CLEVELAND

DESIGN MANUAL FOR TECO TIMBER CONNECTORS

In conjunction with the load and spacing charts in this manual, to follow other applicable design provisions in the **NATIONAL DESIGN SPECIFICATION**, i.e., bending members-shear, stresses in members at joints, number of fastenings, timber connector joints.

NOTE: Load and spacing charts are the same for both TECO and Cleveland Steel Specialty (CSS) Ring and Shear Plate Connectors. The 2-5/8" diameter TECO Shear Plate is no longer in production. The 4" diameter TECO and CSS Shear Plates are duplicates. Since cross-sections of TECO and CSS Rings are different, the proper installation tool must be used. CSS continues to produce both ring configurations.

DESCRIPTION OF CONNECTORS

CHOICE OF SIZES AND TYPES OF TECO CONNECTORS

The following is offered as a guide for the selection of size and type of connector or connectors to be used in a design and to point out the respective advantages of using the different sizes and types under varying conditions.

The **TECO WEDGE-FIT SPLIT RING** — TECO WEDGE-FIT 2½" and 4" split rings are placed in precut conforming grooves made with TECO WEDGE-FIT grooving tools. The tongue and groove "split" in the ring permits simultaneous bearing of the inner surface of the ring against the core left in grooving and the outer face of the ring against the outer wall of the groove. The special wedge shape of the ring section provides maximum tolerance for easy insertion but a tight-fitting joint when the ring is fully seated in the conforming groove.

TECO WEDGE-FIT split rings are the most efficient mechanical devices used for joints in timber construction. The 2½" split rings are widely used in trussed rafter construction in spans up to 50'-0" and in all wood framing involving lumber of 2" nominal dimension. The 4" split rings are used in heavy beam and girder construction, towers, bridges and moderate and long span roof trusses, generally in members 3" or more in nominal thickness. TECO WEDGE-FIT grooving tools are precision-made, high-speed woodworking tools, designed for power operation only.

The **SHEAR PLATE** — The shear plate is intended primarily for wood-to-steel connections or for wood-to-wood connections in demountable structures when used in pairs. They are placed in precut daps and are completely embedded in the timber when in position, being flush with the surface of the timber. In some cases where field connections of pre-assembled sections are to take place, two shear plates used in place of a split ring will enable the members to slide easily into position greatly reducing the labor required for the connection. Shear plates are used to attach columns to footings through steel straps, in connection with steel gusset plates, for transferring loads from steel heel straps in bowstring trusses and for other steel-to-wood connections in timber structures. Their advantage as regards use in demountable structures lies in the fact that they may be installed in the respective members directly after fabrication and may be held in place by nails. There is no danger of their being lost. The lack of projections enables members to slide by one another without interference and since they are not repeatedly installed and removed, there is no wear around the bolt hole or grooves.

Front Back
Malleable Iron

As to choice of size, the 2⅝" shear plate compares with the 2½" split ring and the 4" shear plate with the 4" split ring.

The **TECO SPIKE GRID** — The TECO spike grids are specially designed for use with piles and poles in trestle construction, piers and wharves, and in transmission lines. The single curve grid joins a curved pole or pile surface and a flat sawn timber and the flat grid joins two flat sawn timbers. The grids are installed by pressure similar to the toothed rings.

Flat

Single Curve

The **TECO CIRCULAR GRID** — The TECO circular grid is used between the top of a pile and the cap to prevent lateral movement. It is usually installed for this purpose with several light blows from the pile driver hammer.

The TECO circular grid is also used in trestle and other heavy timber construction in much the same manner as the flat and single curve grids. It is also used as a tie spacer.

GENERAL — It is generally advisable to use the same size connector and the same size bolt throughout a design. This simplifies the fabrication procedure, lessens the chance of a fabrication error and leads to greater economy. It is also advisable not to specify lumber of a higher grade than is required.

The loads, spacing and other design data published herein are based on the use of TECO timber connectors installed with TECO tools. Therefore, when using these data, TECO products should be specified to protect the integrity of the design.

Cleveland rings and shear plates have the same allowable load values as comparable TECO products. However, the proper tool for each type must be specified.

FACTORS AFFECTING DESIGN DATA — SPACINGS, DISTANCES, LOADS

ANGLE OF LOAD TO GRAIN

The angle of load to grain is the angle between the resultant load exerted by the connector acting on the member and the longitudinal axis of the member. See figure #1.

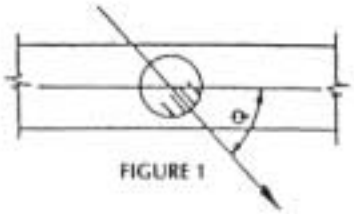


FIGURE 1

ANGLE OF AXIS TO GRAIN

The angle of axis to grain is the angle of connector axis formed by a line joining the centers of two adjacent connectors located in the same face of a member in a joint and the longitudinal axis of the member. See figure #2.

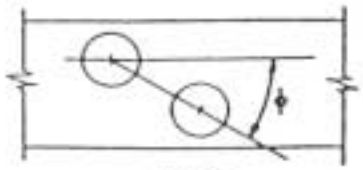


FIGURE 2

USE OF DATA AND CHARTS

General — This book has been arranged with two facing pages devoted to each size of each type of the major connectors. On the left hand page are the load chart and size data as well as required increases or decreases for various conditions and on the right hand page are the spacing, end distance and edge distance charts. One page is given to the spike grids and one page to the clamping plates. The last four pages have information on camber, truss weights, galvanizing, net section, properties of sections and recommended references.

LOAD CHARTS — The load charts show the allowable normal loads for one connector unit and bolt in single shear. The connector unit consists of one split ring or toothed ring, a pair of shear plates, or a single shear plate used with a steel sideplate.

The charts are broken vertically into the three species groups. Select the group from page 4 according to the species of lumber specified and use the portion of the chart applying to this group. Within each group there are several curves, each representing a thickness of lumber and the number of loaded faces. Use the curve conforming to the condition existing in the joint. Each curve is plotted according to the Hankinson Formula with load in pounds and angle of load to grain as the variables. Select the proper angle at bottom or top of chart, proceed vertically to the selected curve and proceed horizontally to read the allowable normal load. Lumber thicknesses less than those shown on the load data charts for the corresponding number of loaded faces are not recommended.

For more than one connector unit, multiply the connector load by the number of units.

CONNECTOR DATA — The data given cover dimensions of the connectors, minimum lumber sizes, recommended bolt and bolt hole diameters, recommended washer sizes and similar self explanatory information.

Lag screws of the same diameter as the recommended bolt sizes may be used instead of bolts in accordance with provisions set forth in the "National Design Specification for Wood Construction.

CONNECTOR SPECIFICATIONS — The design data and other information in the publication are based on the use of standard TECO connectors and tools. It is recommended that the specifications be closely followed to insure the use of products for which the data were prepared.

ADJUSTMENTS FOR LOADING DURATIONS — The allowable connector loads given on the charts are for loadings of normal duration. Normal duration of loading contemplates the joint being fully loaded for approximately ten years, either continuously or cumulatively, by the maximum allowable normal design load shown on the charts and/or that 90% of this load is applied throughout the remainder of the life of the structure. Factors are given with the data on each connector which, applied to the load values in the charts, give the allowable loads for other durations of loading from those of impact character to those applied permanently.

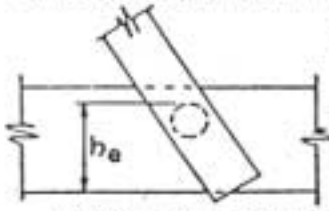
Permanent loading, for which a factor of 90% is given, contemplates the connector will be fully loaded to that percentage of the normal design values on the chart applied permanently or for many years.

Information on design with combinations of loads of different durations is given in National Design Specification for Stress-Grade Lumber and its Fastenings, National Forest Products Association, current edition.

DECREASES FOR MOISTURE CONTENT CONDITION — **The expected condition of lumber when fabricated and used should be determined and the required decreases if necessary made in accordance with the tabulated data with each connector.**

DESIGN OF ECCENTRIC JOINTS AND OF BEAMS SUPPORTED BY FASTENINGS — Eccentric connector joints and beams supported by connectors shall be designed so that H in the following formula does not exceed the allowable unit stresses in horizontal shear

$$H = \frac{V}{bh_e}$$



in which h_e (with connectors) = the depth of the member less the distance from the unloaded edge of the member to the nearest edge of the nearest connector.

MAXIMUM PERMISSIBLE LOADS ON SHEAR PLATES — Due to the type of test failure, there are limits beyond which shear plates should not be loaded. These limits vary with the bolt size. These limits are given with the shear plate data.

SPACING CHARTS — Spacing is the distance between centers of connectors measured along a line joining their centers. "R" in figure #4 is the spacing between the rings shown.

On the right hand page of the data for each connector, is the spacing chart. Each chart has five parabolic curves representing recommended spacing for full load at the particular angle of load to grain noted on the curve. For intermediate angles of load, straight line interpolation may be used. If the spacing for full load is desired, select the proper angle of load to grain curve and find where it intersects the radial lines representing angle of axis to grain, the distance from that point to the lower left hand corner is the spacing. It is probably more convenient, however, in laying out this spacing to use the parallel to grain and perpendicular to grain components or measurements of the spacing. The parallel to grain component may be read at the bottom of the chart by projecting downward from the point on the curve. The perpendicular component of the spacing may be read at the left hand side of the chart by projecting horizontally from the point on the curve.

The sixth curve on the chart is a quarter-circle. This curve represents the spacing for 50% of full load for any angle of load to grain and also the minimum spacing permissible. For percentages between 50% and 100% of full load for an angle of load to grain interpolate radially on a straight line between the 50% curve and the curve corresponding to the proper angle of load to grain.

Reductions in load for edge distance and end distance are not additive to spacing reductions but are coincident.

FACTORS AFFECTING DESIGN DATA—SPACINGS, DISTANCES, LOADS

USE OF DATA AND CHARTS *(continued)*

END DISTANCE CHARTS — End distance is the distance measured parallel to grain from the center of a connector to the square cut end of the member. If the end of the member is not square cut, the end distance shall be taken as the distance from any point on the center half of the connector diameter drawn perpendicular to the center line of the piece to the nearest point on the end of the member measured parallel to grain. The distance measured perpendicular to the end cut to the center of the connector shall never be less than the required edge distance. Figure #5 demonstrates end distance measurement (A).

END DISTANCE

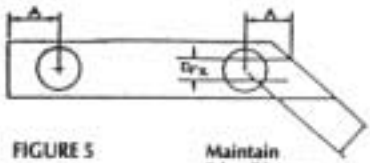


FIGURE 5

Maintain Edge Distance

On the same page with the spacing chart, the end distance chart will be found. This chart is divided into two sections, depending on whether the member is in tension or compression. If in tension, project vertically on the chart from the end distance to the curve, then horizontally to get the percentage of full load allowable. This process can be reversed of course by going from percent of full load required to spacing required. In compression there is an additional variable of angle of load to grain. The operation is the same except the curve for the proper angle of load to grain should be used. For intermediate angles interpolate between the curves on a straight line. On some of the charts the curves are cut off at the right hand side of the chart. The end distance dimension marking this cut off is the minimum permissible and gives full load for an angle of load to grain of zero degrees.

Reductions in load for edge distance or spacing are not additive to end distance reductions but are coincident.

EDGE DISTANCE CHARTS — Edge distance is the distance from the edge of the member to the center of the connector closest to the edge of the member measured perpendicular to the edge. The loaded edge distance is the edge distance measured from the edge toward which the load induced by the connector acts. The unloaded edge distance is the edge distance measured from the edge away from which the load induced by the connector acts. Figure #4 shows a typical measurement of edge distance with "B" being the unloaded edge distance and "C" the loaded edge distance.

EDGE DISTANCE AND SPACING

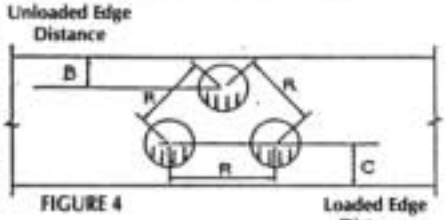


FIGURE 4

Loaded Edge Distance

On the same page with the spacing and end distance charts, the edge distance chart will be found. For unloaded edge distance the standard and minimum edge distance is the dimension at the right hand edge of the chart. For loaded edge distance there is a variation according to angle of load to grain. Select the proper curve for the desired angle and then a given edge distance projected vertically to the curve and then horizontally to the side will give the percentage of full load allowable. The upper right hand corner represents the standard and minimum loaded edge distance for zero degrees angle of load to grain. For intermediate angles, interpolate on a straight line.

INTER-RELATIONSHIP OF THICKNESS, DISTANCE AND SPACING — Loads reduced because of thickness (see tabulated loads) do not permit any reduction of edge distance, and distance or spacing without further reduction of load and conversely loads reduced for edge distance, end distance or spacing do not permit reduction of thickness.

When allowable load is reduced due to reduced edge distance, end distance or spacing, the reduced allowable load for each shall be determined separately and the lowest allowable load so determined for any one connector shall apply to this and all other connectors resisting a common force in a joint. Such load reductions are not comulative. Conversely if the allowable load is reduced because of a reduced distance or spacing, the other distances or spacings may be reduced to those resulting in the same reduced allowable load.

CAMBER CHART — The camber chart on page 25 will give an empirical value for recommended camber for the average truss. The bowstring truss using a glued laminated upper chord requires less camber than other types because of the absence of splices. The value for camber read from the chart is the amount the lower chord should be raised at the center of the span.

To use the chart, determine the values for L (span) and H (depth of truss at center) and multiply to get L_y/H. Then using this value at the left hand side proceed horizontally to the proper curve. Then project vertically to the bottom of the chart and read the camber. For special cases where detailed deformation data is required, write the Timber Engineering Company stating the conditions involved and special recommendations will be made.

EFFECT ON CONNECTOR LOADS OF GRADE OF LUMBER AND SPECIES — The various commercial stress grades of lumber are affected by characteristics which have no effect on the strength values of connectors. Therefore, no variation in connector loads is permissible for variations in assigned stresses to lumber.

Connector loads do vary depending on the species of lumber with which they are used. The species have been classified in groups A, B, and C. Loads for species not listed may be obtained on request from the Timber Engineering Company.

CONNECTOR LOAD GROUPING OF SPECIES WHEN STRUCTURALLY GRADED

CONNECTOR LOAD GROUPING

GROUP A — SPECIES	GROUP B — SPECIES	GROUP C — SPECIES
Douglas fir (dense)	Douglas fir (coast region)	Cypress, southern and tidewater red
Oak, red and white	Larch, western	Hemlock, West Coast
Pine, southern (dense)	Pine, southern	Pine, Norway
		Redwood

NET SECTION — TENSION OR COMPRESSION

NET SECTION — TENSION OR COMPRESSION

The net section of a timber in a connector joint is usually adequate to transmit the full strength of the timber which can be developed outside of the joint when the lower grades of lumber are used. However ever, it may be desirable to check the strength of the net section of timbers when they are of the minimum size recommended herein for a given connector, particularly if a high stress-grade of lumber is used.

The critical or "net" section of a timber in a joint, which will generally pass through the center line of a bolt and connector, occurs at the plane of maximum stress. The next cross section at the plane is equal to the full cross-sectional area of the timber minus the projected area of that portion of the connectors within the member and that portion of the bolt hole, not within the connector projected area, located at this plane.

Shaded Area Shows Net Cross Section of Timber

Due to wood being able to support loads of short-time duration greatly in excess of permanently applied loads, computation of the required net section involves consideration of the different types and amounts of loadings.

The net cross-sectional area in square inches required at the critical section may be determined by multiplying the total load in pounds, which is transferred through the critical section of the member, by the appropriate constant given in the table. Conversely, the total working load capacity in pounds of a given net area may be determined by dividing the net area in square inches by the appropriate constant.

CONSTANTS FOR USE IN DETERMINING REQUIRED NET SECTION IN SQUARE INCHES

Type of Loading	Thickness of Wood Member in Inches	Constants for Each Connector Load Group		
		Group A	Group B	Group C
Normal	4" or less	.00043	.00050	.00061
	over 4"	.00054	.00063	.00077
Permanent	4" or less	.00048	.00055	.00067
	over 4"	.00059	.00069	.00083
Snow	4" or less	.00037	.00044	.00053
	over 4"	.00047	.00054	.00067
Wind or Earthquake	4" or less	.00032	.00038	.00045
	over 4"	.00040	.00047	.00057

*The above constasts, computed from basic recommendations of the Forest Products Laboratory, are based on a permissible stress at the net section equal to the basic stress for clear wood in compression parallel to grain.

The above recommendations assume that a knot approaching the maximum size allowed for the grade will not occur at, or within one-half the connector diameter of the plane of the critical section. Unless the specifications and fabrication control provide that knots will not occur at the joint, stresses in the net section shall not exceed 87.5% of the allowable extreme fiber in bending stress for the grade used.

SPECIFICATION WHEN GALVANIZING IS REQUIRED

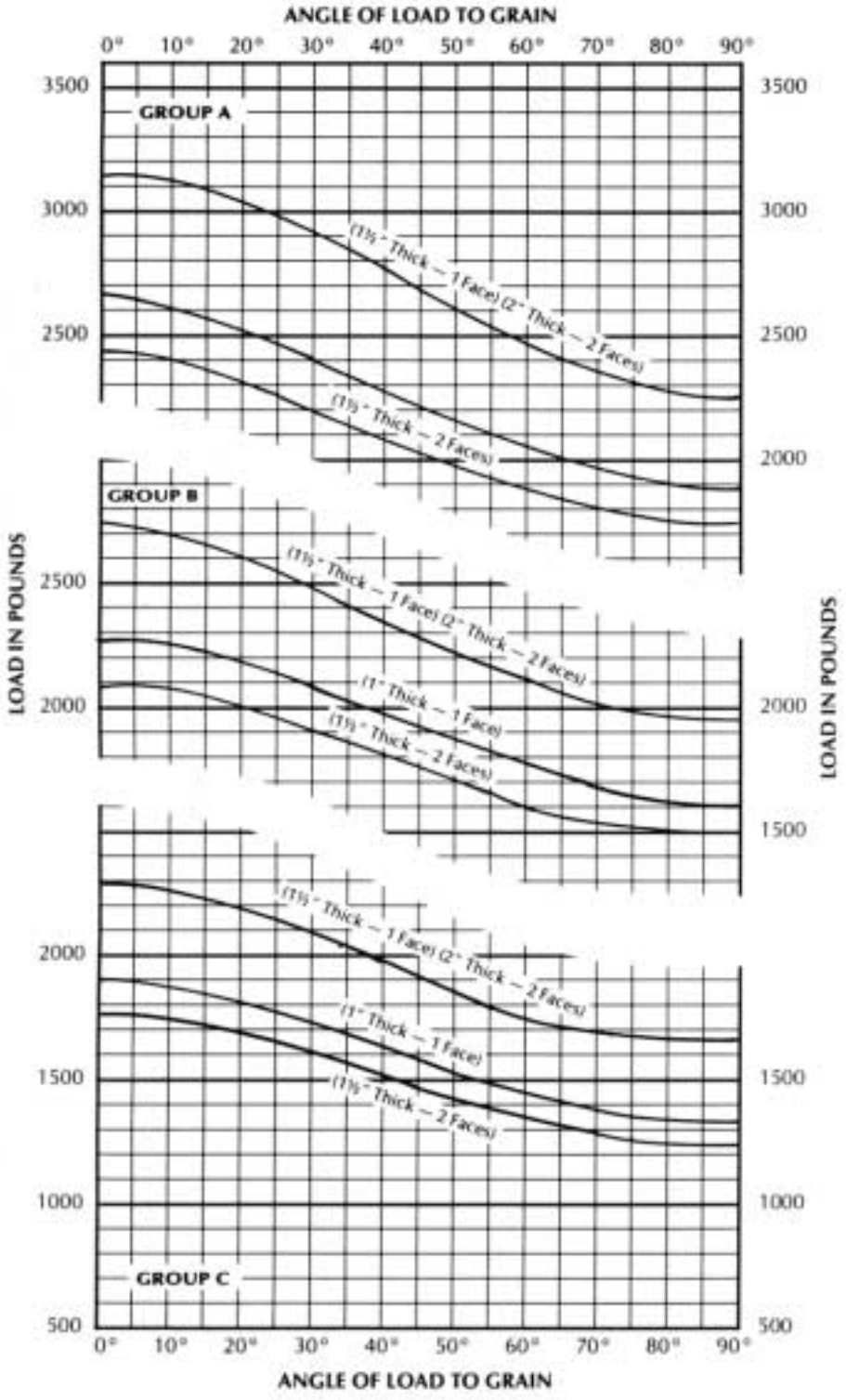
The galvanizing specifications for all types of timber connectors shall conform to current A.S.T.M. Specifications A123 or A153.

1. Zinc used in the bath shall be at least equal to "Prime Western".
2. The weight of the zinc coating per square foot of actual surfaces shall average not less than 2.0 oz. and no individual specimen shall show less than 1.8 oz., weight to be determined by stripping an entire piece by A. 8. T.M. Standard Method A 90-39.
3. The zinc coating shall be adherent, smooth, continuous and thorough, except that uncoated spots on the tongue and groove surfaces in contact will not be cause for rejection. It shall be free from imperfections such as bumps, blisters, gritty areas, uncoated spots, acid and black spots, dross and flux.
4. When visual inspection and testing with ½ lb. hammer is not conclusive, tests shall be made by the Preece method, in which case the minimum thickness of coating shall withstand at least seven 1-minute dips.
5. Test samples may be selected from deliveries at random and will be tested by the purchaser and at purchaser's expense.

PROJECTED AREA OF CONNECTORS AND BOLTS
(For Use In Determining Net Sections)

Connectors		Bolt Diam.	Placement of Connectors	Total Projected Area in Square Inches of Connectors & Bolts in Lumber Thickness of				
No.	Size			1½"	2½"	3½"	5½"	7½"
SPLIT RINGS		½	One Face	1.71	2.27	2.84	3.89	5.02
1	2½	½	Two Faces	2.60	3.16	3.73	4.78	5.91
2	4	¾	One Face	3.01	3.86	4.64	6.16	7.79
		¾	Two Faces	4.85	5.66	6.47	8.00	9.62
SHEAR PLATES		¾	One Face	2.00	2.81	3.62	4.14	6.77
1	2⅛	¾	Two Faces	2.81	2.68	4.43	5.96	7.58
1	2⅛ LG	¾	One Face	1.87	2.68	3.50	5.02	6.65
		¾	Two Faces	2.56	3.38	4.19	5.71	7.34
2	4	¾	One Face	3.24	4.05	4.87	6.39	8.01
		¾	Two Faces	—	6.11	6.93	8.45	10.07
2-A	4	⅞	One Face	3.33	4.27	5.21	6.97	8.84
		⅞	Two Faces	—	6.25	7.19	8.95	10.82

2½" TECO SPLIT RINGS



LOAD CHART FOR NORMAL LOADING ONE 2½" SPLIT RING AND BOLT IN SINGLE SHEAR

2½" SPLIT RING DATA

Split Ring — Dimensions	
Inside Diameter at center when closed	2½"
Inside diameter at center when installed	2.54"
Thickness of ring at center	0.163"
Thickness of ring at edge	0.123"
Depth	¾"
Lumber, Minimum dimensions allowed	
Width	3½"
Thickness, rings in one face	1"
Thickness, rings opposite in both faces	1½"
Bolt, diameter	½"
Bolt hole, diameter	9/16"
Projected Area for portion of one ring within a member, square inches	1.10
Washers, minimum	
Round, Cast or Malleable Iron, diameter	2¼"
Square Plate	
Length of Side	2"
Thickness	⅛"
(For trussed rafters and similar light construction standard wrought washers may be used.)	

SPLIT RING SPECIFICATIONS

Split rings shall be TECO split rings as manufactured by CSS, Cleveland, OH. Split rings shall be manufactured from hot rolled S. A. E. — 1010 carbon steel. Each ring shall form a closed true circle with the principal axis of the cross section of the ring metal parallel to the geometric axis of the ring. The ring shall fit snugly in the prepared groove. The metal section of each ring shall be beveled from the central portion toward the edges to a thickness less than that at mid-section. It shall be cut through in one place in its circumference to form a tongue and slot.

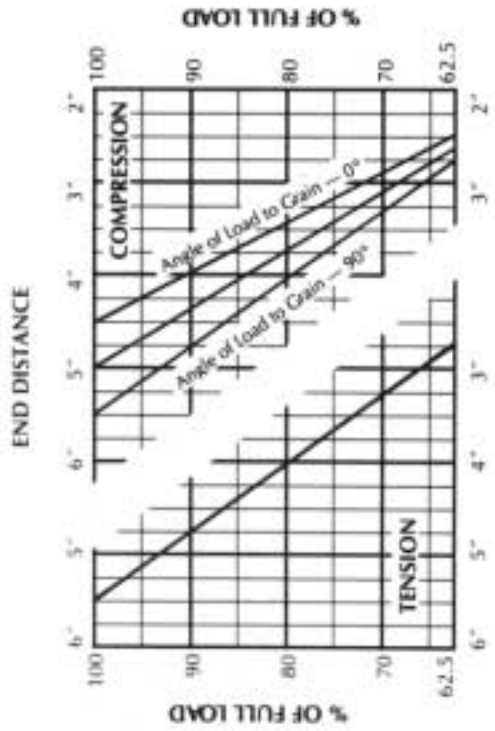
PERCENTAGES FOR DURATION OF MAXIMUM LOAD

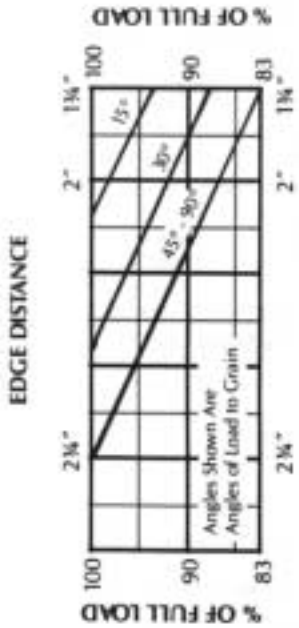
Two Months Loading, as for snow	115%
Seven Days Loading	125%
Wind or Earthquake Loading	133⅓%
Impact Loading	200%
Permanent Loading	90%

DECREASES FOR MOISTURE CONTENT CONDITIONS

Condition when Fabricated	Seasoned	Unseasoned	Unseasoned
Condition when Used	Seasoned	Seasoned	Unseasoned or Wet
Split Rings	0%	20%	33%

2½" TECO SPLIT RINGS

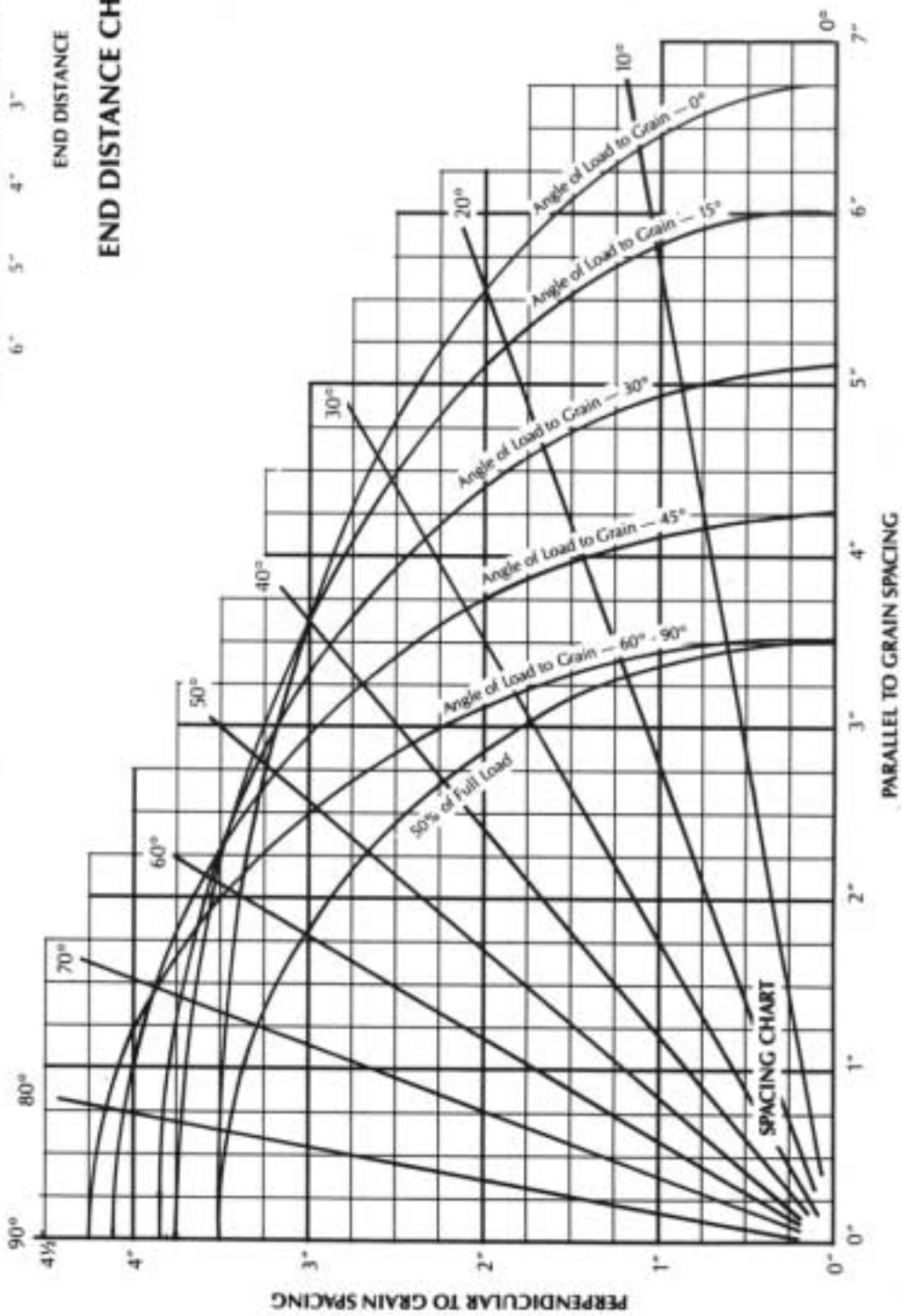




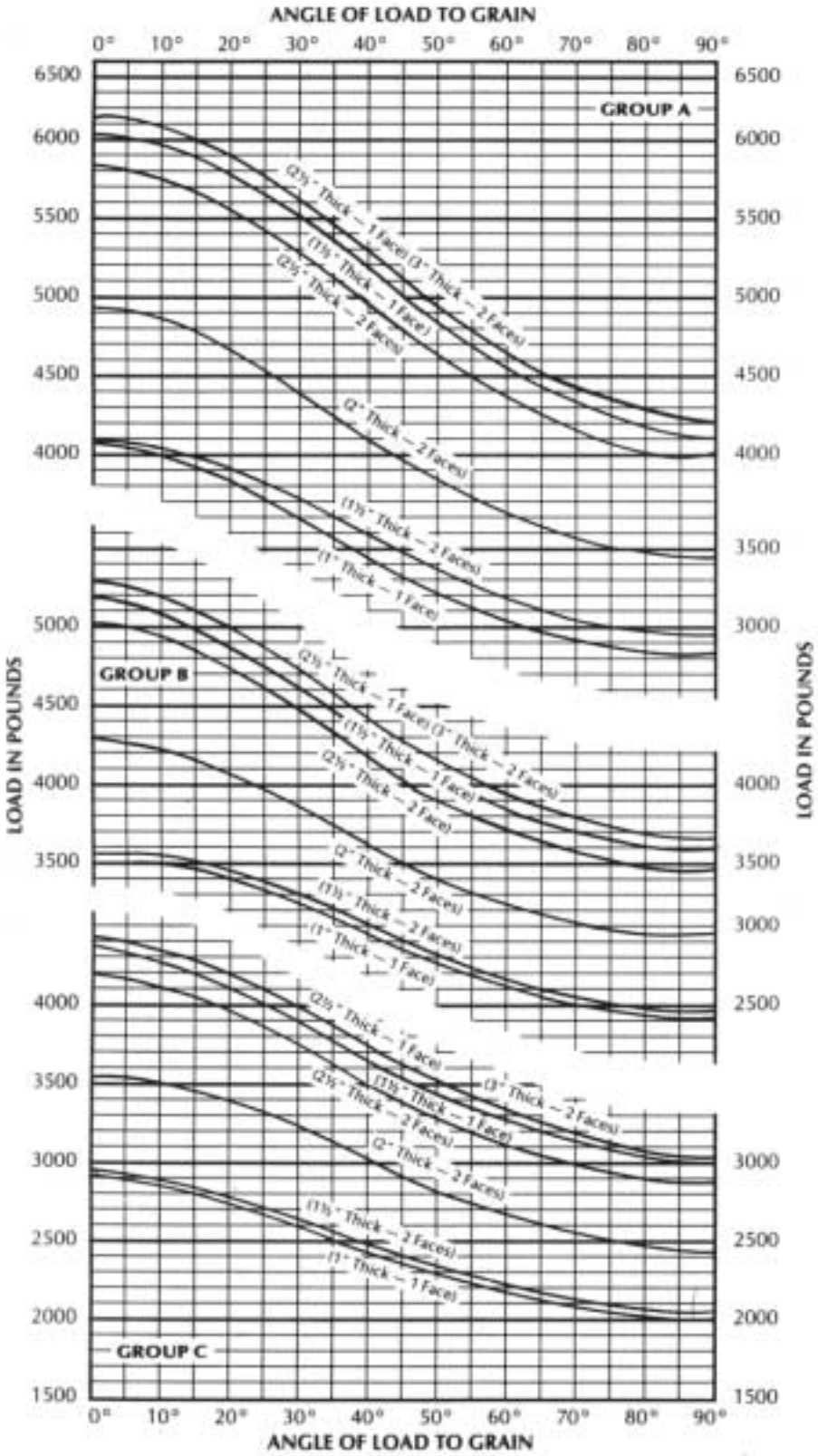
EDGE DISTANCE CHART

END DISTANCE CHART

DO NOT USE THESE CHARTS BEFORE READING PAGE 3



4" TECO SPLIT RINGS



LOAD CHART FOR NORMAL LOADING ONE 4" SHEAR-PLATE UNIT AND BOLT IN SINGLE SHEAR

4" SPLIT RING DATA

Split Ring — Dimensions	
Inside Diameter at center when closed	4"
Inside diameter at center when installed	4.06"
Thickness of ring at center	0.193"
Thickness of ring at edge	0.133"
Depth	1"
Lumber, Minimum dimensions allowed	
Width	5½"
Thickness, rings in one face	1"
Thickness, rings opposite in both faces	1½"
Bolt, diameter	¾"
Bolt hole, diameter	13/16"
Projected Area for portion of one ring within a member, square inches	2.24
Washers, minimum	
Round, Cast or Malleable Iron, diameter	3"
Square Plate	
Length of Side	3"
Thickness	5/16"
(For trussed rafters and similar light construction standard wrought washers may be used.)	

SPLIT RING SPECIFICATIONS

Split rings shall be TECO split rings as manufactured by CSS, Cleveland, OH. Split rings shall be manufactured from hot rolled S. A. E. — 1010 carbon steel. Each ring shall form a closed true circle with the principal axis of the cross section of the ring metal parallel to the geometric axis of the ring. The ring shall fit snugly in the prepared groove. The metal section of each ring shall be beveled from the central portion toward the edges to a thickness less than that at mid-section. It shall be cut through in one place in its circumference to form a tongue and slot.

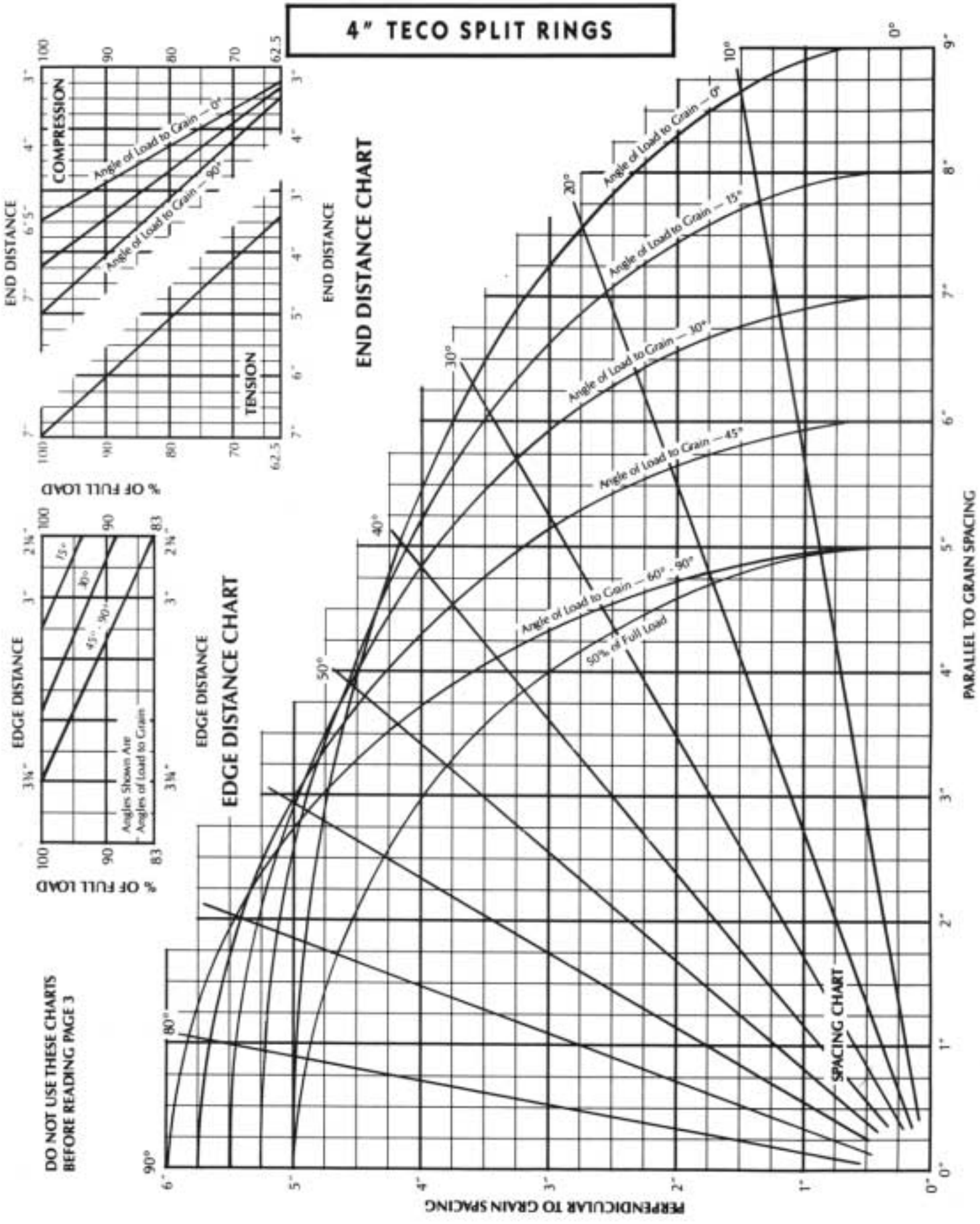
PERCENTAGES FOR DURATION OF MAXIMUM LOAD

Two Months Loading, as for snow	115%
Seven Days Loading	125%
Wind or Earthquake Loading	133⅓%
Impact Loading	200%
Permanent Loading	90%

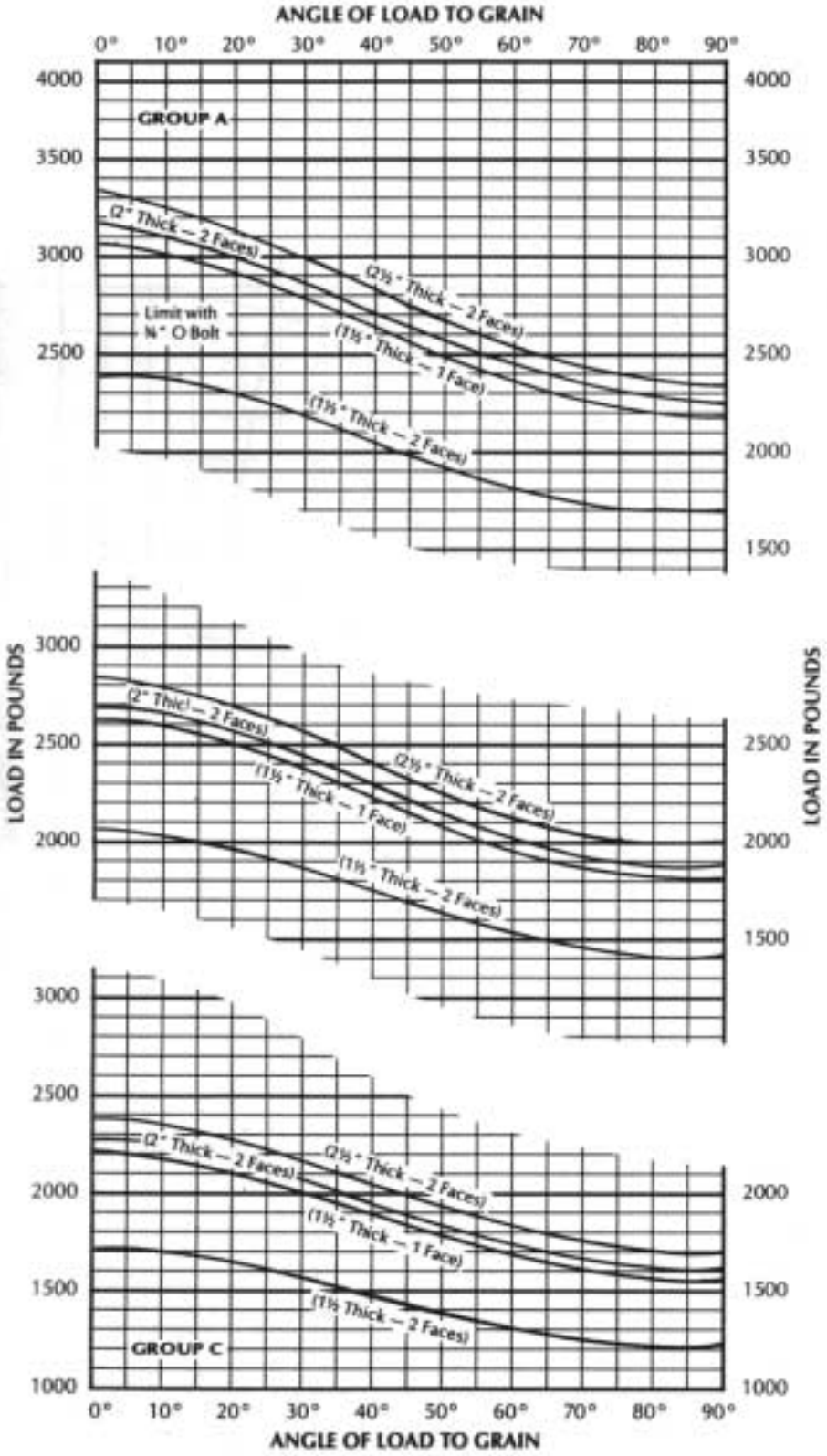
DECREASES FOR MOISTURE CONTENT CONDITIONS

Condition when Fabricated	Seasoned	Unseasoned	Unseasoned
Condition when Used	Seasoned	Seasoned	Unseasoned or Wet
Split Rings	0%	20%	33%

4" TECO SPLIT RINGS



2⅝" TECO SHEAR PLATES



LOAD CHART FOR NORMAL LOADING
ONE 2⅝" SHEAR-PLATE UNIT AND BOLT IN SINGLE SHEAR

2⅝" SHEAR PLATE DATA

Shear Plates, Dimensions		
Material	Pressed Steel	
	Reg.	Lt. Ga.
Diameter of plate	2.62"	2.62"
Diameter of bolt hole	.81"	.81"
Depth of plate	.42"	.35"
Lumber, Minimum Dimensions		
Face, width	3½"	3½"
Thickness, plates in one face only	1½"	1½"
Thickness, plates opposite in both faces	1½"	1½"
Steel Shapes or Straps (Thickness required when used with shear plates) Thickness of steel side plates shall be determined in accordance with A.I.S.C. recommendations.		
Hole, diameter in steel straps or shapes	1 1/16"	1 1/16"
Bolt, diameter	¾"	¾"
Bolt Hole, diameter in timber	1 1/16"	1 1/16"
Washers, standard, timber to timber connections only		
Round, cast or malleable iron, dia.	3"	3"
Square Plate		
Length of side	3"	3"
Thickness	¼"	⅛"
(For trussed rafters and other light structures standard wrought washers may be used.)		
Projected Area, for one shear plate, square inches	1.18	1.00

SHEAR PLATE SPECIFICATIONS

Shear plates shall be CSS shear plates as manufactured by CSS, Cleveland, OH. Malleable Iron Types — Malleable iron shear plates shall be manufactured according to current A. S. T. M. Standard Specifications A 47, Grade 32510, for malleable iron castings. Each casting shall consist of a perforated round plate with a flange around the edge extending at right angles to the face of the plate and projecting from one face only, the plate portion having a central bolt hole reamed to size with an integral hub concentric to the bolt hole and extending from the same face as the flange.

PERCENTAGES FOR DURATION OF MAXIMUM LOAD

Two Months Loading, as for snow	*115%
Seven Days Loading	*125%
Wind or Earthquake Loading	*133⅓%
Impact Loading	*200%
Permanent Loading	90%

*Do not exceed limitations for maximum allowable loads for shear plates given elsewhere on this page.

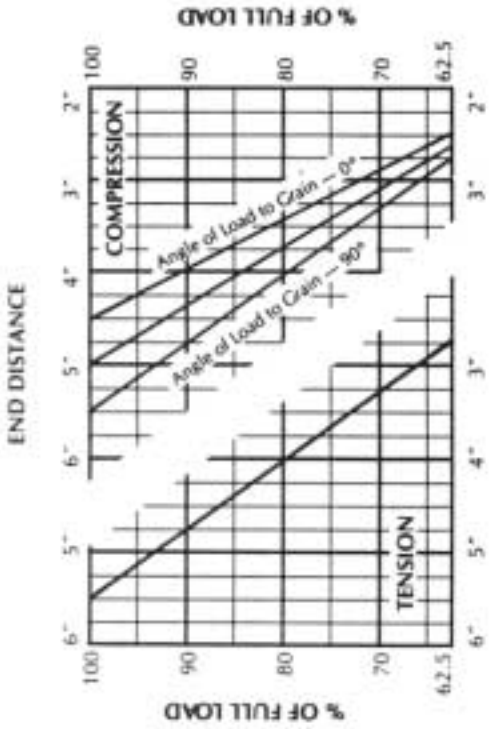
DECREASES FOR MOISTURE CONTENT CONDITIONS

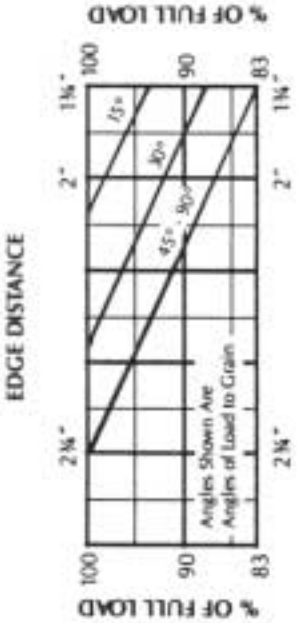
Condition when Fabricated	Seasoned	Unseasoned	Unseasoned
Condition when Used	Seasoned	Seasoned	Unseasoned or Wet
Shear Plates	0%	20%	33%

MAXIMUM PERMISSIBLE LOADS ON SHEAR PLATES

The allowable loads for all loadings except wind shall not exceed 2900 lbs. for 2⅝" shear plates with ¾" bolts. The allowable wind load shall not exceed 3870 lbs. If bolt threads bear on the shear plate, reduce the preceding values by one-ninth.

2⅝" TECO SHEAR PLATES

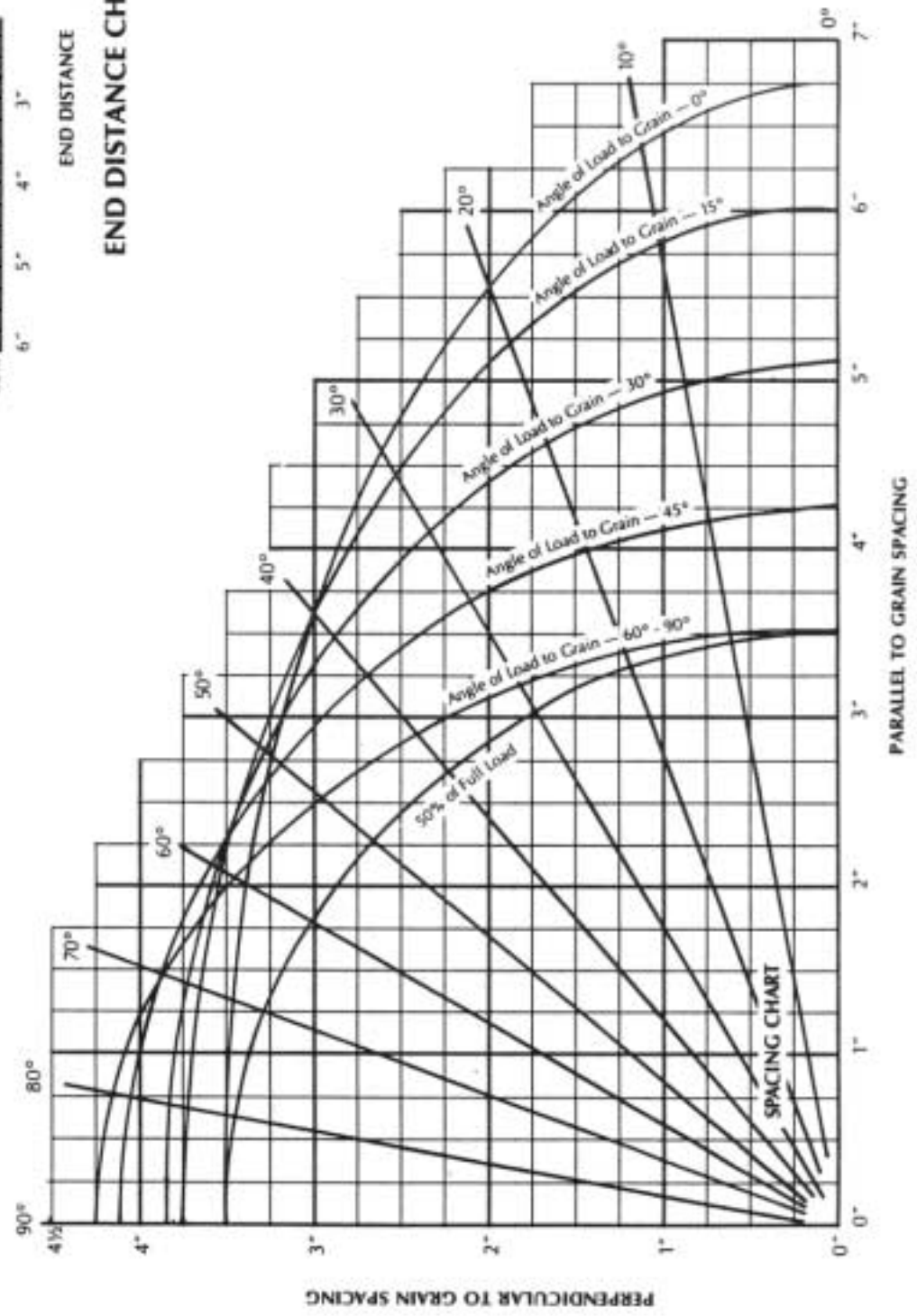




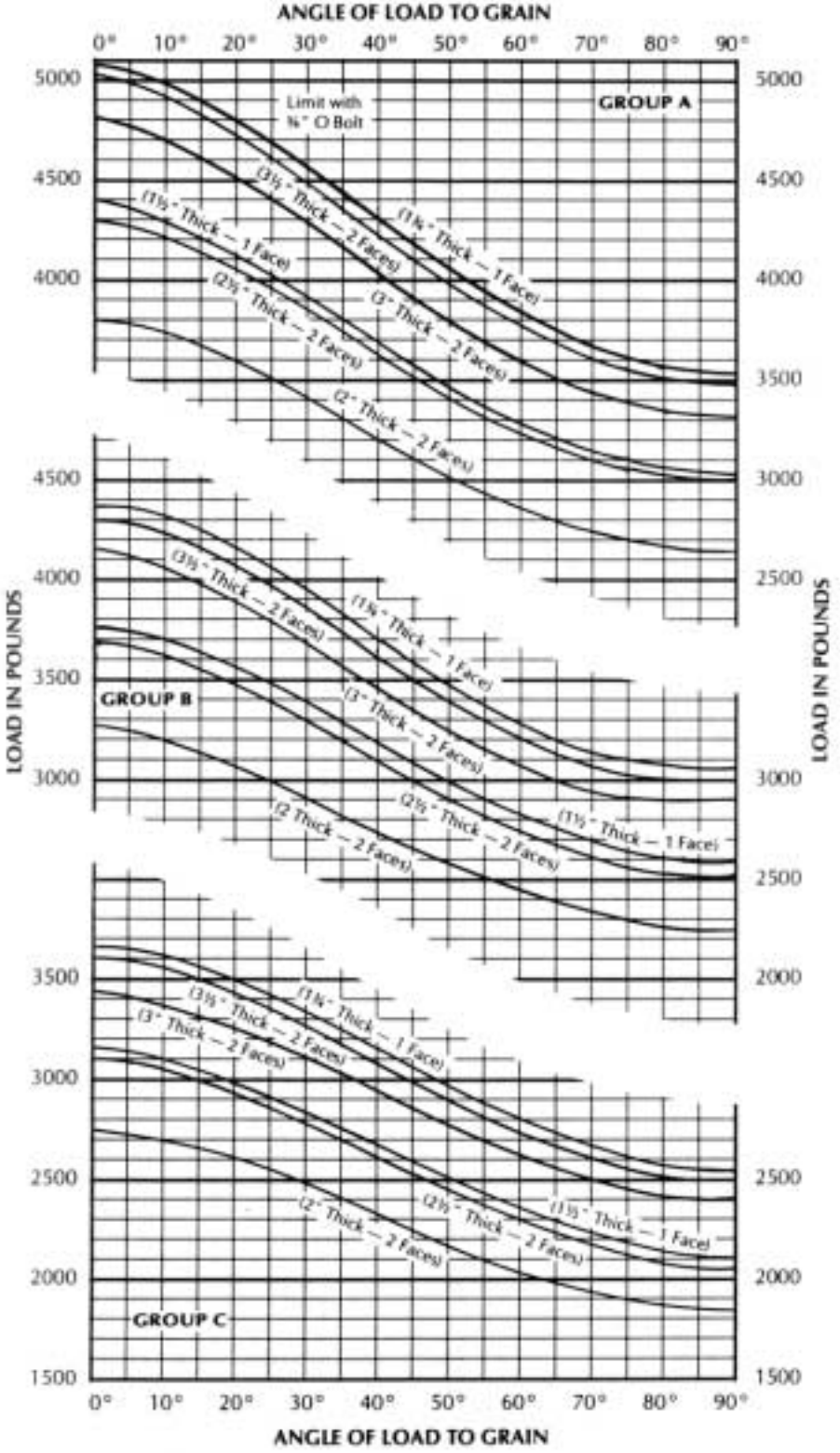
EDGE DISTANCE CHART

END DISTANCE CHART

DO NOT USE THESE CHARTS BEFORE READING PAGE 3



4" TECO SHEAR PLATES (WOOD-TO-WOOD)



LOAD CHART FOR NORMAL LOADING
ONE 4" SHEAR-PLATE UNIT AND BOLT IN SINGLE SHEAR

4" SHEAR PLATE DATA

Shear Plates, Dimensions	Malleable Iron	Malleable Iron
Material	4.03"	4.03"
Diameter of plate	4.03"	4.03"
Diameter of bolt hole	.81"	.94"
Depth of plate	.64"	.64"
Lumber, Minimum Dimensions		
Face, width	5½"	5½"
Thickness, plates in one face only	1½"	1½"
Bolt, diameter	¾"	⅞"
Bolt Hole, diameter in timber	13/16"	15/16"
Washers, standard, timber to timber connections only		
Round, cast or malleable iron, dia.	3"	3½"
Square Plate		
Length of side	3"	3"
Thickness	¼"	¼"
(For trussed rafters and other light structures standard wrought washers may be used.)		
Projected Area, for one shear plate, square inches	2.58	2.58

SHEAR PLATE SPECIFICATIONS

Shear plates shall be TECO shear plates as manufactured by CSS, Cleveland, OH. Malleable Iron Types — Malleable iron shear plates shall be manufactured according to current A. S. T. M. Standard Specifications A 47, Grade 32510, for malleable iron castings. Each casting shall consist of a perforated round plate with a flange around the edge extending at right angles to the face of the plate and projecting from one face only, the plate portion having a central bolt hole reamed to size with an integral hub concentric to the bolt hole and extending from the same face as the flange.

PERCENTAGES FOR DURATION OF MAXIMUM LOAD

Two Months Loading, as for snow	*115%
Seven Days Loading	*125%
Wind or Earthquake Loading	*133⅓%
Impact Loading	*200%
Permanent Loading	90%

*Do not exceed limitations for maximum allowable loads for shear plates given elsewhere on this page.

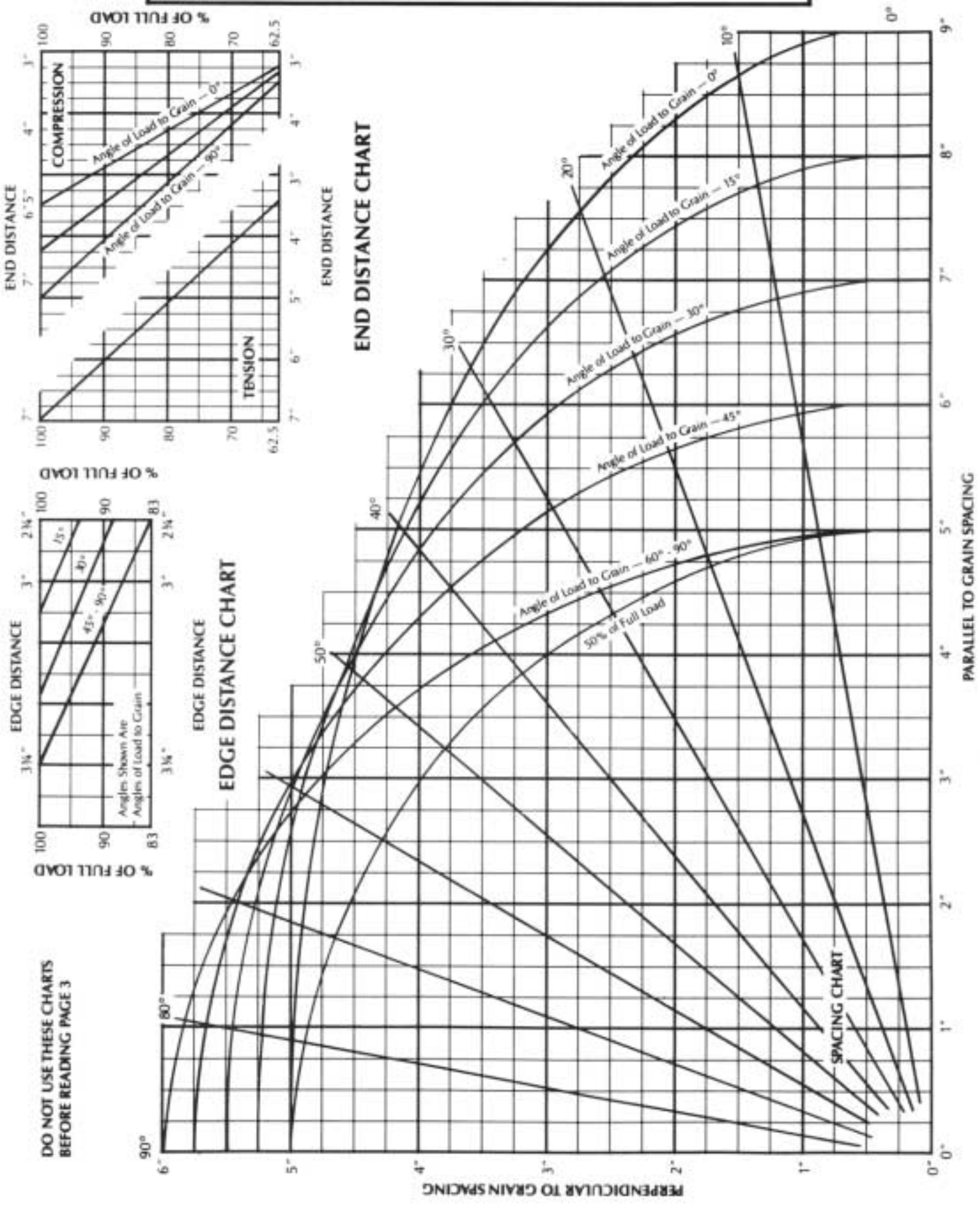
DECREASES FOR MOISTURE CONTENT CONDITIONS

Condition when Fabricated	Seasoned	Unseasoned	Unseasoned
Condition when Used	Seasoned	Seasoned	Unseasoned or Wet
Shear Plates	0%	20%	33%

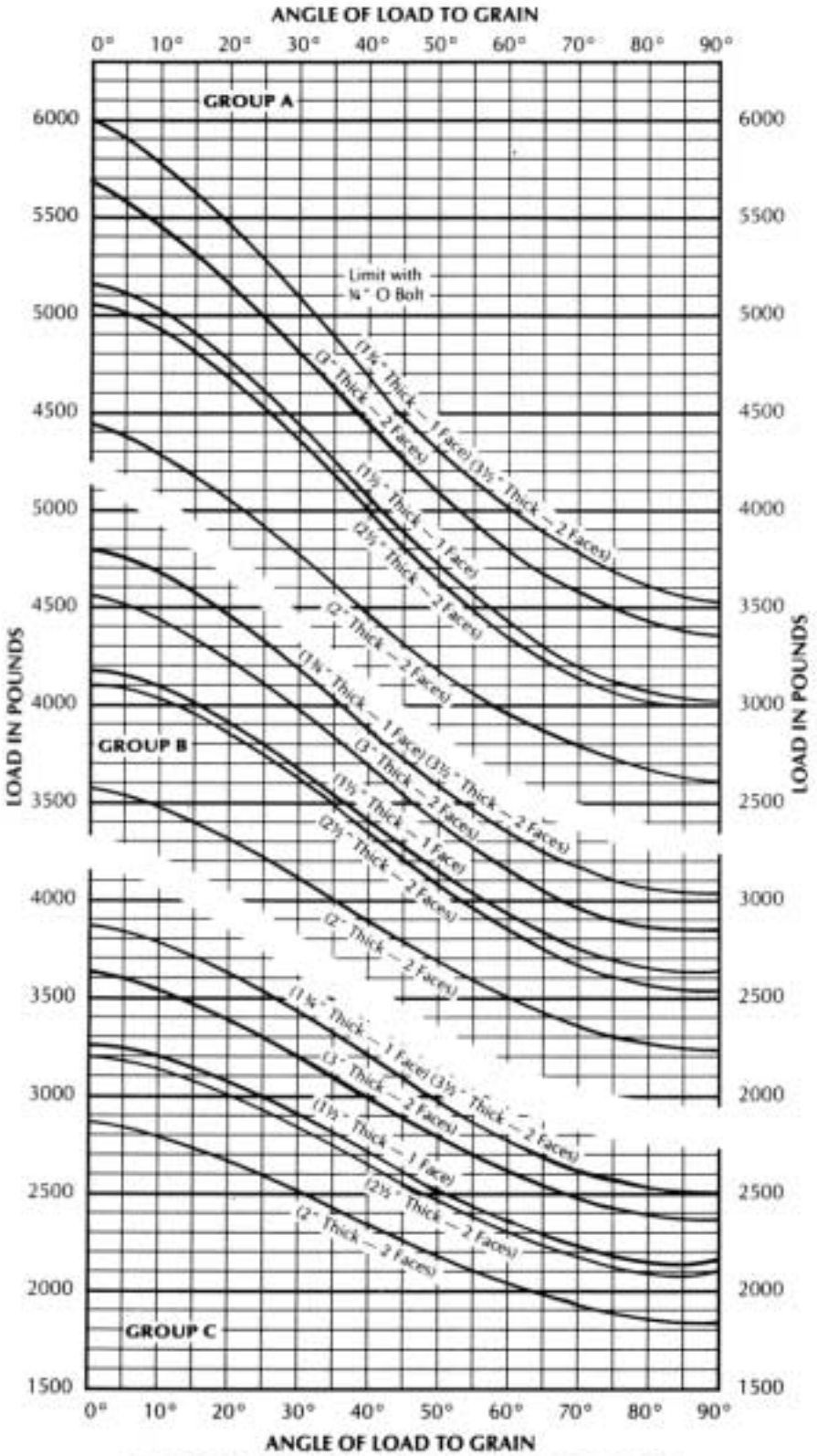
MAXIMUM PERMISSIBLE LOADS ON SHEAR PLATES

The allowable loads for all loadings except wind shall not exceed 4970 lbs. for 4" shear plates with ¾" bolts and 6760 lbs. for 4" shear plates with ⅞" bolts. The allowable wind load shall not exceed 6630 lbs. when used with a ¾" bolt and 9020 lbs. when used with a ⅞" bolt. If bolt threads bear on the shear plate, reduce the preceding values by one-ninth.

4" TECO SHEAR PLATES (WOOD-TO-WOOD)



4" TECO SHEAR PLATES (WOOD-TO-STEEL)



LOAD CHART FOR NORMAL LOADING
ONE 4" SHEAR-PLATE UNIT AND BOLT IN SINGLE SHEAR

4" SHEAR PLATE DATA

Shear Plates, Dimensions Material	Malleable Iron	Malleable Iron
Diameter of plate	4.03"	4.03"
Diameter of bolt hole	.81"	.94"
Depth of plate	.64"	.64"
Lumber, Minimum Dimensions Face, width	5½"	5½"
Thickness, plates in one face only	1½"	1½"
Steel Shapes or Straps (Thickness required when used with shear plates) Thickness of steel side plates shall be determined in accordance with A.I.S.C. recommendations.		
Hole, diameter in steel straps or shapes	13/16"	13/16"
Bolt, diameter	¾"	⅞"
Bolt Hole, diameter in timber	13/16"	13/16"
Projected Area, for one shear plate, square inches	2.58	2.58

SHEAR PLATE SPECIFICATIONS

Shear plates shall be TECO shear plates as manufactured by CSS, Cleveland, OH. Malleable Iron Types — Malleable iron shear plates shall be manufactured according to current A. S. T. M. Standard Specifications A 47, Grade 32510, for malleable iron castings. Each casting shall consist of a perforated round plate with a flange around the edge extending at right angles to the face of the plate and projecting from one face only, the plate portion having a central bolt hole reamed to size with an integral hub concentric to the bolt hole and extending from the same face as the flange.

PERCENTAGES FOR DURATION OF MAXIMUM LOAD

Two Months Loading, as for snow	*115%
Seven Days Loading	*125%
Wind or Earthquake Loading	*133⅓%
Impact Loading	*200%
Permanent Loading	90%

*Do not exceed limitations for maximum allowable loads for shear plates given elsewhere on this page.

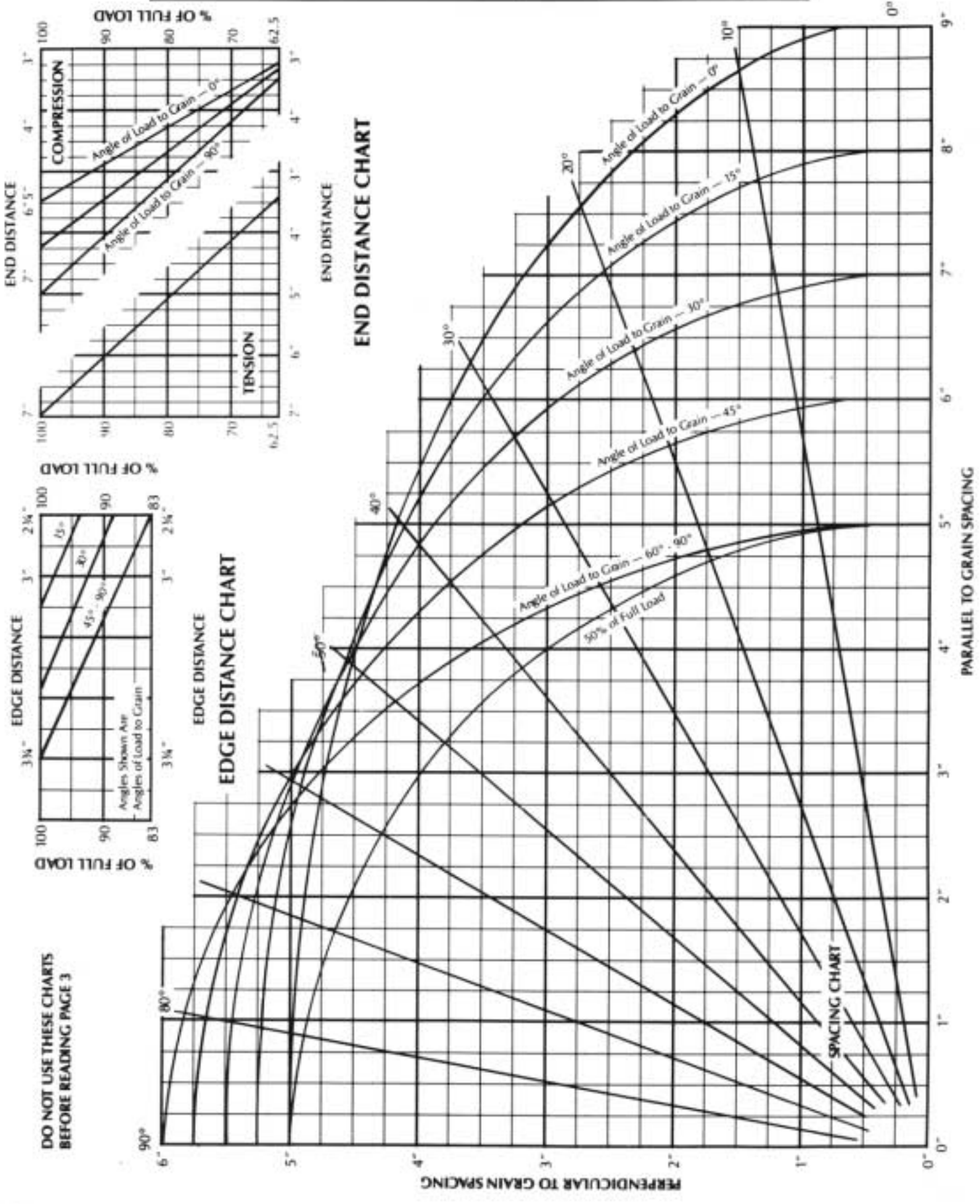
DECREASES FOR MOISTURE CONTENT CONDITIONS

Condition when Fabricated	Seasoned	Unseasoned	Unseasoned
Condition when Used	Seasoned	Seasoned	Unseasoned or Wet
Shear Plates	0%	20%	33%

MAXIMUM PERMISSIBLE LOADS ON SHEAR PLATES

The allowable loads for all loadings except wind shall not exceed 4970 lbs. for 4" shear plates with ¼" bolts and 6760 lbs. for 4" shear plates with ⅜" bolts. The allowable wind load shall not exceed 6630 lbs. when used with a ¼" bolt and 9020 lbs. when used with a ⅜" bolt. If bolt threads bear on the shear plate, reduce the preceding values by one-ninth.

4" TECO SHEAR PLATES (WOOD-TO-STEEL)



TECO SPIKE-GRIDS

TECO SPIKE-GRIDS

TECO SPIKE-GRID Type	Flat	Single Curve	Circular
Size, square	4⅛"	4⅛"	3¼"
Total depth of grids, maximum	1"	1.38"	1.20"
Diameter of bolt hole	1.06"	1.06"	1.33"
Weight, per 100 grids, lbs.	50	75	26
LUMBER DIMENSIONS, minimum recommended for installation of flat grids			
Face, width	5½"	5½"	5½"
Thickness			
Grids one face only	1½"	1½"	1½"
Grids opposite in both faces	2½"		2½"
Minimum diameter of pile for curved grids		10"	
BOLT, diameter	¾" or 1"	¾" or 1"	¾" or 1"
BOLT HOLE, diameter in timber	1 1/16" or 1 1/16"	1 1/16" or 1 1/16"	1 1/16" or 1 1/16"
WASHERS			
Round, cast or malleable iron	Standard Size for Bolt Diameter Used.		
Square plate	3"x3"x⅜" Punched for Bolt Diameter Used.		
SPACING OF GRIDS, minimum, center to center			
0°-30° angle of load to grain			
Spacing parallel to grain	7"	7"	7"
Spacing perpendicular to grain	5½"	5½"	5½"
30°-90° angle of load to grain			
Spacing parallel or perpendicular to grain	5½"	5½"	5½"
END DISTANCES, center of grid to end of piece (tension or compression members)			
Standard	7"	7"	7"
Minimum, reduce loads 15%	5"	5"	5"
EDGE DISTANCES, center of grid to edge of piece			
Load applied at any angle to grain			
Standard	3⅜"	3⅜"	3⅜"
Minimum, reduce loads 15%	2¼"	2¼"	2¼"
PROJECTED AREA for portion of one grid within member, square inches	2.06	2.06	1.95

SPIKE-GRID SPECIFICATIONS

Spike-grids shall be TECO spike-grids as manufactured by CSS, Cleveland, OH. Spike-grid timber connectors shall be manufactured according to current A. S. T. M. Standard Specifications A47, Grade 32510, for malleable iron castings. They shall consist of rows of opposing spikes which are held in place by fillets. Fillets for the flat and circular grid in cross section shall be diamond shaped. Fillets for the single curve grids shall be increased in depth to allow for curvature.

WIND AND EARTHQUAKE LOADS

For wind or earthquake loads alone or a combination of wind or earthquake with dead or live loads or both, the safe loads on spike-grids may be taken as 120% of the Design Loads provided the resulting size and number of connectors is not less than required for the dead and live loads alone.

IMPACT

When using Design Loads, the load on a spike-grid due to a force producing impact shall be taken as 115% of the sum of the force as a static load and the load due to its impact.

LOADS IN RELATION TO DISTANCES AND SPACINGS

Standard Design Loads are for standard distances and spacings. Standard and minimum distances and spacings with load reduction factors are given in the table. Loads for end and edge distances and spacings intermediate of standard and minimum may be determined by interpolation.

DESIGN LOADS* FOR ONE SPIKE-GRID AND BOLT IN SINGLE SHEAR

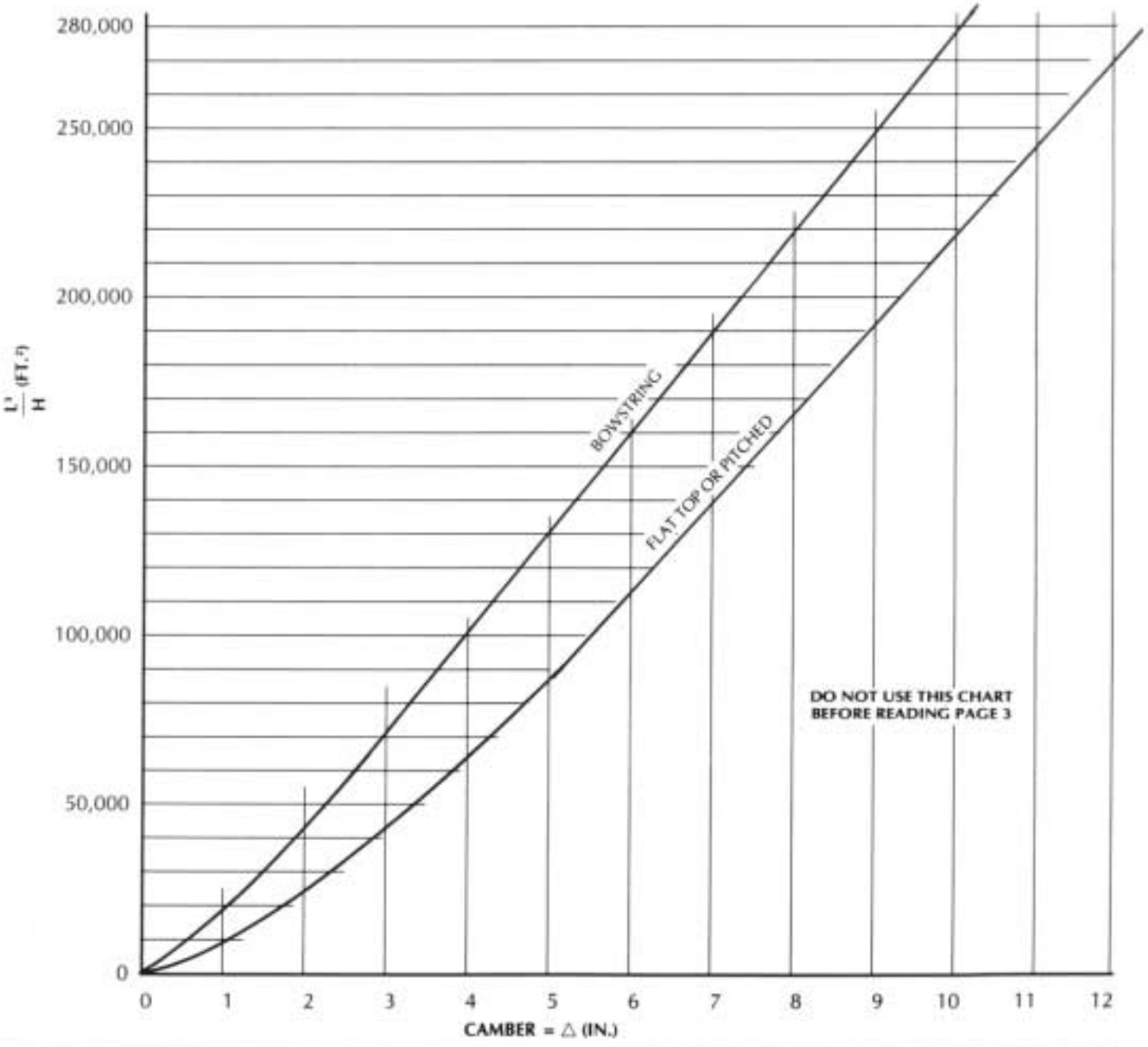
GROUP A			GROUP B			GROUP C		
Type of Grid	Bolt Diameter	Allowable Load	Type of Grid	Bolt Diameter	Allowable Load	Type of Grid	Bolt Diameter	Allowable Load
FLAT	¾"	3900#	FLAT	¾"	3500#	FLAT	¾"	3000#
	1"	4200#		1"	3800#		1"	3300#
SINGLE CURVE	¾"	4200#	SINGLE CURVE	¾"	3800#	SINGLE CURVE	¾"	3200#
	1"	4500#		1"	4100#		1"	3500#
CIRCULAR	¾"	3500#	CIRCULAR	¾"	3100#	CIRCULAR	¾"	2600#
	1"	3800#		1"	3400#		1"	2900#

*Allowable loads on spike-grids same for all angles of load to grain.

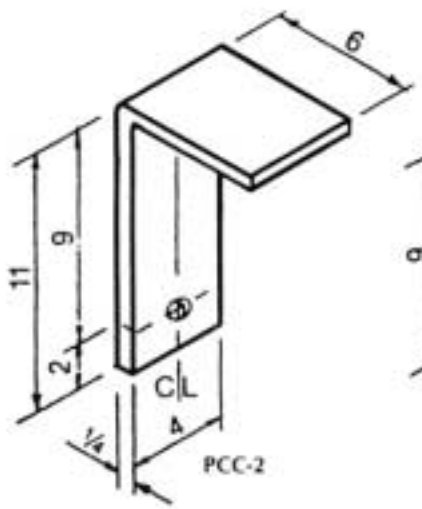
TECO CAMBER CHART

CAMBER FOR FULL-LOAD DEFLECTION

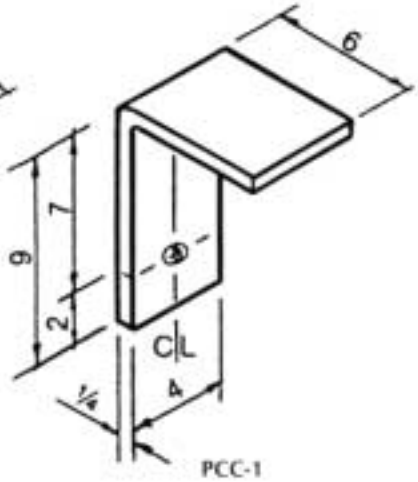
FORMULA — $\triangle = K_1\frac{L^3}{H} + K_2\frac{L^2}{H}$



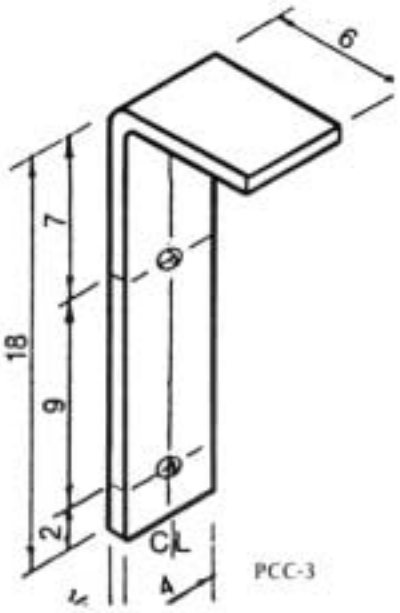
PILE CAP CONNECTORS



PCC-2



PCC-1

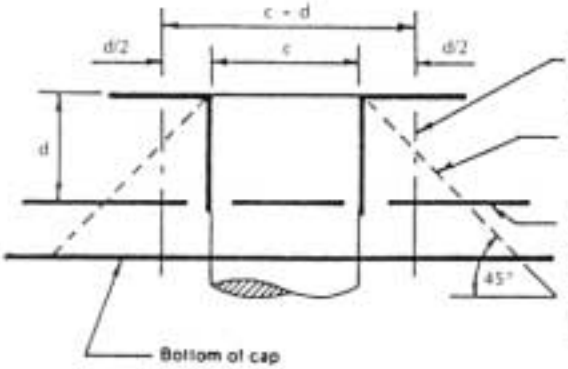


PCC-3

All bolt holes 15/16" diameter.
Custom connectors are available on special order.

SUGGESTED CONCRETE DESIGN PROCEDURES

Analysis by the Portland Cement Association for the development of connector design value in pullout strenth in concrete cap.

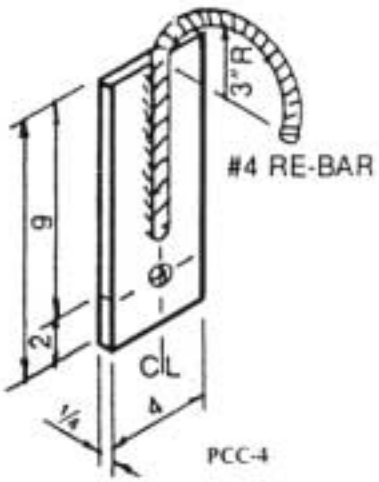


Critical section assumed by ACI code, section 1207.

Plane of failure assumed when cone is pulled out of concrete.

Bottom re-bars in concrete cap.

NOTE: In addition to shear in plain concrete, stirrups or other re-inforcing may be used to develop pull-out strength.



PCC-4

EXAMPLE: Given:

V = 9,214# (allowable uplift load for 2 connector plates or pile)

d = 7½" c = 10½"

b_o = π (c + d) ½
= 3.14 X 18 X 0.5 = 28.2"

$V_c = \frac{V}{b_o d}$ = unit shear stress in concrete

V = total load

d = depth to reinforcing steel

c = pile diameter

b_o = π (c + d) = circumference at critical section

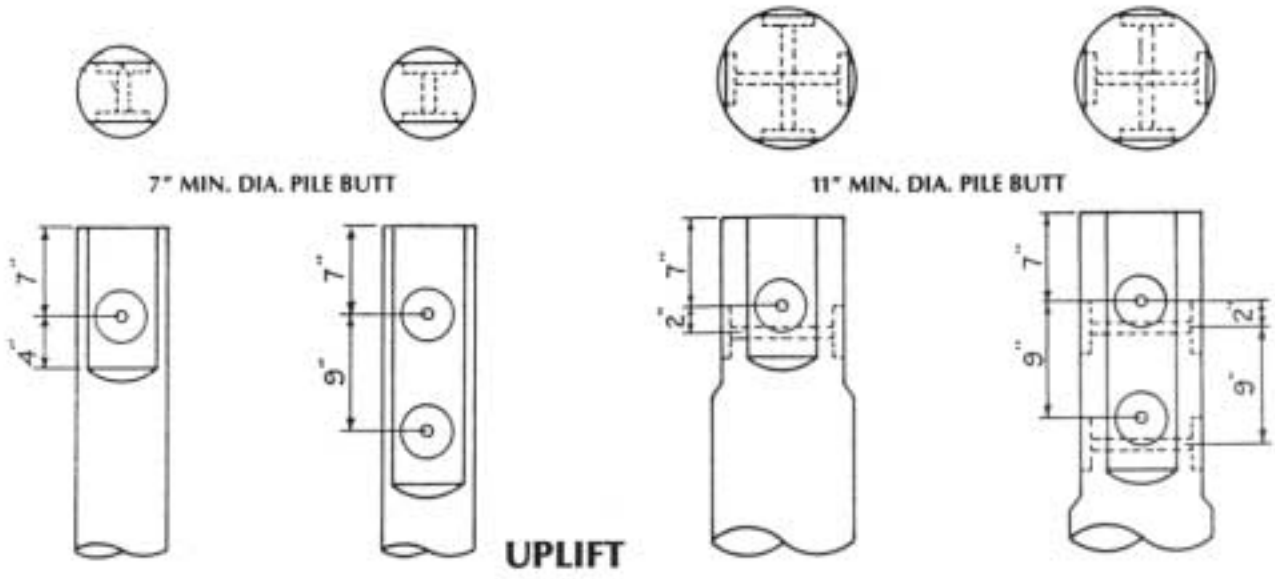
Solve:

$V_c = \frac{V}{b_o d} = \frac{9,214}{28.2 \times 7.5} = 43.6$ psi

V_c allowable for concrete = 100 psi.

NOTE ABOUT b_o: Where only two plates are used, b_o might be assumed to be equivalent to one half a full circumference, or some other fraction thereof. The quantity b_o should be established through experience and engineering judgment.

SHEAR PLATE DESIGN SUGGESTIONS



UPLIFT

SHEAR PLATE DESIGN LOADS (7/8 O BOLT)			
2 Shear Plates	**4 Shear Plates (Vertical)**	**4 Shear Plates (Transverse)**	**8 Shear Plates**
Group "B" Wet Use 7,716 lbs.	Group "C" Wet Use 15,432 lbs.	Group "B" Wet Use 15,432 lbs.	Group "B" Wet Use 30,864 lbs.
Group "C" Wet Use 6,430 lbs.	Group "C" Wet Use 12,860 lbs.	Group "C" Wet Use 12,860 lbs.	Group "C" Wet Use 25,720 lbs.
Group "B" Dry Use 9,214 lbs.	Group "B" Dry Use 18,428 lbs.	Group "B" Dry Use 18,428 lbs.	Group "B" Dry Use 36,856 lbs.
Group "C" Dry Use 7,678 lbs.	Group "C" Dry Use 15,356 lbs.	Group "C" Dry Use 15,356 lbs.	Group "C" Dry Use 30,712 lbs.

DESIGN NOTES:

1. Tabular values are intended as a guide, and should be checked by the design engineer for conformance with current edition of N.D.S.*.
2. A 33⅓% Duration of Load increase is included.
3. Typical Group "B" species include Douglas Fir-Larch and Southern Yellow Pine.
4. Typical Group "C" species include Hem-Fir and Spruce-Pine-Fir.
5. Applicable load adjustment factors are: Load Duration, Wet Service, Temperature, Group Action, Geometry, Penetration and Metal Side Plates.
6. Shear plates are 4" diameter, SP4S.
7. Slab cuts should be parallel, plumb, and a minimum of 5½" in width.
8. Shear plate daps to be made with Tool 3045.

*"National Design Specification for Wood Construction" published by American Forest & Paper Association, Washington, D.C.

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