# STRUCTURAL STEEL SHAPES

INFORMATION AND TABLES

FOR

ENGINEERS AND DESIGNERS

---

CARNEGIE STEEL COMPANY

PITTSBURGH, PA.

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COMPLIMENTS

OF

N BRIDGE COMPANY

BROADWAY, NEW YORK



FIRST EDITION

# STRUCTURAL STEEL SHAPES

INFORMATION AND TABLES

FOR

ENGINEERS AND DESIGNERS

AND OTHER DATA

PERTAINING TO

## STRUCTURAL STEEL

MANUFACTURED BY

CARNEGIE STEEL COMPANY

PITTSBURGH, PA.

First Edition, January 1, 1926. Printed in U. S. A.

THIS pamphlet contains tables and other data for structural sections considered most suitable for use in bridge and building construction.

**The safe loads for structural sections used as beams are given in completely tabulated form for unit fiber stresses of 18,000 and of 16,000 pounds per square inch.**

Structural steel is rolled to permissible variations given in the specifications of the American Society for Testing Materials and of the Association of American Steel Manufacturers. In designs requiring close fitting, allowance should be made for rolling variations to insure ample clearance between abutting or interfitting surfaces.

All dimensions given on profiles are theoretical. The exact dimensions of structural sections depend on condition of rolls.

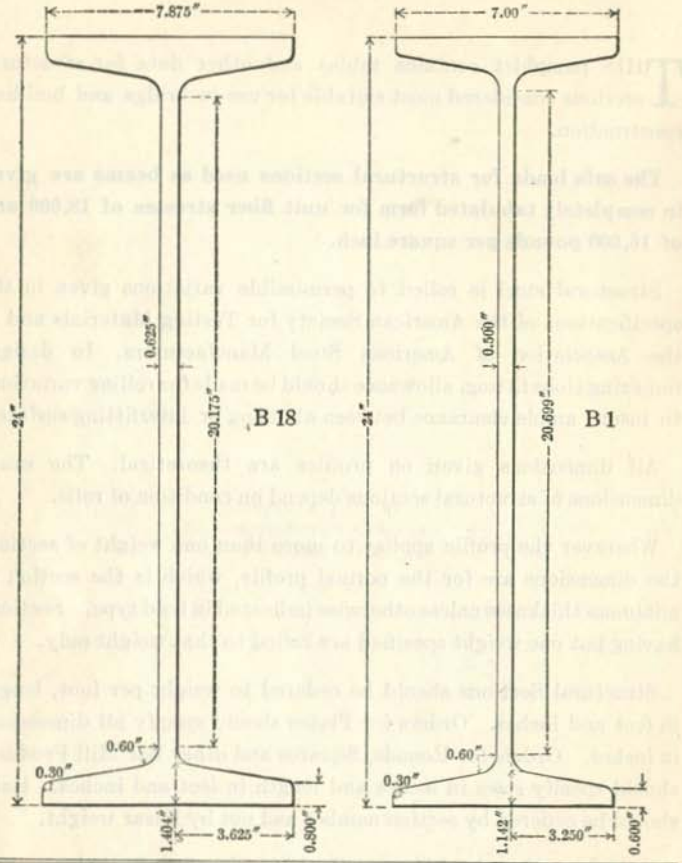
Wherever the profile applies to more than one weight of section, the dimensions are for the normal profile, which is the section of minimum thickness unless otherwise indicated in bold type. Sections having but one weight specified are rolled to that weight only.

Structural Sections should be ordered to weight per foot, length in feet and inches. Orders for Plates should specify all dimensions in inches. Orders for Rounds, Squares and other Bar Mill Products should specify sizes in inches and length in feet and inches. Rails should be ordered by section number and not by linear weight.

Section number should be specified on orders for all sections.

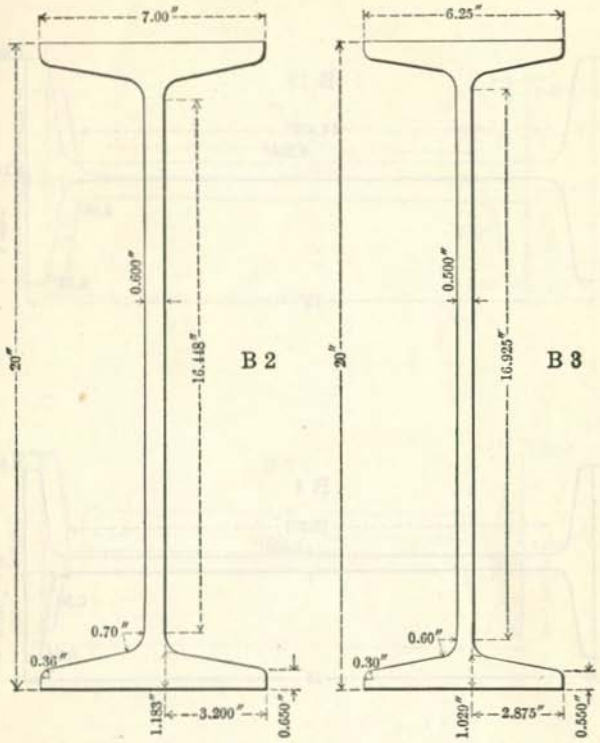
The Association of American Steel Manufacturers has recommended certain angle sections as standard for general building construction, and quicker deliveries can be obtained by ordering standard sizes. Angles not standard are marked "special" on profile pages.

## STRUCTURAL BEAMS



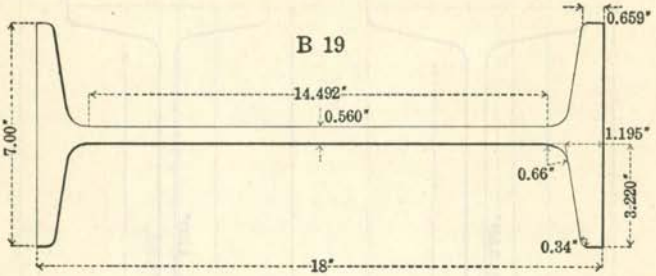

| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 18 (Old No. B24) | 24 | 120.0 | 8.048 | 8 3/64 | 0.798 | 51/64 |
| | | 115.0 | 7.987 | 7 63/64 | 0.737 | 47/64 |
| | | 110.0 | 7.925 | 7 59/64 | 0.675 | 43/64 |
| | | 105.9 | 7.875 | 7 7/8 | 0.625 | 5/8 |
| B 1 | 24 | 100.0 | 7.247 | 7 1/4 | 0.747 | 3/4 |
| | | 95.0 | 7.186 | 7 3/16 | 0.686 | 11/16 |
| | | 90.0 | 7.124 | 7 1/8 | 0.624 | 5/8 |
| | | 85.0 | 7.063 | 7 1/16 | 0.563 | 9/16 |
| | | 79.9 | 7.000 | 7 | 0.500 | 1/2 |

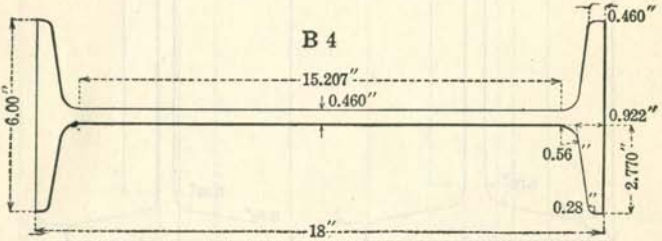
## STRUCTURAL BEAMS—Continued




| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 2 | 20 | 100.0 | 7.273 | 7 17/64 | 0.873 | 7/8 |
| | | 95.0 | 7.200 | 7 13/64 | 0.800 | 51/64 |
| | | 90.0 | 7.126 | 7 1/8 | 0.726 | 23/32 |
| | | 85.0 | 7.053 | 7 3/64 | 0.653 | 21/32 |
| | | 81.4 | 7.000 | 7 | 0.600 | 19/32 |
| B 3 | 20 | 75.0 | 6.391 | 6 25/64 | 0.641 | 41/64 |
| | | 70.0 | 6.317 | 6 5/16 | 0.567 | 9/16 |
| | | 65.4 | 6.250 | 6 1/4 | 0.500 | 1/2 |

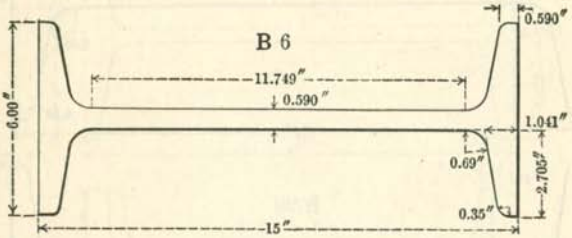
## STRUCTURAL BEAMS—Continued

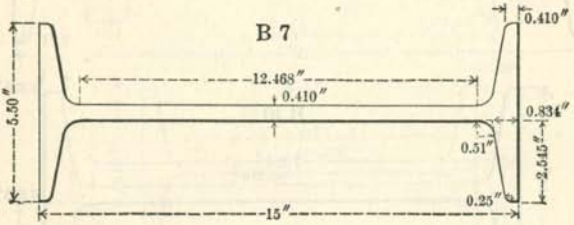



| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 19 (Old No. B 81) | 18 | 90.0 | 7.236 | 7 15/64 | 0.796 | 51/64 |
| | | 85.0 | 7.154 | 7 9/32 | 0.714 | 23/32 |
| | | 80.0 | 7.072 | 7 5/64 | 0.632 | 5/8 |
| | | 75.6 | 7.000 | 7 | 0.560 | 9/16 |
| B 4 (Old No. B 80) | 18 | 70.0 | 6.251 | 6 1/4 | 0.711 | 23/32 |
| | | 65.0 | 6.169 | 6 11/64 | 0.629 | 5/8 |
| | | 60.0 | 6.087 | 6 3/32 | 0.547 | 35/64 |
| | | 54.7 | 6.000 | 6 | 0.460 | 29/64 |

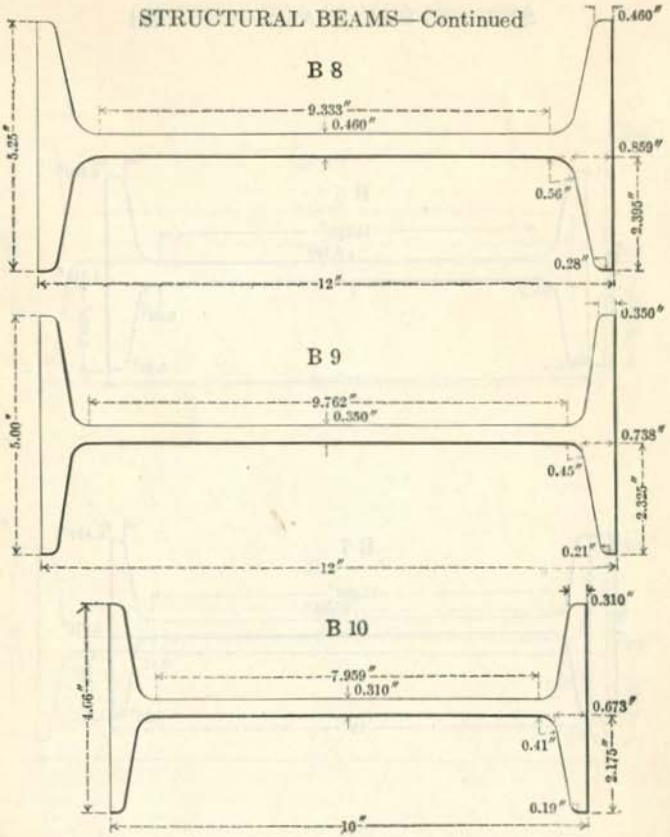
## STRUCTURAL BEAMS—Continued



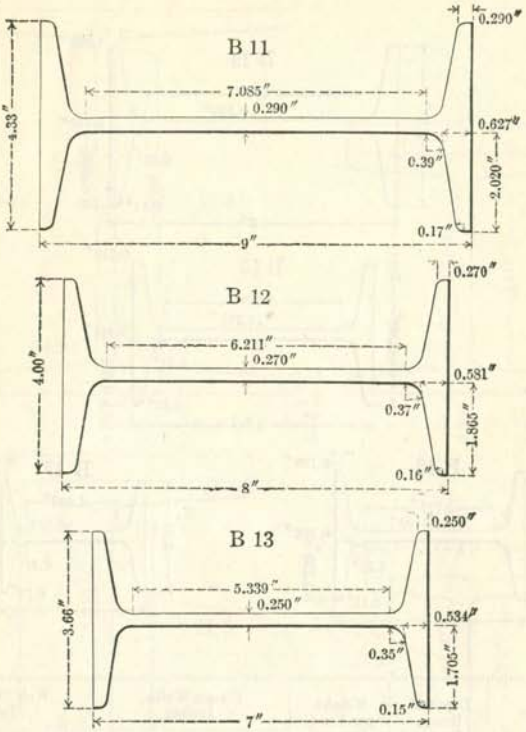

| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 6 (Old No. B 5) | 15 | 75.0 | 6.278 | 6 9/32 | 0.868 | 7/8 |
| | | 70.0 | 6.180 | 6 3/16 | 0.770 | 49/64 |
| | | 65.0 | 6.082 | 6 5/64 | 0.672 | 43/64 |
| | | 60.8 | 6.000 | 6 | 0.590 | 19/32 |
| B 7 | 15 | 55.0 | 5.738 | 5 47/64 | 0.648 | 41/64 |
| | | 50.0 | 5.640 | 5 41/64 | 0.550 | 35/64 |
| | | 45.0 | 5.542 | 5 35/64 | 0.452 | 29/64 |
| | | 42.9 | 5.500 | 5 1/2 | 0.410 | 13/32 |

## STRUCTURAL BEAMS—Continued



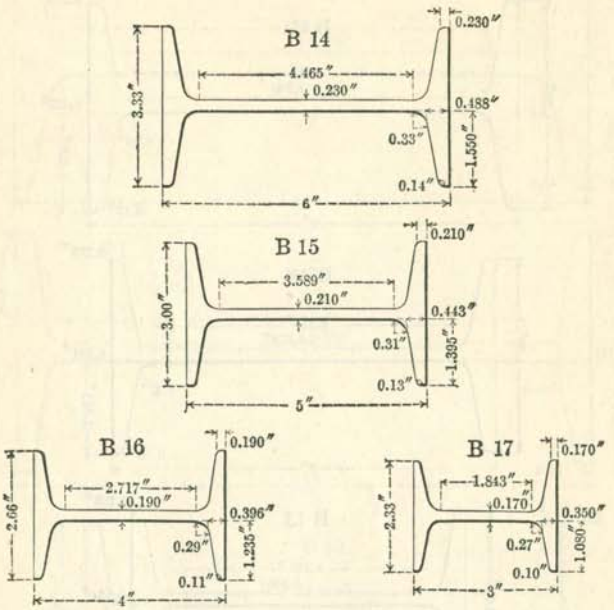

| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 8 | 12 | 55.0 | 5.600 | 5 19/32 | 0.810 | 13/16 |
| | | 50.0 | 5.477 | 5 31/64 | 0.687 | 11/16 |
| | | 45.0 | 5.355 | 5 23/64 | 0.565 | 9/16 |
| | | 40.8 | 5.250 | 5 1/4 | 0.460 | 29/64 |
| B 9 | 12 | 35.0 | 5.078 | 5 5/64 | 0.428 | 27/64 |
| | | 31.8 | 5.000 | 5 | 0.350 | 11/32 |
| B 10 (Old No. B 11) | 10 | 40.0 | 5.091 | 5 3/32 | 0.741 | 47/64 |
| | | 35.0 | 4.944 | 4 15/16 | 0.594 | 19/32 |
| | | 30.0 | 4.797 | 4 51/64 | 0.447 | 29/64 |
| | | 25.4 | 4.660 | 4 21/32 | 0.310 | 5/16 |

## STRUCTURAL BEAMS—Continued



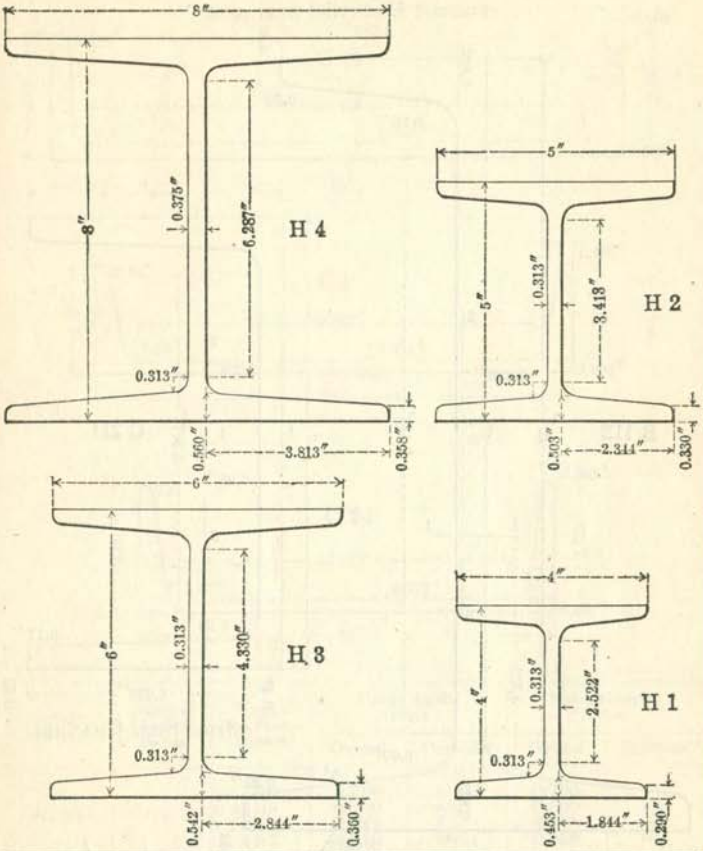

| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 11 (Old No B 13) | 9 | 35.0 | 4.764 | 4 49/64 | 0.724 | 23/32 |
| | | 30.0 | 4.601 | 4 19/32 | 0.561 | 9/16 |
| | | 25.0 | 4.437 | 4 7/16 | 0.397 | 25/64 |
| | | 21.8 | 4.330 | 4 21/64 | 0.290 | 19/64 |
| B 12 (Old No B 15) | 8 | 25.5 | 4.262 | 4 17/64 | 0.532 | 17/32 |
| | | 23.0 | 4.171 | 4 11/64 | 0.441 | 7/16 |
| | | 20.5 | 4.079 | 4 5/64 | 0.349 | 11/32 |
| | | 18.4 | 4.000 | 4 | 0.270 | 17/64 |
| B 13 (Old No B 17) | 7 | 20.0 | 3.860 | 3 55/64 | 0.450 | 29/64 |
| | | 17.5 | 3.755 | 3 3/4 | 0.345 | 11/32 |
| | | 15.3 | 3.660 | 3 21/32 | 0.250 | 1/4 |

## STRUCTURAL BEAMS—Concluded




| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| B 14 (Old No. B 19) | 6 | 17.25 | 3.565 | 3 9/16 | 0.465 | 15/32 |
| | | 14.75 | 3.443 | 3 7/16 | 0.343 | 11/32 |
| | | 12.5 | 3.330 | 3 21/64 | 0.230 | 15/64 |
| B 15 (Old No. B 21) | 5 | 14.75 | 3.284 | 3 9/32 | 0.494 | 1/2 |
| | | 12.25 | 3.137 | 3 9/64 | 0.347 | 11/32 |
| | | 10.0 | 3.000 | 3 | 0.210 | 13/64 |
| B 16 (Old No. B 23) | 4 | 10.5 | 2.870 | 2 7/8 | 0.400 | 13/32 |
| | | 9.5 | 2.796 | 2 51/64 | 0.326 | 21/64 |
| | | 8.5 | 2.723 | 2 23/32 | 0.253 | 1/4 |
| | | 7.7 | 2.660 | 2 21/32 | 0.190 | 3/16 |
| B 17 (Old No. B 77) | 3 | 7.5 | 2.509 | 2 33/64 | 0.349 | 11/32 |
| | | 6.5 | 2.411 | 2 13/32 | 0.251 | 1/4 |
| | | 5.7 | 2.330 | 2 21/64 | 0.170 | 11/64 |

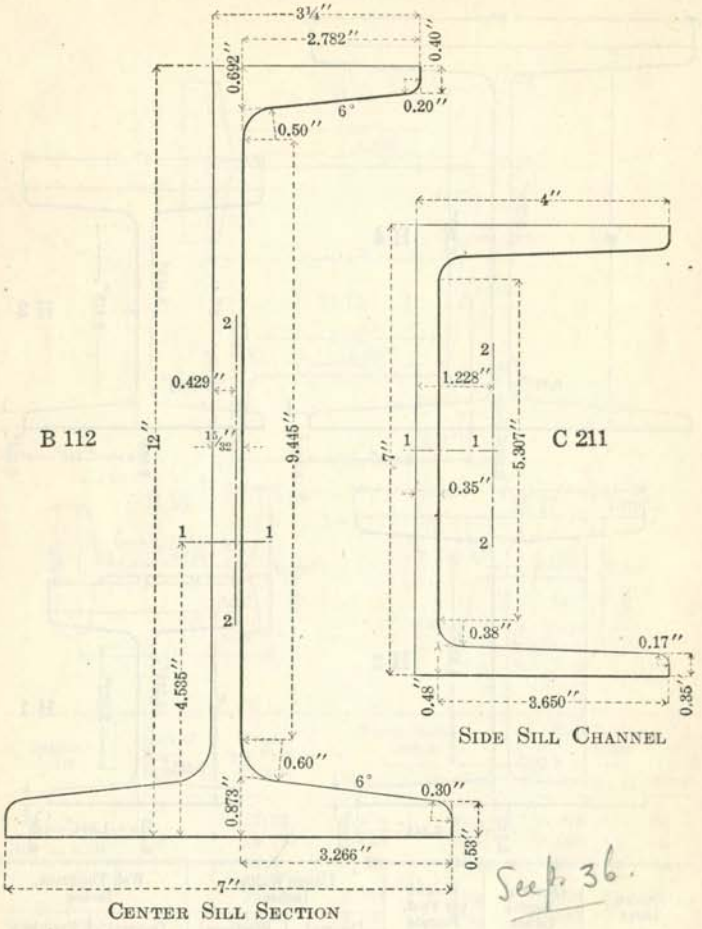
## H-BEAMS




| Section Index | Depth of Beam, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| H 4 | 8 | 37.7 | 8.125 | 8 1/8 | 0.500 | 1/2 |
| | | **34.3** | **8.000** | 8 | **0.375** | 3/8 |
| | | 32.6 | 7.938 | 7 15/16 | 0.313 | 5/16 |
| H 3 | 6 | 26.7 | 6.125 | 6 1/8 | 0.438 | 7/16 |
| | | **24.1** | **6.000** | 6 | **0.313** | 5/16 |
| | | 22.8 | 5.938 | 5 15/16 | 0.250 | 1/4 |
| H 2 | 5 | **18.9** | **5.000** | 5 | **0.313** | 5/16 |
| H 1 | 4 | **13.8** | **4.000** | 4 | **0.313** | 5/16 |

Full information as to uses of H-Beams is given in pamphlet entitled "Steel Mine Timbers."

# CAR SILL SECTIONS



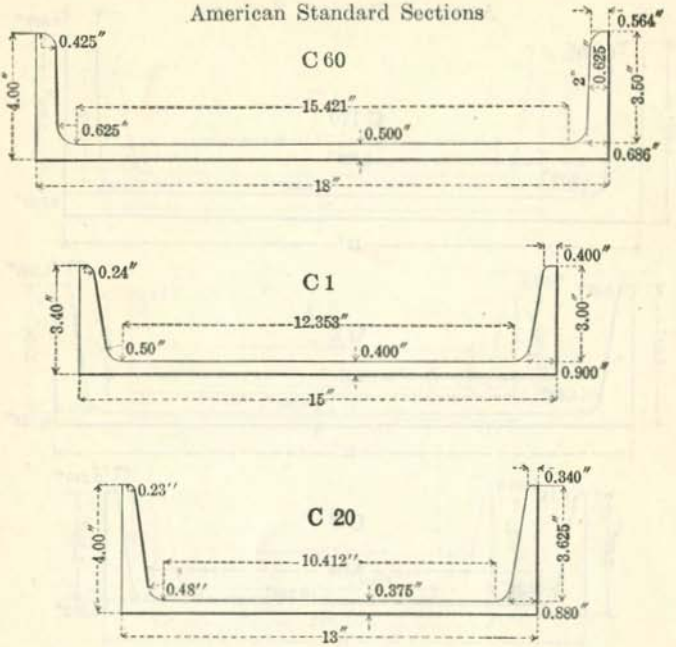

See p. 36.

| Section Index | Depth | Weight per Foot | Area | Width of Flange | Thickness of Web | Axis 1-1 | | | | Axis 2-2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | x | I | r | S | y |
| | In. | Lb. | In.² | In. | In. | In.⁴ | In. | In.³ | In. | In.⁴ | In. | In.³ | In. |
| B112 | 12 | 40.3 | 11.72 | 3¼,7 | 15/32 | 238.1 | 4.51 | 31.9 | 4.54 | 21.8 | 1.36 | 5.9 | 4.54 |
| C211 | 7 | 18.8 | 5.48 | 4 | 0.35 | 42.9 | 2.80 | 12.2 | 3.50 | 8.3 | 1.23 | 3.0 | 1.23 |

Full information is given in pamphlet entitled "Carnegie Car Sill Sections."

# STRUCTURAL CHANNELS

## American Standard Sections

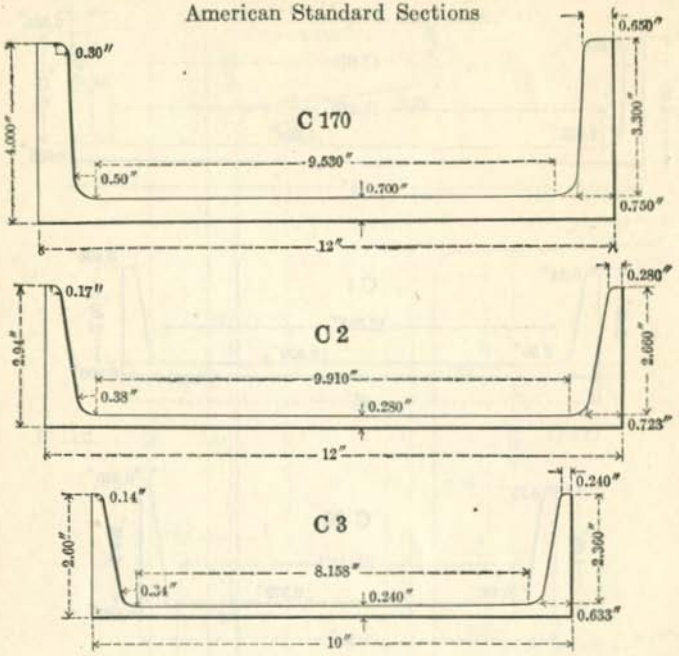



| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| †C 60 | 18 | 58.0 | 4.200 | $4\frac{13}{64}$ | 0.700 | $\frac{45}{64}$ |
| | | 51.9 | 4.100 | $4\frac{3}{32}$ | 0.600 | $\frac{19}{32}$ |
| | | **45.8** | **4.000** | 4 | **0.500** | $\frac{1}{2}$ |
| | | 42.7 | 3.950 | $3\frac{61}{64}$ | 0.450 | $\frac{29}{64}$ |
| C 1 | 15 | 55.0 | 3.814 | $3\frac{13}{16}$ | 0.814 | $\frac{13}{16}$ |
| | | 50.0 | 3.716 | $3\frac{23}{32}$ | 0.716 | $\frac{23}{32}$ |
| | | 45.0 | 3.618 | $3\frac{5}{8}$ | 0.618 | $\frac{5}{8}$ |
| | | 40.0 | 3.520 | $3\frac{33}{64}$ | 0.520 | $\frac{33}{64}$ |
| | | 35.0 | 3.422 | $3\frac{27}{64}$ | 0.422 | $\frac{27}{64}$ |
| | | 33.9 | 3.400 | $3\frac{13}{32}$ | 0.400 | $\frac{13}{32}$ |
| †C 20 | 13 | 50.0 | 4.412 | $4\frac{13}{32}$ | 0.787 | $\frac{25}{32}$ |
| | | 45.0 | 4.298 | $4\frac{19}{64}$ | 0.673 | $\frac{43}{64}$ |
| | | 40.0 | 4.185 | $4\frac{3}{16}$ | 0.560 | $\frac{9}{16}$ |
| | | 37.0 | 4.117 | $4\frac{7}{64}$ | 0.492 | $\frac{31}{64}$ |
| | | 35.0 | 4.072 | $4\frac{5}{64}$ | 0.447 | $\frac{29}{64}$ |
| | | 31.8 | 4.000 | 4 | 0.375 | $\frac{3}{8}$ |

†C 60 is a Ship Building Channel (not an American Standard.) †C 20 is a Car Building Channel.

## STRUCTURAL CHANNELS—Continued

### American Standard Sections

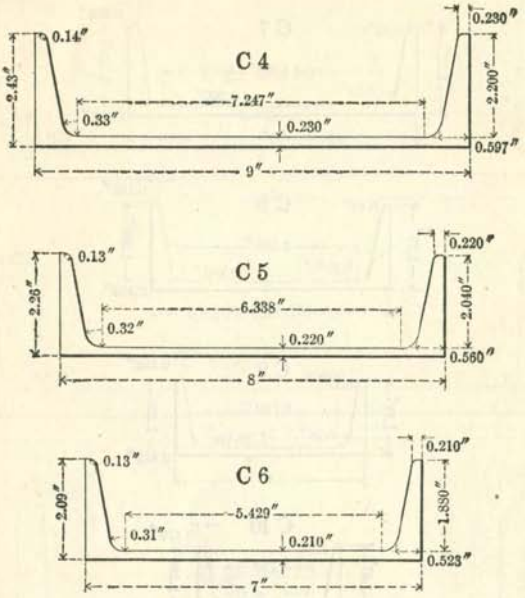



| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| †C 170 | 12 | 50.0 | 4.135 | 4 9/64 | 0.835 | 53/64 |
| | | 48.6 | 4.100 | 4 1/32 | 0.800 | 51/64 |
| | | 46.6 | 4.050 | 4 1/64 | 0.750 | 3/4 |
| | | **44.5** | **4.000** | 4 | **0.700** | 45/64 |
| | | 40.0 | 3.890 | 3 57/64 | 0.590 | 19/32 |
| | | 35.0 | 3.767 | 3 49/64 | 0.467 | 15/32 |
| C 2 | 12 | 40.0 | 3.415 | 3 27/64 | 0.755 | 3/4 |
| | | 35.0 | 3.292 | 3 19/64 | 0.632 | 5/8 |
| | | 30.0 | 3.170 | 3 11/64 | 0.510 | 33/64 |
| | | 25.0 | 3.047 | 3 3/64 | 0.387 | 25/64 |
| | | 20.7 | 2.940 | 2 15/16 | 0.280 | 9/32 |
| C 3 | 10 | 35.0 | 3.180 | 3 3/16 | 0.820 | 13/16 |
| | | 30.0 | 3.033 | 3 1/32 | 0.673 | 43/64 |
| | | 25.0 | 2.886 | 2 57/64 | 0.526 | 17/32 |
| | | 20.0 | 2.739 | 2 47/64 | 0.379 | 3/8 |
| | | 15.3 | 2.600 | 2 19/32 | 0.240 | 15/64 |

†C 170 is a Car Building Channel (not an American Standard.)

## STRUCTURAL CHANNELS—Continued

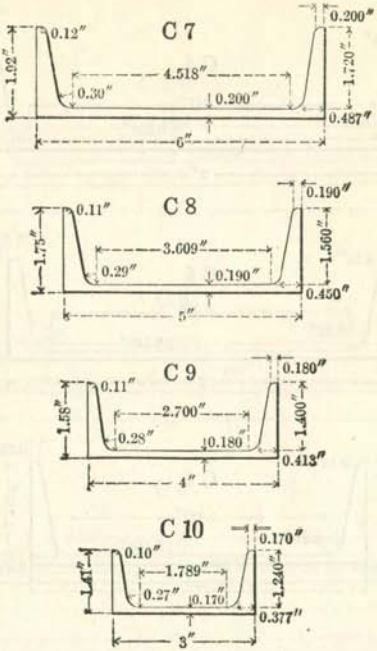
### American Standard Sections




| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 4 | 9 | 25.0 | 2.812 | 2 13/16 | 0.612 | 39/64 |
| | | 20.0 | 2.648 | 2 41/64 | 0.448 | 29/64 |
| | | 15.0 | 2.485 | 2 31/64 | 0.285 | 9/32 |
| | | 13.4 | 2.430 | 2 7/16 | 0.230 | 15/64 |
| C 5 | 8 | 21.25 | 2.619 | 2 5/8 | 0.579 | 37/64 |
| | | 18.75 | 2.527 | 2 17/32 | 0.487 | 31/64 |
| | | 16.25 | 2.435 | 2 7/16 | 0.395 | 25/64 |
| | | 13.75 | 2.343 | 2 11/32 | 0.303 | 19/64 |
| | | 11.5 | 2.260 | 2 17/64 | 0.220 | 7/32 |
| C 6 | 7 | 19.75 | 2.509 | 2 33/64 | 0.629 | 5/8 |
| | | 17.25 | 2.404 | 2 13/32 | 0.524 | 17/32 |
| | | 14.75 | 2.299 | 2 19/64 | 0.419 | 27/64 |
| | | 12.25 | 2.194 | 2 3/16 | 0.314 | 5/16 |
| | | 9.8 | 2.090 | 2 3/32 | 0.210 | 13/64 |

## STRUCTURAL CHANNELS—Concluded

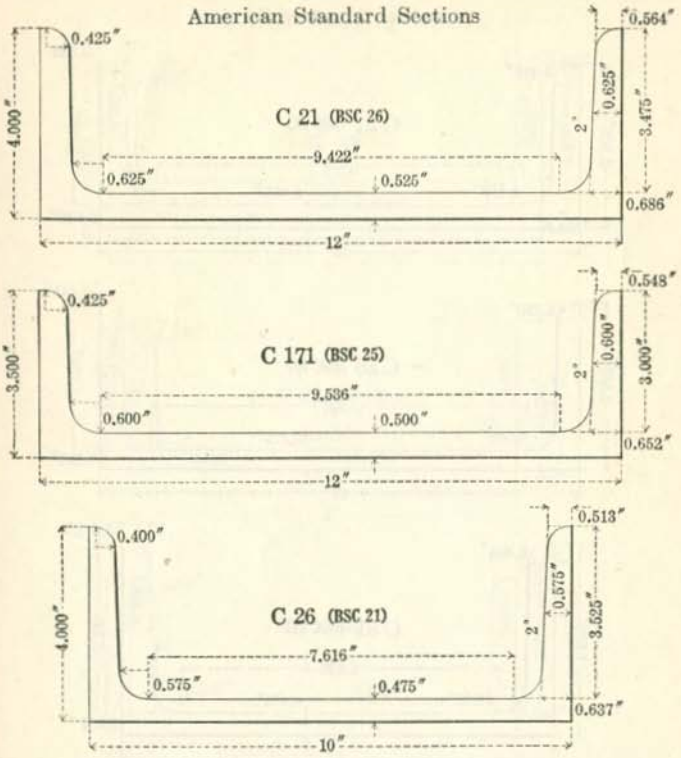
### American Standard Sections




| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 7 | 6 | 15.5 | 2.279 | 2 9/32 | 0.559 | 9/16 |
| | | 13.0 | 2.157 | 2 5/32 | 0.437 | 7/16 |
| | | 10.5 | 2.034 | 2 1/32 | 0.314 | 5/16 |
| | | 8.2 | 1.920 | 1 59/64 | 0.200 | 13/64 |
| C 8 | 5 | 11.5 | 2.032 | 2 1/32 | 0.472 | 15/32 |
| | | 9.0 | 1.885 | 1 57/64 | 0.325 | 21/64 |
| | | 6.7 | 1.750 | 1 3/4 | 0.190 | 3/16 |
| C 9 | 4 | 7.25 | 1.720 | 1 23/32 | 0.320 | 5/16 |
| | | 6.25 | 1.647 | 1 41/64 | 0.247 | 1/4 |
| | | 5.4 | 1.580 | 1 37/64 | 0.180 | 3/16 |
| C 10 (Old No. C 72) | 3 | 6.0 | 1.596 | 1 19/32 | 0.356 | 23/64 |
| | | 5.0 | 1.498 | 1 1/2 | 0.258 | 1/4 |
| | | 4.1 | 1.410 | 1 13/32 | 0.170 | 11/64 |

# SHIP BUILDING CHANNELS

## American Standard Sections

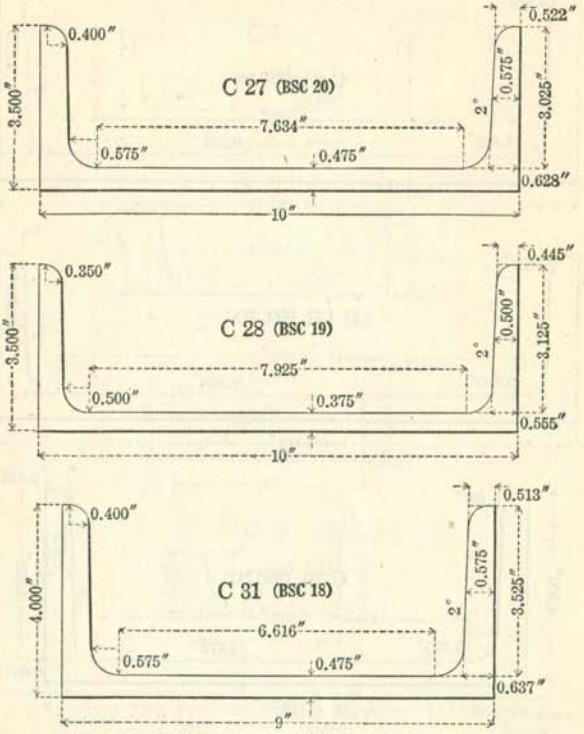



| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 21 (BSC 26) | 12 | 44.7 | 4.200 | 4 13/64 | 0.725 | 23/32 |
| | | 40.6 | 4.100 | 4 1/32 | 0.625 | 5/8 |
| | | **36.5** | **4.000** | **4** | **0.525** | 17/32 |
| | | 34.5 | 3.950 | 3 61/64 | 0.475 | 15/32 |
| C 171 (BSC 25) | 12 | 41.1 | 3.700 | 3 45/64 | 0.700 | 45/64 |
| | | 37.0 | 3.600 | 3 19/32 | 0.600 | 19/32 |
| | | **32.9** | **3.500** | **3 1/2** | **0.500** | 1/2 |
| | | 30.9 | 3.450 | 3 29/64 | 0.450 | 29/64 |
| C 26 (BSC 21) | 10 | 37.0 | 4.200 | 4 13/64 | 0.675 | 43/64 |
| | | 33.6 | 4.100 | 4 1/32 | 0.575 | 37/64 |
| | | **30.2** | **4.000** | **4** | **0.475** | 15/32 |
| | | 28.5 | 3.950 | 3 61/64 | 0.425 | 27/64 |

Dimensions and properties of the British Standard Sections are indicated in **bold type.**

## SHIP BUILDING CHANNELS—Continued

### American Standard Sections

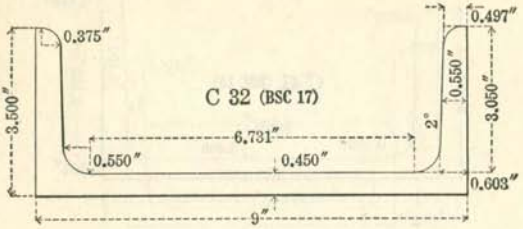


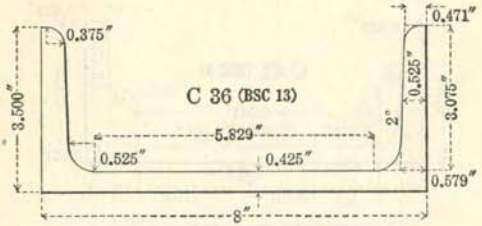

| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 27 (BSC 20) | 10 | 35.1 | 3.700 | 3 45/64 | 0.675 | 43/64 |
| | | 31.7 | 3.600 | 3 19/32 | 0.575 | 37/64 |
| | | **28.3** | **3.500** | 3½ | **0.475** | 15/32 |
| | | 26.6 | 3.450 | 3 29/64 | 0.425 | 27/64 |
| | | 24.9 | 3.400 | 3 13/32 | 0.375 | ⅜ |
| C 28 (BSC 19) | 10 | 25.3 | 3.550 | 3 35/64 | 0.425 | 27/64 |
| | | **23.6** | **3.500** | 3½ | **0.375** | ⅜ |
| | | 21.9 | 3.450 | 3 29/64 | 0.325 | 21/64 |
| C 31 (BSC 18) | 9 | 34.7 | 4.200 | 4 13/64 | 0.675 | 43/64 |
| | | 31.7 | 4.100 | 4 3/32 | 0.575 | 37/64 |
| | | **28.6** | **4.000** | 4 | **0.475** | 15/32 |
| | | 27.1 | 3.950 | 3 61/64 | 0.425 | 27/64 |

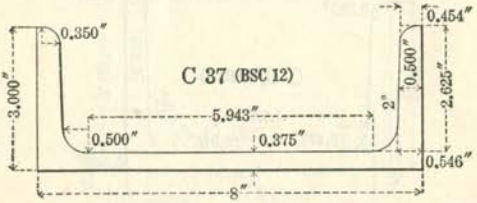
Dimensions and properties of the British Standard Sections are indicated in **bold type.**

## SHIP BUILDING CHANNELS—Continued

### American Standard Sections



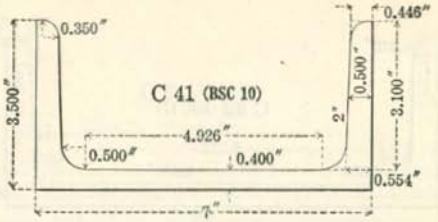



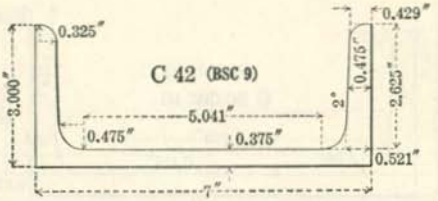

| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 32 (BSC 17) | 9 | 31.6 | 3.700 | 3 45/64 | 0.650 | 21/32 |
| | | 28.5 | 3.600 | 3 19/32 | 0.550 | 35/64 |
| | | **25.4** | **3.500** | 3½ | **0.450** | 29/64 |
| | | 23.9 | 3.450 | 3 29/64 | 0.400 | 13/32 |
| C 36 (BSC 13) | 8 | 28.2 | 3.700 | 3 45/64 | 0.625 | ⅝ |
| | | 25.5 | 3.600 | 3 19/32 | 0.525 | 17/32 |
| | | **22.8** | **3.500** | 3½ | **0.425** | 27/64 |
| | | 21.4 | 3.450 | 3 29/64 | 0.375 | ⅜ |
| C 37 (BSC 12) | 8 | 25.5 | 3.225 | 3 7/32 | 0.600 | 19/32 |
| | | 22.7 | 3.125 | 3⅛ | 0.500 | ½ |
| | | 20.0 | 3.025 | 3 1/32 | 0.400 | 13/32 |
| | | **19.3** | **3.000** | 3 | **0.375** | ⅜ |
| | | 18.7 | 2.975 | 2 31/32 | 0.350 | 11/32 |

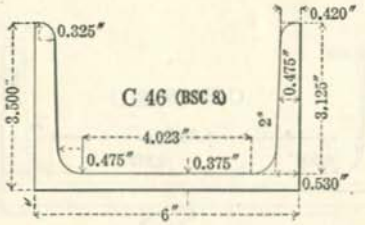
Dimensions and properties of the British Standard Sections are indicated in **bold type.**

## SHIP BUILDING CHANNELS—Continued

### American Standard Sections



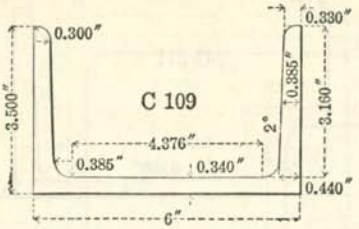



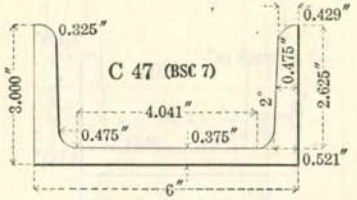

| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 41 (BSC 10) | 7 | 25.0 | 3.700 | 3 45/64 | 0.600 | 19/32 |
| | | 22.7 | 3.600 | 3 19/32 | 0.500 | 1/2 |
| | | **20.3** | **3.500** | 3 1/2 | **0.400** | 13/32 |
| | | 19.1 | 3.450 | 3 29/64 | 0.350 | 11/32 |
| C 42 (BSC 9) | 7 | 20.0 | 3.100 | 3 3/32 | 0.475 | 15/32 |
| | | **17.6** | **3.000** | 3 | **0.375** | 3/8 |
| | | 16.4 | 2.950 | 2 61/64 | 0.325 | 21/64 |
| C 46 (BSC 8) | 6 | 22.0 | 3.700 | 3 45/64 | 0.575 | 37/64 |
| | | 20.0 | 3.600 | 3 19/32 | 0.475 | 15/32 |
| | | **18.0** | **3.500** | 3 1/2 | **0.375** | 3/8 |
| | | 16.9 | 3.450 | 3 29/64 | 0.325 | 21/64 |

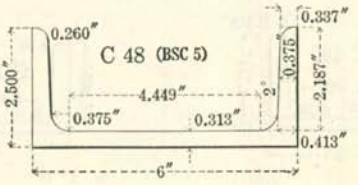
Dimensions and properties of the British Standard Sections are indicated in **bold type.**

## SHIP BUILDING CHANNELS—Concluded

American Standard Sections



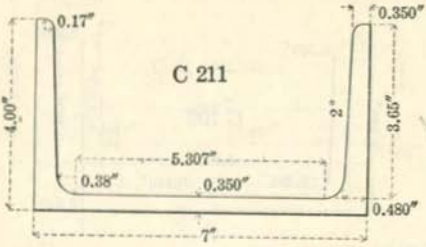



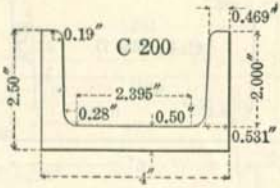



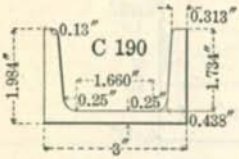

| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 109 | 6 | 15.3 | 3.500 | 3½ | 0.340 | 11/32 |
| C 47 | 6 | **16.3** | **3.000** | 3 | **0.375** | 3/8 |
| (BSC 7) | | 15.1 | 2.938 | 2 15/16 | 0.313 | 5/16 |
| C 48 | 6 | 13.3 | 2.563 | 2 9/16 | 0.375 | 3/8 |
| (BSC 5) | | **12.0** | **2.500** | 2½ | **0.313** | 5/16 |

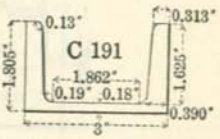
Dimensions and properties of the British Standard Sections are indicated in **bold type.**

# MISCELLANEOUS CAR BUILDING CHANNELS



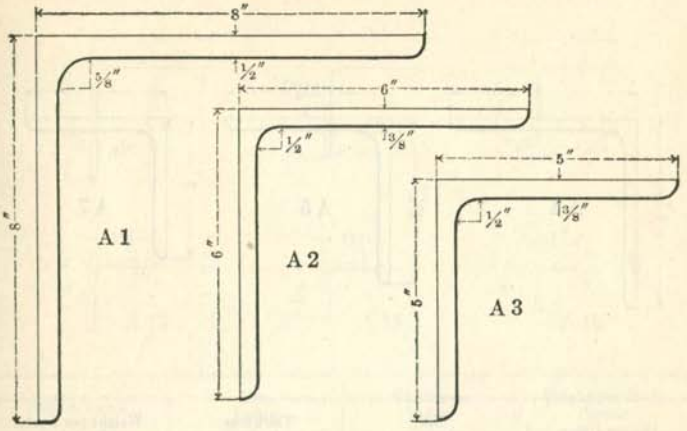




| Section Index | Depth of Channel, Inches | Weight per Foot, Pounds | Flange Width, Inches | | Web Thickness, Inches | |
|---|---|---|---|---|---|---|
| | | | Decimal | Fractional | Decimal | Fractional |
| C 211 | 7 | 18.8 | 4.000 | 4 | 0.350 | 11/32 |
| *C 200 | 4 | 13.8 | 2.500 | 2½ | 0.500 | ½ |
| *C 190 | 3 | 7.1 | 1.984 | 1 63/64 | 0.250 | ¼ |
| *C 191 | 3 | 6.5<br>5.8 | 1.875<br>1.805 | 1⅞<br>1 13/16 | 0.250<br>0.180 | ¼<br>5/16 |

*Furnished only by special arrangement.

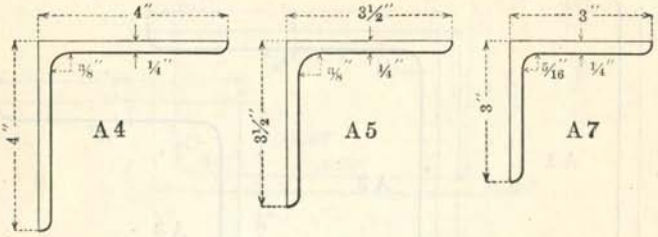
## EQUAL ANGLES




| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| | | 1 1/8 | 56.9 |
| | | 1 1/16 | 54.0 |
| | | 1 | 51.0 |
| | | 15/16 | 48.1 |
| | | 7/8 | 45.0 |
| A 1 | 8 x 8 | 13/16 | 42.0 |
| | | 3/4 | 38.9 |
| | | 11/16 | 35.8 |
| | | 5/8 | 32.7 |
| | | 9/16 | 29.6 |
| | | 1/2 | 26.4 |
| | | 1 | 37.4 |
| | | 15/16 | 35.3 |
| | | 7/8 | 33.1 |
| | | 13/16 | 31.0 |
| | | 3/4 | 28.7 |
| A 2 | 6 x 6 | 11/16 | 26.5 |
| | | 5/8 | 24.2 |
| | | 9/16 | 21.9 |
| | | 1/2 | 19.6 |
| | | 7/16 | 17.2 |
| | | 3/8 | 14.9 |
| | | *1 | 30.6 |
| | | * 15/16 | 28.9 |
| | | * 7/8 | 27.2 |
| | | * 13/16 | 25.4 |
| | | * 3/4 | 23.6 |
| A 3 | 5 x 5 | * 11/16 | 21.8 |
| | | * 5/8 | 20.0 |
| | | * 9/16 | 18.1 |
| | | * 1/2 | 16.2 |
| | | * 7/16 | 14.3 |
| | | * 3/8 | 12.3 |

Angles marked * are special.

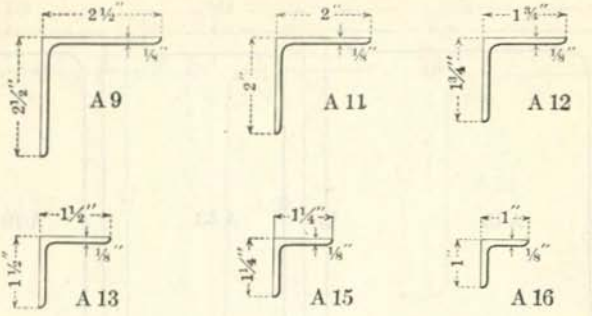
## EQUAL ANGLES—Continued




| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| | | *13/16 | 19.9 |
| | | ¾ | 18.5 |
| | | 11/16 | 17.1 |
| | | ⅝ | 15.7 |
| A 4 | 4 x 4 | 9/16 | 14.3 |
| | | ½ | 12.8 |
| | | 7/16 | 11.3 |
| | | ⅜ | 9.8 |
| | | 5/16 | 8.2 |
| | | * ¼ | 6.6 |
| | | *13/16 | 17.1 |
| | | * ¾ | 16.0 |
| | | *11/16 | 14.8 |
| | | ⅝ | 13.6 |
| A 5 | 3½ x 3½ | 9/16 | 12.4 |
| | | ½ | 11.1 |
| | | 7/16 | 9.8 |
| | | ⅜ | 8.5 |
| | | 5/16 | 7.2 |
| | | * ¼ | 5.8 |
| | | * ⅝ | 11.5 |
| | | * 9/16 | 10.4 |
| | | ½ | 9.4 |
| A 7 | 3 x 3 | 7/16 | 8.3 |
| | | ⅜ | 7.2 |
| | | 5/16 | 6.1 |
| | | ¼ | 4.9 |

Angles marked * are special.

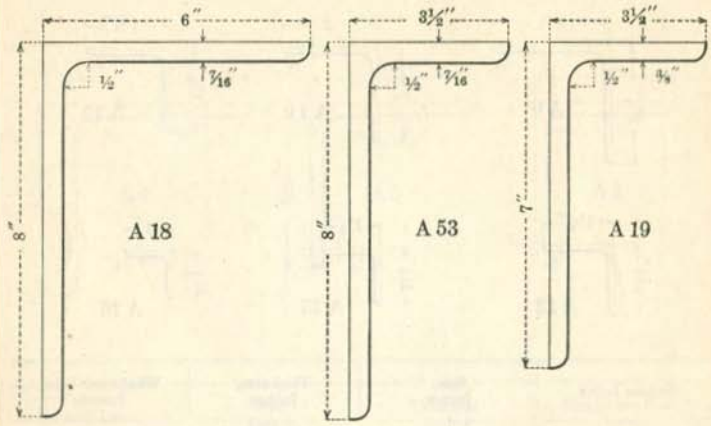
## EQUAL ANGLES—Concluded




| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| A 9 | 2½ x 2½ | * ½ | 7.7 |
| | | 7/16 | 6.8 |
| | | 3/8 | 5.9 |
| | | 5/16 | 5.0 |
| | | ¼ | 4.1 |
| | | 3/16 | 3.07 |
| | | * ⅛ | 2.08 |
| A 11 | 2 x 2 | * 7/16 | 5.3 |
| | | 3/8 | 4.7 |
| | | 5/16 | 3.92 |
| | | ¼ | 3.19 |
| | | 3/16 | 2.44 |
| | | * ⅛ | 1.65 |
| A 12 | 1¾ x 1¾ | * 7/16 | 4.6 |
| | | * 3/8 | 3.99 |
| | | * 5/16 | 3.39 |
| | | * ¼ | 2.77 |
| | | * 3/16 | 2.12 |
| | | * ⅛ | 1.44 |
| A 13 | 1½ x 1½ | * 3/8 | 3.35 |
| | | 5/16 | 2.86 |
| | | ¼ | 2.34 |
| | | 3/16 | 1.80 |
| | | ⅛ | 1.23 |
| A 15 | 1¼ x 1¼ | * 5/16 | 2.33 |
| | | * ¼ | 1.92 |
| | | * 3/16 | 1.48 |
| | | * ⅛ | 1.01 |
| A 16 | 1 x 1 | * ¼ | 1.49 |
| | | * 3/16 | 1.16 |
| | | * ⅛ | 0.80 |

Angles marked * are special.

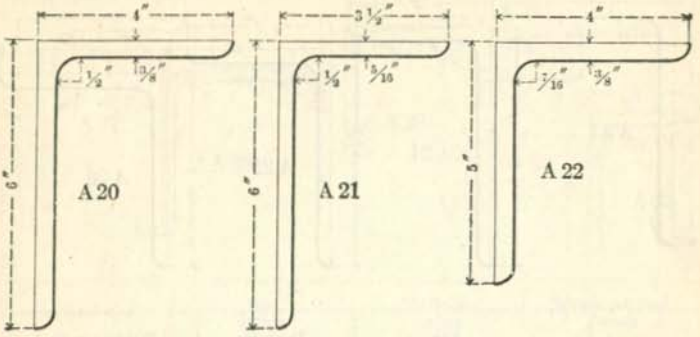
## UNEQUAL ANGLES




| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| A 18 | 8 x 6 | *1 | 44.2 |
| | | * 15/16 | 41.7 |
| | | * ⅞ | 39.1 |
| | | * 13/16 | 36.5 |
| | | * ¾ | 33.8 |
| | | * 11/16 | 31.2 |
| | | * ⅝ | 28.5 |
| | | * 9/16 | 25.7 |
| | | * ½ | 23.0 |
| | | * 7/16 | 20.2 |
| A 53 | 8 x 3½ | *1 | 35.7 |
| | | * 15/16 | 33.7 |
| | | * ⅞ | 31.7 |
| | | * 13/16 | 29.6 |
| | | * ¾ | 27.5 |
| | | * 11/16 | 25.3 |
| | | * ⅝ | 23.2 |
| | | * 9/16 | 21.0 |
| | | * ½ | 18.7 |
| | | * 7/16 | 16.5 |
| A 19 | 7 x 3½ | *1 | 32.3 |
| | | * 15/16 | 30.5 |
| | | * ⅞ | 28.7 |
| | | * 13/16 | 26.8 |
| | | * ¾ | 24.9 |
| | | * 11/16 | 23.0 |
| | | * ⅝ | 21.0 |
| | | * 9/16 | 19.1 |
| | | * ½ | 17.0 |
| | | * 7/16 | 15.0 |
| | | * ⅜ | 13.0 |

Angles marked * are special.

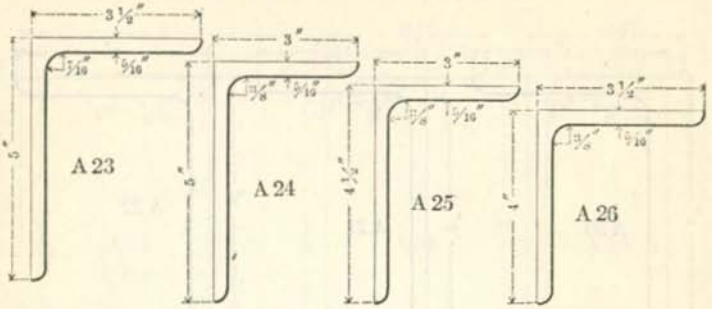
## UNEQUAL ANGLES—Continued




| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| A 20 | 6 x 4 | *1 | 30.6 |
| | | * 15/16 | 28.9 |
| | | 7/8 | 27.2 |
| | | 13/16 | 25.4 |
| | | 3/4 | 23.6 |
| | | 11/16 | 21.8 |
| | | 5/8 | 20.0 |
| | | 9/16 | 18.1 |
| | | 1/2 | 16.2 |
| | | 7/16 | 14.3 |
| | | 3/8 | 12.3 |
| A 21 | 6 x 3½ | *1 | 28.9 |
| | | * 15/16 | 27.3 |
| | | 7/8 | 25.7 |
| | | 13/16 | 24.0 |
| | | 3/4 | 22.4 |
| | | 11/16 | 20.6 |
| | | 5/8 | 18.9 |
| | | 9/16 | 17.1 |
| | | 1/2 | 15.3 |
| | | 7/16 | 13.5 |
| | | 3/8 | 11.7 |
| | | * 5/16 | 9.8 |
| A 22 | 5 x 4 | * 7/8 | 24.2 |
| | | * 13/16 | 22.7 |
| | | * 3/4 | 21.1 |
| | | * 11/16 | 19.5 |
| | | * 5/8 | 17.8 |
| | | * 9/16 | 16.2 |
| | | * 1/2 | 14.5 |
| | | * 7/16 | 12.8 |
| | | * 3/8 | 11.0 |

Angles marked * are special.

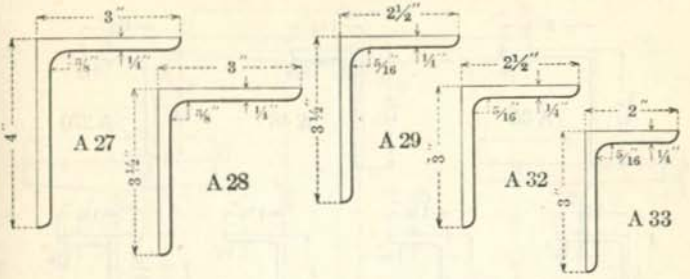
## UNEQUAL ANGLES—Continued




| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| A 23 | 5 x 3½ | * 7/8 | 22.7 |
| | | *13/16 | 21.3 |
| | | 3/4 | 19.8 |
| | | 11/16 | 18.3 |
| | | 5/8 | 16.8 |
| | | 9/16 | 15.2 |
| | | 1/2 | 13.6 |
| | | 7/16 | 12.0 |
| | | 3/8 | 10.4 |
| | | 5/16 | 8.7 |
| A 24 | 5 x 3 | *13/16 | 19.9 |
| | | * 3/4 | 18.5 |
| | | 11/16 | 17.1 |
| | | 5/8 | 15.7 |
| | | 9/16 | 14.3 |
| | | 1/2 | 12.8 |
| | | 7/16 | 11.3 |
| | | 3/8 | 9.8 |
| | | 5/16 | 8.2 |
| A 25 | 4½ x 3 | *13/16 | 18.5 |
| | | * 3/4 | 17.3 |
| | | *11/16 | 16.0 |
| | | * 5/8 | 14.7 |
| | | * 9/16 | 13.3 |
| | | * 1/2 | 11.9 |
| | | * 7/16 | 10.6 |
| | | * 3/8 | 9.1 |
| | | * 5/16 | 7.7 |
| A 26 | 4 x 3½ | *13/16 | 18.5 |
| | | * 3/4 | 17.3 |
| | | *11/16 | 16.0 |
| | | * 5/8 | 14.7 |
| | | * 9/16 | 13.3 |
| | | * 1/2 | 11.9 |
| | | * 7/16 | 10.6 |
| | | * 3/8 | 9.1 |
| | | * 5/16 | 7.7 |

Angles marked * are special.

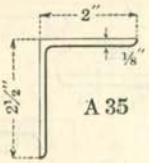
## UNEQUAL ANGLES—Continued



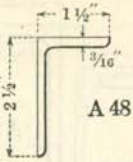

| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| A 27 | 4 x 3 | *13/16 | 17.1 |
| | | * 3/4 | 16.0 |
| | | *11/16 | 14.8 |
| | | 5/8 | 13.6 |
| | | 9/16 | 12.4 |
| | | 1/2 | 11.1 |
| | | 7/16 | 9.8 |
| | | 3/8 | 8.5 |
| | | 5/16 | 7.2 |
| | | * 1/4 | 5.8 |
| A 28 | 3½ x 3 | *13/16 | 15.8 |
| | | * 3/4 | 14.7 |
| | | *11/16 | 13.6 |
| | | * 5/8 | 12.5 |
| | | 9/16 | 11.4 |
| | | 1/2 | 10.2 |
| | | 7/16 | 9.1 |
| | | 3/8 | 7.9 |
| | | 5/16 | 6 6 |
| | | * 1/4 | 5.4 |
| A 29 | 3½ x 2½ | *11/16 | 12.5 |
| | | * 5/8 | 11.5 |
| | | *9/16 | 10.4 |
| | | 1/2 | 9.4 |
| | | 7/16 | 8.3 |
| | | 3/8 | 7.2 |
| | | 5/16 | 6.1 |
| | | 1/4 | 4.9 |
| A 32 | 3 x 2½ | *9/16 | 9.5 |
| | | * 1/2 | 8.5 |
| | | 7/16 | 7.6 |
| | | 3/8 | 6.6 |
| | | 5/16 | 5.6 |
| | | 1/4 | 4.5 |
| A 33 | 3 x 2 | * 1/2 | 7.7 |
| | | *7/16 | 6.8 |
| | | * 3/8 | 5.9 |
| | | *5/16 | 5.0 |
| | | * 1/4 | 4.1 |

Angles marked * are special.

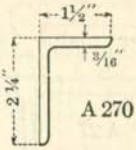
## UNEQUAL ANGLES—Concluded



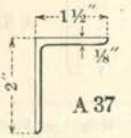
A 35



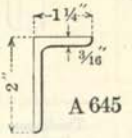
A 48



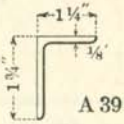
A 270



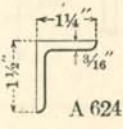
A 37



A 645



A 39

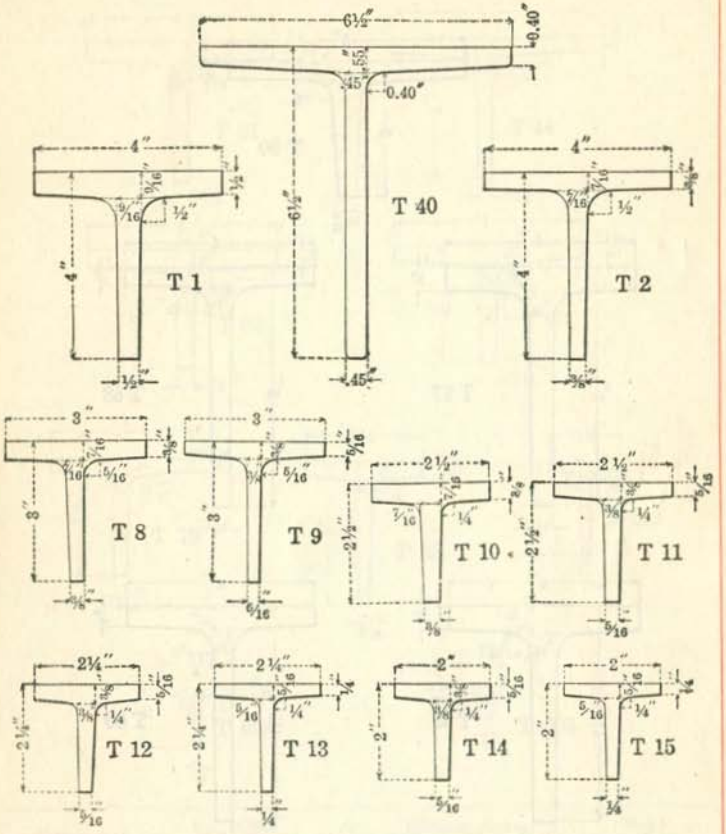


A 624

| Section Index | Size, Inches | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| A 35 | 2½ x 2 | * ½ | 6.8 |
| | | * 7/16 | 6.1 |
| | | 3/8 | 5.3 |
| | | 5/16 | 4.5 |
| | | ¼ | 3.62 |
| | | 3/16 | 2.75 |
| | | * ⅛ | 1.86 |
| A 48 | 2½ x 1½ | * 5/16 | 3.92 |
| | | * ¼ | 3.19 |
| | | * 3/16 | 2.44 |
| A 270 | 2¼ x 1½ | * ½ | 5.6 |
| | | * 7/16 | 5.0 |
| | | * 3/8 | 4.4 |
| | | * 5/16 | 3.66 |
| | | * ¼ | 2.98 |
| | | * 3/16 | 2.28 |
| A 37 | 2 x 1½ | * 3/8 | 3.99 |
| | | * 5/16 | 3.39 |
| | | * ¼ | 2.77 |
| | | * 3/16 | 2.12 |
| | | * ⅛ | 1.44 |
| A 645 | 2 x 1¼ | * ¼ | 2.55 |
| | | * 3/16 | 1.96 |
| A 39 | 1¾ x 1¼ | * ¼ | 2.34 |
| | | * 3/16 | 1.80 |
| | | * ⅛ | 1.23 |
| A 624 | 1½ x 1¼ | * 5/16 | 2.59 |
| | | * ¼ | 2.13 |
| | | * 3/16 | 1.64 |

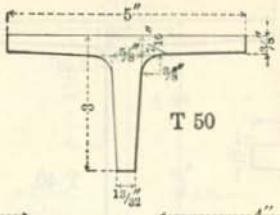
Angles marked * are special.

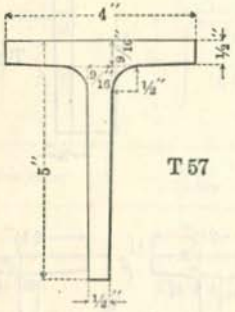
## EQUAL TEES

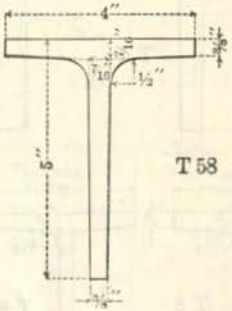


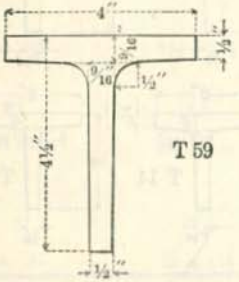

| Section Index | Size, Inches | | Thickness, Inches | | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | Flange | Stem | Flange | Stem | |
| T 40 | 6½ | 6½ | 0.40 to 0.55 | 0.45 | 19.8 |
| T 1 | 4 | 4 | ½ to 9/16 | ½ to 9/16 | 13.5 |
| T 2 | 4 | 4 | 3/8 to 7/16 | 3/8 to 7/16 | 10.5 |
| T 8 | 3 | 3 | 3/8 to 7/16 | 3/8 to 7/16 | 7.8 |
| T 9 | 3 | 3 | 5/16 to 3/8 | 5/16 to 3/8 | 6.7 |
| T 10 | 2½ | 2½ | 3/8 to 7/16 | 3/8 to 7/16 | 6.4 |
| T 11 | 2½ | 2½ | 5/16 to 3/8 | 5/16 to 3/8 | 5.5 |
| T 12 | 2¼ | 2¼ | 5/16 to 3/8 | 5/16 to 3/8 | 4.9 |
| T 13 | 2¼ | 2¼ | ¼ to 5/16 | ¼ to 5/16 | 4.1 |
| T 14 | 2 | 2 | 5/16 to 3/8 | 5/16 to 3/8 | 4.3 |
| T 15 | 2 | 2 | ¼ to 5/16 | ¼ to 5/16 | 3.56 |

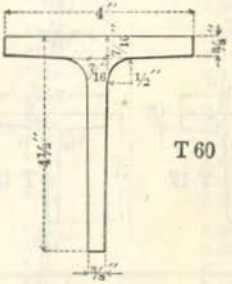
## UNEQUAL TEES



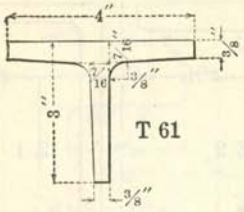



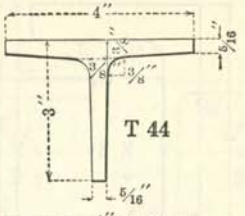



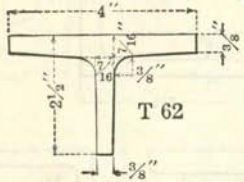

| Section Index | Size, Inches | | Thickness, Inches | | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | Flange | Stem | Flange | Stem | |
| †T 50 | 5 | 3 | ⅜ to 7/16 | 13/32 to ⅝ | 11.5 |
| T 57 | 4 | 5 | ½ to 9/16 | ½ to 9/16 | 15.3 |
| T 58 | 4 | 5 | ⅜ to 7/16 | ⅜ to 7/16 | 11.9 |
| T 59 | 4 | 4½ | ½ to 9/16 | ½ to 9/16 | 14.4 |
| T 60 | 4 | 4½ | ⅜ to 7/16 | ⅜ to 7/16 | 11.2 |

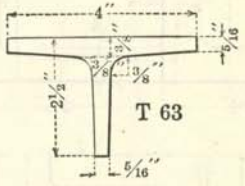
† T 50 can be rolled with flange ½" to 9/16", and stem 3⅛"; weight 13.6 lbs. per foot.

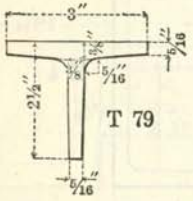
## UNEQUAL TEES—Concluded

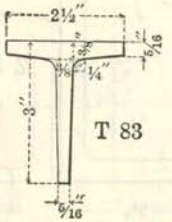


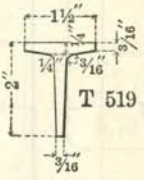



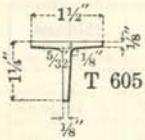



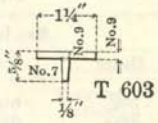



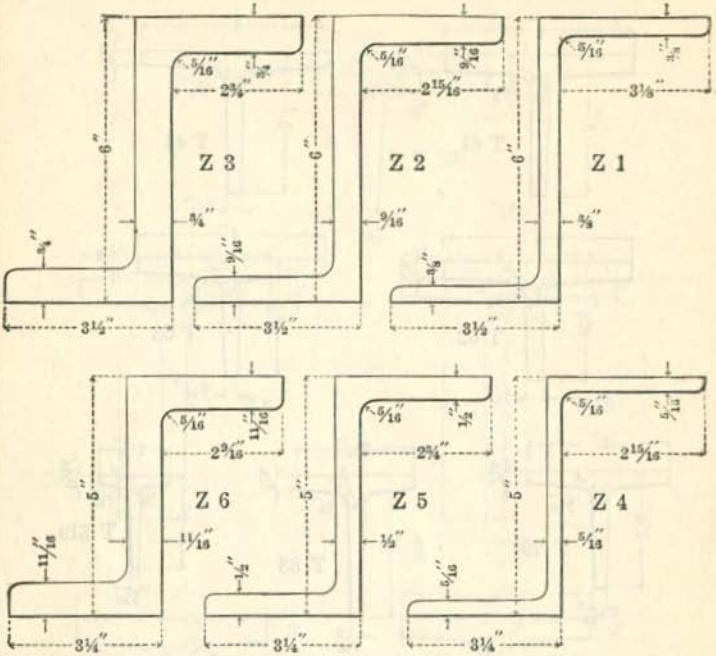




| Section Index | Size, Inches | | Thickness, Inches | | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | Flange | Stem | Flange | Stem | |
| T 61 | 4 | 3 | ⅜ to 7/16 | ⅜ to 7/16 | 9.2 |
| T 44 | 4 | 3 | 5/16 to ⅜ | 5/16 to ⅜ | 7.8 |
| T 62 | 4 | 2½ | ⅜ to 7/16 | ⅜ to 7/16 | 8.5 |
| T 63 | 4 | 2½ | 5/16 to ⅜ | 5/16 to ⅜ | 7.2 |
| T 79 | 3 | 2½ | 5/16 to ⅜ | 5/16 to ⅜ | 6.1 |
| T 83 | 2½ | 3 | 5/16 to ⅜ | 5/16 to ⅜ | 6.1 |
| T 519 | 1½ | 2 | 3/16 to ¼ | 3/16 to ¼ | 2.45 |
| T 605 | 1½ | 1¼ | ⅛ to 5/32 | ⅛ to 5/32 | 1.25 |
| * T 603 | 1¼ | ⅝ | No. 9 | ⅛ to No. 7 | 0 88 |

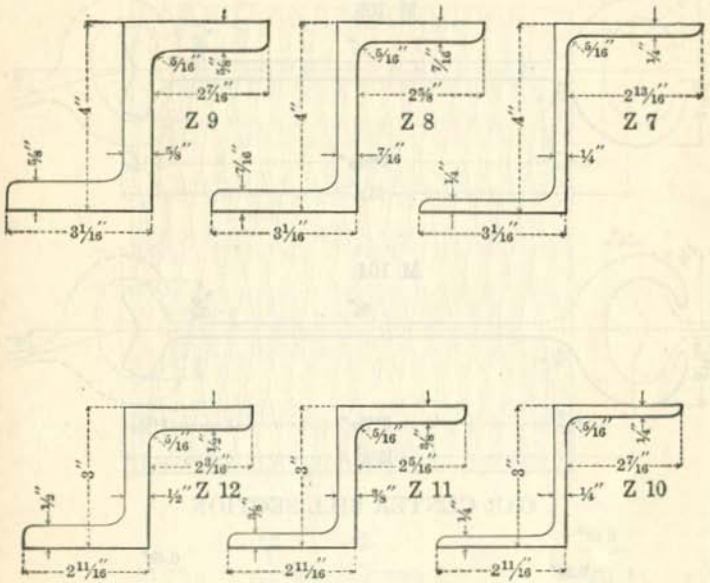
* Furnished only by special arrangement.

## ZEES



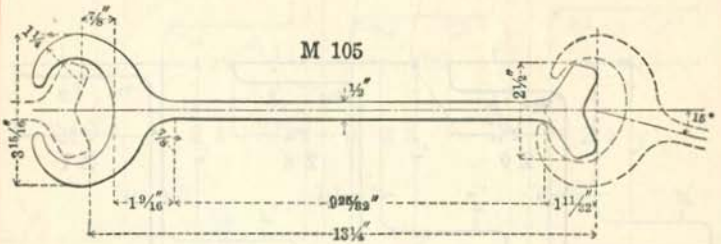

| Section Index | Size, Inches | | | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | Flange | Web | Flange | | |
| Z 3 | 3⅝ | 6⅛ | 3⅝ | ⅞ | 34.6 |
| | 3 9/16 | 6 1/16 | 3 9/16 | 13/16 | 32.0 |
| | 3½ | 6 | 3½ | ¾ | 29.4 |
| Z 2 | 3⅝ | 6⅛ | 3⅝ | 11/16 | 28.1 |
| | 3 9/16 | 6 1/16 | 3 9/16 | 5/8 | 25.4 |
| | 3½ | 6 | 3½ | 9/16 | 22.8 |
| Z 1 | 3⅝ | 6⅛ | 3⅝ | ½ | 21.1 |
| | 3 9/16 | 6 1/16 | 3 9/16 | 7/16 | 18.4 |
| | 3½ | 6 | 3½ | ⅜ | 15.7 |
| Z 6 | 3⅜ | 5⅛ | 3⅜ | 13/16 | 28.4 |
| | 3 5/16 | 5 1/16 | 3 5/16 | ¾ | 26.0 |
| | 3¼ | 5 | 3¼ | 11/16 | 23.7 |
| Z 5 | 3⅜ | 5⅛ | 3⅜ | 5/8 | 22.6 |
| | 3 5/16 | 5 1/16 | 3 5/16 | 9/16 | 20.2 |
| | 3¼ | 5 | 3¼ | ½ | 17.9 |
| Z 4 | 3⅜ | 5⅛ | 3⅜ | 7/16 | 16.4 |
| | 3 5/16 | 5 1/16 | 3 5/16 | ⅜ | 14.0 |
| | 3¼ | 5 | 3¼ | 5/16 | 11.6 |

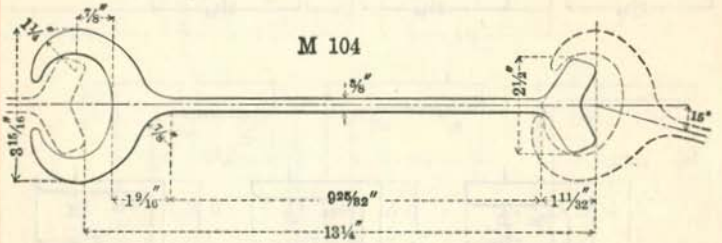
## ZEES—Concluded



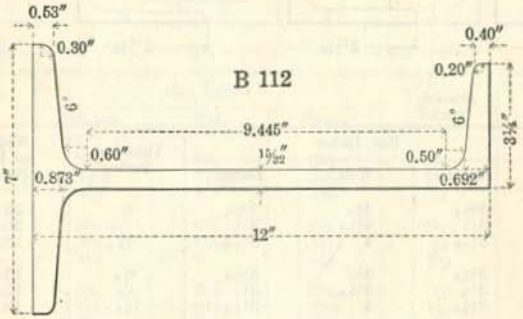

| Section Index | Size, Inches | | | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | Flange | Web | Flange | | |
| Z 9 | 3 3/16 | 4 1/8 | 3 3/16 | 5/16 | 23.0 |
| | 3 1/8 | 4 1/16 | 3 1/8 | 11/16 | 20.9 |
| | 3 1/16 | 4 | 3 1/16 | 5/8 | 18.9 |
| Z 8 | 3 3/16 | 4 1/8 | 3 3/16 | 9/16 | 18.0 |
| | 3 1/8 | 4 1/16 | 3 1/8 | 1/2 | 15.9 |
| | 3 1/16 | 4 | 3 1/16 | 7/16 | 13.8 |
| Z 7 | 3 3/16 | 4 1/8 | 3 3/16 | 3/8 | 12.5 |
| | 3 1/8 | 4 1/16 | 3 1/8 | 5/16 | 10.3 |
| | 3 1/16 | 4 | 3 1/16 | 1/4 | 8.2 |
| Z 12 | 2 3/4 | 3 1/16 | 2 3/4 | 9/16 | 14.3 |
| | 2 11/16 | 3 | 2 11/16 | 1/2 | 12.6 |
| Z 11 | 2 3/4 | 3 1/16 | 2 3/4 | 7/16 | 11.5 |
| | 2 11/16 | 3 | 2 11/16 | 3/8 | 9.8 |
| Z 10 | 2 3/4 | 3 1/16 | 2 3/4 | 5/16 | 8.5 |
| | 2 11/16 | 3 | 2 11/16 | 1/4 | 6.7 |

## UNITED STATES STEEL SHEET PILING



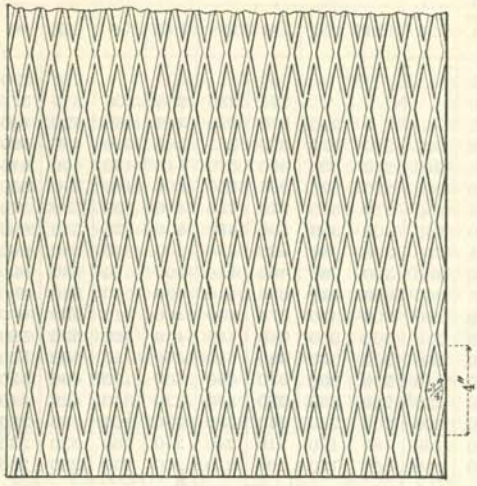

## CAR CENTER SILL SECTION

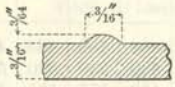



| Section Index | Width, Inches | Web Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|
| M 105 | 13¼ | ½ | 42.5 |
| M 104 | 13¼ | ⅜ | 38 |
| B 112 | 7, 3¼ | 15/32 | 40.3 |

Full information as to the properties and uses of these sections is given in separate pamphlets entitled "Steel Sheet Piling" and "Carnegie Car Sill Sections."

## CHECKERED PLATES






Section at Rib

| Section Index | Thickness, Inches | Width and Length, Inches | | | | | | Weight per Sq. Foot, Pounds |
|---|---|---|---|---|---|---|---|---|
| | | Over 6 to 12 | Over 12 to 24 | Over 24 to 36 | Over 36 to 48 | Over 48 to 60 | Over 60 to 66 | |
| M 56 | 3/4 | . . . | 120 | 180 | 280 | 264 | 240 | 31.6 |
| M 55 | 5/8 | . . . | 180 | 200 | 300 | 300 | 260 | 26.5 |
| M 54 | 1/2 | 120 | 240 | 240 | 320 | 360 | 300 | 21.4 |
| M 53 | 7/16 | 120 | 240 | 240 | 340 | 360 | 300 | 18.9 |
| M 52 | 3/8 | 120 | 240 | 300 | 340 | 360 | 300 | 16.3 |
| M 51 | 5/16 | 120 | 240 | 300 | 320 | 360 | 300 | 13.8 |
| M 50 | 1/4 | 120 | 240 | 300 | 320 | 360 | 240 | 11.2 |
| M 49 | 3/16 | 120 | 240 | 300 | 320 | 360 | 240 | 8.7 |

Checkered plates of greater lengths than shown in above table may be submitted for special consideration.

## RECTANGULAR AND CIRCULAR PLATES—Carbon Steel

### SHEARED PLATES, THREE-SIXTEENTH INCH AND OVER, EXTREME SIZES

| Thickness, Inches | Weight, Lbs. per Sq. Ft. | Widths and Lengths in Inches | | | | | | | | | | Diam., Inches |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 128 | 126 | 120 | 114 | 108 | 102 | 96 | 90 | 84 | 78 | |
| 5/16 | 7.65 | | | | | | | | 270 | 320 | 345 | 90 |
| 1/4 | 10.20 | | | | 175 | 250 | 280 | 300 | 330 | 375 | 400 | 115 |
| 5/16 | 12.75 | | | 240 | 270 | 320 | 360 | 380 | 420 | 440 | 460 | 120 |
| 3/8 | 15.30 | 220 | 240 | 270 | 320 | 365 | 380 | 410 | 450 | 500 | 550 | 130 |
| 7/16 | 17.85 | 240 | 270 | 300 | 360 | 370 | 410 | 430 | 460 | 510 | 550 | 130 |
| 1/2 | 20.40 | 260 | 270 | 320 | 365 | 400 | 450 | 480 | 510 | 550 | 580 | 130 |
| 9/16 | 22.95 | 260 | 270 | 330 | 373 | 420 | 470 | 500 | 530 | 570 | 600 | 130 |
| 5/8 | 25.50 | 260 | 300 | 350 | 390 | 450 | 500 | 520 | 540 | 600 | 620 | 130 |
| 11/16 | 28.05 | 260 | 300 | 360 | 420 | 450 | 500 | 520 | 540 | 600 | 620 | 130 |
| 3/4 | 30.60 | 260 | 300 | 360 | 400 | 450 | 490 | 520 | 540 | 600 | 620 | 130 |
| 13/16 | 33.15 | 260 | 300 | 340 | 385 | 440 | 490 | 510 | 530 | 600 | 620 | 130 |
| 7/8 | 35.70 | 260 | 300 | 330 | 375 | 440 | 480 | 510 | 530 | 600 | 620 | 130 |
| 1 | 40.80 | 250 | 300 | 300 | 340 | 440 | 460 | 500 | 530 | 580 | 600 | 130 |
| 1 1/8 | 45.90 | 250 | 300 | 300 | 330 | 410 | 440 | 450 | 500 | 550 | 580 | 130 |
| 1 1/4 | 51.00 | 240 | 270 | 300 | 310 | 380 | 400 | 420 | 490 | 530 | 550 | 130 |
| 1 1/2 | 61.20 | 220 | 230 | 260 | 280 | 330 | 320 | 340 | 420 | 440 | 480 | 130 |
| 1 3/4 | 71.40 | 200 | 200 | 220 | 240 | 280 | 270 | 300 | 380 | 380 | 410 | 130 |
| 2 | 81.60 | 180 | 180 | 190 | 210 | 240 | 240 | 260 | 320 | 330 | 360 | 130 |
| 2 1/4 | 91.80 | 150 | 160 | 170 | 190 | 210 | 210 | 230 | 280 | 295 | 320 | 130 |

| Thickness, Inches | Weight, Lbs. per Sq. Ft. | 72 | 66 | 60 | 54 | 50 | 48 | 42 | 36 | 30 | 24 | Diam., Inches |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/16 | 7.65 | 375 | 420 | 470 | 480 | 480 | 480 | 480 | 480 | 480 | 480 | 90 |
| 1/4 | 10.20 | 430 | 475 | 525 | 530 | 530 | 530 | 530 | 530 | 530 | 530 | 115 |
| 5/16 | 12.75 | 480 | 500 | 560 | 550 | 575 | 575 | 550 | 550 | 550 | 580 | 120 |
| 3/8 | 15.30 | 600 | 600 | 620 | 620 | 620 | 620 | 600 | 580 | 600 | 600 | 130 |
| 7/16 | 17.85 | 600 | 630 | 630 | 640 | 640 | 640 | 600 | 580 | 600 | 600 | 130 |
| 1/2 | 20.40 | 610 | 630 | 630 | 640 | 640 | 640 | 600 | 580 | 630 | 600 | 130 |
| 9/16 | 22.95 | 620 | 640 | 640 | 640 | 640 | 640 | 600 | 580 | 630 | 600 | 130 |
| 5/8 | 25.50 | 620 | 640 | 640 | 640 | 640 | 640 | 600 | 580 | 600 | 600 | 130 |
| 11/16 | 28.05 | 620 | 640 | 640 | 640 | 640 | 640 | 600 | 580 | 600 | 580 | 130 |
| 3/4 | 30.60 | 620 | 640 | 640 | 640 | 640 | 640 | 600 | 580 | 600 | 580 | 130 |
| 13/16 | 33.15 | 620 | 640 | 640 | 640 | 640 | 640 | 600 | 580 | 570 | 550 | 130 |
| 7/8 | 35.70 | 620 | 640 | 640 | 640 | 640 | 640 | 600 | 580 | 550 | 550 | 130 |
| 1 | 40.80 | 600 | 630 | 630 | 640 | 640 | 640 | 580 | 580 | 520 | 530 | 130 |
| 1 1/8 | 45.90 | 580 | 620 | 620 | 640 | 640 | 640 | 580 | 580 | 520 | 500 | 130 |
| 1 1/4 | 51.00 | 550 | 600 | 600 | 600 | 600 | 600 | 560 | 560 | 520 | 450 | 130 |
| 1 1/2 | 61.20 | 530 | 600 | 600 | 600 | 600 | 600 | 540 | 540 | 470 | 430 | 130 |
| 1 3/4 | 71.40 | 450 | 490 | 550 | 550 | 550 | 550 | 540 | 540 | 430 | 380 | 130 |
| 2 | 81.60 | 400 | 440 | 480 | 500 | 500 | 500 | 500 | 500 | 400 | 350 | 130 |
| 2 1/4 | 91.80 | 350 | 390 | 420 | 450 | 450 | 450 | 450 | 450 | 300 | 200 | 130 |

Plates 48" wide and under can also be rolled on Universal Mills.

For greater length and Universal Mill Sizes, see Universal Mill Plate Table.

Plates of greater dimensions than shown in above table may be submitted for special consideration.

## RECTANGULAR PLATES—Nickel Steel

SHEARED PLATES, ONE-FOURTH INCH AND OVER, EXTREME SIZES

| Thickness, Inches | Widths and Lengths in Inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 102 | 96 | 90 | 84 | 78 | 72 | 66 | 60 | 54 | 50 | 48 | 42 | 36 | 30 | 24 |
| ¼ | | | | | | 240 | 240 | 260 | 280 | 280 | 280 | 280 | 280 | 260 | 260 |
| 5/16 | | | | | 260 | 260 | 270 | 300 | 310 | 310 | 340 | 340 | 340 | 310 | 310 |
| ⅜ | | 280 | 340 | 390 | 420 | 450 | 500 | 500 | 500 | 500 | 480 | 450 | 450 | 430 | 430 |
| 7/16 | 260 | 300 | 360 | 400 | 430 | 480 | 520 | 520 | 520 | 520 | 500 | 490 | 490 | 480 | 480 |
| ½ | 270 | 320 | 380 | 420 | 460 | 485 | 520 | 520 | 520 | 520 | 500 | 490 | 490 | 480 | 480 |
| 9/16 | 270 | 320 | 380 | 420 | 460 | 485 | 520 | 520 | 520 | 520 | 500 | 490 | 490 | 480 | 480 |
| ⅝ | 270 | 300 | 355 | 390 | 440 | 480 | 520 | 520 | 520 | 520 | 500 | 500 | 500 | 480 | 450 |
| 11/16 | 260 | 300 | 355 | 390 | 440 | 460 | 490 | 500 | 500 | 500 | 500 | 500 | 480 | 480 | 450 |
| ¾ | 260 | 300 | 355 | 390 | 440 | 450 | 460 | 500 | 500 | 500 | 500 | 500 | 480 | 480 | 450 |
| 13/16 | 260 | 300 | 355 | 390 | 440 | 440 | 460 | 480 | 500 | 500 | 500 | 500 | 480 | 460 | 440 |
| ⅞ | 260 | 300 | 355 | 390 | 440 | 440 | 460 | 480 | 480 | 480 | 480 | 480 | 480 | 450 | 440 |
| 1 | 260 | 290 | 320 | 370 | 400 | 430 | 440 | 460 | 480 | 480 | 480 | 480 | 440 | 420 | 420 |
| 1⅛ | 250 | 270 | 295 | 330 | 375 | 400 | 410 | 420 | 440 | 440 | 440 | 440 | 440 | 420 | 420 |
| 1¼ | 240 | 260 | 290 | 315 | 330 | 350 | 360 | 380 | 390 | 400 | 400 | 420 | 420 | 400 | 400 |
| 1½ | 230 | 260 | 290 | 290 | 310 | 330 | 350 | 370 | 390 | 390 | 390 | 390 | 380 | 380 | 360 |
| 1¾ | 220 | 230 | 250 | 270 | 300 | 310 | 330 | 350 | 370 | 390 | 390 | 360 | 340 | 340 | 320 |
| 2 | 210 | 230 | 250 | 260 | 290 | 295 | 310 | 330 | 350 | 370 | 370 | 340 | 320 | 320 | 290 |

## RECTANGULAR PLATES—Nickel Steel

UNIVERSAL MILL PLATES, ONE-FOURTH INCH AND OVER, EXTREME SIZES

| Thickness, Inches | Widths and Lengths in Inches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 48-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-20 | 19-17 | 16-15 | 14-12 | 11 | 10-6⅛ |
| ¼ | | | | | | | 660 | 660 | 660 | 540 | 540 |
| 5/16 | 540 | 540 | 600 | 660 | 720 | 780 | 780 | 780 | 780 | 600 | 600 |
| ⅜ | 720 | 720 | 780 | 840 | 960 | 960 | 1020 | 1020 | 1020 | 900 | 840 |
| 7/16 | 840 | 840 | 960 | 1020 | 1080 | 1080 | 1020 | 1020 | 1020 | 900 | 840 |
| ½ | 960 | 960 | 1080 | 1140 | 1200 | 1200 | 1020 | 1020 | 1020 | 1020 | 840 |
| 9/16 | 960 | 960 | 1080 | 1140 | 1200 | 1200 | 1020 | 1020 | 1020 | 1020 | 840 |
| ⅝ | 900 | 900 | 1020 | 1080 | 1140 | 1140 | 1000 | 1000 | 1020 | 1020 | 840 |
| ¾ | 840 | 840 | 960 | 1020 | 1080 | 1080 | 1000 | 1000 | 1020 | 900 | 840 |
| ⅞ | 780 | 780 | 840 | 960 | 960 | 960 | 1000 | 1000 | 1000 | 900 | 840 |
| 1 | 720 | 750 | 780 | 816 | 840 | 900 | 1000 | 1000 | 1000 | 900 | 840 |
| 1⅛ | 640 | 667 | 693 | 725 | 744 | 800 | 1000 | 1000 | 1000 | 840 | 840 |
| 1¼ | 575 | 600 | 624 | 652 | 672 | 720 | 1000 | 1000 | 1000 | 840 | 840 |
| 1⅜ | 525 | 545 | 567 | 593 | 600 | 655 | 970 | 1000 | 1000 | 840 | 840 |
| 1½ | 480 | 500 | 520 | 544 | 540 | 600 | 890 | 1000 | 980 | 840 | 840 |
| 1⅝ | 444 | 461 | 480 | 502 | 504 | 554 | 820 | 978 | 980 | 840 | 840 |
| 1¾ | 410 | 428 | 445 | 466 | 480 | 514 | 765 | 908 | 980 | 720 | 720 |
| 1⅞ | 384 | 400 | 416 | 435 | 444 | 480 | 710 | 847 | 968 | 660 | 720 |
| 2 | 360 | 375 | 390 | 408 | 420 | 450 | 670 | 794 | 908 | 600 | 720 |

All sizes of Rectangular Nickel Steel Plates given in above tables under ½" thick should be specified to gage only. Plates ½" thick and over can be rolled to either gage or weight per square foot.

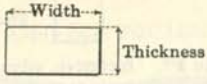
## RECTANGULAR UNIVERSAL PLATES—Carbon Steel

UNIVERSAL MILL PLATES, ONE-FOURTH INCH AND OVER, EXTREME SIZES

| Thickness, Inches | Weight, Lbs. per Sq. Ft. | Widths and Lengths in Inches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 48-46 | 45-41 | 40-36 | 35-31 | 30-26 | 25-20 | 19-17 | 16-15 | 14-12 | 11 | 10-6⅛ |
| ¼ | 10.20 | | | | | | 1020 | 1020 | 1020 | 1020 | 540 | 540 |
| 5/16 | 12.75 | 1020 | 1020 | 1140 | 1260 | 1320 | 1320 | 1080 | 1080 | 1080 | 600 | 600 |
| ⅜ | 15.30 | 1200 | 1200 | 1320 | 1380 | 1380 | 1380 | 1080 | 1080 | 1080 | 900 | 840 |
| 7/16 | 17.85 | 1320 | 1320 | 1380 | 1380 | 1380 | 1380 | 1080 | 1080 | 1080 | 900 | 840 |
| ½ | 20.40 | 1380 | 1380 | 1380 | 1380 | 1380 | 1380 | 1080 | 1080 | 1080 | 1020 | 840 |
| 9/16 | 22.95 | 1380 | 1380 | 1380 | 1380 | 1380 | 1380 | 1080 | 1080 | 1080 | 1020 | 840 |
| ⅝ | 25.50 | 1380 | 1380 | 1380 | 1380 | 1380 | 1380 | 1080 | 1080 | 1080 | 1020 | 840 |
| ¾ | 30.60 | 1353 | 1357 | 1363 | 1372 | 1380 | 1380 | 1080 | 1080 | 1080 | 900 | 840 |
| ⅞ | 35.70 | 1160 | 1163 | 1169 | 1177 | 1188 | 1203 | 1080 | 1080 | 1080 | 900 | 840 |
| 1 | 40.80 | 1015 | 1018 | 1023 | 1030 | 1039 | 1052 | 1080 | 1080 | 1080 | 900 | 840 |
| 1⅛ | 45.90 | 903 | 905 | 910 | 916 | 924 | 936 | 1080 | 1080 | 1080 | 840 | 840 |
| 1¼ | 51.00 | 812 | 814 | 818 | 824 | 832 | 842 | 1071 | 1080 | 1080 | 840 | 840 |
| 1⅜ | 56.10 | 738 | 740 | 744 | 749 | 756 | 766 | 973 | 1080 | 1080 | 840 | 840 |
| 1½ | 61.20 | 677 | 679 | 682 | 687 | 693 | 702 | 892 | 1059 | 1080 | 840 | 840 |
| 1⅝ | 66.30 | 625 | 626 | 629 | 634 | 640 | 648 | 823 | 978 | 1080 | 840 | 840 |
| 1¾ | 71.40 | 580 | 581 | 584 | 588 | 594 | 601 | 765 | 908 | 1038 | 720 | 720 |
| 1⅞ | 76.50 | 541 | 543 | 545 | 549 | 554 | 561 | 714 | 847 | 968 | 660 | 720 |
| 2 | 81.60 | 507 | 509 | 511 | 515 | 519 | 526 | 669 | 794 | 907 | 600 | 720 |

Plates of greater dimensions than shown in above table may be submitted for special consideration.

## SQUARE EDGE FLATS



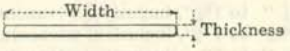

| | | | |
|---|---|---|---|
| ⅛″ to 1″ | wide, x ⅛″ to ⅞″ | 6⅛″ to 6⅜″ | wide, x ¼″ to 2½″ |
| Over 1″ to 2″ | wide, x $\frac{3}{16}$″ to 1¾″ | 6½″ to 6⅝″ | wide, x ¼″ to 2⅜″ |
| Over 2″ to 4¼″ | wide, x ¼″ to 2¼″ | 6¾″ | wide, x ¼″ to 2¼″ |
| Over 4¼″ to 4⅜″ | wide, x ¼″ to 2″ | 6⅞″ to 7¼″ | wide, x ¼″ to 2″ |
| 5″ to 5¼″ | wide, x ¼″ to 3″ | 7⅜″ | wide, x ¼″ to 1¾″ |
| 5⅜″ | wide, x ¼″ to 2⅞″ | 7½″ to 7¾″ | wide, x ¼″ to 1⅝″ |
| 5½″ to 5⅝″ | wide, x ¼″ to 2¾″ | 7⅞″ to 8″ | wide, x ¼″ to 1½″ |
| 5¾″ to 6″ | wide, x ¼″ to 2⅝″ | | |

**Sizes not listed will be considered.**

## NUT STEEL FLATS

**All sizes of Nut Steel Flats within the range of Square Edge Flats can be furnished. Some of the smaller sizes can be furnished in coils.**

## BAND EDGE FLATS




| | | |
|---|---|---|
| ⅝″, | | wide, x No. 18 to No. 4 B. W. G. |
| $\frac{7}{16}$″, | | wide, x No. 19 to No. 4 B. W. G. |
| ½″, | | wide, x No. 22 to No. 4 B. W. G. |
| $\frac{9}{16}$″ | to 1″, | wide, x No. 23 to No. 4 B. W. G. |
| 1$\frac{1}{16}$″ | to 2″, | wide, x No. 21 to No. 4 B. W. G. |
| 2$\frac{1}{16}$″ | to 3″, | wide, x No. 20 to No. 1 B. W. G. |
| 3$\frac{1}{16}$″ | to 3½″, | wide, x No. 19 to No. 1 B. W. G. |
| 3$\frac{9}{16}$″ | to 4″, | wide, x No. 18 to No. 1 B. W. G. |
| 4$\frac{1}{16}$″ | to 4½″, | wide, x No. 17 to No. 1 B. W. G. |
| 4$\frac{9}{16}$″ | to 5$\frac{1}{16}$″, | wide, x No. 16 to No. 1 B. W. G. |
| 5⅛″ | to 6¾″, | wide, x No. 15 to No. 0 B. W. G. |
| 6$\frac{13}{16}$″ | to 9″, | wide, x No. 14 to No. 0 B. W. G. |
| 9⅛″ | to 12″, | wide, x No. 12 to No. 0 B. W. G. |
| 12⅛″ | to 15″, | wide, x No. 10 to No. 0 B. W. G. |
| 15⅛″ | to 16″, | wide, x No. 8 to No. 0 B. W. G. |

Sizes not listed will be considered.

## SKELP

**All sizes within the range of Sheared Plates, Universal Mill Plates and Band Edge Flats can be furnished.**

## SQUARES


Size ¼ " to 2", inclusive, advancing by 64ths.
Size 2 1/32" to 3½", inclusive, advancing by 32ds.
Size 3 3/16" to 5½", inclusive, advancing by 16ths.
Squares can also be rolled to decimal dimensions, if so arranged.
Squares ⅜" and smaller can be furnished in coils.

## ROUND CORNERED SQUARES


Size ¼" to ¾", inclusive, advancing by 64ths.

## ROUNDS


Size ¼ " to 1¾", inclusive, advancing by 64ths.
Size 1 25/32" to 3½", inclusive, advancing by 32ds.
Size 3 3/16" to 7", inclusive, advancing by 16ths.
Rounds can also be rolled to decimal dimensions, if so arranged.
Rounds ⅜" and smaller can be furnished in coils.

## HALF ROUNDS

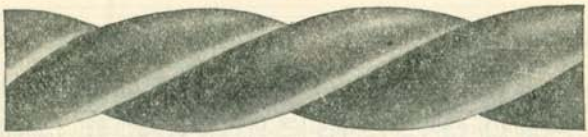

Size 5/8" to ⅞", inclusive, advancing by 64ths.
Size 1 5/16" to 1¾", inclusive, advancing by 16ths.
Size 2", 2½", 3".

## HEXAGONS


Size ⅝" to 1 11/16", inclusive, advancing by 32ds.
Size 1¾" to 3 3/16", inclusive, advancing by 16ths.

# CONCRETE REINFORCEMENT BARS

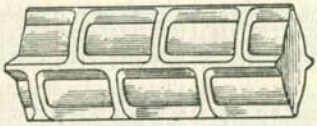
## COLD TWISTED SQUARE BARS



| Section Index | Size, Inches | Weight per Foot, Pounds | Section Index | Size, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | | | 7/8 | 0.7656 | 2.603 |
| | 4.0000 | 13.600 | 13/16 | 0.6602 | 2.245 |
| 17/8 | 3.5156 | 11.953 | 3/4 | 0.5625 | 1.913 |
| 13/4 | 3.0625 | 10.413 | 11/16 | 0.4727 | 1.607 |
| 15/8 | 2.6406 | 8.978 | 5/8 | 0.3906 | 1.328 |
| 11/2 | 2.2500 | 7.650 | 9/16 | 0.3164 | 1.076 |
| 13/8 | 1.8906 | 6.428 | 1/2 | 0.2500 | 0.850 |
| 11/4 | 1.5625 | 5.313 | 7/16 | 0.1914 | 0.651 |
| 11/8 | 1.2656 | 4.303 | 3/8 | 0.1406 | 0.478 |
| 1 | 1.0000 | 3.400 | 5/16 | 0.0977 | 0.332 |
| 15/16 | 0.8789 | 2.988 | 1/4 | 0.0625 | 0.213 |

Cold twisted bars will conform to Manufacturers' Standard Specifications, unless otherwise specified.

## CUP BARS



| Section Index | Size, Inches | Weight per Foot, Pounds | Section Index | Sizes, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | | | *M 1533 | 7/8 | 2.60 |
| *M 1528 | 1½ | 7.65 | *M 1534 | 3/4 | 1.91 |
| *M 1530 | 1¼ | 5.31 | *M 1535 | 5/8 | 1.33 |
| *M 1531 | 1⅛ | 4.30 | *M 1536 | 1/2 | 0.85 |
| *M 1532 | 1 | 3.40 | *M 1537 | 3/8 | 0.48 |

* Furnished only by special arrangement.

# WEIGHTS OF RECTANGULAR SECTIONS

## POUNDS PER LINEAL FOOT

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 1/4 | .053 | .106 | .159 | .213 | .27 | .32 | .37 | .43 | .48 | .53 | .58 | .64 | .69 | .74 | .80 | .85 |
| 1/2 | .106 | .213 | .319 | .425 | .53 | .64 | .74 | .85 | .96 | 1.06 | 1.17 | 1.28 | 1.38 | 1.49 | 1.59 | 1.70 |
| 3/4 | .159 | .319 | .478 | .638 | .80 | .96 | 1.12 | 1.28 | 1.43 | 1.59 | 1.75 | 1.91 | 2.07 | 2.23 | 2.39 | 2.55 |
| 1 | .213 | .425 | .638 | .850 | 1.06 | 1.28 | 1.49 | 1.70 | 1.91 | 2.13 | 2.34 | 2.55 | 2.76 | 2.98 | 3.19 | 3.40 |
| 1 1/4 | .266 | .531 | .797 | 1.063 | 1.33 | 1.59 | 1.86 | 2.13 | 2.39 | 2.66 | 2.92 | 3.19 | 3.45 | 3.72 | 3.98 | 4.25 |
| 1 1/2 | .319 | .638 | .956 | 1.275 | 1.59 | 1.91 | 2.23 | 2.55 | 2.87 | 3.19 | 3.51 | 3.83 | 4.14 | 4.46 | 4.78 | 5.10 |
| 1 3/4 | .372 | .744 | 1.116 | 1.488 | 1.86 | 2.23 | 2.60 | 2.98 | 3.35 | 3.72 | 4.09 | 4.46 | 4.83 | 5.21 | 5.58 | 5.95 |
| 2 | .425 | .850 | 1.275 | 1.700 | 2.13 | 2.55 | 2.98 | 3.40 | 3.83 | 4.25 | 4.68 | 5.10 | 5.53 | 5.95 | 6.38 | 6.80 |
| 2 1/4 | .478 | .956 | 1.434 | 1.913 | 2.39 | 2.87 | 3.35 | 3.83 | 4.30 | 4.78 | 5.26 | 5.74 | 6.22 | 6.69 | 7.17 | 7.65 |
| 2 1/2 | .531 | 1.063 | 1.594 | 2.125 | 2.66 | 3.19 | 3.72 | 4.25 | 4.78 | 5.31 | 5.84 | 6.38 | 6.91 | 7.44 | 7.97 | 8.50 |
| 2 3/4 | .584 | 1.169 | 1.753 | 2.338 | 2.92 | 3.51 | 4.09 | 4.68 | 5.26 | 5.84 | 6.43 | 7.01 | 7.60 | 8.18 | 8.77 | 9.35 |
| 3 | .638 | 1.275 | 1.913 | 2.550 | 3.19 | 3.83 | 4.46 | 5.10 | 5.74 | 6.38 | 7.01 | 7.65 | 8.29 | 8.93 | 9.56 | 10.20 |
| 3 1/4 | .691 | 1.381 | 2.072 | 2.763 | 3.45 | 4.14 | 4.83 | 5.53 | 6.22 | 6.91 | 7.60 | 8.29 | 8.98 | 9.67 | 10.36 | 11.05 |
| 3 1/2 | .744 | 1.488 | 2.231 | 2.975 | 3.72 | 4.46 | 5.21 | 5.95 | 6.69 | 7.44 | 8.18 | 8.93 | 9.67 | 10.41 | 11.16 | 11.90 |
| 3 3/4 | .797 | 1.594 | 2.391 | 3.188 | 3.98 | 4.78 | 5.58 | 6.38 | 7.17 | 7.97 | 8.77 | 9.56 | 10.36 | 11.16 | 11.95 | 12.75 |
| 4 | .850 | 1.700 | 2.550 | 3.400 | 4.25 | 5.10 | 5.95 | 6.80 | 7.65 | 8.50 | 9.35 | 10.20 | 11.05 | 11.90 | 12.75 | 13.60 |
| 4 1/4 | .903 | 1.806 | 2.709 | 3.613 | 4.52 | 5.42 | 6.32 | 7.23 | 8.13 | 9.03 | 9.93 | 10.84 | 11.74 | 12.64 | 13.55 | 14.45 |
| 4 1/2 | .956 | 1.913 | 2.869 | 3.825 | 4.78 | 5.74 | 6.69 | 7.65 | 8.61 | 9.56 | 10.52 | 11.48 | 12.43 | 13.39 | 14.34 | 15.30 |
| 4 3/4 | 1.000 | 2.019 | 3.028 | 4.038 | 5.05 | 6.06 | 7.07 | 8.08 | 9.08 | 10.09 | 11.10 | 12.11 | 13.12 | 14.13 | 15.14 | 16.15 |
| 5 | 1.063 | 2.125 | 3.188 | 4.250 | 5.31 | 6.38 | 7.44 | 8.50 | 9.56 | 10.63 | 11.69 | 12.75 | 13.81 | 14.88 | 15.94 | 17.00 |
| 5 1/4 | 1.116 | 2.231 | 3.347 | 4.463 | 5.58 | 6.69 | 7.81 | 8.93 | 10.04 | 11.16 | 12.27 | 13.39 | 14.50 | 15.62 | 16.73 | 17.85 |
| 5 1/2 | 1.169 | 2.338 | 3.506 | 4.675 | 5.84 | 7.01 | 8.18 | 9.35 | 10.52 | 11.69 | 12.86 | 14.03 | 15.19 | 16.36 | 17.53 | 18.70 |
| 5 3/4 | 1.222 | 2.444 | 3.666 | 4.888 | 6.11 | 7.33 | 8.55 | 9.78 | 11.00 | 12.22 | 13.44 | 14.66 | 15.88 | 17.11 | 18.33 | 19.55 |
| 6 | 1.275 | 2.550 | 3.825 | 5.100 | 6.38 | 7.65 | 8.93 | 10.20 | 11.48 | 12.75 | 14.03 | 15.30 | 16.58 | 17.85 | 19.13 | 20.40 |
| 6 1/4 | 1.328 | 2.656 | 3.984 | 5.313 | 6.64 | 7.97 | 9.30 | 10.63 | 11.95 | 13.28 | 14.61 | 15.94 | 17.27 | 18.59 | 19.92 | 21.25 |
| 6 1/2 | 1.381 | 2.763 | 4.144 | 5.525 | 6.91 | 8.29 | 9.67 | 11.05 | 12.43 | 13.81 | 15.19 | 16.58 | 17.96 | 19.34 | 20.72 | 22.10 |
| 6 3/4 | 1.434 | 2.869 | 4.303 | 5.738 | 7.17 | 8.61 | 10.04 | 11.48 | 12.91 | 14.34 | 15.78 | 17.21 | 18.65 | 20.08 | 21.52 | 22.95 |
| 7 | 1.488 | 2.975 | 4.463 | 5.950 | 7.44 | 8.93 | 10.41 | 11.90 | 13.39 | 14.88 | 16.36 | 17.85 | 19.34 | 20.83 | 22.31 | 23.80 |
| 7 1/4 | 1.541 | 3.081 | 4.622 | 6.163 | 7.70 | 9.24 | 10.78 | 12.33 | 13.87 | 15.41 | 16.95 | 18.49 | 20.03 | 21.57 | 23.11 | 24.65 |
| 7 1/2 | 1.594 | 3.188 | 4.781 | 6.375 | 7.97 | 9.56 | 11.16 | 12.75 | 14.34 | 15.94 | 17.53 | 19.13 | 20.72 | 22.31 | 23.91 | 25.50 |
| 7 3/4 | 1.647 | 3.294 | 4.941 | 6.588 | 8.23 | 9.88 | 11.53 | 13.18 | 14.82 | 16.47 | 18.12 | 19.76 | 21.41 | 23.06 | 24.70 | 26.35 |
| 8 | 1.700 | 3.400 | 5.100 | 6.800 | 8.50 | 10.20 | 11.90 | 13.60 | 15.30 | 17.00 | 18.70 | 20.40 | 22.10 | 23.80 | 25.50 | 27.20 |
| 8 1/4 | 1.753 | 3.506 | 5.259 | 7.013 | 8.77 | 10.52 | 12.27 | 14.03 | 15.78 | 17.53 | 19.28 | 21.04 | 22.79 | 24.54 | 26.30 | 28.05 |
| 8 1/2 | 1.806 | 3.613 | 5.419 | 7.225 | 9.03 | 10.84 | 12.64 | 14.45 | 16.26 | 18.06 | 19.87 | 21.68 | 23.48 | 25.29 | 27.09 | 28.90 |
| 8 3/4 | 1.859 | 3.719 | 5.578 | 7.438 | 9.30 | 11.16 | 13.02 | 14.88 | 16.73 | 18.59 | 20.45 | 22.31 | 24.17 | 26.03 | 27.89 | 29.75 |
| 9 | 1.913 | 3.825 | 5.738 | 7.650 | 9.56 | 11.48 | 13.39 | 15.30 | 17.21 | 19.13 | 21.04 | 22.95 | 24.86 | 26.78 | 28.69 | 30.60 |
| 9 1/4 | 1.966 | 3.931 | 5.897 | 7.863 | 9.83 | 11.79 | 13.76 | 15.73 | 17.69 | 19.66 | 21.62 | 23.59 | 25.55 | 27.52 | 29.48 | 31.45 |
| 9 1/2 | 2.019 | 4.038 | 6.056 | 8.075 | 10.09 | 12.11 | 14.13 | 16.15 | 18.17 | 20.19 | 22.21 | 24.23 | 26.24 | 28.26 | 30.28 | 32.30 |
| 9 3/4 | 2.072 | 4.144 | 6.216 | 8.288 | 10.36 | 12.43 | 14.50 | 16.58 | 18.65 | 20.72 | 22.79 | 24.86 | 26.93 | 29.01 | 31.08 | 33.15 |
| 10 | 2.125 | 4.250 | 6.375 | 8.500 | 10.63 | 12.75 | 14.88 | 17.00 | 19.13 | 21.25 | 23.38 | 25.50 | 27.63 | 29.75 | 31.88 | 34.00 |
| 10 1/4 | 2.178 | 4.356 | 6.534 | 8.713 | 10.89 | 13.07 | 15.25 | 17.43 | 19.60 | 21.78 | 23.96 | 26.14 | 28.32 | 30.49 | 32.67 | 34.85 |
| 10 1/2 | 2.231 | 4.463 | 6.694 | 8.925 | 11.16 | 13.39 | 15.62 | 17.85 | 20.08 | 22.31 | 24.54 | 26.78 | 29.01 | 31.24 | 33.47 | 35.70 |
| 10 3/4 | 2.284 | 4.569 | 6.853 | 9.138 | 11.42 | 13.71 | 15.99 | 18.28 | 20.56 | 22.84 | 25.13 | 27.41 | 29.70 | 31.98 | 34.27 | 36.55 |
| 11 | 2.338 | 4.675 | 7.013 | 9.350 | 11.69 | 14.03 | 16.36 | 18.70 | 21.04 | 23.38 | 25.71 | 28.05 | 30.39 | 32.73 | 35.06 | 37.40 |
| 11 1/4 | 2.391 | 4.781 | 7.172 | 9.563 | 11.95 | 14.34 | 16.73 | 19.13 | 21.52 | 23.91 | 26.30 | 28.69 | 31.08 | 33.47 | 35.86 | 38.25 |
| 11 1/2 | 2.444 | 4.888 | 7.331 | 9.775 | 12.22 | 14.66 | 17.11 | 19.55 | 21.99 | 24.44 | 26.88 | 29.33 | 31.77 | 34.21 | 36.66 | 39.10 |
| 11 3/4 | 2.497 | 4.994 | 7.491 | 9.988 | 12.48 | 14.98 | 17.48 | 19.98 | 22.47 | 24.97 | 27.47 | 29.96 | 32.46 | 34.96 | 37.45 | 39.95 |
| 12 | 2.550 | 5.100 | 7.650 | 10.20 | 12.75 | 15.30 | 17.85 | 20.40 | 22.95 | 25.50 | 28.05 | 30.60 | 33.15 | 35.70 | 38.25 | 40.80 |

# AREAS OF RECTANGULAR SECTIONS

## SQUARE INCHES

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 1/4 | .016 | .031 | .047 | .063 | .078 | .094 | .109 | .125 | .141 | .156 | .172 | .188 | .203 | .22 | .23 | .25 |
| 1/2 | .031 | .063 | .094 | .125 | .156 | .188 | .219 | .250 | .281 | .313 | .344 | .375 | .406 | .44 | .47 | .50 |
| 3/4 | .047 | .094 | .141 | .188 | .234 | .281 | .328 | .375 | .422 | .469 | .516 | .563 | .609 | .66 | .70 | .75 |
| 1 | .063 | .125 | .188 | .250 | .313 | .375 | .438 | .500 | .563 | .625 | .688 | .750 | .813 | .88 | .94 | 1.00 |
| 1 1/4 | .078 | .156 | .234 | .313 | .391 | .469 | .547 | .625 | .703 | .781 | .859 | .938 | 1.016 | 1.09 | 1.17 | 1.25 |
| 1 1/2 | .094 | .188 | .281 | .375 | .469 | .563 | .656 | .750 | .844 | .938 | 1.031 | 1.125 | 1.219 | 1.31 | 1.41 | 1.50 |
| 1 3/4 | .109 | .219 | .328 | .438 | .547 | .656 | .766 | .875 | .984 | 1.094 | 1.203 | 1.313 | 1.422 | 1.53 | 1.64 | 1.75 |
| 2 | .125 | .250 | .375 | .500 | .625 | .750 | .875 | 1.000 | 1.125 | 1.250 | 1.375 | 1.500 | 1.625 | 1.75 | 1.88 | 2.00 |
| 2 1/4 | .141 | .281 | .422 | .563 | .703 | .844 | .984 | 1.125 | 1.266 | 1.406 | 1.547 | 1.688 | 1.828 | 1.97 | 2.11 | 2.25 |
| 2 1/2 | .156 | .313 | .469 | .625 | .781 | .938 | 1.094 | 1.250 | 1.406 | 1.563 | 1.719 | 1.875 | 2.031 | 2.19 | 2.34 | 2.50 |
| 2 3/4 | .172 | .344 | .516 | .688 | .859 | 1.031 | 1.203 | 1.375 | 1.547 | 1.719 | 1.891 | 2.063 | 2.234 | 2.41 | 2.58 | 2.75 |
| 3 | .188 | .375 | .563 | .750 | .938 | 1.125 | 1.313 | 1.500 | 1.688 | 1.875 | 2.063 | 2.250 | 2.438 | 2.63 | 2.81 | 3.00 |
| 3 1/4 | .203 | .406 | .609 | .813 | 1.016 | 1.219 | 1.422 | 1.625 | 1.828 | 2.031 | 2.234 | 2.438 | 2.641 | 2.84 | 3.05 | 3.25 |
| 3 1/2 | .219 | .438 | .656 | .875 | 1.094 | 1.313 | 1.531 | 1.750 | 1.969 | 2.188 | 2.406 | 2.625 | 2.844 | 3.06 | 3.28 | 3.50 |
| 3 3/4 | .234 | .469 | .703 | .938 | 1.172 | 1.406 | 1.641 | 1.875 | 2.109 | 2.344 | 2.578 | 2.813 | 3.047 | 3.28 | 3.52 | 3.75 |
| 4 | .250 | .500 | .750 | 1.000 | 1.250 | 1.500 | 1.750 | 2.000 | 2.250 | 2.500 | 2.750 | 3.000 | 3.250 | 3.50 | 3.75 | 4.00 |
| 4 1/4 | .266 | .531 | .797 | 1.063 | 1.328 | 1.594 | 1.859 | 2.125 | 2.391 | 2.656 | 2.922 | 3.188 | 3.453 | 3.72 | 3.98 | 4.25 |
| 4 1/2 | .281 | .563 | .844 | 1.125 | 1.406 | 1.688 | 1.969 | 2.250 | 2.531 | 2.813 | 3.094 | 3.375 | 3.656 | 3.94 | 4.22 | 4.50 |
| 4 3/4 | .297 | .594 | .891 | 1.188 | 1.484 | 1.781 | 2.078 | 2.375 | 2.672 | 2.969 | 3.266 | 3.563 | 3.859 | 4.16 | 4.45 | 4.75 |
| 5 | .313 | .625 | .938 | 1.250 | 1.563 | 1.875 | 2.188 | 2.500 | 2.813 | 3.125 | 3.438 | 3.750 | 4.063 | 4.38 | 4.69 | 5.00 |
| 5 1/4 | .328 | .656 | .984 | 1.313 | 1.641 | 1.969 | 2.297 | 2.625 | 2.953 | 3.281 | 3.609 | 3.938 | 4.266 | 4.59 | 4.92 | 5.25 |
| 5 1/2 | .344 | .688 | 1.031 | 1.375 | 1.719 | 2.063 | 2.406 | 2.750 | 3.094 | 3.438 | 3.781 | 4.125 | 4.469 | 4.81 | 5.16 | 5.50 |
| 5 3/4 | .359 | .719 | 1.078 | 1.438 | 1.797 | 2.156 | 2.516 | 2.875 | 3.234 | 3.594 | 3.953 | 4.313 | 4.672 | 5.03 | 5.39 | 5.75 |
| 6 | .375 | .750 | 1.125 | 1.500 | 1.875 | 2.250 | 2.625 | 3.000 | 3.375 | 3.750 | 4.125 | 4.500 | 4.875 | 5.25 | 5.63 | 6.00 |
| 6 1/4 | .391 | .781 | 1.172 | 1.563 | 1.953 | 2.344 | 2.734 | 3.125 | 3.516 | 3.906 | 4.297 | 4.688 | 5.078 | 5.47 | 5.86 | 6.25 |
| 6 1/2 | .406 | .813 | 1.219 | 1.625 | 2.031 | 2.438 | 2.844 | 3.250 | 3.656 | 4.063 | 4.469 | 4.875 | 5.281 | 5.69 | 6.09 | 6.50 |
| 6 3/4 | .422 | .844 | 1.266 | 1.688 | 2.109 | 2.531 | 2.953 | 3.375 | 3.797 | 4.219 | 4.641 | 5.063 | 5.484 | 5.91 | 6.33 | 6.75 |
| 7 | .438 | .875 | 1.313 | 1.750 | 2.188 | 2.625 | 3.063 | 3.500 | 3.938 | 4.375 | 4.813 | 5.250 | 5.688 | 6.13 | 6.56 | 7.00 |
| 7 1/4 | .453 | .906 | 1.359 | 1.813 | 2.266 | 2.719 | 3.172 | 3.625 | 4.078 | 4.531 | 4.984 | 5.438 | 5.891 | 6.34 | 6.80 | 7.25 |
| 7 1/2 | .469 | .938 | 1.406 | 1.875 | 2.344 | 2.813 | 3.281 | 3.750 | 4.219 | 4.688 | 5.156 | 5.625 | 6.094 | 6.56 | 7.03 | 7.50 |
| 7 3/4 | .484 | .969 | 1.453 | 1.938 | 2.422 | 2.906 | 3.391 | 3.875 | 4.359 | 4.844 | 5.328 | 5.813 | 6.297 | 6.78 | 7.27 | 7.75 |
| 8 | .500 | 1.000 | 1.500 | 2.000 | 2.500 | 3.000 | 3.500 | 4.000 | 4.500 | 5.000 | 5.500 | 6.000 | 6.500 | 7.00 | 7.50 | 8.00 |
| 8 1/4 | .516 | 1.031 | 1.547 | 2.063 | 2.578 | 3.094 | 3.609 | 4.125 | 4.641 | 5.156 | 5.672 | 6.188 | 6.703 | 7.22 | 7.73 | 8.25 |
| 8 1/2 | .531 | 1.063 | 1.594 | 2.125 | 2.656 | 3.188 | 3.719 | 4.250 | 4.781 | 5.313 | 5.844 | 6.375 | 6.906 | 7.44 | 7.97 | 8.50 |
| 8 3/4 | .547 | 1.094 | 1.641 | 2.188 | 2.734 | 3.281 | 3.828 | 4.375 | 4.922 | 5.469 | 6.016 | 6.563 | 7.109 | 7.66 | 8.20 | 8.75 |
| 9 | .563 | 1.125 | 1.688 | 2.250 | 2.813 | 3.375 | 3.938 | 4.500 | 5.063 | 5.625 | 6.188 | 6.750 | 7.313 | 7.88 | 8.44 | 9.00 |
| 9 1/4 | .578 | 1.156 | 1.734 | 2.313 | 2.891 | 3.469 | 4.047 | 4.625 | 5.203 | 5.781 | 6.359 | 6.938 | 7.516 | 8.09 | 8.67 | 9.25 |
| 9 1/2 | .594 | 1.188 | 1.781 | 2.375 | 2.969 | 3.563 | 4.156 | 4.750 | 5.344 | 5.938 | 6.531 | 7.125 | 7.719 | 8.31 | 8.91 | 9.50 |
| 9 3/4 | .609 | 1.219 | 1.828 | 2.438 | 3.047 | 3.656 | 4.266 | 4.875 | 5.484 | 6.094 | 6.703 | 7.313 | 7.922 | 8.53 | 9.14 | 9.75 |
| 10 | .625 | 1.250 | 1.875 | 2.500 | 3.125 | 3.750 | 4.375 | 5.000 | 5.625 | 6.250 | 6.875 | 7.500 | 8.125 | 8.75 | 9.38 | 10.00 |
| 10 1/4 | .641 | 1.281 | 1.922 | 2.563 | 3.203 | 3.844 | 4.484 | 5.125 | 5.766 | 6.406 | 7.047 | 7.688 | 8.328 | 8.97 | 9.61 | 10.25 |
| 10 1/2 | .656 | 1.313 | 1.969 | 2.625 | 3.281 | 3.938 | 4.594 | 5.250 | 5.906 | 6.563 | 7.219 | 7.875 | 8.531 | 9.19 | 9.84 | 10.50 |
| 10 3/4 | .672 | 1.344 | 2.016 | 2.688 | 3.359 | 4.031 | 4.703 | 5.375 | 6.047 | 6.719 | 7.391 | 8.063 | 8.734 | 9.41 | 10.08 | 10.75 |
| 11 | .688 | 1.375 | 2.063 | 2.750 | 3.438 | 4.125 | 4.813 | 5.500 | 6.188 | 6.875 | 7.563 | 8.250 | 8.938 | 9.63 | 10.31 | 11.00 |
| 11 1/4 | .703 | 1.406 | 2.109 | 2.813 | 3.516 | 4.219 | 4.922 | 5.625 | 6.328 | 7.031 | 7.734 | 8.438 | 9.141 | 9.84 | 10.55 | 11.25 |
| 11 1/2 | .719 | 1.438 | 2.156 | 2.875 | 3.594 | 4.313 | 5.031 | 5.750 | 6.469 | 7.188 | 7.906 | 8.625 | 9.344 | 10.06 | 10.78 | 11.50 |
| 11 3/4 | .734 | 1.469 | 2.203 | 2.938 | 3.672 | 4.406 | 5.141 | 5.875 | 6.609 | 7.344 | 8.078 | 8.813 | 9.547 | 10.28 | 11.02 | 11.75 |
| 12 | .750 | 1.500 | 2.250 | 3.000 | 3.750 | 4.500 | 5.250 | 6.000 | 6.750 | 7.500 | 8.250 | 9.000 | 9.750 | 10.50 | 11.25 | 12.00 |

## WEIGHTS OF RECTANGULAR SECTIONS—Continued

POUNDS PER LINEAL FOOT

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 12½ | 2.66 | 5.31 | 7.97 | 10.63 | 13.28 | 15.94 | 18.59 | 21.25 | 23.91 | 26.56 | 29.2 | 31.9 | 34.5 | 37.2 | 39.8 | 42.5 |
| 13 | 2.76 | 5.53 | 8.29 | 11.05 | 13.81 | 16.58 | 19.34 | 22.10 | 24.86 | 27.63 | 30.4 | 33.2 | 35.9 | 38.7 | 41.4 | 44.2 |
| 13½ | 2.87 | 5.74 | 8.61 | 11.48 | 14.34 | 17.21 | 20.08 | 22.95 | 25.82 | 28.69 | 31.6 | 34.4 | 37.3 | 40.2 | 43.0 | 45.9 |
| 14 | 2.98 | 5.95 | 8.93 | 11.90 | 14.88 | 17.85 | 20.83 | 23.80 | 26.78 | 29.75 | 32.7 | 35.7 | 38.7 | 41.7 | 44.6 | 47.6 |
| 14½ | 3.08 | 6.16 | 9.24 | 12.33 | 15.41 | 18.49 | 21.57 | 24.65 | 27.73 | 30.81 | 33.9 | 37.0 | 40.1 | 43.1 | 46.2 | 49.3 |
| 15 | 3.19 | 6.38 | 9.56 | 12.75 | 15.94 | 19.13 | 22.31 | 25.50 | 28.69 | 31.88 | 35.1 | 38.3 | 41.4 | 44.6 | 47.8 | 51.0 |
| 15½ | 3.29 | 6.59 | 9.88 | 13.18 | 16.47 | 19.76 | 23.06 | 26.35 | 29.64 | 32.94 | 36.2 | 39.5 | 42.8 | 46.1 | 49.4 | 52.7 |
| 16 | 3.40 | 6.80 | 10.20 | 13.60 | 17.00 | 20.40 | 23.80 | 27.20 | 30.60 | 34.00 | 37.4 | 40.8 | 44.2 | 47.6 | 51.0 | 54.4 |
| 16½ | 3.51 | 7.01 | 10.52 | 14.03 | 17.53 | 21.04 | 24.54 | 28.05 | 31.56 | 35.06 | 38.6 | 42.1 | 45.6 | 49.1 | 52.6 | 56.1 |
| 17 | 3.61 | 7.23 | 10.84 | 14.45 | 18.06 | 21.68 | 25.29 | 28.90 | 32.51 | 36.13 | 39.7 | 43.4 | 47.0 | 50.6 | 54.2 | 57.8 |
| 17½ | 3.72 | 7.44 | 11.16 | 14.88 | 18.59 | 22.31 | 26.03 | 29.75 | 33.47 | 37.19 | 40.9 | 44.6 | 48.3 | 52.1 | 55.8 | 59.5 |
| 18 | 3.83 | 7.65 | 11.48 | 15.30 | 19.13 | 22.95 | 26.78 | 30.60 | 34.43 | 38.25 | 42.1 | 45.9 | 49.7 | 53.6 | 57.4 | 61.2 |
| 18½ | 3.93 | 7.86 | 11.79 | 15.73 | 19.66 | 23.59 | 27.52 | 31.45 | 35.38 | 39.31 | 43.2 | 47.2 | 51.1 | 55.0 | 59.0 | 62.9 |
| 19 | 4.04 | 8.08 | 12.11 | 16.15 | 20.19 | 24.23 | 28.26 | 32.30 | 36.34 | 40.38 | 44.4 | 48.5 | 52.5 | 56.5 | 60.6 | 64.6 |
| 19½ | 4.14 | 8.29 | 12.43 | 16.58 | 20.72 | 24.86 | 29.01 | 33.15 | 37.29 | 41.44 | 45.6 | 49.7 | 53.9 | 58.0 | 62.2 | 66.3 |
| 20 | 4.25 | 8.50 | 12.75 | 17.00 | 21.25 | 25.50 | 29.75 | 34.00 | 38.25 | 42.50 | 46.8 | 51.0 | 55.3 | 59.5 | 63.8 | 68.0 |
| 20½ | 4.36 | 8.71 | 13.07 | 17.43 | 21.78 | 26.14 | 30.49 | 34.85 | 39.21 | 43.56 | 47.9 | 52.3 | 56.6 | 61.0 | 65.3 | 69.7 |
| 21 | 4.46 | 8.93 | 13.39 | 17.85 | 22.31 | 26.78 | 31.24 | 35.70 | 40.16 | 44.63 | 49.1 | 53.6 | 58.0 | 62.5 | 66.9 | 71.4 |
| 21½ | 4.57 | 9.14 | 13.71 | 18.28 | 22.84 | 27.41 | 31.98 | 36.55 | 41.12 | 45.69 | 50.3 | 54.8 | 59.4 | 64.0 | 68.5 | 73.1 |
| 22 | 4.68 | 9.35 | 14.03 | 18.70 | 23.38 | 28.05 | 32.73 | 37.40 | 42.08 | 46.75 | 51.4 | 56.1 | 60.8 | 65.5 | 70.1 | 74.8 |
| 22½ | 4.78 | 9.56 | 14.34 | 19.13 | 23.91 | 28.69 | 33.47 | 38.25 | 43.03 | 47.81 | 52.6 | 57.4 | 62.2 | 66.9 | 71.7 | 76.5 |
| 23 | 4.89 | 9.78 | 14.66 | 19.55 | 24.44 | 29.33 | 34.21 | 39.10 | 43.99 | 48.88 | 53.8 | 58.7 | 63.5 | 68.4 | 73.3 | 78.2 |
| 23½ | 4.99 | 9.99 | 14.98 | 19.98 | 24.97 | 29.96 | 34.96 | 39.95 | 44.94 | 49.94 | 54.9 | 59.9 | 64.9 | 69.9 | 74.9 | 79.9 |
| 24 | 5.10 | 10.20 | 15.30 | 20.40 | 25.50 | 30.60 | 35.70 | 40.80 | 45.90 | 51.00 | 56.1 | 61.2 | 66.3 | 71.4 | 76.5 | 81.6 |
| 25 | 5.31 | 10.63 | 15.94 | 21.25 | 26.56 | 31.88 | 37.19 | 42.50 | 47.81 | 53.13 | 58.4 | 63.8 | 69.1 | 74.4 | 79.7 | 85.0 |
| 26 | 5.53 | 11.05 | 16.58 | 22.10 | 27.63 | 33.15 | 38.68 | 44.20 | 49.73 | 55.25 | 60.8 | 66.3 | 71.8 | 77.4 | 82.9 | 88.4 |
| 27 | 5.74 | 11.48 | 17.21 | 22.95 | 28.69 | 34.43 | 40.16 | 45.90 | 51.64 | 57.38 | 63.1 | 68.9 | 74.6 | 80.3 | 86.1 | 91.8 |
| 28 | 5.95 | 11.90 | 17.85 | 23.80 | 29.75 | 35.70 | 41.65 | 47.60 | 53.55 | 59.50 | 65.5 | 71.4 | 77.4 | 83.3 | 89.3 | 95.2 |
| 29 | 6.16 | 12.33 | 18.49 | 24.65 | 30.81 | 36.98 | 43.14 | 49.30 | 55.46 | 61.63 | 67.8 | 74.0 | 80.1 | 86.3 | 92.4 | 98.6 |
| 30 | 6.38 | 12.75 | 19.13 | 25.50 | 31.88 | 38.25 | 44.63 | 51.00 | 57.38 | 63.75 | 70.1 | 76.5 | 82.9 | 89.3 | 95.6 | 102.0 |
| 31 | 6.59 | 13.18 | 19.76 | 26.35 | 32.94 | 39.53 | 46.11 | 52.70 | 59.29 | 65.88 | 72.5 | 79.1 | 85.6 | 92.2 | 98.8 | 105.4 |
| 32 | 6.80 | 13.60 | 20.40 | 27.20 | 34.00 | 40.80 | 47.60 | 54.40 | 61.20 | 68.00 | 74.8 | 81.6 | 88.4 | 95.2 | 102.0 | 108.8 |
| 33 | 7.01 | 14.03 | 21.04 | 28.05 | 35.06 | 42.08 | 49.09 | 56.10 | 63.11 | 70.13 | 77.1 | 84.2 | 91.2 | 98.2 | 105.2 | 112.2 |
| 34 | 7.23 | 14.45 | 21.68 | 28.90 | 36.13 | 43.35 | 50.58 | 57.80 | 65.03 | 72.25 | 79.5 | 86.7 | 93.9 | 101.2 | 108.4 | 115.6 |
| 35 | 7.44 | 14.88 | 22.31 | 29.75 | 37.19 | 44.63 | 52.06 | 59.50 | 66.94 | 74.38 | 81.8 | 89.3 | 96.7 | 104.1 | 111.6 | 119.0 |
| 36 | 7.65 | 15.30 | 22.95 | 30.60 | 38.25 | 45.90 | 53.55 | 61.20 | 68.85 | 76.50 | 84.2 | 91.8 | 99.5 | 107.1 | 114.8 | 122.4 |
| 37 | 7.86 | 15.73 | 23.59 | 31.45 | 39.31 | 47.18 | 55.04 | 62.90 | 70.76 | 78.63 | 86.5 | 94.4 | 102.2 | 110.1 | 117.9 | 125.8 |
| 38 | 8.08 | 16.15 | 24.23 | 32.30 | 40.38 | 48.45 | 56.53 | 64.60 | 72.68 | 80.75 | 88.8 | 96.9 | 105.0 | 113.1 | 121.1 | 129.2 |
| 39 | 8.29 | 16.58 | 24.86 | 33.15 | 41.44 | 49.73 | 58.01 | 66.30 | 74.59 | 82.88 | 91.2 | 99.5 | 107.7 | 116.0 | 124.3 | 132.6 |
| 40 | 8.50 | 17.00 | 25.50 | 34.00 | 42.50 | 51.00 | 59.50 | 68.00 | 76.50 | 85.00 | 93.5 | 102.0 | 110.5 | 119.0 | 127.5 | 136.0 |
| 41 | 8.71 | 17.43 | 26.14 | 34.85 | 43.56 | 52.28 | 60.99 | 69.70 | 78.41 | 87.13 | 95.8 | 104.6 | 113.3 | 122.0 | 130.7 | 139.4 |
| 42 | 8.93 | 17.85 | 26.78 | 35.70 | 44.63 | 53.55 | 62.48 | 71.40 | 80.33 | 89.25 | 98.2 | 107.1 | 116.0 | 125.0 | 133.9 | 142.8 |
| 43 | 9.14 | 18.28 | 27.41 | 36.55 | 45.69 | 54.83 | 63.96 | 73.10 | 82.24 | 91.38 | 100.5 | 109.7 | 118.8 | 127.9 | 137.1 | 146.2 |
| 44 | 9.35 | 18.70 | 28.05 | 37.40 | 46.75 | 56.10 | 65.45 | 74.80 | 84.15 | 93.50 | 102.9 | 112.2 | 121.6 | 130.9 | 140.3 | 149.6 |
| 45 | 9.56 | 19.13 | 28.69 | 38.25 | 47.81 | 57.38 | 66.94 | 76.50 | 86.06 | 95.63 | 105.2 | 114.8 | 124.3 | 133.9 | 143.4 | 153.0 |
| 46 | 9.78 | 19.55 | 29.33 | 39.10 | 48.88 | 58.65 | 68.43 | 78.20 | 87.98 | 97.75 | 107.5 | 117.3 | 127.1 | 136.9 | 146.6 | 156.4 |
| 47 | 9.99 | 19.98 | 29.96 | 39.95 | 49.94 | 59.93 | 69.91 | 79.90 | 89.89 | 99.88 | 109.9 | 119.9 | 129.8 | 139.8 | 149.8 | 159.8 |
| 48 | 10.20 | 20.40 | 30.60 | 40.80 | 51.00 | 61.20 | 71.40 | 81.60 | 91.80 | 102.0 | 112.2 | 122.4 | 132.6 | 142.8 | 153.0 | 163.2 |

## AREAS OF RECTANGULAR SECTIONS—Continued

SQUARE INCHES

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 12½ | .781 | 1.563 | 2.344 | 3.13 | 3.91 | 4.69 | 5.47 | 6.25 | 7.03 | 7.81 | 8.59 | 9.38 | 10.16 | 10.94 | 11.72 | 12.50 |
| 13 | .813 | 1.625 | 2.438 | 3.25 | 4.06 | 4.88 | 5.69 | 6.50 | 7.31 | 8.13 | 8.94 | 9.75 | 10.56 | 11.38 | 12.19 | 13.00 |
| 13½ | .844 | 1.688 | 2.531 | 3.38 | 4.22 | 5.06 | 5.91 | 6.75 | 7.59 | 8.44 | 9.28 | 10.13 | 10.97 | 11.81 | 12.66 | 13.50 |
| 14 | .875 | 1.750 | 2.625 | 3.50 | 4.38 | 5.25 | 6.13 | 7.00 | 7.88 | 8.75 | 9.63 | 10.50 | 11.38 | 12.25 | 13.13 | 14.00 |
| 14½ | .906 | 1.813 | 2.719 | 3.63 | 4.53 | 5.44 | 6.34 | 7.25 | 8.16 | 9.06 | 9.97 | 10.88 | 11.78 | 12.69 | 13.59 | 14.50 |
| 15 | .938 | 1.875 | 2.813 | 3.75 | 4.69 | 5.63 | 6.56 | 7.50 | 8.44 | 9.38 | 10.31 | 11.25 | 12.19 | 13.13 | 14.06 | 15.00 |
| 15½ | .969 | 1.938 | 2.906 | 3.88 | 4.84 | 5.81 | 6.78 | 7.75 | 8.72 | 9.69 | 10.66 | 11.63 | 12.59 | 13.56 | 14.53 | 15.50 |
| 16 | 1.000 | 2.000 | 3.000 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 9.00 | 10.00 | 11.00 | 12.00 | 13.00 | 14.00 | 15.00 | 16.00 |
| 16½ | 1.031 | 2.063 | 3.094 | 4.13 | 5.16 | 6.19 | 7.22 | 8.25 | 9.28 | 10.31 | 11.34 | 12.38 | 13.41 | 14.44 | 15.47 | 16.50 |
| 17 | 1.063 | 2.125 | 3.188 | 4.25 | 5.31 | 6.38 | 7.44 | 8.50 | 9.56 | 10.63 | 11.69 | 12.75 | 13.81 | 14.88 | 15.94 | 17.00 |
| 17½ | 1.094 | 2.188 | 3.281 | 4.38 | 5.47 | 6.56 | 7.66 | 8.75 | 9.84 | 10.94 | 12.03 | 13.13 | 14.22 | 15.31 | 16.41 | 17.50 |
| 18 | 1.125 | 2.250 | 3.375 | 4.50 | 5.63 | 6.75 | 7.88 | 9.00 | 10.13 | 11.25 | 12.38 | 13.50 | 14.63 | 15.75 | 16.88 | 18.00 |
| 18½ | 1.156 | 2.313 | 3.469 | 4.63 | 5.78 | 6.94 | 8.09 | 9.25 | 10.41 | 11.56 | 12.72 | 13.88 | 15.03 | 16.19 | 17.34 | 18.50 |
| 19 | 1.188 | 2.375 | 3.563 | 4.75 | 5.94 | 7.13 | 8.31 | 9.50 | 10.69 | 11.88 | 13.06 | 14.25 | 15.44 | 16.63 | 17.81 | 19.00 |
| 19½ | 1.219 | 2.438 | 3.656 | 4.88 | 6.09 | 7.31 | 8.53 | 9.75 | 10.97 | 12.19 | 13.41 | 14.63 | 15.84 | 17.06 | 18.28 | 19.50 |
| 20 | 1.250 | 2.500 | 3.750 | 5.00 | 6.25 | 7.50 | 8.75 | 10.00 | 11.25 | 12.50 | 13.75 | 15.00 | 16.25 | 17.50 | 18.75 | 20.00 |
| 20½ | 1.281 | 2.563 | 3.844 | 5.13 | 6.41 | 7.69 | 8.97 | 10.25 | 11.53 | 12.81 | 14.09 | 15.38 | 16.66 | 17.94 | 19.22 | 20.50 |
| 21 | 1.313 | 2.625 | 3.938 | 5.25 | 6.56 | 7.88 | 9.19 | 10.50 | 11.81 | 13.13 | 14.44 | 15.75 | 17.06 | 18.38 | 19.69 | 21.00 |
| 21½ | 1.344 | 2.688 | 4.031 | 5.38 | 6.72 | 8.06 | 9.41 | 10.75 | 12.09 | 13.44 | 14.78 | 16.13 | 17.47 | 18.81 | 20.16 | 21.50 |
| 22 | 1.375 | 2.750 | 4.125 | 5.50 | 6.88 | 8.25 | 9.63 | 11.00 | 12.38 | 13.75 | 15.13 | 16.50 | 17.88 | 19.25 | 20.63 | 22.00 |
| 22½ | 1.406 | 2.813 | 4.219 | 5.63 | 7.03 | 8.44 | 9.84 | 11.25 | 12.66 | 14.06 | 15.47 | 16.88 | 18.28 | 19.69 | 21.09 | 22.50 |
| 23 | 1.438 | 2.875 | 4.313 | 5.75 | 7.19 | 8.63 | 10.06 | 11.50 | 12.94 | 14.38 | 15.81 | 17.25 | 18.69 | 20.13 | 21.56 | 23.00 |
| 23½ | 1.469 | 2.938 | 4.406 | 5.88 | 7.34 | 8.81 | 10.28 | 11.75 | 13.22 | 14.69 | 16.16 | 17.63 | 19.09 | 20.56 | 22.03 | 23.50 |
| 24 | 1.500 | 3.000 | 4.500 | 6.00 | 7.50 | 9.00 | 10.50 | 12.00 | 13.50 | 15.00 | 16.50 | 18.00 | 19.50 | 21.00 | 22.50 | 24.00 |
| 25 | 1.563 | 3.125 | 4.688 | 6.25 | 7.81 | 9.38 | 10.94 | 12.50 | 14.06 | 15.63 | 17.19 | 18.75 | 20.31 | 21.88 | 23.44 | 25.00 |
| 26 | 1.625 | 3.250 | 4.875 | 6.50 | 8.13 | 9.75 | 11.38 | 13.00 | 14.63 | 16.25 | 17.88 | 19.50 | 21.13 | 22.75 | 24.38 | 26.00 |
| 27 | 1.688 | 3.375 | 5.063 | 6.75 | 8.44 | 10.13 | 11.81 | 13.50 | 15.19 | 16.88 | 18.56 | 20.25 | 21.94 | 23.63 | 25.31 | 27.00 |
| 28 | 1.750 | 3.500 | 5.250 | 7.00 | 8.75 | 10.50 | 12.25 | 14.00 | 15.75 | 17.50 | 19.25 | 21.00 | 22.75 | 24.50 | 26.25 | 28.00 |
| 29 | 1.813 | 3.625 | 5.438 | 7.25 | 9.06 | 10.88 | 12.69 | 14.50 | 16.31 | 18.13 | 19.94 | 21.75 | 23.56 | 25.38 | 27.19 | 29.00 |
| 30 | 1.875 | 3.750 | 5.625 | 7.50 | 9.38 | 11.25 | 13.13 | 15.00 | 16.88 | 18.75 | 20.63 | 22.50 | 24.38 | 26.25 | 28.13 | 30.00 |
| 31 | 1.938 | 3.875 | 5.813 | 7.75 | 9.69 | 11.63 | 13.56 | 15.50 | 17.44 | 19.38 | 21.31 | 23.25 | 25.19 | 27.13 | 29.06 | 31.00 |
| 32 | 2.000 | 4.000 | 6.000 | 8.00 | 10.00 | 12.00 | 14.00 | 16.00 | 18.00 | 20.00 | 22.00 | 24.00 | 26.00 | 28.00 | 30.00 | 32.00 |
| 33 | 2.063 | 4.125 | 6.188 | 8.25 | 10.31 | 12.38 | 14.44 | 16.50 | 18.56 | 20.63 | 22.69 | 24.75 | 26.81 | 28.88 | 30.94 | 33.00 |
| 34 | 2.125 | 4.250 | 6.375 | 8.50 | 10.63 | 12.75 | 14.88 | 17.00 | 19.13 | 21.25 | 23.38 | 25.50 | 27.63 | 29.75 | 31.88 | 34.00 |
| 35 | 2.188 | 4.375 | 6.563 | 8.75 | 10.94 | 13.13 | 15.31 | 17.50 | 19.69 | 21.88 | 24.06 | 26.25 | 28.44 | 30.63 | 32.81 | 35.00 |
| 36 | 2.250 | 4.500 | 6.750 | 9.00 | 11.25 | 13.50 | 15.75 | 18.00 | 20.25 | 22.50 | 24.75 | 27.00 | 29.25 | 31.50 | 33.75 | 36.00 |
| 37 | 2.313 | 4.625 | 6.938 | 9.25 | 11.56 | 13.88 | 16.19 | 18.50 | 20.81 | 23.13 | 25.44 | 27.75 | 30.06 | 32.38 | 34.69 | 37.00 |
| 38 | 2.375 | 4.750 | 7.125 | 9.50 | 11.88 | 14.25 | 16.63 | 19.00 | 21.38 | 23.75 | 26.13 | 28.50 | 30.88 | 33.25 | 35.63 | 38.00 |
| 39 | 2.438 | 4.875 | 7.313 | 9.75 | 12.19 | 14.63 | 17.06 | 19.50 | 21.94 | 24.38 | 26.81 | 29.25 | 31.69 | 34.13 | 36.56 | 39.00 |
| 40 | 2.500 | 5.000 | 7.500 | 10.00 | 12.50 | 15.00 | 17.50 | 20.00 | 22.50 | 25.00 | 27.50 | 30.00 | 32.50 | 35.00 | 37.50 | 40.00 |
| 41 | 2.563 | 5.125 | 7.688 | 10.25 | 12.81 | 15.38 | 17.94 | 20.50 | 23.06 | 25.63 | 28.19 | 30.75 | 33.31 | 35.88 | 38.44 | 41.00 |
| 42 | 2.625 | 5.250 | 7.875 | 10.50 | 13.13 | 15.75 | 18.38 | 21.00 | 23.63 | 26.25 | 28.88 | 31.50 | 34.13 | 36.75 | 39.38 | 42.00 |
| 43 | 2.688 | 5.375 | 8.063 | 10.75 | 13.44 | 16.13 | 18.81 | 21.50 | 24.19 | 26.88 | 29.56 | 32.25 | 34.94 | 37.63 | 40.31 | 43.00 |
| 44 | 2.750 | 5.500 | 8.250 | 11.00 | 13.75 | 16.50 | 19.25 | 22.00 | 24.75 | 27.50 | 30.25 | 33.00 | 35.75 | 38.50 | 41.25 | 44.00 |
| 45 | 2.813 | 5.625 | 8.438 | 11.25 | 14.06 | 16.88 | 19.69 | 22.50 | 25.31 | 28.13 | 30.94 | 33.75 | 36.56 | 39.38 | 42.19 | 45.00 |
| 46 | 2.875 | 5.750 | 8.625 | 11.50 | 14.38 | 17.25 | 20.13 | 23.00 | 25.88 | 28.75 | 31.63 | 34.50 | 37.38 | 40.25 | 43.13 | 46.00 |
| 47 | 2.938 | 5.875 | 8.813 | 11.75 | 14.69 | 17.63 | 20.56 | 23.50 | 26.44 | 29.38 | 32.31 | 35.25 | 38.19 | 41.13 | 44.06 | 47.00 |
| 48 | 3.000 | 6.000 | 9.000 | 12.00 | 15.00 | 18.00 | 21.00 | 24.00 | 27.00 | 30.00 | 33.00 | 36.00 | 39.00 | 42.00 | 45.00 | 48.00 |

# WEIGHTS OF RECTANGULAR SECTIONS—Concluded

POUNDS PER LINEAL FOOT

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 49 | 10.4 | 20.8 | 31.2 | 41.7 | 52.1 | 62.5 | 72.9 | 83.3 | 93.7 | 104.1 | 114.5 | 125.0 | 135.4 | 145.8 | 156.2 | 166.6 |
| 50 | 10.6 | 21.3 | 31.9 | 42.5 | 53.1 | 63.8 | 74.4 | 85.0 | 95.6 | 106.3 | 116.9 | 127.5 | 138.1 | 148.8 | 159.4 | 170.0 |
| 51 | 10.8 | 21.7 | 32.5 | 43.4 | 54.2 | 65.0 | 75.9 | 86.7 | 97.5 | 108.4 | 119.2 | 130.1 | 140.9 | 151.7 | 162.6 | 173.4 |
| 52 | 11.1 | 22.1 | 33.2 | 44.2 | 55.3 | 66.3 | 77.4 | 88.4 | 99.5 | 110.5 | 121.6 | 132.6 | 143.7 | 154.7 | 165.8 | 176.8 |
| 53 | 11.3 | 22.5 | 33.8 | 45.1 | 56.3 | 67.6 | 78.8 | 90.1 | 101.4 | 112.6 | 123.9 | 135.2 | 146.4 | 157.7 | 168.9 | 180.2 |
| 54 | 11.5 | 23.0 | 34.4 | 45.9 | 57.4 | 68.9 | 80.3 | 91.8 | 103.3 | 114.8 | 126.2 | 137.7 | 149.2 | 160.7 | 172.1 | 183.6 |
| 55 | 11.7 | 23.4 | 35.1 | 46.8 | 58.4 | 70.1 | 81.8 | 93.5 | 105.2 | 116.9 | 128.6 | 140.3 | 151.9 | 163.6 | 175.3 | 187.0 |
| 56 | 11.9 | 23.8 | 35.7 | 47.6 | 59.5 | 71.4 | 83.3 | 95.2 | 107.1 | 119.0 | 130.9 | 142.8 | 154.7 | 166.6 | 178.5 | 190.4 |
| 57 | 12.1 | 24.2 | 36.3 | 48.5 | 60.6 | 72.7 | 84.8 | 96.9 | 109.0 | 121.1 | 133.2 | 145.4 | 157.5 | 169.6 | 181.7 | 193.8 |
| 58 | 12.3 | 24.7 | 37.0 | 49.3 | 61.6 | 74.0 | 86.3 | 98.6 | 110.9 | 123.3 | 135.6 | 147.9 | 160.2 | 172.6 | 184.9 | 197.2 |
| 59 | 12.5 | 25.1 | 37.6 | 50.2 | 62.7 | 75.2 | 87.8 | 100.3 | 112.8 | 125.4 | 137.9 | 150.5 | 163.0 | 175.5 | 188.1 | 200.6 |
| 60 | 12.8 | 25.5 | 38.3 | 51.0 | 63.8 | 76.5 | 89.3 | 102.0 | 114.8 | 127.5 | 140.3 | 153.0 | 165.8 | 178.5 | 191.3 | 204.0 |
| 61 | 13.0 | 25.9 | 38.9 | 51.9 | 64.8 | 77.8 | 90.7 | 103.7 | 116.7 | 129.6 | 142.6 | 155.6 | 168.5 | 181.5 | 194.4 | 207.4 |
| 62 | 13.2 | 26.4 | 39.5 | 52.7 | 65.9 | 79.1 | 92.2 | 105.4 | 118.6 | 131.8 | 144.9 | 158.1 | 171.3 | 184.5 | 197.6 | 210.8 |
| 63 | 13.4 | 26.8 | 40.2 | 53.6 | 66.9 | 80.3 | 93.7 | 107.1 | 120.5 | 133.9 | 147.3 | 160.7 | 174.0 | 187.4 | 200.8 | 214.2 |
| 64 | 13.6 | 27.2 | 40.8 | 54.4 | 68.0 | 81.6 | 95.2 | 108.8 | 122.4 | 136.0 | 149.6 | 163.2 | 176.8 | 190.4 | 204.0 | 217.6 |
| 65 | 13.8 | 27.6 | 41.4 | 55.3 | 69.1 | 82.9 | 96.7 | 110.5 | 124.3 | 138.1 | 151.9 | 165.8 | 179.6 | 193.4 | 207.2 | 221.0 |
| 66 | 14.0 | 28.1 | 42.1 | 56.1 | 70.1 | 84.2 | 98.2 | 112.2 | 126.2 | 140.3 | 154.3 | 168.3 | 182.3 | 196.4 | 210.4 | 224.4 |
| 67 | 14.2 | 28.5 | 42.7 | 57.0 | 71.2 | 85.4 | 99.7 | 113.9 | 128.1 | 142.4 | 156.6 | 170.9 | 185.1 | 199.3 | 213.6 | 227.8 |
| 68 | 14.5 | 28.9 | 43.4 | 57.8 | 72.3 | 86.7 | 101.2 | 115.6 | 130.1 | 144.5 | 159.0 | 173.4 | 187.9 | 202.3 | 216.8 | 231.2 |
| 69 | 14.7 | 29.3 | 44.0 | 58.7 | 73.3 | 88.0 | 102.6 | 117.3 | 132.0 | 146.6 | 161.3 | 176.0 | 190.6 | 205.3 | 219.9 | 234.6 |
| 70 | 14.9 | 29.8 | 44.6 | 59.5 | 74.4 | 89.3 | 104.1 | 119.0 | 133.9 | 148.8 | 163.6 | 178.5 | 193.4 | 208.3 | 223.1 | 238.0 |
| 71 | 15.1 | 30.2 | 45.3 | 60.4 | 75.4 | 90.5 | 105.6 | 120.7 | 135.8 | 150.9 | 166.0 | 181.1 | 196.1 | 211.2 | 226.3 | 241.4 |
| 72 | 15.3 | 30.6 | 45.9 | 61.2 | 76.5 | 91.8 | 107.1 | 122.4 | 137.7 | 153.0 | 168.3 | 183.6 | 198.9 | 214.2 | 229.5 | 244.8 |
| 73 | 15.5 | 31.0 | 46.5 | 62.1 | 77.6 | 93.1 | 108.6 | 124.1 | 139.6 | 155.1 | 170.6 | 186.2 | 201.7 | 217.2 | 232.7 | 248.2 |
| 74 | 15.7 | 31.5 | 47.2 | 62.9 | 78.6 | 94.4 | 110.1 | 125.8 | 141.5 | 157.3 | 173.0 | 188.7 | 204.4 | 220.2 | 235.9 | 251.6 |
| 75 | 15.9 | 31.9 | 47.8 | 63.8 | 79.7 | 95.6 | 111.6 | 127.5 | 143.4 | 159.4 | 175.3 | 191.3 | 207.2 | 223.1 | 239.1 | 255.0 |
| 76 | 16.2 | 32.3 | 48.5 | 64.6 | 80.8 | 96.9 | 113.1 | 129.2 | 145.4 | 161.5 | 177.7 | 193.8 | 210.0 | 226.1 | 242.3 | 258.4 |
| 77 | 16.4 | 32.7 | 49.1 | 65.5 | 81.8 | 98.2 | 114.5 | 130.9 | 147.3 | 163.6 | 180.0 | 196.4 | 212.7 | 229.1 | 245.4 | 261.8 |
| 78 | 16.6 | 33.2 | 49.7 | 66.3 | 82.9 | 99.5 | 116.0 | 132.6 | 149.2 | 165.8 | 182.3 | 198.9 | 215.5 | 232.1 | 248.6 | 265.2 |
| 79 | 16.8 | 33.6 | 50.4 | 67.2 | 83.9 | 100.7 | 117.5 | 134.3 | 151.1 | 167.9 | 184.7 | 201.5 | 218.2 | 235.0 | 251.8 | 268.6 |
| 80 | 17.0 | 34.0 | 51.0 | 68.0 | 85.0 | 102.0 | 119.0 | 136.0 | 153.0 | 170.0 | 187.0 | 204.0 | 221.0 | 238.0 | 255.0 | 272.0 |
| 81 | 17.2 | 34.4 | 51.6 | 68.9 | 86.1 | 103.3 | 120.5 | 137.7 | 154.9 | 172.1 | 189.3 | 206.6 | 223.8 | 241.0 | 258.2 | 275.4 |
| 82 | 17.4 | 34.9 | 52.3 | 69.7 | 87.1 | 104.6 | 122.0 | 139.4 | 156.8 | 174.3 | 191.7 | 209.1 | 226.5 | 244.0 | 261.4 | 278.8 |
| 83 | 17.6 | 35.3 | 52.9 | 70.6 | 88.2 | 105.8 | 123.5 | 141.1 | 158.7 | 176.4 | 194.0 | 211.7 | 229.3 | 246.9 | 264.6 | 282.2 |
| 84 | 17.9 | 35.7 | 53.6 | 71.4 | 89.3 | 107.1 | 125.0 | 142.8 | 160.7 | 178.5 | 196.4 | 214.2 | 232.1 | 249.9 | 267.8 | 285.6 |
| 85 | 18.1 | 36.1 | 54.2 | 72.3 | 90.3 | 108.4 | 126.4 | 144.5 | 162.6 | 180.6 | 198.7 | 216.8 | 234.8 | 252.9 | 270.9 | 289.0 |
| 86 | 18.3 | 36.6 | 54.8 | 73.1 | 91.4 | 109.7 | 127.9 | 146.2 | 164.5 | 182.8 | 201.0 | 219.3 | 237.6 | 255.9 | 274.1 | 292.4 |
| 87 | 18.5 | 37.0 | 55.5 | 74.0 | 92.4 | 110.9 | 129.4 | 147.9 | 166.4 | 184.9 | 203.4 | 221.9 | 240.3 | 258.8 | 277.3 | 295.8 |
| 88 | 18.7 | 37.4 | 56.1 | 74.8 | 93.5 | 112.2 | 130.9 | 149.6 | 168.3 | 187.0 | 205.7 | 224.4 | 243.1 | 261.8 | 280.5 | 299.2 |
| 89 | 18.9 | 37.8 | 56.7 | 75.7 | 94.6 | 113.5 | 132.4 | 151.3 | 170.2 | 189.1 | 208.0 | 227.0 | 245.9 | 264.8 | 283.7 | 302.6 |
| 90 | 19.1 | 38.3 | 57.4 | 76.5 | 95.6 | 114.8 | 133.9 | 153.0 | 172.1 | 191.3 | 210.4 | 229.5 | 248.6 | 267.8 | 286.9 | 306.0 |
| 91 | 19.3 | 38.7 | 58.0 | 77.4 | 96.7 | 116.0 | 135.4 | 154.7 | 174.0 | 193.4 | 212.7 | 232.1 | 251.4 | 270.7 | 290.1 | 309.4 |
| 92 | 19.6 | 39.1 | 58.7 | 78.2 | 97.8 | 117.3 | 136.9 | 156.4 | 176.0 | 195.5 | 215.1 | 234.6 | 254.2 | 273.7 | 293.3 | 312.8 |
| 93 | 19.8 | 39.5 | 59.3 | 79.1 | 98.8 | 118.6 | 138.3 | 158.1 | 177.9 | 197.6 | 217.4 | 237.2 | 256.9 | 276.7 | 296.4 | 316.2 |
| 94 | 20.0 | 40.0 | 59.9 | 79.9 | 99.9 | 119.9 | 139.8 | 159.8 | 179.8 | 199.8 | 219.7 | 239.7 | 259.7 | 279.7 | 299.6 | 319.6 |
| 95 | 20.2 | 40.4 | 60.6 | 80.8 | 100.9 | 121.1 | 141.3 | 161.5 | 181.7 | 201.9 | 222.1 | 242.3 | 262.4 | 282.6 | 302.8 | 323.0 |
| 96 | 20.4 | 40.8 | 61.2 | 81.6 | 102.0 | 122.4 | 142.8 | 163.2 | 183.6 | 204.0 | 224.4 | 244.8 | 265.2 | 285.6 | 306.0 | 326.4 |
| 97 | 20.6 | 41.2 | 61.8 | 82.5 | 103.1 | 123.7 | 144.3 | 164.9 | 185.5 | 206.1 | 226.7 | 247.4 | 268.0 | 288.6 | 309.2 | 329.8 |
| 98 | 20.8 | 41.7 | 62.5 | 83.3 | 104.1 | 125.0 | 145.8 | 166.6 | 187.4 | 208.3 | 229.1 | 249.9 | 270.7 | 291.6 | 312.4 | 333.2 |
| 99 | 21.0 | 42.1 | 63.1 | 84.2 | 105.2 | 126.2 | 147.3 | 168.3 | 189.3 | 210.4 | 231.4 | 252.5 | 273.5 | 294.5 | 315.6 | 336.6 |
| 100 | 21.3 | 42.5 | 63.8 | 85.0 | 106.3 | 127.5 | 148.8 | 170.0 | 191.3 | 212.5 | 233.8 | 255.0 | 276.3 | 297.5 | 318.8 | 340.0 |

# AREAS OF RECTANGULAR SECTIONS—Concluded

## SQUARE INCHES

| Width, Inches | Thickness, Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/16 | 1/8 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| 49 | 3.06 | 6.13 | 9.19 | 12.25 | 15.31 | 18.38 | 21.44 | 24.50 | 27.56 | 30.63 | 33.69 | 36.75 | 39.81 | 42.88 | 45.94 | 49.00 |
| 50 | 3.13 | 6.25 | 9.38 | 12.50 | 15.63 | 18.75 | 21.88 | 25.00 | 28.13 | 31.25 | 34.38 | 37.50 | 40.63 | 43.75 | 46.88 | 50.00 |
| 51 | 3.19 | 6.38 | 9.56 | 12.75 | 15.94 | 19.13 | 22.31 | 25.50 | 28.69 | 31.88 | 35.06 | 38.25 | 41.44 | 44.63 | 47.81 | 51.00 |
| 52 | 3.25 | 6.50 | 9.75 | 13.00 | 16.25 | 19.50 | 22.75 | 26.00 | 29.25 | 32.50 | 35.75 | 39.00 | 42.25 | 45.50 | 48.75 | 52.00 |
| 53 | 3.31 | 6.63 | 9.94 | 13.25 | 16.56 | 19.88 | 23.19 | 26.50 | 29.81 | 33.13 | 36.44 | 39.75 | 43.06 | 46.38 | 49.69 | 53.00 |
| 54 | 3.38 | 6.75 | 10.13 | 13.50 | 16.88 | 20.25 | 23.63 | 27.00 | 30.38 | 33.75 | 37.13 | 40.50 | 43.88 | 47.25 | 50.63 | 54.00 |
| 55 | 3.44 | 6.88 | 10.31 | 13.75 | 17.19 | 20.63 | 24.06 | 27.50 | 30.94 | 34.38 | 37.81 | 41.25 | 44.69 | 48.13 | 51.56 | 55.00 |
| 56 | 3.50 | 7.00 | 10.50 | 14.00 | 17.50 | 21.00 | 24.50 | 28.00 | 31.50 | 35.00 | 38.50 | 42.00 | 45.50 | 49.00 | 52.50 | 56.00 |
| 57 | 3.56 | 7.13 | 10.69 | 14.25 | 17.81 | 21.38 | 24.94 | 28.50 | 32.06 | 35.63 | 39.19 | 42.75 | 46.31 | 49.88 | 53.44 | 57.00 |
| 58 | 3.63 | 7.25 | 10.88 | 14.50 | 18.13 | 21.75 | 25.38 | 29.00 | 32.63 | 36.25 | 39.88 | 43.50 | 47.13 | 50.75 | 54.38 | 58.00 |
| 59 | 3.69 | 7.38 | 11.06 | 14.75 | 18.44 | 22.13 | 25.81 | 29.50 | 33.19 | 36.88 | 40.56 | 44.25 | 47.94 | 51.63 | 55.31 | 59.00 |
| 60 | 3.75 | 7.50 | 11.25 | 15.00 | 18.75 | 22.50 | 26.25 | 30.00 | 33.75 | 37.50 | 41.25 | 45.00 | 48.75 | 52.50 | 56.25 | 60.00 |
| 61 | 3.81 | 7.63 | 11.44 | 15.25 | 19.06 | 22.88 | 26.69 | 30.50 | 34.31 | 38.13 | 41.94 | 45.75 | 49.56 | 53.38 | 57.19 | 61.00 |
| 62 | 3.88 | 7.75 | 11.63 | 15.50 | 19.38 | 23.25 | 27.13 | 31.00 | 34.88 | 38.75 | 42.63 | 46.50 | 50.38 | 54.25 | 58.13 | 62.00 |
| 63 | 3.94 | 7.88 | 11.81 | 15.75 | 19.69 | 23.63 | 27.56 | 31.50 | 35.44 | 39.38 | 43.31 | 47.25 | 51.19 | 55.13 | 59.06 | 63.00 |
| 64 | 4.00 | 8.00 | 12.00 | 16.00 | 20.00 | 24.00 | 28.00 | 32.00 | 36.00 | 40.00 | 44.00 | 48.00 | 52.00 | 56.00 | 60.00 | 64.00 |
| 65 | 4.06 | 8.13 | 12.19 | 16.25 | 20.31 | 24.38 | 28.44 | 32.50 | 36.56 | 40.63 | 44.69 | 48.75 | 52.81 | 56.88 | 60.94 | 65.00 |
| 66 | 4.13 | 8.25 | 12.38 | 16.50 | 20.63 | 24.75 | 28.88 | 33.00 | 37.13 | 41.25 | 45.38 | 49.50 | 53.63 | 57.75 | 61.88 | 66.00 |
| 67 | 4.19 | 8.38 | 12.56 | 16.75 | 20.94 | 25.13 | 29.31 | 33.50 | 37.69 | 41.88 | 46.06 | 50.25 | 54.44 | 58.63 | 62.81 | 67.00 |
| 68 | 4.25 | 8.50 | 12.75 | 17.00 | 21.25 | 25.50 | 29.75 | 34.00 | 38.25 | 42.50 | 46.75 | 51.00 | 55.25 | 59.50 | 63.75 | 68.00 |
| 69 | 4.31 | 8.63 | 12.94 | 17.25 | 21.56 | 25.88 | 30.19 | 34.50 | 38.81 | 43.13 | 47.44 | 51.75 | 56.06 | 60.38 | 64.69 | 69.00 |
| 70 | 4.38 | 8.75 | 13.13 | 17.50 | 21.88 | 26.25 | 30.63 | 35.00 | 39.38 | 43.75 | 48.13 | 52.50 | 56.88 | 61.25 | 65.63 | 70.00 |
| 71 | 4.44 | 8.88 | 13.31 | 17.75 | 22.19 | 26.63 | 31.06 | 35.50 | 39.94 | 44.38 | 48.81 | 53.25 | 57.69 | 62.13 | 66.56 | 71.00 |
| 72 | 4.50 | 9.00 | 13.50 | 18.00 | 22.50 | 27.00 | 31.50 | 36.00 | 40.50 | 45.00 | 49.50 | 54.00 | 58.50 | 63.00 | 67.50 | 72.00 |
| 73 | 4.56 | 9.13 | 13.69 | 18.25 | 22.81 | 27.38 | 31.94 | 36.50 | 41.06 | 45.63 | 50.19 | 54.75 | 59.31 | 63.88 | 68.44 | 73.00 |
| 74 | 4.63 | 9.25 | 13.88 | 18.50 | 23.13 | 27.75 | 32.38 | 37.00 | 41.63 | 46.25 | 50.88 | 55.50 | 60.13 | 64.75 | 69.38 | 74.00 |
| 75 | 4.69 | 9.38 | 14.06 | 18.75 | 23.44 | 28.13 | 32.81 | 37.50 | 42.19 | 46.88 | 51.56 | 56.25 | 60.94 | 65.63 | 70.31 | 75.00 |
| 76 | 4.75 | 9.50 | 14.25 | 19.00 | 23.75 | 28.50 | 33.25 | 38.00 | 42.75 | 47.50 | 52.25 | 57.00 | 61.75 | 66.50 | 71.25 | 76.00 |
| 77 | 4.81 | 9.63 | 14.44 | 19.25 | 24.06 | 28.88 | 33.69 | 38.50 | 43.31 | 48.13 | 52.94 | 57.75 | 62.56 | 67.38 | 72.19 | 77.00 |
| 78 | 4.88 | 9.75 | 14.63 | 19.50 | 24.38 | 29.25 | 34.13 | 39.00 | 43.88 | 48.75 | 53.63 | 58.50 | 63.38 | 68.25 | 73.13 | 78.00 |
| 79 | 4.94 | 9.88 | 14.81 | 19.75 | 24.69 | 29.63 | 34.56 | 39.50 | 44.44 | 49.38 | 54.31 | 59.25 | 64.19 | 69.13 | 74.06 | 79.00 |
| 80 | 5.00 | 10.00 | 15.00 | 20.00 | 25.00 | 30.00 | 35.00 | 40.00 | 45.00 | 50.00 | 55.00 | 60.00 | 65.00 | 70.00 | 75.00 | 80.00 |
| 81 | 5.06 | 10.13 | 15.19 | 20.25 | 25.31 | 30.38 | 35.44 | 40.50 | 45.56 | 50.63 | 55.69 | 60.75 | 65.81 | 70.88 | 75.94 | 81.00 |
| 82 | 5.13 | 10.25 | 15.38 | 20.50 | 25.63 | 30.75 | 35.88 | 41.00 | 46.13 | 51.25 | 56.38 | 61.50 | 66.63 | 71.75 | 76.88 | 82.00 |
| 83 | 5.19 | 10.38 | 15.56 | 20.75 | 25.94 | 31.13 | 36.31 | 41.50 | 46.69 | 51.88 | 57.06 | 62.25 | 67.44 | 72.63 | 77.81 | 83.00 |
| 84 | 5.25 | 10.50 | 15.75 | 21.00 | 26.25 | 31.50 | 36.75 | 42.00 | 47.25 | 52.50 | 57.75 | 63.00 | 68.25 | 73.50 | 78.75 | 84.00 |
| 85 | 5.31 | 10.63 | 15.94 | 21.25 | 26.56 | 31.88 | 37.19 | 42.50 | 47.81 | 53.13 | 58.44 | 63.75 | 69.06 | 74.38 | 79.69 | 85.00 |
| 86 | 5.38 | 10.75 | 16.13 | 21.50 | 26.88 | 32.25 | 37.63 | 43.00 | 48.38 | 53.75 | 59.13 | 64.50 | 69.88 | 75.25 | 80.63 | 86.00 |
| 87 | 5.44 | 10.88 | 16.31 | 21.75 | 27.19 | 32.63 | 38.06 | 43.50 | 48.94 | 54.38 | 59.81 | 65.25 | 70.69 | 76.13 | 81.56 | 87.00 |
| 88 | 5.50 | 11.00 | 16.50 | 22.00 | 27.50 | 33.00 | 38.50 | 44.00 | 49.50 | 55.00 | 60.50 | 66.00 | 71.50 | 77.00 | 82.50 | 88.00 |
| 89 | 5.56 | 11.13 | 16.69 | 22.25 | 27.81 | 33.38 | 38.94 | 44.50 | 50.06 | 55.63 | 61.19 | 66.75 | 72.31 | 77.88 | 83.44 | 89.00 |
| 90 | 5.63 | 11.25 | 16.88 | 22.50 | 28.13 | 33.75 | 39.38 | 45.00 | 50.63 | 56.25 | 61.88 | 67.50 | 73.13 | 78.75 | 84.38 | 90.00 |
| 91 | 5.69 | 11.38 | 17.06 | 22.75 | 28.44 | 34.13 | 39.81 | 45.50 | 51.19 | 56.88 | 62.56 | 68.25 | 73.94 | 79.63 | 85.31 | 91.00 |
| 92 | 5.75 | 11.50 | 17.25 | 23.00 | 28.75 | 34.50 | 40.25 | 46.00 | 51.75 | 57.50 | 63.25 | 69.00 | 74.75 | 80.50 | 86.25 | 92.00 |
| 93 | 5.81 | 11.63 | 17.44 | 23.25 | 29.06 | 34.88 | 40.69 | 46.50 | 52.31 | 58.13 | 63.94 | 69.75 | 75.56 | 81.38 | 87.19 | 93.00 |
| 94 | 5.88 | 11.75 | 17.63 | 23.50 | 29.38 | 35.25 | 41.13 | 47.00 | 52.88 | 58.75 | 64.63 | 70.50 | 76.38 | 82.25 | 88.13 | 94.00 |
| 95 | 5.94 | 11.88 | 17.81 | 23.75 | 29.69 | 35.63 | 41.56 | 47.50 | 53.44 | 59.38 | 65.31 | 71.25 | 77.19 | 83.13 | 89.06 | 95.00 |
| 96 | 6.00 | 12.00 | 18.00 | 24.00 | 30.00 | 36.00 | 42.00 | 48.00 | 54.00 | 60.00 | 66.00 | 72.00 | 78.00 | 84.00 | 90.00 | 96.00 |
| 97 | 6.06 | 12.13 | 18.19 | 24.25 | 30.31 | 36.38 | 42.44 | 48.50 | 54.56 | 60.63 | 66.69 | 72.75 | 78.81 | 84.88 | 90.94 | 97.00 |
| 98 | 6.13 | 12.25 | 18.38 | 24.50 | 30.63 | 36.75 | 42.88 | 49.00 | 55.13 | 61.25 | 67.38 | 73.50 | 79.63 | 85.75 | 91.88 | 98.00 |
| 99 | 6.19 | 12.38 | 18.56 | 24.75 | 30.94 | 37.13 | 43.31 | 49.50 | 55.69 | 61.88 | 68.06 | 74.25 | 80.44 | 86.63 | 92.81 | 99.00 |
| 100 | 6.25 | 12.50 | 18.75 | 25.00 | 31.25 | 37.50 | 43.75 | 50.00 | 56.25 | 62.50 | 68.75 | 75.00 | 81.25 | 87.50 | 93.75 | 100.0 |

# SQUARE AND ROUND BARS

## WEIGHTS AND AREAS

| Size, Inches | Weight, Lbs. per Foot | | Area, Square Inches | | Size, Inches | Weight, Lbs. per Foot | | Area, Square Inches | |
|---|---|---|---|---|---|---|---|---|---|
| | □ | ○ | □ | ○ | | □ | ○ | □ | ○ |
| 0 | | | | | 3 | 30.60 | 24.03 | 9.000 | 7.069 |
| 1/16 | .013 | .010 | .0039 | .0031 | 1/16 | 31.89 | 25.05 | 9.379 | 7.366 |
| 1/8 | .053 | .042 | .0156 | .0123 | 1/8 | 33.20 | 26.08 | 9.766 | 7.670 |
| 3/16 | .120 | .094 | .0352 | .0276 | 3/16 | 34.54 | 27.13 | 10.160 | 7.980 |
| 1/4 | .213 | .167 | .0625 | .0491 | 1/4 | 35.91 | 28.21 | 10.563 | 8.296 |
| 5/16 | .332 | .261 | .0977 | .0767 | 5/16 | 37.31 | 29.30 | 10.973 | 8.618 |
| 3/8 | .478 | .376 | .1406 | .1105 | 3/8 | 38.73 | 30.42 | 11.391 | 8.946 |
| 7/16 | .651 | .511 | .1914 | .1503 | 7/16 | 40.18 | 31.55 | 11.816 | 9.281 |
| 1/2 | .850 | .668 | .2500 | .1963 | 1/2 | 41.65 | 32.71 | 12.250 | 9.621 |
| 9/16 | 1.076 | .845 | .3164 | .2485 | 9/16 | 43.15 | 33.89 | 12.691 | 9.968 |
| 5/8 | 1.328 | 1.043 | .3906 | .3068 | 5/8 | 44.68 | 35.09 | 13.141 | 10.321 |
| 11/16 | 1.607 | 1.262 | .4727 | .3712 | 11/16 | 46.23 | 36.31 | 13.598 | 10.680 |
| 3/4 | 1.913 | 1.502 | .5625 | .4418 | 3/4 | 47.81 | 37.55 | 14.063 | 11.045 |
| 13/16 | 2.245 | 1.763 | .6602 | .5185 | 13/16 | 49.42 | 38.81 | 14.535 | 11.416 |
| 7/8 | 2.603 | 2.044 | .7656 | .6013 | 7/8 | 51.05 | 40.10 | 15.016 | 11.793 |
| 15/16 | 2.988 | 2.347 | .8789 | .6903 | 15/16 | 52.71 | 41.40 | 15.504 | 12.177 |
| 1 | 3.400 | 2.670 | 1.0000 | .7854 | 4 | 54.40 | 42.73 | 16.000 | 12.566 |
| 1/16 | 3.838 | 3.015 | 1.1289 | .8866 | 1/16 | 56.11 | 44.07 | 16.504 | 12.962 |
| 1/8 | 4.303 | 3.380 | 1.2656 | .9940 | 1/8 | 57.85 | 45.44 | 17.016 | 13.364 |
| 3/16 | 4.795 | 3.766 | 1.4102 | 1.1075 | 3/16 | 59.62 | 46.83 | 17.535 | 13.772 |
| 1/4 | 5.313 | 4.172 | 1.5625 | 1.2272 | 1/4 | 61.41 | 48.23 | 18.063 | 14.186 |
| 5/16 | 5.857 | 4.600 | 1.7227 | 1.3530 | 5/16 | 63.23 | 49.66 | 18.598 | 14.607 |
| 3/8 | 6.428 | 5.049 | 1.8906 | 1.4849 | 3/8 | 65.08 | 51.11 | 19.141 | 15.033 |
| 7/16 | 7.026 | 5.518 | 2.0664 | 1.6230 | 7/16 | 66.95 | 52.58 | 19.691 | 15.466 |
| 1/2 | 7.650 | 6.008 | 2.2500 | 1.7671 | 1/2 | 68.85 | 54.07 | 20.250 | 15.904 |
| 9/16 | 8.301 | 6.519 | 2.4414 | 1.9175 | 9/16 | 70.78 | 55.59 | 20.816 | 16.349 |
| 5/8 | 8.978 | 7.051 | 2.6406 | 2.0739 | 5/8 | 72.73 | 57.12 | 21.391 | 16.800 |
| 11/16 | 9.682 | 7.604 | 2.8477 | 2.2365 | 11/16 | 74.71 | 58.67 | 21.973 | 17.257 |
| 3/4 | 10.413 | 8.178 | 3.0625 | 2.4053 | 3/4 | 76.71 | 60.25 | 22.563 | 17.721 |
| 13/16 | 11.170 | 8.773 | 3.2852 | 2.5802 | 13/16 | 78.74 | 61.85 | 23.160 | 18.190 |
| 7/8 | 11.953 | 9.388 | 3.5156 | 2.7612 | 7/8 | 80.80 | 63.46 | 23.766 | 18.665 |
| 15/16 | 12.763 | 10.024 | 3.7539 | 2.9483 | 15/16 | 82.89 | 65.10 | 24.379 | 19.147 |
| 2 | 13.600 | 10.681 | 4.0000 | 3.1416 | 5 | 85.00 | 66.76 | 25.000 | 19.635 |
| 1/16 | 14.463 | 11.359 | 4.2539 | 3.3410 | 1/16 | 87.14 | 68.44 | 25.629 | 20.129 |
| 1/8 | 15.353 | 12.058 | 4.5156 | 3.5466 | 1/8 | 89.30 | 70.14 | 26.266 | 20.629 |
| 3/16 | 16.270 | 12.778 | 4.7852 | 3.7583 | 3/16 | 91.49 | 71.86 | 26.910 | 21.135 |
| 1/4 | 17.213 | 13.519 | 5.0625 | 3.9761 | 1/4 | 93.71 | 73 60 | 27.563 | 21.648 |
| 5/16 | 18.182 | 14.280 | 5.3477 | 4.2000 | 5/16 | 95.96 | 75.36 | 28.223 | 22.166 |
| 3/8 | 19.178 | 15.062 | 5.6406 | 4.4301 | 3/8 | 98.23 | 77.15 | 28.891 | 22.691 |
| 7/16 | 20.201 | 15.866 | 5.9414 | 4.6664 | 7/16 | 100.53 | 78.95 | 29.566 | 23.221 |
| 1/2 | 21.250 | 16.690 | 6.2500 | 4.9087 | 1/2 | 102.85 | 80.78 | 30.250 | 23.758 |
| 9/16 | 22.326 | 17.534 | 6.5664 | 5.1572 | 9/16 | 105.20 | 82.62 | 30.941 | 24.301 |
| 5/8 | 23.428 | 18.400 | 6.8906 | 5.4119 | 5/8 | 107.58 | 84.49 | 31.641 | 24.850 |
| 11/16 | 24.557 | 19.287 | 7.2227 | 5.6727 | 11/16 | 109.98 | 86.38 | 32.348 | 25.406 |
| 3/4 | 25.713 | 20.195 | 7.5625 | 5.9396 | 3/4 | 112.41 | 88.29 | 33.063 | 25.967 |
| 13/16 | 26.895 | 21.123 | 7.9102 | 6.2126 | 13/16 | 114.87 | 90.22 | 33.785 | 26.535 |
| 7/8 | 28.103 | 22.072 | 8.2656 | 6.4918 | 7/8 | 117.35 | 92.17 | 34.516 | 27.109 |
| 15/16 | 29.338 | 23.042 | 8.6289 | 6.7771 | 15/16 | 119.86 | 94.14 | 35.254 | 27.688 |
| 3 | 30.600 | 24.033 | 9.0000 | 7.0686 | 6 | 122.40 | 96.13 | 36.000 | 28.274 |

# SQUARE AND ROUND BARS

## WEIGHTS AND AREAS

| Size, Inches | Weight, Lbs. per Foot | | Area, Square Inches | | Size, Inches | Weight, Lbs. per Foot | | Area, Square Inches | |
|---|---|---|---|---|---|---|---|---|---|
| | □ | ○ | □ | ○ | | □ | ○ | □ | ○ |
| 6 | 122.40 | 96.13 | 36.000 | 28.274 | 9 | 275.40 | 216.30 | 81.000 | 63.617 |
| 1/16 | 124.96 | 98.15 | 36.754 | 28.866 | 1/16 | 279.24 | 219.31 | 82.129 | 64.504 |
| 1/8 | 127.55 | 100.18 | 37.516 | 29.465 | 1/8 | 283.10 | 222.35 | 83.266 | 65.397 |
| 3/16 | 130.17 | 102.23 | 38.285 | 30.069 | 3/16 | 286.99 | 225.41 | 84.410 | 66.296 |
| 1/4 | 132.81 | 104.31 | 39.063 | 30.680 | 1/4 | 290.91 | 228.48 | 85.563 | 67.201 |
| 5/16 | 135.48 | 106.41 | 39.848 | 31.296 | 5/16 | 294.86 | 231.58 | 86.723 | 68.112 |
| 3/8 | 138.18 | 108.53 | 40.641 | 31.919 | 3/8 | 298.83 | 234.70 | 87.891 | 69.029 |
| 7/16 | 140.90 | 110.66 | 41.441 | 32.548 | 7/16 | 302.83 | 237.84 | 89.066 | 69.953 |
| 1/2 | 143.65 | 112.82 | 42.250 | 33.183 | 1/2 | 306.85 | 241.00 | 90.250 | 70.882 |
| 9/16 | 146.43 | 115.00 | 43.066 | 33.824 | 9/16 | 310.90 | 244.18 | 91.441 | 71.818 |
| 5/8 | 149.23 | 117.20 | 43.891 | 34.472 | 5/8 | 314.98 | 247.38 | 92.641 | 72.760 |
| 11/16 | 152.06 | 119.43 | 44.723 | 35.125 | 11/16 | 319.08 | 250.61 | 93.848 | 73.708 |
| 3/4 | 154.91 | 121.67 | 45.563 | 35.785 | 3/4 | 323.21 | 253.85 | 95.063 | 74.662 |
| 13/16 | 157.79 | 123.93 | 46.410 | 36.450 | 13/16 | 327.37 | 257.12 | 96.285 | 75.622 |
| 7/8 | 160.70 | 126.22 | 47.266 | 37.122 | 7/8 | 331.55 | 260.40 | 97.516 | 76.589 |
| 15/16 | 163.64 | 128.52 | 48.129 | 37.800 | 15/16 | 335.76 | 263.71 | 98.754 | 77.561 |
| 7 | 166.60 | 130.85 | 49.000 | 38.485 | 10 | 340.00 | 267.04 | 100.000 | 78.540 |
| 1/16 | 169.59 | 133.19 | 49.879 | 39.175 | 1/16 | 344.26 | 270.38 | 101.254 | 79.525 |
| 1/8 | 172.60 | 135.56 | 50.766 | 39.871 | 1/8 | 348.55 | 273.75 | 102.516 | 80.516 |
| 3/16 | 175.64 | 137.95 | 51.660 | 40.574 | 3/16 | 352.87 | 277.14 | 103.785 | 81.513 |
| 1/4 | 178.71 | 140.36 | 52.563 | 41.282 | 1/4 | 357.21 | 280.55 | 105.063 | 82.516 |
| 5/16 | 181.81 | 142.79 | 53.473 | 41.997 | 5/16 | 361.58 | 283.99 | 106.348 | 83.525 |
| 3/8 | 184.93 | 145.24 | 54.391 | 42.718 | 3/8 | 365.98 | 287.44 | 107.641 | 84.541 |
| 7/16 | 188.07 | 147.71 | 55.316 | 43.445 | 7/16 | 370.40 | 290.91 | 108.941 | 85.563 |
| 1/2 | 191.25 | 150.21 | 56.250 | 44.179 | 1/2 | 374.85 | 294.41 | 110.250 | 86.590 |
| 9/16 | 194.45 | 152.72 | 57.191 | 44.918 | 9/16 | 379.33 | 297.92 | 111.566 | 87.624 |
| 5/8 | 197.68 | 155.26 | 58.141 | 45.664 | 5/8 | 383.83 | 301.46 | 112.891 | 88.664 |
| 11/16 | 200.93 | 157.81 | 59.098 | 46.415 | 11/16 | 388.36 | 305.02 | 114.223 | 89.710 |
| 3/4 | 204.21 | 160.39 | 60.063 | 47.173 | 3/4 | 392.91 | 308.59 | 115.563 | 90.763 |
| 13/16 | 207.52 | 162.99 | 61.035 | 47.937 | 13/16 | 397.49 | 312.19 | 116.910 | 91.821 |
| 7/8 | 210.85 | 165.60 | 62.016 | 48.707 | 7/8 | 402.10 | 315.81 | 118.266 | 92.886 |
| 15/16 | 214.21 | 168.24 | 63.004 | 49.483 | 15/16 | 406.74 | 319.45 | 119.629 | 93.957 |
| 8 | 217.60 | 170.90 | 64.000 | 50.265 | 11 | 411.40 | 323.11 | 121.000 | 95.033 |
| 1/16 | 221.01 | 173.58 | 65.004 | 51.054 | 1/16 | 416.09 | 326.80 | 122.379 | 96.116 |
| 1/8 | 224.45 | 176.29 | 66.016 | 51.849 | 1/8 | 420.80 | 330.50 | 123.766 | 97.205 |
| 3/16 | 227.92 | 179.01 | 67.035 | 52.649 | 3/16 | 425.54 | 334.22 | 125.160 | 98.301 |
| 1/4 | 231.41 | 181.75 | 68.063 | 53.456 | 1/4 | 430.31 | 337.97 | 126.563 | 99.402 |
| 5/16 | 234.93 | 184.52 | 69.098 | 54.269 | 5/16 | 435.11 | 341.73 | 127.973 | 100.510 |
| 3/8 | 238.48 | 187.30 | 70.141 | 55.088 | 3/8 | 439.93 | 345.52 | 129.391 | 101.623 |
| 7/16 | 242.05 | 190.11 | 71.191 | 55.914 | 7/16 | 444.78 | 349.33 | 130.816 | 102.743 |
| 1/2 | 245.65 | 192.93 | 72.250 | 56.745 | 1/2 | 449.65 | 353.16 | 132.250 | 103.869 |
| 9/16 | 249.28 | 195.78 | 73.316 | 57.583 | 9/16 | 454.55 | 357.00 | 133.691 | 105.001 |
| 5/8 | 252.93 | 198.65 | 74.391 | 58.426 | 5/8 | 459.48 | 360.87 | 135.141 | 106.139 |
| 11/16 | 256.61 | 201.54 | 75.473 | 59.276 | 11/16 | 464.43 | 364.76 | 136.598 | 107.284 |
| 3/4 | 260.31 | 204.45 | 76.563 | 60.132 | 3/4 | 469.41 | 368.68 | 138.063 | 108.434 |
| 13/16 | 264.04 | 207.38 | 77.660 | 60.994 | 13/16 | 474.42 | 372.61 | 139.535 | 109.591 |
| 7/8 | 267.80 | 210.33 | 78.766 | 61.863 | 7/8 | 479.45 | 376.56 | 141.016 | 110.754 |
| 15/16 | 271.59 | 213.31 | 79.879 | 62.737 | 15/16 | 484.51 | 380.54 | 142.504 | 111.923 |
| 9 | 275.40 | 216.30 | 81.000 | 63.617 | 12 | 489.60 | 384.53 | 144.000 | 113.098 |

# TABLE OF RAILS AND ACCESSORIES

| Rail Section | Weight per Yard | Height of Rail | Base of Rail | Length of Splice Bar | Size of Bolt | Size of Spike | One Rail Joint: Weight in Pounds: One Pair Splice Bars | One Rail Joint: Weight in Pounds: Bolts and Nuts | One Rail Joint: Weight in Pounds: Total Joint Complete | Accessories for 1000 Tons of Rails: Number: Pairs of Splice Bars | Accessories for 1000 Tons of Rails: Number: Bolts, Nuts | Accessories for 1000 Tons of Rails: Number: Spikes | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Splice Bars | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Bolts, Nuts | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Spikes | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Total Accessories | Material for One Mile of Single Track: Number: Pairs of Splice Bars | Material for One Mile of Single Track: Number: Bolts, Nuts | Material for One Mile of Single Track: Number: Spikes | Material for One Mile of Single Track: Weight in Gross Tons: Splice Bars | Material for One Mile of Single Track: Weight in Gross Tons: Bolts, Nuts | Material for One Mile of Single Track: Weight in Gross Tons: Spikes | Material for One Mile of Single Track: Weight in Gross Tons: Total Accessories | Material for One Mile of Single Track: Weight in Gross Tons: Rails | Material for One Mile of Single Track: Weight in Gross Tons: Total Mat'l Complete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lbs. | In. | In. | In. | In. | In. | | | | | | | | | | | | | | | | | | | |
| **HEAVY RAILS**—Basis of table, 90% furnished 33 ft. and 10% not less than 24 ft. long, varying by full feet. Ties 22 in. centers, 2880 ties per mile. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13031 | 130 | 6 5/8 | 5 1/2 | 24 | 1 1/4 x 6 | 5 1/2 x 9 1/16 | 89.25 | 11.32 | 100.57 | 1596 | 6384 | 56390 | 63.59 | 8.07 | 14.81 | 86.47 | 326 | 1304 | 11520 | 12.99 | 1.65 | 3.03 | 17.67 | 204.28 | 221.95 |
| 10040 | 100 | 5 3/4 | 5 3/4 | 34 | 1 x 4 5/8 | 5 1/2 x 9 1/16 | 85.65 | 9.70 | 95.35 | 2075 | 12450 | 73312 | 79.33 | 8.98 | 19.25 | 107.56 | 326 | 1956 | 11520 | 12.47 | 1.41 | 3.03 | 16.91 | 157.14 | 174.05 |
| 10030 | 100 | 5 41/64 | 5 9/64 | 34 | 1 x 4 5/8 | 5 1/2 x 9 1/16 | 91.62 | 9.70 | 101.32 | 2075 | 12450 | 73312 | 84.87 | 8.98 | 19.25 | 113.10 | 326 | 1956 | 11520 | 13.33 | 1.41 | 3.03 | 17.77 | 157.14 | 174.91 |
| 10020 | 100 | 6 | 5 1/2 | 34 | 1 x 4 5/8 | 5 1/2 x 9 1/16 | 103.94 | 9.70 | 113.64 | 2075 | 12450 | 73312 | 96.28 | 8.98 | 19.25 | 124.51 | 326 | 1956 | 11520 | 15.12 | 1.41 | 3.03 | 19.56 | 157.14 | 176.70 |
| 9040 | 90 | 5 3/8 | 5 3/8 | 34 | 1 x 4 3/8 | 5 1/2 x 9 1/16 | 72.74 | 9.40 | 82.14 | 2305 | 13830 | 81448 | 74.85 | 9.67 | 21.39 | 105.91 | 326 | 1956 | 11520 | 10.59 | 1.37 | 3.03 | 14.99 | 141.43 | 156.42 |
| 9030 | 90 | 5 17/64 | 4 49/64 | 34 | 1 x 4 5/8 | 5 1/2 x 9 1/16 | 77.53 | 9.70 | 87.23 | 2305 | 13830 | 81448 | 79.78 | 9.98 | 21.39 | 111.15 | 326 | 1956 | 11520 | 11.28 | 1.41 | 3.03 | 15.72 | 141.43 | 157.15 |
| 9020 | 90 | 5 5/8 | 5 1/8 | 34 | 1 x 4 1/2 | 5 1/2 x 9 1/16 | 90.51 | 9.52 | 100.03 | 2305 | 13830 | 81448 | 93.14 | 9.80 | 21.39 | 124.33 | 326 | 1956 | 11520 | 13.17 | 1.39 | 3.03 | 17.59 | 141.43 | 159.02 |
| 8540 | 85 | 5 3/16 | 5 3/16 | 34 | 7/8 x 4 1/8 | 5 1/2 x 9 1/16 | 67.56 | 6.90 | 74.46 | 2441 | 14646 | 86248 | 73.62 | 7.52 | 22.65 | 103.79 | 326 | 1956 | 11520 | 9.83 | 1.00 | 3.03 | 13.86 | 133.57 | 147.43 |
| 8040 | 80 | 5 | 5 | 34 | 7/8 x 4 1/8 | 5 1/2 x 9 1/16 | 62.58 | 6.90 | 69.48 | 2593 | 15558 | 91640 | 72.44 | 7.98 | 24.06 | 104.48 | 326 | 1956 | 11520 | 9.11 | 1.00 | 3.03 | 13.14 | 125.71 | 138.85 |
| 7540 | 75 | 4 13/16 | 4 13/16 | 34 | 7/8 x 4 | 5 1/2 x 9 1/16 | 57.97 | 6.74 | 64.71 | 2766 | 16596 | 97744 | 71.58 | 8.32 | 25.67 | 105.57 | 326 | 1956 | 11520 | 8.44 | .98 | 3.03 | 12.45 | 117.86 | 130.31 |
| 7040 | 70 | 4 5/8 | 4 5/8 | 34 | 7/8 x 3 3/4 | 5 1/2 x 9 1/16 | 54.64 | 4.56 | 59.20 | 2964 | 17784 | 104728 | 72.30 | 6.03 | 27.50 | 105.83 | 326 | 1956 | 11520 | 7.95 | .66 | 3.03 | 11.64 | 110.00 | 121.64 |
| 6540 | 65 | 4 7/16 | 4 7/16 | 24 | 7/8 x 3 5/8 | 5 1/2 x 9 1/16 | 35.55 | 2.98 | 38.53 | 3192 | 12768 | 112808 | 50.66 | 4.25 | 29.62 | 84.53 | 326 | 1304 | 11520 | 5.17 | .43 | 3.03 | 8.63 | 102.14 | 110.77 |
| 6040 | 60 | 4 1/4 | 4 1/4 | 24 | 7/8 x 3 1/2 | 5 1/2 x 9 1/16 | 32.40 | 2.93 | 35.33 | 3457 | 13828 | 122176 | 50.00 | 4.52 | 32.08 | 86.60 | 326 | 1304 | 11520 | 4.72 | .43 | 3.03 | 8.18 | 94 29 | 102.47 |
| 5540 | 55 | 4 1/16 | 4 1/16 | 24 | 7/8 x 3 3/8 | 5 1/2 x 9 1/16 | 28.90 | 2.91 | 31.81 | 3772 | 15088 | 133288 | 48.67 | 4.90 | 35.00 | 88.57 | 326 | 1304 | 11520 | 4.21 | .42 | 3.03 | 7.66 | 86.43 | 94.09 |
| 5040 | 50 | 3 7/8 | 3 7/8 | 24 | 7/8 x 3 1/8 | 5 1/2 x 9 1/16 | 25.50 | 2.78 | 28.28 | 4149 | 16596 | 146620 | 47.23 | 5.15 | 38.50 | 90.88 | 326 | 1304 | 11520 | 3.71 | .40 | 3.03 | 7.14 | 78.57 | 85.71 |
| **LIGHT RAILS**—Basis of table 90% furnished 30 ft. and 10% not less than 20 ft. long. Ties 24 in. centers, 2640 ties per mile. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4540 | 45 | 3 11/16 | 3 11/16 | 20 | 3/4 x 3 | 5 1/2 x 9 1/16 | 18 75 | 2.72 | 21.47 | 5148 | 20592 | 149344 | 43.09 | 6.25 | 39.22 | 88.56 | 364 | 1456 | 10560 | 3.05 | .44 | 2.77 | 6.26 | 70.71 | 76.97 |
| 4040 | 40 | 3 1/2 | 3 1/2 | 20 | 3/4 x 2 7/8 | 5 x 1/2 | 16 10 | 2 66 | 18 76 | 5791 | 23164 | 167992 | 41.62 | 6.88 | 30 60 | 79.10 | 364 | 1456 | 10560 | 2.62 | .43 | 1.92 | 4.97 | 62.86 | 67.83 |
| 3540 | 35 | 3 5/16 | 3 5/16 | 16 1/8 | 5/8 x 2 1/2 | 4 1/2 x 1/2 | 12 10 | 1.60 | 13 70 | 6618 | 26472 | 192000 | 35.79 | 4.73 | 31.97 | 72.49 | 364 | 1456 | 10560 | 1.97 | .26 | 1.76 | 3.99 | 55.00 | 58.99 |
| 3040 | 30 | 3 1/8 | 3 1/8 | 16 1/8 | 5/8 x 2 1/2 | 4 x 1/2 | 10 45 | 1.60 | 12 05 | 7722 | 30888 | 224012 | 36.02 | 5.51 | 33.33 | 74.86 | 364 | 1456 | 10560 | 1.70 | .26 | 1.57 | 3.53 | 47.14 | 50.67 |
| 2540 | 25 | 2 3/4 | 2 3/4 | 16 1/8 | 1/2 x 2 1/8 | 4 x 1/2 | 5 70 | .86 | 6 56 | 9264 | 37056 | 268772 | 23.57 | 3.56 | 40.00 | 67.13 | 364 | 1456 | 10560 | .93 | .14 | 1.57 | 2.64 | 39.29 | 41.93 |
| 2040 | 20 | 2 5/8 | 2 5/8 | 16 1/8 | 1/2 x 2 | 3 1/2 x 1/2 | 4.86 | .83 | 5.69 | 11581 | 46324 | 335984 | 25 12 | 4 29 | 48 30 | 77.71 | 364 | 1456 | 10560 | .79 | .13 | 1.52 | 2.44 | 31.42 | 33.87 |
| 1640 | 16 | 2 3/8 | 2 3/8 | 16 1/8 | 1/2 x 1 3/4 | 3 1/2 x 3/8 | 4.36 | .80 | 5.16 | 14479 | 57916 | 420048 | 28 18 | 5.17 | 31.88 | 65 23 | 364 | 1456 | 10560 | .71 | .13 | .80 | 1.64 | 25.14 | 26.78 |
| *1440 | 14 | 2 1/16 | 2 1/16 | 16 1/8 | 1/2 x 1 3/4 | 3 x 3/8 | 3.44 | .80 | 4.24 | 16545 | 66180 | 480000 | 25.41 | 5.91 | 31.93 | 63.25 | 364 | 1456 | 10560 | .56 | .13 | .70 | 1.39 | 22.00 | 23.39 |
| 1240 | 12 | 2 | 2 | 16 1/8 | 1/2 x 1 3/4 | 3 x 3/8 | 3.44 | .80 | 4.24 | 19300 | 77200 | 559916 | 29.64 | 6.89 | 37.24 | 73.77 | 364 | 1456 | 10560 | .56 | .13 | .70 | 1.39 | 18.86 | 20.25 |
| *1040 | 10 | 1 3/4 | 1 3/4 | 16 1/8 | 3/8 x 1 1/2 | 2 1/2 x 5/16 | 2.60 | .45 | 3.05 | 23155 | 92620 | 671756 | 26.88 | 4.65 | 26.99 | 58.52 | 364 | 1456 | 10560 | .42 | .07 | .42 | .91 | 15.72 | 16.63 |
| * 840 | 8 | 1 9/16 | 1 9/16 | 16 1/8 | 3/8 x 1 1/2 | 2 1/2 x 5/16 | 2.00 | .45 | 2.45 | 28958 | 115832 | 840096 | 25.86 | 5.82 | 33.75 | 65.43 | 364 | 1456 | 10560 | .33 | .07 | .42 | .82 | 12.57 | 13.39 |

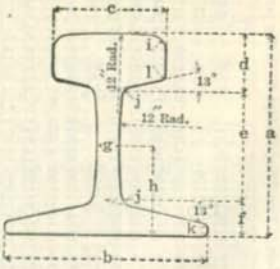
Number and weight of accessories do not allow for any excess. *Not rolled by Carnegie Steel Company.

# TABLE OF RAILS AND ACCESSORIES—Concluded

| Rail Section | Weight per Yard | Height of Rail | Base of Rail | Length of Splice Bar | Size of Bolt | Size of Spike | One Rail Joint: Weight in Pounds: One Pair Splice Bars | One Rail Joint: Weight in Pounds: Bolts and Nuts | One Rail Joint: Weight in Pounds: Total Joint Complete | Accessories for 1000 Tons of Rails: Number: Pairs of Splice Bars | Accessories for 1000 Tons of Rails: Number: Bolts, Nuts | Accessories for 1000 Tons of Rails: Number: Spikes | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Splice Bars | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Bolts, Nuts | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Spikes | Accessories for 1000 Tons of Rails: Weight in Gross Tons: Total Accessories | Material for One Mile of Single Track: Number: Pairs of Splice Bars | Material for One Mile of Single Track: Number: Bolts, Nuts | Material for One Mile of Single Track: Number: Spikes | Material for One Mile of Single Track: Weight in Gross Tons: Splice Bars | Material for One Mile of Single Track: Weight in Gross Tons: Bolts, Nuts | Material for One Mile of Single Track: Weight in Gross Tons: Spikes | Material for One Mile of Single Track: Weight in Gross Tons: Total Accessories | Material for One Mile of Single Track: Weight in Gross Tons: Rails | Material for One Mile of Single Track: Weight in Gross Tons: Total Mat'l Complete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lbs. | In. | In. | In. | In. | In. | | | | | | | | | | | | | | | | | | | |
| **HEAVY RAILS**—Basis of table, 89% furnished 39 ft. and 11% not less than 24 ft. long, varying by full feet. Ties 22 in. centers, 2880 ties per mile. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15025 | 150.45 | 7 3/4 | 6 3/4 | 32 | | 6 | x 5/8 | 147.00 | 4 | | | 1180 | 4720 | 48727 | 77.44 | | 16.18 | | 279 | 1116 | 11520 | 18.31 | | 3.82 | | 236.42 | |
| 14025 | 138.52 | 7 | 6 1/4 | | | 6 | x 5/8 | | | | | 1282 | | 52924 | | | 17.57 | | 279 | | 11520 | | | 3.82 | | 217.67 | |
| 13633 | 136 | 7 | 6 1/2 | 28 | 1 1/8 x 6 | 6 | x 5/8 | 114.85 | 6 | 16.98 | 131.83 | 1306 | 7836 | 53905 | 66.96 | 9.90 | 17.89 | 94.75 | 279 | 1674 | 11520 | 14.31 | 2.12 | 3.82 | 20.25 | 213.71 | 233.96 |
| 13031 | 130 | 6 5/8 | 5 1/2 | 24 | 1 1/8 x 6 | 6 | x 5/8 | 83.50 | 4 | 11.32 | 94.82 | 1366 | 5464 | 56391 | 50.92 | 6.90 | 18.72 | 76.54 | 279 | 1116 | 11520 | 10.40 | 1.41 | 3.82 | 15.63 | 204.29 | 219.92 |
| 13025 | 129.64 | 6 3/4 | 6 | 25 | 1 1/4 x 6 1/4 | 6 | x 5/8 | 109.74 | 4 | 11.10 | 120.84 | 1370 | 5480 | 56548 | 67.12 | 6.79 | 18.77 | 92.68 | 279 | 1116 | 11520 | 13.67 | 1.38 | 3.82 | 18.87 | 203.72 | 222.59 |
| 12722 | 127.3 | 7 | 6 1/4 | 38 | 7/8 x 4 5/8 | 6 | x 5/8 | 127.40 | 6 | 7.38 | 134.78 | 1395 | 8370 | 57539 | 79.34 | 4.60 | 19.12 | 103.06 | 279 | 1674 | 11520 | 15.87 | 0.92 | 3.82 | 20.61 | 200.04 | 220.65 |
| 12025 | 120.87 | 6 1/2 | 5 3/4 | | | 6 | x 5/8 | | | | | 1469 | | 60651 | | | 20.13 | | 279 | | 11520 | | | 3.82 | | 189.94 | |
| 11523 | 115 | 6 1/2 | 5 1/2 | 38 | 7/8 x 4 5/8 | 6 | x 5/8 | 110.99 | 6 | 7.38 | 118.37 | 1544 | 9264 | 63745 | 76.50 | 5.09 | 21.16 | 102.75 | 279 | 1674 | 11520 | 13.83 | 0.92 | 3.82 | 18.57 | 180.72 | 199.29 |
| 11025 | 110.36 | 6 1/4 | 5 1/2 | 24 | 1 x 5 | 6 | x 5/8 | 66.35 | 4 | 7.14 | 73.49 | 1609 | 6436 | 66428 | 47.66 | 5.13 | 22.05 | 74.84 | 279 | 1116 | 11520 | 8.26 | 0.89 | 3.82 | 12.97 | 173.42 | 186.39 |
| 10524 | 104.4 | 6 | 5 1/2 | 38 | 15/16 x 4 3/8 | 6 | x 5/8 | 95.85 | 6 | 8.63 | 104.48 | 1701 | 10206 | 70219 | 72.79 | 6.55 | 23.31 | 102.65 | 279 | 1674 | 11520 | 11.94 | 1.07 | 3.82 | 16.83 | 164.06 | 180.89 |
| 10040 | 100 | 5 3/4 | 5 3/4 | 34 | 1 x 4 5/8 | 5 1/2 | x 9/16 | 85.65 | 6 | 9.70 | 95.35 | 1776 | 10656 | 73310 | 67.91 | 7.69 | 19.25 | 94.85 | 279 | 1674 | 11520 | 10.67 | 1.21 | 3.03 | 14.91 | 157.14 | 172.05 |
| 10031 | 100 | 5 11/16 | 5 | 24 | 1 x 5 3/8 | 5 1/2 | x 9/16 | 60.94 | 4 | 8.20 | 69.14 | 1776 | 7104 | 73310 | 48.32 | 6.50 | 19.25 | 72.70 | 279 | 1116 | 11520 | 7.59 | 1.02 | 3.03 | 11.64 | 157.14 | 168.78 |
| 10030 | 100 | 5 41/64 | 5 9/64 | 34 | 1 x 4 5/8 | 5 1/2 | x 9/16 | 91.62 | 6 | 9.70 | 101.32 | 1776 | 10656 | 73310 | 72.64 | 7.69 | 19.25 | 99.58 | 279 | 1674 | 11520 | 11.41 | 1.21 | 3.03 | 15.65 | 157.14 | 172.79 |
| 10025 | 101.49 | 6 | 5 3/8 | 24 | 1 x 5 1/2 | 5 1/2 | x 9/16 | 67.22 | 4 | 7.80 | 75.02 | 1750 | 7000 | 72235 | 52.52 | 6.09 | 18.97 | 77.58 | 279 | 1116 | 11520 | 8.37 | 0.97 | 3.03 | 12.37 | 159.48 | 171.85 |
| 10020 | 100 | 6 | 5 1/2 | 34 | 1 x 4 5/8 | 5 1/2 | x 9/16 | 103.94 | | 9.70 | 113 64 | 1776 | 10656 | 73310 | 82.41 | 7.69 | 19.25 | 109.35 | 279 | 1674 | 11520 | 12.95 | 1.21 | 3.03 | 17.19 | 157.14 | 174.33 |
| 9040 | 90 | 5 3/8 | 5 3/8 | 34 | 1 x 4 3/8 | 5 1/2 | x 9/16 | 72.74 | 6 Bolts | 9.40 | 82 14 | 1973 | 11838 | 81454 | 64.07 | 8.28 | 21.39 | 93.74 | 279 | 1674 | 11520 | 9.06 | 1.17 | 3.03 | 13.26 | 141.43 | 154.69 |
| 9030 | 90 | 5 17/64 | 4 49/64 | 34 | 1 x 4 5/8 | 5 1/2 | x 9/16 | 77.53 | | 9.70 | 87.23 | 1973 | 11838 | 81454 | 68.29 | 8.54 | 21.39 | 98.22 | 279 | 1674 | 11520 | 9.66 | 1.21 | 3.03 | 13.90 | 141.43 | 155.33 |
| 9020 | 90 | 5 3/8 | 5 1/8 | 34 | 1 x 4 1/2 | 5 1/2 | x 9/16 | 90.51 | | 9.52 | 100.03 | 1973 | 11838 | 81454 | 79.72 | 8.39 | 21.39 | 109.50 | 279 | 1674 | 11520 | 11.27 | 1.19 | 3.03 | 15.49 | 141.43 | 156.92 |

Number and weight of accessories do not allow for any excess.

## A. S. C. E. RAILS

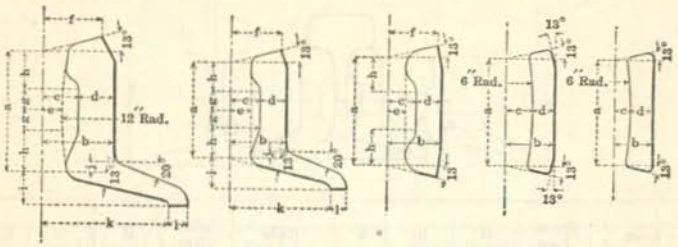



| Section Index | Weight per Yard, Pounds | a | b | c | d | e | f | g | h | i | j | k | l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| **HEAVY RAILS** | | | | | | | | | | | | | |
| 10040 | 100 | 5¾ | 5¾ | 2¾ | 1 45/64 | 3 5/64 | 31/32 | 9/16 | 2 65/128 | 5/16 | ¼ | 1/16 | 1/16 |
| 9040 | 90 | 5⅝ | 5⅝ | 2⅝ | 1 19/32 | 2 55/64 | 59/64 | 9/16 | 2 45/128 | 5/16 | ¼ | 1/16 | 1/16 |
| 8540 | 85 | 5 5/16 | 5 5/16 | 2 9/16 | 1 35/64 | 2¾ | 57/64 | 9/16 | 2 17/64 | 5/16 | ¼ | 1/16 | 1/16 |
| 8040 | 80 | 5 | 5 | 2½ | 1½ | 2⅝ | ⅞ | 35/64 | 2 3/16 | 5/16 | ¼ | 1/16 | 1/16 |
| 7540 | 75 | 4 13/16 | 4 13/16 | 2 15/32 | 1 27/64 | 2 35/64 | 27/32 | 17/32 | 2 15/128 | 5/16 | ¼ | 1/16 | 1/16 |
| 7040 | 70 | 4⅝ | 4⅝ | 2 7/16 | 1 11/32 | 2 15/32 | 13/16 | 33/64 | 2 1/64 | 5/16 | ¼ | 1/16 | 1/16 |
| 6540 | 65 | 4 7/16 | 4 7/16 | 2 13/32 | 1 9/32 | 2¾ | 25/32 | ½ | 1 31/32 | 5/16 | ¼ | 1/16 | 1/16 |
| 6040 | 60 | 4¼ | 4¼ | 2⅜ | 1 7/32 | 2 17/64 | 49/64 | 31/64 | 1 115/128 | 5/16 | ¼ | 1/16 | 1/16 |
| 5540 | 55 | 4 1/16 | 4 1/16 | 2¼ | 1 11/64 | 2 11/64 | 23/32 | 15/32 | 1 103/128 | 5/16 | ¼ | 1/16 | 1/16 |
| 5040 | 50 | 3⅞ | 3⅞ | 2⅛ | 1⅛ | 2 1/16 | 11/16 | 7/16 | 1 23/32 | 5/16 | ¼ | 1/16 | 1/16 |
| **LIGHT RAILS** | | | | | | | | | | | | | |
| 4540 | 45 | 3 11/16 | 3 11/16 | 2 | 1 1/16 | 1 31/32 | 21/32 | 27/64 | 1 41/64 | 5/16 | ¼ | 1/16 | 1/16 |
| 4040 | 40 | 3½ | 3½ | 1⅞ | 1 1/64 | 1 55/64 | 5/8 | 25/64 | 1 73/128 | 5/16 | ¼ | 1/16 | 1/16 |
| 3540 | 35 | 3 5/16 | 3 5/16 | 1¾ | 61/64 | 1 25/32 | 37/64 | 23/64 | 1 15/32 | 5/16 | ¼ | 1/16 | 1/16 |
| 3040 | 30 | 3⅛ | 3⅛ | 1 11/16 | ⅞ | 1 23/32 | 17/32 | 21/64 | 1 25/64 | 5/16 | ¼ | 1/16 | 1/16 |
| 2540 | 25 | 2¾ | 2¾ | 1½ | 25/32 | 1 31/64 | 31/64 | 19/64 | 1 29/128 | ¼ | ¼ | 1/16 | 1/16 |
| 2040 | 20 | 2⅝ | 2⅝ | 1 11/32 | 23/32 | 1 15/32 | 7/16 | ¼ | 1 11/64 | ¼ | 3/16 | | 1/16 |
| 1640 | 16 | 2⅜ | 2⅜ | 1 11/64 | 41/64 | 1 25/64 | 3/8 | 7/32 | 1 7/128 | 3/16 | 3/16 | | 1/16 |
| *1440 | 14 | 2 1/16 | 2 1/16 | 1 1/16 | 5/8 | 1 9/32 | 11/32 | ¼ | 57/64 | 5/32 | 3/16 | | 1/16 |
| 1240 | 12 | 2 | 2 | 1 | 9/16 | 1 9/32 | 11/32 | 3/16 | 57/64 | 5/32 | 3/16 | | 1/16 |
| *1040 | 10 | 1¾ | 1¾ | 15/16 | 33/64 | 1 5/16 | 19/64 | 3/16 | 49/64 | 5/32 | 3/16 | | 1/16 |
| * 840 | 8 | 1 9/16 | 1 9/16 | 1 3/16 | 15/32 | 1 3/16 | 9/32 | 5/32 | 11/16 | 5/32 | 3/16 | | 1/16 |

*Not rolled by Carnegie Steel Company.

# A. S. C. E. SPLICE BARS

S10040 to S5540 S5040 to S3040 S2540 S2040 S1640 to S840

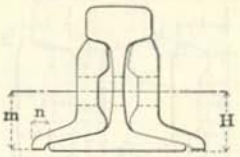



| Section Index | Weight per Foot, Unfinished | a | b | c | d | e | f | g | h | i | j | k | l |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| **HEAVY RAILS** | | | | | | | | | | | | | |
| S 10040 | 15.8 | 3 5/64 | 1 23/32 | 2 7/32 | 7/8 | 1 5/32 | 1 3/8 | 1/2 | 1 51/128 | 2 7/32 | 9/32 | 3 1/8 | 1/2 |
| S 9040 | 13.5 | 2 55/64 | 1 5/8 | 1 31/64 | 1 31/64 | 1 5/32 | 1 51/64 | 1/2 | 1 19/128 | 5 1/64 | 1 5/64 | 2 15/16 | 1/2 |
| S 8540 | 12.4 | 2 3/4 | 1 27/64 | 5 1/64 | 2 5/32 | 1 5/32 | 1 9/32 | 1/2 | 7/8 | 4 9/64 | 7/32 | 2 27/32 | 1/2 |
| S 8040 | 11.5 | 2 5/8 | 1 17/32 | 2 5/32 | 3/4 | 2 9/64 | 1 1/4 | 7/16 | 7/8 | 3/4 | 3/16 | 2 3/4 | 7/16 |
| S 7540 | 10.7 | 2 35/64 | 1 31/64 | 4 9/64 | 2 3/32 | 7/16 | 1 15/64 | 7/16 | 1 07/128 | 2 3/32 | 2 1/128 | 2 21/32 | 7/16 |
| S 7040 | 10.0 | 2 15/32 | 1 27/64 | 4 7/64 | 1 11/16 | 2 7/64 | 1 7/32 | 7/16 | 5 1/64 | 2 3/32 | 1 1/64 | 2 1/2 | 7/16 |
| S 6540 | 9.2 | 2 3/8 | 1 23/64 | 4 5/64 | 2 1/32 | 1 3/32 | 1 13/64 | 7/16 | 3/4 | 1 1/16 | 5/32 | 2 13/32 | 7/16 |
| S 6040 | 8.4 | 2 17/64 | 1 19/64 | 4 3/64 | 5/8 | 2 5/64 | 1 3/16 | 7/16 | 8 9/128 | 4 3/64 | 2 1/128 | 2 5/16 | 3/8 |
| S 5540 | 7.5 | 2 1/64 | 1 15/64 | 4 1/64 | 1 9/32 | 3/8 | 1 1/8 | 7/16 | 8 3/128 | 3/8 | 5/32 | 2 7/32 | 3/8 |
| S 5040 | 6.6 | 2 1/16 | 1 1/8 | 1 9/32 | 1 7/32 | 5/8 | 1 1/32 | 1 3/32 | 5/8 | 5/8 | 9/64 | 2 1/16 | 3/8 |
| **LIGHT RAILS** | | | | | | | | | | | | | |
| S 4540 | 5.8 | 1 31/32 | 1 3/64 | 3 5/64 | 1/2 | 2 3/64 | 31/32 | 1 3/32 | 3 7/64 | 1 9/32 | 7/64 | 1 31/32 | 3/8 |
| S 4040 | 5.0 | 1 55/64 | 31/32 | 1/2 | 1 5/32 | 1 1/32 | 2 9/32 | 1 3/32 | 6 7/128 | 9/16 | 9/128 | 1 7/8 | 5/16 |
| S 3540 | 4.6 | 1 25/32 | 3 7/64 | 2 9/64 | 7/16 | 5/16 | 2 7/32 | 1 1/32 | 3 5/64 | 3 3/64 | 7/64 | 1 25/32 | 5/16 |
| S 3040 | 3.97 | 1 23/32 | 2 7/32 | 7/16 | 1 3/32 | 5/16 | 2 5/32 | 1 3/32 | 2 9/64 | 1/2 | 5/64 | 1 11/16 | 5/16 |
| S 2540 | 2.20 | 1 31/64 | 3/4 | 1 3/32 | 1 1/32 | 9/32 | 1 1/16 | 9/32 | 5 9/128 | | | | |
| S 2040 | 1.87 | 1 15/32 | 1 1/16 | 3/8 | 5/16 | | | | | | | | |
| S 1640 | 1.70 | 1 23/64 | 3 7/64 | 1 7/64 | 5/16 | | | | | | | | |
| *S 1440 | 1.36 | 1 3/32 | 1 7/32 | 7/32 | 5/16 | | | | | | | | |
| S 1240 | 1.36 | 1 3/32 | 1 7/32 | 7/32 | 5/16 | | | | | | | | |
| *S 1040 | 0.99 | 15/16 | 15/32 | 7/32 | 1/4 | | | | | | | | |
| *S 840 | 0.75 | 13/16 | 7/16 | 7/32 | 7/32 | | | | | | | | |

*Not rolled by Carnegie Steel Company.

# A. S. C. E. RAILS

## Dimensions for Standard Drilling and Punching in Inches

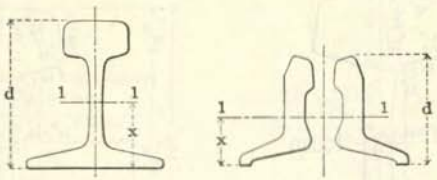



| | Rails | Splice Bars | H | m | n |
|---|---|---|---|---|---|
| Heavy Rails | 10040 | S10040 | $2^{65}/_{128}$ | $2^{49}/_{128}$ | $1^{3}/_{16}$ |
| | 9040 | S 9040 | $2^{45}/_{128}$ | $2^{29}/_{128}$ | $1^{3}/_{16}$ |
| | 8540 | S 8540 | $2^{17}/_{64}$ | $2^{9}/_{64}$ | $1^{3}/_{16}$ |
| | 8040 | S 8040 | $2^{3}/_{16}$ | $2^{1}/_{16}$ | $^{3}/_{4}$ |
| | 7540 | S 7540 | $2^{15}/_{128}$ | $1^{127}/_{128}$ | $^{3}/_{4}$ |
| | 7040 | S 7040 | $2^{3}/_{64}$ | $1^{61}/_{64}$ | $1^{1}/_{16}$ |
| | 6540 | S 6540 | $1^{31}/_{32}$ | $1^{7}/_{8}$ | $1^{1}/_{16}$ |
| | 6040 | S 6040 | $1^{115}/_{128}$ | $1^{103}/_{128}$ | $^{5}/_{8}$ |
| | 5540 | S 5540 | $1^{103}/_{128}$ | $1^{91}/_{128}$ | $^{5}/_{8}$ |
| | 5040 | S 5040 | $1^{29}/_{32}$ | $1^{21}/_{32}$ | $^{9}/_{16}$ |
| Light Rails | 4540 | S 4540 | $1^{41}/_{64}$ | $1^{37}/_{64}$ | $^{9}/_{16}$ |
| | 4040 | S 4040 | $1^{71}/_{128}$ | $1^{63}/_{128}$ | $^{1}/_{2}$ |
| | 3540 | S 3540 | $1^{15}/_{32}$ | $1^{13}/_{32}$ | $^{1}/_{2}$ |
| | 3040 | S 3040 | $1^{25}/_{64}$ | $1^{23}/_{64}$ | $^{1}/_{2}$ |
| | 2540 | S 2540 | $1^{29}/_{128}$ | | |
| | 2040 | S 2040 | $1^{11}/_{64}$ | | |
| | 1640 | S 1640 | $1^{7}/_{128}$ | | |
| | 1440 | S 1440 | $^{57}/_{64}$ | | |
| | 1240 | S 1240 | $^{57}/_{64}$ | | |
| | 1040 | S 1040 | $^{49}/_{64}$ | | |
| | 840 | S 840 | $^{11}/_{16}$ | | |


| Rails, Lb. per Yd. | Size of Hole: Rail | Size of Hole: Splice Bar | a | b | c | d | e | f | g | l |
|---|---|---|---|---|---|---|---|---|---|---|
| 100 to 90 | $1^{1}/_{4}$ | $1^{1}/_{8}$ x $1^{3}/_{8}$ | $2^{1}/_{2}$ | 5 | 6 | $5^{1}/_{16}$ | $7^{1}/_{2}$ | $5^{1}/_{2}$ | $1^{1}/_{16}$ | 34 |
| 85 to 75 | $1^{1}/_{8}$ | 1 x $1^{1}/_{4}$ | $2^{1}/_{2}$ | 5 | 6 | $5^{1}/_{16}$ | $7^{1}/_{2}$ | $5^{1}/_{2}$ | $1^{1}/_{16}$ | 34 |
| 72 to 70 | 1 | $^{7}/_{8}$ x $1^{1}/_{8}$ | $2^{1}/_{2}$ | 5 | 6 | $5^{1}/_{16}$ | $7^{1}/_{2}$ | $5^{1}/_{2}$ | $1^{1}/_{16}$ | 34 |
| 67 to 50 | 1 | $^{7}/_{8}$ x $1^{1}/_{8}$ | $2^{1}/_{2}$ | 5 | | $5^{1}/_{16}$ | $6^{1}/_{2}$ | $2^{1}/_{2}$ | $1^{1}/_{16}$ | 24 |
| 45 to 40 | $^{7}/_{8}$ | $^{13}/_{16}$ x $1^{1}/_{8}$ | $2^{1}/_{2}$ | 5 | | $5^{1}/_{8}$ | $3^{7}/_{8}$ | $1^{1}/_{8}$ | $^{3}/_{4}$ | 20 |
| 35 to 30 | $^{3}/_{4}$ | $1^{1}/_{16}$ x $^{31}/_{32}$ | 2 | 4 | | $4^{1}/_{8}$ | | | | $16^{1}/_{8}$ |
| 25 to 12 | $^{5}/_{8}$ | $^{9}/_{16}$ x $^{3}/_{4}$ | 2 | 4 | | $4^{1}/_{8}$ | | | | $16^{1}/_{8}$ |
| 10 to 8 | $^{1}/_{2}$ | $^{7}/_{16}$ x $^{5}/_{8}$ | 2 | 4 | | $4^{1}/_{8}$ | | | | $16^{1}/_{8}$ |

# A. S. C. E. RAILS

## Elements of Rails and Splice Bars

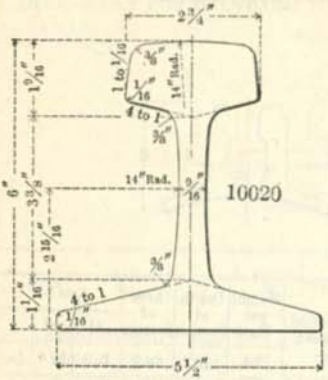



| Section Index | Weight per Yard | Depth of Section | Area of Section | Axis 1-1 | | | Section Index | Weight per Foot | Depth of Section | Area of Section | Axis 1-1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | I | S | x | | | | | *I | *S | x |
| | Lbs. | In. | In.² | In.⁴ | In.³ | In. | | Lbs. | In. | In.² | In.⁴ | In.³ | In. |
| **Heavy Rails** | | | | | | | **Heavy Rail Splice Bars** | | | | | | |
| 10040 | 100 | 5¾ | 9.84 | 43.97 | 14.55 | 2.73 | S10040 | 15.8 | 4 7/32 | 4.65 | 13.43 | 5.82 | 1.91 |
| 9040 | 90 | 5⅝ | 8.83 | 34.39 | 12.19 | 2.55 | S 9040 | 13.5 | 3 61/64 | 3.97 | 10.30 | 4.79 | 1.81 |
| 8540 | 85 | 5 15/16 | 8.33 | 30.07 | 11.08 | 2.47 | S 8540 | 12.4 | 3 15/16 | 3.65 | 8.43 | 4.02 | 1.71 |
| 8040 | 80 | 5 | 7.86 | 26.38 | 10.07 | 2.38 | S 8040 | 11.5 | 3 21/32 | 3.38 | 7.39 | 3.75 | 1.68 |
| 7540 | 75 | 4 15/16 | 7.33 | 22.86 | 9.10 | 2.30 | S 7540 | 10.7 | 3½ | 3.15 | 6.02 | 3.28 | 1.65 |
| 7040 | 70 | 4⅝ | 6.81 | 19.70 | 8.19 | 2.22 | S 7040 | 10.0 | 3 15/32 | 2.95 | 5.82 | 3.15 | 1.61 |
| 6540 | 65 | 4 7/16 | 6.33 | 16.90 | 7.37 | 2.14 | S 6540 | 9.2 | 3 11/32 | 2.71 | 4.85 | 2.73 | 1.56 |
| 6040 | 60 | 4¼ | 5.93 | 14.56 | 6.62 | 2.05 | S 6040 | 8.4 | 3 1/64 | 2.47 | 4.04 | 2.38 | 1.51 |
| 5540 | 55 | 4 1/16 | 5.38 | 12.03 | 5.75 | 1.97 | S 5540 | 7.5 | 3 1/16 | 2.21 | 3.41 | 2.07 | 1.41 |
| 5040 | 50 | 3⅞ | 4.87 | 9.94 | 4.98 | 1.88 | S 5040 | 6.6 | 2 15/16 | 1.95 | 2.72 | 1.74 | 1.37 |
| **Light Rails** | | | | | | | **Light Rail Splice Bars** | | | | | | |
| 4540 | 45 | 3 11/16 | 4.40 | 8.13 | 4.25 | 1.78 | S 4540 | 5.8 | 2 25/32 | 1.70 | | | 1.29 |
| 4040 | 40 | 3½ | 3.94 | 6.57 | 3.62 | 1.68 | S 4040 | 5.0 | 2⅝ | 1.47 | | | 1.27 |
| 3540 | 35 | 3 5/16 | 3.44 | 5.17 | 3.02 | 1.60 | S 3540 | 4.6 | 2 31/64 | 1.35 | | | 1.19 |
| 3040 | 30 | 3⅛ | 3.00 | 4.06 | 2.53 | 1.52 | S 3040 | 3.97 | 2 13/32 | 1.17 | | | 1.10 |
| 2540 | 25 | 2¾ | 2.39 | 2.50 | 1.77 | 1.33 | S 2540 | 2.20 | 1 51/64 | 0.65 | | | 0.90 |
| 2040 | 20 | 2⅝ | 2.00 | 1.94 | 1.43 | 1.27 | S 2040 | 1.87 | 1 23/32 | 0.55 | | | 0.86 |
| 1640 | 16 | 2⅜ | 1.55 | 1.24 | 1.01 | 1.15 | S 1640 | 1.70 | 1 27/64 | 0.50 | | | 0.79 |
| 1440 | 14 | 2 1/16 | 1.34 | 0.76 | 0.73 | 1.02 | S 1440 | 1.36 | 1 19/64 | 0.40 | | | 0.65 |
| 1240 | 12 | 2 | 1.18 | 0.66 | 0.63 | 0.96 | S 1240 | 1.36 | 1 19/64 | 0.40 | | | 0.65 |
| 1040 | 10 | 1¾ | 0.96 | 0.40 | 0.46 | 0.87 | S 1040 | 0.99 | 1 7/64 | 0.29 | | | 0.56 |
| 840 | 8 | 1 9/16 | 0.77 | 0.26 | 0.32 | 0.75 | S 840 | 0.75 | 31/32 | 0.22 | | | 0.49 |

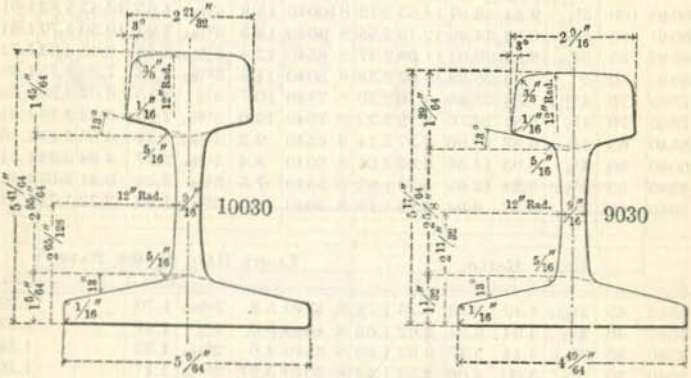
* Moment of Inertia and Section Modulus are given for pair of Splice Bars.

# AMERICAN RAILWAY ASSOCIATION RAILS

## SERIES A



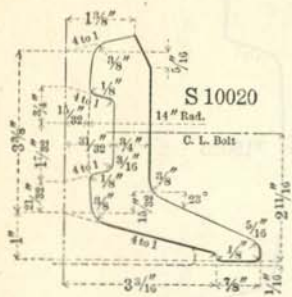

## SERIES B

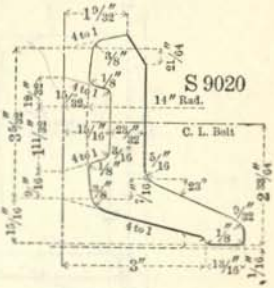



| Section Index | Weight per Yard | Area of Section | Moment of Inertia | Section Modulus | | Neutral Axis | |
|---|---|---|---|---|---|---|---|
| | | | | Base | Head | Base | Head |
| | | A | I | I/x | I/y | x | y |
| | Lb. | In.² | In.⁴ | In.³ | In.³ | In. | In. |
| 10020 | 100 | 9.84 | 48.94 | 17.82 | 15.04 | 2¾ | 3¼ |
| 9020 | 90 | 8.82 | 38.70 | 15.21 | 12.56 | 2 35/64 | 3 5/64 |
| 10030 | 100 | 9.85 | 41.30 | 15.73 | 13.70 | 2⅝ | 3 1/64 |
| 9030 | 90 | 8.87 | 32.30 | 13.21 | 11.45 | 2 7/16 | 2 59/64 |

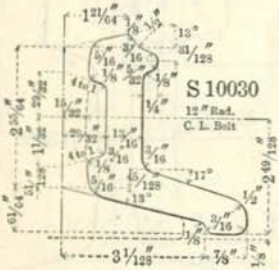
# AMERICAN RAILWAY ASSOCIATION SPLICE BARS

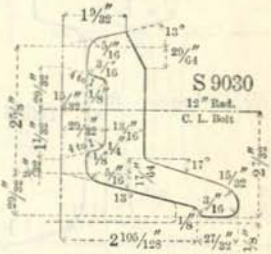
## SERIES A




## SERIES B

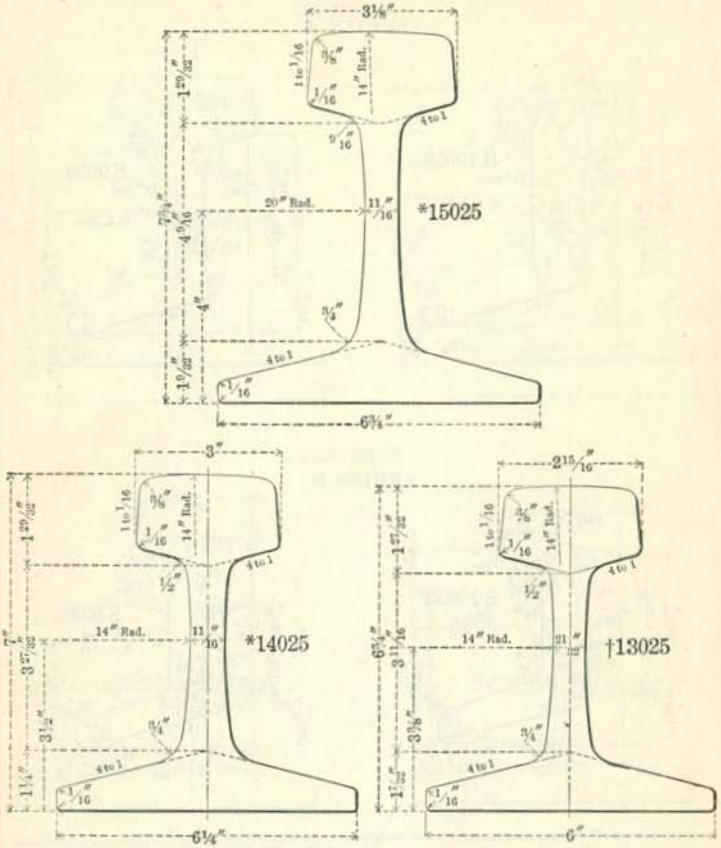



| Section Index | Weight per Foot | Area of Section | Moment of Inertia | Section Modulus | | Neutral Axis | |
|---|---|---|---|---|---|---|---|
| | | | | Bottom | Top | Bottom | Top |
| | | A | I | I/x | I/y | x | y |
| | Lb. | In.$^2$ | In.$^4$ | In.$^3$ | In.$^3$ | In. | In. |
| S 10020 | 19.0 | 5.60 | 21.30 | 10.54 | 7.88 | $2\frac{1}{64}$ | $2\frac{45}{64}$ |
| S 9020 | 16.6 | 4.90 | 16.10 | 8.43 | 6.36 | $1\frac{29}{32}$ | $2\frac{17}{32}$ |
| *S 10030 | 16.9 | 4.98 | 14.34 | 7.84 | 6.30 | $1\frac{53}{64}$ | $2\frac{9}{32}$ |
| *S 9030 | 14.4 | 4.24 | 10.16 | 6.08 | 4.71 | $1\frac{43}{64}$ | $2\frac{5}{32}$ |

Moment of Inertia and Section Modulus are given for pair of Splice Bars.
* Not rolled by Carnegie Steel Company.

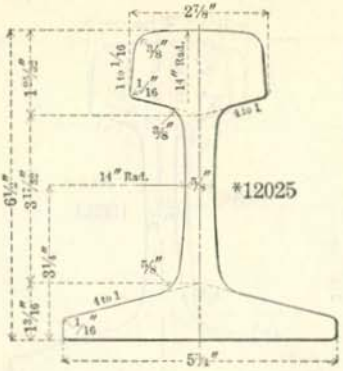
## AMERICAN RAILWAY ENGINEERING ASSOCIATION RAILS

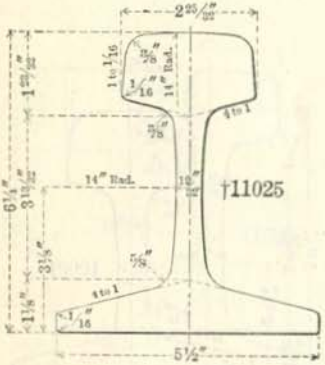


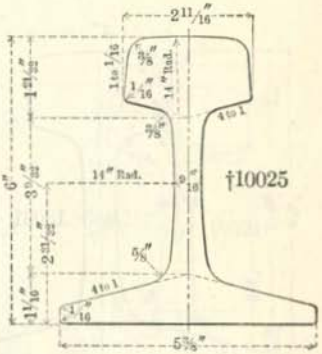

| Section Index | Weight per Yard | Area of Section | Moment of Inertia | Section Modulus | | Neutral Axis | |
|---|---|---|---|---|---|---|---|
| | | | | Base | Head | Base | Head |
| | | A | I | I/x | I/y | x | y |
| | Lb. | In.² | In.⁴ | In.³ | In.³ | In. | In. |
| *15025 | 150.45 | 14.75 | 121.1 | 35.1 | 28.2 | $3\frac{29}{64}$ | $4\frac{19}{64}$ |
| *14025 | 138.52 | 13.58 | 89.2 | 28.4 | 23.1 | $3\frac{9}{64}$ | $3\frac{55}{64}$ |
| †13025 | 129.64 | 12.71 | 77.4 | 25.6 | 20.8 | $3\frac{1}{32}$ | $3\frac{29}{32}$ |

*Not rolled by C. S. Co., I. S. Co., or T. C. I. & R. R. Co.
†Rolled by C. S. Co. and I. S. Co.

# AMERICAN RAILWAY ENGINEERING ASSOCIATION RAILS



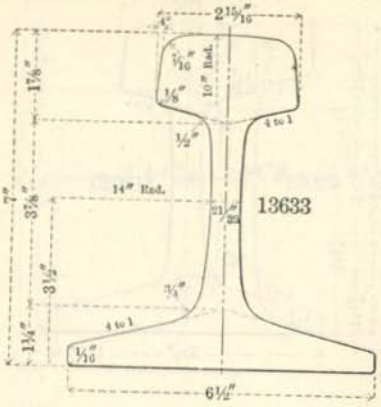



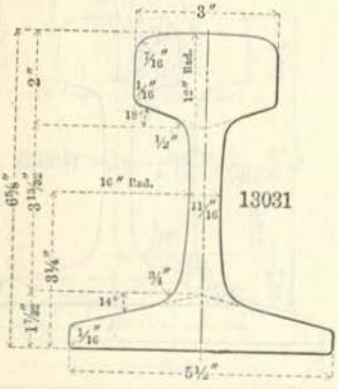



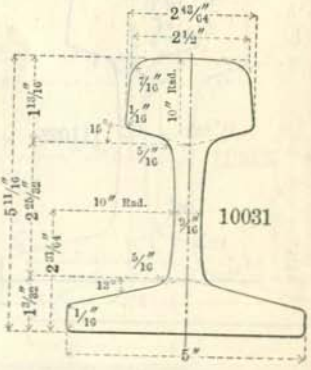

| Section Index | Weight per Yard | Area of Section | Moment of Inertia | Section Modulus | | Neutral Axis | |
|---|---|---|---|---|---|---|---|
| | | | | Base | Head | Base | Head |
| | | A | I | I/x | I/y | x | y |
| | Lb. | In.² | In.⁴ | In.³ | In.³ | In. | In. |
| *12025 | 120.87 | 11.85 | 67.6 | 23.1 | 18.9 | 2 59/64 | 3 37/64 |
| †11025 | 110.36 | 10.82 | 57.0 | 20.1 | 16.7 | 2 53/64 | 3 27/64 |
| †10025 | 101.49 | 9.95 | 49.0 | 17.8 | 15.1 | 2¾ | 3¼ |

*Not rolled by C. S. Co., I. S. Co., or T. C. I. & R. R. Co.
†Rolled by C. S. Co., I. S. Co., and T. C. I. & R. R. Co.

## MISCELLANEOUS RAILS

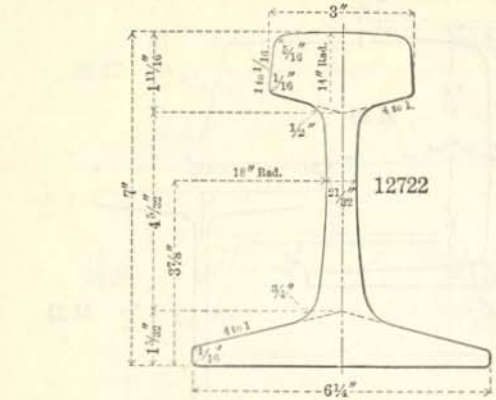


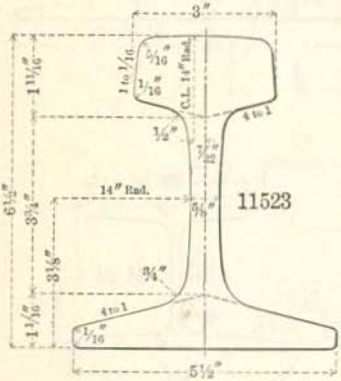



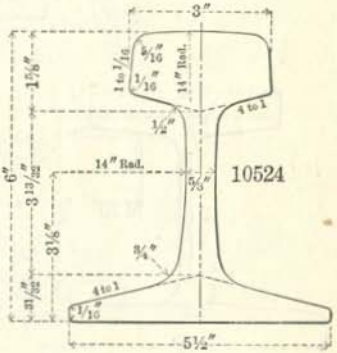




| Section Index | Weight per Yard | Area of Section | Moment of Inertia | Section Modulus | | Neutral Axis | |
|---|---|---|---|---|---|---|---|
| | | | | Base | Head | Base | Head |
| | | A | I | I/x | I/y | x | y |
| | Lb. | In.$^2$ | In.$^4$ | In.$^3$ | In.$^3$ | In. | In. |
| 13633 | 136 | 13.35 | 86.57 | 28.27 | 21.98 | 3 1/16 | 3 15/16 |
| 13031 | 130 | 12.70 | 72.80 | 23.50 | 20.60 | 3 3/32 | 3 17/32 |
| 10031 | 100 | 9.98 | 42.71 | 16.06 | 14.10 | 2 21/32 | 3 1/32 |

## MISCELLANEOUS RAILS—Concluded

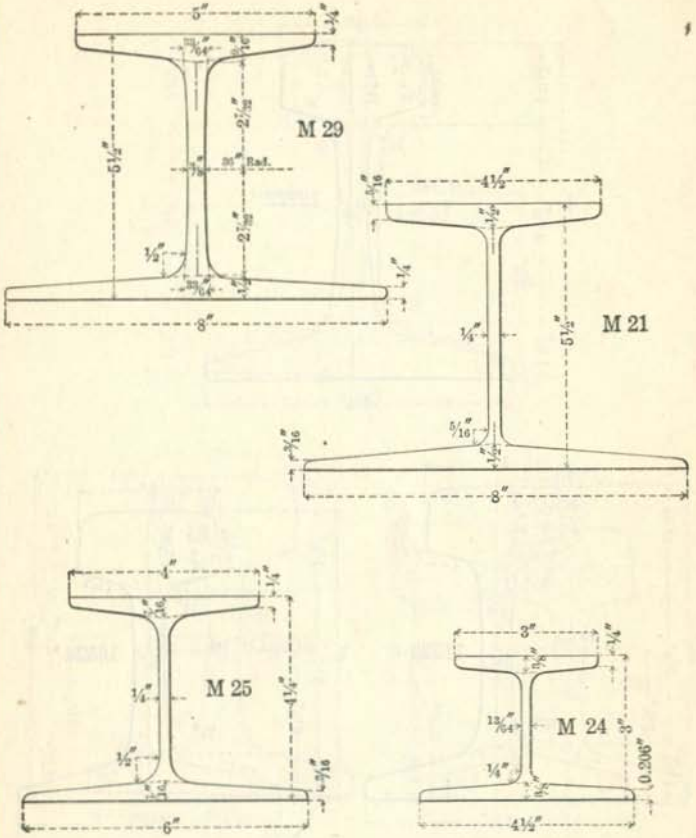



| Section Index | Weight per Yard | Area of Section | Moment of Inertia | Section Modulus | | Neutral Axis | |
|---|---|---|---|---|---|---|---|
| | | | | Base | Head | Base | Head |
| | | A | I | I/x | I/y | x | y |
| | Lb. | In.$^2$ | In.$^4$ | In.$^3$ | In.$^3$ | In. | In. |
| 12722 | 127.3 | 12.48 | 83.70 | 27.00 | 21.46 | 3 3/32 | 3 29/32 |
| 11523 | 115 | 11.24 | 64.00 | 21.33 | 18.24 | 3 | 3 1/2 |
| 10524 | 105 | 10.26 | 49.86 | 17.30 | 15.96 | 2 7/8 | 3 1/8 |

## CROSS TIE SECTIONS

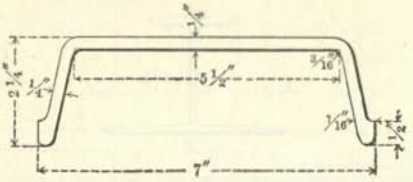



| Section Index | Depth, Inches | Width of Flanges | | Web Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|---|
| | | Top, Inches | Bottom, Inches | | |
| M 29 | 5½ | 5 | 8 | ⅜ | 24.0 |
| M 21 | 5½ | 4½ | 8 | ¼ | 20.0 |
| M 25 | 4¼ | 4 | 6 | ¼ | 14.5 |
| M 24 | 3 | 3 | 4½ | 13/64 | 9.4 |

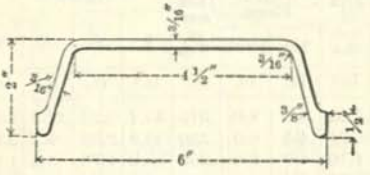
Full information as to uses of steel cross ties is given in a separate pamphlet on Steel Cross Ties.

## CROSS TIE SECTIONS—Concluded

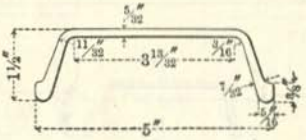
M 27



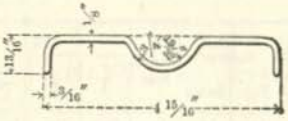

M 20



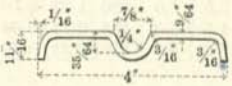

M 18




M 26



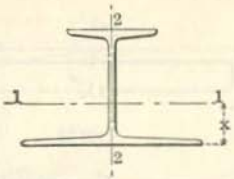

M 19



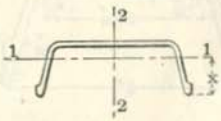

| Section Index | Depth, Inches | Width, Inches | Web Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|
| M 27 | 2¼ | 7 | ¼ | 9.0 |
| M 20 | 2 | 6 | 5/16 | 6.0 |
| M 18 | 1½ | 5 | 5/32 | 4.0 |
| M 26 | 13/16 | 4 15/16 | ⅛ | 3.20 |
| M 19 | 11/16 | 4 | 9/64 | 2.50 |

Full information as to uses of steel cross ties is given in a separate pamphlet on Steel Cross Ties.

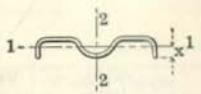
# ELEMENTS OF CROSS TIES




| Section Index | Depth of Section | Wt. per Foot | Area of Section | Width of Flange | | Thickness of Web | Axis 1-1 | | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Top | Bottom | | I | r | S | x | I | r | S |
| | In. | Lbs. | In.² | In. | In. | In. | In.⁴ | In. | In.³ | In. | In.⁴ | In. | In.³ |
| M 29 | 5.50 | 24.0 | 7.01 | 5.0 | 8.0 | .375 | 35.4 | 2.25 | 11.3 | 2.38 | 16.8 | 1.55 | 4.2 |
| M 21 | 5.50 | 20.0 | 5.71 | 4.5 | 8.0 | .250 | 30.9 | 2.33 | 9.7 | 2.33 | 14.9 | 1.62 | 3.7 |
| M 25 | 4.25 | 14.5 | 4.10 | 4.0 | 6.0 | .250 | 13.0 | 1.78 | 5.5 | 1.88 | 6.1 | 1.22 | 2.0 |
| M 24 | 3.00 | 9.4 | 2.77 | 3.0 | 4.5 | .203 | 4.2 | 1.24 | 2.5 | 1.32 | 2.9 | 1.03 | 1.3 |

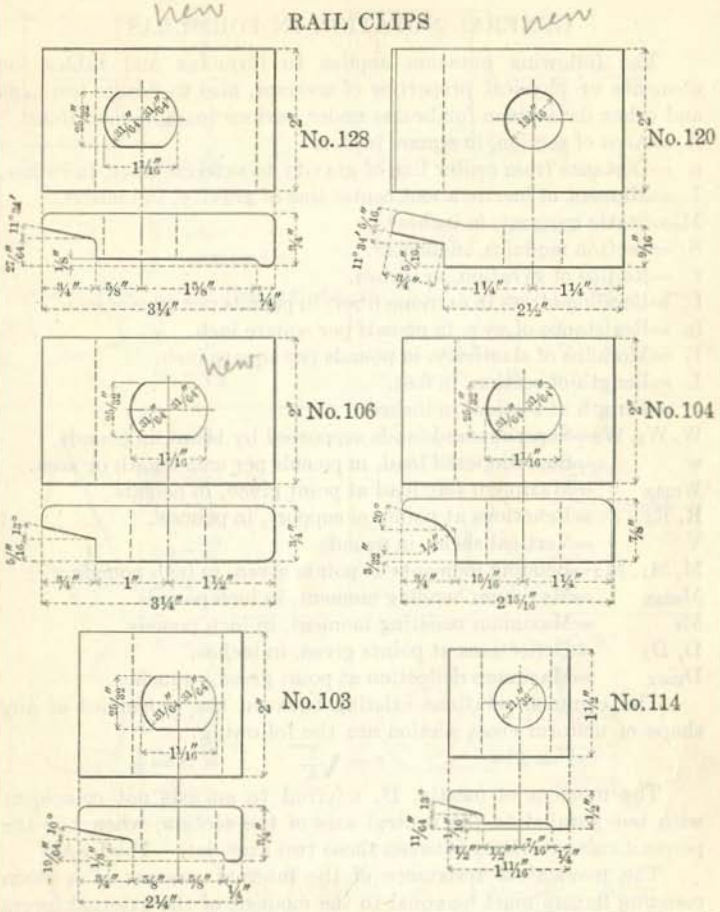



| Section Index | Depth of Section | Wt. per Foot | Area of Section | Width of Section | | Thickness | Axis 1-1 | | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Top | Bottom | | I | r | S | x | I | r | S |
| | In. | Lbs. | In.² | In. | In. | In. | In.⁴ | In. | In.³ | In. | In.⁴ | In. | In.³ |
| M 27 | 2.25 | 9.0 | 2.62 | 5.5 | 7.0 | .250 | 1.28 | 0.70 | 0.79 | 1.62 | 16.8 | 2.53 | 4.8 |
| M 20 | 2.00 | 6.0 | 1.72 | 4.5 | 6.0 | .188 | 0.71 | 0.64 | 0.51 | 1.41 | 8.4 | 2.22 | 2.8 |
| M 18 | 1.50 | 4.0 | 1.21 | 3.4 | 5.0 | .156 | 0.31 | 0.50 | 0.31 | 1.00 | 3.6 | 1.73 | 1.5 |




| Section Index | Depth of Section | Wt. per Foot | Area of Section | Width of Section | Thickness | Axis 1-1 | | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | x | I | r | S |
| | In. | Lbs. | In.² | In. | In. | In.⁴ | In. | In.³ | In. | In.⁴ | In. | In.³ |
| M 26 | 1 5/16 | 3.20 | 0.97 | 4 15/16 | .125 | 0.059 | 0.25 | 0.110 | 0.54 | 2.44 | 1.58 | 0.99 |
| M 19 | 1 1/16 | 2.51 | 0.74 | 4 | .141 | 0.024 | 0.18 | 0.057 | 0.43 | 1.15 | 1.25 | 0.58 |

## RAIL CLIPS




| Clip Number | Weight per Foot, Pounds | Finished Weight, Pounds | | Fastenings for | |
|---|---|---|---|---|---|
| | | Clip Only | Clip, Bolt, Nut | Tie Sections | Rail Sections |
| 128 | 6.0 | 0.87 | 1.53 | M21, M25, M29 | 100 to 60 lb. A. R. A.-B |
| 120 | 5.6 | 0.81 | 1.25 | M18, M20, M27 | 40 to 25 lb. A. S. C. E. |
| 106 | 7.2 | 1.05 | 1.71 | M21, M25, M29 | 100 to 60 lb. A. S. C. E. |
| 104 | 7.2 | 1.02 | 1.68 | M21, M25, M29 | 100 to 60 lb. Angle Bars |
| 103 | 4.3 | 0.58 | 1.24 | M21, M25, M29 | 100 to 55 lb. A. S. C. E. |
| 114 | 2.24 | 0.24 | 0.65 | M24 | 50 to 22 lb. A. S. C. E. |

Clips can be furnished with $^{25}/_{32}$" diameter holes.

## GENERAL NOTATION IN FORMULAS

The following notation applies to formulas and tables for elements or physical properties of sections, also to flexure formulas and other data given for beams under various loading conditions:

A =Area of section, in square inches.
n =Distance from center line of gravity to extreme fiber, in inches.
I =Moment of inertia about center line of gravity, in inches$^4$.
$M_S$=Static moment, in inches$^3$.
S =Section modulus, in inches$^3$.
r =Radius of gyration, in inches.
f =Bending stress in extreme fiber, in pounds per square inch.
$f_b$ =Resistance of web, in pounds per square inch.
E =Modulus of elasticity, in pounds per square inch.
L =Length of section, in feet.
l =Length of section, in inches.
W, $W_1$, $W_2$=Superimposed loads supported by beam, in pounds.
w =Superimposed load, in pounds per unit length or area.
$W_{max}$ =Maximum safe load at point given, in pounds.
R, $R_1$ =Reactions at points of support, in pounds.
V =Vertical shear, in pounds.
M, $M_1$, $M_2$=Bending moments at points given, in inch pounds.
$M_{max}$ =Maximum bending moment, in inch pounds.
$M_r$ =Maximum resisting moment, in inch pounds.
D, $D_1$ =Deflections at points given, in inches.
$D_{max}$ =Maximum deflection at point given, in inches.

The common relations existing between the properties of any shape of uniform cross section are the following:

$$I = Ar^2 \qquad r = \sqrt{\frac{I}{A}} \qquad S = \frac{I}{n}$$

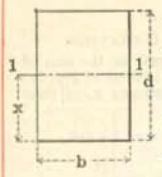
The moment of inertia, $I^1$, referred to an axis not coincident with but parallel to the neutral axis of the section, when z is the perpendicular distance between these two axes, is: $I^1 = I + Az^2$

The moment of resistance of the internal stresses of a beam resisting flexure must be equal to the moment of the external forces producing bending.

$$M_r = M_{max} = f\frac{I}{n} = f\,S.$$

The moment of resistance and the bending moment must, therefore, be expressed in same units of moment, force x length, generally in inch-pounds.

The modulus of elasticity is the ratio between unit stress and the elongation caused by that stress in one unit of length, up to the elastic limit; for steel the modulus of elasticity is 29,000,000 pounds per square inch.



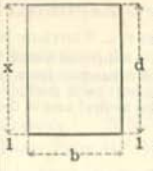
$A = bd$

$x = \frac{d}{2}$

$I_{1-1} = \frac{bd^3}{12}$

$S_{1-1} = \frac{bd^2}{6}$

$r_{1-1} = \frac{d}{\sqrt{12}}$



$A = bd$

$x = d$

$I_{1-1} = \frac{bd^3}{12} + \frac{bd^3}{4} = \frac{bd^3}{3}$

$S_{1-1} = \frac{bd^2}{3}$

$r_{1-1} = \frac{d}{\sqrt{3}}$

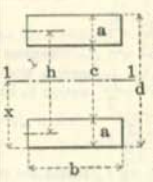
$A = bd$

$x = \frac{b \sin \alpha + d \cos \alpha}{2}$

$I_{1-1} = \frac{bd\,(b^2 \sin^2 \alpha + d^2 \cos^2 \alpha)}{12}$

$S_{1-1} = \frac{I}{x}$

$r_{1-1} = \sqrt{\frac{I}{A}}$



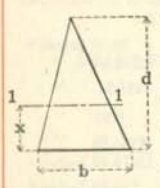
$A = 2ab$

$x = \frac{d}{2}$

$I_{1-1} = \frac{a^3 b}{6} + \frac{abh^2}{2} = \frac{b}{12}(d^3 - c^3)$

$S_{1-1} = \frac{I}{x}$

$r_{1-1} = \sqrt{\frac{I}{A}}$



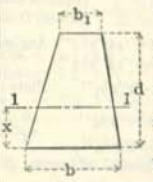
$A = \frac{bd}{2}$

$x = \frac{d}{3}$

$I_{1-1} = \frac{bd^3}{36}$

$S_{1-1} = \frac{bd^2}{24}$

$r_{1-1} = \frac{d}{\sqrt{18}}$



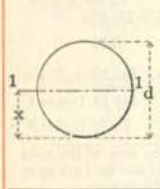
$A = \frac{d\,(b + b_1)}{2}$

$x = \frac{d\,(b + 2b_1)}{3\,(b + b_1)}$

$I_{1-1} = \frac{d^3\,(b^2 + 4bb_1 + b_1^2)}{36\,(b + b_1)}$

$S_{1-1} = \frac{I}{d - x}$

$r_{1-1} = \sqrt{\frac{I}{A}}$



$A = \frac{\pi d^2}{4}$

$x = \frac{d}{2}$

$I_{1-1} = \frac{\pi d^4}{64}$

$S_{1-1} = \frac{\pi d^3}{32}$

$r_{1-1} = \frac{d}{4}$

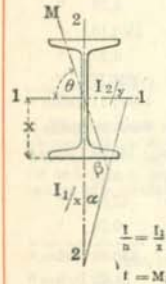
$A = \frac{\pi(d^2 - d_1^2)}{4}$

$x = \frac{d}{2}$

$I_{1-1} = \frac{\pi(d^4 - d_1^4)}{64}$

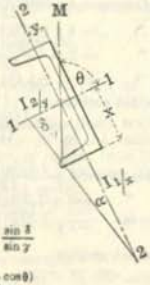
$S_{1-1} = \frac{\pi(d^4 - d_1^4)}{32d}$

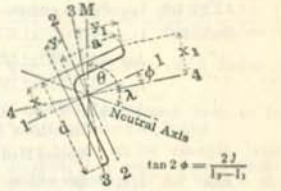
$r_{1-1} = \frac{\sqrt{d^2 + d_1^2}}{4}$



$\frac{I}{n} = \frac{I_2}{x} \frac{\sin \alpha}{\sin \beta} = \frac{I_2}{y} \frac{\sin \delta}{\sin \gamma}$

$f = M\left(\frac{x}{I_1} \sin \theta + \frac{y}{I_2} \cos \theta\right)$






$\tan 2\phi = \frac{2J}{I_y - I_1}$

$J = \frac{t\,[d(2y-t)(d-2x) + a(2x-t)(a+2t-2y)]}{4}$

$I_3 = I_y - J \tan \phi \qquad I_4 = I_1 + J \tan \phi$

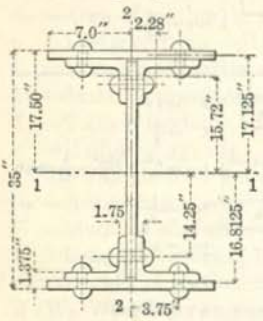
$\tan \lambda = \frac{x_1}{y_1} = -\frac{I_4}{I_3} \cot \theta$

$f = M\left(\frac{x_1}{I_4} \sin \theta + \frac{y_1}{I_3} \cos \theta\right)$

## COMPOUND SECTIONS

### Moments of Inertia, Section Moduli, and Radii of Gyration

The moment of inertia of a compound section about its neutral axis is equal to the sum of the moment of inertia, I, of the component parts about axes through their own centers of gravity, plus the areas A, of the component parts multiplied by the squares of the distances z, of their own centers of gravity from the neutral axis of the compound section, or




$$\text{Moment of Inertia} \quad I^1 = I + Az^2$$

$$\text{Section Modulus} \quad S^1 = \frac{I^1}{n}$$

$$\text{Radius of Gyration} \quad r^1 = \sqrt{\frac{I^1}{A^1}}$$

Example 1. Required the moments of inertia and the section moduli about axes 1-1 and 2-2 of a compound section to be used as a girder, composed of

1 Web Plate 33″x½″
4 Flange Angles 6″x4″x⅝″
2 Flange Plates 14″x¾″

basing the properties on the gross area of the section.

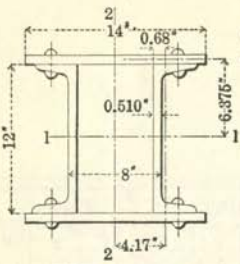
Determine the distances, z, of the center lines of gravity of plates and angles, from the neutral axes of the compound section, from the dimensions given, then for

| | | | | | | |
|---|---|---|---|---|---|---|
| AXIS 1-1 | $I_{1\text{-}1}$ of 4-6″x4″x⅝″ Angles | $= 4 \times$ | 7.5 | $=$ | 30.00 | Inches⁴ |
| | $Az^2$ of 4-6″x4″x⅝″ " | $= 4 \times$ | $5.86 \times 15.72^2$ | $=$ | 5792.46 | " |
| | $I_{1\text{-}1}$ of 1-33″x½″ Plate | $= 1 \times$ | $\frac{0.50 \times 33^3}{12}$ | $=$ | 1497.38 | " |
| | $I_{1\text{-}1}$ of 2-14″x¾″ " | $= 2 \times$ | $\frac{14 \times 0.75^3}{12}$ | $=$ | 0.98 | " |
| | $Az^2$ of 2-14″x¾″ " | $= 2 \times$ | $10.50 \times 17.125^2$ | $=$ | 6158.58 | " |
| | Moment of Inertia, gross section | | | | 13479.40 | Inches⁴ |
| | Section Modulus, " " | $=$ | $\frac{13479.40}{17.50}$ | $=$ | 770.26 | Inches³ |
| AXIS 2-2 | $I_{2\text{-}2}$ of 4-6″x4″x⅝″ Angles | $= 4 \times$ | 21.1 | $=$ | 84.40 | Inches⁴ |
| | $Az^2$ of 4-6″x4″x⅝″ " | $= 4 \times$ | $5.86 \times 2.28^2$ | $=$ | 121.85 | " |
| | $I_{2\text{-}2}$ of 1-33″x½″ Plate | $= 1 \times$ | $\frac{33 \times 0.50^3}{12}$ | $=$ | 0.34 | " |
| | $I_{2\text{-}2}$ of 2-14″x¾″ " | $= 2 \times$ | $\frac{0.75 \times 14^3}{12}$ | $=$ | 343.00 | " |
| | Moment of Inertia, gross section | | | | 549.59 | Inches⁴ |
| | Section Modulus, " " | $=$ | $\frac{549.59}{7}$ | $=$ | 78.51 | Inches³ |

If it is desired to calculate the properties of the net section, viz., to deduct the area of the rivet holes, proceed as follows, assuming that ⅞″ holes for ¾″ rivets are to be deducted and that not more than one rivet will be driven in any one leg of the angles in the same plane of the section.

| | | | | | | |
|---|---|---|---|---|---|---|
| AXIS 1-1 | $I_{1\text{-}1}$ of gross section | | | $=$ | 13479.40 | Inches⁴ |
| Deduct | $I_{1\text{-}1}$ of 4-0.875″x1.375″ Rectangles | $= 4 \times$ | $\frac{0.875 \times 1.375^3}{12}$ | $=$ | 0.76 | " |
| " | $Az^2$ of 4-0.875″x1.375″ " | $= 4 \times$ | $1.203 \times 16.8125^2$ | $=$ | 1360.16 | " |
| " | $I_{1\text{-}1}$ of 2-0.875″x1.75″ " | $= 2 \times$ | $\frac{1.75 \times 0.875^3}{12}$ | $=$ | 0.20 | " |
| " | $Az^2$ of 2-0.875″x1.75″ " | $=$ | $2 \times 1.531 \times 14.25^2$ | $=$ | 621.77 | " |
| | Moment of Inertia, net section | | | | 11496.51 | Inches⁴ |
| | Section Modulus, " " | $=$ | $\frac{11496.51}{17.50}$ | $=$ | 656.94 | Inches³ |
| AXIS 2-2 | $I_{2\text{-}2}$ of gross section | | | $=$ | 549.59 | Inches⁴ |
| Deduct | $I_{2\text{-}2}$ of 4-0.875″x1.375″ Rectangles | $= 4 \times$ | $\frac{1.375 \times 0.875^3}{12}$ | $=$ | 0.31 | " |
| " | $Az^2$ of 4-0.875″x1.375″ " | $= 4 \times$ | $1.203 \times 3.75^2$ | $=$ | 67.67 | " |
| " | $I_{2\text{-}2}$ of 2-0.875″x1.75″ " | $= 2 \times$ | $\frac{0.875 \times 1.75^3}{12}$ | $=$ | 0.78 | " |
| | Moment of Inertia, net section | | | | 480.83 | Inches⁴ |
| | Section Modulus, " " | $=$ | $\frac{480.83}{7}$ | $=$ | 68.69 | Inches³ |

## COMPOUND SECTIONS—Concluded




EXAMPLE 2. Required the moments of inertia and radii of gyration about axes 1-1 and 2-2 of a column section composed as follows:—

2 Channels 12″ x 30 pounds per foot,
2 Flange Plates 14″ x ¾″,

properties to be based on the gross section, no deduction being made for holes.

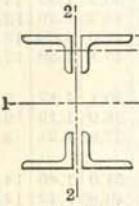
Determine the distances, z, of center lines of gravity for the various sections from the neutral axes 1-1 and 2-2, in accordance with the dimensions given, then for

AXIS 1-1

| | | | |
|---|---|---|---|
| $I_{1\text{-}1}$ of 2-12″ Channels 30 lbs. | $= 2 \times 161.2$ | $=$ | 322.40 Inches⁴ |
| $I_{1\text{-}1}$ of 2-14″ x ¾″ Plates | $= 2 \times \frac{14 \times 0.75^3}{12}$ | $=$ | 0.98 " |
| $Az^2$ of 2-14″ x ¾″ " | $= 2 \times 10.5 \times 6.375^2$ | $=$ | 853.45 " |
| Moment of Inertia, gross section | | | 1176.83 Inches⁴ |
| Radius of Gyration, " " | $= \sqrt{\frac{1176.83}{38.58}}$ | $=$ | 5.52 Inches |

AXIS 2-2

| | | | |
|---|---|---|---|
| $I_{2\text{-}2}$ of 2-12″ Channels 30 lbs. | $= 2 \times 5.2$ | $=$ | 10.40 Inches⁴ |
| $Az^2$ of 2-12″ Channels 30 lbs. | $= 2 \times 8.79 \times 4.17^2$ | $=$ | 305.70 " |
| $I_{2\text{-}2}$ of 2-14″ x ¾″ Plates | $= 2 \times \frac{0.75 \times 14^3}{12}$ | $=$ | 343.00 " |
| Moment of Inertia, gross section | | | 659.10 Inches⁴ |
| Radius of Gyration, " " | $= \sqrt{\frac{659.10}{38.58}}$ | $=$ | 4.13 Inches |




EXAMPLE 3. Required the radii of gyration about axes 1-1 and 2-2 of a strut section composed as follows:—

4-6″ x 4″ x ⅜″ Angles latticed by 5/16″ bars,

properties to be based on the gross section of angles, no deductions being made for rivet holes nor any allowance for lattice bars.

Determine the distances, z, of center lines of gravity of angles from neutral axes 1-1 and 2-2 in accordance with the dimensions given, then for

AXIS 1-1

| | | | |
|---|---|---|---|
| $I_{1\text{-}1}$ of 4-6″ x 4″ x ⅜″ Angles | $= 4 \times 4.9$ | $=$ | 19.60 Inches⁴ |
| $Az^2$ of 4-6″ x 4″ x ⅜″ " | $= 4 \times 3.61 \times 5.06^2$ | $=$ | 369.72 " |
| Moment of Inertia, gross section | | | 389.32 Inches⁴ |
| Radius of Gyration, " " | $= \sqrt{\frac{389.32}{14.44}}$ | $=$ | 5.19 Inches |

AXIS 2-2 From tables of radii of gyration for 2 angles placed back to back axis 2-2, ⅝″ apart, $r_{2\text{-}2}$ of 4-6″ x 4″ x ⅜″ angles = 2.97 Inches.

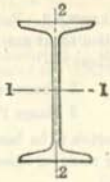
Where sections are assembled without any web or flange plates, as, for example, latticed channel columns or latticed angle struts, the radius of gyration, $r_{1\text{-}1}$ can be readily obtained, without considering the moment of inertia, from the radius of gyration, r of one section about its neutral axis, and the distance, z, between the center of gravity of the section and the neutral axis parallel to the axis of section.

$$r_{1\text{-}1} = \sqrt{\frac{I + Az^2}{A}}, \text{ where } \frac{I}{A} = r^2, \text{ and } r_{1\text{-}1} = \sqrt{r^2 + z^2}$$

Thus, in the above example,

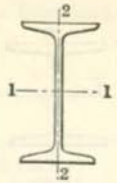
$$r_{1\text{-}1} = \sqrt{1.17^2 + 5.06^2} = 5.19 \text{ Inches}$$

# ELEMENTS OF STRUCTURAL BEAMS



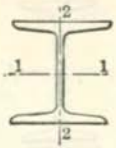

| Section Index | Depth of Beam | Weight per Foot | Area of Section | Width of Flange | Thickness of Web | Axis 1-1 | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | I | r | S |
| | In. | Lbs. | In.² | In. | In. | In.⁴ | In. | In.³ | In.⁴ | In. | In.³ |
| B 18 | 24 | 120.0 | 35.13 | 8.048 | 0.798 | 3010.8 | 9.26 | 250.9 | 84.9 | 1.56 | 21.1 |
| | | 115.0 | 33.67 | 7.987 | 0.737 | 2940.5 | 9.35 | 245.0 | 82.8 | 1.57 | 20.7 |
| | | 110.0 | 32.18 | 7.925 | 0.675 | 2869.1 | 9.44 | 239.1 | 80.6 | 1.58 | 20.3 |
| | | 105.9 | 30.98 | 7.875 | 0.625 | 2811.5 | 9.53 | 234.3 | 78.9 | 1.60 | 20.0 |
| B 1 | 24 | 100.0 | 29.25 | 7.247 | 0.747 | 2371.8 | 9.05 | 197.6 | 48.4 | 1.29 | 13.4 |
| | | 95.0 | 27.79 | 7.186 | 0.686 | 2301.5 | 9.08 | 191.8 | 47.0 | 1.30 | 13.0 |
| | | 90.0 | 26.30 | 7.124 | 0.624 | 2230.1 | 9.21 | 185.8 | 45.5 | 1.32 | 12.8 |
| | | 85.0 | 24.84 | 7.063 | 0.563 | 2159.8 | 9.33 | 180.0 | 44.2 | 1.33 | 12.5 |
| | | 79.9 | 23.33 | 7.000 | 0.500 | 2087.2 | 9.46 | 173.9 | 42.9 | 1.36 | 12.2 |
| B 2 | 20 | 100.0 | 29.20 | 7.273 | 0.873 | 1648.3 | 7.51 | 164.8 | 52.4 | 1.34 | 14.4 |
| | | 95.0 | 27.74 | 7.200 | 0.800 | 1599.7 | 7.59 | 160.0 | 50.5 | 1.35 | 14.0 |
| | | 90.0 | 26.26 | 7.126 | 0.726 | 1550.3 | 7.68 | 155.0 | 48.7 | 1.36 | 13.7 |
| | | 85.0 | 24.80 | 7.053 | 0.653 | 1501.7 | 7.78 | 150.2 | 47.0 | 1.38 | 13.3 |
| | | 81.4 | 23.74 | 7.000 | 0.600 | 1466.3 | 7.86 | 146.6 | 45.8 | 1.39 | 13.1 |
| B 3 | 20 | 75.0 | 21.90 | 6.391 | 0.641 | 1263.5 | 7.60 | 126.3 | 30.1 | 1.17 | 9.4 |
| | | 70.0 | 20.42 | 6.317 | 0.567 | 1214.2 | 7.71 | 121.4 | 28.9 | 1.19 | 9.2 |
| | | 65.4 | 19.08 | 6.250 | 0.500 | 1169.5 | 7.83 | 116.9 | 27.9 | 1.21 | 8.9 |
| B 19 | 18 | 90.0 | 26.29 | 7.236 | 0.796 | 1256.5 | 6.91 | 139.6 | 51.9 | 1.40 | 14.3 |
| | | 85.0 | 24.81 | 7.154 | 0.714 | 1216.6 | 7.00 | 135.2 | 49.8 | 1.42 | 14.0 |
| | | 80.0 | 23.34 | 7.072 | 0.632 | 1176.8 | 7.10 | 130.8 | 47.9 | 1.43 | 13.6 |
| | | 75.6 | 22.04 | 7.000 | 0.560 | 1141.8 | 7.20 | 126.9 | 46.3 | 1.45 | 13.2 |
| B 4 | 18 | 70.0 | 20.46 | 6.251 | 0.711 | 917.5 | 6.70 | 101.9 | 24.5 | 1.09 | 7.8 |
| | | 65.0 | 18.98 | 6.169 | 0.629 | 877.7 | 6.80 | 97.5 | 23.4 | 1.11 | 7.6 |
| | | 60.0 | 17.50 | 6.087 | 0.547 | 837.8 | 6.92 | 93.1 | 22.3 | 1.13 | 7.3 |
| | | 54.7 | 15.94 | 6.000 | 0.460 | 795.5 | 7.07 | 88.4 | 21.2 | 1.15 | 7.1 |
| B 6 | 15 | 75.0 | 21.85 | 6.278 | 0.868 | 687.2 | 5.61 | 91.6 | 30.6 | 1.18 | 9.8 |
| | | 70.0 | 20.38 | 6.180 | 0.770 | 659.6 | 5.69 | 87.9 | 28.8 | 1.19 | 9.3 |
| | | 65.0 | 18.91 | 6.082 | 0.672 | 632.1 | 5.78 | 84.3 | 27.2 | 1.20 | 8.9 |
| | | 60.8 | 17.68 | 6.000 | 0.590 | 609.0 | 5.87 | 81.2 | 26.0 | 1.21 | 8.7 |
| B 7 | 15 | 55.0 | 16.06 | 5.738 | 0.648 | 508.7 | 5.63 | 67.8 | 17.0 | 1.03 | 5.9 |
| | | 50.0 | 14.59 | 5.640 | 0.550 | 481.1 | 5.74 | 64.2 | 16.0 | 1.05 | 5.7 |
| | | 45.0 | 13.12 | 5.542 | 0.452 | 453.6 | 5.88 | 60.5 | 15.0 | 1.07 | 5.4 |
| | | 42.9 | 12.49 | 5.500 | 0.410 | 441.8 | 5.95 | 58.9 | 14.6 | 1.08 | 5.3 |

## ELEMENTS OF STRUCTURAL BEAMS—Concluded



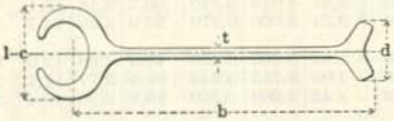

| Section Index | Depth of Beam | Weight per Foot | Area of Section | Width of Flange | Thickness of Web | Axis 1-1 | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | I | r | S |
| | In. | Lbs. | In.$^2$ | In. | In. | In.$^4$ | In. | In.$^3$ | In.$^4$ | In. | In.$^3$ |
| B 8 | 12 | 55.0 | 16.04 | 5.600 | 0.810 | 319.3 | 4.46 | 53.2 | 17.3 | 1.04 | 6.2 |
| | | 50.0 | 14.57 | 5.477 | 0.687 | 301.6 | 4.55 | 50.3 | 16.0 | 1.05 | 5.8 |
| | | 45.0 | 13.10 | 5.355 | 0.565 | 284.1 | 4.66 | 47.3 | 14.8 | 1.06 | 5.5 |
| | | 40.8 | 11.84 | 5.250 | 0.460 | 268.9 | 4.77 | 44.8 | 13.8 | 1.08 | 5.3 |
| B 9 | 12 | 35.0 | 10.20 | 5.078 | 0.428 | 227.0 | 4.72 | 37.8 | 10.0 | 0.99 | 3.9 |
| | | 31.8 | 9.26 | 5.000 | 0.350 | 215.8 | 4.83 | 36.0 | 9.5 | 1.01 | 3.8 |
| B 10 | 10 | 40.0 | 11.69 | 5.091 | 0.741 | 158.0 | 3.68 | 31.6 | 9.4 | 0.90 | 3.7 |
| | | 35.0 | 10.22 | 4.944 | 0.594 | 145.8 | 3.78 | 29.2 | 8.5 | 0.91 | 3.4 |
| | | 30.0 | 8.75 | 4.797 | 0.447 | 133.5 | 3.91 | 26.7 | 7.6 | 0.93 | 3.2 |
| | | 25.4 | 7.38 | 4.660 | 0.310 | 122.1 | 4.07 | 24.4 | 6.9 | 0.97 | 3.0 |
| B 11 | 9 | 35.0 | 10.22 | 4.764 | 0.724 | 111.3 | 3.30 | 24.7 | 7.3 | 0.84 | 3.0 |
| | | 30.0 | 8.76 | 4.601 | 0.561 | 101.4 | 3.40 | 22.5 | 6.4 | 0.85 | 2.8 |
| | | 25.0 | 7.28 | 4.437 | 0.397 | 91.4 | 3.54 | 20.3 | 5.6 | 0.88 | 2.5 |
| | | 21.8 | 6.32 | 4.330 | 0.290 | 84.9 | 3.67 | 18.9 | 5.2 | 0.90 | 2.4 |
| B 12 | 8 | 25.5 | 7.43 | 4.262 | 0.532 | 68.1 | 3.03 | 17.0 | 4.7 | 0.80 | 2.2 |
| | | 23.0 | 6.71 | 4.171 | 0.441 | 64.2 | 3.09 | 16.0 | 4.4 | 0.81 | 2.1 |
| | | 20.5 | 5.97 | 4.079 | 0.349 | 60.2 | 3.18 | 15.1 | 4.0 | 0.82 | 2.0 |
| | | 18.4 | 5.34 | 4.000 | 0.270 | 56.9 | 3.26 | 14.2 | 3.8 | 0.84 | 1.9 |
| B 13 | 7 | 20.0 | 5.83 | 3.860 | 0.450 | 41.9 | 2.68 | 12.0 | 3.1 | 0.74 | 1.6 |
| | | 17.5 | 5.09 | 3.755 | 0.345 | 38.9 | 2.77 | 11.1 | 2.9 | 0.76 | 1.6 |
| | | 15.3 | 4.43 | 3.660 | 0.250 | 36.2 | 2.86 | 10.4 | 2.7 | 0.78 | 1.5 |
| B 14 | 6 | 17.25 | 5.02 | 3.565 | 0.465 | 26.0 | 2.28 | 8.7 | 2.3 | 0.68 | 1.3 |
| | | 14.75 | 4.29 | 3.443 | 0.343 | 23.8 | 2.36 | 7.9 | 2.1 | 0.69 | 1.2 |
| | | 12.5 | 3.61 | 3.330 | 0.230 | 21.8 | 2.46 | 7.3 | 1.8 | 0.72 | 1.1 |
| B 15 | 5 | 14.75 | 4.29 | 3.284 | 0.494 | 15.0 | 1.87 | 6.0 | 1.7 | 0.63 | 1.0 |
| | | 12.25 | 3.56 | 3.137 | 0.347 | 13.5 | 1.95 | 5.4 | 1.4 | 0.63 | 0.91 |
| | | 10.0 | 2.87 | 3.000 | 0.210 | 12.1 | 2.05 | 4.8 | 1.2 | 0.65 | 0.82 |
| B 16 | 4 | 10.5 | 3.05 | 2.870 | 0.400 | 7.1 | 1.52 | 3.5 | 1.0 | 0.57 | 0.70 |
| | | 9.5 | 2.76 | 2.796 | 0.326 | 6.7 | 1.56 | 3.3 | 0.91 | 0.58 | 0.65 |
| | | 8.5 | 2.46 | 2.723 | 0.253 | 6.3 | 1.60 | 3.2 | 0.83 | 0.58 | 0.61 |
| | | 7.7 | 2.21 | 2.660 | 0.190 | 6.0 | 1.64 | 3.0 | 0.77 | 0.59 | 0.58 |
| B 17 | 3 | 7.5 | 2.17 | 2.509 | 0.349 | 2.9 | 1.15 | 1.9 | 0.59 | 0.52 | 0.47 |
| | | 6.5 | 1.88 | 2.411 | 0.251 | 2.7 | 1.19 | 1.8 | 0.51 | 0.52 | 0.43 |
| | | 5.7 | 1.64 | 2.330 | 0.170 | 2.5 | 1.23 | 1.7 | 0.46 | 0.53 | 0.40 |

## ELEMENTS OF H BEAMS




| Section Index | Depth of Beam | Weight per Foot | Area of Section | Width of Flange | Thickness of Web | Axis 1-1 | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | I | r | S |
| | In. | Lbs. | In.² | In. | In. | In.⁴ | In. | In.³ | In.⁴ | In. | In.³ |
| | | 37 7 | 11.00 | 8.125 | 0.500 | 120.8 | 3.31 | 30.2 | 36.9 | 1.83 | 9.1 |
| H 4 | 8 | 34.3 | 10.00 | 8.000 | 0.375 | 115.5 | 3.40 | 28.9 | 35.1 | 1.87 | 8.8 |
| | | 32.6 | 9.50 | 7.938 | 0.313 | 112.8 | 3.45 | 28.2 | 34.2 | 1.90 | 8.6 |
| | | 26.7 | 7.76 | 6.125 | 0.438 | 47.4 | 2.47 | 15.8 | 15.7 | 1.42 | 5.1 |
| H 3 | 6 | 24.1 | 7.01 | 6.000 | 0.313 | 45.1 | 2.54 | 15.0 | 14.7 | 1.45 | 4.9 |
| | | 22.8 | 6.63 | 5.938 | 0.250 | 44.0 | 2.58 | 14.7 | 14.2 | 1.46 | 4.8 |
| H 2 | 5 | 18.9 | 5.47 | 5.000 | 0.313 | 23.8 | 2.08 | 9.5 | 7.8 | 1.20 | 3.1 |
| H 1 | 4 | 13.8 | 3.99 | 4.000 | 0.313 | 10.7 | 1.64 | 5.3 | 3.6 | 0.95 | 1.8 |

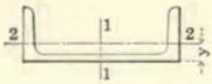
## ELEMENTS OF U. S. STEEL SHEET PILING SECTIONS




| Section Index | Dimensions | | | | Weight per Foot | Area of Section | Axis 1-1 | | |
|---|---|---|---|---|---|---|---|---|---|
| | b | c | d | t | | | I | r | S |
| | In. | In. | In. | In. | Lbs. | In.² | In.⁴ | In. | In.³ |
| M 105 | 13¼ | 3 15/16 | 2½ | ½ | 42.5 | 12.51 | 8.56 | 0.83 | 4.35 |
| M 104 | 13¼ | 3 15/16 | 2½ | 3/8 | 38 | 11.30 | 8.50 | 0.87 | 4.32 |

# ELEMENTS OF STRUCTURAL CHANNELS

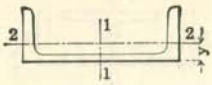
## American Standard Sections




| Section Index | Depth of Channel | Weight per Foot | Area of Section | Width of Flange | Thickness of Web | Axis 1-1 | | | Axis 2-2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | I | r | S | y |
| | In. | Lbs. | In.$^2$ | In. | In. | In.$^4$ | In. | In.$^3$ | In.$^4$ | In. | In.$^3$ | In. |
| | | 55.0 | 16.11 | 3.814 | 0.814 | 429.0 | 5.16 | 57.2 | 12.1 | 0.87 | 4.1 | 0.82 |
| | | 50.0 | 14.64 | 3.716 | 0.716 | 401.4 | 5.24 | 53.6 | 11.2 | 0.87 | 3.8 | 0.80 |
| C 1 | 15 | 45.0 | 13.17 | 3.618 | 0.618 | 373.9 | 5.33 | 49.8 | 10.3 | 0.88 | 3.6 | 0.79 |
| | | 40.0 | 11.70 | 3.520 | 0.520 | 346.3 | 5.44 | 46.2 | 9.3 | 0.89 | 3.4 | 0.78 |
| | | 35.0 | 10.23 | 3.422 | 0.422 | 318.7 | 5.58 | 42.5 | 8.4 | 0.91 | 3.2 | 0.79 |
| | | 33.9 | 9.90 | 3.400 | 0.400 | 312.6 | 5.62 | 41.7 | 8.2 | 0.91 | 3.2 | 0.79 |
| | | 40.0 | 11.73 | 3.415 | 0.755 | 196.5 | 4.09 | 32.8 | 6.6 | 0.75 | 2.5 | 0.72 |
| | | 35.0 | 10.26 | 3.292 | 0.632 | 178.8 | 4.18 | 29.8 | 5.9 | 0.76 | 2.3 | 0.69 |
| C 2 | 12 | 30.0 | 8.79 | 3.170 | 0.510 | 161.2 | 4.28 | 26.9 | 5.2 | 0.77 | 2.1 | 0.68 |
| | | 25.0 | 7.32 | 3.047 | 0.387 | 143.5 | 4.43 | 23.9 | 4.5 | 0.79 | 1.9 | 0.68 |
| | | 20.7 | 6.03 | 2.940 | 0.280 | 128.1 | 4.61 | 21.4 | 3.9 | 0.81 | 1.7 | 0.70 |
| | | 35.0 | 10.27 | 3.180 | 0.820 | 115.2 | 3.34 | 23.0 | 4.6 | 0.67 | 1.9 | 0.69 |
| | | 30.0 | 8.80 | 3.033 | 0.673 | 103.0 | 3.42 | 20.6 | 4.0 | 0.67 | 1.7 | 0.65 |
| C 3 | 10 | 25.0 | 7.33 | 2.886 | 0.526 | 90.7 | 3.52 | 18.1 | 3.4 | 0.68 | 1.5 | 0.62 |
| | | 20.0 | 5.86 | 2.739 | 0.379 | 78.5 | 3.66 | 15.7 | 2.8 | 0.70 | 1.3 | 0.61 |
| | | 15.3 | 4.47 | 2.600 | 0.240 | 66.9 | 3.87 | 13.4 | 2.3 | 0.72 | 1.2 | 0.64 |
| | | 25.0 | 7.33 | 2.812 | 0.612 | 70.5 | 3.10 | 15.7 | 3.0 | 0.64 | 1.4 | 0.61 |
| | | 20.0 | 5.86 | 2.648 | 0.448 | 60.6 | 3.22 | 13.5 | 2.4 | 0.65 | 1.2 | 0.59 |
| C 4 | 9 | 15.0 | 4.39 | 2.485 | 0.285 | 50.7 | 3.40 | 11.3 | 1.9 | 0.67 | 1.0 | 0.59 |
| | | 13.4 | 3.89 | 2.430 | 0.230 | 47.3 | 3.49 | 10.5 | 1.8 | 0.67 | 0.97 | 0.61 |
| | | 21.25 | 6.23 | 2.619 | 0.579 | 47.6 | 2.77 | 11.9 | 2.2 | 0.60 | 1.1 | 0.59 |
| | | 18.75 | 5.49 | 2.527 | 0.487 | 43.7 | 2.82 | 10.9 | 2.0 | 0.60 | 1.0 | 0.57 |
| C 5 | 8 | 16.25 | 4.76 | 2.435 | 0.395 | 39.8 | 2.89 | 9.9 | 1.8 | 0.61 | 0.94 | 0.56 |
| | | 13.75 | 4.02 | 2.343 | 0.303 | 35.8 | 2.99 | 9.0 | 1.5 | 0.62 | 0.86 | 0.56 |
| | | 11.5 | 3.36 | 2.260 | 0.220 | 32.3 | 3.10 | 8.1 | 1.3 | 0.63 | 0.79 | 0.58 |
| | | 19.75 | 5.79 | 2.509 | 0.629 | 33.1 | 2.39 | 9.4 | 1.8 | 0.56 | 0.96 | 0.58 |
| | | 17.25 | 5.05 | 2.404 | 0.524 | 30.1 | 2.44 | 8.6 | 1.6 | 0.56 | 0.86 | 0.55 |
| C 6 | 7 | 14.75 | 4.32 | 2.299 | 0.419 | 27.1 | 2.51 | 7.7 | 1.4 | 0.57 | 0.79 | 0.53 |
| | | 12.25 | 3.58 | 2.194 | 0.314 | 24.1 | 2.59 | 6.9 | 1.2 | 0.58 | 0.71 | 0.53 |
| | | 9.8 | 2.85 | 2.090 | 0.210 | 21.1 | 2.72 | 6.0 | 0.98 | 0.59 | 0.63 | 0.55 |
| | | 15.5 | 4.54 | 2.279 | 0.559 | 19.5 | 2.07 | 6.5 | 1.3 | 0.53 | 0.73 | 0.55 |
| C 7 | 6 | 13.0 | 3.81 | 2.157 | 0.437 | 17.3 | 2.13 | 5.8 | 1.1 | 0.53 | 0.65 | 0.52 |
| | | 10.5 | 3.07 | 2.034 | 0.314 | 15.1 | 2.22 | 5.0 | 0.87 | 0.53 | 0.57 | 0.50 |
| | | 8.2 | 2.39 | 1.920 | 0.200 | 13.0 | 2.34 | 4.3 | 0.70 | 0.54 | 0.50 | 0.52 |
| | | 11.5 | 3.36 | 2.032 | 0.472 | 10.4 | 1.76 | 4.1 | 0.82 | 0.49 | 0.54 | 0.51 |
| C 8 | 5 | 9.0 | 2.63 | 1.885 | 0.325 | 8.8 | 1.83 | 3.5 | 0.64 | 0.49 | 0.45 | 0.48 |
| | | 6.7 | 1.95 | 1.750 | 0.190 | 7.4 | 1.95 | 3.0 | 0.48 | 0.50 | 0.38 | 0.49 |
| | | 7.25 | 2.12 | 1.720 | 0.320 | 4.5 | 1.47 | 2.3 | 0.44 | 0.46 | 0.35 | 0.46 |
| C 9 | 4 | 6.25 | 1.82 | 1.647 | 0.247 | 4.1 | 1.50 | 2.1 | 0.38 | 0.45 | 0.32 | 0.46 |
| | | 5.4 | 1.56 | 1.580 | 0.180 | 3.8 | 1.56 | 1.9 | 0.32 | 0.45 | 0.29 | 0.46 |
| | | 6.0 | 1.75 | 1.596 | 0.356 | 2.1 | 1.08 | 1.4 | 0.31 | 0.42 | 0.27 | 0.46 |
| C 10 | 3 | 5.0 | 1.46 | 1.498 | 0.258 | 1.8 | 1.12 | 1.2 | 0.25 | 0.41 | 0.24 | 0.44 |
| | | 4.1 | 1.19 | 1.410 | 0.170 | 1.6 | 1.17 | 1.1 | 0.20 | 0.41 | 0.21 | 0.44 |

# ELEMENTS OF SHIP BUILDING CHANNELS

## American Standard Sections

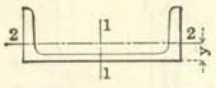



| Section Index | Depth of Channel | Wt. per Foot | Area of Section | Width of Flange | Thickness of Web | Axis 1-1 | | | Axis 2-2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | I | r | S | y |
| | In. | Lbs. | In.$^2$ | In. | In. | In.$^4$ | In. | In.$^3$ | In.$^4$ | In. | In.$^3$ | In. |
| †C 60 | 18 | 58.0 | 16.98 | 4.200 | .700 | 670.7 | 6.29 | 74.5 | 18.5 | 1.04 | 5.6 | 0.88 |
| | | 51.9 | 15.18 | 4.100 | .600 | 622.1 | 6.40 | 69.1 | 17.1 | 1.06 | 5.3 | 0.87 |
| | | 45.8 | 13.38 | 4.000 | .500 | 573.5 | 6.55 | 63.7 | 15.8 | 1.09 | 5.1 | 0.89 |
| | | 42.7 | 12.48 | 3.950 | .450 | 549.2 | 6.64 | 61.0 | 15.0 | 1.10 | 4.9 | 0.90 |
| C 21 (BSC 26) | 12 | 44.7 | 13.05 | 4.200 | .725 | 245.0 | 4.33 | 40.8 | 16.8 | 1.14 | 5.3 | 1.04 |
| | | 40.6 | 11.85 | 4.100 | .625 | 230.6 | 4.41 | 38.4 | 15.5 | 1.15 | 5.1 | 1.04 |
| | | **36.5** | **10.65** | **4.000** | **.525** | **216.2** | **4.51** | **36.0** | **14.2** | **1.16** | **4.8** | **1.06** |
| | | 34.5 | 10.05 | 3.950 | .475 | 209.0 | 4.57 | 34.8 | 13.5 | 1.16 | 4.7 | 1.07 |
| C 171 (BSC 25) | 12 | 41.1 | 12.00 | 3.700 | .700 | 217.8 | 4.26 | 36.3 | 11.3 | 0.97 | 4.0 | 0.89 |
| | | 37.0 | 10.80 | 3.600 | .600 | 203.4 | 4.34 | 33.9 | 10.3 | 0.98 | 3.8 | 0.89 |
| | | **32.9** | **9.60** | **3.500** | **.500** | **189.0** | **4.44** | **31.5** | **9.4** | **0.99** | **3.6** | **0.89** |
| | | 30.9 | 9.00 | 3.450 | .450 | 181.8 | 4.50 | 30.3 | 8.9 | 0.99 | 3.5 | 0.90 |
| C 26 (BSC 21) | 10 | 37.0 | 10.81 | 4.200 | .675 | 146.3 | 3.68 | 29.3 | 14.9 | 1.18 | 4.8 | 1.10 |
| | | 33.6 | 9.81 | 4.100 | .575 | 138.0 | 3.75 | 27.6 | 13.7 | 1.18 | 4.6 | 1.11 |
| | | **30.2** | **8.81** | **4.000** | **.475** | **129.7** | **3.84** | **25.9** | **12.5** | **1.19** | **4.3** | **1.13** |
| | | 28.5 | 8.31 | 3.950 | .425 | 125.5 | 3.89 | 25.1 | 11.8 | 1.19 | 4.2 | 1.15 |
| C 27 (BSC 20) | 10 | 35.1 | 10.23 | 3.700 | .675 | 133.6 | 3.61 | 26.7 | 10.4 | 1.01 | 3.8 | 0.95 |
| | | 31.7 | 9.23 | 3.600 | .575 | 125.2 | 3.69 | 25.0 | 9.5 | 1.01 | 3.6 | 0.95 |
| | | **28.3** | **8.23** | **3.500** | **.475** | **116.9** | **3.77** | **23.4** | **8.6** | **1.02** | **3.4** | **0.96** |
| | | 26.6 | 7.73 | 3.450 | .425 | 112.7 | 3.82 | 22.5 | 8.1 | 1.02 | 3.3 | 0.97 |
| | | 24.9 | 7.23 | 3.400 | .375 | 108.6 | 3.88 | 21.7 | 7.6 | 1.03 | 3.2 | 0.98 |
| C 28 (BSC 19) | 10 | 25.3 | 7.38 | 3.550 | .425 | 106.0 | 3.79 | 21.2 | 7.9 | 1.04 | 3.0 | 0.94 |
| | | **23.6** | **6.88** | **3.500** | **.375** | **101.8** | **3.85** | **20.4** | **7.5** | **1.04** | **2.9** | **0.96** |
| | | 21.9 | 6.38 | 3.450 | .325 | 97.6 | 3.91 | 19.5 | 7.0 | 1.05 | 2.8 | 0.98 |
| C 31 (BSC 18) | 9 | 34.7 | 10.13 | 4.200 | .675 | 113.0 | 3.34 | 25.1 | 14.5 | 1.20 | 4.8 | 1.15 |
| | | 31.7 | 9.23 | 4.100 | .575 | 106.9 | 3.40 | 23.8 | 13.3 | 1.20 | 4.5 | 1.16 |
| | | **28.6** | **8.33** | **4.000** | **.475** | **100.9** | **3.48** | **22.4** | **12.1** | **1.20** | **4.3** | **1.18** |
| | | 27.1 | 7.88 | 3.950 | .425 | 97.8 | 3.52 | 21.7 | 11.4 | 1.20 | 4.2 | 1.20 |
| C 32 (BSC 17) | 9 | 31.6 | 9.21 | 3.700 | .650 | 99.4 | 3.29 | 22.1 | 9.7 | 1.03 | 3.6 | 0.98 |
| | | 28.5 | 8.31 | 3.600 | .550 | 93.4 | 3.35 | 20.7 | 8.8 | 1.03 | 3.4 | 0.98 |
| | | **25.4** | **7.41** | **3.500** | **.450** | **87.3** | **3.43** | **19.4** | **8.0** | **1.04** | **3.2** | **1.00** |
| | | 23.9 | 6.96 | 3.450 | .400 | 84.3 | 3.48 | 18.7 | 7.5 | 1.04 | 3.1 | 1.01 |
| C 36 (BSC 13) | 8 | 28.2 | 8.23 | 3.700 | .625 | 71.8 | 2.95 | 18.0 | 9.0 | 1.05 | 3.4 | 1.02 |
| | | 25.5 | 7.43 | 3.600 | .525 | 67.6 | 3.02 | 16.9 | 8.2 | 1.05 | 3.2 | 1.02 |
| | | **22.8** | **6.63** | **3.500** | **.425** | **63.3** | **3.09** | **15.8** | **7.4** | **1.05** | **3.0** | **1.04** |
| | | 21.4 | 6.23 | 3.450 | .375 | 61.2 | 3.13 | 15.3 | 6.9 | 1.05 | 2.9 | 1.05 |
| C 37 (BSC 12) | 8 | 25.5 | 7.43 | 3.225 | .600 | 62.6 | 2.90 | 15.6 | 5.8 | 0.89 | 2.5 | 0.86 |
| | | 22.7 | 6.63 | 3.125 | .500 | 58.3 | 2.97 | 14.6 | 5.3 | 0.89 | 2.3 | 0.85 |
| | | 20.0 | 5.83 | 3.025 | .400 | 54.0 | 3.05 | 13.5 | 4.7 | 0.90 | 2.2 | 0.86 |
| | | **19.3** | **5.63** | **3.000** | **.375** | **53.0** | **3.07** | **13.2** | **4.5** | **0.90** | **2.1** | **0.87** |
| | | 18.7 | 5.43 | 2.975 | .350 | 51.9 | 3.09 | 13.0 | 4.4 | 0.90 | 2.1 | 0.88 |

Dimensions and properties of the British Standard Sections are indicated in **bold type.**
†C 60 is not an American Standard Section; profile is shown with Structural Channels.

# ELEMENTS OF SHIP BUILDING CHANNELS

## American Standard Sections




| Section Index | Depth of Channel | Wt. per Foot | Area of Section | Width of Flange | Thickness of Web | Axis 1-1 | | | Axis 2-2 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | I | r | S | I | r | S | y |
| | In. | Lbs. | In.² | In. | In. | In.⁴ | In. | In.³ | In.⁴ | In. | In.³ | In. |
| | | 25.0 | 7.30 | 3.700 | 0.600 | 49.9 | 2.62 | 14.3 | 8.3 | 1.07 | 3.2 | 1.06 |
| C 41 | 7 | 22.7 | 6.60 | 3.600 | 0.500 | 47.1 | 2.67 | 13.5 | 7.5 | 1.07 | 3.0 | 1.07 |
| **(BSC 10)** | | **20.3** | **5.90** | **3.500** | **0.400** | **44.2** | **2.74** | **12.6** | **6.7** | **1.07** | **2.8** | **1.09** |
| | | 19.1 | 5.55 | 3.450 | 0.350 | 42.8 | 2.78 | 12.2 | 6.3 | 1.07 | 2.7 | 1.11 |
| | | 20.0 | 5.82 | 3.100 | 0.475 | 40.2 | 2.63 | 11.5 | 4.7 | 0.90 | 2.1 | 0.88 |
| C 42 | 7 | **17.6** | **5.12** | **3.000** | **0.375** | **37.3** | **2.70** | **10.7** | **4.2** | **0.90** | **2.0** | **0.90** |
| (BSC 9) | | 16.4 | 4.77 | 2.950 | 0.325 | 35.9 | 2.74 | 10.2 | 3.9 | 0.90 | 1.9 | 0.91 |
| | | 22.0 | 6.42 | 3.700 | 0.575 | 33.0 | 2.27 | 11.0 | 7.6 | 1.09 | 2.9 | 1.12 |
| C 46 | 6 | 20.0 | 5.82 | 3.600 | 0.475 | 31.2 | 2.32 | 10.4 | 6.9 | 1.09 | 2.8 | 1.13 |
| (BSC 8) | | **18.0** | **5.22** | **3.500** | **0.375** | **29.4** | **2.38** | **9.8** | **6.1** | **1.08** | **2.6** | **1.15** |
| | | 16.9 | 4.92 | 3.450 | 0.325 | 28.5 | 2.41 | 9.5 | 5.7 | 1.08 | 2.5 | 1.17 |
| C 109 | 6 | 15.3 | 4.48 | 3.500 | 0.340 | 25.3 | 2.38 | 8.4 | 5.1 | 1.08 | 2.1 | 1.08 |
| C 47 | 6 | **16.3** | **4.75** | **3.000** | **0.375** | **25.8** | **2.33** | **8.6** | **4.0** | **0.91** | **1.9** | **0.95** |
| (BSC 7) | | 15.1 | 4.37 | 2.938 | 0.313 | 24.7 | 2.38 | 8.2 | 3.6 | 0.91 | 1.8 | 0.97 |
| C 48 | 6 | 13.3 | 3.90 | 2.563 | 0.375 | 19.7 | 2.25 | 6.6 | 2.1 | 0.74 | 1.2 | 0.71 |
| (BSC 5) | | **12.0** | **3.52** | **2.500** | **0.313** | **18.6** | **2.30** | **6.2** | **2.0** | **0.75** | **1.1** | **0.72** |

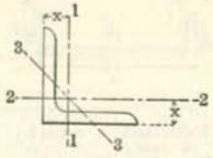
Dimensions and properties of the British Standard Sections are indicated in **bold type.**

# ELEMENTS OF CAR BUILDING CHANNELS

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50.0 | 14.66 | 4.412 | 0.787 | 312.9 | 4.62 | 48.1 | 16.7 | 1.07 | 4.9 | 0.98 |
| | | 45.0 | 13.18 | 4.298 | 0.673 | 292.0 | 4.71 | 44.9 | 15.3 | 1.08 | 4.6 | 0.97 |
| | | 40.0 | 11.71 | 4.185 | 0.560 | 271.4 | 4.82 | 41.7 | 13.9 | 1.09 | 4.3 | 0.97 |
| †C 20 | 13 | 37.0 | 10.82 | 4.117 | 0.492 | 258.9 | 4.89 | 39.8 | 13.0 | 1.10 | 4.2 | 0.98 |
| | | 35.0 | 10.24 | 4.072 | 0.447 | 250.7 | 4.95 | 38.6 | 12.5 | 1.10 | 4.0 | 0.99 |
| | | 31.8 | 9.30 | 4.000 | 0.375 | 237.5 | 5.05 | 36.5 | 11.6 | 1.11 | 3.9 | 1.01 |
| | | 50.0 | 14.64 | 4.135 | 0.835 | 268.1 | 4.28 | 44.7 | 17.8 | 1.10 | 5.8 | 1.06 |
| | | 48.6 | 14.22 | 4.100 | 0.800 | 263.0 | 4.30 | 43.8 | 17.3 | 1.10 | 5.7 | 1.05 |
| †C 170 | 12 | 46.6 | 13.62 | 4.050 | 0.750 | 255.8 | 4.33 | 42.6 | 16.6 | 1.11 | 5.5 | 1.05 |
| | | 44.5 | 13.02 | 4.000 | 0.700 | 248.6 | 4.37 | 41.4 | 16.0 | 1.11 | 5.4 | 1.05 |
| | | 40.0 | 11.70 | 3.890 | 0.590 | 232.8 | 4.46 | 38.8 | 14.5 | 1.12 | 5.1 | 1.05 |
| | | 35.0 | 10.23 | 3.767 | 0.467 | 215.1 | 4.59 | 35.8 | 12.9 | 1.12 | 4.8 | 1.07 |
| C 211 | 7 | 18.8 | 5.48 | 4.000 | 0.350 | 42.9 | 2.80 | 12.2 | 8.3 | 1.23 | 3.0 | 1.23 |
| C 200 | 4 | 13.8 | 4.00 | 2.500 | 0.500 | 8.8 | 1.49 | 4.4 | 2.2 | 0.74 | 1.4 | 0.86 |
| C 190 | 3 | 7.1 | 2.06 | 1.984 | 0.250 | 2.8 | 1.17 | 1.9 | 0.75 | 0.60 | 0.60 | 0.72 |
| C 191 | 3 | 6.5 | 1.89 | 1.875 | 0.250 | 2.6 | 1.17 | 1.7 | 0.63 | 0.58 | 0.52 | 0.67 |
| | | 5.8 | 1.68 | 1.805 | 0.180 | 2.4 | 1.20 | 1.6 | 0.53 | 0.56 | 0.47 | 0.68 |

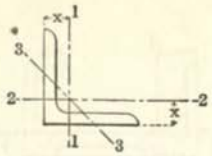
†Profiles of C 20 and C 170 are shown with Structural Channels.

# ELEMENTS OF EQUAL ANGLES



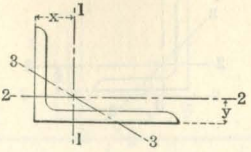

| Section Index | Size | Thickness | Weight per Foot | Area of Section | Axis 1-1 and Axis 2-2 | | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I | r | S | x | r min. |
| | Inches | In. | Pounds | In.² | In.⁴ | In. | In.³ | In. | In. |
| | | 1⅛ | 56.9 | 16.73 | 98.0 | 2.42 | 17.5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

## ELEMENTS OF EQUAL ANGLES—Concluded



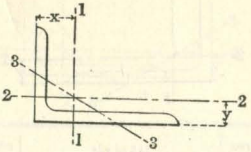

| Section Index | Size | Thickness | Weight per Foot | Area of Section | Axis 1-1 and Axis 2-2 | | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | I | r | S | x | r min. |
| | Inches | In. | Pounds | In.$^2$ | In.$^4$ | In. | In.$^3$ | In. | In. |
| | | 1 13/16 | 17.1 | 5.03 | 5.3 | 1.02 | 2.3 | 1.17 | 0.67 |
| | | 3/4 | 16.0 | 4.69 | 5.0 | 1.03 | 2.1 | 1.15 | 0.67 |
| | | 1 11/16 | 14.8 | 4.34 | 4.7 | 1.04 | 2.0 | 1.12 | 0.67 |
| | | 5/8 | 13.6 | 3.98 | 4.3 | 1.04 | 1.8 | 1.10 | 0.68 |
| A 5 | 3½ x 3½ | 9/16 | 12.4 | 3.62 | 4.0 | 1.05 | 1.6 | 1.08 | 0.68 |
| | | 1/2 | 11.1 | 3.25 | 3.6 | 1.06 | 1.5 | 1.06 | 0.68 |
| | | 7/16 | 9.8 | 2.87 | 3.3 | 1.07 | 1.3 | 1.04 | 0.68 |
| | | 3/8 | 8.5 | 2.48 | 2.9 | 1.07 | 1.2 | 1.01 | 0.69 |
| | | 5/16 | 7.2 | 2.09 | 2.5 | 1.08 | 0.98 | 0.99 | 0.69 |
| | | 1/4 | 5.8 | 1.69 | 2.0 | 1.09 | 0.79 | 0.97 | 0.69 |
| | | 5/8 | 11.5 | 3.36 | 2.6 | 0.88 | 1.3 | 0.98 | 0.57 |
| | | 9/16 | 10.4 | 3.06 | 2.4 | 0.89 | 1.2 | 0.95 | 0.58 |
| | | 1/2 | 9.4 | 2.75 | 2.2 | 0.90 | 1.1 | 0.93 | 0.58 |
| A 7 | 3 x 3 | 7/16 | 8.3 | 2.43 | 2.0 | 0.91 | 0.95 | 0.91 | 0.58 |
| | | 3/8 | 7.2 | 2.11 | 1.8 | 0.91 | 0.83 | 0.89 | 0.58 |
| | | 5/16 | 6.1 | 1.78 | 1.5 | 0.92 | 0.71 | 0.87 | 0.59 |
| | | 1/4 | 4.9 | 1.44 | 1.2 | 0.93 | 0.58 | 0.84 | 0.59 |
| | | 1/2 | 7.7 | 2.25 | 1.2 | 0.74 | 0.73 | 0.81 | 0.47 |
| | | 7/16 | 6.8 | 2.00 | 1.1 | 0.75 | 0.65 | 0.78 | 0.48 |
| | | 3/8 | 5.9 | 1.73 | 0.98 | 0.75 | 0.57 | 0.76 | 0.48 |
| A 9 | 2½ x 2½ | 5/16 | 5.0 | 1.47 | 0.85 | 0.76 | 0.48 | 0.74 | 0.49 |
| | | 1/4 | 4.1 | 1.19 | 0.70 | 0.77 | 0.39 | 0.72 | 0.49 |
| | | 3/16 | 3.07 | 0.90 | 0.55 | 0.78 | 0.30 | 0.69 | 0.49 |
| | | 1/8 | 2.08 | 0.61 | 0.38 | 0.79 | 0.20 | 0.67 | 0.50 |
| | | 7/16 | 5.3 | 1.56 | 0.54 | 0.59 | 0.40 | 0.66 | 0.39 |
| | | 3/8 | 4.7 | 1.36 | 0.48 | 0.59 | 0.35 | 0.64 | 0.39 |
| A 11 | 2 x 2 | 5/16 | 3.92 | 1.15 | 0.42 | 0.60 | 0.30 | 0.61 | 0.39 |
| | | 1/4 | 3.19 | 0.94 | 0.35 | 0.61 | 0.25 | 0.59 | 0.39 |
| | | 3/16 | 2.44 | 0.71 | 0.28 | 0.62 | 0.19 | 0.57 | 0.40 |
| | | 1/8 | 1.65 | 0.48 | 0.19 | 0.63 | 0.13 | 0.55 | 0.40 |
| | | 7/16 | 4.6 | 1.34 | 0.35 | 0.51 | 0.30 | 0.59 | 0.33 |
| | | 3/8 | 3.99 | 1.17 | 0.31 | 0.51 | 0.26 | 0.57 | 0.34 |
| A 12 | 1¾ x 1¾ | 5/16 | 3.39 | 1.00 | 0.27 | 0.52 | 0.23 | 0.55 | 0.34 |
| | | 1/4 | 2.77 | 0.81 | 0.23 | 0.53 | 0.19 | 0.53 | 0.34 |
| | | 3/16 | 2.12 | 0.62 | 0.18 | 0.54 | 0.14 | 0.51 | 0.35 |
| | | 1/8 | 1.44 | 0.42 | 0.13 | 0.55 | 0.10 | 0.48 | 0.35 |
| | | 3/8 | 3.35 | 0.98 | 0.19 | 0.44 | 0.19 | 0.51 | 0.29 |
| | | 5/16 | 2.86 | 0.84 | 0.16 | 0.44 | 0.16 | 0.49 | 0.29 |
| A 13 | 1½ x 1½ | 1/4 | 2.34 | 0.69 | 0.14 | 0.45 | 0.13 | 0.47 | 0.29 |
| | | 3/16 | 1.80 | 0.53 | 0.11 | 0.46 | 0.10 | 0.44 | 0.29 |
| | | 1/8 | 1.23 | 0.36 | 0.08 | 0.46 | 0.07 | 0.42 | 0.30 |
| | | 5/16 | 2.33 | 0.68 | 0.09 | 0.36 | 0.11 | 0.42 | 0.24 |
| A 15 | 1¼ x 1¼ | 1/4 | 1.92 | 0.56 | 0.08 | 0.37 | 0.09 | 0.40 | 0.24 |
| | | 3/16 | 1.48 | 0.43 | 0.06 | 0.38 | 0.07 | 0.38 | 0.24 |
| | | 1/8 | 1.01 | 0.30 | 0.04 | 0.38 | 0.05 | 0.35 | 0.25 |
| | | 1/4 | 1.49 | 0.44 | 0.04 | 0.29 | 0.06 | 0.34 | 0.19 |
| A 16 | 1 x 1 | 3/16 | 1.16 | 0.34 | 0.03 | 0.30 | 0.04 | 0.32 | 0.19 |
| | | 1/8 | 0.80 | 0.23 | 0.02 | 0.31 | 0.03 | 0.30 | 0.19 |

# ELEMENTS OF UNEQUAL ANGLES



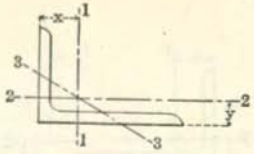

| Section Index | Size | Thickness | Weight per Foot | Area of Section | Axis 1-1 | | | | Axis 2-2 | | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | I | r | S | x | I | r | S | y | r min. |
| | Inches | In. | Lbs. | In.$^2$ | In.$^4$ | In. | In.$^3$ | In. | In.$^4$ | In. | In.$^3$ | In. | In. |
| | | 1 | 44.2 | 13.00 | 80.8 | 2.49 | 15.1 | 2.65 | 38.8 | 1.73 | 8.9 | 1.65 | 1.28 |
| | | 15/16 | 41.7 | 12.25 | 76.6 | 2.50 | 14.3 | 2.63 | 36.8 | 1.73 | 8.4 | 1.63 | 1.28 |
| | | 7/8 | 39.1 | 11.48 | 72.3 | 2.51 | 13.4 | 2.61 | 34.9 | 1.74 | 7.9 | 1.61 | 1.28 |
| | | 13/16 | 36.5 | 10.72 | 67.9 | 2.52 | 12.5 | 2.59 | 32.8 | 1.75 | 7.4 | 1.59 | 1.29 |
| | | 3/4 | 33.8 | 9.94 | 63.4 | 2.53 | 11.7 | 2.56 | 30.7 | 1.76 | 6.9 | 1.56 | 1.29 |
| A 18 | 8 x 6 | 11/16 | 31.2 | 9.15 | 58.8 | 2.54 | 10.8 | 2.54 | 28.6 | 1.77 | 6.4 | 1.54 | 1.29 |
| | | 5/8 | 28.5 | 8.36 | 54.1 | 2.54 | 9.9 | 2.52 | 26.3 | 1.77 | 5.9 | 1.52 | 1.30 |
| | | 9/16 | 25.7 | 7.56 | 49.3 | 2.55 | 8.9 | 2.50 | 24.0 | 1.78 | 5.3 | 1.50 | 1.30 |
| | | 1/2 | 23.0 | 6.75 | 44.3 | 2.56 | 8.0 | 2.47 | 21.7 | 1.79 | 4.8 | 1.47 | 1.30 |
| | | 7/16 | 20.2 | 5.93 | 39.2 | 2.57 | 7.1 | 2.45 | 19.3 | 1.80 | 4.2 | 1.45 | 1.30 |
| | | 1 | 35.7 | 10.50 | 66.2 | 2.51 | 13.7 | 3.17 | 7.8 | 0.86 | 3.0 | 0.92 | 0.73 |
| | | 15/16 | 33.7 | 9.90 | 62.9 | 2.52 | 12.9 | 3.14 | 7.4 | 0.87 | 2.9 | 0.89 | 0.73 |
| | | 7/8 | 31.7 | 9.30 | 59.4 | 2.53 | 12.2 | 3.12 | 7.1 | 0.87 | 2.7 | 0.87 | 0.73 |
| | | 13/16 | 29.6 | 8.68 | 55.9 | 2.54 | 11.4 | 3.10 | 6.7 | 0.88 | 2.5 | 0.85 | 0.73 |
| | | 3/4 | 27.5 | 8.06 | 52.3 | 2.55 | 10.6 | 3.07 | 6.3 | 0.88 | 2.3 | 0.82 | 0.73 |
| A 53 | 8 x 3½ | 11/16 | 25.3 | 7.43 | 48.5 | 2.56 | 9.8 | 3.05 | 5.9 | 0.89 | 2.2 | 0.80 | 0.73 |
| | | 5/8 | 23.2 | 6.80 | 44.7 | 2.57 | 9.0 | 3.03 | 5.4 | 0.90 | 2.0 | 0.78 | 0.74 |
| | | 9/16 | 21.0 | 6.15 | 40.8 | 2.57 | 8.2 | 3.00 | 5.0 | 0.90 | 1.8 | 0.75 | 0.74 |
| | | 1/2 | 18.7 | 5.50 | 36.7 | 2.58 | 7.3 | 2.98 | 4.5 | 0.91 | 1.6 | 0.73 | 0.74 |
| | | 7/16 | 16.5 | 4.84 | 32.5 | 2.59 | 6.4 | 2.95 | 4.1 | 0.92 | 1.5 | 0.70 | 0.74 |
| | | 1 | 32.3 | 9.50 | 45.4 | 2.19 | 10.6 | 2.71 | 7.5 | 0.89 | 3.0 | 0.96 | 0.74 |
| | | 15/16 | 30.5 | 8.97 | 43.1 | 2.19 | 10.0 | 2.69 | 7.2 | 0.89 | 2.8 | 0.94 | 0.74 |
| | | 7/8 | 28.7 | 8.42 | 40.8 | 2.20 | 9.4 | 2.66 | 6.8 | 0.90 | 2.6 | 0.91 | 0.74 |
| | | 13/16 | 26.8 | 7.87 | 38.4 | 2.21 | 8.8 | 2.64 | 6.5 | 0.91 | 2.5 | 0.89 | 0.74 |
| | | 3/4 | 24.9 | 7.31 | 36.0 | 2.22 | 8.2 | 2.62 | 6.1 | 0.91 | 2.3 | 0.87 | 0.74 |
| A 19 | 7 x 3½ | 11/16 | 23.0 | 6.75 | 33.5 | 2.23 | 7.6 | 2.60 | 5.7 | 0.92 | 2.1 | 0.85 | 0.74 |
| | | 5/8 | 21.0 | 6.17 | 30.9 | 2.24 | 7.0 | 2.57 | 5.3 | 0.93 | 2.0 | 0.82 | 0.75 |
| | | 9/16 | 19.1 | 5.59 | 28.2 | 2.25 | 6.3 | 2.55 | 4.9 | 0.93 | 1.8 | 0.80 | 0.75 |
| | | 1/2 | 17.0 | 5.00 | 25.4 | 2.25 | 5.7 | 2.53 | 4.4 | 0.94 | 1.6 | 0.78 | 0.75 |
| | | 7/16 | 15.0 | 4.40 | 22.6 | 2.26 | 5.0 | 2.50 | 4.0 | 0.95 | 1.4 | 0.75 | 0.76 |
| | | 3/8 | 13.0 | 3.80 | 19.6 | 2.27 | 4.3 | 2.48 | 3.5 | 0.96 | 1.3 | 0.73 | 0.76 |
| | | 1 | 30.6 | 9.00 | 30.8 | 1.85 | 8.0 | 2.17 | 10.8 | 1.09 | 3.8 | 1.17 | 0.85 |
| | | 15/16 | 28.9 | 8.50 | 29.3 | 1.86 | 7.6 | 2.14 | 10.3 | 1.10 | 3.6 | 1.14 | 0.85 |
| | | 7/8 | 27.2 | 7.98 | 27.7 | 1.86 | 7.2 | 2.12 | 9.8 | 1.11 | 3.4 | 1.12 | 0.86 |
| | | 13/16 | 25.4 | 7.47 | 26.1 | 1.87 | 6.7 | 2.10 | 9.2 | 1.11 | 3.2 | 1.10 | 0.86 |
| | | 3/4 | 23.6 | 6.94 | 24.5 | 1.88 | 6.2 | 2.08 | 8.7 | 1.12 | 3.0 | 1.08 | 0.86 |
| A 20 | 6 x 4 | 11/16 | 21.8 | 6.40 | 22.8 | 1.89 | 5.8 | 2.06 | 8.1 | 1.13 | 2.8 | 1.06 | 0.86 |
| | | 5/8 | 20.0 | 5.86 | 21.1 | 1.90 | 5.3 | 2.03 | 7.5 | 1.13 | 2.5 | 1.03 | 0.86 |
| | | 9/16 | 18.1 | 5.31 | 19.3 | 1.90 | 4.8 | 2.01 | 6.9 | 1.14 | 2.3 | 1.01 | 0.87 |
| | | 1/2 | 16.2 | 4.75 | 17.4 | 1.91 | 4.3 | 1.99 | 6.3 | 1.15 | 2.1 | 0.99 | 0.87 |
| | | 7/16 | 14.3 | 4.18 | 15.5 | 1.92 | 3.8 | 1.96 | 5.6 | 1.16 | 1.8 | 0.96 | 0.87 |
| | | 3/8 | 12.3 | 3.61 | 13.5 | 1.93 | 3.3 | 1.94 | 4.9 | 1.17 | 1.6 | 0.94 | 0.88 |

## ELEMENTS OF UNEQUAL ANGLES—Continued



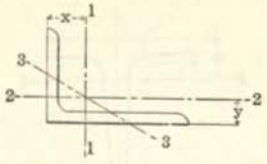

| Section Index | Size | Thickness | Weight per Foot | Area of Section | Axis 1-1 | | | | Axis 2-2 | | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | I | r | S | x | I | r | S | y | rmin. |
| | Inches | In. | Lbs. | In.$^2$ | In.$^4$ | In. | In.$^3$ | In. | In.$^4$ | In | In.$^3$ | In. | In. |
| | | 1 | 28.9 | 8.50 | 29.2 | 1.85 | 7.8 | 2.26 | 7.2 | 0.92 | 2.9 | 1.01 | 0.74 |
| | | 15/16 | 27.3 | 8.03 | 27.8 | 1.86 | 7.4 | 2.24 | 6.9 | 0.93 | 2.7 | 0.99 | 0.74 |
| | | 7/8 | 25.7 | 7.55 | 26.4 | 1.87 | 7.0 | 2.22 | 6.6 | 0.93 | 2.6 | 0.97 | 0.75 |
| | | 13/16 | 24.0 | 7.06 | 24.9 | 1.88 | 6.6 | 2.20 | 6.2 | 0.94 | 2.4 | 0.95 | 0.75 |
| | | 3/4 | 22.4 | 6.56 | 23.3 | 1.89 | 6.1 | 2.18 | 5.8 | 0.94 | 2.3 | 0.93 | 0.75 |
| A 21 | 6 x 3½ | 11/16 | 20.6 | 6.06 | 21.7 | 1.89 | 5.6 | 2.15 | 5.5 | 0.95 | 2.1 | 0.90 | 0.75 |
| | | 5/8 | 18.9 | 5.55 | 20.1 | 1.90 | 5.2 | 2.13 | 5.1 | 0.96 | 1.9 | 0.88 | 0.75 |
| | | 9/16 | 17.1 | 5.03 | 18.4 | 1.91 | 4.7 | 2.11 | 4.7 | 0.96 | 1.8 | 0.86 | 0.75 |
| | | 1/2 | 15.3 | 4.50 | 16.6 | 1.92 | 4.2 | 2.08 | 4.3 | 0.97 | 1.6 | 0.83 | 0.76 |
| | | 7/16 | 13.5 | 3.97 | 14.8 | 1.93 | 3.7 | 2.06 | 3.8 | 0.98 | 1.4 | 0.81 | 0.76 |
| | | 3/8 | 11.7 | 3.42 | 12.9 | 1.94 | 3.3 | 2.04 | 3.3 | 0.99 | 1.2 | 0.79 | 0.77 |
| | | 5/16 | 9.8 | 2.87 | 10.9 | 1.95 | 2.7 | 2.01 | 2.9 | 1.00 | 1.0 | 0.76 | 0.77 |
| | | 7/8 | 24.2 | 7.11 | 16.4 | 1.52 | 5.0 | 1.71 | 9.2 | 1.14 | 3.3 | 1.21 | 0.84 |
| | | 13/16 | 22.7 | 6.65 | 15.5 | 1.53 | 4.7 | 1.68 | 8.7 | 1.15 | 3.1 | 1.18 | 0.84 |
| | | 3/4 | 21.1 | 6.19 | 14.6 | 1.54 | 4.4 | 1.66 | 8.2 | 1.15 | 2.9 | 1.16 | 0.84 |
| | | 11/16 | 19.5 | 5.72 | 13.6 | 1.54 | 4.1 | 1.64 | 7.7 | 1.16 | 2.7 | 1.14 | 0.84 |
| A 22 | 5 x 4 | 5/8 | 17.8 | 5.23 | 12.6 | 1.55 | 3.7 | 1.62 | 7.1 | 1.17 | 2.5 | 1.12 | 0.84 |
| | | 9/16 | 16.2 | 4.75 | 11.6 | 1.56 | 3.4 | 1.60 | 6.6 | 1.18 | 2.3 | 1.10 | 0.85 |
| | | 1/2 | 14.5 | 4.25 | 10.5 | 1.57 | 3.1 | 1.57 | 6.0 | 1.18 | 2.0 | 1.07 | 0.85 |
| | | 7/16 | 12.8 | 3.75 | 9.3 | 1.58 | 2.7 | 1.55 | 5.3 | 1.19 | 1.8 | 1.05 | 0.85 |
| | | 3/8 | 11.0 | 3.23 | 8.1 | 1.59 | 2.3 | 1.53 | 4.7 | 1.20 | 1.6 | 1.03 | 0.86 |
| | | 7/8 | 22.7 | 6.67 | 15.7 | 1.53 | 4.9 | 1.79 | 6.2 | 0.96 | 2.5 | 1.04 | 0.75 |
| | | 13/16 | 21.3 | 6.25 | 14.8 | 1.54 | 4.6 | 1.77 | 5.9 | 0.97 | 2.4 | 1.02 | 0.75 |
| | | 3/4 | 19.8 | 5.81 | 13.9 | 1.55 | 4.3 | 1.75 | 5.6 | 0.98 | 2.2 | 1.00 | 0.75 |
| | | 11/16 | 18.3 | 5.37 | 13.0 | 1.56 | 4.0 | 1.72 | 5.2 | 0.98 | 2.1 | 0.97 | 0.75 |
| | | 5/8 | 16.8 | 4.92 | 12.0 | 1.56 | 3.7 | 1.70 | 4.8 | 0.99 | 1.9 | 0.95 | 0.75 |
| A 23 | 5 x 3½ | 9/16 | 15.2 | 4.47 | 11.0 | 1.57 | 3.3 | 1.68 | 4.4 | 1.00 | 1.7 | 0.93 | 0.75 |
| | | 1/2 | 13.6 | 4.00 | 10.0 | 1.58 | 3.0 | 1.66 | 4.0 | 1.01 | 1.6 | 0.91 | 0.75 |
| | | 7/16 | 12.0 | 3.53 | 8.9 | 1.59 | 2.6 | 1.63 | 3.6 | 1.01 | 1.4 | 0.88 | 0.76 |
| | | 3/8 | 10.4 | 3.05 | 7.8 | 1.60 | 2.3 | 1.61 | 3.2 | 1.02 | 1.2 | 0.86 | 0.76 |
| | | 5/16 | 8.7 | 2.56 | 6.6 | 1.61 | 1.9 | 1.59 | 2.7 | 1.03 | 1.0 | 0.84 | 0.76 |
| | | 13/16 | 19.9 | 5.84 | 14.0 | 1.55 | 4.5 | 1.86 | 3.7 | 0.80 | 1.7 | 0.86 | 0.64 |
| | | 3/4 | 18.5 | 5.44 | 13.2 | 1.55 | 4.2 | 1.84 | 3.5 | 0.80 | 1.6 | 0.84 | 0.64 |
| | | 11/16 | 17.1 | 5.03 | 12.3 | 1.56 | 3.9 | 1.82 | 3.3 | 0.81 | 1.5 | 0.82 | 0.64 |
| | | 5/8 | 15.7 | 4.61 | 11.4 | 1.57 | 3.5 | 1.80 | 3.1 | 0.81 | 1.4 | 0.80 | 0.64 |
| A 24 | 5 x 3 | 9/16 | 14.3 | 4.18 | 10.4 | 1.58 | 3.2 | 1.77 | 2.8 | 0.82 | 1.3 | 0.77 | 0.65 |
| | | 1/2 | 12.8 | 3.75 | 9.5 | 1.59 | 2.9 | 1.75 | 2.6 | 0.83 | 1.1 | 0.75 | 0.65 |
| | | 7/16 | 11.3 | 3.31 | 8.4 | 1.60 | 2.6 | 1.73 | 2.3 | 0.84 | 1.0 | 0.73 | 0.65 |
| | | 3/8 | 9.8 | 2.86 | 7.4 | 1.61 | 2.2 | 1.70 | 2.0 | 0.84 | 0.89 | 0.70 | 0.65 |
| | | 5/16 | 8.2 | 2.40 | 6.3 | 1.61 | 1.9 | 1.68 | 1.8 | 0.85 | 0.75 | 0.68 | 0.66 |

## ELEMENTS OF UNEQUAL ANGLES—Continued



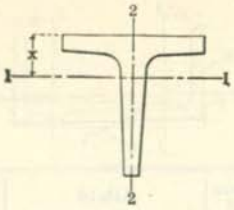

| Section Index | Size | Thickness | Weight per Foot | Area of Section | Axis 1-1 | | | | Axis 2-2 | | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | I | r | S | x | I | r | S | y | rmin. |
| | Inches | In. | Lbs. | In.² | In.⁴ | In. | In.³ | In. | In.⁴ | In. | In.³ | In. | In. |
| | | 13/16 | 18.5 | 5.43 | 10.3 | 1.38 | 3.6 | 1.65 | 3.6 | 0.81 | 1.7 | 0.90 | 0.64 |
| | | 3/4 | 17.3 | 5.06 | 9.7 | 1.39 | 3.4 | 1.63 | 3.4 | 0.82 | 1.6 | 0.88 | 0.64 |
| | | 11/16 | 16.0 | 4.68 | 9.1 | 1.39 | 3.1 | 1.60 | 3.2 | 0.83 | 1.5 | 0.85 | 0.64 |
| | | 5/8 | 14.7 | 4.30 | 8.4 | 1.40 | 2.9 | 1.58 | 3.0 | 0.83 | 1.4 | 0.83 | 0.64 |
| A 25 | 4½x 3 | 9/16 | 13.3 | 3.90 | 7.8 | 1.41 | 2.6 | 1.56 | 2.8 | 0.85 | 1.3 | 0.81 | 0.64 |
| | | 1/2 | 11.9 | 3.50 | 7.0 | 1.42 | 2.4 | 1.54 | 2.5 | 0.85 | 1.1 | 0.79 | 0.65 |
| | | 7/16 | 10.6 | 3.09 | 6.3 | 1.43 | 2.1 | 1.51 | 2.3 | 0.85 | 1.0 | 0.76 | 0.65 |
| | | 3/8 | 9.1 | 2.67 | 5.5 | 1.44 | 1.8 | 1.49 | 2.0 | 0.86 | 0.88 | 0.74 | 0.66 |
| | | 5/16 | 7.7 | 2.25 | 4.7 | 1.44 | 1.5 | 1.47 | 1.7 | 0.87 | 0.75 | 0.72 | 0.66 |
| | | 13/16 | 18.5 | 5.43 | 7.8 | 1.19 | 2.9 | 1.36 | 5.5 | 1.01 | 2.3 | 1.11 | 0.72 |
| | | 3/4 | 17.3 | 5.06 | 7.3 | 1.20 | 2.8 | 1.34 | 5.2 | 1.01 | 2.1 | 1.09 | 0.72 |
| | | 11/16 | 16.0 | 4.68 | 6.9 | 1.21 | 2.6 | 1.32 | 4.9 | 1.02 | 2.0 | 1.07 | 0.72 |
| | | 5/8 | 14.7 | 4.30 | 6.4 | 1.22 | 2.4 | 1.29 | 4.5 | 1.03 | 1.8 | 1.04 | 0.72 |
| A 26 | 4 x3½ | 9/16 | 13.3 | 3.90 | 5.9 | 1.23 | 2.1 | 1.27 | 4.2 | 1.03 | 1.7 | 1.02 | 0.72 |
| | | 1/2 | 11.9 | 3.50 | 5.3 | 1.23 | 1.9 | 1.25 | 3.8 | 1.04 | 1.5 | 1.00 | 0.72 |
| | | 7/16 | 10.6 | 3.09 | 4.8 | 1.24 | 1.7 | 1.23 | 3.4 | 1.05 | 1.3 | 0.98 | 0.72 |
| | | 3/8 | 9.1 | 2.67 | 4.2 | 1.25 | 1.5 | 1.21 | 3.0 | 1.06 | 1.2 | 0.96 | 0.73 |
| | | 5/16 | 7.7 | 2.25 | 3.6 | 1.26 | 1.3 | 1.18 | 2.6 | 1.07 | 1.0 | 0.93 | 0.73 |
| | | 13/16 | 17.1 | 5.03 | 7.3 | 1.21 | 2.9 | 1.44 | 3.5 | 0.83 | 1.7 | 0.94 | 0.64 |
| | | 3/4 | 16.0 | 4.69 | 6.9 | 4.22 | 2.7 | 1.42 | 3.3 | 0.84 | 1.6 | 0.92 | 0.64 |
| | | 11/16 | 14.8 | 4.34 | 6.5 | 1.22 | 2.5 | 1.39 | 3.1 | 0.84 | 1.5 | 0.89 | 0.64 |
| | | 5/8 | 13.6 | 3.98 | 6.0 | 1.23 | 2.3 | 1.37 | 2.9 | 0.85 | 1.4 | 0.87 | 0.64 |
| | | 9/16 | 12.4 | 3.62 | 5.6 | 1.24 | 2.1 | 1.35 | 2.7 | 0.86 | 1.2 | 0.85 | 0.64 |
| A 27 | 4 x 3 | 1/2 | 11.1 | 3.25 | 5.0 | 1.25 | 1.9 | 1.33 | 2.4 | 0.86 | 1.1 | 0.83 | 0.64 |
| | | 7/16 | 9.8 | 2.87 | 4.5 | 1.25 | 1.7 | 1.30 | 2.2 | 0.87 | 1.0 | 0.80 | 0.64 |
| | | 3/8 | 8.5 | 2.48 | 4.0 | 1.26 | 1.5 | 1.28 | 1.9 | 0.88 | 0.87 | 0.78 | 0.64 |
| | | 5/16 | 7.2 | 2.09 | 3.4 | 1.27 | 1.2 | 1.26 | 1.7 | 0.89 | 0.74 | 0.76 | 0.65 |
| | | 1/4 | 5.8 | 1.69 | 2.8 | 1.28 | 1.0 | 1.24 | 1.4 | 0.89 | 0.60 | 0.74 | 0.65 |
| | | 13/16 | 15.8 | 4.62 | 5.0 | 1.04 | 2.2 | 1.23 | 3.3 | 0.85 | 1.7 | 0.98 | 0.62 |
| | | 3/4 | 14.7 | 4.31 | 4.7 | 1.04 | 2.1 | 1.21 | 3.1 | 0.85 | 1.5 | 0.96 | 0.62 |
| | | 11/16 | 13.6 | 4.00 | 4.4 | 1.05 | 1.9 | 1.19 | 3.0 | 0.86 | 1.4 | 0.94 | 0.62 |
| | | 5/8 | 12.5 | 3.67 | 4.1 | 1.06 | 1.8 | 1.17 | 2.8 | 0.87 | 1.3 | 0.92 | 0.62 |
| | | 9/16 | 11.4 | 3.34 | 3.8 | 1.07 | 1.6 | 1.15 | 2.5 | 0.87 | 1.2 | 0.90 | 0.62 |
| A 28 | 3½x 3 | 1/2 | 10.2 | 3.00 | 3.5 | 1.07 | 1.5 | 1.13 | 2.3 | 0.88 | 1.1 | 0.88 | 0.62 |
| | | 7/16 | 9.1 | 2.65 | 3.1 | 1.08 | 1.3 | 1.10 | 2.1 | 0.89 | 0.98 | 0.85 | 0.62 |
| | | 3/8 | 7.9 | 2.30 | 2.7 | 1.09 | 1.1 | 1.08 | 1.8 | 0.90 | 0.85 | 0.83 | 0.62 |
| | | 5/16 | 6.6 | 1.93 | 2.3 | 1.10 | 0.96 | 1.06 | 1.6 | 0.90 | 0.72 | 0.81 | 0.63 |
| | | 1/4 | 5.4 | 1.56 | 1.9 | 1.11 | 0.78 | 1.04 | 1.3 | 0.91 | 0.58 | 0.79 | 0.63 |
| | | 11/16 | 12.5 | 3.65 | 4.1 | 1.06 | 1.9 | 1.27 | 1.7 | 0.69 | 0.99 | 0.77 | 0.53 |
| | | 5/8 | 11.5 | 3.36 | 3.8 | 1.07 | 1.7 | 1.25 | 1.6 | 0.69 | 0.92 | 0.75 | 0.53 |
| | | 9/16 | 10.4 | 3.06 | 3.6 | 1.08 | 1.6 | 1.23 | 1.5 | 0.70 | 0.84 | 0.73 | 0.53 |
| A 29 | 3½x2½ | 1/2 | 9.4 | 2.75 | 3.2 | 1.09 | 1.4 | 1.20 | 1.4 | 0.70 | 0.76 | 0.70 | 0.53 |
| | | 7/16 | 8.3 | 2.43 | 2.9 | 1.09 | 1.3 | 1.18 | 1.2 | 0.71 | 0.68 | 0.68 | 0.54 |
| | | 3/8 | 7.2 | 2.11 | 2.6 | 1.10 | 1.1 | 1.16 | 1.1 | 0.72 | 0.59 | 0.66 | 0.54 |
| | | 5/16 | 6.1 | 1.78 | 2.2 | 1.11 | 0.93 | 1.14 | 0.94 | 0.73 | 0.50 | 0.64 | 0.54 |
| | | 1/4 | 4.9 | 1.44 | 1.8 | 1.12 | 0.75 | 1.11 | 0.78 | 0.74 | 0.41 | 0.61 | 0.54 |

## ELEMENTS OF UNEQUAL ANGLES—Concluded



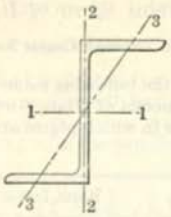

| Section Index | Size | Thickness | Weight per Foot | Area of Section | Axis 1-1 | | | | Axis 2-2 | | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | I | r | S | x | I | r | S | y | rmin. |
| | Inches | In. | Lbs. | In. | In.⁴ | In. | In.³ | In. | In.⁴ | In. | In.³ | In. | In. |
| | | 9/16 | 9.5 | 2.78 | 2.3 | 0.91 | 1.2 | 1.02 | 1.4 | 0.72 | 0.82 | 0.77 | 0.52 |
| | | 1/2 | 8.5 | 2.50 | 2.1 | 0.91 | 1.0 | 1.00 | 1.3 | 0.72 | 0.74 | 0.75 | 0.52 |
| A 32 | 3 x2½ | 7/16 | 7.6 | 2.21 | 1.9 | 0.92 | 0.93 | 0.98 | 1.2 | 0.73 | 0.66 | 0.73 | 0.52 |
| | | 3/8 | 6.6 | 1.92 | 1.7 | 0.93 | 0.81 | 0.96 | 1.0 | 0.74 | 0.58 | 0.71 | 0.52 |
| | | 5/16 | 5.6 | 1.62 | 1.4 | 0.94 | 0.69 | 0.93 | 0.90 | 0.74 | 0.49 | 0.68 | 0.53 |
| | | 1/4 | 4.5 | 1.31 | 1.2 | 0.95 | 0.56 | 0.91 | 0.74 | 0.75 | 0.40 | 0.66 | 0.53 |
| | | 1/2 | 7.7 | 2.25 | 1.9 | 0.92 | 1.0 | 1.08 | 0.67 | 0.55 | 0.47 | 0.58 | 0.43 |
| | | 7/16 | 6.8 | 2.00 | 1.7 | 0.93 | 0.89 | 1.06 | 0.61 | 0.55 | 0.42 | 0.56 | 0.43 |
| A 33 | 3 x 2 | 3/8 | 5.9 | 1.73 | 1.5 | 0.94 | 0.78 | 1.04 | 0.54 | 0.56 | 0.37 | 0.54 | 0.43 |
| | | 5/16 | 5.0 | 1.47 | 1.3 | 0.95 | 0.66 | 1.02 | 0.47 | 0.57 | 0.32 | 0.52 | 0.43 |
| | | 1/4 | 4.1 | 1.19 | 1.1 | 0.95 | 0.54 | 0.99 | 0.39 | 0.57 | 0.26 | 0.49 | 0.43 |
| | | 1/2 | 6.8 | 2.00 | 1.1 | 0.75 | 0.70 | 0.88 | 0.64 | 0.56 | 0.46 | 0.63 | 0.42 |
| | | 7/16 | 6.1 | 1.78 | 1.0 | 0.76 | 0.62 | 0.85 | 0.58 | 0.57 | 0.41 | 0.60 | 0.42 |
| | | 3/8 | 5.3 | 1.55 | 0.91 | 0.77 | 0.55 | 0.83 | 0.51 | 0.58 | 0.36 | 0.58 | 0.42 |
| A 35 | 2½x 2 | 5/16 | 4.5 | 1.31 | 0.79 | 0.78 | 0.47 | 0.81 | 0.45 | 0.58 | 0.31 | 0.56 | 0.42 |
| | | 1/4 | 3.62 | 1.06 | 0.65 | 0.78 | 0.38 | 0.79 | 0.37 | 0.59 | 0.25 | 0.54 | 0.42 |
| | | 3/16 | 2.75 | 0.81 | 0.51 | 0.79 | 0.29 | 0.76 | 0.29 | 0.60 | 0.20 | 0.51 | 0.43 |
| | | 1/8 | 1.86 | 0.55 | 0.35 | 0.80 | 0.20 | 0.74 | 0.20 | 0.61 | 0.13 | 0.49 | 0.43 |
| | | 5/16 | 3.92 | 1.15 | 0.71 | 0.79 | 0.44 | 0.90 | 0.19 | 0.41 | 0.17 | 0.40 | 0.32 |
| A 48 | 2½x1½ | 1/4 | 3.19 | 0.94 | 0.59 | 0.79 | 0.36 | 0.88 | 0.16 | 0.41 | 0.14 | 0.38 | 0.32 |
| | | 3/16 | 2.44 | 0.72 | 0.46 | 0.80 | 0.28 | 0.85 | 0.13 | 0.42 | 0.11 | 0.35 | 0.33 |
| | | 1/2 | 5.6 | 1.63 | 0.75 | 0.68 | 0.54 | 0.86 | 0.26 | 0.40 | 0.26 | 0.48 | 0.32 |
| | | 7/16 | 5.0 | 1.45 | 0.68 | 0.69 | 0.48 | 0.83 | 0.24 | 0.41 | 0.23 | 0.46 | 0.32 |
| A 270 | 2¼x1½ | 3/8 | 4.4 | 1.27 | 0.61 | 0.69 | 0.42 | 0.81 | 0.21 | 0.41 | 0.20 | 0.44 | 0.32 |
| | | 5/16 | 3.66 | 1.07 | 0.53 | 0.70 | 0.36 | 0.79 | 0.19 | 0.42 | 0.17 | 0.42 | 0.32 |
| | | 1/4 | 2.98 | 0.88 | 0.44 | 0.71 | 0.30 | 0.77 | 0.16 | 0.42 | 0.14 | 0.39 | 0.32 |
| | | 3/16 | 2.28 | 0.67 | 0.34 | 0.72 | 0.23 | 0.75 | 0.12 | 0.43 | 0.11 | 0.37 | 0.33 |
| | | 3/8 | 3.99 | 1.17 | 0.43 | 0.61 | 0.34 | 0.71 | 0.21 | 0.42 | 0.20 | 0.46 | 0.32 |
| | | 5/16 | 3.39 | 1.00 | 0.38 | 0.62 | 0.29 | 0.69 | 0.18 | 0.42 | 0.17 | 0.44 | 0.32 |
| A 37 | 2 x1½ | 1/4 | 2.77 | 0.81 | 0.32 | 0.62 | 0.24 | 0.66 | 0.15 | 0.43 | 0.14 | 0.41 | 0.32 |
| | | 3/16 | 2.12 | 0.62 | 0.25 | 0.63 | 0.18 | 0.64 | 0.12 | 0.44 | 0.11 | 0.39 | 0.32 |
| | | 1/8 | 1.44 | 0.42 | 0.17 | 0.64 | 0.13 | 0.62 | 0.09 | 0.45 | 0.08 | 0.37 | 0.33 |
| | | 1/4 | 2.55 | 0.75 | 0.30 | 0.63 | 0.23 | 0.71 | 0.09 | 0.34 | 0.10 | 0.33 | 0.27 |
| A 645 | 2 x1¼ | 3/16 | 1.96 | 0.57 | 0.23 | 0.64 | 0.18 | 0.69 | 0.07 | 0.35 | 0.08 | 0.31 | 0.27 |
| | | 1/4 | 2.34 | 0.69 | 0.20 | 0.54 | 0.18 | 0.60 | 0.09 | 0.35 | 0.10 | 0.35 | 0.27 |
| A 39 | 1¾x1¼ | 3/16 | 1.80 | 0.53 | 0.16 | 0.55 | 0.14 | 0.58 | 0.07 | 0.36 | 0.08 | 0.33 | 0.27 |
| | | 1/8 | 1.23 | 0.36 | 0.11 | 0.56 | 0.09 | 0.56 | 0.05 | 0.37 | 0.05 | 0.31 | 0.27 |
| | | 5/16 | 2.59 | 0.76 | 0.16 | 0.45 | 0.16 | 0.52 | 0.10 | 0.35 | 0.11 | 0.40 | 0.26 |
| A624 | 1½x1¼ | 1/4 | 2.13 | 0.63 | 0.13 | 0.46 | 0.13 | 0.50 | 0.08 | 0.36 | 0.09 | 0.38 | 0.26 |
| | | 3/16 | 1.64 | 0.48 | 0.10 | 0.46 | 0.10 | 0.48 | 0.07 | 0.37 | 0.07 | 0.35 | 0.26 |

## ELEMENTS OF EQUAL AND UNEQUAL TEES




| Section Index | Size | | | | Weight per Foot | Area of Section | Axis 1-1 | | | | Axis 2-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flange | Stem | Minimum Thickness | | | | I | r | S | x | I | r | S |
| | | | Flange | Stem | | | | | | | | | |
| | In. | In. | In. | In. | Lbs. | In.$^2$ | In.$^4$ | In. | In.$^3$ | In. | In.$^4$ | In. | In.$^3$ |
| **EQUAL TEES** | | | | | | | | | | | | | |
| T 40 | 6½ | 6½ | 0.40 | 0.45 | 19.8 | 5.80 | 23.5 | 2.01 | 5.0 | 1.76 | 10.1 | 1.32 | 3.1 |
| T 1 | 4 | 4 | ½ | ½ | 13.5 | 3.97 | 5.7 | 1.20 | 2.0 | 1.18 | 2.8 | 0.84 | 1.4 |
| T 2 | 4 | 4 | ⅝ | ⅝ | 10.5 | 3.09 | 4.5 | 1.21 | 1.6 | 1.13 | 2.1 | 0.83 | 1.1 |
| T 8 | 3 | 3 | ⅝ | ⅝ | 7.8 | 2.27 | 1.8 | 0.90 | 0.86 | 0.88 | 0.90 | 0.63 | 0.60 |
| T 9 | 3 | 3 | 5/16 | 5/16 | 6.7 | 1.95 | 1.6 | 0.90 | 0.74 | 0.86 | 0.75 | 0.62 | 0.50 |
| T 10 | 2½ | 2½ | ⅜ | ⅜ | 6.4 | 1.87 | 1.0 | 0.74 | 0.59 | 0.76 | 0.52 | 0.53 | 0.42 |
| T 11 | 2½ | 2½ | 5/16 | 5/16 | 5.5 | 1.60 | 0.88 | 0.74 | 0.50 | 0.74 | 0.44 | 0.52 | 0.35 |
| T 12 | 2¼ | 2¼ | 5/16 | 5/16 | 4.9 | 1.43 | 0.65 | 0.67 | 0.41 | 0.68 | 0.33 | 0.48 | 0.29 |
| T 13 | 2¼ | 2¼ | ¼ | ¼ | 4.1 | 1.19 | 0.52 | 0.66 | 0.32 | 0.65 | 0.25 | 0.46 | 0.22 |
| T 14 | 2 | 2 | 5/16 | 5/16 | 4.3 | 1.26 | 0.44 | 0.59 | 0.31 | 0.61 | 0.23 | 0.43 | 0.23 |
| T 15 | 2 | 2 | ¼ | ¼ | 3.56 | 1.05 | 0.37 | 0.59 | 0.26 | 0.59 | 0.18 | 0.42 | 0.18 |
| **UNEQUAL TEES** | | | | | | | | | | | | | |
| T 50 | 5 | 3 | ⅝ | 13/32 | 11.5 | 3.37 | 2.4 | 0.84 | 1.1 | 0.76 | 3.9 | 1.10 | 1.6 |
| T 57 | 4 | 5 | ½ | ½ | 15.3 | 4.50 | 10.8 | 1.55 | 3.1 | 1.56 | 2.8 | 0.79 | 1.4 |
| T 58 | 4 | 5 | ⅝ | ⅝ | 11.9 | 3.49 | 8.5 | 1.56 | 2.4 | 1.51 | 2.1 | 0.78 | 1.1 |
| T 59 | 4 | 4½ | ½ | ½ | 14.4 | 4.23 | 7.9 | 1.37 | 2.5 | 1.37 | 2.8 | 0.81 | 1.4 |
| T 60 | 4 | 4½ | ⅝ | ⅝ | 11.2 | 3.29 | 6.3 | 1.39 | 2.0 | 1.31 | 2.1 | 0.80 | 1.1 |
| T 61 | 4 | 3 | ⅝ | ⅝ | 9.2 | 2.68 | 2.0 | 0.86 | 0.90 | 0.78 | 2.1 | 0.89 | 1.1 |
| T 44 | 4 | 3 | 5/16 | 5/16 | 7.8 | 2.29 | 1.7 | 0.87 | 0.77 | 0.75 | 1.8 | 0.88 | 0.88 |
| T 62 | 4 | 2½ | ⅝ | ⅝ | 8.5 | 2.48 | 1.2 | 0.69 | 0.62 | 0.62 | 2.1 | 0.92 | 1.0 |
| T 63 | 4 | 2½ | 5/16 | 5/16 | 7.2 | 2.12 | 1.0 | 0.69 | 0.53 | 0.60 | 1.8 | 0.91 | 0.88 |
| T 79 | 3 | 2½ | 5/16 | 5/16 | 6.1 | 1.77 | 0.94 | 0.73 | 0.52 | 0.68 | 0.75 | 0.65 | 0.50 |
| T 83 | 2½ | 3 | 5/16 | 5/16 | 6.1 | 1.77 | 1.5 | 0.92 | 0.72 | 0.92 | 0.44 | 0.50 | 0.35 |
| T519 | 1½ | 2 | 5/16 | 5/16 | 2.45 | 0.72 | 0.27 | 0.61 | 0.19 | 0.63 | 0.06 | 0.92 | 0.08 |
| T605 | 1½ | 1¼ | ⅛ | ⅛ | 1.25 | 0.37 | 0.05 | 0.37 | 0.05 | 0.33 | 0.04 | 0.32 | 0.05 |
| T603 | 1¼ | ⅝ | No. 9 | ⅛ | 0.88 | 0.26 | 0.01 | 0.16 | 0.01 | 0.16 | 0.02 | 0.31 | 0.04 |

## ELEMENTS OF ZEES




| Section Index | Size | | | Weight per Foot | Area of Section | Axis 1-1 | | | Axis 2-2 | | | Axis 3-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Depth | Flanges | Thickness | | | I | r | S | I | r | S | r min. |
| | In. | In. | In. | Lbs. | In.$^2$ | In.$^4$ | In. | In.$^3$ | In.$^4$ | In. | In.$^3$ | In. |
| Z 3 | 6⅛ | 3⅝ | 7/8 | 34.6 | 10.17 | 50.2 | 2.22 | 16.4 | 19.2 | 1.37 | 6.0 | 0.83 |
| | 6 1/16 | 3 9/16 | 1 13/16 | 32.0 | 9.40 | 46.1 | 2.22 | 15.2 | 17.3 | 1.36 | 5.5 | 0.82 |
| | 6 | 3½ | ¾ | 29.4 | 8.63 | 42.1 | 2.21 | 14.0 | 15.4 | 1.34 | 4.9 | 0.81 |
| Z 2 | 6⅛ | 3⅝ | 1 1/16 | 28.1 | 8.25 | 43.2 | 2.29 | 14.1 | 16.3 | 1.41 | 5.0 | 0.84 |
| | 6 1/16 | 3 9/16 | ⅝ | 25.4 | 7.46 | 38.9 | 2.28 | 12.8 | 14.4 | 1.39 | 4.4 | 0.82 |
| | 6 | 3½ | 9/16 | 22.8 | 6.68 | 34.6 | 2.28 | 11.5 | 12.6 | 1.37 | 3.9 | 0.81 |
| Z 1 | 6⅛ | 3⅝ | ½ | 21.1 | 6.19 | 34.4 | 2.36 | 11.2 | 12.9 | 1.44 | 3.8 | 0.84 |
| | 6 1/16 | 3 9/16 | 7/16 | 18.4 | 5.39 | 29.8 | 2.35 | 9.8 | 11.0 | 1.43 | 3.3 | 0.83 |
| | 6 | 3½ | ⅜ | 15.7 | 4.59 | 25.3 | 2.35 | 8.4 | 9.1 | 1.41 | 2.8 | 0.83 |
| Z 6 | 5⅛ | 3⅜ | 1 3/16 | 28.4 | 8.33 | 28.7 | 1.86 | 11.2 | 14.4 | 1.31 | 4.8 | 0.76 |
| | 5 1/16 | 3 5/16 | ¾ | 26.0 | 7.64 | 26.2 | 1.85 | 10.3 | 12.8 | 1.30 | 4.4 | 0.74 |
| | 5 | 3¼ | 1 1/16 | 23.7 | 6.96 | 23.7 | 1.84 | 9.5 | 11.4 | 1.28 | 3.9 | 0.73 |
| Z 5 | 5⅛ | 3⅜ | 5/8 | 22.6 | 6.64 | 24.5 | 1.92 | 9.6 | 12.1 | 1.35 | 3.9 | 0.76 |
| | 5 1/16 | 3 5/16 | 9/16 | 20.2 | 5.94 | 21.8 | 1.91 | 8.6 | 10.5 | 1.33 | 3.5 | 0.75 |
| | 5 | 3¼ | ½ | 17.9 | 5.25 | 19.2 | 1.91 | 7.7 | 9.1 | 1.31 | 3.0 | 0.74 |
| Z 4 | 5⅛ | 3⅜ | 7/16 | 16.4 | 4.81 | 19.1 | 1.99 | 7.4 | 9.2 | 1.38 | 2.9 | 0.77 |
| | 5 1/16 | 3 5/16 | ⅜ | 14.0 | 4.10 | 16.2 | 1.99 | 6.4 | 7.7 | 1.37 | 2.5 | 0.76 |
| | 5 | 3¼ | 5/16 | 11.6 | 3.40 | 13.4 | 1.98 | 5.3 | 6.2 | 1.35 | 2.0 | 0.75 |
| Z 9 | 4⅛ | 3 3/16 | ¾ | 23.0 | 6.75 | 15.0 | 1.49 | 7.3 | 11.2 | 1.29 | 4.0 | 0.68 |
| | 4 1/16 | 3⅛ | 1 1/16 | 20.9 | 6.14 | 13.5 | 1.48 | 6.7 | 10.0 | 1.27 | 3.6 | 0.67 |
| | 4 | 3 1/16 | ⅝ | 18.9 | 5.55 | 12.1 | 1.48 | 6.1 | 8.7 | 1.25 | 3.2 | 0.66 |
| Z 8 | 4⅛ | 3 3/16 | 9/16 | 18.0 | 5.27 | 12.7 | 1.55 | 6.2 | 9.3 | 1.33 | 3.2 | 0.68 |
| | 4 1/16 | 3⅛ | ½ | 15.9 | 4.66 | 11.2 | 1.55 | 5.5 | 8.0 | 1.31 | 2.8 | 0.67 |
| | 4 | 3 1/16 | 7/16 | 13.8 | 4.05 | 9.7 | 1.55 | 4.8 | 6.7 | 1.29 | 2.4 | 0.66 |
| Z 7 | 4⅛ | 3 3/16 | ⅜ | 12.5 | 3.66 | 9.6 | 1.62 | 4.7 | 6.8 | 1.36 | 2.3 | 0.69 |
| | 4 1/16 | 3⅛ | 5/16 | 10.3 | 3.03 | 7.9 | 1.62 | 3.9 | 5.5 | 1.34 | 1.8 | 0.68 |
| | 4 | 3 1/16 | ¼ | 8.2 | 2.41 | 6.3 | 1.62 | 3.1 | 4.2 | 1.33 | 1.4 | 0.67 |
| Z 12 | 3 1/16 | 2¾ | 9/16 | 14.3 | 4.18 | 5.3 | 1.12 | 3.4 | 5.7 | 1.17 | 2.3 | 0.54 |
| | 3 | 2 11/16 | ½ | 12.6 | 3.69 | 4.6 | 1.12 | 3.1 | 4.9 | 1.15 | 2.0 | 0.53 |
| Z 11 | 3 1/16 | 2¾ | 7/16 | 11.5 | 3.36 | 4.6 | 1.17 | 3.0 | 4.8 | 1.19 | 1.9 | 0.55 |
| | 3 | 2 11/16 | ⅜ | 9.8 | 2.86 | 3.9 | 1.16 | 2.6 | 3.9 | 1.17 | 1.6 | 0.54 |
| Z 10 | 3 1/16 | 2¾ | 5/16 | 8.5 | 2.48 | 3.6 | 1.21 | 2.4 | 3.6 | 1.21 | 1.4 | 0.56 |
| | 3 | 2 11/16 | ¼ | 6.7 | 1.97 | 2.9 | 1.21 | 1.9 | 2.8 | 1.19 | 1.1 | 0.55 |

# MOMENTS OF INERTIA OF RECTANGLES

## In Widths from ¼ to ⅝ Inch and 1 Inch


**Neutral Axis Through Center Normal to Depth**

This and the following table may be used in computing the Moments of Inertia of Plate Girders, Columns and other compound sections in which plates are used.

| Depth, Inches | Width, Inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ¼ | 5/16 | ⅜ | 7/16 | ½ | 9/16 | ⅝ | 1 |
| 1 | .021 | .026 | .031 | .037 | .042 | .047 | .052 | .083 |
| 2 | .167 | .208 | .250 | .292 | .333 | .375 | .417 | .667 |
| 3 | .563 | .703 | .844 | .984 | 1.125 | 1.266 | 1.406 | 2.250 |
| 4 | 1.333 | 1.667 | 2.000 | 2.333 | 2.667 | 3.000 | 3.333 | 5.333 |
| 5 | 2.604 | 3.255 | 3.906 | 4.557 | 5.208 | 5.859 | 6.510 | 10.417 |
| 6 | 4.500 | 5.625 | 6.750 | 7.875 | 9.000 | 10.125 | 11.250 | 18.000 |
| 7 | 7.146 | 8.932 | 10.719 | 12.505 | 14.292 | 16.078 | 17.865 | 28.583 |
| 8 | 10.667 | 13.333 | 16.000 | 18.667 | 21.333 | 24.000 | 26.667 | 42.667 |
| 9 | 15.188 | 18.984 | 22.781 | 26.578 | 30.375 | 34.172 | 37.969 | 60.750 |
| 10 | 20.833 | 26.042 | 31.250 | 36.458 | 41.667 | 46.875 | 52.083 | 83.333 |
| 11 | 27.729 | 34.662 | 41.594 | 48.526 | 55.458 | 62.391 | 69.323 | 110.917 |
| 12 | 36.000 | 45.000 | 54.000 | 63.000 | 72.000 | 81.000 | 90.000 | 144.000 |
| 13 | 45.771 | 57.214 | 68.656 | 80.099 | 91.542 | 102.984 | 114.427 | 183.083 |
| 14 | 57.167 | 71.458 | 85.750 | 100.042 | 114.333 | 128.625 | 142.917 | 228.667 |
| 15 | 70.313 | 87.891 | 105.469 | 123.047 | 140.625 | 158.203 | 175.781 | 281.250 |
| 16 | 85.333 | 106.667 | 128.000 | 149.333 | 170.667 | 192.000 | 213.333 | 341.333 |
| 17 | 102.354 | 127.943 | 153.531 | 179.120 | 204.708 | 230.297 | 255.885 | 409.417 |
| 18 | 121.500 | 151.875 | 182.250 | 212.625 | 243.000 | 273.375 | 303.750 | 486.000 |
| 19 | 142.896 | 178.620 | 214.344 | 250.068 | 285.792 | 321.516 | 357.240 | 571.583 |
| 20 | 166.667 | 208.333 | 250.000 | 291.667 | 333.333 | 375.000 | 416.667 | 666.667 |
| 21 | 192.938 | 241.172 | 289.406 | 337.641 | 385.875 | 434.109 | 482.344 | 771.750 |
| 22 | 221.833 | 277.292 | 332.750 | 388.208 | 443.667 | 499.125 | 554.583 | 887.333 |
| 23 | 253.479 | 316.849 | 380.219 | 443.589 | 506.958 | 570.328 | 633.698 | 1013.917 |
| 24 | 288.000 | 360.000 | 432.000 | 504.000 | 576.000 | 648.000 | 720.000 | 1152.000 |
| 25 | 325.521 | 406.901 | 488.281 | 569.662 | 651.042 | 732.422 | 813.802 | 1302.083 |
| 26 | 366.167 | 457.708 | 549.250 | 640.792 | 732.333 | 823.875 | 915.417 | 1464.667 |
| 27 | 410.063 | 512.578 | 615.094 | 717.609 | 820.125 | 922.641 | 1025.156 | 1640.250 |
| 28 | 457.333 | 571.667 | 686.000 | 800.333 | 914.667 | 1029.000 | 1143.333 | 1829.333 |
| 29 | 508.104 | 635.130 | 762.156 | 889.182 | 1016.208 | 1143.234 | 1270.260 | 2032.417 |
| 30 | 562.500 | 703.125 | 843.750 | 984.375 | 1125.000 | 1265.625 | 1406.250 | 2250.000 |
| 32 | 682.667 | 853.333 | 1024.000 | 1194.667 | 1365.333 | 1536.000 | 1706.667 | 2730.667 |
| 34 | 818.833 | 1023.542 | 1228.250 | 1432.958 | 1637.667 | 1842.375 | 2047.083 | 3275.333 |
| 36 | 972.000 | 1215.000 | 1458.000 | 1701.000 | 1944.000 | 2187.000 | 2430.000 | 3888.000 |
| 38 | 1143.167 | 1428.958 | 1714.750 | 2000.542 | 2286.333 | 2572.125 | 2857.917 | 4572.667 |
| 40 | 1333.333 | 1666.667 | 2000.000 | 2333.333 | 2666.667 | 3000.000 | 3333.333 | 5333.333 |
| 42 | 1543.500 | 1929.375 | 2315.250 | 2701.125 | 3087.000 | 3472.875 | 3858.750 | 6174.000 |
| 44 | 1774.667 | 2218.333 | 2662.000 | 3105.667 | 3549.333 | 3993.000 | 4436.667 | 7098.667 |
| 46 | 2027.833 | 2534.792 | 3041.750 | 3548.708 | 4055.667 | 4562.625 | 5069.583 | 8111.333 |
| 48 | 2304.000 | 2880.000 | 3456.000 | 4032.000 | 4608.000 | 5184.000 | 5760.000 | 9216.000 |
| 50 | 2604.167 | 3255.208 | 3906.250 | 4557.292 | 5208.333 | 5859.375 | 6510.417 | 10416.667 |
| 52 | 2929.333 | 3661.667 | 4394.000 | 5126.333 | 5858.667 | 6591.000 | 7323.333 | 11717.333 |
| 54 | 3280.500 | 4100.625 | 4920.750 | 5740.875 | 6561.000 | 7381.125 | 8201.250 | 13122.000 |
| 56 | 3658.667 | 4573.333 | 5488.000 | 6402.667 | 7317.333 | 8232.000 | 9146.667 | 14634.667 |
| 58 | 4064.833 | 5081.042 | 6097.250 | 7113.458 | 8129.667 | 9145.875 | 10162.083 | 16259.333 |
| 60 | 4500.000 | 5625.000 | 6750.000 | 7875.000 | 9000.000 | 10125.000 | 11250.000 | 18000.000 |

# MOMENTS OF INERTIA OF RECTANGLES

## In Widths of 1 Inch

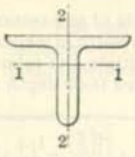

**Neutral Axis Through Center Normal to Depth**

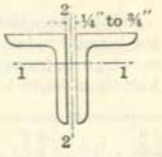
To obtain the Moment of Inertia of any rectangle, multiply the tabular value for its depth by its width in inches. For deeper rectangles of tabular thickness, multiply the tabular values for half their depth by 8; or for one-third their depth by 27, etc.

| Depth, Inches | $I_{1\text{-}1}$ Inches$^4$ | Depth, Inches | $I_{1\text{-}1}$ Inches$^4$ | Depth, Inches | $I_{1\text{-}1}$ Inches$^4$ | Depth, Inches | $I_{1\text{-}1}$ Inches$^4$ | Depth, Inches | $I_{1\text{-}1}$ Inches$^4$ | Depth, Inches | $I_{1\text{-}1}$ Inches$^4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .000 | 6 | 18.000 | 12 | 144.000 | 18 | 486.000 | 24 | 1152.000 | 30 | 2250.000 |
| 1/16 | .000 | 1/16 | 19.149 | 1/16 | 148.547 | 1/16 | 496.195 | 1/16 | 1170.094 | 1/16 | 2278.243 |
| 1/8 | .001 | 1/8 | 20.345 | 1/8 | 153.189 | 1/8 | 506.533 | 1/8 | 1188.376 | 1/8 | 2306.721 |
| 3/16 | .004 | 3/16 | 21.590 | 3/16 | 157.926 | 3/16 | 517.012 | 3/16 | 1206.848 | 3/16 | 2335.434 |
| 1/4 | .010 | 1/4 | 22.885 | 1/4 | 162.760 | 1/4 | 527.635 | 1/4 | 1225.510 | 1/4 | 2364.385 |
| 5/16 | .020 | 5/16 | 24.231 | 5/16 | 167.692 | 5/16 | 538.403 | 5/16 | 1244.364 | 5/16 | 2393.575 |
| 3/8 | .035 | 3/8 | 25.629 | 3/8 | 172.723 | 3/8 | 549.317 | 3/8 | 1263.410 | 3/8 | 2423.004 |
| 7/16 | .056 | 7/16 | 27.079 | 7/16 | 177.853 | 7/16 | 560.376 | 7/16 | 1282.650 | 7/16 | 2452.674 |
| 1 | .083 | 7 | 28.583 | 13 | 183.083 | 19 | 571.583 | 25 | 1302.083 | 31 | 2482.583 |
| 1/16 | .119 | 1/16 | 30.142 | 1/16 | 188.416 | 1/16 | 582.939 | 1/16 | 1321.713 | 1/16 | 2512.737 |
| 1/8 | .163 | 1/8 | 31.757 | 1/8 | 193.850 | 1/8 | 594.444 | 1/8 | 1341.538 | 1/8 | 2543.132 |
| 3/16 | .217 | 3/16 | 33.428 | 3/16 | 199.389 | 3/16 | 606.099 | 3/16 | 1361.561 | 3/16 | 2573.771 |
| 1/4 | .281 | 1/4 | 35.156 | 1/4 | 205.031 | 1/4 | 617.906 | 1/4 | 1381.781 | 1/4 | 2604.656 |
| 5/16 | .358 | 5/16 | 36.944 | 5/16 | 210.779 | 5/16 | 629.866 | 5/16 | 1402.202 | 5/16 | 2635.787 |
| 3/8 | .447 | 3/8 | 38.790 | 3/8 | 216.634 | 3/8 | 641.978 | 3/8 | 1422.821 | 3/8 | 2667.165 |
| 7/16 | .549 | 7/16 | 40.698 | 7/16 | 222.596 | 7/16 | 654.245 | 7/16 | 1443.644 | 7/16 | 2698.792 |
| 2 | .667 | 8 | 42.667 | 14 | 228.667 | 20 | 666.667 | 26 | 1464.667 | 32 | 2730.667 |
| 1/16 | .800 | 1/16 | 44.698 | 1/16 | 234.847 | 1/16 | 679.245 | 1/16 | 1485.893 | 1/16 | 2762.792 |
| 1/8 | .949 | 1/8 | 46.793 | 1/8 | 241.137 | 1/8 | 691.840 | 1/8 | 1507.324 | 1/8 | 2795.168 |
| 3/16 | 1.116 | 3/16 | 48.952 | 3/16 | 247.538 | 3/16 | 704.874 | 3/16 | 1528.961 | 3/16 | 2827.797 |
| 1/4 | 1.302 | 1/4 | 51.177 | 1/4 | 254.052 | 1/4 | 717.927 | 1/4 | 1550.802 | 1/4 | 2860.677 |
| 5/16 | 1.507 | 5/16 | 53.468 | 5/16 | 260.679 | 5/16 | 731.141 | 5/16 | 1572.851 | 5/16 | 2893.812 |
| 3/8 | 1.733 | 3/8 | 55.827 | 3/8 | 267.421 | 3/8 | 744.514 | 3/8 | 1595.108 | 3/8 | 2927.202 |
| 7/16 | 1.980 | 7/16 | 58.254 | 7/16 | 274.277 | 7/16 | 758.051 | 7/16 | 1617.575 | 7/16 | 2960.849 |
| 3 | 2.250 | 9 | 60.750 | 15 | 281.250 | 21 | 771.750 | 27 | 1640.250 | 33 | 2994.750 |
| 1/16 | 2.543 | 1/16 | 63.317 | 1/16 | 288.340 | 1/16 | 785.613 | 1/16 | 1663.136 | 1/16 | 3028.911 |
| 1/8 | 2.861 | 1/8 | 65.954 | 1/8 | 295.548 | 1/8 | 799.652 | 1/8 | 1686.236 | 1/8 | 3063.329 |
| 3/16 | 3.204 | 3/16 | 68.665 | 3/16 | 302.875 | 3/16 | 813.836 | 3/16 | 1709.547 | 3/16 | 3098.009 |
| 1/4 | 3.573 | 1/4 | 71.448 | 1/4 | 310.323 | 1/4 | 828.198 | 1/4 | 1733.073 | 1/4 | 3132.948 |
| 5/16 | 3.970 | 5/16 | 74.305 | 5/16 | 317.891 | 5/16 | 842.727 | 5/16 | 1756.814 | 5/16 | 3168.150 |
| 3/8 | 4.395 | 3/8 | 77.238 | 3/8 | 325.582 | 3/8 | 857.426 | 3/8 | 1780.770 | 3/8 | 3203.614 |
| 7/16 | 4.849 | 7/16 | 80.247 | 7/16 | 333.396 | 7/16 | 872.294 | 7/16 | 1804.943 | 7/16 | 3239.341 |
| 4 | 5.333 | 10 | 83.333 | 16 | 341.333 | 22 | 887.333 | 28 | 1829.333 | 34 | 3275.333 |
| 1/16 | 5.849 | 1/16 | 86.498 | 1/16 | 349.396 | 1/16 | 902.545 | 1/16 | 1853.943 | 1/16 | 3311.592 |
| 1/8 | 6.397 | 1/8 | 89.741 | 1/8 | 357.585 | 1/8 | 917.928 | 1/8 | 1878.773 | 1/8 | 3348.117 |
| 3/16 | 6.978 | 3/16 | 93.064 | 3/16 | 365.900 | 3/16 | 933.486 | 3/16 | 1903.823 | 3/16 | 3384.909 |
| 1/4 | 7.594 | 1/4 | 96.469 | 1/4 | 374.344 | 1/4 | 949.219 | 1/4 | 1929.094 | 1/4 | 3421.969 |
| 5/16 | 8.244 | 5/16 | 99.955 | 5/16 | 382.916 | 5/16 | 965.127 | 5/16 | 1954.588 | 5/16 | 3459.300 |
| 3/8 | 8.931 | 3/8 | 103.525 | 3/8 | 391.618 | 3/8 | 981.212 | 3/8 | 1980.305 | 3/8 | 3496.900 |
| 7/16 | 9.655 | 7/16 | 107.178 | 7/16 | 400.452 | 7/16 | 997.475 | 7/16 | 2006.249 | 7/16 | 3534.772 |
| 5 | 10.417 | 11 | 110.917 | 17 | 409.417 | 23 | 1013.917 | 29 | 2032.417 | 35 | 3572.917 |
| 1/16 | 11.218 | 1/16 | 114.741 | 1/16 | 418.515 | 1/16 | 1030.538 | 1/16 | 2058.811 | 1/16 | 3611.334 |
| 1/8 | 12.059 | 1/8 | 118.652 | 1/8 | 427.746 | 1/8 | 1047.340 | 1/8 | 2085.434 | 1/8 | 3650.027 |
| 3/16 | 12.941 | 3/16 | 122.652 | 3/16 | 437.113 | 3/16 | 1064.323 | 3/16 | 2112.285 | 3/16 | 3688.994 |
| 1/4 | 13.865 | 1/4 | 126.740 | 1/4 | 446.615 | 1/4 | 1081.490 | 1/4 | 2139.365 | 1/4 | 3728.240 |
| 5/16 | 14.832 | 5/16 | 130.918 | 5/16 | 456.253 | 5/16 | 1098.839 | 5/16 | 2166.676 | 5/16 | 3767.763 |
| 3/8 | 15.843 | 3/8 | 135.186 | 3/8 | 466.030 | 3/8 | 1116.374 | 3/8 | 2194.218 | 3/8 | 3807.561 |
| 7/16 | 16.898 | 7/16 | 139.547 | 7/16 | 475.945 | 7/16 | 1134.094 | 7/16 | 2221.992 | 7/16 | 3847.641 |
| 6 | 18.000 | 12 | 144.000 | 18 | 486.000 | 24 | 1152.000 | 30 | 2250.000 | 36 | 3888.000 |

# RADII OF GYRATION FOR TWO UNEQUAL ANGLES

**Long Legs Vertical**

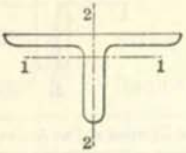


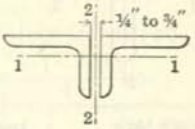




| Single Angle | | | Area of Two Angles, Inches² | Radii of Gyration of Two Angles, Inches | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Axis 1-1 | Axis 2-2 | | | | |
| Size, Inches | Thickness, Inches | Weight, Pounds per Foot | | | In Contact | ¼" Apart | ⅜" Apart | ½" Apart | ¾" Apart |
| 8 x 6 | 1 | 44.2 | 26.00 | 2.49 | 2.39 | 2.48 | 2.52 | 2.57 | 2.66 |
| | ¾ | 33.8 | 19.88 | 2.53 | 2.35 | 2.44 | 2.48 | 2.52 | 2.61 |
| | 7/16 | 20.2 | 11.86 | 2.57 | 2.31 | 2.39 | 2.43 | 2.48 | 2.56 |
| 8 x3½ | 1 | 35.7 | 21.00 | 2.51 | 1.26 | 1.35 | 1.40 | 1.45 | 1.55 |
| | ¾ | 27.5 | 16.12 | 2.55 | 1.20 | 1.29 | 1.34 | 1.39 | 1.49 |
| | 7/16 | 16.5 | 9.68 | 2.59 | 1.15 | 1.23 | 1.28 | 1.32 | 1.41 |
| 7 x3½ | 1 | 32.3 | 19.00 | 2.19 | 1.31 | 1.40 | 1.45 | 1.50 | 1.60 |
| | 11/16 | 23.0 | 13.50 | 2.23 | 1.25 | 1.34 | 1.39 | 1.44 | 1.53 |
| | ⅜ | 13.0 | 7.60 | 2.27 | 1.20 | 1.28 | 1.33 | 1.37 | 1.46 |
| 6 x 4 | 1 | 30.6 | 18.00 | 1.85 | 1.60 | 1.69 | 1.74 | 1.79 | 1.89 |
| | 11/16 | 21.8 | 12.80 | 1.89 | 1.55 | 1.63 | 1.68 | 1.73 | 1.82 |
| | ⅝ | 12.3 | 7.22 | 1.93 | 1.50 | 1.58 | 1.62 | 1.67 | 1.76 |
| 6 x3½ | 1 | 28.9 | 17.00 | 1.85 | 1.37 | 1.47 | 1.51 | 1.56 | 1.66 |
| | 11/16 | 20.6 | 12.12 | 1.89 | 1.31 | 1.41 | 1.45 | 1.49 | 1.60 |
| | 5/16 | 9.8 | 5.74 | 1.95 | 1.25 | 1.33 | 1.37 | 1.42 | 1.50 |
| 5 x 4 | ⅞ | 24.2 | 14.22 | 1.52 | 1.66 | 1.76 | 1.80 | 1.85 | 1.95 |
| | ⅝ | 11.0 | 6.46 | 1.59 | 1.58 | 1.66 | 1.70 | 1.75 | 1.85 |
| 5 x3½ | ⅞ | 22.7 | 13.34 | 1.53 | 1.42 | 1.51 | 1.56 | 1.61 | 1.71 |
| | 5/16 | 8.7 | 5.12 | 1.61 | 1.33 | 1.41 | 1.45 | 1.50 | 1.59 |
| 5 x 3 | 13/16 | 19.9 | 11.68 | 1.55 | 1.18 | 1.27 | 1.32 | 1.37 | 1.47 |
| | 5/16 | 8.2 | 4.80 | 1.61 | 1.09 | 1.17 | 1.22 | 1.26 | 1.35 |
| 4½x 3 | 13/16 | 18.5 | 10.86 | 1.38 | 1.21 | 1.31 | 1.36 | 1.41 | 1.51 |
| | 5/16 | 7.7 | 4.50 | 1.44 | 1.13 | 1.22 | 1.26 | 1.30 | 1.40 |
| 4 x3½ | 13/16 | 18.5 | 10.86 | 1.19 | 1.50 | 1.59 | 1.64 | 1.69 | 1.79 |
| | 5/16 | 7.7 | 4.50 | 1.26 | 1.42 | 1.51 | 1.55 | 1.60 | 1.69 |
| 4 x 3 | 13/16 | 17.1 | 10.06 | 1.21 | 1.25 | 1.35 | 1.40 | 1.45 | 1.55 |
| | ¼ | 5.8 | 3.38 | 1.28 | 1.16 | 1.24 | 1.28 | 1.33 | 1.43 |
| 3½x 3 | 13/16 | 15.8 | 9.24 | 1.04 | 1.30 | 1.40 | 1.45 | 1.50 | 1.60 |
| | ¼ | 5.4 | 3.12 | 1.11 | 1.20 | 1.29 | 1.34 | 1.38 | 1.48 |
| 3½x2½ | 11/16 | 12.5 | 7.30 | 1.06 | 1.03 | 1.13 | 1.18 | 1.23 | 1.33 |
| | ¼ | 4.9 | 2.88 | 1.12 | 0.95 | 1.04 | 1.09 | 1.13 | 1.23 |
| 3 x2½ | 9/16 | 9.5 | 5.56 | 0.91 | 1.05 | 1.15 | 1.20 | 1.25 | 1.35 |
| | ¼ | 4.5 | 2.64 | 0.95 | 1.00 | 1.09 | 1.13 | 1.18 | 1.28 |
| 3 x 2 | ½ | 7.7 | 4.50 | 0.92 | 0.80 | 0.89 | 0.94 | 1.00 | 1.10 |
| | ¼ | 4.1 | 2.38 | 0.95 | 0.74 | 0.84 | 0.88 | 0.93 | 1.03 |
| 2½x 2 | ½ | 6.8 | 4.00 | 0.75 | 0.84 | 0.94 | 0.99 | 1.04 | 1.15 |
| | ¼ | 3.62 | 2.12 | 0.78 | 0.80 | 0.89 | 0.93 | 0.98 | 1.08 |

# RADII OF GYRATION FOR TWO UNEQUAL ANGLES

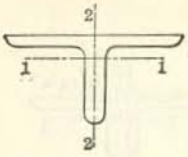
**Short Legs Vertical**

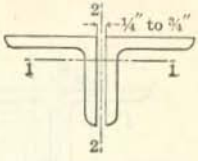



| Single Angle | | | Area of Two Angles, Inches² | Radii of Gyration of Two Angles, Inches | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size, Inches | Thickness, Inches | Weight, Pounds per Foot | | Axis 1-1 | Axis 2-2 | | | | |
| | | | | | In Contact | ¼" Apart | ⅜" Apart | ½" Apart | ¾" Apart |
| 8 x 6 | 1 | 44.2 | 26.00 | 1.73 | 3.64 | 3.73 | 3.78 | 3.83 | 3.92 |
| | ¾ | 33.8 | 19.88 | 1.76 | 3.60 | 3.69 | 3.73 | 3.78 | 3.87 |
| | 7/16 | 20.2 | 11.86 | 1.80 | 3.55 | 3.64 | 3.68 | 3.73 | 3.82 |
| 8 x3½ | 1 | 35.7 | 21.00 | 0.86 | 4.04 | 4.14 | 4.19 | 4.24 | 4.34 |
| | ¾ | 27.5 | 16.12 | 0.88 | 3.99 | 4.09 | 4.13 | 4.18 | 4.28 |
| | 7/16 | 16.5 | 9.68 | 0.92 | 3.93 | 4.02 | 4.07 | 4.12 | 4.22 |
| 7 x3½ | 1 | 32.3 | 19.00 | 0.89 | 3.48 | 3.58 | 3.63 | 3.68 | 3.78 |
| | 11/16 | 23.0 | 13.50 | 0.92 | 3.42 | 3.52 | 3.57 | 3.62 | 3.72 |
| | ⅝ | 13.0 | 7.60 | 0.96 | 3.36 | 3.46 | 3.50 | 3.55 | 3.65 |
| 6 x 4 | 1 | 30.6 | 18.00 | 1.09 | 2.85 | 2.95 | 2.99 | 3.04 | 3.14 |
| | 11/16 | 21.8 | 12.80 | 1.13 | 2.79 | 2.89 | 2.93 | 2.98 | 3.08 |
| | ⅝ | 12.3 | 7.22 | 1.17 | 2.74 | 2.83 | 2.87 | 2.92 | 3.02 |
| 6 x3½ | 1 | 28.9 | 17.00 | 0.92 | 2.92 | 3.02 | 3.07 | 3.12 | 3.22 |
| | 11/16 | 20.6 | 12.12 | 0.95 | 2.87 | 2.96 | 3.01 | 3.06 | 3.16 |
| | 5/16 | 9.8 | 5.74 | 1.00 | 2.81 | 2.90 | 2.95 | 3.00 | 3.09 |
| 5 x 4 | ⅞ | 24.2 | 14.22 | 1.14 | 2.29 | 2.38 | 2.43 | 2.48 | 2.58 |
| | ⅝ | 11.0 | 6.46 | 1.20 | 2.20 | 2.29 | 2.34 | 2.38 | 2.48 |
| 5 x3½ | ¾ | 22.7 | 13.34 | 0.96 | 2.36 | 2.45 | 2.50 | 2.55 | 2.65 |
| | 5/16 | 8.7 | 5.12 | 1.03 | 2.26 | 2.35 | 2.39 | 2.44 | 2.54 |
| 5 x 3 | 13/16 | 19.9 | 11.68 | 0.80 | 2.42 | 2.52 | 2.57 | 2.62 | 2.72 |
| | 5/16 | 8.2 | 4.80 | 0.85 | 2.33 | 2.42 | 2.47 | 2.52 | 2.61 |
| 4½x 3 | 13/16 | 18.5 | 10.86 | 0.81 | 2.15 | 2.25 | 2.30 | 2.35 | 2.45 |
| | 5/16 | 7.7 | 4.50 | 0.87 | 2.06 | 2.15 | 2.20 | 2.25 | 2.34 |
| 4 x3½ | 13/16 | 18.5 | 10.86 | 1.01 | 1.81 | 1.91 | 1.96 | 2.01 | 2.11 |
| | 5/16 | 7.7 | 4.50 | 1.07 | 1.73 | 1.81 | 1.86 | 1.91 | 2.00 |
| 4 x 3 | 13/16 | 17.1 | 10.06 | 0.83 | 1.88 | 1.98 | 2.03 | 2.08 | 2.18 |
| | ¼ | 5.8 | 3.38 | 0.89 | 1.78 | 1.87 | 1.92 | 1.96 | 2.06 |
| 3½x 3 | 13/16 | 15.8 | 9.24 | 0.85 | 1.61 | 1.71 | 1.76 | 1.81 | 1.91 |
| | ¼ | 5.4 | 3.12 | 0.91 | 1.52 | 1.61 | 1.65 | 1.70 | 1.80 |
| 3½x2½ | 11/16 | 12.5 | 7.30 | 0.69 | 1.66 | 1.75 | 1.80 | 1.86 | 1.96 |
| | ¼ | 4.9 | 2.88 | 0.74 | 1.58 | 1.67 | 1.71 | 1.76 | 1.86 |
| 3 x2½ | 9/16 | 9.5 | 5.56 | 0.72 | 1.37 | 1.46 | 1.51 | 1.56 | 1.66 |
| | ¼ | 4.5 | 2.64 | 0.75 | 1.31 | 1.40 | 1.45 | 1.50 | 1.59 |
| 3 x 2 | ½ | 7.7 | 4.50 | 0.55 | 1.42 | 1.52 | 1.57 | 1.62 | 1.72 |
| | ¼ | 4.1 | 2.38 | 0.57 | 1.38 | 1.47 | 1.52 | 1.57 | 1.67 |
| 2½x 2 | ½ | 6.8 | 4.00 | 0.56 | 1.15 | 1.25 | 1.30 | 1.35 | 1.46 |
| | ¼ | 3.62 | 2.12 | 0.59 | 1.11 | 1.20 | 1.25 | 1.30 | 1.40 |

# RADII OF GYRATION FOR TWO EQUAL ANGLES




| Single Angle | | | Area of Two Angles, Inches² | Radii of Gyration of Two Angles, Inches | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Size, Inches | Thickness, Inches | Weight, Pounds per Foot | | Axis 1-1 | Axis 2-2 | | | | |
| | | | | | In Contact | ¼" Apart | ⅜" Apart | ½" Apart | ¾" Apart |
| 8 x 8 | 1⅛ | 56.9 | 33.46 | 2.42 | 3.42 | 3.51 | 3.55 | 3.60 | 3.69 |
| | 13/16 | 42.0 | 24.68 | 2.46 | 3.37 | 3.46 | 3.50 | 3.55 | 3.64 |
| | ½ | 26.4 | 15.50 | 2.50 | 3.33 | 3.41 | 3.45 | 3.50 | 3.59 |
| 6 x 6 | 1 | 37.4 | 22.00 | 1.80 | 2.59 | 2.68 | 2.72 | 2.77 | 2.87 |
| | 11/16 | 26.5 | 15.56 | 1.83 | 2.54 | 2.63 | 2.67 | 2.71 | 2.81 |
| | ⅝ | 14.9 | 8.72 | 1.88 | 2.49 | 2.58 | 2.62 | 2.66 | 2.75 |
| 5 x 5 | 1 | 30.6 | 18.00 | 1.48 | 2.19 | 2.28 | 2.33 | 2.38 | 2.47 |
| | 11/16 | 21.8 | 12.80 | 1.51 | 2.13 | 2.22 | 2.26 | 2.31 | 2.40 |
| | ⅝ | 12.3 | 7.22 | 1.56 | 2.09 | 2.17 | 2.21 | 2.26 | 2.35 |
| 4 x 4 | 13/16 | 19.9 | 11.68 | 1.18 | 1.75 | 1.85 | 1.89 | 1.94 | 2.04 |
| | ¼ | 6.6 | 3.88 | 1.25 | 1.66 | 1.75 | 1.79 | 1.84 | 1.93 |
| 3½x3½ | 13/16 | 17.1 | 10.06 | 1.02 | 1.55 | 1.65 | 1.70 | 1.75 | 1.85 |
| | ¼ | 5.8 | 3.38 | 1.09 | 1.46 | 1.55 | 1.59 | 1.64 | 1.73 |
| 3 x 3 | ⅝ | 11.5 | 6.72 | 0.88 | 1.32 | 1.41 | 1.46 | 1.51 | 1.61 |
| | ¼ | 4.9 | 2.88 | 0.93 | 1.25 | 1.34 | 1.38 | 1.43 | 1.53 |
| 2½x2½ | ½ | 7.7 | 4.50 | 0.74 | 1.09 | 1.19 | 1.24 | 1.29 | 1.39 |
| | ¼ | 4.1 | 2.38 | 0.77 | 1.05 | 1.14 | 1.19 | 1.24 | 1.34 |
| 2 x 2 | 7/16 | 5.3 | 3.12 | 0.59 | 0.88 | 0.98 | 1.03 | 1.08 | 1.19 |
| | ¼ | 3.19 | 1.88 | 0.61 | 0.85 | 0.94 | 0.99 | 1.04 | 1.14 |

This table and the two preceding are employed in computing the safe resistance to compressive stress of two angles, back to back, used as a strut or as the compression chord of a roof truss, etc., as follows:

Obtain from the compression formula in use the allowed stress per square inch corresponding to the ratio of slenderness of the section, and multiply that value by the area. The result will be the allowable compressive stress.

Example 1. Section given. Required the safe load in compression on a strut composed of two angles 4" x 4" x ¼", back to back, with an unsupported length of 9 feet.

Area of Section, A=3.88 square inches; Least Radius, r=1.25.

Ratio of Slenderness, l/r = 9 x 12÷1.25=86.4.

Safe Load, Af=3.88 x allowed unit stress for l/r according to formula.

Example 2. Stress given. Required a section for a member in compression 12'-3" long, made of two angles separated by ½ inch gusset plates, to resist a total stress of 48,000 pounds; ratio of slenderness not to exceed 120.

Assume 2 angles, 5" x 3" x 5/16", 5"- legs, back to back.

Area of Section, A=4.80 square inches; Least Radius, r=1.26 inches.

Ratio of Slenderness, l/r =12.25 x 12÷1.26=116.7.

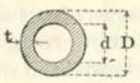
Allowed Unit Stress f, by A. I. S. C. formula = 10,250 lb./sq. in.

Safe Stress, Af=4.80 x 10,250=49,200 pounds.

In the first case the least radius is that about axis 1-1; in the second case about axis 2-2; in all cases the least radius determines the ratio of slenderness and therewith the allowed safe compressive stress. In all cases also the two angles are to be secured together by stay rivets so spaced as to insure that the section acts as a unit. The ratio of slenderness of any single angle between rivets must always be less than that of the strut or compression chord.

# HOLLOW ROUND SECTIONS

## Areas and Radii of Gyration




$$\text{Area} = \frac{\pi(D^2-d^2)}{4} = 0.7854\,(D^2-d^2) \text{ sq. in.}$$

$$\text{Radius of gyration} = \frac{\sqrt{D^2+d^2}}{4} \text{ in.}$$

| Dia. D, Inches | Elements | Thickness in Inches | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ¼ | 5/16 | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1¼ | 1⅜ | 1½ | 1⅝ | 1¾ | 1⅞ | 2 |
| 2 | A | 1.37 | 1.66 | | | | | | | | | | | | | | |
| | r | 0.63 | 0.61 | | | | | | | | | | | | | | |
| 3 | A | 2.16 | 2.64 | | | | | | | | | | | | | | |
| | r | 0.98 | 0.96 | | | | | | | | | | | | | | |
| 4 | A | 2.95 | 3.62 | 4.27 | 5.50 | | | | | | | | | | | | |
| | r | 1.33 | 1.31 | 1.29 | 1.25 | | | | | | | | | | | | |
| 5 | A | 3.73 | 4.60 | 5.45 | 7.07 | 8.59 | 10.01 | | | | | | | | | | |
| | r | 1.68 | 1.66 | 1.64 | 1.60 | 1.56 | 1.53 | | | | | | | | | | |
| 6 | A | 4.52 | 5.58 | 6.63 | 8.64 | 10.55 | 12.37 | 14.09 | 15.71 | | | | | | | | |
| | r | 2.03 | 2.01 | 1.99 | 1.95 | 1.91 | 1.88 | 1.84 | 1.80 | | | | | | | | |
| 7 | A | 5.30 | 6.57 | 7.80 | 10.21 | 12.52 | 14.73 | 16.84 | 18.85 | 20.76 | 22.58 | | | | | | |
| | r | 2.39 | 2.37 | 2.35 | 2.30 | 2.27 | 2.23 | 2.19 | 2.15 | 2.12 | 2.08 | | | | | | |
| 8 | A | 6.09 | 7.55 | 8.98 | 11.78 | 14.48 | 17.08 | 19.59 | 21.99 | 24.30 | 26.51 | 28.62 | 30.63 | | | | |
| | r | 2.74 | 2.72 | 2.70 | 2.66 | 2.62 | 2.58 | 2.54 | 2.50 | 2.46 | 2.43 | 2.39 | 2.36 | | | | |
| 9 | A | 6.87 | 8.53 | 10.16 | 13.35 | 16.44 | 19.44 | 22.33 | 25.13 | 27.83 | 30.43 | 32.94 | 35.34 | 37.65 | 39.86 | | |
| | r | 3.09 | 3.07 | 3.05 | 3.01 | 2.97 | 2.93 | 2.89 | 2.85 | 2.81 | 2.78 | 2.74 | 2.70 | 2.67 | 2.64 | | |
| 10 | A | 7.66 | 9.51 | 11.34 | 14.92 | 18.41 | 21.79 | 25.08 | 28.27 | 31.37 | 34.36 | 37.26 | 40.06 | 42.76 | 45.36 | 47.86 | 50.27 |
| | r | 3.45 | 3.43 | 3.41 | 3.36 | 3.32 | 3.28 | 3.24 | 3.20 | 3.16 | 3.13 | 3.09 | 3.05 | 3.02 | 2.98 | 2.95 | 2.92 |
| 11 | A | 8.44 | 10.49 | 12.52 | 16.49 | 20.37 | 24.15 | 27.83 | 31.42 | 34.90 | 38.29 | 41.58 | 44.77 | 47.86 | 50.85 | 53.75 | 56.55 |
| | r | 3.80 | 3.78 | 3.76 | 3.72 | 3.67 | 3.63 | 3.59 | 3.55 | 3.51 | 3.48 | 3.44 | 3.40 | 3.36 | 3.33 | 3.29 | 3.26 |
| 12 | A | 9.23 | 11.47 | 13.70 | 18.06 | 22.33 | 26.51 | 30.58 | 34.56 | 38.44 | 42.22 | 45.90 | 49.48 | 52.97 | 56.35 | 59.64 | 62.83 |
| | r | 4.16 | 4.13 | 4.11 | 4.07 | 4.03 | 3.99 | 3.95 | 3.91 | 3.87 | 3.83 | 3.79 | 3.75 | 3.71 | 3.68 | 3.64 | 3.61 |
| 13 | A | 10.01 | 12.46 | 14.87 | 19.63 | 24.30 | 28.86 | 33.33 | 37.70 | 41.97 | 46.14 | 50.22 | 54.19 | 58.07 | 61.85 | 65.53 | 69.12 |
| | r | 4.51 | 4.49 | 4.47 | 4.42 | 4.38 | 4.34 | 4.30 | 4.26 | 4.22 | 4.18 | 4.14 | 4.10 | 4.06 | 4.03 | 5.99 | 3.95 |
| 14 | A | 10.80 | 13.44 | 16.05 | 21.21 | 26.26 | 31.22 | 36.08 | 40.84 | 45.50 | 50.07 | 54.54 | 58.91 | 63.18 | 67.35 | 71.42 | 75.40 |
| | r | 4.86 | 4.84 | 4.82 | 4.78 | 4.73 | 4.69 | 4.65 | 4.61 | 4.57 | 4.53 | 4.49 | 4.45 | 4.41 | 4.38 | 4.34 | 4.30 |
| 15 | A | 11.58 | 14.42 | 17.23 | 22.78 | 28.23 | 33.58 | 38.83 | 43.98 | 49.04 | 54.00 | 58.86 | 63.62 | 68.28 | 72.85 | 77.31 | 81.68 |
| | r | 5.22 | 5.19 | 5.17 | 5.13 | 5.09 | 5.05 | 5.00 | 4.96 | 4.92 | 4.88 | 4.84 | 4.80 | 4.76 | 4.73 | 4.69 | 4.65 |
| 16 | A | 12.37 | 15.40 | 18.41 | 24.35 | 30.19 | 35.93 | 41.58 | 47.12 | 52.57 | 57.92 | 63.18 | 68.33 | 73.39 | 78.34 | 83.20 | 87.97 |
| | r | 5.57 | 5.55 | 5.53 | 5.48 | 5.44 | 5.40 | 5.36 | 5.32 | 5.27 | 5.23 | 5.19 | 5.15 | 5.11 | 5.08 | 5.04 | 5.00 |
| 17 | A | 13.16 | 16.38 | 19.59 | 25.92 | 32.15 | 38.29 | 44.33 | 50.27 | 56.11 | 61.85 | 67.50 | 73.04 | 78.49 | 83.84 | 89.09 | 94.25 |
| | r | 5.92 | 5.90 | 5.88 | 5.84 | 5.79 | 5.75 | 5.71 | 5.67 | 5.63 | 5.59 | 5.55 | 5.51 | 5.47 | 5.43 | 5.39 | 5.35 |
| 18 | A | 13.94 | 17.36 | 20.76 | 27.49 | 34.12 | 40.64 | 47.07 | 53.41 | 59.64 | 65.78 | 71.82 | 77.75 | 83.60 | 89.34 | 94.98 | 100.53 |
| | r | 6.28 | 6.25 | 6.23 | 6.19 | 6.15 | 6.10 | 6.06 | 6.02 | 5.98 | 5.94 | 5.90 | 5.86 | 5.82 | 5.78 | 5.74 | 5.70 |
| 19 | A | 14.73 | 18.35 | 21.94 | 29.06 | 36.08 | 43.00 | 49.82 | 56.55 | 63.18 | 69.70 | 76.13 | 82.47 | 88.70 | 94.84 | 100.87 | 106.82 |
| | r | 6.63 | 6.61 | 6.59 | 6.54 | 6.50 | 6.46 | 6.42 | 6.37 | 6.33 | 6.29 | 6.25 | 6.21 | 6.17 | 6.13 | 6.09 | 6.05 |
| 20 | A | 15.51 | 19.33 | 23.12 | 30.63 | 38.04 | 45.36 | 52.57 | 59.69 | 66.71 | 73.63 | 80.45 | 87.18 | 93.81 | 100.33 | 106.77 | 113.10 |
| | r | 6.98 | 6.96 | 6.94 | 6.90 | 6.85 | 6.81 | 6.77 | 6.73 | 6.69 | 6.64 | 6.60 | 6.56 | 6.52 | 6.48 | 6.44 | 6.40 |

## STRESSES IN BEAMS

In the application of the principles of structural mechanics to determine what sections should be used safely to sustain superimposed loads under specified conditions of loading, it is necessary to ascertain, first, the effects produced on the structure by the loads under those conditions; second, to decide what unit strength the material, the use of which is contemplated, has to resist the stresses produced within the structure by the loading; and, third, to select a section whose section modulus is equivalent to the ratio found to exist between the stresses tending to cause deformation within the structure and the unit strength of the material to resist them.

**Reactions.** In the simple case of a beam supported at both ends, each support reacts with an upward pressure called the reaction of the support. The sum of these two reactions is equal to the total load on the beam.

**Shear.** The loads and the reactions of the supports are vertical forces tending to shear or cut the beam across and the stresses they produce within the beam are, therefore, called shearing stresses. The shear at each support is equal to the reaction of the support; the shear at any point between the supports is equal to the reaction of a support less the total load between that support and the point; or, if the reaction acting upward is considered as positive and the loads, acting downwards, as negative, the shear at any point is the algebraic sum of the vertical forces acting on the beam between that point and either support.

If such a simple beam supported at both ends carries a load uniformly distributed over its entire length, the reaction and the shear at each support is equal to one-half the total load on the beam, but the shear decreases uniformly to zero at the center of the span; if the load is concentrated at the center of the span, the reaction and the shear at each support are also equal to one-half the total load, but the shear is uniform throughout the entire length of the beam.

**Bending Moment.** The loads on the beam and the reactions of the supports constitute external forces which produce bending stress in the beam. The summation of the moments of the external forces about any point is called the bending moment and varies from point to point. It attains a maximum value at a point where the shear is either zero or changes from positive to negative or vice versa. If the loads are concentrated at several points, the maximum bending moment always occurs at the point of application of

one of the loads so located that the sum of all the loads on the beam between one support up to and including that load is equal to or greater than the reaction of the support.

**Vertical Deflection.** Bending stress within a beam produces flexure, and the deflection, or the amount of its departure from a straight line, is the measure of the deformation which the beam has undergone in its resistance to bending stress. So long as the stress is within the safe limits allowed for the material, the deflection is negligible so far as concerns the beam itself; it may, however, be of sufficient magnitude to cause the disruption of other materials in contact with or supported by the beam but of less strength, such as plaster. In such cases the limit of allowable deflection may determine or at least influence the choice of a section.

**Lateral Deflection.** The stresses within a beam under transverse loading are compressive on one side of the neutral axis and tensile on the other. The tensile stresses tend to hold the beam in a straight line between the supports, while the compressive stresses tend to deflect it in a lateral direction, just as the bending stresses as a whole tend to deflect it in a vertical plane. On long spans unsupported against sidewise deflection, this consideration may influence the choice of sections.

**Method of Computation.** A complete investigation of the strength of beams under transverse loading must take into account all the elements, the bending moment, the vertical deflection, the lateral deflection and the shearing stress; though under the usual loading conditions the first alone determines the size and weight of section.

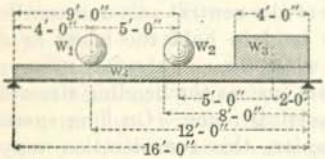
In the calculation of bending stresses, the loads are usually expressed in pounds, the span length and the distance between the loads in feet; the resulting bending moments are in terms of foot pounds, which necessitates conversion to inch pounds before the section can be selected from the tables. The section modulus of the required section is obtained by dividing the maximum bending moment in inch pounds by the allowed fiber stress in pounds per square inch. In such calculations it is assumed that the neutral axis of the section is normal to the line of action of the load. When this is not the case, correction must be made for the eccentricity of the loading.

In the pages which immediately follow are given general formulas for the bending moments and vertical deflections of beams under the usual conditions of loading, and also diagrams illustrative of those conditions. The general method for the computation of the maximum bending moment of a beam supported at its ends and loaded at various points is as follows:—

First. Find the reaction at the left (right) support by multiplying each load by its distance from the right (left) support and dividing the sum of these products by the length of the span.

Second. Starting from the left (right) end of the beam, add the successive loads until a point is reached where the sum of the loads equals or exceeds the reaction of the left (right) support; the point of maximum bending moment is located at this point.

Third. Multiply the reaction at the left (right) support by its distance from the point of maximum bending moment and subtract the sum of the products of all loads to the left (right) of this point by the corresponding distance from this point; the difference between these moments is then the maximum bending moment.




Example: Required the size of a steel beam to support the following quiescent loads over a clear span of 16 feet between supports, at a maximum fiber stress not to exceed 16000 pounds per square inch.

$W_1$ = 16000 pounds, 4 feet from left support.
$W_2$ = 18000 " 9 " " " "
$W_3$ = 2000 " per foot, uniform up to 4 feet from right support.
$W_4$ = 60 " " " assumed weight of beam uniformly distributed over entire span.

Left Reaction, $\frac{16000 \times 12 + (60 \times 16)8 + 18000 \times 7 + (2000 \times 4) \times 2}{16} = 21355$ lbs.

Right Reaction, $\frac{16000 \times 4 + (60 \times 16)8 + 18000 \times 9 + (2000 \times 4) \times 14}{16} = 21605$ lbs.

Sum of reactions = sum of loads = $W_1 + W_2 + W_3 + W_4$ = 42960 lbs.

Points of maximum moment $(60 \times 4) + 16000 = 16240 < 21355$

$(60 \times 9) + 16000 + 18000 = 34540 > 21355$

therefore the point of maximum bending moment is at point of load $W_2$.

Maximum bending moment, $21355 \times 9 - 16000 \times 5 - (60 \times 9) \times 4.5$ = 109765 ft. lbs.

or, $21605 \times 7 - (2000 \times 4) \times 5 - (60 \times 7) \times 3.5$ = 109765 ft. lbs.

Required section modulus $= \frac{109765 \times 12}{16000} = \frac{1317180}{16000} = 82.4$ in.$^3$

As the section modulus of the 15 inch 65 pound or the 18 inch 54.7 pound beam is greater than this, either of these sections may be used.

If the allowed fiber stress were 18000 pounds per square inch, the required section modulus would be $\frac{109765 \times 12}{18000} = \frac{1317180}{18000} = 73.2$ in.$^3$

## COMPARISON OF VARIOUS LOADING CONDITIONS

The formulas and diagrams on the pages which follow give the various stresses in sections used as beams, resulting from usual conditions of loading.

Taking as a unit of comparison a uniformly distributed safe load on beams of equal length and section, supported at the extreme ends, the following table gives the relative maximum safe loads or bending moments and deflections.

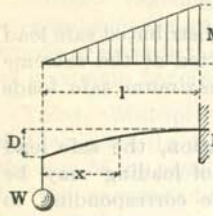
As a check on the accuracy of a computation, the safe load obtained from the formula for any condition of loading may be multiplied by the reciprocal given in the table corresponding to such loading condition; the result should be the maximum allowable uniform load as taken from beam safe load tables.

| Conditions of Loading | Case No. | Maximum Safe Load | | Maximum Deflection |
|---|---|---|---|---|
| | | Relative | Reciprocal | Relative |
| BEAM SUPPORTED AT ENDS | | | | |
| Load uniformly distributed over span | IX | 1 | 1 | 1 |
| Load concentrated at center of span | V | ½ | 2 | .80 |
| Two equal loads symmetrically concentrated | VII | l/4a | 4a/l | |
| Load increasing uniformly to one end | X | .9743 | 1.0264 | .976 |
| Load increasing uniformly to center | XII | ¾ | 1⅓ | .96 |
| Load decreasing uniformly to center | XI | ½ | ⅔ | 1.08 |
| BEAM FIXED AT ONE END, CANTILEVER | | | | |
| Load uniformly distributed over span | II | ¼ | 4 | 2.40 |
| Load concentrated at end | I | ⅛ | 8 | 3.20 |
| Load increasing uniformly to fixed end | III | ⅜ | 2⅔ | 1.92 |
| BEAM CONTINUOUS OVER TWO SUPPORTS EQUIDISTANT FROM ENDS | | | | |
| Load uniformly distributed over span | XVI | | | |
| 1. If distance a >0.2071 l | | $l^2/4a^2$ | $4a^2/l^2$ | |
| 2. If distance a <0.2071 l | | $\frac{l}{l-4a}$ | $\frac{l-4a}{l}$ | |
| 3. If distance a =0.2071 l | | 5.8285 | .1716 | |
| Two equal loads concentrated at ends | XV | l/4a | 4a/l | |

# BEAMS UNDER VARIOUS LOADING CONDITIONS

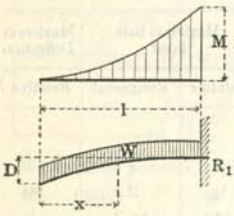
## Bending Moments and Deflections

### I. CANTILEVER BEAM—Concentrated load at free end



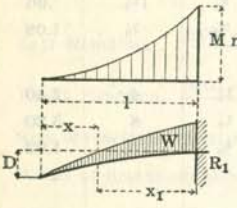

| | |
|---|---|
| $R_1$ (max. shear) | $= W$ |
| M, distance x | $= Wx$ |
| M max. at $R_1$ | $= Wl$ |
| W max. | $= \frac{fS}{l}$ |
| D max. | $= \frac{Wl^3}{3EI}$ |

### II. CANTILEVER BEAM—Uniformly distributed load



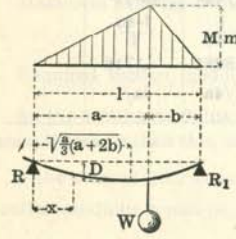

| | |
|---|---|
| $R_1$ (max. shear) | $= W$ |
| M, distance x | $= \frac{Wx^2}{2l}$ |
| M max. at $R_1$ | $= \frac{Wl}{2}$ |
| W max. | $= \frac{2fS}{l}$ |
| D max. | $= \frac{Wl^3}{8EI}$ |

### III. CANTILEVER BEAM—Load increasing uniformly to fixed end




| | |
|---|---|
| $R_1$ (max. shear) | $= W$ |
| M, distance x | $= \frac{W}{3}\frac{x^3}{l^2}$ |
| M max. at $R_1$ | $= \frac{Wl}{3}$ |
| W max. | $= \frac{3fS}{l}$ |
| D max. | $= \frac{Wl^3}{15EI}$ |

### IV. BEAM SUPPORTED AT ENDS—Concentrated load near one end

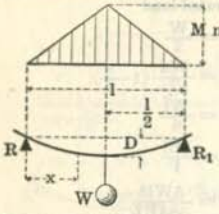



| | |
|---|---|
| R (max. shear if b>a) | $= \frac{Wb}{l}$ |
| $R_1$ (max. shear if a>b) | $= \frac{Wa}{l}$ |
| M, distance x | $= \frac{Wbx}{l}$ |
| M max., at point of load | $= \frac{Wab}{l}$ |
| W max. | $= \frac{fSl}{ab}$ |
| D max. | $= \frac{Wab\,(a+2b)\sqrt{3a\,(a+2b)}}{27EIl}$ |

# BEAMS UNDER VARIOUS LOADING CONDITIONS

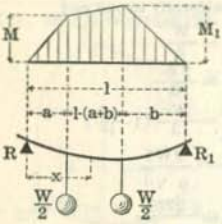
## Bending Moments and Deflections

### V. BEAM SUPPORTED AT ENDS—Concentrated load at center



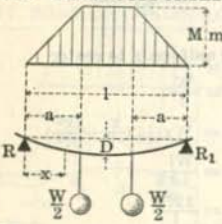

| | |
|---|---|
| R (max. shear) $=R_1$ | $= \frac{W}{2}$ |
| M, distance x | $= \frac{Wx}{2}$ |
| M max., at point of load | $= \frac{Wl}{4}$ |
| W max. | $= \frac{4fS}{l}$ |
| D max. | $= \frac{Wl^3}{48EI}$ |

### VI. BEAM SUPPORTED AT ENDS—Two unsymmetrical concentrated loads



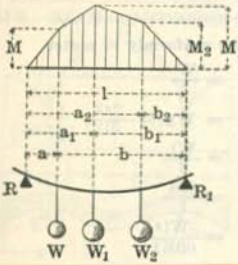

| | |
|---|---|
| R (max. shear if a<b) | $= \frac{W}{2l}(l-a+b)$ |
| $R_1$ | $= \frac{W}{2l}(l+a-b)$ |
| M, distance a | $= Ra = \frac{Wa}{2l}(l-a+b)$ |
| $M_1$ max., distance b (b>a) | $= R_1 b = \frac{Wb}{2l}(l+a-b)$ |
| $M_2$, distance x | $= Rx - \frac{W}{2}(x-a)$ |
| W max. (b>a) | $= \frac{2lfS}{b(l+a-b)}$ |

### VII. BEAM SUPPORTED AT ENDS—Two symmetrical concentrated loads




| | |
|---|---|
| R (max. shear) $=R_1$ | $= \frac{W}{2}$ |
| M, distance x | $= \frac{Wx}{2}$ |
| M max. at and between loads | $= \frac{Wa}{2}$ |
| W max. | $= \frac{2fS}{a}$ |
| D max. | $= \frac{Wa}{12EI}(\frac{3}{4}l^2-a^2)$ |

### VIII. BEAM SUPPORTED AT ENDS—Three concentrated loads

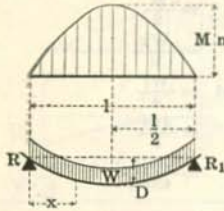



| | |
|---|---|
| R | $= \frac{Wb+W_1b_1+W_2b_2}{l}$ |
| $R_1$ | $= \frac{Wa+W_1a_1+W_2a_2}{l}$ |
| M at W | $= Ra.$ |
| M max. if W | $=$ or $> R$ |
| M at $W_1$ | $= Ra_1 - W(a_1-a)$ |
| M max. if $W_1+W$ | $= R$ or $> R$ |
| M max. if $W_1+W_2$ | $= R_1$ or $> R_1$ |
| M at $W_2$ | $= Ra_2 - W(a_2-a) - W_1(a_2-a_1)$ |
| M max. if $W_2$ | $= R_1$ or $> R_1$ |

# BEAMS UNDER VARIOUS LOADING CONDITIONS

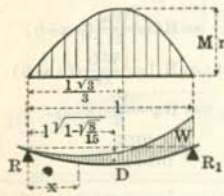
## Bending Moments and Deflections

### IX. BEAM SUPPORTED AT ENDS—Uniformly distributed load



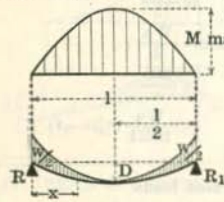

| | |
|---|---|
| R(max. shear)=$R_1$ | $= \frac{W}{2}$ |
| M, distance x | $= \frac{Wx}{2}(1-\frac{x}{l})$ |
| M max. at center | $= \frac{Wl}{8}$ |
| W max. | $= \frac{8fS}{l}$ |
| D max. | $= \frac{5Wl^3}{384EI}$ |

### X BEAM SUPPORTED AT ENDS—Load increasing uniformly to one end



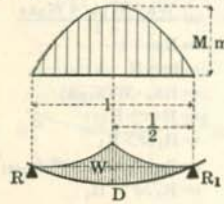

| | |
|---|---|
| R | $= \frac{W}{3}$ |
| $R_1$(max. shear) | $= \frac{2W}{3}$ |
| M, distance x | $= \frac{Wx}{3}(1-\frac{x^2}{l^2})$ |
| M max., distance $\frac{l\sqrt{3}}{3}$ | $= \frac{2Wl}{9\sqrt{3}}$ |
| W max. | $= \frac{27fS}{21\sqrt{3}}$ |
| D max. | $= \frac{.013044\ Wl^3}{EI}$ |

### XI. BEAM SUPPORTED AT ENDS—Load decreasing uniformly to center




| | |
|---|---|
| R(max. shear)=$R_1$ | $= \frac{W}{2}$ |
| M, distance x | $= Wx(\frac{1}{2}-\frac{x}{l}+\frac{2x^2}{3l^2})$ |
| M max., distance $\frac{l}{2}$ | $= \frac{Wl}{12}$ |
| W max. | $= \frac{12fS}{l}$ |
| D max. | $= \frac{3Wl^3}{320EI}$ |

### XII. BEAM SUPPORTED AT ENDS—Load increasing uniformly to center

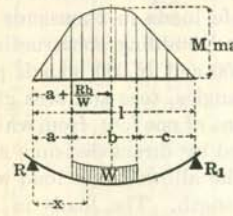



| | |
|---|---|
| R(max. shear)=$R_1$ | $= \frac{W}{2}$ |
| M, distance x | $= Wx(\frac{1}{2}-\frac{2x^2}{3l^2})$ |
| M max., distance $\frac{l}{2}$ | $= \frac{Wl}{6}$ |
| W max. | $= \frac{6fS}{l}$ |
| D max. | $= \frac{Wl^3}{60EI}$ |

# BEAMS UNDER VARIOUS LOADING CONDITIONS

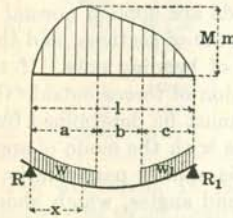
## Bending Moments and Deflections—Concluded

### XIII. BEAM SUPPORTED AT ENDS—Uniform load partially distributed



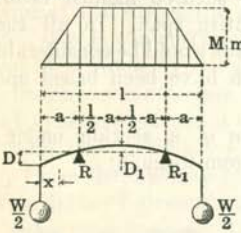

| | |
|---|---|
| R (max. shear if a<c) | $= \frac{W(2c+b)}{2l}$ |
| $R_1$ | $= \frac{W(2a+b)}{2l}$ |
| M, dist. x=a or <a, | $= Rx$ |
| $M_1$ dist. x>a, | $= Rx - \frac{W(x-a)^2}{2b}$ |
| $M_2$, dist. x>(a+b), | $= Rx - \frac{W(2x-2a-b)}{2}$ |
| M max., dist. $a + \frac{Rb}{W}$, | $= \frac{W(2c+b)[4al+b(2c+b)]}{8l^2}$ |
| W max. | $= \frac{8l^2fS}{(2c+b)[4al+b(2c+b)]}$ |

### XIV. BEAM SUPPORTED AT ENDS—Uniform load partially discontinuous



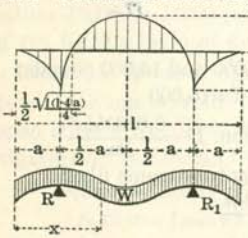

| | |
|---|---|
| R (max. shear if W>$W_1$) | $= \frac{W(2l-a)+W_1c}{2l}$ |
| $R_1$ | $= \frac{W_1(2l-c)+Wa}{2l}$ |
| M, distance x <a, | $= Rx - \frac{Wx^2}{2a}$ |
| $M_1$ distance x >a, | $= Rx - \frac{W(2x-a)}{2}$ |
| M max. dist. $x \frac{2Wal-Wa^2+W_1ca}{2Wl}$ & Wa>$W_1c$ | $= \frac{R^2a}{2W}$ |
| W max. | $= \frac{R^2a}{2fS}$ |

### XV. BEAM CONTINUOUS OVER TWO SUPPORTS—Two exterior symmetrical loads




| | |
|---|---|
| R (max. shear) = $R_1$ | $= \frac{W}{2}$ |
| M, distance x | $= \frac{Wx}{2}$ |
| M max., from R to $R_1$ | $= \frac{Wa}{2}$ |
| W max. | $= \frac{2fS}{a}$ |
| D, distance a | $= \frac{Wa(3al-4a^2)}{12\,EI}$ |
| $D_1$, distance $\frac{l}{2}$ −a | $\frac{Wa(l-2a)^2}{16EI}$ |

### XVI. BEAM CONTINUOUS OVER TWO SUPPORTS—Uniformly distributed load




| | | |
|---|---|---|
| R = $R_1$ | $= \frac{W}{2}$, max. shear $\frac{Wa}{l}$ or $\frac{W}{l}(\frac{l}{2}-a)$ | |
| M, distance x | $= \frac{W(x^2-lx+al)}{2l}$ | o, if $x = \frac{l}{2} - \sqrt{\frac{l(l-4a)}{4}}$ |
| $M_1$ at R and $R_1$ | $= \frac{Wa^2}{2l}$ | max. if a > l(√½−½) |
| $M_2$ at center | $= \frac{W(l-4a)}{8}$ | max. if a < l(√½−½) |
| $W_1$ max. | $= \frac{2lfS}{a^2}$ | max. if a > l(√½−½) |
| $W_2$ max. | $= \frac{8fS}{l-4a}$ | max. if a < l(√½−½) |

## SAFE LOADS FOR SECTIONS USED AS BEAMS

### EXPLANATION OF TABLES

The tables of safe loads for structural beams, channels, H-beams and cross tie sections, used as beams under conditions of transverse loading, give the uniformly distributed safe loads in thousands of pounds for spans customary in bridge and building construction, based upon an extreme fiber stress of 18,000 and 16,000 pounds per square inch. The tables of safe loads for angles, tees and zees give the values at the same fiber stresses on spans of one foot, from which the safe load for any length may be obtained by direct division, and also the values for those spans at which the allowed safe load will produce a deflection of $\frac{1}{360}$ of the span length. The loads in all cases include the weight of the section, which should be deducted in order to arrive at the net load which the section will support.

It is assumed in all cases that the loads are applied normal to the axis 1-1 as shown in the tables of elements of sections, and that the beam deflects vertically in the plane of bending only. If the conditions of loading involve the introduction of forces outside this plane of loading, the allowable safe loads must be determined from the general theory of flexure, in accordance with the mode of application of the load and its character. This applies particularly to unsymmetrical sections, such as zee bars and angles, which should be used only under those conditions of loading where the section can deflect vertically only, being rigidly secured against lateral deflection or twisting throughout the entire span. In all such cases of eccentric loading, the actual safe loads would be considerably lower than the tabulated safe loads which have been based upon the most favorable conditions of loading.

**Vertical Deflection.** The vertical deflection of a section under a uniformly distributed load is determined from formula:

$$\text{Deflection, } D=\frac{5}{384}\frac{Wl^3}{EI}\ ;\ W=\frac{8\,f\,I}{n}$$

$$\text{“ } \quad D=\frac{40}{384}\frac{fl^2}{En}\text{; for span length in feet, } l=L\times 12$$

$$\text{“ } \quad D=\frac{15\,fL^2}{En}\text{ inches}$$

Steel, E=29,000,000; for fiber stresses of 18,000 and 16,000 pounds:

f=18,000 f=16,000

$$\text{Deflection, } D=\frac{0.01862L^2}{2n} \qquad \text{Deflection, } D=\frac{0.01655L^2}{2n}$$

n=distance from center line of gravity to extreme fiber.

$$\text{Deflection}=\frac{\text{Coefficient}}{2n}$$

Deflection Coefficients for Fiber Stresses of 18,000 and 16,000 Pounds

| Span, Feet | Fiber Stress | | Span, Feet | Fiber Stress | | Span, Feet | Fiber Stress | |
|---|---|---|---|---|---|---|---|---|
| | 18,000 | 16,000 | | 18,000 | 16,900 | | 18,000 | 16,000 |
| 1 | 0.019 | 0.017 | 21 | 8.212 | 7.299 | 41 | 31.301 | 27.823 |
| 2 | 0.074 | 0.066 | 22 | 9.012 | 8.011 | 42 | 32.847 | 29.197 |
| 3 | 0.168 | 0.149 | 23 | 9.850 | 8.756 | 43 | 34.430 | 30.604 |
| 4 | 0.298 | 0.265 | 24 | 10.726 | 9.534 | 44 | 36.050 | 32.044 |
| 5 | 0.466 | 0.414 | 25 | 11.638 | 10.345 | 45 | 37.707 | 33.517 |
| 6 | 0.670 | 0.596 | 26 | 12.588 | 11.189 | 46 | 39.401 | 35.023 |
| 7 | 0.912 | 0.811 | 27 | 13.574 | 12.066 | 47 | 41.133 | 36.563 |
| 8 | 1.192 | 1.059 | 28 | 14.599 | 12.977 | 48 | 42.902 | 38.135 |
| 9 | 1.508 | 1.341 | 29 | 15.660 | 13.920 | 49 | 44.708 | 39.741 |
| 10 | 1.862 | 1.655 | 30 | 16.759 | 14.897 | 50 | 46.552 | 41.379 |
| 11 | 2.253 | 2.003 | 31 | 17.894 | 15.906 | 51 | 48.432 | 43.051 |
| 12 | 2.681 | 2.383 | 32 | 19.068 | 16.949 | 52 | 50.350 | 44.756 |
| 13 | 3.147 | 2.797 | 33 | 20.278 | 18.025 | 53 | 52.306 | 46.494 |
| 14 | 3.650 | 3.244 | 34 | 21.526 | 19.134 | 54 | 54.298 | 48.265 |
| 15 | 4.190 | 3.724 | 35 | 22.810 | 20.276 | 55 | 56.328 | 50.069 |
| 16 | 4.767 | 4.237 | 36 | 24.132 | 21.451 | 56 | 58.395 | 51.906 |
| 17 | 5.381 | 4.783 | 37 | 25.492 | 22.659 | 57 | 60.499 | 53.777 |
| 18 | 6.033 | 5.363 | 38 | 26.888 | 23.901 | 58 | 62.640 | 55.680 |
| 19 | 6.722 | 5.975 | 39 | 28.322 | 25.175 | 59 | 64.819 | 57.617 |
| 20 | 7.448 | 6.621 | 40 | 29.793 | 26.483 | 60 | 67.035 | 59.586 |

The deflection, in inches, of sections subjected to transverse stresses due to uniformly distributed loads are obtained as follows:

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

**Unsymmetrical Sections.** To find the deflection in inches of a section not symmetrical about the neutral axis, such as angles, tees, etc., divide the coefficient corresponding to given span and fiber stress by twice the distance of extreme fiber from neutral axis obtained from table of elements of sections.

**Other Fiber Stresses.** To find the deflection of any section for other fiber stresses than those given, multiply the coefficient for either 18000 or 16000 pounds fiber stress corresponding to the span given by the ratio of desired fiber stress and 18000 or 16000.

**Limits of Deflection.** The deflection of floor beams carrying plastered ceilings should be limited to not more than $\frac{1}{360}$ of the span length; this limit is indicated in the safe load tables by lower zigzag line, is derived from the following formulas:

$$\text{Deflection, } D_{max} = \frac{12L}{360} = \frac{15fL^2}{En} \qquad \text{Limiting Span, } L_{max.} = \frac{En}{450f}$$

$f = 18{,}000$, $L_{max.} = 3.580n$ $\qquad$ $f = 16{,}00$, $L_{max.} = 4.027n$

**Lateral Deflection of Beams.** The tabular safe loads are based on the assumption that the compression flanges of the various sections are secured against lateral deflection by the use of tie rods or by other means at proper intervals.

Full tabular safe loads may be used up to a span length equal to fifteen times the flange width, but when the unbraced length exceeds fifteen times the width, the tabular safe loads must be reduced in accordance with the ratios given in the following table in order to insure that the stresses in the compression flanges do not exceed the safe unit stress. The lateral unbraced length of beams and girders should not exceed forty times the width of the compression flanges.

Reduction of Safe Loads for Ratio of Span Length to Flange Width, l/b.

| Ratio, l/b | Tabular Load, Per Cent. | Ratio, l/b | Tabular Load, Per Cent. | Ratio, l/b | Tabular Load, Per Cent. |
|---|---|---|---|---|---|
| 15 | 99.9 | 23.5 | 87.1 | 32 | 73.5 |
| 15.5 | 99.2 | 24 | 86.3 | 32.5 | 72.7 |
| 16 | 98.5 | 24.5 | 85.5 | 33 | 71.9 |
| 16.5 | 97.8 | 25 | 84.7 | 33.5 | 71.2 |
| 17 | 97.1 | 25.5 | 83.9 | 34 | 70.4 |
| 17.5 | 96.4 | 26 | 83.0 | 34.5 | 69.7 |
| 18 | 95.6 | 26.5 | 82.2 | 35 | 68.9 |
| 18.5 | 94.9 | 27 | 81.4 | 35.5 | 68.2 |
| 19 | 94.1 | 27.5 | 80.6 | 36 | 67.4 |
| 19.5 | 93.4 | 28 | 79.8 | 36.5 | 66.7 |
| 20 | 92.6 | 28.5 | 79.0 | 37 | 66.0 |
| 20.5 | 91.8 | 29 | 78.2 | 37.5 | 65.2 |
| 21 | 91.0 | 29.5 | 77.4 | 38 | 64.5 |
| 21.5 | 90.3 | 30 | 76.6 | 38.5 | 63.8 |
| 22 | 89.5 | 30.5 | 75.8 | 39 | 63.1 |
| 22.5 | 88.7 | 31 | 75.1 | 39.5 | 62.4 |
| 23 | 87.9 | 31.5 | 74.3 | 40 | 61.7 |

In addition to this lateral deflection which is induced within the beam by the action of pure bending stresses, lateral deflection may be induced by the thrust of floor arches or other loading acting on an axis perpendicular to the line of principal bending stress. The thrust of these arches should either be neutralized by tie rods, or the safe carrying capacity of the beam should be computed in accordance with the general formulas of flexure to provide for the combined stresses due to the action of both vertical and horizontal forces; that is to say, the safe loads should be figured around both the axes 1-1 and 2-2, and the unit stress computed so as not to exceed the allowable fiber stress.

**Effect of Impact on Stresses.** The formulas upon which the tables of safe loads are based assume all loads to be quiescent or static. The effect of moving loads may be taken care of either by reducing the allowable unit stresses, or else by increasing the theoretical loads.

When a load is suddenly applied, the resultant stresses are twice as great as those due to an equal quiescent load.

When an instantaneously applied load produces impact or percussion, the resultant stresses are dynamic and are measured by the laws governing the energy of bodies in motion. The following formulas give the fiber stress and deflection due to a load falling on center of a beam rigidly supported at both ends when the weight of beam is negligible as compared with that of falling load, and when no account is taken of the local distortion due to impact or percussion at point of application of load; but when the weight of the beam is a real factor, theoretical formulas do not agree with observed results and practical tests give values which are far less than those indicated by theoretical formulas; this is notably true in drop-tests of axles:

W =Weight of falling load, in pounds.
h =Height of fall, in inches.
f =Extreme fiber stress due to static effect of load, W, in pounds per square inch.
$f_d$ =Extreme fiber stress due to impact of load, W, in pounds per square inch.
D =Deflection due to static effect of load, W, in inches.
$D_d$=Deflection due to impact of load, W, in inches.

$$f_d = f\left(1 + \sqrt{\frac{2h}{D} + 1}\right) \qquad D_d = D\left(1 + \sqrt{\frac{2h}{D} + 1}\right)$$

**Shearing Stresses.** The safe load tables for beams and channels are computed solely with reference to safe unit stresses due to flexure, and the safe loads uniformly distributed on the spans given will not produce excessive shearing stresses in the web.

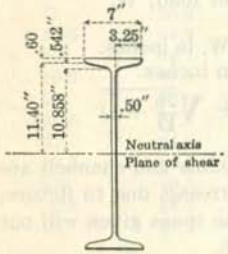
When, however, beams must support heavy loads which are concentrated near the supports, or when beams of short span are loaded with uniformly distributed loads to their full carrying capacity as regards flexure, the bending moments may be small in comparison with the reactions at the supports, and the beams may fail along the neutral plane as a result of longitudinal shearing stresses, or may buckle as a result of the combined longitudinal and vertical web stresses. On such spans the safe shearing or buckling strength of the web may limit the carrying capacity of the beam, so that the deciding factor will often be the resistance of the web to shearing stresses, rather than the resistance of the flanges to bending stresses.

**Longitudinal Shear.** At any point in any section of a beam, the horizontal and vertical components of the web stress are equal to each other and proportional to the vertical shear; their intensities are dependent upon the distance of the point from the neutral axis. In order to determine the intensity of the vertical shearing stress at a given point in a vertical section of the beam, therefore, it is sufficient to find the equal intensity of the horizontal shearing stress at the same point in the horizontal plane.

The longitudinal unit shear is zero at the upper and lower flanges of the beam and a maximum at the neutral plane. It is greatest at the supports and zero where there is no vertical shear.

The intensity of the longitudinal shear at any point in any section is the product of the vertical shear, V, for that section and the static moment, $M_s$, of the section included between the horizontal plane of shear through that point and the extreme fibers on the same side of the neutral plane divided by the product of the moment of inertia of the beam around the proper axis and the thickness at the plane of shear; or

$$\text{Longitudinal shear per square inch} = \frac{V\,M_s}{t\,I}.$$




Example—Required the maximum longitudinal shear per square inch in a 24" 79.9 lb. beam loaded with two symmetrical loads of 100,000 pounds each, disregarding the weight of the beam.

| | | |
|---|---|---|
| $M_s$ of Flange Rectangle | $=7\text{x}.60\text{x}11.7$ | $= 49.14$ |
| $M_s$ of Flange Triangles | $=3.25\text{x}.542\text{x}11.219$ | $= 19.76$ |
| $M_s$ of Web | $=11.40\text{x}.50\text{x}5.70$ | $= 32.49$ |
| Total Static Moment | | 101.39 |

Moment of Inertia of Beam. $I=2087.2$

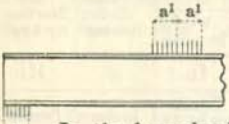
$$\text{Longitudinal Shear} = \frac{100000\text{x}101.39}{2087.2\text{x}.50}$$

$=9715$ pounds per square inch.

Under usual conditions of loading, the longitudinal shear need not be taken into consideration.

**Buckling Values of Beam Webs.** The vertical shearing stresses or the vertical compressive components of the web stress may, under some conditions, exceed the safe resistance of the beam to buckling, and there remains the possibility that a web which is amply secure as against the safe allowed shear will not be of sufficient strength when considered as a column. In such cases provision must be made for security against buckling either by web stiffeners or by increasing the thickness of the web.

A series of experiments have been carried out on beams of various depths and web thicknesses to arrive at a basis for a simpler method of computation to use in the investigation of the safe buckling resistance of beams with unsupported webs, and from these experiments the following formulas have been deduced:




Safe end reaction $R = f_b \times t \left(a + \frac{d}{4}\right)$

Safe interior load $W = 2 f_b \times t \left(a^1 + \frac{d}{4}\right)$

In the formulas R is the end reaction, W the concentrated load, t the web thickness, d the depth of the beam, $a^1$ half the distance over which the concentrated load is applied and a the whole distance over which the end reaction is applied, while $f_b$ is the safe resistance of the web to buckling in pounds per square inch, obtained from formula: $19000 - 100\ d/2r = 19000 - 173\ d/t$.

The first formula is general and applies to any condition of loading. The second formula is for a single load concentrated at the center of a span; it can be extended for a system of concentrated loads, provided the sum of the distances $a^1$ is not less than a.

The tables give for beams and channels with unsupported webs:

1. Allowed web resistance $f_b$, in pounds per square inch, computed from this compression formula.

2. The distance a, or the distance over which the end reaction must be distributed when the shearing stress, V, in the web is the maximum allowable of 12,000 and 10,000 pounds per square inch.

3. The allowable end reaction (R) when a is taken at $3\frac{1}{2}''$, which is the usual length of beam actually resting on the 4″ angles ordinarily used in building construction for beam seats.

4. The allowable shear V, on the gross area of beam or channel webs at 12,000 and 10,000 pounds per square inch.

**Maximum Bending Moments.** In addition to data referring to maximum loads on beams and channels as computed from the web resistance, these tables also give the maximum bending moments in foot pounds, obtained by multiplying the section modulus of each section by the allowed fiber stress of 18,000 and 16,000 pounds and dividing the product by 12 in order to reduce to a foot-pound basis.

These maximum bending moments may be used on inspection instead of the table of properties to ascertain the proper size section to be used in any particular instance.

# BEAMS

## Maximum Bending Moments and Web Resistances

**Bending Stress 18,000 Pounds—Shearing Stress 12,000 Pounds**

| Depth of Beam | Weight per Foot | Thickness of Web | Maximum Bending Moment | Web Resistance | | | Minimum End Bearing | End Reaction, a=3½" |
|---|---|---|---|---|---|---|---|---|
| | | | | Web Shear | Minimum Span | Web Buckling | | |
| d | | t | $M_{max}$ | V | | $f_b$ | a | R |
| Inches | Pounds | Inches | Foot Pounds | Pounds | Feet | Pounds per Sq. In. | Inches | Pounds |
| 24 | 120.0 | .798 | 376350 | 229820 | 6.55 | 13790 | 14.88 | 104560 |
| | 115.0 | .737 | 367570 | 212260 | 6.93 | 13360 | 15.56 | 93550 |
| | 110.0 | .675 | 358640 | 194400 | 7.38 | 12840 | 16.43 | 82350 |
| | 105.9 | .625 | 351440 | 180000 | 7.81 | 12350 | 17.32 | 73320 |
| 24 | 100.0 | .747 | 296470 | 215140 | 5.51 | 13430 | 15.44 | 95330 |
| | 95.0 | .686 | 287690 | 197570 | 5.82 | 12940 | 16.26 | 84320 |
| | 90.0 | .624 | 278760 | 179710 | 6.20 | 12340 | 17.35 | 73130 |
| | 85.0 | .563 | 269980 | 162140 | 6.66 | 11620 | 18.80 | 62120 |
| | 79.9 | .500 | 260900 | 144000 | 7.25 | 10680 | 20.96 | 50750 |
| 20 | 100.0 | .873 | 247250 | 209520 | 4.72 | 15030 | 10.97 | 111550 |
| | 95.0 | .800 | 239950 | 192000 | 5.00 | 14670 | 11.36 | 99750 |
| | 90.0 | .726 | 232550 | 174240 | 5.34 | 14230 | 11.87 | 87810 |
| | 85.0 | .653 | 225250 | 156720 | 5.75 | 13700 | 12.52 | 76010 |
| | 81.4 | .600 | 219950 | 144000 | 6.11 | 13230 | 13.15 | 67450 |
| 20 | 75.0 | .641 | 189520 | 153840 | 4.93 | 13590 | 12.65 | 74070 |
| | 70.0 | .567 | 182120 | 136080 | 5.35 | 12890 | 13.62 | 62130 |
| | 65.4 | .500 | 175420 | 120000 | 5.85 | 12070 | 14.88 | 51300 |
| 18 | 90.0 | .796 | 209410 | 171940 | 4.87 | 15090 | 9.82 | 96080 |
| | 85.0 | .714 | 202770 | 154220 | 5.26 | 14630 | 10.26 | 83580 |
| | 80.0 | .632 | 196130 | 136510 | 5.75 | 14070 | 10.85 | 71140 |
| | 75.6 | .560 | 190300 | 120960 | 6.29 | 13440 | 11.57 | 60210 |
| 18 | 70.0 | .711 | 152920 | 153580 | 3.98 | 14620 | 10.27 | 83160 |
| | 65.0 | .629 | 146280 | 135860 | 4.31 | 14050 | 10.87 | 70690 |
| | 60.0 | .547 | 139640 | 118150 | 4.73 | 13310 | 11.73 | 58230 |
| | 54.7 | .460 | 132590 | 99360 | 5.34 | 12230 | 13.16 | 45010 |
| 15 | 75.0 | .868 | 137440 | 156240 | 3.52 | 16010 | 7.49 | 100730 |
| | 70.0 | .770 | 131920 | 138600 | 3.81 | 15630 | 7.77 | 87230 |
| | 65.0 | .672 | 126410 | 120960 | 4.18 | 15130 | 8.14 | 73730 |
| | 60.8 | .590 | 121800 | 106200 | 4.59 | 14600 | 8.58 | 62430 |
| 15 | 55.0 | .648 | 101740 | 116640 | 3.49 | 14990 | 8.26 | 70430 |
| | 50.0 | .550 | 96230 | 99000 | 3.89 | 14280 | 8.86 | 56930 |
| | 45.0 | .452 | 90690 | 81360 | 4.46 | 13250 | 9.83 | 43430 |
| | 42.9 | .410 | 88350 | 73800 | 4.79 | 12670 | 10.46 | 37650 |

## BEAMS

### Maximum Bending Moments and Web Resistances

**Bending Stress 18,000 Pounds—Shearing Stress 12,000 Pounds**

| Depth of Beam | Weight per Foot | Thickness of Web | Maximum Bending Moment | Web Resistance | | | Minimum End Bearing | End Reaction, a=3½" |
|---|---|---|---|---|---|---|---|---|
| | | | | Web Shear | Minimum Span | Web Buckling | | |
| d | | t | Mmax | V | | fb | a | R |
| Inches | Pounds | Inches | Foot Pounds | Pounds | Feet | Pounds per Sq. In. | Inches | Pounds |
| 12 | 55.0 | .810 | 79840 | 116640 | 2.74 | 16430 | 5.76 | 86530 |
| | 50.0 | .687 | 75410 | 98930 | 3.05 | 15970 | 6.01 | 71330 |
| | 45.0 | .565 | 71020 | 81360 | 3.49 | 15320 | 6.40 | 56270 |
| | 40.8 | .460 | 67240 | 66240 | 4.06 | 14480 | 6.94 | 43300 |
| 12 | 35.0 | .428 | 56760 | 61630 | 3.68 | 14150 | 7.18 | 39350 |
| | 31.8 | .350 | 53950 | 50400 | 4.28 | 13060 | 8.03 | 29710 |
| 10 | 40.0 | .741 | 47400 | 88920 | 2.13 | 16660 | 4.70 | 74080 |
| | 35.0 | .594 | 43730 | 71280 | 2.45 | 16090 | 4.96 | 57330 |
| | 30.0 | .447 | 40050 | 53640 | 2.99 | 15120 | 5.43 | 40560 |
| | 25.4 | .310 | 36630 | 37200 | 3.94 | 13410 | 6.45 | 24950 |
| 9 | 35.0 | .724 | 37100 | 78190 | 1.90 | 16850 | 4.16 | 70130 |
| | 30.0 | .561 | 33800 | 60590 | 2.23 | 16220 | 4.41 | 52320 |
| | 25.0 | .397 | 30470 | 42880 | 2.84 | 15070 | 4.92 | 34410 |
| | 21.8 | .290 | 28310 | 31320 | 3.62 | 13620 | 5.68 | 22720 |
| 8 | 25.5 | .532 | 25520 | 51070 | 2.00 | 16400 | 3.85 | 47970 |
| | 23.0 | .441 | 24060 | 42340 | 2.27 | 15860 | 4.05 | 38460 |
| | 20.5 | .349 | 22590 | 33500 | 2.70 | 15030 | 4.39 | 28850 |
| | 18.4 | .270 | 21330 | 25920 | 3.29 | 13870 | 4.92 | 20590 |
| 7 | 20.0 | .450 | 17980 | 37800 | 1.90 | 16310 | 3.40 | 38520 |
| | 17.5 | .345 | 16690 | 28980 | 2.30 | 15490 | 3.67 | 28050 |
| | 15.3 | .250 | 15530 | 21000 | 2.96 | 14150 | 4.19 | 18570 |
| 6 | 17.25 | .465 | 13010 | 33480 | 1.55 | 16770 | 2.79 | 38980 |
| | 14.75 | .343 | 11910 | 24700 | 1.93 | 15970 | 3.01 | 27390 |
| | 12.50 | .230 | 10890 | 16560 | 2.63 | 14480 | 3.47 | 16660 |
| 5 | 14.75 | .494 | 9030 | 29640 | 1.22 | 17250 | 2.23 | 40470 |
| | 12.25 | .347 | 8110 | 20820 | 1.56 | 16510 | 2.39 | 27200 |
| | 10.0 | .210 | 7250 | 12600 | 2.30 | 14880 | 2.78 | 14840 |
| 4 | 10.5 | .400 | 5310 | 19200 | 1.11 | 17270 | 1.78 | 31080 |
| | 9.5 | .326 | 5020 | 15650 | 1.28 | 16870 | 1.84 | 24750 |
| | 8.5 | .253 | 4730 | 12140 | 1.56 | 16260 | 1.95 | 18510 |
| | 7.7 | .190 | 4470 | 9120 | 1.96 | 15350 | 2.13 | 13120 |
| 3 | 7.5 | .349 | 2880 | 12560 | 0.92 | 17510 | 1.31 | 25970 |
| | 6.5 | .251 | 2660 | 9040 | 1.18 | 16930 | 1.38 | 18060 |
| | 5.7 | .170 | 2480 | 6120 | 1.62 | 15950 | 1.51 | 11520 |

# CHANNELS

## Maximum Bending Moments and Web Resistances

**Bending Stress 18,000 Pounds—Shearing Stress 12,000 Pounds**

| Depth of Channel | Weight per Foot | Thickness of Web | Maximum Bending Moment | Web Resistance | | | Minimum End Bearing | End Reaction, a=3½" |
|---|---|---|---|---|---|---|---|---|
| | | | | Web Shear | Minimum Span | Web Buckling | | |
| d | | t | Mmax | V | | fb | a | R |
| Inches | Pounds | Inches | Foot Pounds | Pounds | Feet | Pounds per Sq. In. | Inches | Pounds |
| | 55.0 | .814 | 85800 | 146520 | 2.34 | 15810 | 7.64 | 93290 |
| | 50.0 | .716 | 80340 | 128880 | 2.49 | 15370 | 7.96 | 79790 |
| 15 | 45.0 | .618 | 74770 | 111240 | 2.69 | 14800 | 8.42 | 66290 |
| | 40.0 | .520 | 69260 | 93600 | 2.96 | 14000 | 9.10 | 52790 |
| | 35.0 | .422 | 63750 | 75960 | 3.36 | 12840 | 10.27 | 39290 |
| | 33.9 | .400 | 62510 | 72000 | 3.47 | 12510 | 10.64 | 36270 |
| | 50.0 | .787 | 72210 | 122770 | 2.35 | 16140 | 6.42 | 85730 |
| | 45.0 | .673 | 67400 | 104990 | 2.57 | 15660 | 6.71 | 71120 |
| | 40.0 | .560 | 62620 | 87360 | 2.87 | 14980 | 7.16 | 56620 |
| 13 | 37.0 | .492 | 59750 | 76750 | 3.11 | 14420 | 7.57 | 47900 |
| | 35.0 | .447 | 57850 | 69730 | 3.32 | 13960 | 7.92 | 42120 |
| | 31.8 | .375 | 54800 | 58500 | 3.75 | 13000 | 8.75 | 32900 |
| | 40.0 | .755 | 49130 | 108720 | 1.81 | 16250 | 5.86 | 79740 |
| | 35.0 | .632 | 44700 | 91010 | 1.96 | 15710 | 6.17 | 64540 |
| 12 | 30.0 | .510 | 40310 | 73440 | 2.20 | 14920 | 6.65 | 49470 |
| | 25.0 | .387 | 35880 | 55730 | 2.58 | 13630 | 7.57 | 34280 |
| | 20.7 | .280 | 32030 | 40320 | 3.18 | 11570 | 9.44 | 21060 |
| | 35.0 | .820 | 34560 | 98400 | 1.41 | 16890 | 4.61 | 83090 |
| | 30.0 | .673 | 30890 | 80760 | 1.53 | 16430 | 4.81 | 66330 |
| 10 | 25.0 | .526 | 27210 | 63120 | 1.72 | 15710 | 5.14 | 49570 |
| | 20.0 | .379 | 23540 | 45480 | 2.07 | 14430 | 5.82 | 32810 |
| | 15.3 | .240 | 20060 | 28800 | 2.79 | 11790 | 7.68 | 16970 |
| | 25.0 | .612 | 23510 | 66100 | 1.42 | 16450 | 4.31 | 57900 |
| | 20.0 | .448 | 20190 | 48380 | 1.67 | 15520 | 4.71 | 39980 |
| 9 | 15.0 | .285 | 16890 | 30780 | 2.19 | 13530 | 5.73 | 22180 |
| | 13.4 | .230 | 15770 | 24840 | 2.54 | 12220 | 6.59 | 16160 |
| | 21.25 | .579 | 17860 | 55580 | 1.29 | 16610 | 3.78 | 52880 |
| | 18.75 | .487 | 16390 | 46750 | 1.40 | 16160 | 3.94 | 43270 |
| 8 | 16.25 | .395 | 14910 | 37920 | 1.57 | 15490 | 4.20 | 33650 |
| | 13.75 | .303 | 13440 | 29090 | 1.85 | 14430 | 4.65 | 24040 |
| | 11.5 | .220 | 12110 | 21120 | 2.29 | 12700 | 5.56 | 15370 |
| | 19.75 | .629 | 14170 | 52840 | 1.07 | 17070 | 3.17 | 56380 |
| | 17.25 | .524 | 12880 | 44020 | 1.17 | 16690 | 3.28 | 45910 |
| 7 | 14.75 | .419 | 11600 | 35200 | 1.32 | 16110 | 3.47 | 35430 |
| | 12.25 | .314 | 10310 | 26380 | 1.56 | 15140 | 3.80 | 24950 |
| | 9.8 | .210 | 9040 | 17640 | 2.05 | 13220 | 4.60 | 14580 |
| | 15.5 | .559 | 9730 | 40250 | 0.97 | 17140 | 2.70 | 47910 |
| | 13.0 | .437 | 8630 | 31460 | 1.10 | 16620 | 2.83 | 36320 |
| 6 | 10.5 | .314 | 7530 | 22610 | 1.33 | 15690 | 3.09 | 24630 |
| | 8.2 | .200 | 6500 | 14400 | 1.81 | 13800 | 3.72 | 13800 |
| | 11.5 | .472 | 6210 | 28320 | 0.88 | 17170 | 2.25 | 38490 |
| 5 | 9.0 | .325 | 5290 | 19500 | 1.09 | 16340 | 2.42 | 25220 |
| | 6.7 | .190 | 4450 | 11400 | 1.56 | 14440 | 2.91 | 13030 |
| | 7.25 | .320 | 3410 | 15360 | 0.89 | 16840 | 1.85 | 24240 |
| 4 | 6.25 | .247 | 3110 | 11860 | 1.05 | 16200 | 1.96 | 18000 |
| | 5.4 | .180 | 2840 | 8640 | 1.32 | 15150 | 2.17 | 12270 |
| | 6.0 | .356 | 2060 | 12820 | 0.64 | 17540 | 1.30 | 26540 |
| 3 | 5.0 | .258 | 1830 | 9290 | 0.79 | 16990 | 1.37 | 18630 |
| | 4.1 | .170 | 1640 | 6120 | 1.07 | 15950 | 1.51 | 11520 |

## BEAMS

### Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections — 24 Inch | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|
| | 120 lbs. | 115 lbs. | 110 lbs. | 105.9 lbs. | 100 lbs. | 95 lbs. | 90 lbs. | 85 lbs. | 79.9 lbs. | |
| 6 | 495.6 | 424.5 | | | 430.3<br>395.3 | 395.1<br>383.6 | 359.4 | 324.3 | | 0.67 |
| 7 | 430.1 | 420.1 | 388.8 | 360.0 | 338.8 | 328.8 | 318.6 | 308.6 | 288.0 | 0.91 |
| 8 | 376.4 | 367.6 | 358.6 | 351.4 | 296.5 | 287.7 | 278.8 | 270.0 | 260.9 | 1.19 |
| 9 | 334.5 | 326.7 | 318.8 | 312.4 | 263.5 | 255.7 | 247.8 | 240.0 | 231.9 | 1.51 |
| 10 | 301.1 | 294.1 | 286.9 | 281.2 | 237.2 | 230.2 | 223.0 | 216.0 | 208.7 | 1.86 |
| 11 | 273.7 | 267.3 | 260.8 | 255.6 | 215.6 | 209.2 | 202.7 | 196.4 | 189.7 | 2.25 |
| 12 | 250.9 | 245.0 | 239.1 | 234.3 | 197.7 | 191.8 | 185.8 | 180.0 | 173.9 | 2.68 |
| 13 | 231.6 | 226.2 | 220.7 | 216.3 | 182.4 | 177.0 | 171.5 | 166.1 | 160.6 | 3.15 |
| 14 | 215.1 | 210.0 | 204.9 | 200.8 | 169.4 | 164.4 | 159.3 | 154.3 | 149.1 | 3.65 |
| 15 | 200.7 | 196.0 | 191.3 | 187.4 | 158.1 | 153.4 | 148.7 | 144.0 | 139.1 | 4.19 |
| 16 | 188.2 | 183.8 | 179.3 | 175.7 | 148.2 | 143.8 | 139.4 | 135.0 | 130.5 | 4.77 |
| 17 | 177.1 | 173.0 | 168.8 | 165.4 | 139.5 | 135.4 | 131.2 | 127.0 | 122.8 | 5.38 |
| 18 | 167.3 | 163.4 | 159.4 | 156.2 | 131.8 | 127.9 | 123.9 | 120.0 | 116.0 | 6.03 |
| 19 | 158.5 | 154.8 | 151.0 | 148.0 | 124.8 | 121.1 | 117.4 | 113.7 | 109.9 | 6.72 |
| 20 | 150.5 | 147.0 | 143.5 | 140.6 | 118.6 | 115.1 | 111.5 | 108.0 | 104.4 | 7.45 |
| 21 | 143.4 | 140.0 | 136.6 | 133.9 | 112.9 | 109.6 | 106.2 | 102.8 | 99.4 | 8.21 |
| 22 | 136.9 | 133.7 | 130.4 | 127.8 | 107.8 | 104.6 | 101.4 | 98.2 | 94.9 | 9.01 |
| 23 | 130.9 | 127.8 | 124.7 | 122.2 | 103.1 | 100.1 | 97.0 | 93.9 | 90.7 | 9.85 |
| 24 | 125.5 | 122.5 | 119.5 | 117.1 | 98.8 | 95.9 | 92.9 | 90.0 | 87.0 | 10.73 |
| 25 | 120.4 | 117.6 | 114.8 | 112.5 | 94.9 | 92.1 | 89.2 | 86.4 | 83.5 | 11.64 |
| 26 | 115.8 | 113.1 | 110.4 | 108.1 | 91.2 | 88.5 | 85.8 | 83.1 | 80.3 | 12.59 |
| 27 | 111.5 | 108.9 | 106.3 | 104.1 | 87.8 | 85.2 | 82.6 | 80.0 | 77.3 | 13.57 |
| 28 | 107.5 | 105.0 | 102.5 | 100.4 | 84.7 | 82.2 | 79.6 | 77.1 | 74.5 | 14.60 |
| 29 | 103.8 | 101.4 | 98.9 | 96.9 | 81.8 | 79.4 | 76.9 | 74.5 | 72.0 | 15.66 |
| 30 | 100.4 | 98.0 | 95.6 | 93.7 | 79.1 | 76.7 | 74.3 | 72.0 | 69.6 | 16.76 |
| 31 | 97.1 | 94.9 | 92.6 | 90.7 | 76.5 | 74.2 | 71.9 | 69.7 | 67.3 | 17.89 |
| 32 | 94.1 | 91.9 | 89.7 | 87.9 | 74.1 | 71.9 | 69.7 | 67.5 | 65.2 | 19.07 |
| 33 | 91.2 | 89.1 | 86.9 | 85.2 | 71.9 | 69.7 | 67.6 | 65.4 | 63.3 | 20.28 |
| 34 | 88.6 | 86.5 | 84.4 | 82.7 | 69.8 | 67.7 | 65.6 | 63.5 | 61.4 | 21.53 |
| 35 | 86.0 | 84.0 | 82.0 | 80.3 | 67.8 | 65.8 | 63.7 | 61.7 | 59.6 | 22.81 |
| 36 | 83.6 | 81.7 | 79.7 | 78.1 | 65.9 | 63.9 | 61.9 | 60.0 | 58.0 | 24.13 |
| 37 | 81.4 | 79.5 | 77.5 | 76.0 | 64.1 | 62.2 | 60.3 | 58.4 | 56.4 | 25.49 |
| 38 | 79.2 | 77.4 | 75.5 | 74.0 | 62.4 | 60.6 | 58.7 | 56.8 | 54.9 | 26.89 |
| 39 | 77.2 | 75.4 | 73.6 | 72.1 | 60.8 | 59.0 | 57.2 | 55.4 | 53.5 | 28.32 |
| 40 | 75.3 | 73.5 | 71.7 | 70.3 | 59.3 | 57.5 | 55.8 | 54.0 | 52.2 | 29.79 |
| 41 | 73.4 | 71.7 | 70.0 | 68.6 | 57.8 | 56.1 | 54.4 | 52.7 | 50.9 | 31.30 |
| 42 | 71.7 | 70.0 | 68.3 | 66.9 | 56.5 | 54.8 | 53.1 | 51.4 | 49.7 | 32.85 |
| 43 | 70.0 | 68.4 | 66.7 | 65.4 | 55.2 | 53.5 | 51.9 | 50.2 | 48.5 | 34.43 |
| 44 | 68.4 | 66.8 | 65.2 | 63.9 | 53.9 | 52.3 | 50.7 | 49.1 | 47.4 | 36.05 |
| 45 | 66.9 | 65.3 | 63.8 | 62.5 | 52.7 | 51.1 | 49.6 | 48.0 | 46.4 | 37.71 |
| 46 | 65.5 | 63.9 | 62.4 | 61.1 | 51.6 | 50.0 | 48.5 | 47.0 | 45.4 | 39.40 |
| 47 | 64.1 | 62.6 | 61.0 | 59.8 | 50.5 | 49.0 | 47.5 | 46.0 | 44.4 | 41.13 |
| 48 | 62.7 | 61.3 | 59.8 | 58.6 | 49.4 | 47.9 | 46.5 | 45.0 | 43.5 | 42.90 |
| 49 | 61.5 | 60.0 | 58.6 | 57.4 | 48.4 | 47.0 | 45.5 | 44.1 | 42.6 | 44.71 |
| 50 | 60.2 | 58.8 | 57.4 | 56.2 | 47.4 | 46.0 | 44.6 | 43.2 | 41.7 | 46.55 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads, see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 Inch | | | | | | | | 18 Inch | | | | |
| | 100 lbs. | 95 lbs. | 90 lbs. | 85 lbs. | 81.4 lbs. | 75 lbs. | 70 lbs. | 65.4 lbs. | 90 lbs. | 85 lbs. | 80 lbs. | 75.6 lbs. | |
| | 419.0 | 384.0 | | | | 307.7 | | | 343.9 | | | | |
| 5 | 395.6 | 383.9 | 348.5 | 313.4 | | 303.2 | 272.2 | 240.0 | 335.1 | 308.4 | 273.0 | | 0.47 |
| 6 | 329.7 | 319.9 | 310.1 | 300.3 | 288.0 | 252.7 | 242.8 | 233.9 | 279.2 | 270.4 | 261.5 | 241.9 | 0.67 |
| 7 | 282.6 | 274.2 | 265.8 | 257.4 | 251.4 | 216.6 | 208.1 | 200.5 | 239.2 | 231.7 | 224.1 | 217.5 | 0.91 |
| 8 | 247.2 | 239.9 | 232.5 | 225.2 | 219.9 | 189.5 | 182.1 | 175.4 | 209.4 | 202.8 | 196.1 | 190.3 | 1.19 |
| 9 | 219.8 | 213.3 | 206.7 | 200.2 | 195.5 | 168.5 | 161.9 | 155.9 | 186.1 | 180.2 | 174.3 | 169.2 | 1.51 |
| 10 | 197.8 | 192.0 | 186.0 | 180.2 | 176.0 | 151.6 | 145.7 | 140.3 | 167.5 | 162.2 | 156.9 | 152.2 | 1.86 |
| 11 | 179.8 | 174.5 | 169.1 | 163.8 | 160.0 | 137.8 | 132.5 | 127.6 | 152.3 | 147.5 | 142.6 | 138.4 | 2.25 |
| 12 | 164.8 | 160.0 | 155.0 | 150.2 | 146.6 | 126.3 | 121.4 | 116.9 | 139.6 | 135.2 | 130.8 | 126.9 | 2.68 |
| 13 | 152.2 | 147.7 | 143.1 | 138.6 | 135.3 | 116.6 | 112.1 | 108.0 | 128.9 | 124.8 | 120.7 | 117.1 | 3.15 |
| 14 | 141.3 | 137.1 | 132.9 | 128.7 | 125.7 | 108.3 | 104.1 | 100.2 | 119.7 | 115.9 | 112.1 | 108.7 | 3.65 |
| 15 | 131.9 | 128.0 | 124.0 | 120.1 | 117.3 | 101.1 | 97.1 | 93.6 | 111.7 | 108.1 | 104.6 | 101.5 | 4.19 |
| 16 | 123.6 | 120.0 | 116.3 | 112.6 | 110.0 | 94.8 | 91.1 | 87.7 | 104.7 | 101.4 | 98.1 | 95.1 | 4.77 |
| 17 | 116.4 | 112.9 | 109.4 | 106.0 | 103.5 | 89.2 | 85.7 | 82.6 | 98.6 | 95.4 | 92.3 | 89.6 | 5.38 |
| 18 | 109.9 | 106.6 | 103.4 | 100.1 | 97.8 | 84.2 | 80.9 | 78.0 | 93.1 | 90.1 | 87.2 | 84.6 | 6.03 |
| 19 | 104.1 | 101.0 | 97.9 | 94.8 | 92.6 | 79.8 | 76.7 | 73.9 | 88.2 | 85.4 | 82.6 | 80.1 | 6.72 |
| 20 | 98.9 | 96.0 | 93.0 | 90.1 | 88.0 | 75.8 | 72.8 | 70.2 | 83.8 | 81.1 | 78.5 | 76.1 | 7.45 |
| 21 | 94.2 | 91.4 | 88.6 | 85.8 | 83.8 | 72.2 | 69.4 | 66.8 | 79.8 | 77.3 | 74.7 | 72.5 | 8.21 |
| 22 | 89.9 | 87.2 | 84.6 | 81.9 | 80.0 | 68.9 | 66.2 | 63.8 | 76.2 | 73.7 | 71.3 | 69.2 | 9.01 |
| 23 | 86.0 | 83.5 | 80.9 | 78.3 | 76.5 | 65.9 | 63.3 | 61.0 | 72.8 | 70.5 | 68.2 | 66.2 | 9.85 |
| 24 | 82.4 | 80.0 | 77.5 | 75.1 | 73.3 | 63.2 | 60.7 | 58.5 | 69.8 | 67.6 | 65.4 | 63.4 | 10.73 |
| 25 | 79.1 | 76.8 | 74.4 | 72.1 | 70.4 | 60.6 | 58.3 | 56.1 | 67.0 | 64.9 | 62.8 | 60.9 | 11.64 |
| 26 | 76.1 | 73.8 | 71.6 | 69.3 | 67.7 | 58.3 | 56.0 | 54.0 | 64.4 | 62.4 | 60.4 | 58.6 | 12.59 |
| 27 | 73.3 | 71.1 | 68.9 | 66.7 | 65.2 | 56.2 | 54.0 | 52.0 | 62.1 | 60.1 | 58.1 | 56.4 | 13.57 |
| 28 | 70.6 | 68.6 | 66.4 | 64.4 | 62.8 | 54.2 | 52.0 | 50.1 | 59.8 | 57.9 | 56.0 | 54.4 | 14.60 |
| 29 | 68.2 | 66.2 | 64.2 | 62.1 | 60.7 | 52.3 | 50.2 | 48.4 | 57.8 | 55.9 | 54.1 | 52.5 | 15.66 |
| 30 | 65.9 | 64.0 | 62.0 | 60.1 | 58.7 | 50.5 | 48.6 | 46.8 | 55.8 | 54.1 | 52.3 | 50.7 | 16.76 |
| 31 | 63.8 | 61.9 | 60.0 | 58.1 | 56.8 | 48.9 | 47.0 | 45.3 | 54.0 | 52.3 | 50.6 | 49.1 | 17.89 |
| 32 | 61.8 | 60.0 | 58.1 | 56.3 | 55.0 | 47.4 | 45.5 | 43.9 | 52.4 | 50.7 | 49.0 | 47.6 | 19.07 |
| 33 | 59.9 | 58.2 | 56.4 | 54.6 | 53.3 | 45.9 | 44.2 | 42.5 | 50.8 | 49.2 | 47.5 | 46.1 | 20.28 |
| 34 | 58.2 | 56.5 | 54.7 | 53.0 | 51.8 | 44.6 | 42.9 | 41.3 | 49.3 | 47.7 | 46.2 | 44.8 | 21.53 |
| 35 | 56.5 | 54.8 | 53.2 | 51.5 | 50.3 | 43.3 | 41.6 | 40.1 | 47.9 | 46.4 | 44.8 | 43.5 | 22.81 |
| 36 | 54.9 | 53.3 | 51.7 | 50.1 | 48.9 | 42.1 | 40.5 | 39.0 | 46.5 | 45.1 | 43.6 | 42.3 | 24.13 |
| 37 | 53.5 | 51.9 | 50.3 | 48.7 | 47.6 | 41.0 | 39.4 | 37.9 | 45.3 | 43.9 | 42.4 | 41.2 | 25.49 |
| 38 | 52.1 | 50.5 | 49.0 | 47.4 | 46.3 | 39.9 | 38.3 | 36.9 | 44.1 | 42.7 | 41.3 | 40.1 | 26.89 |
| 39 | 50.7 | 49.2 | 47.7 | 46.2 | 45.1 | 38.9 | 37.4 | 36.0 | | | | | 28.32 |
| 40 | 49.4 | 48.0 | 46.5 | 45.0 | 44.0 | 37.9 | 36.4 | 35.1 | | | | | 29.79 |
| 41 | 48.2 | 46.8 | 45.4 | 44.0 | 42.9 | 37.0 | 35.5 | 34.2 | | | | | 31.30 |
| 42 | 47.1 | 45.7 | 44.3 | 42.9 | 41.9 | 36.1 | 34.7 | 33.4 | | | | | 32.85 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below horizontal lines will produce excessive deflections.
For maximum safe loads, see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

**Applicable only when sections are braced against lateral deflection. For unbraced sections safe loads must be reduced, see page 101.**

**Maximum Bending Stress, 18,000 Pounds per Square Inch**

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 18 Inch | | | | 15 Inch | | | | | | | | |
| | 70 lbs. | 65 lbs. | 60 lbs. | 54.7 lbs. | 75 lbs. | 70 lbs. | 65 lbs. | 60.8 lbs. | 55 lbs. | 50 lbs. | 45 lbs. | 42.9 lbs. | |
| | 307.2 | | | | 312.5 | 277.2 | | | 223.3 | 198.0 | | | |
| 4 | 305.8 | 271.7 | 236.3 | | 274.9 | 263.8 | 241.9 | 212.4 | 203.5 | 192.5 | 162.7 | 147.6 | 0.30 |
| 5 | 244.7 | 234.0 | 223.4 | | 219.9 | 211.1 | 202.3 | 194.9 | 162.8 | 154.0 | 145.1 | 141.4 | 0.47 |
| | | | | 198.7 | | | | | | | | | |
| 6 | 203.9 | 195.0 | 186.2 | 176.8 | 183.3 | 175.9 | 168.5 | 162.4 | 135.7 | 128.3 | 120.9 | 117.8 | 0.67 |
| 7 | 174.8 | 167.2 | 159.6 | 151.5 | 157.1 | 150.8 | 144.5 | 139.2 | 116.3 | 110.0 | 103.6 | 101.0 | 0.91 |
| 8 | 152.9 | 146.3 | 139.6 | 132.6 | 137.4 | 131.9 | 126.4 | 121.8 | 101.7 | 96.2 | 90.7 | 88.4 | 1.19 |
| 9 | 135.9 | 130.0 | 124.1 | 117.9 | 122.2 | 117.3 | 112.4 | 108.3 | 90.4 | 85.5 | 80.6 | 78.5 | 1.51 |
| 10 | 122.3 | 117.0 | 111.7 | 106.1 | 110.0 | 105.5 | 101.1 | 97.4 | 81.4 | 77.0 | 72.6 | 70.7 | 1.86 |
| 11 | 111.2 | 106.4 | 101.6 | 96.4 | 100.0 | 95.9 | 91.9 | 88.6 | 74.0 | 70.0 | 66.0 | 64.3 | 2.25 |
| 12 | 101.9 | 97.5 | 93.1 | 88.4 | 91.6 | 88.0 | 84.3 | 81.2 | 67.8 | 64.2 | 60.5 | 58.9 | 2.68 |
| 13 | 94.1 | 90.0 | 85.9 | 81.6 | 84.6 | 81.2 | 77.8 | 75.0 | 62.6 | 59.2 | 55.8 | 54.4 | 3.15 |
| 14 | 87.4 | 83.6 | 79.8 | 75.8 | 78.5 | 75.4 | 72.2 | 69.6 | 58.1 | 55.0 | 51.8 | 50.5 | 3.65 |
| 15 | 81.6 | 78.0 | 74.5 | 70.7 | 73.3 | 70.4 | 67.4 | 65.0 | 54.3 | 51.3 | 48.4 | 47.1 | 4.19 |
| 16 | 76.5 | 73.1 | 69.8 | 66.3 | 68.7 | 66.0 | 63.2 | 60.9 | 50.9 | 48.1 | 45.3 | 44.2 | 4.77 |
| 17 | 72.0 | 68.8 | 65.7 | 62.4 | 64.7 | 62.1 | 59.5 | 57.3 | 47.9 | 45.3 | 42.7 | 41.6 | 5.38 |
| 18 | 68.0 | 65.0 | 62.1 | 58.9 | 61.1 | 58.6 | 56.2 | 54.1 | 45.2 | 42.8 | 40.3 | 39.3 | 6.03 |
| 19 | 64.4 | 61.6 | 58.8 | 55.8 | 57.9 | 55.5 | 53.2 | 51.3 | 42.8 | 40.5 | 38.2 | 37.2 | 6.72 |
| 20 | 61.2 | 58.5 | 55.9 | 53.0 | 55.0 | 52.8 | 50.6 | 48.7 | 40.7 | 38.5 | 36.3 | 35.3 | 7.45 |
| 21 | 58.3 | 55.7 | 53.2 | 50.5 | 52.4 | 50.3 | 48.2 | 46.4 | 38.8 | 36.7 | 34.5 | 33.7 | 8.21 |
| 22 | 55.6 | 53.2 | 50.8 | 48.2 | 50.0 | 48.0 | 46.0 | 44.3 | 37.0 | 35.0 | 33.0 | 32.1 | 9.01 |
| 23 | 53.2 | 50.9 | 48.6 | 46.1 | 47.8 | 45.9 | 44.0 | 42.4 | 35.4 | 33.5 | 31.5 | 30.7 | 9.85 |
| 24 | 51.0 | 48.8 | 46.5 | 44.2 | 45.8 | 44.0 | 42.1 | 40.6 | 33.9 | 32.1 | 30.2 | 29.5 | 10.73 |
| 25 | 48.9 | 46.8 | 44.7 | 42.4 | 44.0 | 42.2 | 40.5 | 39.0 | 32.6 | 30.8 | 29.0 | 28.3 | 11.64 |
| 26 | 47.1 | 45.0 | 43.0 | 40.8 | 42.3 | 40.6 | 38.9 | 37.5 | 31.3 | 29.6 | 27.9 | 27.2 | 12.59 |
| 27 | 45.3 | 43.3 | 41.4 | 39.3 | 40.7 | 39.1 | 37.5 | 36.1 | 30.1 | 28.5 | 26.9 | 26.2 | 13.57 |
| 28 | 43.7 | 41.8 | 39.9 | 37.9 | 39.3 | 37.7 | 36.1 | 34.8 | 29.1 | 27.5 | 25.9 | 25.2 | 14.60 |
| 29 | 42.2 | 40.4 | 38.5 | 36.6 | 37.9 | 36.4 | 34.9 | 33.6 | 28.1 | 26.5 | 25.0 | 24.4 | 15.66 |
| 30 | 40.8 | 39.0 | 37.2 | 35.4 | 36.7 | 35.2 | 33.7 | 32.5 | 27.1 | 25.7 | 24.2 | 23.6 | 16.76 |
| 31 | 39.5 | 37.8 | 36.0 | 34.2 | 35.5 | 34.0 | 32.6 | 31.4 | 26.3 | 24.8 | 23.4 | 22.8 | 17.89 |
| 32 | 38.2 | 36.6 | 34.9 | 33.1 | 34.4 | 33.0 | 31.6 | 30.4 | 25.4 | 24.1 | 22.7 | 22.1 | 19.07 |
| 33 | 37.1 | 35.5 | 33.8 | 32.1 | | | | | | | | | 20.28 |
| 34 | 36.0 | 34.4 | 32.9 | 31.2 | | | | | | | | | 21.53 |
| 35 | 35.0 | 33.4 | 31.9 | 30.3 | | | | | | | | | 22.81 |
| 36 | 34.0 | 32.5 | 31.0 | 29.5 | | | | | | | | | 24.13 |
| 37 | 33.1 | 31.6 | 30.2 | 28.7 | | | | | | | | | 25.49 |
| 38 | 32.2 | 30.8 | 29.4 | 27.9 | | | | | | | | | 26.89 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads, see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 Inch | | | | | | 10 Inch | | | | |
| | 55 lbs. | 50 lbs. | 45 lbs. | 40.8 lbs. | 35 lbs. | 31.8 lbs. | 40 lbs. | 35 lbs. | 30 lbs. | 25.4 lbs. | |
| 3 | 233.3 / 212.9 | 197.9 | 162.7 | | 123.3 | | 177.8 / 126.4 | 142.6 / 116.6 | 107.3 / 106.8 | 74.4 | 0.17 |
| 4 | 159.7 | 150.8 | 142.0 | 132.5 | 113.5 | 100.8 | 94.8 | 87.5 | 80.1 | 73.3 | 0.30 |
| 5 | 127.7 | 120.7 | 113.6 | 107.6 | 90.8 | 86.3 | 75.8 | 70.0 | 64.1 | 58.6 | 0.47 |
| 6 | 106.5 | 100.5 | 94.7 | 89.7 | 75.7 | 71.9 | 63.2 | 58.3 | 53.4 | 48.8 | 0.67 |
| 7 | 91.3 | 86.2 | 81.2 | 76.8 | 64.9 | 61.7 | 54.2 | 50.0 | 45.8 | 41.9 | 0.91 |
| 8 | 79.8 | 75.4 | 71.0 | 67.2 | 56.8 | 54.0 | 47.4 | 43.7 | 40.1 | 36.6 | 1.19 |
| 9 | 71.0 | 67.0 | 63.1 | 59.8 | 50.5 | 48.0 | 42.1 | 38.9 | 35.6 | 32.6 | 1.51 |
| 10 | 63.9 | 60.3 | 56.8 | 53.8 | 45.4 | 43.2 | 37.9 | 35.0 | 32.0 | 29.3 | 1.86 |
| 11 | 58.1 | 54.8 | 51.6 | 48.9 | 41.3 | 39.2 | 34.5 | 31.8 | 29.1 | 26.6 | 2.25 |
| 12 | 53.2 | 50.3 | 47.3 | 44.8 | 37.8 | 36.0 | 31.6 | 29.2 | 26.7 | 24.4 | 2.68 |
| 13 | 49.1 | 46.4 | 43.7 | 41.4 | 34.9 | 33.2 | 29.2 | 26.9 | 24.6 | 22.5 | 3.15 |
| 14 | 45.6 | 43.1 | 40.6 | 38.4 | 32.4 | 30.8 | 27.1 | 25.0 | 22.9 | 20.9 | 3.65 |
| 15 | 42.6 | 40.2 | 37.9 | 35.9 | 30.3 | 28.8 | 25.3 | 23.3 | 21.4 | 19.5 | 4.19 |
| 16 | 39.9 | 37.7 | 35.5 | 33.6 | 28.4 | 27.0 | 23.7 | 21.9 | 20.0 | 18.3 | 4.77 |
| 17 | 37.6 | 35.5 | 33.4 | 31.6 | 26.7 | 25.4 | 22.3 | 20.6 | 18.8 | 17.2 | 5.38 |
| 18 | 35.5 | 33.5 | 31.6 | 29.9 | 25.2 | 24.0 | 21.1 | 19.4 | 17.8 | 16.3 | 6.03 |
| 19 | 33.6 | 31.8 | 29.9 | 28.3 | 23.9 | 22.7 | 20.0 | 18.4 | 16.9 | 15.4 | 6.72 |
| 20 | 31.9 | 30.2 | 28.4 | 26.9 | 22.7 | 21.6 | 19.0 | 17.5 | 16.0 | 14.7 | 7.45 |
| 21 | 30.4 | 28.7 | 27.1 | 25.6 | 21.6 | 20.6 | 18.1 | 16.7 | 15.3 | 14.0 | 8.21 |
| 22 | 29.0 | 27.4 | 25.8 | 24.4 | 20.6 | 19.6 | 17.2 | 15.9 | 14.6 | 13.3 | 9.01 |
| 23 | 27.8 | 26.2 | 24.7 | 23.4 | 19.7 | 18.8 | | | | | 9.85 |
| 24 | 26.6 | 25.1 | 23.7 | 22.4 | 18.9 | 18.0 | | | | | 10.73 |
| 25 | 25.5 | 24.1 | 22.7 | 21.5 | 18.2 | 17.3 | | | | | 11.64 |
| 26 | 24.6 | 23.2 | 21.8 | 20.7 | 17.5 | 16.6 | | | | | 12.59 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections
For maximum safe loads, see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 Inch | | | | 8 Inch | | | | 7 Inch | | | |
| | 35 lbs. | 30 lbs. | 25 lbs. | 21.8 lbs. | 25.5 lbs. | 23 lbs. | 20.5 lbs. | 18.4 lbs. | 20 lbs. | 17.5 lbs. | 15.3 lbs. | |
| 2 | 156.4 148.4 | 121.2 | 85.8 | | 102.1 102.1 | 84.7 | 67.0 | | 75.6 71.9 | 58.0 | 42.0 | 0.07 |
| 3 | 98.9 | 90.1 | 81.3 | 62.6 | 68.1 | 64.2 | 60.2 | 51.8 | 47.9 | 44.5 | 41.4 | 0.17 |
| 4 | 74.2 | 67.6 | 60.9 | 56.6 | 51.0 | 48.1 | 45.2 | 42.7 | 36.0 | 33.4 | 31.1 | 0.30 |
| 5 | 59.4 | 54.1 | 48.8 | 45.3 | 40.8 | 38.5 | 36.1 | 34.1 | 28.8 | 26.7 | 24.8 | 0.47 |
| 6 | 49.5 | 45.1 | 40.6 | 37.7 | 34.0 | 32.1 | 30.1 | 28.4 | 24.0 | 22.3 | 20.7 | 0.67 |
| 7 | 42.4 | 38.6 | 34.8 | 32.4 | 29.2 | 27.5 | 25.8 | 24.4 | 20.5 | 19.1 | 17.7 | 0.91 |
| 8 | 37.1 | 33.8 | 30.5 | 28.3 | 25.5 | 24.1 | 22.6 | 21.3 | 18.0 | 16.7 | 15.5 | 1.19 |
| 9 | 33.0 | 30.0 | 27.1 | 25.2 | 22.7 | 21.4 | 20.1 | 19.0 | 16.0 | 14.8 | 13.8 | 1.51 |
| 10 | 29.7 | 27.0 | 24.4 | 22.6 | 20.4 | 19.3 | 18.1 | 17.1 | 14.4 | 13.4 | 12.4 | 1.86 |
| 11 | 27.0 | 24.6 | 22.2 | 20.6 | 18.6 | 17.5 | 16.4 | 15.5 | 13.1 | 12.1 | 11.3 | 2.25 |
| 12 | 24.7 | 22.5 | 20.3 | 18.9 | 17.0 | 16.0 | 15.1 | 14.2 | 12.0 | 11.1 | 10.4 | 2.68 |
| 13 | 22.8 | 20.8 | 18.8 | 17.4 | 15.7 | 14.8 | 13.9 | 13.1 | 11.1 | 10.3 | 9.6 | 3.15 |
| 14 | 21.2 | 19.3 | 17.4 | 16.2 | 14.6 | 13.7 | 12.9 | 12.2 | 10.3 | 9.5 | 8.9 | 3.65 |
| 15 | 19.8 | 18.0 | 16.3 | 15.1 | 13.6 | 12.8 | 12.0 | 11.4 | 9.6 | 8.9 | 8.3 | 4.19 |
| 16 | 18.5 | 16.9 | 15.2 | 14.2 | 12.8 | 12.0 | 11.3 | 10.7 | 9.0 | 8.3 | 7.8 | 4.77 |
| 17 | 17.5 | 15.9 | 14.3 | 13.3 | 12.0 | 11.3 | 10.6 | 10.0 | | | | 5.38 |
| 18 | 16.5 | 15.0 | 13.5 | 12.6 | 11.3 | 10.7 | 10.0 | 9.5 | | | | 6.03 |
| 19 | 15.6 | 14.2 | 12.8 | 11.9 | | | | | | | | 6.72 |
| 20 | 14.8 | 13.5 | 12.2 | 11.3 | | | | | | | | 7.45 |

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 Inch | | | 5 Inch | | | 4 Inch | | | | 3 Inch | | |
| | 17.25 lbs. | 14.75 lbs. | 12.5 lbs. | 14.75 lbs. | 12.25 lbs. | 10 lbs. | 10.5 lbs. | 9.5 lbs. | 8.5 lbs. | 7.7 lbs. | 7.5 lbs. | 6.5 lbs. | 5.7 lbs. | |
| 1 | 67.0 | 49.4 | | 59.3 | 41.6 | | 38.4 | 31.3 | 24.3 | 18.2 | 25.1 23.1 | 18.1 | 12.2 | 0.02 |
| 2 | 52.0 | 47.6 | 33.1 | 36.1 | 32.4 | 25.2 | 21.3 | 20.1 | 18.9 | 17.9 | 11.5 | 10.7 | 9.9 | 0.07 |
| 3 | 34.7 | 31.8 | 29.0 | 24.1 | 21.6 | 19.3 | 14.2 | 13.4 | 12.6 | 11.9 | 7.7 | 7.1 | 6.6 | 0.17 |
| 4 | 26.0 | 23.8 | 21.8 | 18.1 | 16.2 | 14.5 | 10.6 | 10.0 | 9.5 | 8.9 | 5.8 | 5.3 | 5.0 | 0.30 |
| 5 | 20.8 | 19.1 | 17.4 | 14.4 | 13.0 | 11.6 | 8.5 | 8.0 | 7.6 | 7.2 | 4.6 | 4.3 | 4.0 | 0.47 |
| 6 | 17.3 | 15.9 | 14.5 | 12.0 | 10.8 | 9.7 | 7.1 | 6.7 | 6.3 | 6.0 | 3.9 | 3.6 | 3.3 | 0.67 |
| 7 | 14.9 | 13.6 | 12.4 | 10.3 | 9.3 | 8.3 | 6.1 | 5.7 | 5.4 | 5.1 | 3.3 | 3.0 | 2.8 | 0.91 |
| 8 | 13.0 | 11.9 | 10.9 | 9.0 | 8.1 | 7.3 | 5.3 | 5.0 | 4.7 | 4.5 | 2.9 | 2.7 | 2.5 | 1.19 |
| 9 | 11.6 | 10.6 | 9.7 | 8.0 | 7.2 | 6.4 | 4.7 | 4.5 | 4.2 | 4.0 | | | | 1.51 |
| 10 | 10.4 | 9.5 | 8.7 | 7.2 | 6.5 | 5.8 | 4.3 | 4.0 | 3.8 | 3.6 | | | | 1.86 |
| 11 | 9.5 | 8.7 | 7.9 | 6.6 | 5.9 | 5.3 | | | | | | | | 2.25 |
| 12 | 8.7 | 7.9 | 7.3 | 6.0 | 5.4 | 4.8 | | | | | | | | 2.68 |
| 13 | 8.0 | 7.3 | 6.7 | | | | | | | | | | | 3.15 |
| 14 | 7.4 | 6.8 | 6.2 | | | | | | | | | | | 3.65 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads, see tables of Maximum Bending Moments and Web Resistances.

# CHANNELS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 Inch | | | | | | 13 Inch | | | | | | |
| | 55 lbs. | 50 lbs. | 45 lbs. | 40 lbs. | 35 lbs. | 33.9 lbs. | 50 lbs. | 45 lbs. | 40 lbs. | 37 lbs. | 35 lbs. | 31.8 lbs. | |
| | 293.0 | 257.8 | 222.5 | 187.2 | | | 245.5 | 210.0 | 174.7 | | | | |
| 3 | 228.8 | 214.2 | 199.4 | 184.7 | 151.9 | 144.0 | 192.6 | 179.7 | 167.0 | 153.5 | 139.5 | 117.0 | 0.17 |
| 4 | 171.6 | 160.7 | 149.5 | 138.5 | 127.5 | 125.0 | 144.4 | 134.8 | 125.2 | 119.5 | 115.7 | 109.6 | 0.30 |
| 5 | 137.3 | 128.5 | 119.6 | 110.8 | 102.0 | 100.0 | 115.5 | 107.8 | 100.2 | 95.6 | 92.6 | 87.7 | 0.47 |
| 6 | 114.4 | 107.1 | 99.7 | 92.4 | 85.0 | 83.4 | 96.3 | 89.9 | 83.5 | 79.7 | 77.1 | 73.1 | 0.67 |
| 7 | 98.1 | 91.8 | 85.5 | 79.2 | 72.9 | 71.4 | 82.5 | 77.0 | 71.6 | 68.3 | 66.1 | 62.6 | 0.91 |
| 8 | 85.8 | 80.3 | 74.8 | 69.3 | 63.7 | 62.5 | 72.2 | 67.4 | 62.6 | 59.7 | 57.8 | 54.8 | 1.19 |
| 9 | 76.3 | 71.4 | 66.5 | 61.6 | 56.7 | 55.6 | 64.2 | 59.9 | 55.7 | 53.1 | 51.4 | 48.7 | 1.51 |
| 10 | 68.6 | 64.3 | 59.8 | 55.4 | 51.0 | 50.0 | 57.8 | 53.9 | 50.1 | 47.8 | 46.3 | 43.8 | 1.86 |
| 11 | 62.4 | 58.4 | 54.4 | 50.4 | 46.4 | 45.5 | 52.5 | 49.0 | 45.5 | 43.5 | 42.1 | 39.9 | 2.25 |
| 12 | 57.2 | 53.6 | 49.8 | 46.2 | 42.5 | 41.7 | 48.1 | 44.9 | 41.7 | 39.8 | 38.6 | 36.5 | 2.68 |
| 13 | 52.8 | 49.4 | 46.0 | 42.6 | 39.2 | 38.5 | 44.4 | 41.5 | 38.5 | 36.8 | 35.6 | 33.7 | 3.15 |
| 14 | 49.0 | 45.9 | 42.7 | 39.6 | 36.4 | 35.7 | 41.3 | 38.5 | 35.8 | 34.1 | 33.1 | 31.3 | 3.65 |
| 15 | 45.8 | 42.8 | 39.9 | 36.9 | 34.0 | 33.3 | 38.5 | 35.9 | 33.4 | 31.9 | 30.9 | 29.2 | 4.19 |
| 16 | 42.9 | 40.2 | 37.4 | 34.6 | 31.9 | 31.3 | 36.1 | 33.7 | 31.3 | 29.9 | 28.9 | 27.4 | 4.77 |
| 17 | 40.4 | 37.8 | 35.2 | 32.6 | 30.0 | 29.4 | 34.0 | 31.7 | 29.5 | 28.1 | 27.2 | 25.8 | 5.38 |
| 18 | 38.1 | 35.7 | 33.2 | 30.8 | 28.3 | 27.8 | 32.1 | 30.0 | 27.8 | 26.6 | 25.7 | 24.4 | 6.03 |
| 19 | 36.1 | 33.8 | 31.5 | 29.2 | 26.8 | 26.3 | 30.4 | 28.4 | 26.4 | 25.2 | 24.4 | 23.1 | 6.72 |
| 20 | 34.3 | 32.1 | 29.9 | 27.7 | 25.5 | 25.0 | 28.9 | 27.0 | 25.0 | 23.9 | 23.1 | 21.9 | 7.45 |
| 21 | 32.7 | 30.6 | 28.5 | 26.4 | 24.3 | 23.8 | 27.5 | 25.7 | 23.9 | 22.8 | 22.0 | 20.9 | 8.21 |
| 22 | 31.2 | 29.2 | 27.2 | 25.2 | 23.2 | 22.7 | 26.3 | 24.5 | 22.8 | 21.7 | 21.0 | 19.9 | 9.01 |
| 23 | 29.8 | 27.9 | 26.0 | 24.1 | 22.2 | 21.7 | 25.1 | 23.4 | 21.8 | 20.8 | 20.1 | 19.1 | 9.85 |
| 24 | 28.6 | 26.8 | 24.9 | 23.1 | 21.2 | 20.8 | 24.1 | 22.5 | 20.9 | 19.9 | 19.3 | 18.3 | 10.73 |
| 25 | 27.5 | 25.7 | 23.9 | 22.2 | 20.4 | 20.0 | 23.1 | 21.6 | 20.0 | 19.1 | 18.5 | 17.5 | 11.64 |
| 26 | 26.4 | 24.7 | 23.0 | 21.3 | 19.6 | 19.2 | 22.2 | 20.7 | 19.3 | 18.4 | 17.8 | 16.9 | 12.59 |
| 27 | 25.4 | 23.8 | 22.2 | 20.5 | 18.9 | 18.5 | 21.4 | 20.0 | 18.6 | 17.7 | 17.1 | 16.2 | 13.57 |
| 28 | 24.5 | 23.0 | 21.4 | 19.8 | 18.2 | 17.9 | 20.6 | 19.3 | 17.9 | 17.1 | 16.5 | 15.7 | 14.60 |
| 29 | 23.7 | 22.2 | 20.6 | 19.1 | 17.6 | 17.2 | | | | | | | 15.66 |
| 30 | 22.9 | 21.4 | 19.9 | 18.5 | 17.0 | 16.7 | | | | | | | 16.76 |
| 31 | 22.1 | 20.7 | 19.3 | 17.9 | 16.5 | 16.1 | | | | | | | 17.89 |
| 32 | 21.4 | 20.1 | 18.7 | 17.3 | 15.9 | 15.6 | | | | | | | 19.07 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads, see tables of Maximum Bending Moments and Web Resistances.

## CHANNELS

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 Inch | | | | | 10 Inch | | | | | |
| | 40 lbs. | 35 lbs. | 30 lbs. | 25 lbs. | 20.7 lbs. | 35 lbs. | 30 lbs. | 25 lbs. | 20 lbs. | 15.3 lbs. | |
| | 217.4 | 182.0 | | | | 196.8 | 161.5 | 126.2 | | | |
| 2 | 196.5 | 178.8 | 146.9 | 111.5 | | 138.3 | 123.6 | 108.9 | 91.0 | 57.6 | 0.07 |
| 3 | 131.0 | 119.2 | 107.5 | 95.7 | 80.6 | 92.2 | 82.4 | 72.6 | 62.8 | 53.5 | 0.17 |
| 4 | 98.3 | 89.4 | 80.6 | 71.8 | 64.1 | 69.1 | 61.8 | 54.4 | 47.1 | 40.1 | 0.30 |
| 5 | 78.6 | 71.5 | 64.5 | 57.4 | 51.2 | 55.3 | 49.4 | 43.5 | 37.7 | 32.1 | 0.47 |
| 6 | 65.5 | 59.6 | 53.7 | 47.8 | 42.7 | 46.1 | 41.2 | 36.3 | 31.4 | 26.8 | 0.67 |
| 7 | 56.2 | 51.1 | 46.1 | 41.0 | 36.6 | 39.5 | 35.3 | 31.1 | 26.9 | 22.9 | 0.91 |
| 8 | 49.1 | 44.7 | 40.3 | 35.9 | 32.0 | 34.6 | 30.9 | 27.2 | 23.5 | 20.1 | 1.19 |
| 9 | 43.7 | 39.7 | 35.8 | 31.9 | 28.5 | 30.7 | 27.5 | 24.2 | 20.9 | 17.8 | 1.51 |
| 10 | 39.3 | 35.8 | 32.2 | 28.7 | 25.6 | 27.7 | 24.7 | 21.8 | 18.8 | 16.1 | 1.86 |
| 11 | 35.7 | 32.5 | 29.3 | 26.1 | 23.3 | 25.1 | 22.5 | 19.8 | 17.1 | 14.6 | 2.25 |
| 12 | 32.8 | 29.8 | 26.9 | 23.9 | 21.4 | 23.0 | 20.6 | 18.1 | 15.7 | 13.4 | 2.68 |
| 13 | 30.2 | 27.5 | 24.8 | 22.1 | 19.7 | 21.3 | 19.0 | 16.7 | 14.5 | 12.3 | 3.15 |
| 14 | 28.1 | 25.5 | 23.0 | 20.5 | 18.3 | 19.8 | 17.7 | 15.6 | 13.5 | 11.5 | 3.65 |
| 15 | 26.2 | 23.8 | 21.5 | 19.1 | 17.1 | 18.4 | 16.5 | 14.5 | 12.6 | 10.7 | 4.19 |
| 16 | 24.6 | 22.3 | 20.2 | 17.9 | 16.0 | 17.3 | 15.4 | 13.6 | 11.8 | 10.0 | 4.77 |
| 17 | 23.1 | 21.0 | 19.0 | 16.9 | 15.1 | 16.3 | 14.5 | 12.8 | 11.1 | 9.4 | 5.38 |
| 18 | 21.8 | 19.9 | 17.9 | 15.9 | 14.2 | 15.4 | 13.7 | 12.1 | 10.5 | 8.9 | 6.03 |
| 19 | 20.7 | 18.8 | 17.0 | 15.1 | 13.5 | 14.6 | 13.0 | 11.5 | 9.9 | 8.4 | 6.72 |
| 20 | 19.7 | 17.9 | 16.1 | 14.4 | 12.8 | 13.8 | 12.4 | 10.9 | 9.4 | 8.0 | 7.45 |
| 21 | 18.7 | 17.0 | 15.4 | 13.7 | 12.2 | 13.2 | 11.8 | 10.4 | 9.0 | 7.6 | 8.21 |
| 22 | 17.9 | 16.3 | 14.7 | 13.0 | 11.6 | 12.6 | 11.2 | 9.9 | 8.6 | 7.3 | 9.01 |
| 23 | 17.1 | 15.5 | 14.0 | 12.5 | 11.1 | | | | | | 9.85 |
| 24 | 16.4 | 14.9 | 13.4 | 12.0 | 10.7 | | | | | | 10.73 |
| 25 | 15.7 | 14.3 | 12.9 | 11.5 | 10.2 | | | | | | 11.64 |
| 26 | 15.1 | 13.8 | 12.4 | 11.0 | 9.9 | | | | | | 12.59 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# CHANNELS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection. For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 Inch | | | | 8 Inch | | | | | 7 Inch | | | | |
| | 25 lbs. | 20 lbs. | 15 lbs. | 13.4 lbs. | 21.25 lbs. | 18.75 lbs. | 16.25 lbs. | 13.75 lbs. | 11.5 lbs. | 19.75 lbs. | 17.25 lbs. | 14.75 lbs. | 12.25 lbs. | 9.8 lbs. | |
| | 132.2 | 96.8 | | | 111.2 | 93.5 | 75.8 | 58.2 | | 105.7 | 88.0 | 70.4 | 52.8 | | |
| 2 | 94.0 | 80.8 | 61.6 | 49.7 | 71.4 | 65.5 | 59.7 | 53.8 | 42.2 | 56.7 | 51.5 | 46.4 | 41.2 | 35.3 | 0.07 |
| 3 | 62.7 | 53.8 | 45.0 | 42.1 | 47.6 | 43.7 | 39.8 | 35.8 | 32.3 | 37.8 | 34.3 | 30.9 | 27.5 | 24.1 | 0.17 |
| 4 | 47.0 | 40.4 | 33.8 | 31.5 | 35.7 | 32.8 | 29.8 | 26.9 | 24.2 | 28.3 | 25.8 | 23.2 | 20.6 | 18.1 | 0.30 |
| 5 | 37.6 | 32.3 | 27.0 | 25.2 | 28.6 | 26.2 | 23.9 | 21.5 | 19.4 | 22.7 | 20.6 | 18.6 | 16.5 | 14.5 | 0.47 |
| 6 | 31.4 | 26.9 | 22.5 | 21.0 | 23.8 | 21.9 | 19.9 | 17.9 | 16.2 | 18.9 | 17.2 | 15.5 | 13.7 | 12.0 | 0.67 |
| 7 | 26.9 | 23.1 | 19.3 | 18.0 | 20.4 | 18.7 | 17.0 | 15.4 | 13.8 | 16.2 | 14.7 | 13.3 | 11.8 | 10.3 | 0.91 |
| 8 | 23.5 | 20.2 | 16.9 | 15.8 | 17.9 | 16.4 | 14.9 | 13.4 | 12.1 | 14.2 | 12.9 | 11.6 | 10.3 | 9.0 | 1.19 |
| 9 | 20.9 | 17.9 | 15.0 | 14.0 | 15.9 | 14.6 | 13.3 | 11.9 | 10.8 | 12.6 | 11.4 | 10.3 | 9.2 | 8.0 | 1.51 |
| 10 | 18.8 | 16.2 | 13.5 | 12.6 | 14.3 | 13.1 | 11.9 | 10.8 | 9.7 | 11.3 | 10.3 | 9.3 | 8.2 | 7.2 | 1.86 |
| 11 | 17.1 | 14.7 | 12.3 | 11.5 | 13.0 | 11.9 | 10.8 | 9.8 | 8.8 | 10.3 | 9.4 | 8.4 | 7.5 | 6.6 | 2.25 |
| 12 | 15.7 | 13.5 | 11.3 | 10.5 | 11.9 | 10.9 | 9.9 | 9.0 | 8.1 | 9.4 | 8.6 | 7.7 | 6.9 | 6.0 | 2.68 |
| 13 | 14.5 | 12.4 | 10.4 | 9.7 | 11.0 | 10.1 | 9.2 | 8.3 | 7.5 | 8.7 | 7.9 | 7.1 | 6.3 | 5.6 | 3.15 |
| 14 | 13.4 | 11.5 | 9.7 | 9.0 | 10.2 | 9.4 | 8.5 | 7.7 | 6.9 | 8.1 | 7.4 | 6.6 | 5.9 | 5.2 | 3.65 |
| 15 | 12.5 | 10.8 | 9.0 | 8.4 | 9.5 | 8.7 | 8.0 | 7.2 | 6.5 | 7.6 | 6.9 | 6.2 | 5.5 | 4.8 | 4.19 |
| 16 | 11.8 | 10.1 | 8.4 | 7.9 | 8.9 | 8.2 | 7.5 | 6.7 | 6.1 | 7.1 | 6.4 | 5.8 | 5.2 | 4.5 | 4.77 |
| 17 | 11.1 | 9.5 | 8.0 | 7.4 | 8.4 | 7.7 | 7.0 | 6.3 | 5.7 | | | | | | 5.38 |
| 18 | 10.4 | 9.0 | 7.5 | 7.0 | 7.9 | 7.3 | 6.6 | 6.0 | 5.4 | | | | | | 6.03 |
| 19 | 9.9 | 8.5 | 7.1 | 6.6 | | | | | | | | | | | 6.72 |
| 20 | 9.4 | 8.1 | 6.8 | 6.3 | | | | | | | | | | | 7.45 |

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 Inch | | | | 5 Inch | | | 4 Inch | | | 3 Inch | | | |
| | 15.5 lbs. | 13 lbs. | 10.5 lbs. | 8.2 lbs. | 11.5 lbs. | 9 lbs. | 6.7 lbs. | 7.25 lbs. | 6.25 lbs. | 5.4 lbs. | 6 lbs. | 5 lbs. | 4.1 lbs. | |
| | 80.5 | | | | 56.6 | | | 30.7 | | | 25.6 | 18.6 | | |
| 1 | 77.8 | 62.9 | 45.2 | 28.8 | 49.7 | 30.0 | 22.8 | 27.3 | 23.7 | 17.3 | 16.4 | 14.7 | 13.2 | 0.02 |
| 2 | 38.9 | 34.5 | 30.1 | 26.0 | 24.8 | 21.2 | 17.8 | 13.6 | 12.5 | 11.4 | 8.2 | 7.3 | 6.5 | 0.07 |
| 3 | 25.9 | 23.0 | 20.1 | 17.3 | 16.6 | 14.1 | 11.9 | 9.1 | 8.3 | 7.6 | 5.5 | 4.9 | 4.4 | 0.17 |
| 4 | 19.5 | 17.3 | 15.1 | 13.0 | 12.4 | 10.6 | 8.9 | 6.8 | 6.2 | 5.7 | 4.1 | 3.7 | 3.3 | 0.30 |
| 5 | 15.6 | 13.8 | 12.0 | 10.4 | 9.9 | 8.5 | 7.1 | 5.5 | 5.0 | 4.6 | 3.3 | 2.9 | 2.6 | 0.47 |
| 6 | 13.0 | 11.5 | 10.0 | 8.7 | 8.3 | 7.1 | 5.9 | 4.5 | 4.2 | 3.8 | 2.7 | 2.4 | 2.2 | 0.67 |
| 7 | 11.1 | 9.9 | 8.6 | 7.4 | 7.1 | 6.0 | 5.1 | 3.9 | 3.6 | 3.3 | 2.3 | 2.1 | 1.9 | 0.91 |
| 8 | 9.7 | 8.6 | 7.5 | 6.5 | 6.2 | 5.3 | 4.4 | 3.4 | 3.1 | 2.8 | 2.1 | 1.8 | 1.6 | 1.19 |
| 9 | 8.6 | 7.7 | 6.7 | 5.8 | 5.5 | 4.7 | 4.0 | 3.0 | 2.8 | 2.5 | | | | 1.51 |
| 10 | 7.8 | 6.9 | 6.0 | 5.2 | 5.0 | 4.2 | 3.6 | 2.7 | 2.5 | 2.3 | | | | 1.86 |
| 11 | 7.1 | 6.3 | 5.5 | 4.7 | 4.5 | 3.8 | 3.2 | | | | | | | 2.25 |
| 12 | 6.5 | 5.8 | 5.0 | 4.3 | 4.1 | 3.5 | 3.0 | | | | | | | 2.68 |
| 13 | 6.0 | 5.3 | 4.6 | 4.0 | | | | | | | | | | 3.15 |
| 14 | 5.6 | 4.9 | 4.3 | 3.7 | | | | | | | | | | 3.65 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

## MISCELLANEOUS BEAMS

### ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are braced against lateral deflection
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **18,000** Pounds per Square Inch

### H BEAMS

| Span in Feet | Depth and Weight of Sections | | | | | | | | Coefficients of Deflection |
|---|---|---|---|---|---|---|---|---|---|
| | 8 Inch | | | 6 Inch | | | 5 Inch | 4 Inch | |
| | 37.7 lb. | 34.3 lb. | 32.6 lb. | 26.7 lb. | 24.1 lb. | 22.8 lb. | 18.9 lb. | 13.8 lb. | |
| | | | | | | | | 30.6 | |
| 3 | 96.0 | | | 63.0 | | | 37.5 | 21.4 | 0.17 |
| 4 | 90.6 | 72.0 | | 47.4 | 45.0 | 36.0 | 28.5 | 16.0 | 0.30 |
| 5 | 72.5 | 69.3 | 60.0 | 37.9 | 36.1 | 35.2 | 22.8 | 12.8 | 0.47 |
| 6 | 60.4 | 57.7 | 56.4 | 31.6 | 30.1 | 29.3 | 19.0 | 10.7 | 0.67 |
| 7 | 51.8 | 49.5 | 48.3 | 27.1 | 25.8 | 25.1 | 16.3 | 9.2 | 0.91 |
| 8 | 45.3 | 43.3 | 42.3 | 23.7 | 22.6 | 22.0 | 14.3 | 8.0 | 1.19 |
| 9 | 40.3 | 38.5 | 37.6 | 21.1 | 20.1 | 19.6 | 12.7 | 7.1 | 1.51 |
| 10 | 36.2 | 34.6 | 33.8 | 19.0 | 18.1 | 17.6 | 11.4 | 6.4 | 1.86 |
| 11 | 32.9 | 31.5 | 30.8 | 17.2 | 16.4 | 16.0 | 10.4 | | 2.25 |
| 12 | 30.2 | 28.9 | 28.2 | 15.8 | 15.0 | 14.7 | 9.5 | | 2.68 |
| 13 | 27.9 | 26.6 | 26.0 | 14.6 | 13.9 | 13.5 | | | 3.15 |
| 14 | 25.9 | 24.7 | 24.2 | 13.5 | 12.9 | 12.6 | | | 3.65 |
| 15 | 24.2 | 23.1 | 22.6 | | | | | | 4.19 |
| 16 | 22.6 | 21.6 | 21.2 | | | | | | 4.77 |
| 17 | 21.3 | 20.4 | 19.9 | | | | | | 5.38 |
| 18 | 20.1 | 19.2 | 18.8 | | | | | | 6.03 |

### CROSS TIE SECTIONS

| Span in Feet | Depth and Weight of Sections | | | | *Coefficients of Deflection |
|---|---|---|---|---|---|
| | 5.5 Inch 24.0 Pounds | 5.5 Inch 20.0 Pounds | 4.25 Inch 14.5 Pounds | 3 Inch 9.4 Pounds | |
| | 49.5 | | 25.5 | 14.6 | |
| 3 | 45.4 | 33.0 | 22.0 | 10.0 | 0.17 |
| 4 | 34.0 | 29.2 | 16.5 | 7.5 | 0.30 |
| 5 | 27.2 | 23.4 | 13.2 | 6.0 | 0.47 |
| 6 | 22.7 | 19.5 | 11.0 | 5.0 | 0.67 |
| 7 | 19.4 | 16.7 | 9.4 | 4.3 | 0.91 |
| 8 | 17.0 | 14.6 | 8.3 | 3.8 | 1.19 |
| 9 | 15.1 | 13.0 | 7.3 | 3.3 | 1.51 |
| 10 | 13.6 | 11.7 | 6.6 | 3.0 | 1.86 |
| 11 | 12.4 | 10.6 | 6.0 | | 2.25 |
| 12 | 11.3 | 9.7 | | | 2.68 |
| 13 | 10.5 | 9.0 | | | 3.15 |
| 14 | 9.7 | 8.3 | | | 3.65 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
*To obtain deflections divide Coefficient by twice the distance of neutral axis from extreme fiber obtained from table from Elements of Cross Tie Sections.

# UNEQUAL ANGLES

**Neutral Axis Parallel to Shorter Leg**

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 1 | 181.32 | 9.47 | 19.2 | | 1 | 93.96 | 7.02 | 13.4 |
| | 15/16 | 171.24 | 8.91 | 19.2 | | 15/16 | 88.92 | 6.61 | 13.5 |
| | 7/8 | 160.92 | 8.34 | 19.3 | | 7/8 | 83.76 | 6.19 | 13.5 |
| | 13/16 | 150.60 | 7.77 | 19.4 | | 13/16 | 78.60 | 5.78 | 13.6 |
| | 3/4 | 140.04 | 7.19 | 19.5 | | 3/4 | 73.20 | 5.35 | 13.7 |
| 8 x6 | 11/16 | 129.24 | 6.61 | 19.5 | | 11/16 | 67.80 | 4.92 | 13.8 |
| | 5/8 | 118.44 | 6.03 | 19.6 | 6 x3 1/2 | 5/8 | 62.28 | 4.49 | 13.9 |
| | 9/16 | 107.40 | 5.45 | 19.7 | | 9/16 | 56.64 | 4.07 | 13.9 |
| | 1/2 | 96.24 | 4.86 | 19.8 | | 1/2 | 50.88 | 3.63 | 14.0 |
| | 7/16 | 84.84 | 4.27 | 19.9 | | 7/16 | 45.00 | 3.19 | 14.1 |
| | | | | | | 3/8 | 39.00 | 2.75 | 14.2 |
| | 1 | 164.28 | 9.50 | 17.3 | | 5/16 | 32.88 | 2.30 | 14.3 |
| | 15/16 | 155.28 | 8.93 | 17.4 | | | | | |
| | 7/8 | 146.16 | 8.37 | 17.5 | | | | | |
| | 13/16 | 136.80 | 7.80 | 17.5 | | 7/8 | 59.88 | 5.08 | 11.8 |
| | 3/4 | 127.32 | 7.22 | 17.7 | | 13/16 | 56.28 | 4.74 | 11.9 |
| 8 x3 1/2 | 11/16 | 117.60 | 6.64 | 17.7 | | 3/4 | 52.44 | 4.39 | 12.0 |
| | 5/8 | 107.76 | 6.06 | 17.8 | | 11/16 | 48.60 | 4.04 | 12.0 |
| | 9/16 | 97.80 | 5.47 | 17.9 | 5 x4 | 5/8 | 44.76 | 3.70 | 12.1 |
| | 1/2 | 87.72 | 4.88 | 18.0 | | 9/16 | 40.68 | 3.34 | 12.2 |
| | 7/16 | 77.40 | 4.28 | 18.1 | | 1/2 | 36.60 | 2.98 | 12.3 |
| | | | | | | 7/16 | 32.40 | 2.62 | 12.4 |
| | 1 | 126.96 | 8.25 | 15.4 | | 3/8 | 28.08 | 2.26 | 12.4 |
| | 15/16 | 120.00 | 7.78 | 15.4 | | | | | |
| | 7/8 | 113.04 | 7.28 | 15.5 | | 7/8 | 58.56 | 5.10 | 11.5 |
| | 13/16 | 105.84 | 6.78 | 15.6 | | 13/16 | 54.96 | 4.75 | 11.6 |
| | 3/4 | 98.64 | 6.29 | 15.7 | | 3/4 | 51.36 | 4.41 | 11.6 |
| 7 x3 1/2 | 11/16 | 91.20 | 5.79 | 15.8 | | 11/16 | 47.64 | 4.06 | 11.7 |
| | 5/8 | 83.64 | 5.28 | 15.9 | | 5/8 | 43.80 | 3.71 | 11.8 |
| | 9/16 | 75.96 | 4.77 | 15.9 | 5 x3 1/2 | 9/16 | 39.84 | 3.35 | 11.9 |
| | 1/2 | 68.16 | 4.26 | 16.0 | | 1/2 | 35.88 | 3.00 | 12.0 |
| | 7/16 | 60.12 | 3.73 | 16.1 | | 7/16 | 31.68 | 2.63 | 12.1 |
| | 3/8 | 51.96 | 3.21 | 16.2 | | 3/8 | 27.48 | 2.26 | 12.1 |
| | 1 | 96.24 | 7.02 | 13.7 | | 5/16 | 23.28 | 1.91 | 12.2 |
| | 15/16 | 91.08 | 6.59 | 13.8 | | | | | |
| | 7/8 | 85.80 | 6.18 | 13.9 | | 13/16 | 53.40 | 4.75 | 11.2 |
| | 13/16 | 80.40 | 5.76 | 14.0 | | 3/4 | 49.92 | 4.41 | 11.3 |
| | 3/4 | 75.00 | 5.35 | 14.0 | | 11/16 | 46.32 | 4.07 | 11.4 |
| 6 x4 | 11/16 | 69.36 | 4.92 | 14.1 | | 5/8 | 42.60 | 3.72 | 11.5 |
| | 5/8 | 63.72 | 4.49 | 14.2 | 5 x3 | 9/16 | 38.76 | 3.35 | 11.6 |
| | 9/16 | 57.96 | 4.06 | 14.3 | | 1/2 | 34.92 | 3.00 | 11.6 |
| | 1/2 | 52.08 | 3.63 | 14.4 | | 7/16 | 30.96 | 2.64 | 11.7 |
| | 7/16 | 45.96 | 3.18 | 14.5 | | 3/8 | 26.88 | 2.28 | 11.8 |
| | 3/8 | 39.84 | 2.74 | 14.5 | | 5/16 | 22.68 | 1.91 | 11.9 |

## UNEQUAL ANGLES

**Neutral Axis Parallel to Longer Leg**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 1 | 107.04 | 6.87 | 15.6 | | 1 | 34.80 | 3.91 | 8.9 |
| | 15/16 | 101.16 | 6.47 | 15.6 | | 15/16 | 32.88 | 3.66 | 9.0 |
| | 7/8 | 95.28 | 6.06 | 15.7 | | 7/8 | 31.08 | 3.43 | 9.1 |
| | 13/16 | 89.28 | 5.65 | 15.8 | | 13/16 | 29.16 | 3.19 | 9.1 |
| | 3/4 | 83.16 | 5.23 | 15.9 | | 3/4 | 27.24 | 2.96 | 9.2 |
| 8 x6 | 11/16 | 76.92 | 4.82 | 16.0 | | 11/16 | 25.32 | 2.72 | 9.3 |
| | 5/8 | 70.56 | 4.40 | 16.0 | 6 x3 1/2 | 5/8 | 23.28 | 2.48 | 9.4 |
| | 9/16 | 64.08 | 3.98 | 16.1 | | 9/16 | 21.24 | 2.25 | 9.5 |
| | 1/2 | 57.48 | 3.55 | 16.2 | | 1/2 | 19.08 | 2.00 | 9.6 |
| | 7/16 | 50.76 | 3.12 | 16.3 | | 7/16 | 16.92 | 1.76 | 9.6 |
| | | | | | | 3/8 | 14.76 | 1.51 | 9.7 |
| | 1 | 36.24 | 3.92 | 9.2 | | 5/16 | 12.48 | 1.27 | 9.8 |
| | 15/16 | 34.20 | 3.67 | 9.3 | | | | | |
| | 7/8 | 32.28 | 3.43 | 9.4 | | 7/8 | 39.72 | 3.98 | 10.0 |
| | 13/16 | 30.24 | 3.19 | 9.5 | | 13/16 | 37.32 | 3.70 | 10.1 |
| | 3/4 | 28.20 | 2.94 | 9.6 | | 3/4 | 34.80 | 3.42 | 10.2 |
| 8 x3 1/2 | 11/16 | 26.04 | 2.69 | 9.7 | | 11/16 | 32.28 | 3.15 | 10.2 |
| | 5/8 | 24.00 | 2.46 | 9.7 | | 5/8 | 29.76 | 2.89 | 10.3 |
| | 9/16 | 21.84 | 2.22 | 9.9 | 5 x4 | 9/16 | 27.12 | 2.61 | 10.4 |
| | 1/2 | 19.68 | 1.98 | 9.9 | | 1/2 | 24.48 | 2.33 | 10.5 |
| | 7/16 | 17.52 | 1.75 | 10.0 | | 7/16 | 21.72 | 2.06 | 10.6 |
| | 1 | 35.52 | 3.91 | 9.1 | | 3/8 | 18.84 | 1.77 | 10.6 |
| | 15/16 | 33.60 | 3.67 | 9.2 | | | | | |
| | 7/8 | 31.68 | 3.42 | 9.3 | | 7/8 | 30.24 | 3.43 | 8.8 |
| | 13/16 | 29.76 | 3.19 | 9.3 | | 13/16 | 28.44 | 3.20 | 8.9 |
| | 3/4 | 27.72 | 2.94 | 9.4 | | 3/4 | 26.64 | 2.98 | 9.0 |
| 7 x3 1/2 | 11/16 | 25.68 | 2.71 | 9.5 | | 11/16 | 24.72 | 2.73 | 9.1 |
| | 5/8 | 23.64 | 2.47 | 9.6 | | 5/8 | 22.80 | 2.50 | 9.1 |
| | 9/16 | 21.60 | 2.23 | 9.7 | | 9/16 | 20.76 | 2.26 | 9.2 |
| | 1/2 | 19.44 | 2.00 | 9.7 | 5 x3 1/2 | 1/2 | 18.72 | 2.02 | 9.3 |
| | 7/16 | 17.28 | 1.75 | 9.9 | | 7/16 | 16.68 | 1.78 | 9.4 |
| | 3/8 | 15.12 | 1.52 | 9.9 | | 3/8 | 14.52 | 1.54 | 9.5 |
| | 1 | 45.48 | 4.49 | 10.1 | | 5/16 | 12.24 | 1.29 | 9.5 |
| | 15/16 | 43.08 | 4.21 | 10.2 | | | | | |
| | 7/8 | 40.68 | 3.95 | 10.3 | | 13/16 | 20.88 | 2.73 | 7.7 |
| | 13/16 | 38.16 | 3.68 | 10.4 | | 3/4 | 19.56 | 2.53 | 7.7 |
| | 3/4 | 35.64 | 3.41 | 10.5 | | 11/16 | 18.12 | 2.32 | 7.8 |
| 6 x4 | 11/16 | 33.12 | 3.14 | 10.5 | | 5/8 | 16.68 | 2.12 | 7.9 |
| | 5/8 | 30.48 | 2.87 | 10.6 | 5 x3 | 9/16 | 15.24 | 1.91 | 8.0 |
| | 9/16 | 27.72 | 2.59 | 10.7 | | 1/2 | 13.80 | 1.71 | 8.1 |
| | 1/2 | 24.96 | 2.32 | 10.8 | | 7/16 | 12.24 | 1.51 | 8.1 |
| | 7/16 | 22.20 | 2.04 | 10.9 | | 3/8 | 10.68 | 1.30 | 8.2 |
| | 3/8 | 19.20 | 1.75 | 11.0 | | 5/16 | 9.00 | 1.08 | 8.3 |

# UNEQUAL ANGLES

**Neutral Axis Parallel to Shorter Leg**

## Allowable Uniform Load in Thousands of Pounds

**Applicable only when sections are rigidly secured against lateral deflection**

Maximum Bending Stress, **18,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 13/16 | 43.44 | 4.26 | 10.2 | | 9/16 | 13.80 | 1.95 | 7.1 |
| | 3/4 | 40.56 | 3.95 | 10.3 | | 1/2 | 12.48 | 1.74 | 7.2 |
| | 11/16 | 37.68 | 3.63 | 10.4 | 3 x2 1/2 | 7/16 | 11.16 | 1.54 | 7.2 |
| | 5/8 | 34.68 | 3.32 | 10.5 | | 3/8 | 9.72 | 1.33 | 7.3 |
| 4 1/2x3 | 9/16 | 31.68 | 3.01 | 10.5 | | 5/16 | 8.28 | 1.12 | 7.4 |
| | 1/2 | 28.44 | 2.68 | 10.6 | | 1/4 | 6.72 | 0.90 | 7.5 |
| | 7/16 | 25.20 | 2.36 | 10.7 | | | | | |
| | 5/8 | 21.96 | 2.04 | 10.8 | | 1/2 | 12.00 | 1.75 | 6.9 |
| | 5/16 | 18.48 | 1.70 | 10.9 | | 7/16 | 10.68 | 1.54 | 6.9 |
| | | | | | 3 x2 | 3/8 | 9.36 | 1.33 | 7.0 |
| | 13/16 | 35.04 | 3.71 | 9.5 | | 5/16 | 7.92 | 1.12 | 7.1 |
| | 3/4 | 33.00 | 3.47 | 9.5 | | 1/4 | 6.48 | 0.90 | 7.2 |
| | 11/16 | 30.72 | 3.20 | 9.6 | | | | | |
| | 5/8 | 28.20 | 2.91 | 9.7 | | 1/2 | 8.40 | 1.45 | 5.8 |
| 4 x3 1/2 | 9/16 | 25.80 | 2.64 | 9.8 | | 7/16 | 7.56 | 1.28 | 5.9 |
| | 1/2 | 23.16 | 2.35 | 9.9 | | 3/8 | 6.60 | 1.10 | 6.0 |
| | 7/16 | 20.64 | 2.08 | 9.9 | 2 1/2x2 | 5/16 | 5.64 | 0.93 | 6.1 |
| | 3/8 | 18.00 | 1.80 | 10.0 | | 1/4 | 4.56 | 0.75 | 6.1 |
| | 5/16 | 15.12 | 1.50 | 10.1 | | 3/16 | 3.48 | 0.56 | 6.2 |
| | | | | | | 1/8 | 2.40 | 0.38 | 6.3 |
| | 13/16 | 34.44 | 3.76 | 9.2 | | | | | |
| | 3/4 | 32.16 | 3.48 | 9.2 | | 5/16 | 5.28 | 0.92 | 5.7 |
| | 11/16 | 29.88 | 3.20 | 9.3 | 2 1/2x1 1/2 | 1/4 | 4.32 | 0.75 | 5.8 |
| | 5/8 | 27.60 | 2.93 | 9.4 | | 3/16 | 3.36 | 0.57 | 5.9 |
| | 9/16 | 25.20 | 2.66 | 9.5 | | | | | |
| 4 x3 | 1/2 | 22.68 | 2.37 | 9.6 | | 1/2 | 6.48 | 1.30 | 5.0 |
| | 7/16 | 20.16 | 2.08 | 9.7 | | 7/16 | 5.76 | 1.13 | 5.1 |
| | 3/8 | 17.52 | 1.80 | 9.7 | | 3/8 | 5.04 | 0.98 | 5.2 |
| | 5/16 | 14.76 | 1.51 | 9.8 | 2 1/4x1 1/2 | 5/16 | 4.32 | 0.83 | 5.2 |
| | 1/4 | 12.00 | 1.22 | 9.9 | | 1/4 | 3.60 | 0.68 | 5.3 |
| | | | | | | 3/16 | 2.76 | 0.51 | 5.4 |
| | 13/16 | 26.40 | 3.25 | 8.1 | | | | | |
| | 3/4 | 24.60 | 3.00 | 8.2 | | | | | |
| | 11/16 | 22.92 | 2.77 | 8.3 | | 3/8 | 4.08 | 0.88 | 4.6 |
| | 5/8 | 21.12 | 2.53 | 8.3 | | 5/16 | 3.48 | 0.74 | 4.7 |
| | 9/16 | 19.32 | 2.30 | 8.4 | 2 x1 1/2 | 1/4 | 2.88 | 0.60 | 4.8 |
| 3 1/2x3 | 1/2 | 17.40 | 2.05 | 8.5 | | 3/16 | 2.16 | 0.44 | 4.9 |
| | 7/16 | 15.48 | 1.80 | 8.6 | | 1/8 | 1.50 | 0.30 | 4.9 |
| | 3/8 | 13.56 | 1.57 | 8.7 | | | | | |
| | 5/16 | 11.52 | 1.32 | 8.7 | | 1/4 | 2.75 | 0.60 | 4.6 |
| | 1/4 | 9.36 | 1.06 | 8.8 | 2 x1 1/4 | 3/16 | 2.12 | 0.45 | 4.7 |
| | | | | | | | | | |
| | 11/16 | 22.20 | 2.78 | 8.0 | | | | | |
| | 5/8 | 20.52 | 2.55 | 8.1 | | 1/4 | 2.11 | 0.51 | 4.1 |
| | 9/16 | 18.72 | 2.30 | 8.1 | 1 3/4x1 1/4 | 3/16 | 1.64 | 0.39 | 4.2 |
| 3 1/2x2 1/2 | 1/2 | 16.92 | 2.06 | 8.2 | | 1/8 | 1.13 | 0.27 | 4.3 |
| | 7/16 | 15.12 | 1.82 | 8.3 | | | | | |
| | 3/8 | 13.20 | 1.57 | 8.4 | | 5/16 | 1.92 | 0.55 | 3.5 |
| | 5/16 | 11.16 | 1.32 | 8.4 | 1 1/2x1 1/4 | 1/4 | 1.56 | 0.44 | 3.6 |
| | 1/4 | 9.00 | 1.05 | 8.6 | | 3/16 | 1.21 | 0.33 | 3.7 |

## UNEQUAL ANGLES

**Neutral Axis Parallel to Longer Leg**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

**Applicable only when sections are rigidly secured against lateral deflection.**

**Maximum Bending Stress, 18,000 Pounds per Square Inch**

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 15/16 | 20.52 | 2.73 | 7.5 | | 9/16 | 9.84 | 1.59 | 6.2 |
| | 3/4 | 19.20 | 2.53 | 7.6 | | 1/2 | 8.88 | 1.42 | 6.3 |
| | 11/16 | 17.88 | 2.32 | 7.7 | | 7/16 | 7.92 | 1.25 | 6.3 |
| | 5/8 | 16.44 | 2.11 | 7.8 | 3 x2 1/2 | 3/8 | 6.96 | 1.08 | 6.4 |
| 4 1/2x3 | 9/16 | 15.00 | 1.90 | 7.8 | | 5/16 | 5.88 | 0.90 | 6.5 |
| | 1/2 | 13.56 | 1.71 | 7.9 | | 1/4 | 4.80 | 0.73 | 6.6 |
| | 7/16 | 12.12 | 1.51 | 8.0 | | | | | |
| | 3/8 | 10.56 | 1.31 | 8.1 | | 1/2 | 5.64 | 1.11 | 5.1 |
| | 5/16 | 9.00 | 1.10 | 8.2 | | 7/16 | 5.04 | 0.98 | 5.2 |
| | | | | | 3 x2 | 3/8 | 4.44 | 0.85 | 5.2 |
| | 15/16 | 27.60 | 3.22 | 8.6 | | 5/16 | 3.84 | 0.72 | 5.3 |
| | 3/4 | 25.80 | 2.99 | 8.6 | | 1/4 | 3.00 | 0.58 | 5.4 |
| | 11/16 | 24.00 | 2.76 | 8.7 | | | | | |
| | 5/8 | 22.08 | 2.51 | 8.8 | | 1/2 | 5.52 | 1.12 | 4.9 |
| 4 x3 1/2 | 9/16 | 20.16 | 2.27 | 8.9 | | 7/16 | 4.92 | 0.98 | 5.0 |
| | 1/2 | 18.24 | 2.04 | 9.0 | | 3/8 | 4.32 | 0.85 | 5.1 |
| | 7/16 | 16.20 | 1.80 | 9.0 | | 5/16 | 3.72 | 0.72 | 5.2 |
| | 3/8 | 14.16 | 1.56 | 9.1 | 2 1/2x2 | 1/4 | 3.00 | 0.58 | 5.2 |
| | 5/16 | 12.00 | 1.31 | 9.2 | | 3/16 | 2.40 | 0.45 | 5.3 |
| | | | | | | 1/8 | 1.62 | 0.30 | 5.4 |
| | 15/16 | 20.16 | 2.74 | 7.4 | | | | | |
| | 3/4 | 18.84 | 2.53 | 7.4 | | 5/16 | 2.04 | 0.52 | 3.9 |
| | 11/16 | 17.52 | 2.32 | 7.6 | | 1/4 | 1.68 | 0.41 | 4.1 |
| | 5/8 | 16.20 | 2.12 | 7.6 | 2 1/2x1 1/2 | 3/16 | 1.32 | 0.32 | 4.1 |
| | 9/16 | 14.76 | 1.92 | 7.7 | | | | | |
| 4 x3 | 1/2 | 13.32 | 1.71 | 7.8 | | 1/2 | 3.12 | 0.85 | 3.7 |
| | 7/16 | 11.88 | 1.51 | 7.9 | | 7/16 | 2.76 | 0.74 | 3.7 |
| | 3/8 | 10.44 | 1.31 | 7.9 | | 3/8 | 2.40 | 0.63 | 3.8 |
| | 5/16 | 8.88 | 1.11 | 8.0 | | 5/16 | 2.04 | 0.53 | 3.9 |
| | 1/4 | 7.20 | .89 | 8.1 | 2 1/4x1 1/2 | 1/4 | 1.68 | 0.42 | 4.0 |
| | | | | | | 3/16 | 1.32 | 0.33 | 4.0 |
| | 15/16 | 19.80 | 2.74 | 7.2 | | | | | |
| | 3/4 | 18.48 | 2.53 | 7.3 | | 3/8 | 2.40 | 0.65 | 3.7 |
| | 11/16 | 17.28 | 2.34 | 7.4 | | 5/16 | 2.04 | 0.54 | 3.8 |
| | 5/8 | 15.96 | 2.14 | 7.4 | | 1/4 | 1.68 | 0.43 | 3.9 |
| | 9/16 | 14.52 | 1.93 | 7.5 | 2 x1 1/2 | 3/16 | 1.32 | 0.33 | 4.0 |
| 3 1/2x3 | 1/2 | 13.20 | 1.74 | 7.6 | | 1/8 | 0.90 | 0.22 | 4.0 |
| | 7/16 | 11.76 | 1.53 | 7.7 | | | | | |
| | 3/8 | 10.20 | 1.31 | 7.8 | | 1/4 | 1.16 | 0.35 | 3.3 |
| | 5/16 | 8.64 | 1.10 | 7.8 | 2 x1 1/4 | 3/16 | 0.90 | 0.27 | 3.4 |
| | 1/4 | 6.96 | 0.88 | 7.9 | | | | | |
| | | | | | | 1/4 | 1.14 | 0.35 | 3.2 |
| | 11/16 | 11.88 | 1.92 | 6.2 | | 3/16 | 0.90 | 0.27 | 3.3 |
| | 5/8 | 11.04 | 1.76 | 6.3 | | 1/8 | 0.62 | 0.19 | 3.4 |
| | 9/16 | 10.08 | 1.59 | 6.3 | 1 3/4x1 1/4 | | | | |
| | 1/2 | 9.12 | 1.42 | 6.4 | | | | | |
| 3 1/2x2 1/2 | 7/16 | 8.16 | 1.25 | 6.5 | | | | | |
| | 3/8 | 7.08 | 1.07 | 6.6 | | 5/16 | 1.36 | 0.45 | 3.0 |
| | 5/16 | 6.00 | 0.90 | 6.7 | 1 1/2x1 1/4 | 1/4 | 1.12 | 0.36 | 3.1 |
| | 1/4 | 4.92 | 0.73 | 6.8 | | 3/16 | 0.88 | 0.27 | 3.2 |

# EQUAL ANGLES

**Neutral Axis Parallel to Either Leg**

## Allowable Uniform Load in Thousands of Pounds

**Applicable only when sections are rigidly secured against lateral deflection**

**Maximum Bending Stress, 18,000 Pounds per Square Inch**

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 1⅛ | 210.36 | 10.51 | 20.0 | | 15/16 | 27.00 | 3.24 | 8.3 |
| | 1 1/16 | 200.04 | 9.96 | 20.1 | | ¾ | 25.32 | 3.01 | 8.4 |
| | 1 | 189.60 | 9.40 | 20.2 | | 11/16 | 23.52 | 2.76 | 8.5 |
| | 15/16 | 179.04 | 8.84 | 20.2 | | ⅝ | 21.72 | 2.53 | 8.6 |
| | ⅞ | 168.24 | 8.28 | 20.3 | 3 ½x3 ½ | 9/16 | 19.80 | 2.29 | 8.7 |
| 8 x8 | 13/16 | 157.32 | 7.71 | 20.4 | | ½ | 17.88 | 2.05 | 8.7 |
| | ¾ | 146.28 | 7.14 | 20.5 | | 7/16 | 15.84 | 1.80 | 8.8 |
| | 11/16 | 135.00 | 6.56 | 20.6 | | ⅜ | 13.80 | 1.55 | 8.9 |
| | ⅝ | 123.60 | 5.98 | 20.7 | | 5/16 | 11.76 | 1.31 | 9.0 |
| | 9/16 | 112.08 | 5.41 | 20.7 | | ¼ | 9.48 | 1.05 | 9.1 |
| | ½ | 100.44 | 4.83 | 20.8 | | | | | |
| | | | | | | ⅝ | 15.60 | 2.16 | 7.2 |
| | 1 | 102.84 | 6.94 | 14.8 | | 9/16 | 14.28 | 1.95 | 7.3 |
| | 15/16 | 97.32 | 6.54 | 14.9 | | ½ | 12.84 | 1.73 | 7.4 |
| | ⅞ | 91.56 | 6.12 | 15.0 | 3 x3 | 7/16 | 11.40 | 1.52 | 7.5 |
| | 13/16 | 85.80 | 5.70 | 15.0 | | ⅜ | 9.96 | 1.32 | 7.6 |
| | ¾ | 79.92 | 5.29 | 15.1 | | 5/16 | 8.52 | 1.12 | 7.6 |
| 6 x6 | 11/16 | 74.04 | 4.87 | 15.2 | | ¼ | 6.96 | 0.90 | 7.7 |
| | ⅝ | 67.92 | 4.44 | 15.3 | | ½ | 8.76 | 1.45 | 6.1 |
| | 9/16 | 61.68 | 4.02 | 15.4 | 2 ½x2 ½ | 7/16 | 7.80 | 1.27 | 6.2 |
| | ½ | 55.32 | 3.58 | 15.5 | | ⅜ | 6.84 | 1.10 | 6.2 |
| | 7/16 | 48.84 | 3.14 | 15.5 | | 5/16 | 5.76 | 0.92 | 6.3 |
| | ⅜ | 42.36 | 2.71 | 15.6 | | ¼ | 4.68 | 0.74 | 6.4 |
| | | | | | | 8/16 | 3.60 | 0.55 | 6.5 |
| | 1 | 69.60 | 5.73 | 12.1 | | ⅛ | 2.40 | 0.37 | 6.6 |
| | 15/16 | 65.88 | 5.39 | 12.2 | 2 x2 | 7/16 | 4.80 | 1.00 | 4.8 |
| | ⅞ | 62.04 | 5.05 | 12.3 | | ⅜ | 4.20 | .86 | 4.9 |
| | 13/16 | 58.20 | 4.71 | 12.4 | | 5/16 | 3.60 | .72 | 5.0 |
| | ¾ | 54.36 | 4.36 | 12.5 | | ¼ | 3.00 | .59 | 5.1 |
| 5 x5 | 11/16 | 50.40 | 4.02 | 12.5 | | 3/16 | 2.28 | .45 | 5.1 |
| | ⅝ | 46.32 | 3.68 | 12.6 | | ⅛ | 1.56 | .30 | 5.2 |
| | 9/16 | 42.12 | 3.32 | 12.7 | 1 ¾x1 ¾ | 7/16 | 3.60 | .87 | 4.2 |
| | ½ | 37.80 | 2.96 | 12.8 | | ⅜ | 3.12 | .74 | 4.2 |
| | 7/16 | 33.48 | 2.61 | 12.9 | | 5/16 | 2.76 | .64 | 4.3 |
| | ⅜ | 29.04 | 2.25 | 12.9 | | ¼ | 2.28 | .52 | 4.4 |
| | | | | | | 3/16 | 1.68 | .38 | 4.4 |
| | 15/16 | 36.12 | 3.72 | 9.7 | 1 ½x1 ½ | ⅛ | 1.20 | .26 | 4.6 |
| | ¾ | 33.72 | 3.45 | 9.8 | | ⅜ | 2.28 | .64 | 3.5 |
| | 11/16 | 31.32 | 3.18 | 9.8 | | 5/16 | 1.94 | .54 | 3.6 |
| | ⅝ | 28.80 | 2.91 | 9.9 | | ¼ | 1.61 | .44 | 3.7 |
| | 9/16 | 26.28 | 2.63 | 10.0 | | 3/16 | 1.25 | .33 | 3.8 |
| 4 x4 | ½ | 23.64 | 2.34 | 10.1 | 1 ¼x1 ¼ | ⅛ | 0.86 | .22 | 3.9 |
| | 7/16 | 21.00 | 2.06 | 10.2 | | 5/16 | 1.31 | .44 | 3.0 |
| | ⅜ | 18.24 | 1.78 | 10.2 | | ¼ | 1.09 | .36 | 3.0 |
| | 5/16 | 15.48 | 1.50 | 10.3 | | 3/16 | 0.85 | .27 | 3.1 |
| | ¼ | 12.60 | 1.21 | 10.4 | 1 x1 | ⅛ | 0.59 | .18 | 3.2 |
| | | | | | | ¼ | 0.67 | .28 | 2.4 |
| | | | | | | 5/16 | 0.53 | .22 | 2.4 |
| | | | | | | ⅛ | 0.37 | .15 | 2.5 |

## TEES AND ZEES

**Neutral Axis Parallel to Flanges**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection.

Maximum Bending Stress, **18,000** Pounds per Square Inch

### TEES

| Size Flange x Stem, Inches | Weight per Foot, Pounds | 1 Foot Span | Maximum Span 360 x Deflection | | Size Flange x Stem, Inches | Weight per Foot, Pounds | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| 6 1½x6 1½ | 19.8 | 59.40 | 3.50 | 17.0 | 5 x3 | 11.5 | 12.72 | 1.59 | 8.0 |
| 4 x4 | 13.5 | 24.24 | 2.40 | 10.1 | 4 x5 | 15.3 | 37.56 | 3.05 | 12.3 |
| 4 x4 | 10.5 | 18.96 | 1.85 | 10.3 | 4 x5 | 11.9 | 29.16 | 2.33 | 12.5 |
| 3 x3 | 7.8 | 10.32 | 1.36 | 7.6 | 4 x4 1½ | 14.4 | 30.48 | 2.72 | 11.2 |
| 3 x3 | 6.7 | 8.88 | 1.16 | 7.7 | 4 x4 1½ | 11.2 | 23.76 | 2.08 | 11.4 |
| 2 1½x2 1½ | 6.4 | 7.08 | 1.14 | 6.2 | 4 x3 | 9.2 | 10.80 | 1.36 | 7.9 |
| 2 1½x2 1½ | 5.5 | 6.00 | 0.95 | 6.3 | 4 x3 | 7.8 | 9.24 | 1.15 | 8.1 |
| 2 1¼x2 1¼ | 4.9 | 4.92 | 0.88 | 5.6 | 4 x2 1½ | 8.5 | 7.44 | 1.11 | 6.7 |
| 2 1¼x2 1¼ | 4.1 | 3.84 | 0.67 | 5.7 | 4 x2 1½ | 7.2 | 6.36 | 0.94 | 6.8 |
| 2 x2 | 4.3 | 3.72 | 0.75 | 5.0 | 3 x2 1½ | 6.1 | 6.24 | 0.96 | 6.5 |
| 2 x2 | 3.56 | 3.12 | 0.62 | 5.0 | 2 1½x3 | 6.1 | 8.64 | 1.16 | 7.4 |
| | | | | | 1 1½x2 | 2.45 | 2.34 | 0.48 | 4.9 |
| | | | | | 1 1½x1 1¼ | 1.25 | 0.64 | 0.19 | 3.3 |
| | | | | | 1 1¼x ⅝ | 0.88 | 0.17 | 0.10 | 1.7 |

### ZEES

| Size Depth x Flange, Inches | Thick-ness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size Depth x Flange, Inches | Thick-ness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| 6⅛ x3⅝ | ⅞ | 196.80 | 17.95 | 11.0 | 4⅛ x3 15/16 | ¾ | 87.12 | 11.80 | 7.4 |
| 6 1/16x3 15/16 | 13/16 | 182.64 | 16.83 | 10.9 | 4 1/16x3⅛ | 1 11/16 | 79.80 | 10.97 | 7.3 |
| 6 x3½ | ¾ | 168.48 | 15.68 | 10.7 | 4 x3 1/16 | ⅝ | 72.60 | 10.14 | 7.2 |
| 6⅛ x3⅝ | 1 1/16 | 169.20 | 15.43 | 11.0 | 4⅛ x3 15/16 | 9/16 | 74.16 | 10.04 | 7.4 |
| 6 1/16x3 15/16 | ⅝ | 153.84 | 14.18 | 10.9 | 4 1/16x3⅛ | ½ | 66.00 | 9.08 | 7.3 |
| 6 x3½ | 9/16 | 138.60 | 12.91 | 10.7 | 4 x3 1/16 | 7/16 | 57.96 | 8.10 | 7.2 |
| 6⅛ x3⅝ | ½ | 134.64 | 12.28 | 11.0 | 4⅛ x3 15/16 | ⅜ | 56.04 | 7.59 | 7.4 |
| 6 1/16x3 15/16 | 7/16 | 117.96 | 10.87 | 10.9 | 4 1/16x3⅛ | 5/16 | 46.92 | 6.45 | 7.3 |
| 6 x3½ | ⅜ | 101.28 | 9.43 | 10.7 | 4 x3 1/16 | ¼ | 37.68 | 5.26 | 7.2 |
| 5⅛ x3⅝ | 1 5/16 | 134.40 | 14.65 | 9.2 | | | | | |
| 5 1/16x3 15/16 | ¾ | 124.08 | 13.69 | 9.1 | | | | | |
| 5 x3¼ | 1 1/16 | 113.64 | 12.70 | 9.0 | 3 1/16x2¾ | 9/16 | 41.16 | 7.51 | 5.5 |
| 5⅛ x3⅝ | ⅝ | 114.84 | 12.52 | 9.2 | 3 x2 11/16 | ½ | 36.72 | 6.84 | 5.4 |
| 5 1/16x3 15/16 | 9/16 | 103.44 | 11.42 | 9.1 | 3 1/16x2¾ | 7/16 | 35.76 | 6.52 | 5.5 |
| 5 x3¼ | ½ | 92.16 | 10.30 | 9.0 | 3 x2 11/16 | ⅜ | 30.84 | 5.74 | 5.4 |
| 5⅛ x3⅝ | 7/16 | 89.28 | 9.73 | 9.2 | 3 1/16x2¾ | 5/16 | 28.56 | 5.21 | 5.5 |
| 5 1/16x3 15/16 | ⅜ | 76.68 | 8.46 | 9.1 | 3 x2 11/16 | ¼ | 23.04 | 4.29 | 5.4 |
| 5 x3¼ | 5/16 | 64.08 | 7.16 | 9.0 | | | | | |

# BEAMS

## Maximum Bending Moments and Web Resistances

**Bending Stress 16,000 Pounds—Shearing Stress 10,000 Pounds**

| Depth of Beam | Weight per Foot | Thickness of Web | Maximum Bending Moment | Web Resistance | | | Minimum End Bearing | End Reaction, a=3½" |
|---|---|---|---|---|---|---|---|---|
| | | | | Web Shear | Minimum Span | Web Buckling | | |
| d | | t | Mmax | V | | fb | a | R |
| Inches | Pounds | Inches | Foot Pounds | Pounds | Feet | Pounds per Sq. In. | Inches | Pounds |
| 24 | 120.0 | .798 | 334530 | 191520 | 6.99 | 13790 | 11.40 | 104560 |
| | 115.0 | .737 | 326730 | 176880 | 7.39 | 13360 | 11.96 | 93550 |
| | 110.0 | .675 | 318790 | 162000 | 7.87 | 12840 | 12.69 | 82350 |
| | 105.9 | .625 | 312390 | 150000 | 8.33 | 12350 | 13.44 | 73320 |
| 24 | 100.0 | .747 | 263530 | 179280 | 5.88 | 13430 | 11.87 | 95330 |
| | 95.0 | .686 | 255720 | 164640 | 6.21 | 12940 | 12.55 | 84320 |
| | 90.0 | .624 | 247790 | 149760 | 6.62 | 12340 | 13.45 | 73130 |
| | 85.0 | .563 | 239980 | 135120 | 7.10 | 11620 | 14.66 | 62120 |
| | 79.9 | .500 | 231920 | 120000 | 7.73 | 10680 | 16.46 | 50750 |
| 20 | 100.0 | .873 | 219780 | 174600 | 5.04 | 15030 | 8.31 | 111550 |
| | 95.0 | .800 | 213290 | 160000 | 5.33 | 14670 | 8.63 | 99750 |
| | 90.0 | .726 | 206710 | 145200 | 5.69 | 14230 | 9.06 | 87810 |
| | 85.0 | .653 | 200220 | 130600 | 6.13 | 13700 | 9.60 | 76010 |
| | 81.4 | .600 | 195510 | 120000 | 6.52 | 13230 | 10.12 | 67450 |
| 20 | 75.0 | .641 | 168470 | 128200 | 5.26 | 13590 | 9.71 | 74070 |
| | 70.0 | .567 | 161890 | 113400 | 5.71 | 12890 | 10.52 | 62130 |
| | 65.4 | .500 | 155930 | 100000 | 6.24 | 12070 | 11.57 | 51300 |
| 18 | 90.0 | .796 | 186140 | 143280 | 5.20 | 15090 | 7.43 | 96080 |
| | 85.0 | .714 | 180240 | 128520 | 5.61 | 14630 | 7.80 | 83580 |
| | 80.0 | .632 | 174340 | 113760 | 6.13 | 14070 | 8.29 | 71140 |
| | 75.6 | .560 | 169150 | 100800 | 6.71 | 13440 | 8.89 | 60210 |
| 18 | 70.0 | .711 | 135930 | 127980 | 4.25 | 14620 | 7.81 | 83160 |
| | 65.0 | .629 | 130030 | 113220 | 4.59 | 14050 | 8.31 | 70690 |
| | 60.0 | .547 | 124120 | 98460 | 5.04 | 13310 | 9.03 | 58230 |
| | 54.7 | .460 | 117860 | 82800 | 5.69 | 12230 | 10.22 | 45010 |
| 15 | 75.0 | .868 | 122170 | 130200 | 3.75 | 16010 | 5.62 | 100730 |
| | 70.0 | .770 | 117270 | 115500 | 4.06 | 15630 | 5.85 | 87230 |
| | 65.0 | .672 | 112370 | 100800 | 4.46 | 15130 | 6.16 | 73730 |
| | 60.8 | .590 | 108270 | 88500 | 4.89 | 14600 | 6.53 | 62430 |
| 15 | 55.0 | .648 | 90430 | 97200 | 3.72 | 14990 | 6.26 | 70430 |
| | 50.0 | .550 | 85530 | 82500 | 4.15 | 14280 | 6.76 | 56930 |
| | 45.0 | .452 | 80620 | 67800 | 4.76 | 13250 | 7.57 | 43430 |
| | 42.9 | .410 | 78530 | 61500 | 5.11 | 12670 | 8.09 | 37650 |

## BEAMS

### Maximum Bending Moments and Web Resistances

Bending Stress **16,000** Pounds—Shearing Stress **10,000** Pounds

| Depth of Beam | Weight per Foot | Thickness of Web | Maximum Bending Moment | Web Resistance | | | Minimum End Bearing | End Reaction, a=3½" |
|---|---|---|---|---|---|---|---|---|
| | | | | Web Shear | Minimum Span | Web Buckling | | |
| d | | t | Mmax | V | | fb | a | R |
| Inches | Pounds | Inches | Foot Pounds | Pounds | Feet | Pounds per Sq. In. | Inches | Pounds |
| 12 | 55.0 | .810 | 70970 | 97200 | 2.92 | 16430 | 4.30 | 86530 |
| | 50.0 | .687 | 67030 | 82440 | 3.25 | 15970 | 4.51 | 71330 |
| | 45.0 | .565 | 63130 | 67800 | 3.72 | 15320 | 4.83 | 56270 |
| | 40.8 | .460 | 59770 | 55200 | 4.33 | 14480 | 5.29 | 43300 |
| 12 | 35.0 | .428 | 50460 | 51360 | 3.93 | 14150 | 5.48 | 39350 |
| | 31.8 | .350 | 47960 | 42000 | 4.57 | 13060 | 6.19 | 29710 |
| 10 | 40.0 | .741 | 42140 | 74100 | 2.27 | 16660 | 3.50 | 74080 |
| | 35.0 | .594 | 38870 | 59400 | 2.62 | 16090 | 3.72 | 57330 |
| | 30.0 | .447 | 35600 | 44700 | 3.19 | 15120 | 4.11 | 40560 |
| | 25.4 | .310 | 32560 | 31000 | 4.20 | 13410 | 4.96 | 24950 |
| 9 | 35.0 | .724 | 32970 | 65160 | 2.02 | 16850 | 3.09 | 70130 |
| | 30.0 | .561 | 30040 | 50490 | 2.38 | 16220 | 3.30 | 52320 |
| | 25.0 | .397 | 27090 | 35730 | 3.03 | 15070 | 3.72 | 34410 |
| | 21.8 | .290 | 25160 | 26100 | 3.86 | 13620 | 4.36 | 22720 |
| 8 | 25.5 | .532 | 22680 | 42560 | 2.13 | 16400 | 2.88 | 47970 |
| | 23.0 | .441 | 21390 | 35280 | 2.43 | 15860 | 3.05 | 38460 |
| | 20.5 | .349 | 20080 | 27920 | 2.88 | 15030 | 3.32 | 28850 |
| | 18.4 | .270 | 18960 | 21600 | 3.51 | 13870 | 3.77 | 20590 |
| 7 | 20.0 | .450 | 15980 | 31500 | 2.03 | 16310 | 2.54 | 38520 |
| | 17.5 | .345 | 14840 | 24150 | 2.46 | 15490 | 2.77 | 28050 |
| | 15.3 | .250 | 13800 | 17500 | 3.15 | 14150 | 3.20 | 18570 |
| 6 | 17.25 | .465 | 11560 | 27900 | 1.66 | 16770 | 2.08 | 38980 |
| | 14.75 | .343 | 10590 | 20580 | 2.06 | 15970 | 2.26 | 27390 |
| | 12.50 | .230 | 9680 | 13800 | 2.81 | 14480 | 2.64 | 16650 |
| 5 | 14.75 | .494 | 8030 | 24700 | 1.30 | 17250 | 1.65 | 40470 |
| | 12.25 | .347 | 7210 | 17350 | 1.66 | 16510 | 1.78 | 27200 |
| | 10.0 | .210 | 6450 | 10500 | 2.46 | 14880 | 2.11 | 14840 |
| 4 | 10.5 | .400 | 4720 | 16000 | 1.18 | 17270 | 1.32 | 31080 |
| | 9.5 | .326 | 4460 | 13040 | 1.37 | 16870 | 1.37 | 24750 |
| | 8.5 | .253 | 4200 | 10120 | 1.66 | 16260 | 1.46 | 18510 |
| | 7.7 | .190 | 3980 | 7600 | 2.09 | 15350 | 1.61 | 13120 |
| 3 | 7.5 | .349 | 2560 | 10470 | 0.98 | 17510 | 0.96 | 25970 |
| | 6.5 | .251 | 2370 | 7530 | 1.26 | 16930 | 1.02 | 18060 |
| | 5.7 | .170 | 2210 | 5100 | 1.73 | 15950 | 1.13 | 11520 |

# CHANNELS

## Maximum Bending Moments and Web Resistances

**Bending Stress 16,000 Pounds—Shearing Stress 10,000 Pounds**

| Depth of Channel | Weight per Foot | Thickness of Web | Maximum Bending Moment | Web Resistance | | | Minimum End Bearing | End Reaction, a = 3½" |
|---|---|---|---|---|---|---|---|---|
| | | | | Web Shear | Minimum Span | Web Buckling | | |
| d | | t | $M_{max}$ | V | | $f_b$ | a | R |
| Inches | Pounds | Inches | Foot Pounds | Pounds | Feet | Pounds per Sq. In. | Inches | Pounds |
| | 55.0 | .814 | 76270 | 122100 | 2.50 | 15810 | 5.74 | 93290 |
| | 50.0 | .716 | 71420 | 107400 | 2.66 | 15370 | 6.01 | 79790 |
| | 45.0 | .618 | 66470 | 92700 | 2.87 | 14800 | 6.39 | 66290 |
| 15 | 40.0 | .520 | 61570 | 78000 | 3.16 | 14000 | 6.96 | 52790 |
| | 35.0 | .422 | 56670 | 63300 | 3.58 | 12840 | 7.93 | 39290 |
| | 33.9 | .400 | 55570 | 60000 | 3.70 | 12510 | 8.24 | 36270 |
| | 50.0 | .787 | 64190 | 102310 | 2.51 | 16140 | 4.81 | 85730 |
| | 45.0 | .673 | 59910 | 87490 | 2.74 | 15660 | 5.05 | 71120 |
| | 40.0 | .560 | 55660 | 72800 | 3.06 | 14980 | 5.43 | 56620 |
| 13 | 37.0 | .492 | 53110 | 63960 | 3.32 | 14420 | 5.76 | 47900 |
| | 35.0 | .447 | 51420 | 58110 | 3.54 | 13960 | 6.06 | 42120 |
| | 31.8 | .375 | 48720 | 48750 | 4.00 | 13000 | 6.75 | 32900 |
| | 40.0 | .755 | 43670 | 90600 | 1.93 | 16250 | 4.39 | 79740 |
| | 35.0 | .632 | 39730 | 75840 | 2.10 | 15710 | 4.64 | 64540 |
| 12 | 30.0 | .510 | 35830 | 61200 | 2.34 | 14920 | 5.04 | 49470 |
| | 25.0 | .387 | 31890 | 46440 | 2.75 | 13630 | 5.81 | 34280 |
| | 20.7 | .280 | 28470 | 33600 | 3.39 | 11570 | 7.37 | 21060 |
| | 35.0 | .820 | 30720 | 82000 | 1.50 | 16890 | 3.42 | 83090 |
| | 30.0 | .673 | 27460 | 67300 | 1.63 | 16430 | 3.59 | 66330 |
| 10 | 25.0 | .526 | 24190 | 52600 | 1.84 | 15710 | 3.87 | 49570 |
| | 20.0 | .379 | 20920 | 37900 | 2.21 | 14430 | 4.43 | 32810 |
| | 15.3 | .240 | 17830 | 24000 | 2.97 | 11790 | 5.98 | 16970 |
| | 25.0 | .612 | 20900 | 55080 | 1.52 | 16450 | 3.22 | 57900 |
| 9 | 20.0 | .448 | 17950 | 40320 | 1.78 | 15520 | 3.55 | 39980 |
| | 15.0 | .285 | 15010 | 25650 | 2.34 | 13530 | 4.40 | 22180 |
| | 13.4 | .230 | 14020 | 20700 | 2.71 | 12220 | 5.11 | 16160 |
| | 21.25 | .579 | 15870 | 46320 | 1.37 | 16610 | 2.82 | 52880 |
| | 18.75 | .487 | 14570 | 38960 | 1.50 | 16160 | 2.95 | 43270 |
| 8 | 16.25 | .395 | 13260 | 31600 | 1.68 | 15490 | 3.16 | 33650 |
| | 13.75 | .303 | 11950 | 24240 | 1.97 | 14430 | 3.55 | 24040 |
| | 11.5 | .220 | 10770 | 17600 | 2.45 | 12700 | 4.30 | 15370 |
| | 19.75 | .629 | 12590 | 44030 | 1.14 | 17070 | 2.35 | 56380 |
| | 17.25 | .524 | 11450 | 36680 | 1.25 | 16690 | 2.44 | 45910 |
| 7 | 14.75 | .419 | 10310 | 29330 | 1.41 | 16110 | 2.60 | 35430 |
| | 12.25 | .314 | 9170 | 21980 | 1.67 | 15140 | 2.87 | 24950 |
| | 9.8 | .210 | 8030 | 14700 | 2.19 | 13220 | 3.54 | 14580 |
| | 15.5 | .559 | 8650 | 33540 | 1.03 | 17140 | 2.00 | 47910 |
| | 13.0 | .437 | 7670 | 26220 | 1.17 | 16620 | 2.11 | 36320 |
| 6 | 10.5 | .314 | 6690 | 18840 | 1.42 | 15690 | 2.32 | 24630 |
| | 8.2 | .200 | 5780 | 12000 | 1.93 | 13800 | 2.85 | 13800 |
| | 11.5 | .472 | 5520 | 23600 | 0.94 | 17170 | 1.66 | 38490 |
| 5 | 9.0 | .325 | 4710 | 16250 | 1.16 | 16340 | 1.81 | 25220 |
| | 6.7 | .190 | 3950 | 9500 | 1.67 | 14440 | 2.21 | 13030 |
| | 7.25 | .320 | 3030 | 12800 | 0.95 | 16840 | 1.38 | 24240 |
| 4 | 6.25 | .247 | 2770 | 9880 | 1.12 | 16200 | 1.47 | 18000 |
| | 5.4 | .180 | 2530 | 7200 | 1.40 | 15150 | 1.64 | 12270 |
| | 6.0 | .356 | 1830 | 10680 | 0.68 | 17540 | 0.96 | 26540 |
| 3 | 5.0 | .258 | 1630 | 7740 | 0.84 | 16990 | 1.02 | 18630 |
| | 4.1 | .170 | 1450 | 5100 | 1.14 | 15950 | 1.13 | 11520 |

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections — 24 Inch | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|
| | 120 lbs. | 115 lbs. | 110 lbs. | 105.9 lbs. | 100 lbs. | 95 lbs. | 90 lbs. | 85 lbs. | 79.9 lbs. | |
| 6 | 383.0 | | | | 358.6<br>351.4 | 329.2 | 299.5 | | | 0.60 |
| 7 | 382.3 | 353.8 | 324.0 | | 301.2 | 292.3 | 283.2 | 270.2 | 240.0 | 0.81 |
| 8 | 334.5 | 326.7 | 318.8 | 300.0 | 263.5 | 255.7 | 247.8 | 240.0 | 231.9 | 1.06 |
| 9 | 297.4 | 290.4 | 283.4 | 277.7 | 234.2 | 227.3 | 220.3 | 213.3 | 206.1 | 1.34 |
| 10 | 267.6 | 261.4 | 255.0 | 249.9 | 210.8 | 204.6 | 198.2 | 192.0 | 185.5 | 1.66 |
| 11 | 243.3 | 237.6 | 231.8 | 227.2 | 191.7 | 186.0 | 180.2 | 174.5 | 168.7 | 2.00 |
| 12 | 223.0 | 217.8 | 212.5 | 208.3 | 175.7 | 170.5 | 165.2 | 160.0 | 154.6 | 2.38 |
| 13 | 205.9 | 201.1 | 196.2 | 192.2 | 162.2 | 157.4 | 152.5 | 147.7 | 142.7 | 2.80 |
| 14 | 191.2 | 186.7 | 182.2 | 178.5 | 150.6 | 146.1 | 141.6 | 137.1 | 132.5 | 3.24 |
| 15 | 178.4 | 174.3 | 170.0 | 166.6 | 140.5 | 136.4 | 132.2 | 128.0 | 123.7 | 3.72 |
| 16 | 167.3 | 163.4 | 159.4 | 156.2 | 131.8 | 127.9 | 123.9 | 120.0 | 116.0 | 4.24 |
| 17 | 157.4 | 153.8 | 150.0 | 147.0 | 124.0 | 120.3 | 116.6 | 112.9 | 109.1 | 4.78 |
| 18 | 148.7 | 145.2 | 141.7 | 138.8 | 117.1 | 113.7 | 110.1 | 106.7 | 103.1 | 5.36 |
| 19 | 140.9 | 137.6 | 134.2 | 131.5 | 111.0 | 107.7 | 104.3 | 101.0 | 97.6 | 5.98 |
| 20 | 133.8 | 130.7 | 127.5 | 125.0 | 105.4 | 102.3 | 99.1 | 96.0 | 92.8 | 6.62 |
| 21 | 127.4 | 124.5 | 121.4 | 119.0 | 100.4 | 97.4 | 94.4 | 91.4 | 88.3 | 7.30 |
| 22 | 121.6 | 118.8 | 115.9 | 113.6 | 95.8 | 93.0 | 90.1 | 87.3 | 84.3 | 8.01 |
| 23 | 116.4 | 113.6 | 110.9 | 108.7 | 91.7 | 88.9 | 86.2 | 83.5 | 80.7 | 8.76 |
| 24 | 111.5 | 108.9 | 106.3 | 104.1 | 87.8 | 85.2 | 82.6 | 80.0 | 77.3 | 9.53 |
| 25 | 107.1 | 104.6 | 102.0 | 100.0 | 84.3 | 81.8 | 79.3 | 76.8 | 74.2 | 10.35 |
| 26 | 102.9 | 100.5 | 98.1 | 96.1 | 81.1 | 78.7 | 76.2 | 73.8 | 71.4 | 11.19 |
| 27 | 99.1 | 96.8 | 94.5 | 92.6 | 78.1 | 75.8 | 73.4 | 71.1 | 68.7 | 12.07 |
| 28 | 95.6 | 93.4 | 91.1 | 89.2 | 75.3 | 73.1 | 70.8 | 68.6 | 66.3 | 12.98 |
| 29 | 92.3 | 90.1 | 87.9 | 86.2 | 72.7 | 70.5 | 68.4 | 66.2 | 64.0 | 13.92 |
| 30 | 89.2 | 87.1 | 85.0 | 83.3 | 70.3 | 68.2 | 66.1 | 64.0 | 61.8 | 14.90 |
| 31 | 86.3 | 84.3 | 82.3 | 80.6 | 68.0 | 66.0 | 63.9 | 61.9 | 59.8 | 15.91 |
| 32 | 83.6 | 81.7 | 79.7 | 78.1 | 65.9 | 63.9 | 62.0 | 60.0 | 58.0 | 16.95 |
| 33 | 81.1 | 79.2 | 77.3 | 75.7 | 63.9 | 62.0 | 60.1 | 58.2 | 56.2 | 18.03 |
| 34 | 78.7 | 76.9 | 75.0 | 73.5 | 62.0 | 60.2 | 58.3 | 56.5 | 54.6 | 19.13 |
| 35 | 76.5 | 74.7 | 72.9 | 71.4 | 60.2 | 58.5 | 56.6 | 54.9 | 53.0 | 20.28 |
| 36 | 74.3 | 72.6 | 70.8 | 69.4 | 58.6 | 56.8 | 55.1 | 53.3 | 51.5 | 21.45 |
| 37 | 72.3 | 70.6 | 68.9 | 67.5 | 57.0 | 55.3 | 53.6 | 51.9 | 50.1 | 22.66 |
| 38 | 70.4 | 68.8 | 67.1 | 65.8 | 55.5 | 53.8 | 52.2 | 50.5 | 48.8 | 23.90 |
| 39 | 68.6 | 67.0 | 65.4 | 64.1 | 54.1 | 52.5 | 50.8 | 49.2 | 47.6 | 25.18 |
| 40 | 66.9 | 65.3 | 63.8 | 62.5 | 52.7 | 51.1 | 49.6 | 48.0 | 46.4 | 26.48 |
| 41 | 65.3 | 63.8 | 62.2 | 61.0 | 51.4 | 49.9 | 48.4 | 46.8 | 45.3 | 27.82 |
| 42 | 63.7 | 62.2 | 60.7 | 59.5 | 50.2 | 48.7 | 47.2 | 45.7 | 44.2 | 29.20 |
| 43 | 62.2 | 60.8 | 59.3 | 58.1 | 49.0 | 47.6 | 46.1 | 44.6 | 43.1 | 30.60 |
| 44 | 60.8 | 59.4 | 58.0 | 56.8 | 47.9 | 46.5 | 45.1 | 43.6 | 42.2 | 32.04 |
| 45 | 59.5 | 58.1 | 56.7 | 55.5 | 46.8 | 45.5 | 44.1 | 42.7 | 41.2 | 33.52 |
| 46 | 58.2 | 56.8 | 55.4 | 54.3 | 45.8 | 44.5 | 43.1 | 41.7 | 40.3 | 35.02 |
| 47 | 56.9 | 55.6 | 54.3 | 53.2 | 44.9 | 43.5 | 42.2 | 40.8 | 39.5 | 36.56 |
| 48 | 55.8 | 54.5 | 53.1 | 52.1 | 43.9 | 42.6 | 41.3 | 40.0 | 38.7 | 38.14 |
| 49 | 54.6 | 53.3 | 52.1 | 51.0 | 43.0 | 41.8 | 40.5 | 39.2 | 37.9 | 39.74 |
| 50 | 53.5 | 52.3 | 51.0 | 50.0 | 42.2 | 40.9 | 39.6 | 38.4 | 37.1 | 41.38 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20 Inch | | | | | | | | 18 Inch | | | | |
| | 100 lbs. | 95 lbs. | 90 lbs. | 85 lbs. | 81.4 lbs. | 75 lbs. | 70 lbs. | 65.4 lbs. | 90 lbs. | 85 lbs. | 80 lbs. | 75.6 lbs. | |
| | 349.2 | 320.0 | 290.4 | | | 256.4 | 226.8 | | 286.6 | 257.0 | | | |
| 6 | 293.0 | 284.4 | 275.6 | 261.2 | 240.0 | 224.6 | 215.9 | 200.0 | 248.2 | 240.3 | 227.5 | 201.6 | 0.60 |
| 7 | 251.2 | 243.8 | 236.2 | 228.8 | 223.4 | 192.5 | 185.0 | 178.2 | 212.7 | 206.0 | 199.2 | 193.3 | 0.81 |
| 8 | 219.8 | 213.3 | 206.7 | 200.2 | 195.5 | 168.5 | 161.9 | 155.9 | 186.1 | 180.2 | 174.3 | 169.2 | 1.06 |
| 9 | 195.4 | 189.6 | 183.7 | 178.0 | 173.8 | 149.7 | 143.9 | 138.6 | 165.5 | 160.2 | 155.0 | 150.4 | 1.34 |
| 10 | 175.8 | 170.6 | 165.4 | 160.2 | 156.4 | 134.8 | 129.5 | 124.7 | 148.9 | 144.2 | 139.5 | 135.3 | 1.66 |
| 11 | 159.8 | 155.1 | 150.3 | 145.6 | 142.2 | 122.5 | 117.7 | 113.4 | 135.4 | 131.1 | 126.8 | 123.0 | 2.00 |
| 12 | 146.5 | 142.2 | 137.8 | 133.5 | 130.3 | 112.3 | 107.9 | 104.0 | 124.1 | 120.2 | 116.2 | 112.8 | 2.38 |
| 13 | 135.2 | 131.2 | 127.2 | 123.2 | 120.3 | 103.7 | 99.6 | 96.0 | 114.5 | 110.9 | 107.3 | 104.1 | 2.80 |
| 14 | 125.6 | 121.9 | 118.1 | 114.4 | 111.7 | 96.3 | 92.5 | 89.1 | 106.4 | 103.0 | 99.6 | 96.7 | 3.24 |
| 15 | 117.2 | 113.8 | 110.2 | 106.8 | 104.3 | 89.9 | 86.3 | 83.2 | 99.3 | 96.1 | 93.0 | 90.2 | 3.72 |
| 16 | 109.9 | 106.6 | 103.4 | 100.1 | 97.8 | 84.2 | 80.9 | 78.0 | 93.1 | 90.1 | 87.2 | 84.6 | 4.24 |
| 17 | 103.4 | 100.4 | 97.3 | 94.2 | 92.0 | 79.3 | 76.2 | 73.4 | 87.6 | 84.8 | 82.0 | 79.6 | 4.78 |
| 18 | 97.7 | 94.8 | 91.9 | 89.0 | 86.9 | 74.9 | 72.0 | 69.3 | 82.7 | 80.1 | 77.5 | 75.2 | 5.36 |
| 19 | 92.5 | 89.8 | 87.0 | 84.3 | 82.3 | 70.9 | 68.2 | 65.7 | 78.4 | 75.9 | 73.4 | 71.2 | 5.98 |
| 20 | 87.9 | 85.3 | 82.7 | 80.1 | 78.2 | 67.4 | 64.8 | 62.4 | 74.5 | 72.1 | 69.7 | 67.7 | 6.62 |
| 21 | 83.7 | 81.3 | 78.7 | 76.3 | 74.5 | 64.2 | 61.7 | 59.4 | 70.9 | 68.7 | 66.4 | 64.4 | 7.30 |
| 22 | 79.9 | 77.6 | 75.2 | 72.8 | 71.1 | 61.3 | 58.9 | 56.7 | 67.7 | 65.5 | 63.4 | 61.5 | 8.01 |
| 23 | 76.4 | 74.2 | 71.9 | 69.6 | 68.0 | 58.6 | 56.3 | 54.2 | 64.7 | 62.7 | 60.6 | 58.8 | 8.76 |
| 24 | 73.3 | 71.1 | 68.9 | 66.7 | 65.2 | 56.2 | 54.0 | 52.0 | 62.1 | 60.1 | 58.1 | 56.4 | 9.53 |
| 25 | 70.3 | 68.3 | 66.2 | 64.1 | 62.6 | 53.9 | 51.8 | 49.9 | 59.6 | 57.7 | 55.8 | 54.1 | 10.35 |
| 26 | 67.6 | 65.6 | 63.6 | 61.6 | 60.2 | 51.8 | 49.8 | 48.0 | 57.3 | 55.5 | 53.6 | 52.0 | 11.19 |
| 27 | 65.1 | 63.2 | 61.2 | 59.3 | 57.9 | 49.9 | 48.0 | 46.2 | 55.2 | 53.4 | 51.6 | 50.1 | 12.07 |
| 28 | 62.8 | 60.9 | 59.1 | 57.2 | 55.9 | 48.1 | 46.3 | 44.6 | 53.2 | 51.5 | 49.8 | 48.3 | 12.98 |
| 29 | 60.6 | 58.8 | 57.0 | 55.2 | 53.9 | 46.5 | 44.7 | 43.0 | 51.4 | 49.7 | 48.1 | 46.7 | 13.92 |
| 30 | 58.6 | 56.9 | 55.1 | 53.4 | 52.1 | 44.9 | 43.2 | 41.6 | 49.6 | 48.1 | 46.5 | 45.1 | 14.90 |
| 31 | 56.7 | 55.0 | 53.4 | 51.7 | 50.5 | 43.5 | 41.8 | 40.2 | 48.0 | 46.5 | 45.0 | 43.7 | 15.91 |
| 32 | 54.9 | 53.3 | 51.7 | 50.1 | 48.9 | 42.1 | 40.5 | 39.0 | 46.5 | 45.1 | 43.6 | 42.3 | 16.95 |
| 33 | 53.3 | 51.7 | 50.1 | 48.5 | 47.4 | 40.8 | 39.2 | 37.8 | 45.1 | 43.7 | 42.3 | 41.0 | 18.03 |
| 34 | 51.7 | 50.2 | 48.6 | 47.1 | 46.0 | 39.6 | 38.1 | 36.7 | 43.8 | 42.4 | 41.0 | 39.8 | 19.13 |
| 35 | 50.2 | 48.8 | 47.2 | 45.8 | 44.7 | 38.5 | 37.0 | 35.6 | 42.5 | 41.2 | 39.9 | 38.7 | 20.28 |
| 36 | 48.8 | 47.4 | 45.9 | 44.5 | 43.4 | 37.4 | 36.0 | 34.7 | 41.4 | 40.0 | 38.7 | 37.6 | 21.45 |
| 37 | 47.5 | 46.1 | 44.7 | 43.3 | 42.3 | 36.4 | 35.0 | 33.7 | 40.2 | 39.0 | 37.7 | 36.6 | 22.66 |
| 38 | 46.3 | 44.9 | 43.5 | 42.1 | 41.2 | 35.5 | 34.1 | 32.8 | 39.2 | 37.9 | 36.7 | 35.6 | 23.90 |
| 39 | 45.1 | 43.8 | 42.4 | 41.1 | 40.1 | 34.6 | 33.2 | 32.0 | | | | | 25.18 |
| 40 | 44.0 | 42.7 | 41.3 | 40.0 | 39.1 | 33.7 | 32.4 | 31.2 | | | | | 26.48 |
| 41 | 42.9 | 41.6 | 40.3 | 39.1 | 38.1 | 32.9 | 31.6 | 30.4 | | | | | 27.82 |
| 42 | 41.9 | 40.6 | 39.4 | 38.1 | 37.2 | 32.1 | 30.8 | 29.7 | | | | | 29.20 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistance

## BEAMS

### Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 18 Inch | | | | 15 Inch | | | | | | | | |
| | 70 lbs. | 65 lbs. | 60 lbs. | 54.7 lbs. | 75 lbs. | 70 lbs. | 65 lbs. | 60.8 lbs. | 55 lbs. | 50 lbs. | 45 lbs. | 42.9 lbs. | |
| | | | | | 260.4 | | | | 194.4 | | | | |
| 4 | 256.0 | 226.4 | | | 244.3 | 231.0 | 201.6 | 177.0 | 180.9 | 165.0 | 135.6 | | 0.27 |
| 5 | 217.5 | 208.0 | | | 195.5 | 187.6 | 179.8 | 173.2 | 144.7 | 136.9 | 129.0 | | 0.41 |
| | | | 196.9 | 165.6 | | | | | | | | 123.0 | |
| 6 | 181.2 | 173.4 | 165.5 | 157.1 | 162.9 | 156.4 | 149.8 | 144.4 | 120.6 | 114.0 | 107.5 | 104.7 | 0.60 |
| 7 | 155.3 | 148.6 | 141.9 | 134.7 | 139.8 | 134.0 | 128.4 | 123.7 | 103.4 | 97.8 | 92.1 | 89.7 | 0.81 |
| 8 | 135.9 | 130.0 | 124.1 | 117.9 | 122.2 | 117.3 | 112.4 | 108.3 | 90.4 | 85.5 | 80.6 | 78.5 | 1.06 |
| 9 | 120.8 | 115.6 | 110.3 | 104.8 | 108.6 | 104.2 | 99.9 | 96.2 | 80.4 | 76.0 | 71.7 | 69.8 | 1.34 |
| 10 | 108.7 | 104.0 | 99.3 | 94.3 | 97.7 | 93.8 | 89.9 | 86.6 | 72.3 | 68.4 | 64.5 | 62.8 | 1.66 |
| 11 | 98.9 | 94.6 | 90.3 | 85.7 | 88.9 | 85.3 | 81.7 | 78.7 | 65.8 | 62.2 | 58.6 | 57.1 | 2.00 |
| 12 | 90.6 | 86.7 | 82.7 | 78.6 | 81.5 | 78.2 | 74.9 | 72.2 | 60.3 | 57.0 | 53.7 | 52.4 | 2.38 |
| 13 | 83.7 | 80.0 | 76.4 | 72.5 | 75.2 | 72.2 | 69.1 | 66.6 | 55.6 | 52.6 | 49.6 | 48.3 | 2.80 |
| 14 | 77.7 | 74.3 | 70.9 | 67.3 | 69.8 | 67.0 | 64.2 | 61.9 | 51.7 | 48.9 | 46.1 | 44.9 | 3.24 |
| 15 | 72.5 | 69.4 | 66.2 | 62.9 | 65.2 | 62.5 | 59.9 | 57.7 | 48.2 | 45.6 | 43.0 | 41.9 | 3.72 |
| 16 | 68.0 | 65.0 | 62.1 | 58.9 | 61.1 | 58.6 | 56.2 | 54.1 | 45.2 | 42.8 | 40.3 | 39.3 | 4.24 |
| 17 | 64.0 | 61.2 | 58.4 | 55.5 | 57.5 | 55.2 | 52.9 | 50.9 | 42.6 | 40.3 | 37.9 | 37.0 | 4.78 |
| 18 | 60.4 | 57.8 | 55.2 | 52.4 | 54.3 | 52.1 | 49.9 | 48.1 | 40.2 | 38.0 | 35.8 | 34.9 | 5.36 |
| 19 | 57.2 | 54.8 | 52.3 | 49.6 | 51.4 | 49.4 | 47.3 | 45.6 | 38.1 | 36.0 | 33.9 | 33.1 | 5.98 |
| 20 | 54.4 | 52.0 | 49.7 | 47.1 | 48.9 | 46.9 | 44.9 | 43.3 | 36.2 | 34.2 | 32.2 | 31.4 | 6.62 |
| 21 | 51.8 | 49.5 | 47.3 | 44.9 | 46.5 | 44.7 | 42.8 | 41.2 | 34.5 | 32.6 | 30.7 | 29.9 | 7.30 |
| 22 | 49.4 | 47.3 | 45.1 | 42.9 | 44.4 | 42.6 | 40.9 | 39.4 | 32.9 | 31.1 | 29.3 | 28.6 | 8.01 |
| 23 | 47.3 | 45.2 | 43.2 | 41.0 | 42.5 | 40.8 | 39.1 | 37.7 | 31.5 | 29.8 | 28.0 | 27.3 | 8.76 |
| 24 | 45.3 | 43.3 | 41.4 | 39.3 | 40.7 | 39.1 | 37.5 | 36.1 | 30.1 | 28.5 | 26.9 | 26.2 | 9.53 |
| 25 | 43.5 | 41.6 | 39.7 | 37.7 | 39.1 | 37.5 | 36.0 | 34.6 | 28.9 | 27.4 | 25.8 | 25.1 | 10.35 |
| 26 | 41.8 | 40.0 | 38.2 | 36.3 | 37.6 | 36.1 | 34.6 | 33.3 | 27.8 | 26.3 | 24.8 | 24.2 | 11.19 |
| 27 | 40.3 | 38.5 | 36.8 | 34.9 | 36.2 | 34.7 | 33.3 | 32.1 | 26.8 | 25.3 | 23.9 | 23.3 | 12.07 |
| 28 | 38.8 | 37.1 | 35.5 | 33.7 | 34.9 | 33.5 | 32.1 | 30.9 | 25.8 | 24.4 | 23.0 | 22.4 | 12.98 |
| 29 | 37.5 | 35.9 | 34.2 | 32.5 | 33.7 | 32.3 | 31.0 | 29.9 | 24.9 | 23.6 | 22.2 | 21.7 | 13.92 |
| 30 | 36.2 | 34.7 | 33.1 | 31.4 | 32.6 | 31.3 | 30.0 | 28.9 | 24.1 | 22.8 | 21.5 | 20.9 | 14.90 |
| 31 | 35.1 | 33.6 | 32.0 | 30.4 | 31.5 | 30.3 | 29.0 | 27.9 | 23.3 | 22.1 | 20.8 | 20.3 | 15.91 |
| 32 | 34.0 | 32.5 | 31.0 | 29.5 | 30.5 | 29.3 | 28.1 | 27.1 | 22.6 | 21.4 | 20.2 | 19.6 | 16.95 |
| 33 | 33.0 | 31.5 | 30.1 | 28.6 | | | | | | | | | 18.03 |
| 34 | 32.0 | 30.6 | 29.2 | 27.7 | | | | | | | | | 19.13 |
| 35 | 31.1 | 29.7 | 28.4 | 26.9 | | | | | | | | | 20.28 |
| 36 | 30.2 | 28.9 | 27.6 | 26.2 | | | | | | | | | 21.45 |
| 37 | 29.4 | 28.1 | 26.8 | 25.5 | | | | | | | | | 22.66 |
| 38 | 28.6 | 27.4 | 26.1 | 24.8 | | | | | | | | | 23.90 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | Coefficient of Deflection. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 Inch | | | | | | 10 Inch | | | | |
| | 55 lbs. | 50 lbs. | 45 lbs. | 40.8 lbs. | 35 lbs. | 31.8 lbs. | 40 lbs. | 35 lbs. | 30 lbs. | 25.4 lbs. | |
| | 194.4 | | | | | | 148.2 | 118.8 | | | |
| 3 | 189.2 | 164.9 | 135.6 | | 102.7 | | 112.4 | 103.7 | 89.4 | | 0.15 |
| 4 | 141.9 | 134.1 | 126.3 | 110.4 | 100.9 | 84.0 | 84.3 | 77.7 | 71.2 | 62.0 | 0.27 |
| 5 | 113.5 | 107.2 | 101.0 | 95.6 | 80.7 | 76.7 | 67.4 | 62.2 | 57.0 | 52.1 | 0.41 |
| 6 | 94.6 | 89.4 | 84.2 | 79.7 | 67.3 | 63.9 | 56.2 | 51.8 | 47.5 | 43.4 | 0.60 |
| 7 | 81.1 | 76.6 | 72.1 | 68.3 | 57.6 | 54.8 | 48.2 | 44.4 | 40.7 | 37.2 | 0.81 |
| 8 | 71.0 | 67.0 | 63.1 | 59.8 | 50.5 | 48.0 | 42.1 | 38.9 | 35.6 | 32.6 | 1.06 |
| 9 | 63.1 | 59.6 | 56.1 | 53.1 | 44.9 | 42.6 | 37.5 | 34.6 | 31.6 | 28.9 | 1.34 |
| 10 | 56.8 | 53.6 | 50.5 | 47.8 | 40.4 | 38.4 | 33.7 | 31.1 | 28.5 | 26.0 | 1.66 |
| 11 | 51.6 | 48.7 | 45.9 | 43.5 | 36.7 | 34.9 | 30.6 | 28.3 | 25.9 | 23.7 | 2.00 |
| 12 | 47.3 | 44.7 | 42.1 | 39.8 | 33.6 | 32.0 | 28.1 | 25.9 | 23.7 | 21.7 | 2.38 |
| 13 | 43.7 | 41.2 | 38.8 | 36.8 | 31.0 | 29.5 | 25.9 | 23.9 | 21.9 | 20.0 | 2.80 |
| 14 | 40.6 | 38.3 | 36.1 | 34.2 | 28.8 | 27.4 | 24.1 | 22.2 | 20.3 | 18.6 | 3.24 |
| 15 | 37.8 | 35.7 | 33.7 | 31.9 | 26.9 | 25.6 | 22.5 | 20.7 | 19.0 | 17.4 | 3.72 |
| 16 | 35.5 | 33.5 | 31.6 | 29.9 | 25.2 | 24.0 | 21.1 | 19.4 | 17.8 | 16.3 | 4.24 |
| 17 | 33.4 | 31.5 | 29.7 | 28.1 | 23.7 | 22.6 | 19.8 | 18.3 | 16.8 | 15.3 | 4.78 |
| 18 | 31.5 | 29.8 | 28.1 | 26.6 | 22.4 | 21.3 | 18.7 | 17.3 | 15.8 | 14.5 | 5.36 |
| 19 | 29.9 | 28.2 | 26.6 | 25.2 | 21.2 | 20.2 | 17.7 | 16.4 | 15.0 | 13.7 | 5.98 |
| 20 | 28.4 | 26.8 | 25.3 | 23.9 | 20.2 | 19.2 | 16.9 | 15.5 | 14.2 | 13.0 | 6.62 |
| 21 | 27.0 | 25.5 | 24.0 | 22.8 | 19.2 | 18.3 | 16.1 | 14.8 | 13.6 | 12.4 | 7.30 |
| 22 | 25.8 | 24.4 | 23.0 | 21.7 | 18.3 | 17.4 | 15.3 | 14.1 | 12.9 | 11.8 | 8.01 |
| 23 | 24.7 | 23.3 | 22.0 | 20.8 | 17.5 | 16.7 | | | | | 8.76 |
| 24 | 23.7 | 22.3 | 21.0 | 19.9 | 16.8 | 16.0 | | | | | 9.53 |
| 25 | 22.7 | 21.4 | 20.2 | 19.1 | 16.1 | 15.3 | | | | | 10.35 |
| 26 | 21.8 | 20.6 | 19.4 | 18.4 | 15.5 | 14.8 | | | | | 11.19 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# BEAMS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

**Maximum Bending Stress, 16,000 Pounds per Square Inch**

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 Inch | | | | 8 Inch | | | | 7 Inch | | | |
| | 35 lbs. | 30 lbs. | 25 lbs. | 21.8 lbs. | 25.5 lbs. | 23 lbs. | 20.5 lbs. | 18.4 lbs. | 20 lbs. | 17.5 lbs. | 15.3 lbs. | |
| | 130.3 | 101.0 | | | 85.1 | 70.6 | 55.8 | | 63.0 | 48.3 | | |
| 3 | 87.9 | 80.1 | 71.5 | 52.2 | 60.5 | 57.0 | 53.5 | 43.2 | 42.6 | 39.6 | 35.0 | 0.15 |
| 4 | 66.0 | 60.1 | 54.2 | 50.3 | 45.4 | 42.8 | 40.2 | 37.9 | 32.0 | 29.7 | 27.6 | 0.27 |
| 5 | 52.8 | 48.1 | 43.3 | 40.3 | 36.3 | 34.2 | 32.1 | 30.3 | 25.6 | 23.7 | 22.1 | 0.41 |
| 6 | 44.0 | 40.1 | 36.1 | 33.6 | 30.2 | 28.5 | 26.8 | 25.3 | 21.3 | 19.8 | 18.4 | 0.60 |
| 7 | 37.7 | 34.3 | 31.0 | 28.8 | 25.9 | 24.4 | 22.9 | 21.7 | 18.3 | 17.0 | 15.8 | 0.81 |
| 8 | 33.0 | 30.0 | 27.1 | 25.2 | 22.7 | 21.4 | 20.1 | 19.0 | 16.0 | 14.8 | 13.8 | 1.06 |
| 9 | 29.3 | 26.7 | 24.1 | 22.4 | 20.2 | 19.0 | 17.9 | 16.9 | 14.2 | 13.2 | 12.3 | 1.34 |
| 10 | 26.4 | 24.0 | 21.7 | 20.1 | 18.1 | 17.1 | 16.1 | 15.2 | 12.8 | 11.9 | 11.0 | 1.66 |
| 11 | 24.0 | 21.8 | 19.7 | 18.3 | 16.5 | 15.6 | 14.6 | 13.8 | 11.6 | 10.8 | 10.0 | 2.00 |
| 12 | 22.0 | 20.0 | 18.1 | 16.8 | 15.1 | 14.3 | 13.4 | 12.6 | 10.7 | 9.9 | 9.2 | 2.38 |
| 13 | 20.3 | 18.5 | 16.7 | 15.5 | 14.0 | 13.2 | 12.4 | 11.7 | 9.8 | 9.1 | 8.5 | 2.80 |
| 14 | 18.8 | 17.2 | 15.5 | 14.4 | 13.0 | 12.2 | 11.5 | 10.8 | 9.1 | 8.5 | 7.9 | 3.24 |
| 15 | 17.6 | 16.0 | 14.4 | 13.4 | 12.1 | 11.4 | 10.7 | 10.1 | 8.5 | 7.9 | 7.4 | 3.72 |
| 16 | 16.5 | 15.0 | 13.5 | 12.6 | 11.3 | 10.7 | 10.0 | 9.5 | 8.0 | 7.4 | 6.9 | 4.24 |
| 17 | 15.5 | 14.1 | 12.7 | 11.8 | 10.7 | 10.1 | 9.5 | 8.9 | | | | 4.78 |
| 18 | 14.7 | 13.3 | 12.0 | 11.2 | 10.1 | 9.5 | 8.9 | 8.4 | | | | 5.36 |
| 19 | 13.9 | 12.6 | 11.4 | 10.6 | | | | | | | | 5.98 |
| 20 | 13.2 | 12.0 | 10.8 | 10.1 | | | | | | | | 6.62 |

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 Inch | | | 5 Inch | | | 4 Inch | | | | 3 Inch | | |
| | 17.25 lbs. | 14.75 lbs. | 12.5 lbs. | 14.75 lbs. | 12.25 lbs. | 10 lbs. | 10.5 lbs. | 9.5 lbs. | 8.5 lbs. | 7.7 lbs. | 7.5 lbs. | 6.5 lbs. | 5.7 lbs. | |
| | | | | | | | | | | | 20.9 | | | |
| 1 | 55.8 | | | 49.4 | 34.7 | | 32.0 | 26.1 | 20.2 | | 20.5 | 15.1 | 10.2 | 0.02 |
| 2 | 46.3 | 41.2 | 27.6 | 32.1 | 28.8 | 21.0 | 18.9 | 17.8 | 16.8 | 15.2 | 10.3 | 9.5 | 8.8 | 0.07 |
| 3 | 30.8 | 28.2 | 25.8 | 21.4 | 19.2 | 17.2 | 12.6 | 11.9 | 11.2 | 10.6 | 6.8 | 6.3 | 5.9 | 0.15 |
| 4 | 23.1 | 21.2 | 19.4 | 16.1 | 14.4 | 12.9 | 9.4 | 8.9 | 8.4 | 8.0 | 5.1 | 4.7 | 4.4 | 0.27 |
| 5 | 18.5 | 16.9 | 15.5 | 12.8 | 11.5 | 10.3 | 7.6 | 7.1 | 6.7 | 6.4 | 4.1 | 3.8 | 3.5 | 0.41 |
| 6 | 15.4 | 14.1 | 12.9 | 10.7 | 9.6 | 8.6 | 6.3 | 5.9 | 5.6 | 5.3 | 3.4 | 3.2 | 2.9 | 0.60 |
| 7 | 13.2 | 12.1 | 11.1 | 9.2 | 8.2 | 7.4 | 5.4 | 5.1 | 4.8 | 4.5 | 2.9 | 2.7 | 2.5 | 0.81 |
| 8 | 11.6 | 10.6 | 9.7 | 8.0 | 7.2 | 6.4 | 4.7 | 4.5 | 4.2 | 4.0 | 2.6 | 2.4 | 2.2 | 1.06 |
| 9 | 10.3 | 9.4 | 8.6 | 7.1 | 6.4 | 5.7 | 4.2 | 4.0 | 3.7 | 3.5 | | | | 1.34 |
| 10 | 9.3 | 8.5 | 7.7 | 6.4 | 5.8 | 5.2 | 3.8 | 3.6 | 3.4 | 3.2 | | | | 1.66 |
| 11 | 8.4 | 7.7 | 7.0 | 5.8 | 5.2 | 4.7 | | | | | | | | 2.00 |
| 12 | 7.7 | 7.1 | 6.5 | 5.4 | 4.8 | 4.3 | | | | | | | | 2.38 |
| 13 | 7.1 | 6.5 | 6.0 | | | | | | | | | | | 2.80 |
| 14 | 6.6 | 6.1 | 5.5 | | | | | | | | | | | 3.24 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# CHANNELS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 Inch | | | | | | 13 Inch | | | | | | |
| | 55 lbs. | 50 lbs. | 45 lbs. | 40 lbs. | 35 lbs. | 33.9 lbs. | 50 lbs. | 45 lbs. | 40 lbs. | 37 lbs. | 35 lbs. | 31.8 lbs. | |
| | 244.2 | 214.8 | 185.4 | | | | 204.6 | 175.0 | | | | | |
| 3 | 203.4 | 190.4 | 177.2 | 156.0 | 126.6 | 120.0 | 171.2 | 159.8 | 145.6 | 127.9 | 116.2 | 97.5 | 0.15 |
| 4 | 152.5 | 142.8 | 132.9 | 123.1 | 113.3 | 111.1 | 128.4 | 119.8 | 111.3 | 106.2 | 102.8 | 97.4 | 0.27 |
| 5 | 122.0 | 114.3 | 106.3 | 98.5 | 90.7 | 88.9 | 102.7 | 95.9 | 89.1 | 85.0 | 82.3 | 77.9 | 0.41 |
| 6 | 101.7 | 95.2 | 88.6 | 82.1 | 75.6 | 74.1 | 85.6 | 79.9 | 74.2 | 70.8 | 68.6 | 65.0 | 0.60 |
| 7 | 87.1 | 81.6 | 76.0 | 70.6 | 64.8 | 63.5 | 73.3 | 68.5 | 63.6 | 60.7 | 58.8 | 55.7 | 0.81 |
| 8 | 76.3 | 71.4 | 66.5 | 61.6 | 56.7 | 55.6 | 64.2 | 59.9 | 55.7 | 53.1 | 51.4 | 48.7 | 1.06 |
| 9 | 67.8 | 63.5 | 59.1 | 54.7 | 50.4 | 49.4 | 57.1 | 53.2 | 49.5 | 47.2 | 45.7 | 43.3 | 1.34 |
| 10 | 61.0 | 57.1 | 53.2 | 49.3 | 45.3 | 44.5 | 51.3 | 47.9 | 44.5 | 42.5 | 41.1 | 39.0 | 1.66 |
| 11 | 55.5 | 51.9 | 48.3 | 44.8 | 41.2 | 40.4 | 46.7 | 43.6 | 40.5 | 38.6 | 37.4 | 35.4 | 2.00 |
| 12 | 50.8 | 47.6 | 44.3 | 41.1 | 37.8 | 37.0 | 42.8 | 39.9 | 37.1 | 35.4 | 34.3 | 32.5 | 2.38 |
| 13 | 46.9 | 44.0 | 40.9 | 37.9 | 34.9 | 34.2 | 39.5 | 36.9 | 34.3 | 32.7 | 31.6 | 30.0 | 2.80 |
| 14 | 43.6 | 40.8 | 38.0 | 35.2 | 32.4 | 31.8 | 36.7 | 34.2 | 31.8 | 30.3 | 29.4 | 27.8 | 3.24 |
| 15 | 40.7 | 38.1 | 35.5 | 32.8 | 30.2 | 29.6 | 34.2 | 31.9 | 29.7 | 28.3 | 27.4 | 26.0 | 3.72 |
| 16 | 38.1 | 35.7 | 33.2 | 30.8 | 28.3 | 27.8 | 32.1 | 30.0 | 27.8 | 26.6 | 25.7 | 24.4 | 4.24 |
| 17 | 35.9 | 33.6 | 31.3 | 29.0 | 26.7 | 26.1 | 30.2 | 28.2 | 26.2 | 25.0 | 24.2 | 22.9 | 4.78 |
| 18 | 33.9 | 31.7 | 29.5 | 27.4 | 25.2 | 24.7 | 28.5 | 26.6 | 24.7 | 23.6 | 22.9 | 21.7 | 5.36 |
| 19 | 32.1 | 30.1 | 28.0 | 25.9 | 23.9 | 23.4 | 27.0 | 25.2 | 23.4 | 22.4 | 21.6 | 20.5 | 5.98 |
| 20 | 30.5 | 28.6 | 26.6 | 24.6 | 22.7 | 22.2 | 25.7 | 24.0 | 22.3 | 21.2 | 20.6 | 19.5 | 6.62 |
| 21 | 29.1 | 27.2 | 25.3 | 23.5 | 21.6 | 21.2 | 24.5 | 22.8 | 21.2 | 20.2 | 19.6 | 18.6 | 7.30 |
| 22 | 27.7 | 26.0 | 24.2 | 22.4 | 20.6 | 20.2 | 23.3 | 21.8 | 20.2 | 19.3 | 18.7 | 17.7 | 8.01 |
| 23 | 26.5 | 24.8 | 23.1 | 21.4 | 19.7 | 19.3 | 22.3 | 20.8 | 19.4 | 18.5 | 17.9 | 16.9 | 8.76 |
| 24 | 25.4 | 23.8 | 22.2 | 20.5 | 18.9 | 18.5 | 21.4 | 20.0 | 18.6 | 17.7 | 17.1 | 16.2 | 9.53 |
| 25 | 24.4 | 22.9 | 21.3 | 19.7 | 18.1 | 17.8 | 20.5 | 19.2 | 17.8 | 17.0 | 16.5 | 15.6 | 10.35 |
| 26 | 23.5 | 22.0 | 20.5 | 18.9 | 17.4 | 17.1 | 19.8 | 18.4 | 17.1 | 16.3 | 15.8 | 15.0 | 11.19 |
| 27 | 22.6 | 21.2 | 19.7 | 18.2 | 16.8 | 16.5 | 19.0 | 17.7 | 16.5 | 15.7 | 15.2 | 14.4 | 12.07 |
| 28 | 21.8 | 20.4 | 19.0 | 17.6 | 16.2 | 15.9 | 18.3 | 17.1 | 15.9 | 15.2 | 14.7 | 13.9 | 12.98 |
| 29 | 21.0 | 19.7 | 18.3 | 17.0 | 15.6 | 15.3 | | | | | | | 13.92 |
| 30 | 20.3 | 19.0 | 17.7 | 16.4 | 15.1 | 14.8 | | | | | | | 14.90 |
| 31 | 19.7 | 18.4 | 17.2 | 15.9 | 14.6 | 14.3 | | | | | | | 15.91 |
| 32 | 19.1 | 17.9 | 16.6 | 15.4 | 14.2 | 13.9 | | | | | | | 16.95 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# CHANNELS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 Inch | | | | | 10 Inch | | | | | |
| | 40 lbs. | 35 lbs. | 30 lbs. | 25 lbs. | 20.7 lbs. | 35 lbs. | 30 lbs. | 25 lbs. | 20 lbs. | 15.3 lbs. | |
| | 181.2 | | | | | 164.0 | 134.6 | 105.2 | | | |
| 2 | 174.7 | 151.7 | 122.4 | 92.9 | | 122.9 | 109.8 | 96.8 | 75.8 | 48.0 | 0.07 |
| 3 | 116.4 | 105.9 | 95.5 | 85.0 | 67.2 | 81.9 | 73.2 | 64.5 | 55.8 | 47.6 | 0.15 |
| 4 | 87.3 | 79.5 | 71.7 | 63.8 | 56.9 | 61.4 | 54.9 | 48.4 | 41.8 | 35.7 | 0.27 |
| 5 | 69.9 | 63.6 | 57.3 | 51.0 | 45.5 | 49.2 | 43.9 | 38.7 | 33.5 | 28.5 | 0.41 |
| 6 | 58.2 | 53.0 | 47.8 | 42.5 | 38.0 | 41.0 | 36.6 | 32.3 | 27.9 | 23.8 | 0.60 |
| 7 | 49.9 | 45.4 | 40.9 | 36.4 | 32.5 | 35.1 | 31.4 | 27.6 | 23.9 | 20.4 | 0.81 |
| 8 | 43.7 | 39.7 | 35.8 | 31.9 | 28.5 | 30.7 | 27.5 | 24.2 | 20.9 | 17.8 | 1.06 |
| 9 | 38.8 | 35.3 | 31.8 | 28.3 | 25.3 | 27.3 | 24.4 | 21.5 | 18.6 | 15.9 | 1.34 |
| 10 | 34.9 | 31.8 | 28.7 | 25.5 | 22.8 | 24.6 | 22.0 | 19.4 | 16.7 | 14.3 | 1.66 |
| 11 | 31.8 | 28.9 | 26.1 | 23.2 | 20.7 | 22.3 | 20.0 | 17.6 | 15.2 | 13.0 | 2.00 |
| 12 | 29.1 | 26.5 | 23.9 | 21.3 | 19.0 | 20.5 | 18.3 | 16.1 | 13.9 | 11.9 | 2.38 |
| 13 | 26.9 | 24.5 | 22.0 | 19.6 | 17.5 | 18.9 | 16.9 | 14.9 | 12.9 | 11.0 | 2.80 |
| 14 | 25.0 | 22.7 | 20.5 | 18.2 | 16.3 | 17.6 | 15.7 | 13.8 | 12.0 | 10.2 | 3.24 |
| 15 | 23.3 | 21.2 | 19.1 | 17.0 | 15.2 | 16.4 | 14.6 | 12.9 | 11.2 | 9.5 | 3.72 |
| 16 | 21.8 | 19.9 | 17.9 | 15.9 | 14.2 | 15.4 | 13.7 | 12.1 | 10.5 | 8.9 | 4.24 |
| 17 | 20.6 | 18.7 | 16.9 | 15.0 | 13.4 | 14.5 | 12.9 | 11.4 | 9.8 | 8.4 | 4.78 |
| 18 | 19.4 | 17.7 | 15.9 | 14.2 | 12.7 | 13.7 | 12.2 | 10.7 | 9.3 | 7.9 | 5.36 |
| 19 | 18.4 | 16.7 | 15.1 | 13.4 | 12.0 | 12.9 | 11.6 | 10.2 | 8.8 | 7.5 | 5.98 |
| 20 | 17.5 | 15.9 | 14.3 | 12.8 | 11.4 | 12.3 | 11.0 | 9.7 | 8.4 | 7.1 | 6.62 |
| 21 | 16.6 | 15.1 | 13.6 | 12.1 | 10.8 | 11.7 | 10.5 | 9.2 | 8.0 | 6.8 | 7.30 |
| 22 | 15.9 | 14.4 | 13.0 | 11.6 | 10.4 | 11.2 | 10.0 | 8.8 | 7.6 | 6.5 | 8.01 |
| 23 | 15.2 | 13.8 | 12.5 | 11.1 | 9.9 | | | | | | 8.76 |
| 24 | 14.6 | 13.2 | 11.9 | 10.6 | 9.5 | | | | | | 9.53 |
| 25 | 14.0 | 12.7 | 11.5 | 10.2 | 9.1 | | | | | | 10.35 |
| 26 | 13.4 | 12.2 | 11.0 | 9.8 | 8.8 | | | | | | 11.19 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

# CHANNELS

## Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection.
For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 Inch | | | | 8 Inch | | | | | 7 Inch | | | | |
| | 25 lbs. | 20 lbs. | 15 lbs. | 13.4 lbs. | 21.25 lbs. | 18.75 lbs. | 16.25 lbs. | 13.75 lbs. | 11.5 lbs. | 19.75 lbs. | 17.25 lbs. | 14.75 lbs. | 12.25 lbs. | 9.8 lbs. | |
| | 110.2 | 80.6 | | | 92.6 | 77.9 | 63.2 | 48.5 | | 88.1 | 73.4 | 58.7 | 44.0 | | |
| 2 | 83.6 | 71.8 | 51.3 | 41.4 | 63.5 | 58.3 | 53.0 | 47.8 | 35.2 | 50.4 | 45.8 | 41.2 | 36.7 | 29.4 | 0.07 |
| 3 | 55.7 | 47.8 | 40.0 | 37.4 | 42.3 | 38.8 | 35.3 | 31.9 | 28.7 | 33.6 | 30.5 | 27.5 | 24.4 | 21.4 | 0.15 |
| 4 | 41.8 | 35.9 | 30.0 | 28.0 | 31.7 | 29.1 | 26.5 | 23.9 | 21.5 | 25.2 | 22.9 | 20.6 | 18.3 | 16.1 | 0.27 |
| 5 | 33.4 | 28.7 | 24.0 | 22.4 | 25.4 | 23.3 | 21.2 | 19.1 | 17.2 | 20.2 | 18.3 | 16.5 | 14.7 | 12.9 | 0.41 |
| 6 | 27.9 | 23.9 | 20.0 | 18.7 | 21.2 | 19.4 | 17.7 | 15.9 | 14.4 | 16.8 | 15.3 | 13.7 | 12.2 | 10.7 | 0.60 |
| 7 | 23.9 | 20.5 | 17.2 | 16.0 | 18.1 | 16.6 | 15.1 | 13.7 | 12.3 | 14.4 | 13.1 | 11.8 | 10.5 | 9.2 | 0.81 |
| 8 | 20.9 | 17.9 | 15.0 | 14.0 | 15.9 | 14.6 | 13.3 | 11.9 | 10.8 | 12.6 | 11.4 | 10.3 | 9.2 | 8.0 | 1.06 |
| 9 | 18.6 | 16.0 | 13.3 | 12.5 | 14.1 | 12.9 | 11.8 | 10.6 | 9.6 | 11.2 | 10.2 | 9.2 | 8.2 | 7.1 | 1.34 |
| 10 | 16.7 | 14.4 | 12.0 | 11.2 | 12.7 | 11.7 | 10.6 | 9.6 | 8.6 | 10.1 | 9.2 | 8.2 | 7.3 | 6.4 | 1.66 |
| 11 | 15.2 | 13.1 | 10.9 | 10.2 | 11.5 | 10.6 | 9.6 | 8.7 | 7.8 | 9.2 | 8.3 | 7.5 | 6.7 | 5.8 | 2.00 |
| 12 | 13.9 | 12.0 | 10.0 | 9.3 | 10.6 | 9.7 | 8.8 | 8.0 | 7.2 | 8.4 | 7.6 | 6.9 | 6.1 | 5.4 | 2.38 |
| 13 | 12.9 | 11.0 | 9.2 | 8.6 | 9.8 | 9.0 | 8.2 | 7.4 | 6.6 | 7.8 | 7.0 | 6.3 | 5.6 | 4.9 | 2.80 |
| 14 | 11.9 | 10.3 | 8.6 | 8.0 | 9.1 | 8.3 | 7.6 | 6.8 | 6.2 | 7.2 | 6.5 | 5.9 | 5.2 | 4.6 | 3.24 |
| 15 | 11.1 | 9.6 | 8.0 | 7.5 | 8.5 | 7.8 | 7.1 | 6.4 | 5.7 | 6.7 | 6.1 | 5.5 | 4.9 | 4.3 | 3.72 |
| 16 | 10.4 | 9.0 | 7.5 | 7.0 | 7.9 | 7.3 | 6.6 | 6.0 | 5.4 | 6.3 | 5.7 | 5.2 | 4.6 | 4.0 | 4.24 |
| 17 | 9.8 | 8.4 | 7.1 | 6.6 | 7.5 | 6.9 | 6.2 | 5.6 | 5.1 | | | | | | 4.78 |
| 18 | 9.3 | 8.0 | 6.7 | 6.2 | 7.1 | 6.5 | 5.9 | 5.3 | 4.8 | | | | | | 5.36 |
| 19 | 8.8 | 7.6 | 6.3 | 5.9 | | | | | | | | | | | 5.98 |
| 20 | 8.4 | 7.2 | 6.0 | 5.6 | | | | | | | | | | | 6.62 |

| Span in Feet | Depth and Weight of Sections | | | | | | | | | | | | | Coefficient of Deflection |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 Inch | | | | 5 Inch | | | 4 Inch | | | 3 Inch | | | |
| | 15.5 lbs. | 13 lbs. | 10.5 lbs. | 8.2 lbs. | 11.5 lbs. | 9 lbs. | 6.7 lbs. | 7.25 lbs. | 6.25 lbs. | 5.4 lbs. | 6 lbs. | 5 lbs. | 4.1 lbs. | |
| | | | | | 47.2 | | | 25.6 | | | 21.4 | 15.5 | | |
| 1 | 67.1 | 52.4 | 37.7 | 24.0 | 44.2 | 32.6 | 19.0 | 24.3 | 19.8 | 14.4 | 14.7 | 13.0 | 10.2 | 0.02 |
| 2 | 34.6 | 30.7 | 26.8 | 23.1 | 22.1 | 18.8 | 15.8 | 12.1 | 11.1 | 10.1 | 7.3 | 6.5 | 5.8 | 0.07 |
| 3 | 23.1 | 20.5 | 17.8 | 15.4 | 14.7 | 12.5 | 10.5 | 8.1 | 7.4 | 6.7 | 4.9 | 4.3 | 3.9 | 0.15 |
| 4 | 17.3 | 15.3 | 13.4 | 11.6 | 11.0 | 9.4 | 7.9 | 6.1 | 5.5 | 5.1 | 3.7 | 3.3 | 2.9 | 0.27 |
| 5 | 13.8 | 12.3 | 10.7 | 9.2 | 8.8 | 7.5 | 6.3 | 4.9 | 4.4 | 4.1 | 2.9 | 2.6 | 2.3 | 0.41 |
| 6 | 11.5 | 10.2 | 8.9 | 7.7 | 7.4 | 6.3 | 5.3 | 4.0 | 3.7 | 3.4 | 2.4 | 2.2 | 1.9 | 0.60 |
| 7 | 9.9 | 8.8 | 7.6 | 6.6 | 6.3 | 5.4 | 4.5 | 3.5 | 3.2 | 2.9 | 2.1 | 1.9 | 1.7 | 0.81 |
| 8 | 8.6 | 7.7 | 6.7 | 5.8 | 5.5 | 4.7 | 4.0 | 3.0 | 2.8 | 2.5 | 1.8 | 1.6 | 1.5 | 1.06 |
| 9 | 7.7 | 6.8 | 5.9 | 5.1 | 4.9 | 4.2 | 3.5 | 2.7 | 2.5 | 2.2 | | | | 1.34 |
| 10 | 6.9 | 6.1 | 5.4 | 4.6 | 4.4 | 3.8 | 3.2 | 2.4 | 2.2 | 2.0 | | | | 1.66 |
| 11 | 6.3 | 5.6 | 4.9 | 4.2 | 4.0 | 3.4 | 2.9 | | | | | | | 2.00 |
| 12 | 5.8 | 5.1 | 4.5 | 3.9 | 3.7 | 3.1 | 2.6 | | | | | | | 2.38 |
| 13 | 5.3 | 4.7 | 4.1 | 3.6 | | | | | | | | | | 2.80 |
| 14 | 4.9 | 4.4 | 3.8 | 3.3 | | | | | | | | | | 3.24 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
For maximum safe loads see tables of Maximum Bending Moments and Web Resistances.

## MISCELLANEOUS BEAMS

### Allowable Uniform Load in Thousands of Pounds

Applicable only when sections are braced against lateral deflection. For unbraced sections safe loads must be reduced, see page 101.

Maximum Bending Stress, **16,000** Pounds per Square Inch

### H BEAMS

| Span in Feet | Depth and Weight of Sections | | | | | | | | Coefficients of Deflection |
|---|---|---|---|---|---|---|---|---|---|
| | 8 Inch | | | 6 Inch | | | 5 Inch | 4 Inch | |
| | 37.7 lb. | 34.3 lb. | 32.6 lb. | 26.7 lb. | 24.1 lb. | 22.8 lb. | 18.9 lb. | 13.8 lb. | |
| | | | | | | | | 25.0 | |
| 3 | | | | 52.5 | | | 31.3 | 19.0 | 0.15 |
| 4 | 80.0 | | | 42.1 | 37.5 | | 25.4 | 14.3 | 0.27 |
| 5 | 64.4 | 60.0 | | 33.7 | 32.1 | 30.0 | 20.3 | 11.4 | 0.41 |
| 6 | 53.7 | 51.3 | 50.0 | 28.1 | 26.7 | 26.1 | 16.9 | 9.5 | 0.60 |
| 7 | 46.0 | 44.0 | 43.0 | 24.1 | 22.9 | 22.3 | 14.5 | 8.1 | 0.81 |
| 8 | 40.3 | 38.5 | 37.6 | 21.1 | 20.1 | 19.6 | 12.7 | 7.1 | 1.06 |
| 9 | 35.8 | 34.2 | 33.4 | 18.7 | 17.8 | 17.4 | 11.3 | 6.3 | 1.34 |
| 10 | 32.2 | 30.8 | 30.1 | 16.8 | 16.0 | 15.6 | 10.1 | 5.7 | 1.66 |
| 11 | 29.3 | 28.0 | 27.3 | 15.3 | 14.6 | 14.2 | 9.2 | | 2.00 |
| 12 | 26.8 | 25.7 | 25.1 | 14.0 | 13.4 | 13.0 | 8.5 | | 2.38 |
| 13 | 24.8 | 23.7 | 23.1 | 13.0 | 12.3 | 12.0 | | | 2.80 |
| 14 | 23.0 | 22.0 | 21.5 | 12.0 | 11.5 | 11.2 | | | 3.24 |
| 15 | 21.5 | 20.5 | 20.1 | | | | | | 3.72 |
| 16 | 20.1 | 19.2 | 18.8 | | | | | | 4.24 |
| 17 | 18.9 | 18.1 | 17.7 | | | | | | 4.78 |
| 18 | 17.9 | 17.1 | 16.7 | | | | | | 5.36 |

### CROSS TIE SECTIONS

| Span in Feet | Depth and Weight of Sections | | | | Coefficients of Deflection* |
|---|---|---|---|---|---|
| | 5.5 Inch 24.0 Pounds | 5.5 Inch 20.0 Pounds | 4.25 Inch 14.5 Pounds | 3 Inch 9.4 Pounds | |
| | 41.3 | | 21.3 | 12.2 | |
| 3 | 40.3 | 27.5 | 19.6 | 8.9 | 0.15 |
| 4 | 30.3 | 26.0 | 14.7 | 6.7 | 0.27 |
| 5 | 24.2 | 20.8 | 11.7 | 5.3 | 0.41 |
| 6 | 20.2 | 17.3 | 9.8 | 4.5 | 0.60 |
| 7 | 17.3 | 14.8 | 8.4 | 3.8 | 0.81 |
| 8 | 15.1 | 13.0 | 7.3 | 3.3 | 1.06 |
| 9 | 13.4 | 11.5 | 6.5 | 3.0 | 1.34 |
| 10 | 12.1 | 10.4 | 5.9 | 2.7 | 1.66 |
| 11 | 11.0 | 9.4 | 5.3 | | 2.00 |
| 12 | 10.1 | 8.7 | | | 2.38 |
| 13 | 9.3 | 8.0 | | | 2.80 |
| 14 | 8.6 | 7.4 | | | 3.24 |

Loads above upper horizontal lines will produce maximum allowable shear in webs.
Loads below lower horizontal lines will produce excessive deflections.
*To obtain deflection divide coefficient by twice the distance of neutral axis from greatest distance of extreme fiber, obtained from Elements of Cross Tie Sections.

# UNEQUAL ANGLES

**Neutral Axis Parallel to Shorter Leg**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 1 | 161.17 | 7.49 | 21.5 | | 1 | 83.52 | 5.57 | 15.0 |
| | 15/16 | 152.21 | 7.04 | 21.6 | | 15/16 | 79.04 | 5.24 | 15.1 |
| | 7/8 | 143.04 | 6.59 | 21.7 | | 7/8 | 74.45 | 4.90 | 15.2 |
| | 13/16 | 133.87 | 6.14 | 21.8 | | 13/16 | 69.87 | 4.57 | 15.3 |
| | 3/4 | 124.48 | 5.68 | 21.9 | | 3/4 | 65.07 | 4.23 | 15.4 |
| 8 x 6 | 11/16 | 114.88 | 5.22 | 22.0 | | 11/16 | 60.27 | 3.89 | 15.5 |
| | 5/8 | 105.28 | 4.76 | 22.1 | 6 x 3½ | 5/8 | 55.36 | 3.55 | 15.6 |
| | 9/16 | 95.47 | 4.30 | 22.2 | | 9/16 | 50.35 | 3.21 | 15.7 |
| | 1/2 | 85.55 | 3.84 | 22.3 | | 1/2 | 45.23 | 2.86 | 15.8 |
| | 7/16 | 75.41 | 3.37 | 22.4 | | 7/16 | 40.00 | 2.52 | 15.9 |
| | | | | | | 3/8 | 34.67 | 2.17 | 16.0 |
| | 1 | 146.03 | 7.53 | 19.4 | | 5/16 | 29.23 | 1.83 | 16.0 |
| | 15/16 | 138.03 | 7.08 | 19.5 | | | | | |
| | 7/8 | 129.92 | 6.63 | 19.6 | | 7/8 | 53.23 | 4.00 | 13.3 |
| | 13/16 | 121.60 | 6.17 | 19.7 | | 13/16 | 50.03 | 3.73 | 13.4 |
| | 3/4 | 113.17 | 5.72 | 19.8 | | 3/4 | 46.61 | 3.46 | 13.5 |
| 8 x 3½ | 11/16 | 104.53 | 5.23 | 19.9 | | 11/16 | 43.20 | 3.19 | 13.5 |
| | 5/8 | 95.79 | 4.78 | 20.0 | | 5/8 | 39.79 | 2.92 | 13.6 |
| | 9/16 | 86.93 | 4.32 | 20.1 | 5 x 4 | 9/16 | 36.16 | 2.64 | 13.7 |
| | 1/2 | 77.97 | 3.86 | 20.2 | | 1/2 | 32.53 | 2.36 | 13.8 |
| | 7/16 | 68.80 | 3.39 | 20.3 | | 7/16 | 28.80 | 2.07 | 13.9 |
| | | | | | | 3/8 | 24.96 | 1.78 | 14.0 |
| | 1 | 112.85 | 6.52 | 17.3 | | | | | |
| | 15/16 | 106.67 | 6.13 | 17.4 | | | | | |
| | 7/8 | 100.48 | 5.75 | 17.5 | | 7/8 | 52.05 | 4.04 | 12.9 |
| | 13/16 | 94.08 | 5.36 | 17.6 | | 13/16 | 48.85 | 3.76 | 13.0 |
| | 3/4 | 87.68 | 4.97 | 17.6 | | 3/4 | 45.65 | 3.49 | 13.1 |
| 7 x 3½ | 11/16 | 81.07 | 4.58 | 17.7 | | 11/16 | 42.35 | 3.21 | 13.2 |
| | 5/8 | 74.35 | 4.18 | 17.8 | | 5/8 | 38.93 | 2.93 | 13.3 |
| | 9/16 | 67.52 | 3.77 | 17.9 | 5 x 3½ | 9/16 | 35.41 | 2.64 | 13.4 |
| | 1/2 | 60.59 | 3.37 | 18.0 | | 1/2 | 31.89 | 2.36 | 13.5 |
| | 7/16 | 53.44 | 2.96 | 18.1 | | 7/16 | 28.16 | 2.07 | 13.6 |
| | 3/8 | 46.19 | 2.54 | 18.2 | | 3/8 | 24.43 | 1.79 | 13.7 |
| | | | | | | 5/16 | 20.69 | 1.51 | 13.7 |
| | 1 | 85.55 | 5.56 | 15.4 | | | | | |
| | 15/16 | 80.96 | 5.22 | 15.5 | | | | | |
| | 7/8 | 76.27 | 4.89 | 15.6 | | 13/16 | 47.47 | 3.77 | 12.6 |
| | 13/16 | 71.47 | 4.55 | 15.7 | | 3/4 | 44.37 | 3.49 | 12.7 |
| | 3/4 | 66.67 | 4.22 | 15.8 | | 11/16 | 41.17 | 3.22 | 12.8 |
| 6 x 4 | 11/16 | 61.65 | 3.88 | 15.9 | | 5/8 | 37.87 | 2.94 | 12.9 |
| | 5/8 | 56.64 | 3.54 | 16.0 | 5 x 3 | 9/16 | 34.45 | 2.65 | 13.0 |
| | 9/16 | 51.52 | 3.20 | 16.1 | | 1/2 | 31.04 | 2.37 | 13.1 |
| | 1/2 | 46.29 | 2.85 | 16.2 | | 7/16 | 27.52 | 2.09 | 13.2 |
| | 7/16 | 40.85 | 2.51 | 16.3 | | 3/8 | 23.89 | 1.80 | 13.3 |
| | 3/8 | 35.41 | 2.16 | 16.4 | | 5/16 | 20.16 | 1.51 | 13.4 |

## UNEQUAL ANGLES

**Neutral Axis Parallel to Longer Leg**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 1 | 95.15 | 5.44 | 17.5 | | 1 | 30.93 | 3.09 | 10.0 |
| | 15/16 | 89.92 | 5.11 | 17.6 | | 15/16 | 29.23 | 2.90 | 10.1 |
| | 7/8 | 84.69 | 4.79 | 17.7 | | 7/8 | 27.63 | 2.71 | 10.2 |
| | 13/16 | 79.36 | 4.45 | 17.8 | | 13/16 | 25.92 | 2.52 | 10.3 |
| | 3/4 | 73.92 | 4.13 | 17.9 | | 3/4 | 24.21 | 2.33 | 10.4 |
| 8 x 6 | 11/16 | 68.37 | 3.80 | 18.0 | 6 x 3½ | 11/16 | 22.51 | 2.14 | 10.5 |
| | 5/8 | 62.72 | 3.48 | 18.0 | | 5/8 | 20.69 | 1.95 | 10.6 |
| | 9/16 | 56.96 | 3.15 | 18.1 | | 9/16 | 18.88 | 1.76 | 10.7 |
| | 1/2 | 51.09 | 2.81 | 18.2 | | 1/2 | 16.96 | 1.57 | 10.8 |
| | 7/16 | 45.12 | 2.47 | 18.3 | | 7/16 | 15.04 | 1.38 | 10.9 |
| | 1 | 32.21 | 3.10 | 10.4 | | 3/8 | 13.12 | 1.19 | 11.0 |
| | 15/16 | 30.40 | 2.90 | 10.5 | | 5/16 | 11.09 | 1.00 | 11.1 |
| | 7/8 | 28.69 | 2.71 | 10.6 | | | | | |
| | 13/16 | 26.88 | 2.52 | 10.7 | | 7/8 | 35.31 | 3.15 | 11.2 |
| | 3/4 | 25.07 | 2.33 | 10.8 | | 13/16 | 33.17 | 2.93 | 11.3 |
| 8 x 3½ | 11/16 | 23.15 | 2.13 | 10.9 | | 3/4 | 30.93 | 2.71 | 11.4 |
| | 5/8 | 21.33 | 1.94 | 11.0 | | 11/16 | 28.69 | 2.50 | 11.5 |
| | 9/16 | 19.41 | 1.74 | 11.1 | 5 x 4 | 5/8 | 26.45 | 2.28 | 11.6 |
| | 1/2 | 17.49 | 1.57 | 11.2 | | 9/16 | 24.11 | 2.06 | 11.7 |
| | 7/16 | 15.57 | 1.38 | 11.3 | | 1/2 | 21.76 | 1.84 | 11.8 |
| | | | | | | 7/16 | 19.31 | 1.62 | 11.9 |
| | 1 | 31.57 | 3.10 | 10.2 | | 3/8 | 16.75 | 1.40 | 12.0 |
| | 15/16 | 29.87 | 2.90 | 10.3 | | | | | |
| | 7/8 | 28.16 | 2.71 | 10.4 | | 7/8 | 26.88 | 2.71 | 9.9 |
| | 13/16 | 26.45 | 2.52 | 10.5 | | 13/16 | 25.28 | 2.53 | 10.0 |
| | 3/4 | 24.64 | 2.33 | 10.6 | | 3/4 | 23.68 | 2.34 | 10.1 |
| 7 x 3½ | 11/16 | 22.83 | 2.14 | 10.7 | | 11/16 | 21.97 | 2.15 | 10.2 |
| | 5/8 | 21.01 | 1.95 | 10.8 | 5 x 3½ | 5/8 | 20.27 | 1.97 | 10.3 |
| | 9/16 | 19.20 | 1.76 | 10.9 | | 9/16 | 18.45 | 1.78 | 10.4 |
| | 1/2 | 17.28 | 1.57 | 11.0 | | 1/2 | 16.64 | 1.60 | 10.4 |
| | 7/16 | 15.36 | 1.38 | 11.1 | | 7/16 | 14.83 | 1.41 | 10.5 |
| | 3/8 | 13.44 | 1.19 | 11.2 | | 3/8 | 12.91 | 1.22 | 10.6 |
| | | | | | | 5/16 | 10.88 | 1.02 | 10.7 |
| | 1 | 40.43 | 3.55 | 11.4 | | | | | |
| | 15/16 | 38.29 | 3.33 | 11.5 | | 13/16 | 18.56 | 2.16 | 8.6 |
| | 7/8 | 36.16 | 3.12 | 11.6 | | 3/4 | 17.39 | 2.00 | 8.7 |
| | 13/16 | 33.92 | 2.90 | 11.7 | | 11/16 | 16.11 | 1.83 | 8.8 |
| | 3/4 | 31.68 | 2.69 | 11.8 | | 5/8 | 14.83 | 1.67 | 8.9 |
| 6 x 4 | 11/16 | 29.44 | 2.47 | 11.9 | 5 x 3 | 9/16 | 13.55 | 1.51 | 9.0 |
| | 5/8 | 27.09 | 2.26 | 12.0 | | 1/2 | 12.27 | 1.35 | 9.1 |
| | 9/16 | 24.64 | 2.05 | 12.0 | | 7/16 | 10.88 | 1.18 | 9.2 |
| | 1/2 | 22.19 | 1.84 | 12.1 | | 3/8 | 9.49 | 1.02 | 9.3 |
| | 7/16 | 19.73 | 1.62 | 12.2 | | 5/16 | 8.00 | 0.85 | 9.4 |
| | 3/8 | 17.07 | 1.39 | 12.3 | | | | | |

# UNEQUAL ANGLES

**Neutral Axis Parallel to Shorter Leg**

## ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 13/16 | 38.61 | 3.36 | 11.5 | | 9/16 | 12.27 | 1.53 | 8.0 |
| | 3/4 | 36.05 | 3.11 | 11.6 | | 1/2 | 11.09 | 1.37 | 8.1 |
| | 11/16 | 33.49 | 2.87 | 11.7 | 3 x 2½ | 7/16 | 9.92 | 1.22 | 8.1 |
| | 5/8 | 30.83 | 2.62 | 11.8 | | 3/8 | 8.64 | 1.06 | 8.2 |
| 4½ x 3 | 9/16 | 28.16 | 2.38 | 11.8 | | 5/16 | 7.36 | 0.89 | 8.3 |
| | 1/2 | 25.28 | 2.13 | 11.9 | | 1/4 | 5.97 | 0.71 | 8.4 |
| | 7/16 | 22.40 | 1.87 | 12.0 | | | | | |
| | 3/8 | 19.52 | 1.61 | 12.1 | | 1/2 | 10.67 | 1.39 | 7.7 |
| | 5/16 | 16.43 | 1.35 | 12.2 | | 7/16 | 9.49 | 1.22 | 7.8 |
| | | | | | 3 x 2 | 3/8 | 8.32 | 1.05 | 7.9 |
| | 13/16 | 31.15 | 2.94 | 10.6 | | 5/16 | 7.04 | 0.88 | 8.0 |
| | 3/4 | 29.33 | 2.74 | 10.7 | | 1/4 | 5.76 | 0.71 | 8.1 |
| | 11/16 | 27.31 | 2.52 | 10.8 | | | | | |
| | 5/8 | 25.07 | 2.30 | 10.9 | | 1/2 | 7.47 | 1.15 | 6.5 |
| 4 x 3½ | 9/16 | 22.93 | 2.08 | 11.0 | | 7/16 | 6.72 | 1.02 | 6.6 |
| | 1/2 | 20.59 | 1.86 | 11.1 | | 3/8 | 5.87 | 0.88 | 6.7 |
| | 7/16 | 18.35 | 1.64 | 11.2 | 2½ x 2 | 5/16 | 5.01 | 0.74 | 6.8 |
| | 3/8 | 16.00 | 1.41 | 11.3 | | 1/4 | 4.05 | 0.59 | 6.9 |
| | 5/16 | 13.44 | 1.18 | 11.4 | | 3/16 | 3.09 | 0.44 | 7.0 |
| | | | | | | 1/8 | 2.13 | 0.30 | 7.1 |
| | 13/16 | 30.61 | 2.97 | 10.3 | | | | | |
| | 3/4 | 28.59 | 2.75 | 10.4 | | 5/16 | 4.69 | 0.73 | 6.4 |
| | 11/16 | 26.56 | 2.53 | 10.5 | 2½ x 1½ | 1/4 | 3.84 | 0.59 | 6.5 |
| | 5/8 | 24.53 | 2.31 | 10.6 | | 3/16 | 2.99 | 0.45 | 6.6 |
| | 9/16 | 22.40 | 2.09 | 10.7 | | | | | |
| 4 x 3 | 1/2 | 20.16 | 1.87 | 10.8 | | 1/2 | 5.76 | 1.02 | 5.6 |
| | 7/16 | 17.92 | 1.64 | 10.9 | | 7/16 | 5.12 | 0.90 | 5.7 |
| | 3/8 | 15.57 | 1.42 | 11.0 | | 3/8 | 4.48 | 0.77 | 5.8 |
| | 5/16 | 13.12 | 1.19 | 11.0 | 2¼ x 1½ | 5/16 | 3.84 | 0.65 | 5.9 |
| | 1/4 | 10.67 | 0.96 | 11.1 | | 1/4 | 3.20 | 0.53 | 6.0 |
| | | | | | | 3/16 | 2.45 | 0.40 | 6.0 |
| | 13/16 | 23.47 | 2.57 | 9.1 | | | | | |
| | 3/4 | 21.87 | 2.38 | 9.2 | | | | | |
| | 11/16 | 20.37 | 2.19 | 9.3 | | 3/8 | 3.63 | 0.70 | 5.2 |
| | 5/8 | 18.77 | 2.00 | 9.4 | | 5/16 | 3.09 | 0.58 | 5.3 |
| | 9/16 | 17.17 | 1.81 | 9.5 | 2 x 1½ | 1/4 | 2.56 | 0.47 | 5.4 |
| 3½ x 3 | 1/2 | 15.47 | 1.62 | 9.5 | | 3/16 | 1.92 | 0.35 | 5.5 |
| | 7/16 | 13.76 | 1.43 | 9.6 | | 1/8 | 1.33 | 0.24 | 5.6 |
| | 3/8 | 12.05 | 1.24 | 9.7 | | | | | |
| | 5/16 | 10.24 | 1.05 | 9.8 | | | | | |
| | 1/4 | 8.32 | 0.84 | 9.9 | 2 x 1¼ | 1/4 | 2.44 | 0.47 | 5.2 |
| | | | | | | 3/16 | 1.89 | 0.36 | 5.3 |
| | 11/16 | 19.73 | 2.19 | 9.0 | | | | | |
| | 5/8 | 18.24 | 2.00 | 9.1 | | 1/4 | 1.88 | 0.41 | 4.6 |
| | 9/16 | 16.64 | 1.82 | 9.1 | 1¾ x 1¼ | 3/16 | 1.46 | 0.31 | 4.7 |
| | 1/2 | 15.04 | 1.63 | 9.2 | | 1/8 | 1.00 | 0.21 | 4.8 |
| 3½ x 2½ | 7/16 | 13.44 | 1.44 | 9.3 | | | | | |
| | 3/8 | 11.73 | 1.24 | 9.4 | | | | | |
| | 5/16 | 9.92 | 1.04 | 9.5 | | 5/16 | 1.71 | 0.44 | 3.9 |
| | 1/4 | 8.00 | 0.83 | 9.6 | 1½ x 1¼ | 1/4 | 1.39 | 0.35 | 4.0 |
| | | | | | | 3/16 | 1.08 | 0.26 | 4.1 |

## UNEQUAL ANGLES

**Neutral Axis Parallel to Longer Leg**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 13/16 | 18.24 | 2.15 | 8.5 | | 9/16 | 8.75 | 1.25 | 7.0 |
| | 3/4 | 17.07 | 1.99 | 8.6 | | 1/2 | 7.89 | 1.12 | 7.0 |
| | 11/16 | 15.89 | 1.83 | 8.7 | | 7/16 | 7.04 | 0.99 | 7.1 |
| | 5/8 | 14.61 | 1.67 | 8.8 | 3 x 2 1/2 | 3/8 | 6.19 | 0.85 | 7.2 |
| 4 1/2 x 3 | 9/16 | 13.33 | 1.51 | 8.8 | | 5/16 | 5.23 | 0.72 | 7.3 |
| | 1/2 | 12.05 | 1.35 | 8.9 | | 1/4 | 4.27 | 0.58 | 7.4 |
| | 7/16 | 10.77 | 1.19 | 9.0 | | | | | |
| | 3/8 | 9.39 | 1.03 | 9.1 | | 1/2 | 5.01 | 0.88 | 5.7 |
| | 5/16 | 8.00 | 0.87 | 9.2 | | 7/16 | 4.48 | 0.77 | 5.8 |
| | | | | | 3 x 2 | 3/8 | 3.95 | 0.67 | 5.9 |
| | 13/16 | 24.53 | 2.56 | 9.6 | | 5/16 | 3.41 | 0.57 | 6.0 |
| | 3/4 | 22.93 | 2.37 | 9.7 | | 1/4 | 2.77 | 0.46 | 6.1 |
| | 11/16 | 21.33 | 2.18 | 9.8 | | | | | |
| | 5/8 | 19.63 | 1.98 | 9.9 | | 1/2 | 4.91 | 0.89 | 5.5 |
| 4 x 3 1/2 | 9/16 | 17.92 | 1.79 | 10.0 | | 7/16 | 4.37 | 0.78 | 5.6 |
| | 1/2 | 16.21 | 1.60 | 10.1 | | 3/8 | 3.84 | 0.67 | 5.7 |
| | 7/16 | 14.40 | 1.41 | 10.2 | 2 1/2 x 2 | 5/16 | 3.31 | 0.57 | 5.8 |
| | 3/8 | 12.59 | 1.22 | 10.3 | | 1/4 | 2.67 | 0.46 | 5.9 |
| | 5/16 | 10.67 | 1.03 | 10.4 | | 3/16 | 2.13 | 0.35 | 6.0 |
| | | | | | | 1/8 | 1.44 | 0.24 | 6.1 |
| | 13/16 | 17.92 | 2.15 | 8.3 | | | | | |
| | 3/4 | 16.75 | 1.99 | 8.4 | | 5/16 | 1.81 | 0.41 | 4.4 |
| | 11/16 | 15.57 | 1.83 | 8.5 | 2 1/2 x 1 1/2 | 1/4 | 1.49 | 0.33 | 4.5 |
| | 5/8 | 14.40 | 1.67 | 8.6 | | 3/16 | 1.17 | 0.25 | 4.6 |
| 4 x 3 | 9/16 | 13.12 | 1.51 | 8.7 | | | | | |
| | 1/2 | 11.84 | 1.35 | 8.8 | | 1/2 | 2.77 | 0.67 | 4.1 |
| | 7/16 | 10.56 | 1.19 | 8.9 | | 7/16 | 2.45 | 0.58 | 4.2 |
| | 3/8 | 9.28 | 1.03 | 8.9 | | 3/8 | 2.13 | 0.50 | 4.3 |
| | 5/16 | 7.89 | 0.87 | 9.0 | 2 1/4 x 1 1/2 | 5/16 | 1.81 | 0.41 | 4.4 |
| | 1/4 | 6.40 | 0.70 | 9.1 | | 1/4 | 1.49 | 0.33 | 4.5 |
| | | | | | | 3/16 | 1.17 | 0.25 | 4.6 |
| | 13/16 | 17.60 | 2.17 | 8.1 | | | | | |
| | 3/4 | 16.43 | 2.01 | 8.2 | | 3/8 | 2.13 | 0.51 | 4.2 |
| | 11/16 | 15.36 | 1.85 | 8.3 | | 5/16 | 1.81 | 0.42 | 4.3 |
| | 5/8 | 14.19 | 1.69 | 8.4 | | 1/4 | 1.49 | 0.34 | 4.4 |
| 3 1/2 x 3 | 9/16 | 12.91 | 1.52 | 8.5 | 2 x 1 1/2 | 3/16 | 1.17 | 0.26 | 4.5 |
| | 1/2 | 11.73 | 1.36 | 8.6 | | 1/8 | 0.80 | 0.17 | 4.6 |
| | 7/16 | 10.45 | 1.20 | 8.7 | | | | | |
| | 3/8 | 9.07 | 1.04 | 8.7 | | | | | |
| | 5/16 | 7.68 | 0.87 | 8.8 | | 1/4 | 1.03 | 0.28 | 3.7 |
| | 1/4 | 6.19 | 0.70 | 8.9 | 2 x 1 1/4 | 3/16 | 0.80 | 0.21 | 3.8 |
| | | | | | | | | | |
| | 11/16 | 10.56 | 1.51 | 7.0 | | 1/4 | 1.01 | 0.28 | 3.6 |
| | 5/8 | 9.81 | 1.39 | 7.1 | | 3/16 | 0.80 | 0.22 | 3.7 |
| | 9/16 | 8.96 | 1.26 | 7.1 | 1 3/4 x 1 1/4 | 1/8 | 0.56 | 0.15 | 3.8 |
| 3 1/2 x 2 1/2 | 1/2 | 8.11 | 1.13 | 7.2 | | | | | |
| | 7/16 | 7.25 | 0.99 | 7.3 | | | | | |
| | 3/8 | 6.29 | 0.85 | 7.4 | | 5/16 | 1.21 | 0.35 | 3.4 |
| | 5/16 | 5.33 | 0.71 | 7.5 | 1 1/2 x 1 1/4 | 1/4 | 0.99 | 0.28 | 3.5 |
| | 1/4 | 4.37 | 0.58 | 7.6 | | 3/16 | 0.78 | 0.22 | 3.6 |

# EQUAL ANGLES

**Neutral Axis Parallel to Either Leg**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

Applicable only when sections are rigidly secured against lateral deflection

Maximum Bending Stress, **16,000** Pounds per Square Inch

| Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size, Inches | Thickness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| | 1⅛ | 186.99 | 8.31 | 22.5 | | 13/16 | 24.00 | 2.55 | 9.4 |
| | 1 1/16 | 177.81 | 7.87 | 22.6 | | ¾ | 22.51 | 2.37 | 9.5 |
| | 1 | 168.53 | 7.43 | 22.7 | | 11/16 | 20.91 | 2.18 | 9.6 |
| | 15/16 | 159.15 | 6.98 | 22.8 | | ⅝ | 19.31 | 2.00 | 9.7 |
| | ⅞ | 149.55 | 6.53 | 22.9 | 3½ x 3½ | 9/16 | 17.60 | 1.81 | 9.7 |
| 8 x 8 | 13/16 | 139.84 | 6.08 | 23.0 | | ½ | 15.89 | 1.62 | 9.8 |
| | ¾ | 130.03 | 5.63 | 23.1 | | 7/16 | 14.08 | 1.42 | 9.9 |
| | 11/16 | 120.00 | 5.18 | 23.2 | | ⅜ | 12.27 | 1.23 | 10.0 |
| | ⅝ | 109.87 | 4.73 | 23.2 | | 5/16 | 10.45 | 1.04 | 10.1 |
| | 9/16 | 99.63 | 4.28 | 23.3 | | ¼ | 8.43 | 0.83 | 10.2 |
| | ½ | 89.28 | 3.82 | 23.4 | | ⅝ | 13.87 | 1.69 | 8.2 |
| | | | | | | 9/16 | 12.69 | 1.53 | 8.3 |
| | 1 | 91.41 | 5.48 | 16.7 | | ½ | 11.41 | 1.37 | 8.3 |
| | 15/16 | 86.51 | 5.16 | 16.8 | 3 x 3 | 7/16 | 10.13 | 1.21 | 8.4 |
| | ⅞ | 81.39 | 4.84 | 16.8 | | ⅜ | 8.85 | 1.04 | 8.5 |
| | 13/16 | 76.27 | 4.51 | 16.9 | | 5/16 | 7.57 | 0.88 | 8.6 |
| | ¾ | 71.04 | 4.18 | 17.0 | | ¼ | 6.19 | 0.71 | 8.7 |
| | | | | | | ½ | 7.79 | 1.15 | 6.8 |
| 6 x 6 | 11/16 | 65.81 | 3.85 | 17.1 | | 7/16 | 6.93 | 1.01 | 6.9 |
| | ⅝ | 60.37 | 3.51 | 17.2 | | ⅜ | 6.08 | 0.87 | 7.0 |
| | 9/16 | 54.83 | 3.17 | 17.3 | 2½ x 2½ | 5/16 | 5.12 | 0.72 | 7.1 |
| | ½ | 49.17 | 2.83 | 17.4 | | ¼ | 4.16 | 0.58 | 7.2 |
| | 7/16 | 43.41 | 2.48 | 17.5 | | 3/16 | 3.20 | 0.44 | 7.3 |
| | ⅜ | 37.65 | 2.14 | 17.6 | | ⅛ | 2.13 | 0.29 | 7.4 |
| | | | | | | 7/16 | 4.27 | 0.79 | 5.4 |
| | 1 | 61.87 | 4.55 | 13.6 | | ⅜ | 3.73 | 0.68 | 5.5 |
| | 15/16 | 58.56 | 4.28 | 13.7 | 2 x 2 | 5/16 | 3.20 | 0.57 | 5.6 |
| | ⅞ | 55.15 | 4.00 | 13.8 | | ¼ | 2.67 | 0.46 | 5.7 |
| | 13/16 | 51.73 | 3.73 | 13.9 | | 3/16 | 2.03 | 0.35 | 5.8 |
| | ¾ | 48.32 | 3.45 | 14.0 | | ⅛ | 1.39 | 0.24 | 5.8 |
| 5 x 5 | 11/16 | 44.80 | 3.18 | 14.1 | | 7/16 | 3.20 | 0.68 | 4.7 |
| | ⅝ | 41.17 | 2.90 | 14.2 | | ⅜ | 2.77 | 0.60 | 4.7 |
| | 9/16 | 37.44 | 2.62 | 14.3 | 1¾ x 1¾ | 5/16 | 2.45 | 0.51 | 4.8 |
| | ½ | 33.60 | 2.34 | 14.4 | | ¼ | 2.03 | 0.41 | 4.9 |
| | 7/16 | 29.76 | 2.06 | 14.5 | | 3/16 | 1.49 | 0.30 | 5.0 |
| | ⅜ | 25.81 | 1.78 | 14.5 | | ⅛ | 1.07 | 0.21 | 5.1 |
| | | | | | | ⅜ | 2.03 | 0.51 | 4.0 |
| | 13/16 | 32.11 | 2.95 | 10.9 | | 5/16 | 1.73 | 0.42 | 4.1 |
| | ¾ | 29.97 | 2.73 | 11.0 | 1½ x 1½ | ¼ | 1.43 | 0.34 | 4.2 |
| | 11/16 | 27.84 | 2.51 | 11.1 | | 3/16 | 1.11 | 0.26 | 4.3 |
| | ⅝ | 25.60 | 2.29 | 11.2 | | ⅛ | 0.77 | 0.18 | 4.4 |
| | | | | | | 5/16 | 1.19 | 0.36 | 3.3 |
| 4 x 4 | 9/16 | 23.36 | 2.07 | 11.3 | | ¼ | 0.97 | 0.29 | 3.4 |
| | ½ | 21.01 | 1.85 | 11.4 | 1¼ x 1¼ | 3/16 | 0.76 | 0.22 | 3.5 |
| | 7/16 | 18.67 | 1.63 | 11.4 | | ⅛ | 0.52 | 0.14 | 3.6 |
| | ⅜ | 16.21 | 1.41 | 11.5 | | ¼ | 0.60 | 0.22 | 2.6 |
| | 5/16 | 13.76 | 1.19 | 11.6 | 1 x 1 | 3/16 | 0.47 | 0.17 | 2.7 |
| | ¼ | 11.20 | 0.96 | 11.7 | | ⅛ | 0.33 | 0.12 | 2.8 |

## TEES AND ZEES

**Neutral Axis Parallel to Flanges**

ALLOWABLE UNIFORM LOAD IN THOUSANDS OF POUNDS

**Applicable only when sections are rigidly secured against lateral deflection**

**Maximum Bending Stress, 16,000 Pounds per Square Inch**

### TEES

| Size Flange x Stem, Inches | Weight per Foot, Pounds | 1 Foot Span | Maximum Span 360 x Deflection | | Size Flange x Stem, Inches | Weight per Foot, Pounds | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| 6 1/2 x6 1/2 | 19.8 | 52.80 | 2.77 | 19.1 | 5 x3 | 11.5 | 11.31 | 1.25 | 9.0 |
| 4 x4 | 13.5 | 21.55 | 1.90 | 11.4 | 4 x5 | 15.3 | 33.39 | 2.41 | 13.9 |
| 4 x4 | 10.5 | 16.85 | 1.46 | 11.6 | 4 x5 | 11.9 | 25.92 | 1.84 | 14.1 |
| 3 x3 | 7.8 | 9.17 | 1.07 | 8.5 | 4 x4 1/2 | 14.4 | 27.09 | 2.15 | 12.6 |
| 3 x3 | 6.7 | 7.89 | 0.92 | 8.6 | 4 x4 1/2 | 11.2 | 21.12 | 1.65 | 12.8 |
| 2 1/2 x2 1/2 | 6.4 | 6.29 | 0.90 | 7.0 | 4 x3 | 9.2 | 9.60 | 1.07 | 8.9 |
| 2 1/2 x2 1/2 | 5.5 | 5.33 | 0.75 | 7.1 | 4 x3 | 7.8 | 8.21 | 0.91 | 9.1 |
| 2 1/4 x2 1/4 | 4.9 | 4.37 | 0.69 | 6.3 | 4 x2 1/2 | 8.5 | 6.61 | 0.87 | 7.6 |
| 2 1/4 x2 1/4 | 4.1 | 3.41 | 0.53 | 6.4 | 4 x2 1/2 | 7.2 | 5.65 | 0.74 | 7.7 |
| 2 x2 | 4.3 | 3.31 | 0.59 | 5.6 | 3 x2 1/2 | 6.1 | 5.55 | 0.76 | 7.3 |
| 2 x2 | 3.56 | 2.77 | 0.49 | 5.7 | 2 1/2 x3 | 6.1 | 7.68 | 0.92 | 8.4 |
| | | | | | 1 1/2 x2 | 2.45 | 2.08 | 0.38 | 5.5 |
| | | | | | 1 1/2 x1 1/4 | 1.25 | 0.57 | 0.15 | 3.7 |
| | | | | | 1 1/4 x 5/8 | 0.88 | 0.14 | 0.08 | 1.9 |

### ZEES

| Size Depth x Flange, Inches | Thick-ness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | | Size Depth x Flange, Inches | Thick-ness, Inches | 1 Foot Span | Maximum Span 360 x Deflection | |
|---|---|---|---|---|---|---|---|---|---|
| | | Safe Load | Safe Load | Length, Feet | | | Safe Load | Safe Load | Length, Feet |
| 6 1/8 x3 5/8 | 7/8 | 174.93 | 14.18 | 12.3 | 4 1/8 x3 5/16 | 3/4 | 77.44 | 9.32 | 8.3 |
| 6 1/16 x3 9/16 | 13/16 | 162.35 | 13.30 | 12.2 | 4 1/16 x3 1/8 | 11/16 | 70.93 | 8.67 | 8.2 |
| 6 x3 1/2 | 3/4 | 149.76 | 12.40 | 12.1 | 4 x3 1/16 | 5/8 | 64.53 | 8.01 | 8.1 |
| 6 1/8 x3 5/8 | 11/16 | 150.40 | 12.19 | 12.3 | 4 1/8 x3 5/16 | 9/16 | 65.92 | 7.93 | 8.3 |
| 6 1/16 x3 9/16 | 5/8 | 136.75 | 11.20 | 12.2 | 4 1/16 x3 1/8 | 1/2 | 58.67 | 7.17 | 8.2 |
| 6 x3 1/2 | 9/16 | 123.20 | 10.20 | 12.1 | 4 x3 1/16 | 7/16 | 51.52 | 6.40 | 8.1 |
| 6 1/8 x3 5/8 | 1/2 | 119.68 | 9.70 | 12.3 | 4 1/8 x3 5/16 | 3/8 | 49.81 | 6.00 | 8.3 |
| 6 1/16 x3 9/16 | 7/16 | 104.85 | 8.59 | 12.2 | 4 1/16 x3 1/8 | 5/16 | 41.71 | 5.10 | 8.2 |
| 6 x3 1/2 | 3/8 | 90.03 | 7.45 | 12.1 | 4 x3 1/16 | 1/4 | 33.49 | 4.16 | 8.1 |
| 5 1/8 x3 5/8 | 13/16 | 119.47 | 11.58 | 10.3 | | | | | |
| 5 1/16 x3 9/16 | 3/4 | 110.29 | 10.82 | 10.2 | | | | | |
| 5 x3 1/4 | 11/16 | 101.01 | 10.03 | 10.1 | 3 1/16 x2 3/4 | 9/16 | 36.59 | 5.93 | 6.2 |
| 5 1/8 x3 5/8 | 5/8 | 102.08 | 9.89 | 10.3 | 3 x2 11/16 | 1/2 | 32.64 | 5.40 | 6.1 |
| 5 1/16 x3 9/16 | 9/16 | 91.95 | 9.02 | 10.2 | 3 1/16 x2 3/4 | 7/16 | 31.79 | 5.15 | 6.2 |
| 5 x3 1/4 | 1/2 | 81.92 | 8.14 | 10.1 | 3 x2 11/16 | 3/8 | 27.41 | 4.54 | 6.1 |
| 5 1/8 x3 5/8 | 7/16 | 79.36 | 7.69 | 10.3 | 3 1/16 x2 3/4 | 5/16 | 25.39 | 4.12 | 6.2 |
| 5 1/16 x3 9/16 | 3/8 | 68.16 | 6.69 | 10.2 | 3 x2 11/16 | 1/4 | 20.48 | 3.39 | 6.1 |
| 5 x3 1/4 | 5/16 | 56.96 | 5.66 | 10.1 | | | | | |

## PLATE AND ANGLE GIRDERS

Girders, built up of plates and angles, are used for heavy loads and long spans, where rolled sections are insufficient.

Loads upon a plate and angle girder develop compressive and tensile stresses resisted by the upper and lower flanges, and shearing stresses resisted by the web plate.

The most economical section is the single web girder; box girders with double or triple webs are used where great length of span combined with lateral stiffness require them.

**WEB.** The web plate governs the depth of the girder which, to avoid excessive deflection, should not be less than 1/15 of the span, the thickness depends upon the shear which is greatest at the point of support and should not be less than 1/160 of the unsupported distance between the flanges; the web is reinforced by stiffeners at intervals to prevent buckling.

**Web Shear and Stiffeners.** Web plates subjected to direct vertical shear must resist buckling; the allowable vertical shear may be obtained from the table on page 147, based on a maximum shearing stress of 12000 pounds, giving allowable unit web shear, V/A, total vertical shear÷gross area of web, for various ratios of h/t, distance between flanges÷thickness of web.

Stiffeners are required at the ends and at points of concentrated loads and at other points where the clear distance between flange angles, h, exceeds allowable safe stresses obtained from table, and also where h is greater than 60 times the thickness of the web; stiffeners are generally in pairs, one on each side of the web, bearing closely against the projecting leg of the flange angles; the pitch of rivets in stiffeners should not exceed 6 inches.

**FLANGES.** The flange area is so proportioned that the extreme compressive or tensile stress, $f=\frac{n\,M}{I}$, does not exceed the maximum allowable limit, being so proportioned that the unit stress on the net section does not exceed the maximum unit stress as determined by the moment of inertia of the net section of the girder.

When the flanges are alike, as they usually are, the preliminary investigation is simplified by assuming that the stresses in the flanges are uniformly distributed, and their resultants act at the center of gravity of the flanges.

A=Area of one flange  d=Effective depth  t=Web thickness

Total Moment of Resistance, $M = f\ (A\ d + \frac{d^2\ t}{6}) = f\ d\ (A + \frac{d\ t}{6})$.

The net moment of resistance of the web plate, with allowance for reduction of area due to web splices is generally taken as $\frac{d\ t}{8}$, or:

Net Moment of Resistance, $M = f\ (A\ d + \frac{d^2\ t}{8}) = f\ d\ (A + \frac{d\ t}{8})$,

d is the approximate distance between centers of gravity of flange angles, or distance out to out of angles when flange plates are used.

The final design of the girder is obtained in accordance with the method given for the computation of compound sections.

**Flange Plates.** When the girder carries a uniformly distributed load, the flange areas vary as the ordinates of a parabola, and the theoretical length of the flange plates is

$$L_1 = L\sqrt{\frac{a_1}{A}} \qquad L_2 = L\sqrt{\frac{a_2}{A}} \qquad L_3 = L\sqrt{\frac{a_3}{A}}$$

L = Length of girder. A = Total Area of Flange.

$L_1$, $L_2$, $L_3$ = Length of flange plates, beginning with outside plate.

$a_1$, $a_2$, $a_3$ = Total area of flange plates, from outer to inner plates.

Sufficient length, usually from 12 to 18 inches, is added to each end of plate to take up the shear; the plate next to the flange angle is extended to full length of the girder, to resist lateral deflection.

EXAMPLE. Required the length of flange plates of a 60-inch girder, 60 feet long, the flange including flange angles, two flange plates and one-eighth of web plate; rivets ¾" dia.

| | | | | | |
|---|---|---|---|---|---|
| 2—Angles | 6" x 3½" x ½" | Net Area | 9.00—1.75 = 7.25 | sq. in. | Total Area: 20.0 sq. in. |
| 1—Inner Flange Plate | 14" x 7/16" | " " | 6.13—0.77 = 5.36 | " | |
| 1—Outer Flange Plate | 14" x ⅜" | " " | 5.25—0.66 = 4.59 | " | |
| ⅛—Web Plate | 60" x ⅜" | " " | 2.81 = 2.81 | " | |

Outer plate, $L_1 = 60\sqrt{\frac{4.59}{20.0}} = 28.8$ ft. say 32 ft. Inner plate, $L_2 = 60\sqrt{\frac{4.59+5.36}{20.0}} = 42.3$ ft. full length.

**Maximum End Flange Stress.** In addition to a girder having sufficient flange area to resist the maximum bending moment, it must also be capable of withstanding stresses at the ends.

The end resistance of a riveted girder depends on: First, the resistance of the web plate to shearing; second, the resistance of the flange rivets to bearing, it being assumed that the bearing value of rivets does not exceed twice their value in single shear.

The difference in flange stress between any two points is the horizontal shear to be transmitted into the web by the flange rivets between those points, and can not be greater than that of the end reaction considered to be distributed along the flange within a length equal to the distance, a, between the center of the rivets in upper and lower flange with one line of rivets, or between the center lines of two lines of rivets, according to design.

Web Stress: $d \times t \times f$ = Maximum End Resistance if less than flange stress.

d = Depth. t = Thickness of web. f = Allowable unit shearing stress.

Flange Stress: $\frac{a\,R}{p}$ = Maximum End Resistance if less than web stress.

a = Effective distance (d + ½″) — 2 x distance from back of angles, for one or two rivet lines.
R = Bearing value of one rivet. p = Minimum pitch between two rivets.

Required the maximum end resistance of a girder, properly stiffened at ends,

EXAMPLE 1. Girder composed of 1—Web Plate, 36″ x 5/16″ 4—Flange Angles, 5″ x 3½″.
Web Stress: 36 x 5/16 x 12000 = 135,000 pounds.
Flange Rivets: a = (36″ + ½″) — 4½″ = 32″; 32 ÷ 2½ = 13 Rivets.
Bearing value of ¾″ Dia. Rivet: ¾ x 5/16 x 24000 = 5625 pounds.
Flange Stress: 5625 x 13 = 73,125 pounds = Maximum End Resistance.

EXAMPLE 2. Girder composed of 1—Web Plate, 48″ x ⅜″ 4—Flange Angles, 6″ x 6″,
Web Stress: 48 x ⅜ x 12000 = 216,000 pounds.
Flange Rivets: a = (48″ + ½″) — 7″ = 41½″, 41½ ÷ 1½ = 28 Rivets.
Bearing value of ¾″ Dia. Rivet: ¾ x ⅜ x 24000 = 6750 pounds.
Flange Stress: 6750 x 28 = 189,000 pounds = Maximum End Resistance.

**Rivet Spacing in Flanges.** It follows that the rivets connecting the web plate with the flange angles are required to transmit the horizontal shearing stress from the web to the flange, which horizontal shear in any panel is equal to the vertical shear at center of panel multiplied by its length and divided by the vertical distance, a.

As the shear increases from the point of greatest bending moment towards the supports, the number of rivets in vertical legs of the flange angles must also increase as the supports are approached.

Pitch of rivets in flange angles, $p = \frac{a\,R}{V}$

V = Total vertical shear at the panel under consideration.
R = Resistance of one rivet, i. e., the bearing or shearing value, whichever is smaller.
a = Effective distance between upper and lower lines of rivets.

The formula gives the theoretical rivet spacing for any point in the flanges due to the total shear, but in practice the pitch is computed from the maximum stress in each panel, in nearest ¼ inch.

EXAMPLE. A girder composed of 5″ x 3½″ angles and 36″ x 5/16″ web, 30 ft. long, divided into 3-foot panels, supports a uniformly distributed load of 72 tons, or 4800 pounds per foot

Required rivet pitch in panels, when distance between rivet lines = 32 inches.

| | Shearing Stress, Pounds | Horizontal Stress, Pounds per Inch |
|---|---|---|
| Panel 1. | 144000 ÷ 2 = 72000 | 72000 ÷ 32 = 2250 |
| " 2. | 72000 — (4800 x 3) = 57600 | 57600 ÷ 32 = 1800 |
| " 3. | 72000 — (4800 x 6) = 43200 | 43200 ÷ 32 = 1350 |
| " 4. | 72000 — (4800 x 9) = 28800 | 28800 ÷ 32 = 900 |

Bearing value of ¾″ Dia. Rivet: ¾ x 5/16 x 24000 = 5625 pounds.

| | | | |
|---|---|---|---|
| Panel 1. | Rivet Pitch | 5625 ÷ 2250 = 2.50 | say 2½″ spacing |
| " 2. | " " | 5625 ÷ 1800 = 3.13 | " 3″ " |
| " 3. | " " | 5625 ÷ 1350 = 4.17 | " 4″ " |
| " 4. | " " | 5625 ÷ 900 = 6.25 | " 6″ " |

When the load rests directly on the top or bottom flanges, the rivets connecting this flange with the web plate are also required to distribute the load; then the resultant stress on rivets on the loaded flange is represented by the resultant of horizontal shear and vertical load.

EXAMPLE. Loads bearing directly on one flange only, then, first panel, foregoing example:
Horizontal Shear 2250 pounds per inch. Vertical Load 400 pounds per inch,
Resultant Stress $\sqrt{2250^2+400^2}$ = 2285 pounds. Rivet Pitch 5625÷2285=2.46″

**Flange Plates.** At the end of each flange plate, sufficient rivets must be provided to transmit the allowable stress on the net section of the plate to the adjacent members.

EXAMPLE. Required number of rivets, ¾″ Dia., for 14″ x 7/16″ Inner Flange Plate.
14″ x 7/16″ Inner Flange Plate, net area: (6.13—0.77)=5.36 sq. in.
Resistance 5.36 x 18000=96480 pounds.
Shearing value of ¾″ Dia. Rivet: 0.4418 x 12000=5300 pounds.
96480÷5300=18 rivets, or:
Two lines of 9 rivets each end of plate, spaced 2½ to 3 inches.

**SPLICES.** In long and deep girders or in girders to be made from stock lengths, it is often necessary to splice the web plate or also flange angles and plates.

The resistance of all splice plates must be such as to develop the full resisting strength of the rivets in the splice, in particular when rivet stresses are to be transmitted through narrow plates.

**Web Splices.** As there is no vertical shearing stress in the middle of the girder under a uniformly distributed load, web splices are sometimes made at that point, but, generally, the web is spliced in two places equidistant from the center.

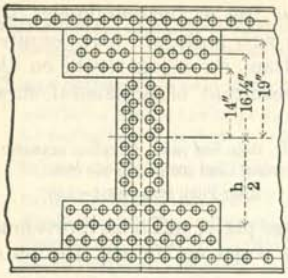
The rivets in the web splice must transmit the web stresses so that no additional stresses are imparted to the flange rivets, these stresses being most effectively transmitted by two pairs of horizontal plates next to the flange angles to resist bending and one pair of vertical plates to resist shearing stresses.

Bending Stress—Horizontal Plates,

Moment of Resistance, $M=\frac{R\,h}{2}=\frac{A\,h\,f}{2}$

R = Total rivet value, one side of splice
A = Total sectional area of splice plate
h = Distance between centers
f = Fiber stress

The rivets are not equally stressed, the stress is zero at the neutral axis and increases uniformly to a maximum at extreme distance, d; the moment stress of each rivet is as its distance from neutral axis, and the moment of resistance as the square of its distance from neutral axis.




EXAMPLE. Required the web splice in a 48-inch girder with ⅜-inch web plate, capable of resisting the bending moment in web at 18000 pounds fiber stress. Horizontal plates to transmit bending stress in web, based on one-eighth of the web action.

Bending Moment in web plate:
$(48 \times \frac{3}{8} \times \frac{1}{8}) \times 48 \times 18{,}000 = 1{,}944{,}000$ inch-pounds.

Investigating the value of rivets assumed:

Bearing value of ¾" Dia. rivet:
$\frac{3}{4} \times \frac{3}{8} \times 24{,}000 = 6750$ pounds.

Distance from neutral axis to top or bottom of girder = 24 inches.

Value of one rivet, one inch from neutral axis: $6750 \div 24 = 281$ pounds.

Moment of Resistance of rivets one side of joint above and below neutral axis is
$M = 281(10 \times 14.0^2 + 8 \times 16.5^2 + 10 \times 19.0^2) = 2{,}178{,}000$ inch-pounds.

The resistance of plates should not be less than the required resistance of the rivets in same:
Stress in center of plates, 16½" from neutral axis:
$18{,}000 \times 16.5 \div 24 = 12{,}375$ lb. per sq. in.
Moment of resistance, when A is the total area of the two pairs of plates:
$12{,}375 \times A \times 16.5 = 204{,}200A$ $\quad A = 1{,}944{,}000 \div 204{,}200 = 9.52$ sq. in.
Net Area of 4—8" x 7/16" plates: $A = (14.0 - 3.06) = 10.94$ sq. in.

## Shearing Stress—Vertical Plates.

Shearing Resistance, $V = \frac{W}{R}$, W = Load producing shear in web.

EXAMPLE. The 13 rivets, ¾" Dia., shown in vertical plates are sufficiently strong to resist in bearing a load of $13 \times \frac{3}{4} \times \frac{3}{8} \times 24{,}000 = 87{,}750$ pounds.

**Flange Splices.** Splices for flange angles and flange plates must develop the full bending moment of the girder at the joint.

Flange splices should be made at points of least flange stress, and joints in component parts of the flange should not be made at the same points.

EXAMPLE. Required top and bottom splices at separate points, for flange angles and inner flange plates as given; Rivets ¾" Diameter.

| | | | |
|---|---|---|---|
| 2 Angles | 6" x 3½" x ½" | Net Area | 9.00—1.75 = 7.25 sq. in. |
| 1 Inner Flange Plate | 14" x 7/16" | " " | 6.13—0.77 = 5.36 " |
| 1 Outer Flange Plate | 14" x ⅜" | " " | 5.25—0.66 = 4.59 " |

Splices for Flange Angles, Top and Bottom.

Stress in Angles 6" x 3½" x ½" 7.25 x 18,000 = 130,500 pounds.
Shearing Value of ¾" Dia. Rivet: 0.4418 x 12000 = 5300 pounds.
Rivets required: 130,500 ÷ 5300 = 25 rivets in single shear, each side of joint.

Splice: 1—plate 14" x 7/16", 18 rivets, resistance 18 x 5300 = 95,400 pounds.
2—plates 3" x 9/16", 4 " 4 x 10600 = 42,400 "
Total resistance of angle splice: 137,800 "
Total Area of splice should not be less than that of the angles:
(6.13—0.77) + (3.38—0.98) = 7.76 sq. in.
Resistance of the two side plates not less than that of the 4 rivets in double shear,
4 x 10,600 = 42,400 pounds:
2—plates 3" x 9/16", net area 2.40 x 18,000 = 43,200 pounds.

Splices for Inner Flange Plates, Top and Bottom.

Stress in Inner Flange Plate 14" x 7/16" net area 5.36 x 18,000 = 96,480 pounds.
Rivets required: 96,480 ÷ 5300 = 19 rivets in single shear, each side of joint.
Splice: 1—plate 14" x 7/16", 20 rivets, resistance 20 x 5300 = 106,000 pounds.

ALLOWABLE WEB SHEAR, V/A FOR VARIOUS RATIOS OF h/t

| h/t | V/A | h/t | V/A | h/t | V/A | h/t | V/A | h/t | V/A | h/t | V/A |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 60 | 12000 | 70 | 10711 | 80 | 9529 | 90 | 8471 | 100 | 7535 | 110 | 6715 |
| 61 | 11867 | 71 | 10587 | 81 | 9418 | 91 | 8372 | 101 | 7448 | 115 | 6345 |
| 62 | 11734 | 72 | 10465 | 82 | 9308 | 92 | 8274 | 102 | 7362 | 120 | 6000 |
| 63 | 11604 | 73 | 10344 | 83 | 9199 | 93 | 8177 | 103 | 7277 | 125 | 5678 |
| 64 | 11473 | 74 | 10224 | 84 | 9091 | 94 | 8082 | 104 | 7194 | 130 | 5378 |
| 65 | 11343 | 75 | 10105 | 85 | 8984 | 95 | 7988 | 105 | 7111 | 135 | 5098 |
| 66 | 11215 | 76 | 9988 | 86 | 8879 | 96 | 7895 | 106 | 7030 | 140 | 4836 |
| 67 | 11087 | 77 | 9871 | 87 | 8775 | 97 | 7803 | 107 | 6950 | 145 | 4592 |
| 68 | 10961 | 78 | 9756 | 88 | 8672 | 98 | 7712 | 108 | 6870 | 150 | 4364 |
| 69 | 10835 | 79 | 9642 | 89 | 8571 | 99 | 7623 | 109 | 6792 | 155 | 4151 |
| | | | | | | | | | | 160 | 3951 |

Ratio h/t = Distance between Flanges ÷ Thickness of Web Plate, inches.
Ratio V/A = Vertical Shear, pounds ÷ Gross Area of Web, sq. inches

## GENERAL REQUIREMENTS FOR RIVETING.

1. In proportioning rivets the nominal diameter of the rivet shall be used, and in deducting rivet holes they shall be taken $\frac{1}{8}$ inch greater than the nominal diameter of the rivets.

2. The minimum distance between centers of rivet holes shall be three diameters of the rivet, but the distance shall preferably be not less than:

$4\frac{1}{2}$"—$1\frac{1}{4}$" rivets  $3\frac{1}{2}$"—1" rivets  $2\frac{1}{2}$"—$\frac{3}{4}$" rivets  $1\frac{3}{4}$"—$\frac{1}{2}$" rivets
4" —$1\frac{1}{8}$" " 3" —$\frac{7}{8}$" " 2" —$\frac{5}{8}$" "

3. The maximum pitch in the line of stress of compression members composed of plates and shapes shall not exceed 16 times the thinnest outside plate or shape, nor 20 times the thinnest enclosed plate with a maximum of 12 inches, and at right angles to the direction of stress the distance between lines of rivets shall not exceed 30 times the thinnest plate or shape.

4. For angles in built-up sections with two gage lines, with rivets staggered, the maximum pitch in the line of stress in each gage line shall not exceed 24 times the thinnest plate, with a maximum of 18 inches.

5. The minimum distance from the center of any rivet hole to a sheared edge shall be:

$2\frac{1}{4}$"—$1\frac{1}{4}$" rivets  $1\frac{3}{4}$"—1" rivets  $1\frac{1}{4}$"—$\frac{3}{4}$" rivets  1"—$\frac{1}{2}$" rivets
2" —$1\frac{1}{8}$" " $1\frac{1}{2}$"—$\frac{7}{8}$" " $1\frac{1}{8}$"—$\frac{5}{8}$" "

The maximum distance from any edge shall be 8 times the thickness of the plate.

6. The pitch of the rivets at the end of built compression members shall not exceed 4 times the diameters of the rivets for a length equal to $1\frac{1}{2}$ times the maximum width of the member.

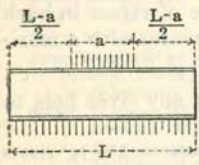
## GRILLAGE FOUNDATIONS

**Grillage Beams.** In the design of foundations for columns, piers and walls, provision must be made for the uniform distribution of the load over the footing. This is best done by the use of a grillage of steel beams and concrete. This method of construction eliminates deep excavations and large masses of masonry and is, therefore, truly economical. For heavy loads on soils of small bearing capacity, three tiers of beams may be necessary; while for lighter loads or better soils two tiers, or even one, may suffice.

The lower tier should rest upon a solid bed of concrete of sufficient thickness to distribute the load to the soil. Good practice requires the spaces between the beams in all the tiers to be filled with, and the beams enclosed in, concrete not less than four inches thick.

The clear distance between the flanges of the beams in each tier should not be less than 2½ inches, nor more than three times the flange width. The first requirement is necessary to permit the introduction and proper tamping of the concrete, the second, to insure uniform distribution of the load. When separators are used to hold the beams in position, they should be of gas pipe, as cast iron separators tend to break the continuity of the concrete. Grillage beams should not be painted, as concrete does not adhere well to painted surfaces but is itself an excellent preservative of steel.

To determine the area in square feet required for the foundation, divide the total load on the column, pier or wall by the allowable pressure per square foot on the soil. This gives the area of the footing, the shape of which is determined by local conditions. On the assumption that the loads on the soil are uniformly distributed, the number, size and weight of the beams required are determined from the maximum bending moment, the maximum shear, or the maximum web resistance to buckling, as follows:




W=Total load on the foundation, in pounds.
L =Length of beam, in feet.
a =Length of loaded portion, in feet.
d =Depth of beam, in inches.
t =Thickness of beam web, in inches.
n =Number of beams in a tier.
$f_b$=Allowable unit web buckling resistance.

The maximum bending moment occurs at the center of the beam and is equal in foot pounds to W (L–a) ÷ 8; this formula is identical with the formula of maximum bending moment for a beam of length (L–a) under a uniformly distributed load, W.

The proper size of beam in any tier as regards flexure at a fiber stress of 18,000 or 16,000 pounds per square inch may be found

in the beam safe load tables for length corresponding to (L—a), by dividing the total load by the number of beams.

Or may be found from the table of maximum bending moments, by dividing the total bending moment by the number of beams;

Or from the table of properties, by dividing by the number of beams in the tier the total section modulus required, which is equal to $\frac{3\,W\,(L-a)}{2\,f}$

Note, however, that the load on the beam for any span must not exceed the maximum tabular safe load for shear.

The maximum vertical shear occurs at the edge of the column base or at a distance in feet of $\frac{L-a}{2}$ from each end of the beam and is equal to: $V=\frac{W}{L} \times \frac{L-a}{2}$

Web thickness to resist average shear: $t = \frac{W}{L} \times \frac{L-a}{2} \times \frac{1}{n \times d \times f_s}$,

Unit average vertical shear: $f_s=\frac{W}{L} \times \frac{L-a}{2} \times \frac{1}{n \times d \times t}$,

which must not exceed the allowable unit shearing stress.

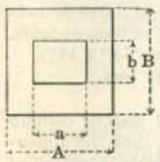
The maximum buckling stress occurs on a length in inches of $12\,a + d/2$ and is equal in total per lineal inch of web to $\frac{W}{12\,a + d/2.}$

Web thickness to resist buckling: $t=\frac{W}{n \times (12\,a + d/2) \times f_b.}$

Unit average web resistance to buckling: $f_b=\frac{W}{n \times (12\,a + d/2) \times t}$

which must not exceed the allowable buckling resistance.

**Rolled Steel Slabs.** To distribute the loads from columns over girders, grillage beams, etc., solid slabs of rolled steel may be advantageously used in the place of cast iron or riveted steel bases, etc. The size of the slab is usually fixed by the dimensions of the column and its thickness is determined from the maximum bending moment, on the assumption of uniform loading, as follows:



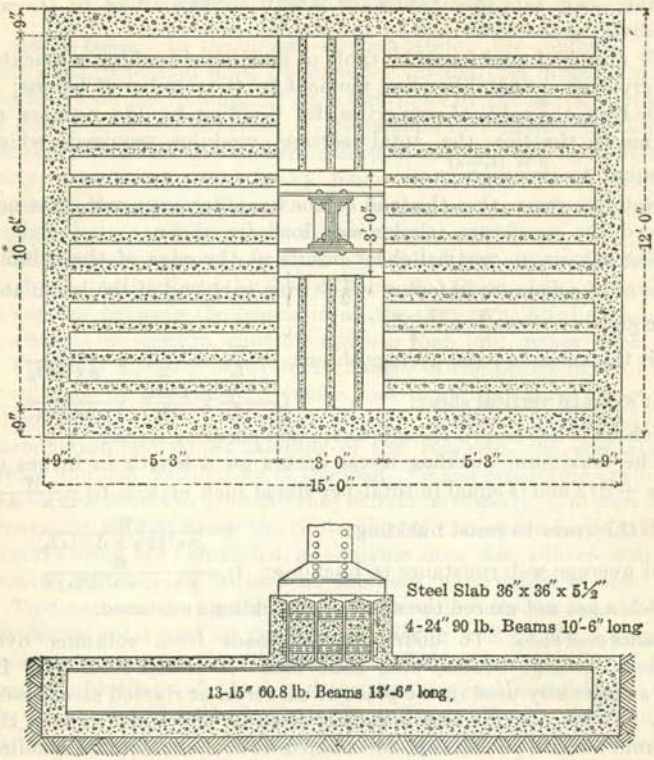

W=Total load, in pounds.
A =Width of slab, in inches.
B =Length of slab, in inches.
t =Thickness of slab, in inches.
a =Outside dimension of column, in inches.
b =Outside dimension of column, in inches.

Assuming the maximum bending moment to be at center of slab: $M=\frac{W\,(A-a)}{8}$ or $\frac{W\,(B-b)}{8}$, and the required thickness of slab:

$$t=\sqrt{\frac{3\,W\,(A-a)}{4\,f\,B}} \quad \text{or} \quad \sqrt{\frac{3\,W\,(B-b)}{4\,f\,A}}$$

Additional data are given under separate heading, "Strength of Steel Slabs".

NOTE—In the examples which follow a fiber stress of 16,000 pounds is used.

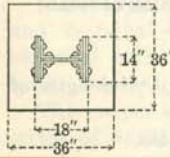



EXAMPLE: Required to design a grillage foundation for a column load of 1,040,000 pounds on soil with an allowable bearing capacity of 6,000 pounds per square foot. Column composed of 1 web plate, 14" x ⅝", 4 flange angles, 6" x 4" x ⅝" and 4 flange plates, 14" x ⅞", outside dimensions 14" x 18".

Required area of footing=1,040,000 ÷ 6,000=173.33 square feet.

Use area 12'-0" x 15'-0"=180 square feet.

Assume 3'-0" square as the dimensions of the rolled steel slab or column base and allow 9" for concrete on the sides and ends of beams, then the dimensions of the steel grillage will be 10'-6" x 13'-6", concrete being assumed of sufficient thickness and strength to distribute to the edges.




Rolled Steel Slab

Thickness required, $t = \sqrt{\frac{3 \times 1{,}040{,}000 \times 22}{64{,}000 \times 36}} = 5.46$ in.

Use 5½".

Beams—Section Modulus Method.

Bottom tier—L=13.5 feet; a= 3.0 feet.

Required total section modulus, $S = \frac{3 \times 1{,}040{,}000 \times 10.5}{32{,}000} = 1{,}023.75$ in.$^3$

Use 13—15″ 60.8 lb. beams—Total section modulus=1,055.6 in.$^3$

Average shear $= \frac{1{,}040{,}000}{13.5} \times \frac{10.5}{2} \times \frac{1}{13 \times 15 \times .59} = 3{,}515$ lbs. per sq. in.

Average buckling stress $= \frac{1{,}040{,}000}{13 \times 43.5 \times .59} = 3{,}120$ lbs. per sq. in.

Top tier—L=10.5 feet; a=3.0 feet.

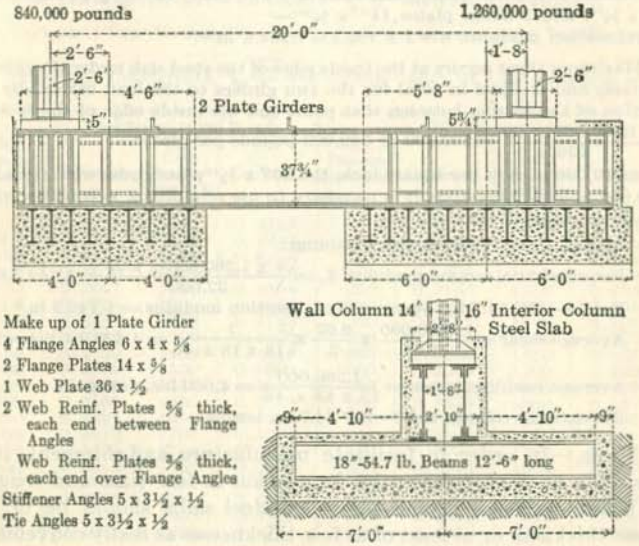
Required total section modulus, $S = \frac{3 \times 1{,}040{,}000 \times 7.5}{32{,}000} = 731.25$ in.$^3$

Use 4—24″ 90 lb. beams—Total section modulus=743.2 in.$^3$

Average shear $= \frac{1{,}040{,}000}{10.5} \times \frac{7.5}{2} \times \frac{1}{4 \times 24 \times .624} = 6{,}200$ lbs. per sq. in.

Average buckling stress $= \frac{1{,}040{,}000}{4 \times 48 \times .624} = 8{,}680$ lbs. per sq. in.

**Plate Girder Grillage Foundations.** In those cases where columns carry very heavy loads, plate girders are used for the top tier of the grillage rather than beams. In the case of symmetrical foundations, the method of computation is the same as has already been illustrated in the case of beams. The following example indicates the procedure in the quite frequent case of unsymmetrical loading conditions:




Make up of 1 Plate Girder
4 Flange Angles 6 x 4 x ⅝
2 Flange Plates 14 x ⅝
1 Web Plate 36 x ½
2 Web Reinf. Plates ⅝ thick, each end between Flange Angles
Web Reinf. Plates ⅜ thick, each end over Flange Angles
Stiffener Angles 5 x 3½ x ½
Tie Angles 5 x 3½ x ½

EXAMPLE:—Required to design a grillage foundation under an exterior or wall column carrying a load of 840,000 pounds, and an interior column with a load of 1,260,000 pounds, on soil with an allowable bearing capacity of 8,000 pounds per square foot.

Required footing area of wall column $= \frac{840,000}{8,000} = 105$ square feet.

Use area 8′-0″ x 14′-0″ = 112 square feet.

Required area of interior column footing $= \frac{1,260,000}{8,000} = 157.5$ square feet.

Use area 12′-0″ x 14′-0″ = 168 square feet.

With these dimensions and areas, the load on the soil will be uniform at 7,500 pounds per square foot, and the footings the same width, both of which are desirable from the standpoint of uniform settlement.

Rolled Steel Slabs for Column Footings: Assume a width of 30″ and a length of 32″, then the required thickness will be as follows:—

Wall column, $t, = \sqrt{\frac{3 \times 840,000 \times (32 - 14)}{64,000 \times 30}} = 4.86$ in.; use 5″.

Interior column, $t, = \sqrt{\frac{3 \times 1,260,000 \times (32 - 16)}{64,000 \times 30}} = 5.61$ in.; use 5¾″.

Plate Girders: Maximum bending moment occurs at the inner beams of the respective footings, and is equal to the load on the column multiplied by the distance of its center from the center of moments.

M max. from wall column = 840,000 x 2′-6″ = 2,100,000 foot pounds.
M max. from interior column = 1,260,000 x 1′-8″ = 2,100,000 foot pounds.

Required section modulus of two girders $= \frac{2,100,000 \times 12}{16,000} = 1,575.0$ in.$^3$

Assume two girders composed each of 1 web plate 36″ x ½″, 4 angles 6″ x 4″ x ⅝″, and 2 flange plates 14″ x ⅝″;—
Total section modulus, S = 2 x 792.3 = 1,584.6 in.$^3$

Maximum shear occurs at the inside edge of the steel slab under the interior column, and is equal in total for the two girders to the load carried by the portion of the footing between that point and the inside edge of the footing, or $\frac{1,260,000 \times 68}{126} = 680,000$ or 340,000 pounds per girder.

At 10,000 pounds per square inch, the 36″ x ½″ plate girder web is good for 180,000 pounds; therefore, it is necessary to use reinforcing web plates where the shear exceeds that amount.

Beams, Lower Tier, Interior Column:

Required total section modulus, $S, = \frac{3 \times 1,260,000 \times 9.67}{32,000} = 1,142.3$ in.$^3$

Use 13—18″ 54.7 lb. beams — Total section modulus = 1,149.2 in.$^3$

Average shear $= \frac{1,260,000}{12.5} \times \frac{9.67}{2} \times \frac{1}{13 \times 18 \times .46} = 4,520$ lbs. per sq. in.

Average buckling stress $= \frac{1,260,000}{13 \times 43 \times .46} = 4,900$ lbs. per sq. in.

For exterior column use 9—18″ 54.7 lb. beams.

NOTE.—In order to facilitate manufacture and shipment, it is desirable to use for the entire foundation as few sizes and weights of beams as possible, and the rolled steel slabs should be of the same thickness or at least of as few thicknesses as really convenient.

**Strength of Steel Slabs.** The formulas given for the bending moments in grillage beams and column base plates in the preceding pages are based on the assumption that the maximum bending moment occurs at the center of the column and grillage beams, producing also a deflection at this point. If, however, it is assumed that the column remains in perfect contact with the comparatively rigid base plate or slab, the latter may be considered rigidly fixed at the column edges, so that there is no bending moment in the center and that the maximum bending moment and also the maximum shear occurs at the fixed end of greatest cantilever projection, $\frac{B-b}{2}$.

The use of the formulas based upon the first assumption is recommended for the reason that maximum bending moment and maximum shearing stress do not occur at the same point and that, with particular reference to grillage beams, the bending stresses alone will generally decide the section to be selected.

The formulas based upon the second assumption give somewhat lower values for maximum bending moment and are frequently used in computing the resistance and the required thickness of heavy steel slabs; in which case, the corresponding values for M and t are:

$$M = \frac{w\,A\,B}{2} \times \frac{B-b}{B} \times \frac{B-b}{4} = \frac{w\,A\,(B-b)^2}{8} = \frac{f\,A\,t^2}{6}, \quad t = \frac{B-b}{2}\sqrt{\frac{3\,w}{f}}.$$

The table gives the coefficients $\sqrt{\frac{3w}{f}}$ for various values of w.

Thickness of Slab = Maximum Projection × Coefficient for corresponding Unit Pressure.

Projection Coefficients, $\sqrt{\frac{3\,w}{f}}$ for various values of Unit Pressure, w.

| Unit Pressure lb. per sq. in. | Fiber Stress, 18,000 Pounds | | | Unit Pressure lb. per sq. in | Fiber Stress, 16,000 Pounds | | |
|---|---|---|---|---|---|---|---|
| | Coefficient | Unit Pressure lb. per sq. in. | Coefficient | | Coefficient | Unit Pressure lb. per sq. in. | Coefficient |
| | | 1050 | 0.4183 | | | | |
| 100 | 0.1291 | 1100 | 0.4282 | 100 | 0.1369 | 1100 | 0.4542 |
| 150 | 0.1581 | 1150 | 0.4378 | 150 | 0.1677 | 1150 | 0.4644 |
| 200 | 0.1826 | 1200 | 0.4472 | 200 | 0.1936 | 1200 | 0.4743 |
| 250 | 0.2041 | 1250 | 0.4564 | 250 | 0.2165 | 1250 | 0.4841 |
| 300 | 0.2236 | 1300 | 0.4655 | 300 | 0.2372 | 1300 | 0.4937 |
| 350 | 0.2415 | 1350 | 0.4743 | 350 | 0.2562 | 1350 | 0.5031 |
| 400 | 0.2582 | 1400 | 0.4830 | 400 | 0.2739 | 1400 | 0.5123 |
| 450 | 0.2739 | 1450 | 0.4916 | 450 | 0.2905 | 1450 | 0.5214 |
| 500 | 0.2887 | 1500 | 0.5000 | 500 | 0.3062 | 1500 | 0.5303 |
| 550 | 0.3028 | 1550 | 0.5083 | 550 | 0.3211 | 1550 | 0.5391 |
| 600 | 0.3162 | 1600 | 0.5164 | 600 | 0.3354 | 1600 | 0.5477 |
| 650 | 0.3291 | 1650 | 0.5244 | 650 | 0.3491 | 1650 | 0.5562 |
| 700 | 0.3416 | 1700 | 0.5323 | 700 | 0.3623 | 1700 | 0.5646 |
| 750 | 0.3536 | 1750 | 0.5401 | 750 | 0.3750 | 1750 | 0.5728 |
| 800 | 0.3652 | 1800 | 0.5478 | 800 | 0.3873 | 1800 | 0.5810 |
| 850 | 0.3764 | 1850 | 0.5553 | 850 | 0.3992 | 1850 | 0.5890 |
| 900 | 0.3873 | 1900 | 0.5627 | 900 | 0.4108 | 1900 | 0.5969 |
| 950 | 0.3979 | 1950 | 0.5701 | 950 | 0.4221 | 1950 | 0.6047 |
| 1000 | 0.4082 | 2000 | 0.5774 | 1000 | 0.4330 | 2000 | 0.6124 |

## COLUMNS AND STRUTS

A compression member, subjected to longitudinal pressure, is shortened by the compression and also tends to deflect laterally, due to the fact that the load cannot be applied coincident with the longitudinal axis and that the material is not perfectly homogeneous. This flexure occurs generally in the direction of the least resisting moment of the section; the load which will cause a column to fail decreases in the ratio of length to least lateral resistance of the section, the ultimate failure being the result of combined stresses due to compression, transverse shear and flexure.

**Column Formulas.** Under ideal conditions, when it can be assumed that the load is applied axially and that the material is perfectly homogeneous, the resistance of the column would equal its resistance to compressive forces up to the elastic limit, and there would not be any flexure; if, however, a deflection be imparted to the column by a lateral force, the column would ultimately fail by bending.

Euler's Formula, $P=k\frac{\pi E I}{l^2}$ or $\frac{P}{A}=k\frac{\pi E}{(l/r)^2}$, is based upon the foregoing theory, and gives results close to the ultimate strength found for long and slender struts, when k is a constant varying with the condition of end bearing, (k=4 for columns fixed both ends). For shorter and heavier columns, or for lower ratios of l/r the results do not correspond with actual tests.

Rankine's Formula, $P=\frac{Af}{1+c\,(l/r)^2}=\frac{P}{A}=\frac{f}{1+c\,(l/r)^2}$, represents the type of formula now in general use and the numerous formulas for proportioning columns which are based upon this general formula agree with actual tests within certain limits. In this formula a certain compressive unit stress for direct crushing is assumed and reduced in ratio of length of column and least radius of gyration, l/r; value of c is an empirical factor, varying with the resistance of the material and with conditions of end bearing.

Straight Line Formulas. In practice compression members of a greater ratio of slenderness, l/r, than 120 are rarely used, and within this limit the curve can be represented by a straight line, the general formula assuming the simpler form: $\frac{P}{A}=f-c\,(\frac{l}{r})$.

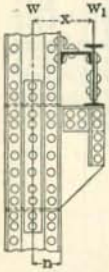
Compression formulas determining the resistance of webs in rolled beams or riveted girders against buckling, or the necessary reduction of safe loads due to lateral deflection of unbraced beams, are likewise based on one or the other type of column formulas.

**Ratio of Slenderness.** The ratio of slenderness, l/r, is ratio of the unsupported length of a compression member to its radius of gyration, generally the least radius, excepting when the unsupported length is rigidly braced in such a manner as to prevent deflection in the direction which corresponds to the least radius of gyration. Compression members, excepting those of square or circular section, have two principal radii of gyration. It is, therefore, necessary to determine the radii of gyration of such sections and to use the proper ratio of slenderness in any particular case.

Usual practice limits the maximum ratio of l/r to 120 for main members under steady stresses. For secondary members under temporary stress, such as those used in wind bracing, higher ratios may be used, but in no case should the ratio exceed 200.

**Compressive Unit Stresses.** Allowable unit stresses for ratios of slenderness, l/r, in accordance with a number of compression formulas of a more general use, for columns and struts, are given in table.

**Combined Bending and Compression Stresses.** Generally the loads are direct and equally distributed over the cross section of the column or balanced on opposite sides thereof. In the case of beams carried on brackets or other forms of eccentric loading, bending stresses are produced which should be taken into consideration and the column sections so proportioned that the combined stresses do not exceed the allowable axial compressive stress.




W = Direct load $W_1$ = Eccentric load.
M = Bending moment due to eccentric load = $W_1 x$.
I = Moment of inertia in direction of bending.
n = Extreme fiber distance in direction of bending.
A = Area of column section, in square inches.
f = Allowable axial unit compression; f should be equal to or greater than $\frac{W + W_1}{A} + \frac{Mn}{I}$, the fiber stresses due to compression and bending respectively.

EXAMPLE:—Required a plate and angle column, 20 feet long, to sustain a balanced load of 210,000 pounds and an eccentric load of 40,000 pounds applied 15 inches from the column center on axis 1-1.

Assume a section made up of 14″x⅜″ web plate, four angles 6″x4″x⁷⁄₁₆″ and two flange plates 14″x⅜″,

$A = 32.47$, $I_{1\text{-}1} = 1351$, $r_{2\text{-}2} = 3.09$, $l/r = 20 \times 12 \div 3.09 = 77$.

Actual fiber stress $= \frac{210{,}000 + 40{,}000}{32.47} + \frac{40{,}000 \times 15 \times 7.625}{1351} = 11{,}090$ pounds.

If this stress is not within the limits of the allowable fiber stress for ratio of l/r = 77, obtained from the column formula in use, another trial is made.

# COMPRESSION FORMULAS FOR STEEL COLUMNS

## Allowable Unit Stresses in Pounds per Square Inch

| Ratio $\frac{l}{r}$ | Rankine<br>Flat End Bearing<br>$\frac{12500}{1+\frac{l^2}{36000r^2}}$ | A. I. S. C. 1923<br>Buildings<br>$\frac{18000}{1+\frac{l^2}{18000r^2}}$ | A. S. C. E. 1923<br>Ry. Bridges<br>$\frac{16000}{1+\frac{l^2}{13500r^2}}$ | A. R. E. A. 1920<br>Ry. Bridges<br>$16000-70\frac{l}{r}$ | New York 1917<br>Buildings<br>$16000-70\frac{l}{r}$ | Chicago 1919<br>Buildings<br>$16000-70\frac{l}{r}$ | Philadelphia 1919<br>Buildings<br>$\frac{16250}{1+\frac{l^2}{11000r^2}}$ |
|---|---|---|---|---|---|---|---|
| 0 | 12500 | | | | 16000 | | 16250 |
| 5 | 12491 | | | | 15650 | | 16213 |
| 10 | 12465 | | | | 15300 | | 16103 |
| 15 | 12422 | | | | 14950 | | 15924 |
| 20 | 12363 | | | Maximum | 14600 | Maximum | 15680 |
| 25 | 12287 | | | 14000 | 14250 | 14000 | 15376 |
| 30 | 12195 | | Maximum | 13900 | 13900 | 13900 | 15021 |
| 35 | 12089 | | 14305 | 13550 | 13550 | 13550 | 14622 |
| 40 | 11968 | | 13913 | 13200 | 13200 | 13200 | 14187 |
| 45 | 11834 | | 13500 | 12850 | 12850 | 12850 | 13724 |
| 50 | 11688 | Maximum | 13071 | 12500 | 12500 | 12500 | 13241 |
| 55 | 11531 | 15000 | 12631 | 12150 | 12150 | 12150 | 12745 |
| 60 | 11364 | 14578 | 12186 | 11800 | 11800 | 11800 | 12243 |
| 65 | 11187 | 14148 | 11739 | 11450 | 11450 | 11450 | 11741 |
| 70 | 11002 | 13714 | 11294 | 11100 | 11100 | 11100 | 11242 |
| 75 | 10811 | 13279 | 10854 | 10750 | 10750 | 10750 | 10752 |
| 80 | 10613 | 12844 | 10422 | 10400 | 10400 | 10400 | 10274 |
| 85 | 10410 | 12414 | 10000 | 10050 | 10050 | 10050 | 9808 |
| 90 | 10204 | 11989 | 9590 | 9700 | 9700 | 9700 | 9358 |
| 95 | 9995 | 11571 | 9192 | 9350 | 9350 | 9350 | 8926 |
| 100 | 9784 | 11163 | 8808 | 9000 | 9000 | 9000 | 8512 |
| 105 | 9571 | 10764 | 8438 | 8650 | 8650 | 8650 | 8116 |
| 110 | 9356 | 10376 | 8082 | 8300 | 8300 | 8300 | 7738 |
| 115 | 9142 | 10000 | 7742 | 7950 | 7950 | 7950 | 7378 |
| 120 | 8929 | 9636 | 7416 | 7600 | 7600 | 7600 | 7037 |
| 125 | 8717 | 9284 | 7105 | | | 7250 | 6714 |
| 130 | 8507 | 8944 | 6809 | | | 6900 | 6407 |
| 135 | 8299 | 8617 | 6526 | | | 6550 | 6116 |
| 140 | 8094 | 8302 | 6256 | | | 6200 | 5842 |
| 145 | 7892 | 8000 | 6000 | | | 5850 | |
| 150 | 7692 | 7710 | 5756 | | | 5500 | |
| 155 | 7496 | 7431 | 5524 | | | | |
| 160 | 7305 | 7164 | 5303 | | | | |
| 165 | 7118 | 6908 | 5094 | | | | |
| 170 | 6934 | 6663 | 4895 | | | | |
| 175 | 6754 | 6429 | 4706 | | | | |
| 180 | 6579 | 6204 | 4526 | | | | |
| 185 | 6408 | 5989 | 4355 | | | | |
| 190 | 6242 | 5783 | 4192 | | | | |
| 195 | 6080 | 5586 | 4037 | | | | |
| 200 | 5921 | | | | | | |

## Maximum Ratio of $\frac{l}{r}$

| Compression Formula | Members | |
|---|---|---|
| | Primary | Secondary |
| Am. Inst. of Steel Construction | 120 | 200 |
| Am. Society of Civil Engineers. | 100 | 200 |
| Am. R'y Engineering Ass'n. . . | 100 | 120 |

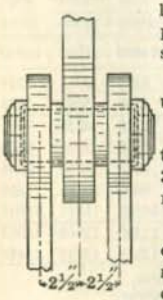
| Compression Formula | Members | |
|---|---|---|
| | Primary | Secondary |
| New York Bldg. Law. . . . 1917 | 120 | 120 |
| Chicago Bldg. Law. . . . . 1919 | 120 | 150 |
| Philadelphia Bldg. Law. . 1919 | 140 | 140 |

## STRESSES IN RIVETS AND PINS

**Rivets.** In transmitting stresses between riveted pieces, it is customary to disregard friction and to proportion rivets to the entire stress to be transmitted. They must be of sufficient size and number to resist shear and to afford such bearing area as not to cause distortion of the metal at the rivet holes. In the case of beams which frame opposite and of single web girders, this latter condition often necessitates a greater thickness of web than required by the shearing stresses. In a plate girder with $\frac{5}{16}$" web, $\frac{3}{4}$" rivets connecting the web with the flange angles would have a bearing value at 24,000 pounds unit stress of 5,630 pounds per rivet, while their value in double shear at 12,000 pounds unit stress is 10,600 pounds per rivet; and it might be necessary to increase the web thickness to $\frac{3}{8}$" or more in order that the pressure of the rivets upon the metal be not excessive.

**Pins.** Pins must be calculated for shearing, bending and bearing stresses, but one of the latter two will in most cases determine the size. When groups of bars are connected to the same pin, as in the lower chord of truss bridges, the size of the bars must be so chosen and the bars so placed that at no point on the pin will there be any excessive bending stress. When the size of pin has been determined from the bending stress, the thickness of the bars or web of the post should be investigated to provide sufficient bearing area, the bars being thickened or pin plates added if necessary.

The following is the formula for flexure applied to pins: $M = f \pi d^3 \div 32$ or $= f A d \div 8$, in which M = moment of forces for any section through pin, f=fiber stress per square inch in bending, A=the area of section, d=diameter, $\pi = 3.14159$. The forces are assumed to act in a plane passing through the axis of the pin.




EXAMPLE 1.—Required the size of a pin carrying a load of 64,000 pounds, at a distance of 5 inches between points of support; maximum fiber stress 24,000 pounds per square inch.

Bending moment=64,000 x 5 ÷ 4=80,000 inch pounds; use a 3¼ inch pin; allowed moment: 80,900 inch pounds.

EXAMPLE 2.—Required the thickness of metal in the top chord of a bridge to give sufficient bearing area to a 3⅜-inch pin, having to transmit a stress of 121,400 pounds; maximum bearing pressure 24,000 pounds per square inch.

The bearing value of a 3⅜-inch pin for 1 inch thickness of metal is 81,000 pounds; therefore, the thickness of metal required=121,400 ÷ 81,000=1½ inch, or each web of the chord must be ¾ inch thick, including pin plates.

# RIVETS

## Shearing and Bearing Values, in Pounds

### ½-INCH RIVETS—Area 0.19635 Square Inch

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Shearing | Unit, Lbs. per Sq. In. | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | Single Shear per Rivet | 1473 | 1571 | 1767 | 1964 | 2160 | 2356 | 2651 | 2945 |
| | Double Shear per Rivet | 2945 | 3142 | 3534 | 3927 | 4320 | 4712 | 5301 | 5890 |
| Bearing | Unit, Lbs. per Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 27000 | 30000 |
| Thickness, in Inches | ⅛ | 938 | 1000 | 1125 | 1250 | 1375 | 1500 | 1688 | 1875 |
| | 3/16 | 1406 | 1500 | 1688 | 1875 | 2063 | 2250 | 2531 | 2813 |
| | ¼ | 1875 | 2000 | 2250 | 2500 | 2750 | 3000 | 3375 | 3750 |
| | 5/16 | 2344 | 2500 | 2813 | 3125 | 3438 | 3750 | 4219 | 4688 |
| | ⅜ | 2813 | 3000 | 3375 | 3750 | 4125 | 4500 | 5062 | 5625 |
| | 7/16 | 3281 | 3500 | 3938 | 4375 | 4813 | 5250 | 5906 | 6563 |
| | ½ | 3750 | 4000 | 4500 | 5000 | 5500 | 6000 | 6750 | 7500 |

### ⅝-INCH RIVETS—Area 0.30680 Square Inch

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Shearing | Unit, Lbs. per Sq. In. | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | Single Shear per Rivet | 2301 | 2454 | 2761 | 3068 | 3375 | 3682 | 4142 | 4602 |
| | Double Shear per Rivet | 4602 | 4908 | 5522 | 6136 | 6750 | 7363 | 8284 | 9204 |
| Bearing | Unit, Lbs. per Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 27000 | 30000 |
| Thickness, in Inches | ⅛ | 1172 | 1250 | 1406 | 1563 | 1719 | 1875 | 2109 | 2344 |
| | 3/16 | 1758 | 1875 | 2109 | 2344 | 2578 | 2813 | 3164 | 3516 |
| | ¼ | 2344 | 2500 | 2813 | 3125 | 3438 | 3750 | 4219 | 4688 |
| | 5/16 | 2930 | 3125 | 3516 | 3906 | 4297 | 4688 | 5273 | 5859 |
| | ⅜ | 3516 | 3750 | 4219 | 4688 | 5156 | 5625 | 6328 | 7031 |
| | 7/16 | 4102 | 4375 | 4922 | 5469 | 6016 | 6563 | 7383 | 8203 |
| | ½ | 4688 | 5000 | 5625 | 6250 | 6875 | 7500 | 8438 | 9375 |
| | 9/16 | 5273 | 5625 | 6328 | 7031 | 7734 | 8438 | 9492 | 10547 |

### ¾-INCH RIVETS—Area 0.44179 Square Inch

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Shearing | Unit, Lbs. per Sq. In. | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | Single Shear per Rivet | 3313 | 3534 | 3976 | 4418 | 4860 | 5301 | 5964 | 6627 |
| | Double Shear per Rivet | 6627 | 7069 | 7952 | 8836 | 9719 | 10603 | 11928 | 13254 |
| Bearing | Unit, Lbs. per Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 27000 | 30000 |
| Thickness, in Inches | 3/16 | 2109 | 2250 | 2531 | 2813 | 3094 | 3375 | 3797 | 4219 |
| | ¼ | 2813 | 3000 | 3375 | 3750 | 4125 | 4500 | 5063 | 5625 |
| | 5/16 | 3516 | 3750 | 4219 | 4688 | 5156 | 5625 | 6328 | 7031 |
| | ⅜ | 4219 | 4500 | 5063 | 5625 | 6188 | 6750 | 7594 | 8438 |
| | 7/16 | 4922 | 5250 | 5906 | 6563 | 7219 | 7875 | 8859 | 9844 |
| | ½ | 5625 | 6000 | 6750 | 7500 | 8250 | 9000 | 10125 | 11250 |
| | 9/16 | 6328 | 6750 | 7594 | 8438 | 9281 | 10125 | 11391 | 12656 |
| | ⅝ | 7031 | 7500 | 8438 | 9375 | 10313 | 11250 | 12656 | 14063 |
| | 11/16 | 7734 | 8250 | 9281 | 10313 | 11343 | 12375 | 13922 | 15469 |

Values above upper dotted lines are less than single shear.
Values below lower dotted lines are greater than double shear.

# RIVETS

## Shearing and Bearing Values, in Pounds

### ⅞-INCH RIVETS—Area 0.60132 Square Inch

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Shearing | Unit, Lbs. per Sq. In. | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | Single Shear per Rivet | 4510 | 4811 | 5412 | 6013 | 6615 | 7216 | 8118 | 9020 |
| | Double Shear per Rivet | 9020 | 9621 | 10824 | 12026 | 13229 | 14432 | 16236 | 18040 |
| Bearing | Unit, Lbs. per Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 27000 | 30000 |
| Thickness, in Inches | ¼ | 3281 | 3500 | 3938 | 4375 | 4813 | 5250 | 5906 | 6563 |
| | 5/16 | 4102 | 4375 | 4922 | 5469 | 6016 | 6563 | 7383 | 8203 |
| | ⅜ | 4922 | 5250 | 5906 | 6563 | 7219 | 7875 | 8859 | 9844 |
| | 7/16 | 5742 | 6125 | 6891 | 7656 | 8422 | 9188 | 10336 | 11484 |
| | ½ | 6563 | 7000 | 7875 | 8750 | 9625 | 10500 | 11813 | 13125 |
| | 9/16 | 7383 | 7875 | 8859 | 9844 | 10828 | 11813 | 13289 | 14766 |
| | ⅝ | 8203 | 8750 | 9844 | 10938 | 12031 | 13125 | 14766 | 16406 |
| | 11/16 | 9023 | 9625 | 10828 | 12031 | 13234 | 14438 | 16242 | 18047 |
| | ¾ | 9844 | 10500 | 11813 | 13125 | 14438 | 15750 | 17719 | 19688 |

### 1-INCH RIVETS—Area 0.78540 Square Inch

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Shearing | Unit, Lbs. per Sq. In. | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | Single Shear per Rivet | 5891 | 6283 | 7069 | 7854 | 8639 | 9425 | 10603 | 11781 |
| | Double Shear per Rivet | 11781 | 12566 | 14137 | 15708 | 17279 | 18850 | 21206 | 23562 |
| Bearing | Unit, Lbs. per Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 27000 | 30000 |
| Thickness, in Inches | 5/16 | 4688 | 5000 | 5625 | 6250 | 6875 | 7500 | 8438 | 9375 |
| | ⅜ | 5625 | 6000 | 6750 | 7500 | 8250 | 9000 | 10125 | 11250 |
| | 7/16 | 6563 | 7000 | 7875 | 8750 | 9625 | 10500 | 11813 | 13125 |
| | ½ | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | 9/16 | 8438 | 9000 | 10125 | 11250 | 12375 | 13500 | 15188 | 16875 |
| | ⅝ | 9375 | 10000 | 11250 | 12500 | 13750 | 15000 | 16875 | 18750 |
| | 11/16 | 10313 | 11000 | 12375 | 13750 | 15125 | 16500 | 18563 | 20625 |
| | ¾ | 11250 | 12000 | 13500 | 15000 | 16500 | 18000 | 20250 | 22500 |
| | 13/16 | 12188 | 13000 | 14625 | 16250 | 17875 | 19500 | 21938 | 24375 |

### 1⅛-INCH RIVETS—Area 0.99402 Square Inch

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Shearing | Unit, Lbs. per Sq. In. | 7500 | 8000 | 9000 | 10000 | 11000 | 12000 | 13500 | 15000 |
| | Single Shear per Rivet | 7455 | 7952 | 8946 | 9940 | 10934 | 11928 | 13419 | 14910 |
| | Double Shear per Rivet | 14910 | 15904 | 17892 | 19880 | 21868 | 23856 | 26839 | 29821 |
| Bearing | Unit, Lbs. per Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 27000 | 30000 |
| Thickness, in Inches | 7/16 | 7383 | 7875 | 8859 | 9844 | 10828 | 11813 | 13289 | 14766 |
| | ½ | 8438 | 9000 | 10125 | 11250 | 12375 | 13500 | 15188 | 16875 |
| | 9/16 | 9492 | 10125 | 11391 | 12656 | 13922 | 15188 | 17086 | 18984 |
| | ⅝ | 10547 | 11250 | 12656 | 14063 | 15469 | 16875 | 18984 | 21094 |
| | 11/16 | 11602 | 12375 | 13922 | 15469 | 17016 | 18563 | 20883 | 23203 |
| | ¾ | 12656 | 13500 | 15188 | 16875 | 18563 | 20250 | 22781 | 25313 |
| | 13/16 | 13711 | 14625 | 16453 | 18281 | 20109 | 21938 | 24680 | 27422 |
| | ⅞ | 14766 | 15750 | 17719 | 19688 | 21656 | 23625 | 26578 | 29531 |
| | 15/16 | 15820 | 16875 | 18984 | 21094 | 23203 | 25313 | 28477 | 31641 |

Values above upper dotted lines are less than single shear.
Values below lower dotted lines are greater than double shear.

# PINS

## Bearing Values on Metal One Inch Thick, in Pounds

### Dia. x 1 x Unit Stress

| Pin | | Fiber Stress in Pounds per Square Inch | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Dia., Inches | Area, Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 25000 | 27000 | 30000 |
| 1 | .785 | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 25000 | 27000 | 30000 |
| 1 ¼ | 1.227 | 18750 | 20000 | 22500 | 25000 | 27500 | 30000 | 31250 | 33750 | 37500 |
| 1 ½ | 1.767 | 22500 | 24000 | 27000 | 30000 | 33000 | 36000 | 37500 | 40500 | 45000 |
| 1 ¾ | 2.405 | 26250 | 28000 | 31500 | 35000 | 38500 | 42000 | 43750 | 47250 | 52500 |
| 2 | 3.142 | 30000 | 32000 | 36000 | 40000 | 44000 | 48000 | 50000 | 54000 | 60000 |
| 2 ¼ | 3.976 | 33750 | 36000 | 40500 | 45000 | 49500 | 54000 | 56250 | 60750 | 67500 |
| 2 ½ | 4.909 | 37500 | 40000 | 45000 | 50000 | 55000 | 60000 | 62500 | 67500 | 75000 |
| 2 ¾ | 5.940 | 41250 | 44000 | 49500 | 55000 | 60500 | 66000 | 68750 | 74250 | 82500 |
| 3 | 7.069 | 45000 | 48000 | 54000 | 60000 | 66000 | 72000 | 75000 | 81000 | 90000 |
| 3 ¼ | 8.296 | 48750 | 52000 | 58500 | 65000 | 71500 | 78000 | 81250 | 87750 | 97500 |
| 3 ½ | 9.621 | 52500 | 56000 | 63000 | 70000 | 77000 | 84000 | 87500 | 94500 | 105000 |
| 3 ¾ | 11.045 | 56250 | 60000 | 67500 | 75000 | 82500 | 90000 | 93750 | 101250 | 112500 |
| 4 | 12.566 | 60000 | 64000 | 72000 | 80000 | 88000 | 96000 | 100000 | 108000 | 120000 |
| 4 ¼ | 14.186 | 63750 | 68000 | 76500 | 85000 | 93500 | 102000 | 106250 | 114750 | 127500 |
| 4 ½ | 15.904 | 67500 | 72000 | 81000 | 90000 | 99000 | 108000 | 112500 | 121500 | 135000 |
| 4 ¾ | 17.721 | 71250 | 76000 | 85500 | 95000 | 104500 | 114000 | 118750 | 128250 | 142500 |
| 5 | 19.635 | 75000 | 80000 | 90000 | 100000 | 110000 | 120000 | 125000 | 135000 | 150000 |
| 5 ¼ | 21.648 | 78750 | 84000 | 94500 | 105000 | 115500 | 126000 | 131250 | 141750 | 157500 |
| 5 ½ | 23.758 | 82500 | 88000 | 99000 | 110000 | 121000 | 132000 | 137500 | 148500 | 165000 |
| 5 ¾ | 25.967 | 86250 | 92000 | 103500 | 115000 | 126500 | 138000 | 143750 | 155250 | 172500 |
| 6 | 28.274 | 90000 | 96000 | 108000 | 120000 | 132000 | 144000 | 150000 | 162000 | 180000 |
| 6 ¼ | 30.680 | 93750 | 100000 | 112500 | 125000 | 137500 | 150000 | 156250 | 168750 | 187500 |
| 6 ½ | 33.183 | 97500 | 104000 | 117000 | 130000 | 143000 | 156000 | 162500 | 175500 | 195000 |
| 6 ¾ | 35.785 | 101250 | 108000 | 121500 | 135000 | 148500 | 162000 | 168750 | 182250 | 202500 |
| 7 | 38.485 | 105000 | 112000 | 126000 | 140000 | 154000 | 168000 | 175000 | 189000 | 210000 |
| 7 ¼ | 41.282 | 108750 | 116000 | 130500 | 145000 | 159500 | 174000 | 181250 | 195750 | 217500 |
| 7 ½ | 44.179 | 112500 | 120000 | 135000 | 150000 | 165000 | 180000 | 187500 | 202500 | 225000 |
| 7 ¾ | 47.173 | 116250 | 124000 | 139500 | 155000 | 170500 | 186000 | 193750 | 209250 | 232500 |
| 8 | 50.265 | 120000 | 128000 | 144000 | 160000 | 176000 | 192000 | 200000 | 216000 | 240000 |
| 8 ¼ | 53.456 | 123750 | 132000 | 148500 | 165000 | 181500 | 198000 | 206250 | 222750 | 247500 |
| 8 ½ | 56.745 | 127500 | 136000 | 153000 | 170000 | 187000 | 204000 | 212500 | 229500 | 255000 |
| 8 ¾ | 60.132 | 131250 | 140000 | 157500 | 175000 | 192500 | 210000 | 218750 | 236250 | 262500 |
| 9 | 63.617 | 135000 | 144000 | 162000 | 180000 | 198000 | 216000 | 225000 | 243000 | 270000 |
| 9 ¼ | 67.201 | 138750 | 148000 | 166500 | 185000 | 203500 | 222000 | 231250 | 249750 | 277500 |
| 9 ½ | 70.882 | 142500 | 152000 | 171000 | 190000 | 209000 | 228000 | 237500 | 256500 | 285000 |
| 9 ¾ | 74.662 | 146250 | 156000 | 175500 | 195000 | 214500 | 234000 | 243750 | 263250 | 292500 |
| 10 | 78.540 | 150000 | 160000 | 180000 | 200000 | 220000 | 240000 | 250000 | 270000 | 300000 |
| 10 ¼ | 82.516 | 153750 | 164000 | 184500 | 205000 | 225500 | 246000 | 256250 | 276750 | 307500 |
| 10 ½ | 86.590 | 157500 | 168000 | 189000 | 210000 | 231000 | 252000 | 262500 | 283500 | 315000 |
| 10 ¾ | 90.763 | 161250 | 172000 | 193500 | 215000 | 236500 | 258000 | 268750 | 290250 | 322500 |
| 11 | 95.033 | 165000 | 176000 | 198000 | 220000 | 242000 | 264000 | 275000 | 297000 | 330000 |
| 11 ¼ | 99.402 | 168750 | 180000 | 202500 | 225000 | 247500 | 270000 | 281250 | 303750 | 337500 |
| 11 ½ | 103.869 | 172500 | 184000 | 207000 | 230000 | 253000 | 276000 | 287500 | 310500 | 345000 |
| 11 ¾ | 108.434 | 176250 | 188000 | 211500 | 235000 | 258500 | 282000 | 293750 | 317250 | 352500 |
| 12 | 113.097 | 180000 | 192000 | 216000 | 240000 | 264000 | 288000 | 300000 | 324000 | 360000 |

## PINS

### Bending Moments in Thousands of Inch Pounds

Dia.$^3$ x 0.098175 x Unit Stress

| Pin | | Fiber Stress in Pounds per Square Inch | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Dia., Inches | Area, Sq. In. | 15000 | 16000 | 18000 | 20000 | 22000 | 24000 | 25000 | 27000 |
| 1 | .785 | 1.5 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.5 | 2.7 |
| 1 ¼ | 1.227 | 2.9 | 3.1 | 3.5 | 3.8 | 4.2 | 4.6 | 4.8 | 5.2 |
| 1 ½ | 1.767 | 5.0 | 5.3 | 6.0 | 6.6 | 7.3 | 8.0 | 8.3 | 8.9 |
| 1 ¾ | 2.405 | 7.9 | 8.4 | 9.5 | 10.5 | 11.6 | 12.6 | 13.2 | 14.2 |
| 2 | 3.142 | 11.8 | 12.6 | 14.1 | 15.7 | 17.3 | 18.8 | 19.6 | 21.2 |
| 2 ¼ | 3.976 | 16.8 | 17.9 | 20.1 | 22.4 | 24.6 | 26.8 | 28.0 | 30.2 |
| 2 ½ | 4.909 | 23.0 | 24.5 | 27.6 | 30.7 | 33.7 | 36.8 | 38.3 | 41.4 |
| 2 ¾ | 5.940 | 30.6 | 32.7 | 36.8 | 40.8 | 44.9 | 49.0 | 51.0 | 55.1 |
| 3 | 7.069 | 39.8 | 42.4 | 47.7 | 53.0 | 58.3 | 63.6 | 66.3 | 71.6 |
| 3 ¼ | 8.296 | 50.6 | 53.9 | 60.7 | 67.4 | 74.1 | 80.9 | 84.3 | 91.0 |
| 3 ½ | 9.621 | 63.1 | 67.3 | 75.8 | 84.2 | 92.6 | 101.0 | 105.2 | 113.7 |
| 3 ¾ | 11.045 | 77.7 | 82.8 | 93.2 | 103.5 | 113.9 | 124.3 | 129.4 | 139.8 |
| 4 | 12.566 | 94.2 | 100.5 | 113.1 | 125.7 | 138.2 | 150.8 | 157.1 | 169.6 |
| 4 ¼ | 14.186 | 113.0 | 120.6 | 135.7 | 150.7 | 165.8 | 180.9 | 188.4 | 203.5 |
| 4 ½ | 15.904 | 134.2 | 143.1 | 161.0 | 178.9 | 196.8 | 214.7 | 223.7 | 241.6 |
| 4 ¾ | 17.721 | 157.8 | 168.3 | 189.4 | 210.4 | 231.5 | 252.5 | 263.0 | 284.1 |
| 5 | 19.635 | 184.1 | 196.4 | 220.9 | 245.4 | 270.0 | 294.5 | 306.8 | 331.3 |
| 5 ¼ | 21.648 | 213.1 | 227.3 | 255.7 | 284.1 | 312.5 | 340.9 | 355.2 | 383.6 |
| 5 ½ | 23.758 | 245.0 | 261.3 | 294.0 | 326.7 | 359.3 | 392.0 | 408.3 | 441.0 |
| 5 ¾ | 25.967 | 280.0 | 298.6 | 336.0 | 373.3 | 410.6 | 447.9 | 466.6 | 503.9 |
| 6 | 28.274 | 318.1 | 339.3 | 381.7 | 424.1 | 466.5 | 508.9 | 530.1 | 572.6 |
| 6 ¼ | 30.680 | 359.5 | 383.5 | 431.4 | 479.4 | 527.3 | 575.2 | 599.2 | 647.1 |
| 6 ½ | 33.183 | 404.4 | 431.4 | 485.3 | 539.2 | 593.1 | 647.1 | 674.0 | 728.0 |
| 6 ¾ | 35.785 | 452.9 | 483.1 | 543.5 | 603.9 | 664.3 | 724.6 | 754.8 | 815.2 |
| 7 | 38.485 | 505.1 | 538.8 | 606.1 | 673.5 | 740.8 | 808.2 | 841.8 | 909.2 |
| 7 ¼ | 41.282 | 561.2 | 598.6 | 673.4 | 748.2 | 823.1 | 897.9 | 935.3 | 1010.1 |
| 7 ½ | 44.179 | 621.3 | 662.7 | 745.5 | 828.4 | 911.2 | 994.0 | 1035.4 | 1118.3 |
| 7 ¾ | 47.173 | 685.5 | 731.2 | 822.6 | 914.0 | 1005.4 | 1096.8 | 1142.5 | 1233.9 |
| 8 | 50.265 | 754.0 | 804.3 | 904.8 | 1005.3 | 1105.8 | 1206.4 | 1256.6 | 1357.2 |
| 8 ¼ | 53.456 | 826.9 | 882.0 | 992.3 | 1102.5 | 1212.8 | 1323.0 | 1378.2 | 1488.4 |
| 8 ½ | 56.745 | 904.4 | 964.7 | 1085.3 | 1205.8 | 1326.4 | 1447.0 | 1507.3 | 1627.9 |
| 8 ¾ | 60.132 | 986.5 | 1052.3 | 1183.9 | 1315.4 | 1446.9 | 1578.5 | 1644.2 | 1775.8 |
| 9 | 63.617 | 1073.5 | 1145.1 | 1288.3 | 1431.4 | 1574.5 | 1717.7 | 1789.2 | 1932.4 |
| 9 ¼ | 67.201 | 1165.5 | 1243.2 | 1398.6 | 1554.0 | 1709.4 | 1864.8 | 1942.5 | 2097.9 |
| 9 ½ | 70.882 | 1262.6 | 1346.8 | 1515.1 | 1683.5 | 1851.8 | 2020.1 | 2104.3 | 2272.7 |
| 9 ¾ | 74.662 | 1364.9 | 1455.9 | 1637.9 | 1819.9 | 2001.9 | 2183.9 | 2274.9 | 2456.8 |
| 10 | 78.540 | 1472.6 | 1570.8 | 1767.1 | 1963.5 | 2159.8 | 2356.2 | 2454.4 | 2650.7 |
| 10 ¼ | 82.516 | 1585.9 | 1691.6 | 1903.0 | 2114.5 | 2325.9 | 2537.4 | 2643.1 | 2854.5 |
| 10 ½ | 86.590 | 1704.7 | 1818.4 | 2045.7 | 2273.0 | 2500.3 | 2727.6 | 2841.2 | 3068.5 |
| 10 ¾ | 90.763 | 1829.4 | 1951.4 | 2195.3 | 2439.2 | 2683.2 | 2927.1 | 3049.1 | 3293.0 |
| 11 | 95.033 | 1960.1 | 2090.7 | 2352.1 | 2613.4 | 2874.8 | 3136.1 | 3266.8 | 3528.1 |
| 11 ¼ | 99.402 | 2096.8 | 2236.5 | 2516.1 | 2795.7 | 3075.2 | 3354.8 | 3494.6 | 3774.2 |
| 11 ½ | 103.869 | 2239.7 | 2389.0 | 2687.6 | 2986.2 | 3284.9 | 3583.5 | 3732.8 | 4031.4 |
| 11 ¾ | 108.434 | 2388.9 | 2548.2 | 2866.7 | 3185.3 | 3503.8 | 3822.3 | 3981.6 | 4300.1 |
| 12 | 113.097 | 2544.7 | 2714.3 | 3053.6 | 3392.9 | 3732.2 | 4071.5 | 4241.2 | 4580.5 |

## FLOOR PLATES

### Flat Rectangular Plates

Rectangular steel plates, plain, checkered or indented, are frequently used in mill floor construction, supported by the floor beams on two sides or on all four sides and more or less securely fixed to the flanges of the supporting beams.

The resistance of rectangular plates to superimposed loads may be obtained from the formulas given below; the formulas given for plates supported on four sides apply generally to rectangular plates subjected to pressures normal to surface of plates.

M = Bending moment, due to uniform or concentrated load, inch-pounds.
f = Unit fiber stress, pounds per square inch.
w = Unit load, pounds per square inch.
a, b = Sides of plate, inches, (a<b) t = Thickness of plate, inches.
c = Perpendicular distance, from corner to diagonal, d, of plate, inches.
$\phi$ = Limiting values for steel plates, fixed and not fixed to supports (v. Bach).

Plate supported on two sides, a—Uniformly distributed load.

$$M=\frac{w\,a\,b^2}{8}=f\,S \qquad S=\frac{a\,t^2}{6} \qquad f=\tfrac{3}{4}\,b^2\,\frac{w}{t^2}$$

Plate supported on four sides, a, b—Uniformly distributed load.

$$f=\phi\,\tfrac{1}{2}\,\frac{a^2\,b^2}{a^2+b^2}\,\frac{w}{t^2} \qquad f=\phi\,\tfrac{1}{2}\,c^2\,\frac{w}{t^2} \qquad \phi=9/16 \text{ to } 3/4$$

Plate supported on four sides, a, b—Concentrated load in center.

$$f=\phi\,\tfrac{3}{2}\,\frac{ab}{a^2+b^2}\,\frac{P}{t^2} \qquad f=\phi\,\tfrac{3}{2}\,\frac{c}{d}\,\frac{P}{t^2} \qquad \phi=1\tfrac{1}{4} \text{ to } 1\tfrac{1}{3}$$

### Buckle Plates

Buckle plates are generally used on highway bridges with paved floors, and may be subjected to concentrated live loads, due to the weight of truck wheels and to a uniform load due to the paving.

The resistance of buckle plates, when the buckle is turned up and in compression may be computed from the formulas (Winkler):

Total uniformly distributed load

$W=4\,f\,d\,t$, pounds per buckle.

Total concentrated load, in addition to uniform dead load.

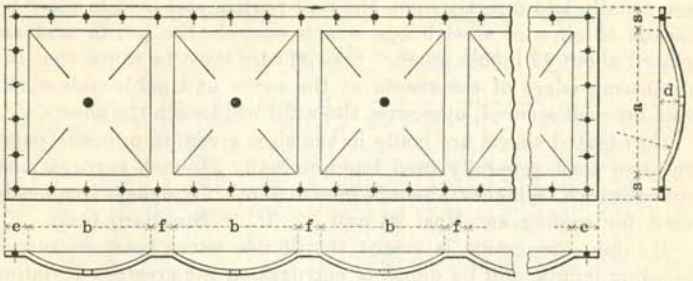
$$P=\frac{t\,(100\,f\,d\,t-25.2\,w\,a\,b)}{6\,d+15\,t}, \text{ pounds per buckle}$$

a, b = Sides. t = Thickness. d = Rise of Buckle, inches.
w = Unit load, pounds per square inch. f = Allowable fiber stress, 9000 lbs. per sq. inch.

Buckle plates are generally placed with the convex side of the buckle turned down and in tension, in which case the strength of the buckle plates is about three times greater.

## BUCKLE PLATES—Dimensions

AMERICAN BRIDGE COMPANY STANDARD




| Size of Buckle, Inches | | | Die No. | Size of Buckle, Inches | | | Die No. | Size of Buckle, Inches | | | Die No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| a | b | d | | a | b | d | | a | b | d | |
| 21 | 21 | 2½ | 39 | 36 | 36 | 2 | 13 | 45 | 37 | 3 | 6 |
| 23½ | 24 | 2½ | 38 | 36 | 37 | 3 | 29 | 45 | 42 | 3 | 24 |
| 23½ | 28½ | 2½ | 36 | 37 | 36 | 3 | 28 | 45 | 45 | 3 | 5 |
| 23½ | 47 | 2½ | 18 | 37 | 38 | 3 | 26 | 47 | 23½ | 2½ | 17 |
| 24 | 23½ | 2½ | 37 | 37 | 45 | 3 | 7 | 47 | 42 | 3 | 4 |
| 24 | 30 | 2½ | 30 | 38 | 37 | 3 | 27 | 47 | 54 | 3½ | 2 |
| 26 | 44 | 2 | 12 | 41 | 42 | 3 | 23 | 48 | 48 | 3 | 34 |
| 28½ | 23½ | 2½ | 35 | 42 | 41 | 3 | 22 | 51¼ | 61 | 4 | 16 |
| 30 | 24 | 2½ | 31 | 42 | 45 | 3 | 25 | 54 | 47 | 3½ | 1 |
| 30 | 30 | 2½ | 21 | 42 | 47 | 3 | 3 | 61 | 51¼ | 4 | 15 |
| 30 | 33 | 2½ | 20 | 42 | 66 | 3½ | 32 | 66 | 42 | 3½ | 33 |
| 32 | 44 | 2 | 10 | 44 | 26 | 2 | 11 | | | | |
| 33 | 30 | 2½ | 19 | 44 | 32 | 2 | 9 | | | | |
| 33 | 33 | 3 | 14 | 44 | 44 | 2 | 8 | | | | |

MAXIMUM WIDTH = 94″ for plates not over 12 ft. long. 71″ for plates not over 35 ft. long.
MAXIMUM LENGTH = 35 ft. Plates of greater length can be obtained by splicing.
ALLOWABLE OVERRUN in length or width must be given on drawing, where clearance is close.
END FLANGES e = 2″ Minimum 18″ Maximum
SIDE FLANGES s = 2″ Minimum 6½″ Maximum 4″ or less, preferred.
FILLETS f = 2′ Minimum 6″ Maximum 4″ or less, preferred.

END FLANGES to be made alike if possible. If over 18″, stiffen with angles across plate.

SIDE FLANGES to be made alike if possible. When side flanges must be of unequal width, the plate should be ordered wide enough to make two flanges of the greater width. After plate is buckled, it will be sheared to required width.

BUCKLES can be lengthwise or crosswise of plate, but different sizes should not be used in the same plate. Plates are buckled one buckle at a time, and the number of buckles is determined by size of buckles, fillets and end flanges, and by length of plate that can be fabricated.
A plate 35 ft. long could have:—14 buckles No. 11, b = 2′-2″, with f = 3½″ and e = 5¼″
or, 9 buckles No. 12, b = 3′-8″, with f = 2¼″ and e = 3″

CONNECTION HOLES are usually for ⅝″, ¾″ or ⅞″ rivets or bolts. Holes of different sizes in the same plate increase the cost. SPACING: Crosswise, usually 6″, with 4½″ Min. Lengthwise, from 6″ to 12″. Odd spaces at ends, in even ¼″.

DRAWING must show **Top View** of plate, give **Die Number,** and state whether buckles are turned **up** or **down.** When buckles are turned **down,** the drawing must show a **Drain Hole** in the center of each buckle.

## CORRUGATED SHEETS

Corrugated sheets are used for roofs and sides of buildings. They are usually laid directly upon the roof purlins and held in place by means of clips of steel hoops which encircle the purlin and are placed about 12 inches apart. Special care must be taken that the projecting edges of the sheets at the eaves and gable ends of the roof are well secured, otherwise the wind will loosen the sheets.

Corrugated sheets are made in the sizes given on opposite page, the size most generally used has nominally 2½-inch corrugations, actual width 2⅝ inches, about ½ inch in depth. The gages frequently used for roofing are Nos. 20 and 22, U. S. Standard Gage.

By one corrugation is meant the double curve between corresponding points, and by depth of corrugation the greatest deviation of the curved surfaces from the straight line.

One and one-half corrugations are allowed for lap in the width of the sheet and 6 inches in the length for the usual quarter pitch roof; one corrugation in width and 4 inches in the length of the sheet is usually allowed for sidings.

Corrugated sheets of 2, 2½ and 3 corrugations are furnished in standard lengths of 5, 6, 7, 8, 9 and 10 feet and with a standard covering width of 24 inches, when laid with a lap of either one or one and one-half corrugations.

By experiment it has been determined that corrugated sheet steel, ⅝ inch deep and No. 20 gage spanning 6 feet, began to give a permanent deflection with a load of 30 pounds per sq. foot, and that it collapsed with a load of 60 pounds per sq. foot. The distance between centers of purlins should, therefore, not exceed 6 feet and should preferably be less than this.

Approximately the uniformly distributed safe load of corrugated sheets may be obtained from the formulas given below, using the following notations:—

W=Total allowable uniform load, in pounds.
b=Curvilinear width of sheet, in inches,
=1.075 x covering width.
l=Unsupported length of sheet, in inches.
t=Thickness of sheet, in inches.
d=Depth of corrugations, in inches.
f=Allowable fiber stress, in pounds per sq. inch.

Then: $W = \frac{8fS}{l} = \frac{8f}{l} \times \frac{4bdt}{15} = \frac{32fbdt}{15\,l}$

for $f = 10000$, $W = \frac{21{,}333\ bdt}{l}$

## CORRUGATED SHEETS—DIMENSIONS

AMERICAN SHEET AND TIN PLATE COMPANY

DESCRIPTION OF SHEETS — AREAS OF SHEETS

| Corrugations | | | | Width, Inches | | Length of Sheet, Inches | Sq. Ft. in 1 Sheet | | | Sheets in 100 Sq. Ft. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Width, Inches | | Depth, Inches | Number per Sheet | Full Sheet | Covering | | Corrugations | | | Corrugations | | |
| Nominal | Actual | | | | | | 5″ | 3″, 2½″, 2″ | 1¼″, ⅝″, ⅝″ | 5″ | 3″, 2½″, 2″ | 1¼″, ⅝″, ⅝″ |
| 5 | 5 | 7/8 | 6 | 28 | 25 | 60 | 11.67 | 10.83 | 10.42 | 8.57 | 9.23 | 9.60 |
| 3 | 3 | 9/16 | 9 | 26 | 24 | 72 | 14.00 | 13.00 | 12.50 | 7.14 | 7.69 | 8.00 |
| *2½ | 2⅜ | ½ | 10½ | 27½ | 24 | 84 | 16.33 | 15.17 | 14.58 | 6.12 | 6.59 | 6.86 |
| 2½ | 2⅜ | ½ | 10 | 26 | 24 | 96 | 18.67 | 17.33 | 16.67 | 5.36 | 5.77 | 6.00 |
| 2 | 2 | 7/16 | 13 | 26 | 24 | 108 | 21.00 | 19.50 | 18.75 | 4.76 | 5.13 | 5.33 |
| 1¼ | 1¼ | ⅜ | 20 | 25 | 23¾ | 120 | 23.33 | 21.67 | 20.83 | 4.29 | 4.62 | 4.80 |
| ⅝ | ⅝ | 5/16 | 40 | 25 | 24⅜ | 144 | 28.00 | 26.00 | 25.00 | 3.57 | 3.85 | 4.00 |

Standard lengths 5, 6, 7, 8, 9 and 10 ft. Maximum length, 12 ft. except for ⅝″ corrugation. Sizes denoted *2½ are for the 27½″ width.

### PAINTED SHEETS—Weights in Pounds per 100 Square Feet.

| Corrug., In. | Thickness, United States Standard Gage | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12 | 14 | 16 | 18 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 5 | | 470 | 336 | 269 | 215 | 162 | 148 | 135 | 122 | 108 | 95 | 81 | 75 | 68 | .. |
| 3 | | 472 | 338 | 270 | 216 | 163 | 149 | 136 | 122 | 109 | 95 | 82 | 75 | 68 | .. |
| *2½ | 615 | 478 | 342 | 274 | 219 | 165 | 151 | 137 | 124 | 110 | 97 | 83 | 76 | 69 | .. |
| 2½ | 607 | 472 | 338 | 270 | 216 | 163 | 149 | 136 | 122 | 109 | 95 | 82 | 75 | 68 | .. |
| 2 | | | | 270 | 216 | 163 | 149 | 136 | 122 | 109 | 95 | 82 | 75 | 68 | .. |
| 1¼ | | | | | | 169 | 155 | 141 | 127 | 113 | 99 | 85 | 78 | 71 | .. |
| ⅝ | | | | | | | | | | 113 | 99 | 85 | 78 | 71 | .. |

### GALVANIZED SHEETS—Weights in Pounds per 100 Square Feet.

| Corrug., In. | Thickness, United States Standard Gage | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 12 | 14 | 16 | 18 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
| 5 | | 486 | 352 | 285 | 231 | 178 | 164 | 151 | 137 | 124 | 111 | 97 | 90 | 84 | 77 |
| 3 | | 488 | 353 | 286 | 232 | 178 | 165 | 151 | 138 | 125 | 111 | 98 | 91 | 84 | 77 |
| *2½ | 631 | 494 | 358 | 290 | 235 | 181 | 167 | 153 | 140 | 126 | 113 | 99 | 92 | 85 | 78 |
| 2½ | 623 | 488 | 353 | 286 | 232 | 178 | 165 | 151 | 138 | 125 | 111 | 98 | 91 | 84 | 77 |
| 2 | | | | 286 | 232 | 178 | 165 | 151 | 138 | 125 | 111 | 98 | 91 | 84 | 77 |
| 1¼ | | | | | | 186 | 172 | 158 | 144 | 130 | 116 | 102 | 95 | 88 | 81 |
| ⅝ | | | | | | | | | | 130 | 116 | 102 | 95 | 88 | 81 |

The weights per 100 square feet given in preceding tables do not include allowances for end or side laps. The following table gives the approximate number of square feet of sheeting necessary to cover an area of 100 square feet and is based on sheets of standard width, 96 inches long. If longer or shorter sheets are used, the number of square feet required will vary accordingly.

### SQ. FEET OF 2½ IN. STANDARD SHEETS TO COVER AREA OF 100 SQ. FT.

| Side Lap | End Lap, Inches | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 Corrugation | 109 | 111 | 112 | 113 | 114 | 116 |
| 1½ " | 116 | 117 | 118 | 120 | 121 | 122 |
| 2 " | 123 | 124 | 126 | 127 | 129 | 130 |

# PIPE—BLACK AND GALVANIZED

NATIONAL TUBE COMPANY STANDARD

## STANDARD PIPE

| Size, In. | Diameters, Inches | | Thickness, Inches | Weight per Foot, Pounds | | Threads per Inch | Couplings | | |
|---|---|---|---|---|---|---|---|---|---|
| | External | Internal | | Plain Ends | Threads and Couplings | | Diameter, Inches | Length, Inches | Weight, Pounds |
| ⅛ | .405 | .269 | .068 | .244 | .245 | 27 | .562 | ⅜ | .029 |
| ¼ | .540 | .364 | .088 | .424 | .425 | 18 | .685 | 1 | .043 |
| ⅜ | .675 | .493 | .091 | .567 | .568 | 18 | .848 | 1⅛ | .070 |
| ½ | .840 | .622 | .109 | .850 | .852 | 14 | 1.024 | 1⅜ | .116 |
| ¾ | 1.050 | .824 | .113 | 1.130 | 1.134 | 14 | 1.281 | 1⅝ | .209 |
| 1 | 1.315 | 1.049 | .133 | 1.678 | 1.684 | 11½ | 1.576 | 1⅞ | .343 |
| 1¼ | 1.660 | 1.380 | .140 | 2.272 | 2.281 | 11½ | 1.950 | 2⅛ | .535 |
| 1½ | 1.900 | 1.610 | .145 | 2.717 | 2.731 | 11½ | 2.218 | 2⅜ | .743 |
| 2 | 2.375 | 2.067 | .154 | 3.652 | 3.678 | 11½ | 2.760 | 2⅝ | 1.208 |
| 2½ | 2.875 | 2.469 | .203 | 5.793 | 5.819 | 8 | 3.276 | 2⅞ | 1.720 |
| 3 | 3.500 | 3.068 | .216 | 7.575 | 7.616 | 8 | 3.948 | 3⅛ | 2.498 |
| 3½ | 4.000 | 3.548 | .226 | 9.109 | 9.202 | 8 | 4.591 | 3⅜ | 4.241 |
| 4 | 4.500 | 4.026 | .237 | 10.790 | 10.889 | 8 | 5.091 | 3⅝ | 4.741 |
| 4½ | 5.000 | 4.506 | .247 | 12.538 | 12.642 | 8 | 5.591 | 3⅝ | 5.241 |
| 5 | 5.563 | 5.047 | .258 | 14.617 | 14.810 | 8 | 6.296 | 4⅛ | 8.091 |
| 6 | 6.625 | 6.065 | .280 | 18.974 | 19.185 | 8 | 7.358 | 4⅛ | 9.554 |
| 7 | 7.625 | 7.023 | .301 | 23.544 | 23.769 | 8 | 8.358 | 4⅛ | 10.932 |
| 8 | 8.625 | 8.071 | .277 | 24.696 | 25.000 | 8 | 9.358 | 4⅝ | 13.905 |
| 8 | 8.625 | 7.981 | .322 | 28.554 | 28.809 | 8 | 9.358 | 4⅝ | 13.905 |
| 9 | 9.625 | 8.941 | .342 | 33.907 | 34.188 | 8 | 10.358 | 5⅛ | 17.236 |
| 10 | 10.750 | 10.192 | .279 | 31.201 | 32.000 | 8 | 11.721 | 6⅛ | 29.877 |
| 10 | 10.750 | 10.136 | .307 | 34.240 | 35.000 | 8 | 11.721 | 6⅛ | 29.877 |
| 10 | 10.750 | 10.020 | .365 | 40.483 | 41.132 | 8 | 11.721 | 6⅛ | 29.877 |
| 11 | 11.750 | 11.000 | .375 | 45.557 | 46.247 | 8 | 12.721 | 6⅛ | 32.550 |
| 12 | 12.750 | 12.090 | .330 | 43.773 | 45.000 | 8 | 13.958 | 6⅛ | 43.098 |
| 12 | 12.750 | 12.000 | .375 | 49.562 | 50.706 | 8 | 13.958 | 6⅛ | 43.098 |
| 13 | 14.000 | 13.250 | .375 | 54.568 | 55.824 | 8 | 15.208 | 6⅛ | 47.152 |
| 14 | 15.000 | 14.250 | .375 | 58.573 | 60.375 | 8 | 16.446 | 6⅛ | 59.493 |
| 15 | 16.000 | 15.250 | .375 | 62.579 | 64.500 | 8 | 17.446 | 6⅛ | 63.294 |

The permissible variation in weight is 5 per cent. above and 5 per cent. below.

Furnished with threads and couplings and in random lengths unless otherwise ordered.

Taper of threads is ¾″ diameter per foot length for all sizes.

The weight per foot of pipe with threads and couplings is based on a length of 20 feet, including the coupling, but shipping lengths of small sizes will usually average less than 20 feet.

All weights and dimensions are nominal. On sizes made in more than one weight, weight desired must be specified.

## PIPE—BLACK AND GALVANIZED—Concluded

NATIONAL TUBE COMPANY STANDARD

### EXTRA STRONG PIPE

| Size, In. | Diameters, Inches | | Thickness, Inches | Weight, per Foot, Pounds |
|---|---|---|---|---|
| | External | Internal | | Plain Ends |
| ⅛ | .405 | .215 | .095 | .314 |
| ¼ | .540 | .302 | .119 | .535 |
| ⅜ | .675 | .423 | .126 | .738 |
| ½ | .840 | .546 | .147 | 1.087 |
| ¾ | 1.050 | .742 | .154 | 1.473 |
| 1 | 1.315 | .957 | .179 | 2.171 |
| 1¼ | 1.660 | 1.278 | .191 | 2.996 |
| 1½ | 1.900 | 1.500 | .200 | 3.631 |
| 2 | 2.375 | 1.939 | .218 | 5.022 |
| 2½ | 2.875 | 2.323 | .276 | 7.661 |
| 3 | 3.500 | 2.900 | .300 | 10.252 |
| 3½ | 4.000 | 3.364 | .318 | 12.505 |
| 4 | 4.500 | 3.826 | .337 | 14.983 |
| 4½ | 5.000 | 4.290 | .355 | 17.611 |
| 5 | 5.563 | 4.813 | .375 | 20.778 |
| 6 | 6.625 | 5.761 | .432 | 28.573 |
| 7 | 7.625 | 6.625 | .500 | 38.048 |
| 8 | 8.625 | 7.625 | .500 | 43.388 |
| 9 | 9.625 | 8.625 | .500 | 48.728 |
| 10 | 10.750 | 9.750 | .500 | 54.735 |
| 11 | 11.750 | 10.750 | .500 | 60.075 |
| 12 | 12.750 | 11.750 | .500 | 65.415 |
| 13 | 14.000 | 13.000 | .500 | 72.091 |
| 14 | 15.000 | 14.000 | .500 | 77.431 |
| 15 | 16.000 | 15.000 | .500 | 82.771 |

### DOUBLE EXTRA STRONG PIPE

| Size, In. | Diameters, Inches | | Thickness, Inches | Weight per Foot, Pounds |
|---|---|---|---|---|
| | External | Internal | | Plain Ends |
| ½ | .840 | .252 | .294 | 1.714 |
| ¾ | 1.050 | .434 | .308 | 2.440 |
| 1 | 1.315 | .599 | .358 | 3.659 |
| 1¼ | 1.660 | .896 | .382 | 5.214 |
| 1½ | 1.900 | 1.100 | .400 | 6.408 |
| 2 | 2.375 | 1.503 | .436 | 9.029 |
| 2½ | 2.875 | 1.771 | .552 | 13.695 |
| 3 | 3.500 | 2.300 | .600 | 18.583 |
| 3½ | 4.000 | 2.728 | .636 | 22.850 |
| 4 | 4.500 | 3.152 | .674 | 27.541 |
| 4½ | 5.000 | 3.580 | .710 | 32.530 |
| 5 | 5.563 | 4.063 | .750 | 38.552 |
| 6 | 6.625 | 4.897 | .864 | 53.160 |
| 7 | 7.625 | 5.875 | .875 | 63.079 |
| 8 | 8.625 | 6.875 | .875 | 72.424 |

Furnished with plain ends and in random lengths unless otherwise ordered.

Permissible variation in weight, for extra strong pipe, 5 per cent. above and 5 per cent. below.

For double extra strong pipe, 10 per cent. above and 10 per cent. below.

All weights and dimensions are nominal.

### LARGE O. D. PIPE

| Size, In. | Weight per Foot, Pounds — Thickness, Inches | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ¼ | 5/16 | ⅜ | 7/16 | ½ | 9/16 | ⅝ | ¾ | ⅞ | 1 |
| 14 | 36.713 | 45.682 | 54.568 | 63.371 | 72.091 | 80.726 | 89.279 | 106.134 | 122.654 | 138.842 |
| 15 | 39.383 | 49.020 | 58.573 | 68.044 | 77.431 | 86.734 | 95.954 | 114.144 | 132.000 | 149.522 |
| 16 | 42.053 | 52.357 | 62.579 | 72.716 | 82.771 | 92.742 | 102.629 | 122.154 | 141.345 | 160.202 |
| 17 | 44.723 | 55.695 | 66.584 | 77.389 | 88.111 | 98.749 | 109.304 | 130.164 | 150.690 | 170.882 |
| 18 | 47.393 | 59.032 | 70.589 | 82.061 | 93.451 | 104.757 | 115.979 | 138.174 | 160.035 | 181.562 |
| 20 | | 65.708 | 78.599 | 91.407 | 104.131 | 116.772 | 129.330 | 154.194 | 178.725 | 202.923 |
| 21 | | 69.045 | 82.604 | 96.079 | 109.471 | 122.780 | 136.005 | 162.204 | | |
| 22 | | 72.383 | 86.609 | 100.752 | 114.811 | 128.787 | 142.680 | 170.215 | | |
| 24 | | | 94.619 | 110.097 | 125.491 | 140.802 | 156.030 | 186.235 | | |
| 26 | | | 102.629 | 119.442 | 136.172 | 152.818 | 169.380 | 202.255 | | |
| 28 | | | | 128.787 | 146.852 | 164.833 | 182.730 | 218.275 | | |
| 30 | | | | 138.132 | 157.532 | 176.848 | 196.081 | 234.296 | | |

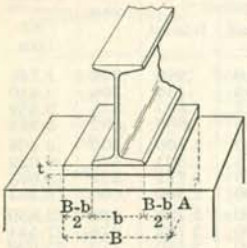
Furnished with plain ends and in random lengths, unless otherwise ordered.
All weights and dimensions are nominal.

## BEARING PLATES

Steel Bearing Plates are provided for the ends of beams resting on masonry, to distribute the pressure over a sufficient area, the allowable unit pressure depending upon the class of masonry used.

The size, area and thickness of a bearing plate depends on the end reaction, the length and width of bearing and allowable unit stress.

Assuming that the maximum bending moment occurs in the center of bearing:




A =Length of bearing plate, in inches.
B =Width of bearing plate, in inches.
t =Thickness of bearing plate, in inches.
b =Flange width of beam, in inches.
w =Allowable unit pressure on masonry.
R =Reaction on bearing plates in pounds = wxAxB

$$M=\frac{R}{2}\times\frac{B}{4}-\frac{R}{2}\times\frac{b}{4}=\frac{R(B-b)}{8}$$

$$=\frac{w\,A\,B\,(B-b)}{8}=\frac{f\,A\,t^2}{6}$$

$$t=\sqrt{\frac{3\,w\,B\,(B-b)}{4\,f}},\quad B(B-b)=\frac{4\,f\,t^2}{3\,w}$$

Taking moments at toe of beam flange, for cantilever projection $\frac{B-b}{2}$

$$M=\frac{w\,A(B-b)^2}{8}=\frac{f\,A\,t^2}{6}\qquad t=\tfrac{1}{2}\,(B-b)\sqrt{\frac{3\,w}{f}}$$

These formulas give lower values for M and t, and are applicable only when it can be assumed that middle part, b, of the plate is rigidly held in place, and that there are no bending stresses in center of plate.

Standard Bearing Plates—Sizes, Allowable Pressures and Limiting Spans.

| Beam Section | | | Bearing Plates | | | | Fiber Stress 18,000 Pounds | | | Fiber Stress 16,000 Pounds | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | Weight | Flange, b | Dimensions A | B | t | Weight | Total Pressure | Pressure | Min. Span | Total Pressure | Pressure | Min. Span |
| Ins. | Lbs. | Ins. | Inches | | | Lbs. | Lbs. | Lb.per sq. in. | Feet | Lbs. | Lb.per sq. in. | Feet |
| 24 | 105.9 | 7.88 | 16 | 16 | 1 | 72.5 | 47262 | 184.6 | 29.74 | 42010 | 164.1 | 29.74 |
| 24 | 79.9 | 7.0 | 16 | 16 | 1 | 72.5 | 42667 | 166.7 | 24.46 | 37926 | 148.1 | 24.46 |
| 20 | 81.4 | 7.0 | 16 | 16 | 1 | 72.5 | 42667 | 166.7 | 20.62 | 37926 | 148.1 | 20.62 |
| 20 | 65.4 | 6.25 | 16 | 16 | 1 | 72.5 | 39385 | 153.8 | 17.82 | 35009 | 136.7 | 17.82 |
| 18 | 75.6 | 7.0 | 16 | 16 | 1 | 72.5 | 42667 | 166.7 | 17.84 | 37926 | 148.1 | 17.84 |
| 18 | 54.7 | 6.0 | 16 | 16 | 1 | 72.5 | 38400 | 150.0 | 13.81 | 34133 | 133.3 | 13.81 |
| 15 | 60.8 | 6.0 | 16 | 16 | 1 | 72.5 | 38400 | 150.0 | 12.69 | 34133 | 133.3 | 12.69 |
| 15 | 42.9 | 5.5 | 12 | 16 | 1 | 54.4 | 27429 | 142.9 | 12.88 | 24381 | 127.0 | 12.88 |
| 12 | 40.8 | 5.25 | 12 | 12 | ¾ | 30.6 | 24000 | 166.7 | 11.21 | 21333 | 148.1 | 11.21 |
| 12 | 31.8 | 5.0 | 12 | 12 | ¾ | 30.6 | 23143 | 160.7 | 9.32 | 20571 | 142.9 | 9.32 |
| 10 | 25.4 | 4.66 | 8 | 12 | ¾ | 20.4 | 14714 | 153.3 | 9.96 | 13079 | 136.2 | 9.96 |
| 9 | 21.8 | 4.33 | 8 | 12 | ⅝ | 17.0 | 9778 | 101.9 | 11.58 | 8692 | 90.5 | 11.58 |
| 8 | 18.4 | 4.0 | 8 | 8 | ⅝ | 11.3 | 18750 | 293.0 | 4.55 | 16667 | 260.4 | 4.55 |
| 7 | 15.3 | 3.66 | 8 | 8 | ⅝ | 11.3 | 17281 | 270.0 | 3.59 | 15361 | 240.0 | 3.59 |
| 6 | 12.5 | 3.33 | 6 | 6 | ½ | 5.1 | 13483 | 374.5 | 3.23 | 11985 | 332.9 | 3.23 |
| 5 | 10.0 | 3.0 | 6 | 6 | ½ | 5.1 | 12000 | 333.3 | 2.42 | 10667 | 296.3 | 2.42 |
| 4 | 7.7 | 2.66 | 4 | 4 | ⅜ | 1.7 | 10075 | 629.7 | 1.78 | 8956 | 559.8 | 1.78 |
| 3 | 5.7 | 2.33 | 4 | 4 | ⅜ | 1.7 | 8084 | 505.3 | 1.23 | 7186 | 449.1 | 1.23 |

Limiting Span = 4 x Bending Moment of Beam ÷ Total Pressure on Bearing Plate.

## Special Bearing Plates

Plates of special sizes may be computed from the foregoing formulas or from the Projection Coefficients, B(B-b), after the required surface of the bearing plate has been determined from the reaction of the beam and the allowable pressure on the masonry.

Example: Required a bearing plate with a wall bearing of 20 inches on masonry sustaining a safe unit pressure of 250 pounds per square inch, to distribute the end reaction of a 24"—100 lb. beam, supporting a uniformly distributed load over a span of 11 feet, beam and plates calculated for fiber stress of 18000 pounds.

Reaction, R, of 24"—100 lb. beam, 11 ft. span = 107,800 pounds.

Area of Plate = Reaction ÷ Unit Pressure, 107,800 ÷ 250 = 431.2 sq. inches.

Dimensions of Bearing Plate: A = 22", B = 20", Area = 440 sq. inches.

Projection Coefficient: B(B-b), 20(20—7.25) = 255.0.

Referring to table of Projection Coefficients: nearest value for unit pressure of 250 pounds and fiber stress of 18000 pounds is 253.5, given for a 1⅝"-plate.

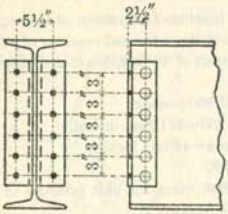
Exact value from formula:—$f = \sqrt{\frac{3\,w\,B\,(B-b)}{4\,f}} = \sqrt{\frac{3x250x20(20-7.25)}{4x18000}} = 1.63''$.

### Projection Coefficients, B (B-b), for various values of w and t

| Thickness, Inch | Unit Pressure, w, in Pounds per Square Inch | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 325 | 350 | 375 | 400 |
| t | Fiber Stress 18,000 Pounds | | | | | | | | | | | | | |
| ¾ | 45.0 | 33.8 | 27.0 | 22.5 | | | | | | | | | | |
| ⅞ | 80.0 | 60.0 | 48.0 | 40.0 | 34.3 | 30.0 | | | | | | | | |
| 1 | 125.0 | 93.8 | 75.0 | 62.5 | 53.6 | 46.9 | 41.7 | 37.5 | 34.1 | 31.3 | | | | |
| 1⅛ | 180.0 | 135.0 | 108.0 | 90.0 | 77.1 | 67.5 | 60.0 | 54.0 | 49.1 | 45.0 | 41.5 | 38.6 | 36.0 | 33.8 |
| 1¼ | 245.0 | 183.8 | 147.0 | 122.5 | 105.0 | 91.9 | 81.7 | 73.5 | 66.8 | 61.3 | 56.5 | 52.5 | 49.0 | 45.9 |
| 1⅜ | 320.0 | 240.0 | 192.0 | 160.0 | 137.1 | 120.0 | 106.7 | 96.0 | 87.3 | 80.0 | 73.8 | 68.6 | 64.0 | 60.0 |
| 1½ | 405.0 | 303.8 | 243.0 | 202.5 | 173.6 | 151.9 | 135.0 | 121.5 | 110.5 | 101.3 | 93.4 | 86.8 | 81.0 | 75.9 |
| 1⅝ | 500.0 | 375.0 | 300.0 | 250.0 | 214.3 | 187.5 | 166.7 | 150.0 | 136.4 | 125.0 | 115.4 | 107.1 | 100.0 | 93.8 |
| 1¾ | | 453.8 | 363.0 | 302.5 | 259.3 | 226.9 | 201.7 | 181.5 | 165.0 | 151.3 | 139.6 | 129.6 | 121.0 | 113.4 |
| 1⅞ | | | 432.0 | 360.0 | 308.6 | 270.0 | 240.0 | 216.0 | 196.4 | 180.0 | 166.2 | 154.3 | 144.0 | 135.0 |
| 2 | | | | 422.5 | 362.1 | 316.9 | 281.7 | 253.5 | 230.5 | 211.3 | 195.0 | 181.1 | 169.0 | 158.4 |
| 2⅛ | | | | 490.0 | 420.0 | 367.5 | 326.7 | 294.0 | 267.3 | 245.0 | 226.2 | 210.0 | 196.0 | 183.8 |
| 2¼ | | | | | 482.1 | 421.9 | 375.0 | 337.5 | 306.8 | 281.3 | 259.6 | 241.1 | 225.0 | 210.9 |
| 2⅜ | | | | | | 480.0 | 426.7 | 384.0 | 349.1 | 320.0 | 295.4 | 274.3 | 256.0 | 240.0 |
| t | Fiber Stress 16,000 Pounds | | | | | | | | | | | | | |
| ¾ | 40.0 | 30.0 | 24.0 | 20.0 | | | | | | | | | | |
| ⅞ | 71.1 | 53.3 | 42.7 | 35.6 | 30.5 | 26.7 | | | | | | | | |
| 1 | 111.1 | 83.3 | 66.7 | 55.6 | 47.6 | 41.7 | 37.0 | 33.3 | 30.3 | 27.8 | | | | |
| 1⅛ | 160.0 | 120.0 | 96.0 | 80.0 | 68.6 | 60.0 | 53.3 | 48.0 | 43.6 | 40.0 | 36.9 | 34.3 | 32.0 | 30.0 |
| 1¼ | 217.8 | 163.3 | 130.7 | 108.9 | 93.3 | 81.7 | 72.6 | 65.3 | 59.4 | 54.4 | 50.2 | 46.7 | 43.6 | 40.8 |
| 1⅜ | 284.4 | 213.3 | 170.7 | 142.2 | 121.9 | 106.7 | 94.8 | 85.3 | 77.6 | 71.1 | 65.6 | 61.0 | 56.9 | 53.3 |
| 1½ | 360.0 | 270.0 | 216.0 | 180.0 | 154.3 | 135.0 | 120.0 | 108.0 | 98.2 | 90.0 | 83.1 | 77.1 | 72.0 | 67.5 |
| 1⅝ | 444.4 | 333.3 | 266.7 | 222.2 | 190.5 | 166.7 | 148.1 | 133.3 | 121.2 | 111.1 | 102.6 | 95.2 | 88.9 | 83.3 |
| 1¾ | | 403.3 | 322.7 | 268.9 | 230.5 | 201.7 | 179.2 | 161.3 | 146.7 | 134.4 | 124.1 | 115.2 | 107.6 | 100.9 |
| 1⅞ | | 480.0 | 384.0 | 320.0 | 274.3 | 240.0 | 213.3 | 192.0 | 174.6 | 160.0 | 147.7 | 137.1 | 128.0 | 120.0 |
| 2 | | | 450.7 | 375.6 | 321.9 | 281.7 | 250.4 | 225.3 | 204.8 | 187.8 | 173.3 | 161.0 | 150.2 | 140.8 |
| 2⅛ | | | | 435.6 | 373.3 | 326.7 | 290.4 | 261.3 | 237.5 | 217.8 | 201.0 | 186.7 | 174.2 | 163.3 |
| 2¼ | | | | 500.0 | 428.6 | 375.0 | 333.3 | 300.0 | 272.7 | 250.0 | 230.8 | 214.3 | 200.0 | 187.5 |
| 2⅜ | | | | | 487.6 | 426.7 | 379.2 | 341.3 | 310.3 | 284.4 | 262.6 | 243.8 | 227.6 | 213.3 |

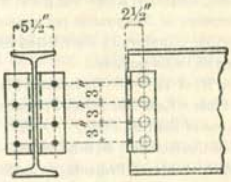
# STANDARD BEAM CONNECTIONS

24″



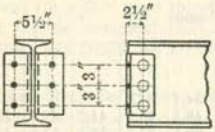

2 L⁵ 4″ x 4″ x ½″ x 1′-5½″
Weight 39 lbs.

20,″ 18,″ 15″



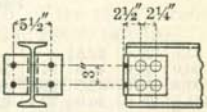

2 L⁵ 4″ x 4″ x 7/16″ x 0′-11½″
Weight 23 lbs.

12″



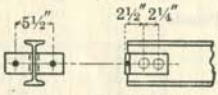

2 L⁵ 4″ x 4″ x 7/16″ x 0′-8½″
Weight 17 lbs.

10,″ 9,″ 8″



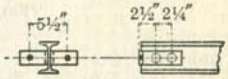

2 L⁵ 6″ x 4″ x ⅜″ x 0′-5½″
Weight 13 lbs.

7,″ 6,″ 5″




2 L⁵ 6″ x 4″ x ⅜″ x 0′-3″
Weight 7 lbs.

4,″ 3″




2 L⁵ 6″ x 4″ x ⅜″ x 0′-2″
Weight 5 lbs.

Rivets and bolts ¾″ diameter.

Weights given are for ¾-inch shop rivets and angle connections; about 20 per cent should be added for field rivets or bolts.

## BEAM CONNECTIONS—Limiting Values

| Beam Section | | | Connection | | Max. Values of Rivets and Bolts | | Min. Span, Floor Beams | | Girder Beam |
|---|---|---|---|---|---|---|---|---|---|
| Depth | Weight | Web | Shop | Field | Web Connection | Outstanding Legs | 18,000 lb. | 16,000 lb. | Web, $t^1$ |
| Inches | Lbs. | Inch | Rivets | Bolts | Pounds | Pounds | Feet | Feet | Inch |
| 24 | 105.9 | .625 | 6 | 12 | 84375 | 53014 | 26.52 | 23.57 | .589 |
| 24 | 79.9 | .500 | 6 | 12 | 67500 | 53014 | 19.69 | 17.50 | .589 |
| 20 | 81.4 | .600 | 4 | 8 | 54000 | 35343 | 24.89 | 22.13 | .589 |
| 20 | 65.4 | .500 | 4 | 8 | 45000 | 35343 | 19.85 | 17.65 | .589 |
| 18 | 75.6 | .560 | 4 | 8 | 50400 | 35343 | 21.54 | 19.14 | .589 |
| 18 | 54.7 | .460 | 4 | 8 | 41400 | 35343 | 15.01 | 13.34 | .589 |
| 15 | 60.8 | .590 | 4 | 8 | 53100 | 35343 | 13.78 | 12.25 | .589 |
| 15 | 42.9 | .410 | 4 | 8 | 36900 | 35343 | 10.00 | 8.89 | .589 |
| 12 | 40.8 | .460 | 3 | 6 | 31050 | 26506 | 10.15 | 9.02 | .589 |
| 12 | 31.8 | .350 | 3 | 6 | 23625 | 26506 | 9.13 | 8.12 | .525 |
| 10 | 25.4 | .310 | 4 | 4 | 27900 | 17671 | 8.29 | 7.37 | .589 |
| 9 | 21.8 | .290 | 4 | 4 | 26100 | 17671 | 6.41 | 5.70 | .589 |
| 8 | 18.4 | .270 | 4 | 4 | 24300 | 17671 | 4.83 | 4.29 | .589 |
| 7 | 15.3 | .250 | 2 | 2 | 11250 | 8836 | 7.03 | 6.25 | .589 |
| 6 | 12.5 | .230 | 2 | 2 | 10350 | 8836 | 4.93 | 4.38 | .589 |
| 5 | 10.0 | .210 | 2 | 2 | 9450 | 8836 | 3.28 | 2.92 | .589 |
| 4 | 7.7 | .190 | 2 | 2 | 8550 | 8836 | 2.09 | 1.86 | .570 |
| 3 | 5.7 | .170 | 2 | 2 | 7650 | 8836 | 1.30 | 1.15 | .510 |

Limiting Span = 4 × Bending Moment of Beam ÷ Least Value of Beam Connection.

The beam connections in above table are based on the resistance of ¾″ rivets in bearing and shear only, no moment stresses being considered, and the values given agree with tests made on beams under ordinary conditions of use.

Web Connection: Bearing Stress—Rivets enclosed—Shop 30,000 lb. per sq. in.
Outstanding Legs: Shearing Stress—Rivets or Bolts—Field 10,000 lb. per sq. in.
Web Thickness, t': Bearing Stress—Rivets or Bolts—Field 20,000 lb. per sq. in.
Web thicknesses, t', of girder beam correspond to required resistance in bearing, when beams frame opposite.

Special connections must be used when limiting conditions are exceeded, such as: End reaction of beam greater than value of connection—Short span with beam fully loaded—Thinner webs of girders resisting maximum end reactions of beams.

## RIVETS AND BOLTS—Unit Stresses.

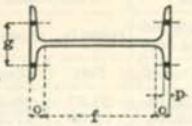
**Bearing Stresses.**

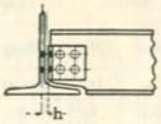
| | | |
|---|---|---|
| Rivets and Turned Bolts, enclosed, | Shop 30,000 | lb. per sq. in. |
| Rivets and Turned Bolts, one side, | Shop 24,000 | " |
| Rivets and Rough Bolts, enclosed, | Field 20,000 | " |
| Rivets and Rough Bolts, one side, | Field 16,000 | " |

**Shearing Stresses.**

| | | |
|---|---|---|
| Rivets and Turned Bolts, single shear, | Shop 13,500 | lb. per sq. in. |
| Rivets and Rough Bolts, single shear, | Field 10,000 | " |

## STANDARD GAGES AND DIMENSIONS FOR BEAMS



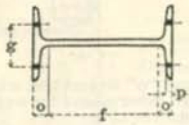



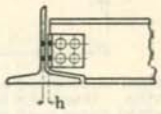

Nominal dimensions are:—flange width and "o" in eighths, web thickness in sixteenths. Gages for connection angles are determined by ½ web thickness.

Standard gages may be varied if conditions require.

| Depth of Beam | Weight per Foot | Flange Width | Web Thickness | ½ Web Thickness | Gage g | Grip p | Distance f | Distance o | Distance h | Max. Rivet in Flange |
|---|---|---|---|---|---|---|---|---|---|---|
| In. | Lbs. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| 24 | 120.0 | 8 | 13/16 | 3/8 | 5 | 1 1/8 | 20 1/4 | 1 7/8 | 1/2 | 7/8 |
| | 115.0 | 8 | 3/4 | 3/8 | 5 | 1 1/8 | 20 1/4 | 1 7/8 | 7/16 | |
| | 110.0 | 7 7/8 | 11/16 | 5/16 | 5 | 1 1/8 | 20 1/4 | 1 7/8 | 7/16 | |
| | 105.9 | 7 7/8 | 5/8 | 5/16 | 5 | 1 1/8 | 20 1/4 | 1 7/8 | 3/8 | |
| 24 | 100.0 | 7 1/4 | 3/4 | 3/8 | 4 | 7/8 | 20 3/4 | 1 5/8 | 7/16 | 7/8 |
| | 95.0 | 7 1/8 | 11/16 | 5/16 | 4 | 7/8 | 20 3/4 | 1 5/8 | 7/16 | |
| | 90.0 | 7 1/8 | 5/8 | 5/16 | 4 | 7/8 | 20 3/4 | 1 5/8 | 3/8 | |
| | 85.0 | 7 1/8 | 9/16 | 5/16 | 4 | 7/8 | 20 3/4 | 1 5/8 | 3/8 | |
| | 79.9 | 7 | 1/2 | 1/4 | 4 | 7/8 | 20 3/4 | 1 5/8 | 5/16 | |
| 20 | 100.0 | 7 1/4 | 7/8 | 7/16 | 4 | 1 | 16 | 2 | 1/2 | 7/8 |
| | 95.0 | 7 1/4 | 13/16 | 3/8 | 4 | 1 | 16 | 2 | 1/2 | |
| | 90.0 | 7 1/8 | 3/4 | 3/8 | 4 | 1 | 16 | 2 | 7/16 | |
| | 85.0 | 7 | 5/8 | 5/16 | 4 | 1 | 16 1/2 | 1 3/4 | 3/8 | |
| | 81.4 | 7 | 5/8 | 5/16 | 4 | 1 | 16 1/2 | 1 3/4 | 3/8 | |
| 20 | 75.0 | 6 3/8 | 5/8 | 5/16 | 4 | 3/4 | 16 1/2 | 1 3/4 | 3/8 | 7/8 |
| | 70.0 | 6 3/8 | 9/16 | 5/16 | 4 | 3/4 | 17 | 1 1/2 | 3/8 | |
| | 65.4 | 6 1/4 | 1/2 | 1/4 | 4 | 3/4 | 17 | 1 1/2 | 5/16 | |
| 18 | 90.0 | 7 1/4 | 13/16 | 3/8 | 4 | 1 | 14 1/2 | 1 3/4 | 1/2 | 7/8 |
| | 85.0 | 7 1/8 | 11/16 | 3/8 | 4 | 1 | 14 1/2 | 1 3/4 | 7/16 | |
| | 80.0 | 7 1/8 | 5/8 | 5/16 | 4 | 1 | 14 1/2 | 1 3/4 | 3/8 | |
| | 75.6 | 7 | 9/16 | 1/4 | 4 | 1 | 14 1/2 | 1 3/4 | 3/8 | |
| 18 | 70.0 | 6 1/4 | 11/16 | 3/8 | 3 1/2 | 3/4 | 14 3/4 | 1 5/8 | 7/16 | 7/8 |
| | 65.0 | 6 1/8 | 5/8 | 5/16 | 3 1/2 | 3/4 | 14 3/4 | 1 5/8 | 3/8 | |
| | 60.0 | 6 1/8 | 9/16 | 1/4 | 3 1/2 | 3/4 | 15 1/4 | 1 3/8 | 3/8 | |
| | 54.7 | 6 | 7/16 | 1/4 | 3 1/2 | 3/4 | 15 1/4 | 1 3/8 | 5/16 | |
| 15 | 75.0 | 6 1/4 | 7/8 | 7/16 | 3 1/2 | 7/8 | 11 3/4 | 1 5/8 | 1/2 | 3/4 |
| | 70.0 | 6 1/8 | 3/4 | 3/8 | 3 1/2 | 7/8 | 11 3/4 | 1 5/8 | 7/16 | |
| | 65.0 | 6 1/8 | 11/16 | 5/16 | 3 1/2 | 7/8 | 11 3/4 | 1 5/8 | 7/16 | |
| | 60.8 | 6 | 9/16 | 5/16 | 3 1/2 | 7/8 | 11 3/4 | 1 5/8 | 3/8 | |
| 15 | 55.0 | 5 3/4 | 5/8 | 5/16 | 3 1/2 | 5/8 | 12 1/2 | 1 1/4 | 3/8 | 3/4 |
| | 50.0 | 5 3/8 | 9/16 | 1/4 | 3 1/2 | 5/8 | 12 1/2 | 1 1/4 | 3/8 | |
| | 45.0 | 5 1/2 | 7/16 | 1/4 | 3 1/2 | 5/8 | 12 1/2 | 1 1/4 | 5/16 | |
| | 42.9 | 5 1/2 | 7/16 | 5/16 | 3 1/2 | 5/8 | 12 1/2 | 1 1/4 | 1/4 | |

## STANDARD GAGES AND DIMENSIONS FOR BEAMS



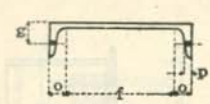



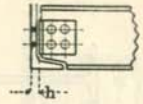

Nominal dimensions are:—flange width and "o" in eighths, web thickness in sixteenths. Gages for connection angles are determined by ½ web thickness.

Standard gages may be varied if conditions require.

| Depth of Beam | Weight per Foot | Flange Width | Web Thickness | ½ Web Thickness | Gage g | Grip p | Distance f | Distance o | Distance h | Max. Rivet in Flange |
|---|---|---|---|---|---|---|---|---|---|---|
| In. | Lbs. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| 12 | 55.0 | 5⅝ | 13/16 | ⅜ | 3½ | ¾ | 9¼ | 1⅜ | ½ | ¾ |
| | 50.0 | 5½ | 11/16 | 5/16 | 3½ | ¾ | 9¼ | 1⅜ | 7/16 | |
| | 45.0 | 5⅜ | 9/16 | 5/16 | 3 | ¾ | 9¼ | 1⅜ | ⅜ | |
| | 40.8 | 5¼ | 7/16 | ¼ | 3 | ¾ | 9¼ | 1⅜ | 5/16 | |
| 12 | 35.0 | 5⅛ | 7/16 | 5/16 | 3 | 9/16 | 9¾ | 1⅛ | 5/16 | ¾ |
| | 31.8 | 5 | ⅜ | 5/16 | 3 | 9/16 | 9¾ | 1⅛ | ¼ | |
| 10 | 40.0 | 5⅛ | ⅜ | ⅜ | 2¾ | ½ | 7½ | 1¼ | 7/16 | ¾ |
| | 35.0 | 5 | 5/16 | 5/16 | 2¾ | ½ | 7½ | 1¼ | ⅜ | |
| | 30.0 | 4¾ | 7/16 | ¼ | 2¾ | ½ | 8 | 1 | 5/16 | |
| | 25.4 | 4⅝ | 5/16 | ⅛ | 2¾ | ½ | 8 | 1 | ¼ | |
| 9 | 35.0 | 4¾ | ⅜ | ⅜ | 2½ | ½ | 7 | 1 | 7/16 | ¾ |
| | 30.0 | 4⅝ | 9/16 | ¼ | 2½ | ½ | 7 | 1 | ⅜ | |
| | 25.0 | 4½ | ⅜ | 5/16 | 2½ | ½ | 7 | 1 | ¼ | |
| | 21.8 | 4⅜ | 5/16 | ⅛ | 2½ | ½ | 7 | 1 | 5/16 | |
| 8 | 25.5 | 4¼ | 9/16 | ¼ | 2¼ | ½ | 6¼ | ⅞ | 5/16 | ¾ |
| | 23.0 | 4⅛ | 7/16 | ¼ | 2¼ | 7/16 | 6¼ | ⅞ | 5/16 | |
| | 20.5 | 4⅛ | ⅜ | 5/16 | 2¼ | 7/16 | 6¼ | ⅞ | ¼ | |
| | 18.4 | 4 | ¼ | ⅛ | 2¼ | 7/16 | 6¼ | ⅞ | 5/16 | |
| 7 | 20.0 | 3⅞ | 7/16 | ¼ | 2¼ | ⅜ | 5¼ | ⅞ | 5/16 | ⅝ |
| | 17.5 | 3¾ | ⅜ | 5/16 | 2¼ | ⅜ | 5¼ | ⅞ | ¼ | |
| | 15.3 | 3⅝ | ¼ | ⅛ | 2¼ | ⅜ | 5¼ | ⅞ | 5/16 | |
| 6 | 17.25 | 3⅝ | 7/16 | ¼ | 2 | ⅜ | 4½ | ¾ | 5/16 | ⅝ |
| | 14.75 | 3½ | ⅜ | 5/16 | 2 | ⅜ | 4½ | ¾ | ¼ | |
| | 12.5 | 3⅜ | ¼ | ⅛ | 2 | ⅜ | 4½ | ¾ | 5/16 | |
| 5 | 14.75 | 3⅜ | ½ | ¼ | 1¾ | ⅜ | 3½ | ¾ | 5/16 | ½ |
| | 12.25 | 3⅛ | ⅜ | 5/16 | 1¾ | ⅜ | 3½ | ¾ | ¼ | |
| | 10.0 | 3 | 5/16 | ⅛ | 1¾ | ⅜ | 3½ | ¾ | 5/16 | |
| 4 | 10.5 | 2⅞ | ⅜ | 5/16 | 1½ | 5/16 | 2¾ | ⅝ | ¼ | ½ |
| | 9.5 | 2¾ | 5/16 | 5/16 | 1½ | 5/16 | 2¾ | ⅝ | ¼ | |
| | 8.5 | 2¾ | ¼ | ⅛ | 1½ | 5/16 | 2¾ | ⅝ | 5/16 | |
| | 7.7 | 2⅝ | 5/16 | ⅛ | 1½ | 5/16 | 2¾ | ⅝ | 5/16 | |
| 3 | 7.5 | 2½ | ⅜ | 5/16 | 1½ | 5/16 | 1¾ | ⅝ | ¼ | ⅜ |
| | 6.5 | 2⅜ | ¼ | ⅛ | 1½ | 5/16 | 1¾ | ⅝ | 5/16 | |
| | 5.7 | 2⅜ | 5/16 | 1/16 | 1½ | 5/16 | 1¾ | ⅝ | ⅛ | |

# STANDARD GAGES AND DIMENSIONS FOR CHANNELS



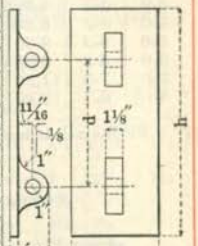

Nominal dimensions are:—flange width and "o" in eighths, web thickness in sixteenths. Gages for connection angles are determined by web thickness. Standard gages may be varied if conditions require.

| Depth of Channel | Weight per Foot | Flange Width | Web Thickness | ½ Web Thickness | Gage g | Grip p | Distance f | Distance o | Distance h | Max. Rivet in Flange |
|---|---|---|---|---|---|---|---|---|---|---|
| In. | Lbs. | In. | In. | In. | In. | In. | In. | In. | In. | In. |
| 15 | 55.0 | 3⅞ | 13/16 | 7/16 | 2½ | 1 1/16 | 12¼ | 1⅜ | ⅞ | ⅞ |
| | 50.0 | 3¾ | 11/16 | ⅜ | 2½ | 1 1/16 | 12¼ | 1⅜ | 13/16 | |
| | 45.0 | 3⅝ | ⅝ | 5/16 | 2 | ⅝ | 12¼ | 1⅜ | 11/16 | |
| | 40.0 | 3½ | ½ | ¼ | 2 | ⅝ | 12¼ | 1⅜ | 9/16 | |
| | 35.0 | 3⅜ | 7/16 | 3/16 | 2 | ⅝ | 12¼ | 1⅜ | ½ | |
| | 33.9 | 3⅜ | ⅜ | 3/16 | 2 | ⅝ | 12¼ | 1⅜ | ½ | |
| 13 | 50.0 | 4½ | 13/16 | ⅜ | 2½ | ⅝ | 10½ | 1¼ | ⅞ | ⅞ |
| | 45.0 | 4⅜ | 11/16 | 5/16 | 2½ | ⅝ | 10½ | 1¼ | ¾ | |
| | 40.0 | 4¼ | 9/16 | ¼ | 2½ | ⅝ | 10½ | 1¼ | 5/8 | |
| | 37.0 | 4⅛ | ½ | ¼ | 2½ | 9/16 | 10½ | 1¼ | 9/16 | |
| | 35.0 | 4⅛ | 7/16 | ¼ | 2½ | 9/16 | 10½ | 1¼ | ½ | |
| | 31.8 | 4 | ⅜ | 3/16 | 2½ | 9/16 | 10½ | 1¼ | 7/16 | |
| 12 | 40.0 | 3⅝ | ¾ | ⅜ | 2 | ⅝ | 9 | 1 | 13/16 | ⅞ |
| | 35.0 | 3½ | ⅝ | 5/16 | 2 | ⅝ | 9 | 1 | 11/16 | |
| | 30.0 | 3⅛ | ½ | ¼ | 1¾ | ½ | 10 | 1 | 9/16 | |
| | 25.0 | 3 | ⅜ | 3/16 | 1¾ | ½ | 10 | 1 | 7/16 | |
| | 20.7 | 3 | ¼ | ⅛ | 1¾ | ½ | 10 | 1 | ⅜ | |
| 10 | 35.0 | 3⅛ | 13/16 | 7/16 | 1¾ | ½ | 7¾ | 1⅛ | ⅞ | ¾ |
| | 30.0 | 3 | 11/16 | 5/16 | 1¾ | ½ | 7¾ | 1⅛ | ¾ | |
| | 25.0 | 2⅞ | ½ | ¼ | 1¾ | ½ | 7¾ | 1⅛ | 9/16 | |
| | 20.0 | 2¾ | ⅜ | 3/16 | 1½ | 7/16 | 8¼ | ⅞ | 7/16 | |
| | 15.3 | 2⅝ | ¼ | ⅛ | 1½ | 7/16 | 8¼ | ⅞ | 5/16 | |
| 9 | 25.0 | 2⅞ | ⅝ | 5/16 | 1½ | ½ | 7 | 1 | 11/16 | ¾ |
| | 20.0 | 2⅝ | 7/16 | ¼ | 1½ | ½ | 7 | 1 | ½ | |
| | 15.0 | 2½ | 5/16 | ⅛ | 1⅜ | 7/16 | 7¼ | ⅞ | ⅜ | |
| | 13.4 | 2⅜ | ¼ | ⅛ | 1⅜ | 7/16 | 7¼ | ⅞ | 5/16 | |
| 8 | 21.25 | 2⅝ | 9/16 | 5/16 | 1½ | 7/16 | 6¼ | ⅞ | 11/16 | ¾ |
| | 18.75 | 2½ | ½ | ¼ | 1½ | 7/16 | 6¼ | ⅞ | 9/16 | |
| | 16.25 | 2⅜ | ⅜ | 3/16 | 1½ | 7/16 | 6¼ | ⅞ | ½ | |
| | 13.75 | 2⅜ | 5/16 | ⅛ | 1⅜ | ⅜ | 6¼ | ⅞ | ⅜ | |
| | 11.5 | 2¼ | ¼ | ⅛ | 1⅜ | ⅜ | 6¼ | ⅞ | 5/16 | |
| 7 | 19.75 | 2½ | ⅝ | 5/16 | 1½ | 7/16 | 5¼ | ⅞ | 11/16 | ⅝ |
| | 17.25 | 2⅜ | ½ | ¼ | 1½ | 7/16 | 5¼ | ⅞ | 9/16 | |
| | 14.75 | 2¼ | 7/16 | 3/16 | 1¼ | 7/16 | 5¼ | ⅞ | ½ | |
| | 12.25 | 2¼ | 5/16 | 3/16 | 1¼ | ⅜ | 5½ | ¾ | ⅜ | |
| | 9.8 | 2⅛ | 3/16 | ⅛ | 1¼ | ⅜ | 5½ | ¾ | 5/16 | |
| 6 | 15.5 | 2¼ | 9/16 | ¼ | 1⅛ | ⅜ | 4½ | ¾ | ⅝ | ⅝ |
| | 13.0 | 2⅛ | 7/16 | ¼ | 1⅛ | ⅜ | 4½ | ¾ | ½ | |
| | 10.5 | 2 | 5/16 | 3/16 | 1⅛ | ⅜ | 4½ | ¾ | ⅜ | |
| | 8.2 | 1⅞ | 3/16 | ⅛ | 1⅛ | 5/16 | 4½ | ¾ | ¼ | |
| 5 | 11.5 | 2 | ½ | ¼ | 1⅛ | 5/16 | 3½ | ¾ | 9/16 | ½ |
| | 9.0 | 1⅞ | 5/16 | 3/16 | 1⅛ | 5/16 | 3¾ | ⅝ | ⅜ | |
| | 6.7 | 1¾ | 3/16 | ⅛ | 1⅛ | 5/16 | 3¾ | ⅝ | ¼ | |
| 4 | 7.25 | 1¾ | 5/16 | 3/16 | 1 | 5/16 | 2¾ | ⅝ | ⅜ | ½ |
| | 6.25 | 1⅝ | ¼ | ⅛ | 1 | 5/16 | 2¾ | ⅝ | 5/16 | |
| | 5.4 | 1⅝ | 3/16 | 1/16 | 1 | 5/16 | 2¾ | ⅝ | ¼ | |
| 3 | 6.0 | 1⅝ | ⅜ | 3/16 | ⅞ | ¼ | 1¾ | ⅝ | 7/16 | ½ |
| | 5.0 | 1½ | ¼ | ⅛ | ⅞ | ¼ | 1¾ | ⅝ | 5/16 | |
| | 4.1 | 1⅜ | 3/16 | 1/16 | ⅞ | ¼ | 1¾ | ⅝ | ¼ | |

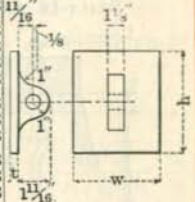
# BEAM SEPARATORS

AMERICAN BRIDGE COMPANY STANDARD

| Beams | | | | Separator | | | | | | ¾″ Bolts | | | Diagrams |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dimensions | | | | | | | | | |
| Depth, Inches | Weight per Foot, Pounds | Center to Center of Beams, Inches | Out to Out of Flanges, Inches | w In. | h In. | d In. | t In | Weight, Pounds | Increase in Weight for 1″ Add. Width | Length, Inches | Weight, Pounds Hex. Head and Nut | Increase in Weight for 1″ Add. Length | |
| 24 | 120 to 105.9 | 8¾ | 16¾ | 8 | 20 | 12 | ⅝ | 31 | 3.6 | 10½ | 3.4 | 0.25 | |
| | 100 | 8 | 15½ | 7¼ | 20 | 12 | ⅝ | 28 | 3.6 | 10 | 3.2 | 0.25 | |
| 24 | 95 and 90 | 8 | 15¼ | 7¼ | 20 | 12 | ⅝ | 28 | 3.6 | 10 | 3.2 | 0.25 | |
| | 85 | 8 | 15¼ | 7¼ | 20 | 12 | ⅝ | 29 | 3.6 | 9½ | 3.1 | 0.25 | |
| | 79.9 | 8 | 15 | 7½ | 20 | 12 | ⅝ | 29 | 3.6 | 9½ | 3.1 | 0.25 | |
| | 100 and 95 | 8 | 15¼ | 7 | 16 | 12 | ⅝ | 22 | 2.9 | 10 | 3.2 | 0.25 | |
| 20 | 90 | 7½ | 14¾ | 6¾ | 16 | 12 | ⅝ | 22 | 2.9 | 9½ | 3.1 | 0.25 | |
| | 85 and 81.4 | 7½ | 14½ | 6¾ | 16 | 12 | ⅝ | 22 | 2.9 | 9 | 3.0 | 0.25 | |
| | 75 | 7½ | 14 | 6¾ | 16 | 12 | ⅝ | 22 | 2.9 | 9 | 3.0 | 0.25 | |
| 20 | 70 | 7 | 13½ | 6½ | 16 | 12 | ⅝ | 21 | 2.9 | 9 | 3.0 | 0.25 | |
| | 65.4 | 7 | 13¼ | 6½ | 16 | 12 | ⅝ | 21 | 2.9 | 8½ | 3.0 | 0.25 | |
| | 90 | 8 | 15¼ | 7 | 14 | 9 | ⅝ | 20 | 2.5 | 10 | 3.2 | 0.25 | |
| 18 | 85 and 80 | 8 | 15⅛ | 7¼ | 14 | 9 | ⅝ | 21 | 2.5 | 10 | 3.2 | 0.25 | |
| | 75.6 | 8 | 15 | 7½ | 14 | 9 | ⅝ | 21 | 2.5 | 10 | 3.2 | 0.25 | |
| | 70 and 65 | 7 | 13¼ | 6¼ | 14 | 9 | ⅝ | 18 | 2.5 | 9 | 3.0 | 0.25 | |
| 18 | 60 | 7 | 13¼ | 6½ | 14 | 9 | ⅝ | 19 | 2.5 | 8½ | 3.0 | 0.25 | |
| | 54.7 | 7 | 13 | 6½ | 14 | 9 | ⅝ | 19 | 2.5 | 8½ | 3.0 | 0.25 | |
| | 75 | 7 | 13¼ | 6 | 12 | 9 | ½ | 12 | 1.6 | 9 | 3.0 | 0.25 | |
| 15 | 70 and 65 | 7 | 13¼ | 6¼ | 12 | 9 | ½ | 12 | 1.6 | 9 | 3.0 | 0.25 | |
| | 60.8 | 6½ | 12½ | 5¾ | 12 | 9 | ½ | 12 | 1.6 | 8 | 2.7 | 0.25 | |
| | 55 | 6½ | 12¼ | 5¾ | 12 | 9 | ½ | 12 | 1.6 | 8 | 2.7 | 0.25 | |
| 15 | 50 and 45 | 6½ | 12¼ | 6 | 12 | 9 | ½ | 12 | 1.6 | 8 | 2.7 | 0.25 | |
| | 42.9 | 6½ | 12 | 6 | 12 | 9 | ½ | 12 | 1.6 | 8 | 2.7 | 0.25 | |
| | 55 | 6 | 11¾ | 5¼ | 9 | 6 | ½ | 9 | 1.3 | 8 | 2.7 | 0.25 | |
| 12 | 50 | 6 | 11½ | 5¼ | 9 | 6 | ½ | 9 | 1.3 | 8 | 2.7 | 0.25 | |
| | 45 | 6 | 11¼ | 5¼ | 9 | 6 | ½ | 9 | 1.3 | 7½ | 2.6 | 0.25 | |
| 12 | 40.8 and 35 | 6 | 11¼ | 5½ | 9 | 6 | ½ | 9 | 1.3 | 7½ | 2.6 | 0.25 | |
| | 31.8 | 6 | 11 | 5½ | 9 | 6 | ½ | 9 | 1.3 | 7½ | 2.6 | 0.25 | |
| | 40 | 5½ | 10¾ | 4¾ | 7½ | | ½ | 6 | 1.1 | 7½ | 1.3 | 0.13 | |
| 10 | 35 | 5½ | 10½ | 4¾ | 7½ | | ½ | 6 | 1.1 | 7 | 1.3 | 0.13 | |
| | 30 | 5½ | 10½ | 5 | 7½ | | ½ | 7 | 1.1 | 7 | 1.3 | 0.13 | |
| | 25.4 | 5½ | 10 | 5 | 7½ | | ½ | 7 | 1.1 | 7 | 1.3 | 0.13 | |
| | 35 | 5 | 10 | 4¼ | 6½ | | ½ | 5 | 0.9 | 7 | 1.3 | 0.13 | |
| 9 | 30 | 5 | 9½ | 4¼ | 6½ | | ½ | 5 | 0.9 | 6½ | 1.2 | 0.13 | |
| | 25 | 5 | 9½ | 4½ | 6½ | | ½ | 5 | 0.9 | 6½ | 1.2 | 0.13 | |
| | 21.8 | 5 | 9¼ | 4½ | 6½ | | ½ | 5 | 0.9 | 6½ | 1.2 | 0.13 | |
| | 25.5 | 4½ | 9 | 4 | 5½ | | ½ | 4 | 0.8 | 6 | 1.1 | 0.13 | |
| 8 | 23 | 4½ | 8¾ | 4 | 5½ | | ½ | 4 | 0.8 | 6 | 1.1 | 0.13 | |
| | 20.5 and 18.4 | 4½ | 8½ | 4 | 5½ | | ½ | 4 | 0.8 | 6 | 1.1 | 0.13 | |
| | 20 | 4½ | 8½ | 4 | 5 | | ½ | 4 | 0.7 | 6 | 1.1 | 0.13 | |
| 7 | 17.5 | 4½ | 8¼ | 4 | 5 | | ½ | 4 | 0.7 | 6 | 1.1 | 0.13 | |
| | 15.3 | 4½ | 8¼ | 4¼ | 5 | | ½ | 4 | 0.7 | 6 | 1.1 | 0.13 | |
| | 17.25 | 4 | 7¾ | 3½ | 4½ | | ½ | 4 | 0.6 | 5½ | 1.1 | 0.13 | |
| 6 | 14.75 | 4 | 7½ | 3½ | 4½ | | ½ | 4 | 0.6 | 5½ | 1.1 | 0.13 | |
| | 12.5 | 4 | 7½ | 3¾ | 4½ | | ½ | 4 | 0.6 | 5½ | 1.1 | 0.13 | |




⅞″ Cored Holes



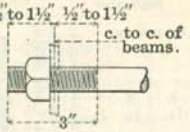

⅞″ Cored Hole

For 5″, 4″ and 3″ beams, use 1″ gas pipe 3¼″, 3″ and 2¾″ long respectively.

# TIE RODS AND ANCHORS

AMERICAN BRIDGE COMPANY STANDARD

## ¾—INCH TIE RODS

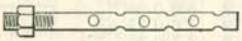



| C. to C. | Length | Weight | C. to C. | Length | Weight | C. to C. | Length | Weight | C. to C. | Length | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ft.-In. | Ft.-In. | Pounds | Ft.-In. | Ft.-In. | Pounds | Ft.-In. | Ft.-In. | Pounds | Ft.-In. | Ft.-In. | Pounds |
| 1-0 | 1-3 | 2.30 | 1-3 | 1-6 | 2.67 | 1-6 | 1-9 | 3.05 | 1-9 | 2-0 | 3.42 |
| 2-0 | 2-3 | 3.80 | 2-3 | 2-6 | 4.17 | 2-6 | 2-9 | 4.55 | 2-9 | 3-0 | 4.92 |
| 3-0 | 3-3 | 5.30 | 3-3 | 3-6 | 5.67 | 3-6 | 3-9 | 6.05 | 3-9 | 4-0 | 6.42 |
| 4-0 | 4-3 | 6.80 | 4-3 | 4-6 | 7.17 | 4-6 | 4-9 | 7.55 | 4-9 | 5-0 | 7.92 |
| 5-0 | 5-3 | 8.30 | 5-3 | 5-6 | 8.67 | 5-6 | 5-9 | 9.05 | 5-9 | 6-0 | 9.42 |
| 6-0 | 6-3 | 9.80 | 6-3 | 6-6 | 10.17 | 6-6 | 6-9 | 10.55 | 6-9 | 7-0 | 10.92 |
| 7-0 | 7-3 | 11.30 | 7-3 | 7-6 | 11.67 | 7-6 | 7-9 | 12.05 | 7-9 | 8-0 | 12.42 |
| 8-0 | 8-3 | 12.80 | 8-3 | 8-6 | 13.17 | 8-6 | 8-9 | 13.55 | 8-9 | 9-0 | 13.92 |

Weights include two Nuts.

## ANCHORS

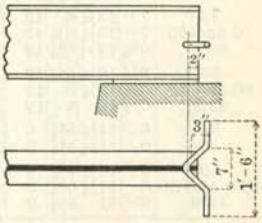
### Swedge Bolt



| Diameter | Length | Weight |
|---|---|---|
| Inches | Feet - Inches | Pounds |
| 1 | 1-0 | 3.1 |
| 1¼ | 1-3 | 6.1 |
| 1½ | 1-3 | 8.9 |

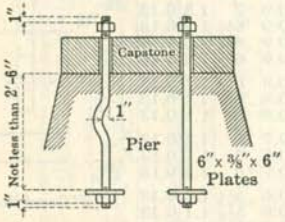
Weight includes Nut

### Government Anchor



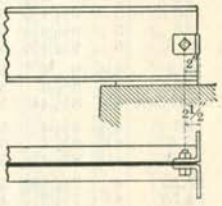

¾" Rod 1' 9" long. Wt., 3 lbs.

### Built-In Anchor Bolts




When center to center of anchors is less than width of washer, use washer with two holes.

### Angle Anchor

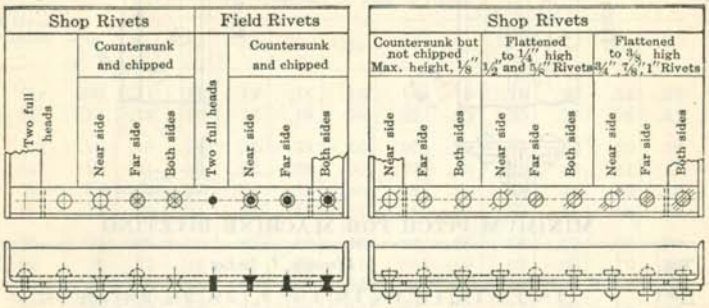



2 Angles 6" x 4" x ⅜" x 0'-3"
Weight with ¾" bolts, 7 lbs.

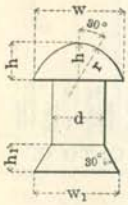
# DETAILS FOR PUNCHING AND RIVETING

AMERICAN BRIDGE COMPANY STANDARD

## CONVENTIONAL SIGNS FOR RIVETING



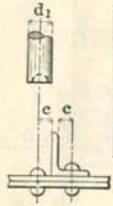

## DIMENSIONS OF STRUCTURAL RIVETS




| | Diameter of Rivet, d, Inches | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 |
| w | 11/16 | 7/8 | 1 1/16 | 1 1/4 | 1 7/16 | 1 5/8 | 1 13/16 | 2 | 2 3/16 | 2 3/8 |
| h | 5/16 | 3/8 | 7/16 | 1/2 | 5/8 | 1 1/16 | 3/4 | 7/8 | 15/16 | 1 |
| r | 7/16 | 9/16 | 11/16 | 13/16 | 15/16 | 1 | 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 |
| w1 | 9/16 | 3/4 | 1 | 1 3/16 | 1 3/8 | 1 9/16 | 1 3/4 | 2 | 2 3/16 | 2 3/8 |
| h1 | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 |

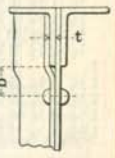
$w = 1\frac{1}{2}\,d + \frac{1}{8}''$ $\quad h = 0.425\,w$ $\quad r = 1\frac{1}{2}\,h.$

## DRIVING CLEARANCE



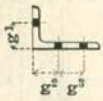

| | Diameter of Rivet, d, Inches | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 |
| d1 | 1 1/2 | 1 3/4 | 2 | 2 1/4 | 2 1/2 | 2 3/4 | 3 | 3 1/4 | 3 1/2 | 3 3/4 |
| c | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 | 1 5/8 | 1 3/4 | 1 7/8 | 2 |

## CRIMPS




$b = t + 1\frac{1}{2}''$ (min. 2")

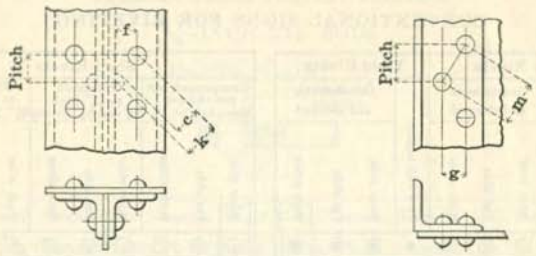
## GAGES FOR ANGLES




| | Width of Leg, Inches | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 | 7 | 6 | 5 | 4 | 3 1/2 | 3 | 2 1/2 | 2 | 1 3/4 | 1 1/2 | 1 3/8 | 1 1/4 | 1 | 3/4 |
| g1 | 4 1/2 | 4 | 3 1/2 | 3 | 2 1/2 | 2 | 1 3/4 | 1 3/8 | 1 1/8 | 1 | 7/8 | 7/8 | 3/4 | 5/8 | 1/2 |
| g2 | 3 | 2 1/2 | 2 1/2 | 2 | | | | | | | | | | | |
| g3 | 3 | 3 | 2 1/4 | 1 3/4 | | | | | | | | | | | |
| Max. rivet | 1 1/8 | 1 | 7/8 | 7/8 | 7/8 | 7/8 | 7/8 | 3/4 | 5/8 | 1/2 | 3/8 | 3/8 | 3/8 | 1/4 | 1/4 |

# RIVET SPACING

AMERICAN BRIDGE COMPANY STANDARD




## MINIMUM PITCH FOR MACHINE RIVETING

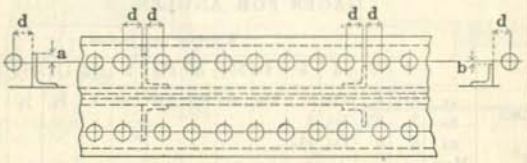
| Dia. of Rivet | c | k | Distance, f, Inches | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 3/8 | 1 1/4 | 1 3/8 | 1 1/2 | 1 5/8 | 1 3/4 | 1 7/8 | 2 | 2 1/8 | 2 1/4 | 2 3/8 | 2 1/2 | 2 3/4 | 3 |
| 3/4 | 7/8 | 1 13/16 | 1/4 | 0 | | | | | | | | | | | | |
| 7/8 | | 1 5/8 | 3/4 | 1/2 | 0 | | | | | | | | | | | |
| 1 | 1 | 1 9/16 | 1 1/8 | 1 | 3/4 | 3/8 | 0 | | | | | | | | | |
| 1 1/8 | 1 1/4 | 1 3/4 | | 1 1/4 | 1 1/8 | 1 | 3/4 | 0 | | | | | | | | |
| 1 1/4 | 1 3/8 | 2 | | | 1 1/2 | 1 3/8 | 1 1/8 | 7/8 | 5/8 | 0 | | | | | | |
| 1 3/8 | 1 1/2 | 2 1/16 | | | | 1 5/8 | 1 1/2 | 1 3/8 | 1 1/8 | 7/8 | 1/2 | 0 | | | | |
| 1 1/2 | 1 5/8 | 2 3/16 | | | | | 1 3/4 | 1 5/8 | 1 1/2 | 1 3/8 | 1 1/8 | 7/8 | 0 | | | |
| 1 5/8 | 1 3/4 | 2 5/16 | | | | | | 2 | 1 7/8 | 1 3/4 | 1 1/2 | 1 1/4 | 1 | 5/8 | 0 | |
| 1 3/4 | 1 7/8 | 2 1 5/16 | | | | | | | 2 1/8 | 2 | 1 7/8 | 1 3/4 | 1 1/2 | 1 1/4 | 1/2 | 0 |
| 1 1/2 | 2 | 3 | | | | | | | | 2 1/4 | 2 1/8 | 2 | 1 7/8 | 1 5/8 | 1 1/4 | 0 |

## MINIMUM PITCH TO MAINTAIN 3 DIAMETERS C. TO C.

| Dia. of Rivet | m | Distance, g, Inches | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 1 1/4 | 1 1/2 | 1 3/4 | 2 | 2 1/4 | 2 1/2 | 2 3/4 | 3 | 3 1/4 | 3 1/2 | 3 3/4 | 4 | 4 1/4 | 4 1/2 |
| 3/4 | 1 1/4 | 1/2 | 0 | | | | | | | | | | | | | |
| 1/2 | 1 1/2 | 1 1/8 | 7/8 | 0 | | | | | | | | | | | | |
| 5/8 | 1 7/8 | 1 5/8 | 1 3/8 | 1 1/4 | 5/8 | 0 | | | | | | | | | | |
| 3/4 | 2 1/4 | 2 | 1 7/8 | 1 5/8 | 1 3/8 | 1 | 0 | | | | | | | | | |
| 7/8 | 2 5/8 | 2 1/2 | 2 3/8 | 2 1/8 | 2 | 1 3/4 | 1 3/8 | 3/4 | 0 | | | | | | | |
| 1 | 3 | 2 3/8 | 2 1/4 | 2 3/8 | 2 1/2 | 2 1/4 | 2 | 1 5/8 | 1 1/8 | 0 | | | | | | |
| 1 1/8 | 3 3/8 | 3 1/4 | 3 1/8 | 3 | 2 7/8 | 2 3/4 | 2 1/2 | 2 1/4 | 2 | 1 1/2 | 7/8 | 0 | | | | |
| 1 1/4 | 3 3/4 | 3 5/8 | 3 1/2 | 3 3/8 | 3 1/4 | 3 1/4 | 3 | 2 3/4 | 2 1/2 | 2 1/4 | 1 7/8 | 1 3/8 | 0 | | | |
| 1 3/8 | 4 1/8 | 4 | 4 | 3 7/8 | 3 3/4 | 3 5/8 | 3 1/2 | 3 1/4 | 3 1/4 | 3 1/4 | 2 7/8 | 2 1/2 | 2 1/8 | 1 3/4 | 1 | 0 |
| 1 1/2 | 4 1/2 | 4 3/8 | 4 3/8 | 4 1/4 | 4 1/8 | 4 | 3 7/8 | 3 3/4 | 3 1/2 | 3 3/8 | 3 1/8 | 2 7/8 | 2 1/2 | 2 | 1 1/2 | 0 |

## COVER PLATE RIVETING

| a, Ins. | d, Ins. |
|---|---|
| 1/2 | 2 1/2 |
| 1 | 2 5/8 |
| 1 1/2 | 2 3/4 |
| 2 | 2 3/4 |
| 2 1/2 | 2 7/8 |
| 3 | 2 7/8 |
| 3 1/2 | 3 |
| 4 | 3 1/16 |
| 5 | 3 1/4 |
| 6 | 3 3/8 |




| b, Ins. | d, Ins. |
|---|---|
| | 2 1/2 |
| 1/2 | 2 5/8 |
| 3/4 | 2 3/4 |
| 1 | 2 3/4 |
| 1 1/4 | 2 7/8 |
| 1 1/2 | 2 |
| 1 3/4 | 1 3/4 |
| 2 | 1 1/2 |
| 2 1/4 | 1 |
| 2 1/2 | |

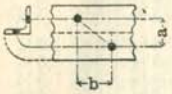
## REDUCTION OF AREA FOR RIVET HOLES

Area in Square Inches=Diameter of Hole by Thickness of Metal

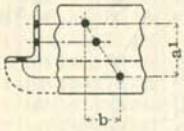
| Thickness of Metal, Inches | Diameter of Hole in Inches | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ½ | 9/16 | 5/8 | 11/16 | ¾ | 13/16 | ⅞ | 15/16 | 1 | 1 1/16 | 1 ⅛ | 1 ¼ |
| 3/16 | .09 | .11 | .12 | .13 | .14 | .15 | .16 | .18 | .19 | .20 | .21 | .23 |
| ¼ | .13 | .14 | .16 | .17 | .19 | .20 | .22 | .23 | .25 | .27 | .28 | .31 |
| 5/16 | .16 | .18 | .20 | .21 | .23 | .25 | .27 | .29 | .31 | .33 | .35 | .39 |
| ⅜ | .19 | .21 | .23 | .26 | .28 | .30 | .33 | .35 | .38 | .40 | .42 | .47 |
| 7/16 | .22 | .25 | .27 | .30 | .33 | .36 | .38 | .41 | .44 | .46 | .49 | .55 |
| ½ | .25 | .28 | .31 | .34 | .38 | .41 | .44 | .47 | .50 | .53 | .56 | .63 |
| 9/16 | .28 | .32 | .35 | .39 | .42 | .46 | .49 | .53 | .56 | .60 | .63 | .70 |
| ⅝ | .31 | .35 | .39 | .43 | .47 | .51 | .55 | .59 | .63 | .66 | .70 | .78 |
| 11/16 | .34 | .39 | .43 | .47 | .52 | .56 | .60 | .64 | .69 | .73 | .77 | .86 |
| ¾ | .38 | .42 | .47 | .52 | .56 | .61 | .66 | .70 | .75 | .80 | .84 | .94 |
| 13/16 | | | .51 | .56 | .61 | .66 | .71 | .76 | .81 | .86 | .91 | 1.02 |
| ⅞ | | | .55 | .60 | .66 | .71 | .77 | .82 | .88 | .93 | .98 | 1.09 |
| 15/16 | | | .59 | .64 | .70 | .76 | .82 | .88 | .94 | 1.00 | 1.05 | 1.17 |
| 1 | | | .63 | .69 | .75 | .81 | .88 | .94 | 1.00 | 1.06 | 1.13 | 1.25 |
| 1 1/16 | | | | | .80 | .86 | .93 | 1.00 | 1.06 | 1.13 | 1.20 | 1.33 |
| 1 ⅛ | | | | | .84 | .91 | .98 | 1.05 | 1.13 | 1.20 | 1.27 | 1.41 |
| 1 3/16 | | | | | .89 | .96 | 1.04 | 1.11 | 1.19 | 1.26 | 1.34 | 1.48 |
| 1 ¼ | | | | | .94 | 1.02 | 1.09 | 1.17 | 1.25 | 1.33 | 1.41 | 1.56 |
| 1 5/16 | | | | | | | 1.15 | 1.23 | 1.31 | 1.39 | 1.48 | 1.64 |
| 1 ⅜ | | | | | | | 1.20 | 1.29 | 1.38 | 1.46 | 1.55 | 1.72 |
| 1 7/16 | | | | | | | 1.26 | 1.35 | 1.44 | 1.53 | 1.62 | 1.80 |
| 1 ½ | | | | | | | 1.31 | 1.41 | 1.50 | 1.59 | 1.69 | 1.88 |

## PITCH OF RIVETS TO MAINTAIN NET SECTION

1 Hole Out




2 Holes Out




y=diameter of rivet + 1/8″

$a-y=\sqrt{a^2+b^2}-2y$

$a^1-2y=\sqrt{a^2+b^2}-3y$

$b=\sqrt{2ay+y^2}$

$b=\sqrt{2ay+y^2}$

Dimensions in Inches

| a | ¾″ Rivet b | ⅞″ Rivet b | $a^1$ | ¾″ Rivet b | ⅞″ Rivet b |
|---|---|---|---|---|---|
| 1 | 1⅝ | 1¾ | 5 | 3 1/16 | 3 5/16 |
| 1½ | 1⅞ | 2 | 5½ | 3¼ | 3½ |
| 2 | 2 1/16 | 2¼ | 6 | 3⅜ | 3⅝ |
| 2½ | 2¼ | 2 7/16 | 6½ | 3½ | 3¾ |
| 3 | 2 7/16 | 2⅝ | 7 | 3⅝ | 3⅞ |
| 3½ | 2 9/16 | 2 13/16 | 7½ | 3¾ | 4 |
| 4 | 2 13/16 | 3 | 8 | 3⅞ | 4⅛ |
| 4½ | 2 15/16 | 3 1/16 | 8½ | 4 | 4¼ |

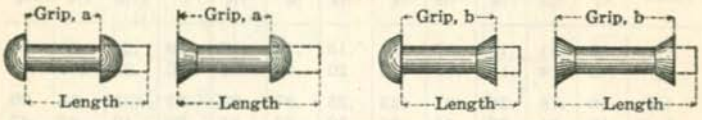
a, $a^1$ = sum of gages minus thickness of angle.
⅝″ rivets, can be taken at 1/8″ less than for ¾″ rivets.
1″ rivets, can be taken at 1/8″ more than for ⅞″ rivets.

# STRUCTURAL RIVETS

AMERICAN BRIDGE COMPANY STANDARD

## Lengths of Field Rivets for Various Grips

Dimensions in Inches




| Grip, a | Diameter of Rivet | | | | |
|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ⅞ | 1 |
| ½ | 1 5/16 | 1 3/4 | 1 7/8 | 2 | 2 1/16 |
| ⅝ | 1 3/4 | 1 7/8 | 2 | 2 1/16 | 2 1/4 |
| ¾ | 1 7/8 | 2 | 2 1/16 | 2 1/4 | 2 3/8 |
| ⅞ | 2 | 2 1/16 | 2 1/4 | 2 3/8 | 2 1/2 |
| 1 | 2 1/4 | 2 3/8 | 2 3/8 | 2 1/2 | 2 5/8 |
| 1/8 | 2 3/8 | 2 1/2 | 2 1/2 | 2 5/8 | 2 3/4 |
| 1/4 | 2 1/2 | 2 5/8 | 2 5/8 | 2 3/4 | 2 7/8 |
| 3/8 | 2 5/8 | 2 3/4 | 2 3/4 | 2 7/8 | 3 |
| 1/2 | 2 7/8 | 2 7/8 | 3 | 3 1/16 | 3 1/4 |
| 5/8 | 3 | 3 | 3 1/16 | 3 1/4 | 3 3/8 |
| 3/4 | 3 1/16 | 3 1/4 | 3 1/4 | 3 3/8 | 3 1/2 |
| 7/8 | 3 1/4 | 3 3/8 | 3 3/8 | 3 1/2 | 3 5/8 |
| 2 | 3 1/2 | 3 1/2 | 3 5/8 | 3 3/4 | 3 3/4 |
| 1/8 | 3 5/8 | 3 5/8 | 3 3/4 | 3 7/8 | 4 |
| 1/4 | 3 3/4 | 3 7/8 | 4 | 4 1/8 | 4 1/4 |
| 3/8 | 4 | 4 | 4 1/8 | 4 1/4 | 4 3/8 |
| 1/2 | 4 1/8 | 4 1/8 | 4 1/4 | 4 3/8 | 4 1/2 |
| 5/8 | 4 1/4 | 4 1/4 | 4 3/8 | 4 1/2 | 4 5/8 |
| 3/4 | 4 3/8 | 4 3/8 | 4 1/2 | 4 5/8 | 4 3/4 |
| 7/8 | 4 5/8 | 4 5/8 | 4 5/8 | 4 3/4 | 4 7/8 |
| 3 | | 4 3/4 | 4 3/4 | 4 7/8 | 4 7/8 |
| 1/8 | | 4 7/8 | 4 7/8 | 5 | 5 1/8 |
| 1/4 | | 5 | 5 | 5 1/8 | 5 1/4 |
| 3/8 | | 5 1/8 | 5 1/8 | 5 1/4 | 5 3/8 |
| 1/2 | | 5 1/8 | 5 1/8 | 5 3/8 | 5 1/2 |
| 5/8 | | 5 1/2 | 5 1/2 | 5 1/2 | 5 5/8 |
| 3/4 | | 5 5/8 | 5 5/8 | 5 5/8 | 5 3/4 |
| 7/8 | | 5 3/4 | 5 3/4 | 5 3/4 | 5 7/8 |
| 4 | | | 5 7/8 | 6 | 6 |
| 1/8 | | | 6 | 6 1/8 | 6 1/4 |
| 1/4 | | | 6 1/8 | 6 1/4 | 6 3/8 |
| 3/8 | | | 6 1/8 | 6 1/2 | 6 1/2 |
| 1/2 | | | 6 1/2 | 6 5/8 | 6 5/8 |
| 5/8 | | | 6 3/4 | 6 3/4 | 6 3/4 |
| 3/4 | | | 6 3/4 | 6 7/8 | 6 7/8 |
| 7/8 | | | 6 7/8 | 7 | 7 |
| 5 | | | | 7 1/8 | 7 1/8 |
| 1/8 | | | | 7 1/4 | 7 1/4 |
| 1/4 | | | | 7 3/8 | 7 3/8 |
| 3/8 | | | | 7 3/8 | 7 3/8 |
| 1/2 | | | | 7 3/4 | 7 3/4 |
| 5/8 | | | | 7 7/8 | 7 7/8 |
| 3/4 | | | | 8 | 8 |
| 7/8 | | | | 8 1/8 | 8 1/8 |

| Grip, b | Diameter of Rivet | | | | |
|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ⅞ | 1 |
| ½ | 1 | 1 | 1 1/8 | 1 1/4 | 1 1/4 |
| ⅝ | 1 1/8 | 1 1/4 | 1 1/4 | 1 3/8 | 1 3/8 |
| ¾ | 1 3/8 | 1 3/8 | 1 3/8 | 1 1/2 | 1 1/2 |
| ⅞ | 1 1/2 | 1 1/2 | 1 1/2 | 1 5/8 | 1 5/8 |
| 1 | 1 5/8 | 1 5/8 | 1 5/8 | 1 3/4 | 1 3/4 |
| 1/8 | 1 3/4 | 1 3/4 | 1 7/8 | 1 7/8 | 1 7/8 |
| 1/4 | 2 | 2 | 2 | 2 | 2 |
| 3/8 | 2 1/8 | 2 1/8 | 2 1/8 | 2 1/4 | 2 1/4 |
| 1/2 | 2 1/4 | 2 1/4 | 2 1/4 | 2 3/8 | 2 3/8 |
| 5/8 | 2 3/8 | 2 3/8 | 2 3/8 | 2 1/2 | 2 1/2 |
| 3/4 | 2 5/8 | 2 5/8 | 2 5/8 | 2 5/8 | 2 5/8 |
| 7/8 | 2 3/4 | 2 3/4 | 2 3/4 | 2 3/4 | 2 3/4 |
| 2 | 2 7/8 | 2 7/8 | 2 7/8 | 2 7/8 | 2 7/8 |
| 1/8 | 3 1/8 | 3 | 3 | 3 | 3 |
| 1/4 | 3 1/4 | 3 1/8 | 3 1/8 | 3 1/8 | 3 1/4 |
| 3/8 | 3 3/8 | 3 3/8 | 3 3/8 | 3 3/8 | 3 3/8 |
| 1/2 | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2 | 3 1/2 |
| 5/8 | 3 3/4 | 3 5/8 | 3 5/8 | 3 5/8 | 3 5/8 |
| 3/4 | 3 7/8 | 3 3/4 | 3 3/4 | 3 3/4 | 3 3/4 |
| 7/8 | 4 | 3 7/8 | 3 7/8 | 3 7/8 | 3 7/8 |
| 3 | | 4 1/8 | 4 1/8 | 4 1/8 | 4 1/8 |
| 1/8 | | 4 1/4 | 4 1/4 | 4 1/4 | 4 1/4 |
| 1/4 | | 4 3/8 | 4 3/8 | 4 3/8 | 4 3/8 |
| 3/8 | | 4 1/2 | 4 1/2 | 4 1/2 | 4 1/2 |
| 1/2 | | 4 5/8 | 4 5/8 | 4 5/8 | 4 5/8 |
| 5/8 | | 4 3/4 | 4 3/4 | 4 3/4 | 4 3/4 |
| 3/4 | | 5 | 5 | 5 | 5 |
| 7/8 | | 5 1/8 | 5 1/8 | 5 1/8 | 5 1/8 |
| 4 | | | 5 1/4 | 5 1/4 | 5 1/4 |
| 1/8 | | | 5 3/8 | 5 3/8 | 5 3/8 |
| 1/4 | | | 5 1/2 | 5 1/2 | 5 1/2 |
| 3/8 | | | 5 5/8 | 5 5/8 | 5 5/8 |
| 1/2 | | | 5 3/4 | 5 3/4 | 5 3/4 |
| 5/8 | | | 6 | 6 | 6 |
| 3/4 | | | 6 1/8 | 6 1/8 | 6 1/8 |
| 7/8 | | | 6 1/4 | 6 1/4 | 6 1/4 |
| 5 | | | | 6 3/8 | 6 3/8 |
| 1/8 | | | | 6 1/2 | 6 1/2 |
| 1/4 | | | | 6 5/8 | 6 5/8 |
| 3/8 | | | | 6 3/4 | 6 3/4 |
| 1/2 | | | | 6 7/8 | 6 7/8 |
| 5/8 | | | | 7 | 7 |
| 3/4 | | | | 7 1/4 | 7 1/4 |
| 7/8 | | | | 7 3/8 | 7 3/8 |

# STRUCTURAL RIVETS

AMERICAN BRIDGE COMPANY STANDARD

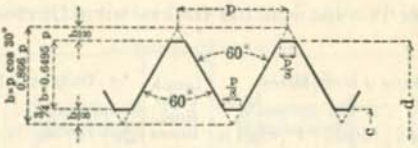
## Weight in Pounds per 100 Rivets with Button Heads

| Length Under Head, Inches | Diameter of Rivet, Inches | | | | | | | | Length Under Head, Inches | Diameter of Rivet, Inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1¼ | | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1¼ |
| | | | | | | | | | 5 | 18 | 33 | 53 | 78 | 109 | 146 | 190 | 252 |
| | | | | | | | | | ⅛ | 18 | 34 | 54 | 80 | 111 | 149 | 193 | 256 |
| 1¼ | 6 | 12 | | | | | | | ¼ | 19 | 34 | 55 | 82 | 113 | 152 | 197 | 260 |
| ⅜ | 7 | 13 | | | | | | | ⅜ | 19 | 35 | 56 | 83 | 115 | 155 | 200 | 265 |
| ½ | 7 | 13 | 23 | 35 | 50 | 68 | 91 | 130 | ½ | 20 | 36 | 57 | 85 | 118 | 157 | 204 | 269 |
| ⅝ | 7 | 14 | 24 | 36 | 52 | 71 | 95 | 134 | ⅝ | 20 | 36 | 58 | 86 | 120 | 160 | 207 | 273 |
| ¾ | 8 | 15 | 25 | 37 | 54 | 74 | 98 | 139 | ¾ | 20 | 37 | 60 | 88 | 122 | 163 | 211 | 278 |
| ⅞ | 8 | 15 | 26 | 39 | 56 | 77 | 102 | 143 | ⅞ | 21 | 38 | 61 | 89 | 124 | 166 | 214 | 282 |
| 2 | 9 | 16 | 27 | 41 | 58 | 80 | 105 | 148 | 6 | 21 | 38 | 62 | 91 | 126 | 169 | 218 | 287 |
| ⅛ | 9 | 17 | 28 | 43 | 60 | 82 | 109 | 152 | ⅛ | 22 | 39 | 63 | 93 | 128 | 171 | 222 | 291 |
| ¼ | 9 | 18 | 29 | 44 | 62 | 85 | 112 | 156 | ¼ | 22 | 40 | 64 | 94 | 130 | 174 | 225 | 295 |
| ⅜ | 10 | 18 | 30 | 46 | 64 | 88 | 116 | 161 | ⅜ | 22 | 40 | 65 | 96 | 132 | 177 | 229 | 300 |
| ½ | 10 | 19 | 31 | 47 | 67 | 91 | 119 | 165 | ½ | 23 | 41 | 66 | 97 | 135 | 180 | 232 | 304 |
| ⅝ | 11 | 20 | 32 | 49 | 69 | 93 | 123 | 169 | ⅝ | 23 | 42 | 67 | 99 | 137 | 182 | 236 | 308 |
| ¾ | 11 | 20 | 34 | 50 | 71 | 96 | 126 | 174 | ¾ | 24 | 43 | 68 | 100 | 139 | 185 | 239 | 313 |
| ⅞ | 11 | 21 | 35 | 52 | 73 | 99 | 130 | 178 | ⅞ | 24 | 43 | 69 | 102 | 141 | 188 | 243 | 317 |
| 3 | 12 | 22 | 36 | 54 | 75 | 102 | 133 | 182 | 7 | 24 | 44 | 70 | 104 | 143 | 191 | 246 | 321 |
| ⅛ | 12 | 22 | 37 | 55 | 77 | 105 | 137 | 187 | ⅛ | 25 | 45 | 71 | 105 | 145 | 194 | 250 | 326 |
| ¼ | 13 | 23 | 38 | 57 | 79 | 107 | 141 | 191 | ¼ | 25 | 45 | 73 | 107 | 147 | 196 | 253 | 330 |
| ⅜ | 13 | 24 | 39 | 58 | 81 | 110 | 144 | 195 | ⅜ | 26 | 46 | 74 | 108 | 149 | 199 | 257 | 334 |
| ½ | 13 | 24 | 40 | 60 | 84 | 113 | 148 | 200 | ½ | 26 | 47 | 75 | 110 | 152 | 202 | 260 | 339 |
| ⅝ | 14 | 25 | 41 | 61 | 86 | 116 | 151 | 204 | ⅝ | 26 | 47 | 76 | 111 | 154 | 205 | 264 | 343 |
| ¾ | 14 | 26 | 42 | 63 | 88 | 118 | 155 | 208 | ¾ | 27 | 48 | 77 | 113 | 156 | 207 | 267 | 347 |
| ⅞ | 15 | 27 | 43 | 64 | 90 | 121 | 158 | 213 | ⅞ | 27 | 49 | 78 | 114 | 158 | 210 | 271 | 352 |
| 4 | 15 | 27 | 44 | 66 | 92 | 124 | 162 | 217 | 8 | 27 | 50 | 79 | 116 | 160 | 213 | 274 | 356 |
| ⅛ | 15 | 28 | 45 | 68 | 94 | 127 | 165 | 221 | ⅛ | 28 | 50 | 80 | 118 | 162 | 216 | 278 | 360 |
| ¼ | 16 | 29 | 47 | 69 | 96 | 130 | 169 | 226 | ¼ | 28 | 51 | 81 | 119 | 164 | 219 | 281 | 365 |
| ⅜ | 16 | 29 | 48 | 71 | 98 | 132 | 172 | 230 | ⅜ | 29 | 52 | 82 | 121 | 166 | 221 | 285 | 369 |
| ½ | 16 | 30 | 49 | 72 | 101 | 135 | 176 | 234 | ½ | 29 | 52 | 83 | 122 | 169 | 224 | 288 | 373 |
| ⅝ | 17 | 31 | 50 | 74 | 103 | 138 | 179 | 239 | ⅝ | 29 | 53 | 84 | 124 | 171 | 227 | 292 | 378 |
| ¾ | 17 | 31 | 51 | 75 | 105 | 141 | 183 | 243 | ¾ | 30 | 54 | 86 | 125 | 173 | 230 | 295 | 382 |
| ⅞ | 18 | 32 | 52 | 77 | 107 | 143 | 186 | 247 | ⅞ | 30 | 54 | 87 | 127 | 175 | 232 | 299 | 386 |

| Button Heads | Diameter of Rivets, Inches | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1¼ |
| 100 Heads as made on rivets, Pounds | 2.4 | 5.0 | 9.7 | 16.0 | 24.0 | 35.0 | 49.0 | 78.0 |
| 100 Heads as driven in work, Pounds | 1.9 | 4.0 | 7.5 | 12.5 | 18.5 | 27.0 | 37.5 | 51.0 |

# SCREW THREADS

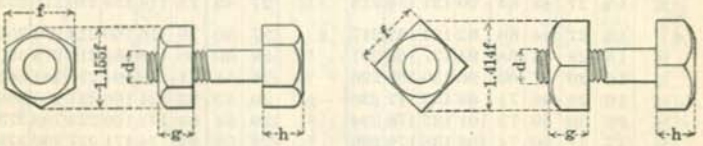
UNITED STATES AND AMERICAN BRIDGE COMPANY STANDARD




| Diameter | | Area | | Number of Threads per Inch | Diameter | | Area | | Number of Threads per Inch |
|---|---|---|---|---|---|---|---|---|---|
| Total d, In. | Net, c, In. | Total Dia., d, Sq. In. | Net Dia., c, Sq. In. | | Total, d, In. | Net, c, In. | Total Dia., d, Sq. In. | Net Dia., c, Sq. In. | |
| ¼ | .185 | .049 | .027 | 20 | 2½ | 2.175 | 4.909 | 3.716 | 4 |
| ⅜ | .294 | .110 | .068 | 16 | 2¾ | 2.425 | 5.940 | 4.619 | 4 |
| ½ | .400 | .196 | .126 | 13 | 3 | 2.629 | 7.069 | 5.428 | 3½ |
| ⅝ | .507 | .307 | .202 | 11 | 3¼ | 2.879 | 8.296 | 6.509 | 3½ |
| ¾ | .620 | .442 | .302 | 10 | 3½ | 3.100 | 9.621 | 7.549 | 3¼ |
| ⅞ | .731 | .601 | .419 | 9 | 3¾ | 3.317 | 11.045 | 8.641 | 3 |
| 1 | .838 | .785 | .551 | 8 | 4 | 3.567 | 12.566 | 9.993 | 3 |
| 1⅛ | .939 | .994 | .693 | 7 | 4¼ | 3.798 | 14.186 | 11.330 | 2⅞ |
| 1¼ | 1.064 | 1.227 | .890 | 7 | 4½ | 4.028 | 15.904 | 12.741 | 2¾ |
| 1⅜ | 1.158 | 1.485 | 1.054 | 6 | 4¾ | 4.255 | 17.721 | 14.221 | 2⅝ |
| 1½ | 1.283 | 1.767 | 1.294 | 6 | 5 | 4.480 | 19.635 | 15.766 | 2½ |
| 1⅝ | 1.389 | 2.074 | 1.515 | 5½ | 5¼ | 4.730 | 21.648 | 17.574 | 2½ |
| 1¾ | 1.490 | 2.405 | 1.744 | 5 | 5½ | 4.953 | 23.758 | 19.268 | 2⅜ |
| 1⅞ | 1.615 | 2.761 | 2.049 | 5 | 5¾ | 5.203 | 25.967 | 21.262 | 2⅜ |
| 2 | 1.711 | 3.142 | 2.300 | 4½ | 6 | 5.423 | 28.274 | 23.095 | 2¼ |
| 2¼ | 1.961 | 3.976 | 3.021 | 4½ | | | | | |

# BOLT HEADS AND NUTS

UNITED STATES AND AMERICAN BRIDGE COMPANY STANDARD




| Heads and Nuts | | U. S. Standard | A. B. Co. Standard |
|---|---|---|---|
| Head | Height, h | 0.75 d + 1/16″ | 0.75 d |
| | Short Dia., f | 1.50 d + ⅛″ | 1.50 d |
| Nut | Height, g | d | d |
| | Short Dia., f | 1.50 d + ⅛″ | 1.50 d + ⅛″ |

Heads for Bolts 1½″ and under, A. B. Co. Standard.
Heads for Bolts 1⅝″ and over, U. S. Standard.

## BOLT HEADS AND NUTS

AMERICAN BRIDGE COMPANY STANDARD

| Dia. of Bolt, In. | Head | | | | | Dia. of Bolt, In. | Nut | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hexagon | | Height, In. | Square | | | Hexagon | | Height, In. | Square | |
| | Diameter, In. | | | Diameter, In. | | | Diameter, In. | | | Diameter, In. | |
| | Long | Short | | Long | Short | | Long | Short | | Long | Short |
| ¼ | 7/16 | ⅜ | 5/16 | ½ | ⅜ | ¼ | 9/16 | ½ | ¼ | 11/16 | ½ |
| ⅝ | ⅝ | 9/16 | ¼ | ¾ | 9/16 | ⅝ | 13/16 | 11/16 | ⅜ | 1 | 11/16 |
| ½ | ⅞ | ¾ | ⅜ | 1 1/16 | ¾ | ½ | 1 | ⅞ | ½ | 1¼ | ⅞ |
| ⅝ | 1⅛ | 13/16 | ½ | 1⅜ | 13/16 | ⅝ | 1¼ | 1 1/16 | ⅝ | 1½ | 1 1/16 |
| ¾ | 1¼ | 1⅛ | 9/16 | 1⅝ | 1⅛ | ¾ | 1½ | 1¼ | ¾ | 1¾ | 1¼ |
| ⅞ | 1½ | 1 5/16 | ⅝ | 1⅞ | 1 5/16 | ⅞ | 1⅝ | 1 7/16 | ⅞ | 2 | 1 7/16 |
| 1 | 1¾ | 1½ | ¾ | 2⅛ | 1½ | 1 | 1⅞ | 1⅝ | 1 | 2¼ | 1⅝ |
| 1⅛ | 2 | 1 11/16 | ⅞ | 2⅜ | 1 11/16 | 1⅛ | 2⅛ | 1 13/16 | 1⅛ | 2⅜ | 1 13/16 |
| 1¼ | 2⅛ | 1⅞ | 15/16 | 2⅝ | 1⅞ | 1¼ | 2¼ | 2 | 1¼ | 2⅞ | 2 |
| 1⅜ | 2⅜ | 2 1/16 | 1 | 2⅞ | 2 1/16 | 1⅜ | 2½ | 2 1/16 | 1⅜ | 3⅛ | 2 1/16 |
| 1½ | 2⅝ | 2¼ | 1⅛ | 3⅛ | 2¼ | 1½ | 2¾ | 2⅜ | 1½ | 3⅜ | 2⅜ |
| 1⅝ | 3 | 2 9/16 | 1¼ | 3⅜ | 2 9/16 | 1⅝ | 3 | 2 9/16 | 1⅝ | 3⅝ | 2 9/16 |
| 1¾ | 3⅛ | 2⅝ | 1⅜ | 3⅝ | 2⅝ | 1¾ | 3⅛ | 2⅝ | 1¾ | 3⅞ | 2⅝ |
| 1⅞ | 3⅜ | 2 15/16 | 1½ | 4⅛ | 2 15/16 | 1⅞ | 3⅜ | 2 15/16 | 1⅞ | 4⅛ | 2 15/16 |
| 2 | 3⅝ | 3⅛ | 1 9/16 | 4⅜ | 3⅛ | 2 | 3⅝ | 3⅛ | 2 | 4⅜ | 3⅛ |
| 2¼ | 4 | 3½ | 1¾ | 5 | 3½ | 2¼ | 4 | 3½ | 2¼ | 5 | 3½ |
| 2½ | 4½ | 3⅞ | 1 15/16 | 5½ | 3⅞ | 2½ | 4½ | 3⅞ | 2½ | 5½ | 3⅞ |
| 2¾ | 4⅞ | 4¼ | 2⅛ | 6 | 4¼ | 2¾ | 4⅞ | 4¼ | 2¾ | 6 | 4¼ |
| 3 | 5⅜ | 4⅝ | 2 1/16 | 6½ | 4⅝ | 3 | 5⅜ | 4⅝ | 3 | 6½ | 4⅝ |
| 3¼ | 5¾ | 5 | 2½ | 7 | 5 | 3¼ | 5¾ | 5 | 3¼ | 7 | 5 |
| 3½ | 6¼ | 5⅜ | 2 11/16 | 7⅝ | 5⅜ | 3½ | 6¼ | 5⅜ | 3½ | 7⅝ | 5⅜ |
| 3¾ | 6⅝ | 5¾ | 2⅞ | 8⅛ | 5¾ | 3¾ | 6⅝ | 5¾ | 3¾ | 8⅛ | 5¾ |
| 4 | 7 | 6⅛ | 3 1/16 | 8⅝ | 6⅛ | 4 | 7 | 6⅛ | 4 | 8⅝ | 6⅛ |
| 4¼ | 7½ | 6½ | 3¼ | 9¼ | 6½ | 4¼ | 7½ | 6½ | 4¼ | 9¼ | 6½ |
| 4½ | 8 | 6⅞ | 3 11/16 | 9¾ | 6⅞ | 4½ | 8 | 6⅞ | 4½ | 9¾ | 6⅞ |
| 4¾ | 8⅜ | 7¼ | 3⅝ | 10¼ | 7¼ | 4¾ | 8⅜ | 7¼ | 4¾ | 10¼ | 7¼ |
| 5 | 8¾ | 7⅝ | 3 13/16 | 10¾ | 7⅝ | 5 | 8¾ | 7⅝ | 5 | 10¾ | 7⅝ |
| 5¼ | 9¼ | 8 | 4 | 11¼ | 8 | 5¼ | 9¼ | 8 | 5¼ | 11¼ | 8 |
| 5½ | 9⅝ | 8⅜ | 4 1/16 | 11⅞ | 8⅜ | 5½ | 9⅝ | 8⅜ | 5½ | 11⅞ | 8⅜ |
| 5¾ | 10⅛ | 8¾ | 4⅛ | 12⅜ | 8¾ | 5¾ | 10⅛ | 8¾ | 5¾ | 12⅜ | 8¾ |
| 6 | 10½ | 9⅛ | 4 5/16 | 12⅞ | 9⅛ | 6 | 10½ | 9⅛ | 6 | 12⅞ | 9⅛ |

## LENGTH OF BOLT THREADS

| Length of Bolt, In. | Diameter of Bolt, Inches | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ¼ | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 | 1⅛ | 1¼ |
| 1 to 1½ | ¾ | ¾ | 1 | 1¼ | | | | | |
| 1⅜ to 2 | ¾ | ¾ | 1 | 1¼ | 1½ | 1½ | | | |
| 2⅛ to 2½ | ¾ | ¾ | 1 | 1¼ | 1½ | 1¾ | 1¾ | | |
| 2⅝ to 3 | ⅞ | ⅞ | 1 | 1¼ | 1½ | 1¾ | 1¾ | 2¼ | |
| 3⅛ to 4 | ⅞ | ⅞ | 1¼ | 1¼ | 1½ | 1¾ | 1¾ | 2¼ | 2½ |
| 4⅛ to 8 | 1 | 1 | 1¼ | 1½ | 1¾ | 2 | 2¼ | 2½ | 2¾ |
| 8⅛ to 12 | 1 | 1 | 1½ | 1¾ | 2 | 2¼ | 2½ | 3 | 3 |
| 12⅛ to 20 | 1 | 1 | 1½ | 2 | 2 | 2¼ | 2½ | 3 | 3 |

Bolts not listed are threaded about 3 times the diameter; in no case are standard bolts threaded closer to the head than ¼ inch.

## BOLTS WITH SQUARE HEADS AND NUTS

AMERICAN BRIDGE COMPANY STANDARD

### Weight in Pounds per 100 Bolts

| Length Under Head, Inches | Diameter of Bolt, Inches | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ¼ | 5/16 | ⅜ | 7/16 | ½ | ⅝ | ¾ | ⅞ | 1 |
| 1 | 4 | 7 | 11 | 15 | 22 | 37 | 56 | | |
| 1¼ | 4 | 7 | 11 | 16 | 23 | 39 | 59 | | |
| 1½ | 5 | 8 | 12 | 17 | 24 | 41 | 62 | | |
| 1¾ | 5 | 8 | 13 | 18 | 26 | 43 | 64 | | |
| 2 | 5 | 9 | 14 | 19 | 27 | 45 | 67 | 101 | 144 |
| 2¼ | 6 | 9 | 15 | 20 | 28 | 47 | 71 | 104 | 150 |
| 2½ | 6 | 10 | 15 | 21 | 30 | 49 | 74 | 109 | 155 |
| 2¾ | 6 | 10 | 16 | 22 | 31 | 51 | 77 | 113 | 161 |
| 3 | 7 | 11 | 17 | 24 | 33 | 54 | 80 | 117 | 167 |
| 3½ | 7 | 12 | 18 | 25 | 35 | 58 | 86 | 126 | 178 |
| 4 | 8 | 13 | 20 | 28 | 38 | 62 | 92 | 134 | 189 |
| 4½ | 9 | 14 | 21 | 30 | 41 | 66 | 98 | 142 | 198 |
| 5 | 10 | 15 | 23 | 32 | 43 | 71 | 104 | 151 | 209 |
| 5½ | 10 | 16 | 25 | 34 | 46 | 75 | 111 | 159 | 220 |
| 6 | 11 | 17 | 26 | 36 | 49 | 79 | 117 | 168 | 232 |
| 6½ | | | 28 | 38 | 52 | 84 | 123 | 176 | 243 |
| 7 | | | 29 | 40 | 55 | 88 | 129 | 185 | 254 |
| 7½ | | | 31 | 42 | 57 | 92 | 136 | 193 | 265 |
| 8 | | | 32 | 45 | 60 | 97 | 142 | 202 | 276 |
| 9 | | | 34 | 49 | 65 | 105 | 154 | 218 | 298 |
| 10 | | | | 53 | 71 | 114 | 167 | 235 | 320 |
| 12 | | | | 61 | 82 | 131 | 192 | 269 | 364 |
| 14 | | | | | 93 | 148 | 217 | 303 | 409 |
| Per Inch Additional | 1.4 | 2.2 | 3.1 | 4.3 | 5.6 | 8.7 | 12.5 | 17.0 | 22.3 |

## SQUARE NUTS AND BOLT HEADS

AMERICAN BRIDGE COMPANY STANDARD

### Weight in Pounds for One Head and One Nut

| Diameter of Bolt, Inches | 1¼ | 1½ | 1¾ | 2 | 2½ | 3 |
|---|---|---|---|---|---|---|
| Square Head and Nut.... | 2.05 | 3.51 | 5.48 | 8.08 | 15.5 | 26.2 |
| Weight of Shank per Inch | .3477 | .5007 | .6815 | .8900 | 1.391 | 2.003 |

## BOLTS WITH HEXAGON HEADS AND NUTS

AMERICAN BRIDGE COMPANY STANDARD

### WEIGHT IN POUNDS PER 100 BOLTS

| Length Under Head, Inches | Diameter of Bolt, Inches | | | | | Length Under Head, Inches | Diameter of Bolt, Inches | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ⅞ | 1 | | ½ | ⅝ | ¾ | ⅞ | 1 |
| 1 | 19 | 33 | 52 | | | 8 | 58 | 92 | 137 | 194 | 264 |
| 1¼ | 20 | 34 | 54 | | | 8½ | 60 | 96 | 143 | 202 | 274 |
| 1½ | 22 | 36 | 57 | | | 9 | 63 | 100 | 149 | 210 | 285 |
| 1¾ | 23 | 38 | 60 | | | 9½ | 66 | 105 | 156 | 219 | 296 |
| 2 | 24 | 40 | 63 | 93 | 132 | 10 | 68 | 109 | 162 | 227 | 307 |
| 2¼ | 26 | 43 | 66 | 97 | 137 | 10½ | 71 | 114 | 168 | 236 | 318 |
| 2½ | 27 | 45 | 69 | 101 | 143 | 11 | 74 | 118 | 174 | 244 | 329 |
| 2¾ | 29 | 47 | 72 | 105 | 148 | 11½ | 77 | 122 | 181 | 253 | 341 |
| 3 | 30 | 49 | 75 | 109 | 154 | 12 | 80 | 127 | 187 | 261 | 352 |
| 3¼ | 31 | 51 | 78 | 114 | 160 | 12½ | 82 | 131 | 193 | 270 | 363 |
| 3½ | 33 | 54 | 82 | 118 | 165 | 13 | 85 | 135 | 199 | 278 | 374 |
| 3¾ | 34 | 56 | 85 | 122 | 171 | 13½ | 88 | 139 | 206 | 287 | 385 |
| 4 | 35 | 58 | 88 | 126 | 176 | 14 | 91 | 144 | 212 | 295 | 396 |
| 4¼ | 37 | 60 | 90 | 130 | 180 | 14½ | 93 | 148 | 218 | 304 | 407 |
| 4½ | 38 | 62 | 94 | 134 | 186 | 15 | 96 | 152 | 225 | 312 | 418 |
| 4¾ | 39 | 64 | 97 | 138 | 191 | 15½ | 99 | 157 | 231 | 321 | 430 |
| 5 | 41 | 66 | 100 | 143 | 197 | 16 | 102 | 161 | 237 | 329 | 441 |
| 5¼ | 42 | 68 | 103 | 147 | 202 | 16½ | 105 | 165 | 243 | 338 | 452 |
| 5½ | 44 | 71 | 106 | 151 | 208 | 17 | 107 | 170 | 250 | 346 | 463 |
| 5¾ | 45 | 73 | 109 | 156 | 213 | 17½ | 110 | 174 | 256 | 355 | 474 |
| 6 | 46 | 75 | 112 | 160 | 219 | 18 | 113 | 177 | 262 | 364 | 485 |
| 6¼ | 48 | 77 | 115 | 164 | 225 | 18½ | 116 | 183 | 268 | 372 | 496 |
| 6½ | 49 | 79 | 119 | 168 | 230 | 19 | 119 | 187 | 275 | 381 | 507 |
| 6¾ | 51 | 81 | 122 | 173 | 236 | 19½ | 121 | 191 | 281 | 389 | 519 |
| 7 | 52 | 84 | 125 | 177 | 241 | 20 | 124 | 196 | 287 | 398 | 530 |
| 7¼ | 53 | 86 | 128 | 181 | 247 | | | | | | |
| 7½ | 55 | 88 | 131 | 185 | 252 | | | | | | |
| 7¾ | 56 | 90 | 134 | 190 | 258 | | | | | | |
| Per Inch Additional | 5.6 | 8.7 | 12.5 | 17.0 | 22.3 | Per Inch Additional | 5.6 | 8.7 | 12.5 | 17.0 | 22.3 |

## HEXAGON NUTS AND BOLT HEADS

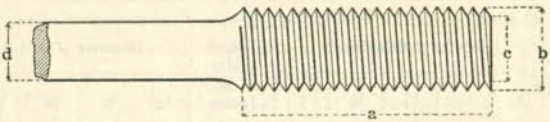
AMERICAN BRIDGE COMPANY STANDARD

### WEIGHT IN POUNDS FOR ONE HEAD AND ONE NUT

| Diameter of Bolt, Inches | 1¼ | 1½ | 1¾ | 2 | 2½ | 3 |
|---|---|---|---|---|---|---|
| Hexagon Head and Nut.. | 1.73 | 2.95 | 4.61 | 6.79 | 13.0 | 22.0 |
| Weight of Shank per Inch | .3477 | .5007 | .6815 | .8900 | 1.391 | 2.003 |

# UPSET SCREW ENDS FOR SQUARE BARS

AMERICAN BRIDGE COMPANY STANDARD



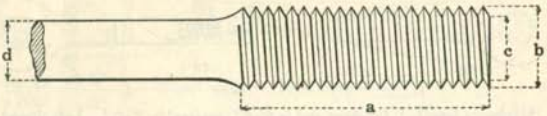

Thread: Shape and Pitch, U. S. Standard.

| BAR | | | UPSET | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Area | |
| Side of Square d, Inches | Area, Sq. Inches | Weight per Foot, Lbs. | Diameter b, Inches | Length a, Inches | Additional Length for Upset +10%, Inches | Diameter at Root of Thread c, Inches | At Root of Thread, Sq. Inches | Excess Over Area of Bar, % |
| * ¾ | 0.563 | 1.91 | 1⅛ | 4 | 4 | 0.939 | 0.693 | 23.2 |
| * ⅞ | 0.766 | 2.60 | 1¼ | 4 | 4 | 1.064 | 0.890 | 16.2 |
| 1 | 1.000 | 3.40 | 1½ | 4 | 4 | 1.283 | 1.294 | 29.4 |
| 1⅛ | 1.266 | 4.30 | 1⅝ | 4 | 3½ | 1.389 | 1.515 | 19.7 |
| 1¼ | 1.563 | 5.31 | 1⅞ | 4½ | 4½ | 1.615 | 2.049 | 31.1 |
| 1⅜ | 1.891 | 6.43 | 2 | 4½ | 4 | 1.711 | 2.300 | 21.7 |
| 1½ | 2.250 | 7.65 | 2¼ | 5 | 5 | 1.961 | 3.021 | 34.3 |
| 1⅝ | 2.641 | 8.98 | 2⅜ | 5 | 4½ | 2.086 | 3.419 | 29.5 |
| 1¾ | 3.063 | 10.41 | 2½ | 5½ | 4½ | 2.175 | 3.716 | 21.3 |
| 1⅞ | 3.516 | 11.95 | 2¾ | 5½ | 5 | 2.425 | 4.619 | 31.4 |
| 2 | 4.000 | 13.60 | 2⅞ | 6 | 5 | 2.550 | 5.108 | 27.7 |
| 2⅛ | 4.516 | 15.35 | 3 | 6 | 4½ | 2.629 | 5.428 | 20.2 |
| 2¼ | 5.063 | 17.21 | 3¼ | 6½ | 5½ | 2.879 | 6.509 | 28.6 |
| 2⅜ | 5.641 | 19.18 | 3½ | 7 | 6½ | 3.100 | 7.549 | 33.8 |
| 2½ | 6.250 | 21.25 | 3¾ | 7 | 7 | 3.317 | 8.641 | 38.3 |
| 2⅝ | 6.891 | 23.43 | 3¾ | 7 | 5½ | 3.317 | 8.641 | 25.4 |
| 2¾ | 7.563 | 25.71 | 4 | 7½ | 6½ | 3.567 | 9.993 | 32.1 |
| 2⅞ | 8.266 | 28.10 | 4¼ | 8 | 7½ | 3.798 | 11.330 | 37.1 |
| 3 | 9.000 | 30.60 | 4¼ | 8 | 6 | 3.798 | 11.330 | 25.9 |
| 3⅛ | 9.766 | 33.20 | 4½ | 8½ | 7 | 4.028 | 12.741 | 30.5 |
| 3¼ | 10.563 | 35.91 | 4¾ | 8½ | 7½ | 4.255 | 14.221 | 34.6 |

*Upsets are special.

# UPSET SCREW ENDS FOR ROUND BARS

AMERICAN BRIDGE COMPANY STANDARD




Thread: Shape and Pitch, U. S. Standard.

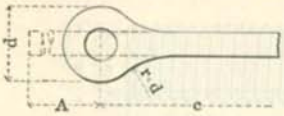
| BAR | | | UPSET | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Area | |
| Diameter d, Inches | Area, Sq. Inches | Weight per Foot, Lbs. | Diameter b, Inches | Length a, Inches | Additional Length for Upset +10%, Inches | Diameter at Root of Thread c, Inches | At Root of Thread, Sq. Inches | Excess Over Area of Bar, % |
| * ¾ | 0.442 | 1.50 | 1 | 4 | 5 | 0.838 | 0.551 | 24.7 |
| * ⅞ | 0.601 | 2.04 | 1¼ | 4 | 5½ | 1.064 | 0.890 | 48.0 |
| 1 | 0.785 | 2.67 | 1⅜ | 4 | 4 | 1.158 | 1.054 | 34.2 |
| 1⅛ | 0.994 | 3.38 | 1½ | 4 | 4 | 1.283 | 1.294 | 30.2 |
| 1¼ | 1.227 | 4.17 | 1⅝ | 4 | 4 | 1.389 | 1.515 | 23.5 |
| 1⅜ | 1.485 | 5.05 | 1¾ | 4 | 4 | 1.490 | 1.744 | 17.5 |
| 1½ | 1.767 | 6.01 | 2 | 4½ | 4½ | 1.711 | 2.300 | 30.2 |
| 1⅝ | 2.074 | 7.05 | 2⅛ | 4½ | 4 | 1.836 | 2.649 | 27.7 |
| 1¾ | 2.405 | 8.18 | 2¼ | 5 | 4 | 1.961 | 3.021 | 25.6 |
| 1⅞ | 2.761 | 9.39 | 2⅜ | 5 | 4 | 2.086 | 3.419 | 23.8 |
| 2 | 3.142 | 10.68 | 2½ | 5½ | 4 | 2.175 | 3.716 | 18.3 |
| 2⅛ | 3.547 | 12.06 | 2⅝ | 5½ | 3½ | 2.300 | 4.156 | 17.2 |
| 2¼ | 3.976 | 13.52 | 2⅞ | 6 | 4½ | 2.550 | 5.108 | 28.4 |
| 2⅜ | 4.430 | 15.06 | 3 | 6 | 4½ | 2.629 | 5.428 | 22.5 |
| 2½ | 4.909 | 16.69 | 3¼ | 6½ | 5½ | 2.879 | 6.509 | 32.6 |
| 2⅝ | 5.412 | 18.40 | 3¼ | 6½ | 4½ | 2.879 | 6.509 | 20.3 |
| 2¾ | 5.940 | 20.19 | 3½ | 7 | 5½ | 3.100 | 7.549 | 27.1 |
| 2⅞ | 6.492 | 22.07 | 3¾ | 7 | 6 | 3.317 | 8.641 | 33.1 |
| 3 | 7.069 | 24.03 | 3¾ | 7 | 5 | 3.317 | 8.641 | 22.2 |
| 3⅛ | 7.670 | 26.08 | 4 | 7½ | 6 | 3.567 | 9.993 | 30.3 |
| 3¼ | 8.296 | 28.21 | 4 | 7½ | 5 | 3.567 | 9.993 | 20.5 |
| 3⅜ | 8.946 | 30.42 | 4¼ | 8 | 5½ | 3.798 | 11.330 | 26.6 |
| 3½ | 9.621 | 32.71 | 4¼ | 8 | 5 | 3.798 | 11.330 | 17.8 |
| 3⅝ | 10.321 | 35.09 | 4½ | 8½ | 5½ | 4.028 | 12.741 | 23.4 |
| 3¾ | 11.045 | 37.55 | 4¾ | 8½ | 6 | 4.255 | 14.221 | 28.8 |
| 3⅞ | 11.793 | 40.10 | 4¾ | 8½ | 5½ | 4.255 | 14.221 | 20.6 |

*Upsets are special.

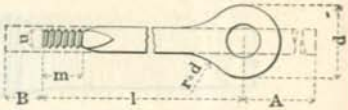
# EYE BARS

AMERICAN BRIDGE COMPANY STANDARD

ORDINARY EYE BAR




ADJUSTABLE EYE BAR




Minimum length, l, for short end is 6′-6″, preferably 7′-0″. Left thread.

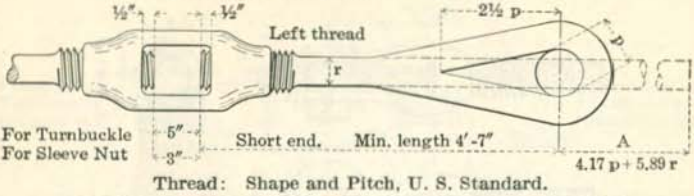
Thread: Shape and Pitch, U. S. Standard.

| BAR | | | HEAD | | | | | BAR | | SCREW END | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Width In. | Thickness | | Dia. d, In. | Maximum Pin | | Additional Material, A, Ft. and In. | | Width In. | Min. thickness In. | Dia. u, In. | Excess Upset over Bar % | Length m, In. | Additional Material, B, Ft. and In. | |
| | Max. In. | Min. In. | | Dia. In. | Excess Head over Bar, % | For ordering Bar | For figuring Weight | | | | | | For ordering Bar | For figuring Wt. |
| 2 | 1 | ½ | 4½ | 1¾ | 37.5 | 0-10½ | 0- 7 | 2 | * ⅝ | 1¾ | 39.6 | 4 | 1- 0 | 8 |
| | | | 5½ | 2¾ | | 1- 2½ | 0-11 | | ¾ | 1⅞ | 36.6 | 4½ | 1- 0 | 7½ |
| | | | * 6½ | 3¾ | | 1- 7½ | 1- 4 | | ⅞ | 2 | 31.4 | 4½ | 0-11 | 7½ |
| 2½ | 1 | ⅝ | 6 | 2½ | 40.0 | 1- 1¾ | 0-10 | 2½ | * ¾ | 2⅛ | 41.2 | 4½ | 1- 0 | 8 |
| | | | 7 | 3½ | | 1- 5¾ | 1- 2 | | ⅞ | 2¼ | 38.1 | 5 | 1- 0 | 8 |
| | | | * 8 | 4½ | | 1-10¾ | 1- 7 | | 1 | 2⅜ | 36.7 | 5 | 1- 0 | 7½ |
| 3 | 1½ | ⅝ | 7½ | 3¼ | 41.7 | 1- 4½ | 1- 1 | 3 | * ¾ | 2¼ | 34.3 | 5 | 1- 0 | 7½ |
| | | | 8½ | 4¼ | | 1- 9½ | 1- 5 | | ⅞ | 2¼ | 41.6 | 5 | 1 -1 | 9½ |
| | | | * 9½ | 5¼ | | 2- 2½ | 1-10 | | 1 | 2½ | 23.9 | 5½ | 1- 1 | 8½ |
| 4 | 1¾ | ¾ | 10 | 4½ | 37.5 | 1- 9 | 1- 6 | 4 | * ¾ | 2½ | 23.9 | 5½ | 1- 1 | 8½ |
| | | ⅞ | 11 | 5½ | | 2- 3 | 1-10 | | ⅞ | 2¾ | 32.0 | 5½ | 0-11 | 7½ |
| | | 1 | *12 | 6½ | | 2- 8 | 2- 2 | | 1 | 3 | 35.7 | 6 | 1- 1 | 8½ |
| | | | | | | | | | 1⅛ | 3¼ | 44.6 | 6½ | 1- 2 | 9½ |
| 5 | 2 | ¾ | 12 | 5¼ | 35.0 | 1-10½ | 1- 8 | 5 | * ¾ | 2⅞ | 36.2 | 6 | 1- 0 | 8 |
| | | 1 | 13½ | 6¾ | | 2- 6 | 2- 2 | | ⅞ | 3 | 24.1 | 6 | 0-11 | 7 |
| | | 1 | *15 | 8¼ | | 3- 3 | 2- 9 | | 1 | 3¼ | 30.2 | 6½ | 1- 0 | 8 |
| | | | | | | | | | 1⅛ | 3½ | 34.2 | 7 | 1- 1 | 8½ |
| 6 | 2 | ¾ | 14 | 5¾ | 37.5 | 2- 1 | 1-10 | | 1¼ | 3¾ | 38.3 | 7 | 1- 2 | 9 |
| | | 1 | 14¾ | 6½ | | 2- 4 | 2- 1 | | | | | | | |
| | | 1 | *16½ | 8¼ | | 3- 2 | 2- 8 | 6 | *1 | 3½ | 25.8 | 7 | 1- 0 | 7½ |
| 7 | 2 | 1 | 16½ | 7 | 35.7 | 2- 4½ | 2- 2 | | 1⅛ | 3¾ | 28.0 | 7 | 1- 0 | 8 |
| | | 1⅛ | 17½ | 8 | | 2-11 | 2- 6 | | 1¼ | 4 | 33.2 | 7½ | 1- 1 | 8½ |
| | | 1⅛ | *18½ | 9 | | 3- 4 | 2-11 | | 1⅜ | 4¼ | 37.3 | 8 | 1- 2 | 9½ |
| 8 | 2 | 1 | 18 | 7 | 37.5 | 2- 5½ | 2- 3 | 7 | *1⅛ | 4 | 26.9 | 7½ | 1- 0 | 8 |
| | | 1⅛ | 19 | 8 | | 2- 9½ | 2- 6 | | 1¼ | 4¼ | 29.5 | 8 | 1- 1 | 8½ |
| | | 1¼ | *20 | 9 | | 3- 4 | 2-11 | | 1⅜ | 4½ | 32.4 | 8½ | 1- 2 | 9 |
| | | | | | | | | | 1½ | 4¾ | 35.4 | 8½ | 1- 2 | 9½ |
| 9 | 2 | 1⅛ | 20 | 7½ | 38.9 | 2- 8½ | 2- 6 | 8 | *1⅛ | 4¼ | 25.9 | 8 | 1- 0 | 8 |
| | | 1¼ | 22 | 9½ | | 3- 4½ | 3- 1 | | 1¼ | 4½ | 27.4 | 8½ | 1- 1 | 8½ |
| 10 | 2 | 1⅛ | 22½ | 9 | 35.0 | 3- 2½ | 2-10 | | 1⅜ | 4¾ | 29.3 | 8½ | 1- 1 | 8½ |
| | | 1¼ | 24 | 10½ | | 3- 9 | 3- 3 | | 1½ | 5 | 31.4 | 9 | 1- 2 | 9 |
| | | 1⅜ | *25 | 11½ | | 4- 1 | 3- 7 | | 1⅝ | 5¼ | 35.2 | 9½ | 1- 3 | 10 |
| 12 | 2 | 1¼ | 26½ | 10 | 37.5 | 3- 4 | 3- 3 | 9 | *1⅜ | 5 | 28.3 | 9¼ | 1- 2 | 9 |
| | | 1⅜ | 28 | 11½ | | 4- 2 | 3- 8 | | 1½ | 5¼ | 30.2 | 9¼ | 1- 1 | 8 |
| | | 1½ | *29½ | 13 | | 4- 8 | 4- 1 | | 1⅝ | 5½ | 31.7 | 9¾ | 1- 1 | 8 |
| 14 | 2 | 1⅜ | 31 | 12 | 35.7 | 3-11 | 3- 9 | 10 | *1⅜ | 5¼ | 27.8 | 9¼ | 1- 1 | 7½ |
| | | 1½ | †33 | 14 | | 4- 7 | 4- 4 | | 1½ | 5½ | 28.4 | 9¾ | 1- 1 | 8 |
| | | 1⅝ | *34 | 15 | | 5- 5 | 4- 8 | | 1⅝ | 5¾ | 30.8 | 10 | 1- 1 | 8 |
| 16 | 2 | 1¾ | 36 | 14 | 37.5 | 4- 7 | 4- 5 | 12 | *1½ | 6 | 28.3 | 10½ | 1- 1 | 8 |
| | | 1⅞ | *37½ | 16 | 34.4 | 4-11 | 4-10 | | 1⅝ | 6¼ | 29.6 | 10¾ | 1- 1 | 8 |
| | | | | | | | | | 1¾ | 6½ | 29.7 | 11 | 1- 1 | 8 |

*Bars are special. †33″, 14″, 1¾″ and over, add 4′-5½″ for material, 4′-2″ for weight.
Pin hole to be deducted in estimating weight of Eye Bars.

# LOOP RODS AND STUB ENDS

**AMERICAN BRIDGE COMPANY STANDARD**

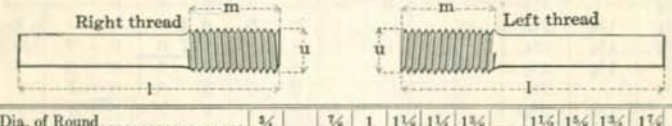



**Thread: Shape and Pitch, U. S. Standard.**

## LENGTH A FOR ONE LOOP IN FEET AND INCHES

| Diam. of Pin, p | Size of Square or Round Bar, in Inches | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | ⅞ | 1 | 1⅛ | 1¼ | 1⅜ | 1½ | 1⅝ | 1¾ | 1⅞ | 2 |
| 1⅛ | 0- 9½ | 0-10 | 0-11 | 0-11½ | | | | | | | |
| 1¼ | 0-10 | 0-10½ | 0-11½ | 1- 0 | 1- 1 | | | | | | |
| 1½ | 0-11 | 0-11½ | 1- 0½ | 1- 1 | 1- 2 | 1- 2½ | | | | | |
| 1¾ | 1- 0 | 1- 0½ | 1- 1½ | 1- 2 | 1- 3 | 1- 3½ | 1- 4½ | 1- 5 | 1- 6 | | |
| 2 | 1- 1 | 1- 1½ | 1- 2½ | 1- 3 | 1- 4 | 1- 4½ | 1- 5½ | 1- 6 | 1- 7 | 1- 7½ | 1- 8½ |
| 2¼ | 1- 2 | 1- 3 | 1- 3½ | 1- 4½ | 1- 5 | 1- 5½ | 1- 6½ | 1- 7 | 1- 8 | 1- 8½ | 1- 9½ |
| 2½ | 1- 3 | 1- 4 | 1- 4½ | 1- 5½ | 1- 6 | 1- 7 | 1- 7½ | 1- 8 | 1- 9 | 1- 9½ | 1-10½ |
| 2¾ | 1- 4 | 1- 5 | 1- 5½ | 1- 6½ | 1- 7 | 1- 8 | 1- 8½ | 1- 9½ | 1-10 | 1-11 | 1-11½ |
| 3 | 1- 5 | 1- 6 | 1- 6½ | 1- 7½ | 1- 8 | 1- 9 | 1- 9½ | 1-10½ | 1-11 | 2- 0 | 2- 0½ |
| *3¼ | 1- 6 | 1- 7 | 1- 7½ | 1- 8½ | 1- 9 | 1-10 | 1-10½ | 1-11½ | 2- 0 | 2- 1 | 2- 1½ |
| 3½ | 1- 7½ | 1- 8 | 1- 8½ | 1- 9½ | 1-10 | 1-11 | 1-11½ | 2- 0½ | 2- 1 | 2- 2 | 2- 2½ |
| *3¾ | 1- 8½ | 1- 9 | 1-10 | 1-10½ | 1-11 | 2- 0 | 2- 0½ | 2- 1½ | 2- 2 | 2- 3 | 2- 3½ |
| 4 | 1- 9½ | 1-10 | 1-11 | 1-11½ | 2- 0½ | 2- 1 | 2- 2 | 2- 2½ | 2- 3 | 2- 4 | 2- 4½ |
| *4¼ | | 1-11 | 2- 0 | 2- 0½ | 2- 1½ | 2- 2 | 2- 3 | 2- 3½ | 2- 4½ | 2- 5 | 2- 6 |
| 4½ | | 2- 0 | 2- 1 | 2- 1½ | 2- 2½ | 2- 3 | 2- 4 | 2- 4½ | 2- 5½ | 2- 6 | 2- 7 |
| *4¾ | | 2- 1 | 2- 2 | 2- 2½ | 2- 3½ | 2- 4 | 2- 5 | 2- 5½ | 2- 6½ | 2- 7 | 2- 8 |
| 5 | | 2- 2½ | 2- 3 | 2- 3½ | 2- 4½ | 2- 5 | 2- 6 | 2- 6½ | 2- 7½ | 2- 8 | 2- 9 |
| *5¼ | | | 2- 4 | 2- 5 | 2- 5½ | 2- 6 | 2- 7 | 2- 7½ | 2- 8½ | 2- 9 | 2-10 |
| 5½ | | | 2- 5 | 2- 6 | 2- 6½ | 2- 7½ | 2- 8 | 2- 9 | 2- 9½ | 2-10 | 2-11 |
| *5¾ | | | 2- 6 | 2- 7 | 2- 7½ | 2- 8½ | 2- 9 | 2-10 | 2-10½ | 2-11½ | 3- 0 |
| 6 | | | 2- 7 | 2- 8 | 2- 8½ | 2- 9½ | 2-10 | 2-11 | 2-11½ | 3- 0½ | 3- 1 |
| *6¼ | | | | 2- 9 | 2- 9½ | 2-10½ | 2-11 | 3- 0 | 3- 0½ | 3- 1½ | 3- 2 |
| 6½ | | | | 2-10 | 2-10½ | 2-11½ | 3- 0 | 3- 1 | 3- 1½ | 3- 2½ | 3- 3 |
| *6¾ | | | | 2-11 | 3- 0 | 3- 0½ | 3- 1 | 3- 2 | 3- 2½ | 3- 3½ | 3- 4 |
| 7 | | | | 3- 0 | 3- 1 | 3- 1½ | 3- 2½ | 3- 3 | 3- 3½ | 3- 4½ | 3- 5 |

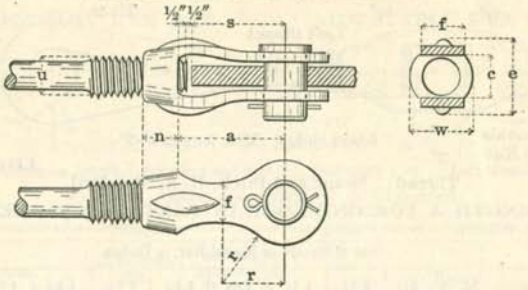
*Pins are special. Maximum shipping length of long end = 35 feet.




| Dia. of Round | ¾ | | ⅞ | 1 | 1⅛ | 1¼ | 1⅜ | | 1½ | 1⅝ | 1¾ | 1⅞ | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Side of Square | | ¾ | ⅞ | | 1 | 1⅛ | | 1¼ | 1⅜ | | 1½ | 1⅝ | 1¾ |
| Dia. of Upset, u | 1 | 1⅛ | 1¼ | 1⅜ | 1½ | 1⅝ | 1¾ | 1⅞ | 2 | 2⅛ | 2¼ | 2⅜ | 2½ |
| Length of Upset, m | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4½ | 4½ | 4½ | 5 | 5 | 5½ |
| Length, l | 9½ | 9½ | 10 | 10½ | 10½ | 11 | 11½ | 11½ | 11½ | 11½ | 12 | 12½ | 13 |

# CLEVISES

AMERICAN BRIDGE COMPANY STANDARD




Grip = thickness of plate + ¼" but must not exceed dimension, c.

Thread: Shape and Pitch, U. S. Standard.

| Clevis Number | Upset | | Pin | | Head | | | Fork | | | | Nut | | | Weight, Pounds |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | | | | | | | | | | | |
| | u | u | p | p | d | t | r | f | s | c | d | n | w | e | |
| 3 | 1 | 1 1/8 | 1 | 1 1/2 | 3 | 1/2 | 2 1/4 | 1 1/2 | 4 | 1 1/4 | 5 | 1 1/2 | 2 1/4 | 3 1/16 | 4 |
| 4 | 1 1/8 | 1 5/8 | 1 1/4 | 2 | 4 | 1/2 | 3 | 2 | 5 | 1 3/4 | 6 | 1 3/4 | 2 7/8 | 3 5/8 | 8 |
| 5 | 1 1/2 | 2 1/8 | 1 1/2 | 2 1/2 | 5 | 5/8 | 3 3/4 | 2 1/2 | 6 | 2 1/4 | 7 | 2 1/4 | 3 3/4 | 4 1/2 | 17 |
| 6 | 2 | 2 5/8 | 2 | 3 | 6 | 3/4 | 4 1/2 | 3 | 7 | 2 3/4 | 8 | 2 1/2 | 4 3/8 | 5 3/8 | 26 |
| 7 | 2 1/4 | 3 | 2 1/2 | 3 1/2 | 7 | 7/8 | 5 1/4 | 3 1/2 | 8 | 3 1/4 | 9 | 3 | 5 | 6 3/16 | 40 |

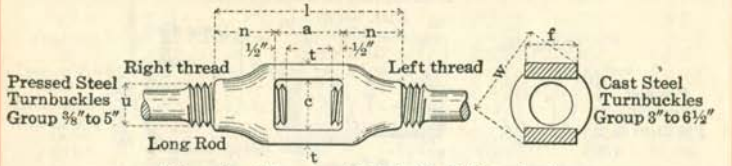
## Clevis Numbers for Various Rods and Pins

| Rods | | | Pins | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Round | Square | Upset | 1 | 1 1/4 | 1 1/2 | 1 3/4 | 2 | 2 1/4 | 2 1/2 | 2 3/4 | 3 | 3 1/4 | 3 1/2 |
| 3/4 | ..... | 1 | 3 | 3 | 3 | | | | | | | | |
| ..... | 3/4 | 1 1/8 | 3 | 3 | 3 | 4 | 4 | | | | | | |
| 7/8 | 7/8 | 1 1/4 | | 4 | 4 | 4 | 4 | | | | | | |
| 1 | ..... | 1 3/8 | | 4 | 4 | 4 | 4 | | | | | | |
| 1 1/8 | 1 | 1 1/2 | | 4 | 4 | 4 | 4 | 5 | 5 | | | | |
| 1 1/4 | 1 1/8 | 1 5/8 | | 4 | 4 | 4 | 4 | 5 | 5 | | | | |
| 1 3/8 | ..... | 1 3/4 | | | 5 | 5 | 5 | 5 | 5 | | | | |
| ..... | 1 1/4 | 1 7/8 | | | 5 | 5 | 5 | 5 | 5 | | | | |
| 1 1/2 | 1 3/8 | 2 | | | 5 | 5 | 5 | 5 | 5 | 6 | 6 | | |
| 1 5/8 | ..... | 2 1/8 | | | 5 | 5 | 5 | 5 | 5 | 6 | 6 | | |
| 1 3/4 | 1 1/2 | 2 1/4 | | | | | 6 | 6 | 6 | 6 | 6 | 7 | 7 |
| 1 7/8 | 1 5/8 | 2 3/8 | | | | | 6 | 6 | 6 | 6 | 6 | 7 | 7 |
| 2 | 1 3/4 | 2 1/2 | | | | | 6 | 6 | 6 | 6 | 6 | 7 | 7 |
| 2 1/8 | ..... | 2 3/8 | | | | | 6 | 6 | 6 | 6 | 6 | 7 | 7 |
| ..... | 1 7/8 | 2 3/4 | | | | | | | 7 | 7 | 7 | 7 | 7 |
| 2 1/4 | 2 | 2 7/8 | | | | | | | 7 | 7 | 7 | 7 | 7 |
| 2 3/8 | 2 1/8 | 3 | | | | | | | 7 | 7 | 7 | 7 | 7 |

Clevises above and to right of zigzag line may be used with forks straight, clevices below and to left of this line should have forks closed so as not to overstrain pin.

# TURNBUCKLES AND SLEEVE NUTS

AMERICAN BRIDGE COMPANY STANDARD

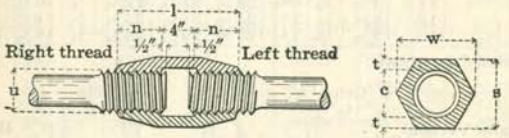



Thread: Shape and Pitch, U. S. Standard.

| Dia. of Screw, u | Dimensions in Inches | | | | | | Weight, Pounds |
|---|---|---|---|---|---|---|---|
| | w | l | n | c | t | f | |
| ⅜ | 1 1/16 | 7 1/8 | 9/16 | 9/16 | 3/16 | ½ | 0.4 |
| 7/16 | 1 3/8 | 7 1/4 | 5/8 | 5/8 | ¼ | 5/8 | 0.4 |
| ½ | 1 3/8 | 7 ½ | ¾ | 5/8 | ¼ | 5/8 | 0.6 |
| 9/16 | 1 9/16 | 7 ¾ | ⅞ | 1 3/16 | 5/16 | ¾ | 0.6 |
| ⅝ | 1 9/16 | 8 | 1 | 1 3/16 | 5/16 | ¾ | 1.0 |
| ¾ | 2 | 8 ¼ | 1 1/8 | 1 1/16 | ⅜ | ⅞ | 1.4 |
| ⅞ | 2 ¼ | 8 ½ | 1 ¼ | 1 ¼ | ⅜ | 1 | 1.7 |
| 1 | 2 7/16 | 9 | 1 ½ | 1 5/16 | 7/16 | 1 ¼ | 2.3 |
| 1 ⅛ | 2 9/16 | 9 ½ | 1 ¾ | 1 7/16 | ½ | 1 ¼ | 3.2 |
| 1 ¼ | 2 ¾ | 9 ¾ | 1 ⅞ | 1 9/16 | ½ | 1 ⅜ | 4.0 |
| 1 ⅜ | 3 1/16 | 10 | 2 | 1 11/16 | ½ | 1 ⅜ | 4.9 |
| 1 ½ | 3 5/16 | 10 ½ | 2 ¼ | 1 ¾ | 9/16 | 1 ¾ | 6.3 |
| 1 ⅝ | 3 ½ | 11 | 2 ½ | 2 | 9/16 | 1 ⅞ | 7.0 |
| 1 ¾ | 3 ¾ | 11 ¼ | 2 ⅝ | 2 ⅛ | ⅝ | 2 | 8.4 |
| 1 ⅞ | 3 ⅞ | 11 ½ | 2 ¾ | 2 5/16 | 11/16 | 2 ⅛ | 10.5 |
| 2 | 4 ¼ | 12 | 3 | 2 ⅝ | 11/16 | 2 ¼ | 11.9 |
| 2 ⅛ | 4 ⅜ | 12 ¾ | 3 ⅜ | 2 11/16 | 13/16 | 2 ½ | 18.6 |
| 2 ¼ | 4 ¾ | 12 ¾ | 3 ⅜ | 2 11/16 | 13/16 | 2 ½ | 18.6 |
| 2 ⅜ | 5 ⅛ | 13 ½ | 3 ¾ | 3 1/16 | ⅞ | 2 ¾ | 25.5 |
| 2 ½ | 5 ⅜ | 13 ½ | 3 ¾ | 3 1/16 | ⅞ | 2 ¾ | 25.5 |
| 2 ⅝ | 5 ¾ | 14 ¼ | 4 ⅛ | 3 ¼ | 15/16 | 3 | 34.2 |
| 2 ¾ | 5 ¾ | 14 ¼ | 4 ⅛ | 3 ¼ | 15/16 | 3 | 34.2 |
| 2 ⅞ | 6 ⅜ | 15 | 4 ½ | 3 ⅝ | 1 | 3 ¼ | 40.5 |
| 3 | 6 ⅜ | 15 | 4 ½ | 3 ⅝ | 1 | 3 ¼ | 40.5 |

| Dia. of Screw, u | Dimensions in Inches | | | | | | Weight, Pounds |
|---|---|---|---|---|---|---|---|
| | w | l | n | c | t | s | |
| 3 | 7 ¼ | 15 | 4 ½ | 3 ⅝ | 1 ¼ | 4 | 50 |
| 3 ¼ | 7 ¾ | 15 ¾ | 4 ⅝ | 3 ⅞ | 1 ⅜ | 4 ¼ | 62 |
| 3 ½ | 8 ¼ | 16 ½ | 5 ¼ | 4 ¼ | 1 ½ | 4 ⅜ | 79 |
| 3 ¾ | 9 | 17 ¼ | 5 ⅝ | 4 ½ | 1 ⅝ | 4 ¾ | 94 |
| 4 | 9 ½ | 18 | 6 | 4 ¾ | 1 ¾ | 5 ¼ | 116 |
| 4 ¼ | 10 ½ | 21 ¾ | 6 ⅜ | 5 ¼ | 1 ⅞ | 5 ⅝ | 158 |
| 4 ½ | 11 | 22 ½ | 6 ¾ | 5 ½ | 1 ⅞ | 6 ⅛ | 173 |
| 4 ¾ | 11 ½ | 23 ¼ | 7 ⅛ | 5 ¾ | 2 | 6 ½ | 198 |
| 5 | 12 | 24 | 7 ½ | 6 | 2 | 7 | 231 |
| 5 ¼ | 12 ½ | 24 ¾ | 7 ⅝ | 6 ¼ | 2 ⅛ | 7 ⅜ | 264 |
| 5 ½ | 13 ¼ | 25 ½ | 8 ¼ | 6 ½ | 2 ¼ | 7 ¾ | 301 |
| 5 ¾ | 13 ¾ | 26 ¼ | 8 ⅝ | 6 ¾ | 2 ⅜ | 8 | 344 |
| 6 | 14 ½ | 27 | 9 | 7 | 2 ⅝ | 8 ¼ | 400 |
| 6 ¼ | 15 | 27 ¾ | 9 ⅜ | 7 ¼ | 2 ¾ | 8 ½ | 487 |
| 6 ½ | 15 ½ | 28 ½ | 9 ¾ | 7 ½ | 2 ⅞ | 8 ¾ | 583 |

a = 6″ for screws 4″ or under. a = 9″ for screws 4½″ or over.



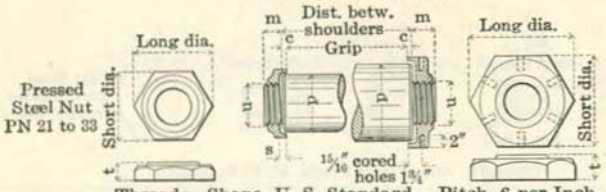

| Dia. of Screw, u | Dimensions in Inches | | | | | | Weight, Pounds |
|---|---|---|---|---|---|---|---|
| | w | l | n | c | t | s | |
| 4 | 7 ⅛ | 13 | 4 ½ | 4 ¼ | 15/16 | 6 ⅛ | 63 |
| 4 ¼ | 7 ½ | 13 ½ | 4 ¾ | 4 ½ | 1 | 6 ½ | 73 |
| 4 ½ | 8 | 14 | 5 | 4 ¾ | 1 1/16 | 6 ⅞ | 84 |
| 4 ¾ | 8 ⅜ | 14 ½ | 5 ¼ | 5 | 1 ⅛ | 7 ¼ | 98 |

| Dia. of Screw, u | Dimensions in Inches | | | | | | Weight, Pounds |
|---|---|---|---|---|---|---|---|
| | w | l | n | c | t | s | |
| 5 | 8 ⅞ | 15 | 5 ½ | 5 ¼ | 1 3/16 | 7 ⅝ | 110 |
| 5 ¼ | 9 ¼ | 15 ½ | 5 ¾ | 5 ½ | 1 ¼ | 8 | 122 |
| 5 ½ | 9 ¾ | 16 | 6 | 5 ¾ | 1 5/16 | 8 ⅜ | 142 |
| 5 ¾ | 10 ⅛ | 16 ½ | 6 ¼ | 6 | 1 ⅜ | 8 ¾ | 157 |
| 6 | 10 ⅝ | 17 | 6 ½ | 6 ¼ | 1 7/16 | 9 ⅛ | 176 |

# RECESSED PIN NUTS AND COTTER PINS

AMERICAN BRIDGE COMPANY STANDARD

Dimensions in Inches




Thread: Shape, U. S. Standard. Pitch, 6 per Inch.

| Diameter of Pin p | Pin Thread u | Pin Thread m | Pin c | Nut Thickness t | Nut Diameter Short Dia. | Nut Diameter Long Dia. | Nut Recess Rough Dia. | Nut Recess s | Diameter Rough Hole | Weight, Pounds | Pattern No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2, 2 1/4 | 1 1/2 | 1 | 1/4 | 7/8 | 3 | 3 3/4 | 2 5/8 | 1/4 | 1 1/4 | 1 | PN 21 |
| 2 1/2, 2 3/4 | 2 | 1 1/4 | 1/4 | 1 | 3 5/8 | 4 1/8 | 3 1/8 | 1/4 | 1 3/4 | 2 | PN 22 |
| 3, *3 1/4, 3 1/2 | 2 1/2 | 1 1/4 | 1/4 | 1 1/8 | 4 3/8 | 5 | 3 7/8 | 3/8 | 2 1/4 | 3 | PN 23 |
| *3 3/4, 4 | 3 | 1 3/4 | 1/4 | 1 1/4 | 4 7/8 | 5 5/8 | 4 3/8 | 3/8 | 2 3/4 | 4 | PN 24 |
| *4 1/4, 4 1/2, *4 3/4 | 3 1/2 | 1 1/2 | 1/4 | 1 3/8 | 5 3/4 | 6 5/8 | 5 1/4 | 1/2 | 3 1/4 | 5 | PN 25 |
| 5, *5 1/4 | 4 | 1 5/8 | 1/4 | 1 1/2 | 6 1/4 | 7 1/4 | 5 3/4 | 1/2 | 3 3/4 | 6 | PN 26 |
| 5 1/2, *5 3/4, 6 | 4 1/2 | 1 3/4 | 1/4 | 1 5/8 | 7 | 8 1/8 | 6 1/2 | 5/8 | 4 1/4 | 8 | PN 27 |
| *6 1/4, *6 1/2 | 5 | 1 7/8 | 3/8 | 1 3/4 | 7 5/8 | 8 7/8 | 7 | 5/8 | 4 3/4 | 10 | PN 28 |
| *6 3/4, 7 | 5 1/2 | 2 | 3/8 | 1 7/8 | 8 1/8 | 9 3/8 | 7 1/2 | 3/4 | 5 1/4 | 12 | PN 29 |
| *7 1/4, *7 1/2 | 5 1/2 | 2 | 3/8 | 1 7/8 | 8 5/8 | 10 | 8 | 3/4 | 5 1/4 | 14 | PN 30 |
| *7 3/4, 8, *8 1/4 | 6 | 2 1/4 | 3/8 | 2 1/8 | 9 3/8 | 10 7/8 | 8 3/4 | 3/4 | 5 3/4 | 19 | PN 31 |
| *8 1/2, *8 3/4, 9 | 6 | 2 1/4 | 3/8 | 2 1/8 | 10 1/4 | 11 7/8 | 9 5/8 | 3/4 | 5 3/4 | 24 | PN 32 |
| *9 1/4, *9 1/2 | 6 | 2 3/8 | 3/8 | 2 1/4 | 11 1/4 | 13 | 10 5/8 | 3/4 | 5 3/4 | 32 | PN 33 |
| *9 3/4, 10 | 6 | 2 3/8 | 3/8 | 2 1/4 | 11 1/4 | 13 | 10 5/8 | 3/4 | 5 3/4 | 32 | PN 33 |
| 11 | 6 | 2 1/2 | 1/2 | 2 7/8 | 12 1/2 | 14 3/8 | 11 3/4 | 3/4 | 5 3/4 | 60 | PN 34 |
| 12 | 6 | 2 5/8 | 1/2 | 2 7/8 | 13 1/2 | 15 5/8 | 12 3/4 | 3/4 | 5 3/4 | 73 | PN 35 |
| 13 | 7 | 2 3/4 | 1/2 | 2 7/8 | 14 1/2 | 16 3/4 | 13 3/4 | 3/4 | 6 3/4 | 81 | PN 36 |
| 14 | 7 | 3 | 1/2 | 2 7/8 | 15 1/2 | 17 7/8 | 14 3/4 | 3/4 | 6 3/4 | 94 | PN 37 |
| 15 | 8 | 3 | 1/2 | 2 7/8 | 16 1/2 | 19 | 15 3/4 | 3/4 | 7 3/4 | 103 | PN 38 |
| 16 | 8 | 3 1/8 | 1/2 | 3 | 17 1/2 | 20 1/8 | 16 3/4 | 3/4 | 7 3/4 | 126 | PN 39 |
| 17 | 9 | 3 1/4 | 1/2 | 3 1/8 | 18 1/2 | 21 1/4 | 17 3/4 | 3/4 | 8 3/4 | 145 | PN 40 |
| 18 | 9 | 3 3/8 | 1/2 | 3 1/4 | 19 1/2 | 22 3/4 | 18 3/4 | 3/4 | 8 3/4 | 173 | PN 41 |
| 19 | 10 | 3 1/2 | 1/2 | 3 3/8 | 20 1/2 | 23 1/2 | 19 3/4 | 3/4 | 9 3/4 | 196 | PN 42 |
| 20 | 10 | 3 1/2 | 1/2 | 3 3/8 | 21 1/2 | 24 3/4 | 20 3/4 | 3/4 | 9 3/4 | 222 | PN 43 |
| 21 | 11 | 3 1/2 | 1/2 | 3 3/8 | 22 1/2 | 26 | 21 3/4 | 3/4 | 10 3/4 | 240 | PN 44 |
| 22 | 11 | 3 1/2 | 1/2 | 3 3/8 | 23 1/2 | 27 1/8 | 22 3/4 | 3/4 | 10 3/4 | 266 | PN 45 |
| 23 | 12 | 3 1/2 | 1/2 | 3 3/8 | 24 1/2 | 28 1/4 | 23 3/4 | 3/4 | 11 3/4 | 282 | PN 46 |
| 24 | 12 | 3 1/2 | 1/2 | 3 3/8 | 25 1/2 | 29 3/8 | 24 3/4 | 3/4 | 11 3/4 | 310 | PN 47 |

Sizes marked * are special.


| Pin p | Head h | Cotter c | Cotter d | Pin p | Head h | Cotter c | Cotter d |
|---|---|---|---|---|---|---|---|
| 1 1/4 | 1 1/2 | 2 | 1/4 | 2 3/4 | 3 1/8 | 4 | 3/8 |
| 1 1/2 | 1 3/4 | 2 1/2 | 1/4 | 3 | 3 1/2 | 5 | 1/2 |
| 1 3/4 | 2 | 2 3/4 | 1/4 | 3 1/4 | 3 3/4 | 5 | 1/2 |
| 2 | 2 3/4 | 3 | 3/8 | 3 1/2 | 4 | 6 | 1/2 |
| 2 1/4 | 2 5/8 | 3 1/4 | 3/8 | 3 3/4 | 4 1/4 | 6 | 1/2 |
| 2 1/2 | 2 7/8 | 3 3/4 | 3/8 | | | | |

# DECIMAL OF AN INCH AND OF A FOOT

| Fractions of Inch or Foot | | Inch Equivalents to Foot Fractions | Fractions of Inch or Foot | | Inch Equivalents to Foot Fractions | Fractions of Inch or Foot | | Inch Equivalents to Foot Fractions | Fractions of Inch or Foot | | Inch Equivalents to Foot Fractions |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | .0052 | 1/16 in | | .2552 | 3 1/16 in | | .5052 | 6 1/16 in | | .7552 | 9 1/16 in |
| | .0104 | 1/8 | | .2604 | 3 1/8 | | .5104 | 6 1/8 | | .7604 | 9 1/8 |
| 1/64 | .015625 | 3/16 in | 17/64 | .265625 | 3 3/16 in | 33/64 | .515625 | 6 3/16 in | 49/64 | .765625 | 9 3/16 in |
| | .0208 | 1/4 | | .2708 | 3 1/4 | | .5208 | 6 1/4 | | .7708 | 9 1/4 |
| | .0260 | 5/16 in | | .2760 | 3 5/16 in | | .5260 | 6 5/16 in | | .7760 | 9 5/16 in |
| 1/32 | .03125 | 3/8 | 9/32 | .28125 | 3 3/8 | 17/32 | .53125 | 6 3/8 | 25/32 | .78125 | 9 3/8 |
| | .0365 | 7/16 in | | .2865 | 3 7/16 in | | .5365 | 6 7/16 in | | .7865 | 9 7/16 in |
| | .0417 | 1/2 | | .2917 | 3 1/2 | | .5417 | 6 1/2 | | .7917 | 9 1/2 |
| 3/64 | .046875 | 9/16 in | 19/64 | .296875 | 3 9/16 in | 35/64 | .546875 | 6 9/16 in | 51/64 | .796875 | 9 9/16 in |
| | .0521 | 5/8 | | .3021 | 3 5/8 | | .5521 | 6 5/8 | | .8021 | 9 5/8 |
| | .0573 | 11/16 in | | .3073 | 3 11/16 in | | .5573 | 6 11/16 in | | .8073 | 9 11/16 in |
| 1/16 | .0625 | 3/4 | 5/16 | .3125 | 3 3/4 | 9/16 | .5625 | 6 3/4 | 13/16 | .8125 | 9 3/4 |
| | .0677 | 13/16 in | | .3177 | 3 13/16 in | | .5677 | 6 13/16 in | | .8177 | 9 13/16 in |
| | .0729 | 7/8 | | .3229 | 3 7/8 | | .5729 | 6 7/8 | | .8229 | 9 7/8 |
| 5/64 | .078125 | 15/16 in | 21/64 | .328125 | 3 15/16 in | 37/64 | .578125 | 6 15/16 in | 53/64 | .828125 | 9 15/16 in |
| | .0833 | 1 | | .3333 | 4 | | .5833 | 7 | | .8333 | 10 |
| | .0885 | 1 1/16 in | | .3385 | 4 1/16 in | | .5885 | 7 1/16 in | | .8385 | 10 1/16 in |
| 3/32 | .09375 | 1 1/8 | 11/32 | .34375 | 4 1/8 | 19/32 | .59375 | 7 1/8 | 27/32 | .84375 | 10 1/8 |
| | .0990 | 1 3/16 in | | .3490 | 4 3/16 in | | .5990 | 7 3/16 in | | .8490 | 10 3/16 in |
| | .1042 | 1 1/4 | | .3542 | 4 1/4 | | .6042 | 7 1/4 | | .8542 | 10 1/4 |
| 7/64 | .109375 | 1 5/16 in | 23/64 | .359375 | 4 5/16 in | 39/64 | .609375 | 7 5/16 in | 55/64 | .859375 | 10 5/16 in |
| | .1146 | 1 3/8 | | .3646 | 4 3/8 | | .6146 | 7 3/8 | | .8646 | 10 3/8 |
| | .1198 | 1 7/16 in | | .3698 | 4 7/16 in | | .6198 | 7 7/16 in | | .8698 | 10 7/16 in |
| 1/8 | .1250 | 1 1/2 | 3/8 | .3750 | 4 1/2 | 5/8 | .6250 | 7 1/2 | 7/8 | .8750 | 10 1/2 |
| | .1302 | 1 9/16 in | | .3802 | 4 9/16 in | | .6302 | 7 9/16 in | | .8802 | 10 9/16 in |
| | .1354 | 1 5/8 | | .3854 | 4 5/8 | | .6354 | 7 5/8 | | .8854 | 10 5/8 |
| 9/64 | .140625 | 1 11/16 in | 25/64 | .390625 | 4 11/16 in | 41/64 | .640625 | 7 11/16 in | 57/64 | .890625 | 10 11/16 in |
| | .1458 | 1 3/4 | | .3958 | 4 3/4 | | .6458 | 7 3/4 | | .8958 | 10 3/4 |
| | .1510 | 1 13/16 in | | .4010 | 4 13/16 in | | .6510 | 7 13/16 in | | .9010 | 10 13/16 in |
| 5/32 | .15625 | 1 7/8 | 13/32 | .40625 | 4 7/8 | 21/32 | .65625 | 7 7/8 | 29/32 | .90625 | 10 7/8 |
| | .1615 | 1 15/16 in | | .4115 | 4 15/16 in | | .6615 | 7 15/16 in | | .9115 | 10 15/16 in |
| | .1667 | 2 | | .4167 | 5 | | .6667 | 8 | | .9167 | 11 |
| 11/64 | .171875 | 2 1/16 in | 27/64 | .421875 | 5 1/16 in | 43/64 | .671875 | 8 1/16 in | 59/64 | .921875 | 11 1/16 in |
| | .1771 | 2 1/8 | | .4271 | 5 1/8 | | .6771 | 8 1/8 | | .9271 | 11 1/8 |
| | .1823 | 2 3/16 in | | .4323 | 5 3/16 in | | .6823 | 8 3/16 in | | .9323 | 11 3/16 in |
| 3/16 | .1875 | 2 1/4 | 7/16 | .4375 | 5 1/4 | 11/16 | .6875 | 8 1/4 | 15/16 | .9375 | 11 1/4 |
| | .1927 | 2 5/16 in | | .4427 | 5 5/16 in | | .6927 | 8 5/16 in | | .9427 | 11 5/16 in |
| | .1979 | 2 3/8 | | .4479 | 5 3/8 | | .6979 | 8 3/8 | | .9479 | 11 3/8 |
| 13/64 | .203125 | 2 7/16 in | 29/64 | .453125 | 5 7/16 in | 45/64 | .703125 | 8 7/16 in | 61/64 | .953125 | 11 7/16 in |
| | .2083 | 2 1/2 | | .4583 | 5 1/2 | | .7083 | 8 1/2 | | .9583 | 11 1/2 |
| | .2135 | 2 9/16 in | | .4635 | 5 9/16 in | | .7135 | 8 9/16 in | | .9635 | 11 9/16 in |
| 7/32 | .21875 | 2 5/8 | 15/32 | .46875 | 5 5/8 | 23/32 | .71875 | 8 5/8 | 31/32 | .96875 | 11 5/8 |
| | .2240 | 2 11/16 in | | .4740 | 5 11/16 in | | .7240 | 8 11/16 in | | .9740 | 11 11/16 in |
| | .2292 | 2 3/4 | | .4792 | 5 3/4 | | .7292 | 8 3/4 | | .9792 | 11 3/4 |
| 15/64 | .234375 | 2 13/16 in | 31/64 | .484375 | 5 13/16 in | 47/64 | .734375 | 8 13/16 in | 63/64 | .984375 | 11 13/16 in |
| | .2396 | 2 7/8 | | .4896 | 5 7/8 | | .7396 | 8 7/8 | | .9896 | 11 7/8 |
| | .2448 | 2 15/16 in | | .4948 | 5 15/16 in | | .7448 | 8 15/16 in | | .9948 | 11 15/16 in |
| 1/4 | .2500 | 3 | 1/2 | .5000 | 6 | 3/4 | .7500 | 9 | 1 | 1.0000 | 12 |

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