

Tables for Plastic Design of Beams with Rectangular Holes

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THE REQUIREMENT for holes in the webs of beams and girders in building structures for the passage of utility ducts has become common, and rational methods for the design of beams with certain types of such holes have become available. In this paper, tables are presented which provide an aid to the design of reinforcement for rectangular holes in the webs of flanged beams. The reinforcement considered consists of horizontal bars placed above and below the hole and located close to its edge. Single holes centered on the mid-depth of symmetrical beams are considered, and the limitations pertaining to proportioning on the basis of plastic design apply to the beams. (See for example, Sect. 2.7 of Ref. 1, or Par. 30.11 of Ref. 2.) Figure 1 shows typical hole and reinforcement details; the reinforcement may be either on both sides or on one side of the web. The tables give, for a wide range of combinations of moment and shear acting at the center line of the hole, the minimum area of reinforcement required for the beam to carry that moment and shear before plastic collapse, expressed as a fraction of the area of the beam flange. The tables also indicate when reinforcement is not necessary, and when horizontal bar reinforcement is not adequate.

The basis for the tables lies in the equations given in the Appendix. Further reference to the development of these equations, and to the experimental work which confirmed their validity, may be made elsewhere.³⁻⁶ In addition, the equations given in the Appendix enable moment vs. shear interaction diagrams to be rapidly constructed for cases that may not be given in the tables.

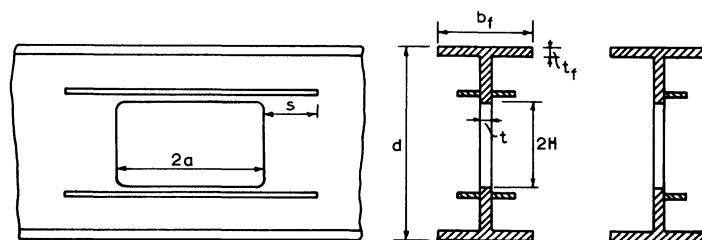


Figure 1

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INTERACTION DIAGRAMS FOR BEAM COLLAPSE

The method of design used herein is based on interaction diagrams relating the moment M and shear force V which, acting together at the center line of the hole, will cause collapse of the beam in the vicinity of the hole. The interaction diagram, shown in Fig. 2, is constructed by means of two straight lines joining the point 1 to 2 and 2 to 3. Non-dimensional parameters are used in which moments are divided by M_p , which is the plastic moment of the basic (i.e., unperforated, unreinforced) beam section, and shear forces are divided by V_p , the plastic shear capacity of the basic beam section. Values of M and V which correspond to points on or outside the boundary of the diagram are indicative of an under-reinforced beam, and will cause collapse of the beam, whereas values corresponding to points within the enclosed area will not produce collapse.

Explicit equations from which the ratios M_1/M_p , M_2/M_p , and V_2/V_p can be obtained are given in the Appendix. For given beam, hole, and reinforcement dimensions, these equations enable the diagram to be constructed; thus for given loading conditions, the capacity of the selected hole and reinforcement can be checked.

Since the analysis is based on the ultimate strength of the beam in the region of the hole, *moments and shears used in entering the tables should be those corresponding to loads factored according to Sect. 2.1 of Ref. 1, or Par. 30.4 of Ref. 2.* This applies equally to the use of the tables and all equations given in this report.

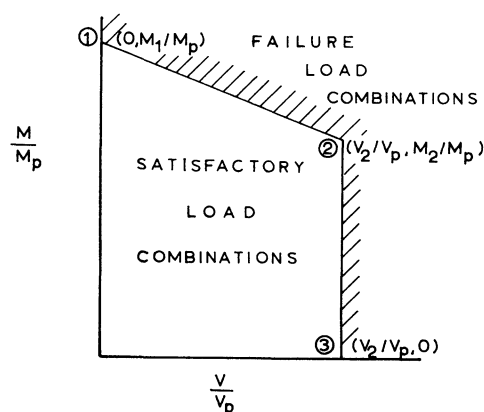


Figure 2

TABLES FOR REINFORCEMENT AREAS

The problem of selection of the reinforcement area is equivalent to finding an interaction diagram which passes through a certain point specified by the applied loading. Corresponding to this interaction diagram is the appropriate minimum reinforcement area. It is on this approach that the tables are based, and the procedure is outlined in the Appendix.

All parameters in the tables are non-dimensionalized and are listed below, together with the range and increments given.

- Beam Parameter:** Ratio of web area of the basic beam section to the area of one flange; 0.75 to 2.00 in 0.25 increments.
- Hole Parameters:** Ratio of hole length to hole height (aspect ratio); 1.0, 1.5, 2.0, and 3.0. Ratio of hole height to beam depth; 0.40 to 0.70 in 0.05 increments.
- Load Parameters:** Ratio of factored applied moment at the hole center line to the plastic moment of the basic beam section; 0.0 and 0.4 to 1.0 in 0.1 increments. Ratio of factored applied shear force at the hole center line to the fully plastic shear of the basic beam section; 0.0 to 0.60 in 0.10 increments.

For cases not included in the above ranges, the checking of a particular design can be carried out by constructing the interaction diagram as outlined above.

As an example of the use of the tables, consider a beam with web area/flange area = 1.25, containing a hole with aspect ratio 1.5, and with ratio of hole height to beam depth 0.5. If, as shown in Fig. 3, the ratio of factored moment to plastic moment is 0.70 and the ratio of factored shear force to plastic shear is 0.30, the required reinforcement area is 0.213 times the area of one beam flange. If the shear ratio had been only 0.10, no reinforcement would have been required. If, on the other hand, it had been 0.60, another type of reinforcement with greater shear capacity would be necessary.

In many cases, particularly when the shear force is small, the beam will not require reinforcement. The method of constructing the interaction diagram for this case is summarized in the Appendix. Hole and beam parameters satisfying these criteria are indicated in the table as requiring zero reinforcement area.

Some values given in the tables indicate the requirement for very large areas of reinforcement. These correspond to extreme cases, which are likely to be avoided in practice, such as very long holes subjected to high shear forces. Care should therefore be exercised if an area ratio approaching or exceeding unity is indicated.

		WEB AREA / FLANGE AREA = 1.25								HOLE LENGTH / HEIGHT = 1.5							
		HOLE LENGTH / HEIGHT = 1.0								HOLE LENGTH / HEIGHT = 1.5							
		HOLE HEIGHT / BEAM DEPTH								HOLE HEIGHT / BEAM DEPTH							
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70		0.40	0.45	0.50	0.55	0.60	0.65	0.70	
1.00	0.0	0.125	0.141	0.156	0.172	0.187	0.203	0.219		0.125	0.141	0.156	0.172	0.187	0.203	0.219	
1.00	0.10	0.268	0.292	0.318	0.347	0.379	0.418	0.464		0.324	0.353	0.385	0.421	0.463	0.513	0.575	
1.00	0.20	0.377	0.411	0.448	0.492	0.543	0.605	0.684		0.477	0.520	0.570	0.628	0.698	0.785	0.896	
1.00	0.30	0.477	0.520	0.570	0.628	0.698	0.785	0.996		0.619	0.677	0.745	0.826	0.925	1.052	1.225	
1.00	0.40	0.572	0.626	0.688	0.761	0.850	*****	*****		0.755	0.830	0.917	1.022	1.162	*****	*****	
1.00	0.50	0.665	0.727	0.803	*****	*****	*****	*****		0.890	0.979	1.095	*****	*****	*****	*****	
1.00	0.60	0.755	*****	*****	*****	*****	*****	*****		1.025	*****	*****	*****	*****	*****	*****	
0.90	0.0	0.0	0.0	0.0	0.0	0.001	0.031			0.0	0.0	0.0	0.0	0.0	0.001	0.031	
0.90	0.10	0.040	0.103	0.131	0.164	0.202	0.247	0.300		0.120	0.152	0.190	0.232	0.281	0.339	0.409	
0.90	0.20	0.161	0.202	0.247	0.299	0.358	0.428	0.515		0.244	0.299	0.360	0.428	0.508	0.604	0.724	
0.90	0.30	0.244	0.299	0.360	0.428	0.508	0.604	0.724		0.369	0.443	0.526	0.620	0.730	0.864	1.038	
0.90	0.40	0.327	0.395	0.471	0.556	0.656	*****	*****		0.494	0.597	0.690	0.809	0.949	*****	*****	
0.90	0.50	0.410	0.491	0.581	*****	*****	*****	*****		0.619	0.730	0.854	*****	*****	*****	*****	
0.90	0.60	0.494	*****	*****	*****	*****	*****	*****		0.745	*****	*****	*****	*****	*****	*****	
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.80	0.10	0.0	0.0	0.0	0.070	0.092	0.122	0.165		0.0	0.0	0.087	0.113	0.149	0.196	0.261	
0.80	0.20	0.0	0.094	0.123	0.161	0.210	0.275	0.359		0.119	0.156	0.204	0.265	0.342	0.437	0.560	
0.80	0.30	0.119	0.156	0.204	0.265	0.342	0.437	0.560		0.201	0.264	0.341	0.435	0.548	0.687	0.864	
0.80	0.40	0.172	0.227	0.294	0.377	0.478	*****	*****		0.295	0.384	0.489	0.612	0.759	*****	*****	
0.80	0.50	0.231	0.303	0.390	*****	*****	*****	*****		0.398	0.511	0.641	*****	*****	*****	*****	
0.80	0.60	0.295	*****	*****	*****	*****	*****	*****		0.507	*****	*****	*****	*****	*****	*****	
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.70	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.085		0.0	0.0	0.0	0.0	0.081	0.109	0.152	
0.70	0.20	0.0	0.0	0.0	0.091	0.120	0.164	0.231		0.0	0.091	0.119	0.159	0.215	0.296	0.410	
0.70	0.30	0.0	0.091	0.119	0.159	0.215	0.296	0.410		0.119	0.158	0.213	0.288	0.389	0.523	0.700	
0.70	0.40	0.101	0.134	0.179	0.242	0.328	*****	*****		0.178	0.242	0.328	0.440	0.583	*****	*****	
0.70	0.50	0.137	0.184	0.249	*****	*****	*****	*****		0.249	0.340	0.458	*****	*****	*****	*****	
0.70	0.60	0.178	*****	*****	*****	*****	*****	*****		0.330	*****	*****	*****	*****	*****	*****	

Figure 3

The reinforcement areas given are based on plastic collapse, and therefore other failure or serviceability criteria may in some cases be critical. This applies particularly to holes larger than those considered in the tables. Thus it may be necessary to compute the deflections over the length of the hole under working loads; to do this a frame analysis, assuming rigid end fixity of the sections above and below the hole, has been found satisfactory. Long and deep holes subjected to high bending moment may cause failure by buckling of the compression section above or below the hole. Such sections should be treated as columns with due account taken of local buckling.

DESIGN DETAILS

Once the reinforcement area has been determined, additional design details must be considered as follows:

Length of Bars—Adequate anchorage of the bars can be developed if they are extended sufficiently beyond the ends of the hole so that the full tensile yield strength of the bar can be developed in the weld between the end of the bar and the near edge of the hole.³ However a minimum length of 3 in. should be maintained. In calculating the required anchorage length, the weld stresses required to develop yield of the bar should be taken as 1.70 times their allowable working stress values.

One-sided Reinforcement—Bars placed on one side only of the web have been found to perform as well as bars placed symmetrically on both sides of the web; that is, the collapse load of the beam has not been reduced when one-sided reinforcement was used instead of two-sided reinforcement. Thus, the design tables are equally applicable for both types of reinforcement. However, this has been established by tests in which the maximum reinforcement area to flange area ratio was 0.333. It is therefore suggested that if this ratio must be exceeded, the reinforcement should be placed on both sides of the web.

Width-Thickness Ratios of Reinforcement—The restrictions normally applied to the flanges of beams designed plastically should be applied to the reinforcement. (See Ref. 1, Sec. 2.7; Ref. 2, Par. 30.11.)

Reinforcement Material—If the material of the reinforcing bars has a lower yield stress than that of the beam, the area of reinforcement obtained from the tables should be multiplied by the ratio of the beam yield stress to reinforcement yield stress. The factored weld stress shall then be controlled by the weaker material.

Weld Size—The weld size should be chosen so that, over the length of the hole, the weld can develop a force equal to twice the yield strength of the reinforcement. This is because, at failure of the beam at the hole, the reinforcing

bar will be fully yielded in tension at one end of the hole, and fully yielded in compression at the other end. Again, factored weld stresses may be used in calculating this developed force.

One-sided Welding—Limited experimental evidence⁴ suggests that a fillet weld on one side of the bar is adequate. However, to reduce the anchorage length, it is probable that welding on both sides of the reinforcement would be used beyond the ends of the hole.

Offset from Hole Edge—When a fillet weld has to be placed between the reinforcing bars and the horizontal edge of the hole, a nominal gap between the bar and the edge should be made $\frac{1}{16}$ -in. larger than the nominal weld size, in order to avoid burning the edge of the hole. When one-sided welding is used and the weld is placed on the flange side of the reinforcing bar, no gap is required.

Beam Loads Near the Hole—In no case should a concentrated load bear on a flange at a section containing a web hole. It has been suggested elsewhere⁷ that holes should be located such that there is a spacing of at least half the beam depth between the edge of the hole and the edge of the bearing. Care should be taken so that distributed loads on the flange near the hole will tend to redistribute in the event of local deflections occurring over the length of the hole.

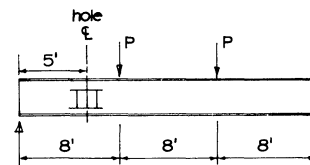


Figure 4

DESIGN EXAMPLE

Select a beam and detail suitable reinforcement for a hole 12 in. long and 8 in. deep to be placed at the mid-depth of the beam shown in Fig. 4. The center of the hole is to be located 5 ft from the end support. Steel is A36 and the working load $P = 13$ kips. Adequate lateral support is provided.

Selection of beam section:

Maximum factored shear force $= 1.70(13) = 22.1$ kips

Maximum factored moment $= 22.1(8) = 176.8$ kip-ft

Required plastic modulus $= 176.8(12)/(36) = 59.0$ in.³

Try W14×38 $Z_x = 61.6$ in.³

Check shear: $V_p = 0.55tdF_y = 0.55(0.313)(14.12)(36)$
 $= 87.5 > 22.1$ kips

Section is compact in A36 steel.

Use W14×38

Relevant properties of W14×38 section:

$$M_p = Z_x F_y = (61.6)(36)/(12) = 184.8 \text{ kip-ft}$$

$$V_p = 87.5 \text{ kips}; \quad b_f = 6.776 \text{ in.}; \quad t_f = 0.513 \text{ in.}$$

$$d = 14.12 \text{ in.}; \quad t = 0.313 \text{ in.}; \quad d/A_f = 4.06$$

Beam and hole parameters:

$$a/H = 1.5; \quad 2H/d = 8/14.12 = 0.565;$$

$$A_f = (6.776)(0.513) = 3.48 \text{ in.}^2$$

$$A_w/A_f = 0.95t(d/A_f) = 0.95(0.313)(4.06) = 1.21$$

Load parameters at center of hole:

$$\text{Factored moment} = (1.70)(13)(5) = 110.5 \text{ kip-ft}$$

$$\text{Factored shear force} = (1.70)(13) = 22.1 \text{ kips}$$

$$\text{Therefore } M/M_p = 0.60; \quad V/V_p = 0.253$$

Calculation of A_r :

By linear interpolation from Tables 6 and 10, the required A_r/A_f is found to be 0.176. Details of the interpolation follow (interpolated values are boldface):

Table 10: ($A_w/A_f = 1.25$; $a/H = 1.5$; $M/M_p = 0.60$)

$2H/D$	0.550	0.565	0.600
$V/V_p = 0.20$	0.132	0.141	0.162
$= 0.253$		0.182	
$= 0.30$	0.198	0.219	0.267

Table 6: ($A_w/A_f = 1.00$; $a/H = 1.5$; $M/M_p = 0.60$)

$V/V_p = 0.20$	0.106	0.113	0.130
$= 0.253$		0.143	
$= 0.300$	0.159	0.170	0.195

Interpolation for $A_w/A_f = 1.21$ between 0.143 and 0.182 gives 0.176.

$$\therefore \text{Required } A_r = (0.176)(3.48) = 0.611 \text{ in.}^2$$

Try plates 1.75 in. x $\frac{3}{8}$ -in. in A36 steel:

$$\text{Area} = 0.655 \text{ in.}^2 > 0.611 \text{ in.}^2$$

$$b_f/2t_f = 1.75/0.375 = 4.65$$

Maximum $b_f/2t_f$ for compact flange in A36 = 8.5 > 4.65

Since $A_r/A_f = 0.176$ is less than 0.333, the reinforcement can be put on one side of the web.

$\therefore$ Use A36 plates $1\frac{3}{4}$ in. x $\frac{3}{8}$ -in. on one side only.

Size of weld:

Weld must develop, over the length of the hole, a force equal to $2(0.611)(36) = 44.0$ kips

$$\text{Required weld size for single weld} = [44.0(\sqrt{2})]/[12(1.70)(21)] = 0.145 \text{ in.}$$

$\therefore$ Use $\frac{3}{16}$ -in. weld over length of hole on one side of reinforcement.

Offset from edge:

Place the reinforcement flush with the horizontal hole edge, and weld on the flange side.

Anchorage length:

With fillet welds on both sides of the reinforcement, beyond the ends of the hole, the required anchorage length is given by:

$$s = \frac{\text{Yield strength of bar}}{2(1.70)(\text{permissible weld stress})(\text{effective throat})}$$

For $\frac{3}{16}$ -in. welds:

$$s = \frac{(0.611)(36)(\sqrt{2})}{2(1.70)(21)(0.1875)} = 2.33 \text{ in.}$$

$\therefore$ Use 3 in. minimum length (see Fig. 5)

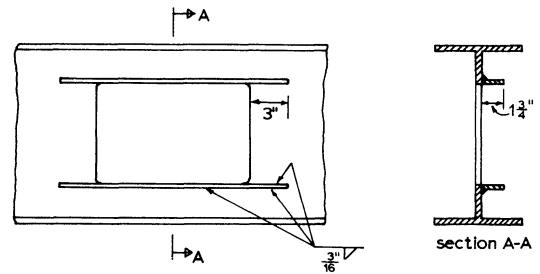


Figure 5

NOMENCLATURE

a	= half length of hole
A_f	= area of one flange
A_r	= area of reinforcement above the hole; also equal to the area of reinforcement below the hole
A_w	= nominal area of web = (web thickness) $\times$ (depth of beam)
b_f	= width of flange
d	= overall beam depth
F_y	= yield stress
H	= half height of hole
M	= moment at centerline of hole
M_p	= plastic moment of basic beam section
M_0, M_1, M_2	= moments at specific points on the interaction diagram
s	= anchorage length of reinforcement
t	= thickness of web
t_f	= thickness of flange
V	= shear force
V_{max}	= maximum shear force the perforated beam can carry
V_p	= shear force on basic beam section to cause yielding
V_0, V_2	= shear forces at specific points on the interaction diagram
Z_x	= plastic modulus of the basic beam section

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APPENDIX

Construction of Interaction Diagrams for Reinforced Holes—The following method has been fully described in Ref. 6. A typical diagram 1-2-3 is shown in Fig. 6, in which a further point 0 is introduced. The coordinates of points 0 and 1 are given by the following:

$$\left. \begin{aligned} \frac{V_0}{V_p} &= \sqrt{3} \left(1 - \frac{2H}{d} \right) \left(\frac{d}{a} \right) \left(\frac{A_r}{A_w} \right) & A_r \leq A_f \\ &= \sqrt{3} \left(1 - \frac{2H}{d} \right) \left(\frac{d}{a} \right) \left(\frac{A_f}{A_w} \right) & A_r \geq A_f \end{aligned} \right\} \quad (1)$$

$$\left. \begin{aligned} \frac{M_0}{M_p} &= \frac{1 - A_r/A_f}{1 + A_w/4A_f} & A_r \leq A_f \\ &= \frac{\left(\frac{2H}{d} \right) \left(\frac{A_r}{A_f} - 1 \right)}{1 + A_w/4A_f} & A_r \geq A_f \end{aligned} \right\} \quad (2)$$

$$\frac{M_1}{M_p} = \frac{1 + \frac{A_w}{4A_f} \left[1 - \left(\frac{2H}{d} \right)^2 \right] + \frac{A_r}{A_f} \left(\frac{2H}{d} \right)}{1 + A_w/4A_f} \quad (3)$$

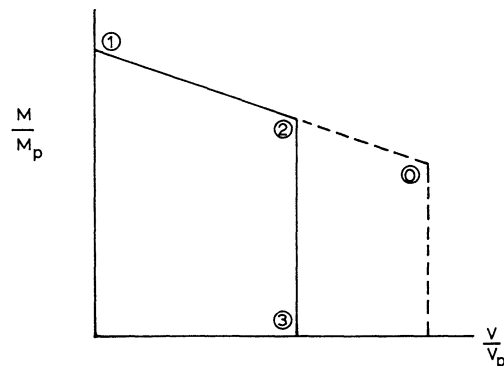


Figure 6

The maximum shear force which can be carried by the web remaining above and below the hole, V_{max} , is:

$$\frac{V_{max}}{V_p} = \left(1 - \frac{2H}{d} \right) \quad (4)$$

The shear force V_2 is then given by the lesser of V_0 and V_{max} . Thus the interaction diagram can be constructed as follows:

- (1) Plot the points 0 and 1 using Eqs. (1), (2), and (3) above. Join them by a straight line and drop a perpendicular on to the V/V_p axis from 0.
- (2) Inspect the magnitude of V_{max}/V_p . If it is less than the value given by Eq. (1), construct the vertical line $V_2/V_p = V_{max}/V_p$. The intersection of this line with the line 0-1 locates point 2. If V_{max} is greater than V_0 , then $V_2/V_p = V_0/V_p$, and the points 0 and 2 are coincident.

It should be noted that, because of simplifying assumptions used in their derivation, Eqs. (1) and (2) do not apply if no reinforcement is used. Equations for the unreinforced case are given below.

Construction of Interaction Diagrams for Unreinforced Holes—The derivation of the following is described in Ref. 5. A typical diagram (Fig. 2) is obtained by locating the point 1 by means of Eq. (3) with $A_r = 0$, and point 2 by use of the following equations:

$$\frac{V_2}{V_p} = \left(1 - \frac{2H}{d} \right) \sqrt{\frac{\alpha}{1 + \alpha}} \quad (5)$$

$$\frac{M_2}{M_p} = \frac{1 - \frac{A_w}{4A_f} \left(1 - \frac{2H}{d} \right) \sqrt{1 + \alpha}}{1 + \frac{A_w}{4A_f}} \quad (6)$$

$$\text{where} \quad \alpha = \frac{3}{16} \left(\frac{d}{a} \right)^2 \left(1 - \frac{2H}{d} \right)^2 \quad (7)$$

Selection of Required Reinforcement Area—For given beam and hole details and specified loading, the required area of reinforcement can be found such that the corresponding interaction diagram passes through the point representing the applied moment M , and shear force V . Thus Eqs. (1) to (4) yield the following:

$$\frac{A_r}{A_f} = \frac{B + \sqrt{B^2 + 4AC}}{2A} \quad \text{if } A \geq B + C \quad (8)$$

or

$$\frac{A_r}{A_f} = \frac{B + C}{A} \quad \text{if } A \leq B + C \quad (9)$$

in which the conditions correspond to $A_r/A_f \leq 1.0$ and $A_r/A_f \geq 1.0$ in Eqs. (8) and (9) respectively, and where

$$A = \frac{2H}{d}$$

$$B = \left(\frac{M}{M_p} - 1 \right) \left(1 + \frac{A_w}{4A_f} \right) + \left(\frac{2H}{d} \right)^2 \left(\frac{A_w}{4A_f} \right) + \frac{1}{\sqrt{3}} \left(\frac{V}{V_p} \right) \left(\frac{a}{d} \right) \left(\frac{A_w}{A_f} \right) \left(1 + \frac{2H}{d} \right) \left/ \left(1 - \frac{2H}{d} \right) \right.$$

$$C = \frac{1}{4\sqrt{3}} \left(\frac{A_w}{A_f} \right)^2 \left(\frac{V}{V_p} \right) \left(\frac{a}{d} \right) \left(1 + \frac{2H}{d} \right)$$

These solutions are subject to two conditions, the first being that $V \leq V_{max}$. If this is not satisfied, the horizontal bar reinforcement is not adequate. Secondly, it is re-

quired that $V_0 \geq V$. The above solutions do not ensure the satisfaction of this, since they are based on definition of the inclined line 1-2-0 passing through the point corresponding to the given values of M and V , but are not necessarily restricted to that part of the line forming the boundary of the interaction diagram. Substitution of Eq. (1) in the above inequality gives:

$$\frac{A_r}{A_f} \geq \frac{1}{\sqrt{3}} \left(\frac{V}{V_p} \right) \left(\frac{a}{d} \right) \left(\frac{A_w}{A_f} \right) \left/ \left(1 - \frac{2H}{d} \right) \right. \quad \text{if } A_r \leq A_f \quad (10)$$

and

$$\frac{V}{V_p} \leq \sqrt{3} \left(1 - \frac{2H}{d} \right) \left(\frac{d}{a} \right) \left(\frac{A_f}{A_w} \right) \quad \text{if } A_r \geq A_f \quad (11)$$

Generation of Tables—The procedure used to generate the tables was to first check the loading against the requirements for no reinforcement. Thus, if the point corresponding to the factored applied moment and shear was found to lie within the interaction diagram constructed as described above, A_r was put equal to zero in the tables. If this condition was not satisfied, then computations based on Eqs. (8), (9), and (10) were carried out. The condition $V > V_{max}$, for which no solution is possible, and failure to satisfy the inequality (11), are indicated in the tables by asterisks.

Tables 1 through 14 appear on the pages that follow.

TABLE 1

WEB AREA / FLANGE AREA = 0.75

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.075	0.084	0.094	0.103	0.112	0.122	0.131	0.075	0.084	0.094	0.103	0.112	0.122	0.131
1.00	0.10	0.161	0.175	0.191	0.208	0.228	0.251	0.279	0.195	0.212	0.231	0.252	0.278	0.308	0.345
1.00	0.20	0.226	0.246	0.269	0.295	0.326	0.363	0.410	0.286	0.312	0.342	0.377	0.419	0.471	0.538
1.00	0.30	0.286	0.312	0.342	0.377	0.419	0.471	0.538	0.371	0.406	0.447	0.496	0.555	0.629	0.726
1.00	0.40	0.343	0.375	0.413	0.457	0.510	*****	*****	0.453	0.498	0.550	0.612	0.689	*****	*****
1.00	0.50	0.399	0.437	0.482	*****	*****	*****	*****	0.534	0.588	0.651	*****	*****	*****	*****
1.00	0.60	0.453	*****	*****	*****	*****	*****	*****	0.613	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.90	0.10	0.0	0.0	0.048	0.062	0.081	0.105	0.135	0.0	0.058	0.075	0.097	0.123	0.156	0.198
0.90	0.20	0.062	0.081	0.104	0.132	0.166	0.208	0.260	0.100	0.129	0.163	0.204	0.252	0.310	0.384
0.90	0.30	0.100	0.129	0.163	0.204	0.252	0.310	0.384	0.163	0.206	0.256	0.313	0.381	0.464	0.568
0.90	0.40	0.141	0.180	0.225	0.277	0.338	*****	*****	0.230	0.286	0.350	0.424	0.511	*****	*****
0.90	0.50	0.185	0.232	0.287	*****	*****	*****	*****	0.299	0.368	0.446	*****	*****	*****	*****
0.90	0.60	0.230	*****	*****	*****	*****	*****	*****	0.371	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.051	0.0	0.0	0.0	0.0	0.049	0.065	0.090
0.80	0.20	0.0	0.0	0.0	0.054	0.072	0.098	0.138	0.0	0.054	0.071	0.095	0.128	0.177	0.245
0.80	0.30	0.0	0.054	0.071	0.095	0.128	0.177	0.245	0.071	0.094	0.127	0.172	0.232	0.312	0.418
0.80	0.40	0.060	0.080	0.107	0.144	0.196	*****	*****	0.106	0.144	0.195	0.263	0.348	*****	*****
0.80	0.50	0.082	0.110	0.149	*****	*****	*****	*****	0.148	0.203	0.273	*****	*****	*****	*****
0.80	0.60	0.106	*****	*****	*****	*****	*****	*****	0.196	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.076
0.70	0.20	0.0	0.0	0.0	0.0	0.065	0.080	0.101	0.0	0.0	0.0	0.079	0.097	0.121	0.152
0.70	0.30	0.0	0.0	0.0	0.079	0.097	0.121	0.152	0.0	0.0	0.097	0.119	0.146	0.191	0.284
0.70	0.40	0.0	0.071	0.087	0.106	0.130	*****	*****	0.087	0.106	0.130	0.159	0.218	*****	*****
0.70	0.50	0.072	0.089	0.108	*****	*****	*****	*****	0.108	0.133	0.162	*****	*****	*****	*****
0.70	0.60	0.087	*****	*****	*****	*****	*****	*****	0.130	*****	*****	*****	*****	*****	*****

TABLE 2

WEB AREA / FLANGE AREA = 0.75

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.076
0.60	0.20	0.0	0.0	0.0	0.0	0.065	0.080	0.101	0.0	0.0	0.0	0.079	0.097	0.121	0.152
0.60	0.30	0.0	0.0	0.0	0.079	0.097	0.121	0.152	0.0	0.0	0.097	0.119	0.146	0.181	0.227
0.60	0.40	0.0	0.071	0.087	0.106	0.130	*****	*****	0.087	0.106	0.130	0.159	0.195	*****	*****
0.60	0.50	0.072	0.089	0.108	*****	*****	*****	*****	0.108	0.133	0.162	*****	*****	*****	*****
0.60	0.60	0.087	*****	*****	*****	*****	*****	*****	0.130	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.076
0.50	0.20	0.0	0.0	0.0	0.0	0.065	0.080	0.101	0.0	0.0	0.0	0.079	0.097	0.121	0.152
0.50	0.30	0.0	0.0	0.0	0.079	0.097	0.121	0.152	0.0	0.0	0.097	0.119	0.146	0.181	0.227
0.50	0.40	0.0	0.071	0.087	0.106	0.130	*****	*****	0.087	0.106	0.130	0.159	0.195	*****	*****
0.50	0.50	0.072	0.089	0.108	*****	*****	*****	*****	0.108	0.133	0.162	*****	*****	*****	*****
0.50	0.60	0.087	*****	*****	*****	*****	*****	*****	0.130	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.076
0.40	0.20	0.0	0.0	0.0	0.0	0.065	0.080	0.101	0.0	0.0	0.0	0.079	0.097	0.121	0.152
0.40	0.30	0.0	0.0	0.0	0.079	0.097	0.121	0.152	0.0	0.0	0.097	0.119	0.146	0.181	0.227
0.40	0.40	0.0	0.071	0.087	0.106	0.130	*****	*****	0.087	0.106	0.130	0.159	0.195	*****	*****
0.40	0.50	0.072	0.089	0.108	*****	*****	*****	*****	0.108	0.133	0.162	*****	*****	*****	*****
0.40	0.60	0.087	*****	*****	*****	*****	*****	*****	0.130	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.076
0.0	0.20	0.0	0.0	0.0	0.0	0.065	0.080	0.101	0.0	0.0	0.0	0.079	0.097	0.121	0.152
0.0	0.30	0.0	0.0	0.0	0.079	0.097	0.121	0.152	0.0	0.0	0.097	0.119	0.146	0.181	0.227
0.0	0.40	0.0	0.071	0.087	0.106	0.130	*****	*****	0.087	0.106	0.130	0.159	0.195	*****	*****
0.0	0.50	0.072	0.089	0.108	*****	*****	*****	*****	0.108	0.133	0.162	*****	*****	*****	*****
0.0	0.60	0.087	*****	*****	*****	*****	*****	*****	0.130	*****	*****	*****	*****	*****	*****

TABLE 3

WEB AREA / FLANGE AREA = 0.75

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.075	0.084	0.094	0.103	0.112	0.122	0.131	0.075	0.084	0.094	0.103	0.112	0.122	0.131
1.00	0.10	0.226	0.246	0.269	0.295	0.326	0.363	0.410	0.286	0.312	0.342	0.377	0.419	0.471	0.538
1.00	0.20	0.343	0.375	0.413	0.457	0.510	0.577	0.664	0.453	0.498	0.550	0.612	0.689	0.785	0.913
1.00	0.30	0.453	0.498	0.550	0.612	0.689	0.785	0.913	0.613	0.676	0.751	0.842	0.953	1.101	1.298
1.00	0.40	0.560	0.617	0.685	0.765	0.865	*****	*****	0.770	0.852	0.950	1.074	1.230	*****	*****
1.00	0.50	0.666	0.735	0.818	*****	*****	*****	*****	0.925	1.029	1.159	*****	*****	*****	*****
1.00	0.60	0.770	*****	*****	*****	*****	*****	*****	1.087	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.90	0.10	0.062	0.081	0.104	0.132	0.166	0.208	0.260	0.100	0.129	0.163	0.204	0.252	0.310	0.384
0.90	0.20	0.141	0.180	0.225	0.277	0.338	0.412	0.507	0.230	0.286	0.350	0.424	0.511	0.617	0.753
0.90	0.30	0.230	0.286	0.350	0.424	0.511	0.617	0.753	0.371	0.452	0.542	0.646	0.770	0.923	1.128
0.90	0.40	0.323	0.396	0.478	0.572	0.683	*****	*****	0.516	0.619	0.735	0.869	1.032	*****	*****
0.90	0.50	0.419	0.507	0.606	*****	*****	*****	*****	0.664	0.789	0.929	*****	*****	*****	*****
0.90	0.60	0.516	*****	*****	*****	*****	*****	*****	0.813	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.0	0.054	0.072	0.098	0.138	0.0	0.0	0.071	0.095	0.128	0.177	0.245
0.80	0.20	0.060	0.080	0.107	0.144	0.196	0.266	0.359	0.106	0.144	0.195	0.263	0.348	0.457	0.597
0.80	0.30	0.106	0.144	0.195	0.263	0.348	0.457	0.597	0.196	0.268	0.357	0.464	0.594	0.755	0.961
0.80	0.40	0.163	0.224	0.300	0.395	0.511	*****	*****	0.309	0.413	0.535	0.678	0.848	*****	*****
0.80	0.50	0.232	0.315	0.415	*****	*****	*****	*****	0.435	0.568	0.720	*****	*****	*****	*****
0.80	0.60	0.309	*****	*****	*****	*****	*****	*****	0.570	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.0	0.080	0.101	0.0	0.0	0.0	0.0	0.097	0.121	0.152
0.70	0.20	0.0	0.0	0.087	0.106	0.130	0.161	0.232	0.0	0.106	0.130	0.159	0.218	0.314	0.450
0.70	0.30	0.0	0.106	0.130	0.159	0.218	0.314	0.450	0.130	0.159	0.218	0.310	0.433	0.594	0.804
0.70	0.40	0.115	0.142	0.177	0.252	0.357	*****	*****	0.177	0.255	0.362	0.501	0.674	*****	*****
0.70	0.50	0.144	0.184	0.263	*****	*****	*****	*****	0.264	0.381	0.528	*****	*****	*****	*****
0.70	0.60	0.177	*****	*****	*****	*****	*****	*****	0.370	*****	*****	*****	*****	*****	*****

TABLE 4

WEB AREA / FLANGE AREA = 0.75

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.080	0.101	0.0	0.0	0.0	0.0	0.097	0.121	0.152
0.60	0.20	0.0	0.0	0.087	0.106	0.130	0.161	0.202	0.0	0.106	0.130	0.159	0.195	0.241	0.319
0.60	0.30	0.0	0.106	0.130	0.159	0.195	0.241	0.319	0.130	0.159	0.195	0.238	0.297	0.445	0.652
0.60	0.40	0.115	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.350	0.512	*****	*****
0.60	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.367	*****	*****	*****	*****
0.60	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.080	0.101	0.0	0.0	0.0	0.0	0.097	0.121	0.152
0.50	0.20	0.0	0.0	0.087	0.106	0.130	0.161	0.202	0.0	0.106	0.130	0.159	0.195	0.241	0.303
0.50	0.30	0.0	0.106	0.130	0.159	0.195	0.241	0.303	0.130	0.159	0.195	0.238	0.292	0.362	0.509
0.50	0.40	0.115	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.318	0.390	*****	*****
0.50	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.325	*****	*****	*****	*****
0.50	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.080	0.101	0.0	0.0	0.0	0.0	0.097	0.121	0.152
0.40	0.20	0.0	0.0	0.087	0.106	0.130	0.161	0.202	0.0	0.106	0.130	0.159	0.195	0.241	0.303
0.40	0.30	0.0	0.106	0.130	0.159	0.195	0.241	0.303	0.130	0.159	0.195	0.238	0.292	0.362	0.455
0.40	0.40	0.115	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.318	0.390	*****	*****
0.40	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.325	*****	*****	*****	*****
0.40	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.080	0.101	0.0	0.0	0.0	0.0	0.097	0.121	0.152
0.0	0.20	0.0	0.0	0.087	0.106	0.130	0.161	0.202	0.0	0.106	0.130	0.159	0.195	0.241	0.303
0.0	0.30	0.0	0.106	0.130	0.159	0.195	0.241	0.303	0.130	0.159	0.195	0.238	0.292	0.362	0.455
0.0	0.40	0.115	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.318	0.390	*****	*****
0.0	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.325	*****	*****	*****	*****
0.0	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****

TABLE 5

WEB AREA / FLANGE AREA = 1.00

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.100	0.112	0.125	0.137	0.150	0.163	0.175	0.100	0.112	0.125	0.137	0.150	0.163	0.175
1.00	0.10	0.214	0.233	0.254	0.277	0.304	0.334	0.372	0.259	0.282	0.308	0.337	0.370	0.410	0.460
1.00	0.20	0.302	0.328	0.359	0.393	0.434	0.484	0.547	0.382	0.416	0.456	0.503	0.558	0.628	0.717
1.00	0.30	0.382	0.416	0.456	0.503	0.558	0.628	0.717	0.495	0.542	0.596	0.661	0.740	0.839	0.968
1.00	0.40	0.458	0.501	0.550	0.609	0.680	*****	*****	0.604	0.664	0.733	0.816	0.918	*****	*****
1.00	0.50	0.532	0.583	0.642	*****	*****	*****	*****	0.712	0.783	0.868	*****	*****	*****	*****
1.00	0.60	0.604	*****	*****	*****	*****	*****	*****	0.817	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.90	0.10	0.0	0.067	0.087	0.111	0.140	0.175	0.217	0.079	0.102	0.130	0.163	0.201	0.247	0.303
0.90	0.20	0.108	0.138	0.173	0.214	0.261	0.317	0.387	0.169	0.211	0.260	0.315	0.379	0.457	0.554
0.90	0.30	0.169	0.211	0.260	0.315	0.379	0.457	0.554	0.263	0.323	0.390	0.466	0.555	0.663	0.801
0.90	0.40	0.232	0.286	0.346	0.416	0.497	*****	*****	0.360	0.436	0.520	0.616	0.729	*****	*****
0.90	0.50	0.295	0.360	0.433	*****	*****	*****	*****	0.458	0.549	0.650	*****	*****	*****	*****
0.90	0.60	0.360	*****	*****	*****	*****	*****	*****	0.557	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.0	0.0	0.056	0.074	0.102	0.0	0.0	0.0	0.070	0.093	0.125	0.171
0.80	0.20	0.0	0.0	0.078	0.102	0.135	0.181	0.245	0.076	0.100	0.132	0.174	0.230	0.304	0.401
0.80	0.30	0.076	0.100	0.132	0.174	0.230	0.304	0.401	0.129	0.172	0.228	0.299	0.387	0.498	0.640
0.80	0.40	0.110	0.147	0.194	0.256	0.334	*****	*****	0.193	0.257	0.337	0.434	0.552	*****	*****
0.80	0.50	0.150	0.200	0.263	*****	*****	*****	*****	0.266	0.351	0.454	*****	*****	*****	*****
0.80	0.60	0.193	*****	*****	*****	*****	*****	*****	0.345	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.067	0.0	0.0	0.0	0.0	0.0	0.080	0.101
0.70	0.20	0.0	0.0	0.0	0.0	0.087	0.107	0.141	0.0	0.0	0.087	0.106	0.133	0.186	0.268
0.70	0.30	0.0	0.0	0.087	0.106	0.133	0.186	0.268	0.0	0.106	0.132	0.181	0.251	0.351	0.488
0.70	0.40	0.0	0.094	0.115	0.151	0.208	*****	*****	0.115	0.151	0.208	0.287	0.394	*****	*****
0.70	0.50	0.096	0.118	0.156	*****	*****	*****	*****	0.155	0.215	0.297	*****	*****	*****	*****
0.70	0.60	0.115	*****	*****	*****	*****	*****	*****	0.207	*****	*****	*****	*****	*****	*****

TABLE 6

WEB AREA / FLANGE AREA = 1.00

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.101
0.60	0.20	0.0	0.0	0.0	0.0	0.087	0.107	0.135	0.0	0.0	0.0	0.106	0.130	0.161	0.202
0.60	0.30	0.0	0.0	0.0	0.106	0.130	0.161	0.202	0.0	0.0	0.130	0.159	0.195	0.241	0.353
0.60	0.40	0.0	0.094	0.115	0.141	0.173	*****	*****	0.115	0.142	0.173	0.212	0.268	*****	*****
0.60	0.50	0.096	0.118	0.144	*****	*****	*****	*****	0.144	0.177	0.217	*****	*****	*****	*****
0.60	0.60	0.115	*****	*****	*****	*****	*****	*****	0.173	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.101
0.50	0.20	0.0	0.0	0.0	0.0	0.087	0.107	0.135	0.0	0.0	0.0	0.106	0.130	0.161	0.202
0.50	0.30	0.0	0.0	0.0	0.106	0.130	0.161	0.202	0.0	0.0	0.130	0.159	0.195	0.241	0.303
0.50	0.40	0.0	0.094	0.115	0.141	0.173	*****	*****	0.115	0.142	0.173	0.212	0.260	*****	*****
0.50	0.50	0.096	0.118	0.144	*****	*****	*****	*****	0.144	0.177	0.217	*****	*****	*****	*****
0.50	0.60	0.115	*****	*****	*****	*****	*****	*****	0.173	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.101
0.40	0.20	0.0	0.0	0.0	0.0	0.087	0.107	0.135	0.0	0.0	0.0	0.106	0.130	0.161	0.202
0.40	0.30	0.0	0.0	0.0	0.106	0.130	0.161	0.202	0.0	0.0	0.130	0.159	0.195	0.241	0.303
0.40	0.40	0.0	0.094	0.115	0.141	0.173	*****	*****	0.115	0.142	0.173	0.212	0.260	*****	*****
0.40	0.50	0.096	0.118	0.144	*****	*****	*****	*****	0.144	0.177	0.217	*****	*****	*****	*****
0.40	0.60	0.115	*****	*****	*****	*****	*****	*****	0.173	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.101
0.0	0.20	0.0	0.0	0.0	0.0	0.087	0.107	0.135	0.0	0.0	0.0	0.106	0.130	0.161	0.202
0.0	0.30	0.0	0.0	0.0	0.106	0.130	0.161	0.202	0.0	0.0	0.130	0.159	0.195	0.241	0.303
0.0	0.40	0.0	0.094	0.115	0.141	0.173	*****	*****	0.115	0.142	0.173	0.212	0.260	*****	*****
0.0	0.50	0.096	0.118	0.144	*****	*****	*****	*****	0.144	0.177	0.217	*****	*****	*****	*****
0.0	0.60	0.115	*****	*****	*****	*****	*****	*****	0.173	*****	*****	*****	*****	*****	*****

TABLE 7

WEB AREA / FLANGE AREA = 1.00

M/MP V/VP	HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
	HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00 0.0	0.100	0.112	0.125	0.137	0.150	0.163	0.175	0.100	0.112	0.125	0.137	0.150	0.163	0.175
1.00 0.10	0.302	0.328	0.359	0.393	0.434	0.484	0.547	0.382	0.416	0.456	0.503	0.558	0.628	0.717
1.00 0.20	0.458	0.501	0.550	0.609	0.680	0.769	0.885	0.604	0.664	0.733	0.816	0.918	1.050	1.230
1.00 0.30	0.604	0.664	0.733	0.816	0.918	1.050	1.230	0.817	0.902	1.002	1.133	1.293	1.494	1.758
1.00 0.40	0.747	0.823	0.913	1.022	1.166	*****	*****	1.030	1.151	1.294	1.465	1.674	*****	*****
1.00 0.50	0.887	0.980	1.099	*****	*****	*****	*****	1.262	1.411	1.586	*****	*****	*****	*****
1.00 0.60	1.030	*****	*****	*****	*****	*****	*****	1.494	*****	*****	*****	*****	*****	*****
0.90 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.90 0.10	0.108	0.138	0.173	0.214	0.261	0.317	0.387	0.169	0.211	0.260	0.315	0.379	0.457	0.554
0.90 0.20	0.232	0.286	0.346	0.416	0.497	0.595	0.719	0.360	0.436	0.520	0.616	0.729	0.869	1.052
0.90 0.30	0.360	0.436	0.520	0.616	0.729	0.869	1.052	0.557	0.662	0.779	0.915	1.085	1.302	1.579
0.90 0.40	0.491	0.586	0.693	0.815	0.962	*****	*****	0.756	0.889	1.044	1.238	1.466	*****	*****
0.90 0.50	0.623	0.738	0.866	*****	*****	*****	*****	0.956	1.133	1.336	*****	*****	*****	*****
0.90 0.60	0.756	*****	*****	*****	*****	*****	*****	1.182	*****	*****	*****	*****	*****	*****
0.80 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80 0.10	0.0	0.0	0.078	0.102	0.135	0.181	0.245	0.0	0.100	0.132	0.174	0.230	0.304	0.401
0.80 0.20	0.110	0.147	0.194	0.256	0.334	0.432	0.560	0.193	0.257	0.337	0.434	0.552	0.697	0.883
0.80 0.30	0.193	0.257	0.337	0.434	0.552	0.697	0.883	0.345	0.451	0.574	0.718	0.889	1.110	1.401
0.80 0.40	0.291	0.384	0.493	0.622	0.776	*****	*****	0.518	0.660	0.822	1.010	1.258	*****	*****
0.80 0.50	0.401	0.519	0.656	*****	*****	*****	*****	0.701	0.877	1.086	*****	*****	*****	*****
0.80 0.60	0.518	*****	*****	*****	*****	*****	*****	0.891	*****	*****	*****	*****	*****	*****
0.70 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70 0.10	0.0	0.0	0.0	0.0	0.087	0.107	0.141	0.0	0.0	0.0	0.106	0.133	0.186	0.268
0.70 0.20	0.0	0.094	0.115	0.151	0.208	0.293	0.413	0.115	0.151	0.208	0.287	0.394	0.536	0.723
0.70 0.30	0.115	0.151	0.208	0.287	0.394	0.536	0.723	0.207	0.289	0.399	0.538	0.710	0.926	1.222
0.70 0.40	0.172	0.239	0.330	0.450	0.602	*****	*****	0.334	0.463	0.623	0.814	1.049	*****	*****
0.70 0.50	0.246	0.344	0.471	*****	*****	*****	*****	0.485	0.659	0.862	*****	*****	*****	*****
0.70 0.60	0.334	*****	*****	*****	*****	*****	*****	0.653	*****	*****	*****	*****	*****	*****

TABLE 8

WEB AREA / FLANGE AREA = 1.00

M/MP V/VP	HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
	HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60 0.10	0.0	0.0	0.0	0.0	0.0	0.107	0.135	0.0	0.0	0.0	0.0	0.130	0.161	0.202
0.60 0.20	0.0	0.0	0.115	0.141	0.173	0.214	0.286	0.0	0.142	0.173	0.212	0.268	0.392	0.571
0.60 0.30	0.0	0.142	0.173	0.212	0.268	0.392	0.571	0.173	0.213	0.268	0.385	0.546	0.759	1.043
0.60 0.40	0.154	0.189	0.231	0.311	0.447	*****	*****	0.231	0.314	0.452	0.633	0.863	*****	*****
0.60 0.50	0.192	0.236	0.325	*****	*****	*****	*****	0.326	0.474	0.667	*****	*****	*****	*****
0.60 0.60	0.231	*****	*****	*****	*****	*****	*****	0.459	*****	*****	*****	*****	*****	*****
0.50 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50 0.10	0.0	0.0	0.0	0.0	0.0	0.107	0.135	0.0	0.0	0.0	0.0	0.130	0.161	0.202
0.50 0.20	0.0	0.0	0.115	0.141	0.173	0.214	0.269	0.0	0.142	0.173	0.212	0.260	0.322	0.433
0.50 0.30	0.0	0.142	0.173	0.212	0.260	0.322	0.433	0.173	0.213	0.260	0.318	0.404	0.603	0.880
0.50 0.40	0.154	0.189	0.231	0.282	0.346	*****	*****	0.231	0.283	0.346	0.476	0.694	*****	*****
0.50 0.50	0.192	0.236	0.289	*****	*****	*****	*****	0.289	0.354	0.499	*****	*****	*****	*****
0.50 0.60	0.231	*****	*****	*****	*****	*****	*****	0.346	*****	*****	*****	*****	*****	*****
0.40 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40 0.10	0.0	0.0	0.0	0.0	0.0	0.107	0.135	0.0	0.0	0.0	0.0	0.130	0.161	0.202
0.40 0.20	0.0	0.0	0.115	0.141	0.173	0.214	0.269	0.0	0.142	0.173	0.212	0.260	0.322	0.404
0.40 0.30	0.0	0.142	0.173	0.212	0.260	0.322	0.404	0.173	0.213	0.260	0.318	0.390	0.483	0.728
0.40 0.40	0.154	0.189	0.231	0.282	0.346	*****	*****	0.231	0.283	0.346	0.423	0.542	*****	*****
0.40 0.50	0.192	0.236	0.289	*****	*****	*****	*****	0.289	0.354	0.433	*****	*****	*****	*****
0.40 0.60	0.231	*****	*****	*****	*****	*****	*****	0.346	*****	*****	*****	*****	*****	*****
0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0 0.10	0.0	0.0	0.0	0.0	0.0	0.107	0.135	0.0	0.0	0.0	0.0	0.130	0.161	0.202
0.0 0.20	0.0	0.0	0.115	0.141	0.173	0.214	0.269	0.0	0.142	0.173	0.212	0.260	0.322	0.404
0.0 0.30	0.0	0.142	0.173	0.212	0.260	0.322	0.404	0.173	0.213	0.260	0.318	0.390	0.483	0.606
0.0 0.40	0.154	0.189	0.231	0.282	0.346	*****	*****	0.231	0.283	0.346	0.423	0.520	*****	*****
0.0 0.50	0.192	0.236	0.289	*****	*****	*****	*****	0.289	0.354	0.433	*****	*****	*****	*****
0.0 0.60	0.231	*****	*****	*****	*****	*****	*****	0.346	*****	*****	*****	*****	*****	*****

TABLE 9

WEB AREA / FLANGE AREA = 1.25

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.125	0.141	0.156	0.172	0.187	0.203	0.219	0.125	0.141	0.156	0.172	0.187	0.203	0.219
1.00	0.10	0.268	0.292	0.318	0.347	0.379	0.418	0.464	0.324	0.353	0.385	0.421	0.463	0.513	0.575
1.00	0.20	0.377	0.411	0.448	0.492	0.543	0.605	0.684	0.477	0.520	0.570	0.628	0.698	0.785	0.896
1.00	0.30	0.477	0.520	0.570	0.628	0.698	0.785	0.896	0.619	0.677	0.745	0.826	0.925	1.052	1.225
1.00	0.40	0.572	0.626	0.688	0.761	0.850	*****	*****	0.756	0.830	0.917	1.022	1.162	*****	*****
1.00	0.50	0.665	0.729	0.803	*****	*****	*****	*****	0.890	0.979	1.095	*****	*****	*****	*****
1.00	0.60	0.755	*****	*****	*****	*****	*****	*****	1.025	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.031	0.0	0.0	0.0	0.0	0.0	0.001	0.031
0.90	0.10	0.080	0.103	0.131	0.164	0.202	0.247	0.300	0.120	0.152	0.190	0.232	0.281	0.339	0.408
0.90	0.20	0.161	0.202	0.247	0.299	0.358	0.428	0.515	0.244	0.299	0.360	0.428	0.508	0.604	0.724
0.90	0.30	0.244	0.299	0.360	0.428	0.508	0.604	0.724	0.369	0.443	0.526	0.620	0.730	0.864	1.038
0.90	0.40	0.327	0.395	0.471	0.556	0.656	*****	*****	0.494	0.587	0.690	0.809	0.949	*****	*****
0.90	0.50	0.410	0.491	0.581	*****	*****	*****	*****	0.619	0.730	0.854	*****	*****	*****	*****
0.90	0.60	0.494	*****	*****	*****	*****	*****	*****	0.745	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.0	0.070	0.092	0.122	0.165	0.0	0.0	0.087	0.113	0.149	0.196	0.261
0.80	0.20	0.0	0.094	0.123	0.161	0.210	0.275	0.359	0.119	0.156	0.204	0.265	0.342	0.437	0.560
0.80	0.30	0.119	0.156	0.204	0.265	0.342	0.437	0.560	0.201	0.264	0.341	0.435	0.548	0.687	0.864
0.80	0.40	0.172	0.227	0.294	0.377	0.478	*****	*****	0.295	0.384	0.489	0.612	0.759	*****	*****
0.80	0.50	0.231	0.303	0.390	*****	*****	*****	*****	0.398	0.511	0.641	*****	*****	*****	*****
0.80	0.60	0.295	*****	*****	*****	*****	*****	*****	0.507	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.085	0.0	0.0	0.0	0.0	0.081	0.109	0.152
0.70	0.20	0.0	0.0	0.0	0.091	0.120	0.164	0.231	0.0	0.091	0.119	0.159	0.215	0.296	0.410
0.70	0.30	0.0	0.091	0.119	0.159	0.215	0.296	0.410	0.119	0.158	0.213	0.288	0.389	0.523	0.700
0.70	0.40	0.101	0.134	0.179	0.242	0.328	*****	*****	0.178	0.242	0.328	0.440	0.583	*****	*****
0.70	0.50	0.137	0.184	0.249	*****	*****	*****	*****	0.249	0.340	0.458	*****	*****	*****	*****
0.70	0.60	0.178	*****	*****	*****	*****	*****	*****	0.330	*****	*****	*****	*****	*****	*****

TABLE 10

WEB AREA / FLANGE AREA = 1.25

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.126
0.60	0.20	0.0	0.0	0.0	0.0	0.108	0.134	0.168	0.0	0.0	0.0	0.132	0.162	0.201	0.284
0.60	0.30	0.0	0.0	0.0	0.132	0.162	0.201	0.284	0.0	0.133	0.162	0.198	0.267	0.381	0.547
0.60	0.40	0.0	0.118	0.144	0.176	0.219	*****	*****	0.144	0.177	0.219	0.306	0.430	*****	*****
0.60	0.50	0.120	0.143	0.180	*****	*****	*****	*****	0.180	0.227	0.318	*****	*****	*****	*****
0.60	0.60	0.144	*****	*****	*****	*****	*****	*****	0.219	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.126
0.50	0.20	0.0	0.0	0.0	0.0	0.108	0.134	0.168	0.0	0.0	0.0	0.132	0.162	0.201	0.253
0.50	0.30	0.0	0.0	0.0	0.132	0.162	0.201	0.253	0.0	0.0	0.162	0.198	0.244	0.302	0.411
0.50	0.40	0.0	0.118	0.144	0.176	0.217	*****	*****	0.144	0.177	0.217	0.265	0.325	*****	*****
0.50	0.50	0.120	0.148	0.180	*****	*****	*****	*****	0.180	0.221	0.271	*****	*****	*****	*****
0.50	0.60	0.144	*****	*****	*****	*****	*****	*****	0.217	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.126
0.40	0.20	0.0	0.0	0.0	0.0	0.108	0.134	0.168	0.0	0.0	0.0	0.132	0.162	0.201	0.253
0.40	0.30	0.0	0.0	0.0	0.132	0.162	0.201	0.253	0.0	0.0	0.162	0.198	0.244	0.302	0.379
0.40	0.40	0.0	0.118	0.144	0.176	0.217	*****	*****	0.144	0.177	0.217	0.265	0.325	*****	*****
0.40	0.50	0.120	0.148	0.180	*****	*****	*****	*****	0.180	0.221	0.271	*****	*****	*****	*****
0.40	0.60	0.144	*****	*****	*****	*****	*****	*****	0.217	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.126
0.0	0.20	0.0	0.0	0.0	0.0	0.108	0.134	0.168	0.0	0.0	0.0	0.132	0.162	0.201	0.253
0.0	0.30	0.0	0.0	0.0	0.132	0.162	0.201	0.253	0.0	0.0	0.162	0.198	0.244	0.302	0.379
0.0	0.40	0.0	0.118	0.144	0.176	0.217	*****	*****	0.144	0.177	0.217	0.265	0.325	*****	*****
0.0	0.50	0.120	0.148	0.180	*****	*****	*****	*****	0.180	0.221	0.271	*****	*****	*****	*****
0.0	0.60	0.144	*****	*****	*****	*****	*****	*****	0.217	*****	*****	*****	*****	*****	*****

TABLE 11

WEB AREA / FLANGE AREA = 1.25

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.125	0.141	0.156	0.172	0.187	0.203	0.219	0.125	0.141	0.156	0.172	0.187	0.203	0.219
1.00	0.10	0.377	0.411	0.448	0.492	0.543	0.605	0.684	0.477	0.520	0.570	0.628	0.698	0.785	0.896
1.00	0.20	0.572	0.626	0.688	0.761	0.850	0.961	1.113	0.756	0.830	0.917	1.022	1.162	1.335	1.561
1.00	0.30	0.756	0.830	0.917	1.022	1.162	1.335	1.561	1.025	1.144	1.283	1.448	1.649	1.902	2.232
1.00	0.40	0.934	1.032	1.158	1.306	1.487	*****	*****	1.325	1.478	1.658	1.873	2.136	*****	*****
1.00	0.50	1.125	1.255	1.408	*****	*****	*****	*****	1.625	1.813	2.034	*****	*****	*****	*****
1.00	0.60	1.325	*****	*****	*****	*****	*****	*****	1.925	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.031	0.0	0.0	0.0	0.0	0.0	0.001	0.031
0.90	0.10	0.161	0.202	0.247	0.299	0.358	0.428	0.515	0.244	0.299	0.360	0.428	0.508	0.604	0.724
0.90	0.20	0.327	0.395	0.471	0.556	0.656	0.777	0.931	0.494	0.587	0.690	0.809	0.949	1.134	1.373
0.90	0.30	0.494	0.587	0.690	0.809	0.949	1.134	1.373	0.745	0.874	1.020	1.209	1.430	1.700	2.044
0.90	0.40	0.661	0.778	0.909	1.067	1.268	*****	*****	0.997	1.187	1.396	1.634	1.917	*****	*****
0.90	0.50	0.829	0.969	1.145	*****	*****	*****	*****	1.297	1.521	1.771	*****	*****	*****	*****
0.90	0.60	0.997	*****	*****	*****	*****	*****	*****	1.597	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.094	0.123	0.161	0.210	0.275	0.359	0.119	0.156	0.204	0.265	0.342	0.437	0.560
0.80	0.20	0.172	0.227	0.294	0.377	0.478	0.603	0.762	0.295	0.384	0.489	0.612	0.759	0.939	1.186
0.80	0.30	0.295	0.384	0.489	0.612	0.759	0.939	1.186	0.507	0.643	0.797	0.975	1.211	1.498	1.857
0.80	0.40	0.434	0.554	0.693	0.853	1.049	*****	*****	0.736	0.914	1.133	1.396	1.699	*****	*****
0.80	0.50	0.582	0.732	0.901	*****	*****	*****	*****	0.975	1.230	1.509	*****	*****	*****	*****
0.80	0.60	0.736	*****	*****	*****	*****	*****	*****	1.268	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.091	0.120	0.164	0.231	0.0	0.0	0.119	0.159	0.215	0.296	0.410
0.70	0.20	0.101	0.134	0.179	0.242	0.328	0.445	0.602	0.178	0.242	0.328	0.440	0.583	0.764	0.998
0.70	0.30	0.178	0.242	0.328	0.440	0.583	0.764	0.998	0.330	0.449	0.598	0.777	0.994	1.296	1.669
0.70	0.40	0.274	0.375	0.504	0.662	0.855	*****	*****	0.517	0.691	0.895	1.157	1.480	*****	*****
0.70	0.50	0.389	0.527	0.695	*****	*****	*****	*****	0.729	0.951	1.246	*****	*****	*****	*****
0.70	0.60	0.517	*****	*****	*****	*****	*****	*****	0.954	*****	*****	*****	*****	*****	*****

TABLE 12

WEB AREA / FLANGE AREA = 1.25

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.134	0.168	0.0	0.0	0.0	0.132	0.162	0.201	0.284
0.60	0.20	0.0	0.0	0.144	0.176	0.219	0.313	0.455	0.144	0.177	0.219	0.306	0.430	0.602	0.834
0.60	0.30	0.144	0.177	0.219	0.306	0.430	0.602	0.834	0.219	0.308	0.433	0.599	0.812	1.094	1.482
0.60	0.40	0.192	0.253	0.354	0.494	0.680	*****	*****	0.356	0.504	0.697	0.933	1.261	*****	*****
0.60	0.50	0.260	0.369	0.516	*****	*****	*****	*****	0.526	0.735	0.987	*****	*****	*****	*****
0.60	0.60	0.355	*****	*****	*****	*****	*****	*****	0.722	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.134	0.168	0.0	0.0	0.0	0.0	0.162	0.201	0.253
0.50	0.20	0.0	0.0	0.144	0.176	0.217	0.268	0.337	0.0	0.177	0.217	0.265	0.325	0.402	0.535
0.50	0.30	0.0	0.177	0.217	0.265	0.325	0.402	0.535	0.217	0.266	0.325	0.397	0.499	0.747	1.107
0.50	0.40	0.192	0.236	0.289	0.353	0.433	*****	*****	0.289	0.354	0.433	0.588	0.859	*****	*****
0.50	0.50	0.241	0.295	0.361	*****	*****	*****	*****	0.361	0.443	0.617	*****	*****	*****	*****
0.50	0.60	0.289	*****	*****	*****	*****	*****	*****	0.433	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.134	0.168	0.0	0.0	0.0	0.0	0.162	0.201	0.253
0.40	0.20	0.0	0.0	0.144	0.176	0.217	0.268	0.337	0.0	0.177	0.217	0.265	0.325	0.402	0.535
0.40	0.30	0.0	0.177	0.217	0.265	0.325	0.402	0.535	0.217	0.266	0.325	0.397	0.499	0.747	1.107
0.40	0.40	0.192	0.236	0.289	0.353	0.433	*****	*****	0.289	0.354	0.433	0.588	0.859	*****	*****
0.40	0.50	0.241	0.295	0.361	*****	*****	*****	*****	0.361	0.443	0.617	*****	*****	*****	*****
0.40	0.60	0.289	*****	*****	*****	*****	*****	*****	0.433	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.134	0.168	0.0	0.0	0.0	0.0	0.162	0.201	0.253
0.0	0.20	0.0	0.0	0.144	0.176	0.217	0.268	0.337	0.0	0.177	0.217	0.265	0.325	0.402	0.505
0.0	0.30	0.0	0.177	0.217	0.265	0.325	0.402	0.505	0.217	0.266	0.325	0.397	0.487	0.603	0.758
0.0	0.40	0.192	0.236	0.289	0.353	0.433	*****	*****	0.289	0.354	0.433	0.529	0.650	*****	*****
0.0	0.50	0.241	0.295	0.361	*****	*****	*****	*****	0.361	0.443	0.541	*****	*****	*****	*****
0.0	0.60	0.289	*****	*****	*****	*****	*****	*****	0.433	*****	*****	*****	*****	*****	*****

TABLE 13

WEB AREA / FLANGE AREA = 1.50

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MF	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.150	0.169	0.188	0.206	0.225	0.244	0.263	0.150	0.169	0.188	0.206	0.225	0.244	0.263
1.00	0.10	0.322	0.350	0.381	0.416	0.455	0.501	0.557	0.389	0.423	0.462	0.505	0.555	0.615	0.691
1.00	0.20	0.453	0.493	0.538	0.590	0.651	0.726	0.821	0.572	0.624	0.684	0.754	0.838	0.942	1.081
1.00	0.30	0.572	0.624	0.684	0.754	0.838	0.942	1.081	0.742	0.813	0.895	0.992	1.121	1.283	1.491
1.00	0.40	0.687	0.751	0.825	0.913	1.022	*****	*****	0.907	0.996	1.113	1.252	1.420	*****	*****
1.00	0.50	0.798	0.874	0.963	*****	*****	*****	*****	1.078	1.202	1.344	*****	*****	*****	*****
1.00	0.60	0.907	*****	*****	*****	*****	*****	*****	1.264	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.032	0.066	0.0	0.0	0.0	0.0	0.0	0.032	0.066
0.90	0.10	0.111	0.143	0.179	0.220	0.267	0.320	0.383	0.165	0.206	0.252	0.304	0.363	0.432	0.515
0.90	0.20	0.217	0.268	0.323	0.385	0.456	0.540	0.643	0.321	0.388	0.461	0.543	0.638	0.752	0.895
0.90	0.30	0.321	0.388	0.461	0.543	0.638	0.752	0.895	0.476	0.565	0.663	0.774	0.905	1.071	1.294
0.90	0.40	0.425	0.506	0.596	0.697	0.816	*****	*****	0.629	0.739	0.862	1.002	1.191	*****	*****
0.90	0.50	0.527	0.623	0.729	*****	*****	*****	*****	0.782	0.913	1.069	*****	*****	*****	*****
0.90	0.60	0.629	*****	*****	*****	*****	*****	*****	0.935	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.0	0.102	0.134	0.177	0.233	0.0	0.096	0.125	0.162	0.211	0.274	0.355
0.80	0.20	0.104	0.135	0.175	0.227	0.291	0.373	0.476	0.169	0.220	0.284	0.362	0.457	0.573	0.721
0.80	0.30	0.169	0.220	0.284	0.362	0.457	0.573	0.721	0.281	0.363	0.460	0.575	0.711	0.877	1.098
0.80	0.40	0.242	0.314	0.400	0.503	0.626	*****	*****	0.405	0.516	0.644	0.792	0.967	*****	*****
0.80	0.50	0.321	0.413	0.521	*****	*****	*****	*****	0.537	0.675	0.831	*****	*****	*****	*****
0.80	0.60	0.405	*****	*****	*****	*****	*****	*****	0.675	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.0	0.095	0.130	0.0	0.0	0.0	0.0	0.121	0.163	0.225
0.70	0.20	0.0	0.0	0.102	0.133	0.177	0.240	0.331	0.0	0.132	0.173	0.231	0.309	0.415	0.558
0.70	0.30	0.100	0.132	0.173	0.231	0.309	0.415	0.558	0.171	0.229	0.306	0.406	0.535	0.700	0.913
0.70	0.40	0.146	0.194	0.259	0.345	0.457	*****	*****	0.257	0.346	0.460	0.602	0.777	*****	*****
0.70	0.50	0.198	0.266	0.355	*****	*****	*****	*****	0.356	0.478	0.628	*****	*****	*****	*****
0.70	0.60	0.257	*****	*****	*****	*****	*****	*****	0.467	*****	*****	*****	*****	*****	*****

TABLE 14

WEB AREA / FLANGE AREA = 1.50

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.101	0.0	0.0	0.0	0.0	0.0	0.121	0.152
0.60	0.20	0.0	0.0	0.0	0.0	0.130	0.161	0.219	0.0	0.0	0.130	0.159	0.206	0.289	0.413
0.60	0.30	0.0	0.0	0.130	0.159	0.206	0.289	0.413	0.130	0.159	0.205	0.281	0.389	0.540	0.747
0.60	0.40	0.115	0.142	0.173	0.234	0.323	*****	*****	0.173	0.234	0.321	0.442	0.605	*****	*****
0.60	0.50	0.144	0.178	0.241	*****	*****	*****	*****	0.241	0.333	0.459	*****	*****	*****	*****
0.60	0.60	0.173	*****	*****	*****	*****	*****	*****	0.321	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.152
0.50	0.20	0.0	0.0	0.0	0.0	0.130	0.161	0.202	0.0	0.0	0.0	0.159	0.195	0.241	0.303
0.50	0.30	0.0	0.0	0.0	0.159	0.195	0.241	0.303	0.0	0.0	0.195	0.238	0.292	0.403	0.594
0.50	0.40	0.0	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.321	0.458	*****	*****
0.50	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.334	*****	*****	*****	*****
0.50	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.152
0.40	0.20	0.0	0.0	0.0	0.0	0.130	0.161	0.202	0.0	0.0	0.0	0.159	0.195	0.241	0.303
0.40	0.30	0.0	0.0	0.0	0.159	0.195	0.241	0.303	0.0	0.0	0.195	0.238	0.292	0.362	0.459
0.40	0.40	0.0	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.318	0.390	*****	*****
0.40	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.325	*****	*****	*****	*****
0.40	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.152
0.0	0.20	0.0	0.0	0.0	0.0	0.130	0.161	0.202	0.0	0.0	0.0	0.159	0.195	0.241	0.303
0.0	0.30	0.0	0.0	0.0	0.159	0.195	0.241	0.303	0.0	0.0	0.195	0.238	0.292	0.362	0.455
0.0	0.40	0.0	0.142	0.173	0.212	0.260	*****	*****	0.173	0.213	0.260	0.318	0.390	*****	*****
0.0	0.50	0.144	0.177	0.217	*****	*****	*****	*****	0.217	0.266	0.325	*****	*****	*****	*****
0.0	0.60	0.173	*****	*****	*****	*****	*****	*****	0.260	*****	*****	*****	*****	*****	*****

TABLE 15

WEB AREA / FLANGE AREA = 1.50

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.150	0.169	0.188	0.206	0.225	0.244	0.263	0.150	0.169	0.188	0.206	0.225	0.244	0.263
1.00	0.10	0.453	0.493	0.538	0.590	0.651	0.726	0.821	0.572	0.624	0.684	0.754	0.838	0.942	1.081
1.00	0.20	0.687	0.751	0.825	0.913	1.022	1.167	1.354	0.907	0.996	1.113	1.252	1.420	1.629	1.900
1.00	0.30	0.907	0.996	1.113	1.252	1.420	1.629	1.900	1.264	1.408	1.576	1.775	2.018	2.322	2.719
1.00	0.40	1.140	1.270	1.422	1.601	1.818	*****	*****	1.635	1.821	2.039	2.298	2.615	*****	*****
1.00	0.50	1.388	1.546	1.730	*****	*****	*****	*****	2.007	2.234	2.501	*****	*****	*****	*****
1.00	0.60	1.635	*****	*****	*****	*****	*****	*****	2.378	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.0	0.032	0.066	0.0	0.0	0.0	0.0	0.0	0.032	0.066
0.90	0.10	0.217	0.268	0.323	0.385	0.456	0.540	0.643	0.321	0.388	0.461	0.543	0.638	0.752	0.895
0.90	0.20	0.425	0.506	0.596	0.697	0.816	0.960	1.158	0.629	0.739	0.862	1.002	1.191	1.418	1.704
0.90	0.30	0.629	0.739	0.862	1.002	1.191	1.418	1.704	0.935	1.103	1.301	1.525	1.789	2.111	2.523
0.90	0.40	0.833	0.971	1.147	1.351	1.589	*****	*****	1.291	1.516	1.764	2.048	2.386	*****	*****
0.90	0.50	1.044	1.240	1.455	*****	*****	*****	*****	1.663	1.929	2.226	*****	*****	*****	*****
0.90	0.60	1.291	*****	*****	*****	*****	*****	*****	2.034	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.135	0.175	0.227	0.291	0.373	0.476	0.169	0.220	0.284	0.362	0.457	0.573	0.721
0.80	0.20	0.242	0.314	0.400	0.503	0.626	0.775	0.966	0.405	0.516	0.644	0.792	0.967	1.206	1.508
0.80	0.30	0.405	0.516	0.644	0.792	0.967	1.206	1.508	0.675	0.838	1.026	1.275	1.559	1.899	2.326
0.80	0.40	0.583	0.729	0.895	1.101	1.360	*****	*****	0.959	1.210	1.489	1.798	2.157	*****	*****
0.80	0.50	0.769	0.948	1.180	*****	*****	*****	*****	1.319	1.623	1.951	*****	*****	*****	*****
0.80	0.60	0.959	*****	*****	*****	*****	*****	*****	1.690	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.133	0.177	0.240	0.331	0.0	0.132	0.173	0.231	0.309	0.415	0.558
0.70	0.20	0.146	0.194	0.259	0.345	0.457	0.603	0.794	0.257	0.346	0.460	0.602	0.777	0.995	1.311
0.70	0.30	0.257	0.346	0.460	0.602	0.777	0.995	1.311	0.467	0.621	0.804	1.025	1.330	1.687	2.130
0.70	0.40	0.392	0.524	0.686	0.879	1.131	*****	*****	0.714	0.927	1.214	1.548	1.928	*****	*****
0.70	0.50	0.546	0.720	0.925	*****	*****	*****	*****	0.982	1.318	1.676	*****	*****	*****	*****
0.70	0.60	0.714	*****	*****	*****	*****	*****	*****	1.347	*****	*****	*****	*****	*****	*****

TABLE 16

WEB AREA / FLANGE AREA = 1.50

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.130	0.161	0.219	0.0	0.0	0.130	0.159	0.206	0.289	0.413
0.60	0.20	0.0	0.142	0.173	0.234	0.323	0.452	0.633	0.173	0.234	0.321	0.442	0.605	0.819	1.115
0.60	0.30	0.173	0.234	0.321	0.442	0.605	0.819	1.115	0.321	0.447	0.614	0.824	1.101	1.476	1.934
0.60	0.40	0.266	0.370	0.509	0.691	0.920	*****	*****	0.516	0.713	0.953	1.298	1.699	*****	*****
0.60	0.50	0.381	0.531	0.723	*****	*****	*****	*****	0.747	1.012	1.401	*****	*****	*****	*****
0.60	0.60	0.516	*****	*****	*****	*****	*****	*****	1.003	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.161	0.202	0.0	0.0	0.0	0.0	0.195	0.241	0.303
0.50	0.20	0.0	0.0	0.173	0.212	0.260	0.329	0.488	0.0	0.213	0.260	0.321	0.458	0.656	0.931
0.50	0.30	0.173	0.213	0.260	0.321	0.458	0.656	0.931	0.260	0.323	0.459	0.648	0.898	1.264	1.737
0.50	0.40	0.231	0.283	0.373	0.530	0.744	*****	*****	0.374	0.537	0.757	1.048	1.469	*****	*****
0.50	0.50	0.289	0.389	0.552	*****	*****	*****	*****	0.558	0.797	1.126	*****	*****	*****	*****
0.50	0.60	0.374	*****	*****	*****	*****	*****	*****	0.777	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.161	0.202	0.0	0.0	0.0	0.0	0.195	0.241	0.303
0.40	0.20	0.0	0.0	0.173	0.212	0.260	0.322	0.404	0.0	0.213	0.260	0.318	0.390	0.513	0.771
0.40	0.30	0.0	0.213	0.260	0.318	0.390	0.513	0.771	0.260	0.319	0.390	0.501	0.729	1.053	1.541
0.40	0.40	0.231	0.283	0.346	0.423	0.589	*****	*****	0.346	0.425	0.591	0.851	1.240	*****	*****
0.40	0.50	0.289	0.354	0.433	*****	*****	*****	*****	0.433	0.619	0.895	*****	*****	*****	*****
0.40	0.60	0.346	*****	*****	*****	*****	*****	*****	0.594	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.161	0.202	0.0	0.0	0.0	0.0	0.195	0.241	0.303
0.0	0.20	0.0	0.0	0.173	0.212	0.260	0.322	0.404	0.0	0.213	0.260	0.318	0.390	0.483	0.606
0.0	0.30	0.0	0.213	0.260	0.318	0.390	0.483	0.606	0.260	0.319	0.390	0.476	0.585	0.724	0.909
0.0	0.40	0.231	0.283	0.346	0.423	0.520	*****	*****	0.346	0.425	0.520	0.635	0.779	*****	*****
0.0	0.50	0.289	0.354	0.433	*****	*****	*****	*****	0.433	0.531	0.650	*****	*****	*****	*****
0.0	0.60	0.346	*****	*****	*****	*****	*****	*****	0.520	*****	*****	*****	*****	*****	*****

TABLE 17

WEB AREA / FLANGE AREA = 1.75

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.175	0.197	0.219	0.241	0.262	0.284	0.306	0.175	0.197	0.219	0.241	0.262	0.284	0.306
1.00	0.10	0.375	0.409	0.445	0.485	0.531	0.585	0.650	0.454	0.494	0.538	0.589	0.648	0.718	0.806
1.00	0.20	0.528	0.575	0.628	0.688	0.760	0.847	0.957	0.668	0.728	0.798	0.879	0.977	1.108	1.278
1.00	0.30	0.668	0.728	0.798	0.879	0.977	1.108	1.278	0.866	0.948	1.050	1.178	1.331	1.520	1.764
1.00	0.40	0.801	0.876	0.963	1.074	1.212	*****	*****	1.068	1.188	1.327	1.490	1.687	*****	*****
1.00	0.50	0.931	1.023	1.142	*****	*****	*****	*****	1.291	1.436	1.604	*****	*****	*****	*****
1.00	0.60	1.068	*****	*****	*****	*****	*****	*****	1.514	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.0	0.023	0.063	0.101	0.0	0.0	0.0	0.0	0.023	0.063	0.101
0.90	0.10	0.146	0.184	0.228	0.277	0.332	0.394	0.468	0.212	0.261	0.316	0.377	0.445	0.525	0.621
0.90	0.20	0.276	0.335	0.400	0.472	0.555	0.651	0.771	0.401	0.478	0.563	0.658	0.767	0.899	1.072
0.90	0.30	0.401	0.473	0.563	0.658	0.767	0.899	1.072	0.584	0.687	0.800	0.928	1.091	1.299	1.558
0.90	0.40	0.524	0.618	0.721	0.839	0.976	*****	*****	0.765	0.892	1.039	1.229	1.448	*****	*****
0.90	0.50	0.645	0.755	0.878	*****	*****	*****	*****	0.945	1.117	1.317	*****	*****	*****	*****
0.90	0.60	0.765	*****	*****	*****	*****	*****	*****	1.155	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.107	0.139	0.181	0.235	0.305	0.0	0.129	0.168	0.216	0.278	0.354	0.450
0.80	0.20	0.139	0.180	0.232	0.297	0.376	0.473	0.594	0.224	0.290	0.368	0.462	0.574	0.711	0.882
0.80	0.30	0.224	0.290	0.368	0.462	0.574	0.711	0.882	0.367	0.466	0.582	0.716	0.875	1.078	1.353
0.80	0.40	0.318	0.406	0.510	0.631	0.774	*****	*****	0.520	0.652	0.801	0.973	1.208	*****	*****
0.80	0.50	0.417	0.528	0.655	*****	*****	*****	*****	0.681	0.842	1.029	*****	*****	*****	*****
0.80	0.60	0.520	*****	*****	*****	*****	*****	*****	0.846	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.100	0.133	0.182	0.0	0.0	0.0	0.126	0.166	0.223	0.305
0.70	0.20	0.0	0.0	0.138	0.182	0.241	0.323	0.435	0.136	0.178	0.235	0.310	0.409	0.539	0.708
0.70	0.30	0.136	0.178	0.235	0.310	0.409	0.539	0.708	0.231	0.307	0.406	0.530	0.685	0.879	1.147
0.70	0.40	0.197	0.261	0.346	0.454	0.591	*****	*****	0.344	0.458	0.598	0.768	0.974	*****	*****
0.70	0.50	0.267	0.355	0.468	*****	*****	*****	*****	0.472	0.623	0.803	*****	*****	*****	*****
0.70	0.60	0.344	*****	*****	*****	*****	*****	*****	0.612	*****	*****	*****	*****	*****	*****

TABLE 18

WEB AREA / FLANGE AREA = 1.75

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.118	0.0	0.0	0.0	0.0	0.114	0.142	0.198
0.60	0.20	0.0	0.0	0.0	0.123	0.157	0.215	0.304	0.0	0.0	0.157	0.209	0.284	0.393	0.549
0.60	0.30	0.0	0.124	0.157	0.209	0.284	0.393	0.549	0.157	0.209	0.281	0.382	0.520	0.704	0.951
0.60	0.40	0.135	0.177	0.236	0.320	0.437	*****	*****	0.235	0.320	0.435	0.588	0.786	*****	*****
0.60	0.50	0.181	0.243	0.330	*****	*****	*****	*****	0.328	0.451	0.612	*****	*****	*****	*****
0.60	0.60	0.235	*****	*****	*****	*****	*****	*****	0.436	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.177
0.50	0.20	0.0	0.0	0.0	0.0	0.152	0.188	0.236	0.0	0.0	0.0	0.185	0.227	0.282	0.412
0.50	0.30	0.0	0.0	0.0	0.185	0.227	0.282	0.412	0.0	0.186	0.227	0.278	0.386	0.549	0.783
0.50	0.40	0.0	0.165	0.202	0.247	0.318	*****	*****	0.202	0.248	0.317	0.442	0.620	*****	*****
0.50	0.50	0.164	0.207	0.253	*****	*****	*****	*****	0.253	0.329	0.459	*****	*****	*****	*****
0.50	0.60	0.202	*****	*****	*****	*****	*****	*****	0.317	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.177
0.40	0.20	0.0	0.0	0.0	0.0	0.152	0.188	0.236	0.0	0.0	0.0	0.185	0.227	0.281	0.354
0.40	0.30	0.0	0.0	0.0	0.185	0.227	0.281	0.354	0.0	0.0	0.227	0.278	0.341	0.422	0.630
0.40	0.40	0.0	0.165	0.202	0.247	0.303	*****	*****	0.202	0.248	0.303	0.370	0.480	*****	*****
0.40	0.50	0.168	0.207	0.253	*****	*****	*****	*****	0.253	0.310	0.379	*****	*****	*****	*****
0.40	0.60	0.202	*****	*****	*****	*****	*****	*****	0.303	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.177
0.0	0.20	0.0	0.0	0.0	0.0	0.152	0.188	0.236	0.0	0.0	0.0	0.185	0.227	0.281	0.354
0.0	0.30	0.0	0.0	0.0	0.185	0.227	0.281	0.354	0.0	0.0	0.227	0.278	0.341	0.422	0.530
0.0	0.40	0.0	0.165	0.202	0.247	0.303	*****	*****	0.202	0.248	0.303	0.370	0.455	*****	*****
0.0	0.50	0.168	0.207	0.253	*****	*****	*****	*****	0.253	0.310	0.379	*****	*****	*****	*****
0.0	0.60	0.202	*****	*****	*****	*****	*****	*****	0.303	*****	*****	*****	*****	*****	*****

TABLE 19

WEB AREA / FLANGE AREA = 1.75

M/MP V/VP	HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
	HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00 0.0	0.175	0.197	0.219	0.241	0.262	0.284	0.306	0.175	0.197	0.219	0.241	0.262	0.284	0.306
1.00 0.10	0.528	0.575	0.628	0.688	0.760	0.847	0.957	0.668	0.728	0.798	0.879	0.977	1.108	1.278
1.00 0.20	0.801	0.876	0.963	1.074	1.212	1.383	1.602	1.068	1.188	1.327	1.490	1.687	1.932	2.249
1.00 0.30	1.068	1.188	1.327	1.490	1.687	1.932	2.249	1.514	1.684	1.881	2.115	2.399	2.756	****
1.00 0.40	1.366	1.519	1.696	1.907	2.162	****	****	1.961	2.180	2.435	2.740	3.112	****	****
1.00 0.50	1.663	1.849	2.066	****	****	****	****	2.407	2.675	2.989	****	****	****	****
1.00 0.60	1.961	****	****	****	****	****	****	2.854	****	****	****	****	****	****
0.90 0.0	0.0	0.0	0.0	0.0	0.023	0.063	0.101	0.0	0.0	0.0	0.0	0.023	0.063	0.101
0.90 0.10	0.276	0.335	0.400	0.472	0.555	0.651	0.771	0.401	0.478	0.563	0.658	0.767	0.899	1.072
0.90 0.20	0.524	0.618	0.721	0.839	0.976	1.162	1.396	0.765	0.892	1.039	1.229	1.448	1.711	2.044
0.90 0.30	0.765	0.892	1.039	1.229	1.448	1.711	2.044	1.155	1.365	1.594	1.854	2.160	2.535	****
0.90 0.40	1.006	1.199	1.409	1.645	1.922	****	****	1.601	1.860	2.148	2.478	2.872	****	****
0.90 0.50	1.304	1.530	1.778	****	****	****	****	2.048	2.356	2.702	****	****	****	****
0.90 0.60	1.601	****	****	****	****	****	****	2.494	****	****	****	****	****	****
0.80 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80 0.10	0.139	0.180	0.232	0.297	0.376	0.473	0.594	0.224	0.290	0.368	0.462	0.574	0.711	0.882
0.80 0.20	0.318	0.406	0.510	0.631	0.774	0.948	1.191	0.520	0.652	0.801	0.973	1.208	1.490	1.839
0.80 0.30	0.520	0.652	0.801	0.973	1.208	1.490	1.839	0.846	1.045	1.306	1.592	1.920	2.314	****
0.80 0.40	0.736	0.906	1.121	1.384	1.683	****	****	1.242	1.541	1.860	2.217	2.633	****	****
0.80 0.50	0.958	1.210	1.491	****	****	****	****	1.689	2.036	2.414	****	****	****	****
0.80 0.60	1.242	****	****	****	****	****	****	2.135	****	****	****	****	****	****
0.70 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70 0.10	0.0	0.0	0.138	0.182	0.241	0.323	0.435	0.0	0.178	0.235	0.310	0.409	0.539	0.708
0.70 0.20	0.197	0.261	0.346	0.454	0.591	0.764	0.987	0.344	0.458	0.598	0.768	0.974	1.269	1.633
0.70 0.30	0.344	0.458	0.598	0.768	0.974	1.269	1.633	0.612	0.798	1.019	1.331	1.681	2.093	****
0.70 0.40	0.518	0.681	0.873	1.123	1.443	****	****	0.917	1.221	1.573	1.956	2.393	****	****
0.70 0.50	0.711	0.919	1.203	****	****	****	****	1.329	1.717	2.127	****	****	****	****
0.70 0.60	0.917	****	****	****	****	****	****	1.776	****	****	****	****	****	****

TABLE 20

WEB AREA / FLANGE AREA = 1.75

M/MP V/VP	HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
	HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60 0.10	0.0	0.0	0.0	0.123	0.157	0.215	0.304	0.0	0.0	0.157	0.209	0.284	0.393	0.549
0.60 0.20	0.0	0.177	0.236	0.320	0.437	0.597	0.814	0.235	0.320	0.435	0.588	0.786	1.048	1.428
0.60 0.30	0.235	0.320	0.435	0.588	0.786	1.048	1.428	0.436	0.599	0.804	1.070	1.441	1.871	****
0.60 0.40	0.363	0.499	0.674	0.894	1.204	****	****	0.690	0.931	1.285	1.694	2.153	****	****
0.60 0.50	0.516	0.705	0.938	****	****	****	****	0.979	1.398	1.839	****	****	****	****
0.60 0.60	0.690	****	****	****	****	****	****	1.416	****	****	****	****	****	****
0.50 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50 0.10	0.0	0.0	0.0	0.0	0.0	0.188	0.236	0.0	0.0	0.0	0.185	0.227	0.282	0.412
0.50 0.20	0.0	0.0	0.202	0.247	0.318	0.453	0.654	0.202	0.248	0.317	0.442	0.620	0.862	1.223
0.50 0.30	0.202	0.248	0.317	0.442	0.620	0.862	1.223	0.317	0.446	0.624	0.859	1.201	1.650	****
0.50 0.40	0.269	0.366	0.512	0.711	0.972	****	****	0.514	0.727	0.998	1.433	1.914	****	****
0.50 0.50	0.377	0.533	0.743	****	****	****	****	0.758	1.078	1.552	****	****	****	****
0.50 0.60	0.514	****	****	****	****	****	****	1.057	****	****	****	****	****	****
0.40 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40 0.10	0.0	0.0	0.0	0.0	0.0	0.188	0.236	0.0	0.0	0.0	0.0	0.227	0.281	0.354
0.40 0.20	0.0	0.0	0.202	0.247	0.303	0.375	0.512	0.0	0.248	0.303	0.370	0.480	0.699	1.017
0.40 0.30	0.0	0.248	0.303	0.370	0.480	0.699	1.017	0.303	0.372	0.480	0.687	0.971	1.429	****
0.40 0.40	0.269	0.331	0.404	0.557	0.797	****	****	0.404	0.562	0.806	1.172	1.674	****	****
0.40 0.50	0.337	0.413	0.580	****	****	****	****	0.583	0.846	1.264	****	****	****	****
0.40 0.60	0.404	****	****	****	****	****	****	0.820	****	****	****	****	****	****
0.0 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0 0.10	0.0	0.0	0.0	0.0	0.0	0.188	0.236	0.0	0.0	0.0	0.0	0.227	0.281	0.354
0.0 0.20	0.0	0.0	0.202	0.247	0.303	0.375	0.472	0.0	0.248	0.303	0.370	0.455	0.563	0.707
0.0 0.30	0.0	0.248	0.303	0.370	0.455	0.563	0.707	0.303	0.372	0.455	0.556	0.682	0.844	****
0.0 0.40	0.269	0.331	0.404	0.494	0.606	****	****	0.404	0.496	0.606	0.741	0.909	****	****
0.0 0.50	0.337	0.413	0.505	****	****	****	****	0.505	0.620	0.758	****	****	****	****
0.0 0.60	0.404	****	****	****	****	****	****	0.606	****	****	****	****	****	****

TABLE 21

WEB AREA / FLANGE AREA = 2.00

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.200	0.225	0.250	0.275	0.300	0.325	0.350	0.200	0.225	0.250	0.275	0.300	0.325	0.350
1.00	0.10	0.420	0.467	0.508	0.555	0.607	0.668	0.743	0.519	0.565	0.615	0.673	0.740	0.820	0.921
1.00	0.20	0.603	0.657	0.717	0.787	0.868	0.968	1.102	0.763	0.832	0.912	1.006	1.131	1.284	1.479
1.00	0.30	0.763	0.832	0.912	1.006	1.131	1.284	1.479	0.990	1.098	1.224	1.371	1.547	1.764	2.043
1.00	0.40	0.915	1.001	1.116	1.249	1.409	*****	*****	1.251	1.389	1.549	1.737	1.963	*****	*****
1.00	0.50	1.076	1.195	1.333	*****	*****	*****	*****	1.513	1.681	1.874	*****	*****	*****	*****
1.00	0.60	1.251	*****	*****	*****	*****	*****	*****	1.776	*****	*****	*****	*****	*****	*****
0.90	0.0	0.0	0.0	0.0	0.002	0.050	0.094	0.136	0.0	0.0	0.0	0.002	0.050	0.094	0.136
0.90	0.10	0.182	0.228	0.279	0.335	0.397	0.468	0.552	0.260	0.318	0.381	0.450	0.528	0.618	0.728
0.90	0.20	0.335	0.404	0.478	0.560	0.653	0.763	0.899	0.481	0.569	0.665	0.773	0.897	1.054	1.264
0.90	0.30	0.481	0.569	0.665	0.773	0.897	1.054	1.264	0.693	0.809	0.937	1.099	1.297	1.533	1.829
0.90	0.40	0.623	0.730	0.847	0.980	1.159	*****	*****	0.902	1.056	1.249	1.464	1.713	*****	*****
0.90	0.50	0.763	0.888	1.033	*****	*****	*****	*****	1.138	1.347	1.574	*****	*****	*****	*****
0.90	0.60	0.902	*****	*****	*****	*****	*****	*****	1.401	*****	*****	*****	*****	*****	*****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.0	0.0	0.138	0.179	0.231	0.296	0.378	0.128	0.166	0.214	0.273	0.346	0.436	0.547
0.80	0.20	0.177	0.229	0.292	0.369	0.462	0.574	0.713	0.283	0.362	0.455	0.564	0.693	0.848	1.050
0.80	0.30	0.283	0.362	0.455	0.564	0.693	0.848	1.050	0.455	0.572	0.706	0.859	1.047	1.303	1.615
0.80	0.40	0.397	0.501	0.622	0.760	0.924	*****	*****	0.638	0.790	0.960	1.191	1.463	*****	*****
0.80	0.50	0.516	0.644	0.790	*****	*****	*****	*****	0.827	1.014	1.274	*****	*****	*****	*****
0.80	0.60	0.638	*****	*****	*****	*****	*****	*****	1.026	*****	*****	*****	*****	*****	*****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.0	0.0	0.132	0.176	0.239	0.0	0.0	0.0	0.164	0.216	0.289	0.388
0.70	0.20	0.0	0.138	0.179	0.235	0.310	0.410	0.542	0.174	0.229	0.301	0.394	0.513	0.664	0.860
0.70	0.30	0.174	0.229	0.301	0.394	0.513	0.664	0.860	0.296	0.391	0.511	0.658	0.837	1.072	1.400
0.70	0.40	0.253	0.334	0.438	0.568	0.728	*****	*****	0.438	0.575	0.740	0.937	1.213	*****	*****
0.70	0.50	0.341	0.451	0.586	*****	*****	*****	*****	0.595	0.773	0.980	*****	*****	*****	*****
0.70	0.60	0.438	*****	*****	*****	*****	*****	*****	0.764	*****	*****	*****	*****	*****	*****

TABLE 22

WEB AREA / FLANGE AREA = 2.00

		HOLE LENGTH / HEIGHT = 1.0							HOLE LENGTH / HEIGHT = 1.5						
		HOLE HEIGHT / BEAM DEPTH							HOLE HEIGHT / BEAM DEPTH						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.0	0.0	0.109	0.149	0.0	0.0	0.0	0.0	0.140	0.189	0.263
0.60	0.20	0.0	0.0	0.0	0.156	0.207	0.283	0.395	0.0	0.156	0.205	0.273	0.369	0.503	0.688
0.60	0.30	0.0	0.156	0.205	0.273	0.369	0.503	0.688	0.203	0.271	0.364	0.490	0.656	0.872	1.186
0.60	0.40	0.173	0.230	0.307	0.413	0.556	*****	*****	0.305	0.413	0.556	0.740	0.971	*****	*****
0.60	0.50	0.235	0.316	0.425	*****	*****	*****	*****	0.424	0.577	0.771	*****	*****	*****	*****
0.60	0.60	0.305	*****	*****	*****	*****	*****	*****	0.561	*****	*****	*****	*****	*****	*****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.135	0.0	0.0	0.0	0.0	0.0	0.161	0.202
0.50	0.20	0.0	0.0	0.0	0.0	0.173	0.214	0.282	0.0	0.0	0.173	0.212	0.265	0.372	0.535
0.50	0.30	0.0	0.0	0.173	0.212	0.265	0.372	0.535	0.0	0.213	0.265	0.362	0.503	0.702	0.977
0.50	0.40	0.0	0.189	0.231	0.301	0.417	*****	*****	0.231	0.302	0.415	0.573	0.788	*****	*****
0.50	0.50	0.192	0.236	0.311	*****	*****	*****	*****	0.311	0.430	0.595	*****	*****	*****	*****
0.50	0.60	0.231	*****	*****	*****	*****	*****	*****	0.415	*****	*****	*****	*****	*****	*****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.202
0.40	0.20	0.0	0.0	0.0	0.0	0.173	0.214	0.269	0.0	0.0	0.0	0.212	0.260	0.322	0.407
0.40	0.30	0.0	0.0	0.0	0.212	0.260	0.322	0.407	0.0	0.213	0.260	0.318	0.390	0.553	0.809
0.40	0.40	0.0	0.189	0.231	0.282	0.346	*****	*****	0.231	0.283	0.346	0.441	0.627	*****	*****
0.40	0.50	0.192	0.236	0.289	*****	*****	*****	*****	0.289	0.354	0.458	*****	*****	*****	*****
0.40	0.60	0.231	*****	*****	*****	*****	*****	*****	0.346	*****	*****	*****	*****	*****	*****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.202
0.0	0.20	0.0	0.0	0.0	0.0	0.173	0.214	0.269	0.0	0.0	0.0	0.212	0.260	0.322	0.404
0.0	0.30	0.0	0.0	0.0	0.212	0.260	0.322	0.404	0.0	0.0	0.260	0.318	0.390	0.483	0.606
0.0	0.40	0.0	0.189	0.231	0.282	0.346	*****	*****	0.231	0.283	0.346	0.423	0.520	*****	*****
0.0	0.50	0.192	0.236	0.289	*****	*****	*****	*****	0.289	0.354	0.433	*****	*****	*****	*****
0.0	0.60	0.231	*****	*****	*****	*****	*****	*****	0.346	*****	*****	*****	*****	*****	*****

TABLE 23

WEB AREA / FLANGE AREA = 2.00

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		----- HOLE HEIGHT / BEAM DEPTH -----							----- HOLE HEIGHT / BEAM DEPTH -----						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
1.00	0.0	0.200	0.225	0.250	0.275	0.300	0.325	0.350	0.200	0.225	0.250	0.275	0.300	0.325	0.350
1.00	0.10	0.603	0.657	0.717	0.787	0.868	0.968	1.102	0.763	0.832	0.912	1.006	1.131	1.284	1.479
1.00	0.20	0.915	1.001	1.116	1.249	1.409	1.604	1.855	1.251	1.389	1.549	1.737	1.963	2.244	2.607
1.00	0.30	1.251	1.389	1.549	1.737	1.963	2.244	2.607	1.776	1.972	2.199	2.467	2.794	3.203	****
1.00	0.40	1.601	1.778	1.982	2.224	2.517	****	****	2.302	2.554	2.848	3.198	****	****	****
1.00	0.50	1.951	2.166	2.415	****	****	****	****	2.927	3.136	3.498	****	****	****	****
1.00	0.60	2.302	****	****	****	****	****	****	3.352	****	****	****	****	****	****
0.90	0.0	0.0	0.0	0.0	0.002	0.050	0.094	0.136	0.0	0.0	0.0	0.002	0.050	0.094	0.136
0.90	0.10	0.335	0.404	0.478	0.560	0.653	0.763	0.899	0.481	0.569	0.665	0.773	0.897	1.054	1.264
0.90	0.20	0.623	0.730	0.847	0.980	1.159	1.373	1.641	0.902	1.056	1.249	1.464	1.713	2.013	2.393
0.90	0.30	0.902	1.056	1.249	1.464	1.713	2.013	2.393	1.401	1.638	1.899	2.195	2.544	2.973	****
0.90	0.40	1.226	1.444	1.682	1.951	2.267	****	****	1.927	2.220	2.548	2.926	****	****	****
0.90	0.50	1.576	1.832	2.115	****	****	****	****	2.452	2.803	3.198	****	****	****	****
0.90	0.60	1.927	****	****	****	****	****	****	2.977	****	****	****	****	****	****
0.80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.80	0.10	0.177	0.229	0.292	0.369	0.462	0.574	0.713	0.283	0.362	0.455	0.564	0.693	0.848	1.050
0.80	0.20	0.397	0.501	0.622	0.760	0.924	1.143	1.426	0.638	0.790	0.960	1.191	1.463	1.782	2.179
0.80	0.30	0.638	0.790	0.960	1.191	1.463	1.782	2.179	1.026	1.305	1.599	1.922	2.294	2.742	****
0.80	0.40	0.891	1.111	1.382	1.678	2.017	****	****	1.552	1.887	2.248	2.653	****	****	****
0.80	0.50	1.201	1.499	1.815	****	****	****	****	2.077	2.469	2.898	****	****	****	****
0.80	0.60	1.552	****	****	****	****	****	****	2.602	****	****	****	****	****	****
0.70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.70	0.10	0.0	0.0	0.179	0.235	0.310	0.410	0.542	0.174	0.229	0.301	0.394	0.513	0.664	0.860
0.70	0.20	0.253	0.334	0.438	0.568	0.728	0.927	1.212	0.438	0.575	0.740	0.937	1.213	1.552	1.965
0.70	0.30	0.438	0.575	0.740	0.937	1.213	1.552	1.965	0.764	0.979	1.299	1.649	2.044	2.511	****
0.70	0.40	0.650	0.841	1.082	1.406	1.767	****	****	1.177	1.554	1.948	2.380	****	****	****
0.70	0.50	0.881	1.166	1.515	****	****	****	****	1.702	2.136	2.598	****	****	****	****
0.70	0.60	1.177	****	****	****	****	****	****	2.227	****	****	****	****	****	****

TABLE 24

WEB AREA / FLANGE AREA = 2.00

		HOLE LENGTH / HEIGHT = 2.0							HOLE LENGTH / HEIGHT = 3.0						
		----- HOLE HEIGHT / BEAM DEPTH -----							----- HOLE HEIGHT / BEAM DEPTH -----						
M/MP	V/VP	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.40	0.45	0.50	0.55	0.60	0.65	0.70
0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.60	0.10	0.0	0.0	0.0	0.156	0.207	0.283	0.395	0.0	0.156	0.205	0.273	0.369	0.503	0.688
0.60	0.20	0.173	0.230	0.307	0.413	0.556	0.746	0.998	0.305	0.413	0.556	0.740	0.971	1.321	1.750
0.60	0.30	0.305	0.413	0.556	0.746	0.971	1.321	1.750	0.561	0.758	0.999	1.377	1.794	2.280	****
0.60	0.40	0.468	0.636	0.845	1.133	1.517	****	****	0.872	1.220	1.648	2.107	****	****	****
0.60	0.50	0.660	0.886	1.215	****	****	****	****	1.327	1.803	2.298	****	****	****	****
0.60	0.60	0.872	****	****	****	****	****	****	1.852	****	****	****	****	****	****
0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.50	0.10	0.0	0.0	0.0	0.0	0.173	0.214	0.282	0.0	0.0	0.0	0.212	0.265	0.372	0.535
0.50	0.20	0.0	0.189	0.231	0.301	0.417	0.585	0.825	0.231	0.302	0.415	0.573	0.788	1.090	1.536
0.50	0.30	0.231	0.302	0.415	0.573	0.788	1.090	1.536	0.415	0.579	0.798	1.104	1.544	2.049	****
0.50	0.40	0.344	0.477	0.660	0.900	1.267	****	****	0.668	0.927	1.348	1.835	****	****	****
0.50	0.50	0.493	0.688	0.942	****	****	****	****	0.970	1.469	1.998	****	****	****	****
0.50	0.60	0.668	****	****	****	****	****	****	1.477	****	****	****	****	****	****
0.40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.40	0.10	0.0	0.0	0.0	0.0	0.0	0.214	0.269	0.0	0.0	0.0	0.212	0.260	0.322	0.407
0.40	0.20	0.0	0.0	0.231	0.282	0.346	0.451	0.667	0.0	0.283	0.346	0.441	0.627	0.893	1.322
0.40	0.30	0.231	0.283	0.346	0.441	0.627	0.893	1.322	0.346	0.444	0.629	0.884	1.294	1.819	****
0.40	0.40	0.308	0.378	0.512	0.724	1.017	****	****	0.513	0.735	1.048	1.562	****	****	****
0.40	0.50	0.385	0.533	0.755	****	****	****	****	0.764	1.136	1.698	****	****	****	****
0.40	0.60	0.513	****	****	****	****	****	****	1.102	****	****	****	****	****	****
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10	0.0	0.0	0.0	0.0	0.0	0.214	0.269	0.0	0.0	0.0	0.0	0.260	0.322	0.404
0.0	0.20	0.0	0.0	0.231	0.282	0.346	0.429	0.539	0.0	0.283	0.346	0.423	0.520	0.643	0.808
0.0	0.30	0.0	0.283	0.346	0.423	0.520	0.643	0.808	0.346	0.425	0.520	0.635	0.779	0.965	****
0.0	0.40	0.308	0.378	0.462	0.565	0.693	****	****	0.462	0.567	0.693	0.847	****	****	****
0.0	0.50	0.385	0.472	0.577	****	****	****	****	0.577	0.709	0.866	****	****	****	****
0.0	0.60	0.462	****	****	****	****	****	****	0.693	****	****	****	****	****	****