30	6.38	5.11
27	16.00	0.68	2250	11.85	9.48	7.90	6.77	5.92	4.74
28	15.42	0.73	2333	11.01	8.81	7.34	6.29	5.50	4.40
29	14.89	0.78	2417	10.27	8.21	6.84	5.87	5.13	4.10
30	14.40	0.84	2500	9.60	7.67	6.40	5.48	4.80	3.83
31	13.93	0.90	2583	8.98	7.19	5.98	5.13	4.49	3.59
32	13.50	0.96	2667	8.43	6.75	5.62	4.82	4.21	3.37
33	13.09	1.02	2750	7.93	6.34	5.28	4.53	3.96	3.17

POTTSVILLE ROLLING MILLS

15" I Beam, Shape No. 2, 200 Lbs. Per Yard.

Depth 15". Width of Flange 5⅝". Thickness of Web ⅝".

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	35.95	0.09	666	71.9	57.52	47.93	41.08	35.95	28.76
11	32.68	0.11	733	59.42	47.53	39.61	33.95	29.71	23.76
12	29.96	0.14	800	49.93	39.95	33.29	28.53	24.96	19.97
13	27.65	0.16	867	42.54	34.03	28.36	23.86	21.27	17.01
14	25.68	0.19	933	36.68	29.35	24.45	20.96	18.34	14.67
15	23.96	0.21	1000	31.95	25.56	21.29	18.25	15.97	12.78
16	22.47	0.24	1067	28.09	22.47	18.72	16.08	14.04	11.23
17	21.15	0.27	1133	24.88	19.90	16.58	14.12	12.44	9.95
18	19.97	0.30	1200	22.18	17.75	14.79	12.69	11.09	8.87
19	18.92	0 33	1267	19.91	15.93	13.28	11.36	9.95	7.96
20	17.97	0.37	1333	17.97	14.37	11.98	10.27	8.98	7.18
21	17.12	0.41	1400	16.31	13.04	10.87	9.31	8.15	6.52
22	16.34	0.45	1467	14.85	11.88	9.90	8.49	7.42	5.94
23	15.63	0.49	1533	13.59	10.87	9.06	7.81	6.79	5.43
24	14.98	0.53	1600	12.48	9.99	8.32	7.13	6.24	4.99
25	14.38	0.58	1667	11.50	9.20	7.67	6.57	5.75	4.60
26	13.83	0.63	1733	10.64	8.51	7.09	6.08	5.32	4.25
27	13.31	0.68	1800	9.85	7.89	6.57	5.63	4.92	3.94
28	12.84	0.73	1867	9.17	7.34	6.11	5.24	4.58	3.67
29	12.39	0.78	1933	8.54	6.83	5.69	4.88	4.27	3.41
30	11.98	0.84	2000	7.99	6.39	5.32	4.56	3.99	3.19
31	11.59	0.90	2067	7.48	5.98	4.98	4.27	3.74	2.99
32	11.23	0.96	2133	7.02	5.61	4.68	4.01	3.51	2.80
33	10.89	1.02	2200	6.60	5.28	4.40	3.77	3.30	2.64

POTTSVILLE ROLLING MILLS

15" I Beam, Shape No. 3, 150 Lbs. Per Yard.

Depth 15". Width of Flange 5". Thickness of Web ½".

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load, uniformly distributed (including weight of beam) in Net Tons.	Deflexion under Safe Load.	Weight of Beams in Net Tons.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	27.6	0.09	500	55.2	44.16	36.80	31.54	27.6	22.08
11	25.09	0.11	550	45.62	36.49	30.41	26.07	22.81	18.24
12	23.00	0.14	600	33.33	30.64	25.50	21.90	19.16	15.32
13	21.23	0.16	650	32.66	26.13	21.77	18.66	16.33	13.06
14	19.71	0.19	700	28.16	22.53	18.77	16.09	14.08	11.26
15	18.40	0.21	750	24.53	19.62	16.36	14.02	12.26	9.81
16	17.25	0.24	800	21.56	17.25	14.37	12.32	10.78	8.62
17	16.23	0.27	850	19.09	15.27	12.80	10.91	9.54	7.63
18	15.33	0.30	900	17.03	13.62	11.35	9.73	8.52	6.81
19	14.52	0.33	950	15.28	12.22	10.19	8.73	7.64	6.11
20	13.80	0.37	1000	13.80	11.04	9.20	7.88	6.90	5.52
21	13.14	0.41	1050	12.51	10.01	8.35	7.15	6.25	5.00
22	12.54	0.45	1100	11.40	9.12	7.60	6.51	5.70	4.56
23	12.00	0.49	1150	10.43	8.35	6.95	5.96	5.22	4.17
24	11.50	0.53	1200	9.58	7.66	6.39	5.47	4.79	3.83
25	11.04	0.58	1250	8.83	7.06	5.89	5.05	4.41	3.53
26	10.62	0.63	1300	8.17	6.57	5.44	4.66	4.08	3.28
27	10.22	0.68	1350	7.57	6.05	5.04	4.33	3.78	3.02
28	9.85	0.73	1400	7.03	5.62	4.69	4.02	3.51	2.81
29	9.51	0.78	1450	6.55	5.24	4.37	3.74	3.27	2.62
30	9.20	0.84	1500	6.13	4.91	4.09	3.50	3.06	2.45
31	8.90	0.90	1550	5.74	4.59	3.82	3.28	2.87	2.29
32	8.62	0.96	1600	5.38	4.32	3.59	3.01	2.69	2.16
33	8.36	1.02	1650	5.07	4.05	3.37	2.89	2.53	2.02

POTTSVILLE ROLLING MILLS

12" I Beam, Shape No. 4, 170 Lbs. Per Yard.

Depth 12". Width of Flange $5\frac{5}{16}$". Thickness of Web $\frac{3}{4}$".

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	23.70	0.12	566						
11	21.55	0.14	623						
12	19.75	0.16	679					16.45	13.16
13	18.23	0.20	735					14.00	11.25
14	16.39	0.23	792			16.12	13.82	12.10	9.66
15	15.80	0.26	848			14.08	12.03	10.55	8.45
16	14.81	0.30	905		14.81	12.35	10.55	9.25	7.40
17	13.94	0.34	962		13.14	10.80	9.35	8.19	6.57
18	13.17	0.38	1020	14.63	11.70	9.70	8.35	7.32	5.85
19	12.47	0 42	1077	13.20	10.50	8.75	7.50	6.60	5.25
20	11.85	0.46	1132	11.90	9.48	7.90	6.75	5.95	4.74
21	11.29	0.51	1188	10.78	8.58	7.15	6.10	5.39	4.27
22	10.77	0.56	1246	9.80	7.83	6.45	5.60	4.90	3.91
23	10.30	0.62	1303	8.96	7.15	5.90	5.10	4.48	3.57
24	9.87	0.67	1358	8.25	6.60	5.45	4.70	4.12	3.30
25	9.48	0.73	1415	7.60	6.05	5.05	4.25	3.80	3.02
26	9.12	0.79	1475	7.05	5.60	4.66	4.00	3.52	2.80
27	8.78	0.84	1535	6.50	5.17	4.30	3.68	3.25	2.58
28	8.46	0.91	1584	6.05	4.83	4.00	3.45	3.02	2.41
29	8.17	0.98	1641	5.60	4.50	3.74	3.40	2.80	2.25
30	7.90	1.05	1698	5.20	4.15	3.49	3.01	2.60	2.07
31	7.65	1.12	1754	4.95	3.85	3.20			
32	7.41	1.20	1810	4.60	3.65	3.06			
33	7.18	1.27	1869	4.34	3.45	2.85			

POTTSVILLE ROLLING MILLS

12″ I Beam, Shape No. 5, 125 Lbs. Per Yard.

Depth 12″. Width of Flange 4 1/16″. Thickness of Web 1/2″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	18.50	0.12	416						14.40
11	16.82	0.14	458					15.35	12.25
12	15.42	0.17	500			17.13	14.69	12.90	10.32
13	14.23	0.20	542			14.65	12.55	10.96	8.77
14	13.21	0.23	583		15.09	12.59	10.79	9.46	7.54
15	12.33	0.26	625		13.15	10.96	9.40	8.25	6.57
16	11.56	0.30	667	14.45	11.61	9.65	8.25	7.22	5.80
17	10.88	0.34	708	12.81	10.27	8.55	7.31	6.40	5.13
18	10.28	0.38	750	11.43	9.15	7.61	6.53	5.71	4.57
19	9.74	0.42	792	10.25	8.21	6.83	5.84	5.12	4.10
20	9.25	0.46	833	9.28	7.40	6.19	5.28	4.64	3.70
21	8.81	0.51	875	8.39	6.70	5.59	4.81	4.19	3.35
22	8.41	0.56	915	7.65	6.10	5.07	4.68	3.82	3.05
23	8.04	0.61	956	7.01	5.59	4.64	3.99	3.50	2.79
24	7.71	0.66	1000	6.45	5.16	4.30	3.67	3.22	2.58
25	7.40	0.72	1042	5.95	4.76	3.95	3.35	2.97	2.38
26	7.12	0.78	1083	5.48	4.38	3.66	3.15	2.74	2.19
27	6.85	0.84	1125	5.07	4.04	2.85	2.88	2.58	2.02
28	6.61	0.91	1167	4.73	3.77	3.14	2.69	2.36	1.88
29	6.38	0.98	1208	4.40	3.52	2.92	2.66	2.20	
30	6.17	1.05	1250	4.12	3.28	2.74	2.35	2.06	
31	5.97	1.12	1292	3.85	3.08	2.53	2.19		
32	5.78	1.19	1333	3.61	2.90	2.41			
33	5.61	1.26	1375	2.69	2.70				

POTTSVILLE ROLLING MILLS

10½" I Beam, Shape No. 6, 135 Lbs. Per Yard.

Depth 10½". Width of Flange 5". Thickness of Web ½".

MAXIMUM FIBRE STRESS—12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	18.20	0.15	450						14.50
11	16.55	0.18	495					15.00	12.01
12	15.17	0.20	540				14.40	12.65	10.10
13	14.00	0.24	585			14.32	12.26	10.75	8.61
14	13.00	0.29	630	18.50	14.82	12.34	10.60	9.28	7.40
15	12.13	0.33	675	16.12	12.90	10.75	9.20	8.06	6.45
16	11.37	0.38	720	14.21	11.34	9.45	8.10	7.10	5.67
17	10.71	0.43	765	12.55	9.95	8.35	7.18	6.27	4.97
18	10.11	0.48	810	11.21	8.95	7.47	6.38	5.60	4.47
19	9.58	0.52	855	10.04	8.06	6.67	5.71	5.02	4.03
20	9.10	0.59	900	9.10	7.26	6.05	5.17	4.55	3.63
21	8.67	0.65	945	8.25	6.60	5.50	4.70	4.12	3.30
22	8.27	0.72	990	7.51	6.00	5.00	4.28	3.75	3.00
23	7.91	0.78	1035	6.87	5.50	4.58	3.80	3.43	2.75
24	7.58	0.85	1080	6.30	5.04	4.20	3.60	3.15	2.52
25	7.28	0.92	1125	5.80	4.66	3.86	3.32	2.90	2.33
26	7.00	1.00	1170	5.38	4.28	3.58	3.06	2.69	2.14
27	6.74	1.08	1215	5.00	3.99	3.32	2.90	2.50	1.99
28	6.50	1.16	1260	4.62	3.70	3.09	2.65	2.31	1.85
29	6.28	1.24	1305	4.32	3.44	2.90	2.56	2.16	
30	6.07	1.33	1350	4.03	3.22	2.69	2.30		
31	5.87	1.41	1395	3.78	2.92	2.52			
32	5.69	1.49	1440	3.55	2.83				
33	5.52	1.58	1485	3.31					

POTTSVILLE ROLLING MILLS

10½″ I Beam, Shape No. 7, 105 Lbs. Per Yard.

Depth 10½″. Width of Flange 4 7/16″. Thickness of Web ½″.

MAXIMUM FIBRE STRESS — 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	13.40	0.14	350	26.80	21.44	17.87	15.31	13.40	10.72
11	12.18	0.16	385	22.15	17.72	14.77	12.66	11.07	8.86
12	11.17	0.19	420	18.62	14.90	12.41	10.64	9.31	7.45
13	10.31	0.23	455	15.86	12.69	10.57	9.06	7.93	6.34
14	9.57	0.27	490	13.67	10.94	9.11	7.81	6.83	5.47
15	8.93	0.31	525	11.91	9.53	7.94	6.81	5.95	4.76
16	8.37	0.35	560	10.46	8.37	6.97	5.98	5.23	4.18
17	7.88	0.39	595	9.27	7.42	6.18	5.30	4.63	3.71
18	7.44	0.44	630	8.27	6.62	5.51	4.73	4.13	3.31
19	7.05	0.49	665	7.42	5.74	4.78	4.10	3.58	2.87
20	6.70	0.54	700	6.79	5.36	4.47	3.83	3.35	2.68
21	6.38	0.60	735	6.08	4.86	4.05	3.47	3.04	2.43
22	6.09	0.66	770	5.54	4.43	3.69	3.17	2.77	2.22
23	5.83	0.72	805	5.07	4.06	3.38	2.90	2.53	2.03
24	5.58	0.78	840	4.65	3.72	3.10	2.66	2.32	1.86
25	5.36	0.85	875	4.29	3.43	2.86	2.45	2.14	1.72
26	5.15	0.92	910	3.96	3.17	2.64	2.26	1.98	1.58
27	4.96	0.99	945	3.67	2.94	2.45	2.10	1.83	1.47
28	4.79	1.07	980	3.42	2.74	2.28	1.95	1.71	1.37
29	4.62	1.14	1015	3.19	2.55	2.13	1.82	1.59	1.28
30	4.47	1.22	1050	2.98	2.38	1.99	1.70	1.49	1.19
31	4.32	1.30	1085	2.79	2.23	1.86	1.59	1.39	1.12
32	4.19	1.39	1120	2.62	2.10	1.75	1.50	1.31	1.05
33	4.06	1.48	1155	2.46	1.97	1.64	1.41	1.23	0.98

POTTSVILLE ROLLING MILLS

10½" I Beam, Shape No. 8, 90 Lbs. Per Yard.

Depth 10½". Width of Flange 4⅛". Thickness of Web $\frac{7}{16}$".

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beams	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	11.60	0.14	300	23.20	18.56	15.47	14.03	11.60	9.28
11	10.55	0.16	330	19.18	15.34	12.79	10.96	9.59	7.67
12	9.67	0.19	360	16.12	12.88	10.74	9.20	8.05	6.44
13	8.92	0.23	390	13.72	10.90	9.08	7.78	6.81	5.49
14	8.29	0.27	420	11.84	9.47	7.89	6.77	5.92	4.74
15	7.73	0.31	450	10.31	8.25	6.87	5 89	5.15	4.12
16	7.25	0.35	480	9.06	7.25	6.04	5.18	4.53	3.62
17	6.82	0.39	510	8.02	6.42	5.35	4.58	4.01	3.21
18	6.44	0.44	540	7.16	5.73	4.77	4.09	3.58	2.86
19	6.11	0.49	570	6.43	5.14	4.29	3.67	3.21	2.57
20	5.80	0.54	600	5.80	4.64	3.87	3.31	2.90	2.32
21	5.52	0.60	630	5.26	4.21	3.51	3.01	2.63	2.10
22	5.27	0.66	660	4.79	3.83	3.19	2.72	2.39	1.92
23	5.04	0.72	690	4.38	3.50	2.92	2.50	2.19	1.75
24	4.83	0.78	720	4.02	3.22	2.68	2.29	2.01	1.61
25	4.64	0.85	750	3.71	2.97	2.47	2.12	1.85	1.48
26	4.46	0.92	780	3.43	2.74	2.29	1.96	1.71	1.37
27	4.30	0.99	810	3.30	2.54	2.12	1.82	1.59	1.27
28	4.14	1.07	840	2.96	2.37	1.97	1.69	1.48	1.18
29	4.00	1.14	870	2.76	2.21	1.84	1.58	1.38	1.10
30	3.87	1.22	900	2.58	2.06	1.72	1.47	1.29	1.03
31	3.74	1.30	930	2.41	1.93	1.61	1.38	1.20	0.96
32	3.62	1.39	960	2.26	1.81	1.51	1.29	1.13	0.90
33	3.52	1.48	990	2.13	1.70	1.42	1.22	1.06	0.85

POTTSVILLE ROLLING MILLS

9″ I Beam, Shape No. 9, 90 Lbs. Per Yard.

Depth 9″. Width of Flange $4\frac{7}{16}$″. Thickness of Web $\frac{9}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	9.40	0.16	300	18.80	15.04	12.53	10.74	9.40	7.52
11	8.55	0.19	330	15.55	12.44	10.37	8.89	7.77	6.22
12	7.83	0.23	360	13.05	10.44	8.70	7.46	6.52	5.22
13	7.23	0.27	390	11.12	8.90	7.42	6.35	5.56	4.45
14	6.71	0.31	420	9.59	7.67	6.39	5.48	4.79	3.84
15	6.27	0.35	450	8.36	6.69	5.56	4.78	4.17	3.34
16	5.87	0.40	480	7.34	5.87	4.89	4.19	3.67	2.94
17	5.53	0.46	510	6.51	5.21	4.34	3.72	3.25	2.60
18	5.22	0.51	540	5.80	4.64	3.87	3.31	2.90	2.32
19	4.95	0.57	570	5.21	4.17	3.47	2.98	2.60	2.08
20	4.70	0.63	600	4.70	3.76	3.13	2.69	2.35	1.88
21	4.48	0.70	630	4.27	3.42	2.85	2.44	2.13	1.71
22	4.27	0.77	660	3.88	3.10	2.59	2.22	1.94	1.55
23	4.09	0.84	690	3.56	2.85	2.37	2.03	1.78	1.42
24	3.92	0.91	720	3.27	2.62	2.18	1.87	1.63	1.31
25	3.76	0.99	750	3.01	2.41	2.01	1.72	1.50	1.20
26	3.62	1.07	780	2.78	2.22	1.85	1.59	1.39	1.11
27	3.48	1.16	810	2.58	2.06	1.72	1.47	1.29	1.03
28	3.36	1.2	840	2.40	1.92	1.60	1.37	1.20	0.96
29	3.24	1.33	870	2.23	1.78	1.49	1.27	1.11	0.89
30	3.13	1.43	900	2.09	1.67	1.39	1.19	1.04	0.84
31	3.03	1.53	930	1.95	1.56	1.30	1.11	0.97	0.78
32	2.94	1.63	960	1.84	1.47	1.23	1.05	0.92	
33	2.85	1.74	990	1.73	1.38	1.15	0.99	0.86	

POTTSVILLE ROLLING MILLS

9″ I Beam, Shape No. 10, 85 Lbs. Per Yard.

Depth 9″. Width of Flange 4¼″. Thickness of Web $\frac{7}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	9.60	0.16	283	19.20	15.36	12.80	10.97	9.60	7.68
11	8.73	0.19	312	15.87	12.70	10.58	9.07	7.93	6.35
12	8.00	0.23	340	13.33	10.66	8.89	7.62	6.66	5.33
13	7.38	0.27	368	12.12	9.70	8.08	6.93	6.06	4.85
14	6.86	0.31	397	9.80	7.84	6.53	5.60	4.90	3.92
15	6.40	0.35	425	8.53	6.82	5.68	4.87	4.26	3.41
16	6.00	0.40	453	7.50	6.00	5.00	4.28	3.75	3.00
17	5.65	0.46	482	6.65	5.32	4.43	3.80	3.32	2.66
18	5.33	0.51	510	5.92	4.73	3.94	3.38	2.96	2.36
19	5.05	0.57	538	5.32	4.25	3.55	3.04	2.66	2.13
20	4.80	0.63	567	4.80	3.84	3.20	2.74	2.40	1.92
21	4.57	0.70	595	4.35	3.48	2.90	2.49	2.17	1.74
22	4.36	0.77	623	3.96	3.17	2.64	2.26	1.98	1.58
23	4.17	0.84	652	3.63	2.90	2.42	2.07	1.81	1.45
24	4.00	0.91	680	3.33	2.66	2.22	1.90	1.66	1.33
25	3.84	0.99	708	3.07	2.42	2.01	1.73	1.51	1.21
26	3.69	1.07	737	2.84	2.27	1.89	1.62	1.42	1.14
27	3.56	1.16	765	2.64	2.11	1.76	1.51	1.32	1.06
28	3.43	1.2	793	2.45	1.96	1.63	1.40	1.22	0.98
29	3.31	1.33	822	2.28	1.82	1.52	1.30	1.14	0.91
30	3.20	1.43	850	2.13	1.70	1.42	1.22	1.06	0.85
31	3.10	1.53	878	2.00	1.60	1.33	1.14	1.00	0.80
32	3.00	1.63	907	1.87	1.50	1.25	1.07	0.93	
33	2.91	1.74	935	1.76	1.41	1.17	1.01	0.88	

POTTSVILLE ROLLING MILLS

9″ I Beam, Shape No. 11, 70 Lbs. Per Yard.

Depth 9″. Width of Flange 4⅛″. Thickness of Web ⅜″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	7.90	0.16	233	15.80	12.64	10.53	9.03	7.90	6.32
11	7.18	0.19	257	13.96	9.17	7.64	6.55	5.73	4.58
12	6.58	0.23	280	10.97	8.76	7.31	6.27	5.48	4.39
13	6.08	0.27	303	9.35	7.48	6.23	5.34	4.67	3.74
14	5.64	0.31	327	8.05	6.44	5.37	4.60	4.02	3.22
15	5.27	0.35	350	7.03	5.62	4.69	4 02	3.51	2.81
16	4.94	0.40	373	6.17	4.94	4.11	3.53	3.08	2.47
17	4.65	0.46	397	5.47	4.38	3.65	3.13	2.73	2.19
18	4.39	0.51	420	4.88	3.90	3.25	2.79	2.44	1.95
19	4.16	0.57	443	4.38	3.50	2.92	2.50	2.19	1.75
20	3.95	0.63	467	3.95	3.16	2.63	2.26	1.97	1.58
21	3.76	0.70	490	3.58	2.86	2.39	2.05	1.79	1.43
22	3.59	0.77	513	3.26	2.61	2.17	1.86	1.63	1.30
23	3.43	0.84	537	2.98	2.38	1.99	1.70	1.49	1.19
24	3.29	0.91	560	2.74	2.19	1.83	1.57	1.37	1.10
25	3.16	0.99	583	2.53	2.02	1.69	1.45	1.26	1.01
26	3.04	1.07	607	2.34	1.87	1.56	1.34	1.17	0.94
27	2.93	1.16	630	2.17	1.74	1.45	1.24	1.08	0.87
28	2.82	1.24	653	2.01	1.61	1.34	1.15	1.00	0.80
29	2.72	1.33	677	1.91	1.53	1.27	1.09	0.95	0.76
30	2.63	1.43	700	1.75	1.40	1.17	1.00	0.87	
31	2.55	1.53	723	1.65	1.28	1.07	0.91	0.80	
32	2.47	1.63	747	1.54	1.23	1.03	0.88	0.77	
33	2.39	1.74	770	1.44	1.15	0.96	0.82		

POTTSVILLE ROLLING MILLS

8″ I Beam, Shape No. 12, 80 Lbs. Per Yard.

Depth 8″. Width of Flange $4\frac{3}{16}$″. Thickness of Web $\frac{1}{2}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	7.70	0.18	266	15.40	12.32	10.26	8.80	7.70	6.16
11	7.00	0.22	293	12.73	10.18	8.48	7.28	6.36	5.09
12	6.42	0.26	320	10.70	8.56	7.13	6.11	5.35	4.28
13	5.92	0.30	346	9.11	7.29	6.07	5.20	4.55	3.64
14	5.50	0.35	373	7.85	6.28	5.23	4.49	3.92	3.14
15	5.13	0.40	400	6.84	5.47	4.56	3.91	3.42	2.73
16	4.81	0.46	426	6.01	4.80	4.01	3.43	3.00	2.40
17	4.53	0.52	453	5.66	4.53	3.77	3.23	2.83	
18	4.28	0.58	480	4.75	3.80	3.16	2.71	2.37	
19	4.05	0.64	506	4.25	3.40	2.83	2.43		
20	3.85	0.71	532	3.85	3.10	2.56			
21	3.67	0.79	560	3.50	2.80				
22	3.50	0.86	586	3.18	2.54				
23	3.35	0.94	613	2.91					
24	3.21	1.03	640	2.67					
25	3.08	1.12	666	2.46					
26	2.96	1.20	692						
27	2.85	1.30	720						
28	2.75	1.40	746						
29	2.66	1.50	773						
30	2.57	1.60	800						
31	2.48	1.71	826						
32	2.41	1.82	853						
33	2.33	1.93	880						

POTTSVILLE ROLLING MILLS

8″ I Beam, Shape No. 13, 65 Lbs. Per Yard.

Depth 8″. Width of Flange 4″. Thickness of Web $\frac{5}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	6.80	0.18	216	13.60	10.88	9.06	7.77	6.80	5.44
11	6.18	0.22	238	11.23	8.98	7.48	6.41	5.62	4.49
12	5.67	0.26	260	9.45	7.56	6.30	5.40	4.72	3.78
13	5.23	0.30	282	8.04	6.43	5.36	4.59	4.02	3.21
14	4.86	0.35	304	6.94	5.55	4.62	3.96	3.47	2.77
15	4.53	0.40	325	6.04	4.83	4.03	3.45	3.02	2.41
16	4.34	0.46	347	5.42	4.33	3.61	3.09	2.71	2.16
17	4 00	0.52	369	4.70	3.76	3.13	2.68	2.35	
18	3.78	0.58	390	4.20	3.36	2.80	2.40		
19	3.58	0.64	412	3.76	3.00	2.51			
20	3.40	0.71	432	3.40	2.72				
21	3.24	0.79	454	3.08	2.46				
22	3.09	0.86	476	2.81					
23	2.96	0.94	498	2.57					
24	2.83	1.03	520						
25	2.72	1.12	542						
26	2.62	1.20	564						
27	2.52	1.30	586						
28	2 43	1.40	608						
29	2.34	1.50	629						
30	2.21	1.60	648						
31	2.19	1.71	672						
32	2.12	1.82	694						
33	2.06	1.93	714						

POTTSVILLE ROLLING MILLS

7″ I Beam, Shape No. 14, 65 Lbs. Per Yard.

Depth 7″. Width of Flange $3\frac{9}{16}$″. Thickness of Web $\frac{7}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	5.70	0.20	216	11.40	9.12	7.60	6.51	5.70	4.56
11	5.18	0.25	238	9.42	7.53	6.28	5.38	4.71	3.76
12	4.75	0.29	260	7.91	6.32	5.27	4.52	3.95	3.16
13	4.38	0.35	282	6.73	5.38	4.48	3.84	3.36	2.69
14	4.07	0.40	304	5.81	4.64	3.84	3.32	2.90	2.32
15	3.80	0.46	325	5.04	4.04	3.36	2.88	2.52	
16	3.56	0.52	347	4.45	3.56	2.96	2.54		
17	3.35	0.59	369	3.94	3.15	2.62			
18	3.17	0.66	390	3.52	2.82				
19	3.00	0.74	412	3.15	2.52				
20	2.85	0.82	432	2.85					
21	2.71	0.90	454	2.58					
22	2.59	0.99	476						
23	2.48	1.08	498						
24	2.37	1.17	520						
25	2.28	1.27	542						
26	2.19	1.38	564						
27	2.11	1. 9	586						
28	2.04	1.60	608						
29	1.97	1.72	629						
30	1.90	1.84	648						
31	1.84	1.96	672						
32	1.78	2.08	694						
33	1.73	2.20	714						

POTTSVILLE ROLLING MILLS

7″ I Beam, Shape No. 15, 55 Lbs. Per Yard.

Depth 7″. Width of Flange $3\frac{7}{16}$″. Thickness of Web $\frac{5}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	5.00	0.20	183	10.00	8.00	6.66	5.71	5.00	4.00
11	4.55	0.25	201	8.27	6.62	5.51	4.72	4.13	3.31
12	4.17	0.29	220	6.95	5.56	4.63	3.97	3.47	2.78
13	3.84	0.35	238	5.90	4.72	3.93	3.37	2.95	2.36
14	3.57	0.40	257	5.10	4.08	3.40	2.91	2.55	
15	3.33	0.46	275	4.44	3.55	2.96	2.53		
16	3.12	0.52	293	3.90	3.12	2.60			
17	2.94	0.59	312	3.46	2.76	2.30			
18	2.78	0.66	330	3.09	2.47				
19	2.63	0.74	348	2.76					
20	2.50	0.82	366	2.50					
21	2.38	0.90	385						
22	2.27	0.99	402						
23	2.17	1.08	421						
24	2.08	1.17	440						
25	2.00	1.27	458						
26	1.92	1.38	476						
27	1.85	1.49	495						
28	1.79	1.60	515						
29	1.72	1.72	532						
30	1.67	1.84	550						
31	1.61	1.96	568						
32	1.56	2.08	586						
33	1.52	2.20	605						

POTTSVILLE ROLLING MILLS

6″ I Beam, Shape No. 16, 50 Lbs. Per Yard.

Depth 6″. Width of Flange $3\frac{7}{16}$″. Thickness of Web $\frac{5}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	3.90	0.24	166	7.80	6.24	5.20	4.45	3.90	3.12
11	3.55	0.29	183	6.45	5.19	4.30	3.68	3.22	2.59
12	3.25	0.34	200	5.41	4.32	3.60	3.09	2.70	2.16
13	3.00	0.40	217	4.61	3.69	3.07	2.63	2.30	
14	2.79	0.47	233	3.98	3.18	2.65	2.27		
15	2.60	0.54	250	3.46	2.76	2.31			
16	2.44	0.61	267	3.05	2.44				
17	2.29	0.69	284	2.69					
18	2.17	0.77	300	2.41					
19	2.05	0.86	317						
20	1.95	0.95	333						
21	1.86	1.05	350						
22	1.77	1.15	366						
23	1.70	1.26	383						
24	1.62	1.37	400						
25	1.56	1.49	417						
26	1.50	1.61	434						
27	1.44	1.74	450						
28	1.39	1.87	466						
29	1.34	2.00	483						
30	1.30	2.14	500						
31	1.26	2.27	517						
32	1.22	2.40	534						
33	1.18	2.53	550						

POTTSVILLE ROLLING MILLS

6″ I Beam, Shape No. 17, 40 Lbs. Per Yard.

Depth 6″. Width of Flange 3⅜″. Thickness of Web ¼″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
10	3.20	0.24	133	6.40	5.12	4.26	3.65	3.20	2.56
11	2.90	0.29	146	5.26	4.20	3.50	3.01	2.63	2.10
12	2.67	0.34	160	4.45	3.64	2.96	2.54	2.22	
13	2.46	0.40	173	3.78	3.02	2.52	2.16		
14	2.29	0.47	187	3.27	2.61	2.27			
15	2.13	0.54	200	2.84	2.27				
16	2.00	0.60	213	2.50					
17	1.88	0.69	227						
18	1.78	0.77	240						
19	1.68	0.86	253						
20	1.60	0.95	267						
21	1.52	1.05	280						
22	1.45	1.15	293						
23	1.39	1.26	307						
24	1.33	1.37	320						
25	1 28	1.49	333						
26	1.23	1.61	347						
27	1.19	1.74	360						
28	1.14	1.87	373						
29	1.10	2.00	387						
30	1.07	2.14	400						
31	1.03	2.27	413						
32	1.00	2.40	427						
33	0.97	2.53	440						

POTTSVILLE ROLLING MILLS

5″ I Beam, Shape No. 18, 40 Lbs. Per Yard.

Depth 5″. Width of Flange 3″. Thickness of Web $\frac{5}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
3	8.34	0.02	40	55.60	44.48	37.06	31.77	27.80	22.24
4	6.25	0.04	53	31.25	25.00	20.83	17.83	15.62	12.50
5	5.00	0.07	67	20.00	16.00	13.33	11.43	10.00	8.00
6	4.17	0 10	80	13.90	11.12	9.27	7.94	6.95	5.56
7	3.57	0.14	93	10 20	8.16	6.80	5.83	5.10	4.08
8	3.12	0 18	107	7.80	6.24	5.20	4.46	3.90	3.12
9	2.87	0.23	120	6.38	5.10	4.25	3.65	3.19	2.55
10	2.50	0.28	133	5.00	4.00	3.33	2.85	2.50	2.00
11	2.27	0.34	146	4 13	3.31	2.75	2.36	2.06	
12	2.08	0.41	160	3.47	2.78	2.31			
13	1.92	0.48	173	2.95	2.36				
14	1.79	0.56	187	2.05					
15	1.67	0.64	200						
16	1.56	0.73	213						
17	1.47	0.82	227						
18	1.39	0.92	240						
19	1.32	1.03	253						
20	1.25	1 14	267						
21	1.19								
22	1.14								
23	1.09								
24	1.04								
25	1.00								
26	0.96								

POTTSVILLE ROLLING MILLS

5″ I Beam, Shape No. 19, 30 Lbs. Per Yard.

Depth 5″. Width of Flange $2\frac{3}{4}$″. Thickness of Web $\frac{3}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
3	6.40	0.02	30	42.66	34.12	28.44	24.37	21.33	17.06
4	4.80	0.04	40	24.00	19.20	16.00	13.71	12.00	9.60
5	3.84	0.07	50	15.36	12.28	10.24	8.77	7.68	6.14
6	3.20	0.10	60	10.66	8.52	7.10	6.09	5.33	4.26
7	2.74	0.14	70	7.82	6.25	5.21	4.47	3.91	3.12
8	2.40	0.18	80	6.00	4.80	4.00	3.42	3.00	2.40
9	2.13	0.23	90	4 74	3.79	3.16	2.71	2.37	1.89
10	1.92	0.28	100	3.84	3.08	2.56	2.19	1.92	1.54
11	1.75	0.34	110	3.19	2.55	2.12	1.82		
12	1.60	0.41	120	2.66	2.12	1.77			
13	1.48	0.48	130	2.27	1.81				
14	1.37	0.56	140	1.95					
15	1.28	0.64	150						
16	1.20	0.73	160						
17	1.13	0.82	170						
18	1.07	0.92	180						
19	1 01	1.03	190						
20	0.96	1.14	200						
21	0.91	1.26	210						
22	0.87	1.38	220						
23	0.83	1.51	230						
24	0.80	1.65	240						
25	0.77	1.79	250						
26	0.74	1.93	260						

POTTSVILLE ROLLING MILLS

4" I Beam, Shape No. 20, 30 Lbs. Per Yard.

Depth 4". Width of Flange $2\frac{1}{2}$". Thickness of Web $\frac{7}{16}$".

MAXIMUM FIBRE STRESS — 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
3	4.66	0.03	30	31.16	24.92	20.77	17.80	15.58	12.46
4	3.50	0.06	40	17.50	14.00	11.66	10.00	8.75	7.00
5	2.80	0.09	50	11.20	8.96	7.46	6.40	5.60	4.48
6	2.33	0.13	60	7.77	6.22	5.18	4.44	3.88	3.11
7	2.00	0.17	70	5.71	4.56	3.81	3.26	2.85	2.28
8	1.75	0.23	80	4.37	3.49	2.91	2.49	2.18	1.74
9	1.55	0.29	90	3.22	2.57	2.14	1.84	1.61	1.28
10	1.40	0.36	100	2.80	2.24	1.87	1.60	1.40	1.12
11	1.27	0.43	110	2.31	1.85	1.54	1.32	1.15	0.92
12	1.17	0.51	120	1.95	1.56	1.30	1.11	0.97	0.78
13	1.08	0.60	130	1.66	1.33	1.11	0.95	0.83	
14	1.00	0.70	140	1.43	1.14	0.95	0.82		
15	0.93	0.81	150	1.24	0.99	0.83			
16	0.87	0.91	160	1.09	0.87				
17	0.82	1.03	170	0.96	0.77				
18	0.78	1.16	180	0.87					
19	0.74	1.29	190	0.78					
20	0.70	1.43	200						
21	0.67	1.58	210						
22	0.64	1.73	220						
23	0.61	1.89	230						
24	0.58	2.06	240						
25	0.56	2.23	250						
26	0.54	2.41	260						

POTTSVILLE ROLLING MILLS

4″ I Beam, Shape No. 21, 24 Lbs. Per Yard.

Depth 4″. Width of Flange 2½″. Thickness of Web $\frac{5}{16}$″.

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
3	4.33	0.03	24	28.86	23.08	19.24	16.49	14.43	11.54
4	3.25	0.06	32	16.25	13.00	10.83	9.28	8.12	6.50
5	2.60	0.09	40	10.40	8.32	6.93	5.94	5.20	4.16
6	2.16	0.13	48	7.20	5.76	4.80	4.11	3.60	2 88
7	1.85	0.17	56	5.28	4.22	3.52	3.01	2.64	2.11
8	1.62	0.23	64	4.05	3.24	2.70	2.31	2.02	1.62
9	1.44	0.29	72	3.20	2.56	2.10	1.82	1.60	1.28
10	1.30	0.36	80	2.60	2.08	1.73	1.49	1.30	1.04
11	1.18	0.43	88	2.15	1.72	1.43	1.23	1.07	0.86
12	1.08	0.51	96	1.80	1.44	1.37	1.03	0.90	
13	1.00	0.60	104	1.54	1.23	1.03	0.88	0.77	
14	0.93	0.70	112	1.33	1.06	0.89	0.76		
15	0.87	0.81	120	1.16	0.93	0.77			
16	0.81	0.91	128	1.01	0.81				
17	0.76	1.03	136	0.89					
18	0.72	1.16	144	0.80					
19	0.68	1.29	152						
20	0.65	1.43	160						
21	0.62	1.58	168						
22	0 59	1.73	176						
23	0.57	1.89	184						
24	0.54	2.06	192						
25	0.52	2.23	200						
26	0.50	2.41	208						

POTTSVILLE ROLLING MILLS

4" I Beam, Shape No. 22, 18 Lbs. Per Yard.

Depth 4". Width of Flange $2\frac{1}{8}$". Thickness of Web $\frac{3}{16}$".

MAXIMUM FIBRE STRESS = 12,000 LBS. PER SQUARE INCH.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Beam.	Distance apart, in feet, centre to centre of Beams, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
3	2.66	0.03	18	17.73	14.18	11.82	10.13	8.86	7.09
4	2.00	0.06	24	10.00	8.00	6.66	5.71	5.00	4.00
5	1.60	0.09	30	6.40	5.12	4.26	3.65	3.20	2.56
6	1.33	0.13	36	4.43	3.54	2.95	2.53	2.21	1.77
7	1.14	0.17	42	3.25	2.60	2.16	1.85	1.62	1.30
8	1.00	0.23	48	2.50	2.00	1.66	1.43	1.25	1.00
9	0.88	0.29	54	1.95	1.56	1.30	1.11	0.97	0.78
10	0.80	0.36	60	1.60	1.28	1.07	0.93	0.80	0.64
11	0.73	0.43	66	1.27	1.02	0.85			
12	0.67	0.51	72	1.12	0.89				
13	0.62	0.60	78	1.03	0.82				
14	0.57	0.70	84	0.95	0.76				
15	0.53	0.81	90	0.88					
16	0.50	0.91	96	0.83					
17	0.47	1.03	102	0.78					
18	0.44	1.16	108						
19	0.42	1.29	114						
20	0.40	1.43	120						
21	0.38	1.58	126						
22	0.36	1.73	132						
23	0.35	1.89	138						
24	0.33	2.06	144						
25	0.32	2.23	150						
26	0.31	2.41	156						

POTTSVILLE ROLLING MILLS

12 Channel, No. 26, 150 Lbs. Per Yard.

Depth 12″. Width of Flange 3½″. Thickness of Web ⅞″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	29.33	0.05	300						39.11
8	22.00	0.08	400					27.50	22.00
10	17.60	0.13	500			23.46	20.11	17.60	14.08
12	14.66	0.19	600	24.43	19.55	16.28	13.96	12.21	9.77
14	12.57	0.26	700	17.95	14.36	11.97	10.25	8.97	7.18
16	11.00	0.34	800	13.75	11.00	9.16	7.85	6.87	5.50
18	9.77	0.43	900	10.85	8.68	7.23	6.20	5.42	4.34
20	8.80	0.54	1000	8.80	6.40	5.86	5.02	4.40	3.20
22	8.00	0.65	1100	7.27	5.82	4.84	4.15	3.62	2.91
24	7.33	0.77	1200	6.11	4.88	4.07	3.49	3.05	2.44
26	6.77	0.90	1300	5.21	4.16	3.47	2.97	2.59	
28	6.28	1.05	1400	4.48	3.59	2.99	2.39		
30	5.86	1.20	1500	3.91	3.12	2.60			
32	5.50	1.35	1600	3.43	2.75				
34	5.17	1.50	1700	3.04					

POTTSVILLE ROLLING MILLS

12″ Channel, No. 26, 90 Lbs. Per Yard.

Depth 12″. Width of Flange 3″. Thickness of Web $\frac{3}{8}$″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	21.33	0.05	180					35.50	28.44
8	16.00	0.08	240			26.66	22.85	20.00	16.00
10	12.80	0.13	300	25.60	20.48	17.06	14.62	12.80	10.24
12	10.66	0.19	360	17.76	14.21	11.84	10.15	8.88	7.11
14	9.14	0.26	420	13.05	10.45	8.70	7.46	6.52	5.27
16	8.00	0.34	480	10.00	8.00	6.66	5.71	5.00	4.00
18	7.11	0.43	540	7.90	6.32	5.26	4.51	3.95	3.16
20	6.40	0.54	600	6.40	5.12	4.26	3.66	3.20	2.56
22	5.82	0.65	660	5.29	4.23	3.52	3.02	2.64	
24	5.33	0.77	720	4.44	3.55	2.96	2.54		
26	4.85	0.90	780	3.73	2.98	2.48			
28	4.57	1.05	840	3.26	2.61				
30	4.26	1.20	900	2.84					

POTTSVILLE ROLLING MILLS

12″ Channel, No. 27, 84½ Lbs. Per Yard.

Depth 12″. Width of Flange $2\frac{5}{16}$″. Thickness of Web ½″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	17.00	0.05	179				32.38	28.33	22.66
8	12.75	0.08	225		25.50	21.25	18.22	15.92	12.75
10	10.20	0.13	282	20.40	16.32	13.60	11.65	10.20	8.16
12	8.50	0.19	338	14.16	11.33	9.44	8.09	7.08	5.66
14	7.28	0.26	394	10.40	8.32	6.93	5.94	5.20	4.16
16	6.37	0.34	450	7.96	6.37	5.31	4.50	3.98	3.18
18	5.66	0.43	507	6.29	5.03	4.19	3.59	3.14	2.51
20	5.10	0.54	564	5.10	4.08	3.40	2.91	2.55	2.04
22	4.63	0.65	619	4.21	3.36	2.81	2.40	2.11	
24	4.25	0.77	676	3.54	2.83	2.36	2.02		
26	3.92	0.90	732	3.01	2.41	2.01			
28	3.64	1.05	788	2.60	2.09				
30	3.40	1.20	846	2.26					

POTTSVILLE ROLLING MILLS

12″ Channel, No. 27, 62 Lbs. Per Yard.

Depth 12″. Width of Flange 2¾″. Thickness of Web $\frac{5}{16}$″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	14.00	0.05	124		37.33	31.11	26.66	23.33	18.66
8	10.50	0.08	164	26.25	21.00	17.50	15.00	13.12	10.50
10	8.40	0.13	206	16.80	13.44	11.20	9.60	8.40	6.72
12	7.00	0.19	248	11.66	9.33	7.77	6.66	5.83	4.66
14	6.00	0.26	289	8.56	6.85	5.71	4.89	4.28	3.42
16	5.25	0.34	331	6.56	5.25	4.37	3.75	3.28	2.62
18	4.66	0.43	375	5.17	4.14	3.45	2.95	2.59	
20	4.20	0.54	417	4.20	3.36	2.80	2 40		
22	3.82	0.65	454	3.47	2.77	2.31			
24	3.50	0.77	496	2.91	2.33				
26	3.23	0.90	537	2.48					
28	3.00	1.05	578						
30	2.80	1.20	620						

POTTSVILLE ROLLING MILLS

10″ Channel, No. 28, 128 Lbs. Per Yard.

Depth 10″. Width of Flange 3½″. Thickness of Web 1$\frac{1}{16}$″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channels.	Distance apart, in feet, centre to centre of Channels, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	18.66	0.04	256					31.10	24.80
8	14.00	0.09	341		28.00	23.33	20.00	17.50	14.00
10	11.20	0.15	426	22.40	17.92	14.93	12.80	11.20	8.96
12	9.33	0.22	512	15.55	12.44	10.36	8.88	7.77	6.22
14	8.00	0.30	597	11.42	9.14	7.62	6.53	5.71	4.57
16	7.00	0.40	682	8.75	7.00	5.83	5.00	4.37	3.50
18	6.22	0.50	768	6.91	5.52	4.61	3.94	3.45	2.76
20	5.60	0.62	852	5.60	4.48	3.73	3.20	2.80	2.24
22	5.09	0.76	938	4.63	3.70	3.08	2.64	2.31	
24	4.66	0.92	1024	3.88	3.11	2.59	2.22		
26	4.31	1.08	1109	3.31	2.59	2.21			
28	4.00	1.24	1194	2.85	2.28				
30	3.73	1.42	1278	2.42					

POTTSVILLE ROLLING MILLS

10" Channel, No. 28, 60 Lbs. Per Yard.

Depth 10". Width of Flange $2\frac{13}{16}$". Thickness of Web $\frac{3}{8}$".

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	11.00	0.04	120		29.33	24.44	20.95	18.33	14.66
8	8.25	0.09	160	20.62	16.50	13.75	11.78	10.31	8.25
10	6.60	0.15	200	13.20	10.56	8.80	7.54	6.60	5.28
12	5.50	0.20	240	9.16	7.33	6.11	5.23	4.58	3.66
14	4.71	0.30	280	6.73	5.38	4.48	3.84	3.36	2.69
16	4.12	0.40	320	5.15	4.12	3.43	2.94	2.57	2.06
18	3.66	0.50	360	4.06	3.25	2.72	2.32		
20	3.30	0.62	400	3.30	2.64	2.20			
22	3.00	0.76	440	2.72	2.18				
24	2.75	0.92	480	2.29	1.83				
26	2.53	1.08	520	1.95					
28	2.35	1.24	560						
30	2.20	1.42	600						

POTTSVILLE ROLLING MILLS

10" Channel, No. 29, 62 Lbs. Per Yard.

Depth 10". Width of Flange $2\frac{5}{8}$". Thickness of Web $\frac{7}{16}$".

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channels, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	10.00	0.04	124	33.33	26.66	22.22	19.04	16.66	13.33
8	7.50	0.09	165	18.75	15.00	12.50	10.71	9.37	7.50
10	6.00	0.15	206	12.00	9.60	8.00	6.85	6.00	4.80
12	5.00	0.22	248	8.33	6.66	5.55	4.76	4.16	3.33
14	4.28	0.30	289	6.11	4.89	4.07	3.49	3.05	2.49
16	3.75	0.40	330	4.68	3.75	3.12	2.68	2.34	
18	3.33	0.50	372	3.70	2.96	2.46	2.11		
20	3.00	0.62	412	3.00	2.40	2.00			
22	2.72	0.76	454	2.47	1.97				
24	2.50	0.92	496	2.08					
26	2.31	1.08	537						
28	2.14	1.24	578						
30	2.00	1.42	620						

POTTSVILLE ROLLING MILLS

10" Channel, No. 29, 48 Lbs. Per Yard.

Depth 10". Width of Flange 2½". Thickness of Web $\frac{5}{16}$".

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channels, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	8.66	0.04	96	28.87	23.09	19.24	16.42	14.43	11.54
8	6.50	0.09	128	16.25	13.00	10.83	9.30	8.12	6.50
10	5.20	0.15	160	10.40	8.32	6.93	5.94	5.20	4.16
12	4.33	0.22	192	7.22	5.77	4.81	4.12	3.61	2.89
14	3.71	0.30	224	5.30	4.24	3.53	3.03	2.65	2.12
16	3.25	0.40	256	4.06	3.25	2.71	2.32		
18	2.88	0.50	288	3.20	2.56				
20	2.60	0.62	320	2.60					
22	2.36	0.76	352						
24	2.17	0.92	384						
26	2.00	1.08	416						
28	1.86	1.24	448						
30	1.73	1.42	480						

POTTSVILLE ROLLING MILLS

9″ Channel, No. 30, 60 Lbs. Per Yard.

Depth 9″. Width of Flange 2¾″. Thickness of Web ⅜″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	10.33	0.03	120	34.44	27.55	22.96	19.68	17.22	13.77
8	7.75	0.10	160	19.38	15.50	12.92	11.08	9.69	7.75
10	6.20	0.18	200	12.40	9.92	8.26	7.09	6.20	4.96
12	5.17	0.26	240	8.62	6.89	5.74	4.92	4.31	3.45
14	4.43	0.35	280	6.33	5.06	4.22	3.62	3.17	2.53
16	3.87	0.46	320	4.85	3.88	3.24	2.76	2.43	1.94
18	3.44	0.58	360	3.82	3.06	2.56	2.18	1.92	1.53
20	3.10	0.71	400	3.10	2.48	2.07	1.77	1.55	1.24
22	2.82	0.86	440	2.56	2.05	1.70	1.46		
24	2.58	1.03	480	2.15	1.70				
26	2 00	1.20	520	1.54					
28	2.21	1.40	560						
30	2.07	1.60	600						

POTTSVILLE ROLLING MILLS

9″ Channel, No. 31, 46 Lbs. Per Yard.

Depth 9″. Width of Flange 2½″. Thickness of Web $\frac{5}{16}$″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	7.66	0.03	92	25.53	20.42	17.02	14.59	12.76	10.21
8	5.75	0.10	122	14.38	11.50	9.58	8.22	7.19	5.75
10	4.60	0.18	153	9.20	7.36	6.14	5.26	4.60	3.68
12	3.83	0.26	184	6.40	5.12	4.26	3.66	3.20	2.56
14	3.29	0.35	214	4.70	3.76	3.14	2.70	2.35	1.88
16	2.87	0.46	244	3.20	2.56	2.14	1.83	1.60	1.28
18	2.55	0.58	276	2.83	2.06	1.88	1.64	1.41	1.03
20	2 30	0.71	307	2.30	1.84	1.54	1.31		
22	2.09	0.86	337	1.90	1.52	1.26			
24	1.91	1.03	368	1.60	1.28				

POTTSVILLE ROLLING MILLS

8″ Channel, No. 32, 40 Lbs. Per Yard.

Depth 8″. Width of Flange 2⅜″. Thickness of Web $\frac{5}{16}$″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart in feet, centre to centre, of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	6.0	0.05	80	20.00	16.00	13.30	11.42	10.00	8.00
8	4.5	0.11	107	11.25	9.00	7.50	6.42	5.62	4.50
10	3.6	0.20	133	7.20	5.76	4 80	4.11	3.60	2.88
12	3.0	0.30	160	5.00	4.00	3.33	2.85	2.50	2.00
14	2.57	0.40	187	3.70	2.96	2.46	2.11	1.85	1.48
16	2.25	0.50	213	2.80	2.24	1.86	1.60	1.40	1.12
18	2.0	0.66	240	2.22	1.77	1.48	1.26	1.11	.88
20	1 8	0.80	267	1.80	1.44	1.20	1.02	.90	.72

POTTSVILLE ROLLING MILLS

6″ Channel, No. 34, 30 Lbs. Per Yard.

Depth 6″. Width of Flange 2⅛″. Thickness of Web ¼″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	3.33	0.05	60	11.11	8.88	7.40	6.34	5.55	4.44
8	2.75	0.15	80	6.87	5.49	4.58	3.92	3.43	2.74
10	2.20	0.26	100	4.40	3.52	2.93	2.51	2.20	1.76
12	1.83	0.38	120	3.05	2.44	2.03	1.74	1.52	1.22
14	1.57	0.58	140	2.25	1.80	1.50	1.28	1.12	.90
16	1.38	0.70	160	1.73	1.38	1.15	.98	.86	.69
18	1.22	0.87	180	1.37	1.09	.91	.78	.68	.54
20	1.10	1.08	200	1.10	.88	.73	.62	.55	.44

POTTSVILLE ROLLING MILLS

5″ Channel, No. 37, 17 Lbs. Per Yard.

Depth 5″. Width of Flange $1\frac{3}{4}$″. Thickness of Web $\frac{3}{16}$″.

SAFE UNIFORMLY DISTRIBUTED LOAD IN TONS OF 2,000 LBS.

Span in Feet.	Safe Load in Net Tons.	Deflexion in Inches.	Weight of Channel.	Distance apart, in feet, centre to centre of Channel, for Safe Loads of					
				100 Lbs. per Square Foot.	125 Lbs. per Square Foot.	150 Lbs. per Square Foot.	175 Lbs. per Square Foot.	200 Lbs. per Square Foot.	250 Lbs. per Square Foot.
6	1.66	0.01	34	5.55	4.44	3.70	3.17	2.77	2.22
8	1.25	0.21	46	4.17	3.33	2.78	2.38	2.08	1.66
10	1.0	0.33	58	3.33	2.66	2.22	1.90	1.66	1.33
12	0.83	0.48	70	2.76	2.20	1.84	1.57	1.38	1.10
14	0.71	0.60	82	2.37	1.89	1.58	1.35	1.18	.94
16	0.62	0.80	94	2.07	1.65	1.38	1.18	1.03	.82
18	0.55	1.00	106	1.83	1.06	1.22	1.04	.91	.53
20	0.50	1.30	118	1.67	1.33	1.11	.95	.83	.66

Let—

S = Area of section.

l = Length of span.

W = Total load uniformly distributed.

M_o = Maximum bending moment of external forces.

h = Height of beam.

y = Distance from neutral axis to edge of beam which first ruptures, and which in symmetrical sections is one-half the height.

f = Stress per square inch on extreme fibres of beam, on the side of neutral axis which first ruptures.

I = Maximum moment of Inertia of section.

J = Minimum moment of Inertia of section.

r_I = Maximum radius of gyration of section, $\sqrt{\frac{I}{S}}$

r_J = Minimum radius of gyration of section, $\sqrt{\frac{J}{S}}$

C = Coefficient for one foot span $= \frac{8\,I}{h} = 4\,R.$

R = Modulus of section $= \frac{I}{y}$ = for a symmetrical shape $\frac{2\,I}{h}$.

Δ = Maximum deflexion.

E = Coefficient of elasticity, which for wrought iron is 26,000,000 lbs. per square inch.

$\Delta = \frac{5}{384} \cdot \frac{W\,l^3}{E\,I}$, for beam supported at both ends, and uniformly loaded over its entire length.

$\Delta = \frac{W\,l^3}{8\,E\,I}$ for beam fixed at one end, and uniformly loaded over its entire length.

$\Delta = \frac{P\,l^3}{48\,E\,I}$ for beam supported at both ends, and having a concentrated load P at the centre.

$\Delta = \frac{P l^3}{3 E I}$ for beam fixed at one end, and loaded at the other.

The relation connecting the external and molecular forces on a beam, subject to transverse loading is

(1.) $$M_o = \frac{f I}{y}$$

the second member of which is called the moment of resistance.

When the beam is supported at ends, and uniformly loaded over its entire length, the maximum moment of the external forces is at the centre of beam, and is given by the expression $M_o = \frac{W l}{8}$. The moment of resistance of the beams should at least equal this—and for beams of symmetrical sections, in which y is equal to one-half the height—the relation becomes

(2.) $$\frac{W l}{8} = \frac{2 f I}{h}$$

whence

(3.) $$W = \frac{16 f I}{l h}.$$

If, as usual, we assume the maximum fibre stress as 6 tons, and consider length as in feet, the height as in inches, the above equation becomes

(4.) $$W = \frac{8 I}{l h}$$

where l is in feet and h is inches.

If we consider length as one foot, then we have what has been called the coefficient for one foot of span, *i. e.*,

(5.) $$C = \frac{8 I}{h}.$$

The relations deduced from foregoing are frequently use-

ful, and considering the length in feet, the height in inches, we have the following

$$f = \tfrac{3}{4} W l. \frac{h}{I}$$

$$I = \tfrac{3}{4} W l. \frac{h}{f}$$

$$l = \frac{4 f}{3 W} \cdot \frac{I}{h} = \frac{2 f}{3 W} \cdot \frac{2 I}{h} = \frac{2 f}{3 W} \cdot R.$$

$$W = \tfrac{4}{3} \cdot \frac{f I}{l h} \cdot = \tfrac{2}{3} \cdot \frac{f}{l} \cdot \frac{2 I}{h} = \frac{2 f}{3 l} \cdot R.$$

Example I.—Having a 12″ I beam, 125 lbs. per yard, whose distance centre to centre of bearings is 10′, carrying a load of 15.0 tons uniformly distributed over its length, required the maximum fibre stress f in the flanges.

Here W = 15.0 tons; l = 10.0 feet; h = 12″.

Referring to tables of properties of I beams, we find for a 12″ I, 125 lbs., the moment of Inertia I to be 278.

Then from formula $f = \tfrac{3}{4} \cdot W l. \frac{h}{I}$ we have

$$f = \frac{3 \times 15 \times 10 \times 12}{4 \times 278} = 4.85 \text{ tons.}$$

Example II.—Having a load of 9.75 tons, a span centre to centre of supports of 12 feet, and a height limiting us to the use of a 10½ beam, required the moment of inertia of the necessary 10½″ beam, assuming the fibre stress to be 6.0 tons. From the formula

$$I = \tfrac{3}{4} \cdot \frac{W l h}{f} \text{ we have}$$

$$I = \frac{3 \times 9.75 \times 12 \times 10\tfrac{1}{2}}{4 \times 6.0} = 153.56.$$

Referring to the table of properties of I beams, we find

that a 10½ I beam, 90 lbs. per yard, shape No. 8, has a moment of inertia of 151.0. Hence this beam would answer the requirements.

Example III.—Suppose we have an 8″ I, 65 lbs. per yard, whose moment of inertia I is as per tables 68.0, and that the load to be carried is 6.75 tons, the fibre stress to be limited to 6.0 tons. Required the span, centre to centre of supports, in which this beam could be used.

From formula we have

$$l = \frac{4\,f.}{3\,W.}\cdot\frac{I}{h} = \frac{2\,f}{3\,W.}\cdot\frac{2\,I}{h} = \frac{2\,f}{3\,W.}\cdot R.$$

We have given f = 6.0 tons per □″; W = 6.75 tons, and from the tables we find R for an 8″ I, 65 lbs. per yard, to be 17.0.

$$\text{Whence } l = \frac{2 \times 6 \times 17}{3 \times 6.75} = 10.2 \text{ feet.}$$

Thus 10. feet is the limiting span of this beam, for the assumed load and fibre stress.

Example IV.—Suppose we have a span of 15 feet, and that we wish to use a 15″ I beam, 150 lbs. per yard, required the safe load which we can put on this beam, when the fibre stress is limited to 5.0 tons per □″.

We have given R for a 15″ I, 150 lbs. per yard, as per tables = 69.0; l = 15′; f = 5.0. Inserting these values in the formula

$$W = \frac{2\,f\,r}{3\,l} \text{ we have}$$

$$W = \frac{2 \times 5 \times 69}{3 \times 15} = 15.33 \text{ tons.}$$

Hence our safe load is 15.33 tons.

PROPERTIES
OF
POTTSVILLE IRON COMPANY'S
I BEAMS AND CHANNELS.

(PAGES 84 AND 85.)

THE tables on the properties of I beams and channel bars are calculated for the minimum and maximum weights to which these shapes are rolled. The plates illustrate how the increase in weight is effected, which is simply by increasing the distance apart of the rolls; consequently the increase in width of flanges is the same as increase in thickness of web.

Beams, channels, and angle-irons may be rolled to any weight intermediate between the minimum and maximum weights as given. T iron can be rolled but to the one weight.

Columns 11 in the tables for beams and channels give coefficients, by means of which the safe uniformly distributed load for any beam or channel on the list can at once be obtained, when we know the span. We have only to divide this coefficient by the span in feet, when the result is the safe load in tons, uniformly distributed, that the beam or channel will carry.

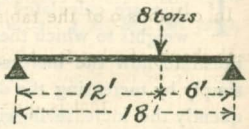
The fibre stress upon which this coefficient is based is 12,000 lbs. per square inch. Should any case arise in which a lower fibre stress is desirable, the coefficient is simply reduced in the same proportion. For example, the coefficient for a fibre stress of 12,000 lbs. in a 12″ I beam, 125 lbs. per yard, is given by the table as 185.0; should we

wish the fibre stress to be but 8,000 lbs., this being two-thirds of 12,000 lbs., the coefficient required for the former is $\frac{2}{3} \times 185.0 = 123.33$.

In case the load is concentrated at the centre of the beam or channel, multiply it by 2, and consider the result as a uniformly distributed load.

Should the load be concentrated at any other point, the bending moment should be found, and then by means of equation (1), page 78, we find what should be the value of $\frac{I}{y}$, which for a symmetrical shape becomes $\frac{2\,I}{h}$; and looking in column 10, the beam corresponding to the required value of $\frac{2\,I}{h}$ can be obtained.

For example, suppose a load of 8 tons to be concentrated at a point 6 feet from the right-hand support of an 18 feet span. The reaction at the left support is $\frac{6}{18} \times 8$ tons $= 2\frac{2}{3}$ tons; the bending moment is then $2\frac{2}{3} \times 12 = 32$ foot-tons $= 384$ inch-tons. Then from equation (I), bearing in mind that for a symmetrical shape, $\frac{I}{y}$ becomes $\frac{2\,I}{h}$, we have



384 inch-tons $= \frac{2\,f\,I}{h} = f\,R$. Now suppose we wish to use a fibre stress of $4\frac{1}{4}$ tons per square inch, then we would have $\frac{2\,I}{h} = R = \frac{384}{4\frac{1}{4}} = 90.3$. Now look in column 10 of the table, on the properties of I beams, and we find that the nearest value is 90.0, which is for a 15″ beam, 200 lbs. per yard.

The resistance of a beam of any kind to bending is proportional to the modulus of the section of the beam. If two beams of different forms be subjected to the same loading, that one will be the more economical which, with a given value of the modulus of section, has the smaller sectional area S. Thus, for example, looking in the tables in column

10, we find that a 4″ I beam, 30 lbs. per yard, has a modulus R = 3.5, and also that a 6″ channel, 22½ lbs. per yard, has the same value for the modulus R.

Whence we see that the 6″ channel is the more economical, since it weighs 25 per cent. less than the 4″ beam. Moreover it is a stiffer shape than the beam, for with the same loads and span, that shape has the less deflexion, the greater is the value of the moment of inertia I; for the 4″ I beam, 30 lbs. per yard, the value of I is (see column 7) 7.0, while that for the 6″ channel, 22½ lbs. per yard, is 10.75. Hence if these shapes be protected against *lateral* deflexion, it would be more economical to use the 6″ channel than the 4″ beam, for the weakness of the channel is in its small width of flange; having only a flange width of 1¾″, whilst the beam has 2½″.

In columns 9 of the tables, we have given the values for each shape, of what Rankine calls q, which is the ratio $\frac{2\,I}{h^2\,S}$

that is, $q = \frac{2\,I}{h^2\,S} = \frac{R}{n\,S}$.

This shows that with two beams of the same depth, that one is the more economical which has the greater value of the ratio $\frac{R}{S}$, or in other words, that whose value of q is the greater. For example, consider shape No. 29 in the list of channels—the 12″ [, 62 lbs. per yard, has q = 0.282; R = 21.0; the 12″ [, 84½ lbs. per yard, has q = 0.251, and R = 25.5. Now for the former, $\frac{21}{6.2} = 3.387$, and for the latter, $\frac{25.5}{8.45} = 3.002$. It is evident then that 12″ [, 62 lbs. has greater carrying capacity for its weight than the 12″ [, 84½ lbs. Thus it appears that the strength of beams do not increase in proportion to their increase of weight. We should, then, always use the minimum or standard section of a shape, in preference to one obtained by widening the rolls. Of course this applies to beams only when subjected to transverse loads. From the values of q in the tables, we can at once see the relative economy of the shapes.

POTTSVILLE ROLLING MILLS.

Properties of I Beams.

No. of Shape.	Name.	Weight per foot in lbs.	Area of section in square inches.	Width of flange in inches.	Thickness of web in inches.	Neutral axis at centre of shape and perpendicular to web.					Neutral axis coincident with web.	
						Moment of Inertia, I.	Radius of Gyration, r_1.	$q = \frac{2I}{h^2S}$	$R = \frac{2I}{h}$	$C = \frac{8I}{h}$	Moment of Inertia, I.	Radius of Gyration, r_1.
	"			"	"							
1	15	83⅓	25.0	5⅞	⅞	813	6.38	.287	108.0	432.0	25.89	1.0
2	15	66⅔	20.0	5⅝	⅝	674	5.83	.303	90.0	360.0	31.00	1.57
3	15	50.0	15.0	5	½	518	5.88	.307	69.0	276.0	17.36	1.08
4	12	56⅔	17.0	5 5/16	¾	356	4.57	.290	59.25	237.0	21.89	1.14
5	12	41⅔	12.5	4 11/16	½	278	4.72	.310	46.25	185.0	13.33	1.03
6	10½	45	13.5	5	½	239	4.21	.321	45.5	182.0	19.10	1.19
7	10½	35	10.5	4 7/16	½	176	4.09	.304	33.5	134.0	9.71	0.96
8	10½	30	9 0	4⅛	7/16	151	4.00	.304	29.0	116.0	6.99	0.88
9	9	30	9.0	4 7/16	9/16	106	3.42	.289	23.5	94.0	7.40	0.91
10	9	28⅓	8.5	4¼	7/16	107.5	3.56	.312	24.0	96.0	7.65	0.95
11	9	23⅓	7.0	4⅛	⅜	89	3.56	.314	19.75	79.0	5.67	0.90
12	8	26⅔	8.0	4 3/16	½	77	3.10	.302	19.25	77.0	6.66	0.91
13	8	21⅔	6.5	4	5/16	68	3.26	.331	17.0	68.0	5.81	0.95
14	7	21⅔	6.5	3 15/16	7/16	50.5	2.79	.316	14.25	57.0	4.73	0.85
15	7	18⅓	5.5	3 7/16	5/16	44	2.83	.326	12.5	50.0	3.84	0.84
16	6	16⅔	5.0	3 7/16	5/16	29	2.42	.326	9.75	39.0	3.39	0.82
17	6	13⅓	4.0	3⅜	¼	24	2.45	.334	8.0	32.0	2.56	0.80
18	5	13⅓	4.0	3	5/16	16	1.99	.316	6.25	25.0	2.04	0.71
19	5	10	3.0	2¾	3/16	12	2.0	.32	4.8	19.2	1.39	0.68
20	4	10	3.0	2½	7/16	7	1.53	.292	3.5	14.0	0.83	0.53
21	4	8	2.4	2¼	5/16	6.5	1.66	.346	3.25	13.0	0.59	0.50
22	4	6	1.8	2⅛	3/16	4	1.5	.28	2.0	8.0	0.42	0.48

POTTSVILLE ROLLING MILLS.

Properties of Channel Bars.

No. of Shape.	Name.	Weight per foot in lbs.	Area of section in square inches.	Width of flange in inches.	Thickness of web in inches.	Neutral axis at centre of shape and perpendicular to web.					Neutral axis parallel to web.		
						Moment of Inertia, I.	Radius of Gyration, r.	$q = \frac{2I}{h^2 S}$	Modulus of section, $R = \frac{2I}{h}$	Coefficient for one foot of Span, $C = (8I \div h)$.	Moment of Inertia, J.	Radius of Gyration, r.	Distance of neutral axis from outside of web.
	"			"	"								
26	12	50.0	15.0	3½	⅞	265	4.20	0.245	44.0	176.0	15.71	1.07	0.97
26	12	30.0	9.0	3	⅜	193	4.63	0.298	32.0	128.0	8.94	0.99	0.94
27	12	28.2	8.45	2 5/8	½	153	4.25	0.251	25.5	102.0	5.06	0.77	0.67
27	12	20⅔	6.2	2¾	5/16	126	4.51	0.282	21.0	84.0	4.04	0.81	0.70
28	10	42.9	12.87	3½	1 1/16	140	3.29	0.217	28.0	112.0	7.78	0 77	0.84
28	10	20.0	6.0	2 1/16	⅜	82	3.70	0.274	16.5	66.0	3.92	0.81	0.70
29	10	20⅔	6.2	2⅝	7/16	75.5	3.49	0.244	15.0	60.0	2.64	0.65	0.62
29	10	16.0	4.8	2½	5/16	65	3.68	0.271	13.0	52.0	2.42	0.71	0.59
30	9	31.0	9.3	3⅛	¾	91	3.13	0.242	20.25	81.0	6.02	0.80	0.80
30	9	20.0	6.0	2¾	⅜	70	3.41	0.287	15.5	62.0	4.07	0.82	0.79
31	9	19.0	5.7	2⅝	7/16	59.5	3.23	0.257	13.25	53.0	2.89	0.71	0.62
31	9	15⅓	4.6	2½	5/16	52.0	3.37	0.279	11.5	46.0	3.17	0.83	0.64
32	8	21⅔	6.5	2 11/16	⅝	48.75	2.74	0.234	12.25	49.0	2.79	0.66	0.61
32	8	13⅓	4.0	2⅜	5/16	35.25	2.97	0.283	9.0	36.0	2.30	0 76	0.60
33	8	11⅔	3.5	2 1/16	5/16	28.25	2.84	0.253	7.0	28.0	1.60	0.67	0.52
33	8	10	3.0	2½	¼	25.5	2.92	0.267	6.5	26.0	1.46	0.69	0.55
34	6	17½	5.25	2⅝	⅝	23.0	2.10	0.246	7.75	31.0	2 47	0 68	0.68
34	6	10	3.0	2⅛	¼	16.25	2.33	0.30	5.5	22.0	1.29	0.66	0.65
35	6	10	3.0	1⅞	⅜	13.0	2.08	0.24	4.25	17.0	0.66	0.47	0.43
35	6	7½	2.25	1¾	¼	10.75	2.18	0.267	3.5	14 0	0 53	0.49	0 42
36	5	8⅔	2.6	2	5/16	9.0	1.88	0.276	3.5	14.0	0 88	0 58	0.56
37	5	5⅔	1.7	1¾	3/16	6 25	1.92	0.295	2.5	10.0	0.48	0.53	0 49
38	4	8	2.4	2	5/16	5.5	1.52	0.288	2.75	11.0	0.87	0.60	0 64
39	4	5	1.5	1¾	3/16	3 75	1.56	0.304	2 0	8.0	0.44	0.54	0.54

COLUMNS AND POSTS.

The table of the ultimate and safe strength of hollow cylindrical wrought and cast-iron columns is given on page 87. It is computed by Gordon's formula for varying values of the ratio of length to diameter. The factor of safety for cast-iron columns has been taken at 6, and that for wrought-iron columns at 4. It is assumed that the ends are fixed in direction, such as having planed bearings on capitals and bases.

The table on the ultimate and safe strength of wrought-iron columns is computed according to Rankine's formula for varying values of the ratio of the length to the least radius of gyration, and for the three conditions of square end-bearings, one square end-bearing and the other pin-end, and for both ends with pin-bearings. The factor of safety used in the tables for safe strength is 5. If the column be subjected to loads without vibration the factor could be 4.

To illustrate the use of this table, suppose we wish the ultimate strength of 12″ I beam, 125 lbs. per yard, when used as a post, its ends being fixed, and having an unsupported length of 8′ 6″.

Referring to the tables of the properties of I beams, we find that the least radius of gyration I_J, is given as 1.03″; the length being 8′ 6″ = 102″; the ratio $\frac{l}{r} = \frac{102}{1.03} =$ say 100; for which, on looking at the table, we find the ultimate strength to be 32,000 lbs. per square inch. The section of the 12″ beam being 12.5 □″, the ultimate strength is then 12½ × 32,000 lbs. = 400,000 lbs.

STRENGTH

OF HOLLOW, CYLINDRICAL

WROUGHT AND CAST-IRON COLUMNS,

WHEN FIXED AT THE ENDS.

Computed by Gordon's formula. $$P = \frac{fS}{1 + c\left(\frac{l}{h}\right)^2}$$

Let P = Ultimate strength in lbs. per square inch.
S = Sectional area in square inches.
l = Length of column, } both in same units.
h = Diameter of column, }
$\frac{l}{h}$ = Ratio of length to diameter.
f = { 40,000 lbs. for wrought-iron, } / { 80,000 lbs. for cast-iron. }
C = $\frac{1}{36000}$ for wrought-iron, and $\frac{1}{800}$ for cast-iron.

For cast-iron, $$P = \frac{80000\ S}{1 + \frac{1}{800}\left(\frac{l}{h}\right)^2}$$

For wrought-iron, $$P = \frac{40000\ S}{1 + \frac{1}{36000}\left(\frac{l}{h}\right)^2}$$

Ratio of Length to Diameter, $\frac{l}{h}$	Maximum Load per Square Inch.		Safe Load per Square Inch.	
	Cast-Iron.	Wrought-Iron	Cast-Iron, Factor of 6.	Wrought-Iron, Factor of 4.
8	74075	39164	12346	9791
10	71110	38710	11851	9677
12	67796	38168	11299	9542
14	64256	37546	10709	9386
16	60606	36854	10101	9213
18	56938	36100	9489	9025
20	53332	35294	8889	8823
22	49845	34442	8307	8610
24	46510	33556	7751	8389
26	43360	32642	7226	8161
28	40404	31712	6734	7928
30	37646	30768	6274	7692
32	35088	29820	5848	7455
34	32718	28874	5453	7218
36	30584	27932	5097	6983
38	28520	27002	4753	6750
40	26666	26086	4444	6522
42	24962	25188	4160	6297
44	23396	24310	3899	6077
46	21946	23454	3658	5863
48	20618	22620	3436	5655
50	19392	21818	3262	5454
52	18282	21036	3047	5259
54	17222	20284	2870	5071
56	16260	19556	2710	4889
58	15368	18856	2561	4714
60	14544	18180	2424	4545

ULTIMATE STRENGTH

OF

WROUGHT-IRON COLUMNS.

p = ultimate strength per square inch.
l = length of column in inches.
r = least radius of gyration in inches.

For square end bearings, $$p = \frac{40000}{1 + \frac{1}{200000}\left(\frac{l}{r}\right)^2}$$

For one pin and one square bearing, $$p = \frac{40000}{1 + \frac{1}{300000}\left(\frac{l}{r}\right)^2}$$

For two pin bearings, $$p = \frac{40000}{1 + \frac{1}{200000}\left(\frac{l}{r}\right)^2}$$

For safe working load on these columns use a factor of 4 when used in buildings, or when subjected to dead load only; but when used in bridges the factor should be 5.

$\frac{l}{r}$	Ultimate Strength in lbs. per Square Inch.			$\frac{l}{r}$	Safe Strength in lbs. per Square Inch—Factor of 5.		
	Square Ends.	Pin and Square End.	Pin Ends.		Square Ends.	Pin and Square End.	Pin Ends.
10.0	39944	39866	39800	10.0	7989	7973	7960
15.0	39776	39702	39554	15.0	7955	7940	7911
20.0	39604	39472	39214	20.0	7921	7894	7843
25.0	39384	39182	38788	25.0	7877	7836	7758
30.0	39118	38834	38278	30.0	7821	7767	7656
35.0	38810	38430	37690	35.0	7762	7686	7538
40.0	38460	37974	37036	40 0	7692	7595	7407
45.0	38072	37470	36322	45.0	7614	7494	7264
50.0	37646	36928	35525	50.0	7529	7386	7105
55.0	37186	36336	34744	55.0	7437	7267	6949
60.0	36697	35714	33898	60.0	7339	7143	6780
65.0	36182	34478	33024	65.0	7236	6896	6605
70.0	35634	34384	32128	70.0	7127	6877	6426
75.0	35076	33682	31218	75.0	7015	6736	6244
80.0	34482	32966	30288	80.0	6896	6593	6058
85.0	33883	32236	29384	85.0	6777	6447	5877
90.0	33264	31496	28470	90.0	6653	6299	5694
95.0	32636	30750	27562	95.0	6527	6150	5512
100.0	32000	30000	26666	100.0	6400	6000	5333
105.0	31357	29250	25786	105.0	6271	5850	5157

AVERAGE ULTIMATE CRUSHING LOADS.

TIMBER.	Weight per Cubic Foot.	Lb. per Inch.
Ash	48	8600
Beech, unseason	53	7700
" season	43	9300
Cedar, unseason	56	5700
" season	50	6500
Oak, unseason	54	4200
" season	67	6000
Pine Pitch	..	6800
Pine, yellow, unseason	..	5300
" " season	..	5400
" white, unseason	35	5000
Poplar, unseason	..	3100
" season	..	5100
Sycamore	..	7000
Spruce, unseason	..	6500
" season	..	6800

AVERAGE ULTIMATE CRUSHING LOADS.

STONE AND CEMENTS.	Mean Ton Per Sq. Foot.
	Tons.
Limestone	625
Sandstone	425
Brick	175
Ordinary crack	25
In Cement	35
First-class Cement	60
Concrete	40
Portland Cement	120

STRENGTH OF TIMBER AS POSTS.

Formula for the ultimate strength of square or rectangular posts of moderately seasoned white and yellow pine, with ends flat and fixed:

$$P = \frac{f}{1 + \frac{1}{250}\left(\frac{l}{h}\right)^2}$$

Where P = crushing load per square inch.

f = 5000 lbs. per square inch.

l = length of post in inches.

h = least width of post in inches.

$\frac{l}{h}$ = ratio of length to least width.

LEAST WIDTH OF SQUARE PINE POSTS IN INCHES.

BREAKING LOAD IN TONS.

Height.	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Feet.														
4	9.9	22.7	40.8	63.8	92.1	125.	163.	204.	251.	302.	358.	418.	482.	552.
6	6.1	15.6	30.5	51.0	76.8	108.	143.	184.	231.	281.	335.	394.	456.	526.
8	3.9	10.8	12.5	39.7	62.4	90.8	124.	163.	207.	255.	303.	367.	429.	500.
10	2.7	7.8	16.9	30.9	50.3	75.3	106.	142.	183.	230.	281.	339.	400.	466.
12	2.0	5.8	12.9	24.3	40.6	62.5	87.	122.	160.	204.	252.	307.	365.	432.
14	1.4	4.4	10.1	19.4	33.1	51.9	76.	105.	140.	180.	225.	277.	333.	397.
16	1.1	3.5	8.1	15.8	27.3	43.4	64.	90.	122.	159.	201.	250.	303.	363.
18	0.92	2.8	6.6	13.0	22.7	36.6	55.	78.	106.	140.	179.	224.	274.	331.
20	0.76	2.3	5.5	10.9	19.2	31.1	47.	68.	93.	124.	160.	201.	248.	301.
22	..	..	4.6	9.2	16.3	26.8	40.	59.	82.	109.	143.	182.	224.	274.
24	.	..	3.9	7.9	14.1	23.2	36.	52.	72.	97.	127.	163.	203.	249.
26	..	..	3.4	6.8	12.2	20.1	30.	49.	64.	87.	115.	148.	184.	226.
28	..	..	2.9	5.9	10.7	17.7	28.	41.	57.	78.	103.	133.	167.	206.
30	..	..	2.1	5.2	9.4	15.3	25.	34.	51.	70.	93.	121.	152.	189.
Feet.														
Height.	3	4	5	6	7	8	9	10	11	12	13	14	15	16

WOODEN BEAMS.

Safe Uniformly Distributed Load in Tons of 2,000 lbs. for Rectangular White or Yellow Pine Beams 1 inch in Thickness. (Cooper & Hewitt.)

Span in feet.	DEPTH IN INCHES. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.069	0.278	0.625	1.111	1.736	2.500	3.403	4.444	5.625	6.944	8.403	10.000	11.737	13.611	15.625
2	0.035	0.139	0.312	0.556	0.868	1.250	1.701	2.222	2.812	3.472	4.201	5.000	5.868	6.806	7.813
3	0.023	0.093	0.208	0.370	0.579	0.833	1.134	1.481	1.875	2.315	2.801	3.333	3.912	4.537	5.208
4	0.017	0.069	0.156	0.278	0.434	0.625	0.851	1.111	1.406	1.738	2.101	2.500	2.934	3.403	3.906
5	0.014	0.056	0.125	0.222	0.347	0.500	0.681	0.888	1.125	1.389	1.681	2.000	2.347	2.722	3.125
6	0.012	0.046	0.104	0.185	0.289	0.417	0.567	0.741	0.938	1.157	1.400	1.667	1.956	2.269	2.604
7	0.010	0.040	0.089	0.159	0.248	0.357	0.486	0.635	0.804	0.992	1.200	1.429	1.677	1.944	2.232
8	0.009	0.035	0.078	0.139	0.217	0.312	0.425	0.555	0.703	0.868	1.050	1.250	1.467	1.701	1.953
9	0.008	0.031	0.069	0.123	0.193	0.278	0.378	0.494	0.625	0.772	0.934	1.111	1.304	1.512	1.736
10	0.007	0.028	0.062	0.111	0.174	0.250	0.340	0.444	0.562	0.694	0.840	1.000	1.174	1.361	1.562
11	0.006	0.025	0.057	0.101	0.158	0.227	0.309	0.404	0.511	0.631	0.764	0.909	1.067	1.237	1.420
12	0.006	0.023	0.052	0.093	0.145	0.208	0.284	0.370	0.469	0.579	0.700	0.833	0.978	1.134	1.302
13	0.005	0.021	0.048	0.085	0.134	0.192	0.261	0.342	0.433	0.534	0.646	0.769	0.903	1.047	1.202
14	0.005	0.020	0.045	0.079	0.124	0.179	0.243	0.317	0.402	0.496	0.600	0.714	0.838	0.972	1.116
15	0.005	0.019	0.042	0.074	0.116	0.167	0.227	0.296	0.375	0.463	0.560	0.667	0.782	0.907	1.042
16	0.004	0.017	0.039	0.069	0.109	0.156	0.213	0.278	0.352	0.434	0.525	0.625	0.734	0.851	0.977
17	0.004	0.016	0.037	0.065	0.102	0.147	0.200	0.261	0.331	0.408	0.494	0.588	0.690	0.801	0.919
18	0.004	0.015	0.035	0.062	0.096	0.139	0.189	0.247	0.312	0.386	0.467	0.556	0.652	0.756	0.868
19	0.004	0.015	0.033	0.058	0.091	0.132	0.179	0.234	0.296	0.365	0.442	0.526	0.617	0.716	0.822
20	0.003	0.014	0.031	0.056	0.087	0.125	0.170	0.222	0.281	0.347	0.420	0.500	0.587	0.681	0.781
21	.....	0.013	0.030	0.053	0.083	0.119	0.162	0.212	0.268	0.331	0.400	0.476	0.559	0.648	0.744
22	.....	0.013	0.028	0.051	0.079	0.114	0.155	0.202	0.256	0.311	0.382	0.455	0.533	0.619	0.710
23	.....	.....	0.027	0.048	0.075	0.109	0.148	0.193	0.245	0.302	0.365	0.435	0.510	0.592	0.679
24	.....	.....	.....	0.046	0.072	0.104	0.142	0.185	0.234	0.289	0.350	0.417	0.489	0.567	0.651
25	.....	.....	.....	.....	0.069	0.100	0.136	0.178	0.225	0.278	0.336	0.400	0.469	0.544	0.625
26	.....	.....	.....	.....	.....	0.096	0.131	0.171	0.216	0.267	0.323	0.385	0.451	0.524	0.601
27	.....	.....	.....	.....	.....	.....	0.126	0.165	0.208	0.257	0.311	0.370	0.435	0.504	0.579
28	.....	.....	.....	.....	.....	.....	.....	0.159	0.201	0.248	0.300	0.357	0.419	0.486	0.558
29	.....	.....	.....	.....	.....	.....	.....	.....	0.196	0.239	0.290	0.345	0.405	0.469	0.539
30	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.231	0.280	0.333	0.391	0.454	0.521

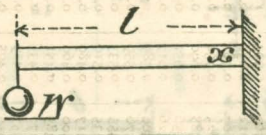
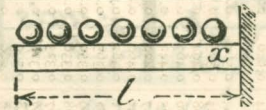
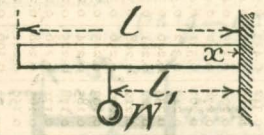
These loads are about one-eighth the breaking load.

RULE.—**To find the safe uniformly distributed load** in tons for white or yellow pine beams, multiply the number given in the above table by the thickness of the beam in inches. For beams of other wood, multiply also by the following numbers:

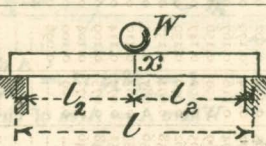
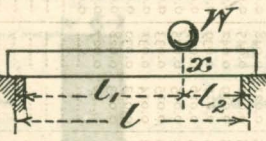
White Oak, 1.45. Hemlock, .95. White Cedar, .63. Spruce, 1.00.

BENDING MOMENTS AND SHEARING FORCES FOR DIFFERENT LOADS AND SUPPORTS.

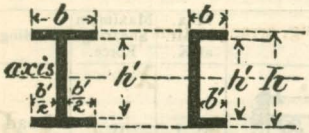
BEAMS FIXED AT ONE END.

DIAGRAM.	Max. B. Mt. at X.	Maximum Shearing Force.	Loading.
	$W\,l.$	$W.$	Load at end.
	$\frac{W\,l^2}{2}$	$W\,l$	Uniformly loaded with W lbs. per lineal ft.
	$W\,l_1$	W	Eccentric Loading.

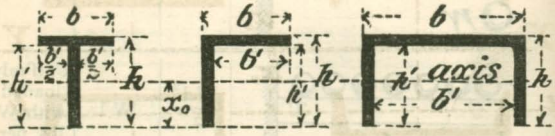
BEAMS WITH SUPPORTED ENDS.

	$\frac{W\,l.}{4}$	$\frac{W}{2}$	Load at Centre.
	$\frac{W\,l_1\,l_2}{l}$	$\frac{W\,l_1}{l}$ and $\frac{W\,l_2}{l}$	Eccentric Loading.
	$\frac{W\,l^2}{8}$	$\frac{W\,l}{2}$	Uniformly distributed Load of W lbs. per lineal ft.

MOMENTS OF INERTIA FOR SIMPLE SHAPES.

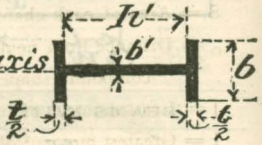


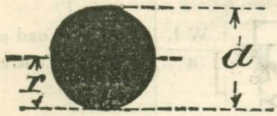
$$I = \frac{b\,h^3 - b^1\,h^{1\,3}}{12}$$



$$I = \frac{(b\,h^2 - b^1\,h^{1\,2})^2 - 4.\,b\,h.\,b^1\,h^1\,(h - h^1)^2}{12\,(b\,h - b^1\,h^1)}$$

$$J = \tfrac{1}{12}\,(t\,b^3 + h^1\,b^{1\,3}$$



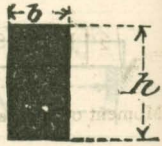


$$I = .7854\ r^4 = \frac{A\,d^2}{16}$$

Where A = Area of circle.

$$I = \frac{b\,h^3}{12} = \frac{A\,h^2}{12}$$

Where A = area = b h.

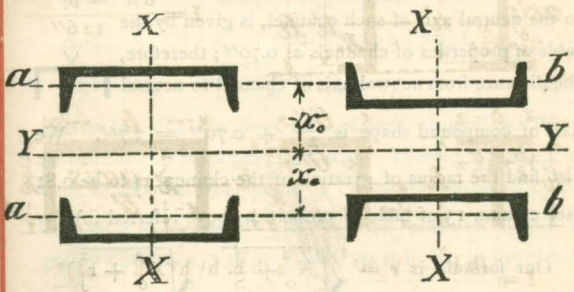


$$I = \frac{b\,t^3}{12} = \frac{A\,t^2}{12}$$

Where A = area = b t.

MOMENTS OF INERTIA FOR COMPOUND SHAPES.

Two channels, with lacing, arranged thus:



Line ab = Neutral axes of channels.

S = Area of each channel.

x_o = Distance from neutral axis of channel to axis of compound shape YY.

J = Least moment of inertia of the channel.

I = Greatest moment of inertia of the channel.

Moment of inertia, axis YY

$$= 2\left[J + x_o^2 S\right]$$

Radius of gyration, axis YY

$$= \sqrt{\frac{2\left[J + x_o^2 S\right]}{2S}} = \sqrt{x_o^2 + \frac{J}{S}} = \sqrt{x_o^2 + r_J^2}$$

Moment of inertia, axis XX

$$= 2\,I.$$

Radius of gyration, axis YY

$$= \sqrt{\frac{2I}{2S}} = \sqrt{\frac{I}{S}}. = r_I.$$

Required the least radius of gyration of a column formed of 2-10″ channels, 60 lbs. per yard, placed 6″ apart, back to back of webs, as shown in figure.

The distance from back of a 10″ channel, 60 lbs. to the neutral axis of such channel, is given by the table of properties of channels as 0.70″; therefore, the distance from neutral axis of channel to neutral axis of compound shape is $\frac{6''}{2} + 0.70'' = 3.7''$. We also find the radius of gyration of the channel r_J to be 0.81 (see column 13 of table of properties above referred to).

Our formula is $r = \sqrt{X_o^2 + \frac{J}{S}} \quad \sqrt{X_o^2 + r_J^2}$

which for the 10″ channel post is

$$r = \sqrt{3.7^2 + 0.81^2} = 3.78.$$

The radius of gyration when the axis is perpendicular to web is, for the 10″ channel, 60 lbs. per yard, as per table, 3.70.

Thus, we find that the column is slightly weaker in the direction of plane of channels, than in a direction perpendicular to such plane.

Suppose we wish to form a post of 2-12″ channels, 90 lbs. per yard, and that we desire to know how far apart in the clear to place these channels, in order that both radii of gyration be the same. We simply equate the expressions

$$\sqrt{x_o^2 + r_J^2} \text{ and } r_I,$$

Whence $x_o^2 = r_I^2 - r_J^2 = (r_I + r_J)(r_I - r_J)$

Now for the 12″ channel, 90 lbs., the table gives us $r_I = 4.63$; $r_J = 0.99$.

Therefore, $4.63 + 0.99 = 5.62$

And $4.63 - 0.99 = 3.64$.

And $x_o^2 = 5.62 \times 3.64 = 20.46$.

Therefore, $x_o = \sqrt{20.40} = 4.52''$.

Now the distance from back of 12″ channel, 90 lbs. to its neutral axis is, as per table, 0.94. Therefore, distance of back of channel from centre of compound shape $= x_o - 0.94 = 4.52 - .94 = 3.58''$. Thus channels should be placed apart $2 \times 3.58 = 7.16''$, say 7 inches in the clear.

TWO CHANNELS AND I BEAM.

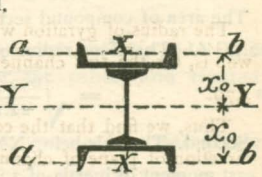
a b = Neutral axis of channel.

S_1 = Area of channel.

S_2 = Area of beam.

J_1 = Least moment of inertia of channel.

J_2 = Least moment of inertia of beam.



I_1 = Greatest moment of inertia of channel.

I_2 = Greatest moment of inertia of beam.

Moment of inertia, axis YY

$$= I_2 + 2\left[J + x_{o.}^2 \; S_1\right]$$

Radius of gyration, axis YY.

$$= \sqrt{\left[\frac{I_2 + 2\left[J + x_{o.}^2 S_1\right]}{2S_1 + S_2}\right]}$$

Moment of inertia, axis XX.

$$= J_2 + 2\,I_1$$

Radius of gyration, axis XX

$$= \sqrt{\frac{J_2 + 2\,I_1}{2\,S_1 + S_2}}$$

Required the moments of inertia of a column, formed as above, of 2-10″ channels, 48 lbs. per yard, and 1-12″ I beam, 125 lbs. per yard.

First, axis being YY.

Maximum moment of inertia of 12″ I, 125 lbs. = 278.0. Least moment of inertia of 10″ channel, 48 lbs. = 2.42; distance from back of channel to neutral axis = 0.59. Whence x_0 = ½ depth of beam + 0.59 = 6.59.

Therefore, total moment of inertia of column, the axis being YY is

$$278.0 + 2\left[\,2.42 + (6.59)^2 \times 4.8\,\right] =$$

$$278.0 + 2 \times 210.87 = 699.74.$$

The area of compound section = 12.5 □″ + 2 × 4.8 = 22.1 □″. Therefore, radius of gyration, axis being as above is

$$= \sqrt{\frac{699.74}{22.1}} = 5.626''.$$

Second. The axis being XX.

Least moment of inertia of 12″ I beam, 125 lbs. =	13.33.
Twice maximum moment of inertia of 10″ channel, 48 lbs. . . . . =	130.00.
Moment of inertia of compound section, axis XX. =	143.33.

The radius of gyration is

$$\sqrt{\frac{143.33}{22.1}} = 2.55''.$$

Thus, around the axis YY, the compound section formed of 1-12″ beam, 125 lbs., and 2-10″ channels, 48 lbs., is

more than twice as strong as around the axis XX; provided, of course, the condition of ends of columns is the same, as, for example, both fixed ends.

BEARING OF GIRDERS ON BRICK WALLS.

The pressure on a brick wall should not exceed 8 tons per square foot; hence when beams are used for floor-joist, their bearings on wall should be so proportioned as not to exceed the above limit—this is conveniently done by means of a loose $\frac{3}{8}''$ plate of wrought-iron.

The ends of girders and floor-joist should have "check-angles" at their wall-ends, thus checking the walls from falling outwards in case of fire.

The depth which the beam extends in the wall must not be less than 8 inches.

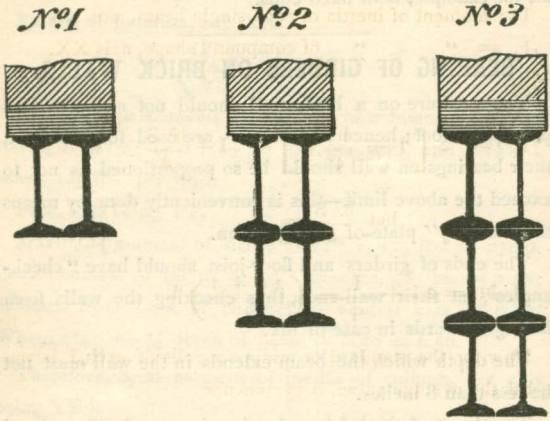
The thrust of the brick arches is taken up by tie-rods $\frac{3}{4}$ to 1 inch in diameter, spaced from 5 to 8 apart—the holes for which are punched in middle of web.

Girders formed of beams placed side by side, and beams placed one over the other, and riveted along the flanges.

In supporting heavy walls, the beams can be placed side by side, or be coupled, as in the following sketches.

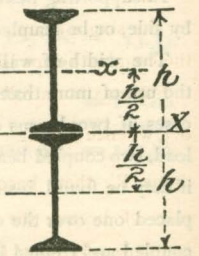
The width of wall to be supported sometimes prevents the use of more than two beams under them; and, in such cases, if two beams cannot be found sufficient to carry the load, two coupled beams can be used as shown by Fig. 2; or, if they be found insufficient, two sets of three beams each, placed one over the other, can be used. See Fig. 3. The coupled and trebled beams are used in lieu of plate-girders. If plate-girders be used, they would be with a single web,

and the wide-top flange necessary to carry wall would make the use of heavy vertical stiffeners a necessity.



In using coupled and trebled beams, cast-iron separators are needed, and are generally made of depth of the compound shape. Between brickwork and top of beams should be placed a slate or granite-plate 2½ to 5″ thick, to get an even bearing for wall. This plan of carrying heavy walls is much used by the United States government in the Public Buildings.

2–I beams coupled, as in adjoining sketch. Required the moment of inertia. Both beams being of same depth and weight.



Let h = height of beam, then $\frac{h}{2}$ = distance from centre of inertia of single beam to centre of inertia of compound shape. Let S

= area of one beam, then 2 S = area of compound section.

I = moment of inertia of each single beam, axis XX.

I_c = " " of compound shape, axis XX.

Then

$$I_c = 2\left[I + \frac{h^2}{4} S\right] = 2I + \frac{h^2 S}{2}$$

$$\text{but } \frac{h^2 S}{2} = \frac{I}{q}$$

$$\therefore I_c = 2I + \frac{I}{q} = \left(\frac{2q + 1}{q}\right) I.$$

Now for the standard or minimum rolls of each I beam, q has the average value, 0.33, whence

$$\frac{2q + 1}{q} = \frac{2 \times 0.33 + 1}{0.33} = 5$$

$$\therefore I_c = 5\ I.$$

If R_c be the modulus of this compound shape, then $R_c = \frac{2.\ I_c}{2.\ h} = \frac{I_c}{h} = \frac{5\ I}{h} = 2.5$ R, where R is the modulus for the single beam. Whence the moment of resistance of the coupled beams is 2½ times that for a single beam.

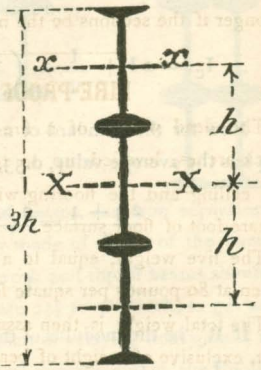
For maximum rolls of a beam, q has the average value of 0.3, whence $\frac{2q + 1}{q} = 5.33$; and $I_c = 5.33$ I. The modulus R_c then becomes 2.67. R. Thus for the heavier rolls of beams, the moment of resistance of the coupled beams is 2.67 times that for a single beam.

Comparing the coupled beams with two beams of same depth and weight, placed side by side, the coupled beams

are 1.25 stronger than if the two beams be placed side by side, if the sections be the minimum rolls; and 1.33 times stronger if the sections be the heavier rolls.

The rivets connecting the flanges together should be 7/8" or 3/4" diameter, dependent upon the thickness of the flanges, and the pitch should be about 6" or 8" staggered. At ends of beams the pitch of rivets should be from 3" to 4" for a length of twice the depth of the compound shape.

Three beams riveted together, as in adjoining sketch. Each beam being of same depth and weight.



Let h = height of each beam, then h is the distance from centre of inertia of outside beams to centre of inertia of compound shapes.

Let S = area of each beam, then 3 s = area of compound section.

I = moment of inertia of each beam, when referred to its own neutral axis.

I_c = moment of inertia of compound shape.

Then

$$I_c = I + 2\left[I + h^2 S\right] = 3I + 2h^2 S$$

$$\text{but } 2h^2 S = \frac{4I}{q}$$

$$\therefore I_c = 3I + \frac{4I}{q} = \left(\frac{3q+4}{q}\right) I$$

For minimum rolls, $I_c = 15$ I.
" maximum " $I_c = 16$ I.
" minimum " $R_c = 5$ R.
" maximum " $R_c = 5.33$ R.

Comparing the trebled beams with 3 beams of the same depth and weight, placed side by side, the trebled beams are 1.66 times stronger than if the 3 beams be placed side by side, if the beams be the minimum rolls; and 1.78 times stronger if the sections be the maximum rolls.

FIRE-PROOF FLOORS.

The dead weight of a fire-proof floor, comprising 4″ brick-arches, levelled up to top of beam with concrete, the ceiling and the flooring will run about 70 pounds per square foot of floor surface.

The live weight, equal to a dense crowd of people, is taken at 80 pounds per square foot.

The total weight is then assumed 150 pounds per square foot, exclusive of weight of beams themselves.

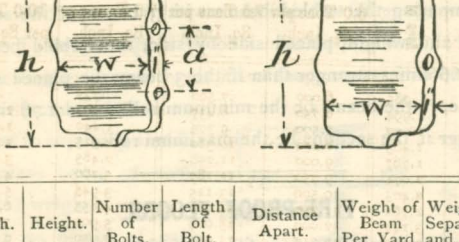
The following loads are *exclusive* of weight of arches and beams:

Dense crowd of people	80	lbs. per sq. ft.
Floors of houses	50	" "
Theatres, churches	80	" "
Ball-rooms	90	" "
Warehouses	250	" "
Factories	200 to 450	" "
Snow, 30 inches deep	15	" "
Brick walls	112	per cub. ft.
Stone walls	116 to 144	" "

STANDARD SEPARATORS

—OF—

POTTSVILLE IRON AND STEEL CO.



Width.	Height.	Number of Bolts.	Length of Bolt.	Distance Apart.	Weight of Beam Per Yard.	Weight of Separators and Bolts.
w.	h.		l.	a.		
5 in.	15 in.	2	7¼ in.	8 in.	200 lbs.	22.29 lbs.
4½ "	15 "	2	6½ "	8 "	150 "	20.06 "
4⅝ "	12 "	2	7⅛ "	6 "	170 "	17.2 "
4¼ "	12 "	2	6¼ "	6 "	125 "	16.06 "
4½ "	10½ "	1	6½ "	In centre.	135 "	13.45 "
4 "	10½ "	1	6 "	" "	105 "	11.97 "
3⅝ "	10½ "	1	5½ "	" "	90 "	10.82 "
4 "	9 "	1	6⅛ "	" "	90 "	10.88 "
3⅞ "	9 "	1	5¾ "	" "	85 "	8.5 "
3⅞ "	9 "	1	5⅝ "	" "	70 "	8.4 "
3⅞ "	8 "	1	5⅞ "	" "	80 "	7.88 "
3⅝ "	8 "	1	5¼ "	" "	65 "	7.5 "
3¼ "	7 "	1	5⅛ "	" "	65 "	6.8 "
3¼ "	7 "	1	4⅞ "	" "	55 "	6.76 "
3 "	6 "	1	4⅝ "	" "	50 "	5.73 "
2⅞ "	6 "	1	4⅜ "	" "	40 "	5.2 "

All Standard Separators are 1 inch thick.

All Separator Holes are ⅞ in. diameter for ¾ Bolts.

All Standard Separators made for close girders, except when ordered otherwise.

BEARING VALUES AND BENDING MOMENTS OF PINS.

Diameter of Pin.	Area of Pin.	Bearing Value for 1" Thickness of Plate.		Bending Moment for a Fibre Stress of	
		6.0 Tons per Sq. Inch.	7.5 Tons per Sq. Inch.	7.5 Tons per Sq. Inch.	10.0 Tons per Sq. In.
"					
1	.785	6.000	7.500	.735	.980
1 1/8	.994	6.750	8.437	1.050	1.400
1 1/4	1.227	7.500	9.375	1.440	1.915
1 3/8	1.485	8.250	10.312	1.915	2.500
1 1/2	1.767	9.000	11.250	2.485	3.315
1 5/8	2.074	9.750	12.187	3.160	4.215
1 3/4	2.405	10.500	13.125	3.945	5.250
1 7/8	2.761	11.250	14.062	4.855	6.450
2	3.142	12.000	15.000	5.900	7.850
2 1/8	3.547	12.750	15.937	7.050	9.400
2 1/4	3.976	13.500	16.875	8.400	11.200
2 3/8	4.430	14.250	17.812	9.850	13.150
2 1/2	4.909	15.000	18.750	11.500	15.350
2 5/8	5.412	15.750	19.687	13.300	17.750
2 3/4	5.940	16.500	20.625	15.300	20.400
2 7/8	6.492	17.250	21.562	17.500	23.350
3	7.069	18.000	22.500	19.900	26.500
3 1/8	7.670	18.750	23.437	22.450	29.950
3 1/4	8.296	19.500	24.375	25.300	33.700
3 3/8	8.946	20.250	25.312	28.300	37.750
3 1/2	9.62	21.000	26.250	31.550	42.100
3 5/8	10.32	21.750	27.187	35.050	46.750
3 3/4	11.04	22.500	28.125	38.850	51.750
3 7/8	11.79	23.250	29.062	42.850	57.100
4	12.57	24.000	30.000	47.100	62.850
4 1/8	13.36	24.750	30.937	51.700	68.900
4 1/4	14.19	25.500	31.875	56.500	75.350
4 3/8	15.03	26.250	32.812	61.650	82.200
4 1/2	15.90	27.000	33.750	67.100	89.450
4 5/8	16.80	27.750	34.687	72.850	97.150
4 3/4	17.72	28.500	35.625	78.900	105.200
4 7/8	18.67	29.250	36.562	85.300	113.750
5	19.63	30.000	37.500	92.550	122.700
5 1/8	20.63	30.750	38.437	99.100	132.150
5 1/4	21.65	31.500	39.375	106.550	142.050
5 3/8	22.69	32.250	40.312	114.350	152.450
5 1/2	23.76	33.000	41.250	122.500	163.350
5 5/8	24.85	33.750	42.187	131.050	174.750
5 3/4	25.97	34.500	43.125	140.000	186.650
5 7/8	27.11	35.250	44.062	149.300	199.100
6	28.27	36.000	45.000	159.050	212.050
6 1/8	29.46	36.750	45.937	169.200	225.600
6 1/4	30.68	37.500	46.875	179.750	239.700
6 3/8	31.92	38.250	47.812	190.750	254.350
6 1/2	33.18	39.000	48.750	202.200	269.600
6 5/8	34.47	39.750	49.687	214.100	285.450
6 3/4	35.78	40.500	50.625	226.450	301.950
6 7/8	37.12	41.250	51.562	239.250	319.000

SHEARING AND BEARING VALUE OF RIVETS.

Diam. of Rivet.	Area of Rivet.	Single Shear at 3.0 tons per □″.	BEARING VALUE FOR DIFFERENT THICKNESSES OF PLATE AT 6.0 TONS PER SQUARE INCH. Diameter of Rivet × Thickness of Plate × 6.0 Tons.												
			1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″
3/8	.1104	.331	.562	.703	.844										
7/16	.1503	.451	.656	.820	.984	1.148									
1/2	.1963	.589	.750	.937	1.125	1.313	1.500								
9/16	.2485	.745	.844	1.055	1.266	1.475	1.687	1.900							
5/8	.3068	.920	.937	1.172	1.417	1.640	1.875	2.110	2.344						
11/16	.3712	1.114	1.031	1.290	1.547	1.805	2.062	2.320	2.578	2.836					
3/4	.4418	1.325	1.125	1.406	1.687	1.968	2.249	2.530	2.811	3.092	3.375				
13/16	.5185	1.555	1.219	1.524	1.828	2.134	2.438	2.743	3.047	3.352	3.655	3.960			
7/8	.6013	1.804	1.312	1.640	1.968	2.296	2.624	2.952	3.280	3.608	3.936	4.264	4.592		
15/16	.6903	2.071	1.406	1.757	2.110	2.462	2.813	3.165	3.516	3.867	4.219	4.570	4.921	5.273	
1	.7854	2.356	1.500	1.875	2.250	2.625	3.000	3.375	3.750	4.125	4.500	4.875	5.250	5.625	6.000
1 1/16	.8866	2.660	1.594	1.992	2.391	2.789	3.188	3.586	3.985	4.383	4.782	5.180	5.579	5.977	6.375
1 1/8	.9940	2.972	1.688	2.109	2.531	2.953	3.375	3.797	4.219	4.640	5.062	5.485	5.907	6.329	6.750
1 3/16	1.1075	3.322	1.782	2.227	2.672	3.117	3.562	4.007	4.453	4.898	5.344	5.789	6.235	6.680	7.125

WIND PRESSURE UPON THE INCLINED SURFACES OF ROOFS.

If P = intensity of wind pressure in lbs. per square foot upon any surface normal to its direction and φ = angle made by roof surface with the direction of wind, then the normal pressure on the roof surface is given by

$$P_n = P. \text{ Sin } \varphi^{1.84 \text{ Sin } \varphi - 1.}$$

Let P_h, P_r, be the components of this normal force P_n, parallel and perpendicular respectively, to the direction of wind.

Then $P_h = P_n$, Sin φ, and $P_r = P_n$, cos φ.

If P be assumed to blow horizontally, then φ is angle made by roof surface with the horizontal, and P_n is perpendicular to roof surface, and P_h and P_r are respectively parallel and perpendicular to direction of wind, that is, respectively horizontal and vertical wind forces.

TABLE OF NORMAL PRESSURES,

AND

VERTICAL AND HORIZONTAL COMPONENTS

FOR

VARYING INCLINATIONS OF ROOF SURFACE TO DIRECTION OF WIND, WHEN P = 40 LBS.

ANGLE OF ROOF.	LBS. PER SQUARE FOOT OF SURFACE.		
	P_n	P_r.	P_h.
5°	5.0	4.9	0.4
10°	9.7	9.6	1.7
20°	18.1	17.0	6.2
30°	26.4	22.8	13.2
40°	33.3	25.5	21.4
50°	38.1	24.5	29.2
60°	40.0	20.0	34.0
70°	41.0	14.0	38.5

Thus, for instance, if the angle of roof to the horizontal be 20°, and the wind be assumed as blowing horizontally, we find from preceding table that the force of wind normal to roof surface is 18.1 lbs. per square foot—the horizontal and vertical components of which are respectively 17.0 lbs. per square foot and 6.2 lbs. per square foot.

The horizontal component tends to turn the roof framing about the leeward side considered as a fulcrum, and also to slide it off the walls; the vertical component acts as a one-sided load on the windward side of roof trusses. The trusses and framing should be proportioned to resist these eccentric loadings, and not for a *uniform* load distributed over *whole* surface of roof.

Usually the computation of the stresses is most quickly done by means of the Graphical method.

WEIGHT OF ROOF COVERINGS IN LBS. PER SQUARE FOOT.

Slate, $\frac{3}{16}$″ thick, on 1″ boards, . .	10.0 lbs.
" $\frac{1}{8}$″ " " " . .	7.5 "
Corrugated Iron, No. 20, on 1″ boards,	6.0 "
Felt on Boards, 3-ply, on 1″ Boards =	3.5 "
Tin on 1″ Boards, ...	4.0 "
Slate on T Purlins, ...	12.0 "
Corrugated Iron and Laths, ...	6.0 "
Slate or Iron Laths, ...	10.0 "

When slate is used on purlins of T irons, the purlins should be 2×2×¼, 10 lbs. per yard, and spaced from 10″ to 12″ apart—the spacing between rafters (jacks and principals, or between jacks and jacks) should be about 5 feet.

WEIGHT OF BAR IRON

Size in Inches.	Square Bar 1 Foot Long.	Round Bar 1 Foot Long.	Area in □ Inches.	Area in ○ Inches.	Size in Inches.	Square Bar 1 Foot Long.	Round Bar 1 Foot Long.	Area in □ Inches.	Area in ○ Inches.
1/16	.0132	.0104	.0039	.0031	7/16	6.9600	5.4660	2.0670	1.6230
1/8	.0526	.0414	.0156	.0123	1/2	7.5780	5.9520	2.2500	1.7670
3/16	.1184	.9300	.0351	.0276	9/16	8.2230	6.4530	2.4390	1.9160
1/4	.2105	.1653	.0625	.0491	5/8	8.8970	6.9850	2.6410	2.0740
5/16	.3290	.2583	.0976	.0767	11/16	9.6460	7.5780	2.8640	2.2500
3/8	.4736	.3720	.1406	.1104	3/4	10.3100	8.1010	3.0630	2.4050
7/16	.6446	.5063	.1914	.1503	13/16	11.0700	8.6930	3.2870	2.5810
1/2	.8420	.6612	.2500	.1963	7/8	11.8400	9.3000	3.5160	2.7610
9/16	1.0660	.8370	.3166	.2485	15/16	12.6400	9.9300	3.7520	2.9480
5/8	1.3160	1.0330	.3906	.3068	2	13.4700	10.5800	4.0000	3.1420
11/16	1.5920	1.2500	.4727	.3712	1/8	15.2100	11.9500	4.5160	3.5460
3/4	1.8950	1.4880	.5625	.4418	1/4	17.0500	13.2900	5.0620	3.9760
13/16	2.2230	1.7460	.6603	.5185	3/8	19.0000	14.9200	5.6400	4.4300
7/8	2.5790	2.0250	.7656	.6013	1/2	21.0500	16.5300	6.2500	4.9080
15/16	2.9600	2.3250	.8790	.6903	5/8	23.2100	18.2300	6.8890	5.4120
1	3.3680	2.6450	1.0000	.7854	3/4	25.4700	20.0100	7.5600	5.9390
1/16	3.8030	2.9860	1.1290	.8868	7/8	27.8400	21.8700	8.2640	6.4920
1/8	4.2630	3.3480	1.2660	.9940	3	30.3100	23.8100	9.0000	7.0690
3/16	4.7500	3.7270	1.4090	1.1070	1/8	32.8900	25.8300	9.7640	7.6700
1/4	5.2630	4.1330	1.5620	1.2270	1/4	35.5700	27.9400	10.5610	8.2960
5/16	5.8020	4.5570	1.7230	1.3530	3/8	38.3600	30.1300	11.3880	8.9460
3/8	6.3680	5.0010	1.8910	1.4850	1/2	41.2600	32.4100	12.2500	9.6210

WEIGHT OF BAR IRON—*Continued.*

Size in Inches.	Square Bar 1 Foot Long.	Round Bar 1 Foot Long.	Area in □ Inches.	Area in ○ Inches.	Size in Inches.	Square Bar 1 Foot Long.	Round Bar 1 Foot Long.	Area in □ Inches	Area in ○ Inches
5/8	44.250	34.760	13.138	10.321	3/4	153.500	120.500	45.562	35.785
3/4	47.370	37.200	14.065	11.045	7	165.000	129.600	49.000	38.485
7/8	50.550	39.720	15.010	11.793	1/4	177.000	139.000	52.562	41.282
4	53.890	42.330	16.000	12.566	1/2	189.500	148.800	56.250	44.179
1/8	57.290	45.010	17.012	13.364	3/4	202.300	158.900	60.062	47.173
1/4	60.820	47.780	18.058	14.186	8	215.600	169.300	64.000	50.266
3/8	64.470	50.630	19.141	15.033	1/4	229.300	180.100	68.062	53.456
1/2	68.210	53.570	20.254	15.904	1/2	243.400	191.100	72.250	56.745
5/8	72.030	56.590	21.385	16.800	3/4	247.900	202.500	76.562	60.132
3/4	75.990	59.690	22.556	17.721	9	272.800	214.300	81.000	63.617
7/8	80.000	62.830	23.748	18.655	1/4	288.200	226.300	85.563	67.201
5	84.200	66.130	25.000	19.635	1/2	304.000	238.700	90.250	70.882
1/8	88.440	69.480	26.260	20.629	3/4	320.200	251.500	95.062	74.662
1/4	92.810	72.910	27.557	21.648	10	336.800	264.500	99.800	78.540
3/8	97.280	76.430	28.884	22.690	1/4	353.900	277.900	105.400	82.516
1/2	101.900	80.020	30.250	23.758	1/2	371.300	291.600	110.230	86.590
5/8	106.600	83.700	31.641	24.851	3/4	389.200	305.700	115.550	90.763
3/4	111.400	87.460	33.060	25.967	11	407.500	320.100	121.000	95.033
7/8	116.300	91.310	34.516	27.109	1/4	426.300	334.800	126.540	99.402
6	121.300	95.230	36.000	28.274	1/2	445.400	349.800	132.220	103.870
1/4	131.600	103.300	39.063	30.679	3/4	465.000	365.200	138.060	108.430
1/2	142.300	111.800	42.250	33.183	12	485.000	380.900	144.000	113.100

WEIGHT OF WROUGHT-IRON PLATES.

WIDTH.	THICKNESS IN INCHES.													WIDTH.
	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	
1	.84	1.05	1.26	1.47	1.68	1.89	2.11	2.32	2.53	2.74	2.95	3.16	3.37	1
1 1/8	.95	1.18	1.42	1.66	1.90	2.14	2.37	2.61	2.84	3.08	3.32	3.56	3.79	1 1/8
1 1/4	1.05	1.32	1.58	1.84	2.11	2.37	2.63	2.89	3.16	3.42	3.68	3.94	4.21	1 1/4
1 3/8	1.16	1.45	1.74	2.03	2.32	2.61	2.89	3.18	3.47	3.76	4.05	4.34	4.63	1 3/8
1 1/2	1.26	1.58	1.90	2.21	2.53	2.85	3.16	3.48	3.79	4.11	4.42	4.74	5.05	1 1/2
1 5/8	1.37	1.71	2.05	2.39	2.74	3.08	3.42	3.76	4.11	4.45	4.79	5.13	5.47	1 5/8
1 3/4	1.47	1.84	2.21	2.58	2.95	3.32	3.68	4.05	4.42	4.79	5.16	5.53	5.89	1 3/4
1 7/8	1.58	1.97	2.37	2.76	3.16	3.56	3.95	4.35	4.74	5.14	5.53	5.93	6.32	1 7/8
2	1.68	2.11	2.53	2.95	3.37	3.79	4.21	4.63	5.05	5.47	5.89	6.31	6.74	2
2 1/4	1.90	2.37	2.84	3.32	3.79	4.26	4.74	5.21	5.68	6.15	6.83	7.30	7.58	2 1/4
2 1/2	2.11	2.63	3.16	3.68	4.21	4.74	5.26	5.79	6.32	6.85	7.37	7.90	8.42	2 1/2
2 3/4	2.32	2.89	3.47	4.05	4.63	5.21	5.79	6.37	6.95	7.53	8.10	8.68	9.26	2 3/4
3	2.53	3.16	3.79	4.42	5.05	5.68	6.32	6.92	7.58	8.21	8.84	9.47	10.10	3
3 1/4	2.74	3.42	4.11	4.79	5.47	6.15	6.84	7.52	8.21	9.09	9.58	10.26	10.95	3 1/4
3 1/2	2.95	3.68	4.42	5.16	5.89	6.63	7.37	8.11	8.84	9.58	10.32	11.06	11.79	3 1/2
3 3/4	3.16	3.95	4.74	5.53	6.32	7.11	7.89	8.68	9.47	10.26	11.05	11.84	12.63	3 3/4
4	3.37	4.21	5.05	5.89	6.74	7.58	8.42	9.26	10.10	10.94	11.79	12.63	13.47	4
4 1/4	3.58	4.47	5.37	6.26	7.16	8.06	8.95	9.85	10.74	11.64	12.53	13.43	14.31	4 1/4
4 1/2	3.79	4.74	5.68	6.63	7.58	8.53	9.47	10.42	11.38	12.33	13.26	14.21	15.16	4 1/2
4 3/4	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	4 3/4
5	4.21	5.26	6.32	7.37	8.42	9.47	10.53	11.58	12.63	13.68	14.74	15.79	16.84	5
5 1/4	4.42	5.53	6.53	7.74	8.84	9.94	11.05	12.16	13.26	14.37	15.47	16.58	17.68	5 1/4
5 1/2	4.63	5.79	6.95	8.10	9.26	10.42	11.58	12.74	13.89	15.05	16.21	17.37	18.52	5 1/2
5 3/4	4.84	6.05	7.26	8.47	9.68	10.89	12.10	13.31	14.53	15.74	16.95	18.16	19.37	5 3/4

WEIGHT OF WROUGHT-IRON PLATES—*Continued.*

WIDTH.	THICKNESS IN INCHES.													WIDTH.
	¼	5/16	⅜	7/16	½	9/16	⅝	11/16	¾	13/16	⅞	15/16	1	
6	5.05	6.32	7.58	8.84	10.10	11.36	12.63	13.89	15.16	16.42	17.68	18.94	20.21	6
6¼	5.27	6.58	7.90	9.21	10.53	11.84	13.16	14.47	15.79	17.10	18.42	19.73	21.05	6¼
6½	5.47	6.84	8.21	9.58	10.94	12.30	13.68	15.04	16.42	17.78	19.16	20.52	21.88	6½
6¾	5.69	7.10	8.53	9.95	11.36	12.78	14.21	15.63	17.05	18.47	19.90	21.32	22.73	6¾
7	5.90	7.36	8.84	10.32	11.79	13.36	14.74	16.21	17.68	19.15	20.64	22.11	23.58	7
7¼	6.11	7.63	9.16	10.68	12.21	13.74	15.26	16.79	18.32	19.85	21.37	22.90	24.42	7¼
7½	6.32	7.90	9.48	11.06	12.64	14.22	15.78	17.36	18.94	20.52	22.11	23.69	25.28	7½
7¾	6.53	8.16	9.79	11.42	13.06	14.69	16.31	17.94	19.57	21.20	22.84	24.47	26.12	7¾
8	6.74	8.42	10.10	11.78	13.48	15.16	16.84	18.52	20.20	21.88	23.58	25.26	26.94	8
8¼	6.95	8.68	10.42	12.16	13.89	15.63	17.37	19.11	20.84	22.58	24.32	26.06	27.79	8¼
8½	7.16	8.94	10.74	12.52	14.32	16.11	17.90	19.69	21.48	23.27	25.06	26.85	28.63	8½
8¾	7.37	9.21	11.05	12.89	14.74	16.58	18.42	20.26	22.10	23.94	25.79	27.63	29.47	8¾
9	7.58	9.48	11.36	13.26	15.16	17.06	18.95	20.85	22.75	24.65	26.52	28.42	30.32	9
9¼	7.79	9.74	11.68	13.63	15.58	17.53	19.47	21.42	23.38	25.33	27.26	29.21	31.16	9¼
9½	8.00	10.00	12.00	14.00	16.00	18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00	9½
9¾	8.21	10.26	12.32	14.37	16.42	18.47	20.53	22.58	24.63	26.68	28.74	30.79	32.84	9¾
10	8.42	10.52	12.64	14.74	16.84	18.94	21.05	23.15	25.26	27.36	29.48	31.58	33.68	10
10¼	8.63	10.79	12.95	15.11	17.26	19.42	21 58	23.74	25.89	28.05	30.21	32.37	34.52	10¼
10½	8.84	11 05	13.26	15.48	17.68	19.89	22.10	24.31	26.52	28.73	30.95	33.16	35.36	10½
10¾	9.05	11.32	13.58	15.84	18.10	20.36	22.63	24.89	27.16	29.42	31.68	33.94	36.21	10¾
11	9.26	11.58	13.90	16.21	18.52	20.84	23.16	25.48	27.78	30.10	32.42	34.74	37.04	11
11¼	9.47	11.85	14.21	16.58	18.94	21.31	23.68	26.05	28.42	30.79	33.15	35.52	37.89	11¼
11½	9.68	12.10	14.52	16.94	19.36	21.78	24.20	26.62	29.06	31.48	33.90	36.32	38.74	11½
11¾	9.89	12.37	14.84	17.31	19.78	22.25	24.73	27.20	29.69	32.16	34.63	37.10	39.56	11¾
12	10 10	12.64	15.16	17 68	20.20	22.72	25.26	27.78	30.32	32.84	35.36	37.88	40.40	12

WEIGHTS FOR PLATES OVER 12" WIDE.

WIDTH.	THICKNESS IN INCHES.													WIDTH.
	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	
13	10 94	13 69	16.42	19.15	21.88	24.60	27.36	30.08	32.84	35.56	38.32	41.04	43.76	13
14	11 78	14 72	17.68	20.64	23.58	26.72	29.48	32.42	35.36	38.30	41.28	44.22	47.16	14
15	12 62	15.77	18.94	22.11	25.26	28.61	31.59	34.74	37.89	41.04	44.23	47.38	50.53	15
16	13.46	16.84	20.20	23.56	26 96	30.32	33.68	37.04	40.40	43.76	47.16	50.52	53.88	16
17	14 30	17 89	21.46	25.03	28.64	32.21	35.79	39.36	42.93	46.50	50.11	53.68	57.25	17
18	15.16	18.96	22.72	26.52	30.32	34.12	37.90	41.70	45.50	49.30	53.04	56.84	60.62	18
19	16 00	20.01	23.98	27.99	32.00	36.01	40.01	44.02	48.03	52.04	55.99	60.00	63.99	19
20	16 84	21.04	25.28	29.48	33.68	37.88	42.10	46.30	50.52	54.72	58.96	62.16	67.36	20
21	17.68	22.09	26.54	31.95	35.36	39.77	44.21	48.62	53.05	57.46	61.91	65.32	71.73	21
22	18.52	23.16	27.80	32.42	37.04	41.68	46.32	50.96	55.56	60.20	64.82	69.48	74.08	22
23	19.36	24.21	29.06	33.89	38.72	43.57	48.43	53.28	58.09	62.94	67.77	73.64	77.45	23
24	20.20	25.28	30.32	35.38	40.40	45.44	50.52	55.56	60.64	65.68	70.72	75.76	80.80	24
25	21.04	26.33	31.58	36.85	42.08	47.33	52.63	57.88	63.17	68.42	73.67	78.92	84.17	25
26	21.88	27.39	32.85	38.33	43.77	49.23	54.73	60.19	65.69	71.15	76.61	82.07	87.54	26
27	22.72	28.44	34.11	39.80	45.45	51.12	56.84	62.51	68.22	73.89	79.56	85.23	90.91	27
28	23.56	29.44	35.36	41.28	47.16	53.44	58.96	64.84	70.72	76.60	82.56	88.44	94.32	28
29	24.40	30.49	36.62	42.75	48.84	55.33	61.07	67.16	73.25	79.34	85.51	91.60	97.69	29
30	25.24	31.55	37.89	44.23	50.53	57.23	63.17	69.47	75.77	82.07	88.45	94.75	101.06	30
31	26.08	32.60	39.15	45.70	52.21	59.12	65.28	71.79	78.30	84.81	91.40	97.91	104.43	31
32	26.92	33.68	40.40	47.12	53.92	60.64	67.36	74.08	80.80	87.52	95.32	101.04	107.76	32
33	27.76	34.73	41.66	48.59	55.60	62.53	69.47	76.40	83.33	90.26	98.27	104.20	111.13	33
34	28.60	35.79	42.93	50.07	57.29	64.43	71.57	78.71	85.85	92.99	101.21	107.35	114.50	34
35	29.44	36.84	44.19	51.54	58.97	66.32	73.68	81.03	88.38	95.73	104.16	110.51	117.87	35
36	30.32	37.92	45.44	53.04	60.64	68.24	75.80	83.40	91.00	98.60	106.08	113.68	121.24	36

WEIGHTS FOR PLATES OVER 12" WIDE—*Continued*

WIDTH.	THICKNESS IN INCHES												WIDTH
	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1	
37	31.16	38 97	46.70	54.51	62.32	70.13	77.91	85.72	93.53	101 34	109.03	116.84	124.61	37
38	32.00	40.00	48.00	56.00	64 00	72.00	80.00	88.00	96.00	104.00	112.00	120.00	128 00	38
39	32.84	41.05	49.26	57.47	65.68	71.89	82.11	90.32	98.53	106.74	114 95	123.16	131 37	39
40	33.68	42.08	50.56	58.96	67.36	75.76	84.20	92.60	101.04	109.44	117.92	124.32	134.72	40
41	34 52	43.13	51.82	60.43	69.04	77.65	86.31	94 92	103.57	112.18	120.87	127.48	138.09	41
42	3 .36	44.19	53.09	61.91	70.73	79.55	88.41	97.23	106.09	114.91	123.81	130.63	141.46	42
43	36.20	45.24	54.35	63.38	72.41	81.44	90.52	99.55	108.62	117.65	126.76	133.79	144.83	43
44	37.04	46. 2	55.60	64.84	74.08	83.36	92.64	101.92	111.12	120.40	129.64	138.96	148.08	44
45	37.88	47.37	56.86	66.31	75.76	85.25	94.75	104.24	113.65	123.14	132.59	142.12	151.45	45
46	38.72	48.43	58.13	67.79	77.45	88.15	96.85	106.55	116.17	125.87	135.53	145.27	154.82	46
47	39.56	49.48	59.39	69.26	79.13	89.04	98.96	108.87	118.70	128.61	138 48	148.43	158.19	47
48	40.40	50.56	60.64	70.76	80.80	90.88	101.04	111.12	121.28	131.36	141.44	151.52	161.60	48
49	41.24	51.61	61.90	72.23	82.48	92.77	103.15	113.42	123.81	134.10	144.39	154.68	164.97	49
50	42.08	52.67	63.17	73.71	84.17	94.67	105.25	115.75	126.33	136.83	147.33	157.83	168.34	50
51	42.92	53.73	64.43	75.18	85.85	96.56	107.36	118.07	128.86	139.57	150.28	160.99	171.71	51
52	43.74	54.78	65.70	76.66	87.54	98.46	109.46	120.38	131.38	142.30	153.22	164.14	175.c8	52
53	44.58	55.83	66.96	78.13	89.22	100.35	111.57	122.70	133.91	145.04	156.17	167.30	178.45	53
54	45.42	56.89	68.23	79.61	90.91	102.25	113.67	125.01	136.43	147.77	159.11	170.55	181.82	54
55	46.26	57.94	69.49	81.08	92.59	104.14	115.78	127.33	138.96	150.51	162.06	173.71	185.19	55
56	47.12	58.88	70.72	82.56	94.32	106.88	117.92	129.64	141.44	153.20	165.12	176.88	188.64	56
57	47.96	59.93	71.98	84.03	96.00	108.77	120.03	131.96	143.97	155.94	168.07	180.04	192.01	57
58	48.80	60.99	73.25	85.51	97.69	110.67	122.13	134.27	146.49	158.67	171.01	183.19	195.38	58
59	49.64	62.04	74.51	86.98	99.37	112.46	124.24	136.59	149.02	161.41	173.96	186.35	198.75	59
60	50.48	63.10	75.78	88.46	101.c6	114.46	126.34	138.90	151.54	164.14	176.90	189.50	202.12	60

WEIGHT OF BARS OVER 1" IN THICKNESS PER LINEAL FOOT OF LENGTH.

THICKNESS.	WIDTH IN INCHES.								THICKNESS.
	1"	2"	3"	4"	5"	6"	7"	8"	
"									"
1 1/16	3.6	7.2	10.7	14.3	17.9	21.5	25.0	28.6	1 1/16
1 1/8	3.8	7.6	11.4	15.2	19.0	22.7	26.5	30.4	1 1/8
1 3/16	4.0	8.0	12.0	16.0	20.0	24.0	28.0	32.0	1 3/16
1 1/4	4.2	8.4	12.6	16.8	21.1	25.3	29.5	33.6	1 1/4
1 5/16	4.5	8.9	13.3	17.7	22.1	26.5	31.0	35.4	1 5/16
1 3/8	4.7	9.3	13.9	18.5	23.2	27.8	32.4	37.0	1 3/8
1 7/16	4.9	9.7	14.5	19.4	24.2	29.1	33.9	38.8	1 7/16
1 1/2	5.1	10.1	15.2	20.2	25.3	30.3	35.4	40.4	1 1/2
1 9/16	5.3	10.6	15.8	21.1	26.3	31.6	36.9	42.2	1 9/16
1 5/8	5.5	10.9	16.4	21.9	27.4	32.8	38.3	43.8	1 5/8
1 11/16	5.7	11.4	17.0	22.7	28.4	34.1	39.8	45.4	1 11/16
1 3/4	5.9	11.8	17.6	23.6	29.5	35.6	41.3	47.2	1 3/4
1 13/16	6.1	12.2	18.3	24.4	30.5	36.6	42.7	48.8	1 13/16
1 7/8	6.3	12.6	18.9	25.3	31.5	37.9	44.2	50.6	1 7/8
1 15/16	6.5	13.0	19.6	26.1	32.6	39.2	45.7	52.2	1 15/16
2	6.7	13.4	20.2	26.9	33.7	40.4	47.2	53.8	2

AMERICAN AND BIRMINGHAM WIRE GAUGES.

THICKNESS IN INCHES.

HASWELL.

No. Gauge.	Thickness American Gauge.	Thickness Birmingham Gauge.	No. Gauge.	Thickness American Gauge.	Thickness Birmingham Gauge.	No. Gauge.	Thickness American Gauge.	Thickness Birmingham Gauge.
	Inch.	Inch.		Inch.	Inch.		Inch.	Inch.
0000	.46	.454	11	.0907	.12	25	.0179	.02
000	.4096	.425	12	.0808	.109	26	.0160	.018
00	.3648	.38	13	.0719	.095	27	.0142	.016
0	.3248	.34	14	.0641	.083	28	.0126	.014
1	.2893	.30	15	.057	.072	29	.0112	.013
2	.2576	.284	16	.0508	.065	30	.01	.012
3	.2294	.259	17	.0452	.058	31	.0089	.01
4	.2043	.238	18	.0403	.049	32	.0079	.009
5	.1819	.22	19	.0359	.042	33	.007	.008
6	.1620	.203	20	.0319	.035	34	.0063	.007
7	.1443	.18	21	.0284	.032	35	.0056	.005
8	.1285	.165	22	.0253	.028	36	.005	.004
9	.1144	.148	23	.0225	.025			
10	.1019	.134	24	.0201	.022			

WEIGHT OF ONE SQUARE FOOT OF SHEET IRON, STEEL OR COPPER.

BIRMINGHAM GAUGE.					AMERICAN GAUGE.				
No. of Gauge.	Thickness in Inches.		Iron.	Steel.	No. of Gauge.	Thickness in Inches.		Iron.	Steel.
	In Decim.	In Fractions.				In Decim.	In Fractions.		
0000	.454	$\frac{29}{64}$	18.35	18.54	0000	.46	$\frac{15}{32}$	18.63	18.87
000	.425	$\frac{27}{64}$	17.18	17.35	000	.41	$\frac{13}{32}$	16.58	16.8
00	.38	$\frac{49}{128}$	15.36	15.51	00	.365	$\frac{23}{64}$	14.77	15.0
0	.34	$\frac{11}{32}$	13.74	13.87	0	.325	$\frac{21}{64}$	13.15	13.32
1	.30	$\frac{19}{64}$	12.13	12.25	1	.289	$\frac{19}{64}$	11.7	11.86
2	.284	$\frac{9}{32}$	11 48	11.59	2	.257	$\frac{17}{64}$	10.43	10.57
3	.259	$\frac{33}{128}$	10.47	10.57	3	.229	$\frac{15}{64}$	9.29	9.42
4	.238	$\frac{31}{128}$	9.62	9.72	4	.204	$\frac{13}{64}$	8.27	8.38
5	.220	$\frac{7}{32}$	8.89	8.98	5	.182	$\frac{3}{16}$	7.37	7.46
6	.203	..	8.21	8.29	6	.162	$\frac{11}{64}$	6.56	6.64
7	.180	$\frac{23}{128}$	7.27	7.35	7	.144	$\frac{9}{64}$	5.84	5.92
8	.165	..	6.70	6.74	8	.128	$\frac{1}{8}$	5.20	5.27
9	.148	$\frac{19}{128}$	5.98	6.04	9	.114	..	4.63	4.69
10	.134	..	5.42	5.47	10	.102	$\frac{7}{64}$	4.12	4.18
11	.120	$\frac{15}{128}$	4.85	4.90	11	.091	$\frac{3}{32}$	3.67	3.72
12	.109	$\frac{7}{64}$	4.41	4.45	12	.080	..	3.27	3.31
13	.095	$\frac{3}{32}$	3.84	3.88	13	.072	$\frac{5}{64}$	2.92	2.95
14	.083	..	3.35	3.39	14	.064	$\frac{1}{16}$	2.59	2.63

WEIGHT OF ONE SQUARE FOOT OF SHEET IRON, STEEL OR COPPER—*Continued.*

BIRMINGHAM GAUGE.					AMERICAN GAUGE.				
No. of Gauge.	Thickness in Inches. In Decim.	Thickness in Inches. In Fractions.	Iron.	Steel.	No. of Gauge.	Thickness in Inches. In Decim.	Thickness in Inches. In Fractions.	Iron.	Steel.
15	.072	..	2.91	2.94	15	.057	..	2.31	2.34
16	.065	1/16	2.63	2.65	16	.050	..	2.05	2.08
17	.058	..	2.34	2.37	17	.045	3/64	1.83	1.86
18	.049	..	1.98	2.00	18	.040	..	1.63	1.65
19	.042	..	1.70	1.71	19	.036	..	1.45	1.47
20	.035	..	1.41	1.43	20	.032	1/32	1.29	1.31
21	.032	1/32	1.29	1.30	21	.028	..	1.15	1 16
22	.028	..	1.13	1.14	22	.025	..	1.03	1.04
23	.025	..	1.01	1.02	23	.023	..	.91	.92
24	.022	..	.889	.898	24	.020	..	.81	.82
25	.020	..	.808	.816	25	.018	.	.72	.73
26	.018	..	.722	.735	26	.016	1/64	.64	.65
27	.016	1/64	.647	.653	27	.014	..	.57	.58
28	.014	..	.568	.572	28	.013	..	.51	.52
29	.013	..	.525	.531	29	.011	..	.46	.47
30	.012	..	.485	.490	30	.010	..	.41	.41
31	.010	..	.404	.408	31	.009	..	.36	.37
32	.009	..	.364	.367	32	.008	1/128	.32	.33
33	.008	1/128	.323	.326	33	.007	..	.29	.29
34	.007	..	.283	.286	34	.006	..	.25	.26
35	.005	..	.202	.204	35	.005	..	.23	.23

RAILROAD BARS.

TABLE

Showing the number of tons per mile corresponding to the following weight of rails per lineal yard. Ton of 2,240 lbs.

Weight per Yd.	Tons per Mile.	Weight per Yd.	Tons per Mile.
8 lbs.	$12.\frac{1280}{2240}$	52 lbs.	$81.\frac{1600}{2240}$
12 "	$18.\frac{1920}{2240}$	56 "	88
16 "	$25.\frac{320}{2240}$	57 "	$89.\frac{1280}{2240}$
25 "	$39.\frac{640}{2240}$	60 "	$94.\frac{640}{2240}$
30 "	$47.\frac{320}{2240}$	62 "	$97.\frac{960}{2240}$
35 "	55	64 "	$100.\frac{1280}{2240}$
40 "	$62.\frac{1920}{2240}$	65 "	$102.\frac{320}{2240}$
45 "	$70.\frac{1600}{2240}$	68 "	$106.\frac{1920}{2240}$
50 "	$78.\frac{1280}{2240}$	70 "	110.

Calculated for "single track" (2 rails).

Multiply the pounds per yard by $1\frac{4}{7}$, and the result will be the number of tons (of 2,240 lbs.) per mile of single track.

RAILROAD SPLICE OR "FISH" JOINTS.

The ordinary length of splice plates is 23 or 24 inches, with 4 bolts of $\frac{3}{4}$ ins. diam. to each pair of plates. The average weight of the plates is 16 lbs., and of the 4 bolts (with *single* nuts), 4 lbs., making 20 lbs. total weight per "joint." If double or "jam" nuts are used, the weight of the 4 bolts will be $5\frac{1}{2}$ lbs., or $21\frac{1}{2}$ lbs. per joint.

"SINGLE TRACK."

Lengths of Rails.	No. of Joints per Mile.	Lbs. of Plates per Mile.	Lbs. of Bolts per Mile.	Total Weight per Mile.
18 feet.	588	9,408	2,352	11,760
21 feet.	528	8,448	2,112	10,560
24 feet.	440	7,040	1,760	8,800
25 feet.	423	6,768	1,692	8,460
27 feet.	391	6,256	1,564	7,820
30 feet.	352	5,632	1,408	7,040

NOTE.—If double nuts are used, add $37\frac{1}{2}$ per cent. to the weight of the bolts.

PAINTING AND GLAZING.

Painting is measured by the superficial yard, girting every part of the work that is covered by paint and allowing an addition to the actual surface for covering deep quirks of moulding.

Generally estimates are made for each coat of paint at a certain price per superficial yard.

WINDOW GLASS.—Number of Lights Per Box of 50 Feet.

Inches.	*No.*	*Inches.*	*No.*	*Inches.*	*No.*	*Inches.*	*No.*
6 x 8	150	12 x 18	33	16 x 44	10	26 x 32	9
7 x 9	115	12 x 20	30	18 x 20	20	26 x 34	8
8 x 10	90	12 x 22	27	18 x 22	18	26 x 36	8
8 x 11	82	12 x 24	25	18 x 24	17	26 x 40	7
8 x 12	75	12 x 26	23	18 x 26	15	26 x 42	7
8 x 13	70	12 x 28	21	18 x 28	14	26 x 44	6
8 x 14	64	12 x 30	20	18 x 30	13	26 x 48	6
8 x 15	60	12 x 32	18	18 x 32	13	26 x 50	6
8 x 16	55	12 x 34	17	18 x 34	12	26 x 54	5
9 x 11	72	13 x 14	40	18 x 36	11	26 x 58	5
9 x 12	67	13 x 16	35	18 x 38	11	28 x 30	9
9 x 13	62	13 x 18	31	18 x 40	10	28 x 32	8
9 x 14	57	13 x 20	28	18 x 44	9	28 x 34	8
9 x 15	53	13 x 22	25	20 x 22	16	28 x 36	7
9 x 16	50	13 x 24	23	20 x 24	15	28 x 38	7
9 x 17	47	13 x 26	21	20 x 26	14	28 x 40	6
9 x 18	44	13 x 28	19	20 x 28	13	28 x 44	6
9 x 20	40	13 x 30	18	20 x 30	12	28 x 46	6
10 x 12	60	14 x 16	32	20 x 32	11	28 x 50	5
10 x 13	55	14 x 18	29	20 x 34	11	28 x 52	5
10 x 14	52	14 x 20	26	20 x 36	10	28 x 56	4
10 x 15	48	14 x 22	23	20 x 38	9	30 x 36	7
10 x 16	45	14 x 24	22	20 x 40	9	30 x 40	6
10 x 17	42	14 x 26	20	20 x 44	8	30 x 42	6
10 x 18	40	14 x 28	18	20 x 46	8	30 x 44	5
10 x 20	36	14 x 30	17	20 x 48	8	30 x 46	5
10 x 22	33	14 x 32	16	20 x 50	7	30 x 48	5
10 x 24	30	14 x 34	15	20 x 60	6	30 x 50	5
10 x 26	28	14 x 36	14	22 x 24	14	30 x 54	4
10 x 28	26	14 x 40	13	22 x 26	13	30 x 56	4
10 x 30	24	14 x 44	11	22 x 28	12	30 x 60	4
10 x 32	22	15 x 18	27	22 x 30	11	32 x 42	5
10 x 34	21	15 x 20	24	22 x 32	10	32 x 44	5
11 x 13	50	15 x 22	22	22 x 34	10	32 x 46	5
11 x 14	47	15 x 24	20	22 x 36	9	32 x 48	5
11 x 15	44	15 x 26	18	22 x 38	9	32 x 50	4
11 x 16	41	15 x 28	17	22 x 40	8	32 x 54	4
11 x 17	39	15 x 30	16	22 x 44	8	32 x 56	4
11 x 18	36	15 x 32	15	22 x 46	7	32 x 60	4
11 x 20	33	16 x 18	25	22 x 50	7	34 x 40	5
11 x 22	30	16 x 20	23	24 x 28	11	34 x 44	5
11 x 24	27	16 x 22	20	24 x 30	10	34 x 46	5
11 x 26	25	16 x 24	19	24 x 32	9	34 x 50	4
11 x 28	23	16 x 26	17	24 x 36	8	34 x 52	4
11 x 30	21	16 x 28	16	24 x 40	8	34 x 56	4
11 x 32	20	16 x 30	15	24 x 44	7	36 x 44	5
11 x 34	19	16 x 32	14	24 x 46	7	36 x 50	4
12 x 14	43	16 x 34	13	24 x 48	6	36 x 56	4
12 x 15	40	16 x 36	12	24 x 50	6	36 x 60	3
12 x 16	38	16 x 38	12	24 x 54	5	36 x 64	3
12 x 17	35	16 x 40	11	24 x 56	5	40 x 60	3

AMERICAN SLATING.

Slating is estimated by the "square," which is the quantity required to cover 100 square feet. The slates are usually laid so that the third laps the first three inches. Therefore to compute the number of slates of a given size required per square: Subtract three inches from the length of the slate, multiply the remainder by the width, and divide by two. This will give the number of square inches covered per slate; divide 14,400 (the number of square inches in a square) by the number so found, and the result will be the number of slates required.

The following table gives the number of slates per square for the usual sizes:

NUMBER OF SLATES PER SQUARE.

Size in Inches.	Pieces per Square.	Size in Inches.	Pieces per Square.	Size in Inches.	Pieces per Square.
6×12	533	8×16	277	12×20	141
7×12	457	9×16	246	14×20	121
8×12	400	10×16	221	11×22	137
9×12	355	9×18	213	12×22	126
7×14	374	10×18	192	14×22	108
8×14	327	12×18	160	12×24	114
9×14	291	10×20	169	14×24	98
10×14	261	11×20	154	16×24	86

The weight of slate per cubic foot is about 174 lbs. or per sq. foot of various thicknesses, as follows:

Thickness in Inches.....	1/8	3/16	1/4	3/8	1/2
Weight in Pounds	1.81	2.71	3.62	5.43	7.25

The weight of slating laid per sq. foot of surface covered, will, of course, depend on the size used. The weight of 10×18 slate, 3/16 thick, for example, per square foot of roof, would be 5.86 lbs.

SHINGLING.

An average shingle 7½ inches wide in 8½ inches courses shows 64 □ inches, making 3 shingles to a square foot of roof, including waste; they are usually laid in 3 thicknesses.

SKYLIGHT AND FLOOR GLASS.

Lennox Plate Glass Co., Ward & Co., Agents, Philadelphia.

WEIGHT PER CUBIC FOOT, 156 POUNDS.

WEIGHT PER SQUARE FOOT.

Thickness,	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1 inch.
Weight,	1.62	2.43	3.25	4.88	6.50	8.13	9.75	13 lbs.

FLAGGING.

WEIGHT PER CUBIC FOOT, 168 POUNDS.

WEIGHT PER SQUARE FOOT.

Thickness,	1	2	3	4	5	6	7	8 inch.
Weight,	14	28	42	56	70	84	98	112 lbs.

GALVANIZED AND BLACK IRON.

WEIGHT IN POUNDS PER SQUARE FOOT OF GALVANIZED SHEET IRON, BOTH FLAT AND CORRUGATED.

The numbers and thicknesses are those of the iron before it is galvanized. When a flat sheet (the ordinary size of which is from 2 to 2½ feet in width, by 6 to 8 feet in length) is converted into a corrugated one, with corrugations 5 inches wide from centre to centre, and about an inch deep (the common sizes), its width is thereby reduced about $\frac{1}{10}$th part, or from 30 to 27 inches; and consequently the weight per square foot of area covered is increased about $\frac{1}{9}$th part. When the corrugated sheets are laid upon a roof, the overlapping of about 2½ inches along their sides, and of 4 inches along their ends, diminishes the covered area about $\frac{1}{7}$th part more; making their weight per square foot of roof about $\frac{1}{6}$th part greater than before. Or the weight of cor-

rugated iron per square foot in place on a roof is about ⅓ greater than that of the flat sheets of above sizes of which it is made.

Number by Birmingham Wire Gauge.	BLACK.		GALVANIZED.		
	Thickness in inches.	Flat. Lbs.	Flat. Lbs.	Corrugated. Lbs.	Cor. on Roof. Lbs.
30	.012	.485	.806	.896	1.08
29	.013	.526	.857	.952	1.14
28	.014	.565	.897	.997	1.20
27	.016	.646	.978	1.09	1.30
26	.018	.722	1.06	1.18	1.41
25	.020	.808	1.14	1.27	1.52
24	.022	.889	1.22	1.36	1.62
23	.025	1.01	1.34	1.49	1.79
22	.028	1.13	1.46	1.62	1.95
21	.032	1.29	1.63	1.81	2.17
20	.035	1.41	1.75	1.94	2.33
19	.042	1.69	2.03	2.26	2.71
18	.049	1.98	2.32	2.58	3.09
17	.058	2.34	2.68	2.98	3.57
16	.065	2.63	2.96	3.29	3.95
15	.072	2.91	3.25	3.61	4.33
14	.083	3.36	3.69	4.10	4.92
13	.095	3.84	4.18	4.64	5.57

NOTE.—The galvanizing of sheet iron adds about one-third of a pound to its weight per square foot.

Nos. 20 to 22 are the usual sizes for roof coverings.

BRICK WORK AND MASONRY.

Stone work is estimated by the perch of 25 cubic feet. Brick-work is estimated by the thousand, and for various thicknesses of wall runs as follows:

9 in. wall, or 1 brick in thickness, 14 bricks per superficial ft.
13 " " 1½ " " 21 " " "
18 " " 2 " " 28 " " "
22 " " 2½ " " 35 " " "

For each additional half brick in thickness count seven (7) bricks per superficial foot.

One square yard of paving requires 36 bricks when laid flat, or 82 when laid on edge.

TABLE OF DECIMAL PARTS OF A FOOT FOR EACH $\frac{1}{32}$ OF AN INCH.

In.	0	1	2	3	4	5	6	7	8	9	10	11
0	0000	0833	1667	2500	3333	4167	5000	5833	6667	7500	8333	9167
$\frac{1}{32}$	0026	0859	1693	2526	3359	4193	5026	5859	6693	7526	8359	9193
$\frac{1}{16}$	0052	0885	1719	2552	3385	4219	5052	5885	6719	7552	8385	9219
$\frac{3}{32}$	0078	0911	1745	2578	3411	4245	5078	5911	6745	7578	8411	9245
$\frac{1}{8}$	0104	0938	1772	2604	3438	4271	5104	5938	6771	7604	8438	9271
$\frac{5}{32}$	0130	0964	1797	2630	3464	4297	5130	5964	6797	7630	8464	9297
$\frac{3}{16}$	0156	0990	1823	2656	3490	4323	5156	5990	6823	7656	8490	9323
$\frac{7}{32}$	0182	1016	1849	2682	3516	4349	5182	6016	6849	7682	8516	9349
$\frac{1}{4}$	0208	1042	1875	2708	3542	4375	5208	6042	6875	7708	8542	9375
$\frac{9}{32}$	0234	1068	1901	2734	3568	4401	5234	6068	6901	7734	8568	9401
$\frac{5}{16}$	0260	1094	1927	2760	3594	4427	5260	6094	6927	7760	8594	9427
$\frac{11}{32}$	0286	1120	1953	2786	3620	4453	5286	6120	6953	7786	8620	9453
$\frac{3}{8}$	0313	1146	1979	2813	3646	4479	5313	6146	6979	7813	8646	9479
$\frac{13}{32}$	0339	1172	2005	2839	3672	4505	5339	6172	7005	7839	8672	9505
$\frac{7}{16}$	0365	1198	2031	2865	3698	4531	5365	6198	7031	7865	8698	9531
In.	0	1	2	3	4	5	6	7	8	9	10	11

TABLE OF DECIMAL PARTS OF A FOOT FOR EACH $\frac{1}{32}$ OF AN INCH—*Continued.*

In.	0	1	2	3	4	5	6	7	8	9	10	11
15/32	0391	1224	2057	2891	3724	4557	5391	6224	7057	7891	8724	9557
1/2	0417	1250	2083	2917	3750	4583	5417	6250	7083	7917	8750	9583
17/32	0443	1276	2109	2943	3776	4609	5443	6276	7109	7943	8776	9609
9/16	0469	1302	2135	2969	3802	4635	5469	6302	7135	7969	8802	9635
19/32	0495	1328	2161	2995	3828	4661	5495	6328	7161	7995	8828	9661
5/8	0521	1354	2188	3021	3854	4688	5521	6354	7188	8021	8854	9688
21/32	0547	1380	2214	3047	3880	4714	5547	6380	7214	8047	8880	9714
11/16	0573	1406	2240	3073	3906	4740	5573	6406	7240	8073	8906	9740
23/32	0599	1432	2266	3099	3932	4766	5599	6432	7266	8099	8932	9766
3/4	0625	1458	2292	3125	3958	4792	5625	6458	7292	8125	8958	9792
25/32	0651	1484	2318	3151	3984	4818	5651	6484	7318	8151	8984	9818
13/16	0677	1510	2344	3177	4010	4844	5677	6510	7344	8177	9010	9844
27/32	0703	1536	2370	3203	4036	4870	5703	6536	7370	8203	9036	9870
7/8	0729	1563	2396	3229	4063	4896	5729	6563	7396	8229	9063	9896
29/32	0755	1589	2422	3255	4089	4922	5755	6589	7422	8255	9089	9922
15/16	0781	1615	2448	3281	4115	4948	5781	6615	7448	8281	9115	9948
31/32	0807	1641	2474	3307	4141	4974	5807	6641	7474	8307	9141	9974
In.	0	1	2	3	4	5	6	7	8	9	10	11

TABLES OF DECIMAL PARTS OF AN INCH FOR EACH $\frac{1}{64}$.

$\frac{1}{64}$	.015625	$\frac{11}{64}$	0.1718	$\frac{3}{8}$	0.3750	$\frac{19}{32}$	0.5938	$\frac{27}{32}$	0.8437
$\frac{1}{32}$	.03125	$\frac{3}{16}$	0.1875	$\frac{13}{32}$	0.4063	$\frac{39}{64}$	0.6094	$\frac{7}{8}$	0.8750
$\frac{3}{64}$	.04687	$\frac{7}{32}$	0.2187	$\frac{27}{64}$	0.4219	$\frac{5}{8}$	0.6250	$\frac{57}{64}$	0.8906
$\frac{1}{16}$	.062	$\frac{15}{64}$	0.2344	$\frac{7}{16}$	0.4375	$\frac{21}{32}$	0.6562	$\frac{29}{32}$	0.9062
$\frac{5}{64}$	.07812	$\frac{1}{4}$	0.2500	$\frac{15}{32}$	0.4688	$\frac{43}{64}$	0.6719	$\frac{15}{16}$	0.9375
$\frac{3}{32}$	.09375	$\frac{9}{32}$	0.2813	$\frac{31}{64}$	0.4844	$\frac{11}{16}$	0.6875	$\frac{61}{64}$	0.9531
$\frac{7}{64}$	.10937	$\frac{19}{64}$	0.2969	$\frac{1}{2}$	0.5000	$\frac{23}{32}$	0.7188	$\frac{31}{32}$	0.9688
$\frac{1}{8}$	0.1250	$\frac{5}{16}$	0.3125	$\frac{17}{32}$	0.5312	$\frac{3}{4}$	0.7500		
$\frac{9}{64}$	0.1406	$\frac{11}{32}$	0.3438	$\frac{35}{64}$	0.5469	$\frac{25}{32}$	0.7812		
$\frac{5}{32}$	0.1563	$\frac{23}{64}$	0.3594	$\frac{9}{16}$	0.5625	$\frac{13}{16}$	0.8125		

TABLE OF SQUARES AND CUBES,

OF

ALL NUMBERS FROM 1 TO 500.

No.	Squares.	Cubes.	No.	Squares.	Cubes.
1	1	1	50	25 00	125 000
2	4	8	51	26 01	132 651
3	9	27	52	27 04	140 608
4	16	64	53	28 09	148 877
5	25	125	54	29 16	157 464
6	36	216	55	30 25	166 375
7	49	343	56	31 36	175 616
8	64	512	57	32 49	185 193
9	81	729	58	33 64	195 112
10	1 00	1 000	59	34 81	205 379
11	1 21	1 331	60	36 00	216 000
12	1 44	1 728	61	37 21	226 981
13	1 69	2 197	62	38 44	238 328
14	1 96	2 744	63	39 69	250 047
15	2 25	3 375	64	40 96	262 144
16	2 56	4 096	65	42 25	274 626
17	2 89	4 913	66	43 56	287 496
18	3 24	5 832	67	44 89	300 763
19	3 61	6 859	68	46 24	314 432
20	4 00	8 000	69	47 61	328 509
21	4 41	9 261	70	49 00	343 000
22	4 84	10 648	71	50 41	357 911
23	5 29	12 167	72	51 84	373 248
24	5 76	13 824	73	53 29	389 017
25	6 25	15 625	74	54 76	405 224
26	6 76	17 576	75	56 25	421 875
27	7 29	19 683	76	57 76	438 976
28	7 84	21 952	77	59 29	456 533
29	8 41	24 389	78	60 84	474 552
30	9 00	27 000	79	62 41	493 039
31	9 61	29 791	80	64 00	512 000
32	10 24	32 768	81	65 81	531 441
33	10 89	35 937	82	67 24	551 368
34	11 56	39 304	83	68 89	571 787
35	12 25	42 875	84	70 56	592 704
36	12 96	46 656	85	72 25	614 125
37	13 69	50 653	86	73 96	636 056
38	14 44	54 872	87	75 69	658 503
39	15 21	59 319	88	77 44	681 472
40	16 00	64 000	89	79 21	704 969
41	16 81	68 921	90	81 00	729 000
42	17 64	74 088	91	82 81	753 571
43	18 49	79 507	92	84 64	778 688
44	19 36	85 184	93	86 49	804 357
45	20 25	91 125	94	88 36	830 584
46	21 16	97 336	95	90 25	857 375
47	22 09	103 823	96	92 16	884 736
48	23 04	110 592	97	94 09	912 673
49	24 01	117 649	98	96 04	941 192

TABLE OF SQUARES AND CUBES—*Continued.*

No.	Squares.	Cubes.	No.	Squares.	Cubes.
99	98 01	970 299	156	2 43 36	3 796 416
100	1 00 00	1 000 000	157	2 46 49	3 869 893
101	1 02 01	1 030 301	158	2 49 64	3 944 312
102	1 04 04	1 061 2 8	159	2 52 81	4 019 679
103	1 06 09	1 092 727	160	2 56 00	4 096 000
104	1 08 16	1 124 864	161	2 59 21	4 173 281
105	1 10 25	1 157 625	162	2 62 44	4 251 528
106	1 12 36	1 191 016	163	2 65 69	4 330 747
107	1 14 49	1 225 043	164	2 68 96	4 410 944
108	1 16 64	1 259 712	165	2 72 25	4 492 125
109	1 18 81	1 295 029	166	2 75 56	4 574 296
110	1 21 00	1 331 000	167	2 78 89	4 657 463
111	1 23 21	1 367 631	168	2 82 24	4 741 632
112	1 25 44	1 404 928	169	2 85 61	4 826 809
113	1 27 69	1 442 897	170	2 89 00	4 913 000
114	1 29 96	1 481 544	171	2 92 41	5 000 211
115	1 32 25	1 520 875	172	2 95 84	5 088 448
116	1 34 56	1 560 896	173	2 99 29	5 177 717
117	1 36 89	1 601 613	174	3 02 76	5 268 024
118	1 39 24	1 643 032	175	3 06 25	5 359 375
119	1 41 61	1 685 159	176	3 09 76	5 451 776
120	1 44 00	1 728 000	177	3 13 29	5 545 233
121	1 46 41	1 771 561	178	3 16 84	5 639 752
122	1 48 84	1 815 848	179	3 20 41	5 735 339
123	1 51 29	1 860 867	180	3 24 00	5 832 000
124	1 53 76	1 906 624	181	3 27 61	5 929 741
125	1 56 25	1 953 125	182	3 31 24	6 028 568
126	1 58 76	2 000 376	183	3 34 89	6 128 487
127	1 61 29	2 048 383	184	3 38 56	6 229 504
128	1 63 84	2 097 152	185	3 42 25	6 331 625
129	1 66 41	2 146 689	186	3 45 96	6 434 856
130	1 69 00	2 197 000	187	3 49 69	6 539 203
131	1 71 61	2 248 091	188	3 53 44	6 644 672
132	1 74 24	2 299 968	189	3 57 21	6 751 269
133	1 76 89	2 352 637	190	3 61 00	6 859 000
134	1 79 56	2 406 104	191	3 64 81	6 967 871
135	1 82 25	2 460 375	192	3 68 64	7 077 888
136	1 84 96	2 515 456	193	3 72 49	7 189 057
137	1 87 69	2 571 353	194	3 76 36	7 301 384
138	1 90 44	2 628 072	195	3 80 25	7 414 875
139	1 93 21	2 685 619	196	3 84 16	7 529 536
140	1 96 00	2 744 000	197	3 88 09	7 645 373
141	1 98 81	2 803 221	198	3 92 04	7 762 392
142	2 01 64	2 863 288	199	3 96 01	7 880 599
143	2 04 49	2 924 207	200	4 00 00	8 000 000
144	2 07 36	2 985 984	201	4 04 01	8 120 601
145	2 10 25	3 048 625	202	4 08 04	8 242 408
146	2 13 16	3 112 136	203	4 12 09	8 365 427
147	2 16 09	3 176 523	204	4 16 16	8 489 664
148	2 19 04	3 241 792	205	4 20 25	8 615 125
149	2 22 01	3 307 949	206	4 24 36	8 741 816
150	2 25 00	3 375 000	207	4 28 49	8 869 743
151	2 28 01	3 442 951	208	4 32 64	8 998 912
152	2 31 04	3 511 808	209	4 36 81	9 129 329
153	2 34 09	3 581 577	210	4 41 00	9 261 000
154	2 37 16	3 652 264	211	4 45 21	9 393 931
155	2 40 25	3 723 875	212	4 49 44	9 528 128

TABLE OF SQUARES AND CUBES—*Continued*

No.	Squares.	Cubes.	No.	Squares	Cubes.
213	4 53 69	9 663 597	270	7 29 00	19 683 000
214	4 57 96	9 800 344	271	7 34 41	19 902 511
215	4 62 25	9 938 375	272	7 39 84	20 123 648
216	4 66 56	10 077 646	273	7 45 29	20 346 417
217	4 70 89	10 218 313	274	7 50 76	20 570 824
218	4 75 24	10 360 232	275	7 56 25	20 796 875
219	4 79 61	10 503 459	276	7 61 76	21 024 576
220	4 84 00	10 648 000	277	7 67 29	21 253 933
221	4 88 41	10 793 861	278	7 72 84	21 484 952
222	4 92 84	10 941 048	279	7 78 41	21 717 639
223	4 97 29	11 089 567	280	7 84 00	21 952 000
224	5 01 76	11 239 424	281	7 89 61	22 188 041
225	5 06 25	11 390 625	282	7 95 24	22 425 768
226	5 10 76	11 543 176	283	8 00 89	22 665 187
227	5 15 29	11 697 083	284	8 06 56	22 906 304
228	5 19 84	11 852 352	285	8 12 25	23 149 125
229	5 24 41	12 008 989	286	8 17 96	23 393 656
230	5 29 00	12 167 000	287	8 23 69	23 639 903
231	5 33 61	12 326 391	288	8 29 44	23 887 872
232	5 38 24	12 487 168	289	8 35 21	24 137 569
233	5 42 89	12 649 337	290	8 41 00	24 389 000
234	5 47 56	12 812 904	291	8 46 81	24 642 171
235	5 52 25	12 977 875	292	8 52 64	24 897 088
236	5 56 96	13 144 256	293	8 58 49	25 153 757
237	5 61 69	13 312 053	294	8 64 36	25 412 184
238	5 66 44	13 481 272	295	8 70 25	25 672 375
239	5 71 21	13 651 919	296	8 76 16	25 934 336
240	5 76 00	13 824 000	297	8 82 09	26 198 073
241	5 80 81	13 997 521	298	8 88 04	26 463 592
242	5 85 64	14 172 488	299	8 94 01	26 730 899
243	5 90 49	14 348 907	300	9 00 00	27 000 000
244	5 95 36	14 526 784	301	9 06 01	27 270 901
245	6 00 25	14 706 125	302	9 12 04	27 543 608
246	6 05 16	14 886 936	303	9 18 09	27 818 127
247	6 10 09	15 069 223	304	9 24 16	28 094 464
248	6 15 04	15 252 992	305	9 30 25	28 372 625
249	6 20 01	15 438 249	306	9 36 36	28 652 616
250	6 25 00	15 625 000	307	9 42 49	28 934 443
251	6 30 01	15 813 251	308	9 48 64	29 218 112
252	6 35 04	16 003 008	309	9 54 81	29 503 629
253	6 40 09	16 194 277	310	9 61 00	29 791 000
254	6 45 16	16 387 064	311	9 67 21	30 080 231
255	6 50 25	16 581 375	312	9 73 44	30 371 328
256	6 55 36	16 777 216	313	9 79 69	30 664 297
257	6 60 49	16 974 593	314	9 85 96	30 959 144
258	6 65 64	17 173 512	315	9 92 25	31 255 875
259	6 70 81	17 373 979	316	9 98 56	31 554 496
260	6 76 00	17 576 000	317	10 04 89	31 855 013
261	6 81 21	17 779 581	318	10 11 24	32 157 432
262	6 86 44	17 984 728	319	10 17 61	32 461 759
263	6 91 69	18 191 447	320	10 24 00	32 768 000
264	6 96 96	18 399 744	321	10 30 41	33 076 161
265	7 02 25	18 609 625	322	10 36 84	33 386 248
266	7 06 56	18 821 096	323	10 43 29	33 698 267
267	7 12 89	19 034 163	324	10 49 76	34 012 224
268	7 18 24	19 248 832	325	10 56 25	34 328 125
269	7 23 61	19 465 109	326	10 62 76	34 645 976

TABLE OF SQUARES AND CUBES—*Continued.*

No.	Squares.	Cubes.	No.	Squares.	Cubes.
327	10 69 29	34 965 783	384	14 74 56	56 623 104
328	10 75 84	35 287 552	385	14 82 25	56 066 625
329	10 82 41	35 611 289	386	14 89 96	57 512 456
330	10 89 00	35 937 000	387	14 97 69	57 960 603
331	10 95 61	36 264 691	388	15 05 44	58 411 072
332	11 02 24	36 594 368	389	15 13 21	58 863 869
333	11 08 89	36 926 037	390	15 21 00	59 319 000
334	11 15 56	37 259 704	391	15 28 81	59 776 471
335	11 22 25	37 595 375	392	15 36 64	60 236 288
336	11 28 96	37 933 056	393	15 44 49	60 698 457
337	11 35 69	38 272 753	394	15 52 36	61 162 984
338	11 42 44	38 614 472	395	15 60 25	61 629 875
339	11 49 21	38 958 219	396	15 68 16	62 099 136
340	11 56 00	39 304 000	397	15 76 09	62 570 773
341	11 62 81	39 651 821	398	15 84 04	63 044 792
342	11 69 64	40 001 688	399	15 92 01	63 521 199
343	11 76 49	40 353 607	400	16 00 00	64 000 000
344	11 83 36	40 707 584	401	16 08 01	64 481 201
345	11 90 25	41 063 625	402	16 16 04	64 964 808
346	11 97 16	41 421 736	403	16 24 09	65 450 827
347	12 04 09	41 781 923	404	16 32 16	65 939 264
348	12 11 04	42 144 192	405	16 40 25	66 430 125
349	12 18 01	42 508 549	406	16 48 36	66 923 416
350	12 25 00	42 875 000	407	16 56 49	67 419 143
351	12 32 01	43 243 551	408	16 64 64	67 917 312
352	12 39 04	43 614 208	409	16 72 81	68 417 929
353	12 46 09	43 986 977	410	16 81 00	68 921 000
354	12 53 16	44 361 864	411	16 89 21	69 426 531
355	12 60 25	44 738 875	412	16 97 44	69 934 528
356	12 67 36	45 118 016	413	17 05 69	70 444 997
357	12 74 49	45 499 293	414	17 13 96	70 957 944
358	12 81 64	45 882 712	415	17 22 25	71 473 375
359	12 88 81	46 268 279	416	17 30 56	71 991 296
360	12 96 00	46 656 000	417	17 38 89	72 511 713
361	13 03 21	47 045 881	418	17 47 24	73 034 632
362	13 10 44	47 437 928	419	17 55 61	73 560 059
363	13 17 69	47 832 147	420	17 64 00	74 088 000
364	13 24 96	48 228 544	421	17 72 41	74 618 461
365	13 32 25	48 627 125	422	17 80 84	75 151 448
366	13 39 56	49 027 896	423	17 89 29	75 686 967
367	13 46 89	49 430 863	424	17 97 76	76 225 024
368	13 54 24	49 836 032	425	18 06 25	76 765 625
369	13 61 61	50 243 409	426	18 14 76	77 308 776
370	13 69 00	50 653 000	427	18 23 29	77 854 483
371	13 76 41	51 064 811	428	18 31 84	78 402 752
372	13 83 84	51 478 848	429	18 40 41	78 953 589
373	13 91 29	51 895 117	430	18 49 00	79 507 000
374	13 98 76	52 313 624	431	18 57 61	80 062 991
375	14 06 25	52 734 375	432	18 66 24	80 621 568
376	14 13 76	53 157 376	433	18 74 89	81 182 737
377	14 21 29	53 582 633	434	18 83 56	81 746 504
378	14 28 84	54 010 152	435	18 92 25	82 312 875
379	14 36 41	54 439 939	436	19 00 96	82 881 856
380	14 44 00	54 872 000	437	19 09 69	83 453 453
381	14 51 61	55 306 341	438	19 18 44	84 027 672
382	14 59 24	55 742 968	439	19 27 21	84 604 519
383	14 66 89	56 181 887	440	19 36 00	85 184 000

TABLE OF SQUARES AND CUBES—*Continued.*

No.	Squares.	Cubes.	No.	Squares.	Cubes.
441	19 44 81	85 766 121	471	22 18 41	104 487 111
442	19 53 64	86 350 888	472	22 27 84	105 154 048
443	19 62 49	86 938 307	473	22 37 29	105 823 817
444	19 71 36	87 528 284	474	22 46 76	106 496 424
445	19 80 25	88 121 125	475	22 56 25	107 171 875
446	19 89 16	88 716 536	476	22 65 76	107 850 176
447	19 98 09	89 314 623	477	22 75 29	108 531 333
448	20 07 04	89 915 392	478	22 84 84	109 215 352
449	20 16 01	90 518 849	479	22 94 41	109 902 239
450	20 25 00	91 125 000	480	23 04 00	110 592 000
451	20 34 01	91 733 751	481	23 13 61	111 284 641
452	20 43 04	92 345 408	482	23 23 24	111 980 168
453	20 52 09	92 959 677	483	23 32 89	112 678 587
454	20 61 16	93 576 664	484	23 42 56	113 379 904
455	20 70 25	94 196 375	485	23 52 25	114 084 125
456	20 79 36	94 818 816	486	23 61 96	114 791 256
457	20 88 49	95 443 993	487	23 71 69	115 501 303
458	20 97 64	96 071 912	488	23 81 44	116 214 272
459	21 06 81	96 702 579	489	23 91 21	116 930 169
460	21 16 00	97 336 000	490	24 01 00	117 649 000
461	21 25 21	97 972 181	491	24 10 81	118 370 771
462	21 34 44	98 611 128	492	24 20 64	119 095 488
463	21 43 69	99 252 847	493	24 30 49	119 823 157
464	21 52 96	99 897 344	494	24 40 36	120 553 784
465	21 62 25	100 554 625	495	24 50 25	121 287 375
466	21 71 56	101 194 696	496	24 60 16	122 023 936
467	21 80 89	101 847 563	497	24 70 09	122 763 473
468	21 90 24	102 503 232	498	24 80 04	123 505 992
469	21 99 61	103 161 709	499	24 90 01	124 251 499
470	22 09 00	103 823 000	500	25 00 00	125 000 000

LENGTH OF CIRCULAR ARC.

(Huygen's Approximation.)

Huygen's approximation to length of a circular arc:

A = Chord of any circular arc.

B = Chord of half that arc.

R = Radius of the circular arc.

L = Length of the circular arc.

Then

$$L = \frac{8\,B - A}{3}.$$

Or as it is usually written,

$$L = 2\,B + \tfrac{1}{3}\,(2\,B - A).$$

NATURAL SINES, ETC.

Deg.	Sine.	Cover.	Cosecnt.	Tangt.	Cotang.	Secant.	Versin.	Cosin.	Deg.
0	.00	1.00000	Infinite	.0	Infinite.	1.00000	.0	1.00000	90
1	.01745	.98254	57.2986	.01745	57.2899	1.00015	.0001	.99984	89
2	.03489	.96510	28.6537	.03492	28.6362	1.00060	.0006	.99939	88
3	.05233	.94766	19.1073	.05240	19.0811	1.00137	.0013	.99862	87
4	.06975	.93024	14.3355	.06992	14.3006	1.00244	.0024	.99756	86
5	.08715	.91284	11.4737	.08748	11.4300	1.00381	.0038	.99619	85
6	.10452	.89547	9.5667	.10510	9.5143	1.00550	.0054	.99452	84
7	.12186	.87813	8.2055	.12278	8.1443	1.00750	.0074	.99254	83
8	.13917	.86082	7 1852	.14054	7.1153	1.00982	.0097	.99026	82
9	.15643	.84356	6.3924	.15838	6.3137	1.01246	.0123	.98768	81
10	.17364	.82635	5.7587	.17632	5.6712	1.01542	.0151	.98480	80
11	.19080	.80919	5.2408	.19438	5.1445	1.01871	.0183	.98162	79
12	.20791	.79208	4.8097	.21255	4.7046	1.02234	.0218	.97814	78
13	.22495	.77504	4.4454	.23086	4.3314	1.02630	.0256	.97437	77
14	.24192	.75807	4.1335	.24932	4.0107	1.03061	.0297	.97029	76
15	.25881	.74118	3.8637	.26794	3.7320	1.03527	.0340	.96592	75
16	.27563	.72436	3.6279	.28674	3.4874	1.04029	.0387	.96126	74
17	.29237	.70762	3.4203	.30573	3.2708	1.04569	.0436	.95630	73
18	.30901	.69098	3.2360	.32491	3.0776	1.05146	.0489	.95105	72
19	.32556	.67443	3.0715	.34432	2.9042	1.05762	.0544	.94551	71
20	.34202	.65797	2.9238	.36397	2.7474	1.06417	.0603	.93969	70
21	.35836	.64163	2.7904	.38386	2.6050	1.07114	.0664	.93358	69
22	.37460	.62539	2.6694	.40402	2.4750	1.07853	.0728	.92718	68
23	.39073	.60926	2.5593	.42447	2.3558	1.08636	.0794	.92050	67
24	.40673	.59326	2.4585	.44522	2.2460	1.09463	.0864	.91354	66
25	.42261	.57738	2.3662	.46630	2.1445	1.10337	.0936	.90630	65
26	.43837	.56162	2.2811	.48773	2.0503	1.11260	.1012	.89879	64
27	.45399	.54600	2.2026	.50952	1.9626	1.12232	.1089	.89100	63
28	.46947	.53052	2.1300	.53170	1.8807	1.13257	.1170	.88294	62
29	.48480	.51519	2.0626	.55430	1.8040	1.14335	.1253	.87461	61
30	.50000	.50000	2.0000	.57735	1.7320	1.15470	.1339	.86602	60
31	.51503	.48496	1.9416	.60086	1.6642	1.16663	.1428	.85716	59
32	.52991	.47008	1.8870	.62486	1.6003	1.17917	.1519	.84804	58
33	.54463	.45536	1.8360	.64940	1.5398	1.19236	.1613	.83867	57
34	.55919	.44080	1.7882	.67450	1.4825	1.20621	.1709	.82903	56
35	.57357	.42642	1.7434	.70020	1.4281	1.22077	.1808	.81915	55
36	.58778	.41221	1.7013	.72654	1.3763	1.23606	.1909	.80901	54
37	.60181	.39818	1.6616	.75355	1.3270	1.25213	.2013	.79863	53
38	.61566	.38433	1 6242	.78128	1.2799	1.26901	.2119	.78801	52
39	.62932	.37067	1.5890	.80978	1.2348	1.28675	.2228	.77714	51
40	.64278	.35721	1.5557	.83909	1.1917	1.30540	.2339	.76604	50
41	.65605	.34394	1.5242	.86928	1.1503	1.32501	.2452	.75470	49
42	.66913	.33086	1.4944	.90040	1.1106	1.34563	.2568	.74314	48
43	.68199	.31800	1.4662	.93251	1.0723	1.36732	.2686	.73135	47
44	.69465	.30534	1.4395	.96568	1.0355	1.39016	.2806	.71933	46
45	.70710	.29289	1.4142	1.00000	1.0000	1.41421	.2928	.70710	45
	Cosin.	Versin.	Secant.	Cotang.	Tangt.	Cosecnt.	Cover.	Sine.	

TABLE OF PROPORTIONS OF THE CIRCLE AND ITS EQUAL.

The diameter of any circle $\times$ 3.1416 = the circumference.

The circumference of any circle $\times \left(\frac{1}{3.1416} = 0.31831\right)$ = the diameter.

The square of the diameter $\times \left(\frac{3.1416}{4} = 0.7854\right)$ = the area.

The square of the circumference $\times \left(\frac{0.7854}{3.1416^2} = 0.07958\right)$ = the area.

The diameter of a circle $\times \left(\sqrt{0.7854} = 0.8862\right)$ = side of equal square.

The circumference of a circle $\times \left(\sqrt{0.07958} = 0.2821\right)$ = side of equal square.

The side of any square $\times \left(\frac{1}{0.8862} = 1.1284\right)$ = diameter of equal circle.

The side of any square $\times \left(\frac{1}{0.2821} = 3.545\right)$ = circumference of equal circle.

Square of side $\times \left(\frac{1}{0.7854} = 1.27324366\right)$ = square of diameter of equal circle = so-called round inches.

Round inches $\times \left(\frac{0.7854}{144.} = 0.0546\right)$ = square feet.

Square of diameter of equal circle $\times$ 0.7854 = square of side.

Area of segment of circle = area of sector of equal radius, less area of triangle.

Area of parabola = base $\times \frac{2}{3}$ height.

Area of ellipse = longest diameter $\times$ shortest diameter $\times$ .7854.

Area of any regular polygon = sum of its sides $\times$ perpendicular from its centre to one of its sides, divided by 2.

Surface of cylinder = area of both ends + length $\times$ circumference.

Surface of segment = height of segment $\times$ whole circumference of sphere of which it is a part.

Cubic contents of a cylinder = area of one end $\times$ length.

AREAS OF CIRCLES,

ADVANCING BY EIGHTHS.

AREAS.

Diam.	.0	.⅛	.¼	.⅜	.½	.⅝	.¾	.⅞
0	.0	.0122	.0490	.1104	.1963	.3068	.4417	.6013
1	.7854	.9940	1.227	1.484	1.767	2.073	2.405	2.761
2	3.1416	3.546	3.976	4.430	4.908	5.411	5.939	64.91
3	7.068	7.669	8.295	8.946	9.621	10.32	11.04	11.79
4	12.56	13.36	14.18	15.03	15.90	16.80	17.72	18.66
5	19.63	20.62	21.64	22.69	23.75	24.85	25.96	27.10
6	28.27	29.46	30.67	31.91	33.18	34.47	35.78	37.12
7	38.48	39.87	41.28	42.71	44.17	45.66	47.17	48.70
8	50.26	51.84	53.45	55.08	56.74	58.42	60.13	61.86
9	63.61	65.39	67.20	69.02	70.88	72.75	74.69	76.58
10	78.54	80.51	82.51	84.54	86.59	88.66	90.76	92.88
11	95.03	97.20	99.40	101.6	103.8	106.1	108.4	110.7
12	113.0	115.4	117.8	120.2	122.7	125.1	127.6	130.1
13	132.7	135.2	137.8	140.5	143.1	145.8	148.4	151.2
14	153.9	156.6	159.4	162.2	165.1	167.9	170.8	173.7
15	176.7	179.6	182.6	185.6	188.6	191.7	194.8	197.9
16	201.0	204.2	207.3	210.5	213.8	217.0	220.3	223.6
17	226.9	230.3	233.7	237.1	240.5	243.9	247 4	250.9
18	254.4	258.0	261.5	265.1	268.8	272.4	276.1	279.8
19	283.5	287.2	291.0	294.8	298.6	302.4	306.3	310.2
20	314.1	318.1	322.0	326.0	330.0	334.1	338.1	342.2
21	346.3	350.4	354.6	358.8	363.0	367.2	371.5	375.8
22	380.1	384.4	388.8	393.2	397.6	402.0	406.4	410.9
23	415.4	420.0	424.5	429.1	433.7	438.3	443.0	447.6
24	452.3	457.1	461.8	466.6	471.4	476.2	481.1	485.9
25	490.8	495 7	500.7	505.7	510.7	515.7	520.7	525.8
26	530.9	536.0	541.1	546.3	551.5	556.7	562.0	567.2
27	572.5	577.8	583.2	588.5	593.9	599.3	604.8	610.2
28	615.7	621.2	626.7	632.3	637.9	643.5	649.1	654.8
29	660.5	666.2	671.9	677.7	683.4	689.2	695.1	700.9
30	706.8	712.7	718.6	724.6	730.6	736.6	742.6	748.6
31	754.8	760.9	767.0	773.1	779.3	785.5	791.7	798.0
32	804.3	810.6	816.9	823.2	829.6	836.0	842.4	848.8
33	855.3	861.8	868.3	874.9	881.4	888.0	894.6	901.3
34	907.9	914.7	921.3	928.1	934.8	941.6	948.4	955.3
35	962.1	969.0	975.9	982.8	989.8	996.8	1003.8	1010.8
36	1017.9	1025.0	1032.1	1039.2	1046.3	1053.5	1060.7	1068.0
37	1075.2	1082.5	1089.8	1097.1	1104.5	1111.8	1119.2	1126.7
38	1134 1	1141.6	1149.1	1156.6	1164.2	1171.7	1179.3	1186.9
39	1194.6	1202.3	1210.0	1217.7	1225.4	1233.2	1241.0	1248.8
40	1256.6	1264.5	1272.4	1280.3	1288.2	1296.2	1304.2	1312.2
41	1320.3	1328.3	1336.4	1344.5	1352.7	1360.8	1369.0	1377.2
42	1385.4	1393.7	1402.0	1410.3	1418.6	1427.0	1435.4	1443.8
43	1452.2	1460.7	1469.1	1477.6	1486.2	1494.7	1503.3	1511.9
44	1520.5	1529.2	1537.9	1546.6	1555.3	1564.0	1572.8	1581.6
45	1590.4	1599.3	1608.2	1617.0	1626.0	1634.9	1643.9	1652.9

CIRCUMFERENCES OF CIRCLES,

ADVANCING BY EIGHTHS.

CIRCUMFERENCES.

Diam.	.0	.⅛	.¼	.⅜	.½	.⅝	.¾	.⅞
0	.0	.3927	.7854	1.178	1.570	1.963	2.356	2.748
1	3.141	3.534	3.927	4.319	4.712	5.105	5.497	5.890
2	6.283	6.675	7.068	7.461	7.854	8.246	8.639	9.032
3	9.424	9.817	10.21	10.60	10.99	11.38	11.78	12.17
4	12.56	12.95	13.35	13.74	14.13	14.52	14.92	15.31
5	15.70	16.10	16.49	16.88	17.27	17.67	18.06	18.45
6	18.84	19.24	19.63	20.02	20.42	20.81	21.20	21.59
7	21.99	22.38	22.77	23.16	23.56	23.95	24.34	24.74
8	25.13	25.52	25.91	26.31	26.70	27.09	27.48	27.88
9	28.27	28.66	29.05	29.45	29.84	30.23	30.63	31.02
10	31.41	31.80	32.20	32.59	32.98	33.37	33.77	34.16
11	34.55	34.95	35.34	35.73	36.12	36.52	36.91	37.30
12	37.69	38.09	38.48	38.87	39.27	39.66	40.05	40.44
13	40.84	41.23	41.62	42.01	42.41	42.80	43.19	43.58
14	43.98	44.37	44.76	45.16	45.55	45.94	46.33	46.73
15	47.12	47.51	47.90	48.30	48.69	49.08	49.48	49.87
16	50.26	50.65	51.05	51.44	51.83	52.22	52.62	53.01
17	53.40	53.79	54.19	54.58	54.97	55.37	55.76	56.15
18	56.54	56.94	57.33	57.72	58.11	58.51	58.90	59.29
19	59.69	60.08	60.47	60.86	61.26	61.65	62.04	62.43
20	62.83	63.22	63.61	64.01	64.40	64.79	65.18	65.58
21	65.97	66.36	66.75	67.15	67.54	67.93	68.32	68.72
22	69.11	69.50	69.90	70.29	70.68	71.07	71.47	71.86
23	72.25	72.64	73.04	73.43	73.82	74.22	74.61	75.00
24	75.39	75.79	76.18	76.57	76.96	77.36	77.75	78.14
25	78.54	78.93	79.32	79.71	80.10	80.50	80.89	81.28
26	81.68	82.07	82.46	82.85	83.25	83.64	84.03	84.43
27	84.82	85.21	85.60	86.00	86.39	86.78	87.17	87.57
28	87.96	88.35	88.75	89.14	89.53	89.92	90.32	90.71
29	91.10	91.49	91.89	92.28	92.67	93.06	93.46	93.85
30	94.24	94.64	95.03	95.42	95.81	96.21	96.60	96.99
31	97.39	97.78	98.17	98.57	98.96	99.35	99.75	100.14
32	100.53	100.92	101.32	101.71	102.10	102.49	102.89	103.29
33	103.67	104.07	104.46	104.85	105.24	105.64	106.03	106.42
34	106.81	107.21	107.60	107.99	108.39	108.78	109.17	109.56
35	109.96	110.35	110.74	111.13	111.53	111.92	112.31	112.71
36	113.10	113.49	113.88	114.28	114.67	115.06	115.45	115.85
37	116.24	116.63	117.02	117.42	117.81	118.20	118.60	118.99
38	119.38	119.77	120.17	120.56	120.95	121.34	121.74	122.13
39	122.52	122.92	123.31	123.70	124.09	124.49	124.88	125.27
40	125.66	126.06	126.45	126.84	127.24	127.63	128.02	128 41
41	128.81	129.20	129.59	129.98	130.38	130.77	131.16	131.55
42	131.95	132.34	132.73	133.13	133.52	133.91	134.30	134.70
43	135.09	135.48	135.87	136.27	136.66	137.05	137.45	137.84
44	138.23	138.62	139.02	139 41	139.80	140.19	140.59	140.98
45	141 37	141.76	142.16	142.55	142 94	143.34	143 73	144 12

MEASUREMENTS OF LENGTH.

Miles.	Rods	Yards.	Feet.	Inches
1.	320.	1760.	5280.	63360.
0.003125	1.	5.5	16.5	198.
0.000568	0.1818	1.	3.	36.
0.00019	0.0606	0.333	1.	12.
0.0000157	0.00505	0.0277	0.08333	1.

MEASUREMENT OF WEIGHTS.

Ton.	Cwts.	Pounds.	Ounces.
1.	20.	2240.	35840.
0.050	1.	112.	1792
	0.0089	1.	16.
		0.0625	1.

1 POUND = 27.7 cub. in. of distilled water at 40° Fahrenheit.

MEASUREMENT OF CAPACITY.

Cub. Yards.	Barrels.	Bushels.	Cub. Feet.	Gallons	Cub. Inch.
1.	5.6103	25.2467	27.	201.97	46656.
0.1782	1.	4.5	4.8125	36.	8316.
0.0396	0.222	1.	1.2438	8	2150.
	0.2078	0.804	1.	7.476	1728.
	0.0277	0.125	0.13369	1.	231.
			0.000578	0.00433	1.

Bushels are here calculated without *cones*.

1 BUSHEL = 2150.42 cub inches of distilled water, at 40° Fahrenheit. Its dimensions are 18½ in. diameter inside, 8 in. deep, and, when heaped, the cone must be 6 in. high, or = 2748 cub. in.

MEASUREMENT OF SURFACE.

Sq. Miles.	Sq. Acres	Sq. Rods.	Sq. Yards.	Sq Feet.	Sq. Inches.
1.	640.	102400.	3097600.	27878400	4014489600
001562	1	160	4840.	43560	696960.
	0.00625	1	30.25	272.25	39204.
		0.033	1	9.0	1296
			0 111	1.	144
				0 00694	1