THE
ST. PAUL FOUNDRY COMPANY
ST. PAUL, U. S. A.

1929
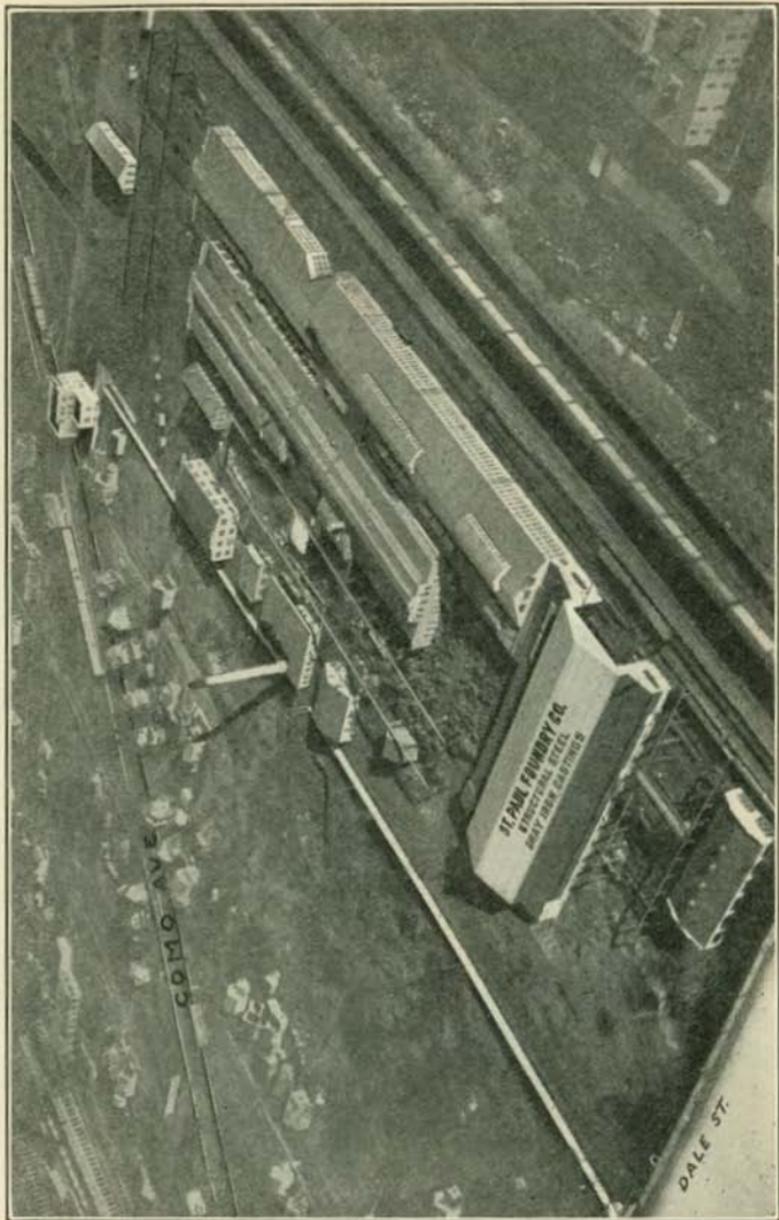
1929—AEROPLANE VIEW OF PLANT
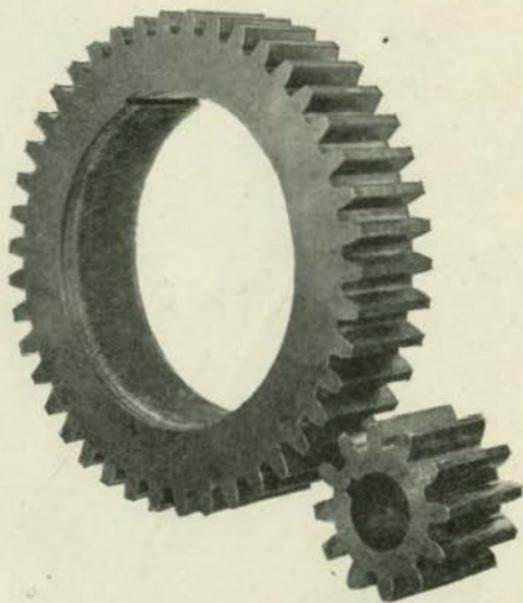
OFFICERS OF THE COMPANY

FRED S. POWER, President and Gen. Manager
GEO. I. ASHTON, Secretary and Treasurer
WM. J. SNYKER, Superintendent

DEPARTMENTS

GEO. E. COOK, Contracting
EDGAR A. GOETZ, Engineering
JOHN H. GUNTHER, Purchasing
CHAS. A. HAAG, Cashier
STEPHEN GRESHL, City Desk
H. M. LUFKIN, Traffic

HANDBOOK

of

Tables and Information

(In three parts)

Appertaining to the use of

Cast Iron and Structural Steel

and of

This Company's Products

for

Engineers-Architects-Builders

St. Paul Foundry Company

MANUFACTURERS AND ENGINEERS

Structural Steel and Iron   Grey Iron and Alloy-Iron Castings

Special Machinery   Light Forgings

St. Paul, Minnesota

Established 1883

STRUCTURAL STEEL SHOP   **FOUNDRY**

Annual capacity..15,000 tons   Annual capacity..12,000 tons

We Manufacture

ARCHITECTURAL-STRUCTURAL STEEL
STEEL LINTELS, BEAMS, COLUMNS
TRUSSES FOR FLOORS AND ROOFS
GIRDERS, HEAVY AND LIGHT
BRIDGES, HIGHWAY AND RAILROAD
BREECHING, PENTSTOCKS, STACKS
WATER TOWERS AND TANKS

PRISON CELL WORK OF ALL KINDS
MISCELLANEOUS STRUCTURES OF ALL TYPES
AND SIZES
RAILROAD CASTINGS
WATER AND SEWER CASTINGS
CAST IRON COLUMNS AND PLATES
CAST SPANDRELS AND FACIAS
MISCELLANEOUS CASTINGS UP
TO TWENTY TONS

SPECIAL MACHINERY
LIGHT FORGINGS
BOILER FRONTS
STEEL BOILER BUCK STAYS
REAR ARCH BARS
BOILER FITTINGS OF VARIOUS KINDS
GRATES AND GRATE BARS

ORNAMENTAL CAST AND WROUGHT WORK
GAS PIPE RAILINGS AND COLUMNS
STANDARD FIRE ESCAPES
STEEL AND IRON STAIRWAYS
CIRCULAR OR SPIRAL STAIRS
ACETYLENE AND ELECTRIC WELDING
RAILROAD AND CONTRACTORS'
HEAVY EQUIPMENT REPAIRS

We carry a stock of from 3,000 to 4,000 tons of steel shapes, protected from the weather and the elements in our new warehouse, and are prepared to execute orders on short notice.

MACHINE SHOP   **BLACKSMITH SHOP**

PREFACE TO FIFTH EDITION
(REVISED)

THIS handbook is written to give detailed and general information to the architect, contractor, and structural engineer on the products of our various shops and on the allied materials of the building industry. The book contains data, details, and tables for the design of steel structures and for the castings, forgings, and machinery made by this Company.

PART 1 consists of three sections— (1) Properties and safe loads of rolled structural bars, angles, and shapes used as beams or as tension members, (2) Properties and safe loads of rolled structural bars, angles, and shapes used as struts or columns, (3) Detailed information on standard connections, rivets, weights of plates, etc.

All safe load tables have been calculated upon a unit tensile strength of 18,000 pounds per square inch to conform with the specifications of the American Institute of Steel Construction. These specifications are a part of the St. Paul building ordinance and of the building codes of most of the larger cities of the United States.

PART 2 contains detailed information principally on the products of our foundry and machine shop and is written in two sections— (1) Covering data, details, and tables on plain and ornamental cast iron columns, (2) Showing our principal standard castings and a wide variety of miscellaneous castings and forgings.

Portions of section 2 are devoted entirely to information on flag poles, stairways, fire escapes, prisons and prison equipment, and machinery.

PART 3 comprises various engineering data and information on the products of other companies allied to those of our Company. The standard specifications of the American Institute of Steel Construction and of the American Society for Testing Materials with reference to structural steel for buildings are quoted, and a wide variety of information on floors, roofs, and building material is included.
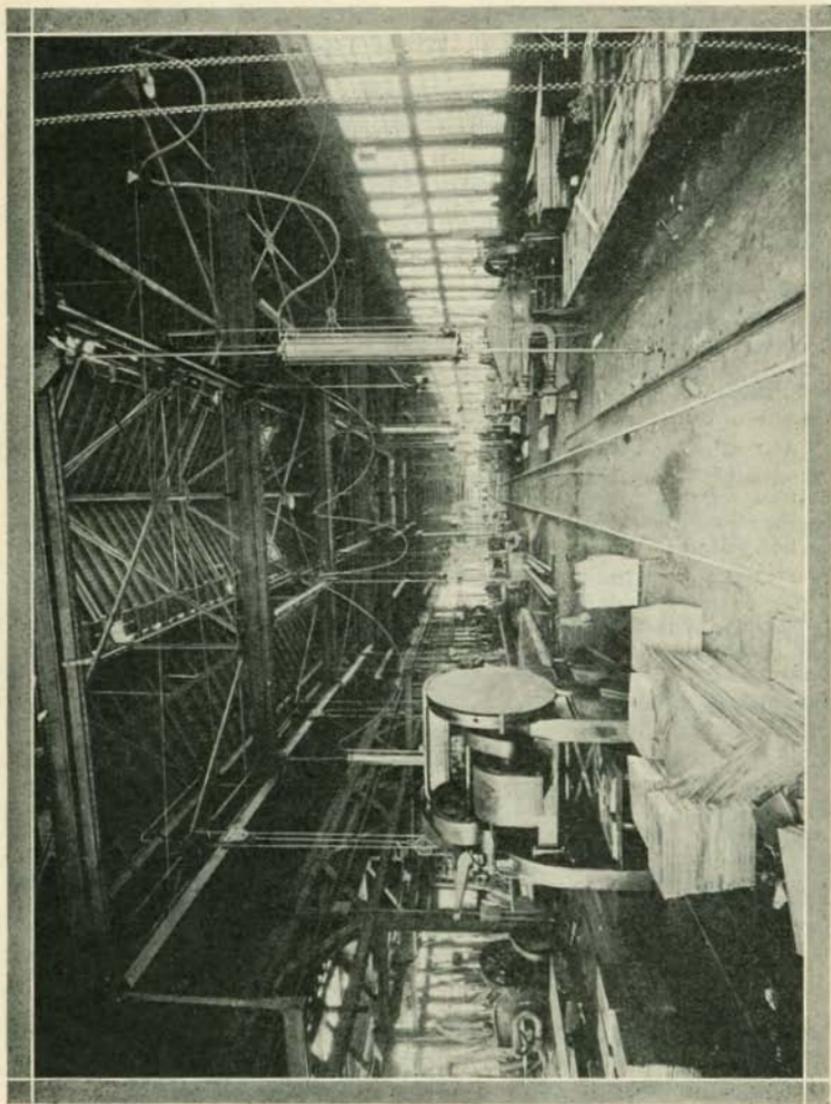
Part View of Structural Steel Shop of the St. Paul Foundry Company

PART I

TABLES ON STRUCTURAL STEEL

Section 1

Properties and Safe Loads of American Standard Channels and Beams
Properties and Safe Loads of Carnegie Beams
Properties and Safe Loads of Bethlehem Beams, Girders
Safe Loads of Riveted Girders
Properties and Safe Loads of Angles
Properties and Safe Loads of Bars
Properties and Safe Loads of Tees
Properties of Rails and Small Channels

Section 2

Safe Loads of Angle Struts
Safe Loads on Rolled Steel Slabs for Column Bases
Safe Loads of Standard I Beam Columns
Properties and Safe Loads of Carnegie Columns
Properties and Safe Loads of Bethlehem Columns
Safe Loads of Plate and Angle Columns
Safe Loads of Latticed Channel Columns
Safe Loads of Plate and Channel Columns

Section 3

Standard Connections for American Standard Beams and Channels, Carnegie Beams, Bethlehem Beams and Girders

Rivet Values and Riveting Details

Miscellaneous Information on Angles, Plates, Beams, Columns, Channels and Zs

See Index

SAFE LOADS ON BEAMS AND GIRDERS

The following tables give the greatest safe load (evenly distributed over the entire length) which steel shapes used as beams or girders will carry. The tabulated loads include the weight of the beam which weight must be deducted to obtain the net load.

Note that the weights of other sections than those fully described in the tables are noted on their respective pages. Bearing in mind the respective variation in weights, the safe loads for these sections can be approximated by interpolation from the safe loads shown.

The loads given are based on a fiber stress of 18,000 pounds per square inch and are entirely reliable for ordinary conditions of quiescent loads. For fluctuating loads causing vibration, the tabular load should be reduced one-fifth, and for rapidly moving loads causing slight impact, reduce the tabular load by one-third.

The tables give the safe loads for laterally free and fixed beams. The following table is generally convenient for finding the relative safe load of a beam fixed sideways (to prevent buckling in the compression flange) under various conditions. See also table on page 160.

Unbraced Length of Span	Allowable Safe Load	Unbraced Length of Span	Allowable Safe Load
5 x flange width	Full tabular load	25 x flange width	84.6% tabular load
10 x " "	" " "	30 x " "	76.6% " "
15 x " "	" " "	35 x " "	68.9% " "
20 x " "	92.5% " "	40 x " "	61.7% " "

The choice of a beam is also governed by its deflection due to the load and span. In order to prevent cracked plastered ceilings, the live load deflection must not exceed 1/360 of the span.

$$\text{Live Load Def.} = \frac{\text{Tot. Def. X Live Load}}{\text{Tabular Load}}$$

EQUIVALENT UNIFORM LOADS.

The size of beam necessary to carry a uniformly distributed load and one or more concentrated loads, or several concentrated loads alone can be readily obtained from the tables of safe loads of beams, by first obtaining a total uniformly distributed load which is equivalent to the various loads on the beam. The table at the right gives the equivalent uniformly distributed load of a concentrated load of 1,000 pounds located at different points on the beam.

1/2	2,000
1/3	1,780
1/4	1,500
1/5	1,280
1/6	1,100
1/7	980
1/8	875
1/9	790
1/10	720

On pages 268 and 269, part 3 of miscellaneous information, formulae are given for obtaining the safe load under various systems of loading.
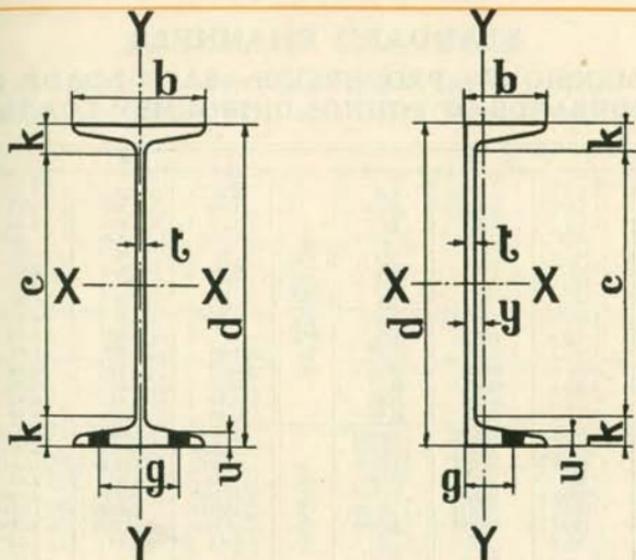
STANDARD AMERICAN CHANNELS AND BEAMS

Indicated dimensions for various sizes of channels and beams are shown in the following tables of their safe loads.

SYMBOLS

I —Moment of Inertia
S —Section Modulus
r —Radius of Gyration
V —Maximum Web Shear in Pounds
P —Minimum Span in feet, uniformly loaded to cause **V**
R —Allowable End Reaction for $3\frac{1}{2}''$ bearing
B —Unit Stress in Buckling
W —Maximum Load on one Standard Connection
Q —Minimum Span in feet, uniformly loaded to cause **W**
w —Weight of one Standard Connection including Angles and Web Rivets
y —Distance in inches between Center of Gravity and back of Channel

Rivet given is maximum diameter in flange.

Allowable concentrated center loads are 50% and their deflections 80% of those shown.

Refer to safe load tables for the computed figures on the above items.

UNIT STRESS IN BUCKLING

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

ST. PAUL FOUNDRY CO.

STANDARD CHANNELS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		3''	3''	3''		4''	4''	4''	
Depth = d''		3	3	3		4	4	4	
Wt. per foot.		4.1	5.0	6.0		5.4	6.25	7.25	
Area. sq. in..		1.19	1.46	1.75		1.56	1.82	2.12	
b''........		1.41	1.50	1.60		1.58	1.65	1.72	
t.........		.170	.258	.356	For Detailed Cut, See Page 7.	.180	.247	.320	For Detailed Cut, See Page 7.
k.........		⅝	⅝	⅝		⅝	⅝	⅝	
c.........		1¾	1¾	1¾		2¼	2¼	2¼	
g.........		⅞	⅞	¾		1''	1''	1''	
u.........		¼	¼	¼		⅜	⅜	⅜	
AXES X-X I.....		1.6	1.8	2.1		3.8	4.1	4.5	
S.....		1.07	1.2	1.4		1.9	2.05	2.25	
r.....		1.17	1.12	1.08		1.56	1.50	1.47	
AXES Y-Y I.....		0.20	0.25	0.31		0.32	0.38	0.44	
S.....		0.21	0.24	0.27		0.29	0.32	0.35	
r.....		0.41	0.41	0.42		0.45	0.45	0.46	
y....		0.44	0.44	0.46		0.46	0.46	0.46	
Coef. Str....		12800	14400	16800		22800	24600	27000	
Max.Mom."@		19200	21600	25200		34200	36900	40500	
V.......		6100	9300	12800		8600	11900	15400	
P. feet...		1.05	.77	.66	Deflection	1.33	1.03	0.88	Deflection
R.......		10800	16400	22700		12100	16700	21600	
B.......		15000	15000	15000		15000	15000	15000	
W.......		7700	11600	11900		8100	11100	11900	
Q. feet....		.83	.62	.71		1.41	1.11	1.13	
w. lbs....		5	5	5		5	5	5	
Rivet dia....		½	½	½		½	½	½	

	Span feet	Laterally		Laterally		Laterally			Laterally		Laterally		Laterally		
		fixed	free	fixed	free	fixed	free		fixed	free	fixed	free	fixed	free	
whichever is divide the	1	12.2	12.2	14.4	14.4	16.8	16.8	.025	17.2	17.2	23.8	23.8	27.0	27.0	.019
	2	6.4	6.3	7.2	7.1	8.4	8.4	.056	11.4	11.4	12.3	12.3	13.5	13.5	.042
	3	4.3	3.7	4.8	4.1	5.6	5.0	.099	7.6	6.7	8.2	7.3	9.0	8.3	.074
	4	3.2	2.3	3.6	2.6	4.2	3.2	.155	5.7	4.3	6.2	4.8	6.7	5.4	.116
	5	2.6	..	2.9	1.8	3.4	2.2		4.6	3.0	4.9	3.4	5.4	3.7	
or flexure, tabulated, in feet.	6	2.1	..	2.4	..	2.8	..	.223	3.8	..	4.1	..	4.5	..	.168
	7	1.8	..	2.1	..	2.4	..	.304	3.3	..	3.5	..	3.8	..	.228
	8	1.6	..	1.8	..	2.1	..	.396	2.9	..	3.1	..	3.4	..	.298
	9	1.4	..	1.6	..	1.9	..	.503	2.5	..	2.7	..	3.0	..	.378
	10	1.3	..	1.4	..	1.7	..	.620	2.3	..	2.5	..	2.7	..	.465
shear by the Span	11	1.2	..	1.3	..	1.5	..	.750	2.1	..	2.2	..	2.5	..	.562
	12	1.1	..	1.2	..	1.4	..	.896	1.9	..	2.1	..	2.3	..	.670
	13	1.0	..	1.1	..	1.3	..	1.05	1.8	..	1.9	..	2.1	..	.787
	14	0.9	..	1.0	..	1.2	..	1.22	1.6	..	1.8	..	1.9	..	.912
	15	0.8	..	1.0	..	1.1	..	1.39	1.5	..	1.6	..	1.8	..	1.05

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span by the Span in feet.

STANDARD CHANNELS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

For Detailed Cut See Page 7

SYMBOLS	5″			6″			
Depth = d″	5	5	5	6	6	6	6
Wt. per foot	6.7	9.0	11.5	8.2	10.5	13.0	15.5
Area, sq. in.	1.95	2.63	3.36	2.39	3.07	3.81	4.54
b″	1.75	1.89	2.03	1.92	2.03	2.16	2.28
t	.190	.325	.472	.200	.314	.437	.559
k	⅜	⅜	⅜	¾	¾	¾	¾
c	3¾	3¾	3¾	4½	4½	4½	4½
g	1⅛	1⅛	1⅛	1¼	1¼	1⅜	1⅜
u	⅝	⅝	⅝	⅝	⅝	⅝	⅝
AXES X-X I	7.4	8.8	10.4	13.0	15.1	17.3	19.5
X-X S	2.96	3.52	4.16	4.33	5.03	5.77	6.5
X-X r	1.95	1.83	1.76	2.34	2.22	2.13	2.07
Y-Y I	0.48	0.64	0.82	0.70	0.87	1.1	1.3
Y-Y S	0.38	0.45	0.54	0.50	0.57	0.65	0.73
Y-Y r	0.50	0.49	0.49	0.54	0.53	0.53	0.53
Y-Y y	0.49	0.49	0.51	0.52	0.50	0.52	0.55
Coef. Str.	35500	42200	49900	52000	60400	69200	78000
Max.Mom.″‡	53300	63400	74900	78000	90200	103800	117000
V	11400	19500	28500	14400	22600	31500	40200
P. feet	1.56	1.08	0.88	1.81	1.34	1.10	.97
R	13500	23100	33600	15000	23500	32700	41900
B	15000	15000	15000	15000	15000	15000	15000
W	8600	11900	11900	9000	11900	11900	11900
Q. feet	2.07	1.77	2.10	2.89	2.54	2.91	3.28
w. lbs	6	6	6	6	6	6	6
Rivet dia	½	½	½	¾	¾	¾	⅝

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	5″ Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection	6″ Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
1	22.8	22.8	39.0	39.0	49.2	49.2		28.8	28.8	45.2	45.2	63.0	63.0	78.0	78.0	
2	17.8	17.8	21.1	21.1	24.9	24.9		26.0	26.0	30.2	30.2	34.6	34.6	39.0	39.0	.028
3	11.8	10.9	14.0	13.2	16.6	15.6	.033	17.3	16.4	20.1	19.3	23.1	22.5	26.0	25.7	.050
4	8.9	7.2	10.5	8.8	12.5	10.4	.059	13.0	11.0	15.1	13.1	17.3	15.4	19.5	18.1	.078
5	7.1	5.0	8.4	6.2	10.0	7.4	.093	10.4	7.8	12.1	9.4	13.8	11.0	15.6	12.9	
6	5.9	..	7.0	4.5	8.3	5.3	.134	8.7	5.7	10.1	6.9	11.5	8.3	13.0	9.6	.112
7	5.1	..	6.0	..	7.1	..	.182	7.4	..	8.6	..	9.9	..	11.1	7.3	.152
8	4.4	..	5.3	..	6.2	..	.238	6.5	..	7.6	..	8.7	..	9.8	..	.198
9	3.9	..	4.7	..	5.5	..	.302	5.8	..	6.7	..	7.7	..	8.7	..	.252
10	3.6	..	4.2	..	5.0	..	.372	5.2	..	6.0	..	6.9	..	7.8	..	.310
11	3.2	..	3.8	..	4.5	..	.450	4.7	..	5.5	..	6.3	..	7.1	..	.375
12	3.0	..	3.5	..	4.2	..	.537	4.3	..	5.0	..	5.8	..	6.5	..	.447
13	2.7	..	3.2	..	3.8	..	.630	4.0	..	4.6	..	5.4	..	6.0	..	.525
14	2.5	..	3.0	..	3.6	..	.730	3.7	..	4.3	..	5.0	..	5.6	..	.608
15	2.4	..	2.8	..	3.3	..	.838	3.5	..	4.0	..	4.6	..	5.2	..	.698
16	2.2	..	2.6	..	3.1	..	.955	3.3	..	3.8	..	4.3	..	4.9	..	.795
17	2.1	..	2.5	..	2.9	..	1.08	3.1	..	3.6	..	4.1	..	4.6	..	.898
18	2.0	..	2.3	..	2.8	..	1.20	2.9	..	3.4	..	3.8	..	4.3	..	1.01
19	1.9	..	2.2	..	2.6	..	1.34	2.7	..	3.2	..	3.6	..	4.1	..	1.12
20	1.8	..	2.1	..	2.5	..	1.49	2.6	..	3.0	..	3.5	..	3.9	..	1.24

STANDARD CHANNELS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	7"				8"			
Depth = d"	7	7	7	For Detailed Cut See Page 7.	8	8	8	8
Wt. per foot	9.8	12.25	14.75		11.50	13.75	16.25	18.75
Area. sq. in.	2.85	3.58	4.32		3.36	4.02	4.76	5.49
b"	2.09	2.19	2.30		2.26	2.34	2.44	2.53
t	.210	.314	.419		.220	.303	.395	.487
k	¾	¾	¾		⅞	⅞	⅞	⅞
c	5½	5½	5½		6¼	6¼	6¼	6¼
g	1¼	1¼	1¼		1⅜	1⅜	1½	1½
u	⅝	⅝	⅝		⅝	⅝	⅝	⅝
AXES X-X I	21.1	24.1	27.1		32.3	35.8	39.8	43.7
AXES X-X S	6.03	6.88	7.74		8.08	8.95	9.95	10.92
AXES X-X r	2.72	2.59	2.51		3.10	2.99	2.89	2.82
AXES Y-Y I	0.98	1.2	1.4		1.3	1.5	1.8	2.0
AXES Y-Y S	0.63	0.71	0.79		.79	.86	.94	1.0
AXES Y-Y r	0.59	0.58	0.57		.63	.62	.61	.60
AXES Y-Y y	0.55	0.53	0.53		.58	.56	.56	.57
Corf. Str.	72300	82600	92900	Deflection	96900	107400	119400	131100
Max.Mom."#	108500	123900	139400		145400	161100	179100	196700
V	17600	26500	35200		21100	29100	37900	46800
P. feet	2.05	1.56	1.32		2.30	1.80	1.58	1.40
R	16500	24700	33000		18100	25000	32600	40200
B	15000	15000	15000		15000	15000	15000	15000
W	9500	11900	11900		19800	23800	23800	23800
Q. feet	3.81	3.47	3.90		2.45	2.26	2.51	2.75
w. lbs	6	6	6		13	13	13	13
Rivet dia.	⅝	⅝	⅝		¾	¾	¾	¾

Span feet	Laterally		Laterally		Laterally			Laterally		Laterally		Laterally		Laterally		
	fix'd	free	fix'd	free	fix'd	free		fix'd	free	fix'd	free	fix'd	free	fix'd	free	
3	24.1	23.3	27.5	26.9	31.0	30.7	.024	32.3	31.9	35.8	35.6	39.8	39.8	43.7	43.7	.021
4	18.1	15.9	20.7	18.5	23.2	21.2	.043	24.2	22.0	26.9	24.7	29.8	27.7	32.8	30.9	.037
5	14.5	11.2	16.5	13.4	18.6	15.4	.067	19.4	15.9	21.5	18.0	23.9	20.4	26.3	22.8	.058
6	12.1	8.5	13.8	10.0	15.5	11.1	.096	16.1	12.0	17.9	13.5	19.9	15.4	21.9	17.3	.084
7	10.3	6.4	11.8	7.6	13.3	8.9	.130	13.8	9.0	15.3	10.3	17.1	12.0	18.7	13.4	.114
8	9.0	..	10.3	..	11.6	..	.170	12.1	..	13.4	..	14.9	9.3	16.4	10.6	.149
9	8.0	..	9.2	..	10.3	..	.216	10.8	..	11.9	..	13.3	..	14.5	..	.189
10	7.2	..	8.3	..	9.3	..	.266	9.7	..	10.7	..	11.9	..	13.1	..	.233
11	6.6	..	7.5	..	8.4	..	.321	8.8	..	9.8	..	10.8	..	11.9	..	.281
12	6.0	..	6.9	..	7.7	..	.383	8.1	..	8.9	..	9.9	..	10.9	..	.335
13	5.5	..	6.4	..	7.1	..	.450	7.5	..	8.3	..	9.1	..	10.1	..	.394
14	5.1	..	5.9	..	6.6	..	.521	6.9	..	7.7	..	8.5	..	9.3	..	.456
15	4.8	..	5.5	..	6.2	..	.599	6.5	..	7.2	..	7.9	..	8.7	..	.524
16	4.5	..	5.2	..	5.8	..	.681	6.1	..	6.8	..	7.4	..	8.2	..	.596
17	4.3	..	4.9	..	5.5	..	.770	5.7	..	6.4	..	7.0	..	7.7	..	.674
18	4.0	..	4.6	..	5.2	..	.861	5.4	..	6.0	..	6.6	..	7.3	..	.754
19	3.8	..	4.3	..	4.9	..	.960	5.1	..	5.7	..	6.3	..	6.9	..	.840
20	3.6	..	4.1	..	4.6	..	1.06	4.8	..	5.4	..	6.0	..	6.6	..	.931
21	3.4	..	3.9	..	4.4	..	1.17	4.6	..	5.1	..	5.7	..	6.2	..	1.03
22	3.3	..	3.8	..	4.2	..	1.29	4.4	..	4.9	..	5.4	..	6.0	..	1.13
23	3.1	..	3.6	..	4.0	..	1.41	4.2	..	4.7	..	5.2	..	5.7	..	1.23
24	3.0	..	3.4	..	3.9	..	1.53	4.0	..	4.5	..	5.0	..	5.5	..	1.34
25	2.9	..	3.3	..	3.7	..	1.66	3.9	..	4.3	..	4.8	..	5.2	..	1.46

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Additional sections rolled—7"-17.25, 7"-19.75, 8"-21.25, see page 6.

STANDARD CHANNELS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		9"				10"			
Depth = d"	9	9	9		10	10	10	10	
Wt. per foot	13.4	15.0	20.0		15.3	20.0	25.0	30.0	
Area. sq. in.	3.89	4.39	5.86		4.47	5.86	7.33	8.80	
b"	2.43	2.49	2.65		2.60	2.74	2.89	3.03	
t	.230	.285	.448	For Detailed Cut See Page 7	.240	.379	.526	.673	For Detailed Cut See Page 7
k	7/8	7/8	7/8		7/8	7/8	7/8	7/8	
c	7 1/4	7 1/4	7 1/4		8 1/4	8 1/4	8 1/4	8 1/4	
g	1 3/4	1 3/4	1 1/2		1 1/2	1 1/2	1 3/4	1 3/4	
u	7/16	7/16	1/2		7/16	7/16	1/2	1/2	
X-X I	47.3	50.7	60.6		66.9	78.5	90.7	103.0	
X-X S	10.51	11.27	13.47		13.38	15.7	18.14	20.6	
X-X r	3.49	3.40	3.22		3.87	3.66	3.52	3.42	
Y-Y I	1.8	1.9	2.4		2.3	2.8	3.4	4.0	
Y-Y S	0.97	1.0	1.2		1.2	1.3	1.5	1.7	
Y-Y r	.67	.67	.65		.72	.70	.68	.67	
Y-Y y	.61	.59	.59		.64	.61	.62	.65	
Coef. Str.	126100	135200	161600		160600	188400	217700	247200	
Max. Mom. "#	189200	202800	242400		240900	282600	326500	370800	
V	24800	30800	48500	Deflection	28800	45500	63100	80800	Deflection
P. feet	2.54	2.19	1.67		2.79	2.07	1.73	1.53	
R	18800	24600	38600		20200	34100	47300	60600	
B	14200	15000	15000		14000	15000	15000	16000	
W	20700	23800	23800		21600	23800	23800	23800	
Q. feet	3.05	2.84	3.39		3.72	3.96	4.57	5.19	
w. lbs.	13	13	13		13	13	13	13	
Rivet dia.	3/4	3/4	3/4		3/4	3/4	3/4	3/4	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
3	42.0	42.0	45.1	45.1	53.9	53.9	.019	54	54	63	63	73	73	82	82	.017
4	31.5	29.3	33.8	31.7	40.4	38.6	.033	40	38	47	45	54	53	62	61	.030
5	25.2	21.5	27.0	23.2	32.3	28.6	.052	32	28	38	34	44	40	49	46	.047
6	21.0	16.2	22.5	17.6	26.9	21.8	.074	27	22	31	26	36	31	41	36	.067
7	18.0	12.5	19.4	13.7	23.1	17.1	.101	23	17	27	20	31	24	35	28	.091
8	15.8	9.9	16.9	10.7	20.2	13.6	.132	20	14	24	16	27	20	31	23	.119
9	14.0	..	15.0	..	18.0	..	.168	18	..	21	13	24	16	28	19	.151
10	12.6	..	13.5	..	16.2	..	.207	16	..	19	..	22	..	25	15	.186
11	11.5	..	12.3	..	14.7	..	.250	15	..	17	..	20	..	23	..	.225
12	10.5	..	11.3	..	13.5	..	.298	13	..	16	..	18	..	21	..	.268
13	9.7	..	10.4	..	12.4	..	.350	12	..	15	..	17	..	19	..	.315
14	9.0	..	9.7	..	11.5	..	.406	12	..	14	..	16	..	18	..	.365
15	8.4	..	9.0	..	10.8	..	.466	11	..	13	..	15	..	17	..	.419
16	7.9	..	8.4	..	10.2	..	.530	10	..	12	..	14	..	16	..	.477
17	7.4	..	8.0	..	9.5	..	.599	9	..	11	..	13	..	15	..	.539
18	7.0	..	7.5	..	9.0	..	.670	9	..	11	..	12	..	14	..	.603
19	6.6	..	7.1	..	8.5	..	.747	8	..	10	..	12	..	13	..	.672
20	6.3	..	6.8	..	8.1	..	.828	8	..	9	..	11	..	12	..	.745
21	6.0	..	6.4	..	7.7	..	.912	8	..	9	..	10	..	12	..	.821
22	5.7	..	6.1	..	7.3	..	1.00	7	..	8	..	10	..	11	..	.901
23	5.5	..	5.9	..	7.0	..	1.10	7	..	8	..	10	..	11	..	.986
24	5.3	..	5.6	..	6.7	..	1.19	7	..	8	..	9	..	10	..	1.07
25	5.0	..	5.4	..	6.5	..	1.29	6	..	8	..	9	..	10	..	1.16

STANDARD CHANNELS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	12"				(For Detailed Cut See Page 7)	15"			(For Detailed Cut See Page 7)
Depth = d"	12	12	12	12		15	15	15	
Wt. per foot	20.7	25.0	30.0	40.0		33.9	40.0	50.0	
Area. sq. in.	6.03	7.32	8.79	11.73		9.90	11.70	14.64	
b"	2.94	3.05	3.17	3.42		3.40	3.52	3.72	
t	.280	.387	.510	.755		.400	.520	.716	
k	1	1	1	1		1⅝	1⅝	1⅝	
c	10	10	10	10		12¼	12¼	12¼	
g	1¾	1¾	1¾	2		2	2	2½	
u	½	½	½	⅝		¾	¾	⅝	
AXES X-X I	128.1	143.5	161.2	196.5		312.6	346.3	401.4	
AXES X-X S	21.35	23.92	26.87	32.75		41.68	46.17	53.52	
AXES X-X r	4.61	4.43	4.28	4.09		5.62	5.44	5.24	
AXES Y-Y I	3.9	4.5	5.2	6.6		8.2	9.3	11.2	
AXES Y-Y S	1.7	1.9	2.1	2.5		3.2	3.4	3.8	
AXES Y-Y r	.81	.79	.77	.75		.91	.89	.87	
AXES Y-Y y	.70	.68	.68	.72		.79	.78	.80	
Coef. Str.	256200	287000	322400	393000	Deflection	500200	554100	642200	Deflection
Max.Mom."#	384300	430500	483600	589500		750300	831100	963400	
V	40300	55700	73400	108700		72000	93600	128900	
P. Feet	3.18	2.58	2.20	1.81		3.47	2.96	2.49	
R	24900	37700	49800	73600		42300	56500	77900	
B	13700	15000	15000	15000		14600	15000	15000	
W	23860	23860	23850	23860		36000	46800	47700	
Q. feet	5.37	6.01	6.76	8.24		6.95	5.92	6.73	
w. lbs	13	13	13	13		19	19	19	
Rivet dia	¾	⅞	¾	⅞		¾	½	¾	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Defl.	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Defl.
3	81	81	96	96	108	108	131	131	.014	144	144	187	185	214	214	.011
4	64	63	72	71	81	80	98	98	.025	125	125	139	138	161	161	.020
5	51	47	57	53	65	61	79	76	.039	100	96	111	108	128	126	.031
6	43	37	48	42	54	47	66	60	.056	83	76	92	85	107	100	.045
7	37	29	41	33	46	38	56	48	.076	71	61	79	69	92	81	.061
8	32	23	36	27	40	31	49	39	.099	63	50	69	56	80	67	.079
9	28	19	32	22	36	25	44	32	.126	56	41	62	47	72	56	.101
10	26	..	29	18	32	21	39	27	.155	50	34	55	39	64	47	.124
11	23	..	26	..	29	..	36	23	.188	45	29	50	33	58	40	.150
12	21	..	24	..	27	..	33	..	.223	42	..	46	..	54	34	.179
13	20	..	22	..	25	..	30	..	.263	39	..	43	..	49	..	.210
14	18	..	21	..	23	..	28	..	.304	36	..	40	..	46	..	.243
15	17	..	19	..	22	..	26	..	.341	33	..	37	..	43	..	.279
16	16	..	18	..	20	..	25	..	.398	31	..	35	..	40	..	.318
17	15	..	17	..	19	..	23	..	.449	29	..	33	..	38	..	.359
18	14	..	16	..	18	..	22	..	.503	28	..	31	..	36	..	.402
19	13	..	15	..	17	..	21	..	.560	26	..	29	..	34	..	.448
20	13	..	14	..	16	..	20	..	.621	25	..	28	..	32	..	.497
21	12	..	14	..	15	..	19	..	.684	24	..	26	..	31	..	.547
22	12	..	13	..	15	..	18	..	.751	23	..	25	..	29	..	.601
23	11	..	13	..	14	..	17	..	.822	22	..	24	..	28	..	.651
24	11	..	12	..	13	..	16	..	.894	21	..	23	..	27	..	.715
25	10	..	12	..	13	..	16	..	.970	20	..	22	..	26	..	.776
26	10	..	11	..	12	..	15	..	1.050	19	..	21	..	25	..	.839
27	..	..	..	..	..	..	..	..	..	19	..	21	..	24	..	.909
28	..	..	..	..	..	..	..	..	..	18	..	20	..	23	..	.973
29	..	..	..	..	..	..	..	..	..	17	..	19	..	22	..	1.040
30	..	..	..	..	..	..	..	..	..	17	..	19	..	21	..	1.120

Additional sections rolled—12"-35.0, 15"-35.0, 15"-45.0, 15"-55.0, see page 6.

STANDARD BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	3"			4"			
Depth = d"	3	3	3	4	4	4	4
Wt. per foot.	5.7	6.5	7.5	7.7	8.5	9.5	10.5
Area. sq. in..	1.64	1.88	2.17	2.21	2.46	2.76	3.05
b"......	2.33	2.41	2.51	2.66	2.72	2.80	2.87
t.......	.170	.251	.349	1.90	.253	.326	.400
k.......	⅝	⅝	⅝	⅝	⅝	⅝	⅝
c.......	1¾	1¾	1¾	2¾	2¾	2¾	2¾
g.......	1½	1½	1½	1½	1½	1½	1½
u.......	⅝	⅝	⅝	⅝	⅝	⅝	⅝
AXES X-X I.....	2.5	2.7	2.9	6.0	6.3	6.7	7.1
S.....	1.67	1.80	1.93	3.0	3.15	3.35	3.55
r.....	1.23	1.19	1.15	1.64	1.60	1.56	1.52
Y-Y I.....	0.46	0.51	0.59	0.77	0.83	0.91	1.0
S.....	0.40	0.43	0.47	0.58	0.61	0.65	0.70
r.....	0.53	0.52	0.52	0.59	0.58	0.58	0.57
Coef. Str....	20000	21600	23200	36000	37800	40200	42600
Max.Mom."#	30000	32400	34800	54000	56700	60300	63900
V........	6100	9000	12600	9100	12100	15600	19200
P. feet...	1.64	1.20	0.92	1.98	1.56	1.29	1.11
R........	6100	9000	12600	9100	12100	15600	19200
W........	7650	11300	11900	8550	11400	11900	11900
Q. feet...	1.31	0.96	0.97	2.11	1.66	1.79	1.79
w. lbs....	5	5	5	5	5	5	5
Rivet dia....	⅝	¾	¾	½	½	½	½

For Detailed Cut See Page 7

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
1	12.2	12.2	18.0	18.0	23.2	23.2		18.2	18.2	24.2	24.2	31.2	31.2	38.4	38.4	.019
2	10.0	10.0	10.8	10.8	11.6	11.6	.025	18.0	18.0	18.9	18.9	20.1	20.1	21.3	21.3	.042
3	6.7	6.6	7.2	7.2	7.7	7.7	.056	12.0	12.0	12.6	12.6	13.4	13.4	14.2	14.2	.074
4	5.0	4.6	5.4	5.0	5.8	5.5	.099	9.0	8.6	9.5	9.1	10.1	10.0	10.7	10.4	.116
5	4.0	3.3	4.3	3.6	4.6	4.0	.155	7.2	6.4	7.6	6.8	8.0	7.2	8.5	7.7	
6	3.3	2.5	3.6	2.8	3.9	3.1	.223	6.0	4.9	6.3	5.2	6.7	5.6	7.1	6.0	.168
7	2.9	1.9	3.1	2.1	3.3	2.3	.304	5.1	3.8	5.4	4.1	5.7	4.4	6.1	4.7	.228
8	2.5	..	2.7	1.7	2.9	1.9	.396	4.5	3.0	4.7	3.2	5.0	3.5	5.3	3.8	.298
9	2.2	..	2.4	..	2.6	..	.503	4.0	..	4.2	2.6	4.5	2.9	4.7	3.1	.378
10	2.0	..	2.2	..	2.3	..	.620	3.6	..	3.8	..	4.0	..	4.3	..	.465
11	1.8	..	2.0	..	2.1	..	.750	3.3	..	3.4	..	3.7	..	3.9	..	.562
12	1.7	..	1.8	..	1.9	..	.896	3.0	..	3.1	..	3.4	..	3.6	..	.670
13	1.5	..	1.7	..	1.8	..	1.05	2.8	..	2.9	..	3.1	..	3.3	..	.787
14	1.4	..	1.5	..	1.7	..	1.22	2.6	..	2.7	..	2.9	..	3.0	..	.912
15	1.3	..	1.4	..	1.5	..	1.39	2.4	..	2.5	..	2.7	..	2.8	..	1.05

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Co-efficient of Strength by the Span in feet. B = 15,000.

STANDARD BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	5"				6"			
Depth = d''	5	5	5		6	6	6	
Wt. per foot	10.0	12.25	14.75		12.5	14.75	17.25	
Area. sq. in.	2.87	3.56	4.29		3.61	4.29	5.02	
b''	3.00	3.14	3.28	For Detailed Cut See Page 7	3.33	3.44	3.57	For Detailed Cut See Page 7
t	.210	.347	.494		.230	.343	.465	
k	3/4	3/4	3/4		3/4	3/4	3/4	
e	3 1/2	3 1/2	3 1/2		4 1/2	4 1/2	4 1/2	
g	1 3/4	1 3/4	1 3/4		2	2	2	
u	5/8	5/8	5/8		5/8	5/8	5/8	
X-X — I	12.1	13.5	15.0		21.8	23.8	26.0	
X-X — S	4.84	5.40	6.00		7.27	7.93	8.67	
X-X — r	2.05	1.95	1.87		2.46	2.36	2.28	
Y-Y — I	1.2	1.4	1.7		1.8	2.1	2.3	
Y-Y — S	0.82	0.91	1.0		1.1	1.2	1.3	
Y-Y — r	0.65	0.63	0.63		0.72	0.69	0.68	
Coef. Str.	58100	64800	72000		87200	95200	104000	
Max.Mom."#	87120	97200	108000		130800	142800	156000	
V	12600	20800	29600	Deflection	16640	24700	34500	Deflection
P. feet	2.30	1.56	1.22		2.63	1.93	1.51	
R	12600	20800	29600		16600	24700	34500	
W	9450	11900	11900		10350	11900	11900	
Q. feet	3.07	2.73	3.03		4.21	4.00	4.37	
w. lbs	6	6	6		6	6	6	
Rivet dia.	1/2	1/2	1/2		5/8	5/8	5/8	

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Deflection	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Deflection
2	25.2	25.2	32.4	32.4	36.0	36.0		33.2	33.2	47.6	47.6	52.0	52.0	.028
3	19.4	19.4	21.6	21.6	24.0	24.0	.033	29.1	29.1	31.7	31.7	34.7	34.7	.050
4	14.5	14.3	16.2	16.1	18.0	18.0	.059	21.8	21.8	23.8	23.8	26.0	26.0	.078
5	11.6	10.7	13.0	12.2	14.4	13.7	.093	17.4	16.6	19.0	18.3	20.8	20.2	
6	9.7	8.4	10.8	9.5	12.0	10.8	.134	14.5	13.1	15.9	14.5	17.3	16.0	.112
7	8.3	6.6	9.3	7.6	10.3	8.6	.182	12.5	10.5	13.6	11.6	14.9	13.0	.152
8	7.3	5.4	8.1	6.1	9.0	7.0	.238	10.9	8.5	11.9	9.5	13.0	10.6	.198
9	6.5	4.4	7.2	5.0	8.0	5.8	.302	9.7	7.1	10.6	7.9	11.6	8.9	.252
10	5.8	..	6.5	4.2	7.2	4.8	.372	8.7	5.9	9.5	6.6	10.4	7.4	.310
11	5.3	..	5.9	..	6.5	..	.450	7.9	5.0	8.7	5.6	9.5	6 3	.375
12	4.8	..	5.4	..	6.0	..	.537	7.3	..	7.9	..	8.7	..	.447
13	4.5	..	5.0	..	5.5	..	.630	6.7	..	7.3	..	8.0	..	.525
14	4.2	..	4.6	..	5.1	..	.730	6.2	..	6.8	..	7.4	..	.608
15	3.9	..	4.3	..	4.8	..	.838	5.8	..	6.3	..	6.9	..	.698
16	3.6	..	4.1	..	4.5	..	.955	5.5	..	6.0	..	6.5	..	.795
17	3.4	..	3.8	..	4.2	..	1.08	5.1	..	5.6	..	6.1	..	.898
18	3.2	..	3.6	..	4.0	..	1.20	4.8	..	5.3	..	5.8	..	1.01
19	3.1	..	3.4	..	3.8	..	1.34	4.6	..	5.0	..	5.5	..	1.12
20	2.9	..	3.2	..	3.6	..	1.49	4.4	..	4.8	..	5.2	..	1.24
21	..	..	..	..	..	..	..	4.2	..	4.5	..	5.0	..	1.37
22	..	..	..	..	..	..	..	4.0	..	4.3	..	4.7	..	1.51
23	..	..	..	..	..	..	..	3.8	..	4.1	..	4.5	..	1.64
24	..	..	..	..	..	..	..	3.6	..	4.0	..	4.3	..	1.79
25	..	..	..	..	..	..	..	3.5	..	3.8	..	4.2	..	1.94

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. B = 15000.

STANDARD BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

Note: "For Detailed Cut See Page 7" applies to both the 7″ and the 8″ groups. The "Deflection" heading applies to the load tables below.

SYMBOLS	7″	7″	7″	8″	8″	8″	8″
Depth = d″	7	7	7	8	8	8	8
Wt. per foot	15.3	17.5	20.0	18.4	20.5	23.0	25.5
Area, sq. in.	4.43	5.09	5.83	5.34	5.97	6.71	7.43
b″	3.66	3.76	3.86	4.00	4.08	4.17	4.26
t	.250	.345	.450	.270	.349	.441	.532
k	⅞	⅞	⅞	⅞	⅞	⅞	⅞
c	5¼	5¼	5¼	6¼	6¼	6¼	6¼
g	2¼	2¼	2¼	2¼	2¼	2¼	2¼
u	½	⅝	⅝	⅞	⅞	⅞	½
AXES X-X: I	36.2	38.9	41.9	56.9	60.2	64.2	68.1
AXES X-X: S	10.34	11.11	11.97	14.22	15.05	16.05	17.02
AXES X-X: r	2.86	2.77	2.68	3.26	3.18	3.09	3.03
AXES Y-Y: I	2.7	2.9	3.1	3.8	4.0	4.4	4.7
AXES Y-Y: S	1.5	1.6	1.6	1.9	2.0	2.1	2.2
AXES Y-Y: r	0.78	0.76	0.74	0.84	0.82	0.81	0.80
Coef. Str.	124100	133400	143700	170700	180600	192600	204300
Max. Mom.″	186200	200100	215500	256100	270900	288900	306450
V	21000	29000	37800	25900	33500	42300	51100
P. feet	2.95	2.30	1.90	3.30	2.70	2.28	2.00
R	19700	27200	35400	22300	28800	36400	43900
W	11250	11900	11900	23800	23800	23900	23800
Q. feet	5.52	5.60	6.04	3.59	3.79	4.05	4.29
w. lbs.	6	6	6	13	13	13	13
Rivet dia.	⅝	⅝	¾	¾	¾	¾	¾

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. B = 15000.

Span feet	15.3 fix'd	15.3 free	17.5 fix'd	17.5 free	20.0 fix'd	20.0 free	Deflection	18.4 fix'd	18.4 free	20.5 fix'd	20.5 free	23.0 fix'd	23.0 free	25.5 fix'd	25.5 free
2	42.0	42.0	58.0	58.0	71.9	71.9		51.8	51.8	67.0	67.0	84.6	84.6		
3	41.4	41.4	44.5	44.5	47.9	47.9	.024	51.8	51.8	60.2	60.2	64.2	64.2	68.1	68.1
4	31.0	31.0	33.4	33.4	36.0	36.0	.043	42.7	42.7	45.2	45.2	48.2	48.2	51.1	51.1
5	24.8	24.3	26.7	26.3	28.7	28.5	.067	34.1	34.1	36.1	36.1	38.5	38.5	40.9	40.9
6	20.7	19.3	22.2	20.9	24.0	22.7	.096	28.5	27.2	30.1	28.9	32.1	31.0	34.1	33.1
7	17.7	15.6	19.1	17.0	20.5	18.4	.130	24.4	22.2	25.8	23.7	27.5	25.4	29.2	27.2
8	15.5	12.8	16.7	14.0	18.0	15.3	.170	21.3	18.4	22.6	19.7	24.1	21.2	25.5	22.6
9	13.8	10.7	14.8	11.6	16.0	12.7	.216	19.0	15.5	20.1	16.5	21.4	17.8	22.7	19.1
10	12.4	9.0	13.3	9.8	14.4	10.8	.266	17.1	13.1	18.1	14.0	19.3	15.2	20.4	16.2
11	11.3	7.6	12.1	8.3	13.1	9.2	.321	15.5	11.1	16.4	11.9	17.5	13.0	18.6	14.0
12	10.3	6.4	11.1	7.1	12.0	7.9	.383	14.2	9.6	15.1	10.3	16.1	11.2	17.0	12.0
13	9.5	..	10.3	..	11.1	..	.450	13.1	8.3	13.9	8.9	14.8	9.7	15.7	10.4
14	8.9	..	9.5	..	10.3	..	.521	12.2	..	12.9	..	13.8	..	14.6	9.1
15	8.3	..	8.9	..	9.6	..	.599	11.4	..	12.0	..	12.8	..	13.6	..
16	7.7	..	8.3	..	9.0	..	.681	10.7	..	11.3	..	12.0	..	12.8	..
17	7.3	..	7.8	..	8.5	..	.770	10.0	..	10.6	..	11.3	..	12.0	..
18	6.9	..	7.4	..	8.0	..	.861	9.5	..	10.0	..	10.7	..	11.4	..
19	6.5	..	7.0	..	7.6	..	.960	9.0	..	9.5	..	10.1	..	10.8	..
20	6.2	..	6.7	..	7.2	..	1.06	8.5	..	9.0	..	9.6	..	10.2	..
21	5.9	..	6.4	..	6.8	..	1.17	8.1	..	8.6	..	9.2	..	9.7	..
22	5.6	..	6.1	..	6.5	..	1.29	7.8	..	8.2	..	8.8	..	9.3	..
23	5.4	..	5.8	..	6.2	..	1.41	7.4	..	7.9	..	8.4	..	8.9	..
24	5.2	..	5.6	..	6.0	..	1.53	7.1	..	7.5	..	8.0	..	8.5	..
25	5.0	..	5.3	..	5.7	..	1.66	6.8	..	7.2	..	7.7	..	8.2	..

STANDARD BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		9″				10″			
Depth = d″		9	9	9		10	10	10	10
Wt. per foot.		21.8	25.0	30.0		22.0	25.4	30.0	40.0
Area. sq. in..		6.32	7.28	8.76		6.42	7.38	8.75	11.69
b″........		4.33	4.44	4.60		5.00	4.66	4.80	5.09
t.........		.290	.397	.561		.250	.310	.447	.741
k.........		1	1	1		1	1	1	1
c.........		7	7	7		7⅜	8	8	8
g.........		2½	2½	2½		2¾	2¾	2¾	2¾
u.........		½	½	½		⅜	½	½	½
AXES X-X I.....		84.9	91.4	101.4	For Detailed Cut See Page 7	110.3	122.1	133.5	158.0
S.....		18.87	20.31	22.53		22.1	24.42	26.70	31.60
r.....		3.67	3.54	3.40		4.15	4.07	3.91	3.68
Y-Y I.....		5.2	5.6	6.4		6.8	6.9	7.6	9.4
S.....		2.4	2.5	2.8		2.7	3.0	3.2	3.7
r.....		0.90	0.88	0.85		0.97	0.97	0.93	0.90
Coef. Str....		226400	243700	270400	Deflection	265200	293000	320400	379200
Max.Mom.″#		339600	365600	405600		397800	439600	480600	568800
V........		31300	42900	60600		30000	37200	53600	88900
P. feet...		3.62	2.84	2.23		4.41	3.94	2.99	2.13
R........		25000	34200	48400		21327	27900	40200	66700
W........		23800	23800	23800		22500	23800	23800	23800
Q. feet...		4.76	5.12	5.68		5.87	6.16	6.73	7.97
w. lbs....		13	13	13		13	13	13	13
Rivet dia...		¾	¾	¾		¾	¾	¾	¾

	Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free		Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. B = 15000.	3	62.6	62.6	81.2	81.2	90.1	90.1	.033	60	60	74.4	74.4	106	106	126	126	.030
	4	56.6	56.6	60.9	60.9	67.6	67.6	.052	60	60	73.3	73.3	80.1	80.1	94.8	94.8	.047
	5	45.3	45.3	48.7	48.7	54.1	54.1		53	53	58.6	58.6	64.1	64.1	75.8	75.8	
	6	37.7	36.8	40.6	39.9	45.1	44.7	.074	44	44	48.8	48.4	53.4	53.4	63.2	63.2	.067
	7	32.3	30.2	34.8	32.8	38.6	36.7	.101	38	37	41.9	40.0	45.8	44.1	54.2	53.0	.091
	8	28.3	25.2	30.5	27.5	33.8	30.8	.132	33	31	36.6	33.6	40.1	37.1	47.4	44.7	.119
	9	25.2	21.4	27.1	23.2	30.0	26.1	.168	29	26	32.6	28.6	35.6	31.6	42.1	39.2	.151
	10	22.6	18.1	24.4	19.9	27.0	22.4	.207	26	22	29.3	24.5	32.0	27.1	37.9	32.9	.186
	11	20.6	15.6	22.2	17.1	24.6	19.3	.250	24	19	26.6	21.1	29.1	23.5	34.5	28.7	.225
	12	18.9	13.5	20.3	14.8	22.5	16.8	.298	22	17	24.4	18.4	26.7	20.5	31.6	25.1	.268
	13	17.4	11.7	18.7	12.9	20.8	14.7	.350	20	15	22.5	16.0	24.6	17.9	29.2	22.1	.315
	14	16.2	....	17.4	11.3	19.3	12.9	.406	19	13	20.9	14.1	22.9	15.8	27.1	19.5	.365
	15	15.1	....	16.2	....	18.0	11.3	.466	17	12	19.5	12.4	21.4	14.0	25.3	17.3	.419
	16	14.2	....	15.2	....	16.9	....	.530	16	....	18.3	....	20.0	12.3	23.7	15.4	.477
	17	13.3	....	14.3	....	15.9	....	.599	15	....	17.2	....	18.8	....	22.3	....	.539
	18	12.6	....	13.5	....	15.0	....	.670	14	....	16.3	....	17.8	....	21.1	....	.603
	19	11.9	....	12.8	....	14.2	....	.747	14	....	15.4	....	16.9	....	20.0	....	.672
	20	11.3	....	12.2	....	13.5	....	.828	13	....	14.7	....	16.0	....	19.0	....	.745
	21	10.8	....	11.6	....	12.9	....	.912	12	....	14.0	....	15.3	....	18.1	....	.821
	22	10.3	....	11.1	....	12.3	....	1.00	12	....	13.3	....	14.6	....	17.2	....	.901
	23	9.8	....	10.6	....	11.8	....	1.10	11	....	12.7	....	13.9	....	16.5	....	.986
	24	9.4	....	10.2	....	11.3	....	1.19	11	....	12.2	....	13.4	....	15.8	....	1.07
	25	9.1	....	9.7	....	10.8	....	1.29	10	....	11.7	....	12.8	....	15.2	....	1.16

Additional sections rolled—9″-35.0, 10″-35.0, see page 6.

STANDARD BEAMS
### DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS							12″	
Depth = d″	12	12	12	12	12	12	12	For Detailed Cut See Page 7
Wt. per foot	25.0	31.8	35.0	40.8	45.0	50.0	55.0	
Area. sq. in.	7.35	9.26	10.20	11.84	13.10	14.57	16.04	
b″	5.00	5.00	5.08	5.25	5.36	5.48	5.60	
t	.27	.350	.428	.460	.565	.687	.810	
k	1⅜	1⅜	1⅜	1⅜	1⅜	1¾	1¾	
c	9¼	9¾	9¾	9¼	9¼	9¼	9¼	
g	3	3″	3″	3″	3″	3½	3½	
u	½	⅞	⅞	¾	¾	¾	¾	
AXES X-X I	175.5	215.8	227.0	268.9	284.1	301.6	319.3	
S	29.2	35.97	37.83	44.82	47.35	50.27	53.22	
r	4.89	4.83	4.72	4.77	4.66	4.55	4.46	
AXES Y-Y I	7.30	9.5	10.0	13.8	14.8	16.0	17.3	
S	2.92	3.8	3.9	5.3	5.5	5.8	6.2	
r	1.00	1.01	0.99	1.08	1.06	1.05	1.04	
Coef. Str	350400	431600	454000	537800	568200	603200	638600	Deflection
Max.Mom."#	525600	647400	681000	806700	852300	904800	957900	
V	38880	50400	61600	66200	81400	98900	116600	
P. feet	4.5	4.28	3.68	4.06	3.49	3.05	2.74	
R	23800	34100	41700	44900	55100	67000	79000	
W	23840	23860	23860	23860	23860	23860	23860	
Q. feet	7.33	9.04	9.51	11.27	11.91	12.64	13.38	
w. lbs	13	13	13	13	13	13	13	
Rivet dia	¾	¾	¾	¾	¾	¾	¾	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
3	77	77	101	101	123	123	132	132	163	163	198	198	213	213	
4	77	77	101	101	114	114	132	132	142	142	151	151	160	160	
5	70	70	86	86	91	91	108	108	114	114	121	121	128	128	.039
6	58	58	72	72	76	76	90	90	95	95	101	101	106	106	.056
7	50	49	62	60	65	64	77	76	81	80	86	85	91	91	.076
8	44	41	54	51	57	54	67	64	71	68	75	72	80	78	.099
9	39	35	48	43	50	45	60	55	63	58	67	62	71	67	.126
10	35	30	43	37	45	39	54	48	57	51	60	54	64	58	.155
11	32	26	39	32	41	34	49	41	52	44	55	47	58	50	.188
12	29	23	36	28	38	30	45	36	47	38	50	41	53	44	.223
13	27	20	33	25	35	26	41	32	44	34	46	36	49	39	.263
14	25	18	31	22	32	23	38	28	41	31	43	33	46	35	.304
15	23	15	29	20	30	21	36	25	38	27	40	29	43	32	.341
16	22	14	27	17	28	18	34	23	36	24	38	26	40	28	.398
17	20	..	25	..	27	..	32	20	33	21	35	23	38	25	.449
18	19	..	24	..	25	..	30	..	32	..	34	21	35	22	.503
19	18	..	23	..	24	..	28	..	30	..	32	..	34	..	.560
20	17	..	22	..	23	..	27	..	28	..	30	..	32	..	.621
21	17	..	21	..	22	..	26	..	27	..	29	..	30	..	.684
22	16	..	20	..	21	..	24	..	26	..	27	..	29	..	.751
23	15	..	19	..	20	..	23	..	25	..	26	..	28	..	.822
24	14	..	18	..	19	..	22	..	24	..	25	..	27	..	.894
25	14	..	17	..	18	..	21	..	23	..	24	..	26	..	.970

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, B = 15000. Coefficient of Strength by the Span in feet, divide the

STANDARD BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS							15"		
Depth = d"	15	15	15	15	15	15	15	15	
Wt. per foot	35.0	42.9	50.0	55.0	60.8	70.0	75.0	81.3	
Area. sq. in	10.22	12.49	14.59	16.06	17.68	20.38	21.85	23.81	
b"	5.50	5.50	5.64	5.74	6.00	6.18	6.28	6.40	For Detailed Cut See Page 7
t	.33	.410	.550	.648	.590	.770	.868	.81	
k	1⅜	1¼	1⅜	1¼	1⅝	1⅝	1⅝	2	
c	11¾	12½	12½	12½	11¾	11¾	11¾	11	
g	3½	3½	3½	3½	3½	3½	3½	3¾	
u	½	¾	⅝	⅝	⅝	¾	⅝	1	

AXES									
X-X I	367.9	441.8	481.1	508.7	609.0	659.6	687.2	795.5	
X-X S	49.0	58.91	64.15	67.83	81.20	87.95	91.63	106.1	
X-X r	6.0	5.95	·5.74	5.63	5.87	5.69	5.61	5.78	
Y-Y I	11.56	14.6	16.0	17.0	26.0	28.8	30.6	41.8	
Y-Y S	4.20	5.3	5.7	5.9	8.7	9.3	9.8	13.1	
Y-Y r	1.06	1.08	1.05	1.03	1.21	1.19	1.18	1.32	

Coef. Str.									
Max.Mom."#	588000	706900	769800	813900	974400	1055400	1099500	1273200	
	882000	1060300	1154600	1220000	1461600	1583000	1649300	1909800	
V	59400	73800	99600	116600	106200	138600	156200	145800	
F. feet	4.91	4.79	3.89	3.49	4.59	3.81	3.52	4.16	Deflection
R	32060	43800	59800	70500	64200	83700	94400	88080	
B	13401	14730	15000	15000	15000	15000	15000	15000	
W	29720	36900	47700	47700	47700	47700	47700	47700	
Q. feet	9.83	9.58	8.07	8.53	10.21	11.06	11.53	13.25	
w. lbs	19	19	19	19	19	19	19	19	
Rivet dia	¾	¾	¾	¾	¾	¾	¾	⅞	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	ffee	Laterally fix'd	free	
6	98	98	118	118	128	128	136	136	162	162	176	176	183	183	212	212	.045
7	84	83	101	100	110	110	116	116	139	139	151	151	157	157	182	182	.061
8	73	71	88	85	96	93	102	99	122	120	132	131	137	136	159	159	.079
9	65	61	79	74	86	81	90	85	108	103	117	113	122	118	141	137	.101
10	59	53	71	64	77	70	81	74	97	90	106	99	110	103	127	120	.124
11	53	46	64	55	70	61	74	65	89	80	96	87	100	91	116	106	.150
12	49	40	59	49	64	54	68	57	81	70	88	77	92	81	106	94	.179
13	45	36	54	43	59	47	63	51	75	62	81	68	85	72	98	84	.210
14	42	32	50	38	55	42	58	45	70	56	75	61	79	65	91	75	.243
15	39	28	47	34	51	38	54	40	65	50	70	55	73	58	85	67	.279
16	37	25	44	30	48	34	51	36	61	45	66	50	69	52	79	61	.318
17	34	23	42	28	45	30	48	33	57	40	62	45	65	47	75	55	.359
18	32	20	39	24	43	28	45	29	54	36	59	41	61	43	71	50	.402
19	31	..	37	..	41	..	43	27	51	33	56	37	58	39	67	45	.448
20	29	..	35	..	38	..	41	..	49	30	53	34	55	35	63	41	.497
21	28	..	34	..	37	..	39	..	46	..	50	..	52	..	60	38	.547
22	27	..	32	..	35	..	37	..	44	..	48	..	50	..	58	..	.601
23	25	..	31	..	33	..	35	..	42	..	46	..	48	..	55	..	.651
24	24	..	29	..	32	..	34	..	41	..	44	..	46	..	53	..	.715
25	23	..	28	..	31	..	33	..	39	..	42	..	44	..	51	..	.776
26	22	..	27	..	29	..	31	..	37	..	41	..	42	..	49	..	.839
27	22	..	26	..	29	..	30	..	36	..	39	..	41	..	47	..	.905
28	21	..	25	..	27	..	29	..	35	..	38	..	39	..	45	..	.973
29	20	..	24	..	27	..	28	..	34	..	36	..	38	..	44	..	1.040
30	19	..	24	..	26	..	27	..	32	..	35	..	37	..	42	..	1.120

Allowable Uniform Load, as fixed beam loads by shear or flexure, whichever is least. For laterally fixed beam loads by the Span in feet tabulated, divide the Coefficient of Strength by the Span in feet.

Additional sections rolled—15"-45.0, 15"-65.0, see page 6.

STANDARD BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

18″

SYMBOLS									
Depth = d″	18	18	18	18	18	18	18	18	*For Detailed Cut See Page 7*
Wt. per foot	46.0	54.7	60.0	65.0	70.0	75.6	80.0	90.0	
Area. sq. in.	13.34	15.94	17.50	18.98	20.46	22.04	23.34	26.29	
b″	6.00	6.00	6.09	6.17	6.25	7.00	7.07	7.24	
t	.38	.460	.547	.629	.711	.560	.632	.796	
k	1⅜	1⅜	1⅝	1⅝	1⅝	1¾	1¾	1¾	
e	14⅛	15⅛	15¼	15¼	15¼	14½	14½	14½	
g	3¾	3¾	3¾	3¾	3¾	4″	4″	4″	
u	⅝	¾	¾	¾	¾	1″	1″	1″	
X-X I	675.7	795.5	837.8	877.7	917.5	1141.8	1176.8	1256.5	
S	75.1	88.39	93.09	97.53	101.94	126.87	130.76	139.61	
r	7.12	7.07	6.92	6.80	6.70	7.20	7.10	6.91	
Y-Y I	17.14	21.2	22.3	23.4	24.5	46.3	47.9	51.9	
S	5.71	7.1	7.3	7.6	7.8	13.2	13.6	14.3	
r	1.13	1.15	1.13	1.11	1.09	1.45	1.43	1.40	
Coef. Str.	901200	1060700	1117100	1170300	1223300	1522400	1569100	1675300	
Max.Mom.″#	1351800	1591000	1675600	1755400	1835000	2283600	2353600	2513000	
V	82080	99400	118200	135900	153600	121000	136500	171900	*Deflection*
P. feet	5.41	5.34	4.73	4.31	3.98	6.29	5.75	4.88	
R	39866	52800	65600	75500	85300	67200	75800	95500	
B	13114	14350	15000	15000	15000	15000	15000	15000	
W	34200	41400	47700	47700	47700	47700	47700	47700	
Q. feet	13.16	12.81	11.71	12.27	12.82	15.96	16.45	17.56	
w. lbs	19	19	19	19	19	19	19	19	
Rivet dia	⅞	⅞	⅞	⅞	⅞	⅞	⅞	⅞	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	
10	90	83	106	98	112	104	117	109	122	114	152	147	157	152	168	164	.103
11	82	73	96	86	102	92	106	96	111	100	138	130	143	135	152	145	.125
12	75	64	88	76	93	81	98	86	102	90	127	116	131	121	140	130	.149
13	69	57	86	68	86	72	90	76	94	80	117	104	121	108	129	116	.175
14	64	51	76	61	80	64	84	68	87	71	109	94	112	97	120	105	.203
15	60	54	71	54	74	57	78	61	82	64	102	85	105	88	112	95	.233
16	56	41	66	49	70	52	73	55	76	57	95	77	98	80	105	86	.265
17	53	37	62	44	66	47	69	50	72	52	90	70	92	72	99	79	.299
18	50	33	59	40	62	42	65	45	68	47	85	64	87	66	93	72	.335
19	47	30	56	36	59	39	62	41	64	43	80	58	83	61	88	65	.373
20	45	27	53	33	56	35	59	37	61	39	76	53	78	55	84	60	.414
21	43	..	51	..	53	..	56	..	58	..	73	49	75	51	80	55	.456
22	41	..	48	..	51	..	53	..	56	..	69	45	71	47	76	50	.501
23	39	..	46	..	49	..	51	..	53	..	66	41	68	43	73	47	.548
24	37	..	44	..	47	..	49	..	51	..	63	..	65	..	70	43	.596
25	36	..	42	..	45	..	47	..	49	..	61	..	63	..	67	..	.647
26	34	..	41	..	43	..	45	..	47	..	59	..	60	..	64	..	.699
27	33	..	39	..	41	..	43	..	45	..	56	..	58	..	62	..	.754
28	32	..	38	..	40	..	42	..	44	..	54	..	56	..	60	..	.811
29	31	..	37	..	39	..	40	..	42	..	52	..	54	..	58	..	.870
30	30	..	35	..	37	..	39	..	41	..	51	..	52	..	56	..	.931
31	29	..	34	..	36	..	38	..	39	..	49	..	51	..	54	..	.994
32	28	..	33	..	35	..	37	..	38	..	48	..	49	..	52	..	1.06
33	27	..	32	..	34	..	35	..	37	..	46	..	48	..	51	..	1.13
34	26	..	31	..	33	..	34	..	36	..	45	..	46	..	49	..	1.20
35	25	..	30	..	32	..	33	..	35	..	44	..	45	..	48	..	1.27
36	25	..	29	..	31	..	32	..	34	..	42	..	44	..	47	..	1.34

STANDARD BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS								20″	21′	
Depth = d″	20	20	20	20	20	20	20		21	For Detailed Cut See Page 7
Wt. per foot.	65.4	70.0	75.0	81.4	85.0	90.0	95.0		58.0	
Area. sq. in..	19.08	20.42	21.90	23.74	24.8	26.26	27.74		16.90	
b″........	6.25	6.32	6.39	7.00	7.05	7.13	7.20		6.5	
t........	.500	.567	.641	.600	.653	.726	.800		.43	
k........	1½	1½	1½	1½	1¾	1¾	1¾		2	
c........	17	17	17	16½	16½	16½	16½		17	
g........	4″	4″	4″	4″	4″	4″	4″		4″	
u........	¾	¾	¾	1″	1″	1″	1″		⅝	
AXES X-X I....	1169.5	1214.2	1263.5	1466.3	1501.7	1550.3	1599.7		1143	
S....	116.95	121.42	126.35	146.63	150.17	155.03	159.97		108.8	
r....	7.83	7.71	7.60	7.86	7.78	7.68	7.59		8.22	
Y-Y I....	27.9	28.9	30.1	45.8	47.0	48.7	50.5		24.50	
S....	8.9	9.2	9.4	13.1	13.3	13.7	14.0		7.54	
r....	1.21	1.19	1.17	1.39	1.38	1.36	1.35		1.20	
Coef. Str....	1403400	1457000	1516200	1759600	1802000	1860400	1919600		1305600	Deflection
Max.Mom."#	2105100	2185600	2274300	2639300	2703100	2790500	2879500		1958400	
V.......	120000	136100	153800	144000	156700	174200	192000		108360	
P. feet...	5.85	5.35	4.93	6.11	5.75	5.34	5.00		6.0	
R.......	60400	71900	81700	76500	83300	92600	102000		48520	
B.......	14210	14910	15000	15000	15000	15000	15000		12896	
W.......	56250	59600	59600	59600	59600	59600	59600		48400	
Q. feet...	12.47	12.22	12.72	14.76	15.12	15.61	16.10		13.5	
w. lbs...	25	25	25	25	25	25	25		25	
Rivet dia....	¾	⅞	⅞	⅞	⅞	⅞	⅞		⅞	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	65.4 Lat. fix'd	free	70.0 fix'd	free	75.0 fix'd	free	81.4 fix'd	free	85.0 fix'd	free	90.0 fix'd	free	95.0 fix'd	free	58.0 fix'd	free	Deflection
10	140	131	146	137	152	143	176	171	180	175	186	180	192	187	130	124	.093
11	128	116	132	120	138	126	160	151	164	155	169	161	175	167	119	109	.113
12	117	103	121	107	126	112	147	135	150	138	155	143	160	148	109	97	.134
13	108	91	112	95	117	100	135	120	139	124	143	128	148	133	100	86	.158
14	100	82	104	85	108	89	126	109	129	112	133	116	137	120	93	78	.183
15	94	74	97	77	101	80	117	98	120	101	124	105	128	108	87	70	.210
16	88	66	91	69	95	73	110	89	113	92	116	95	120	98	81	63	.239
17	83	60	86	63	89	66	104	81	106	83	109	86	113	90	77	57	.270
18	78	54	81	57	84	59	98	74	100	76	103	78	107	82	72	52	.302
19	74	49	77	52	80	54	93	68	95	69	98	72	101	75	68	47	.336
20	70	45	73	47	76	50	88	62	90	63	93	66	96	69	65	43	.373
21	67	..	69	43	72	45	84	57	86	58	89	60	91	63	62	..	.411
22	64	..	66	..	69	..	80	52	82	54	85	56	87	58	59	..	.451
23	61	..	63	..	66	..	77	48	78	49	81	51	83	53	57	..	.493
24	58	..	61	..	63	..	73	..	75	..	78	..	80	49	54	..	.537
25	56	..	58	..	61	..	70	..	72	..	74	..	77	..	52	..	.582
26	54	..	56	..	58	..	68	..	69	..	72	..	74	..	50	..	.630
27	52	..	54	..	56	..	65	..	67	..	69	..	71	..	48	..	.679
28	50	..	52	..	54	..	63	..	64	..	66	..	69	..	46	..	.736
29	48	..	50	..	52	..	61	..	62	..	64	..	66	..	45	..	.783
30	47	..	49	..	51	..	59	..	60	..	62	..	64	..	43	..	.838
31	45	..	47	..	49	..	57	..	58	..	60	..	62	..	42	..	.895
32	44	..	46	..	47	..	55	..	56	..	58	..	60	..	41	..	.954
33	43	..	44	..	46	..	53	..	55	..	56	..	58	..	39	..	1.01
34	41	..	43	..	45	..	52	..	53	..	55	..	56	..	38	..	1.08
35	40	..	42	..	43	..	50	..	51	..	53	..	55	..	37	..	1.14
36	39	..	40	..	42	..	49	..	50	..	52	..	53	..	36	..	1.21
37	38	..	39	..	41	..	48	..	49	..	50	..	52	..	35	..	1.28
38	37	..	38	..	40	..	46	..	47	..	49	..	50	..	34	..	1.34

STANDARD BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

24"

SYMBOLS									
Depth = d"	24	24	24	24	24	24	24	24	
Wt. per ft...	71.0	79.9	85.0	90.0	95.0	100.0	105.9	110.0	
Area, sq. in..	20.88	23.33	24.84	26.30	27.79	29.25	30.98	32.18	
b"........	7.00	7.000	7.063	7.124	7.186	7.247	7.875	7.925	
t.........	.48	.500	.563	.624	.686	.747	.625	.675	
k.........	2 5/8	1 5/8	1 5/8	1 5/8	1 5/8	1 3/4	1 7/8	1 7/8	
c.........	19 3/8	20 1/4	20 1/4	20 3/4	20 3/4	20 3/4	20 1/4	20 1/4	
g.........	4"	4"	4"	4"	4"	4"	5"	5"	
u.........	3/4	3/4	3/4	3/4	3/4	3/4	1 1/2	1 1/2	
X-X I....	1815.	2087.2	2159.8	2230.1	2301.5	2371.8	2811.5	2869.1	
X-X S....	151.2	173.93	180.00	185.84	191.80	197.65	234.30	239.10	
X-X r....	9.32	9.46	9.33	9.21	9.08	9.05	9.53	9.44	
Y-Y I....	33.98	42.9	44.2	45.5	47.0	48.4	78.9	80.6	
Y-Y S....	9.71	12.2	12.5	12.8	13.0	13.4	20.0	20.3	
Y-Y r....	1.26	1.36	1.33	1.32	1.30	1.29	1.60	1.58	
Coef. Str...	1814400	2087200	2159800	2230100	2301500	2371800	2811500	2869100	
Max.Mom."#	2721600	3130000	3240000	3345000	3452000	3557700	4217000	4304000	
V........	138240	144000	162100	179700	197600	215000	180000	194400	
P. feet...	6.5	7.25	6.66	6.20	5.82	5.51	7.80	7.38	
R.......	57980	61800	73900	85700	97400	106400	85800	95400	
B.......	12715	13010	13820	14450	14950	15000	14450	14870	
W.......	64800	67500	71600	71600	71600	71600	71600	71600	
Q. feet...	14.00	15.5	15.1	15.6	16.1	16.6	19.6	20.0	
w. lbs....	30	30	30	30	30	30	30	30	
Rivet dia....	3/8	3/8	3/8	1/4	1/4	1/4	1/4	1/4	

(Right margin, rotated: For Detailed Cut See Page 7 — Deflection)

(Left margin, rotated: Allowable Uniform Load, as fixed by shear by beam loads in feet. For laterally fixed beam loads the Span in feet, whichever is least. Coefficient of Strength by the Span in feet, divide the)

Span ft.	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
10	181	176	209	203	216	210	223	217	230	224	237	231	281	280	287	286	.078
12	151	139	174	160	180	166	186	172	192	178	198	184	234	223	239	228	.112
14	129	112	149	129	154	133	159	138	164	143	169	148	201	182	205	186	.152
16	113	91	130	105	135	109	139	113	144	118	148	122	176	151	179	154	.199
18	100	76	116	87	120	91	124	94	128	98	132	102	156	126	159	129	.251
20	90	63	104	73	108	76	111	79	115	82	119	85	141	107	143	109	.310
21	86	58	99	66	103	70	106	72	110	76	113	78	134	98	137	101	.342
22	82	53	95	62	98	64	101	66	105	70	108	72	128	91	130	93	.375
23	79	49	91	57	94	59	97	61	100	64	103	66	122	84	125	86	.411
24	75	..	87	..	90	..	93	..	96	59	99	62	117	78	120	80	.447
25	72	..	83	..	86	..	89	..	92	..	95	..	112	72	115	74	.485
26	69	..	80	..	83	..	86	..	89	..	91	..	108	67	110	69	.525
27	67	..	77	..	80	..	83	..	85	..	88	..	104	..	106	..	.566
28	65	..	74	..	77	..	80	..	82	..	85	..	100	..	102	..	.608
29	62	..	72	..	74	..	77	..	79	..	82	..	97	..	99	..	.653
30	60	..	70	..	72	..	74	..	77	..	79	..	94	..	96	..	.698
31	58	..	67	..	70	..	72	..	74	..	77	..	91	..	93	..	.746
32	56	..	65	..	68	..	70	..	72	..	74	..	88	..	90	..	.795
33	55	..	63	..	65	..	68	..	70	..	72	..	85	..	87	..	.845
34	53	..	61	..	63	..	66	..	68	..	70	..	83	..	84	..	.897
35	52	..	60	..	62	..	64	..	66	..	68	..	80	..	82	..	.950
36	50	..	58	..	60	..	62	..	64	..	66	..	78	..	80	..	1.01
38	48	..	55	..	57	..	59	..	61	..	62	..	74	..	76	..	1.12
40	45	..	52	..	54	..	56	..	58	..	59	..	70	..	72	..	1.24
42	43	..	50	..	51	..	53	..	55	..	56	..	67	..	68	..	1.37
44	41	..	47	..	49	..	51	..	52	..	54	..	64	..	65	..	1.50
46	39	..	45	..	47	..	48	..	50	..	52	..	61	..	62	..	1.64
48	38	..	43	..	45	..	46	..	48	..	49	..	59	..	60	..	1.79
50	36	..	42	..	43	..	45	..	46	..	47	..	56	..	57	..	1.94

Additional sections rolled—24"-115, 24"-120, see page 6.
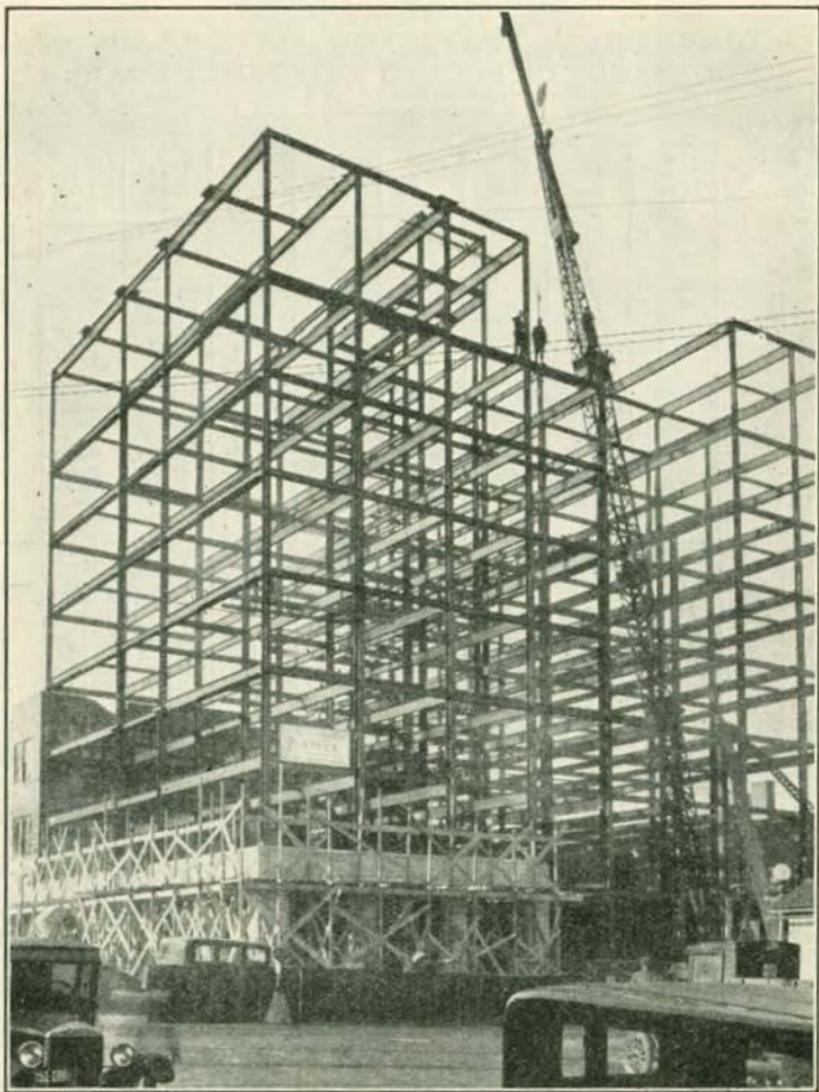
STRUCTURAL STEEL FRAME FOR VALKER BUILDING,
MINOT, NORTH DAKOTA

450 tons of Carnegie Beams and Columns
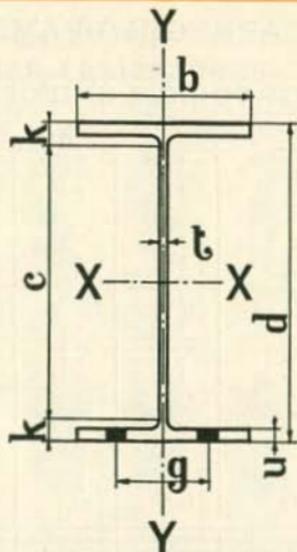
CARNEGIE BEAMS

Indicated dimensions for various sizes of Carnegie beams are shown in the following tables of their safe loads.

SYMBOLS

I —Moment of Inertia
S —Section Modulus
r —Radius of Gyration
V —Maximum Web Shear in Pounds
P —Minimum Span in feet, uniformly loaded to cause **V**
R —Allowable End Reaction for 3½" bearing
B —Unit Stress in Buckling
W—Maximum Load on one Standard Connection
Q —Minimum Span in feet, uniformly loaded to cause **W**
w —Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.

Allowable concentrated center loads are 50% and their deflections 80% of those shown.

Refer to safe load tables for the computed figures on the above items.

UNIT STRESS IN BUCKLING

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing prov'ded; but in no case shall the reaction exceed the allowable shearing value V.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		ℕ''					
Depth = d''		8.000	8.098	8.196	8.060	8.198	8.360
Wt. per foot.		24.0	27.0	30.0	31.0	36.0	42.0
Area		7.06	7.93	8.81	9.10	10.58	12.34
b''		6.500	6.529	6.559	8.000	8.046	8.100
t		.239	.268	.298	.290	.336	.390
k		⅞	⅞	1	⅞	1	1⅛
u		.400	.449	.498	.430	.499	.580
c		6¼	6¼	6¼	6¼	6¼	6¼
g		3''	3''	3''	5½	5½	5½
AXES X-X	I	84.3	95.9	107.8	110.9	131.3	156.2
	S	21.08	23.68	26.31	27.52	32.03	37.37
	r	3.46	3.48	3.50	3.49	3.52	3.56
AXES Y-Y	I	18.3	20.8	23.4	36.7	43.4	51.4
	S	5.6	6.4	7.1	9.2	10.8	12.7
	r	1.61	1.62	1.63	2.01	2.02	2.04
Coef. Str.		252900	284200	315700	330200	384400	448400
Max.Mom."#		379400	426300	473500	495300	576600	672600
V		22900	26000	29300	28100	33100	39100
P. feet		5.52	5.46	5.38	5.88	5.81	5.74
R		19720	22210	24800	23990	27970	32700
W		21510	23860	23860	26100	30240	35100
Q. feet		5.88	5.95	6.62	6.32	6.35	6.38
w. lbs		13	13	13	16	16	16
Rivet dia		¾	¾	¾	⅞	⅞	⅞

For Detailed Cut See Page 23

Deflection

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	
5	45.9	45.9	52.1	52.1	58.6	58.6	56.1	56.1	66.1	66.1	78.2	78.2	
6	42.1	42.1	47.3	47.3	52.6	52.6	55.0	55.0	64.1	64.1	74.8	74.8	.084
7	36.1	36.1	40.6	40.6	45.1	45.1	47.2	47.2	54.9	54.9	64.1	64.1	.114
8	31.6	31.6	35.5	35.5	39.5	39.5	41.3	41.3	48.0	48.0	56.1	56.1	.149
9	28.1	27.5	31.6	30.9	35.1	34.3	36.7	36.7	42.7	42.7	49.8	49.8	.189
10	25.3	24.0	28.4	27.0	31.6	30.1	33.0	33.0	38.4	38.4	44.9	44.9	.233
11	23.0	21.2	25.8	23.8	28.7	26.5	30.0	29.4	34.9	34.2	40.8	40.0	.281
12	21.1	18.8	23.7	21.2	26.3	23.5	27.5	26.3	32.0	30.6	37.4	36.6	.335
13	19.4	16.8	21.9	18.9	24.3	21.1	25.4	23.7	29.6	27.6	34.5	32.3	.394
14	18.1	15.1	20.3	16.9	22.6	18.9	23.6	21.5	27.5	25.0	32.0	29.3	.456
15	16.9	..	18.9	..	21.1	..	22.0	..	25.6	..	29.9	26.6	.524
16	15.8	..	17.8	..	19.7	..	20.6	..	24.0	..	28.0	..	.596
17	14.9	..	16.7	..	18.6	..	19.4	..	22.6	..	26.4	..	.674
18	14.1	..	15.8	..	17.5	..	18.3	..	21.4	..	24.9	..	.754
19	13.3	..	15.0	..	16.6	..	17.4	..	20.2	..	23.6	..	.840
20	12.6	..	14.2	..	15.8	..	16.5	..	19.2	..	22.4	..	.931
21	12.0	..	13.5	..	15.0	..	15.7	..	18.3	..	21.5	..	1.03
22	11.5	..	12.9	..	14.4	..	15.0	..	17.5	..	20.4	..	1.13
23	11.0	..	12.4	..	13.7	..	14.4	..	16.7	..	19.5	..	1.23
24	10.5	..	11.8	..	13.2	..	13.8	..	16.0	..	18.7	..	1.34
25	10.1	..	11.4	..	12.6	..	13.2	..	15.4	..	17.9	..	1.46

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not fixed by the Span in feet. Coefficient of Strength tabulated. B = 15000, divide the tabulated.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		9"					
Depth = d"		9.000	9.096	9.192	9.000	9.122	9.242
Wt. per foot		29.0	32.0	35.0	38.0	43.0	48.0
Area		8.53	9.40	10.29	11.17	12.65	14.11
b"		6.500	6.528	6.556	9.000	9.041	9.082
t		.279	.307	.335	.316	.357	.398
k		1	1⅜	1½	1	1⅜	1½
u		.470	.518	.566	.470	.531	.591
c		7"	7"	7"	7"	7"	7"
g		3"	3"	3"	5½	5½	5½
AXES X-X	I	126.0	140.5	155.4	170.4	195.5	221.1
	S	28.00	30.89	33.81	37.87	42.86	47.85
	r	3.84	3.87	3.89	3.91	3.93	3.96
AXES Y-Y	I	21.5	24.0	26.6	57.1	65.4	73.8
	S	6.6	7.4	8.1	12.7	14.5	16.3
	r	1.59	1.60	1.61	2.26	2.28	2.29
Coef. Str		336000	370700	405700	454400	514400	574200
Max. Mom."#		504000	556100	608600	681600	771500	861200
V			33500	37000	34100	39100	44100
P. feet		5.58	5.53	5.49	6.66	6.59	6.50
R		24060	26590	29130	27250	30950	34690
W		23860	23860	23860	28440	32130	35820
Q. feet		7.04	7.77	8.50	6.98	8.00	8.01
w. lbs		13	13	13	16	16	16
Rivet dia		¾	¾	¾	⅞	⅞	⅞

For Detailed Cut See Page 23

Deflection

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Deflection
5	60.3	60.3	67.0	67.0	73.9	73.9	68.3	68.3	78.2	78.2	88.3	88.3	
6	56.0	56.0	61.8	61.8	67.6	67.6	68.3	68.3	78.2	78.2	88.3	88.3	
7	48.0	48.0	53.0	53.0	58.0	58.0	64.9	64.9	73.5	73.5	82.0	82.0	.101
8	42.0	42.0	46.4	46.4	50.7	50.7	56.8	56.8	64.3	64.3	71.8	71.8	.132
9	37.3	36.5	41.2	40.3	45.1	44.1	50.5	50.5	57.2	57.2	63.8	63.8	.168
10	33.6	31.9	37.1	35.2	40.6	38.7	45.4	45.4	51.4	51.4	57.4	57.4	.207
11	30.5	28.2	33.7	31.1	36.9	34.0	41.3	41.3	46.8	46.8	52.2	52.2	.250
12	28.0	24.9	30.9	27.6	33.8	30.3	37.9	37.3	42.9	42.2	47.8	47.3	.298
13	25.8	22.3	28.5	24.6	31.2	27.1	35.0	33.8	39.6	38.3	44.2	42.7	.350
14	24.0	20.0	26.5	22.1	29.0	24.2	32.5	30.7	36.7	34.9	41.0	38.9	.406
15	22.4	18.0	24.7	19.9	27.1	21.8	30.3	28.1	34.3	31.8	38.3	35.6	.466
16	21.0	16.3	23.2	17.9	25.4	19.7	28.4	25.7	32.2	29.1	35.9	32.5	.530
17	19.8	..	21.8	..	23.9	..	26.7	..	30.3	..	33.8	..	.599
18	18.7	..	20.6	..	22.5	..	25.2	..	28.6	..	31.9	..	.670
19	17.7	..	19.5	..	21.4	..	23.9	..	27.1	..	30.2	..	.747
20	16.8	..	18.5	..	20.3	..	22.7	..	25.7	..	28.7	..	.828
21	16.0	..	17.7	..	19.3	..	21.6	..	24.5	..	27.3	..	.912
22	15.3	..	16.9	..	18.4	..	20.7	..	23.4	..	26.1	..	1.00
23	14.6	..	16.1	..	17.6	..	19.8	..	22.4	..	25.0	..	1.10
24	14.0	..	15.4	..	16.9	..	18.9	..	21.4	..	23.9	..	1.19
25	13.4	..	14.8	..	16.2	..	18.2	..	20.6	..	23.0	..	1.29

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. B = 15000.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		10"						
Depth = d"	9.902	10.000	10.098	10.228	10.0	10.0	
Wt. per foot	21.0	23.0	26.0	30.0	31.0	36.0	
Area	6.17	6.76	7.64	8.82	9.11	10.58	
b"	6.000	6.000	6.029	6.068	8.000	8.147	For Detailed Cut See Page 23
t	.230	.230	.259	.298	.320	.467	
k	5/8	11/16	3/4	7/8	7/8	15/16	
u	.332	.381	.430	.495	.381	.381	
c	8 1/3	8 1/3	8 1/3	8 1/3	8 1/3	8 1/3	
g	3"	3"	3"	3"	4"	4"	
AXES X-X I	107.6	122.2	139.5	163.2	163.4	175.6	
S	21.73	24.44	27.63	31.91	32.68	35.12	
r	4.18	4.25	4.27	4.30	4.23	4.07	
Y-Y I	12.0	13.7	15.7	18.5	32.5	34.4	
S	4.0	4.6	5.2	6.1	8.1	8.5	
r	1.39	1.43	1.43	1.45	1.89	1.80	
Coef. Str.	260800	293300	331500	382900	392200	421400	
Max. Mom."#	391200	439900	497300	574400	588200	632200	
V	27300	27600	31400	36600	38400	56000	Deflection
P. feet	4.76	5.30	5.28	5.23	5.11	3.76	
R	18900	18890	22410	27070	28800	42030	
B	13750	13690	14360	15000	15000	15000	
W	20700	20700	23310	23860	28800	42030	
Q. feet	6.29	7.08	7.11	8.02	6.81	5.01	
w. lbs	13	13	13	13	16	16	
Rivet dia	3/4	3/4	3/4	3/4	7/8	7/8	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	
4	55	55	55	55	63	63	73	73	77	77	105	105	
5	52	52	55	55	63	63	73	73	77	77	84	84	
6	44	44	49	49	55	55	64	64	65	65	70	70	.067
7	37	37	42	42	47	47	55	55	56	56	60	60	.091
8	33	32	37	36	41	41	48	47	49	49	53	53	.119
9	29	28	33	31	37	35	43	41	44	44	47	47	.151
10	26	24	29	27	33	31	38	36	39	39	42	42	.186
11	24	21	27	24	30	27	35	31	36	35	38	38	.225
12	22	19	24	21	28	24	32	29	33	31	35	34	.268
13	20	17	23	19	26	21	30	25	30	28	32	30	.315
14	19	15	21	17	24	19	27	22	28	26	30	28	.365
15	17	13	20	15	22	17	26	20	26	23	28	25	.419
16	16	12	18	14	21	15	24	18	25	21	26	23	.477
17	15	11	17	12	20	14	23	16	23	19	25	21	.539
18	15	..	16	..	18	13	21	15	22	..	23	..	.603
19	14	..	15	..	18	..	20	..	21	..	22	..	.672
20	13	..	15	..	17	..	19	..	20	..	21	..	.745
21	12	..	14	..	16	..	18	..	19	..	20	..	.821
22	12	..	13	..	15	..	17	..	18	..	19	..	.901
23	11	..	13	..	14	..	17	..	17	..	18	..	.986
24	11	..	12	..	14	..	16	..	16	..	18	..	1.07
25	10	..	12	..	13	..	15	..	16	..	17	..	1.16

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

Properties — 10″

SYMBOLS					
Depth = d″	10.0	10.0	10.0	10.0	10.0
Wt. per foot.	42.0	49.0	54.0	59.0	64.0
Area	12.35	14.40	15.87	17.34	18.81
b″	8.324	10.000	10.147	10.294	10.441
t	.644	.350	.497	.644	.791
k	¾	1⅛	1⅛	1½	1⅝
u	.381	.558	.558	.558	.558
e	8⅜	7¾	7¾	7¾	7¾
g	4″	5½	5½	5½	5½
AXES X-X I	190.4	272.0	284.3	296.5	308.8
AXES X-X S	38.08	54.4	56.9	59.3	61.8
AXES X-X r	3.93	4.35	4.23	4.13	4.05
AXES Y-Y I	36.8	93.0	97.3	101.7	106.3
AXES Y-Y S	8.9	18.6	19.2	19.8	20.4
AXES Y-Y r	1.73	2.54	2.48	2.42	2.38
Coef. Str.	457000	652800	682800	711600	741600
Max. Mom.″#	685400	979200	1024200	1067400	1112400
V	77300	42000	59640	77280	94920
P. feet	2.96	7.77	5.72	4.60	3.91
R	57960	31500	44730	57960	71190
B	15000	15000	15000	15000	15000
W	47720	31520	44120	47680	47680
Q. feet	4.79	10.33	7.66	7.41	7.75
w. lbs	16	16	16	16	16
Rivet dia	¾	¾	¾	¾	⅞

For Detailed Cut See Page 23 — *Deflection*

Safe Loads

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fixed	Laterally free	Laterally fixed	Laterally free	Laterally fixed	Laterally free	Laterally fixed	Laterally free	Laterally fixed	Laterally free	Deflection
3	152	152	…	…	…	…	…	…	…	…	
4	114	114	…	…	…	…	…	…	185	185	
5	91	91	…	…	119	119	142	142	148	148	
6	76	76	…	…	113	113	118	118	123	123	
7	65	65	84	84	97	97	101	101	105	105	
8	57	57	81	81	85	85	89	89	92	92	.119
9	51	51	72	72	75	75	79	79	82	82	.151
10	46	46	65	65	68	68	71	71	74	74	.186
11	42	41	59	59	62	62	64	64	67	67	.225
12	38	37	54	54	56	56	59	59	61	61	.268
13	35	33	50	49	52	52	54	54	57	57	.315
14	33	30	46	45	48	47	50	49	53	52	.365
15	31	28	43	41	45	43	47	45	49	47	.419
16	29	25	40	38	42	40	44	42	46	44	.477
17	27	23	38	35	40	37	41	38	43	40	.539
18	25	…	36	…	37	…	39	…	41	…	.603
19	24	…	34	…	35	…	37	…	39	…	.672
20	23	…	32	…	34	…	35	…	37	…	.745
21	22	…	31	…	32	…	33	…	35	…	.821
22	21	…	29	…	31	…	32	…	33	…	.901
23	20	…	28	…	29	…	30	…	32	…	.986
24	19	…	27	…	28	…	29	…	30	…	1.07
25	18	…	…	…	…	…	…	…	…	…	1.16

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

12"

SYMBOLS									For Detailed Cut See Page 23
Depth = d"	11.924	12.000	12.118	*12.022	12.236	12.000	12.130	12.258	
Wt. per foot.	25.0	28.0	32.0	34.0	36.0	40.0	45.0	50.0	
Area........	7.34	8.22	9.40	9.99	10.59	11.76	13.23	14.69	
b"........	6.000	6.500	6.534	6.635	6.568	8.000	8.036	8.071	
t.........	.240	.240	.274	.375	.308	.290	.326	.361	
k.........	¾	¾	¾	¾	¾	1½	1½	1⅜	
u.........	.382	.420	.479	.431	.538	.526	.591	.655	
c.........	10¾	10¾	10¾	10¾	10¾	9⅛	9⅞	9¾	
g.........	3"	3½	3½	3½	3½	4"	4"	4"	
AXES X-X I.....	183.0	213.4	246.3	238.1	280.1	313.7	356.9	400.5	
S....	30.69	35.57	40.65	39.61	45.78	52.28	58.85	65.35	
r....	4.99	5.10	5.12	4.88	5.14	5.17	5.19	5.22	
Y-Y I.....	13.8	19.2	22.3	21.0	25.4	44.9	51.2	57.5	
S....	4.6	5.9	6.8	6.3	7.7	11.2	12.7	14.2	
r....	1.37	1.53	1.54	1.45	1.55	1.95	1.97	1.98	
Coef. Str...	368300	426800	487800	475300	549400	627400	706100	784100	
Max.Mom."#	552500	640200	731700	713000	824100	941100	1059200	1176200	
V........	34300	34600	39800	45100	45200	41800	47500	53100	
P. feet...	5.36	6.18	6.13	4.39	6.08	7.51	7.43	7.39	
R........	19840	19820	24290	36590	28790	26400	31140	35550	
B........	12750	12710	13580	15000	14250	14000	14630	15000	
W........	21600	21600	23860	23860	23860	23860	23860	23860	
Q. feet...	8.53	9.88	10.22	9.96	11.51	13.14	14.79	16.43	
w. lbs....	13	13	13	13	13	13	13	13	
Rivet dia....	⅞	⅞	⅞	⅞	⅞	⅞	⅞	⅞	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
5	69	69	69	69	80	80	95	95	90	90	84	84	95	95	106	106	
6	61	61	69	69	80	80	79	79	90	90	84	84	95	95	106	106	
7	53	53	61	61	70	70	68	68	79	79	84	84	95	95	106	106	.099
8	46	45	53	53	61	61	59	59	69	69	78	78	88	88	98	98	.126
9	41	39	47	46	54	53	53	52	61	60	70	70	79	79	87	87	.155
10	37	34	43	41	49	47	48	46	55	52	63	63	71	71	78	78	
11	34	30	39	36	44	41	43	40	50	46	57	56	64	63	71	70	.188
12	31	27	36	32	41	36	40	36	46	41	52	50	59	56	65	63	.223
13	28	24	33	28	38	32	37	32	42	37	48	45	54	51	60	57	.263
14	26	21	31	25	35	29	34	29	39	33	45	41	50	46	56	51	.304
15	25	19	29	23	33	26	32	26	37	30	42	37	47	42	52	47	.341
16	23	17	27	21	31	24	30	23	34	27	39	34	44	38	49	43	.398
17	22	15	25	19	29	21	28	21	32	24	37	31	42	35	46	39	.449
18	21	14	24	17	27	20	26	19	31	22	35	28	39	32	44	36	.503
19	19	13	23	16	26	18	25	18	29	20	33	26	37	30	41	33	.560
20	18	11	21	14	24	16	24	16	28	18	31	24	35	27	39	30	.621
21	18	..	20	13	23	15	23	15	26	17	30	22	34	25	37	28	.684
22	17	..	19	..	22	..	22	..	25	..	29	..	32	..	36	..	.751
23	16	..	19	..	21	..	21	..	24	..	27	..	31	..	34	..	.822
24	15	..	18	..	20	..	20	..	23	..	26	..	29	..	33	..	.894
25	15	..	17	..	19	..	19	..	22	..	25	..	28	..	31	..	.970

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

*Special Section.   Web Thickness ½".

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS — 12"

	1	2	3	4	5	6	7	8	
Depth = d''	12.000	12.118	12.260	12.000	12.000	12.000	12.000	12.000	
Wt. per foot	55.0	60.0	66.0	65.0	70.0	76.0	82.0	88.0	
Area sq. in	16.17	17.65	19.41	19.11	20.58	22.35	24.11	25.88	For Detailed Cut See Page 23
b''	9.000	9.034	9.073	12.000	12.123	12.270	12.000	12.147	
t	.375	.409	.448	.400	.523	.670	.453	.600	
k	1¼	1⅝	1¾	1⅜	1⅝	1⅞	1¾	1⅝	
u	.665	.724	.795	.608	.608	.608	.800	.800	
c	9½	9½	9½	9⅝	9⅝	9⅝	9¼	9¼	
g	5½	5½	5½	5½	7½	7½	7½	7½	
X-X I	428.4	472.0	525.7	521.3	539.0	560.2	650.8	672.0	
X-X S	71.40	77.9	85.8	86.9	89.8	93.4	108.5	112.0	
X-X r	5.15	5.17	5.20	5.22	5.12	5.01	5.20	5.10	
Y-Y I	80.9	89.0	99.1	175.2	180.7	187.5	230.5	239.2	
Y-Y S	18.0	19.7	21.8	29.2	29.8	30.6	38.4	39.4	
Y-Y r	2.24	2.25	2.26	3.03	2.96	2.90	3.09	3.04	
Coef. Str.	856800	934800	1029600	1042800	1077600	1120800	1302000	1344000	
Max.Mom."#	1285200	1402200	1544400	1564200	1616400	1681200	1953000	2016000	
V	54000	59470	65910	57600	75310	96480	65230	86400	
P. feet	7.93	7.86	7.81	9.05	7.15	5.81	9.98	7.78	Deflection
R	36560	40060	44120	39000	50990	65320	44170	58500	
B	15000	15000	15000	15000	15000	15000	15000	15000	
W	50630	54000	59400	54000	70200	71580	60780	71580	
Q. feet	8.46	8.62	8.66	9.58	7.66	7.75	10.66	9.33	
w. lbs	24	24	24	24	24	24	24	24	
Rivet dia	⅞	⅞	⅞	¾	⅞	1	1	1	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
4	108	108	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
5	108	108	..	..	..	..	..	..	..	..	193	193	..	..	..	..	
6	108	108	..	..	..	..	..	..	..	..	186	186	..	..	..	..	
7	108	108	119	119	131	131	..	..	150	150	160	160	..	..	172	172	
8	107	107	116	116	128	128	..	..	134	134	140	140	..	..	168	168	.099
9	95	95	103	103	114	114	115	115	119	119	124	124	130	130	149	149	.126
10	86	86	93	93	103	103	104	104	107	107	112	112	130	130	134	134	.155
11	78	78	85	85	93	93	94	94	98	98	101	101	118	118	122	122	.188
12	71	70	77	76	85	84	86	86	89	89	93	93	108	108	112	112	.223
13	66	64	71	69	79	76	80	80	82	82	86	86	100	100	103	103	.263
14	61	58	66	63	73	69	74	74	77	77	80	80	93	93	96	96	.304
15	57	53	62	57	68	63	69	69	71	71	74	74	86	86	89	89	.341
16	54	49	58	53	64	58	65	64	67	66	70	69	81	80	84	83	.398
17	50	45	55	48	60	53	61	59	63	61	65	64	76	74	79	77	.449
18	48	41	51	44	57	49	57	55	59	57	62	60	72	69	74	71	.503
19	45	38	49	41	54	45	54	51	56	53	59	56	68	64	70	66	.560
20	43	35	46	38	51	42	52	48	53	50	56	52	65	60	67	62	.621
21	41	33	44	35	49	39	49	45	51	46	53	49	62	56	64	58	.684
22	39	..	42	..	46	..	47	..	49	..	50	..	59	..	61	..	.751
23	37	..	40	..	44	..	45	..	46	..	48	..	56	..	58	..	.822
24	36	..	39	..	42	..	43	..	44	..	46	..	54	..	56	..	.894

Additional sections rolled—12"-95, 12"-102, see page 6.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

14″

SYMBOLS									
Depth = d″	14.122	14.242	14.094	14.238	14.382	14.000	14.186	14.370	
Wt. per foot	53.0	58.0	61.0	68.0	75.0	85.0	95.0	105.0	
Area	15.59	17.05	17.94	19.99	22.05	24.99	27.93	30.88	
b″	8.035	8.070	10.000	10.043	10.086	12.000	12.050	12.101	
t	.378	.413	.382	.425	.468	.435	.485	.536	For Detailed Cut See Page 23
k	1¼	1⅝	1¼	1⅜	1¾	1½	1⅝	1⅝	
u	.656	.716	.642	.714	.786	.805	.898	.990	
c	11¾	11⅝	11⅝	11¾	11¾	11″	11″	11″	
g	4″	4″	5½	5½	5½	7½	7½	7½	
AXES X-X I	552.5	609.4	656.2	738.8	823.5	921.3	1044.0	1169.6	
S	78.25	85.58	93.12	103.78	114.52	131.61	147.19	162.78	
r	5.95	5.98	6.05	6.08	6.11	6.07	6.11	6.15	
AXES Y-Y I	56.8	62.8	107.1	120.6	134.5	232.0	262.0	292.6	
S	14.1	15.6	21.4	24.0	26.7	38.7	43.5	48.4	
r	1.91	1.92	2.44	2.46	2.47	3.05	3.06	3.08	
Coef. Str.	939000	1026900	1117400	1245300	1374200	1579400	1766200	1953400	
Max. Mom."#	1408400	1540400	1676100	1868000	2061300	2369100	2649400	2930100	
V	64100	70600	64600	72600	80800	73100	82600	92400	
P. feet	7.32	7.28	8.65	8.58	8.51	10.80	10.70	10.57	Deflection
R	38810	43740	39360	45000	49510	45670	51260	57020	
B	14600	15000	14670	15000	15000	15000	15000	15000	
W	51030	55760	51570	57370	63180	58730	65470	71580	
Q. feet	9.20	9.21	10.83	10.85	10.88	13.45	13.49	13.64	
w. lbs	24	24	24	24	24	24	24	24	
Rivet dia.	⅞	⅞	⅞	1″	1″	1″	1″	1″	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
7	128	128	141	141	129	129	145	145	162	162	146	146	165	165	185	185	
8	117	117	128	128	129	129	145	145	162	162	146	146	165	165	185	185	
9	104	104	114	114	124	124	138	138	153	153	146	146	165	165	185	185	
10	94	94	103	103	112	112	125	125	137	137	146	146	165	165	185	185	
11	85	84	93	92	102	102	113	113	125	125	144	144	161	161	178	178	.161
12	78	75	86	82	93	93	104	104	115	115	132	132	147	147	163	163	.192
13	72	67	79	74	86	85	96	95	106	105	122	122	136	136	150	150	.225
14	67	61	73	67	80	78	89	87	98	96	113	113	126	126	140	140	.261
15	63	56	69	61	75	71	83	79	92	88	105	105	118	118	130	130	.299
16	59	51	64	56	70	66	78	73	86	81	99	97	110	109	122	121	.341
17	55	46	60	51	66	61	73	68	81	75	93	90	104	101	115	112	.384
18	52	43	57	47	62	56	69	62	76	69	88	84	98	94	109	104	.431
19	49	39	54	43	59	52	66	58	72	64	83	78	93	88	103	97	.480
20	47	36	51	40	56	48	62	54	69	60	79	73	88	82	98	91	.532
21	45	33	49	37	53	45	59	50	65	55	75	69	84	77	93	85	.587
22	43	31	47	34	51	42	57	47	63	52	72	64	80	72	89	80	.644
23	41	29	45	31	49	39	54	44	60	48	69	60	77	68	85	75	.704
24	39	27	43	29	47	37	52	41	57	45	66	57	74	64	81	71	.766
25	38	25	41	27	45	34	50	38	55	42	63	54	71	60	78	67	.831
26	36	..	40	..	43	..	48	..	53	..	61	..	68	..	75	..	.899
27	35	..	38	..	41	..	46	..	51	..	59	..	65	..	72	..	.970
28	34	..	37	..	40	..	45	..	49	..	56	..	63	..	70	..	1.043
29	32	..	35	..	39	..	43	..	47	..	54	..	61	..	67	..	1.119
30	31	..	34	..	37	..	42	..	46	..	53	..	59	..	65	..	1.197

Allowable Uniform, Load as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS				16"					
Depth = d"	15.930	16.012	16.000	*15.934	16.128	16.254	16.000	16.114	
Wt. per foot	35.0	38.0	40.0	43.0	45.0	50.0	58.0	63.0	
Area	10.29	11.17	11.75	12.65	13.23	14.70	17.06	18.52	
b"	6.000	6.024	7.000	7.085	7.036	7.072	8.500	8.531	
t	.290	.314	.290	.375	.326	.362	.375	4.06	For Detailed Cut See Page 23
k	1⅜	1	1	1	1⅜	1½	1⅝	1¾	
u	.485	.526	.520	.487	.584	.647	.663	.720	
c	14"	14"	14"	14"	14"	14"	13⅜	13⅜	
g	3"	3"	4"	4"	4"	4"	5½	5½	
AXES X-X I	435.5	475.1	524.6	523.8	595.0	666.0	776.6	849.9	
S	54.68	59.34	65.58	65.75	73.78	81.95	97.08	105.49	
r	6.50	6.52	6.68	6.44	6.71	6.73	6.75	6.77	
Y-Y I	17.5	19.2	29.8	28.9	34.0	38.2	68.0	74.6	
S	5.8	6.4	8.5	8.2	9.7	10.8	16.0	17.5	
r	1.30	∔ 1.31	−1.59	1.51	1.60	1.61	2.00	2.01	
Coef. Str.	656100	712100	786900	789000	885400	983400	1164900	1265800	
Max.Mom."#	984200	1068200	1180400	1183400	1328100	1475100	1747400	1898700	
V	55400	60300	55700	71700	63100	70600	72000	78500	
P. feet	5.92	5.90	7.07	5.50	7.02	6.96	8.09	8.06	Deflection
R	25990	29590	25970	38830	31390	36890	38840	43580	
B	11980	12560	11940	13840	12790	13470	13810	14260	
W	26100	28260	26100	33750	29340	32580	67600	73080	
Q. feet	12.56	12.59	15.06	11.69	15.09	15.09	8.63	8.66	
w. lbs	19	19	19	19	19	19	33	33	
Rivet dia	⅞	⅞	⅞	⅞	⅞	⅞	⅞	⅞	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
9	73	70	79	76	87	87	88	87	98	98	109	109	129	129	141	141	.094
10	66	61	71	66	79	77	79	77	89	86	98	95	117	117	127	127	.116
11	60	53	65	58	72	68	72	68	80	76	89	84	106	105	115	114	.141
12	55	47	59	51	66	61	66	61	74	68	82	76	97	94	106	102	.168
13	51	42	55	45	61	54	61	54	68	61	76	68	90	85	97	93	.197
14	47	37	51	41	56	48	56	49	63	56	70	61	83	77	90	84	.228
15	44	34	47	36	52	43	53	42	59	49	66	55	78	70	84	77	.262
16	41	30	44	33	49	40	49	40	55	45	61	50	73	65	79	70	.298
17	39	27	42	30	46	36	47	37	52	41	58	46	69	59	75	64	.336
18	37	25	40	27	44	33	44	33	49	37	55	42	65	54	70	59	.377
19	35	22	37	24	41	30	42	30	47	34	52	38	61	50	67	55	.420
20	33	20	36	22	39	27	40	28	44	31	49	35	58	46	63	50	.466
21	31	..	34	..	37	25	38	26	42	28	47	32	56	43	60	47	.513
22	30	..	32	..	36	23	36	24	40	26	45	29	53	40	58	43	.563
23	29	..	31	..	34	21	34	22	38	24	43	27	51	37	55	40	.616
24	27	..	30	..	33	..	33	..	37	..	41	..	49	34	53	37	.670
25	26	..	28	..	31	..	32	..	35	..	39	..	47	32	51	35	.727
26	25	..	27	..	30	..	30	..	34	..	38	..	45	30	49	33	.787
27	24	..	26	..	29	..	29	..	33	..	36	..	43	28	47	30	.848
28	24	..	25	..	28	..	28	..	32	..	35	..	42	26	45	28	.912
29	23	..	25	..	27	..	27	..	31	..	34	..	40	..	44	..	.979
30	22	..	24	..	26	..	26	..	30	..	33	..	39	..	42	..	1.047
31	21	..	23	..	25	..	26	..	29	..	32	..	38	..	41	..	1.118
32	21	..	22	..	25	..	25	..	28	..	31	..	36	..	40	..	1.192
33	20	..	22	..	24	..	24	..	27	..	30	..	35	..	38	..	1.267

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by Span in feet.

*Special Section.   Web Thickness ⅜".

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

16"

SYMBOLS								
Depth = d"	16.226	16.000	16.120	16.240ₐ	16.000	16.110	16.236	
Wt. per foot	68.0	76.0	83.0	90.0	100.0	107.0	115.0	
Area	20.00	22.34	24.41	26.46	29.41	31.46	33.82	
b"	8.563	12.000	12.039	12.076	14.000	14.032	14.068	
t	4.38	.419	.458	.495	.464	.496	.532	
k	1½	1⅝	1¾	1⅞	1½	1⅝	1¾	For Detailed Cut See Page 23
u	.776	.663	.723	.783	.800	.855	.918	
c	13¾	13¾	13¾	13¾	13"	13"	13"	
g	5½	7½	7½	7½	10"	10"	10"	
AXES X-X I	923.7	1061.3	1167.7	1275.5	1426.8	1537.2	1665.6	
S	113.85	132.66	144.88	157.08	178.35	190.84	205.17	
r	6.80	6.89	6.92	6.94	6.97	6.99	7.02	
Y-Y I	81.3	191.1	210.4	230.0	366.0	393.9	426.2	
S	19.0	31.8	35.0	38.1	52.3	56.1	60.6	
r	2.02	2.92	2.94	2.95	3.53	3.54	3.55	
Coef. Str.	1366200	1591900	1738500	1885000	2140200	2290000	2462100	
Max.Mom."#	2049400	2387900	2607800	2827500	3210300	3435100	3693100	
V	85300	80500	88600	96500	89100	95900	103700	
P. feet	8.01	9.90	9.81	9.77	12.01	11.94	11.88	Deflection
R	48480	45510	51450	56130	52200	56000	60320	
B	14650	14480	14920	15000	15000	15000	15000	
W	78840	75420	82440	89100	83520	89280	95440	
Q. feet	8.66	10.55	10.54	10.58	12.81	12.82	12.90	
w. lbs.	33	33	33	33	33	33	35	
Rivet dia.	⅝	1"	1"	1"	1"	1"	1"	

Safe Loads (Allowable Uniform Load as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.)

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
9	152	152	161	161	177	177	193	193	178	178	192	192	207	207	
10	137	137	159	159	174	174	189	189	178	178	192	192	207	207	
11	124	123	145	145	158	158	171	171	178	178	192	192	207	207	.197
12	114	111	133	133	145	145	157	157	178	178	191	191	205	205	.228
13	105	100	123	123	134	134	145	145	165	165	176	176	189	189	.262
14	98	91	114	114	124	124	135	135	153	153	164	164	176	176	
15	91	83	106	106	116	116	126	126	143	143	153	153	164	164	
16	85	76	100	100	109	107	118	116	134	134	143	143	154	154	.298
17	80	70	94	91	102	99	111	108	126	126	135	135	145	145	.336
18	76	64	88	85	97	92	105	100	119	118	127	126	137	136	.377
19	72	59	84	79	92	86	99	93	113	111	121	118	130	127	.420
20	68	55	80	74	87	81	94	88	107	103	114	111	123	120	.466
21	65	50	76	69	83	75	90	82	102	97	109	104	117	112	.513
22	62	47	72	65	79	71	86	77	97	92	104	98	112	106	.563
23	59	43	69	61	76	66	82	72	93	87	100	93	107	100	.616
24	57	40	66	57	72	63	79	68	89	82	95	88	103	94	.670
25	55	38	64	54	70	59	75	64	86	77	92	83	98	89	.727
26	53	35	61	51	67	56	73	61	82	73	88	78	95	84	.787
27	51	33	59	48	64	52	70	57	79	69	85	75	91	80	.848
28	49	31	57	45	62	50	67	54	76	66	82	71	88	76	.912
29	47	..	55	..	60	..	65	51	74	..	79	..	85	72	.979
30	46	..	53	..	58	..	63	..	71	..	76	..	82	..	1.047
31	44	..	51	..	56	..	61	..	69	..	74	..	79	..	1.118
32	43	..	50	..	54	..	59	..	67	..	72	..	77	..	1.192
33	41	..	48	..	53	..	57	..	65	..	69	..	75	..	1.267
34	..	..	47	..	51	..	55	..	63	..	67	..	72	..	1.345

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		18″			
Depth = d″	18.000	*18.024	18.114	18.252	For Detailed Cut See Page 23
Wt. per foot.	47.0	51.0	52.0	58.0	
Area	13.82	15.00	15.30	17.05	
b″	7.500	7.555	7.534	7.573	
t	.320	.375	.354	.393	
k	1⅛	1⅛	1½	1⅜	
u	.550	.562	.607	.676	
c	15⅝	15⅝	15⅝	15⅝	
g	3¾	3¾	3¾	3¾	
AXES X-X I	768.6	810.0	855.1	960.8	
S	85.4	89.88	94.41	105.28	
r	7.46	7.35	7.48	7.51	
Y-Y I	38.7	40.5	43.3	49.0	
S	10.3	10.7	11.5	13.0	
r	1.67	1.64	1.68	1.70	
Coef. Str	1024800	1078600	1133000	1263400	
Max.Mom.″‡	1537200	1617800	1699400	1895100	Deflection
V	69100	81100	77000	86100	
P. feet	7.41	6.65	7.36	7.34	
R	30170	39020	35610	41950	
B	11790	13000	12530	13240	
W	36000	42190	39830	44220	
Q. feet	14.23	12.78	14.22	14.28	
w. lbs	25	25	25	25	
Rivet dia	⅞	⅞	¾	¾	

Span feet	Laterally fixed	Laterally free	Laterally fixed	Laterally free	Laterally fixed	Laterally free	Laterally fixed	Laterally free	
10	102	101	108	106	113	112	126	125	.103
11	93	90	98	94	103	99	115	111	.125
12	85	80	90	85	94	89	105	99	.149
13	79	72	83	76	87	80	97	89	.175
14	73	65	77	69	81	72	90	80	.203
15	68	59	72	62	76	65	84	73	.233
16	64	54	67	57	71	59	79	67	.265
17	60	49	63	52	67	54	74	61	.299
18	57	45	60	47	63	49	70	55	.335
19	54	41	57	43	60	45	66	51	.373
20	51	38	54	40	57	42	63	47	.414
21	49	35	51	37	54	38	60	43	.456
22	47	32	49	34	52	35	57	40	.501
23	45	30	47	31	49	33	55	37	.548
24	43	27	45	29	47	30	53	34	.596
25	41	25	43	27	45	28	51	32	.647
26	39	..	41	..	44	..	49	..	.699
27	38	..	40	..	42	..	47	..	.754
28	37	..	39	..	40	..	45	..	.811
29	35	..	37	..	39	..	44	..	.870
30	34	..	36	..	38	..	42	..	.931
31	33	..	35	..	37	..	41	..	.994
32	32	..	34	..	35	..	39	..	1.06
33	31	..	33	..	34	..	38	..	1.13
34	30	..	32	..	33	..	37	..	1.20
35	29	..	31	..	32	..	36	..	1.27

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

*Special Section.   Web Thickness ¾″.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		18"						
Depth = d"		18.000	18.110	18.242	18.000	18.120	18.238	
Wt. per foot		67.0	72.0	78.0	86.0	93.0	100.0	
Area		19.69	21.17	22.94	25.29	27.35	29.40	
b"		8.500	8.530	8.565	12.000	12.034	12.069	
t		.406	.436	.471	.429	.463	.498	For Detailed Cut See Page 23
k		1⅞	1½	1⅞	1⅞	1½	1⅞	
u		.745	.800	.866	.745	.805	.864	
c		15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	
g		5½	5½	5½	7½	7½	7½	
AXES X-X	I	1117.1	1208.1	1318.8	1514.1	1648.4	1783.4	
	S	124.12	133.42	144.59	168.23	181.94	195.57	
	r	7.53	7.55	7.58	7.74	7.76	7.79	
AXES Y-Y	I	76.4	82.9	90.9	214.7	234.0	253.4	
	S	18.0	19.4	21.2	35.8	38.9	42.0	
	r	1.97	1.98	1.99	2.91	2.93	2.94	
Coef. Str		1489500	1601000	1735100	2018800	2183300	2346800	
Max. Mom."#		2234200	2401500	2602600	3028200	3275000	3520200	
V		87700	94800	103100	92700	100700	109000	
P. feet		8.49	8.45	8.41	10.89	10.84	10.77	Deflection
R		44040	48930	54670	47760	53310	59040	
B		13560	13980	14400	13920	14340	14710	
W		91350	98100	105980	96530	104180	112050	
Q. feet		8.15	8.16	8.18	10.46	10.48	10.47	
w. lbs		41	41	41	41	41	41	
Rivet dia		⅞	⅞	⅞	1"	1"	1"	

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	
10	149	149	160	160	174	174	185	185	201	201	218	218	
11	135	134	146	144	158	156	184	184	198	198	213	213	.125
12	124	120	133	130	145	141	168	168	182	182	196	196	.149
13	115	109	123	117	133	127	155	155	168	168	181	181	.175
14	106	99	114	106	124	116	144	144	156	156	168	168	.203
15	99	90	107	97	116	105	135	135	146	146	156	156	.233
16	93	83	100	89	108	96	126	124	136	134	147	144	.265
17	88	76	94	81	102	88	119	115	128	125	138	134	.299
18	83	69	89	75	96	81	112	107	121	116	130	125	.335
19	78	64	84	69	91	75	106	100	115	108	124	116	.373
20	74	59	80	64	87	69	101	93	109	101	117	109	.414
21	71	55	76	59	83	64	96	88	104	95	112	102	.456
22	68	51	73	55	79	60	92	82	99	89	107	96	.501
23	65	47	70	51	75	55	88	77	95	83	102	90	.548
24	62	44	67	47	72	51	84	73	91	78	98	85	.596
25	60	41	64	44	69	48	81	68	87	74	94	80	.647
26	57	38	62	41	67	45	78	64	84	70	90	75	.699
27	55	36	59	38	64	42	75	61	81	66	87	71	.754
28	53	33	57	36	62	39	72	58	78	62	84	67	.811
29	51	..	55	..	60	..	70	54	75	59	81	64	.870
30	50	..	53	..	58	..	67	52	73	56	78	60	.931
31	48	..	52	..	56	..	65	49	70	53	76	57	.994
32	47	..	50	..	54	..	63	46	68	50	73	54	1.06
33	45	..	49	..	53	..	61	..	66	..	71	..	1.13
34	44	..	47	..	51	..	59	..	64	..	69	..	1.20
35	43	..	46	..	50	..	58	..	62	..	67	..	1.27
36	41	..	44	..	48	..	56	..	61	..	65	..	1.34

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		21''			
Depth = d''	21.000	*21.034	21.126	21.248	For Detailed Cut See Page 23
Wt. per foot.	58.0	60.0	64.0	70.0	
Area.......	17.05	17.64	18.82	20.59	
b''........	8.000	8.015	8.036	8.073	
t.........	.360	.375	.396	.433	
k.........	1⅜	1⅜	1¼	1⅜	
u.........	.603	.625	.671	.732	
c.........	18⅝	18⅝	18⅝	18⅝	
g.........	4''	4''	4''	4''	
AXES X-X I.....	1263.2	1304.9	1403.3	1542.9	
S....	120.30	124.08	132.85	145.23	
r.....	8.61	8.60	8.64	8.66	
AXES Y-Y I.....	52.0	53.7	58.3	64.3	
S....	13.0	13.4	14.5	15.9	
r.....	1.75	1.75	1.76	1.77	
Coef. Str...	1443600	1488900	1594200	1742700	Deflection
Max.Mom."#	2165500	2233400	2391300	2614100	
V.........	90700	94700	100400	110400	
P. feet...	7.96	7.87	7.94	7.89	
R.........	36180	38780	42460	49010	
B.........	11490	11810	12210	12850	
W.........	48600	50630	53460	58460	
Q. feet...	14.85	14.70	14.91	14.91	
w. lbs....	30	30	30	30	
Rivet dia....	⅞	⅞	⅞	⅞	

Span feet	Laterally		Laterally		Laterally		Laterally		
	fixed	free	fixed	free	fixed	free	fixed	free	
10	144	144	149	149	159	159	174	174	.089
11	131	128	135	132	145	142	158	156	.107
12	120	115	124	119	133	127	145	139	.123
13	111	104	115	107	123	115	134	126	.150
14	103	94	106	97	114	104	124	114	.174
15	96	85	99	88	106	94	116	103	.200
16	90	78	93	80	100	86	109	94	.227
17	85	71	88	73	94	79	103	86	.257
18	80	65	83	67	89	72	97	79	.287
19	76	60	78	62	84	67	92	73	.320
20	72	55	74	57	80	61	87	67	.355
21	69	51	71	53	76	57	83	62	.391
22	66	47	68	49	72	52	79	57	.429
23	63	44	65	45	69	49	76	53	.470
24	60	41	62	42	66	45	73	49	.511
25	58	38	60	39	64	42	70	46	.554
26	56	35	57	36	61	39	67	43	.600
27	53	..	55	..	59	..	65	..	.646
28	52	..	53	..	57	..	62	..	.695
29	50	..	51	..	55	..	60	..	.746
30	48	..	50	..	53	..	58	..	.798
32	45	..	47	..	50	..	54	..	.908
34	42	..	44	..	47	..	51	..	1.03
36	40	..	41	..	44	..	48	..	1.15
38	38	..	39	..	42	..	46	..	1.28
40	36	..	37	..	40	..	44	..	1.42
42	34	..	35	..	38	..	41	..	1.56

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

*Special Section.   Web Thickness ⅜".

CARNEGIE BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		21"					
Depth = d"	21.000	21.120	21.240	21.000	21.126	21.248	
Wt. per foot	80.0	86.0	92.0	104.0	112.0	120.0	
Area	23.53	25.28	27.05	30.57	32.93	35.28	For Detailed Cut See Page 23
b"	9.000	9.032	9.064	13.000	13.034	13.070	
t	.438	.470	.502	.465	.499	.535	
k	1⅜	1⅝	1⅝	1⅜	1⅝	1⅝	
u	.815	.875	.935	.815	.878	.939	
c	17⅝	17⅝	17⅝	17⅝	17⅝	17⅝	
g	5½	5½	5½	7½	7½	7½	
AXES X-X I	1794.4	1939.3	2086.4	2475.3	2683.7	2890.9	
S	170.90	183.65	196.46	235.74	254.07	272.11	
r	8.73	8.76	8.78	9.00	9.03	9.05	
Y-Y I	99.2	107.7	116.3	298.7	324.3	349.7	
S	22.0	23.8	25.7	45.9	49.8	53.5	
r	2.05	2.06	2.07	3.13	3.14	3.15	
Coef. Str.	2050700	2203700	2357500	2828900	3048800	3265300	
Max. Mom."#	3076100	3305600	3536300	4243400	4573200	4898000	
V	110400	119100	128000	117200	126500	136400	
P. feet	9.29	9.25	9.21	12.07	12.05	11.97	Deflection
R	49980	55580	61320	54660	60730	67190	
B	13010	13470	13430	13430	13860	14250	
W	59130	63450	67770	104630	112280	119300	
Q. feet	17.34	17.37	17.39	13.52	13.58	13.69	
w. lbs	30	30	30	41	41	41	
Rivet dia	⅞	⅞	¾	1"	1"	1"	

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	
10	205	205	220	220	236	236	234	234	253	253	273	273	
11	186	186	200	200	214	214	234	234	253	253	273	273	
12	171	168	184	181	196	194	234	234	253	253	272	272	
13	158	153	170	164	181	175	218	218	235	235	251	251	.150
14	146	138	157	149	168	160	202	202	218	218	233	233	.174
15	137	127	147	136	157	146	189	189	203	203	218	218	.200
16	128	116	138	125	147	134	177	177	191	191	204	204	.227
17	121	106	130	115	139	123	166	164	179	178	192	191	.257
18	114	98	122	106	131	114	157	154	169	166	181	177	.287
19	108	91	116	98	124	105	149	143	160	155	172	166	.320
20	103	84	110	91	118	97	141	134	152	145	163	156	.355
21	98	78	105	84	112	90	135	126	145	136	155	146	.391
22	93	73	100	78	107	83	129	119	139	128	148	137	.429
23	89	67	96	73	103	78	123	111	133	120	142	129	.470
24	85	63	92	67	98	73	118	105	127	114	136	122	.511
25	82	59	88	63	94	68	113	99	122	107	131	115	.554
26	79	55	85	59	91	63	109	94	117	101	126	109	.600
27	76	51	82	55	87	59	105	89	113	96	121	103	.646
28	73	48	79	52	84	56	101	84	109	91	117	97	.695
29	71	45	76	48	81	52	98	80	105	86	113	92	.746
30	68	42	73	46	79	49	94	76	102	82	109	88	.798
32	64	..	69	..	74	..	88	68	95	74	102	79	.908
34	60	..	65	..	69	..	83	62	90	67	96	72	1.03
36	57	..	61	..	65	..	79	56	85	61	91	65	1.15
38	54	..	58	..	62	..	74	..	80	..	86	59	1.28
40	51	..	55	..	59	..	71	..	76	..	82	..	1.42
42	49	..	52	..	56	..	67	..	73	..	78	..	1.56

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

CARNEGIE BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		24"		
Depth = d"	24.000	24.000	24.154	24.308
Wt. per foot.	70.0	76.0	85.0	94.0
Area	20.58	22.35	24.99	27.64
b"	8.500	9.750	9.797	9.844
t	.400	.405	.452	.499
k	1⅝	1⅝	1¾	1⅞
u	.663	.663	.740	.817
c	21⅜	21⅜	21⅜	21⅜
g	4"	5½	5½	5½

For Detailed Cut See Page 23

AXES					
X-X	I	1953.8	2184.4	2457.2	2734.9
	S	162.82	182.03	203.46	225.02
	r	9.74	9.89	9.92	9.95
Y-Y	I	68.0	102.6	116.2	130.2
	S	16.0	21.0	23.7	26.4
	r	1.82	2.14	2.16	2.17

Coef. Str	1953800	2184400	2441500	2700200
Max.Mom."#	2930700	3276600	3662300	4050400
V	115200	116600	131000	145600
P. feet	8.48	9.36	9.32	9.27
R	42750	43680	52580	61640
B	11250	11350	12200	12900
W	54000	54680	61020	67370
Q. feet	18.09	19.97	20.00	20.04
w. lbs	30	30	30	30
Rivet dia	⅞	⅞	¾	¾

Deflection

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally		Laterally		Laterally		Laterally		Deflection
	fixed	free	fixed	free	fixed	free	fixed	free	
10	195	195	218	218	244	244	270	270	.078
12	163	158	182	182	203	203	225	225	.112
14	140	130	156	151	174	169	193	187	.152
16	122	108	137	127	153	142	169	158	.199
18	109	91	121	108	136	121	150	134	.251
20	98	78	109	93	122	104	135	115	.310
21	93	72	104	87	116	97	129	108	.342
22	89	67	99	81	111	90	123	100	.375
23	85	62	95	75	106	84	117	94	.411
24	81	57	91	70	102	79	113	88	.447
25	78	54	87	66	98	74	108	82	.485
26	75	50	84	62	94	69	104	77	.525
27	72	47	81	58	90	65	100	72	.566
28	70	44	78	54	87	61	96	68	.608
29	67	..	75	51	84	57	93	64	.653
30	65	..	73	48	81	54	90	60	.698
31	63	..	70	45	79	51	87	57	.746
32	61	..	68	43	76	48	84	53	.795
33	59	..	66	..	74	..	82	..	.845
34	57	..	64	..	72	..	79	..	.897
35	56	.	62	..	70	..	77	..	.950
36	54	..	61	..	68	..	75	..	1.01
38	51	..	57	..	64	..	71	..	1.12
40	49	..	55	..	61	..	68	..	1.24
42	47	..	52	..	58	..	64	..	1.37
44	44	..	50	..	55	..	61	..	1.50
46	42	..	47	..	53	..	59	..	1.64
48	41	..	46	..	51	..	56	..	1.79
50	39	..	44	..	49	..	54	..	1.94

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

Symbols — 24"

For Detailed Cut See Page 23

Symbol							
Depth = d"	24.000	24.156	24.310	24.250	24.388	24.526	24.664
Wt. per foot.	100.0	110.0	120.0	130.0	140.0	150.0	160.0
Area........	29.41	32.34	35.29	38.23	41.16	44.10	47.06
b"........	12.000	12.044	12.089	14.000	14.041	14.082	14.123
t........	.450	.494	.539	.547	.588	.629	.670
k........	1¼	1⅜	1⅜	1⅜	1½	1½	1⅝
u........	.787	.865	.942	.912	.981	1.050	1.119
c........	20¾	20¾	20¾	20¾	20¾	20¾	20¾
g........	7½	7½	7½	10"	10"	10"	10"

AXES

X-X I.....	3020.5	3343.5	3669.7	4045.1	4380.4	4720.5	5065.7
X-X S.....	251.71	276.83	301.91	333.62	359.23	384.94	410.78
X-X r.....	10.14	10.17	10.20	10.29	10.32	10.35	10.38
Y-Y I.....	226.9	252.2	277.8	417.5	453.1	489.3	526.0
Y-Y S.....	37.8	41.9	46.0	59.6	64.5	69.5	74.5
Y-Y r.....	2.78	2.79	2.81	3.31	3.32	3.33	3.34

Deflection

Coef. Str....	3020500	3321900	3622900	4003400	4310700	4619300	4929300
Max.Mom."#	4530700	4982900	5434300	6005100	6466100	6928900	7394000
V......	129600	143200	157200	159200	172100	185100	198300
P. feet...	11.65	11.60	11.52	12.57	12.52	12.47	12.43
R......	52200	60650	69400	70920	78940	87000	95100
B......	12210	12870	13440	13560	13990	14360	14680
W......	121500	133380	143160	143160	143160	143160	143160
Q. feet...	12.43	12.45	12.65	13.98	15.06	16.13	17.22
w lbs.....	49	49	49	49	49	49	49
Rivet dia....	1"	1"	1"	1"	1"	1"	1"

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	100# fix'd	100# free	110# fix'd	110# free	120# fix'd	120# free	130# fix'd	130# free	140# fix'd	140# free	150# fix'd	150# free	160# fix'd	160# free	Deflection
10	259	259	286	286	314	314	318	318	344	344	370	370	397	397	
12	252	252	277	277	302	302	318	318	344	344	370	370	397	397	
14	216	216	237	237	259	259	286	286	308	308	330	330	352	352	.152
16	189	186	208	205	226	223	250	250	269	269	289	289	308	308	.199
18	168	160	185	176	201	193	222	221	239	238	257	255	274	273	.251
20	151	140	166	154	181	168	200	194	216	209	231	224	246	239	.310
21	144	131	158	144	173	158	191	182	205	196	220	210	235	225	.342
22	137	123	151	135	165	148	182	172	196	185	210	198	224	212	.375
23	131	115	144	127	158	139	174	162	187	174	200	188	214	200	.411
24	126	109	138	119	151	131	167	153	180	165	192	177	205	189	.447
25	121	102	133	112	145	123	160	145	172	156	185	167	197	179	.485
26	116	96	128	106	139	116	154	137	166	148	178	158	190	170	.525
27	112	91	123	100	134	110	148	130	160	140	171	150	183	160	.566
28	108	86	119	95	129	104	143	123	154	133	165	143	176	153	.608
29	104	81	115	90	125	98	138	117	149	126	159	135	169	145	.653
30	101	77	111	85	121	93	133	111	144	121	154	129	164	138	.698
31	97	73	107	80	117	88	129	106	139	114	149	123	159	131	.746
32	94	69	104	75	113	84	125	101	135	109	144	117	154	125	.795
33	92	66	101	71	110	79	121	96	131	104	140	112	149	119	.845
34	89	63	98	68	107	75	118	92	127	99	136	106	145	113	.897
35	86	59	95	64	104	72	114	88	123	94	132	102	141	108	.950
36	84	57	92	61	101	68	111	84	120	90	128	97	137	104	1.01
38	79	51	87	55	95	62	105	77	113	82	122	88	130	95	1.12
40	76	47	83	..	91	56	100	70	108	75	115	80	123	87	1.24
42	72	..	79	..	86	..	95	64	103	69	110	75	117	80	1.37
44	69	..	75	..	82	..	91	..	98	..	105	..	112	73	1.50
46	66	..	72	..	79	..	87	..	94	..	100	..	107	..	1.64
48	63	..	69	..	75	..	83	..	90	..	96	..	103	..	1.79
50	60	..	66	..	72	..	80	..	86	..	92	..	99	..	1.94

CARNEGIE BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

27″

SYMBOLS									
Depth = d″	27.000	27.166	27.340	27.536	27.742	27.000	27.200	27.400	
Wt. per foot	91.0	101.0	112.0	124.0	137.0	145.0	160.0	175.0	
Area	26.76	29.70	32.94	36.47	40.29	42.64	47.04	51.47	For Detailed Cut See Page 23
b″	9.750	9.799	9.855	9.913	9.977	14.000	14.059	14.118	
t	.461	.510	.566	.624	.688	.580	.639	.698	
k	1¾	1½	1¾	1⅞	1⅝	1¾	2	2⅜	
u	.755	.838	.925	1.023	1.126	.985	1.085	1.185	
c	24¼	24¼	24¼	24¼	24¼	23¼	23¼	23¼	
g	5½	5½	5½	5½	5½	10″	10″	10″	
AXES X-X — I	3217.0	3595.7	4007.6	4472.1	4975.9	5508.7	6121.8	6746.8	
AXES X-X — S	238.30	264.72	293.17	324.8	358.7	408.05	450.13	492.47	
AXES X-X — r	10.97	11.00	11.03	11.07	11.11	11.37	11.41	11.45	
AXES Y-Y — I	116.9	131.7	148.0	166.7	187.1	451.0	503.2	556.6	
AXES Y-Y — S	24.0	26.9	30.0	33.6	37.5	64.4	71.6	78.9	
AXES Y-Y — r	2.09	2.11	2.12	2.14	2.16	3.25	3.27	3.29	
Coef. Str.	2859500	3176600	3518000	3897600	4304400	4896600	5401600	5909600	
Max.Mom.″#	4289300	4765000	5277000	5864400	6456600	7344900	8102400	8864400	
V	149400	166300	185700	206190	229040	187900	208600	229500	Deflection
P. feet	9.57	9.55	9.47	9.45	9.40	13.03	12.95	12.88	
R	54120	64140	75810	88060	101680	78620	90990	103470	
B	11453	12221	12960	13590	14162	13220	13830	14320	
W	82980	91800	95440	95440	95440	167020	167020	167020	
Q. feet	17.23	17.30	18.43	20.41	22.55	14.66	16.17	17.69	
w. lbs	40	40	40	40	40	58	58	58	
Rivet dia	1″	1″	1″	1″	1″	1″	1″	1″	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Deflection
	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	ux'd	free	nx'd	free	fix'd	free	
10	286	286	318	318	352	352	390	390	423	423	376	376	417	417	459	459	
12	238	238	265	265	293	293	325	325	352	352	376	376	417	417	459	459	.135
14	204	198	227	219	251	244	278	270	302	294	350	350	386	386	422	422	.177
16	179	166	199	185	220	206	244	228	264	248	306	306	338	338	369	369	.223
18	159	141	176	158	195	175	217	197	235	211	272	270	300	299	328	327	.276
20	143	122	159	136	176	151	195	167	211	182	245	237	270	262	295	287	
21	136	114	151	126	168	140	186	156	201	170	233	223	257	246	281	270	.304
22	130	106	144	118	160	131	177	145	192	158	223	210	246	232	269	254	.334
23	124	99	138	110	153	122	169	136	184	147	213	198	235	218	257	240	.365
24	119	92	132	102	147	114	162	127	176	138	204	187	225	207	246	226	.397
25	114	86	127	96	141	107	156	119	169	130	196	177	216	196	236	214	.431
26	110	81	122	90	135	100	150	111	163	121	188	168	208	185	227	203	.466
27	106	76	118	85	130	94	144	104	157	114	181	159	200	176	219	192	.503
28	102	71	113	79	126	88	139	98	151	107	175	151	193	166	211	183	.540
29	99	67	110	75	121	83	134	93	146	100	169	144	186	158	204	173	.580
30	95	63	106	70	117	78	130	87	141	95	163	136	180	151	197	165	.621
31	92	59	102	66	113	74	126	82	136	89	158	130	174	143	191	158	.662
32	89	56	99	62	110	69	122	77	132	84	153	123	169	137	185	150	.706
33	87	..	96	..	107	..	118	73	128	79	148	118	164	130	179	143	.751
34	84	..	93	..	103	..	115	..	124	..	144	112	159	124	174	136	.797
35	82	..	91	..	101	..	111	..	121	..	140	107	154	119	169	130	.844
36	79	..	88	..	98	..	108	..	117	..	136	103	150	113	164	124	.894
38	75	..	84	..	93	..	103	..	111	..	129	94	142	103	156	114	.996
40	71	..	79	..	88	..	97	..	106	..	122	86	135	95	148	104	1.10
42	68	..	76	..	84	..	93	..	101	..	117	79	129	87	141	95	1.22
44	65	..	72	..	80	..	89	..	96	..	111	72	123	80	134	88	1.34
46	62	..	69	..	76	..	85	..	92	..	106	66	117	74	128	81	1.46
48	60	..	66	..	73	..	81	..	88	..	102	..	113	..	123	..	1.59
50	57	..	64	..	70	..	78	..	85	..	98	..	108	..	118	..	1.72

Additional section rolled—27″-190, see page 6.

CARNEGIE BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN
THOUSANDS OF POUNDS UNIFORMLY LOADED

30″

SYMBOLS									
Depth = d″	30.000	30.162	30.344	30.538	30.742	30.000	30.263	30.522	
Wt. per foot.	115.0	126.0	138.0	151.0	165.0	180.0	200.0	220.0	
Area........	33.81	37.05	40.58	44.41	48.52	52.93	58.82	64.70	
b″........	10.500	10.551	10.604	10.662	10.725	14.000	14.073	14.146	For Detailed Cut See Page 23
t........	.530	.581	.634	.692	.755	.670	.743	.816	
k........	1⅝	1¾	1⅞	1⅞	1⅝	2⅛	2⅜	2½	
u........	.882	.963	1.054	1.151	1.253	1.207	1.338	1.468	
c........	26¼	26¼	26¼	26¼	26¼	25½	25½	25½	
g........	5½	5½	5½	5½	5½	10″	10″	10″	
AXES X–X	I.....	4985.3	5486.7	6049.5	6663.7	7326.7	8301.4	9305.7	10320.4	
	S.....	332.35	363.8	398.7	436.4	476.7	553.43	614.99	676.26	
	r.....	12.14	12.17	12.21	12.25	12.29	12.52	12.58	12.63	
AXES Y–Y	I.....	170.6	189.0	210.1	233.4	258.7	552.7	622.7	693.9	
	S.....	32.5	35.8	39.6	43.8	48.2	79.0	88.5	98.1	
	r.....	2.25	2.26	2.28	2.29	2.31	3.23	3.25	3.28	
Coef. Str....	3988200	4365600	4784400	5236800	5720400	6641100	7379900	8115100	
Max. Mom.″#	5982400	6548400	7176600	7855200	8580600	9961700	11069800	12172700	
V........	190800	210290	230860	253590	278520	241200	269800	298900	Deflection
P. feet...	10.45	10.38	10.36	10.32	10.27	13.77	13.68	13.58	
R........	68410	79680	91560	104710	119110	99440	115940	132570	
B........	11734	12421	13027	13589	14103	13490	14100	14600	
W........	107330	107280	107280	190720	190720	190880	190880	190880	
Q. feet...	18.58	20.33	22.25	13.66	14.91	17.40	19.33	21.26	
w. lbs....	45	45	45	66	66	66	66	66	
Rivet dia....	1″	1″	1″	1″	1″	1″	1″	1″	

Span feet	Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally	
	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	
10	382	382	421	421	462	462	507	507	557	557	482	482	540	540	598	598	
12	332	332	364	364	399	399	436	436	477	477	482	482	540	540	598	598	.122
14	285	281	312	307	342	338	374	370	409	404	474	474	527	527	580	580	.159
16	249	237	273	260	299	286	327	313	358	342	415	415	461	461	507	507	.201
18	222	203	243	223	266	245	291	268	318	293	369	366	410	408	451	449	.201
20	199	176	218	193	239	211	262	232	286	254	332	321	369	358	406	394	.248
21	190	164	208	179	228	197	249	216	272	237	316	302	351	336	386	371	.274
22	181	153	198	168	217	184	238	202	260	222	302	285	335	317	369	349	.300
23	173	143	190	157	208	173	228	189	249	208	289	268	321	300	353	329	.329
24	166	134	182	147	199	162	218	178	238	195	277	254	307	282	338	312	.358
25	160	126	175	138	191	152	209	166	229	183	266	240	295	268	325	294	.388
26	153	118	168	130	184	142	201	157	220	172	255	227	284	253	312	279	.420
27	148	111	162	122	177	134	194	147	212	162	246	215	273	240	301	264	.452
28	142	105	156	115	171	126	187	139	204	153	237	205	264	227	290	251	.487
29	138	98	151	108	165	119	181	131	197	143	229	195	254	216	280	239	.522
30	133	93	145	102	159	112	175	124	191	136	221	185	246	206	271	227	.559
31	129	88	141	97	154	106	169	116	185	128	214	176	238	196	262	216	.596
32	125	83	136	91	150	100	164	110	179	121	208	167	231	187	254	205	.636
33	121	78	132	86	145	95	159	104	173	114	201	160	224	178	246	196	.676
34	117	74	128	81	141	90	154	99	168	109	195	152	217	170	239	188	.718
35	114	70	125	77	137	85	150	93	163	103	190	145	211	162	232	179	.760
36	111	..	121	..	133	..	145	..	159	..	184	139	205	155	225	171	.804
38	105	..	115	..	126	..	138	..	151	..	175	127	194	141	214	156	.896
40	100	..	109	..	120	..	131	..	143	..	166	116	184	130	203	143	.993
42	95	..	104	..	114	..	125	..	136	..	158	107	176	119	193	131	1.10
44	91	..	99	..	109	..	119	..	130	..	151	98	168	109	184	121	1.20
46	87	..	95	..	104	..	114	..	124	..	144	90	160	101	176	111	1.31
48	83	..	91	..	100	..	109	..	119	..	138	..	154	..	169	..	1.43
50	80	..	87	..	96	..	105	..	114	..	133	..	148	..	162	..	1.55
52	77	..	84	..	92	..	101	..	110	..	128	..	142	..	156	..	1.68

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Additional section rolled—30″-240, see page 6.
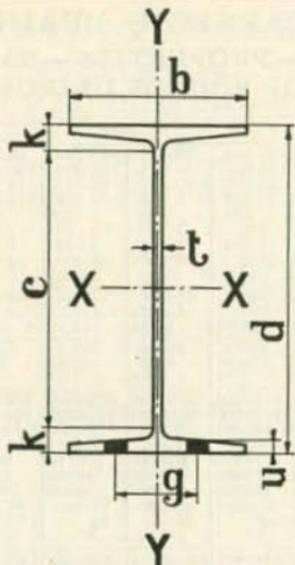
BETHLEHEM BEAMS

Indicated dimensions for various sizes of Bethlehem beams are shown in the following tables of their safe loads.

SYMBOLS

I —Moment of Inertia
S —Section Modulus
r —Radius of Gyration
V —Maximum Web Shear in Pounds
P —Minimum Span in feet, uniformly loaded to cause **V**
R —Allowable End Reaction for 3½" bearing
B —Unit Stress in Buckling
W—Maximum Load on one Standard Connection
Q —Minimum Span in feet, uniformly loaded to cause **W**
w —Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.

Allowable concentrated center loads are 50% and their deflections 80% of those shown.

Refer to safe load tables for the computed figures on the above items.

UNIT STRESS IN BUCKLING

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	8"			9"			10"		
Depth = d"	8.00	8.06		9.00	9.06		9.90	10.00	
Wt. per foot	17.5	19.0		20.5	22.0		21.0	23.5	
Area. Sq. In.	5.20	5.68		6.09	6.51		6.28	6.96	
b"	5.250	5.270		5.500	5.510		5.740	5.750	
t	.250	.270		.250	.260		.240	.250	
k	¾	¾	For Detailed Cut See Page 42	¾	¾	For Detailed Cut See Page 42	¾	¾	For Detailed Cut See Page 42
c	6⅜	6⅝		7½	7½		8⅜	8⅜	
g	2¼	2¾		2½	2½		2¾	2¾	
u	11/16	⅞		11/16	11/16		11/16	11/16	
AXES X-X I	57.7	63.7		86.5	93.9		108.1	123.2	
S	14.43	15.81		19.22	20.73		21.84	24.64	
r	3.33	3.35		3.77	3.80		4.15	4.21	
Y-Y I	6.39	7.20		8.54	9.42		9.30	10.9	
S	2.44	2.73		3.10	3.42		3.24	3.80	
r	1.11	1.13		1.18	1.20		1.22	1.25	
Coef. Str.	173100	189700		230700	248700		262100	295700	
Max.Mom."#	259700	284500		346000	373100		393100	443500	
V	24000	26100		27000	28300		28500	30000	
P. feet	3.61	3.63	Deflection	4.27	4.39	Deflection	4.60	4.93	Deflection
R	20600	22300		21300	22400		20200	21300	
B	15000	15000		14800	15000		14030	14210	
W	22500	23900		22500	23400		21600	22500	
Q. feet	3.85	3.97		5.13	5.31		6.07	6.57	
w. lbs	13	13		13	13		13	13	
Rivet dia	¾	¾		¾	¾		¾	¾	

Span feet	Laterally fixed	free	Laterally fixed	free	Defl.	Laterally fixed	free	Laterally fixed	free	Defl.	Laterally fixed	free	Laterally fixed	free	Defl.
3	48.0	48.0	52.2	52.2		54.0	54.0	56.6	56.6		57.0	57.0	60.0	60.0	
4	43.3	43.3	47.4	47.4	.037	54.0	54.0	56.6	56.6	.052	57.0	57.0	60.0	60.0	.047
5	34.6	34.6	38.0	38.0	.058	46.1	46.1	49.7	49.7		52.4	52.4	59.1	59.1	
6	28.9	28.9	31.6	31.6	.084	38.5	38.5	41.5	41.5	.074	43.7	43.7	49.3	49.3	.067
7	24.7	24.3	27.1	26.7	.114	33.0	32.8	35.5	35.4	.101	37.5	37.5	42.2	42.2	.091
8	21.6	20.6	23.7	22.6	.149	28.8	27.7	31.1	30.0	.132	32.8	32.0	37.0	36.1	.119
9	19.2	17.6	21.1	19.4	.189	25.6	23.9	27.6	25.7	.168	29.1	27.5	32.9	31.1	.151
10	17.3	15.2	19.0	16.8	.233	23.1	20.7	24.9	22.4	.207	26.2	23.9	29.6	27.0	.186
11	15.7	13.3	17.2	14.6	.281	21.0	18.1	22.6	19.5	.250	23.8	20.9	26.9	23.6	.225
12	14.4	11.6	15.8	12.8	.335	19.2	15.9	20.7	17.2	.298	21.9	18.5	24.6	20.8	.268
13	13.3	10.3	14.6	11.3	.394	17.7	14.0	19.1	15.2	.350	20.2	16.4	22.7	18.4	.315
14	12.4	9.1	13.6	10.0	.456	16.5	12.5	17.8	13.5	.406	18.7	14.5	21.1	16.4	.365
15	11.5	8.0	12.6	8.8	.524	15.4	11.1	16.6	12.0	.466	17.5	13.0	19.7	14.7	.419
16	10.8	7.2	11.9	8.0	.596	14.4	9.9	15.5	10.7	.530	16.4	11.7	18.5	13.2	.477
17	10.2	6.5	11.2	7.1	.674	13.6	9.0	14.6	9.6	.599	15.4	10.5	17.4	11.9	.539
18	..	..	..	..		12.8	8.0	13.8	8.7	.670	14.6	9.5	16.4	10.7	.603
19	..	..	..	..		12.1	..	13.1	..	.747	13.8	8.6	15.6	9.7	.672
20	..	..	..	..		..	..	..	..		13.1	..	14.8	..	.745
21	..	..	..	..		..	..	..	..		12.5	..	14.1	..	.821

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Additional sections rolled—10"-26, 10"-28.5, see page 6.

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	12"					14"			
Depth = d"	11.88	12.00	12.12	12.25		13.88	14.00	14.12	
Wt. per foot.	25.0	28.0	31.5	36.0		30.0	33.0	37.5	
Area. Sq. In.	7.44	8.28	9.36	10.58		8.89	9.70	11.07	
b"	6.495	6.500	6.525	6.555	For Detailed Cut See Page 42	6.750	6.750	6.790	For Detailed Cut See Page 42
t	.240	.245	.270	.300		.265	.265	.305	
k	⅜	⅝	⅜	1		¾	¾	⅞	
c	10¼	10¼	10¼	10¼		12½	12½	12½	
g	3"	3"	3"	3"		3½	3½	3½	
u	¾	⅜	½	⅜		11/16	11/16	½	
AXES X-X — I	185.1	213.6	245.7	281.8		294.9	334.3	383.7	
AXES X-X — S	31.16	35.60	40.54	46.01		42.49	47.76	54.35	
AXES X-X — r	4.99	5.08	5.12	5.16		5.76	5.87	5.89	
AXES Y-Y — I	13.6	16.4	19.4	22.7		16.9	19.9	23.4	
AXES Y-Y — S	4.19	5.04	5.93	6.93		4.99	5.90	6.91	
AXES Y-Y — r	1.35	1.41	1.44	1.46		1.38	1.43	1.46	
Coef. Str.	373900	427200	486500	552100	Deflection	509900	573100	652200	Deflection
Max. Mom."#	560800	640800	729800	828100		764900	859600	978300	
V.	34200	35300	39300	44100		44100	44500	51700	
P. feet	5.47	6.05	6.19	6.26		5.78	6.44	6.31	
R.	19900	20500	23800	27800		22900	22800	28300	
B.	12780	12860	13470	14090		12350	12290	13260	
W.	21600	22100	24300	27000		23900	23900	27500	
Q. feet	8.66	9.67	10.01	10.22		10.67	11.99	11.86	
w. lbs.	13	13	13	13		19	19	19	
Rivet dia.	¾	¾	¾	¾		¾	¾	¾	

Left margin (rotated): *Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.*

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
5	68	68	71	71	79	79	88	88		88.2	88.2	89.0	89.0	103	103	
6	62	62	71	71	79	79	88	88	.056	85.0	85.0	89.0	89.0	103	103	
7	53	53	61	61	70	70	79	79	.076	72.8	72.8	81.9	81.9	93.2	93.2	
8	47	47	53	53	61	61	69	69	.099	63.7	63.7	71.6	71.6	81.5	81.5	
9	42	41	47	46	54	53	61	60	.126	56.7	55.8	63.7	62.7	72.5	71.5	.108
10	37	35	43	41	49	47	55	52	.155	51.0	49.0	57.3	55.0	65.2	62.7	.133
11	34	31	39	36	44	41	50	46	.188	46.4	43.3	52.1	48.6	59.3	55.4	.161
12	31	28	36	32	41	37	46	41	.223	42.5	38.5	47.8	43.3	54.4	49.4	.192
13	29	25	33	28	37	32	42	36	.263	39.2	34.4	44.1	38.7	50.2	44.1	.225
14	27	22	31	26	35	29	39	33	.304	36.4	30.9	40.9	34.7	46.6	39.7	.261
15	25	20	28	22	32	26	37	30	.341	34.0	27.9	38.2	31.3	43.5	35.8	.299
16	23	18	27	21	30	23	35	27	.398	31.9	25.2	35.8	28.3	40.8	32.4	.341
17	22	16	25	19	29	22	32	24	.449	30.0	22.9	33.7	25.7	38.4	29.4	.384
18	21	15	24	17	27	19	31	22	.503	28.3	20.8	31.8	23.4	36.2	26.7	.431
19	20	14	22	15	26	18	29	20	.560	26.8	19.0	30.2	21.4	34.3	24.4	.480
20	19	13	21	14	24	16	28	19	.621	25.5	17.4	28.7	19.5	32.6	22.3	.532
21	18	11	20	13	23	15	26	17	.684	24.3	15.9	27.3	17.9	31.1	20.5	.587
22	17	..	19	..	22	..	25	..	.751	23.2	14.6	26.0	16.4	29.6	18.7	.644
23	16	..	19	..	21	..	24	..	.822	22.2	..	24.9	..	28.4	..	.704
24	16	..	18	..	20	..	23	..	.894	21.3	..	23.9	..	27.2	..	.766
25	15	..	17	..	19	..	22	..	.970	20.4	..	22.9	..	26.1	..	.831
26	..	..	..	..	..	..	..	..	..	19.6	..	22.0	..	25.1	..	.899
27	..	..	..	..	..	..	..	..	..	18.9	..	21.2	..	24.2	..	.969
28	..	..	..	..	..	..	..	..	..	18.2	..	20.5	..	23.3	..	1.043
29	..	..	..	..	..	..	..	..	..	17.6	..	19.8	..	22.5	..	1.119
30	..	..	..	..	..	..	..	..	..	17.0	..	19.1	..	21.7	..	1.197

Additional sections rolled—12"-40, 12"-44, 12"-48.5, 14"-42, see page 6.

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

15″

SYMBOLS								
Depth = d″	14.91	15.00	15.03	15.09	14.75	14.88	15.00	15.12
Wt. per foot.	36.0	38.5	40.0	42.5	46.0	50.5	54.5	59.5
Area, sq. in..	10.61	11.37	11.80	12.50	13.63	14.84	16.05	17.49
b″........	6.740	6.750	6.765	6.785	6.955	6.975	7.000	7.040
t.........	.280	.290	.305	.325	3.65	.385	.410	.450
k.........	1 5/16	1 3/8	1 5/16	1 3/8	1 3/8	1 1/4	1 3/8	1 5/8
c.........	12 5/8	12 3/8	12 5/8	12 7/8	12 5/8	12 5/8	12 5/8	12 3/4
g.........	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 1/4
u.........	1/2	11/16	3/4	11/16	3/4	9/16	3/4	9/16

For Detailed Cut See Page 12

AXES									
X-X	I....	410.9	447.6	463.3	492.0	508.2	563.3	617.0	676.2
	S....	55.12	59.68	61.65	65.21	68.91	75.71	82.27	89.44
	r....	6.22	6.27	6.27	6.27	6.11	6.16	6.20	6.22
Y-Y	I....	21.7	24.1	25.1	26.9	30.8	34.7	38.6	42.8
	S....	6.45	7.15	7.42	7.93	8.85	9.96	11.0	12.2
	r....	1.43	1.46	1.46	1.47	1.50	1.53	1.55	1.56

Coef. Str...	661400	716200	739800	782500	826900	908500	987200	1073300
Max. Mom. @″	992100	1074200	1109700	1173700	1240300	1362800	1480800	1610000
V........	50100	52200	55000	58900	64600	68700	73800	81700
P. feet...	6.60	6.86	6.73	6.64	6.40	6.61	6.69	6.57
R........	24800	26200	28400	31300	37400	40100	43800	48900
B........	12220	12460	12830	13290	14150	14360	14720	15000
W........	25200	26100	27500	29300	32900	34700	36900	40500
Q. feet...	13.12	13.72	13.45	13.35	12.57	13.09	13.38	13.25
w. lbs....	19	19	19	19	19	19	19	19
Rivet dia...	3/4	3/4	5/8	5/8	3/4	3/4	5/8	3/4

Deflection

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.
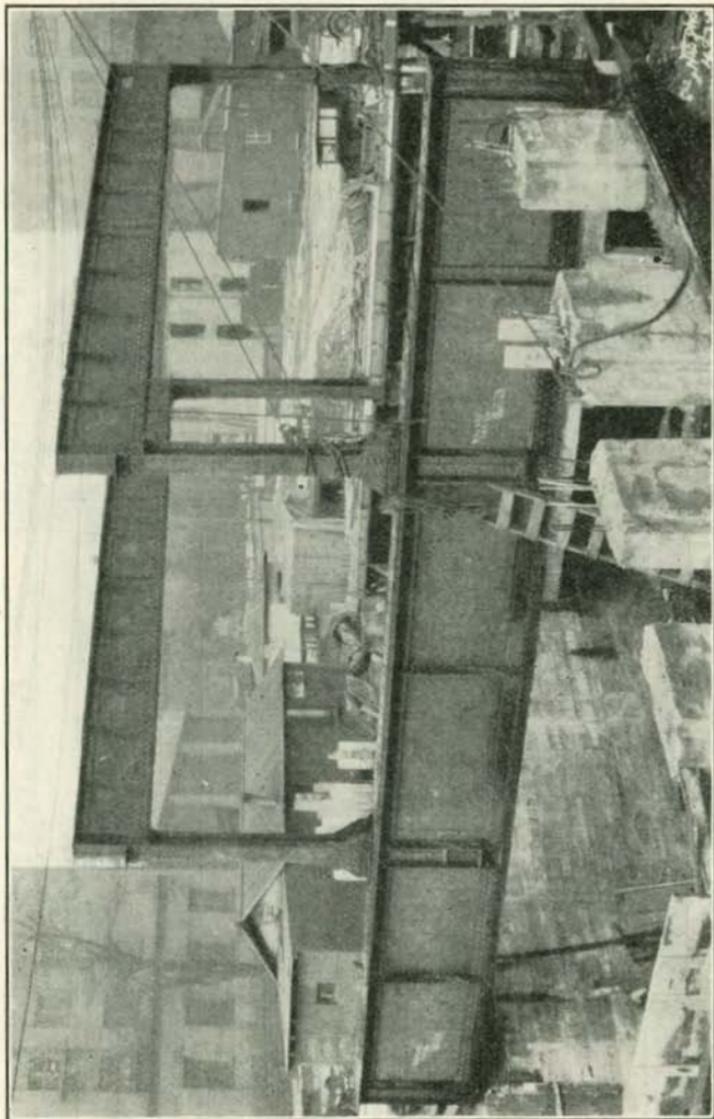
Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
4	100	100	104	104	110	110	118	118	129	129	137	137	148	148	163	163	
5	100	100	104	104	110	110	118	118	129	129	137	137	148	148	163	163	
6	100	100	104	104	110	110	118	118	129	129	137	137	148	148	163	163	
7	94	94	102	102	106	106	112	112	118	118	130	130	141	141	153	153	.061
8	83	83	90	90	92	92	98	98	103	103	114	114	123	123	134	134	.079
9	73	72	80	79	82	81	87	86	92	91	101	100	110	109	119	118	.101
10	66	63	72	69	74	71	78	75	83	80	91	88	99	96	107	104	.124
11	60	56	65	61	67	63	71	66	75	71	83	78	90	85	98	93	.150
12	55	50	60	54	62	56	65	59	69	63	76	70	82	75	89	82	.179
13	51	45	57	48	57	50	60	53	64	57	70	62	76	68	83	74	.210
14	47	40	51	43	53	45	56	48	59	51	65	56	71	61	77	67	.243
15	44	36	48	39	49	40	52	43	55	46	61	51	66	55	72	60	.279
16	41	32	45	36	46	36	49	39	52	42	57	46	62	50	67	54	.318
17	39	30	42	32	43	33	46	35	49	38	53	41	58	45	63	49	.359
18	37	27	40	29	41	30	43	32	46	34	50	38	55	41	60	45	.402
19	35	25	38	27	39	28	41	29	44	32	48	35	52	38	56	41	.448
20	33	22	36	24	37	25	39	27	41	29	45	31	49	34	54	38	.497
21	32	21	34	22	35	23	37	24	39	26	43	29	47	32	51	35	.547
22	30	19	33	21	34	21	36	23	38	25	41	27	45	29	49	32	.601
23	29	..	31	..	32	..	34	..	36	22	39	24	43	27	47	30	.651
24	28	..	30	..	31	..	33	..	35	..	38	..	41	..	45	..	.715
25	27	..	29	..	30	..	31	..	33	..	36	..	40	..	43	..	.776
26	25	..	28	..	28	..	30	..	32	..	35	..	38	..	41	..	.839
27	25	..	27	..	27	..	29	..	31	..	34	..	37	..	40	..	.905
28	24	..	26	..	26	..	28	..	30	..	32	..	35	..	38	..	.973
29	23	..	25	..	25	..	27	..	29	..	31	..	34	..	37	..	1.040
30	22	..	24	..	25	..	26	..	28	..	30	..	33	..	36	..	1.120

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	16″								
Depth = d″	15.81	16.00	16.12	16.25	15.88	16.00	16.12	16.25	
Wt. per foot.	35.0	40.0	45.0	50.0	56.5	60.5	66.0	71.5	
Area. Sq. In.	10.29	11.83	13.26	14.78	16.63	17.89	19.40	21.07	
b″	7.240	7.250	7.285	7.320	8.485	8.500	8.530	8.565	For Detailed Cut See Page 42
t	.285	.295	.330	.365	.375	.390	.420	.455	
k	²⁹⁄₃₂	1	1	1⅛	1¼	1⁵⁄₁₆	1⅜	1⁷⁄₁₆	
c	14	14	14	14	13¾	13½	13⅝	13⅜	
g	3¼	3¾	3¾	3¾	3¾	3¾	3¾	3¾	
u	1¹¹⁄₁₆	½	½	⁵⁄₁₆	⅝	¼	⁹⁄₁₆	⅞	
AXES X-X I	435.8	526.2	594.5	669.0	742.3	812.1	888.4	973.5	
S	55.13	65.78	73.76	82.34	93.49	101.51	110.22	119.82	
r	6.51	6.67	6.69	6.73	6.68	6.74	6.77	6.80	
AXES Y-Y I	21.4	27.6	31.9	36.6	57.8	64.3	71.2	79.0	
S	5.92	7.61	8.75	10.01	13.6	15.1	16.7	18.4	
r	1.44	1.53	1.55	1.57	1.86	1.90	1.92	1.94	
Coef. Str.	661500	789300	885100	988100	1121900	1218100	1322700	1437800	
Max.Mom.″#	992300	1184000	1327700	1482100	1682800	1827200	1984000	2156700	
V	54100	56600	63800	71200	71500	74900	81200	88700	Deflection
P. feet	6.11	6.97	6.94	6.94	7.85	8.13	8.14	8.11	
R	25400	26700	31900	37100	39000	41100	45500	50600	
B	11900	12080	12880	13530	13860	14060	14450	14840	
W	25700	25700	28800	32400	33800	35100	37800	41000	
Q. feet	12.87	15.36	15.37	15.25	16.60	17.35	17.50	17.53	
w. lbs	19	19	19	19	19	19	19	19	
Rivet dia	⅞	⅞	⅞	⅞	⅞	⅞	⅞	⅞	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
6	108	108	113	113	128	128	142	142	143	143	150	150	162	162	177	177	
7	95	95	113	113	126	126	141	141	143	143	150	150	162	162	177	177	
8	83	83	99	99	111	111	124	124	140	140	150	150	162	162	177	177	
9	74	74	88	88	98	98	110	110	125	125	135	135	147	147	160	160	
10	66	65	79	77	89	87	99	97	112	112	122	122	132	132	144	144	.116
11	60	57	72	69	81	77	90	86	102	101	111	110	120	119	131	130	.141
12	55	51	66	61	74	69	82	76	94	91	102	99	110	107	120	117	.168
13	51	46	61	55	68	61	76	69	86	82	94	89	102	97	111	106	.197
14	47	41	56	49	63	55	71	62	80	74	87	81	95	88	103	96	.228
15	44	37	53	45	59	50	66	56	75	68	81	74	88	80	96	87	.262
16	41	34	49	40	55	45	62	51	70	62	76	67	83	74	90	80	.298
17	39	31	46	37	52	42	58	46	66	57	72	62	78	67	85	74	.336
18	37	28	44	34	49	38	55	43	62	52	68	57	74	62	80	67	.377
19	35	26	42	31	47	35	52	39	59	48	64	52	70	57	76	62	.420
20	33	24	40	29	44	32	49	35	56	44	61	48	66	53	72	57	.466
21	32	22	38	26	42	29	47	33	53	41	58	45	63	49	69	54	.513
22	30	20	36	24	40	27	45	30	51	38	55	41	60	45	65	49	.563
23	29	19	34	22	38	25	43	28	49	36	53	39	58	42	63	46	.616
24	28	17	33	21	37	23	41	26	47	33	51	36	55	39	60	43	.670
25	27	..	32	..	35	..	40	..	45	31	49	34	53	36	58	40	.727
26	25	..	30	..	34	..	38	..	43	29	47	31	51	34	53	37	.787
27	25	..	29	..	33	..	37	..	42	27	45	29	49	32	53	34	.848
28	24	..	28	..	32	..	35	..	40	25	44	27	47	29	51	32	.912
29	23	..	27	..	31	..	34	..	39	..	42	..	46	..	50	..	.979
30	22	..	26	..	30	..	33	..	37	..	41	..	44	..	48	..	1.047

BETHLEHEM BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN
THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS — 18″

									For Detailed Cut See Page 42
Depth = d″	17.94	18.00	18.06	18.12	17.75	17.88	18.00	18.12	
Wt. per foot	47.0	49.0	52.0	54.5	59.0	64.5	69.0	74.0	
Area, Sq. In.	13.90	14.44	15.34	16.06	17.48	18.97	20.38	21.79	
b″	7.495	7.500	7.525	7.540	8.710	8.730	8.750	8.770	
t	.325	.330	.355	.370	.380	.400	.420	.440	
k	1⅛	1½	1½	1⅝	1¼	1⅜	1⅜	1⅝	
c	15¾	15¾	15¾	15¾	15¼	15¼	15¼	15¼	
g	3¾	3¾	3¾	3¾	4″	4″	4″	4″	
u	⅞	⅞	⅞	⅞	⅝	⅝	⅝	⅝	

AXES

X–X I	764.1	802.8	851.7	896.1	960.3	1059.7	1153.7	1249.2	
X–X S	85.18	89.20	94.32	98.91	108.20	118.53	128.19	137.88	
X–X r	7.42	7.46	7.45	7.47	7.41	7.47	7.53	7.57	
Y–Y I	34.0	36.1	38.7	41.1	60.7	68.4	75.6	82.9	
Y–Y S	9.06	9.64	10.3	10.9	13.9	15.7	17.3	18.9	
Y–Y r	1.56	1.58	1.59	1.60	1.86	1.90	1.93	1.95	

									Deflection
Coef. Str	1022200	1070400	1131800	1186900	1298400	1422400	1538300	1654600	
Max.Mom."#	1533300	1605600	1697700	1780300	1947600	2133600	2307400	2481800	
V	70000	71300	76900	80500	80900	85800	90700	95700	
P. feet	7.30	7.51	7.36	7.37	8.02	8.29	8.48	8.64	
R	31000	31500	35800	38200	40200	43100	46390	49500	
B	11940	12630	12600	12910	13200	13460	13780	14080	
W	36600	37100	39900	41600	42800	45000	47300	49500	
Q. feet	13.96	14.43	14.18	14.27	15.17	15.80	16.26	16.71	
w. lbs	25	25	25	25	25	25	25	25	
Rivet dia	¾	¾	¾	¾	¾	¾	¾	¾	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
6	140	140	143	143	154	154	161	161	162	162	172	172	181	181	191	191	
7	140	140	143	143	154	154	161	161	162	162	172	172	181	181	191	191	
8	128	128	134	134	141	141	148	148	162	162	172	172	181	181	191	191	
9	114	114	119	119	126	126	132	132	144	144	158	158	171	171	184	184	.084
10	102	100	107	105	113	111	119	117	130	130	142	142	154	154	165	165	.103
11	93	89	97	93	103	99	108	104	118	118	129	129	140	140	150	150	.125
12	85	80	89	83	94	88	99	93	108	106	119	116	128	125	138	135	.149
13	79	72	82	75	87	80	91	83	100	96	109	104	118	113	127	122	.175
14	73	65	76	68	81	72	85	76	93	87	102	96	110	103	118	111	.203
15	68	59	71	61	75	65	79	68	87	80	95	87	103	94	110	101	.233
16	64	54	67	56	71	60	74	62	81	72	89	80	96	86	103	92	.265
17	60	49	63	51	67	54	70	57	76	66	84	73	90	79	97	85	.299
18	57	45	59	46	63	50	66	52	72	61	79	67	85	72	92	78	.335
19	54	41	56	43	60	46	62	47	68	56	75	62	81	67	87	72	.373
20	51	37	54	40	57	42	59	44	65	52	71	57	77	62	83	67	.414
21	49	35	51	36	54	38	57	41	62	47	68	53	73	57	79	62	.456
22	47	32	49	34	51	35	54	37	59	45	65	50	70	53	75	57	.501
23	44	29	47	31	49	33	52	35	56	41	62	46	67	50	72	53	.548
24	43	28	45	29	47	30	49	31	54	39	59	42	64	46	69	50	.596
25	41	..	43	27	45	28	47	29	52	36	57	40	62	43	66	46	.647
26	39	..	41	..	44	..	46	..	50	34	55	37	59	40	64	44	.699
27	38	..	40	..	42	..	44	..	48	32	53	35	57	38	61	40	.754
28	37	..	38	..	40	..	42	..	46	29	51	33	55	35	59	38	.811
29	35	..	37	..	39	..	41	..	45	28	49	30	53	33	57	35	.870
30	34	..	36	..	38	..	40	..	43	..	47	..	51	..	55	..	.931
31	33	..	35	..	37	..	38	..	42	..	46	..	50	..	53	..	.994
32	32	..	33	..	35	..	37	..	41	..	44	..	48	..	52	..	1.06
33	31	..	32	..	34	..	36	..	39	..	43	..	47	..	50	..	1.13
34	30	..	31	..	33	..	35	..	38	..	42	..	45	..	49	..	1.20
35	29	..	31	..	32	..	34	..	37	..	41	..	44	..	47	..	1.27

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

20″

Symbols								
Depth = d″	19.88	20.00	20.06	20.12	19.88	20.00	20.09	
Wt. per foot	56.0	59.5	62.0	64.5	68.5	73.0	78.0	
Area, Sq. In.	16.51	17.47	18.25	18.93	20.12	21.58	22.98	
b″	8.000	8.000	8.015	8.025	8.855	8.875	8.905	
t	.375	.375	.390	.400	.410	.430	.460	For Detailed cut See Page 42
k	1½	1⅜	1¼	1¼	1⅜	1⅜	1½	
c	17⅝	17⅝	17⅜	17⅝	17⅛	17⅛	17⅛	
g	4″	4″	4″	4″	4″	4″	4″	
u	¹¹⁄₁₆	¹¹⁄₁₆	¹³⁄₁₆	¹³⁄₁₆	¹¹⁄₁₆	¹¹⁄₁₆	¹³⁄₁₆	
AXES X-X I	1086.1	1181.5	1239.8	1295.1	1366.0	1485.0	1585.5	
S	109.27	118.15	123.61	128.74	137.42	148.50	157.84	
r	8.11	8.22	8.24	8.27	8.24	8.30	8.31	
Y-Y I	43.5	48.6	51.5	54.3	71.0	78.5	84.7	
S	10.9	12.2	12.9	13.5	16.0	17.7	19.0	
r	1.62	1.67	1.68	1.69	1.88	1.91	1.92	
Coef. Str	1311200	1417800	1483300	1544800	1649100	1782000	1894100	
Max.Mom.″#	1966800	2126700	2225000	2317300	2473600	2673000	2841100	
V	89500	90000	93900	96600	97800	103200	110900	
P. feet	7.33	7.88	7.90	8.00	8.43	8.63	8.54	Deflection
R	39100	38900	41500	43200	45100	48400	53500	
B	12260	12210	12520	12710	12930	13230	13690	
W	42200	42200	43900	45000	46200	48400	51800	
Q. feet	15.54	16.80	16.89	17.17	17.85	18.41	18.28	
w. lbs	25	25	25	25	25	25	25	
Rivet dia	⅞	⅞	⅞	⅞	⅞	⅞	⅞	

Allowable Uniform Load as fixed by shear or flexure, whichever is least. For laterally fixed beam loads is not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		
	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	
6	179	179	180	180	188	188	193	193	196	196	206	206	222	222	
8	164	164	177	177	185	185	193	193	196	196	206	206	222	222	
10	131	131	142	142	148	148	154	154	165	165	178	178	189	189	.093
11	119	116	129	126	135	132	140	137	150	150	162	162	172	172	.113
12	109	104	118	113	124	119	129	124	137	134	149	146	158	155	.134
13	101	94	109	102	114	106	119	111	127	122	137	132	146	141	.158
14	94	86	101	92	106	97	110	100	118	111	127	120	135	127	.183
15	87	77	95	84	99	88	103	91	110	101	119	110	126	116	.210
16	82	71	89	77	93	80	97	84	103	93	111	100	118	106	.239
17	77	65	83	70	87	73	91	79	97	85	105	92	111	98	.270
18	73	59	79	64	82	67	86	70	92	79	99	85	105	90	.302
19	69	55	75	59	78	62	81	64	87	73	94	79	100	84	.336
20	66	51	71	54	74	57	77	59	83	67	89	72	95	78	.373
21	62	46	68	50	71	53	74	55	79	62	85	67	90	71	.411
22	60	43	64	46	67	48	70	50	75	58	81	62	86	66	.451
23	57	40	62	43	64	45	67	47	72	54	77	58	82	62	.493
24	55	37	59	40	62	42	64	43	69	50	74	54	79	58	.537
25	52	34	57	37	59	39	62	41	66	47	71	50	76	54	.582
26	50	32	55	35	57	36	59	37	63	43	69	47	73	50	.630
27	49	..	53	..	55	..	57	..	61	41	66	44	70	47	.679
28	47	..	51	..	53	..	55	..	59	38	64	41	68	44	.736
29	45	..	49	..	51	..	53	..	57	36	61	38	65	41	.783
30	44	..	47	..	49	..	51	..	55	..	59	..	63	..	.838
31	42	..	46	..	48	..	50	..	53	..	57	..	61	..	.895
32	41	..	44	..	46	..	48	..	52	..	56	..	59	..	.954
33	40	..	43	..	45	..	47	..	50	..	54	..	57	..	1.01
34	39	..	42	..	44	..	45	..	49	..	52	..	56	..	1.08
35	38	..	41	..	42	..	44	..	47	..	51	..	54	..	1.14
36	36	..	39	..	41	..	43	..	46	..	50	..	53	..	1.21
37	35	..	38	..	40	..	42	..	45	..	48	..	51	..	1.28

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

22″

SYMBOLS									
Depth = d″	21.88	22.00	22.12	22.25	21.88	22.00	22.12	22.25	For Detailed Cut See Page 42
Wt. per foot.	58.0	62.5	67.5	73.0	77.0	83.0	89.0	96.5	
Area, Sq. In.	17.14	18.38	19.84	21.51	22.74	24.51	26.28	28.38	
b″........	8.490	8.500	8.520	8.545	9.220	9.250	9.280	9.320	
t........	.360	.370	.390	.415	.425	.455	.485	.525	
k........	1⅜	1¼	1⅜	1⅞₆	1⅞₆	1⅛	1⅜	1⅝	
c........	19½	19½	19½	19½	19	19	19	19	
g........	4″	4″	4″	4″	4″	4″	4″	4″	
u........	¾	⅝	⅝	¾	11/16	11/16	11/16	11/16	

AXES									
X-X I....	1363.9	1495.4	1637.5	1796.7	1866.7	2026.5	2188.6	2373.7	
X-X S....	124.67	135.95	148.06	161.50	170.63	184.23	197.88	213.37	
X-X r....	8.92	9.02	9.08	9.14	9.06	9.09	9.13	9.15	
Y-Y I....	48.9	55.2	61.8	69.1	87.0	95.8	104.8	115.1	
Y-Y S....	11.5	13.0	14.5	16.2	18.9	20.7	22.6	24.7	
Y-Y r....	1.69	1.73	1.76	1.96	1.96	1.96	2.00	2.01	

Coef. Str....	1496000	1631300	1776700	1938000	2047600	2210700	2374600	2560400	
Max.Mom.″#	2244100	2447000	2665000	2907000	3071300	3316100	3561900	3840600	Deflection
V........	94500	97700	103500	110800	111600	120100	128700	140200	
P. feet...	7.92	8.35	8.58	8.75	9.17	9.20	9.23	9.13	
R........	36000	37700	41300	45800	47700	53000	58400	65400	
B........	11140	11330	11720	12170	12480	12950	13370	13850	
W........	48600	49980	52680	56060	57400	61400	65500	70900	
Q. feet..	15.39	16.32	16.86	17.29	17.84	18.00	18.13	18.96	
w. lbs...	30	30	30	30	30	30	30	30	
Rivet dia..	⅞	⅞	⅞	⅞	⅞	⅞	⅞	⅞	

Span feet	Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		Laterally		
	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	fix'd	free	
6	189	189	195	195	207	207	222	222	223	223	240	240	257	257	280	280	
8	187	187	195	195	207	207	222	222	223	223	240	240	257	257	280	280	
10	150	150	163	163	178	178	194	194	205	205	221	221	237	237	256	256	.085
12	125	121	136	132	148	144	162	158	171	169	184	182	198	196	213	211	.122
14	107	99	117	109	127	118	138	128	146	139	158	151	170	162	183	175	.166
16	94	83	102	90	111	98	121	107	128	117	138	126	148	135	160	147	.217
18	83	70	91	76	99	83	108	91	114	99	123	107	132	115	142	124	.274
20	75	60	82	65	89	71	97	77	102	85	111	92	119	99	128	107	.339
21	71	55	78	60	85	66	92	71	98	79	105	85	113	92	122	99	.373
22	68	51	74	55	81	61	88	66	93	73	101	80	108	86	116	92	.410
23	65	47	71	52	77	56	84	61	89	68	96	74	103	79	111	86	.448
24	62	44	68	48	74	52	81	57	85	64	92	69	99	74	107	80	.488
25	60	41	65	44	71	49	78	54	82	60	88	64	95	69	102	75	.529
26	58	39	63	42	68	45	75	50	79	56	85	60	91	65	99	70	.572
27	55	35	60	39	66	43	72	47	76	52	82	56	88	61	95	66	.617
28	53	33	58	36	63	39	69	43	73	49	79	53	85	57	91	61	.664
29	52	..	56	..	61	..	67	..	71	46	76	49	82	53	88	58	.712
30	50	..	54	..	59	..	65	..	68	43	74	47	79	50	85	54	.762
31	48	..	53	..	57	..	63	..	66	..	71	..	77	..	83	51	.813
32	47	..	51	..	56	..	61	..	64	..	69	..	74	..	80	..	.867
33	45	..	49	..	54	..	59	..	62	..	67	..	72	..	78	..	.927
34	44	..	48	..	52	..	57	..	60	..	65	..	70	..	75	..	.979
35	43	..	47	..	51	..	55	..	59	..	63	..	68	..	73	..	1.04
36	42	..	45	..	49	..	54	..	57	..	61	..	66	..	71	..	1.10
38	39	..	43	..	47	..	51	..	54	..	58	..	63	..	67	..	1.22
40	37	..	41	..	44	..	48	..	51	..	55	..	59	..	64	..	1.35
42	36	..	39	..	42	..	46	..	49	..	53	..	57	..	61	..	1.49
44	34	..	37	..	40	..	44	..	..	..	..	..	..	..	..	..	1.64
46	33	..	35	..	39	..	42	..	..	..	..	..	..	..	..	..	1.79

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

ST. PAUL FOUNDRY CO.

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	21″							
Depth = d″	23.88	24.00	24.09	24.00	24.12	23.91	24.00	24.09
Wt. per foot.	70.0	73.5	79.5	84.5	90.5	95.5	99.5	104.5
Area, Sq. In.	20.62	21.70	23.35	24.97	26.47	28.05	29.40	30.88
b″	9.000	9.000	9.035	9.500	9.515	9.730	9.750	9.775
t	.395	.395	.430	.460	.475	.505	.525	.550
k	1¼	1⅝	1⅝	1⅝	1½	1¾	1⅝	1⅝
c	21⅜	21⅜	21⅜	21⅛	21¼	20¾	20¾	20¾
g	4″	4″	4″	4″	4″	5½	5½	5½
u	11/16	11/16	11/16	11/16	11/16	11/16	11/16	11/16
X-X I	1954.1	2108.8	2266.7	2405.7	2588.2	2692.7	2841.3	2997.3
S	163.66	175.73	188.19	200.48	214.61	225.24	236.78	248.84
r	9.74	9.86	9.85	9.82	9.89	9.80	9.83	9.85
Y-Y I	67.4	74.7	81.2	95.8	104.9	117.1	124.9	132.9
S	15.0	16.6	18.0	20.2	22.1	24.1	25.6	27.2
r	1.81	1.86	1.87	1.96	1.99	2.04	2.06	2.07
Coef. Str.	1963900	2108800	2258200	2405700	2575300	2702800	2841300	2986100
Max.Mom.″#	2945900	3163200	3387300	3608600	3863000	4054200	4262000	4479100
V	113200	113800	124300	132500	137500	144900	151200	159000
P. feet	8.67	9.27	9.08	9.08	9.36	9.33	9.40	9.39
R	42000	41800	48400	54100	56800	62700	66600	71400
B	11190	11150	11850	12380	12590	13080	13350	13660
W	53300	53300	58100	62100	64100	68200	70900	71600
Q. feet	18.42	19.78	19.43	19.37	20.09	19.82	20.04	20.85
w. lbs	30	30	30	30	30	30	30	30
Rivet dia	¾	¾	¾	¾	¾	¾	¾	¾

Vertical label (left margin): Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Vertical label (right margin): Deflection

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
6	226	226	228	228	249	249	265	265	275	275	290	290	302	302	318	318	
8	226	226	228	228	249	249	265	265	275	275	290	290	302	302	318	318	
10	196	196	211	211	226	226	241	241	258	258	270	270	284	284	299	299	.078
12	164	162	176	173	188	185	201	200	215	214	225	225	237	237	249	249	.112
14	140	132	151	143	161	152	172	165	184	177	193	187	203	197	213	206	.152
16	123	111	132	120	141	128	150	138	161	149	169	157	178	166	187	174	.199
18	109	94	117	101	125	108	134	118	143	126	150	134	158	141	166	148	.251
20	98	80	105	86	113	93	120	101	129	109	135	115	142	121	149	127	.310
21	94	75	100	80	108	86	114	94	123	101	129	107	135	113	142	118	.342
22	89	69	96	75	103	80	109	87	117	94	123	100	129	105	136	111	.375
23	85	64	92	69	98	74	105	82	112	88	117	93	124	98	130	103	.411
24	82	60	88	65	94	69	100	76	107	82	113	87	118	91	124	96	.447
25	79	56	84	60	90	64	96	71	103	76	108	81	114	86	119	90	.485
26	76	53	81	56	87	61	93	67	99	72	104	76	109	80	115	85	.525
27	73	49	78	53	84	57	89	63	95	67	100	71	105	75	111	80	.566
28	70	46	75	49	81	53	86	59	92	63	97	68	101	70	107	75	.608
29	68	43	73	46	78	50	83	55	89	59	93	63	98	67	103	70	.653
30	66	41	70	43	75	47	80	52	86	56	90	59	95	63	100	66	.698
31	63	..	68	..	73	..	78	49	83	52	87	56	92	59	96	62	.746
32	61	..	66	..	71	..	75	..	81	..	84	52	89	56	93	58	.795
33	60	..	64	..	68	..	73	..	78	..	82	..	86	..	90	..	.845
34	58	..	62	..	66	..	71	..	76	..	79	..	84	..	88	..	.897
35	56	..	60	..	65	..	69	..	74	..	77	..	81	..	85	..	.950
36	55	..	59	..	63	..	67	..	72	..	75	..	79	..	83	..	1.01
38	52	..	55	..	59	..	63	..	68	..	71	..	75	..	79	..	1.12
40	49	..	53	..	56	..	60	..	64	..	68	..	71	..	75	..	1.24
42	47	..	50	..	54	..	57	..	61	..	64	..	68	..	71	..	1.37
44	45	..	48	..	51	..	55	..	59	..	61	..	65	..	68	..	1.50
46	43	..	46	..	49	..	52	..	56	..	59	..	62	..	65	..	1.64
48	41	..	44	..	47	..	50	..	54	..	56	..	59	..	62	..	1.79

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	26"			28"			
Depth = d"	25.78	25.88	26.00	27.88	28.00	28.12	28.25
Wt. per foot	81.0	85.5	91.0	91.0	97.0	104.0	112.0
Area, Sq. In.	23.00	25.11	26.76	26.86	28.61	30.66	32.95
b"	9.470	9.480	9.500	9.980	10.000	10.030	10.065
t	.440	.450	.470	.450	.470	.500	.535
k	1⅝	1⅞	1½	1½	1⅝	1¾	1⅞
c	23	23	23	24⅞	24⅞	24⅞	24⅞
g	5½	5¼	⅝	5½	5½	5½	5½
u	⅝	⅝	¾	¾	¾	¾	¾
X-X I	2600.1	2772.5	2993.1	3441.1	3711.5	4003.3	4328.0
X-X S	201.71	214.26	230.24	246.85	265.11	284.73	306.41
X-X r	10.43	10.51	10.58	11.32	11.39	11.43	11.46
Y-Y I	84.3	91.7	100.9	106.7	117.4	128.7	141.2
Y-Y S	17.8	19.3	21.2	21.4	23.5	25.7	28.1
Y-Y r	1.88	1.91	1.94	1.99	2.03	2.05	2.07
Coef. Str	2420600	2571100	2762900	2962200	3181300	3416700	3676900
Max.Mom."#	3630900	3856600	4144300	4443300	4771900	5125100	5515300
V	136100	139700	146600	150600	157900	168700	181400
P. feet	8.89	9.20	9.42	9.83	10.07	10.13	10.13
R	50400	52100	56000	51700	55900	62100	69500
B	11450	11570	11920	10980	11310	11790	12290
W	69300	70900	74000	81000	84600	90000	95400
Q. feet	17.46	18.13	18.67	18.29	18.80	18.98	19.27
w. lbs	35	35	35	40	40	40	40
Rivet dia	1"	1"	1"	1"	1"	1"	1"

For Detailed Cut See Page 42. — Deflection.

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	26" Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Defl.	28" Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Defl.
10	242	242	257	257	276	276	.072	296	296	316	316	337	337	363	363	.066
12	202	201	214	213	230	229	.103	247	247	265	265	285	285	306	306	.096
14	173	166	184	177	197	189	.140	212	206	227	221	244	238	263	256	.123
16	151	139	161	148	173	160	.183	185	174	199	187	214	201	230	216	.170
18	135	119	143	126	153	135	.232	165	149	177	159	190	171	204	184	.215
20	121	102	129	109	138	116	.287	148	128	159	137	171	148	184	159	.266
21	115	94	122	100	132	109	.316	141	119	151	127	163	138	175	148	.293
22	110	88	117	94	126	101	.347	135	111	145	119	155	128	167	138	.322
23	105	82	112	87	120	94	.379	129	104	138	111	149	120	160	129	.352
24	101	77	107	81	115	88	.413	123	96	133	104	142	112	153	121	.383
25	97	72	103	76	110	82	.448	118	90	127	97	137	105	147	113	.416
26	93	67	99	71	106	77	.484	110	85	122	91	131	98	141	106	.450
27	90	63	95	67	102	72	.522	110	80	118	86	127	93	136	100	.485
28	87	59	92	63	99	68	.562	106	75	114	81	122	87	131	93	.521
29	84	56	89	59	95	63	.602	102	70	110	76	118	82	127	88	.559
30	81	52	86	55	92	59	.645	99	67	106	71	114	77	123	83	.599
31	78	49	83	52	89	56	.688	96	63	103	68	110	72	119	78	.639
32	76	..	80	..	86	..	.733	93	59	99	63	107	69	115	74	.681
33	73	..	78	..	84	..	.780	90	56	96	60	104	65	111	70	.724
34	71	..	76	..	81	..	.832	87	..	94	..	100	..	108	..	.769
35	69	..	74	..	79	..	.877	85	..	91	..	98	..	105	..	.815
36	67	..	72	..	77	..	.928	82	..	88	..	95	..	102	..	.862
38	64	..	68	..	73	..	1.03	78	..	84	..	90	..	97	..	.960
40	61	..	64	..	69	..	1.15	74	..	80	..	85	..	92	..	1.06
42	58	..	61	..	66	..	1.26	71	..	76	..	81	..	88	..	1.17
44	55	..	58	..	63	..	1.39	67	..	72	..	78	..	84	..	1.29
46	53	..	56	..	60	..	1.52	64	..	69	..	74	..	80	..	1.40
48	50	..	54	..	58	..	1.65	62	..	66	..	71	..	77	..	1.53
50	48	..	51	..	55	..	1.79	59	..	64	..	68	..	74	..	1.66

Additional sections rolled—26"-98.0, see page 6.

BETHLEHEM BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS		30"					33"		36"	
Depth = d"	29.78	29.88	30.00	30.12		32.88	33.00	35.88	36.0
Wt. per foot	110.0	115.0	121.0	129.0		125.0	135.0	147.0	155.0
Area. Sq. In.	32.45	33.80	35.65	37.82		36.88	39.55	43.24	45.58
b"	10.470	10.480	10.500	10.530		11.210	11.250	11.975	12.000
t.	.520	.530	.550	.580	For Detailed Out See Page 42	.540	.580	.590	.615
k.	1⅝	1⅝	1¾	1⅞		1⅝	1⅝	1¾	1⅞
c.	26½	26½	26½	26½		29.38	29	32.13	32.125
g.	5½	5½	5½	5½		7½	7½	7½	7½
u.	4¾			1"		⁵⁄₁₆	⅝	⅝	1"
AXES X-X I.	4687.7	4942.9	5269.7	5622.7		6482.7	6967.4	8986.2	9547.4
S.	314.82	330.85	351.31	373.35		394.3	422.3	500.9	530.4
r.	12.02	12.09	12.16	12.19		13.26	13.27	14.42	14.47
Y-Y I.	141.8	151.8	164.3	177.6		182.3	198.7	240.9	259.9
S.	27.1	29.0	31.3	33.7		32.5	35.3	40.2	43.3
r.	2.09	2.12	2.15	2.17		2.22	2.24	2.36	2.39
coef. Str.	3777900	3970200	4215800	4480200		4732000	5067000	6011000	6365000
Max.Mom."#	5666800	5955300	6323600	6720400		7097400	7601400	9016200	9540000
V.	185800	190000	198000	209700		213030	229680	254030	265680
P. feet	10.17	10.45	10.65	10.68	Deflection	11.08	11.03	11.83	11.97
R.	66600	68400	72800	79400		70500	79800	82000	88200
B.	11640	11740	12040	12450		11139	11704	11147	11473
W.	105300	107400	107400	107400		Conn	ections t	o be fig	ured
Q. feet	17.94	18.48	19.63	20.86					
w. lbs.	45	45	45	45					
Rivet dia.	1"	1"	1"	1"		1"	1"	1"	1"

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Span in feet. Coefficient of Strength of the Span in feet.

Span feet	Laterally		Laterally		Laterally		Laterally			Laterally		Laterally		Laterally		Laterally	
	fix'd	free	fix'd	free	fix'd	free	fix'd	free		fix'd	free	fix'd	free	fix'd	free	fix'd	free
12	315	315	331	331	351	351	373	373	.089	..	..	..	..	..	..	..	..
14	270	266	284	280	301	296	320	315	.122	..	..	..	..	..	..	..	..
16	236	225	248	236	263	250	280	267	.159	..	..	..	..	..	..	..	..
18	210	192	221	203	234	214	249	229	.201	..	..	..	..	..	..	..	..
20	189	166	198	174	211	186	224	198	.248	231	..	253	..	..	..	..	..
21	180	155	189	163	201	173	213	184	.274	225	..	241	..	275	..	300	..
22	172	145	180	152	192	162	204	172	.300	215	..	230	..	273	..	289	..
23	164	135	173	143	183	151	195	161	.329	206	..	220	..	261	..	277	..
24	157	127	165	133	176	142	187	151	.358	197	..	211	..	250	..	265	..
25	151	119	159	125	169	133	179	141	.388	189	..	203	..	240	..	255	..
26	145	112	153	118	162	125	172	133	.420	182	..	195	..	231	..	245	..
27	140	105	147	111	156	117	166	125	.452	175	..	188	..	223	..	236	..
28	135	99	142	104	151	111	160	118	.487	169	..	181	..	215	..	227	..
29	130	93	137	98	145	104	154	111	.522	163	..	175	..	207	..	219	..
30	126	88	132	92	141	99	149	104	.559	158	..	169	..	200	..	212	..
31	122	83	128	87	136	93	144	99	.596	153	..	163	..	194	..	205	..
32	118	78	124	83	132	88	140	93	.636	148	..	158	..	188	..	199	..
33	115	75	120	78	128	83	136	89	.676	143	..	153	..	182	..	193	..
34	111	70	117	74	124	78	132	84	.718	139	..	149	..	177	..	187	..
35	108	..	113	..	120	74	128	79	.760	135	..	145	..	172	..	182	..
36	105	..	110	..	117	..	124	..	.804	131	..	141	..	167	..	177	..
38	99	..	104	..	111	..	118	..	.896	124	..	133	..	158	..	167	..
40	95	..	99	..	105	..	112	..	.993	118	..	127	..	150	..	159	..
42	90	..	95	..	100	..	107	..	1.10	113	..	121	..	143	..	152	..
44	86	..	90	..	96	..	102	..	1.20	107	..	115	..	137	..	145	..
46	82	..	86	..	92	..	97	..	1.31	103	..	110	..	131	..	138	..
48	79	..	83	..	88	..	93	..	1.43	99	..	106	..	125	..	133	..
50	76	..	79	..	84	..	90	..	1.55	95	..	101	..	120	..	127	..
52	73	..	76	..	81	..	86	..	1.68	91	..	97	..	116	..	122	..
54	70	..	74	..	78	..	83	..	1.81	..	..	..	..	..	..	..	..

Additional sections rolled—33"-143, 33"-152, 36"-164, 36"-173, see page 6.

BETHLEHEM GIRDER BEAMS

Indicated dimensions for various sizes of Bethlehem girder beams are shown in the following tables of their safe loads.

SYMBOLS

I —Moment of Inertia
S —Section Modulus
r —Radius of Gyration
V —Maximum Web Shear in Pounds
P —Minimum Span in feet, uniformly loaded to cause V
R —Allowable End Reaction for $3\frac{1}{2}''$ bearing
B —Unit Stress in Buckling
W—Maximum Load on one Standard Connection
Q —Minimum Span in feet, uniformly loaded to cause W
w —Weight of one Standard Connection including Angles and Web Rivets

Rivet given is Maximum Diameter in flange.

Allowable concentrated center loads are 50% and their deflections 80% of those shown.

Refer to safe load tables for the computed figures on the above items.

UNIT STRESS IN BUCKLING

The beam web is treated as a column with fixed ends, having an effective length L of one-half the beam depth. The unit stress is determined by the A. I. S. C. column formula. The length of web resisting buckling is assumed as the actual bearing on the bracket or wall plate plus one-fourth the beam depth. This agrees with the results of numerous tests.

When the reaction from the load exceeds the allowable reaction R, the beam web must be stiffened or additional length of bearing provided; but in no case shall the reaction exceed the allowable shearing value V.

ST. PAUL FOUNDRY CO.

BETHLEHEM GIRDER BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	8"			(For Detailed Cut See Page 53)	9"			(For Detailed Cut See Page 53)
Depth = d"	7.88	8.00	8.12		8.94	9.00	9.12	
Wt. per foot.	29.5	33.0	36.5		36.0	38.5	43.5	
Area. Sq. In.	8.69	9.69	10.81		10.66	11.35	12.73	
b"	7.995	8.000	8.020		8.480	8.500	8.540	
t	.285	.290	.310		.290	.310	.350	
k	15/16	1	1 1/16		1 1/16	1 3/16	1 5/16	
c	6	6	6		6 7/8	6 7/8	6 7/8	
g	5 1/2	5 1/2	5 1/2		5 1/2	5 1/2	5 1/2	
u	11/16	11/16	11/16		11/16	11/16	9/16	
AXES x-x I	100.7	116.1	132.6		160.5	171.9	195.4	
S	25.56	29.03	32.66		35.91	38.20	42.85	
r	3.41	3.46	3.50		3.88	3.89	3.92	
y-y I	28.4	33.6	39.0		41.0	44.4	51.3	
S	7.10	8.39	9.72		9.67	10.4	12.0	
r	1.81	1.86	1.90		1.96	1.98	2.01	
Coef. Str.	306700	348300	391900		430900	458400	514200	
Max. Mom."#	460000	522500	587900		646300	687600	771300	
V	26900	27800	30200		31100	33500	38300	
P. feet	5.70	6.27	6.49		6.93	6.84	6.71	
R	23400	23900	25700		25000	26700	30200	
W	25650	26100	27920		26100	27900	31500	
Q. feet	5.98	6.67	7.02		8.26	8.22	8.16	
w. lbs	16	16	16		16	16	16	
Rivet dia	7/8	13/16	7/8		3/4	3/4	7/8	

Note: columns between the 8" and 9" groups (and at the far right) carry the rotated labels "For Detailed Cut See Page 53" and "Deflection".

Span feet	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	(Deflection)	Laterally fixed	free	Laterally fixed	free	Laterally fixed	free	(Deflection)
5	54	54	56	56	60	60		62	62	67	67	77	77	
6	51	51	56	56	60	60	.084	62	62	67	67	77	77	.101
7	44	44	50	50	56	56	.114	62	62	66	66	74	74	.132
8	38	38	44	44	49	49	.149	54	54	57	57	64	64	.168
9	34	34	39	39	44	44	.189	48	48	51	51	57	57	.207
10	31	31	35	35	39	39	.233	43	43	46	46	51	51	
11	28	27	32	31	36	35	.281	39	39	42	42	47	47	.250
12	26	25	29	28	33	32	.335	36	35	38	37	43	42	.298
13	24	22	27	25	30	28	.394	33	31	35	33	40	38	.350
14	22	20	25	23	28	26	.456	31	29	33	31	37	34	.406
15	20	18	23	20	26	23	.524	29	26	31	28	34	31	.466
16	19	16	22	19	24	21	.596	27	24	29	26	32	28	.530
17	18	15	20	17	23	19	.674	25	22	27	23	30	26	.599
18	17	14	19	15	22	18	.754	24	20	25	21	29	24	.670
19	16	13	18	14	21	16	.840	23	19	24	20	27	22	.747
20	15	11	17	13	20	15	.931	22	17	23	18	26	21	.828

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. B = 15000.

BETHLEHEM GIRDER BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	10″				12″				
Depth = d″	9.91	10.00	10.12		11.91	12.00	12.12	11.88	
Wt. per foot.	41.5	44.5	50.0		51.5	55.5	61.0	66.0	
Area. Sq. In.	12.23	13.14	14.62		15.21	16.35	17.92	19.32	
b″	8.990	9.000	9.040	For Detailed Cut See Page 53	9.980	10.000	10.030	10.230	For Detailed Cut See Page 53
t	.310	.320	.360		.360	.380	.410	.450	
k	1⅛	1⅛	1¾		1⅝	1¼	1⅝	1⅞	
c	7¾	7¾	7¾		9½	9½	9½	9	
g	5½	5½	5½		5½	5½	5½	5½	
u	½	⅝	⅝		⅝	⅝	⅝	11/16	
AXES X-X I	225.8	246.7	277.5		400.6	435.6	483.6	496.9	
AXES X-X S	45.57	49.34	54.84		67.27	72.60	79.80	83.65	
AXES X-X r	4.30	4.33	4.36		5.13	5.16	5.20	5.07	
AXES Y-Y I	52.6	58.2	66.4		76.9	84.9	95.9	108.3	
AXES Y-Y S	11.7	12.9	14.7		15.4	17.0	19.1	21.2	
AXES Y-Y r	2.07	2.10	2.13		2.25	2.28	2.31	2.37	
Coef. Str.	546800	592100	658100		807300	871200	957600	1003800	
Max.Mom.″#	820300	888100	987100	Deflection	1210900	1306800	1436400	1505800	Deflection
V	36900	38400	43700		51500	54700	59700	64100	
P. feet	7.41	7.71	7.84		7.84	7.96	8.02	7.83	
R	27900	28800	32400		35100	37100	40000	43900	
W	27900	28800	32400		48600	51300	55350	60750	
Q. feet	9.80	10.28	10.16		8.31	8.49	8.65	8.26	
w. lbs	16	16	16		24	24	24	24	
Rivet dia	⅞	⅞	¾		1″	1″	1″	1″	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
6	74	74	77	77	87	87		103	103	109	109	119	119	128	128	
7	74	74	77	77	87	87		103	103	109	109	119	119	128	128	
8	68	68	74	74	82	82	.119	101	101	109	109	119	119	126	126	
9	61	61	66	66	73	73	.151	90	90	97	97	106	106	112	112	.126
10	55	55	59	59	66	66	.186	81	81	87	87	96	96	100	100	.155
11	50	50	54	54	60	60	.225	73	73	79	79	87	87	91	91	.188
12	46	45	49	48	55	54	.268	67	67	73	73	80	80	84	84	.223
13	42	41	46	44	51	49	.315	62	61	67	66	74	73	77	77	.263
14	39	37	42	40	47	45	.365	58	56	62	60	68	66	72	71	.304
15	36	33	39	36	44	41	.419	54	52	58	55	64	61	67	64	.341
16	34	31	37	34	41	37	.477	50	47	54	51	60	56	63	59	.398
17	32	28	35	31	39	35	.539	48	44	51	47	56	52	59	55	.449
18	30	26	33	28	37	32	.603	45	41	48	43	53	48	56	51	.503
19	29	24	31	26	35	30	.672	43	38	46	41	50	44	53	47	.560
20	27	22	30	25	33	27	.745	40	35	44	38	48	41	50	44	.621
21	26	21	28	22	31	25	.821	38	32	41	35	46	39	48	41	.684
22	25	19	27	21	30	23	.901	37	30	40	33	44	36	46	38	.751
23	24	18	26	20	29	22	.986	35	28	38	31	44	34	44	36	.822
24	..	..	..	..	..	..	..	34	27	36	28	40	31	42	33	.894
25	..	..	..	..	..	..	..	32	24	35	27	38	29	40	31	.970

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet. B = 15000.

Additional sections rolled—12″-70.5, 12″-76.5, see page 6.

BETHLEHEM GIRDER BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS — 15"

SYMBOLS									
Depth = d"	14.82	14.88	15.00	15.12	14.80	14.88	15.00	15.12	For Detailed Cut See Page 53
Wt. per foot.	64.5	69.0	74.0	80.5	94.0	99.0	105.0	111.0	
Area. Sq. In.	19.09	20.18	21.76	23.66	27.66	29.00	30.80	32.75	
b"......	10.700	10.730	10.750	10.790	11.190	11.220	11.250	11.290	
t.......	.390	.420	.440	.480	.540	.570	.600	.640	
k.......	1⅝	1⅝	1⅞	1½	1¾	1¹³⁄₁₆	1⅞	1¹⁵⁄₁₆	
c.......	12⅛	12⅛	12⅛	12⅛	11¼	11¼	11¼	11¼	
g.......	7½	7½	7½	7½	7½	7½	7½	7½	
u.......	⅝	⅝	1¹¹⁄₁₆	1¹¹⁄₁₆	⅞	⅞	⅞	1"	

Properties

AXES		64.5	69.0	74.0	80.5	94.0	99.0	105.0	111.0	
X–X	I.....	771.6	815.3	892.7	977.4	1090.2	1147.7	1231.3	1319.3	
X–X	S.....	104.13	109.58	119.03	129.29	147.32	154.26	164.17	174.51	
X–X	r.....	6.36	6.36	6.40	6.43	6.28	6.29	6.32	6.35	
Y–Y	I.....	108.6	115.8	128.9	143.1	187.4	198.5	214.4	231.3	
Y–Y	S.....	20.3	21.6	24.0	26.5	33.5	35.4	38.1	41.0	
Y–Y	r.....	2.39	2.40	2.43	2.46	2.60	2.62	2.64	2.66	

	64.5	69.0	74.0	80.5	94.0	99.0	105.0	111.0	
Coef. Str....	1249500	1315000	1428300	1551400	1767900	1851100	1970100	2094100	Deflection
Max.Mom." #	1874300	1972500	2142500	2327100	2651800	2776700	2955100	3141200	
V..........	69400	75000	79200	87100	95900	101700	108000	116200	
P. feet...	9.00	8.77	9.02	8.91	9.22	9.10	9.12	9.01	
R..........	41000	45200	47900	52200	58700	62000	65300	69600	
B..........	14510	14850	15000	15000	15000	15000	15000	15000	
W..........	70200	75600	79200	86400	95440	95440	95440	95440	
Q. feet...	8.90	8.70	9.02	8.98	9.26	9.70	10.32	10.97	
w. lbs....	33	33	33	33	33	33	33	33	
Rivet dia....	1"	1"	1"	1"	1"	1"	1"	1"	

Safe Loads — Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
9	139	139	146	146	158	158	172	172	192	192	203	203	216	216	232	232	.101
10	125	125	132	132	143	143	155	155	177	177	185	185	197	197	209	209	.124
11	114	114	120	120	130	130	141	141	161	161	168	168	179	179	190	190	.150
12	104	104	110	110	119	119	129	129	147	147	154	154	164	164	175	175	.179
13	96	96	101	101	110	110	119	119	136	136	142	142	152	152	161	161	.210
14	89	88	94	93	102	101	111	110	126	126	132	132	141	141	150	150	.243
15	83	81	88	86	95	93	103	100	118	116	123	121	131	129	140	138	.279
16	78	75	82	79	89	85	97	93	111	107	116	112	123	119	131	127	.318
17	74	70	77	72	84	79	91	86	104	99	109	104	116	111	123	117	.359
18	69	64	73	67	79	73	86	80	98	92	103	96	109	102	116	109	.402
19	66	60	69	63	75	68	82	75	93	86	97	89	104	96	110	102	.448
20	63	56	66	59	71	63	78	70	88	80	93	84	99	90	105	95	.497
21	60	52	63	55	68	59	74	65	84	74	88	78	94	83	100	89	.547
22	57	49	60	51	65	55	71	61	80	70	84	73	90	78	95	83	.601
23	54	45	57	48	62	52	67	56	77	66	81	69	86	73	91	78	.651
24	52	42	55	45	60	49	65	53	74	62	77	64	82	69	87	73	.715
25	50	40	53	42	57	46	62	50	71	58	74	61	79	65	84	69	.776
26	48	37	51	40	55	43	60	47	68	54	71	57	76	61	81	65	.839
27	46	35	49	37	53	41	57	44	66	52	69	54	73	57	78	61	.905
28	45	33	47	35	51	38	55	41	63	48	66	51	70	54	75	58	.973
29	43	31	45	33	49	36	54	39	61	46	64	48	68	51	72	54	1.040
30	42	30	44	31	48	34	52	37	59	43	62	45	66	48	70	52	1.120
32	39	26	41	28	45	31	48	33	55	38	58	41	62	44	65	46	1.270
34	37	24	39	25	42	27	46	30	53	35	54	36	58	39	62	42	1.440
36	..	..	37	..	40	..	43	..	..	..	51	33	55	35	58	37	1.610

Additional sections rolled—15"-127, 15"-135, 15"-141, 15"-147, see page 6.

BETHLEHEM GIRDER BEAMS

DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	16"					18"			
Depth = d"	15.88	16.00	16.12	16.25	For Detailed Cut See Page 53	17.88	18.00	18.12	For Detailed Cut See Page 53
Wt. per foot.	74.5	81.0	87.0	94.0		80.0	86.0	92.0	
Area. Sq. In.	21.96	23.82	25.68	27.75		23.59	25.35	27.13	
b"	11.470	11.500	11.530	11.565		11.730	11.750	11.770	
t	.390	.420	.450	.485		.420	.440	.460	
k	1⅜	1⅜	1⅜	1⅜		1⅜	1⅜	1⅜	
c	12⅝	12⅝	12⅝	12⅝		14⅜	14⅜	14⅜	
g	7½	7½	7½	7½		7½	7½	7½	
u	⅝	⅝	¾	¾		⅝	⅝	¾	
AXES X-X I	1033.6	1131.3	1230.8	1341.4		1380.7	1503.6	1628.5	
X-X S	130.18	141.41	152.70	165.10		154.44	167.07	179.75	
X-X r	6.86	6.89	6.92	6.95		7.65	7.70	7.75	
Y-Y I	148.1	164.6	181.3	199.9		157.8	174.9	192.2	
Y-Y S	25.8	28.6	31.5	34.6		26.9	29.8	32.7	
Y-Y r	2.60	2.63	2.63	2.68		2.59	2.63	2.66	
Coef. Str.	1562100	1696900	1832400	1981100		1853300	2004800	2157000	
Max.Mom."#	2343200	2545400	2748700	2971700		2779900	3007200	3235400	
V	74300	80600	87000	94600	Deflection	90100	95000	100000	Deflection
P. feet	10.51	10.53	10.53	10.47		10.28	10.55	10.79	
R	41300	45700	50000	54600		46200	49500	52800	
B	14100	14490	14830	15000		13820	14070	14300	
W	70200	75600	81000	87300		94500	99000	103500	
Q. feet	11.13	11.22	11.31	11.35		9.81	10.13	10.42	
w. lbs	33	33	33	33		41	41	41	
Rivet dia	1"	1"	1"	1"		1"	1"	1"	

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free		Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	
10	149	149	161	161	174	174	189	189		180	180	190	190	200	200	
11	142	142	154	154	167	167	180	180		168	168	182	182	196	196	.125
12	130	130	141	141	153	153	165	165		154	154	167	167	180	180	.149
13	120	120	131	131	141	141	152	152		143	143	154	154	166	166	.175
14	112	112	121	121	131	131	142	142		132	132	143	143	154	154	.203
15	104	103	113	112	122	121	132	131	.262	124	124	134	133	144	143	.233
16	98	96	106	104	115	112	124	121	.298	116	114	125	123	135	132	.265
17	92	88	100	96	108	104	117	113	.336	109	105	118	114	127	123	.299
18	87	82	94	89	102	96	110	104	.377	103	98	111	105	120	114	.335
19	82	76	89	83	96	89	104	97	.420	98	92	106	99	114	107	.373
20	78	71	85	78	92	84	99	91	.466	93	85	100	92	108	99	.414
21	74	66	81	73	87	78	94	85	.513	89	79	95	86	103	93	.456
22	71	62	77	68	83	73	90	79	.563	84	74	91	81	98	87	.501
23	68	59	74	64	80	69	86	74	.616	81	71	87	76	94	82	.548
24	65	55	71	60	76	64	83	70	.670	77	66	84	72	90	77	.596
25	63	52	68	56	73	61	79	66	.727	74	62	80	67	86	72	.647
26	60	49	65	53	71	58	76	62	.787	71	58	77	63	83	68	.699
27	58	46	63	50	68	54	73	58	.848	69	56	74	60	80	64	.754
28	56	43	61	48	65	51	71	55	.912	66	52	72	57	77	61	.811
29	54	41	59	45	63	48	68	52	.979	64	49	69	53	74	57	.870
30	52	39	57	43	61	46	66	49	1.047	62	47	67	51	72	54	.931
32	49	35	53	38	57	41	62	44	1.192	58	42	63	46	67	49	1.06
34	46	31	50	34	54	37	58	40	1.346	55	38	59	41	63	44	1.20
36	43	28	47	31	51	33	55	36	1.508	51	34	56	37	60	40	1.34
38	..	..	..	..	..	..	..	..		49	31	53	34	57	36	1.49
40	..	..	..	..	..	..	..	..		46	..	50	..	54	..	1.66

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Additional sections rolled—18"-99.0, see page 6.

BETHLEHEM GIRDER BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN
THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS					20″				
Depth = d″	19.75	19.88	20.00	20.12	19.75	19.88	20.00	20.12	
Wt. per foot.	99.0	107.0	113.0	120.0	127.0	135.0	142.0	149.0	
Area. Sq. In.	29.21	31.36	33.20	35.24	37.33	39.58	41.71	43.84	
b″	11.950	11.980	12.000	12.030	12.690	12.720	12.750	12.780	
t	.510	.540	.560	.590	.600	.630	.660	.690	For Detailed Cut See Page 53
k	1 9/16	1 3/4	1 15/16	1 15/16	2	2 3/16	2 3/8	2 7/16	
c	16 3/8	16 3/8	16 3/8	16 3/8	15 3/4	15 3/4	15 3/4	15 3/4	
g	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	7 1/2	
u	11/16	13/16	7/8	15/16	1″	1 1/16	1 3/32	1 3/32	
X-X I	2034.4	2206.5	2362.8	2528.0	2607.3	2788.9	2960.6	3134.9	
X-X S	206.02	221.98	236.28	251.29	264.03	280.57	296.06	311.62	
X-X r	8.35	8.39	8.44	8.47	8.36	8.39	8.43	8.46	
Y-Y I	202.1	222.4	240.8	260.2	313.0	337.7	361.0	384.6	
Y-Y S	33.8	37.1	40.1	43.3	49.3	53.1	56.6	60.2	
Y-Y r	2.63	2.66	2.69	2.72	2.90	2.92	2.94	2.96	
Coef. Str	2472200	2663800	2835400	3015500	3168400	3366900	3552700	3739400	
Max.Mom.″#	3708300	3995700	4253000	4523300	4752500	5050300	5329100	5609200	
V	120900	128800	134400	142500	142200	150300	158400	166600	Deflection
P. feet	10.22	10.34	10.55	10.58	11.14	11.20	11.21	11.22	
R	62400	67200	70700	75200	76500	80300	84200	88000	
B	14400	14650	14850	15000	15000	15000	15000	15000	
W	114800	119300	119300	119300	119300	119300	119300	119300	
Q. feet	10.77	11.16	11.88	12.64	13.28	14.11	14.89	15.67	
w. lbs	41	41	41	41	41	41	41	41	
Rivet dia	1″	1″	1″	1″	1″	1″	1″	1″	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Laterally fix'd	Laterally free	Deflection
10	242	242	258	258	269	269	285	285	284	284	301	301	317	317	333	333	
11	225	225	242	242	258	258	274	274	284	284	301	301	317	317	333	333	.134
12	206	206	222	222	236	236	251	251	264	264	281	281	296	296	312	312	.158
13	190	190	205	205	218	218	232	232	244	244	259	259	273	273	288	288	.183
14	177	177	190	190	203	203	215	215	226	226	240	240	254	254	267	267	.210
15	165	165	178	178	189	189	201	201	211	211	224	224	237	237	249	249	
16	155	153	167	164	177	174	188	185	198	197	210	209	222	221	234	234	.239
17	145	141	157	152	167	162	177	172	186	183	198	195	209	206	220	217	.270
18	137	131	148	142	158	151	168	161	176	171	187	182	197	192	208	202	.302
19	130	122	140	132	149	140	159	150	167	160	177	170	187	179	197	189	.336
20	124	115	133	123	142	131	151	140	158	149	168	158	178	168	187	177	.373
21	118	107	127	116	135	123	144	131	151	140	160	149	169	157	178	166	.411
22	112	100	121	108	129	115	137	123	144	132	153	140	162	148	170	156	.451
23	108	95	116	102	123	108	131	115	138	124	146	131	154	139	163	147	.493
24	103	89	111	96	118	102	126	109	132	117	140	124	148	131	156	138	.537
25	99	84	107	91	113	.96	121	103	127	110	135	117	142	124	150	131	.582
26	95	79	102	85	109	91	116	97	122	104	130	111	137	117	144	123	.630
27	92	75	99	81	105	86	112	91	117	98	125	105	132	111	139	117	.679
28	88	70	95	76	101	81	108	86	113	93	120	99	127	105	134	111	.736
29	85	66	92	72	98	77	104	82	109	88	116	94	123	100	129	105	.783
30	82	63	89	68	95	73	100	77	106	84	112	89	118	94	125	99	.838
32	77	56	83	61	89	65	94	69	99	76	105	80	111	85	117	90	.954
34	73	51	78	55	83	58	89	63	93	68	99	73	105	77	110	81	1.08
36	69	46	74	50	79	53	84	57	88	62	94	66	99	70	104	74	1.21
38	65	42	70	45	75	48	79	51	83	56	89	60	94	64	98	67	1.34
40	62	..	67	..	71	44	75	46	79	51	84	55	89	58	93	61	1.49

BETHLEHEM GIRDER BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	22"					24"			
Depth = d''	21.88	22.00	22.12	22.25		23.78	23.88	24.00	
Wt. per foot.	101.0	108.0	116.0	124.0		107.0	113.0	120.0	
Area. Sq. In.	29.68	31.89	34.12	36.59		31.60	33.18	35.36	
b''	12.970	13.000	13.030	13.065	For Detailed Cut See Page 53	12.195	12.210	12.240	For Detailed Cut See Page 53
t	.450	.480	.510	.545		.485	.500	.530	
k	1⅝	1⅝	1¾	1¹³⁄₁₆		1¹¹⁄₁₆	1¾	1¹³⁄₁₆	
c	18⅝	18⅝	18⅝	18⅝		20⅜	20⅜	20⅜	
g	7½	7½	7½	7½		7½	7½	7½	
u	¾	¾	¾	⅝		11/16	⅝	⅝	
AXES X-X I	2590.4	2804.3	3021.2	3261.7		3173.1	3363.3	3607.8	
S	236.78	254.94	273.16	293.19		266.87	281.68	300.65	
r	9.34	9.38	9.41	9.44		10.02	10.10	10.10	
AXES Y-Y I	238.1	261.9	286.0	312.6		220.0	236.1	256.3	
S	36.7	40.3	43.9	47.9		36.1	38.7	41.9	
r	2.83	2.87	2.90	2.92		2.64	2.67	2.69	
Coef. Str.	2841400	3059200	3278000	3518200		3202500	3380200	3607800	
Max.Mom."#	4262100	4588800	4917000	5277300	Deflection	4803700	5070300	5411700	Deflection
V	118200	126700	135400	145500		138400	143300	152600	
P. feet	12.02	12.07	12.10	12.09		11.57	11.79	11.82	
B	52300	57600	62900	69100		58800	61700	67500	
R	12910	13330	13700	14000		12850	13040	13420	
W	121600	129600	137800	143160		130980	135000	143160	
Q. feet	11.68	11.80	11.89	12.29		12.22	12.52	12.60	
w. lbs	49	49	49	49		49	49	49	
Rivet dia	1"	1"	1"	1"		1"	1"	1"	

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Span in feet by the Coefficient of Strength.

Span feet	21.88 fix'd	free	22.00 fix'd	free	22.12 fix'd	free	22.25 fix'd	free	Defl.	23.78 fix'd	free	23.88 fix'd	free	24.00 fix'd	free	Defl.
12	236	236	253	253	271	271	291	291		267	267	282	282	301	301	.112
13	219	219	252	252	271	271	271	271		246	246	260	260	278	278	.131
14	203	203	219	219	234	234	251	251		229	229	241	241	258	258	.152
15	189	189	204	204	219	219	235	235		214	214	225	225	241	241	.175
16	178	178	191	191	205	205	220	220		200	198	211	209	225	223	.199
17	167	167	180	178	193	191	207	205	.241	188	183	199	194	212	207	.225
18	158	154	170	166	182	178	195	191	.274	178	170	188	181	200	192	.251
19	150	144	161	155	173	167	185	179	.305	169	160	178	168	190	180	.280
20	142	135	153	145	164	156	176	167	.339	160	149	169	157	180	168	.310
21	135	126	146	137	156	146	168	157	.373	151	140	161	148	172	158	.342
22	129	119	139	128	149	137	160	148	.410	146	132	154	139	164	148	.375
23	124	112	133	121	143	130	153	139	.448	139	123	147	130	157	139	.411
24	118	105	128	114	137	122	147	131	.488	133	116	141	123	150	131	.447
25	114	100	122	107	131	115	141	124	.529	128	109	135	115	144	123	.485
26	109	94	118	102	126	109	135	117	.572	123	103	130	109	139	117	.525
27	105	89	113	96	121	103	130	111	.617	119	98	125	103	134	110	.566
28	102	85	109	91	117	98	126	105	.664	114	92	121	98	129	104	.608
29	98	80	106	87	113	93	121	99	.712	110	87	117	92	124	98	.653
30	95	76	102	82	109	88	117	94	.762	110	83	113	87	120	93	.698
32	89	69	96	74	102	79	110	85	.867	100	74	106	79	113	84	.795
34	84	63	90	67	96	72	104	78	.979	94	67	99	71	106	76	.897
36	79	56	85	61	91	65	98	70	1.10	89	61	94	64	100	68	1.01
38	75	52	81	56	86	59	93	64	1.22	84	55	89	58	95	62	1.12
40	71	47	77	51	82	54	88	58	1.35	80	50	85	53	90	57	1.24
42	68	43	73	46	78	50	84	53	1.49	76	..	80	..	86	..	1.37
44	65	..	70	..	75	..	80	..	1.64	73	..	77	..	82	..	1.50
46	62	..	67	..	71	..	76	..	1.79	70	..	73	..	78	..	1.64
48	..	..	67	..	..	..	..	..		67	..	70	..	75	..	1.79

Additional sections rolled—24"-128, 24"-132, 24"-140, 24"-148, see page 6.

BETHLEHEM GIRDER BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	26"					28"		
Depth = d"	25.81	25.88	26.00	26.12		27.75	27.88	28.00
Wt. per foot	138.0	144.0	151.0	160.0		145.0	156.0	165.0
Area. Sq. In.	40.65	42.38	44.55	47.25		42.69	45.93	48.75
b"	13.700	13.730	13.750	13.790	For Detailed Cut See Page 53	14.160	14.210	14.250
t	.580	.610	.630	.670		.585	.635	.675
k	1⅝	1⅝	1⅝	2⅛		2	2⅛	2⅛
c	22	22	22	22		23¾	23¾	23¾
g	10"	10"	10"	10"		10"	10"	10"
u	⅞	¾	¾	1⅛		1⅛	1⅛	1⅛
AXES X-X I	4779.9	4983.4	5289.8	5629.4		5772.3	6218.6	6624.6
S	370.39	385.12	406.91	431.04		416.02	446.10	473.19
r	10.84	10.84	10.90	10.92		11.63	11.64	11.66
Y-Y I	357.4	375.0	402.8	432.8		389.8	425.4	458.3
S	52.2	54.6	58.6	62.8		55.1	59.9	64.3
r	2.97	2.97	3.01	3.03		3.02	3.04	3.07
Coef. Str.	4444700	4621400	4882900	5172500		4992300	5353200	5678200
Max. Mom."#	6667000	6932100	7324300	7758700	For Detailed Cut See Page 53	7488400	8029700	8517300
V	179600	189400	196600	210000		194800	212400	226800
P. feet	12.37	12.20	12.42	12.32		12.81	12.60	12.52
R	78500	84300	88300	96400		80000	90600	99100
B	13530	13820	14020	14390		13090	13620	13990
W	167000	167000	167000	167000		167000	167000	167000
Q. feet	13.31	13.84	14.62	15.49		14.95	16.03	17.00
w. lbs	58	58	58	58		58	58	58
Rivet dia	1"	1"	1"	1"		1"	1"	1"

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Coefficient of Strength by the Span in feet.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Deflection
12	359	359	379	379	393	393	420	420		390	390	425	425	454	454	
13	342	342	355	355	376	376	398	398	.121	384	384	412	412	437	437	.113
14	317	317	330	330	349	349	369	369	.140	357	357	382	382	406	406	.123
15	296	296	308	308	326	326	345	345	.161	333	333	357	357	379	379	.150
16	278	278	289	289	305	305	323	323	.183	312	312	335	335	355	355	.170
17	261	261	272	272	287	287	304	304	.207	294	294	315	315	334	334	.193
18	247	244	257	254	271	268	287	284	.232	277	276	297	296	315	314	.215
19	234	229	243	237	257	251	272	266	.258	263	259	282	278	299	295	.240
20	222	214	231	223	244	235	259	250	.287	250	243	268	261	284	277	.266
21	212	201	220	209	233	222	246	234	.316	238	228	255	245	270	259	.293
22	202	189	210	197	222	208	235	221	.347	230	215	243	230	258	245	.322
23	193	178	201	186	212	196	225	208	.379	217	203	233	218	247	231	.352
24	185	168	193	176	203	185	215	196	.413	208	192	223	205	237	219	.383
25	178	160	185	166	195	175	207	186	.448	200	181	214	194	227	206	.416
26	171	151	178	157	188	166	199	176	.484	192	172	206	184	218	195	.450
27	165	143	171	149	181	157	192	167	.522	185	163	198	175	210	186	.485
28	159	136	165	141	174	149	185	158	.562	178	154	191	166	203	176	.521
29	153	129	159	134	168	141	178	150	.602	171	147	185	158	196	168	.559
30	148	122	154	127	163	135	172	143	.645	166	139	178	150	189	159	.599
32	139	111	144	115	153	122	162	130	.733	156	127	167	136	177	144	.681
34	131	101	137	105	144	111	152	117	.832	147	115	157	124	167	132	.769
36	124	92	128	95	136	101	144	107	.928	139	105	149	113	158	120	.862
38	117	84	122	87	128	92	136	98	.960	131	96	141	103	149	109	.960
40	111	76	116	80	122	84	129	89	1.15	125	88	134	95	142	101	1.06
42	106	..	110	73	116	77	123	82	1.26	119	81	127	87	135	92	1.17
44	101	..	105	67	111	71	118	76	1.39	113	74	122	80	129	85	1.29
46	97	..	100	..	106	..	112	..	1.52	109	69	116	74	123	78	1.40
48	93	..	96	..	102	..	108	..	1.65	104	..	112	..	118	..	1.53
50	89	..	92	..	98	..	103	..	1.79	100	..	107	..	114	..	1.66

Additional sections rolled—28"-175.0, see page 6.

BETHLEHEM GIRDER BEAMS
DIMENSIONS — PROPERTIES — SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY LOADED

SYMBOLS	30"					33"		36"	
Depth = d"	29.88	30.00	30.12	30.25		32.88	33.0	35.88	36.0
Wt. per foot	173.0	180.0	190.0	200.0		202.0	210.0	231.0	240.0
Area. Sq. In.	50.80	53.20	55.90	58.92		59.53	61.91	67.85	70.55
b"	14.980	15.000	15.030	15.065		15.735	15.750	16.480	16.500
t	.660	.680	.710	.745		.720	.735	.770	.790
k	2½	2⅝	2¼	2⅜	For Detailed Cut See Page 53	2⅜	2⅞	2⅜	2⅞
c	25⅝	25⅝	25⅝	25⅝		28.13	28.125	31.005	30.875
g	10"	10"	10"	10"		10"	10"	10"	10"
u	⅞	1 1/32	1 1/32	1 1/32		1¼	1⅝	1⅝	1⅝
X-X I	7895.2	8343.1	8818.0	9343.8		11114	11671	14979	15696
X-X S	528.46	556.21	585.52	617.77		676.0	707.3	835.0	872.0
X-X r	12.47	12.52	12.56	12.59		13.66	13.73	14.86	14.92
Y-Y I	519.1	555.1	592.7	634.2		667.3	708.5	825.3	873.5
Y-Y S	69.3	74.0	78.9	84.2		84.8	90.0	100.2	105.9
Y-Y r	3.20	3.23	3.26	3.28		3.35	3.38	3.49	
Coef. Str.	6341500	6674500	7026300	7413300		8112000	8488000	10020000	10460000
Max. Mom."#	9512300	10011700	10539400	11119900		12168000	12726000	15030000	15696000
V	236600	244800	256600	270400	Deflection	112800	116500	127000	132200
P. feet	13.40	13.63	13.69	13.71		14.28	14.57	15.11	15.33
R	97200	101600	108400	116400		112800	116500	127000	132200
B	13420	13590	13850	14120		13366	13488	13227	13383
W	190880	190880	190880	190880		....	....	....	....
Q. feet	16.61	17.48	18.40	19.42		.... Con	nections	to be fig	ured.
w. lbs	66	66	66	66					
Rivet dia.	1"	1"	1"	1"		1"	1"	1"	1"

Allowable Uniform Load, as fixed by shear or flexure, whichever is least. For laterally fixed beam loads not tabulated, divide the Span in feet by the Coefficient of Strength.

Span feet	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Defl.	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free	Laterally fix'd	free
13	473	473	490	490	513	513	541	541		..	..	..	..	..	..	..	..
14	453	453	477	477	502	502	530	530	.122	..	..	..	..	..	..	..	..
15	423	423	445	445	468	468	494	494	.140	..	..	..	..	..	..	..	..
16	396	396	417	417	439	439	463	463	.159	..	..	..	..	..	..	..	..
17	373	373	393	393	413	413	436	436	.180	..	..	..	..	..	..	..	..
18	352	352	371	371	390	390	412	412	.201	..	..	..	..	..	..	..	..
19	334	333	351	350	370	369	390	389	.224	..	..	..	..	..	..	..	..
20	317	312	334	329	351	346	371	366	.248	406	..	422	..	..	..	..	..
21	302	294	318	310	335	326	353	344	.274	385	..	404	..	466	..	489	..
22	288	277	303	292	319	307	337	325	.300	369	..	386	..	455	..	475	..
23	276	262	290	276	305	290	322	306	.329	353	..	369	..	436	..	455	..
24	264	248	278	261	293	275	309	290	.358	338	..	354	..	417	..	436	..
25	254	235	267	247	281	260	297	275	.388	324	..	339	..	409	..	418	..
26	244	223	257	235	270	247	285	261	.420	312	..	326	..	385	..	402	..
27	235	212	247	223	260	234	275	248	.452	300	..	314	..	371	..	387	..
28	226	201	238	211	251	223	265	236	.487	290	..	303	..	358	..	374	..
29	219	192	230	201	242	212	256	225	.522	280	..	293	..	345	..	361	..
30	211	182	222	192	234	202	247	213	.559	270	..	283	..	334	..	349	..
32	198	166	209	175	220	184	232	195	.636	253	..	265	..	313	..	327	..
34	187	152	196	159	207	168	218	177	.718	239	..	250	..	295	..	307	..
36	176	138	185	145	195	153	206	162	.804	225	..	236	..	278	..	291	..
38	167	127	176	134	185	141	195	148	.896	213	..	223	..	264	..	275	..
40	159	117	167	123	176	130	185	136	.993	203	..	212	..	250	..	261	..
42	151	107	159	113	167	119	177	126	1.10	193	..	202	..	239	..	249	..
44	144	99	152	104	160	110	168	116	1.20	184	..	193	..	228	..	238	..
46	138	91	145	96	153	102	161	107	1.31	176	..	184	..	218	..	227	..
48	132	84	139	89	146	94	154	99	1.43	169	..	177	..	209	..	218	..
50	127	..	133	78	141	87	148	92	1.55	162	..	170	..	200	..	209	..
52	122	..	128	..	135	..	143	..	1.68	156	..	163	..	193	..	201	..
54	117	..	124	..	130	..	137	..	1.81	150	..	157	..	186	..	194	..

Additional sections rolled—35"-220, 33"-230, 36"-250, 36"-260, see page 6.

HEAVY RIVETED PLATE GIRDERS
Bethel Hotel, St. Paul, Minn.

NOTES ON RIVETED GIRDERS

Riveted girders are used where the load to be carried exceeds the capacity of single I beams, or girders composed of two or more I beams with separators and bolts. or with plates riveted to the top and bottom flanges.

Where beam box girders are of insufficient strength or where their width prohibits their use, riveted girders composed of plates and angles may be used. In some cases sufficient strength can be obtained by riveting plates to the top and bottom flanges of I beams. On page 64 we give a table of safe loads for these girders.

On pages 65 to 71 are tables giving the safe loads for riveted plate and angle girders based on an extreme fibre stress, due to bending, of 18,000 lbs. on the net area of the sections. Where the girders span a distance exceeding twenty times the width of their flange, they must be braced laterally. Web stiffeners must also be provided at the points of bearing and of concentrated loads. Where the distance between the flanges is equal to or greater than sixty times the thickness of the web, intermediate stiffeners must be provided at distances approximately equal to the depth of the web, but not to exceed 6 feet; these will prevent buckling of the web. The depth of girders should be about one-tenth of the span in feet.

Care should also be taken in arranging the rivet spacing for connecting the flange angles to the web, so that sufficient rivets are provided to transmit stresses which act between these two portions of the construction. The spacing at any point along the girder may be obtained by the following formula:

$$p = \frac{rh}{S}$$

Where p = the pitch of the rivets in the flange angles, in inches.
r = the value of one rivet in bearing or shear.
h = the distance between the center lines of the extreme rivets.
S = the total vertical shear in pounds at the point under consideration.

The above formula gives the theoretical spacing; the rivets should not be spaced to exceed 6 inches in any panel, and the pitch obtained for the maximum load in any panel is usually maintained throughout that panel. Where concentrated loads are imposed, additional rivets should be added to take care of this load.

At the ends of the girder, and through the end stiffeners, sufficient rivets should be provided to carry the maximum end reaction.

RIVETED BEAM GIRDERS

MAXIMUM BENDING STRESS 18,000 LBS. PER SQUARE INCH ON NET SECTION

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Span in Feet	I Beam 24" 79.9 Lb. 2 Plates 12"x¾" A	B	I Beam 24" 79.9 Lb. 2 Plates 10"x⅝" A	B	I Beam 20" 81.4 Lb. 2 Plates 10"x¾" A	B	I Beam 20" 65.4 Lb. 2 Plates 10"x⅝" A	B	I Beam 18" 54.7 Lb. 2 Plates 9"x⅝" A	B	I Beam 15" 60.8 Lb. 2 Plates 9"x⅝" A	B	I Beam 15" 42.9 Lb. 2 Plates 8"x½" A	B	Deflection Coefficients of
15	278	12.8	227	10.6	208	8.7	169	9.0	133	6.9	115	5.5	82	5.1	4.190
16	261	12.0	214	9.9	195	8.1	159	8.3	125	6.4	108	5.2	76	4.7	4.767
17	245	11.4	201	9.3	183	7.6	148	7.9	117	6.0	101	4.8	72	4.5	5.381
18	233	10.7	190	8.9	173	7.2	141	7.4	111	5.6	96	4.6	69	4.3	6.033
19	219	10.1	180	8.4	164	6.9	134	7.1	105	5.4	91	4.4	64	3.9	6.722
20	209	9.7	170	8.0	156	6.5	127	6.7	100	5.2	87	4.2	62	3.7	7.448
21	199	9.2	163	7.6	148	6.2	120	6.4	94	4.8	82	3.9	58	3.6	8.211
22	190	8.8	155	7.2	142	5.8	115	6.1	91	4.6	79	3.7	56	3.5	9.012
23	181	8.4	148	7.0	135	5.6	110	5.8	87	4.4	75	3.6	53	3.3	9.850
24	174	8.0	142	6.6	129	5.4	106	5.6	83	4.3	72	3.5	51	3.1	10.725
25	166	7.6	136	6.4	125	5.2	101	5.4	80	4.0	69	3.3	49	3.0	11.638
26	161	7.4	132	6.1	119	4.9	97	5.2	76	3.9	66	3.1	47	2.9	12.587
27	155	7.2	126	5.8	116	4.8	93	4.9	74	3.8	64	3.0	45	2.8	13.574
28	150	6.9	121	5.6	111	4.6	90	4.7	71	3.6	62	2.9	44	2.7	14.598
29	144	6.6	118	5.5	108	4.5	88	4.6	69	3.5	60	2.8	43	2.6	15.659
30	139	6.4	114	5.3	103	4.4	84	4.5	66	3.4	57	2.7	40	2.5	16.758
Area....	41.32 Sq. In.		35.82 Sq. In.		38.73 Sq. In.		31.58 Sq. In.		27.18 Sq. In.		28.92 Sq. In.		20.48 Sq. In.		
S$_{r-r}$....	348.0 In.³		284.5 In.³		259.5 In.³		211.5 In.³		166.7 In.³		143.8 In.³		101.7 In.³		
Weight...	141.2 Lbs. Per Ft.		122.5 Lbs. Per Ft.		131.0 Lbs. Per Ft.		107.5 Lbs. Per Ft.		93.3 Lbs. Per Ft.		98.3 Lbs. Per Ft.		69.2 Lbs. Per Ft.		

A = Safe load.
B = Increase in safe loads for ¹⁄₁₆" increase in thickness of flange plates. One ⅞" dia. hole (for ¾" riv.) is deducted from each flange.
Weights given for girders do not include stiffeners, rivet heads or other details.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Distance Center to Center of Bearings	Web 30x¼", 4Ls 5"x3½" — Thickness of Flange Angles Inches			Web 30x⅜", 4Ls 6"x4" — Thickness of Flange Angles in Inches			Web 30x⅜", 4Ls 5x3½", 2 Plates 12" Wide — Thickness of Flange Angles and Plates in Inches			Web 30x⅜", 4Ls 6x4", 2 Plates 14" Wide — Thickness of Flange Angles and Plates in Inches			Web 30x½", 4Ls 6x4" — Thickness of Flange Angles in Inches			Web 30x½", 4Ls 5x3½", 2 Plates 12" Wide — Thickness of Flange Angles and Plates in Inches		Web 30x½", 4Ls 6x4", 2 Plates 14" Wide — Thickness of Flange and Plates in Inches	
	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	⅝	¾	⅝	¾
25	94	117	139	109	137	164	156	199	242	183	236	288	124	146	170	207	248	243	295
26	91	112	134	104	131	157	151	192	233	176	227	277	119	140	164	199	239	234	283
27	88	109	129	101	127	152	145	184	224	170	219	266	115	135	158	191	230	225	273
28	84	104	125	98	122	147	139	179	216	163	210	256	110	130	153	184	221	217	263
29	81	101	120	94	118	142	135	172	208	158	203	247	107	126	147	178	215	209	254
30	79	98	117	91	115	137	130	166	201	153	197	239	103	121	142	172	207	202	246
31	76	94	112	88	111	133	126	161	196	148	190	233	100	118	137	166	200	196	238
32	74	91	109	85	107	128	122	156	189	144	184	225	97	115	133	162	194	190	230
33	72	89	106	83	103	125	118	152	183	139	179	218	93	111	129	156	188	184	224
34	70	86	102	80	101	121	115	147	178	135	174	211	91	108	126	152	182	179	217
35	68	84	100	77	98	118	111	143	173	131	169	206	89	104	121	147	178	173	210
36	65	82	97	75	95	115	109	138	167	128	164	200	85	101	118	144	173	169	205
37	64	80	94	73	92	111	106	135	163	124	160	194	83	99	115	139	167	164	199
38	62	77	92	72	90	108	102	131	160	120	155	189	81	97	112	136	164	160	193
39	61	75	90	70	88	106	100	128	155	118	152	184	80	93	110	133	160	155	189
40	59	73	88	68	85	103	98	125	151	115	147	180	77	91	107	129	155	152	184
41	58	71	85	66	83	101	95	121	146	111	143	175	75	88	104	126	151	148	180
42	57	68	83	65	81	98	92	118	142	108	138	171	73	84	101	122	146	145	175
43	56	66	81	63	79	95	90	115	138	104	135	167	71	81	98	119	142	142	171
44	54	64	79	62	76	93	88	112	134	101	130	163	68	79	95	116	138	139	167
45	53	62	76	61	74	91	85	110	130	99	127	160	66	76	93	112	134	137	164
Weight Per ft.	79	92	105	87	103	118	110	133	156	123	150	177	105	118	131	146	169	163	190
Sect. Mod.	199.2	244.6	287.9	229.5	284.7	337.8	315.	395.1	473.2	365.9	462.5	557.1	260.4	306.9	354.5	412.9	491	480.4	574.8

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ⅞" holes have been deducted from each flange and two from those without covers.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Thickness of Flange Angles and Plates in Inches

Distance Center to Center of Bearings	Web 36x¼" 4Ls 5x3½		Web 36x¼" 4Ls 6x4				Web 36x⅜" 4Ls 6x6		Web 36x⅜" 4Ls 5x3½ 2 Plts. 12" Wide		Web 36x⅜" 4Ls 6x4 2 Plts. 14" Wide				Web 36x⅜" 4Ls 6x6 2 Plts. 14" Wide		
	⅜	½	⅜	½	⅝	¾	⅝	¾	⅝	¾	⅜	½	⅝	¾	½	⅝	¾
30	123	144	114	142	170	196	125	162	204	245	187	240	291	342	198	254	307
31	118	139	110	137	164	190	122	158	197	239	181	232	282	331	191	246	297
32	115	136	107	133	159	185	117	153	191	231	176	225	273	321	186	239	288
33	111	132	103	129	154	179	114	147	185	224	170	218	264	311	180	231	279
34	108	127	100	125	150	173	110	143	179	217	165	212	257	302	174	224	271
35	105	124	98	121	145	169	108	140	174	210	161	206	250	294	170	218	263
36	102	120	96	118	142	164	105	135	170	205	156	200	243	285	164	212	257
37	99	117	92	115	137	159	101	132	164	199	152	195	236	277	160	206	249
38	97	115	90	112	134	155	99	128	161	194	149	189	230	270	156	200	243
39	94	111	88	109	131	151	97	125	156	189	144	185	224	263	152	196	236
40	92	109	85	107	127	147	95	122	153	185	141	180	218	257	149	191	231
41	90	106	83	105	124	144	92	119	149	180	137	176	213	250	145	187	225
42	88	103	81	101	122	141	90	116	145	176	134	171	208	244	142	182	219
43	85	101	80	99	118	137	88	114	142	170	131	168	204	239	138	178	215
44	83	99	78	97	116	134	83	111	138	168	128	163	198	233	135	173	209
45	81	97	75	95	114	131	81	108	135	164	125	160	194	228	132	170	205
46	79	94	73	92	111	127	79	105	132	161	122	155	189	224	128	165	200
47	76	92	71	90	109	124	77	101	128	158	118	152	185	219	125	162	196
48	74	90	69	88	107	120	74	98	125	154	116	149	181	216	122	159	191
49	72	88	66	86	105	118	74	96	123	151	114	145	178	213	119	155	188
50	70	85	64	83	102	115	73	93	119	149	111	143	174	210	116	153	183
Weight Per foot	100.3	113.1	95.1	110.7	125.9	140.3	105.5	124.3	141.1	164.1	130.8	158.3	185.4	211.7	141.2	171.9	202.2
Sect. Mod.	309.6	362.7	291.2	358.8	423.8	485.8	319.8	396.6	491.8	587.4	490.5	574.3	689.9	800.8	484.8	612.3	736.1

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ⅞" holes have been deducted from each flange, and two from those without covers.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Thickness of Flange Angles in Inches (for single-angle web groups); Thickness of Flange Angles and Plates in Inches (for the 2-plate groups).

Distance Center to Center of Bearings	Web 36x⅜" 4Ls 6x4		Web 36x⅜" 4Ls 6x6		Web 36x½" 4Ls 6x4 2 Plts. 14" Wide			Web 36x½" 4Ls 6x6 2 Plts. 14" Wide			Web 42x⅜" 4Ls 6x4					Web 42x⅜" 4Ls 6x6				
	¼	⅜	¼	⅜	¼	⅜	½	¼	⅜	½	¼	⅜	½	⅝	¾	¼	⅜	½	⅝	¾
30	150	178	170	203	248	299	351	262	317	372	138	171	204	235	266	156	196	235	273	311
31	145	172	164	196	241	290	341	252	307	360	134	165	197	227	257	151	190	227	264	300
32	141	167	160	190	233	281	330	245	298	349	129	161	191	221	249	146	183	221	257	290
33	136	161	154	185	226	272	320	239	289	339	126	155	186	214	241	142	178	214	249	281
34	133	156	150	179	219	264	311	232	280	329	122	151	180	208	234	138	173	208	242	273
35	128	152	146	174	213	257	302	225	272	320	118	147	174	203	228	134	167	201	235	266
36	125	147	142	169	207	250	294	218	264	311	115	143	170	197	222	131	163	196	228	259
37	122	144	137	164	201	243	285	213	258	302	113	138	165	191	215	127	159	191	222	251
38	118	141	134	160	196	236	278	207	251	295	109	135	161	186	209	124	155	186	216	245
39	115	136	131	156	191	231	270	201	244	287	106	132	156	181	204	120	151	181	210	239
40	113	133	127	152	186	225	264	197	239	280	104	128	153	177	199	117	147	177	205	233
41	110	129	124	149	181	219	258	191	232	272	101	125	150	172	194	115	143	172	200	227
42	107	127	122	145	177	214	251	187	227	267	99	123	145	168	189	111	141	168	196	222
43	105	124	118	142	173	209	245	183	222	260	97	119	142	164	186	109	137	164	191	216
44	102	122	116	138	169	205	239	179	216	254	95	117	138	160	181	107	134	161	187	212
45	100	118	114	135	165	200	234	174	212	249	92	115	136	156	177	105	131	156	182	207
46	98	115	111	132	161	196	230	170	206	243	90	113	133	152	172	102	127	152	178	203
47	96	113	108	128	158	191	225	165	201	238	88	110	129	149	168	100	124	147	173	198
48	93	108	106	125	154	187	222	161	196	232	86	108	127	145	164	98	120	143	169	194
49	91	105	104	122	152	182	218	158	190	226	83	106	124	142	161	96	117	140	165	189
50	89	102	101	119	150	179	215	154	186	221	81	104	122	138	158	93	115	136	162	185
Weight Per foot	126.0	141.2	139.6	158.0	173.0	200.7	227.0	187.0	217.2	247.5	102.75	118.35	133.55	147.95	162.35	113.15	131.95	150.35	168.35	185.95
Sect. Mod.	382.4	448.2	420.1	494.9	600.5	715.3	826.3	638.1	762.	881.7	357.7	437.6	514.5	587.9	658.	394.	486.5	575.3	660.8	743.4

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ⅞" holes have been deducted from each flange, and two from those without covers.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Web 42x⅜", 4Ls 6x4, 2 Plts. 14" Wide — Thickness of Flange Angles and Plates in Inches

Distance Center to Center of Bearings				
35	191	244	295	345
36	186	237	287	336
37	180	231	279	327
38	175	224	271	318
39	171	218	264	310
40	166	213	259	303
41	163	208	252	295
42	159	204	246	288
43	155	198	241	281
44	152	193	235	274
45	148	189	229	269
46	145	186	225	263
47	142	181	219	258
48	139	178	215	252
49	136	174	211	246
50	134	171	207	242
52	128	164	198	233
54	124	157	189	224
56	119	151	180	214
58	115	144	171	205
60	110	137	162	196
Weight Per foot	138.45	165.95	193.05	219.35
Sect. Mod.	552.1	695.2	827.3	959.6

Web 42x⅜", 4Ls 6x6, 2 Plts. 14" Wide — Thickness of Flange Angles and Plates in Inches

Distance Center to Center of Bearings				
35	202	260	316	371
36	197	253	307	361
37	191	245	299	351
38	186	239	290	342
39	181	233	283	333
40	177	227	277	325
41	172	222	270	317
42	169	216	263	309
43	164	211	258	301
44	161	207	252	296
45	157	201	246	289
46	154	198	241	282
47	151	193	235	277
48	147	189	231	271
49	144	186	226	265
50	142	182	222	260
52	135	175	213	249
54	128	169	204	237
56	121	162	195	226
58	115	155	186	216
60	108	148	179	205
Weight Per foot	148.85	179.55	209.85	239.75
Sect. Mod.	588.7	740.	887.9	1031.5

Web 42x⅜", 4Ls 6x4, 2 Plts. 16" Wide — Thickness of Flange Angles and Plates in Inches

Distance Center to Center of Bearings				
35	258	314	368	421
36	253	305	358	409
37	244	296	348	397
38	237	288	339	387
39	232	281	330	377
40	226	274	322	368
41	220	267	314	359
42	215	261	306	350
43	210	254	299	342
44	205	249	292	334
45	200	243	286	327
46	196	239	279	319
47	192	234	273	313
48	188	228	268	307
49	184	224	262	300
50	181	219	256	294
52	174	210	245	280
54	168	201	234	267
56	161	192	223	253
58	154	183	213	240
60	148	175	200	226
Weight Per foot	143.55	172.75	201.55	229.55	257.55
Sect. Mod.	583.7	733.4	880.4	1023.4	1161.4

Web 42x⅜", 4Ls 6x6, 2 Plts. 16" Wide — Thickness of Flange Angles and Plates in Inches

Distance Center to Center of Bearings					
35	214	274	334	393	450
36	207	267	324	381	438
37	201	259	315	371	425
38	197	252	307	361	414
39	191	245	299	351	403
40	187	240	292	343	394
41	182	233	285	334	384
42	178	228	278	326	375
43	173	223	271	319	366
44	170	218	265	312	359
45	166	213	259	305	350
46	162	208	253	298	342
47	159	204	249	292	334
48	155	200	243	286	327
49	152	196	239	280	321
50	150	191	233	274	315
52	143	182	222	263	304
54	136	173	210	252	292
56	129	164	200	241	281
58	123	155	190	229	271
60	117	146	180	219	260
Weight Per foot	153.95	186.35	218.35	249.95	281.15
Sect. Mod.	620.5	782.6	941.	1094.9	1244.9

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ¾" holes have been deducted from each flange, and two from those without covers.

For loads above black lines webs must be reinforced at bearings.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Distance Center to Center of Bearings	Web 42x¼" 4Ls 6x4"			Web 42x½" 4Ls 6x6"			Web 42x½" 4Ls 6x4" 2 Plates 14" Wide			Web 42x½" 4Ls 6x6" 2 Plates 14" Wide			Web 42x½" 4Ls 6x4" 2 Plates 16" Wide				Web 42x½" 4Ls 6x6" 2 Plates 16" Wide			
	Thickness of Flange Angles in Inches			Thickness of Flange Angles in Inches			Thickness of Flange Angles and Plates in Inches			Thickness of Flange Angles and Plates in Inches			Thickness of Flange Angles and Plates in Inches				Thickness of Flange Angles and Plates in Inches			
	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	¾	⅜	½	⅝	¾
35	156	185	210	177	210	243	253	305	356	269	325	380	268	323	377	431	284	343	401	459
36	152	179	205	172	205	236	246	297	345	262	316	370	261	314	367	419	276	333	390	447
37	147	174	199	168	199	230	240	288	335	254	307	360	253	306	356	407	268	324	379	434
38	143	170	194	163	195	223	233	280	327	248	299	350	246	297	348	396	261	315	369	423
39	140	165	189	159	189	218	227	273	318	241	291	341	241	289	339	386	254	307	360	412
40	136	161	185	155	185	213	222	267	311	235	285	333	234	282	330	377	248	299	351	402
41	133	156	180	151	180	208	216	260	303	230	277	324	228	276	322	367	241	291	342	392
42	131	153	176	147	176	203	210	254	296	224	271	317	223	269	314	359	235	286	334	383
43	127	150	171	144	171	198	206	249	289	219	264	309	218	262	307	351	231	279	326	374
44	124	146	168	141	168	194	201	243	282	214	259	303	213	257	300	342	225	272	318	365
45	122	143	164	137	164	189	197	238	277	209	253	296	208	251	293	334	221	267	312	357
46	118	140	160	135	160	185	192	232	270	205	248	289	204	245	287	327	216	261	305	349
47	116	137	156	132	156	181	188	227	264	200	242	284	199	241	280	321	210	255	299	342
48	114	134	154	129	154	178	185	223	259	196	236	278	196	235	275	314	206	250	293	335
49	111	132	151	126	151	174	181	218	254	192	232	272	191	231	269	307	203	244	286	327
50	109	128	147	124	147	170	177	214	249	188	227	266	188	226	261	302	198	240	281	321
52	105	122	141	117	141	161	169	205	238	180	218	252	179	217	245	290	189	231	272	305
54	100	115	134	113	134	152	160	196	226	171	209	239	170	208	230	279	180	222	263	289
56	96	108	127	107	127	145	153	189	216	164	200	227	161	199	216	268	173	213	254	276
58	91	101	120	102	120	138	146	182	207	158	191	216	152	190	203	259	167	204	245	262
60	87	97	114	98	114	132	140	176	198	151	182	205	143	181	191	250	159	195	236	249
Weight Per foot...	136.2	151.4	165.8	149.8	168.2	186.2	183.8	210.9	237.2	197.4	227.7	257.6	190.6	219.4	247.4	275.4	204.2	236.2	267.8	299.0
Sect. Mod.	470.1	547.2	622.6	518.9	607.8	693.3	726.7	862.6	994.2	775.4	922.9	1066.1	769.	915.7	1057.9	1196.1	817.9	976.	1129.9	1279.6

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ⅞" holes have been deducted from each flange, and two from those without covers.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Distance Center to Center of Bearings	Web 48x⅜" 4Ls 6x4" (Thickness of Flange Angles in Inches)			Web 48x⅜" 4Ls 6x6"			Web 48x⅜" 4Ls 6x4" 2 Plates 14" Wide (Thickness of Flange Angles and Plates in Inches)				Web 48x⅜" 4Ls 6x6" 2 Plates 14" Wide				Web 48x⅜" 4Ls 6x4" 2 Plates 16" Wide					Web 48x⅜" 4Ls 6x6" 2 Plates 16" Wide				
	⅜	½	⅝	⅜	½	⅝	⅜	½	⅝	¾	⅜	½	⅝	¾	⅜	½	⅝	¾	⅞	⅜	½	⅝	¾	⅞
40	122	152	179	138	173	207	194	247	299	349	208	265	322	377	206	262	317	371	424	218	279	338	398	456
41	119	147	174	135	169	202	189	241	291	340	202	259	313	367	200	255	309	362	414	212	272	331	387	444
42	117	144	171	133	165	198	185	235	284	333	198	252	305	359	196	250	301	353	404	208	265	323	378	434
43	115	140	166	129	162	193	181	229	278	324	193	246	299	350	191	243	295	345	395	202	259	315	370	423
44	111	138	163	126	157	189	176	225	272	317	189	241	292	342	187	238	288	337	386	198	253	308	362	414
45	109	135	160	124	154	184	173	219	265	310	184	235	286	334	183	233	281	329	377	193	247	301	353	405
46	107	131	156	121	151	180	170	215	260	304	180	230	279	327	179	227	275	323	369	189	242	300	345	396
47	104	129	153	118	147	176	165	210	254	297	176	226	273	320	175	223	270	316	361	185	237	288	338	387
48	102	126	149	116	145	173	162	206	248	291	172	220	268	314	171	218	264	309	353	182	233	282	332	379
49	100	124	146	113	142	170	158	202	244	284	170	216	262	307	167	214	259	302	346	178	227	277	325	371
50	98	121	144	111	139	166	156	198	238	279	167	212	258	301	164	209	253	297	340	174	223	271	318	365
51	97	119	140	109	136	163	153	193	234	274	163	208	252	296	161	206	248	291	333	171	218	265	312	358
52	94	117	138	107	134	160	149	190	229	268	160	203	247	289	158	201	244	286	326	167	214	260	306	350
53	92	115	135	104	131	156	147	187	226	263	156	200	243	284	155	198	239	280	319	164	210	255	300	344
54	91	112	133	102	128	153	144	183	221	259	154	196	238	279	152	193	235	275	314	161	207	251	295	338
55	89	110	129	101	124	149	140	179	217	254	151	192	234	273	149	189	229	270	308	158	202	246	289	331
56	86	108	126	99	121	146	137	174	212	250	147	189	229	268	147	184	225	264	302	156	198	242	283	324
57	84	106	122	97	120	143	135	171	209	246	145	185	225	262	145	180	220	260	297	154	194	237	278	317
58	82	104	120	94	119	140	133	167	206	243	143	182	221	257	143	176	217	255	292	152	191	234	272	311
59	81	103	118	93	118	138	130	165	202	239	140	179	218	253	142	173	214	251	288	151	188	229	268	305
60	80	102	117	92	117	136	129	163	200	237	138	176	216	250	140	170	210	247	283	149	185	226	263	299
Weight Per foot	110	126	141	120	139	158	146	173	200	227	156	187	217	247	151	180	209	237	265	161	194	226	257	288
Sect. Mod.	428	520	609	473	581	684	651	812	969	1122	697	872	1044	1211	688	861	1030	1194	1355	733	921	1104	1283	1458

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ⅜' holes have been deducted from each flange, and two from those without covers.

RIVETED PLATE GIRDERS

Safe loads in thousands of pounds—uniformly loaded

Thickness of Flange Angles in Inches (Web 48x⅜″ groups); Thickness of Flange Angles and Plates in Inches (plated groups)

Dist. C. to C. of Bearings	Web 48x⅜″ 4Ls 6x4″ — ⅜	— ½	— ⅝	Web 48x⅜″ 4Ls 6x6″ — ⅜	— ½	Web 48x½″ 4Ls 6x4″ 2 Plts. 14″ Wide — ½	— ⅝	— ¾	Web 48x½″ 4Ls 6x6″ 2 Plts. 14″ Wide — ½	— ⅝	— ¾	Web 48x½″ 4Ls 6x4″ 2 Plts. 16″ Wide — ½	— ⅝	— ¾	— ⅞	Web 48x½″ 4Ls 6x6″ 2 Plts. 16″ Wide — ½	— ⅝	— ¾	— ⅞
40	162	190	217	183	251	259	309	360	276	332	387	273	327	382	435	290	350	408	467
41	159	186	211	179	244	252	301	351	269	324	377	265	319	372	424	282	340	398	455
42	154	181	207	175	239	245	295	343	262	316	368	260	313	364	415	276	332	389	444
43	151	177	202	171	233	240	288	335	256	308	360	252	305	355	405	269	324	379	433
44	147	172	198	168	228	235	281	327	251	301	352	249	298	348	395	263	317	371	422
45	144	169	193	163	223	229	276	321	245	295	344	243	291	340	387	258	310	363	414
46	141	165	189	160	218	225	269	313	240	288	336	237	285	332	378	252	304	355	405
47	138	162	184	156	214	219	263	307	234	282	330	233	279	325	370	246	297	348	396
48	135	159	181	153	209	215	258	300	229	275	323	227	273	318	363	241	291	341	388
49	133	155	178	150	205	210	253	295	225	271	316	223	268	312	355	236	286	333	380
50	129	152	174	147	200	207	247	288	220	265	309	218	262	306	348	232	279	326	373
51	127	150	171	144	197	202	243	282	216	260	304	214	258	301	342	227	273	321	366
52	125	146	168	142	192	198	239	277	211	255	298	209	252	294	335	223	268	314	359
53	123	143	164	138	189	195	234	272	208	251	292	206	247	288	328	218	263	308	352
54	120	141	161	136	186	191	229	267	204	246	287	202	243	282	322	215	259	303	345
55	118	138	159	134	182	188	225	262	200	241	281	198	239	278	316	210	254	297	339
56	116	136	156	132	179	184	220	258	197	236	276	195	234	273	310	206	250	291	332
57	115	134	154	129	175	181	216	253	193	232	271	191	231	269	306	202	246	287	326
58	114	132	152	127	173	179	213	249	191	227	267	189	227	264	301	199	243	282	321
59	111	130	150	126	171	177	209	245	189	224	263	187	224	261	297	196	240	278	316
60	110	129	148	125	169	174	207	242	187	220	260	184	220	258	294	192	237	274	313
Weight Per ft.	146.4	161.6	178.4	160.0	196.4	194.0	221.1	247.4	207.6	232.9	267.8	200.8	229.6	257.6	285.6	214.4	246.4	278.0	309.2
Sect. Mod.	563.7	652.8	727.8	623.9	827.8	858.9	1016	1168.2	919.1	1090.4	1257	907.4	1076.6	1241	1400.9	967.6	1151.1	1329.8	1504.1

The safe load table above is based upon 18,000 lbs. per square inch of net section. From girders with cover plates four ⅞″ holes have been deducted from each flange and two from those without covers.

PROPERTIES OF ANGLES
Equal Legs

| Size | Weight per Foot | Area of Section | Axis 1-1 and Axis 2-2 | | | | Axis 3-3 |
| | | | I | r | S | x | r min. |
Inches	Pounds	In.²	In.⁴	In.	In.³	In.	In.
8 x 8 x 1⅛	56.9	16.73	98.0	2.42	17.5	2.41	1.55
8 x 8 x 1 1/16	54.0	15.87	93.5	2.43	16.7	2.39	1.56
8 x 8 x 1	51.0	15.00	89.0	2.44	15.8	2.37	1.56
8 x 8 x 15/16	48.1	14.12	84.3	2.44	14.9	2.34	1.56
8 x 8 x ⅞	45.0	13.23	79.6	2.45	14.0	2.32	1.56
8 x 8 x 13/16	42.0	12.34	74.7	2.46	13.1	2.30	1.57
8 x 8 x ¾	38.9	11.44	69.7	2.47	12.2	2.28	1.57
8 x 8 x 11/16	35.8	10.53	64.6	2.48	11.2	2.25	1.58
8 x 8 x ⅝	32.7	9.61	59.4	2.49	10.3	2.23	1.58
8 x 8 x 9/16	29.6	8.68	54.1	2.50	9.3	2.21	1.58
8 x 8 x ½	26.4	7.75	48.6	2.51	8.4	2.19	1.58
6 x 6 x 1	37.4	11.00	35.5	1.80	8.6	1.86	1.16
6 x 6 x 15/16	35.3	10.37	33.7	1.80	8.1	1.84	1.16
6 x 6 x ⅞	33.1	9.73	31.9	1.81	7.6	1.82	1.17
6 x 6 x 13/16	31.0	9.09	30.1	1.82	7.2	1.80	1.17
6 x 6 x ¾	28.7	8.44	28.2	1.83	6.7	1.78	1.17
6 x 6 x 11/16	26.5	7.78	26.2	1.83	6.2	1.75	1.17
6 x 6 x ⅝	24.2	7.11	24.2	1.84	5.7	1.73	1.17
6 x 6 x 9/16	21.9	6.43	22.1	1.85	5.1	1.71	1.18
6 x 6 x ½	19.6	5.75	19.9	1.86	4.6	1.68	1.18
6 x 6 x 7/16	17.2	5.06	17.7	1.87	4.1	1.66	1.19
6 x 6 x ⅜	14.9	4.36	15.4	1.88	3.5	1.64	1.19
5 x 5 x 1	30.6	9.00	19.6	1.48	5.8	1.61	0.96
5 x 5 x 15/16	28.9	8.50	18.7	1.48	5.5	1.59	0.96
5 x 5 x ⅞	27.2	7.98	17.8	1.49	5.2	1.57	0.96
5 x 5 x 13/16	25.4	7.47	16.8	1.50	4.9	1.55	0.97
5 x 5 x ¾	23.6	6.94	15.7	1.50	4.5	1.52	0.97
5 x 5 x 11/16	21.8	6.40	14.7	1.51	4.2	1.50	0.97
5 x 5 x ⅝	20.0	5.86	13.6	1.52	3.9	1.48	0.97
5 x 5 x 9/16	18.1	5.31	12.4	1.53	3.5	1.46	0.98
5 x 5 x ½	16.2	4.75	11.3	1.54	3.2	1.43	0.98
5 x 5 x 7/16	14.3	4.18	10.0	1.55	2.8	1.41	0.98
5 x 5 x ⅜	12.3	3.61	8.7	1.56	2.4	1.39	0.99
4 x 4 x 13/16	19.9	5.84	8.1	1.18	3.0	1.29	0.77
4 x 4 x ¾	18.5	5.44	7.7	1.19	2.8	1.27	0.77
4 x 4 x 11/16	17.1	5.03	7.2	1.19	2.6	1.25	0.77
4 x 4 x ⅝	15.7	4.61	6.7	1.20	2.4	1.23	0.77
4 x 4 x 9/16	14.3	4.18	6.1	1.21	2.2	1.21	0.78
4 x 4 x ½	12.8	3.75	5.6	1.22	2.0	1.18	0.78
4 x 4 x 7/16	11.3	3.31	5.0	1.23	1.8	1.16	0.78
4 x 4 x ⅜	9.8	2.86	4.4	1.23	1.5	1.14	0.79
4 x 4 x 5/16	8.2	2.40	3.7	1.24	1.3	1.12	0.79
4 x 4 x ¼	6.6	1.94	3.0	1.25	1.0	1.09	0.79

PROPERTIES OF ANGLES
Equal Legs

Size	Weight per Foot	Area of Section	Axis 1-1 and Axis 2-2				Axis 3-3
			I	r	S	x	r min.
Inches	Pounds	In.²	In.⁴	In.	In.³	In.	In.
3½x3½x¾	16.0	4.69	5.0	1.03	2.1	1.15	0.67
3½x3½x⅝	13.6	3.98	4.3	1.04	1.8	1.10	0.68
3½x3½x⁹⁄₁₆	12.4	3.62	4.0	1.05	1.6	1.08	0.68
3½x3½x½	11.1	3.25	3.6	1.06	1.5	1.06	0.68
3½x3½x⁷⁄₁₆	9.8	2.87	3.3	1.07	1.3	1.04	0.68
3½x3½x⅜	8.5	2.48	2.9	1.07	1.2	1.01	0.69
3½x3½x⁵⁄₁₆	7.2	2.09	2.5	1.08	0.98	0.99	0.69
3½x3½x¼	5.8	1.69	2.0	1.09	0.79	0.97	0.69
3 x 3 x⅝	11.5	3.36	2.6	0.88	1.3	0.98	0.57
3 x 3 x½	9.4	2.75	2.2	0.90	1.1	0.93	0.58
3 x 3 x⁷⁄₁₆	8.3	2.43	2.0	0.91	0.95	0.91	0.58
3 x 3 x⅜	7.2	2.11	1.8	0.91	0.83	0.89	0.58
3 x 3 x⁵⁄₁₆	6.1	1.78	1.5	0.92	0.71	0.87	0.59
3 x 3 x¼	4.9	1.44	1.2	0.93	0.58	0.84	0.59
2½x2½x½	7.7	2.25	1.2	0.74	0.73	0.81	0.47
2½x2½x⅜	5.9	1.73	0.98	0.75	0.57	0.76	0.48
2½x2½x⁵⁄₁₆	5.0	1.47	0.85	0.76	0.48	0.74	0.49
2½x2½x¼	4.1	1.19	0.70	0.77	0.39	0.72	0.49
2½x2½x³⁄₁₆	3.07	0.90	0.55	0.78	0.30	0.69	0.49
2½x2½x⅛	2.08	0.61	0.38	0.79	0.20	0.67	0.50
2 x 2 x⅜	4.7	1.36	0.48	0.59	0.35	0.64	0.39
2 x 2 x⁵⁄₁₆	3.92	1.15	0.42	0.60	0.30	0.61	0.39
2 x 2 x¼	3.19	0.94	0.35	0.61	0.25	0.59	0.39
2 x 2 x³⁄₁₆	2.44	0.71	0.28	0.62	0.19	0.57	0.40
2 x 2 x⅛	1.65	0.48	0.19	0.63	0.13	0.55	0.40
1¾x1¾x⅜	3.99	1.17	0.31	0.51	0.26	0.57	0.34
1¾x1¾x⁵⁄₁₆	3.39	1.00	0.27	0.52	0.23	0.55	0.34
1¾x1¾x¼	2.77	0.81	0.23	0.53	0.19	0.53	0.34
1¾x1¾x³⁄₁₆	2.12	0.62	0.18	0.54	0.14	0.51	0.35
1¾x1¾x⅛	1.44	0.42	0.13	0.55	0.10	0.48	0.35
1½x1½x⅜	3.35	0.98	0.19	0.44	0.19	0.51	0.29
1½x1½x⁵⁄₁₆	2.86	0.84	0.16	0.44	0.16	0.49	0.29
1½x1½x¼	2.34	0.69	0.14	0.45	0.13	0.47	0.29
1½x1½x³⁄₁₆	1.80	0.53	0.11	0.46	0.10	0.44	0.29
1½x1½x⅛	1.23	0.36	0.08	0.46	0.07	0.42	0.30
1¼x1¼x⁵⁄₁₆	2.33	0.68	0.09	0.36	0.11	0.42	0.24
1¼x1¼x¼	1.92	0.56	0.08	0.37	0.09	0.40	0.24
1¼x1¼x³⁄₁₆	1.48	0.43	0.06	0.38	0.07	0.38	0.24
1¼x1¼x⅛	1.01	0.30	0.04	0.38	0.05	0.35	0.25
1 x 1 x¼	1.49	0.44	0.04	0.29	0.06	0.34	0.19
1 x 1 x³⁄₁₆	1.16	0.34	0.03	0.30	0.04	0.32	0.19
1 x 1 x⅛	0.80	0.23	0.02	0.31	0.03	0.30	0.19

PROPERTIES OF ANGLES
Unequal Legs

Size	Weight per Foot	Area of Section	Axis 1-1				Axis 2-2				Axis 3-3 min.
Inches	Lbs.	In.²	I In.⁴	r In.	S In.³	x In.	I In.⁴	r In.	S In.³	y In.	In.
8 x 6 x 1	44.2	13.00	80.8	2.49	15.1	2.65	38.8	1.73	8.9	1.65	1.28
8 x 6 x 15/16	41.7	12.25	76.6	2.50	14.3	2.63	36.8	1.73	8.4	1.63	1.28
8 x 6 x 7/8	39.1	11.48	72.3	2.51	13.4	2.61	34.9	1.74	7.9	1.61	1.28
8 x 6 x 13/16	36.5	10.72	67.9	2.52	12.5	2.59	32.8	1.75	7.4	1.59	1.29
8 x 6 x 3/4	33.8	9.94	63.4	2.53	11.7	2.56	30.7	1.76	6.9	1.56	1.29
8 x 6 x 11/16	31.2	9.15	58.8	2.54	10.8	2.54	28.6	1.77	6.4	1.54	1.29
8 x 6 x 5/8	28.5	8.36	54.1	2.54	9.9	2.52	26.3	1.77	5.9	1.52	1.30
8 x 6 x 9/16	25.7	7.56	49.3	2.55	8.9	2.50	24.0	1.78	5.3	1.50	1.30
8 x 6 x 1/2	23.0	6.75	44.3	2.56	8.0	2.47	21.7	1.79	4.8	1.47	1.30
8 x 6 x 7/16	20.2	5.93	39.2	2.57	7.1	2.45	19.3	1.80	4.2	1.45	1.30
8 x 3½ x 1	35.7	10.50	66.2	2.51	13.7	3.17	7.8	0.86	3.0	0.92	0.73
8 x 3½ x 15/16	33.7	9.90	62.9	2.52	12.9	3.14	7.4	0.87	2.9	0.89	0.73
8 x 3½ x 7/8	31.7	9.30	59.4	2.53	12.2	3.12	7.1	0.87	2.7	0.87	0.73
8 x 3½ x 13/16	29.6	8.68	55.9	2.54	11.4	3.10	6.7	0.88	2.5	0.85	0.73
8 x 3½ x 3/4	27.5	8.06	52.3	2.55	10.6	3.07	6.3	0.88	2.3	0.82	0.73
8 x 3½ x 11/16	25.3	7.43	48.5	2.56	9.8	3.05	5.9	0.89	2.2	0.80	0.73
8 x 3½ x 5/8	23.2	6.80	44.7	2.57	9.0	3.03	5.4	0.90	2.0	0.78	0.74
8 x 3½ x 9/16	21.0	6.15	40.8	2.57	8.2	3.00	5.0	0.90	1.8	0.75	0.74
8 x 3½ x 1/2	18.7	5.50	36.7	2.58	7.3	2.98	4.5	0.91	1.6	0.73	0.74
8 x 3½ x 7/16	16.5	4.84	32.5	2.59	6.4	2.95	4.1	0.92	1.5	0.70	0.74
7 x 3½ x 1	32.3	9.50	45.4	2.19	10.6	2.70	7.5	0.89	3.0	0.96	0.74
7 x 3½ x 15/16	30.5	8.97	43.1	2.19	10.0	2.69	7.2	0.89	2.8	0.94	0.74
7 x 3½ x 7/8	28.7	8.42	40.8	2.20	9.4	2.66	6.8	0.90	2.6	0.91	0.74
7 x 3½ x 13/16	26.8	7.87	38.4	2.21	8.8	2.64	6.5	0.91	2.5	0.89	0.74
7 x 3½ x 3/4	24.9	7.31	36.0	2.22	8.2	2.62	6.1	0.91	2.3	0.87	0.74
7 x 3½ x 11/16	23.0	6.75	33.5	2.23	7.6	2.60	5.7	0.92	2.1	0.85	0.74
7 x 3½ x 5/8	21.0	6.17	30.9	2.24	7.0	2.57	5.3	0.93	2.0	0.82	0.75
7 x 3½ x 9/16	19.1	5.59	28.2	2.25	6.3	2.55	4.9	0.93	1.8	0.80	0.75
7 x 3½ x 1/2	17.0	5.00	25.4	2.25	5.7	2.53	4.4	0.94	1.6	0.78	0.75
7 x 3½ x 7/16	15.0	4.40	22.6	2.26	5.0	2.50	4.0	0.95	1.4	0.75	0.76
7 x 3½ x 3/8	13.0	3.80	19.6	2.27	4.3	2.48	3.5	0.96	1.3	0.73	0.76
6 x 4 x 1	30.6	9.00	30.8	1.85	8.0	2.17	10.8	1.09	3.8	1.17	0.85
6 x 4 x 15/16	28.9	8.50	29.3	1.86	7.6	2.14	10.3	1.10	3.6	1.14	0.85
6 x 4 x 7/8	27.2	7.98	27.7	1.86	7.2	2.12	9.8	1.11	3.4	1.12	0.86
6 x 4 x 13/16	25.4	7.47	26.1	1.87	6.7	2.10	9.2	1.11	3.2	1.10	0.86
6 x 4 x 3/4	23.6	6.94	24.5	1.88	6.2	2.08	8.7	1.12	3.0	1.08	0.86
6 x 4 x 11/16	21.8	6.40	22.8	1.89	5.8	2.06	8.1	1.13	2.8	1.06	0.86
6 x 4 x 5/8	20.0	5.86	21.1	1.90	5.3	2.03	7.5	1.13	2.5	1.03	0.86
6 x 4 x 9/16	18.1	5.31	19.3	1.90	4.8	2.01	6.9	1.14	2.3	1.01	0.87
6 x 4 x 1/2	16.2	4.75	17.4	1.91	4.3	1.99	6.3	1.15	2.1	0.99	0.87
6 x 4 x 7/16	14.3	4.18	15.5	1.92	3.8	1.96	5.6	1.16	1.8	0.96	0.87
6 x 4 x 3/8	12.3	3.61	13.5	1.93	3.3	1.94	4.9	1.17	1.6	0.94	0.88

PROPERTIES OF ANGLES
Unequal Legs

Size	Weight per Foot	Area of Section	Axis 1-1				Axis 2-2				Axis 3-3
			I	r	S	x	I	r	S	y	r min.
Inches	Lbs.	In.²	In.⁴	In.	In.³	In.	In.⁴	In.	In.³	In.	In.
6 x 3½ x 1	28.9	8.50	29.2	1.85	7.8	2.26	7.2	0.92	2.9	1.01	0.74
6 x 3½ x 15/16	27.3	8.03	27.8	1.86	7.4	2.24	6.9	0.93	2.7	0.99	0.74
6 x 3½ x 7/8	25.7	7.55	26.4	1.87	7.0	2.22	6.6	0.93	2.6	0.97	0.75
6 x 3½ x 13/16	24.0	7.06	24.9	1.88	6.6	2.20	6.2	0.94	2.4	0.95	0.75
6 x 3½ x 3/4	22.4	6.56	23.3	1.89	6.1	2.18	5.8	0.94	2.3	0.93	0.75
6 x 3½ x 11/16	20.6	6.06	21.7	1.89	5.6	2.15	5.5	0.95	2.1	0.90	0.75
6 x 3½ x 5/8	18.9	5.55	20.1	1.90	5.2	2.13	5.1	0.96	1.9	0.88	0.75
6 x 3½ x 9/16	17.1	5.03	18.4	1.91	4.7	2.11	4.7	0.96	1.8	0.86	0.75
6 x 3½ x 1/2	15.3	4.50	16.6	1.92	4.2	2.08	4.3	0.97	1.6	0.83	0.76
6 x 3½ x 7/16	13.5	3.97	14.8	1.93	3.7	2.06	3.8	0.98	1.4	0.81	0.76
6 x 3½ x 3/8	11.7	3.42	12.9	1.94	3.3	2.04	3.3	0.99	1.2	0.79	0.77
6 x 3½ x 5/16	9.8	2.87	10.9	1.95	2.7	2.01	2.9	1.00	1.0	0.76	0.77
5 x 4 x 7/8	24.2	7.11	16.4	1.52	5.0	1.71	9.2	1.14	3.3	1.21	0.84
5 x 4 x 13/16	22.7	6.65	15.5	1.53	4.7	1.68	8.7	1.15	3.1	1.18	0.84
5 x 4 x 3/4	21.1	6.19	14.6	1.54	4.4	1.66	8.2	1.15	2.9	1.16	0.84
5 x 4 x 11/16	19.5	5.72	13.6	1.54	4.1	1.64	7.7	1.16	2.7	1.14	0.84
5 x 4 x 5/8	17.8	5.23	12.6	1.55	3.7	1.62	7.1	1.17	2.5	1.12	0.84
5 x 4 x 9/16	16.2	4.75	11.6	1.56	3.4	1.60	6.6	1.18	2.3	1.10	0.85
5 x 4 x 1/2	14.5	4.25	10.5	1.57	3.1	1.57	6.0	1.18	2.0	1.07	0.85
5 x 4 x 7/16	12.8	3.75	9.3	1.58	2.7	1.55	5.3	1.19	1.8	1.05	0.85
5 x 4 x 3/8	11.0	3.23	8.1	1.59	2.3	1.53	4.7	1.20	1.6	1.03	0.86
5 x 3½ x 7/8	22.7	6.67	15.7	1.53	4.9	1.79	6.2	0.96	2.5	1.04	0.75
5 x 3½ x 13/16	21.3	6.25	14.8	1.54	4.6	1.77	5.9	0.97	2.4	1.02	0.75
5 x 3½ x 3/4	19.8	5.81	13.9	1.55	4.3	1.75	5.6	0.98	2.2	1.00	0.75
5 x 3½ x 11/16	18.3	5.37	13.0	1.56	4.0	1.72	5.2	0.98	2.1	0.97	0.75
5 x 3½ x 5/8	16.8	4.92	12.0	1.56	3.7	1.70	4.8	0.99	1.9	0.95	0.75
5 x 3½ x 9/16	15.2	4.47	11.0	1.57	3.3	1.68	4.4	1.00	1.7	0.93	0.75
5 x 3½ x 1/2	13.6	4.00	10.0	1.58	3.0	1.66	4.0	1.01	1.6	0.91	0.75
5 x 3½ x 7/16	12.0	3.53	8.9	1.59	2.6	1.63	3.6	1.01	1.4	0.88	0.76
5 x 3½ x 3/8	10.4	3.05	7.8	1.60	2.3	1.61	3.2	1.02	1.2	0.86	0.76
5 x 3½ x 5/16	8.7	2.56	6.6	1.61	1.9	1.59	2.7	1.03	1.0	0.84	0.76
5 x 3 x 13/16	19.9	5.84	14.0	1.55	4.5	1.86	3.7	0.80	1.7	0.86	0.64
5 x 3 x 3/4	18.5	5.44	13.2	1.55	4.2	1.84	3.5	0.80	1.6	0.84	0.64
5 x 3 x 11/16	17.1	5.03	12.3	1.56	3.9	1.82	3.3	0.81	1.5	0.82	0.64
5 x 3 x 5/8	15.7	4.61	11.4	1.57	3.5	1.80	3.1	0.81	1.4	0.80	0.64
5 x 3 x 9/16	14.3	4.18	10.4	1.58	3.2	1.77	2.8	0.82	1.3	0.77	0.65
5 x 3 x 1/2	12.8	3.75	9.5	1.59	2.9	1.75	2.6	0.83	1.1	0.75	0.65
5 x 3 x 7/16	11.3	3.31	8.4	1.60	2.6	1.73	2.3	0.84	1.0	0.73	0.65
5 x 3 x 3/8	9.8	2.86	7.4	1.61	2.2	1.70	2.0	0.84	0.89	0.70	0.65
5 x 3 x 5/16	8.2	2.40	6.3	1.61	1.9	1.68	1.8	0.85	0.75	0.68	0.66

PROPERTIES OF ANGLES
Unequal Legs

Size	Weight per Foot	Area of Section	Axis 1-1				Axis 2-2				Axis 3-3 r min.
			I	r	S	x	I	r	S	y	
Inches	Lbs.	In.²	In.⁴	In.	In.³	In.	In.⁴	In.	In.³	In.	In.
4½x 3 x 13/16	18.5	5.43	10.3	1.38	3.6	1.65	3.6	0.81	1.7	0.90	0.64
4½x 3 x ¾	17.3	5.06	9.7	1.39	3.4	1.63	3.4	0.82	1.6	0.88	0.64
4½x 3 x 11/16	16.0	4.68	9.1	1.39	3.1	1.60	3.2	0.83	1.5	0.85	0.64
4½x 3 x ⅝	14.7	4.30	8.4	1.40	2.9	1.58	3.0	0.83	1.4	0.83	0.64
4½x 3 x 9/16	13.3	3.90	7.8	1.41	2.6	1.56	2.8	0.85	1.3	0.81	0.64
4½x 3 x ½	11.9	3.50	7.0	1.42	2.4	1.54	2.5	0.85	1.1	0.79	0.65
4½x 3 x 7/16	10.6	3.09	6.3	1.43	2.1	1.51	2.3	0.85	1.0	0.76	0.65
4½x 3 x ⅜	9.1	2.67	5.5	1.44	1.8	1.49	2.0	0.86	0.88	0.74	0.66
4½x 3 x 5/16	7.7	2.25	4.7	1.44	1.5	1.47	1.7	0.87	0.75	0.72	0.66
4 x3½x ¾	17.3	5.06	7.3	1.20	2.8	1.34	5.2	1.01	2.1	1.09	0.72
4 x3½x 11/16	16.0	4.68	6.9	1.21	2.6	1.32	4.9	1.02	2.0	1.07	0.72
4 x3½x ⅝	14.7	4.30	6.4	1.22	2.4	1.29	4.5	1.03	1.8	1.04	0.72
4 x3½x 9/16	13.3	3.90	5.9	1.23	2.1	1.27	4.2	1.03	1.7	1.02	0.72
4 x3½x ½	11.9	3.50	5.3	1.23	1.9	1.25	3.8	1.04	1.5	1.00	p.72
4 x3½x 7/16	10.6	3.09	4.8	1.24	1.7	1.23	3.4	1.05	1.3	0.98	0.72
4 x3½x ⅜	9.1	2.67	4.2	1.25	1.5	1.21	3.0	1.06	1.2	0.96	0.73
4 x3½x 5/16	7.7	2.25	3.6	1.26	1.3	1.18	2.6	1.07	1.0	0.93	0.73
4 x 3 x 13/16	17.1	5.03	7.3	1.21	2.9	1.44	3.5	0.83	1.7	0.94	0.64
4 x 3 x ¾	16.0	4.69	6.9	1.22	2.7	1.42	3.3	0.84	1.6	0.92	0.64
4 x 3 x 11/16	14.8	4.34	6.5	1.22	2.5	1.39	3.1	0.84	1.5	0.89	0.64
4 x 3 x ⅝	13.6	3.98	6.0	1.23	2.3	1.37	2.9	0.85	1.4	0.87	0.64
4 x 3 x 9/16	12.4	3.62	5.6	1.24	2.1	1.35	2.7	0.86	1.2	0.85	0.64
4 x 3 x ½	11.1	3.25	5.0	1.25	1.9	1.33	2.4	0.86	1.1	0.83	0.64
4 x 3 x 7/16	9.8	2.87	4.5	1.25	1.7	1.30	2.2	0.87	1.0	0.80	0.64
4 x 3 x ⅜	8.5	2.48	4.0	1.26	1.5	1.28	1.9	0.88	0.87	0.78	0.64
4 x 3 x 5/16	7.2	2.09	3.4	1.27	1.2	1.26	1.7	0.89	0.74	0.76	0.65
4 x 3 x ¼	5.8	1.69	2.8	1.28	1.0	1.24	1.4	0.89	0.60	0.74	0.65
3½x 3 x ¾	14.7	4.31	4.7	1.04	2.1	1.21	3.1	0.85	1.5	0.96	0.62
3½x 3 x 11/16	13.6	4.00	4.4	1.05	1.9	1.19	3.0	0.86	1.4	0.94	0.62
3½x 3 x ⅝	12.5	3.67	4.1	1.06	1.8	1.17	2.8	0.87	1.3	0.92	0.62
3½x 3 x 9/16	11.4	3.34	3.8	1.07	1.6	1.15	2.5	0.87	1.2	0.90	0.62
3½x 3 x ½	10.2	3.00	3.5	1.07	1.5	1.13	2.3	0.88	1.1	0.88	0.62
3½x 3 x 7/16	9.1	2.65	3.1	1.08	1.3	1.10	2.1	0.89	0.98	0.85	0.62
3½x 3 x ⅜	7.9	2.30	2.7	1.09	1.1	1.08	1.8	0.90	0.85	0.83	0.62
3½x 3 x 5/16	6.6	1.93	2.3	1.10	0.96	1.06	1.6	0.90	0.72	0.81	0.63
3½x 3 x ¼	5.4	1.56	1.9	1.11	0.78	1.04	1.3	0.91	0.58	0.79	0.63
3½x2½x ⅝	11.5	3.36	3.8	1.07	1.7	1.25	1.6	0.69	0.92	0.75	0.53
3½x2½x 9/16	10.4	3.06	3.6	1.08	1.6	1.23	1.5	0.70	0.84	0.73	0.53
3½x2½x ½	9.4	2.75	3.2	1.09	1.4	1.20	1.4	0.70	0.76	0.70	0.53
3½x2½x 7/16	8.3	2.43	2.9	1.09	1.3	1.18	1.2	0.71	0.68	0.68	0.54
3½x2½x ⅜	7.2	2.11	2.6	1.10	1.1	1.16	1.1	0.72	0.59	0.66	0.54
3½x2½x 5/16	6.1	1.78	2.2	1.11	0.93	1.14	0.94	0.73	0.50	0.64	0.54
3½x2½x ¼	4.9	1.44	1.8	1.12	0.75	1.11	0.78	0.74	0.41	0.61	0.54

PROPERTIES OF ANGLES
Unequal Legs

Size	Weight per Foot	Area of Section	Axis 1-1				Axis 2-2				Axis 3-3
			I	r	S	x	I	r	S	y	r min.
Inches	Lbs	In.²	In.⁴	In.	In.³	In.	In.⁴	In.	In.³	In.	In.
3 x2½x½	9.5	2.78	2.3	0.91	1.2	1.02	1.4	0.72	0.82	0.77	0.52
3 x2½x⁷⁄₁₆	8.5	2.50	2.1	0.91	1.0	1.00	1.3	0.72	0.74	0.75	0.52
3 x2½x⅜	7.6	2.21	1.9	0.92	0.93	0.98	1.2	0.73	0.66	0.73	0.52
3 x2½x⁵⁄₁₆	6.6	1.92	1.7	0.93	0.81	0.96	1.0	0.74	0.58	0.71	0.52
3 x2½x¼	5 6	1.62	1.4	0.94	0.69	0.93	0.90	0.74	0.49	0.68	0.53
3 x2½x³⁄₁₆	4 5	1.31	1.2	0.95	0.56	0.91	0.74	0.75	0.40	0.66	0.53
3 x 2 x½	7.7	2.25	1.9	0.92	1.0	1.08	0.67	0.55	0.47	0.58	0.43
3 x 2 x⁷⁄₁₆	6.8	2.00	1.7	0.93	0.89	1.06	0.61	0.55	0.42	0.56	0.43
3 x 2 x⅜	5.9	1.73	1.5	0.94	0.78	1.04	0.54	0.56	0.37	0.54	0.43
3 x 2 x⁵⁄₁₆	5.0	1.47	1.3	0.95	0.66	1.02	0.47	0.57	0.32	0.52	0.43
3 x 2 x¼	4.1	1.19	1.1	0.95	0.54	0.99	0.39	0.57	0.25	0.49	0.43
2½x 2 x½	6.8	2.00	1.1	0.75	0.70	0.88	0.64	0.56	0.46	0.63	0.42
2½x 2 x⁷⁄₁₆	6.1	1.78	1.0	0.76	0.62	0.85	0.58	0.57	0.41	0.60	0.42
2½x 2 x⅜	5.3	1.55	0.91	0.77	0.55	0.83	0.51	0.58	0.36	0.58	0.42
2½x 2 x⁵⁄₁₆	4.5	1.31	0.79	0.78	0.47	0.81	0.45	0.58	0.31	0.56	0.42
2½x 2 x¼	3.62	1.06	0.65	0.78	0.38	0.79	0.37	0.59	0.25	0.54	0.42
2½x 2 x³⁄₁₆	2.75	0.81	0.51	0.79	0.29	0.76	0.29	0.60	0.20	0.51	0.43
2½x 2 x⅛	1.86	0.55	0.35	0.80	0.20	0.74	0.20	0.61	0.13	0.49	0.43
2½x1½x⁵⁄₁₆	3.92	1.15	0.71	0.79	0.44	0.90	0.19	0.41	0.17	0.40	0.32
2½x1½x¼	3.19	0.94	0.59	0.79	0.36	0.88	0.16	0.41	0.14	0.38	0.32
2½x1½x³⁄₁₆	2.44	0.72	0.46	0.80	0.28	0.85	0.13	0.42	0.11	0.35	0.33
2¼x1½x½	5.6	1.63	0.75	0.68	0.54	0.86	0.26	0.40	0.26	0.48	0.32
2¼x1½x⁷⁄₁₆	5.0	1.45	0.68	0.69	0.48	0.83	0.24	0.41	0.23	0.46	0.32
2¼x1½x⅜	4.4	1.27	0.61	0.69	0.42	0.81	0.21	0.41	0.20	0.44	0.32
2¼x1½x⁵⁄₁₆	3.66	1.07	0.53	0.70	0.36	0.79	0.19	0.42	0.17	0.42	0.32
2¼x1½x¼	2.98	0.88	0.44	0.71	0.30	0.77	0.16	0.42	0.14	0.39	0.32
2¼x1½x³⁄₁₆	2.28	0.67	0.34	0.72	0.23	0.75	0.12	0.43	0.11	0.37	0.33
2 x1½x⅜	3.99	1.17	0.43	0.61	0.34	0.71	0.21	0.42	0.20	0.46	0.32
2 x1½x⁵⁄₁₆	3.39	1.00	0.38	0.62	0.29	0.69	0.18	0.42	0.17	0.44	0.32
2 x1½x¼	2.77	0.81	0.32	0.62	0.24	0.66	0.15	0.43	0.14	0.41	0.32
2 x1½x³⁄₁₆	2.12	0.62	0.25	0.63	0.18	0.64	0.12	0.44	0.11	0.39	0.32
2 x1½x⅛	1.44	0.42	0.17	0.64	0.13	0.62	0.09	0.45	0.08	0.37	0.33
2 x1¼x¼	2.55	0.75	0.30	0.63	0.23	0.71	0.09	0.34	0.10	0.33	0.27
2 x1¼x³⁄₁₆	1.96	0.57	0.23	0.64	0.18	0.69	0.07	0.35	0.08	0.31	0.27
1¾x1¼x¼	2.34	0.69	0.20	0.54	0.18	0.60	0.09	0.35	0.10	0.35	0.27
1¾x1¼x³⁄₁₆	1.80	0.53	0.16	0.55	0.14	0.58	0.07	0.36	0.08	0.33	0.27
1¾x1¼x⅛	1.23	0.36	0.11	0.56	0.09	0.56	0.05	0.37	0.05	0.31	0.27
1½x1¼x⁵⁄₁₆	2.59	0.76	0.16	0.45	0.16	0.52	0.10	0.35	0.11	0.40	0.26
1½x1¼x¼	2.13	0.63	0.13	0.46	0.13	0.50	0.08	0.36	0.09	0.38	0.26
1½x1¼x³⁄₁₆	1.64	0.48	0.10	0.46	0.10	0.48	0.07	0.37	0.07	0.35	0.26

ST. PAUL FOUNDRY CO.

EQUAL LEGGED ANGLES
Safe loads in pounds—uniformly loaded

Size of Angle	1	2	3	4	5	6	7	8	9	10
				DISTANCE BETWEEN SUPPORTS IN FEET						
8 x8 x¾	146283	73136	48757	36573	29250	24378	20902	18281	16256	14625
8 x8 x½	100440	50220	33480	25110	20092	16740	14343	12555	11160	10046
6 x6 x¾	79920	39960	26640	19980	15986	13210	11418	9990	8876	7962
6 x6 x½	55316	27663	18438	13826	11058	9225	7897	6918	6143	4535
6 x6 x⅜	42345	21172	14103	10575	8460	7065	6052	5287	4702	4230
5 x5 x½	37800	18900	12600	9450	7560	6300	5400	4725	4195	3780
5 x5 x⅜	29047	14512	9675	7267	5805	4837	4140	3622	3217	2902
4 x4 x½	23636	11823	7875	5906	4725	3937	3375	2958	2632	2362
4 x4 x⅜	18236	9123	6075	4556	3645	3037	2610	2284	2025	1822
4 x4 x$\frac{5}{16}$	15480	7740	5152	3870	3105	2587	2205	1935	1710	1552
3½x3½x⅜	13803	6907	4601	3453	2756	2306	1969	1721	1530	1384
3½x3½x$\frac{5}{16}$	11700	5850	3892	2925	2340	1957	1665	1462	1305	1170
3 x3 x⅜	9956	4983	3318	2485	1991	1665	1417	1248	1102	1001
3 x3 x$\frac{5}{16}$	8516	4263	2835	2126	1698	1417	1215	1068	945	855
3 x3 x¼	6952	3487	2317	1732	1395	1170	990	866	765	697
2½x2½x$\frac{5}{16}$	6848	3420	2283	1710	1372	1136	977	855	765	686
2½x2½x$\frac{5}{16}$	5760	2880	1923	1440	1147	956	821	720	641	573
2½x2½x¼	4680	2340	1563	1170	933	776	663	585	529	483
2 x2 x⅜	4196	2103	1395	1046	843	697	596	528	461	416
2 x2 x$\frac{5}{16}$	3600	1800	1203	900	720	596	517	450	405	360
2 x2 x¼	3003	1507	1001	753	596	506	427	371	337	303
1¾x1¾x$\frac{5}{16}$	2756	1373	922	686	551	461	393	349	303	270
1¾x1¾x¼	2283	1142	765	573	461	382	326	281	258	225
1⅝x1⅝x¼	866	427	292	213	168	146	123	112	101	
1¼x1¼x¼	1091	540	360	270	213	180	157	135	112	
1¼x1¼x⅛	585	292	191	146	112	90	78	67		
1 x1 x¼	675	337	225	168	135	112	90	78		
1 x1 x⅛	371	180	124	90	78					

For lengths to the right of heavy line the deflection will be greater than $\frac{1}{16}$".
For lengths to the right of dotted line the deflection will be greater than ⅜".

UNEQUAL LEGGED ANGLES
Safe loads in pounds—uniformly loaded
LONG LEG VERTICAL

Size of Angle	DISTANCE BETWEEN SUPPORTS IN FEET									
	1	2	3	4	5	6	7	8	9	10
8 x6 x¾	140040	70020	46676	35010	28012	23343	20002	17505	15558	14006
8 x6 x½	96243	48116	32085	24063	19248	16042	1372	12026	10687	9618
7 x3½x½	68163	34076	22725	17043	13635	11362	9731	8516	7571	6817
7 x3½x 5⁄16	60120	30060	20047	15030	12015	10012	8595	7515	6682	6007
6 x4 x½	51963	25976	17313	12993	10395	8651	7425	6491	5771	5197
6 x4 x⅜	39847	19912	13275	9967	7965	6637	5692	4972	4432	3982
6 x3½x½	50883	25436	16953	12723	10181	8482	7267	6356	5647	5085
6 x3½x⅜	38992	19507	13005	9742	7807	6502	5580	4883	4342	3892
5 x4 x½	36607	18303	12195	9157	7312	6097	5231	4578	4061	3656
5 x4 x⅜	28080	14040	9360	7020	5625	4680	4005	3510	3116	2812
5 x3½x½	35876	17943	11958	8977	7177	5985	5130	4488	3982	3588
5 x3½x⅜	27483	13736	9157	6873	5501	4578	3926	3431	3048	2745
5 x3½x 5⁄16	23287	11655	7762	5827	4657	3892	3330	2902	2587	2340
5 x3 x⅜	26876	13443	8955	6716	5377	4477	3836	3352	2981	2688
5 x3 x 5⁄16	22680	11340	7560	5670	4545	3780	3240	2835	2520	2272
4 x3½x⅜	18000	9000	5996	4500	3600	2992	2576	2250	2002	1800
4 x3½x 5⁄16	15120	7560	5040	3780	3015	2520	2160	1890	1687	1507
4 x3 x⅜	17516	8763	5838	4376	3498	2913	2497	2193	1946	1755
4 x3 x 5⁄16	14760	7380	4927	3690	2947	2475	2115	1845	1642	1485
3½x3 x⅜	13556	6783	4522	3386	2712	2261	1935	1687	1507	1361
3½x3 x 5⁄16	11520	5760	3847	2880	2295	1912	1642	1440	1282	1147
3½x2½x⅜	13196	6536	4365	3272	2621	2182	1867	1631	1451	1305
3½x2½x¼	9000	4500	2992	2250	1800	1507	1282	1125	990	900
3 x2½x⅜	9720	4860	3240	2430	1946	1620	1383	1215	1080	967
3 x2½x¼	6727	3363	2238	1676	1350	1125	967	832	742	675
3 x2 x⅜	9360	4680	3128	2340	1867	1552	1338	1170	1035	933
3 x2 x¼	6480	3241	2160	1620	1293	1080	922	810	720	652
2½x2 x⅜	6603	3296	2205	1653	1316	1102	945	821	731	663
2½x2 x¼	4556	2283	1518	1136	911	753	652	562	506	450
2 x1½x 5⁄16	2160	1080	720	540	427	360	315	270	236	213

For lengths to the right of **heavy** line the deflection will be greater than ¹⁄₄″

UNEQUAL LEGGED ANGLES

Safe loads in pounds—uniformly loaded

SHORT LEG VERTICAL

Size of Angle	DISTANCE BETWEEN SUPPORTS IN FEET									
	1	2	3	4	5	6	7	8	9	10
8 x6 x¾	83160	41580	27720	20790	16627	13860	11880	10495	9236	8313
8 x6 x½	57476	28732	19158	14360	11497	9573	8212	7183	6390	5748
7 x3½x½	19440	9720	6480	4860	3892	3240	2778	2430	2160	1946
7 x3½x⁷₁₆	17280	8628	5748	4410	3532	2947	2520	2205	1957	1755
6 x4 x½	24952	12476	8313	6232	4983	4151	3555	3116	2767	2497
6 x4 x⅜	19192	9607	6390	4792	3847	3195	2745	2407	2137	1912
6 x3½x½	19080	9540	6356	4770	3813	3172	2722	2385	2115	1912
6 x3½x⅜	14760	7380	4927	3690	2947	2452	2115	1845	1642	1485
5 x4 x½	24480	12240	8156	6120	4893	4072	3487	3060	2722	2452
5 x4 x⅜	18832	9427	6277	4702	3757	3150	2700	2362	2092	1890
5 x3½x½	18720	9360	6243	4680	3735	3128	2677	2340	2081	1867
5 x3½x⅜	14523	7256	4837	3622	2902	2418	2070	1811	1608	1451
5 x3½x⁵₁₆	12240	6120	4072	3060	2452	2047	1755	1530	1350	1215
5 x3 x⅝	10676	5339	3555	2666	2126	1777	1530	1327	1181	1068
5 x3 x⁷₁₆	9000	4500	2992	2250	1800	1507	1282	1125	990	900
4 x3½x⅝	14163	7076	4713	3543	2835	2351	2025	1766	1575	1417
4 x3½x⁷₁₆	12127	6052	4050	3037	2430	2024	1732	1507	1350	1215
4 x3 x⅜	10440	5220	3476	2610	2092	1732	1485	1305	1158	1035
4 x3 x⁷₁₆	8887	4432	2970	2227	1777	1485	1260	1102	990	877
3½x3 x⅜	10192	5096	3397	2542	2036	1697	1451	1271	1125	1012
3½x3 x⁷₁₆	8640	4320	2880	2160	1732	1440	1237	1080	967	855
3½x2½x⅜	7076	3532	2351	1766	1417	1181	1012	888	776	708
3½x2½x¼	4928	2407	1642	1237	990	810	697	607	540	495
3 x2½x⅜	6952	3476	2317	1732	1383	1159	990	866	770	697
3 x2½x¼	4792	2406	1597	1192	967	810	675	607	540	472
3 x2 x⅜	4443	2216	1485	1113	888	742	630	551	495	438
3 x2 x¼	2992	1507	990	742	607	495	427	382	337	293
2½x2 x⅜	4320	2160	1440	1080	866	720	618	540	472	427
2½x2 x¼	2992	1507	990	742	607	495	427	382	337	292
2 x1½x⁷₁₆	1316	652	438	326	258	213	191	168		

For lengths to the right of heavy line the deflection will be greater than ⁷₁₆".
For lengths to the right of dotted line the deflection will be greater than ⅜".

VALUE OF TWO ANGLES IN TENSION

FIBRE STRESS OF 18000 LBS. PER SQUARE INCH OF SECTION

Size of Angles	Grs. area 2Ls	⅝" Rivets Two Holes Ded.	⅝" Rivets Four Holes Ded.	¾" Rivets Two Holes Ded.	¾" Rivets Four Holes Ded.
2 x1½x⅛	1.24	17280			
¼	1.62	22320			
2 x2 x⅛	1.44	20880			
¼	1.88	27000			
5/16	2.30	33120			
⅜	2.72	38880			
2½x2 x⅛	1.62	24120			
¼	2.12	31320		30240	
5/16	2.62	38880		37440	
⅜	3.10	45720		43920	
3 x2 x¼	2.38	36000		34920	
5/16	2.94	44640		43200	
⅜	3.46	52200		50400	
3 x2½x¼	2.62	40320	33480	39240	31320
5/16	3.24	50040	41760	48600	38880
⅜	3.84	59040	48960	57240	45360
3½x2½x¼	2.88	45000	38160	43920	36000
5/16	3.56	55800	47520	54360	44640
⅜	4.22	65880	55800	64080	52200
3½x3 x¼	3.12	49500	42840	48420	40680
5/16	3.86	61200	52920	59760	50040
⅜	4.60	72720	62640	70920	59040
½	6.00	94320	80640	92160	76320
4 x3 x¼	3.38	54180	47520	53100	45360
5/16	4.18	66960	58680	65520	55800
⅜	4.96	79200	69120	77400	65520
7/16	5.74	91440	79560	89640	75960
½	6.50	103320	89640	101160	85320
4 x3½x¼	3.62	58500	51840	57420	49680
5/16	4.50	72720	64440	71280	61560
⅜	5.34	86040	75960	84240	72360
7/16	6.18	99360	87480	97560	83880
½	7.00	112320	98640	110160	94320
9/16	8.60	137880	120960	135000	115200
5 x3 x⅜	4.80	78120	69840	76680	66960
7/16	5.72	92880	82800	91080	79200
½	6.62	107280	95400	105480	91800
9/16	7.50	121320	107640	119160	102070
⅝	9.22	149040	132120	146160	126360
5 x3½x⅜	5.12	83880	75600	82440	72720
7/16	6.10	99720	89640	97920	86040
½	7.06	115200	103320	113400	99720
9/16	8.00	130320	116640	128160	112320
⅝	9.84	160200	143280	157320	137520

Size of Angles	Grs. area 2Ls	¾" Rivets Two Holes Ded.	¾" Rivets Four Holes Ded.	⅞" Rivets Two Holes Ded.	⅞" Rivets Four Holes Ded.
5 x4 x⅜	6.46	104400	92520	102600	88920
7/16	7.50	121320	107640	119160	103320
½	8.50	137160	121320	135000	117000
9/16	9.50	153360	135720	150840	130680
⅝	10.46	168480	148680	165600	142920
6 x3½x5/16	5.74	93600	83880	92160	81000
⅜	6.84	111240	99360	109440	95760
7/16	7.94	129240	115310	127080	111240
½	9.00	146160	130320	144000	126000
9/16	10.06	163440	145800	160920	140760
⅝	11.10	180000	160200	177120	154440
¾	13.12	212400	188640	209160	182160
6 x4 x⅜	6.06	99360	89640	97920	86760
7/16	7.22	118080	106200	116280	102600
½	8.36	136680	123120	134640	118800
9/16	9.50	155160	139320	153000	135000
⅝	10.62	173520	155880	171000	150840
11/16	11.72	191160	171360	188280	165600
¾	13.88	226080	202320	222840	195840
⅞	15.98	257420	232200	255960	224280
6 x6 x⅜	8.72	145080	133200	143280	129600
½	11.50	191160	176445	189000	171000
¾	16.88	280080	256320	276840	249840
7 x3½x⅜	7.6	125280	113760	123300	109800
7/16	8.80	144720	131040	142560	128970
½	10.00	164160	148320	162000	144000
9/16	11.18	183600	165960	181080	160920
⅝	12.34	202320	182520	199440	176640
¾	14.62	239400	215640	236160	209160
8 x6 x⅜	13.50	227160	211320	225000	207000
⅝	16.72	281160	261360	278280	255600
¾	19.88	334080	310320	330840	303840
⅞	22.96	385560	357840	381600	350932
1	26.00	435420	404640	432000	393750
8 x8 x½	15.50	263160	247320	261000	243000
⅝	19.22	326160	306360	323280	300600
¾	22.88	388080	364320	384840	357840
1	30.00	508320	476640	504000	468000

WEIGHTS AND AREAS OF ■ AND ● BARS

ONE CUBIC FOOT OF STEEL WEIGHING 489.6 POUNDS

Diameter of ● or Side of ■ (Inches)	Weight of ■ Bar per Lin. Foot (Pounds)	Weight of ● Bar per Lin. Foot (Pounds)	Area of ■ Bar (Sq. Ins.)	Area of ● Bar (Sq. Ins.)	Diameter of ● or Side of ■ (Inches)	Weight of ■ Bar per Lin. Foot (Pounds)	Weight of ● Bar per Lin. Foot (Pounds)	Area of ■ Bar (Sq. Ins.)	Area of ● Bar (Sq. Ins.)
0	......	......	......	......	3	30.60	24.03	9.0000	7.0686
1/16	.013	.010	.0039	.0031	1/16	31.89	25.04	9.3789	7.3662
1/8	.053	.042	.0156	.0123	1/8	33.20	26.08	9.7656	7.6699
3/16	.119	.094	.0352	.0276	3/16	34.55	27.13	10.160	7.9798
1/4	.212	.167	.0625	.0491	1/4	35.92	28.20	10.563	8.2958
5/16	.333	.261	.0977	.0767	5/16	37.31	29.30	10.973	8.6179
3/8	.478	.375	.1406	.1104	3/8	38.73	30.42	11.391	8.9462
7/16	.651	.511	.1914	.1503	7/16	40.18	31.56	11.816	9.2806
1/2	.850	.667	.2500	.1963	1/2	41.65	32.71	12.250	9.6211
9/16	1.076	.845	.3164	.2485	9/16	43.14	33.90	12.691	9.9678
5/8	1.328	1.043	.3906	.3068	5/8	44.68	35.09	13.141	10.321
11/16	1.608	1.262	.4727	.3712	11/16	46.24	36.31	13.598	10.680
3/4	1.913	1.502	.5625	.4418	3/4	47.82	37.56	14.063	11.045
13/16	2.245	1.763	.6602	.5185	13/16	49.42	38.81	14.535	11.416
7/8	2.603	2.044	.7656	.6013	7/8	51.05	40.10	15.016	11.793
15/16	2.989	2.347	.8789	.6903	15/16	52.71	41.40	15.504	12.177
1	3.400	2.670	1.0000	.7854	4	54.40	42.73	16.000	12.566
1/16	3.838	3.014	1.1289	.8866	1/16	56.11	44.07	16.504	12.962
1/8	4.303	3.379	1.2656	.9940	1/8	57.85	45.44	17.016	13.364
3/16	4.795	3.766	1.4102	1.1075	3/16	59.62	46.83	17.535	13.772
1/4	5.312	4.173	1.5625	1.2272	1/4	61.41	48.24	18.063	14.186
5/16	5.857	4.600	1.7227	1.3530	5/16	63.23	49.66	18.598	14.607
3/8	6.428	5.049	1.8906	1.4849	3/8	65.08	51.11	19.141	15.033
7/16	7.026	5.518	2.0664	1.6230	7/16	66.95	52.58	19.691	15.466
1/2	7.650	6.008	2.2500	1.7671	1/2	68.85	54.07	20.250	15.904
9/16	8.301	6.520	2.4414	1.9175	9/16	70.78	55.59	20.816	16.349
5/8	8.978	7.051	2.6406	2.0739	5/8	72.73	57.12	21.391	16.800
11/16	9.682	7.604	2.8477	2.2365	11/16	74.70	58.67	21.973	17.257
3/4	10.41	8.178	3.0625	2.4053	3/4	76.71	60.25	22.563	17.721
13/16	11.17	8.773	3.2852	2.5802	13/16	78.74	61.84	23.160	18.190
7/8	11.95	9.388	3.5156	2.7612	7/8	80.81	63.46	23.766	18.665
15/16	12.76	10.02	3.7539	2.9483	15/16	82.89	65.10	24.379	19.147
2	13.60	10.68	4.0000	3.1416	5	85.00	66.76	25.000	19.635
1/16	14.46	11.36	4.2539	3.3410	1/16	87.14	68.44	25.629	20.129
1/8	15.35	12.06	4.5156	3.5466	1/8	89.30	70.14	26.266	20.629
3/16	16.27	12.78	4.7852	3.7583	3/16	91.49	71.86	26.910	21.135
1/4	17.22	13.52	5.0625	3.9761	1/4	93.72	73.60	27.563	21.648
5/16	18.19	14.28	5.3477	4.2000	5/16	95.96	75.37	28.223	22.166
3/8	19.18	15.07	5.6406	4.4301	3/8	98.23	77.15	28.891	22.691
7/16	20.20	15.86	5.9414	4.6664	7/16	100.5	78.95	29.566	23.221
1/2	21.25	16.69	6.2500	4.9087	1/2	102.8	80.77	30.250	23.758
9/16	22.33	17.53	6.5664	5.1572	9/16	105.2	82.62	30.941	24.301
5/8	23.43	18.40	6.8906	5.4119	5/8	107.6	84.49	31.641	24.850
11/16	24.56	19.29	7.2227	5.6727	11/16	110.0	86.38	32.348	25.406
3/4	25.71	20.20	7.5625	5.9396	3/4	112.4	88.29	33.063	25.967
13/16	26.90	21.12	7.9102	6.2126	13/16	114.9	90.22	33.785	26.535
7/8	28.10	22.07	8.2656	6.4918	7/8	117.4	92.17	34.516	27.109
15/16	29.34	23.04	8.6289	6.7771	15/16	119.9	94.14	35.254	27.688

WEIGHTS AND AREAS OF ■ AND
● BARS

ONE CUBIC FOOT OF STEEL WEIGHING 489.6 POUNDS

Diameter of ● or Side of ■	Weight of ■ Bar per Lin. Foot	Weight of ● Bar per Lin. Foot	Area of ■ Bar	Area of ● Bar	Diameter of ● or Side of ■	Weight of ■ Bar per Lin. Foot	Weight of ● Bar per Lin. Foot	Area of ■ Bar	Area of ● Bar
Inches	Pounds	Pounds	Sq. Ins.	Sq. Ins.	Inches	Pounds	Pounds	Sq. Ins.	Sq. Ins.
6	122.4	96.14	36.000	28.274	**9**	275.4	216.3	81.000	63.617
1/16	125.0	98.14	36.754	28.866	1/16	279.2	219.3	82.129	64.504
1/8	127.6	100.2	37.516	29.465	1/8	283.1	222.3	83.266	65.397
3/16	130.2	102.2	38.285	30.069	3/16	287.0	225.4	84.410	66.296
1/4	132.8	104.3	39.063	30.680	1/4	290.9	228.5	85.563	67.201
5/16	135.5	106.4	39.848	31.296	5/16	294.9	231.6	86.723	68.112
3/8	138.2	108.5	40.641	31.919	3/8	298.8	234.7	87.891	69.029
7/16	140.9	110.7	41.441	32.548	7/16	302.8	237.8	89.066	69.953
1/2	143.6	112.8	42.250	33.183	1/2	306.9	241.0	90.250	70.882
9/16	146.5	114.9	43.066	33.824	9/16	310.9	244.2	91.441	71.818
5/8	149.2	117.2	43.891	34.472	5/8	315.0	247.4	92.641	72.760
11/16	152.1	119.4	44.723	35.125	11/16	319.1	250.6	93.848	73.708
3/4	154.9	121.7	45.563	35.785	3/4	323.2	253.8	95.063	74.662
13/16	157.8	123.9	46.410	36.450	13/16	327.4	257.1	96.285	75.622
7/8	160.8	126.2	47.266	37.122	7/8	331.6	260.4	97.516	76.589
15/16	163.6	128.5	48.129	37.800	15/16	335.8	263.7	98.754	77.561
7	166.6	130.9	49.000	38.485	**10**	340.0	267.0	100.00	78.540
1/16	169.6	133.2	49.879	39.175	1/16	344.3	270.4	101.25	79.525
1/8	172.6	135.6	50.766	39.871	1/8	348.6	273.8	102.52	80.516
3/16	175.6	137.9	51.660	40.574	3/16	352.9	277.1	103.79	81.513
1/4	178.7	140.4	52.563	41.282	1/4	357.2	280.6	105.06	82.516
5/16	181.8	142.8	53.473	41.997	5/16	361.6	284.0	106.35	83.525
3/8	184.9	145.3	54.391	42.718	3/8	366.0	287.4	107.64	84.541
7/16	188.1	147.7	55.316	43.445	7/16	370.4	290.9	108.94	85.563
1/2	191.3	150.2	56.250	44.179	1/2	374.9	294.4	110.25	86.590
9/16	194.4	152.7	57.191	44.918	9/16	379.3	297.9	111.57	87.624
5/8	197.7	155.2	58.141	45.664	5/8	383.8	301.5	112.89	88.664
11/16	200.9	157.8	59.098	46.415	11/16	388.4	305.0	114.22	89.710
3/4	204.2	160.3	60.063	47.173	3/4	392.9	308.6	115.56	90.763
13/16	207.6	163.0	61.035	47.937	13/16	397.5	312.2	116.91	91.821
7/8	210.8	165.6	62.016	48.707	7/8	402.1	315.8	118.27	92.886
15/16	214.2	168.2	63.004	49.483	15/16	406.7	319.5	119.63	93.957
8	217.6	170.9	64.000	50.266	**11**	411.4	323.1	121.00	95.033
1/16	221.0	173.6	65.004	51.054	1/16	416.1	326.8	122.38	96.116
1/8	224.5	176.3	66.016	51.849	1/8	420.8	330.5	123.77	97.206
3/16	227.9	179.0	67.035	52.649	3/16	425.5	334.3	125.16	98.301
1/4	231.4	181.8	68.063	53.456	1/4	430.3	338.0	126.56	99.402
5/16	234.9	184.5	69.098	54.269	5/16	435.1	341.7	127.97	100.51
3/8	238.5	187.3	70.141	55.088	3/8	439.9	345.5	129.39	101.62
7/16	242.1	190.1	71.191	55.914	7/16	444.8	349.3	130.82	102.74
1/2	245.7	192.9	72.250	56.745	1/2	449.7	353.2	132.25	103.87
9/16	249.3	195.8	73.316	57.583	9/16	454.6	357.0	133.69	105.00
5/8	252.9	198.6	74.391	58.426	5/8	459.5	360.9	135.14	106.14
11/16	256.6	201.5	75.473	59.276	11/16	464.4	364.8	136.60	107.28
3/4	260.3	204.4	76.563	60.132	3/4	469.4	368.7	138.06	108.43
13/16	264.0	207.4	77.660	60.994	13/16	474.4	372.6	139.54	109.59
7/8	267.8	210.3	78.766	61.863	7/8	479.5	376.6	141.02	110.75
15/16	271.6	213.3	79.879	62.737	15/16	484.5	380.5	142.50	111.92

TENSILE STRENGTH OF ■ AND ● BARS

AT 16,000 LBS. PER SQUARE INCH

		SQUARE						ROUND			
Side of Square	Weight Per Lineal ft.	Area at root of thread	Tensile Strength Not Upset	Area of Bar	Tensile Strength for Upset	Diameter	Weight per Lineal ft.	Area at root of thread	Tensile Strength Not Upset	Area of Bar	Tensile Strength for Upset
Ins.	Lbs.	Sq. Ins.	Lbs.	Sq. Ins.	Lbs.	Ins.	Lbs.	Sq. Ins.	Lbs.	Sq. Ins.	Lbs.
¼	.213	.026	430	.0625	1000	¼	.167	.026	430	.0491	786
⅜	.478	.068	1090	.1406	2250	⅜	.376	.068	1090	.1105	1770
½	.850	.126	2020	.2500	4000	½	.668	.126	2020	.1963	3140
⅝	1.328	.202	3230	.3906	6250	⅝	1.043	.202	3230	.3068	4910
¾	1.913	.302	4830	.5625	9000	¾	1.502	.302	4830	.4418	7070
⅞	2.603	.419	6720	.7656	12250	⅞	2.044	.419	6720	.6013	9620
1	3.400	.551	8800	1.000	16000	1	2.670	.551	8800	.7854	12570
1⅛	4.303	.694	11100	1.2656	20250	1⅛	3.380	.694	11100	.9940	15900
1¼	5.313	.893	14290	1.5625	25000	1¼	4.172	.893	14290	1.2272	19640
1⅜	6.428	1.057	16910	1.8906	32500	1⅜	5.049	1.057	16910	1.4849	23760
1½	7.650	1.295	20720	2.2500	36000	1½	6.008	1.295	20720	1.7671	28270
1⅝	8.978	1.515	24240	2.6406	42250	1⅝	7.051	1.515	24240	2.0739	33180
1¾	10.41	1.746	27900	3.0625	49000	1¾	8.178	1.746	27900	2.4053	38480
1⅞	11.95	2.051	32770	3.5156	56250	1⅞	9.388	2.051	32770	2.7612	44180
2	13.60	2.302	36830	4.0000	64000	2	10.68	2.302	36830	3.1416	50270
2⅛	15.35	2.650	42400	4.5156	72250	2⅛	12.06	2.650	42400	3.5466	56750
2¼	17.21	3.023	48370	5.0625	81000	2¼	13.52	3.023	48370	3.9761	63620
2⅜	19.18	3.419	54700	5.6406	90250	2⅜	15.06	3.419	54700	4.4301	70880
2½	21.25	3.719	59440	6.2500	100000	2½	16.69	3.719	59440	4.9087	78540
2⅝	23.43	4.155	66480	6.8906	110250	2⅝	18.40	4.155	66480	5.4119	86590
2¾	25.71	4.620	73900	7.5625	121000	2¾	20.20	4.619	73900	5.9396	95030
2⅞	28.10	5.108	81720	8.2656	132250	2⅞	22.07	5.108	81720	6.4918	103870
3	30.60	5.428	86850	9.0000	144000	3	24.03	5.428	86850	7.0686	113100
3⅛	33.20	5.957	95310	9.7656	156250	3⅛	26.08	5.957	95310	7.6699	122720
3¼	35.91	6.510	104160	10.563	169010	3¼	28.21	6.510	104160	8.2958	132730
3⅜	38.73	7.087	113390	11.391	182260	3⅜	30.42	7.087	113390	8.4462	143140
3½	41.65	7.548	120770	12.250	196000	3½	32.71	7.548	120770	9.6211	153940
3⅝	44.68	8.171	130740	13.141	210260	3⅝	35.09	8.171	130740	10.321	165140
3¾	47.81	8.641	138260	14.063	225010	3¾	37.55	8.641	138260	11.045	176720
3⅞	51.05	9.305	148880	15.016	240260	3⅞	40.10	9.305	148880	11.793	188690
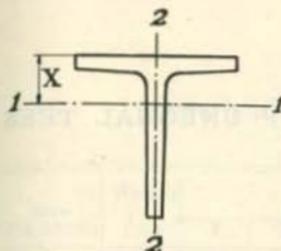
PROPERTIES OF EQUAL TEES

Size				Weight per Foot	Area of Section	Axis 1-1				Axis 2-2		
Flange	Stem	Minimum Thickness				I	r	S	x	I	r	S
		Flange	Stem									
In.	In.	In.	In.	Lbs.	In.²	In.⁴	In.	In.³	In.	In.⁴	In.	In.³
6½	6½	0.40	0.45	19.8	5.80	23.5	2.01	5.0	1.76	10.1	1.32	3.1
4	4	½	½	13.5	3.97	5.7	1.20	2.0	1.18	2.8	0.84	1.4
4	4	⅜	⅜	10.5	3.09	4.5	1.21	1.6	1.13	2.1	0.83	1.1
3½	3½	½	½	11.7	3.44	3.0	1.04	1.5	1.05	1.9	0.74	1.1
3½	3½	⅜	⅜	9.2	2.68	3.7	1.05	1.2	1.01	1.4	0.73	0.81
3	3	½	½	9.9	2.91	2.3	0.88	1.1	0.93	1.2	0.64	0.80
3	3	$\frac{7}{16}$	$\frac{7}{16}$	8.9	2.59	2.1	0.89	0.98	0.91	1.0	0.63	0.70
3	3	⅜	⅜	7.8	2.27	1.8	0.90	0.86	0.88	0.90	0.63	0.60
3	3	$\frac{5}{16}$	$\frac{5}{16}$	6.7	1.95	1.6	0.90	0.74	0.86	0.75	0.62	0.50
2½	2½	⅜	⅜	6.4	1.87	1.0	0.74	0.59	0.76	0.52	0.53	0.42
2½	2½	$\frac{5}{16}$	$\frac{5}{16}$	5.5	1.60	0.88	0.74	0.50	0.74	0.44	0.52	0.35
2¼	2¼	$\frac{5}{16}$	$\frac{5}{16}$	4.9	1.43	0.65	0.67	0.41	0.68	0.33	0.48	0.29
2¼	2¼	¼	¼	4.1	1.19	0.52	0.66	0.32	0.65	0.25	0.46	0.22
2	2	$\frac{5}{16}$	$\frac{5}{16}$	4.3	1.26	0.44	0.59	0.31	0.61	0.23	0.43	0.23
2	2	¼	¼	3.56	1.05	0.37	0.59	0.26	0.59	0.18	0.42	0.18
1¾	1¾	¼	¼	3.09	0.91	0.23	0.51	0.19	0.54	0.12	0.37	0.14
1½	1½	¼	¼	2.47	0.73	0.15	0.45	0.14	0.47	0.08	0.32	0.10
1½	1½	$\frac{3}{16}$	$\frac{3}{16}$	1.94	0.57	0.11	0.45	0.11	0.44	0.06	0.32	0.08
1¼	1¼	¼	¼	2.02	0.59	0.08	0.37	0.10	0.40	0.05	0.28	0.07
1¼	1¼	$\frac{3}{16}$	$\frac{3}{16}$	1.59	0.47	0.06	0.37	0.07	0.38	0.03	0.27	0.05
1	1	$\frac{3}{16}$	$\frac{3}{16}$	1.25	0.37	0.03	0.29	0.05	0.32	0.02	0.22	0.04
1	1	⅛	⅛	0.89	0.26	0.02	0.30	0.03	0.29	0.01	0.21	0.02
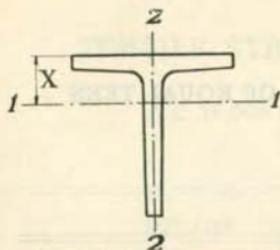
PROPERTIES OF UNEQUAL TEES

Size				Weight per Foot	Area of Section	Axis 1-1				Axis 2-2		
Flange	Stem	Minimum Thickness				I	r	S	x	I	r	S
		Flange	Stem									
In.	In.	In.	In.	Lbs.	In.²	In.⁴	In.	In.³	In.	In.⁴	In.	In.³
5	3	3/8	11/16	11.5	3.37	2.4	0.84	1.1	0.76	3.9	1.10	1.6
5	2½	3/8	11/16	10.9	3.18	1.5	0.68	0.78	0.63	4.1	1.14	1.6
4½	3½	7/16	11/16	15.7	4.60	5.1	1.05	2.1	1.11	3.7	0.90	1.7
4½	3	3/8	7/16	9.8	2.88	2.1	0.84	0.91	0.74	3.0	1.02	1.3
4½	3	5/16	3/8	8.4	2.46	1.8	0.85	0.78	0.71	2.5	1.01	1.1
4½	2½	3/8	3/8	9.2	2.68	1.2	0.67	0.63	0.59	3.0	1.05	1.3
4½	2½	5/16	5/16	7.8	2.29	1.0	0.68	0.54	0.57	2.5	1.05	1.1
4	5	1/2	1/2	15.3	4.50	10.8	1.55	3.1	1.56	2.8	0.79	1.4
4	5	3/8	3/8	11.9	3.49	8.5	1.56	2.4	1.51	2.1	0.78	1.1
4	4½	1/2	1/2	14.4	4.23	7.9	1.37	2.5	1.37	2.8	0.81	1.4
4	4½	3/8	3/8	11.2	3.29	6.3	1.39	2.0	1.31	2.1	0.80	1.1
4	3	3/8	3/8	9.2	2.68	2.0	0.86	0.90	0.78	2.1	0.89	1.1
4	3	5/16	5/16	7.8	2.29	1.7	0.87	0.77	0.75	1.8	0.88	0.88
4	2½	3/8	5/16	8.5	2.48	1.2	0.69	0.62	0.62	2.1	0.92	1.0
4	2½	5/16	5/16	7.2	2.12	1.0	0.69	0.53	0.60	1.8	0.91	0.88
4	2	3/8	5/16	7.8	2.27	0.60	0.52	0.40	0.48	2.1	0.96	1.1
4	2	5/16	1/4	6.7	1.95	0.53	0.52	0.34	0.46	1.8	0.95	0.88
3½	4	1/2	1/2	12.6	3.70	5.5	1.21	2.0	1.24	1.9	0.72	1.1
3½	4	3/8	5/8	9.8	2.88	4.3	1.23	1.5	1.19	1.4	0.70	0.81
3½	3	3/8	1/2	10.8	3.17	2.4	0.87	1.1	0.88	1.9	0.77	1.1
3½	3	3/8	3/8	8.5	2.48	1.9	0.88	0.89	0.83	1.4	0.75	0.81
3½	3	5/16	5/16	7.5	2.20	1.8	0.91	0.85	0.85	1.2	0.74	0.68
3	4	1/2	1/2	11.7	3.44	5.2	1.23	1.9	1.32	1.2	0.59	0.81
3	4	5/16	5/16	10.5	3.06	4.7	1.23	1.7	1.29	1.1	0.59	0.70
3	4	5/8	5/8	9.2	2.68	4.1	1.24	1.5	1.27	0.90	0.58	0.60
3	3½	1/2	1/2	10.8	3.17	3.5	1.06	1.5	1.12	1.2	0.62	0.80
3	3½	5/16	5/16	9.7	2.83	3.2	1.06	1.3	1.10	1.0	0.60	0.69
3	3½	3/8	3/8	8.5	2.48	2.8	1.07	1.2	1.07	0.93	0.61	0.62
3	2½	5/16	5/16	7.1	2.07	1.1	0.72	0.60	0.71	0.89	0.66	0.59
3	2½	5/16	5/16	6.1	1.77	0.94	0.73	0.52	0.68	0.75	0.65	0.50
2½	3	3/8	5/8	7.1	2.07	1.7	0.91	0.84	0.95	0.53	0.51	0.42
2½	3	5/16	5/16	6.1	1.77	1.5	0.92	0.72	0.92	0.44	0.50	0.35
2½	1¼	1/4	1/4	2.87	0.84	0.08	0.31	0.09	0.32	0.29	0.58	0.23
2	1½	1/4	1/4	3.09	0.91	0.16	0.42	0.15	0.42	0.18	0.45	0.18
1½	2	1/8	1/8	2.45	0.72	0.27	0.61	0.19	0.63	0.06	0.92	0.08
1½	1¼	1/8	1/8	1.25	0.37	0.05	0.37	0.05	0.33	0.04	0.32	0.05
1¼	5/8	No. 9	5/8	0.88	0.26	0.01	0.16	0.01	0.16	0.02	0.31	0.04

STANDARD TEES

Safe loads in pounds—uniformly loaded

Size Flg.&Stem	Weight Per Foot	LENGTH IN FEET									
		1	2	3	4	5	6	7	8	9	10
5 x3	13.4	12836	6423	4275	3217	2565	2137	1833	1608	1428	1282
5 x2½	10.9	10080	5040	3363	2520	2013	1681	1440	1260	1121	1006
4½x3	9.8	10923	5456	3645	2733	2182	1822	1563	1361	1215	1091
4½x3	8.4	9360	4680	3116	2340	1867	1563	1338	1170	1035	933
4 x5	15.3	37563	18776	12521	9382	7515	6255	5366	4691	4173	3757
4 x5	11.9	29160	14580	9720	7290	5827	4860	4162	3645	3240	2913
4 x4	13.5	24243	12127	8077	6063	4848	4038	3465	3026	2677	2424
4 x4	10.5	18956	9483	6311	4736	3791	3155	2711	2373	2103	1895
4 x3	9.2	10800	5400	3600	2700	2160	1800	1541	1350	1203	1080
4 x3	7.8	9236	4623	3071	2317	1845	1535	1316	1158	1029	933
3½x4	12.6	23760	11880	7920	5940	4747	3960	3397	2970	2643	2373
3½x4	9.8	18596	9292	6198	4646	3723	3093	2655	2328	2058	1856
3½x3½	11.7	18360	9180	6120	4590	3672	3060	2632	2295	2041	1836
3½x3½	9.2	14276	7143	4758	3577	2855	2379	2047	1788	1586	1428
3½x3	10.8	13556	6783	4511	3397	2711	2250	1935	1698	1501	1355
3½x3	8.5	10676	5343	3555	3093	2137	1777	1518	1546	1186	1068
3½x3	7.5	10203	5107	3397	2553	2041	1698	1462	1276	1136	1023
3 x3	9.9	13196	6603	4398	3307	2643	2199	1890	1653	1462	1321
3 x3	8.9	11756	5883	3915	2947	2351	1957	1676	1473	1305	1175
3 x3	7.8	10316	5163	3442	2576	2064	1721	1473	1288	1147	1035
3 x3	6.7	8876	4443	2958	2216	1777	1479	1271	1108	984	888
3 x2½	7.1	7200	3600	2407	1800	1440	1203	1029	900	798	......
3 x2½	6.1	6243	3127	2081	1563	1248	1040	894	781	691	......
2½x3	7.1	10080	5040	3363	2520	2013	1676	1440	1260	1113	1001
2½x3	6.1	8640	4320	2880	2160	1721	1440	1226	1080	956	855
2½x2½	6.4	7076	3543	2351	1777	1417	1175	1012	888	781	......
2½x2½	5.5	5996	3003	2002	1507	1203	1001	855	753	669	......
2¼x2¼	4.9	4916	2463	1642	1237	990	821	703	618	......	......
2¼x2¼	4.1	3836	1923	1282	961	765	641	545	483	......	......
2 x2	4.3	3723	1856	1237	928	742	618	534	......	......	......
2 x2	3.56	3116	1563	1046	781	618	523	445	......	......	......
2 x1½	3.09	1800	900	596	450	360	298	......	......	......	......
1¾x1¾	3.09	2283	1147	720	573	461	382	......	......	......	......
1½x2	2.45	2283	1136	753	573	461	382	326	281	247	225
1½x1½	2.47	1676	838	556	421	331	281	......	......	......	......
1½x1½	1.94	1316	658	438	331	264	219	......	......	......	......
1¼x1¼	2.02	1136	568	380	281	......	......	......	......	......	......
1¼x1¼	1.59	877	438	292	219	......	......	......	......	......	......
1 x1	1.25	551	275	185	......	......	......	......	......	......	......
1 x1	0.89	393	191	129	......	......	......	......	......	......	......

Loads to right of heavy line will crack plastered ceiling.

	Weight Per Yard	Area of Section	Dimensions				Axis 1-1		
			a	b	c	g	I	r	x
	Pounds	Sq. In.	In.	In.	In.	In.	In.	In.	Ins.
Slope of upper side of lower flange is 13° or 2¾″ in 12″									
	110	10.80	6⅛	6⅛	2⅞		55.2	2.26	2.92
	100	9.84	5¾	5¾	2¾		44.0	2.11	2.73
	95	9.28	5⅝	5⅝	2⅛		38.8	2.05	2.65
	90	8.83	5⅝	5⅝	2⅝		34.4	1.97	2.55
	85	8.33	5⅛	5⅛	2⅛		30.1	1.90	2.47
	80	7.86	5	5	2½		26.4	1.83	2.38
	75	7.33	4⅞	4⅞	2⅜		22.9	1.77	2.30
	70	6.81	4⅝	4⅝	2⅜		19.7	1.70	2.22
	65	6.33	4⅛	4⅛	2⅜		16.9	1.63	2.14
	60	5.93	4¼	4¼	2⅜		14.6	1.57	2.05
PROPERTIES OF A. S. C. E. & LIGHT RAILS	55	5.38	4⅛	4⅛	2¼		12.0	1.50	1.97
	50	4.87	3⅞	3⅞	2⅛		9.9	1.43	1.88
	45	4.40	3⅛	3⅛	2		8.1	1.36	1.78
	40	3.94	3½	3½	1⅞		6.6	1.29	1.68
	35	3.44	3⅛	3⅛	1¾		5.2	1.23	1.60
	30	3.00	3⅛	3⅛	1⅛		4.1	1.16	1.52
	25	2.39	2¾	2¾	1½		2.5	1.02	1.33
	20	2.00	2⅝	2⅝	1⅛		1.9	0.99	1.27
	16	1.55	2⅜	2⅜	1⅛		1.2	0.89	1.15
	14	1.34	2⅛	2⅛	1⅛		0.76	0.75	1.02
	12	1.18	2	2	1		0.66	0.75	0.96
	10	0.96	1¾	1¾			0.40	0.65	0.87
	8	0.77	1⅛	1⅛			0.26	0.58	0.75
Series A — Properties of A. R. A. Rails	100	9.84	6	5½	2¾		48.9	2.23	2.75
	90	8.82	5⅝	5⅛	2⅛		38.7	2.09	2.54
	80	7.86	5⅛	4⅝	2½		28.8	1.91	2.31
	70	6.82	4¾	4¼	2⅝		21.1	1.76	2.20
	60	5.86	4½	4	2¼		15.4	1.62	2.13
Series B — Properties of A. R. A. Rails	100	9.85	5⅛	5	2⅞		41.3	2.05	2.63
	90	8.87	5⅛	4⅛	2⅞		32.3	1.91	2.45
	80	7.91	4⅛	4⅛	2⅛		25.1	1.78	2.27
	70	6.89	4⅜	4⅛	2⅝		18.6	1.64	2.16
	60	5.87	4⅛	3⅛	2⅛		13.3	1.51	1.95

PROPERTIES FOR SMALL CHANNELS

Depth, Inches	Flange Width, Ins.	Web Thickness, Inches	Weight Per Foot, Lbs.	Depth, Inches	Flange Width, Ins.	Web Thickness, Inches	Weight Per Foot, Lbs.	Depth, Inches	Flange Width, Ins.	Web Thickness, Inches	Weight Per Foot, Lbs.	Depth, Inches	Flange Width, Ins.	Web Thickness, Inches	Weight Per Foot, Lbs.
⅜	¼	⅛ / 15B	0.28	⅞	⅜	⅛	0.61	1½	½	¼	1.12	2	⅝	¼	1.95
⅝			0.35	1	⅜	⅛	0.68	1½	¾		1.53	2		¼	2.35
¾	⅜	W.G.	0.40	1	½	⅛	0.84	1½	¾	¼	1.76	2	1		2.40
			0.52	1¼	½	⅛	1.00	1½	¾	⅜	1.17	2½	⅝		2.27

NOTES ON COLUMNS

The tables for safe loads, pages 90 to 133, for I beam, channel and plate, angle and plate, single and double angle, Carnegie and Bethlehem H section, were calculated according to the formula and with a factor of safety as indicated in the heading in each case.

As there is no direct solution for the additional material required (reduction of the formulae shown) where the loads are eccentrically imposed upon the columns, we give a trial method herewith.

Assume a section in excess of that required for the direct compression, $W + W_1$ and compute the combined fibre stress; if it works out too small or too large, try again.
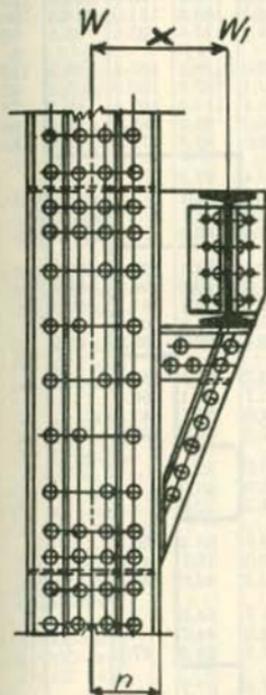
Let W = the direct load in pounds.

W_1 = the eccentric load in pounds.

M = the bending moment due to eccentric load in inch pounds, i. e. $W_1 x$.

I = the moment of inertia of column in direction of bending.

n = the distance from center of gravity of column to extreme fibre in direction of bending.

r = radius of gyration.

A = the area of column section, in sq. inches.

f = the allowable unit compression in pounds per sq. inch; then, f should be equal to or greater than

$$\frac{W + W_1}{A} + \frac{Mn}{I}$$

the fibre stresses due to compression and bending respectively.

BENDING FACTOR.

If the bending moment in inch pounds (produced by an eccentric load) is multiplied by $\frac{n}{r^2}$ (called the bending factor) the product is an equivalent direct load on the column producing the same compressive stress as the bending moment and this product should be added to the vertical direct loads.

VALUES OF SINGLE ANGLES IN COMPRESSION
LOAD IN THOUSANDS OF POUNDS

Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

S = Safe Fibre Stress Per Square Inch. r = Least Radius of Gyration in Inches. l = Length of Strut in Inches.

SIZE			Weight Pounds Per Foot	Area Sq. In.	Least Rad. of Gyration	LENGTH IN FEET							
						3	4	5	6	8	10	12	14
8	x8	x1	51.0	15.00	1.56	225.0	225.0	225.0	225.0	223.7	203.1	183.6	163.8
8	x8	x¾	38.9	11.44	1.57	171.6	171.6	171.6	171.6	170.6	155.9	144.0	125.8
8	x8	x⅝	32.7	9.61	1.58	144.1	144.1	144.1	144.1	143.3	131.0	118.5	106.5
8	x8	x½	26.4	7.75	1.58	116.2	116.2	116.2	116.2	115.6	105.6	95.5	85.9
8	x6	x1	44.2	13.00	1.28	195.0	195.0	195.0	195.0	178.2	156.9	136.9	119.8
8	x6	x¾	33.8	9.94	1.29	149.1	149.1	149.1	149.1	137.2	120.8	105.4	92.3
8	x6	x⅝	28.5	8.36	1.30	125.4	125.4	125.4	125.4	115.4	102.4	89.3	78.2
8	x6	x½	23.0	6.75	1.30	101.2	101.2	101.2	101.2	93.2	82.6	72.1	63.1
8	x6	x7⁄16	20.2	5.93	1.30	88.9	88.9	88.9	88.9	81.8	72.6	63.4	55.5
7	x3½	x¾	24.9	7.31	0.74	109.6	106.6	96.4	86.4	67.9	.....	.....	.....
7	x3½	x⅝	21.0	6.17	0.75	92.5	90.4	81.9	73.4	58.1	.....	.....	.....
7	x3½	x½	17.0	5.00	0.75	75.0	73.3	66.4	59.5	47.1	.....	.....	.....
7	x3½	x⅜	13.0	3.80	0.76	57.0	56.0	50.8	45.6	36.3	.....	.....	.....
6	x6	x1	37.4	11.00	1.16	165.0	165.0	165.0	163.1	143.1	124.5	106.7	.....
6	x6	x¾	28.7	8.44	1.17	126.6	126.6	126.6	125.9	110.6	96.2	82.5	.....
6	x6	x⅝	24.2	7.11	1.17	106.6	106.6	106.6	106.0	93.1	81.1	69.5	.....
6	x6	x½	19.6	5.75	1.18	86.2	86.2	86.2	85.8	75.8	65.6	56.6	.....
6	x6	x⅜	14.9	4.36	1.19	65.4	65.4	65.4	65.4	57.5	50.0	43.2	.....
6	x4	x¾	23.6	6.94	0.86	104.1	104.1	98.2	89.7	73.6	59.8	.....	.....
6	x4	x⅝	20.0	5.86	0.86	87.9	87.9	82.9	75.7	62.1	50.5	.....	.....
6	x4	x½	16.2	4.75	0.87	71.2	71.2	67.6	61.8	51.1	41.5	.....	.....
6	x4	x⅜	12.3	3.61	0.88	54.1	54.1	51.7	47.3	39.1	32.0	.....	.....
6	x3½	x⅝	18.9	5.55	0.75	83.2	81.3	73.7	66.0	52.3	.....	.....	.....
6	x3½	x½	15.3	4.50	0.76	67.5	66.3	60.5	53.9	43.0	.....	.....	.....
6	x3½	x⅜	11.7	3.42	0.77	51.3	50.7	46.0	41.2	32.9	.....	.....	.....
5	x5	x⅝	20.0	5.86	0.97	87.9	87.9	86.9	80.8	68.3	56.8	.....	.....
5	x5	x½	16.2	4.75	0.98	71.2	71.2	70.8	66.0	55.7	46.4	.....	.....
5	x5	x⅜	12.3	3.61	0.99	54.1	54.1	53.8	50.1	42.6	35.8	.....	.....
5	x4	x⅝	17.8	5.23	0.84	78.4	78.4	73.5	66.7	54.6	.....	.....	.....
5	x4	x½	14.5	4.25	0.85	63.7	63.7	59.7	54.6	44.7	.....	.....	.....
5	x4	x⅜	11.0	3.23	0.86	48.4	48.4	45.7	41.7	34.2	27.8	.....	.....
5	x3½	x½	13.6	4.00	0.75	60.0	58.6	53.1	47.6	37.7	.....	.....	.....
5	x3½	x⅜	10.4	3.05	0.76	45.7	45.0	40.8	36.5	29.2	.....	.....	.....
5	x3½	x5⁄16	8.7	2.56	0.76	38.4	37.7	34.2	30.7	24.5	.....	.....	.....
5	x3	x½	12.8	3.75	0.65	56.2	51.7	45.9	40.1	.....	.....	.....	.....
5	x3	x⅜	9.8	2.86	0.65	42.9	39.5	35.0	30.6	.....	.....	.....	.....
5	x3	x5⁄16	8.2	2.40	0.66	36.0	33.3	29.6	26.0	.....	.....	.....	.....

To left of heavy line $\dfrac{l}{r}$ does not exceed 120. To right of heavy line $\dfrac{l}{r}$ does not exceed 140.

VALUES OF SINGLE ANGLES IN COMPRESSION
LOAD IN THOUSANDS OF POUNDS

Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

S = Safe Fibre Stress Per Square Inch.   r = Least Radius of Gyration in Inches.   l = Length of Strut in Inches.

SIZE	Weight Pounds Per Foot	Area Sq. In.	Least Rad. of Gyration	LENGTH IN FEET							
				3	4	5	6	8	10	12	14
4 x4 x½	12.8	3.75	.78	56.3	55.6	50.8	45.9	36.7	.....	.....	.....
4 x4 x⅜	9.8	2.86	.79	42.9	42.7	39.0	35.3	28.2	.....	.....	.....
4 x4 x5/16	8.2	2.40	.79	36.0	35.8	32.7	29.6	23.6	.....	.....	.....
4 x3½x½	11.9	3.50	.72	52.5	50.4	45.6	40.5	31.8	.....	.....	.....
4 x3½x⅜	9.1	2.67	.73	40.1	38.7	35.0	31.1	24.6	.....	.....	.....
4 x3½x5/16	7.7	2.25	.73	33.8	32.6	29.5	26.2	20.7	.....	.....	.....
4 x3 x⅜	8.5	2.48	.64	37.2	34.0	29.9	26.1	.....	.....	.....	.....
4 x3 x5/16	7.2	2.09	.65	31.4	28.8	25.6	22.3	.....	.....	.....	.....
4 x3 x¼	5.8	1.69	.65	25.4	23.3	20.7	18.1	.....	.....	.....	.....
3½x3½x⅜	8.5	2.48	.69	37.2	35.1	31.4	27.9	21.5	.....	.....	.....
3½x3½x5/16	7.2	2.09	.69	31.4	29.6	26.5	23.5	18.1	.....	.....	.....
3½x3½x¼	5.8	1.69	.69	25.4	23.9	21.4	19.0	14.7	.....	.....	.....
3½x3 x⅜	7.9	2.30	.62	34.5	31.1	27.2	23.7	.....	.....	.....	.....
3½x3 x5/16	6.6	1.93	.63	29.0	26.3	23.1	20.2	.....	.....	.....	.....
3½x3 x¼	5.4	1.56	.63	23.4	21.3	18.7	16.3	.....	.....	.....	.....
3 x3 x⅜	7.2	2.11	.58	31.3	27.5	23.7	20.5	.....	.....	.....	.....
3 x3 x5/16	6.1	1.78	.59	26.5	23.5	20.3	17.5	.....	.....	.....	.....
3 x3 x¼	4.9	1.44	.59	21.5	19.0	16.4	14.2	.....	.....	.....	.....
3 x2½x⅜	6.6	1.92	.52	27.3	23.5	19.9	16.8	.....	.....	.....	.....
3 x2½x5/16	5.6	1.62	.53	23.2	20.0	17.0	14.4	.....	.....	.....	.....
3 x2½x¼	4.5	1.31	.53	18.8	16.2	13.8	11.6	.....	.....	.....	.....
3 x2 x⅜	5.9	1.73	.43	22.4	18.4	14.9	.....	.....	.....	.....	.....
3 x2 x5/16	5.0	1.47	.43	19.0	15.6	12.7	.....	.....	.....	.....	.....
3 x2 x¼	4.1	1.19	.43	15.4	12.6	102.5	.....	.....	.....	.....	.....
2½x2½x⅜	5.9	1.73	.48	23.7	20.0	16.7	.....	.....	.....	.....	.....
2½x2½x5/16	5.0	1.47	.49	20.4	17.3	14.5	.....	.....	.....	.....	.....
2½x2½x¼	4.1	1.19	.49	16.5	14.0	11.7	.....	.....	.....	.....	.....
2½x2 x5/16	4.5	1.31	.42	16.7	13.7	.....	.....	.....	.....	.....	.....
2½x2 x¼	3.62	1.06	.43	13.7	11.2	9.1	.....	.....	.....	.....	.....
2½x2 x3/16	2.75	0.81	.43	10.5	8.6	7.0	.....	.....	.....	.....	.....
2 x2 x5/16	3.92	1.15	.39	14.0	11.2	.....	.....	.....	.....	.....	.....
2 x2 x¼	3.19	.94	.39	11.4	9.2	.....	.....	.....	.....	.....	.....
2 x2 x5/16	2.44	.71	.40	8.8	7.1	.....	.....	.....	.....	.....	.....
2 x1½x¼	3.39	1.00	.32	10.6	.....	.....	.....	.....	.....	.....	.....
2 x1½x3/16	2.77	.81	.32	8.6	.....	.....	.....	.....	.....	.....	.....
2 x1½x⅛	2.12	.62	.32	6.6	.....	.....	.....	.....	.....	.....	.....

To left of heavy line $\dfrac{l}{r}$ does not exceed 120.   To right of heavy line $\dfrac{l}{r}$ does not exceed 140.

ST. PAUL FOUNDRY CO.
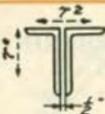
VALUES OF TWO ANGLES IN COMPRESSION
LONG LEGS TOGETHER
LOAD IN THOUSANDS OF POUNDS

By Formula
$$S = \frac{18000}{1 + \dfrac{l^2}{18000r^2}}$$

SIZE OF ANGLES	Weight of One Angle Lbs. Per Ft.	Area of Two Angles Sq. In.	Radii of Gyration	LENGTH IN FEET							
				4	6	8	10	12	14	16	18
7 x3½x 1/16	15.0	8.80	r°=2.26	132.0	132.0	132.0	132.0	129.0	121.4	113.0	104.7
			r²=1.39	132.0	132.0	132.0	125.3	112.2	98.9	87.3	77.0 ....
6 x4 x5/8	20.0	11.72	r°=1.90	175.8	175.8	175.8	172.8	159.7	147.5	134.6	122.5
			r²=1.71	175.8	175.8	175.8	165.8	151.5	137.5	124.3	112.1
6 x4 x3/8	12.3	7.22	r°=1.93	108.3	108.3	108.3	107.1	99.0	91.5	84.1	76.5
			r²=1.67	108.3	108.3	108.3	100.9	92.1	83.5	74.9	67.5
6 x3½x1/2	15.3	9.00	r°=1.92	135.0	135.0	135.0	133.5	123.4	114.0	104.1	95.4
			r²=1.45	135.0	135.0	130.4	117.1	104.9	92.7	81.7	....
6 x3½x3/8	11.7	6.84	r°=1.94	102.6	102.6	102.6	101.4	94.4	86.6	79.7	73.1
			r²=1.43	102.6	102.6	98.5	88.4	78.6	69.9	61.6	....
5 x4 x1/2	14.5	8.50	r°=1.57	127.5	127.5	126.8	115.8	104.0	93.5	83.7	74.4
			r²=1.77	127.5	127.5	127.5	121.7	112.1	101.9	92.8	83.7
5 x4 x3/8	11.0	6.46	r°=1.59	96.9	96.9	96.9	88.6	79.6	71.6	64.1	57.3
			r²=1.75	96.9	96.9	96.9	91.9	84.6	76.9	69.5	63.2
5 x3½x1/2	13.6	8.00	r°=1.58	120.0	120.0	119.3	109.0	98.6	88.6	78.8	70.5
			r²=1.54	120.0	120.0	118.6	107.6	97.0	86.7	77.1	68.9
5 x3½x 1/16	8.7	5.12	r°=1.61	76.8	76.8	76.8	70.6	64.0	57.5	51.6	46.1
			r²=1.50	76.8	76.8	75.0	67.9	60.9	54.3	48.2	42.8
5 x3 x1/2	12.8	7.50	r°=1.59	112.5	112.5	112.5	102.8	93.1	83.1	74.4	66.6
			r²=1.30	112.5	112.5	103.5	91.8	80.1	70.1	....	....
5 x3 x 1/16	8.2	4.80	r°=1.61	72.0	72.0	72.0	66.2	60.0	53.9	48.3	43.2
			r²=1.26	72.0	72.0	65.4	57.5	50.2	43.6	....	....
4 x3½x1/2	11.9	7.00	r°=1.23	105.0	105.0	94.1	82.2	71.6	61.6	....	....
			r²=1.63	105.0	105.0	105.0	96.6	88.1	79.3	71.0	64.0
4 x3½x 1/16	7.7	4.50	r°=1.26	67.5	67.5	61.3	53.9	47.0	40.8	....	....
			r²=1.59	67.5	67.5	67.5	61.7	55.5	49.8	44.6	39.9
4 x3 x1/2	11.1	6.50	r°=1.25	97.5	97.5	88.0	77.3	67.4	58.5	....	....
			r²=1.39	97.5	97.5	92.5	82.9	73.6	64.5	56.8	....
4 x3 x 1/16	7.2	4.18	r°=1.27	62.7	62.7	56.9	50.4	44.0	38.2	....	....
			r²=1.35	62.7	62.7	58.8	52.2	46.0	40.6	....	....
3½x3 x1/2	10.2	6.00	r°=1.08	90.0	86.4	75.0	64.1	54.5	....	....	....
			r²=1.44	90.0	90.0	86.4	78.1	69.4	61.3	54.4	....
3½x3 x 1/16	6.6	3.86	r°=1.10	57.9	56.3	48.9	41.8	35.5	....	....	....
			r²=1.40	57.9	57.9	54.9	49.2	43.7	38.6	34.0	....
3½x2½x3/8	7.2	4.22	r°=1.10	63.3	61.5	53.5	45.7	38.9	....	....	....
			r²=1.15	63.3	62.2	54.9	47.4	40.6	....	....	....
3½x2½x1/4	4.9	2.88	r°=1.12	43.2	42.2	36.7	31.7	26.9	....	....	....
			r²=1.13	43.2	42.2	37.0	31.9	27.3	....	....	....
3 x2½x3/8	6.6	3.84	r°=0.93	57.6	52.0	43.5	35.9	....	....	....	....
			r²=1.21	57.6	57.6	51.3	44.6	38.7	33.3	....	....
3 x2½x1/4	4.5	2.62	r°=0.95	39.3	35.7	30.1	25.0	....	....	....	....
			r²=1.18	39.3	39.1	34.5	29.9	25.8	....	....	....
3 x2 x3/8	5.9	3.46	r°=0.94	51.9	47.1	39.4	32.6	....	....	....	....
			r²=0.96	51.9	47.4	40.0	33.3	....	....	....	....
3 x2 x1/4	4.1	2.38	r°=0.96	35.7	32.6	27.5	22.9	....	....	....	....
			r²=0.93	35.7	32.2	26.9	22.2	....	....	....	....
2½x2 x3/8	5.3	3.10	r°=0.77	46.0	37.7	29.8	....	....	....	....	....
			r²=1.01	44.5	43.6	37.2	31.2	....	....	....	....
2½x2 x1/4	3.6	2.12	r°=0.78	31.4	25.9	20.7	....	....	....	....	....
			r²=0.98	31.8	29.4	24.9	20.9	....	....	....	....

To left of heavy line $\dfrac{l}{r}$ does not exceed 120. To right of heavy line $\dfrac{l}{r}$ does not exceed 140.
Radii of Gyration correspond to direction indicated by arrowheads.

VALUES OF TWO ANGLES IN COMPRESSION
SHORT LEGS TOGETHER
LOAD IN THOUSANDS OF POUNDS

By Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

SIZE OF ANGLES	Weight of One Angle Lbs. Per Ft.	Area of Two Angles Sq. In.	Radii of Gyration	LENGTH IN FEET							
				4	6	8	10	12	14	16	18
7 x3½x₁₆	15.0	8.80	r⁰=0.95	132.0	119.9	101.1	84.2	....	....	....	....
			r²=3.56	132.0	132.0	132.0	132.0	132.0	132.0	132.0	131.3
6 x4 x⅝	20.0	11.72	r⁰=1.13	175.8	171.83	150.5	129.9	111.3	....	....	....
			r²=2.97	175.8	175.8	175.8	175.8	175.8	175.8	170.9	162.8
6 x4 x⅜	12.3	7.22	r⁰=1.17	108.3	104.6	94.6	81.8	70.6	....	....	....
			r²=2.92	108.3	108.3	108.3	108.3	108.3	108.3	104.6	99.6
6 x3½x½	15.3	9.00	r⁰=0.97	135.0	124.2	104.9	87.3	....	....	....	....
			r²=3.02	135.0	135.0	135.0	135.0	135.0	135.0	131.9	125.8
6 x3½x⅜	11.7	6.84	r⁰=0.99	102.6	95.0	80.8	67.9	....	....	....	....
			r²=3.00	102.6	102.6	102.6	102.6	102.6	102.6	100.3	95.6
5 x4 x½	14.5	8.50	r⁰=1.18	127.5	126.8	112.1	96.9	83.7	....	....	....
			r²=2.40	127.5	127.5	127.5	127.5	127.5	120.3	113.0	105.5
5 x4 x⅜	11.0	6.46	r⁰=1.20	96.9	96.9	85.8	74.7	64.6	....	....	....
			r²=2.38	96.9	96.9	96.9	96.9	96.3	90.8	85.2	79.6
5 x3½x½	13.6	8.00	r⁰=1.01	120.0	112.5	95.9	80.6	....	....	....	....
			r²=2.47	120.0	120.0	120.0	120.0	120.0	114.6	107.6	101.4
5 x3½x₁₆	8.7	5.12	r⁰=1.03	76.8	72.4	62.24	52.73	....	....	....	....
			r²=2.44	76.8	76.8	76.8	76.8	76.8	72.9	68.4	64.0
5 x3 x½	12.8	7.50	r⁰=0.83	112.5	95.0	77.3	....	....	....	....	....
			r²=2.54	112.5	112.5	112.5	112.5	112.5	108.7	102.2	96.3
5 x3 x₁₆	8.2	4.80	r⁰=0.85	72.0	61.7	50.5	....	....	....	....	....
			r²=2.51	72.0	72.0	72.0	72.0	72.0	69.2	65.0	61.2
4 x3½x½	11.9	7.00	r⁰=1.04	105.0	99.6	85.6	72.6	61.2	....	....	....
			r²=1.94	105.0	105.0	105.0	103.8	96.6	88.7	81.6	74.8
4 x3½x₁₆	7.7	4.50	r⁰=1.07	67.5	64.8	55.9	47.7	40.2	....	....	....
			r²=1.91	67.5	67.5	67.5	66.4	61.7	56.6	52.0	47.4
4 x3 x½	11.1	6.50	r⁰=0.87	97.5	84.6	70.0	56.9	....	....	....	....
			r²=2.01	97.5	97.5	97.5	97.5	90.8	84 6	77.9	71.5
4 x3 x₁₆	7.2	4.18	r⁰=0.89	62.7	55.1	45.7	37.4	....	....	....	....
			r²=1.97	62.7	62.7	62.7	62.4	58.0	53.7	49.4	45.0
3½x3 x½	10.2	6.00	r⁰=0.88	90.0	78.6	65.0	53.3	....	....	....	....
			r²=1.75	90.0	90.0	90.0	85.9	78.6	71.4	64.6	58.7
3½x3 x₁₆	6.6	3.86	r⁰=0.90	57.9	51.3	42.5	35.04	....	....	....	....
			r²=1.71	57.9	57.9	57.9	54.6	50.0	45.3	40.9	36.9
3½x2½x⅜	7.2	4.22	r⁰=0.72	60.79	48.8	38.3	....	....	....	....	....
			r²=1.79	63.3	63.3	63.3	60.8	56.0	50.9	46.4	41.9
3½x2½x¼	4.9	2.88	r⁰=0.74	42.0	34.0	26.7	....	....	....	....	....
			r²=1.76	43.2	43.2	43.2	41.2	37.7	34.5	31.2	28.2
3 x2½x⅜	6.6	3.84	r⁰=0.74	56.0	45.4	35.6	....	....	....	....	....
			r²=1.52	57.6	57.6	56.6	51.3	46.0	41.0	36.7	....
3 x2½x¼	4.5	2.62	r⁰=0.75	38.4	31.2	24.7	....	....	....	....	....
			r²=1.50	39.3	39.3	38.4	34.8	31.2	27.8	24.7	....
3 x2 x⅜	5.9	3.46	r⁰=0.56	44.1	32.4	....	....	....	....	....	....
			r²=1.59	51.9	51.9	51.9	47.5	42.7	38.3	34.3	30.7
3 x2 x¼	4.1	2.38	r⁰=0.58	31.0	23.1	....	....	....	....	....	....
			r²=1.56	35.7	35.7	35.5	32.2	29.1	26.0	23.3	20.7
2½x2 x⅜	5.3	3.10	r⁰=0.58	40.4	30.1	....	....	....	....	....	....
			r²=1.32	46.5	46.5	43.0	38.2	33.6	29.4	....	....
2½x2 x¼	3.62	2.12	r⁰=0.59	27.9	20.9	....	....	....	....	....	....
			r²=1.29	31.8	31.8	29.3	25.8	22.5	19.7	....	....

To left of heavy line $\frac{l}{r}$ does not exceed 120.   To right of heavy line $\frac{l}{r}$ does not exceed 140.

Radii of Gryation correspond to direction indicated by arrowheads.

VALUES OF TWO ANGLES IN COMPRESSION
EQUAL LEGGED ANGLES
LOAD IN THOUSANDS OF POUNDS

$$S = \frac{18000}{1 + \dfrac{l^2}{18000 r^2}}$$

SIZE OF ANGLES	Weight of One angle Lbs. per Ft.	Area of Two Angles Sq. In.	Radii of Gyration	LENGTH IN FEET							
				4	6	8	10	12	14	16	18
8 x8 x½	26.4	15.50	r⁰=2.51	232.5	232.5	232.5	232.5	232.5	223.3	211.2	197.7
			r²=3.49	232.5	232.5	232.5	232.5	232.5	232.5	232.5	229.9
6 x6 x¾	28.7	16.88	r⁰=1.83	253.2	253.2	253.2	246.0	225.6	206.6	188.4	171.1
			r²=2.73	253.2	253.2	253.2	253.2	253.2	250.3	238.8	225.6
6 x6 x½	19.6	11.50	r⁰=1.86	172.5	172.5	172.5	167.6	155.7	142.8	130.2	118.5
			r²=2.68	172.5	172.5	172.5	172.5	172.5	169.6	160.6	151.7
6 x6 x⅜	14.9	8.72	r⁰=1.87	130.8	130.8	130.8	127.9	118.1	108.3	98.8	90.5
			r²=2.67	130.8	130.8	130.8	130.8	130.8	128.6	121.8	115.0
5 x5 x½	16.2	9.50	r⁰=1.54	142.5	142.5	140.9	127.8	115.5	103.0	91.5	81.9
			r²=2.28	142.5	142.5	142.5	142.5	140.1	131.1	122.8	113.9
5 x5 x⅜	12.3	7.22	r⁰=1.56	108.3	108.1	107.1	97.8	88.4	78.9	70.7	63.2
			r²=2.26	108.3	108.3	108.3	108.3	105.9	99.6	92.7	85.9
4 x4 x½	12.8	7.50	r⁰=1.22	112.5	112.5	100.3	88.0	76.1	65.6	.....	
			r²=1.88	112.5	112.5	112.5	110.0	101.5	93.8	85.6	77.8
4 x4 x⅜	9.8	5.72	r⁰=1.23	85.8	85.8	76.9	67.1	58.5	50.4	.....	
			r²=1.86	85.8	85.8	85.8	83.9	77.4	71.0	64.8	58.9
4 x4 x₁₆	8.2	4.80	r⁰=1.24	72.0	72.0	65.0	56.7	49.4	42.6	.....	.....
			r²=1.85	72.0	72.0	72.0	70.0	64.6	59.2	54.0	49.1
3½x3½x⅜	8.5	4.96	r⁰=1.07	74.4	71.5	61.6	52.6	44.4	.....	.....	46.4
			r²=1.67	74.4	74.4	74.4	69.3	63.3	57.0	51.5	
3½x3½x₁₆	7.2	4.18	r⁰=1.08	62.7	60.2	52.3	44.7	37.9	.....	.....	38.5
			r²=1.65	62.7	62.7	62.7	58.0	53.0	47.7	43.0	
3 x3 x⅜	7.2	4.22	r⁰= .91	63.3	56.4	46.8	38.6	.....	.....	.....	.....
			r²=1.46	63.3	63.3	61.2	55.3	49.2	43.8	38.9	
3 x3 x₁₆	6.1	3.56	r⁰= .92	53.4	47.9	40.0	33.0	.....	.....	.....	.....
			r²=1.45	53.4	53.4	51.6	46.0	41.5	36.7	32.6	
3 x3 x¼	4.9	2.88	r⁰= .93	43.2	38.7	32.6	26.9	.....	.....	.....	.....
			r²=1.43	43.2	43.2	41.5	37.2	33.1	29.5	26.0	
2½x2½x⅜	5.9	3.46	r⁰= .75	50.7	41.2	32.6	.....	.....	.....	.....	
			r²=1.26	51.9	51.9	47.1	41.5	36.2	31.4		
2½x2½x₁₆	5.0	2.94	r⁰= .76	43.4	35.2	28.1	.....	.....	.....	.....	
			r²=1.25	44.1	44.1	39.8	35.0	30.5	26.5		
2½x2½x¼	4.1	2.38	r⁰= .77	35.3	28.7	22.9	.....	.....	.....	.....	
			r²=1.24	35.7	35.7	32.2	28.1	24.5	21.1		
2 x2 x⅜	4.7	2.72	r⁰= .59	35.9	26.8	.....	.....	.....	.....		
			r²=1.07	40.8	39.2	33.8	28.9	24.3			
2 x2 x₁₆	3.92	2.30	r⁰= .60	30.5	23.0	.....	.....	.....	.....		
			r²=1.05	34.5	32.7	28.4	24.0	20.3			
2 x2 x¼	3.19	1.88	r⁰= .61	25.1	19.1	.....	.....	.....	.....		
			r²=1.04	28.2	26.8	23.0	19.5	16.4			

To left of heavy line $\frac{l}{r}$ does not exceed 120.   To right of heavy line $\frac{l}{r}$ does not exceed 140.

Radii of gyration correspond to direction indicated by arrowheads.

VALUES OF TWO ANGLES STARRED IN COMPRESSION
LOADS IN THOUSANDS OF POUNDS
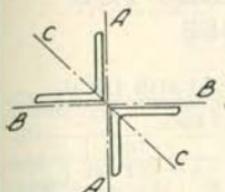
Formula $$S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$$

For unequal leg angles, the angle between axes B-B and C-C varies between 10° and 34°. Values are given for tie plates ⅜" thick. Least radii of gyration are on axes C-C. Values for axes A-A and B-B same as on pages 92 to 94.
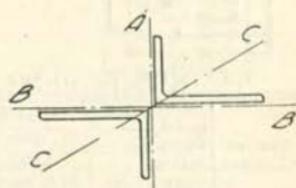
VALUES FOR EQUAL LEG ANGLES

Size of Angles	Area 2 Ls in.²	Wt. Per Ft. Lbs.	Least r Ins.	4	6	8	10	12	14	16	18
6 x 6 x ⅜	8.72	29.8	2.37	130.8	130.8	130.8	130.8	130.0	122.6	115.0	107.5
5 x 5 x ½	9.50	32.4	1.95	142.5	142.5	142.5	141.7	131.9	121.2	111.5	101.5
⅜	7.22	24.6	1.98	108.3	108.3	108.3	107.6	100.3	92.7	85.3	78.3
4 x 4 x ½	7.50	25.6	1.53	112.5	112.5	110.6	100.9	90.5	80.7	72.3	64.1
⅜	5.72	19.6	1.56	85.8	85.8	85.3	77.4	70.0	62.5	55.9	50.0
5⁄16	4.80	16.4	1.57	72.0	72.0	71.6	65.4	58.8	52.8	47.3	42.0
3½ x 3½ x ⅜	4.96	17.0	1.08	74.4	74.4	69.7	62.0	54.6	48.1	42.1	36.8
5⁄16	4.18	14.4	1.36	62.7	62.7	58.8	52.6	46.3	40.6	35.7	31.3
3 x 3 x ⅜	4.22	14.4	1.16	63.3	62.6	54.9	47.8	40.9	35.0	30.0	
5⁄16	3.56	12.2	1.16	53.4	52.8	46.3	40.3	34.6	29.5	25.3	
¼	2.88	9.8	1.17	43.2	42.9	37.7	32.6	28.2	24.1	20.8	
2½ x 2½ x ⅜	3.46	11.8	.95	51.9	47.1	39.7	33.1	27.3	22.7		
5⁄16	2.94	10.0	.97	44.1	40.6	34.3	28.5	23.0	19.9		
¼	2.38	8.1	.97	35.7	32.8	27.7	23.1	19.3	16.1		
2 x 2 x 5⁄16	2.30	7.8	.77	34.1	27.9	22.1	17.6				
¼	1.88	6.4	.77	27.9	22.8	18.1	14.4				

VALUES FOR UNEQUAL LEG ANGLES

Size of Angles	Area 2 Ls in.²	Wt. Per Ft. Lbs.	Least r Ins.	4	6	8	10	12	14	16	18
6 x 4 x ½	9.50	32.4	1.56	142.5	142.5	140.9	128.6	116.3	103.7	92.9	83.1
⅜	7.22	24.6	1.56	108.3	108.3	107.1	97.7	88.4	78.8	70.6	63.1
5 x 3½ x ½	8.00	27.2	1.35	120.0	120.0	112.5	100.0	88.0	77.6	67.9	59.4
⅜	6.10	20.8	1.37	91.5	91.5	86.3	76.7	68.1	59.6	52.5	46.0
5 x 3 x ½	7.50	25.6	1.16	112.5	111.2	97.6	84.9	72.8	62.3	53.7	
⅜	5.72	19.6	1.16	85.8	84.8	74.4	64.8	55.5	47.5	41.0	
4 x 3 x ⅜	4.96	17.0	1.21	74.4	74.4	66.3	57.8	49.9	43.0	37.1	32.3
¼	3.38	11.6	1.23	50.7	50.7	45.5	39.9	34.5	29.8	25.9	22.4
3½ x 3 x ⅜	4.60	15.8	1.20	69.0	69.0	61.1	53.2	46.0	39.6	34.2	29.6
¼	3.12	10.8	1.22	46.8	46.8	41.7	36.6	31.7	27.3	23.7	20.5
3 x 2½ x ⅜	3.84	13.2	1.00	57.6	53.6	45.7	38.4	32.1	26.9		
¼	2.62	9.0	1.00	39.3	36.6	31.2	26.2	21.9	18.4		
2½ x 2 x ⅜	3.10	10.6	.78	46.2	37.9	30.3	24.0				
¼	2.12	7.2	.78	31.6	25.9	20.7	16.5				

Values to left of solid heavy line do not exceed 140 for $\dfrac{l}{r}$

Values to left of dotted heavy line do not exceed 160 for $\dfrac{l}{r}$

Values for $\dfrac{l}{r}$ in excess of 180 are not given.

SAFE LOADS ON
ROLLED STEEL SLABS FOR
COLUMN BASES

MAXIMUM BENDING STRESS· 18,000 POUNDS PER SQUARE INCH.

Size of Column.	Load, Thousands of Lbs.	Pressure on Slab Support, Pounds per Square Inch.											
		500				600				750			
		N	M	Thickness.	Wt.	N	M	Thickness.	Wt.	N	M	Thickness.	Wt.
		In.	In.	In.	Lbs.	In.	In.	In.	Lbs.	In.	In.	In.	Lbs.
6"x6" or larger.	50	14	10	1¼	50	14	10	1¼	50	14	10	1¼	50
	75	14	11	1¼	55	14	10	1¼	50	16	11	1½	75
	100	16	13	1½	88	16	11	2	100	16	11	2	100
	125	16	16	2	145	16	13	2	118	16	11	2	100
	150	19	16	2	172	16	16	2	145	16	13	2	118
	175	20	18	2	204	19	16	2	172	16	15	2	136
8"x6½" or larger.	50	14	10	1¼	50	14	10	1¼	50	14	10	1¼	50
	75	14	11	1¼	55	14	10	1¼	50	14	10	1¼	50
	100	15	14	1¼	74	14	12	1¼	60	14	10	1¼	50
	125	16	16	1½	109	16	13	1½	88	14	12	1¼	60
	150	19	16	2	172	16	16	2	145	16	13	1½	88
8"x8" or larger.	75	14	11	1¼	55	14	10	1¼	50	14	10	1¼	50
	100	15	14	1¼	74	14	12	1¼	60	14	10	1¼	50
	125	16	16	1½	109	16	13	1½	88	14	12	1¼	60
	150	19	16	2	172	16	16	1½	109	16	13	1¼	88
	175	20	18	2	204	19	16	2	172	16	15	1½	102
	200	20	20	2	227	20	17	2	193	17	16	2	154
	250	24	21	3	428	21	20	2½	297	20	17	2½	241
	300	25	24	3	510	24	21	3	428	24	17	3	347
	350	28	25	3½	694	25	24	3	510	24	20	3	408
	400	29	28	3½	805	28	24	3½	666	24	23	3	469
10"x8" or larger.	100	15	14	1¼	74	14	12	1¼	60	14	10	1¼	50
	125	18	14	1¼	89	15	14	1¼	74	14	12	1¼	60
	150	19	16	1½	129	16	16	1½	109	16	13	1½	88
	175	20	18	2	204	19	16	1½	129	16	15	1½	102
	200	20	20	2	227	20	17	2	193	17	16	2	154
	250	24	21	2½	357	21	20	2½	297	20	17	2	193
10"x8" or larger.	125	18	14	1¼	89	15	14	1¼	74	14	12	1¼	60
	150	19	16	1½	129	16	16	1½	109	15	14	1¼	74
	175	20	18	2	204	19	16	1½	129	16	15	1½	102
	200	20	20	2	227	20	17	2	193	17	16	1½	116
	250	24	21	2½	357	21	20	2	238	20	17	2	193
	300	25	24	2½	425	24	21	2½	357	20	20	2½	283
	350	28	25	3	595	25	24	3	510	24	20	3	408
	400	29	28	3½	805	28	24	3½	666	24	22	3	449
	450	32	28	3½	889	28	27	3½	750	25	24	3	510
	500	32	31	3½	984	30	28	3½	833	28	24	3½	666
	550	34	32	4	1233	32	29	4	1052	28	26	3½	722
	600	36	33	4	1346	32	31	4	1124	32	25	4	907

Instructions for Ordering are given on page 266.
Courtesy Bethlehem Steel Co.

SAFE LOADS ON
ROLLED STEEL SLABS FOR
COLUMN BASES

MAXIMUM BENDING STRESS: 18,000 POUNDS PER SQUARE INCH.

Size of Column.	Load, Thousands of Lbs.	Pressure on Slab Support, Pounds per Square Inch.											
		500				600				750			
		N	M	Thickness.	Wt.	N	M	Thickness.	Wt.	N	M	Thickness.	Wt.
		In.	In.	In.	Lbs.	In.	In.	In.	Lbs.	In.	In.	In.	Lbs.
12″x8″ or larger.	100	15	14	1¼	74	14	12	1¼	60	14	10	1¼	50
	125	16	16	1½	109	15	14	1¼	74	14	12	1¼	60
	150	19	16	1½	129	18	14	1¼	89	16	13	1½	88
	175	22	16	2	199	19	16	1½	129	16	15	1½	102
	200	20	20	2	227	20	17	2	193	17	16	2	154
	250	25	20	2	283	21	20	2½	297	20	17	2	193
12″x10″ or larger.	125	18	14	1¼	89	15	14	1¼	74	14	12	1¼	60
	150	19	16	1½	129	18	14	1¼	89	15	14	1¼	74
	175	20	18	2	204	19	16	1½	129	17	14	1¼	84
	200	20	20	2	227	20	17	2	193	17	16	1½	116
	250	25	20	2	283	21	20	2	238	20	17	2	193
	300	25	24	2½	425	24	21	2½	357	20	20	2½	283
	350	28	25	3	595	25	24	3	510	24	20	2½	340
12″x12″ or larger.	200	20	20	2	227	21	16	1½	143	17	16	1½	116
	250	25	20	2	283	21	20	2	238	20	17	2	193
	300	25	24	2½	425	24	21	2½	357	20	20	2	227
	350	28	25	3	595	25	24	2½	425	24	20	2½	340
	400	29	28	3	690	28	24	3	571	24	22	2½	374
	450	32	28	3½	889	28	27	3	643	25	24	3	510
	500	32	31	3½	984	30	28	3½	833	28	24	3½	666
	550	34	32	3½	1079	32	29	3½	920	28	26	3½	722
	600	36	33	4	1346	32	31	4	1124	29	28	3½	805
	650	36	36	4	1469	34	32	4	1233	32	27	4	979
	700	39	36	4¼	1790	36	33	4¼	1515	32	29	4	1052
	750	40	38	4½	1938	36	35	4½	1607	32	31	4	1124
	800	40	40	5	2267	37	36	4½	1698	36	30	4½	1377
	850	43	40	5	2437	40	35	5	1983	36	32	4½	1469
14″x8″ or larger.	100	16	14	1¼	79	16	14	1¼	79	16	14	1¼	79
	125	18	14	1¼	89	16	14	1¼	79	16	14	1¼	79
	150	19	16	1¼	129	18	14	1¼	89	16	14	1¼	79
	175	22	16	1½	150	19	16	1½	129	16	15	1½	102
	200	20	20	2	227	21	16	1½	143	17	16	2	154
	250	25	20	2	283	21	20	2½	297	20	17	2	193
	300	25	24	3	510	24	21	2½	357	24	17	2½	289

Instructions for Ordering are given on page 266.
Courtesy Bethlehem Steel Co.

SAFE LOADS ON
ROLLED STEEL SLABS FOR COLUMN BASES

MAXIMUM BENDING STRESS: 18,000 POUNDS PER SQUARE INCH.

Size of Column.	Load, Thousands of Lbs.	Pressure on Slab Support, Pounds per Square Inch.											
		500				600				750			
		N	M	Thickness.	Wt.	N	M	Thickness.	Wt.	N	M	Thickness.	Wt.
		In.	In.	In.	Lbs.	In.	In.	In.	Lbs.	In.	In.	In.	Lbs.
14″x10″ or larger.	125	18	14	1¼	89	16	14	1¼	79	16	14	1¼	79
	150	19	16	1½	129	18	14	1¼	89	16	14	1¼	79
	175	22	16	1½	150	21	14	1¼	104	17	14	1¼	84
	200	20	20	2	227	21	16	1½	143	17	16	1½	116
	250	25	20	2	283	21	20	2	238	21	16	1½	143
	300	25	24	2½	425	25	20	2	283	20	20	2½	283
	350	29	24	2½	493	25	24	3	510	24	20	2½	340
14″x12″ or larger.	200	20	20	2	227	21	16	1½	143	20	14	1¼	99
	250	25	20	2	283	21	20	2	238	20	16	1½	143
	300	25	24	2½	425	25	20	2	283	20	20	2	227
	350	29	24	2½	493	25	24	2½	425	24	20	2	272
	400	29	28	3	690	28	24	3	571	24	22	2½	374
14″x14″ or larger.	200	20	20	2	227	21	16	1½	143	17	16	1½	116
	250	25	20	2	283	21	20	2	238	21	16	1½	143
	300	25	24	2½	425	25	20	2	283	20	20	2	227
	350	29	24	2½	493	25	24	2½	425	20	20	2	272
	400	29	28	3	690	28	24	3	571	24	22	2½	374
	450	32	28	3	762	28	27	3	643	25	24	2½	425
	500	32	31	3½	984	30	28	3	714	28	24	3	571
	550	34	32	3½	1079	32	29	3½	920	28	26	3	619
	600	36	33	4	1346	32	31	3½	984	29	28	3½	805
	650	36	36	4	1469	34	32	3½	1079	31	28	3½	861
	700	39	36	4	1591	36	33	4	1346	32	29	3½	920
	750	42	36	4½	1928	36	35	4	1428	32	31	4	1124
	800	40	40	4½	2040	37	36	4½	1698	33	32	4	1197
	850	43	40	4½	2193	39	36	4½	1790	36	32	4½	1469
	900	44	41	5	2556	40	38	4½	1938	36	33	4½	1515
	950	44	43	5	2680	40	40	5	2267	36	35	4½	1607
	1000	45	44	5	2805	42	40	5	2380	40	34	5	1927
	1050	48	44	5½	3291	44	40	5	2493	40	35	5	1983
	1100	48	46	5½	3441	44	42	5	2618	40	37	5	2097
	1150	48	48	5½	3590	44	44	5½	3017	40	38	5	2153
	1200	50	48	5½	3740	46	44	5½	3154	44	37	5½	2537
	1250	52	48	6	4243	47	44	5½	3223	44	39	5½	2674
	1300	52	50	6	4420	48	45	6	3672	44	40	5½	2743

Instructions for Ordering are given on page 266.
Courtesy Bethlehem Steel Co.

SAFE LOADS ON
ROLLED STEEL SLABS FOR COLUMN BASES

MAXIMUM BENDING STRESS: 18,000 POUNDS PER SQUARE INCH.

Size of Column	Load, Thousands of Lbs.	Pressure on Slab Support, Pounds per Square Inch.											
		500				600				750			
		N	M	Thickness.	Wt.	N	M	Thickness.	Wt.	N	M	Thickness.	Wt.
		In.	In.	In.	Lbs.	In.	In.	In.	Lbs.	In.	In.	In.	Lbs.
	450	32	28	3	762	28	27	3	643	25	24	2½	425
	500	32	31	3½	984	30	28	3	714	28	24	3	571
	550	34	32	3½	1079	33	28	3½	916	28	26	3	619
	600	36	33	3½	1178	32	31	3½	984	29	28	3	690
	650	36	36	4	1469	34	32	3½	1079	31	28	3½	861
	700	39	36	4	1591	36	32	4	1306	32	29	3½	920
	750	40	38	4½	1938	36	35	4	1428	32	31	3½	984
	800	40	40	4½	2040	37	36	4	1510	33	32	4	1197
	850	42	40	4½	2142	39	36	4½	1790	35	32	4	1269
	900	45	40	4½	2295	40	38	4½	1938	36	33	4	1346
14½"x 15½" or larger, up to 17"x17"	950	44	43	5	2680	40	40	4½	2040	36	35	4½	1606
	1000	45	44	5	2805	42	40	4½	2142	37	36	4½	1698
	1050	48	44	5	2992	44	40	5	2493	39	36	4½	1790
	1100	48	46	5½	3441	46	40	5	2607	40	37	4½	1887
	1150	48	48	5½	3590	44	43	5	2680	40	38	5	2153
	1200	50	48	5½	3740	45	44	5½	3085	40	40	5	2267
	1250	52	48	5½	3890	47	44	5½	3222	42	40	5	2380
	1300	52	50	5½	4052	48	45	5½	3366	44	39	5½	2674
	1350	52	52	6	4597	48	47	5½	3516	44	41	5½	2811
	1400	54	52	6	4774	48	48	6	3917	44	42	5½	2880
	1450	56	52	6	4950	50	48	6	4080	44	44	6	3291
	1500	57	52	6	5039	52	48	6	4243	45	44	6	3366
	1550	56	55	6¼	5672	54	48	6	4406	47	44	6	3516
	1600	57	56	6½	5879	52	51	6½	4884	48	44	6	3590
	1650	59	56	6½	6085	53	52	6½	5076	50	44	6	3740
	1700	61	56	6½	6291	54	52	6½	5171	48	47	6½	4155
	1750	62	56	7	6886	56	52	6½	5363	49	48	6½	4332
	1800	64	56	7	7108	56	53	6½	5466	52	46	6½	4405
	1850	.....	...	....	.....	56	55	7	6109	52	47	6½	4501
	1900	.....	...	....	.....	57	56	7	6331	52	49	6½	4693

Instructions for Ordering are given on page 266.
Courtesy Bethlehem Steel Co.
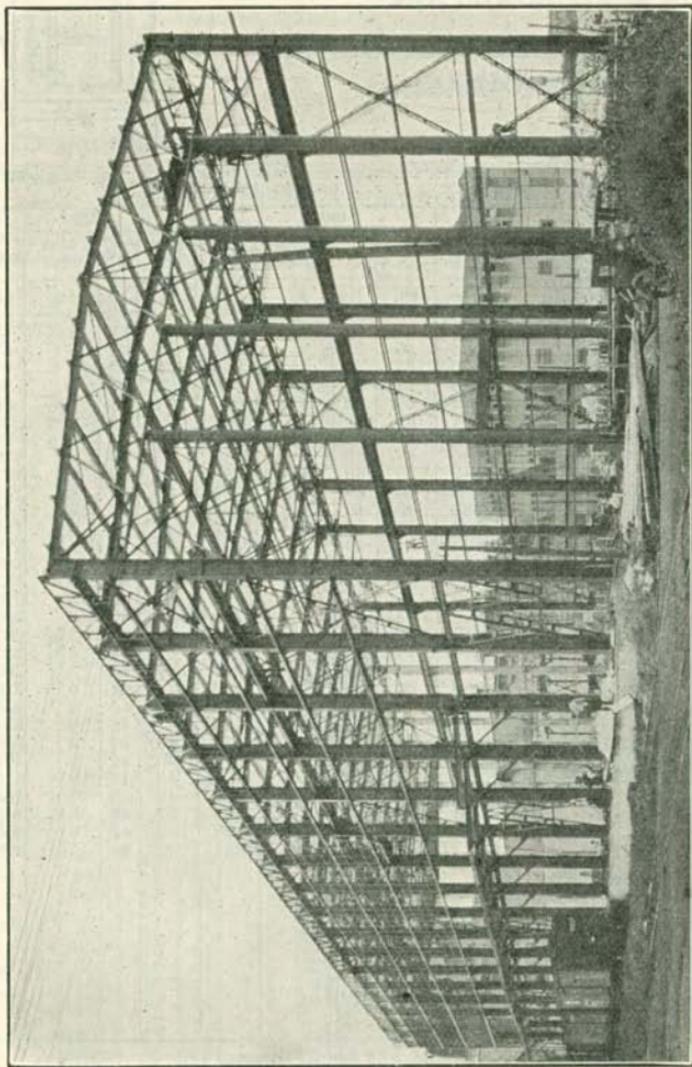
STRUCTURAL STEEL FRAME FOR PAPER WAREHOUSE, WALDORF PAPER PRODUCTS CO.
Building 81x342, height to bottom of trusses 56 feet. Tons of structural steel, 500.
Fabricated by St. Paul Foundry Co.
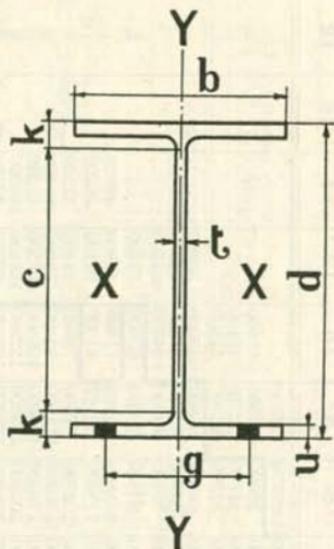
*CARNEGIE COLUMNS

SYMBOLS

Refer to properties tables for the computed figures on the above items.

$\mathbf{I}$—Moment of Inertia
$\mathbf{S}$—Section Modulus
$\mathbf{r}$—Radius of Gyration

Indicated dimensions for various sizes of Carnegie columns are shown in the following tables.

*TABLES INCLUDE

Standard I Beam Columns
Carnegie H Beam Columns
Illinois H Beam Columns
Carnegie Beam Columns

I BEAM COLUMNS
SAFE LOADS IN POUNDS

Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000\, r^2}}$

Loads given are for least radius of gyration Axis 2-2.

STANDARD I BEAMS
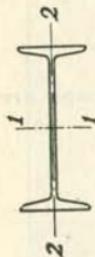
Depth of Beam	Weight per foot pounds	Area of Section Sq. Inches	Radius of Gyration Axis 2-2	Radius of Gyration Axis 1-1	Length in Feet							
					4	6	8	10	12	14	16	18
4	7.7	2.21	.59	1.64	29150	21770	16100					
5	10.0	2.87	.65	2.05	39600	30600	23300	17800				
6	12.5	3.61	.72	2.46	52000	41770	32770	25400				
7	15.3	4.43	.78	2.86	66000	54200	43300	34400				
8	18.4	5.34	.84	3.26	80100	68100	55800	45000	36600			
9	21.8	6.32	.90	3.67	94800	83900	69500	57300	46900			
9	25.0	7.28	.88	3.54	109200	95400	78900	64600	52500			
10	22.0	6.42	1.03	4.15	96300	90800	78000	65600	55300			
10	25.4	7.38	.97	4.07	110700	101800	86000	71600	59900	49800		
10	30.0	8.75	.93	3.91	131200	118500	99100	81800	67400	56200		
12	25.0	7.35	1.00	4.89	110250	102700	87500	73500	61400	51500		
12	31.8	9.26	1.01	4.83	138900	130200	111000	93300	78600	65800		
12	40.8	11.84	1.08	4.77	177600	170600	148000	126500	107500	91200		
12	50.0	14.57	1.05	4.55	218500	207400	179000	152200	128400	108200		
15	35.0	10.22	1.06	6.00	153300	146400	126000	107600	90700	77100		
15	42.9	12.49	1.08	5.95	187300	179900	156100	133300	113400	96200		
15	50.0	14.59	1.05	5.74	218800	207700	188500	152500	128600	108200		
15	60.8	17.68	1.21	5.87	265200	265200	236300	206000	178100	153400	132300	

Loads given to the right of heavy lines are for lengths where $\dfrac{l}{r}$ is greater than 120 and should not be used unless beams are stiffened or braced sideways.

Because of their narrower flange, Standard American I Beams are conveniently used in partitions and other restricted places where heavy concentrated loads require support.

4", 5", 6", 8" CARNEGIE AND 6" AND 8" ILLINOIS H BEAM COLUMNS

4", 5", 6" AND 8" ILLINOIS H BEAM COLUMNS

DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	d	b	t	k	e	g	u	Rtv.	I (X-X)	s (X-X)	r (X-X)	I (Y-Y)	s (Y-Y)	r (Y-Y)
4" CARNEGIE H BEAMS															
13.8	3.99	4.000	4.000	.313	3/4	2 1/2	2 1/4	5/8	3/4	10.7	5.35	1.64	3.6	1.80	0.95
5" CARNEGIE H BEAMS															
18.9	5.47	5.000	5.000	.313	7/8	3 1/8	2 3/4	11/16	3/4	23.8	9.52	2.08	7.8	3.12	1.20
6" CARNEGIE H BEAMS AND 6" ILLINOIS H BEAMS															
20.0	5.86	6.000	5.538	.250	3/4	4 5/8	3 1/2			38.8	12.93	2.57	11.4	3.84	1.39
22.5	6.61	6.000	6.063	.375	3/4	4 5/8	3 1/2			41.0	13.67	2.49	12.2	4.02	1.36
25.0	7.33	6.000	5.538	.313	7/8	4 3/4	3 1/2			47.0	15.67	2.53	14.9	5.02	1.43
27.5	8.08	6.000	6.063	.438	7/8	4 3/4	3 1/2			49.3	16.43	2.47	16.0	5.28	1.41
8" CARNEGIE H BEAMS AND 8" ILLINOIS H BEAMS															
32.6	9.50	8.000	7.938	.313	7/8	6 1/4	5 1/2			112.8	28.20	3.45	34.2	8.62	1.90
34.3	10.00	8.000	8.000	.375	7/8	6 1/4	5 1/2			115.5	28.88	3.40	35.1	8.78	1.87
37.7	11.00	8.000	8.125	.500	7/8	6 3/4	5 1/2			120.8	30.20	3.31	36.9	9.08	1.83
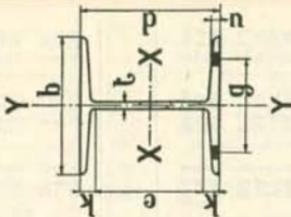
ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

UNSUPPORTED LENGTH IN FEET

Weight per foot	4	6	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30
4" CARNEGIE H BEAMS																				
13.8	60	54	46	42	38	35	32	29	26	24										
5" CARNEGIE H BEAMS																				
18.9	82	82	73	68	63	59	55	51	47	44	41	38	35	33	31					
6" CARNEGIE H BEAMS AND 6" ILLINOIS H BEAMS																				
20.0	88	88	83	79	75	70	66	62	58	55	51	48	45	42	40	35				
22.5	99	99	93	88	83	78	73	69	64	60	56	53	50	46	44	38				
25.0	110	110	106	100	95	90	84	79	75	70	66	62	58	55	51	46				
27.5	121	121	116	110	104	98	92	87	81	76	72	67	63	59	56	49				
8" CARNEGIE H BEAMS AND 8" ILLINOIS H BEAMS																				
32.6	143	143	143	143	140	135	130	124	119	114	109	104	100	95	91	83	75	68	62	57
34.3	150	150	150	150	146	141	136	130	124	119	114	108	103	99	94	85	78	71	64	59
37.7	165	165	165	165	160	154	147	141	135	129	123	117	112	106	101	92	83	76	69	63

Illinois 6" and 8" H Beams are the same as 6" and 8" Carnegie H Beams. Loads to right of heavy vertical lines are for secondary members only.

8" AND 9" CARNEGIE COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	DIMENSIONS								AXIS X-X			AXIS Y-Y		
		d	b	t	k	u	c	g	Riv.	I	S	r	I	S	r
8" CARNEGIE BEAM SECTIONS															
24.0	7.06	8.000	6.500	.239	15/16	.400	6¼	3½	⅞	84.3	21.08	3.46	18.3	5.63	1.61
27.0	7.93	8.098	6.529	.268	15/16	.449	6¼	3½	⅞	95.9	23.68	3.48	20.8	6.37	1.62
30.0	8.81	8.196	6.559	.298	1	.498	6¼	3½	⅞	107.8	26.31	3.50	23.4	7.14	1.63
31.0	9.10	8.060	8.000	.290	⅞	.430	6¼	5½	⅞	110.9	27.52	3.49	36.7	9.18	2.01
36.0	10.58	8.198	8.046	.336	1	.499	6¼	5½	⅞	131.3	32.03	3.52	43.4	10.79	2.02
42.0	12.34	8.360	8.100	.390	1⅛	.580	6¼	5½	⅞	156.2	37.37	3.56	51.4	12.69	2.04
48.0	14.10	8.520	8.155	.445	1⅛	.660	6¼	5½	⅞	182.2	42.77	3.59	59.7	14.64	2.06
54.0	15.87	8.680	8.208	.498	1⅛	.740	6¼	5½	⅞	209.2	48.20	3.63	63.3	16.64	2.07
60.0	17.63	8.838	8.261	.551	1⅛	.819	6¼	5½	⅞	237.1	53.65	3.67	77.1	18.67	2.09
66.0	19.40	8.994	8.314	.604	1¼	.897	6¼	5½	⅞	265.9	59.13	3.70	86.1	20.71	2.11
72.0	21.17	9.150	8.366	.656	1⅜	.975	6¼	5½	⅞	295.9	64.68	3.74	95.3	22.78	2.12
78.0	22.93	9.302	8.418	.708	1⅜	1.051	6¼	5½	⅞	326.5	70.20	3.77	104.7	24.88	2.14
84.0	24.47	9.456	8.469	.759	1⅜	1.128	6¼	5½	⅞	358.6	75.85	3.81	114.5	27.04	2.15
90.0	26.47	9.606	8.520	.810	1⅜	1.203	6¼	5½	⅞	391.2	81.45	3.84	124.4	29.20	2.17
9" CARNEGIE BEAM SECTIONS															
29.0	8.53	9.000	6.500	.279	1	.470	7	3½	⅞	126.0	28.00	3.84	21.5	6.62	1.59
32.0	9.40	9.096	6.528	.307	1 3/16	.518	7	3½	⅞	140.5	30.89	3.87	24.0	7.35	1.60
35.0	10.29	9.192	6.556	.335	1 3/16	.566	7	3½	⅞	155.4	33.81	3.89	26.6	8.11	1.61
38.0	11.17	9.000	9.000	.316	1	.470	7	5½	⅞	170.4	37.87	3.91	57.1	12.69	2.26
43.0	12.65	9.122	9.041	.357	1 3/16	.531	7	5½	⅞	195.5	42.86	3.93	65.4	14.47	2.28
48.0	14.11	9.242	9.082	.398	1 3/16	.591	7	5½	⅞	221.1	47.85	3.96	73.8	16.25	2.29

See page 101 for cut.

8" AND 9" CARNEGIE COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

Weight per foot	UNSUPPORTED LENGTH IN FEET																			
	4	6	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30
8" CARNEGIE BEAM SECTIONS																				
24.0	106	106	106	102	97	93	88	84	79	75	71	67	64	60	57	51	46	41		
27.0	119	119	119	114	109	104	99	94	89	85	80	76	72	68	64	58	52	47		
30.0	132	132	132	127	122	116	111	105	100	95	90	85	80	76	72	65	58	52		
31.0	137	137	137	137	137	132	127	123	118	113	109	104	100	96	91	84	77	70	64	59
36.0	159	159	159	159	159	154	149	143	138	132	127	122	116	112	107	98	89	82	75	69
42.0	185	185	185	185	185	180	174	168	161	155	149	143	137	131	126	115	105	97	89	81
48.0	212	212	212	212	212	207	200	192	185	178	171	164	158	151	145	133	122	112	102	94
54.0	238	238	238	238	238	233	225	217	209	201	193	186	178	171	164	150	138	126	116	107
60.0	264	264	264	264	264	260	251	242	234	225	216	208	199	191	183	168	154	142	130	120
66.0	291	291	291	291	291	287	277	268	258	249	239	230	221	212	203	187	172	158	145	133
72.0	318	318	318	318	318	314	303	293	282	272	262	252	242	232	223	205	188	173	159	146
78.0	344	344	344	344	344	341	330	319	307	296	285	274	264	253	243	224	200	189	174	160
84.0	371	371	371	371	371	368	356	344	332	320	308	296	285	274	263	242	223	205	189	174
90.0	397	397	397	397	397	395	383	370	357	345	332	320	307	295	284	261	241	222	204	188
9" CARNEGIE BEAM SECTIONS																				
29.0	128	128	128	122	117	111	105	100	95	90	85	80	76	72	68	61	54	49		
32.0	141	141	141	135	129	123	117	111	105	99	94	89	84	80	75	67	60	54		
35.0	154	154	154	148	142	135	128	122	115	109	103	98	93	88	83	74	67	60		
38.0	168	168	168	168	165	168	164	159	154	149	144	138	133	128	124	114	106	95	90	83
43.0	190	190	190	190	190	190	186	181	175	169	163	157	152	146	141	130	120	111	103	95
48.0	212	212	212	212	212	212	208	202	196	189	183	176	170	164	158	146	135	125	116	107

Loads to right of heavy vertical lines are for Secondary Members only.

10″ CARNEGIE COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	DIMENSIONS								AXIS X-X			AXIS Y-Y		
		d	b	t	k	u	c	g	Riv.	I	S	r	I	S	r
						10″ CARNEGIE BEAM SECTIONS									
21	6.17	9.902	6.000	.230	15/16	.332	8⅜	3″	¾	107.6	21.7	4.18	12.0	4.0	1.39
23	6.76	10.000	6.000	.230	15/16	.381	8⅜	3″	¾	122.2	24.4	4.25	13.7	4.5	1.43
26	7.64	10.088	6.029	.259	15/16	.430	8⅜	3″	¾	139.5	27.6	4.27	15.7	5.2	1.43
30	8.82	10.228	6.068	.258	15/16	.495	8⅜	3″	¾	163.2	31.9	4.30	18.5	6.1	1.45
31	9.11	10.000	8.000	.320	15/16	.381	8⅜	5½	¾	163.4	32.7	4.23	32.5	8.1	1.89
36	10.58	10.000	8.147	.467	1 1/16	.381	8⅜	5½	¾	175.6	35.1	4.07	34.4	8.5	1.80
42	12.35	10.000	8.324	.644	1 1/16	.381	8⅜	5½	¾	190.4	38.1	3.93	36.8	18.6	1.73
49	14.40	10.000	10.000	.350	1 1/16	.558	7⅞	5½	¾	272.0	54.4	4.35	93.0	18.6	2.54
54	15.87	10.000	10.147	.497	1 1/16	.558	7⅞	5½	¾	284.3	56.9	4.23	97.3	19.2	2.48
59	17.34	10.000	10.294	.644	1 1/16	.558	7⅞	5½	¾	296.5	59.3	4.13	101.7	19.8	2.42
64	18.81	10.000	10.441	.791	1 1/16	.558	7¾	5½	¾	308.8	61.8	4.05	106.3	20.4	2.38
70	20.59	10.000	10.000	.515	1 1/16	.805	7¾	5½	¾	369.3	73.9	4.24	134.3	26.9	2.54
77	22.65	10.000	10.206	.721	1 1/16	.805	7¾	5½	¾	386.5	77.3	4.13	142.9	28.0	2.51
84	24.70	10.000	10.411	.926	1 1/16	.805	7¾	5½	¾	403.6	80.7	4.04	152.0	29.2	2.48
92	27.06	10.000	10.647	1.152	1 1/16	.805	7¾	5½	¾	423.2	84.6	3.96	163.1	30.6	2.50
100	29.40	10.000	12.000	.600	1⅜	1.016	6¾	9″	1″	525.1	105.0	4.23	292.8	48.8	3.16
108	31.76	10.000	12.236	.836	1⅜	1.016	6¾	9″	1″	544.8	109.0	4.14	310.7	50.8	3.13
116	34.41	10.000	12.471	1.071	1⅜	1.016	6¾	9″	1″	564.3	112.8	4.07	329.4	52.8	3.11
124	36.46	10.000	12.706	1.306	1⅜	1.016	6¾	9″	1″	583.9	116.8	4.00	349.0	54.9	3.09
132	38.81	10.000	12.941	1.541	1⅜	1.016	6¾	9″	1″	603.5	120.7	3.94	369.6	57.1	3.09
140	41.17	10.000	13.177	1.777	1⅝	1.016	6¾	9″	1″	623.2	124.6	3.89	391.4	59.4	3.08

See page 101 for cut.

10″ CARNEGIE COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

UNSUPPORTED LENGTH IN FEET

10″ CARNEGIE BEAM SECTIONS

Weight per foot	8	10	12	13	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38
21	88	79	70	65	61	57	54	51	47	45	42	37								
23	97	87	78	73	69	65	61	57	54	50	47	42								
26	110	99	88	83	78	73	69	65	61	57	54	48	42							
30	128	115	103	97	91	86	80	76	71	69	63	56	50							
31	137	134	124	119	114	109	104	100	95	91	86	79	72	65	60					
36	159	153	140	134	128	122	117	111	106	101	96	87	79	71	65	54				
42	185	175	161	153	146	139	132	125	119	113	107	97	88	79	72	59				
49	216	216	216	214	209	203	194	191	185	179	173	162	151	141	131	123	114	107	99	
54	238	238	238	234	228	221	211	208	201	194	188	175	163	152	141	132	123	114	106	
59	260	260	260	254	246	239	231	224	216	209	202	188	175	162	151	140	130	121	113	
64	282	282	281	273	265	257	249	240	232	224	216	201	187	173	161	149	138	129	120	
70	309	309	309	309	299	290	282	273	265	257	248	232	217	202	189	176	164	153	143	133
77	340	340	340	336	326	317	308	298	289	280	270	253	235	219	204	190	177	165	154	144
84	371	371	371	364	354	344	334	323	313	303	292	273	254	237	220	205	191	178	166	154
92	406	406	406	400	389	378	367	356	344	333	322	301	280	261	243	226	211	195	183	171
100	441	441	441	441	441	441	439	430	420	410	401	381	362	343	325	307	291	275	260	245
108	476	476	476	476	476	476	473	463	452	442	431	410	389	368	349	330	311	294	278	262
116	512	512	512	512	512	512	507	496	484	473	461	438	416	394	372	352	332	314	296	280
124	547	547	547	547	547	547	540	528	516	504	492	467	443	419	396	374	353	333	315	297
132	582	582	582	582	582	582	575	562	549	536	523	497	472	446	422	398	376	355	335	316
140	618	618	618	618	618	618	609	596	582	568	554	526	499	472	446	421	398	375	354	334

Loads to right of heavy vertical lines are for Secondary Members only.

12" CARNEGIE COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	d	b	t	k	u	c	g	Riv.	AXIS X-X I	AXIS X-X s	AXIS X-X r	AXIS Y-Y I	AXIS Y-Y s	AXIS Y-Y r
							12" CARNEGIE BEAM SECTIONS								
25	7.34	11.924	6.000	.240	⅞	.382	10⅛	3	⅞	183.0	30.7	4.99	13.8	4.6	1.37
28	8.22	12.000	6.500	.240	⅞	.420	10⅛	3	⅞	213.4	35.6	5.10	19.2	5.9	1.53
32	9.40	12.118	6.534	.274	⅞	.479	10⅛	3	⅞	246.3	40.7	5.12	22.3	6.8	1.54
34	9.99	12.022	6.635	.375	⅞	.431	10⅛	3	⅞	238.1	39.8	4.88	21.0	6.3	1.45
† 36	10.59	12.235	6.568	.308	⅞	.538	10⅛	3	⅞	280.1	45.8	5.14	25.4	7.7	1.55
40	11.76	12.000	8.000	.290	1⅛	.526	9⅜	5½	1	313.7	52.3	5.17	44.9	11.2	1.95
45	13.23	12.130	8.036	.326	1⅛	.591	9⅜	5½	1	356.9	58.8	5.19	51.2	12.7	1.97
50	14.69	12.258	8.071	.361	1⅛	.655	9⅜	5½	1	400.5	65.4	5.22	57.5	14.2	1.98
55	16.17	12.000	9.000	.375	1⅛	.665	9⅜	5½	1	428.4	71.4	5.15	80.9	18.0	2.24
60	17.65	12.118	9.034	.409	1⅛	.724	9⅜	5½	1	472.0	77.9	5.17	89.0	19.7	2.25
62	19.41	12.260	9.073	.448	1½	.795	9⅜	5½	1	525.7	85.8	5.20	99.1	21.8	2.26
65	19.11	12.000	12.000	.400	1½	.608	9½	9	1	521.3	86.9	5.22	175.2	29.2	3.03
70	20.58	12.000	12.123	.523	1½	.608	9½	9	1	539.0	89.8	5.12	180.7	29.8	2.96
76	22.35	12.000	12.270	.670	1½	.608	9½	9	1	560.2	93.4	5.01	187.5	30.6	2.90
82	24.11	12.000	12.000	.453	1½	.800	9½	9	1	630.8	108.5	5.20	230.5	38.4	3.09
88	25.88	12.000	12.147	.600	1¾	.800	9¼	9	1	672.0	112.0	5.10	239.2	39.4	3.04
95	27.93	12.000	12.318	.771	1¾	.800	9¼	9	1	696.4	116.1	4.99	249.7	40.5	2.99
102	29.93	12.000	12.490	.943	1¾	.800	8⅞	9	1	721.4	120.2	4.90	260.6	41.7	2.95
110	32.34	12.000	12.000	.640	1¾	1.075	8⅞	9	1	828.8	138.1	5.06	309.0	51.6	3.10
120	35.28	12.000	12.245	.885	1¾	1.075	8⅞	9	1	864.1	144.0	4.95	329.6	53.8	3.06
130	38.24	12.000	12.491	1.131	1 15⁄16	1.075	8⅜	9	1	899.5	149.9	4.85	350.5	56.5	3.03
140	41.18	12.000	12.736	1.376	1 15⁄16	1.075	8⅜	10	1	934.8	155.8	4.76	372.4	58.5	3.01
150	44.12	12.000	14.000	.757	1 15⁄16	1.312	8	10	1	1112.2	185.4	5.02	600.4	85.8	3.69
160	47.06	12.000	14.245	1.002	1 15⁄16	1.312	8	10	1	1147.5	191.3	4.94	633.0	88.9	3.67
170	50.00	12.000	14.490	1.247	1 15⁄16	1.312	8	10	1	1182.8	197.1	4.86	666.9	92.1	3.65
180	52.94	12.000	14.735	1.492	2¼	1.312	8	10	1	1218.1	203.0	4.80	702.4	95.3	3.64
190	55.88	12.000	14.000	1.000	2¼	1.677	7¾	10	1	1320.8	220.1	4.86	767.8	109.7	3.71
200	58.82	12.000	14.245	1.245	2¼	1.677	7¾	10	1	1356.1	226.0	4.80	809.5	113.7	3.71
210	61.76	12.000	14.490	1.490	2¼	1.677	7¾	10	1	1391.3	231.9	4.75	852.9	117.7	3.72
220	64.70	12.000	14.735	1.735	2¼	1.677	7¾	10	1	1426.5	237.8	4.70	898.2	121.9	3.73
230	67.64	12.000	14.980	1.980	2¾	1.677	7¾	10	1	1461.9	243.7	4.65	945.5	126.2	3.74

†Special Section; Web Thickness ¾".

12″ CARNEGIE COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

UNSUPPORTED LENGTH IN FEET

12″ CARNEGIE BEAM SECTIONS

Weight per foot	8	10	12	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38	40
25	104	93	82	72	67	63	59	55	52	49	43									
28	121	110	99	89	84	79	74	70	66	62	56									
32	139	127	114	102	96	91	86	81	76	72	64									
34	145	130	116	103	97	91	86	81	76	71	63									
36	157	143	129	115	109	103	97	92	87	82	73									
40	176	175	163	150	144	138	132	125	121	115	105	96	88	80	73	67				
45	198	197	184	170	163	156	146	143	137	131	119	109	99	91	83	77				
50	220	220	204	189	181	173	166	159	152	146	133	122	111	102	93	86				
55	243	243	237	223	214	207	199	189	183	178	164	152	140	129	120	111	102			
60	265	265	259	243	234	226	218	210	202	195	180	166	154	142	131	121	112			
65	291	291	285	267	258	249	241	232	223	215	199	184	170	157	145	134	124			
65	287	287	287	287	287	281	275	268	262	255	242	229	216	204	193	182	171			
70	309	309	309	309	307	300	293	286	279	271	257	243	229	216	203	191	180			
76	335	335	335	335	331	324	316	308	299	291	275	260	245	230	217	204	192			
82	362	362	362	362	362	357	349	341	333	325	309	293	277	262	247	234	220			
88	388	388	388	388	388	381	373	364	355	346	328	311	294	278	262	247	233			
95	419	419	419	419	418	409	399	390	380	370	351	332	313	295	278	262	247			
102	450	450	450	450	447	437	427	416	405	395	374	353	333	314	295	278	262			
110	485	485	485	485	485	480	469	458	448	437	415	393	373	352	333	314	297	280		
120	529	529	529	529	521	521	509	497	485	473	449	426	403	380	359	339	319	301		
130	574	574	574	574	574	563	550	537	524	510	484	458	433	409	386	364	343	323	305	287
140	618	618	618	618	618	605	591	576	562	548	519	491	464	438	413	389	367	346	326	307
150	662	662	662	662	662	662	662	662	655	643	618	593	568	544	519	496	473	451	430	409
160	706	706	706	706	706	706	706	706	698	684	658	631	604	578	552	527	502	479	456	434
170	750	750	750	750	750	750	750	750	740	726	697	669	640	612	584	557	531	506	482	459
180	794	794	794	794	794	794	794	794	782	768	737	707	677	647	617	589	561	535	509	485
190	838	838	838	838	838	838	838	838	831	816	785	754	722	691	660	631	602	574	547	521
200	882	882	882	882	882	882	882	882	875	861	826	793	760	727	695	664	633	604	576	549
210	926	926	926	926	926	926	926	926	920	903	859	834	799	765	731	698	666	636	606	578
220	971	971	971	971	971	971	971	971	964	947	911	875	839	803	767	733	700	667	636	607
230	1015	1015	1015	1015	1015	1015	1015	1015	1009	991	954	916	878	841	804	768	733	699	667	636

Loads to right of heavy vertical lines are for Secondary Members only.
†Special section web thickness ⅜″.

14″ CARNEGIE COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	d	b	t	k	u	c	g	Riv.	AXIS X-X I	AXIS X-X S	AXIS X-X r	AXIS Y-Y I	AXIS Y-Y S	AXIS Y-Y r
							14″ CARNEGIE BEAM SECTIONS								
30	8.82	13.964	6.000	.270	1⅜	431	12¼	3″	⅞	292.0	41.8	5.75	15.5	5.2	1.33
33	9.71	14.000	6.750	.270	1⅜	449	12¼	3″	⅞	333.4	47.6	5.86	23.0	6.8	1.54
36	10.58	14.080	6.774	.294	1⅜	489	12¼	3″	⅞	365.6	51.9	5.88	25.4	7.5	1.55
38	11.18	14.000	6.855	.375	1⅜	449	12¼	3″	⅞	357.5	51.1	5.66	24.2	7.1	1.47
†39	11.47	14.160	6.798	.318	1	529	12¼	3″	⅞	398.3	56.3	5.89	27.7	8.2	1.56
42	12.35	14.240	6.822	.342	1	569	12¼	3″	⅞	431.5	60.6	5.91	30.2	8.8	1.56
48	14.12	14.000	8.000	.343	1⅜	595	11⅜	5½	⅞	496.0	70.9	5.93	50.8	12.7	1.90
53	15.59	14.122	8.035	.378	1¼	656	11⅜	5½	⅞	552.5	78.2	5.95	56.8	14.1	1.91
58	17.05	14.242	8.070	.413	1⅜	716	11⅜	5½	⅞	609.4	85.6	5.98	62.8	15.6	1.92
61	17.94	14.094	10.000	.382	1¼	642	11⅜	5½	1″	656.2	93.1	6.05	107.1	21.4	2.44
68	19.99	14.238	10.043	.425	1⅜	714	11⅜	5½	1″	738.8	103.8	6.08	120.6	24.0	2.46
75	22.05	14.382	10.086	.468	1⅜	786	11⅜	5½	1″	823.5	114.5	6.11	134.5	26.7	2.47
85	24.99	14.000	12.000	.435	1⅜	805	11	9½	1″	921.3	131.6	6.07	232.0	38.5	3.05
95	27.93	14.186	12.050	.485	1⅜	898	11	9½	1″	1044.0	147.2	6.11	262.0	43.5	3.06
105	30.88	14.370	12.101	.536	1⅜	990	11	9½	1″	1169.6	162.8	6.15	292.6	48.4	3.08
86	25.28	13.714	15.008	.414	1⅜	662	11	10″	1″	923.0	136.6	6.04	373.1	49.7	3.84
96	28.23	13.866	15.056	.462	1⅜	738	11	10″	1″	1042.1	150.3	6.08	419.9	55.8	3.86
106	31.18	14.018	15.103	.509	1⅜	814	11	10″	1″	1164.1	166.1	6.11	467.6	61.9	3.87
115	33.82	14.154	15.145	.551	1⅜	882	11	10″	1″	1275.9	180.3	6.14	510.9	67.5	3.89
125	36.75	14.304	15.191	.597	1⅜	957	11	10″	1″	1402.1	196.0	6.18	559.4	73.7	3.90
‡131	38.52	14.162	15.468	.874	1⅜	886	11	10″	1″	1358.4	191.8	5.94	547.3	70.8	3.77
135	39.70	14.452	15.239	.645	1⅜	1,031	11	10″	1″	1530.4	211.8	5.21	608.4	79.9	3.92
145	42.64	14.602	15.284	.690	1⅜	1,106	11	10″	1″	1662.7	227.7	6.24	658.5	86.2	3.93
155	45.58	14.750	15.330	.736	1⅜	1,180	11	10″	1″	1796.8	243.6	6.28	709.0	92.5	3.94
165	48.52	14.896	15.377	.783	1⅜	1,253	11	10″	1″	1932.6	259.5	6.31	759.9	98.8	3.96
175	51.47	15.042	15.424	.830	2⅜	1,326	11	10″	1″	2071.7	275.5	6.34	811.6	105.2	3.97
185	54.41	15.188	15.469	.875	2⅜	1,399	11	10″	1″	2213.5	291.5	6.38	863.9	111.7	3.98
195	57.34	15.334	15.513	.919	2⅜	1,472	11	10″	1″	2358.2	307.6	6.41	916.8	118.2	4.00
205	60.28	15.478	15.559	.965	2¼	1,544	11	10″	1″	2505.0	323.7	6.45	970.3	124.7	4.01
215	63.23	15.622	15.604	1.010	2⅜	1,616	11	10″	1″	2654.7	339.9	6.48	1024.5	131.3	4.03
225	66.17	15.764	15.650	1.056	2⅜	1,687	11	10″	1″	2806.2	336.0	6.51	1079.1	137.9	4.04
235	69.11	15.908	15.693	1.099	2⅜	1,759	11	10″	1″	2961.9	372.4	6.55	1134.5	144.6	4.05
245	72.06	16.060	15.738	1.144	2⅜	1,830	11	10″	1″	3119.0	388.7	6.58	1190.6	151.3	4.06
255	74.99	16.192	15.781	1.187	2⅜	1,901	11	10″	1″	3280.0	405.1	6.61	1247.1	158.0	4.08
265	77.93	16.332	15.826	1.232	2⅜	1,971	11	10″	1″	3442.4	421.6	6.65	1304.2	164.8	4.09

See page 101 for cut.   †Special Section; Web Thickness ⅜″.   ‡Special Section for Column core.

14" CARNEGIE COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

UNSUPPORTED LENGTH IN FEET

14" CARNEGIE BEAM SECTIONS

Weight per foot	8	10	12	14	15	16	17	18	19	20	22	24	26	28	30	32	34	36	38	40
30	123	109	96	84	79	74	69	64	60	57										
33	144	131	118	105	99	94	88	84	79	74	66	59								
36	157	143	129	115	109	103	97	92	86	82	73	65								
39	163	147	131	117	110	103	97	91	85	81	72	64								
†	171	155	140	126	119	112	106	100	94	89	80	71	64							
42	184	167	151	135	128	121	114	108	102	96	86	77	69							
48	212	208	193	177	177	162	155	148	141	135	123	112	102	93	85					
53	234	230	213	196	188	180	172	164	157	149	136	124	113	103	94					
58	256	252	234	215	206	197	189	180	172	164	150	136	124	114	104	95				
61	269	269	269	256	248	240	233	225	217	210	196	182	169	157	146	136	126			
68	300	300	300	286	277	269	260	252	244	235	219	204	190	177	164	153	142			
75	331	331	331	316	305	297	288	279	269	260	243	226	210	196	182	169	158			
85	375	375	375	375	375	369	369	352	343	335	318	301	284	269	254	239	226			
95	419	419	419	419	419	413	403	394	384	375	356	337	319	301	284	268	253			
105	463	463	463	463	463	457	447	437	426	416	395	374	354	335	316	298	281			
86	379	379	379	379	379	379	379	379	379	374	360	347	333	319	306	293	280	267	255	244
96	423	423	423	423	423	423	423	423	423	418	403	388	373	358	343	328	314	300	286	273
106	468	468	468	468	468	468	468	468	468	462	446	429	412	396	379	363	347	332	317	303
115	507	507	507	507	507	507	507	507	507	502	485	467	448	430	413	395	378	361	345	330
125	551	551	551	551	551	551	551	551	551	547	537	508	488	468	449	430	411	393	376	359
‡ 131	578	578	578	578	578	578	578	578	578	566	545	524	502	481	460	440	420	401	382	365
135	596	596	596	596	596	596	596	596	596	591	570	549	528	507	486	466	446	426	407	389
145	640	640	640	640	640	640	640	640	640	636	614	591	568	546	523	502	480	459	439	420
155	684	684	684	684	684	684	684	684	684	680	657	633	608	584	560	537	514	492	470	450
165	728	728	728	728	728	728	728	728	728	725	700	675	649	624	599	574	549	526	503	481
175	772	772	772	772	772	772	772	772	772	770	744	717	690	663	636	610	584	559	535	511
185	816	816	816	816	816	816	816	816	816	815	787	759	731	702	674	646	619	593	567	542
195	860	860	860	860	860	860	860	860	860	860	831	801	771	741	712	683	654	626	599	573
205	904	904	904	904	904	904	904	904	904	904	874	843	812	781	749	719	689	660	631	604
215	949	949	949	949	949	949	949	949	949	949	919	886	853	821	788	756	725	694	664	636
225	993	993	993	993	993	993	993	993	993	993	963	929	895	860	826	793	760	728	697	668
235	1037	1037	1037	1037	1037	1037	1037	1037	1037	1037	1006	971	936	900	864	830	795	762	730	699
245	1081	1081	1081	1081	1081	1081	1081	1081	1081	1081	1051	1014	977	940	903	876	832	797	763	731
255	1125	1125	1125	1125	1125	1125	1125	1125	1125	1125	1095	1057	1019	980	942	905	868	832	797	763
265	1169	1169	1169	1169	1169	1169	1169	1169	1169	1169	1139	1100	1060	1020	981	942	903	866	830	795

Loads to right of heavy vertical lines are for Secondary Members only. †Special Section for Column Core. ‡Special Section; Web Thickness ⅜".

LIVESTOCK PAVILION, MINNESOTA STATE FAIR GROUNDS
Eight hundred tons of structural and miscellaneous steel and iron required in this building, the largest of its kind in the Northwest. Fabricated and Erected by The St. Paul Foundry Company
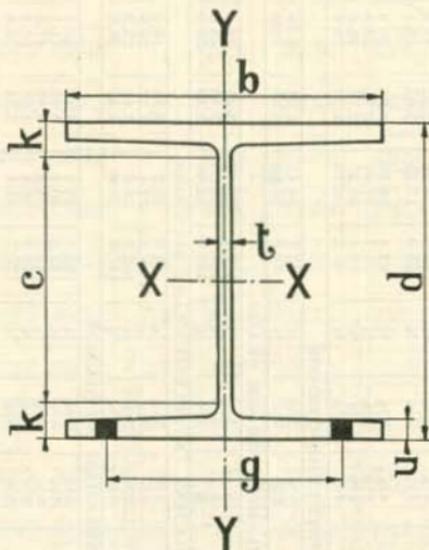
BETHLEHEM COLUMNS

Refer to properties tables for the computed figures on the above items.

SYMBOLS

I—Moment of Inertia
S—Section Modulus
r—Radius of Gyration

Indicated dimensions for various sizes of Bethlehem columns are shown in the following tables.

6" AND 8" BETHLEHEM COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	DIMENSIONS								AXIS X-X			AXIS Y-Y		
		d	b	t	k	u	c	g	Riv.	I	S	r	I	S	r
6" BETHLEHEM H COLUMNS															
20.0	5.81	6.000	6.000	.250	⅝	⅜	4⅜	3½	¾	38.7	12.90	2.58	13.0	4.34	1.50
23.0	6.69	6.125	6.020	.270	¾	½	4⅜	3½	¾	45.9	14.99	2.62	15.4	5.12	1.52
26.5	7.69	6.250	6.060	.300	¾	½	4⅜	3½	¾	53.9	17.25	2.65	18.1	5.96	1.53
30.0	8.70	6.375	6.100	.350	¾	⅜	4⅜	3½	¾	62.4	19.58	2.68	20.8	6.82	1.55
33.5	9.72	6.500	6.140	.390	⅞	½	4⅜	3½	¾	71.2	21.91	2.71	23.6	7.69	1.56
37.0	10.76	6.625	6.180	.430	⅞	½	4⅜	3½	¾	80.4	24.27	2.73	26.6	8.59	1.57
40.5	11.80	6.750	6.220	.470	1⅛	¾	4⅜	3½	¾	90.1	26.70	2.76	29.6	9.52	1.58
8" BETHLEHEM BEAMS															
17.5	5.20	8.000	5.250	.250	⅝	1⅛	6⅜	2¾	¾	57.7	14.43	3.33	6.39	2.44	1.11
19.0	5.68	8.060	5.270	.270	¾	¾	6⅜	2¾	¾	62.9	15.60	3.35	7.20	2.73	1.13
8" BETHLEHEM GIRDER BEAMS															
29.5	8.69	7.880	7.995	.285	⅝	1⅛	6	5½	⅞	100.7	25.56	3.41	28.4	7.10	1.81
33.0	9.69	8.000	8.000	.290	1⅛	1⅛	6	5½	⅞	116.1	29.03	3.46	33.6	8.39	1.86
36.5	10.81	8.120	8.020	.310	1⅛	1⅛	6	5½	⅞	132.6	32.66	3.50	39.0	9.72	1.90
8" BETHLEHEM H COLUMNS															
23.5	6.72	7.750	6.500	.250	⅝	⅜	6⅛	3½	¾	74.6	19.2	3.33	16.8	5.17	1.58
27.0	7.76	7.875	6.530	.280	⅞	½	6⅛	3½	¾	88.2	22.4	3.37	20.0	6.11	1.60
30.5	8.82	8.000	6.560	.310	⅞	½	6⅛	3½	¾	102.3	25.6	3.41	23.2	7.07	1.62
34.5	9.97	8.125	6.600	.350	1	⅝	6⅛	3½	¾	117.4	28.9	3.43	26.6	8.07	1.63
8" BETHLEHEM H COLUMNS															
32.0	9.17	7.875	8.000	.310	⅝	⅜	6⅛	5½	¾	105.7	26.9	3.40	35.8	8.90	1.98
35.0	10.17	8.000	8.000	.310	⅞	½	6⅛	5½	¾	121.5	30.4	3.46	41.1	10.30	2.01
39.5	11.50	8.125	8.040	.350	1⅛	½	6⅛	5½	¾	139.5	34.3	3.48	47.2	11.70	2.03
44.0	12.83	8.250	8.080	.390	1⅛	⅝	6⅛	5½	¾	158.3	38.4	3.51	53.4	13.20	2.04
48.5	14.18	8.375	8.120	.430	1⅛	¾	6⅛	5½	¾	177.7	42.4	3.54	59.8	14.70	2.05
53.0	15.53	8.500	8.160	.470	1⅛	1	6⅛	5½	¾	197.8	46.5	3.57	66.3	16.30	2.07
58.0	16.90	8.625	8.200	.510	1⅛	1	6⅛	5½	¾	218.6	50.7	3.60	73.1	17.80	2.08
62.5	18.27	8.750	8.240	.550	1⅛	1	6⅛	5½	¾	240.2	54.9	3.63	80.0	19.40	2.09
67.5	19.66	8.875	8.280	.590	1⅛	1	6⅛	5½	¾	262.5	59.2	3.65	87.1	21.00	2.11
72.0	21.05	9.000	8.320	.630	1¼	1	6⅛	5½	¾	285.6	63.5	3.68	94.4	22.70	2.12
77.0	22.46	9.125	8.360	.670	1⅛	1¼	6⅛	5½	¾	309.5	67.8	3.71	101.9	24.40	2.13
81.5	23.78	9.250	8.390	.700	1⅜	1⅛	6⅛	5½	¾	333.5	72.1	3.75	109.2	26.00	2.14
86.0	25.20	9.375	8.430	.740	1⅜	1⅛	6⅛	5½	¾	359.0	76.6	3.77	117.1	27.80	2.16
91.0	26.64	9.500	8.470	.780	1⅜	1⅛	6⅛	5½	¾	385.3	81.1	3.80	125.1	29.60	2.17

See page 113 for cut.

6" AND 8" BETHLEHEM COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

Weight per foot	UNSUPPORTED LENGTH IN FEET																			
	4	6	8	9	10	11	12	13	14	15	16	17	18	19	20	22	24	26	28	30
6" BETHLEHEM H COLUMNS — SUPPLEMENTARY SECTIONS																				
20.0	87	87	85	81	77	73	69	65	62	58	55	52	49	46	43	38	34			
23.0	100	100	99	98	89	85	80	76	72	68	64	60	57	54	51	45	40			
26.5	115	115	114	108	103	98	93	88	83	78	74	70	66	62	58	52	47			
30.0	131	131	129	123	117	112	106	100	95	90	85	80	75	71	67	60	54			
33.5	146	146	145	138	132	125	119	112	106	101	95	90	85	80	76	67	60			
37.0	161	161	160	153	146	139	132	125	118	112	106	100	94	89	84	75	67			
40.5	177	177	176	169	161	153	145	138	130	123	117	110	104	98	93	83	75			
8" BETHLEHEM BEAMS																				
17.5	78	76	66	61	57	52	48	45	41	38	35	33	30							
19.0	85	83	73	68	63	58	54	50	46	42	39	36	34							
8" BETHLEHEM GIRDER BEAMS																				
29.5	130	130	130	130	126	121	116	111	106	101	96	92	87	83	79	71	65	59	53	
33.0	145	145	145	145	141	136	131	125	120	115	110	105	100	95	91	82	75	68	62	
36.5	162	162	162	162	159	154	148	142	136	130	124	119	113	108	103	94	86	78	71	
8" BETHLEHEM H COLUMNS — SUPPLEMENTARY SECTIONS																				
23.5	101	101	100	96	92	87	83	78	74	70	66	63	59	56	53	47	42			
27.0	116	116	116	111	106	101	96	91	87	82	78	74	69	66	62	55	50			
30.5	132	132	132	127	122	116	110	105	99	94	89	84	80	76	72	64	58	52		
34.5	150	150	150	144	138	132	125	119	113	107	101	96	91	86	81	73	66	59		
8" BETHLEHEM H COLUMNS																				
32.0	138	138	138	138	137	132	128	123	118	114	108	104	99	95	91	83	76	69	63	58
35.0	153	153	153	153	153	148	142	137	132	127	122	117	112	107	102	93	86	78	72	66
39.5	173	173	173	173	173	168	162	156	150	144	138	133	127	122	116	107	98	90	82	75
44.0	192	192	192	192	192	187	181	174	168	161	155	148	142	136	131	120	110	100	92	85
48.5	213	213	213	213	213	207	200	193	186	179	172	165	158	151	145	133	122	112	102	94
53.0	233	233	233	233	233	228	220	212	205	197	189	182	174	167	160	147	135	124	114	104
58.0	254	254	254	254	254	249	240	232	223	215	206	198	190	183	175	161	147	135	124	114
62.5	274	274	274	274	274	269	260	251	242	233	224	215	206	198	190	174	160	147	135	124
67.5	295	295	295	295	295	291	281	272	262	252	242	233	224	215	206	189	174	160	147	135
72.0	316	316	316	316	316	312	302	291	281	271	260	250	240	231	221	204	187	172	158	146
77.0	337	337	337	337	337	334	323	312	301	290	279	268	257	247	237	218	201	184	170	156
81.5	357	357	357	357	357	353	342	331	319	307	296	285	273	263	252	232	214	196	180	166
86.0	378	378	378	378	378	376	364	352	339	327	315	303	292	280	269	248	228	210	194	178
91.0	400	400	400	400	400	398	385	373	360	347	334	322	310	297	286	263	242	223	206	190

Loads to right of heavy vertical lines are for Secondary Members only.

10" BETHLEHEM COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	d	b	t	k	u	c	g	Riv.	X-X I	X-X S	X-X r	Y-Y I	Y-Y S	Y-Y r
10" BETHLEHEM Bs.															
21.0	6.28	9.90	5.740	.240	¾	1¼	8⅜	2¾	⅞	108.1	21.84	4.15	9.3	3.24	1.22
23.5	6.96	10.00	5.750	.250	⅞	1¼	8⅜	2¾	⅞	123.2	24.64	4.21	10.9	3.80	1.25
26.0	7.68	10.09	5.770	.270	⅞	1¼	8⅜	2¾	⅞	137.9	27.33	4.24	12.5	4.33	1.28
28.5	8.41	10.19	5.785	.285	⅞	1¼	8⅜	2¾	⅞	154.1	30.25	4.28	14.2	4.92	1.30
10" BETHLEHEM Gs.															
41.5	12.23	9.91	8.990	.310	1 5/16	1⅜	7¼	5½	⅞	225.8	45.57	4.30	52.6	11.7	2.07
44.0	13.14	10.00	9.000	.320	1 5/16	1⅜	7¼	5½	⅞	246.7	49.34	4.33	58.2	12.9	2.10
50.0	14.62	10.12	9.040	.360	1 5/16	1⅜	7¾	5½	⅞	277.5	54.84	4.36	66.4	14.7	2.13
10" BETHLEHEM SUPPLEMENTARY Hs															
33.5	9.60	9.625	8.00	.28	1	1⅜	7⅞	5½	⅞	166.2	34.50	4.16	36.6	9.14	1.95
38.0	10.89	9.750	8.03	.31	1 3/16	1⅜	7⅞	5½	⅞	192.0	39.40	4.20	42.4	10.56	1.97
42.5	12.29	9.875	8.07	.35	1 3/16	1⅜	7⅞	5½	⅞	219.4	44.40	4.23	48.5	12.02	1.99
47.5	13.70	10.000	8.11	.39	1 3/16	1⅜	7⅞	5½	⅞	247.6	49.50	4.25	54.8	13.52	2.00
10" BETHLEHEM Hs															
49.5	14.37	9.875	9.97	.36	1 3/16	⅞	7 9/16	5½	⅞	263.5	53.4	4.28	89.1	17.9	2.49
55.0	15.57	10.000	10.00	.39	1 3/16	⅞	7 9/16	5½	⅞	296.8	59.4	4.32	100.4	20.1	2.51
60.5	17.57	10.125	10.04	.43	1 5/16	⅞	7 9/16	5½	⅞	331.9	65.6	4.35	112.2	22.3	2.53
66.0	19.23	10.250	10.08	.47	1 5/16	⅞	7 9/16	5½	⅞	368.0	71.8	4.37	124.2	24.6	2.54
72.0	20.91	10.375	10.12	.51	1⅜	⅞	7 9/16	5½	⅞	405.2	78.1	4.40	136.5	27.0	2.56
77.5	22.59	10.500	10.16	.55	1⅜	⅞	7 9/16	5½	⅞	433.6	84.5	4.43	149.1	29.4	2.57
83.5	24.59	10.625	10.20	.59	1 7/16	⅞	7 9/16	5½	⅞	483.0	90.9	4.46	162.0	31.8	2.58
89.0	25.99	10.750	10.24	.63	1 7/16	1⅛	7 9/16	5½	⅞	523.5	97.4	4.49	175.1	34.2	2.60
95.0	27.71	10.875	10.28	.67	1½	1⅛	7 9/16	5½	⅞	565.5	103.9	4.52	188.6	36.1	2.61
100.5	29.32	11.000	10.31	.70	1½	1⅜	7 9/16	5½	⅞	607.0	110.4	4.55	201.7	39.1	2.62
106.5	31.06	11.125	10.35	.74	1⅝	1⅜	7⅞	5½	⅞	651.0	117.0	4.58	215.6	41.7	2.64
112.0	32.80	11.250	10.39	.78	1⅝	1⅞	7⅞	5½	⅞	696.2	123.6	4.61	229.6	44.3	2.65
118.0	34.55	11.375	10.43	.82	1 11/16	1⅞	7⅞	5½	⅞	742.7	130.6	4.64	244.4	46.9	2.66
124.0	36.32	11.500	10.47	.86	1 11/16	1⅞	7⅞	5½	⅞	790.4	137.3	4.67	259.3	49.5	2.67
130.0	38.09	11.625	10.51	.90	2	1⅞	7⅞	5½	⅞	839.4	144.4	4.69	274.5	52.2	2.68
136.5	39.88	11.750	10.55	.94	2⅜	1½	7¾	5½	⅞	889.7	151.4	4.72	289.9	55.0	2.70

See page 113 for cut.

10" BETHLEHEM COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

Weight per foot	UNSUPPORTED LENGTH IN FEET														
	6	7	8	9	10	12	14	16	18	20	22	24	26	28	30
10" BETHLEHEM Bs															
21.0	94	89	84	79	73	64	55	48	41	36					
23.5	104	100	94	89	83	72	63	54	47	41					
25.0	115	112	105	99	93	81	71	61	54	47					
28.5	126	123	116	109	103	90	78	68	60	52					
10" BETHLEHEM Gs															
41.5	183	183	183	183	183	174	161	149	137	126	116	106	97	89	82
44.5	197	197	197	197	197	188	174	161	149	137	126	116	106	98	90
50.0	219	219	219	219	219	210	196	181	168	154	142	131	120	110	102
10" BETHLEHEM SUPPLEMENTARY Hs															
33.5	..	..	144	144	143	132	122	112	103	94	86	78	71		
38.0	..	..	163	163	162	151	140	128	118	107	98	90	82		
42.5	..	..	..	184	184	171	158	146	134	122	112	102	94		
47.5	..	..	..	206	206	192	177	163	150	137	125	115	105		
10" BETHLEHEM Hs															
49.5	..	..	..	..	216	216	206	194	182	171	159	148	138	128	120
55.0	..	..	..	..	239	239	229	216	203	190	177	165	154	143	134
60.5	..	..	..	..	264	264	254	240	225	211	197	184	171	160	149
66.0	..	..	..	..	288	288	278	263	247	231	216	202	188	176	164
72.0	..	..	..	..	314	314	304	287	270	253	237	221	206	192	179
77.5	..	..	..	..	339	339	329	310	292	274	256	239	224	209	194
83.5	..	..	..	..	364	364	354	334	315	295	276	258	241	225	210
89.0	..	..	..	..	390	390	380	359	338	318	297	278	260	243	227
95.0	..	..	..	..	416	416	405	383	361	339	318	298	278	270	242
100.5	..	..	..	..	440	440	430	406	383	360	337	316	295	276	258
106.5	..	..	..	..	466	466	456	432	409	383	359	337	315	294	275
112.0	..	..	..	..	492	492	482	457	431	406	380	357	334	312	292
118.0	..	..	..	..	518	518	509	482	455	428	402	377	352	330	308
124.0	..	..	..	..	545	545	536	508	479	451	424	397	372	348	325
130.0	..	..	..	..	571	571	563	534	504	474	445	417	391	366	342
136.5	..				598	598	591	560	530	499	469	440	412	386	361

Loads to right of heavy vertical lines are for Secondary Members only.

12″ BETHLEHEM COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	d	b	t	k	c	g	Riv.	AXIS X-X I	AXIS X-X s	AXIS X-X r	AXIS Y-Y I	AXIS Y-Y s	AXIS Y-Y r
12″ BETHLEHEM Bs														
28.0	8.28	12.00	6.500	.245	⅞	10¾	3	⅞	213.6	35.60	5.08	16.4	5.04	1.41
36.0	10.58	12.25	6.555	.300	1	10¾	3	⅞	281.8	46.01	5.16	22.7	6.93	1.46
40.0	11.80	12.00	6.750	.330	1⅛	9¾	3	⅞	301.2	50.20	5.05	27.6	8.18	1.53
48.5	14.28	12.25	6.815	.395	1¼	9¾	3	⅞	373.2	60.93	5.11	35.1	10.29	1.57
12″ BETHLEHEM Gs														
55.0	16.35	12.00	10.000	.380	1⅛	9¾	5½	⅞	435.6	72.60	5.16	84.9	17.0	2.28
61.0	17.92	12.12	10.030	.470	1¼	9¾	5½	⅞	483.6	79.80	5.20	95.9	19.1	2.31
70.5	20.79	12.00	10.250	.470	1¼	9	5½	⅞	533.6	90.80	5.04	119.7	23.4	2.40
76.5	22.50	12.12	10.290	.510	1⅜	9	5½	⅞	594.2	98.05	5.14	132.1	25.7	2.42
12″ BETHLEHEM SUPPLEMENTARY Hs														
40.5	11.55	11.500	8.00	.31	⅞	9½	5½	⅞	280.1	48.7	4.92	42.8	10.7	1.92
45.5	13.02	11.625	8.04	.35	1	9½	5½	⅞	318.8	54.8	4.95	48.8	12.1	1.94
50.0	14.49	11.750	8.08	.39	1	9½	5½	⅞	358.5	61.0	4.97	55.1	15.1	1.95
55.0	15.98	11.875	8.12	.43	1⅛	9½	5½	⅞	399.3	67.3	5.00	61.5	15.2	1.96
52.5	15.11	11.625	10.00	.35	1	9½	5½	⅞	383.2	65.9	5.04	91.5	18.3	2.46
58.0	16.83	11.750	10.04	.39	1⅛	9½	5½	⅞	431.3	73.4	5.06	103.2	20.5	2.48
64.0	18.56	11.875	10.08	.43	1⅛	9½	5½	⅞	480.6	80.9	5.09	115.1	22.8	2.49
70.0	20.30	12.000	10.12	.47	1¼	9½	5½	⅞	531.3	88.5	5.12	127.3	25.2	2.50
12″ BETHLEHEM Hs														
65.5	19.00	11.750	11.92	.39	1¼	9¾	5½	⅞	499.0	84.9	5.13	168.6	28.3	2.98
72.5	20.96	11.875	11.96	.43	1¼	9¾	5½	⅞	556.6	93.7	5.15	188.2	31.5	3.00
79.0	22.94	12.000	12.00	.47	1⅜	9¾	5½	⅞	615.6	102.6	5.18	208.1	34.7	3.01
85.5	24.92	12.125	12.04	.51	1⅜	9¾	5½	⅞	676.1	111.5	5.21	228.5	37.9	3.03
92.5	26.92	12.250	12.08	.55	1½	9¾	5½	⅞	738.1	120.5	5.24	249.2	41.3	3.04
99.5	28.92	12.375	12.12	.59	1½	9½	5½	⅞	801.7	129.6	5.27	270.1	44.6	3.06
106.0	30.94	12.500	12.16	.63	1⅝	9½	5½	⅞	866.8	138.6	5.30	291.7	48.0	3.07
113.0	32.96	12.625	12.20	.67	1⅝	9½	5½	⅞	933.4	147.9	5.33	313.6	51.4	3.08
119.5	34.87	12.750	12.23	.70	1¾	9½	5½	⅞	1000.0	156.9	5.36	335.0	54.8	3.10
126.5	36.91	12.875	12.27	.74	1¾	9½	5½	1	1069.8	166.2	5.38	357.7	58.3	3.11
133.5	38.97	13.000	12.31	.78	1¾	9¼	5½	1	1141.3	175.6	5.41	380.7	61.9	3.13
140.5	41.03	13.125	12.35	.82	1⅞	9¼	5½	1	1214.5	185.0	5.44	404.1	65.4	3.14
147.5	43.10	13.250	12.39	.86	1⅞	9¼	5½	1	1289.4	194.6	5.47	428.0	69.1	3.15
154.5	45.45	13.375	12.43	.90	2	9¼	5½	1	1366.0	204.3	5.50	452.2	72.8	3.16
162.0	47.28	13.500	12.47	.94	2	9¼	5½	1	1444.3	214.0	5.53	477.0	76.5	3.18
169.0	49.38	13.625	12.51	.98	2⅛	9	5½	1	1524.4	223.8	5.56	502.1	80.3	3.19
176.0	51.50	13.750	12.55	1.02	2¼	9	5½	1	1600.3	233.6	5.59	527.6	84.1	3.20
183.0	53.48	13.875	12.58	1.05	2¼	9	5½	1	1687.8	243.3	5.62	552.2	87.8	3.21
190.0	55.62	14.000	12.62	1.09	2⅜	9	5½	1	1773.4	253.3	5.65	578.6	91.7	3.23

See page 113 for cut.

12" BETHLEHEM COLUMNS
ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

Weight per foot						UNSUPPORTED LENGTH IN FEET									
	4	8	12	14	16	18	20	22	24	26	28	30	32	34	36
12" BETHLEHEM Bs															
28.0	124	118	94	83	73	65	57	51							
36.0	159	154	124	110	97	86	76	68	60						
40.0	177	174	142	127	113	101	90	80	72						
48.5	214	213	175	157	140	125	112	100	90						
12" BETHLEHEM Gs															
55.5	245	245	241	226	211	196	182	169	156	144	134	123			
61.0	269	269	265	249	233	217	202	187	173	160	148	137	127		
70.5	312	312	302	294	276	258	241	224	208	193	179	166	154		
76.5	338	338	338	319	300	281	262	244	227	210	196	182	169		
12" BETHLEHEM SUPPLEMENTARY Hs															
40.5	173	173	158	146	134	122	111	101	92	84					
45.5	195	195	179	165	152	139	127	117	105	96					
50.5	217	217	200	185	170	155	142	129	118	108	98				
55.0	240	240	221	204	188	172	157	143	131	120	109				
52.5		227	227	216	203	190	178	166	154	144	134	124			
58.0		252	252	241	227	213	199	186	173	161	150	140			
64.0		278	278	267	251	236	220	206	192	179	166	155			
70.0		305	305	292	275	258	242	226	210	196	182	170	158		
12" BETHLEHEM Hs															
65.5			285	285	278	264	251	238	225	213	200	189	178	168	158
72.5			314	314	307	293	279	264	249	236	223	210	197	186	175
79.0			344	344	337	321	305	289	274	259	244	230	217	204	192
85.5			374	374	367	350	333	316	299	282	266	251	237	224	211
92.5			404	404	397	378	360	341	323	306	289	272	257	242	228
99.5			434	434	427	408	388	368	349	330	312	294	278	262	247
106.0			464	464	457	437	416	395	374	354	334	316	298	281	265
113.0			494	494	488	466	444	421	399	378	357	337	318	300	283
119.5			523	523	517	494	471	447	424	402	380	359	339	320	302
126.5			554	554	548	524	499	474	450	426	403	381	360	339	321
133.5			585	585	580	555	529	503	477	452	428	404	382	361	341
140.5			616	616	611	585	558	531	503	477	451	427	403	381	360
147.5			647	647	643	615	587	558	530	502	475	450	425	401	379
154.5			678	678	675	646	616	586	557	527	499	473	447	422	399
162.0			709	709	708	677	646	616	585	555	525	497	470	444	420
169.0			741	741	740	708	676	644	612	580	550	520	492	466	440
176.0			773	773	773	740	706	673	639	607	575	544	515	487	460
183.0				802	802	769	734	700	665	631	598	566	536	507	480
190.0				834	834	802	766	730	695	660	625	592	561	532	502

Loads to right of heavy vertical lines for Secondary Members only.

14″ BETHLEHEM COLUMNS — DIMENSIONS AND PROPERTIES

14″ BETHLEHEM H COLUMNS — 8-10 and 12″ Nominal Flange Widths

Weight per foot	Area Sq. In.	d	b	Riv.	AXIS X-X I	S	r	AXIS Y-Y I	S	r
43.0	12.58	13.375	8.00	⅞	408.2	61.0	5.70	43.6	10.9	1.86
48.0	14.12	13.500	8.04	⅞	461.5	68.4	5.72	49.7	12.4	1.88
53.5	15.67	13.625	8.08	⅞	516.2	75.8	5.74	56.0	13.9	1.89
58.5	17.23	13.750	8.12	⅞	572.2	83.2	5.76	62.4	15.4	1.90
55.0	16.25	13.500	10.00	⅞	551.0	81.6	5.82	93.1	18.6	2.39
61.5	18.04	13.625	10.04	⅞	616.9	90.6	5.85	104.8	20.9	2.41
67.5	19.85	13.750	10.08	⅞	684.3	99.5	5.87	116.8	23.2	2.43
73.5	21.66	13.875	10.12	⅞	753.3	108.6	5.90	129.1	25.5	2.44
69.0	20.34	13.625	12.00	⅞	714.6	104.9	5.93	174.7	29.1	2.93
76.0	22.39	13.750	12.04	⅞	793.3	115.4	5.95	194.7	32.3	2.95
83.0	24.45	13.875	12.08	⅞	874.2	126.0	5.98	215.1	35.6	2.97
90.0	26.52	14.000	12.12	⅞	956.7	136.7	6.01	235.8	38.9	2.98

14″ BETHLEHEM H COLUMNS — 14″ Nominal Flange Width

Weight per foot	Area Sq. In.	d	b	Riv.	AXIS X-X I	S	r	AXIS Y-Y I	S	r
84.0	24.76	13.92	13.750	1	895.5	130.2	6.01	294.5	42.3	3.45
92.0	27.05	13.96	13.875	1	987.4	142.3	6.04	325.5	46.6	3.47
100.5	29.36	14.00	14.000	1	1081.2	154.5	6.07	356.9	51.0	3.49
107.5	31.67	14.04	14.125	1	1177.2	166.7	6.10	388.9	55.4	3.50
115.5	34.00	14.08	14.250	1	1275.1	179.0	6.12	421.4	59.9	3.52
123.5	36.33	14.12	14.375	1	1375.1	191.3	6.15	454.4	64.4	3.54
131.5	38.68	14.16	14.500	1	1477.3	203.8	6.18	488.0	68.9	3.55
139.0	40.88	14.19	14.625	1	1578.9	215.9	6.21	520.9	73.4	3.57
147.0	43.25	14.23	14.750	1	1685.3	228.5	6.24	555.5	78.2	3.58
155.0	45.62	14.27	14.875	1	1793.8	241.2	6.27	590.6	82.8	3.60
161.0	47.33	15.00	15.000	1	1874.4	252.0	6.29	682.5	91.0	3.80
168.0	49.51	15.02	15.125	1	1984.6	264.6	6.33	720.6	96.0	3.82
177.0	51.99	15.06	15.125	1	2102.6	278.2	6.36	762.1	101.2	3.83
185.0	54.48	15.10	15.250	1	2223.0	291.5	6.39	804.2	106.5	3.84
194.0	56.99	15.14	15.375	1	2345.8	305.1	6.42	846.9	111.9	3.86
202.0	59.50	15.18	15.500	1	2470.9	318.8	6.44	890.3	117.3	3.87
210.0	61.86	15.21	15.625	1	2595.4	332.2	6.48	932.4	122.6	3.88
219.0	64.40	15.25	15.750	1	2725.3	346.1	6.51	976.9	128.1	3.89
227.0	66.94	15.29	15.875	1	2857.8	360.0	6.53	1022.0	133.7	3.91
236.0	69.49	15.33	16.000	1	2992.9	374.1	6.56	1067.8	139.3	3.92
245.0	72.05	15.37	16.125	1	3130.4	388.3	6.59	1114.2	145.0	3.93
254.0	74.62	15.41	16.250	1	3270.6	402.5	6.62	1161.2	150.7	3.94
262.0	77.20	15.45	16.500	1	3413.4	416.9	6.65	1209.0	156.5	3.95
271.0	79.79	15.49	16.500	1	3558.8	431.4	6.68	1257.3	162.3	3.97
280.0	82.39	15.53	16.625	1	3706.9	445.9	6.71	1306.4	168.2	3.98
289.0	85.01	15.57	16.750	1	3857.7	460.6	6.74	1356.1	174.2	3.99
298.0	87.63	15.61	16.875	1	4011.3	475.4	6.77	1406.5	180.2	4.01

See page 113 for Cut.

14" BETHLEHEM COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

UNSUPPORTED LENGTH IN FEET

14" BETHLEHEM H COLUMNS 8—10 and 12" Nominal Flange Widths

Weight Per Foot	9	10	12	14	16	18	20	22	24	26	28	30	32	36	40	44	48
43.0	189	184	170	156	142	129	118	107	97	88	81						
48.0	212	207	192	176	161	147	133	121	110	101	92						
53.5	235	231	213	196	179	163	149	135	123	112	102						
58.5	258	254	235	216	198	181	164	150	136	124	113						
55.0	244	244	243	229	215	201	188	174	162	150	139						
61.5	271	271	271	256	240	224	209	195	181	168	156						
67.5	298	298	298	282	265	248	232	216	201	186	173	161	150				
73.5	325	325	305	309	290	272	254	236	220	204	190	177	164				
69.0	305	305	305	305	296	281	267	252	238	225	212	199	187	166	147		
76.0	336	336	336	336	326	311	295	279	264	249	234	221	208	184	163		
83.0	367	367	367	367	357	340	323	306	289	273	257	242	228	202	179		
90.0	398	398	398	398	388	369	351	333	314	297	280	264	248	220	195		

14" BETHLEHEM H COLUMNS 14" Nominal Flange Width

Weight Per Foot	9	10	12	14	16	18	20	22	24	26	28	30	32	36	40	44	48
84.0	371	371	371	371	371	366	351	336	321	306	292	278	264	238	215	194	
92.0	406	406	406	406	406	401	385	368	352	336	320	305	290	262	236	213	
100.0	440	440	440	440	440	436	418	401	383	366	349	332	316	285	257	233	
107.5	475	475	475	475	475	471	452	433	414	396	377	359	342	309	279	252	
115.5	510	510	510	510	510	506	486	466	446	426	407	387	369	333	301	272	
123.5	545	545	545	545	545	542	521	500	478	457	436	415	395	358	323	292	
131.5	580	580	580	580	580	577	555	533	510	487	465	443	422	382	345	312	
139.0	613	613	613	613	613	612	588	565	540	517	493	470	448	406	367	332	
147.0	649	649	649	649	649	647	623	598	573	548	523	499	473	430	389	352	
155.0	684	684	684	684	684	684	659	632	606	579	553	528	503	456	413	374	
161.0	710	710	710	710	710	710	697	672	646	620	594	568	544	496	452	411	
168.0	743	743	743	743	743	743	731	705	677	650	623	597	571	521	475	432	
177.0	780	780	780	780	780	780	768	740	712	684	656	628	600	548	500	455	
185.0	817	817	817	817	817	817	806	777	747	718	688	659	630	576	525	478	
194.0	855	855	855	855	855	855	845	814	784	753	722	692	662	605	552	503	
202.0	893	893	893	893	893	893	882	851	819	787	755	724	692	632	577	527	
210.0	928	928	928	928	928	928	918	886	852	819	786	753	721	659	602	549	500
219.0	966	966	966	966	966	966	957	923	888	854	820	786	752	688	628	573	523
227.0	1004	1004	1004	1004	1004	1004	996	961	926	890	854	819	785	718	656	598	546
236.0	1042	1042	1042	1042	1042	1042	1035	999	962	925	888	852	816	747	682	623	569
245.0	1081	1081	1081	1081	1081	1081	1074	1038	999	960	922	885	847	776	709	648	592
254.0	1119	1119	1119	1119	1119	1119	1113	1075	1036	996	957	918	879	805	736	672	614
262.0	1158	1158	1158	1158	1158	1158	1154	1115	1075	1033	993	953	913	836	765	699	638
271.0	1197	1197	1197	1197	1197	1197	1194	1153	1111	1069	1028	986	945	866	792	724	662
280.0	1236	1236	1236	1236	1236	1236	1233	1191	1149	1106	1062	1020	978	896	821	750	685
289.0	1275	1275	1275	1275	1275	1275	1274	1231	1187	1142	1097	1053	1011	927	848	775	709
298.0	1314	1314	1314	1314	1314	1314	1314	1272	1226	1180	1135	1089	1045	959	878	804	735

Loads to right of heavy vertical lines are for Secondary Members only.

16" BETHLEHEM COLUMNS
DIMENSIONS AND PROPERTIES

Weight per foot	Area Sq. In.	d	b	t	k	u	c	g	Riv.	I	S	r	I	S	r
										AXIS X-X			**AXIS Y-Y**		
										I	S	r	I	S	r
									16" BETHLEHEM H COLUMNS						
143.0	42.03	14.500	15.54	.72	1¾	1⅜	11⅜	10"	1"	1610.4	222.1	6.19	638.3	82.2	3.90
151.0	44.56	14.625	15.58	.76	1⅞	1⅜	11⅜	10"	1"	1723.8	235.7	6.22	683.4	87.7	3.92
160.0	47.10	14.750	15.62	.80	1⅞	1⅜	11⅜	10"	1"	1839.3	249.4	6.25	728.5	93.3	3.93
169.0	49.65	14.875	15.66	.84	1⅞	1⅜	11⅜	10"	1"	1957.6	263.2	6.28	774.2	98.9	3.95
177.0	52.20	15.000	15.70	.88	2	1⅜	11⅜	10"	1"	2078.0	277.1	6.31	820.7	104.5	3.96
186.0	54.77	15.125	15.74	.92	2	1⅜	11⅜	10"	1"	2200.9	291.0	6.34	867.7	110.3	3.98
195.0	57.35	15.250	15.78	.96	2	1⅜	11⅜	10"	1"	2326.1	305.1	6.37	915.5	116.0	4.00
203.0	59.94	15.375	15.82	1.00	2	1⅜	11⅜	10"	1"	2453.9	319.2	6.40	963.9	121.9	4.01
212.0	62.53	15.500	15.86	1.04	2⅛	1⅜	11⅜	10"	1"	2584.1	333.4	6.43	1013.0	127.7	4.02
221.0	65.14	15.625	15.90	1.08	2⅛	1⅜	11⅜	10"	1"	2716.9	347.8	6.46	1062.7	133.7	4.04
230.0	67.60	15.750	15.93	1.11	2⅛	1⅜	11⅜	10"	1"	2848.9	361.8	6.49	1111.0	139.5	4.05
238.0	70.07	15.875	15.96	1.14	2⅛	1½	11⅜	10"	1"	2983.4	375.9	6.53	1159.8	145.3	4.07
247.0	72.70	16.000	16.00	1.18	2¼	1⅞	11⅜	10"	1"	3123.7	390.5	6.55	1211.4	151.4	4.08
256.0	75.35	16.125	16.04	1.22	2¼	1⅞	11⅜	10"	1"	3266.7	405.2	6.58	1263.8	157.6	4.10
265.0	78.00	16.250	16.08	1.26	2¼	2	11⅜	10"	1"	3412.4	420.0	6.61	1316.8	163.8	4.11
274.0	80.67	16.375	16.12	1.30	2¼	2	11⅜	10"	1"	3650.7	434.9	6.64	1370.6	170.0	4.12
288.0	84.69	16.563	16.18	1.36	2⅜	2⅛	11⅜	10"	1"	3788.4	457.5	6.69	1452.5	179.5	4.14
301.0	88.56	16.750	16.23	1.41	2⅜	2⅛	11⅜	10"	1"	4018.4	479.8	6.74	1533.2	188.9	4.16
314.0	92.45	16.938	16.28	1.46	2⅜	2⅛	11⅜	10"	1"	4180.5	502.4	6.78	1615.2	198.4	4.18
328.0	96.53	17.125	16.34	1.52	2⅜	2⅛	11⅜	10"	1"	4500.9	525.7	6.83	1701.8	208.3	4.20
342.0	100.63	17.313	16.40	1.58	2½	2⅜	11⅜	10"	1"	4764.0	549.2	6.87	1790.1	218.3	4.22
356.0	104.75	17.500	16.46	1.64	2½	2⅜	11⅜	10"	1"	5013.7	573.0	6.92	1880.0	228.4	4.24
370.0	108.90	17.688	16.52	1.70	2½	2⅜	11⅜	10"	1"	5280.2	597.1	6.96	1971.7	238.4	4.26
384.0	113.07	17.875	16.58	1.76	2½	2⅜	11⅜	10"	1"	5553.6	621.4	7.01	2065.1	249.1	4.27
399.0	117.26	18.063	16.64	1.82	2⅝	2⅞	11⅜	10"	1"	5834.0	646.0	7.05	2160.3	259.6	4.29
413.0	121.48	18.250	16.70	1.88	2⅝	2⅞	11⅜	10"	1"	6121.5	670.8	7.10	2257.2	270.3	4.31
427.0	125.72	18.438	16.76	1.94	2⅝	3	11⅜	10"	1"	6416.2	696.0	7.14	2355.9	281.1	4.33

See page 113 for cut.

16" BETHLEHEM COLUMNS

ALLOWABLE CONCENTRIC LOADS IN THOUSANDS OF POUNDS

Weight per foot	UNSUPPORTED LENGTH IN FEET														
	16	18	20	22	24	26	28	30	32	34	36	38	40	44	48
	16" BETHLEHEM H COLUMNS														
143.0	630	630	625	603	580	558	536	514	492	470	450	430	411	375	342
150.0	668	668	664	641	617	593	569	546	523	501	479	458	438	400	365
160.0	707	707	702	678	653	628	603	578	554	530	507	485	463	423	387
169.0	745	745	742	716	690	664	638	612	586	561	537	513	491	448	410
177.0	783	783	780	754	727	698	671	644	617	591	565	541	517	472	432
186.0	822	822	820	792	763	735	706	678	650	622	595	570	546	498	456
195.0	860	860	860	832	801	771	742	712	683	654	626	599	574	524	479
203.0	899	899	899	870	839	807	776	745	715	685	656	628	601	550	503
212.0	938	938	938	909	875	844	811	778	747	716	685	657	628	575	526
221.0	977	977	977	948	914	881	847	814	780	748	717	687	657	602	550
230.0	1014	1014	1014	984	950	915	880	846	811	778	746	714	683	626	573
238.0	1051	1051	1051	1022	987	951	914	879	844	809	776	743	711	652	597
247.0	1091	1091	1091	1061	1025	988	950	913	877	841	806	773	739	678	621
256.0	1130	1130	1130	1102	1065	1026	988	949	912	875	839	804	770	706	647
265.0	1170	1170	1170	1142	1103	1064	1024	984	945	907	870	834	799	732	672
274.0	1210	1210	1210	1183	1142	1101	1060	1020	979	940	901	864	828	759	696
288.0	1270	1270	1270	1243	1201	1159	1116	1073	1032	991	950	910	873	801	734
301.0	1328	1328	1328	1303	1259	1214	1170	1126	1082	1039	997	956	917	841	772
314.0	1387	1387	1387	1362	1317	1270	1225	1179	1133	1088	1045	1002	961	882	810
328.0	1448	1448	1448	1425	1377	1330	1282	1234	1186	1140	1095	1050	1007	925	849
342.0	1509	1509	1509	1487	1439	1390	1339	1290	1241	1192	1145	1099	1055	969	891
356.0	1571	1571	1571	1551	1501	1450	1397	1346	1296	1245	1196	1148	1102	1013	931
370.0	1634	1634	1634	1616	1563	1509	1456	1403	1350	1299	1247	1198	1149	1056	972
384.0	1696	1696	1696	1679	1625	1569	1514	1459	1404	1350	1297	1246	1195	1099	1012
399.0	1759	1759	1759	1744	1687	1631	1574	1517	1460	1405	1350	1297	1245	1146	1054
413.0	1822	1822	1822	1810	1753	1695	1635	1577	1517	1460	1403	1348	1295	1192	1097
427.0	1886	1886	1886	1876	1817	1756	1696	1636	1575	1515	1457	1401	1345	1238	1142

Loads to right of heavy vertical lines are for Secondary Members only.

PLATE AND ANGLE COLUMNS

Safe loads in thousands of pounds

Loads Given Are For Least Radius of Gyration.   Axis 2-2

Based on Formula

$$S = \frac{18000}{1 + \dfrac{l^2}{18000 r^2}}$$

(LENGTH IN FEET — left margin)

The following values are read across the plate/angle column groups. Each plate‑and‑angle group carries two sub‑columns.

	6x¼ 4Lˢ 3x2	6x¼ 4Lˢ 3x2½	6x½ 4Lˢ 3x2½	7x⅜ 4Lˢ 3½x2½	7x½ 4Lˢ 3½x2½	8x¼ 4Lˢ 4x3	8x⅜ 4Lˢ 4x3	8x½ 4Lˢ 4x3	8x⅝ 4Lˢ 4x3	8x¾ 4Lˢ 4x3	8x¾ 4Lˢ 4x3
Area of Col. Section Sq. Inches	6.3	6.7 / 8.0	8.36 / 9.56	9.31 / 10.63	7.8	9.1 / 10.4	11.9	12.9	16.0	17.0	19.9
Weight of Column Per Lineal Foot	21.5	25.1 / 27.1	38.80 / 32.78	30.35 / 31.80	36.40	26.4 / 31.2	35.6	40.8	44.2	54.6 / 58.0	68.0
Rad. of Gyr. Axis 2-2	1.28 / 1.32	1.24 / 1.27	1.27 / 1.31	1.46 / 1.50	1.49 / 1.54	1.43 / 1.49	1.69 / 1.72	1.47 / 1.51	1.67 / 1.71	1.70 / 1.77	1.76 / 1.82
Rad. of Gyr. Axis 1-1	2.51 / 2.50	2.41 / 2.42	2.39 / 2.39	2.88 / 2.89	2.86 / 2.87	3.31 / 3.32	3.29 / 3.29	3.28 / 3.29	3.25 / 3.26	3.23 / 3.23	3.18 / 3.18
6	94.5	110.7 / 108.2	120.0 / 116.0	125.4 / 121.1	143.4 / 140.1	133.5 / 133.5	139.6 / 139.6	117.0 / 112.0	136.5 / 136.5	156.0 / 156.0	178.5 / 178.5
7	91.3	108.2	116.0	121.1	140.1	133.5	139.6	112.0	136.5	156.0	178.5
8	86.4	102.5	109.0	118.1 / 122.8	130.4 / 136.5						
9	81.4	96.7	107.3	112.0 / 116.4	124.3 / 130.0						
10	76.0	91.0	100.0	98.2 / 109.8	118.1 / 122.8	143.0 / 135.6					
12	71.3	85.4	94.0	93.1 / 102.9	112.0 / 116.4	106.0 / 110.0	125.6	113.7 / 139.9	125.8 / 146.2	145.6 / 167.9	173.5 / 189.1
13	66.8	80.0	88.0	87.4	106.0 / 110.0	125.6	107.6 / 133.5	119.7 / 138.6	145.9 / 167.9	165.7 / 160.3	
14	62.0	74.9 / 64.0	78.2	81.8 / 96.3	82.5 / 100.0	103.9 / 122.1	84.5 / 101.0	127.3 / 146.7	106.3 / 123.9	132.5 / 152.8	157.9
16	58.0	70.1 / 60.0	73.2 / 76.4	90.1 / 77.8	94.4 / 98.0	115.2	79.1 / 95.8	121.2 / 139.6	100.3 / 116.9	125.2 / 145.5	150.3
18	—	68.6	83.8	87.0 / 102.4	91.6	70.3 / 85.1	108.7 / 126.2	98.0 / 114.6	88.5 / 103.8	113.1 / 131.5	135.5
20	—	—	—	—	—	102.5	106.8	113.1 / 131.1	102.0 / 118.6	122.4 / 157.6	142.0 / 150.0

Additional higher‑capacity columns (8x¾ 4Lˢ 4x3) continue to the right with length‑6 values: 193.5 / 193.5, 240.0 / 240.0, 255.0 / 255.0, 298.5 / 298.5, decreasing to 182.0 / 200.5 / 222.1 / 243.6 / 253.9 at the longer lengths.

Values above heavy line are for $\dfrac{l}{r}$ less than 120.   Values above dotted line are for $\dfrac{l}{r}$ less than 140.

PLATE AND ANGLE COLUMNS

Safe loads in thousands of pounds

Loads Given Are For Least Radius of Gyration. Axis 2-2

Based on Formula

$$g = \dfrac{18000}{1 + \dfrac{l^2}{18000\,r^2}}$$

Plates	10x½	10x½	10x½	10x¾	10x¾	10x¾	12x¼	12x¼	12x¼	12x¼	12x¼	12x⅜	12x⅜	12x⅜	12x⅜	12x⅝	12x⅝	12x½	12x⅝	12x⅞	12x¾	12x⅞
Angles	4Ls 5x3½	4Ls 6x3½	4Ls 6x4	4Ls 6x3½	4Ls 6x4	4Ls 6x4	4Ls 3½x2½	4Ls 4x3	4Ls 5x3	4Ls 6x3½	4Ls 6x3½	4Ls 4x3	4Ls 4x3	4Ls 5x3½	4Ls 5x3½	4Ls 6x3½	4Ls 6x3½	4Ls 4x3	4Ls 4x3	4Ls 4x3	4Ls 5x3½	4Ls 5x3½
Area of Column Section Sq. Inches	21.00	24.68	23.00	27.20	24.00	28.44	8.76	11.36	12.60	14.48	16.68	12.11	13.67	13.99	15.95	15.23	17.43	14.42	17.50	16.70	20.50	24.18
Weight of Column Per Lineal Foot	71.4	84.2	78.2	92.6	81.8	97.0	29.8	39.0	43.0	49.4	57.0	41.6	46.8	47.6	54.35	51.95	59.55	49.3	59.7	56.9	69.7	82.5
Rad. of Gyr. Axis 2-2	2.16	2.23	2.67	2.75	2.62	2.69	1.35	1.61	2.11	2.58	2.63	1.58	1.63	2.03	2.08	2.53	2.59	1.61	1.70	2.06	2.15	2.21
Rad. of Gyr. Axis 1-1	4.03	4.04	4.12	4.12	4.03	4.04	4.94	4.99	5.10	5.11	5.12	4.91	4.95	4.98	4.98	5.04	5.06	4.89	4.93	4.92	4.96	4.98
6	315.0	370.0	345.0	408.0	360.0	426.6	131.4	170.0	189.0	217.0	250.0	181.6	205.0	209.8	239.0	228.4	261.4	216.3	262.5	250.5	307.5	362.7
8	315.0	370.0	345.0	408.0	360.0	426.6	123.2	170.0	189.0	217.0	250.0	180.0	205.0	209.8	239.0	228.4	261.4	216.3	262.5	250.5	307.5	362.7
10	315.0	370.0	345.0	408.0	360.0	426.6	109.0	155.7	189.0	217.0	250.0	165.0	188.6	209.8	239.0	228.4	261.4	199.0	246.0	250.5	307.5	362.7
12	302.5	360.7	345.0	408.0	360.0	426.6	96.3	142.0	180.0	217.0	250.0	149.2	172.0	196.7	227.0	228.4	261.4	180.2	224.7	236.4	295.3	352.5
14	282.5	338.4	339.0	405.7	351.8	421.8	85.0	127.7	167.3	211.0	244.5	134.2	154.8	182.0	210.0	220.7	254.0	162.1	204.0	219.5	275.7	329.5
16	262.5	314.8	321.4	384.8	333.0	400.0		114.4	155.3	199.8	231.6	120.2	138.7	167.7	195.0	207.5	240.5	145.2	184.2	202.8	256.0	306.4
18	243.0	291.7	303.4	365.8	314.4	377.6		102.4	143.7	187.0	218.0	106.7	124.1	155.0	179.3	195.6	227.0	129.9	166.1	186.6	237.2	283.8
20	224.4	269.0	285.9	344.6	293.8	355.5			131.6	176.0	205.6			142.0	165.5	182.5	212.0			171.4	217.4	262.2
22	206.9	250.0	268.0	323.7	275.7	333.8			121.4	165.0	193.0			129.8	151.4	171.2	198.8			157.2	200.5	243.5
24	190.7	230.8	251.2	303.6	258.0	312.8			111.8	153.6	180.8				139.5	159.1	186.2			144.1	184.7	224.4
26		212.6	235.1	286.4	241.7	293.0				143.7	168.0					146.8	174.0					
28			220.0	268.2	226.1	274.0				134.2	156.1					138.5	161.8					
30			205.7	250.6	211.5	256.3				125.2	146.9						151.3					

LENGTH IN FEET

Values above heavy line are for $\frac{l}{r}$ less than 120. Values above dotted line are for $\frac{l}{r}$ less than 140.

Based on Formula

$$s = \frac{18000}{1 + \dfrac{l^2}{18000r^2}}$$

PLATE AND ANGLE COLUMNS

Safe loads in thousands of pounds

Loads Given Are For Least Radius of Gyration. Axis 2-2

LENGTH IN FEET

Plates	Angles	Thk	Area of Col. Section Sq. In.	Wt. per Lin. Ft.	Rad. Gyr. Axis 2-2	Rad. Gyr. Axis 1-1	8	10	12	14	16	18	20	22	24	26	28	30
10x¼	4L⁸ 3½x2½	¼	8.26	28.1	1.39	4.13	117.6	105.4	92.9	82.0	72.3	—	—	—	—	—	—	—
10x¼	4L⁸ 4x3	⁷⁄₁₆	9.62	32.9	1.45	4.17	139.4	125.3	112.1	99.1	87.9	—	—	—	—	—	—	—
10x¼	4L⁸ 5x3	⁷⁄₁₆	10.86	37.3	1.65	4.14	162.9	150.8	137.6	123.8	111.9	100.1	—	—	—	—	—	—
10x¼	4L⁸ 5x3	⅝	12.10	41.3	2.16	4.24	181.5	181.5	174.3	162.8	151.3	140.0	129.3	119.2	109.9	—	—	—
10x⅜	4L⁸ 3½x2½	⅜	10.25	35.0	1.42	4.11	146.8	132.5	117.8	104.0	91.7	—	—	—	—	—	—	—
10x⅜	4L⁸ 4x3	⁷⁄₁₆	11.56	39.4	1.47	4.14	168.5	151.5	132.5	117.8	106.5	—	—	—	—	—	—	—
10x⅜	4L⁸ 4x3	½	13.05	44.6	1.62	4.09	172.4	158.6	143.6	129.2	116.6	104.3	—	—	—	—	—	—
10x⅜	4L⁸ 5x3	⁷⁄₁₆	13.40	45.4	1.67	4.11	195.8	182.4	166.5	149.9	135.4	122.0	—	—	—	—	—	—
10x½	4L⁸ 5x3	½	12.73	43.4	2.14	4.20	191.0	191.0	182.3	170.1	156.9	145.2	134.0	122.7	113.0	—	—	—
10x½	4L⁸ 5x3½	⅜	14.57	49.8	2.08	4.10	218.6	218.4	209.9	196.0	180.9	167.4	154.5	142.5	130.3	—	—	—
10x½	4L⁸ 5x3½	⁷⁄₁₆	13.37	45.4	2.12	4.12	200.6	200.6	190.3	176.4	163.6	150.3	138.7	126.9	117.0	—	—	—
10x½	4L⁸ 6x3½	⁷⁄₁₆	15.32	52.2	2.58	4.20	229.8	229.8	219.4	204.8	188.9	174.7	161.3	147.6	136.0	—	—	—
10x⅝	4L⁸ 6x3½	⁷⁄₁₆	14.61	49.8	2.58	4.19	219.9	219.4	219.4	213.0	201.7	188.9	177.6	166.6	155.0	145.0	135.6	125.9
10x⅝	4L⁸ 6x3½	½	16.81	57.4	2.64	4.20	252.2	252.2	252.2	233.4	233.4	220.3	207.3	194.5	182.3	170.6	159.6	149.3
10x¾	4L⁸ 4x3½	½	13.67	46.8	1.65	4.07	205.1	189.8	173.8	155.9	140.8	126.0	—	—	—	—	—	—
10x¾	4L⁸ 5x3	½	16.75	57.15	1.73	4.12	251.3	238.4	218.1	198.0	179.0	161.4	145.4	—	—	—	—	—
10x¾	4L⁸ 5x3½	½	15.19	51.95	2.15	4.16	227.8	227.8	218.8	204.3	189.9	175.8	161.1	148.6	136.9	—	—	—
10x¾	4L⁸ 6x3½	½	18.75	63.95	2.24	4.18	281.3	281.3	274.1	257.1	239.2	223.2	206.3	190.3	175.4	162.8	—	—
10x¾	4L⁸ 5x3½	½	15.95	54.35	2.10	4.08	239.3	239.2	228.4	211.8	196.6	180.6	166.7	152.6	140.6	—	—	—
10x¾	4L⁸ 5x3½	½	19.75	67.15	2.19	4.10	296.3	296.3	286.2	267.4	248.5	230.2	212.6	197.5	180.6	—	—	—
10x¾	4L⁸ 5x3½	½	17.43	59.55	2.62	4.16	261.5	261.5	261.5	255.5	242.1	228.4	213.4	200.3	187.6	175.6	164.3	153.6
10x¾	4L⁸ 6x3½	½	21.75	73.95	2.70	4.18	326.3	326.3	326.3	322.6	305.8	288.8	271.8	255.3	239.3	224.0	211.1	197.5

Values above heavy line are for $\frac{l}{r}$ less than 120. Values above dotted line are for $\frac{l}{r}$ less than 140.

PLATE AND ANGLE COLUMNS

Safe loads in thousands of pounds

Loads Given Are For Least Radius of Gyration.   Axis 2-2

Based on Formula

$$s = \dfrac{18000}{1 + \dfrac{l^2}{18000\,r^2}}$$

The table is organized with the column properties (plate, angle, area, weight, radii of gyration) at the top and the safe loads tabulated by column LENGTH IN FEET (8 to 30). Blank cells (…) correspond to values below the limiting slenderness (dotted line = l/r less than 140; heavy line = l/r less than 120).

Length (ft) ↓ / Section →	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22
Plate	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x½	12x¾	12x¾	14x¾	14x¾	16x¾	16x¾
Angles	4Lˢ 6x3½			4Lˢ 6x4			4Lˢ 4x3		4Lˢ 5x3½		4Lˢ 6x3½			4Lˢ 6x4			4Lˢ 6x4		4Lˢ 4x3		4Lˢ 5x3	
Area of Col. Section Sq. Inches	18.18	22.50	26.70	18.94	23.50	27.94	19.00	21.92	22.00	25.68	24.00	28.20	32.24	25.00	29.44	33.76	30.94	35.26	11.86	13.42	13.10	14.94
Weight Per Lineal Foot	62.1	76.5	90.9	64.5	80.1	95.3	64.8	74.8	74.8	87.6	81.6	96.0	110.0	85.2	100.4	114.8	105.5	119.9	40.7	45.9	44.7	51.1
Rad. of Gyr. Axis 2-2	2.56	2.66	2.73	2.51	2.61	2.67	1.67	1.74	2.12	2.19	2.62	2.67	2.78	2.57	2.65	2.72	2.62	2.70	1.58	1.63	2.07	2.13
Rad. of Gyr. Axis 1-1	5.01	5.06	5.06	4.94	4.97	4.98	4.85	4.88	4.88	4.90	4.97	4.99	4.99	4.89	4.91	4.90	4.86	4.85	5.82	5.88	5.94	5.99
8	272.7	337.5	400.0	284.1	352.5	419.1	285.0	328.8	330.0	385.2	360.0	423.0	483.6	375.0	441.6	506.4	464.1	528.9	176.9	201.3	196.5	224.1
10	272.7	337.5	400.0	284.1	352.5	419.1	265.5	312.0	330.0	385.2	360.0	423.0	483.6	375.0	441.6	506.4	464.1	528.9	161.6	183.2	196.5	224.1
12	272.7	337.5	400.0	284.1	352.5	419.1	242.3	285.4	315.0	372.1	360.0	423.0	483.6	375.0	441.6	506.4	464.1	528.9	146.2	168.9	185.3	213.4
14	264.1	331.8	396.0	272.8	344.5	412.1	218.3	260.9	294.0	347.7	351.9	415.9	482.5	364.4	434.2	500.7	453.6	523.0	131.4	152.0	172.8	199.2
16	249.3	314.4	377.8	258.1	324.3	390.5	197.1	235.9	271.2	323.2	333.3	394.0	458.9	342.8	411.4	474.7	429.0	495.8	117.7	136.2	159.3	184.9
18	235.0	296.8	356.9	241.6	305.9	368.6	177.7	212.8	250.9	299.3	314.4	372.0	433.7	323.2	385.8	451.2	405.4	468.2	104.5	122.7	147.3	171.2
20	219.5	279.3	336.0	225.5	287.7	346.8	…	191.7	231.7	276.4	293.8	350.0	411.3	303.0	363.0	424.8	378.8	440.7	…	…	134.9	156.9
22	205.8	262.0	315.6	211.4	269.9	325.6	…	…	212.0	255.7	275.7	328.6	386.5	283.5	340.6	399.0	355.5	413.8	…	…	123.9	144.6
24	192.8	245.7	298.0	196.5	252.8	308.3	…	…	195.3	236.6	258.3	308.0	365.1	265.1	319.2	374.1	333.2	387.8	…	…	113.7	133.3
26	179.1	230.0	279.0	183.9	235.5	288.3	…	…	…	…	241.7	288.3	341.9	248.1	298.8	350.2	311.7	363.2	…	…	…	…
28	167.5	215.2	261.1	170.7	219.7	267.4	…	…	…	…	230.4	269.5	320.0	230.7	279.5	327.7	291.7	342.3	…	…	…	…
30	…	201.2	244.2	…	205.6	249.9	…	…	…	…	211.5	252.8	301.5	…	261.4	308.2	272.8	320.1	…	…	…	…

Values above heavy line are for $\dfrac{l}{r}$ less than 120.   Values above dotted line are for $\dfrac{l}{r}$ less than 140.

Based on Formula

$$S = \dfrac{18000}{1 + \dfrac{l^2}{18000\, r^2}}$$

PLATE AND ANGLE COLUMNS

Safe loads in thousands of pounds

Loads Given Are For Least Radius of Gyration Axis 2-2

Plates / Angles	14x¾ 4Ls 6x3½	14x⅜ 4Ls 5x3½	14x⅜ 4Ls 5x3½	14x⅜ 4Ls 6x3½	14x⅜ 4Ls 6x3½	14x½ 4Ls 6x3½	14x½ 4Ls 6x3½	14x½ 4Ls 6x3½	14x½ 4Ls 5x3½	14x½ 4Ls 5x3½	14x½ 4Ls 5x3½	14x⅝ 4Ls 6x3½	14x⅝ 4Ls 6x3½	14x⅝ 4Ls 6x3½	14x⅝ 4Ls 6x4	14x⅝ 4Ls 6x4	14x⅝ 4Ls 6x4	14x½ 4Ls 6x4	14x¾ 4Ls 6x4	14x¾ 4Ls 6x3½	14x⅝ 4Ls 7x3½
Area of Column Section Sq. Inches	14.98	17.18	17.45	21.25	24.93	18.93	23.25	27.45	19.49	24.25	28.69	23.00	26.68	25.00	29.20	33.24	26.00	30.44	34.76	20.45	25.25
Weight of Column Per Lineal Foot	51.1	58.7	59.5	72.3	85.1	64.7	79.1	93.5	67.1	82.7	97.9	78.2	91.0	85.0	99.4	113.4	88.6	103.8	118.2	69.9	85.9
Rad. of Gyration Axis 2-2	2.54	2.59	2.01	2.11	2.18	2.51	2.62	2.69	2.46	2.57	2.64	2.07	2.15	2.57	2.63	2.73	2.52	2.60	2.73	3.02	3.14
Rad. of Gyration Axis 1-1	5.97	6.00	5.75	5.82	5.85	5.85	5.93	5.96	5.78	5.84	5.86	5.71	5.75	5.81	5.85	5.86	5.74	5.78	5.78	5.94	5.99
LENGTH IN FEET 10	224.7	257.7	261.8	318.8	374.0	283.9	348.7	411.7	295.3	363.7	430.3	345.0	400.2	375.0	438.0	498.6	390.0	456.6	521.4	306.7	378.7
12	224.7	257.7	243.9	304.3	361.3	283.9	348.7	411.7	294.2	363.7	430.3	345.0	400.2	375.0	438.0	498.6	390.0	456.6	521.4	306.7	378.7
14	217.1	250.5	227.2	282.2	337.5	272.7	340.9	407.1	282.0	353.4	420.6	342.8	398.4	364.4	428.1	495.8	374.6	443.7	512.6	303.5	374.6
16	204.1	237.1	209.2	262.0	313.7	258.0	322.9	386.0	264.9	331.6	398.4	323.3	382.6	342.8	405.5	470.3	354.3	420.1	485.7	299.8	359.4
18	192.4	223.6	192.0	242.4	290.5	241.5	304.7	364.5	247.8	313.6	375.0	323.3	358.7	323.3	382.6	444.3	331.7	396.3	458.5	287.6	344.1
20	180.8	208.9	175.8	222.1	268.3	225.3	284.6	343.1	232.7	294.8	353.7	283.0	360.0	303.9	360.0	418.3	311.7	372.7	431.5	273.3	344.1
22	168.4	195.9	160.8	204.7	247.5	211.3	267.1	322.2	216.2	274.6	332.0	260.9	216.7	283.1	337.9	392.9	290.2	349.7	408.0	259.1	326.5
24	157.7	183.6		188.7	228.0	196.4	250.2	302.0	201.3	257.2	311.1	240.4	199.7	265.2	316.6	371.1	271.7	325.3	382.4	245.2	309.1
26	146.5	171.8		170.6		183.6	234.2	282.7	186.9	240.7	291.2			248.2	294.2	347.9	252.4	304.4	358.0	231.6	294.3
28	137.0	159.5				170.6	219.1	264.5	173.5	223.5	272.4			230.0	275.2	325.1	236.1	284.7	334.9	218.5	277.8
30		149.1					204.9	247.4			254.7				257.3	304.0		266.3	313.3	206.0	262.0
32																				194.1	248.8
34																				182.9	234.4
36																					220.8

Values above heavy line are for $\frac{l}{r}$ less than 120. Values above dotted line are for $\frac{l}{r}$ less than 140.

PLATE AND ANGLE COLUMNS

Safe loads in thousands of pounds

Loads Given Are For Least Radius of Gyration. Axis 2-2

Based on Formula

$$S = \frac{18000}{1 + \dfrac{l^2}{18000\,r^2}}$$

Web Plates	12x⅜						12x½					14x⅜				14x½						
Angles	4L⁸ 6x4						4L⁸ 6x4					4L⁸ 6x4				4L⁸ 6x4						
Cover Plates	14 x ⅜	14 x ½	14 x ⅝	14 x ¾	14 x ⅜	14 x ½	14 x ⅝	14 x ¾	14 x 1	14 x 1¼	14 x 1½	14 x ⅜	14 x ½	14 x ⅝	14 x ¾	14 x ⅜	14 x ½	14 x ⅝	14 x ¾	14 x 1	14 x 1¼	14 x 2
Area of Column Section Sq. Inches	29.44	32.94	37.50	39.00	42.50	46.94	48.44	51.94	58.94	65.94	72.94	30.19	34.75	38.25	41.75	43.50	47.94	49.69	53.19	60.19	74.19	88.19
Weight of Column Per Lineal Foot	100.2	112.1	127.7	132.8	144.7	159.9	165.0	176.9	200.7	224.5	248.3	102.8	118.4	130.3	142.2	148.1	163.3	169.3	181.2	205.0	252.6	300.2
Rad. of Gyr. Axis 2-2	3.14	3.25	3.22	3.18	3.26	3.24	3.21	3.27	3.45	3.37	3.51	3.10	3.09	3.19	3.27	3.22	3.20	3.17	3.23	3.34	3.48	3.58
LENGTH IN FEET																						
10	441	562	585	637	704	726	779	884	989	1094		452	521	573	626	652	719	745	797	902	1113	1323
12	441	562	585	637	704	726	779	884	989	1094		452	521	573	626	652	719	745	797	902	1113	1323
14	441	562	585	637	704	726	779	884	989	1094		452	521	573	626	652	719	745	797	902	1113	1323
16	439	562	585	637	704	726	779	884	989	1094		452	515	573	626	652	719	745	797	902	1113	1323
18	419	540	558	615	676	697	752	864	972	1088		447	491	547	605	626	686	711	766	877	1100	1270
20	401	514	531	586	647	664	721	828	933	1044		427	467	524	579	600	657	677	734	841	1056	1217
22	380	491	507	560	619	634	685	792	892	1000		408	446	497	550	570	624	646	697	804	1011	1171
24	360	468	480	534	586	601	653	757	858	955		387	422	474	525	543	595	612	664	767	965	1117
26	343	443	457	505	558	572	622	716	818	911		367	399	448	500	514	562	583	628	731	921	1065
28	323	421	432	481	527	540	588	682	779	868		346	376	427	472	489	535	550	598	691	883	1013
30	305	397	410	457	501	513	559	648	741	831		329	357	402	449	461	504	523	568	657	840	
32	290	377	387	431	476	488	531	616	704	790		310	337	382	426	438	479	493	535	624	798	970
34	273	356	367	409	449	459	500	585	669	751		293	317	360	402	413	451	464	508	593	758	921
36	257	337	346	388	426	436	475	555	635	713		276	299	342	381	392	428	441	479	562	720	875
Rad. of Gyr. Axis 1-1	5.58	5.71	5.65	5.58	5.69	5.64	5.59	5.69	6.06	6.22	6.46	6.43	6.55	6.67	6.58	6.54	6.41	6.58	6.78	7.13	7.46	

Values above heavy line are for $\dfrac{l}{r}$ less than 120.

LATTICED CHANNEL COLUMNS

SAFE LOADS IN THOUSANDS OF POUNDS

Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

Size of ⊏s	6'		7'		8'		9'		10'		12'		15'	
	8.2	10.5	9.8	14.75	11.5	16.25	13.4	25.0	15.3	25.0	20.7	30.0	33.9	40.0
Area of Section	4.76	6.18	5.70	8.68	6.70	9.56	7.78	14.70	8.92	14.70	12.06	17.64	19.80	23.52
Least Radius of Gyration	2.34	2.21	2.72	2.50	3.11	2.89	3.45	3.08	3.84	3.52	4.61	4.28	5.59	5.44
Distance back to back ⊏s	3.60	3.37	4.33	3.91	5.06	4.71	5.54	4.78	6.27	5.70	7.69	7.23	9.46	9.21
Length Ft.														
10	71.4	92.7	85.5	130.2	100.5	143.4	116.7	220.5	133.8	220.5	180.9	264.6	297.0	352.8
11	71.4	92.7	85.5	130.2	100.5	143.4	116.7	220.5	133.8	220.5	180.9	264.6	297.0	352.8
12	70.6	90.0	85.5	130.2	100.5	143.4	116.7	220.5	133.8	220.5	180.9	264.6	297.0	352.8
13	68.6	86.9	85.5	128.7	100.5	143.4	116.7	220.5	133.8	220.5	180.9	264.6	297.0	352.8
14	66.5	84.2	84.5	125.0	100.5	143.4	116.7	220.5	133.8	220.5	180.9	264.6	297.0	352.8
15	64.5	81.5	82.6	121.3	100.5	141.8	116.7	220.5	133.8	220.5	180.9	264.6	297.0	352.8
16	62.4	78.3	80.2	117.5	99.4	138.5	116.7	218.0	133.8	220.5	180.9	264.6	297.0	352.8
17	60.3	75.7	78.2	113.7	97.7	134.4	116.7	213.0	133.8	220.5	180.9	264.6	297.0	352.8
18	58.3	72.5	76.2	110.7	95.4	131.0	114.7	208.0	133.8	219.3	180.9	264.6	297.0	352.8
19	56.3	70.0	73.7	107.0	93.0	127.8	112.7	202.9	133.8	214.3	180.9	264.6	297.0	352.8
20	54.7	67.0	71.7	103.3	90.7	124.5	110.1	198.0	132.3	210.5	180.9	264.6	297.0	352.8
21	52.0	64.6	69.3	99.7	88.4	121.1	108.0	193.0	129.3	205.5	180.9	264.6	297.0	352.8
22	50.1	62.3	67.4	96.2	86.1	117.9	106.0	187.5	127.0	201.6	180.9	261.6	297.0	352.8
23	48.3	59.5	65.4	93.4	83.7	113.8	103.3	182.5	124.7	197.7	180.9	258.6	297.0	352.8
24	46.6	57.4	63.2	90.0	81.5	110.6	101.3	178.7	122.0	192.6	178.9	254.1	297.0	352.8
25	44.9	54.9	61.4	86.8	79.7	107.5	98.6	173.8	120.0	188.8	175.8	249.6	297.0	352.8
26	43.2	....	59.1	83.6	77.5	104.4	96.5	168.9	117.6	183.7	172.7	245.0	297.0	352.8
27	41.6	....	57.4	80.6	75.3	101.4	93.9	164.1	115.4	180.0	170.6	240.4	297.0	352.8
28	....	....	55.3	78.2	73.2	98.5	92.0	159.4	113.0	176.2	167.5	237.3	297.0	348.8
29	....	....	53.7	75.4	71.1	95.6	89.4	154.8	110.0	171.3	165.4	232.7	293.7	344.8
30	....	....	52.1	....	69.0	92.1	87.5	150.0	107.7	167.7	162.2	228.1	290.0	340.8
32	....	....	....	....	65.5	86.8	83.1	141.6	103.1	159.4	157.0	219.0	280.6	330.7
34	....	....	....	....	61.7	....	79.0	133.4	98.8	151.4	151.8	211.5	274.1	322.0
36	....	....	....	....	58.2	....	75.0	....	94.6	143.8	145.6	202.7	268.0	314.3
40	....	....	....	....	....	....	67.5	....	85.9	129.5	135.6	187.1	252.0	296.0
42	....	....	....	....	....	....	....	....	82.2	....	130.8	179.0	245.8	286.0
44	....	....	....	....	....	....	....	....	78.0	....	125.1	172.5	239.0	278.0
46	....	....	....	....	....	....	....	....	....	....	120.6	165.0	230.7	270.2
48	....	....	....	....	....	....	....	....	....	....	116.2	157.8	224.2	260.6

For loads above heavy lines, $\dfrac{l}{r}$ is less than 120.

PLATE AND CHANNEL COLUMNS
SAFE LOADS IN THOUSANDS OF POUNDS
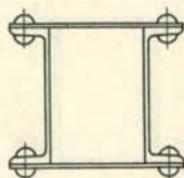
Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

Size Plates	Width of plate 8″			Width of plate 9″			Width of Plate 10″			Width of Plate 12″		
Size ⊏s	6′ 8.2 pounds			7′ 9.8 pounds			8′ 11.5 pounds			9′ 13.4 pounds		
Thickness Plates	¼″	⁵⁄₁₆″	⅜″	¼″	⁵⁄₁₆″	⅜″	¼″	⁵⁄₁₆″	⅜″	⁵⁄₁₆″	⅜″	⁷⁄₁₆″
Area of Column Section	8.76	9.76	10.76	10.20	11.32	12.45	11.70	12.95	14.20	15.28	16.78	18.28
Weight of Column Per Ft.	29.60	33.00	36.40	34.80	38.60	42.50	39.50	43.70	48.00	51.90	57.10	62.20
Least Radius of Gyration	2.35	2.35	2.34	2.63	2.63	2.62	2.98	2.97	2.97	3.70	3.68	3.66
Length Ft.												
10	131.4	146.4	161.4	153.0	169.8	186.8	175.5	194.3	213.0	229.2	251.7	274.2
11	131.4	146.4	161.4	153.0	169.8	186.8	175.5	194.3	213.0	229.2	251.7	274.2
12	130.7	145.6	160.5	153.0	169.8	186.8	175.5	194.3	213.0	229.2	251.7	274.2
13	126.9	141.4	155.0	153.0	169.8	186.8	175.5	194.3	213.0	229.2	251.7	274.2
14	123.2	137.2	150.4	149.5	166.0	182.5	175.5	194.3	213.0	229.2	251.7	274.2
15	118.6	132.2	145.7	146.1	162.1	177.2	175.5	194.3	211.8	229.2	251.7	274.2
16	114.8	127.9	141.0	141.7	157.2	172.9	171.5	189.9	207.0	229.2	251.7	274.2
17	111.0	123.7	136.4	137.2	152.3	167.5	167.5	185.5	202.1	229.2	251.7	274.2
18	107.2	119.5	131.7	133.7	148.3	163.1	163.5	179.8	197.2	229.2	251.7	274.2
19	103.6	115.4	127.2	129.3	143.4	157.8	158.4	176.5	192.3	227.9	248.9	271.1
20	99.9	111.3	122.7	125.7	139.6	153.5	154.3	172.0	187.3	222.7	244.6	266.5
21	96.4	107.4	117.5	121.4	134.7	148.2	151.3	167.5	182.3	218.8	240.3	261.8
22	92.9	103.5	113.3	118.0	131.0	143.0	146.3	163.0	177.5	213.9	236.0	255.5
23	89.6	99.8	109.2	114.0	126.4	138.0	142.2	157.4	172.6	210.9	230.1	250.7
24	85.7	95.4	105.2	110.6	122.7	135.0	139.3	153.1	167.8	206.9	225.7	245.9
25	82.6	91.9	101.4	106.6	118.3	130.1	134.4	148.9	163.1	201.6	221.4	241.1
26	79.5	88.6	97.7	102.7	114.0	125.4	130.6	144.6	158.5	197.6	217.0	234.8
28	....	....	....	96.1	106.7	117.3	124.1	136.4	149.5	188.4	206.9	225.4
30	....	....	....	89.9	99.8	109.7	116.1	128.5	141.0	180.6	196.9	214.6
32	....	....	....	....	....	....	109.4	120.2	131.8	171.8	188.7	205.5
34	....	....	....	....	....	....	103.1	114.8	125.1	164.5	180.6	195.3
36	....	....	....	....	....	....	....	....	....	157.4	171.6	185.5
38	....	....	....	....	....	....	....	....	....	147.2	162.9	176.1

For loads above heavy lines, $\dfrac{l}{r}$ is less than 120.
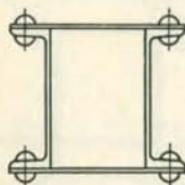
PLATE AND CHANNEL COLUMNS
SAFE LOADS IN THOUSANDS OF POUNDS

Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

Size Plates	Width of Plate 12"			Width of Plate 12"			Width of Plate 14"			Width of Plate 14"		
Size ⌷s	10' 15.3 lbs.			10' 30 lbs.			12' 20.7 lbs.			12' 30 lbs.		
Thickness Plates	5/16	3/8	1/2	5/16	1/2	5/8	5/16	3/8	1/2	5/16	1/2	5/8
Area of Column Section	16.42	17.92	20.92	28.14	29.64	32.64	20.81	22.56	26.06	29.89	31.64	35.14
Weight of Col. per ft.	55.5	60.6	70.8	95.7	100.8	111.0	70.8	76.7	88.6	101.7	107.6	119.5
Least Radius of Gyration	3.61	3.59	3.58	3.36	3.36	3.37	4.38	4.36	4.32	4.23	4.22	4.21
Length Ft.												
12	246.3	268.8	313.8	422.1	444.6	489.6	312.2	338.4	390.9	448.4	474.6	527.1
16	246.3	268.8	313.8	422.1	444.6	489.6	312.2	338.4	390.9	448.4	474.6	527.1
18	246.3	268.8	313.8	412.6	434.6	478.5	312.2	338.4	390.9	448.4	474.6	527.1
19	242.2	262.7	306.7	403.0	424.5	467.4	312.2	338.4	390.9	448.4	474.6	527.1
20	236.6	258.2	301.4	395.7	416.8	458.8	312.2	338.4	390.9	448.4	474.6	537.1
21	232.3	253.6	296.0	385.9	406.5	447.6	312.2	338.4	390.9	448.4	474.6	527.1
22	228.0	247.3	288.7	378.5	398.7	439.0	312.2	338.4	388.7	443.3	466.6	518.2
23	222.3	242.6	283.3	368.7	388.4	427.7	306.9	332.7	382.1	435.7	461.2	509.3
24	218.0	238.0	277.8	359.0	378.1	419.2	301.6	326.9	375.4	428.0	453.1	503.2
25	213.7	231.7	270.5	351.7	370.5	408.0	298.0	321.1	371.0	420.3	446.9	494.1
26	209.5	227.1	265.1	342.1	360.4	396.8	292.6	315.3	364.2	412.5	436.6	485.0
27	204.0	222.5	259.7	335.0	352.8	388.5	287.2	311.4	357.4	407.3	428.4	475.8
28	199.6	216.4	252.6	325.6	343.0	377.7	281.8	305.5	350.5	399.5	420.1	466.6
29	194.1	211.8	247.3	316.4	333.2	369.6	278.1	299.6	346.1	391.7	414.6	457.5
30	190.0	207.3	240.3	309.6	326.1	359.1	272.7	293.7	339.2	384.0	406.4	451.4
31	185.9	201.5	235.2	300.7	316.7	351.3	267.3	289.8	332.4	376.2	398.2	442.2
32	181.9	197.1	230.1	294.2	309.8	341.2	261.9	283.9	325.8	368.5	390.1	433.2
33	176.7	192.8	223.6	285.6	301.0	331.3	258.3	278.1	319.1	363.4	382.0	424.0
34	172.9	187.3	218.7	278.4	294.2	326.4	253.0	272.4	314.6	355.8	374.0	415.4
35	169.1	183.2	214.0	271.1	285.6	314.5	247.7	268.0	308.0	348.3	368.7	406.6
36	164.2	179.2	207.6	263.2	277.2	307.6	242.5	262.9	301.5	341.0	361.0	398.0
37	160.6	174.0	203.1	257.4	271.1	306.0	239.0	257.3	295.1	333.6	353.0	392.2
38	157.1	170.1	198.6	249.9	263.2	294.5	234.0	251.9	288.8	326.4	345.6	383.7
39	152.4	166.4	192.8	....	....	....	229.0	248.0	284.6	321.7	338.1	376.5
40	149.1	161.5	188.5	....	....	....	224.0	242.8	278.5	314.7	330.5	367.3
42	....	....	....	....	....	....	216.0	232.4	266.4	301.1	318.7	351.4
44	....	....	....	....	....	....	208.1	223.9	256.8	288.0	304.8	338.6
46	....	....	....	....	....	....	199.0	214.4	245.6	277.5	291.6	323.8
48	....	....	....	....	....	....	190.3	206.4	236.6	265.4	280.9	309.7

For loads above heavy lines, $\dfrac{l}{r}$ is less than 120.

PLATE AND CHANNEL COLUMNS
SAFE LOADS IN THOUSANDS OF POUNDS

Based on Formula $S = \dfrac{18000}{1 + \dfrac{l^2}{18000r^2}}$

Size Plates	Width of Plate 14″ 12′ 40 Pounds			Width of Plate 18″ 15′ 33.9 Pounds			Width of Plate 18″ 15′ 40 Pounds			Width of Plate 18″ 15′ 50 Pounds		
Size ⊏s Thickness Plates	7/16″	1/2″	5/8″	3/8″	1/2″	5/8″	1/2″	5/8″	3/4″	1/2″	5/8″	3/4″
Area of Column Section	35.77	37.52	41.02	33.3	37.8	42.3	41.52	46.02	50.52	47.42	51.92	56.42
Weight of Col. per ft.	121.7	127.6	139.5	111.9	127.2	142.4	141.2	156.4	171.8	161.2	176.4	191.8
Least Radius of Gyration	4.12	4.11	4.11	5.83	5.76	5.70	5.72	5.67	5.63	5.66	5.62	5.59
Length Ft.												
19	536.5	562.5	615.0	....	....	....	....	....	....	....	....	....
20	536.5	562.5	615.0	....	....	....	....	....	....	....	....	....
22	524.4	550.0	601.0	....	....	....	....	....	....	....	....	....
24	506.1	531.0	580.0	....	....	....	....	....	....	....	....	....
26	487.4	511.0	559.0	499.5	567.0	634.0	622.8	690.0	757.5	711.0	778.5	846.0
28	468.7	491.5	537.5	499.5	567.0	634.0	622.8	690.0	757.5	711.0	778.5	846.0
30	453.3	472.2	516.2	493.5	560.5	623.5	612.0	678.5	740.5	695.0	761.0	827.0
32	434.9	456.5	498.5	482.0	544.5	609.0	598.0	659.0	723.0	679.0	743.5	803.0
34	416.8	437.0	478.0	471.0	531.5	591.1	583.5	643.0	706.0	662.5	725.5	783.5
36	399.3	418.5	457.5	459.5	518.0	576.0	569.0	627.0	684.0	646.0	703.0	763.5
38	382.2	400.5	438.0	447.5	505.0	561.5	551.0	611.0	666.0	629.5	684.5	744.0
40	368.4	383.5	419.5	436.0	492.0	547.0	536.5	591.0	648.5	609.0	666.5	719.5
42	352.5	367.0	401.0	424.5	479.0	532.0	522.5	575.0	631.5	592.5	644.5	700.0
44	337.1	353.5	386.5	413.0	462.5	514.0	508.0	559.5	609.5	576.5	626.5	681.0
46	....	....	....	399.0	450.0	500.0	494.0	544.0	593.0	560.5	609.0	657.0
48	....	....	....	388.0	437.0	486.0	477.0	528.5	576.0	540.5	592.0	638.5
50	....	....	....	377.0	425.0	472.0	463.0	510.0	559.5	525.5	571.0	620.5
52	....	....	....	366.0	412.8	458.5	450.0	495.0	539.5	510.0	554.5	598.0
54	....	....	....	355.5	400.5	442.0	437.0	481.0	524.0	495.5	538.5	581.0
56	....	....	....	345.5	386.0	429.0	424.5	467.0	508.5	477.5	523.0	564.0
58	....	....	....	335.0	375.0	416.8	409.0	450.0	490.0	463.5	504.0	547.5
60	....	....	....	325.5	364.0	404.5	397.0	436.5	476.0	450.0	489.0	527.5

For loads above heavy line. $\dfrac{l}{r}$ is less than 120.

STRUCTURAL STEEL FOR RESIDENCES
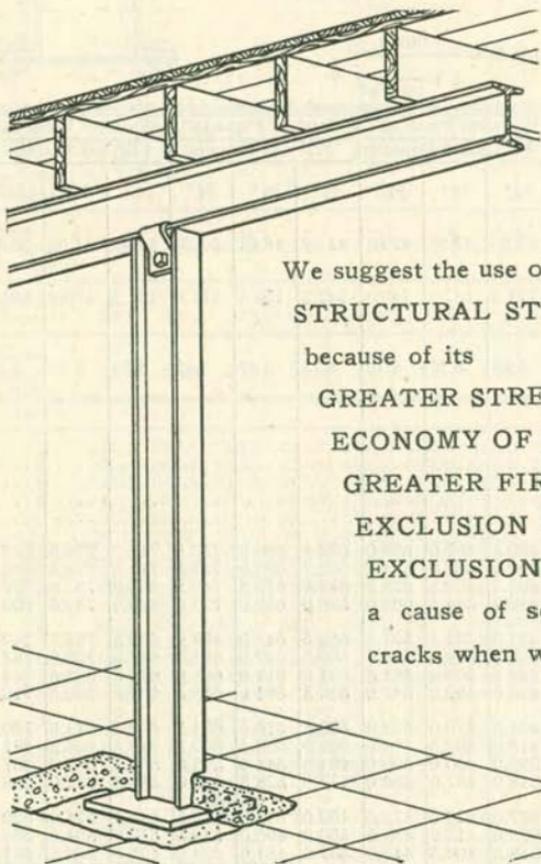
We suggest the use of
STRUCTURAL STEEL for homes
because of its
GREATER STRENGTH
ECONOMY OF SPACE
GREATER FIRE PROTECTION
EXCLUSION OF VERMIN
EXCLUSION OF SHRINKAGE,
a cause of settlement and plaster
cracks when wood is used.

Steel H columns 4″ and 5″ square can be set into partitions conveniently without unsightly projection.

Erection of columns and beams in residences is simple and rapid.

CONNECTION ANGLES FOR AMERICAN STANDARD CHANNELS

DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Channel Depth	Weight per foot	Web	Outstanding Single Shear — Power Driven Rivets	Outstanding Single Shear — Unfinished Bolts	Framing Distance C	Gage g	Size and Length	Weight Inc. Web Rivets	Connection Details
3"	4.1	7650	11930	8840	¼	2 5/16			
	5.0	11610	11930	8840	5/16	2 5/16	6" x 4" x ⅜" Long 0' — 2"	5 lbs.	
	6.0	16020	11930	8840	⅜	2 5/16			
4"	5.4	8100	11930	8840	¼	2 5/16			
	6.25	11120	11930	8840	5/16	2 5/16			
	7.25	14400	11930	8840	⅜	2 5/16			
5"	6.7	8550	11930	8840	¼	2 ⅜			
	9.0	14630	11930	8840	⅜	2 ⅜			
	11.5	21240	11930	8840	9/16	2 ½			
6"	8.2	9000	11930	8840	¼	2 ⅜	6" x 4" x ⅜" Long 0' — 2½"	6 lbs.	
	10.5	14130	11930	8840	⅜	2 ⅜			
	13.0	19670	11930	8840	½	2 ⅜			
	15.5	23860	11930	8840	⅝	2 ½			
7"	9.8	9450	11930	8840	¼	2 ⅜			
	12.25	14130	11930	8840	⅜	2 ⅜			
	14.75	18860	11930	8840	½	2 ⅜			
8"	11.5	19800	23860	17670	5/16	2 ⅜			
	13.75	27270	23860	17670	⅜	2 ⅜			
	16.25	35550	23860	17670	7/16	2 ⅜			
	18.75	43830	23860	17670	9/16	2 ½			
9"	13.4	20700	23860	17670	5/16	2 ⅜			
	15.0	25650	23860	17670	⅜	2 ⅜			
	20.0	40320	23860	17670	½	2 ½	6" x 4" x ⅜" Long 0' — 5½"	13 lbs.	
10"	15.3	21600	23860	17670	5/16	2 ⅜			
	20.0	34100	23860	17670	7/16	2 ⅜			
	25.0	47340	23860	17670	9/16	2 ½			
	30.0	47720	23860	17670	¾	2 7/16			
12"	20.7	25200	23860	17670	5/16	2 ⅜			
	25.0	34830	23860	17670	⅜	2 ⅝			
	30.0	45900	23860	17670	9/16	2 ½			
	40.0	47720	23860	17670	13/16	2 ¾			
15"	33.9	36000	47720	35340	7/16	2 ⅝			
	40.0	46800	47720	35340	9/16	2 ½	4" x 3½" x ⅜" Long 0' — 11½"	19 lbs.	
	50.0	47720	47720	35340	¾	2 ¾			

CONNECTION ANGLES FOR AMERICAN STANDARD BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Beam			Connection Value		Framing Distance C	Connection Angles			Connection Details
Depth	Weight per foot	Web	Outstanding Single Shear — Power Driven Rivets	Outstanding Single Shear — Unfinished Bolts		Gage g	Size and Length	Weight Inc. Web Rivets	
3"	5.7	7650	11930	8840	1/4	2 3/16	6" x 4" x 3/8" x 2" Long	5 lbs.	
	6.5	11296	11930	8840	5/16	2 5/8			
	7.5	15706	11930	8840	1/4	2 7/8			
4"	7.7	8550	11930	8840	5/16	2 5/8			
	8.5	11390	11930	8840	5/16	2 5/8			
	9.5	14670	11930	8840	1/4	2 9/16			
	10.5	18000	11930	8840	1/4	2 3/16			
5"	10.0	9450	11930	8840	5/16	2 5/8	6" x 4" x 3/8" x 2 1/2" Long	6 lbs.	
	12.25	15620	11930	8840	1/4	2 9/16			
	14.75	22230	11930	8840	5/16	2 1/2			
6"	12.5	10350	11930	8840	5/16	2 5/8			
	14.75	15440	11930	8840	1/4	2 3/16			
	17.25	20930	11930	8840	5/16	2 1/2			
7"	15.3	11250	11930	8840	5/16	2 5/8			
	17.5	15530	11930	8840	1/4	2 3/16			
	20.0	20250	11930	8840	5/16	2 1/2			
8"	18.4	24300	23860	17670	5/16	2 5/8	6" x 4" x 3/8" x 5 1/2" Long	13 lbs.	
	20.5	31410	23860	17670	1/4	2 3/16			
	23.0	39690	23860	17670	5/16	2 1/2			
	25.5	47720	23860	17670	5/16	2 1/2			
9"	21.8	26100	23860	17670	5/16	2 5/8			
	25.0	35730	23860	17670	1/4	2 3/8			
	30.0	47720	23860	17670	5/8	2 1/2			
10"	22.0	22520	23860	17670	5/16	2 5/8			
	25.4	27900	23860	17670	1/4	2 3/8			
	30.0	40230	23860	17670	5/16	2 1/2			
	40.0		23860	17670	3/8	2 3/8			
12"	25.0	24320	23860	17670	1/4	2 5/8			
	31.8	31500	23860	17670	1/4	2 3/8			
	35.0	38520	23860	17670	1/4	2 3/8			
	40.8	41400	23860	17670	5/8	2 1/2			
	45.0	47720	23860	17670	3/8	2 7/8			
	50.0	47720	23860	17670	7/8	2 3/8			
	55.0	47720	23860	17670	1/2	2 3/8			

CONNECTION ANGLES FOR AMERICAN STANDARD BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS. ¾" POWER DRIVEN RIVETS.

Beam		Connection Value			Framing Distance	Connection Angles			Connection Details.
Depth	Weight per foot	Web	Outstanding			Gage	Size and Length	Weight Inc. Web Rivets	
			Single Shear						
			Power Driven Rivets	Unfinished Bolts					
					C	g			
15"	35.0	29720	47720	35340	3/16	2 3/16			
	42.9	36900	47720	35340	1/4	2 1/16			
	50.0	47720	47720	35340	5/16	2 1/16			
	55.0	47720	47720	35340	3/8	2 1/16			
	60.8	47720	47720	35340	7/16	2 7/16	4" x 3 1/2" x 3/8" Long 0' — 11 1/2"	19 lbs.	
	70.0	47720	47720	35340	7/16	2 3/16			
	75.0	47720	47720	35340	1/2	2 3/16			
	81.3	47720	47720	35340	1/2	2 7/16			
18"	46.0	34200	47720	35340	1/4	2 9/16			
	54.7	41400	47720	35340	5/16	2 1/2			
	60.0	47720	47720	35340	5/16	2 1/2			
	65.0	47720	47720	35340	7/16	2 7/16			
	70.0	47720	47720	35340	7/16	2 3/8			
	75.6	47720	47720	35340	3/8	2 1/2			
	80.0	47720	47720	35340	3/8	2 7/16			
	90.0	47720	47720	35340	7/16	2 3/8			
20"	65.4	56250	59650	44180	5/16	2 1/2			
	70.0	59650	59650	44180	5/16	2 7/16			
	75.0	59650	59650	44180	5/16	2 7/16			
	81.4	59650	59650	44180	3/8	2 7/16	4" x 3 1/2" x 3/8" Long 1' — 2 1/2"	25 lbs.	
	85.0	59650	59650	44180	7/16	2 7/16			
	90.0	59650	59650	44180	7/16	2 3/4			
	95.0	59650	59650	44180	7/16	2 3/4			
21"	58.0	48400	59650	44180	5/16	2 1/2			
24"	71.0	64800	71580	53020	5/16	2 1/2			
	79.9	67500	71580	53020	5/16	2 1/2			
	85.0	71580	71580	53020	5/16	2 7/16			
	90.0	71580	71580	53020	3/8	2 7/16	4" x 3 1/2" x 3/8" Long 1' — 5 1/2"	30 lbs.	
	95.0	71580	71580	53020	3/8	2 7/16			
	100.0	71580	71580	53020	7/16	2 3/4			
	105.9	71580	71580	53020	3/8	2 7/16			
	110.0	71580	71580	53020	3/8	2 7/16			

CONNECTION ANGLES FOR CARNEGIE BEAMS (LIGHT)

DIMENSIONS, WEIGHTS, AND WORKING LOADS. ¾" POWER DRIVEN RIVETS.

Beam Depth	Weight per foot	Web	Outstanding Single Shear — Power Driven Rivets	Outstanding Single Shear — Unfinished Bolts	Framing Distance C	Gage g	Size and Length	Weight inc. Web Rivets	Connection Details
8"	24.0	21510	23860	17670	3/8	2 5/8			
	27.0	24120	23860	17670	5/16	2 5/8			
	30.0	26820	23860	17670	3/8	2 5/8			
9"	29.0	25110	23860	17670	3/8	2 5/8			
	32.0	27630	23860	17670	5/16	2 5/8			
	35.0	30150	23860	17670	1/4	2 5/8			
10"	21.0	20700	23860	17670	3/8	2 5/8	6" x 4" x 3/8" Long 0' — 5½"	13 lbs.	
	23.0	20700	23860	17670	3/8	2 5/8			
	26.0	23310	23860	17670	3/8	2 5/8			
	30.0	26820	23860	17670	3/8	2 5/8			
	25.0	21600	23860	17670	3/8	2 5/8			
	28.0	21600	23860	17670	5/16	2 5/8			
	32.0	24660	23860	17670	5/16	2 5/8			
12"	34.0	33750	23860	17670	1/4	2 7/16			
	36.0	27720	23860	17670	3/8	2 5/8			
	40.0	26120	23860	17670	5/16	2 5/8			
	45.0	29340	23860	17670	1/4	2 7/16			
	50.0	32490	23860	17670	1/4	2 7/16			
14"	30.0	24300	47720	35340	3/8	2 5/8			
	33.0	24300	47720	35340	5/16	2 5/8			
	36.0	26460	47720	35340	5/16	2 5/8			
	38.0	33750	47720	35340	1/4	2 7/16	4" x 3½" x 3/8" Long 0' — 11½"	19 lbs	
	39.0	28620	47720	35340	1/4	2 7/16			
	42.0	30780	47720	35340	1/4	2 7/16			
	35.0	26100	47720	35340	3/8	2 5/8			
	38.0	28260	47720	35340	1/4	2 5/8			
16"	40.0	26100	47720	35340	3/8	2 5/8			
	43.0	33750	47720	35340	1/4	2 7/16			
	45.0	29340	47720	35340	1/4	2 7/16			
	50.0	32580	47720	35340	1/4	2 7/16			
18"	47.0	36000	59659	44180	1/4	2 9/16	4" x 3½" x 3/8" Long 1' — 2½"	25 lbs.	
	51.0	42190	59650	44180	1/4	2 9/16			
	52.0	39830	59650	44180	1/4	2 9/16			
	58.0	44220	59650	44180	1/4	2 9/16			

CONNECTION ANGLES FOR CARNEGIE BEAMS (LIGHT)

DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Beam		Connection Value			Framing Distance C	Connection Angles			Connection Details
Depth	Weight per foot	Web	Outstanding Single Shear			Gage g	Size and Length	Weight inc. Web Rivets	
			Power Driven Rivets	Unfinished Bolts					
21"	58.0	48600	71580	53020	¼	2⅜			
	60.0	50630	71580	53020	¼	2⅜			
	64.0	53460	71580	53020	¼	2⅜	4" x 3½" x ¾" 1'—5½" Long	30 lbs.	
	70.0	58460	71580	53020	¼	2⅜			
	80.0	59130	71580	53020	⅜	2½			
	86.0	63450	71580	53020	⅜	2½			
	92.0	67770	71580	53020	⅜	2½			
24"	70.0	54000	71580	53020	¼	2⅜			
	76.0	54680	71580	53020	¼	2⅜			
	85.0	61020	71580	53020	⅜	2½			
	94.0	67370	71580	53020	⅜	2½			
27"	91.0	82980	95440	70690	⅜	2½			
	101.0	91800	95440	70690	5/16	2 9/16	4" x 3½" x ¾" 1'—11½" Long	40 lbs.	
	112.0	95440	95440	70690	¼	2½			
	124.0	95440	95440	70690	¼	2 7/16			
	137.0	95440	95440	70690	3/16	2⅜			
30"	115.0	107330	107330	79530	⅜	2½			
	126.0	107330	107330	79530	5/16	2⅝	4" x 3½" x ¾" 2'—2½" Long	45 lbs.	
	138.0	107330	107330	79530	¼	2⅜			

CONNECTION ANGLES FOR CARNEGIE BEAMS (HEAVY)
DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Beam		Connection Value			Framing Distance	Connection Angles			Connection Details
			Outstanding						
			Single Shear			Gage	Size and Length	Weight inc. Web Rivets	
Depth	Weight per foot	Web	Power Driven Rivets	Unfinished Bolts C		g			
8"	31.0	26100	47720	35340	5/8	2 1/2			
	36.0	30240	47720	35340	1/4	2 5/8			
	42.0	35100	47720	35340	1/4	2 7/8			
9"	38.0	28440	47720	35340	1/4	2 7/8	6" x 3 1/2" Long	16 lbs.	
	43.0	32130	47720	35340	1/4	2 7/8			
	48.0	35820	47720	35340	1/4	2 7/8			
10"	31.0	28800	47720	35340	1/4	2 7/8	6" x 3 1/2" Long		
	36.0	42030	47720	35340	5/8	2 1/4	0' —		
	42.0	47720	47720	35340	5/8	2 7/8			
	49.0	31520	47720	35340	1/4	2 5/8			
	54.0	44120	47720	35340	5/8	2 1/2			
	59.0	47720	47720	35340	3/4	2 3/4			
	64.0	47720	47720	35340	7/8	2 7/8			
12"	55.0	50630	71580	53020	1/4	2 7/8			
	60.0	55240	71580	53020	5/8	2 5/8			
	66.0	59400	71580	53020	5/8	2 1/2			
	65.0	54000	71580	53020	3/8	2 1/2			
	70.0	70200	71580	53020	5/8	2 1/2	6" x 8 1/2" Long		
	76.0	71580	71580	53020	5/8	2 3/4	0' —	24 lbs.	
	82.0	60780	71580	53020	5/8	2 5/8			
	88.0	71580	71580	53020	3/8	2 7/8			
	48.0	46300	71580	53020	1/4	2 5/8			
	53.0	51030	71580	53020	1/4	2 7/8			
	58.0	55760	71580	53020	1/4	2 7/8			
14"	61.0	51570	71580	53020	1/4	2 7/8			
	68.0	57370	71580	53020	1/4	2 7/8			
	75.0	63180	71580	53020	5/8	2 1/2			
	85.0	58730	71580	53020	1/4	2 7/8			
	58.0	67500	95440	70690	1/4	2 7/8			
	63.0	73080	95440	70690	1/4	2 7/8			
	68.0	78840	95440	70690	3/8	2 7/8			
16"	76.0	75420	95440	70690	1/4	2 7/8	6" x 11 1/2" Long	33 lbs.	
	83.0	82440	95440	70690	5/8	2 1/2	0' —		
	90.0	89100	95440	70690	3/8	2 1/2			
	100.0	83520	95440	70690	5/8	2 1/2			
	107.0	89280	95440	70690	3/8	2 1/2			
	115.0	95440	95440	70690	3/8	2 1/2			
18"	67.0	91350	119300	88360	1/4	2 7/8			
	72.0	98100	119300	88360	1/4	2 3/8			
	78.0	105980	119300	88360	3/8	2 1/2			
	86.0	96530	119300	88360	1/4	2 5/8	6" x 21 1/2" Long	41 lbs.	
	93.0	104180	119300	88360	5/8	2 1/2	1' —		
	100.0	112050	119300	88360	3/8	2 1/2			
21"	104.0	104630	119300	88360	5/8	2 1/2			
	112.0	112280	119300	88360	5/8	2 1/2			
	120.0	119300	119300	88360	3/8	2 1/2			

CONNECTION ANGLES FOR CARNEGIE BEAMS (HEAVY)

DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Beam		Connection Value			Framing Distance C	Connection Angles			Connection Details.
Depth	Weight per foot	Web	Outstanding Single Shear			Gage g	Size and Length	Weight inc. Web Rivets	
			Power Driven Rivets	Unfinished Bolts					
24″	100.0	121500	143160	106030	⅜	2½	6″ x 6″ x ⅜″ Long 1′ — 5½″	49 lbs.	
	110.0	133380	143160	106030	5/16	2½			
	120.0	143160	143160	106030	5/16	2½			
	130.0	143160	143160	106030	⅜	2½			
	140.0	143160	143160	106030	⅜	2 3/16			
	150.0	143160	143160	106030	⅜	2 3/16			
	160.0	143160	143160	106030	⅜	2 3/16			
27″	145.0	167020	167020	123700	⅜	2 3/16	6″ x 6″ x ⅜″ Long 1′ — 8½″	58 lbs.	
	160.0	167020	167020	123700	⅜	2 3/16			
	175.0	167020	167020	123700	3/16	2 3/16			
30″	151.0	190880	190880	141380	7/16	2¾	6″ x 6″ x ⅜″ Long 1′ — 11½″	66 lbs.	
	165.0	190880	190880	141380	⅜	2¾			
	180.0	190880	190880	141380	⅜	2¾			
	200.0	190880	190880	141380	⅜	2¾			
	220.0	190880	190880	141380	½	2 3/16			

CONNECTION ANGLES FOR BETHLEHEM BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Beam		Connection Value			Framing Distance C	Connection Angles			Connection Details
			Outstanding						
			Single Shear						
Depth	Weight per foot	Web	Power Driven Rivets	Unfinished Bolts C		Gage g	Size and Length	Weight Inc. Web Rivets	
8"	17.5	22500	23860	17670	⅜	2⅝			
	19.0	24300	23860	17670	⅜	2⅝			
9"	20.5	22500	23860	17670	⅜	2⅝	6" x 4" x ¾" — 5½" Long	13 lbs.	
	22.0	23400	23860	17670	⅜	2⅝			
10"	21.0	21600	23860	17670	⅜	2⅝			
	23.5	22500	23860	17670	⅜	2⅝			
12"	25.0	21600	23860	17670	⅜	2⅝			
	28.0	22050	23860	17670	⅜	2⅝			
	31.5	24300	23860	17670	⅜	2⅝			
	36.0	27000	23860	17670	⅜	2⅝			
14"	30.0	23850	47720	35340	⅜	2⅝			
	33.0	23850	47720	35340	⅜	2⅝			
	37.5	27450	47720	35340	⅜	2⅝			
15"	36.0	25200	47720	35340	⅜	2⅝			
	38.5	26100	47720	35340	⅜	2⅝			
	40.0	27450	47720	35340	¼	2⅝	4" x 3½" x ¾" — 11½" Long	19 lbs	
	42.5	29250	47720	35340	¼	2⅜			
	46.0	32850	47720	35340	¼	2⅜			
	50.5	34650	47720	35340	¼	2⅜			
	54.5	36900	47720	35340	¼	2⅜			
	59.5	40500	47720	35340	⅜	2½			
16"	35.0	25650	47720	35340	⅜	2⅝			
	40.0	25650	47720	35340	⅜	2⅝			
	45.0	28800	47720	35340	¼	2⅝			
	50.0	32400	47720	35340	¼	2⅝			
	56.5	33750	47720	35340	¼	2⅜			
	60.5	35100	47720	35340	¼	2⅜			
	66.0	37800	47720	35340	¼	2⅜			
	71.5	40960	47720	35340	⅜	2½			
18"	47.0	36580	59650	44180	¼	2⅝			
	49.0	37130	59650	44180	¼	2⅝			
	52.0	39940	59650	44180	¼	2⅝			
	54.5	41630	59650	44180	¼	2⅝			
	59.0	42750	59650	44180	¼	2⅝	4" x 3½" x ¾" — 2½" Long	25 lbs.	
	64.5	45000	59650	44180	¼	2⅝			
	69.0	47250	59650	44180	¼	2⅝			
	74.0	49500	59650	44180	⅜	2½			
20"	56.0	42200	59650	44180	¼	2⅝			
	59.5	42200	59650	44180	¼	2⅝			
	62.0	43880	59650	44180	¼	2⅝			
	64.5	45000	59650	44180	¼	2⅝			
	68.5	46150	59650	44180	¼	2⅝			
	73.0	48380	59650	44180	¼	2⅝			
	78.0	51750	59650	44180	⅜	2½			

CONNECTION ANGLES FOR BFTHLEHEM BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS.　　¾″ POWER DRIVEN RIVETS.

Beam			Connection Value			Framing Distance	Connection Angles			Connection Details.
			Outstanding							
			Single Shear				Gage	Size and Length	Weight Inc. Web Rivets	
Depth	Weight per foot	Web	Power Driven Rivets	Unfinished Bolts		C	g			
22″	58.0	48600	71580	53020		⅛	2⅜			
	62.5	49980	71580	53020		⅛	2⅜			
	67.5	52680	71580	53020		⅛	2⅜	4″ x 3½″ x ¾″ Long		
	73.0	56060	71580	53020		⅛	2⅜	1′ — 5½″		
	77.0	57390	71580	53020		⅛	2⅜		30 lbs.	
	83.0	61440	71580	53020		⅜	2½			
	89.0	65490	71580	53020		⅜	2½			
	96.5	70890	71580	53020		⅜	2½			
24″	70.0	53330	71580	53020		⅛	2⅜			
	73.5	53330	71580	53020		⅛	2⅜			
	79.5	58050	71580	52020		⅛	2⅜			
	84.5	62100	71580	53020		⅜	2½			
	90.5	64140	71580	53020		⅜	2½			
	95.5	68180	71580	53020		⅜	2½			
	99.5	70880	71580	53020		⅜	2½			
	104.5	71580	71580	53020		⅜	2½			
26″	81.0	69300	83510	61850		⅜	2½	4″ x 3½″ x ¾″ Long		
	85.5	70875	83510	61850		⅜	2½	1′ — 8½″	35 lbs.	
	91.0	74030	83510	61850		⅜	2½			
28″	91.0	81040	95440	70690		⅜	2½	4″ x 3½″ x ¾″ Long		
	97.0	84640	95440	70690		⅜	2½	1′ — 11½″	40 lbs.	
	104.0	90000	95440	70690		⅜	2½			
	112.0	95440	95440	70690		⅜	2½			
30″	110.0	105300	107370	79530		⅜	2½	4″ x 3½″ x ¾″ Long		
	115.0	107370	107370	79530		⅜	2½	2′ — 2½″	45 lbs.	
	121.0	107370	107370	99530		⅜	2½			
	129.0	107370	107370	79530		¾	2⅞			
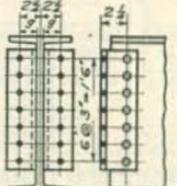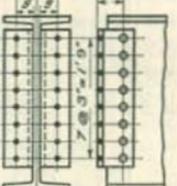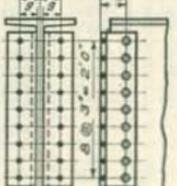
CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS.　　¾" POWER DRIVEN RIVETS.

Beam			Connection Value		Framing Distance C	Connection Angles			Connection Details.
			Outstanding						
			Single Shear			Gage			
Depth	Weight per foot	Web	Power Driven Rivets	Unfinished Bolts	C	g	Size and Length	Weight inc. Web Rivets	
8"	29.5	25650	47720	35340	3/16	2 5/8	6" x 8" x ¾" Long 0' — 5½"	16 lbs.	
	33.0	26100	47720	35340	5/16	2 5/8			
	36.5	27920	47720	35340	3/16	2 5/8			
9"	36.0	26100	47720	35340	5/16	2 5/8			
	38.5	27900	47720	35340	1/4	2 5/8			
	43.5	31500	47720	35340	3/16	2 5/8			
10"	41.5	27900	47720	35340	1/4	2 5/8			
	44.5	28800	47720	35340	1/4	2 5/8			
	50.0	32400	47720	35340	1/4	2 5/8			
12"	51.5	48600	71580	53020	1/4	2 5/8	6" x 8" x ¾" Long 0' — 8½"	24 lbs.	
	55.5	51300	71580	53020	1/4	2 5/8			
	61.0	55350	71580	53020	1/4	2 5/8			
	66.0	60750	71580	53020	3/16	2 1/2			
15"	64.5	70200	95440	70690	1/4	2 5/8	6" x 6" x ¾" Long 0' — 11½"	33 lbs.	
	69.0	75600	95440	70690	1/4	2 5/8			
	74.0	79200	95440	70690	3/16	2 1/2			
	80.5	86400	95440	70690	3/16	2 1/2			
	94.0	95440	95440	70690	5/16	2 1/2			
	99.0	95440	95440	70690	5/16	2 3/16			
	105.0	95440	95440	70690	3/8	2 5/16			
	111.0	95440	95440	70690	3/8	2 7/16			
16"	74.5	70200	95440	70690	1/4	2 5/8			
	81.0	75600	95440	70690	1/4	2 5/8			
	87.0	81000	95440	70690	5/16	2 1/2			
	94.0	87300	95440	70690	3/8	2 1/2			
18"	80.0	94500	119300	88360	1/4	2 7/8	6" x 6" x ¾" Long 1' — 2½"	41 lbs.	
	86.0	99000	119300	88360	5/16	2 1/2			
	92.0	103500	119300	88360	3/8	2 1/2			
20"	99.0	114800	119300	88360	5/16	2 1/4			
	107.0	113900	119300	88360	5/16	2 1/4			
	113.0	119300	119300	88360	3/8	2 1/4			
	120.0	119300	119300	88360	3/8	2 7/16			
	127.0	119300	119300	88360	3/8	2 7/8			
	135.0	119300	119300	88360	3/8	2 7/8			
	142.0	119300	119300	88360	3/8	2 7/8			
	149.0	119300	119300	88360	7/16	2 7/8			

CONNECTION ANGLES FOR BETHLEHEM GIRDER BEAMS

DIMENSIONS, WEIGHTS, AND WORKING LOADS.   ¾" POWER DRIVEN RIVETS.

Beam		Connection Value			Framing Distance C	Connection Angles			Connection Details
Depth	Weight per foot	Web	Outstanding Single Shear			Gage g	Size and Length	Weight Inc. Web Rivets	
			Power Driven Rivets	Unfinished Bolts					
22"	101.0	121600	143160	106030	3/8	2½	6" x 6" x 3/8" Long 1' — 5½" Long	49 lbs.	
	108.0	129600	143160	106030	5/16	2½			
	116.0	137800	143160	106030	5/16	2½			
	124.0	143160	143160	106030	3/8	2½			
24"	107.0	130980	143160	106030	3/8	2½			
	113.0	135000	143160	106030	5/16	2½			
	120.0	143160	143160	106030	3/8	2½			
26"	138.0	167020	167020	123700	3/8	2⅜	6" x 6" x 3/8" 1' — 8½" Long	58 lbs.	
	144.0	167020	167020	123700	3/8	2⅜			
	151.0	167020	167020	123700	3/8	2⅜			
	160.0	167020	167020	123700	3/8	2 7/16			
28"	145.0	167020	167020	123700	3/8	2⅜			
	156.0	167020	167020	123700	3/8	2⅜			
	165.0	167020	167020	123700	3/8	2 7/16			
30"	173.0	190880	190880	141380	3/8	2 7/16	6" x 6" x 3/8" 1' — 11½" Long	66 lbs.	
	180.0	190880	190880	141380	3/8	2 7/16			
	190.0	190880	190880	141380	7/16	2⅜			
	200.0	190880	190880	141380	7/16	2⅜			

SHEARING AND BEARING VALUE OF RIVETS

Bearing Values in Pounds for Different Thickness of Plate in inches

ROUGH BOLTS — Bearing at 20000 lbs. per square inch

Diam. of Rivet	Single Shear (Shear at 10000)	¼"	⁵⁄₁₆"	⅜"	⁷⁄₁₆"	½"	⁹⁄₁₆"	⅝"	¹¹⁄₁₆"	¾"	¹³⁄₁₆"	⅞"	¹⁵⁄₁₆"	1"
⅜	1100	1880	2340	2810										
½	1960	2500	3130	3750	4380	5000								
⅝	3070	3130	3910	4690	5470	6250	7030	7810						
¾	4420	3750	4690	5630	6560	7500	8440	9380	10310	11250				
⅞	6010	4380	5470	6560	7660	8750	9840	10940	12030	13130	14220	15310	16410	
1	7850	5000	6250	7500	8750	10000	11250	12500	13750	15000	16250	17500	18750	20000

FIELD RIVETS — *Bearing at 24000 lbs. per square inch

Diam. of Rivet	Single Shear (Shear at 12000)	¼"	⁵⁄₁₆"	⅜"	⁷⁄₁₆"	½"	⁹⁄₁₆"	⅝"	¹¹⁄₁₆"	¾"	¹³⁄₁₆"	⅞"	¹⁵⁄₁₆"	1"
⅜	1320	2250	2800	3370										
½	2360	3000	3750	4500	5250	6000								
⅝	3680	3750	4690	5630	6560	7500	8440	9380						
¾	5300	4500	5630	6750	7880	9000	10130	11250	12370	13500				
⅞	7220	5250	6560	7880	9190	10500	11810	13130	14430	15750	17060	18370	19690	
1	9420	6000	7500	9000	10500	12000	13500	15000	16500	18000	19500	21000	22500	24000

SHOP RIVETS — *Bearing at 30000 lbs. per square inch

Diam. of Rivet	Single Shear (Shear at 13500)	¼"	⁵⁄₁₆"	⅜"	⁷⁄₁₆"	½"	⁹⁄₁₆"	⅝"	¹¹⁄₁₆"	¾"	¹³⁄₁₆"	⅞"	¹⁵⁄₁₆"	1"
⅜	1480	2820	3510	4210										
½	2640	3750	4690	5630	6570	7500								
⅝	4140	4690	5860	7030	8200	9370	10540	11710						
¾	5960	5630	7030	8440	9840	11250	12660	14060	15460	16870				
⅞	8110	6570	8200	9840	11490	13120	14760	16410	18040	19690	21330	22960	24610	
1	10590	7500	9370	11250	13120	15000	16870	18750	20620	22500	24370	26250	28120	30000

DEDUCTION OF AREA FOR RIVET HOLES

Area in square inches = Diameter of hole × Thickness of metal.

Diam. of Rivet	Diameter of Hole	¼"	⁵⁄₁₆"	⅜"	⁷⁄₁₆"	½"	⁹⁄₁₆"	⅝"	¹¹⁄₁₆"	¾"	¹³⁄₁₆"	⅞"	¹⁵⁄₁₆"	1"
⅜	⁷⁄₁₆"	.11	.14	.16	.19	.22	.25	.27	.30	.33	.36	.38	.41	.44
½	⁹⁄₁₆"	.14	.18	.21	.25	.28	.32	.35	.39	.42	.46	.49	.53	.56
⅝	¹¹⁄₁₆"	.17	.21	.26	.30	.34	.39	.43	.47	.52	.56	.60	.64	.69
¾	¹³⁄₁₆"	.20	.25	.30	.36	.41	.46	.51	.56	.61	.66	.71	.76	.81
⅞	¹⁵⁄₁₆"	.23	.29	.35	.41	.47	.53	.59	.64	.70	.76	.82	.88	.94
1	1 ¹⁄₁₆"	.27	.33	.40	.46	.53	.60	.66	.73	.80	.86	.93	1.00	1.06

Diameter of Rivet	Area of Rivet	Shear at 10000	Shear at 12000	Shear at 13500
3/8	.1104	1100	1320	1480
1/2	.1963	1960	2360	2640
5/8	.3068	3070	3680	4140
3/4	.4418	4420	5300	5960
7/8	.6013	6010	7220	8110
1	.7854	7850	9420	10590

Bearing values given above or to the right of the upper heavy lines are greater than double shear. Bearing values given between the upper and lower heavy lines are less than double shear and greater than single shear. Bearing values given below or to the left of the lower heavy lines are less than single shear.

CAUTION { *Bearing value with double shear at 30000 pounds per square inch.
　　　　　 *Bearing value with single shear at 24000 pounds per square inch.

GENERAL INFORMATION ON RIVETS AND RIVETING.

The pitch or distance from center to center of rivets should not be less than 3 diameters of the rivet. In the flanges of beams and girders where plates more than 12 inches wide are used, an extra line of rivets with a pitch not greater than 9 inches should be driven along each edge to draw the plates together.

At the ends of compression members the pitch should not exceed 4 diameters of the rivet for a length equal to 1½ times the width or diameter of the member. In girder stiffeners the pitch should not exceed 6 inches.

In the flanges of girders and chords, carrying floors, the pitch should not exceed 6 inches.

For members in compression, the pitch in the direction of the line of stress should not exceed 16 times the thinnest outside plate, nor 20 times the thinnest enclosed plate or shape with a maximum of 12 inches, and at right angles to the direction of stress the distance between lines of rivets shall not exceed 30 times the thinnest plate or shape. For angles in built sections with two gauge lines, with rivets staggered, the maximum pitch in the line of stress in each gauge line shall not exceed 24 times the thinnest plate with a maximum of 18 inches.

Generally the distance between the edge of any piece and the center of the rivet hole should not be less than 1¼ inches for ¾ and ⅞ inch rivets except in bars less than 2½ inches wide; when practicable it should, for all sizes, be at least 2 diameters of the rivet and should not exceed 12 times the thickness of plate with a maximum of 6 inches.

In figuring clearance of rivets for special cases, allow ⅜ inch in addition to diameter of head.

The shop cost of round and flattened head rivets is the same, while countersunk rivets entail more labor and expense. Countersunk holes should not be used in plates of less thickness than one-half the diameter of rivet.

CONVENTIONAL SIGNS FOR RIVETING.

Two full heads.

Countersunk far side and chipped.

Countersunk near side and chipped.

Countersunk both sides and chipped.

Shop Field

Flattened to ⅛" high or countersunk and not chipped.

Flattened to ¼" high.

Flattened to ⅜" high.

Far Side. Near Side. Both Sides.

Clearance for Web Riveting.

Rivets in Crimped Angles.
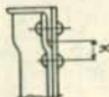
Distance X should be 1½ in. plus thickness of chord angles, but never less than 2 in.

Standard Rivet Dies.

MINIMUM RIVET SPACING.

Dia. of rivet, in.	¼	⅜	½	⅝	¾	⅞	1	1½
x, minimum, in.	1	1¼	1¾	2	2¼	2⅝	3	3⅜

STANDARD GAUGES FOR ANGLES

Leg.	a	Max. Riv.	Leg.	b	c	Max. Riv.
4	2½	⅞	8	3	3	1
3½	2	⅞	7	2½	3	Variable
3	1¾	⅞	6	2½	2¼	"
2½	1⅜	¾	5	1¾	2	"
2	1⅛	⅝	4	1½	1¾	½
1¾	1	½		All Dimensions in Inches		

MINIMUM PITCH FOR MACHINE RIVETING

Riv. Diam. D	Std. c	Std. b	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½	2¾
⅜	⅞	1 3/16	¼	0	...	...	...	...	...	...	...	...	...	...	...
½	1	1⅜	¾	½	0	...	...	...	...	...	...	...	...	...	...
⅝	1⅛	1 9/16	1 3/16	1	¾	⅜	0	...	...	...	...	...	...	...	...
¾	1¼	1¾	...	1¼	1¼	¾	⅜	0	...	...	...	...	...	...	...
⅞	1⅜	2	...	...	1½	1⅜	1⅛	¾	⅜	0	...	...	...	...	...
1	1½	2 3/16	...	...	...	1⅝	1½	1¾	1⅛	⅞	½	0	...	...	...
1⅛	1⅝	2⅜	...	...	...	1¾	1⅝	1½	1⅜	1⅛	⅞	⅜	0	...	...
1¼	1¾	2½	...	...	...	...	...	2	1⅞	1¾	1½	1¼	1	⅜	0
1⅜	1⅞	2⅝	...	...	...	...	...	2⅛	2	1⅞	1¾	1½	1¼	1	⅜
1½	2	3	...	...	...	...	...	...	2⅛	2¼	2⅛	2	1¾	1⅝	1¾

COVER PLATE RIVETING

a	c
½	2½
1	2⅝
1½	2¾
2	2¾
2½	2⅞
3	2⅞
3½	3
4	3⅛
5	3¼
6	3⅜

b	c
...	2½
½	2⅜
¾	2¼
1	2¼
1¼	2⅛
1½	2
1¾	1¾
2	1¾
2¼	1
2½	...

The use of hand pneumatic hammers is avoided where construction permits these clearances.

STAGGER OF RIVETS TO MAINTAIN NET SECTION

DIMENSIONS IN INCHES
1 Hole Out   2 Holes Out

a	¾ Rivet b	⅞ Rivet b	a	¾ Rivet b	⅞ Rivet b
1	1⅝	1¾	5	3½	3⅝
1½	1⅞	2	5½	3¼	3½
2	2⅛	2¼	6	3⅜	3⅝
2½	2¼	2⅜	6½	3½	3¾
3	2⅜	2½	7	3⅝	3⅞
3½	2 7/16	2 9/16	7½	3¾	4
4	2⅝	3	8	3⅞	4⅛
4½	2⅝	3 3/16	8½	4	4¼

⅝" rivets, can be taken at ⅛" less than for ¾".
1" rivets, can be taken at ⅛" more than for ⅞".

STANDARD GAUGES FOR TEES	STANDARD TIE PLATES

DISTANCE C/L TO C/L OF STAGGERED RIVETS.
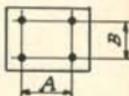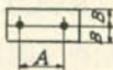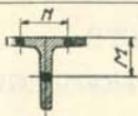
Width of Flange	Distance N	Max. Rivet or Bolt Flg.	Depth of Bar	Distance M	Max. Rvt. or Bolt Stem.	Size of Beam or Girder	Distance A	Distance B	Size of Plate
1	5⁄8	1⁄4	1	7⁄16	3⁄8	3″- I	4	1¼	2½ x 7⁄16 x 0′-7″
1⅛	5⁄8	1⁄4	1⅛	7⁄16	3⁄8	4 - I	4	1¼	″
1 7⁄16	5⁄8	1⁄4	1⅛	7⁄16	1⁄2	5 - I	4	1¼	″
1¼	5⁄8	1⁄4	1⅛	5⁄8	1⁄2	6 - I	4	1¼	″
1⅜	5⁄8	1⁄4	1¼	11⁄16	1⁄2	7 - I	4	1¼	″
2	1	1⁄2	1⅜	3⁄4	1⁄2	8 - I	4	1¼	″
2¼	1⅛	1⁄2	1¾	1	5⁄8	9 - I	4	1¼	″
2½	1¼	1⁄2	2	1⅛	5⁄8	10 - I	4	1¼	″
2¾	1⅜	1⁄2	2¼	1¼	3⁄4	12 - I	4	4	7 x 5⁄16 -0′-7″
3	1½	1⁄2	2½	1⅜	3⁄4	15 - I	4	4	″
3½	1¾	5⁄8	3	1¾	7⁄8	18 - I	4	4	″
4	2	5⁄8	3½	2	1	20 - I	4	4	″
4½	2¼	3⁄4	4	2¼	1	24 - I	4	4	″
5	2⅜	3⁄4	...	...	...	12-Girder	6	4	7 x 7⁄16 -0′-9″
						15- ″	7½	4	7 x 7⁄16 -0′-10½″
						18- ″	9	4	7 x 7⁄16 -1′-0″
						20- ″	10	4	7 x 3⁄8 -1′-1″
						24- ″	12	4	7 x 3⁄8 -1′-3″

VALUES OF X FOR VARYING VALUES OF "A" AND "B"
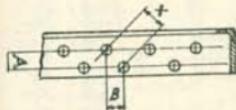
Values below or to the right of upper heavy line are large enough for 5⁄8″ Rivets.

Values below or to the right of second heavy line are large enough for ¾″ Rivets.

Values below or to the right of lower heavy line are large enough for 7⁄8″ Rivets.

Values of "B"	VALUES OF "A"													
	7⁄8	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜	2½
1⅛	1 7⁄16	1½	1 9⁄16	1 11⁄16	1¾	1 7⁄8	2	2 1⁄16	2 3⁄16	2 5⁄16	2⅜	2½	2⅝	2¾
1¼	1 7⁄16	1⅝	1 11⁄16	1¾	1 7⁄8	1 15⁄16	2 1⁄16	2 3⁄16	2¼	2⅜	2 7⁄16	2 9⁄16	2 11⁄16	2 13⁄16
1⅜	1⅝	1 11⁄16	1¾	1 7⁄8	1 15⁄16	2	2⅛	2 3⁄16	2 5⁄16	2 7⁄16	2½	2⅝	2¾	2⅞
1½	1¾	1 13⁄16	1 7⁄8	1 15⁄16	2	2⅛	2 3⁄16	2 5⁄16	2⅜	2½	2⅝	2 11⁄16	2 13⁄16	2 15⁄16
1⅝	1 13⁄16	1 7⁄8	2	2⅛	2 3⁄16	2¼	2 5⁄16	2⅜	2½	2 9⁄16	2 11⁄16	2¾	2⅞	3
1¾	1 15⁄16	2	2 1⁄16	2⅛	2¼	2 5⁄16	2⅜	2½	2 9⁄16	2 11⁄16	2¾	2⅞	2 15⁄16	3⅛
1⅞	2 1⁄16	2⅛	2 3⁄16	2¼	2 5⁄16	2 7⁄16	2½	2 9⁄16	2 11⁄16	2¾	2⅞	2 15⁄16	3	3⅛
2	2 1⁄16	2¼	2 5⁄16	2⅜	2 7⁄16	2½	2 9⁄16	2 11⁄16	2¾	2⅞	2 15⁄16	3	3⅛	3⅛
2⅛	2 7⁄16	2 5⁄16	2⅜	2 7⁄16	2½	2⅝	2 11⁄16	2¾	2 13⁄16	3	3 1⁄16	3⅛	3 3⁄16	3⅛
2¼	2 7⁄16	2 7⁄16	2½	2 9⁄16	2⅝	2 11⁄16	2¾	2 13⁄16	2 15⁄16	3	3 1⁄16	3¼	3¼	3⅜
2⅜	2½	2 7⁄16	2⅝	2 11⁄16	2¾	2 13⁄16	2 15⁄16	3	3⅛	3 1⁄16	3¼	3⅜	3 3⁄16	3 1⁄16
2½	2⅝	2 11⁄16	2¾	2 13⁄16	2 15⁄16	2⅞	3	3 1⁄16	3⅛	3¼	3⅜	3 9⁄16	3 1⁄16	

STANDARD RIVET SPACING FOR CAULKING.

Thickness of Plate	½″-Rivets				5⁄8″-Rivets				¾″-Rivets				7⁄8″-Rivets			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
3⁄16	1⅝	3⁄4	2¼	1⅜												
¼	1¾	7⁄8	2½	1½	1 7⁄8	1										
5⁄16	1¾	7⁄8	2½	1½	2	1	2⅝	1⅝	2	1⅛	2¾	1¾				
⅜	1 7⁄8	1	2⅝	1½	2	1	2¾	1¾	2⅛	1⅛	2¾	1⅞				
7⁄16	...	...	...	...	2	1	2¾	1¾	2¼	1⅜	3	2	2⅜	1⅛	3⅛	2⅛
½	...	...	...	...	2¼	1	3	1⅞	2⅝	1¼	3⅛	2	2⅜	1⅜	3⅛	2¼
5⁄8	...	...	...	...	...	...	...	...	2½	1¼	3¼	2⅛	2⅝	1½	3⅜	2¼
¾	...	...	...	...	...	...	...	...	...	...	...	...				

STRUCTURAL RIVETS

LENGTHS OF FIELD RIVETS FOR VARIOUS GRIPS

Dimensions in Inches

Grip in Inches	Diameter in Inches					Diameter in Inches					Grip in Inches
	½	⅝	¾	⅞	1	½	⅝	¾	⅞	1	
	Length in Inches					Length in Inches					
½	1½	1¾	1⅞	2	2⅛	1⅛	1¼	1¼	1⅜	1⅜	½
⅝	1⅝	1⅞	2	2⅛	2¼	1¼	1⅜	1⅜	1½	1½	⅝
¾	1¾	2	2⅛	2¼	2⅜	1⅜	1½	1½	1⅝	1⅝	¾
⅞	1⅞	2⅛	2¼	2⅜	2½	1½	1⅝	1⅝	1¾	1¾	⅞
1	2	2¼	2⅜	2½	2⅝	1⅝	1¾	1¾	1⅞	1⅞	1
1⅛	2⅛	2⅜	2½	2⅝	2¾	1¾	1⅞	1⅞	2	2	1⅛
1¼	2¼	2½	2⅝	2¾	2⅞	1⅞	2	2	2⅛	2⅛	1¼
1⅜	2⅜	2⅝	2¾	2⅞	3	2	2⅛	2⅛	2¼	2¼	1⅜
1½	2⅝	2¾	3	3⅛	3¼	2⅛	2¼	2⅜	2⅜	2½	1½
1⅝	2¾	3	3⅛	3¼	3⅜	2¼	2⅜	2⅜	2½	2⅝	1⅝
1¾	3	3¼	3⅜	3½	3⅝	2¼	2⅝	2½	2⅝	2¾	1¾
1⅞	3⅛	3⅜	3½	3⅝	3¾	2⅝	2¾	2¾	2⅞	3	1⅞
2	3¼	3½	3⅝	3¾	3⅞	2¾	2⅞	3	3	3⅛	2
2⅛	3⅜	3⅝	3¾	3⅞	4	2⅞	3	3⅛	3¼	3¼	2⅛
2¼	3½	3¾	3⅞	4	4⅛	3	3⅛	3¼	3¼	3⅜	2¼
2⅜	3⅝	3⅞	4	4⅛	4¼	3⅛	3¼	3⅜	3⅜	3½	2⅜
2½	3¾	4	4⅛	4¼	4⅜	3¼	3⅜	3½	3½	3⅝	2½
2⅝	3⅞	4⅛	4¼	4⅜	4½	3⅜	3½	3⅝	3⅝	3¾	2⅝
2¾	4	4¼	4⅜	4½	4⅝	3½	3⅝	3¾	3¾	3⅞	2¾
2⅞	4⅛	4⅜	4½	4⅝	4¾	3⅝	3¾	3⅞	3⅞	4	2⅞
3	4⅜	4⅝	4¾	4⅞	5	3⅞	4	4	4⅛	4¼	3
3⅛	4½	4¾	4⅞	5	5⅛	4	4⅛	4⅛	4¼	4⅜	3⅛
3¼	4⅝	4⅞	5	5⅛	5¼	4⅛	4¼	4¼	4⅜	4½	3¼
3⅜	4¾	5	5⅛	5¼	5⅜	4¼	4⅜	4⅜	4½	4⅝	3⅜
3½	4⅞	5⅛	5¼	5⅜	5½	4⅜	4½	4½	4⅝	4¾	3½
3⅝	5	5¼	5⅜	5½	5⅝	4½	4⅝	4⅝	4¾	4⅞	3⅝
3¾	5⅛	5⅜	5½	5⅝	5¾	4⅝	4¾	4¾	4⅞	5	3¾
3⅞	5¼	5½	5⅝	5¾	5⅞	4¾	4⅞	4⅞	5	5⅛	3⅞
4	5⅜	5⅝	5¾	5⅞	6	4⅞	5	5	5⅛	5¼	4
4⅛	5½	5⅞	6	6⅛	6¼	5⅛	5¼	5¼	5⅜	5½	4⅛
4¼	5¾	6	6⅛	6¼	6⅜	5¼	5⅜	5⅜	5½	5⅝	4¼
4⅜	6	6¼	6⅜	6½	6⅝	5¼	5½	5½	5⅝	5¾	4⅜
4½	6⅛	6⅜	6½	6⅝	6¾	5⅝	5¾	5¾	5¾	5⅞	4½

Use following lengths: For ⅜-inch rivets—cold—add ½-inch stock to grip; for ⅝ and ¾-inch rivets—hot—add ¾-inch stock to grip; prefer to use rivets ⅛".

IN TANK WORK NOT WATER TIGHT and with FLAT HEADS Use following lengths: rivets—cold—add ½-inch stock to grip; for ½-inch stock to grip. ¾-inch rivets—hot—add 1-inch stock to grip.

NOTE: For lengths running in sixteenths use lowest eighth.

Some erectors, because they use a shallower dolly, prefer to use rivets ⅛" shorter than shown in the table.

Rivets over 3½ inches in length are not made in ⅛ inch lengths.

WEIGHTS OF STEEL ANGLES.

Size in inches	1/8"	3/16"	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"
8 x 8							26.4	29.6	32.7	35.8	38.9	42.0	45.0	48.1	51.0
8 x 6						20.2	23.0	25.7	28.5	31.2	33.8	36.5	39.1	41.7	44.2
*8 x 3½						16.5	18.7	21.0	23.2	25.3	27.5	29.6	31.7	33.7	35.7
7 x 3½					13.0	15.0	17.0	19.1	21.0	23.0	24.9	26.8	28.7	30.5	32.3
6 x 6					14.9	17.2	19.6	21.9	24.2	26.5	28.7	31.0	33.1	35.3	37.4
6 x 4				10.3	12.3	14.3	16.2	18.1	20.0	21.8	23.6	25.4	27.2	28.9	30.6
6 x 3½				9.8	11.7	13.5	15.3	17.1	18.9	20.6	22.4	24.0	25.7	27.3	28.9
5 x 5					12.3	14.3	16.2	18.1	20.0	21.8	23.6	25.4	27.2	28.9	30.6
5 x 4					11.0	12.8	14.5	16.2	17.8	19.5	21.1	22.7	24.2		
5 x 3½				8.7	10.4	12.0	13.6	15.2	16.8	18.3	19.8	21.3	22.7		
5 x 3				8.2	9.8	11.3	12.8	14.3	15.7	17.1	18.5	19.9			
*4½ x 3				7.7	9.1	10.6	11.9	13.3	14.7	16.0	17.3	18.5			
4 x 4			6.6	8.2	9.8	11.3	12.8	14.3	15.7	17.1	18.5	19.9			
4 x 3½			6.2	7.7	9.1	10.6	11.9	13.3	14.7	16.0	17.3	18.5			
4 x 3			5.8	7.2	8.5	9.8	11.1	12.4	13.6	14.8	16.0	17.1			
3½ x 3½			5.8	7 2	8.5	9.8	11.1	12.4	13.6	14.8	16.0	17.1			
3½ x 3			5.4	6.6	7.9	9.1	10 2	11.4	12.5	13.6	14.7	15.8			
3½ x 2½			4.9	6.1	7.2	8.3	9 4	10.4	11.5	12.5					
3 x 3			4.9	6.1	7.2	8.3	9.4	10.4	11.5						
3 x 2½			4.5	5.6	6.6	7.6	8.5	9.5							
3 x 2			4.1	5.0	5.9	6.8	7.7								
*2¾ x 2¾		3.39	4.5	5.6	6.6	7.6	8.5								
2½ x 2½	2.08	3.07	4.1	5.0	5.9	6.8	7.7								
2½ x 2	1.86	2.75	3.62	4.5	5.3	6.1	6.8								
2½ x 1½		2.44	3.19	3.92											
2¼ x 2¼		2.75	3.62	4.5	5.3	6.1									
2¼ x 1½		2.28	2.98	3.66	4.40	5.00	5.60								
2 x 2	1.65	2.44	3.19	3.92	4.7	5.3									
2 x 1½	1.44	2.12	2.77	3.39	3.99										
2 x 1¼		1.96	2.55												
1¾ x 1¾	1.44	2.12	2.77	3.39	3.99	4.6									
1¾ x 1¼	1.23	1.80	2.34												
1½ x 1½	1.23	1.50	2.34	2.86	3.35										
1½ x 1¼		1.64	2.13	2.59											
1¼ x 1¼	1.01	1.48	1.92	2.33											
1 x 1	0.80	1.16	1.49												
¾ x ¾	.59	.84													

Angles marked * are special.

WEIGHT OF STEEL PLATE.

Pounds per Lineal Foot.

Width in Inches	THICKNESS IN INCHES													
	3/16″	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	.638	.850	1.06	1.28	1.49	1.70	1.91	2.13	2.34	2.55	2.76	2.98	3.19	3.40
1¼	.797	1.06	1.33	1.59	1.86	2.13	2.39	2.66	2.92	3.19	3.45	3.72	3.98	4.25
1½	.957	1.28	1.59	1.91	2.23	2.55	2.87	3.19	3.51	3.83	4.14	4.46	4.78	5.10
1¾	1.12	1.49	1.86	2.23	2.60	2.98	3.35	3.72	4.09	4.46	4.83	5.21	5.58	5.95
2	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25	4.68	5.10	5.53	5.95	6.38	6.80
2¼	1.43	1.91	2.39	2.87	3.35	3.83	4.30	4.78	5.26	5.74	6.22	6.69	7.17	7.65
2½	1.59	2.13	2.66	3.19	3.72	4.25	4.78	5.31	5.84	6.38	6.91	7.44	7.97	8.50
2¾	1.75	2.34	2.92	3.51	4.09	4.68	5.26	5.84	6.43	7.01	7.60	8.18	8.77	9.35
3	1.91	2.55	3.19	3.83	4.46	5.10	5.74	6.38	7.01	7.65	8.29	8.93	9.56	10.20
3¼	2.07	2.76	3.45	4.14	4.83	5.53	6.22	6.91	7.60	8.29	8.98	9.67	10.36	11.05
3½	2.23	2.98	3.72	4.46	5.21	5.95	6.69	7.44	8.18	8.93	9.67	10.41	11.16	11.90
3¾	2.39	3.19	3.98	4.78	5.58	6.38	7.17	7.97	8.77	9.56	10.36	11.16	11.95	12.75
4	2.55	3.40	4.25	5.10	5.95	6.80	7.65	8.50	9.35	10.20	11.05	11.90	12.75	13.60
4½	2.87	3.83	4.78	5.74	6.69	7.65	8.61	9.56	10.52	11.48	12.43	13.39	14.34	15.30
5	3.19	4.25	5.31	6.38	7.44	8.50	9.56	10.63	11.69	12.75	13.81	14.88	15.94	17.00
5½	3.51	4.68	5.84	7.01	8.18	9.35	10.52	11.69	12.86	14.03	15.19	16.36	17.53	18.70
6	3.83	5.10	6.38	7.65	8.93	10.20	11.48	12.75	14.03	15.30	16.58	17.85	19.13	20.40
6½	4.14	5.53	6.91	8.29	9.67	11.05	12.43	13.81	15.19	16.58	17.96	19.34	20.72	22.10
7	4.46	5.95	7.44	8.93	10.41	11.90	13.39	14.88	16.36	17.85	19.34	20.83	22.31	23.80
7½	4.78	6.38	7.97	9.56	11.16	12.75	14.34	15.94	17.53	19.13	20.72	22.31	23 91	25.50
8	5.10	6.80	8.50	10.20	11.90	13.60	15.30	17.00	18.70	20.40	22.10	23.80	25.50	27.20
9	5.74	7.65	9.56	11.48	13.39	15.30	17.21	19.13	21.04	22.95	24.86	26.78	28.69	30.60
10	6.38	8.50	10.63	12.75	14.88	17.00	19.13	21.25	23.38	25.50	27.63	29.75	31.88	34.00
11	7.01	9.35	11.69	14.03	16.36	18.70	21.04	23.38	25.71	28.05	30.39	32.72	35.06	37.40
12	7.65	10.20	12.75	15.30	17.85	20.40	22.95	25.50	28.05	30.60	33.15	35.70	38.25	40.80
13	8.29	11.05	13.81	16.58	19.34	22.10	24.86	27.63	30.40	33.20	35.91	38.68	41.44	44.20
14	8.93	11.90	14.88	17.85	20.83	23.80	26.78	29.75	32.72	35.71	38.67	41.65	44.63	47.60
15	9.56	12.75	15.94	19.13	22.31	25.50	28.69	31.88	35.06	38.26	41.43	44.62	47.82	51.00
16	10.20	13.60	17.00	20.40	23.80	27.20	30.60	34.00	37.40	40.80	44.20	47.60	51.00	54.40
17	10.84	14.45	18.06	21.68	25.29	28.90	32.51	36.13	39.74	43.36	46.96	50.58	54.20	57.80
18	11.48	15.30	19.13	22.95	26.78	30.60	34.43	38.25	42.08	45.90	49.72	53.56	57.38	61.20
19	12.11	16.15	20.19	24.23	28.26	32.30	36.34	40.38	44.42	48.46	52.48	56.52	60.57	64.60
20	12.75	17.00	21.25	25.50	29.75	34.00	38.25	42.50	46.75	51.00	55.25	59.50	63.75	68.00
21	13.39	17.85	22.31	26.78	31.24	35.70	40.16	44.63	49.08	53.56	58.01	62.49	66.94	71.40
22	14.03	18.70	23.38	28.05	32.73	37.40	42.08	46.75	51.45	56.10	60.79	65.44	70.13	74.80
23	14.66	19.55	24.44	29.33	34.21	39.10	43.99	48.88	53.76	58.66	63.53	68.43	73.32	78.20
24	15.30	20.40	25.50	30.60	35.70	40.80	45 90	51.00	56.10	61.20	66.30	71.40	76.50	81.60
26	16.58	22.10	27.63	33.15	38.68	44.20	49.73	55.25	60.78	66.30	71.82	77.36	82.88	88.40
28	17.85	23.80	29.75	35.70	41.65	47.60	53.56	59.50	65.44	71.40	77.34	83.30	89.26	95.20
30	19.13	25.50	31.88	38.25	44.63	51.00	57.38	63.75	70.13	76.50	82.86	89.24	95.64	102.00
36	22.95	30.60	38.25	45.90	53.55	61.20	68.85	76.50	84.15	91.80	99.45	107.10	114.75	122.40
42	26.78	35.70	44.63	53.55	62.48	71.40	80.33	89.25	98.18	107.10	116.03	124.95	133.88	142.80

AREA OF STEEL PLATE.

Width in Inches	THICKNESS IN INCHES.													
	$\frac{3}{16}''$	$\frac{1}{4}''$	$\frac{5}{16}''$	$\frac{3}{8}''$	$\frac{7}{16}''$	$\frac{1}{2}''$	$\frac{9}{16}''$	$\frac{5}{8}''$	$\frac{11}{16}''$	$\frac{3}{4}''$	$\frac{13}{16}''$	$\frac{7}{8}''$	$\frac{15}{16}''$	$1''$
1	.188	.250	.313	.375	.438	.500	.563	.625	.688	.750	.813	.875	.938	1.00
1¼	.234	.313	.391	.469	.547	.625	.703	.781	.859	.938	1.02	1.09	1.17	1.25
1½	.281	.375	.469	.563	.656	.750	.844	.938	1.03	1.13	1.22	1.31	1.41	1.50
1¾	.328	.438	.547	.656	.766	.875	.984	1.09	1.20	1.31	1.42	1.53	1.64	1.75
2	.375	.500	.625	.750	.875	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00
2¼	.422	.563	.703	.844	.984	1.13	1.27	1.41	1.55	1.69	1.83	1.97	2.11	2.25
2½	.469	.625	.781	.938	1.09	1.25	1.41	1.56	1.72	1.88	2.03	2.19	2.34	2.50
2¾	.516	.688	.859	1.03	1.20	1.38	1.55	1.72	1.89	2.06	2.23	2.41	2.58	2.75
3	.563	.750	.938	1.13	1.31	1.50	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00
3¼	.609	.813	1.02	1.22	1.42	1.63	1.83	2.03	2.23	2.44	2.64	2.84	3.05	3.25
3½	.656	.875	1.09	1.31	1.53	1.75	1.97	2.19	2.41	2.63	2.84	3.06	3.28	3.50
3¾	.703	.938	1.17	1.41	1.64	1.88	2.11	2.34	2.58	2.81	3.05	3.28	3.52	3.75
4	.750	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
4½	.844	1.13	1.41	1.69	1.97	2.25	2.53	2.81	3.09	3.38	3.66	3.94	4.22	4.50
5	.938	1.25	1.56	1.88	2.19	2.50	2.81	3.13	3.44	3.75	4.06	4.38	4.69	5.00
5½	1.03	1.38	1.72	2.06	2.41	2.75	3.09	3.44	3.78	4.13	4.47	4.81	5.16	5.50
6	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75	4.13	4.50	4.88	5.25	5.63	6.00
6½	1.22	1.63	2.03	2.44	2.84	3.25	3.66	4.06	4.47	4.88	5.28	5.69	6.09	6.50
7	1.31	1.75	2.19	2.63	3.06	3.50	3.94	4.38	4.81	5.25	5.69	6.13	6.56	7.00
7½	1.41	1.88	2.34	2.81	3.28	3.75	4.22	4.69	5.16	5.63	6.09	6.56	7.03	7.50
8	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00
9	1.69	2.25	2.81	3.38	3.94	4.50	5.06	5.63	6.19	6.75	7.31	7.88	8.44	9.00
10	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25	6.88	7.50	8.13	8.75	9.38	10.00
11	2.06	2.75	3.44	4.13	4.81	5.50	6.19	6.88	7.56	8.25	8.94	9.63	10.31	11.00
12	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00
13	2.44	3.25	4.06	4.88	5.69	6.50	7.31	8.13	8.94	9.75	10.56	11.38	12.19	13.00
14	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75	9.63	10.50	11.38	12.25	13.13	14.00
15	2.81	3.75	4.69	5.63	6.56	7.50	8.44	9.38	10.31	11.25	12.19	13.13	14.06	15.00
16	3.00	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
17	3.19	4.25	5.31	6.38	7.44	8.50	9.56	10.63	11.69	12.75	13.81	14.88	15.94	17.00
18	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25	12.38	13.50	14.63	15.75	16.88	18.00
19	3.56	4.75	5.94	7.13	8.31	9.50	10.69	11.88	13.06	14.25	15.44	16.63	17.81	19.00
20	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50	13.75	15.00	16.25	17.50	18.75	20.00
21	3.94	5.25	6.56	7.88	9.19	10.50	11.81	13.13	14.44	15.75	17.06	18.38	19.69	21.00
22	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75	15.13	16.50	17.88	19.25	20.63	22.00
23	4.31	5.75	7.19	8.63	10.06	11.50	12.94	14.38	15.81	17.25	18.69	20.13	21.56	23.00
24	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.00	19.50	21.00	22.50	24.00
26	4.88	6.50	8.13	9.75	11.38	13.00	14.63	16.25	17.88	19.50	21.13	22.75	24.38	26.00
28	5.25	7.00	8.75	10.50	12.25	14.00	15.75	17.50	19.25	21.00	22.75	24.50	26.25	28.00
30	5.63	7.50	9.38	11.25	13.13	15.00	16.88	18.75	20.63	22.50	24.38	26.25	28.13	30.00
36	6.75	9.00	11.25	13.50	15.75	18.00	20.25	22.50	24.75	27.00	29.25	31.50	33.75	36.00
42	7.88	10.50	13.13	15.75	18.38	21.00	23.63	26.25	28.88	31.50	34.13	36.75	39.38	42.00

WEIGHT OF SHEET STEEL

POUNDS PER LINEAL FOOT

United States Standard Gauge

Number of Gauge	Approximate Thickness in Fractions of an Inch	Approximate Thickness in Decimal Parts of an Inch	WIDTH IN INCHES											
			20	22	24	26	28	30	36	42	48	50	54	60
8	11/64	.17188	11.68	12.86	14.03	15.20	16.37	17.53	21.04	24.55	28.06	29.21	31.55	35.06
9	5/32	.15625	10.62	11.69	12.75	13.81	14.87	15.94	19.13	22.32	25.51	26.55	28.67	31.88
10	9/64	.14063	9.56	10.51	11.46	12.41	13.36	14.34	17.21	20.08	22.95	23.90	25.80	28.68
11	1/8	.125	8.50	9.35	10.20	11.05	11.90	12.75	15.30	17.85	20.40	21.25	22.95	25.50
12	7/64	.10938	7.43	8.18	8.93	9.68	10.43	11.16	13.39	15.62	17.85	18.59	20.09	22.32
13	3/32	.09375	6.37	7.00	7.64	8.28	8.92	9.56	11.47	13.38	15.29	15.93	17.21	19.12
14	5/64	.07813	5.31	5.83	6.36	6.89	7.42	7.97	9.56	11.15	12.74	13.28	14.34	15.94
15	9/128	.07031	4.78	5.25	5.73	6.21	6.69	7.17	8.64	10.11	11.58	11.94	12.90	14.34
16	1/16	.0625	4.25	4.67	5.09	5.51	5.93	6.37	7.65	8.93	10.21	10.61	11.45	12.74
17	9/160	.05625	3.82	4.20	4.58	4.96	5.34	5.74	6.89	8.04	9.19	9.56	10.32	11.48
18	1/20	.05	3.40	3.74	4.08	4.42	4.76	5.10	6.12	7.14	8.16	8.49	9.17	10.20
19	7/160	.04375	2.97	3.27	3.57	3.87	4.17	4.46	5.36	6.26	7.10	7.43	8.03	8.92
20	3/80	.0375	2.55	2.81	3.07	3.32	3.58	3.82	4.59	5.36	6.13	6.37	6.89	7.64

STANDARD GAUGES.
COMPARATIVE TABLE.

				Thickness in Decimals of an Inch			
Gauge Number	Birmingham Wire (B.W.G.) also known as Stubs Iron Wire	United States Standard Sheet and Plate, Iron & Steel	American Wire or Brown & Sharpe	American Steel and Wire Co.	Trenton Iron Company	British Imperial Standard Wire (S.W.G.)	Standard Birmingham Sheet and Hoop (B. & G.)
0000000	....	.500	....	.4900	....	.500	....
000000	....	.46875	.580000	.4600	....	.464	....
00000	.500	.4375	.516500	.4300	.450	.432	....
0000	.454	.40625	.460000	.3938	.400	.400	....
000	.425	.375	.409642	.3625	.360	.372	.5000
00	.380	.34375	.364796	.3310	.330	.348	.4452
0	.340	.3125	.324861	.3065	.305	.324	.3964
1	.300	.28125	.289297	.2830	.285	.300	.3532
2	.284	.265625	.257627	.2625	.265	.276	.3147
3	.259	.25	.229423	.2437	.245	.252	.2804
4	.238	.234375	.204307	.2253	.225	.232	.2500
5	.220	.21875	.181940	.2070	.205	.212	.2225
6	.203	.203125	.162023	.1920	.190	.192	.1981
7	.180	.1875	.144285	.1770	.175	.176	.1764
8	.165	.171875	.128490	.1620	.160	.160	.1570
9	.148	.15625	.114423	.1483	.145	.144	.1398
10	.134	.140625	.101897	.1350	.130	.128	.1250
11	.120	.125	.090742	.1205	.1175	.116	.1113
12	.109	.109375	.080808	.1055	.105	.104	.0991
13	.095	.09375	.071962	.0915	.0925	.092	.0882
14	.083	.078125	.064084	.0800	.0806	.080	.0785
15	.072	.0703125	.057068	.0720	.070	.072	.0699
16	.065	.0625	.050821	.0625	.061	.064	.0625
17	.058	.05625	.045257	.0540	.0525	.056	.0556
18	.049	.05	.040303	.0475	.045	.048	.0495
19	.042	.04375	.035890	.0410	.040	.040	.0440
20	.035	.0375	.031961	.0348	.035	.036	.0392
21	.032	.034375	.028462	.03175	.031	.032	.0349
22	.028	.03125	.025346	.0286	.028	.028	.03125
23	.025	.028125	.022572	.0258	.025	.024	.02782
24	.022	.025	.020101	.0230	.0225	.022	.02476
25	.020	.021875	.017900	.0204	.020	.020	.02204
26	.018	.01875	.015941	.0181	.018	.018	.01961
27	.016	.0171875	.014195	.0173	.017	.0164	.01745
28	.014	.015625	.012641	.0162	.016	.0148	.015625
29	.013	.0140625	.011257	.0150	.015	.0136	.0139
30	.012	.0125	.010025	.0140	.014	.0124	.0123
31	.010	.0109375	.008928	.0132	.013	.0116	.0110
32	.009	.01015625	.007950	.0128	.012	.0108	.0098
33	.008	.009375	.007080	.0118	.011	.0100	.0087
34	.007	.00859375	.006305	.0104	.010	.0092	.0077
35	.005	.0078125	.005615	.0095	.0095	.0084	.0069
36	.004	.00703125	.005000	.0090	.009	.0076	.0061
37	....	.006640625	.004453	.0085	.0085	.0068	.0054
38	....	.00625	.003965	.0080	.008	.0060	.0048
39	....	....	.003531	.0075	.0075	.0052	....
40	....	....	.003144	.0070	.007	.0048	....

APPROXIMATE RADII OF GYRATION
COMMON BUILDING AND BRIDGE SECTIONS

1 — $r_{11} = 0.29d$ $r_{22} = 0.29b$

2 — $r_{11} = 0.41d$ $r_{22} = 0.41b$ d & b = MEAN DIST.

3 — $r_{11} = 0.25d$ $r_{22} = 0.25d$

4 — $r_{11} = 0.35d$ $r_{22} = 0.35d$ d & b = MEAN DIST.

5 — $r_{11} = 0.43d$ $r_{22} = 0.24b$

6 — $r_{11} = 0.30d$ $r_{22} = 0.30b$ $r_{33} = 0.19d$

7 — $r_{11} = 0.22d$ $r_{22} = 0.22b$

8 — $r_{11} = 0.31d$ $r_{22} = 0.18b$

9 — $r_{11} = 0.25d$ $r_{22} = 0.21b$

10 — $r_{11} = 0.40d$ $r_{22} = 0.23b$

11 — $r_{11} = 0.39d$ $r_{22} = 0.21b$

12 — $r_{11} = 0.45d$ $r_{22} = 0.24b$

13 — $r_{11} = 0.32d$ $r_{22} = 0.32b$

14 — $r_{11} = 0.25d$ $r_{22} = 0.37b$

15 — $r_{11} = 0.25d$ $r_{22} = 0.32b$

16 — $r_{11} = 0.42d$ $r_{22} = 0.42d$

17 — $r_{11} = 0.36d$ $r_{22} = 0.45b$

18 — $r_{11} = 0.36d$ $r_{22} = 0.32b$

19 — $r_{11} = 0.40d$ $r_{22} = 0.34b$

20 — $r_{11} = 0.45d$ $r_{22} = 0.30b$

21 — $r_{11} = 0.40d$ $r_{22} = 0.33b$

22 — $r_{11} = 0.41d$ $r_{22} = 0.22b$

23 — $r_{11} = 0.38d$ $r_{22} = 0.21b$

24 — $r_{11} = 0.38d$ $r_{22} = 0.45b$

25 — $r_{11} = 0.38d$ $r_{22} = 0.60b$

26 — $r_{11} = 0.36d$

27 — $r_{11} = 0.39d$ $r_{22} = 0.32b$

28 — $r_{11} = 0.45d$ $r_{22} = 0.31b$

29 — $r_{11} = 0.36d$

30 — $r_{11} = 0.41d$ $r_{22} = 0.22b$

31 — $r_{11} = 0.40d$ $r_{22} = 0.24b$

32 — $r_{11} = 0.31d$ $r_{22} = 0.45b$

33 — $r_{11} = 0.31d$ $r_{22} = 0.54b$

34 — $r_{11} = 0.32d$ $r_{22} = 0.49b$

b = OVERALL WIDTH OF SECTION EXCEPT AS NOTED.
d = OVERALL HEIGHT OF SECTION EXCEPT AS NOTED.
IF JUDGEMENT IS USED THE VALUES OF r OBTAINED BY MEANS OF THESE FORMULAE WILL AGREE WITH THE EXACT VALUES WITHIN A FEW PER CENT.

MOMENTS OF INERTIA OF RECTANGLES

Neutral Axis

Depth In Inches	THICKNESS IN INCHES									
	¼	5⁄16	⅜	7⁄16	½	9⁄16	⅝	¾	⅞	1
2	.17	.21	.25	.29	.33	.38	.42	.50	.58	.67
3	.56	.70	.84	.98	1.13	1.27	1.41	1.69	1.97	2.25
4	1.33	1.67	2.00	2.33	2.67	3.00	3.33	4.00	4.67	5.33
5	2.60	3.26	3.91	4.56	5.21	5.86	6.51	7.81	9.11	10.42
6	4.50	5.63	6.75	7.88	9.00	10.13	11.25	13.50	15.75	18.00
7	7.15	8.93	10.72	12.51	14.29	16.08	17.86	21.44	25.01	28.58
8	10.67	13.33	16.00	18.67	21.33	24.00	26.67	32.00	37.33	42.67
9	15.19	18.98	22.78	26.58	30.38	34.17	37.97	45.56	53.16	60.75
10	20.83	26.04	31.25	36.46	41.67	46.87	52.08	62.50	72.92	83.33
11	27.73	34.66	41.59	48.53	55.46	62.39	69.32	83.19	97.05	110.92
12	36.00	45.00	54.00	63.00	72.00	81.00	90.00	108.00	126.00	144.00
13	45.77	57.21	68.66	80.10	91.54	102.98	114.43	137.31	160.20	183.08
14	57.17	71.46	85.75	100.04	114.33	128.63	142.92	171.50	200.08	228.67
15	70.31	87.89	105.47	123.05	140.63	158.20	175.78	210.94	246.09	281.25
16	85.33	106.67	128.00	149.33	170.67	192.00	213.33	256.00	298.67	341.33
17	102.35	127.94	153.53	179.12	204.71	230.30	255.89	307.06	358.24	409.42
18	121.50	151.88	182.25	212.63	243.00	273.38	303.75	364.50	425.25	486.00
19	142.90	178.62	214.34	250.07	285.79	321.52	357.24	428.69	500.14	571.58
20	166.67	208.33	250.00	291.67	333.33	375.00	416.67	500.00	583.33	666.67
21	192.94	241.17	289.41	337.64	385.88	434.11	482.34	578.81	675.28	771.75
22	221.83	277.29	332.75	388.21	443.67	499.13	554.58	665.50	776.42	887.33
23	253.48	316.85	380.22	443.59	506.96	570.33	633.70	760.44	887.18	1013.92
24	288.00	360.00	432.00	504.00	576.00	648.00	720.00	864.00	1008.00	1152.00
25	325.52	406.90	488.28	569.66	651.04	732.42	813.80	976.56	1139.32	1302.08
26	366.17	457.71	549.25	640.79	732.33	823.88	915.42	1098.50	1281.58	1464.67
27	410.06	512.58	615.09	717.61	820.13	922.64	1025.16	1230.19	1435.22	1640.25
28	457.33	571.67	686.00	800.33	914.67	1029.00	1143.33	1372.00	1600.67	1829.33
29	508.10	635.13	762.16	889.18	1016.21	1143.23	1270.26	1524.31	1778.36	2032.42
30	562.50	703.13	843.75	984.38	1125.00	1265.63	1406.25	1687.50	1968.75	2250.00
32	682.67	853.33	1024.00	1194.67	1365.33	1536.00	1706.67	2048.00	2389.33	2730.67
34	818.83	1023.54	1228.25	1432.96	1637.67	1842.38	2047.08	2456.50	2865.92	3275.33
36	972.00	1215.00	1458.00	1701.00	1944.00	2187.00	2430.00	2916.00	3402.00	3888.00
38	1143.17	1428.96	1714.75	2000.54	2286.33	2572.13	2857.92	3429.50	4001.08	4572.67
40	1333.33	1666.67	2000.00	2333.33	2666.67	3000.00	3333.33	4000.00	4666.67	5333.33
42	1543.50	1929.38	2315.25	2701.13	3087.00	3472.88	3858.75	4630.50	5402.25	6174.00
44	1774.67	2218.33	2662.00	3105.67	3549.33	3993.00	4436.67	5324.00	6211.33	7098.67
46	2027.83	2534.79	3041.75	3548.71	4055.67	4562.63	5069.58	6083.50	7097.42	8111.33
48	2304.00	2880.00	3456.00	4032.00	4608.00	5184.00	5760.00	6912.00	8064.00	9216.00
50	2604.17	3255.21	3906.25	4557.29	5208.33	5859.38	6510.42	7812.50	9114.58	10416.67
52	2929.33	3661.67	4394.00	5126.33	5858.67	6591.00	7323.33	8788.00	10252.67	11717.33
54	3280.50	4100.63	4920.75	5740.88	6561.00	7381.13	8201.25	9841.50	11481.75	13122.00
56	3658.67	4573.33	5488.00	6402.67	7317.33	8232.00	9146.67	10976.00	12805.33	14634.67
58	4064.83	5081.04	6097.25	7113.46	8129.67	9145.87	10162.08	12194.50	14226.92	16259.33
60	4500.00	5625.00	6750.00	7875.00	9000.00	10125.00	11250.00	13500.00	15750.00	18000.00

MOMENTS OF INERTIA OF TWO PLATES
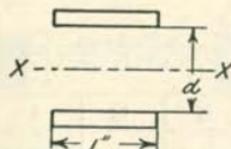
Moments of Inertia of Two Plates

ONE INCH WIDE

About Axis X-X

Distances Measured from Inside to Inside

For Moments of Inertia, deducting for rivet holes, multiply tabular value by net width.

d Ins.	Thickness of Plates in Inches.													
	⅛	¼	5⁄16	⅜	7⁄16	½	9⁄16	⅝	11⁄16	¾	13⁄16	⅞	15⁄16	1
6	2.3	4.9	6.2	7.6	9.1	10.6	12.1	13.8	15.4	17.2	18.9	20.7	22.7	24.7
6¼	2.5	5.3	6.7	8.2	9.8	11.4	13.1	14.8	16.6	18.5	20.4	22.3	24.4	26.5
6½	2.7	5.7	7.3	8.9	10.5	12.3	14.1	15.9	17.8	19.8	21.8	23.9	26.1	28.3
6¾	3.0	6.1	7.8	9.5	11.3	13.2	15.1	17.0	19.1	21.2	23.3	25.5	27.8	30.2
8	4.1	8.5	10.8	13.2	15.6	18.1	20.6	23.3	26.0	28.8	31.6	34.6	37.6	40.7
8¼	4.4	9.0	11.5	14.0	16.5	19.2	21.9	24.7	27.5	30.5	33.5	36.5	39.7	43.0
8½	4.6	9.6	12.1	14.8	17.5	20.3	23.1	26.1	29.1	32.2	35.3	38.6	41.9	*45.3
8¾	4.9	10.1	12.8	15.6	18.5	21.4	24.4	27.5	30.7	33.9	37.2	40.6	44.1	47.7
9	5.2	10.7	13.6	16.5	19.5	22.6	25.7	29.0	32.3	35.7	39.2	42.8	46.4	50.2
9¼	5.5	11.3	14.3	17.4	20.5	23.8	27.1	30.5	34.0	37.6	41.2	45.0	48.8	52.7
9½	5.8	11.9	15.0	18.3	21.6	25.0	28.5	32.1	35.7	39.5	43.3	47.2	51.2	55.3
9¾	6.1	12.5	15.8	19.2	22.7	26.3	29.9	33.7	37.5	41.4	45.4	49.5	53.7	57.9
10	6.4	13.1	16.6	20.2	23.8	27.6	31.4	35.3	39.3	43.4	47.6	51.9	56.2	60.7
10¼	6.7	13.8	17.4	21.2	25.0	28.9	32.9	37.0	41.2	45.5	49.8	54.3	58.8	63.5
10½	7.1	14.5	18.3	22.2	26.2	30.3	34.5	38.7	43.1	47.5	52.1	56.7	61.5	66.3
10¾	7.4	15.1	19.1	23.2	27.4	31.7	36.0	40.5	45.0	49.7	54.4	59.2	64.2	69.2
12	9.2	18.8	23.7	28.7	33.9	39.1	44.2	49.8	55.4	61.0	66.8	72.6	76.8	84.7
12¼	9.6	19.5	24.7	29.9	35.2	40.7	46.2	51.8	57.6	63.5	69.4	75.5	81.7	88.0
12½	10.0	20.3	25.7	31.1	36.6	42.3	48.0	53.9	59.8	65.9	72.1	78.4	84.8	91.3
12¾	10.4	21.1	26.7	32.3	38.1	43.9	49.9	55.9	62.1	68.4	74.8	81.3	88.0	94.7
14	12.5	25.4	32.0	38.8	45.6	52.6	59.7	66.9	74.2	81.7	89.2	96.9	104.7	112.7
14¼	12.9	26.3	33.1	40.1	47.2	54.4	61.7	69.2	76.8	84.5	92.3	100.2	108.3	116.5
14½	13.4	27.2	34.3	41.5	48.8	56.3	63.8	71.5	79.4	87.3	95.3	103.5	111.9	120.3
14¾	13.8	28.1	35.5	42.9	50.5	58.2	66.0	73.9	82.0	90.2	98.4	106.9	115.5	124.2
15	14.3	29.1	36.7	44.3	52.1	60.1	68.1	76.3	84.7	93.1	101.7	110.4	119.2	128.2
15¼	14.8	30.0	37.9	45.8	53.9	62.0	70.4	78.8	87.4	96.1	104.9	113.9	123.0	132.2
15½	15.3	31.0	39.1	47.3	55.6	64.0	72.6	81.3	90.1	99.1	108.2	117.4	126.8	136.3
15¾	15.7	32.0	40.3	48.7	57.3	66.0	74.9	83.8	92.9	102.2	111.5	121.0	130.7	140.4
16	16.2	33.0	41.6	50.2	59.1	68.1	77.2	86.4	95.8	105.3	114.5	124.7	134.6	144.7
16¼	16.8	34.0	42.9	51.8	60.9	70.2	79.5	89.0	98.7	108.5	118.4	128.4	138.6	149.0
16½	17.3	35.1	44.2	53.4	62.8	72.3	81.9	91.7	101.6	111.7	121.9	132.2	142.7	153.3
16¾	17.8	36.1	45.5	55.0	64.6	74.4	84.3	94.4	104.6	114.9	125.4	136.0	146.8	157.7
18¼	21.1	42.8	53.9	65.1	76.4	87.9	99.6	111.4	123.3	135.5	147.7	160.1	172.7	185.5
18½	21.7	43.9	55.3	66.8	78.5	90.3	102.2	114.3	126.6	139.0	151.6	164.3	177.2	190.3
20¼	26.0	52.5	66.1	79.8	93.6	107.7	121.9	136.2	150.8	165.5	180.3	195.4	210.6	226.0
20½	26.6	53.8	67.7	81.7	95.9	110.3	124.8	139.5	154.4	169.4	184.6	200.0	215.6	231.3
22¼	31.3	63.3	79.6	96.0	112.6	129.4	146.4	163.6	180.9	198.5	216.2	234.1	252.2	270.5
22½	32.0	64.7	81.3	98.1	115.1	132.3	149.6	167.2	184.9	202.8	220.9	239.2	257.6	276.3
24¼	37.1	75.0	94.3	113.7	133.3	153.2	173.2	193.4	213.8	234.5	255.3	276.3	297.5	319.0
24½	37.9	76.6	96.2	116.0	136.0	156.3	176.7	197.3	218.1	239.2	260.4	281.8	303.5	325.3
26¼	43.5	87.8	110.3	132.9	155.8	178.9	202.2	225.8	249.5	273.5	297.6	322.0	346.6	371.5
26½	44.3	89.4	112.3	135.4	158.7	182.3	206.0	230.0	254.1	278.5	303.1	328.0	353.0	378.3
28¼	50.3	101.5	127.5	153.7	180.0	206.7	233.5	260.6	287.9	315.5	343.2	371.2	399.5	428.0
28½	51.2	103.3	129.7	156.3	183.2	210.3	237.6	265.1	292.9	320.9	349.2	377.6	406.3	435.3

BEAMS AND GIRDERS WITH LATERALLY UNSUPPORTED FLANGES

Allowable Stress, in Pounds per Sq. Inch, in Extreme Fibre for Various Ratios of *l / b*

$\frac{l}{b}$	Fibre Stress	$\frac{l}{b}$	Fibre Stress	$\frac{l}{b}$	Fibre Stress	$\frac{l}{b}$	Fibre Stress	$\frac{l}{b}$	Fibre Stress
15.0	18000	20.0	16667	25.0	15238	30.0	13793	35.0	12403
16.0	17730	21.0	16387	26.0	14948	31.0	13509	36.0	12136
17.0	17475	22.0	16103	27.0	14657	32.0	13228	37.0	11873
18.0	17212	23.0	15817	28.0	14368	33.0	12949	38.0	11614
19.0	16942	24.0	15528	29.0	14080	34.0	12674	39.0	11360
								40.0	11111

PERCENTAGE OF FIXED BEAM LOADS FOR VARIOUS RATIOS of *l/b*

$\frac{l}{b}$	%	$\frac{l}{b}$	%	$\frac{l}{b}$	%	$\frac{l}{b}$	%	$\frac{l}{b}$	%
15.0	100.00	20.0	92.58	25.0	84.65	30.0	76.63	35.0	68.90
15.1	99.74	20.1	92.43	25.1	84.49	30.1	76.47	35.1	68.76
15.2	99.61	20.2	92.28	25.2	84.33	30.2	76.31	35.2	68.61
15.3	99.47	20.3	92.13	25.3	84.17	30.3	76.15	35.3	68.46
15.4	99.33	20.4	91.97	25.4	84.01	30.4	75.99	35.4	68.31
15.5	99.19	20.5	91.82	25.5	83.85	30.5	75.84	35.5	68.16
15.6	99.06	20.6	91.66	25.6	83.69	30.6	75.68	35.6	68.01
15.7	98.93	20.7	91.50	25.7	83.53	30.7	75.52	35.7	67.86
15.8	98.78	20.8	91.35	25.8	83.37	30.8	75.36	35.8	67.72
15.9	98.64	20.9	91.19	25.9	83.20	30.9	75.21	35.9	67.57
16.0	98.50	21.0	91.04	26.0	83.04	31.0	75.05	36.0	67.42
16.1	98.36	21.1	90.88	26.1	82.88	31.1	74.89	36.1	67.27
16.2	98.22	21.2	90.72	26.2	82.72	31.2	74.74	36.2	67.13
16.3	98.08	21.3	90.56	26.3	82.55	31.3	74.58	36.3	66.98
16.4	97.94	21.4	90.41	26.4	82.39	31.4	74.42	36.4	66.83
16.5	97.80	21.5	90.25	26.5	82.23	31.5	74.26	36.5	66.69
16.6	97.65	21.6	90.09	26.6	82.07	31.6	74.11	36.6	66.54
16.7	97.51	21.7	89.93	26.7	81.91	31.7	73.95	36.7	66.39
16.8	97.37	21.8	89.78	26.8	81.75	31.8	73.79	36.8	66.25
16.9	97.23	21.9	89.62	26.9	81.59	31.9	73.64	36.9	66.11
17.0	97.08	22.0	89.46	27.0	81.43	32.0	73.48	37.0	65.96
17.1	96.94	22.1	89.30	27.1	81.27	32.1	73.33	37.1	65.82
17.2	96.80	22.2	89.14	27.2	81.11	32.2	73.17	37.2	65.67
17.3	96.65	22.3	88.98	27.3	80.94	32.3	73.02	37.3	65.53
17.4	96.50	22.4	88.82	27.4	80.78	32.4	72.86	37.4	65.38
17.5	96.35	22.5	88.66	27.5	80.62	32.5	72.71	37.5	65.24
17.6	96.21	22.6	88.51	27.6	80.46	32.6	72.55	37.6	65.09
17.7	96.06	22.7	88.35	27.7	80.30	32.7	72.40	37.7	64.95
17.8	95.92	22.8	88.19	27.8	80.14	32.8	72.25	37.8	64.81
17.9	95.77	22.9	88.03	27.9	79.98	32.9	72.09	37.9	64.67
18.0	95.62	23.0	87.87	28.0	79.82	33.0	71.94	38.0	64.52
18.1	95.47	23.1	87.71	28.1	79.66	33.1	71.78	38.1	64.38
18.2	95.33	23.2	87.55	28.2	79.50	33.2	71.63	38.2	64.24
18.3	95.17	23.3	87.39	28.3	79.34	33.3	71.48	38.3	64.09
18.4	95.02	23.4	87.23	28.4	79.18	33.4	71.32	38.4	63.96
18.5	94.87	23.5	87.07	28.5	79.02	33.5	71.17	38.5	63.81
18.6	94.72	23.6	86.91	28.6	78.86	33.6	71.02	38.6	63.67
18.7	94.57	23.7	86.75	28.7	78.69	33.7	70.87	38.7	63.53
18.8	94.43	23.8	86.59	28.8	78.53	33.8	70.72	38.8	63.39
18.9	94.27	23.9	86.43	28.9	78.38	33.9	70.56	38.9	63.25
19.0	94.12	24.0	86.27	29.0	78.22	34.0	70.41	39.0	63.11
19.1	93.97	24.1	86.11	29.1	78.06	34.1	70.26	39.1	62.97
19.2	93.82	24.2	85.94	29.2	77.90	34.2	70.11	39.2	62.83
19.3	93.66	24.3	85.78	29.3	77.74	34.3	69.96	39.3	62.69
19.4	93.51	24.4	85.62	29.4	77.58	34.4	69.80	39.4	62.55
19.5	93.36	24.5	85.46	29.5	77.42	34.5	69.65	39.5	62.42
19.6	93.20	24.6	85.30	29.6	77.26	34.6	69.50	39.6	62.27
19.7	93.05	24.7	85.14	29.7	77.10	34.7	69.35	39.7	62.14
19.8	92.90	24.8	84.98	29.8	76.94	34.8	69.21	39.8	62.00
19.9	92.75	24.9	84.81	29.9	76.78	34.9	69.05	40.0	61.72

l—the unsupported length, in inches, of the compression flange.
b—the width of the flange in inches.

Allowable Working Stress for Columns. Various Ratios *l/r*

In Thousands of Pounds.

Primary Members

l/r	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
79	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.2
78	13.4	13.4	13.4	13.4	13.4	13.4	13.3	13.3	13.3	13.3
77	13.5	13.5	13.5	13.5	13.5	13.4	13.4	13.4	13.4	13.4
76	13.6	13.6	13.6	13.6	13.6	13.5	13.5	13.5	13.5	13.5
75	13.7	13.7	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
74	13.8	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
73	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8	13.8
72	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.8	13.8
71	14.0	14.0	14.0	14.0	14.0	14.0	13.9	13.9	13.9	13.9
70	14.1	14.1	14.1	14.1	14.1	14.1	14.0	14.0	14.0	14.0
69	14.2	14.2	14.2	14.2	14.2	14.1	14.1	14.1	14.1	14.1
68	14.3	14.3	14.3	14.2	14.2	14.2	14.2	14.2	14.2	14.2
67	14.4	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3
66	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4
65	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5
64	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
63	14.7	14.7	14.7	14.7	14.7	14.7	14.6	14.6	14.6	14.6
62	14.8	14.8	14.8	14.8	14.7	14.7	14.7	14.7	14.7	14.7
61	14.9	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
60	15.0	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
99	11.6	11.6	11.6	11.6		11.6	11.5	11.5	11.5	
98	11.7	11.7	11.7	11.7		11.6	11.6	11.6	11.6	
97	11.8	11.8	11.7	11.7		11.7	11.7	11.7	11.7	
96	11.9	11.9	11.8	11.8		11.8	11.8	11.8	11.8	
95	11.9	11.9	11.9	11.9		11.9	11.9	11.9	11.9	
94	12.0	12.0	12.0	12.0		12.0	12.0	12.0	11.9	
93	12.1	12.1	12.1	12.1		12.1	12.0	12.0	12.0	
92	12.2	12.2	12.2	12.2		12.1	12.1	12.1	12.1	
91	12.3	12.3	12.3	12.3		12.2	12.2	12.2	12.2	
90	12.4	12.3	12.3	12.3		12.3	12.3	12.3	12.3	
89	12.4	12.4	12.4	12.4		12.4	12.4	12.4	12.4	
88	12.5	12.5	12.5	12.5		12.5	12.5	12.5	12.5	
87	12.6	12.6	12.6	12.6		12.6	12.5	12.5	12.5	
86	12.7	12.7	12.7	12.7		12.7	12.6	12.6	12.6	
85	12.8	12.8	12.8	12.8		12.7	12.7	12.7	12.7	
84	12.9	12.9	12.9	12.9		12.8	12.8	12.8	12.8	
83	13.0	13.0	12.9	12.9		12.9	12.9	12.9	12.9	
82	13.1	13.0	13.0	13.0		13.0	13.0	13.0	13.0	
81	13.1	13.1	13.1	13.1		13.1	13.1	13.1	13.1	
80	13.2	13.2	13.2	13.2		13.2	13.2	13.2	13.1	
119	10.0	10.0	10.0	10.0		10.0	10.0	10.0	10.0	
118	10.1	10.1	10.1	10.1		10.1	10.0	10.0	10.0	
117	10.2	10.2	10.2	10.1		10.1	10.1	10.1	10.1	
116	10.3	10.2	10.2	10.2		10.2	10.2	10.2	10.2	
115	10.3	10.3	10.3	10.3		10.3	10.3	10.3	10.3	
114	10.4	10.4	10.4	10.4		10.4	10.3	10.3	10.3	
113	10.5	10.5	10.5	10.5	10.4	10.4	10.4	10.4	10.4	
112	10.6	10.6	10.5	10.5	10.5	10.5	10.5	10.5	10.5	
111	10.6	10.6	10.6	10.6		10.6	10.6	10.6	10.6	
110	10.7	10.7	10.7	10.7		10.7	10.7	10.7	10.6	
109	10.8	10.8	10.8	10.8		10.8	10.7	10.7	10.7	
108	10.9	10.9	10.9	10.8		10.8	10.8	10.8	10.8	
107	11.0	10.9	10.9	10.9		10.9	10.9	10.9	10.9	
106	11.0	11.0	11.0	11.0		11.0	11.0	11.0	11.0	
105	11.1	11.1	11.1	11.1		11.1	11.1	11.1	11.0	
104	11.2	11.2	11.2	11.2		11.2	11.1	11.1	11.1	
103	11.3	11.3	11.3	11.2		11.2	11.2	11.2	11.2	
102	11.4	11.3	11.3	11.3		11.3	11.3	11.3	11.3	
101	11.4	11.4	11.4	11.4		11.4	11.4	11.4	11.4	
100	11.5	11.5	11.5	11.5		11.5	11.5	11.5	11.4	

l/r	value	value
139	8.68	8.65
138	8.74	8.71
137	8.81	8.78
136	8.87	8.84
135	8.94	8.91
134	9.01	8.97
133	9.07	9.04
132	9.14	9.11
131	9.21	9.18
130	9.28	9.25
129	9.35	9.31
128	9.42	9.38
127	9.49	9.45
126	9.56	9.53
125	9.63	9.60
124	9.70	9.67
123	9.78	9.74
122	9.85	9.81
121	9.92	9.89
120	10.0	9.96

Secondary Members Only

l/r	value	value
159	7.45	7.45
158	7.54	7.51
157	7.59	7.56
156	7.65	7.62
155	7.71	7.68
154	7.76	7.73
153	7.82	7.79
152	7.88	7.85
151	7.94	7.91
150	8.00	7.97
149	8.06	8.03
148	8.12	8.09
147	8.18	8.15
146	8.24	8.21
145	8.30	8.27
144	8.36	8.33
143	8.42	8.39
142	8.48	8.45
141	8.55	8.52
140	8.61	8.58
179	6.47	6.45
178	6.52	6.49
177	6.56	6.54
176	6.61	6.59
175	6.66	6.63
174	6.71	6.68
173	6.75	6.73
172	6.80	6.78
171	6.85	6.83
170	6.90	6.88
169	6.95	6.93
168	7.00	6.98
167	7.06	7.03
166	7.11	7.08
165	7.16	7.13
164	7.21	7.19
163	7.27	7.24
162	7.32	7.29
161	7.37	7.35
160	7.43	7.40
199	5.62	5.60
198	5.66	5.64
197	5.70	5.68
196	5.74	5.72
195	5.78	5.76
194	5.82	5.80
193	5.86	5.84
192	5.90	5.88
191	5.94	5.92
190	5.98	5.96
189	6.03	6.01
188	6.07	6.05
187	6.11	6.09
186	6.16	6.13
185	6.20	6.18
184	6.24	6.22
183	6.30	6.27
182	6.33	6.31
181	6.38	6.36
180	6.42	6.40

SAFE LOADS FOR CHANNELS LAID FLAT IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED

Extreme fibre stress 18,000 lbs. per square inch.
Table also shows end reactions in thousands of pounds from safe uniform loads.
Deflections shown in inches, those to right of heavy line are excessive for plaster ceiling.

Size	Weight Per Foot Pounds	Length of span in feet							Size	Weight Per Foot Pounds	Length of span in feet						
		3	4	5	6	7	8	9			3	4	5	6	7	8	9
15″	50.0	15.4	11.4	9.2	7.6	6.4	5.8	5.2	**8″**	16.25	3.8	2.8	2.4	18.8	1.60	1.40	1.24
	40.0	13.2	10.2	8.0	6.6	5.6	5.0	4.6		11.5	3.2	2.4	1.88	1.56	1.34	1.18	1.06
	33.9	12.6	9.4	7.6	6.2	5.4	4.8	4.0		Defl.	.05	.09	.14	.20	.27	.36	.45
	Defl.	.03	.06	.09	.13	.18	.23	.29	**7″**	14.75	3.2	2.4	1.88	1.56	1.34	1.20	1.06
12″	40.0	9.8	7.4	5.8	5.0	4.2	3.6	3.4		9.8	2.6	1.86	1.50	1.24	1.10	.96	.86
	30.0	8.4	6.2	5.0	4.2	3.6	3.2	2.8		Defl.	.05	.10	.15	.22	.29	.39	.49
	20.7	7.0	5.2	4.4	3.4	3.0	2.8	2.4	**6″**	10.5	2.2	1.68	1.38	1.14	.98	.88	.80
	Defl.	.04	.07	.10	.15	.20	.27	.34		8.2	1.92	1.44	1.18	1.00	.84	.74	.64
10″	25.0	6.0	4.6	3.6	3.0	2.6	2.4	1.80		Defl.	.06	.11	.17	.24	.33	.42	.54
	15.3	4.8	3.4	2.8	2.4	1.80	1.58	1.56	**5″**	6.7	1.42	1.08	.86	.74	.64	.56	.50
	Defl.	.04	.08	.12	.17	.23	.30	.39		Defl.	.07	.12	.18	.26	.36	.47	.59
9″	20.0	4.8	3.6	3.0	2.4	2.0	1.78	1.56	**4″**	5.4	1.16	.86	.68	.60	.50	.44	.40
	13.4	3.8	3.0	2.4	1.92	1.64	1.46	1.30		Defl.	.08	.13	.21	.30	.40	.53	.67
	Defl.	.05	.09	.13	.18	.25	.33	.41	**3″**	4.1	.82	.64	.50	.44	.38	.34	.28
										Defl.	.09	.15	.24	.34	.47	.61	.77

COEFFICIENTS OF DEFLECTION, UNIFORMLY DISTRIBUTED LOADS

To find the deflection in inches of a section symmetrical about the neutral axis, such as beams, channels, zees, etc., divide the coefficient in the table corresponding to given span and fibre stress by the depth of the section in inches.

For unsymmetrical sections such as channels laid flat and angles, divide the coefficient by twice the distance from the neutral axis to most extreme fibre.

For concentrated load at center use four-fifths the tabular coefficient.

Span in Feet.	Fibre Stress in Pounds Per Sq. inch			Span in Feet.	Fibre Stress in Pounds Per Sq. inch			Span in Feet.	Fibre Stress in Pounds Per Sq. inch		
	18000	16000	12500		18000	16000	12500		18000	16000	12500
1	0.018	0.017	0.013	**16**	4.767	4.237	3.310	**31**	17.894	15.906	12.427
2	0.074	0.066	0.052	**17**	5.381	4.783	3.737	**32**	19.067	16.949	13.241
3	0.168	0.149	0.116	**18**	6.033	5.363	4.190	**33**	20.277	18.025	14.082
4	0.298	0.265	0.207	**19**	6.722	5.975	4.668	**34**	21.525	19.134	14.948
5	0.466	0.414	0.323	**20**	7.448	6.621	5.172	**35**	22.810	20.276	15.841
6	0.670	0.596	0.466	**21**	8.211	7.299	5.703	**36**	24.132	21.451	16.759
7	0.912	1.811	0.634	**22**	9.012	8.011	6.259	**37**	25.491	22.659	17.703
8	1.192	0.059	0.828	**23**	9.850	8.756	6.841	**38**	26.887	23.901	18.672
9	1.508	1.341	1.047	**24**	10.725	9.534	7.448	**39**	28.321	25.175	19.668
10	1.862	1.655	1.293	**25**	11.638	10.345	8.082	**40**	29.792	26.483	20.690
11	2.253	2.003	1.565	**26**	12.587	11.189	8.741	**41**	31.300	27.824	21.737
12	2.681	2.383	1.862	**27**	13.574	12.066	9.427	**42**	32.846	29.197	22.810
13	3.147	2.797	2.185	**28**	14.598	12.977	10.138	**43**	34.428	30.603	23.909
14	3.650	3.244	2.534	**29**	15.659	13.920	10.875	**44**	36.048	31.954	25.034
15	4.190	3.724	2.909	**30**	16.758	14.897	11.638	**45**	37.706	33.517	26.185
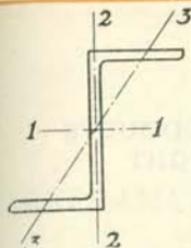
PROPERTIES OF ZEES

Size			Weight per Foot	Area of Section	Axis 1-1			Axis 2-2			Axis 3-3
Depth	Flanges	Thickness			I	r	S	I	r	S	r min.
In.	In.	In.	Lbs.	In.²	In.⁴	In.	In.³	In.⁴	In.	In.³	In.
6⅛	3⅝	⅞	34.6	10.17	50.2	2.22	16.4	19.2	1.37	6.0	0.83
6 1/16	3 9/16	13/16	32.0	9.40	46.1	2.22	15.2	17.3	1.36	5.5	0.82
6	3½	¾	29.4	8.63	42.1	2.21	14.0	15.4	1.34	4.9	0.81
6⅛	3⅝	11/16	28.1	8.25	43.2	2.29	14.1	16.3	1.41	5.0	0.84
6 1/16	3 9/16	⅝	25.4	7.46	38.9	2.28	12.8	14.4	1.39	4.4	0.82
6	3½	9/16	22.8	6.68	34.6	2.28	11.5	12.6	1.37	3.9	0.81
6⅛	3⅝	½	21.1	6.19	34.4	2.36	11.2	12.9	1.44	3.8	0.84
6 1/16	3 9/16	7/16	18.4	5.39	29.8	2.35	9.8	11.0	1.43	3.3	0.83
6	3½	⅜	15.7	4.59	25.3	2.35	8.4	9.1	1.41	2.8	0.83
5⅛	3⅜	13/16	28.4	8.33	28.7	1.86	11.2	14.4	1.31	4.8	0.76
5 1/16	3 5/16	¾	26.0	7.64	26.2	1.85	10.3	12.8	1.30	4.4	0.74
5	3¼	11/16	23.7	6.96	23.7	1.84	9.5	11.4	1.28	3.9	0.73
5⅛	3⅜	⅝	22.6	6.64	24.5	1.92	9.6	12.1	1.35	3.9	0.76
5 1/16	3 5/16	9/16	20.2	5.94	21.8	1.91	8.6	10.5	1.33	3.5	0.75
5	3¼	½	17.9	5.25	19.2	1·91	7.7	9.1	1.31	3.0	0.74
5⅛	3⅜	7/16	16.4	4.81	19.1	1.99	7.4	9.2	1.38	2.9	0.77
5 1/16	3 5/16	⅜	14.0	4.10	16.2	1.99	6.4	7.7	1.37	2.5	0.76
5	3¼	5/16	11.6	3.40	13.4	1.98	5.3	6.2	1.35	2.0	0.75
4⅛	3 3/16	¾	23.0	6.75	15.0	1.49	7.3	11.2	1.29	4.0	0.68
4 1/16	3⅛	11/16	20.9	6.14	13.5	1.48	6.7	10.0	1.27	3.6	0.67
4	3 1/16	⅝	18.9	5.55	12.1	1.48	6.1	8.7	1.25	3.2	0.66
4⅛	3 3/16	9/16	18.0	5.27	12.7	1.55	6.2	9.3	1.33	3.2	0.68
4 1/16	3⅛	½	15.9	4.66	11.2	1.55	5.5	8.0	1.31	2.8	0.67
4	3 1/16	7/16	13.8	4.05	9.7	1.55	4.8	6.7	1.29	2.4	0.66
4⅛	3 3/16	⅜	12.5	3.66	9.6	1.62	4.7	6.8	1.36	2.3	0.69
4 1/16	3⅛	5/16	10.3	3.03	7.9	1.62	3.9	5.5	1.34	1.8	0.68
4	3 1/16	¼	8.2	2.41	6.3	1.62	3.1	4.2	1.33	1.4	0.67
3 1/16	2¾	9/16	14.3	4.18	5.3	1.12	3.4	5.7	1.17	2.3	0.54
3	2 11/16	½	12.6	3.69	4.6	1.12	3.1	4.9	1.15	2.0	0.53
3 1/16	2¾	7/16	11.5	3.36	4.6	1.17	3.0	4.8	1.19	1.9	0.55
3	2 11/16	⅜	9.8	2.86	3.9	1.16	2.6	3.9	1.17	1.6	0.54
3 1/16	2¾	5/16	8.5	2.48	3.6	1.21	2.4	3.6	1.21	1.4	0.56
3	2 11/16	¼	6.7	1.97	2.9	1.21	1.9	2.8	1.19	1.1	0.55

PART II

CASTINGS AND MISCELLANEOUS PRODUCTS
ORNAMENTAL CAST AND WROUGHT
IRON WORK

Section 1

Safe Loads of Cast Iron Columns
Cast Iron Column Bases and Details
Cast Iron Bases and Caps
Ornamental Columns, Pilasters and Caps
Cast Iron Separators, Plates and Washers

Section 2

Coal Hole and Catch Basin Rings and Covers, Light and
    Heavy
Catch Basin Frames and Covers, Light and Heavy
Manhole Frames and Covers, Trap and Drip Pan
Special Frames and Covers
Waterpipe Specials
Cleanout Doors, Smokestacks, Coal Chutes and Sidewalk
    Doors, Stoves, Boiler Arches and Grates, Chimney
    Caps, and Vents
Corner Guards, Thresholds
Cast Iron Spandrels and Sills
Cast Iron Letters
Miscellaneous Wrought and Cast Anchors, Hinges and
    Stirrups
Flag Poles, Sockets and Bases
Stairways, Handrail Brackets and Railings, Fire Escapes
Gates, Fences and Grilles
Door Frames, Guards
Area Grates, Anchors and Bolts
Prisons and Prison Equipment
Machinery
See Index

EXPLANATION OF TABLES ON SAFE LOADS FOR CAST IRON COLUMNS

The loads in these tables are based on the following formulæ:

$$p = \frac{80000}{1 + \dfrac{(12L)^2}{800d^2}} \quad \text{for round columns.}$$

$$p = \frac{80000}{1 + \dfrac{3(12L)^2}{3200d^2}} \quad \text{for rectangular columns.}$$

In which —

p = pressure in pounds per square inch.

L = length in feet.

d = outside diameter or least side of rectangle in inches.

Factor of safety, 8.

It is assumed that the columns are set with the care usual in building work, that the bases have a square bearing, and that the ends of the shafts are accurately turned to a true plane.

For diameters or lengths intermediate of those given in the table, the loads may be found by interpolation.

For practical purposes it may be assumed that the loads diminish in the same proportion as the thickness of the metal, the outer diameter remaining the same; but where the thickness is increased special calculations will be necessary unless the new thickness is less than ⅛ of the outside diameter.

SAFE LOAD IN POUNDS FOR ROUND HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Outside Diameter	Thickness of Metal	Length of Column in Feet.							
		6	**7**	**8**	**9**	**10**	**11**	**12**	**13**
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
4	½	39,000	35,400	31,900	28,800	25,900	.....	.....	.....
	¾	54,400	49,400	44,500	40,000	36,000	.....	.....	.....
	1	67,000	60,800	54,800	49,300	44,400	.....	.....	.....
5	½	56,100	52,300	48,400	44,600	41,100	37,600	34,600	31,400
	¾	79,500	74,000	68,400	63,100	58,100	53,300	49,000	44,400
	1	99,800	92,800	85,900	79,300	73,000	66,900	61,500	55,800
6	¾	104,900	99,300	93,800	88,000	82,400	77,000	71,900	67,300
	1	133,100	126,100	119,000	111,800	104,600	97,800	91,400	85,400
	1¼	158,000	149,600	141,300	132,600	124,300	116,100	108,400	101,400
7	¾	130,000	124,900	119,600	113,400	107,800	101,500	96,100	90,800
	1	166,400	159,800	153,100	145,100	137,900	129,900	123,000	116,100
	1¼	199,300	191,400	183,500	173,900	165,100	155,500	147,400	139,100
8	¾	155,400	150,100	144,800	139,000	133,400	127,500	121,500	115,800
	1	200,300	193,400	186,500	179,000	171,800	164,100	156,500	149,000
	1½	278,800	269,100	259,600	249,300	239,100	228,600	217,900	207,500
9	¾	180,000	174,000	168,900	164,600	159,100	153,100	147,300	141,100
	1	232,500	226,500	220,000	213,000	205,800	197,900	190,400	182,500
	1¼	281,500	274,300	266,300	257,900	249,100	239,600	230,500	221,000
	1¾	368,700	359,300	348,800	337,900	326,400	313,900	302,000	289,500
10	¾	204,600	200,300	195,400	190,300	184,800	178,800	173,000	167,000
	1	265,500	259,900	253,500	246,700	239,600	231,900	224,500	216,800
	1¼	322,600	315,800	308,000	299,900	291,300	281,900	272,800	263,400
	1¾	425,900	416,800	406,500	395,800	384,400	372,000	360,000	347,600
11	1	298,100	292,600	286,800	280,400	273,400	266,300	258,400	250,600
	1¼	364,500	356,600	349,400	340,300	333,100	324,500	314,900	305,400
	1½	424,800	416,900	408,500	397,900	389,500	379,400	368,300	357,000
	2	536,500	526,600	516,000	502,600	492,000	479,300	465,100	451,000
12	1	329,500	324,800	318,800	313,600	306,300	299,400	292,000	284,300
	1¼	402,700	396,900	389,600	383,300	374,400	365,900	357,000	347,500
	1½	472,300	465,500	458,300	449,500	438,900	429,100	418,600	407,500
	2	600,000	591,400	581,800	570,900	557,600	545,000	531,800	517,600
13	1	362,600	357,900	353,100	347,000	340,900	333,900	326,800	319,300
	1¼	443,800	438,000	432,300	424,800	417,300	408,600	400,000	390,800
	1½	521,300	514,500	507,800	499,000	490,100	480,000	469,900	459,000
	2	665,000	656,400	647,800	636,500	625,300	612,300	599,400	585,500
14	1	395,800	391,100	386,500	381,400	374,300	368,100	361,000	354,300
	1¼	484,800	479,100	473,500	467,100	458,400	450,900	442,100	434,100
	1½	569,600	563,000	556,300	549,000	538,600	529,900	519,500	510,000
	2	729,100	720,600	712,100	702,800	690,500	678,300	665,000	652,800
15	1	427,400	423,000	418,500	413,100	406,300	401,500	394,400	387,300
	1¼	523,300	519,100	513,600	506,900	499,500	492,800	484,000	475,300
	1½	618,600	612,400	606,000	598,000	589,300	581,300	570,900	560,500
	2	793,300	785,000	776,900	766,600	755,500	745,300	732,500	718,800
16	1	459,300	453,400	450,400	445,600	439,800	433,900	428,600	421,000
	1¼	564,400	557,300	553,600	547,900	540,600	533,400	526,900	517,500
	1½	665,900	657,400	653,100	646,300	637,800	629,300	621,500	610,400
	2	858,000	847,000	841,500	832,800	821,800	810,800	800,800	786,500

SAFE LOAD IN POUNDS FOR ROUND HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Length of Column in Feet.						Weight of Col. Shaft Lbs. per Lineal foot	Thickness of Metal.	Outside Diameter.
14 Pounds	**16** Pounds	**18** Pounds	**20** Pounds	**22** Pounds	**24** Pounds			
....	....	....	....	....	....	17.20	½	
....	....	....	....	....	....	24.00	¾	4
....	....	....	....	....	....	29.50	1	
29,300	....	....	....	....	....	22.10	½	
41,400	....	....	....	....	....	31.30	¾	5
52,000	....	....	....	....	....	39.30	1	
62,600	54,300	....	....	....	....	39.00	¾	
79,500	68,900	....	....	....	....	49.10	1	6
94,400	81,900	....	....	....	....	58.30	1¼	
85,600	76,000	67,300	59,500	52,600	47,500	46.00	¾	
109,600	97,400	86,000	76,100	67,400	60,800	59.00	1	7
131,300	116,000	103,600	91,100	80,800	72,900	70.60	1¼	
110,100	99,500	89,300	80,500	72,400	65,100	53.40	¾	
141,900	127,900	115,000	103,600	93,300	83,900	69.10	1	8
197,600	178,000	160,000	144,400	129,800	116,800	95.80	1½	
135,400	123,900	113,000	102,800	93,500	85,300	60.70	¾	
175,000	160,300	146,100	132,900	121,000	110,300	78.60	1	
211,900	194,000	176,900	160,900	146,500	133,500	95.10	1¼	9
277,500	254,100	231,600	210,800	191,900	174,900	124.36	1¾	
161,000	149,000	137,600	126,800	116,100	107,600	68.00	¾	
209,000	193,400	178,500	164,400	150,600	139,600	88.40	1	
253,900	235,000	217,000	199,800	183,000	169,800	107.40	1¼	10
335,100	310,100	286,600	263,600	241,500	224,000	142.00	1¾	
243,100	227,400	211,800	196,400	182,600	168,900	98.20	1	
296,300	277,100	258,300	244,500	223,500	205,800	120.10	1¼	
346,400	321,800	301,700	285,800	260,300	240,600	140.00	1½	11
437,500	409,300	381,000	361,000	328,800	304,000	176.80	2	
276,500	261,000	245,100	229,600	214,500	200,100	108.00	1	
338,000	319,000	299,600	280,600	262,300	244,900	131.40	1¼	
396,400	374,100	351,300	329,000	307,500	287,100	154.70	1½	12
503,500	475,300	446,300	418,000	390,500	364,600	195.80	2	
311,800	295,800	279,800	264,100	248,500	233,300	117.53	1	
381,500	362,000	343,000	323,500	304,400	285,300	144.20	1¼	
448,100	425,100	402,000	379,800	357,500	335,100	169.40	1½	13
571,800	542,400	513,000	484,500	456,000	427,500	216.00	2	
346,600	330,800	313,900	298,600	283,300	266,900	128.10	1	
424,600	405,500	386,000	365,800	347,000	326,900	156.50	1¼	
498,900	478,400	454,300	429,800	407,600	384,100	184.10	1½	14
638,600	560,500	581,000	551,500	521,900	493,000	235.70	2	
381,300	364,100	349,300	333,300	317,000	300,900	137.50	1	
467,800	448,300	428,600	409,100	390,100	369,300	169.40	1¼	
550,000	527,100	505,600	482,500	458,800	435,500	198.90	1½	15
707,500	678,000	648,300	618,600	588,100	558,400	255.30	2	
413,900	399,100	383,300	367,600	351,500	335,000	147.30	1	
508,800	490,800	471,100	452,000	432,100	411,900	181.00	1¼	
600,100	578,900	555,800	534,400	509,800	485,800	213.50	1½	16
773,300	745,800	716,100	687,000	656,800	625,900	274.90	2	

SAFE LOAD IN POUNDS FOR SQUARE HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Side of Square	Thickness of Metal	Length of Column in Feet.							
		6	7	8	9	10	11	12	13'
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
4	1/2	53,800	49,500	45,400	41,500		......	......	......
	3/4	75,000	69,000	63,300	57,900		......	......	......
5	5/8	91,500	86,400	81,300	76,100	71,000	66,000	61,500	57,100
	3/4	106,400	100,600	94,600	88,600	82,800	77,000	71,800	66,600
	7/8	120,800	114,100	107,300	100,400	93,600	87,100	81,300	75,500
6	3/4	138,800	132,800	127,300	121,000	115,000	108,300	102,100	96,500
	1	176,300	168,500	161,300	153,800	146,000	137,500	129,800	122,500
	1 1/4	209,300	200,100	191,500	182,600	173,400	163,300	154,100	145,500
7	3/4	170,600	165,000	159,400	153,300	147,000	140,600	134,100	128,000
	1	218,400	211,500	204,000	196,100	188,100	180,000	171,600	163,800
	1 1/4	261,600	253,400	244,400	236,300	225,400	215,600	205,600	196,300
8	3/4	202,000	197,100	191,600	185,600	179,400	173,100	166,600	160,900
	1	260,000	253,800	246,800	239,000	231,000	223,000	214,500	207,300
	1 1/4	313,500	305,900	297,400	288,100	278,500	268,800	258,600	249,800
9	3/4	233,200	228,600	223,600	218,100	211,900	205,800	199,500	193,400
	1	302,100	295,600	289,300	282,000	274,000	266,000	258,000	250,000
	1 1/2	424,200	415,600	406,800	396,600	385,400	374,100	362,900	351,600
10	3/4	264,400	260,100	255,300	249,800	244,500	237,600	232,000	225,800
	1	342,900	337,500	331,300	324,000	317,300	308,300	301,000	293,000
	1 1/2	485,800	477,500	469,300	459,000	449,500	436,800	426,500	415,000
	2	609,600	600,000	588,800	576,000	564,000	548,000	535,100	506,800
11	3/4	295,600	291,700	286,800	281,800	276,500	271,000	263,300	258,300
	1	384,500	379,500	373,000	366,500	360,000	352,500	343,000	336,000
	1 1/2	547,900	540,800	531,500	522,300	513,000	502,400	488,800	478,800
	2	692,100	683,100	671,400	659,600	648,000	634,500	617,400	604,900
12	3/4	326,100	322,400	318,100	313,500	308,400	302,900	297,400	294,900
	1	425,100	420,300	414,800	408,600	402,000	394,900	387,800	379,500
	1 1/2	608,800	601,600	593,800	585,100	575,600	565,400	555,300	543,400
	2	773,000	764,000	754,000	734,000	731,000	718,000	705,000	690,000
13	1	466,300	461,400	456,100	452,400	445,300	437,400	430,300	423,000
	1 1/4	570,600	564,800	558,900	553,800	544,900	535,400	526,500	517,800
	1 1/2	670,100	663,300	658,900	650,400	640,000	628,800	618,400	~608,100
	2	854,800	845,900	837,100	829,400	816,300	801,900	788,800	775,500
14	1	507,000	503,800	497,900	492,000	486,300	479,800	472,500	465,400
	1 1/2	731,300	726,600	718,100	709,800	701,300	691,900	681,600	671,300
	2	936,000	930,000	919,300	908,400	897,600	885,500	872,500	859,300
15	1	548,100	543,900	538,300	533,400	527,800	521,500	514,500	508,300
	1 1/2	792,800	786,600	778,600	771,400	763,400	754,300	744,100	735,000
	2	1,017,900	1,010,000	999,800	990,600	980,300	968,500	955,500	943,800
16	1	588,000	584,300	581,300	575,300	569,300	564,000	557,300	550,500
	2	1,097,600	1,090,600	1,085,000	1,073,800	1,062,600	1,052,800	1,040,300	1,027,600
17	1	628,800	625,600	621,500	616,000	611,300	605,600	599,300	593,600
	2	1,179,000	1,173,000	1,165,500	1,155,000	1,146,000	1,135,500	1,123,500	1,113,000
18	1	669,800	666,400	662,100	657,000	652,800	646,900	640,900	635,000
	2	1,260,900	1,254,500	1,246,400	1,236,800	1,228,700	1,217,600	1,206,400	1,195,300
19	1	710,100	706,500	702,900	698,400	693,900	688,500	682,300	676,800
	2	1,341,000	1,334,500	1,327,800	1,319,300	1,310,800	1,300,500	1,287,400	1,278,400
20	1	750,500	746,800	743,900	739,100	734,400	729,600	723,900	718,300
	2	1,420,000	1,414,800	1,409,400	1,400,400	1,391,400	1,382,400	1,371,600	1,360,800

SAFE LOAD IN POUNDS FOR SQUARE HOLLOW CAST IRON COLUMNS WITH SQUARE ENDS

Length of Column in Feet.						Weight lbs. of Column per foot of Length.	Thickness of Metal.	Side of Square.
14 Pounds	**16** Pounds	**18** Pounds	**20** Pounds	**22** Pounds	**24** Pounds			
....	....	....	....	....	....	21.8	½	4
....	....	....	....	....	....	30.4	¾	
53,100	....	....	....	....	....	34.2	⅝	⁞ 5
62,000	....	....	....	....	....	39.8	¾	
70,000	....	....	....	....	....	45.1	⅞	
90,800	80,400	71,100	....	....	....	49.2	¾	6
115,300	102,000	90,200	....	....	....	62.5	1	
136,900	121,100	107,100	....	....	....	74.2	1¼	
121,600	110,100	98,800	89,200	79,700	72,400	58.6	¾	7
155,500	140,000	126,600	114,200	102,600	92,700	75.0	1	
186,500	168,900	151,900	136,900	122,800	111,000	89.8	1¼	
153,900	141,100	129,100	117,300	107,300	98,100	68.0	¾	8
198,000	181,600	166,200	151,500	138,200	126,300	87.5	1	
238,800	219,000	200,400	182,600	166,600	152,200	105.5	1¼	
187,100	173,200	160,600	148,500	136,700	126,200	77.3	¾	9
242,000	224,000	207,600	192,000	176,700	163,200	100.0	1	
340,400	315,000	292,000	270,000	248,600	229,500	140.6	1½	
219,600	206,000	193,200	180,000	167,500	155,400	86.7	¾	10
284,900	267,200	250,600	233,500	217,400	201,600	112.5	1	
403,500	378,600	355,100	330,800	308,000	285,600	159.4	1½	
506,400	475,200	445,600	415,200	386,300	358,400	200.0	2	
252,100	239,500	225,600	212,500	199,500	186,000	96.1	¾	11
328,000	311,500	293,500	276,500	259,500	242,500	125.0	1	
467,400	443,700	418,100	393,700	368,700	345,000	178.1	1½	
590,400	560,700	528,200	497,500	467,100	436,500	225.0	2	
284,400	272,100	259,500	246,400	232,200	219,400	105.5	¾	12
370,800	354,700	338,200	321,200	303,000	285,500	137.5	1	
530,800	508,000	484,400	459,800	433,900	408,700	196.6	1½	
673,800	645,000	615,000	584,000	551,000	519,000	250.0	2	
415,800	398,400	381,000	363,000	345,600	328,500	150.0	1	13
508,900	487,600	466,400	444,200	423,000	402,500	183.6	1¼	
597,800	572,700	547,700	521,900	496,700	472,600	215.6	1½	
762,300	730,400	698,500	665,500	633,700	602,700	275.0	2	
458,300	444,600	425,100	406,900	390,000	372,500	162.5	1	14
661,300	641,200	613,100	586,900	562,500	537,100	234.4	1½	
846,000	820,700	784,700	751,200	720,000	687,600	300.0	2	
500,500	485,100	468,200	451,500	433,200	415,700	175.0	1	15
723,900	701,600	677,400	653,000	626,700	601,400	253.2	1½	
929,500	900,900	869,700	838,500	804,700	772,200	325.0	2	
543,800	528,700	512,200	495,000	477,700	459,700	187.5	1	16
1,015,000	987,000	956,200	924,000	891,600	858,200	350.0	2	
585,600	572,000	555,200	539,200	521,600	504,000	193.8	1	17
1,098,000	1,072,300	1,041,000	1,011,000	978,000	945,000	374.4	2	
628,100	614,500	599,200	582,200	565,200	548,200	212.5	1	18
1,182,400	1,156,700	1,128,000	1,096,000	1,064,000	1,032,000	400.0	2	
670,500	656,100	641,600	626,400	609,200	593,100	225.0	1	19
1,266,500	1,239,200	1,212,100	1,183,200	1,150,900	1,120,200	425.0	2	
712,500	699,200	685,000	669,700	652,600	636,500	237.5	1	20
1,350,000	1,324,700	1,297,700	1,269,000	1,236,600	1,206,000	450.0	2	

SAFE LOADS IN POUNDS FOR RECTANGULAR CAST IRON COLUMNS

Size in Inches.	Thickness of Metal.	6	7	8	9	10	11	12	13
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
4 x 6	¾ 1 1¼	98,000 123,000 143,800	90,300 113,300 132,500	82,800 103,800 121,300	75,800 95,000 111,400	69,100 86,800 101,400	63,100 79,300 92,800	57,500 72,300 84,600	52,600 66,000 77,400
4 x 8	¾ 1 1¼	121,100 153,800 182,600	111,400 141,500 168,000	102,100 129,800 154,100	93,500 118,800 141,000	85,400 108,500 128,900	78,000 99,000 117,500	71,100 90,300 107,100	65,000 82,500 98,000
4 x 10	¾ 1 1¼	143,800 184,500 221,000	132,500 169,800 203,400	121,300 155,800 186,500	111,400 142,500 170,800	101,400 130,100 156,000	92,800 118,800 142,300	84,600 108,400 129,800	77,400 99,000 118,600
5 x 7	¾ 1 1¼	131,500 167,000 198,300	124,400 158,000 187,600	117,000 148,500 176,300	109,500 139,000 165,000	102,100 129,800 154,100	95,000 120,800 143,400	88,600 112,500 133,600	82,300 104,500 124,000
5 x 12	¾ 1 1¼	194,100 250,500 302,600	183,600 237,000 286,300	172,600 222,800 269,100	161,600 208,500 251,900	150,900 194,600 235,100	140,400 181,100 218,800	130,800 168,800 203,900	121,500 156,800 189,400
6 x 8	¾ 1 1¼	165,300 211,500 253,300	158,000 202,100 242,300	151,100 193,500 231,800	144,100 184,500 221,000	136,900 175,000 209,900	128,900 165,000 197,600	121,600 155,600 186,500	114,900 147,000 176,100
6 x 12	⅜ 1 1¼	218,100 282,000 341,500	208,500 269,600 326,500	199,500 258,000 312,500	190,300 246,000 297,900	180,600 233,600 282,900	170,100 220,000 266,400	160,600 207,600 251,400	151,600 -,196,000 237,400
7 x 10	¾ 1 1¼	213,900 276,000 333,500	204,900 264,400 319,500	200,000 258,000 311,800	190,100 245,300 296,400	182,300 235,100 284,100	174,400 225,000 271,900	166,300 214,500 259,100	158,600 204,800 247,400
7 x 12	¾ 1 1¼	241,500 312,800 379,500	231,400 299,600 363,500	225,800 292,400 354,800	214,600 278,000 337,300	205,800 266,500 323,300	196,900 255,000 309,400	187,600 243,100 294,900	180,300 232,000 281,500
8 x 12	¾ 1 1¼	257,800 334,400 406,500	251,500 326,300 396,500	244,500 317,300 385,500	236,900 307,400 373,500	228,900 297,000 360,900	221,000 286,600 348,400	212,600 275,900 335,300	205,400 266,900 323,600
8 x 16	¾ 1 1¼	313,500 408,600 499,300	305,900 398,800 487,100	297,400 387,800 473,600	288,100 375,600 458,900	278,400 363,000 443,400	268,800 350,300 425,500	258,600 337,100 411,900	249,800 325,600 397,600
9 x 12	¾ 1 1¼	275,600 358,100 435,900	270,300 351,000 427,300	264,500 343,400 418,000	257,800 334,900 407,600	250,500 325,400 396,000	243,100 315,900 384,500	235,900 306,400 372,900	228,600 296,900 361,400
9 x 16	¾ 1 1¼	332,300 433,500 530,100	325,600 425,000 519,600	318,600 415,900 508,400	310,600 405,600 495,800	301,900 393,800 481,600	293,000 382,400 467,600	284,300 370,900 453,500	275,400 359,400 439,500
10 x 16	¾ 1 1¼	350,000 457,300 559,600	344,500 450,000 550,800	338,100 441,300 540,500	331,100 432,600 529,400	323,400 422,400 517,000	315,600 412,300 504,500	307,300 401,400 491,300	299,000 390,600 478,100
10 x 20	⅜ 1 1¼	407,300 533,400 654,900	400,800 525,000 644,500	393,300 515,300 632,500	385,300 504,800 619,700	376,300 492,800 605,000	367,100 480,900 590,400	357,500 468,300 574,900	347,900 455,800 559,500
12 x 16	1 1¾	502,500 828,500	496,600 818,700	490,000 808,300	483,000 796,400	475,100 783,500	466,600 769,600	458,300 755,800	448,500 739,600
12 x 24	1 1¾	657,000 1,099,100	649,400 1,086,300	640,900 1,072,100	631,500 1,056,500	621,300 1,039,400	610,300 1,020,900	599,300 1,002,400	586,500 981,100

SAFE LOADS IN POUNDS FOR RECTANGULAR CAST IRON COLUMNS.

Length of Column in Feet.						Weight of Column Shaft per Lineal Foot.	Thickness of Metal.	Size in Inches.
14 Pounds	**16** Pounds	**18** Pounds	**20** Pounds	**22** Pounds	**24** Pounds			
48,000	....	....	....	....	....	39.8	¾	4
60,300	....	....	....	....	....	50.0	1	x
70,600	59,300	....	....	....	....	58.6	1¼	6
59,300	49,800	42,100	35,900	....	....	49.2	¾	4
75,300	63,300	53,500	45,500	....	....	62.5	1	x
89,400	75,100	63,500	53,800	....	....	74.2	1¼	8
70,600	59,300	50,000	42,600	....	....	58.6	¾	4
90,300	75,900	64,300	54,600	....	....	75.0	1	x
108,100	90,900	76,900	65,400	....	....	89.8	1¼	10
76,400	66,000	57,100	49,800	43,800	38,300	49.2	¾	5
97,000	83,800	72,500	63,300	55,500	48,500	62.5	1	x
115,100	99,500	86,100	75,300	65,900	57,600	74.2	1¼	7
112,800	97,400	84,300	73,500	64,500	56,400	72.7	¾	5
145,500	125,600	108,800	94,900	83,300	72,800	93.8	1	x
175,800	151,800	131,400	114,600	100,500	87,900	113.3	1¼	12
108,000	95,500	84,500	75,000	66,800	59,300	58.6	¾	6
138,300	122,400	108,300	96,000	85,500	75,900	75.0	1	x
165,600	146,600	129,600	115,000	102,400	90,900	89.8	1¼	8
142,600	126,300	111,600	99,000	88,100	78,300	77.3	¾	6
184,400	163,300	144,400	128,000	114,000	101,300	100.0	1	x
223,300	197,600	174,900	155,000	138,000	122,500	121.1	1¼	12
151,500	136,600	122,600	110,600	99,400	89,800	72.7	¾	7
194,500	176,300	158,300	142,900	128,300	115,900	93.8	1	x
235,100	213,000	191,300	172,600	155,000	140,000	113.3	1¼	10
170,300	154,300	138,500	125,000	112,300	101,400	82.0	¾	7
220,600	199,800	179,400	161,900	145,400	131,400	106.3	1	x
267,600	242,400	217,600	196,500	176,400	159,400	128.9	1¼	12
196,400	180,000	164,800	150,300	137,000	125,300	86.7	¾	8
254,500	233,500	213,800	294,900	177,800	162,500	112.5	1	x
309,500	283,900	259,800	236,800	216,000	197,400	136.7	1¼	12
238,800	218,900	200,400	182,600	166,600	152,300	105.5	¾	8
311,300	285,500	261,300	238,100	217,300	198,500	137.5	1	x
379,300	348,800	319,100	290,900	265,400	242,500	168.0	1¼	16
221,300	204,800	189,800	175,500	161,600	149,100	91.4	¾	9
287,400	266,000	246,500	228,000	210,000	193,800	118.8	1	x
349,800	323,800	300,000	277,500	255,500	235,900	144.5	1¼	12
266,600	246,800	228,600	211,500	194,800	179,600	110.2	¾	9
347,800	322,000	298,400	276,000	254,100	234,600	143.8	1	x
425,400	393,800	364,900	337,500	310,800	286,900	175.8	1¼	16
290,400	272,900	255,300	238,400	222,400	207,100	114.8	¾	10
379,300	356,400	333,600	311,100	290,400	270,600	150.0	1	x
464,100	436,300	408,300	381,100	355,400	331,300	183.6	1¼	16
337,900	317,400	297,100	277,300	258,600	241,000	133.6	¾	10
442,400	415,800	389,300	363,300	338,800	315,800	175.0	1	x
543,100	510,800	477,800	446,000	415,900	387,600	214.9	1¼	20
438,100	419,300	399,800	379,600	358,100	337,400	162.5	1	12
722,500	691,500	659,400	626,000	590,600	556,400	268.0	1¾	16
572,900	548,300	523,000	496,400	468,400	441,100	212.5	1	12
958,400	917,100	874,500	830,400	783,800	738,000	355.5	1¾	24

BASES FOR CAST IRON COLUMNS

Size of Column	Thickness of Metal	Size of Plate (Ordinary Masonry)	Weight	Size of Plate (Cut Stone)	Weight
5	¾	14 x 14 x 1¾	90 lbs.	10 x 10 x 1½	40 lbs.
5	1	16 x 16 x 2¼*	110 "	12 x 12 x 2	75 "
6	¾	16 x 16 x 2*	105 "	12 x 12 x 1¾	65 "
6	1	18 x 18 x 2½*	165 "	14 x 14 x 2¼	115 "
7	¾	18 x 18 x 2¼*	140 "	14 x 14 x 2	105 "
7	1	20 x 20 x 2½*	205 "	16 x 16 x 2½*	135 "
8	¾	20 x 20 x 2¾*	230 "	16 x 16 x 2¼*	125 "
8	1¼	24 x 24 x 6	330 "	18 x 18 x 2¾*	185 "
9	1	24 x 24 x 6	270 "	18 x 18 x 2½*	175 "
9	1½	30 x 30 x 8	555 "	20 x 20 x 2¾*	235 "
10	1	28 x 28 x 7	360 "	20 x 20 x 2¾*	235 "
10	1½	32 x 32 x 10	715 "	24 x 24 x 6	370 "
11	1	30 x 30 x 8	420 "	24 x 24 x 6	270 "
11	1½	36 x 36 x 10	840 "	28 x 28 x 7	490 "
12	1	32 x 32 x 10	515 "	28 x 28 x 7	360 "
12	1½	38 x 38 x 12	1020 "	30 x 30 x 8	570 "

Bases marked thus * are beveled to ½ thickness shown.

Bases of greater thickness than 2¾" will be ribbed.

Above sizes are based on a pressure of 250 pounds per square inch for masonry and 500 pounds per square inch for cut stone.

Sizes given can be varied for allowable load on concrete from 250 to 450 pounds per square inch.

Bases for columns less than 8 feet in length and loaded to full safe load and bases for columns of thicker metal than sizes shown by more than ¼ inch will require special calculation.

Thickness of metal in ribbed bases same as thickness of metal in columns.

Weights of ribbed bases are approximate only.

STANDARD CAST IRON COLUMN BASES AND FLANGES
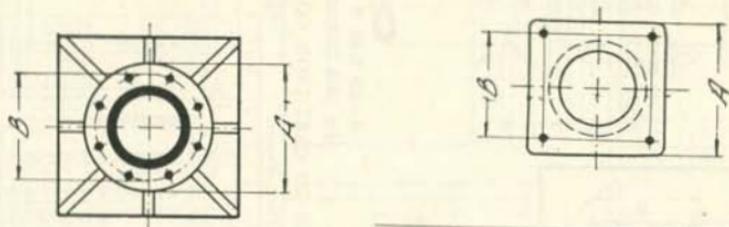
Size of Column	A	B
7	13	10¼
8	14	11¼
9	15	12¼
10	16	13¼
11	17	14¼
12	18	15¼
13	19	16¼
14	20	17¼
15	21	18¼
16	22	19¼

Size of Column	A	B
4	7½	4½
5	8	5⅛
6	9	6
7	9¾	6¾
8	10½	7½
9	11¼	8¼
10	12	9
11	13	9½
12	14	10½
13	14½	11½
14	16	12
15	17	13
16	18	14

DIMENSIONS OF STANDARD PIPE FLANGES
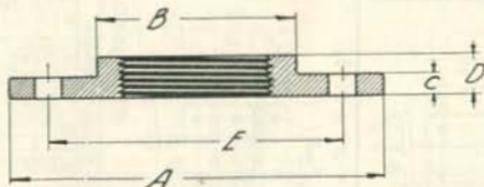
Size of Pipe——Inches	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6	7	8	9	10
A Dia. of Flange	3¾	4	4½	5¼	5¾	6½	7⅞	8⅜	9½	10	10½	11¼	13	14	15¼	16⅜
B Dia. of Hub	1½	1⅞	2¼	2½	3	3 11/16	4¾	4⅞	5½	6	6⅝	7¾	8 11/16	9⅞	11	12 1/16
C Thickness of Flange	7/16	7/16	⅜	⅜	⅜	½	9/16	9/16	⅝	⅝	⅝	11/16	¾	13/16	⅞	15/16
D Height of Flange	¾	11/16	⅞	11/16	1	1⅜	1 1/16	1½	1 1/16	1⅝	1 11/16	1 11/16	1⅞	1 11/16	2 1/16	2¼
E Dia. of Bolt Circle	2⅝	3	3⅜	3⅞	4¾	5½	6½	6⅞	7½	8	8⅝	9¾	10⅞	12	13¼	14¼
Size of Bolts	⅜	⅜	⅜	½	½	⅝	⅝	⅝	¾	¾	¾	¾	¾	¾	¾	¾
No. of Bolts	4	4	4	4	4	4	4	4	4	8	8	8	8	8	12	12

STANDARD CONNECTIONS FOR SINGLE I-BEAMS TO CAST IRON COLUMNS.

5"-6"-7"-8"-9" & 10" Is

12" I

15" I

18"-20" & 24" Is
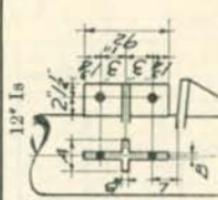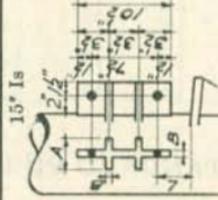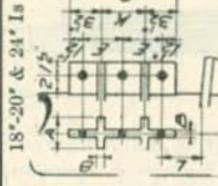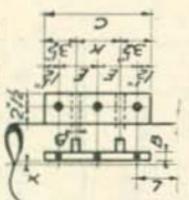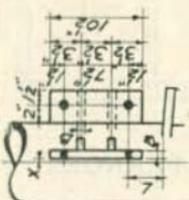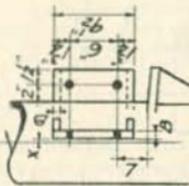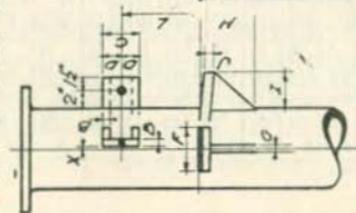
$X = \dfrac{\text{Web Thickness}}{2} + \tfrac{1}{16}''$

Slope of All Beam Seats $\tfrac{1}{2}''$ in 12"

$A = \text{Ctr. to Ctr. of Beams}$
Less (Web Thickness $+ \tfrac{1}{16}''$)

STANDARD CONNECTIONS FOR DOUBLE I-BEAMS TO CAST IRON COLUMNS.

5"-6"-7"-8"-9" & 10" Is

12" Is

15" Is

18"-20" & 24" Is

Distances for Single I-Beams

Size	Wgt.	B.	C.	D.	E.	F.	G.	H.	L.	J.	K.	L.	Maximum Load
5	10.0	5/8	3	1½	..	4	3/4	5	3½	..	..	2½	13200
6	12.5	5/8	3	1½	..	4	3/4	5	3½	..	..	3	13200
7	15.3	3/4	3	1½	..	4	3/8	6	3½	..	..	3	17500
8	18.4	3/4	4	1½	..	5	5/8	6½	4	1	..	3½	18700
9	21.8	3/4	4	..	..	5	5/8	8	4	1	..	4½	18700
10	25.4	3/4	4	2	..	6	5/8	8	4	1	..	4½	24000
12	31.8	7/8	4	2	..	6	1 1/8	10	4	1	..	5	26000
15	40.8	7/8	..	..	..	7	1 1/8	10	4	1	..	3¾	29700
18	42.9	7/8	..	..	..	7	1 3/8	10½	4	1 3/8	..	3¾	35700
20	60.8	1	12	..	4½	7	1 3/8	11½	7	1 3/8	..	4½	37900
20	54.7	1	12	..	4½	7½	1 3/8	11½	7½	1 3/8	..	6.5	41800
24	65.4	1	13	..	5	8	1 3/8	12¼	8	1 3/8	..	6.5	54900
24	79.9	1	15	..	6	8¼	1 3/8	14.4	8¼	1 3/8	..	8.6	59800

Distances for Double I-Beams

A.	B.	C.	D.	E.	F.	G.	H.	J.	L.	K.	L.	Maximum Load
3 3/4	5/8	3	1½	..	6¾	3/4	5	1	3½	..	2½	24000
3 1/8	5/8	3	1½	..	7½	3/4	5	1	3½	..	3	27000
3 1/8	3/4	3	1½	..	8	3/8	6	1	3½	..	3½	30000
4 1/8	3/4	4	2	..	8¼	5/8	6	1	4	..	4	37500
4½	3/4	4	2	..	9½	5/8	8	1	4	..	4½	47000
4½	3/4	4	2	..	10½	5/8	8	1	4	..	5	49000
5¼	7/8	4	2	..	11	1 1/8	10	1	4	..	5	58000
5 1/8	7/8	9½	..	..	11½	1 3/8	10	1 3/8	4	3½	3¾	63500
5¾	7/8	10½	..	..	12	1 3/8	11	1 3/8	4	3½	3¾	71400
6¼	1	10½	..	4½	13	1 3/8	12	1 3/8	4	5	4½	78000
6¼	1	12	..	4½	13	1 3/8	12¾	1 3/8	4	5	4½	88600
6 1/8	1	13	..	5	13½	1 3/8	14	1 3/8	4	6	5	103800
7 1/8	1	15	..	6	15	1½	15	1½	4	8	6	126000

Loads figured at 2000 lbs. per square inch shear on shelf and bracket. All holes cored for 3/4 bolts.

Distances A and F are for standard separator spacing for beams of weight shown.

CAST IRON POST CAPS, BASES AND QUILLS
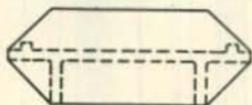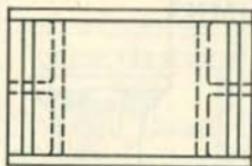
Fig. 1
CAP FOR WOOD POSTS & GIRDERS
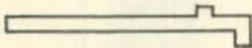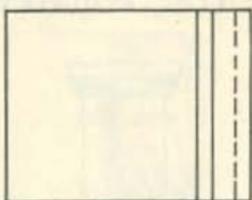
Fig. 2
BEARING PLATE FOR WOOD GIRDER
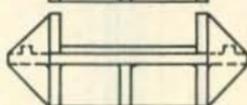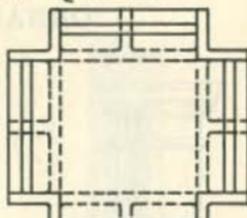
Fig. 3
CAP FOR WOOD POSTS & GIRDERS
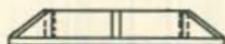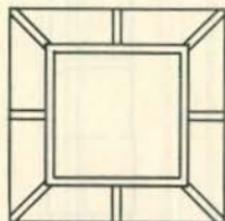
Fig. 4
BASE FOR WOOD POST
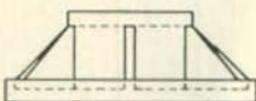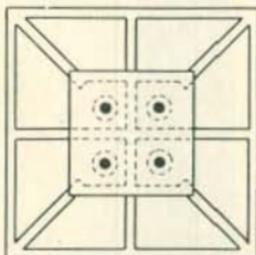
Fig. 5
BASE FOR STEEL COLUMN
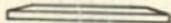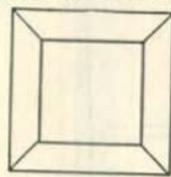
Fig. 6
BASE FOR WOOD POST
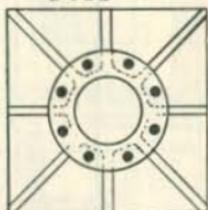
Fig. 7
BASE FOR ROUND CAST IRON COLUMN
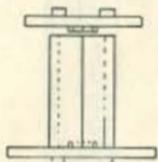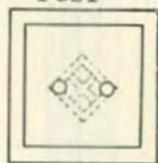
Fig. 8
QUILL FOR WOOD POST & GIRDERS

We have stock patterns for various sizes of post caps, bases and bearing plates for wood posts and wood girders.

ORNAMENTAL ROUND COLUMNS
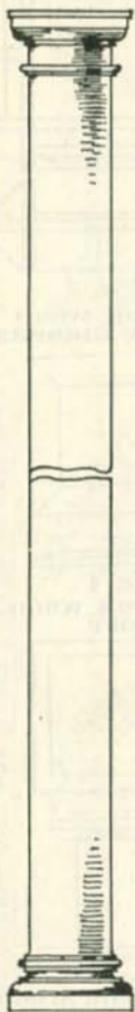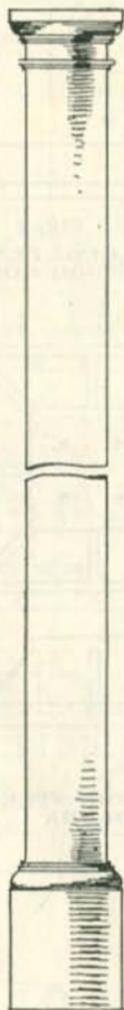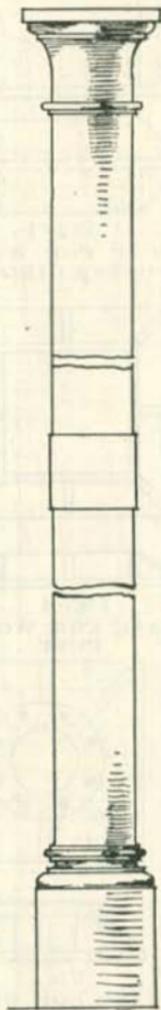
Fig. 9   Fig. 10   Fig. 11

Special Designs Upon Application.

PILASTERS
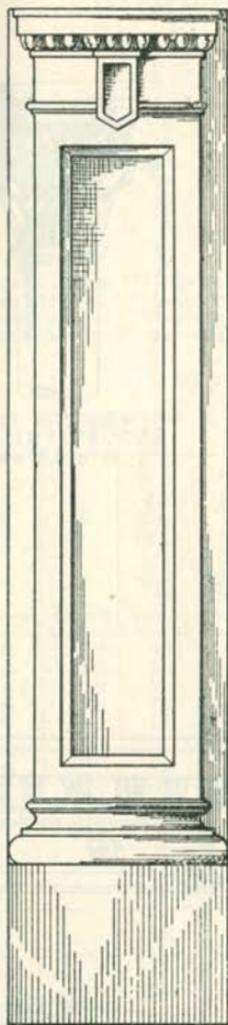
Fig. 12
16½" Face

Fig. 13
18 and 20" Face

Fig. 14
8, 9 and 12" Face

Plain or combed panels in any width or height.
Give width of face, depth and thickness of metal when ordering.
Special Designs Upon Application.

ORNAMENTAL CAPS
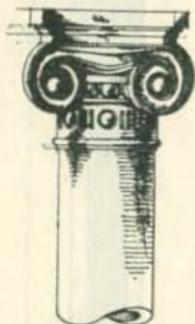
Cap No. 15
7"

Cap No. 16
5" and 7"

Cap No. 17
6", 7", 8", 9", 11", 13",
16" and 6" sq.
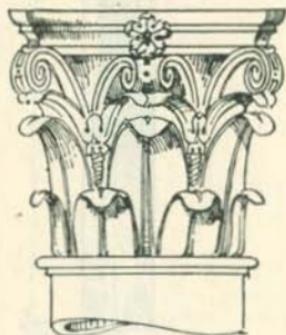
Cap No. 18
Any Size

Cap No. 19
Any Size
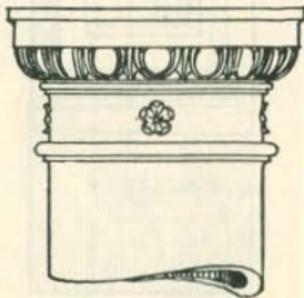
Cap No. 20
Any Size

Sizes indicated are those for which we have patterns. Special designs and sizes upon application.

STANDARD CAST-IRON SEPARATORS
FOR I-BEAMS
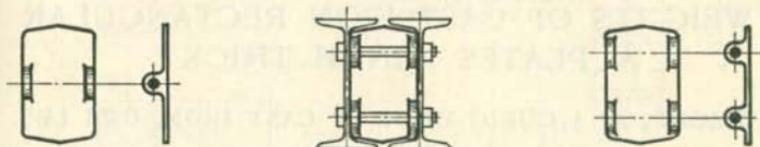
Separators for 12" beams and over are made of 1/2" metal.
Separators for 10" beams and under are made of 3/8" metal.
Separators for 6" beams or under are usually made of 1" gas pipe fastened with 3/4" bolts.
Separators for 3" beams are usually made of 3/4" gas pipe fastened with 5/8" bolts.

SEPARATORS WITH ONE BOLT

BEAMS				BOLTS			WEIGHTS			
Depth	Weight	Out to Out of Flanges of Beams	Center to Center of Beams	Size	Distance Center to Center	Length	Bolts and Nuts	Increase in wt. of Separator Bolts for 1" additional spread of Beams	Separator	Increase in wt. of Separator for 1" additional spread of Beams
Inches	Pounds	Inches	Inches	Inches	Inches	Inches	Pounds	Pounds	Pounds	Pounds
3	5.7	5 5/16	3	5/8	....	4 1/4	0.70	.09	2.	.25
4	7.7	5 5/8	3 1/4	3/4	....	4 1/2	1.13	.125	3.	.40
5	10.0	6 1/2	3 1/2	3/4	....	4 3/4	1.16	.125	3.	.50
6	12.5	7 1/8	4	3/4	....	5 1/4	1.22	.125	4.	.60
7	15.3	7 7/8	4 1/4	3/4	....	5 1/2	1.25	.125	4.	.75
8	18.4	8 1/2	4 1/2	3/4	....	5 3/4	1.28	.125	6.	1.00
9	21.8	9 1/8	5	3/4	....	6 1/4	1.34	.125	7.	1.20
10	25.4	10 1/8	5 1/2	3/4	....	6 3/4	1.40	.125	8.	1.25
12	31.8	10 3/4	5 3/4	3/4	....	7 1/4	1.46	.125	10.	1.50
12	40.8	11 1/4	6	3/4	....	7 1/2	1.49	.125	10.	1.50

SEPARATORS WITH TWO BOLTS

12	31.8	10 3/4	5 3/4	3/4	6	7 1/4	2.92	.250	11.	1.50
12	40.8	11 1/4	6	3/4	6	7 1/2	2.98	.250	11.	1.50
15	42.9	11 3/4	6 1/4	3/4	7 1/2	7 1/2	2.98	.250	15.	1.75
15	60.8	12 3/4	6 3/4	3/4	7 1/2	8 1/2	3.23	.250	15.	1.75
15	81.3	13 5/8	7 1/4	3/4	7 1/2	9	3.35	.250	15.	1.75
18	54.7	12 3/4	6 3/4	3/4	9	8 1/4	3.16	.250	16.	2.75
20	65.4	13 1/4	7	3/4	10	8 1/2	3.23	.250	25.	3.10
20	81.4	14 3/4	7 3/4	3/4	10	9 1/4	3.41	.250	28.	3.10
24	79.9	14 3/4	7 3/4	3/4	12	9 1/4	3.41	.250	32.	5.50

WEIGHTS OF CAST IRON RECTANGULAR PLATES 1 INCH THICK

WEIGHT OF 1 CUBIC INCH OF CAST IRON, 0.26 LBS.

Length in inches	WIDTH IN INCHES												
	4	6	8	10	12	14	16	18	20	24	28	30	36
4	4.16	6.25	8.3	10.4	12.5	14.6	16.6	18.7	20.8	25	29	31	37
5	5.21	7.81	10.4	13.2	15.6	18.2	20.8	23.4	26.0	31	36	39	47
6	6.25	9.37	12.5	15.6	18.7	21.8	25.0	28.1	31.2	38	44	47	56
7	6.29	10.94	14.6	18.2	21.9	25.5	29.2	32.8	36.5	44	51	55	66
8	8.33	12.50	16.6	20.8	25.0	29.2	33.3	37.5	41.6	50	58	62	75
9	9.37	14.06	18.7	23.4	28.1	32.8	37.5	42.2	46.9	56	66	70	84
10	10.42	15.62	20.8	26.0	31.2	36.5	41.7	46.9	52.1	63	73	78	94
11	11.46	17.19	22.9	28.6	34.4	40.1	45.8	51.6	57.3	69	80	86	103
12	12.50	18.75	25.0	31.2	37.5	43.7	50.0	56.2	62.5	75	88	94	112
14	14.58	21.87	29.2	36.5	43.7	51.0	58.3	65.6	72.9	88	102	109	131
16	16.67	25.00	33.3	41.7	50.0	58.3	66.7	75.0	83.3	100	117	125	150
18	18.75	28.12	37.5	46.9	56.2	65.6	75.0	84.4	93.7	112	131	141	169
20	20.83	31.25	41.6	52.1	62.5	72.9	83.3	93.7	104.2	125	146	156	188
22	22.92	34.37	45.8	57.3	68.7	80.2	91.7	103.1	114.6	138	160	172	206
24	25.00	37.50	50.0	62.5	75.0	87.5	100.0	112.5	125.0	150	175	187	225
26	27.08	40.62	54.2	67.7	81.2	94.8	108.3	121.9	135.4	162	190	203	224
28	29.17	43.75	58.3	72.9	87.5	102.1	116.7	131.2	145.8	175	204	219	263
30	31.25	46.87	62.5	78.1	93.7	109.4	125.0	140.6	156.2	187	219	234	281
32	33.33	50.00	66.7	83.3	100.0	116.7	133.3	150.0	166.7	200	233	250	300
34	35.42	53.12	70.8	88.5	106.2	124.0	141.7	159.4	177.1	212	248	266	319
36	37.50	56.25	75.0	93.7	112.5	131.2	150.0	168.7	187.5	225	263	281	337
38	39.58	59.37	79.2	99.0	118.7	138.5	158.3	178.1	197.9	237	277	297	356
40	41.67	62.50	83.3	104.2	125.0	145.8	166.7	187.5	208.3	250	292	312	375
42	43.75	65.62	87.5	109.4	131.2	153.1	175.0	196.9	218.7	262	306	328	394
44	45.83	68.75	91.7	114.6	137.5	160.4	183.3	206.2	229.2	275	321	344	412
46	47.92	71.87	95.8	119.8	143.7	167.7	191.7	215.6	239.6	287	335	359	431
48	50.00	75.00	100.0	125.0	150.0	175.0	200.0	225.0	250.0	300	350	375	450
50	52.08	78.12	104.2	130.2	156.2	182.3	208.3	234.4	260.4	312	365	391	469
52	54.16	81.25	108.3	135.4	162.5	189.6	216.7	243.7	270.8	325	379	406	487
54	56.25	84.37	112.5	140.6	168.7	196.9	225.0	253.1	281.2	337	394	422	506

STANDARD CAST IRON BEVEL WASHERS AND CHECK WASHERS

HOLE CORED TO SUIT THREAD DIAM. OF ROD.

Std. Check Washer No. 1

HOLE CORED TO SUIT THREAD DIAM. OF ROD.

Std. Check Washer No. 2

Std. Bevel Washer.

Wshr No.	Dimensions in Inches of Std. Cast Iron Bevel Washers												Size of Slot Req'd.	Chk. Wshr	Rod Thrd
	A	B	C	D	E	F	G	H	I	J	K	Rad.			
1	2⅜	1 11/16	1⅜	1⅜	1½	1⅜	12	6	12	9	1⅛	4¾	1¼ x 2⅜	1	⅝"
2	2⅜	2	1¾	1½	1½	1⅜	12	9	12	12	1⅛	4¾	1¼ x 3	1	rd.
3	2⅞	2¼	2¼	1⅝	1½	1⅜	12	12	9	12	1⅛	4¾	1¼ x 3½	1	to
4	3⅝	2¾	3½	2¼	1½	1⅜	9	12	6	12	1⅛	4¾	1¼ x 4½	1	1"
5	2⅛	1¾	11/16	1¼	1½	1⅜	12	3	12	6	1⅛	4¾	1¼ x 2½	1	rd.
6	3⅜	2 1/16	1 11/16	1 11/16	2	2	12	6	12	9	1¾	5¾	1⅞ x 3⅞	2	1¼"
7	3¾	2 11/16	2 1/16	2 1/16	2	2	12	9	12	12	1¾	5¾	1⅞ x 4⅜	2	rd.
8	4⅛	3	3	2½	2	2	12	12	9	12	1¾	5¾	1⅞ x 5	2	to
9	5⅛	3 9/16	4¼	3½	2	2	9	12	6	12	1¾	5¾	1⅞ x 6¼	2	1⅝"
10	3	2 1/16	1¼	1 11/16	2	2	12	3	12	6	1¾	5¾	1⅞ x 3½	2	rd.

STANDARD ROUND CAST IRON WASHERS

Size of Bolt Inches	Dimensions in Inches				Approx. Weight Per 100 in lbs.
	A	B	C	D	
½	⅝	2	½	1¼	23
⅝	¾	2½	⅝	1½	70
¾	⅞	3	¾	1⅞	110
⅞	1	3½	⅞	2⅛	150
1	1⅛	4	1	2⅜	200
1⅛	1¼	4½	1⅛	2⅝	265
1¼	1⅜	5	1¼	2⅞	400
1⅜	1½	5½	1⅜	3⅛	462
1½	1⅝	6	1½	3⅜	612
1⅝	1¾	6½	1⅝	3⅝	772
1¾	2	7	1¾	3⅞	936
1⅞	2⅛	7½	1⅞	4¼	1186
2	2¼	7½	2	4½	1288
2¼	2½	7¾	2¼	5	1609

FOUNDRY
of St. Paul Foundry Company

SPECIAL MIXTURES FOR GREY IRON CASTINGS

For ordinary castings, which are not subjected particularly to wear, we produce various mixtures of grey iron, and for some which are subjected to wear, we produce what is called a white iron.

Grey iron castings are used mostly for various machinery parts, sewer castings and structural columns.

By the addition of about 25% of steel, we produce a 'semi-steel' casting which is harder and tougher and will resist wear more (by about 100%) than ordinary grey iron. This mixture is used particularly for bushings, pistons, piston rings, and cylinders.

We also produce a chrome nickel cast iron which is stronger, (transverse tests, cast iron 3500 pounds, chrome nickel cast iron 4600 pounds). These castings are easily machined and are used principally for some railroad castings and many machinery parts.

MEMORANDA

COAL HOLE AND CATCH BASIN RINGS
AND COVERS
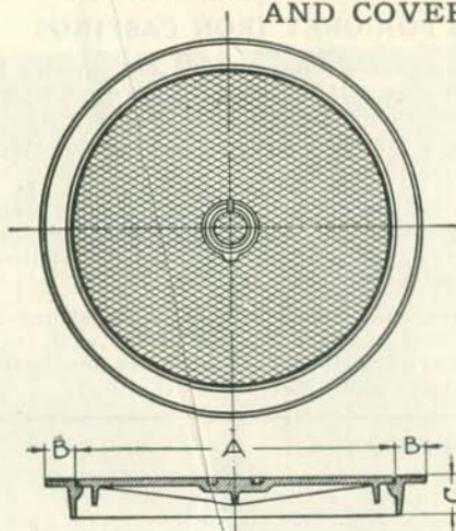
COAL HOLE RINGS AND COVERS

A	B	C
36	3	4
30	3	4
24	2¼	3
20½	2	2¼
18	1¾	2
16	1¾	2
14	2¼	2¼
12	2	2
10	2	2

Stock sizes are in heavy type.

Fig. 21

CATCH BASIN RINGS AND COVERS
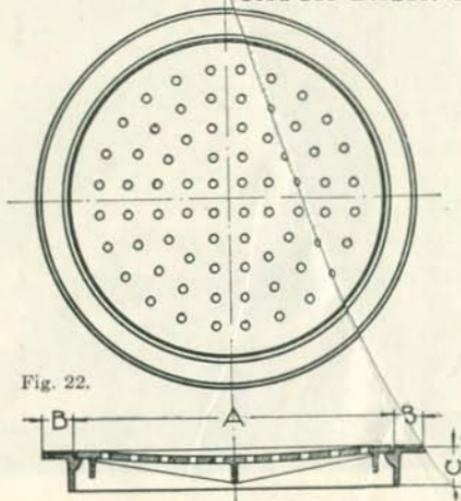
A	B	C
24	2¼	3
20½	2	2¼
18	1¾	2
16	1¾	2
12	2	2
10	2	2
8	1¾	1¾
7	1½	1½
6	1½	1½

Stock sizes are in heavy type

Fig. 22.

Not to be used for Heavy Traffic.

HEAVY STREET RINGS AND COVERS
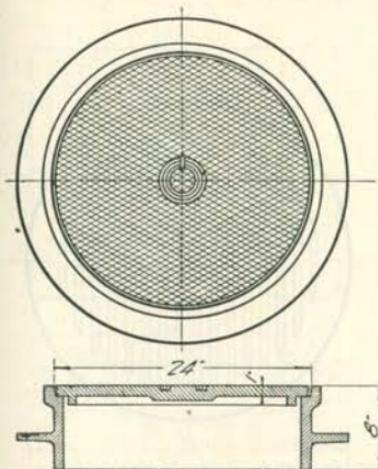
Fig. 23

HEAVY RING AND COVER
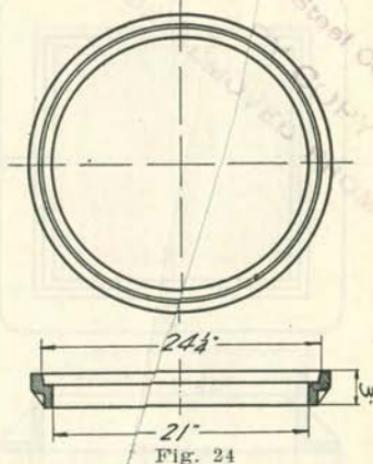
Fig. 24

HEAVY STREET RING

FRAME B.   FRAME A.
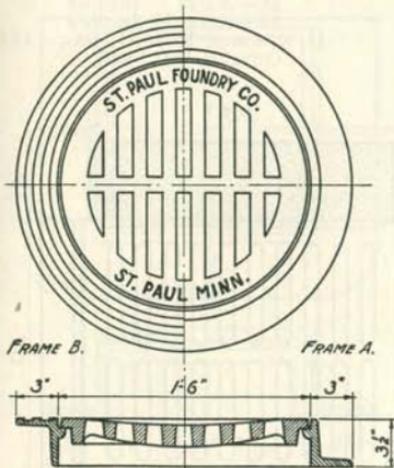
Fig. 25

18" HEAVY RINGS AND COVER
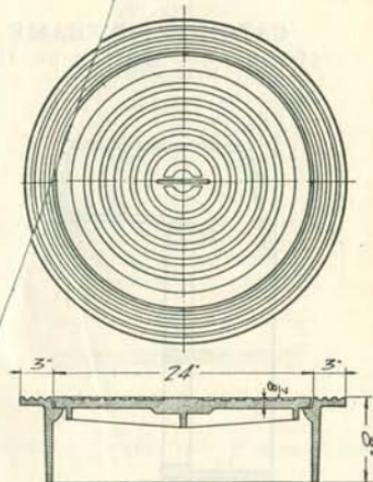
Fig. 26

HEAVY RING AND COVER

Figs. 23 and 26 Covers will fit Frames 35-A, 38 and 24.
Used for Heavy Traffic.

CATCH BASIN FRAMES AND COVERS
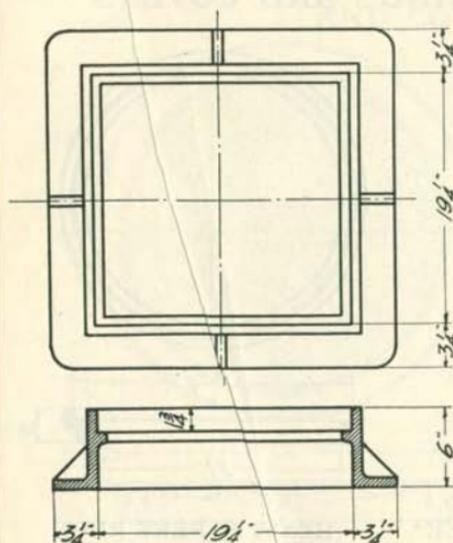
Fig. 27
CATCH BASIN FRAME
Covers 31F and 32-G, page 187 fit
this Frame
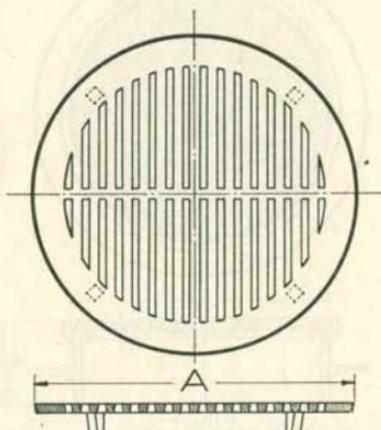
Fig. 28 and 29
28—A=24 inches
29—A=20½ inches
Fits Frames Fig. 21, page 184
Omaha Ry. Std.
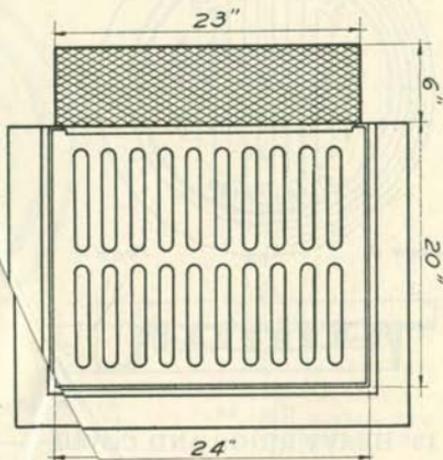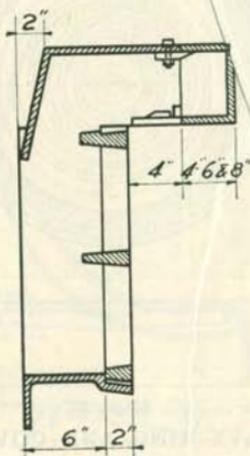
Fig. 30
CURB CATCH BASIN FRAME AND COVER

CATCH BASIN FRAME AND COVERS
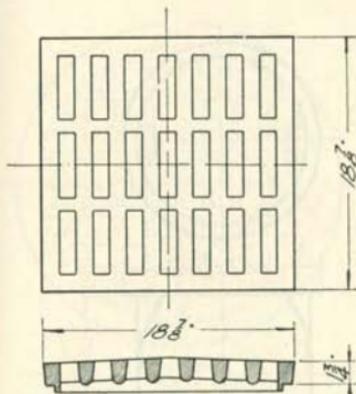
Fig. 31-F

Fig. 32-G

These Covers fit Frames 27, 33-E and 54.

VENTILATED STREET COVER
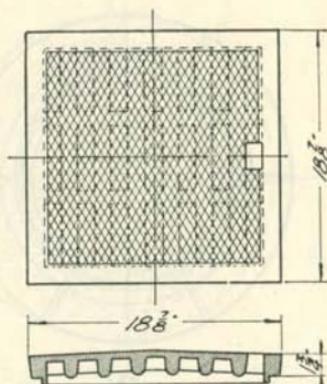
SOLID STREET COVER

Fig. 33-H

Fig. 34-I

This Cover fits Frame 33-H and 54.

CATCH BASIN FRAME

Also pattern 33-E, same as above except end is closed and cover is thicker.

SOLID CURB COVER

The letters indicate that these patterns are City of St. Paul Standards.

MANHOLE FRAMES, TRAP AND DRIP PAN

24"
10½"
27"
37"
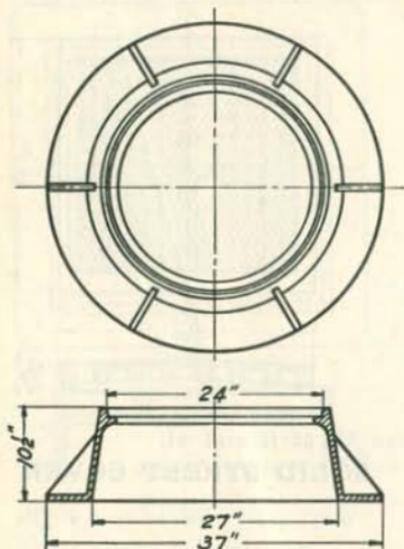
Fig. 35-A
HEAVY MANHOLE FRAME
Also made for 30" cover.

21¾"
12"
19¼"

Fig. 36
DRIP PAN FOR LIGHT MANHOLE

14"
6"
9"
17¾"
8½"
9"

Fig. 37-KL
TRAP FOR CATCH BASIN

24"
10½"
25½"
35½"
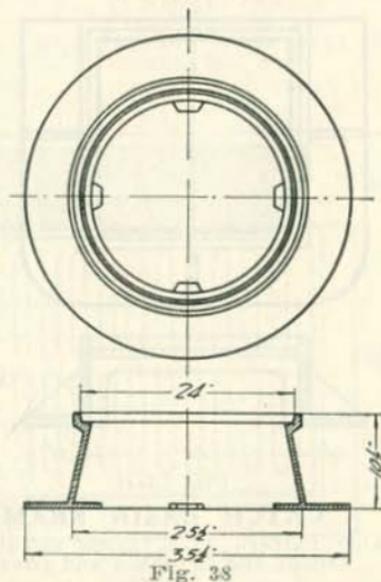
Fig. 38
LIGHT MANHOLE FRAME

MANHOLE COVERS
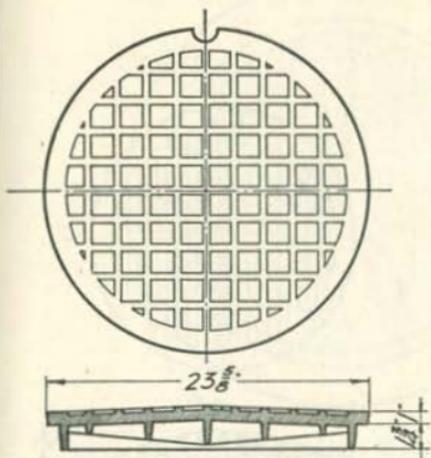
Fig. 39-B
Fig. 39R-B has Radial Ribs
SOLID COVER
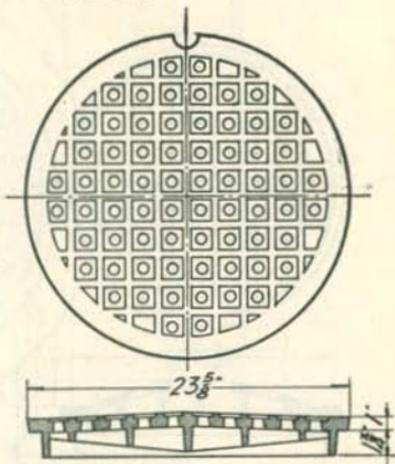
Fig. 40-C
Fig. 40R-C has Radial Ribs.
PERFORATED COVER
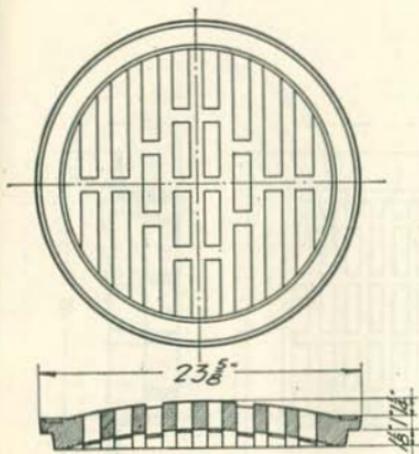
Fig. 41-D
CONVEX COVER
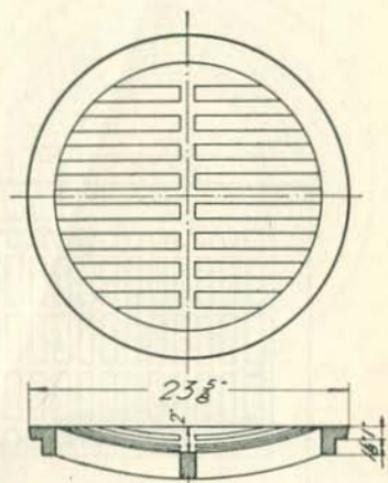
Fig. 42
CONCAVE COVER

All of the above Covers will fit Frames Figs. 35-A, 38 and 24.

SEWER CASTINGS
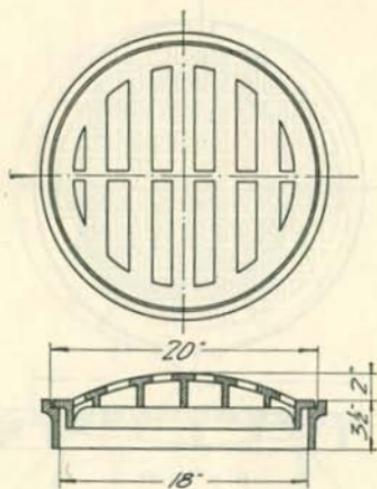
Fig. 43

RING AND COVER
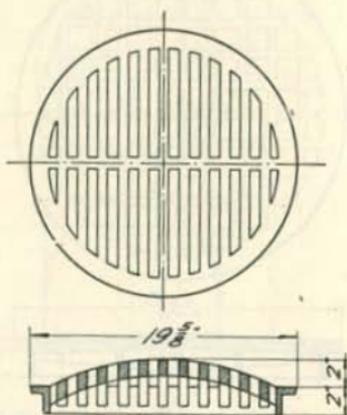
Fig. 44

COVER
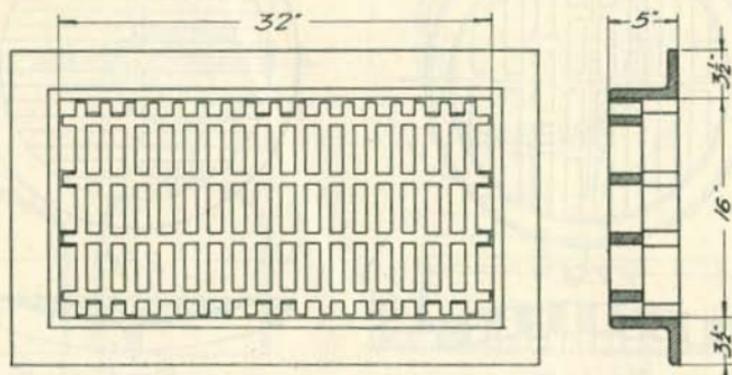
Fig. 45

FRAME AND GRATING
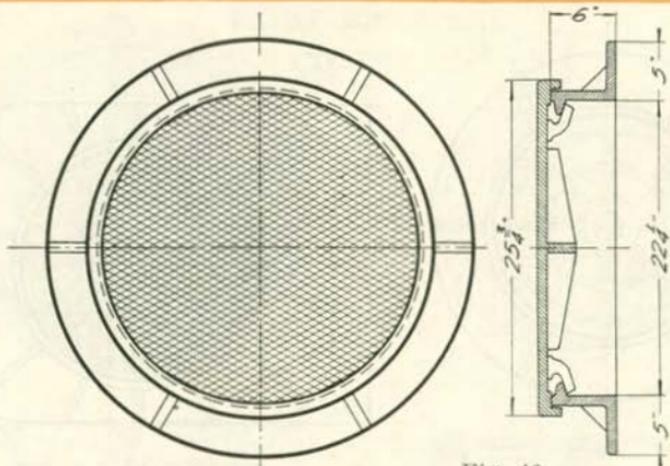
Fig. 46

CISTERN RING AND COVER
Cover Has Locking Device
If desired, this frame and cover can be machined for watertight fit.
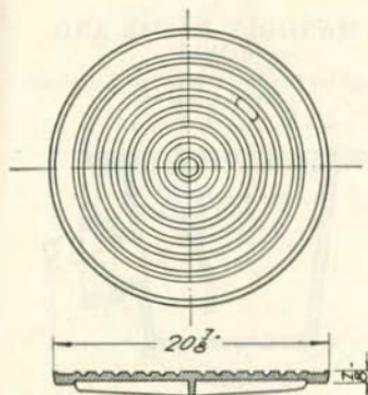
Fig. SB1

Fig. 47-J

COVER FOR CORNER
STONE CATCH BASIN
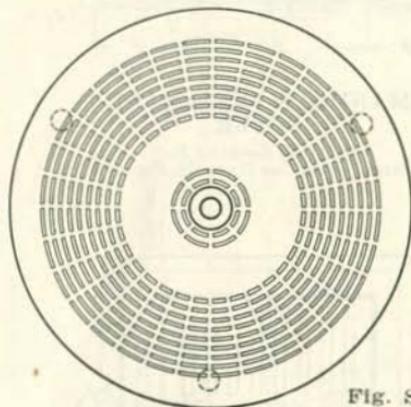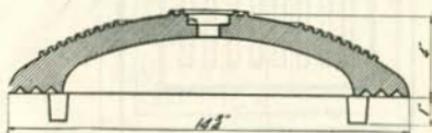
STREET INTERSECTION
BUTTONS
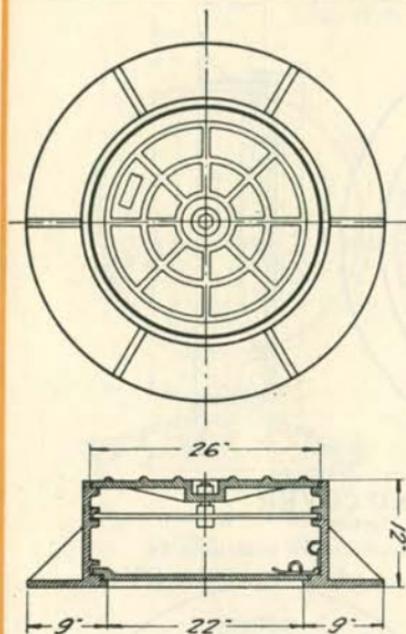
Fig. 48

MANHOLE FRAME AND COVER

Cover has Locking Bar
Bottom cover has Hasp for Padlock
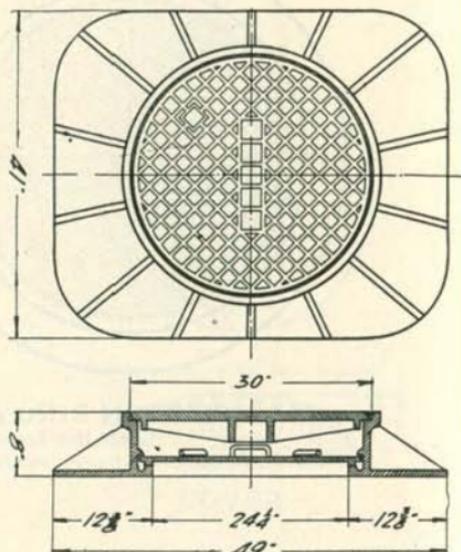
Fig. 49

MANHOLE FRAME AND COVER

Used for Electric Power and Telephone
Street Openings
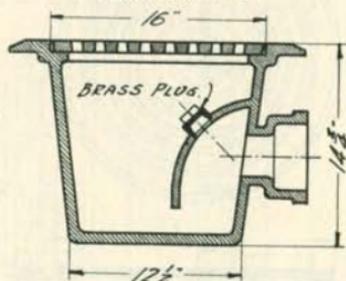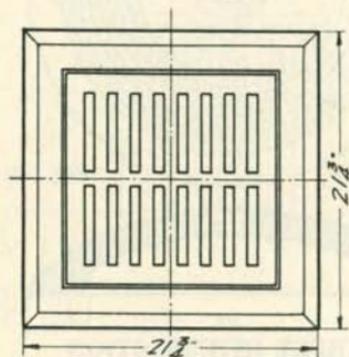
Fig. T1

SEWER TRAP
Standard for Railroad in Roundhouses

TIGHT RINGS AND COVERS
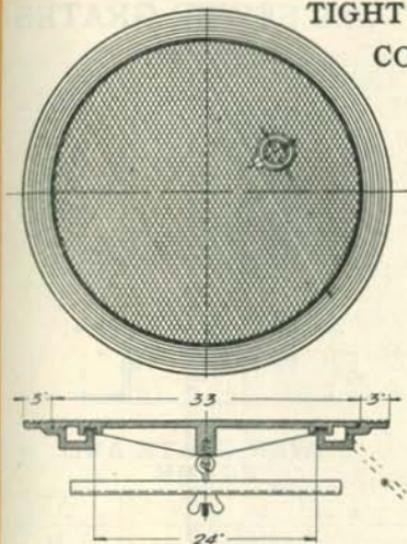
Fig. 50

WATERTIGHT RING AND COVER
Locking device under slab with drain pipe.
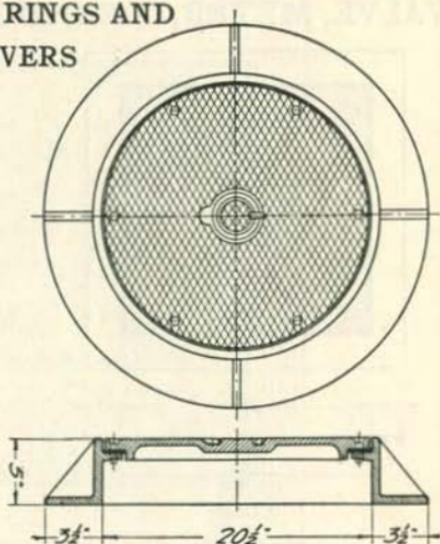
Fig. 51

WATERTIGHT RING AND COVER
Cover screwed to ring.

PIPE TAP.

Fig. 52

HOLE FOR PADLOCK

$4\frac{1}{2}''$

$2'-3''$ BAR

$4\frac{1}{2}''$

$7''$

$26''$

$32''$

$36''$

$\frac{5}{8}'' \times 5$ BOLTS.

Used by State
Sanitary
Department
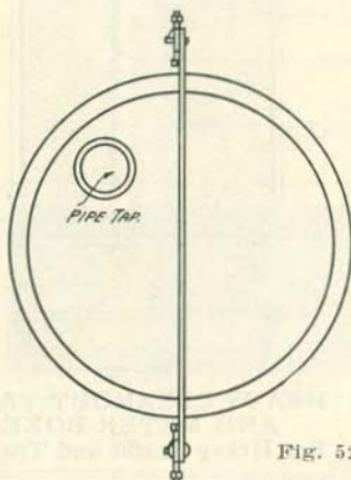
C. I. MANHOLE FRAME AND COVER
With Locking Bar.

VALVE, METER, CLEANOUT and SEWER GRATES
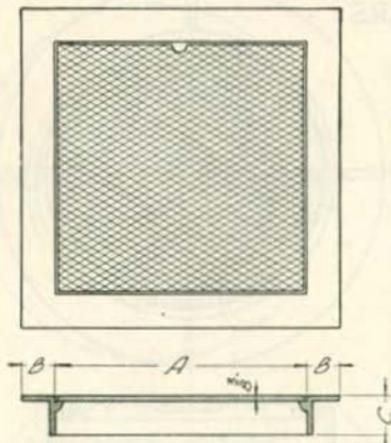
Fig. 53

CLEANOUT VALVE AND METER BOXES
Stock Patterns

A	B	C
In.	In.	In.
6×6	⅞	1½
8×8	1½	2
9×9	2	3
10×10	2	3
12×12	2½	3
18×18	2½	2½
20×20	2½	2¼
22×22	3	3½
24×24	3	3½
8×24	2	2¼
10×12	2	2
10×16	2½	3
10×20	2	2½
12×16	2½	3
12×20	2	2
12×30	2½	3
18×24	2½	2½
20×30	3	3
20×36	2½	2½
24×26	3	3½
24×30	2½	2½
24×36	2½	2½
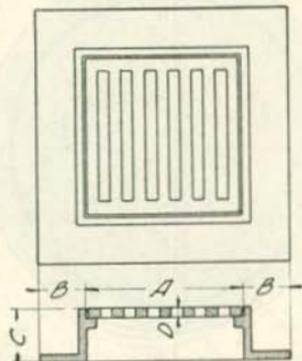
Fig. 54
SEWER GRATE AND FRAME

A	B	C	D
12	3½	4	⅝
19	3½	6	1⅛
19	3½	6	1¾
19½	3½	3½	1⅛
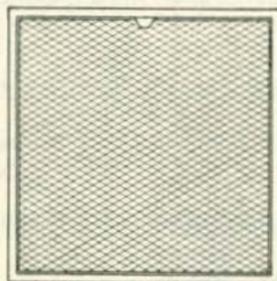
Fig. 55
HEAVY CLEANOUT VALVE AND METER BOXES
For Heavy Traffic and Trucking

A	B
13½×13½	3
16½×26½	4
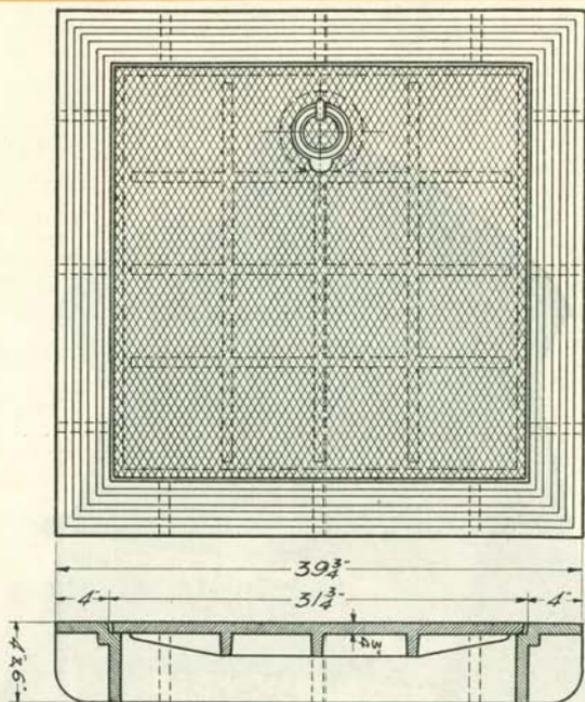
Fig. 56
HEAVY FRAME AND COVER
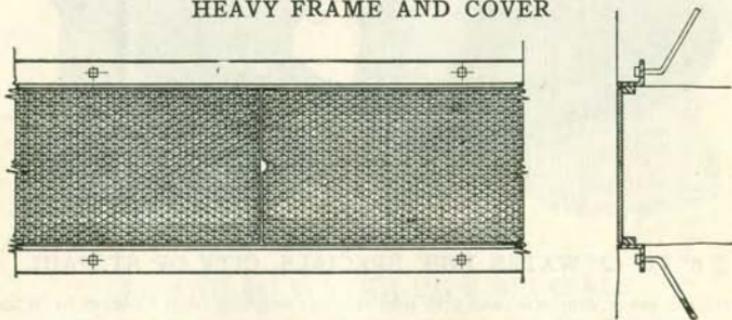
Fig. 57
TRENCH COVERS
Cast Iron or Steel Plate—Checkered Covers.   Covers Made in
4' 6" Lengths.   2×2×¼" L Frame in 20' 0" Lengths Anchored.

42" x 42" x 30" Y — 6900 lbs.

6" TO 42" WATER PIPE SPECIALS, CITY OF ST. PAUL

Railroad, sewer, semi-steel and grey iron castings weighing from 8 ounces to 20 ton

Cast by St. Paul Foundry Co.

PIPE CASTINGS
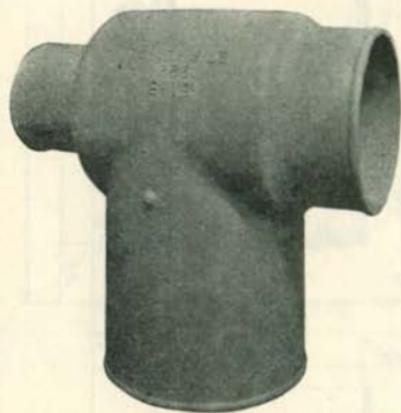
30″ AND 36″ WATER PIPE SPECIALS
WATER DEPARTMENT, CITY OF ST. PAUL

Cast by the St. Paul Foundry Company

CLEAN-OUT DOORS.

Fig. 58

STOCK SIZES

Nominal Size	A	B	C	D
8 x 8	6¼"	6	9¼	9
10 x 8	8¼"	8	11¼	11
10 x 10	10¼"	10	13¼	13
12 x 10	12¼"	10	15¼	13
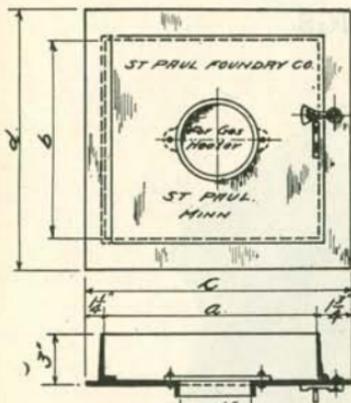
STOCK SIZES

Nominal Sizes	a	b	c	d
12 x 12	12	12	19	19
12 x 16	12	16	19	23
16 x 12	16	12	23	19
16 x 16	16	16	23	23
16 x 24	16	24	23	31
18 x 18	18	18	25	25
18 x 24	18	24	25	31
24 x 16	24	16	31	23
20 x 24	20	24	27	31
24 x 18	24	18	31	25
24 x 24	24	24	31	3
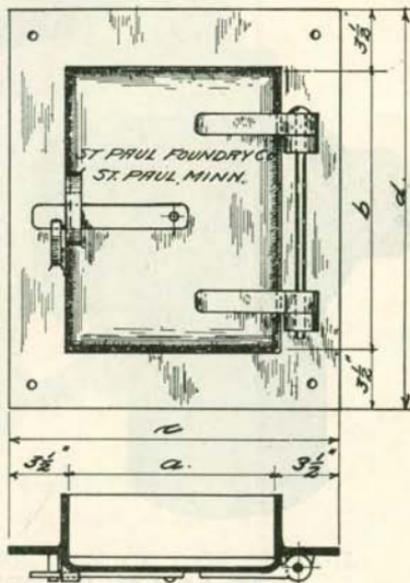
Fig. 59

Above list shows sizes of patterns which we have in stock.
We carry the following sizes for immediate shipment: 8x8, 10x8, 12x10, 12x16.

SPECIAL SIZES TO ORDER.

CAST IRON SMOKE STACKS
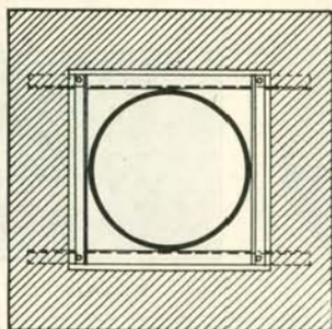
PLAN OF BRACE
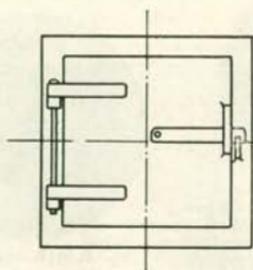
CLEANOUT DOOR
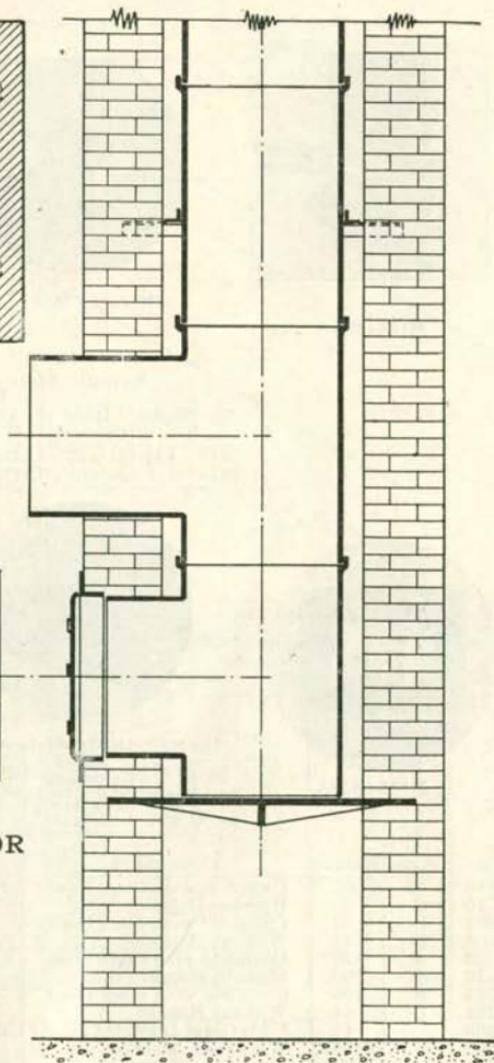
Fig. 60
Made in all sizes
Standard for Minnesota State Schools.

MAJESTIC FOUNDATION COAL-CHUTE.

M10A-M20A
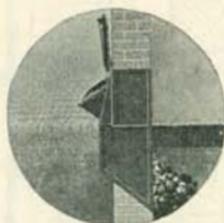
M12 and M15
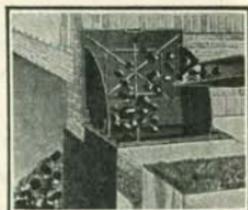
M16-M18

Majestic Store Chute

No.	Wght.	Door Opening	Wall Opening Above Grade	Wall Opening Below Grade
M12	105	21″x15″	23″x16¾″	23″x25″
M15	151	29″x19¼″	31″x21½″	31″x24½″
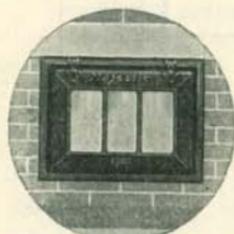
M10A-M20A
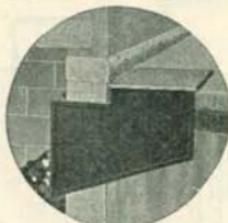
The Majestic Grade-Line Chute

No.	Wght.	Door Opening	Wall Opening
M16	135	23¼″x18¼″	25″x25″
M18	200	29″x24″	31″x31″
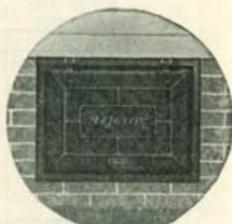
M101B-M203B

No.	Style	Weight	Description	Size of Wall Opening		
M 10	A	63	Complete with Glass Door	23 in. wide	17 in. high	12 in. deep
M 10	C	52	Without Hopper	Do	Do	Do
M101	B	52	Complete with Steel Door	Do	Do	Do
M101	D	41	Without Hopper	Do	Do	Do
M 20	A	120	Complete with Glass Door	32 in. wide	22 in. high	17 in. deep
M 20	C	100	Without Hopper	Do	Do	Do
M203	B	105	Complete with Steel Door	Do	Do	Do
M203	D	84	Without Hopper	Do	Do	Do
M600		45	With Glass Door	23 in. wide	17 in. high	9 in. deep
M500		35	With Steel Door	Do	Do	Do
M620		88	With Glass Door	32 in. wide	22 in. high	12 in. deep
M520		70	With Steel Door	Do	Do	Do

Nos. M600, M620, M500 and M520 are without Hopper and Chain, and bottom of body is straight. Nos. M12 and M15 can be furnished without hopper.

COAL CHUTES AND SIDEWALK DOORS
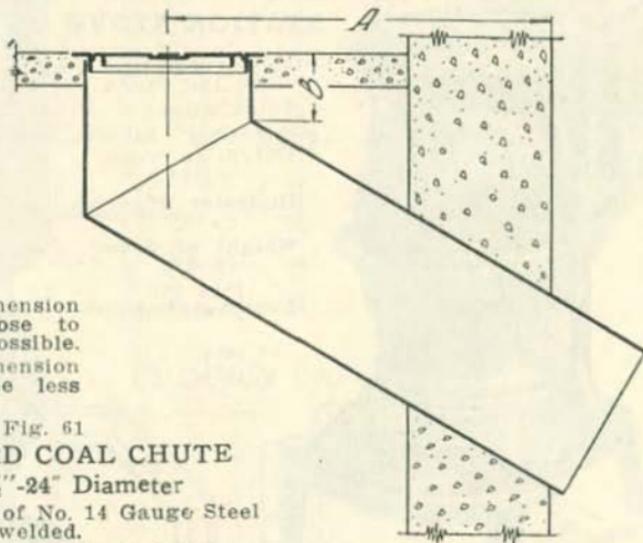
A. This dimension to be as close to building as possible.

B. This dimension should not be less than 9".

Fig. 61

STANDARD COAL CHUTE

18"-20½"-24" Diameter

Chute made of No. 14 Gauge Steel plate. Butt welded.

Chain locking device if desired.

Give dimensions A and B when ordering.

STANDARD SIDEWALK DOOR

Fig. 63

WATERTIGHT SIDEWALK DOOR

Stock Patterns For { 4'-0"x4'-0" 5'-0"x5'-0"

Fig. 62

STANDARD SIDEWALK DOOR

Made either with single or double doors in suitable sizes. Frame cast iron with ⁵⁄₁₆" checkered steel plate doors. Doors have locking device on underside.

Special coal chutes and sidewalk doors of any kind or size made to order.

STATION STOVE

Dimensions of 20"
Fire Pot Stove
Total height 6'-3".
Base 2'-1" square.
Height to drum
3'-11".
Diameter of drum
1'-8½".
Height of drum
2'-4".
Fire Pot
1'-6½"x12" deep.

CABOOSE STOVE

Type A—Without Oven
Type B—With Oven

General Dimensions

Height 2'-8".
Base 1'-7½"x1'-11½".
Fire Pot 1'-3" by 8" deep.
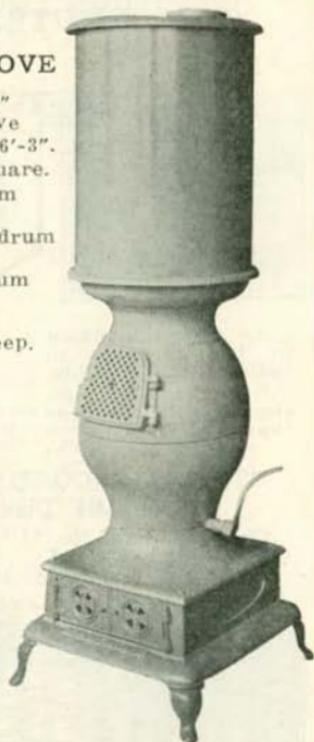
STATION STOVE

Furnished also without drum.
Made in four sizes with 14", 18", 20" and 22" diameter of fire pot.

We Have a Great Variety of Patterns for Grates of Different Size and Type

We have patterns for Tupper Grates, sizes 16" to 5'-6".

TUPPER GRATE BARS

Fig. 64
CHIMNEY CAP

SECTION-A-A.
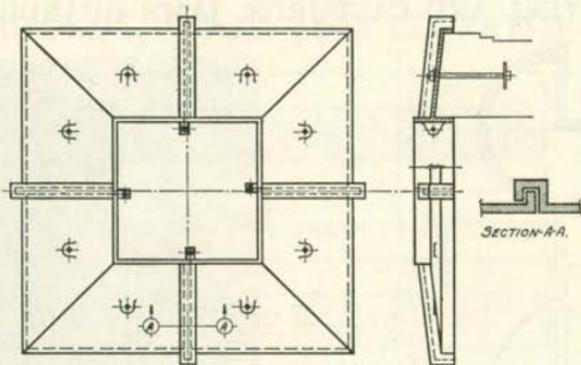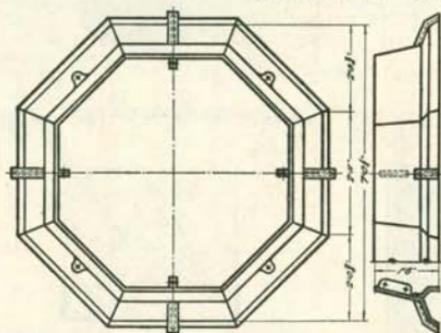
Fig. 65
CHIMNEY CAP
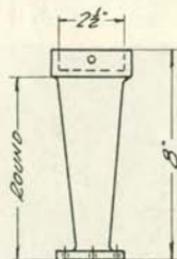
Fig. 67
TOILET
PARTITION
LEGS
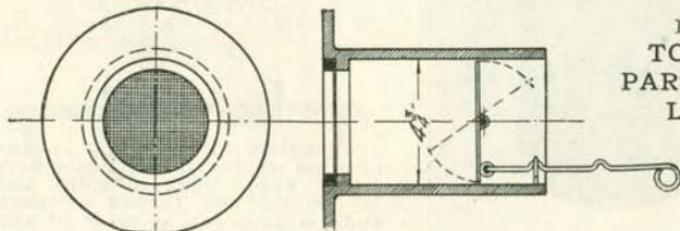
Fig. 66
VEGETABLE CELLAR VENTS
Built Into Walls, with Screen and Damper.
Have patterns for various designs and sizes.

STEEL AND CAST IRON JAMB GUARDS
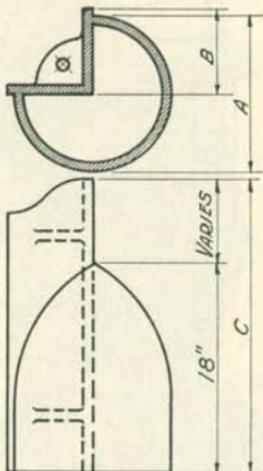
Fig. 68
When ordering give dimensions
A, B and C
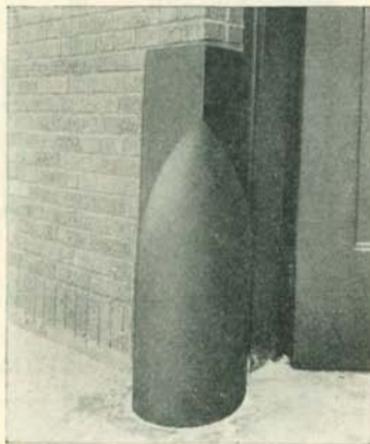
Fig. 69
Diam. 8″-9″-12″-14″-16″-18″

Fig. 70, 8″ diam.

Fig. 71

Fig. 72

Anchored in place by means of clips riveted to main members (rivet heads flush outside) and ½″ round bar turned at each end. Guards can be made of any section or height to suit conditions.

Cast Iron Guards have lugs on back to which hook bars are fastened for anchorage or they can be expansion bolted to brick and concrete walls.

Special designs upon request.

THRESHOLDS, DOOR AND ELEVATOR SILLS
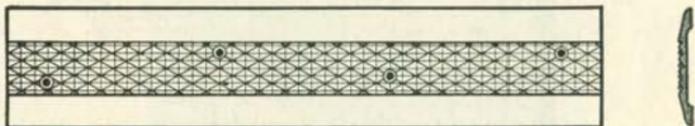
Fig. 73
CHECKERED CAST IRON THRESHOLD
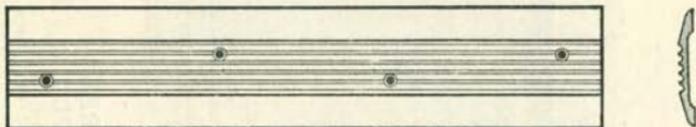
Fig. 74
RIBBED BRASS OR CAST IRON THRESHOLD

Note: In ordering, state width of opening and thickness of door. Steel thresholds with plain tops can be furnished; also thresholds of checkered steel plate.

Unless otherwise specified, plain top cast iron thresholds will be furnished.
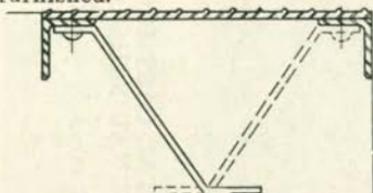
Fig. 75
DOOR SILL OF CHECK-ERED STEEL

Plate and angles riveted, with bent bar anchors for concrete or expansion bolts for brick.
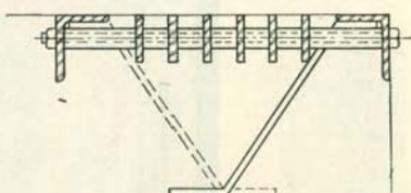
Fig. 76
DOOR SILL OF ANGLES AND BARS

With gas pipe spreaders about 24" centers. Bent bar anchors for concrete or expansion bolts for brick.
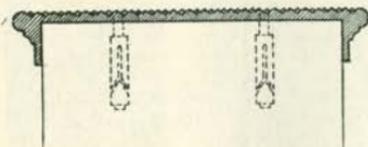
Fig. 77
CAST IRON DOOR SILL
Anchored with expansion bolts
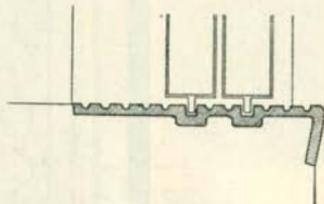
Fig. 78
CAST IRON ELEVATOR DOOR SILL
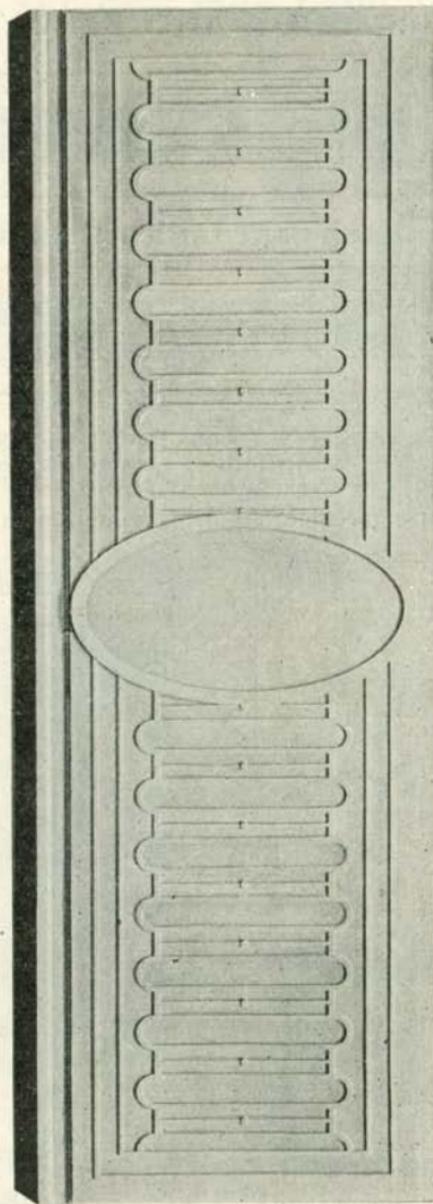
ORNAMENTAL CAST IRON SPANDRELS
VOCATIONAL SCHOOL, ST. PAUL

A fine example of large (4'-6"x12'-0") spandrel castings
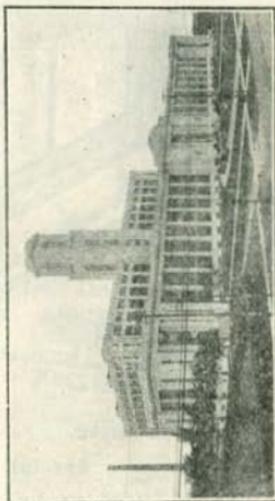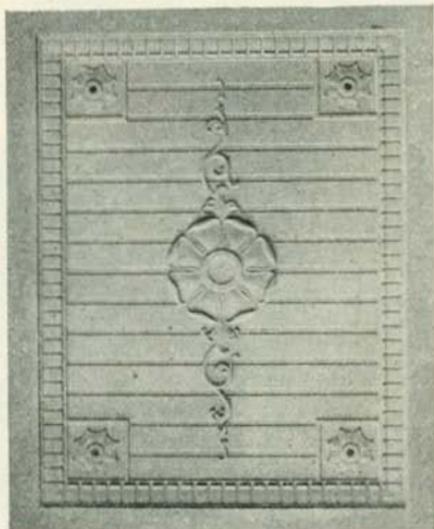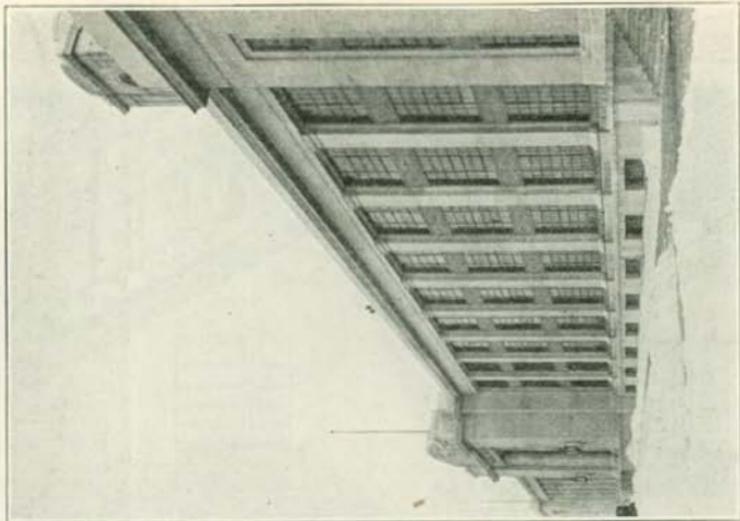
ORNAMENTAL CAST IRON SPANDRELS
MONTGOMERY WARD BUILDING, ST. PAUL
Spandrels are especially adapted to concrete buildings where steel
sash is used, for maximum opening and illumination.
Designs Upon Application.

CAST IRON WINDOW SILLS.
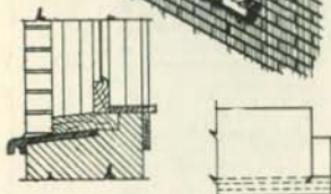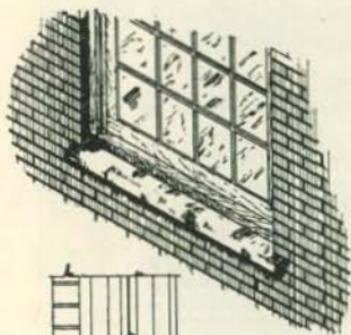
Fig. 79
For Wood Sash.
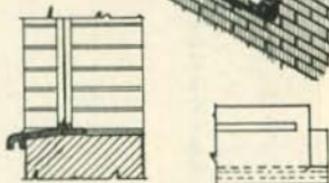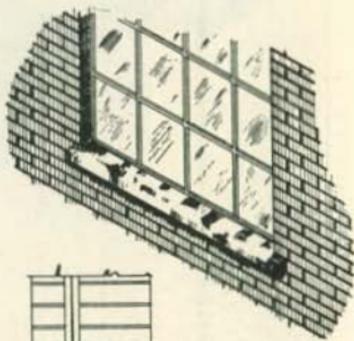
Fig. 80
For Steel Sash.
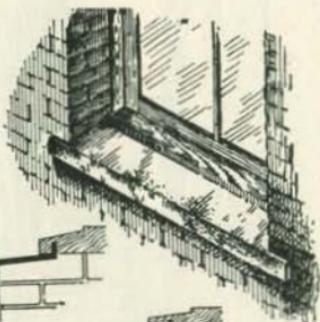
Fig. 81

Fig. 82
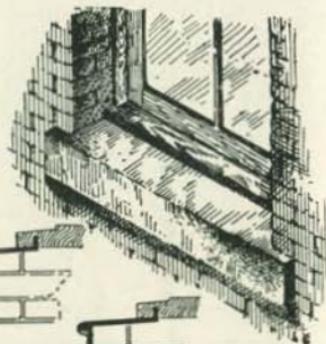
Fig. 83
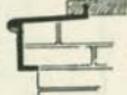
Fig. 84

Special Designs Upon Application.

CAST IRON SILLS are well adapted to large and small sash particularly for factory buildings. They do not rust or crack and therefore are very durable. As indicated in the design, they will shed water so that discoloration on brick or stone walls from drip is entirely eliminated. The sills can be made for wood or steel sash with provision for storm sash if desired.

LETTERS

Fig. 85

We Design and Fabricate Cast Iron
Letters.

Special Designs Furnished Upon
Request.

Offset from Building and Securely Fastened
with Expansion Bolts.

Fig. 86

ORNAMENTAL WALL AND CHIMNEY ANCHORS.
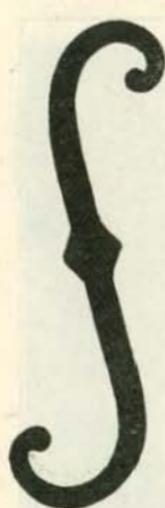
Fig. 88
24" x 2¾" x 1¼"
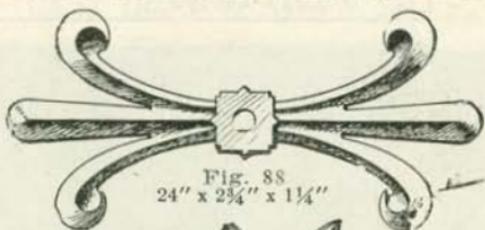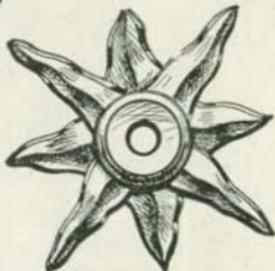
Fig. 89
9" diameter x 1¼" thick

Fig. 90

Fig. 91

WROUGHT IRON WINDOW BOXES
Special Designs Upon Application.

MISCELLANEOUS HINGES
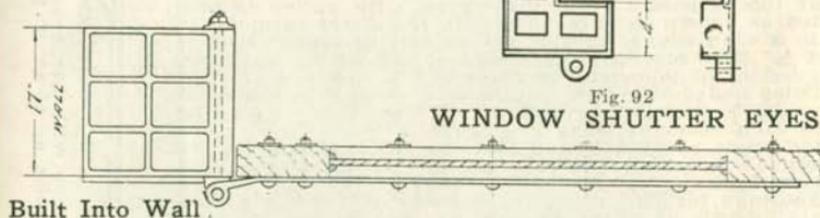
Fig. 92

WINDOW SHUTTER EYES

Built Into Wall
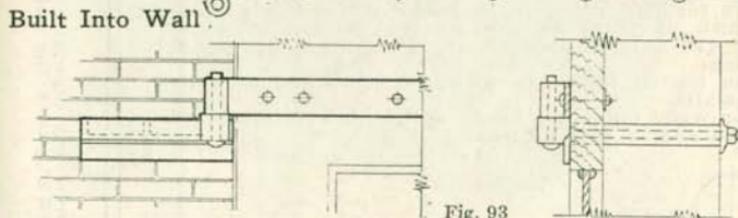
Fig. 93

STRAP HINGE, HINGE CASTING AND LUG FOR HEAVY WOOD DOORS
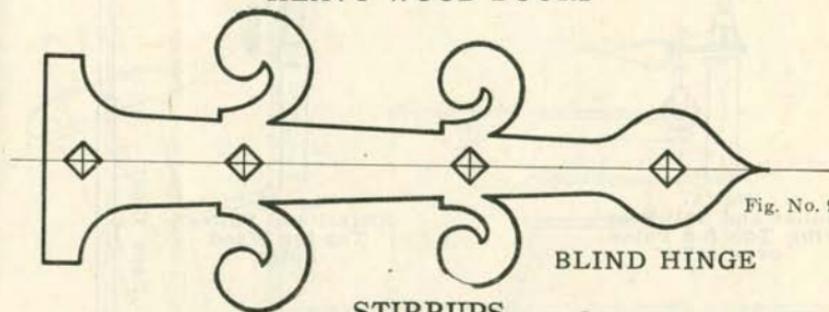
Fig. No. 94

BLIND HINGE

STIRRUPS

Size of Joist or Timber	Size of Material
2″x 4″ to 2″x10″	¼″x2″
2″x12″ to 3″x10″	¼″x2½″
4″x10″ to 4″x12″	₅⁄₁₆″x3½″
6″x12″ to 3″x14″	₅⁄₁₆″x3½″
8″x12″ to 4″x14″	⅜″x3½″
6″x14″ to 10″x12″	⅜″x3½″
8″x14″ to 10″x14″	⅜″x4″
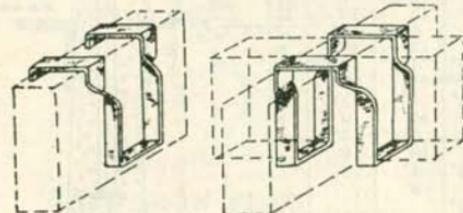
Fig. No. 95
SINGLE STIRRUP

Fig. No. 96
DOUBLE STIRRUP

Unless otherwise ordered stirrups will be made ¼″ smaller than nominal size of timber or joist. The sizes of stirrups are proportioned to capacities of timbers.

FLAG POLES

FLAG POLES are fabricated from lengths of various sizes of wrought iron pipe as shown in tables below; near top of pole a revolving swivel with pulley is provided as shown in cuts. The top of pole is surmounted with a spun copper or zinc gilded ball of proper size.

A ¾" "Samson Spot" sash cord or ⅜" wire cable twice the height of pole will be furnished if specified.

Poles under 50' 0" in length have shrunk joints, poles over 50' 0" in length are made with sections of pipe let into each other at least 3' 0" and riveted.

Poles are painted 2 shop coats of red lead and oil and another coat of color to suit in field. All joints are made water-tight.

Footings for flag poles to be made of 1-3-5 mix concrete; depth of poles in ground 1/10 height of pole. ½" rd. × 12" anchor pins about 12" centers are built into footings.

Poles on top of buildings to be securely anchored to roof and walls.

Tops for wood poles are made with a ¾" rd. or 1" rd. rod let into end of pole at least 1' 0".
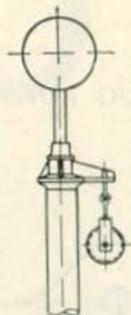
Fig. 97
Roller and Ball Bearing Top for Poles over 50' 0"
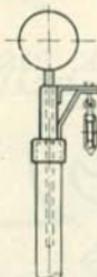
Fig. 98
Swivel and Pulley Top for Wood Poles

Revolving pipe sleeve with bar bracket and 2" pulley for poles up to 50' 0" high
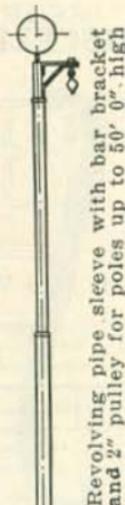
Rope Cleat

Fig. 99

9 0	Size of Pipe	7" EH	6" EH	5"	4½"	4"	3½"
	Length....	21	18	18	18	13	11
8 0	Size of Pipe	7" EH	6" EH	5"	4½"	4"	3½"
	Length....	21	18	18	12	10	9
7 0	Size of Pipe	6" EH	5"	4½"	4"	3½"	......
	Length....	21	18	18	11	9	......
6 0	Size of Pipe	6"	5"	4½"	4"	3½"	3"
	Length....	15	13	11	10	9	8
5 0	Size of Pipe	5"	4½"	4"	3½"	3"	......
	Length....	15	12	10	10	8	......
4 0	Size of Pipe	4½"	4"	3½"	3"	......	......
	Length....	16	11	10	8	......	......
3 0	Size of Pipe	3½"	3"	2½"	......	......	......
	Length....	13	12	9	......	......	......
2 0	Size of Pipe	3"	2½"	......	......	......	......
	Length....	14	9	......	......	......	......

Lengths are in feet.   EH=Extra Heavy Pipe.

CAST IRON FLAG POLE BASES
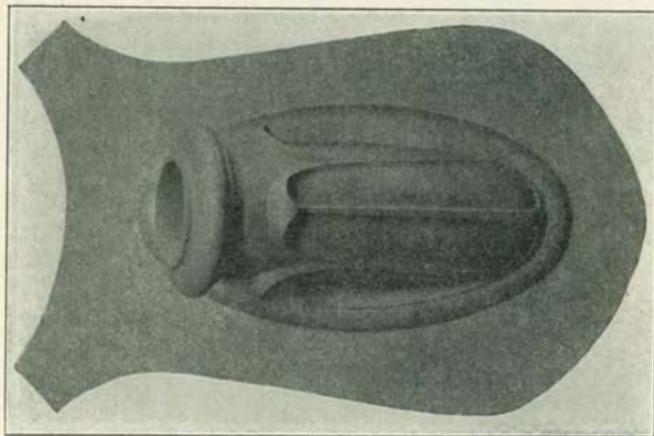
Fig. 101
FLAG POLE SOCKET
Vocational School, St. Paul
(Pole inclined)
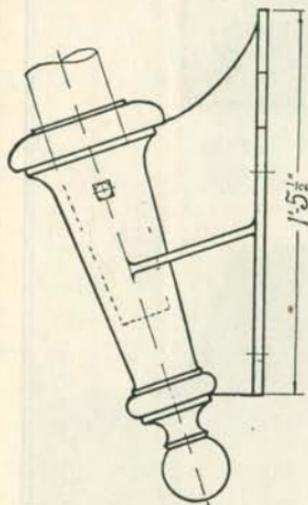
Fig. 100

**CAST IRON FLAG
POLE SOCKET**
Anchored to Face of Wall
For 3½" Wood Pole
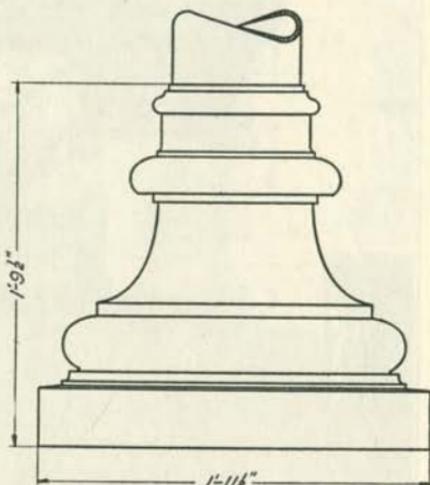
Fig. 102

CAST IRON FLAG POLE BASE
For 7" Pipe Pole

We have patterns for other sizes and designs.
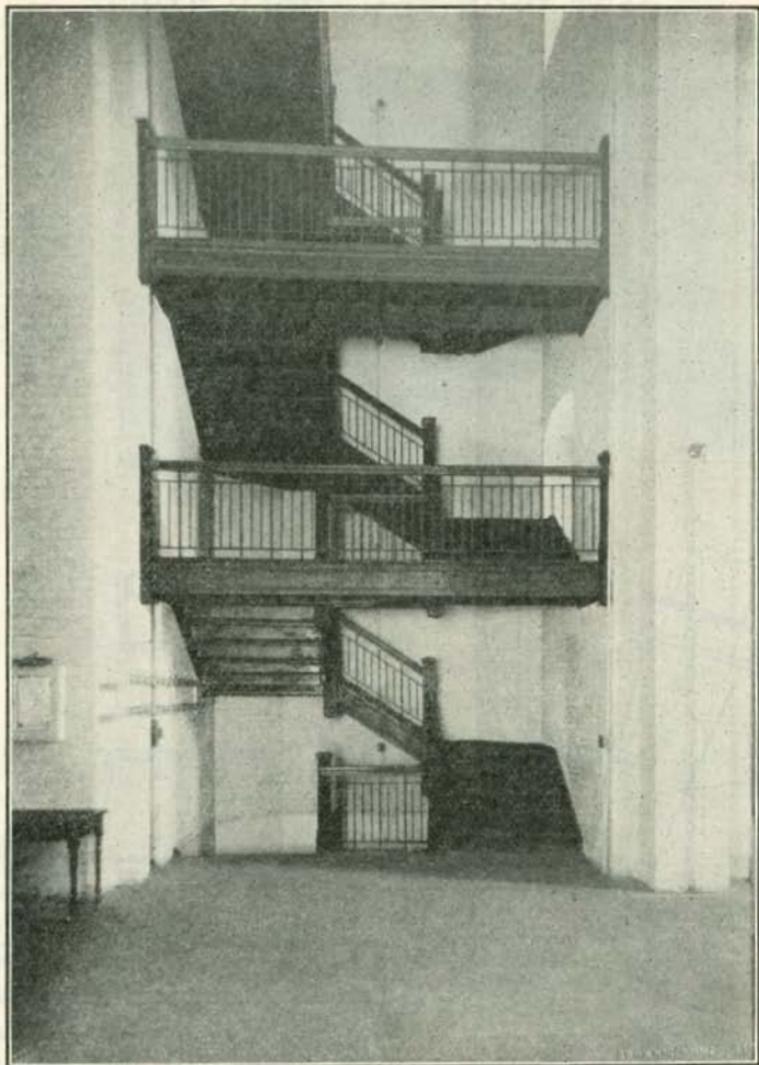
STAIRWAY FOR ST. PAUL CATHEDRAL
Fabricated and Erected by The St. Paul Foundry Company

CAST IRON HAND RAIL AND COAT BRACKETS
FOR WOOD OR PIPE RAILS
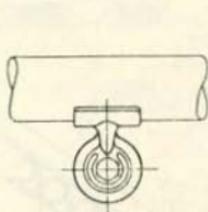
Fig. 103
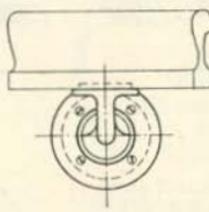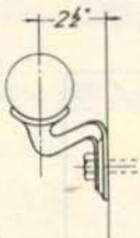
Fig. 104
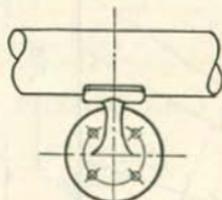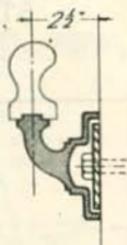
Fig. 105
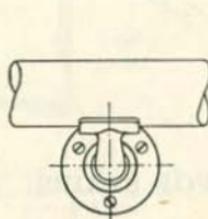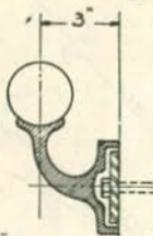
Fig. 106
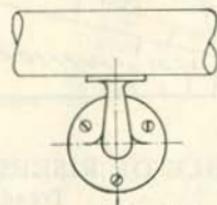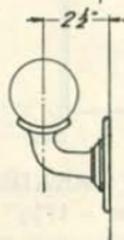
Fig. 107
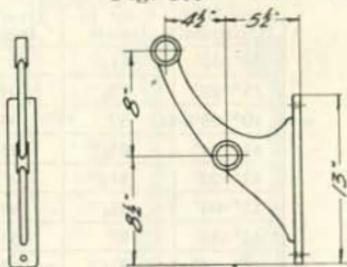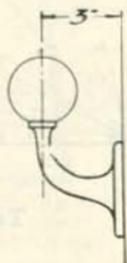
Fig. 108
Coat Rail Brackets
For supporting 2—1½" rd. Wood
Rails for Coat Hooks
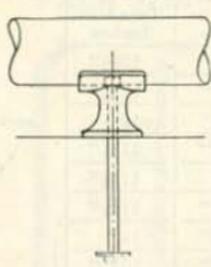
Fig. 109
Brackets for Stair Curb
⅜"x8" Bolts Built into Curb

STAIRS, LADDERS, RAMPS AND INCLINES
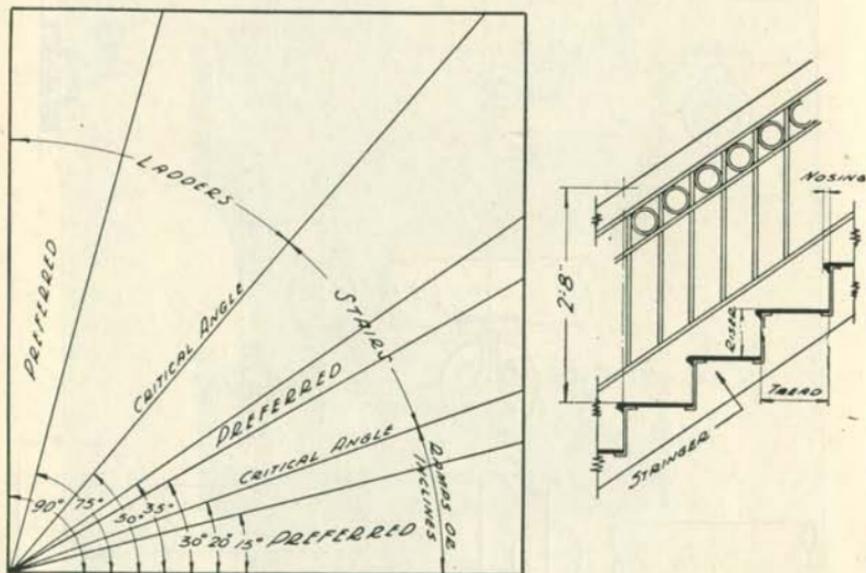
TABLE OF RISERS AND TREADS FOR STAIRS
Tread + Riser = 17½″

Angle With Horizontal	Riser in Inches	Tread in Inches		Angle With Horizontal	Riser in Inches	Tread in Inches
22°–00′	5″	12½″		36°–52′	7½″	10″
23°–14′	5¼″	12¼″		38°–29′	7¾″	9¾″
24°–38′	5½″	12″		40°–08′	8″	9½″
26°–00′	5¾″	11¾″		41°–44′	8¼″	9¼″
27°–33′	6″	11½″		43°–22′	8½″	9″
29°–03′	6¼″	11¼″		45°–00′	8¾″	8¾″
30°–35′	6½″	11″		46°–38′	9″	8½″
32°–08′	6¾″	10¾″	⎫	48°–16′	9¼″	8¼″
33°–41′	7″	10½″	⎬ Preferred.	49°–54′	9½″	8″
35°–16′	7¼″	10¼″	⎭			

MASON SAFETY TREAD.

Fig. 110
Cross Section
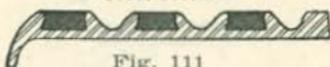
Fig. 111
Cross Section

Fig. 112
Cross Section
This section not made
in Steel

Steel Treads with Nosing
Widths 3″ and 3½″
Steel Treads without Nosing
Widths 2½″, 4,″ 4¾″ and 6″

Brass Treads with Nosing
Widths, 2⅛″ and 3½″
Brass Treads without Nosing
Widths, 2¼,″ 3″, 4″ and 6″

These treads are composed of rolled unperforated steel or hard brass (Delta Metal) in one uniform thickness (¼ inch), with alternate U-shaped and dovetailed grooves, filled with the non-slippery, soft metal lead or with carborundum grains. They are clean, neat in appearance and noiseless in use.

These treads can be furnished in lengths up to 14′-0″.

TREADS AND RISERS.
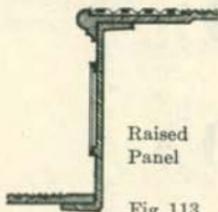
Raised
Panel

Fig. 113
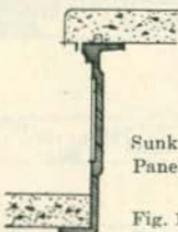
Sunk
Panel

Fig. 114
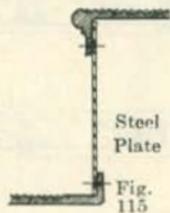
Steel
Plate

Fig.
115
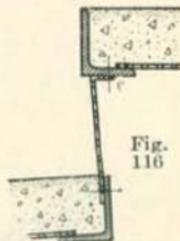
Fig.
116

Cast Iron Diamond
Checkered with Mason
Safety Treads

Slate, Stone or
Marble Treads

Cast Iron Diamond
Checkered Treads

Concrete Treads
held in Steel
Angle Framing

FACE STRINGS.
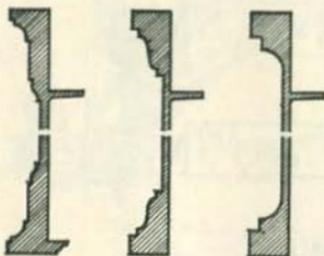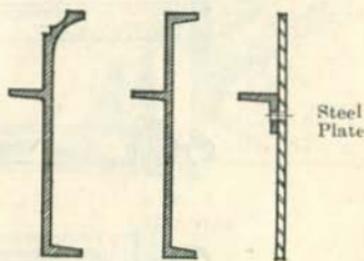
WALL STRINGS.

Steel
Plate

Fig. 117   Fig. 118   Fig. 119
12″   10″-12″   12″-14″

Fig. 120   Fig. 121   Fig. 122
12″   Any Depth   Any Depth

NEWEL POSTS

No. 123
2"

No. 124
2½"

No. 125
4"

No. 126
4"

No. 127
5"

No. 128
Shaft 4"
Base 6½"

No. 129
Shaft 5"
Base 6"

No. 130
Shaft 5"
Base 6"

No. 131
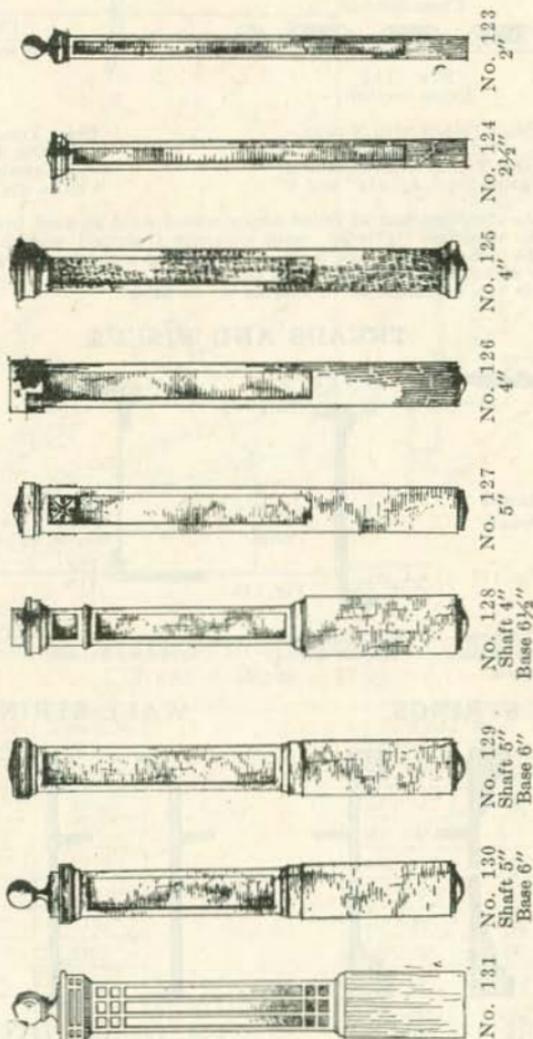
Special Designs Upon Application.

ORNAMENTAL STAIR RAILING
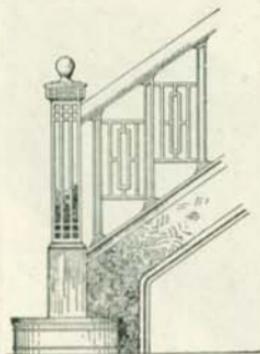
Fig. 132
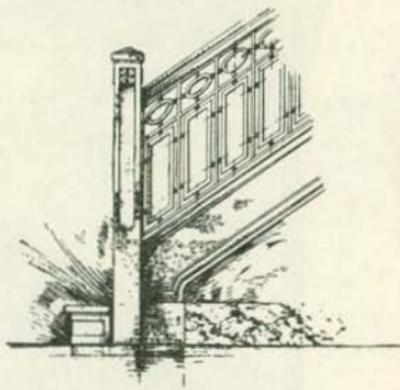
Fig. 133
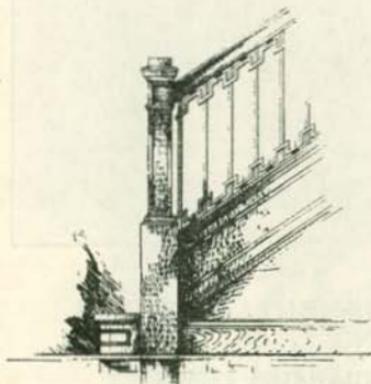
Fig. 134
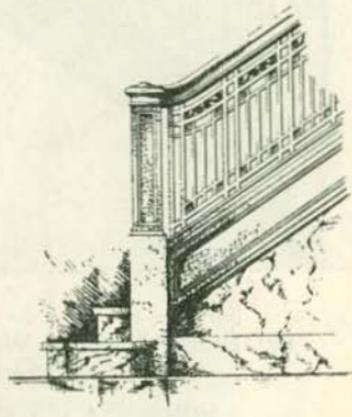
Fig. 135

Special Designs Upon Application.
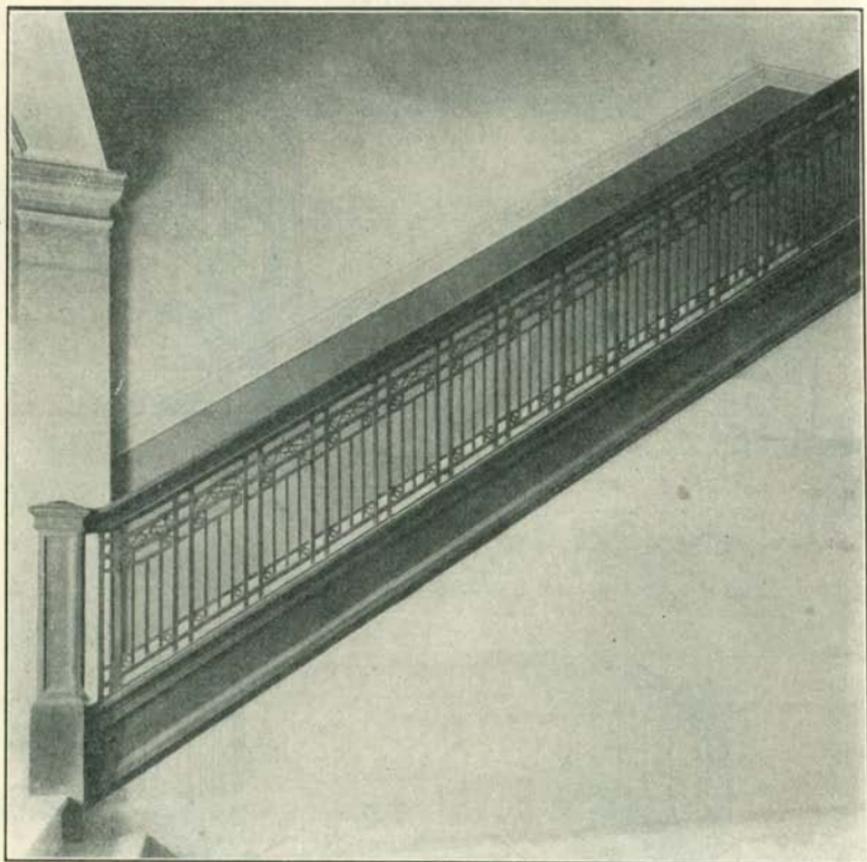
IRON STAIRWAY WITH ORNAMENTAL NEWELS AND RAILING

ADMINISTRATION BUILDING, STILLWATER PRISON

Fabricated and Erected by The St. Paul Foundry Company

Special Designs Upon Request
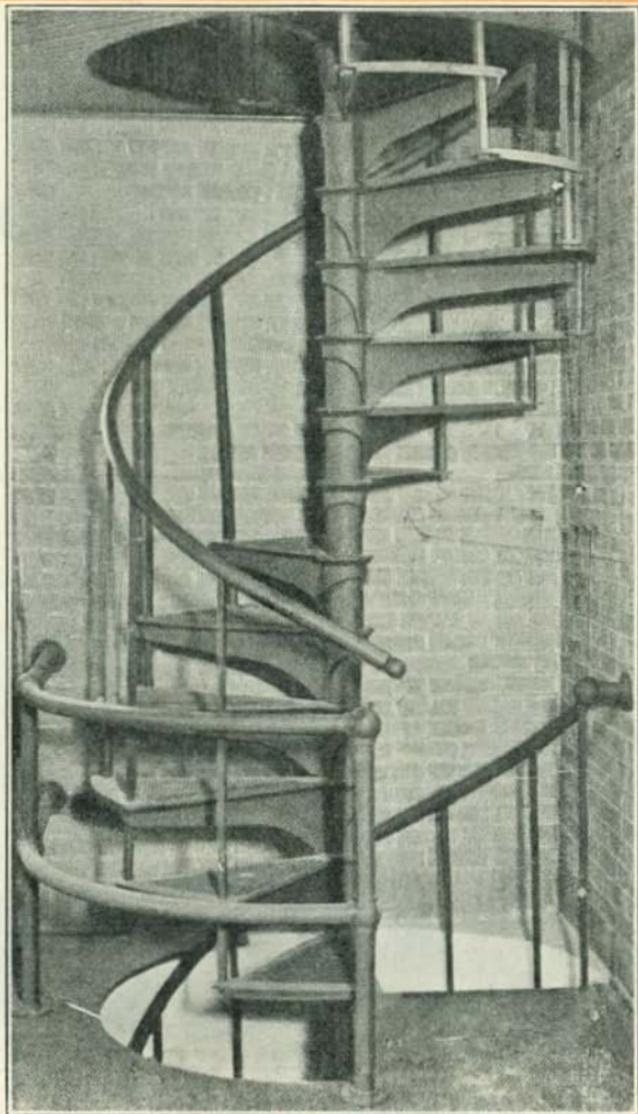
Fig. 136
CIRCULAR STAIRS
Well adapted to pumping stations, power plants, vaults and schools
Fabricated and Erected by The St. Paul Foundry Company
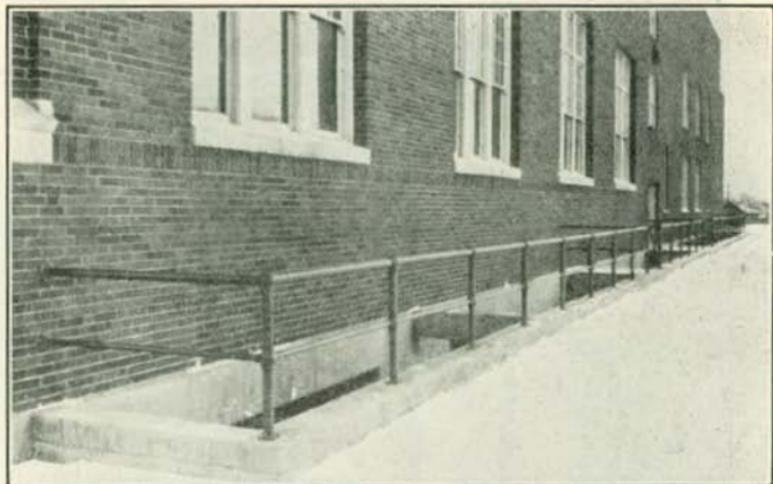
AREA RAILING
Can also be made with spiked top if desired
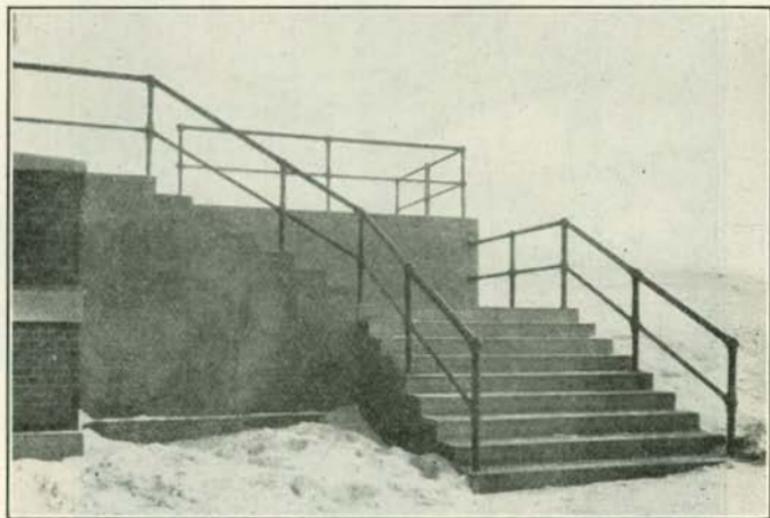
GAS PIPE STAIR RAILING

Fittings for gas pipe railing can be made in either plain or ball fittings.

Post for gas pipe railing should be built into concrete wherever possible by setting inserts (or cans) into concrete approximately 6" deep.
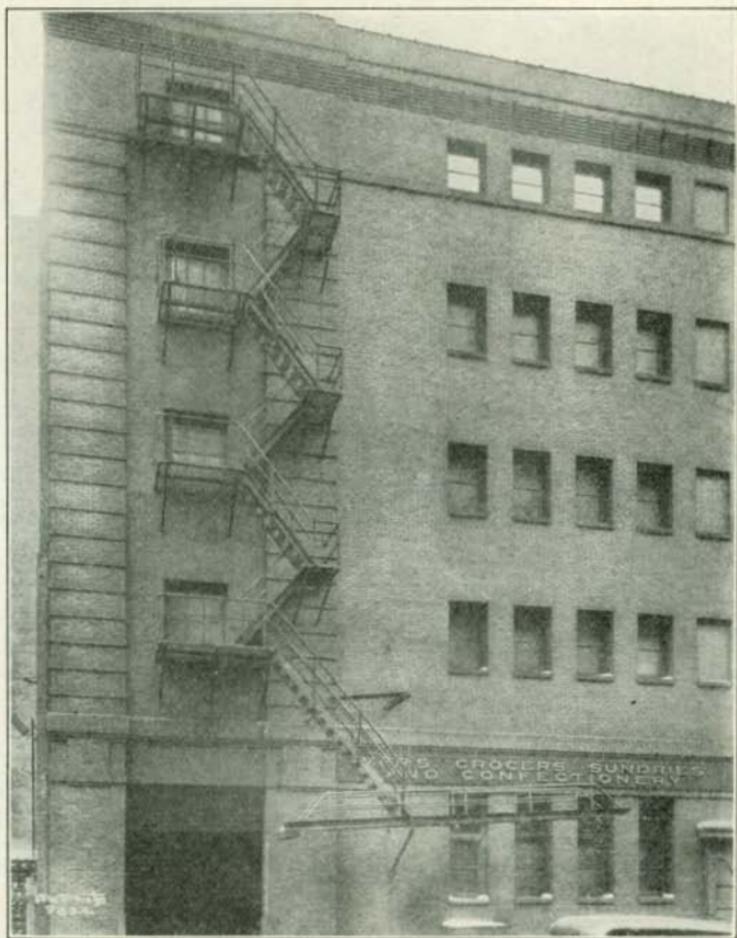
Fig. 137

FIRE ESCAPE, Wm. McMURRAY BUILDING, ST. PAUL
Designed, Constructed and Erected by the St. Paul Foundry Company
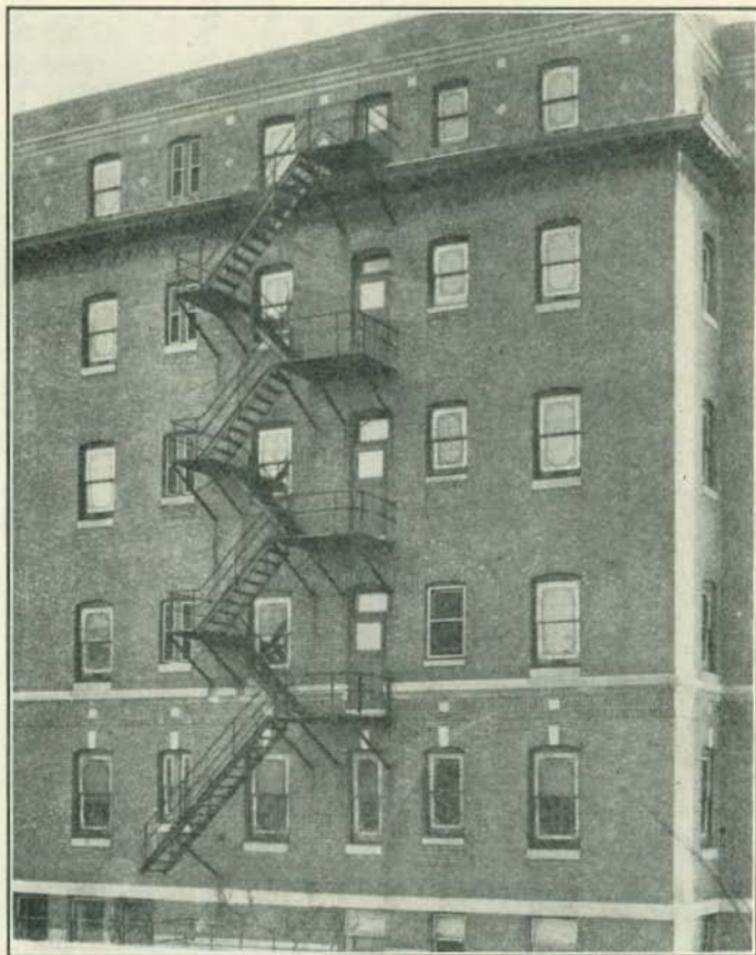
Fig. 138

FIRE ESCAPE, ST. JOSEPH'S HOSPITAL

Fabricated and Erected by The St. Paul Foundry Company.

Our Fire Escapes conform to the specifications and laws of the State in which the building is located.

The construction is standard and of latest approved detail.

STAIR TOWER AND BRIDGE, CITY OF ST. PAUL
Fabricated and Erected by The St. Paul Foundry Company
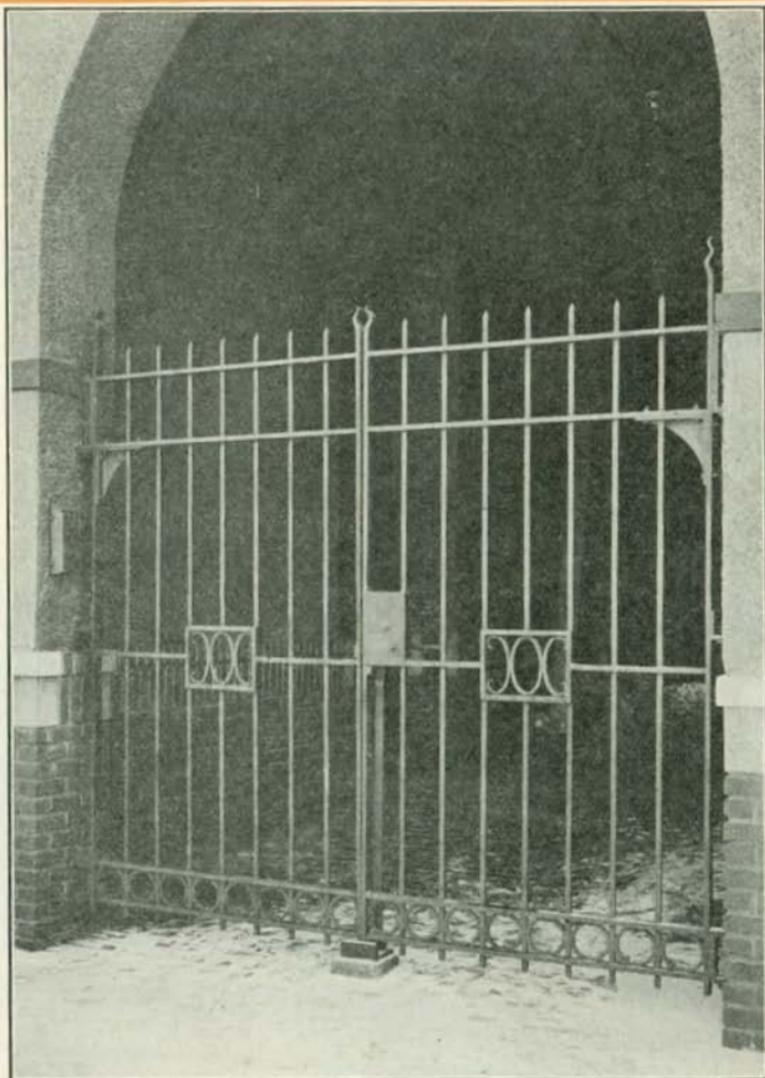
Fig. 139
ORNAMENTAL WROUGHT IRON GATES AND
ENCLOSURES
TWIN CITY CURLING CLUB, ST. PAUL
Special Designs Upon Request.
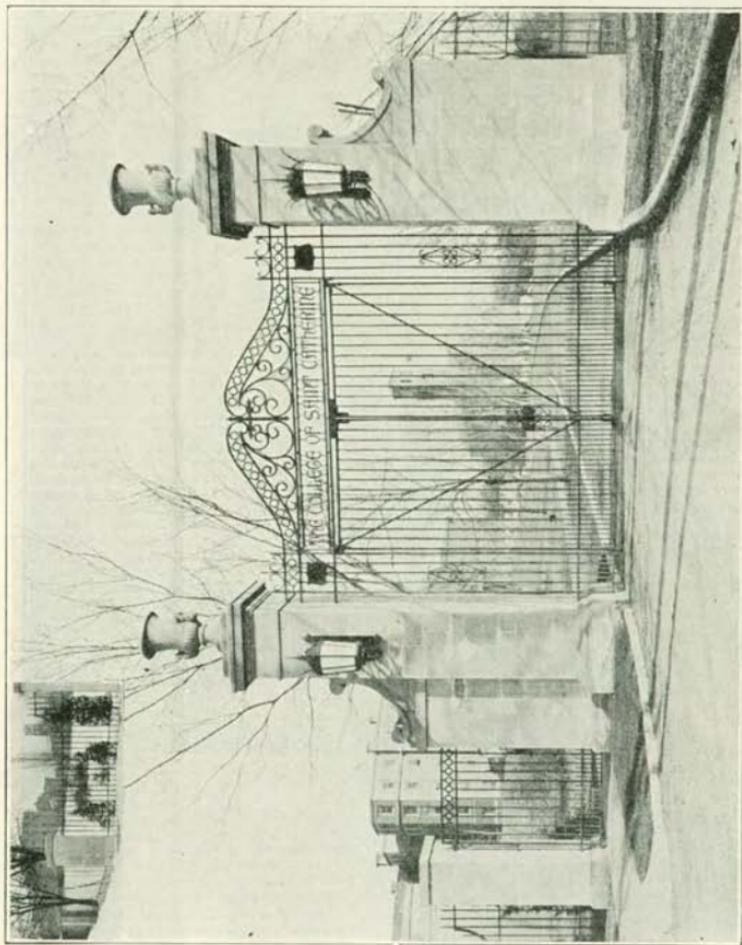
1000 FEET WROUGHT IRON FENCE WITH ORNAMENTAL GATE

Fabricated and erected by the St. Paul Foundry Co.
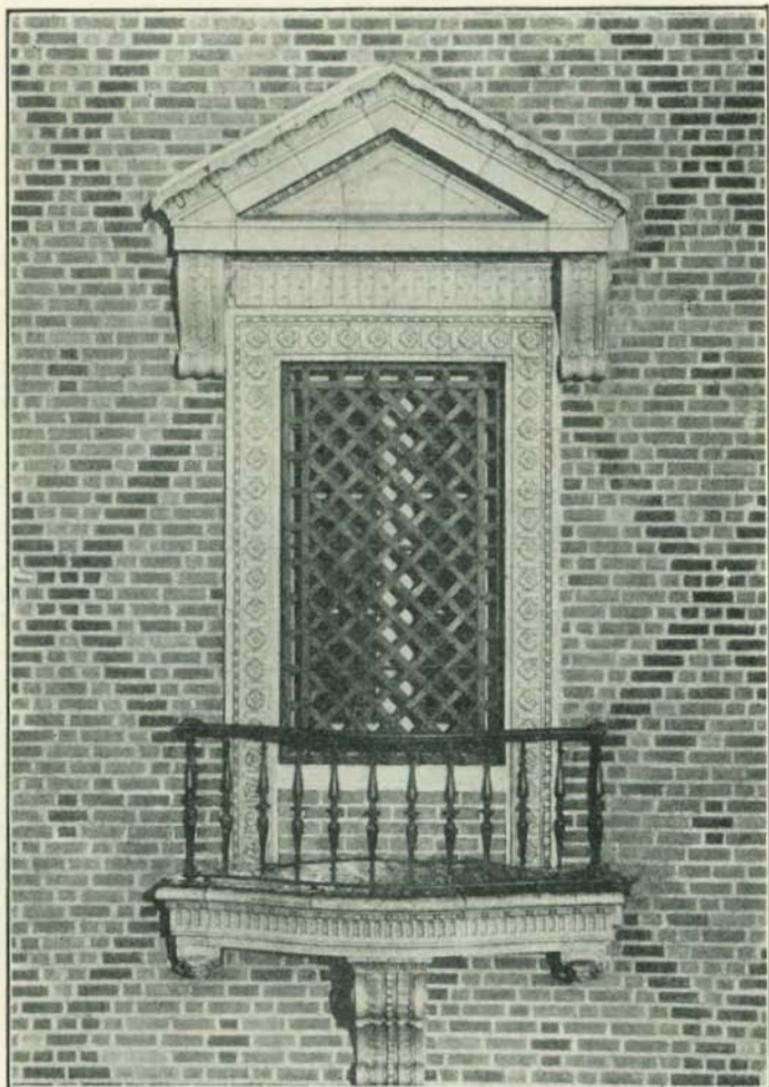
Fig. 140
ORNAMENTAL WROUGHT IRON GRILLES AND
CAST IRON RAILING
TOWER THEATRE, ST. PAUL
Special Designs Upon Request.
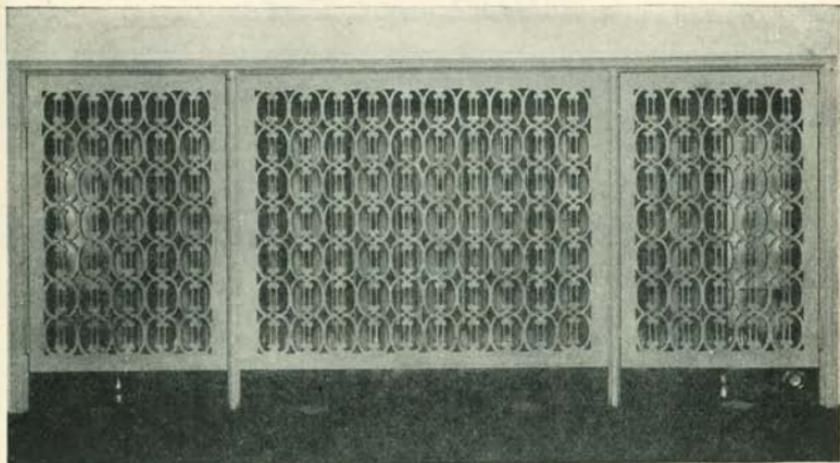
Fig. 141
ORNAMENTAL CAST IRON RADIATOR GRILLE
TOWER THEATRE, ST. PAUL
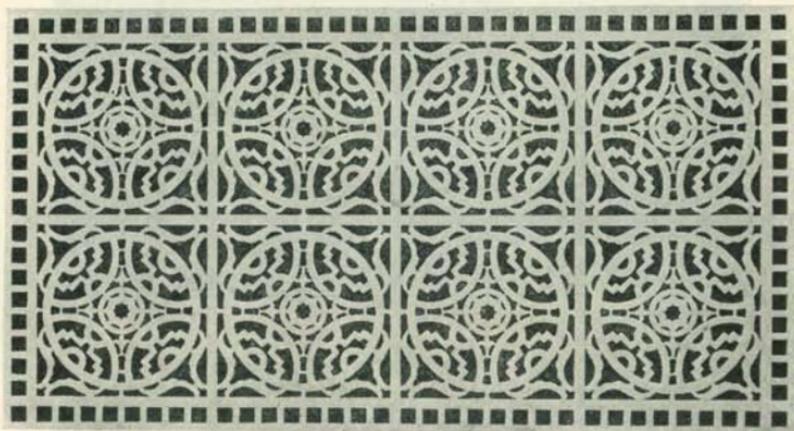
Fig. 142
ORNAMENTAL GRILLE, ST. CATHERINE'S CHAPEL, ST. PAUL
Cast in one piece 9 ft. x 3 ft.
Fabricated by the St. Paul Foundry Company
Special Designs Upon Request
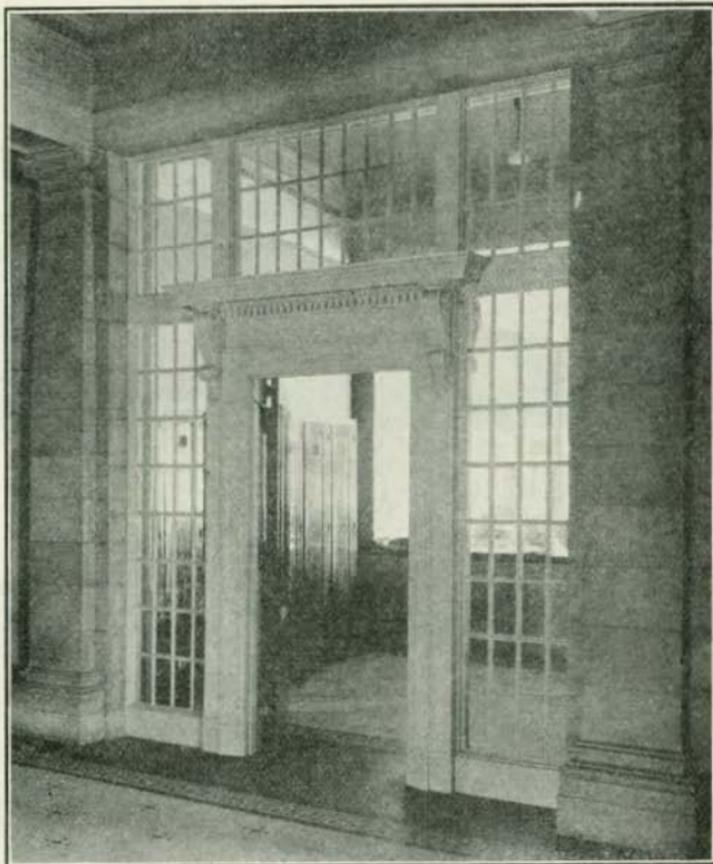
ORNAMENTAL CAST IRON DOOR FRAMES
ADMINISTRATION BUILDING, PRISON
STILLWATER, MINN.

All types of Steel and Cast Iron Door Frames well adapted to
fire-proof buildings.

Special Designs Upon Request.

STEEL DOOR FRAMES

BEAM OR SLAB.

CAST IRON,
STEEL OR
WROUGHT IRON
MOULDINGS.

L FRAME
STEEL STOP BARS.

CAST IRON PLINTHS

FLOOR LINE.
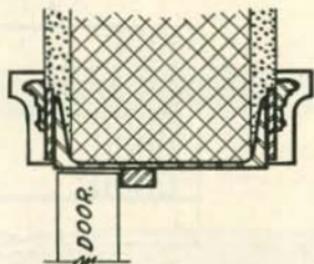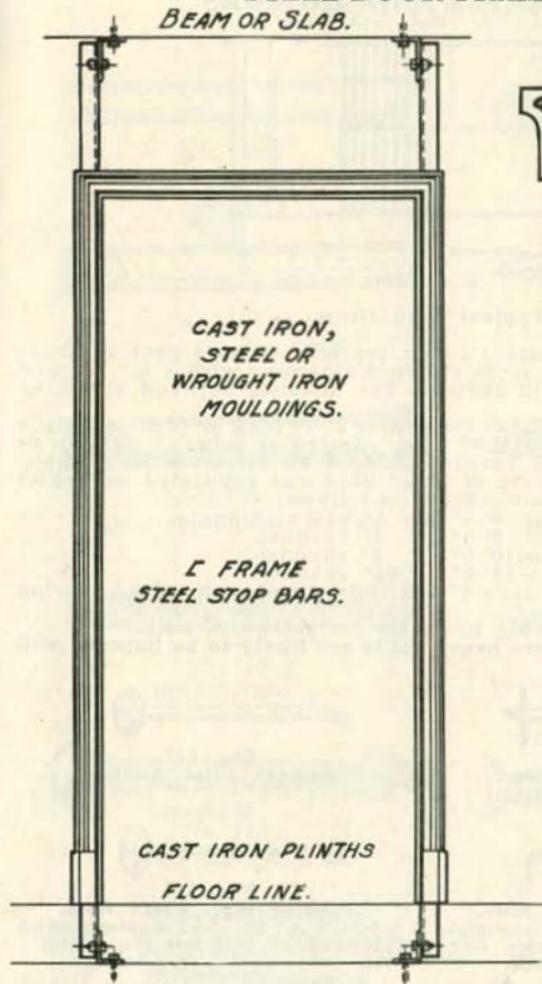
DOOR.

TYPICAL SECTION.

DOOR FRAMES of structural steel are particularly well adapted to tile walls where shocks from the operation of the doors crack the plaster and dislodge tile. It is best to run the vertical members of the frame from floor to ceiling (or from floor to floor steel framing).

Door frames, as well as window frames, are built of structural angles, of channels, or of plates and angles. They are either riveted or welded and are plain or ornamental as desired.

For large or small heavy doors, steel door frames not only support the door, but also protect the brick or concrete walls into which they are built.

STEEL DOORS for chute openings, vaults, coal bins, smoke houses, boiler rooms, etc., are fabricated of steel plates with plate or angle stiffeners and with hinges and locking device. They are best suited to conditions where protection and fireproofness are desired and will stand hard usage. The doors are furnished with or without angle or channel frames and are either welded or riveted. See also Prison Section, pages 236 to 243.

AREA GRATES AND ANCHORS.
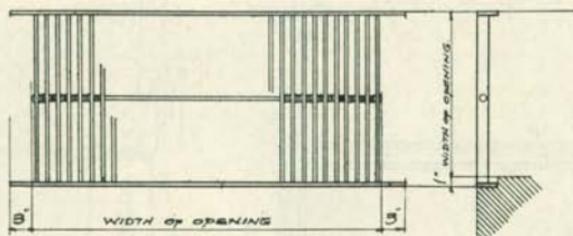
Fig. 143

Typical Area Grate.

Cross bars 1¼ x ¼, bars 1¼″ on centers. Where grates exceed 2′-0″ in width, cross bars to be stiffened sideways with a ⅝″ rod and cast thimbles as shown in sketch. The distance between stiffening rods not to exceed 1′-6″.

Frames to be of 2x⅜″ bar for grates 3′-0″ long or less. Of 2½″x ⅜″ bar for grates 3′-0″ to 4′-0″ long. Grates of longer length to be supported by angle iron brackets placed at intervals if possible, otherwise frame to be made of 2x⅜″ bars and supported by angles or channels placed loose underneath as follows:

Span 4′-0″ to 6′-0″ use 3½x2½x¼″ angle.
" 6′-0″ to 8′-0″ " 3″ channel.
" 8′-0″ to 10′-0″ " 4″ channel.
" 10′-0″ to 12′-0″ " 5″ channel.

Channels and angles have 6″ bearing at each end and no bearing plates.

These instructions apply to grates for sidewalks only.

Grates for alleys where heavy loads are likely to be imposed will require special design.

No. 144
Standard Joist Anchor.
Bar 1″x¼″—2′-6″ and pin
½″x4″.

Fig. 147
Special Joist Anchor.
Bar 1″x¼″—2′-6″ and cast
Washer.
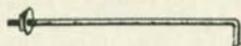
Fig. 145
Standard Wall Plate Bolt.
⅝″∅—2′-6″ lg. turned 3″ one end.
Cut washer and nut other end.

Fig. 148
Special Wall Plate Bolt.
⅝″∅—2′-6″ lg. cast washer 1 end.
Cut washer and nut other end.
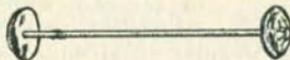
Fig. 146
Vault Rod.
Round rod (dia. variable) and
cast washers.
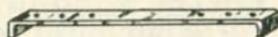
Fig. 149
Strap Anchor.
Bar 1″x¼″—2′-6″

Note:—We make special anchors of any size and kind.
See opposite page for various types of bolts.

TYPES OF BOLTS

No. 150
Plain Round Drift Bolt

No. 151
Plain Square Drift Bolt

No. 152
Round Drift Bolt, Pointed

No. 153
Square Drift Bolt, Pointed

No. 154
Round Drift Bolt, Head and Point

No. 155
Square Drift Bolt, Head and Point

No. 156
Boat Spike

No. 157
Lag Screw

No. 158
Round Head Machine Bolt

No. 159
Countersunk Head Machine Bolt
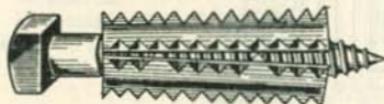
No. 160
Expansion Bolt

No. 161
Wedge Expansion Bolt

**We carry a large stock of Machine Bolts, and can deliver on short notice.
We manufacture bolts as illustrated above in a variety of sizes.
Special bolts of any description made to order.**

WROUGHT IRON AND WIRE WINDOW GRILLES
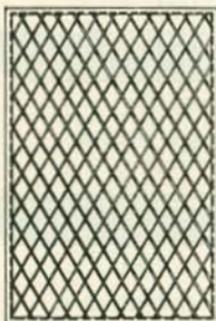
Diamond Mesh, Crimped Wire. | Diamond Mesh, Crimped Wire. | Basket Weave, Flat Wire.
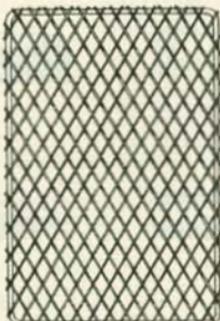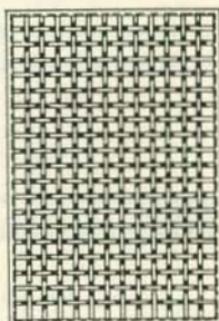
Fig. 162

Made of Channel Iron Frame and

No. 12 Wire—1″	mesh.
No. 10 Wire—1½″	mesh.
No. 8 Wire—2″	mesh.
No. 7 Wire—2″	mesh.
No. 6 Wire—2½″	mesh.

These can be made square mesh.

Fig. 163

Made of Round Iron Frame and

No. 12 Wire—1″	mesh.
No. 10 Wire—1½″	mesh.
No. 8 Wire—2″	mesh.
No. 7 Wire—2″	mesh.
No. 6 Wire—2½″	mesh.

These can be made square mesh.

Fig. 164

Made of Channel Iron Frame and

¼ x ¹⁄₃₂″ Flat Iron—1″	mesh.
¼ x ¹⁄₃₂″ Flat Iron—1¼″	mesh.
¼ x ¹⁄₃₂″ Flat Iron—1½″	mesh.
½ x ⅛″ Flat Iron—2″	mesh.
⅝ x ⅛″ Flat Iron—2½″	mesh.

These can be made diamond mesh.
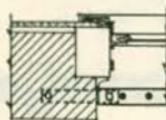
Fig. 166

Method A.

In this case anchors are first built in and guard placed later.

Fig. 167

Method B.

The guard in this case must be set before wall is built up.

Fig. 165

Method A. | Method B.
Of anchoring guard into wall. | Of anchoring guard into wall.

Special Designs Upon Application.

AUTOMOBILE TURNTABLE.

Plan of
Top Casting

Plan of
Bottom Casting

10½"

¾ Anchor bolt

6'-0"
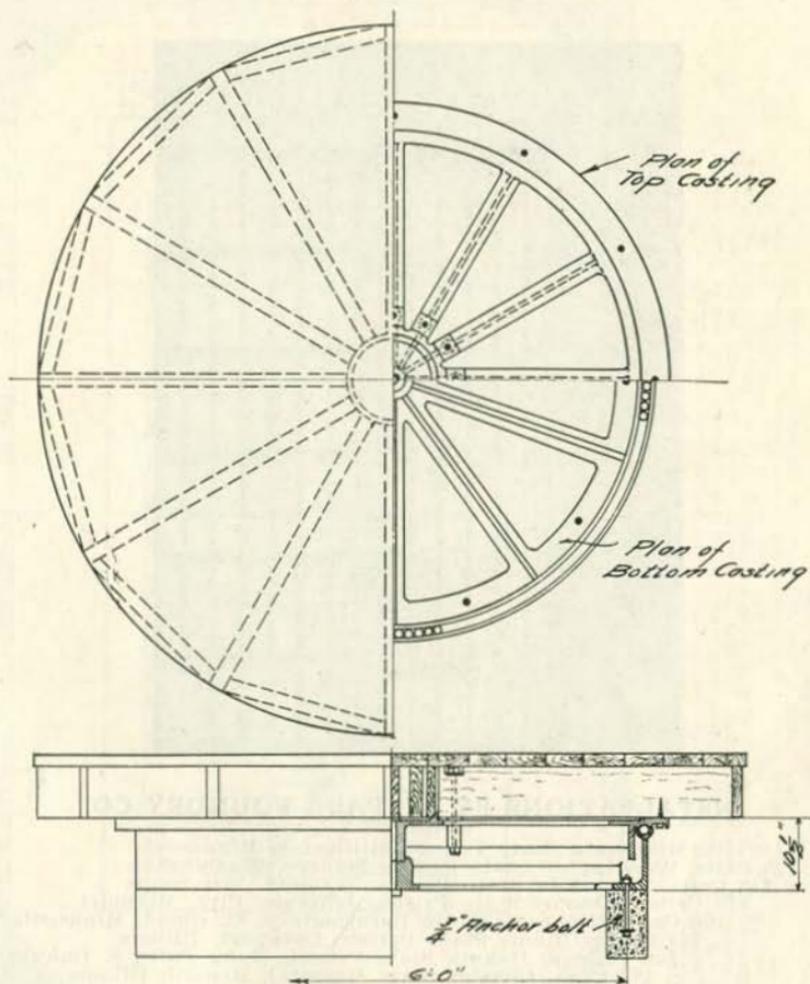
The entire support is the ball bearing rim which eliminates friction at the sides and allows the table to turn easily.

There are no parts to lose and no attention is required after setting.

Made 10 to 12 feet in diameter.

Will carry the heaviest cars.

PRISONS, CELLS AND EQUIPMENT
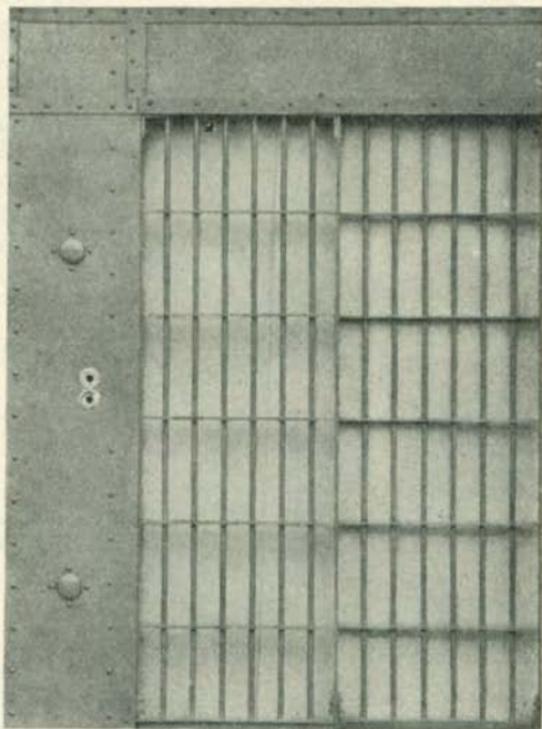
INSTALLATIONS BY ST. PAUL FOUNDRY CO.

1224 Cells, Minnesota State Prison, Stillwater, Minnesota
320 Cells, Washington State Prison, Monroe, Washington
440 Cells, Wisconsin State Prison, Waupun, Wisconsin
320 Cells, Missouri State Prison, Jefferson City, Missouri
160 Cells, Minnesota State Reformatory, St. Cloud, Minnesota
744 Cells, Illinois State Prison, Lockport, Illinois
200 Cells, S. Dakota State Prison, Sioux Falls, S. Dakota
184 Cells, Chester State Hospital, Menard, Illinois

These installations include, severally, window guards, barred partitions, plate and barred doors, balcony framing with stairs and railing, cell equipment, wagon locks, and railroad gates, all as illustrated on the following pages.

KEY:
A—CELL FRONTS.
B—OPERATING LEVER BOX.
C—BUNKS.
D—FOLDING SHELVES.
E—CLOSETS.
F—WASH BASINS.
G—IRON STAIRS.
H—STEEL BARS, PANEL.
I—STEEL FRAMING.
J—GUARD OR BALCONY RAILING.
K—FACILITY CORRIDOR.
L—VENT CHAMBER.
M—DOOR STAND.

LENGTH OF CELL BLOCK VARIABLE UP TO 40 CELLS OPERATED BY ONE LOCKING STATION.
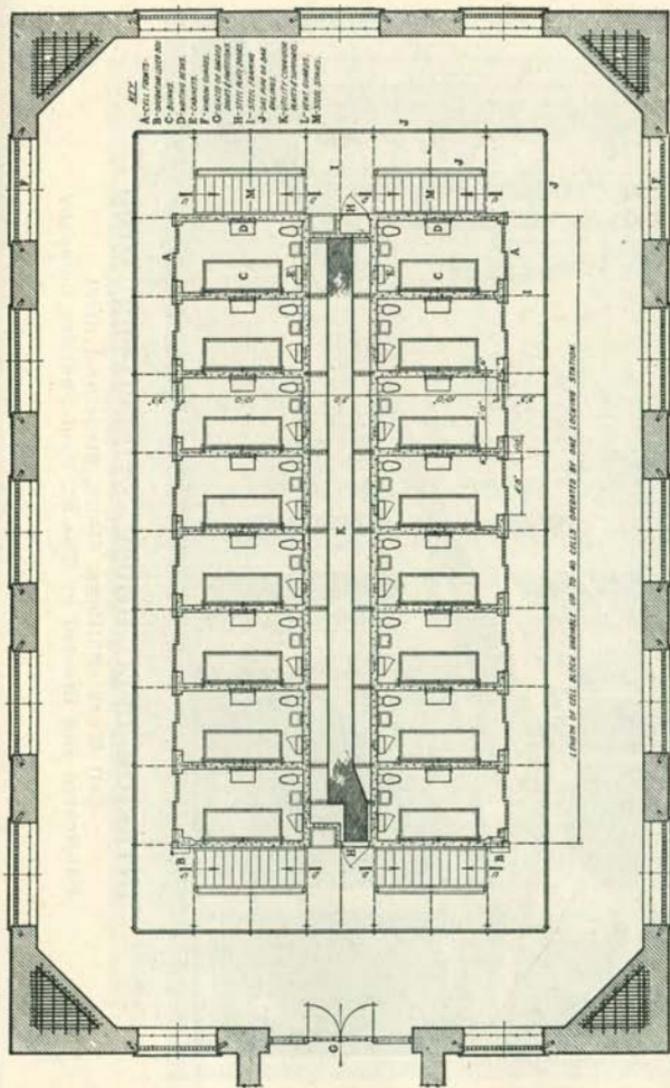
TYPICAL PLAN OF CELL HOUSE

SPECIFICATIONS

The construction of our cell installations complies with the following specifications:

The cells are to be locked or unlocked simultaneously by the operation of a geared lever box at one end of a battery of cells. The locking mechanism is to be arranged so that the officer in charge may unlock any one or a number of cells and may withdraw from the gang operation, i. e. dead lock with a key, any one, or a number of cells. Furthermore, the mechanism shall be so arranged that any or all doors are locked in the open position, if desired, are locked in any intermediate position from open towards the closed position, and locked upon being closed by the prisoner. When the doors are closed and dead locked at the operating box, the cells are locked at five places, i. e. by means of three dogs on the door, by means of a pawl, and by the lock. Doors are to hang true and be provided with roller bearings. All workmanship is to be first class and foot-proof.
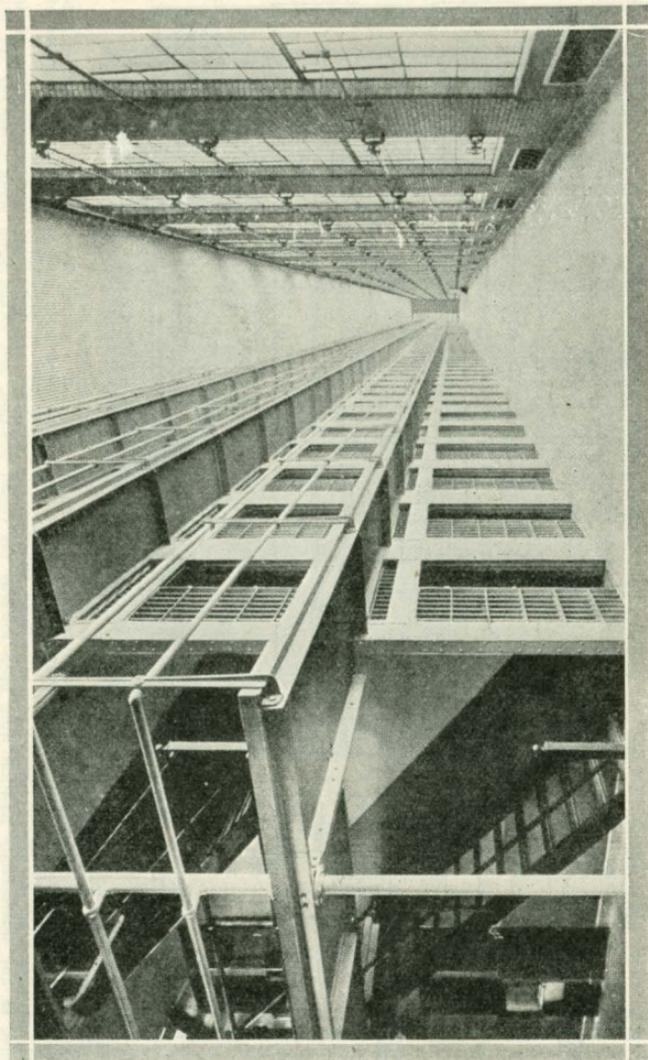
INTERIOR CELL HOUSE, STILLWATER, MINN.
Cell Work, Railings, Stairs, Structural Steel
Fabricated and Erected by The St. Paul Foundry Company
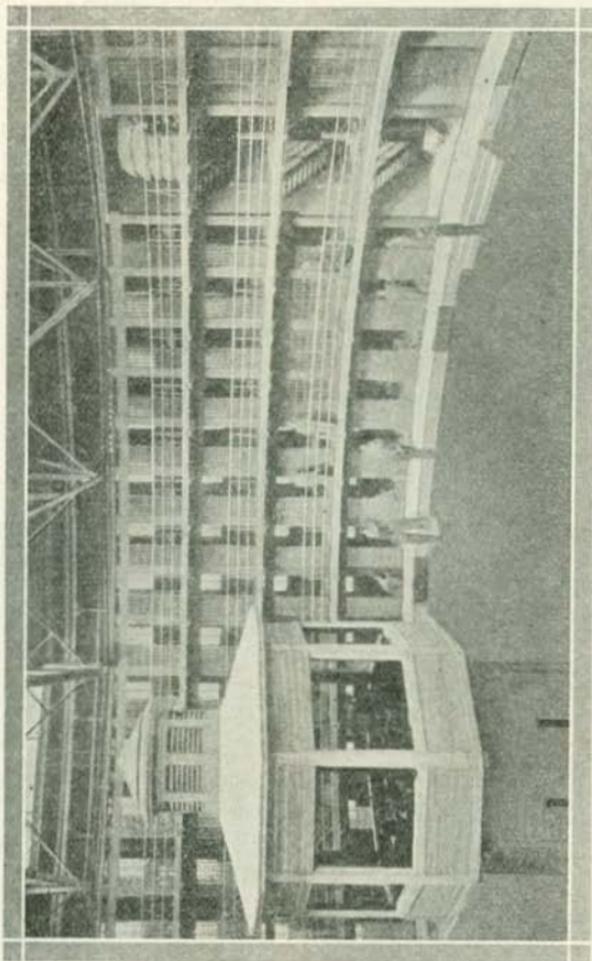
CELL HOUSE, LOCKPORT, ILL.

Cell House of 248 cells with locks operated hydraulically in batteries of 31 cells from a central station. Three cell houses equipped by the St. Paul Foundry Co.
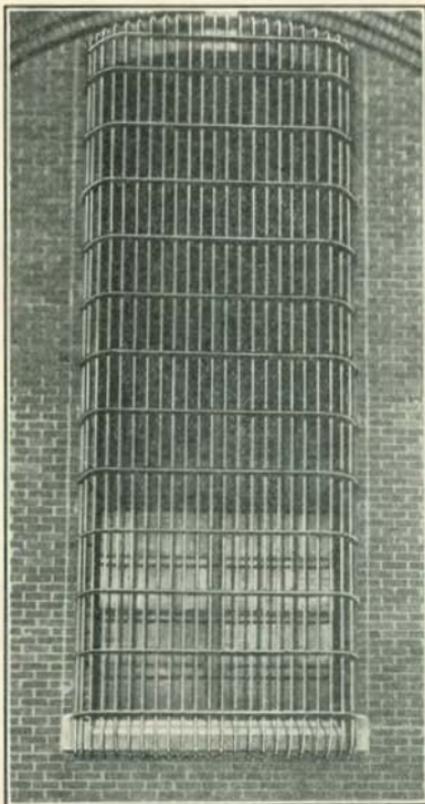
WINDOW GUARDS
Indiana Reformatory
Pendleton, Indiana

These guards are 7'-2" wide by 20'-9" high, of tool-proof steel, horizontal bars 2¼" by ½" with vertical bars ⅞" round, all carefully mortised and welded. These were made in sections to be riveted in the field.

Among other guards fabricated by us were the 23 window guards 8'-6" by 36'-9" for cell house D and 128 similar guards for cell houses A and B of Stillwater Prison. Some window guards, those installed at the St. Cloud Minnesota Reformatory, have 1¼" round bars.

PLATE DOORS

These doors can be made in varying sizes carefully fitted, riveted and welded. They are equipped with standard prison locks in steel case, cast steel ball bearing hinges, nickel plated brass door pulls and escutcheons.

The same equipment applies to our steel barred doors which are designed with bar or angle frames for strength and stiffness.

Both types of doors may be fitted to angle or channel frames and double doors are fitted with a lock of the Cremorne type.
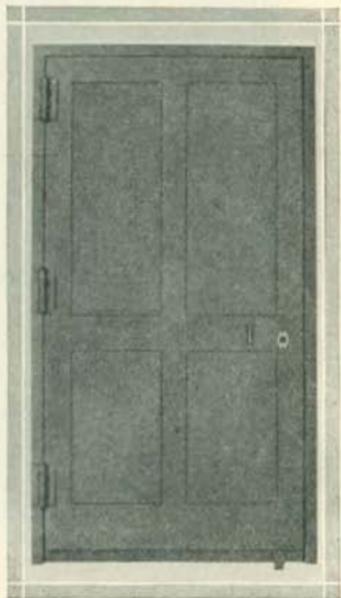
CABINETS

These cast iron cabinets, about 18 in. by 24 in., are part of the equipment installed in each cell. They are furnished with shelves, mirror, and a lock.

A cast iron support frame is set into the concrete forms as a permanent and rigid anchor for the cabinet.
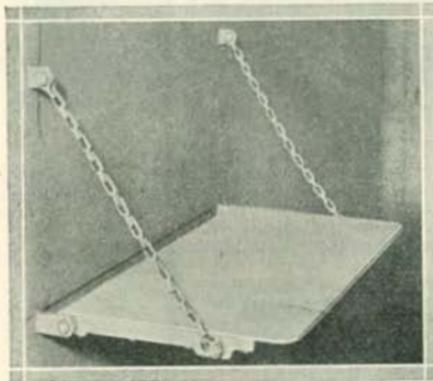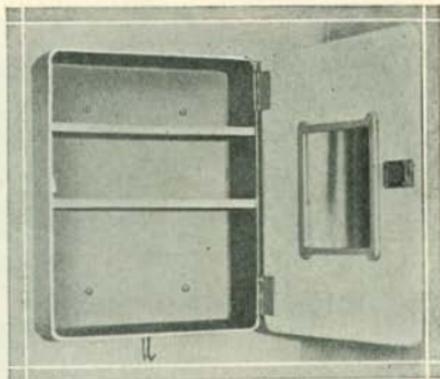
WRITING DESKS

Each cell is equipped with a hinged writing desk 12" deep by 2' long , of $\frac{3}{16}$" steel plate.

A cast iron frame is set into the forms as a permanent support, after concreting, for these desks. A substantial chain supports the desk in its lowered position.

BUNKS

The sleeping bed or bunk for the prisoner is a hinged structural steel frame, 2'-6" deep by 6'-7½" long, equipped with suitable slats or springs to support the mattress.

These bunks are pivoted on a structural steel supporting frame which is set into the forms before concreting. Substantial chains support the bunk in its lowered position.
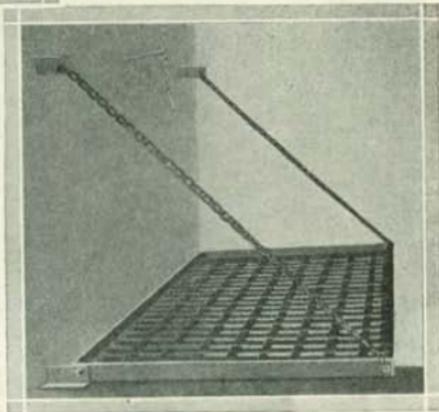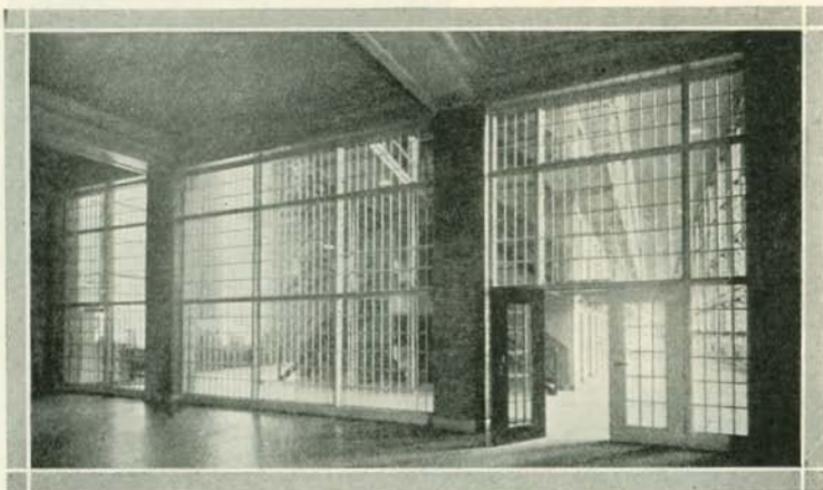
GLAZED STEEL PARTITIONS

This picture shows glazed partitions of various sizes, the largest being 10'-10" wide by 16'-5" high. The frame consists of 7" channels with cover plates, stops, etc. The frame for the doors is of 3" channel, the door opening being 6' wide by 7' high. Steel sash frames for the glass are fitted into the structural steel panels.

BARRED PARTITIONS

The partition shown is 15' wide by 13' high, made of 5" channel framing with 2¼" by ⅜" horizontal bars, and ⅞" round vertical bars. Several of these partitions around an enclosure form the turnkey's cage at the Stillwater Prison.
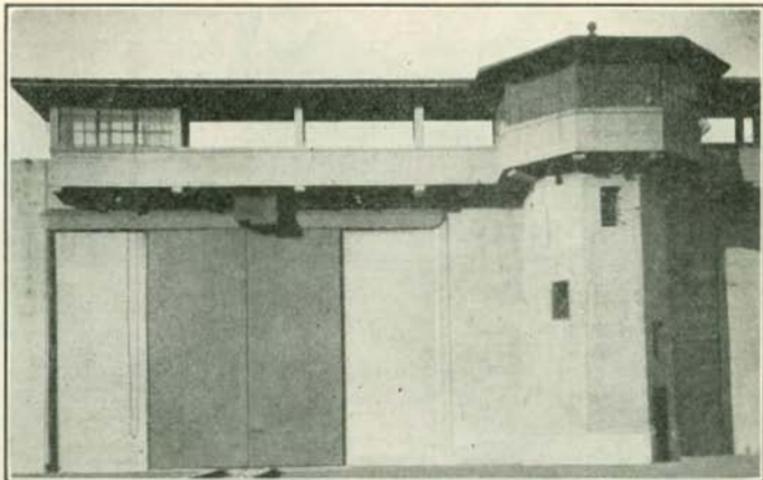
RAILROAD GATE, ILLINOIS STATE PENITENTIARY
Lockport, Illinois

The railroad gate is 17' wide by 22' high, built of channel framing, covered with plating on both sides. The gate is operated by an electric motor actuated by push button control by a man in the tower while a man on the ground unlocks the door with a key which throws the control in circuit and permits the door to open. Limit switches automatically control the open and closed position of the door.
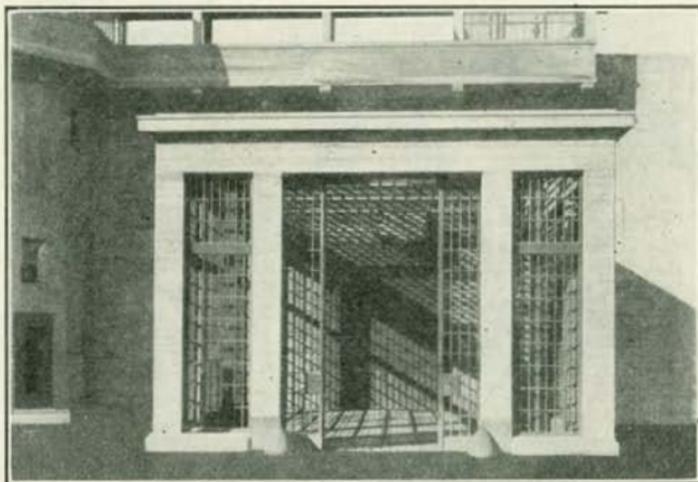
WAGON LOCK

The wagon lock is a barred enclosure 21' wide by 30' long with a 10' by 14' plate door at one end and a similar barred door at the other. The operation of the door controls is similar to the railroad gate above except that the doors of the wagon lock are interconnected electrically so that neither can be opened unless the other is closed and locked.

**LOCOMOTIVE
CYLINDER
CASTING**

(7 tons)

**MOTOR
BLOCK
CASTING**

(3½ lbs.)

We also make brake shoes and hundreds
of miscellaneous railroad castings.
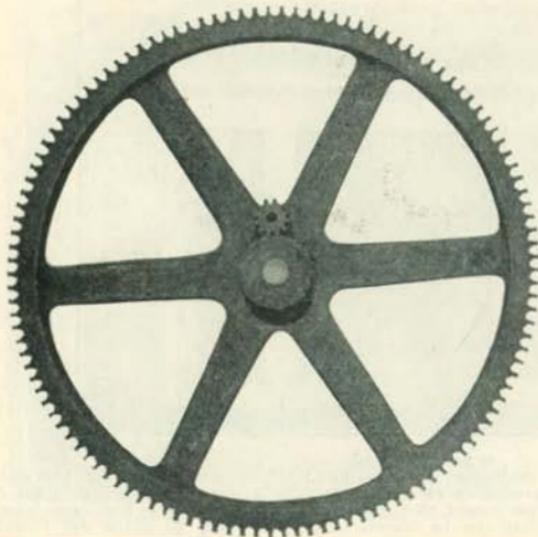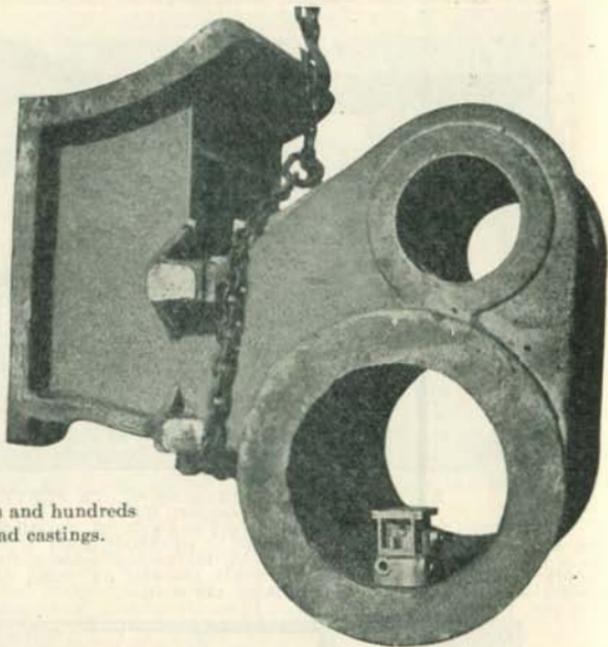
**GREY IRON SPUR
GEARS**

(4″ to 5′-6″ diam.)

We make various designs of
cut gears and pinions.
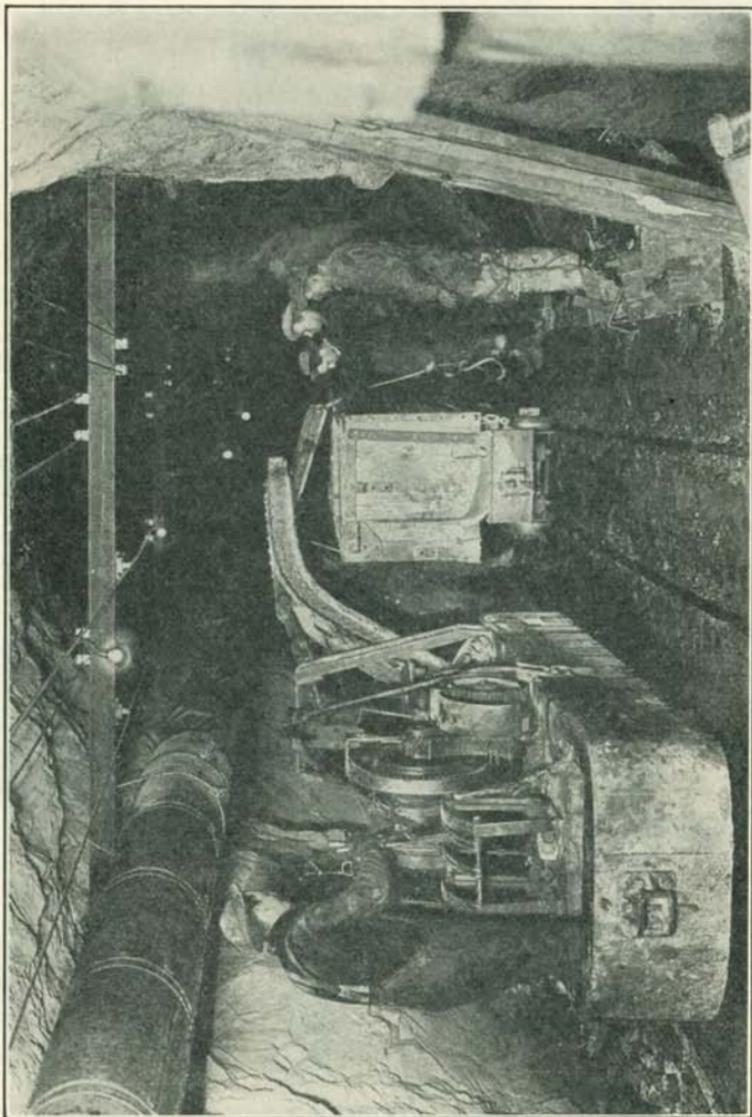
"CHERRY PICKER" G. N. RY. CASCADE TUNNEL
Used for Shifting Empty Cars to the Loading Track.
Fabricated for A. Guthrie & Co., St. Paul, Minn.
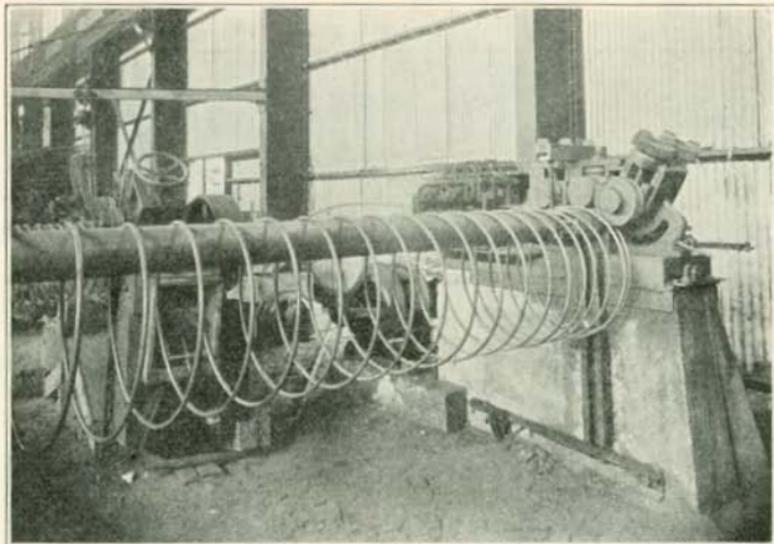
MACHINE FOR MAKING REINFORCED BAR COLUMN SPIRALS
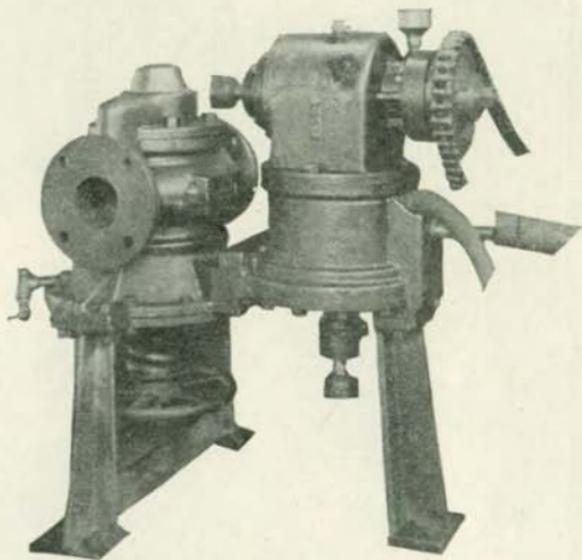
MEYER GOVERNOR
Installed for the control of machinery in paper mills
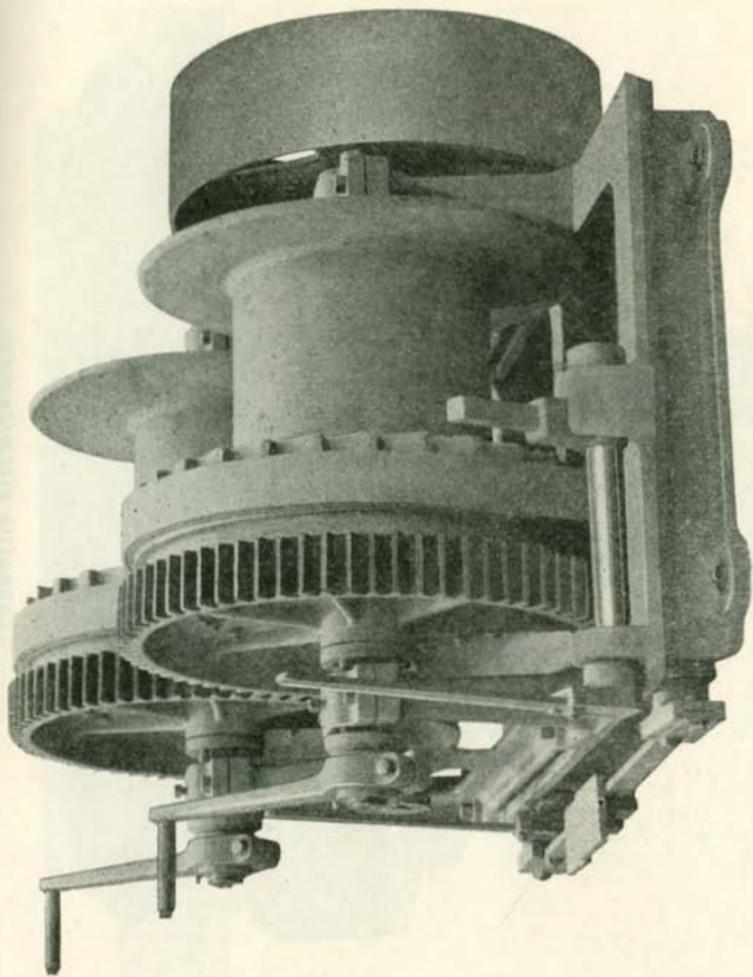
TWO DRUM HOISTING MACHINE
Used for Drag Line Buckets on Highway Construction
Manufactured by the St. Paul Foundry Co.
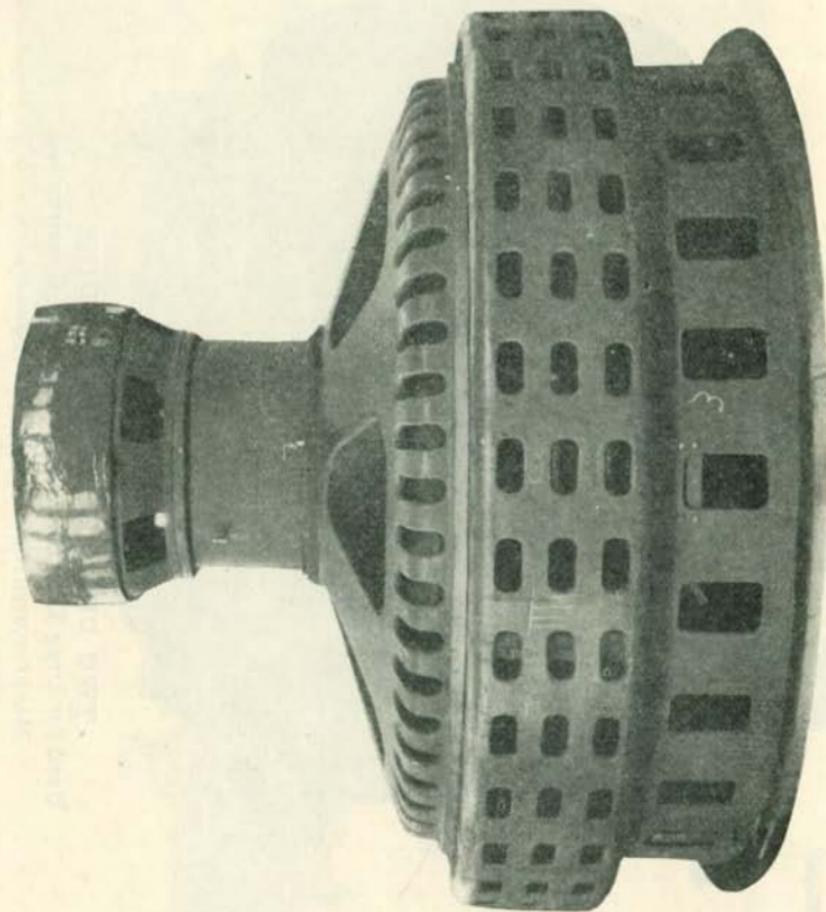
GENERATOR FIELD CASTING.
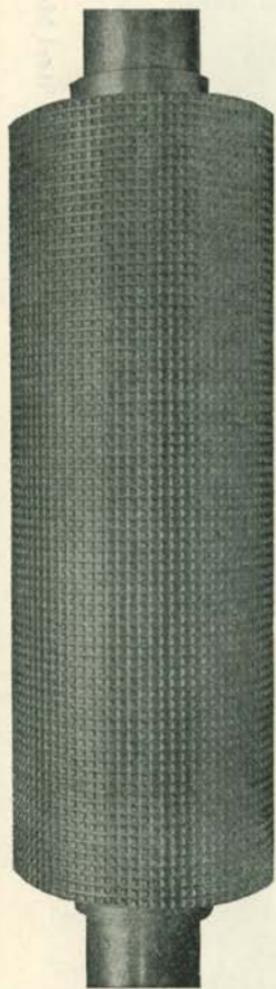
KNURLED ROLLS

18" x 12'6"

Made of cast iron and machined for installation in paper machines
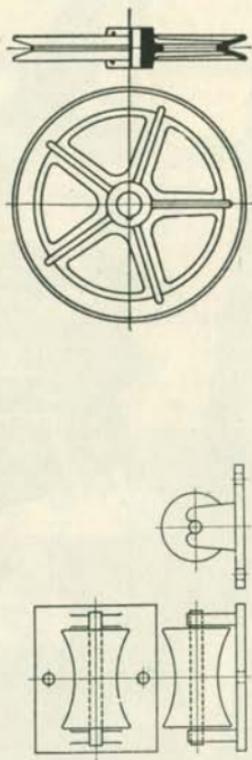
STANDARD PIPE ROLLERS

Fig. R1

CAST IRON SHEAVES

Fig. S1

We have patterns for many sizes of Rollers and Sheaves.

EQUIPMENT REPAIRS
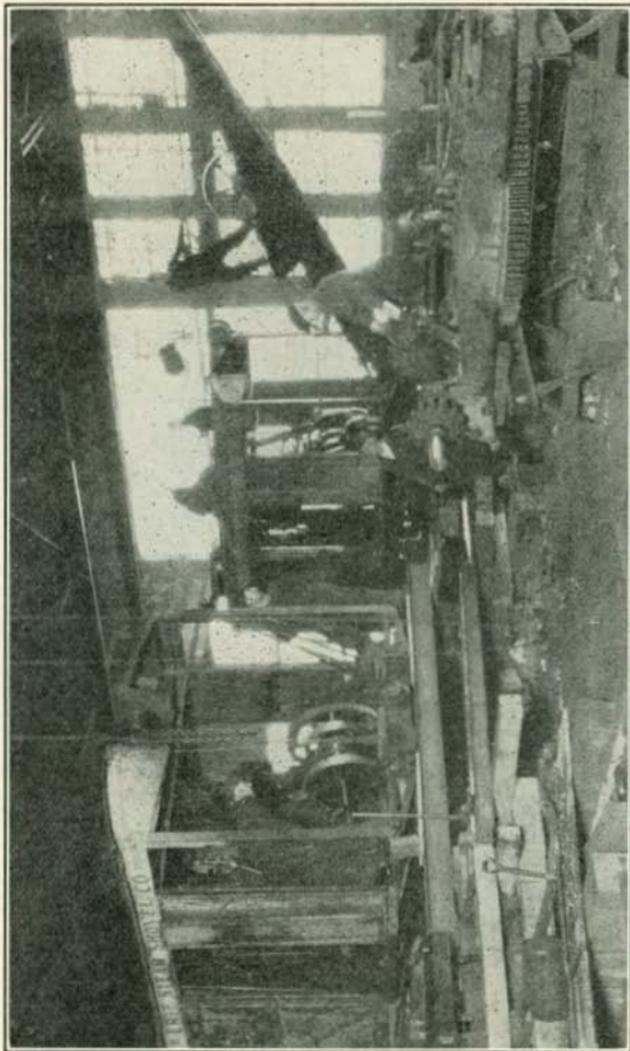
We invite you to store your
Steamshovels—Trench Machines
Road Machinery—Farm Machinery
with us for GENERAL REPAIRS by
expert Blacksmiths, Machinists and Steel Men.
(The Winter Months are best)

PART III

MISCELLANEOUS INFORMATION

Specifications, American Institute of Steel Construction
Specifications, American Society for Testing Material
Specifications, Painting
Building Codes, Various Cities
Weights of Building Material
Slabs, Footings, Grillages, Bearing Plates, Calculations
Calculations for Beams
Notes on Wood and Fireproof Floors, Various Types
Notes on Roofs, Various Types of Trusses, Suspended
    Ceilings
Notes on Federal Tile, Gypsum, and Steel Roofs
Corrugated Sheeting, Hy-Rib
Notes on Copper Steel, Checkered Plate
Properties and Safe Loads of Gas Pipe Columns
Dimensions for Round and Square Bars, Turnbuckles,
    Clevises, Pins and Loops
Nails and Spikes, Bolts and Nuts
Steel Sash
Water Tanks
Notes on Chains and Chain Slings
Safe Loads of Wood Columns and Beams
Notes on Gears and Pinions, Sprockets and Chains, Belts
    and Pulleys, Rope Drives, Shafting
Typical Construction Details
Mensuration, Equivalents of Measure

See Index

STANDARD SPECIFICATION FOR STRUCTURAL STEEL FOR BUILDINGS

As adopted by the
American Institute of Steel Construction

1. This Specification defines the practice adopted by the American Institute of Steel Construction for the design, fabrication, and erection of structural steel for buildings.

2. GENERAL

To obtain a satisfactory structure, the following major requirements must be fulfilled.

(a) The material used must be suitable, of uniform quality, and without defects affecting the strength or service of the structure.

(b) Proper loads and conditions must be assumed in the design.

(c) The unit stresses must be suitable for the material used.

(d) The workmanship must be good, so that defects or injuries are not produced in the manufacture.

(e) The computations and design must be properly made so that the unit stresses specified shall not be exceeded, and the structure and its details shall possess the requisite strength and rigidity.

3. MATERIAL

Structural steel shall conform to the Standard Specifications of the American Society for Testing Materials for Structural Steel for Buildings, Serial Designation A9-21, as amended to date.

4. LOADING

(a) Steel structures shall be designed to sustain the dead weight imposed upon them, including the weight of the steel frame itself, and, in addition, the maximum live load as specified in each particular case. Proper provision shall be made for temporary stresses caused by erection.

(b) In cases where live loads have the effect of producing impact or vibration, a proper percentage shall be added to the static live load stresses to provide for such influences, so that the total stress found in any member is an equivalent static stress.

(c) Proper provision shall be made for stresses caused by wind both during erection and after completion of the building. The wind pressure is dependent upon the conditions of exposure, but the allowable stresses specified in section five (5), paragraphs (f) and (g), are based upon the steel frame being designed to carry a wind pressure of not less than twenty (20) pounds per square foot on the vertical projection of exposed surfaces during erection, and fifteen (15) pounds per square foot on the vertical projection of the finished structure.

(d) Proper provision shall be made to securely fasten the reaction points of all steel construction and transmit the stresses to the foundations of the structure.

5. ALLOWABLE STRESSES

All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per sq. in. shall not exceed the following:

(a) **Tension.** Rolled Steel, on net section...............18,000

(b) **Compression.** Rolled Steel, on short lengths or where lateral deflection is prevented......................................18,000

On gross section of columns,

$$\frac{18,000}{1 + \frac{l^2}{18,000r^2}}$$

with a maximum of......................................15,000

in which l is the unsupported length of the column, and r is the corresponding least radius of gyration of the section, both in inches.

For main compression members, the ratio l/r shall not exceed 120, and for bracing and other secondary members, 200.

(c) **Bending.** On extreme fibres of rolled shapes, and built up sections, net section, if lateral deflection is prevented.........18,000

When the unsupported length l exceeds 15 times b, the width of the compression flange, the stress in pounds per sq. in. in the latter shall not exceed

$$\frac{20,000}{1 + \frac{l^2}{2,000b^2}}$$

The laterally unsupported length of beams and girders shall not exceed 40 times b the width of the compression flange.

On extreme fibres of pins, when the forces are assumed as acting at the center of gravity of the pieces...........................27,000

(d) **Shearing.** On pins...13,500
On power-driven rivets......................13,500
On turned bolts in reamed holes with a clearance of not more than $\frac{1}{50}$ of an inch..13,500
On hand-driven rivets......................10,000
On unfinished bolts........................10,000

On the gross area of the webs of beams and girders, where h, the height between flanges in inches, is not more than 60 times t, the thickness of the web in inches..............................12,000

On the gross area of the webs of beams and girders if the web is not stiffened where h, the height between flanges in inches, is more than 60 times, t, the thickness of the web, the maximum shear per square inch, $\frac{V}{A}$ shall not exceed

$$\frac{18,000}{1 + \frac{h^2}{7,200t^2}}$$

In which V is the total shear, and A is gross area of web in square inches.

		Double Shear	Single Shear
(e) **Bearing.**	On pins...........................30,000	24,000
	On power-driven rivets.............30,000	24,000
	On turned bolts in reamed holes....30,000	24,000
	On hand-driven rivets..............20,000	16,000
	On unfinished bolts................20,000	16,000
	On expansion rollers per lineal inch 600 times the diameter of the roller in inches.	

(f) **Combined Stresses.** For combined stresses due to wind and other loads, the permissible working stress may be increased $33\frac{1}{3}\%$, provided the section thus found is not less than that required by the dead and live loads alone.

(g) **Members Carrying Wind Only.**

For members carrying wind stresses only, the permissible working stresses may be increased $33\frac{1}{3}\%$.

6. SYMMETRICAL MEMBERS

Sections shall preferably be symmetrical.

7. BEAMS AND GIRDERS

(a) **Rolled beams** shall be proportioned by the moment of inertia of their net section. Plate girders with webs fully spliced for tension and compression shall be so proportioned that the unit stress on the net section does not exceed the stresses specified in section five (5) as determined by the moment of inertia of the net section.

(b) **Plate girder webs** shall have a thickness of not less than 1-160 of the unsupported distance between the flanges.

(c) **Web splices** shall consist of a plate on each side of the web capable of transmitting the full stress through the splice rivets.

(d) **Stiffeners.** Stiffeners shall be required on the webs of rolled beams and plate girders at the ends and at points of concentrated

loads, and at other points where h the clear distance between flanges is greater than $85t\sqrt{18,000}$ (A/V)—1, in which t is the thickness of the web. When stiffeners are required, the distance in inches between them shall not be greater than $85t\sqrt{18,000}$ (A/V)—1, or not greater than 6 feet. When h is greater than 60 times t the thickness of the web of a plate girder, stiffeners shall be required at distances not greater than 6 feet apart. Stiffeners under or over concentrated loads shall be proportioned to distribute such loads into the web.

Plate girder stiffeners shall generally be in pairs, one on each side of the web, and shall have a close bearing against the flange angles at points of concentrated loading; stiffeners over the end bearings shall be on plate fillers. The pitch of rivet in stiffeners shall not exceed 6".

(e) **Flange plates** of all girders shall be limited in width so as not to extend more than 6" or more than 12 times the thickness of thinnest plate beyond the outer row of rivets connecting them to the angles.

(f) **Crane runway girders** and the supporting framework shall be proportioned to resist the greatest horizontal stresses caused by the operation of the cranes.

(g) **Rivets connecting** the flanges to the web at points of direct load on the flange between stiffeners shall be proportioned to carry the resultant of the longitudinal and tranverse shears.

(h) **Rivets** connecting the flanges to the webs of plate girders and of columns subjected to bending shall be so spaced as to carry the increment of the flange stress between the rivets.

S. COLUMN BASES

(a) Proper provision shall be made to distribute the column loads on the footings and foundations.

(b) The top surface of all column bases shall be planed for the column bearing.

(c) Column bases shall be set true and level, with full bearing on the masonry, and be properly secured to the footings.

9. ECCENTRIC LOADING

Full provision shall be made for stresses caused by eccentric loads.

10. COMBINED STRESSES

(a) Members subject to both direct and bending stresses shall be so proportioned that the greatest combined stresses shall not exceed the allowed limits.

(b) All members and their connections which are subject to stresses of both tension and compression due to the action of live loads shall be designed to sustain stress giving the largest section, with 50% of the smaller stress added to it. If the reversal of stress is due to the action of wind, the member shall be designed for the stress giving the largest section and the connections proportioned for the largest stress.

11. ABUTTING JOINTS

Compression members when faced for bearings shall be spliced sufficiently to hold the connecting members accurately in place. Other joints in riveted work, whether in tension or compression, shall be fully spliced.

12. NET SECTIONS

(a) In calculating tension members, the net section shall be used, and in deducting the rivet holes they shall be taken ⅛ inch greater in diameter than the nominal diameter of the rivets.

(b) Pin-connected tension members shall have the section through the pinhole 25% in excess of the net section of the member, and a net section back of the pin hole equal to 75% of that required through the pin hole.

13. RIVETS AND BOLTS

(a) In proportioning rivets, the nominal diameter of the rivet shall be used.

(b) Rivets carrying calculated stresses, and whose grip exceeds five diameters, shall have their number increased 1% for each addi-

tional 1/10 inch in the rivet grip. Special care shall be used in heating and driving such rivets.

(c) Rivets shall be used for the connections of main members carrying live loads which produce impact, and for connections subject to reversal of stresses.

(d) Finished bolts in reamed holes may be used in shop or field work where it is impracticable to obtain satisfactory power-driven rivets. The finished shank shall be long enough to provide full bearing, and washers used under the nuts to give full grip when turned tight.

Unfinished bolts may be used in shop or field work for connections in small structures used for shelters, and for secondary members of all structures such as purlins, girts, door and window framing, alignment bracing and secondary beams in floor.

14. RIVET SPACING

(a) The minimum distance between centers of rivet holes shall be three diameters of the rivet; but the distance shall preferably be not less than 4½ inches for 1¼ inch rivets, 4 inches for 1⅛ inch rivets, 3½ inches for 1 inch rivets, 3 inches for ⅞ inch rivets, 2½ inches for ¾ inch rivets, 2 inches for ⅝ inch rivets, and 1¾ inches for ½ inch rivets. The maximum pitch in the line of stress of compression members composed of plates and shapes shall not exceed 16 times the thinnest outside plate or shape, nor 20 times the thinnest enclosed plate or shape with a maximum of 12 inches, and at right angles to the direction of stress the distance between lines of rivets shall not exceed 30 times the thinnest plate or shape. For angles in built sections with two gage lines, with rivet staggered, the maximum pitch in the line of stress in each gage line shall not exceed 24 times the thinnest plate with a maximum of 18 inches.

(b) In tension members composed of two angles, a pitch of 3'-6" will be allowed, and in compression members, 2'-0" but the ratio l/r for each angle between rivets shall not be more than ¾ of that for the whole member.

(c) The pitch of rivets at the ends of built compression members shall not exceed four diameters of the rivets for a length equal to 1½ times the maximum width of the member.

(d) The minimum distance from the center of any rivet hole to a sheared edge shall be 2¼ inches for 1¼ inch rivets, 2 inches for 1⅛ inch rivets, 1¾ inches for 1 inch rivets, 1½ inches for ⅞ inch rivets, 1¼ inches for ¾ inch rivets, 1⅛ inches for ⅝ inch rivets, and 1 inch for ½ inch rivets. The maximum distance from any edge shall be 12 times the thickness of the plate, but shall not exceed 6 inches.

15. CONNECTIONS

(a) Connections carrying calculated stresses except for lacing, sag bars, or angles, hand rails, or beam connections, shall not have less than 2 rivets; or for field connections not less than 3 rivets.

(b) Members meeting at a joint shall have their lines of center of gravity meet at a point if practicable; if not, provision shall be made for any eccentricity.

(c) The rivets at the ends of any member transmitting the stresses into that member should have their centers of gravity in the line of the center of gravity of the member; if not, provision shall be made for the effect of the resulting eccentricity. Pins may be so placed as to counteract the effect of bending due to dead load.

(d) When a beam or girder "A" is connected to another member in such a manner that "A" acts as a continuous or fixed end beam, proper provision shall be made for the bending moments at such a connection.

(e) Where stress is transmitted from one piece to another, through a loose filler, the number of rivets shall be properly increased; tight-fitting fillers shall be preferred.

16. LATTICE

(a) The open sides of compression members shall be provided with lattice having tie plates at each end and at intermediate points

if the lattice is interrupted. Tie plates shall be as near the ends as practicable. In main members carrying calculated stresses the end tie plates shall have a length of not less than the distance between the lines of rivets connecting them to the flanges, and intermediate ones of not less than one-half of this distance. The thickness of tie plates shall not be less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the members, and the rivet pitch shall not be more than four diameters. Tie plates shall be sufficient in size and number to equalize the stress in the parts of the members.

(b) Lattice bars shall have neatly finished ends. The thickness of lattice bars shall be not less than one-fortieth for single lattice and one-sixtieth for double lattice of the distance between end rivets; their minimum width shall be as follows:

For 15″ channels, or built sections with 3½″ and 4″ angles—2¼″ (¾″ rivets), or 2½″ (⅞″ rivets).

For 12″, 10″, and 9″ channels, or built sections with 3″ angles—2¼″ (¾″ rivets).

For 8″ and 7″ channels, or built sections with 2½″ angles—2″ (⅝″ rivets), or 2¼″ (¾″ rivets).

For 6″ and 5″ channels, or built sections with 2″ angles—1½″ (½″ rivets), or 1¾″ (⅝″ rivets).

(c) The inclination of lattice bars to the axis of the members shall generally be not less than 45° but when the distance between the rivet lines in the flanges is more than 15 inches, the lattice shall be double and riveted at the intersection if bars are used, or else shall be made of angles.

(d) Lattice bars shall be so spaced that the ratio l/r of the flange included between their connections shall be not over ¾ of that of the member as a whole.

17. EXPANSION

Proper provision shall be made for expansion and contraction.

18. MINIMUM THICKNESS

No steel less than 5⁄16 inch thick shall be used for exterior construction, nor less than ¼ inch for interior construction, except for linings or fillers and rolled structural shapes.

These provisions do not apply to light structures such as skylights, marquees, fire-escapes, light one-story buildings, or light miscellaneous steel work.

For trusses having end reactions of 35,000 pounds or over, the Gusset Plates shall be not less than ⅜ inch thick.

19. ADJUSTABLE MEMBERS

The initial stress in adjustable members shall be assumed as not less than 5,000 lbs.

20. WORKMANSHIP

(a) All workmanhip shall be equal to the best practice in modern structural shops.

(b) Drifting to enlarge unfair holes shall not be permitted.

(c) The several pieces forming built sections shall be straight and fit close together; and finished members shall be free from twists, bends, or open joints.

(d) Rolled sections, except for minor details, shall not be heated.

(e) Wherever steel castings are used, they shall be properly annealed.

(f) **Punching.** Material may be punched 1⁄16 inch larger than the nominal diameter of the rivets, whenever the thickness of the metal is equal to or less than the diameter of the rivets, plus ⅛ inch. When the metal is thicker than the diameter of the rivet, plus ⅛ inch, the holes shall be drilled, or sub-punched and reamed.

(g) Rivets are to be driven hot, and wherever practicable, by power. Rivet heads shall be of hemispherical shape and uniform size throughout the work for the same size rivet, full, neatly finished, and concentric with the holes. Rivets, after driving, shall be tight, completely filling the holes, and with heads in full contact with the surface.

(h) Compression joints depending upon contact bearing shall have the bearing surfaces truly faced after the members are riveted. All other joints shall be cut or dressed true and straight, especially where exposed to view.

(i) The use of a burning torch is permissible if the burned metal is not carrying stresses during the burning. Stresses shall not be transmitted into the metal through a burned surface.

21. PAINTING

(a) Parts not in contact, but inaccessible after assembling, shall be properly protected by paint.

(b) All steel work, except where encased in concrete, shall be thoroughly cleaned and given one coat of acceptable metal protection well worked into the joints and open spaces.

(c) Machine finished surfaces shall be protected against corrosion.

(d) Field painting is a phase of maintenance, but it is important that unless otherwise properly protected, all steel work shall after erection be protected by a field coat of good paint applied by a competent painter.

22. ERECTION

(a) The frame of all steel skeleton buildings shall be carried up true and plumb, and temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment, and the operation of same. Such bracing shall be left in place as long as may be required for safety.

(b) As erection progresses the work shall be securely bolted up to take care of all dead load, wind and erection stresses.

(c) Wherever piles of material, erection equipment, or other loads are carried during erection, proper provision shall be made to take care of stresses resulting from the same.

(d) No riveting shall be done until the structure has been properly aligned.

(e) Rivets driven in the field shall be heated and driven with the same care as those driven in the shop.

23. INSPECTION

(a) Material and workmanship at all times shall be subject to the inspection of experienced engineers representing the purchaser.

(b) Material or workmanship not conforming to the provisions of this Specification shall be rejected at any time defects are found during the progress of the work.

(c) The Contractor furnishing such material or doing such work shall promptly replace the same.

(d) All inspection as far as possible shall be made at the place of manufacture, and the Contractor or Manufacturer shall co-operate with the Inspector, permitting access for inspection to all places where work is being done.

STRUCTURAL CAST IRON

1. Except where chilled iron is specified, all castings shall be tough gray iron, free from injurious cold-shuts or blow-holes, true to pattern, and of a workmanlike finish. Sample pieces, one inch square, cast from the same heat of metal in sand moulds, shall be capable of sustaining on a clear span of 4 feet 8 inches a central load of 500 pounds when tested in the rough bar.

Chemical Relations of Pig Iron, Wrought Iron and Plain Steel

Name	PER CENT. OF					
	Iron	Carbon	Manganese	Sulphur	Phosphorus	Silicon
Pig Iron	91 —94	3.50—4.50	.50—2.50	.018—.100	.030—1.00	.25—3.50
Plain Steel	98.1—99.5	.07—1.30	.30—1.00 (.03—.10 as cast)	.020—.060 (.120)	.002—.100	.005— .50
Wrought Iron	99.0—99.8	.05— .25	.01— .10	.020—.100	.050— .20	.02— .20

AMERICAN SOCIETY FOR TESTING MATERIALS
1315 Spruce Street, Philadelphia, Pa.
STANDARD SPECIFICATIONS
FOR
STRUCTURAL STEEL FOR BUILDINGS
Serial Designation: A9-24

These specifications are issued under the fixed designation A 9: the final number indicates the year of original adoption as standard or, in the case of revision, the year of last revision.

Adopted, 1901; Revised, 1909, 1913, 1914, 1916, 1921, 1924.

I. MANUFACTURE
Process

1. (a) Structural steel, except as noted in Paragraph (b), shall be made by either or both the following processes: Bessemer or open-hearth.

(b) Rivet steel, and steel for plates or angles over ¾ in. in thickness which are to be punched, shall be made by the open-hearth process.

II. CHEMICAL PROPERTIES AND TESTS
Chemical Composition

2. The steel shall conform to the following requirements as to chemical composition:

		Structural Steel	Rivet Steel
Phosphorus	{ Bessemer ....not over 0.10 per cent	....
	{ Open-hearth ....not over 0.06 per cent	........not over 0.06 per cent
Sulfur	....	................not over 0.045 per cent

Ladle Analyses

3. (a) A carbon determination shall be made of each melt of Bessemer steel, and determinations for manganese, phosphorus and sulfur representing the average of the melts applied for each 12-hour period.

(b) An analysis of each melt of open-hearth steel shall be made for carbon, manganese, phosphorus and sulfur.

(c) These analyses shall be made by the manufacturer from test ingots taken during the pouring of each melt. The chemical composition thus determined shall be reported to the purchaser or his representative and shall conform to the requirements specified in Section 2.

Check Analyses

4. Analyses may be made by the purchaser from finished material representing each melt. The phosphorus and sulfur content thus determined shall not exceed that specified in Section 2 by more than 25 per cent.

III. PHYSICAL PROPERTIES AND TESTS
Tension Tests

5. (a) The material shall conform to the following requirements as to tensile properties:

Properties Considered	Structural Steel	Rivet Steel
Tensile strength, lb. per sq. in...	55,000—65,000	46,000—56,000
Yield point, min., per sq. in......	0.5 tens. str.	0.5 tens. str.
but in no case less than.......	30,000	25,000
Elongation in 8 in., min., per cent.	1,400,000[A]	1,400,000
Elongation in 2 in., min., per cent.	Tens. str. 22	Tens. str. ....

[A] See section 6.

(b) The yield point shall be determined by the drop of the beam of the testing machine.

Modifications in Elongation

6. (a) For structural steel over ¾ in. in thickness, a deduction from the percentage of elongation in 8 in. specified in Section 5 (a) of 0.25 per cent shall be made for each increase of ⅟₃₂ in. of the

specified thickness above ¾ in., to a minimum of 18 per cent.

(b) For structural steel under ⁵⁄₁₆ in. in thickness, a deduction from the percentage of elongation in 8 in. specified in Section 5 (a) of 1.25 per cent shall be made for each decrease of ¹⁄₃₂ in. of the specified thickness below ⁵⁄₁₆ in.

Bend Tests

7. (a) Bend test specimens, except as specified in Paragraph (b), shall stand being bent cold through 180 deg. without cracking on the outside of the bent portion, as follows: For material ¾ in. or under in thickness, flat on itself; for material over ¾ in. to and including 1¼ in. in thickness, around a pin the diameter of which is equal to the thickness of the specimen; and for material over 1¼ in. in thickness, around a pin the diameter of which is equal to twice the thickness of the specimen.

(b) Bend test specimens for rivet steel shall stand being bent cold through 180 deg. flat on themselves without cracking on the outside of the bent portion.

Test Specimens

8. (a) Test specimens shall be prepared for testing from the material in its rolled or forged condition, except as specified in Paragraphs (b) and (c).

(b) Test specimens for annealed material shall be prepared from the material as annealed for use, or from a short length of a full section similarly treated.

(c) Test specimens for rivet bars which have been cold-drawn shall be normalized before testing.

(d) Test specimens shall be taken longitudinally and, except as specified in Paragraphs (f), (g), and (h), shall be of the full thickness or section of material as rolled.

(e) Test specimens for plates, shapes and flats may be machined to the form and dimensions shown in Fig. 1, or with both edges parallel.

(f) Tension test specimens for material over 1½ in. in thickness or diameter, except pins and rollers, may be machined to a thickness or diameter of at least ¾ in. for a length of at least 9 in., or they may conform to the dimensions shown in Fig. 2.
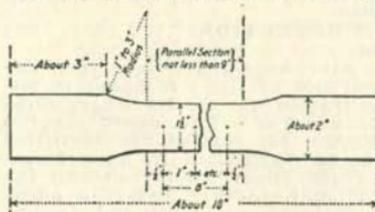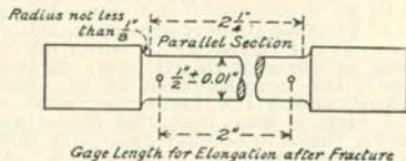
Fig. 1   Fig. 2

(g) Bend test specimens for material over 1½ in. in thickness or diameter, except pins and rollers, may be machined to a thickness or diameter of at least ¾ in. or to 1 by ½ in. in section.

(h) Tension test specimens for pins and rollers shall conform to the dimensions shown in Fig. 2, and bend test specimens shall be 1 by ½ in. in section.

(i) Test specimens for pins and rollers shall be taken so that the axis is 1 in. from the surface.

(j) The machined sides of rectangular bend test specimens may have the corners rounded to a radius not over ¹⁄₁₆ in.

Number of Tests

9. (a) One tension and one bend test shall be made from each melt; except that if material from one melt differs ¾ in. or more in thickness, one tension and one bend test shall be made from both

the thickest and the thinnest material rolled.

(b) If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) If the percentage of elongation of any tension test specimen is less than that specified in Section 5 (a) and any part of the fracture is more than ¾ in. from the center of the gage length of a 2-in. specimen or is outside the middle third of the gage length of an 8-in. specimen, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

IV. PERMISSIBLE VARIATIONS IN WEIGHT AND THICKNESS
Permissible Variations

10. (a) The cross-section or weight of each piece of steel shall not vary more than 2.5 per cent from that specified; except in the case of sheared plates, which shall be covered by the permissible variations specified in Paragraphs (b) and (c). (One cubic inch of rolled steel is assumed to weigh 0.2833 lb.)

(b) **Sheared Plates, When Ordered to Weight per Square Foot:** The weight of each lot[1] in each shipment shall not vary from the weight ordered more than the amount given in Table I.

(c) **Sheared Plates, When Ordered to Thickness:** The thickness of each plate shall not vary more than 0.01 in. under that ordered.

The overweight of each lot[1] in each shipment shall not exceed the amount given in Table II.

V. FINISH
Finish

11. The finished material shall be free from injurious defects and shall have a workmanlike finish.

VI. MARKING
Marking

12. The name or brand of the manufacturer and the melt number shall be legibly stamped or rolled on all finished material, except that rivet and lattice bars and other small sections shall, when loaded for shipment, be properly separated and marked for identification. The identification marks shall be legibly stamped on the end of each pin and roller. The melt number shall be legibly marked, by stamping if practicable, on each test specimen.

VII. INSPECTION AND REJECTION
Inspection

13. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with these specifications. All tests (except check analyses) and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

Rejection

14. (a) Unless otherwise specified, any rejection based on tests made in accordance with Section 4 shall be reported within five working days from the receipt of samples.

(b) Material which shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

Rehearing

15. Samples tested in accordance with Section 4, which represent rejected material, shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the tests, the manufacturer may make claim for a rehearing within that time.

[1]The term "lot" as applied to Table I means all of the plates of each group width and group weight; as applied to Table II, it means all of the plates of each group width and group thickness.

NOTES ON QUANTITY OF
PAINT FOR STRUCTURAL STEEL.

THE QUANTITY of paint required to coat a given number of tons of structural steel in a bridge, building, or similar structure is determined by the spreading capacity of the paint and the character of the surface to be covered, also the temperature.

The spreading capacity of a paint varies with different paints, i. e., oil alone, red lead, graphite, iron oxide, with the specific gravity, the fineness of the pigment, the consistency of the mixture, the manner of mixing, and with the "brushing out" given the paint in its application.

The kind and condition of the surface has even a greater influence on the amount required. On a smooth rolled plate a paint may be spread over fully 50% more area than on a rough, porous, rusty surface. More paint is required on a cold surface than on a warm one, approximating 20%. Again the area of the surface to be covered varies with the character of the construction irrespective of the tonnage.

The surface area of structural steel varies from 100 square feet to 1,000 square feet per ton of metal. The data given below is therefore only approximate, but will give a reasonably close estimate of the areas and quantities required in ordinary structural work.

(a) Area per ton of metal, light structural steel, 250 to 325 square feet. Includes plate ¼" to ½" thick per ton of metal, 3" to 5" I's and channels.

(b) Area per ton of metal, medium structural steel, 100 to 250 square feet. Includes plate ½" to 1" thick per ton of metal, 6" to 24" I's and channels.

(c) Area per ton of metal, heavy girders and columns, 50 to 100 square feet.

(d) Paint required first coat, (a) 3/5 to 5/7 gal., (b) 2/5 gal., (c) 1/5 to 1/7 gal.

(e) Paint required two coat, (a) ¾ to 1 gal., (b) ⅝ gal., (c) ¼ gal.

(f) Paint required one coat applied on erected work at intervals, (b) 2/5 to ½ gal.

In the interest of economy and for the longer life of steel structures exposed to the elements, it is absolutely necessary that they be well painted with a good quality of paint and that the structures be watched for the time when they will require repainting.

When structural steel is used in creameries and laundries, where there is a great deal of moisture, it has been found advisable to paint with blue lead. Any succeeding coats of paint will last longer without change of color or deterioration.

ALLOWABLE UNIT STRESSES

IN ACCORDANCE WITH THE BUILDING CODES OF SEVERAL CITIES

	COMPRESSION	St. Paul	New York	Chicago	Minn'pls	Seattle
		Pounds per square inch				
Steel and Iron	Rolled Steel	15000	16000	14000	18000	18000
	Cast Steel	14000	16000	14000	16000	16000
	Wrought Iron	10000	....	10000	12000	10000
	Cast Iron (in Short Blocks)	10000	16000	10000	16000	10000
	Steel Pins and Rivets (Bearing)	24000	24000	25000	18000	24000
	Wrought Iron Pins and Rivets (Bear'g)	....	....	....	15000	....
Timber	Oak With Grain	1000	1400	900	....	....
	Oak Across "	500	1000	500	500	....
	Yellow Pine, Wash. Fir With "	1100	1200	1100	....	1600
	Yellow Pine, Wash. Fir Across "	250	800	250	250	400
	Spruce With "	800	1200	....	....	800
	Spruce Across "	250	800	....	....	300
	Hemlock With "	500	800	500	....	1400
	Hemlock Across "	150	800	150	150	350
Concrete	Concrete P. C. (1) sand (2) stone (4)	500	500	400	....	500
	Concrete P. C. (1) sand (2½) stone (5)	350	400	350	....	375
Masonry	Rubble Stonework in P. C. Mortar	100	140	100	160	100
	Rubble Stonework in L. & C. Mortar	....	100	....	110	....
	Rubble Stonework in Lime Mortar	60	....	60	80	60
	Brickwork in P. C. Mortar 1:3	175	250	175	200	175
	Brickwork in L. & C. Mortar 1:1:3	125	160	125	160	125
	Brickwork in Lime Mortar 1:3	100	110	100	110	100
	Granite Masonry	600	....	....	....	800
	Limestone Masonry	500	....	....	....	400
	Sandstone Masonry	500	300	....	....	350

TENSION

		St. Paul	New York	Chicago	Minn'pls	Seattle
Steel and Iron	Cast Iron	3000	3000	....	3000	....
	Rolled Steel	18000	16000	16000	18000	18000
	Cast Steel	16000	16000	16000	16000	16000
	Wrought Iron	12000	....	12000	12000	12000
Timber	Oak	1000	1200	1200	1000	....
	Yellow Pine (Short Leaf)	1000	900	1000	....	....
	Yellow Pine (Long Leaf) & Wash. Fir	12C0	1200	1300	1200	1600
	Spruce	1000	800	....	800	1000

SHEAR

		St. Paul	New York	Chicago	Minn'pls	Seattle
Steel and Iron	Cast Iron	2000	3000	....	....	2000
	Steel Plates & Girders with stiffeners	12000	10000	10000	10000	12000
	Steel Shop Rivets and Pins	13500	12000	12000	12000	13500
	Steel Field Rivets	10000	8000	10000	10000	10000
	Steel Field Bolts	....	7000	....	....	....
Timber	Yellow Pine (Short Leaf) With Grain	120	100	120	....	....
	Yellow Pine (Long Leaf) With "	130	150	130	....	150
	Yellow Pine Across "	....	1000	....	....	....
	Spruce With "	120	100	....	....	100
	Spruce Across "	....	500	....	....	....
	Oak With "	200	200	200	....	....
	Oak Across "	....	1000	....	....	....
	Hemlock With "	60	100	60	....	130
	Hemlock Across "	....	600	....	....	....

P = Portland.   C = Cement.   L = Lime.

ALLOWABLE UNIT STRESSES
IN ACCORDANCE WITH THE BUILDING CODES OF SEVERAL CITIES

SAFE EXTREME FIBER STRESS	Revised to 1929				
	St.Paul	New York	Chicago	Minn'pis	Seattle
BENDING	Pounds per square inch.				
Rolled Steel Beams.....................	18000	16000	16000	18000	18000
Rolled Steel Pins, Rivets and Bolts............	27000	20000	25000	24000	27000
Riveted Steel Beams (net flange section)..	18000	16000	16000	16000	18000
Cast Iron Compressive Side...................	10000	16000	10000	....	10000
Cast Iron Tension Side......................	3000	3000	3000	....	3000
Short Leaf Yellow Pine, Wash. or Oregon Fir.. .	1000	1000	1000	1620	1600
Long Leaf Yellow Pine......................	1200	1600	1300	....	......
Spruce...............................	1000	1200	....	....	1000
Oak..................................	1000	1200	1200	1350	....
Hemlock.............................	600	800	600	1080	1400
Granite..............................	180	180	....	....	......
Limestone............................	150	....	....	....	......
Slate.................................	400	....	....	....	......
Marble...............................	120	....	....	....	......
Sandstone............................	100	....	....	....	......
Concrete Portland Cement 1:2:4...............	30	....	......	....	......
Concrete Portland Cement 1:2:5...............	20	....	....	....	......

COLUMN FORMULAE.

CITY	STEEL		CAST IRON		WROUGHT IRON		WOOD				
	Formula	Max. Lgth.	Formula	Max. Lgth.	Formula	Max. Lgth.	Long Leaf Yellow Pine	Spruce	Oak	Hem-lock	Max. Lgth.
St. Paul	C	.....	E	.....	F	.....	M	M	M	M	30D
New York	L	120R	D	70R	....	.....	U	P	U	.....	30D
Chicago	L 14000 Max.	120R	E	70R	F 10000 Max.	.....	M	M	M	M	30D
Mpls.	C	40 D	D	30D	....	.....	1000	800 R	800 S	600 R	12D & less / over 12D
Seattle	C 15000 Max.	120R	E	70R	....	.....	T	T	T	T	24D

NOTATION: L =Length in inches, R = Radius of Gyration in inches, D =Diameter or least dimension in inches, C =Allowable compressive unit stress (with grain) for that wood.

Formulae below give allowable unit stress in pounds per square inch

$$C \dfrac{18000}{1+\left(\dfrac{l^2}{18000r^2}\right)}$$	$$F \quad 1200-20\,\dfrac{L}{D}$$	$$M \quad C\left(1-\dfrac{L}{80D}\right)$$	$$R \quad 625-6\,\dfrac{L}{D}$$ $$U \quad 1200-20\dfrac{L}{D}$$
$$D \quad 9000-40\,\dfrac{L}{R}$$	$$G \quad 19000-100\,\dfrac{L}{R}$$	$$P \quad 900-17\,\dfrac{L}{D}$$	$$S \quad 750-7.5\,\dfrac{L}{D}$$
$$E \quad 10000-60\,\dfrac{L}{R}$$	$$L \quad 16000-70\,\dfrac{L}{R}$$		$$T \quad C\left(1-\dfrac{L}{70D}\right)$$

WEIGHTS OF BUILDING MATERIAL, ETC.

WEIGHT OF MATERIALS IN LBS. PER SQUARE FOOT

Kind of Material	THICKNESS IN INCHES															
	2	3	4	5	6	7	8	9	10	12	13	18	20	22	26	30
Hollow tile (Wall)	13	16	17	19	25	...	...	...	...	...	...	...	...	...	...	...
Reinf. Con. slab	24	36	48	60	72	84	96	108	120	144	...	...	...	...	...	...
Concrete fill	22	32	43	54	65	...	...	...	...	...	...	...	...	...	...	...
Cinder Con. fill	16	24	32	40	48	...	...	...	...	...	...	...	...	...	...	...
Stone wall Rubble Masonry Sandstone	...	...	...	...	...	...	86	...	108	130	...	...	217	...	282	325
Brick wall Common Brick	...	...	40	...	...	...	90	...	...	130	180	...	...	220	260	...

2″x4″ spruce sleepers 16″ ctrs. and 2″ dry cinder concrete fill	8.50
Copper sheets	1.50
Corrugated sheets	1.00
⅞″ single flooring, wood	3.00
Metal lath and plaster	10.00
Plastering	5.00

5 ply felt and gravel	6.00
4 ply felt and gravel	5.50
3 ply ready roofing	1.00
Skylight with galv. iron frame	5.00
2 inch book tile	12.00
3 inch book tile	20.00
Ludowici tile	8.00

Weights of Various Building Materials in Lbs. per Cubic Foot.

Ashes and cinders	40–45
Asphalt, paving comp	87–100
Brass and Bronze	504–524
Brick, pressed, fire and paving	120–150
Brickwork, common	110–120
Cement, bulk	92–115
Coal, anthracite (Loose and Solid)	56–93
Coal, bituminous (Loose and Solid)	47–84
Coke	23–32
Copper	542–555
Cork	15
Glass	160–186
Gravel	170
Gypsum and plaster of paris	65
Ice	58
Iron, cast	450
Lead	709
Limestone, marble	165
Masonry, ashlar	140–150
Mortar	103
Sand,(Clay and earth dry to wet)	72–120
Snow,(Dry and loose to wet)	10–50
Steel	490
Terra cotta masonry	100
Timber, pine (Southern Yellow and white)	25–48
Timber, white oak	48–52

Weights of Contents of Storage Warehouses in Lbs. per Cubic Foot of Space

Canned goods, in cases	58
Clement, Portland	73
Coffee, green in bags	39
Flour, in barrels	40
Molasses, in barrels	48
Rice, in bags	58
Salt, in bags	65
Sugar, in barrels	43
Tea, in chests	25
Wine and Liquors, in barrels	43
Burlap, in bales	43
Cotton in bales, compressed	22
Cotton bleached goods, in cases	28
Hemp, Manila, compressed	28
Linen goods, in cases	33
Sisal, compressed	24
Wool in bales, compressed	48
Sheet tin, in boxes	278
Wire cables, on reels	425
Linseed Oil, in barrels	36
White lead paste, in cans	174
White lead, dry	86
Hides and leather, in bales	20
Paper, Newspaper, strawboard	35
Paper, writing and calendered	60
Rope, in coils	40

SOLID STEEL SLAB BASES FOR COLUMNS

Data to Determine Thickness

For Data to Determine Length L and Width W, See Page 266
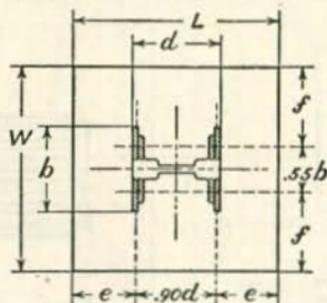
The column load C is assumed to be concentrated on the four outer corners or shaded areas shown above, the web area of the column being practically relieved of pressure by the dish or saucer-like action of the slab.

These corners constitute 60 to 75 per cent of the column area, so that this assumption does not produce a bearing stress in any case equal to the allowable pressure of metal upon metal.

For H columns, plate and angle columns, and plate, angle and cover plated columns, the average effective dimensions are .90 of the column depth d, and .55 of the column width b as shown above.

From these dimensions the projections e and f, in the directions L and W, are easily obtained. The determining bending moment will occur along the inner line of these projections and will be maximum for the greater projection.

The square of the required thickness t is obtained as given below.

C = Total load on column in pounds.
L = Length of slab in inches.
W = Width of slab in inches.
A = Area of slab = L × W.
U = Unit pressure = C ÷ A.

$$M = \text{Moment for 1" width of slab} = U \times e \times \frac{e}{2} = \frac{U \times e^2}{2} \text{ or } \frac{U \times f^2}{2} \quad \ldots \ldots \quad (1)$$

$$S = \text{Sec. Mod. for 1" width of slab} = \frac{M}{18000} = \frac{U \times e^2}{36000} \text{ or } \frac{U \times f^2}{36000} \quad \ldots \ldots \ldots \quad (2)$$

$$\text{Since } S = t^2 \div 6, \quad \therefore \quad t^2 = \frac{U \times e^2}{6000} \text{ or } \frac{U \times f}{6000} \quad \ldots \ldots \ldots \ldots \quad (3)$$

Having this value of t_2, the required slab may be selected from Table III below, which is arranged to show the value of t_2 for all available thicknesses.

Slabs 4" and less in thickness can be straightened and do not require planing. For slabs over 4" we have deducted ¼" for planing under column, and also ⅜" for planing bottom surface when required.

TABLE III Values of t2 for various thicknesses			
t^2	Rough Thick- ness	Finished Thickness	
		Top planed	Top & Bottom planed
6.25	2½		
9.00	3	Top planed	Top & Bottom planed
12.25	3½		
16.00	4		
18.06	4½	4¼	3⅞
15.02	4½		
22.56	5	4¾	4⅜
19.14	5		
27.56	5½	5¼	4⅞
23.77	5½		
33.06	6	5¾	5⅜
28.90	6		
39.06	6½	6¼	5⅞
34.51	6½		
45.56	7	6¾	6⅜
40.64	7		

—EXAMPLE—

Col. Load C = 955400.
Col. dimensions $d = 16.75$ & $b = 14.00$.
Unit pressure U = 600.
A = 955400 ÷ 600 = 1592 sq. in. = 40 × 40 or 44 × 36.
.90 × 16.75 = 15.00 & .55 × 14.00 = 7.70.
For 40 × 40 base,

$$e = \frac{40-15}{2} = 12.50 \text{ & } f = \frac{40-7.70}{2} = 16.15.$$

$$t^2 = (600 \times 16.15 \times 16.15) \div 6000 = 26.10$$

Use 5½" rough base, planed on top.*

For 44 × 36 base,

$$e = \frac{44-15}{2} = 14.50 \text{ & } f = \frac{36-7.70}{2} = 14.15$$

$$t^2 = (600 \times 14.50 \times 14.50) \div 6000 = 21.02$$

Use 5" rough base, planed on top.

*The 40" width is not rolled over 5" thick. Use 44 × 36 base.

SOLID STEEL SLABS FOR COLUMN BASES

Data to Determine Length L and Width W

See Page 265 for Data to Determine Thickness Required
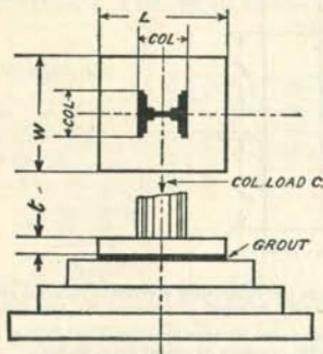
FIG. 1.
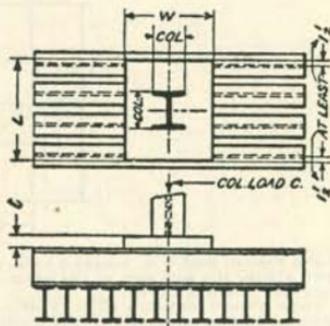
FIG. 2.

CASE I

Base Resting Upon Masonry

C = Total Load on Col. (In Pounds).

U = { Allowed Unit Press. on Masonry - see table, page 262.

A = Area of Base in sq. in. = $C \div U$

Select a slab having a rolled width of one of the dimensions L or W. (See Table II Below). The other dimension is then $A \div$ width selected.

From L & W and the column dimensions, determine the overhangs e and f as shown on page 265.

With this data, determine the SQUARE of the thickness by one of the formulae (3) on page 265. The thickness corresponding to this value of t^2 is selected from Table III, page 265.

Care must be taken to see that the slab selected is rolled of sufficient thickness. (See example on page 265.)

Bases resting on masonry need not be planed on the bottom, but should always be grouted.

CASE II

Base Resting Upon Grillage Beams

In this case, the dimension W, Fig. 2, is selected arbitrarily from the widths available. Roughly, it may be 25% to 30% of the length of the top grillage beams. This dimension affects the size and weight of these beams.

The other dimension L must be made large enough to extend at least $1\frac{1}{2}''$ beyond the center lines of the outside grillage beams, as shown in the plan view above.

The area $A = L \times W$, and $U = C \div A$

Use this value of U in formula (3) on page 265 to determine the SQUARE of the required thickness as before.

Bases resting on grillage should be planed top and bottom, if over 4″ thick.

—Table II—
Available Sizes of Steel Slabs

Width	Thickness	Length	Wt. pr. Lin. In.
16″	2″	6′-8″ to 60′- 0″	9.07
20″	2″	6′-8″ to 50′- 0″	11.33
20″	2½″	6′-8″ to 36′- 8″	14.17
24″	2½″	6′-8″ to 36′- 8″	17.00
24″	3″	6′-8″ to 24′- 2″	20.40
28″	3″	6′-8″ to 24′- 2″	23.80
28″	3½″	6′-8″ to 18′- 4″	27.77
32″	3½″	6′-8″ to 18′- 4″	31.73
32″	4″	6′-8″ to 18′- 4″	36.27
36″	4″	6′-8″ to 22′-11″	40.80
36″	4½″	6′-8″ to 22′-11″	45.90
40″	4½″	6″-8″ to 20′-10″	51.00
40″	5″	6″-8″ to 20′-10″	56.67
44″	5″	13′-9″ to 17′- 1″	62.33
44″	5½″	11′-3″ to 14′- 2″	68.57
44″	6″	11′-3″ to 14′- 2″	74.80
48″	5½″	11′-3″ to 14′- 0″	74.80
48″	6″	11′-3″ to 14′- 0″	81.60
48″	6½″	9′-7″ to 12′- 0″	88.40
52″	6″	11′-3″ to 14′- 7″	88.40
52″	6½″	9′-7″ to 12′- 6″	95.77
56″	6½″	10′-0″ to 11′- 8″	103.10
56″	7″	10′-0″ to 11′- 8″	111 07

BEARING PLATES FOR BEAMS AND CHANNELS ON BRICK AND MASONRY.

Size of Beam or Channel	Bearing on wall in inches	Size of plate inches	CAST IRON		STEEL		SAFE END REACTION			
			Thickness inches	Weight in pounds	Thickness inches	Weight in pounds	Common Brick at 100 lbs. per sq. in.	First class brick at 150 lbs. per sq. in.	Masonry at 200 lbs. per sq. in.	Masonry at 250 lbs. per sq. in.
3"-4"-5" and 6'	6 6	6x 6 6x 6	½ ⅝	5 6	5/16 ⅜	3 4	3600	5400	7200	9000
7" and 8"	8 8	8x 8 8x 8	½ ¾	8 13	½ ⅝	9 12	6400	9600	12800	16000
9" and 10"	8 8	8x12 8x12	⅝ ⅞	16 20	½ ⅝	14 17	9600	14400	19200	24000
12" I @ 31.8 lbs.	12 12	12x12 12x12	1 1¼	38 47	½ ¾	20 30	14400	21600	28800	36000
12" I @ 40.8 lbs. and up and 15" I @ 42.9 lbs.	12 12	12x16 12x16	1¼ 1½	63 75	¾ 1	41 54	19200	28800	38400	48000
15" I @ 60. lbs. 15" I @ 81.3 lbs.	16 16	16x16 16x16	1¼ 1½	84 100	1 1	73 73	25600	38400	51200	64000
18", 20" and 24"	16	16x16	1¾	117	1	73	25600	38400	51200	64000

Use the thicker plates for bearing values of 150 lbs. per square inch and over.

When end reactions of beams exceed the values given under safe end reactions, or allowable pressure per square inch on the masonry is greater than the values given in the table above, special plates will be required. The length and width of special plates is first obtained from the area required to distribute the beam load on the wall and then the thickness of the plate is calculated by the formula.

$$t = .866 \, (p\text{-}f) \sqrt{\frac{W}{S}}$$

t = thickness of plate in inches.
p = width of plate perpendicular to beam, in inches.
f = Width of flange of beam in inches. W = Allowable pressure on wall in pounds per square inch. S = Allowable stress in steel in pounds per square inch; usually 18000 lbs.

See page 262 for allowable unit pressure on masonry.

SAFE BEARING CAPACITY OF SOILS—
TONS PER SQ. FT.

Character of soil	New York	Baltimore	Chicago	St. Paul	Minneapolis	Seattle
Soft clay...........................	1	1		1	1	1
Clay and sand, wet and springy...........	2	2	1½	2	2	2
Loam clay or fine sand, firm and dry.....	3	3	1¾-2½	3	3	2½
Very firm coarse sand, gravel or hard clay	4	4	1¾-2½	4	4	3-5

DATA ON WOODEN PILES

According to the building laws of various cities the most common dimension for wooden piles less than twenty feet long is 5 inches on the small end and 10 inches on the butt end. For piles longer than 20 feet the butt end is increased to 12 inches. The safe load for piles is figured by the following formulae; (A) being for drop hammer and (B) for steam hammer. The maximum load per pile is limited to 20 to 25 tons.

(A) Safe load in tons = $\frac{2\,W\,H}{P+1}$ (B) Safe load in tons = $\frac{2\,W\,H}{P+\frac{1}{10}}$

"H" = Drop of hammer in feet   "W" = weight of hammer in ton. "P" = Penetration of last blow in inches (or average of last several blows).

GENERAL FORMULÆ ON THE FLEXURE OF BEAMS
OF ANY CROSS-SECTION

Let $A =$ area of section in square inches.

$l =$ length of span in inches,

$W =$ load uniformly distributed in pounds,

$M =$ bending moment in inch pounds,

$h =$ height of cross section, out to out, in inches,

$n =$ distance of center of gravity of section, from top or from bottom, in inches,

$f =$ stress per square inch in extreme fibers of beam, either top or bottom, in pounds according as n relates to distance from top or from bottom of section,

$D =$ maximum deflection in inches.

$I =$ moment of inertia of section neutral axis through center of gravity,

$I' =$ moment of inertia of section neutral axis parallel to above, but not through center of gravity,

$d =$ distance between these neutral axes,

$S =$ section modulus,

$r =$ radius of gyration in inches.

$E =$ modulus of elasticity for steel 29,000,000

Then $S = \dfrac{I}{n}$ $\qquad\qquad r = \sqrt{\dfrac{I}{A}}$

$$M = \frac{fI}{n} = fS.$$

$$f = \frac{Mn}{I} = \frac{M}{S}.$$

$$W = \frac{8fI}{ln} = \frac{8f}{l} S.$$

$$f = \frac{Wln}{8I} = \frac{Wl}{8S}.$$

$$I' = I + Ad^2.$$

$D = \dfrac{5Wl^3}{384EI}$ for beam supported at both ends uniformly loaded,

$D = \dfrac{Pl^3}{48EI}$ for beam supported at both ends and loaded with a single load P at middle.

$D = \dfrac{Wl^3}{8EI}$ for beam fixed at one end and unsupported at the other and uniformly loaded.

$D = \dfrac{Pl^3}{3EI}$ for beam fixed at one end and unsupported at other and load d with a single load P at the latter end.

Weight of beam not considered in the above.

BENDING MOMENTS AND DEFLECTIONS OF BEAMS UNDER VARIOUS SYSTEMS OF LOADING

W = Total load.   l = Length of beam in inches.

(1) Beam supported at both ends and uniformly loaded.
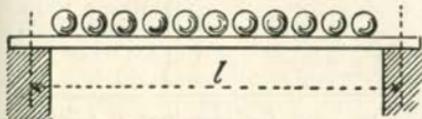
Safe load = that given in tables. Maximum bending moment at center of beam = $\frac{Wl}{8}$

(2) Beam supported at both ends, single load in middle.
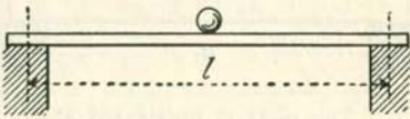
Safe load = $\frac{1}{2}$ that given in tables. Maximum bending moment at center of beam = $\frac{Wl}{4}$

(3) Beam fixed at one end and uniformly loaded.
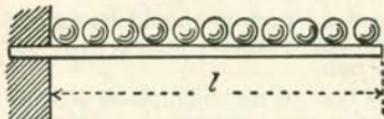
Safe load = $\frac{1}{4}$ that given in tables. Maximum bending moment at point of support = $\frac{Wl}{2}$

(4) Beam fixed at one end and loaded at the other.
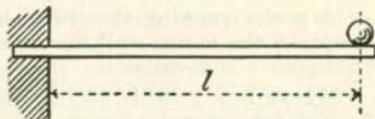
Safe load = $\frac{1}{8}$ that given in tables. Maximum bending moment at point of support = Wl.

(5) Beam supported at both ends, single unsymmetrical load.
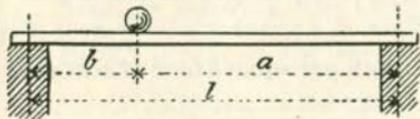
Safe load = that given in tables × $\frac{l^2}{8ab}$

Maximum bending moment under load = $\frac{Wab}{l}$

(6) Beams supported at both ends, two symmetrical loads.
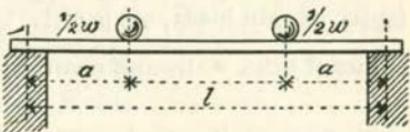
Safe loads = that given in tables × $\frac{l}{4a}$

Maximum bending moment between loads = $\frac{1}{2}$ Wa

Case 1 — Deflection under safe load =   that given in tables.
  "   2 —   "   "   "   "   = $\frac{8}{10}$ "   "   "   "
  "   3 —   "   "   "   "   = 2.4   "   "   "   "
  "   4 —   "   "   "   "   = 3.2   "   "   "   "

Case 1—Deflection = $\frac{5 \, Wl^3}{384 \, EI}$

where E = modulus of elasticity = 29 000 000
I = moment of inertia

BEAMS SUPPORTING BRICK WALLS
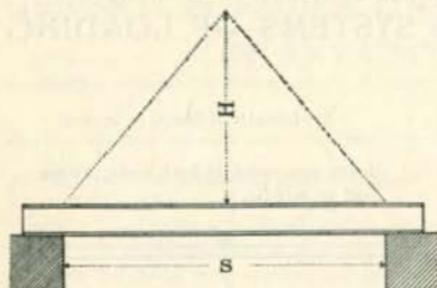
$H = S$ then

load $= \frac{1}{2} (S)^2 \times$ weight per foot of wall.

The method illustrated above may be used for openings 6 feet in width or less, provided there are no openings above, which, by a failure in the masonry, might cause the concentration of a heavy load on the girder.

For larger openings different conditions prevail. If the masonry is not thoroughly bonded, if there is danger of failure along a series of openings one above another, or if great inflexibility is desired it is good practice to consider the weight of entire wall as carried by the girder.

A girder running the entire length of a structure should be figured to support the entire wall above, as excessive deflection might push out the supports and cause the structure to fail.

Where heavy loads are carried, it is best to use columns of steel or cast iron for supports, for masonry, as ordinarily constructed, will fail by crushing out under heavy concentrated loads. When the wall carries any portion of the floor load, same should be added to weight of wall to ascertain the entire load carried by the girder.

Figures 179 to 184, page 316, show various types of steel lintels in common use, and their supporting capacity may be obtained from tables of safe loads, see part 1.

Weights of brick walls and number of brick per square foot of surface:

Thickness of wall, inches	Common Brick, pounds	No. of Brick in sq. foot
9	75	15
13	112	$22\frac{1}{2}$
17	150	30
21	188	$37\frac{1}{2}$
25	224	45
29	262	$52\frac{1}{2}$
33	300	60
37	336	$67\frac{1}{2}$

NOTES ON WOOD FLOORS.

The common type of wood floors used for store buildings, small office buildings, etc., where the loads are not heavy consists of joists placed transversely, supported by girders of steel or wood.

Methods of supporting wood joists on steel girders are shown on page 316. The method shown in Fig. 178 may be used where girders are not concealed. Where a flush ceiling is desired, a plate as shown in Fig. 177 or stirrups may be used without notching the joists.

Mill or slow-burning construction is used for storehouses, mill buildings, etc., where heavy loads must be carried. These floors are constructed of beams placed from 4 to 8 feet on centers and covered with plank from 2 to 3½ inches thick, on top of which is laid the finished floor.

Safe loads for wood beams and posts are given on pages 311 and 310 and for gas pipe columns on page 290.

Details of cast iron post caps and bases will be found on page 175.

Several types of joist hangers are in use for framing around stair and wall openings. On page 211 we have illustrated the single and double stirrups.

We have shown in Figs. 144 to 149, page 232, our stock joist and strap anchors; special anchors made to order.

WEIGHTS OF WOOD FLOORS IN POUNDS PER SQUARE FOOT.
INCLUDING PLASTER CEILING.

Spacing of Joists	DIMENSIONS OF JOISTS					
	2 X 10	**2 X 12**	**2 X 14**	**3 X 12**	**3 X 14**	**3 X 16**
12	22	22	23	24	26	27
14	21	22	22	24	25	26
16	21	21	22	23	24	25
18	20	21	21	22	23	24

Based on softwood joist at 2½ lbs. per board foot, 1 thickness of ⅞ inch softwood flooring at 2½ lbs. per square foot and 1 thickness of ⅞ inch hardwood flooring at 4 lbs. per square foot.
When no ceiling is used deduct 12 lbs. per sq. ft.

Weight per sq. foot for various woods. ⅞" thick.

White Oak	White Pine	Southern Long Leaf or Georgia Yellow Pine	Hemlock	Cedar	Spruce California	Maple
4.16	1.98	3.17	2.08	1.93	2.08	3.5

FIREPROOF FLOORS.

Fireproof floors are constructed with a framework of steel beams and girders, the spaces between the beams being filled with fireproofing, which consists of arches of brick or hollow tile, or concrete steel in the form of arches or slabs.

Brick arches leveled with concrete are used with a spacing of from 4 feet to 6 feet, or more, provided that the arch is suitably stiffened with concrete against failure from a concentrated load, and that the beams are of sufficient depth to allow a rise of 1/10 of the span. Floors of this type weigh, including filling and steel beams, from 75 pounds per square foot up.

Several types of tile arches are in common use, the tiles being hollow blocks of dense or porous structure made to form a flat or segmental arch. The webs of these blocks are either parallel with the floor beams or perpendicular thereto, the systems being termed side or end construction, respectively. Floors of this type will weigh from 70 to 90 pounds per square foot, including filling and steel beams.

Tie rods to take the thrust of the arches are required for both brick and tile construction. These are ¾ or ⅞ inches in diameter, placed at or below the center of the beam, and from 4 to 6 feet apart.

Floors of concrete, reinforced with steel wire, or rods are used extensively. We carry a large stock of round, square and deformed reinforcing rods in stock and are able to make immediate shipments on orders for this material.

Examples of different methods of concrete floor construction are shown on pages 273 to 276 together with tables of safe loads and necessary rods for reinforced concrete floor slabs. On page 275 table gives the quantities of material required, for different proportions, in one yard of concrete.

ALLOWABLE FLOOR LOADS IN POUNDS PER SQUARE FOOT.
From St. Paul Building Code.

Dwellings, flats, apartments, tenements...................	40 lbs.
Hotels, club houses, lodging or rooming houses, family hotels, offices, hospitals.............................	50 lbs.
Schools	60 lbs.
Private garages, stables, work shops....................	85 lbs.
Light manufactories, and storage.......................	100 lbs.
Garages, fire stations, churches, assembly and dance halls, lodges, skating rinks, exhibition halls, theatres.......	100 lbs.
Large department stores.................................	125 lbs.
Heavy storage and manufactories........................	200-250 lbs.
Sidewalks and sidewalk doors............................	250 lbs.

NOTE.—To the above loads the dead weight of floor must be added to obtain the total load.

TRUSCON OPEN TRUSS STEEL JOISTS

The use of steel joist construction for economical and fireproof floors is exemplified in O-T (Open Truss) steel joists. Their design is based on good engineering practice and includes many attractive features.

The top and bottom chords of the Warren truss are wide "tee-shaped" members providing necessary resistance to buckling strains. The bottom "tee" is continuous to the bearings, where it is welded with web plate and top chord to form a solid I-Beam. The web members are continuous from end to end to positively transmit the stresses. The welding of all joints is done under a method of high pressure electric welding making positive connections.

The entire design is not only efficient but is economical of materials. O-T steel joists are manufactured of the highest grade open hearth steel in accordance with accepted standards of quality workmanship.

In practical use, O-T steel joists are very simple to install, insuring utmost speed of erection. The under-slung design of the bearing permits full head-room under the supporting girders. The open web allows the passage of pipes and conduits of any number and in any direction.

Open Truss steel joists are shop fabricated and reach the job ready for placing. Each joist is marked to correspond with the erection diagram, to simplify and speed construction work.
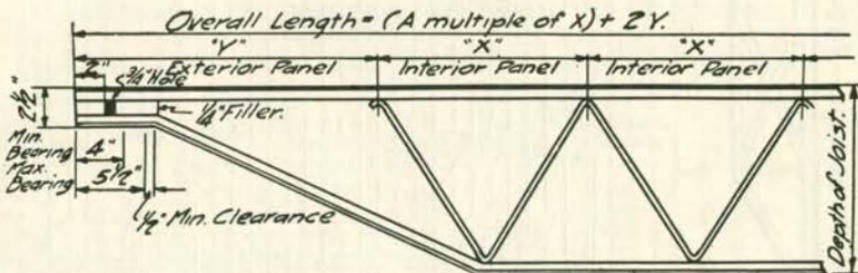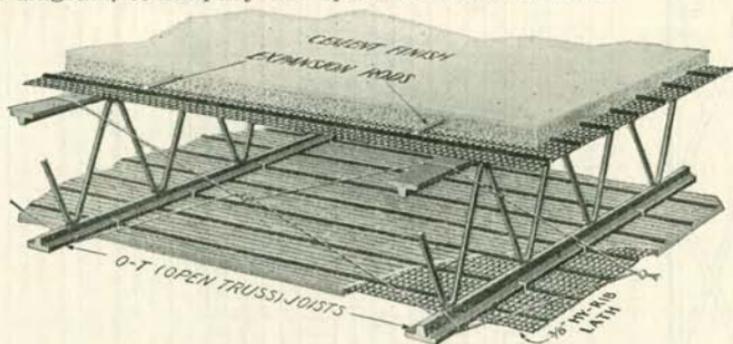
DETAIL OF TRUSS JOIST

Loading tables and details on solid web plate girder joists furnished on request.

See page 336 for illustration.

KALMAN TRUSS STEEL JOISTS

Elements—Properties and Total Safe Loads in Pounds Uniformly Loaded

Mₙ — MINIMUM SPAN
Mₓ — MAXIMUM SPAN
L — OVERALL LENGTH

See page 336 for illustration.

	8″	10″		12″		14″		16″
Joist Depth	8″	10″		12″		14″		16″
Joist Mark	8	10L	10H	12L	12H	14L	14H	16
Moment Inertia ..	12.68	20.87	27.29	40.32	49.45	70.74	85.96	116.82
Section Modulus	3.17	4.12	5.43	6.61	8.18	9.97	12.24	14.40
Area Top Chord	.484	.497	.663	.662	.832	.859	1.076	1.086
Area Bot. Chord	.426	.435	.580	.580	.728	.752	.932	.950
Area Diagonals .	.123	.154	.169	.200	.209	.250	.264	.313
Flange Width ..	1.63	1.66	2.00	2.02	2.25	2.29	2.63	2.66
Clear Span in feet								
10	3381							
11	3074							
12	2818	3660						
13	2601	3380						
14	2415	3139						
15	2254	2930						
16		2747	3620					
17		2585	3407					
18			3180	4230				
19			3048	4140	4592	5330		
20				3917	4363	5310		
21				3525	4155	5061		
22					3906	4834	5677	6670
23					3794	4624	5440	6400
24						4431	5222	6150
25							5022	5908
26							4836	5689
27							4663	5486
28								5297
29								5120
30								

Tabulated Safe Loads are based on joists being braced laterally as in standard floor construction, and on a maximum tensile stress of 16,000 lbs. per sq. in. Maximum deflections for tabulated spans and loads will not exceed 1/360 of span. See page 336 for illustration.

CONCRETE FLOORS

Strength of Floor Slabs

Calculated for $M = \frac{1}{10} WL^2$; For $M = \frac{1}{12} WL^2$ multiply given span lengths by 1.08.

M = Bending Moment in Foot Lbs.
W = Load per square foot.
L = Length of Span in feet taken C. to C. of supports.

Ratio of Modulus of Elasticity of Steel to that of concrete = 15.
700 lbs. = Unit stress on concrete per sq. in.   Coefficient of Resistance = 113.1.
18000 lbs. = Unit stress on steel per sq. in.   Percentage of Steel in Concrete = .716%.

Total thickness of slab, Inches	Thickn's concrete below under side of steel, In.	Weight of Slab Per Sq. Foot	Span in Feet For Given Live Loads in Pounds Per Square Foot of Floor														Area Steel Req. Per Lin. Foot	Reinforcing Rods	
			30	40	50	60	75	80	90	100	125	150	175	200	250	300		Size	Spac.
2″	¾″	24	6.5	6.0	5.6	5.3	4.9	4.7	4.5	4.3	4.0	3.7	3.4	3.2	2.8	2.7	.108	*	*
2½″	¾″	30	8.7	8.1	7.6	7.1	6.6	6.5	6.2	5.9	5.4	5.0	4.7	4.5	4.0	3.7	.151	*	*
3″	¾″	36	10.8	10.0	9.4	8.9	8.3	8.1	7.8	7.5	6.9	6.4	6.0	5.7	5.1	4.8	.194	¼φ	3 ″
3½″	¾″	42	11.4	10.7	10.1	9.6	8.9	8.8	8.4	8.1	7.5	7.0	6.6	6.2	5.7	5.2	.215	⅜φ	6 ″
4″	¾″	48	13.2	12.4	11.7	11.2	10.5	10.3	9.9	9.5	8.8	8.3	7.8	7.4	6.7	6.2	.258	⅜φ	5 ″
4½″	¾″	54	14.8	14.0	13.3	12.7	12.0	11.7	11.3	10.9	10.2	9.5	9.0	8.5	7.8	7.3	.301	⅝φ	4¾″
5″	¾″	60	16.6	15.5	14.8	14.1	13.4	13.1	12.6	12.2	11.8	10.7	10.1	9.6	8.8	8.2	.344	½φ	7 ″
5½″	¾″	66	17.8	16.9	16.2	15.5	14.7	14.4	14.0	13.5	12.6	11.9	11.2	10.7	9.8	9.1	.387	½φ	6 ″
6″	¾″	72	19.2	18.3	17.5	16.8	16.0	15.7	15.2	14.8	13.8	12.6	12.3	11.8	10.8	10.0	.430	⅝φ	8½″
6½″	¾″	78	20.4	19.6	18.8	18.2	17.2	16.9	16.4	16.0	15.0	14.1	13.4	12.8	11.8	11.0	.473	⅝φ	8 ″
7″	¾″	84	21.8	20.8	20.0	19.4	18.4	18.1	17.6	17.1	16.1	15.2	14.5	13.8	12.7	11.9	.516	⅝φ	7¾″
7½″	¾″	90	23.0	22.0	21.2	20.6	19.6	19.3	18.8	18.3	17.2	16.2	15.4	14.8	13.7	12.8	.559	⅝φ	6½″
8″	¾″	96	24.1	23.2	22.4	21.7	20.7	20.4	19.9	19.4	18.2	17.3	16.5	15.7	14.6	13.6	.602	⅝φ	6 ″
9″	¾″	108	26.4	25.4	24.6	23.8	22.9	22.6	22.0	21.4	20.3	19.3	18.4	17.6	16.4	15.3	.688	⅝φ	5¾″
10″	¾″	120	28.4	27.5	26.8	26.0	25.0	24.6	24.0	23.5	22.2	21.2	20.3	19.5	18.1	17.0	.774	⅝φ	4¾″
11″	¾″	132	30.4	29.5	28.7	28.0	27.0	26.6	26.0	25.4	24.2	23.1	22.1	21.2	19.8	18.6	.860	⅝φ	4¼″
12″	¾″	144	32.3	31.4	30.6	29.8	28.8	28.4	27.8	27.2	26.0	24.8	23.8	23.0	21.5	20.2	.946	⅝φ	4 ″

MATERIALS REQUIRED FOR ONE CUBIC YARD OF CONCRETE

Proportion by Parts			Material Required on the Basis of 1 Barrel = 3.8 Cubic Feet			Material Required on the Basis of 1 Barrel = 4.0 Cubic Feet		
Portland Cement	Sand	Stone	Cement in Barrels	Sand In Cubic Yards	Stone In Cubic Yards	Cement in Barrels	Sand In Cubic Yards	Stone In Cubic Yards
1	1.5	3	1.94	0.41	0.82	1.86	0.41	0.82
1	2	4	1.52	0.43	0.86	1.46	0.43	0.86
1	2.5	5	1.26	0.44	0.88	1.20	0.44	0.88
1	3	5	1.17	0.49	0.82	1.10	0.49	0.82
1	3	6	1.07	0.45	0.90	1.02	0.45	0.90

Approximately the same quantities will be required if gravel is used.   Quantities may be found to vary 10 per cent from those given due to variation in fineness of sand and stone.
*Patented or Wire Reinforcement.

NATCO "ONE-WAY" LONG SPAN FLOORS
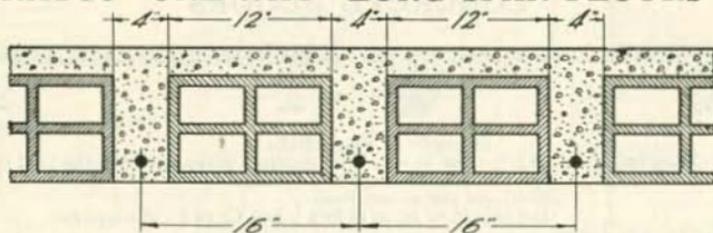
The upper figures in tables denote the depth of tile; the lower figures indicate the area of reinforcing steel required in each concrete joist. Thickness of floor=depth of tile+2" of concrete top.

The tables below are so arranged that they can be used for floor slabs freely supported at both ends, semi-continuous, or continuous.

For slabs freely supported at both ends (simple span) use load given opposite WL/8. For slabs freely supported at one end and continuous over other support use loads given opposite WL/9, or if building code permits WL/10. For slabs continuous over both supports use loads given opposite WL/10, or if building code permits WL/12.

For semi-continuous and continuous spans proper reinforcement must be provided in top of slab over support to take care of negative bending moment. Where heavy loads and short spans are encountered, the vertical and longitudinal shear must be investigated.

The load tables are for general information only as each particular operation should be designed in accordance with actual conditions.

2" CONCRETE TOP

fc. 700 pounds per square inch.
fs. 18000 pounds per square inch.

$\dfrac{Ec}{Es} = \dfrac{1}{15}$

¾" of concrete below reinforcement
4" concrete joists 16" on centers.

Bending Moment	TOTAL SAFE LOADS (Dead & Live)										
WL/12 WL/10 WL/9 WL/8	150 125 110 100	165 135 120 110	180 150 135 120	195 160 145 130	210 175 155 140	225 185 170 150	240 200 180 160	260 220 195 175	300 250 225 200	335 280 250 225	375 310 280 250	450 375 335 300
Span 6'-0"						3/.17	3/.18	3/.20	3/.23	3/.26	3/.29	3/.34
" 8'-0"	3/.20	3/.22	3/.24	3/.26	3/.28	3/.30	3/.32	3/.35	3/.41	3/.46	4/.40	4/.49
" 10'-0"	3/.32	3/.35	3/.38	3/.41	3/.44	4/.38	4/.40	4/.44	4/.51	4/.57	5/.53	5/.63
" 12'-0"	3/.46	4/.40	4/.44	4/.47	4/.51	4/.55	5/.48	5/.53	5/.60	5/.68	6/.64	7/.69
" 14'-0"	4/.50	4/.55	5/.50	5/.54	5/.58	5/.62	5/.66	6/.61	6/.70	7/.71	7/.78	8/.83
" 16'-0"	5/.54	5/.59	5/.65	6/.60	6/.64	6/.69	6/.73	7/.72	8/.72	8/.81	9/.82	10/.89
" 18'-0"	5/.68	6/.64	6/.69	6/.75	7/.73	7/.78	8/.73	8/.80	9/.83	10/.84	10/.93	12/.93
" 20'-0"	6/.71	7/.70	7/.77	8/.73	8/.79	8/.84	9/.82	10/.81	10/.92	12/.86	12/.97	15/.92
" 22'-0"	7/.77	8/.75	8/.82	9/.81	9/.87	10/.85	10/.89	12/.81	12/.93	15/.83	15/.92	
" 24'-0"	8/.81	9/.81	9/.89	10/.86	10/.93	12/.83	12/.88	12/.97	15/.88	15/.99		

Weights of Natco Combination Floors and Concrete Required

Thickness of Tile	3"	4"	5"	6"	7"	8"	9"	10"	12"	15"

ONE-WAY—2" Concrete Top—4" Joists, 16" on centers

	3"	4"	5"	6"	7"	8"	9"	10"	12"	15"
Weight per sq. ft. of floor area	45 lbs.	50 lbs.	55 lbs.	60 lbs.	65 lbs.	70 lbs.	75 lbs.	80 lbs.	90 lbs.	105 lbs.
Cu. ft. concrete per sq. ft. floor	0.229	0.250	0.271	0.292	0.313	0.333	0.354	0.375	0.417	0.479

NOTES ON ROOFS.

Where roof loads are to be supported over wide spans, steel trusses are generally used.

A common type of combination truss is illustrated on page 281, the top and bottom chords and compression members being made of wood, with iron rods to take tension.

Wood members at connections are notched in and bolted, or castings and wrought iron straps may be used. In all cases the connections should be of sufficient strength to develop the entire strength of members connected.

Where top chord is notched into bottom chord, care should be taken to leave sufficient section in bottom chord at that point to resist shear and bending. Where bottom chord forms an arched ceiling provisions must be made either in the truss or in the supporting walls to take the thrust.

Over large spans, steel trusses may be built stronger, lighter and at less cost than wood trusses. The cost of assembling is saved as in most cases they can be shipped in one or two pieces. Their lightness and stiffness make erection of steel trusses relatively easy.

On page 279 we illustrate a few types of steel trusses of simple form and good for short and long spans. We will furnish designs and estimates for any type and size of truss upon application.

The size of steel trusses varies with the span, and with the roof and other loads to be imposed. For preliminary estimates of the weight where only an approximation is necessary, the following formula is applicable:

$$W = \tfrac{1}{4}\left(\sqrt{L} + \tfrac{1}{4}L\right)$$

Where L is the length of span in feet

W is the approximate weight per horizontal square foot, when 40 pounds is the weight of the imposed load per square foot.

For loads greater or less than 40 lbs. per square foot, interpolate.

Note the table of roof loads including both dead and live loads for various kinds of roofing and figured per horizontal square foot; these to be used generally on spans of 80 feet or less. We also give a table of weights for various kinds of roofing materials.

Approximate Weight of Roofing Materials		TOTAL LOADS		Weight per sq. ft. Lbs.
Material	Weight per sq. ft.	KIND OF ROOFING		
Copper No. 22 B. W. G.	1¼	Gravel or Composition Roofing	on boards, slope 1:6 or less	50
Corr. Galvanized iron No. 22B.W.G.	2¼			
Corr. Galvanized iron No. 26B.W.G.	1¼		on boards, slope over 1:6	45
Felt, two layers	½		on 3-in. flat tile or cinder concrete	60
Felt and asphalt or coal tar	2			
Glass, ⅛-inch thick	1¾			
Lath and plaster ceiling	6–8			
Lead, ⅛-inch thick	7½			
Sheathing, white pine or spruce, 1 inch thick	2¼-2½	Corr. sheathing on boards or purlins		40
Sheathing, yellow pine, 1-inch thick	3½			
Shingles, 6x18, 6 in. to weather	2			
Skylight glass ₇⁄₁₆x½ in. thick, including frame	4–10	Slate	on boards or purlins	50
Slag roof 4 ply with cement and sand	4		on 3-in flat tile or cinder concrete	65
Slate ₃⁄₁₆-in. thick, 3 in. double lap	6¾			
Tiles, plain, 5¼ in. to weather	18			
Tiles, Spanish, 7¼ in. to weather	8½	Tile on steel purlins		55
Tin roofing and one thickness of felt	1			
Five ply felt and gravel	6			
Concrete slab, 3 in. thick	37½	Glass		45
Concrete cinder slab 4 in. thick	33⅓			
For Ceiling tiles see page 264				
Federal Tile, see page 283				
Pyrobar Blocks, 3 in. thk.	13			

To the loads given, classed as dead loads, must be added the loads due to snow or wind, or both, i. e., the live loads. Any live load due to machinery, hangers for balconies, trolleys, etc., should not be omitted.

Generally 30 pounds total live load, for snow and wind combined, will suffice. That loading may be changed, due to climatic conditions and type of truss selected. In temperate climes a minimum snow load of 25 pounds should be used on each horizontal square foot for all pitches of the roof surface up to 20 degrees; this loading is to be reduced one pound for each degree of increase of the slope up to 45 degrees; beyond this no snow load need be considered. Special calculations are necessary in severe climes or where snow or ice is apt to concentrate. Where advisable, wind loads for various pitches of roofs may be figured according to the following:

Wind Pressure Normal to Slope of Roof.

FROM HUTTON'S TRIGONO-METRIC FORMULA $P = P'$ sine$-x$ $^{1.84 \cos x-1}$	RISE	Angle of slope with Horizontal	Pitch Proportion of Rise to span	Wind Pressure Normal to slope Pounds per sq. ft.
P = Pressure in pounds per sq. ft. normal to slope of roof	4 inches per foot horizontal	18°–25′	⅛	12.6
P' = Wind pressure in pounds per sq. ft. of vertical surface (30 lbs. per sq. ft.)	6 inches per foot horizontal	26°–33′	¼	17.8
	8 inches per foot horizontal	33°–42′	⅜	21.7
	12 inches per foot horizontal	45°–0′	½	27.0
X = Internal angle roof slope makes with horizontal	16 inches per foot horizontal	53°–7′	⅔	29.0
	18 inches per foot horizontal	56°–20′	¾	29.4
	24 inches per foot horizontal	63°–27′	1	30.0

Method of Obtaining Correct Standard Sizes of Beam Hangers:
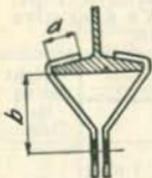
Size of Beam	a	b
For 3″-4″ and 5″ Is	⅞″	3½″
For 6″-7″ Is	1½″	4″
For 8″-9″ and 10″ Is	1½″	4½″
For 12″-15″-18″ and 20″ Is	2″	5″
For 20″ heavy—24″ Is	2½″	6″
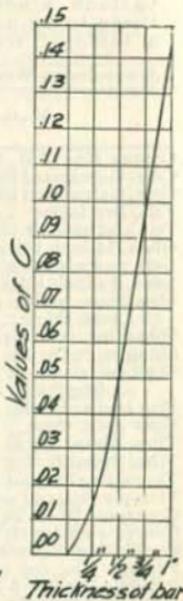
Method of Calculation.

Given:

P = load carried by hanger in lbs.
S = Allowable fibre stress in lbs. per sq. in.
B = width of bar used in inches

$$Then \ C = \frac{P}{2BS} \quad or \ S = \frac{P}{2BC}$$

When C is obtained then thickness of bar may be found from the accompanying curve,

Example: load to be carried = 3000 lbs.
Fibre stress = 16000 lbs./ □″
Width of hanger used = 3″

$$Then \ C = \frac{3000}{2x3x16000} = 0.03$$

This corresponds to a bar ⅜″ thick. Therefore a hanger of 2-⅜″x3″ bars should be used.

TYPICAL STEEL TRUSSES

BOW STRING TRUSS
Fig. 168

CAMEL BACK TRUSS
Fig. 169
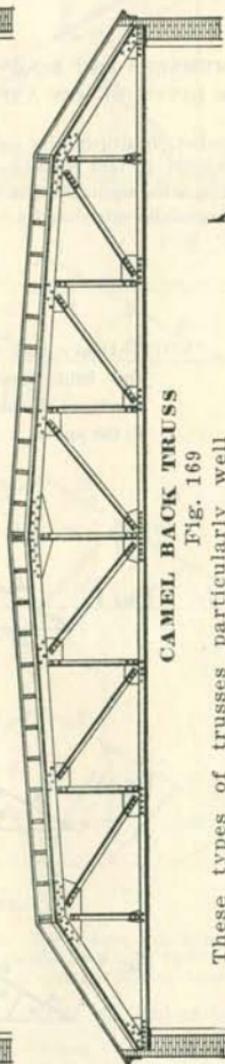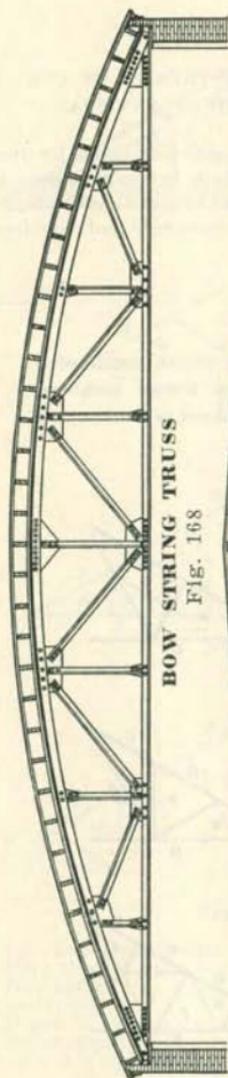
These types of trusses particularly well adapted to garages of various spans.

Fig. 171

Fig. 170
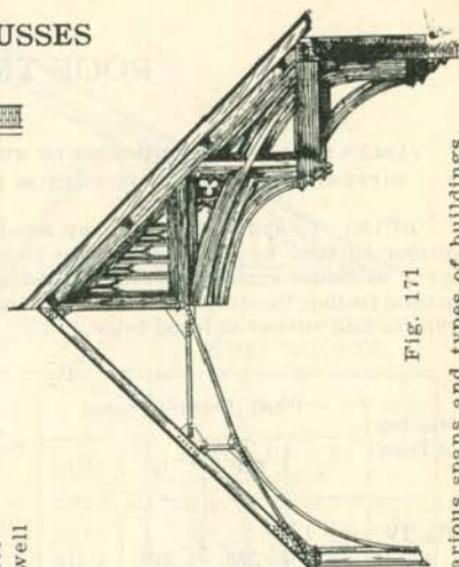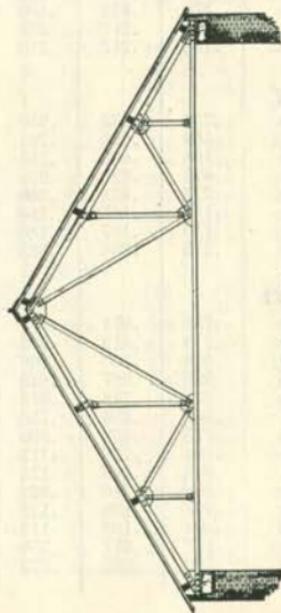
We design and fabricate all styles of trusses for various spans and types of buildings.

ROOF TRUSSES

TABLES FOR FINDING STRESSES IN MEMBERS FOR ROOF TRUSSES OF THE
DIFFERENT TYPES AND PITCHES AS GIVEN BELOW AND OF ANY SPAN .

RULE: To find the stress in any member, multiply the coefficient given for that
member by total load carried by truss (=span in feet × distance between trusses in
feet × weight per square foot). If the truss is acted upon by wind forces or other unsymmetrical loading, the stresses in the members must be calculated accordingly and combined
with the load stresses as found below.

Member of Truss	Pitch (Depth to Span)			
	$\frac{1}{3}$	**30°**	$\frac{1}{4}$	$\frac{1}{5}$
Fig. IV				
A-a	.675	.750	.838	1.010
B-b	.537	.625	.726	.917
C-a	.563	.650	.750	.938
C-c	.375	.433	.500	.625
a-b	.208	.217	.224	.232
b-c	.188	.217	.250	.313
Fig. V				
A-a	.750	.833	.930	1.120
B-b	.589	.666	.757	.928
C-c	.568	.666	.783	.995
D-a	.625	.721	.833	1.042
D-d	.375	.433	.500	.625
a-b	.155	.167	.180	.202
b-c	.155	.167	.180	.202
c-d	.250	.288	.333	.417
Fig. VI				
A-a	.788	.874	.978	1.178
B-b	.718	.812	.922	1.131
C-e	.649	.750	.866	1.085
D-d	.580	.687	.810	1.038
E-a	.655	.758	.875	1.094
E-f	.562	.650	.750	.938
E-e	.375	.433	.500	.625
a-b	.104	.108	.112	.116
b-f	.093	.108	.125	.156
f-g	.208	.216	.224	.232
g-c	.093	.108	.125	.156
c-d	.104	.108	.112	.116
g-e	.187	.217	.250	.313
d-e	.280	.325	.375	.469

NOTE—Heavy lines denote compression and light lines tension members. Loads are considered as concentrated at the joints.
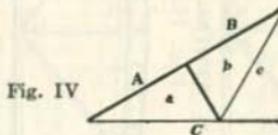
Fig. IV
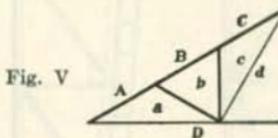
Fig. V
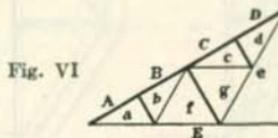
Fig. VI
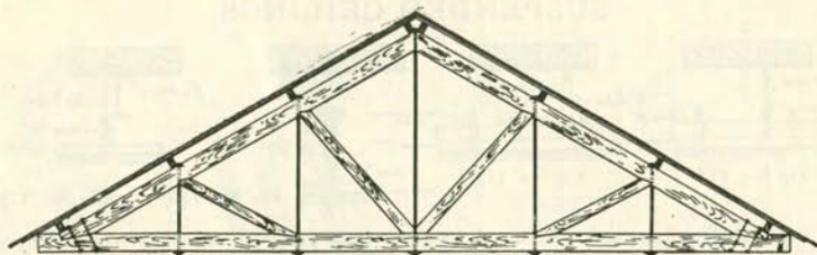
Wooden Roof Truss.
Fig. 172
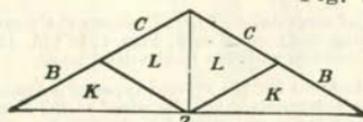
Fig. I
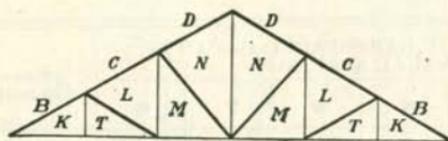
Fig. II
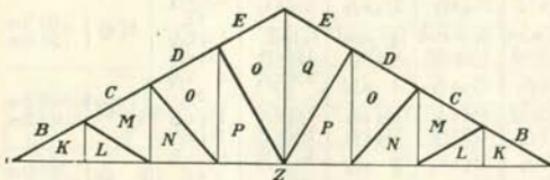
Fig. III

COEFFICIENTS

Member of Truss	Pitch (depth to span)		
	1:3	30°	1:4
Fig. I			
BK	.676	.750	.837
CL	.450	.500	.558
KL	.225	.250	.279
KZ	.562	.647	.750
LL	.250	.250	.250
Fig. II			
BK	.750	.835	.930
CL	.600	.665	.749
DN	.450	.497	.555
KT	.0	.0	.0
LM	.083	.083	.083
NN	.334	.334	.334
TL	.150	.170	.185
MN	.207	.220	.235
KZ	.625	.720	.830
TZ	.625	.720	.830
MZ	.500	.575	.667
Fig. III			
BK	.785	.870	.986
CM	.673	.750	.845
DO	.560	.620	.700
EQ	.450	.500	.560
QQ	.375	.375	.375
PQ	.210	.215	.225
OP	.125	.125	.125
NO	.156	.165	.176
MN	.062	.062	.062
LM	.112	.124	.141
KL	.0	.0	.0
KZ	.655	.755	.875
LZ	.655	.755	.875
NZ	.560	.645	.750
PZ	.470	.540	.625

Light lines denote tension. Heavy lines denote compression.
Stress in any member = coefficient × total **load carried.**
Total load = Span in feet × distance between trusses in feet × load per square foot.
Trusses loaded unsymmetrically or with load on bottom chord will require special calculations.
Use Fig. 1 for spans up to 30 feet.
" 2 " " 50 "
" 3 " " 70 "

SUSPENDED CEILINGS

Fig No. 173 Fig No. 174 Fig No. 175 Fig No. 176
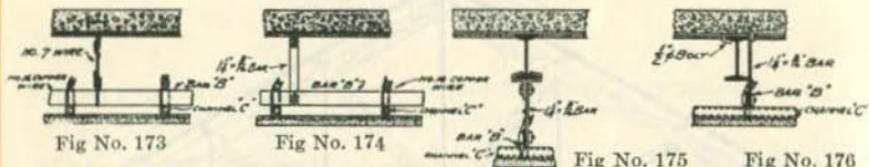
Suspended ceilings are constructed wherever it is necessary to cover overhead floor framing so as to secure a lower flat ceiling. These ceilings will cover overhead ducts and passages and will prevent undue condensation on the under side of roof or similar cold surfaces.

The above sketches show several types of suspension. Fig. 173 shows the method used for ceilings carrying the dead load of framing and plaster only; Figs. 174, 175, 176, show the method used for ceilings carrying live loads in addition to the dead loads.

The various sizes of hangers, bars and channels for the several types of suspended ceilings are given in the table below. The small channels should be wired to the longitudinal bars with No. 16 copper wire, and the expanded metal should be fastened to the small channels in the same way at every crossing. Where a ribbed expanded metal is used the small channels are omitted.

For special conditions of loading and spacing, different sizes from those given should be designed.

Total Load Lbs. Per Sq. Ft.		SPAN IN FEET, BARS SPACED 4'-0" CTRS. USUAL SPACING						Size of Channels C
		3	4	5	6	7	8	
10	Bar "B"	1¼x¼	1½x¼	2 x₁₆	2½x¼	3 x₁₆	5 x₁₆ 4⊏	¾ @ { .40 lbs. / .56 lbs.
	Hanger	No.7 wire ¼—rod	No.7 wire ¼—rod	¼—rod	¼—rod	¼—rod	1¼x₁₆ 1¼x₁₆	
16	Bar "B"	1½x¼	2 x¼	2¼x₁₆	2½x₁₆	3½x¼	5½x₁₆ 4⊏	¾ @ { .40 lbs. / .56 lbs.
	Hanger	No.7 wire ¼—rod	No.7 wire ¼—rod	¼—rod	¼—rod	¼ rod	1¼x₁₆ 1¼x₁₆	
20	Bar "B"	1½x₁₆	2 x₁₆	2½x₁₆	3 x¼	3½x₁₆ 3⊏	6 x₁₆ 4⊏	⅞ @ { .68 lbs. / .92 lbs.
	Hanger	No.7 wire ¼—rod	¼—rod 1¼x₁₆	1¼x₁₆ 1¼x₁₆	1¼x₁₆ 1¼x₁₆	1¼x₁₆ 1¼x₁₆	1¼x₁₆ 1¼x₁₆	
25	Bar "B"	1¾x¼	2¼x₁₆	2½x⅜	3 x₁₆	4 x¼ 3⊏	6½x₁₆ 4⊏	1 @ { .68 lbs. / .82 lbs.
	Hanger	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	
30	Bar "B"	1¾x₁₆	2½x₁₆	3 x¼	3½x¼	4½x¼ 3⊏	6½x₁₆ 4⊏	1¼ @ { 1.29 lbs. / .92 lbs.
	Hanger	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	
35	Bar "B"	2 x⅜	3 x¼	3 x₁₆	3½x₁₆ 3⊏	5 x₁₆ 4⊏	7 x¼ 4⊏	1¼ @ { 1.54 lbs. / .85 lbs.
	Hanger	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	
40	Bar "B"	2½x⅜	3 x₁₆	3½x¼	4 x₁₆ 3⊏	5½x₁₆ 4⊏	7 x₁₆ 4⊏	1½ @ { 1.12 lbs. / 1.67 lbs.
	Hanger	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x₁₆	1¼x¾	1¼x¼	

A ½" Bolt is sufficient for all connections. Rods round.
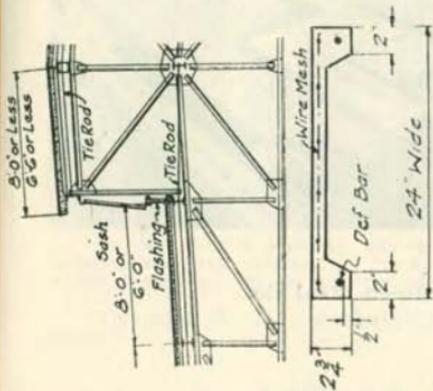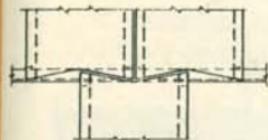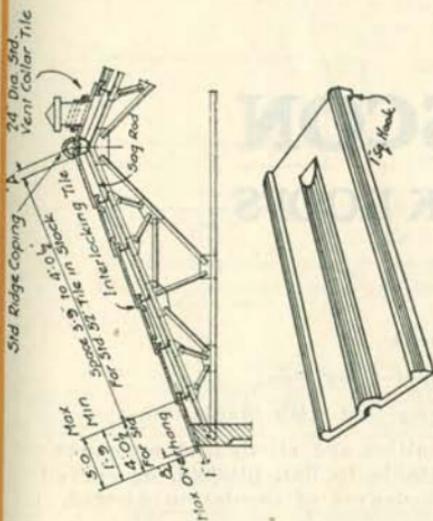
FEDERAL PRECAST CONCRETE ROOF SLABS

These fireproof Pre-Cast Reinforced Concrete Slabs are composed of one part Portland cement to three parts highest grade washed torpedo sand graded, thoroughly mixed, and mechanically tamped for greatest possible density. Safe carrying load 60 pounds per square foot, factor of safety, four. Data on three types follows:

	(1) 2¾" CHANNEL SLAB	(2) 3½" CHANNEL SLAB	(3) INTERLOCKING TILE
Type			
Roof	Slab Spans up to 6'6"	Slab Spans 6'6" to 8'0"	Sloping
Reinforcing	Flat or Sloping Deformed bars in legs and wire mesh in web.	Sloping or Flat Deformed bars in legs and wire mesh in web.	Galvanized wire mesh
Standard Size	6 ft. long x 24" wide x 2¾" thick. See cut.	8 ft. long x 18" wide x 3½" thick. See cut.	52" long x 24" wide x 1½" thick. Other lengths to 64" special. Similar to (1).
Weight	15 pounds per sq. ft.	20 pounds per sq. ft.	17 pounds per sq. ft.
Joints	Asphaltic cement upper side.	Asphaltic cement upper side.	High grade plastic oil cement.
Color			Permanent red integral with concrete. Standard size made also with glass insert.

Purlin spacing as indicated in cuts. Types 1 and 2 made also as nailing concrete slab and as cork insulation slab, weighing 24 pounds per sq. foot and 23 pounds per sq. foot respectively. Types 1 and 2 are covered with a composition roofing material by owner. No composition covering is required on Type 3.

TRUSCON
STEELDECK ROOFS

Permanent

Incombustible—copper-alloy steel

Light in weight—5 lbs. per. sq. foot with insulation.

Expansion and contraction difficulties are eliminated by expansion joints in two directions. Adaptable to flat, pitched, or curved roofs with minimum 40' radius. Any degree of insulation desired.

Standard sizes of I plates—18 or 20 gage:—

Width 2'-0"

Lengths 8' or 10'

Special as required

I sections.

Spaced 6" O. C.

Depth 1" or 1½"

Bottom flange ⅝"
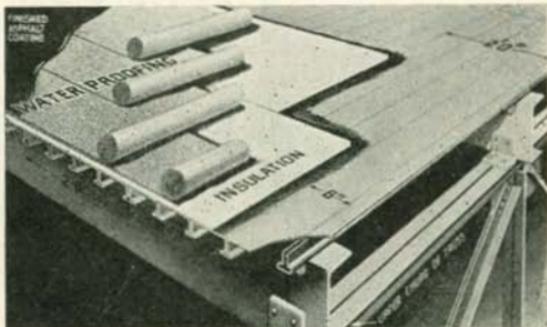
Further data by Truscon Steel Co.

DETAILS OF PYROBAR ROOF TILE

NOTE: ALL TILE REINFORCED WITH ELECTRICALLY WELDED GALVANIZED STEEL MAT

SHORT SPAN ROOF TILE - 30" TYPE
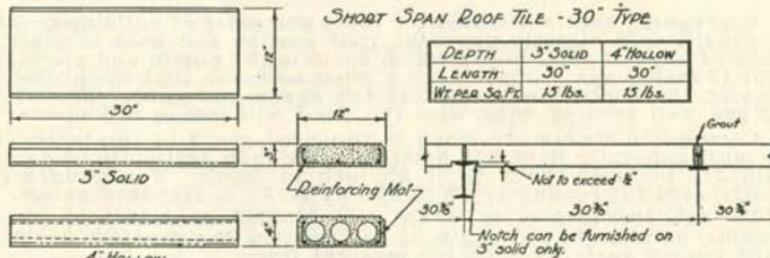
DEPTH	3" SOLID	4" HOLLOW
LENGTH	30"	30"
WT PER SQ. FT.	15 lbs.	15 lbs.

3" SOLID

Reinforcing Mat

Not to exceed ⅛"

Notch can be furnished on 3" solid only.

4" HOLLOW

Grout

DESIGNING DATA

Spans for various T-irons spaced 30¾ in. on centers

Span........	Up to 5'3"	5'3" to 5'10½"	5'10½" to 6'5½"	6'5½" to 8'0"
Size T-Iron..	2¼"x2¼"-4.1 lb.	2¼"x2¼"-4.9 lb.	2½"x2½"-5.5 lb.	3"x3"-6.7 lb.

REINFORCING MAT

LENGTH

NOTCH NOT TO EXCEED ½"
TILE CAN BE FURNISHED
WITH OR WITHOUT NOTCH
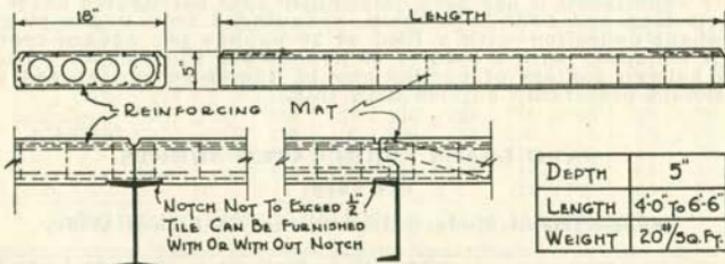
DEPTH	5"
LENGTH	4'0" to 6'6"
WEIGHT	20"/SQ. FT.

STANDARD LONG SPAN
HOLLOW TILE WITH NOTCH

LAP JOINT HOLLOW
ROOF TILE WITH NOTCH

LONG SPAN HOLLOW ROOF TILE

Pyrobar roof tile are made of "Structolite", a specially prepared dense structural gypsum, reinforced with electrically welded, galvanized steel mats. "Structolite" is made in two general types, long span hollow and 30" block, either solid or hollow.

Pyrobar fill consists of gypsum stucco, to which a small percentage of fibre, usually soft wood shavings, is added as a binder or aggregate.

In Sheetrock Pyrofill construction, gypsum is poured on permanent sheetrock forms or centering resting on light rails or other steel framing. It is reinforced with welded wire matting.

Gypsum Roofs are fireproof and hold condensation to a minimum.

Further data by U. S. Gypsum Co.

CORRUGATED SHEETS.

Corrugated sheets are used for roofs and sides of buildings. They are usually laid directly upon the roof purlins and held in place by means of clips of steel hoops which encircle the purlin and are placed about 12 inches apart. Special care must be taken that the projecting edges of the corrugated sheets at the eaves and gable ends of the roof are well secured, otherwise the wind will loosen the sheets.

Corrugated sheets are made in the sizes given in the tables, the size most generally used has nominally 2½ inch corrugations (actual width 2⅜ inches), about ½ of an inch in depth. The gauges frequently used for roofing are Nos. 20 and 22, U. S. standard gauge.

By one corrugation is meant the double curve between corresponding points, and by depth of corrugation the greatest deviation of the curved surfaces from the straight line.

One and one-half corrugations are allowed for lap in the width of the sheet and 6 inches in the length for the usual quarter pitch roof; one corrugation in width and 4 inches in the length of the sheets is usually allowed for sidings.

Corrugated sheets are furnished in standard lengths of 5, 6, 7, 8, 9 and 10 feet, and with a covering width of 24 inches, when laid with a lap of either one or one and one-half corrugations.

By experiment it has been determined that corrugated sheet steel, ⅝ inch deep and 0.035 inch thick, spanning 6 feet, began to give a permanent deflection with a load of 30 pounds per square foot, and that it collapsed with a load of 60 pounds per square foot. The distance betwen centers of purlins should, therefore, not exceed 6 feet and should preferably be less than this.

SAFE LOADS CORRUGATED SHEETS

Per Sheet

Supported at Ends Only. Sheets, 26 Inches Wide.

	Gauge	28	27	26	24	22	20	18	16
2½″ Corrugations	6′ 0″ Span	88	97	106	141	176	211	282	352
	7′ 0″ Span	75	83	91	121	151	181	242	302
	8′ 0″ Span	66	73	79	106	132	158	211	264
	9′ 0″ Span	59	65	70	94	117	141	188	235
	10′ 0″ Span	53	58	63	85	106	127	169	211
1¼″ Corrugations	6′ 0″ Span	53	58	64	85	106	127	169	211
	7′ 0″ Span	45	50	55	73	91	109	145	181
	8′ 0″ Span	40	44	47	64	79	95	127	158
	9′ 0″ Span	35	39	42	56	70	85	113	141
	10′ 0″ Span	32	34	38	51	64	76	101	127

⅝ inch is taken as depth of 2½ inch corrugations, ⅜ inch as depth of 1¼ inch corrugations.

The following formula has been used: $W = \dfrac{99900 \ t \ b \ d}{L}$

L=Supported length of sheet in inches.

t=Thickness of sheet in inches.

b=Width of sheet in inches.

d=Depth of corrugations in inches.

W=Breaking weight distributed in pounds.

$\dfrac{W}{4}$=Safe loads per sheet between supports.

CORRUGATED SHEETS.

Description of Corrugated Sheets   Area of Corrugated Sheets.

Corrugations				Width Ins.		Length of Sheet Ins.	Sq. Ft. in 1 Sheet — Corrugations			Sheets in 100 Sq. Ft. — Corrugations		
Width Ins. Nominal	Act'l	Depth Approx Ins.	Number per Sheet	Full Sheet	Covers Approx		5″	3″, 2½″, 2″	1¼″, ⅝″	5″	3″, 2½″, 2″	1¼″, ⅝″
5	4¾	⅞	6	28	24	60	11.67	10.83	10.42	8.57	9.23	9.60
3	2⅜	⅝	9	26	24	72	14.00	13.00	12.50	7.14	7.69	8.00
2½	2⅛	½	10	26	24	84	16.33	15.17	14.58	6.12	6.59	6.86
2	2	½	11	26	24	96	18.67	17.33	16.67	5.36	5.77	6.00
1¼	1¼	⅜	20	25	24	108	21.00	19.50	18.75	4.76	5.13	5.33
⅝	⅝	³⁄₁₆	26	25	24	120	23.33	21.67	20.83	4.29	4.62	4.80
						144	28.00	26.00	25.00	3.57	3.85	4.00

Standard lengths, 5, 6, 7, 8, 9 and 10 ft. maximum length, 12 ft. for 5″ to 1¼″ Corrugations.

CORRUGATED SHEETS—PAINTED.

Weight in Pounds per 100 square Feet

Nominal Corrugations Inches	Thickness, U. S. Standard Gauge and Decimals of an Inch												
	12	14	16	18	20	21	22	23	24	25	26	27	28
	.109	.078	.063	.050	.038	.034	.031	.028	.025	.022	.019	.017	.016
5	.....	339	271	217	163	150	136	123	110	96	83	76	68
3	.....	.....	271	217	163	150	136	123	110	96	83	76	68
2½	474	339	271	217	163	150	136	123	110	96	83	76	68
2	.....	.....	.....	217	163	150	136	123	110	96	83	76	68
1¼	.....	.....	.....	.....	170	.....	142	.....	114	.....	86	79	72
⅝	.....	.....	.....	.....	.....	.....	.....	.....	114	.....	86	79	72

CORRUGATED SHEETS—GALVANIZED.

Weight in Pounds per 100 Square Feet

Nom. Corrug. Inches	Thickness, U. S. Standard Gauge and Decimals of an Inch												
	12	14	16	18	20	21	22	23	24	25	26	27	28
	.109	.078	.063	.050	.038	.034	.031	.028	.025	.022	.019	.017	.016
5	.....	354	286	232	178	165	151	138	124	111	98	91	85
3	.....	.....	286	232	178	165	151	138	124	111	98	91	85
2½	488	354	286	232	178	165	151	138	124	111	98	91	85
2	.....	.....	.....	232	178	165	151	138	124	111	98	91	85
1¼	.....	.....	.....	.....	185	.....	157	.....	129	.....	101	94	87
⅝	.....	.....	.....	.....	.....	.....	.....	.....	129	.....	101	94	87

The weights per 100 square feet given in preceding tables do not include allowances for end or side laps. The following table gives the approximate number of square feet of sheeting necessary to cover an area of 100 square feet and is based on sheets of standard width, 96 inches long. If longer or shorter sheets are used, the number of square feet required will vary accordingly.

Square Feet of Corrugated Sheets to Cover 100 square feet

Side Lap	End Lap, Inches					
	1	2	3	4	5	6
1 Corrugation	110	111	112	113	114	115
1½ "	116	117	118	119	120	121
2 "	123	124	125	126	127	128

TRUSCON ¾" HY-RIB FOR FLOORS AND ROOF SLABS

SAFE LOADS FOR ¾" HY-RIB SLABS
Safe Loads Include Weight of Slab.   For Safe Live Load Deduct Weight of Slab.

Thickness of Slabs above Base of Hy-Rib	Weight Per Sq. Ft. ¾" Hy-Rib	Moment of Resistance Per Ft. of Width	SPAN IN FEET								
			3	4	5	6	7	8	9	10	11
2" thick slab	.58	3440	318	179	115	80	....	....	....	....	....
Wgt. = 24 lbs.	.68	3940	365	205	131	91	....	....	....	....	....
per sq. ft.	.78	4160	385	216	138	96	....	....	....	....	....
2½" thick slab	.58	4530	420	236	151	105	77	59	....	....	....
Wgt. = 30 lbs.	.68	5380	498	280	179	125	91	70	....	....	....
per sq. ft.	.78	6230	577	325	208	144	106	81	....	....	....
3" thick slab	.58	5630	522	293	188	131	96	73	....	....	....
Wgt. = 30 lbs.	.68	6710	622	349	224	155	114	87	69	....	....
per sq. ft.	.78	7780	720	405	259	180	132	101	80	....	....
3½" thick slab	.58	6750	625	352	225	156	115	88	....	....	....
Wgt. = 42 lbs.	.68	8020	743	418	268	186	136	104	83	....	....
per sq. ft.	.78	9300	862	484	310	215	158	121	96	78	....
4" thick slab	.58	7850	727	409	262	182	134	102	81	....	....
Wgt. = 48 lbs.	.68	9350	866	487	312	216	159	122	96	78	....
per sq. ft.	.78	10870	1060	566	362	252	185	142	112	91	75

B. M. = 1/10WL² For B. M. = 1/12WL², add 20% to above loads.
For B. M. = 1/8WL², deduct 20% from above loads.

HY-RIB, of plain or copper-alloyed steels in various gages, is also used in place of wood lath for plastered walls and ceilings and for plastered partitions in which case the rib is ⅜" or ¾", depending upon the span over which the Hy-rib lath is supported.

COPPER-ALLOY STEEL

COPPER-ALLOY STEEL contains a minimum of .15 per cent copper alloyed with steel resulting in an increase in the life of this steel of from 300 to 500 per cent. The commonly accepted theory is that this alloy of copper and steel neutralizes the influence of the trace of sulphur left in all steels. Furthermore, the oxide or rust on non-copper bearing steel is coarse and loose, therefore holding moisture which hastens corrosion. The oxide formed on copper bearing steel sheets, however, being fine grained and tightly adherent, retards corrosion, and after exposure to moisture, copper-alloy steels dry more rapidly.

In extensive tests conducted over a period of ten years by the American Society for Testing Materials, the average result showed initial failure for various metals as follows (#22 Gauge Sheets).

Non-copper-bearing steel sheets after 32 months.
Non-copper-bearing "Pure Iron" sheets after 48 months.
Copper-bearing "Pure Iron" sheets after 101 months.
Copper-bearing steel sheets after 132 months.

Because of its resistance under constant exposure, copper-alloy steel is best adaptable to the following uses—Sidings for hangars and other buildings, Taintor gates, Tanks and bins, Flumes, and many other structures.

STEEL CHECKERED PLATES
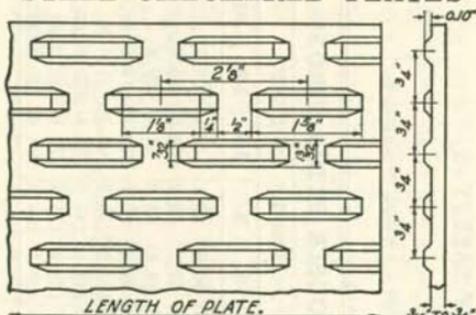
FLOOR PLATE
I. S. Co. M-41

ELEMENTS OF SECTION

I. S. Co.	Thickness	Width		Length	Weight	Section Modulus Per Foot	
		Min.	Max.			Transverse	Longitudinal
	In.	In.	In.	In.	Lb./ft.	In. 3	In. 3
M-41	1/16	6	72	240	8.8	0.085	0.070
M-41	1/4	6	72	240	11.3	0.142	0.125
M-41	5/16	6	72	240	13.9	0.214	0.195
M-41	3/8	6	72	240	16.4	0.301	0.281
M-41	7/16	6	72	240	19.0	0.405	0.383
M-41	1/2	6	72	240	21.5	0.524	0.500
M-41	5/8	6	72	240	26.6	0.807	0.781
M-41	3/4	6	72	240	31.7	1.153	1.125

Note: Moduli of section are precise mathematical values.
Plates are rolled with ribs parallel to length.

ALLOWABLE UNIFORM LOAD IN POUNDS PER SQUARE FOOT FOR STEEL PLATES—RIBBING NOT INCLUDED.

Span In Feet	Fibre Stress 16000 Pounds per Sq. Inch.								Fibre Stress 12000 Pounds per Sq. Inch.							
	1/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	1/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4
1	746	1333	2083	3000	4083	5333	8330	12000	560	1000	1560	2248	3064	4000	6247	9000
2	187	333	520	750	1021	1333	2082	3000	140	250	390	562	766	1000	1561	2250
3	83	148	232	333	454	593	925	1333	62	111	173	250	340	444	693	1000
4	47	83	130	188	255	333	520	750		63	97	141	191	250	390	562
5		53	83	120	163	213	333	480			62	90	122	160	249	360
6			58	83	113	148	231	333				62	85	111	173	250
7				61	83	109	170	244					63	82	127	183
8					64	83	130	187						62	97	140
9						66	102	148							76	111
10							83	120							62	90

The values given in above table are the safe loads per square foot of plates supported on two sides only and are based upon the Resistance of Rectangular sections, 12 inches by the net section, thickness.

The weight of the plates are included in the safe loads and must be deducted to obtain the net superimposed safe load.

Safe loads for other fiber stresses than those given in table may be obtained from the values given by direct proportion of the fiber stresses.

GAS PIPE COLUMNS

SAFE LOADS IN THOUSANDS OF POUNDS—FACTOR OF SAFETY=5.

Based on Formula $P = 11000 - 35\ \dfrac{l}{r}$ P = Pressure Per Sq. In. l = Length in Inches r = Rad. of Gyration.

Nom. Size	STANDARD						EXTRA STRONG						DOUBLE EXTRA STRONG					
	LENGTH IN FEET						LENGTH IN FEET						LENGTH IN FEET					
	7	8	9	10	12	14	7	8	9	10	12	14	7	8	9	10	12	14
3	19.2	18.5	17.7	16.9	15.0		25.4	24.2	23.2	22.0	19.8		44.7	43.6	40.1	38.1	33.7	
3½	23.4	22.8	21.9	21.0	19.1		32.2	31.0	29.8	28.6	26.2		57.6	55.2	52.9	50.6	45.8	
4	28.6	27.8	27.0	26.1	24.3		39.6	38.4	37.2	35.9	33.5		72.1	69.4	66.8	64.4	59.4	
4½	34.0	33.2	32.3	31.4	29.5		47.8	46.4	45.2	43.7	41.2		87.0	84.4	81.6	79.2	73.8	68.6
5	40.4	39.6	38.7	37.7	35.7		57.4	56.0	54.6	53.2	50.4	47.6	105.3	102.5	99.8	97.2	91.6	86.1
6	53.9	53.0	52.0	50.8	48.9	46.8	77.6	76.2	74.6	73.1	70.0	67.0	149.0	146.6	142.6	139.4	133.8	127.3
7	68.1	67.2	66.1	65.0	62.6	60.4	110.3	108.3	106.6	103.6	100.8	97.1	181.6	178.2	174.9	171.9	165.2	158.9
8	72.5	71.6	70.6	69.6	68.4	65.4	127.4	125.3	123.6	121.8	117.8	114.2	211.6	208.1	204.8	201.9	191.0	188.6

Except in special cases gas pipe columns are more expensive and less satisfactory than cast iron columns. Where beams are supported at the side, brackets are fastened with tap screws, making a connection neither safe nor economical. Cast flanges screwed to the shaft are used for making the connection between columns. Columns of this type may be used to advantage, however, where the loads are light and rest on top of the column, the cap and base plate being loose.

PROPERTIES OF GAS PIPE

Nom. Size	STANDARD						EXTRA STRONG						DOUBLE EXTRA STRONG					
	Actual Outside Diam.	Inside Diam.	Thickness in ins.	Wt. Per Foot	Area sq. ins.	Rad. of Gyration	Actual Outside Diam.	Inside Diam.	Thickness in Ins.	Wt. Per Foot	Area Sq. ins.	Rad. of Gyration	Actual Outside Diam.	Inside Diam.	Thickness in	Wt. per Foot	Area Sq. Ins.	Rad. of Gyration
¾	1.050	0.824	0.113	1.130	0.333	0.328	1.050	0.742	0.154	1.473	0.433	0.313	1.050	0.434	0.308	2.44	0.718	0.259
1	1.315	1.049	0.133	1.678	0.494	0.420	1.315	0.957	0.179	2.17	0.639	0.407	1.315	0.599	0.358	3.66	1.076	0.361
1¼	1.660	1.380	0.140	2.272	0.668	0.540	1.660	1.278	0.191	3.00	0.881	0.524	1.660	0.896	0.382	5.21	1.534	0.472
1½	1.900	1.610	0.145	2.717	0.800	0.623	1.900	1.500	0.200	3.63	1.068	0.605	1.900	1.100	0.400	6.41	1.885	0.549
2	2.375	2.067	0.154	3.652	1.075	0.787	2.375	1.939	0.218	5.02	1.477	0.766	2.375	1.503	0.436	9.03	2.656	0.703
2½	2.875	2.469	0.203	5.793	1.704	0.947	2.875	2.323	0.276	7.66	2.254	0.924	2.875	1.771	0.552	13.69	4.028	0.844
3	3.500	3.068	0.216	7.575	2.228	1.164	3.500	2.900	0.300	10.25	3.016	1.136	3.500	2.300	0.600	18.58	5.466	1.047
3½	4.000	3.548	0.226	9.109	2.680	1.337	4.000	3.364	0.318	12.50	3.678	1.307	4.000	2.728	0.636	22.85	6.721	1.210
4	4.500	4.026	0.237	10.790	3.174	1.510	4.500	3.826	0.337	14.98	4.407	1.477	4.500	3.152	0.674	27.54	8.101	1.374
4½	5.000	4.506	0.247	12.538	3.688	1.683	5.000	4.290	0.355	17.61	5.180	1.647	5.000	3.580	0.710	32.53	9.569	1.537
5	5.563	5.047	0.258	14.617	4.300	1.878	5.563	4.813	0.375	20.78	6.112	1.839	5.563	4.063	0.750	38.55	11.34	1.722
6	6.625	6.065	0.280	18.974	5.581	2.245	6.625	5.761	0.432	28.57	8.405	2.195	6.625	4.897	0.864	53.16	15.64	2.060
7	7.625	7.023	0.301	23.544	6.926	2.592	7.625	6.625	0.500	38.05	11.19	2.525	7.625	5.875	0.875	63.08	18.56	2.406
8	8.625	8.071	0.277	24.696	7.265	2.953	8.625	7.625	0.500	43.39	12.76	2.878	8.625	6.875	0.875	72.42	21.30	2.757

UPSET SCREW ENDS FOR SQUARE BARS

Diameter of Side of Square Bar	Area of Body of Bar	Diameter of Screw	Length of Upset	Area at Root of Thread	Number of Threads per Inch	Weight per foot of Bar	Add for Upset
Inches	Sq. Inches	Inches	Inches	Sq. Inches		Pounds	Inches
½	.25	¾	4¼	.302	10	.850	4
⅝	.391	1	4½	.550	8	1.328	5¾
¾	.563	1⅛	4¾	.694	7	1.913	4½
⅞	.766	1⅜	5	1.057	6	2.603	5¾
1	1.000	1½	5	1.295	6	3.400	4¾
1⅛	1.266	1⅝	5¼	1.515	5½	4.303	4¼
1¼	1.563	1⅞	5½	2.048	5	5.312	5¼
1⅜	1.891	2	5½	2.302	4½	6.428	4½
1½	2.250	2⅛	5¾	2.650	4½	7.650	4¼
1⅝	2.641	2⅜	6	3.419	4½	8.978	5
1¾	3.063	2½	6	3.715	4	10.410	4½
1⅞	3.516	2⅝	6¼	4.155	4	11.950	4¼
2	4.000	2⅞	6½	5.108	4	13.60	5
2⅛	4.516	3	6½	5.428	3½	15.35	4½
2¼	5.063	3⅛	6¾	5.957	3½	17.22	4¼
2⅜	5.641	3⅜	7	7.087	3½	19.18	5¼
2½	6.250	3½	7	7.548	3¼	21.25	4¾
2⅝	6.891	3⅝	7¼	8.171	3¼	23.43	4½
2¾	7.563	3⅞	7½	9.305	3	25.71	5¼
2⅞	8.266	4	7½	9.993	3	28.10	4¾
3	9.000	4⅛	7¾	10.706	3	30.60	4½
3⅛	9.766	4⅜	8	12.087	2⅛	33.20	5¼
3¼	10.563	4½	8	12.743	2¾	35.92	5
3⅜	11.391	4⅝	8¼	13.544	2¾	38.73	5
3½	12.250	4⅞	8½	15.068	2⅝	41.65	5½

UPSET SCREW ENDS FOR ROUND BARS

Diameter of Bar	Area of Body of Bar	Diameter of Screw	Length of Upset	Area at Root of Thread	Number of Threads per Inch	Weight per Foot of Bar	Add for Upset
Inches	Sq. In.	Inches	Inches	Sq. In.		Pounds	Inches
½	.196	¾	4¼	.302	10	.668	6½
⅝	.307	⅞	4½	.420	9	1.043	5½
¾	.442	1	4½	.550	8	1.502	4½
⅞	.601	1¼	4¾	.893	7	2.044	6¼
1	.785	1⅜	5	1.057	6	2.670	5¼
1⅛	.994	1½	5	1.295	6	3.379	4¾
1¼	1.227	1⅝	5¼	1.515	5½	4.173	4½
1⅜	1.485	1¾	5¼	1.744	5	5.049	4
1½	1.767	2	5½	2.302	4½	6.008	5¼
1⅝	2.074	2⅛	5¾	2.650	4½	7.051	5
1¾	2.405	2¼	5¾	3.023	4½	8.178	4¾
1⅞	2.761	2⅜	6	3.419	4½	9.388	4½
2	3.142	2½	6	3.715	4	10.68	4¼
2⅛	3.547	2⅝	6¼	4.155	4	12.06	4
2¼	3.976	2⅞	6½	5.108	4	13.52	5¼
2⅜	4.430	3	6½	5.428	3½	15.07	4¾
2½	4.909	3⅛	6¾	5.957	3½	16.69	4¾
2⅝	5.412	3¼	6¾	6.510	3½	18.40	4½
2¾	5.940	3⅜	7	7.087	3½	20.20	4½
2⅞	6.492	3⅝	7¼	8.171	3¼	22.07	5¼
3	7.069	3¾	7¼	8.641	3	24.03	5
3⅛	7.570	3⅞	7½	9.305	3	26.08	5¼
3¼	8.296	4	7½	9.993	3	28.20	4¾
3⅜	8.946	4⅛	7¾	10.706	3	30.42	4¾
3½	9.621	4¼	8	11.329	2⅞	32.71	4½

TURNBUCKLES

ALL DIMENSIONS IN INCHES

Dia. of Screw	L	T	A	B	C	t	Weight in pounds
3/8	7⅛	⅜	½	1⅜	⅜	⅜	.....
½	7½	¾	⅝	1⅜	⅝	¼	.....
⅝	7⅞	⅞	¾	1⅜	¾	⁷⁄₁₆	.....
¾	8¼	1⅜	⅞	2	1⅜	½	.....
⅞	8⅝	1⅜	1	2¼	1¼	⅜	2½
1	9	1½	1¼	2⅜	1⅜	⅜	3½
1⅛	9⅜	1¾	1¼	2⅜	1⅜	½	4
1¼	9¾	1⅞	1½	2¾	1⅜	½	5¼
1⅜	10⅛	2⅜	1⅝	3⅜	1⅜	½	6
1½	10½	2¼	1¾	3⅜	1¾	⅝	7
1⅝	10⅞	2⅜	1⅞	3½	2	⅝	8½
1¾	11¼	2⅝	2	3¾	2⅛	⅝	10
1⅞	11⅝	2⅜	2⅛	3⅞	2⅜	¾	11½
2	12	3	2¼	4¼	2⅜	¾	13
2⅛	12⅜	3⅛	2½	4½	2½	¾	15
2¼	12¾	3⅜	2½	4¾	2¾	¾	18
2⅜	13⅛	3⅜	2¾	4⅞	2¾	¾	20
2½	13½	3¾	3	5⅜	3⅛	⅞	24
2⅝	13⅞	3⅛	3	5⅜	3⅛	⅞	28
2¾	14¼	4⅛	3¼	5¾	3¼	⅞	30
2⅞	14⅝	4⅛	3¼	6⅛	3⅛	1⅛	34
3	15	4½	3½	6⅜	3⅝	1½	38

Dia. of Screw	L	T	C	Sht. Dia. of Head	Min. Opening	Max. Opening	Weight in pounds
3/8	7¼	⅞	⅜	¾	2	5½	.65
½	7½	1	½	1	2	15	1.2
⅝	7⅞	1⅛	⅝	1⅛	2	15	1.5
¾	8¼	1⅜	¾	1⅜	4	18	2.2
⅞	8⅝	1⅜	⅞	1⅜	4	18	2.35
1	9	1¾	1	1⅜	4	18	3.2
1⅛	9⅜	1⅜	1⅛	1⅝	5½	24	3.75
1¼	9¾	2⅛	1¼	1⅞	5½	24	4.8
1⅜	10⅛	2⅛	1⅜	2⅜	5½	24	6.
1½	10½	2½	1½	2⅜	5½	24	7.31
1⅝	10⅞	2⅜	1⅝	2⅜	5½	24	7.9
1¾	11¼	2⅞	1¾	2⅜	5½	24	8.94
1⅞	11⅝	3⅛	1⅞	2⅝	5½	24	10.8
2	12	3⅛	2	2⅜	5½	24	14.9
2⅛	12⅜	3⅜	2⅛	2⅜	5½	24	16.5
2¼	12⅝	3⅜	2¼	3¼	5½	24	19.2
2⅜	12⅞	3⅜	2⅝	3¼	5½	24	20.3
2½	13½	4	2½	3⅜	5½	24	26.25
2⅝	13⅞	4⅛	2⅝	3⅜	5½	24	27.5
2¾	14¼	4⅝	2¾	4⅛	5½	24	32.
2⅞	14⅝	4⅛	2⅞	4⅛	5½	24	33.5
3	15	4¾	3	4⅛	5½	24	35.

Weights given are for Turnbuckles only.

STANDARD CLEVIS NUTS.

DIAMETER I FOR VARIOUS GIVEN SIZES OF PINS

	Used with steel rods 68,000 lbs. per sq. in.								Wrought iron Rods 50,000 lbs. per sq. in.							
D	B	A	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4

DIMENSIONS E. F. G. FOR VARIOUS DIAMETERS-I.

I	E	F	G	I	E	F	G

N. B. All Clevis Nuts with Diameter I-8 in. or larger dimension A will be 12 in.

Dimension J to suit requirements.

PINS AND RECESSED PIN NUTS
All Dimensions in Inches

To obtain grip, add 1/16″ for each bar.

Nuts threaded 6 threads per inch.

To obtain distance between shoulders, add amount given in table to grip.

Diameter of Pin, d	Pin Thread a	Pin Thread b	Add to Grip	Thickness t	Nut Diameter n	Nut Diameter m	Nut Diameter c	Depth s	Diameter rough hole	Weight, Pounds	Pattern No.
2, 2¼	1½	1	¼	⅞	2 11/16	3¾	2⅝	¼	1⅝	1.1	PN 21
2½, 2¾	2	1⅛	¼	1	3 1/16	4⅛	3⅛	¼	1 11/16	1.7	PN 22
3, 3¼, 3½	2½	1¼	¼	1⅛	4 1/16	5	3 11/16	⅜	2 1/16	2.5	PN 23
3¾, 4	3	1⅜	½	1¼	4 7/16	5⅝	4⅜	⅜	2 11/16	3.7	PN 24
4¼, 4½, 4¾	3½	1½	½	1⅜	5¾	6⅝	5¼	½	3 1/16	4.6	PN 25
5, 5¼	4	1⅝	½	1½	6¼	7 1/16	5¾	½	3 11/16	6.2	PN 26
5½, 5¾, 6	4½	1¾	½	1⅝	7	8¼	6½	⅝	4 1/16	7.8	PN 27
6¼, 6½	5	1⅞	¾	1¾	7⅝	8⅞	7	⅝	4 11/16	9.9	PN 28
6¾, 7	5½	2	¾	1⅞	8¼	9⅝	7½	¾	5 1/16	11.8	PN 29
7¼, 7½	5½	2	¾	1⅞	8⅝	10	8	¾	5 1/16	14.3	PN 30
7¾, 8, 8¼	6	2¼	¾	2⅛	9⅜	10⅞	8¾	¾	5 11/16	18.6	PN 31
8½, 9	6	2⅜	¾	2⅛	10¼	11⅞	9⅝	¾	5 11/16	23.8	PN 32
9½, 10	6	2⅝	¾	2¼	11¼	13	10⅝	¾	5 11/16	31.1	PN 33

COTTER PINS
All Dimensions in Inches
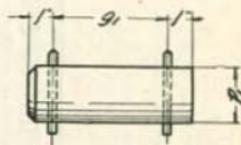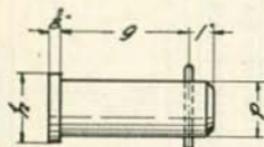
Horizontal or Vertical Pin Finished

Horizontal Pin Rough or Finished

Pin p	Head h	g	Cotter c	Cotter d	Pin p₁	g₁	Cotter c	Cotter d
1¼	1½		2	¼	1¼		2	¼
1½	1¾		2½	¼	1½		2½	¼
1¾	2		2¾	¼	1¾		2¾	¼
2	2⅜	Net Grip + ½″	3	⅜	2	Net Grip + ¾″	3	⅜
2¼	2⅝		3¼	⅜	2¼		3¼	⅜
2½	2⅞		3½	⅜	2½		3½	⅜
2¾	3⅛		4	⅜	2¾		4	⅜
3	3½		5	½	3		5	½
3¼	3¾		5	½	3¼		5	½
3½	4		6	½	3½		6	½
3¾	4¼		6	½	3¾		6	½

LATERAL AND SWAY BARS

Dimensions for Loops and Forks
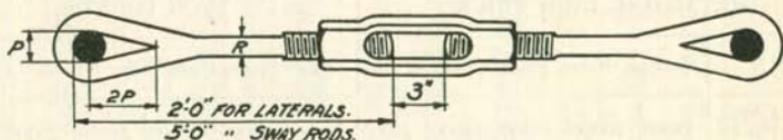
FORMULA: LENGTH IN INCHES BEYOND PIN CENTER TO FORM ONE EYE EQUALS 3.7(P+R)

Diam. of Pins	Diameter of Round or Side of Square Bars													Diam. of Pins
	¾"	⅞"	1"	1⅛"	1¼"	1⅜"	1½"	1⅝"	1¾"	1⅞"	2"	2⅛"	2¼"	
1	11½	12	12½	13⅝	14¼									1
1¼	12½	12⅞	13⅜	14¾	15¼	15⅝								1¼
1½	13⅜	13⅞	14¼	15¼	16⅛	16⅝	17							1½
1¾	14¼	14¾	15¼	15⅝	16⅝	17	17½	18						1¾
2	15¼	15⅝	16⅛	16⅝	17	17½	18	18⅜	18⅞	19⅜	19¾			2
2¼	16⅛	16⅝	17	17½	18	18⅝	18⅞	19⅜	19¾	20¼	20¾	21⅛		2¼
2½	17	17½	18	18⅝	19⅝	19¾	20¼	20¾	21⅛	21⅝	22⅛	22⅝	23	2½
2¾	18	18⅝	18⅞	19½	19¾	20¼	20¾	21⅛	21⅝	22⅛	22⅝	23	23½	2¾
3	18⅞	19¾	19¾	20¼	20¾	21¼	21⅝	22⅛	22⅝	23	23½	24	24⅜	3
3¼	19¾	20¼	20¾	21⅛	21⅝	22⅛	23	23⅛	24	24¾	24⅞	25⅜	25⅞	3¼
3½	20¾	21⅛	21⅝	22⅛	22⅜	23	23½	24	24¾	25⅜	25⅞	26¼	27¼	3½
3¾	21⅝	22⅛	22⅝	23	23½	24	24⅜	24¾	25⅜	25⅞	26¼	27¼	27½	3¾
4	22⅝	23	23½	24	24⅜	24⅞	25⅜	25⅞	26¼	26⅜	27¼	27⅝	28⅛	4
4¼	23⅛	24	24⅜	24⅞	25⅜	26⅛	26⅜	27⅛	27⅝	28⅛	28⅝	29		4¼
4½	24⅜	24⅞	25⅜	25⅝	26¼	26¾	27¼	27⅝	28⅛	29	29½	30		4½
4¾	25⅜	25⅞	26¼	26¾	27¼	27⅜	28⅛	28⅝	29	29½	30½	31		4¾
5	26¼	26¾	27⅛	27½	28⅛	29	29½	30	30½	31	31¾	31⅞		5
5¼	27¼	27⅝	28⅛	29	29½	30	30½	31	31⅞	32¼	32¾	32¾		5¼
5½	28⅛	28⅝	29	29½	30	31	31½	31⅞	32¼	32¾	33¼	33⅜	34½	5½
5¾	29	29½	30	30½	31	31⅛	31⅞	32¼	32¾	33¼	33⅜	34⅛	34½	5¾
6	30	30½	31	31⅜	31⅞	32¼	32¾	33¼	33⅝	34⅛	34⅝	35	35½	6

SIZE OF FORKED EYE FOR ● OR ■ BARS.

Diameter of ● or Side of ■ Bars	R	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾
Side of ■ for Eye	F	⅜	⁷⁄₁₆	½	⁹⁄₁₆	¹¹⁄₁₆	¾	¹³⁄₁₆	⅞	1	1¹⁄₁₆	1⅛

G = Thickness of Plt. + ⅛'

Maximum Shipping Length Should Not Exceed 35 Ft.

ST. PAUL FOUNDRY CO.
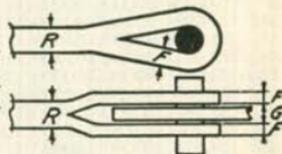
PINS

		BEARING VALUES IN POUNDS ON METAL ONE INCH THICK					BENDING MOMENTS IN INCH POUNDS					
PIN		Bearing Stress, Pounds Per Sq. In.					Fibre Stress Pounds Per Sq. In.					PIN
Dia. In.	Area Sq.In.	18000	20000	22000	24000	25000	18000	20000	22000	24000	25000	Dia. In.
1	.785	18000	20000	22000	24000	25000	1770	1960	2150	2350	2450	1
1⅛	.994	20250	22500	24750	27000	28125	2520	2800	3070	3350	3490	1⅛
1¼	1.227	22500	25000	27500	30000	31250	3450	3830	4210	4600	4790	1¼
1⅜	1.485	24750	27500	30250	33000	34375	4590	5100	5610	6120	6380	1⅜
1½	1.767	27000	30000	33000	36000	37500	5960	6630	7290	7950	8280	1½
1⅝	2.074	29250	32500	35750	39000	40625	7580	8430	9270	10110	10530	1⅝
1¾	2.405	31500	35000	38500	42000	43750	9470	10520	11570	12620	13150	1¾
1⅞	2.761	33750	37500	41250	45000	46875	11650	12940	14230	15530	16180	1⅞
2	3.142	36000	40000	44000	48000	50000	14140	15710	17280	18840	19630	2
2⅛	3.547	38250	42500	46750	51000	53125	16960	18840	20720	22610	23550	2⅛
2¼	3.976	40500	45000	49500	54000	56250	20130	22370	24600	26840	27960	2¼
2⅜	4.430	42750	47500	52250	57000	59375	23670	26300	28930	31560	32880	2⅜
2½	4.909	45000	50000	55000	60000	62500	27610	30680	33750	36810	38350	2½
2⅝	5.412	47250	52500	57750	63000	65625	31960	35520	39090	42660	44450	2⅝
2¾	5.940	49500	55000	60500	66000	68750	36750	40830	44910	49000	51040	2¾
2⅞	6.492	51750	57500	63260	69000	71875	41990	46660	51320	55990	58320	2⅞
3	7.069	54000	60000	66000	72000	75000	47680	52970	58270	63570	66220	3
3⅛	7.670	56250	62500	68750	75000	78125	53930	59920	65910	71900	74900	3⅛
3¼	8.296	58500	65000	71500	78000	81250	60660	67400	74140	80880	84250	3¼
3⅜	8.946	60750	67500	74250	81000	84375	67940	75480	83030	90570	94350	3⅜
3½	9.621	63000	70000	77000	84000	87500	75770	84180	92600	101020	105230	3½
3⅝	10.321	65250	72500	79750	87000	90625	84180	93530	102880	112230	116910	3⅝
3¾	11.045	67500	75000	82500	90000	93750	93190	103540	113890	124250	129430	3¾
3⅞	11.793	69750	77500	85250	93000	96875	102820	114250	125670	137100	142810	3⅞
4	12.566	72000	80000	88000	96000	100000	113100	125660	138230	150790	157080	4
4⅛	13.364	74250	82500	90750	99000	103125	124040	137820	151600	165380	172270	4⅛
4¼	14.186	76500	85000	93500	102000	106250	135660	150730	165800	180870	188410	4¼
4⅜	15.033	78750	87500	96250	105000	109375	147980	164420	180860	197310	205530	4⅜
4½	15.904	81000	90000	99000	108000	112500	161030	178920	196810	214700	223650	4½
4⅝	16.800	83250	92500	101750	111000	115625	174830	194250	213670	233100	242810	4⅝
4¾	17.721	85500	95000	104500	114000	118750	189390	210430	231470	252520	263040	4¾
4⅞	18.665	87750	97500	107250	117000	121875	204740	227490	250240	272990	284360	4⅞
5	19.635	90000	100000	110000	120000	125000	220890	245440	269980	294530	306800	5
5⅛	20.629	92250	102500	112750	123000	128125	237880	264310	290740	317170	330390	5⅛
5¼	21.648	94500	105000	115500	126000	131250	255710	284120	312530	340950	355160	5¼
5⅜	22.691	96750	107500	118250	129000	134375	274420	304910	335400	365880	381130	5⅜
5½	23.758	99000	110000	121000	132000	137500	294010	326680	359350	392010	408350	5½
5⅝	24.850	101250	112500	123750	135000	140625	314510	349460	384410	419350	436830	5⅝
5¾	25.967	103500	115000	126500	138000	143750	335950	373280	410610	447930	466600	5¾
5⅞	27.109	105750	117500	129250	141000	146875	358340	398160	437980	477790	497700	5⅞
6	28.274	108000	120000	132000	144000	150000	381700	424120	466530	508930	530140	6
6⅛	29.465	110250	122500	134750	147000	153125	406060	451180	496300	541410	563970	6⅛
6¼	30.680	112500	125000	137500	150000	156250	431430	479370	527300	575240	599210	6¼
6⅜	31.919	114750	127500	140250	153000	159375	457840	508710	559580	610450	635890	6⅜
6½	33.183	117000	130000	143000	156000	162500	485400	539230	593150	647070	674030	6½

NAILS AND SPIKES.

Size	Lgth. Ins.	Common Diameter — Am. Steel & Wire Gauge	Common Diameter — Ins.	No. Per Lb.	Finish-ing	Barbed Car Hvy.	Barbed Car Light	Cut Steel Nails Common Size	Leng. Ins.	No. Per Lb.	Steel Wire Spikes Leng. Ins.	Dia. Ins.	No. Per Lb.
2d	1	15	.072	876	1351	.....	.....	2d	1	740	3	.192	41
3d	1¼	14	.080	568	807	.....	.....	3d	1¼	460	3¼	.192	38
4d	1½	12½	.099	316	584	165	274	4d	1½	280	3½	.207	30
5d	1¾	12½	.099	271	500	118	142	5d	1¾	210	4	.225	23
6d	2	11½	.113	181	309	103	124	6d	2	160	4½	.244	17
7d	2¼	11½	.113	161	238	76	92	7d	2¼	120	5	.263	13
8d	2½	10¼	.131	106	189	69	82	8d	2½	88	5½	.283	10
9d	2¾	10¼	.131	96	172	54	62	9d	2¾	73	6	.283	8
10d	3	9	.148	69	121	50	57	10d	3	60	7	⅞	7
12d	3¼	9	.148	63	113	42	50	12d	3¼	46	8	⅝	6
16d	3½	8	.162	49	90	35	43	16d	3½	33	9	⅝	5
20d	4	6	.192	31	62	26	31	20d	4	23	10	⅝	4
30d	4½	5	.207	24	.....	24	28	30d	4½	16	12	⅝	3
40d	5	4	.225	18	.....	18	21	40d	5	12	.....	.....	.....
50d	5½	3	.244	14	.....	15	17	50d	5½	10	.....	.....	.....
60d	6	2	.263	11	.....	13	15	60d	6	8	.....	.....	.....

SQUARE BOAT SPIKES. Approximate Number in a Keg of 200 Pounds

Size Inches	LENGTH OF SPIKE, INCHES 3	4	5	6	7	8	9	10	11	12	14	16
¼	3000	2375	2050	1825	.....	.....	.....	.....	.....	.....	.....	.....
5/16	1660	1360	1230	1175	990	880	.....	.....	.....	.....	.....	.....
⅜	1320	1140	940	800	650	600	525	475	.....	.....	.....	.....
7/16	.....	.....	.....	600	590	510	400	360	320	280	.....	.....
½	.....	.....	.....	450	375	335	300	275	260	240	.....	.....
⅝	.....	.....	.....	.....	.....	260	240	220	205	190	175	160

WOOD SCREWS. Diameter = Number x 0.01325 + 0.056

No.	Dia. Ins.	Dia. Ins.	No.	Dia. Ins.	Dia. Ins.	No.	Dia. Ins.	Dia. Ins.	No.	Dia. Ins.	Dia. Ins.	No.	Dia. Ins.	Dia. Ins.
0	.056	1/16	6	.135	9/64	12	.215	7/32	18	.293	19/64	24	.374	⅜
1	.069	5/64	7	.149	5/32	13	.228	15/64	19	.308	5/16	25	.387	25/64
2	.082	5/64	8	.162	5/32	14	.241	1/4	20	.321	21/64	26	.401	13/32
3	.096	3/32	9	.175	11/64	15	.255	1/4	21	.334	21/64	27	.414	27/64
4	.109	7/64	10	.188	3/16	16	.268	17/64	22	.347	11/32	28	.427	27/64
5	.122	⅛	11	.201	13/64	17	.281	9/32	23	.361	23/64	29	.440	7/16
												30	.453	29/64

BREAKING STRENGTH OF ROPE.

Manila, New — Dia. Inches	Brk. Str. Pounds	No. Feet In Lb.	STEEL WIRE ROPE — 6 Strands, 19 Wires Per Strand, Hemp Center — Crucible Steel Break. Weight Pounds	Proper Work Ld Pounds	Weight Pounds 100 Ft.	Dia. Inches	Plow Steel Break. Weight Pounds	Proper Work Ld Pounds	Weight Pounds 100 Ft.
¼	620	54.5	4400	880	10	¼	5300	1060	10
⅜	1275	27.2	9600	1920	22	⅜	11500	2300	22
½	2400	13.3	16800	3360	39	½	20000	4000	39
⅝	4700	6.0	25000	5000	62	⅝	31000	6200	62
¾	6500	4.4	35000	7000	89	¾	46000	9200	89
⅞	7500	3.7	46000	9200	120	⅞	58000	11600	120
1	12500	2.3	60000	12000	158	1	76000	15200	158
1¼	17000	1.6	76000	15200	200	1⅛	94000	19080	200
1½	25000	1.2	94000	18800	245	1¼	116000	24000	245
1¾	30000	0.9							
2½	43000	0.6							

APPROXIMATE WEIGHT IN POUNDS OF 100 MACHINE BOLTS WITH SQUARE HEADS AND NUTS.

Length	¼″	5⁄16″	3⁄8″	½″	5⁄8″	¾″	7⁄8″	1″	1⅛″	1¼″	Length
1½	3.7	6.	9.	19.6	34.3	54.3	....	....	....	....	1½
2	4.2	7.	10.5	22.2	38.4	60.	90.8	....	....	....	2
2½	4.8	8.	12.	24.8	42.5	65.7	99.1	148.2	209.	277.	2½
3	5.5	9.	13.5	27.5	46.7	71.4	107.4	159.	222.5	293.5	3
3½	6.1	10.	15.	30.1	50.8	77.1	115.7	169.8	236.	310.	3½
4	6.8	11.	16.5	32.8	55.	82.8	124.	180.6	249.5	326.5	4
4½	7.4	12.	18.	35.4	59.1	88.9	132.3	191.4	263.	343.	4½
5	8.1	13.	19.5	38.1	63.3	95.	140.6	202.2	276.5	359.5	5
5½	8.7	14.	21.	40.7	67.4	101.1	148.9	213.	290.	376.	5½
6	9.4	15.	22.5	43.4	71.6	107.2	157.2	223.8	303.5	392.5	6
6½	10.1	16.	24.1	46.	75.7	113.3	165.5	234.6	317.	409.	6½
7	10.8	17.	25.7	48.7	79.9	119.4	173.8	245.4	330.5	425.5	7
7½	11.5	18.	27.3	51.3	84.	125.5	182.1	256.2	344.	442.	7½
8	12.2	19.	28.9	54.	88.2	131.6	190.4	267.	357.5	458.5	8
9	......	......	32.1	59.5	96.5	143.8	207.	288.6	385.5	493.	9
10	......	......	35.3	65.	104.8	156.	223.6	310.2	413.5	527.5	10
11	....	....	38.5	70.5	113.1	168.2	240.2	331.8	441.5	562.	11
12	....	....	41.7	76.	121.4	180.4	256.8	353.4	469.5	596.5	12
13	....	....	....	81.5	129.7	192.6	273.4	375.	497.5	631.	13
14	....	....	....	87.	138.	204.8	290.	396.6	525.5	665.5	14
15	....	....	....	92.5	146.3	217.	306.6	418.2	553.5	700.	15
16	....	....	....	98.	154.6	229.2	323.2	439.8	581.5	734.5	16
17	....	....	....	103.5	162.9	241.4	339.8	461.4	609.5	769.0	17
18	....	....	....	109.	171.2	253.6	356.4	483.	637.5	803.5	18
19	....	....	....	114.5	179.5	265.8	373.	504.6	665.5	838.	19
20	....	....	....	120.	187.8	278.	389.6	526.2	693.5	872.5	20
21	....	....	....	....	....	290.4	406.5	548.2	721.5	907.	21
22	....	....	....	....	....	302.8	423.4	570.2	749.5	941.5	22
23	....	....	....	....	....	315.2	440.3	592.2	777.5	976.	23
24	....	....	....	....	....	327.6	457.2	614.2	805.5	1010.5	24
25	....	....	....	....	....	340.	474.1	636.2	833.5	1045.	25
26	....	....	....	....	....	352.4	491.	658.2	861.5	1079.5	26
27	....	....	....	....	....	364.8	507.9	680.2	889.5	1114.	27
28	....	....	....	....	....	377.2	524.8	702.2	917.5	1148.5	28
29	....	....	....	....	....	389.6	541.7	724.2	945.5	1183.	29
30	....	....	....	....	....	402.	558.6	746.2	973.5	1217.5	30

Lengths of bolts are given under head over all.

BOLTS AND NUTS

BOLTS U. S. Standard Screw Threads					NUTS U. S. Standard			
					HEXAGON		SQUARE	
Diam. of Bolt	Number of Threads per Inch	Diam. at Root of Thread	Area of Body of Bolt	Area at Root of Thread	Short Diam.	Long Diam.	Side of Square	Diagonal
Inches		Inches	Sq. In.	Sq. In.	Inches	Inches	Inches	Inches
1/4	20	.185	.049	.027	1/2	.577	1/2	.707
5/16	18	.240	.077	.045	19/32	.686	19/32	.840
3/8	16	.294	.110	.068	11/16	.794	11/16	.972
7/16	14	.344	.150	.093	25/32	.902	25/32	1.105
1/2	13	.400	.196	.126	7/8	1.010	7/8	1.238
9/16	12	.454	.249	.162	31/32	1.119	31/32	1.370
5/8	11	.507	.307	.202	1 1/16	1.227	1 1/16	1.503
3/4	10	.620	.442	.302	1 1/4	1.443	1 1/4	1.768
7/8	9	.731	.601	.420	1 7/16	1.660	1 7/16	2.033
1	8	.837	.785	.550	1 5/8	1.876	1 5/8	2.298
1 1/8	7	.940	.994	.694	1 13/16	2.093	1 13/16	2.563
1 1/4	7	1.065	1.227	.893	2	2.309	2	2.829
1 3/8	6	1.160	1.485	1.057	2 3/16	2.526	2 3/16	3.094
1 1/2	6	1.284	1.767	1.295	2 3/8	2.742	2 3/8	3.359
1 5/8	5 1/2	1.389	2.074	1.515	2 9/16	2.959	2 9/16	3.624
1 3/4	5	1.490	2.405	1.744	2 3/4	3.175	2 3/4	3.889
1 7/8	5	1.615	2.761	2.048	2 15/16	3.392	2 15/16	4.154
2	4 1/2	1.712	3.142	2.302	3 1/8	3.608	3 1/8	4.420
2 1/4	4 1/2	1.962	3.976	3.023	3 1/2	4.042	3 1/2	4.950
2 1/2	4	2.175	4.909	3.715	3 7/8	4.475	3 7/8	5.480
2 3/4	4	2.425	5.940	4.619	4 1/4	4.908	4 1/4	6.011
3	3 1/2	2.629	7.069	5.428	4 5/8	5.341	4 5/8	6.541
3 1/4	3 1/2	2.879	8.296	6.510	5	5.774	5	7.071
3 1/2	3 1/4	3.100	9.621	7.548	5 3/8	6.207	5 3/8	7.602
3 3/4	3	3.317	11.045	8.641	5 3/4	6.640	5 3/4	8.132
4	3	3.567	12.566	9.993	6 1/8	7.073	6 1/8	8.662
4 1/4	2 7/8	3.798	14.186	11.329	6 1/2	7.506	6 1/2	9.193
4 1/2	2 3/4	4.028	15.904	12.743	6 7/8	7.939	6 7/8	9.723
4 3/4	2 5/8	4.255	17.721	14.220	7 1/4	8.372	7 1/4	10.253
5	2 1/2	4.480	19.635	15.763	7 5/8	8.805	7 5/8	10.784
5 1/2	2 3/8	4.953	23.758	19.267	8 3/8	9.671	8 3/8	11.844
6	2 1/4	5.423	28.274	23.098	9 1/8	10.537	9 1/8	12.905

WROUGHT IRON WASHERS

Size of Bolt in Inches.	Diameter in Inches	Size of Hole in Inches	Thickness in Inches	Number in 100 lbs.	Size of Bolt in Inches	Diameter in Inches	Size of Hole in Inches	Thickness in Inches	Number in 100 lbs.
1/4	3/4	5/16	.065	15600	1 1/8	2 3/4	1 1/4	.165	473
5/16	7/8	3/8	.065	11250	1 1/4	3	1 3/8	.165	364
3/8	1	7/16	.083	6800	1 3/8	3 1/4	1 1/2	.180	275
1/2	1 3/8	9/16	.083	2600	1 1/2	3 1/2	1 5/8	.180	256
5/8	1 3/4	11/16	.134	1300	1 5/8	3 3/4	1 3/4	.180	220
3/4	2	13/16	.148	900	1 3/4	4	1 7/8	.180	197
7/8	2 1/4	15/16	.165	782	1 7/8	4 1/4	2	.180	174
1	2 1/2	1 1/16	.165	568	2	4 1/2	2 1/8	.180	160

WEIGHT OF RIVETS AND ROUND HEADED BOLTS WITHOUT NUTS, PER 100

STRUCTURAL

Length Under Head, Inches	Diameter of Rivet, Inches							
	⅜	½	⅝	¾	⅞	1	1⅛	1¼
1¼	6	12		35	50	68	91	130
½	7	13	23	35	50	68	91	130
¾	8	15	25	37	54	74	98	139
2	9	16	27	41	58	80	105	148
¼	9	18	29	44	62	85	112	156
½	10	19	31	47	67	91	119	165
¾	11	20	34	50	71	96	126	174
3	12	22	36	54	75	102	133	182
¼	13	23	38	57	79	107	141	191
½	13	24	40	60	84	113	148	200
¾	14	26	42	63	88	118	155	208
4	15	27	44	66	92	124	162	217
¼	16	29	47	69	96	130	169	226
½	16	30	49	72	101	135	176	234
¾	17	31	51	75	105	141	183	243
5	18	33	53	78	109	146	190	252
¼	19	34	55	82	113	152	197	260
½	20	36	57	85	118	157	204	269
¾	20	37	60	88	122	163	211	278
6	21	38	62	91	126	169	218	287
¼	22	40	64	94	130	174	225	295
½	23	41	66	97	135	180	232	304
¾	24	43	68	100	139	185	239	313
7	24	44	70	104	143	191	246	321
¼	25	45	73	107	147	196	253	330
½	26	47	75	110	152	202	260	339
¾	27	48	77	113	156	207	267	347
8	27	50	79	116	160	213	274	356
¼	28	51	81	119	164	219	281	365
½	29	52	83	122	169	224	288	373
¾	30	54	86	125	173	230	295	382

Button Heads	Diameter of Rivets, Inches							
	⅜	½	⅝	¾	⅞	1	1⅛	1¼
100 Heads as made on rivets, Pounds	2.4	5.0	9.7	16.0	24.0	35.0	49.0	78.0
100 Heads as driven in work, Pounds.	1.9	4.0	7.5	12.5	18.5	27.0	37.5	51.0
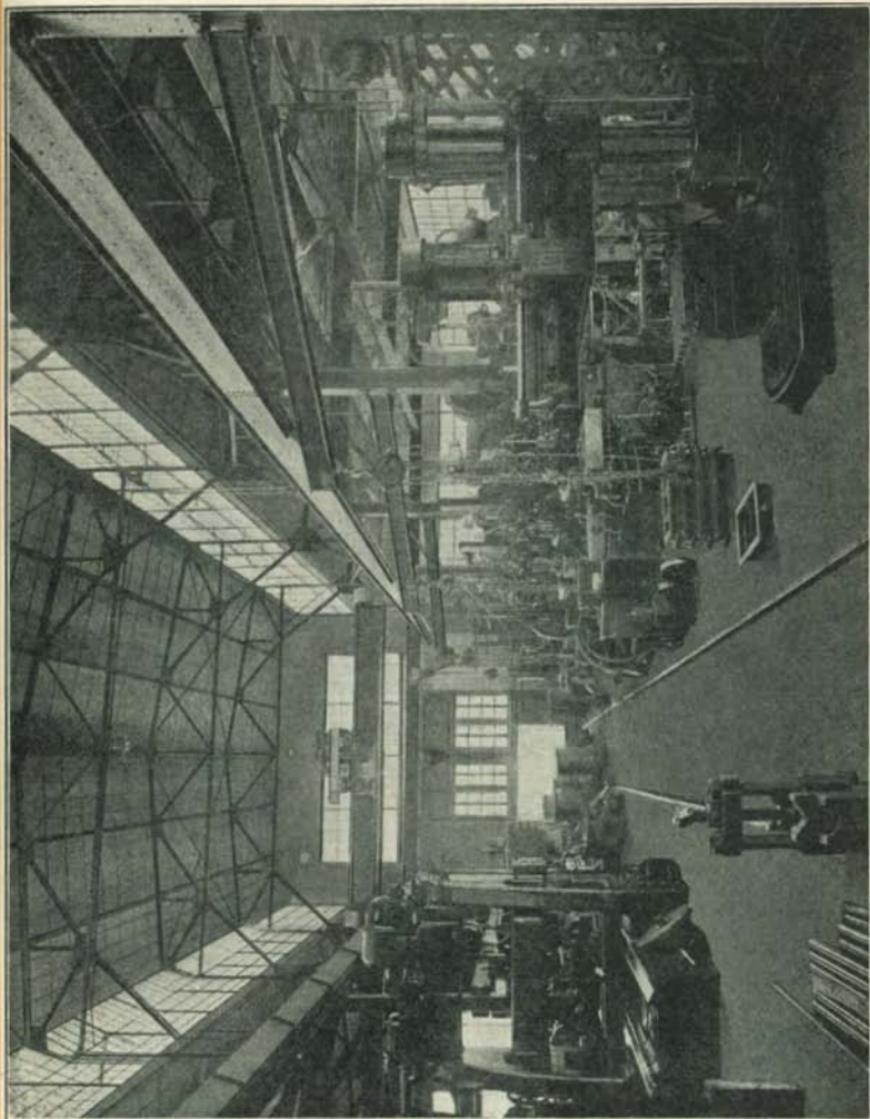
PART VIEW OF MACHINE SHOP OF THE ST. PAUL FOUNDRY COMPANY

STEEL SASH

In modern fire-proof, or semi fire-proof construction and where building laws or fire regulations require it, steel sash is used in place of wood sash. Steel sash improves the general appearance of a building and provides maximum illumination of the interior.

HEIGHTS
2 PANES
Y-3'-1⅝"
Z-3'-5⅝"

32 32/60   42 42/60   52 52/60

3 PANES
Y-4'-8"
Z-5'-2"

23/41   33 33/61   43 43/81   53 53/61

4 PANES
Y-6'-2⅜"
Z-6'10⅜"

34 34/61   44 44/81   54 54/61

5 PANES
Y-7'-8¾"
Z-8'-6¾"
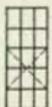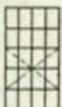
35 35/61   45 45/81   55 55/61

	2 PANES	3 PANES	4 PANES	5 PANES
WIDTHS	Y-2'-1⅝" Z-2'-5⅝"	Y-3'-2" Z-3'-8"	Y-4'-2⅜" Z-4'-10⅜"	Y-5'-2¾" Z-6'-0¾"

Y = 12"X18" GLASS.
Z = 14"X20" GLASS.

NOTE — Fixed Light Sash Furnished in "Z" Size Only.

BASEMENT WINDOW STEEL SASH

10"x12" GLASS — 2'-9¼" OVERALL

14"x20" GLASS — 2'-7½" OVERALL

12"x18" GLASS — 3'-3¼" OVERALL

11"x24" GLASS — 5'-0½" OVERALL
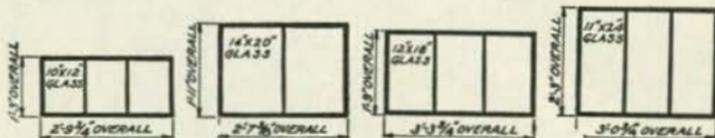
The above sketches give the sizes and ventilator locations of stock Fenestra Steel Sash. Other steel sash is quite similar in size and construction.

Courtesy Detroit Steel Products Co.

STEEL SASH

Typical details of construction with an installation of Fenestra Steel Sash.
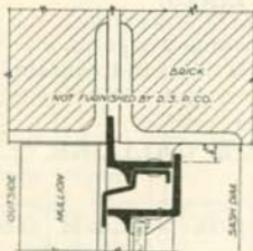
HEAD
Detail A
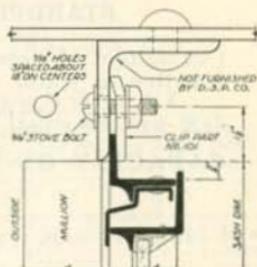
HEAD
Detail B
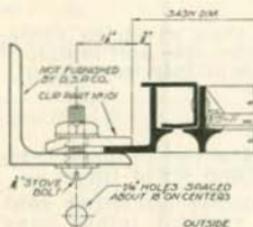
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Detail C
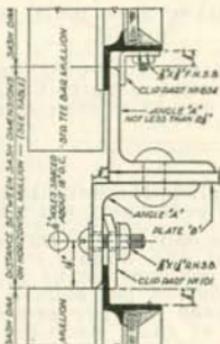
HORIZONTAL
MULLION DETAIL
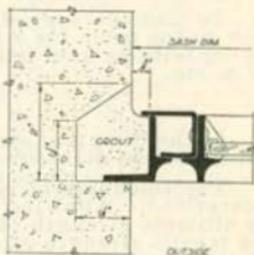
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Detail D
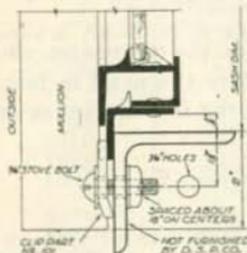
SILL
Detail E
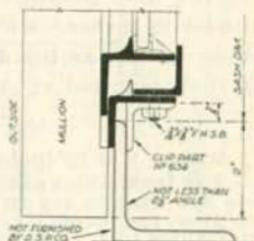
SILL
Detail F

Note—A, when installed in brick work.
Note—B, when installed in steel work.
Note—C, when installed in steel work.
Note—D, when installed in concrete.
Note—E, when installed in steel work.
Note—F, when installed in steel work.

Courtesy Detroit Steel Products Co.

STANDPIPES, TANKS AND PIPE LINES.

1 cubic foot of water weighs 62½ lbs., and contains 7½ gallons.
1 gallon of water (U. S. standard) weighs 8⅓ lbs., and contains 231 cubic inches.
31½ gallons equal one barrel.

CAPACITY OF ROUND TANKS IN U. S. GALLONS.

Per Foot of Depth.

Dia. of Tanks	3 Ft.	5 Ft.	10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.	20 Ft.	24 Ft.	28 Ft.	30 Ft.	32 Ft.
No. U. S. Gallons	52.88	146.88	578.52	846.03	1151.5	1504.1	1903.6	2350.1	3384.1	4606.2	5287.7	6016.2
Cubic Ft. and Area in Sq. Ft.	7.069	19.63	78.54	113.1	153.94	201.06	254.47	314.16	452.39	615.75	706.86	804.25

To find the capacity of tanks of other sizes than given in table, look in the table for a tank of one-half of the given size and multiply its capacity by 4, or one of one-third its size and multiply its capacity by 9, etc.

In the design of stand pipes the height should never be more than ten times the diameter and preferably not more than eight times.

The thickness of plates can be determined by the following considerations: Allowing that the double-riveted vertical joints have an ultimate strength of 70 per cent of the gross section, and counting the tensile strength at 60,000 lbs. per square inch, the actual strength of the vertical joint is 42,000 lbs. per square inch of gross section. Taking a factor of safety of four, we may allow a tensile stress of 10,500 lbs. per square inch on the gross section or of 15,000 lbs. per square inch on net section.

The tensile stress in the shell, per vertical inch, is $T=pr$, where p is the fluid pressure per square inch, and r is the radius of the cylinder in inches. But $p=\dfrac{62.4h}{144}=0.434\,h$, where h is the head in feet. taking $d=\dfrac{2\,r}{12}$ as the diameter in feet, we have, for the thickness of the shell required at any depth

$$t=\frac{Pr}{10500}=0.00025\ hd\ \text{(nearly)}$$

Where t is in inches and h and d in feet.

The least thickness should not be less than one-fourth of an inch. It is not wise to try to use plates thicker than one inch. If this does not give the capacity required it would be better to duplicate the plant than to try to use thicker plates.

To find the thickness of steel to be used in hollow cylinders under tension, such as pipe lines, etc.: Multiply the specified working pressure in pounds by the radius of the cylinder in inches, then by the factor of safety, and divide the result obtained by the tensile strength of the steel multiplied by the percentage of efficiency of the riveted joint employed.

EFFICIENCY OF RIVETED JOINTS OF VARIOUS TYPES IN PER CENT.

Type of Joint	Rivet Size and Spacing	¼" Plt.	Rivet Size and Spacing	⁵⁄₁₆" Plt.	Rivet Size and Spacing	⅜" Plt.	Rivet Size and Spacing	⁷⁄₁₆" Plt.	Rivet Size and Spacing	½" Plt.
Single Riveted Lap Joints	⅝" 1 11/16" o.c.	59.2	11/16" 1 11/16" o.c.	58.6	⅞" 2¼" o.c.	58.3	1" 2 7/16" o.c.	56.4	1" 2 11/16" o.c.	54.8
Double Riveted Lap Joints	⅝" 1 11/16" o.c.	71.8	⅝" 1 11/16" o.c.	71.8	¾" 1⅝" o.c.	71.7	⅞" 1⅞" o.c.	70.0	1" 2⅛" o.c.	70.4
Triple Riveted Lap Joints	½" 1⅝" o.c.	78.5	⅝" 1⅞" o.c.	77.0	¾" 2⅛" o.c.	75.0	⅞" 2⅜" o.c.	75.0	⅞" 2⅜" o.c.	75.0
Double Riveted Butt Joints	⅝" 1 11/16" o.c.	80.7	11/16" 1 11/16" o.c.	80.6	¾" 2⅛" o.c.	80.8	¾" 2⅛" o.c.	80.8	⅞" 2⅜" o.c.	80.2
Triple Riveted Butt Joints	½" 2¼" o.c.	87.5	11/16" 3⅛" o.c.	88.0	¾" 3¼" o.c.	87.5	⅞" 3⅜" o.c.	86.1	1" 3¾" o.c.	85.8

The above figures are for standard tank splices. The rivet spacing given for double and triple riveted joints is the short pitch. The long pitch being double in each case.

STANDARD WOODEN WATER TANKS.

Capacity in Gallons	Weight of Water	Inside Diameter	Inside Depth	Size of Wood Joists
5000	41667 Lbs.	10 Ft.	11¼ Ft.	3" x 12"-16" o.c.
7500	62500 "	11½ "	11¼ "	3" x 12"-14" o.c.
10000	83333 "	13½ "	11¼ "	4" x 12"-15" o.c.
12000	100000 "	13½ "	13⅓ "	4" x 12"-12" o.c.
15000	125000 "	14½ "	13⅓ "	3" x 12"-15" o.c.
20000	166667 "	15½ "	15½ "	3" x 12"-13" o.c.
25000	208333 "	17½ "	15½ "	3" x 12"-11" o.c.
30000	250000 "	18 "	17½ "	4" x 12"-12" o.c.
40000	333333 "	19½ "	19½ "	4" x 12"-12" o.c.
50000	416667 "	22 "	19⅓ "	4" x 14"-12" o.c.
60000	500000 "	24 "	19¼ "	4" x 14"-12" o.c.
75000	625000 "	24½ "	23½ "	6" x 14"-15" o.c.
100000	833333 "	28½ "	23½ "	6" x 14"-15" o.c.

Capacities and weights of tanks taken from Caldwell's catalogue of factory mutual tanks. Staves for tanks of 20000 gals. or less, 2½" thick, over 20,000 gals. 3" thick.

Designs and estimates of steel towers for support of above tanks will be furnished upon application.

WEIGHTS, DIMENSIONS
AND SAFE LOADS OF CHAINS.

Dameter of Link Bar		⁷⁄₁₆	½	⁹⁄₁₆	⅝	¹¹⁄₁₆	¾	¹³⁄₁₆	⅞	¹⁵⁄₁₆	1	1⅛	1¼
Common or Proof Coil Chain	Length of Link Inches (Outside)	1¾	1½	1¾	2⅛	2¼	2½	2⅞	3⅜	3⅞	4⅜	5	5½	6⅛
	Width of Link Inches (Outside)	⅞	1¹⁄₁₆	1¼	1½	1¹¹⁄₁₆	1⅞	2⅛	2¼	2¹¹⁄₁₆	3⅛	3⅝	4	4⅜
	Approximate Weight Lbs. Per Foot	.46	.75	1.10	1.65	2.05	2.65	3.25	4.25	6.10	8.10	10.25	13.50	16.50
	Safe Load in Thousand Lbs.	.50	.82	1.32	1.85	2.55	3.35	4.25	5.25	7.55	10.30	13.45	17.05	21.05
BB Chain	Length of Link Inches (Outside)	1¼	1¹⁄₁₆	1¾	1¹¹⁄₁₆	2²⁄₁₆	2¹⁄₁₆	2¹¹⁄₁₆	3½	3⅝	4⅛	4¾	5¼	5⅞
	Width of Link Inches (Outside)	¾	¹¹⁄₁₆	1½	1⁷⁄₁₆	1¹⁄₁₆	1¾	2	2⅛	2⁷⁄₁₆	3	3½	3⅞	4¼
	Approximate Weight Lbs. Per Foot	.50	.80	1.15	1.70	2.10	2.70	3.35	4.30	6.15	8.20	10.30	13.60	16.60
	Safe Load in Thousand Lbs.	.55	.82	1.50	2.00	2.75	3.50	4.40	5.37	7.75	10.50	14.25	18.00	21.50
BBB or Crane Quality Chain	Length of Link Inches (Outside)	1⅛	1⅜	1⅝	1⅞	2⅛	2⅜	2¾	3	3½	4¹⁄₁₆	4⅝	5⅛	5¾
	Width of Link Inches (Outside)	¾	¹¹⁄₁₆	1⅛	1⁷⁄₁₆	1⁷⁄₁₆	1¾	2	2⅛	2⁷⁄₁₆	3	3½	3⅞	4¼
	Approximate Weight Lbs. Per Foot	.52	.83	1.18	1.75	2.15	2.75	3.40	4.35	6.20	8.30	10.40	14.00	16.65
	Safe Load in Thousand Lbs.	.60	.87	1.70	2.25	3.15	4.00	5.00	6.25	8.87	12.00	15.67	19.00	23.50

DIMENSIONS OF CRANE HOOKS.

	Capacity of Hooks in Tons.											
	⅜	¼	½	1	1½	2	3	4	5	6	8	10
	Dimensions Common to Swivel Hooks, Inches											
A	.625	.687	.75	1.062	1.25	1.375	1.75	2.0	2.25	2.5	2.875	3.25
B	.156	.171	.187	.265	.312	.343	.437	.5	.562	.625	.718	.812
C	.546	.625	.656	.937	1.093	1.218	1.531	1.75	1.968	2.187	2.5	2.812
D	1.312	1.375	1.5	1.75	2.	2.25	2.75	3.25	3.75	4.25	5.25	6.25
E	.687	.75	.812	1.156	1.359	1.5	1.890	2.171	2.437	2.703	3.125	3.5
F	.843	.921	1.0	1.421	1.671	1.843	2.343	2.671	3.0	3.343	3.843	4.343
G	.75	.828	.906	1.281	1.5	1.656	2.109	2.406	2.703	3.0	3.453	3.906
H	.718	.781	.859	1.203	1.421	1.562	1.984	2.265	2.546	2.843	3.25	3.687
I	.562	.625	.687	.937	1.125	1.25	1.562	1.75	2.0	2.187	2.5	2.875
J	.812	.875	.937	1.375	1.562	1.75	2.187	2.5	2.812	3.125	3.625	4.0
K	.937	.968	1.062	1.218	1.375	1.562	1.875	2.25	2.562	2.875	3.562	4.25
L	1.0	1.062	1.125	1.312	1.5	1.687	2.0	2.437	2.812	3.187	3.937	4.687
M	.312	.343	.375	.531	.625	.687	.875	1.0	1.125	1.25	1.437	1.625
N	.328	.375	.437	.640	.796	.906	1.187	1.328	1.546	1.703	1.968	2.281
O	.562	.625	.687	.875	1.062	1.25	1.625	2.0	2.375	2.75	3.5	4.25
P	.656	.734	.796	1.125	1.312	1.453	1.843	2.109	2.375	2.625	3.031	3.437
Q	1.687	1.75	1.937	2.25	2.562	2.937	3.562	4.187	4.812	5.5	6.75	8.0
R	1.687	1.75	1.937	2.25	2.562	2.937	3.562	4.187	4.812	5.5	6.75	8.0
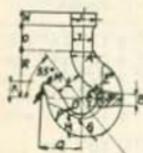
The safe working loads for chains are approximately one-fourth of the ultimate breaking strength. The ultimate breaking load on a chain is obtained from the formula.
W = 54000 D².   W = breaking load in pounds. D = diameter of link bar in inches.
The best material to be used for chains is wrought iron; steel has a higher tensile strength but wrought iron has a relatively greater elastic limit and will always show signs of bending or stretching before finally breaking.

SAFE LOADS FOR SLING CHAINS
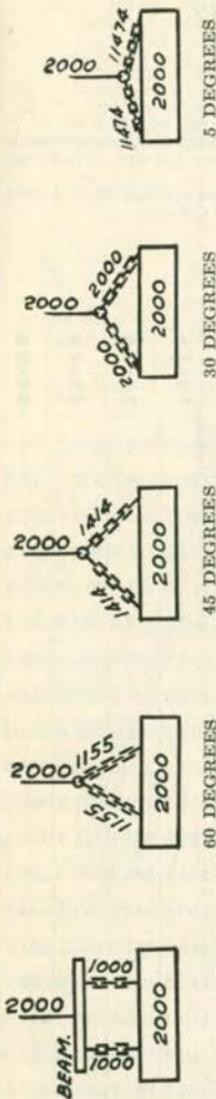
The Above Illustrations Show the Increase of Loads When Angle Between the Load and Chain is Decreased

SAFE LOADS FOR DOUBLE SLING CHAINS

SIZE OF CHAIN	86% 60 Degrees.	70% 45 Degrees.	50% 30 Degrees.	34% 20 Degrees.	25% 15 Degrees.	17% 10 Degrees.	8½% 5 Degrees.	Safe Working Loads For Single Strand Chain
⅜	5108	4158	2970	2020	1485	1010	505	2970
½	8514	6930	4950	3366	2475	1683	841	4950
⅝	13106	10668	7620	5182	3810	2591	1295	7620
¾	19195	15624	11160	7589	5580	3794	1897	11160
⅞	26488	21560	15400	10472	7700	5236	2618	15400
1	35191	28644	20400	13913	10230	6956	3478	20400
1⅛	44273	36036	25740	17503	12870	8752	4376	25740
1¼	54490	44352	31680	21542	15840	10771	5386	31680
1⅜	65274	53130	37950	25806	18975	12903	6451	37950
1½	77228	62860	44900	30532	22450	15266	7633	44900
1⅝	88064	71680	51200	34816	25600	17408	8704	51200
1¾	99416	80920	57800	39304	28900	19652	9826	57800
2	126076	102620	73300	49844	36650	24922	12461	73300

*This figure gives percent of load in each sloping strand to bring stress to safe working load in each strand.

NOTES—
1—Distribute load evenly on both legs.
2—A clean chain lasts longer.
3—Keep chain free of twists or knots.
4—Inspect chain at regular intervals.
5—Every time a chain is overloaded, it is weakened.

SAFE LOADS IN THOUSANDS OF POUNDS

FOR RECTANGULAR WOOD COLUMNS.
UNIT STRESS = 1000 LBS. PER SQ. IN.

$$P = C\left(1 - \frac{L}{70D}\right)$$

P = Allowable load per sq. in.   C = allowable unit compressive stress per square inch.   L = length of columns in inches.   D = least side in inches.   For any other unit compressive stress divide the load given for any particular column by 1000 and multiply by the new unit stress.

For example we want to find the safe load carried by an 8″x8″ spruce column 12 feet long at a unit stress of 800 lbs. per square inch. The tabular load is 47500, hence:

$\frac{47500}{1000}$ x 800 = 38000 = safe load carried by spruce column.

For unit stress adopted by several cities see pages 262-263.

Length in feet \ Size in Inches	6x6	6x8	6x10	8x8	8x10	8x12	10x10	10x12	10x14	12x12	12x14	12x16	14x14	16x16	18x18	20x20
6	28.8	39.8	49.8	55.8	69.8	83.7	89.8	107.8	125.7	131.8	153.7	175.8	181.6	239.5	304.2	378.0
7	28.8	38.4	48.0	54.4	68.0	81.6	88.0	105.6	123.0	129.4	151.1	172.9	179.0	236.7	302.6	376.0
8	27.8	37.0	46.4	53.0	66.4	79.5	86.3	103.5	120.1	127.5	148.8	170.0	176.7	234.0	299.2	372 8
9	26.7	35.6	44.5	51.6	64.5	77.5	84.5	104.4	118.2	125.4	146.3	167.1	174.2	231.5	296.0	369.2
10	25.7	34.2	42.8	50.3	63.0	75.5	82.8	99.5	116.0	123.4	144.0	164.6	172.0	228.6	293.4	365.6
11	24.8	32.9	41.1	48.8	61.0	73.2	81.1	97.3	113.4	121.3	141.6	161.9	169.6	225.8	290.0	362.4
12	23.7	31.6	39.4	47.5	59.4	71.2	79.4	95.4	111.0	119.3	139.1	159.1	167.1	222 9	287.0	358.8
13	22.6	30.2	37.7	46.2	57.6	69.2	77.7	93.4	108.7	117.1	136.7	156.2	164.8	220.2	283.9	355.6
14	21.6	28.8	36.0	44.8	56.0	67.2	76.0	91.2	106.4	115.1	134.4	153.6	162.3	217.5	280.9	35.02
15	20.6	27.4	34.4	43.5	54.2	65.1	74.3	89.3	104.0	113.1	132.0	150.9	159.9	215.0	278.0	348.8
16	19.5	26.1	32.6	42.0	52.6	63.1	72.6	87.2	101.6	111.1	129.7	148.2	157.5	212.1	275.0	345.2
17	18.5	24.6	30.8	40.7	50.9	61.0	70.8	85.1	99.2	109.0	127.1	145.4	155.0	209.4	271.9	342.0
18	17.5	23.3	29.2	39.3	49.1	59.0	69.2	83.0	97.0	107.0	124.7	142.7	152.9	206.2	268.5	338.4
19	16.4	21.9	27.4	38.0	47.5	56.9	67.4	81.0	94.4	104.8	122.4	139.7	150.3	203.9	265.2	334.8
20	15.4	20.6	25.6	36.6	45.7	55.0	65.6	78.7	92.0	102.8	119.1	137.0	147.2	201.2	262.3	331.6
21	14.4	19.2	24.0	35.2	44.0	52.8	64.0	76.8	89.6	100.8	117.6	134.3	145.6	198.4	259.2	328.0
22	13.4	17.8	22.3	33.8	42.2	50.7	62.2	74.6	87.0	98.8	115.2	131.7	143.1	195.4	256.0	324.8
23	12.4	16.5	20.6	32.2	40.3	48.3	60.6	78.2	84.9	96.6	112.8	128.8	140.8	193.0	253.5	321.2
24	11.3	15.1	18.8	31.0	38.6	46.6	58.8	70.6	82.5	94.5	110.2	126.0	138.2	190.2	251.0	317.6

SAFE SUPERIMPOSED LOAD IN POUNDS UNIFORMLY DISTRIBUTED FOR DOUGLAS FIR BEAMS

Values in this table are based on surfaced sizes. For values of rough sizes, multiply given values by factors in Column F.
Unit stress allowed=1200 lbs. per sq. in. E=1643000 lbs. per sq. in.
For values to the right of heavy line the deflection will crack plastered ceiling.

Rough	S4S	Factor F	4	6	8	10	12	14	16	18	20	22	24	26	28	30
2x4	1⅝x3⅝	1.50	700	450	350	250	200									
2x6	1⅝x5⅝	1.40	1700	1100	800	650	550	450	400							
2x8	1⅝x7⅝	1.40		2000	1500	1200	1000	800	700	600						
2x10	1⅝x9½	1.36			2400	1900	1600	1350	1150	1000	900					
2x12	1⅝x11½	1.34			3550	2800	2300	2000	1700	1500	1300	1200	1050			
2x14	1⅝x13½	1.32				3900	3200	2700	2350	2100	1850	1650	1500	1350	1250	
2x16	1⅝x15½	1.31					4250	3600	3150	2750	2450	2200	2000	1800	1650	1500
3x10	2½x9½	1.33			3700	2950	2400	2050	1800	1550	1350					
3x12	2½x11½	1.31			5450	4300	3600	3050	2600	2300	2050	1800	1650			
3x14	2½x13½	1.29				6000	4950	4200	3650	3200	2850	2550	2300	2100		
4x12	3½x11½	1.25			7600	6050	5000	4250	3700	3200	2850	2550	2300			
4x16	3½x15½	1.22					9100	7800	6800	5900	5300	4800	4300	3850	3500	
6x12	5½x11½	1.19			12000	9500	7800	6700	5800	5100	4500	4000	3600			
6x16	5½x15½	1.16					14250	12250	10650	9300	8350	7400	6700	6000	5500	
8x10	7½x9½	1.18			11100	8800	7200	6200	5350	4700	4100					
8x12	7½x11½	1.16			16350	13000	10650	9100	7900	6900	6150	5500	4900			
8x14	7½x13½	1.15				17950	14750	12650	10950	9550	8550	7600	6850	6150	5500	
10x10	9½x9½	1.17			14100	11200	9100	7800	6750	5900	5250					
10x12	9½x11½	1.15			20700	16450	13400	11550	10000	8700	7800	6900	6200			
10x14	9½x13½	1.13				22700	18000	16000	14200	12100	10850	9650	8700	7750		
10x16	9½x15½	1.12					24650	21200	18400	16000	14450	12850	11600	10400	9550	
12x12	11½x11½	1.14			25050	19900	16300	14000	12100	10550	9250	8250	7500			
12x14	11½x13½	1.12				27550	22000	19400	16800	14600	13150	11700	10550	9400		
12x16	11½x15½	1.11					29800	25650	22250	19400	17450	15550	14050	12600	11550	
12x20	11½x19½	1.10						40700	35500	31000	27950	24900	22600	20300	18750	17150
14x16	13½x15½	1.11						30100	26150	22800	20500	18250	16500	14550	13600	12150
14x20	13½x19½	1.09						47800	41600	36350	32800	29250	26550	23850	22200	20150

WELDING OF STRUCTURAL STEEL

Among others, there are two modern methods of welding metals, the oxygen-acetylene and the electric arc. The oxygen-acetylene method is slower, with a greater spread of heat, and therefore is not adaptable where rapid welding with intense local heat is necessary.

We repair grey iron castings with the oxygen-acetylene torch, using a rod of iron to provide the additional or "building up" material. Steel castings are repaired with either the oxygen-acetylene or electric arc, depending upon conditions.

The cutting of iron or steel is very readily accomplished also with the oxygen-acetylene torch.

The electric arc method, in which a rod is used for building up a bead, is applied more successfully in the welding of structural steel where the material is one-quarter inch or more thick. Electric arc welding is common in structural shops in the fabrication of composite structures, such as lintels, steel doors and frames, coal chutes, stacks and breeching, hoppers, and gas pipe railing, etc.

Electric arc welding has been resorted to in the fabrication and erection of structural steel buildings. In one building, a working stress of 3,000 pounds per lineal inch of bead for a ⅜" x ⅜" fillet weld was used, while in another a working stress of 2,000 pounds and 2,500 pounds per lineal inch respectively was used as a working stress for ¼" x ¼" and ⁵⁄₁₆" x ⁵⁄₁₆" fillet welds.

Results from a series of tests indicate that the safe allowable shearing strength per square inch of longitudinal section of bead on the minimum section and with a safety factor of four is approximately 9,000 pounds which results in the following values.
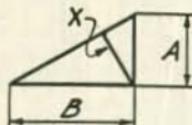
	A Inches.	B Inches.	X = Inches Plane of Shear or Fracture.	Safe Shearing Strength per Linear Inch of Bead in Pounds.
	½	½	0.355	3195
	⅜	½	0.300	2700
	⅜	⅜	0.266	2394
	¼	⅜	0.203	1827
	¼	¼	0.177	1593

Test specimens developed in tension a longitudinal shearing strength of 13,300 pounds and in compression of 16,800 pounds per lineal inch of fillet for a ⅜" x ⅜" fillet weld.

To recognize a good weld, the following rules may be used:—

(1) Surfaces must be "tacked" together. With hand welding the arc should be swung from side to side, forming half-moon beads which look somewhat like heavy thread in a seam in leather. In machine welding these half-moons are absent, but a very little experience plus intelligent observation will show whether the metal has flowed over both surfaces enough to establish good contact on each one.

(2) Color indicates quality. If the bead turns red and rusty looking within twenty minutes or so after the weld is completed, it indicates that the heat was too great and that the metal is burned. If the metal stays steel color, it has not been overheated.

(3) Penetration, or depth of weld, which is obviously necessary to obtain thorough uniting of the parts, is indicated by absence of spattering of metal. The presence of "spattered" metal shows lack of depth and consequently probable weakness. When the bead has an undercut edge, that is, looks like a drop of solder on the surface, the fusion is insufficient. When the surface of the bead adjacent to the junction is curved in the other direction and looks saucer-shaped, the fusion is complete.

GEARS AND PINIONS

Modern cut gears, made of various materials to meet different requirements, are 20% to 50% more silent and efficient in the operation of present high speed machinery than former gears.

Practically all gears have involute teeth with a 14½ degree pressure angle, the rack teeth having straight sides at an angle of 14½ degrees from the vertical to mesh with gears or pinions.

RULES FOR GEAR CALCULATIONS:
OUTLINE FACTORS Y FOR CALCULATING STRENGTH OF GEAR TEETH.
TABLE 1.

No. of Teeth...	15	16	17	18	19	20	21	23	25	27	30
Factor Y......	.236	.242	.251	.261	.273	.283	.289	.295	.305	.314	.320
No. of Teeth...	34	38	43	50	60	75	100	150	300	Rack	
Factor Y......	.327	.336	.346	.352	.358	.364	.371	.377	.383	.390	

Allowable working stresses S in lbs. per sq. in. for calculating strength of gear teeth—without allowance for impact or variable loads. Table 2.

V	Ft. per Min.....	0	100	200	300	450	600	900	1200	1800	2400
S	Cast Iron.......	8000	6850	6000	5350	4550	4000	3200	2650	2000	1600
	Steel..........	20000	17100	15000	13300	11400	10000	8000	6650	5000	4000

V = Velocity in ft. per min. at pitch line. See table 2.
S = Allowable unit stress for material at given velocity. See table 2.
A = Width of face in inches.
Y = Outline factor. See table 1.
P = Diametral pitch.
W = Max. safe load in lbs. at pitch line.
Hp = Max. safe horse power Gear will Transmit.

$$W = \frac{SAY}{P}$$

$$H.P. = \frac{WV}{33,000}$$

For pitch diameter— divide number of teeth by the diametral pitch.

For center distance between gears add the number of teeth in both gears and divide the sum by diametral pitch x 2.

For outside diameter— add 2 to the number of teeth and divide the sum by the diametral pitch.

For diametral pitch— divide number of teeth by pitch diameter.

For circular pitch— divide 3.1416 by the diametral pitch.

For length of rack— multiply number of teeth in rack by circular pitch of gear.

When ordering gears, the following information must be given:—

Number required
Number of teeth
Circular pitch
Diametral pitch
Face
Bore
Pitch Diameter
Diameter of hub
Length of hub
Projection of hub on one or both sides
No. and size of keys
Material

If these dimensions cannot be determined, or are not all fixed by requirements we can usually make satisfactory gears if the distance between centers—number of teeth in each gear—face—fore—etc., are given, and if the number of teeth cannot be determined, give R. P. M. of each gear—distance between centers—and H. P. to be transmitted.

Proper lubrication for exposed or enclosed gears is of importance to obtain minimum wear, least noise, and highest efficiency.

SPROCKETS AND CHAINS

Where the distance between driving and driven shafts is too great for gears and too short for belt transmission, the use of chain and sprockets is satisfactory. Although slightly higher in initial cost, chain transmission is warranted for its positive and powerful action and its compactness, over belt transmission. There are several types of chains—block, roller, bushing, and silent chains, each adapted to a particular variety of load, velocity, and drive.

INFORMATION REQUIRED WHEN ORDERING CHAINS AND SPROCKETS:

Sketch of drive, showing whether horizontal, vertical, or slanting.

Mark drive sprocket A, and driven sprocket B, and give direction of drive by arrow.

Horse power to be transmitted—is load steady, irregular or pulsating, and does the drive start or stop suddenly.

Give distance between centers of shafts with amount of variation for adjustment.

Type of chain, whether roller, block, or silent.

Pitch of chain, its number and width.

Sprocket hub bore.

Sprocket—kind of material.

Number of teeth.

Number and size of keys or of set screws.

BELTS AND PULLEYS

Running under rapid load variations and at high speed, narrow thick belts are more desirable than wide thin belts because of the latter's sideway slip and wave motion on the slack side.

Belts on pulleys 12″ in diameter cr larger should be two ply, pulleys over 20″ in diameter should be three ply, and on pulleys 30″ or over, four ply. The life of a belt depends upon the power transmitted, its splice, and the care given it, and not necessarily upon its speed, when this is under 2,500 feet per minute. Oak tanned leather belts run with greatest transmission efficiency at 65 to 80 feet per second, and chromium treated leather belts at about 100 feet per second, and under tension of from 575 to 850 lbs. per square inch of section respectively. The thickness should be from $\frac{1}{20}$ to $\frac{1}{90}$ of the radius of the pulley with $\frac{1}{15}$ permissible to chromium leather. Rubber belts are desirable where exposed to weather, steam or vapors, as they are less absorbent and stretch less. In strength, a three or four ply, a five or six ply, and a seven or eight ply rubber belt, is respectively equal to a single, double, or triple ply leather belt. Belts should not be run faster than 4,400 to 4,800 feet per minute and the pulling stresses per inch of width for a $\frac{5}{16}$″ single ply, $\frac{3}{8}$″ double ply, $\frac{9}{16}$″ triple ply, and $\frac{3}{4}$″ four ply leather belt, should be 45 lbs., 80 lbs., 110 lbs., and 145 lbs., respectively, to be most effective.

The horse power transmitted by leather and rubber belts of given width is calculated thus,

Leather Belt

$$H. P. = \frac{SDRW}{132000}$$

Rubber Belt

$$H. P. = \frac{PWDR}{12000}$$

Where H. P. = horse power, S = effective pull of belt per inch of width in lbs. as given above, D = diameter of driving pulley in inches, R = number of revolutions of pulley per minute, W = width of belt in inches, P = number of plies of belt, all based on contact arc on pulley of not less than 180 degrees.

INFORMATION REQUIRED WHEN ORDERING PULLEYS:

Kind of belt, ply and width.

Pulley solid or split, crowned or straight face, loose or tight on shaft.

Kind of hub, set screw, key seat, or special.

Pulley to be bushed, babbited, or left open.

Cast iron belt pulleys should not be run at a higher rim velocity than 100 feet per second.

ROPE DRIVES

For power transmission, where requirements are beyond the efficient operation of belts, the American system of rope drives can be economically used. High grade manila rope running in machined grooved sheaves is successful for steady transmission of power in like or different planes at long distances between shafts.

HORSE POWER TRANSMITTED FOR ROPE DRIVES:

$$\text{H. P.} = \frac{2V\ (T-F)}{3\ x\ 550} \qquad T = 160D^2 \qquad F = \frac{WV^2}{32}$$

Where H. P. = horse power transmitted per rope, V = velocity of rope in feet per second, T = safe working tension in lbs. per rope, F = centrifugal tension in lbs. per rope, W = weight of rope per foot, D = nominal diameter of rope.

SHAFTING

Cold rolled steel shafting, smooth, strong and uniform in section, is carried in stock in variations of ¼" diameters to suit bearings, couplings, pulleys, gears, sprockets, etc.

Calculate the horse power transmitted by cold rolled steel shafting thus,

For main power drive shafts: $\text{H. P.} = \dfrac{D^3R}{125}$

For line shafts carrying pulleys: $\text{H. P.} = \dfrac{D^3R}{75}$

For small short shafts: $\text{H. P.} = \dfrac{D^3R}{50}$

Where H. P. = horse power, D = diameter of shaft in inches, R = R. P. M.

Shafting under sudden variations of load should be increased in area and where greater stiffness is desired, i. e., a twist of not over five minutes or about .08 degrees per foot of length of shaft, use the following formula,

$$D = 4.6\ \sqrt[4]{\frac{\text{H.P.}}{R}}$$

The allowable distance between hangers or bearings with a maximum linear deflection of .01 inch per foot of length of shaft, (L being maximum distance between bearings in feet) is obtained thus,

For bare shafts: $L = \sqrt[3]{720D^2}$.

For shafts carrying pulleys, etc.; $L = \sqrt[3]{140D^2}$
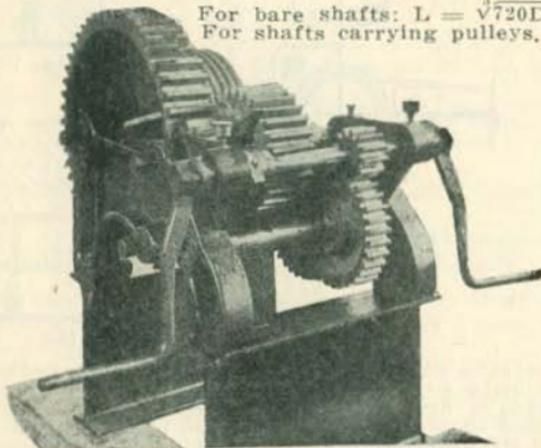
HAND
WINCH
OF
SPECIAL
DESIGN

Fabricated by us to be used to lift water gates.

TYPICAL CONSTRUCTION—DETAILS
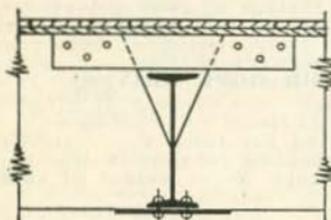
Fig. 177
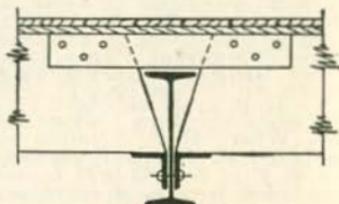
Fig. 178
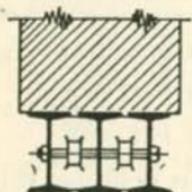
Fig. 179
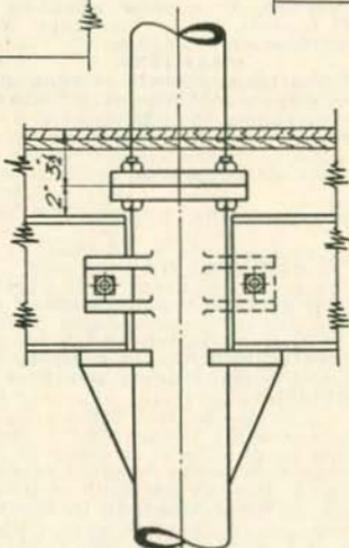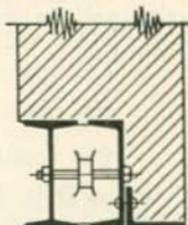
Fig. 180
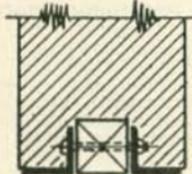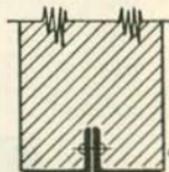
Fig. 181

Fig. 182
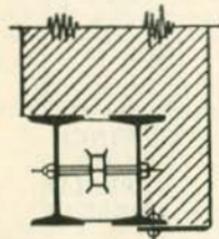
Fig. 183
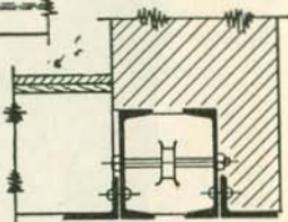
Fig. 185

Fig. 184

In the above details Figures 177 and 178 show two methods of supporting wood joists on steel beams with plates or angles. In Figure 177 the beam is flush with the ceiling, while in Figure 178 the steel beam would show as a plastered beam in the ceiling. Figures 179 to 184 show different types of lintels for the support of brick walls over openings. Figure 185 shows a typical detail of cast iron column and beam construction with minimum dimensions.

MENSURATION

LENGTH

Circumference of circle = diameter $\times$ 3.1416 or diameter $\times$ $3\frac{1}{7}$ approx.

Diameter of circle=circumference $\times$.3183 or $\frac{7}{22}$ of circumference approx.

Side of square of equal periphery as circle = diameter $\times$ .7854.
Diameter of circle of equal periphery as square = side $\times$ 1.2732
Side of inscribed square = diameter of circle $\times$ .7071.
Length of arc = No. of degrees $\times$ diameter $\times$ .008727
Radius = .5642 $\sqrt{\text{area}}$.

AREA OF REGULAR POLYGONS

Regular polygon = sum of sides $\times$ half perpendicular distance from center to sides
Square the length of one side and multiply by proper number in following table.

Name	No. of sides	Multiply
Triangle	3	.433
Square	4	1.
Pentagon	5	1.720
Hexagon	6	2.598
Heptagon	7	3.634
Octagon	8	4.828
Nonagon	9	6.182
Decagon	10	7.694

Triangle = base $\times$ $\frac{1}{2}$ perpendicular height.

Trapezoid = half the sum of parallel sides $\times$ perpendicular height.

Circle = diameter squared $\times$ 0.7854.

    = circumference squared $\times$ .07958.

Ring =.7854 $\times$ [square of outside diameter—square of inside diameter.]
Sector of circle = Length of arc $\times$ $\frac{1}{2}$ radius.

Segment of circle = Area of sector— area of triangle when the segment is less and $+$ the area of the triangle when segment is greater than semicircle.

Side of square that shall equal area of circle = diameter $\times$ .8862; circumference $\times$ .2821
Diameter of circle that shall equal area of square = side of square $\times$ 1.1284.

Parabola = base $\times$ $\frac{2}{3}$ height.

Ellipse = long diameter $\times$ short diameter $\times$ .7854.

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

Surface of sphere = diameter squared $\times$ 3.1416. or = circumference $\times$ diameter

TRIGONOMETRIC FORMULAE
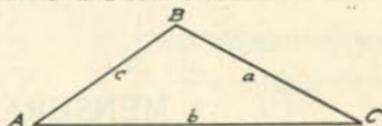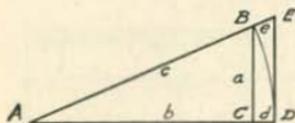
SOLUTION OF RIGHT TRIANGLES

1. $\sin A = \frac{a}{c} = \cos B$ 2. $\cos A = \frac{b}{c} = \sin B$

3. $\tan A = \frac{a}{b} = \cot B$ 4. $\cot A = \frac{b}{a} = \tan B$

5. $\sec A = \frac{c}{b} = \cosec B$ 6. $\cosec A = \frac{c}{a} = \sec B$

7. $\vers A = \frac{c-b}{c} = \frac{d}{c} = \covers B$ 8. $\exsec A = \frac{e}{c}$

9. $a = c \sin A = b \tan A = c \cos B = b \cot B = \sqrt{(c+b)(c-b)}$

10. $b = c \cos A = a \cot A = c \sin B = a \tan B = \sqrt{(c+a)(c-a)}$

11. $d = c \vers A$ 12. $e = c \exsec A$

13. $c = \frac{a}{\cos B} = \frac{b}{\sin B} = \frac{a}{\sin A} = \frac{b}{\cos A} = \frac{d}{\vers A} = \frac{e}{\exsec A}$

SOLUTION OF OBLIQUE TRIANGLES

GIVEN	SOUGHT	FORMULAES
14. A, B, a	b, c	$b = \frac{a}{\sin A} \cdot \sin B$ $c = \frac{a}{\sin A} \cdot \sin (A+B)$
15. A, a, b	B, c	$\sin B = \frac{\sin A}{a} \cdot b$ $c = \frac{a}{\sin A} \cdot \sin C$
16. C, a, b	A, B	$\tan \frac{1}{2}(A-B) = \frac{a-b}{a+b} \cdot \tan \frac{1}{2}(A+B)$
17. a, b, c	A	$\text{LET } s = \frac{1}{2}(a+b+c); \;\; \sin \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}}$
18.		$\cos \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}; \;\; \tan \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$
19.		$\sin A = \frac{2}{bc}\sqrt{s(s-a)(s-b)(s-c)}$
20.		$\vers A = \frac{2(s-b)(s-c)}{bc}$
21.	AREA	$\text{AREA} = \sqrt{s(s-a)(s-b)(s-c)}$
22. A, B, C, a	AREA	$\text{AREA} = \frac{a^2 \sin B \cdot \sin C}{2 \sin A}$
23. C, a, b	AREA	$\text{AREA} = \frac{1}{2} a b \sin C$

QUADRANT	I	II	III	IV	ANGLES		
ANGLES	0° to 90°	90° to 180°	180° to 270°	270° to 360°	30°	45°	60°
FUNCTIONS	VALUES VARY FROM				EQUIVALENT VALUES		
SIN	0 to +1	+1 to 0	0 to -1	-1 to 0	½	½√2	½√3
COS	+1 to 0	0 to -1	-1 to 0	0 to +1	½√3	½√2	½
TAN	0 to +∞	-∞ to 0	0 to +∞	-∞ to 0	⅓√3	1	√3
COT	+∞ to +0	-0 to -∞	+∞ to 0	-0 to -∞	√3	1	⅓√3

ANGLE $a < 90°$				
ANGLE	SINE	COS	TAN	COT
$\beta°$	$\phi°$	$\phi°$	$\phi°$	$\beta°$
$0° \pm a$	$\pm \sin a$	$+ \cos a$	$\pm \tan a$	$\pm \cot a$
$90° \pm a$	$+ \cos a$	$\mp \sin a$	$\mp \cot a$	$\mp \tan a$
$180° \pm a$	$\mp \sin a$	$- \cos a$	$\pm \tan a$	$\pm \cot a$
$270° \pm a$	$- \cos a$	$\pm \sin a$	$\mp \cot a$	$\mp \tan a$

SOLID CONTENTS

Prism = area of base $\times$ perpendicular height.
Cylinder = area of section at right angle to side $\times$ length of side
Sphere = diameter cubed $\times$ .5236.
    = surface $\times$ ⅙ diameter.
Pyramid or Cone = area of base $\times$ ⅓ perpendicular height.

AREA OF CIRCULAR SECTIONS
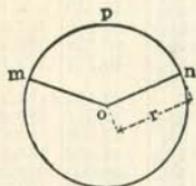
Circular Sector, m o n p

Area = ½ (length of arc, m p n x radius, r)

    = area of circle x $\dfrac{\text{arc, m p n, in degrees}}{360}$

    = 0.0087266 x square of radius, r^2, x angle of arc, m p n, in degrees.
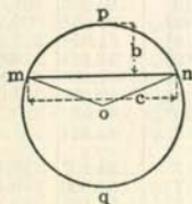
Circular Segment, m p n, less than half circle.

Area = area of sector, m o n p–area of triangle, m o n

    = $\dfrac{\text{(length of arc,mpn,x radius,r)}-\text{(radius,r,–rise,b)xchord,c}}{2}$

Circular Segment, m q n, greater than half circle.

Area = area of circle–area of segment, m n p
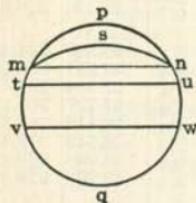
Circular Zone, t u w v

Area = area of circle—(area of segment, tpu+area of segment, vqw).

Circular Lune, m p n s

Area = segment, m p n–segment, m s n.

Courtesy Carnegie Steel Co.

CIRCUMFERENCES AND AREAS OF CIRCLES

Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area
1/64	.04909	.00019	2 7/16	7.6576	4.6664	6	18.850	28.274	12 7/8	40.448	130.19
1/32	.09818	.00077	2 1/2	7.8540	4.9087	6 1/8	19.242	29.465	13	40.841	132.73
3/64	.14726	.00173	2 9/16	8.0503	5.1572	6 1/4	19.635	30.680	13 1/8	41.233	135.30
1/16	.19635	.00307	2 5/8	8.2467	5.4119	6 3/8	20.028	31.919	13 1/4	41.626	137.89
3/32	.29452	.00690	2 11/16	8.4430	5.6727	6 1/2	20.420	33.183	13 3/8	42.019	140.50
1/8	.39270	.01227	2 3/4	8.6394	5.9396	6 5/8	20.813	34.472	13 1/2	42.412	143.14
5/32	.49087	.01917	2 13/16	8.8357	6.2126	6 3/4	21.206	35.785	13 5/8	42.804	145.80
3/16	.58905	.02761	2 7/8	9.0321	6.4918	6 7/8	21.598	37.122	13 3/4	43.197	148.49
7/32	.68722	.03758	2 15/16	9.2284	6.7771	7	21.991	38.485	13 7/8	43.590	151.20
1/4	.78540	.04909	3	9.4248	7.0686	7 1/8	22.384	39.871	14	43.982	153.94
9/32	.88357	.06213	3 1/16	9.6211	7.3662	7 1/4	22.776	41.282	14 1/8	44.375	156.70
5/16	.98175	.07670	3 1/8	9.8175	7.6699	7 3/8	23.169	42.718	14 1/4	44.768	159.48
11/32	1.0799	.09281	3 3/16	10.014	7.9798	7 1/2	23.562	44.179	14 3/8	45.160	162.30
3/8	1.1781	.11045	3 1/4	10.210	8.2958	7 5/8	23.955	45.664	14 1/2	45.553	165.13
13/32	1.2763	.12962	3 5/16	10.407	8.6179	7 3/4	24.347	47.173	14 5/8	45.946	167.99
7/16	1.3744	.15033	3 3/8	10.603	8.9462	7 7/8	24.740	48.707	14 3/4	46.338	170.87
15/32	1.4726	.17257	3 7/16	10.799	9.2806	8	25.133	50.265	14 7/8	46.731	173.78
1/2	1.5708	.19635	3 1/2	10.996	9.6211	8 1/8	25.525	51.849	15	47.124	176.71
17/32	1.6690	.22166	3 9/16	11.192	9.9678	8 1/4	25.918	53.456	15 1/8	47.517	179.67
9/16	1.7671	.24850	3 5/8	11.388	10.321	8 3/8	26.311	55.088	15 1/4	47.909	182.65
19/32	1.8653	.27688	3 11/16	11.585	10.680	8 1/2	26.704	56.745	15 3/8	48.302	185.66
5/8	1.9635	.30680	3 3/4	11.781	11.045	8 5/8	27.096	58.426	15 1/2	48.695	188.69
21/32	2.0617	.33824	3 13/16	11.977	11.416	8 3/4	27.489	60.132	15 5/8	49.087	191.75
11/16	2.1598	.37122	3 7/8	12.174	11.973	8 7/8	27.882	61.862	15 3/4	49.480	194.83
23/32	2.2580	.40574	3 15/16	12.370	12.177	9	28.274	63.617	15 7/8	49.873	197.93
3/4	2.3562	.44179	4	12.566	12.566	9 1/8	28.667	65.397	16	50.265	201.06
25/32	2.4544	.47937	4 1/16	12.763	12.962	9 1/4	29.060	67.201	16 1/8	50.658	204.22
13/16	2.5525	.51849	4 1/8	12.959	13.364	9 3/8	29.452	69.029	16 1/4	51.051	207.39
27/32	2.6507	.55914	4 3/16	13.155	13.772	9 1/2	29.845	70.882	16 3/8	51.444	210.60
7/8	2.7489	.60132	4 1/4	13.352	14.186	9 5/8	30.238	72.760	16 1/2	51.836	213.82
29/32	2.8471	.64504	4 5/16	13.548	14.607	9 3/4	30.631	74.662	16 5/8	52.229	217.08
15/16	2.9452	.69029	4 3/8	13.744	15.033	9 7/8	31.023	76.589	16 3/4	52.622	220.35
31/32	3.0434	.73708	4 7/16	13.941	15.466	10	31.416	78.540	16 7/8	53.014	223.65
1	3.1416	.7854	4 1/2	14.137	15.904	10 1/8	31.809	80.516	17	53.407	226.98
1 1/16	3.3379	.8866	4 9/16	14.334	16.349	10 1/4	32.201	82.516	17 1/8	53.800	230.33
1 1/8	3.5343	.9940	4 5/8	14.530	16.800	10 3/8	32.594	84.541	17 1/4	54.192	233.71
1 3/16	3.7306	1.1075	4 11/16	14.726	17.257	10 1/2	32.987	86.590	17 3/8	54.585	237.10
1 1/4	3.9270	1.2272	4 3/4	14.923	17.721	10 5/8	33.379	88.664	17 1/2	54.978	240.53
1 5/16	4.1233	1.3530	4 13/16	15.119	18.190	10 3/4	33.772	90.763	17 5/8	55.371	243.98
1 3/8	4.3197	1.4849	4 7/8	15.315	18.665	10 7/8	34.165	92.886	17 3/4	55.763	247.45
1 7/16	4.5160	1.6230	4 15/16	15.512	19.147	11	34.558	95.033	17 7/8	56.156	250.95
1 1/2	4.7124	1.7671	5	15.708	19.635	11 1/8	34.950	97.205	18	56.549	254.47
1 9/16	4.9087	1.9175	5 1/16	15.904	20.129	11 1/4	35.343	99.402	18 1/8	56.941	258.02
1 5/8	5.1051	2.0739	5 1/8	16.101	20.629	11 3/8	35.736	101.62	18 1/4	57.334	261.59
1 11/16	5.3014	2.2365	5 3/16	16.297	21.135	11 1/2	36.128	103.87	18 3/8	57.727	265.18
1 3/4	5.4978	2.4053	5 1/4	16.493	21.648	11 5/8	36.521	106.14	18 1/2	58.119	268.80
1 13/16	5.6941	2.5802	5 5/16	16.690	22.166	11 3/4	36.914	108.43	18 5/8	58.512	272.45
1 7/8	5.8905	2.7612	5 3/8	16.886	22.691	11 7/8	37.306	110.75	18 3/4	58.905	276.12
1 15/16	6.0868	2.9483	5 7/16	17.082	23.221	12	37.699	113.10	18 7/8	59.298	279.81
2	6.2832	3.1416	5 1/2	17.279	23.758	12 1/8	38.092	115.47	19	59.690	283.53
2 1/16	6.4795	3.3410	5 9/16	17.475	24.301	12 1/4	38.485	117.86	19 1/8	60.083	287.27
2 1/8	6.6759	3.5466	5 5/8	17.671	24.850	12 3/8	38.877	120.28	19 1/4	60.476	291.04
2 3/16	6.8722	3.7583	5 11/16	17.868	25.406	12 1/2	39.270	122.72	19 3/8	60.868	294.83
2 1/4	7.0686	3.9761	5 3/4	18.064	25.967	12 5/8	39.663	125.19			
2 5/16	7.2649	4.2000	5 13/16	18.261	26.535	12 3/4	40.055	127.68			
2 3/8	7.4613	4.4301	5 7/8	18.457	27.109						
			5 15/16	18.653	27.688						

Courtesy Ryerson & Son.

CIRCUMFERENCES AND AREAS OF CIRCLES
—Continued

Diam.	Circum.	Area
19½	61.261	298.65
19⅝	61.654	302.49
19¾	62.046	306.35
19⅞	62.439	310.24
20	62.832	314.16
20⅛	63.225	318.10
20¼	63.617	322.06
20⅜	64.010	326.05
20½	64.403	330.06
20⅝	64.795	334.10
20¾	65.188	338.16
20⅞	65.581	342.25
21	65.973	346.36
21⅛	66.366	350.50
21¼	66.759	354.66
21⅜	67.152	358.84
21½	67.544	363.05
21⅝	67.937	367.28
21¾	68.330	271.54
21⅞	68.722	375.83
22	69.115	380.13
22⅛	69.508	384.46
22¼	69.900	388.82
22⅜	70.293	393.20
22½	70.686	397.61
22⅝	71.079	402.04
22¾	71.471	406.49
22⅞	71.864	410.97
23	72.257	415.48
23⅛	72.649	420.00
23¼	73.042	424.56
23⅜	73.435	429.13
23½	73.827	433.74
23⅝	74.220	438.36
23¾	74.613	443.01
23⅞	75.006	447.69
24	75.398	452.39
24⅛	75.791	457.11
24¼	76.184	461.86
24⅜	76.576	466.64
24½	76.969	471.44
24⅝	77.362	476.26
24¾	77.754	481.11
24⅞	78.147	485.98
25	78.540	490.87
25⅛	78.933	495.79
25¼	79.325	500.74
25⅜	79.718	505.71
25½	80.111	510.71
25⅝	80.503	515.72
25¾	80.896	520.77
25⅞	81.289	525.84
26	81.681	530.93
26⅛	82.074	536.05
26¼	82.467	549.11
26⅜	82.860	546.35
26½	83.252	551.55
26⅝	83.645	556.76
26¾	84.038	562.00
26⅞	84.430	567.27
27	84.823	572.56
27⅛	85.216	577.87
27¼	85.608	583.21
27⅜	86.001	588.57
27½	86.394	593.96
27⅝	86.786	599.37
27¾	87.179	604.81
27⅞	87.572	610.27
28	87.965	615.75
28⅛	88.357	621.26
28¼	88.750	626.80
28⅜	89.143	632.36
28½	89.535	637.94
28⅝	89.928	643.55
28¾	90.321	649.18
28⅞	90.713	654.84
29	91.106	660.52
29⅛	91.499	666.23
29¼	91.892	671.96
29⅜	92.284	677.71
29½	92.677	683.49
29⅝	93.070	689.30
29¾	93.462	695.13
29⅞	93.855	700.98
30	94.248	706.86
30⅛	94.640	712.70
30¼	95.033	718.69
30⅜	95.426	724.64
30½	95.819	730.62
30⅝	96.211	736.62
30¾	96.604	742.64
30⅞	96.997	748.69
31	97.389	754.77
31⅛	97.782	760.87
31¼	98.175	766.99
31⅜	98.567	773.14
31½	98.960	779.31
31⅝	99.353	785.51
31¾	99.746	791.73
31⅞	100.138	797.98
32	100.531	804.25
32⅛	100.924	810.54
32¼	101.316	816.86
32⅜	101.709	823.21
32½	102.102	829.58
32⅝	102.494	835.97
32¾	102.887	842.39
32⅞	103.280	848.83
33	103.673	855.30
33⅛	104.065	861.79
33¼	104.458	868.31
33⅜	104.851	874.85
33½	105.243	881.41
33⅝	105.636	888.00
33¾	106.029	894.62
33⅞	106.421	901.26
34	106.814	907.92
34⅛	107.207	914.61
34¼	107.600	921.32
34⅜	107.992	928.06
34½	108.385	934.82
34⅝	108.778	941.61
34¾	109.170	948.42
34⅞	109.563	955.25
35	109.956	962.11
35⅛	110.348	969.00
35¼	110.741	975.91
35⅜	111.134	982.84
35½	111.527	989.80
35⅝	111.919	996.87
35¾	112.312	1003.8
35⅞	112.705	1010.8
36	113.097	1017.9
36⅛	113.490	1025.0
36¼	113.883	1032.1
36⅜	114.275	1039.2
36½	114.668	1046.3
36⅝	115.061	1053.5
36¾	115.454	1060.7
36⅞	115.846	1068.0
37	116.239	1075.2
37⅛	116.632	1082.5
37¼	117.024	1089.8
37⅜	117.417	1097.1
37½	117.810	1104.5
37⅝	118.202	1111.8
37¾	118.596	1119.2
37⅞	118.988	1126.7
38	119.381	1134.1
38⅛	119.773	1141.0
38¼	120.166	1149.1
38⅜	120.559	1156.6
38½	120.951	1164.2
38⅝	121.344	1171.7
38¾	121.737	1179.3
38⅞	122.129	1186.9
39	122.522	1194.6
39⅛	122.915	1202.3
39¼	123.308	1210.0
39⅜	123.700	1217.7
39½	124.093	1225.4
39⅝	124.486	1233.2
39¾	124.878	1241.0
39⅞	125.271	1248.8
40	125.664	1256.6
40⅛	126.056	1264.5
40¼	126.449	1272.4
40⅜	126.842	1280.3
40½	127.235	1288.2
40⅝	127.627	1296.2
40¾	128.020	1304.2
40⅞	128.413	1312.2
41	128.805	1320.3
41⅛	129.198	1328.3
41¼	129.591	1336.4
41⅜	129.983	1344.5
41½	130.376	1352.7
41⅝	130.769	1360.8
41¾	131.161	1369.0
41⅞	131.554	1377.2
42	131.947	1385.4
42⅛	132.340	1393.7
42¼	132.732	1402.0
42⅜	133.125	1410.3
42½	133.518	1418.6
42⅝	133.910	1427.0
42¾	134.303	1435.4
42⅞	134.696	1443.8
43	135.088	1452.2
43⅛	135.481	1460.7
43¼	135.874	1469.1
43⅜	136.267	1477.6
43½	136.659	1486.2
43⅝	137.052	1494.3
43¾	137.445	1503.7
43⅞	137.837	1511.9
44	138.230	1520.5
44⅛	138.623	1529.2
44¼	139.015	1537.9
44⅜	139.408	1546.6
44½	139.801	1555.3
44⅝	140.194	1564.0
44¾	140.586	1572.8
44⅞	140.979	1581.6
45	141.372	1590.4
45⅛	141.764	1599.3
45¼	142.157	1608.2
45⅜	142.550	1617.0
45½	142.942	1626.0
45⅝	143.335	1634.9
45¾	143.728	1643.9
45⅞	144.121	1652.9
46	144.513	1661.9
46⅛	144.906	1670.9
46¼	145.299	1680.0
46⅜	145.691	1689.1

CIRCUMFERENCES AND AREAS OF CIRCLES
—Continued

Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area
46½	146.084	1698.2	53¼	167.290	2227.0	60	188.496	2827.4	66⅞	210.094	3512.5
46⅝	146.477	1707.4	53⅜	167.683	2237.5	60⅛	188.888	2839.2			
46¾	146.869	1716.5	53½	168.075	2248.0	60¼	189.281	2851.0	67	210.487	3525.7
46⅞	147.262	1725.7	53⅝	168.468	2258.5	60⅜	189 674	2862.9	67⅛	210.879	3538.8
			53¾	168.861	2269.1	60½	190.006	2874.8	67¼	211.272	3552.0
47	147.655	1734.9	53⅞	169.253	2279.6	60⅝	190.459	2886.6	67⅜	211.665	3565.2
47⅛	148.048	1744.2				60¾	190.852	2898.6	67½	212.058	3578.5
47¼	148.440	1753.5	54	169.646	2290.2	60⅞	191.244	2910.5	67⅝	212.450	3591.7
47⅜	148.833	1762.7	54⅛	170.039	2300.8				67¾	212.843	3605.0
47½	149.226	1772.1	54¼	170.431	2311.5	61	191.637	2922.5	67⅞	213.236	3618.3
47⅝	149.618	1781.4	54⅜	170.824	2322.1	61⅛	192.030	2934.5			
47¾	150.011	1790.8	54½	171.217	2332.8	61¼	192.423	2946.5	68	213.628	3631.7
47⅞	150.404	1800.1	54⅝	171.609	2343.5	61⅜	192.815	2958.5	68⅛	214.021	3645.0
			54¾	172.002	2354.3	61½	193.208	2970.6	68¼	214.414	3658.4
48	150.796	1809.6	54⅞	172.395	2365.0	61⅝	193.601	2982.7	68⅜	214.806	3671.8
48⅛	151.189	1819.0				61¾	193.993	2994.8	68½	215.199	3685.3
48¼	151.582	1828.5	55	172.788	2375.8	61⅞	194.386	3006.9	68⅝	215.592	3698.7
48⅜	151.975	1837.9	55⅛	173.180	2386.6				68¾	215.984	3712.2
48½	152.367	1847.5	55¼	173.573	2397.5	62	194.779	3019.1	68⅞	216.377	3725.7
48⅝	152.760	1857.0	55⅜	173.966	2408.3	62⅛	195.171	2031.3			
48¾	153.153	1866.5	55½	174.358	2419.2	62¼	195.564	3043.5	69	216.770	3739.3
48⅞	153.545	1876.1	55⅝	174.751	2430.1	62⅜	195.957	3055.7	69⅛	217.163	3752.8
			55¾	175.144	2441.1	62½	196.350	3068.0	69¼	217.555	3766.4
49	153.938	1885.7	55⅞	175.536	2452.0	62⅝	196. 42	3080.3	69⅜	217.948	3780.0
49⅛	154.331	1895.4				62¾	197.135	3092.6	69½	218.341	3793.7
49¼	154.723	1905.0	56	175.929	2463.0	62⅞	197.528	3104.9	69⅝	218.733	3807.3
49⅜	155.116	1914.7	56⅛	176.322	2474.0				69¾	219.126	3821.0
49½	155.509	1924.4	56¼	176.715	2485.0	63	197.920	3117.2	69⅞	219.519	3834.7
49⅝	155.902	1934.2	56⅜	177.107	2496.1	63⅛	198.313	3129.6			
49¾	156.294	1943.9	56½	177.500	2507.2	63¼	198.706	3142.0	70	219.911	3848.5
49⅞	156.687	1953.7	56⅝	177.893	2518.3	63⅜	199.098	3154.5	70⅛	220.304	3862.2
			56¾	178.285	2529.4	63½	199.491	3166.9	70¼	220.697	3876.0
50	157.080	1963.5	56⅞	178.678	2540.6	63⅝	199.884	3179.4	70⅜	221.090	3889.8
50⅛	157.472	1973.3				63¾	200.277	3191.9	70½	221.482	3903.6
50¼	157.865	1983.2	57	179.071	2551.8	63⅞	200.669	3204.4	70⅝	221.875	3917.5
50⅜	158.258	1993.1	57⅛	179.463	2563.0				70¾	222.268	3931.4
50½	158.650	2003.0	57¼	179.856	2574.2	64	201.062	3217.0	70⅞	222.660	3945.3
50⅝	159.043	2012.9	57⅜	180.249	2585.4	64⅛	201.4 5	3229.6			
50¾	159.436	2022.8	57½	180.642	2596.7	64¼	201.847	3242.2	71	223.053	3959.2
50⅞	159.829	2032.8	57⅝	181.034	2608.0	64⅜	202.240	3254.8	71⅛	223.446	3973.1
			57¾	181.427	2619.4	64½	202.6 33	3267.5	71¼	223.838	3987.1
51	160.221	2042.8	57⅞	181.820	2630.7	64⅝	203.025	3280.1	71⅜	224.231	4001.1
51⅛	160.614	2052.8				64¾	203.418	3292.8	71½	224.624	4015.2
51¼	161.007	2062.9	58	182.212	2642.1	64⅞	203.811	3305.6	71⅝	225.017	4029.2
51⅜	161.399	2073.0	58⅛	182.605	2653.5				71¾	225.409	4043.3
51½	161.792	2083.1	58¼	182.998	2664.9	65	204.204	3318.3	71⅞	225.802	4057.4
51⅝	162.185	2093.2	58⅜	183.390	2676.4	65⅛	204.596	3331.1			
51¾	162.577	2103.3	58½	183.783	2687.8	65¼	204.989	3343.9	72	226.195	4071.5
51⅞	162.970	2113.5	58⅝	184.176	2699.3	65⅜	205.382	3356.7	72⅛	226.587	4085.7
			58¾	184.569	2710.9	65½	205.774	3369.6	72¼	226.980	4099.8
52	163.363	2123.7	58⅞	184.961	2722.4	65⅝	206.167	3382.4	72⅜	227.373	4114.0
52⅛	163.756	2133.9				65¾	206.560	3395.3	72½	227.765	4128.2
52¼	164.148	2144.2	59	185.354	2734.0	65⅞	206.952	3408.2	72⅝	228.158	4142.5
52⅜	164.541	2154.5	59⅛	185.747	2745.6				72¾	228.551	4156.8
52½	164.934	2164.8	59¼	186.139	2757.2	66	207.345	3421.2	72⅞	228.944	4171.1
52⅝	165.326	2175.1	59⅜	186.532	2768.8	66⅛	207.738	3434.2			
52¾	165.719	2185.4	59½	186.925	2780.5	66¼	208.131	3447.2	73	229.336	4185.4
52⅞	166.112	2195.8	59⅝	187.317	2792.2	66⅜	208.523	3460.2	73⅛	229.729	4199.7
			59¾	187.710	2803.9	66½	208.916	3473.2	73¼	230.122	4214.1
53	166.504	2206.2	59⅞	188.103	2815.7	66⅝	209.309	3486.3	73⅜	230.514	4228.5
53⅛	166.897	2216.6				66¾	209.701	3499.4	73⅜	230.514	4228.5

Courtesy Ryerson & Son.

CIRCUMFERENCES AND AREAS OF CIRCLES
—Continued

Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area	Diam.	Circum.	Area
73½	230.907	4242.9	80⅛	251.720	5042.3	86⅞	272.926	5927.6	93½	293.739	6866.1
73⅝	231.300	4257.4	80¼	252.113	5058.0				93⅝	294.132	6884.5
73¾	231.692	4271.8	80⅜	252.506	5073.8	87	273.319	5944.7	93¾	294.524	6902.9
73⅞	232.085	4286.3	80½	252.898	5089.6	87⅛	273.711	5961.8	93⅞	294.917	6921.3
			80⅝	253.291	5105.4	87¼	274.104	5978.9			
74	232.478	4300.8	80¾	253.684	5121.2	87⅜	274.497	5996.0	94	295.310	6939.8
74⅛	232.871	4315.4	80⅞	254.076	5137.1	87½	274.889	6013.2	94⅛	295.702	6958.2
74¼	233.263	4329.9				87⅝	275.282	6030.4	94¼	296.095	6976.7
74⅜	233.656	4344.5	81	254.469	5153.0	87¾	275.675	6047.6	94⅜	296.488	6995.3
74½	234.049	4359.2	81⅛	254.862	5168.9	87⅞	276.067	6064.9	94½	296.881	7013.8
74⅝	234.441	4373.8	81¼	255.254	5184.9				94⅝	297.273	7032.4
74¾	234.834	4388.5	81⅜	255.647	5200.8	88	276.460	6082.1	94¾	297.666	7051.0
74⅞	235.227	4403.1	81½	256.040	5216.8	88⅛	276.853	6099.4	94⅞	298.059	7069.6
			81⅝	256.433	5232.8	88¼	277.246	6116.7			
75	235.619	4417.9	81¾	256.825	5248.9	88⅜	277.638	6134.1	95	298.451	7088.2
75⅛	236.012	4432.6	81⅞	257.218	5264.9	88½	278.031	6151.4	95⅛	298.844	7106.9
75¼	236.405	4447.4				88⅝	278.424	6168.8	95¼	299.237	7125.6
75⅜	236.798	4462.2	82	257.611	5281.0	88¾	278.816	6186.2	95⅜	299.629	7144.3
75½	237.190	4477.0	82⅛	258.003	5297.1	88⅞	279.209	6203.7	95½	300.022	7163.0
75⅝	237.583	4491.8	82¼	258.396	5313.3				95⅝	300.415	7181.8
75¾	237.976	4506.7	82⅜	258.789	5329.4	89	279.602	6221.1	95¾	300.807	7200.6
75⅞	238.368	4521.5	82½	259.181	5345.6	89⅛	279.994	6238.6	95⅞	301.200	7219.4
			82⅝	259.574	5361.8	89¼	280.387	6256.1			
76	238.761	4536.5	82¾	259.967	5378.1	89⅜	280.780	6273.7	96	301.593	7238.2
76⅛	239.154	4551.4	82⅞	260.359	5394.3	89½	281.173	6291.2	96⅛	301.986	7257.1
76¼	239.546	4566.4				89⅝	281.565	6308.8	96¼	302.378	7276.0
76⅜	239.939	4581.3	83	260.752	5410.6	89¾	281.958	6326.4	96⅜	302.771	7294.9
76½	240.332	4596.3	83⅛	261.145	5426.9	89⅞	282.351	6344.1	96½	303.164	7313.8
76⅝	240.725	4611.4	83¼	261.538	5443.3				96⅝	303.556	7332.8
76¾	241.117	4626.4	83⅜	261.930	5459.6	90	282.743	6361.7	96¾	303.949	7351.8
76⅞	241.510	4641.5	83½	262.323	5476.0	90⅛	283.136	6379.4	96⅞	304.342	7370.8
			83⅝	262.716	5492.4	90¼	283.529	6397.1			
77	241.903	4656.6	83¾	263.108	5508.8	90⅜	283.921	6414.9	97	304.734	7389.8
77⅛	242.295	4671.8	83⅞	263.501	5525.3	90½	284.314	6432.6	97⅛	305.127	7408.9
77¼	242.688	4686.9				90⅝	284.707	6450.4	97¼	305.520	7428.0
77⅜	243.081	4702.1	84	263.894	5541.8	90¾	285.100	6468.2	97⅜	305.913	7447.1
77½	243.473	4717.3	84⅛	264.286	5558.3	90⅞	285.492	6486.0	97½	306.305	7466.2
77⅝	243.866	4732.5	84¼	264.679	5574.8				97⅝	306.698	7485.3
77¾	244.259	4747.8	84⅜	265.072	5591.4	91	285.885	6503.9	97¾	307.091	7504.5
77⅞	244.652	4763.1	84½	265.465	5607.9	91⅛	286.278	6521.8	97⅞	307.483	7523.7
			84⅝	265.857	5624.5	91¼	286.670	6539.7			
78	245.044	4778.4	84¾	266.250	5641.2	91⅜	287.063	6557.6	98	307.876	7543.0
78⅛	245.437	4793.7	84⅞	266.643	5657.8	91½	287.456	6575.5	98⅛	308.269	7562.2
78¼	245.830	4809.0				91⅝	287.848	6593.5	98¼	308.661	7581.5
78⅜	246.222	4824.4	85	267.035	5674.5	91¾	288.241	6611.5	98⅜	309.054	7600.8
78½	246.615	4839.8	85⅛	267.428	5691.2	91⅞	288.634	6629.6	98½	309.447	7620.1
78⅝	247.008	4855.2	85¼	267.821	5707.9				98⅝	309.840	7639.5
78¾	247.400	4870.7	85⅜	268.213	5724.7	92	289.027	6647.6	98¾	310.232	7658.9
78⅞	247.793	4886.2	85½	268.606	5741.5	92⅛	289.419	6665.7	98⅞	310.625	7678.3
			85⅝	268.999	5758.3	92¼	289.812	6683.8			
79	248.186	4901.7	85¾	269.392	5775.1	92⅜	290.205	6701.9	99	311.018	7697.7
79⅛	248.579	4917.2	85⅞	269.784	5791.9	92½	290.597	6720.1	99⅛	311.410	7717.1
79¼	248.971	4932.7				92⅝	290.990	6738.2	99¼	311.803	7736.6
79⅜	249.364	4948.3	86	270.177	5808.8	92¾	291.383	6756.4	99⅜	312.196	7756.1
79½	249.757	4963.9	86⅛	270.570	5825.7	92⅞	291.775	6774.7	99½	312.588	7775.6
79⅝	250.149	4979.5	86¼	270.962	5842.6				99⅝	312.981	7795.2
79¾	250.542	4995.2	86⅜	271.355	5859.6	93	292.168	6792.9	99¾	313.374	7814.8
79⅞	250.935	5010.9	86½	271.748	5876.5	93⅛	292.561	6811.2	99⅞	313.767	7834.4
			86⅝	272.140	5893.5	93¼	292.954	6829.5			
80	251.327	5026.5	86¾	272.533	5910.6	93⅜	293.346	6847.8	100	314.159	7854.0

EQUIVALENTS OF MEASURE

Lengths

1 meter, m =10 decimeters, dm =100 centimeters, cm =1000 millimeters, mm.
1 meter, m =0.1 decameter, dkm =0.01 hectometer, hm =0.001 kilometer, km.
1 meter, m =39.37 inches, U. S. Standard =39.370113 inches, British Standard.
1 millimeter, mm =1000 microns, μ =0.03937 inch =39.37 mils.

Meters, m	Inches, in.	Feet, ft.	Yard, yd.	Rods, r.	Chains, ch.	Miles, U. S. Statute	Miles, U. S. Nautical	Kilos. km.
1	39.37	3.28083	1.09361	0.19884	0.04971	$0.{}^{3}_{0}6214$	$0.{}^{3}_{0}5396$	0.001
0.02540	1	0.08333	0.02778	$0.{}^{2}_{0}5051$	$0.{}^{2}_{0}1263$	$0.{}^{4}_{0}1578$	$0.{}^{4}_{0}1371$	$0.{}^{4}_{0}2540$
0.30480	12	1	0.33333	0.06061	0.01515	$0.{}^{3}_{0}1894$	$0.{}^{3}_{0}1645$	$0.{}^{3}_{0}3048$
0.91440	36	3	1	0.18182	0.04545	$0.{}^{3}_{0}5682$	$0.{}^{3}_{0}4934$	$0.{}^{3}_{0}9144$
5.02921	198	16.5	5.5	1	0.25	$0.{}^{2}_{0}3125$	$0.{}^{2}_{0}2714$	$0.{}^{2}_{0}5029$
20.1168	792	66	22	4	1	0.01250	0.01085	0.02012
1609.35	63360	5280	1760	320	80	1	0.86839	1.60935
1853.25	72962.5	6080.20	2026.73	368.497	92.1243	1.15155	1	1.85325
1000	39370	3280.83	1093.61	198.838	49.7096	0.62137	0.53959	1

1 yard, U. S. =1.0000029 yards British   1 yard British =0.9999971 yard U. S.
1 chain, Gunter's =100 links   1 link =7.92 inches.
1 cable length, U. S. =120 fathoms =960 spans =720 feet =219.457 meters.
1 league, U. S. =3 statute miles =24 furlongs.
1 international geographical mile = $\frac{1}{15}°$ at equator =7422 m
    =4.611808 U. S. statute miles.
1 international nautical mile   = $\frac{1}{60}°$ at meridian =1852 m
    =0.999326 U. S. nautical miles.
1 U. S. nautical mile = $\frac{1}{60}°$ of circumference of sphere whose surface equals that of the earth
    =6080.27 feet =1.15155 statute miles =1853.27 meters.
1 British nautical mile =6080.00 feet =1.15152 statute miles =1853.19 meters.

SURFACES AND AREAS

1 sq. meter, m^2 =1000 sq. decimeters, dm^2 =10000 sq. centimeters, cm^2.
1 sq. meter, m^2 =0.01 are, a =0.0001 hectare, ha.
1 sq. millimeter, mm^2 =0.01 cm^2 =0.00155 sq. inch =1973.5 circular mils.
1 are, a =1 sq. decameter, dkm^2 =0.0247104 acre.

Sq. Meters m^2	Sq. Inches sq. in.	Sq. Feet sq. ft.	Sq. Yards sq. yd.	Sq. Rods sq. r.	Acres A	Hectares ha.	Sq. Miles Statute	Sq. Kilos km^2
1	1550.00	10.7639	1.19599	0.03954	$0.{}^{3}_{0}2471$	0.0001	$0.{}^{6}_{0}3861$	$0.{}^{6}_{0}1$
$0.{}^{3}_{0}6452$	1	$0.{}^{2}_{0}6944$	$0.{}^{3}_{0}7716$	$0.{}^{4}_{0}2551$	$0.{}^{6}_{0}1594$	$0.{}^{7}_{0}6452$	$0.{}^{9}_{0}2491$	$0.{}^{9}_{0}6452$
0.09290	144	1	0.11111	$0.{}^{2}_{0}3673$	$0.{}^{4}_{0}2296$	$0.{}^{5}_{0}9290$	$0.{}^{7}_{0}3587$	$0.{}^{6}_{0}9290$
0.83613	1296	9	1	0.03306	$0.{}^{3}_{0}2066$	$0.{}^{4}_{0}8361$	$0.{}^{6}_{0}3228$	$0.{}^{6}_{0}8361$
25.2930	39204	272.25	30.25	1	0.00625	$0.{}^{2}_{0}2529$	$0.{}^{5}_{0}9766$	$0.{}^{4}_{0}2529$
4046.87	6272640	43560	4840	160	1	0.40469	$0.{}^{3}_{0}1563$	$0.{}^{2}_{0}4047$
10000	15499969	107639	11959.9	395.366	2.47104	1	$0.{}^{2}_{0}3861$	0.01
2589999		27878400	3097600	102400	640	259.000	1	2.59000
1000000		10763867	1195985	39536.6	247.104	100	0.38610	1

1 sq. rod, sq. pole, or sq. perch =625 sq. links =1/160 acre.
1 sq. chain, Gunter's =16 sq. rods =1/10 acre.
1 acre =4 sq. roods =160 sq. rods.   Square of 1 acre =208.7103 feet square.

Notations $^{2}_{0},^{3}_{0},^{4}_{0}$, etc., indicate that the $^{2}_{0},^{3}_{0},^{4}_{0}$, etc., are to be replaced by 2,3,4, etc., ciphers.
Example—1 sq. rod = $0.{}^{5}_{0}9766$ =0.000009766 sq. miles.

Courtesy Carnegie Steel Co.

EQUIVALENTS OF MEASURE

VOLUME AND CAPACITY

1 cu. meter, m^3 = 1000 cu. decimeter, dm^3 = 1000000 cu. centimeters, cm^3. 1 liter, 1 = 10 deciliters, dl = 100 centiliters, cl = 1000 milliliters, ml = 1000 cu. centimeters, cm^3. or cc. 1 liter, 1 = 0.1 decaliter, dkl = 0.01 hectoliter, hl = 1 cu. decimeter, dm^3.

Cubic Decimeter dm^3, l	Cubic Inches cu. in.	Cubic Feet, cu. ft.	Cubic Yards, cu. yd.	U. S. Quarts		U. S. Gallons		U. S. Bushels, bu.
				Liquid, l. qt.	Dry, d. qt.	Liquid, l. gal.	Dry, d. gal.	
1	61.0234	0.03531	$0.{}^{2}_{0}1308$	1.05668	0.90808	0.26417	0.22702	0.02838
0.01639	1	$0.{}^{3}_{0}5787$	$0.{}^{4}_{0}2143$	0.01732	0.01488	$0.{}^{2}_{0}4329$	$0.{}^{2}_{0}3720$	$0.{}^{3}_{0}4650$
28.3170	1728	1	0.03704	29.9221	25.7140	7.48055	6.42851	0.80356
764.559	46656	27	1	807.896	694.279	201.974	173.570	21.6962
0.94636	57.75	0.03342	$0.{}^{2}_{0}1238$	1	0.85937	0.25	0.21484	0.02686
1.10123	67.2006	0.03889	$0.{}^{2}_{0}1440$	1.16365	1	0.29091	0.25	0.03125
3.78543	231	0.13368	$0.{}^{3}_{0}4951$	4	3.43747	1	0.85937	0.10742
4.40492	268.803	0.15556	$0.{}^{2}_{0}5761$	4.65460	4	1.16365	1	0.125
35.2393	2150.42	1.24446	0.04609	37.2368	32	9.30920	8	1

U. S. Dry Measure: 1 bushel = 4 pecks = 8 gallons = 32 quarts = 64 pints.
U. S. Liquid Measure: 1 gallon = 4 quarts = 8 pints = 32 gills = 128 fluid ounces.
U. S. Apoth. Measure: 1 fl. ounce, f℥ =8 fl. drams, fʒ = 480 minims, m = 29.574 cm^3.
British Imperial gallon dry and liquid measure = 1.03202 U. S. dry gallon = 1.20091 U. S liquid gallons.
British Imperial gallon = 277.410 cu. in. = 4545.9631 cm^3.
Weight of water at maximum density, 4°C, 45° Lat., and sea level.
1 cu. ft. = 62.4283 lbs. av. = 28.3170 kg. 1 cu in.. = 0.57804 oz. av. = 16.3872 g.
1 gallon, U. S. liquid = 8.34545 lbs. = 3.78543 kg.
1 gallon, British Imperial = 10.0221 lbs. = 4.5459631 kg.

MASSES AND WEIGHTS

1 gram, g =10 decigrams, dg =100 centigrams, cg =1000 milligrams, mg.
1 gram, g =0.1 decagram, dkg =0.01 hectogram, hg =0.001 kilogram, kg.
1 kilogram, kg =1 cu. decimeter of water or liter, 4°C, 45° Lat. and sea level.
=15432.35639 grains, U. S. and British Standard.

Kilograms, kg.	Grains, gr.	Ounces		Pounds		Tons		
		Troy, oz. t.	Avoir., oz. av.	Troy, lb. t.	Avoir., lb. av.	Net, Short 2000 lbs.	Gross, Long, 2240 lbs.	Metric, 1000 kg.
1	15432.4	32.1507	35.2740	2.67923	2.20462	$0.{}^{3}_{0}1102$	$0.{}^{3}_{0}9842$	0.001
$0.{}^{4}_{0}6480$	1	$0.{}^{2}_{0}2083$	$0.{}^{2}_{0}2286$	$0.{}^{3}_{0}1736$	$0.{}^{3}_{0}1429$	$0.{}^{7}_{0}7143$	$0.{}^{6}_{0}6378$	$0.{}^{6}_{0}6480$
0.03110	480	1	1.09714	0.08333	0.06857	$0.{}^{3}_{0}3429$	$0.{}^{3}_{0}3061$	$0.{}^{3}_{0}3110$
0.02835	437.5	0.91146	1	0.07595	0.06250	$0.{}^{3}_{0}3125$	$0.{}^{2}_{0}2790$	$0.{}^{2}_{0}2835$
0.37324	5760	12	13.1657	1	0.82286	$0.{}^{3}_{0}4114$	$0.{}^{3}_{0}3674$	$0.{}^{3}_{0}3732$
0.45359	7000	14.5833	16	1.21528	1	0.00050	$0.{}^{3}_{0}4464$	$0.{}^{3}_{0}4532$
907.185	14000000	29166.7	32000	2430.56	2000	1	0.89286	0.90719
1016.05	15680000	32666.7	35840	2722.22	2240	1.12	1	1.01605
1000	15432356	32150.7	35274.0	2679.23	2204.62	1.10231	0.98421	1

1 ounce avoir. =16 drams, avoir. 1 ounce troy =20 pennyweight, dwt.
1 ounce apoth., ℥ =8 drams, ʒ =24 scruples, ℈ =480 grains, gr =31.1035 g.
1 hundredweight =1/20 long ton =4 quarters =8 stone =112 lbs. =50.8024 kg.

Notations $0.{}^{2}_{0}, 0.{}^{3}_{0}, 0.{}^{4}_{0}$, etc., indicate that the $0^2, 0^3, 0^4$, etc., are to be replaced by 2, 3, 4, etc., ciphers. Example—1 grain =$0.{}^{2}_{0}2083$ =.002083 oz. t. 1 grain =$0.{}^{4}_{0}6480$ =0.00006480 kg.

EQUIVALENTS OF MEASURE

FORCES OR WEIGHTS PER UNITS OF LENGTH, LINEAR WEIGHTS
1 dyne per centimeter = 0.00010179 g/cm = 0.000183719 poundal/in.
1 gram per centimeter = 980.5966 dynes/cm = 0.180154 poundal/in.
1 poundal per inch = 5443.11 dynes/cm = 5.55081 g/cm = 0.0310832 pound/in.

Grams per Centimeter g/cm	Grains per Inch gr./in.	Pounds per Inch, lb./in.	Pounds per Foot, lb./ft.	Pounds per Yard, lb./yd.	Kilograms per Meter kg/m	Net Tons 2000 lbs., per Mile	Gross Tons, 2240 lbs., per Mile	Metric Tons, 1000 kg, per Kilo.
1	39.1983	$0.^2_05600$	0.06720	0.20159	0.10	0.17740	0.15839	0.10
0.02551	1	$0.^3_01429$	$0.^2_01714$	$0.^2_05143$	$0.^2_02551$	$0.^2_04526$	$0.^2_04041$	$0.^2_02551$
178.579	7000	1	12	36	17.8579	31.6800	28.2857	17.8579
14.8816	583.333	0.08333	1	3	1.48816	2.64000	2.35714	1.48816
4.96054	194.444	0.02778	0.33333	1	0.49605	0.88000	0.78571	0.49605
10	391.983	0.05600	0.67197	2.01591	1	1.77400	1.58393	1
5.63698	220.960	0.03157	0.37879	1.13636	0.56370	1	0.89286	0.56370
6.31342	247.475	0.03535	0.42424	1.27273	0.63134	1.12	1	0.63134
10	391.983	0.05600	0.67197	2.01591	1	1.77400	1.58393	1

FORCES OR WEIGHTS PER UNITS OF AREA, PRESSURE
1 dyne per sq. centimeter = 0.00101979 g/cm² = 0.000466646 poundals/in².
1 gram per sq. centimeter = 980.5966 dynes/cm² = 0.457592 poundals/in².
1 poundal per sq. inch = 2142.95 dynes/cm² = 2.18536 g/cm² = 0.0310832 pound/in².

Kil'grams per Sq. Centimeter, kg/cm²	Pounds per Sq. Inch, lb./in.²	Pounds per Sq. Foot, lb./ft.²	Net Tons 2000 lbs. per Sq. Foot	Atmospheres, Standard, 760 mm	Columns of Mercury Hg. 13.59593 Sp.G.		Columns of Water, Max. Density 4°C	
					Millimeters	Inches	Meters	Feet
1	14.2234	2048.17	1.02408	0.96778	735.514	28.9572	10	32.8083
0.07031	1	144	0.07200	0.06804	51.7116	2.03588	0.70307	2.30665
$0.^2_04882$	$0.^2_06944$	1	.000050	$0.^2_04725$	0.35911	0.01414	$0.^2_04882$	0.01602
0.97648	13.8889	2000	1	0.94502	718.216	28.2762	9.76482	32.0367
1.03329	14.6969	2116.35	1.05818	1	760	29.9212	10.3329	33.9006
$0.^2_01360$	0.01934	2.78468	$1.^3_01392$	$0.^2_01316$	1	0.03937	0.01360	0.04461
0.03453	0.49119	70.7310	0.03537	0.03342	25.4001	1	0.34534	1.13299
0.10	1.42234	204.817	0.10241	0.09678	73.5514	2.89572	1	3.28083
0.03048	0.43353	62.4283	0.03121	0.02950	22.4185	0.88262	0.30480	1

FORCES OR WEIGHTS PER UNITS OF VOLUME, DENSITY
1 dyne per cu. centimeter = 0.00101979 gram/cm³ = 0.00118528 poundals/in³.
1 gram per cu. centimeter = 980.5966 dynes/cm³ = 1.162283 poundals/in³.
1 poundal per cu. inch = 843.683 dynes/cm³ = 0.860378 g/cm³ = 0.0310832 pound/in³.

Grams per Cu. Centimeter, g/cm³	Pounds per Cu. Inch, lb./in.³	Pounds per Cu. Foot, lb./ft.³	Pounds per Cu. Yard, lb./yd.³	Kilograms per Cu. Meter kg/m³	Pounds per Bushel, U.S.	Pounds per Gallon, Dry, U.S.	Pounds per Gallon, Liquid, U.S.	Kilograms per Hectoliter, kg/hl
1	0.03613	62.4283	1685.56	1000	77.6893	9.71116	8.34545	100
27.6797	1	1728	46656	27679.7	2150.42	268.803	231	2767.97
0.01602	$0.^2_05787$	1	27	16.0184	1.24446	0.15556	0.13368	1.60184
$0.^3_05933$	$0.^4_02143$	0.03704	1	0.59327	0.04609	$0.^2_05762$	$0.^2_04951$	0.05933
0.001	$0.^4_03613$	0.06243	1.68556	1	0.07769	$0.^2_09711$	$0.^2_08345$	0.10
0.01287	$0.^4_04650$	0.80356	21.6962	12.8718	1	0.125	0.10742	1.28718
0.10297	$0.^3_03720$	6.42851	173.570	102.974	8	1	0.85937	10.2974
0.11983	$0.^4_04329$	7.48052	210.974	119.826	9.30920	1.16365	1	11.9826
0.01	$0.^3_03613$	0.62428	16.8557	10	0.77689	0.09711	0.08345	1

Notations $0.^2_0$, $0.^3_0$, $0.^4_0$, etc., indicate that the $0.^2_0$, $0.^3_0$, $0.^4_0$, etc., are to be replaced by 2, 3, 4, etc., ciphers.
Example—1 kg/m³ = $0.^4_03613$ = 0.00003613 lb./in³.
Courtesy Carnegie Steel Co.

EQUIVALENTS OF MEASURE
ENERGY, WORK, HEAT

1 dyne-centimeter = 1 erg = 0.00101979 gram-centimeter = $0.{}^{7}_{0}7737612$ foot-pound.

1 gram-centimeter = 980.5966 ergs = $0.{}^{6}_{0}7233$ foot-pound.

1 foot-pound = 13557300 ergs = 13825.5 gram-centimeters.

| Kilogram-meters, kg-m | Foot-Pounds, ft.-lbs. | Horsepower-hour | | Poncelet-hours, 100 kg-m-h | Kilowatt-hours, kw-h | Joules, 10^7 ergs, j-s | Thermal Units | |
		U. S., H. P.-h	Metric, 75 kg-m-h				B. T. U. b. t. u.	Calorie, kg-cal
1	7.23300	$0.{}^{5}_{0}3653$	$0.{}^{5}_{0}3704$	$0.{}^{5}_{0}2778$	$0.{}^{5}_{0}2724$	9.80597	$0.{}^{2}_{0}9296$	$0.{}^{2}_{0}2342$
0.13826	1	$0.{}^{6}_{0}5051$	$0.{}^{6}_{0}5121$	$0.{}^{6}_{0}3840$	$0.{}^{6}_{0}3766$	1.35573	$0.{}^{2}_{0}1285$	$0.{}^{3}_{0}3239$
273745	1980000	1	1.01387	0.76040	0.74565	2684340	2544.65	641.240
270000	1952910	0.98632	1	0.75	0.73545	2647610	2509.83	632.467
360000	2603880	1.31509	1.33333	1	0.98060	3530147	3346.44	843.289
367123	2655403	1.34111	1.35972	1.01979	1	3600000	3412.66	859.975
0.10198	0.73761	$0.{}^{6}_{0}3725$	$0.{}^{6}_{0}3777$	$0.{}^{6}_{0}2833$	$0.{}^{6}_{0}2778$	1	$0.{}^{3}_{0}9480$	$0.{}^{3}_{0}2389$
107.577	778.104	$0.{}^{3}_{0}3930$	$0.{}^{3}_{0}3984$	$0.{}^{3}_{0}2988$	$0.{}^{3}_{0}2930$	1054.90	1	0.25200
426.900	3087.77	$0.{}^{2}_{0}1559$	$0.{}^{2}_{0}1581$	$0.{}^{2}_{0}1186$	$0.{}^{2}_{0}1163$	4186.17	3.96832	1

POWER, RATE OF ENERGY AND HEAT

1 erg per sec. = 1 dyne-cm/sec. = 0.00101979 gram-cm/sec. = $0.{}^{7}_{0}7737612$ foot-pounds/sec.

1 gram-centimeter per second = 980.5966 ergs/sec. = $0.{}^{6}_{0}7238$ foot-pounds/sec.

1 foot-pound per second = 13557300 ergs/sec = 13825.5 gram-cm/sec.

| Kilogram-meters per Second, kg-m/s | Foot-pounds per Second, ft.-lbs./s | Horsepower | | | Poncelet, 100 kg-m/s | Kilowatt, kw. | Watts, 10^7ergs/s | Thermal Units per Sec. | |
		U. S., 550 ft.-lbs./s	Metric, 75 kg-m/s					B. T. U. btu/s	Calorie kg-cal/s
1	7.23300	0.01315	0.01333	0.01	$0.{}^{2}_{0}9806$	9.80597	$0.{}^{2}_{0}9296$	$0.{}^{2}_{0}2342$
0.13826	1	$0.{}^{2}_{0}1818$	$0.{}^{2}_{0}1843$	$0.{}^{2}_{0}1383$	$0.{}^{2}_{0}1356$	1.35573	$0.{}^{2}_{0}1285$	$0.{}^{3}_{0}3237$
76.0404	550	1	1.01387	0.76040	0.74565	745.650	0.70685	0.17812
75	542.475	0.98632	1	0.75	0.73545	735.448	0.69718	0.17569
100	723.300	1.31509	1.33333	1	0.98060	980.597	0.92957	0.23425
101.979	737.612	1.34111	1.35972	1.01979	1	1000	0.94796	0.23888
0.10198	0.73761	$0.{}^{2}_{0}1341$	$0.{}^{2}_{0}1360$	$0.{}^{2}_{0}1020$	0.001	1	$0.{}^{3}_{0}9480$	$0.{}^{3}_{0}2389$
107.577	778.104	1.41474	1.43436	1.07577	1.05490	1054.90	1	0.25200
426.900	3087.77	5.61412	5.69200	4.26900	4.18617	4186.17	3.96832	1

VELOCITIES AND ACCELERATIONS

1 kine = 1 centimeter per second = 0.0328083 foot per second.

1 radian per second = 57.2958 degrees per sec. = 0.159155 revolutions per sec.

1 gravity = 980.5966 centimeters per sec. per sec. = 32.1717 feet per sec. per sec.

Meters per Second, m/s	Feet per Second, ft./s	Miles per Hour, M/h	Knots per Hour, U. S.	Kilometers per Hour, km/h	Meter per sec/sec, m/s²	Feet per sec/sec, ft./s²	Miles per hour/sec, M/h-s	Kilometer per hour/sec, km/h-s
1	3.28083	2.23693	1.94254	3.6				
0.30480	1	0.68182	0.59209	1.09728				
0.44704	1.46667	1	0.86839	1.60935				
.51479	1.68894	1.15155	1	1.85325				
0.27778	0.91134	0.62137	0.53959	1				
					1	3.28083	2.23693	3.6
					0.30480	1	0.68182	1.09728
					0.44704	1.46667	1	1.60935
					.27778	0.91134	0.62137	1

Notations $0.{}^{2}_{0}$, $0.{}^{3}_{0}$, $0.{}^{4}_{0}$, etc., indicate that the ${}^{2}_{0}$, ${}^{3}_{0}$, ${}^{4}_{0}$, etc., are to be replaced by 2, 3, 4, etc., ciphers.

Example—1 Calorie = $0.{}^{2}_{0}1163$ = 0.001163 kilowatt-hours.

Courtesy Carnegie Steel Co.

HOLLOW SQUARE SECTIONS
AREAS AND RADII OF GYRATION

Area $= (D^2 - d^2)$ sq. in. Radius of Gyration $= \sqrt{\dfrac{D^2 + d^2}{12}}$ in.

Side D, in.	Elem.	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
							Thickness, t, Inches									
2	A	1.75	2.44	3.00	3.44	3.75	3.94									
	r	.72	.68	.65	.62	.60	.58									
3	A	2.75	3.94	5.00	5.94	6.75	7.44	8.00	8.44	8.75	8.94					
	r	1.13	1.08	1.04	1.00	.97	.94	.91	.89	.88	.87					
4	A	3.75	5.44	7.00	8.44	9.75	10.94	12.00	12.94	13.75	14.44	15.00	15.44	15.75	15.94	
	r	1.53	1.49	1.44	1.40	1.36	1.32	1.29	1.26	1.23	1.21	1.19	1.17	1.16	1.16	
5	A	4.75	6.94	9.00	10.94	12.75	14.44	16.00	17.44	18.75	19.94	21.00	21.94	22.75	23.44	24.00
	r	1.94	1.89	1.85	1.80	1.76	1.72	1.68	1.65	1.61	1.58	1.55	1.53	1.51	1.49	1.47
6	A	5.75	8.44	11.00	13.44	15.75	17.94	20.00	21.94	23.75	25.44	27.00	28.44	29.75	30.94	32.00
	r	2.35	2.30	2.25	2.21	2.17	2.12	2.08	2.04	2.01	1.97	1.94	1.91	1.88	1.85	1.83
7	A	6.75	9.94	13.00	15.94	18.75	21.44	24.00	26.44	28.75	30.94	33.00	34.94	36.75	38.44	40.00
	r	2.76	2.71	2.66	2.62	2.57	2.53	2.48	2.44	2.40	2.36	2.33	2.29	2.26	2.23	2.20
8	A	7.75	11.44	15.00	18.44	21.75	24.94	28.00	30.94	33.75	36.44	39.00	41.44	43.75	45.94	48.00
	r	3.17	3.12	3.07	3.02	2.98	2.93	2.89	2.84	2.80	2.76	2.72	2.69	2.65	2.62	2.58
9	A	8.75	12.94	17.00	20.94	24.75	28.44	32.00	35.44	38.75	41.94	45.00	47.94	50.75	53.44	56.00
	r	3.57	3.53	3.48	3.43	3.38	3.34	3.29	3.25	3.20	3.16	3.12	3.08	3.05	3.01	2.97
10	A	9.75	14.44	19.00	23.44	27.75	31.94	36.00	39.94	43.75	47.44	51.00	54.44	57.75	60.94	64.00
	r	3.98	3.93	3.88	3.84	3.79	3.74	3.70	3.65	3.61	3.57	3.52	3.48	3.44	3.40	3.37
11	A	10.75	15.94	21.00	25.94	30.75	35.44	40.00	44.44	48.75	52.94	57.00	60.94	64.75	68.44	72.00
	r	4.39	4.34	4.29	4.24	4.20	4.15	4.10	4.06	4.01	3.97	3.93	3.88	3.84	3.80	3.76
12	A	11.75	17.44	23.00	28.44	33.75	38.94	44.00	48.94	53.75	58.44	63.00	67.44	71.75	75.94	80.00
	r	4.80	4.75	4.70	4.65	4.60	4.56	4.51	4.46	4.42	4.37	4.33	4.29	4.25	4.20	4.16
13	A	12.75	18.94	25.00	30.94	36.75	42.44	48.00	53.44	58.75	63.94	69.00	73.94	78.75	83.44	88.00
	r	5.21	5.16	5.11	5.06	5.01	4.96	4.92	4.87	4.82	4.78	4.74	4.69	4.65	4.61	4.56
14	A	13.75	20.44	27.00	33.44	39.75	45.94	52.00	57.94	63.75	69.44	75.00	80.44	85.75	90.94	96.00
	r	5.61	5.56	5.51	5.47	5.42	5.37	5.32	5.28	5.23	5.18	5.14	5.10	5.05	5.01	4.97
15	A	14.75	21.94	29.00	35.94	42.75	49.44	56.00	62.44	68.75	74.94	81.00	86.94	92.75	98.44	104.00
	r	6.02	5.97	5.92	5.87	5.83	5.78	5.73	5.68	5.64	5.59	5.55	5.50	5.46	5.41	5.37
16	A	15.75	23.44	31.00	38.44	45.75	52.94	60.00	66.94	73.75	80.44	87.00	93.44	99.75	105.94	112.00
	r	6.43	6.38	6.33	6.28	6.23	6.19	6.14	6.09	6.04	6.00	5.95	5.91	5.86	5.82	5.77
17	A	16.75	24.94	33.00	40.94	48.75	56.44	64.00	71.44	78.75	85.94	93.00	99.94	106.75	113.44	120.00
	r	6.84	6.79	6.74	6.69	6.64	6.59	6.54	6.50	6.45	6.40	6.36	6.31	6.27	6.23	6.18
18	A	17.75	26.44	35.00	43.44	51.75	59.94	68.00	75.94	83.75	91.44	99.00	106.44	113.75	120.94	128.00
	r	7.25	7.20	7.15	7.10	7.05	7.00	6.95	6.90	6.86	6.81	6.76	6.72	6.67	6.63	6.58
19	A	18.75	27.94	37.00	45.94	54.75	63.44	72.00	80.44	88.75	96.94	105.00	112.94	120.75	128.44	136.00
	r	7.66	7.61	7.56	7.51	7.46	7.41	7.36	7.31	7.26	7.22	7.17	7.12	7.08	7.03	6.99
20	A	19.75	29.44	39.00	48.44	57.75	66.94	76.00	84.94	93.75	102.44	111.00	119.44	127.75	135.94	144.00
	r	8.06	8.01	7.96	7.91	7.87	7.82	7.77	7.72	7.67	7.62	7.58	7.52	7.49	7.44	7.39

Courtesy Carnegie Steel Co.

HOLLOW ROUND SECTIONS
AREAS AND RADII OF GYRATION

$$\text{Area} = \frac{\pi (D^2 - d^2)}{4} = 0.7854\,(D^2 - d^2)\ \text{sq. in.} \qquad \text{Radius of Gyration} = \frac{\sqrt{D^2 + d^2}}{4}\ \text{in.}$$

Dia. D in.	Elem.	¼	5/16	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2
2	A	1.37	1.66														
2	r	0.63	0.61														
3	A	2.16	2.64														
3	r	0.98	0.96														
4	A	2.95	3.62	4.27	5.50												
4	r	1.33	1.31	1.29	1.25												
5	A	3.73	4.60	5.45	7.07	8.59	10.01										
5	r	1.68	1.66	1.64	1.60	1.56	1.53										
6	A	4.52	5.58	6.63	8.64	10.55	12.37	14.09	15.71								
6	r	2.03	2.01	1.99	1.95	1.91	1.88	1.84	1.80								
7	A	5.30	6.57	7.80	10.21	12.52	14.73	16.84	18.85	20.76	22.58						
7	r	2.39	2.37	2.35	2.30	2.27	2.23	2.19	2.15	2.12	2.08						
8	A	6.09	7.55	8.98	11.78	14.48	17.08	19.59	21.99	24.30	26.51	28.62	30.63				
8	r	2.74	2.72	2.70	2.66	2.62	2.58	2.54	2.50	2.46	2.43	2.39	2.36				
9	A	6.87	8.53	10.16	13.35	16.44	19.44	22.33	25.13	27.83	30.43	32.94	35.34	37.65	39.86		
9	r	3.09	3.07	3.05	3.01	2.97	2.93	2.89	2.85	2.81	2.78	2.74	2.70	2.67	2.64		
10	A	7.66	9.51	11.34	14.92	18.41	21.79	25.08	28.27	31.37	34.36	37.26	40.06	42.76	45.36	47.86	50.27
10	r	3.45	3.43	3.41	3.36	3.32	3.28	3.24	3.20	3.16	3.13	3.09	3.05	3.02	2.98	2.95	2.92
11	A	8.44	10.49	12.52	16.49	20.37	24.15	27.83	31.42	34.90	38.29	41.58	44.77	47.86	50.85	53.75	56.55
11	r	3.80	3.78	3.76	3.72	3.67	3.63	3.59	3.55	3.51	3.48	3.44	3.40	3.36	3.33	3.29	3.26
12	A	9.23	11.47	13.70	18.06	22.33	26.51	30.58	34.56	38.44	42.21	45.90	49.48	52.97	56.35	59.64	62.83
12	r	4.16	4.13	4.11	4.07	4.03	3.99	3.95	3.91	3.87	3.83	3.79	3.75	3.71	3.68	3.64	3.61
13	A	10.01	12.46	14.87	19.63	24.30	28.86	33.33	37.70	41.97	46.14	50.22	54.19	58.07	61.85	65.53	69.12
13	r	4.51	4.49	4.47	4.42	4.38	4.34	4.30	4.26	4.22	4.18	4.14	4.10	4.06	4.03	3.99	3.95
14	A	10.80	13.44	16.05	21.21	26.26	31.22	36.08	40.84	45.50	50.07	54.54	58.91	63.18	67.35	71.42	75.40
14	r	4.86	4.84	4.82	4.78	4.73	4.69	4.65	4.61	4.57	4.53	4.49	4.45	4.41	4.38	4.34	4.30
15	A	11.58	14.42	17.23	22.78	28.23	33.58	38.83	43.98	49.04	54.00	58.86	63.62	68.28	72.85	77.31	81.68
15	r	5.22	5.19	5.17	5.13	5.09	5.05	5.00	4.96	4.92	4.88	4.84	4.80	4.76	4.73	4.69	4.65
16	A	12.37	15.40	18.41	24.35	30.19	35.93	41.58	47.12	52.57	57.92	63.18	68.33	73.39	78.34	83.20	87.97
16	r	5.57	5.55	5.53	5.48	5.44	5.40	5.36	5.32	5.27	5.23	5.19	5.15	5.11	5.08	5.04	5.00
17	A	13.16	16.38	19.59	25.92	32.15	38.29	44.33	50.27	56.11	61.85	67.50	73.04	78.49	83.84	89.09	94.25
17	r	5.92	5.90	5.88	5.84	5.79	5.75	5.71	5.67	5.63	5.59	5.55	5.51	5.47	5.43	5.39	5.35
18	A	13.94	17.36	20.76	27.49	34.12	40.64	47.07	53.41	59.64	65.78	71.82	77.75	83.60	89.34	94.98	100.53
18	r	6.28	6.25	6.23	6.19	6.15	6.10	6.06	6.02	5.98	5.94	5.90	5.86	5.82	5.78	5.74	5.70
19	A	14.73	18.35	21.94	29.06	36.08	43.00	49.82	56.55	63.18	69.70	76.13	82.47	88.70	94.84	100.87	106.82
19	r	6.63	6.61	6.59	6.54	6.50	6.46	6.42	6.37	6.33	6.29	6.25	6.21	6.17	6.13	6.09	6.05
20	A	15.51	19.33	23.12	30.63	38.04	45.36	52.57	59.69	66.71	73.63	80.45	87.18	93.81	100.33	106.77	113.10
20	r	6.98	6.96	6.94	6.90	6.85	6.81	6.77	6.73	6.69	6.64	6.60	6.56	6.52	6.48	6.44	6.40

Courtesy Carnegie Steel Co.

EXPANSION OF BODIES BY HEAT

The linear coefficient of expansion of a body is the rate at which the unit of length changes, under constant pressure, with an increase of unit or one degree of temperature; the square surface coefficient of expansion is, approximately, two times, and the cubical or volumetric coefficient three times the linear coefficient of expansion. A bar, if not fixed, undergoes a change in length $=$ltn, where l is the length of the bar in inches, t the number of degrees, n the corresponding linear coefficient; if fixed at both ends, the internal stress per unit of area $=$tnE, pounds per square inch, where E is the modulus of elasticity, and the total temperature stress $=$ AtnE, pounds, where A is the cross section of the bar in square inches.

To find the increase of a bar due to an increase in temperature, from the table, multiply the length of the bar by the increase in degrees and by the coefficient for 100 degrees, and divide by 100.

COEFFICIENTS OF EXPANSION FOR 100 DEGREES $=$100n

Substance	Linear Expansion		Substance	Linear Expansion	
	Centigrade	Fahrenheit		Centigrade	Fahrenheit
Metals and Alloys			**Stone and Masonry**		
Aluminum, wrought...	.00231	.00128	Ashlar masonry.....	.00063	.00035
Brass................	.00188	.00104	Brick masonry.....	.00055	.00031
" wire............	.00193	.00107	Cement, portland...	.00107	.00059
Bronze.............	.00181	.00101	Concrete...........	.00143	.00079
Copper.............	.00168	.00093	" masonry.....	.00120	.00067
German Silver........	.00183	.00102	Granite............	.00084	.00047
Gold................	.00150	.00083	Limestone.........	.00080	.00044
Iron, cast, gray.......	.00106	.00059	Marble............	.00100	.00056
" wrought........	.01120	.00067	Plaster............	.00166	.00092
" wire............	.00124	.00069	Rubble masonry....	.00063	.00035
Lead................	.00286	.00159	Sandstone.........	.00110	.00061
Nickel..............	.00126	.00070	Slate..............	.00104	.00058
Platinum............	.00090	.00050	**Timber**		
Platinum-Iridium,15%					
Ir.................	.00081	.00045	Fir	.00037	.00021
Silver..............	.00192	.00107	Maple ⎱ parallel	.00064	.00036
Steel, cast..........	.00110	.00061	Oak ⎰ to fibre	.00049	.00027
" hard..........	.00132	.00073	Pine	.00054	.00030
" medium........	.00120	.00067	Fir ⎰ perpen-	.0058	.0032
" soft...........	.00110	.00061	Maple ⎰dicular to	.0048	.0027
Tin................	.00210	.00117	Oak ⎰ fiber	.0054	.0030
Zinc, rolled.........	.00311	.00173	Pine	.0034	.0019
Miscellaneous Solids			**Liquid Substances**	**Volumetric**	**Expansion**
Glass...............	.00085	.00047	Alcohol............	.104	.058
Graphite............	.00079	.00044	Acid, nitric........	.110	.061
Gutta-percha........	.05980	.03322	" sulphuric......	.063	.035
Paraffin............	.02785	.01547	Mercury...........	.018	.010
Porcelain...........	.00036	.00020	Oil, turpentine.....	.090	.050

EXPANSION OF WATER, MAXIMUM DENSITY $=$1

C°	Volume	C°	Volume	C°	Volume	C°	Volume	C°	Volume	C°	Volume
4	1.000126	10	1.000257	30	1.004234	50	1.011877	70	1.022384	90	1.035829
0	1.000000	20	1.001732	40	1.007627	60	1.016954	80	1.029003	100	1.043116

Courtesy Carnegie Steel Co.

DECIMAL EQUIVALENTS FOR VULGAR FRACTIONS

The figures in central columns give the decimal parts in inches of the fraction at the left in column marked inches, and decimal parts of one foot for inches and fractions of inches shown in column to the right, marked foot.

Example, 1/8 inches = .1250 inches.   1 1/2 inches = .1250 feet.

Inches	Decimal	Foot	Inches	Decimal	Foot	Inches	Decimal	Foot	Inches	Decimal	Foot
	.0052	1/16		.2552	3 1/16		.5052	6 1/16		.7552	9 1/16
	.0104	1/8		.2604	3 1/8		.5104	6 1/8		.7604	9 1/8
1/64	.015625	3/16	17/64	.265625	3 3/16	33/64	.515625	6 3/16	49/64	.765625	9 3/16
	.0208	1/4		.2708	3 1/4		.5208	6 1/4		.7708	9 1/4
	.0260	5/16		.2760	3 5/16		.5260	6 5/16		.7760	9 5/16
1/32	.03125	3/8	9/32	.28125	3 3/8	17/32	.53125	6 3/8	25/32	.78125	9 3/8
	.0364	7/16		.2865	3 7/16		.5364	6 7/16		.7865	9 7/16
	.0417	1/2		.2917	3 1/2		.5417	6 1/2		.7917	9 1/2
3/64	.046875	9/16	19/64	.296875	3 9/16	35/64	.546875	6 9/16	51/64	.796875	9 9/16
	.0521	5/8		.3021	3 5/8		.5521	6 5/8		.8021	9 5/8
	.0573	11/16		.3073	3 11/16		.5573	6 11/16		.8073	9 11/16
1/16	.0625	3/4	5/16	.3125	3 3/4	9/16	.5625	6 3/4	13/16	.8125	9 3/4
	.0677	13/16		.3177	3 13/16		.5677	6 13/16		.8177	9 13/16
	.0729	7/8		.3229	3 7/8		.5729	6 7/8		.8229	9 7/8
5/64	.078125	15/16	21/64	.328125	3 15/16	37/64	.578125	6 15/16	53/64	.828125	9 15/16
	.0833	1		.3333	4		.5833	7		.8333	10
	.0885	1 1/16		.3385	4 1/16		.5885	7 1/16		.8385	10 1/16
3/32	.09375	1 1/8	11/32	.34375	4 1/8	19/32	.59375	7 1/8	27/32	.84375	10 1/8
	.0990	1 3/16		.3490	4 3/16		.5990	7 3/16		.8490	10 3/16
	.1042	1 1/4		.3542	4 1/4		.6042	7 1/4		.8542	10 1/4
7/64	.109375	1 5/16	23/64	.359375	4 5/16	39/64	.609375	7 5/16	55/64	.859375	10 5/16
	.1146	1 3/8		.3646	4 3/8		.6146	7 3/8		.8646	10 3/8
	.1198	1 7/16		.3698	4 7/16		.6198	7 7/16		.8698	10 7/16
1/8	.1250	1 1/2	3/8	.3750	4 1/2	5/8	.6250	7 1/2	7/8	.8750	10 1/2
	.1302	1 9/16		.3802	4 9/16		.6302	7 9/16		.8802	10 9/16
	.1354	1 5/8		.3854	4 5/8		.6354	7 5/8		.8854	10 5/8
9/64	.140625	1 11/16	25/64	.390625	4 11/16	41/64	.640625	7 11/16	57/64	.890625	10 11/16
	.1458	1 3/4		.3958	4 3/4		.6458	7 3/4		.8958	10 3/4
	.1510	1 13/16		.4010	4 13/16		.6510	7 13/16		.9010	10 13/16
5/32	.15625	1 7/8	13/32	.40625	4 7/8	21/32	.65625	7 7/8	29/32	.90625	10 7/8
	.1615	1 15/16		.4114	4 15/16		.6615	7 15/16		.9115	10 15/16
	.1667	2		.4167	5		.6667	8		.9167	11
11/64	.171875	2 1/16	27/64	.421875	5 1/16	43/64	.671875	8 1/16	59/64	.921875	11 1/16
	.1771	2 1/8		.4271	5 1/8		.6771	8 1/8		.9271	11 1/8
	.1823	2 3/16		.4323	5 3/16		.6823	8 3/16		.9323	11 3/16
3/16	.1875	2 1/4	7/16	.4375	5 1/4	11/16	.6875	8 1/4	15/16	.9375	11 1/4
	.1927	2 5/16		.4427	5 5/16		.6927	8 5/16		.9427	11 5/16
	.1979	2 3/8		.4479	5 3/8		.6979	8 3/8		.9479	11 3/8
13/64	.203125	2 7/16	29/64	.453125	5 7/16	45/64	.703125	8 7/16	61/64	.953125	11 7/16
	.2083	2 1/2		.4583	5 1/2		.7083	8 1/2		.9583	11 1/2
	.2135	2 9/16		.4635	5 9/16		.7135	8 9/16		.9635	11 9/16
7/32	.21875	2 5/8	15/32	.46875	5 5/8	23/32	.71875	8 5/8	31/32	.96875	11 5/8
	.2240	2 11/16		.4740	5 11/16		.7240	8 11/16		.9740	11 11/16
	.2292	2 3/4		.4792	5 3/4		.7292	8 3/4		.9792	11 3/4
15/64	.234375	2 13/16	31/64	.484375	5 13/16	47/64	.734375	8 13/16	63/64	.984375	11 13/16
	.2395	2 7/8		.4896	5 7/8		.7396	8 7/8		.9896	11 7/8
	.2448	2 15/16		.4948	5 15/16		.7448	8 15/16		.9948	11 15/16
1/4	.25000	3	1/2	.5000	6	3/4	.7500	9	1	1.0000	12
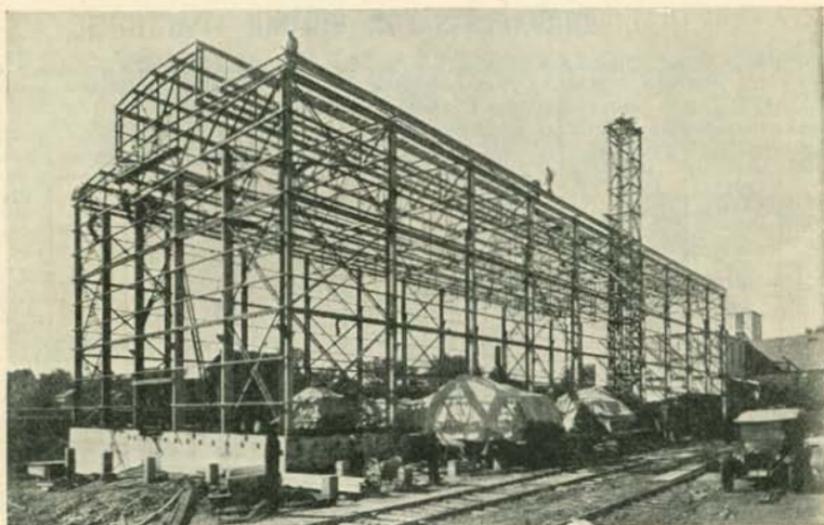
WAREHOUSE, SEEGER REFRIGERATOR CO., ST. PAUL, MINN.
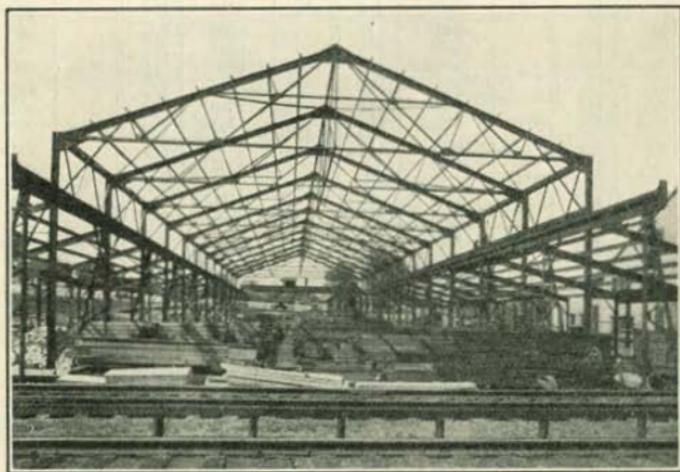
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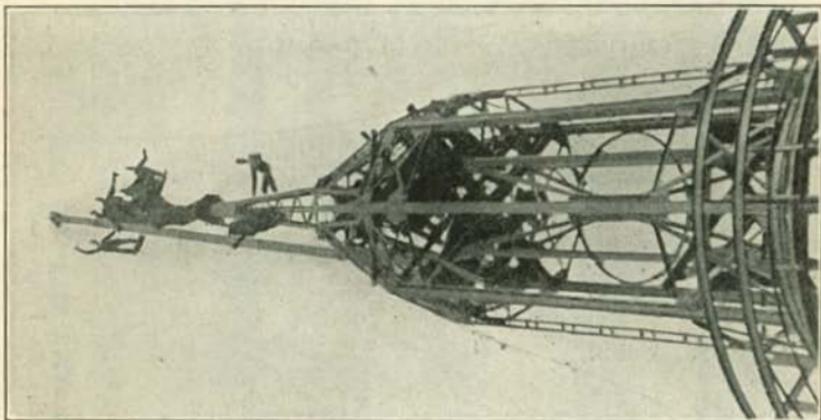
CATHEDRAL LANTERN FRAMING

CATHEDRAL DOME FRAMING

Structural Steel and Ornamental Iron Furnished by the St. Paul Foundry Company
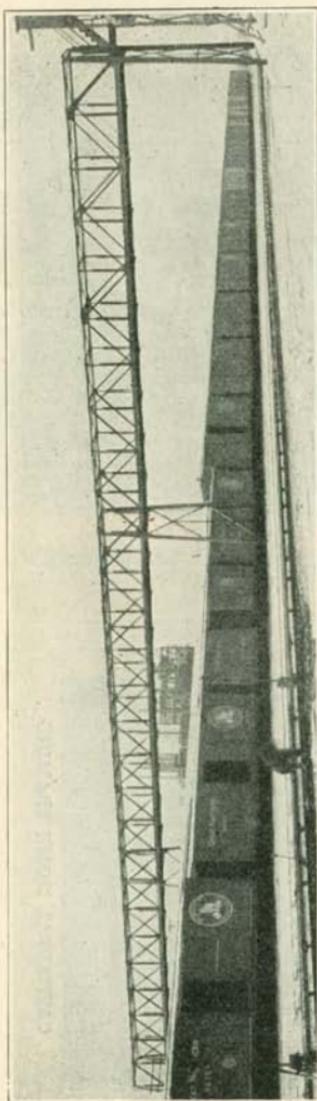
THREE EIGHTY FOOT SPANS. GRAVEL, CONVEYOR BRIDGE FOR
J. L. SHIELY COMPANY, ST. PAUL.
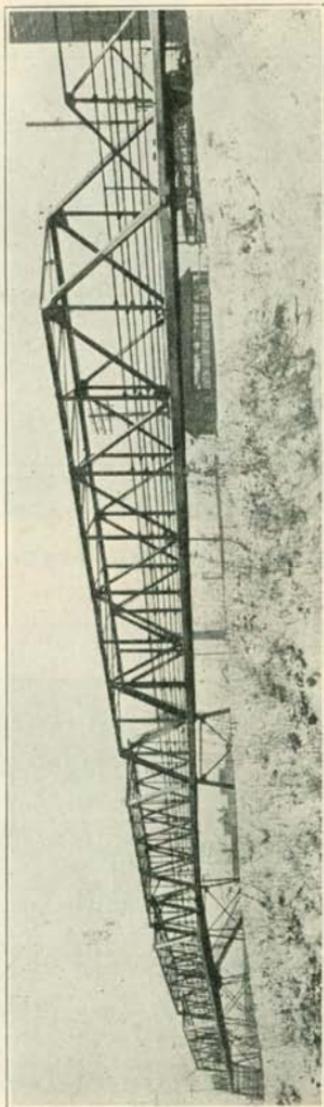
FOOT BRIDGE OVER RAILROAD TRACKS, ST. PAUL.

These structures fabricated and erected by the St. Paul Foundry Co.
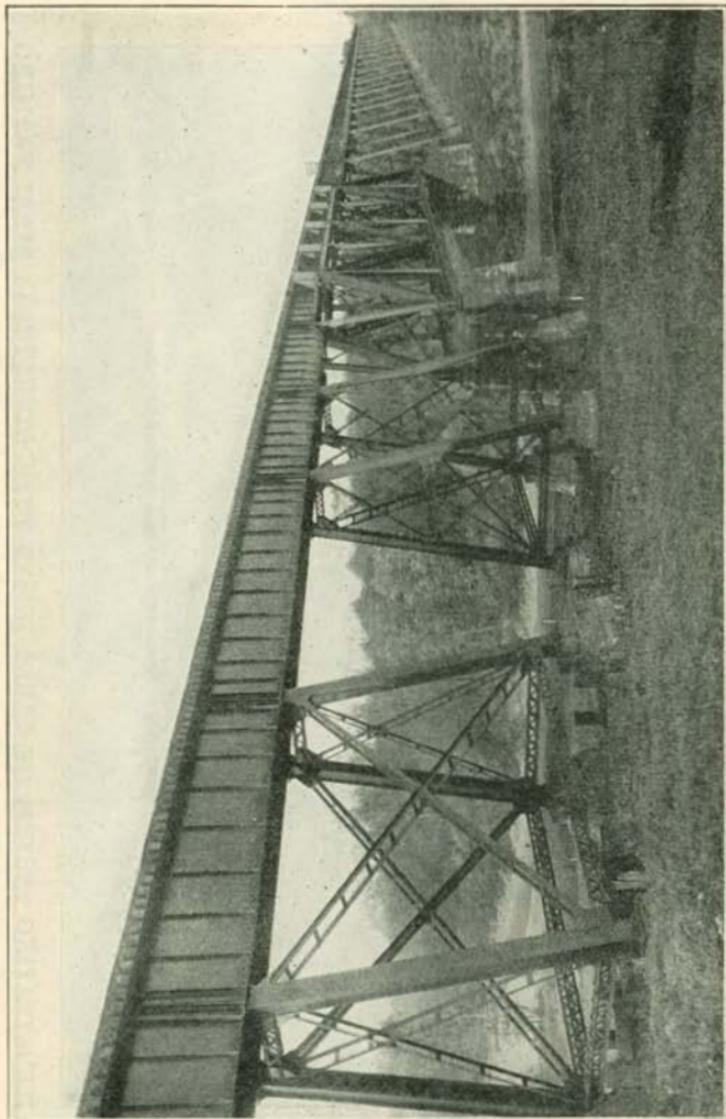
R. R. BRIDGE FOR G. N. RY.

2,000 Tons Fabricated by the St. Paul Foundry Company
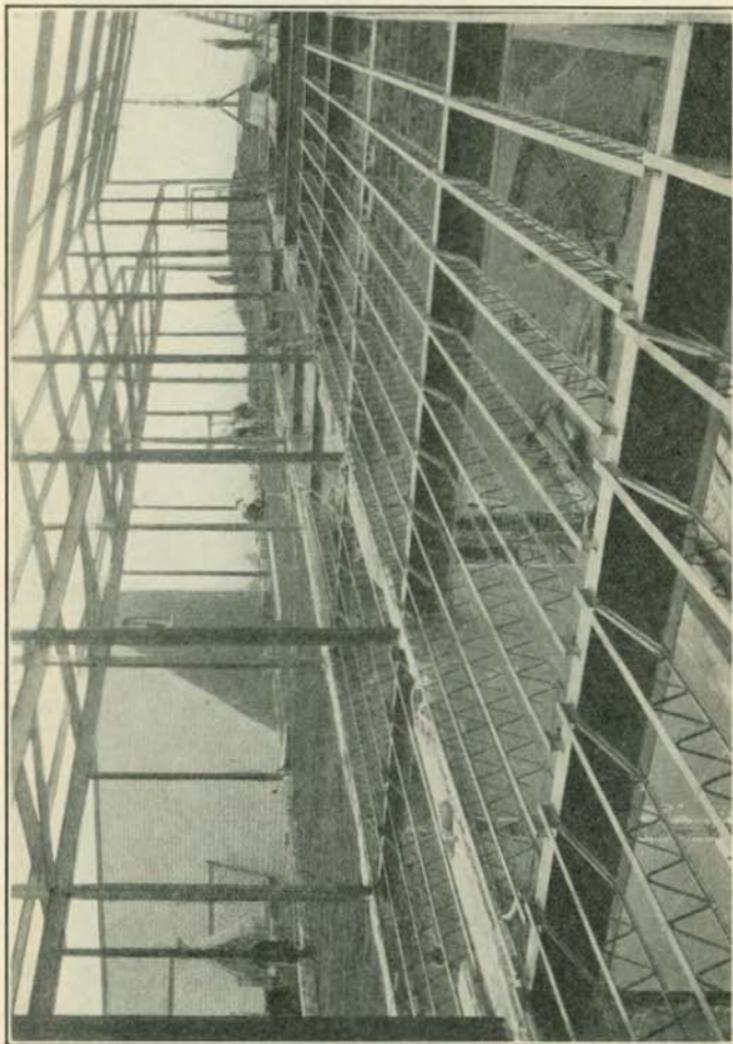
ILLUSTRATING SYSTEM OF TRUSS JOISTS WITH STRUCTURAL STEEL FRAMING
Structural Steel by St. Paul Foundry Co. Joists by Truscon Steel Co.

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TRAFFIC FACILITIES

Trucks—Our fleet of motor trucks ranging from one to ten tons in capacity assure quick deliveries over a radius of 100 miles.

Freight—We are adjacent to the main line of the Great Northern giving us daily, direct connections with the eight principal railroads of the Northwest. Shipments are made on day of loading.

Cranes—A twenty car track capacity is served by four twenty ton, electrically operated traveling cranes giving us splendid loading and unloading facilities.

MEMORANDUM