Bethlehem Steel Company
Structural Steel
1907

DIMENSIONS, WEIGHTS AND PROPERTIES

OF

SPECIAL AND STANDARD

STRUCTURAL STEEL SHAPES

MANUFACTURED BY

BETHLEHEM STEEL COMPANY,

SOUTH BETHLEHEM, PA.

Including tables of strengths and other data relating to Bethlehem Special Structural Shapes, or wide flange beams, and their use as beams, girders and columns; also similar data relating to American Standard I Beams, Channels, Angles and other sections; together with general information regarding steel construction,

FOR ENGINEERS, ARCHITECTS AND DRAFTSMEN.

PREPARED BY

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MEM. AM. SOC. C. E.

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PRINTING AND PUBLISHING CO.,

PHILADELPHIA, PA.

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Works at South Bethlehem, Pa.,

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INTRODUCTION.

The purpose of this work, in general, is to supply information and tables, relating to steel construction, of value and service to those interested and engaged in the use of Bethlehem structural steel shapes ; and, in particular, to illustrate the advantages and economy of the special structural steel shapes introduced and manufactured by Bethlehem Steel Company.

The work is divided into three parts.

Part I gives the dimensions, weights and structural properties of the Bethlehem special shapes, or wide flange beam sections, with tables of strength and other data relating to their use as beams, girders and columns in construction.

Part II gives similar information and data pertaining to the standard structural steel shapes manufactured by Bethlehem Steel Company.

Part III gives information and data concerning steel construction in general, together with a collection of useful tables, rules, etc., for the engineer, architect and draftsman engaged in structural work.

The essential data relating to all the special and standard structural steel shapes manufactured by Bethlehem Steel Company is given in Parts I and II. General information applying to both special and standard shapes is given in Part III, as well as much other data that pertains to structural materials not manufactured by Bethlehem Steel Company. The latter data has been selected as a collection of matter of the most frequent use and service to those engaged in structural work.

Special care has been exercised in the arrangement of the tabular matter to secure compactness of form and convenience for the use of the designer.

Such of the tables as were not calculated expressly for this work were obtained from works of presumably independent origin, which were compared for the elimination of errors.

PART I

SPECIAL

STRUCTURAL STEEL SHAPES

MANUFACTURED BY

BETHLEHEM STEEL COMPANY

BETHLEHEM

SPECIAL STRUCTURAL SHAPES.

The Bethlehem special structural shapes are wide flange I beam sections rolled by the Grey Universal Beam Mill. Instead of the horizontal grooved rolls of the ordinary beam mill, the Grey mill has horizontal and vertical rolls, by which the flanges and web of an I beam shape are each produced by combined rolling operations acting at right angles. This method of rolling makes it possible to obtain wider flanges than can be produced by the ordinary beam mill, where the web is the only part of the shape subjected to a true rolling operation and where the flanges are formed by the crowding or dragging of the metal through the flange grooves.

Wide flange beams from 10 inches to 30 inches deep, with flanges from 10 inches to 12 inches wide, have been rolled successfully for the past five years in Germany by this method. Such sections in regard to their shape and properties of strength present great advantages for structural work not obtainable with beams of the existing standard shapes. The wide flange beams can be used instead of riveted or built up sections for a variety of purposes with an economy in the weight of material, or with a saving in the labor and cost of punching, assembling and riveting, and in many cases with a saving of both material and labor.

Sections produced by this improved method have a uniform amount of work, or reduction, in the rolling on all parts of the shape, which is not the case in beams of I shape rolled by the ordinary mill. Especially the larger sizes of I beams rolled by the usual method show a great variation between the quality of the material in the webs and flanges, due to the difference in work of reduction of the metal during rolling. Such differences in quality of material between various parts of the section indicate a condition of internal stress existing in the metal caused by unequal deformation during the rolling process. Beams of all shapes and sizes rolled by the Grey mill have a uniformity in strength of material throughout the section, indicating not only an equal amount of work of reduction in the rolling without unequal deformation, but also the absence of internal stress in consequence: they are therefore safer and more reliable for any purpose, especially when subject to impact and vibration, than beams rolled in the old way.

In the case of an I beam shape, it follows from the principles of structural mechanics that an addition of material to the flange increases the transverse strength of the section three times as much as the same amount of additional material would if added in the form of increased thickness of web. Thus, if *a* represents a small area and *d* the depth of the beam, the addition of the area *a*, in the form of an increased thickness of the web, produces an increase in the section modulus of the shape equal to $\frac{1}{6}\,ad$; but if the same area is added, one-half at the extreme edge of each flange, then $\frac{1}{2}\,ad$ is the amount that the section modulus of the shape is increased. The latter value is three times the former. Metal in the flange is therefore three times more effective than in the web when the moment of inertia, moment of resistance or coefficient of transverse strength of an I beam shape is considered.

By means of the Grey mill and the improved method of rolling, in which the flanges and web are each formed by rolling operations, a more economical distribution of metal can be made between relative areas of flange and web than in the present standard beam shape produced by the old rolling methods. Wide flange beams can be rolled which will have the same coefficient of strength as present American standard beams of the same depth, but which will weigh less than the equivalent standard beams; this result being obtained by making the flange wider and of greater sectional area relative to the area of the web. Conversely, wide flange beams designed in this manner, when of the same weight as present standard sections, will have a greater coefficient of strength than the corresponding standard shape of equal depth and weight.

By this method a beam with wide flanges can be designed and readily rolled having the same depth as a standard beam and which will have double the coefficient of strength of the standard shape, but with a weight less than twice the weight of the latter. Such a wide flange girder beam can be substituted for the ordinary girder of the same depth, composed of two present standard beams, with considerable economy in weight of material and a saving in the expense of assembling, also eliminating the separators and separator bolts. Larger beams are produced by this process than it is possible to roll by the ordinary method. Such large rolled beams can be used to great advantage in many cases where it otherwise would be necessary to employ riveted girders.

Beam shapes with wide flanges make a desirable and economical column section. Riveted sections of I beam shape, made with a web plate and four angles, are a common form of column for buildings and other purposes. The wide flange beam offers a rolled section with greater radius of gyration for equal area, and with a saving in the fabrication of the column, as no punching or riveting is required in the case of the rolled section except for splicing and connections. When the flanges of the rolled beam section are made of adequate width to give sufficient radius of gyration, the wide flange beam shape can be used with great economy for all usual purposes of construction instead of any of the customary forms of built up riveted columns.

The Bethlehem special shapes are designed to fill the requirements of American structural practice. Three separate types of shapes are provided, viz.: the special I beam sections, the girder beam sections, and the H or column sections.

SPECIAL I BEAMS.

The special I beams, from 8 inches to 24 inches in depth inclusive, have the same section modulus, or coefficient of strength, as American standard beams of corresponding depth; but by reason of the better proportion and distribution of metal their weight is 10% less than the American sections. For example, a Bethlehem special I beam, section B15 a, 15 in. deep and weighing 54 lbs. per foot has a coefficient of strength of 868,100. The corresponding American standard section is a 15 in. I beam weighing 60 lbs. per foot with a coefficient of strength of 866,100; so that for equal strength the Bethlehem beam weighs 6 lbs. per foot less than the American shape, which is a saving of 10% in weight. The coefficient of strength for this depth of beam is increased 7850 for each pound increase in weight; therefore, if the Bethlehem beam is increased to 60 lbs. per foot—the same weight as the American section—then its coefficient will be increased to 915,200, which is nearly 6% greater than that of the standard beam for equal weight.

For equal coefficients of strength the Bethlehem special I beams of minimum section are 10 per cent. lighter than corresponding standard sections. Conversely, for equal weights of sections, the Bethlehem beams have a coefficient of strength about 5% greater than standard shapes.

The 26, 28 and 30 inch special I beams are respectively equal in coefficient of strength to girders of two 20 inch 65 lbs., 20 inch 80 lbs. and 24 inch 80 lbs. standard beams, and where the depth is available may be used instead of such girders, except in the case of very short spans with heavy loads, and with a considerable economy of material. They can also be used where otherwise riveted girders would be required, with economy of material and saving in work. The table of "Comparison of Bethlehem Special I Beams with American Standard I Beams," on page 59, shows the relation between the two types of beams for all sizes.

GIRDER BEAMS.

The Bethlehem girder beams, from 8 inches to 24 inches in depth inclusive, have a coefficient of strength, or section modulus, equal to that of two standard I beams of minimum weight of the same depth; but the girder beam weighs 12½% less than the combined weight of the two standard sections, not considering the saving in the weight of separators that would be used for assembling the standard beams into a girder. For example, a Bethlehem girder beam, section G15, 15 inches in depth and weighing 73 lbs. per foot, has a coefficient of strength of 1,260,900. Two standard 15 inch I beams, each weighing 42 lbs. per foot, have a combined coefficient of strength of 1,256,600. Thus, for equal depth and coefficient of strength, the girder beam weighs 11 lbs. per foot less than the two standard beams, or a saving in weight of 13%, not taking into account the separators required for the latter which, if spaced the usual distance of 6 ft. apart, would add 2½ lbs. per foot to the weight of the assembled girder, thereby making a total saving of 16% in weight effected by the Bethlehem girder beam, beside the saving in the cost of handling and assembling the ordinary standard beams into a girder. The table of "Comparison of Bethlehem Girder Beams with Girders of American Standard Beams," on page 58, shows the relation existing between the two types of beams for all sizes up to 24 inches in depth.

The 26 inch, 28 inch and 30 inch girder beams may be used where the depth is available instead of the ordinary box girders made of two standard I beams with cover plates, except for relatively short spans, with marked economy in weight and saving in cost of punching, assembling and riveting necessary to build the compound section and which are not required for the rolled shape. These large rolled girder beams also can be used to great advantage as girders for crane runways, girders for bridges and for many other purposes where otherwise riveted girders would be required, with a saving in weight or in cost of fabrication, and often with a saving in both items.

The tables on pages 58 and 59 furnish a key for the comparison of Bethlehem I beams and girder beams with American standard beams. A framing plan already laid out for standard beam shapes may be revised with great ease for the substitution of Bethlehem beam sections. In general no rearrangement of the plan will be found necessary and no recalculation will be required except to select the proper Bethlehem I beams or girder beams that are the equivalent in strength of the standard beams or girders.

The wide flanges give an increased lateral stiffness to the construction, which is an advantage gained by the use of these beams and will commend them in many cases where the narrow flanges and lack of sufficient side stiffness prevent the use of the ordinary standard beams.

In the case of heavy concentrated loads or short spans with full loads, the web may become the controlling factor in the strength of the beam. The safe loads on the webs are given in the tables, and were calculated by the accepted formula in general use for that purpose. Experiments made expressly for the purpose of testing the reliability of this formula show that it gives a safe load on the web, which has an even greater margin of safety against crippling of the web than the beam itself has against transverse failure by bending. Wherever thicker webs are required, the sections can be increased to secure the desired web thickness, and the beams will then have greater transverse strength, or section modulus, than the corresponding standard beams of equal depth and weight.

ROLLED H COLUMNS.

The special I beam and girder beam sections can be used as columns, in many cases, for mill buildings and other purposes with economy in weight or labor, or both. The rolled H, or column sections, however, are designed specially to meet the requirements of column purposes for buildings and other construction.

It is to be noted that all column shapes having the same section number are rolled from the same main rolls without change. For instance, the 12″ H columns, comprising all the weights and variations in size of sections H12s, H12, H12a and H12b, on page 64, are from the same main rolls, furnishing a series of rolled columns of similar shape from an area of 11.76 square inches, increasing by successive increments to an area of 79.06 square inches without change of rolls. The columns for a 12 to 15 story building thus can be selected having the proper areas to suit the variations of load, and by using shapes of the same section number throughout the columns for the entire building can be made at the same rolling without a roll change, thereby securing a promptness of delivery from the mill unobtainable by any other type or system of steel column construction. As these columns are rolled sections, the only fabrication required is to provide for splices and for connections. The sections can be spliced to make a practically continuous column from basement to roof, and connections are made easily to them in the most approved manner of the best modern practice in construction.

The difference in cost of fabrication of the rolled steel column, as compared with a built up riveted column, is a great advantage in favor of the rolled section. The shop work on a two story length of rolled H column with details of the type shown by fig. 1, page 46, requires drilling or punching only 91 holes and driving only 13 shop rivets. The same column with details of the type shown by fig. 2, on the same page, requires drilling or punching 100 holes and driving 59 shop rivets. Compared with these, an equal column of channels and plates requires the handling of four shapes, punching 520 holes and driving 240 shop rivets to build it into an assembled shape. Facing the ends square, and to exact length, is an operation common to both kinds of columns.

In the case of the rolled column with thick metal, the holes require to be drilled. As the only holes needed are for the splices and connections, which are generally arranged in groups having similar spacing, the work is performed economically with a gang or multiple drill to make all the holes of a group at a single operation. Even in ordinary punched work, good workmanship requires that the holes for splices and connections after punching shall be reamed to templet or with parts assembled in order to secure proper fitting between connecting parts. This is accomplished in the one operation when these holes are drilled from the solid. In general, from one-half to two-thirds the shop cost of fabrication of built up riveted columns can be saved by the use of the rolled steel H column.

Ingots of large size are used in the manufacture of these sections, so that the work of reduction in rolling out the shapes, especially the larger ones, shall be sufficient to develop the proper ductility of the metal. The material is exclusively medium open hearth steel conforming in quality to the requirements of the standard specifications of the Association of American Steel Manufacturers. Open hearth steel complying with any other standard specification may be furnished by special arrangement.

These special sections form a system of construction which greatly extends the range of application of rolled shapes to steel construction with a simplification of detail and an improvement in design. Their saving in weight of material, and their decreased cost of fabrication, handling and erection, will be found to effect a material reduction in the cost of steel framing construction.

EXPLANATORY NOTES
ON SPECIAL STRUCTURAL SHAPES.

Bethlehem special structural shapes are exclusively of open hearth steel.

All weights are given in pounds per lineal foot of the section. In computing the areas and weights of the sections, the fillets have been disregarded in all cases.

The flanges of the special I beams and girder beams have a uniform slope of 12½ per cent. equivalent to 1½ inches per foot. The flanges of the H column sections have a uniform slope of 2 per cent.

Owing to the method of rolling these sections, the flanges have practically square corners, as shown in the cuts of the shapes.

The cuts of the various shapes show the dimensions of the minimum size. The method of increasing the sectional area is shown on the opposite page.

The special I beams and girder beams are increased, as shown in Fig. 1, by spreading the main rolls, which adds an equal amount to the thickness of the web and to the width of the flanges, all other dimensions remaining unchanged.

The H column sections are increased, as shown in Fig. 2, by spreading both the horizontal and vertical rolls; the thickness of the web and the width of the flanges are increased equally, and the thickness of the flange is increased at the same time a proportionate amount.

The different weights tabulated for the special I beams provide a sufficient variation for ordinary purposes. Only the minimum weights are tabulated for the girder beams. Intermediate or increased weights, corresponding to the usual variations of American standard beams, may be furnished by special arrangement. The H column sections are rolled only to the variations of weight given in the tables.

The sections are numbered in the cuts and throughout the tables for convenience in identification and ordering.

Unless otherwise ordered, all shapes will be cut to length with an extreme variation not exceeding ¾ of an inch. For cutting with a less variation, or to exact length, an extra price will be charged.

Sections are furnished only at catalogued weight. Shapes may have an allowable variation of 2½ per cent. either way from the nominal section.

METHOD OF INCREASING SECTIONAL AREAS.

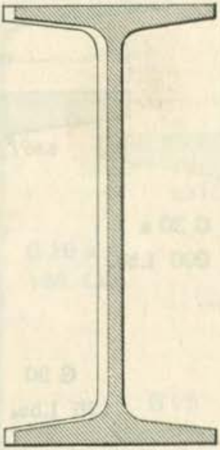


FIG. 1

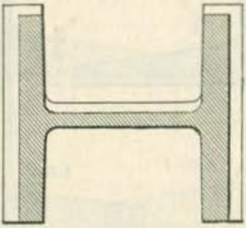
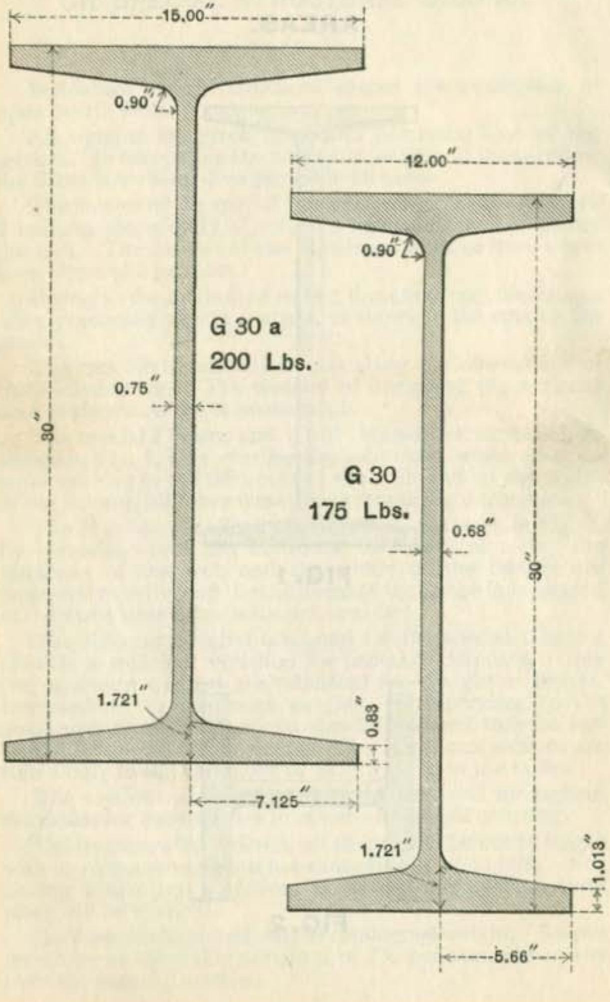


FIG. 2

BETHLEHEM GIRDER BEAMS.



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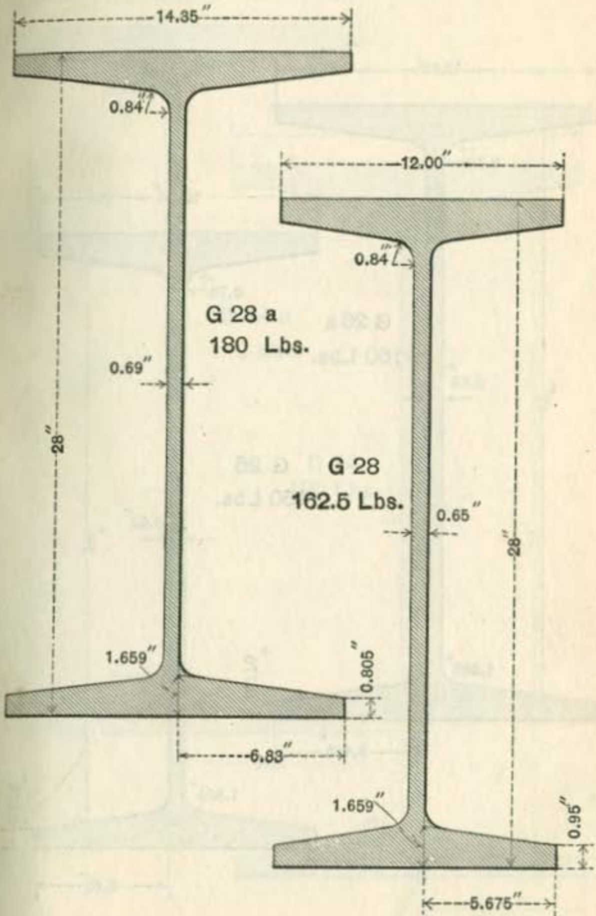

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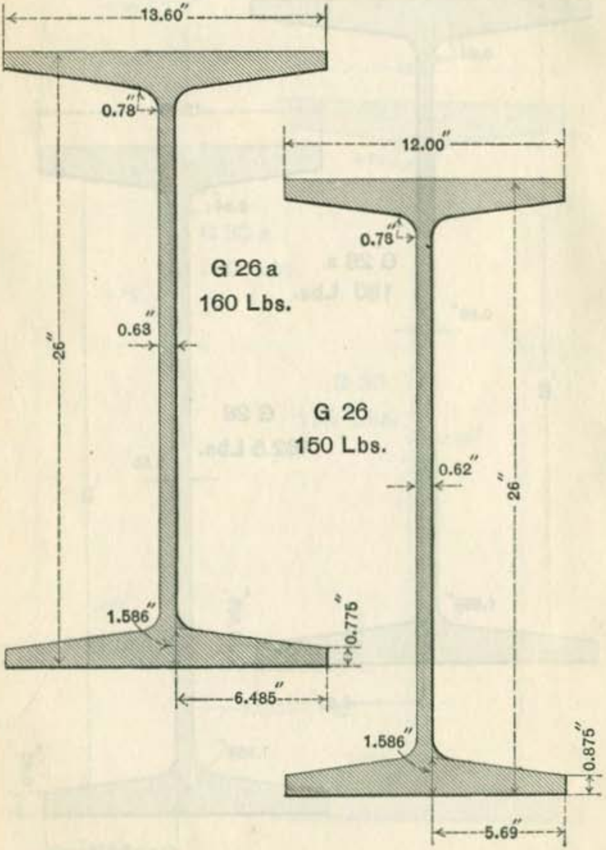

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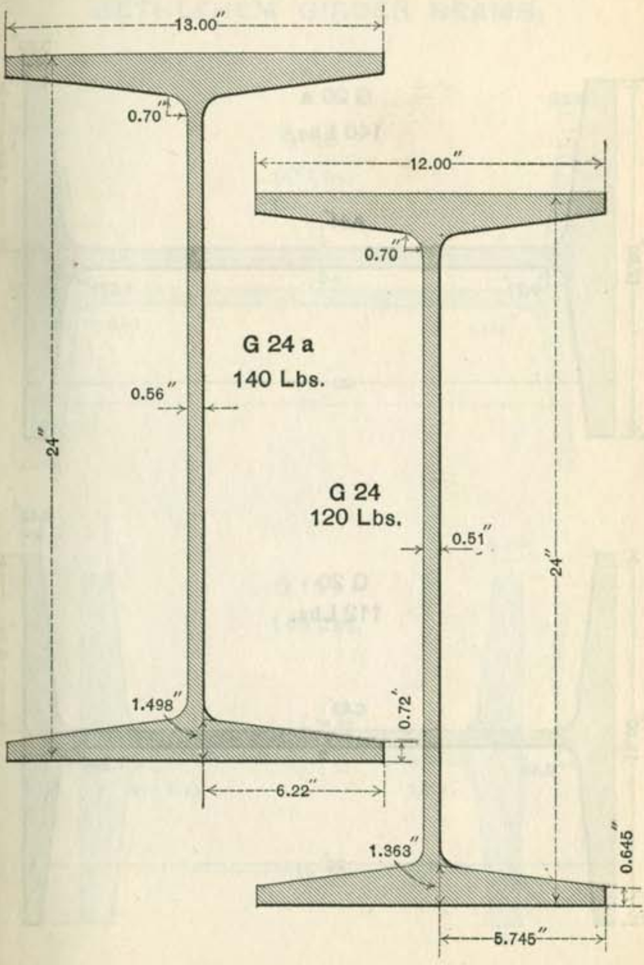

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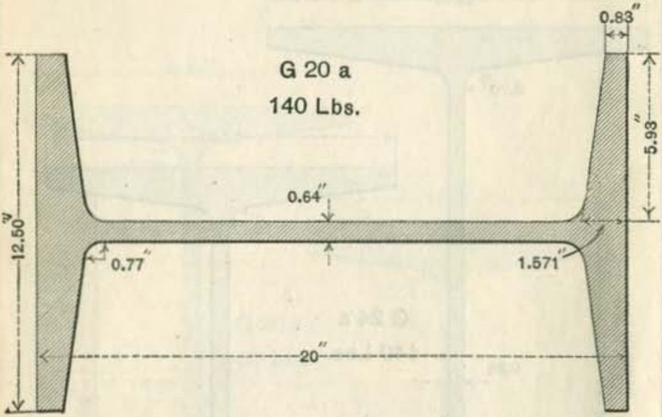

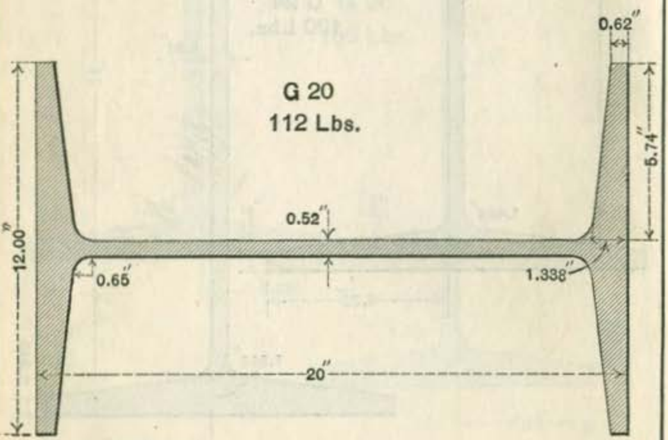

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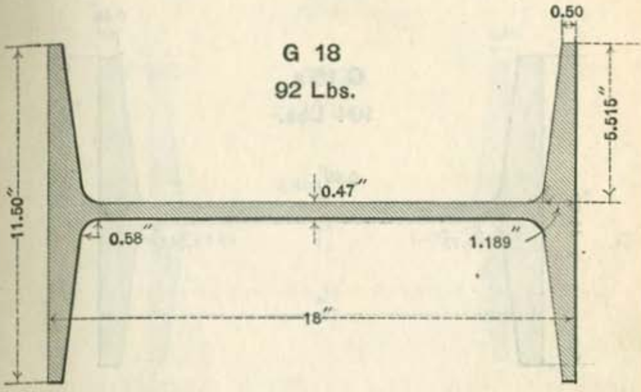

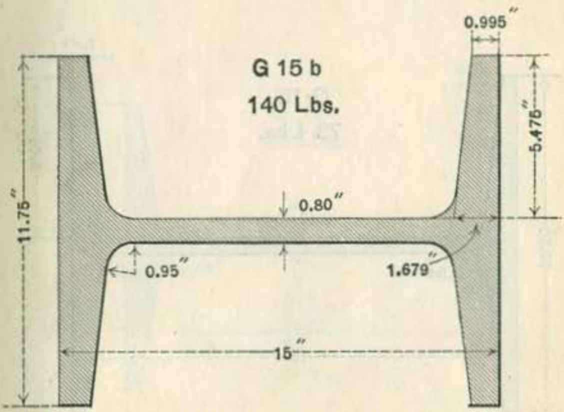

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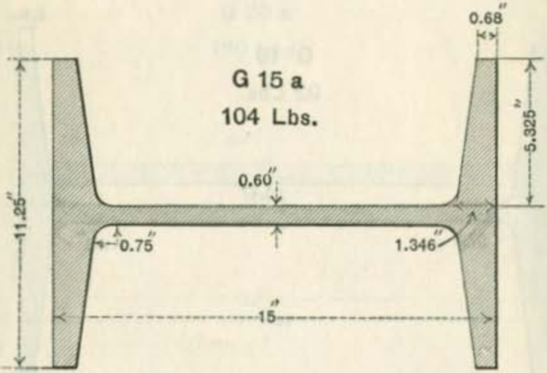

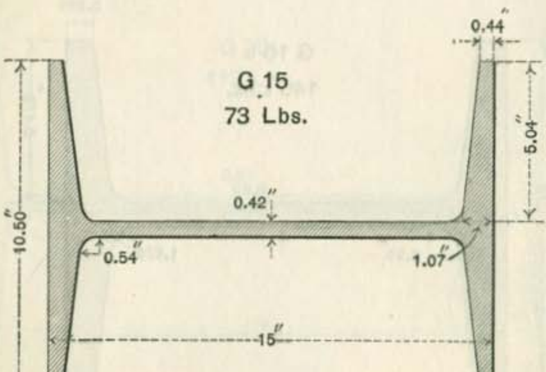

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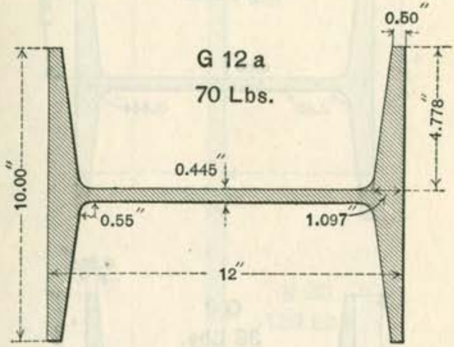

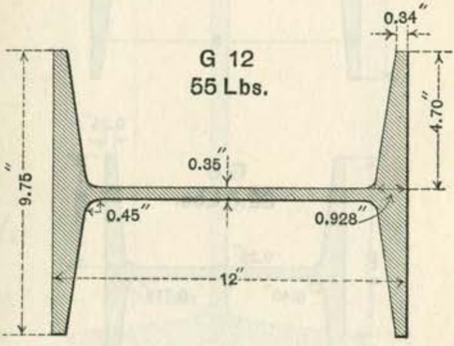

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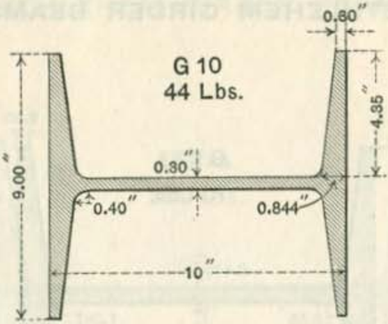

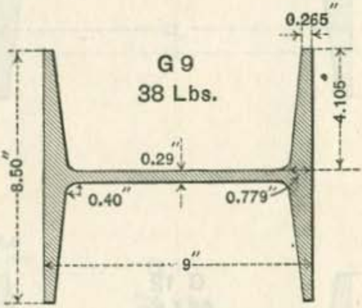

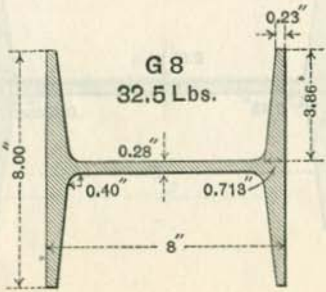

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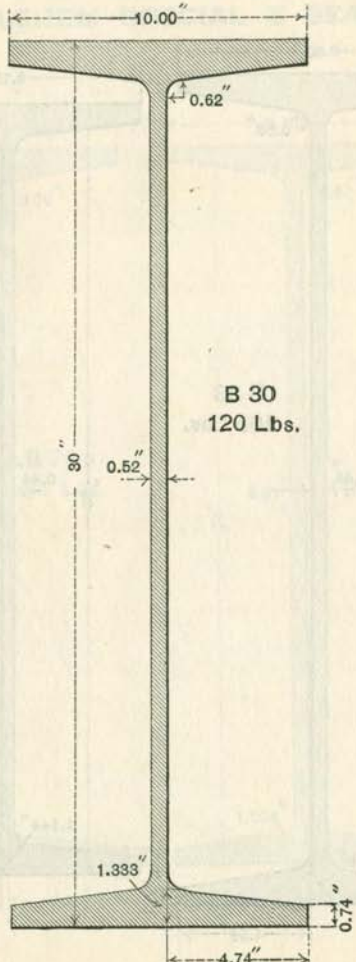

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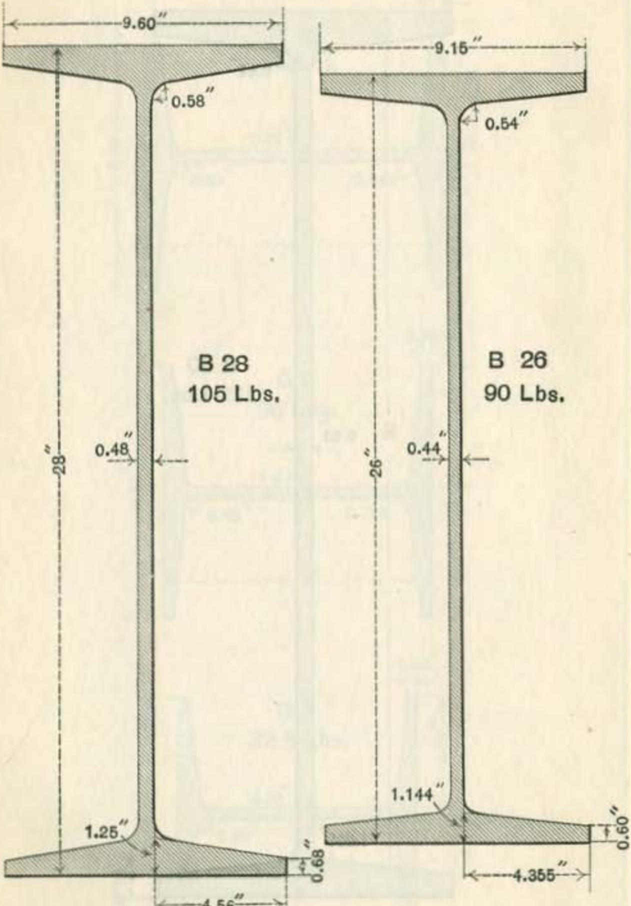

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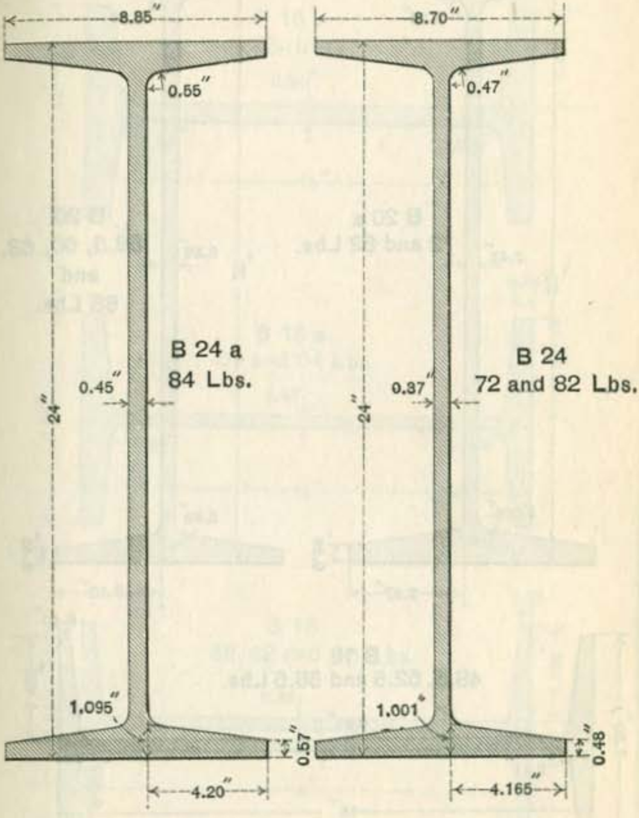

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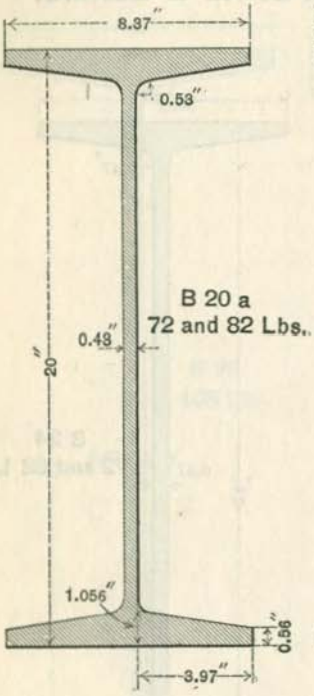

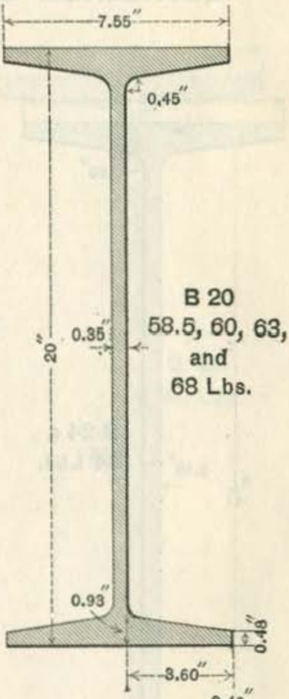

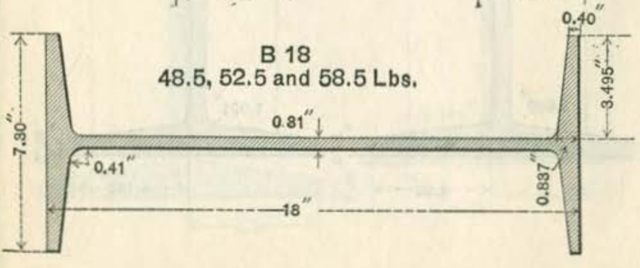

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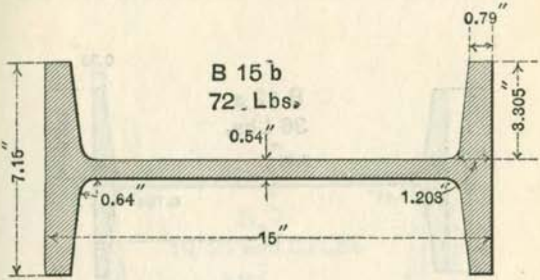

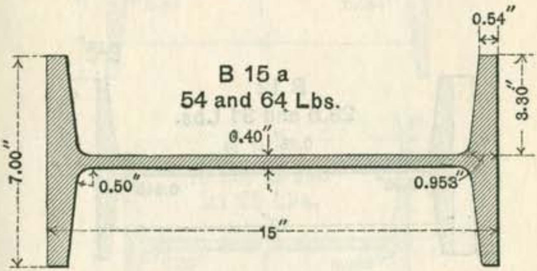

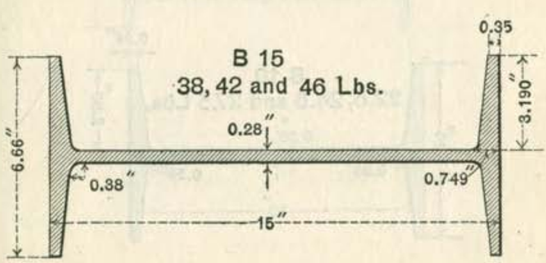

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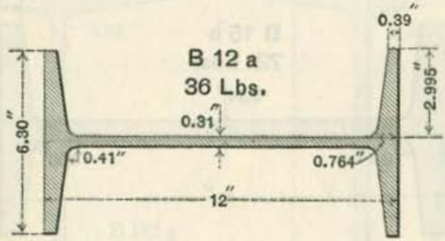

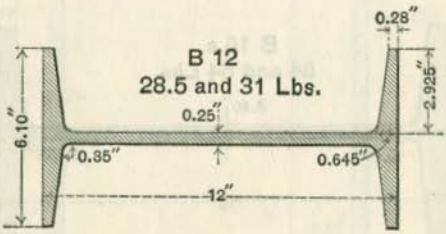

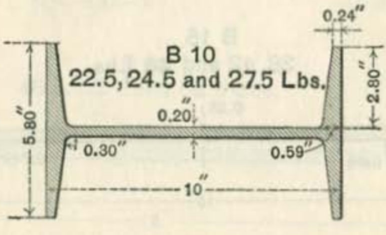

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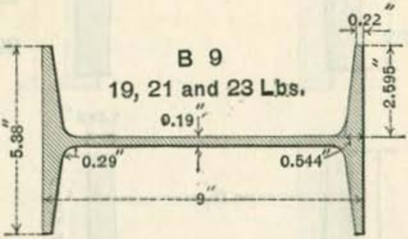
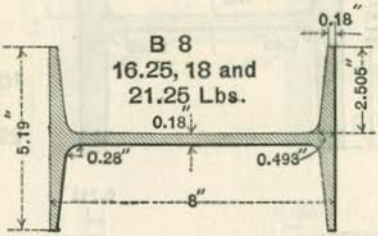
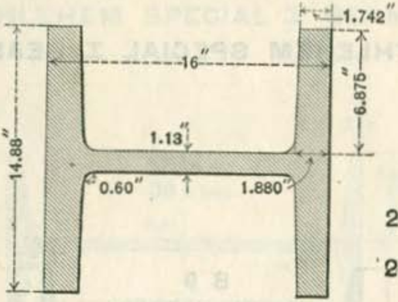




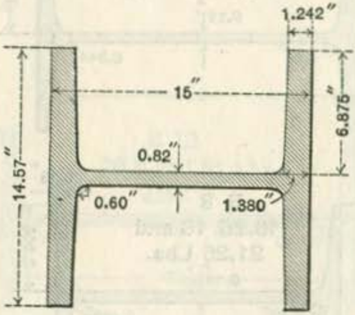
BETHLEHEM ROLLED H COLUMNS.

H 14 b



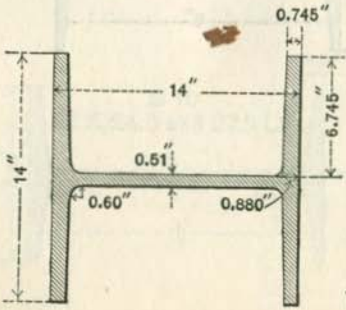
230.8 Lbs.
to
291.2 Lbs.

H 14 a



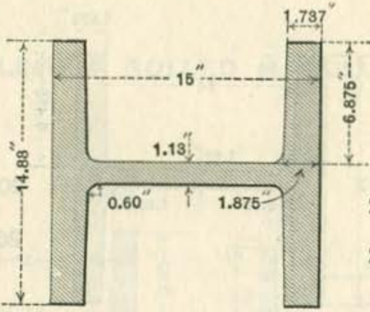
164.4 Lbs.
to
222.3 Lbs.

H 14



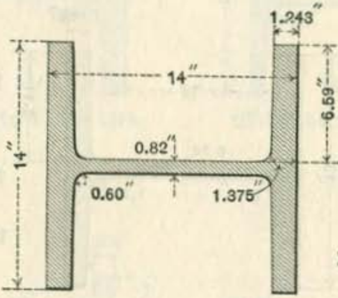
98.8 Lbs.
to
162.2 Lbs.

BETHLEHEM ROLLED H COLUMNS.



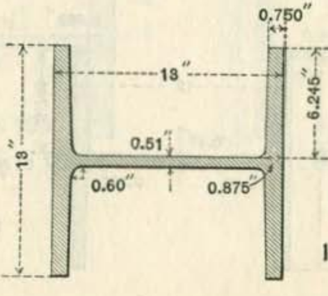
H 13 b

226. 5 Lbs. to 285.9 Lbs.



H 13 a

156.4 Lbs. to 219.8 Lbs.

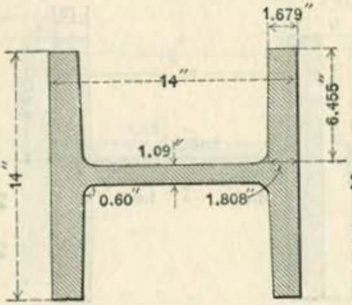


H 13

91.5 Lbs. to 150.5 Lbs.

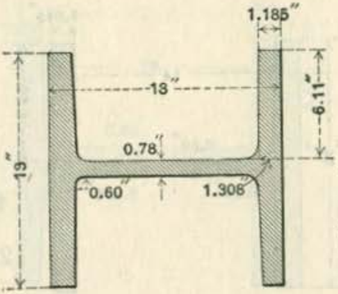
BETHLEHEM ROLLED H COLUMNS.

H 12 b



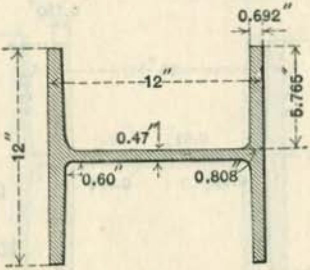
204.9 Lbs.
to
268.8 Lbs.

H 12 a



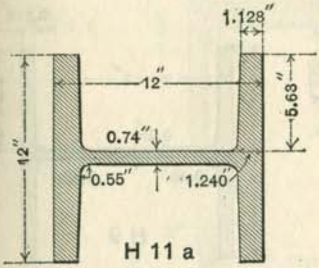
138.1 Lbs.
to
197.1 Lbs.

H 12

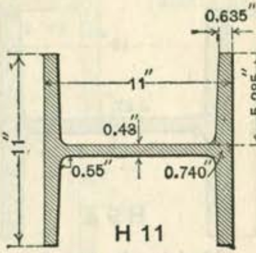


78.0 Lbs.
to
132.5 Lbs.

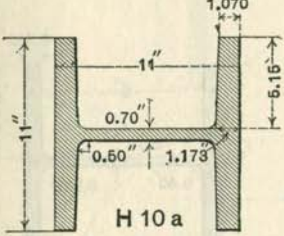
BETHLEHEM ROLLED H COLUMNS.



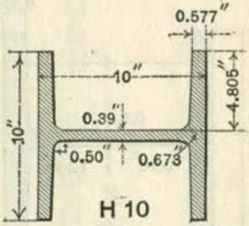
120.9 Lbs. to 175.8 Lbs.



65.5 Lbs. to 115.5 Lbs.

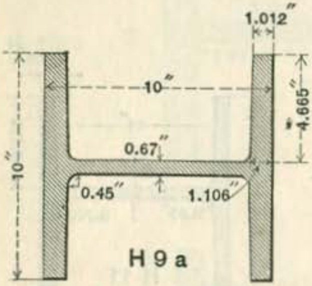


104.7 Lbs. to 155.2 Lbs.

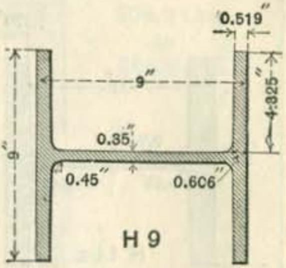


54.1 Lbs. to 99.7 Lbs.

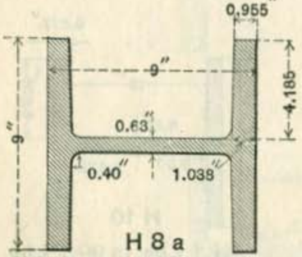
BETHLEHEM ROLLED H COLUMNS.



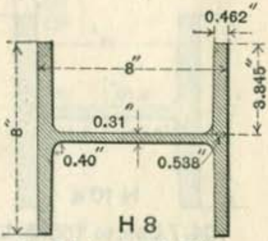
90 Lbs. to 135.6 Lbs.



43.8 Lbs. to 85.3 Lbs



76 Lbs. to 117.1 Lbs.

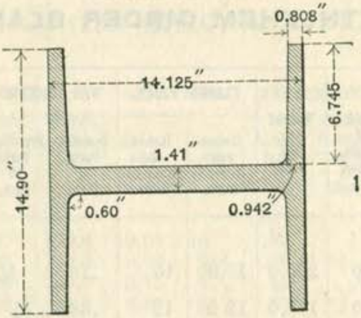


34.6 Lbs.to 71.6 Lbs.

BETHLEHEM ROLLED H COLUMNS.

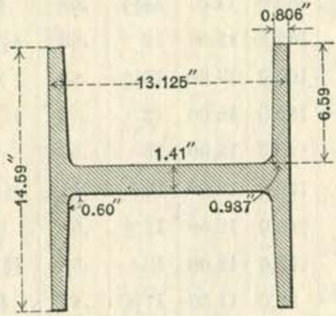
BASE SECTIONS FOR BUILDING UP COLUMNS OF LARGE SECTIONAL AREA.

H 14 c



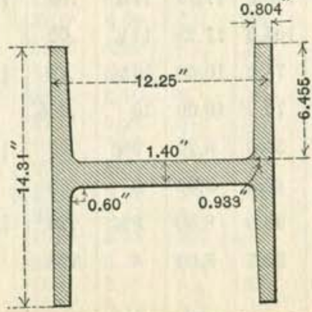
148.0 Lbs.

H 13 c



141.0 Lbs.

H 12 c



134.5 Lbs.

WEIGHTS AND DIMENSIONS OF

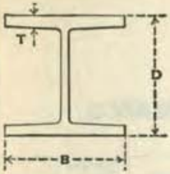
BETHLEHEM GIRDER BEAMS.

Section Number.	Depth of Beams, Inches.	Weight per Foot, Lbs.	FLANGE WIDTH.		WEB THICKNESS.		Increase of Web Thickness and Flange Width for each Lb. Increase in Weight, Inches.	Page Number of Section.
			Inches and Decimal Parts.	Inches and Fractional Parts.	Decimal Parts of Inch.	Fractional Parts of Inch.		
G30 a	30	200.0	15.00	15	.75	$\frac{3}{4}$	.010	16
G30	30	175.0	12.00	12	.68	$\frac{11}{16}$	.010	16
G28 a	28	180.0	14.35	$14\frac{11}{32}$	.69	$\frac{11}{16}$	.011	17
G28	28	162.5	12.00	12	.65	$\frac{21}{32}$	.011	17
G26 a	26	160.0	13.60	$13\frac{19}{32}$	.63	$\frac{5}{8}$	.011	18
G26	26	150.0	12.00	12	.62	$\frac{5}{8}$	.011	18
G24 a	24	140.0	13.00	13	.56	$\frac{9}{16}$	.012	19
G24	24	120.0	12.00	12	.51	$\frac{1}{2}$	.012	19
G20 a	20	140.0	12.50	$12\frac{1}{2}$	.64	$\frac{41}{64}$	.015	20
G20	20	112.0	12.00	12	.52	$\frac{33}{64}$	.015	20
G18	18	92.0	11.50	$11\frac{1}{2}$	.47	$\frac{15}{32}$	.016	21
G15 b	15	140.0	11.75	$11\frac{3}{4}$	.80	$\frac{51}{64}$	.020	21
G15 a	15	104.0	11.25	$11\frac{1}{4}$	.60	$\frac{19}{32}$	.020	22
G15	15	73.0	10.50	$10\frac{1}{2}$	.42	$\frac{27}{64}$	.020	22
G12 a	12	70.0	10.00	10	.445	$\frac{7}{16}$	.025	23
G12	12	55.0	9.75	$9\frac{3}{4}$	.35	$\frac{11}{32}$	.025	23
G10	10	44.0	9.00	9	.30	$\frac{19}{64}$	.030	24
G 9	9	38.0	8.50	$8\frac{1}{2}$	.29	$\frac{19}{64}$	.033	24
G 8	8	32.5	8.00	8	.28	$\frac{9}{32}$	.037	24

WEIGHTS AND DIMENSIONS OF

BETHLEHEM SPECIAL I BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	Flange Width. Inches and Decimal Parts.	Flange Width. Inches and Fractional Parts.	Web Thickness. Decimal Parts of Inch.	Web Thickness. Fractional Parts of Inch.	Increase of Web Thickness and Flange Width for each Lb. Increase in Weight, Inches.	Page Number of Section.
B30	30	120.0	10.00	10	.52	$\frac{33}{64}$	.010	25
B28	28	105.0	9.60	$9\frac{19}{32}$	.48	$\frac{31}{64}$	.011	26
B26	26	90.0	9.15	$9\frac{5}{32}$	.44	$\frac{7}{16}$	.011	26
B24 a	24	84.0	8.85	$8\frac{27}{32}$	.45	$\frac{29}{64}$	.012	27
B24	24	82.0	8.83	$8\frac{53}{64}$	.50	$\frac{1}{2}$	.012	27
	24	72.0	8.70	$8\frac{45}{64}$	.37	$\frac{3}{8}$	.012	
B20 a	20	82.0	8.51	$8\frac{33}{64}$	.57	$\frac{9}{16}$	.015	28
	20	72.0	8.37	$8\frac{3}{8}$	.43	$\frac{7}{16}$	.015	
B20	20	68.0	7.69	$7\frac{11}{16}$	.49	$\frac{31}{64}$	.015	28
	20	63.0	7.62	$7\frac{5}{8}$	.42	$\frac{27}{64}$	.015	
	20	60.0	7.58	$7\frac{37}{64}$	.375	$\frac{3}{8}$	.015	
	20	58.5	7.55	$7\frac{35}{64}$	.35	$\frac{11}{32}$	.015	
B18	18	58.5	7.47	$7\frac{15}{32}$	.48	$\frac{31}{64}$	.016	28
	18	52.5	7.37	$7\frac{3}{8}$	.375	$\frac{3}{8}$	.016	
	18	48.5	7.30	$7\frac{19}{64}$	.31	$\frac{5}{16}$	.016	
B15 b	15	72.0	7.15	$7\frac{5}{32}$	.54	$\frac{35}{64}$	.020	29
B15 a	15	64.0	7.20	$7\frac{13}{64}$	.60	$\frac{19}{32}$	.020	29
	15	54.0	7.00	7	.40	$\frac{13}{32}$	.020	
B15	15	46.0	6.81	$6\frac{13}{16}$	.43	$\frac{7}{16}$	.020	29
	15	42.0	6.74	$6\frac{3}{4}$	.36	$\frac{23}{64}$	.020	
	15	38.0	6.66	$6\frac{21}{32}$	.28	$\frac{9}{32}$	.020	
B12 a	12	36.0	6.30	$6\frac{19}{64}$	.31	$\frac{5}{16}$	.025	30
B12	12	31.0	6.16	$6\frac{5}{32}$	.31	$\frac{5}{16}$	.025	30
	12	28.5	6.10	$6\frac{3}{32}$	.25	$\frac{1}{4}$	.025	
B10	10	27.5	5.94	$5\frac{15}{16}$	.34	$\frac{11}{32}$	.029	30
	10	24.5	5.85	$5\frac{27}{32}$	.25	$\frac{1}{4}$	.029	
	10	22.5	5.80	$5\frac{51}{64}$	.20	$\frac{13}{64}$	.029	
B 9	9	23.0	5.50	$5\frac{1}{2}$	.31	$\frac{5}{16}$	.033	31
	9	21.0	5.44	$5\frac{7}{16}$	.25	$\frac{1}{4}$	.033	
	9	19.0	5.38	$5\frac{3}{8}$	.19	$\frac{3}{16}$	.033	
B 8	8	21.25	5.37	$5\frac{3}{8}$	.36	$\frac{23}{64}$	.037	31
	8	18.0	5.26	$5\frac{1}{4}$	.25	$\frac{1}{4}$	.037	
	8	16.25	5.19	$5\frac{3}{16}$	.18	$\frac{3}{16}$	.037	



MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

BETHLEHEM ROLLED H COLUMNS.

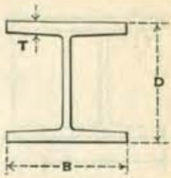
Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.
H14s	13 3/8	1/2	8.00	42.6	12.53
	13 1/2	9/16	8.04	47.8	14.07
	13 1/2	9/16	9.00	51.4	15.12
	13 5/8	5/8	9.04	57.1	16.79
	13 5/8	5/8	10.00	61.0	17.95
	13 3/4	11/16	10.03	66.7	19.61
	13 3/4	11/16	11.00	71.0	20.88
	13 7/8	3/4	11.04	77.6	22.81
	13 7/8	3/4	12.00	82.2	24.17
	14	13/16	12.04	89.2	26.23
	14	13/16	13.00	93.7	27.56
H14	14	13/16	14.00	98.8	29.06
	14 1/8	7/8	14.04	106.7	31.38
	14 1/4	15/16	14.08	114.6	33.70
	14 3/8	1	14.12	122.5	36.04
	14 1/2	1 1/16	14.16	130.5	38.38
	14 5/8	1 1/8	14.19	138.0	40.59
	14 3/4	1 3/16	14.23	146.0	42.95
	14 7/8	1 1/4	14.27	154.1	45.33
	15	1 5/16	14.31	162.2	47.71
H14a	15	1 5/16	14.57	164.4	48.36
	15 1/8	1 3/8	14.61	172.7	50.78
	15 1/4	1 7/16	14.65	180.9	53.22
	15 3/8	1 1/2	14.69	189.3	55.67
	15 1/2	1 9/16	14.73	197.6	58.12
	15 5/8	1 5/8	14.77	206.0	60.59
	15 3/4	1 11/16	14.81	214.4	63.07
	15 7/8	1 3/4	14.84	222.3	65.39
H14b	16	1 13/16	14.88	230.8	67.89
	16 1/8	1 7/8	14.92	239.3	70.39
	16 1/4	1 15/16	14.96	247.9	72.91
	16 3/8	2	15.00	256.5	75.43
	16 1/2	2 1/16	15.04	265.1	77.97
	16 5/8	2 1/8	15.08	273.7	80.51
	16 3/4	2 3/16	15.12	282.4	83.07
	16 7/8	2 1/4	15.16	291.2	85.63

Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.
H13s	12 3/8	1/2	8.00	41.2	12.12
	12 1/2	9/16	8.04	46.3	13.62
	12 1/2	9/16	9.00	49.9	14.67
	12 5/8	5/8	9.03	55.0	16.17
	12 5/8	5/8	10.00	58.9	17.33
	12 3/4	11/16	10.04	64.9	19.09
	12 3/4	11/16	11.00	69.1	20.33
	12 7/8	3/4	11.04	75.6	22.22
	12 7/8	3/4	12.00	79.8	23.46
	13	13/16	12.04	86.6	25.48
H13	13	13/16	13.00	91.5	26.93
	13 1/8	7/8	13.04	98.9	29.08
	13 1/4	15/16	13.08	106.2	31.24
	13 3/8	1	13.12	113.6	33.41
	13 1/2	1 1/16	13.16	121.0	35.59
	13 5/8	1 1/8	13.19	128.0	37.64
	13 3/4	1 3/16	13.23	135.5	39.84
	13 7/8	1 1/4	13.27	143.0	42.05
	14	1 5/16	13.31	150.5	44.27
H13a	14	1 5/16	14.00	156.4	45.99
	14 1/8	1 3/8	14.04	164.2	48.30
	14 1/4	1 7/16	14.08	172.1	50.63
	14 3/8	1 1/2	14.12	180.1	52.96
	14 1/2	1 9/16	14.16	188.0	55.31
	14 5/8	1 5/8	14.20	196.1	57.66
	14 3/4	1 11/16	14.24	204.1	60.03
	14 7/8	1 3/4	14.27	211.7	62.25
	15	1 13/16	14.31	219.8	64.64
H13b	15	1 13/16	14.88	226.5	66.62
	15 1/8	1 7/8	14.92	234.9	69.09
	15 1/4	1 15/16	14.96	243.3	71.56
	15 3/8	2	15.00	251.8	74.05
	15 1/2	2 1/16	15.04	260.2	76.54
	15 5/8	2 1/8	15.08	268.8	79.05
	15 3/4	2 3/16	15.12	277.3	81.56
	15 7/8	2 1/4	15.16	285.9	84.09

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

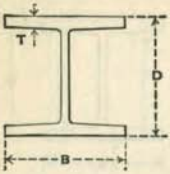
BETHLEHEM ROLLED H COLUMNS

(CONTINUED).



Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.
H12s	11½	½	8.00	40.0	11.76
	11⅝	$\frac{9}{16}$	8.04	45.0	13.23
	11⅝	$\frac{9}{16}$	9.00	48.1	14.16
	11¾	⅝	9.04	55.6	15.75
	11¾	⅝	10.00	57.4	16.89
	11⅞	$\frac{11}{16}$	10.04	63.3	18.61
	11⅞	$\frac{11}{16}$	11.00	67.1	19.74
	12	¾	11.04	73.4	21.60
H12	12	¾	12.00	78.0	22.94
	12⅛	$\frac{13}{16}$	12.04	84.7	24.92
	12¼	⅞	12.08	91.5	26.92
	12⅜	$\frac{15}{16}$	12.12	98.3	28.92
	12½	1	12.16	105.2	30.94
	12⅝	$1\frac{1}{16}$	12.20	112.1	32.96
	12¾	1⅛	12.23	118.6	34.87
	12⅞	$1\frac{3}{16}$	12.27	125.5	36.91
	13	1¼	12.31	132.5	38.97
H12a	13	1¼	13.00	138.1	40.61
	13⅛	$1\frac{5}{16}$	13.04	145.4	42.76
	13¼	1⅜	13.08	152.7	44.92
	13⅜	$1\frac{7}{16}$	13.12	160.1	47.09
	13½	1½	13.16	167.5	49.27
	13⅝	$1\frac{9}{16}$	13.20	174.9	51.46
	13¾	1⅝	13.24	182.4	53.66
	13⅞	$1\frac{11}{16}$	13.28	189.9	55.87
	14	1¾	13.31	197.1	57.96
H12b	14	1¾	14.00	204.9	60.27
	14⅛	$1\frac{13}{16}$	14.04	212.8	62.58
	14¼	1⅞	14.08	220.7	64.91
	14⅜	$1\frac{15}{16}$	14.12	228.6	67.24
	14½	2	14.16	236.6	69.59
	14⅝	$2\frac{1}{16}$	14.20	244.6	71.94
	14¾	2⅛	14.24	252.8	74.31
	14⅞	$2\frac{3}{16}$	14.28	260.7	76.68
	15	2¼	14.32	268.8	79.06

Section Number.	Dimensions in Inches. D	T	B	Weight per Ft. Lbs.	Area, Square Inches.
H11s	10⅝	½	8.00	38.4	11.30
	10¾	$\frac{9}{16}$	8.04	43.3	12.73
	10¾	$\frac{9}{16}$	9.00	46.8	13.76
	10⅞	⅝	9.04	52.1	15.32
	10⅞	⅝	10.00	55.9	16.44
	11	$\frac{11}{16}$	10.03	61.3	18.02
H11	11	$\frac{11}{16}$	11.00	65.5	19.26
	11⅛	¾	11.04	71.7	21.08
	11¼	$\frac{13}{16}$	11.08	77.9	22.91
	11⅜	⅞	11.12	84.2	24.75
	11½	$\frac{15}{16}$	11.16	90.5	26.60
	11⅝	1	11.20	96.8	28.46
	11¾	$1\frac{1}{16}$	11.24	103.1	30.33
	11⅞	1⅛	11.27	109.1	32.10
	12	$1\frac{3}{16}$	11.31	115.5	33.98
H11a	12	$1\frac{3}{16}$	12.00	120.9	35.54
	12⅛	1¼	12.04	127.6	37.53
	12¼	$1\frac{5}{16}$	12.08	134.4	39.52
	12⅜	1⅜	12.12	141.2	41.53
	12½	$1\frac{7}{16}$	12.16	148.1	43.54
	12⅝	1½	12.20	154.9	45.57
	12¾	$1\frac{9}{16}$	12.24	161.9	47.60
	12⅞	1⅝	12.28	168.8	49.65
	13	$1\frac{11}{16}$	12.32	175.8	51.70



MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

BETHLEHEM ROLLED H COLUMNS

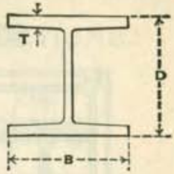
(CONTINUED).

Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.	Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.
	9¾	½	8.00	37.2	10.95		8¾	7/16	7.00	28.8	8.46
	9⅞	9/16	8.04	42.0	12.34		8⅞	½	7.04	32.9	9.69
H10 s						H9 s					
	9⅞	9/16	9.00	45.4	13.36		8⅞	½	8.00	36.0	10.59
	10	⅝	9.04	50.6	14.88		9	9/16	8.04	40.6	11.95
	10	⅝	10.00	54.1	15.91		9	9/16	9.00	43.8	12.88
	10⅛	11/16	10.04	59.7	17.57		9⅛	⅝	9.04	48.9	14.37
	10¼	¾	10.08	65.4	19.23		9¼	11/16	9.08	54.0	15.87
	10⅜	13/16	10.12	71.1	20.91		9⅜	¾	9.12	59.1	17.38
H10	10½	⅞	10.16	76.8	22.59	H9	9½	13/16	9.16	64.3	18.90
	10⅝	15/16	10.20	82.6	24.29		9⅝	⅞	9.20	69.5	20.43
	10¾	1	10.24	88.4	25.99		9¾	15/16	9.24	74.7	21.97
	10⅞	1 1/16	10.28	94.2	27.71		9⅞	1	9.28	80.0	23.52
	11	1⅛	10.31	99.7	29.32		10	1 1/16	9.32	85.3	25.08
	11	1⅛	11.00	104.7	30.80		10	1 1/16	10.00	90.0	26.46
	11⅛	1 3/16	11.04	110.9	32.62		10⅛	1⅛	10.03	95.3	28.02
	11¼	1¼	11.08	117.1	34.45		10¼	1 3/16	10.07	100.9	29.68
	11⅜	1 5/16	11.12	123.4	36.29		10⅜	1¼	10.11	106.6	31.35
H10 a	11½	1⅜	11.16	129.7	38.14	H9 a	10½	1 5/16	10.15	112.3	33.04
	11⅝	1 7/16	11.20	136.0	40.00		10⅝	1⅜	10.19	118.1	34.73
	11¾	1½	11.24	142.4	41.87		10¾	1 7/16	10.23	123.9	36.44
	11⅞	1 9/16	11.28	148.8	43.75		10⅞	1½	10.27	129.7	38.15
	12	1⅝	11.32	155.2	45.64		11	1 9/16	10.31	135.6	39.87

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

BETHLEHEM ROLLED H COLUMNS

(CONCLUDED).



Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.	Section Number.	Dimensions in Inches. D	T	B	Weight per Ft., Lbs.	Area, Square Inches.
H8 s	7 7/8	7/16	7.00	27.7	8.15	Base Sections for Building up Columns of Large Sectional Area.					
	8	1/2	7.04	31.8	9.35						
H8	8	1/2	8.00	34.6	10.17	H14 c	14 1/8	7/8	14.90	148.0	43.52
	8 1/8	9/16	8.04	39.1	11.50						
	8 1/4	5/8	8.08	43.6	12.83						
	8 3/8	11/16	8.12	48.2	14.18	H13 c	13 1/8	7/8	14.59	141.0	41.48
	8 1/2	3/4	8.16	52.8	15.53						
	8 5/8	13/16	8.20	57.4	16.90						
	8 3/4	7/8	8.24	62.1	18.27	H12 c	12 1/4	7/8	14.31	134.5	39.57
	8 7/8	15/16	8.28	66.8	19.66						
	9	1	8.32	71.6	21.05						
H8 a	9	1	9.00	76.0	22.35	For full detail dimensions of all sections of Bethlehem Rolled H Columns, see tables of Dimensions and Properties of Rolled H Columns, pages 60 to 75 inclusive.					
	9 1/8	1 1/16	9.04	81.1	23.84						
	9 1/4	1 1/8	9.07	85.9	25.25						
	9 3/8	1 3/16	9.11	91.0	26.76						
	9 1/2	1 1/4	9.15	96.1	28.28						
	9 5/8	1 5/16	9.19	101.3	29.81						
	9 3/4	1 3/8	9.23	106.6	31.35						
	9 7/8	1 7/16	9.27	111.8	32.89						
	10	1 1/2	9.31	117.1	34.45						

STRUCTURAL DETAILS.

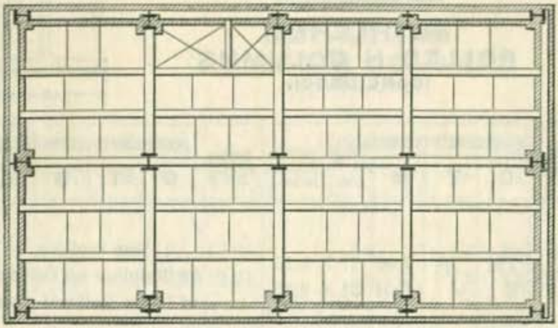


FIG. 1

FIG. 2

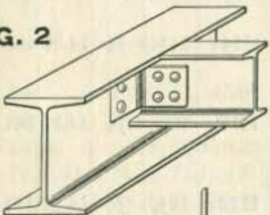
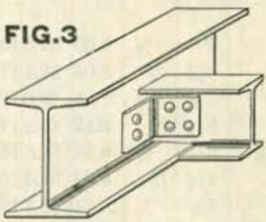


FIG. 3



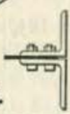


FIG. 4

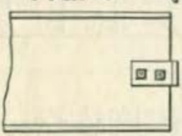


FIG 5

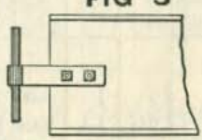
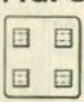


FIG. 6

FIG. 8



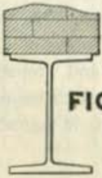


FIG. 7

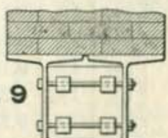


FIG. 9

BETHLEHEM H COLUMN SECTIONS.

Fig. 1

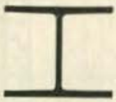


Fig. 2

Fig. 3

BUILT COLUMN SECTIONS.

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 13

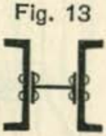
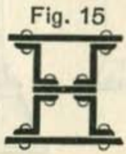


Fig. 14

Fig. 15



TYPES OF H COLUMN DETAILS.

Fig. 1

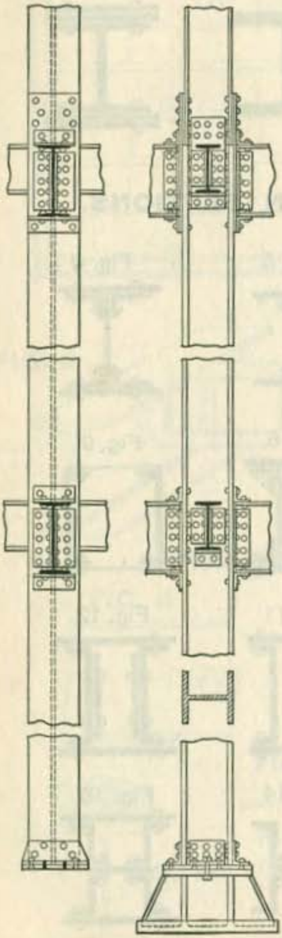
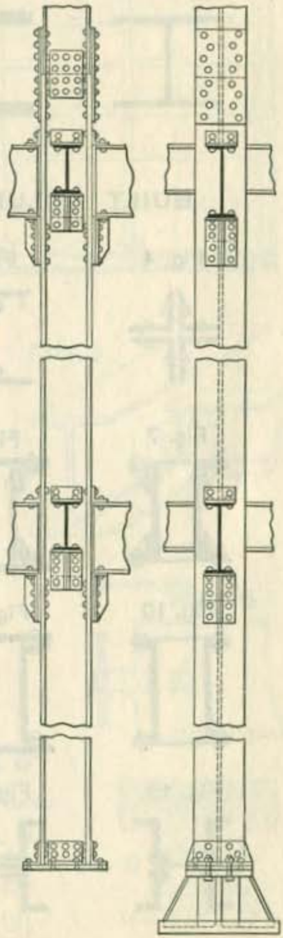
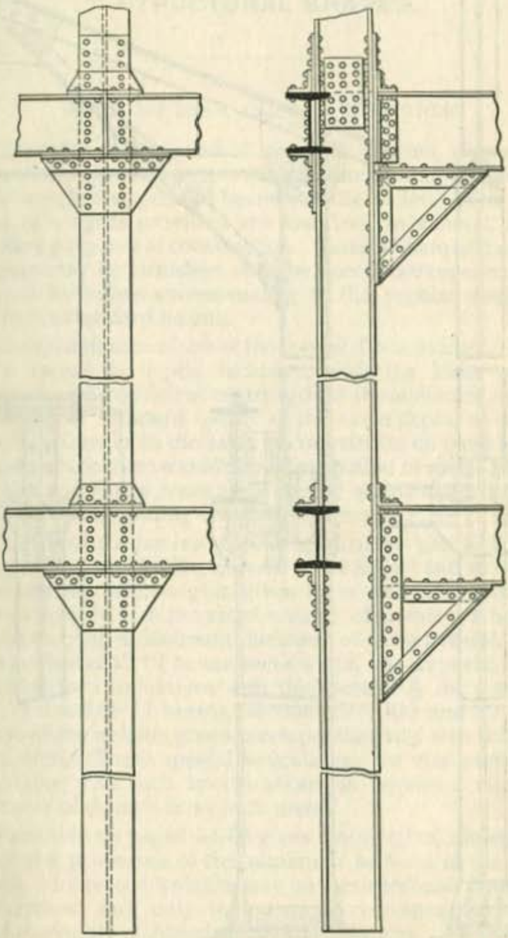


Fig. 2

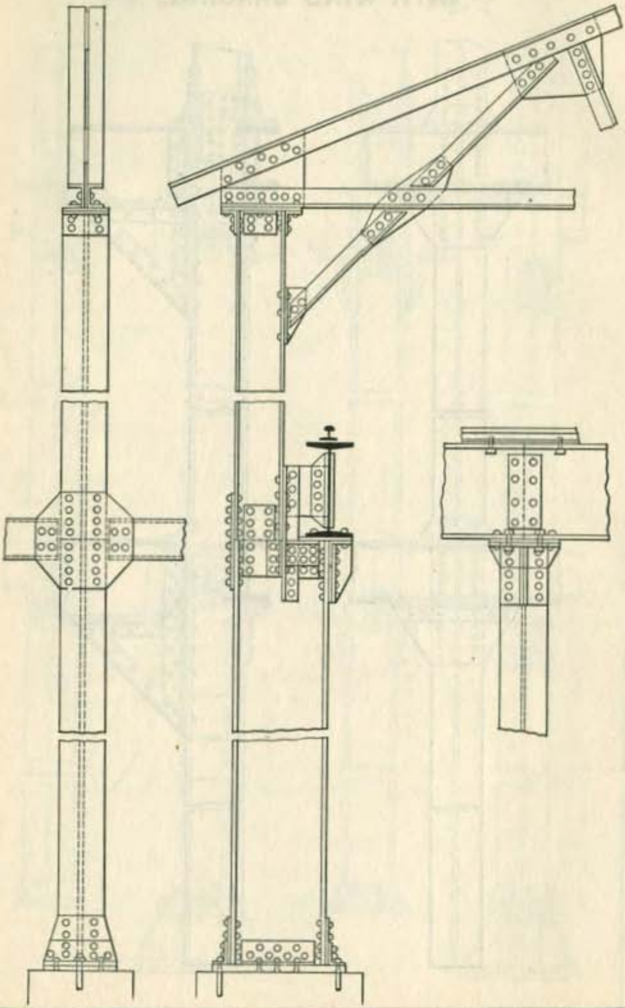


TYPES OF H COLUMN DETAILS WITH WIND BRACING.



SHOP BUILDING CONSTRUCTION

WITH BETHLEHEM WIDE FLANGE BEAMS USED FOR COLUMNS AND CRANE GIRDERS.



EXPLANATION OF TABLES

OF THE PROPERTIES OF BETHLEHEM SPECIAL STRUCTURAL SHAPES.

SPECIAL I BEAM AND GIRDER SECTIONS.

The table on pages 56–57 gives the weights, dimensions, areas and structural properties of the minimum weights, and other weights of special I beams usually rolled. The variations of weights provided are sufficient, in general, for all ordinary purposes of construction. Intermediate or increased weights may be furnished only by special arrangement, and only in variations corresponding to the regular weights of American standard beams.

The minimum sections of the special I beams from 8 inches to 24 inches in depth, inclusive, have the same section modulus and coefficient of strength as the minimum sections of American standard beams of the same depth, as will be seen by reference to the table of comparison on page 59 ; but because of the more economical distribution of metal between the web and flange areas these special beams weigh 10% less than the corresponding standard sections.

Certain of the intermediate weights of the special I beams are provided for specific reasons. The 8″, 9″ and 10″ beams have intermediate weights given for a web thickness of ¼ inch to comply with the requirements of municipal building laws specifying a minimum thickness of ¼ inch metal. The light section of 12″ I beam, section B12, has a special weight provided for a minimum web thickness of $\frac{5}{16}$ inch, and the 15″, 18″ and 20″ I beams, sections B15, B18 and B20, have intermediate weights given corresponding to a web thickness of ⅜ inch. These special weights are for the purpose of complying with such specifications as require a minimum thickness of $\frac{5}{16}$ inch or ⅜ inch metal.

The table on pages 54–55 gives the weights, dimensions, areas and properties of the minimum sections of the girder beams. Increased weights may be furnished only by special arrangement and only in variations corresponding to the regular weights of American standard beams.

The girder beams from 8 inches to 24 inches in depth, inclusive, have a section modulus and coefficient of strength equal to that of two American standard beams of minimum section of the same depth, as will be seen by reference to the table of comparison on page 58 ; but the weight of the girder beam is, in general, 12½ % less than that of the two standard beams, not including the separators required for the latter.

The increase in thickness of web and width of flanges is given for one pound increase in weight of the beam or girder sections, by means of which the dimensions of intermediate or increased weights can be determined.

The coefficients of strength, C and C′, are calculated for maximum fiber stresses of 16,000 lbs. and 12,500 lbs. per square inch, respectively. If the loads are quiescent or nearly so, as in buildings, the coefficients given for a fiber stress of 16,000 lbs. per square inch are generally used ; but if moving loads are to be supported, the coefficients for a fiber stress of 12,500 lbs. per square inch should be used. Where there is a sudden application of loads, as in railroad bridges, coefficients corresponding to still smaller fiber stresses should be used, as a suddenly applied load produces a stress double that due to the same load in a quiescent state. The coefficients are proportional to the fiber stress assumed, so that they can be found for any other fiber stress by proportion. Thus, for a fiber stress of 8000 lbs. per square inch the coefficients will be one-half of those given for a fiber stress of 16,000 lbs. per square inch.

The coefficients of strength provide a simple means of finding the safe uniformly distributed load on any shape. Divide the coefficient given for the shape by the length of the span in feet and the quotient will be the safe uniformly distributed load in pounds, including the weight of the beam itself. For example, to find the safe uniformly distributed load for a 12″ I beam, section B12a, weighing 36 lbs. per foot, on a span of 20 feet allowing a maximum fiber stress of 16,000 lbs. per square inch, refer to the table on page 57, where the coefficient of the section for the assumed fiber stress is given as 480,300 ; then the total safe uniformly distributed load on the beam is

$$480{,}300 \div 20 = 24{,}015 \text{ lbs.},$$

which includes the weight of the beam itself. Deduct the weight of the beam and the remainder is the net safe uniform load.

In the usual case of selecting the proper beam to support a given load on a given span, it is only necessary to determine the coefficient of strength required and refer to the tables to find the section having a coefficient of that value. The coefficient required is obtained by multiplying the uniformly distributed load in pounds by the span in feet. For example, to select the proper size of beam for supporting a uniformly distributed load of 30,000 lbs., including its own weight, on a span of 20 feet allowing a fiber stress of 16,000 lbs. per square inch, the coefficient required is found thus,

$$C = 30{,}000 \times 20 = 600{,}000$$

Referring to the table on page 57, a 15″ beam, section B15, weighing 38 lbs. per foot, has a coefficient of 629,200 and is the proper beam for the purpose.

If the load is concentrated at the center of the span, the safe load is one-half the safe uniformly distributed load for the same span. To select the proper beam for supporting a load concentrated at the center of the span, multiply the given load by 2 and consider the result as a uniformly distributed load.

If the load is not uniformly distributed or not concentrated at the center of the span, the bending moment in foot-lbs. must be obtained, which multiplied by 8 will give the coefficient required.

The section modulus may also be used for selecting the proper beam, or other shape required to support a given loading. The section modulus required is obtained by dividing the bending moment, in inch-lbs., by the allowed fiber stress in lbs. per square inch.

The maximum fiber stress in lbs. per square inch in a beam or other shape supporting a given loading is found by dividing the bending moment, in inch-lbs., by the section modulus of the shape.

Formulas for obtaining the bending moments for the most usual cases of loading occurring in ordinary practice are given on page 234. The loads are to be expressed in pounds and the bending moment will be in foot-lbs., or inch-lbs., according as the lengths are taken in feet or in inches.

In the case of short spans fully loaded or with heavy concentrated loads, the crippling strength of the web may limit the allowable safe load on the beam, or may determine in the selection of a beam for supporting a given load. The tables of properties of the special I beams and girder beams give the maximum safe shear on the webs, in net tons of 2000 lbs., calculated by the customary formula,

$$\left.\begin{array}{r}\text{Maximum safe shear,}\\ \text{in tons of 2000 lbs.}\end{array}\right\} = \frac{6\,d\,t}{1 + \dfrac{h^2}{3000\,t^2}}$$

where d=depth of beam, t=thickness of web and h=clear distance between flanges, all dimensions in inches.

The shear at the end of a beam is one-half of the uniformly distributed load on the span and one-half of the load if concentrated at the center of the span. Therefore the maximum uniformly distributed load on any span, and the maximum load concentrated at the center of the span, must not be greater than twice the safe shear given for the web of the shape.

If the safe load for the beam, found by means of the coefficient of strength or section modulus, produces a shear greater than the safe shear given for the section, the load must be reduced until the safe shear given for the web is not exceeded. Likewise, in selecting a beam for a given loading, if the section found to have the required coefficient of strength or section modulus has a maximum allowable safe shear on the web less than that produced by the given loading, either the web must be stiffened or a heavier beam must be used having the required safe shearing strength. In general the shearing strength of the webs will be ample for all ordinary cases of loading.

ROLLED H COLUMN SECTIONS.

The tables on pages 60–73, inclusive, give the dimensions, weights, areas and structural properties of the H column sections for all the variations in size which are rolled.

The dimension T, given in the tables, is the nominal average thickness of the flange and is stated in even fractions of an inch for convenience. The actual average thickness of the flange is the half sum of the two dimensions M and N. In the groups of sections having letters appended to the section number the nominal average thickness, T, differs slightly from the actual average thickness, as will be seen by inspection of the tables. The slight difference is due to the taper of the flange and change in flange width.

The clear distance between the flange fillets is denoted by the dimension L given in the tables, and is the depth of the flat surface of the web available for connections.

All columns with the same numerical section number are from the same main rolls. Thus, all the sizes of 14″ H columns (sections H14, H14a, H14b and H14s) tabulated on pages 60–61 are produced by the same main rolls. The variation in dimensions of the H14 group of sections is formed by the proportionate separation of the horizontal and vertical rolls. The flanges in the H14a group of sections are permitted to spread to a greater width than in the H14 group, and in the H14b group the flanges are allowed to spread to a still greater width, the variation in the sizes of each group being produced as in the H14 sections by proportionate separation of the rolls. The H14s sections are special sections from the same main rolls as H14, but with flanges of reduced width. The letters appended to the section numbers of the different groups thus indicate a change only in the allowed width of the flanges.

In selecting columns, it is advisable where possible to secure the desired range of size, from minimum to maximum, by confining the selection to columns having the same numerical section number, as all the columns can then be secured from the same rolling.

The moment of inertia, section modulus and radius of gyration are given around both axes for all columns. The section modulus around the axis XX may be used to determine the transverse strength in case it is desired to use the column sections as beams. The coefficient of strength for such purpose may be obtained in the following manner:

$$C = \tfrac{2}{3} f S,$$

where f=allowed fiber stress in lbs. per square inch, and S=the section modulus.

The section modulus is also of use where columns are subject to bending due to eccentric loading, as is explained in connection with the tables of strength of columns. The use of the radius of gyration is also explained in connection with the tables of strength of columns.

PROPERTIES OF

BETHLEHEM GIRDER BEAMS.

Section Number.	Dpth. of Beam Ins.	Weight per Foot, Lbs.	Area of Section, So Ins.	Thickness of Web, Inches.	Width of Flange, Inches.	Increase of Web and Flange for each Lb. Increase of Weight, Inches.	NEUTRAL AXIS PERPENDICULAR TO WEB AT CENTER.		
							Moment of Inertia. I	Radius of Gyration. r	Section Modulus. S
G30 a	30	200.0	58.85	.75	15.00	.010	9154.7	12.47	610.3
G30	30	175.0	51.35	.68	12.00	.010	7851.8	12.37	523.5
G28 a	28	180.0	52.98	.69	14.35	.011	7269.0	11.72	519.2
G28	28	162.5	47.81	.65	12.00	.011	6465.1	11.63	461.8
G26 a	26	160.0	47.00	.63	13.60	.011	5618.7	10.93	432.2
G26	26	150.0	44.13	.62	12.00	.011	5200.4	10.86	400.0
G24 a	24	140.0	41.03	.56	13.00	.012	4241.9	10.17	353.5
G24	24	120.0	35.31	.51	12.00	.012	3630.7	10.14	302.6
G20	20	140.0	41.28	.64	12.50	.015	2938.3	8.44	293.8
G20	20	112.0	32.88	.52	12.00	.015	2368.9	8.49	236.9
G18	18	92.0	27.09	.47	11.50	.016	1595.3	7.67	177.3
G15 b	15	140.0	41.28	.80	11.75	.020	1591.5	6.21	212.2
G15 a	15	104.0	30.58	.60	11.25	.020	1219.7	6.32	162.6
G15	15	73.0	21.52	.42	10.50	.020	886.5	6.42	118.2
G12 a	12	70.0	20.60	.445	10.00	.025	540.9	5.12	90.2
G12	12	55.0	16.12	.35	9.75	.025	432.0	5.18	72.0
G10	10	44.0	12.95	.30	9.00	.030	244.3	4.34	48.9
G9	9	38.0	11.18	.29	8.50	.033	169.8	3.90	37.7
G8	8	32.5	9.52	.28	8.00	.037	113.9	3.46	28.5

W=Safe load in pounds uniformly distributed including weight of beam.
L=Span in feet. M=Moment of forces in foot pounds.

PROPERTIES OF

BETHLEHEM GIRDER BEAMS.

COEFFICIENTS OF STRENGTH				Maximum Safe Shear on Web, in Tons of 2000 Lbs.	NEUTRAL AXIS COINCIDENT WITH CENTER LINE OF WEB.		Section Number.
For Fiber Stress of 16,000 Lbs. per Sq. In. for Buildings. C	Add for each Lb. Increase in Weight of Beam.	For Fiber Stress of 12,500 Lbs. per Sq. In. for Moving Loads. C′	Add for each Lb. Increase in Weight of Beam.		Moment of Inertia. I′	Radius of Gyration. r′	
6,510,000	15690	5,085,900	12270	95.2	599.7	3.19	G30 a
5,583,500	15690	4,362,100	12270	81.1	346.4	2.60	G30
5,538,200	14640	4,326,700	11450	81.3	507.6	3.09	G28 a
4,925,800	14640	3,848,200	11450	73.8	328.2	2.62	G28
4,610,200	13600	3,601,700	10630	68.3	414.5	2.97	G26 a
4,267,000	13600	3,333,600	10630	66.6	306.5	2.63	G26
3,770,700	12550	2,945,800	9820	54.9	338.3	2.87	G24 a
3,227,200	12550	2,521,200	9820	46.5	240.0	2.61	G24
3,134,200	10460	2,448,600	8180	62.4	334.3	2.85	G20 a
2,526,700	10460	1,974,000	8180	45.6	232.8	2.66	G20
1,890,800	9410	1,477,200	7360	37.1	172.4	2.52	G18
2,263,500	7850	1,768,300	6140	67.3	319.2	2.78	G15 b
1,734,700	7850	1,355,200	6140	47.4	203.3	2.58	G15 a
1,260,900	7850	985,100	6140	28.8	116.6	2.33	G15
961,600	6280	751,200	4910	28.0	109.5	2.31	G12 a
768,000	6280	600,000	4910	19.7	76.1	2.17	G12
521,200	5230	407,200	4090	14.3	53.6	2.03	G10
402,500	4710	314,400	3680	12.8	40.7	1.91	G9
303,800	4180	237,400	3270	11.4	30.3	1.78	G8

C and C′=Coefficients given in the tables.

$W=\frac{C \text{ or } C'}{L}$; $M=\frac{C \text{ or } C'}{8}$; C or C′=WL=8M=$\frac{4}{3}$fS.

PROPERTIES OF

BETHLEHEM SPECIAL I BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.	Thickness of Web, Inches.	Width of Flange, Inches.	Increase of Web and Flange for each Lb. Increase of Weight, Inches.	NEUTRAL AXIS PERPENDICULAR TO WEB AT CENTER.		
							Moment of Inertia. I	Radius of Gyration. r	Section Modulus. S
B30	30	120.0	35.25	.52	10.00	.010	5270.9	12.23	351.4
B28	28	105.0	31.04	.48	9.60	.011	4089.1	11.43	292.1
B26	26	90.0	26.63	.44	9.15	.011	3043.1	10.71	234.1
B24 a	24	84.0	24.79	.45	8.85	.012	2391.6	9.82	199.3
B24	24	82.0	24.33	.50	8.83	.012	2240.3	9.60	186.7
	24	72.0	21.21	.37	8.70	.012	2090.5	9.93	174.2
B20 a	20	82.0	24.23	.57	8.51	.015	1561.3	8.03	156.1
	20	72.0	21.43	.43	8.37	.015	1467.9	8.28	146.8
B20	20	68.0	19.95	.49	7.69	.015	1269.6	7.98	127.0
	20	63.0	18.55	.42	7.62	.015	1223.0	8.12	122.3
	20	60.0	17.65	.375	7.58	.015	1193.1	8.22	119.3
	20	58.5	17.15	.35	7.55	.015	1176.3	8.28	117.6
B18	18	58.5	17.29	.48	7.47	.016	883.6	7.15	98.2
	18	52.5	15.40	.375	7.37	.016	832.9	7.35	92.5
	18	48.5	14.23	.31	7.30	.016	801.3	7.50	89.0
B15 b	15	72.0	21.27	.54	7.15	.020	797.9	6.13	106.4
B15 a	15	64.0	18.85	.60	7.20	.020	666.8	5.95	88.9
	15	54.0	15.85	.40	7.00	.020	610.5	6.21	81.4
B15	15	46.0	13.46	.43	6.81	.020	484.6	5.99	64.6
	15	42.0	12.41	.36	6.74	.020	464.9	6.12	62.0
	15	38.0	11.21	.28	6.66	.020	442.4	6.28	59.0
B12 a	12	36.0	10.63	.31	6.30	.025	270.2	5.04	45.0
B12	12	31.0	9.13	.31	6.16	.025	225.2	4.97	37.5
	12	28.5	8.41	.25	6.10	.025	216.6	5.07	36.1
B10	10	27.5	8.05	.34	5.94	.029	134.6	4.09	26.9
	10	24.5	7.15	.25	5.85	.029	127.1	4.22	25.4
	10	22.5	6.65	.20	5.80	.029	122.8	4.27	24.6
B9	9	23.0	6.76	.31	5.50	.033	92.4	3.70	20.5
	9	21.0	6.22	.25	5.44	.033	88.8	3.78	19.7
	9	19.0	5.68	.19	5.38	.033	85.1	3.87	18.9
B8	8	21.25	6.25	.36	5.37	.037	64.7	3.22	16.2
	8	18.00	5.37	.25	5.26	.037	60.0	3.34	15.0
	8	16.25	4.81	.18	5.19	.037	57.0	3.44	14.3

W—Safe load in pounds uniformly distributed including weight of beam.
L—Span in feet. M—Moment of forces in foot pounds.

PROPERTIES OF

BETHLEHEM SPECIAL I BEAMS.

COEFFICIENTS OF STRENGTH.				Maximum Safe Shear on Web, in Tons of 2000 Lbs.	NEUTRAL AXIS COINCIDENT WITH CENTER LINE OF WEB.		Section Number.
For Fiber Stress of 16,000 Lbs. per Square Inch for Buildings. C	Add for each Lb. Increase in Weight of Beam.	For Fiber Stress of 12,500 Lbs. per Square Inch for Moving Loads. C′	Add for each Lb. Increase in Weight of Beam.		Moment of Inertia. I′	Radius of Gyration. r′	
3,748,200	15690	2,928,300	12270	48.7	149.7	2.11	B30
3,115,700	14640	2,434,200	11450	41.5	122.6	1.98	B28
2,496,900	13600	1,950,700	10630	34.9	93.4	1.87	B26
2,125,900	12550	1,660,800	9820	36.3	82.0	1.82	B24 a
1,991,600	12550	1,556,000	9820	43.8	71.1	1.71	B24
1,858,100	12550	1,451,700	9820	24.4	67.7	1.79	
1,665,400	10460	1,301,100	8180	51.5	71.5	1.72	B20 a
1,565,800	10460	1,223,200	8180	32.7	67.6	1.78	
1,354,600	10460	1,058,000	8180	40.4	45.7	1.51	B20
1,304,500	10460	1,019,100	8180	31.1	44.3	1.54	
1,272,600	10460	994,200	8180	25.3	43.4	1.57	
1,254,800	10460	980,300	8180	22.2	43.0	1.58	
1,047,500	9410	818,300	7360	37.4	35.9	1.44	B18
987,200	9410	771,300	7360	24.8	34.4	1.49	
949,800	9410	742,000	7360	17.4	33.4	1.53	
1,134,800	7850	886,600	6140	41.2	55.1	1.61	B15 b
948,100	7850	740,700	6140	46.6	40.8	1.47	B15 a
868,100	7850	678,200	6140	26.5	37.2	1.53	
689,200	7850	538,400	6140	29.1	24.2	1.34	B15
661,200	7850	516,500	6140	22.1	23.4	1.37	
629,200	7850	491,600	6140	14.2	22.5	1.42	
480,300	6280	375,300	4910	16.2	20.4	1.38	B12 a
400,300	6280	312,800	4910	16.0	14.7	1.27	B12
385,000	6280	300,800	4910	11.2	14.2	1.30	
287,300	5230	224,400	4090	16.7	11.7	1.20	B10
271,300	5230	211,900	4090	10.6	11.1	1.24	
262,000	5230	204,700	4090	7.3	10.8	1.27	
219,100	4710	171,200	3680	13.8	8.5	1.12	B9
210,300	4710	164,300	3680	10.0	8.2	1.15	
201,800	4710	157,700	3680	6.5	7.9	1.18	
172,500	4180	134,800	3270	15.3	6.8	1.05	B8
160,000	4180	125,000	3270	9.5	6.4	1.09	
152,000	4180	118,800	3270	5.7	6.1	1.12	

C and C′=Coefficients given in the table.

$W = \frac{C \text{ or } C'}{L}$; $M = \frac{C \text{ or } C'}{8}$; C or C′ = W L = 8M = $\frac{2}{3}$ f S.

COMPARISON OF

BETHLEHEM GIRDER BEAMS

WITH GIRDERS OF AMERICAN STANDARD BEAMS.

BETHLEHEM GIRDER BEAMS.				EQUIVALENT GIRDERS OF AMERICAN STANDARD BEAMS.				Economy of Bethlehem Beams, Pounds per Foot.
Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Section Modulus.	Number of Beams.	Depth of Beams, Inches.	Weight of each Beam, Lbs. per Foot.	Section Modulus of two Beams.	
G30 a	30	200	610.3					
G30	30	175	523.5					
G28 a	28	180	519.2					
G28	28	162.5	461.8					
G26 a	26	160	432.2					
G26	26	150	400.0	2	24	100	396.8	50
G24 a	24	140	353.5	2	24	80	348.0	20
G24	24	120	302.6	2	20	85	301.8	50
G20 a	20	140	293.8	2	20	80	293.4	20
G20	20	112	236.9	2	20	65	234.0	18
G18	18	92	177.3	2	18	55	176.8	18
G15 b	15	140	212.2	2	15	80	212.2	20
G15 a	15	104	162.6	2	15	60	162.4	16
G15	15	73	118.2	2	15	42	117.8	11
G12 a	12	70	90.2	2	12	40	89.6	10
G12	12	55	72.0	2	12	31.5	72.0	8
G10	10	44	48.9	2	10	25	48.8	6
G9	9	38	37.7	2	9	21	37.8	4
G8	8	32.5	28.5	2	8	18	28.4	3.5

The difference in weights does not include separators for assembling the American standard beams into girders. The weights of such separators vary from about 1.5 lbs per foot for for 8″ beams to about 5.5 lbs. per foot for 24″ beams. The actual economy in weight of the Bethlehem Girder Beams is increased to the same extent.

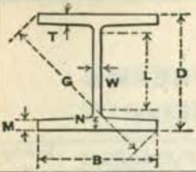
COMPARISON OF

BETHLEHEM SPECIAL I BEAMS

WITH AMERICAN STANDARD I BEAMS.

BETHLEHEM SPECIAL BEAMS.				EQUIVALENT AMERICAN STANDARD BEAMS.				Economy of Bethlehem Beams, Pounds per Foot.
Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Section Modulus.	Number of Beams.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Section Modulus.	
B30	30	120.0	351.4	2	24	80 each	348 0	40.0*
B28	28	105.0	292.1	2	20	80 each	293.4	55.0*
B26	26	90.0	234.1	2	20	65 each	234.0	40.0*
B24 a	24	84.0	199.3	1	24	100.0	198.4	16.0
	24	82.0	186.7	1	24	90.0	186.6	8.0
B24	24	72.0	174.2	1	24	80.0	174.0	8.0
	20	82.0	156.1	1	20	90.0	155.8	8.0
B20 a	20	72.0	146.8	1	20	80.0	146.7	8.0
	20	68.0	127.0	1	20	75.0	126.9	7.0
	20	63.0	122.3	1	20	70.0	122.0	7.0
	20	60.0	119.3	1	20	67.0	119.0	7.0
B20	20	58.5	117.6	1	20	65.0	117.0	6.5
	18	58.5	98.2	1	18	65.0	97.9	6.5
B18	18	52.5	92.5	1	18	59.0	92.6	6.5
	18	48.5	89.0	1	18	55.0	88.4	6.5
B15 b	15	72.0	106.4	1	15	80.0	106.1	8.0
	15	64.0	88.9	1	15	70.0	88.5	6.0
B15 a	15	54.0	81.4	1	15	60.0	81.2	6.0
	15	46.0	64.6	1	15	50.0	64.5	4.0
	15	42.0	62.0	1	15	46.5	61.9	4.5
B15	15	38.0	59.0	1	15	42.0	58.9	4.0
B12 a	12	36.0	45.0	1	12	40.0	44.8	4.0
	12	31.0	37.5	1	12	34.0	37.5	3.0
B12	12	28.5	36.1	1	12	31.5	36.0	3.0
	10	27.5	26.9	1	10	30.0	26.8	2.5
B10	10	24.5	25.4	1	10	27.0	25 4	2.5
	10	22.5	24.6	1	10	25.0	24.4	2.5
	9	23.0	20.5	1	9	25.0	20.4	2.0
B9	9	21.0	19 7	1	9	23.5	19.8	2.5
	9	19.0	18.9	1	9	21.0	18.9	2.0
	8	21.25	16.2	1	8	23.0	16.1	1.75
B8	8	18.0	15.0	1	8	20.0	15.0	2.0
	8	16.25	14.3	1	8	18.0	14.2	1.75

*This difference in weights does not include separators for assembling the American standard beams into girders.



DIMENSIONS AND PROPERTIES OF

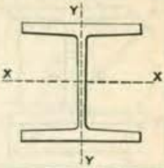
BETHLEHEM ROLLED STEEL

14″ H COLUMNS.

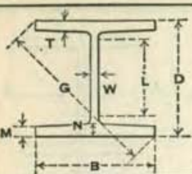
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES. D	Nominal. T	B	W	M	N	G	L
H14s	42.6	13 3/8	1/2	8.00	.33	.491	.567	15 5/8	L is constant = 11.06″
	47.8	13 1/2	9/16	8.04	.37	.553	.630	15 3/4	
	51.4	13 1/2	9/16	9.00	.37	.544	.630	16 1/4	
	57.1	13 5/8	5/8	9.04	.41	.606	.692	16 3/8	
	61.0	13 5/8	5/8	10.00	.41	.597	.692	16 15/16	
	66.7	13 3/4	11/16	10.03	.44	.659	.755	17 1/16	
	71.0	13 3/4	11/16	11.00	.44	.649	.755	17 5/8	
	77.6	13 7/8	3/4	11.04	.48	.712	.817	17 3/4	
	82.2	13 7/8	3/4	12.00	.48	.702	.817	18 3/8	
	89.2	14	13/16	12.04	.52	.765	.880	18 1/2	
	93.7	14	13/16	13.00	.51	.755	.880	19 1/8	
H14	98.8	14	13/16	14.00	.51	.745	.880	19 13/16	
	106.7	14 1/8	7/8	14.04	.55	.808	.942	19 15/16	
	114.6	14 1/4	15/16	14.08	.59	.870	1.005	20 1/16	
	122.5	14 3/8	1	14.12	.63	.933	1.067	20 3/16	
	130.5	14 1/2	1 1/16	14.16	.67	.995	1.130	20 1/4	
	138.0	14 5/8	1 1/8	14.19	.70	1.058	1.192	20 3/8	
	146.0	14 3/4	1 3/16	14.23	.74	1.120	1.255	20 1/2	
	154.1	14 7/8	1 1/4	14.27	.78	1.183	1.317	20 5/8	
	162.2	15	1 5/16	14.31	.82	1.245	1.380	20 3/4	
H14a	164.4	15	1 5/16	14.57	.82	1.242	1.380	20 15/16	
	172.7	15 1/8	1 3/8	14.61	.86	1.305	1.442	21 1/16	
	180.9	15 1/4	1 7/16	14.65	.90	1.367	1.505	21 3/16	
	189.3	15 3/8	1 1/2	14.69	.94	1.430	1.567	21 1/4	
	197.6	15 1/2	1 9/16	14.73	.98	1.492	1.630	21 3/8	
	206.0	15 5/8	1 5/8	14.77	1.02	1.555	1.692	21 1/2	
	214.4	15 3/4	1 11/16	14.81	1.06	1.617	1.755	21 5/8	
	222.3	15 7/8	1 3/4	14.84	1.09	1.680	1.817	21 3/4	
H14b	230.8	16	1 13/16	14.88	1.13	1.742	1.880	21 7/8	
	239.3	16 1/8	1 7/8	14.92	1.17	1.805	1.942	22	
	247.9	16 1/4	1 15/16	14.96	1.21	1.867	2.005	22 1/8	
	256.5	16 3/8	2	15.00	1.25	1.930	2.067	22 1/4	
	265.1	16 1/2	2 1/16	15.04	1.29	1.992	2.130	22 3/8	
	273.7	16 5/8	2 1/8	15.08	1.33	2.055	2.192	22 7/16	
	282.4	16 3/4	2 3/16	15.12	1.37	2.117	2.255	22 9/16	
	291.2	16 7/8	2 1/4	15.16	1.41	2.180	2.317	22 11/16	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL
14″ H COLUMNS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX. Moment of Inertia. I	AXIS XX. Section Modulus. S	AXIS XX. Radius of Gyration. r	AXIS YY. Moment of Inertia. I′	AXIS YY. Section Modulus. S′	AXIS YY. Radius of Gyration. r′	Section Number.
42 6	12.53	400.8	59.9	5 66	43.6	10.9	1.87	
47.8	14.07	454.1	67.3	5.68	49.7	12.4	1.88	
51.4	15.12	498 3	73.8	5.75	68.8	15.3	2.13	
57.1	16.79	558.5	82.0	5.77	77.5	17.1	2.15	
61.0	17.95	607.5	89.2	5.82	103.7	20.7	2.40	
66.7	19.61	672.5	97.8	5.84	115.1	23.0	2.42	H14s
71.0	20.88	727 0	105.7	5.90	150.2	27.3	2.68	
77.6	22.81	800.6	115.4	5.93	165.9	30.1	2.70	
82.2	24.17	860.4	124.0	5.97	211.0	35.2	2.96	
89.2	26.23	942 4	134.6	5.99	231.4	38.4	2.97	
93.7	27.56	1004.7	143.5	6.04	288.5	44.4	3.24	
98.8	29.06	1070 6	153.0	6.07	355.9	50.8	3.50	
106 7	31.38	1166.6	165.2	6.10	387.8	55.2	3.52	
114.6	33.70	1264.5	177.5	6.13	420.3	59.7	3.53	
122.5	36.04	1364.6	189.9	6.16	453.4	64.2	3.55	
130.5	38.38	1466.7	202.3	6.18	486.9	68.8	3·56	H14
138.0	40.59	1568.4	214.5	6.21	519.7	73.3	3.58	
146.0	42.95	1674.7	227.1	6.24	554.4	77.9	3.59	
154.1	45.33	1783.3	239.8	6.27	589.5	82.6	3.61	
162.2	47.71	1894.0	252.5	6.31	625.1	87.4	3.62	
164.4	48.36	1924.7	256.6	6.32	659 8	90.6	3.69	
172.7	50.78	2039 5	269.7	6.34	697.9	95 5	3.71	
180.9	53.22	2156.7	282.8	6.37	736.5	100.5	3.72	
189.3	55.67	2276.1	296.1	6.39	775.8	105.6	3.73	H14a
197.6	58.12	2397.9	309.3	6.42	815.6	110.7	3.75	
206.0	60.59	2522.1	322.8	6.45	856.0	115.9	3.76	
214.4	63.07	2648.7	336.3	6.48	897.0	121.1	3.77	
222.3	65.39	2774.5	349.5	6.51	936.6	126.2	3.78	
230.8	67.89	2905 9	363.2	6.55	978.7	131.5	3.80	
239.3	70.39	3039.9	377.0	6.57	1021.4	136.9	3.81	
247.9	72.91	3176.3	390.9	6.60	1064 7	142.3	3.82	
256.5	75.43	3315.4	404.9	6.63	1108.7	147.8	3.83	H14b
265.1	77.97	3457.0	419.0	6.66	1153.3	153.4	3 85	
273.7	80.51	3601.2	433.2	6.69	1198.5	158.9	3.86	
282.4	83.07	3748.1	447.5	6.72	1244.3	164.6	3.87	
291.2	85.63	3897.7	462.0	6.75	1290.7	170.3	3.88	

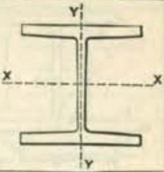


DIMENSIONS AND PROPERTIES OF
BETHLEHEM ROLLED STEEL
13″ H COLUMNS.

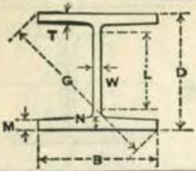
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES.							
		D	Nominal. T	B	W	M	N	G	L
	41.2	12⅜	½	8.00	.33	.486	.562	14¾	L is constant = 10.07″
	46.3	12½	9/16	8.04	.37	.548	.625	14⅞	
	49.9	12½	9/16	9.00	.37	.539	.625	15 7/16	
	55.0	12⅝	⅝	9.03	.40	.601	.687	15 9/16	
H13 s	58.9	12⅝	⅝	10.00	.40	.591	.687	16⅛	
	64.9	12¾	11/16	10.04	.44	.654	.750	16¼	
	69.1	12¾	11/16	11.00	.44	.644	.750	16⅞	
	75.6	12⅞	¾	11.04	.48	.707	.812	17	
	79.8	12⅞	¾	12.00	.47	.697	.812	17⅝	
	86.6	13	13/16	12.04	.51	.760	.875	17¾	
	91.5	13	13/16	13.00	.51	.750	.875	18 7/16	
	98.9	13⅛	⅞	13.04	.55	.813	.937	18½	
	106.2	13¼	15/16	13.08	.59	.875	1.000	18⅝	
	113.6	13⅜	1	13.12	.63	.938	1.062	18¾	
H13	121.0	13½	1 1/16	13.16	.67	1.000	1.125	18⅞	
	128.0	13⅝	1⅛	13.19	.70	1.063	1.187	19	
	135.5	13¾	1 3/16	13.23	.74	1.125	1.250	19⅛	
	143.0	13⅞	1¼	13.27	.78	1.188	1.312	19¼	
	150.5	14	1 5/16	13.31	.82	1.250	1.375	19⅜	
	156.4	14	1 5/16	14.00	.82	1.243	1.375	19 13/16	
	164.2	14⅛	1⅜	14.04	.86	1.306	1.437	19 15/16	
	172.1	14¼	1 7/16	14.08	.90	1.368	1.500	20 1/16	
	180.1	14⅜	1½	14.12	.94	1.431	1.562	20 3/16	
H13 a	188.0	14½	1 9/16	14.16	.98	1.493	1.625	20¼	
	196.1	14⅝	1⅝	14.20	1.02	1.556	1.687	20⅜	
	204.1	14¾	1 11/16	14.24	1.06	1.618	1.750	20½	
	211.7	14⅞	1¾	14.27	1.09	1.681	1.812	20⅝	
	219.8	15	1 13/16	14.31	1.13	1.743	1.875	20¾	
	226.5	15	1 13/16	14.88	1.13	1.737	1.875	21⅛	
	234.9	15⅛	1⅞	14.92	1.17	1.800	1.937	21¼	
	243.3	15¼	1 15/16	14.96	1.21	1.862	2.000	21⅜	
H13 b	251.8	15⅜	2	15.00	1.25	1.925	2.062	21½	
	260.2	15½	2 1/16	15.04	1.29	1.987	2.125	21⅝	
	268.8	15⅝	2⅛	15.08	1.33	2.050	2.187	21¾	
	277.3	15¾	2 3/16	15.12	1.37	2.112	2.250	21⅞	
	285.9	15⅞	2¼	15.16	1.41	2.175	2.312	22	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL
13″ H COLUMNS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX.			AXIS YY.			Section Number.
		Moment of Inertia. I	Section Modulus. S	Radius of Gyration. r	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration. r′	
41.2	12.12	334.5	54.1	5.25	43.2	10.8	1.89	
46.3	13.62	379.7	60.8	5.28	49.3	12.3	1.90	
49.9	14.67	417.0	66.7	5.33	68.2	15.2	2.16	
55.0	16.17	466.5	73.9	5.37	76.6	17.0	2.18	
58.9	17.33	508.3	80.5	5.42	102.8	20.6	2.44	H13 s
64.9	19.09	565.6	88.7	5.44	114.6	22.8	2.45	
69.1	20.33	611.2	95.9	5.48	149.1	27.1	2.71	
75.6	22.22	674.8	104.8	5.51	164.8	29.9	2.72	
79.8	23.46	723.5	112.4	5.55	209.5	34.9	2.99	
86.6	25.48	793.6	122.1	5.58	229.9	38.2	3.00	
91.5	26.93	847.9	130.5	5.61	286.7	44.1	3.26	
98.9	29.08	924.8	140.9	5.64	312.5	47.9	3.28	
106.2	31.24	1003.5	151.5	5.67	338.8	51.8	3.29	
113.6	33.41	1083.9	162.1	5.70	365.5	55.7	3.31	
121.0	35.59	1166.1	172.8	5.72	392.7	59.7	3.32	H13
128.0	37.64	1248.1	183.2	5.76	419.3	63.6	3.34	
135.5	39.84	1333.9	194.0	5.79	447.4	67.6	3.35	
143.0	42.05	1421.7	204.9	5.82	475.9	71.7	3.36	
150.5	44.27	1511.4	215.9	5.84	504.9	75.9	3.38	
156.4	45.99	1581.6	225.9	5.86	585.1	83.6	3.57	
164.2	48.30	1677.5	237.5	5.89	619.0	88.2	3.58	
172.1	50.63	1775.5	249.2	5.92	653.6	92.8	3.59	
180.1	52.96	1875.5	260.9	5.95	688.6	97.5	3.61	
188.0	55.31	1977.7	272.8	5.98	724.2	102.3	3.62	H13 a
196.1	57.66	2081.9	284.7	6.01	760.3	107.1	3.63	
204.1	60.03	2188.4	296.7	6.04	797.0	111.9	3.64	
211.7	62.25	2294.2	308.5	6.07	832.4	116.7	3.66	
219.8	64.64	2404.9	320.7	6.10	870.2	121.6	3.67	
226.5	66.62	2492.7	332.4	6.12	975.8	131.2	3.83	
234.9	69.09	2609.7	345.1	6.15	1018.5	136.5	3.84	
243.3	71.56	2729.1	357.9	6.18	1061.8	141.9	3.85	
251.8	74.05	2850.8	370.8	6.21	1105.7	147.4	3.86	H13 b
260.2	76.54	2974.9	383.9	6.24	1150.2	152.9	3.88	
268.8	79.05	3101.5	396.9	6.26	1195.4	158.5	3.89	
277.3	81.56	3230.5	410.2	6.29	1241.2	164.2	3.90	
285.9	84.09	3361.9	423.6	6.32	1287.6	169.9	3.91	



DIMENSIONS AND PROPERTIES OF

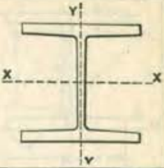
BETHLEHEM ROLLED STEEL 12″ H COLUMNS.

Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES.							
		D	Nominal. T	B	W	M	N	G	L
H12s	40.0	11½	½	8.00	.33	.481	.558	14 1/16	L is constant = 9.21″
	45.0	11⅝	9/16	8.04	.37	.543	.620	14⅛	
	48.1	11⅝	9/16	9.00	.36	.534	.620	14¾	
	55.6	11¾	⅝	9.04	.40	.596	.683	14⅞	
	57.4	11¾	⅝	10.00	.40	.587	.683	15 7/16	
	63.3	11⅞	11/16	10.04	.44	.649	.745	15 9/16	
	67.1	11⅞	11/16	11.00	.43	.639	.745	16 3/16	
	73.4	12	¾	11.04	.47	.702	.808	16 5/16	
H12	78.0	12	¾	12.00	.47	.692	.808	17	
	84.7	12⅛	13/16	12.04	.51	.755	.870	17⅛	
	91.5	12¼	⅞	12.08	.55	.817	.933	17¼	
	98.3	12⅜	15/16	12.12	.59	.880	.995	17⅜	
	105.2	12½	1	12.16	.63	.942	1.058	17 7/16	
	112.1	12⅝	1 1/16	12.20	.67	1.005	1.120	17 9/16	
	118.6	12¾	1⅛	12.23	.70	1.067	1.183	17 11/16	
	125.5	12⅞	1 3/16	12.27	.74	1.130	1.245	17 13/16	
	132.5	13	1¼	12.31	.78	1.192	1.308	17 15/16	
H12a	138.1	13	1¼	13.00	.78	1.185	1.308	18 7/16	
	145.4	13⅛	1 5/16	13.04	.82	1.248	1.370	18½	
	152.7	13¼	1⅜	13.08	.86	1.310	1.433	18⅝	
	160.1	13⅜	1 7/16	13.12	.90	1.373	1.495	18¾	
	167.5	13½	1½	13.16	.94	1.435	1.558	18⅞	
	174 9	13⅝	1 9/16	13.20	.98	1.498	1.620	19	
	182.4	13¾	1⅝	13.24	1.02	1.560	1.683	19⅛	
	189.9	13⅞	1 11/16	13.28	1.06	1.623	1.745	19¼	
	197.1	14	1¾	13.31	1.09	1.685	1.808	19⅜	
H12b	204.9	14	1¾	14.00	1.09	1.679	1.808	19 13/16	
	212.8	14⅛	1 13/16	14.04	1.13	1.741	1.870	19 15/16	
	220.7	14¼	1⅞	14.08	1.17	1.804	1.933	20 1/16	
	228.6	14⅜	1 15/16	14.12	1.21	1.866	1.995	20 3/16	
	236.6	14½	2	14.16	1.25	1.929	2.058	20 5/16	
	244.6	14⅝	2 1/16	14.20	1.29	1.991	2.120	20⅜	
	252.8	14¾	2⅛	14.24	1.33	2.054	2.183	20½	
	260.7	14⅞	2 3/16	14.28	1.37	2.116	2.245	20⅝	
	268.8	15	2¼	14.32	1.41	2.179	2.308	20¾	

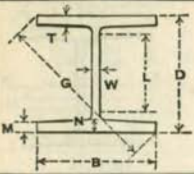
DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

12″ H COLUMNS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX.			AXIS YY.			Section Number.
		Moment of Inertia. I	Section Modulus. S	Radius of Gyration. r	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration. r′	
40.0	11.76	282.1	49.1	4.90	42.8	10.7	1.91	
45.0	13.23	320.8	55.2	4.92	48.9	12.2	1.92	
48.1	14.16	351.6	60.5	4.98	67.6	15.0	2.19	
55.6	15.75	395.4	67.3	5.01	76.3	16.9	2.20	H12 s
57.4	16.89	430.8	73.3	5.05	102.0	20.4	2.46	
63.3	18.61	480.0	80.8	5.08	113.8	22.7	2.47	
67.1	19.74	518.0	87.3	5.12	148.0	26.9	2.74	
73.4	21.60	572.8	95.5	5.15	163.7	29.7	2.75	
78.0	22.94	615.6	102.6	5.18	208.1	34.7	3.01	
84.7	24.92	676.1	111.5	5.21	228.5	37.9	3.03	
91.5	26.92	738.1	120.5	5.24	249.2	41.3	3.04	
98.3	28.92	801.7	129.6	5.27	270.1	44.6	3.06	
105.2	30.94	866.8	138.6	5.30	291.7	48.0	3.07	H12
112.1	32.96	933.4	147.9	5.33	313.6	51.4	3.08	
118.6	34.87	1000.0	156.9	5.36	335.0	54.8	3.10	
125.5	36.91	1069.8	166.2	5.38	357.7	58.3	3.11	
132.5	38.97	1141.3	175.6	5.41	380.7	61.9	3.13	
138.1	40.61	1198.8	184.4	5.43	446.4	68.7	3.32	
145.4	42.76	1275.6	194.4	5.46	473.7	72.7	3.33	
152.7	44.92	1354.2	204.4	5.49	501.5	76.7	3.34	
160.1	47.09	1434.6	214.5	5.52	529.8	80.8	3.35	
167.5	49.27	1516.9	224.7	5.55	558.5	84.9	3.37	H12 a
174.9	51.46	1601.0	235.0	5.58	587.7	89.0	3.38	
182.4	53.66	1686.9	245.4	5.61	617.4	93.3	3.39	
189.9	55.87	1774.7	255.8	5.64	647.5	97.5	3.40	
197.1	57.96	1862.2	266.0	5.67	676.6	101.7	3.42	
204.9	60.27	1950.8	278.7	5.69	784.8	112.1	3.61	
212.8	62.58	2046.7	289.8	5.72	820.5	116.9	3.62	
220.7	64.91	2144.7	301.0	5.75	856.8	121.6	3.63	
228.6	67.24	2244.7	312.3	5.78	893.6	126.6	3.65	
236.6	69.59	2346.9	323.7	5.81	931.0	131.5	3.66	H12 b
244.6	71.94	2451.1	335.2	5.84	969.0	136.5	3.67	
252.8	74.31	2557.6	346.8	5.87	1007.5	141.5	3.68	
260.7	76.68	2666.2	358.5	5.90	1046.5	146.6	3.69	
268.8	79.06	2777.0	370.3	5.93	1086.2	151.7	3.71	



DIMENSIONS AND PROPERTIES OF

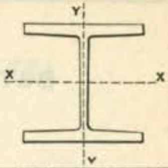
BETHLEHEM ROLLED STEEL

11″ H COLUMNS.

Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES.							
		D	Nominal. T	B	W	M	N	G	L
	38.4	$10\frac{5}{8}$	$\frac{1}{2}$	8.00	.32	.476	.553	$13\frac{5}{16}$	
	43.3	$10\frac{3}{4}$	$\frac{9}{16}$	8.04	.36	.539	.615	$13\frac{7}{16}$	
H11 s	46.8	$10\frac{3}{4}$	$\frac{9}{16}$	9.00	.36	.529	.615	$14\frac{1}{16}$	
	52.1	$10\frac{7}{8}$	$\frac{5}{8}$	9.04	.40	.591	.678	$14\frac{3}{16}$	
	55.9	$10\frac{7}{8}$	$\frac{5}{8}$	10.00	.40	.582	.678	$14\frac{13}{16}$	
	61.3	11	$\frac{11}{16}$	10.03	.43	.644	.740	$14\frac{15}{16}$	
	65.5	11	$\frac{11}{16}$	11.00	.43	.635	.740	$15\frac{9}{16}$	
	71.7	$11\frac{1}{8}$	$\frac{3}{4}$	11.04	.47	.697	.803	$15\frac{11}{16}$	
	77.9	$11\frac{1}{4}$	$\frac{13}{16}$	11.08	.51	.760	.865	$15\frac{13}{16}$	
	84.2	$11\frac{3}{8}$	$\frac{7}{8}$	11.12	.55	.822	.928	$15\frac{15}{16}$	
H11	90.5	$11\frac{1}{2}$	$\frac{15}{16}$	11.16	.59	.885	.990	$16\frac{1}{16}$	L is constant = 8.44″
	96.8	$11\frac{5}{8}$	1	11.20	.63	.947	1.053	$16\frac{3}{16}$	
	103.1	$11\frac{3}{4}$	$1\frac{1}{16}$	11.24	.67	1.010	1.115	$16\frac{5}{16}$	
	109.1	$11\frac{7}{8}$	$1\frac{1}{8}$	11.27	.70	1.072	1.178	$16\frac{3}{8}$	
	115.5	12	$1\frac{3}{16}$	11.31	.74	1.135	1.240	$16\frac{1}{2}$	
	120.9	12	$1\frac{3}{16}$	12.00	.74	1.128	1.240	17	
	127.6	$12\frac{1}{8}$	$1\frac{1}{4}$	12.04	.78	1.190	1.303	$17\frac{1}{8}$	
	134.4	$12\frac{1}{4}$	$1\frac{5}{16}$	12.08	.82	1.253	1.365	$17\frac{1}{4}$	
	141.2	$12\frac{3}{8}$	$1\frac{3}{8}$	12.12	.86	1.315	1.428	$17\frac{3}{8}$	
H11 a	148.1	$12\frac{1}{2}$	$1\frac{7}{16}$	12.16	.90	1.378	1.490	$17\frac{7}{16}$	
	154.9	$12\frac{5}{8}$	$1\frac{1}{2}$	12.20	.94	1.440	1.553	$17\frac{9}{16}$	
	161.9	$12\frac{3}{4}$	$1\frac{9}{16}$	12.24	.98	1.503	1.615	$17\frac{11}{16}$	
	168.8	$12\frac{7}{8}$	$1\frac{5}{8}$	12.28	1.02	1.565	1.678	$17\frac{13}{16}$	
	175.8	13	$1\frac{11}{16}$	12.32	1.06	1.628	1.740	$17\frac{15}{16}$	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL 11″ H COLUMNS.

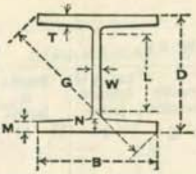


Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX.			AXIS YY.			Section Number.
		Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′	
38.4	11.30	234.1	44.1	4.55	42.4	10.6	1.94	
43.3	12.73	266.8	49.6	4.58	48.4	12.0	1.95	
46.8	13.76	293.5	54.6	4.62	67.0	14.9	2.21	H11s
52.1	15.32	330.7	60.8	4.65	75.7	16.7	2.22	
55.9	16.44	360.5	66.3	4.68	101.2	20.2	2.47	
61.3	18.02	401.2	73.0	4.72	112.6	22.4	2.50	
65.5	19.26	434.6	79.0	4.75	147.0	26.7	2.76	
71.7	21.08	481.2	86.5	4.78	162.6	29.5	2.78	
77.9	22.91	529.2	94.1	4.81	178.6	32.2	2.79	
84.2	24.75	578.4	101.7	4.83	194.9	35.1	2.81	
90.5	26.60	628.9	109.4	4.86	211.6	37.9	2.82	H11
96.8	28.46	680.8	117.1	4.89	228.6	40.8	2.83	
103.1	30.33	734.0	124.9	4.92	245.9	43.7	2.85	
109.1	32.10	787.2	132.5	4.95	262.8	46.6	2.86	
115.5	33.98	843.1	140.5	4.98	280.7	49.6	2.87	
120.9	35.54	889.4	148.2	5.00	333.5	55.6	3.06	
127.6	37.53	949.9	156.7	5.03	355.4	59.0	3.08	
134.4	39.52	1011.9	165.2	5.06	377.4	62.5	3.09	
141.2	41.53	1075.5	173.9	5.09	399.8	65.9	3.10	
148.1	43.54	1140.5	182.4	5.12	422.6	69.5	3.12	H11 a
154.9	45.57	1207.2	191.2	5.15	445.8	73.1	3.13	
161.9	47.60	1275.5	200.8	5.18	469.4	76.7	3.14	
168.8	49.65	1345.4	209.0	5.21	493.4	80.4	3.15	
175.8	51.70	1417.0	218.0	5.24	517.9	84.1	3.17	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

10″ H COLUMNS.

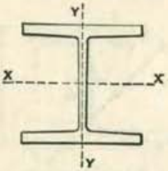


Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES.							
		D	Nominal. T	B	W	M	N	G	L
	37.2	9¾	½	8.00	.32	.471	.548	12⅝	L is constant = 7.67″
	42.0	9⅞	9/16	8.04	.36	.534	.611	12¾	
H10s	45.4	9⅞	9/16	9.00	.36	.524	.611	13⅜	
	50.6	10	⅝	9.04	.40	.587	.673	13½	
	54.1	10	⅝	10.00	.39	.577	.673	14 3/16	
	59.7	10⅛	11/16	10.04	.43	.639	.736	14 5/16	
	65.4	10¼	¾	10.08	.47	.702	.798	14⅜	
	71.1	10⅜	13/16	10.12	.51	.764	.861	14½	
H10	76.8	10½	⅞	10.16	.55	.827	.923	14⅝	
	82.6	10⅝	15/16	10.20	.59	.889	.986	14¾	
	88.4	10¾	1	10.24	.63	.952	1.048	14⅞	
	94.2	10⅞	1 1/16	10.28	.67	1.014	1.111	15	
	99.7	11	1⅛	10.31	.70	1.077	1.173	15⅛	
	104.7	11	1⅛	11.00	.70	1.070	1.173	15 9/16	
	110.9	11⅛	1 3/16	11.04	.74	1.133	1.236	15 11/16	
	117.1	11¼	1¼	11.08	.78	1.195	1.298	15 13/16	
	123.4	11⅜	1 5/16	11.12	.82	1.258	1.361	15 15/16	
H10a	129.7	11½	1⅜	11.16	.86	1.320	1.423	16 1/16	
	136.0	11⅝	1 7/16	11.20	.90	1.383	1.486	16 3/16	
	142.4	11¾	1½	11.24	.94	1.445	1.548	16 5/16	
	148.8	11⅞	1 9/16	11.28	.98	1.508	1.611	16⅜	
	155.2	12	1⅝	11.32	1.02	1.570	1.673	16½	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

10″ H COLUMNS.

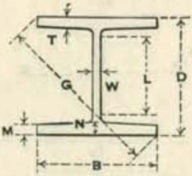


Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX. Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	AXIS YY. Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′	Section Number.
37.2	10.95	192.0	39.4	4.19	41.9	10.5	1.96	
42.0	12.34	219.2	44.4	4.22	48.0	11.9	1.97	H10s
45.4	13.36	241.4	48.9	4.25	66.4	14.8	2.23	
50.6	14.88	272.5	54.5	4.28	75.1	16.6	2.25	
54.1	15.91	296.8	59.4	4.32	100.4	20.1	2.51	
59.7	17.57	331.9	65.6	4.35	112.2	22.3	2.53	
65.4	19.23	368.0	71.8	4.37	124.2	24.6	2.54	
71.1	20.91	405.2	78.1	4.40	136.5	27.0	2.56	
76.8	22.59	443.6	84.5	4.43	149.1	29.4	2.57	H10
82.6	24.29	483.0	90.9	4.46	162.0	31.8	2.58	
88.4	25.99	523.5	97.4	4.49	175.1	34.2	2.60	
94.2	27.71	565.2	103.9	4.52	188.6	36.7	2.61	
99.7	29.32	607.0	110.4	4.55	201.7	39.1	2.62	
104.7	30.80	643.6	117.0	4.57	243.7	44.3	2.81	
110.9	32.62	690.3	124.1	4.60	260.5	47.2	2.83	
117.1	34.45	738.2	131.2	4.63	277.6	50.1	2.84	
123.4	36.29	787.4	138.4	4.66	295.0	53.1	2.85	
129.7	38.14	838.0	145.7	4.69	312.7	56.0	2.86	H10a
136.0	40.00	889.8	153.1	4.72	330.8	59.1	2.88	
142.4	41.87	943.0	160.5	4.75	349.3	62.1	2.89	
148.8	43.75	997.6	168.0	4.78	368.0	65.3	2.90	
155.2	45.64	1053.6	175.6	4.80	387.2	68.4	2.91	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

9″ H COLUMNS.

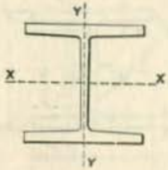


Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES. D	Nominal. T	B	W	M	N	G	L
H9 s	28.8	8¾	7/16	7.00	.28	.414	.481	11¼	L is constant = 6.91″
	32.9	8⅞	½	7.04	.32	.476	.543	11⅜	
	36.0	8⅞	½	8.00	.32	.466	.543	12	
	40.6	9	9/16	8.04	.36	.529	.606	12⅛	
H9	43.8	9	9/16	9.00	.35	.519	.606	12¾	
	48.9	9⅛	⅝	9.04	.39	.582	.668	12⅞	
	54.0	9¼	11/16	9.08	.43	.644	.731	13	
	59.1	9⅜	¾	9.12	.47	.707	.793	13⅛	
	64.3	9½	13/16	9.16	.51	.769	.856	13¼	
	69.5	9⅝	⅞	9.20	.55	.832	.918	13 5/16	
	74.7	9¾	15/16	9.24	.59	.894	.981	13 7/16	
	80.0	9⅞	1	9.28	.63	.957	1.043	13 9/16	
	85.3	10	1 1/16	9.32	.67	1.019	1.106	13 11/16	
H9 a	90.0	10	1 1/16	10.00	.67	1.012	1.106	14 3/16	
	95.3	10⅛	1⅛	10.03	.70	1.075	1.168	14¼	
	100.9	10¼	1 3/16	10.07	.74	1.137	1.231	14⅜	
	106.6	10⅜	1¼	10.11	.78	1.200	1.293	14½	
	112.3	10½	1 5/16	10.15	.82	1.262	1.356	14⅝	
	118.1	10⅝	1⅜	10.19	.86	1.325	1.418	14¾	
	123.9	10¾	1 7/16	10.23	.90	1.387	1.481	14⅞	
	129.7	10⅞	1½	10.27	.94	1.450	1.543	15	
	135.6	11	1 9/16	10.31	.98	1.512	1.606	15⅛	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

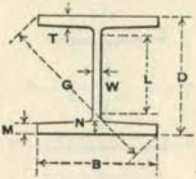
9″ H COLUMNS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX.			AXIS YY.			Section Number.
		Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′	
28.8	8.46	119.3	27.3	3.76	24.7	7.0	1.71	H9 s
32.9	9.69	138.6	31.2	3.78	28.7	8.2	1.72	
36.0	10.59	154.6	34.8	3.82	41.5	10.4	1.98	
40.6	11.95	177.0	39.3	3.85	47.6	11.8	2.00	
43.8	12.88	194.7	43.3	3.89	65.9	14.6	2.26	H9
48.9	14.37	220.3	48.3	3.91	74.5	16.5	2.28	
54.0	15.87	246.8	53.4	3.94	83.3	18.3	2.29	
59.1	17.38	274.2	58.5	3.97	92.3	20.2	2.31	
64.3	18.90	302.4	63.7	4.00	101.6	22.2	2.32	
69.5	20.43	331.6	68.9	4.03	111.0	24.1	2.33	
74.7	21.97	361.6	74.2	4.06	120.8	26.1	2.34	
80.0	23.52	392.6	79.5	4.09	130.7	28.2	2.36	
85.3	25.08	424.6	84.9	4.11	140.9	30.2	2.37	
90.0	26.46	452.6	90.5	4.14	173.1	34.6	2.56	H9 a
95.3	28.02	486.8	96.2	4.17	185.2	36.9	2.57	
100.9	29.68	522.9	102.0	4.20	198.1	39.4	2.58	
106.6	31.35	560.1	108.0	4.23	211.3	41.8	2.60	
112.3	33.04	598.4	114.0	4.26	224.8	44.3	2.61	
118.1	34.73	637.8	120.1	4.29	238.6	46.8	2.62	
123.9	36.44	678.3	126.0	4.32	252.6	49.4	2.63	
129.7	38.15	720.0	132.4	4.34	266.9	52.0	2.65	
135.6	39.87	762.8	138.7	4.38	281.6	54.6	2.66	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL
8″ H COLUMNS.

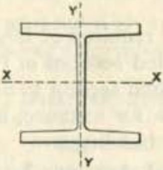


Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES. D	Nominal. T	B	W	M	N	G	L
H8 s	27.7	7⅞	7/16	7.00	.28	.409	.476	10 9/16	L is constant = 6.14″
	31.8	8	½	7.04	.32	.471	.538	10 11/16	
H8	34.6	8	½	8.00	.31	.462	.538	11⅜	
	39.1	8⅛	9/16	8.04	.35	.524	.601	11 7/16	
	43.6	8¼	⅝	8.08	.39	.587	.663	11 9/16	
	48.2	8⅜	11/16	8.12	.43	.649	.726	11 11/16	
	52.8	8½	¾	8.16	.47	.712	.788	11 13/16	
	57.4	8⅝	13/16	8.20	.51	.774	.851	12	
	62.1	8¾	⅞	8.24	.55	.837	.913	12 1/16	
	66.8	8⅞	15/16	8.28	.59	.899	.976	12⅛	
	71.6	9	1	8.32	.63	.962	1.038	12¼	
H8 a	76.0	9	1	9.00	.63	.955	1.038	12¾	
	81.1	9⅛	1 1/16	9.04	.67	1.017	1.101	12⅞	
	85.9	9¼	1⅛	9.07	.70	1.080	1.163	13	
	91.0	9⅜	1 3/16	9.11	.74	1.142	1.226	13⅛	
	96.1	9½	1¼	9.15	.78	1.205	1.288	13¼	
	101.3	9⅝	1 5/16	9.19	.82	1.267	1.351	13 5/16	
	106.6	9¾	1⅜	9.23	.86	1.330	1.413	13 7/16	
	111.8	9⅞	1 7/16	9.27	.90	1.392	1.476	13 9/16	
	117.1	10	1½	9.31	.94	1.455	1.538	13 11/16	

DIMENSIONS AND PROPERTIES OF

BETHLEHEM ROLLED STEEL

8″ H COLUMNS.



Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX. Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	AXIS YY. Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′	Section Number.
27.7	8.15	93.6	23.8	3.39	24.4	7.0	1.73	H8 s
31.8	9.35	109.1	27.3	3.42	28.5	8.1	1.74	
34.6	10.17	121.5	30.4	3.46	41.1	10.3	2.01	H8
39.1	11.50	139.5	34.3	3.48	47.2	11.7	2.03	
43.6	12.83	158.3	38.4	3.51	53.4	13.2	2.04	
48.2	14.18	177.7	42.4	3.54	59.8	14.7	2.05	
52.8	15.53	197.8	46.5	3.57	66.3	16.3	2.07	
57.4	16.90	218.6	50.7	3.60	73.1	17.8	2.08	
62.1	18.27	240.2	54.9	3.63	80.0	19.4	2.09	
66.8	19.66	262.5	59.2	3.65	87.1	21.0	2.11	
71.6	21.05	285.6	63.5	3.68	94.4	22.7	2.12	
76.0	22.35	306.8	68.2	3.70	118.9	26.4	2.31	H8 a
81.1	23.84	332.4	72.9	3.73	128.2	28.4	2.32	
85.9	25.25	358.2	77.5	3.77	137.3	30.3	2.33	
91.0	26.76	385.6	82.3	3.80	147.0	32.3	2.34	
96.1	28.28	413.8	87.1	3.83	157.0	34.3	2.36	
101.3	29.81	442.9	92.0	3.85	167.2	36.4	2.37	
106.6	31.35	472.9	97.0	3.88	177.7	38.5	2.38	
111.8	32.89	503.9	102.1	3.91	188.3	40.6	2.39	
117.1	34.45	535.9	107.2	3.94	199.3	42.8	2.41	

EXPLANATION OF THE BASE SECTIONS OF ROLLED STEEL H COLUMNS.

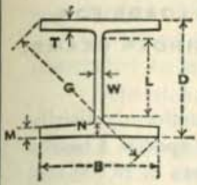
When columns are required of larger sectional area than is provided by the rolled sections of H columns, it is necessary to build a compound section to obtain the desired area. This may be the case, for instance, in the columns for the lower stories of a high building.

Additional sectional area may be obtained by riveting plates to the flanges of the regular H columns. But where the drilling of the increased number of holes required for attaching such plates may be objectionable, on account of the thick metal in the flanges of the heavy sections of H columns, the base sections may be used. These base sections are designed to match their corresponding H columns and permit the addition of plates or other shapes for increasing the area to the desired extent, avoiding the drilling of thick metal in the flanges.

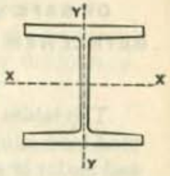
The dimensions and properties of these base sections are given on the opposite page. The section H12 c is produced by the same main rolls and has the same inner contour as the series of 12″ H columns on pages 64–65. If the maximum size of the regular 12″ H column does not provide the required area, the base section, H12 c, can be used and increased in area to the desired amount, in the manner indicated by Figs. 1, 2 or 3 on the opposite page. This may be necessary for the heavy columns required in the lower stories of a high building. The regular series of similar 12″ H columns can then be used in the upper stories, for which they provide sufficient sectional area. The regular H column section can be joined and spliced to its corresponding base section in the usual way.

In like manner the section H13 c can be used in connection with the regular series of 13″ H columns with which it matches; and similarly, section H14 c can be used in connection with the regular series of 14″ H columns to which it corresponds.

BETHLEHEM ROLLED STEEL H COLUMNS.



DIMENSIONS AND PROPERTIES OF
BASE SECTIONS
FOR BUILDING UP COLUMNS OF LARGE SECTIONAL AREA.



DIMENSIONS.

Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS IN INCHES.							
		D	Nominal. T	B	W	M	N	G	L
H12c	134.5	12¼	⅞	14.31	1.40	.804	.933	18 13/16	9.21
H13c	141.0	13⅛	⅞	14.59	1.41	.806	.937	19 15/16	10.07
H14c	148.0	14⅛	⅞	14.90	1.41	.808	.942	20⅞	11.06

PROPERTIES.

Section Number.	Weight of Section, Lbs. per Foot.	Area of Section, Square Inches.	AXIS XX.			AXIS YY.		
			Moment of Inertia. I	Section Modulus. S	Radius of Gyration, Inches. r	Moment of Inertia. I′	Section Modulus. S′	Radius of Gyration, Inches. r′
H12c	134.5	39.57	941.6	153.7	4.88	412.3	57.6	3.23
H13c	141.0	41.48	1129.3	172.1	5.22	438.5	60.1	3.25
H14c	148.0	43.52	1368.5	193.8	5.61	468.6	62.9	3.28

SUGGESTIONS FOR USING THE BASE SECTIONS OF H COLUMNS IN BUILDING UP COLUMNS OF LARGE SECTIONAL AREA.

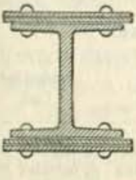


Fig. 1

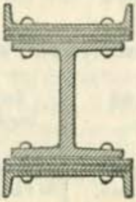


Fig. 2

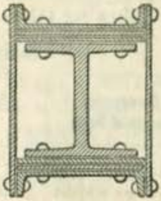


Fig. 3

EXPLANATION OF TABLES

OF SAFE UNIFORMLY DISTRIBUTED LOADS FOR BETHLEHEM SPECIAL I BEAMS AND GIRDER BEAMS.

The tables on pages 78–86 give the safe uniformly distributed load in tons of 2000 lbs. on Bethlehem special I beams and girder beams for a maximum fiber stress of 16,000 lbs. per square inch. The tabular loads include the weights of the beams, which must be deducted to obtain the net loads the beams will support.

Safe loads for intermediate or heavier weights of beams than those tabulated can be obtained by using the separate column of corrections, given for each size, stating the increase of safe load for each pound increase in the weight per foot of beam.

The safe loads on short spans may be limited by the shearing strength of the web instead of by the maximum fiber stress allowed in the flanges. This limit is indicated in the tables by heavy cross lines. The loads given above these lines are greater than the safe crippling strength of the web and must not be used, unless the webs are stiffened. In such cases it will generally be advisable to select a heavier beam with a thicker web. The maximum safe shear and corresponding least span on which the various beams can be used for full uniform distributed load is given on page 89.

It is assumed in these tables that the compression flanges of the beams are properly secured against yielding sideways. They should be held in position by tie rods, or other means, at distances not exceeding 20 times the width of the flange, otherwise the allowable loads must be reduced as per the following table :

BEAMS UNSUPPORTED SIDEWAYS.

Unsupported Length of Beam.	Greatest Safe Load.	Unsupported Length of Beam.	Greatest Safe Load.
20 flange widths.	Full tabular load.	50 flange widths.	$\frac{7}{10}$ tabular load.
30 flange widths.	$\frac{9}{10}$ tabular load.	60 flange widths	$\frac{6}{10}$ tabular load.
40 flange widths.	$\frac{8}{10}$ tabular load.	70 flange widths.	$\frac{5}{10}$ tabular load.

The Bethlehem beam sections in this respect have superior lateral stiffness due to their wide flanges.

The vertical deflection of the beams under the uniformly distributed loads given in the tables is found by the formula,

$$\text{Deflection, in inches} = 0.01655\,L^2 \div d$$
$$= L^2 \div 60\,d \text{ (very closely)}$$

where L = length of span in feet, and d = depth of beam in inches. The deflection is proportional to the load, so that for any other intensity of loading it can be found by simple proportion.

The safe load concentrated at the center of the span is one-half the safe uniformly distributed load. The deflection will be $\frac{8}{10}$ of the deflection for the latter load.

In the case of beams supporting plastered ceilings, if the deflection exceeds $\frac{1}{360}$ of the distance between supports, or $\frac{1}{30}$ of an inch per foot of span, there is danger of cracking the plaster. This allowable deflection is not exceeded under the tabular loads given unless the span is greater than 24 times the depth of the beam. This limit of span is indicated in the tables by dotted cross lines and the beams should not be used on longer spans unless the loads given in the tables are reduced in the following manner,

where L' = limiting span, in feet, for maximum deflection.
L = given span, in feet.
W = tabular safe load given for span L.
W' = reduced load on span L to limit deflection.
d = depth of beam in inches.

$$\text{Then}\quad L' = 2\,d, \quad \text{and}\quad W' = \frac{L'}{L}\,W.$$

Thus, to find the load on a 12″ special I beam weighing 28.5 lbs. per foot, on a span of 30 ft. which will produce a deflection of only $\frac{1}{360}$ of the span, the tabular load given on page 85 of 6.42 tons for the beam on this span must be reduced, as follows:

$$L' = 24, \text{ and } W' = \tfrac{24}{30} \times 6.42 = 5.136 \text{ tons.}$$

With this reduced load, the deflection will be $\frac{1}{360}$ of the span.

Comparison of these tables of safe loads with the similar tables on pages 187–189 for American standard I beams will show the economy in the weight of the Bethlehem special beam and girder sections over standard beams of equal capacity.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 LBS.

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS.

Span in Feet.	30″ G		Add for each Lb. Inc. in Wgt.	28″ G		Add for each Lb. Inc. in Wgt.	26″ G		Add for each Lb. Inc. in Wgt.
	G30 a	G30		G28 a	G28		G26 a	G26	
	200 Lbs.	175 Lbs.		180 Lbs.	162.5 Lbs.		160 Lbs.	150 Lbs.	
18	180.83	155.09	.44	153.83	136.82	.41	128.06	118.52	.38
19	171.31	146.93	.41	145.74	129.62	.39	121.32	112.28	.36
20	162.75	139.58	.39	138.45	123.14	.37	115.25	106.67	.34
21	155.00	132.94	.37	131.86	117.28	.35	109.76	101.59	.32
22	147.95	126.89	.36	125.86	111.95	.33	104.77	96.97	.31
23	141.52	121.38	.34	120.39	107.08	.32	100.22	92.76	.30
24	135.62	116.32	.33	115.37	102.62	.31	96.04	88.89	.28
25	130.20	111.67	.31	110.76	98.51	.29	92.20	85.34	.27
26	125.19	107.37	.30	106.50	94.72	.28	88.65	82.05	.26
27	120.55	103.39	.29	102.55	91.21	.27	85.37	79.01	.25
28	116.25	99.70	.28	98.89	87.96	.26	82.32	76.19	.24
29	112.24	96.26	.27	95.48	84.92	.25	79.49	73.56	.23
30	108.50	93.05	.26	92.30	82.09	.24	76.83	71.11	.23
31	105.00	90.05	.25	89.32	79.44	.24	74.35	68.82	.22
32	101.71	87.24	.25	86.53	76.96	.23	72.03	66.67	.21
33	98.63	84.59	.24	83.91	74.63	.22	69.85	64.65	.21
34	95.73	82.11	.23	81.44	72.43	.22	67.79	62.75	.20
35	93.00	79.76	.22	79.11	70.36	.21	65.86	60.95	.19
36	90.41	77.54	.22	76.91	68.41	.20	64.03	59.26	.19
37	87.97	75.45	.21	74.30	66.56	.20	62.30	57.66	.18
38	85.65	73.46	.21	72.87	64.81	.19	60.66	56.14	.18
39	83.46	71.58	.20	71.00	63.15	.19	59.10	54.70	.17
40	81.37	69.79	.20	69.22	61.57	.18	57.62	53.33	.17
41	79.39	68.09	.19	67.53	60.07	.18	56.22	52.03	.17
42	77.50	66.47	.19	65.93	58.64	.17	54.88	50.79	.16
43	75.69	64.92	.18	64.39	57.27	.17	53.60	49.61	.16
44	73.97	63.44	.18	62.93	55.97	.17	52.38	48.48	.15
45	72.33	62.03	.17	61.53	54.73	.16	51.22	47.41	.15
46	70.76	60.69	.17	60.19	53.54	.16	50.11	46.38	.15
47	69.25	59.39	.17	58.91	52.40	.16	49.04	45.37	.14
48	67.81	58.16	.16	57.68	51.31	.15	48.02	44.44	.14

Safe loads given include weight of beam.
Maximum fiber stress, 16,000 lbs. per square inch.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 LBS.

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS.

Span in Feet.	24″ G		Add for each Lb. Increase in Weight.	20″ G		Add for each Lb. Increase in Weight.	18″ G	Add for each Lb. Increase in Weight.
	G24 a	G24		G20 a	G20		G18	
	140 Lbs.	120 Lbs.		140 Lbs.	112 Lbs.		92 Lbs.	
12	157.11	134.47	.52	130.59	105.28	.44	78.78	.39
13	145.03	124.12	.48	120.55	97.18	.40	72.72	.36
14	134.67	115.26	.45	111.94	90.24	.37	67.53	.34
15	125.69	107.57	.42	104.47	84.22	.35	63.03	.31
16	117.83	100.85	.39	97.94	78.96	.33	59.09	.29
17	110.90	94.92	.37	92.18	74.32	.31	55.61	.28
18	104.74	89.64	.35	87.06	70.19	.29	52.52	.26
19	99.23	84.93	.33	82.48	66.49	.28	49.76	.25
20	94.27	80.68	.31	78.35	63.17	.26	47.27	.24
21	89.78	76.84	.30	74.63	60.16	.25	45.02	.22
22	85.70	73.35	.29	71.23	57.43	.24	42.97	.21
23	81.97	70.16	.27	68.13	54.93	.23	41.10	.20
24	78.56	67.23	.26	65.30	52.64	.22	39.39	.20
25	75.41	64.54	.25	62.68	50.53	.21	37.82	.19
26	72.51	62.06	.24	60.27	48.59	.20	36.36	.18
27	69.83	59.76	.23	58.04	46.79	.19	35.01	.17
28	67.33	57.63	.22	55.97	45.12	.19	33.76	.17
29	65.01	55.64	.22	54.04	43.56	.18	32.60	.16
30	62.84	53.79	.21	52.24	42.11	.17	31.51	.16
31	60.82	52.05	.20	50.55	40.75	.17	30.50	.15
32	58.92	50.43	.20	48.97	39.48	.16	29.54	.15
33	57.13	48.90	.19	47.49	38.28	.16	28.65	.14
34	55.45	47.46	.18	46.09	37.16	.15	27.81	.14
35	53.87	46.10	.18	44.77	36.10	.15	27.01	.13
36	52.37	44.82	.17	43.53	35.09	.15	26.26	.13
37	50.96	43.61	.17	42.35	34.14	.14	25.55	.13
38	49.61	42.46	.17	41.24	33.25	.14	24.88	.12
39	48.47	41.37	.16	40.18	32.39	.13	24.34	.12
40	47.13	40.34	.16	39.18	31.58	.13	23.64	.12

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads given below the dotted line produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM GIRDER BEAMS

IN TONS OF 2000 LBS.

BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS.

Span, in Feet.	15″ G			Add for each Lb. Inc. in Wgt.	12″ G		Add for each Lb. Inc. in Wgt.
	G15 b	G15 a	G15		G12 a	G12	
	140 Lbs.	104 Lbs.	73 Lbs.		70 Lbs.	55 Lbs.	
10	113.17	86.74	63.05	.39	48.08	38.40	.31
11	102.89	78.85	57.31	.36	43.71	34.91	.29
12	94.31	72.28	52.54	.33	40.07	32.00	.26
13	87.06	66.72	48.50	.30	36.98	29.54	.24
14	80.84	61.95	45.03	.28	34.34	27.43	.22
15	75.48	57.82	42.03	.26	32.05	25.60	.21
16	70.73	54.21	39.40	.25	30.05	24.00	.20
17	66.57	51.02	37.09	.23	28.28	22.59	.19
18	62.87	48.19	35.03	.22	26.71	21.33	.18
19	59.56	45.65	33.18	.21	25.31	20.21	.17
20	56.59	43.37	31.52	.20	24.04	19.20	.16
21	53.89	41.30	30.02	.19	22.90	18.29	.15
22	51.44	39.43	28.66	.18	21.85	17.45	.14
23	49.21	37.71	27.41	.17	20.90	16.70	.14
24	47.16	36.14	26.27	.16	20.03	16.00	.13
25	45.27	34.69	25.22	.16	19.23	15.36	.13
26	43.53	33.36	24.25	.15	18.49	14.77	.12
27	41.92	32.12	23.35	.15	17.81	14.22	.12
28	40.42	30.98	22.52	.14	17.17	13.71	.11
29	39.03	29.91	21.74	.14	16.58	13.24	.11
30	37.74	28.91	21.02	.13	16.03	12.80	.10
31	36.51	27.98	20.34	.13	15.51	12.39	.10
32	35.37	27.11	19.70	.12	15.03	12.00	.10
33	34.30	26.28	19.10	.12	14.57	11.64	.10
34	33.29	25.51	18.54	.12	14.14	11.29	.09
35	32.34	24.78	18.01	.11	13.74	10.97	.09

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy line are greater than safe loads for web crippling.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR
BETHLEHEM GIRDER BEAMS
IN TONS OF 2000 LBS.
BEAMS BEING SECURED AGAINST YIELDING SIDEWAYS.

Span, in Feet.	10″ G G10 44 Lbs.	Add for each Lb. Increase in Weight.	Span, in Feet.	9″ G G9 38 Lbs.	Add for each Lb. Increase in Weight.	8″ G G8 32.5 Lbs.	Add for each Lb. Increase in Weight.
10	26.06	.26	5	40.25	.47	30.38	.42
11	23.69	.24	6	33.54	.39	25.32	.35
12	21.72	.22	7	28.75	.34	21.70	.30
13	20.05	.20	8	25.15	.29	18.99	.26
14	18.61	.19	9	22.36	.26	16.88	.23
15	17.37	.17	10	20.12	.23	15.19	.21
16	16.39	.16	11	18.29	.21	13.81	.19
17	15.33	.15	12	16.77	.20	12.66	.17
18	14.48	.15	13	15.48	.18	11.69	.16
19	13.72	.14	14	14.37	.17	10.85	.15
20	13.03	.13	15	13.42	.16	10.13	.14
21	12.41	.12	16	12.58	.15	9.50	.13
22	11.84	.12	17	11.83	.14	8.94	.12
23	11.33	.11	18	11.18	.13	8.44	.12
24	10.86	.11	19	10.59	.12	8.00	.11
25	10.42	.10	20	10.06	.12	7.60	.10
26	10.02	.10	21	9.58	.11	7.23	.10
27	9.65	.10	22	9.15	.11	6.91	.09
28	9.31	.09	23	8.75	.10	6.61	.09
29	8.99	.09	24	8.38	.10	6.33	.08
30	8.69	.09	25	8.05	.09	6.08	.08
31	8.41	.08	26	7.74	.09		
32	8.14	.08	27	7.45	.09		
33	7.90	.08	28	7.19	.08		
34	7.66	.08	29	6.94	.08		
35	7.45	.07	30	6.71	.07		

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM SPECIAL I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	30″ I B30 120 Lbs.	Add for each Lb. Increase in Weight.	28″ I B28 105 Lbs.	Add for each Lb. Increase in Weight.	26″ I B26 90 Lbs.	Add for each Lb. Increase in Weight.
18	104.12	.44	86.55	.41	69.36	.38
19	98.64	.41	81.99	.39	65.71	.36
20	93.70	.39	77.89	.37	62.42	.34
21	89.24	.37	74.18	.35	59.45	.32
22	85.19	.36	70.81	.33	56.75	.31
23	81.48	.34	67.73	.32	54.28	.30
24	78.09	.33	64.91	.31	52.02	.28
25	74.96	.31	62.31	.29	49.94	.27
26	72.08	.30	59.92	.28	48.02	.26
27	69.41	.29	57.70	.27	46.24	.25
28	66.93	.28	55.64	.26	44.59	.24
29	64.62	.27	53.72	.25	43.05	.23
30	62.47	.26	57.93	.24	41.61	.23
31	60.45	.25	50.25	.24	40.27	.22
32	58.57	.25	48.68	.23	39.01	.21
33	56.79	.24	47.21	.22	37.83	.21
34	55.12	.23	45.82	.22	36.72	.20
35	53.55	.22	44.51	.21	35.67	.19
36	52.06	.22	43.27	.20	34.68	.19
37	50.65	.21	42.10	.20	33.74	.18
38	49.32	.21	41.00	.19	32.85	.18
39	48.05	.20	39.95	·19	32.01	.17
40	46.85	.20	38.95	.19	31.21	.17
41	45.71	.19	38.00	.18	30.45	.17
42	44.62	.19	37.09	.18	29.72	.16
43	43.58	.18	36.23	.17	29.03	.16
44	42.59	.18	35.41	.17	28.37	.15
45	41.65	.17	34.62	.16	27.74	.15
46	40.74	.17	33.87	.16	27.14	.15
47	39.87	.17	33.15	.16	26.56	.14
48	39.04	.16	32.46	.15	26.01	.14

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM SPECIAL I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	24″ I		Add for each Lb. Increase in Weight	20″ I					Add for each Lb. Increase in Weight.
	B24 a	B24		B20 a	B20				
	84 Lbs.	72 Lbs.		72 Lbs.	68 Lbs.	63 Lbs.	60 Lbs.	58.5 Lbs.	
12	88.58	77.42	.52	65.24	56.44	54.35	53.03	52.28	.44
13	81.76	71.47	.48	60.22	52.10	50.17	48.95	48.26	.40
14	75.92	66.36	.45	55.92	48.38	46.59	45.45	44.81	.37
15	70.86	61.94	.42	52.19	45.15	43.48	42.42	41.83	.35
16	66.43	58.07	.39	48.93	42.33	40.76	39.77	39.21	.33
17	62.53	54.65	.37	46.05	39.84	38.37	37.43	36.91	.31
18	59.05	51.62	.35	43.49	37.63	36.24	35.35	34.86	.29
19	55.94	48.90	.33	41.21	35.65	34.33	33.49	33.02	.28
20	53.15	46.45	.31	39.15	33.87	32.61	31.82	31.37	.26
21	50.62	44.24	.30	37.28	32 25	31.06	30.30	29.87	.25
22	48.32	42.23	.29	35.59	30.79	29.65	28.92	28.52	.24
23	46.21	40.39	.27	34.04	29.45	28.36	27.67	27.28	.23
24	44.29	38.71	.26	32.62	28.22	27.18	26.52	26.14	.22
25	42.52	37.16	.25	31.32	27.09	26.09	25.45	25.10	.21
26	40.88	35.74	.24	30.11	26.05	25.09	24.48	24.13	.20
27	39.37	34.41	.23	29.00	25.09	24.16	23.57	23.24	.19
28	37.96	33.18	.22	27.96	24.19	23.30	22.73	22.41	.19
29	36.65	32.04	.22	27.00	23.36	22.49	21.94	21.64	.18
30	35.43	30.97	.21	26.10	22.58	21.74	21.21	20.92	.17
31	34.29	29.97	.20	25.25	21.85	21.04	20.53	20.24	.17
32	33.22	29.04	.20	24.47	21.17	20.38	19.89	19.61	.16
33	32.21	28.15	.19	23.72	20.52	19.77	19.28	19.01	.16
34	31.27	27.33	.19	23.03	19.92	19.18	18.72	18.46	.15
35	30.37	26.54	.18	22.37	19.35	18.63	18.18	17.93	.15
36	29.53	25.81	.17	21.75	18.82	18.12	17.68	17.43	.15
37	28.73	25.11	.17	21.16	18.31	17.63	17.20	16.96	.14
38	27.97	24.45	.17	20.60	17.82	17.16	16.75	16.51	.14
39	27.25	23.82	.16	20.07	17.37	16.72	16.32	16.09	.13
40	26.58	23.23	.16	19.57	16.93	16.31	15.91	15.69	.13

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM SPECIAL I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	18″ I B18 58.5 Lbs.	18″ I B18 52.5 Lbs.	18″ I B18 48.5 Lbs.	Add for each Lb. Increase in Weight.	15″ I B15 b 72 Lbs.	15″ I B15 a 54 Lbs.	15″ I B15 46 Lbs.	15″ I B15 42 Lbs.	15″ I B15 38 Lbs.	Add for each Lb. Increase in Weight.
12	43.65	41.13	39.58	.39	47.28	36.17	28.72	27.55	26.22	.33
13	40.29	37.97	36.53	.36	43.65	33.39	26.51	25.43	24.20	.30
14	37.41	35.26	33.92	.34	40.53	31.00	24.61	23.61	22.47	.28
15	34.92	32.91	31.66	.31	37.83	28.94	22.97	22.04	20.97	.25
16	32.73	30.85	29.68	.29	35.46	27.13	21.54	20.66	19.66	.26
17	30.81	29.04	27.93	.28	33.38	25.53	20.27	19.45	18.51	.23
18	29.10	27.42	26.38	.26	31.52	24.11	19.14	18.37	17.48	.22
19	27.57	25.98	25.00	.25	29.86	22.84	18.14	17.40	16.56	.21
20	26.19	24.68	23.75	.24	28.37	21.70	17.23	16.53	15.73	.20
21	24.94	23.50	22.61	.22	27.02	20.67	16.41	15.74	14.98	.19
22	23.81	22.44	21.59	.21	25.79	19.73	15.66	15.03	14.30	.18
23	22.77	21.46	20.65	.21	24.67	18.87	14.98	14.37	13.68	.17
24	21.82	20.57	19.79	.20	23.64	18.09	14.36	13.78	13.11	.16
25	20.95	19.74	19.00	.19	22.70	17.36	13.79	13.22	12.59	.16
26	20.14	18.98	18.27	.18	21.82	16.70	13.26	12.72	12.10	.15
27	19.40	18.28	17.59	.17	21.01	16.08	12.76	12.24	11.65	.15
28	18.71	17.63	16.96	.17	20.27	15.50	12.31	11.81	11.24	.14
29	18.06	17.02	16.38	.16	19.57	14.97	11.88	11.40	10.85	.14
30	17.46	16.46	15.83	.16	18.92	14.47	11.49	11.02	10.49	.13
31	16.90	15.92	15.32	.15	18.30	14.00	11.12	10.66	10.15	.13
32	16.37	15.43	14.84	.15	17.73	13.57	10.77	10.33	9.83	.12
33	15.87	14.96	14.39	.14	17.19	13.15	10.44	10.02	9.53	.12
34	15.40	14.52	13.97	.14	16.69	12.77	10.14	9.73	9.25	.12
35	14.96	14.10	13.57	.13	16.21	12.40	9.85	9.45	8.99	.11
36	14.55	13.71	13.19	.13	15.76	12.06	9.57	9.18	8.74	.11
37	14.16	13.34	12.84	.13	15.34	11.73	9.31	8.94	8.50	.11
38	13.78	12.99	12.50	.12	14.93	11.42	9.07	8.70	8.28	.10
39	13.43	12.66	12.18	.12	14.55	11.13	8.85	8.48	8.07	.10
40	13.10	12.34	11.88	.12	14.19	10.85	8.62	8.27	7.87	.10

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy line exceed safe load for web crippling.

Safe loads below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM SPECIAL I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	12″ I			Add for each Lb. Increase in Weight.	10″ I			Add for each Lb. Increase in Weight.
	B12 a	B12			B10			
	36 Lbs.	31 Lbs.	28.5 Lbs.		27.5 Lbs.	24.5 Lbs.	22.5 Lbs.	
9	26.68	22.24	21.39	.35	15.96	15.07	14.56	.29
10	24.02	20.02	19.27	.31	14.37	13.57	13.10	.26
11	21.83	18.20	17.51	.29	13.06	12.33	11.91	.24
12	20.01	16.68	16.05	.26	11.97	11.30	10.92	.22
13	18.47	15.40	14.82	.24	11.05	10.43	10.08	.20
14	17.15	14.30	13.76	.22	10.26	9.69	9.36	.19
15	16.01	13.34	12.84	.21	9.58	9.04	8.73	.17
16	15.01	12.51	12.04	.20	8.98	8.48	8.19	.16
17	14.13	11.77	11.33	.19	8.45	7.98	7.71	.15
18	13.34	11.12	10.70	.17	7.98	7.54	7.28	.15
19	12.64	10.53	10.14	.17	7.56	7.14	6.89	.14
20	12.01	10.01	9.63	.16	7.18	6.78	6.55	.13
21	11.44	9.53	9.17	.15	6.84	6.46	6.24	.12
22	10.92	9.10	8.76	.14	6.53	6.17	5.95	.12
23	10.44	8.70	8.38	.14	6.25	5.90	5.70	.11
24	10.01	8.34	8.03	.13	5.99	5.65	5.46	.11
25	9.61	8.01	7.71	.13	5.75	5.43	5.24	.10
26	9.24	7.70	7.41	.12	5.53	5.22	5.04	.10
27	8.89	7.41	7.14	.12	5.32	5.02	4.85	.10
28	8.58	7.15	6.88	.11	5.13	4.84	4.68	.09
29	8.28	6.90	6.64	.11	4.95	4.68	4.52	.09
30	8.01	6.67	6.42	.11	4.79	4.52	4.37	.09
31	7.75	6.47	6.21	.10				
32	7.50	6.25	6.02	.10				
33	7.28	6.07	5.84	.10				
34	7.06	5.89	5.67	.09				
35	6.86	5.72	5.50	.09				

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Safe loads below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

BETHLEHEM SPECIAL I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	9″ I B9 23 Lbs.	9″ I B9 21 Lbs.	9″ I B9 19 Lbs.	Add for each Lb. Increase in Weight.	8″ I B8 21.25 Lbs.	8″ I B8 18 Lbs.	8″ I B8 16.25 Lbs.	Add for each Lb. Increase in Weight.
5	21.91	21.03	20.18	.47	17.25	16.00	15.20	.42
6	18.25	17.53	16.82	.39	14.38	13.33	12.67	.35
7	15.64	15.02	14.41	.34	12.32	11.43	10.85	.30
8	13.69	13.15	12.61	.29	10.78	10.00	9.50	.26
9	12.17	11.69	11.21	.26	9.58	8.89	8.44	.23
10	10.95	10.52	10.09	.24	8.63	8.00	7.60	.21
11	9.96	9.56	9.17	.21	7.84	7.27	6.91	.19
12	9.13	8.76	8.41	.20	7.19	6.67	6.33	.17
13	8.43	8.09	7.76	.18	6.63	6.15	5.85	.16
14	7.82	7.51	7.21	.17	6.16	5.71	5.43	.15
15	7.30	7.01	6.73	.16	5.75	5.33	5.07	.14
16	6.85	6.57	6.31	.15	5.39	5.00	4.75	.13
17	6.44	6.19	5.94	.14	5.07	4.71	4.47	.12
18	6.08	5.84	5.61	.13	4.79	4.44	4.22	.12
19	5.76	5.54	5.31	.13	4.54	4.21	4.00	.11
20	5.48	5.26	5.05	.12	4.31	4.00	3.80	.11
21	5.22	5.01	4.81	.11	4.11	3.81	3.62	.10
22	4.98	4.78	4.59	.11	3.92	3.64	3.45	.10
23	4.76	4.57	4.39	.10	3.75	3.48	3.30	.09
24	4.56	4.38	4.20	.10	3.59	3.33	3.17	.09
25	4.38	4.21	4.04	.10	3.45	3.20	3.04	.08
26	4.21	4.05	3.88	.09				
27	4.06	3.90	3.74	.09				
28	3.91	3.76	3.60	.09				
29	3.78	3.63	3.48	.08				
30	3.65	3.51	3.36	.08				

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given above the heavy lines are greater than safe loads for web crippling.

Safe loads below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

MAXIMUM SAFE SHEAR
ON THE WEBS OF BEAMS AND GIRDERS.

On relatively short spans the safe strength of the web of the beam against crippling caused by the shearing stress may determine the maximum safe load which the beam should support.

The shearing stresses in the web of a beam may be resolved into two component stresses of equal intensity at right angles to each other and at angles of 45 degrees with the neutral axis. Both of these stresses are of the same intensity and equal to that of the vertical shear. These component stresses are equivalent to compressive and tensile forces acting upon the web of the beam. The compressive forces tend to buckle the web, but it is not entirely free to do so because the tensile forces acting at right angles have the effect of stiffening it.

The formula in general use for determining the maximum safe shear on the webs of beams and girders is as follows, in which,

v = Safe shearing stress, in pounds per square inch.
V = Maximum safe shear, in pounds.
d = Depth of beam, in inches.
t = Thickness of web, in inches.
h = Clear distance between flanges, in inches.

$$v = \frac{12{,}000}{1 + \frac{h^2}{3000t^2}} \quad \text{and} \quad V = vdt = \frac{12{,}000\,dt}{1 + \frac{h^2}{3000t^2}}$$

Some experiments were made to test the reliability of this formula. Standard I beams of open hearth steel of the usual quality were taken for the purpose. Several of the beams had their webs reduced in thickness by planing to secure the desired ratio of thickness of web to depth of beam.

The beams, all of short span, were placed upon supports under a testing machine and loaded at two points symmetrical about the center. The webs were left entirely free to act under the shearing stress; no connection angles or stiffeners were used at the ends, under the loads or elsewhere. No parts of the beams were machined except the webs, which had been planed to secure the desired thickness. The flanges, in most cases, were not perfectly square to the web and the loads applied by the testing machine were allowed to bring them square, the intention being to secure tests representing conditions occurring in actual construction.

When the elastic limit was passed, the mill scale or particles of rust began to flake from the webs. When the webs began to cripple, no further addition of load was possible. Results of these tests are shown in the table on the next page.

TESTS ON THE CRIPPLING STRENGTH OF WEBS.

Size of Beam.	Thickness of Web, Inches.	Ratio of $\frac{h}{t}$	Observed Shear in Lbs.		Safe Shear Allowed by Formula, Lbs.	Factor of Safety, Provided by Formula.	
			At Elastic Limit.	At Crippling of Web.		Within Elastic Limit.	Within Crippling Load.
5″ I	.210	19.6	....	41,400	11,170	....	3.7
5″ I	.125	31.9	....	23,675	5,700	....	4.1
6″ I	.235	21.4	31,100	49,800	14,720	2.1	3.4
6″ I	.235	21.4	32,650	52,550	14,720	2.2	3.6
6″ I	.128	39.2	17,500	22,650	6,090	2.9	3.7
6″ I	.129	39.0	19,800	22,900	6,160	3.2	3.7
8″ I	.126	54.3	21,550	21,850	6,100	3.5	3.6
8″ I	.125	54.6	20,050	23,050	6,020	3.3	3.8
10″ I	.192	45.1	33,000	40,700	13,730	2.4	3.0
10″ I	.196	44.2	32,900	44,850	14,240	2.3	3.2
10″ I	.130	66.5	22,550	24,750	6,310	3.6	3.9
10″ I	.130	66.5	22,050	24,300	6,310	3.5	3.8

As the compression flanges of steel beams under transverse loading fail at a fiber stress not exceeding 52,000 lbs. per square inch, the fiber stress of 16,000 lbs. per square inch usually allowed corresponds to an actual factor of safety not greater than 3.25 within the ultimate. It likewise is one-half the elastic limit of the material, or provides a safety factor of 2 within the elastic limit.

The above tests show that the usual formula for the safe shear on the webs of steel beams provides a larger margin of safety, within both the elastic limit and the ultimate strength, than the beam has against failure by transverse bending under a load producing a maximum fiber stress of 16,000 lbs. per square inch. The formula also provides a larger margin of safety for thin webs than for thick webs, which is desirable.

The safe shears on the webs of Bethlehem beams and girders, derived from this formula, are given in the table on the opposite page, and also the corresponding minimum spans for the greatest safe uniformly distributed loads.

The safe uniformly distributed load for any span less than the minimum span given must not exceed twice the safe shear. The safe load concentrated at the center of a span must not be greater than twice the safe shear given, and the corresponding minimum span will be one-half the minimum span given in the table. Loading of any kind must not produce a shear exceeding the safe shear given, unless the webs are stiffened.

Similar tables are given on pages 192 and 193 for American standard I beams and channels.

MAXIMUM SAFE SHEAR FOR

BETHLEHEM SPECIAL I BEAMS AND GIRDER BEAMS,

BASED UPON THE CRIPPLING STRENGTH OF THE WEBS: AND THE CORRESPONDING MINIMUM SPANS FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS.

SPECIAL I BEAMS

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Maximum Safe Shear, Pounds.	Minimum Span, Feet.
B30	30	120.0	97,400	19.2
B28	28	105.0	83,000	18.8
B26	26	90.0	69,700	17.9
B24 a	24	84.0	72,600	14.7
B24	24	82.0	87,500	11.4
	24	72.0	48,900	19.0
B20 a	20	82.0	103,000	8.1
	20	72.0	65,400	12.0
B20	20	68.0	80,700	8.4
	20	63.0	62,100	10.5
	20	60.0	50,500	12.6
	20	58.5	44,300	14.2
B18	18	58.5	74,900	7.0
	18	52.5	49,700	9.9
	18	48.5	34,800	13.6
B15 b	15	72.0	82,300	6.9
B15 a	15	64.0	93,200	5.1
	15	54.0	53,100	8.2
B15	15	46.0	58,300	5.9
	15	42.0	44,100	7.5
	15	38.0	28,400	11.1
B12 a	12	36.0	32,400	7.4
B12	12	31.0	32,000	6.3
	12	28.5	22,400	8.6
B10	10	27.5	33,300	4.3
	10	24.5	21,200	6.4
	10	22.5	14,600	9.0
B9	9	23.0	27,500	4.0
	9	21.0	20,100	5.2
	9	19.0	13,000	7.8
B8	8	21.25	30,700	2.8
	8	18.00	19,000	4.2
	8	16.25	11,500	6.6

GIRDER BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Maximum Safe Shear, Pounds.	Minimum Span, Feet.
G30 a	30	200.0	190,400	17.1
G30	30	175.0	162,300	17.2
G28 a	28	180.0	162,500	17.0
G28	28	162.5	147,600	16.7
G26 a	26	160.0	136,700	16.8
G26	26	150.0	133,200	16.0
G24 a	24	140.0	109,800	17.2
G24	24	120.0	93,000	17.4
G20 a	20	140.0	124,700	12.6
G20	20	112.0	91,100	13.9
G18	18	92.0	74,200	12.7
G15 b	15	140.0	134,500	8.4
G15 a	15	104.0	93,700	9.3
G15	15	73.0	57,600	10.9
G12 a	12	70.0	55,900	8.6
G12	12	55.0	39,400	9.8
G10	10	44.0	28,700	9.1
G9	9	38.0	25,700	7.8
G8	8	32.5	22,700	6.7

$$\text{Maximum Safe Shear} = \frac{12{,}000\,dt}{1 + \dfrac{h^2}{3000\,t^2}}$$

Where,
d = depth of beam,
t = thickness of web,
h = clear distance between flanges.
All dimensions in inches.

EXPLANATION OF TABLES

ON SPACING OF BETHLEHEM SPECIAL I BEAMS AND GIRDER BEAMS.

The tables on pages 92–107 give the proper spacing, in feet center to center, for Bethlehem girder beams and principal weights of special I beams for the uniformly distributed floor loads specified. The tables are calculated for total loads, which include the superimposed load which the floor is to support and the dead weight of the floor construction itself. The spacing in computed for a maximum fiber stress of 16,000 lbs. per square inch. These tables provide a convenient means of readily selecting the proper sizes of beams and girders to be used for supporting floors.

For example, if 12″ special I beams weighing 28.5 lbs. per foot are to be used for supporting a total live and dead load of 175 lbs. per square foot on a span of 20 ft., the table on page 107 gives the spacing for this size of beam on the given span to be 5.5 ft. This is the proper distance the beams should be spaced.

When the load is given, and the span and spacing of the beams are fixed, the proper size of beam to be used can be selected. Thus, for a total load of 150 lbs. per square foot, if the length of the beams is 18 feet and the spacing fixed at 5.5 feet centers, the table on page 105 shows that 10″ special I beams weighing 24.5 lbs. can be spaced 5.6 feet apart, and are the proper size to be used for the purpose.

Beams used as girders in floors can be selected from the tables.

Example. Find the proper beam to be used as a girder to support a total load of 150 lbs. per square foot, the span being 22 feet in length and the girders spaced 17 feet apart. On page 104 for a span of 22 feet the spacing for a 20″ special I beam, weighing 58.5 lbs. per foot, is given as 17.3 feet for the assumed loading. This is the most economical beam that can be used for the purpose. On account of limited headroom, it might be necessary, however, to use a shallower beam; in which case the Bethlehem girder beams may be used. On page 97 the spacing of a 15″ girder beam, weighing 73 lbs. per foot, is given as 17.4 feet for the assumed loading and span. If standard beams only were available, in this case it would have required two standard $15'' \times 42$ lb. beams with separators, or a total weight of about 87 lbs. per foot as against the 73 lbs. weight of the Bethlehem girder beam.

The spacing varies inversely as the intensity of the loading, so that the tables may be used for other loadings. Thus, to find the spacing for a total load of 250 lbs. per square foot, refer to the tables for 125 lbs. and divide the spacings given there by 2. The result will be the spacing for a total uniform load of 250 lbs. per square foot.

On short spans the spacings given in the tables may produce a loading greater than the safe crippling strength of the webs of the beams. This limit is indicated in the tables by heavy cross lines. The beams must not be used on shorter spans with the spacing given unless the webs are stiffened. But it will generally be advisable in such cases to use a heavier beam with a thicker web.

Spacings given for spans greater than 24 times the depth of the beams produce deflections exceeding $\frac{1}{360}$ of the span. This limit is indicated in the tables by dotted lines. If the beams are to carry plastered ceilings, the spacings given below these dotted must not be used, unless they are reduced in the following manner:

Let L' = limiting span, in feet, for maximum deflection.
L = given span, in feet.
S = spacing given in table for span L.
S' = reduced spacing.
d = depth of beam, in inches.

Then $L' = 2\,d$, and $S' = \frac{L'}{L}\,S.$

Thus, on page 101 for a total load of 100 lbs. per square foot the spacing for 12″ special I beams weighing 28.5 lbs. per foot on a span of 28 feet is given as 4.9 feet. The proper spacing to limit the deflection will be found as follows:

$$L' = 24, \quad \text{and } S' = \tfrac{24}{28} \times 4.8 = 4.2 \text{ feet},$$

and the beams, if used with this reduced spacing, will deflect only $\frac{1}{360}$ of the span.

The spacings are calculated only for uniformly distributed loading. When the loads are concentrated, or irregularly spaced, the tables of spacing do not apply, and the proper size of beams to be used in such cases can be determined only by calculation of the bending moments using the actual concentrations of loads.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ G		28″ G		26″ G		24″ G	
	G30a	G30	G28a	G28	G26a	G26	G24a	G24
	200 Lbs.	175 Lbs.	180 Lbs.	162.5 Lbs.	160 Lbs.	150 Lbs.	140 Lbs.	120 Lbs.
16	254.3	218.1	216.3	192.4	180.1	166.7	147.3	126.1
17	225.3	193.2	191.6	170.4	159.5	147.6	130.5	111.7
18	200.9	172.3	170.9	152.0	142.3	131.7	116.4	99.6
19	180.3	154.7	153.4	136.4	127.7	118.2	104.5	89.4
20	162.8	139.6	138.5	123.1	115.3	106.7	94.3	80.7
21	147.6	126.6	125.6	111.7	104.5	96.8	85.5	73.2
22	134.5	115.4	114.4	101.8	95.3	88.2	77.9	66.7
23	123.1	105.5	104.7	93.1	87.2	80.7	71.3	61.0
24	113.0	96.9	96.2	85.5	80.0	74.1	65.5	56.0
25	104.2	89.3	88.6	78.8	73.8	68.3	60.3	51.6
26	96.3	82.6	81.9	72.9	68.2	63.1	55.8	47.7
27	89.3	76.6	76.0	67.6	63.2	58.5	51.7	44.3
28	83.0	71.2	70.6	62.8	58.8	54.4	48.1	41.2
29	77.4	66.4	65.9	58.6	54.8	50.7	44.8	38.4
30	72.3	62.1	61.5	54.7	51.2	47.4	41.9	35.9
31	67.7	58.1	57.6	51.3	48.0	44.4	39.2	33.6
32	63.6	54.5	54.1	48.1	45.0	41.7	36.8	31.5
33	59.8	51.3	50.9	45.2	42.3	39.2	34.6	29.6
34	56.3	48.3	47.9	42.6	39.9	36.9	32.6	27.9
35	53.1	45.6	45.2	40.2	37.6	34.8	30.8	26.3
36	50.2	43.1	42.7	38.0	35.6	32.9	29.1	24.9
37	47.6	40.8	40.5	36.0	33.7	31.2	27.5	23.6
38	45.1	38.7	38.4	34.1	31.9	29.6	26.1	22.3
39	42.8	36.7	36.4	32.4	30.3	28.1	24.8	21.2
40	40.7	34.9	34.6	30.8	28.8	26.7	23.6	20.2
41	38.7	33.2	32.9	29.3	27.4	25.4	22.4	19.2
42	36.9	31.7	31.4	27.9	26.1	24.2	21.4	18.3
43	35.2	30.2	30.0	26.6	24.9	23.1	20.4	17.5
44	33.6	28.9	28.6	25.4	23.8	22.1	19.5	16.7
45	32.1	27.6	27.4	24.3	22.8	21.1	18.6	15.9

For load of 200 lbs. per square foot divide spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.
Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

SPACING OF
BETHLEHEM GIRDER BEAMS
FOR
A TOTAL UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.
PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	20″ G		18″ G	15″ G			12″ G		10″ G	9″ G	8″ G
	G20a	G20	G18	G15b	G15a	G15	G12a	G12	G10	G9	G8
	140 Lbs.	112 Lbs.	92 Lbs.	140 Lbs.	104 Lbs.	73 Lbs.	70 Lbs.	55 Lbs.	44 Lbs.	38 Lbs.	32.5 Lbs.
6										111.8	84.4
7										82.1	62.0
8				353.7	271.5	197.0	150.4	120.0	81.4	62.9	47.5
9				279.4	214.2	155.6	118.7	94.8	64.4	49.8	37.5
10				226.4	173.5	126.1	96.2	76.8	52.1	40.3	30.4
11				187.1	143.4	104.2	79.5	63.5	43.1	33.3	25.1
12	217.7	175.5	131.3	157.2	120.5	87.6	66.8	53.3	36.2	28.0	21.1
13	185.5	149.5	111.9	133.9	102.6	74.6	56.9	45.4	30.8	23.8	18.0
14	159.9	128.9	96.5	115.5	88.5	64.3	49.1	39.2	26.6	20.5	15.5
15	139.3	112.3	84.0	100.6	77.1	56.0	42.7	34.1	23.2	17.9	13.5
16	122.4	98.7	73.9	88.4	67.8	49.3	37.6	30.0	20.4	15.7	11.9
17	108.4	87.4	65.4	78.3	60.0	43.6	33.3	26.6	18.0	13.9	10.5
18	96.7	78.0	58.4	69.9	53.5	38.9	29.7	23.7	16.1	12.4	9.4
19	86.8	70.0	52.4	62.7	48.1	34.9	26.6	21.3	14.4	11.2	8.4
20	78.4	63.2	47.3	56.6	43.4	31.5	24.0	19.2	13.0	10.1	7.6
21	71.1	57.3	42.9	51.3	39.3	28.6	21.8	17.4	11.8	9.1	6.9
22	64.8	52.2	39.1	46.8	35.8	26.1	19.9	15.9	10.8	8.3	6.3
23	59.2	47.8	35.7	42.8	32.8	23.8	18.2	14.5	9.9	7.6	5.7
24	54.4	43.9	32.8	39.3	30.1	21.9	16.7	13.3	9.1	7.9	5.3
25	50.2	40.4	30.3	36.2	27.8	20.2	15.4	12.3	8.3	6.4	4.9
26	46.4	37.4	28.0	33.5	25.7	18.7	14.2	11.4	7.7	6.0	
27	43.0	34.7	25.9	31.1	23.8	17.3	13.2	10.5	7.1	5.5	
28	40.0	32.2	24.1	28.9	22.1	16.1	12.3	9.8	6.7	5.1	
29	37.3	30.0	22.5	26.9	20.6	15.0	11.4	9.1	6.2	4.8	
30	34.8	28.1	21.0	25.2	19.3	14.0	10.7	8.5	5.8	4.5	
31	32.6	26.3	19.7	23.6	18.1	13.1	10.0	8.0			
32	30.6	24.7	18.5	22.1	16.9	12.3	9.4	7.5			
33	28.8	23.2	17.4	20.8	15.9	11.6	8.8	7.1			
34	27.1	21.9	16.4	19.6	15.0	10.9	8.3	6.6			
35	25.6	20.6	15.4	18.5	14.2	10.3	7.9	6.3			

For load of 200 lbs. per square foot divide spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ G		28″ G		26″ G		24″ G	
	G30 a	G30	G28 a	G28	G26 a	G26	G24 a	G24
	200 Lbs.	175 Lbs.	180 Lbs.	162.5 Lbs.	160 Lbs.	150 Lbs.	140 Lbs.	120 Lbs.
16	203.4	174.5	173.1	153.9	144.1	133.3	117.8	100.8
17	180.2	154.6	153.3	136.4	127.6	118.1	104.4	89.3
18	160.7	137.9	136.7	121.6	113.8	105.4	93.1	79.7
19	144.3	123.7	122.7	109.2	102.2	94.6	83.6	71.5
20	130.2	111.7	110.8	98.5	92.2	85.3	75.4	64.5
21	118.1	101.3	100.5	89.4	83.6	77.4	68.4	58.5
22	107.6	92.3	91.5	81.4	76.2	70.5	62.3	53.3
23	98.5	84.4	83.8	74.5	69.7	64.5	57.0	48.8
24	90.4	77.6	76.9	68.4	64.0	59.3	52.4	44.8
25	83.3	71.5	70.9	63.0	59.0	54.6	48.2	41.3
26	77.0	66.1	65.5	58.3	54.6	50.5	44.6	38.2
27	71.4	61.3	60.8	54.1	50.6	46.8	41.4	35.4
28	66.4	57.0	56.5	50.3	47.0	43.5	38.5	32.9
29	61.9	53.1	52.7	46.9	43.9	40.6	35.8	30.7
30	57.9	49.6	49.2	43.8	41.0	37.9	33.5	28.7
31	54.2	46.5	46.1	41.0	38.4	35.5	31.4	26.9
32	50.9	43.6	43.3	38.5	36.0	33.3	29.5	25.2
33	47.8	41.0	40.7	36.2	33.9	31.3	27.7	23.7
34	45.1	38.6	38.3	34.1	31.9	29.5	26.1	22.3
35	42.5	36.4	36.2	32.2	30.1	27.9	24.6	21.1
36	40.2	34.5	34.2	30.4	28.5	26.3	23.3	19.9
37	38.0	32.6	32.4	28.8	26.9	24.9	22.0	18.9
38	36.1	30.9	30.7	27.3	25.5	23.6	20.9	17.9
39	34.2	29.4	29.1	25.9	24.2	22.4	19.8	17.0
40	32.6	27.9	27.7	24.6	23.1	21.3	18.9	16.1
41	31.0	26.5	26.4	23.4	21.9	20.3	17.9	15.4
42	29.6	25.4	25.1	22.3	20.9	19.4	17.1	14.6
43	28.2	24.2	24.0	21.3	19.9	18.5	16.3	14.0
44	26.9	23.1	22.9	20.4	19.0	17.6	15.6	13.3
45	25.7	22.1	21.9	19.5	18.2	16.9	14.9	12.7

For load of 250 lbs. per square foot divide spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.
Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	20″ G		18″ G	15″ G			12″ G		10″ G	9″ G	8″ G
	G20a	G20	G18	G15b	G15a	G15	G12a	G12	G10	G9	G8
	140 Lbs.	112 Lbs.	92 Lbs.	140 Lbs.	104 Lbs.	73 Lbs.	70 Lbs.	55 Lbs.	44 Lbs.	38 Lbs.	32.5 Lbs.
6										89.4	67.5
7										65.7	49.6
8				282.9	216.8	157.6	120.2	95.5	65.2	50.3	38.0
9				223.6	171.3	124.5	95.0	75.7	51.4	39.8	30.0
10				181.1	138.8	100.9	76.9	61.4	41.7	32.2	24.3
11				149.7	114.7	83.3	63.6	50.8	34.5	26.6	20.1
12	174.1	140.4	105.0	125.8	96.4	70.1	53.4	42.7	29.0	22.4	16.9
13	148.4	119.6	89.5	107.1	82.1	59.7	45.5	36.4	24.6	19.1	14.4
14	127.9	103.1	77.2	92.4	70.8	51.5	39.3	31.4	21.3	16.4	12.4
15	111.4	89.8	67.2	80.5	61.7	44.8	34.2	27.3	18.5	14.3	10.8
16	98.0	79.0	59.1	70.7	54.2	39.4	30.1	24.0	16.3	12.6	9.5
17	86.8	69.9	52.3	62.7	48.0	34.9	26.6	21.3	14.4	11.1	8.4
18	77.4	62.4	46.7	55.9	42.8	31.1	23.7	19.0	12.9	9.9	7.5
19	69.5	56.0	41.9	50.2	38.4	27.9	21.3	17.0	11.6	8.9	6.7
20	62.7	50.5	37.8	45.3	34.7	25.2	19.2	15.4	10.4	8.1	6.1
21	56.9	45.8	34.3	41.1	31.4	22.9	17.4	13.9	9.5	7.3	5.5
22	51.8	41.8	31.3	37.4	28.7	20.8	15.9	12.7	8.6	6.7	5.0
23	47.4	38.2	28.6	34.2	26.2	19.1	14.5	11.6	7.9	6.1	4.6
24	43.5	35.1	26.3	31.4	24.1	17.5	13.4	10.7	7.2	5.6	4.2
25	40.1	32.3	24.2	29.0	22.2	16.1	12.3	9.8	6.7	5.2	3.9
26	37.1	29.9	22.4	26.8	20.5	14.9	11.4	9.1	6.2	4.8	
27	34.4	27.7	20.7	24.8	19.0	13.8	10.6	8.4	5.7	4.4	
28	32.0	25.8	19.3	23.1	17.7	12.9	9.8	7.8	5.3	4.1	
29	29.8	24.0	18.0	21.5	16.5	12.0	9.1	7.3	5.0	3.8	
30	27.9	22.5	16.8	20.1	15.4	11.2	8.5	6.8	4.6	3.6	
31	26.1	21.0	15.7	18.8	14.4	10.5	8.0	6.4			
32	24.5	19.7	14.8	17.7	13.6	9.9	7.5	6.0			
33	23.0	18.6	13.6	16.6	12.7	9.3	7.1	5.6			
34	21.7	17.5	13.1	15.7	12.0	8.7	6.7	5.3			
35	20.5	16.5	12.3	14.8	11.3	8.2	6.3	5.0			

For load of 250 lbs. per square foot divide spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.
Spacing given above the heavy lines produces loads greater than safe loads for web crippling.
Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ G		28″ G		26″ G		24″ G	
	G30 a	G30	G28 a	G28	G26 a	G26	G24 a	G24
	200 Lbs.	175 Lbs.	180 Lbs.	162.5 Lbs.	160 Lbs.	150 Lbs.	140 Lbs.	120 Lbs.
16	169.5	145.4	144.2	128.3	120.0	111.1	98.2	84.0
17	150.2	128.8	127.7	113.6	106.3	98.4	87.0	74.4
18	133.9	114.9	113.9	101.3	94.8	87.8	77.6	66.4
19	120.2	103.1	102.3	90.9	85.1	78.8	69.6	59.6
20	108.5	93.1	92.3	82.1	76.8	71.1	62.9	53.8
21	98.4	84.4	83.7	74.5	69.7	64.5	57.0	48.8
22	89.7	76.9	76.3	67.9	63.5	58.8	51.9	44.4
23	82.1	70.3	69.8	62.1	58.1	53.8	47.5	40.7
24	75.3	64.6	64.1	57.0	53.3	49.4	43.6	37.3
25	69.5	59.5	59.1	52.5	49.2	45.5	40.2	34.4
26	64.2	55.1	54.6	48.6	45.5	42.1	37.2	31.8
27	59.5	51.1	50.7	45.1	42.1	39.0	34.5	29.5
28	55.3	47.5	47.1	41.9	39.2	36.3	32.1	27.4
29	51.6	44.3	43.9	39.1	36.5	33.8	29.9	25.6
30	48.2	41.4	41.0	36.5	34.1	31.6	27.9	23.9
31	45.1	38.7	38.4	34.2	32.0	29.6	26.2	22.4
32	42.4	36.3	36.1	32.1	30.0	27.8	24.5	21.0
33	39.9	34.2	33.9	30.1	28.2	26.1	23.1	19.8
34	37.5	32.2	31.9	28.4	26.6	24.6	21.7	18.6
35	35.4	30.4	30.1	26.8	25.1	23.2	20.5	17.6
36	33.5	28.7	28.5	25.3	23.7	21.9	19.4	16.6
37	31.7	27.2	27.0	24.0	22.5	20.8	18.4	15.7
38	30.1	25.8	25.6	22.7	21.3	19.7	17.4	14.9
39	28.5	24.5	24.3	21.6	20.2	18.7	16.5	14.1
40	27.1	23.3	23.1	20.5	19.2	17.8	15.7	13.4
41	25.8	22.1	21.9	19.5	18.3	16.9	14.9	12.8
42	24.6	21.1	20.9	18.6	17.4	16.1	14.3	12.2
43	23.5	20.1	20.0	17.7	16.6	15.4	13.6	11.7
44	22.4	19.3	19.1	16.9	15.9	14.7	13.0	11.1
45	21.4	18.4	18.3	16.2	15.2	14.0	12.4	10.6

For load of 300 lbs. per square foot divide spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.
Spacing given above the heavy lines produces load greater than safe loads for web crippling.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	20″ G		18″ G	15″ G			12″ G		10″ G	9″ G	8″ G
	G20a	G20	G18	G15b	G15a	G15	G12a	G12	G10	G9	G8
	140 Lbs.	112 Lbs.	92 Lbs.	140 Lbs.	104 Lbs.	73 Lbs.	70 Lbs.	55 Lbs.	44 Lbs.	38 Lbs.	32.5 Lbs.
6										74.5	56.3
7										54.7	41.3
8				235.8	180.7	131.3	100.2	80.0	54.4	41.9	31.6
9				186.3	142.8	103.8	79.2	63.2	42.9	33.1	25.0
10				150.9	115.7	84.1	64.1	51.2	34.7	26.8	20.3
11				124.7	95.6	69.5	53.0	42.3	28.7	22.2	16.7
12	145.1	117.0	87.5	104.8	80.3	58.4	44.5	35.6	24.1	18.6	14.1
13	123.7	99.6	74.6	89.3	68.4	49.7	37.9	30.3	20.6	15.9	12.0
14	106.6	85.9	64.3	77.0	59.0	42.9	32.7	26.1	17.7	13.7	10.3
15	92.9	74.9	56.0	67.1	51.4	37.4	28.5	22.8	15.4	11.9	9.0
16	81.6	65.8	49.2	58.9	45.2	32.8	25.0	20.0	13.6	10.5	7.9
17	72.3	58.3	43.6	52.2	40.0	29.1	22.2	17.7	12.0	9.3	7.0
18	64.5	52.0	38.9	46.6	35.7	25.9	19.8	15.8	10.7	8.3	6.2
19	57.9	46.7	34.9	41.8	32.0	23.3	17.7	14.2	9.6	7.4	5.6
20	52.2	42.1	31.5	37.7	28.9	21.0	16.0	12.8	8.7	6.7	5.1
21	47.4	38.2	28.6	34.2	26.2	19.1	14.5	11.6	7.9	6.1	4.6
22	43.2	34.8	26.0	31.2	23.9	17.4	13.2	10.6	7.2	5.5	4.2
23	39.5	31.8	23.8	28.5	21.9	15.9	12.1	9.7	6.6	5.1	3.8
24	36.3	29.2	21.9	26.2	20.1	14.6	11.1	8.9	6.0	4.7	3.5
25	33.4	26.9	20.2	24.1	18.5	13.4	10.3	8.2	5.6	4.3	3.2
26	30.9	24.9	18.6	22.3	17.1	12.4	9.5	7.6	5.1	4.0	
27	28.7	23.1	17.3	20.7	15.9	11.5	8.8	7.0	4.8	3.7	
28	26.6	21.5	16.1	19.2	14.7	10.7	8.2	6.5	4.4	3.4	
29	24.8	20.0	15.0	17.9	13.7	10.0	7.6	6.1	4.1	3.2	
30	23.2	18.7	14.0	16.8	12.8	9.3	7.1	5.7	3.9	3.0	
31	21.7	17.5	13.1	15.7	12.0	8.7	6.7	5.3			
32	20.4	16.4	12.3	14.7	11.3	8.2	6.3	5.0			
33	19.2	15.5	11.6	13.9	10.6	7.7	5.9	4.7			
34	18.1	14.6	10.9	13.1	10.0	7.3	5.5	4.4			
35	17.1	13.7	10.3	12.3	9.4	6.8	5.2	4.2			

For load of 300 lbs. per square foot divide the spacing given by 2.

Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ G		28″ G		26″ G		24″ G	
	G30a	G30	G28a	G28	G26a	G26	G24a	G24
	200 Lbs.	175 Lbs.	180 Lbs.	162.5 Lbs.	160 Lbs.	150 Lbs.	140 Lbs.	120 Lbs.
16	145.3	124.6	123.6	109.9	102.9	95.2	84.2	72.0
17	128.7	110.4	109.5	97.4	91.1	84.4	74.6	63.8
18	114.8	98.5	97.7	86.9	81.3	75.3	66.5	56.9
19	103.0	88.4	87.7	78.0	73.0	67.5	59.7	51.1
20	93.0	79.8	79.1	70.4	65.9	61.0	53.9	46.1
21	84.3	72.4	71.8	63.8	59.7	55.3	48.9	41.8
22	76.9	65.9	65.4	58.2	54.4	50.4	44.5	38.1
23	70.3	60.3	59.8	53.2	49.8	46.1	40.7	34.9
24	64.6	55.4	54.9	48.9	45.7	42.3	37.4	32.0
25	59.5	51.1	50.6	45.0	42.2	39.0	34.5	29.5
26	55.0	47.2	46.8	41.6	39.0	36.1	31.9	27.3
27	51.0	43.8	43.4	38.6	36.1	33.4	29.6	25.3
28	47.4	40.7	40.4	35.9	33.6	31.1	27.5	23.5
29	44.2	37.9	37.6	33.5	31.3	29.0	25.6	21.9
30	41.3	35.5	35.2	31.3	29.3	27.1	23.9	20.5
31	38.7	33.2	32.9	29.3	27.4	25.4	22.4	19.2
32	36.3	31.2	30.9	27.5	25.7	23.8	21.0	18.0
33	34.2	29.3	29.1	25.8	24.2	22.4	19.8	16.9
34	32.2	27.6	27.4	24.3	22.8	21.1	18.6	16.0
35	30.4	26.1	25.8	23.0	21.5	19.9	17.6	15.1
36	28.7	24.6	24.4	21.7	20.3	18.8	16.6	14.2
37	27.2	23.3	23.1	20.6	19.2	17.8	15.7	13.5
38	25.8	22.1	21.9	19.5	18.2	16.9	14.9	12.8
39	24.5	21.0	20.8	18.5	17.3	16.0	14.2	12.1
40	23.3	19.9	19.8	17.6	16.5	15.2	13.5	11.5
41	22.1	19.0	18.8	16.7	15.7	14.5	12.8	11.0
42	21.1	18.1	17.9	16.0	14.9	13.8	12.2	10.5
43	20.1	17.3	17.1	15.2	14.2	13.2	11.7	10.0
44	19.2	16.5	16.4	14.5	13.6	12.6	11.1	9.5
45	18.4	15.8	15.6	13.9	13.0	12.0	10.6	9.1

For load of 350 lbs. per square foot divide spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

SPACING OF

BETHLEHEM GIRDER BEAMS

FOR

A TOTAL UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	20″ G		18G″	15″ G			12″ G		10″G	9″G	8″ G
	G20a	G20	G18	G15b	G15a	G15	G12a	G12	G10	G9	G8
	140 Lbs.	112 Lbs.	92 Lbs.	140 Lbs.	104 Lbs.	73 Lbs.	70 Lbs.	55 Lbs.	44 Lbs.	38 Lbs.	32.5 Lbs.
6										63.9	48.2
7										46.9	35.4
8				202.1	154.9	112.6	85.9	68.2	46.5	35.9	27.1
9				159.7	122.4	89.0	67.8	54.2	36.8	28.4	21.4
10				129.3	99.1	72.1	54.9	43.9	29.8	23.0	17.4
11				106.9	81.9	59.6	45.4	36.3	24.6	19.0	14.3
12	124.4	100.3	75.0	89.8	68.8	50.0	38.1	30.5	20.7	16.0	12.1
13	106.0	85.4	63.9	76.5	58.7	42.6	32.5	26.0	17.6	13.6	10.3
14	91.4	73.7	55.1	66.0	50.6	36.8	28.0	22.4	15.2	11.7	8.9
15	79.6	64.2	48.0	57.5	44.1	32.0	24.4	19.5	13.2	10.2	7.7
16	70.0	56.4	42.2	50.5	38.7	28.1	21.5	17.1	11.6	9.0	6.8
17	62.0	50.0	37.4	44.8	34.3	24.9	19.0	15.2	10.3	8.0	6.0
18	55.3	44.6	33.3	39.9	30.6	22.2	17.0	13.5	9.2	7.1	5.4
19	49.6	40.0	29.9	35.8	27.5	19.9	15.2	12.2	8.3	6.4	4.8
20	44.8	36.1	27.0	32.3	24.8	18.0	13.7	11.0	7.4	5.8	4.3
21	40.6	32.7	24.5	29.3	22.5	16.3	12.5	10.0	6.8	5.2	3.9
22	37.0	29.8	22.3	26.7	20.5	14.9	11.4	9.1	6.2	4.8	3.6
23	33.9	27.3	20.4	24.5	18.7	13.6	10.4	8.3	5.6	4.3	3.3
24	31.1	25.1	18.8	22.5	17.2	12.5	9.5	7.6	5.2	4.0	3.0
25	28.7	23.1	17.3	20.7	15.9	11.5	8.8	7.0	4.8	3.7	2.8
26	26.5	21.4	16.0	19.1	14.7	10.7	8.1	6.5	4.4	3.4	
27	24.6	19.8	14.8	17.7	13.6	9.9	7.5	6.0	4.1	3.2	
28	22.8	18.4	13.8	16.5	12.6	9.2	7.0	5.6	3.8	2.9	
29	21.3	17.2	12.9	15.4	11.8	8.6	6.5	5.2	3.5	2.7	
30	19.9	16.0	12.0	14.4	11.0	8.0	6.1	4.9	3.3	2.6	
31	18.6	15.0	11.2	13.5	10.3	7.5	5.7	4.6			
32	17.5	14.1	10.6	12.6	9.7	7.0	5.4	4.3			
33	16.4	13.3	9.9	11.9	9.1	6.6	5.0	4.0			
34	15.5	12.5	9.3	11.2	8.6	6.2	4.7	3.8			
35	14.6	11.8	8.8	10.6	8.1	5.9	4.5	3.6			

For load of 350 lbs. per square foot divide spacing given by 2.

Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF
BETHLEHEM SPECIAL I BEAMS
FOR
A TOTAL UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.
PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ I	28″ I	26″ I	24″ I		20″ I		18″ I
	B30	B28	B26	B24 a	B24	B20 a	B20	B18
	120 Lbs.	105 Lbs.	90 Lbs.	84 Lbs.	72 Lbs.	72 Lbs.	58.5 Lbs.	48.5 Lbs.
16	146.4	121.7	97.5	83.0	72.6	61.2	49.0	37.1
17	129.7	107.8	86.4	73.6	64.3	54.2	43.4	32.9
18	115.7	96.2	77.1	65.6	57.4	48.3	38.7	29.3
19	103.8	86.3	69.2	58.9	51.5	43.4	34.8	26.3
20	93.7	77.9	62.4	53.2	46.5	39.1	31.4	23.8
21	85.0	70.7	56.6	48.2	42.1	35.5	28.5	21.5
22	77.4	64.4	51.6	43.9	38.4	32.4	25.9	19.6
23	70.9	58.9	47.2	40.2	35.1	29.6	23.7	18.0
24	65.1	54.1	43.4	36.9	32.3	27.2	21.8	16.5
25	60.0	49.9	40.0	34.0	29.7	25.1	20.1	15.2
26	55.5	46.1	36.9	31.5	27.5	23.2	18.6	14.1
27	51.4	42.7	34.3	29.2	25.5	21.5	17.2	13.0
28	47.8	39.7	31.9	27.1	23.7	20.0	16.0	12.1
29	44.6	37.1	29.7	25.3	22.1	18.6	14.9	11.3
30	41.7	34.6	27.7	23.6	20.7	17.4	13.9	10.6
31	39.0	32.4	26.0	22.1	19.3	16.3	13.1	9.9
32	36.6	30.4	24.4	20.8	18.2	15.3	12.3	9.3
33	34.4	28.6	22.9	19.5	17.1	14.4	11.5	8.7
34	32.4	27.0	21.6	18.4	16.1	13.5	10.9	8.2
35	30.6	25.4	20.4	17.4	15.2	12.8	10.2	7.8
36	28.9	24.0	19.2	16.4	14.3	12.1	9.7	7.3
37	27.4	22.8	18.2	15.5	13.6	11.4	9.2	6.9
38	26.0	21.6	17.3	14.7	12.9	10.8	8.7	6.6
39	24.6	20.5	16.4	14.0	12.2	10.3	8.3	6.2
40	23.4	19.5	15.6	13.3	11.6	9.8	7.8	5.9
41	22.3	18.5	14.9	12.7	11.1	9.3	7.5	5.7
42	21.3	17.7	14.2	12.1	10.5	8.9	7.1	5.4
43	20.3	16.9	13.5	11.5	10.1	8.5	6.8	5.1
44	19.4	16.1	12.9	11.0	9.6	8.1	6.5	4.9
45	18.5	15.4	12.3	10.5	9.2	7.7	6.2	4.7

For load of 200 lbs. per square foot divide the spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.
Spacing given above the heavy lines produces loads greater than safe loads for web crippling.
Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM SPECIAL I BEAMS

FOR

A TOTAL UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	15″ I			12″ I		10″ I		9″		8″ I	
	B15 b	B15 a	B15	B12 a	B12	B10	B10	B9	B9	B8	B8
	72 Lbs.	54 Lbs.	38 Lbs.	36 Lbs.	28.5 Lbs	24.5 Lbs	22.5 Lbs	21 Lbs.	19 Lbs.	18 Lbs.	16.25 Lbs.
6	315.2	241.1	174.8	133.4	106.9	75.4	72.8	58.4	56.1	44.5	42.2
7	331.6	177.2	128.4	98.0	78.6	55.4	53.5	42.9	41.2	32.7	31.0
8	177.3	135.6	98.3	75.1	60.2	42.4	40.9	32.9	31.5	25.0	23.8
9	140.0	107.2	77.7	59.3	47.5	33.5	32.4	26.0	24.9	19.8	18.8
10	113.5	86.8	62.9	48.0	38.5	27.1	26.2	21.0	20.2	16.0	15.2
11	93.8	71.7	52.0	39.7	31.8	22.4	21.7	17.4	16.7	13.2	12.6
12	78.8	60.3	43.7	33.4	26.7	18.8	18.2	14.6	14.0	11.1	10.6
13	67.2	51.4	37.2	28.4	22.8	16.1	15.5	12.4	11.9	9.5	9.0
14	58.0	44.3	32.1	24.5	19.6	13.8	13.4	10.7	10.3	8.2	7.8
15	50.4	38.6	28.0	21.4	17.1	12.1	11.6	9.4	9.0	7.1	6.8
16	44.3	33.9	24.6	18.8	15.0	10.6	10.2	8.2	7.9	6.3	5.9
17	39.3	30.0	21.8	16.6	13.3	9.4	9.1	7.3	7.0	5.5	5.3
18	35.0	26.8	19.4	14.8	11.9	8.4	8.1	6.5	6.2	4.9	4.7
19	31.4	24.1	17.4	13.3	10.7	7.5	7.3	5.8	5.6	4.4	4.2
20	28.4	21.7	15.7	12.0	9.6	6.8	6.6	5.3	5.1	4.0	3.8
21	25.7	19.7	14.3	10.9	8.7	6.2	5.9	4.8	4.6	3.6	3.5
22	23.5	17.9	13.0	9.9	8.0	5.6	5.4	4.4	4.2	3.3	3.1
23	21.5	16.4	11.9	9.1	7.3	5.1	5.0	4.0	3.8	3.0	2.9
24	19.7	15.1	10.9	8.3	6.7	4.7	4.6	3.7	3.5	2.8	2.6
25	18.2	13.9	10.1	7.7	6.2	4.3	4.2	3.4	3.2	2.6	2.4
26	16.8	12.8	9.3	7.1	5.7	4.0	3.9	3.1	3.0		
27	15.6	11.9	8.6	6.6	5.3	3.7	3.6	2.9	2.8		
28	14.5	11.1	8.0	6.1	4.9	3.5	3.3	2.7	2.6		
29	13.5	10.3	7.5	5.7	4.6	3.2	3.1	2.5	2.4		
30	12.6	9.7	7.0	5.3	4.3	3.0	2.9	2.3	2.2		
31	11.8	9.0	6.6	5.0	4.0						
32	11.1	8.5	6.1	4.7	3.8						
33	10.4	8.0	5.8	4.4	3.5						
34	9.8	7.5	5.4	4.2	3.3						
35	9.3	7.1	5.1	3.9	3.1						

For load of 200 lbs. per square foot divide the spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than the safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF
BETHLEHEM SPECIAL I BEAMS
FOR
A TOTAL UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ I	28″ I	26″ I	24″ I		20″ I		18″ I
	B30	B28	B26	B24 a	B24	B20 a	B20	B18
	120 Lbs.	105 Lbs.	90 Lbs.	84 Lbs.	72 Lbs.	72 Lbs.	58.5 Lbs.	48.5 Lbs.
16	117.1	97.4	78.0	66.4	58.1	48.9	39.2	29.7
17	103.8	86.3	69.1	58.9	51.4	43.3	34.7	26.3
18	92.6	76.9	61.7	52.5	45.9	38.7	31.0	23.5
19	83.1	69.1	55.3	47.1	41.2	34.7	27.8	21.1
20	75.0	62.3	49.9	42.5	37.2	31.3	25.1	19.0
21	68.0	56.5	45.3	38.6	33.7	28.4	22 8	17.2
22	62.0	51.5	41.3	35.1	30.7	25.9	20.7	15.7
23	56.7	47.1	37.8	32.2	28.1	23.7	19.0	14.4
24	52.1	43.3	34.7	29.5	25.8	21.7	17.4	13.2
25	48.0	39.9	32.0	27.2	23.8	20.0	16.1	12.2
26	44.4	36.9	29.6	25.2	22.0	18.5	14.9	11.2
27	41.1	34.2	27.4	23.3	20.4	17.2	13.8	10.4
28	38.3	31.8	25.5	21.7	19.0	16.0	12.8	9.7
29	35.7	29.6	23.8	20.2	17.7	14.9	11.9	9.0
30	33.3	27.7	22.2	18.9	16.5	13.9	11.2	8.4
31	31.2	25.9	20.8	17.7	15.5	13.0	10.5	7.9
32	29.3	24.3	19.5	16.6	14.5	12.2	9.8	7.4
33	27.5	22.9	18.3	15.6	13.7	11.5	9.2	7.0
34	25.9	21.6	17.3	14.7	12.9	10.8	8.7	6.6
35	24.5	20.3	16.3	13.9	12.1	10.2	8.2	6.2
36	23.1	19.2	15.4	13.1	11.5	9.7	7.7	5.9
37	21.9	18.2	14.6	12.4	10.9	9.2	7.3	5.6
38	20.8	17.3	13.8	11.8	10.3	8.7	7.0	5.3
39	19.7	16.4	13.1	11.2	9.8	8.2	6.6	5.0
40	18.7	15.6	12.5	10.6	9.3	7.8	6.3	4.8
41	17.8	14.8	11.9	10.1	8.9	7.5	6.0	4.5
42	17.0	14.1	11.3	9.6	8.4	7.1	5.7	4.3
43	16.2	13.5	10.8	9.2	8.0	6.8	5.4	4.1
44	15.5	12.9	10.3	8.8	7.7	6.5	5.2	3.9
45	14.8	12.3	9.9	8.4	7.3	6.2	5.0	3.8

For load of 250 lbs. per square foot divide the spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.
Spacing given above the heavy lines produces loads greater than safe loads for web crippling.
Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF
BETHLEHEM SPECIAL I BEAMS
FOR
A TOTAL UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.
PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	15″ I			12″ I		10″ I		9″ I		8″ I	
	B15b	B15a	B15	B12 a	B12	B10	B10	B9	B9	B8	B8
	72 Lbs.	54 Lbs.	38 Lbs.	36 Lbs.	28.5 Lbs.	24.5 Lbs.	22.5 Lbs.	21 Lbs.	19 Lbs.	18 Lbs.	16.25 Lbs.
6	252.2	192.9	139.8	106.7	85.6	60.3	58.2	46.7	44.9	35.6	33.8
7	185.3	141.7	102.7	78.4	62.9	44.3	42.8	34.3	32.9	26.1	24.8
8	141.9	108.5	78.7	60.0	48.1	33.9	32.8	26.3	25.2	20.0	19.0
9	112.1	85.7	62.1	47.4	38.0	26.8	25.9	20.8	19.9	15.8	15.0
10	90.8	69.5	50.3	38.4	30.8	21.7	21.0	16.8	16.1	12.8	12.2
11	75.0	57.4	41.6	31.8	25.5	17.9	17.3	13.9	13.3	10.6	10.1
12	63.1	48.2	35.0	26.7	21.4	15.1	14.6	11.7	11.2	8.9	8.5
13	53.7	41.1	29.8	22.7	18.2	12.8	12.4	10.0	9.6	7.6	7.2
14	46.3	35.4	25.7	19.6	15.7	11.1	10.7	8.6	8.2	6.5	6.2
15	40.4	30.9	22.4	17.1	13.7	9.6	9.3	7.5	7.2	5.7	5.4
16	35.5	27.1	19.7	15.0	12.0	8.5	8.2	6.6	6.3	5.0	4.8
17	31.4	24.0	17.4	13.3	10.7	7.5	7.3	5.8	5.6	4.4	4.2
18	28.0	21.4	15.7	11.9	9.5	6.7	6.5	5.2	5.0	4.0	3.8
19	25.2	19.2	13.9	10.6	8.5	6.0	5.8	4.7	4.5	3.5	3.4
20	22.7	17.4	12.6	9.6	7.7	5.4	5.2	4.2	4.0	3.2	3.0
21	20.6	15.7	11.4	8.7	7.0	4.9	4.8	3.8	3.7	2.9	2.8
22	18.8	14.4	10.4	7.9	6.4	4.5	4.3	3.5	3.3	2.7	2.5
23	17.2	13.1	9.5	7.3	5.8	4.1	4.0	3.2	3.1	2.4	2.3
24	15.8	12.1	8.7	6.7	5.3	3.8	3.6	2.9	2.8	2.2	1.9
25	14.5	11.1	8.1	6.4	4.9	3.5	3.4	2.7	2.6	2.1	1.9
26	13.4	10.3	7.4	5.7	4.6	3.2	3.1	2.5	2.4		
27	12.5	9.5	6.9	5.3	4.2	3.0	2.9	2.3	2.2		
28	11.6	8.9	6.4	4.9	3.9	2.8	2.7	2.1	2.1		
29	10.8	8.3	6.0	4.6	3.7	2.6	2.5	2.0	1.9		
30	10.1	7.7	5.6	4.3	3.4	2.4	2.3	1.9	1.8		
31	9.5	7.2	5.2	4.0	3.2						
32	8.9	6.8	4.9	3.8	3.0						
33	8.3	6.4	4.6	3.5	2.8						
34	7.9	6.0	4.4	3.3	2.7						
35	7.4	5.7	4.1	3.1	2.5						

For load of 250 lbs. per square foot divide the spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM SPECIAL I BEAMS

FOR

A TOTAL UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ I	28″ I	26″ I	24″ I		20″ I		18″ I
	B30	B28	B26	B24 a	B24	B20 a	B20	B18
	120 Lbs.	105 Lbs.	90 Lbs.	84 Lbs.	72 Lbs.	72 Lbs.	58.5 Lbs.	48.5 Lbs.
16	97.6	81.1	65.0	55.4	48.4	40.8	32.7	24.7
17	86.5	71.9	57.6	49.0	42.9	36.1	29.0	21.9
18	77.1	64.1	51.4	43.7	38.2	32.2	25.8	19.5
19	69.2	57.5	46.1	39.3	34.3	28.9	23.2	17.5
20	62.5	51.9	41.6	35.4	31.0	26.1	20.9	15.8
21	56.7	47.1	37.8	32.1	28.1	23.7	19.0	14.4
22	51.6	42.9	34.4	29.3	25.6	21.6	17.3	13.1
23	47.2	39.3	31.5	26.8	23.4	19.7	15.8	12.0
24	43.4	36.1	28.9	24.6	21.5	18.1	14.5	11.0
25	40.0	33.2	26.6	22.7	19.8	16.7	13.4	10.1
26	37.0	30.7	24.6	21.0	18.3	15.4	12.4	9.4
27	34.3	28.5	22.8	19.4	17.0	14.3	11.5	8.7
28	31.9	26.5	21.2	18.1	15.8	13.3	10.7	8.1
29	29.7	24.7	19.8	16.9	14.7	12.4	10.0	7.5
30	27.8	23.1	18.5	15.8	13.8	11.6	9.3	7.0
31	26.0	21.6	17.3	14.8	12.9	10.9	8.7	6.6
32	24.4	20.3	16.3	13.8	12.1	10.2	8.2	6.2
33	23.0	19.1	15.3	13.0	11.4	9.6	7.7	5.8
34	21.6	18.0	14.4	12.3	10.7	9.0	7.2	5.5
35	20.4	17.0	13.6	11.6	10.1	8.5	6.8	5.2
36	19.3	16.0	12.9	10.9	9.6	8.1	6.5	4.9
37	18.3	15.2	12.2	10.4	9.1	7.6	6.1	4.6
38	17.3	14.4	11.5	9.8	8.6	7.2	5.8	4.4
39	16.4	13.7	10.9	9.3	8.2	6.9	5.5	4.2
40	15.6	13.0	10.4	8.9	7.7	6.5	5.2	4.0
41	14.9	12.4	9.9	8.4	7.4	6.2	5.0	3.8
42	14.2	11.8	9.4	8.0	7.0	5.9	4.7	3.6
43	13.5	11.2	9.0	7.7	6.7	5.7	4.5	3.4
44	12.9	10.7	8.6	7.3	6.4	5.4	4.3	3.3
45	12.3	10.3	8.2	7.0	6.1	5.2	4.1	3.1

For load of 300 lbs. per square foot divide the spacing given by 2.

Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM SPECIAL I BEAMS

FOR

A TOTAL UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	15″ I			12″ I		10″ I		9″ I		8″ I	
	B15 b	B15 a	B15	B12 a	B12	B10	B10	B9	B9	B8	B8
	72 Lbs.	54 Lbs.	38 Lbs.	36 Lbs.	28.5 Lbs	24.5 Lbs	22.5 Lbs	21 Lbs.	19 Lbs.	18 Lbs.	16.25 Lbs.
6	210.1	160.8	116.5	88.9	71.3	50.2	48.5	38.9	37.4	29.6	28.1
7	154.4	118.1	85.6	65.3	52.4	36.9	35.6	28.6	27.5	21.8	20.7
8	118.2	90.4	65.5	50.0	40.1	28.3	27.3	21.9	21.0	16.7	15.8
9	93.4	71.4	51.8	39.5	31.7	22.3	21.6	17.3	16.6	13.2	12.5
10	75.7	57.9	41.9	32.0	25.7	18.1	17.5	14.0	13.5	10.7	10.1
11	62.5	47.8	34.7	26.5	21.2	14.9	14.4	11.6	11.1	8.8	8.4
12	52.5	40.2	29.1	22.2	17.8	12.6	12.1	9.7	9.3	7.4	7.0
13	44.8	34.2	24.8	18.9	15.2	10.7	10.3	8.3	8.0	6.3	6.0
14	38.6	29.5	21.4	16.3	13.1	9.2	8.9	7.2	6.9	5.4	5.2
15	33.6	25.7	18.6	14.2	11.4	8.0	7.8	6.2	6.0	4.7	4.5
16	29.6	22.6	16.4	12.5	10.0	7.1	6.8	5.5	5.3	4.2	4.0
17	26.2	20.0	14.5	11.1	8.9	6.3	6.0	4.9	4.7	3.7	3.5
18	23.3	17.9	12.9	9.9	7.9	5.6	5.4	4.3	4.2	3.3	3.1
19	21.0	16.0	11.6	8.9	7.1	5.0	4.8	3.9	3.7	3.0	2.8
20	18.9	14.5	10.5	8.0	6.4	4.5	4.4	3.5	3.4	2.7	2.5
21	17.2	13.1	9.5	7.3	5.8	4.1	4.0	3.2	3.1	2.4	2.3
22	15.6	12.0	8.7	6.6	5.3	3.7	3.6	2.9	2.8	2.2	2.1
23	14.3	10.9	7.9	6.1	4.9	3.4	3.3	2.7	2.5	2.0	1.9
24	13.1	10.0	7.3	5.6	4.5	3.1	3.0	2.4	2.3	1.9	1.8
25	12.1	9.3	6.7	5.1	4.1	2.9	2.8	2.2	2.2	1.7	1.6
26	11.2	8.6	6.2	4.7	3.8	2.7	2.6	2.1	2.0		
27	10.4	7.9	5.8	4.4	3.5	2.5	2.4	1.9	1.8		
28	9.7	7.4	5.4	4.1	3.3	2.3	2.2	1.8	1.7		
29	9.0	6.9	5.0	3.8	3.1	2.1	2.1	1.7	1.6		
30	8.4	6.4	4.7	3.6	2.9	2.0	1.9	1.6	1.5		
31	7.9	6.0	4.4	3.3	2.7						
32	7.4	5.7	4.1	3.1	2.5						
33	6.9	5.3	3.9	2.9	2.4						
34	6.5	5.0	3.6	2.8	2.2						
35	6.2	4.7	3.4	2.6	2.1						

For load of 300 lbs. per square foot divide the spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than the safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM SPECIAL I BEAMS

FOR

A TOTAL UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	30″ I	28″ I	26″ I	24″ I		20″ I		18″ I
	B30	B28	B26	B24 a	B24	B20 a	B20	B18
	120 Lbs.	105 Lbs.	90 Lbs.	84 Lbs.	72 Lbs.	72 Lbs.	58.5 Lbs.	48.5 Lbs.
16	83.7	69.6	55.7	47.5	41.5	35.0	28.0	21.2
17	74.1	61.6	49.4	42.0	36.7	31.0	24.8	18.8
18	66.1	55.0	44.0	37.5	32.8	27.6	22.1	16.8
19	59.3	49.3	39.5	33.7	29.4	24.8	19.9	15.0
20	53.5	44.5	35.7	30.4	26.5	22.4	17.9	13.6
21	48.6	40.4	32.4	27.6	24.1	20.3	16.3	12.3
22	44.3	36.8	29.5	25.1	21.9	18.5	14.8	11.2
23	40.5	33.7	27.0	23.0	20.1	16.9	13.6	10.3
24	37.2	30.9	24.8	21.1	18.4	15.5	12.5	9.4
25	34.3	28.5	22.8	19.4	17.0	14.3	11.5	8.7
26	31.7	26.3	21.1	18.0	15.7	13.2	10.6	8.0
27	29.4	24.4	19.6	16.7	14.6	12.3	9.8	7.5
28	27.3	22.7	18.2	15.5	13.5	11.4	9.1	6.9
29	25.5	21.2	17.0	14.5	12.6	10.6	8.5	6.5
30	23.8	19.8	15.9	13.5	11.8	9.9	8.0	6.0
31	22.3	18.5	14.9	12.6	11.1	9.3	7.5	5.7
32	20.9	17.4	13.9	11.9	10.4	8.7	7.0	5.3
33	19.7	16.4	13.1	11.2	9.8	8.2	6.6	5.0
34	18.5	15.4	12.3	10.5	9.2	7.7	6.2	4.7
35	17.5	14.5	11.7	9.9	8.7	7.3	5.9	4.4
36	16.5	13.7	11.0	9.4	8.2	6.9	5.5	4.2
37	15.7	13.0	10.4	8.9	7.8	6.5	5.2	4.0
38	14.8	12.3	9.9	8.4	7.4	6.2	5.0	3.8
39	14.1	11.7	9.4	8.0	7.0	5.9	4.7	3.6
40	13.4	11.1	8.9	7.6	6.6	5.6	4.5	3.4
41	12.7	10.6	8.5	7.2	6.3	5.3	4.3	3.2
42	12.1	10.1	8.1	6.9	6.0	5.1	4.1	3.1
43	11.6	9.6	7.7	6.6	5.7	4.8	3.9	2.9
44	11.1	9.2	7.4	6.3	5.5	4.6	3.7	2.8
45	10.6	8.8	7.1	6.0	5.2	4.4	3.5	2.7

For load of 350 lbs. per square foot divide the spacing given by 2.

Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

SPACING OF

BETHLEHEM SPECIAL I BEAMS

FOR

A TOTAL UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

PROPER DISTANCE IN FEET, CENTER TO CENTER OF BEAMS.

Span, in Feet.	15″ I			12″ I		10″ I		9″ I		8″ I	
	B15 b	B15 a	B15	B12 a	B12	B10	B10	B9	B9	B8	B8
	72 Lbs.	54 Lbs.	38 Lbs.	36 Lbs.	28.5 Lbs	24.5 Lbs	22.5 Lbs	21 Lbs.	19 Lbs.	18 Lbs.	16.25 Lbs.
6	180.1	137.8	99.9	76.2	61.1	43.1	41.6	33.4	32.0	25.4	24.1
7	132.3	101.2	73.4	56.0	44.9	31.6	30.6	24.5	23.5	18.7	17.7
8	101.3	77.5	56.2	42.9	34.4	24.2	23.4	18.8	18.0	14.3	13.6
9	80.1	61.2	44.4	33.9	27.2	19.1	18.5	14.8	14.2	11.3	10.7
10	64.9	49.6	36.0	27.5	22.0	15.5	15.0	12.0	11.5	9.1	8.7
11	53.6	41.0	29.7	22.7	18.2	12.8	12.4	9.9	9.5	7.6	7.2
12	45.0	34.5	25.0	19.1	15.3	10.8	10.4	8.3	8.0	6.4	6.0
13	38.4	29.4	21.3	16.2	13.0	9.2	8.9	7.1	6.8	5.4	5.1
14	33.1	25.3	18.3	14.0	11.2	7.9	7.6	6.1	5.9	4.7	4.4
15	28.8	22.1	16.0	12.2	9.8	6.9	6.7	5.3	5.1	4.1	3.9
16	25.3	19.4	14.1	10.7	8.6	6.1	5.9	5.0	4.5	3.6	3.4
17	22.4	17.2	12.4	9.5	7.6	5.2	5.2	4.2	4.0	3.2	3.0
18	20.0	15.3	11.1	8.5	6.8	4.8	4.6	3.7	3.6	2.8	2.7
19	18.0	13.7	10.0	7.6	6.1	4.4	4.2	3.3	3.2	2.5	2.4
20	16.2	12.4	9.0	6.9	5.5	3.9	3.7	3.0	2.9	2.3	2.2
21	14.7	11.3	8.2	6.2	5.0	3.5	3.4	2.7	2.6	2.1	2.0
22	13.4	10.3	7.4	5.7	4.5	3.2	3.1	2.5	2.4	1.9	1.8
23	12.3	9.4	6.8	5.2	4.2	2.9	2.8	2.3	2.2	1.7	1.6
24	11.3	8.6	6.2	4.8	3.8	2.7	2.6	2.1	2.0	1.6	1.5
25	10.4	7.9	5.8	4.4	3.5	2.5	2.4	1.9	1.9	1.5	1.4
26	9.6	7.3	5.3	4.1	3.3	2.3	2.2	1.8	1.7		
27	8.9	6.8	4.9	3.8	3.0	2.1	2.1	1.7	1.6		
28	8.3	6.3	4.6	3.5	2.8	2.0	1.9	1.5	1.5		
29	7.7	5.9	4.3	3.3	2.6	1.9	1.8	1.4	1.4		
30	7.2	5.5	4.0	3.1	2.5	1.7	1.6	1.3	1.3		
31	6.8	5.2	3.7	2.9	2.3						
32	6.3	4.9	3.5	2.7	2.2						
33	6.0	4.6	3.3	2.5	2.0						
34	5.6	4.4	3.1	2.4	1.9						
35	5.3	4.1	2.9	2.2	1.8						

For load of 350 lbs. per square foot divide the spacing given by 2.
Maximum fiber stress, 16,000 lbs. per square inch.

Spacing given above the heavy lines produces loads greater than the safe loads for web crippling.

Spacing given below the dotted lines produces deflections exceeding $\frac{1}{360}$ of the span.

EXPLANATION OF TABLES OF SAFE LOADS FOR BETHLEHEM ROLLED STEEL H COLUMNS.

The superiority of steel columns over columns of any other material is so well understood and recognized as to need no comment. Cast iron columns are sometimes used solely on the score of cheapness because of the relatively greater cost of riveted steel columns—the only kind of steel columns heretofore obtainable; but in buildings of anything more than the most moderate height, or wherever stiffness of frame and absolute security is essential, steel columns are exclusively employed.

Bethlehem rolled steel H sections reduce the cost of steel columns to such an extent that they can be used for all purposes with economy. These rolled steel columns provide all the desired qualities of safety and reliability at a cost less than that of any other form of steel column, and at a cost as low or even less than cast iron.

For very short lengths the compressive strength of structural steel of standard quality is the same as its tensile strength. As the length increases the compressive strength diminishes. A short column has a practically uniform compressive strength for all lengths less than about fifteen times its least diameter; but for greater lengths the strength decreases, the decrease being a function of the length of the column and the radius of gyration of the section in the direction of its least resistance to bending. Conforming to these conditions, the safe allowable stress, in lbs. per square inch, on square ended columns of medium steel used for buildings is given by the following formula:

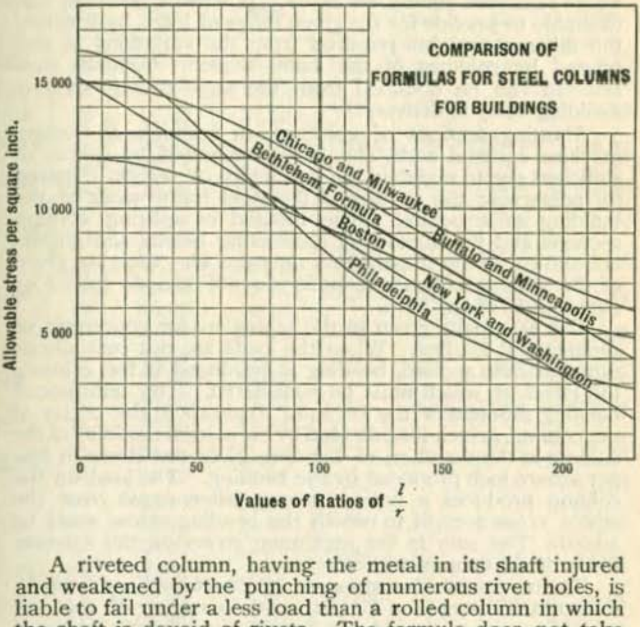
13,000 lbs. for lengths under 55 radii of gyration.

$16,000 - 55\frac{l}{r}$ for lengths over 55 radii of gyration.

in which l = unsupported length of column and r = least radius of gyration, both in inches.

The safe strength of steel columns given by this formula agrees in a satisfactory manner with the available experimental data on the subject. In addition it is of correct theoretical form. It represents a straight line which becomes tangent to the curve of Euler's formula for very long columns and fixes a maximum limit of stress for columns of relatively short length. The safe stress allowed on steel columns by this rule corresponds to the safe stress usually allowed for beams and girders in buildings. Columns proportioned in accordance with this formula have the same proper degree of safety as the beams and girders which they support, thus maintaining a symmetrical proportion of all parts of the structure.

A comparison of this formula with the column formulas specified by the building laws of the principal cities in the United States is shown by the diagram herewith, from which it will be seen that it represents about an average of general practice.



A riveted column, having the metal in its shaft injured and weakened by the punching of numerous rivet holes, is liable to fail under a less load than a rolled column in which the shaft is devoid of rivets. The formula does not take into consideration this advantage in favor of the rolled steel column sections. It represents only the best current practice in general steel column design, and is not limited to columns of special or superior shape.

Safe loads computed by this formula are given in the tables on pages 116–129 for all the sizes of Bethlehem rolled H columns and on pages 112–115 for the special I beams and girder beams when used as columns. The column required for any given load and length is readily selected from these tables.

The unsupported length of a column should not exceed 150 radii of gyration, which is the limit of length for which safe loads are given in the tables. In the best practice the unsupported length of a column is frequently required not to exceed 125 times the least radius of gyration; this latter limit is indicated in the tables by zigzag lines.

An example is given on page 130 showing the method of selecting rolled H column sections for buildings, and to which reference should be made. Wherever possible, it is desirable to provide for the given range of loads by selecting the different weights required from the variations in size offered by columns of the same section. Columns thus selected can be obtained from the same rolling, thereby avoiding delay in delivery.

Abutting sections of columns, in addition to having machine squared ends, should be connected by splices of sufficient size to maintain the continuity of section required for preserving the rigidity of the steel frame work of the building or structure. The method of splicing column sections and the manner of connecting beams and girders are shown by the illustrations on page 46. Weights given of the various column sections do not include splices or connections of any kind.

The safe loads given in the tables are for concentric or symmetrical loading. When the loads are not centrally or symmetrically applied, bending is produced in the column, the effect of which must be considered. The unbalanced bending moment of the eccentric loads about the center of the column, in inch-lbs., divided by the section modulus of the column in the direction of bending gives the stress in lbs. per square inch produced by the bending. The load on the column produces a uniform compressive stress over the whole cross section to which the bending stress must be added. The sum is the maximum stress on the extreme fibers of the column section.

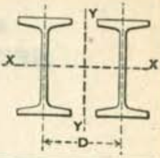
The maximum fiber stress due to direct load and bending must not be more than 25 per cent. in excess of the permissible stress on the column, for the given length, obtained from the formula for concentric loading, otherwise the section of the column must be increased until this limit is not exceeded.

The section modulus about each principal axis for all the sections of rolled H columns is given in the tables of their properties on pages 60–73, by means of which the effect of eccentric loading is easily calculated and considered in the above manner.

SPACING OF

BETHLEHEM SPECIAL I BEAMS AND GIRDER BEAMS,

CENTER TO CENTER, TO PRODUCE EQUAL RADII OF GYRATION ABOUT BOTH AXES XX AND YY.



SPECIAL I BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot of each Beam, Lbs.	Distance D, Inches.
B30	30	120.00	24.06
B28	28	105.00	22.52
B26	26	90.00	21.09
B24 a	24	84.00	19.30
B24	24	82.00	18.90
	24	72.00	19.54
B20 a	20	82.00	15.69
	20	72.00	16.18
B20	20	68.00	15.68
	20	63.00	15.94
	20	60.00	16.14
	20	58.50	16.26
B18	18	58.50	14.00
	18	52.50	14.40
	18	48.50	14.69
B15 b	15	72.00	11.82
B15 a	15	64.00	11.54
	15	54.00	12.04
B15	15	46.00	11.68
	15	42.00	11.93
	15	38.00	12.24
B12 a	12	36.00	9.70
B12	12	31.00	9.60
	12	28.50	9.80
B10	10	27.50	7.82
	10	24.50	8.06
	10	22.50	8.16
B9	9	23.00	7.06
	9	21.00	7.20
	9	19.00	7.37
B8	8	21.25	6.07
	8	18.00	6.32
	8	16.25	6.50

GIRDER BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot of each Beam, Lbs.	Distance D, Inches.
G30 a	30	200.0	24.12
G30	30	175.0	24.19
G28 a	28	180.0	22.62
G28	28	162.5	22.66
G26 a	26	160.0	21.04
G26	26	150.0	21.08
G24 a	24	140.0	19.52
G24	24	120.0	19.60
G20 a	20	140.0	15.89
G20	20	112.0	16.13
G18	18	92.0	14.49
G15 b	15	140.0	*11.10
G15 a	15	104.0	11.54
G15	15	73.0	11.96
G12 a	12	70.0	*9.14
G12	12	55.0	*9.41
G10	10	44.0	*7.68
G9	9	38.0	*6.80
G8	8	32.5	*5.94

* Denotes that the value of D given is less than the distance center to center of beams when placed close together with flanges in contact.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM GIRDER BEAMS

USED AS COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	Area of Section, Sq. In.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS, IN FEET.					
					8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.	13 Ft.
G30 a	30	200.0	58.85	3.19	382.5	382.5	382.5	382.5	382.5	382.5
G30	30	175.0	51.35	2.60	333.8	333.8	333.8	333.8	332.6	326.0
G28 a	28	180.0	52.98	3.09	344.4	344.4	344.4	344.4	344.4	344.4
G28	28	162.5	47.81	2.62	310.8	310.8	310.8	310.8	310.2	304.2
G26 a	26	160.0	47.00	2.97	305.5	305.5	305.5	305.5	305.5	305.5
G26	26	150.0	44.13	2.63	286.9	286.9	286.9	286.9	286.6	281.0
G24 a	24	140.0	41.03	2.87	266.7	266.7	266.7	266.7	266.7	266.7
G24	24	120.0	35.31	2.61	229.5	229.5	229.5	229.5	228.9	224.4
G20 a	20	140.0	41.28	2.85	268.3	268.3	268.3	268.3	268.3	268.1
G20	20	112.0	32.88	2.66	213.7	213.7	213.7	213.7	213.7	210.0
G18	18	92.0	27.09	2.52	176.1	176.1	176.1	176.1	174.1	170.6
G15 b	15	140.0	41.28	2.78	268.3	268.3	268.3	268.3	268.3	266.6
G15 a	15	104.0	30.58	2.58	198.8	198.8	198.8	198.8	197.7	193.8
G15	15	73.0	21.52	2.33	139.9	139.9	139.9	138.6	135.6	132.5
G12 a	12	70.0	20.60	2.31	133.9	133.9	133.9	132.4	129.5	126.5
G12	12	55.0	16.12	2.17	104.8	104.8	104.4	102.0	99.5	97.1
G10	10	44.0	12.95	2.03	84.2	84.2	82.5	80.4	78.3	76.2
G9	9	38.0	11.18	1.91	72.7	72.1	70.1	68.2	66.3	64.3
G8	8	32.5	9.52	1.78	61.9	60.3	58.5	56.8	55.0	53.2

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM GIRDER BEAMS USED AS COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS, IN FEET.

14 Ft.	15 Ft.	16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	28 Ft.	32 Ft.	36 Ft.	Section Number.
385.6	379.5	373.4	361.2	349.1	336.9	324.7	300.3	276.0	251.6	G30 a
319.5	313.0	306.5	293.5	280.4	267.4	254.4	228.3	202.3	176.2	G30
344.4	339.0	333.3	322.0	310.7	299.4	288.1	265.4	242.8	220.2	G28 a
298.2	292.2	286.1	274.1	262.0	250.0	238.0	213.9	189.8	165.7	G28
302.9	297.7	292.4	282.0	271.6	261.1	250.7	229.8	208.9	188.0	G26 a
275.5	270.0	264.4	253.4	242.3	231.2	220.1	198.0	175.9	153.7	G26
262.2	257.5	252.8	243.4	233.9	224.5	215.1	196.2	177.3	158.5	G24 a
220.0	215.5	211.1	202.1	193.2	184.3	175.4	157.5	139.7	121.8	G24
263.3	258.6	253.8	244.2	234.7	225.1	215.6	196.5	177.3	158.2	G20 a
205.9	201.8	197.8	189.6	181.5	173.3	165.1	148.8	132.5	....	G20
167.0	163.5	160.0	152.9	145.8	138.7	131.6	117.4	103.2	....	G18
261.7	256.8	251.9	242.1	232.3	222.5	212.7	193.1	173.5	....	G15 b
189.9	186.0	182.1	174.2	166.4	158.6	150.8	135.1	119.5	....	G15 a
129.5	126.4	123.4	117.3	111.2	105.1	99.0	86.8	....	....	G15
123.6	120.7	117.7	111.8	106.0	100.1	94.2	82.4	....	....	G12 a
94.6	92.2	89.7	84.8	79.9	75.0	70.1	60.3	....	....	G12
74.1	72.0	69.9	65.7	61.5	57.3	53.1	....	....	....	G10
62.4	60.5	58.5	54.7	50.8	47.0	43.1	....	....	....	G9
51.5	49.7	47.9	44.4	40.9	37.3	33.8	....	....	....	G8

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM SPECIAL I BEAMS

USED AS COLUMNS.

SQUARE ENDS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	Area of Section, Sq. In.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS 5 Ft.	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10
B30	30	120.0	35.25	2.11	229.1	229.1	229.1	229.1	229.1	226.9
B28	28	105.0	31.04	1.98	201.8	201.8	201.8	201.8	201.8	196.6
B26	26	90.0	26.63	1.87	173.1	173.1	173.1	170.8	166.1	161.4
B24 a	24	84.0	24.79	1.82	161.1	161.1	161.1	161.1	157.9	153.4
B24	24	72.0	21.21	1.79	137.9	137.9	137.9	137.9	134.5	130 6
B20 a	20	72.0	21.43	1.78	139.3	139.3	139.3	139.3	135.7	131.8
B20	20	68.0	19.95	1.51	129.7	129.7	129.1	124.7	120.4	116.0
	20	63.0	18.55	1.54	120.6	120.6	120.6	116.6	112.6	108.7
	20	60.0	17.65	1.57	114.7	114.7	114.7	111.5	107.8	104.1
	20	58.5	17.15	1.58	111.5	111.5	111.5	108.6	105.0	101.4
B18	18	58.5	17.29	1.44	112.4	112.4	110.6	106.6	102.7	98.7
	18	52.5	15.40	1.49	100.1	100.1	99.3	95.9	92.5	89.1
	18	48.5	14.23	1.53	92.5	92.5	92.4	89.4	86.3	83.3
B15 b	15	72.0	21.27	1.61	138.3	138.3	138.3	135.3	130.9	126.6
B15 a	15	54.0	15.85	1.53	103.0	103.0	102.9	99.5	96.0	92.6
B15	15	46.0	13.46	1.34	87.5	87.5	84.5	81.2	77.9	74.5
	15	42.0	12.41	1.37	80.7	80.7	78.4	75.4	72.4	69.4
	15	38.0	11.21	1.42	72.9	72.9	71.4	68.8	66.2	63.6
B12 a	12	36.0	10.63	1.38	69.1	69.1	67.3	64.7	62.2	59.6
B12	12	31.0	9.13	1.27	59.4	58.8	56.4	54.1	51.7	49.3
	12	28.5	8.41	1.30	54.7	54.5	52.3	50.2	48.1	45.9
B10	10	27.5	8.05	1.20	52.3	51.1	48.9	46.7	44.5	42.3
	10	24.5	7.15	1.24	46.5	45.8	43.9	42.0	40.1	38.2
	10	22.5	6.65	1.27	43.2	42.8	41.1	39.4	37.6	35.9
B9	9	23.0	6.76	1.12	43.9	42.1	40.1	38.1	36.2	34.2
	9	21.0	6.22	1.15	40.4	39.1	37.3	35.5	33.7	31.9
	9	19.0	5.68	1.18	36.9	35.9	34.3	32.7	31.1	29.6
B8	8	21.25	6.25	1.05	40.2	38.2	36.3	34.3	32.3	30.4
	8	18.00	5.37	1.09	34.8	33.2	31.6	30.0	28.3	26.7
	8	16.25	4.81	1.12	31.3	30.0	28.6	27.1	25.7	24.3

Beams not secured against yielding sideways and free to fail in direction of least radius of gyration.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM SPECIAL I BEAMS

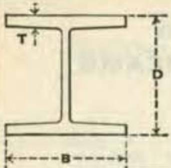
USED AS COLUMNS.

SQUARE ENDS.

UNSUPPORTED LENGTH OF COLUMNS.										Section Number.
11 Ft.	12 Ft.	13 Ft.	14 Ft.	15 Ft.	16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	
221.4	215.9	210.3	204.8	199.3	193.8	182.8	171.7	160.7	149.7	B30
191.4	186.2	181.1	175.9	170.7	165.5	155.2	144.9	134.5	124.2	B28
156.7	152.0	147.3	142.6	140.2	137.9	128.5	119.1	109.7	100.3	B26
148.9	144.4	139.9	135.4	130.9	126.4	117.4	108.4	99.4	90.4	B24 a
126.7	122.8	118.8	114.9	111.0	107.1	99.3	91.5	83.7	....	B24
127.8	123.8	119.8	115.9	111.9	107.9	100.0	92.0	84.0	....	B20 a
111.6	107.3	102.9	98.6	94.2	89.8	81.1	72.4	....	....	
104.7	100.7	96.7	92.8	88.8	84.8	76.9	68.9	....	....	B20
100.4	96.7	93.0	89.3	85.6	81.8	74.4	67.0	....	....	
97.8	94.2	90.6	87.1	83.5	79.9	72.7	65.6	....	....	
94.8	90.8	86.8	82.9	78.9	74.9	67.0	59.1	....	....	
85.7	82.3	78.9	75.5	72.1	68.7	61.8	55.0	....	....	B18
80.2	77.2	74.1	71.0	68.0	64.9	58.7	52.6	....	....	
122.2	117.9	113.5	109.1	104.8	100.4	91.7	83.0	....	....	B15 b
89.2	85.8	82.3	79.0	75.5	72.1	65.3	58.4	....	....	B15 a
71.2	67.9	64.6	61.3	58.0	54.7	48.0	....	....	....	
66.4	63.4	60.4	57.4	54.4	51.5	45.5	....	....	....	B15
61.0	58.4	55.8	53.2	50.6	48.0	42.8	....	....	....	
57.1	54.5	52.0	49.5	46.9	44.4	39.3	....	....	....	B12 a
47.0	44.6	42.2	39.8	37.5	35.1	....	....	....	....	B12
43.8	41.6	39.5	37.4	35.2	33.1	....	....	....	....	
40.1	37.8	35.6	33.4	31.2	29.0	....	....	....	....	
36.3	34.4	32.5	30.6	28.7	26.8	....	....	....	....	B10
34.2	32.4	30.7	29.0	27.2	25.5	....	....	....	....	
32.2	30.2	28.2	26.2	24.2						
30.1	28.3	26.6	24.8	23.0						B9
30.0	26.4	24.8	23.2	21.6						
28.4	26.4	24.5	22.5	20.6						
25.1	23.5	21.8	20.2	18.6						B8
22.9	21.5	20.1	18.6	17.2						

Allowable stress per square inch:
13,000 lbs. for lengths under 55 radii.
$16{,}000 - 55\frac{l}{r}$ for lengths over 55 radii.

Loads given to the right of the zigzag line are for lengths greater than 125 radii of gyration.



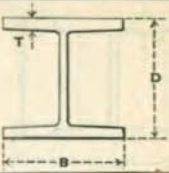
SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 14″ H COLUMNS.

SQUARE ENDS.

Section Number.	Weight of Section, Lbs. per Foot.	Dimensions, Inches. D	T	B	Area of Section, Square Inches.	Least Radius of Gyration, Inches.	Unsupported Length of Columns. 10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.
H14 s	42 6	13 3/8	1/2	8.00	12.53	1.87	78.1	73.7	69.3	64.9	60.4
	47.8	13 1/2	9/16	8.04	14.07	1.88	87.9	82.9	78.0	73.0	68.1
	51.4	13 1/2	9/16	9.00	15.12	2.13	97.5	92.9	88.2	83.5	78.8
	57.1	13 5/8	5/8	9.04	16.79	2.15	108.6	103.4	98.2	93.1	87.9
	61.0	13 5/8	5/8	10.00	17.95	2.40	116.7	114.0	109.1	104.1	99.2
	66.7	13 3/4	11/16	10.03	19.61	2.42	127.5	124.8	119.4	114.1	108.8
	71.0	13 3/4	11/16	11.00	20.88	2.68	135.7	135.7	131.1	125.9	120.8
	77.6	13 7/8	3/4	11.04	22.81	2.70	148.3	148.3	143.5	137.9	132.3
	82.2	13 7/8	3/4	12.00	24.17	2.96	157.1	157.1	155.6	150.3	144.9
	89.2	14	13/16	12.04	26.23	2.97	170.5	170.5	169.0	163.2	157.4
	93.7	14	13/16	13.00	27.56	3.24	179.1	179.1	179.1	175.6	170.0
H14	98.8	14	13/16	14.00	29.06	3.50	188.9	189.0	189.0	188.6	183.2
	106.7	14 1/8	7/8	14.04	31.38	3.52	204.0	204.0	204.0	204.0	198.1
	114.6	14 1/4	15/16	14.08	33.70	3.53	219.1	219.1	219.1	219.1	212.9
	122.5	14 3/8	1	14.12	36.04	3.55	234.3	234.3	234.3	234.3	228.0
	130.5	14 1/2	1 1/16	14.16	38.38	3.56	249.5	249.5	249.5	249.5	243.0
	138.0	14 5/8	1 1/8	14.19	40.59	3.58	263.8	263.8	263.8	263.8	257.4
	146.0	14 3/4	1 3/16	14.23	42.95	3.59	279.2	279.2	279.2	279.2	272.5
	154.1	14 7/8	1 1/4	14.27	45.33	3.61	294.7	294.7	294.7	294.7	288.1
	162.2	15	1 5/16	14.31	47.71	3.62	310.1	310.1	310 1	310.1	303.4
H14 a	164.4	15	1 5/16	14.57	48.36	3.69	314.3	314.3	314.3	314.3	309.3
	172.7	15 1/8	1 3/8	14.61	50.78	3.71	330.1	330.1	330 1	330.1	324.9
	180.9	15 1/4	1 7/16	14.65	53.22	3.72	345.9	345.9	345.9	345.9	340.8
	189.3	15 3/8	1 1/2	14.69	55.67	3.73	361.9	361.9	361.9	361.9	356.7
	197.6	15 1/2	1 9/16	14.73	58.12	3.75	377.8	377.8	377.8	377.8	372 9
	206.0	15 5/8	1 5/8	14.77	60.59	3.76	393.8	393.8	393.8	393.8	389.0
	214.4	15 3/4	1 11/16	14.81	63.07	3.77	410.0	410.0	410.0	410.0	405.2
	222.3	15 7/8	1 3/4	14.84	65.39	3.78	425.0	425.0	425.0	425.0	420.4
H14 b	230.8	16	1 13/16	14.88	67.89	3.80	441.3	441.3	441.3	441.3	437.0
	239.3	16 1/8	1 7/8	14.92	70.39	3.81	457.5	457.5	457.5	457.5	453.4
	247.9	16 1/4	1 15/16	14.96	72.91	3.82	473.9	473.9	473.9	473.9	469.9
	256.5	16 3/8	2	15.00	75.43	3.83	490.3	490.3	490.3	490.3	486.5
	265.1	16 1/2	2 1/16	15.04	77.97	3.85	506.8	506.8	506.8	506.8	503.5
	273.7	16 5/8	2 1/8	15.08	80.51	3.86	523.3	523.3	523.3	523.3	520.2
	282.4	16 3/4	2 3/16	15.12	83.07	3.87	540.0	540.0	540.0	540.0	537.1
	291.2	16 7/8	2 1/4	15.16	85.63	3.88	556.6	556.6	556.6	556.6	554.0

For detail dimensions, see page 60.



SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL

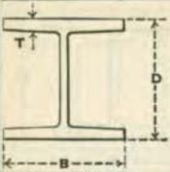
14″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS. 20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	36 Ft.	40 Ft.	44 Ft.	Weight of Section, Lbs. per Foot.
56.0	51.6	47.2	....	....						42.6
63.2	58.2	53.3	....	....						47.8
74.1	69.4	64.7	60.1	55.4						51.4
82.8	77.6	72.5	67.3	62.2						57.1
94.2	89.3	84.5	79.4	74.5	69.6	....	....	....	....	61.0
103.4	98.1	92.7	87.4	82.0	76.7	....	....	....	....	66.7
115.6	110.5	105.3	100.2	95.1	89.9	84.8	74.5	....	....	71.0
126.7	121.2	115.6	110.0	104.4	98.8	93.3	82.1	....	....	77.6
139.5	134.1	128.7	123.3	117.9	112.5	107.1	96.4	85.6	....	82.2
151.6	145.7	139.9	134.1	128.2	122.4	116.6	104.9	93.3	....	89.2
164.3	158.7	153.1	147.5	141.9	136.3	130.7	119.4	108.2	....	93.7
177.7	172.2	166.7	161.2	155.8	150.3	144.8	133.8	122.9	111.9	98.8
192.2	186.3	180.4	174.6	168.7	162.8	156.9	145.1	133.4	121.6	106.7
206.6	200.3	194.0	187.7	181.4	175.1	168.8	156.2	143.6	131.0	114.6
221.3	214.6	207.9	201.2	194.5	187.8	181.1	167.7	154.3	140.9	122.5
235.9	228.8	221.7	214.5	207.4	200.3	193.2	179.0	164.7	150.5	130.5
249.9	242.4	234.9	227.4	220.0	212.5	205.0	190.0	175.1	160.1	138.0
264.6	256.7	248.9	241.0	233.1	225.2	217.3	201.5	185.7	170.0	146.0
279.8	271.5	263.2	254.9	246.6	238.3	230.0	213.5	196.9	180.3	154.1
294.7	286.0	277.3	268.6	259.9	251.2	242.5	225.1	207.7	190.3	162.2
300.4	291.7	283.1	274.4	265.8	257.1	248.5	231.2	213.9	196.6	164.4
315.9	306.9	297.8	288.8	279.8	270.7	261.7	243.6	225.6	207.5	172.7
331.3	321.9	312.5	303.0	293.6	284.1	274.7	255.8	236.9	218.0	180.9
346.9	337.0	327.2	317.3	307.5	297.6	287.8	268.1	248.4	228.7	189.3
362.7	352.4	342.2	332.0	321.8	311.5	301.3	280.8	260.4	239.9	197.6
378.4	367.7	357.1	346.5	335.8	325.2	314.6	293.3	272.0	250.7	206.0
394.2	383.1	372.1	361.0	350.0	338.9	327.9	305.8	283.7	261.7	214.4
409.0	397.5	386.1	374.7	363.3	351.9	340.4	317.6	294.8	271.9	222.3
425.2	413.4	401.6	389.8	378.0	366.3	354.5	330.9	307.3	283.7	230.8
441.2	429.0	416.8	404.6	392.4	380.2	368.0	343.6	319.3	294.9	239.3
457.3	444.7	432.1	419.5	406.9	394.3	381.7	356.5	331.3	306.2	247.9
473.5	460.5	447.5	434.5	421.5	408.5	395.5	369.5	343.5	317.5	256.5
490.1	476.7	463.4	450.0	436.6	423.3	409.9	383.2	356.4	329.7	265.1
506.4	492.7	478.9	465.1	451.4	437.6	423.8	396.3	368.8	341.2	273.7
522.9	508.7	494.6	480.4	466.2	452.1	437.9	409.6	381.2	352.9	282.4
539.4	524.8	510.3	495.7	481.1	466.6	452.0	422.9	393.7	364.6	291.2

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 13″ H COLUMNS.

SQUARE ENDS.

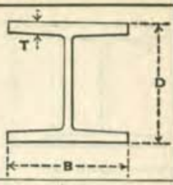
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES. D	T	B	Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS. 10 Ft	12 Ft.	14 Ft.	16 Ft.	18 Ft.
H13 s	41.2	12 3/8	1/2	8.00	12.12	1.89	75.8	71.6	67.3	63.1	58.9
	46.3	12 1/2	9/16	8.04	13.62	1.90	85.3	80.6	75.8	71.1	66.4
	49.9	12 1/2	9/16	9.00	14.67	2.16	94.9	90.5	86.0	81.5	77.0
	55.0	12 5/8	5/8	9.03	16.17	2.18	104.9	100.0	95.1	90.2	85.3
	58.9	12 5/8	5/8	10.00	17.33	2.44	112.6	110.5	105 8	101.1	96.5
	64.9	12 3/4	11/16	10.04	19.09	2.45	124.1	121.9	116.7	111.6	106.4
	69.1	12 3/4	11/16	11.00	20.33	2.71	132.1	132.2	128.0	123.0	118.1
	75.6	12 7/8	3/4	11.04	22.22	2.72	144.4	144.4	140.0	134.6	129.2
	79.8	12 7/8	3/4	12.00	23.46	2.99	152.5	152.5	151.4	146.3	141.1
	86.6	13	13/16	12.04	25.48	3.00	165.6	165.6	164.6	159.0	153.4
H13	91.5	13	13/16	13.00	26.93	3.26	175.1	175.1	175.1	171.8	166.4
	98.9	13 1/8	7/8	13.04	29.08	3.28	189.0	189.0	189.0	185.8	180.0
	106.2	13 1/4	15/16	13.08	31.24	3.29	203.1	203.1	203.1	199.8	193.5
	113.6	13 3/8	1	13.12	33.41	3.31	217.2	217.2	217.2	214.0	207.3
	121.0	13 1/2	1 1/16	13.16	35.59	3.32	231.3	231.3	231.3	228.1	221.0
	128.0	13 5/8	1 1/8	13.19	37.64	3.34	244.7	244.7	244.7	241.6	234 2
	135.5	13 3/4	1 3/16	13.23	39.84	3.35	259.0	259.0	259.0	255.9	248.1
	143.0	13 7/8	1 1/4	13.27	42.05	3.36	273.3	273.3	273.3	270.3	262 1
	150.5	14	1 5/16	13.31	44.27	3.38	287.8	287.8	287.8	285.0	276.4
H13 a	156.4	14	1 5/16	14.00	45.99	3.57	298.9	298.9	298.9	298.9	291.4
	164.2	14 1/8	1 3/8	14.04	48.30	3.58	314.0	314.0	314.0	314.0	306.3
	172.1	14 1/4	1 7/16	14.08	50.63	3.59	329.1	329.1	329.1	329.1	321.3
	180.1	14 3/8	1 1/2	14.12	52.96	3.61	344.2	344.2	344.2	344.2	336.5
	188.0	14 1/2	1 9/16	14.16	55.31	3.62	359.5	359.5	359.5	359.5	351.7
	196.1	14 5/8	1 5/8	14.20	57.66	3.63	374.8	374.8	374.8	374.8	366 9
	204.1	14 3/4	1 11/16	14.24	60.03	3.64	390.2	390.2	390.2	390.2	382.3
	211.7	14 7/8	1 3/4	14.27	62.25	3.66	404.6	404.6	404.6	404.6	397.0
	219.8	15	1 13/16	14.31	64.64	3.67	420.2	420.2	420.2	420.2	412.5
H13 b	226.5	15	1 13/16	14.88	66.62	3.83	433.0	433.0	433.0	433.0	429.6
	234.9	15 1/8	1 7/8	14.92	69.09	3.84	449.1	449.1	449.1	449.1	445.9
	243.3	15 1/4	1 15/16	14.96	71.56	3.85	465.1	465.1	465.1	465.1	462.1
	251.8	15 3/8	2	15.00	74.05	3.86	481.3	481.3	481.3	481.3	478.5
	260.2	15 1/2	2 1/16	15.04	76.54	3.88	497.5	497.5	497.5	497.5	495.1
	268.8	15 5/8	2 1/8	15.08	79.05	3.89	513.8	513.8	513.8	513.8	511.7
	277.3	15 3/4	2 3/16	15.12	81.56	3.90	530.1	530.1	530.1	530.1	528.3
	285.9	15 7/8	2 1/4	15.16	84.09	3.91	546.6	546.6	546.6	546.6	545.0

For detail dimensions, see page 62.

SAFE LOADS IN TONS OF 2000 LBS. FOR

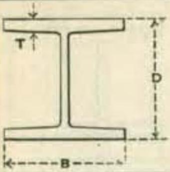
BETHLEHEM ROLLED STEEL
13″ H COLUMNS.

SQUARE ENDS.



UNSUPPORTED LENGTH OF COLUMNS.										Weight of Section, Lbs. per Foot.
20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	36 Ft.	40 Ft.	44 Ft.	
54.6	50.4	46.2	.....	....	Allowable stress per square inch:					41.2
61.7	56.9	52.2	....	....	13,000 lbs. for lengths under 55 radii.					46.3
72.5	68.1	63.6	59.1	54.6	16,000—55 $\frac{l}{r}$ for lengths over 55 radii.					49.9
80.4	75.5	70.6	65.7	60.8						55.0
91.8	87.1	82.4	77.7	73.0	68.3	63.6	....	....	....	58.9
101.3	96.2	91.0	85.9	80.7	75.6	70.4	....	....	....	64.9
113.1	108.2	103.2	98.3	93.3	88.4	83.4	73.5	....	....	69.1
123.8	118.5	113.1	107.7	102.3	96.9	91.5	80.7	....	....	75.6
135.9	130.7	125.5	120.4	115.2	110.0	104.8	94.5	84.1	......	79.8
147.8	142.2	136.6	131.0	125.4	119.8	114.2	102.9	91.7	....	86.6
160.9	155.5	150.0	144.6	139.1	133.7	128.2	117.3	106.4	95.5	91.5
174.1	168.3	162.4	156.6	150.7	144.9	139.0	127.3	115.6	103.9	98.9
187.3	181.0	174.7	168.5	162.2	155.9	149.7	137.1	124.6	112.1	106.2
200.7	194.0	187.3	180.7	174.0	167.4	160.7	147.4	134.0	120.7	113.6
214.0	206.9	199.8	192.7	185.7	178.6	171.5	157.4	143.2	129.1	121.0
226.7	219.3	211.9	204.4	197.0	189.6	182.1	167.2	152.4	137.5	128.0
240.2	232.4	224.5	216.7	208.8	201.0	193.1	177.4	161.7	146.0	135.5
253.8	245.5	237.3	229.0	220.8	212.5	204.2	187.7	171.2	154.7	143.0
267.7	259.1	250.4	241.8	233.1	224.5	215.9	198.6	181.3	164.0	150.5
282.9	274.4	265.9	257.4	248.9	240.4	231.9	214.9	197.9	180.9	156.4
297.4	288.5	279.6	270.6	261.7	252.8	243.9	226.1	208.3	190.5	164.2
312.0	302.7	293.3	284.0	274.7	265.4	256.1	237.5	218.9	200.3	172.1
326.9	317.2	307.5	297.8	288.1	278.4	268.8	249.4	230.0	210.7	180.1
341.6	331.6	321.5	311.4	301.3	291.2	281.1	261.0	240.8	220.6	188.0
356.4	346.0	335.5	325.0	314.5	304.0	293.5	272.6	251.6	230.6	196.1
371.4	360.5	349.6	338.7	327.9	317.0	306.1	284.3	262.6	240.8	204.1
385.8	374.5	363.3	352.1	340.8	329.6	318.4	295.9	273.5	251.0	211.7
400.9	389.3	377.6	366.0	354.4	342.8	331.1	307.9	284.6	261.4	219.8
418.2	406.7	395.2	383.7	372.2	360.8	349.3	326.3	303.4	280.4	226.5
434.0	422.1	410.2	398.4	386.5	374.6	362.7	339.0	315.2	291.5	234.9
449.8	437.6	425.3	413.0	400.8	388.5	376.2	351.7	327.1	302.6	243.3
465.8	453.1	440.5	427.8	415.1	402.5	389.8	364.5	339.2	313.9	251.8
482.1	469.1	456.1	443.1	430.1	417.0	404.0	378.0	351.9	325.9	260.2
498.3	484.9	471.5	458.0	444.6	431.2	417.8	391.0	464.2	337.3	268.8
514.5	500.7	486.9	473.1	459.2	445.4	431.6	404.0	376.4	348.8	277.3
530.8	516.6	502.4	488.2	474.0	459.8	445.6	417.2	388.8	360.5	285.9

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR
BETHLEHEM ROLLED STEEL
12″ H COLUMNS.
SQUARE ENDS.

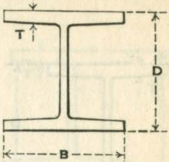
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES. D	T	B	Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS. 10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.
	40.0	$11\frac{1}{2}$	$\frac{1}{2}$	8.00	11.76	1.91	73.8	69.7	65.6	61.6	57.5
	45.0	$11\frac{5}{8}$	$\frac{9}{16}$	8.04	13.33	1.92	83.1	78.6	74.0	69.5	64.9
	48.1	$11\frac{5}{8}$	$\frac{9}{16}$	9.00	14.16	2.19	92.0	87.7	83.4	79.1	74.9
H12s	51.6	$11\frac{3}{4}$	$\frac{5}{8}$	9.04	15.75	2.20	102.4	97.7	92.9	88.2	83.5
	57.4	$11\frac{3}{4}$	$\frac{5}{8}$	10.00	16.89	2.46	109.8	107.9	103.4	98.9	94.4
	63.3	$11\frac{7}{8}$	$\frac{11}{16}$	10.04	18.61	2.47	121.0	119.0	114.1	109.1	104.1
	67.1	$11\frac{7}{8}$	$\frac{11}{16}$	11.00	19.74	2.74	128.3	128.3	124.6	119.9	115.1
	73.4	12	$\frac{3}{4}$	11.04	21.60	2.75	140.4	140.4	136.5	131.3	126 1
	78.0	12	$\frac{3}{4}$	12.00	22.94	3.01	149.1	149.1	148.3	143.3	138.3
	84.7	$12\frac{1}{8}$	$\frac{13}{16}$	12.04	24.92	3.03	162.0	162.0	161.4	155.9	150.5
	91.5	$12\frac{1}{4}$	$\frac{7}{8}$	12.08	26.92	3.04	175.0	175.0	174.5	168.6	162.8
	98.3	$12\frac{3}{8}$	$\frac{15}{16}$	12.12	28.92	3.06	188.0	188.0	187.7	181.5	175.2
H12	105.2	$12\frac{1}{2}$	1	12.16	30.94	3.07	201.1	201.1	201.0	194.3	187.7
	112.1	$12\frac{5}{8}$	$1\frac{1}{16}$	12.20	32.96	3.08	214.2	214.2	214.2	207.2	200.1
	118.6	$12\frac{3}{4}$	$1\frac{1}{8}$	12.23	34.87	3.10	226.7	226.7	226.7	219.6	212.1
	125.5	$12\frac{7}{8}$	$1\frac{3}{16}$	12.27	36.91	3.11	239.9	239.9	239.9	232.6	224.8
	132.5	13	$1\frac{1}{4}$	12.31	38.97	3.13	253.3	253.3	253.3	246.0	237.8
	138.1	13	$1\frac{1}{4}$	13.00	40.61	3.32	264.0	264.0	264.0	260.3	252.2
	145.4	$13\frac{1}{8}$	$1\frac{5}{16}$	13.04	42.76	3.33	277.9	277.9	277.9	274.3	265.8
	152.7	$13\frac{1}{4}$	$1\frac{3}{8}$	13.08	44.92	3.34	292.0	292.0	292.0	288.4	279.5
	160.1	$13\frac{3}{8}$	$1\frac{7}{16}$	13.12	47.09	3 35	306.1	306.1	306.1	302.5	293.2
H12a	167.5	$13\frac{1}{2}$	$1\frac{1}{2}$	13.16	49.27	3.37	320.3	320.3	320.3	317.0	307.3
	174.9	$13\frac{5}{8}$	$1\frac{9}{16}$	13.20	51.46	3.38	334.5	334 5	334.5	331.3	321.2
	182 4	$13\frac{3}{4}$	$1\frac{5}{8}$	13.24	53.66	3.39	348.8	348.8	348.8	345.7	335.3
	189.9	$13\frac{7}{8}$	$1\frac{11}{16}$	13.28	55.87	3.40	363.2	363.2	363.2	360.2	349.4
	197.1	14	$1\frac{3}{4}$	13.31	57.96	3.42	376.7	376.7	376.7	374.1	363.0
	204.9	14	$1\frac{3}{4}$	14.00	60.27	3.61	391.8	391.8	391.8	391.8	383.0
	212.8	$14\frac{1}{8}$	$1\frac{13}{16}$	14.04	62.58	3.62	406.8	406.8	406.8	406.8	398.0
	220.7	$14\frac{1}{4}$	$1\frac{7}{8}$	14.08	64.91	3.63	421.9	421.9	421.9	421.9	413.1
	228.6	$14\frac{3}{8}$	$1\frac{15}{16}$	14.12	67.24	3.65	437.1	437.1	437.1	437.1	428.5
H12b	236.6	$14\frac{1}{2}$	2	14.16	69.59	3.66	452.3	452.3	452.3	452.3	443.8
	244.6	$14\frac{5}{8}$	$2\frac{1}{16}$	14.20	71.94	3.67	467.6	467.6	467.6	467.6	459.1
	252.8	$14\frac{3}{4}$	$2\frac{1}{8}$	14.24	74.31	3.68	483.0	483.0	483.0	483.0	474.5
	260.7	$14\frac{7}{8}$	$2\frac{3}{16}$	14.28	76.68	3.69	498.4	498.4	498.4	498.4	490 0
	268.8	15	$2\frac{1}{4}$	14.32	79.06	3.71	514.0	514.0	514 0	514.0	506.0

For detail dimensions, see page 64.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL
12″ H COLUMNS.

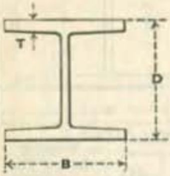
SQUARE ENDS.



UNSUPPORTED LENGTH OF COLUMNS.

20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	34 Ft.	36 Ft.	40 Ft.	Weight of Section, Lbs. per Foot.
53.4	49.4	45.3	......	......	Allowable stress per square inch:					40.0
60.4	55.8	51.3	......	......	13,000 lbs. for lengths under 55 radii.					45.0
70.6	66.3	62.1	57.8	53.5	$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.					48.1
78.8	74.0	69.3	64.6	59.9						51.6
89.8	85.3	80.7	76.2	71.7	67.2	62.6	......	......	......	57.4
99.2	94.2	89.2	84.2	79.3	74.3	69.3	......	......	......	63.3
110.4	105.6	100.9	96.1	91.4	86.6	81.8	77.1	......	......	67.1
121.0	115.8	110.6	105.4	100.2	95.0	89.9	84.7	......	......	73.4
133.2	128.2	123.2	118.1	113.1	108.1	103.0	98.0	93.0	......	78.0
145.1	139.7	134.2	128.8	123.4	117.9	112.5	107.1	101.7	......	84.7
156.9	151.1	145.2	139.4	133.5	127.7	121.9	116.0	110.2	......	91.5
169.0	162.8	156.5	150.3	144.0	137.8	131.6	125.3	119.1	......	98.3
181.0	174.4	167.7	161.1	154.4	147.8	141.1	134.4	127.8	......	105.2
193.1	186.0	178.9	171.9	164.8	157.7	150.7	143.6	136.6	......	112.1
204.7	197.3	189.9	182.5	175.0	167.6	160.2	152.8	145.3	......	118.6
217.0	209.1	201.3	193.5	185.6	177.8	170.0	162.1	154.3	......	125.5
229.6	221.4	213.2	204.9	196.7	188.5	180.3	172.1	163.9	......	132.5
244.2	236.1	228.0	219.9	211.9	203.8	195.7	187.6	179.6	163.4	138.1
257.3	248.9	240.4	231.9	223.4	215.0	206.5	198.0	189.5	172.6	145.4
270.6	261.7	252.8	244.0	235.1	226.2	217.3	208.5	199.6	181.8	152.7
284.0	274.7	265.4	256.1	246.8	237.6	228.3	219.0	209.7	191.2	160.1
297.7	288.0	278.4	268.7	259.1	249.4	239.8	230.1	220.5	201.2	167.5
311.2	301.2	291.1	281.1	271.0	261.0	250.9	240.9	230.8	210.7	174.9
324.8	314.4	303.9	293.5	283.0	272.6	262.1	251.7	241.2	220.3	182.4
338.5	327.7	316.8	306.0	295.1	284.3	273.4	262.6	251.7	230.1	189.9
351.8	340.6	329.4	318.2	307.0	295.9	284.7	273.5	262.3	239.9	197.1
372.0	361.0	349.9	338.9	327.9	316.9	305.9	294.8	283.8	261.8	204.9
386.5	375.1	363.7	352.3	340.9	329.5	318.1	306.7	295.3	272.4	212.8
401.3	389.5	377.7	365.9	354.1	342.3	330.5	318.7	306.9	283.2	220.7
416.3	404.2	392.0	379.9	367.7	355.5	343.4	331.2	319.1	294.8	228.6
431.2	418.7	406.1	393.6	381.0	368.5	355.9	343.4	330.8	305.7	236.6
446.2	433.2	420.3	407.3	394.4	381.5	368.5	355.6	342.7	316.8	244.6
461.2	447.9	434.6	421.2	407.9	394.6	381.2	367.9	354.6	327.9	252.8
476.3	462.6	448.9	435.1	421.4	407.7	394.0	380.3	366.6	339.1	260.7
491.9	477.8	463.8	449.7	435.6	421.6	407.5	393.4	379.4	351.2	268.8

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 11″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

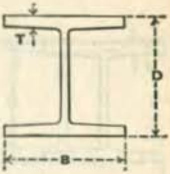
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES.			Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS.				
		D	T	B			10 Ft.	11 Ft.	12 Ft.	13 Ft.	14 Ft.
	38.4	10⅝	½	8.00	11.30	1.94	71.2	69.3	67.3	65.4	63.5
	43.3	10¾	$\frac{9}{16}$	8.04	12.73	1.95	80.3	78.1	76.0	73.8	71.7
H11s	46.8	10¾	$\frac{9}{16}$	9.00	13.76	2.21	89.4	87.5	85.4	83.4	81.3
	52.1	10⅞	⅝	9.04	15.32	2.22	99.6	97.5	95.2	93.0	90.7
	55.9	10⅞	⅝	10.00	16.44	2.47	106.9	106.9	105.2	103.0	100.8
	61.3	11	$\frac{11}{16}$	10.03	18.02	2.50	117.1	117.1	115.6	113.2	110.9
	65.5	11	$\frac{11}{16}$	11.00	19.26	2.76	125.2	125.2	125.2	124.1	121.8
	71.7	11⅛	¾	11.04	21.08	2.78	137.0	137.0	137.0	136.1	133.6
	77.9	11¼	$\frac{13}{16}$	11.08	22.91	2.79	148.9	148.9	148.9	148.1	145.3
	84.2	11⅜	⅞	11.12	24.75	2.81	160.9	160.9	160.9	160.2	157.3
H11	90.5	11½	$\frac{15}{16}$	11.16	26.60	2.82	172.9	172.9	172.9	172.3	169.2
	96.8	11⅝	1	11.20	28.46	2.83	185.0	185.0	185.0	184.5	181.2
	103.1	11¾	$1\frac{1}{16}$	11.24	30.33	2.85	197.2	197.2	197.2	197.0	193.5
	109.1	11⅞	1⅛	11.27	32.10	2.86	208.7	208.7	208.7	208.7	205.0
	115.5	12	$1\frac{3}{16}$	11.31	33.98	2.87	220.9	220.9	220.9	220.9	217.1
	120.9	12	$1\frac{3}{16}$	12.00	35.54	3.06	231.0	231.0	231.0	231.0	230.7
	127.6	12⅛	1¼	12.04	37.53	3.08	243.9	243.9	243.9	243.9	243.9
	134.4	12¼	$1\frac{5}{16}$	12.08	39.52	3.09	256.9	256.9	256.9	256.9	256.9
	141.2	12⅜	1⅜	12.12	41.53	3.10	270.0	270.0	270.0	270.0	270.0
H11a	148.1	12½	$1\frac{7}{16}$	12.16	43.54	3.12	283.0	283.0	283.0	283.0	283.0
	154.9	12⅝	1½	12.20	45.57	3.13	296.2	296.2	296.2	296.2	296.2
	161.9	12¾	$1\frac{9}{16}$	12.24	47.60	3.14	309.4	309.4	309.4	309.4	309.4
	168.8	12⅞	1⅝	12.28	49.65	3.15	322.7	322.7	322.7	322.7	322.7
	175.8	13	$1\frac{11}{16}$	12.32	51.70	3.17	336.1	336.1	336.1	336.1	336.1

For detail dimensions, see page 66.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 11″ H COLUMNS.

SQUARE ENDS.



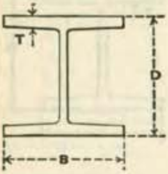
Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Weight of Section, Lbs. per Foot.
16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	36 Ft.	
59.7	55.8	52.0	48.1	44.3	......	......	......	......	......	38.4
67.4	63.1	58.8	54.5	50.1	......	......	......	......	......	43.3
77.2	73.1	69.0	64.9	60.8	56.7	52.6	......	......	......	46.8
86.1	81.6	77.0	72.5	67.9	63.4	58.8	......	......	......	52.1
96.4	92.0	87.6	83.2	78.8	74.4	70.0	65.6	61.2	......	55.9
106.1	101.3	96.6	91.8	87.1	82.3	77.6	72.8	68.0	......	61.3
117.2	112.6	108.0	103.4	98.8	94.2	89.6	85.0	80.4	71.2	65.5
128.6	123.6	118.6	113.6	108.6	103.6	98.6	93.6	88.6	78.6	71.7
139.9	134.5	129.1	123.7	118.3	112.8	107.4	102.0	96.6	85.7	77.9
151.5	145.7	139.9	134.1	128.2	122.4	116.6	110.8	105.0	93.4	84.2
163.0	156.8	150.5	144.3	138.1	131.9	125.6	119.4	113.2	100.7	90.5
174.6	167.9	161.3	154.7	148.0	141.4	134.8	128.1	121.5	108.2	96.8
186.5	179.4	172.4	165.4	158.4	151.3	144.3	137.3	130.3	116.2	103.1
197.5	190.1	182.7	175.3	167.9	160.5	153.1	145.7	138.3	123.5	109.1
209.3	201.5	193.7	185.9	178.1	170.3	162.4	154.6	146.8	131.2	115.5
223.0	215.3	207.7	200.0	192.3	184.7	177.0	169.3	161.7	146.3	120.9
235.9	227.9	219.8	211.8	203.7	195.7	187.7	179.6	171.6	155.5	127.6
248.6	240.2	231.8	223.3	214.9	206.4	198.0	189.5	181.1	164.2	134.4
261.5	252.7	243.8	235.0	226.1	217.3	208.5	199.6	190.8	173.1	141.2
274.6	265.4	256.2	247.0	237.8	228.6	219.4	210.2	201.0	182.5	148.1
287.7	278.1	268.5	258.9	249.3	239.6	230.0	220.4	210.8	191.6	154.9
300.8	290.8	280.8	270.7	260.7	250.7	240.7	230.7	220.7	200.7	161.9
314.0	303.6	293.2	282.8	272.4	262.0	251.6	241.2	230.8	209.9	168.8
327.5	316.7	306.0	295.2	284.4	273.7	262.9	252.1	241.4	219.9	175.8

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 10″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

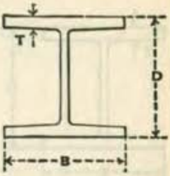
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES.			Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS.				
		D	T	B			10 Ft	11 Ft.	12 Ft.	13 Ft.	14 Ft.
H10 s	37.2	9¾	½	8.00	10.95	1.96	69.2	67.3	65.5	63.6	61.8
	42.0	9⅞	9/16	8.04	12.34	1.97	78.1	76.0	73.9	71.9	69.8
	45.4	9⅞	9/16	9.00	13.36	2.23	86.8	85.1	83.2	81.2	79.2
	50.6	10	⅝	9.04	14.88	2.25	96.7	95.0	92.9	90.7	88.5
H10	54.1	10	⅝	10.00	15.91	2.51	103.4	103.4	102.2	100.1	98.0
	59.7	10⅛	11/16	10.04	17.57	2.53	114.2	114.2	113.1	110.8	108.5
	65.4	10¼	¾	10.08	19.23	2.54	125.0	125.0	123.9	121.4	118.9
	71.1	10⅜	13/16	10.12	20.91	2.56	135.9	135.9	134.9	132.2	129.5
	76.8	10½	⅞	10.16	22.59	2.57	146.8	146.8	145.9	143.0	140.1
	82.6	10⅝	15/16	10.20	24.29	2.58	157.9	157.9	157.0	153.9	150.8
	88.4	10¾	1	10.24	25.99	2.60	168.9	168.9	168.3	165.0	161.7
	94.2	10⅞	1 1/16	10.28	27.71	2.61	180.1	180.1	179.6	176.1	172.6
	99.7	11	1⅛	10.31	29.32	2.62	190.6	190.6	190.2	186.6	182.9
H10 a	104.7	11	1⅛	11.00	30.80	2.81	200.2	200.2	200.2	199.4	195.8
	110.9	11⅛	1 3/16	11.04	32.62	2.83	212.0	212.0	212.0	211.5	207.7
	117.1	11¼	1¼	11.08	34.45	2.84	223.9	223.9	223.9	223.6	219.6
	123.4	11⅜	1 5/16	11.12	36.29	2.85	235.9	235.9	235.9	235.7	231.5
	129.7	11½	1⅜	11.16	38.14	2.86	247.9	247.9	247.9	247.9	243.5
	136.0	11⅝	1 7/16	11.20	40.00	2.88	260.0	260.0	260.0	260.0	255.8
	142.4	11¾	1½	11.24	41.87	2.89	272.2	272.2	272.2	272.2	268.0
	148.8	11⅞	1 9/16	11.28	43.75	2.90	284.4	284.4	284.4	284.4	280.3
	155.2	12	1⅝	11.32	45.64	2.91	296.7	296.7	296.7	296.7	292.7

For detail dimensions, see page 68.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 10″ H COLUMNS.

SQUARE ENDS.



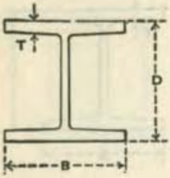
Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Weight of Section, Lbs. per Foot.
16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	34 Ft.	
58.1	54.4	50.7	47.0	43.4	......	......	......	......	......	37.2
65.7	61.5	57.4	53.2	49.1	......	......	......	......	......	42.0
75.3	71.3	67.3	63.4	59.4	55.5	51.5	......	......	......	45.4
84.1	79.8	75.4	71.0	66.7	62.3	57.9	......	......	......	50.6
93.8	89.6	85.4	81.3	77.1	72.9	68.7	64.5	60.3	......	54.1
103.9	99.3	94.7	90.1	85.6	81.0	76.4	71.8	67.2	......	59.7
113.9	108.9	103.9	98.9	93.9	88.9	83.9	78.9	73.9	......	65.4
124.2	118.8	113.4	108.0	102.6	97.2	91.8	86.4	81.0	......	71.1
134.3	128.5	122.7	116.9	111.1	105.3	99.5	93.7	87.9	......	76.8
144.6	138.4	132.2	126.0	119.8	113.5	107.3	101.1	94.9	......	82.6
155.1	148.5	142.0	135.4	128.8	122.2	115.6	109.0	102.4	......	88.4
165.6	158.6	151.6	144.6	137.6	130.6	123.6	116.6	109.6	......	94.2
175.5	168.1	160.7	153.3	145.9	138.5	131.2	123.8	116.4	......	99.7
188.5	181.3	174.1	166.8	159.6	152.4	145.1	137.9	130.7	123.4	104.7
200.1	192.5	184.9	177.3	169.7	162.1	154.5	146.9	139.2	131.6	110.9
211.6	203.6	195.5	187.5	179.5	171.5	163.5	155.5	147.5	139.5	117.1
223.1	214.7	206.3	197.9	189.5	181.1	172.7	164.3	155.9	147.5	123.4
234.7	225.9	217.1	208.3	199.5	190.7	181.9	173.1	164.3	155.5	129.7
246.7	237.5	228.3	219.2	210.0	200.8	191.7	182.5	173.3	164.2	136.0
258.5	248.9	239.3	229.8	220.2	210.7	201.1	191.5	182.0	172.4	142.4
270.3	260.4	250.4	240.5	230.5	220.6	210.6	200.7	190.7	180.7	148.8
282.3	272.0	261.6	251.3	240.9	230.6	220.2	209.9	199.5	189.2	155.2

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 9″ H COLUMNS.

SQUARE ENDS.

Allowable stress per square inch:
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

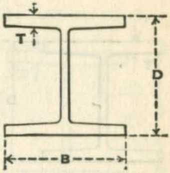
Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES.			Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS.				
		D	T	B			10 Ft.	11 Ft.	12 Ft.	13 Ft.	14 Ft.
H9 s	28.8	8¾	7/16	7.00	8.46	1.71	51.4	49.7	48.1	46.5	44.8
	32.9	8⅞	½	7.04	9.69	1.72	58.9	57.1	55.2	53.4	51.5
	36.0	8⅞	½	8.00	10.59	1.98	67.1	65.3	63.5	61.8	60.0
	40.6	9	9/16	8.04	11.95	2.00	75.9	73.9	71.9	70.0	68.0
H9	43.8	9	9/16	9.00	12.88	2.26	84.2	82.4	80.5	78.6	76.7
	48.9	9⅛	⅝	9.04	14.37	2.28	94.2	92.1	90.0	87.9	85.8
	54.0	9¼	11/16	9.08	15.87	2.29	103.2	101.8	99.5	97.2	94.9
	59.1	9⅜	¾	9.12	17.38	2.31	113.0	111.7	109.3	106.8	104.3
	64.3	9½	13/16	9.16	18.90	2.32	122.9	121.6	118.9	116.3	113.6
	69.5	9⅝	⅞	9.20	20.43	2.33	132.8	131.6	128.7	125.8	122.9
	74.7	9¾	15/16	9.24	21.97	2.34	142.8	141.7	138.6	135.5	132.4
	80.0	9⅞	1	9.28	23.52	2.36	152.9	152.0	148.7	145.4	142.1
	85.3	10	1 1/16	9.32	25.08	2.37	163.0	162.2	158.7	155.2	151.8
H9 a	90.0	10	1 1/16	10.00	26.46	2.56	172.0	172.0	170.8	167.3	163.9
	95.3	10⅛	1⅛	10.03	28.02	2.57	182.1	182.1	181.0	177.4	173.8
	100.9	10¼	1 3/16	10.07	29.68	2.58	192.9	192.9	191.9	188.1	184.3
	106.6	10⅜	1¼	10.11	31.35	2.60	203.8	203.8	203.1	199.1	195.1
	112.3	10½	1 5/16	10.15	33.04	2.61	214.8	214.8	214.2	210.0	205.8
	118.1	10⅝	1⅜	10.19	34.73	2.62	225.8	225.8	225.4	221.0	216.6
	123.9	10¾	1 7/16	10.23	36.44	2.63	236.9	236.9	236.7	232.1	227.5
	129.7	10⅞	1½	10.27	38.15	2.65	248.0	248.0	248.0	243.4	238.7
	135.6	11	1 9/16	10.31	39.87	2.66	259.2	259.2	259.2	254.7	249.7

For detail dimensions, see page 70.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL
9″ H COLUMNS.

SQUARE ENDS.



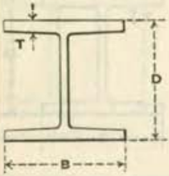
Allowable stress per square inch :

13,000 lbs. for lengths under 55 radii.

$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Weight of Section, Lbs. per Foot.
15 Ft.	16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	
43.2	41.6	38.3	35.0	31.8	....	....	....	....	....	28.8
49.6	47.8	44.1	40.3	36.6	....	....	....	....	....	32.9
58.3	56.5	53.0	49.4	45.9	42.4	38.8	....	....	....	36.0
66.0	64.1	60.1	56.2	52.2	48.3	44.3	....	....	....	40.6
74.8	73.0	69.2	65.4	61.7	57.9	54.1	50.4	46.6	....	43.8
83.8	81.7	77.5	73.4	69.2	65.0	60.9	56.7	52.6	....	48.9
92.7	90.4	85.8	81.2	76.7	72.1	67.5	62.9	58.4	....	54.0
101.8	99.3	94.4	89.4	84.4	79.5	74.5	69.5	64.6	....	59.1
110.9	108.2	102.8	97.4	92.1	86.7	81.3	75.9	70.6	....	64.3
120.0	117.1	111.4	105.6	99.8	94.0	88.2	82.4	76.6	....	69.5
129.3	126.2	120.0	113.8	107.6	101.4	95.2	89.0	82.8	....	74.7
138.8	135.5	129.0	122.4	115.8	109.2	102.7	96.1	89.5	....	80.0
148.3	144.8	137.8	130.8	123.8	116.8	109.8	102.9	95.9	....	85.3
160.5	157.1	150.3	143.5	136.6	129.8	123.0	116.2	109.4	102.5	90.0
170.2	166.6	159.4	152.2	145.0	137.8	130.6	123.4	116.2	109.0	95.3
180.5	176.7	169.1	161.5	153.9	146.3	138.7	131.1	123.6	116.0	100.9
191.1	187.1	179.2	171.2	163.3	155.3	147.3	139.4	131.4	123.5	106.6
201.7	197.5	189.1	180.8	172.4	164.1	155.7	147.4	139.0	130.6	112.3
212.2	207.9	199.1	190.4	181.6	172.9	164.1	155.4	146.6	137.9	118.1
222.9	218.4	209.2	200.1	190.9	181.8	172.6	163.5	154.4	145.2	123.9
233.9	229.2	219.7	210.2	200.7	191.2	181.7	172.2	162.7	153.2	129.7
244.8	239.8	229.9	220.0	210.1	200.3	190.4	180.5	170.6	160.7	135.6

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 8″ H COLUMNS.

SQUARE ENDS.

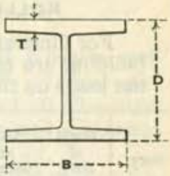
Allowable stress per square inch :
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

Section Number.	Weight of Section, Lbs. per Foot.	DIMENSIONS, INCHES. D	T	B	Area of Section, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS. 8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.
H8 s	27.7	7⅞	7/16	7.00	8.15	1.73	52.8	51.2	49.7	48.1	46.5
	31.8	8	½	7.04	9.35	1.74	60.6	58.8	57.1	55.3	53.5
H8 a	34.6	8	½	8.00	10.17	2.01	66.1	66.1	64.7	63.0	61.3
	39.1	8⅛	9/16	8.04	11.50	2.03	74.8	74.8	73.3	71.4	69.6
	43.6	8¼	⅝	8.08	12.83	2.04	83.4	83.4	81.9	79.8	77.7
	48.2	8⅜	11/16	8.12	14.18	2.05	92.2	92.2	90.6	88.3	86.1
	52.8	8½	¾	8.16	15.53	2.07	101.0	101.0	99.5	97.0	94.5
	57.4	8⅝	13/16	8.20	16.90	2.08	109.9	109.9	108.4	105.7	103.0
	62.1	8¾	⅞	8.24	18.27	2.09	118.8	118.8	117.3	114.4	111.5
	66.8	8⅞	15/16	8.28	19.66	2.11	127.8	127.8	126.5	123.5	120.4
	71.6	9	1	8.32	21.05	2.12	136.8	136.8	135.6	132.4	129.1
H8 b	76.0	9	1	9.00	22.35	2.31	145.3	145.3	145.3	143.7	140.5
	81.1	9⅛	1 1/16	9.04	23.84	2.32	155.0	155.0	155.0	153.4	150.0
	85.9	9¼	1⅛	9.07	25.25	2.33	164.1	164.1	164.1	162.7	159.1
	91.0	9⅜	1 3/16	9.11	26.76	2.34	173.9	173.9	173.9	172.6	168.8
	96.1	9½	1¼	9.15	28.28	2.36	183.8	183.8	183.8	182.7	178.8
	101.3	9⅝	1 5/16	9.19	29.81	2.37	193.8	193.8	193.8	192.8	188.7
	106.6	9¾	1⅜	9.23	31.35	2.38	203.8	203.8	203.8	203.0	198.6
	111.8	9⅞	1 7/16	9.27	32.89	2.39	213.8	213.8	213.8	213.2	208.6
	117.1	10	1½	9.31	34.45	2.41	223.9	223.9	223.9	223.7	219.0

For detail dimensions, see page 72.

SAFE LOADS IN TONS OF 2000 LBS. FOR

BETHLEHEM ROLLED STEEL 8″ H COLUMNS.



SQUARE ENDS.

Allowable stress per square inch:

13,000 lbs. for lengths under 55 radii.

$16{,}000 - 55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.										Weight of Section, Lbs. per Foot
13 Ft.	14 Ft.	15 Ft.	16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	
45.0	43.4	41.9	40.3	37.2	34.1	31.0	....	....	....	27.7
51.8	50.0	48.2	46.4	42.9	39.3	35.8	....	....	....	31.8
59.7	58.0	56.3	54.6	51.3	48.0	44.6	41.3	38.0	....	34.6
67.7	65.8	64.0	62.1	58.4	54.6	50.9	47.1	43.4	....	39.1
75.7	73.6	71.5	69.4	65.3	61.1	57.0	52.8	48.7	....	43.6
83.8	81.5	79.2	76.9	72.4	67.8	63.2	58.7	54.1	....	48.2
92.1	89.6	87.1	84.6	79.7	74.7	69.8	64.8	59.9	....	52.8
100.3	97.7	95.0	92.3	86.9	81.6	76.2	70.9	65.5	....	57.4
108.7	105.8	102.9	100.0	94.2	88.5	82.7	76.9	71.2	....	62.1
117.3	114.2	111.2	108.1	101.9	95.8	89.6	83.5	77.3	....	66.8
125.8	122.5	119.2	116.0	109.4	102.9	96.3	89.8	83.2	....	71.6
137.3	134.1	130.9	127.7	121.3	114.9	108.6	102.2	95.8	89.4	76.0
146.6	143.3	139.9	136.5	129.7	122.9	116.1	109.3	102.6	95.8	81.1
155.5	151.9	148.4	144.8	137.6	130.5	123.3	116.2	109.0	101.9	85.9
165.0	161.2	157.5	153.7	146.2	138.6	131.1	123.5	116.0	108.4	91.0
174.8	170.9	166.9	163.0	155.1	147.2	139.2	131.3	123.4	115.5	96.1
184.5	180.4	176.2	172.1	163.8	155.5	147.2	138.9	130.6	122.3	101.3
194.3	189.9	185.6	181.3	172.6	163.9	155.2	146.5	137.8	129.1	106.6
204.1	199.5	195.0	190.5	181.4	172.3	163.2	154.1	145.0	136.0	111.8
214.3	209.6	204.8	200.1	190.7	181.3	171.8	162.4	153.0	143.5	117.1

Loads to the right of the zigzag line are for lengths greater than 125 radii.

EXAMPLE

SHOWING THE METHOD OF SELECTING BETHLEHEM ROLLED H COLUMNS FOR BUILDINGS.

For illustration, the interior columns of an actual 14-story building are taken as an example. The story heights and the loads on the columns are as given in the table.

Story.	Height of Story, Feet.	Load on Column, Tons.	H Column Section Required. Safe Load, Tons.	Dimensions, Inches. D	T	B	Weight of Section, Lbs. per Ft.	Section Number.
14	12	32	69.7	11½	½	8.00	40.0	H12 s
13 12	12 13	54 75	76.3	11⅝	$\frac{9}{16}$	8.04	45.0	H12 s
11 10	12 12	97 118	119.0	11⅞	$\frac{11}{16}$	10.04	63.3	H12 s
9 8	12 12	140 162	162.0	12⅛	$\frac{13}{16}$	12.04	84.7	H12
6 7	12 12	185 207	214.2	12⅝	$1\frac{1}{16}$	12.20	112.1	H12
5 4	12 12	229 252	253.3	13	1¼	12.31	132.5	H12
3 2	12 14	275 298	306.1	13⅜	$1\frac{7}{16}$	13.12	160.1	H12 a
1 Basement.	16 12	321 345	348.8	13¾	1⅝	13.24	182.4	H12 a

The columns will be selected in lengths of two stories. From inspection of the tables given for safe loads on H columns, it is found that no columns less than the 12″ H sections have the desired range of capacity. Assuming that it is desirable, on account of space, to limit the size of columns as much as possible, the 12″ H columns will be the minimum size for the purpose. From the table on page 120 the sections of 12″ H columns required are then selected, as given in the above example. Smaller columns might be used for the upper story, but for the sake of uniformity the lightest section of 12″ H columns are selected.

All the columns as selected and given in the above example are produced by the same rolls and obtainable complete at one rolling.

When there is no limitation as to size of column, the largest dimension columns having the desired capacity will be the most economical.

CONNECTION ANGLES
FOR BETHLEHEM SPECIAL I BEAMS AND GIRDER BEAMS.

Connection angles for Bethlehem special I beams and girder beams are shown on pages 134 and 135. These connections are proportioned on the usual basis of an allowable shearing stress of 10,000 lbs. per square inch and a bearing stress of 20,000 lbs. per square inch on rivets.

These connections will be found sufficient for most cases occurring in ordinary construction. Where beams of relative short spans are loaded to their full capacity, it may be necessary to provide additional strength in the connections.

The capacity of the connection depends upon the shearing or bearing value of the rivets attaching it to the web of the beam, and also upon the shearing value of the rivets in the outstanding legs of the angles by which it is attached to its supports. Where two beams frame opposite each other into another beam or girder, which is a very usual case, the bearing of the rivets on the web of the latter may determine the minimum strength of the connection.

Tables on pages 132 and 133 give the least spans on which the connections may be used with beams fully loaded, depending upon each of the foregoing conditions, also for a shearing stress of 8000 lbs. per square inch on field rivets, a stipulation of some specifications. The greatest value of the least span given for any of the governing conditions is the minimum span for which the connection may be used.

Referring to the table on page 133, the least span for the connection of a 15 inch special I beam weighing 38 lbs. per foot, so far as determined by the value of the rivets to the web of the beam, is given as 12.5 feet. With the shearing stress of the field rivets limited to 8000 lbs. per square inch, the least span for the same connection is 11.1 feet. The greater of these values, or 12.5 feet, is the minimum span for the connection under the given conditions. If, however, two such beams frame into a girder having a web thickness of 3/8 inch, the least span for this condition is 14.0 feet, which becomes the minimum span for which the connection may be used.

Similar connection angles for American standard I beams are shown on page 223; and the minimum spans on which they may safely be used is given on page 222.

MINIMUM SPANS IN FEET ON WHICH THE CONNECTION ANGLES FOR
BETHLEHEM GIRDER BEAMS
CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS.

Depth of Beam, Inches.	Weight per Foot, Lbs.	LEAST SPAN IN FEET FOR VARIOUS CONDITIONS.								
		Rivets: Shearing 10,000 Lbs., bearing 20,000 Lbs. per Square In.								Field Connection. Rivet Shear, 8,000 Lbs. per Square Inch.
		Connection to Web of Beam.	Field Connection.	When two beams frame opposite each other to a beam or girder with a web thickness as follows:						
				$\frac{9}{16}''$	$\frac{1}{2}''$	$\frac{7}{16}''$	$\frac{3}{8}''$	$\frac{5}{16}''$	$\frac{1}{4}''$	
30	200.0	24.5	24.5	25.7	28.9	33.1	38.5	46.3	57.9	30.7
30	175.0	21.1	21.1	22.1	24.8	28.4	33.1	39.7	49.6	26.4
28	180.0	24.1	24.1	25.2	28.4	32.5	37.8	45.4	56.8	30.2
28	162.5	21.4	21.4	22.4	25.3	28.9	33.7	40.4	50.5	26.8
26	160.0	20.1	20.1	21.0	23.6	27.0	31.5	37.8	47.3	25.1
26	150.0	18.6	18.6	19.4	21.9	25.0	29.2	35.0	43.8	23.2
24	140.0	20.4	19.4	20.3	22.9	26.1	30.4	36.5	45.7	24.3
24	120.0	19.2	16.6	17.4	19.6	22.4	26.1	31.3	39.1	20.8
20	140.0	19.7	19.7	20.6	23.2	26.5	30.9	37.1	46.4	24.7
20	112.0	18.0	15.9	16.6	18.7	21.4	24.9	29.9	37.4	19.9
18	92.0	14.9	11.9	12.4	14.0	16.0	18.7	22.4	28.0	14.9
15	140.0	18.3	18.3	19.2	21.6	24.6	28.7	34.5	43.1	22.9
15	104.0	14.0	14.0	14.7	16.5	18.9	22.0	26.4	33.0	17.6
15	73.0	14.3	10.2	10.7	12.0	13.7	16.0	19.2	24.0	12.8
12	70.0	12.0	10.9	11.4	12.8	14.7	17.1	20.5	25.6	13.6
12	55.0	12.2	8.7	9.1	10.2	11.7	13.6	16.4	20.5	10.9
10	44.0	9.7	5.9	6.2	6.9	7.9	9.3	11.1	13.9	7.4
9	38.0	11.6	7.6	7.9	8.9	10.2	11.9	14.3	17.9	9.5
8	32.5	9.0	5.7	6.0	6.8	7.7	9.0	10.8	13.5	7.2

The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.

WEIGHTS OF CONNECTION ANGLES FOR GIRDER BEAMS.

Depth of Beam.	Weight of One Connection.	Depth of Beam.	Weight of One Connection.	Depth of Beam.	Weight of One Connection.
30 Inches.	77 Lbs.	20 Inches.	48 Lbs.	10 Inches.	25 Lbs.
28 "	67 "	18 "	41 "	9 "	17 "
26 "	67 "	15 "	32 "	8 "	17 "
24 "	57 "	12 "	25 "		

Weights given do not include rivets for field connections.

MINIMUM SPANS IN FEET ON WHICH THE CONNECTION ANGLES FOR

BETHLEHEM SPECIAL I BEAMS

CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS.

Depth of Beam, Inches.	Weight per Foot, Lbs.	LEAST SPAN IN FEET FOR VARIOUS CONDITIONS. Rivets: Shearing 10,000 Lbs., bearing 20,000 Lbs. per Square In.								Field Connection. Rivet Shear, 8,000 Lbs. per Square Inch.
		Connection to Web of Beam.	Field Connection.	When two beams frame opposite each other to a beam or girder with a web thickness as follows:						
				$\frac{9}{16}''$	$\frac{1}{2}''$	$\frac{7}{16}''$	$\frac{3}{8}''$	$\frac{5}{16}''$	$\frac{1}{4}''$	
30	120.0	24.0	21.2	22.2	25.0	28.6	33.3	40.0	50.0	26.5
28	105.0	24.0	19.6	20.5	23.1	26.4	30.7	36.9	46.2	24.5
26	90.0	23.6	17.7	18.5	20.8	23.8	27.7	33.3	41.6	22.1
24	84.0	22.5	17.2	18.0	20.2	23.2	27.0	32.4	40.5	21.5
24	72.0	23.9	15.0	15.7	17.7	20.2	23.6	28.3	35.4	18.8
20	72.0	20.2	14.8	15.5	17.4	19.9	23.2	27.8	34.8	18.5
20	58.5	19.9	11.8	12.4	13.9	15.9	18.6	22.3	27.9	14.8
18	48.5	17.0	10.7	11.3	12.7	14.5	16.9	20.3	25.3	13.5
15	72.0	11.7	16.0	16.8	18.9	21.6	25.2	30.2	37.8	20.1
15	54.0	12.1	12.3	12.9	14.5	16.5	19.3	23.1	28.9	15.3
15	38.0	12.5	8.9	9.3	10.5	12.0	14.0	16.8	21.0	11.1
12	36.0	10.3	9.1	9.5	10.7	12.2	14.2	17.1	21.3	11.3
12	28.5	10.3	7.3	7.6	8.6	9.8	11.4	13.7	17.1	9.1
10	22.5	10.9	7.4	7.8	8.7	10.0	11.6	14.0	17.5	9.3
9	19.0	8.9	5.7	6.0	6.7	7.7	9.0	10.8	13.5	7.1
8	16.25	7.0	4.3	4.5	5.1	5.8	6.7	8.1	10.1	5.4

The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.

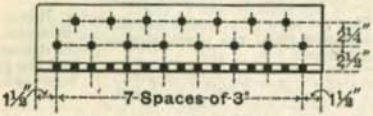
WEIGHTS OF CONNECTION ANGLES FOR SPECIAL I BEAMS.

Depth of Beam.	Weight of One Connection.	Depth of Beam.	Weight of One Connection.	Depth of Beam.	Weight of One Connection.
30 Inches.	46 Lbs.	20 Inches.	28 Lbs.	10 Inches.	12 Lbs.
28 "	41 "	18 "	28 "	9 "	12 "
26 "	37 "	15 "	24 "	8 "	12 "
24 "	32 "	12 "	18 "		

Weights given do not include rivets for field connections.

CONNECTION ANGLES
FOR BETHLEHEM GIRDER BEAMS.

30″G

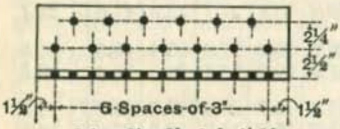


2-Ls. 6″ x 6″ x 7/16″ x 2′-0″

18″G

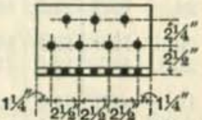
2-Ls. 6″ x 6″ x 7/16″ x 1′-0½″

26″ and 28″ Gs



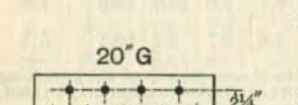
2-Ls. 6″ x 6″ x 7/16″ x 1′-9″

15″G



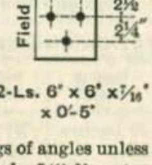
2-Ls. 6″ x 6″ x 7/16″ x 0′-10″

24″G



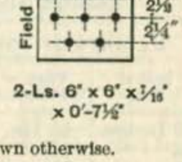
2-Ls. 6″ x 6″ x 7/16″ x 1′-6″

8″ and 9″ Gs



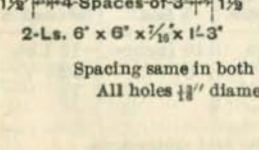
2-Ls. 6″ x 6″ x 7/16″ x 0′-5″

10″ and 12″ Gs



2-Ls. 6″ x 6″ x 7/16″ x 0′-7½″

20″G

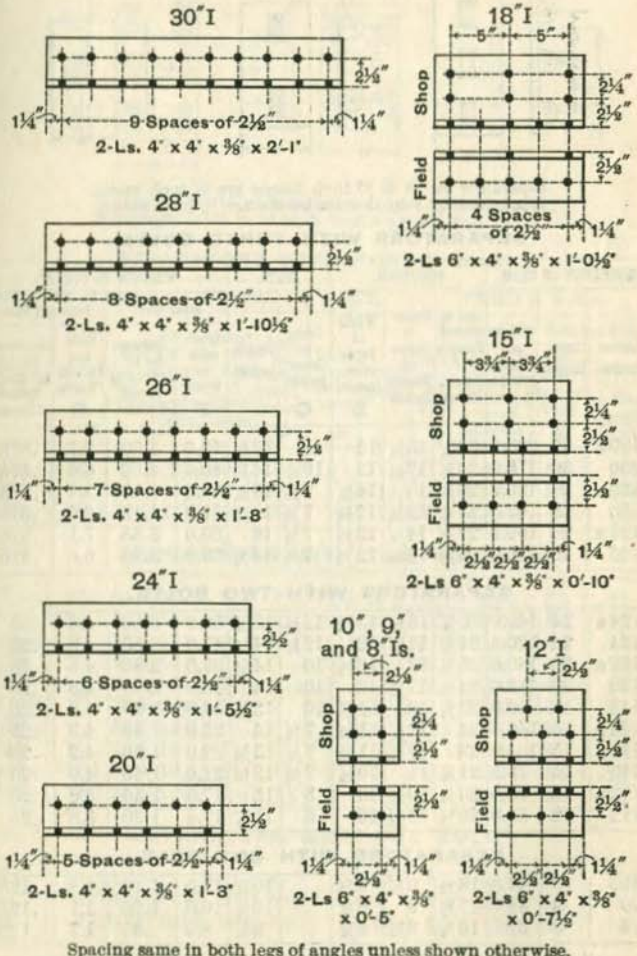


2-Ls. 6″ x 6″ x 7/16″ x 1′-3″

Spacing same in both legs of angles unless shown otherwise.
All holes 13/16″ diameter for ¾″ diameter rivets or bolts.

CONNECTION ANGLES

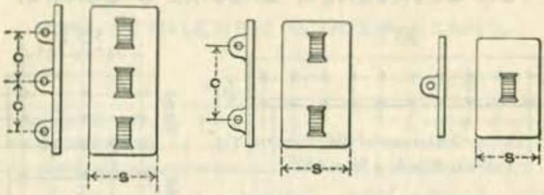
FOR BETHLEHEM SPECIAL I BEAMS.



Spacing same in both legs of angles unless shown otherwise.
All holes $\frac{13}{16}''$ diameter for $\frac{3}{4}''$ diameter rivets or bolts.

CAST IRON SEPARATORS FOR

BETHLEHEM GIRDER BEAMS.



Separators for 18 to 30 inch beams are ⅝ inch metal.
Separators for 8 to 15 inch beams are ½ inch metal.

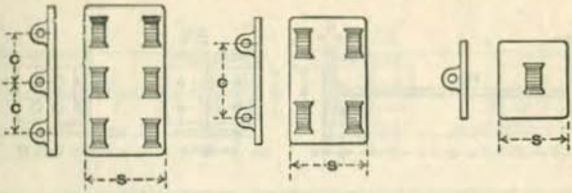
SEPARATORS WITH THREE BOLTS.

Designation of Beam.			Distances.			Bolts.		Weights in Pounds.			
								Separators.		Bolts and Nuts.	
Section Number.	Depth, Inches.	Weight per Foot, Pounds.	Out to Out of Flanges of Beams, Inches.	Center to Center of Beams, Inches.	Width of Separator, Inches. S	Center to Center, Inches. C	Length, Inches.	Separator for Width S	Increase for 1″ Additional Spread of Beams.	Bolts and Nuts for Width S	Increase for 1″ Additional Spread of Beams.
G30 a	30	200.0	30¾	15¾	15	10	17½	73.0	4.50	7.7	.375
G30	30	175.0	24¾	12¾	12	10	14½	60.0	4.50	6.6	.375
G28 a	28	180.0	29⅜	15	14¼	7½	16¾	65.0	4.15	7.4	.375
G28	28	162.5	24¾	12¾	12⅛	7½	14½	57.0	4.15	6.6	.375
G26 a	26	160.0	27⅞	14¼	13⅝	7½	16	59.0	3.85	7.1	.375
G26	26	150.0	24¾	12¾	12⅛	7½	14½	53.0	3.85	6.6	.375
SEPARATORS WITH TWO BOLTS.											
G24 a	24	140.0	26¾	13¾	13⅛	12½	15¼	50.0	3.50	4.6	.25
G24	24	120.0	24¾	12¾	12¼	12½	14¼	47.0	3.50	4.3	.25
G20 a	20	140.0	25½	13	12⅜	10	14¾	39.0	2.80	4.5	.25
G20	20	112.0	24½	12½	12	10	14	38.0	2.80	4.3	.25
G18	18	92.0	23½	12	11½	10	13½	34.0	2.60	4.2	.25
G15 b	15	140.0	24	12¼	11⅜	7½	14	22.0	1.50	4.3	.25
G15 a	15	104.0	23	11¾	11⅛	7½	13½	22.0	1.60	4.2	.25
G15	15	73.0	21½	11	10½	7½	12½	21.0	1.60	4.0	.25
G12 a	12	70.0	20½	10½	10	5	12	17.5	1.30	3.8	.25
G12	12	55.0	20⅛	10⅜	10	5	11¾	17.5	1.30	3.8	.25
SEPARATORS WITH ONE BOLT.											
G10	10	44.0	18½	9½	9⅛		10¾	11.0	1.10	1.8	.125
G9	9	38.0	17½	9	8¾		10¼	10.0	1.00	1.7	.125
G8	8	32.5	16½	8½	8¼		9¾	8.0	.85	1.7	.125

All bolts ¾ inch diameter.

CAST IRON SEPARATORS FOR

BETHLEHEM SPECIAL I BEAMS.



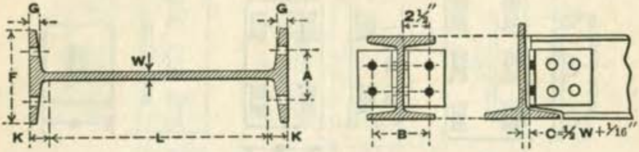
Separators for 18 to 30 inch beams are 5/8 inch metal.
Separators for 8 to 15 inch beams are 1/2 inch metal.

Designation of Beam.			Distances.			Bolts.		Weights in Pounds.			
								Separators.		Bolts and Nuts.	
Section Number.	Depth, Inches.	Weight per Foot, Pounds.	Out to Out of Flanges of Beams, Inches.	Center to Center of Beams, Inches.	Width of Separator, Inches. S	Center to Center, Inches. C	Length, Inches.	Separator for Width S	Increase for 1″ Additional Spread of Beams.	Bolts and Nuts for Width S	Increase for 1″ Additional Spread of Beams.
SEPARATORS WITH THREE BOLTS.											
B30	30	120.0	20 3/4	10 3/4	10 1/4	10	12 1/4	47.8	4.50	5.8	.375
B28	28	105.0	19 7/8	10 1/4	9 3/4	7 1/2	11 3/4	42.3	4.15	5.6	.375
B26	26	90.0	18 7/8	9 3/4	9 1/4	7 1/2	11 1/4	37.9	3.85	5.4	.375
SEPARATORS WITH TWO BOLTS.											
B24 a	24	84.0	18 3/16	9 3/8	8 7/8	12 1/2	10 3/4	33.7	3.65	3.5	.25
B24	24	72.0	18	9 1/4	8 7/8	12 1/2	10 3/4	33.7	3.65	3.5	.25
B20 a	20	72.0	17 3/8	9	8 1/2	10	10 1/2	26.7	3.00	3.4	.25
B20	20	58.5	15 9/16	8	7 5/8	10	9 1/2	24.2	3.00	3.2	.25
B18	18	48.5	15	7 3/4	7 3/8	10	9	21.4	2.70	3.1	.25
B15 b	15	72.0	14 3/4	7 5/8	7	7 1/2	9 1/4	12.3	1.65	3.1	.25
B15 a	15	54.0	14 1/2	7 1/2	7	7 1/2	9	12.3	1.65	3.1	.25
B15	15	38.0	14	7 1/4	7	7 1/2	8 1/2	13.3	1.80	3.0	.25
B12 a	12	36.0	13 1/16	6 3/4	6 3/8	5	8	9.1	1.30	2.8	.25
B12	12	28.5	12 5/8	6 1/2	6 1/4	5	7 3/4	9.0	1.30	2.8	.25
SEPARATORS WITH ONE BOLT.											
B10	10	22.50	12	6 1/4	6		7 1/2	7.5	1.10	1.4	.125
B9	9	19.00	11 1/8	5 3/4	5 1/2		7	6.4	1.00	1.3	.125
B8	8	16.25	10 13/16	5 5/8	5 3/8		6 3/4	5.5	.85	1.3	.125

All bolts 3/4 inch diameter.

DETAIL DIMENSIONS FOR

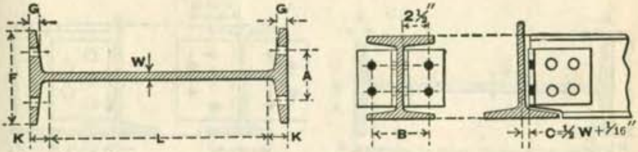
BETHLEHEM SPECIAL I BEAMS.



Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	F	W	L	K	G	A	B	C	Maximum Rivet or Bolt, Inch.
			DIMENSIONS IN INCHES.								
B30	30	120.0	10	33/64	26¼	1⅞	1	6	5½	5/16	1
B28	28	105.0	9 19/32	31/64	24½	1¾	15/16	5¾	5½	5/16	1
B26	26	90.0	9 5/32	7/16	22¾	1⅝	27/32	5½	5 7/16	5/16	1
B24 a	24	84.0	8 27/32	29/64	20⅞	1 9/16	13/16	5¼	5 7/16	5/16	⅞
B24	24	82.0	8 53/64	½	21⅛	1 7/16	11/16	5¼	5½	5/16	⅞
	24	72.0	8 45/64	⅜	21⅛	1 7/16	11/16	5¼	5⅜	¼	⅞
B20 a	20	82.0	8 33/64	9/16	17	1½	25/32	5	5 9/16	⅜	⅞
	20	72.0	8⅜	7/16	17	1½	25/32	5	5 7/16	5/16	⅞
B20	20	68.0	7 11/16	31/64	17⅜	1 5/16	11/16	4½	5½	5/16	⅞
	20	63.0	7⅝	27/64	17⅜	1 5/16	11/16	4½	5 7/16	5/16	⅞
	20	60.0	7 37/64	⅜	17⅜	1 5/16	11/16	4½	5⅜	¼	⅞
	20	58.5	7 35/64	11/32	17⅜	1 5/16	11/16	4½	5⅜	¼	⅞
B18	18	58.5	7 15/32	31/64	15⅝	1 3/16	19/32	4¼	5½	5/16	⅞
	18	52.5	7⅜	⅜	15⅝	1 3/16	19/32	4¼	5⅜	¼	⅞
	18	48.5	7 19/64	5/16	15⅝	1 3/16	19/32	4¼	5 5/16	¼	⅞

DETAIL DIMENSIONS FOR

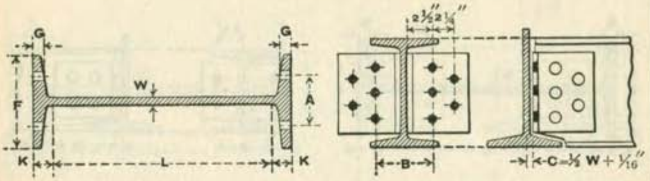
BETHLEHEM SPECIAL I BEAMS.



Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	DIMENSIONS IN INCHES.								Maximum Rivet or Bolt, Inch.
			F	W	L	K	G	A	B	C	
B15 b	15	72.00	7 5/32	35/64	11 1/2	1 3/4	1	4	5 9/16	3/8	7/8
B15 a	15	64.00	7 13/64	19/32	12 1/4	1 3/8	3/4	4	5 5/8	3/8	7/8
	15	54.00	7	13/32	12 1/4	1 3/8	23/32	4	5 7/16	1/4	7/8
B15	15	46.00	6 13/16	7/16	12 7/8	1 1/16	17/32	3 3/4	5 7/16	5/16	7/8
	15	42.00	6 3/4	23/64	12 7/8	1 1/16	17/32	3 3/4	5 3/8	1/4	7/8
	15	38.00	6 21/32	9/32	12 7/8	1 1/16	17/32	3 3/4	5 5/16	1/4	7/8
B12 a	12	36.00	6 19/64	5/16	9 3/4	1 1/8	9/16	3 1/2	5 5/16	1/4	3/4
B12	12	31.00	6 5/32	5/16	10 1/8	15/16	7/16	3 1/2	5 5/16	1/4	3/4
	12	28.50	6 3/32	1/4	10 1/8	15/16	7/16	3 1/2	5 1/4	3/16	3/4
B10	10	27.50	5 15/16	11/32	8 1/4	7/8	13/32	3 1/4	5 3/8	1/4	3/4
	10	24.50	5 27/32	1/4	8 1/4	7/8	13/32	3 1/4	5 1/4	3/16	3/4
	10	22.50	5 51/64	13/64	8 1/4	7/8	13/32	3 1/4	5 3/16	3/16	3/4
B9	9	23.00	5 1/2	5/16	7 3/8	13/16	3/8	3	5 5/16	1/4	3/4
	9	21.00	5 7/16	1/4	7 3/8	13/16	3/8	3	5 1/4	3/16	3/4
	9	19.00	5 3/8	3/16	7 3/8	13/16	3/8	3	5 3/16	3/16	3/4
B8	8	21.25	5 3/8	23/64	6 1/2	3/4	11/32	2 3/4	5 3/8	1/4	3/4
	8	18.00	5 1/4	1/4	6 1/2	3/4	11/32	2 3/4	5 1/4	3/16	3/4
	8	16.25	5 3/16	3/16	6 1/2	3/4	11/32	2 3/4	5 3/16	3/16	3/4

DETAIL DIMENSIONS FOR

BETHLEHEM GIRDER BEAMS.



Section Number.	Depth of Beam,	Weight per Foot, Lbs.	DIMENSIONS IN INCHES.								Maximum Rivet or Bolt, Inch.
			F	W	L	K	G	A	B	C	
G30 a	30	200.0	15	$\frac{3}{4}$	25	$2\frac{1}{2}$	$1\frac{3}{32}$	11	$5\frac{3}{4}$	$\frac{7}{16}$	1
G30	30	175.0	12	$\frac{11}{16}$	25	$2\frac{1}{2}$	$1\frac{9}{32}$	8	$5\frac{11}{16}$	$\frac{7}{16}$	1
G28 a	28	180.0	$14\frac{11}{32}$	$\frac{11}{16}$	$23\frac{3}{16}$	$2\frac{13}{32}$	$1\frac{1}{16}$	$10\frac{1}{4}$	$5\frac{11}{16}$	$\frac{7}{16}$	1
G28	28	162.5	12	$\frac{21}{32}$	$23\frac{3}{16}$	$2\frac{13}{32}$	$1\frac{3}{16}$	8	$5\frac{11}{16}$	$\frac{7}{16}$	1
G26 a	26	160.0	$13\frac{19}{32}$	$\frac{5}{8}$	$21\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{1}{32}$	$9\frac{1}{2}$	$5\frac{5}{8}$	$\frac{3}{8}$	1
G26	26	150.0	12	$\frac{5}{8}$	$21\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{1}{8}$	8	$5\frac{5}{8}$	$\frac{3}{8}$	1
G24 a	24	140.0	13	$\frac{9}{16}$	$19\frac{3}{4}$	$2\frac{1}{8}$	$\frac{31}{32}$	9	$5\frac{9}{16}$	$\frac{3}{8}$	1
G24	24	120.0	12	$\frac{1}{2}$	20	2	$\frac{29}{32}$	8	$5\frac{1}{2}$	$\frac{5}{16}$	1
G20 a	20	140.0	$12\frac{1}{2}$	$\frac{41}{64}$	$15\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{3}{32}$	$8\frac{1}{2}$	$5\frac{5}{8}$	$\frac{7}{16}$	1
G20	20	112.0	12	$\frac{33}{64}$	$16\frac{1}{8}$	$1\frac{15}{16}$	$\frac{7}{8}$	8	$5\frac{1}{2}$	$\frac{3}{8}$	1
G18	18	92.0	$11\frac{1}{2}$	$\frac{15}{32}$	$14\frac{5}{8}$	$1\frac{11}{16}$	$\frac{3}{4}$	$7\frac{1}{2}$	$5\frac{1}{2}$	$\frac{5}{16}$	1
G15 b	15	140.0	$11\frac{3}{4}$	$\frac{51}{64}$	10	$2\frac{1}{2}$	$1\frac{1}{4}$	$7\frac{3}{4}$	$5\frac{13}{16}$	$\frac{1}{2}$	1
G15 a	15	104.0	$11\frac{1}{4}$	$\frac{19}{32}$	11	2	$\frac{15}{16}$	$7\frac{1}{4}$	$5\frac{5}{8}$	$\frac{3}{8}$	1
G15	15	73.0	$10\frac{1}{2}$	$\frac{27}{64}$	$11\frac{7}{8}$	$1\frac{9}{16}$	$\frac{11}{16}$	$6\frac{1}{2}$	$5\frac{7}{16}$	$\frac{5}{16}$	1
G12 a	12	70.0	10	$\frac{7}{16}$	$8\frac{7}{8}$	$1\frac{9}{16}$	$\frac{3}{4}$	6	$5\frac{7}{16}$	$\frac{5}{16}$	1
G12	12	55.0	$9\frac{3}{4}$	$\frac{11}{32}$	$9\frac{3}{8}$	$1\frac{5}{16}$	$\frac{19}{32}$	6	$5\frac{3}{8}$	$\frac{1}{4}$	1
G10	10	44.0	9	$\frac{19}{64}$	$7\frac{5}{8}$	$1\frac{3}{16}$	$\frac{17}{32}$	$5\frac{1}{2}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{7}{8}$
G9	9	38.0	$8\frac{1}{2}$	$\frac{19}{64}$	$6\frac{3}{4}$	$1\frac{1}{8}$	$\frac{15}{32}$	$5\frac{1}{4}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{7}{8}$
G8	8	32.5	8	$\frac{9}{32}$	$5\frac{7}{8}$	$1\frac{1}{16}$	$\frac{13}{32}$	5	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{7}{8}$

Part II

STANDARD

STRUCTURAL STEEL SHAPES

MANUFACTURED BY

BETHLEHEM STEEL COMPANY

EXPLANATORY NOTES
ON STANDARD STRUCTURAL SHAPES.

The standard structural shapes manufactured by Bethlehem Steel Company are exclusively of open hearth steel.

The I beam and channel sections are the American standard shapes. The angle sections are also the usual American standard shapes.

The flanges of the standard I beams and standard channels have a uniform slope of $16\frac{2}{3}$ per cent., equivalent to 2 inches per foot.

The cuts of the various shapes show the dimensions of the minimum size. The method of increasing the area is shown on the opposite page.

Standard I beams and channels are increased, as shown in figs. 2 and 3, by separating the rolls which adds an equal amount to the thickness of the web and to the width of the flanges, all other dimensions remaining unchanged.

Angles are increased, as shown in Fig. 1, by separating the rolls which also slightly increases the length of the legs. Several finishing grooves are provided for each size so that the exact dimensions are nearly maintained for different thicknesses.

The sections are numbered in the cuts and in the tables for convenience in identification and ordering.

Beams and channels are rolled only to the weights given in the tables. Angles are rolled only to the variations in thickness and weight given in the tables.

Beams and channels are furnished only at catalogued weight. Angles are furnished either to weight or to thickness. Orders for angles should specify either the weight or thickness wanted, but not both.

All shapes may have an allowable variation of $2\frac{1}{2}$ per cent. either way from the nominal weight or section.

Unless otherwise ordered all shapes will be cut to length with an extreme variation not exceeding $\frac{1}{4}$ of an inch. For cutting with a less variation an extra price will be charged.

All weights are given in pounds per lineal foot. In calculating the areas and weights of the shapes the fillets have been disregarded in all cases.

METHOD OF INCREASING SECTIONAL AREAS.

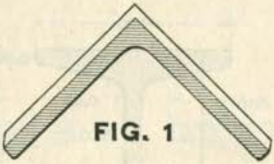


FIG. 1

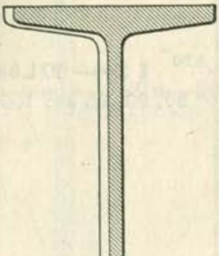


FIG. 2

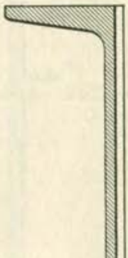
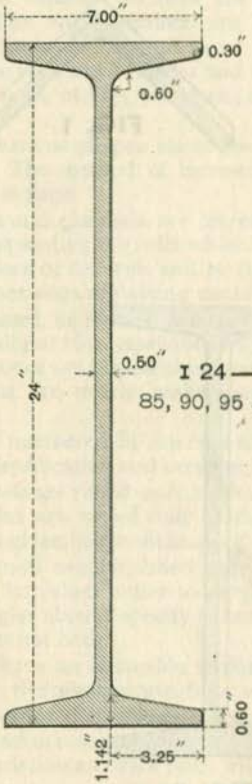


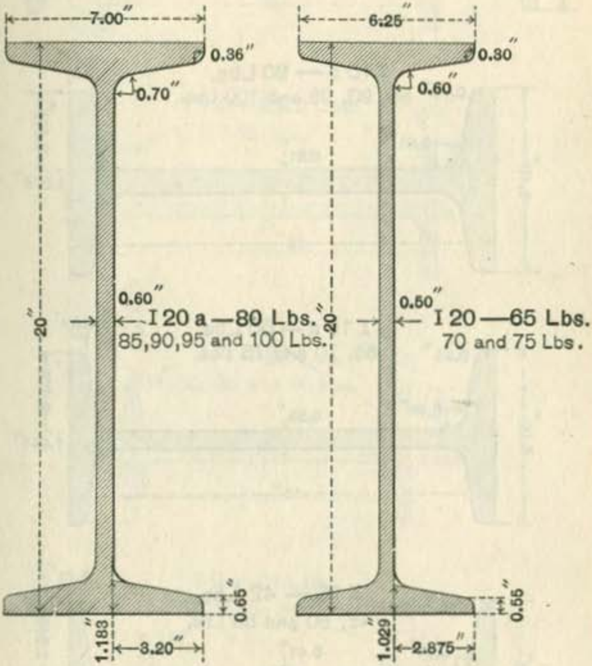
FIG. 3

AMERICAN STANDARD I BEAMS.



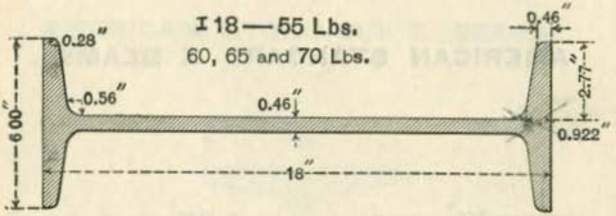
I 24 — 80 Lbs.
85, 90, 95 and 100 Lbs.

AMERICAN STANDARD I BEAMS.

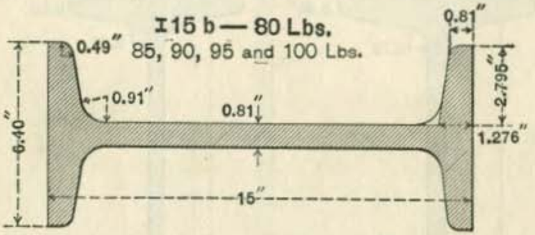


AMERICAN STANDARD I BEAMS.

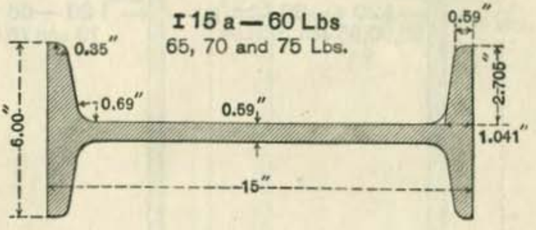
I 18 — 55 Lbs.
60, 65 and 70 Lbs.



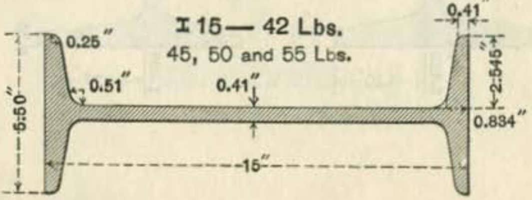
I 15 b — 80 Lbs.
85, 90, 95 and 100 Lbs.



I 15 a — 60 Lbs
65, 70 and 75 Lbs.

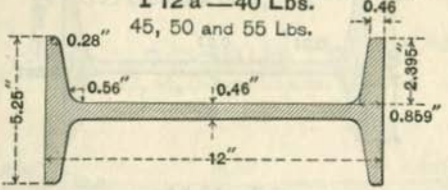


I 15 — 42 Lbs.
45, 50 and 55 Lbs.

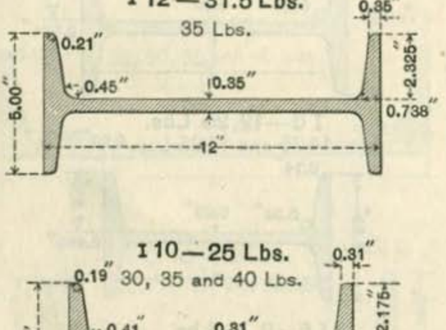


AMERICAN STANDARD I BEAMS.

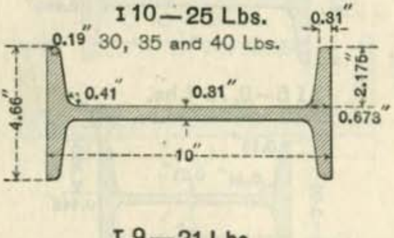
I 12 a—40 Lbs.
45, 50 and 55 Lbs.



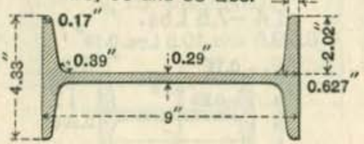
I 12—31.5 Lbs.
35 Lbs.



I 10—25 Lbs.
30, 35 and 40 Lbs.

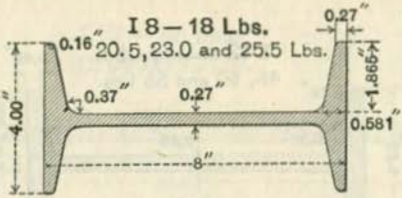


I 9—21 Lbs.
25, 30 and 35 Lbs.

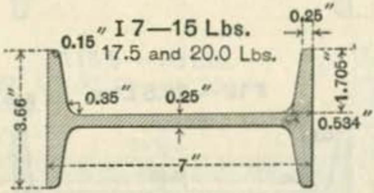


AMERICAN STANDARD I BEAMS.

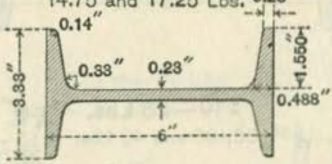
I 8—18 Lbs.
20.5, 23.0 and 25.5 Lbs.



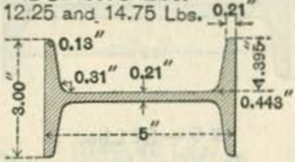
I 7—15 Lbs.
17.5 and 20.0 Lbs.



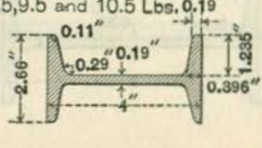
I 6—12.25 Lbs.
14.75 and 17.25 Lbs.



I 5—9.75 Lbs.
12.25 and 14.75 Lbs.

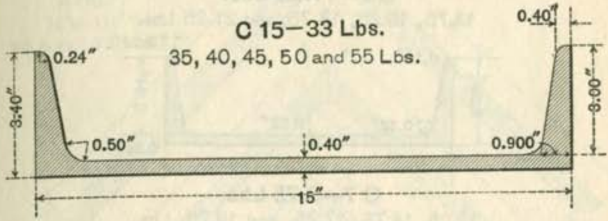


I 4 —7.5 Lbs.
8.5, 9.5 and 10.5 Lbs.

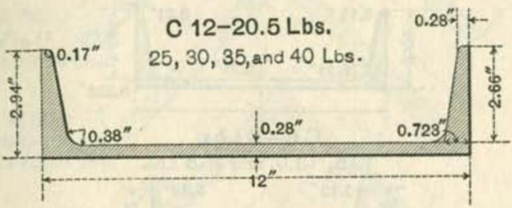


AMERICAN STANDARD CHANNELS.

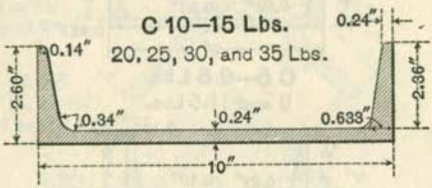
C 15—33 Lbs.
35, 40, 45, 50 and 55 Lbs.



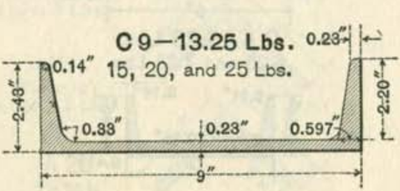
C 12—20.5 Lbs.
25, 30, 35, and 40 Lbs.



C 10—15 Lbs.
20, 25, 30, and 35 Lbs.



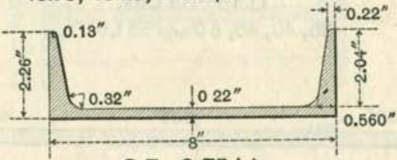
C 9—13.25 Lbs.
15, 20, and 25 Lbs.



AMERICAN STANDARD CHANNELS.

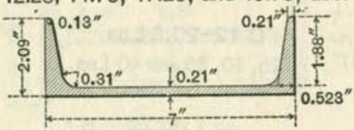
C 8—11.25 Lbs.

13.75, 16.25, 18.75, and 21.25 Lbs.



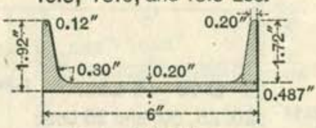
C 7—9.75 Lbs.

12.25, 14.75, 17.25, and 19.75, Lbs.



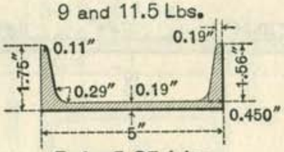
C 6—8 Lbs.

10.5, 13.0, and 15.5 Lbs.



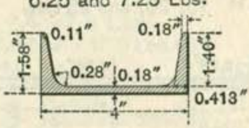
C 5—6.5 Lbs.

9 and 11.5 Lbs.

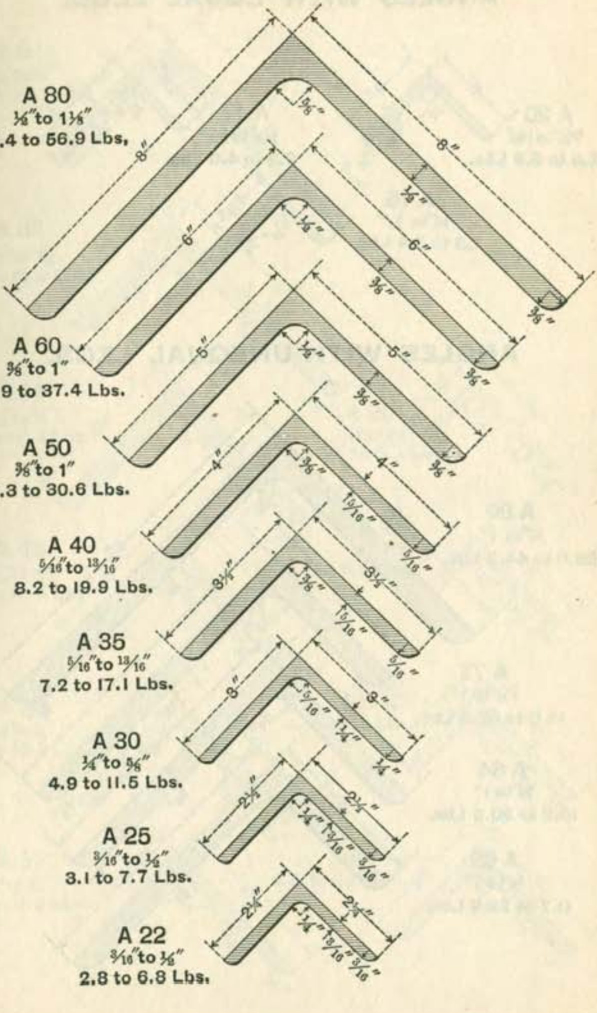


C 4–5.25 Lbs.

6.25 and 7.25 Lbs.



ANGLES WITH EQUAL LEGS.



A 80
½" to 1⅛"
26.4 to 56.9 Lbs.

A 60
⅜" to 1"
14.9 to 37.4 Lbs.

A 50
⅜" to 1"
12.3 to 30.6 Lbs.

A 40
5/16" to 13/16"
8.2 to 19.9 Lbs.

A 35
5/16" to 13/16"
7.2 to 17.1 Lbs.

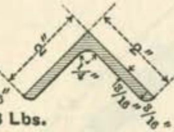
A 30
¼" to ⅝"
4.9 to 11.5 Lbs.

A 25
3/16" to ½"
3.1 to 7.7 Lbs.

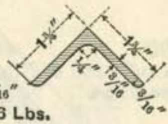
A 22
3/16" to ½"
2.8 to 6.8 Lbs.

ANGLES WITH EQUAL LEGS.

A 20
$\frac{3}{16}''$ to $\frac{7}{16}''$
2.5 to 5.3 Lbs.



A 17
$\frac{3}{16}''$ to $\frac{7}{16}''$
2.2 to 4.6 Lbs.



A 15
$\frac{1}{8}''$ to $\frac{3}{8}''$
1.3 to 3.4 Lbs.

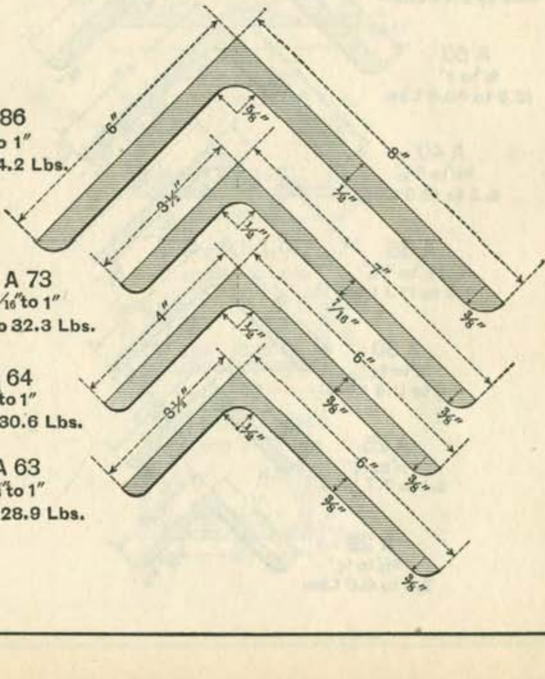
ANGLES WITH UNEQUAL LEGS.

A 86
$\frac{1}{2}''$ to 1"
23.0 to 44.2 Lbs.

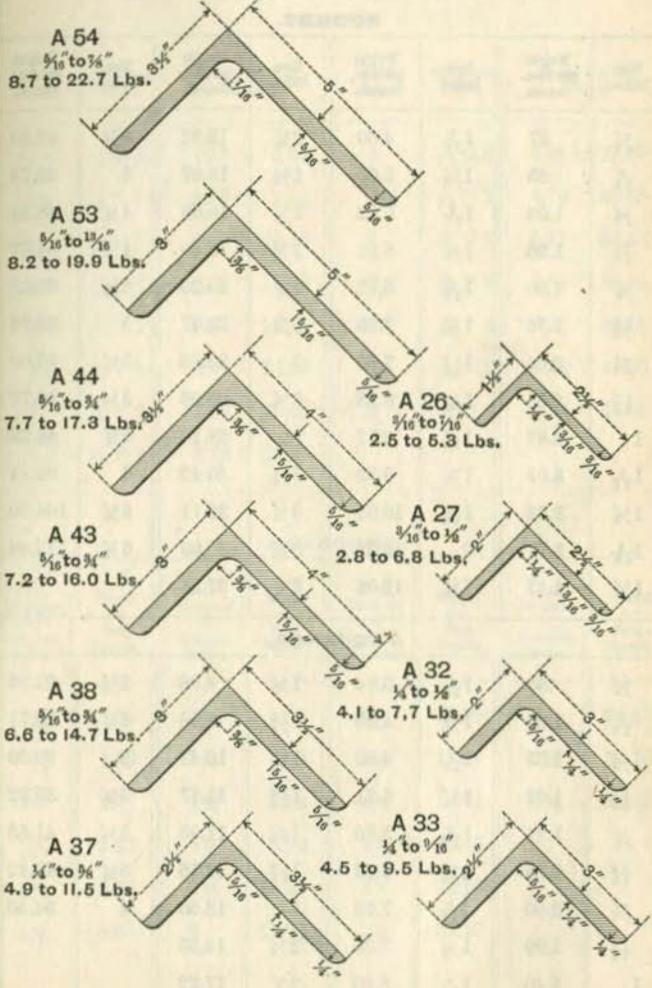
A 73
$\frac{7}{16}''$ to 1"
15.0 to 32.3 Lbs.

A 64
$\frac{3}{8}''$ to 1"
12.3 to 30.6 Lbs.

A 63
$\frac{3}{8}''$ to 1"
11.7 to 28.9 Lbs.



ANGLES WITH UNEQUAL LEGS.



DIMENSIONS AND WEIGHTS OF

BETHLEHEM BARS.

ROUNDS.

Size, Inches.	Weight per Foot, Pounds.	Size, Inches.	Weight per Foot, Pounds.	Size, Inches.	Weight per Foot, Pounds.	Size, Inches.	Weight per Foot, Pounds.
1/2	.67	1 5/16	4.60	2 1/4	13.52	3 7/8	40.10
9/16	.85	1 3/8	5.05	2 3/8	15.07	4	42.73
5/8	1.04	1 7/16	5.52	2 1/2	16.69	4 1/4	48.24
11/16	1.26	1 1/2	6.01	2 5/8	18.40.	4 1/2	54.07
3/4	1.50	1 9/16	6.52	2 3/4	20.20	4 3/4	60.25
13/16	1.76	1 5/8	7.05	2 7/8	22.07	5	66.76
7/8	2.04	1 11/16	7.60	3	24.03	5 1/4	73.60
15/16	2.35	1 3/4	8.18	3 1/8	26.08	5 1/2	80.77
1	2.67	1 13/16	8.77	3 1/4	28.20	5 3/4	88.29
1 1/16	3.01	1 7/8	9.39	3 3/8	30.42	6	96.14
1 1/8	3.38	1 15/16	10.02	3 1/2	32.71	6 1/4	104.30
1 3/16	3.77	2	10.68	3 5/8	35.09	6 1/2	112.80
1 1/4	4.17	2 1/8	12.06	3 3/4	37.56		

SQUARES.

Size, Inches.	Weight per Foot, Pounds.	Size, Inches.	Weight per Foot, Pounds.	Size, Inches.	Weight per Foot, Pounds.	Size, Inches.	Weight per Foot, Pounds.
1/2	.85	1 1/16	3.84	1 5/8	8.98	2 1/2	21.25
9/16	1.08	1 1/8	4.30	1 11/16	9.68	2 3/4	25.71
5/8	1.33	1 3/16	4.80	1 3/4	10.41	3	30.60
11/16	1.61	1 1/4	5.31	1 13/16	11.17	3 1/4	35.92
3/4	1.91	1 5/16	5.86	1 7/8	11.95	3 1/2	41.65
13/16	2.25	1 3/8	6.43	1 15/16	12.76	3 3/4	47.82
7/8	2.60	1 7/16	7.03	2	13.60	4	54.40
15/16	2.99	1 1/2	7.65	2 1/8	15.35		
1	3.40	1 9/16	8.30	2 1/4	17.22		

DIMENSIONS AND WEIGHTS OF

BETHLEHEM BARS (CONTINUED).

FLATS.

Width, Inches.	Thickness, Inches.	Weight per Foot, Pounds.	Width, Inches.	Thickness, Inches.	Weight per Foot, Pounds.
1½	5/16 to 1¼	1.59 to 6.38	4	5/16 to 2	4.25 to 27.20
1¾	5/16 " 1¼	1.86 " 7.44	4½	5/16 " 2	4.78 " 30.60
2	5/16 " 1½	2.12 " 10.20	5	5/16 " 2	5.31 " 34.00
2¼	5/16 " 1½	2.39 " 11.48	5½	5/16 " 2	5.84 " 37.40
2½	5/16 " 1½	2.65 " 12.75	6	5/16 " 2	6.38 " 40.80
2¾	5/16 " 1½	2.92 " 14.03	7	5/16 " 2	7.44 " 47.60
3	5/16 " 2	3.19 " 20.40	8	5/16 " 2	8.50 " 54.40
3½	5/16 " 2	3.72 " 23.80			

HEXAGONS.

Short Diameter of Hexagon, Inches.	Weight per Foot, Pounds.	Short Diameter of Hexagon, Inches.	Weight per Foot, Pounds.	Short Diameter of Hexagon, Inches.	Weight per Foot, Pounds.	Short Diameter of Hexagon, Inches.	Weight per Foot, Pounds.
⅞	2.25	1⅜	5.57	2⅛	13.30	3	26.50
15/16	2.59	1½	6.63	2¼	14.91	3¼	31.10
1	2.94	1⅝	7.78	2⅜	16.61	3½	36.07
1 1/16	3.32	1¾	9.02	2½	18.40		
1⅛	3.73	1⅞	10.35	2⅝	20.29		
1¼	4.60	2	11.78	2¾	22.27		

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

AMERICAN STANDARD I BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Flange Width. Inches and Decimal Parts.	Flange Width. Inches and Fractional Parts.	Web Thickness. Decimal Parts of Inch.	Web Thickness. Fractional Parts of Inch.	Page No. of Section.
I 24	24	100.00	7.254	$7\frac{1}{4}$	.754	$\frac{3}{4}$	144
		95.00	7.192	$7\frac{3}{16}$	.692	$\frac{11}{16}$	
		90.00	7.131	$7\frac{1}{8}$	.631	$\frac{5}{8}$	
		85.00	7.070	$7\frac{1}{16}$	.570	$\frac{9}{16}$	
		80.00	7.000	7	.500	$\frac{1}{2}$	
I 20 a	20	100.00	7.284	$7\frac{9}{32}$	.884	$\frac{7}{8}$	145
		95.00	7.210	$7\frac{13}{64}$	.810	$\frac{51}{64}$	
		90.00	7.137	$7\frac{9}{64}$	.737	$\frac{47}{64}$	
		85.00	7.063	$7\frac{1}{16}$	.663	$\frac{21}{32}$	
		80.00	7.000	7	.600	$\frac{19}{32}$	
I 20	20	75.00	6.399	$6\frac{13}{32}$	.649	$\frac{21}{32}$	145
		70.00	6.325	$6\frac{21}{64}$	.575	$\frac{37}{64}$	
		65.00	6.250	$6\frac{1}{4}$	.500	$\frac{1}{2}$	
I 18	18	70.00	6.259	$6\frac{17}{64}$	.719	$\frac{23}{32}$	146
		65.00	6.177	$6\frac{11}{64}$	.637	$\frac{5}{8}$	
		60.00	6.095	$6\frac{3}{32}$	.555	$\frac{35}{64}$	
		55.00	6.000	6	.460	$\frac{29}{64}$	
I 15 b	15	100.00	6.774	$6\frac{25}{32}$	1.184	$1\frac{3}{16}$	146
		95.00	6.675	$6\frac{43}{64}$	1.085	$1\frac{5}{64}$	
		90.00	6.577	$6\frac{37}{64}$	.987	$\frac{63}{64}$	
		85.00	6.479	$6\frac{31}{64}$	.889	$\frac{57}{64}$	
		80.00	6.400	$6\frac{13}{32}$	.810	$\frac{13}{16}$	
I 15 a	15	75.00	6.292	$6\frac{19}{64}$	.882	$\frac{57}{64}$	146
		70.00	6.194	$6\frac{3}{16}$	.784	$\frac{25}{32}$	
		65.00	6.096	$6\frac{3}{32}$	.686	$\frac{11}{16}$	
		60.00	6.000	6	.590	$\frac{19}{32}$	
I 15	15	55.00	5.746	$5\frac{3}{4}$	.656	$\frac{21}{32}$	146
		50.00	5.648	$5\frac{41}{64}$	.558	$\frac{35}{64}$	
		45.00	5.550	$5\frac{35}{64}$	.460	$\frac{29}{64}$	
		42.00	5.500	$5\frac{1}{2}$	.410	$\frac{13}{32}$	

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

AMERICAN STANDARD I BEAMS

(CONTINUED).

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Flange Width. Inches and Decimal Parts.	Flange Width. Inches and Fractional Parts.	Web Thickness. Decimal Parts of Inch.	Web Thickness. Fractional Parts of Inch.	Page No. of Section.
I 12 a	12	55.00	5.612	$5\frac{39}{64}$	.822	$\frac{13}{16}$	147
		50.00	5.489	$5\frac{31}{64}$	.699	$\frac{11}{16}$	
		45.00	5.366	$5\frac{23}{64}$	.576	$\frac{9}{16}$	
		40.00	5.250	$5\frac{1}{4}$	.460	$\frac{29}{64}$	
I 12	12	35.00	5.086	$5\frac{3}{32}$	.436	$\frac{7}{16}$	147
		31.50	5.000	5	.350	$\frac{11}{32}$	
I 10	10	40.00	5.099	$5\frac{3}{32}$	.749	$\frac{3}{4}$	147
		35.00	4.952	$4\frac{61}{64}$	.602	$\frac{39}{64}$	
		30.00	4.805	$4\frac{13}{16}$	.455	$\frac{15}{32}$	
		25.00	4.660	$4\frac{21}{32}$	.310	$\frac{5}{16}$	
I 9	9	35.00	4.772	$4\frac{49}{64}$	.732	$\frac{47}{64}$	147
		30.00	4.609	$4\frac{39}{64}$	.569	$\frac{37}{64}$	
		25.00	4.446	$4\frac{29}{64}$	.406	$\frac{27}{64}$	
		21.00	4.330	$4\frac{21}{64}$	.290	$\frac{19}{64}$	
I 8	8	25.50	4.271	$4\frac{17}{64}$	.541	$\frac{17}{32}$	148
		23.00	4.179	$4\frac{11}{64}$	.449	$\frac{7}{16}$	
		20.50	4.087	$4\frac{3}{32}$	.357	$\frac{23}{64}$	
		18.00	4.000	4	.270	$\frac{17}{64}$	
I 7	7	20.00	3.868	$3\frac{7}{8}$	.458	$\frac{15}{32}$	148
		17.50	3.763	$3\frac{49}{64}$	.353	$\frac{23}{64}$	
		15.00	3.660	$3\frac{21}{32}$	.250	$\frac{1}{4}$	
I 6	6	17.25	3.575	$3\frac{37}{64}$	.475	$\frac{31}{64}$	148
		14.75	3.452	$3\frac{29}{64}$	.352	$\frac{23}{64}$	
		12.25	3.330	$3\frac{21}{64}$	.230	$\frac{15}{64}$	
I 5	5	14.75	3.294	$3\frac{19}{64}$	.504	$\frac{1}{2}$	148
		12.25	3.147	$3\frac{9}{64}$	.357	$\frac{11}{32}$	
		9.75	3.000	3	.210	$\frac{13}{64}$	
I 4	4	10.50	2.880	$2\frac{7}{8}$	.410	$\frac{13}{32}$	148
		9.50	2.807	$2\frac{13}{16}$	.337	$\frac{11}{32}$	
		8.50	2.733	$2\frac{47}{64}$	.263	$\frac{17}{64}$	
		7.50	2.660	$2\frac{21}{32}$	.190	$\frac{3}{16}$	

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

AMERICAN STANDARD CHANNELS.

Section Number.	Depth of Channel, Inches.	Weight per Foot, Pounds.	Flange Width. Inches and Decimal Parts.	Flange Width. Inches and Fractional Parts.	Web Thickness. Decimal Parts of Inch.	Web Thickness. Fractional Parts of Inch.	Page No. of Section.
C 15	15	55.00	3.818	$3\frac{13}{16}$	.818	$\frac{13}{16}$	149
		50.00	3.720	$3\frac{23}{32}$	.720	$\frac{23}{32}$	
		45.00	3.622	$3\frac{5}{8}$	.622	$\frac{5}{8}$	
		40.00	3.524	$3\frac{17}{32}$	.524	$\frac{17}{32}$	
		35.00	3.426	$3\frac{27}{64}$	.426	$\frac{27}{64}$	
		33.00	3.400	$3\frac{13}{32}$	.400	$\frac{13}{32}$	
C 12	12	40.00	3.418	$3\frac{27}{64}$	.758	$\frac{49}{64}$	149
		35.00	3.296	$3\frac{19}{64}$	.636	$\frac{41}{64}$	
		30.00	3.173	$3\frac{11}{64}$	.513	$\frac{33}{64}$	
		25.00	3.050	$3\frac{3}{64}$	.390	$\frac{25}{64}$	
		20.50	2.940	$2\frac{15}{16}$	.280	$\frac{9}{32}$	
C 10	10	35.00	3.183	$3\frac{3}{16}$	.823	$\frac{53}{64}$	149
		30.00	3.036	$3\frac{1}{32}$	.676	$\frac{43}{64}$	
		25.00	2.889	$2\frac{57}{64}$	.529	$\frac{17}{32}$	
		20.00	2.742	$2\frac{47}{64}$	.382	$\frac{3}{8}$	
		15.00	2.600	$2\frac{19}{32}$	.240	$\frac{15}{64}$	
C 9	9	25.00	2.815	$2\frac{13}{16}$	.615	$\frac{39}{64}$	149
		20.00	2.652	$2\frac{21}{32}$	.452	$\frac{29}{64}$	
		15.00	2.488	$2\frac{31}{64}$	.288	$\frac{9}{32}$	
		13.25	2.430	$2\frac{7}{16}$	.230	$\frac{15}{64}$	

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

AMERICAN STANDARD CHANNELS

(CONTINUED).

Section Number.	Depth of Channel, Inches.	Weight per Foot, Pounds.	Flange Width. Inches and Decimal Parts.	Flange Width. Inches and Fractional Parts.	Web Thickness. Decimal Parts of Inch.	Web Thickness. Fractional Parts of Inch.	Page No. of Section.
		21.25	2.622	$2\frac{5}{8}$	.582	$\frac{37}{64}$	
		18.75	2.530	$2\frac{17}{32}$	.490	$\frac{31}{64}$	
C 8	8	16.25	2.439	$2\frac{7}{16}$	.399	$\frac{25}{64}$	150
		13.75	2.347	$2\frac{11}{32}$	.307	$\frac{19}{64}$	
		11.25	2.260	$2\frac{17}{64}$	.220	$\frac{7}{32}$	
		19.75	2.513	$2\frac{33}{64}$	.633	$\frac{5}{8}$	
		17.25	2.408	$2\frac{13}{32}$	.528	$\frac{33}{64}$	
C 7	7	14.75	2.303	$2\frac{19}{64}$	.423	$\frac{13}{32}$	150
		12.25	2.198	$2\frac{13}{64}$	.318	$\frac{5}{16}$	
		9.75	2.090	$2\frac{3}{32}$	.210	$\frac{13}{64}$	
		15.50	2.283	$2\frac{9}{32}$	.563	$\frac{9}{16}$	
C 6	6	13.00	2.160	$2\frac{5}{32}$	.440	$\frac{7}{16}$	150
		10.50	2.038	$2\frac{1}{32}$	.318	$\frac{5}{16}$	
		8.00	1.920	$1\frac{59}{64}$	.200	$\frac{13}{64}$	
		11.50	2.037	$2\frac{1}{32}$	.477	$\frac{15}{32}$	
C 5	5	9.00	1.890	$1\frac{57}{64}$	.330	$\frac{21}{64}$	150
		6.50	1.750	$1\frac{3}{4}$	.190	$\frac{3}{16}$	
		7.25	1.725	$1\frac{23}{32}$	.325	$\frac{21}{64}$	
C 4	4	6.25	1.652	$1\frac{21}{32}$	.252	$\frac{17}{64}$	150
		5.25	1.580	$1\frac{37}{64}$	.180	$\frac{3}{16}$	

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

ANGLES.

EQUAL LEGS.

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A80	8 x 8	1⅛	56.9	16.73
		1 1/16	54.0	15.87
		1	51.0	15.00
		15/16	48.1	14.12
		⅞	45.0	13.23
		13/16	42.0	12.34
		¾	38.9	11.44
		11/16	35.8	10.53
		⅝	32.7	9.61
		9/16	29.6	8.68
		½	26.4	7.75
A60	6 x 6	1	37.4	11.00
		15/16	35.3	10.37
		⅞	33.1	9.74
		13/16	31.0	9.09
		¾	28.7	8.44
		11/16	26.5	7.78
		⅝	24.2	7.11
		9/16	21.9	6.43
		½	19.6	5.75
		7/16	17.2	5.06
		⅜	14.9	4.36

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A50	5 x 5	1	30.6	9.00
		15/16	28.9	8.50
		⅞	27.2	7.99
		13/16	25.4	7.46
		¾	23.6	6.94
		11/16	21.8	6.42
		⅝	20.0	5.86
		9/16	18.1	5.31
		½	16.2	4.75
		7/16	14.3	4.18
		⅜	12.3	3.61
A40	4 x 4	13/16	19.9	5.84
		¾	18.5	5.44
		11/16	17.1	5.03
		⅝	15.7	4.61
		9/16	14.3	4.18
		½	12.8	3.75
		7/16	11.3	3.31
		⅜	9.8	2.86
		5/16	8.2	2.40
A35	3½ x 3½	13/16	17.1	5.03
		¾	16.0	4.69
		11/16	14.8	4.34
		⅝	13.6	3.98
		9/16	12.4	3.62
		½	11.1	3.25
		7/16	9.8	2.87
		⅜	8.5	2.48
		5/16	7.2	2.09

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

ANGLES—(CONTINUED).

EQUAL LEGS.

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A30	3x3	5/8	11.5	3.36
		9/16	10.4	3.06
		1/2	9.4	2.75
		7/16	8.3	2.43
		3/8	7.2	2.11
		5/16	6.1	1.78
		1/4	4.9	1.44
A25	2½x2½	1/2	7.7	2.25
		7/16	6.8	2.00
		3/8	5.9	1.73
		5/16	5.0	1.47
		1/4	4.1	1.19
		3/16	3.1	.90
A22	2¼x2¼	1/2	6.8	2.00
		7/16	6.1	1.78
		3/8	5.3	1.55
		5/16	4.5	1.31
		1/4	3.7	1.06
		3/16	2.8	.81
A20	2x2	7/16	5.3	1.56
		3/8	4.7	1.36
		5/16	4.0	1.15
		1/4	3.2	.94
		3/16	2.5	.72

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A17	1¾x1¾	7/16	4.6	1.34
		3/8	4.0	1.17
		5/16	3.4	1.00
		1/4	2.8	.81
		3/16	2.2	.62
A15	1½x1½	3/8	3.4	.99
		5/16	2.9	.84
		1/4	2.4	.69
		3/16	1.8	.53
		1/8	1.3	.36

Angles are rolled only to the variations of thickness and weight given in this list.

Orders for angles should specify either the thickness or weight, but not both.

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

ANGLES.

UNEQUAL LEGS.

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A86	8x6	1	44.2	13.00
		$\frac{15}{16}$	41.6	12.25
		$\frac{7}{8}$	39.0	11.48
		$\frac{13}{16}$	36.4	10.72
		$\frac{3}{4}$	33.8	9.94
		$\frac{11}{16}$	31.1	9.15
		$\frac{5}{8}$	28.4	8.36
		$\frac{9}{16}$	25.7	7.56
		$\frac{1}{2}$	23.0	6.75
A73	7x3½	1	32.3	9.50
		$\frac{15}{16}$	30.5	8.97
		$\frac{7}{8}$	28.7	8.42
		$\frac{13}{16}$	26.8	7.87
		$\frac{3}{4}$	24.9	7.31
		$\frac{11}{16}$	23.0	6.75
		$\frac{5}{8}$	21.0	6.17
		$\frac{9}{16}$	19.1	5.59
		$\frac{1}{2}$	17.0	5.00
		$\frac{7}{16}$	15.0	4.40
A64	6x4	1	30.6	9.00
		$\frac{15}{16}$	28.9	8.50
		$\frac{7}{8}$	27.2	7.99
		$\frac{13}{16}$	25.4	7.47
		$\frac{3}{4}$	23.6	6.94
		$\frac{11}{16}$	21.8	6.41
		$\frac{5}{8}$	20.0	5.86
		$\frac{9}{16}$	18.1	5.31
		$\frac{1}{2}$	16.2	4.75
		$\frac{7}{16}$	14.3	4.18
		$\frac{3}{8}$	12.3	3.61

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A63	6x3½	1	28.9	8.50
		$\frac{15}{16}$	27.3	8.03
		$\frac{7}{8}$	25.7	7.55
		$\frac{13}{16}$	24.0	7.06
		$\frac{3}{4}$	22.4	6.56
		$\frac{11}{16}$	20.6	6.06
		$\frac{5}{8}$	18.9	5.55
		$\frac{9}{16}$	17.1	5.03
		$\frac{1}{2}$	15.3	4.50
		$\frac{7}{16}$	13.5	3.97
		$\frac{3}{8}$	11.7	3.42
A54	5x3½	$\frac{7}{8}$	22.7	6.67
		$\frac{13}{16}$	21.3	6.25
		$\frac{3}{4}$	19.8	5.81
		$\frac{11}{16}$	18.3	5.37
		$\frac{5}{8}$	16.8	4.92
		$\frac{9}{16}$	15.2	4.47
		$\frac{1}{2}$	13.6	4.00
		$\frac{7}{16}$	12.0	3.53
		$\frac{3}{8}$	10.4	3.05
		$\frac{5}{16}$	8.7	2.56
A53	5x3	$\frac{13}{16}$	19.9	5.84
		$\frac{3}{4}$	18.5	5.44
		$\frac{11}{16}$	17.1	5.03
		$\frac{5}{8}$	15.7	4.61
		$\frac{9}{16}$	14.3	4.18
		$\frac{1}{2}$	12.8	3.75
		$\frac{7}{16}$	11.3	3.31
		$\frac{3}{8}$	9.8	2.86
		$\frac{5}{16}$	8.2	2.40

MINIMUM, MAXIMUM AND INTERMEDIATE WEIGHTS AND DIMENSIONS OF

ANGLES—(CONTINUED).

UNEQUAL LEGS.

Section Number.	Size of Angle, Inches.	Thickness of Metal, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.
A44	4x3½	¾	17.3	5.06
		11/16	16.0	4.68
		⅝	14.7	4.30
		9/16	13.3	3.90
		½	11.9	3.50
		7/16	10.6	3.09
		⅜	9.1	2.67
		5/16	7.7	2.25
A43	4x3	¾	16.0	4.69
		11/16	14.8	4.34
		⅝	13.6	3.98
		9/16	12.4	3.62
		½	11.1	3.25
		7/16	9.8	2.87
		⅜	8.5	2.48
		5/16	7.2	2.09
A38	3½x3	¾	14.7	4.31
		11/16	13.6	4.00
		⅝	12.5	3.67
		9/16	11.4	3.34
		½	10.2	3.00
		7/16	9.1	2.65
		⅜	7.9	2.30
		5/16	6.6	1.93
A37	3½x2½	⅝	11.5	3.36
		9/16	10.4	3.06
		½	9.4	2.75
		7/16	8.3	2.43
		⅜	7.2	2.11
		5/16	6.1	1.78
		¼	4.9	1.44
A33	3x2½	9/16	9.5	2.78
		½	8.5	2.50
		7/16	7.6	2.22
		⅜	6.6	1.92
		5/16	5.6	1.62
		¼	4.5	1.31
A32	3x2	½	7.7	2.25
		7/16	6.8	2.00
		⅜	5.9	1.73
		5/16	5.0	1.47
		¼	4.1	1.19
A27	2½x2	½	6.8	2.00
		7/16	6.1	1.78
		⅜	5.3	1.55
		5/16	4.5	1.31
		¼	3.7	1.06
		3/16	2.8	.81
A26	2½x1½	7/16	5.3	1.56
		⅜	4.7	1.36
		5/16	4.0	1.16
		¼	3.2	.94
		3/16	2.5	.72

Angles are rolled only to the variations of thickness and weight given in this list.

Orders for angles should specify either the thickness or weight, but not both.

EXPLANATION OF TABLES
OF THE PROPERTIES OF STANDARD I BEAMS, CHANNELS AND ANGLES.

The tables on pages 166–169 give the weights, dimensions, areas and structural properties of all the sizes of Standard I beams that are rolled. These tables are given in the same general form as those for the properties of Bethlehem special I beams and girder beams, so that comparisons of the standard beams with the special beams and rolled girder sections can be easily made.

Properties for all weights of standard channels that are rolled are given in similar form in the table on pages 170–171.

Coefficients of strength are given for Standard I beams and channels calculated for a fiber stress of 16,000 lbs. per square inch to be used for static loads in buildings and for like purposes, also for a fiber stress of 12,500 lbs. per square inch to be used where moving loads are to be provided for, as in highway bridges, crane runways, etc. Coefficients of strength for Standard I beams are also given for a fiber stress of 10,000 lbs. per square inch, to be used where loads producing impact are to be provided for, as in railroad bridges.

The use of these coefficients of strength is explained in connection with the properties of Bethlehem special structural shapes, to which reference may be made. See pages 50–51 and also pages 232–233 for the general application of their use.

The section modulus is given around the principal axis for both I beams and channels by means of which the proper size section may be selected for a given loading and span ; or the maximum fiber stress may be determined when the size of section, length of span and method of loading are given.

The radii of gyration are given for beams and channels around each axis. When two beams are used as a column, the proper distance, center to center of beams, to make the radius equal about both axes, is given in a separate table on page 208. Likewise the proper distance, back to back of channels to make the radius of gyration equal about both axes, is given in the table on page 209.

If the section modulus of a channel sideways is desired, it may be obtained in the following manner :

S' = section modulus of channel sideways.

b = width of flange of channel, in inches.

x = distance, in inches, from back of channel to neutral axis.

I' = moment of inertia of channel, neutral axis parallel to back of flange.

Then, $S' = \frac{I'}{(b-x)}$.

Values of I' and x are given in the tables of properties of channels for all weights of each size.

The properties of angles are given in the tables on pages 172–182 for all the weights rolled of each size. For unsymmetrical sections, like angles, there are two values of the section modulus for each position of the neutral axis, because the distance from the neutral axis to the extreme fiber is greater on one side of the axis than it is on the other. The section modulus given in the tables of properties of angles is the smaller of these two values for each position of the neutral axis. The stress calculated from it gives the stress in the fibers most remote from the neutral axis, which is the maximum stress in the angle.

The coefficients of strength given for angles are calculated for a maximum fiber stress of 16,000 lbs. per square inch. These coefficients can be used in the usual manner for obtaining the safe uniformly distributed load for any angle on a given span, or for selecting the proper size of angle required to support a given load on a given span. For any other fiber stress the coefficients can be obtained by proportion.

Coefficients of strength for unequal angles are given for each position of the neutral axis. The coefficient C is to be used when the long leg of the angle is in the direction of bending, and the coefficient C' when bending takes place in the direction of the short leg.

The least radius of gyration for angles is that about a diagonal neutral axis. This minimum radius, r'', is given in the tables and is to be used in the calculation of struts, or columns consisting of a single angle, where failure is liable to take place in the direction of least resistance.

PROPERTIES OF

AMERICAN STANDARD I BEAMS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Area of Section, Sq. Ins.	Thickness of Web, Inches.	Width of Flange, Inches.	Neutral Axis Perpendicular to Web at Center. Moment of Inertia. I	Radius of Gyration. r	Section Modulus. S
I 24	24	100.0	29.41	.754	7.254	2380.3	9.00	198.4
		95.0	27.94	.692	7.192	2309.6	9.09	192.5
		90.0	26.47	.631	7.131	2239.1	9.20	186.6
		85.0	25.00	.570	7.070	2168.6	9.31	180.7
		80.0	23.32	.500	7.000	2087.9	9.46	174.0
I 20a	20	100.0	29.41	.884	7.284	1655.8	7.50	165.6
		95.0	27.94	.810	7.210	1606.8	7.58	160.7
		90.0	26.47	.737	7.137	1557.8	7.67	155.8
		85.0	25.00	.663	7.063	1508.7	7.77	150.9
		80.0	23.73	.600	7.000	1466.5	7.86	146.7
I 20	20	75.0	22.06	.649	6.399	1268.9	7.58	126.9
		70.0	20.59	.575	6.325	1219.9	7.70	122.0
		65.0	19.08	.500	6.250	1169.6	7.83	117.0
I 18	18	70.0	20.59	.719	6.259	921.3	6.69	102.4
		65.0	19.12	.637	6.177	881.5	6.79	97.9
		60.0	17.65	.555	6.095	841.8	6.91	93.5
		55.0	15.93	.460	6.000	795.6	7.07	88.4
I 15b	15	100.0	29.41	1.184	6.774	900.5	5.53	120.1
		95.0	27.94	1.085	6.675	872.9	5.59	116.4
		90.0	26.47	.987	6.577	845.4	5.65	112.7
		85.0	25.00	.889	6.479	817.8	5.72	109.0
		80.0	23.81	.810	6.400	795.5	5.78	106.1
I 15a	15	75.0	22.06	.882	6.292	691.2	5.60	92.2
		70.0	20.59	.784	6.194	663.6	5.68	88.5
		65.0	19.12	.686	6.096	636.0	5.77	84.8
		60.0	17.67	.590	6.000	609.0	5.87	81.2
I 15	15	55.0	16.18	.656	5.746	511.0	5.62	68.1
		50.0	14.71	.558	5.648	483.4	5.73	64.5
		45.0	13.24	.460	5.550	455.8	5.87	60.8
		42.0	12.48	.410	5.500	441.7	5.95	58.9

W=Safe load in pounds uniformly distributed, including weight of beam.
L=Span in feet. M=Moment of forces in foot pounds.

PROPERTIES OF

AMERICAN STANDARD I BEAMS.

COEFFICIENTS OF STRENGTH.			Maximum Safe Shear on Web, in Tons of 2000 Lbs.	NEUTRAL AXIS COINCIDENT WITH CENTER LINE OF WEB.		Section Number.
For Fiber Stress of 16,000 Lbs. per Sq. In., for Buildings. C	For Fiber Stress of 12,500 Lbs. per Sq. In., for Moving Loads. C′	For Fiber Stress of 10,000 Lbs. per Sq. In. C″		Moment of Inertia. I′	Radius of Gyration. r′	
2,115,800	1,653,000	1,322,700	85.1	48.6	1.28	
2,052,900	1,603,900	1,316,700	75.0	47.1	1.30	
1,990,300	1,554,900	1,244,000	65.1	45.7	1.31	I 24
1,927,600	1,505,900	1,204,700	55.3	44.4	1.33	
1,855,900	1,449,900	1,160,000	44.2	42.9	1.36	
1,766,100	1,379,800	1,104,000	93.7	52.7	1.34	
1,713,900	1,339,000	1,071,300	83.9	50.8	1.35	
1,661,600	1,298,100	1,038,700	74.3	49.0	1.36	I 20a
1,609,300	1,257,200	1,006,000	64.4	47.3	1.37	
1,564,300	1,222,100	978,000	55.9	45.8	1.39	
1,353,500	1,057,400	846,000	62.1	30.3	1.17	
1,301,200	1,016,600	813,300	52.1	29.0	1.19	I 20
1,247,600	974,700	780,000	42.0	27.9	1.21	
1,091,900	853,000	682,700	66.5	24.6	1.09	
1,044,800	816,200	652,700	56.7	23.5	1.11	I 18
997,700	779,500	626,000	46.7	22.4	1.13	
943,000	736,700	589,300	35.2	21.2	1.15	
1,280,700	1,000,600	800,700	102.8	51.0	1.31	
1,241,500	969,900	776,000	93.5	48.4	1.32	
1,202,300	939,300	751,300	84.4	45.9	1.32	I 15b
1,163,000	908,600	726,700	75.1	43.6	1.32	
1,131,300	883,900	707,300	67.6	41.8	1.32	
983,000	768,000	614,700	74.1	30.7	1.18	
943,800	737,400	590,000	64.7	29.0	1.19	I 15a
904,600	706,700	565,300	55.2	27.4	1.20	
866,100	676,600	541,300	45.8	26.0	1.21	
726,800	567,800	454,000	51.9	17.1	1.02	
687,500	537,100	430,000	42.2	16.0	1.04	I 15
648,200	506,400	405,300	32.3	15.0	1.07	
628,300	490,800	392,300	27.3	14.6	1.08	

C, C′ and C″=Coefficients given in the table.

$W=\frac{C \text{ or } C' \text{ or } C''}{L}$; $M=\frac{C \text{ or } C' \text{ or } C''}{8}$; C or C′ or C″=WL=8M=$\frac{2}{3}$ f S.

PROPERTIES OF

AMERICAN STANDARD I BEAMS (CONTINUED).

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Area of Section, Sq. Ins.	Thickness of Web, Inches.	Width of Flange, Inches.	Neutral Axis Perpendicular to Web at Center. Moment of Inertia. I	Radius of Gyration. r	Section Modulus. S
I 12 a	12	55.0	16.18	.822	5.612	321.0	4.45	53.5
		50.0	14.71	.699	5.489	303.3	4.54	50.6
		45.0	13.24	.576	5.366	285.7	4.65	47.6
		40.0	11.84	.460	5.250	268.9	4.77	44.8
I 12	12	35.0	10.29	.436	5.086	228.3	4.71	38.0
		31.5	9.26	.350	5.000	215.8	4.83	36.0
I 10	10	40.0	11.76	.749	5.099	158.7	3.67	31.7
		35.0	10.29	.602	4.952	146.4	3.77	29.3
		30.0	8.82	.455	4.805	134.2	3.90	26.8
		25.0	7.37	.310	4.660	122.1	4.07	24.4
I 9	9	35.0	10.29	.732	4.772	111.8	3.29	24.8
		30.0	8.82	.569	4.609	101.9	3.40	22.6
		25.0	7.35	.406	4.446	91.9	3.54	20.4
		21.0	6.31	.290	4.330	84.9	3.67	18.9
I 8	8	25.5	7.50	.541	4.271	68.4	3.02	17.1
		23.0	6.76	.449	4.179	64.5	3.09	16.1
		20.5	6.03	.357	4.087	60.6	3.17	15.1
		18.0	5.33	.270	4.000	56.9	3.27	14.2
I 7	7	20.0	5.88	.458	3.868	42.2	2.68	12.1
		17.5	5.15	.353	3.763	39.2	2.76	11.2
		15.0	4.42	.250	3.660	36.2	2.86	10.4
I 6	6	17.25	5.07	.475	3.575	26.2	2.27	8.7
		14.75	4.34	.352	3.452	24.0	2.35	8.0
		12.25	3.61	.230	3.330	21.8	2.46	7.3
I 5	5	14.75	4.34	.504	3.294	15.2	1.87	6.1
		12.25	3.60	.357	3.147	13.6	1.94	5.4
		9.75	2.87	.210	3.000	12.1	2.05	4.8
I 4	4	10.5	3.09	.410	2.880	7.1	1.52	3.6
		9.5	2.79	.337	2.807	6.7	1.55	3.4
		8.5	2.50	.263	2.733	6.4	1.59	3.2
		7.5	2.21	.190	2.660	6.0	1.64	3.0

W—Safe load in pounds uniformly distributed, including weight of beam.
L—Span in feet. M—Moment of forces in foot pounds.

PROPERTIES OF

AMERICAN STANDARD I BEAMS (CONTINUED)

COEFFICIENT OF STRENGTH.			Maximum Safe Shear on Web, in Tons of 2000 Lbs.	NEUTRAL AXIS COINCIDENT WITH CENTER LINE OF WEB.		Section Number.
For Fiber Stress of 16,000 Lbs. per Sq In., for Buildings. C	For Fiber Stress of 12,500 Lbs. per Sq. In., for Moving Loads. C′	For Fiber Stress of 10,000 Lbs. per Sq. In. C″		Moment of Inertia. I′	Radius of Gyration. r′	
570,600	445,800	356,700	56.2	17.46	1.04	I 12 a
539,200	421,300	337,300	46.9	16.12	1.05	
507,900	396,800	317,300	37.5	14.89	1.06	
478,100	373,500	298,700	28.4	13.81	1.08	
405,800	317,000	253,300	26.3	10.07	.99	I 12
383,700	299,700	240,000	19.4	9.50	1.01	
338,500	264,500	211,300	43.0	9.50	.90	I 10
312,400	244,100	195,300	33.8	8.52	.91	
286,300	223,600	178,700	24.4	7.65	.93	
260,500	203,500	162,700	14.8	6.89	.97	
265,000	207,000	165,300	38.1	7.31	.84	I 9
241,500	188,700	150,700	28.9	6.42	.85	
217,900	170,300	136,000	19.6	5.65	.88	
201,300	157,300	126,000	12.7	5.16	.90	
182,500	142,600	114,000	24.7	4.75	.80	I 8
172,000	134,400	107,300	20.0	4.39	.81	
161,600	126,200	100,700	15.3	4.07	.82	
151,700	118,500	94,700	10.7	3.78	.84	
128,600	100,400	80,700	18.2	3.24	.74	I 7
119,400	93,300	74,700	13.6	2.94	.76	
110,400	86,300	69,300	8.8	2.67	.78	
93,100	72,800	58,000	16.5	2.36	.68	I 6
85,300	66,600	53,300	11.9	2.09	.69	
77,500	60,500	48,700	7.1	1.85	.72	
64,600	50,500	40,700	14.8	1.70	.63	I 5
58,100	45,400	36,000	10.3	1.45	.63	
51,600	40,300	32,000	5.6	1.23	.65	
38,100	29,800	24,000	9.6	1.01	.57	I 4
36,000	28,100	22,700	7.8	.93	.58	
33,900	26,500	21,300	6.0	.85	.58	
31,800	24,900	20,000	4.2	.77	.59	

C, C′ and C″=Coefficients given in the table.

$W=\frac{C \text{ or } C' \text{ or } C''}{L}$; $M=\frac{C \text{ or } C' \text{ or } C''}{8}$; $C \text{ or } C' \text{ or } C''=WL=8M=\frac{2}{3} f S$.

PROPERTIES OF AMERICAN STANDARD CHANNELS.

Section Number.	Depth of Channel, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.	Thickness of Web, Inches.	Width of Flange, Inches.	Neutral Axis Perpendicular to Web at Center. Moment of Inertia. I	Radius of Gyration. r	Section Modulus. S
C15	15	55.00	16.18	.818	3.818	430.2	5.16	57.4
		50.00	14.71	.720	3.720	402.7	5.23	53.7
		45.00	13.24	.622	3.622	375.1	5.32	50.0
		40.00	11.76	.524	3.524	347.5	5.43	46.3
		35.00	10.29	.426	3.426	320.0	5.58	42.7
		33.00	9.90	.400	3.400	312.6	5.62	41.7
C12	12	40.00	11.76	.758	3.418	197.0	4.09	32.8
		35.00	10.29	.636	3.296	179.3	4.17	29.9
		30.00	8.82	.513	3.173	161.7	4.28	26.9
		25.00	7.35	.390	3.050	144.0	4.43	24.0
		20.50	6.03	.280	2.940	128.1	4.61	21.4
C10	10	35.00	10.29	.823	3.183	115.5	3.35	23.1
		30.00	8.82	.676	3.036	103.2	3.42	20.6
		25.00	7.35	.529	2.889	91.0	3.52	18.2
		20.00	5.88	.382	2.742	78.7	3.66	15.7
		15.00	4.46	.240	2.600	66.9	3.87	13.4
C9	9	25.00	7.35	.615	2.815	70.7	3.10	15.7
		20.00	5.88	.452	2.652	60.8	3.21	13.5
		15.00	4.41	.288	2.488	50.9	3.40	11.3
		13.25	3.89	.230	2.430	47.3	3.49	10.5
C8	8	21.25	6.25	.582	2.622	47.8	2.77	11.9
		18.75	5.51	.490	2.530	43.8	2.82	11.0
		16.25	4.78	.399	2.439	39.9	2.89	10.0
		13.75	4.04	.307	2.347	36.0	2.98	9.0
		11.25	3.35	.220	2.260	32.3	3.11	8.1
C7	7	19.75	5.81	.633	2.513	33.2	2.39	9.5
		17.25	5.07	.528	2.408	30.2	2.44	8.6
		14.75	4.34	.423	2.303	27.2	2.50	7.8
		12.25	3.60	.318	2.198	24.2	2.59	6.9
		9.75	2.85	.210	2.090	21.1	2.72	6.0
C6	6	15.50	4.56	.563	2.283	19.5	2.07	6.5
		13.00	3.82	.440	2.160	17.3	2.13	5.8
		10.50	3.09	.318	2.038	15.1	2.21	5.0
		8.00	2.38	.200	1.920	13.0	2.34	4.3
C5	5	11.50	3.38	.477	2.037	10.4	1.75	4.2
		9.00	2.65	.330	1.890	8.9	1.83	3.5
		6.50	1.95	.190	1.750	7.4	1.95	3.0
C4	4	7.25	2.13	.325	1.725	4.6	1.46	2.3
		6.25	1.84	.252	1.652	4.2	1.51	2.1
		5.25	1.55	.180	1.580	3.8	1.56	1.9

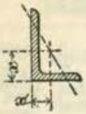
W—Safe load in pounds uniformly distributed, including weight of channel.
L—Span in feet. M—Moment of forces in foot pounds.

PROPERTIES OF AMERICAN STANDARD CHANNELS.

COEFFICIENTS OF STRENGTH. For Fiber Stress of 16,000 Lbs. per Sq. In., for Buildings. C	For Fiber Stress of 12,500 Lbs. per Sq. In., for Moving Loads. C′	Maximum Safe Shear on Web, in Tons of 2000 Lbs.	NEUTRAL AXIS PARALLEL TO WEB OF CHANNEL. Dist. Center of Gravity from Back of Channel. x	Moment of Inertia. I′	Radius of Gyration. r′	Weight per Foot, Pounds.	Depth of Channel, Inches.
611,900	478,000	67.7	.823	12.19	.868	55.00	
572,700	447,400	58.3	.803	11.22	.873	50.00	
533,500	416,800	48.7	.788	10.29	.882	45.00	15
494,200	386,100	38.9	.783	9.39	.893	40.00	
455,000	355,500	29.0	.789	8.48	.908	35.00	
444,500	347,300	26.4	.794	8.23	.912	33.00	
350,200	273,600	51.3	.722	6.63	.751	40.00	
318,800	249,100	41.9	.694	5.90	.757	35.00	
287,400	224,500	32.4	.677	5.21	.768	30.00	12
256,100	200,000	22.6	.678	4.53	.785	25.00	
227,800	178,000	13.7	.704	3.91	.805	20.50	
246,400	192,500	47.6	.695	4.66	.672	35.00	
220,300	172,100	38.4	.651	3.99	.672	30.00	
194,100	151,700	29.1	.620	3.40	.680	25.00	10
168,000	131,200	19.5	.609	2.85	.696	20.00	
142,700	111,500	10.0	.639	2.30	.718	15.00	
167,600	130,900	31.5	.615	2.98	.637	25.00	
144,100	112,600	22.2	.585	2.45	.646	20.00	9
120,500	94,200	12.5	.590	1.95	.665	15.00	
112,200	87,600	9.0	.607	1.77	.674	13.25	
127,400	99,500	26.7	.587	2.25	.600	21.25	
116,900	91,300	22.1	.567	2.01	.603	18.75	
106,400	83,200	14.4	.556	1.78	.610	16.25	8
96,000	75,000	12.6	.557	1.55	.619	13.75	
86,100	67,300	8.0	.576	1.33	.630	11.25	
101,100	79,000	25.8	.583	1.85	.565	19.75	
92,000	71,800	21.3	.555	1.62	.564	17.25	
82,800	64,700	16.7	.535	1.40	.568	14.75	7
73,700	57,500	12.0	.528	1.19	.575	12.25	
66,800	52,200	7.0	.546	.98	.586	9.75	
69,500	54,300	19.7	.546	1.28	.529	15.50	
61,600	48,100	15.2	.517	1.07	.529	13.00	6
53,800	42,000	10.6	.503	.88	.534	10.50	
46,200	36,100	5.9	.517	.70	.542	8.00	
44,400	34,700	14.0	.508	.82	.493	11.50	
37,900	29,600	9.4	.481	.64	.493	9.00	5
31,600	24,700	4.9	.489	.48	.498	6.50	
24,400	19,000	7.6	.463	.44	.455	7.25	
22,300	17,400	5.7	.458	.38	.454	6.25	4
20,200	15,800	3.9	.464	.32	.453	5.25	

C or C′=Coefficients given in the table.

$W = \frac{C \text{ or } C'}{L}$; $M = \frac{C \text{ or } C'}{8}$; C or C′=WL=8M=$\frac{2}{3}$ f S.



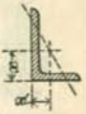
PROPERTIES OF

ANGLES WITH UNEQUAL LEGS.

Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Pounds.	Area of Section, Square Inches.	NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO SHORTER FLANGE.				
					Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C
		1	44.2	13.00	2.65	80.78	2.49	15.11	161,200
		15/16	41.6	12.25	2.63	76.59	2.50	14.26	152,200
		7/8	39.0	11.48	2.61	72.31	2.51	13.41	143,100
		13/16	36.4	10.72	2.59	67.92	2.52	12.55	133,800
A86	8 x 6	3/4	33.8	9.94	2.56	63.41	2.53	11.66	124,400
		11/16	31.1	9.15	2.54	58.82	2.54	10.77	214,900
		5/8	28.4	8.36	2.52	54.10	2.55	9.87	105,300
		9/16	25.7	7.56	2.50	49.26	2.55	8.95	95,500
		1/2	23.0	6.75	2.47	44.31	2.56	8.02	85,500
		1	32.3	9.50	2.71	45.37	2.19	10.58	112,800
		15/16	30.5	8.97	2.69	43.13	2.19	10.00	106,700
		7/8	28.7	8.42	2.67	40.82	2.20	9.42	100,500
		13/16	26.8	7.87	2.64	38.45	2.21	8.82	94,100
A73	7 x 3½	3/4	24.9	7.31	2.62	35.99	2.22	8.22	87,600
		11/16	23.0	6.75	2.60	33.47	2.23	7.60	81,000
		5/8	21.0	6.17	2.57	30.86	2.24	6.97	74,300
		9/16	19.1	5.59	2.55	28.18	2.25	6.33	67,600
		1/2	17.0	5.00	2.53	25.41	2.25	5.68	60,600
		7/16	15.0	4.40	2.50	22.56	2.26	5.01	53,400
		1	30.6	9.00	2.17	30.75	1.85	8.02	85,600
		15/16	28.9	8.50	2.14	29.26	1.86	7.59	81,000
		7/8	27.2	7.99	2.12	27.73	1.86	7.15	76,300
		13/16	25.4	7.47	2.10	26.15	1.87	6.70	71,500
		3/4	23.6	6.94	2.08	24.51	1.88	6.25	66,700
A64	6 x 4	11/16	21.8	6.41	2.06	22.82	1.89	5.78	61,700
		5/8	20.0	5.86	2.03	21.07	1.90	5.31	56,600
		9/16	18.1	5.31	2.01	19.26	1.90	4.83	51,500
		1/2	16.2	4.75	1.99	17.40	1.91	4.33	46,200
		7/16	14.3	4.18	1.96	15.46	1.92	3.83	40,900
		3/8	12.3	3.61	1.94	13.47	1.93	3.32	35,400

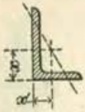
The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.

PROPERTIES OF
ANGLES WITH UNEQUAL LEGS.



NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO LONGER FLANGE.					Least Radius of Gyration, Neutral Axis Diagonal.	Thickness, Inches.	Size of Angle, Inches.
Center of Gravity from Back of Flange, Inches. x′	Moment of Inertia. I′	Radius of Gyration, Inches. r′	Section Modulus. S′	Coefficient of Strength. C′	r″		
1.65	38.78	1.73	8.92	95,200	1.28	1	
1.63	36.85	1.73	8.43	90,000	1.28	15/16	
1.61	34.86	1.74	7.94	84,700	1.28	7/8	
1.59	32.82	1.75	7.44	79,300	1.29	13/16	
1.56	30.72	1.76	6.93	73,900	1.29	3/4	8 x 6
1.54	28.56	1.77	6.41	68,300	1.29	11/16	
1.52	26.34	1.78	5.88	62,700	1.30	5/8	
1.50	24.04	1.78	5.34	56,900	1.30	9/16	
1.47	21.68	1.79	4.79	51,100	1.30	1/2	
.96	7.53	.89	2.96	31,600	.74	1	
.94	7.18	.89	2.80	29,900	.74	15/16	
.92	6.83	.90	2.64	28,200	.74	7/8	
.89	6.46	.91	2.48	26,400	.74	13/16	
.87	6.08	.91	2.41	24,600	.74	3/4	
.85	5.69	.92	2.31	22,900	.74	11/16	7 x 3½
.82	5.28	.93	1.97	21,000	.75	5/8	
.80	4.86	.93	1.80	19,200	.75	9/16	
.78	4.41	.94	1.62	17,300	.75	1/2	
.75	3.95	.95	1.44	15,400	.76	7/16	
1.17	10.75	1.09	3.79	40,500	.85	1	
1.14	10.26	1.10	3.59	38,300	.85	15/16	
1.12	9.75	1.11	3.39	36,100	.86	7/8	
1.10	9.23	1.11	3.18	33,900	.86	13/16	
1.08	8.68	1.12	2.97	31,700	.86	3/4	
1.06	8.11	1.13	2.76	29,400	.86	11/16	6 x 4
1.03	7.52	1.13	2.54	27,100	.86	5/8	
1.01	6.91	1.14	2.31	24,600	.87	9/16	
.99	6.27	1.15	2.08	22,200	.87	1/2	
.96	5.60	1.16	1.85	19,700	.87	7/16	
.94	4.90	1.17	1.60	17,100	.88	3/8	

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.



PROPERTIES OF

ANGLES WITH UNEQUAL LEGS

(CONTINUED).

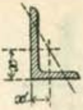
Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Lbs.	Area of Section, Square Inches.	NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO SHORTER FLANGE.				
					Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C
A63	6x3½	1	28.9	8.50	2.26	29.24	1.85	7.83	83,500
		15/16	27.3	8.03	2.24	27.84	1.86	7.41	79,000
		7/8	25.7	7.55	2.22	26.38	1.87	6.98	74,500
		13/16	24.0	7.06	2.20	24.89	1.88	6.55	69,800
		3/4	22.4	6.56	2.18	23.34	1.89	6.10	65,100
		11/16	20.6	6.06	2.15	21.74	1.89	5.65	60,300
		5/8	18.9	5.55	2.13	20.08	1.90	5.19	55,300
		9/16	17.1	5.03	2.11	18.37	1.91	4.72	50,300
		1/2	15.3	4.50	2.08	16.59	1.92	4.24	45,200
		7/16	13.5	3.97	2.06	14.76	1.93	3.75	40,000
		3/8	11.7	3.42	2.04	12.86	1.94	3.25	34,600
A54	5x3½	7/8	22.7	6.67	1.79	15.67	1.53	4.88	52,100
		13/16	21.3	6.25	1.77	14.81	1.54	4.58	48,900
		3/4	19.8	5.81	1.75	13.92	1.55	4.28	45,600
		11/16	18.3	5.37	1.72	12.99	1.56	3.97	42,300
		5/8	16.8	4.92	1.70	12.03	1.56	3.65	38,900
		9/16	15.2	4.47	1.68	11.03	1.57	3.32	35,400
		1/2	13.6	4.00	1.66	9.99	1.58	2.99	31,900
		7/16	12.0	3.53	1.63	8.90	1.59	2.64	28,200
		3/8	10.4	3.05	1.61	7.78	1.60	2.29	24,500
		5/16	8.7	2.56	1.59	6.60	1.61	1.94	20,700
A53	5x3	13/16	19.9	5.84	1.86	13.98	1.55	4.45	47,500
		3/4	18.5	5.44	1.84	13.15	1.55	4.16	44,400
		11/16	17.1	5.03	1.82	12.28	1.56	3.86	41,200
		5/8	15.7	4.61	1.80	11.37	1.57	3.55	37,900
		9/16	14.3	4.18	1.77	10.43	1.58	3.23	34,500
		1/2	12.8	3.75	1.75	9.45	1.59	2.91	31,000
		7/16	11.3	3.31	1.73	8.43	1.60	2.58	27,500
		3/8	9.8	2.86	1.70	7.37	1.61	2.24	23,900
		5/16	8.2	2.40	1.68	6.26	1.61	1.89	20,100

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.

PROPERTIES OF

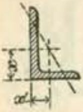
ANGLES WITH UNEQUAL LEGS

(CONTINUED).



NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO LONGER FLANGE.					Least Radius of Gyration, Neutral Axis Diagonal.	Thickness, Inches.	Size of Angle, Inches.
Center of Gravity from Back of Flange, Inches. x′	Moment of Inertia. I′	Radius of Gyration, Inches. r′	Section Modulus. S′	Coefficient of Strength. C′	r″		
1.01	7.21	.92	2.90	30,900	.74	1	
.99	6.88	.93	2.74	29,300	.74	15/16	
.97	6.55	.93	2.59	27,600	.75	7/8	
.95	6.20	.94	2.43	25,900	.75	13/16	
.93	5.84	.94	2.27	24,200	.75	3/4	
.90	5.47	.95	2.11	22,500	.75	11/16	6 x 3½
.88	5.08	.96	1.94	20,700	.75	5/8	
.86	4.67	.96	1.77	18,900	.75	9/16	
.83	4.25	.97	1.59	17,000	.76	1/2	
.81	3.81	.98	1.41	15,100	.76	7/16	
.79	3.34	.99	1.23	13,100	.77	3/8	
1.04	6.21	.96	2.52	26,900	.75	7/8	
1.02	5.89	.97	2.37	25,300	.75	13/16	
1.00	5.55	.98	2.22	23,600	.75	3/4	
.97	5.20	.98	2.06	22,000	.75	11/16	
.95	4.83	.99	1.90	20,200	.75	5/8	
.93	4.45	1.00	1.73	18,500	.75	9/16	5 x 3½
.91	4.05	1.01	1.56	16,600	.75	1/2	
.88	3.63	1.01	1.39	14,800	.76	7/16	
.86	3.18	1.02	1.21	12,900	.76	3/8	
.84	2.72	1.03	1.02	10,900	.76	5/16	
.86	3.71	.80	1.74	18,500	.64	13/16	
.84	3.51	.80	1.63	17,300	.64	3/4	
.82	3.29	.81	1.51	16,100	.64	11/16	
.80	3.06	.82	1.39	14,800	.64	5/8	
.77	2.83	.82	1.27	13,500	.65	9/16	5 x 3
.75	2.58	.83	1.15	12,200	.65	1/2	
.73	2.32	.84	1.02	10,900	.65	7/16	
.70	2.04	.84	.89	9,480	.65	3/8	
.68	1.75	.85	.75	8,040	.66	5/16	

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.



PROPERTIES OF

ANGLES WITH UNEQUAL LEGS

(CONTINUED).

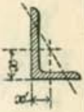
Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Lbs.	Area of Section, Square Inches.	NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO SHORTER FLANGE.				
					Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C
A44	4x3½	¾	17.3	5.06	1.34	7.32	1.20	2.75	29,400
		11/16	16.0	4.68	1.32	6.86	1.21	2.56	27,300
		⅝	14.7	4.30	1.29	6.37	1.22	2.35	25,100
		9/16	13.3	3.90	1.27	5.86	1.23	2.15	22,900
		½	11.9	3.50	1.25	5.32	1.23	1.93	20,600
		7/16	10.6	3.09	1.23	4.76	1.24	1.72	18,300
		⅜	9.1	2.67	1.21	4.18	1.25	1.50	16,000
		5/16	7.7	2.25	1.18	3.56	1.26	1.26	13,500
A43	4 x 3	¾	16.0	4.69	1.42	6.93	1.22	2.68	28,600
		11/16	14.8	4.34	1.39	6.49	1.22	2.49	26,600
		⅝	13.6	3.98	1.37	6.03	1.23	2.30	24,500
		9/16	12.4	3.62	1.35	5.55	1.24	2.09	22,300
		½	11.1	3.25	1.33	5.05	1.25	1.89	20,100
		7/16	9.8	2.87	1.30	4.52	1.25	1.68	17,900
		⅜	8.5	2.48	1.28	3.96	1.26	1.46	15,600
		5/16	7.2	2.09	1.26	3.38	1.27	1.23	13,200
A38	3½x3	¾	14.7	4.31	1.21	4.70	1.04	2.05	21,900
		11/16	13.6	4.00	1.19	4.41	1.05	1.91	20,400
		⅝	12.5	3.67	1.17	4.11	1.06	1.76	18,800
		9/16	11.4	3.34	1.15	3.79	1.07	1.61	17,200
		½	10.2	3.00	1.13	3.45	1.07	1.45	15,500
		7/16	9.1	2.65	1.10	3.10	1.08	1.29	13,800
		⅜	7.9	2.30	1.08	2.72	1.09	1.13	12,000
		5/16	6.6	1.93	1.06	2.33	1.10	.96	10,200
A37	3½ x 2½	⅝	11.5	3.36	1.25	3.85	1.07	1.71	18,240
		9/16	10.4	3.06	1.23	3.55	1.08	1.56	16,660
		½	9.4	2.75	1.20	3.24	1.09	1.41	15,060
		7/16	8.3	2.43	1.18	2.91	1.09	1.26	13,390
		⅜	7.2	2.11	1.16	2.56	1.10	1.09	11,660
		5/16	6.1	1.78	1.14	2.19	1.11	.93	19,880
		¼	4.9	1.44	1.11	1.80	1.12	.75	8,040

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.

PROPERTIES OF

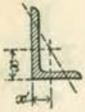
ANGLES WITH UNEQUAL LEGS

(CONTINUED).



NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO LONGER FLANGE.					Least Radius of Gyration, Neutral Axis Diagonal.	Thickness, Inches.	Size of Angle, Inches.
Center of Gravity from Back of Flange, Inches. x'	Moment of Inertia. I'	Radius of Gyration, Inches. r'	Section Modulus. S'	Coefficient of Strength. C'	r''		
1.09	5.18	1.01	2.15	22,900	.72	3/4	
1.07	4.86	1.02	2.00	21,300	.72	11/16	
1.04	4.52	1.03	1.84	19,600	.72	5/8	
1.02	4.17	1.03	1.68	17,900	.72	9/16	4 x 3 1/2
1.00	3.79	1.04	1.52	16,200	.72	1/2	
.98	3.40	1.05	1.35	14,400	.72	7/16	
.96	2.99	1.06	1.18	12,600	.73	3/8	
.93	2.59	1.07	1.01	10,800	.73	5/16	
.92	3.28	.84	1.57	16,800	.64	3/4	
.89	3.08	.84	1.46	15,600	.64	11/16	
.87	2.87	.85	1.35	14,400	.64	5/8	
.85	2.66	.86	1.23	13,160	.64	9/16	4 x 3
.83	2.42	.86	1.12	11,900	.64	1/2	
.80	2.18	.87	.99	10,580	.64	7/16	
.78	1.92	.88	.87	9,240	.64	3/8	
.76	1.65	.89	.74	7,840	.65	5/16	
.96	3.15	.85	1.54	16,460	.62	3/4	
.94	2.96	.86	1.44	15,320	.62	11/16	
.92	2.76	.87	1.33	14,140	.62	5/8	
.90	2.55	.87	1.21	12,920	.62	9/16	3 1/2 x 3
.88	2.33	.88	1.10	11,690	.62	1/2	
.85	2.09	.89	.98	10,400	.62	7/16	
.83	1.85	.90	.85	9,080	.62	3/8	
.81	1.58	.90	.72	7,700	.63	5/16	
.75	1.61	.69	.92	9,780	.53	5/8	
.73	1.49	.70	.84	8,960	.53	9/16	
.70	1.36	.70	.76	8.100	.53	1/2	
.68	1.23	.71	.68	7,220	.54	7/16	3 1/2 x 2 1/2
.66	1.09	.72	.59	6,320	.54	3/8	
.64	.94	.73	.50	5,380	.54	5/16	
.61	.78	.74	.41	4,400	.54	1/4	

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.



PROPERTIES OF

ANGLES WITH UNEQUAL LEGS

(CONTINUED).

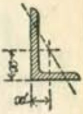
Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Lbs.	Area of Section, Square Inches.	NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO SHORTER FLANGE.				
					Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C
A33	3 x 2½	9/16	9.5	2.78	1.02	2.28	.91	1.15	12,280
		½	8.5	2.50	1.00	2.08	.91	1.04	11,120
		7/16	7.6	2.22	.98	1.88	.92	.93	9,900
		⅜	6.6	1.92	.96	1.66	.93	.81	8,640
		5/16	5.6	1.62	.93	1.42	.94	.69	7,340
		¼	4.5	1.31	.91	1.17	.95	.56	5,980
A32	3 x 2	½	7.7	2.25	1.08	1.92	.92	1.00	10,700
		7/16	6.8	2.00	1.06	1.73	.93	.89	9,540
		⅜	5.9	1.73	1.04	1.53	.94	.78	8,340
		5/16	5.0	1.47	1.02	1.32	.95	.66	7,080
		¼	4.1	1.19	.99	1.09	.95	.54	5,780
A27	2½ x 2	½	6.8	2.00	.88	1.14	.75	.70	7,460
		7/16	6.1	1.78	.85	1.03	.76	.62	6,660
		⅜	5.3	1.55	.83	.91	.77	.55	5,840
		5/16	4.5	1.31	.81	.79	.78	.47	4,980
		¼	3.7	1.06	.79	.65	.78	.38	4,060
		3/16	2.8	.81	.76	.51	.79	.29	3,120
A26	2½ x 1½	7/16	5.3	1.56	.94	.92	.77	.59	6,320
		⅜	4.7	1.36	.92	.82	.78	.52	5,540
		5/16	4.0	1.16	.90	.71	.79	.44	4,740
		¼	3.2	.94	.88	.59	.79	.36	3,880
		3/16	2.5	.72	.85	.46	.80	.28	2,980

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.

PROPERTIES OF

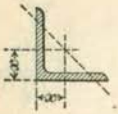
ANGLES WITH UNEQUAL LEGS

(CONTINUED).



Neutral Axis through Center of Gravity Parallel to Longer Flange.					Least Radius of Gyration, Neutral Axis Diagonal.	Thickness, Inches.	Size of Angle, Inches.
Center of Gravity from Back of Flange, Inches. x'	Moment of Inertia. I'	Radius of Gyration, Inches. r'	Section Modulus. S'	Coefficient of Strength. C'	r''		
.77	1.42	.72	.82	8,760	.52	9/16	3 x 2½
.75	1.30	.72	.74	7,940	.52	½	
.73	1.18	.73	.66	7,080	.52	7/16	
.71	1.04	.74	.58	6,200	.52	⅜	
.68	0.90	.74	.49	5,280	.53	5/16	
.66	0.74	.75	.40	4,300	.53	¼	
.58	.67	.55	.47	5,060	.43	½	3 x 2
.56	.61	.55	.42	4,520	.43	7/16	
.54	.54	.56	.37	3,960	.43	⅜	
.52	.47	.57	.32	3,380	.43	5/16	
.49	.39	.57	.25	2,700	.43	¼	
.63	.64	.56	.46	4,920	.42	½	2½ x 2
.60	.58	.57	.41	4,400	.42	7/16	
.58	.51	.58	.36	3,860	.42	⅜	
.56	.45	.58	.31	3,300	.42	5/16	
.54	.37	.59	.25	2,720	.42	¼	
.51	.29	.60	.20	2,100	.43	3/16	
.44	.24	.40	.23	2,460	.32	7/16	2½ x 1½
.42	.22	.40	.20	2,160	.32	⅜	
.40	.19	.41	.17	1,860	.32	5/16	
.38	.16	.41	.14	1,520	.32	¼	
.35	.13	.42	.11	1,180	.33	3/16	

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.



PROPERTIES OF

ANGLES WITH EQUAL LEGS.

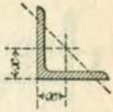
Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Lbs.	Area of Section, Square Inches.	NEUTRAL AXIS THROUGH CENTER OF GRAVITY PARALLEL TO EITHER FLANGE.					Least Radius of Gyration, Neutral Axis Diagonal.
					Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C	r''
		1⅛	56.9	16.73	2.41	97.97	2.42	17.53	187,000	1.55
		1 1/16	54.0	15.87	2.39	93.53	2.43	16.67	177,800	1.56
		1	51.0	15.00	2.37	88.98	2.44	15.80	168,500	1.56
		15/16	48.1	14.12	2.34	84.33	2.44	14.91	159,100	1.56
		⅞	45.0	13.23	2.32	79.58	2.45	14.01	149,500	1.57
A80	8 x 8	13/16	42.0	12.34	2.30	74.71	2.46	13.11	139,800	1.57
		¾	38.9	11.44	2.28	69.74	2.47	12.18	130,000	1.57
		11/16	35.8	10.53	2.25	64.64	2.48	11.25	120,000	1.58
		⅝	32.7	9.61	2.23	59.42	2.49	10.30	109,900	1.58
		9/16	29.6	8.68	2.21	54.09	2.50	9.34	99,600	1.58
		½	26.4	7.75	2.19	48.63	2.50	8.37	89,300	1.58
		1	37.4	11.00	1.86	35.46	1.80	8.57	91,400	1.16
		15/16	35.3	10.37	1.84	33.72	1.80	8.11	86,500	1.16
		⅞	33.1	9.74	1.82	31.92	1.81	7.64	81,400	1.17
		13/16	31.0	9.09	1.80	30.06	1.82	7.15	76,300	1.17
		¾	28.7	8.44	1.78	28.15	1.83	6.66	71,100	1.17
A60	6 x 6	11/16	26.5	7.78	1.75	26.19	1.83	6.17	65,800	1.17
		⅝	24.2	7.11	1.73	24.16	1.84	5.66	60,300	1.18
		9/16	21.9	6.43	1.71	22.07	1.85	5.14	54,800	1.18
		½	19.6	5.75	1.68	19.91	1.86	4.61	49,200	1.18
		7/16	17.2	5.06	1.66	17.68	1.87	4.07	43,400	1.19
		⅜	14.9	4.36	1.64	15.39	1.88	3.53	37,600	1.19
		1	30.6	9.00	1.61	19.64	1.48	5.80	61,800	.96
		15/16	28.9	8.50	1.59	18.71	1.48	5.49	58,600	.96
		⅞	27.2	7.99	1.57	17.75	1.49	5.17	55,100	.96
		13/16	25.4	7.46	1.55	16.77	1.50	4.85	51,700	.97
		¾	23.6	6.94	1.52	15.74	1.51	4.53	48,300	.97
A50	5 x 5	11/16	21.8	6.42	1.50	14.68	1.51	4.20	44,800	.97
		⅝	20.0	5.86	1.48	13.58	1.52	3.86	41,100	.97
		9/16	18.1	5.31	1.46	12.44	1.53	3.51	37,400	.98
		½	16.2	4.75	1.43	11.25	1.54	3.15	33,600	.98
		7/16	14.3	4.18	1.41	10.02	1.55	2.79	29,800	.98
		⅜	12.3	3.61	1.39	8.74	1.56	2.42	25,800	.99

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.

PROPERTIES OF

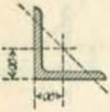
ANGLES WITH EQUAL LEGS

(CONTINUED).



Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Lbs.	Area of Section, Square Inches.	Neutral Axis through Center of Gravity Parallel to either Flange. Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C	Least Radius of Gyration, Neutral Axis Diagonal. r''
		13/16	19.9	5.84	1.29	8.14	1.18	3.01	32,100	.77
		3/4	18.5	5.44	1.27	7.67	1.19	2.81	30,000	.77
		11/16	17.1	5.03	1.25	7.17	1.19	2.61	27,800	.77
		5/8	15.7	4.61	1.23	6.66	1.20	2.40	25,600	.77
A40	4 x 4	9/16	14.3	4.18	1.21	6.12	1.21	2.19	23,400	.78
		1/2	12.8	3.75	1.18	5.56	1.22	1.97	21,100	.78
		7/16	11.3	3.31	1.16	4.97	1.23	1.75	18,700	.78
		3/8	9.8	2.86	1.14	4.36	1.23	1.52	16,200	.79
		5/16	8.2	2.40	1.12	3.71	1.24	1.29	13,700	.79
		13/16	17.1	5.03	1.17	5.25	1.02	2.25	24,000	.67
		3/4	16.0	4.69	1.15	4.96	1.03	2.11	22,500	.67
		11/16	14.8	4.34	1.12	4.65	1.04	1.96	20,900	.67
		5/8	13.6	3.98	1.10	4.33	1.04	1.81	19,300	.67
A35	3½x3½	9/16	12.4	3.62	1.08	3.99	1.05	1.65	17,600	.68
		1/2	11.1	3.25	1.06	3.64	1.06	1.49	15,900	.68
		7/16	9.8	2.87	1.04	3.26	1.07	1.32	14,100	.68
		3/8	8.5	2.48	1.01	2.87	1.07	1.15	12,300	.69
		5/16	7.2	2.09	.99	2.45	1.08	.98	10,400	.69
		5/8	11.5	3.36	.98	2.62	.88	1.30	13,860	.57
		9/16	10.4	3.06	.95	2.43	.89	1.19	12,680	.58
		1/2	9.4	2.75	.93	2.22	.90	1.07	11,440	.58
A30	3 x 3	7/16	8.3	2.43	.91	1.99	.91	.95	10,180	.58
		3/8	7.2	2.11	.89	1.76	.91	.83	8,880	.58
		5/16	6.1	1.78	.87	1.51	.92	.71	7,540	.59
		1/4	4.9	1.44	.84	1.24	.93	.58	6,160	.59
		1/2	7.7	2.25	.81	1.23	.74	.73	7,780	.47
		7/16	6.8	2.00	.78	1.11	.74	.65	6,900	.48
A25	2½x2½.	3/8	5.9	1.73	.76	.98	.75	.57	6,040	.48
		5/16	5.0	1.47	.74	.85	.76	.48	5,140	.49
		1/4	4.1	1.19	.72	.70	.77	.40	4,240	.49
		3/16	3.1	.90	.69	.55	.78	.30	3,220	.49

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.



PROPERTIES OF

ANGLES WITH EQUAL LEGS

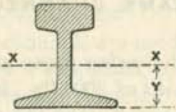
(CONTINUED).

Section Number.	Size of Angle, Inches.	Thickness, Inches.	Weight per Foot, Lbs.	Area of Section, Square Inches.	Neutral Axis through Center of Gravity Parallel to either Flange: Center of Gravity from Back of Flange, Inches. x	Moment of Inertia. I	Radius of Gyration, Inches. r	Section Modulus. S	Coefficient of Strength. C	Least Radius of Gyration, Neutral Axis Diagonal. r''
A22	2¼x2¼	½	6.8	2.00	.74	.87	.66	.58	6,180	.43
		7/16	6.1	1.78	.72	.79	.67	.52	5,500	.43
		⅜	5.3	1.55	.70	.70	.67	.45	4,820	.43
		5/16	4.5	1.31	.68	.61	.68	.39	4,120	.44
		¼	3.7	1.06	.66	.51	.69	.32	3,380	.44
		3/16	2.8	.81	.63	.39	.70	.24	2,600	.44
A20	2x2	7/16	5.3	1.56	.66	.54	.59	.40	4,260	.39
		⅜	4.7	1.36	.64	.48	.59	.35	3,740	.39
		5/16	4.0	1.15	.61	.42	.60	.30	3,200	.39
		¼	3.2	.94	.59	.35	.61	.25	2,640	.39
		3/16	2.5	.72	.57	.28	.62	.19	2,040	.40
A17	1¾x1¾	7/16	4.6	1.34	.59	.35	.51	.30	3,200	.33
		⅜	4.0	1.17	.57	.31	.51	.26	2,800	.34
		5/16	3.4	1.00	.55	.27	.52	.23	2,400	.34
		¼	2.8	.81	.53	.23	.53	.19	1,980	.34
		3/16	2.2	.62	.51	.18	.54	.14	1,520	.35
A15	1½x1½	⅜	3.4	.99	.51	.19	.44	.189	2,020	.29
		5/16	2.9	.84	.49	.16	.44	.162	1,730	.29
		¼	2.4	.69	.47	.14	.45	.134	1,430	.29
		3/16	1.8	.53	.44	.11	.46	.104	1,110	.29
		⅛	1.3	.36	.42	.08	.46	.071	760	.30

The coefficients of strength are calculated for a fiber stress of 16,000 lbs. per square inch.

DIMENSIONS AND PROPERTIES OF

AMERICAN STANDARD RAIL SECTIONS.



Section Number.	Weight per Yard in Pounds.	Area in Square Inches.	Width of Base and Height in Inches.	Thickness of Web in Inches.	Width of Head in Inches.	Height of Center of Gravity above Base in Inches. Y	AXIS XX. Moment of Inertia. I	Section Modulus. S	Radius of Gyration. r
R100	100	9.8	5¾	9/16	2¾	2.8	43.8	14.6	2.13
R95	95	9.3	5 9/16	9/16	2 11/16	2.7	38.6	13.3	2.06
R90	90	8.8	5⅜	9/16	2⅝	2.5	34.0	12.0	1.97
R85	85	8.3	5 3/16	9/16	2 9/16	2.5	30.0	11.0	1.90
R80	80	7.8	5	35/64	2½	2.4	26.2	10.0	1.83
R75	75	7.4	4 13/16	17/32	2 15/32	2.4	22.9	9.3	1.78
R70	70	6.9	4⅝	33/64	2 7/16	2.2	19.6	8.2	1.70
R65	65	6.4	4 7/16	½	2 13/32	2.2	16.9	7.4	1.63
R60	60	5.9	4¼	31/64	2⅜	2.1	14.5	6.7	1.58
*	55	5.4	4 1/16	15/32	2¼	2.0	11.9	5.8	1.49
*	50	4.9	3⅞	7/16	2⅛	1.9	9.8	4.9	1.42
*	45	4.4	3 11/16	27/64	2	1.8	8.0	4.2	1.35
*	40	3.9	3½	25/64	1⅞	1.7	6.6	3.6	1.30
*	35	3.4	3¼	23/64	1¾	1.6	4.8	2.8	1.19
*	30	3.0	3	21/64	1⅝	1.4	3.5	2.3	1.11
*	25	2.5	2¾	19/64	1½	1.3	2.4	1.7	.99
*	20	2.0	2½	17/64	1⅜	1.2	1.7	1.3	.92

* Rails lighter than 60 lbs. per yard are not rolled by Bethlehem Steel Co.

EXPLANATION OF TABLES

OF SAFE UNIFORMLY DISTRIBUTED LOADS FOR STANDARD I BEAMS, CHANNELS AND ANGLES.

The tables on the following pages give the safe uniformly distributed loads, in tons of 2000 lbs., for standard I beams, channels and angles, based upon the usual maximum fiber stress of 16,000 lbs. per square inch.

The loads given in these tables include the weights of the shapes themselves and which must be deducted from the tabular loads given in order to obtain the net superimposed loads which the sections will support.

For standard I beams the safe loads are given only for the minimum weight of each section. Safe loads for the heavier weights of each section can be obtained by using the separate column of corrections, given in the tables for each depth of beam, which shows the increase of safe load for each pound increase in weight per foot of the beam.

The safe loads for channels are tabulated only for the minimum weight of each section. A separate column of corrections, given in the tables for each depth of channel, shows the increase of safe load for each pound per foot increase in the weight of the channel, by means of which the safe loads for the heavier weights of channels may be obtained.

It is assumed in these tables of safe loads that the compression flanges of the beams and channels are secured against yielding sideways. They should be held in position laterally by tie rods, or other means, at intervals not exceeding twenty times the width of the flange, otherwise the allowable safe loads must be reduced in the proportion given by the table at the bottom of page 76. Standard beams, because of their narrow flanges, are deficient in lateral stiffness as compared with the wide flange Bethlehem special I beams.

The tables of safe loads for standard I beams given on pages 187–189 are calculated on the same basis as the similar tables of safe loads for Bethlehem special I beams which are given on pages 82–86. By comparing these tables the equality in strength of the two types of sections is clearly shown, as is also the economy of weight in favor of the Bethlehem special beam sections.

When beams and channels are used on shorter spans than are given in the tables of safe loads, their greatest safe load may be limited by the safe shearing strength of the webs. Tables on pages 192 and 193 give the maximum safe shear for the webs of standard beams and channels, calculated by the usual formula for the safe crippling strength of webs. These tables also give the corresponding minimum spans on which the beams and channels can be used for their full safe uniformly distributed loads.

The deflection of the beams and channels produced by the uniformly distributed loads given in the tables is found by the formula,

$$\text{Deflection, in inches} = 0.01655\ L^2 \div d,$$

where L = length of span in feet, and d = depth of beam or channel in inches. As the deflection is proportional to the load, it can be found for any other intensity of loading by proportion.

The usual allowable deflection of $\frac{1}{360}$ of the distance between supports is not exceeded under the loads given in the tables, unless the span is greater than 24 times the depth of the beam or channel. This limit of span is indicated in the tables of safe loads for beams and channels by dotted cross lines. If used on longer spans and the deflection is a governing consideration, the loads given in the tables must be reduced in the manner explained on page 77.

Channels laid flat are sometimes used on short spans as lintels for supporting walls over door and window openings, for which purpose they are desirable when of sufficient strength as they furnish a flat soffit. The table on page 194 gives the safe uniformly distributed loads on channels when laid flat, or with the web horizontal. This table furnishes a convenient means of selecting channels for lintels, or for other purposes where the load is similarly applied. Loads given in this table to the right of the zigzag line produce deflections exceeding the usual limit of $\frac{1}{360}$ of the span. The deflections of channels when used in this manner, under the safe uniformly distributed loads given in the table, may be found from the following formula, in which,

L = length of span, in feet.
D = deflection, in inches, of channel under tabular load.
b = width of flange of channel, in inches.
x = distance, in inches, from back of channel to neutral axis.

Then, $D = \frac{0.01655L^2}{2\ (b-x)}$

The distance x is given in the table of the properties of channels.

Safe loads for the minimum and maximum weights of angles of each size are given in the tables on pages 195–197. If the safe loads for intermediate weights of angles are desired, they can be obtained from the coefficients of strength given in the tables of properties of angles for all thicknesses. The deflection of angles under their safe uniformly distributed loads for a maximum fiber stress of 16,000 lbs. per square inch can be found in the following manner:

D or D' = deflection, in inches, in direction of long or short legs, respectively.
b or b' = length, in inches, of long or short leg of angle.
x or x' = distance, in inches, in direction of long or short leg from back of angle to neutral axis.
L = length of span, in feet.

Then, $D = \frac{0.01655L^2}{2\ (b-x)}$ and $D' = \frac{0.01655L^2}{2\ (b'-x')}$

The distances x and x' are given in the tables of properties of angles.

The safe load concentrated at the center of the span for any shape is one-half the safe uniformly distributed load and produces a deflection $\frac{8}{10}$ of that for the latter.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	24" I	Add for each Lb. Inc. in Wgt.	20" I		Add for each Lb Inc. in Wgt.	18" I	Add for each Lb. Inc. in Wgt.	15" I			Add for each Lb. Inc. in Wgt.
	I24		I20a	I20		I18		I15b	I15a	I15	
	80 Lbs.		80 Lbs.	65 Lbs.		55 Lbs.		80 Lbs.	60 Lbs.	42 Lbs.	
12	77.33	.53	65.18	51.98	.44	39.29	.39	47.14	36.09	26.18	.33
13	71.38	.48	60.16	47.98	.40	36.27	.36	43.51	33.31	24.17	.30
14	66.28	.45	55.87	44.56	.37	33.68	.34	40.40	30.93	22.44	.28
15	61.86	.42	52.14	41.59	.35	31.43	.31	37.71	28.87	20.94	.26
16	58.00	.39	48.88	38.99	.33	29.47	.29	35.35	27.07	19.63	.24
17	54.58	.37	46.01	36.69	.31	27.74	.28	33.27	25.47	18.48	.23
18	51.56	.35	43.45	34.66	.29	26.19	.26	31.42	24.06	17.45	.22
19	48.84	.33	41.17	32.83	.28	24.82	.25	29.77	22.79	16.53	.21
20	46.40	.32	39.11	31.19	.26	23.58	.24	28.28	21.65	15.71	.20
21	44.19	.30	37.24	29.70	.25	22.45	.22	26.94	20.62	14.96	.19
22	42.18	.29	35.55	28.35	.24	21.43	.21	25.71	19.68	14.28	.18
23	40.35	.27	34.01	27.12	.23	20.50	.20	24.59	18.83	13.66	.17
24	38.67	.26	32.59	25.99	.22	19.65	.20	23.57	18.04	13.09	.16
25	37.12	.25	31.29	24.95	.21	18.86	.19	22.63	17.32	12.57	.16
26	35.69	.24	30.08	23.99	.20	18.14	.18	21.76	16.66	12.08	.15
27	34.37	.23	28.97	23.10	.19	17.46	.17	20.95	16.04	11.64	.14
28	33.14	.23	27.93	22.28	.19	16.84	.17	20.20	15.47	11.22	.14
29	32.00	.22	26.97	21.51	.18	16.26	.16	19.51	14.93	10.83	.13
30	30.93	.21	26.07	20.79	.17	15.72	.16	18.86	14.43	10.47	.13
31	29.94	.20	25.23	20.12	.17	15.21	.15	18.25	13.97	10.13	.13
32	29.00	.20	24.44	19.49	.16	14.73	.15	17.68	13.53	9.82	.12
33	28.12	.19	23.70	18.90	.16	14.29	.14	17.14	13.12	9.52	.12
34	27.29	.19	23.00	18.35	.15	13.87	.14	16.64	12.74	9.24	.11
35	26.51	.18	22.35	17.82	.15	13.47	.13	16.16	12.37	8.98	.11
36	25.78	.18	21.73	17.33	.15	13.10	.13	15.71	12.03	8.73	.11
37	25.08	.17	21.14	16.86	.14	12.74	.13	15.29	11.70	8.49	.11
38	24.42	.17	20.59	16.41	.14	12.41	.12	14.89	11.40	8.27	.10
39	23.79	.16	20.06	16.00	.13	12.09	.12	14.50	11.10	8.06	.10
40	23.20	.16	19.55	15.60	.13	11.79	.12	14.14	10.83	7.85	.10

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	12″ I		Add for each Lb. Increase in Weight.	10″ I	Add for each Lb. Increase in Weight.	9″ I	Add for each Lb. Increase in Weight.
	I 12 a	I 12		I 10		I 9	
	40 Lbs.	31.5 Lbs.		25 Lbs.		21 Lbs.	
10	23.91	19.19	.31	13.03	.26	10.07	.24
11	21.73	17.44	.29	11.84	.24	9.15	.22
12	19.92	15.99	.26	10.85	.22	8.39	.20
13	18.39	14.76	.24	10.02	.20	7.74	.18
14	17.08	13.70	.23	9.30	.19	7.19	.17
15	15.94	12.79	.21	8.68	.17	6.71	.16
16	14.94	11.99	.20	8.14	.16	6.29	.15
17	14.06	11.29	.19	7.66	.15	5.92	.14
18	13.28	10.66	.18	7.24	.14	5.59	.13
19	12.58	10.10	.17	6.86	.14	5.30	.12
20	11.95	9.59	.16	6.51	.13	5.03	.12
21	11.38	9.14	.15	6.20	.12	4.79	.11
22	10.87	8.72	.14	5.92	.12	4.58	.11
23	10.39	8.34	.14	5.66	.11	4.38	.10
24	9.96	7.99	.13	5.43	.11	4.19	.10
25	9.56	7.67	.13	5.21	.10	4.03	.09
26	9.19	7.38	.12	5.01	.10	3.87	.09
27	8.85	7.11	.12	4.82	.10	3.73	.09
28	8.54	6.85	.11	4.65	.09	3.59	.08
29	8.24	6.62	.11	4.49	.09	3.47	.08
30	7.97	6.40	.11	4.34	.09	3.36	.08
31	7.71	6.19	.10	4.20	.08		
32	7.47	6.00	.10	4.07	.08		
33	7.24	5.81	.10	3.95	.08		
34	7.03	5.64	.09	3.83	.08		
35	6.83	5.48	.09	3.72	.07		

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAMS,

IN TONS OF 2000 LBS.

Beams being secured against yielding sideways.

Span, in Feet.	8" I I 8 18 Lbs.	Add for each Lb. Increase in Weight.	7" I I 7 15 Lbs.	Add for each Lb. Increase in Weight.	6" I I 6 12.25 Lbs.	Add for each Lb. Increase in Weight.	5" I I 5 9.75 Lbs.	Add for each Lb. Increase in Weight.	4" I I 4 7.5 Lbs.	Add for each Lb. Increase in Weight.
5	15.17	.42	11.04	.36	7.75	.31	5.16	.26	3.18	.21
6	12.64	.35	9.20	.30	6.46	.26	4.30	.22	2.65	.18
7	10.84	.30	7.89	.26	5.54	.22	3.69	.19	2.27	.15
8	9.48	.26	6.90	.23	4.84	.19	3.23	.16	1.99	.13
9	8.43	.23	6.13	.20	4.31	.17	2.87	.14	1.77	.12
10	7.59	.21	5.52	.18	3.88	.16	2.58	.13	1.59	.11
11	6.90	.19	5.02	.16	3.52	.14	2.35	.12	1.45	.10
12	6.32	.18	4.60	.15	3.23	.13	2.15	.11	1.33	.09
13	5.83	.16	4.25	.14	2.98	.12	1.98	.10	1.22	.08
14	5.42	.15	3.94	.13	2.77	.11	1.84	.09		
15	5.06	.14	3.68	.12	2.58	.10	1.72	.09		
16	4.74	.13	3.45	.11	2.42	.10	1.61	.08		
17	4.46	.12	3.25	.11	2.28	.09	1.52	.08		
18	4.21	.12	3.07	.10	2.15	.09				
19	3.99	.11	2.91	.09	2.04	.08				
20	3.79	.11	2.76	.09	1.94	.08				
21	3.61	.10	2.63	.09	1.85	.07				

Safe loads given include weight of beam. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD CHANNELS,

IN TONS OF 2000 LBS.

Channels being secured against yielding sideways.

Span, in Feet.	15″ C C 15 33 Lbs.	Add for each Lb. Increase in Weight.	12″ C C 12 20.5 Lbs.	Add for each Lb. Increase In Weight.	10″ C C 10 15 Lbs.	Add for each Lb. Increase in Weight.	9″ C C 9 13.25 Lbs.	Add for each Lb. Increase in Weight.
10	22.23	.39	11.39	.32	7.14	.26	5.61	.24
11	20.20	.35	10.35	.29	6.49	.24	5.10	.21
12	18.52	.33	9.49	.26	5.95	.22	4.68	.20
13	17.10	.30	8.76	.24	5.49	.20	4.32	.18
14	15.87	.28	8.14	.23	5.10	.19	4.01	.17
15	14.82	.26	7.59	.21	4.76	.17	3.74	.16
16	13.89	.24	7.12	.20	4.46	.16	3.51	.15
17	13.07	.23	6.70	.18	4.20	.15	3.30	.14
18	12.35	.22	6.33	.18	3.96	.14	3.12	.13
19	11.70	.21	5.99	.17	3.76	.14	2.95	.12
20	11.11	.20	5.70	.16	3.57	.13	2.81	.12
21	10.58	.19	5.42	.15	3.40	.12	2.67	.11
22	10.10	.18	5.18	.14	3.24	.12	2.55	.11
23	9.66	.17	4.95	.14	3.10	.11	2.44	.10
24	9.26	.16	4.75	.13	2.97	.11	2.34	.10
25	8.89	.16	4.56	.13	2.85	.10	2.24	.09
26	8.55	.15	4.38	.12	2.74	.10	2.16	.09
27	8.23	.14	4.22	.12	2.64	.10	2.08	.09
28	7.94	.14	4.07	.11	2.55	.09	2.00	.08
29	7.66	.13	3.93	.11	2.46	.09	1.93	.08
30	7.41	.13	3.80	.11	2.38	.09	1.87	.08

Safe loads given include weight of channel. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD CHANNELS,

IN TONS OF 2000 LBS.

Channels being secured against yielding sideways.

Span, in Feet.	8″ ⊏ C 8 11.25 Lbs.	Add for each Lb. Increase in Weight.	7″ ⊏ C 7 9.75 Lbs.	Add for each Lb. Increase in Weight.	6″ ⊏ C 6 8 Lbs.	Add for each Lb. Increase in Weight.	5″ ⊏ C 5 6.5 Lbs.	Add for each Lb. Increase in Weight.	4″ ⊏ C 4 5.25 Lbs.	Add for each Lb. Increase in Weight.
5	8.61	.42	6.68	.36	4.62	.31	3.16	.26	2.02	.21
6	7.18	.35	5.57	.30	3.85	.26	2.63	.22	1.68	.18
7	6.15	.30	4.77	.26	3.30	.22	2.26	.19	1.44	.15
8	5.38	.26	4.18	.23	2.89	.19	1.98	.16	1.26	.13
9	4.78	.23	3.71	.20	2.57	.17	1.76	.14	1.12	.12
10	4.31	.21	3.34	.18	2.31	.16	1.58	.13	1.01	.11
11	3.91	.19	3.04	.16	2.10	.14	1.44	.12	.92	.10
12	3.59	.18	2.78	.15	1.93	.13	1.32	.11	.84	.09
13	3.31	.16	2.57	.14	1.78	.12	1.22	.10	.78	.08
14	3.08	.15	2.39	.13	1.65	.11	1.13	.09	.72	.08
15	2.87	.14	2.23	.12	1.54	.10	1.05	.09	.67	.07
16	2.69	.13	2.09	.11	1.44	.10	.99	.08		
17	2.53	.12	1.96	.11	1.36	.09	.93	.08		
18	2.39	.11	1.86	.10	1.28	.09	.88	.07		
19	2.27	.11	1.76	.09	1.22	.08	.83	.07		
20	2.15	.11	1.67	.09	1.16	.08	.79	.07		
21	2.05	.10	1.59	.09						
22	1.96	.10	1.52	.08						
23	1.87	.09	1.45	.08						
24	1.79	.09	1.39	.08						
25	1.72	.08	1.34	.07						

Safe loads given include weight of channel. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

MAXIMUM SAFE SHEAR FOR

AMERICAN STANDARD I BEAMS,

BASED UPON THE CRIPPLING STRENGTH OF THE WEBS: AND THE CORRESPONDING MINIMUM SPANS FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS.

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Maximum Safe Shear, Pounds.	Minimum Span, Feet.
I 24	24	100.0	170,100	6.2
		95.0	150,000	6.8
		90.0	130,300	7.6
		85.0	110,600	8.7
		80.0	88,400	10.5
I 20 a	20	100.0	187,300	4.5
		95.0	167,900	5.2
		90.0	148,500	5.6
		85.0	128,700	6.3
		80.0	111,800	7.0
I 20	20	75.0	124,100	5.5
		70.0	104,200	6.2
		65.0	84,000	7.4
I 18	18	70.0	132,900	4.1
		65.0	113,300	4.6
		60.0	93,500	5.3
		55.0	70,400	6.7
I 15 b	15	100.0	205,600	3.1
		95.0	187,100	3.3
		90.0	168,700	3.6
		85.0	150,200	3.9
		80.0	135,200	4.2
I 15 a	15	75.0	148,100	3.3
		70.0	129,400	3.6
		65.0	110,400	4.1
		60.0	91,600	4.7
I 15	15	55.0	103,800	3.5
		50.0	84,400	4.1
		45.0	64,700	5.0
		42.0	54 500	5.8

Section Number.	Depth of Beam, Inches.	Weight per Foot, Pounds.	Maximum Safe Shear, Pounds.	Minimum Span, Feet.
I 12 a	12	55.00	112,500	2.5
		50.00	93,900	2.9
		45.00	75,000	3.4
		40.00	56,800	4.2
I 12	12	35.00	52,600	3.9
		31.50	38,700	5.0
I 10	10	40.00	86,100	2.0
		35.00	67,500	2.3
		30.00	48,700	2.9
		25.00	29,500	4.4
I 9	9	35.00	76,200	1.9
		30.00	57,900	2.1
		25.00	39,100	2.8
		21.00	25,300	4.0
I 8	8	25.50	49,300	1.9
		23.00	40,000	2.2
		20.50	30,500	2.6
		18.00	21,300	3.6
I 7	7	20.00	36,400	1.8
		17.50	27,100	2.2
		15.00	17,700	3.1
I 6	6	17.25	33,000	1.4
		14.75	23,700	1.8
		12.25	14,300	2.7
I 5	5	14.75	29,600	1.1
		12.25	20,500	1.4
		9.75	11,200	2.3
I 4	4	10.50	19,300	1.0
		9.50	15,700	1.1
		8.50	12.000	1.4
		7.50	8 300	1.9

Maximum Safe Shear, in Pounds. $\left.\right\} = \dfrac{12{,}000\,dt}{1+\dfrac{h^2}{3000\,t^2}}$

Where d = depth of beam, t = thickness of web and h = clear distance between flanges, all dimensions in inches.

MAXIMUM SAFE SHEAR FOR

AMERICAN STANDARD CHANNELS,

BASED UPON THE CRIPPLING STRENGTH OF THE WEBS: AND THE CORRESPONDING MINIMUM SPANS FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS.

Section Number.	Depth of Channel, Inches.	Weight per Foot, Pounds.	Maximum Safe Shear, Pounds.	Minimum Span, Feet.
C15	15	55.00	135,500	2.3
		50.00	116,500	2.5
		45.00	97,300	2.7
		40.00	77,800	3.2
		35.00	58,100	3.9
		33.00	52,800	4.2
C12	12	40.00	102,500	1.7
		35.00	83,900	1.9
		30.00	64,700	2.2
		25.00	45,100	2.8
		20.50	27,400	4.2
C10	10	35.00	95,200	1.3
		30.00	76,800	1.4
		25.00	58,200	1.7
		20.00	39,000	2.2
		15.00	20,000	3.6
C9	9	25.00	63,000	1.3
		20.00	44,400	1.6
		15.00	25,000	2.4
		13.25	17,900	3.1

Section Number.	Depth of Channel, Inches.	Weight per Foot, Pounds.	Maximum Safe Shear, Pounds.	Minimum Span, Feet.
C8	8	21.25	53,400	1.2
		18.75	44,100	1.3
		16.25	28,800	1.8
		13.75	25,200	1.9
		11.25	15,900	2.7
C7	7	19.75	51,600	1.0
		17.25	42,500	1.1
		14.75	33,300	1.2
		12.25	23,900	1.5
		9.75	13,900	2.4
C6	6	15.50	39,500	0.9
		13.00	30,400	1.0
		10.50	21,100	1.3
		8.00	11,900	1.9
C5	5	11.50	27,900	0.8
		9.00	18,800	1.0
		6.50	9,900	1.6
C4	4	7.25	15,100	0.8
		6.25	11,500	1.0
		5.25	7,800	1.3

$$\left.\begin{array}{c}\text{Maximum Safe Shear,}\\ \text{in Pounds.}\end{array}\right\} = \frac{12{,}000\ dt}{1+\frac{h^2}{3000\ t^2}}$$

Where d = depth of channel, t = thickness of web and h = clear distance between flanges, all dimensions in inches.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR
AMERICAN STANDARD CHANNELS,
IN TONS OF 2000 LBS.
WEB HORIZONTAL.

Depth of Channel, Inches.	Weight per Foot, Pounds.	DISTANCE BETWEEN SUPPORTS.									
		1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.
15	55.00	21.70	10.85	7.23	5.43	4.34	3.62	3.10	2.71	2.41	2.17
	50.00	20.50	10.25	6.83	5.13	4.10	3.42	2.93	2.56	2.28	2.05
	45.00	19.35	9.68	6.45	4.84	3.87	3.23	2.76	2.42	2.15	1.94
	40.00	18.25	9.13	6.08	4.56	3.65	3.04	2.61	2.28	2.03	1.83
	35.00	17.15	8.58	5.72	4.29	3.43	2.86	2.45	2.14	1.91	1.72
	33.00	16.85	8.43	5.62	4.21	3.37	2.81	2.41	2.11	1.87	1.69
12	40.00	13.10	6.55	4.37	3.28	2.62	2.18	1.87	1.64	1.46	1.31
	35.00	12.10	6.05	4.03	3.03	2.42	2.02	1.73	1.51	1.34	1.21
	30.00	11.15	5.58	3.72	2.79	2.23	1.86	1.59	1.39	1.24	1.12
	25.00	10.20	5.10	3.40	2.55	2.04	1.70	1.46	1.28	1.13	1.02
	20.50	9.30	4.65	3.10	2.33	1.86	1.55	1.33	1.16	1.03	.93
10	35.00	10.00	5.00	3.33	2.50	2.00	1.67	1.43	1.25	1.11	1.00
	30.00	8.90	4.45	2.97	2.23	1.78	1.48	1.27	1.11	.99	.89
	25.00	8.00	4.00	2.67	2.00	1.60	1.33	1.14	1.00	.89	.80
	20.00	7.15	3.58	2.38	1.79	1.43	1.19	1.02	.89	.79	.72
	15.00	6.25	3.13	2.08	1.56	1.25	1.04	.89	.78	.69	.63
9	25.00	7.20	3.60	2.40	1.80	1.44	1.20	1.03	.90	.80	.72
	20.00	6.30	3.15	2.10	1.58	1.26	1.05	.90	.79	.70	.63
	15.00	5.50	2.75	1.83	1.38	1.10	.92	.79	.69	.61	.55
	13.25	5.15	2.58	1.72	1.29	1.03	.86	.74	.64	.57	.52
8	21.25	5.90	2.95	1.97	1.48	1.18	.98	.84	.74	.66	.59
	18.75	5.45	2.73	1.82	1.36	1.09	.91	.78	.68	.61	.55
	16.25	5.05	2.53	1.68	1.26	1.01	.84	.72	.63	.56	.51
	13.75	4.62	2.31	1.54	1.15	.92	.77	.66	.58	.51	.46
	11.25	4.21	2.11	1.40	1.05	.84	.70	.60	.53	.47	.42
7	19.75	5.10	2.55	1.70	1.28	1.02	.85	.73	.64	.57	
	17.25	4.66	2.33	1.55	1.17	.93	.78	.67	.58	.52	
	14.75	4.22	2.11	1.41	1.06	.84	.70	.60	.53	.47	
	12.25	3.80	1.90	1.27	.95	.76	.63	.54	.48	.42	
	9.75	3.38	1.69	1.13	.85	.68	.56	.48	.42	.38	
6	15.50	3.93	1.96	1.31	.98	.79	.65	.56	.49	.44	
	13.00	3.47	1.74	1.16	.87	.69	.58	.50	.43	.39	
	10.50	3.06	1.53	1.02	.76	.61	.51	.44	.38	.34	
	8.00	2.66	1.33	.89	.66	.53	.44	.38	.33	.30	
5	11.50	2.86	1.43	.95	.72	.57	.48	.41	.36		
	9.00	2.42	1.21	.81	.61	.48	.40	.35	.30		
	6.50	2.03	1.01	.68	.51	.41	.34	.29	.25		
4	7.25	1.86	.93	.62	.46	.37	.31	.27			
	6.25	1.70	.85	.57	.42	.34	.28	.24			
	5.25	1.53	.76	.51	.38	.31	.25	.22			

Safe loads given include weight of channel.
Maximum fiber stress, 16,000 lbs. per square inch.
Loads to the right of the zigzag line produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS, IN TONS OF 2000 LBS., UNIFORMLY DISTRIBUTED FOR

ANGLES WITH EQUAL LEGS.

EITHER LEG VERTICAL.

Angles being secured against yielding sideways.

Size of Angle, Inches.	DISTANCE BETWEEN SUPPORTS.									
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.	8 Ft.	10 Ft.	12 Ft.
8 x 8 x 1⅛	93.50	46.75	31.17	23.38	18.70	15.58	13.36	11.69	9.35	7.79
8 x 8 x ½	44.65	22.33	14.88	11.16	8.93	7.44	6.38	5.58	4.47	3.72
6 x 6 x 1	45.70	22.85	15.23	11.43	9.14	7.62	6.53	5.71	4.57	3.81
6 x 6 x ⅜	18.80	9.40	6.27	4.70	3.76	3.13	2.69	2.35	1.88	1.57
5 x 5 x 1	30.90	15.45	10.30	7.73	6.18	5.15	4.41	3.86	3.09	2.58
5 x 5 x ⅜	12.90	6.45	4.30	3.23	2.58	2.15	1.84	1.61	1.29	1.08
4 x 4 x $\frac{13}{16}$	16.05	8.03	5.35	4.01	3.21	2.68	2.29	2.01	1.61	1.34
4 x 4 x $\frac{5}{16}$	6.85	3.43	2.28	1.71	1.37	1.14	.98	.86	.69	.57
3½ x 3½ x $\frac{13}{16}$	12.00	6.00	4.00	3.00	2.40	2.00	1.71	1.50	1.20	1.00
3½ x 3½ x $\frac{5}{16}$	5.20	2.60	1.73	1.30	1.04	.87	.74	.65	.52	.43
3 x 3 x ⅝	6.93	3.47	2.31	1.73	1.39	1.16	.99	.87	.69	.58
3 x 3 x ¼	3.08	1.54	1.03	.77	.62	.51	.44	.39	.31	.26
2½ x 2½ x ½	3.89	1.95	1.30	.97	.78	.65	.56	.49	.39	.32
2½ x 2½ x $\frac{3}{16}$	1.61	.81	.54	.40	.32	.27	.23	.20	.16	.13
2¼ x 2¼ x ½	3.09	1.55	1.03	.77	.62	.52	.44	.39	.31	
2¼ x 2¼ x $\frac{3}{16}$	1.30	.65	.43	.32	.26	.22	.19	.16	.13	
2 x 2 x $\frac{7}{16}$	2.13	1.07	.71	.53	.43	.36	.30	.26		
2 x 2 x $\frac{3}{16}$	1.02	.51	.34	.25	.20	.17	.15	.13		
1¾ x 1¾ x $\frac{7}{16}$	1.60	.80	.53	.40	.32	.27	.23	.20		
1¾ x 1¾ x $\frac{3}{16}$	.76	.38	.25	.19	.15	.12	.11	.10		
1½ x 1½ x ⅜	1.01	.51	.34	.25	.20	.17	.14			
1½ x 1½ x ⅛	.38	.19	.13	.095	.076	.063	.055			

Safe loads given include weight of angle. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given to the right of the zigzag line produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS, IN TONS OF 2000 LBS., UNIFORMLY DISTRIBUTED FOR

ANGLES WITH UNEQUAL LEGS.

LONG LEG VERTICAL.

Angles being secured against yielding sideways.

Size of Angle, Inches.	DISTANCE BETWEEN SUPPORTS.									
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.	8 Ft.	10 Ft.	12 Ft.
8 x 6 x 1	80.60	40.30	26.87	20.15	16.12	13.43	11.51	10.08	8.06	6.72
8 x 6 x ½	42.75	21.38	14.25	10.69	8.55	7.13	6.11	5.34	4.28	3.56
7 x 3½ x 1	56.40	28.20	18.80	14.10	11.28	9.40	8.06	7.05	5.64	4.70
7 x 3½ x 7/16	26.70	13.35	8.90	6.68	5.34	4.45	3.81	3.34	2.67	2.23
6 x 4 x 1	42 80	21.40	14.27	10.70	8.56	7.13	6.11	5.35	4.28	3.57
6 x 4 x ⅜	17.70	8.85	5.90	4.43	3.54	2.95	2.53	2.21	1.77	1.48
6 x 3½ x 1	41.75	20.88	13.92	10.44	8.35	6.96	5.96	5.22	4.18	3.48
6 x 3½ x ⅜	17.30	8.65	5.77	4.33	3.46	2.88	2.47	2.16	1.73	1.44
5 x 3½ x ⅞	26.05	13.03	8.68	6.51	5.21	4.34	3.72	3.26	2.61	2.17
5 x 3½ x 5/16	10.35	5.18	3.45	2.59	2.07	1.73	1.48	1.29	1.04	.86
5 x 3 x 13/16	23.75	11.88	7.92	5.94	4.75	3.96	3.39	2.94	2.38	1.98
5 x 3 x 5/16	10.05	5.03	3.35	2.51	2.01	1.68	1.44	1.26	1.01	.84
4 x 3½ x ¾	14.70	7.35	4 90	3.68	2.94	2.45	2.10	1.84	1.47	1.23
4 x 3½ x 5/16	6.75	3.38	2.25	1.69	1.35	1.13	.96	.84	.68	.56
4 x 3 x ¾	14.30	7.15	4.77	3.58	2.86	2.38	2.04	1.79	1.43	1.19
4 x 3 x 5/16	6.60	3.30	2.20	1.65	1.32	1.10	.94	.83	.66	.55
3½ x 3 x ¾	10.95	5.48	3.65	2.74	2.19	1.83	1.56	1.37	1.10	.91
3½ x 3 x 5/16	5.10	2.55	1.70	1.28	1.02	.85	.73	.64	.51	.43
3½x2½x⅝	9.12	4.56	3.04	2.28	1.82	1.52	1.30	1.14	.91	.76
3½x2½x¼	4.02	2.01	1.34	1.01	.80	.67	.57	.50	.40	.34
3 x 2½ x 9/16	6.14	3.07	2.05	1.54	1.23	1.02	.88	.77	.61	.51
3 x 2½ x ¼	2.99	1.50	1.00	.75	.60	.50	.43	.37	.30	.25
3 x 2 x ½	5.35	2.68	1.78	1.34	1.07	.89	.76	.67	.54	.45
3 x 2 x ¼	2.89	1.45	.96	.72	.58	.48	.41	.36	.29	.24
2½ x 2 x ½	3.73	1.87	1.24	.93	.75	.62	.53	.47	.37	.31
2½ x 2 x 3/16	1.56	.78	.52	.39	.31	.26	.22	.20	.16	.13
2½x1½x7/16	3.16	1.58	1.05	.54	.63	.53	.45	.27	.32	
2½x1½x3/16	1.49	.75	.50	.37	.30	.25	.21	.19	.15	

Safe loads given include weight of angle. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given to the right of the zigzag line produce deflections exceeding 1/360 of the span.

SAFE LOADS, IN TONS OF 2000 LBS., UNIFORMLY DISTRIBUTED FOR

ANGLES WITH UNEQUAL LEGS.

SHORT LEG VERTICAL.

Angles being secured against yielding sideways.

Size of Angle, Inches.	DISTANCE BETWEEN SUPPORTS.									
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.	8 Ft.	10 Ft.	12 Ft.
8 x 6 x 1	47.60	23.80	15.87	11.90	9.52	7.93	6.80	5.95	4.76	3.97
8 x 6 x ½	25.55	12.78	8.52	6.39	5.11	4.26	3.65	3.19	2.56	2.13
7 x 3½ x 1	15.80	7.90	5.27	3.95	3.16	2.63	2.26	1.98	1.58	1.32
7 x 3½ x 7/16	7.70	3.85	2.57	1.93	1.54	1.28	1.10	.96	.77	.64
6 x 4 x 1	20.25	10.13	6.75	5.06	4.05	3.38	2.89	2.53	2.03	1.69
6 x 4 x ⅜	8.55	4.28	2.85	2.14	1.71	1.43	1.22	1.07	.86	.71
6 x 3½ x 1	15.45	7.73	5.15	3.86	3.09	2.58	2.21	1.93	1.55	1.29
6 x 3½ x ⅜	6.55	3.28	2.18	1.64	1.31	1.09	.94	.82	.66	.55
5 x 3½ x ⅞	13.45	6.73	4.48	3.36	2.69	2.24	1.92	1.68	1.35	1.11
5 x 3½ x 5/16	5.45	2.73	1.82	1.36	1.09	.91	.78	.68	.55	.45
5 x 3 x 13/16	9.25	4.63	3.08	2.31	1.85	1.54	1.32	1.16	.93	.77
5 x 3 x 5/16	4.02	2.01	1.34	1.01	.80	.67	.57	.50	.40	.34
4 x 3½ x ¾	11.45	5.73	3.82	2.86	2.29	1.91	1.64	1.43	1.15	.95
4 x 3½ x 5/16	5.40	2.70	1.80	1.35	1.08	.90	.77	.68	.54	.45
4 x 3 x ¾	8.40	4.20	2.80	2.10	1.68	1.40	1.20	1.05	.84	.70
4 x 3 x 5/16	3.92	1.96	1.31	.98	.78	.65	.56	.49	.39	.33
3½ x 3 x ¾	8.23	4.12	2.74	2.06	1.65	1.37	1.18	1.03	.82	.69
3½ x 3 x 5/16	3.85	1.93	1.28	.96	.77	.64	.55	.48	.39	.32
3½x2½x⅝	4.89	2.45	1.63	1.22	.98	.82	.70	.61	.49	.41
3½x2½x¼	2.20	1.10	.73	.55	.44	.37	.31	.28	.22	.18
3 x 2½ x 9/16	4.38	2.19	1.46	1.10	.88	.73	.63	.55	.44	.37
3 x 2½ x ¼	2.15	1.08	.72	.54	.43	.36	.31	.27	.22	.18
3 x 2 x ½	2.53	1.27	.84	.63	.51	.42	.36	.32	.25	
3 x 2 x ¼	1.35	.68	.45	.34	.27	.23	.19	.17	.14	
2½ x 2 x ½	2.46	1.23	.82	.62	.49	.41	.35	.31	.25	
2½ x 2 x 3/16	1.05	.53	.35	.26	.21	.18	.15	.13	.11	
2½x1½x7/16	1.23	.62	.41	.31	.25	.21	.18			
2½x1½x3/16	.59	.30	.20	.15	.12	.10	.084			

Safe loads given include weight of angle. Maximum fiber stress, 16,000 lbs. per square inch.

Loads given to the right of the zigzag line produce deflections exceeding 1/360 of the span.

AMERICAN STANDARD I BEAM BOX GIRDERS.

Safe loads for box girders made of two standard I beams with cover plates are given in the following tables on pages 199–203. These tables are calculated from the moments of inertia of the sections, deductions being made for rivet holes in both flanges. In accordance with usual practice, the maximum fiber stress is limited to 15,000 lbs. per square inch, in order to compensate for the injury to the strength of the material due to the punching of rivet holes.

Deflection of these girders under the loads given in the tables is found in the following manner:

$$\text{Deflection, in inches} = 0.01552L^2 \div d$$

where L = length of span, in feet, and d = depth of girder over cover plates, in inches.

These girders should not be used with full load on spans less than those given in the tables, unless the crippling strength of the webs are examined. The load must not produce a shear greater than the crippling strength of the webs of the beams of which the girder is composed. Safe shears on the webs of standard beams are given in the table on page 192.

Bethlehem rolled girder beams are more economical for supporting the same loads. For example, if it is required to support a total load of 30 tons on a span of 16 feet: on page 203 the safe load for a 10″ I beam box girder for this span is given as 28.13 tons with an increase of 1.90 tons for each $\frac{1}{16}$″ increase in thickness of cover plates. The required section will be that given in the table with cover plates $\frac{9}{16}$″ thick. The weight of this box girder is 99.1 lbs. per foot. In comparison, a 12″ rolled girder beam, section G12a, weighing 70 lbs. per foot has a safe load of 30.05 tons, as will be found by reference to the table on page 80. The equivalent rolled girder weighs 30% less than the riveted section, and in addition there is a further saving in the cost of fabrication, as the rolled section does not require punching and riveting to build it into a girder.

Box girders should not be used in damp or exposed places, as the interior surfaces cannot be repainted. This objection is obviated by the use of the single rolled girder section.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAM BOX GIRDERS

IN TONS OF 2000 LBS.

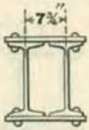
Weight, 255.0 Lbs. per Foot.

24 Inch I Beams, 80.0 Lbs. per Foot.

2 Plates, 18 x ¾.

Span, in Feet.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for 1/16 In. Increase in Thickness of Plates.	Add to Weight of Girder for 1/16 In. Increase in Thickness of Plates.
17	174.58	2.17	6.82	.06
18	164.88	2.29	6.45	.07
19	156.21	2.42	6.10	.07
20	148.40	2.55	5.80	.08
21	141.32	2.68	5.53	.08
22	134.91	2.80	5.27	.08
23	129.04	2.93	5.04	.09
24	123.66	3.06	4.83	.09
25	118.72	3.19	4.64	.09
26	114.15	3.31	4.47	.10
27	109.91	3.44	4.29	.10
28	105.99	3.57	4.14	.11
29	102.33	3.69	4.00	.11
30	98.93	3.82	3.87	.11
31	95.73	3.95	3.74	.12
32	92.75	4.08	3.62	.12
33	89.93	4.20	3.53	.12
34	87.29	4.33	3.42	.13
35	84.80	4.46	3.31	.13
36	82.44	4.59	3.22	.14
37	80.22	4.71	3.14	.14
38	78.10	4.84	3.06	.14
39	76.10	4.97	2.98	.15
40	74.19	5.10	2.90	.15
41	72.39	5.22	2 83	.16
42	70.66	5.35	2.76	.16
43	69.02	5.48	2.70	.16
44	67.45	5.61	2.64	.17

Weight, 244 7 Lbs. per Foot.



20 Inch I Beams, 80 Lbs. per Foot.

2 Plates, 16 x ¾.

Span, in Feet.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for 1/16 In. Increase in Thickness of Plates.	Add to Weight of Girder for 1/16 In. Increase in Thickness of Plates.
13	178.44	1.59	6.39	.04
14	165.70	1.71	5.94	.05
15	154.65	1.83	5.55	.05
16	144.99	1.96	5.19	.05
17	136.47	2.08	4.89	.06
18	128.87	2.20	4.62	.06
19	122.10	2.32	4.37	.06
20	116.00	2.45	4.15	.07
21	110.47	2.57	3.96	.07
22	105.45	2.69	3.78	.07
23	100.87	2.81	3.61	.08
24	96.67	2.94	3.46	.08
25	92.79	3.06	3.32	.08
26	89.23	3.18	3.20	.09
27	85.92	3.30	3.08	.09
28	82.85	3.42	2.97	.09
29	80.01	3.55	2.87	.10
30	77.33	3.67	2.77	.10
31	74.84	3.79	2.69	.10
32	72.51	3.91	2.60	.11
33	70.29	4.04	2.52	.11
34	68.24	4.16	2.45	.11
35	66.28	4.28	2.38	.12
36	64.45	4.40	2.31	.12
37	62.70	4.53	2.25	.12
38	61.05	4.65	2.19	.13
39	59.49	4.77	2.13	.13
40	58.00	4.88	2.08	.13

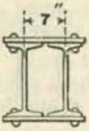
Maximum fiber stress, 15,000 lbs. per square inch. Weights of girders correspond to lengths center to center of bearings.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAM BOX GIRDERS

IN TONS OF 2000 LBS.

Weight, 214.7 Lbs. per Foot.



20 Inch I Beams, 65.0 Lbs. per Foot.
2 Plates, 16 x ¾.

Weight, 196.0 Lbs. per Foot.

18 Inch I Beams, 55 Lbs. per Foot.
2 Plates, 16 x ¾.

Span, in Feet.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for 1/16 In. Increase in Thickness of Plates.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for 1/16 In. Increase in Thickness of Plates.	Add to Weight of Girder for 1/16 In. Increase in Thickness of Plates.
13	158.37	1.39	6.52	130.95	1.27	5.78	.04
14	147.06	1.50	6.05	121.59	1.37	5.38	.05
15	137.25	1.61	5.64	113.49	1.47	5.02	.05
16	128.68	1.72	5.30	106.39	1.57	4.70	.05
17	121.11	1.82	4.98	100.14	1.66	4.42	.06
18	114.31	1.93	4.71	94.57	1.76	4.18	.06
19	108.36	2.04	4.45	89.60	1.86	3.96	.06
20	102.93	2.15	4.23	85.12	1.96	3.76	.07
21	98.05	2.25	4.03	81.06	2.06	3.58	.07
22	93.58	2.36	3.85	77.38	2.15	3.42	.07
23	89.52	2.47	3.68	74.01	2.25	3.27	.08
24	85.78	2.58	3.53	70.93	2.35	3.14	.08
25	82.36	2.68	3.39	68.09	2.45	3.01	.08
26	79.19	2.79	3.25	65.47	2.55	2.90	.09
27	76.25	2.90	3.14	63.05	2.64	2.78	.09
28	73.52	3.00	3.02	60.80	2.74	2.69	.09
29	71.00	3.11	2.92	58.70	2.84	2.60	.10
30	68.63	3.22	2.83	56.74	2.94	2.50	.10
31	66.42	3.33	2.73	54.91	3.03	2.42	.10
32	64.34	3.43	2.64	53.20	3.13	2.35	.11
33	62.39	3.54	2.56	51.59	3.23	2.28	.11
34	60.55	3.65	2.49	50.07	3.33	2.22	.11
35	58.82	3.76	2.42	48.64	3.43	2.15	.12
36	57.18	3.86	2.35	47.29	3.52	2.09	.12
37	55.64	3.97	2.28	46.01	3.62	2.03	.12
38	54.17	4.08	2.23	44.80	3.72	1.98	.13
39	52.80	4.18	2.17	43.65	3.82	1.93	.13
40	51.47	4.28	2.12	42.56	3.92	1.88	.13

Maximum fiber stress, 15,000 lbs. per square inch. Weights of girders correspond to lengths center to center of bearings.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

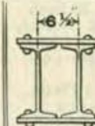
AMERICAN STANDARD I BEAM BOX GIRDERS

IN TONS OF 2000 LBS.

6¾"

15 Inch I Beams, 80.0 Lbs. per Foot. 2 Plates, 14 x ⅝.

Weight, 222.6 Lbs. per Foot.



6½"

15 Inch I Beams, 60.0 Lbs. per Foot. 2 Plates, 14 x ⅝.

Weight, 182.6 Lbs. per Foot.

6"

15 Inch I Beams, 42.0 Lbs. per Foot. 2 Plates, 14 x ⅝.

Weight, 146.7 Lbs. per Foot.

	15 Inch I Beams, 80.0 Lbs. per Foot. 2 Plates, 14 x ⅝. Weight, 222.6 Lbs. per Foot.			15 Inch I Beams, 60.0 Lbs. per Foot. 2 Plates, 14 x ⅝. Weight, 182.6 Lbs. per Foot.			15 Inch I Beams, 42.0 Lbs. per Foot. 2 Plates, 14 x ⅝. Weight, 146.7 Lbs. per Foot.			
Span, in Feet.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for $\frac{1}{16}$ In. Increase in Thickness of Plates.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for $\frac{1}{16}$ In. Increase in Thickness of Plates.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for $\frac{1}{16}$ In. Increase in Thickness of Plates.	Add to Weight of Girder for $\frac{1}{16}$ In. Increase in Thickness of Plates.
12	121.66	1.34	4.30	104.05	1.10	4.44	88.41	.88	4.56	.03
13	112.30	1.45	3.98	96.05	1.19	4.10	81.60	.95	4.21	.04
14	104.28	1.56	3.69	89.18	1.28	3.81	75.77	1.03	3.91	.04
15	97.34	1.67	3.45	83.24	1.37	3.55	70.73	1.10	3.65	.04
16	91.25	1.78	3.23	78.03	1.46	3.33	66.30	1.18	3.43	.05
17	85.88	1.89	3.05	73.44	1.55	3.14	62.40	1 25	3.22	.05
18	81.12	2.00	2.87	69.37	1.64	2.97	58.94	1.32	3.05	.05
19	76.85	2.11	2.72	65.71	1.73	2.80	55.83	1.39	2.88	.05
20	73.00	2.23	2.58	62.43	1.83	2.67	53.04	1.47	2.73	.06
21	69.52	2 34	2.46	59.46	1.92	2.54	50.52	1.54	2.61	.06
22	66.37	2.45	2.35	56.76	2.01	2.42	48.22	1.61	2.49	.06
23	63.47	2.56	2.25	54.29	2.10	2.32	46.12	1.68	2.38	·07
24	60.83	2.67	2.16	52.03	2.19	2.23	44.20	1.76	2.28	.07
25	58.40	2.78	2.07	49.94	2.28	2.13	42.44	1.83	2.19	.07
26	56.16	2.89	1.98	48.02	2.37	2.05	40.80	1.90	2.10	.08
27	54.07	3.00	1.92	46.25	2.46	1.97	39.29	1.98	2.03	.08
28	52.14	3.12	1.85	44.60	2.56	1.90	37.89	2.05	1.95	.08
29	50.34	3.23	1.78	43.05	2.65	1.83	36.59	2.12	1.89	.08
30	48.67	3.34	1.72	41.62	2.74	1.78	35 37	2.20	1.82	.09
31	47.10	3.45	1.67	40.28	2 83	1.72	34.22	2.27	1.77	.09
32	45.62	3.56	1.62	39.02	2.92	1.66	33.15	2.34	1.71	.09
33	44.24	3.67	1.57	37.83	3.01	1.62	32.15	2.42	1.66	.10
34	42.95	3 78	1.52	36.73	3.10	1.57	31 20	3.49	1.62	.10
35	41.71	3.89	1.48	35.68	3.19	1.52	30.31	2.56	1.57	.10
36	40.56	4.01	1.43	34.68	3.29	1.48	29.47	2 64	1.52	.10
37	39.46	4.12	1.40	33.75	3.38	1.44	28.67	2.71	1.48	.11
38	38.42	4 23	1.36	32.86	3.47	1.41	27.92	2.78	1.44	.11
39	37.43	4.34	1.33	32.02	3.56	1.36	27.20	2.86	1.42	.11

Maximum fiber stress, 15,000 lbs. per square inch. Weights of girders correspond to lengths center to center of bearings.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAM BOX GIRDERS

IN TONS OF 2000 LBS.

Weight, 130.8 Lbs. per Foot.

12 Inch I Beams, 40.0 Lbs. per Foot.
2 Plates, 14 x ½.

12 Inch I Beams, 31.5 Lbs. per Foot.
2 Plates. 14 x ½.

Weight, 113.8 Lbs. per Foot.

Span, in Feet.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for $\frac{1}{16}$ In. Increase in Thickness of Plates.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for $\frac{1}{16}$ In. Increase in Thickness of Plates.	Add to Weight of Girder for $\frac{1}{16}$ In. Increase in Thickness of Plates.
10	73.33	.65	4.33	65.97	.57	4.40	.03
11	66.67	.72	3.93	59.98	.63	3.99	.03
12	61.11	.78	3.61	54.98	.68	3.66	.03
13	56.40	.85	3.33	50.75	.74	3.38	.04
14	52.37	.91	3.09	47.12	.80	3.14	.04
15	48.89	.98	2.88	43.98	.85	2.93	.04
16	45.83	1.05	2.70	41.23	.91	2.75	.05
17	43.13	1.11	2.55	38.80	.97	2.58	.05
18	40.73	1.18	2.40	36.65	1.02	2.45	.05
19	38.60	1.24	2.27	34.72	1.08	2.31	.05
20	36.67	1.31	2.17	32.99	1.14	2.19	.06
21	34.92	1.37	2.07	31.42	1.19	2.09	.06
22	33.33	1.44	1.97	29.99	1.25	2.00	.06
23	31.88	1.50	1.88	28.68	1.31	1.92	.07
24	30.55	1.57	1.80	27.48	1.36	1.83	.07
25	29.33	1.63	1.73	26.39	1.42	1.75	.07
26	28.20	1.70	1.66	25.37	1.48	1.68	.08
27	27.16	1.76	1.60	24.44	1.53	1.63	.08
28	26.19	1.83	1.55	23.56	1.59	1.57	.08
29	25.28	1.89	1.49	22.75	1.65	1.51	.08
30	24.44	1.96	1.44	21.99	1.70	1.47	.09
31	23.65	2.02	1.40	21.28	1.76	1.42	.09
32	22.92	2.09	1.35	20.62	1.81	1.37	.09
33	22.22	2.16	1.32	20.00	1.87	1.33	.10
34	21.57	2.22	1.27	19.41	1.93	1.29	.10
35	20.95	2.29	1.23	18.85	1.99	1.26	.10
36	20.37	2.35	1.20	18.32	2.05	1.22	.10

Maximum fiber stress, 15,000 lbs. per square inch. Weights of girders correspond to lengths center to center of bearings.

Loads given below the dotted lines produce deflections exceeding $\frac{1}{360}$ of the span.

SAFE LOADS UNIFORMLY DISTRIBUTED FOR

AMERICAN STANDARD I BEAM BOX GIRDERS

IN TONS OF 2000 LBS.

Weight, 94.0 Lbs. per Foot.

10 Inch I Beams, 25.0 Lbs. per Foot.

2 Plates, 12 x ½.

Span, in Feet.	Safe Load, including Weight of Girder, in Tons of 2000 Lbs.	Weight of Girder, in Tons of 2000 Lbs.	Add to Safe Load for $\frac{1}{16}$ In. Increase in Thickness of Plates.	Add to Weight of Girder for $\frac{1}{16}$ In. Increase in Thickness of Plates.
10	45.00	.47	3.06	.02
11	40.92	.52	2.78	.03
12	37.50	.56	2.55	.03
13	34.62	.61	2.35	.03
14	32.15	.66	2.18	.03
15	30.00	.70	2.04	.04
16	28.13	.75	1.90	.04
17	26.47	.80	1.80	.04
18	25.00	.84	1.70	.04
19	23.69	.89	1.60	.05
20	22.50	.94	1.53	.05
21	21.43	.99	1.45	.05
22	20.46	1.03	1.38	.05
23	19.57	1.08	1.32	.06
24	18.75	1.13	1.28	.06
25	18.00	1.17	1.22	.06
26	17.31	1.22	1.18	.06
27	16.67	1.27	1.13	.07
28	16.07	1.31	1.10	.07
29	15.52	1.36	1.05	.07
30	15.00	1.41	1.02	.07
31	14.52	1.45	.99	.08
32	14.07	1.50	.96	.08
33	13.64	1.55	.92	.08

Maximum fiber stress, 15,000 lbs. per square inch. Weights of girders correspond to lengths center to center of bearings.

Loads given below the dotted line produce deflections exceeding $\frac{1}{360}$ of the span.

EXPLANATION OF TABLES
OF SAFE LOADS FOR LATTICED CHANNEL COLUMNS AND ANGLE STRUTS.

Safe loads for latticed channel columns with square ends are given in the table on pages 210-211 calculated for an allowable stress, in lbs. per square inch, by the following formula:

13,000 lbs. for lengths under 55 radii of gyration.

$16{,}000-55\frac{l}{r}$ for lengths over 55 radii of gyration.

This is the same formula as that given on page 108 for rolled steel H columns.

The channels are assumed to be properly latticed together and placed far enough apart so that the column will be of equal strength about either axis, in which case the radius of gyration is the same as the greatest radius of the single channel. In the table on page 209 the distances back to back of channels are given which make the radii equal about both axes.

Weights given for the channel columns do not include lattice bars, batten plates or connections. Such details add about 30% or more to the weight of the heavier columns, and as much as 50 or 60% to the weight of the lightest columns.

Single and double angles are used for struts in roof trusses and for similar purposes. Safe loads on angle struts are given in the tables on pages 212-221. These loads are calculated by the following formula for the allowable stress, in lbs. per square inch:

13,000 lbs. for lengths under 36 radii of gyration.

$15{,}000-55\frac{l}{r}$ for lengths over 36 radii of gyration.

Except for very short lengths, this gives a permissible stress 1000 lbs. per square inch less than that allowed by the standard formula. Angles are unsymmetrical sections and the load is seldom centrally applied, thus causing more or less eccentricity. For this reason the allowable stress should be less than for symmetrical sections.

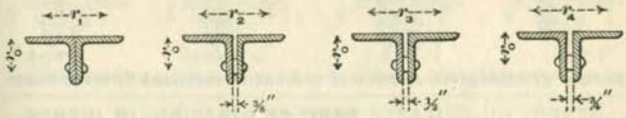
Radii of gyration for all sizes of single angles are given in the tables of properties of angles on pages 172-182, and for pairs of angles with different degrees of separation in the tables on pages 205-207.

The safe loads in the tables are, in general, not given for lengths greater than 150 times the least radius of gyration. The usual limit of length of 125 times the least radius of gyration is indicated by zigzag lines.

All loads are assumed to be centrally or symmetrically applied. The effect of eccentric loading must be separately investigated and considered.

RADII OF GYRATION FOR TWO EQUAL ANGLES.

PLACED BACK TO BACK.

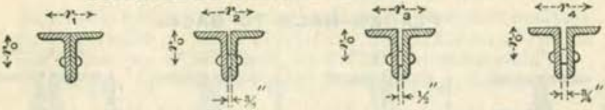


Radii of gyration given correspond to direction indicated by arrow heads.

Size of Angle, Inches.	Thickness, Inches.	Area of Two Angles, Sq. Inches.	RADII OF GYRATION, IN INCHES.				
			r_0	r_1	r_2	r_3	r_4
8x8	1⅛	33.46	2.42	3.42	3.55	3.60	3.69
8x8	½	15.50	2.50	3.32	3.45	3.49	3.58
6x6	1	22.00	1.80	2.59	2.73	2.77	2.87
6x6	⅜	8.72	1.88	2.49	2.62	2.67	2.76
5x5	1	18.00	1.48	2.19	2.33	2.38	2.48
5x5	⅜	7.22	1.56	2.09	2.22	2.26	2.35
4x4	13/16	11.68	1.18	1.75	1.89	1.94	2.04
4x4	5/16	4.80	1.24	1.67	1.80	1.85	1.94
3½x3½	13/16	10.06	1.02	1.55	1.70	1.74	1.85
3½x3½	5/16	4.18	1.08	1.47	1.60	1.65	1.74
3x3	⅝	6.72	.88	1.32	1.46	1.51	1.62
3x3	¼	2.88	.93	1.25	1.39	1.43	1.53
2½x2½	½	4.50	.74	1.10	1.24	1.29	1.40
2½x2½	3/16	1.80	.78	1.04	1.17	1.22	1.32
2¼x2¼	½	4.00	.66	.99	1.14	1.19	1.30
2¼x2¼	3/16	1.62	.70	.94	1.08	1.12	1.23
2x2	7/16	3.12	.59	.89	1.03	1.08	1.19
2x2	3/16	1.44	.62	.84	.97	1.03	1.13
1¾x1¾	7/16	2.68	.51	.78	.93	.98	1.09
1¾x1¾	3/16	1.24	.54	.75	.88	.93	1.03
1½x1½	⅜	1.98	.44	.67	.82	.88	.98
1½x1½	⅛	.72	.46	.62	.76	.81	.92

RADII OF GYRATION FOR TWO UNEQUAL ANGLES.

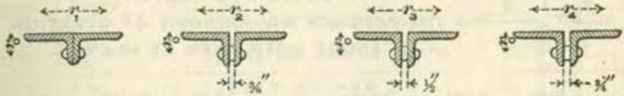
LONG LEGS PLACED BACK TO BACK.



Radii of gyration given correspond to direction indicated by arrow heads.

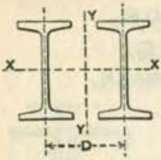
Size of Angle, Inches.	Thickness, Inches.	Area of Two Angles, Sq. Inches.	RADII OF GYRATION, IN INCHES. r_o	r_1	r_2	r_3	r_4
8x6	1	26.00	2.49	2.39	2.52	2.57	2.66
8x6	½	13.50	2.56	2.32	2.44	2.48	2.58
7x3½	1	19.00	2.19	1.31	1.45	1.50	1.60
7x3½	7/16	8.80	2.26	1.21	1.34	1.39	1.47
6x4	1	18.00	1.85	1.60	1.74	1.79	1.89
6x4	⅜	7.22	1.93	1.50	1.63	1.67	1.76
6x3½	1	17.00	1.85	1.37	1.51	1.56	1.67
6x3½	⅜	6.84	1.94	1.26	1.39	1.43	1.53
5x3½	⅞	13.34	1.53	1.42	1.56	1.61	1.71
5x3½	5/16	5.12	1.61	1.33	1.45	1.50	1.59
5x3	13/16	11.68	1.55	1.18	1.32	1.37	1.47
5x3	5/16	4.80	1.61	1.09	1.22	1.26	1.35
4x3½	¾	10.12	1.20	1.49	1.63	1.68	1.78
4x3½	5/16	4.50	1.26	1.42	1.55	1.59	1.69
4x3	¾	9.38	1.22	1.25	1.39	1.44	1.54
4x3	5/16	4.18	1.27	1.17	1.30	1.35	1.44
3½x3	¾	8.62	1.04	1.28	1.43	1.48	1.58
3½x3	5/16	3.86	1.10	1.22	1.34	1.40	1.49
3½x2½	⅝	6.72	1.07	1.02	1.16	1.22	1.32
3½x2½	¼	2.88	1.12	.96	1.09	1.13	1.23
3x2½	9/16	5.56	.91	1.05	1.20	1.25	1.35
3x2½	¼	2.62	.95	1.00	1.13	1.18	1.28
3x2	½	4.50	.92	.80	.94	1.00	1.10
3x2	¼	2.38	.95	.75	.89	.93	1.03
2½x2	½	4.00	.75	.84	.99	1.04	1.15
2½x2	3/16	1.62	.79	.79	.92	.97	1.07
2½x1½	7/16	3.12	.77	.60	.74	.80	.91
2½x1½	3/16	1.44	.80	.55	.68	.73	.84

RADII OF GYRATION FOR
TWO UNEQUAL ANGLES.
SHORT LEGS PLACED BACK TO BACK.



Radii of gyration given correspond to direction indicated by arrow heads.

Size of Angle, Inches.	Thickness, Inches.	Area of Two Angles, Sq. Inches.	RADII OF GYRATION, IN INCHES. r_0	r_1	r_2	r_3	r_4
8x6	1	26.00	1.73	3.63	3.78	3.82	3.92
8x6	½	13.50	1.79	3.56	3.69	3.74	3.83
7x3½	1	19.00	.89	3.48	3.63	3 68	3.78
7x3½	7/16	8.80	.95	3.37	3.51	3.56	3.66
6x4	1	18.00	1.09	2.85	3.00	3.04	3.14
6x4	⅜	7.22	1.17	2.74	2.87	2.92	3.01
6x3½	1	17.00	.92	2.93	3.07	3.13	3.23
6x3½	⅜	6.84	.99	2.81	2.95	3.00	3.10
5x3½	⅞	13.34	.96	2.36	2.50	2.55	2.65
5x3½	5/16	5.12	1.03	2.26	2.40	2.44	2.54
5x3	13/16	11.68	.80	2.42	2.57	2.62	2.72
5x3	5/16	4.80	.85	2.33	2.47	2.51	2.61
4x3½	¾	10.12	1.01	1.80	1.94	1.99	2.09
4x3½	5/16	4.50	1.07	1.73	1.86	1.91	2.00
4x3	¾	9.38	.84	1.87	2.02	2.07	2.17
4x3	5/16	4.18	.89	1.79	1.93	1.97	2.07
3½x3	¾	8.62	.85	1.60	1.74	1.79	1.90
3½x3	5/16	3.86	.90	1.52	1.66	1.71	1.80
3½x2½	⅝	6.72	.69	1.65	1.79	1.84	1.95
3½x2½	¼	2.88	.74	1.58	1.74	1.76	1.86
3x2½	9/16	5.56	.72	1.37	1.51	1.56	1·66
3x2½	¼	2.62	.75	1.31	1.45	1.50	1.59
3x2	½	4.50	.55	1.42	1.57	1.62	1.73
3x2	¼	2.38	.57	1.38	1.51	1.56	1.66
2½x2	½	4.00	.56	1.16	1.30	1.35	1.46
2½x2	3/16	1.62	.60	1.10	1.23	1.28	1.39
2½x1½	7/16	3.12	.40	1.21	1.37	1.42	1.52
2½x1½	3/16	1.44	.42	1.17	1.31	1.36	1.46



SPACING OF
AMERICAN STANDARD I BEAMS
CENTER TO CENTER,
TO PRODUCE EQUAL RADII OF GYRATION
ABOUT BOTH AXES XX AND YY.

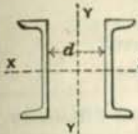
Section Number.	Depth of Beam, Inches.	Weight per Foot of each Beam, Lbs.	Distance D, Inches.
I 24	24	100.00	17.82
		95.00	17.99
		90.00	18.21
		85.00	18.43
		80.00	18.72
I 20a	20	100.00	14.76
		95.00	14.92
		90.00	15.10
		85.00	15.30
		80.00	15.47
I 20	20	75.00	14.98
		70.00	15.21
		65.00	15.47
I 18	18	70.00	13.20
		65.00	13.40
		60.00	13.63
		55.00	13.95
I 15b	15	100.00	10.75
		95.00	10.86
		90.00	10.99
		85.00	11.13
		80.00	11.25
I 15a	15	75.00	10.95
		70.00	11.11
		65.00	11.29
		60.00	11.49
I 15	15	55.00	11.05
		50.00	11.27
		45.00	11.54
		42.00	11.70

Section Number.	Depth of Beam, Inches.	Weight per Foot of each Beam, Lbs.	Distance D, Inches.
I 12a	12	55.00	8.65
		50.00	8.83
		45.00	9.06
		40.00	9.29
I 12	12	35.00	9.21
		31.50	9.45
I 10	10	40.00	7.12
		35.00	7.32
		30.00	7.57
		25.00	7.91
I 9	9	35.00	6.36
		30.00	6.58
		25.00	6.86
		21.00	7.12
I 8	8	25.50	5.82
		23.00	5.96
		20.50	6.12
		18.00	6.32
I 7	7	20.00	5.15
		17.50	5.31
		15.00	5.50
I 6	6	17.25	4.33
		14.75	4.49
		12.25	4.70
I 5	5	14.75	3.52
		12.25	3.67
		9.75	3.89
I 4	4	10.50	*2.81
		9.50	2.87
		8.50	2.96
		7.50	3.06

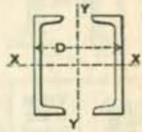
* Denotes that the value of D given is less than the distance center to center of beams when placed close together with flanges in contact.

SPACING OF

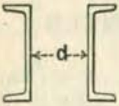
AMERICAN STANDARD CHANNELS



TO PRODUCE EQUAL RADII OF GYRATION ABOUT BOTH AXES XX AND YY.



Section Number.	Depth of Channel, Inches.	Weight per Foot of each Channel, Lbs.	Distance d, Inches.	Distance D, Inches.	Section Number.	Depth of Channel, Inches.	Weight per Foot of each Channel, Lbs.	Distance d, Inches.	Distance D, Inches.
C15	15	55.00	8.53	11.82	C8	8	21.25	4.23	6.58
		50.00	8.71	11.92			18.75	4.38	6.65
		45.00	8.92	12.07			16.25	4.54	6.76
		40.00	9.15	12.28			13.75	4.72	6.95
		35.00	9.43	12.59			11.25	4.94	7.24
		33.00	9.50	12.68	C7	7	19.75	3.48	5.81
C12	12	40.00	6.60	9.48			17.25	3.64	5.86
		35.00	6.81	9.59			14.75	3.80	5.94
		30.00	7.07	9.78			12.25	3.99	6.10
		25.00	7.36	10.07			9.75	4.22	6.40
		20.50	7.67	10.49	C6	6	15.50	2.91	5.09
C10	10	35.00	5.17	7.95			13.00	3.09	5.16
		30.00	5.40	8.00			10.50	3.28	5.29
		25.00	5.67	8.15			8.00	3.52	5.59
		20.00	5.97	8.41	C5	5	11.50	2.34	4.37
		15.00	6.33	8.89			9.00	2.56	4.48
C9	9	25.00	4.84	7.30			6.50	2.79	4.75
		20.00	5.12	7.46	C4	4	7.25	1.85	3.70
		15.00	5.49	7.85			6.25	1.96	3.79
		13.25	5.63	8.06			5.25	2.06	3.92



SAFE LOADS IN TONS OF 2000 LBS. FOR

LATTICED CHANNEL COLUMNS

WITH SQUARE ENDS.

Allowable stress per square inch.
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

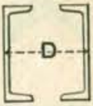
Depth of Channel, Inches.	Weight of each Channel, Lbs. per Foot.	Area of Two Channels, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF COLUMNS.					
				10 Ft.	11 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.
15	55.00	32.36	5.16	210.3	210.3	210.3	210.3	210.3	210.3
	50.00	29.42	5.23	191.2	191.2	191.2	191.2	191.2	191.2
	45.00	26.48	5.32	172.1	172.1	172.1	172.1	172.1	172.1
	40.00	23.52	5.43	152.9	152.9	152.9	152.9	152.9	152.9
	35.00	20.58	5.58	133.8	133.8	133.8	133.8	133.8	133.8
	33.00	19.80	5.62	128.7	128.7	128.7	128.7	128.7	128.7
12	40.00	23.52	4.09	152.9	152.9	152.9	152.9	152.9	152.9
	35.00	20.58	4.17	133.8	133.8	133.8	133.8	133.8	133.8
	30.00	17.64	4.28	114.7	114.7	114.7	114.7	114.7	114.7
	25.00	14.70	4.43	95.6	95.6	95.6	95.6	95.6	95.6
	20.50	12.06	4.61	78.4	78.4	78.4	78.4	78.4	78.4
10	35.00	20.58	3.35	133.8	133.8	133.8	133.8	132.2	128.1
	30.00	17.64	3.42	114.7	114.7	114.7	114.7	113.9	110.5
	25.00	14.70	3.52	95.6	95.6	95.6	95.6	95.6	92.8
	20.00	11.76	3.66	76.4	76.4	76.4	76.4	76.4	75.0
	15.00	8.92	3.87	58.0	58.0	58.0	58.0	58.0	57.7
9	25.00	14.70	3.10	95.6	95.6	95.6	95.6	92.6	89.4
	20.00	11.76	3.21	76.4	76.4	76.4	76.4	74.7	72.3
	15.00	8.82	3.40	57.3	57.3	57.3	57.3	56.9	55.2
	13.25	7.78	3.49	50.6	50.6	50.6	50.6	50.5	49.0
8	21.25	12.50	2.77	81.3	81.3	81.3	79.2	76.2	73.2
	18.75	11.02	2.82	71.6	71.6	71.6	70.1	67.5	64.9
	16.25	9.56	2.89	62.1	62.1	62.1	61.2	59.0	56.8
	13.75	8.08	2.98	52.5	52.5	52.5	52.1	50.3	48.5
	11.25	6.70	3.11	43.6	43.6	43.6	43.6	42.2	40.8
7	19.75	11.62	2.39	75.5	75.3	73.7	70.5	67.3	64.1
	17.25	10.14	2.44	65.9	65.9	64.7	61.9	59.2	56.4
	14.75	8.68	2.50	56.4	56.4	55.7	53.4	51.1	48.8
	12.25	7.20	2.59	46.8	46.8	46.6	44.8	42.9	41.1
	9.75	5.70	2.72	37.1	37.1	37.1	35.9	34.5	33.2
6	15.50	9.12	2.07	58.4	57.0	55.5	52.6	49.7	46.8
	13.00	7.64	2.13	49.3	48.1	46.9	44.5	42.2	39.8
	10.50	6.18	2.21	40.2	39.3	38.4	36.5	34.7	32.8
	8.00	4.76	2.34	30.9	30.7	30.0	28.7	27.3	26.0

Channels must be properly latticed together and separated not less than the distance *d* or *D*, respectively, as given in the table on page 209.

SAFE LOADS IN TONS OF 2000 LBS. FOR

LATTICED CHANNEL COLUMNS

WITH SQUARE ENDS.



Allowable stress per square inch:
13,000 lbs. for lengths under 55 radii.
$16{,}000-55\frac{l}{r}$ for lengths over 55 radii.

UNSUPPORTED LENGTH OF COLUMNS.									Weight of each Channel, Lbs. per Foot.
20 Ft.	22 Ft.	24 Ft.	26 Ft.	28 Ft.	30 Ft.	32 Ft.	36 Ft.	40 Ft.	
210.3	210.3	209.2	205.1	200.9	196.8	192.7	184.4	176.1	55.00
191.2	191.2	190.8	187.1	183.4	179.7	176.0	168.5	161.1	50.00
172.1	172.1	172.1	169.1	165.9	162.6	159.3	152.7	146.1	45.00
152.9	152.9	152.9	151.0	148.1	145.3	142.4	136.7	131.0	40.00
133.8	133.8	133.8	133.0	130.6	128.1	125.7	120.8	116.0	35.00
128.7	128.7	128.7	128.2	125.8	123.5	121.2	116.5	111.9	33.00
150.2	146.4	142.6	138.8	135.0	131.2	127.4	119.8	112.2	40.00
132.1	128.8	125.6	122.3	119.0	115.8	112.5	106.0	99.5	35.00
113.9	111.2	108.5	105.8	103.0	100.3	97.6	92.2	86.7	30.00
95.6	93.5	91.3	89.1	86.9	84.8	82.6	78.2	73.8	25.00
78.4	77.5	75.8	74.0	72.3	70.6	68.9	65.4	61.9	20.50
124.1	120.0	116.0	111.9	107.9	103.8	99.8	91.7	83.5	35.00
107.1	103.7	100.3	96.9	93.5	90.1	86.7	79.8	73.0	30.00
90.0	87.3	84.5	81.8	79.0	76.3	73.5	68.0	62.5	25.00
72.9	70.8	68.6	66.5	64.4	62.3	60.2	55.9	51.7	20.00
56.1	54.6	53.1	51.6	50.1	48.5	47.0	44.0	40.9	15.00
86.3	83.2	80.0	76.9	73.8	70.7	67.5	61.3	55.0	25.00
69.9	67.5	65.1	62.6	60.2	57.8	55.4	50.6	45.7	20.00
53.4	51.7	50.0	48.3	46.6	44.9	43.2	39.7	36.3	15.00
47.5	46.1	44.6	43.1	41.6	40.2	38.7	35.8	32.8	13.25
70.2	67.2	64.3	61.3	58.3	55.3	52.3	46.4	40.4	21.25
62.4	59.8	57.2	54.6	52.1	49.4	46.9	41.7	36.4	18.75
54.6	52.5	50.3	48.1	45.9	43.7	41.5	37.2	32.8	16.25
46.7	45.0	43.2	41.4	39.6	37.8	36.0	32.4	28.9	13.75
39.4	38.0	36.5	35.1	33.7	32.3	30.8	28.0	25.2	11.25
60.9	57.7	54.5	51.2	48.0	44.8	41.6	....	....	19.75
53.7	50.9	48.2	45.5	42.7	40.0	37.2	....	....	17.25
46.5	44.2	41.9	39.7	37.4	35.1	32.8	....	....	14.75
39.3	37.4	35.6	33.7	31.9	30.1	28.2	....	....	12.25
31.8	30.4	29.0	27.6	26.2	24.9	23.5	....	....	9.75
43.9	41.0	38.1	35.2	32.2	....	....	....	....	15.50
37.4	35.1	32.7	30.3	28.0	....	....	....	....	13.00
31.0	29.1	27.3	25.4	23.6	....	....	....	....	10.50
24.7	23.3	22.0	20.6	19.3	....	....	....	....	8.00

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
SINGLE EQUAL LEG ANGLES.

Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000-55\frac{l}{r}$ for lengths over 36 radii.

Size of Angle, Inches.	Thickness, Inches.	Area of Angle, Sq. Ins.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF STRUT. 1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.
8 x 8	1⅛	16.73	1.55	108.7	108.7	108.7	108.7	107.7	104.1
	⅞	13.23	1.57	86.0	86.0	86.0	86.0	85.3	82.5
	⅝	9.61	1.58	62.5	62.5	62.5	62.5	62.0	60.0
	½	7.75	1.58	50.4	50.4	50.4	50.4	50.0	48.4
6 x 6	1	11.00	1.16	71.5	71.5	71.5	70.0	66.9	63.7
	¾	8.44	1.17	54.9	54.9	54.9	53.8	51.4	49.0
	½	5.75	1.18	37.4	37.4	37.4	36.7	35.1	33.5
	⅜	4.36	1.19	28.3	28.3	28.3	27.9	26.7	25.4
5 x 5	1	9.00	.96	58.5	58.5	58.2	55.1	52.0	48.9
	¾	6.94	.97	45.1	45.1	45.0	42.6	40.2	37.9
	½	4.75	.98	30.9	30.9	30.8	29.2	27.6	26.0
	⅜	3.61	.99	23.5	23.5	23.5	22.3	21.1	19.9
4 x 4	13/16	5.84	.77	38.0	38.0	36.3	33.8	31.3	28.8
	9/16	4.18	.78	27.2	27.2	26.0	24.3	22.5	20.7
	7/16	3.31	.78	21.5	21.5	20.6	19.2	17.8	16.4
	5/16	2.40	.79	15.6	15.6	15.0	14.0	13.0	12.0
3½x3½	13/16	5.03	.67	32.7	32.7	30.3	27.8	25.3	22.9
	9/16	3.62	.68	23.5	23.5	21.9	20.1	18.4	16.6
	7/16	2.87	.68	18.7	18.7	17.3	16.0	14.6	13.2
	5/16	2.09	.69	13.6	13.6	12.7	11.7	10.7	9.7
3 x 3	⅝	3.36	.57	21.8	21.3	19.4	17.4	15.5	13.5
	½	2.75	.58	17.9	17.5	15.9	14.4	12.8	11.2
	⅜	2.11	.58	13.7	13.4	12.2	11.0	9.8	8.6
	¼	1.44	.59	9.4	9.2	8.4	7.6	6.8	6.0
2½x2½	½	2.25	.47	14.6	13.7	12.1	10.6	9.0	7.4
	⅜	1.73	.48	11.2	10.6	9.4	8.2	7.0	5.8
	¼	1.19	.49	7.7	7.3	6.5	5.7	4.9	4.1
	3/16	.90	.49	5.9	5.5	4.9	4.3	3.7	3.1
2¼x2¼	½	2.00	.43	13.0	11.9	10.4	8.9	7.3	5.8
	⅜	1.55	.43	10.1	9.2	8.1	6.9	5.7	4.5
	¼	1.06	.44	6.9	6.4	5.6	4.8	4.0	3.2
	3/16	.81	.44	5.5	4.9	4.3	3.6	3.0	2.4
2 x 2	7/16	1.56	.39	10.1	9.1	7.7	6.4	5.1	
	5/16	1.15	.39	7.5	6.7	5.7	4.7	3.8	
	¼	.94	.39	6.1	5.5	4.7	3.9	3.0	
	3/16	.72	.40	4.7	4.2	3.6	3.0	2.4	

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
SINGLE EQUAL LEG ANGLES.

Allowable stress per square inch :
13,000 lbs. for lengths under 36 radii.
$15{,}000-55\frac{l}{r}$ for lengths over 36 radii.

UNSUPPORTED LENGTH OF STRUT.								Thickness, Inches.	Size of Angle, Inches.
7 Ft.	8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.	14 Ft.	16 Ft.		
100.5	97.0	93.4	89.9	86.3	82.7	75.6	68.5	1 1/8	8 x 8
97.8	77.0	74.2	71.4	68.6	65.9	60.3	54.7	7/8	
58.0	56.0	54.0	52.0	50.0	48.0	44.0	40.0	5/8	
46.8	45.2	43.6	41.9	40.0	38.7	35.5	32.2	1/2	
60.6	57.5	54.3	51.2	48.1	44.9	38.7	32.4	1	6 x 6
46.6	44.3	41.9	39.5	37.1	34.7	30.0	25.2	3/4	
31.9	30.3	28.7	27.0	25.4	23.8	20.6	17.4	1/2	
24.2	23.0	21.8	20.6	19.4	18.2	15.8	13.4	3/8	
45.8	42.8	39.7	36.6	33.5	30.4	......	......	1	5 x 5
35.5	33.2	30.8	28.4	26.1	23.7	......	......	3/4	
24.4	22.8	21.2	19.6	18.0	16.4	......	......	1/2	
18.7	17.4	16.2	15.0	13.8	12.6	......	......	3/8	
26.3	23.8	21.3	18.8	......	......	......	......	13/16	4 x 4
19.0	17.2	15.4	13.7	......	......	......	......	9/16	
15.0	13.6	12.2	10.8	......	......	......	......	7/16	
11.0	10.0	9.0	8.0	......	......	......	......	5/16	
20.4	17.9	15.4	......	......	......	......	......	13/16	3½x3½
14.9	13.1	11.3	......	......	......	......	......	9/16	
11.8	10.4	9.0	......	......	......	......	......	7/16	
8.7	7.7	6.5	......	......	......	......	......	5/16	
11.6	9.6	......	......	......	......	......	......	5/8	3 x 3
9.7	8.1	......	......	......	......	......	......	1/2	
7.4	6.2	......	......	......	......	......	......	3/8	
5.2	4.4	......	......	......	......	......	......	1/4	
5.8	......	......	......	......	......	......	......	1/2	2½x2½
4.6	......	......	......	......	......	......	......	3/8	
3.3	......	......	......	......	......	......	......	1/4	
2.5	......	......	......	......	......	......	......	3/16	

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
SINGLE UNEQUAL LEG ANGLES.

Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000 - 55\frac{l}{r}$ for lengths over 36 radii.

Size of Angle, Inches.	Thickness, Inches.	Area of Angle, Square Inches.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF STRUT. 1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.
8 x 6	1	13.00	1.28	84.5	84.5	84.5	84.1	80.7
	½	6.75	1.30	43.9	43.9	43.9	43.8	42.1
7 x 3½	1	9.50	.74	61.8	61.8	58.5	54.3	50.1
	7/16	4.40	.76	28.6	28.6	27.3	25.4	23.4
6 x 4	1	9.00	.85	58.5	58.5	57.0	53.5	50.0
	⅜	3.61	.88	23.5	23.5	23.0	21.7	20.3
6 x 3½	1	8.50	.74	55.3	55.3	52.4	48.6	44.8
	⅜	3.42	.77	22.2	22.2	21.3	19.8	18.3
5 x 3½	⅞	6.67	.75	43.3	43.3	41.2	38.3	35.4
	5/16	2.56	.76	16.6	16.6	15.9	14.8	13.6
5 x 3	13/16	5.84	.64	38.0	37.8	34.8	31.8	28.7
	5/16	2.40	.66	15.6	15.6	14.4	13.2	12.0
4 x 3½	¾	5.06	.72	32.9	32.9	31.0	28.7	26.4
	5/16	2.25	.73	14.6	14.6	13.8	12.8	11.8
4 x 3	¾	4.69	.64	30.5	30.3	27.9	25.5	23.1
	5/16	2.09	.65	13.6	13.6	12.5	11.4	10.4
3½ x 3	¾	4.31	.62	28.0	27.7	25.4	23.1	20.9
	5/16	1.93	.63	12.5	12.5	11.4	10.4	9.4
3½ x 2½	⅝	3.36	.53	21.8	21.0	18.9	16.8	14.7
	¼	1.44	.54	9.4	9.0	8.2	7.3	6.4
3 x 2½	9/16	2.78	.52	18.1	17.3	15.6	13.8	12.0
	¼	1.31	.53	8.5	8.2	7.4	6.6	5.7
3 x 2	½	2.25	.43	14.6	13.4	11.7	10.0	8.2
	¼	1.19	.43	7.7	7.1	6.2	5.3	4.4
2½ x 2	½	2.00	.42	13.0	11.9	10.3	8.7	7.1
	3/16	.81	.43	5.3	4.8	4.2	3.6	3.0
2½ x 1½	7/16	1.56	.32	10.1	8.5	6.9	5.3	3.7
	3/16	.72	.33	4.7	4.0	3.2	2.5	1.8

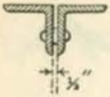
Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
SINGLE UNEQUAL LEG ANGLES.

Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15,000-55\frac{l}{r}$ for lengths over 36 radii.

UNSUPPORTED LENGTH OF STRUT.							Thickness, Inches.	Size of Angle, Inches.
6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.		
77.4	74.0	70.7	67.3	64.0	60.6	57.3	1	8 x 6
40.3	38.6	36.9	35.2	33.5	31.8	30.1	½	
45.8	41.6	37.4	33.1	28.9	24.6	....	1	7 x 3½
21.5	19.6	17.7	15.8	14.0	12.0	....	7/16	
46.5	43.0	39.5	36.1	32.6	29.1	....	1	6 x 4
19.0	17.6	16.2	14.9	13.5	12.2	....	⅜	
41.0	37.2	33.4	29.6	25.8	....	....	1	6 x 3½
16.9	15.4	13.9	12.5	11.0	....	....	⅜	
32.4	29.5	26.5	23.6	20.7	....	....	⅞	5 x 3½
12.5	11.4	10.3	9.2	8.1	....	....	5/16	
25.7	22.7	19.7	16.7	....	....	....	13/16	5 x 3
10.8	9.6	8.4	7.2	....	....	....	5/16	
24.0	21.7	19.4	17.1	....	....	....	¾	4 x 3½
10.8	9.8	8.7	7.7	....	....	....	5/16	
20.7	18.2	15.8	13.4	....	....	....	¾	4 x 3
9.3	8.2	7.2	6.1	....	....	....	5/16	
18.6	16.3	14.0	....	....	....	....	¾	3½ x 3
8.4	7.4	6.4	....	....	....	....	5/16	
12.6	10.6	....	....	....	....	....	⅝	3½ x 2½
5.5	4.6	....	....	....	....	....	¼	
10.3	8.5	....	....	....	....	....	9/16	3 x 2½
4.9	4.1	....	....	....	....	....	¼	
6.5	....	....	....	....	....	....	½	3 x 2
3.4	....	....	....	....	....	....	¼	
5.6	....	....	....	....	....	....	½	2½ x 2
2.3	....	....	....	....	....	....	3/16	

Loads to the right of the zigzag line are for lengths greater than 125 radii.



SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
TWO EQUAL LEG ANGLES, BACK TO BACK ½" APART.

Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000 - 55\frac{l}{r}$ for lengths over 36 radii.

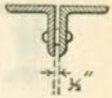
Size of Angle, Inches.	Thickness, Inches.	Area of Two Angles, Sq. Ins.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF STRUT. 2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.
8 x 8	1⅛	33.46	2.42	217.5	217.5	217.5	217.5	217.5	217.5
	½	15.50	2.50	100.8	100.8	100.8	100.8	100.8	100.8
6 x 6	1	22.00	1.80	143.0	143.0	143.0	143.0	140.8	136.8
	⅜	8.72	1.88	56.7	56.7	56.7	56.7	56.2	54.7
5 x 5	1	18.00	1.48	117.0	117.0	117.0	114.9	110.9	106.9
	⅜	7.22	1.56	46.9	46.9	46.9	46.5	45.0	43.5
4 x 4	13/16	11.68	1.18	75.9	75.9	74.5	71.3	68.0	64.7
	5/16	4.80	1.24	31.2	31.2	30.9	29.6	28.3	27.1
3½x3½	13/16	10.06	1.02	65.4	65.4	62.4	59.2	55.9	52.7
	5/16	4.18	1.08	27.2	27.2	26.2	25.0	23.7	22.4
3 x 3	⅝	6.72	.88	43.7	42.8	40.3	37.8	35.3	32.8
	¼	2.88	.93	18.7	18.5	17.5	16.5	15.5	14.4
2½x2½	½	4.50	.74	29.3	27.7	25.7	23.7	21.7	19.7
	3/16	1.80	.78	11.7	11.2	10.5	9.7	8.9	8.2
2¼x2¼	½	4.00	.66	26.0	24.0	22.0	20.0	18.0	16.0
	3/16	1.62	.70	10.5	9.9	9.1	8.3	7.6	6.8
2 x 2	7/16	3.12	.59	19.9	18.2	16.4	14.7	12.9	11.2
	3/16	1.44	.62	9.3	8.5	7.7	7.0	6.2	5.4

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR

ANGLE STRUTS WITH SQUARE ENDS.

TWO EQUAL LEG ANGLES, BACK TO BACK ½" APART.



Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000-55\frac{l}{r}$ for lengths over 36 radii.

UNSUPPORTED LENGTH OF STRUT.								Thickness, Inches.	Size of Angle, Inches.
8 Ft.	9 Ft.	10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.	20 Ft.		
214.4	209.9	205.3	196.2	187.1	177.9	168.8	159.7	1⅛	8 x 8
99.9	97.8	95.8	91.7	87.6	83.5	79.4	75.3	½	
132.7	128.7	124.7	116.6	108.5	100.5	92.4	84.3	1	6 x 6
53.2	51.6	50.1	47.0	44.0	40.9	37.8	34.8	⅜	
102.9	98.9	94.9	86.8	78.8	70.8	62.8	54.7	1	5 x 5
41.9	40.4	38.9	35.8	32.8	29.7	26.7	23.6	⅜	
61.5	58.2	54.9	48.4	41.9	35.3	....	....	13/16	4 x 4
25.8	24.5	23.2	20.7	18.1	15.6	....	....	5/16	
49.4	46.2	42.9	36.4	29.9	....	....	....	13/16	3½x3½
21.1	19.9	18.6	16.0	13.5	....	....	....	5/16	
30.2	27.7	25.2	20.2	....	....	....	....	⅝	3 x 3
13.4	12.4	11.4	9.3	....	....	....	....	¼	
17.7	15.7	13.7	....	....	....	....	....	½	2½x2½
7.4	6.6	5.9	....	....	....	....	....	3/16	
14.0	12.0	....	....	....	....	....	....	½	2¼x2¼
6.0	5.3	....	....	....	....	....	....	3/16	
9.4	....	....	....	....	....	....	....	7/16	2x2
4.7	....	....	....	....	....	....	....	3/16	

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
TWO UNEQUAL LEG ANGLES, LONG LEGS BACK TO BACK ½" APART.

Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000-55\frac{l}{r}$ for lengths over 36 radii.

Size of Angle, Inches.	Thickness, Inches.	Area of Two Angles, Sq. Ins.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF STRUT. 3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.	8 Ft.
8x6	1	26.00	2.49	169.0	169.0	169.0	169.0	169.0	167.4
	¾	19.88	2.52	129.2	129.2	129.2	129.2	129.2	128.3
	⅝	16.72	2.51	108.7	108.7	108.7	108.7	108.7	107.8
	$\frac{9}{16}$	15.12	2.50	98.3	98.3	98.3	98.3	98.3	97.4
	½	13.50	2.48	87.8	87.8	87.8	87.8	87.8	86.9
7x3½	1	19.00	1.50	123.5	123.5	121.6	117.4	113.2	109.1
	¾	14.62	1.44	95.0	95.0	92.9	89.5	86.2	82.8
	⅝	12.34	1.42	80.2	80.2	78.2	75.3	72.5	69.6
	½	10.00	1.39	65.0	65.0	63.1	60.8	58.4	56.0
	$\frac{7}{16}$	8.80	1.39	57.2	57.2	55.6	53.5	51.4	49.3
6x4	1	18.00	1.79	117.0	117.0	117.0	115.1	111.8	108.5
	¾	13.88	1.74	90.2	90.2	90.2	88.3	85.7	83.0
	⅝	11.72	1.71	76.2	76.2	76.2	74.3	72.1	69.8
	½	9.50	1.69	61.8	61.8	61.8	60.1	58.3	56.4
	$\frac{7}{16}$	8.36	1.68	54.3	54.3	54.3	52.8	51.2	49.6
	⅜	7.22	1.67	46.9	46.9	46.9	45.6	44.2	42.7
6x3½	1	17.00	1.56	110.5	110.5	109.5	105.9	102.3	98.7
	¾	13.12	1.51	85.3	85.3	84.1	81.2	78.3	75.5
	⅝	11.10	1.48	72.2	72.2	70.9	68.4	65.9	63.5
	½	9.00	1.45	58.5	58.5	57.3	55.2	53.2	51.1
	$\frac{7}{16}$	7.94	1.44	51.6	51.6	50.5	48.6	46.8	45.0
	⅜	6.84	1.44	44.5	44.5	43.5	41.9	40.3	38.8
5x3½	⅞	13.34	1.53	86.7	86.7	85.7	82.8	79.9	77.0
	⅝	9.84	1.56	64.0	64.0	63.4	61.3	59.2	57.1
	½	8.00	1.54	52.0	52.0	51.4	49.7	48.0	46.3
	⅜	6.10	1.51	39.7	39.7	39.1	37.8	36.4	35.1
	$\frac{5}{16}$	5.12	1.50	33.3	33.3	32.8	31.6	30.5	29.4
5x3	$\frac{13}{16}$	11.68	1.37	75.9	75.9	73.5	70.7	67.9	65.1
	⅝	9.22	1.33	59.9	59.9	57.7	55.4	53.1	50.8
	½	7.50	1.30	48.8	48.6	46.7	44.8	42.9	41.0
	⅜	5.72	1.27	37.2	37.0	35.5	34.0	32.5	31.0
	$\frac{5}{16}$	4.80	1.27	31.2	31.0	29.7	28.5	27.2	25.9

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS.
TWO UNEQUAL LEG ANGLES, LONG LEGS BACK TO BACK ½″ APART.

Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000 - 55\,\frac{l}{r}$ for lengths over 36 radii.

UNSUPPORTED LENGTH OF STRUT.								Thickness, Inches.	Size of Angle, Inches.
9 Ft.	10 Ft.	11 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.	20 Ft.		
164.0	160.5	157.1	153.7	146.8	139.9	133.0	126.1	1	
125.7	123.1	120.5	117.9	112.7	107.4	102.2	97.0	¾	
105.6	103.4	101.2	99.0	94.6	90.2	85.8	81.4	⅝	8x6
95.4	93.4	91.4	89.5	85.5	81.5	77.5	73.5	$\frac{9}{16}$	
85.1	83.3	81.5	79.7	76.1	72.5	68.9	65.3	½	
104.9	100.7	96.5	92.3	84.0	75.6	67.3	....	1	
79.5	76.1	72.8	69.4	62.7	56.0	49.3	....	¾	
66.7	63.9	61.0	58.1	52.4	46.7	40.9	....	⅝	7x3½
53.6	51.3	48.9	46.5	41.8	37.0	32.3	....	½	
47.2	45.1	43.0	40.9	36.8	32.6	28.4	....	$\frac{7}{16}$	
105.1	101.8	98.5	95.2	88.5	81.9	75.3	68.6	1	
80.4	77.8	75.1	72.5	67.2	62.0	56.7	51.5	¾	
67.5	65.3	63.0	60.8	56.2	51.7	47.2	42.7	⅝	
54.6	52.7	50.8	49.0	45.3	41.6	37.9	34.2	½	6x4
47.9	46.3	44.6	43.0	39.7	36.4	33.1	29.9	$\frac{7}{16}$	
41.3	39.9	38.5	37.0	34.2	31.3	28.5	25.6	⅜	
95.1	91.5	87.9	84.3	77.2	70.0	62.8	....	1	
72.6	69.7	66.9	64.0	58.3	52.5	46.8	....	¾	
61.0	58.5	56.0	53.6	48.6	43.7	38.7	....	⅝	
49.1	47.0	45.0	42.9	38.8	34.7	30.6	....	½	6x3½
43.2	41.4	39.5	37.7	34.1	30.4	26.8	....	$\frac{7}{16}$	
37.2	35.6	34.1	23.5	29.4	26.2	23.1	....	⅜	
74.2	71.3	68.4	65.5	59.8	54.0	48.3	....	⅞	
55.1	53.0	50.9	48.8	44.7	40.5	36.3	....	⅝	
44.6	42.9	41.1	39.4	36.0	32.6	29.1	....	½	5x3½
33.8	32.4	31.1	29.8	27.1	24.4	21.8	....	⅜	
28.3	27.1	26.0	24.9	22.6	20.4	18.1	....	$\frac{5}{16}$	
62.3	59.5	56.7	53.8	48.2	42.6	....	....	$\frac{13}{16}$	
48.6	46.3	44.0	41.7	37.1	32.5	....	....	⅝	
39.1	37.2	35.3	33.4	29.6	25.8	....	....	½	5x3
29.5	28.0	26.6	25.1	22.1	19.1	....	....	⅜	
24.7	23.4	22.2	20.9	18.4	15.9	....	....	$\frac{5}{16}$	

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS—(Continued).
TWO UNEQUAL LEG ANGLES, LONG LEGS BACK TO BACK ½" APART.

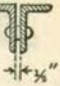
Allowable stress per square inch:
13,000 lbs. for lengths under 36 radii.
$15{,}000-55\frac{l}{r}$ for lengths over 36 radii.

Size of Angle, Inches.	Thickness, Inches.	Area of Two Angles, Sq. Ins.	Least Radius of Gyration, Inches.	UNSUPPORTED LENGTH OF STRUT. 2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.	7 Ft.
4 x 3½	¾	10.12	1.20	65.8	65.8	64.8	62.0	59.2	56.4
	½	7.00	1.23	45.5	45.5	45.0	43.1	41.2	39.4
	⅜	5.34	1.25	34.7	34.7	34.4	33.0	31.6	30.2
	5/16	4.50	1.26	29.3	29.3	29.0	27.9	26.7	25.5
4 x 3	¾	9.38	1.22	61.0	61.0	60.2	57.7	55.1	52.6
	½	6.50	1.25	42.3	42.3	41.9	40.2	38.5	36.7
	⅜	4.96	1.26	32.2	32.2	32.0	30.7	29.4	28.1
	5/16	4.18	1.27	27.2	27.2	27.0	25.9	24.8	23.7
3½ x 3	¾	8.62	1.04	56.1	56.1	53.7	51.0	48.2	45.5
	½	6.00	1.07	39.0	39.0	37.6	35.7	33.9	32.0
	⅜	4.60	1.09	29.9	29.9	28.9	27.5	26.1	24.8
	5/16	3.86	1.10	25.1	25.1	24.3	23.2	22.0	20.8
3½ x 2½	⅝	6.72	1.07	43.7	43.7	42.1	40.0	38.0	35.9
	½	5.50	1.09	35.8	35.8	34.6	32.9	31.3	29.6
	⅜	4.22	1.10	27.4	27.4	26.6	25.3	24.1	22.8
	5/16	3.56	1.11	23.1	23.1	22.5	21.4	20.4	19.3
	¼	2.88	1.12	18.7	18.7	18.2	17.4	16.5	15.7
3 x 2½	9/16	5.56	.91	36.1	35.7	33.6	31.6	29.6	27.6
	7/16	4.44	.92	28.9	28.5	26.9	25.3	23.7	22.2
	5/16	3.24	.94	21.1	20.9	19.8	18.6	17.5	16.3
	¼	2.62	.95	17.0	16.9	16.0	15.1	14.2	13.3
3 x 2	½	4.50	.92	29.3	28.9	27.3	25.7	24.1	22.5
	⅜	3.46	.94	22.5	22.3	21.1	19.9	18.7	17.4
	5/16	2.94	.95	19.1	19.0	18.0	16.9	15.9	14.9
	¼	2.38	.93	15.5	15.3	14.5	13.6	12.8	11.9
2½ x 2	½	4.00	.75	26.0	24.7	23.0	21.2	19.4	17.7
	⅜	3.10	.77	20.2	19.3	17.9	16.6	15.3	13.9
	¼	2.12	.78	13.8	13.2	12.3	11.4	10.5	9.6
	3/16	1.62	.79	10.5	10.1	9.4	8.8	8.1	7.4
2½ x 1½	7/16	3.12	.77	20.3	19.4	18.1	16.7	15.4	14.0
	5/16	2.32	.77	15.1	14.4	13.4	12.4	11.4	10.4
	¼	1.88	.75	12.2	11.6	10.8	10.0	9.1	8.3
	3/16	1.44	.73	9.4	8.8	8.2	7.5	6.9	6.2

Loads to the right of the zigzag line are for lengths greater than 125 radii.

SAFE LOADS IN TONS OF 2000 LBS. FOR
ANGLE STRUTS WITH SQUARE ENDS—(Continued).

TWO UNEQUAL LEG ANGLES, LONG LEGS BACK TO BACK ½″ APART.



Allowable stress per square inch :

13,000 lbs. for lengths under 36 radii.

$15{,}000-55\,\frac{l}{r}$ for lengths over 36 radii.

UNSUPPORTED LENGTH OF STRUT								Thickness, Inches.	Size of Angle, Inches.
8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.	13 Ft.	14 Ft.	15 Ft.		
53.6	50.9	48.1	45.3	42.5	39.7	36.9	34.2	¾	4 x 3½
37.5	35.6	33.7	31.8	30.0	28.1	26.2	24.3	½	
28.8	27.4	26.0	24.5	23.1	21.7	20.3	18.9	⅜	
24.3	23.1	22.0	20.8	19.6	18.4	17.3	16.1	5/16	
50.1	47.5	45.0	42.4	39.9	37.4	34.8	32.3	¾	4 x 3
35.0	33.3	31.6	29.9	28.2	26.4	24.7	23.0	½	
26.8	25.5	24.2	22.9	21.6	20.3	19.0	17.7	⅜	
22.7	21.6	20.5	19.4	18.3	17.2	16.1	15.1	5/16	
42.8	40.0	37.3	34.6	31.8	29.1	26.4	....	¾	3½ x 3
30.2	28.3	26.5	24.6	22.8	20.9	19.1	....	½	
23.4	22.0	20.6	19.2	17.8	16.4	15.0	....	⅜	
19.7	18.5	17.4	16.2	15.1	13.9	12.7	....	5/16	
33.8	31.7	29.7	27.6	25.5	23.5	21.4	....	⅝	3½x2½
27.9	26.3	24.6	22.9	21.3	19.6	17.9	....	½	
21.5	20.3	19.0	17.7	16.5	15.2	13.9	....	⅜	
18.2	17.2	16.1	15.1	14.0	12.9	11.9	....	5/16	
14.8	14.0	13.1	12.3	11.4	10.6	9.7	....	¼	
25.6	23.6	21.5	19.5	17.5	....	....	....	9/16	3 x 2½
20.6	19.0	17.4	15.8	14.2	....	....	....	7/16	
15.2	14.1	12.9	11.8	10.7	....	....	....	5/16	
12.4	11.5	10.5	9.6	8.7	....	....	....	¼	
20.8	19.2	17.6	16.0	14.4	....	....	....	½	3 x 2
16.2	15.0	13.8	12.6	11.4	....	....	....	⅜	
13.9	12.9	11.8	10.8	9.8	....	....	....	5/16	
11.1	10.2	9.4	8.6	7.7	....	....	....	¼	
15.9	14.2	12.4	....	....	....	....	....	½	2½ x 2
12.6	11.3	10.0	....	....	....	....	....	⅜	
8.7	7.8	6.9	....	....	....	....	....	¼	
6.7	6.1	5.4	....	....	....	....	....	3/16	
12.7	11.4	10.0	....	....	....	....	....	7/16	2½x1½
9.4	8.5	7.5	....	....	....	....	....	5/16	
7.5	6.7	5.8	....	....	....	....	....	¼	
5.6	4.9	4.3	....	....	....	....	....	3/16	

Loads to the right of the zigzag line are for lengths greater than 125 radii.

MINIMUM SPANS IN FEET ON WHICH THE CONNECTION ANGLES FOR
AMERICAN STANDARD I BEAMS
CAN BE USED FOR GREATEST SAFE UNIFORMLY DISTRIBUTED LOADS.

Depth of Beam, Inches.	Weight per Foot, Lbs.	LEAST SPAN IN FEET FOR VARIOUS CONDITIONS. Rivets: Shearing 10,000 Lbs., bearing 20,000 Lbs. per Square Inch. Connection to Web of Beam.	Field Connection.	When two beams frame opposite each other to a beam or girder with a web thickness as follows: $\frac{9}{16}''$	$\frac{1}{2}''$	$\frac{7}{16}''$	$\frac{3}{8}''$	$\frac{5}{16}''$	$\frac{1}{4}''$	Field Connection. Rivet Shear, 8,000 Lbs. per Square Inch.
24	80.	17.7	15.0	15.7	17.7	20.2	23.5	28.3	35.4	18.8
20	80.	14.8	14.8	15.4	17.4	19.9	23.2	27.8	34.8	18.5
20	65.	13.9	11.8	12.3	13.9	15.8	18.5	22.2	27.7	14.7
18	55.	13.7	10.7	11.2	12.6	14.4	16.7	20.1	25.1	13.4
15	80.	10.7	16.0	16.8	18.9	21.6	25.1	30.2	37.7	20.0
15	60.	8.2	12.2	12.8	14.4	16.5	19.2	23.1	28.9	15.3
15	42.	8.5	8.9	9.3	10.5	12.0	13.9	16.7	20.9	11.1
12	40.	6.9	9.0	9.4	10.6	12.1	14.2	17.0	21.2	11.3
12	31.5	7.3	7.2	7.6	8.5	9.7	11.4	13.6	17.1	9.1
10	25.	9.3	7.4	7.7	8.7	9.9	11.6	13.9	17.4	9.2
9	21.	7.7	5.7	6.0	6.7	7.7	8.9	10.7	13.4	7.1
8	18.	6.2	4.3	4.5	5.1	5.8	6.7	8.1	10.1	5.4
7	15.	4.9	3.1	3.3	3.7	4.2	4.9	5.9	7.4	3.9
6	12.25	5.6	4.4	4.6	5.2	5.9	6.9	8.3	10.3	5.5
5	9.75	4.1	2.9	3.1	3.4	3.9	4.6	5.5	6.9	3.7
4	7.50	2.8	1.8	1.9	2.1	2.4	2.8	3.4	4.2	2.3

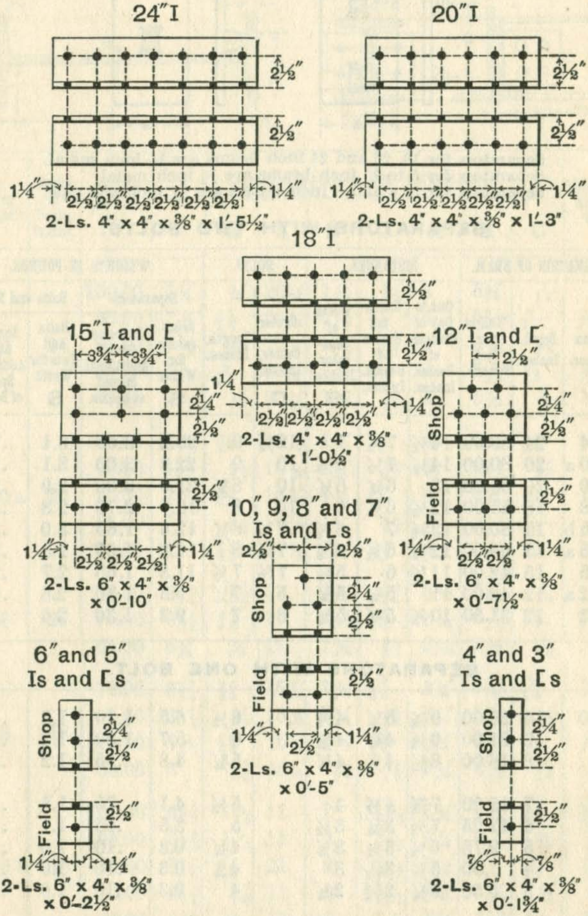
The greatest value given of the least span for any of the governing conditions is the minimum span for which the connection may be used.

WEIGHTS OF CONNECTION ANGLES FOR STANDARD I BEAMS.

Depth of Beam.	Weight of One Connection.	Depth of Beam.	Weight of One Connection.	Depth of Beam.	Weight of One Connection.
24 Inches.	32 Lbs.	12 Inches.	18 Lbs.	7 Inches.	12 Lbs.
20 "	28 "	10 "	12 "	6 "	7 "
18 "	24 "	9 "	12 "	5 "	7 "
15 "	24 "	8 "	12 "	4 "	5 "

Weights given do not include rivets for field connections.

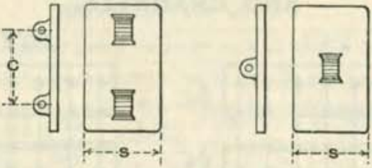
CONNECTION ANGLES
FOR AMERICAN STANDARD I BEAMS AND CHANNELS.



All holes $\frac{13}{16}''$ diameter for $\frac{3}{4}''$ diameter rivets or bolts.

CAST IRON SEPARATORS FOR

AMERICAN STANDARD I BEAMS.



Separators for 18, 20 and 24 inch beams are ⅝ inch metal.
Separators for 6 to 15 inch beams are ½ inch metal.
Separators for 3, 4 and 5 inch beams are ¾ inch gas pipe.

SEPARATORS WITH TWO BOLTS.

DESIGNATION OF BEAM.			DISTANCES.			BOLTS.		WEIGHTS IN POUNDS.			
								Separators.		Bolts and Nuts.	
Section Number.	Depth, Inches.	Weight per Foot, Pounds.	Out to Out of Flanges of Beams, Inches.	Center to Center of Beams. Inches.	Width of Separator, Inches. S	Center to Center, Inches. C	Length, Inches.	Separators for Width S	Increase for 1″ Additional Spread of Beams.	Bolts and Nuts for Width S	Increase for 1″ Additional Spread of Beams.
I 24	24	80.00	14½	7½	7	12½	9	28.2	3.65	3.1	.25
I 20 a	20	80.00	14½	7½	6⅞	10	9	22.9	3.00	3.1	.25
I 20	20	65.00	13	6¾	6¼	10	8¼	21.0	3.00	2.9	.25
I 18	18	55.00	12½	6½	6	10	8	18.7	2.70	2.8	.25
I 15 b	15	80.00	13⅜	7	6⅛	7½	8¾	12.6	1.65	3.0	.25
I 15 a	15	60.00	12½	6½	5⅞	7½	8	12.2	1.65	2.8	.25
I 15	15	42.00	11½	6	5⅝	7½	7½	11.8	1.65	2.7	.25
I 12 a	12	40.00	11	5¾	5¼	5	7¼	9.3	1.30	2.6	.25
I 12	12	31.50	10⅝	5⅝	5¼	5	7	9.3	1.30	2.6	.25

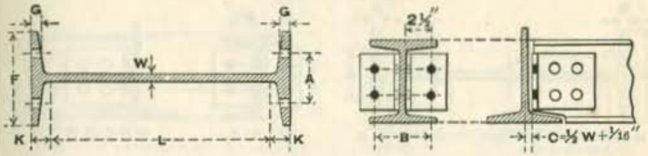
SEPARATORS WITH ONE BOLT.

I 10	10	25.00	9⅞	5¼	4⅞		6½	6.5	1.10	1.2	.125
I 9	9	21.00	9⅛	4¾	4½		6	5.7	1.00	1.2	.125
I 8	8	18.00	8½	4½	4¼		5¾	4.8	.85	1.2	.125
I 7	7	15.00	7⅞	4½	4		5½	4.1	.75	1.1	.125
I 6	6	12.25	7⅛	3¾	3½		5	3.5	.65	1.1	.125
I 5	5	9.75	6½	3½	3¼		4¾	0.3	.10	1.0	.125
I 4	4	7.50	5⅞	3 3/16	3		4¼	0.3	.10	1.0	.125
I 3	3	5.50	5¼	2 15/16	2¾		4	0.3	.10	1.0	.125

All bolts ¾ inch diameter.

DETAIL DIMENSIONS FOR

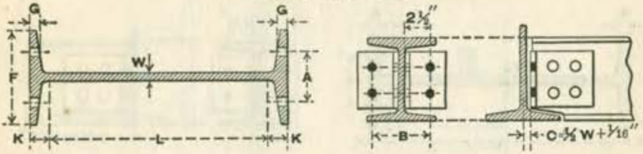
AMERICAN STANDARD I BEAMS.



Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	DIMENSIONS IN INCHES. F	W	L	K	G	A	B	C	Maximum Rivet or Bolt.
		100.00	7¼	¾	20¾	1⅝	27/32	4	5¾	7/16	⅞
		95.00	7 3/16	11/16	20¾	1⅝	27/32	4	5 11/16	7/16	⅞
I24	24	90.00	7⅛	⅝	20¾	1⅝	27/32	4	5⅝	⅜	⅞
		85.00	7 1/16	9/16	20¾	1⅝	27/32	4	5 9/16	⅜	⅞
		80.00	7	½	20¾	1⅝	27/32	4	5½	5/16	⅞
		100.00	7 9/32	⅞	16½	1¾	29/32	4	5⅞	½	⅞
		95.00	7 13/64	51/64	16½	1¾	29/32	4	5 13/16	½	⅞
I20 a	20	90.00	7 3/64	47/64	16½	1¾	29/32	4	5¾	7/16	⅞
		85.00	7 1/16	21/32	16½	1¾	29/32	4	5 11/16	7/16	⅞
		80.00	7	19/32	16½	1¾	29/32	4	5⅝	⅜	⅞
		75.00	6 13/32	21/32	17	1½	25/32	3½	5 11/16	7/16	⅞
I20	20	70.00	6 21/64	37/64	17	1½	25/32	3½	5 9/16	⅜	⅞
		65.00	6¼	½	17	1½	25/32	3½	5½	5/16	⅞
		70.00	6 17/64	23/32	15¼	1⅜	11/16	3¼	5¾	7/16	⅞
		65.00	6 11/64	⅝	15¼	1⅜	11/16	3¼	5⅝	⅜	⅞
I18	18	60.00	6 3/32	35/64	15¼	1⅜	11/16	3¼	5 9/16	⅜	⅞
		55.00	6	29/64	15¼	1⅜	11/16	3¼	5½	5/16	⅞
		100.00	6 25/32	1 3/16	11	2	1 1/32	3¾	6 3/16	11/16	⅞
		95.00	6 43/64	1 5/64	11	2	1 1/32	3¾	6 1/16	⅝	⅞
I15 b	15	90.00	6 37/64	63/64	11	2	1 1/32	3¾	6	9/16	⅞
		85.00	6 31/64	57/64	11	2	1 1/32	3¾	5⅞	½	⅞
		80.00	6 13/32	13/16	11	2	1 1/32	3¾	5 13/16	½	⅞

DETAIL DIMENSIONS FOR

AMERICAN STANDARD I BEAMS
(CONTINUED).

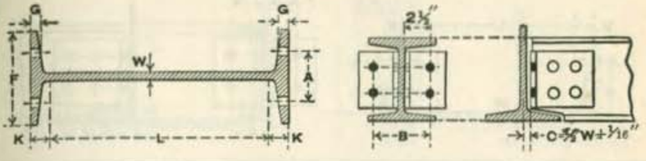


Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	F	W	L	K	G	A	B	C	Maximum Rivet or Bolt.
			DIMENSIONS IN INCHES.								
I15 a	15	75.00	$6\frac{19}{64}$	$\frac{57}{64}$	$11\frac{3}{4}$	$1\frac{5}{8}$	$\frac{13}{16}$	$3\frac{1}{4}$	$5\frac{7}{8}$	$\frac{1}{2}$	$\frac{3}{4}$
		70.00	$6\frac{3}{16}$	$\frac{25}{32}$	$11\frac{3}{4}$	$1\frac{5}{8}$	$\frac{13}{16}$	$3\frac{1}{4}$	$5\frac{3}{4}$	$\frac{7}{16}$	$\frac{3}{4}$
		65.00	$6\frac{3}{32}$	$\frac{11}{16}$	$11\frac{3}{4}$	$1\frac{5}{8}$	$\frac{13}{16}$	$3\frac{1}{4}$	$5\frac{11}{16}$	$\frac{7}{16}$	$\frac{3}{4}$
		60.00	6	$\frac{19}{32}$	$11\frac{3}{4}$	$1\frac{5}{8}$	$\frac{13}{16}$	$3\frac{1}{4}$	$5\frac{5}{8}$	$\frac{3}{8}$	$\frac{3}{4}$
I15	15	55.00	$5\frac{3}{4}$	$\frac{21}{32}$	$12\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	3	$5\frac{5}{8}$	$\frac{3}{8}$	$\frac{3}{4}$
		50.00	$5\frac{41}{64}$	$\frac{35}{64}$	$12\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	3	$5\frac{9}{16}$	$\frac{3}{8}$	$\frac{3}{4}$
		45.00	$5\frac{35}{64}$	$\frac{29}{64}$	$12\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	3	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{3}{4}$
		42.00	$5\frac{1}{2}$	$\frac{13}{32}$	$12\frac{1}{2}$	$1\frac{1}{4}$	$\frac{5}{8}$	3	$5\frac{7}{16}$	$\frac{1}{4}$	$\frac{3}{4}$
I12 a	12	55.00	$5\frac{39}{64}$	$\frac{13}{16}$	$9\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	3	$5\frac{13}{16}$	$\frac{1}{2}$	$\frac{3}{4}$
		50.00	$5\frac{31}{64}$	$\frac{11}{16}$	$9\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	3	$5\frac{11}{16}$	$\frac{7}{16}$	$\frac{3}{4}$
		45.00	$5\frac{23}{64}$	$\frac{9}{16}$	$9\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	3	$5\frac{9}{16}$	$\frac{3}{8}$	$\frac{3}{4}$
		40.00	$5\frac{1}{4}$	$\frac{29}{64}$	$9\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	3	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{3}{4}$
I12	12	35.00	$5\frac{3}{32}$	$\frac{7}{16}$	$9\frac{3}{4}$	$1\frac{1}{8}$	$\frac{17}{32}$	$2\frac{3}{4}$	$5\frac{7}{16}$	$\frac{5}{16}$	$\frac{3}{4}$
		31.50	5	$\frac{11}{32}$	$9\frac{3}{4}$	$1\frac{1}{8}$	$\frac{17}{32}$	$2\frac{3}{4}$	$5\frac{3}{8}$	$\frac{1}{4}$	$\frac{3}{4}$
I10	10	40.00	$5\frac{3}{32}$	$\frac{3}{4}$	8	1	$\frac{15}{32}$	$2\frac{5}{8}$	$5\frac{3}{4}$	$\frac{7}{16}$	$\frac{3}{4}$
		35.00	$4\frac{61}{64}$	$\frac{39}{64}$	8	1	$\frac{15}{32}$	$2\frac{5}{8}$	$5\frac{5}{8}$	$\frac{3}{8}$	$\frac{3}{4}$
		30.00	$4\frac{13}{16}$	$\frac{15}{32}$	8	1	$\frac{15}{32}$	$2\frac{5}{8}$	$5\frac{1}{2}$	$\frac{5}{16}$	$\frac{3}{4}$
		25.00	$4\frac{21}{32}$	$\frac{5}{16}$	8	1	$\frac{15}{32}$	$2\frac{5}{8}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{4}$
I9	9	35.00	$4\frac{49}{64}$	$\frac{47}{64}$	7	1	$\frac{7}{16}$	$2\frac{1}{2}$	$5\frac{3}{4}$	$\frac{7}{16}$	$\frac{3}{4}$
		30.00	$4\frac{39}{64}$	$\frac{37}{64}$	7	1	$\frac{7}{16}$	$2\frac{1}{2}$	$5\frac{9}{16}$	$\frac{3}{8}$	$\frac{3}{4}$
		25.00	$4\frac{29}{64}$	$\frac{27}{64}$	7	1	$\frac{7}{16}$	$2\frac{1}{2}$	$5\frac{7}{16}$	$\frac{5}{16}$	$\frac{3}{4}$
		21.00	$4\frac{21}{64}$	$\frac{19}{64}$	7	1	$\frac{7}{16}$	$2\frac{1}{2}$	$5\frac{5}{16}$	$\frac{1}{4}$	$\frac{3}{4}$

DETAIL DIMENSIONS FOR

AMERICAN STANDARD I BEAMS

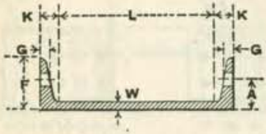
(CONTINUED).

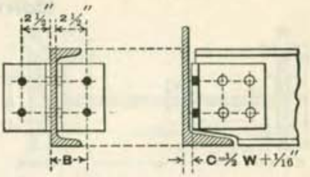


Section Number.	Depth of Beam, Inches.	Weight per Foot, Lbs.	DIMENSIONS IN INCHES. F	W	L	K	G	A	B	C	Maximum Rivet or Bolt.
I8	8	25.50	4 17/64	17/32	6¼	⅞	13/32	2¼	5 9/16	⅜	¾
		23.00	4 11/64	7/16	6¼	⅞	13/32	2¼	5 7/16	5/16	¾
		20.50	4 3/32	23/64	6¼	⅞	13/32	2¼	5⅜	¼	¾
		18.00	4	17/64	6¼	⅞	13/32	2¼	5 5/16	3/16	¾
I7	7	20.00	3⅞	15/32	5¼	⅞	⅜	2¼	5½	5/16	⅝
		17.50	3 49/64	23/64	5¼	⅞	⅜	2¼	5⅜	¼	⅝
		15.00	3 21/32	¼	5¼	⅞	⅜	2¼	5¼	3/16	⅜
I6	6	17.25	3 37/64	31/64	4½	¾	11/32	2	5½	5/16	⅝
		14.75	3 29/64	23/64	4½	¾	11/32	2	5⅜	¼	⅝
		12.25	3 21/64	15/64	4½	¾	11/32	2	5¼	3/16	⅝
I5	5	14.75	3 19/64	½	3½	¾	5/16	1¾	5½	5/16	½
		12.25	3 9/64	11/32	3½	¾	5/16	1¾	5⅜	¼	½
		9.75	3	13/64	3½	¾	5/16	1¾	5¼	3/16	½
I4	4	10.50	2⅞	13/32	2¾	⅝	9/32	1½	5 7/16	5/16	½
		9.50	2 13/16	11/32	2¾	⅝	9/32	1½	5⅜	¼	½
		8.50	2 47/64	17/64	2¾	⅝	9/32	1½	5¼	3/16	½
		7.50	2 21/32	3/16	2¾	⅝	9/32	1½	5 3/16	3/16	½

DETAIL DIMENSIONS FOR

AMERICAN STANDARD CHANNELS.



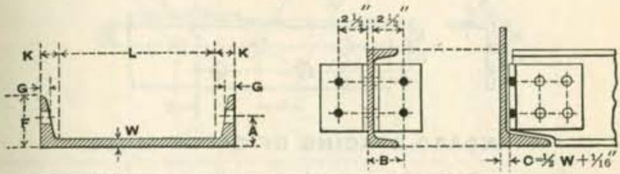


Section Number.	Depth of Channel, Inches.	Weight per Foot, Lbs.	DIMENSIONS IN INCHES.								Maximum Rivet or Bolt.
			F	W	L	K	G	A	B	C	
C15	15	55.00	$3\frac{13}{16}$	$\frac{13}{16}$	$12\frac{1}{4}$	$1\frac{3}{8}$	$\frac{5}{8}$	$2\frac{1}{4}$	$3\frac{5}{16}$	$\frac{7}{8}$	$\frac{3}{4}$
		50.00	$3\frac{23}{32}$	$\frac{23}{32}$	$12\frac{1}{4}$	$1\frac{3}{8}$	$\frac{5}{8}$	$2\frac{1}{4}$	$3\frac{1}{4}$	$\frac{13}{16}$	$\frac{3}{4}$
		45.00	$3\frac{5}{8}$	$\frac{5}{8}$	$12\frac{1}{4}$	$1\frac{3}{8}$	$\frac{5}{8}$	$2\frac{1}{4}$	$3\frac{1}{8}$	$\frac{11}{16}$	$\frac{3}{4}$
		40.00	$3\frac{17}{32}$	$\frac{17}{32}$	$12\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	$1\frac{7}{8}$	3	$\frac{5}{8}$	$\frac{3}{4}$
		35.00	$3\frac{27}{64}$	$\frac{27}{64}$	$12\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	$1\frac{7}{8}$	$2\frac{15}{16}$	$\frac{1}{2}$	$\frac{3}{4}$
		33.00	$3\frac{13}{32}$	$\frac{13}{32}$	$12\frac{1}{4}$	$1\frac{3}{8}$	$\frac{21}{32}$	$1\frac{7}{8}$	$2\frac{7}{8}$	$\frac{1}{2}$	$\frac{3}{4}$
C12	12	40.00	$3\frac{27}{64}$	$\frac{49}{64}$	10	1	$\frac{15}{32}$	2	$3\frac{1}{4}$	$\frac{13}{16}$	$\frac{3}{4}$
		35.00	$3\frac{19}{64}$	$\frac{41}{64}$	10	1	$\frac{15}{32}$	2	$3\frac{1}{8}$	$\frac{11}{16}$	$\frac{3}{4}$
		30.00	$3\frac{11}{64}$	$\frac{33}{64}$	10	1	$\frac{15}{32}$	2	3	$\frac{9}{16}$	$\frac{3}{4}$
		25.00	$3\frac{3}{64}$	$\frac{25}{64}$	10	1	$\frac{15}{32}$	$1\frac{3}{4}$	$2\frac{7}{8}$	$\frac{7}{16}$	$\frac{3}{4}$
		20.50	$2\frac{15}{16}$	$\frac{9}{32}$	10	1	$\frac{15}{32}$	$1\frac{3}{4}$	$2\frac{13}{16}$	$\frac{3}{8}$	$\frac{3}{4}$
C10	10	35.00	$3\frac{3}{16}$	$\frac{53}{64}$	$8\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	2	$3\frac{5}{16}$	$\frac{7}{8}$	$\frac{3}{4}$
		30.00	$3\frac{1}{32}$	$\frac{43}{64}$	$8\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	2	$3\frac{3}{16}$	$\frac{3}{4}$	$\frac{3}{4}$
		25.00	$2\frac{57}{64}$	$\frac{17}{32}$	$8\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	2	3	$\frac{5}{8}$	$\frac{3}{4}$
		20.00	$2\frac{47}{64}$	$\frac{3}{8}$	$8\frac{1}{4}$	$\frac{7}{8}$	$\frac{7}{16}$	$1\frac{1}{2}$	$2\frac{7}{8}$	$\frac{7}{16}$	$\frac{3}{4}$
		15.00	$2\frac{19}{32}$	$\frac{15}{64}$	$8\frac{1}{4}$	$\frac{7}{8}$	$\frac{7}{16}$	$1\frac{1}{2}$	$2\frac{3}{4}$	$\frac{5}{16}$	$\frac{3}{4}$
C9	9	25.00	$2\frac{13}{16}$	$\frac{39}{64}$	$7\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	$1\frac{3}{4}$	$3\frac{1}{8}$	$\frac{11}{16}$	$\frac{3}{4}$
		20.00	$2\frac{21}{32}$	$\frac{29}{64}$	$7\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	$1\frac{3}{4}$	3	$\frac{1}{2}$	$\frac{3}{4}$
		15.00	$2\frac{31}{64}$	$\frac{9}{32}$	$7\frac{1}{4}$	$\frac{7}{8}$	$\frac{13}{32}$	$1\frac{3}{8}$	$2\frac{13}{16}$	$\frac{3}{8}$	$\frac{3}{4}$
		13.25	$2\frac{7}{16}$	$\frac{15}{64}$	$7\frac{1}{4}$	$\frac{7}{8}$	$\frac{13}{32}$	$1\frac{3}{8}$	$2\frac{3}{4}$	$\frac{5}{16}$	$\frac{3}{4}$

DETAIL DIMENSIONS FOR

AMERICAN STANDARD CHANNELS

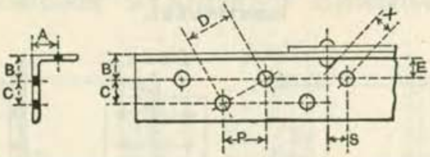
(CONTINUED).



Section Number.	Depth of Channel, Inches.	Weight per Foot, Lbs.	DIMENSIONS IN INCHES.								Maximum Rivet or Bolt.
			F	W	L	K	G	A	B	C	
		21.25	2 5/8	37/64	6 1/4	7/8	3/8	1 1/2	3 1/16	5/8	3/4
		18.75	2 17/32	31/64	6 1/4	7/8	3/8	1 1/2	3	9/16	3/4
C8	8	16.25	2 7/16	25/64	6 1/4	7/8	3/8	1 1/2	2 7/8	7/16	3/4
		13.75	2 11/32	19/64	6 1/4	7/8	3/8	1 1/4	2 13/16	3/8	3/4
		11.25	2 17/64	7/32	6 1/4	7/8	3/8	1 1/4	2 3/4	5/16	3/4
		19.75	2 33/64	5/8	5 1/2	3/4	3/8	1 1/2	3 1/8	11/16	5/8
		17.25	2 13/32	33/64	5 1/2	3/4	3/8	1 1/2	3	9/16	5/8
C7	7	14.75	2 19/64	13/32	5 1/2	3/4	11/32	1 1/4	2 15/16	1/2	5/8
		12.25	2 13/64	5/16	5 1/2	3/4	11/32	1 1/4	2 13/16	3/8	5/8
		9.75	2 3/32	13/64	5 1/2	3/4	11/32	1 1/4	2 11/16	1/4	5/8
		15.50	2 9/32	9/16	4 1/2	3/4	11/32	1 3/8	3 1/16	5/8	5/8
C6	6	13.00	2 5/32	7/16	4 1/2	3/4	11/32	1 3/8	2 15/16	1/2	5/8
		10.50	2 1/32	5/16	4 1/2	3/4	11/32	1 1/8	2 13/16	3/8	5/8
		8.00	1 59/64	13/64	4 1/2	3/4	11/32	1 1/8	2 11/16	1/4	5/8
		11.50	2 1/32	15/32	3 3/4	5/8	5/16	1 1/4	3	9/16	1/2
C5	5	9.00	1 57/64	21/64	3 3/4	5/8	5/16	1 1/4	2 13/16	3/8	1/2
		6.50	1 3/4	3/16	3 3/4	5/8	5/16	1	2 11/16	1/4	1/2
		7.25	1 23/32	21/64	2 3/4	5/8	9/32	1	2 13/16	3/8	1/2
C4	4	6.25	1 21/32	17/64	2 3/4	5/8	9/32	1	2 3/4	5/16	1/2
		5.25	1 37/32	3/16	2 3/4	5/8	9/32	1	2 11/16	1/4	1/2

RIVET SPACING FOR ANGLES.

ALL DIMENSIONS ARE IN INCHES.



STANDARD SPACING OF GAUGE LINES.

Length of Leg.	GAUGES. A	GAUGES. B	GAUGES. C	Maximum Rivet.	Length of Leg.	GAUGE. A	Maximum Rivet.
8	5	3	3	1	3	1 3/4	3/4
7	4 1/2	2 1/2	3	1	2 1/2	1 3/8	3/4
6	4	2 1/2	2 1/4	7/8	2 1/4	1 1/4	5/8
5	3	2	1 3/4	7/8	2	1 1/8	1/2
4	2 1/2	1 3/4	1	7/8	1 3/4	1	1/2
3 1/2	2			7/8	1 1/2	7/8	3/8

STAGGERED DISTANCE CENTERS OF RIVETS.

TABLE GIVING DISTANCE D FOR VARYING VALUES OF P AND C.

Gauge. C	VALUES OF P OR PITCH OF RIVETS. 1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2
1	1 1/2	1 5/8	1 11/16	1 13/16	1 7/8	2	2 1/8	2 1/4	2 5/16	2 7/16	2 9/16	2 11/16
1 1/4	1 11/16	1 3/4	1 7/8	1 15/16	2 1/16	2 1/8	2 1/4	2 3/8	2 7/16	2 9/16	2 11/16	2 13/16
1 1/2	1 7/8	1 15/16	2	2 1/8	2 3/16	2 5/16	2 3/8	2 1/2	2 5/8	2 11/16	2 13/16	2 15/16
1 3/4	2 1/16	2 1/8	2 3/16	2 5/16	2 3/8	2 7/16	2 9/16	2 5/8	2 3/4	2 7/8	2 15/16	3 1/16
2	2 5/16	2 3/8	2 7/16	2 1/2	2 9/16	2 5/8	2 3/4	2 13/16	2 15/16	3	3 1/8	3 3/16
2 1/4	2 1/2	2 9/16	2 5/8	2 11/16	2 3/4	2 7/8	2 15/16	3	3 1/16	3 3/16	3 1/4	3 3/8
2 1/2	2 3/4	2 13/16	2 7/8	2 15/16	3	3 1/16	3 1/8	3 3/16	3 1/4	3 3/8	3 7/16	3 9/16

Values of D below or to right of upper zigzag line are sufficient for 3/4″ rivets.
Values of D below or to right of lower zigzag line are sufficient for 7/8″ rivets.

MINIMUM STAGGER FOR CLEARANCE IN DRIVING.

Distance. E	S 3/4 Rivet.	S 7/8 Rivet.	Distance. E	S 3/4 Rivet.	S 7/8 Rivet.	Distance. E	S 3/4 Rivet.	S 7/8 Rivet.
1 1/8	1 1/8	1 3/8	1 3/8	3/4	1 1/8	1 5/8	0	11/16
1 3/16	1 1/16	1 5/16	1 7/16	5/8	1	1 11/16	0	1/2
1 1/4	15/16	1 1/4	1 1/2	7/16	15/16	1 3/4	0	0
1 5/16	7/8	1 3/16	1 9/16	0	13/16			

X = 1″ for 3/4″ rivets. X = 1 1/32″ for 7/8″ rivets.

PART III

GENERAL INFORMATION

RELATING TO

STEEL CONSTRUCTION

NOTES ON THE STRENGTH AND DEFLECTION OF BEAMS.

The general notation employed throughout is as follows:

a = area of section, in square inches.
L = length of span, in feet.
l = length of span, in inches.
W = load uniformly distributed, in lbs.
P = load concentrated at any point, in lbs.
d = depth of cross-section, in inches.
M = bending moment, in foot-lbs.
m = bending moment, in inch-lbs.
n = greatest distance of center of gravity of section from top or from bottom, in inches.
f = stress, in lbs., per square inch in extreme fibers of beam, either top or bottom, according as n refers 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.
z = distance between these neutral axes.
S = section modulus.
R = least moment of resistance of section, in inch-lbs.
r = radius of gyration, in inches.
C = coefficient of transverse strength, in lbs.
E = modulus of elasticity (29,000,000 for steel).

For a beam of any cross-section the relations existing between the properties of the section are as follows:

$$I'' = I + az^2. \qquad r = \sqrt{\frac{I}{a}}. \qquad S = \frac{I}{n}.$$

$$R = \frac{I}{n}f = fS. \qquad C = \frac{2}{3}fS.$$

The moment of resistance of the internal stresses of the beam resisting flexure must be equal to the moment of the external forces which act on the beam producing bending. The moment of resistance of a section is usually expressed in inch-lbs., in which case the bending moment must be expressed also in inch-lbs.

The relations existing between bending moment, moment of resistance, section modulus and stress per square inch are expressed thus:

$$m = R. \qquad S = \frac{m}{f}.$$

$$m = fS. \qquad f = \frac{m}{S}.$$

When the bending moment is in foot-lbs., the following relations are useful:

$$C = 8M. \qquad M = \frac{C}{8}.$$

If W is a uniformly distributed load in lbs., and the span, L, is taken in feet, then:

$$C = WL. \qquad W = \frac{C}{L}.$$

The last two formulas are convenient. To find the safe uniformly distributed load in lbs. for any section, it is only necessary to divide its coefficient of strength by the span in feet. If the uniformly distributed load in lbs. is given, multiply it by the span in feet and the result is the coefficient of strength required by the section.

On the next page formulas are given for finding bending moments, safe loads and deflections for beams loaded and supported in usual ways. Bending moments will be in foot-lbs. or inch-lbs. according as the lengths are taken in feet or inches. To obtain deflection in inches the lengths must be taken in inches.

For illustration, take a center load of 30,000 lbs. on a span of 20 feet:

$$M = \frac{30{,}000 \times 20}{4} = 150{,}000 \text{ foot-lbs.}$$

$$C = 8M = 8 \times 150{,}000 = 1{,}200{,}000.$$

The nearest beam is a 20″ Bethlehem special I beam, weighing 58.5 lbs. per foot, which has a coefficient of 1,254,800.

If the bending moment had been taken in inch-lbs., then

$$m = \frac{30{,}000 \times 240}{4} = 1{,}800{,}000 \text{ inch-lbs.}$$

$$S = \frac{m}{f} = 1{,}800{,}000 \div 16{,}000 = 112.5$$

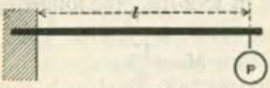
The beam selected by the first method has a section modulus of 117.6, which is the nearest to that required. Both methods of calculation give identical results.

BENDING MOMENTS AND DEFLECTIONS OF BEAMS FOR USUAL METHODS OF LOADING.

P or W = total load
l = length of beam

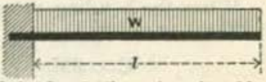
I = moment of inertia
E = modulus of elasticity

(1.) Beam fixed at one end and loaded at the other.



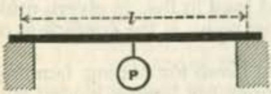
Safe load = ⅛ that given in tables.
Maximum bending moment at point of support = Pl.
Maximum shear at point of support = P.
Deflection = $\frac{Pl^3}{3EI}$.

(2.) Beam fixed at one end and uniformly loaded.



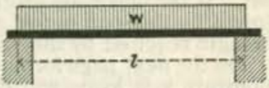
Safe load = ¼ that given in tables.
Maximum bending moment at point of support = $\frac{Wl}{2}$.
Maximum shear at point of support = W.
Deflection = $\frac{Wl^3}{8EI}$.

(3.) Beam supported at both ends, single load in the middle.



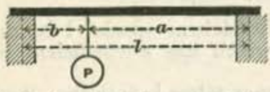
Safe load = ½ that given in tables.
Maximum bending moment at middle of beam = $\frac{Pl}{4}$.
Maximum shear at points of support = ½ P.
Deflection = $\frac{Pl^3}{48EI}$.

(4.) Beam supported at both ends and uniformly loaded.



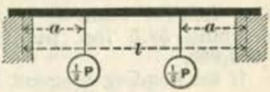
Safe load = that given in tables.
Maximum bending moment at middle of beam = $\frac{Wl}{8}$.
Maximum shear at points of support = ½ W.
Deflection = $\frac{5Wl^3}{384EI}$.

(5.) Beam supported at both ends, single unsymmetrical load.



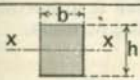
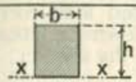
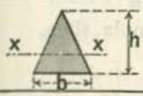
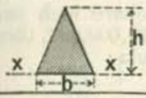
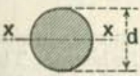
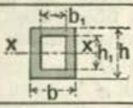
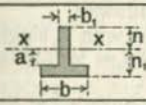
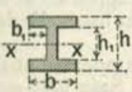
Safe load = that given in tables × $\frac{l^2}{8ab}$.
Maximum bending moment under load = $\frac{Pab}{l}$.
Maximum shears: at support, a end = $\frac{Pb}{l}$; at other support = $\frac{Pa}{l}$.
Max. Deflec. = $\frac{Pab(2l-a)}{9EIl}\sqrt{\tfrac{1}{3}a(2l-a)}$.

(6.) Beam supported at both ends, two symmetrical loads.



Safe load = that given in tables × $\frac{l}{4a}$.
Maximum bending moment between loads = ½ Pa.
Maximum shear between load and nearer support = ½ P.
Max. Deflection = $\frac{Pa}{48EI}(3l^2-4a^2)$.

MOMENT OF INERTIA AND SECTION MODULUS FOR USUAL SECTIONS.

Sections.	Moment of Inertia. I	Section Modulus. S
	$I = \frac{bh^3}{12}$	$\frac{bh^2}{6}$
	$I' = \frac{bh^3}{3}$	
	$I = \frac{bh^3}{36}$	Min. $= \frac{bh^2}{24}$
	$I' = \frac{bh^3}{12}$	
	$I = \frac{\pi d^4}{64}$ $= 0.0491\ d^4$	$\frac{\pi d^3}{32}$ $= 0.0982\ d^3$
	$I = \frac{bh^3 - b_1h_1^3}{12}$	$\frac{I}{\frac{1}{2}h}$
	$I = 0.0491\ (d^4 - d_1^4)$	$0.0982\left(d^3 - \frac{d_1^4}{d}\right)$
	$I = \frac{b_1n^3 + bn_1^3 - (b - b_1)a^3}{3}$	Min. $= \frac{I}{n}$
	$I = \frac{bh^3 - 2b_1h_1^3}{12}$	$\frac{I}{\frac{1}{2}h}$

XX indicates position of neutral axis.

DEFLECTION

OF STEEL BEAMS AND GIRDERS UNDER TRANSVERSE LOADS.

Using the notation given on page 232, the deflection, in inches, of a steel beam or other section under a uniformly distributed load of W, in lbs., is found from the formula,

$$D=\frac{5}{384}\frac{Wl^3}{EI}=\frac{5}{384}\frac{W(12L)^3}{EI}.$$

When W is the safe uniformly distributed load corresponding to a coefficient of strength C, the following relations exist between W and C and the properties of the shape:

$$W=\frac{C}{L}, \quad \text{and} \quad C=\tfrac{2}{3}fS=\tfrac{2}{3}f\frac{I}{n}.$$

Substituting these values in the above formula, then,

$$D=\frac{15fL^2}{nE}.$$

When the fiber stress is 16,000 lbs. per square inch and the modulus of elasticity of steel taken as 29,000,000, then the deflection, in inches, is given by the formula:

$$D=\frac{0.01655L^2}{2n}.$$

In the case of a beam, girder or other section symmetrical about its neutral axis, $2n$ equals the depth of the beam. The deflection, in inches, of such a section under its safe uniformly distributed load which produces a fiber stress of 16,000 lbs. per square inch is given by the simple formula,

$$D=\frac{0.01655L^2}{d}, \text{ or very nearly}=\frac{1}{60}\frac{L^2}{d}.$$

The table on the opposite page gives the value of the expression $0.01655L^2$ for spans from 1 foot to 60 feet.

The safe loads and corresponding deflections for other usual cases of loading, as compared with the safe uniformly distributed loads given in the tables, are as follows:

Beam supported at both ends and loaded with a single load concentrated at center of span. Safe load $=\frac{1}{2}$ tabular load. Deflection $=\frac{8}{10}$.

Cantilever beam, fixed at one end and unsupported at the other, uniformly loaded. Safe load $=\frac{1}{4}$ tabular load. Deflection $=2\frac{4}{10}$.

Cantilever beam, fixed at one end and unsupported at the other, single load concentrated at free end. Safe load $=\frac{1}{8}$ tabular load. Deflection $=3\frac{2}{10}$.

DEFLECTION COEFFICIENTS

FOR UNIFORMLY DISTRIBUTED LOADS.

FIBER STRESS, 16,000 LBS. PER SQUARE INCH.

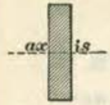
Length of Span, Feet.	Deflection Coefficient.	Length of Span, Feet.	Deflection Coefficient.	Length of Span, Feet.	Deflection Coefficient.	Length of Span, Feet.	Deflection Coefficient.
1	.0166	16	4.2372	31	15.9062	46	35.0234
2	.0662	17	4.7834	32	16.9490	47	36.5628
3	.1490	18	5.3628	33	18.0248	48	38.1352
4	.2648	19	5.9752	34	19.1338	49	39.7407
5	.4138	20	6.6207	35	20.2759	50	41.3793
6	.5959	21	7.2993	36	21.4510	51	43.0510
7	.8110	22	8.0110	37	22.6593	52	44.7559
8	1.0593	23	8.7559	38	23.9007	53	46.4938
9	1.3407	24	9.5338	39	25.1752	54	48.2648
10	1.6552	25	10.3448	40	26.4828	55	50.0690
11	2.0028	26	11.1890	41	27.8234	56	51.9062
12	2.3834	27	12.0662	42	29.1972	57	53.7766
13	2.7972	28	12.9766	43	30.6041	58	55.6800
14	3.2441	29	13.9200	44	32.0441	59	57.6166
15	3.7241	30	14.8966	45	33.5172	60	59.5862

These coefficients furnish a convenient means of finding the deflection of steel sections under their uniformly distributed safe loads for a maximum fiber stress of 16,000 lbs. per square inch.

To find the deflection of a steel beam, girder or other section which is symmetrical about its neutral axis, under the above conditition of loading, divide the deflection coefficient found in the above table for the given span by the depth of the beam in inches. The quotient will be the deflection in inches.

To find the deflection of an angle or other section which is not symmetrical about its neutral axis under the above condition of loading, divide the deflection coefficient in the table for the given span by twice the greatest distance, in inches, of the neutral axis from the outside fiber in the direction of bending.

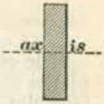
Under uniformly distributed loading corresponding to other intensities of stress the deflection can be found by simple proportion. Thus, for a uniformly distributed load producing a fiber stress of 12,000 lbs. per square inch the deflection will be $\frac{12000}{16000}$ or $\frac{3}{4}$ of that found by the use of the above coefficients.



MOMENTS OF INERTIA OF RECTANGLES.

Depth, in Inches.	WIDTH OF RECTANGLE.						
	1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″
5	2.60	3.26	3.91	4.56	5.21	5.86	6.51
6	4.50	5.63	6.75	7.88	9.00	10.13	11.25
7	7.15	8.93	10.72	12.51	14.29	16.08	17.86
8	10.67	13.33	16.00	18.67	21.33	24.00	26.67
9	15.19	18.98	22.78	26.58	30.38	34.17	37.97
10	20.83	26.04	31.25	36.46	41.67	46.87	52.08
11	27.73	34.66	41.59	48.53	55.46	62.39	69.32
12	36.00	45.00	54.00	63.00	72.00	81.00	90.00
13	45.77	57.21	68.66	80.10	91.54	102.98	114.43
14	57.17	71.46	85.75	100.04	114.33	128.63	142.92
15	70.31	87.89	105.47	123.05	140.63	158.20	175.78
16	85.33	106.67	128.00	149.33	170.67	192.00	213.33
17	102.35	127.94	153.53	179.12	204.71	230.30	255.89
18	121.50	151.88	182.25	212.63	243.00	273.38	303.75
19	142.90	178.62	214.34	250.07	285.79	321.52	357.24
20	166.67	208.33	250.00	291.67	333.33	375.00	416.67
21	192.94	241.17	289.41	337.64	385.88	434.11	482.34
22	221.83	277.29	332.75	388.21	443.67	499.13	554.58
23	253.48	316.85	380.22	443.59	506.96	570.33	633.70
24	288.00	360.00	432.00	504.00	576.00	648.00	720.00
25	325.52	406.90	488.28	569.66	651.04	732.42	813.80
26	366.17	457.71	549.25	640.79	732.33	823.88	915.42
27	410.06	512.58	615.09	717.61	820.13	922.64	1025.16
28	457.33	571.67	686.00	800.33	914.67	1029.00	1143.33
29	508.10	635.13	762.16	889.18	1016.21	1143.23	1270.26
30	562.50	703.13	843.75	984.38	1125.00	1265.63	1406.25
32	682.67	853.33	1024.00	1194.67	1365.33	1536.00	1706.67
34	818.83	1023.54	1228.25	1432.96	1637.67	1842.38	2047.08
36	972.00	1215.00	1458.00	1701.00	1944.00	2187.00	2430.00
38	1143.17	1428.96	1714.75	2000.54	2286.33	2572.13	2857.92
40	1333.33	1666.67	2000.00	2333.33	2666.67	3000.00	3333.33
42	1543.50	1929.38	2315.25	2701.13	3087.00	3472.88	3858.75
44	1774.67	2218.33	2662.00	3105.67	3549.33	3993.00	4436.67
46	2027.83	2534.79	3041.75	3548.71	4055.67	4562.63	5069.58
48	2304.00	2880.00	3456.00	4032.00	4608.00	5184.00	5760.00

MOMENTS OF INERTIA OF RECTANGLES.



WIDTH OF RECTANGLE.						
$\frac{11}{16}''$	$\frac{3}{4}''$	$\frac{13}{16}''$	$\frac{7}{8}''$	$\frac{15}{16}''$	$1''$	Depth, in Inches.
7.16	7.81	8.46	9.11	9.77	10.42	5
12.38	13.50	14.63	15.75	16.88	18.00	6
19.65	21.44	23.22	25.01	26.80	28.58	7
29.33	32.00	34.67	37.33	40.00	42.67	8
41.77	45.56	49.36	53.16	56.95	60.75	9
57.29	62.50	67.71	72.92	78.13	83.33	10
76.26	83.19	90.12	97.05	103.98	110.92	11
99.00	108.00	117.00	126.00	135.00	144.00	12
125.87	137.31	148.75	160.20	171.64	183.08	13
157.21	171.50	185.79	200.08	214.38	228.67	14
193.36	210.94	228.52	246.09	263.67	281.25	15
234.67	256.00	277.33	298.67	320.00	341.33	16
281.47	307.06	332.65	358.24	383.83	409.42	17
334.13	364.50	394.88	425.25	455.63	486.00	18
392.96	428.69	464.41	500.14	535.86	571.58	19
458.33	500.00	541.67	583.33	625.00	666.67	20
530.58	578.81	627.05	675.28	723.52	771.75	21
610.04	665.50	720.96	776.42	831.87	887.33	22
697.07	760.44	823.81	887.18	950.55	1013.92	23
792.00	864.00	936.00	1008.00	1080.00	1152.00	24
895.18	976.56	1057.94	1139.32	1220.70	1302.08	25
1006.96	1098.50	1190.04	1281.58	1373.13	1464.67	26
1127.67	1230.19	1332.70	1435.22	1537.73	1640.25	27
1257.67	1372.00	1486.33	1600.67	1715.00	1829.33	28
1397.29	1524.31	1651.34	1778.36	1905.39	2032.42	29
1546.88	1687.50	1828.13	1968.75	2109.38	2250.00	30
1877.33	2048.00	2218.67	2389.33	2560.00	2730.67	32
2251.79	2456.50	2661.21	2865.92	3070.63	3275.33	34
2673.00	2916.00	3159.00	3402.00	3645.00	3888.00	36
3143.71	3429.50	3715.29	4001.08	4286.88	4572.67	38
3666.67	4000.00	4333.33	4666.67	5000.00	5333.33	40
4244.63	4630.50	5016.38	5402.25	5788.13	6174.00	42
4880.33	5324.00	5767.67	6211.33	6655.00	7098.67	44
5576.54	6083.50	6590.46	7097.42	7604.38	8111.33	46
6336.00	6912.00	7488.00	8064.00	8640.00	9216.00	48

SPACING OF TIE RODS.

Tie rods are used in fire proof floors to resist the thrust of the floor arches and to hold the steel beams in position laterally. Rods of ¾ inch diameter are generally employed for this purpose. They should be placed as near as possible in the line of thrust of the arch, usually 3 inches above the bottom of the beams.

The proper spacing of tie rods is determined by two considerations. The stress on the net area of the rod produced by the thrust of the arch must not exceed 15,000 lbs. per square inch. Also the lateral stress produced in the beams or channels by the thrust of the arches must not be excessive.

The spacing required to satisfy the first of these requirements is found in the following manner:

Let t = thrust of arch, in lbs. per lineal foot.
r = rise of arch, in inches.
l = distance between beams, or span of arch, in feet.
w = load per square foot, in lbs.
a = net area of tie rod, in square inches.
d = distance between tie rods, in feet.

Then, $t = \frac{3wl^2}{2r}$, (1); and $d = \frac{10{,}000ar}{wl^2}$, (2)

The net areas, in square inches, of the usual sizes of tie rods are as follows:

Diameter of rod =	⅝″	¾″	⅞″	1″
Net area, a =	0.20	0.30	0.42	0.55

For ¾ inch rods, the size generally used, and for a total load of 150 lbs. per square foot the spacing given by formula (2) becomes $d = 20r \div l^2$.

The effective rise of flat tile arches may be assumed as 2 inches less than the depth of the arch.

The maximum spacing, in feet, of ¾ inch tie rods for a total load of 150 lbs. per square foot, producing a stress of 15,000 lbs. per square inch in net area of rods is given in the following table:

MAXIMUM SPACING, IN FEET, OF ¾″ TIE RODS FOR A TOTAL LOAD OF 150 LBS. PER SQUARE FOOT.

Span of Arch, Feet.	Effective Rise of Arch.							
	3″	4″	5″	6″	7″	8″	9″	10″
4	3.7	5.0	6.2	7.5	8.7	10.0	11.2	12.5
5	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0
6		2.2	2.8	3.3	3.9	4.4	5.0	5.5
7			2.0	2.4	2.9	3.3	3.7	4.1
8					2.2	2.5	2.8	3.1

It may be necessary to decrease the distance between tie rods given in the preceding table or found from formula (2), in order to satisfy the second requirement that the lateral stress in the beams or channels produced by the thrust of the arches may not be excessive.

Let I' = moment of inertia of beam or channel, sideways.

b = width of flange of beam or channel, in inches.

x = distance, in inches, of neutral axis from back of channel.

f = fiber stress produced by thrust of arch, in lbs., per square inch.

The beams or channels may be considered as continuous, in which case the stress produced by flexure and the corresponding spacing of rods are given by the following formulas:

For Beams, $f=\frac{td^2b}{2I'}$, (3); and $d=\sqrt{\frac{2fI'}{tb}}$, (4)

For Channels, $f=\frac{td^2(b-x)}{I'}$, (5); and $d=\sqrt{\frac{fI'}{t(b-x)}}$, (6)

Where the thrusts of adjacent arches are opposed to each other, as in the interior beams of a floor, the thrust t in these formulas may be taken only for the live loads. The sum of the stresses produced by lateral thrust and vertical loading should not exceed 20,000 lbs. per square inch. As the vertical loading in building construction is usually allowed to produce a fiber stress of 16,000 lbs. per square inch, the lateral stress must therefore be limited to 4000 lbs. per square inch. In such case the fiber stress, f, in formula (4) is to be taken as 4000.

For exterior arches along walls, or around openings, the thrust t must be taken for the full live and dead load.

Channels will be found to require a greater number of tie rods than interior beams, and it may be advisable in some instances to use a beam for a skewback instead of a channel.

If formulas (4) and (6) give a greater distance between rods than is obtained by the use of formula (2), the value given by the latter is to be used, as the stress on the tie rod itself must not exceed its safe limit.

Beams must be held laterally at intervals not greater than twenty times the width of their flanges, otherwise their safe loads as given the tables must be reduced in the proportion given in the table at the bottom of page 76.

BEARING PLATES.

Steel bearing plates are used under the ends of steel beams resting on walls to distribute the pressure on the latter. The plate must be of a sufficient size so that the allowable safe pressure on the wall will not be exceeded.

For good brickwork laid in cement mortar, capable of sustaining a safe pressure of 200 lbs. per square inch, the table below gives standard sizes of bearing plates which will suffice in general on ordinary spans for I beams up to 24 inches in depth.

STANDARD BEARING PLATES FOR I BEAMS.

Depth of Beam, Inches.	Bearing on Wall, Inches.	Size of Bearing Plates. Length, Inches.	Width, Inches.	Thickness, Inches.	Safe End Reaction at 200 Lbs. per Sq. In., Tons.	Weight of Bearing Plate, Lbs.
24	16	16	16	⅞	25.6	64
20	16	16	15	⅞	24.0	60
18	16	16	14	⅞	22.4	56
15	12	12	14	⅞	16.8	42
12	12	12	12	¾	14.4	31
10	10	10	10	⅝	10.0	18
9	8	8	9	½	7.2	11
8	8	8	8	½	6.4	9
7	8	8	8	½	6.4	9
6 and less	6	6	6	½	3.6	5

Larger I beams, girder beams and girders will require plates of increased size. In such special cases the size of the bearing plate must be determined by the area required to distribute the pressure and its thickness then obtained by the following formula:

$$t = \tfrac{1}{2}(w-b)\sqrt{\frac{3p}{f}},$$

in which,

t = thickness of plate, in inches.
w = width of plate perpendicular to beam, in inches.
b = width of flange of beam, in inches.
p = allowable pressure on wall, in lbs. per square inch.
f = allowable fiber stress in plate, in lbs. per square inch.

For an allowable stress of 16,000 lbs. per square inch the thickness of the plate required can be obtained for various pressures by multiplying $\tfrac{1}{2}(w-b)$, or the cantilever projection of the plate, by the following coefficients:

Pressure, lbs. sq. in.,	100	150	200	350	500
Coefficient,..............	0.137	0.168	0.194	0.256	0.306

BEARING VALUES OF PLATES,

IN TONS OF 2000 LBS.

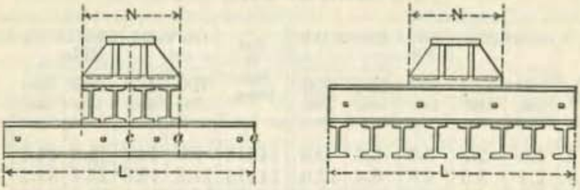
Size of Plate, Inches.	Allowable Pressure per Square Inch.					Size of Plate, Inches.	Allowable Pressure per Square Inch.				
	100 Lbs.	150 Lbs.	200 Lbs.	350 Lbs.	500 Lbs.		100 Lbs.	150 Lbs.	200 Lbs.	350 Lbs.	500 Lbs.
6x 6	1.8	2.7	3.6	6.3	9.0	14x14	9.8	14.7	19.6	34.3	49.0
6x 8	2.4	3.6	4.8	8.4	12.0	14x16	11.2	16.8	22.4	39.2	56.0
6x10	3.0	4.5	6.0	10.5	15.0	14x18	12.6	18.9	25.2	44.1	63.0
8x 8	3.2	4.8	6.4	11.2	16.0	16x16	12.8	19.2	25.6	44.8	64.0
8x10	4.0	6.0	8.0	14.0	20.0	16x18	14.4	21.6	28.8	50.4	72.0
8x12	4.8	7.2	9.6	16.8	24.0	16x20	16.0	24.0	32.0	56.0	80.0
10x10	5.0	7.5	10.0	17.5	25.0	18x18	16.2	24.3	32.4	56.7	81.0
10x12	6.0	9.0	12.0	21.0	30.0	18x20	18.0	27.0	36.0	63.0	90.0
10x14	7.0	10.5	14.0	24.5	35.0	18x22	19.8	29.7	39.6	69.3	99.0
12x12	7.2	10.8	14.4	25.2	36.0	20x20	20.0	30.0	40.0	70.0	100.0
12x14	8.4	12.6	16.8	29.4	42.0	20x22	22.0	33.0	44.0	77.0	110.0
12x16	9.6	14.4	19.2	33.6	48.0	20x24	24.0	36.0	48.0	84.0	120.0

The pressure on masonry of different kinds should not exceed the following values, in lbs. per square inch:

Kind of Masonry.	Pressure, Lbs. per Sq. In.
Brickwork in lime mortar,	100
Brickwork in cement and lime mortar,	150
Brickwork in Portland cement mortar,	200
Portland cement concrete,	350
Sandstone of good quality,	400
Bluestone and limestone,	500
Granite,	600

Frequently a template of bluestone, or other hard quality of stone, is used instead of a steel bearing plate. Where the load to be supported is considerable, as at the ends of girders, both steel bearing plates and stone templates should be used; in which case the size of the bearing plate is determined by the allowable pressure on the stone template according to the safe pressure given above for the kind of stone used. The size of the stone template must also be sufficient to limit the pressure on the brickwork to the safe allowable value as given above for the quality of masonry used. The stone should not project beyond the steel bearing plate in any direction more than ¾ of the thickness of the stone.

GRILLAGE BEAMS IN FOUNDATIONS.



Grillages of steel beams imbedded in concrete are used in column footings to distribute the load over the desired area on yielding soil, thereby avoiding large masses of masonry and deep excavations. The beams should not be less than 3 inches apart in the clear between flanges so that the space between beams can be thoroughly filled with concrete. Separators should be used to keep the beams properly spaced.

The load supported by each beam in a layer equals the total load on the foundation divided by the number of beams in the layer. Loading is uniformly distributed over the length on which it is applied and the beam is uniformly supported from below over its entire length. Maximum bending occurs at c, the center of length of the beam.

W = load supported by each beam, in lbs.
L = length of beam, in feet.
N = length, in feet, on which load is applied.
C = coefficient of strength for the beam.

Maximum bending moment, in foot-lbs. $= \frac{1}{8} W(L-N)$.

This formula for bending moment is the same as that for a simple beam of the length $(L-N)$ supporting a uniformly distributed load of W. By using the length $(L-N)$ as the span the size or safe load of grillage beams may be obtained directly from the tables of safe loads for I beams and girder beams. If $(L-N)$ is less than the spans given in these tables the size or safe load must be obtained by means of the coefficient of strength or section modulus. When W is in pounds and L and N are in feet, the safe load on a given grillage beam is found by the formula,

$$W = \frac{C}{L-N}; \qquad (1)$$

and the coefficient of strength required by a beam for a given loading from the formula,

$$C = W(L-N). \qquad (2)$$

The greatest safe load may be limited by the safe shearing or crippling strength of the web which should be investigated. The shear due to the load W is a maximum at the point a under the outer edge of the superimposed load, and is found as follows:

V_s = maximum shear due to the load W.

V = greatest safe allowable shear on web of beam.

$$V_s = \frac{W(L-N)}{2L}.$$

The shear V_s must not exceed V, the safe shearing strength of the web. If the beams are thoroughly imbedded in concrete and the webs prevented from buckling,

$V = 12{,}000dt$ = safe allowable shear, in lbs.

But if the webs are not supported against buckling,

$$V = \frac{12{,}000dt}{1 + \frac{h^2}{3000t^2}} = \left\{ \begin{array}{l} \text{safe crippling strength} \\ \text{of web, in lbs.} \end{array} \right.$$

where d = depth of beam, t = thickness of web and h = clear distance between flanges, all in inches. The last formula is that for the safe crippling strength of webs and values for it are given for Bethlehem beam and girder sections in the table on page 89 and for American standard beams on page 192.

When shearing strength of the web is considered the maximum load on a given grillage beam is

$$W = 2V\frac{L}{L-N}; \qquad (3)$$

and the safe shearing strength required by the web of a beam for a given loading is

$$V = \frac{W}{2}\ \frac{L-N}{L}. \qquad (4)$$

To find the safe load on a given beam use formulas (1) and (3) and take the lesser of the two values. When formula (3) gives the smaller value the safe load is limited by the shearing strength of the web.

To select a grillage beam for a given loading find the coefficient of strength required by formula (2) and the safe shearing strength of web required by formula (4). The proper beam must then be selected to satisfy both requirements.

It will be found that Bethlehem girder beams are desirable and economical for use as grillage beams.

WIND BRACING.

All buildings must have adequate provision for resisting wind pressure. Walls and partitions afford a certain amount of resistance, but in high buildings the thin walls and light partitions used in modern construction are insufficient for the purpose and special provision must be made in the steel framing.

Steel columns should always be used. They should be in lengths of two or more stories, and spliced with sufficient plates and rivets to make the columns continuous, so far as transverse bending is concerned. All column splices should be riveted. Connections of girders and beams to the columns also should be riveted. With a properly constructed steel frame of this kind, such as that known by Fig. 1 on page 46, special wind bracing will seldom be needed unless the height of the building is more than twice its least base.

Higher buildings will usually require wind bracing of some form. It is seldom possible to use diagonal rods between the columns and either of the two forms of bracing shown on the opposite page is generally used.

Bethlehem H columns, as shown by the illustrations on pages 46-47, afford every facility for the construction of an ideal steel frame for buildings.

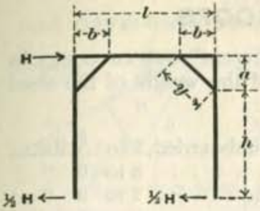
It is customary to provide for a horizontal wind pressure of 30 lbs. per square foot of exposed surface. The steel frame must be designed for that part of the wind pressure which the walls and partitions are unable to safely resist. The steel frame must also be able to resist the wind pressure on its exposed surface during erection before the walls and partitions are in place.

The total live, dead and wind loads should not produce stresses exceeding the following in lbs. per square inch:

$$\text{Tension, } 20{,}000\text{; compression, } 20{,}000-75\frac{l}{r}.$$

Wind increases the compression in the leeward columns and also produces bending in the columns, both of which effects must be considered.

Columns in massive buildings may be considered as having fixed ends. In sheds and mill buildings the columns are not fixed at the ends, unless they are securely anchored to much larger size foundations than are usually provided.



CASE 1.

H = total horizontal force at top of frame.

Columns considered fixed at both ends.

All members constructed to resist tension or compression.

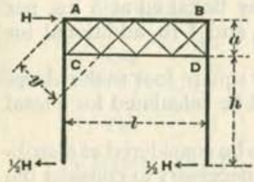
Stress in the Knee Braces, . . . $= \pm H \left(\frac{1}{2} + \frac{h}{4a}\right)\frac{y}{b}$

Stress in the Columns, ... $= \pm H \left(a + \frac{h}{2}\right)\frac{1}{l}$

Stress in the Girder, ... $= \pm H \left(1 + \frac{h}{4a}\right)$

Bending moment on Columns, . $= H\frac{h}{4}$

Bending moment on Girder, . . $= H\left(\frac{1}{2} - \frac{b}{l}\right)\left(a + \frac{h}{2}\right)$



CASE 2.

H = total horizontal force at top of frame.

Columns considered fixed at both ends.

All members constructed to resist tension or compression.

Stress in AB, ... $= \pm H \left(1 + \frac{h}{4a}\right)$

Stress in CD, ... $= \pm H \left(\frac{1}{2} + \frac{h}{4a}\right)$

Stress in Diagonals, ... $= \pm H \left(\frac{a}{2} + \frac{h}{4}\right)\frac{y}{la}$

Stress in Columns, ... $= \pm H \left(a + \frac{h}{2}\right)\frac{1}{l}$

Bending moment on Columns, $= H\frac{h}{4}$

NOTE.—If the columns are not fixed at the ends, substitute $2h$ for h everywhere in the above formulas.

NOTES ON ROOFS.

The approximate weight of different roof coverings in pounds per square foot, exclusive of the weight of the steel construction required, is as follows :

Corrugated iron, No. 26 to No. 18, unboarded,	1 to 3 lbs.
Felt and gravel, unboarded	8 to 10 "
Slate, $\frac{3}{16}''$ to $\frac{1}{4}''$, without sheathing	7 to 9 "
Copper, without sheathing	1 to 1½ "
Tin, without sheathing	1 to 1½ "
Shingles, with lath	5 "
Skylight of glass, $\frac{3}{16}''$ to $\frac{1}{2}''$, including frame,	4 to 10 "
White pine sheathing, 1″ thick	3 "
Yellow pine sheathing, 1″ thick	4 "
Lath and plaster ceiling	8 to 10 "
Tile, flat	15 to 20 "
Tile, corrugated	8 to 10 "
Tile on 3″ fireproof blocks	30 to 35 "

The weight of the steel roof construction must be added to the above. For ordinary light roofs without ceilings the weight of the steel construction may be taken at 5 lbs. per square foot for spans up to 50 ft., and 1 lb. additional for each 10 ft. increase of span.

It is customary to add 30 lbs. per square foot to the above for wind and snow. No roof should be calculated for a total load of less than 40 lbs. per sq. ft.

The total load found as above is to be considered as distributed over the entire truss. It is not necessary to consider the separate effects of the wind and snow on spans of less than 100 ft., but for greater spans separate calculations should be made.

The components of pressure caused by wind acting upon inclined surfaces are given in the following table :

A = Angle of surface of roof with direction of wind.
F = Force of wind, in lbs. per square foot.
N = Pressure normal to surface of roof.
V = Pressure perpendicular to direction of wind.
H = Pressure parallel to direction of wind.

Angle of Roof.	5°	10°	20°	30°	40°	50°	60°	70°	80°	90°
N = F ×	.125	.24	.45	.66	.83	.95	1.00	1.02	1.01	1.00
V = F ×	.122	.24	.42	.57	.64	.61	.50	.35	.17	.00
H = F ×	.01	.04	.15	.33	.53	.73	.85	.96	.99	1.00

COEFFICIENTS
FOR OBTAINING THE STRESSES IN ROOF TRUSSES.

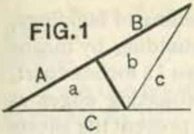
FIG.1


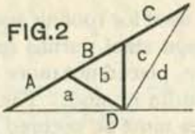
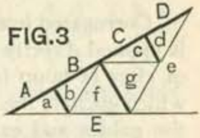
FIG.2


FIG.3


Heavy lines denote compression and light lines tension.

Ratio of depth to length of span.			.333 $\frac{1}{3}$	.289 $\frac{1}{3.464}$	.250 $\frac{1}{4}$	.200 $\frac{1}{5}$	.167 $\frac{1}{6}$	.125 $\frac{1}{8}$
Slope of Rafters.			33° 41′	30°	26° 34′	21° 48′	18° 26′	14° 2′
Fig. 1	Bottom chord.	Ca	2.25	2.60	3.00	3.75	4.50	6.00
		Cc	1.50	1.73	2.00	2.50	3.00	4.00
	Top chord.	Aa	2.70	3.00	3.35	4.04	4.75	6.19
		Bb	2.15	2.50	2.90	3.67	4.44	5.95
	Tie	bc	.75	.87	1.00	1.25	1.50	2.00
	strut.	ab	.83	.87	.89	.93	.95	.97
Fig. 2	Bottom chord.	Da	3.75	4.33	5.00	6.25	7.50	10.00
		Dd	2.25	2.60	3.00	3.75	4.50	6.00
	Top chord.	Aa	4.51	5.00	5.59	6.74	7.91	10.31
		Bb	3.53	4.00	4.55	5.59	6.65	8.77
		Cc	3.40	4.00	4.70	6.00	7.29	9.83
	Tie.	cd	1.50	1.73	2.00	2.50	3.00	4.00
	Struts	ab & bc	.93	1.00	1.07	1.22	1.34	1.62
Fig. 3	Bottom chord.	Ea	5.25	6.06	7.00	8.75	10.50	14.00
		Ef	4.50	5.19	6.00	7.50	9.00	12.00
		Ee	3.00	3.46	4.00	5.00	6.00	8.00
	Top chord.	Aa	6.30	7.00	7.83	9.42	11.08	14.44
		Bb	5.75	6.50	7.38	9.05	10.76	14.20
		Cc	5.20	6.00	6.93	8.68	10.45	13.95
		Dd	4.65	5.50	6.48	8.31	10.13	13.71
	Ties.	eg	1.50	1.73	2.00	2.50	3.00	4.00
		ed	2.25	2.60	3.00	3.75	4.50	6.00
		bf & cg	.75	.87	1.00	1.25	1.50	2.00
	Struts.	ab & cd	.83	.87	.89	.93	.95	.97
		fg	1.66	1.73	1.78	1.86	1.90	1.94

To find the stress in any member of these trusses multiply the panel load by the coefficient given in the table.

Loads are considered as concentrated at the joints.

CORRUGATED IRON.

Corrugated iron, used for roofing and siding of buildings, is applied directly upon steel purlins or studding by means of clips of hoop iron, placed not more than 12 inches apart, which encircle the purlin or stud. The projecting edges at the gables and eaves must be secured to prevent the sheets from being loosened or folded up by the wind.

The usual dimensions of corrugated iron are given in the following table. The 2½ inch corrugation is the one generally employed for roofing and siding, and the regular lengths of sheets are 6, 7, 8, 9 and 10 feet.

DIMENSIONS OF SHEETS AND CORRUGATIONS.

Width of Corrugation.	Depth of Corrugation.	Number of Corrugations to the Sheet.	Covering Width, Lap of One Corrugation.	Width of Sheet after Corrugation.	Length of Longest Sheets.
2½ inch.	⅝ inch.	10	24 inch.	26 inch.	10 feet.
1¼ "	½ "	19½	24 "	26 "	8 "
¾ "	¼ "	34½	25 "	26 "	8 "

Roofing is measured by the square, equal to 100 square feet of finished roofing in place. The corrugated sheets are usually laid with one corrugation lap on the sides and an end lap of 6 inches for roofing and 2 inches for siding.

NUMBER OF SQUARE FEET OF 2½ INCH CORRUGATED IRON REQUIRED TO LAY ONE SQUARE.

SIDE LAP, ONE CORRUGATION.

Length of Sheet, Feet.	LENGTH OF END LAP.					
	1 Inch.	2 Inch.	3 Inch.	4 Inch.	5 Inch.	6 Inch.
5	110	112	114	116	118	120
6	110	111	113	115	117	118
7	110	110	112	114	115	117
8	109	110	112	113	114	115
9	109	110	112	113	114	115
10	108	109	110	111	112	113

The maximum spans for roofing and siding are as follows:

	No. 16.	No. 18.	No. 20.	No. 22.	No. 24.	No. 26.
Roofing,	5′ 6″	5′ 0″	4′ 6″	4′ 0″	3′ 6″	3′ 0″
Siding,	7′ 0″	6′ 3″	5′ 3″	4′ 9″	4′ 3″	3′ 9″

If used on greater spans, the excessive deflection is liable to impair the tightness of the joints.

Numbers 20 and 22 are the gauges most frequently used for roofs, and numbers 22 and 24 for siding. The sheets are either painted or galvanized, preferably the latter.

The United States standard gauge, adopted by act of Congress in 1893, is in general use by manufacturers of sheet steel. The following table gives the thickness and weight of corrugated iron in accordance with United States standard gauge:

No. by United States Gauge.	Thickness, Inches.	Weight per Square Foot Flat, Lbs.	Weight per Sq. Ft. Corrugated, Lbs.	Weight per Square of 100 Square Feet, when laid, allowing 6″ lap in length, and 2½″ or one Corrugation in width of sheet, for sheet lengths of:						Galvanized, Weight per Sq. Ft. Corrugated.
				5 Ft.	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.	
16	.0625	2.50	2.75	331	325	320	318	315	311	2.91
18	.05	2.00	2.20	264	260	256	254	252	249	2.36
20	.0375	1.50	1.65	198	195	193	190	189	187	1.82
22	.0313	1.25	1.38	166	163	161	159	158	156	1.54
24	.025	1.00	1.11	134	131	130	128	127	126	1.27
26	.0188	.75	.84	101	100	99	98	96	95	.99
28	.0156	.63	.69	83	82	81	80	79	78	.86

TRANSVERSE STRENGTH OF CORRUGATED IRON.

The transverse strength of corrugated iron may be calculated in the following manner:

l = unsupported length of sheet, in inches.

t = thickness of sheet, in inches.

b = width of sheet, in inches.

d = depth of corrugation, in inches.

W = safe uniformly distributed load, in pounds.

Then, $W = \dfrac{25{,}000\, b\, t\, d}{l}$

SAFE LOADS, IN POUNDS, UNIFORMLY DISTRIBUTED FOR

RECTANGULAR WOODEN BEAMS

ONE INCH THICK.

The table gives the safe uniformly distributed loads, in pounds, on rectangular wooden beams one inch thick, for a maximum fiber stress of 1000 lbs. per square inch.

For different kinds of wood, the values given in the table are to be multiplied by the following factors:

For Ordinary Purposes.		For Static Loads.
0.75	Spruce or White Pine	1.00
1.00	White Oak	1.25
1.25	Southern Yellow Pine	1.50

Span, in Feet.	DEPTH OF BEAM.										
	6″	7″	8″	9″	10″	11″	12″	13″	14″	15″	16″
5	800	1090	1420	1800							
6	670	910	1190	1500	1850	2240					
7	570	780	1020	1290	1590	1920	2290				
8	500	680	890	1130	1390	1680	2000	2490	2740	3130	
9	440	610	790	1000	1230	1490	1780	2210	2430	2780	3160
10	400	540	710	900	1110	1340	1600	1990	2190	2500	2840
11	360	495	650	820	1010	1220	1450	1810	1990	2270	2590
12	330	450	590	750	930	1120	1330	1660	1820	2080	2370
13	310	420	550	690	860	1030	1230	1530	1690	1930	2200
14	290	390	510	640	800	960	1150	1430	1570	1790	2040
15	270	360	480	600	740	900	1070	1330	1460	1670	1900
16	250	340	450	560	700	840	1000	1250	1370	1570	1780
17	240	320	420	530	650	790	940	1170	1290	1470	1680
18	220	300	400	500	620	750	890	1110	1220	1390	1590
19	210	290	380	480	590	710	840	1050	1150	1320	1500
20	200	272	360	450	560	670	800	990	1090	1250	1420
21	190	260	340	430	530	640	760	950	1040	1190	1360
22	180	248	325	410	510	610	730	910	1000	1140	1300
23	175	237	310	390	480	590	700	870	950	1090	1240
24	167	228	297	380	460	560	670	830	910	1040	1190
25	160	218	285	360	450	540	640	800	880	1000	1140
26	154	210	275	350	430	520	620	770	840	960	1100
27	149	202	265	330	410	500	590	740	810	930	1060
28	143	195	255	315	400	480	570	710	780	890	1020
29	138	188	246	307	380	465	550	690	750	860	980
30	134	182	237	297	370	450	530	660	730	830	950

Loads given below the zigzag line produce deflections exceeding $\frac{1}{360}$ of the span.

To obtain the safe load for any thickness, multiply the values given for 1 inch by the thickness of the beam.

To obtain the required thickness for any load, divide by safe load given for 1 inch.

SAFE LOADS FOR SEASONED RECTANGULAR WOODEN COLUMNS.

Calculated from the following formulas for safe loads, in lbs. per square inch, on square end columns.

l = length of column, in inches.
d = width of smallest side, in inches.

Southern Yellow Pine.	White Oak.	White Pine and Spruce.
$\dfrac{1125}{1+\dfrac{l^2}{1100d^2}}$	$\dfrac{925}{1+\dfrac{l^2}{1100d^2}}$	$\dfrac{800}{1+\dfrac{l^2}{1100d^2}}$

These formulas give safe loads of one-fourth the ultimate strength for short columns decreasing to one-fifth the ultimate for long columns.

Ratio of Length to Least Side. $\frac{l}{d}$	SAFE LOAD, IN POUNDS PER SQUARE INCH OF SECTION.		
	Southern Yellow Pine.	White Oak.	White Pine and Spruce.
12	995	818	707
14	955	785	679
16	913	750	649
18	869	715	618
20	825	678	587
22	781	642	556
24	738	607	525
26	697	575	495
28	657	541	467
30	619	509	440
32	583	479	414
34	549	451	390
36	516	425	367
38	487	400	346
40	458	377	326

SAFE LOADS IN TONS OF 2000 LBS. FOR

SQUARE WOODEN COLUMNS.

WHITE PINE OR SPRUCE.

Unsupported Length of Column, in Feet.	SIZE OF COLUMN, IN INCHES.						
	6 x 6	8 x 8	9 x 9	10 x 10	12 x 12	14 x 14	16 x 16
6	12.80	....	....	....	....	....	....
8	11.70	22.7	29.6	....	....	....	....
10	10.60	21.3	28.0	35.5	....	....	....
12	9.54	19.8	26.3	33.7	51.1	....	....
14	8.46	18.4	24.7	31.9	49.0	69.6	....
16	7.38	17.0	23.1	30.1	46.8	67.0	91.0
18	....	15.5	21.5	28.3	44.7	64.5	88.0
20	....	14.1	19.8	26.5	42.5	62.0	85.2
22	....	....	18.2	24.7	40.3	59.5	82.3
24	....	....	....	22.9	38.2	57.0	79.4

WHITE OAK.

6	14.80	....	....	....	....	....	....
8	13.50	26.2	34.0	....	....	....	....
10	12.20	24.6	32.4	41.0	....	....	....
12	11.00	22.7	30.4	39.1	59.1	....	....
14	9.73	21.1	28.4	36.7	56.9	80.4	....
16	8.64	19.5	26.5	34.6	54.0	77.8	105.0
18	....	17.8	24.7	32.4	51.1	74.5	102.0
20	....	16.3	22.7	30.5	49.0	71.3	98.5
22	....	....	21.1	28.2	46.1	68.3	94.7
24	....	....	....	26.4	43.9	65.5	90.9

SOUTHERN YELLOW PINE.

6	18.00	....	....	....	....	....	....
8	16.40	32.0	41.6	....	....	....	....
10	14.90	29.9	39.4	50.0	....	....	....
12	13.30	27.8	36.9	47.6	72.0	....	....
14	11.90	25.8	34.7	44.7	69.1	98.0	132.0
16	10.40	23.7	32.3	42.3	65.5	94.6	128.0
18	....	21.8	30.0	39.5	62.6	90.7	124.0
20	....	19.8	27.8	37.0	59.8	86.9	120.0
22	....	....	25.7	34.6	56.2	83.6	115.0
24	....	....	....	32.2	53.3	80.0	111.0

ULTIMATE STRENGTH OF HOLLOW CYLINDRICAL AND RECTANGULAR CAST IRON COLUMNS.

CYLINDRICAL COLUMNS. Ultimate Strength in Lbs. per square inch.			RECTANGULAR COLUMNS. Ultimate Strength in Lbs. per square inch.		
Square Bearing	Pin and Square	Pin Bearing	Square Bearing	Pin and Square	Pin Bearing
$\frac{80,000}{1+\frac{(12L)^2}{800\,d^2}}$	$\frac{80,000}{1+\frac{3(12L)^2}{1600\,d^2}}$	$\frac{80,000}{1+\frac{(12L)^2}{400\,d^2}}$	$\frac{80,000}{1+\frac{3(12L)^2}{3200\,d^2}}$	$\frac{80,000}{1+\frac{9(12L)^2}{6400\,d^2}}$	$\frac{80,000}{1+\frac{3(12L)^2}{1600\,d^2}}$

L=Length of Column, in feet.
d=External diameter or least side of rectangle, in inches.

$\frac{L}{d}$	CYLINDRICAL COLUMNS. Ultimate Strength in Lbs. per square inch.			RECTANGULAR COLUMNS. Ultimate Strength in Lbs. per square inch.		
	Square Bearing.	Pin and Square.	Pin Bearing.	Square Bearing.	Pin and Square.	Pin Bearing.
.5	76,560	74,940	73,390	77,380	76,150	74,940
.6	75,130	72,910	70,820	76,290	74,560	72,910
.7	73,520	70,650	68,000	75,030	72,780	70,650
.8	71,740	68,210	65,020	73,640	70,820	68,210
.9	69,820	65,640	61,940	72,110	68,730	65,640
1.0	67,800	62,990	58,820	70,480	66,520	62,990
1.1	65,690	60,300	55,730	68,790	64,260	60,300
1.2	63,530	57,600	52,690	67,000	61,940	57,600
1.3	61,340	54,930	49,740	65,140	59,600	54,960
1.4	59,140	52,310	46,900	63,260	57,270	52,320
1.5	56,940	49,770	44,200	61,350	54,960	49,760
1.6	54,760	47,300	41,630	59,450	52,680	47,300
1.7	52,620	44,940	39,210	57,550	50,460	44,960
1.8	50,530	42,670	36,930	55,670	48,300	42,670
1.9	48,490	40,510	34,790	53,800	46,230	40,510
2.0	46,510	38,460	32,790	51,940	44,200	38,460
2.1	44,600	36,520	30,920	50,160	42,260	36,520
2.2	42,750	34,680	29,180	48,400	40,400	34,680
2.3	40,980	32,940	27,540	46,670	38,630	32,950
2.4	39,280	31,310	26,030	44,990	36,930	31,310
2.5	37,650	29,770	24,620	43,390	35,310	29,760
2.6	36,090	28,320	23,300	41,820	33,770	28,320
2.7	34,600	26,950	22,070	40,320	32,310	26,950
2.8	33,180	25,670	20,930	38,870	30,920	25,670
2.9	31,820	24,460	19,860	37,470	29,600	24,460

For safe quiescent loads, as in buildings, divide the above values by 8.

SAFE LOADS IN TONS OF 2000 LBS. FOR
HOLLOW CYLINDRICAL
CAST IRON COLUMNS.

Square ends. Factor of safety of 8.

Outside Diameter, Inches.	Thickness of Metal, Inches.	LENGTH OF COLUMN. 8 Ft.	10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	Area of Section, Sq. Ins.	Weight per Foot, Lbs.
6	¾	47	41	36	31						12.4	39
6	1	60	52	46	40						15.7	49
7	¾	60	54	48	43	38					14.7	46
7	1	76	69	62	55	49					18.9	60
8	¾	72	67	61	55	50	45				17.1	53
8	1	93	86	78	71	64	58				22.0	69
8	1¼	112	104	94	86	77	69				26.5	83
9	¾	85	80	74	68	62	57	52			19.4	61
9	1	110	103	95	88	80	73	67			25.1	78
9	1¼	133	125	115	106	97	89	81			30.4	95
9	1½	155	145	134	123	113	103	94			35.3	110
10	1	127	120	112	105	97	89	82	76		28.3	88
10	1¼	154	146	136	127	118	109	100	92		34.4	107
10	1½	180	170	159	148	137	127	117	107		40.1	125
10	1¾	203	192	180	168	155	143	132	121		45.4	142
11	1	144	137	129	122	114	106	100	91	85	31.4	98
11	1¼	175	167	158	148	139	129	122	112	103	38.3	119
11	1½	204	195	184	173	161	151	143	130	121	44.8	140
11	1¾	232	221	209	197	184	172	162	148	137	50.9	159
11	2	258	246	233	219	205	191	181	164	152	56.6	176
12	1	160	154	147	139	131	123	115	108	101	34.6	108
12	1¼	196	188	180	170	160	150	141	132	123	42.2	131
12	1½	229	220	210	199	187	176	165	154	144	49.5	154
12	1¾	261	251	239	226	213	201	188	176	164	56.4	176
12	2	291	279	266	252	238	224	210	196	183	62.8	196
13	1¼	216	209	200	191	181	172	162	152	143	46.1	144
13	1½	254	245	235	224	213	201	190	179	168	54.2	169
13	1¾	289	280	268	256	243	229	217	204	192	61.9	193
13	2	324	312	300	286	272	257	242	228	214	69.1	216
14	1¼	237	229	221	212	203	193	183	173	164	50.1	156
14	1½	278	270	260	250	239	227	215	204	193	58.9	184
14	1¾	318	308	297	285	273	260	246	233	220	67.4	210
14	2	356	345	333	320	305	291	276	261	247	75.4	235
15	1¼	257	250	242	233	224	214	205	195	185	54.0	168
15	1½	303	295	285	275	264	253	241	229	218	63.6	199
15	1¾	347	337	327	315	302	289	276	263	249	72.9	227
15	2	389	378	366	353	339	324	309	294	280	81.7	255
16	1¼	277	270	262	254	245	235	225	216	206	57.8	180
16	1½	327	319	311	300	290	278	267	255	244	68.4	214
16	1¾	375	366	356	344	332	319	306	292	279	78.4	245
16	2	421	411	400	387	373	358	343	328	313	88.0	275
16	2¼	465	454	441	427	412	396	379	363	346	97.2	304

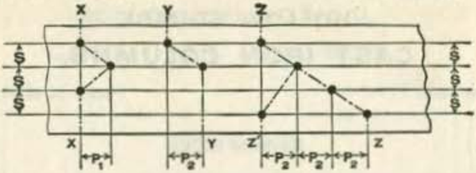
SAFE LOADS IN TONS OF 2000 LBS. FOR

HOLLOW SQUARE
CAST IRON COLUMNS.

Square ends. Factor of safety of 8.

Outside of Square. Inches.	Thickness of Metal, Inches.	Length of Column. 8 Ft.	10 Ft.	12 Ft.	14 Ft.	16 Ft.	18 Ft.	20 Ft.	22 Ft.	24 Ft.	Area of Section, Sq. Ins.	Weight per Foot, Lbs.
6	¾	64	57	51	45						15.8	49
6	1	81	73	65	58						20.0	63
7	¾	80	73	67	61	55					18.8	59
7	1	102	94	86	78	70					24.0	75
8	¾	96	90	83	77	71	65				21.8	68
8	1	123	116	107	99	91	83				28.0	88
8	1¼	149	139	129	119	110	100				33.8	106
9	¾	112	106	100	93	87	80	74			24.8	77
9	1	144	137	129	121	112	104	96			32.0	100
9	1¼	175	166	156	146	136	126	116			38.8	121
9	1½	203	193	182	170	158	146	135			45.0	141
10	1	166	159	151	142	134	125	117	109		36.0	113
10	1¼	201	193	183	173	163	152	142	132		43.8	137
10	1½	235	225	214	202	189	177	166	154		51.0	159
10	1¾	266	254	242	228	215	201	188	175		57.8	181
11	1	187	180	172	164	156	147	138	130	122	40.0	125
11	1¼	227	219	210	200	190	179	169	158	148	48.8	152
11	1½	266	256	246	234	222	209	197	185	174	57.0	178
11	1¾	302	291	279	266	252	238	224	210	197	64.8	202
11	2	336	324	310	295	280	264	249	234	219	72.0	225
12	1	208	201	194	186	177	169	160	151	143	44.0	138
12	1¼	254	246	237	227	217	206	196	185	174	53.8	168
12	1½	297	288	278	266	254	242	229	217	205	63.0	197
12	1¾	338	328	316	303	289	275	261	247	233	71.8	224
12	2	377	366	352	338	323	307	291	275	260	80.0	250
13	1¼	279	272	263	254	244	233	223	212	201	58.8	184
13	1½	328	319	309	298	286	274	261	249	236	69.0	216
13	1¾	375	365	353	341	327	313	298	284	270	78.8	246
13	2	419	407	394	380	365	350	334	317	301	88.0	275
14	1¼	305	298	290	281	271	261	250	239	228	63.8	199
14	1½	359	351	341	330	319	307	294	281	268	75.0	234
14	1¾	411	401	390	378	365	351	336	322	307	85.8	268
14	2	460	449	437	423	408	393	376	360	344	96.0	300
15	1¼	331	324	316	308	298	288	277	266	255	68.8	215
15	1½	390	382	373	362	351	339	327	314	301	81.0	253
15	1¾	446	437	427	415	402	388	374	359	345	92.8	289
15	2	501	490	479	465	451	436	420	403	386	104.0	325
16	1¼	357	350	343	334	325	315	305	294	286	73.8	231
16	1½	421	413	404	394	383	372	359	347	334	87.0	272
16	1¾	482	474	463	452	440	426	412	397	383	99.8	312
16	2	541	532	520	507	493	478	463	446	429	112.0	350
16	2¼	598	588	575	561	545	529	511	493	475	123.8	387

SPACING OF STAGGERED RIVET HOLES
FOR MINIMUM REDUCTION OF AREA.



VALUES OF P_1 AND P_2 IN INCHES.

Gauge. S Inches.	1/2″ Rivets.		5/8″ Rivets.		3/4″ Rivets.		7/8″ Rivets.		1″ Rivets.	
	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2
1	1 1/8	1 9/16	1 1/4	1 11/16	1 1/4	1 13/16				
1 1/8	1 1/4	1 11/16	1 5/16	1 13/16	1 3/8	1 15/16	1 7/16	2		
1 1/4	1 3/8	1 3/4	1 7/16	1 7/8	1 1/2	2	1 9/16	2 1/8		
1 3/8	1 1/2	1 7/8	1 9/16	2	1 5/8	2 1/8	1 5/8	2 1/4	1 11/16	2 3/8
1 1/2	1 9/16	2	1 5/8	2 1/8	1 11/16	2 1/4	1 3/4	2 3/8	1 13/16	2 1/2
1 5/8	1 11/16	2 1/8	1 3/4	2 1/4	1 13/16	2 3/8	1 7/8	2 1/2	1 15/16	2 5/8
1 3/4	1 13/16	2 3/16	1 7/8	2 3/8	1 15/16	2 1/2	2	2 5/8	2 1/16	2 3/4
1 7/8	1 7/8	2 5/16	1 15/16	2 7/16	2	2 5/8	2 1/16	2 11/16	2 1/8	2 13/16
2	2	2 7/16	2 1/16	2 9/16	2 1/8	2 11/16	2 3/16	2 13/16	2 1/4	2 15/16
2 1/8	2 1/8	2 9/16	2 3/16	2 11/16	2 1/4	2 13/16	2 5/16	2 15/16	2 3/8	3 1/16
2 1/4	2 3/16	2 5/8	2 1/4	2 3/4	2 3/8	2 15/16	2 3/8	3 1/16	2 7/16	3 3/16
2 3/8	2 5/16	2 3/4	2 3/8	2 7/8	2 7/16	3	2 1/2	3 3/16	2 9/16	3 5/16
2 1/2	2 7/16	2 7/8	2 1/2	3	2 9/16	3 1/8	2 5/8	3 1/4	2 11/16	3 3/8
2 5/8	2 1/2	2 15/16	2 9/16	3 1/8	2 5/8	3 1/4	2 11/16	3 3/8	2 3/4	3 1/2
2 3/4	2 5/8	3 1/16	2 11/16	3 3/16	2 3/4	3 3/8	2 13/16	3 1/2	2 7/8	3 5/8
2 7/8	2 3/4	3 3/16	2 3/4	3 5/16	2 7/8	3 7/16	2 15/16	3 9/16	3	3 3/4
3	2 7/8	3 5/16	2 7/8	3 7/16	2 15/16	3 9/16	3	3 11/16	3 1/8	3 13/16
3 1/2	3 1/4	3 11/16	3 5/16	3 7/8	3 3/8	4	3 7/16	4 1/8	3 1/2	4 1/4
4	3 11/16	4 1/8	3 3/4	4 1/4	3 13/16	4 7/16	3 7/8	4 9/16	3 15/16	4 11/16
4 1/2	4 1/16	4 9/16	4 1/8	4 11/16	4 1/4	4 13/16	4 5/16	5	4 3/8	5 1/8
5	4 1/2	4 15/16	4 9/16	5 1/4	4 5/8	5 1/4	4 11/16	5 3/8	4 3/4	5 9/16
5 1/2	4 15/16	5 3/8	5	5 1/2	5 1/16	5 11/16	5 1/8	5 13/16	5 3/16	6
6	5 5/16	5 13/16	5 3/8	5 15/16	5 1/2	6 1/16	5 9/16	6 1/4	5 5/8	6 3/8

Rupture is equally probable through a transverse or a diagonal line of holes unless the net diagonal section exceeds by 30% the net section along the transverse line. Values of P_1 and P_2 given in the table produce spacings having a diagonal net section 30% in excess of the net transverse section. Rivet holes are assumed 1/8 inch larger in diameter than the rivets.

When P_1 equals or exceeds the distance given in the table, only two holes are to be deducted at the section XX to obtain the net area.

When P_2 equals or exceeds the distance given in the table, only one hole is to be deducted at the section YY or ZZ, and only two holes at the section ZZ′ to obtain the net area.

Values above the cross lines produce spacing less than 3 rivet diameters.

REDUCTION OF AREA,

IN SQUARE INCHES, FOR ONE RIVET HOLE.

To be deducted from gross area of plates or shapes to obtain net area.

Thickness of Metal, Inches.	DIAMETER OF HOLE.										
	1/2″	9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″	1 1/16″	1 1/8″
1/16	.03	.04	.04	.04	.05	.05	.05	.06	.06	.07	.07
1/8	.06	.07	.08	.09	.09	.10	.11	.12	.13	.13	.14
3/16	.09	.11	.12	.13	.14	.15	.16	.18	.19	.20	.21
1/4	.13	.14	.16	.17	.19	.20	.22	.23	.25	.27	.28
5/16	.16	.18	.20	.21	.23	.25	.27	.29	.31	.33	.35
3/8	.19	.21	.23	.26	.28	.30	.33	.35	.38	.40	.42
7/16	.22	.25	.27	.30	.33	.36	.38	.41	.44	.46	.49
1/2	.25	.28	.31	.34	.38	.41	.44	.47	.50	.53	.56
9/16	.28	.32	.35	.39	.42	.46	.49	.53	.56	.60	.63
5/8	.31	.35	.39	.43	.47	.51	.55	.59	.63	.66	.70
11/16	.34	.39	.43	.47	.52	.56	.60	.64	.69	.73	.77
3/4	.38	.42	.47	.52	.56	.61	.66	.70	.75	.80	.84
13/16	.41	.46	.51	.56	.61	.66	.71	.76	.81	.86	.91
7/8	.44	.49	.55	.60	.66	.71	.77	.82	.88	.93	.98
15/16	.47	.53	.59	.64	.70	.76	.82	.88	.94	1.00	1.05
1	.50	.56	.63	.69	.75	.81	.88	.94	1.00	1.06	1.13
1 1/16	.53	.60	.66	.73	.80	.86	.93	1.00	1.06	1.13	1.20
1 1/8	.56	.63	.70	.77	.84	.91	.98	1.05	1.13	1.20	1.27
1 3/16	.59	.67	.74	.82	.89	.96	1.04	1.11	1.19	1.26	1.34
1 1/4	.63	.70	.78	.86	.94	1.02	1.09	1.17	1.25	1.33	1.41
1 5/16	.66	.74	.82	.90	.98	1.07	1.15	1.23	1.31	1.39	1.48
1 3/8	.69	.77	.86	.95	1.03	1.12	1.20	1.29	1.38	1.46	1.55
1 7/16	.72	.81	.90	.99	1.08	1.17	1.26	1.35	1.44	1.53	1.62
1 1/2	.75	.84	.94	1.03	1.13	1.22	1.31	1.41	1.50	1.59	1.69
1 9/16	.78	.88	.98	1.07	1.17	1.27	1.37	1.46	1.56	1.66	1.76
1 5/8	.81	.91	1.02	1.12	1.22	1.32	1.42	1.52	1.63	1.73	1.83
1 11/16	.84	.95	1.05	1.16	1.27	1.37	1.47	1.58	1.69	1.79	1.90
1 3/4	.88	.98	1.09	1.20	1.31	1.42	1.53	1.64	1.75	1.86	1.97
1 13/16	.91	1.02	1.13	1.25	1.36	1.47	1.59	1.70	1.81	1.93	2.04
1 7/8	.94	1.05	1.17	1.29	1.41	1.52	1.64	1.76	1.88	1.99	2.11
1 15/16	.97	1.09	1.21	1.33	1.45	1.57	1.70	1.82	1.94	2.06	2.18
2	1.00	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00	2.13	2.25

When holes are punched the diameter of the hole should be taken 1/8 inch greater than the diameter of the rivet or bolt.

For drilled holes the diameter may be taken only 1/16 inch greater than the diameter of the rivet or bolt.

SHEARING AND BEARING VALUE OF RIVETS.

Diameter of Rivet, Inches.	Area in Square Inches.	Single Shear at 7500 Lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 15,000 Lbs. per Square Inch.				
			¼″	$\frac{5}{16}$″	⅜″	$\frac{7}{16}$″	½″
⅜	.1104	830	1410	1760	2110	....	....
½	.1963	1470	1880	2340	2810	3280	3750
⅝	.3068	2300	2340	2930	3520	4100	4690
¾	.4418	3310	2810	3520	4220	4920	5630
⅞	.6013	4510	3280	4100	4920	5740	6560
1	.7854	5890	3750	4690	5620	6560	7500

Diameter of Rivet, Inches.	Area in Square Inches.	Single Shear at 9000 Lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 18,000 Lbs. per Square Inch.				
			¼″	$\frac{5}{16}$″	⅜″	$\frac{7}{16}$″	½″
⅜	.110	990	1680	2110	2530	....	....
½	.196	1770	2250	2820	3370	3940	4500
⅝	.307	2760	2790	3480	4180	4870	5580
¾	.442	3970	3370	4210	5050	5910	6750
⅞	.601	5410	3940	4920	5910	6880	7870
1	.785	7060	4500	5620	6750	7870	9000

Diameter of Rivet, Inches.	Area in Square Inches.	Single Shear at 10,000 Lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 20,000 Lbs. per Square Inch.				
			¼″	$\frac{5}{16}$″	⅜″	$\frac{7}{16}$″	½″
⅜	.1104	1100	1880	2340	2810	....	....
½	.1963	1960	2500	3130	3750	4380	5,000
⅝	.3068	3070	3130	3910	4690	5470	6.250
¾	.4418	4420	3750	4690	5630	6560	7,500
⅞	.6013	6010	4380	5470	6570	7660	8,750
1	.7854	7850	5000	6250	7500	8750	10,000

Diameter of Rivet, Inches.	Area in Square Inches.	Single Shear at 11,000 Lbs.	Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 22,000 Lbs. per Square Inch.				
			¼″	$\frac{5}{16}$″	⅜″	$\frac{7}{16}$″	½″
⅜	.1104	1210	2060	2580	3090	....	....
½	.1963	2160	2750	3440	4130	4820	5,500
⅝	.3068	3370	3440	4300	5160	6020	6,880
¾	.4418	4860	4130	5160	6190	7220	8,250
⅞	.6013	6610	4810	6020	7220	8430	9,630
1	.7854	8640	5500	6880	8250	9630	11,000

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

SHEARING AND BEARING VALUE OF RIVETS.

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 15,000 Lbs. per Square Inch.								Diameter of Rivet, Inches.
9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″	
....	....	....	....	....	....	....	....	3/8
....	....	....	....	....	....	....	....	1/2
5280	5860	....	....	....	....	....	....	5/8
6330	7030	7,720	8,440	....	....	....	....	3/4
7380	8200	9,030	9,850	10,670	11,480	12,300	....	7/8
8440	9380	10,310	11,250	12,190	13,130	14,060	15.000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 18,000 Lbs. per Square Inch.								Diameter of Rivet, Inches.
9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″	
....	....	....	....	....	....	....	....	3/8
....	....	....	....	....	....	....	....	1/2
6,330	7,030	....	....	....	....	....	....	5/8
7,590	8 440	9,280	10,130	....	....	....	....	3/4
8,860	9,840	10,830	11,810	12,800	13,780	14,770	....	7/8
10,120	11,250	12,370	13,500	14,630	15,750	16,880	18,000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 20,000 Lbs. per Square Inch.								Diameter of Rivet, Inches.
9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″	
....	....	....	....	....	....	....	....	3/8
....	....	....	....	....	....	....	....	1/2
7,030	7,810	....	....	....	....	....	....	5/8
8,440	9,380	10,310	11,250	....	....	....	....	3/4
9,840	10,940	12,030	13,130	14,220	15,310	16,410	....	7/8
11,250	12,500	13,750	15,000	16,250	17,500	18,750	20,000	1

Bearing Values, in Pounds, for Different Thickness of Plate in Inches at 22,000 Lbs. per Square Inch.								Diameter of Rivet, Inches.
9/16″	5/8″	11/16″	3/4″	13/16″	7/8″	15/16″	1″	
....	....	....	....	....	....	....	....	3/8
....	....	....	....	....	....	....	....	1/2
7,740	8,600	....	....	....	....	....	....	5/8
9,280	10,320	11,340	12,380	....	....	....	....	3/4
10,840	12,040	13,240	14,440	15,640	16,840	18,050	....	7/8
12,380	13,750	15,130	16,500	17,880	19,250	20,630	22,000	1

Bearing values given below or to the left of the lower zigzag lines are less than single shear.

MAXIMUM BENDING MOMENTS ON PINS

FOR EXTREME FIBER STRESSES

VARYING FROM 15,000 TO 24,000 POUNDS PER SQUARE INCH.

Diameter of Pin, in Inches.	Area of Pin, in Square Inches.	Moments in Inch-Pounds for Fiber Stresses of				
		15,000 Lbs. per Square Inch.	18,000 Lbs. per Square Inch.	20,000 Lbs. per Square Inch.	22,000 Lbs. per Square Inch.	24,000 Lbs. per Square Inch.
1	.785	1,470	1,770	1,960	2,160	2,350
1⅛	.994	2,100	2,520	2,800	3,060	3,340
1¼	1.227	2,880	3,450	3,830	4,190	4,570
1⅜	1.485	3,830	4,590	5,100	5,610	6,120
1½	1.767	4,970	5,960	6,630	7,280	7,940
1⅝	2.074	6,320	7,580	8,430	9,260	10,100
1¾	2.405	7,890	9,470	10,500	11,600	12,600
1⅞	2.761	9,710	11,600	12,900	14,200	15,500
2	3.142	11,800	14,100	15,700	17,300	18,800
2⅛	3.547	14,100	17,000	18,800	20,700	22,600
2¼	3.976	16,800	20,100	22,400	26,800	24,600
2⅜	4.430	19,700	23,700	26,300	28,900	31,600
2½	4.909	23,000	27,600	30,700	33,700	36,800
2⅝	5.412	26,600	32,000	35,500	39,100	42,600
2¾	5.940	30,600	36,800	40,800	44,900	49,000
2⅞	6.492	35,000	42,000	46,700	51,300	56,000
3	7.069	39,800	47,700	53,000	58,300	63,600
3⅛	7.670	44,900	53,900	59,900	65,900	71,900
3¼	8.296	50,600	60,700	67,400	74,100	80,900
3⅜	8.946	56,600	67,900	75,500	83,000	90,600
3½	9.621	63,100	75,800	84,200	92,600	101,000
3⅝	10.321	70,100	84,200	93,500	102,900	112,200
3¾	11.045	77,700	93,200	103,500	113,900	124,200
3⅞	11.793	85,700	102,800	114,200	125,700	137,100
4	12.566	94,200	113,100	125,700	138,200	150,800
4⅛	13.364	103,400	124,000	137,800	151,600	165,400
4¼	14.186	113,000	135,700	150,700	165,800	180,900
4⅜	15.033	123,300	148,000	164,400	180,900	197,300
4½	15.904	134,200	161,000	178,900	196,500	214,400
4⅝	16.800	145,700	174,800	194,300	213,700	233,100
4¾	17.721	157,800	189,400	210,400	231,500	252,500
4⅞	18.665	170,600	204,700	227,500	250,200	273,000

MAXIMUM BENDING MOMENTS ON PINS

FOR EXTREME FIBER STRESSES

VARYING FROM 15,000 TO 24,000 POUNDS PER SQUARE INCH.

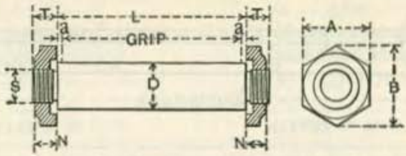
Diameter of Pin, in Inches.	Area of Pin, in Square Inches.	MOMENTS IN INCH-POUNDS FOR FIBER STRESSES OF				
		15,000 Lbs. per Square Inch.	18,000 Lbs. per Square Inch.	20,000 Lbs. per Square Inch.	22,000 Lbs. per Square Inch.	24,000 Lbs. per Square Inch.
5	19.635	184,100	220,900	245,400	270,000	294,500
5⅛	20.629	198,200	237,900	264,300	290,700	317,200
5¼	21.648	213,100	255,700	284,100	312,500	340,900
5⅜	22.691	228,700	274,400	304,900	335,400	365,900
5½	23.758	245,000	294,000	326,700	359,300	392,000
5⅝	24.850	262,100	314,500	349,500	384,400	419,300
5¾	25.967	280,000	335,900	373,300	410,600	447,900
5⅞	27.109	298,600	358,300	398,200	438,000	477,800
6	28.274	318,100	381,700	424,100	466,500	508,900
6¼	30.680	359,500	431,400	479,400	527,300	575,200
6½	33.183	404,400	485,300	539,200	593,100	647,100
6¾	35.785	452,900	543,500	603,900	664,200	724,600
7	38.485	505,100	606,100	673,500	740,800	808,200
7¼	41.282	561,200	673,400	748,200	823,000	897,900
7½	44.179	621,300	745,500	828,400	911,200	994,000
7¾	47.173	685,500	822,600	914,000	1,005,400	1,096,800
8	50.265	754,000	904,800	1,005,300	1,105,800	1,206,400
8¼	53.456	826,900	992,300	1,102,500	1,212,800	1,323,000
8½	56.745	904,400	1,085,200	1,205,800	1,326,400	1,447,000
8¾	60.132	986,500	1,183,800	1,315,400	1,446,900	1,578,500
9	63.617	1,073,500	1,288,200	1,431,400	1,574,500	1,717,700
9¼	67.201	1,165,500	1,398,600	1,554,000	1,709,400	1,864,800
9½	70.882	1,262,600	1,515,100	1,683,400	1,851,800	2,020.100
9¾	74.662	1,364,900	1,637,900	1,819,900	2,001,900	2,183,900
10	78.540	1,472,600	1,767,100	1,963,500	2,159,900	2,356,200
10¼	82.520	1,585,900	1,903,000	2,114,500	2,326,000	2,537,500
10½	86.590	1,704,700	2,045,700	2,273,000	2,500,300	2,727,600
10¾	90.760	1,829,400	2,195,300	2,439,300	2,683,100	2,927,000
11	95.030	1,960,100	2,352,100	2,613,400	2,874,700	3,136,000
11¼	99.400	2,096,800	2,516,100	2,795,700	3,075,200	3,354,700
11½	103.870	2,239,700	2,687,600	2,986,300	3,284,900	3,583,500
12	113.100	2,544,700	3,053,600	3,392,900	3,732,300	4,071,600

BEARING VALUE OF PINS
FOR ONE INCH THICKNESS OF PLATE.

Bearing Value = Diam. of Pin × 1 In. × Stress per Sq. In.

Diameter of Pin, Inches.	Bearing Values. At 15,000 Lbs. per Sq. In., Lbs.	Bearing Values. At 18,000 Lbs. per Sq. In., Lbs.	Bearing Values. At 20,000 Lbs. per Sq. In., Lbs.	Diameter of Pin, Inches.	Bearing Values. At 15,000 Lbs. per Sq. In., Lbs.	Bearing Values. At 18,000 Lbs. per Sq. In., Lbs.	Bearing Values. At 20,000 Lbs. per Sq. In., Lbs.
1	15,000	18,000	20,000	4½	67,500	81,000	90,000
1⅛	16,900	20,300	22,500	4⅝	69,400	83,300	92,500
1¼	18,800	22,500	25,000	4¾	71,300	85,500	95,000
1⅜	20,600	24,800	27,500	4⅞	73,100	87,800	97,500
1½	22,500	27,000	30,000	5	75,000	90,000	100,000
1⅝	24,400	29,300	32,500	5⅛	76,900	92,300	102,500
1¾	26,300	31,500	35,000	5¼	78,800	94,500	105,000
1⅞	28,100	33,800	37,500	5⅜	80,600	96,800	107,500
2	30,000	36,000	40,000	5½	82,500	99,000	110,000
2⅛	31,900	38,300	42,500	5⅝	84,400	101,300	112,500
2¼	33,800	40,500	45,000	5¾	86,300	103,500	115,000
2⅜	35,600	42,800	47,500	5⅞	88,100	105,800	117,500
2½	37,500	45,000	50,000	6	90,000	108,000	120,000
2⅝	39,400	47,300	52,500	6⅛	91,900	110,300	122,500
2¾	41,300	49,500	55,000	6¼	93,800	112,500	125,000
2⅞	43,100	51,800	57,500	6¾	95,600	114,800	127,500
3	45,000	54,000	60,000	6½	97,500	117,000	130,000
3⅛	46,900	56,300	62,500	6⅝	99,400	119,300	132,500
3¼	48,800	58,500	65,000	6¾	101,300	121,500	135,000
3⅜	50,600	60,800	67,500	6⅞	103,100	123,800	137,500
3½	52,500	63,000	70,000	7	105,000	126,000	140,000
3⅝	54,400	65,300	72,500	7½	112,500	135,000	150,000
3¾	56,300	67,500	75,000	8	120,000	144,000	160,000
3⅞	58,100	69,800	77,500	8½	127,500	153,000	170,000
4	60,000	72,000	80,000	9	135,000	162,000	180,000
4⅛	61,900	74,300	82,500	10	150,000	180,000	200,000
4¼	63,800	76,500	85,000	11	165,000	198,000	220,000
4⅜	65,600	78,800	87,500	12	180,000	216,000	240,000

PINS AND LOMAS NUTS

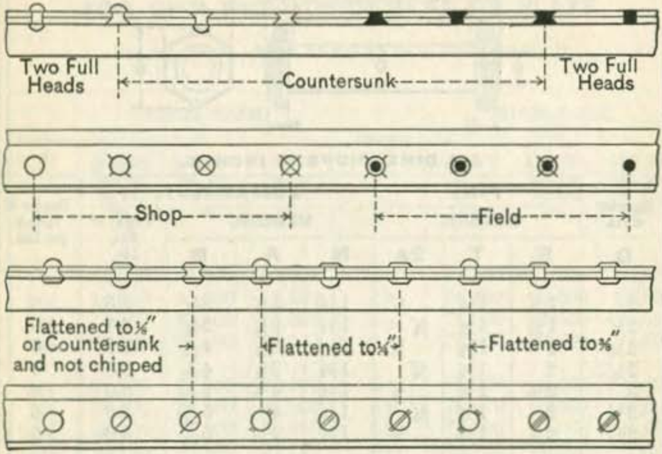


ALL DIMENSIONS IN INCHES.

Diameter of Pin.	PIN.			LOMAS NUT.				Number of Threads per Inch.
	DIMENSIONS.			DIMENSIONS.			Weight of Nut, Lbs.	
D	S	T	2a	N	A	B		
2	1½	1½	¼	1⅜	3¼	3¾	2.5	6
2¼	1½	1½	¼	1⅜	3¼	3¾	2.5	6
2½	2	1½	¼	1⅜	3¾	4 5/16	2.5	6
2¾	2	1½	¼	1⅜	3¾	4 5/16	2.5	6
3	2½	1½	¼	1⅜	4½	5 3/16	3.0	6
3¼	2½	1½	¼	1⅜	4½	5 3/16	3.0	6
3½	2½	1½	¼	1⅜	4½	5 3/16	3.0	6
3¾	3	1⅞	½	1¾	5	5¾	5.5	6
4	3	1⅞	½	1¾	5	5¾	5.5	6
4¼	3½	1⅞	½	1¾	5¾	6⅝	7.0	6
4½	3½	1⅞	½	1¾	5¾	6⅝	7.0	6
4¾	3½	1⅞	½	1¾	5¾	6⅝	7.0	6
5	4	1⅞	½	1¾	6½	7½	8.5	6
5¼	4	1⅞	½	1¾	6½	7½	8.5	6
5½	4½	1⅞	½	1¾	7	8⅛	11.0	6
5¾	4½	1⅞	½	1¾	7	8⅛	11.0	6
6	4½	1⅞	½	1¾	7	8⅛	11.0	6
6¼	5	2⅜	¾	2¼	7¾	8 15/16	12.0	6
6½	5	2⅜	¾	2¼	7¾	8 15/16	12.0	6
6¾	5½	2⅜	¾	2¼	8¼	9½	13.5	6
7	5½	2⅜	¾	2¼	8¼	9½	13.5	6
7¼	5½	2⅜	¾	2¼	8¼	9½	13.5	6
7½	5½	2⅜	¾	2¼	8¼	9½	13.5	6
7¾	6	2⅜	¾	2¼	9	10⅜	17.0	6
8	6	2⅜	¾	2¼	9	10⅜	17.0	6
8¼	6	2⅜	¾	2¼	9	10⅜	17.0	6
8½	6	2⅜	¾	2¼	9½	10⅞	19.0	6
8¾	6	2⅜	¾	2¼	10½	12⅛	23.5	6
9	6	2⅜	¾	2¼	10½	12⅛	23.5	6

L=Grip+2a. Total Length of Pin=L+2T.

CONVENTIONAL SIGNS FOR RIVETING.



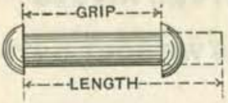
SIZES OF RIVET HEADS AND CLEARANCES FOR MACHINE DRIVING.

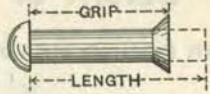
All dimensions in inches.

Diameter of Rivet.	Button Head.		Countersunk Head.	
	Height.	Diameter "H"	Depth.	Diameter.
$\frac{1}{2}$	$\frac{3}{8}$	$\frac{7}{8}$	$\frac{1}{4}$	$\frac{3}{4}$
$\frac{5}{8}$	$\frac{15}{32}$	$1\frac{1}{16}$	$\frac{5}{16}$	1
$\frac{3}{4}$	$\frac{9}{16}$	$1\frac{1}{4}$	$\frac{3}{8}$	$1\frac{3}{16}$
$\frac{7}{8}$	$\frac{21}{32}$	$1\frac{7}{16}$	$\frac{7}{16}$	$1\frac{3}{8}$
1	$\frac{3}{4}$	$1\frac{5}{8}$	$\frac{1}{2}$	$1\frac{9}{16}$

A must not be less than $\frac{3}{8}$ in. + $\frac{1}{2}$ H.

LENGTHS OF RIVETS FOR VARIOUS GRIPS.





Grip of Rivet, Inches.	DIAMETER OF RIVET.					DIAMETER OF RIVET.					Grip of Rivet, Inches.
	½″	⅝″	¾″	⅞″	1″	½″	⅝″	¾″	⅞″	1″	
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	2⅞	3	3⅛	3¼	2⅛	2¼	2⅜	2⅜	2½	1½
1⅝	2¾	3	3⅛	3¼	3⅜	2¼	2⅜	2½	2½	2⅝	1⅝
1¾	2⅞	3⅛	3¼	3⅜	3½	2⅜	2½	2⅝	2⅝	2¾	1¾
1⅞	3	3¼	3⅜	3½	3⅝	2½	2⅝	2¾	2¾	2⅞	1⅞
2	3⅛	3⅜	3½	3⅝	3¾	2⅝	2¾	2⅞	2⅞	3	2
2⅛	3¼	3½	3⅝	3¾	3⅞	2¾	2⅞	3	3	3⅛	2⅛
2¼	3⅜	3⅝	3¾	3⅞	4	2⅞	3	3⅛	3⅛	3¼	2¼
2⅜	3½	3¾	3⅞	4	4⅛	3	3⅛	3¼	3¼	3⅜	2⅜
2½	3⅝	3⅞	4	4⅛	4¼	3⅛	3¼	3⅜	3⅜	3½	2½
2⅝	3¾	4	4⅛	4¼	4⅜	3¼	3⅜	3½	3½	3⅝	2⅝
2¾	3⅞	4⅛	4¼	4⅜	4½	3⅜	3½	3⅝	3⅝	3¾	2¾
2⅞	4	4¼	4⅜	4½	4⅝	3½	3⅝	3¾	3¾	3⅞	2⅞
3	4¼	4½	4⅝	4¾	4⅞	3¾	3⅞	3⅞	4	4⅛	3
3⅛	4⅜	4⅝	4¾	4⅞	5	3⅞	4	4	4⅛	4¼	3⅛
3¼	4½	4¾	4⅞	5	5⅛	4	4⅛	4⅛	4¼	4⅜	3¼
3⅜	4⅝	4⅞	5	5⅛	5¼	4⅛	4¼	4¼	4⅜	4½	3⅜
3½	4¾	5	5⅛	5¼	5⅜	4¼	4⅜	4⅜	4½	4⅝	3½
3⅝	4⅞	5⅛	5¼	5⅜	5½	4⅜	4½	4½	4⅝	4¾	3⅝
3¾	5	5¼	5⅜	5½	5⅝	4½	4⅝	4⅝	4¾	4⅞	3¾
3⅞	5⅛	5⅜	5½	5⅝	5¾	4⅝	4¾	4¾	4⅞	5	3⅞
4	5¼	5½	5⅝	5¾	5⅞	4¾	4⅞	4⅞	5	5⅛	4
4⅛	5⅜	5⅝	5¾	5⅞	6	4⅞	5	5	5⅛	5¼	4⅛
4¼	5½	5¾	5⅞	6	6⅛	5	5⅛	5⅛	5¼	5⅜	4¼
4⅜	5⅝	5⅞	6	6⅛	6¼	5⅛	5¼	5¼	5⅜	5½	4⅜
4½	5¾	6	6¼	6⅜	6½	5¼	5⅜	5½	5½	5⅝	4½
4⅝	6	6¼	6⅜	6½	6⅝	5½	5⅝	5⅝	5⅝	5¾	4⅝
4¾	6⅛	6⅜	6½	6⅝	6¾	5⅝	5¾	5¾	5¾	5⅞	4¾
4⅞	6¼	6½	6⅝	6¾	6⅞	5¾	5⅞	5⅞	5⅞	6	4⅞
5	6⅜	6⅝	6¾	6⅞	7	5⅞	6	6	6	6⅛	5

For field rivets add ⅛ inch to tabular lengths.

WEIGHT OF 100 STEEL RIVETS

OR ROUND HEAD BOLTS WITHOUT NUTS.

POUNDS.

Length, Inches.	3/8 In. Diam.	1/2 In. Diam.	5/8 In. Diam.	3/4 In. Diam.	7/8 In. Diam.	1 In. Diam.	1 1/8 In. Diam.	1 1/4 In. Diam.
1 1/4	5.5	12.8	22.0	29.3	43.9	66.6	93.3	127.0
1 1/2	6.3	14.2	24.1	32.4	48.2	72.1	100.0	136.0
1 3/4	7.0	15.5	26.3	35.5	52.5	77.7	107.0	145.0
2	7.9	16.9	28.5	38.7	56.7	83.3	114.0	153.0
2 1/4	8.7	18.3	30.7	41.8	61.0	88.8	121.0	162.0
2 1/2	9.4	19.7	32.8	44.9	65.2	94.4	128.0	171.0
2 3/4	10.2	21.1	35.0	48.0	69.5	100.0	136.0	179.0
3	11.0	22.5	37.2	51.1	73.7	105.0	143.0	188.0
3 1/4	11.7	23.9	39.3	54.3	78.0	111.0	150.0	197.0
3 1/2	12.6	25.3	41.5	57.4	82.3	116.0	157.0	205.0
3 3/4	13.4	26.7	43.7	60.5	86.5	122.0	164.0	214.0
4	14.1	28.1	45.9	63.6	90.8	128.0	170.0	223.0
4 1/4	14.9	29.4	48.0	66.7	95.0	134 0	177.0	231.0
4 1/2	15.7	30.8	50.2	69.9	99.3	139.0	185.0	240.0
4 3/4	16.5	32.2	52.4	73.0	104.0	145.0	192.0	249.0
5	17.2	33.6	54.5	76.1	108.0	150.0	199.0	258.0
5 1/4	18.1	35.0	56.7	79.2	112.0	156.0	206.0	266.0
5 1/2	18.8	36.4	58.9	82.3	116.0	161.0	213.0	275.0
5 3/4	19.6	37.8	61.1	85.5	120.0	166.0	220.0	284.0
6	20.4	39.2	63.2	88.6	124.0	172.0	227.0	292.0
6 1/2	21.9	42.0	67.6	95.1	133.0	184.0	241.0	310.0
7	23.5	44.7	71.9	101.0	142.0	195.0	255.0	327.0
7 1/2	25.1	47.5	76.1	108.0	150.0	206.0	269.0	345.0
8	26.6	50.3	80.6	114.0	159.0	217.0	284.0	362.0
8 1/2	28.2	53.1	85.0	120.0	167.0	227.0	298.0	379.0
9	29.8	55.9	89.3	126.0	176.0	239.0	312.0	397.0
9 1/2	31.3	58.7	93.7	133.0	185.0	250 0	325.0	414.0
10	32.8	61.4	98.0	139.0	193.0	261.0	340.0	431.0
10 1/2	34.5	64.2	103.0	145.0	202.0	272.0	354.0	449.0
11	36.0	67.0	107.0	151.0	210.0	284.0	368.0	466.0
11 1/2	37.6	69.8	111.0	158.0	218.0	295.0	382.0	484.0
12	39.2	72.5	115.0	164.0	227.0	306.0	396.0	501.0
100 Heads.	1.8	5.8	11.1	13.6	22.6	39.0	58.0	83.5

WEIGHT, IN POUNDS, OF 100 BOLTS
WITH SQUARE HEADS AND NUTS.

Length under Head, Inches.	Diameter of Bolts.								
	¼ In.	$\frac{5}{16}$ In.	⅜ In.	$\frac{7}{16}$ In.	½ In.	⅝ In.	¾ In.	⅞ In.	1 In.
1½	4.0	7.0	10.5	15.2	22.5	39.5	63.0	....	....
1¾	4.4	7.5	11.3	16.3	23.8	41.6	66.0	....	....
2	4.8	8.0	12.0	17.4	25.2	43.8	69.0	109.0	163
2¼	5.2	8.5	12.8	18.5	26.5	45.8	72.0	113.3	169
2½	5.5	9.0	13.5	19.6	27.8	48.0	75.0	117.5	174
2¾	5.8	9.5	14.3	20.7	29.1	50.1	78.0	121.8	180
3	6.3	10.0	15.0	21.8	30.5	52.3	81.0	126.0	185
3½	7.0	11.0	16.5	24.0	33.1	56.5	87.0	134.3	196
4	7.8	12.0	18.0	26.2	35.8	60.8	93.1	142.5	207
4½	8.5	13.0	19.5	28.4	38.4	65.0	99.1	151.0	218
5	9.3	14.0	21.0	30.6	41.1	69.3	105.2	159.6	229
5½	10.0	15.0	22.5	32.8	43.7	73.5	111.3	168.0	240
6	10.8	16.0	24.0	35.0	46.4	77.8	117.3	176.6	251
6½	....	....	25.5	37.2	49.0	82.0	123.4	185.0	262
7	....	....	27.0	39.4	51.7	86.3	129.4	193.7	273
7½	....	....	28.5	41.6	54.3	90.5	135.0	202.0	284
8	....	....	30.0	43.8	59.6	94.8	141.5	210.7	295
9	....	....	....	48.2	64.9	103.3	153.6	227.8	317
10	....	....	....	52.6	70.2	111.8	165.7	244.8	339
11	....	....	....	57.0	75.5	120.3	177.8	261.9	360
12	....	....	....	61.4	80.8	128.8	189.9	278.9	382
14	....	....	....	....	91.4	145.8	214.1	313.0	426
16	....	....	....	....	102.0	162.8	238.3	347.1	470
18	....	....	....	....	112.6	179.5	262.6	381.2	514
20	....	....	....	....	123.2	206.5	286.8	415.3	558
Per Inch Additional	1.4	2.1	3.1	4.2	5.5	8.5	12.3	16.7	21.8

WEIGHTS OF NUTS AND BOLT HEADS IN POUNDS.

Diameter of Bolt in Inches.	¼ In.	$\frac{5}{16}$ In.	⅜ In.	½ In.	⅝ In.	¾ In.	⅞ In.
Weight of Hexagon Nut and Head.........	.021	.036	.064	.13	.26	.40	.68
Weight of Square Nut and Head.........	.024	.042	.070	.15	.29	.47	.77
Diameter of Bolt in Inches.	**1 In.**	**1¼ In.**	**1½ In.**	**1¾ In.**	**2 In.**	**2½ In.**	**3 In.**
Weight of Hexagon Nut and Head.........	1.01	2.10	4.26	6.89	9.24	17.3	27.2
Weight of Square Nut and Head.........	1.19	2.39	5.01	8.41	12.93	21.4	33.5

DIMENSIONS AND WEIGHTS OF

HOT PRESSED SQUARE NUTS.

MANUFACTURERS' STANDARD SIZES.

Weights and sizes are for the unfinished nuts.

Size of Bolt, Inches.	Weight of 100 Nuts, Lbs.	Rough Hole, Inches.	Thickness of Nut, Inches.	Side of Square, Inches.	Diagonal, Inches.	No. of Nuts in 100 Lbs.
1/4	1.5	7/32	1/4	1/2	.71	6800.0
5/16	2.9	9/32	5/16	5/8	.88	3480.0
3/8	4.9	11/32	3/8	3/4	1.06	2050.0
7/16	7.7	13/32	7/16	7/8	1.24	1290.0
1/2	8.6	7/16	1/2	7/8	1.24	1170.0
1/2	11.8	7/16	1/2	1	1.41	850.0
9/16	16.7	1/2	9/16	1 1/8	1.59	600.0
5/8	17.7	9/16	5/8	1 1/8	1.59	570.0
5/8	22.8	9/16	5/8	1 1/4	1.77	440.0
3/4	32.3	21/32	3/4	1 3/8	1.94	310.0
3/4	39.8	21/32	3/4	1 1/2	2.12	251.0
7/8	53.0	25/32	7/8	1 5/8	2.30	190.0
7/8	63.0	25/32	7/8	1 3/4	2.47	159.0
1	68.0	7/8	1	1 3/4	2.47	146.0
1	94.0	7/8	1	2	2.83	106.0
1 1/8	103.0	15/16	1 1/8	2	2.83	97.0
1 1/8	137.0	15/16	1 1/8	2 1/4	3.18	73.0
1 1/4	145.0	1 1/16	1 1/4	2 1/4	3.18	69.0
1 1/4	186.0	1 1/16	1 1/4	2 1/2	3.54	54.0
1 3/8	247.0	1 3/16	1 3/8	2 3/4	3.89	41.0
1 1/2	319.0	1 5/16	1 1/2	3	4.24	31.3
1 5/8	400.0	1 7/16	1 5/8	3 1/4	4.60	24.8
1 3/4	500.0	1 9/16	1 3/4	3 1/2	4.95	19.9
1 7/8	620.0	1 11/16	1 7/8	3 3/4	5.30	16.2
2	750.0	1 13/16	2	4	5.66	13.4
2 1/8	780.0	1 7/8	2 1/8	4	5.66	12.8
2 1/4	930.0	2	2 1/4	4 1/4	6.01	10.7
2 3/8	960.0	2 1/8	2 3/8	4 1/4	6.01	10.4
2 1/2	1130.0	2 1/4	2 1/2	4 1/2	6.36	8.9
2 3/4	1370.0	2 7/16	2 3/4	4 3/4	6.72	7.3
3	1610.0	2 11/16	3	5	7.07	6.2
3 1/4	2110.0	2 15/16	3 1/4	5 1/2	7.78	4.7
3 1/2	2750.0	3 1/8	3 1/2	6	8.49	3.6

DIMENSIONS AND WEIGHTS OF

HOT PRESSED HEXAGON NUTS.

MANUFACTURERS' STANDARD SIZES.

Weights and sizes are for the unfinished nut.

Size of Bolt, Inches.	Weight of 100 Nuts, Lbs.	Rough Hole, Inches.	Thickness of Nut, Inches.	Short Diameter, Inches.	Long Diameter, Inches.	No. of Nuts in 100 Lbs.
$\frac{1}{4}$	1.3	$\frac{7}{32}$	$\frac{1}{4}$	$\frac{1}{2}$	.58	8000.0
$\frac{5}{16}$	2.4	$\frac{9}{32}$	$\frac{5}{16}$	$\frac{5}{8}$	.72	4170.0
$\frac{3}{8}$	4.1	$\frac{11}{32}$	$\frac{3}{8}$	$\frac{3}{4}$	.87	2410.0
$\frac{7}{16}$	6.8	$\frac{13}{32}$	$\frac{7}{16}$	$\frac{7}{8}$	1.01	1460.0
$\frac{1}{2}$	7.1	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{7}{8}$	1.01	1410.0
$\frac{1}{2}$	9.8	$\frac{7}{16}$	$\frac{1}{2}$	1	1.15	1020.0
$\frac{9}{16}$	14.0	$\frac{1}{2}$	$\frac{9}{16}$	$1\frac{1}{8}$	1.30	710.0
$\frac{5}{8}$	14.7	$\frac{9}{16}$	$\frac{5}{8}$	$1\frac{1}{8}$	1.30	680.0
$\frac{5}{8}$	19.1	$\frac{9}{16}$	$\frac{5}{8}$	$1\frac{1}{4}$	1.44	520.0
$\frac{5}{8}$	22.9	$\frac{9}{16}$	$\frac{3}{4}$	$1\frac{1}{4}$	1.44	440.0
$\frac{3}{4}$	27.2	$\frac{21}{32}$	$\frac{3}{4}$	$1\frac{3}{8}$	1.59	370.0
$\frac{3}{4}$	39.0	$\frac{21}{32}$	$\frac{7}{8}$	$1\frac{1}{2}$	1.73	256.0
$\frac{7}{8}$	44.0	$\frac{25}{32}$	$\frac{7}{8}$	$1\frac{5}{8}$	1.88	226.0
$\frac{7}{8}$	50.0	$\frac{25}{32}$	1	$1\frac{5}{8}$	1.88	198.0
1	57.0	$\frac{7}{8}$	1	$1\frac{3}{4}$	2.02	176.0
1	64.0	$\frac{7}{8}$	$1\frac{1}{8}$	$1\frac{3}{4}$	2.02	156.0
$1\frac{1}{8}$	96.0	$\frac{15}{16}$	$1\frac{1}{4}$	2	2.31	104.0
$1\frac{1}{4}$	134.0	$1\frac{1}{16}$	$1\frac{3}{8}$	$2\frac{1}{4}$	2.60	75.0
$1\frac{3}{8}$	180.0	$1\frac{3}{16}$	$1\frac{1}{2}$	$2\frac{1}{2}$	2.89	56.0
$1\frac{1}{2}$	235.0	$1\frac{5}{16}$	$1\frac{5}{8}$	$2\frac{3}{4}$	3.18	42.0
$1\frac{5}{8}$	300.0	$1\frac{7}{16}$	$1\frac{3}{4}$	3	3.46	33.4
$1\frac{3}{4}$	370.0	$1\frac{9}{16}$	$1\frac{7}{8}$	$3\frac{1}{4}$	3.75	26.7
$1\frac{7}{8}$	460.0	$1\frac{11}{16}$	2	$3\frac{1}{2}$	4.04	21.5
2	450.0	$1\frac{13}{16}$	2	$3\frac{1}{2}$	4.04	22.4
$2\frac{1}{8}$	560.0	$1\frac{7}{8}$	$2\frac{1}{8}$	$3\frac{3}{4}$	4.33	18.0
$2\frac{1}{4}$	560.0	2	$2\frac{1}{4}$	$3\frac{3}{4}$	4.33	17.7
$2\frac{3}{8}$	680.0	$2\frac{1}{8}$	$2\frac{3}{8}$	4	4.62	14.7
$2\frac{1}{2}$	810.0	$2\frac{1}{4}$	$2\frac{1}{2}$	$4\frac{1}{4}$	4.91	12.3
$2\frac{3}{4}$	980.0	$2\frac{7}{16}$	$2\frac{3}{4}$	$4\frac{1}{2}$	5.20	10.2
3	1150.0	$2\frac{11}{16}$	3	$4\frac{3}{4}$	5.48	8.7
$3\frac{1}{4}$	1340.0	$2\frac{15}{16}$	$3\frac{1}{4}$	5	5.77	7.5
$3\frac{1}{2}$	1580.0	$3\frac{1}{8}$	$3\frac{1}{2}$	$5\frac{1}{4}$	6.06	6.3

BOLTS AND NUTS.

BOLTS. U. S. Standard Screw Threads.					NUTS. Manufacturers' Standard.			
					HEXAGON.		SQUARE.	
Diam. of Bolt, Ins.	No. of Threads per Inch.	Diam. at Root of Thread, Ins.	Area of Body of Bolt, Sq. Ins.	Area at Root of Thread, Sq. Ins.	Short Diam., Ins.	Long Diam., Ins.	Side of Square, Ins.	Diagonal, Ins.
¼	20	.185	.049	.027	½	.58	½	.71
5/16	18	.240	.077	.045	⅝	.72	⅝	.88
⅜	16	.294	.110	.068	¾	.87	¾	1.06
7/16	14	.344	.150	.093	⅞	1.01	⅞	1.24
½	13	.400	.196	.126	⅞	1.01	⅞	1.24
9/16	12	.454	.249	.162	1⅛	1.30	1⅛	1.59
⅝	11	.507	.307	.201	1⅛	1.30	1⅛	1.59
¾	10	.620	.442	.302	1⅜	1.59	1⅜	1.94
⅞	9	.731	.601	.419	1⅝	1.88	1⅝	2.30
1	8	.837	.785	.550	1¾	2.02	1¾	2.47
1⅛	7	.940	.994	.694	2	2.31	2	2.83
1¼	7	1.06	1.23	.890	2¼	2.60	2¼	3.18
1⅜	6	1.16	1.48	1.06	2½	2.89	2¾	3.89
1½	6	1.28	1.77	1.29	2¾	3.18	3	4.24
1⅝	5½	1.39	2.07	1.51	3	3.46	3¼	4.60
1¾	5	1.49	2.40	1.74	3¼	3.75	3½	4.95
1⅞	5	1.61	2.76	2.05	3½	4.04	3¾	5.30
2	4½	1.71	3.14	2.30	3½	4.04	4	5.66
2¼	4½	1.96	3.98	3.02	3¾	4.33	4¼	6.01
2½	4	2.17	4.91	3.71	4¼	4.91	4½	6.36
2¾	4	2.42	5.94	4.62	4½	5.20	4¾	6.72
3	3½	2.63	7.07	5.43	4¾	5.48	5	7.07
3¼	3½	2.88	8.30	6.51	5	5.77	5½	7.78
3½	3¼	3.10	9.62	7.55	5¼	6.06	5¾	8.13
3¾	3	3.32	11.04	8.64	5¾	6.64	6¼	8.84
4	3	3.57	12.57	10.00	6¼	7.22	6¾	9.55
4¼	2⅞	3.80	14.19	11.33	6½	7.50	7	9.90
4½	2¾	4.03	15.90	12.74	7	8.08	7½	10.61
4¾	2⅝	4.25	17.72	14.23	7¼	8.37	7¾	10.96
5	2½	4.48	19.63	15.76	7¾	8.95	8¼	11.66
5½	2⅜	4.95	23.76	19.27	8½	9.81	9	12.72
6	2¼	5.42	28.27	23.10	9¼	10.67	9¾	13.79

UPSET SCREW ENDS

FOR ROUND AND SQUARE RODS.

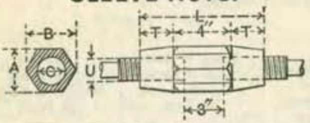
All dimensions are in inches.

Diameter of Round Rod, or Side of Square Rod.		Diameter of Upset Screw End.	Length of Upset.	Number of Threads per Inch.	Excess of Area at Root of Thread over Area of Rod. Per Cent.		Additional Length of Rod Required to Make One Upset.	
○	□				○	□	○	□
⅝		⅞	4	9	37		4½	
¾	⅝	1	4	8	25	41	3⅞	4⅝
	¾	1⅛	4	7		23		3½
⅞	⅞	1¼	4	7	48	16	5	4
1		1⅜	4	6	35		4⅜	
1⅛	1	1½	4	6	30	29	3⅞	4
1¼	1⅛	1⅝	4½	5½	23	20	3⅞	4½
1⅜		1¾	4½	5	18		3½	
	1¼	1⅞	4½	5		31		4½
1½	1⅜	2	5	4½	30	22	4⅝	4⅛
1⅝		2⅛	5	4½	28		4¼	
1¾	1½	2¼	5	4½	26	34	4	4¾
1⅞	1⅝	2⅜	5½	4½	24	30	4⅛	4⅝
2	1¾	2½	5½	4	18	21	3⅞	4¼
2⅛		2⅝	5½	4	17		3⅝	
	1⅞	2¾	6	4		31		5⅛
2¼	2	2⅞	6	4	28	28	4⅝	4¾
2⅜	2⅛	3	6	3½	22	20	4⅜	4⅜
2½		3⅛	6½	3½	21		4⅜	
2⅝	2¼	3¼	6½	3½	20	29	4¼	5⅛
2¾		3⅜	7	3¼	19		4¼	
	2⅜	3½	7	3¼		34		6⅛
2⅞	2½	3⅝	8	3¼	26	31	5½	6¼
3		3¾	8	3	22		5¼	
3⅛	2⅝	3⅞	8	3	21	35	5⅛	6¾
3¼	2¾	4	8	3	20	32	4⅞	6
3⅜		4⅛	9	3	20		5½	
3½	2⅞	4¼	9	2⅞	18	37	5¼	8
		4⅜	9	2¾				
3⅝	3	4½	9	2¾	23	42	5¾	7½
3¾		4⅝	9	2¾	23		5½	

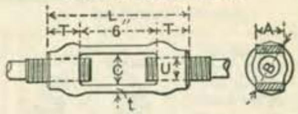
SLEEVE NUTS AND TURNBUCKLES.

ALL DIMENSIONS IN INCHES.

SLEEVE NUTS.



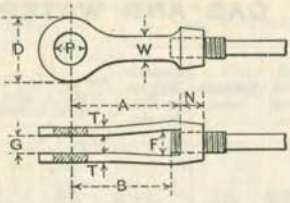
TURNBUCKLES.



Diameter of Screw.	DIMENSIONS.					Weight in Pounds.	DIMENSIONS.						Weight in Pounds.
U	L	T	A	B	C		L	T	A	B	C	t	
7/8	7	1 1/2	1 5/8	1 7/8	1 1/8	2 3/4	8 5/8	1 5/16	1 1/4	2 1/4	1 1/4	3/8	2 1/2
1	7	1 1/2	1 5/8	1 7/8	1 1/8	3	9	1 1/2	1 1/4	2 7/16	1 5/16	7/16	3 1/2
1 1/8	7 1/2	1 3/4	2	2 5/16	1 3/8	3 1/2	9 3/8	1 11/16	1 1/4	2 9/16	1 7/16	1/2	4
1 1/4	7 1/2	1 3/4	2	2 5/16	1 3/8	4	9 3/4	1 7/8	1 1/2	2 3/4	1 9/16	1/2	5 1/4
1 3/8	8	2	2 3/8	2 3/4	1 5/8	4 1/2	10 1/8	2 1/16	1 5/8	3 1/16	1 11/16	1/2	6
1 1/2	8	2	2 3/8	2 3/4	1 5/8	6 1/2	10 1/2	2 1/4	1 5/8	3 3/16	1 3/4	5/8	7
1 5/8	8 1/2	2 1/4	2 3/4	3 3/16	1 7/8	8	10 7/8	2 7/16	1 3/4	3 1/2	2	5/8	8 1/2
1 3/4	8 1/2	2 1/4	2 3/4	3 3/16	1 7/8	8 1/2	11 1/4	2 5/8	2	3 3/4	2 1/8	5/8	10
1 7/8	9	2 1/2	3 1/8	3 5/8	2 1/8	10	11 5/8	2 13/16	2	3 7/8	2 3/16	11/16	11 1/2
2	9	2 1/2	3 1/8	3 5/8	2 1/8	11	12	3	2 1/4	4 1/4	2 3/8	11/16	13
2 1/8	9 1/2	2 3/4	3 1/2	4 1/16	2 3/8	14	12 3/8	3 3/16	2 1/2	4 1/2	2 1/2	23/32	15
2 1/4	9 1/2	2 3/4	3 1/2	4 1/16	2 3/8	15	12 3/4	3 3/8	2 1/2	4 3/4	2 11/16	13/16	18
2 3/8	10	3	3 7/8	4 1/2	2 5/8	18	13 1/8	3 9/16	2 3/4	4 7/8	2 3/4	13/16	20
2 1/2	10	3	3 7/8	4 1/2	2 5/8	19	13 1/2	3 3/4	3	5 3/8	3 1/16	27/32	24
2 5/8	10 1/2	3 1/4	4 1/4	4 15/16	2 7/8	22	13 7/8	3 15/16	3	5 9/16	3 1/8	15/16	28
2 3/4	10 1/2	3 1/4	4 1/4	4 15/16	2 7/8	23	14 1/4	4 1/8	3 1/4	5 3/4	3 1/4	15/16	30
2 7/8	11	3 1/2	4 5/8	5 3/8	3 1/8	27	14 5/8	4 5/16	3 1/4	6 1/16	3 7/16	1 1/32	34
3	11	3 1/2	4 5/8	5 3/8	3 1/8	28	15	4 1/2	3 1/2	6 3/8	3 5/8	1 1/32	38
3 1/8	11 1/2	3 3/4	5	5 13/16	3 3/8	34	......	......	......	......	......	......	......
3 1/4	11 1/2	3 3/4	5	5 13/16	3 3/8	35	15 3/4	4 7/8	4	6 3/4	3 7/8	1 1/16	50
3 3/8	12	4	5 3/8	6 1/8	3 5/8	39	......	......	......	......	......	......	......
3 1/2	12	4	5 3/8	6 1/8	3 5/8	40	16 1/2	5 1/4	4	7 1/4	4 1/4	1 7/32	65
3 5/8	12 1/2	4 1/4	5 3/4	6 11/16	3 7/8	45	......	......	......	......	......	......	......
3 3/4	12 1/2	4 1/4	5 3/4	6 11/16	3 7/8	47	18	6	5	8 1/4	4 7/16	1 5/16	......
3 7/8	13	4 1/2	6 1/8	7 1/8	4 1/8	52	......	......	......	......	......	......	......
4	13	4 1/2	6 1/8	7 1/8	4 1/8	55	18	6	5	8 3/4	4 5/8	1 7/16	......
4 1/4	13 1/2	4 3/4	6 1/2	7 9/16	4 3/8	65	......	......	......	......	......	......	......
4 1/2	14	5	6 7/8	8	4 3/4	75	......	......	......	......	......	......	......

CLEVISES.

All dimensions in inches.



Grip G can be made to suit connections.

Diameter of Clevis. D	Maximum Pin. P	DIMENSIONS OF CLEVIS, IN INCHES. F	N	W	T	A	B
3	1½	1½	1½	1½	⅜	6	5
4	2¼	1¾	1¾	1¾	½	9	8
5	3	2¼	2¼	2¼	⅝	9	8
6	3½	2¾	2¾	2¾	¾	9	8
7	4	3¼	3¼	3¼	⅞	9	8

DIAMETER OF CLEVIS TO BE USED FOR A GIVEN ROD AND PIN.

ROD. Round.	Square.	Upset.	DIAMETER OF PINS. 1"	1¼"	1½"	1¾"	2"	2¼"	2½"	2¾"	3"	3¼"	3½"	3¾"	4"
¾	⅝	1	3	3	3										
	¾	1⅛	3	3	3	4	4	4							
⅞	⅞	1¼	.....	4	4	4	4	4							
1		1⅜	.....	4	4	4	4	4							
1⅛	1	1½	.....	4	4	4	4	4	5	5	5				
1¼	1⅛	1⅝	.....	.....	4	4	5	5	5	5	5				
1⅜		1¾	.....	.....	5	5	5	5	5	5	5				
	1¼	1⅞	.....	.....	5	5	5	5	5	5	5				
1½	1⅜	2	.....	.....	.....	5	5	5	5	5	6	6	6		
1⅝		2⅛	.....	.....	.....	5	5	5	5	6	6	6	6		
1¾	1½	2¼	.....	.....	.....	.....	6	6	6	6	6	6	7	7	7
1⅞	1⅝	2⅜	.....	.....	.....	.....	6	6	6	6	7	7	7	7	7
2	1¾	2½	.....	.....	.....	.....	.....	6	6	7	7	7	7	7	7
2⅛		2⅝	.....	.....	.....	.....	.....	.....	7	7	7	7	7		
	1⅞	2¾	.....	.....	.....	.....	.....	.....	7	7	7	7	7		
2¼	2	2⅞	.....	.....	.....	.....	.....	.....	.....	7	7				

Clevises above and to right of heavy zigzag line may be used with forks straight.

Clevises below and to left of same line should have forks closed in until pin is not overstrained.

STANDARD
STEAM, GAS AND WATER PIPE.

Nominal Inside Diameter, Inches.	Actual Inside Diameter, Inches.	Actual Outside Diameter, Inches.	Thickness, Inches.	Nominal Weight per Foot, Pounds.	Internal Area, Sq. Inches.	External Area, Sq. Inches.	Length Containing 1 Cubic Foot, Feet.	No. of Threads per Inch.
1/8	.27	.405	.07	.24	.06	.13	2500.00	27
1/4	.36	.540	.09	.42	.10	.23	1385.00	18
3/8	.49	.675	.09	.56	.19	.36	751.50	18
1/2	.62	.840	.11	.84	.30	.55	472.40	14
3/4	.82	1.050	.11	1.12	.53	.87	270.00	14
1	1.04	1.315	.13	1.67	.86	1.36	166.90	11 1/2
1 1/4	1.38	1.660	.14	2.24	1.50	3.16	96.25	11 1/2
1 1/2	1.61	1.900	.14	2.68	2.04	2.83	70.65	11 1/2
2	2.06	2.375	.15	3.61	3.35	4.43	42.36	11 1/2
2 1/2	2.46	2.875	.20	5.74	4.78	6.49	30.11	8
3	3.06	3.500	.22	7.54	7.39	9.62	19.49	8
3 1/2	3.56	4.000	.23	9.00	9.89	12.57	14.56	8
4	4.02	4.500	.24	10.66	12.73	15.90	11.31	8
4 1/2	4.50	5.000	.25	12.34	15.94	19.63	9.03	8
5	5.04	5.560	.26	14.50	19.99	24.30	7.20	8
6	6.06	6.625	.28	18.76	28.89	34.47	4.98	8
7	7.02	7.625	.30	23.27	38.74	45.66	3.72	8
8	7.98	8.625	.32	28.18	50.04	58.43	2.88	8
9	9.00	9.625	.34	33.70	63.63	73.72	2.26	8
10	10.01	10.750	.37	40.06	78.84	90.79	1.80	8
11	11.00	11.75	.37	45.00	95.03	108.43	1.50	8
12	12.00	12.75	.37	49.00	113.09	127.67	1.27	8
13	13.25	14.00	.37	54.00	137.88	153.94	1.04	8
14	14.25	15.00	.37	58.00	159.48	176.71	.90	8
15	15.40	16.00	.28	66.00	187.04	201.06	.77	8
16	16.40	17.00	.30	70.00	211.24	226.98	.68	8

SPIKES, NAILS AND SCREWS.

Standard Steel Wire Nails.						Steel Wire Spikes.			Common Iron Nails.		
		Common.		Finishing.							
Sizes.	Length, Inches.	Diam., Inches.	No. per Pound.	Diam., Inches.	No. per Pound.	Length, Inches.	Diam., Inches.	No. per Pound.	Sizes.	Length, Inches.	No. per Pound.
2d	1	.0524	1060	.0453	1558	3	.1620	41	2d	1	800
3d	1¼	.0588	640	.0508	913	3½	.1819	30	3d	1¼	400
4d	1½	.0720	380	.0508	761	4	.2043	23	4d	1½	300
5d	1¾	.0764	275	.0571	500	4½	.2294	17	5d	1¾	200
6d	2	.0808	210	.0641	350	5	.2576	13	6d	2	150
7d	2¼	.0858	160	.0641	315	5½	.2893	11	7d	2¼	120
8d	2½	.0935	115	.0720	214	6	.2893	10	8d	2½	85
9d	2¾	.0963	93	.0720	195	6½	.2249	7½	9d	2¾	75
10d	3	.1082	77	.0808	137	7	.2249	7	10d	3	60
12d	3¼	.1144	60	.0808	127	8	.3648	5	12d	3¼	50
16d	3½	.1285	48	.0907	90	9	.3648	4½	16d	3½	40
20d	4	.1620	31	.1019	62	....	....	....	20d	4	20
30d	4½	.1819	22	....	....	....	....	....	30d	4½	16
40d	5	.2043	17	....	....	....	....	....	40d	5	14
50d	5½	.2294	13	....	....	....	....	....	50d	5½	11
60d	6	.2576	11	....	....	....	....	....	60d	6	8

WROUGHT SPIKES.

Number to a keg of 150 lbs.

Length, Inches.	¼ Inch. No.	5/16 Inch. No.	⅜ Inch. No.	Length, Inches.	¼ Inch. No.	5/16 Inch. No.	⅜ Inch. No.	7/16 Inch. No.	½ Inch. No.
3	2250	....	....	7	1161	662	482	445	306
3½	1890	1208	....	8	....	635	455	384	256
4	1650	1135	....	9	....	573	424	300	240
4½	1464	1064	....	10	....	....	391	270	222
5	1380	930	742	11	....	....	....	249	203
6	1292	868	570	12	....	....	....	236	180

WOOD SCREWS.

No.	Diam.	No.	Diam.	No.	Diam.	No.	Diam.	No.	Diam.
0	.056	6	.135	12	.215	18	.293	24	.374
1	.069	7	.149	13	.228	19	.308	25	.387
2	.082	8	.162	14	.241	20	.321	26	.401
3	.096	9	.175	15	.255	21	.334	27	.414
4	.109	10	.188	16	.268	22	.347	28	.427
5	.122	11	.201	17	.281	23	.361	29	.440
								30	.453

UNITED STATES STANDARD GAUGE

FOR SHEET AND PLATE IRON AND STEEL.

Number of Gauge.	Approximate Thickness, Fractions of an Inch.	Approximate Thickness, Decimals of an Inch.	Approximate Thickness, Millimeters.	Weight per Square Foot, Pounds, Iron.	Weight per Square Foot, Pounds, Steel.	Weight for Square Meter, Kilograms, Steel.	Number of Gauge.
7°	1—2	.5	12.70	20.	20.4	99.601	7°
6°	15—32	.46875	11.91	18.75	19.125	93 376	6°
5°	7—16	.4375	11.11	17 50	17.85	87.151	5°
4°	13—32	.40625	10.32	16.25	16.575	80.926	4°
3°	3—8	.375	9.53	15.	15.3	74.701	3°
2°	11—32	.34375	8.73	13.75	14.025	68.476	2°
0	5—16	.3125	7.94	12.50	12.75	62.251	0
1	9—32	.28125	7.14	11.25	11.475	56.026	1
2	17—64	.265625	6.75	10.625	10.8375	52.913	2
3	1—4	.25	6.35	10.	10.2	49.800	3
4	15—64	.234375	5.95	9.375	9.5625	46.688	4
5	7—32	.21875	5.56	8.75	8.925	43.575	5
6	13—64	.203125	5.16	8.125	8.2875	40.463	6
7	3—16	.1875	4.76	7.5	7.65	37.350	7
8	11—64	.171875	4.37	6 875	7.0125	34.238	8
9	5—32	.15625	3 97	6.25	6.375	31.125	9
10	9—64	.140625	3.57	5.625	5.7375	28.013	10
11	1—8	.125	3.18	5.	5.1	24.900	11
12	7—64	.109375	2.78	4.375	4.4625	21.788	12
13	3—32	.09375	2.38	3.75	3.825	18.675	13
14	5—64	.078125	1.98	3.125	3.1875	15.563	14
15	9—128	.0703125	1.79	2.8125	2.86875	14.006	15
16	1—16	.0625	1.59	2.5	2.55	12.450	16
17	9—160	.05625	1.43	2.25	2.295	11.205	17
18	1—20	.05	1.27	2.	2.04	9.960	18
19	7—160	.04375	1.11	1.75	1.785	8.715	19
20	3—80	.0375	.953	1.50	1.53	7.470	20
21	11—320	.034375	.873	1.375	1.4025	6.848	21
22	1—32	.03125	.794	1.25	1.275	6.225	22
23	9—320	.028125	.714	1.125	1.1475	5.603	23
24	1—40	.025	.635	1.	1.02	4.980	24
25	7—320	.021875	.556	.875	.8925	4.358	25
26	3—160	.01875	.476	.75	.765	3.735	26
27	11—640	.0171875	.437	.6875	.70125	3.424	27
28	1—64	.015625	.397	.625	.6375	3.113	28
29	9—640	.0140625	.357	.5625	.57375	2.801	29
30	1—80	.0125	.318	.5	.51	2.490	30
31	7—640	.0109375	.278	.4375	.44625	2.179	31
32	13—1280	.01015625	.258	.40625	.414375	2.023	32
33	3—320	.009375	.238	.375	.3825	1.868	33
34	11—1280	.00859375	.218	.34375	.350625	1.712	34
35	5—640	.0078125	.198	.3125	.31875	1.556	35
36	9—1280	.00703125	.179	.28125	.286875	1.401	36
37	17—2560	.006640625	.169	·265625	.2709375	1.323	37
38	1—160	.00625	.159	.25	.255	1.245	38

Legalized by Act of Congress, March 3, 1893.

VARIOUS STANDARD GAUGES IN USE.

No. of Gauge.	THICKNESS IN DECIMALS OF AN INCH.							No. of Gauge.
	Birmingham	Browne & Sharpe.	United States Standard Plate Iron and Steel.	British Imperial.	American Steel & Wire Co.	Trenton Iron Co.	Stubs Steel Wire.	
7°	....	....	.500	.500	....	....	....	7°
6°	....	....	.46875	.464	....	....	....	6°
5°	....	....	.4375	.432	....	.45	....	5°
4°	.454	.46	.40625	.400	.3938	.40	....	4°
3°	.425	.40964	.375	.372	.3625	.36	....	3°
2°	.380	.3648	.34375	.348	.3310	.33	....	2°
0	.340	.32486	.3125	.324	.3065	.305	....	0
1	.300	.2893	.28125	.300	.2830	.285	.227	1
2	.284	.25763	.265625	.276	.2625	.265	.219	2
3	.259	.22942	.25	.252	.2437	.245	.212	3
4	.238	.20431	.234375	.232	.2253	.225	.207	4
5	.220	.18194	.21875	.212	.2070	.205	.204	5
6	.203	.16202	.203125	.192	.1920	.190	.201	6
7	.180	.14428	.1875	.176	.1770	.175	.199	7
8	.165	.12849	.171875	.160	.1620	.160	.197	8
9	.148	.11443	.15625	.144	.1483	.145	.194	9
10	.134	.10189	.140625	.128	.1350	.130	.191	10
11	.120	.090742	.125	.116	.1205	.1175	.188	11
12	.109	.080808	.109375	.104	.1055	.1050	.185	12
13	.095	.071961	.09375	.092	.0915	.0925	.182	13
14	.083	.064084	.078125	.080	.0800	.0800	.180	14
15	.072	.057068	.0703125	.072	.0720	.0700	.178	15
16	.065	.05082	.0625	.064	.0625	.0610	.175	16
17	.058	.045257	.05625	.056	.0540	.0525	.172	17
18	.049	.040303	.05	.048	.0475	.0450	.168	18
19	.042	.03589	.04375	.040	.0410	.0400	.164	19
20	.035	.031961	.0375	.036	.0348	.0350	.161	20
21	.032	.028462	.034375	.032	.03175	.0310	.157	21
22	.028	.025347	.03125	.028	.0286	.0280	.155	22
23	.025	.022571	.028125	.024	.0258	.0250	.153	23
24	.022	.0201	.025	.022	.0230	.0225	.151	24
25	.020	.0179	.021875	.020	.0204	.0200	.148	25
26	.018	.01594	.01875	.018	.0181	.0180	.146	26
27	.016	.014195	.0171875	.0164	.0173	.0170	.143	27
28	.014	.012641	.015625	.0148	.0162	.0160	.139	28
29	.013	.011257	·0140625	.0136	.0150	.0150	.134	29
30	.012	.010025	.0125	.0124	.0140	.0140	.127	30
31	.010	.008928	.0109375	.0116	.0132	.0130	.120	31
32	.009	.00795	.01015625	.0108	.0128	.0120	.115	32
33	.008	.00708	.009375	.0100	.0118	.0110	.112	33
34	.007	·006304	.00859375	.0092	.0104	.0100	.110	34
35	.005	.005614	.0078125	.0084	.0095	.0095	.108	35
36	.004	.005	.00703125	.0076	.0090	.0090	.106	36
37	....	.004453	.006640625	.0068	....	.0085	.103	37
38	....	.003965	.00625	.0060	....	.0080	.101	38
39	....	.003531	....	....	....	.0075	.099	39
40	....	.003144	....	....	....	.0070	.097	40

AREAS AND WEIGHTS OF

SQUARE AND ROUND STEEL BARS.

Diameter or Side, Inches.	□ Area, Sq. Ins.	□ Weight per Ft., Lbs.	○ Area, Sq. Ins.	○ Weight per Ft., Lbs.
0				
1/16	.004	.013	.003	.010
1/8	.016	.053	.012	.042
3/16	.035	.119	.028	.094
1/4	.062	.212	.049	.167
5/16	.098	.333	.077	.261
3/8	.141	.478	.110	.375
7/16	.191	.651	.150	.511
1/2	.250	.850	.196	.667
9/16	.316	1.076	.248	.845
5/8	.391	1.328	.307	1.043
11/16	.473	1.608	.371	1.262
3/4	.562	1.913	.442	1.502
13/16	.660	2.245	.518	1.763
7/8	.766	2.603	.601	2.044
15/16	.879	2.989	.690	2.347
1	1.000	3.400	.785	2.670
1/16	1.129	3.838	.887	3.014
1/8	1.266	4.303	.994	3.379
3/16	1.410	4.795	1.108	3.766
1/4	1.563	5.312	1.227	4.173
5/16	1.723	5.857	1.353	4.600
3/8	1.891	6.428	1.485	5.049
7/16	2.066	7.026	1.623	5.518
1/2	2.250	7.650	1.767	6.008
9/16	2.441	8.301	1.918	6.520
5/8	2.641	8.978	2.074	7.051
11/16	2.848	9.682	2.237	7.604
3/4	3.063	10.41	2.405	8.178
13/16	3.285	11.17	2.580	8.773
7/8	3.516	11.95	2.761	9.388
15/16	3.754	12.76	2.948	10.02

Diameter or Side, Inches.	□ Area, Sq. Ins.	□ Weight per Ft., Lbs.	○ Area, Sq. Ins.	○ Weight per Ft., Lbs.
2	4.000	13.60	3.142	10.68
1/16	4.254	14.46	3.341	11.36
1/8	4.516	15.35	3.547	12.06
3/16	4.785	16.27	3.758	12.78
1/4	5.063	17.22	3.976	13.52
5/16	5.348	18.19	4.200	14.28
3/8	5.641	19.18	4.430	15.07
7/16	5.941	20.20	4.666	15.86
1/2	6.250	21.25	4.909	16.69
9/16	6.566	22.33	5.157	17.53
5/8	6.891	23.43	5.412	18.40
11/16	7.223	24.56	5.673	19.29
3/4	7.563	25.71	5.940	20.20
13/16	7.910	26.90	6.213	21.12
7/8	8.266	28.10	6.492	22.07
15/16	8.629	29.34	6.777	23.04
3	9.000	30.60	7.069	24.03
1/16	9.379	31.89	7.366	25.04
1/8	9.766	33.20	7.670	26.08
3/16	10.16	34.55	7.980	27.13
1/4	10.56	35.92	8.296	28.20
5/16	10.97	37.31	8.618	29.30
3/8	11.39	38.73	8.946	30.42
7/16	11.82	40.18	9.281	31.56
1/2	12.25	41.65	9.621	32.71
9/16	12.69	43.14	9.968	33.90
5/8	13.14	44.68	10.32	35.09
11/16	13.60	46.24	10.68	36.31
3/4	14.06	47.82	11.05	37.56
13/16	14.54	49.42	11.42	38.81
7/8	15.02	51.05	11.79	40.10
15/16	15.50	52.71	12.18	41.40

AREAS AND WEIGHTS OF

SQUARE AND ROUND STEEL BARS

(CONTINUED).

Diameter or Side, Inches.	□ Area, Sq. Ins.	□ Weight per Ft., Lbs.	○ Area, Sq. Ins.	○ Weight per Ft., Lbs.	Diameter or Side, Inches.	□ Area, Sq. Ins.	□ Weight per Ft., Lbs.	○ Area, Sq. Ins.	○ Weight per Ft., Lbs.
4	16.00	54.40	12.57	42.73	6	36.00	122.4	28.27	96.14
1/16	16.50	56.11	12.96	44.07	1/8	37.52	127.6	29.47	100.2
1/8	17.02	57.85	13.36	45.44	1/4	39.06	132.8	30.68	104.3
3/16	17.54	59.62	13.77	46.83	3/8	40.64	138.2	31.92	108.5
1/4	18.06	61.41	14.19	48.24	1/2	42.25	143.6	33.18	112.8
5/16	18.60	63.23	14.61	49.66	5/8	43.89	149.2	34.47	117.2
3/8	19.14	65.08	15.03	51.11	3/4	45.56	154.9	35.79	121.7
7/16	19.69	66.95	15.47	52.58	7/8	47.27	160.8	37.12	126.2
1/2	20.25	68.85	15.90	54.07	7	49.00	166.6	38.49	130.9
9/16	20.82	70.78	16.35	55.59	1/4	52.56	178.7	41.28	140.4
5/8	21.39	72.73	16.80	57.12	1/2	56.25	191.3	44.18	150.2
11/16	21.97	74.70	17.26	58.67	3/4	60.06	204.2	47.17	160.3
3/4	22.56	76.71	17.72	60.25	8	64.00	217.6	50.27	171.0
13/16	23.16	78.74	18.19	61.84	1/4	68.06	231.4	53.46	181.8
7/8	23.77	80.81	18.67	63.46	1/2	72.25	245.6	56.75	193.0
15/16	24.38	82.89	19.15	65.10	3/4	76.56	260.3	60.13	204.4
5	25.00	85.00	19.64	66.76	9	81.00	275.4	63.62	216.3
1/16	25.63	87.14	20.13	68.44	1/4	85.56	290.9	67.20	228.5
1/8	26.27	89.30	20.63	70.14	1/2	90.25	306.8	70.88	241.0
3/16	26.91	91.49	21.14	71.86	3/4	95.06	323.2	74.66	253.9
1/4	27.56	93.72	21.65	73.60	10	100.00	340.0	78.54	267.0
5/16	28.22	95.96	22.17	75.37	1/4	105.06	357.2	82.52	280.6
3/8	28.89	98.23	22.69	77.15	1/2	110.25	374.9	86.59	294.4
7/16	29.57	100.5	23.22	78.95	3/4	115.56	392.9	90.76	308.6
1/2	30.25	102.8	23.76	80.77	11	121.00	411.4	95.03	323.1
9/16	30.94	105.2	24.30	82.62	1/4	126.56	430.3	99.40	337.9
5/8	31.64	107.6	24.85	84.49	1/2	132.25	449.6	103.87	353.1
11/16	32.35	110.0	25.41	86.38	3/4	138.06	469.4	108.43	368.6
3/4	33.06	112.4	25.97	88.29	12	144.00	489.6	113.10	384.5
13/16	33.79	114.9	26.54	90.22	13	169.00	574.6	132.73	451.3
7/8	34.52	117.4	27.11	92.17	14	196.00	666.4	153.94	523.4
15/16	35.25	119.9	27.69	94.14	15	225.00	765.0	176.72	600.8

WEIGHTS OF STEEL FLATS.

POUNDS PER LINEAL FOOT.

1 cubic foot weighing 489.6 lbs.

Thickness, in Inches.	1/4"	1/2"	3/4"	1"	1 1/4"	1 1/2"	1 3/4"	2"	12"
3/16	.159	.319	.478	.638	.797	.957	1.11	1.28	7.65
1/4	.212	.425	.636	.850	1.06	1.28	1.49	1.70	10.20
5/16	.265	.531	.797	1.06	1.33	1.59	1.86	2.12	12.75
3/8	.319	.638	.957	1.28	1.59	1.92	2.23	2.55	15.30
7/16	.372	.744	1.12	1.49	1.86	2.23	2.60	2.98	17.85
1/2	.425	.850	1.28	1.70	2.12	2.55	2.98	3.40	20.40
9/16	.478	.957	1.43	1.92	2.39	2.87	3.35	3.83	22.95
5/8	.531	1.06	1.59	2.12	2.65	3.19	3.72	4.25	25.50
11/16	.584	1.17	1.75	2.34	2.92	3.51	4.09	4.67	28.05
3/4	.638	1.28	1.91	2.55	3.19	3.83	4.47	5.10	30.60
13/16	.690	1.38	2.07	2.76	3.45	4.14	4.84	5.53	33.15
7/8	.744	1.49	2.23	2.98	3.72	4.47	5.20	5.95	35.70
15/16	.797	1.59	2.39	3.19	3.99	4.78	5.58	6.38	38.25
1	.850	1.70	2.55	3.40	4.25	5.10	5.95	6.80	40.80
1 1/16	.903	1.81	2.71	3.61	4.52	5.42	6.32	7.22	43.35
1 1/8	.957	1.91	2.87	3.83	4.78	5.74	6.70	7.65	45.90
1 3/16	1.01	2.02	3.03	4.04	5.05	6.06	7.07	8.08	48.45
1 1/4	1.06	2.13	3.19	4.25	5.31	6.38	7.44	8.50	51.00
1 5/16	1.12	2.23	3.35	4.46	5.58	6.69	7.81	8.93	53.55
1 3/8	1.17	2.34	3.51	4.67	5.84	7.02	8.18	9.35	56.10
1 7/16	1.22	2.44	3.67	4.89	6.11	7.34	8.56	9.78	58.65
1 1/2	1.28	2.55	3.83	5.10	6.38	7.65	8.93	10.20	61.20
1 9/16	1.33	2.66	3.98	5.32	6.64	7.97	9.30	10.63	63.75
1 5/8	1.38	2.76	4.14	5.52	6.90	8.29	9.67	11.05	66.30
1 11/16	1.43	2.87	4.30	5.74	7.17	8.61	10.04	11.47	68.85
1 3/4	1.49	2.98	4.46	5.95	7.44	8.93	10.42	11.90	71.40
1 13/16	1.54	3.08	4.62	6.16	7.70	9.24	10.79	12.33	73.95
1 7/8	1.59	3.19	4.78	6.38	7.97	9.57	11.15	12.75	76.50
1 15/16	1.65	3.29	4.94	6.59	8.24	9.88	11.53	13.18	79.05
2	1.70	3.40	5.10	6.80	8.50	10.20	11.90	13.60	81.60

WEIGHTS OF STEEL FLATS

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	2¼″	2½″	2¾″	3″	3¼″	3½″	3¾″	4″	12″
$\frac{3}{16}$	1.44	1.59	1.75	1.91	2.07	2.23	2.39	2.55	7.65
¼	1.91	2.12	2.34	2.55	2.76	2.98	3.19	3.40	10.20
$\frac{5}{16}$	2.39	2.65	2.92	3.19	3.45	3.72	3.99	4.25	12.75
⅜	2.87	3.19	3.51	3.83	4.15	4.47	4.78	5.10	15.30
$\frac{7}{16}$	3.35	3.72	4.09	4.46	4.83	5.20	5.58	5.95	17.85
½	3.83	4.25	4.67	5.10	5.53	5.95	6.38	6.80	20.40
$\frac{9}{16}$	4.30	4.78	5.26	5.74	6.22	6.70	7.17	7.65	22.95
⅝	4.78	5.31	5.84	6.38	6.91	7.44	7.97	8.50	25.50
$\frac{11}{16}$	5.26	5.84	6.43	7.02	7.60	8.18	8.76	9.35	28.05
¾	5.75	6.38	7.02	7.65	8.29	8.93	9.57	10.20	30.60
$\frac{13}{16}$	6.21	6.90	7.60	8.29	8.98	9.67	10.36	11.05	33.15
⅞	6.69	7.44	8.18	8.93	9.67	10.41	11.16	11.90	35.70
$\frac{15}{16}$	7.18	7.97	8.77	9.57	10.36	11.16	11.95	12.75	38.25
1	7.65	8.50	9.35	10.20	11.05	11.90	12.75	13.60	40.80
$1\frac{1}{16}$	8.13	9.03	9.93	10.84	11.74	12.65	13.55	14.45	43.35
1⅛	8.61	9.57	10.52	11.48	12.43	13.39	14.34	15.30	45.90
$1\frac{3}{16}$	9.09	10.10	11.11	12.12	13.12	14.13	15.14	16.15	48.45
1¼	9.57	10.63	11.69	12.75	13.81	14.87	15.94	17.00	51.00
$1\frac{5}{16}$	10.04	11.16	12.27	13.39	14.50	15.62	16.74	17.85	53.55
1⅜	10.52	11.69	12.85	14.03	15.20	16.36	17.53	18.70	56.10
$1\frac{7}{16}$	11.00	12.22	13.44	14.66	15.88	17.10	18.33	19.55	58.65
1½	11.48	12.75	14.03	15.30	16.58	17.85	19.13	20.40	61.20
$1\frac{9}{16}$	11.95	13.28	14.61	15.94	17.27	18.60	19.92	21.25	63.75
1⅝	12.43	13.81	15.19	16.58	17.96	19.34	20.72	22.10	66.30
$1\frac{11}{16}$	12.91	14.34	15.78	17.22	18.65	20.08	21.51	22.95	68.85
1¾	13.40	14.88	16.37	17.85	19.34	20.83	22.32	23.80	71.40
$1\frac{13}{16}$	13.86	15.40	16.95	18.49	20.03	21.57	23.11	24.65	73.95
1⅞	14.34	15.94	17.53	19.13	20.72	22.31	23.91	25.50	76.50
$1\frac{15}{16}$	14.83	16.47	18.12	19.77	21.41	23.06	24.70	26.35	79.05
2	15.30	17.00	18.70	20.40	22.10	23.80	25.50	27.20	81.60

WEIGHTS OF STEEL FLATS

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	4¼″	4½″	4¾″	5″	5¼″	5½″	5¾″	6″	12″
$\frac{3}{16}$	2.71	2.87	3.03	3.19	3.35	3.51	3.67	3.83	7.65
¼	3.61	3.83	4.04	4.25	4.46	4.67	4.89	5.10	10.20
$\frac{5}{16}$	4.52	4.78	5.05	5.31	5.58	5.84	6.11	6.38	12.75
⅜	5.42	5.74	6.06	6.38	6.69	7.02	7.34	7.65	15.30
$\frac{7}{16}$	6.32	6.70	7.07	7.44	7.81	8.18	8.56	8.93	17.85
½	7.22	7.65	8.08	8.50	8.93	9.35	9.77	10.20	20.40
$\frac{9}{16}$	8.13	8.61	9.09	9.57	10.04	10.52	11.00	11.48	22.95
⅝	9.03	9.57	10.10	10.63	11.16	11.69	12.22	12.75	25.50
$\frac{11}{16}$	9.93	10.52	11.11	11.69	12.27	12.85	13.44	14.03	28.05
¾	10.84	11.48	12.12	12.75	13.39	14.03	14.67	15.30	30.60
$\frac{13}{16}$	11.74	12.43	13.12	13.81	14.50	15.19	15.88	16.58	33.15
⅞	12.65	13.39	14.13	14.87	15.62	16.36	17.10	17.85	35.70
$\frac{15}{16}$	13.55	14.34	15.14	15.94	16.74	17.53	18.33	19.13	38.25
1	14.45	15.30	16.15	17.00	17.85	18.70	19.55	20.40	40.80
$1\frac{1}{16}$	15.35	16.26	17.16	18.06	18.96	19.87	20.77	21.68	43.35
1⅛	16.26	17.22	18.17	19.13	20.08	21.04	21.99	22.95	45.90
$1\frac{3}{16}$	17.16	18.17	19.18	20.19	21.20	22.21	23.22	24.23	48.45
1¼	18.06	19.13	20.19	21.25	22.32	23.38	24.44	25.50	51.00
$1\frac{5}{16}$	18.96	20.08	21.20	22.32	23.43	24.54	25.66	26.78	53.55
1⅜	19.87	21.04	22.21	23.38	24.54	25.71	26.88	28.05	56.10
$1\frac{7}{16}$	20.77	21.99	23.22	24.44	25.66	26.88	28.10	29.33	58.65
1½	21.68	22.95	24.23	25.50	26.78	28.05	29.33	30.60	61.20
$1\frac{9}{16}$	22.58	23.91	25.24	26.57	27.89	29.22	30.55	31.88	63.75
1⅝	23.48	24.87	26.25	27.63	29.01	30.39	31.77	33.15	66.30
$1\frac{11}{16}$	24.38	25.82	27.26	28.69	30.12	31.55	32.99	34.43	68.85
1¾	25.29	26.78	28.27	29.75	31.24	32.73	34.22	35.70	71.40
$1\frac{13}{16}$	26.19	27.73	29.27	30.81	32.35	33.89	35.43	36.98	73.95
1⅞	27.10	28.69	30.28	31.87	33.47	35.06	36.65	38.25	76.50
$1\frac{15}{16}$	28.00	29.64	31.29	32.94	34.59	36.23	37.88	39.53	79.05
2	28.90	30.60	32.30	34.00	35.70	37.40	39.10	40.80	81.60

WEIGHTS OF STEEL FLATS

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	6¼″	6½″	6¾″	7″	7¼″	7½″	7¾″	8″	12″
3/16	3.99	4.14	4.30	4.46	4.62	4.78	4.94	5.10	7.65
¼	5.31	5.53	5.74	5.95	6.16	6.36	6.58	6.80	10.20
5/16	6.64	6.90	7.17	7.44	7.70	7.97	8.23	8.50	12.75
⅜	7.97	8.29	8.61	8.93	9.25	9.57	9.88	10.20	15.30
7/16	9.29	9.67	10.04	10.41	10.78	11.16	11.53	11.90	17.85
½	10.63	11.05	11.48	11.90	12.32	12.75	13.18	13.60	20.40
9/16	11.95	12.43	12.91	13.39	13.86	14.34	14.82	15.30	22.95
⅝	13.28	13.81	14.34	14.87	15.40	15.94	16.47	17.00	25.50
11/16	14.61	15.20	15.78	16.36	16.94	17.53	18.12	18.70	28.05
¾	15.94	16.58	17.22	17.85	18.49	19.13	19.77	20.40	30.60
13/16	17.27	17.95	18.65	19.34	20.03	20.72	21.41	22.10	33.15
⅞	18.60	19.34	20.08	20.83	21.57	22.32	23.05	23.80	35.70
15/16	19.92	20.72	21.51	22.32	23.11	23.91	24.70	25.50	38.25
1	21.25	22.10	22.95	23.80	24.65	25.50	26.35	27.20	40.80
1 1/16	22.58	23.48	24.39	25.29	26.19	27.10	28.00	28.90	43.35
1⅛	23.91	24.87	25.82	26.78	27.73	28.68	29.64	30.60	45.90
1 3/16	25.23	26.24	27.25	28.26	29.27	30.28	31.29	32.30	48.45
1¼	26.56	27.62	28.69	29.75	30.81	31.88	32.94	34.00	51.00
1 5/16	27.90	29.01	30.12	31.23	32.35	33.48	34.59	35.70	53.55
1⅜	29.22	30.39	31.56	32.72	33.89	35.06	36.23	37.40	56.10
1 7/16	30.55	31.77	32.99	34.21	35.44	36.66	37.88	39.10	58.65
1½	31.88	33.15	34.43	35.70	36.98	38.26	39.53	40.80	61.20
1 9/16	33.20	34.53	35.86	37.19	38.51	39.84	41.17	42.50	63.75
1⅝	34.53	35.91	37.29	38.67	40.05	41.44	42.82	44.20	66.30
1 11/16	35.86	37.30	38.73	40.16	41.59	43.03	44.47	45.90	68.85
1¾	37.19	38.68	40.17	41.65	43.14	44.63	46.12	47.60	71.40
1 13/16	38.52	40.05	41.60	43.14	44.68	46.22	47.76	49.30	73.95
1⅞	39.85	41.44	43.03	44.63	46.22	47.82	49.40	51.00	76.50
1 15/16	41.17	42.82	44.46	46.12	47.76	49.41	51.05	52.70	79.05
2	42.50	44.20	45.90	47.60	49.30	51.00	52.70	54.40	81.60

WEIGHTS OF STEEL FLATS

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	8¼″	8½″	8¾″	9″	9¼″	9½″	9¾″	10″	12″
3/16	5.26	5.42	5.58	5.74	5.90	6.06	6.22	6.38	7.65
¼	7.01	7.22	7.43	7.65	7.86	8.08	8.29	8.50	10.20
5/16	8.76	9.03	9.29	9.56	9.83	10.10	10.36	10.62	12.75
⅜	10.52	10.84	11.16	11.48	11.80	12.12	12.44	12.75	15.30
7/16	12.27	12.64	13.02	13.40	13.76	14.14	14.51	14.88	17.85
½	14.03	14.44	14.87	15.30	15.73	16.16	16.58	17.00	20.40
9/16	15.78	16.26	16.74	17.22	17.69	18.18	18.65	19.14	22.95
⅝	17.53	18.06	18.59	19.13	19.65	20.19	20.72	21.25	25.50
11/16	19.28	19.86	20.45	21.04	21.62	22.21	22.79	23.38	28.05
¾	21.04	21.68	22.32	22.96	23.59	24.23	24.86	25.50	30.60
13/16	22.79	23.48	24.17	24.86	25.55	26.24	26.94	27.62	33.15
⅞	24.55	25.30	26.04	26.78	27.52	28.26	29.01	29.75	35.70
15/16	26.30	27.10	27.89	28.69	29.49	30.28	31.08	31.88	38.25
1	28.05	28.90	29.75	30.60	31.45	32.30	33.15	34.00	40.80
1 1/16	29.80	30.70	31.61	32.52	33.41	34.32	35.22	36.12	43.35
1⅛	31.56	32.52	33.47	34.43	35.38	36.34	37.29	38.25	45.90
1 3/16	33.31	34.32	35.33	36.34	37.35	38.36	39.37	40.38	48.45
1¼	35.06	36.12	37.20	38.26	39.31	40.37	41.44	42.50	51.00
1 5/16	36.81	37.93	39.05	40.16	41.28	42.40	43.52	44.64	53.55
1⅜	38.57	39.74	40.91	42.08	43.25	44.41	45.58	46.75	56.10
1 7/16	40.32	41.54	42.77	44.00	45.22	46.44	47.66	48.88	58.65
1½	42.08	43.35	44.63	45.90	47.18	48.45	49.73	51.00	61.20
1 9/16	43.83	45.16	46.49	47.82	49.14	50.48	51.80	53.14	63.75
1⅝	45.58	46.96	48.34	49.73	51.10	52.49	53.87	55.25	66.30
1 11/16	47.33	48.76	50.20	51.64	53.07	54.51	55.94	57.38	68.85
1¾	49.09	50.58	52.07	53.56	55.04	56.53	58.01	59.50	71.40
1 13/16	50.84	52.38	53.92	55.46	57.00	58.54	60.09	61.62	73.95
1⅞	52.60	54.20	55.79	57.38	58.97	60.56	62.16	63.75	76.50
1 15/16	54.35	56.00	57.64	59.29	60.94	62.58	64.23	65.88	79.05
2	56.10	57.80	59.50	61.20	62.90	64.60	66.30	68.00	81.60

WEIGHTS OF STEEL FLATS

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	10¼″	10½″	10¾″	11″	11¼″	11½″	11¾″	12″	12½″
3/16	6.54	6.70	6.86	7.02	7.17	7.32	7.49	7.65	7.98
¼	8.71	8.92	9.14	9.34	9.57	9.78	10.00	10.20	10.63
5/16	10.89	11.16	11.42	11.68	11.95	12.22	12.49	12.75	13.28
⅜	13.07	13.39	13.71	14.03	14.35	14.68	14.99	15.30	15.94
7/16	15.25	15.62	15.99	16.36	16.74	17.12	17.49	17.85	18.60
½	17.42	17.85	18.28	18.70	19.13	19.55	19.97	20.40	21.25
9/16	19.61	20.08	20.56	21.02	21.51	22.00	22.48	22.95	23.90
⅝	21.78	22.32	22.85	23.38	23.91	24.44	24.97	25.50	26.56
11/16	23.96	24.54	25.13	25.70	26.30	26.88	27.47	28.05	29.22
¾	26.14	26.78	27.42	28.05	28.68	29.33	29.97	30.60	31.88
13/16	28.32	29.00	29.69	30.40	31.08	31.76	32.46	33.15	34.53
⅞	30.50	31.24	31.98	32.72	33.47	34.21	34.95	35.70	37.19
15/16	32.67	33.48	34.28	35.06	35.86	36.66	37.46	38.25	39.84
1	34.85	35.70	36.55	37.40	38.25	39.10	39.95	40.80	42.50
1 1/16	37.03	37.92	38.83	39.74	40.64	41.54	42.45	43.35	45.16
1⅛	39.21	40.17	41.12	42.08	43.04	44.00	44.94	45.90	47.82
1 3/16	41.39	42.40	43.40	44.42	45.42	46.44	47.45	48.45	50.46
1¼	43.56	44.63	45.69	46.76	47.82	48.88	49.94	51.00	53.12
1 5/16	45.75	46.86	47.97	49.08	50.20	51.32	52.44	53.55	55.78
1⅜	47.92	49.08	50.25	51.42	52.59	53.76	54.93	56.10	58.44
1 7/16	50.10	51.32	52.54	53.76	54.99	56.21	57.43	58.65	61.10
1½	52.28	53.55	54.83	56.10	57.37	58.65	59.93	61.20	63.75
1 9/16	54.46	55.78	57.11	58.42	59.76	61.10	62.43	63.75	66.40
1⅝	56.63	58.02	59.40	60.78	62.16	63.54	64.92	66.30	69.06
1 11/16	58.81	60.24	61.68	63.10	64.55	65.98	67.42	68.85	71.72
1¾	60.99	62.48	63.97	65.45	66.93	68.43	69.92	71.40	74.38
1 13/16	63.17	64.70	66.24	67.80	69.33	70.86	72.41	73.95	77.03
1⅞	65.35	66.94	68.53	70.12	71.72	73.31	74.90	76.50	79.69
1 15/16	67.52	69.18	70.83	72.46	74.11	75.76	77.41	79.05	82.34
2	69.70	71.40	73.10	74.80	76.50	78.20	79.90	81.60	85.00

WEIGHTS OF STEEL PLATES.

POUNDS PER LINEAL FOOT.

1 cubic foot weighing 489.6 lbs.

Thickness, in Inches.	13″	14″	15″	16″	17″	18″	19″	20″	21″
$\frac{3}{16}$	8.28	8.92	9.56	10.20	10.84	11.48	12.10	12.76	13.40
$\frac{1}{4}$	11.06	11.90	12.75	13.60	14.44	15.30	16.16	17.00	17.84
$\frac{5}{16}$	13.81	14.88	15.94	17.00	18.06	19.12	20.20	21.24	22.32
$\frac{3}{8}$	16.58	17.86	19.14	20.40	21.68	22.96	24.24	25.50	26.78
$\frac{7}{16}$	19.34	20.82	22.32	23.80	25.28	26.79	28.28	29.75	31.24
$\frac{1}{2}$	22.10	23.80	25.50	27.20	28.89	30.60	32.31	34.00	35.70
$\frac{9}{16}$	24.86	26.78	28.70	30.60	32.52	34.44	36.34	38.27	40.16
$\frac{5}{8}$	27.62	29.74	31.88	34.00	36.12	38.25	40.37	42.50	44.64
$\frac{11}{16}$	30.39	32.72	35.06	37.40	39.72	42.08	44.42	46.74	49.08
$\frac{3}{4}$	33.16	35.71	38.26	40.80	43.36	45.92	48.46	51.00	53.56
$\frac{13}{16}$	35.91	38.67	41.43	44.20	46.96	49.72	52.48	55.25	58.01
$\frac{7}{8}$	38.68	41.65	44.62	47.60	50.60	53.56	56.52	59.50	62.49
$\frac{15}{16}$	41.44	44.63	47.82	51.00	54.20	57.38	60.57	63.76	66.96
1	44.20	47.60	51.00	54.40	57.80	61.20	64.60	68.00	71.40
$1\frac{1}{16}$	46.96	50.57	54.20	57.80	61.40	65.02	68.64	72.25	75.85
$1\frac{1}{8}$	49.72	53.55	57.37	61.20	65.04	68.85	72.68	76.50	80.33
$1\frac{3}{16}$	52.48	56.52	60.56	64.60	68.64	72.68	76.72	80.75	84.79
$1\frac{1}{4}$	55.25	59.50	63.76	68.00	72.26	76.50	80.74	85.00	89.26
$1\frac{5}{16}$	58.02	62.47	66.95	71.40	75.86	80.33	84.80	89.28	93.72
$1\frac{3}{8}$	60.77	65.45	70.12	74.80	79.48	84.15	88.83	93.50	98.17
$1\frac{7}{16}$	63.54	68.42	73.32	78.20	83.08	88.00	92.88	97.75	102.65
$1\frac{1}{2}$	66.30	71.40	76.51	81.60	86.70	91.80	96.90	102.00	107.10
$1\frac{9}{16}$	69.06	74.38	79.69	85.00	90.31	95.63	100.94	106.25	111.56
$1\frac{5}{8}$	71.83	77.35	82.88	88.40	93.93	99.45	104.98	110.50	116.03
$1\frac{11}{16}$	74.59	80.33	86.06	91.80	97.54	103.28	109.01	114.75	120.49
$1\frac{3}{4}$	77.35	83.30	89.25	95.20	101.15	107.10	113.05	119.00	124.95
$1\frac{13}{16}$	80.11	86.28	92.44	98.60	104.76	110.93	117.09	123.25	129.41
$1\frac{7}{8}$	82.88	89.25	95.63	102.00	108.38	114.75	121.13	127.50	133.88
$1\frac{15}{16}$	85.64	92.23	98.81	105.40	111.99	118.58	125.16	131.75	138.34
2	88.40	95.20	102.00	108.80	115.60	122.40	129.20	136.00	142.80

WEIGHTS OF STEEL PLATES

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	22″	23″	24″	25″	26″	27″	28″	29″	30″
3/16	14.04	14.64	15.32	15.96	16.56	17.20	17.84	18.48	19.12
1/4	18.69	19.56	20.40	21.26	22.12	22.96	23.80	24.64	25.50
5/16	23.36	24.44	25.52	26.56	27.62	28.68	29.76	30.80	31.88
3/8	28.06	29.33	30.60	31.88	33.16	34.44	35.72	37.00	38.28
7/16	32.72	34.24	35.72	37.20	38.68	40.17	41.65	43.14	44.64
1/2	37.40	39.10	40.80	42.50	44.20	45.92	47.60	49.28	51.00
9/16	42.04	44.00	45.92	47.80	49.73	51.64	53.56	55.48	57.40
5/8	46.76	48.88	51.00	53.12	55.24	57.37	59.49	61.60	63.76
11/16	51.40	53.76	56.12	58.44	60.78	63.11	65.44	67.77	70.13
3/4	56.10	58.66	61.20	63.76	66.32	68.88	71.42	73.97	76.53
13/16	60.79	63.53	66.29	69.06	71.82	74.58	77.34	80.10	82.86
7/8	65.44	68.43	71.40	74.38	77.36	80.33	83.30	86.29	89.24
15/16	70.13	73.32	76.50	79.68	82.88	86.07	89.26	92.44	95.64
1	74.80	78.20	81.60	85.00	88.40	91.80	95.20	98.60	102.00
1 1/16	79.48	83.08	86.70	90.32	93.92	97.54	101.14	104.75	108.38
1 1/8	84.16	88.00	91.80	95.64	99.44	103.26	107.10	110.92	114.74
1 3/16	88.83	92.88	96.92	100.92	104.96	109.01	113.05	117.09	121.13
1 1/4	93.52	97.76	102.00	106.24	110.50	114.76	119.00	123.24	127.51
1 5/16	98.16	102.64	107.12	111.56	116.04	120.50	124.94	129.40	133.89
1 3/8	102.84	107.52	112.20	116.88	121.54	126.22	130.90	135.58	140.24
1 7/16	107.52	112.42	117.30	122.20	127.08	131.96	136.84	141.76	146.64
1 1/2	112.20	117.30	122.40	127.50	132.60	137.72	142.80	147.92	153.02
1 9/16	116.88	122.19	127.50	132.81	138.13	143.44	148.75	154.06	159.38
1 5/8	121.55	127.08	132.60	138.13	143.65	149.18	154.70	160.23	165.75
1 11/16	126.23	131.96	137.70	143.44	149.18	154.91	160.65	166.39	172.13
1 3/4	130.90	136.85	142.80	148.75	154.70	160.65	166.60	172.55	187.50
1 13/16	135.58	141.74	147.90	154.06	160.23	166.39	172.55	178.71	184.88
1 7/8	140.25	146.63	153.00	159.38	165.75	172.13	178.50	184.88	191.25
1 15/16	144.93	151.51	158.10	164.69	171.28	177.86	184.45	191.04	197.63
2	149.60	156.40	163.20	170.00	176.80	183.60	190.40	197.20	204.00

WEIGHTS OF STEEL PLATES

(CONTINUED)

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	31″	32″	33″	34″	35″	36″	38″	40″	42″
3/16	19.75	20.40	21.04	21.68	22.32	22.96	24.20	25.52	26.80
1/4	26.36	27.20	28.04	28.88	29.72	30.59	32.32	34.00	35.68
5/16	32.94	34.00	35.04	36.12	37.16	38.24	40.39	42.48	44.64
3/8	39.54	40.80	42.08	43.36	44.64	45.92	48.48	51.00	53.56
7/16	46.12	47.60	49.08	50.57	52.07	53.58	56.56	59.50	62.48
1/2	52.70	54.40	56.10	57.78	59.50	61.20	64.62	68.00	71.40
9/16	59.32	61.22	63.12	65.04	66.96	68.88	72.68	76.54	80.32
5/8	65.88	68.00	70.13	72.24	74.36	76.50	80.74	85.00	89.28
11/16	72.48	74.80	77.12	79.44	81.79	84.15	88.84	93.48	98.16
3/4	79.08	81.61	84.16	86.72	89.28	91.84	96.92	102.00	107.12
13/16	85.62	88.39	91.15	93.91	96.68	99.44	104.96	110.50	116.02
7/8	92.20	95.20	98.20	101.20	104.16	107.12	113.04	119.00	124.98
15/16	98.82	102.00	105.20	108.40	111.59	114.76	121.14	127.52	133.92
1	105.40	108.80	112.20	115.60	119.00	122.40	129.20	136.00	142.80
1 1/16	112.00	115.59	119.20	122.80	126.42	130.04	137.28	144.50	151.70
1 1/8	118.56	122.40	126.24	130.08	133.90	137.70	145.36	153.00	160.66
1 3/16	125.16	129.21	133.24	137.28	141.32	145.36	153.44	161.50	169.58
1 1/4	131.76	136.00	140.28	144.52	148.76	153.00	161.48	170.00	178.52
1 5/16	138.36	142.81	147.24	151.72	156.20	160.66	169.60	178.56	187.44
1 3/8	144.92	149.60	154.28	158.96	163.62	168.30	177.66	187.00	196.34
1 7/16	151.52	156.40	161.28	166.16	171.08	176.00	185.75	195.50	205.29
1 1/2	158.11	163.20	168.32	173.40	178.51	183.60	193.80	204.00	214.20
1 9/16	164.69	170.00	175.31	180.63	185.94	191.25	201.88	212.50	223.13
1 5/8	171.28	176.80	182.33	187.85	193.38	198.90	209.95	221.00	232.05
1 11/16	177.86	183.60	189.34	195.08	200.81	206.55	218.03	229.50	240.98
1 3/4	184.45	190.40	196.35	202.30	208.25	214.20	226.10	238.00	249.90
1 13/16	191.04	197.20	203.36	209.53	215.69	221.85	234.18	246.50	258.83
1 7/8	197.63	204.00	210.38	216.75	223.13	229.50	242.25	255.00	267.75
1 15/16	204.21	210.80	217.39	223.98	230.56	237.15	250.33	263.50	276.68
2	210.80	217.60	224.40	231.20	238.00	244.80	258.40	272.00	285.60

WEIGHTS OF STEEL PLATES

(CONTINUED).

POUNDS PER LINEAL FOOT.

Thickness, in Inches.	44″	46″	48″	50″	52″	54″	56″	58″	60″
$\frac{3}{16}$	28.08	29.29	30.64	31.92	33.12	34.40	35.68	36.96	38.24
$\frac{1}{4}$	37.38	39.11	40.80	42.52	44.24	45.92	47.60	49.28	51.00
$\frac{5}{16}$	46.72	48.88	51.04	53.12	55.24	57.36	59.51	61.60	63.76
$\frac{3}{8}$	56.12	58.65	61.20	63.76	66.32	68.88	71.44	74.00	76.56
$\frac{7}{16}$	65.44	68.47	71.44	74.40	77.37	80.34	83.30	86.28	89.28
$\frac{1}{2}$	74.80	78.20	81.60	85.00	88.40	91.84	95.20	98.56	102.00
$\frac{9}{16}$	84.09	88.00	91.84	95.60	99.46	103.28	107.12	110.96	114.80
$\frac{5}{8}$	93.52	97.76	102.00	106.24	110.48	114.74	118.98	123.20	127.52
$\frac{11}{16}$	102.81	107.53	112.24	116.88	121.56	126.22	130.88	135.54	140.26
$\frac{3}{4}$	112.20	117.31	122.40	127.52	132.64	137.76	142.85	147.94	153.06
$\frac{13}{16}$	121.56	127.06	132.58	138.12	143.64	149.16	154.68	160.20	165.72
$\frac{7}{8}$	130.89	136.86	142.80	148.76	154.72	160.66	166.60	172.58	178.48
$\frac{15}{16}$	140.27	146.64	153.00	159.36	165.76	172.15	178.52	184.88	191.28
1	149.60	156.40	163.20	170.00	176.80	183.60	190.40	197.20	204.00
$1\frac{1}{16}$	158.96	166.16	173.40	180.64	187.84	195.08	202.28	209.50	216.76
$1\frac{1}{8}$	168.32	175.99	183.60	191.28	198.88	206.52	214.20	221.84	229.48
$1\frac{3}{16}$	177.66	185.76	193.84	201.84	209.92	218.02	226.10	234.18	242.26
$1\frac{1}{4}$	187.04	195.52	204.00	212.48	221.00	229.52	238.00	246.48	255.02
$1\frac{5}{16}$	196.32	205.28	214.24	223.12	232.08	241.00	249.88	258.80	267.78
$1\frac{3}{8}$	205.68	215.04	224.40	233.76	243.08	252.44	261.80	271.16	280.48
$1\frac{7}{16}$	215.04	224.84	234.60	244.40	254.16	263.92	273.68	283.52	293.28
$1\frac{1}{2}$	224.40	234.60	244.80	255.00	265.20	275.44	285.60	295.84	306.04
$1\frac{9}{16}$	233.75	244.38	255.00	265.63	276.25	286.88	297.50	308.13	318.75
$1\frac{5}{8}$	243.10	254.15	265.20	276.25	287.30	298.35	309.40	320.45	331.50
$1\frac{11}{16}$	252.45	263.93	275.40	286.88	298.35	309.83	321.30	332.78	344.25
$1\frac{3}{4}$	261.80	273.70	285.60	297.50	309.40	321.30	333.20	345.10	357.00
$1\frac{13}{16}$	271.15	283.48	295.80	308.13	320.45	332.78	345.10	357.43	369.75
$1\frac{7}{8}$	280.50	293.25	306.00	318.75	331.50	344.25	357.00	369.75	382.50
$1\frac{15}{16}$	289.85	303.03	316.20	329.38	342.55	355.73	368.90	382.08	395.25
2	299.20	312.80	326.40	340.00	353.60	367.20	380.80	394.40	408.00

AREAS
OF STEEL FLATS.

SQUARE INCHES.

Thickness, in Inches.	¼″	½″	¾″	1″	1¼″	1½″	1¾″	2″	12″
1/16	.016	.031	.047	.063	.078	.094	.109	.125	.75
⅛	.031	.063	.094	.125	.156	.188	.219	.250	1.50
3/16	.047	.094	.141	.188	.234	.281	.328	.375	2.25
¼	.063	.125	.188	.250	.313	.375	.438	.500	3.00
5/16	.078	.156	.234	.313	.391	.469	.547	.625	3.75
⅜	.094	.188	.281	.375	.469	.563	.656	.750	4.50
7/16	.109	.219	.328	.438	.547	.656	.766	.875	5.25
½	.125	.250	.375	.500	.625	.750	.875	1.000	6.00
9/16	.141	.281	.422	.563	.703	.844	.984	1.13	6.75
⅝	.156	.313	.469	.625	.781	.938	1.09	1.25	7.50
11/16	.172	.344	.516	.688	.859	1.03	1.20	1.38	8.25
¾	.188	.375	.563	.750	.938	1.13	1.31	1.50	9.00
13/16	.203	.406	.609	.813	1.02	1.22	1.42	1.63	9.75
⅞	.219	.438	.656	.875	1.09	1.31	1.53	1.75	10.50
15/16	.234	.469	.703	.938	1.17	1.41	1.64	1.88	11.25
1	.250	.500	.750	1.000	1.25	1.50	1.75	2.00	12.00
1 1/16	.266	.531	.797	1.06	1.33	1.59	1.86	2.13	12.75
1⅛	.281	.563	.844	1.13	1.41	1.69	1.97	2.25	13.50
1 3/16	.297	.594	.891	1.19	1.48	1.78	2.08	2.38	14.25
1¼	.313	.625	.938	1.25	1.56	1.88	2.19	2.50	15.00
1 5/16	.328	.656	.984	1.31	1.64	1.97	2.30	2.63	15.75
1⅜	.344	.688	1.03	1.38	1.72	2.06	2.41	2.75	16.50
1 7/16	.359	.719	1.08	1.44	1.80	2.16	2.52	2.88	17.25
1½	.375	.750	1.13	1.50	1.88	2.25	2.63	3.00	18.00
1 9/16	.391	.781	1.17	1.56	1.95	2.34	2.73	3.13	18.75
1⅝	.406	.813	1.22	1.63	2.03	2.44	2.84	3.25	19.50
1 11/16	.422	.844	1.27	1.69	2.11	2.53	2.95	3.38	20.25
1¾	.438	.875	1.31	1.75	2.19	2.63	3.06	3.50	21.00
1 13/16	.453	.906	1.36	1.81	2.27	2.72	3.17	3.63	21.75
1⅞	.469	.938	1.41	1.88	2.34	2.81	3.28	3.75	22.50
1 15/16	.484	.969	1.45	1.94	2.42	2.91	3.39	3.88	23.25
2	.500	1.000	1.50	2.00	2.50	3.00	3.50	4.00	24.00

AREAS
OF STEEL FLATS—(CONTINUED).
SQUARE INCHES.

Thickness, in Inches.	2¼″	2½″	2¾″	3″	3¼″	3½″	3¾″	4″	12″
1/16	.141	.156	.172	.188	.203	.219	.234	.25	.75
⅛	.281	.313	.344	.375	.406	.438	.469	.50	1.50
3/16	.422	.469	.516	.563	.609	.656	.703	.75	2.25
¼	.563	.625	.688	.750	.813	.875	.938	1.00	3.00
5/16	.703	.781	.859	.938	1.02	1.09	1.17	1.25	3.75
⅜	.844	.938	1.03	1.13	1.22	1.31	1.41	1.50	4.50
7/16	.984	1.09	1.20	1.31	1.42	1.53	1.64	1.75	5.25
½	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00	6.00
9/16	1.27	1.41	1.55	1.69	1.83	1.97	2.11	2.25	6.75
⅝	1.41	1.56	1.72	1.88	2.03	2.19	2.34	2.50	7.50
11/16	1.55	1.72	1.89	2.06	2.23	2.41	2.58	2.75	8.25
¾	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00	9.00
13/16	1.83	2.03	2.23	2.44	2.64	2.84	3.05	3.25	9.75
⅞	1.97	2.19	2.41	2.63	2.84	3.06	3.28	3.50	10.50
15/16	2.11	2.34	2.58	2.81	3.05	3.28	3.52	3.75	11.25
1	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	12.00
1 1/16	2.39	2.66	2.92	3.19	3.45	3.72	3.98	4.25	12.75
1⅛	2.53	2.81	3.09	3.38	3.66	3.94	4.22	4.50	13.50
1 3/16	2.67	2.97	3.27	3.56	3.86	4.16	4.45	4.75	14.25
1¼	2.81	3.13	3.44	3.75	4.06	4.38	4.69	5.00	15.00
1 5/16	2.95	3.28	3.61	3.94	4.27	4.59	4.92	5.25	15.75
1⅜	3.09	3.44	3.78	4.13	4.47	4.81	5.16	5.50	16.50
1 7/16	3.23	3.59	3.95	4.31	4.67	5.03	5.39	5.75	17.25
1½	3.38	3.75	4.13	4.50	4.88	5.25	5.63	6.00	18.00
1 9/16	3.52	3.91	4.30	4.69	5.08	5.47	5.86	6.25	18.75
1⅝	3.66	4.06	4.47	4.88	5.28	5.69	6.09	6.50	19.50
1 11/16	3.80	4.22	4.64	5.06	5.48	5.91	6.33	6.75	20.25
1¾	3.94	4.38	4.81	5.25	5.69	6.13	6.56	7.00	21.00
1 13/16	4.08	4.53	4.98	5.44	5.89	6.34	6.80	7.25	21.75
1⅞	4.22	4.69	5.16	5.63	6.09	6.56	7.03	7.50	22.50
1 15/16	4.36	4.84	5.33	5.81	6.30	6.78	7.27	7.75	23.25
2	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	24.00

AREAS
OF STEEL FLATS—(CONTINUED).
SQUARE INCHES.

Thickness, in Inches.	4½″	5″	5½″	6″	6½″	7″	7½″	8″	12″
1/16	.281	.313	.344	.375	.406	.438	.469	.50	.75
⅛	.563	.625	.688	.750	.813	.875	.938	1.00	1.50
3/16	.844	.938	1.03	1.13	1.22	1.31	1.41	1.50	2.25
¼	1.13	1.25	1.38	1.50	1.63	1.75	1.88	2.00	3.00
5/16	1.41	1.56	1.72	1.88	2.03	2.19	2.34	2.50	3.75
⅜	1.69	1.88	2.06	2.25	2.44	2.63	2.81	3.00	4.50
7/16	1.97	2.19	2.41	2.63	2.84	3.06	3.28	3.50	5.25
½	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00	6.00
9/16	2.53	2.81	3.09	3.38	3.66	3.94	4.22	4.50	6.75
⅝	2.81	3.13	3.44	3.75	4.06	4.38	4.69	5.00	7.50
11/16	3.09	3.44	3.78	4.13	4.47	4.81	5.16	5.50	8.25
¾	3.38	3.75	4.13	4.50	4.88	5.25	5.63	6.00	9.00
13/16	3.66	4.06	4.47	4.88	5.28	5.69	6.09	6.50	9.75
⅞	3.94	4.38	4.81	5.25	5.69	6.13	6.56	7.00	10.50
15/16	4.22	4.69	5.16	5.63	6.09	6.56	7.03	7.50	11.25
1	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	12.00
1 1/16	4.78	5.31	5.84	6.38	6.91	7.44	7.97	8.50	12.75
1⅛	5.06	5.63	6.19	6.75	7.31	7.88	8.44	9.00	13.50
1 3/16	5.34	5.94	6.53	7.13	7.72	8.31	8.91	9.50	14.25
1¼	5.63	6.25	6.88	7.50	8.13	8.75	9.38	10.00	15.00
1 5/16	5.91	6.56	7.22	7.88	8.53	9.19	9.84	10.50	15.75
1⅜	6.19	6.88	7.56	8.25	8.94	9.63	10.31	11.00	16.50
1 7/16	6.47	7.19	7.91	8.63	9.34	10.06	10.78	11.50	17.25
1½	6.75	7.50	8.25	9.00	9.75	10.50	11.25	12.00	18.00
1 9/16	7.03	7.81	8.59	9.38	10.16	10.94	11.72	12.50	18.75
1⅝	7.31	8.13	8.94	9.75	10.56	11.38	12.19	13.00	19.50
1 11/16	7.59	8.44	9.28	10.13	10.97	11.81	12.66	13.50	20.25
1¾	7.88	8.75	9.63	10.50	11.38	12.25	13.13	14.00	21.00
1 13/16	8.16	9.06	9.97	10.88	11.78	12.69	13.59	14.50	21.75
1⅞	8.44	9.38	10.31	11.25	12.19	13.13	14.06	15.00	22.50
1 15/16	8.72	9.69	10.66	11.63	12.59	13.56	14.53	15.50	23.25
2	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	24.00

AREAS
OF STEEL FLATS—(CONTINUED).
SQUARE INCHES.

Thickness, in Inches.	8½″	9″	9½″	10″	10½″	11″	11½″	12″	12½″
$\frac{1}{16}$	.531	.563	.594	.625	.656	.688	.719	.750	.781
⅛	1.06	1.13	1.19	1.25	1.31	1.38	1.44	1.50	1.56
$\frac{3}{16}$	1.59	1.69	1.78	1.88	1.97	2.06	2.16	2.25	2.34
¼	2.13	2.25	2.38	2.50	2.63	2.75	2.88	3.00	3.13
$\frac{5}{16}$	2.66	2.81	2.97	3.13	3.28	3.44	3.59	3.75	3.91
⅜	3.19	3.38	3.56	3.75	3.94	4.13	4.31	4.50	4.69
$\frac{7}{16}$	3.72	3.94	4.16	4.38	4.59	4.81	5.03	5.25	5.47
½	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25
$\frac{9}{16}$	4.78	5.06	5.34	5.63	5.91	6.19	6.47	6.75	7.03
⅝	5.31	5.63	5.94	6.25	6.56	6.88	7.19	7.50	7.81
$\frac{11}{16}$	5.84	6.19	6.53	6.88	7.22	7.56	7.91	8.25	8.59
¾	6.38	6.75	7.13	7.50	7.88	8.25	8.63	9.00	9.38
$\frac{13}{16}$	6.91	7.31	7.72	8.13	8.53	8.94	9.34	9.75	10.16
⅞	7.44	7.88	8.31	8.75	9.19	9.63	10.06	10.50	10.94
$\frac{15}{16}$	7.97	8.44	8.91	9.38	9.84	10.31	10.78	11.25	11.72
1	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50
$1\frac{1}{16}$	9.03	9.56	10.09	10.63	11.16	11.69	12.22	12.75	13.28
1⅛	9.56	10.13	10.69	11.25	11.81	12.38	12.94	13.50	14.06
$1\frac{3}{16}$	10.09	10.69	11.28	11.88	12.47	13.06	13.66	14.25	14.84
1¼	10.63	11.25	11.88	12.50	13.13	13.75	14.38	15.00	15.63
$1\frac{5}{16}$	11.16	11.81	12.47	13.13	13.78	14.44	15.09	15.75	16.41
1⅜	11.69	12.38	13.06	13.75	14.44	15.13	15.81	16.50	17.19
$1\frac{7}{16}$	12.22	12.94	13.66	14.38	15.09	15.81	16.53	17.25	17.97
1½	12.75	13.50	14.25	15.00	15.75	16.50	17.25	18.00	18.75
$1\frac{9}{16}$	13.28	14.06	14.84	15.63	16.41	17.19	17.97	18.75	19.53
1⅝	13.81	14.63	15.44	16.25	17.06	17.88	18.69	19.50	20.31
$1\frac{11}{16}$	14.34	15.19	16.03	16.88	17.72	18.56	19.41	20.25	21.09
1¾	14.88	15.75	16.63	17.50	18.38	19.25	20.13	21.00	21.88
$1\frac{13}{16}$	15.41	16.31	17.22	18.13	19.03	19.94	20.84	21.75	22.66
1⅞	15.94	16.88	17.81	18.75	19.69	20.63	21.56	22.50	23.44
$1\frac{15}{16}$	16.47	17.44	18.41	19.38	20.34	21.31	22.28	23.25	24.22
2	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00

CIRCUMFERENCES OF CIRCLES.

ADVANCING BY EIGHTHS.

Diameter.	0	⅛	¼	⅜	½	⅝	¾	⅞
0	.0	.3927	.7854	1.178	1.571	1.963	2.356	2.749
1	3.142	3.534	3.927	4.320	4.712	5.105	5.498	5.890
2	6.283	6.676	7.069	7.461	7.854	8.246	8.639	9.032
3	9.425	9.817	10.21	10.60	10.99	11.39	11.78	12.17
4	12.56	12.96	13.35	13.74	14.13	14.53	14.92	15.31
5	15.71	16.10	16.49	16.88	17.28	17.67	18.06	18.45
6	18.85	19.24	19.63	20.02	20.42	20.81	21.20	21.60
7	21.99	22.38	22.77	23.17	23.56	23.95	24.34	24.74
8	25.13	25.52	25.92	26.31	26.70	27.09	27.49	27.88
9	28.27	28.66	29.06	29 45	29.84	30.23	30.63	31.02
10	31.41	31.81	32.20	32.59	32.98	33.38	33.77	34.16
11	34.55	34.95	35.34	35.73	36.13	36.52	36.91	37.30
12	37.70	38.09	38.48	38.87	39.27	39.66	40.05	40.45
13	40.84	41.23	41.62	42.02	42.41	42.80	43.19	43.59
14	43.98	44.37	44.76	45.16	45.55	45 94	46.34	46.73
15	47.12	47.51	47.91	48.30	48.69	49.08	49.48	49.87
16	50.26	50.66	51.05	51.44	51.83	52.23	52.62	53.01
17	53.40	53.80	54.19	54.58	54.97	55.37	55.76	56.15
18	56.55	56.94	57.33	57.72	58.12	58.51	58.90	59.29
19	59.69	60.08	60.47	60.87	61.26	61.65	62.04	62.43
20	62.83	63.22	63.61	64.01	64.40	64.79	65.19	65.58
21	65.97	66.36	66.76	67.15	67.54	67.93	68.33	68.72
22	69.11	69.50	69.90	70.29	70.68	71.08	71.47	71.86
23	72.25	72.65	73.04	73.43	73.82	74.22	74.61	75.00
24	75.40	75.79	76.18	76.57	76.97	77.36	77.75	78.14
25	78.54	78.93	79.32	79.71	80.11	80.50	80.89	81.29
26	81.68	82.07	82.46	82.86	83.25	83.64	84.03	84.43
27	84.82	85.21	85.60	86.00	86.39	86.78	87.18	87.57
28	87.96	88.35	88.75	89.14	89.53	89.93	90.32	90.71
29	91.10	91.50	91.89	92.28	92.67	93.07	93.46	93.85
30	94.24	94.64	95.03	95.42	95.82	96.21	96.60	96.99
31	97.39	97.78	98.17	98.57	98.96	99.35	99.75	100.14
32	100.53	100.92	101.32	101.71	102.10	102.49	102.89	103.28
33	103.67	104.07	104.46	104.85	105.24	105.64	106.03	106.42
34	106.81	107.21	107.60	107.99	108.39	108.78	109.17	109.56
35	109.96	110.35	100.74	111.13	111.53	111.92	112.31	112.71
36	113.10	113.49	113.88	114.28	114.67	115.06	115.45	115.85
37	116.24	116.63	117.02	117.42	117.81	118.20	118.60	118.99
38	119.38	119.77	120.17	120.56	120.95	121.34	121.74	122.13
39	122.52	122.92	123.31	123.70	124.09	124.49	124.88	125.27
40	125.66	126.06	126.45	126.84	127.24	127.63	128.02	128.41
41	128.81	129.20	129.59	129.98	130.38	130.77	131.16	131.55
42	131.95	132.34	132.73	133.13	133.52	133.91	134.30	134.70
43	135.09	135.48	135.87	136.27	136.66	137.05	137.45	137.84
44	138.23	138.62	139.02	139.41	139.80	140.19	140.59	140.98
45	141.37	141.76	142.16	142.55	142.94	143.34	143.73	144.12
46	144.51	144.91	145.30	145.69	146.08	146.48	146.87	147.26
47	147.66	148.05	148.44	148.83	149.23	149.62	150.01	150.40
48	150.80	151.19	151.58	151.97	152.37	152.76	153.15	153.55
49	153.94	154.33	154.72	155.12	155.51	155.90	156.29	156.69

CIRCUMFERENCES OF CIRCLES
(CONTINUED).
ADVANCING BY EIGHTHS.

Diameter.	0	⅛	¼	⅜	½	⅝	¾	⅞
50	157.08	157.47	157.87	158.26	158.65	159.04	159.44	159.83
51	160.22	160.61	161.01	161.40	161.79	162.19	162.58	162.97
52	163.36	163.76	164.15	164.54	164.93	165.33	165.72	166.11
53	166.50	166.90	167.29	167.68	168.08	168.47	168.86	169.25
54	169.65	170.04	170.43	170.82	171.22	171.61	172.00	172.40
55	172.79	173.18	173.57	173.97	174.36	174.75	175.14	175.54
56	175.93	176.32	176.72	177.11	177.50	177.89	178.29	178.68
57	179.07	179.46	179.86	180.25	180.64	181.03	181.43	181.82
58	182.21	182.61	183.00	183.39	183.78	184.18	184.57	184.96
59	185.35	185.75	186.14	186.53	186.93	187.32	187.71	188.10
60	188.50	188.89	189.28	189.67	190.07	190.46	190.85	191.24
61	191.64	192.03	192.42	192.82	193.21	193.60	193.99	194.39
62	194.78	195.17	195.56	195.96	196.35	196.74	197.14	197.53
63	197.92	198.31	198.71	199.10	199.49	199.88	200.28	200.67
64	201.06	201.46	201.85	202.24	202.63	203.03	203.42	203.81
65	204.20	204.60	204.99	205.38	205.77	206.17	206.56	206.95
66	207.35	207.74	208.13	208.52	208.92	209.31	209.70	210.09
67	210.49	210.88	211.27	211.67	212.06	212.45	212.84	213.24
68	213.63	214.02	214.41	214.81	215.20	215.59	215.98	216.38
69	216.77	217.16	217.56	217.95	218.34	218.73	219.13	219.52
70	219.91	220.30	220.70	221.09	221.48	221.88	222.27	222.66
71	223.05	223.45	223.84	224.23	224.62	225.02	225.41	225.80
72	226.20	226.59	226.98	227.37	227.77	228.16	228.55	228.94
73	229.34	229.73	230.12	230.51	230.91	231.30	231.69	232.09
74	232.48	232.87	233.26	233.66	234.05	234.44	234.83	235.23
75	235.62	236.01	236.41	236.80	237.19	237.58	237.98	238.37
76	238.76	239.15	239.55	239.94	240.33	240.73	241.12	241.51
77	241.90	242.30	242.69	243.08	243.47	243.87	244.26	244.65
78	245.04	245.44	245.83	246.22	246.62	247.01	247.40	247.79
79	248.19	248.58	248.97	249.36	249.76	250.15	250.54	250.94
80	251.33	251.72	252.11	252.51	252.90	253.29	253.68	254.08
81	254.47	254.86	255.25	255.65	256.04	256.43	256.83	257.22
82	257.61	258.00	258.40	258.79	259.18	259.57	259.97	260.36
83	260.75	261.15	261.54	261.93	262.32	262.72	263.11	263.50
84	263.89	264.29	264.68	265.07	265.47	265.86	266.25	266.64
85	267.04	267.43	267.82	268.22	268.61	269.00	269.39	269.78
86	270.18	270.57	270.96	271.36	271.75	272.14	272.53	272.93
87	273.32	273.71	274.10	274.50	274.89	275.28	275.68	276.07
88	276.46	276.85	277.25	277.64	278.03	278.42	278.82	279.21
89	279.60	279.99	280.39	280.78	281.17	281.57	281.96	282.35
90	282.74	283.14	283.53	283.92	284.31	284.71	285.10	285.49
91	285.89	286.28	286.67	287.06	287.46	287.85	288.24	288.63
92	289.03	289.42	289.81	290.21	290.60	290.99	291.38	291.78
93	292.17	292.56	292.95	293.35	293.74	294.13	294.52	294.92
94	295.31	295.70	296.10	296.49	296.88	297.27	297.67	298.06
95	298.45	298.84	299.24	299.63	300.02	300.42	300.81	301.20
96	301.59	301.99	302.38	302.77	303.16	303.56	303.95	304.34
97	304.73	305.13	305.52	305.91	306.31	306.70	307.09	307.48
98	307.88	308.27	308.66	309.05	309.45	309.84	310.23	310.63
99	311.02	311.41	311.80	312.20	312.59	312.98	313.37	313.77

AREAS OF CIRCLES.

ADVANCING BY EIGHTHS.

Diameter.	0	⅛	¼	⅜	½	⅝	¾	⅞
0	.0	.0122	.0491	.1104	.1963	.3068	.4418	.6013
1	.7854	.9940	1.227	1.485	1.767	2.074	2 405	2.761
2	3.1416	3.546	3.976	4.430	4.908	5.411	5.939	6 492
3	7.068	7.670	8.296	8.946	9.621	10.32	11.04	11.79
4	12.56	13.36	14.18	15.03	15.90	16.80	17.72	18.66
5	19.63	20.63	21.65	22.69	23.76	24 85	25.96	27.10
6	28.27	29.46	30 68	31.92	33.18	34.47	35.78	37.12
7	38.48	39.87	41.28	42.72	44.18	45.66	47.17	48.70
8	50.26	51.85	53.45	55.09	56.74	58.42	60.13	61.86
9	63.61	65.39	67.20	69.03	70.88	72.76	74.66	76.59
10	78.54	80.51	82.51	84.54	86.59	88.66	90.76	92.88
11	95.03	97.20	99.40	101.6	103.9	106.1	108 4	110.7
12	113.1	115.5	117 9	120.3	122.7	125.2	127.7	130.2
13	132.7	135.3	137 9	140.5	143.1	145.8	148.5	151.2
14	153 9	156.7	159.5	162.3	165.1	168 0	170.9	173.8
15	176.7	179.7	182.7	185.7	188.7	191.7	194.8	197.9
16	201.1	204.2	207.4	210.6	213.8	217.1	220.3	223.6
17	227.0	230.3	233.7	237.1	240.5	244.0	247.4	250.9
18	254.5	258.0	261.6	265.2	268.8	272.4	276.1	279.8
19	283 5	287.3	291.0	294.8	298.6	302.5	306.3	310.2
20	314.2	318.1	322.1	326.0	330.1	334.1	338.2	342.2
21	346.4	350.5	354.7	358.8	363.0	367.3	371.5	375.8
22	380.1	384.5	388.8	393.2	397.6	402.0	406.5	411.0
23	415.5	420.0	424.6	429.1	433.7	438.4	443.0	447.7
24	452.4	457.1	461.9	466.6	471.4	476.3	481.1	486.0
25	490.9	495.8	500.7	505.7	510.7	515.7	520.8	525.8
26	530.9	536.0	541.2	546.3	551.6	556.8	562.0	567.3
27	572.6	577.9	583.2	588.6	594.0	599.4	604.8	610.3
28	615.7	621.3	626.8	632.4	637.9	643.5	649.2	654.8
29	660.5	666.2	672.0	677.7	683.5	689.3	695.1	701.0
30	706.9	712.8	718.7	724.6	730.6	736.6	742.6	748.7
31	754.8	760.9	767.0	773.1	779.3	785.5	791.7	798.0
32	804.3	810.5	816.9	823.2	829.6	836.0	842.4	848.8
33	855.3	861.8	868.3	874.9	881.4	888.0	894.6	901.3
34	907.9	914 6	921.3	928.1	934.8	941.6	948.4	955.2
35	962.1	969.0	975.9	982.8	989.8	996.8	1003.8	1010.8
36	1017.9	1025.0	1032.1	1039.2	1046.3	1053.5	1060.7	1068.0
37	1075.2	1082.5	1089.8	1097.1	1104.5	1111.8	1119.2	1126.7
38	1134.1	1141.6	1149.1	1156.6	1164.2	1171.7	1179.3	1186.9
39	1194.6	1202.3	1210.0	1217.7	1225.4	1233.2	1241.0	1248.8
40	1256.6	1264.5	1272.4	1280.3	1288.2	1296.2	1304.2	1312.2
41	1320.3	1328.3	1336.4	1344.5	1352.7	1360.8	1369.0	1377.2
42	1385.4	1393.7	1402.0	1410.3	1418.6	1427.0	1435.4	1443.8
43	1452.2	1460.7	1469.1	1477.6	1486.2	1494.7	1503.3	1511.9
44	1520.5	1529.2	1537.9	1546.6	1555.3	1564.0	1572.8	1581.6
45	1590.4	1599.3	1608.2	1617.0	1626.0	1634.9	1643.9	1652.9
46	1661.9	1670.9	1680.0	1689.1	1698.2	1707.4	1716.5	1725.7
47	1734.9	1744.2	1753.5	1762.7	1772.1	1781.4	1790.8	1800.1
48	1809.6	1819.0	1828.5	1837.9	1847.5	1857.0	1866.5	1876.1
49	1885.7	1895.4	1905.0	1914.7	1924.4	1934.2	1943.9	1953.7

AREAS OF CIRCLES—(CONTINUED).
ADVANCING BY EIGHTHS.

Diameter.	0	⅛	¼	⅜	½	⅝	¾	⅞
50	1963.5	1973.3	1983.2	1993.1	2003.0	2012.9	2022.8	2032.8
51	2042.8	2052.8	2062.9	2073.0	2083.1	2093.2	2103.3	2113.5
52	2123.7	2133.9	2144.2	2154.5	2164.8	2175.1	2185.4	2195.8
53	2206.2	2216.6	2227.0	2237.5	2248.0	2258.5	2269.1	2279.6
54	2290.2	2300.8	2311.5	2322.1	2332.8	2343.5	2354.3	2365.0
55	2375.8	2386.6	2397.5	2408.3	2419.2	2430.1	2441.1	2452.0
56	2463.0	2474.0	2485.0	2496.1	2507.2	2518.3	2529.4	2540.6
57	2551.8	2563.0	2574.2	2585.4	2596.7	2608.0	2619.4	2630.7
58	2642.1	2653.5	2664.9	2676.4	2687.8	2699.3	2710.9	2722.4
59	2734.0	2745.6	2757.2	2768.8	2780.5	2792.2	2803.9	2815.7
60	2827.4	2839.2	2851.0	2862.9	2874.8	2886.6	2898.6	2910.5
61	2922.5	2934.5	2946.5	2958.5	2970.6	2982.7	2994.8	3006.9
62	3019.1	3031.3	3043.5	3055.7	3068.0	3080.3	3092.6	3104.9
63	3117.2	3129.6	3142.0	3154.5	3166.9	3179.4	3191.9	3204.4
64	3217.0	3229.6	3242.2	3254.8	3267.5	3280.1	3292.8	3305.6
65	3318.3	3331.1	3343.9	3356.7	3369.6	3382.4	3395.3	3408.2
66	3421.2	3434.3	3447.2	3460.2	3473.2	3486.3	3499.4	3512.5
67	3525.7	3538.8	3552.0	3565.2	3578.5	3591.7	3605.0	3618.3
68	3631.7	3645.0	3658.4	3671.8	3685.3	3698.7	3712.2	3725.7
69	3739.3	3752.8	3766.4	3780.0	3793.7	3807.3	3821.0	3834.7
70	3848.5	3862.2	3876.0	3889.8	3903.6	3917.5	3931.4	3945.3
71	3959.2	3973.1	3987.1	4001.1	4015.2	4029.2	4043.3	4057.4
72	4071.5	4085.7	4099.8	4114.0	4128.2	4142.5	4156.8	4171.1
73	4185.4	4199.7	4214.1	4228.5	4242.9	4257.4	4271.8	4286.3
74	4300.8	4315.4	4329.9	4344.5	4359.2	4373.8	4388.5	4403.1
75	4417.9	4432.6	4447.4	4462.2	4477.0	4491.8	4506.7	4521.5
76	4536.5	4551.4	4566.4	4581.3	4596.3	4611.4	4626.4	4641.5
77	4656.6	4671.8	4686.9	4702.1	4717.3	4732.5	4747.8	4763.1
78	4778.4	4793.7	4809.0	4824.4	4839.8	4855.2	4870.7	4886.2
79	4901.7	4917.2	4932.7	4948.3	4963.9	4979.5	4995.2	5010.9
80	5026.5	5042.3	5058.0	5073.8	5089.6	5105.4	5121.2	5137.1
81	5153.0	5168.9	5184.9	5200.8	5216.8	5232.8	5248.9	5264.9
82	5281.0	5297.1	5313.3	5329.4	5345.6	5361.8	5378.1	5394.3
83	5410.6	5426.9	5443.3	5459.6	5476.0	5492.4	5508.8	5525.3
84	5541.8	5558.3	5574.8	5591.4	5607.9	5624.5	5641.2	5657.8
85	5674.5	5691.2	5707.9	5724.7	5741.5	5758.3	5775.1	5791.9
86	5808.8	5825.7	5842.6	5859.6	5876.5	5893.5	5910.6	5927.6
87	5944.7	5961.8	5978.9	5996.0	6013.2	6030.4	6047.6	6064.9
88	6082.1	6099.4	6116.7	6134.1	6151.4	6168.8	6186.2	6203.7
89	6221.1	6238.6	6256.1	6273.7	6291.2	6308.8	6326.4	6344.1
90	6361.7	6379.4	6397.1	6414.9	6432.6	6450.4	6468.2	6486.0
91	6503.9	6521.8	6539.7	6557.6	6575.5	6593.5	6611.5	6629.6
92	6647.6	6665.7	6683.8	6701.9	6720.1	6738.2	6756.4	6774.7
93	6792.9	6811.2	6829.5	6847.8	6866.1	6884.5	6902.9	6921.3
94	6939.8	6958.2	6976.7	6995.3	7013.8	7032.4	7051.0	7069.6
95	7088.2	7106.9	7125.6	7144.3	7163.0	7181.8	7200.6	7219.4
96	7238.2	7257.1	7276.0	7294.9	7313.8	7332.8	7351.8	7370.8
97	7389.8	7408.9	7428.0	7447.1	7466.2	7485.3	7504.5	7523.7
98	7543.0	7562.2	7581.5	7600.8	7620.1	7639.5	7658.9	7678.3
99	7697.7	7717.1	7736.6	7756.1	7775.6	7795.2	7814.8	7834.4

DECIMALS OF A FOOT

FOR EACH $\frac{1}{64}$th OF AN INCH.

Inch.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
0	0	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167
$\frac{1}{64}$	.0013	.0846	.1680	.2513	.3346	.4180	.5013	.5846	.6680	.7513	.8346	.9180
$\frac{1}{32}$	.0026	.0859	.1693	.2526	.3359	.4193	.5026	.5859	.6693	.7526	.8359	.9193
$\frac{3}{64}$	.0039	.0872	.1706	.2539	.3372	.4206	.5039	.5872	.6706	.7539	.8372	.9206
$\frac{1}{16}$	.0052	.0885	.1719	.2552	.3385	.4219	5052	.5885	.6719	.7552	.8385	.9219
$\frac{5}{64}$	.0065	.0898	.1732	.2565	.3398	.4232	.5065	.5898	.6732	.7565	.8398	.9232
$\frac{3}{32}$	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9245
$\frac{7}{64}$	.0091	.0924	.1758	.2591	.3424	.4258	.5091	.5924	.6758	.7591	.8424	.9258
$\frac{1}{8}$	.0104	.0937	.1771	.2604	.3437	.4271	.5104	.5937	.6771	.7604	.8437	.9271
$\frac{9}{64}$	.0117	.0951	.1784	.2617	.3451	.4284	.5117	.5951	.6784	.7617	.8451	.9284
$\frac{5}{32}$	.0130	.0964	.1797	.2630	.3464	.4297	.5130	.5964	.6797	.7630	.8464	.9297
$\frac{11}{64}$	.0143	.0977	.1810	.2643	.3477	.4310	.5143	.5977	.6810	.7643	.8477	.9310
$\frac{3}{16}$	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323
$\frac{13}{64}$	.0169	.1003	.1836	.2669	.3503	.4336	.5169	.6003	.6836	.7669	.8503	.9336
$\frac{7}{32}$	.0182	.1016	.1849	.2682	.3516	.4349	.5182	.6016	.6849	.7682	.8516	.9349
$\frac{15}{64}$	.0195	.1029	.1862	.2695	.3529	.4362	.5195	.6029	.6862	.7695	.8529	.9362
$\frac{1}{4}$	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.6875	.7708	.8542	.9375
$\frac{17}{64}$	.0221	.1055	.1888	.2721	.3555	.4388	.5221	.6055	.6888	.7721	.8555	.9388
$\frac{9}{32}$	.0234	.1068	.1901	.2734	.3568	.4401	.5234	.6068	.6901	.7734	.8568	.9401
$\frac{19}{64}$	.0247	.1081	.1914	.2747	.3581	.4414	.5247	.6081	.6914	.7747	.8581	.9414
$\frac{5}{16}$	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427
$\frac{21}{64}$	.0273	.1107	.1940	.2773	.3607	.4440	.5273	.6107	.6940	.7773	.8607	.9440
$\frac{11}{32}$	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6120	.6953	.7786	.8620	.9453
$\frac{23}{64}$	.0299	.1133	.1966	.2799	.3633	.4466	.5299	.6133	.6966	.7799	.8633	.9466
$\frac{3}{8}$	.0312	.1146	.1979	.2812	.3646	.4479	.5312	.6146	.6979	.7812	.8646	.9479
$\frac{25}{64}$	·0326	.1159	.1992	.2826	.3659	.4492	.5326	.6159	.6992	.7826	.8659	.9492
$\frac{13}{32}$	.0339	.1172	.2005	.2839	.3672	.4505	.5339	.6172	.7005	.7839	·8672	.9505
$\frac{27}{64}$	.0352	.1185	.2018	.2852	.3685	.4518	.5352	.6185	.7018	.7852	.8685	.9518
$\frac{7}{16}$	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531
$\frac{29}{64}$	.0378	.1211	.2044	.2878	.3711	.4544	.5378	.6211	.7044	.7878	.8711	.9544
$\frac{15}{32}$	.0391	.1224	.2057	.2891	.3724	.4557	.5391	.6224	.7057	.7891	.8724	.9557
$\frac{31}{64}$	.0404	.1237	.2070	.2904	.3737	.4570	.5404	.6237	.7070	.7904	.8737	.9570
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583

DECIMALS OF A FOOT

FOR EACH $\frac{1}{64}$th OF AN INCH.

Inch.	0″	1″	2″	3″	4″	5″	6″	7″	8″	9″	10″	11″
½	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583
$\frac{33}{64}$	.0430	.1263	.2096	.2930	.3763	.4596	.5430	.6263	.7096	.7930	.8763	.9596
$\frac{17}{32}$	.0443	.1276	.2109	.2943	.3776	.4609	.5443	.6276	.7109	.7943	.8776	.9609
$\frac{35}{64}$	.0456	.1289	.2122	.2956	.3789	.4622	.5456	.6289	.7122	.7956	.8789	.9622
$\frac{9}{16}$	.0469	.1302	.2135	.2969	.3802	.4635	.5469	.6302	.7135	.7969	.8802	.9635
$\frac{37}{64}$	.0482	.1315	.2148	.2982	.3815	.4648	.5482	.6315	.7148	.7982	.8815	.9648
$\frac{19}{32}$	.0495	.1328	.2161	.2995	.3828	.4661	.5495	.6328	.7161	.7995	.8828	.9661
$\frac{39}{64}$	.0508	.1341	.2174	.3008	.3841	.4674	.5508	.6341	.7174	.8008	.8841	.9674
⅝	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688
$\frac{41}{64}$	.0534	.1367	.2201	.3034	.3867	.4701	.5534	.6367	.7201	.8034	.8867	.9701
$\frac{21}{32}$	.0547	.1380	.2214	.3047	.3880	.4714	.5547	.6380	.7214	.8047	.8880	.9714
$\frac{43}{64}$	.0560	.1393	.2227	.3060	.3893	.4727	.5560	.6393	.7227	.8060	.8893	.9727
$\frac{11}{16}$	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740
$\frac{45}{64}$	.0586	.1419	.2253	.3086	.3919	.4753	.5586	.6419	.7253	.8096	.8919	.9753
$\frac{23}{32}$	.0599	.1432	.2266	.3099	.3932	.4766	.5599	.6432	.7266	.8099	.8932	.9766
$\frac{47}{64}$	.0612	.1445	.2279	.3112	.3945	.4779	.5612	.6445	.7279	.8112	.8945	.9779
¾	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792
$\frac{49}{64}$	.0638	.1471	.2305	.3138	.3971	.4805	.5638	.6471	.7305	.8138	.8971	.9805
$\frac{25}{32}$	.0651	.1484	.2318	.3151	.3984	.4818	.5651	.6484	.7318	.8151	.8984	.9818
$\frac{51}{64}$	.0664	.1497	.2331	.3164	.3997	.4831	.5664	.6497	.7331	.8164	.8997	.9831
$\frac{13}{16}$	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844
$\frac{53}{64}$	.0690	.1523	.2357	.3190	.4023	.4857	.5690	.6523	.7357	.8190	.9023	.9857
$\frac{27}{32}$	.0703	.1536	.2370	.3203	.4036	.4870	.5703	.6536	.7370	.8203	.9036	.9870
$\frac{55}{64}$	.0716	.1549	.2383	.3216	.4049	.4883	.5716	.6549	.7383	.8216	.9049	.9883
⅞	.0729	.1562	.2396	.3229	.4062	.4896	.5729	.6562	.7396	.8229	.9062	.9896
$\frac{57}{64}$	.0742	.1576	.2409	.3242	.4076	.4909	.5742	.6576	.7409	.8242	.9076	.9909
$\frac{29}{32}$	.0755	.1589	.2422	.3255	.4089	.4922	.5755	.6589	.7422	.8255	.9089	.9922
$\frac{59}{64}$	.0768	.1602	.2435	.3268	.4102	.4935	.5768	.6602	.7435	.8268	.9102	.9935
$\frac{15}{16}$	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948
$\frac{61}{64}$	.0794	.1628	.2461	.3294	.4128	.4961	.5794	.6628	.7461	.8294	.9128	.9961
$\frac{31}{32}$	.0807	.1641	.2474	.3307	.4141	.4974	.5807	.6641	.7474	.8307	.9141	.9974
$\frac{63}{64}$	.0820	.1654	.2487	.3320	.4154	.4987	.5820	·6654	.7487	.8320	.9154	.9987
1												1.0000

DECIMALS OF AN INCH
FOR EACH $\frac{1}{64}$TH.

$\frac{1}{32}$ds.	$\frac{1}{64}$ths.	Decimal.	Fraction.	$\frac{1}{32}$ds.	$\frac{1}{64}$ths.	Decimal.	Fraction.
	1	.015625			33	.515625	
1	2	.03125		17	34	.53125	
	3	.046875			35	.546875	
2	4	.0625	1-16	18	36	.5625	9-16
	5	.078125			37	.578125	
3	6	.09375		19	38	.59375	
	7	.109375			39	.609375	
4	8	.125	1-8	20	40	.625	5-8
	9	.140625			41	.640625	
5	10	.15625		21	42	.65625	
	11	.171875			43	.671875	
6	12	.1875	3-16	22	44	.6875	11-16
	13	.203125			45	.703125	
7	14	.21875		23	46	.71875	
	15	.234375			47	.734375	
8	16	.25	1-4	24	48	.75	3-4
	17	.265625			49	.765625	
9	18	.28125		25	50	.78125	
	19	.296875			51	.796875	
10	20	.3125	5-16	26	52	.8125	13-16
	21	.328125			53	.828125	
11	22	.34375		27	54	.84375	
	23	.359375			55	.859375	
12	24	.375	3-8	28	56	.875	7-8
	25	.390625			57	.890625	
13	26	.40625		29	58	.90625	
	27	.421875			59	.921875	
14	28	.4375	7-16	30	60	.9375	15-16
	29	.453125			61	.953125	
15	30	.46875		31	62	.96875	
	31	.484375			63	.984375	
16	32	.5	1-2	32	64	1.	1

MULTIPLIERS FOR CONVERTING
METRIC SYSTEM
TO U. S. WEIGHTS AND MEASURES.

Millimeters	×	0.03937	=	Inches.
Centimeters	×	0.3937	=	"
Meters	×	39.37	=	" (Act of Congress.)
Meters	×	3.2809	=	Feet.
Meters	×	1.0936	=	Yards.
Kilometers	×	0.6214	=	Miles.
Kilometers	×	3280.9	=	Feet.
Square Millimeters	×	0.00155	=	Square Inches.
Square Centimeters	×	0.155	=	" "
Square Meters	×	10.7641	=	Square Feet.
Square Kilometers	×	247.10	=	Acres.
Hectare	×	2.47104	=	"
Cubic Centimeters	×	0.0610	=	Cubic Inches.
Cubic Centimeters	×	0.2704	=	Fl. Drams. (U. S. P.)
Cubic Centimeters	×	0.0338	=	Fl. Ounces. (U. S. P.)
Cubic Meters	×	35.3155	=	Cubic Feet.
Cubic Meters	×	1.3080	=	Cubic Yards.
Cubic Meters	×	264.1785	=	Gallons. (231 cu. ins.)
Liters	×	61.025	=	Cubic Inches. (Act of Congress.)
Liters	×	33.8006	=	Fl. Ounces. (U. S. P.)
Liters	×	0.2642	=	Gallons. (231 cu. ins.)
Liters	×	0.0353	=	Cubic Feet.
Hectoliters	×	3.5315	=	Cubic Feet.
Hectoliters	×	2.8378	=	Bushels. (2150.42 cu. ins.)
Hectoliters	×	0.1308	=	Cubic Yards.
Hectoliters	×	26.42	=	Gallons. (231 cu. ins.)
Grams	×	15.432	=	Grains. (Act Cong.)
Grams (water)	×	0.03381	=	Fl. Ounces.
Grams	×	0.03527	=	Ozs. avoirdupois.
Grams per cu. cent.	×	0.0361	=	Lbs. per cu. in.
Kilograms	×	2.2046	=	Pounds.
Kilograms	×	35.2736	=	Ozs. avoirdupois.
Kilograms	×	0.0011023	=	Tons. (2000 lbs.)
Kilograms per sq. cent.	×	14.223	=	Lbs. per sq. in.
Kilogram meters	×	7.2331	=	Foot-pounds.
Kilogram per meter	×	0.6720	=	Lbs. per foot.
Kilogram per cu. meter	×	0.0624	=	Lbs. per cubic foot.
Kilo per cheval	×	2.235	=	Lbs. per H. P.
Kilowatts	×	1.34	=	H. P.
Calorie	×	3.968	=	B. T. U.
Cheval vapeur	×	.9863	=	H. P.

1° Centigrade = 1.8° Fahrenheit.

(Degrees, Centigrade, × 1.8) + 32 = Degrees, Fahrenheit.

NOTES ON MENSURATION.

LENGTHS.

Circumference of circle = diameter $\times$ 3.14159.

Diameter of circle = circumference $\times$ 0.31831.

Side of square of same periphery as circle = diameter $\times$ 0.785398.

Diameter of circle of same periphery as square = side $\times$ 1.2732.

Side of an inscribed square = diameter of circle $\times$ 0.7071.

Length of arc = No. of degrees $\times$ diameter $\times$ 0.0087266.

$\pi = 3.14159265$ $\qquad \log \pi = 0.4971499$

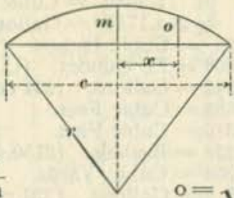
$\sqrt{\pi} = 1.772454$

$\pi^2 = 9.869604$

$$r = \frac{4m^2 + c^2}{8m}$$

or very nearly $= \frac{c^2}{8m}$

$$m = r - \sqrt{r^2 - \frac{c^2}{4}}$$



$\frac{1}{\pi} = 0.318310$

$\frac{1}{\pi^2} = 0.101321$

$\sqrt{\frac{1}{\pi}} = 0.564190$

$$o = \sqrt{r^2 - x^2} - (r - m)$$

or very nearly $= \frac{c^2}{8r}$ for small arcs.

AREAS.

Triangle = base $\times$ half perpendicular height.

Parallelogram = base $\times$ perpendicular height.

Trapezoid = half the sum of the parallel sides $\times$ perpendicular height.

Trapezium, found by dividing into two triangles.

Circle = diameter squared $\times$ 0.785398
= radius squared $\times$ 3.14159.

Sector of Circle = length of arc $\times$ half radius.

AREAS—(CONTINUED).

Segment of Circle = area of sector less triangle; also for flat segments very nearly = $\frac{4m}{3}\sqrt{0.388m^2 + \frac{c^2}{4}}$.

Side of square of equal area as circle = diameter × 0.88623.

Diameter of circle of equal area as square = side × 1.12838.

Parabola = base × ⅔ height.

Ellipse = long diameter × short diameter × 0.785398.

Regular Polygon = sum of sides × half perpendicular distance from center to sides.

Surface of cylinder = circumference × height + area of both ends.

Surface of sphere = diameter squared × 3.14159; also = circumference × diameter.

Surface of a right pyramid or cone = periphery or circumference of base × half slant height.

Surface of a frustrum of a regular right pyramid or cone = sum of peripheries or circumferences of the two ends × half slant height + area of both ends.

SOLID CONTENTS.

Prism, right or oblique, = area of base × perpendicular height.

Cylinder, right or oblique, = area of section at right angles to sides × length of side.

Sphere = diameter cubed × 0.523599;
also = surface × ⅙ diameter.

Pyramid or cone, right or oblique, regular or irregular, = area of base × ⅓ perpendicular height.

Prismoid. A prismoid is a solid bounded by six plane surfaces, only two of which are parallel. To find the contents of a prismoid, add together the areas of the two parallel surfaces and four times the area of a section taken midway between and parallel to them, and multiply the sum by ⅙th of the perpendicular distance between the parallel surfaces.

WEIGHTS OF FIREPROOF MATERIALS.

END CONSTRUCTION, FLAT ARCHES.

Width of Span between Beams.	Depth of Arch.	Weight per Square Foot.
5 feet to 6 feet	8 inches.	27 pounds.
6 " 7 "	9 "	29 "
7 " 8 "	10 "	33 "
8 " 9 "	12 "	38 "

SIDE CONSTRUCTION, FLAT ARCHES.

Width of Span between Beams.	Depth of Arch.	Weight per Square Foot.
3 feet 6 inches to 4 feet 0 inches	6 inches.	27 pounds.
4 " 0 " 4 " 6 "	7 "	29 "
4 " 6 " 5 " 0 "	8 "	32 "
5 " 6 " 6 " 0 "	9 "	36 "
6 " 0 " 6 " 6 "	10 "	39 "
6 " 6 " 7 " 0 "	12 "	44 "

PARTITIONS.

	Thickness.	Weight per Square Foot.
Hollow Brick (Clay) Partitions	2 inches.	11 pounds.
" " " "	3 "	14 "
" " " "	4 "	15 "
" " " "	5 "	19 "
" " " "	6 "	20 "
" " " "	8 "	27 "
Porous Terra-Cotta Partitions	3 "	16 "
" " " "	4 "	19 "
" " " "	5 "	22 "
" " " "	6 "	23 "
" " " "	8 "	33 "

FURRING, ROOFING AND CEILING.

	Thickness.	Weight per Square Foot.
Porous Terra-Cotta Furring	2 inches.	8 pounds.
" " " Roofing	2 "	12 "
" " " "	3 "	15 "
" " " "	4 "	19 "
" " " Ceiling	2 "	11 "
" " " "	3 "	15 "
" " " "	4 "	19 "

6 inch Segmental Arches, 27 pounds per square foot.
8 " " " 33 " " " "
2 inch Porous Terra-Cotta Partition, 8 pounds per square foot.

WEIGHTS OF BUILDING MATERIALS, ETC.

KIND OF MATERIAL.	Weight per Cubic Foot, Lbs.
Asphalt, pavement composition	100
Brick, best pressed	135-150
" common hard	110-125
" fire	140-150
" paving	150
Brickwork, pressed brick	120-140
" common hard brick	110-120
Cement, American Portland, loose	85
Coal, anthracite, broken, loose	56
" bituminous, broken, loose	54
Concrete, cinder	72
" broken stone	120-140
Glass	160
Gravel	120
Iron, cast	450
" wrought	480
Masonry, granite or marble ashlar	160
" limestone ashlar	150
" sandstone ashlar	140
Mortar	100
Plaster ceilings, 10 to 15 lbs. per square foot.	
Plaster of Paris	140
Sand, clay and earth, dry	100
" " " " wet	120
Snow, freshly fallen	10
" saturated with moisture	20-50
Steel	490
Stone: Bluestone	160
" Granite	170
" Limestone	160
" Marble	165
" Sandstone	145
" Slate	175
Terra Cotta	110
" " masonry	100
Timber: Douglas fir	30
" Hemlock	26
" Southern yellow pine	45-48
" Spruce	25-28
" White oak	48-52
" White pine	25-28

LINEAR EXPANSION OF SUBSTANCES BY HEAT.

To find the increase in the length of a bar of any material due to an increase of temperature, multiply the number of degrees of increase of temperature by the coefficient for 100° and by the length of the bar, and divide by one hundred.

NAME OF SUBSTANCE.	Coefficient for 100° Fahrenheit.	Coefficient for 180° Fahrenheit, or 100° Centigrade.
Aluminum (cast)	.001234	.00222
Brass (cast)	.000957	.00172
Brick	.000306	.00055
Bronze	.000986	.00177
Cement, Portland	.000594	.00107
Concrete	.000795	.00143
Copper	.000887	.00160
Glass, flint	.000451	.00081
Granite	.000438	.00079
Gold, pure	.000786	.00142
Iron, wrought	.000648	.00117
Iron, cast	.000556	.00100
Lead	.001571	.00283
Marble, from	.000308	.00055
Marble, to	.000786	.00142
Masonry, brick, from	.000256	.00046
Masonry, brick, to	.000494	.00089
Mercury (cubic expansion)	.009984	.01797
Sandstone	.000652	.00117
Silver, pure	.001079	.00194
Slate	.000577	.00104
Steel, cast	.000636	.00114
Steel, structural	.000663	.00119
Steel, tempered	.000689	.00124
Tin	.001163	.00210
Wood, pine	.000276	.00050
Zinc	.001407	.00253

NOTES ON STEEL AND IRON.

Wrought iron weighs 480 lbs. per cubic foot. A bar 1 inch square and 3 feet long weighs, therefore, exactly 10 pounds. Hence:

The sectional area, in sq. ins. = the weight per foot $\times \frac{3}{10}$

The weight per foot, in lbs. = sectional area $\times \frac{10}{3}$

Steel weighs 489.6 lbs. per cubic foot, or 2 per cent. greater than wrought iron. Hence for steel:

The sectional area, in sq. ins. = weight per foot ÷ 3.4

The weight per foot in lbs. = sectional area × 3.4

The melting points of iron and steel are about as follows:

Wrought Iron	3000°	Fahrenheit
Cast Iron	2000°	"
Steel	2400°	"

The welding heat of wrought iron is 2700° Fahrenheit.

Within the elastic limit the extension and compression of steel is very nearly $\frac{1}{10000}$ of its length for a stress of 1½ tons (3000 lbs.) per square inch.

The expansion of a steel rod is about equivalent to $\frac{1}{10000}$ of its length for an increase of 15° Fahrenheit, and the stress thus produced is about 1½ tons (3000 lbs.) for each square inch of sectional area in the bar if the ends are held rigidly fixed.

For a rod of the lengths given below, the expansion will be as follows:

Length of rod, in feet . .	10	20	30	40	50	100	150
Expansion in inches for 15°	.012	.024	.036	.048	.060	.120	.180
" " 150°	.120	.240	.360	.480	.600	1.200	1.800
" " 100°	.080	.160	.240	.320	.400	.800	1.200

Contraction and expansion being equal, the stress per square inch produced by heating or cooling is as follows, for temperatures varying by 15° Fahrenheit:

Variation . . .	15	30	45	60	75	105	120	150 degrees.
Stress	1½	3	4½	6	7½	9	10½	15 net tons.

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