Cálculo de suporte tipo Sapata de Vaso de pressão
Fonte: Pressure Vessel Design Manual

PROCEDURE 3-13

DESIGN OF LUG SUPPORTS

Notation

Q = vertical load per lug, lb
Q_a = axial load on gusset, lb
Q_b = bending load on gusset, lb
n = number of gussets per lug
F_a = allowable axial stress, psi
F_b = allowable bending stress, psi
f_a = axial stress, psi
f_b = bending stress, psi
A = cross-sectional area of assumed column, in.^{2}
Z = section modulus, in.^{3}
w = uniform load on base plate, lb/in.
I = moment of inertia of compression plate, in.^{4}
E_v = modulus of elasticity of vessel shell at design temperature, psi
E_s = modulus of elasticity of compression plate at design temperature, psi
e = log base 2.71
M_b = bending moment, in.-lb
M_x = internal bending moment in compression plate, in.-lb
K = spring constant or foundation modulus
β = damping factor

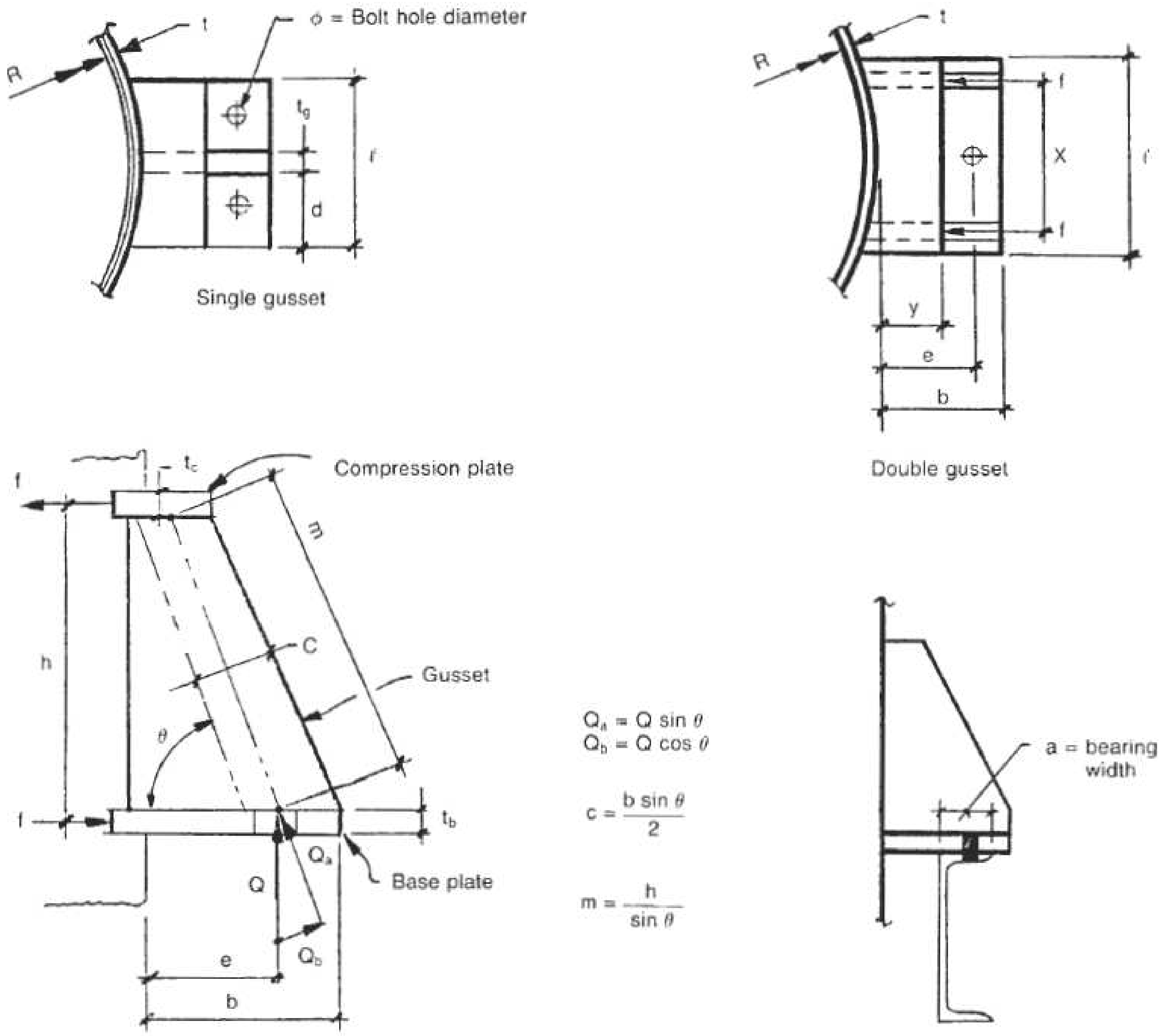

Figure 3-64. Dimensions and forces on a lug support.

Design of Gussets

Assume gusset thickness from Table 3-31.

$$Q_a = Q \sin\theta$$

$$Q_b = Q \cos\theta$$

$$C = \frac{b \sin\theta}{2}$$

$$A = t_g C$$

$$F_a = 0.4F_y$$

$$F_b = 0.6F_y$$

$$Z = \frac{t_g C^2}{6}$$

$$M_b = \frac{Q_b m}{n}$$

$$f_a = \frac{Q_a}{nA}$$

$$f_b = \frac{M_b}{Z}$$

Table 3-31
Standard Lug Dimensions

Type	e	b	y	x	h	$t_g = t_b$	Capacity (b)
1	4	6	2	6	6	3/8	23,500
2	4	6	2	6	9	7/16	45,000
3	4	6	2	6	12	1/2	45,000
4	5	7	2.5	7	15	9/16	70,000
5	5	7	2.5	7	18	5/8	70,000
6	5	7	2.5	7	21	11/16	70,000
7	6	8	3	8	24	3/4	100,000

Design of Base Plate

Single Gusset

- *Bending.* Assume to be a simply supported beam.

$$M_b = \frac{Ql}{4}$$

- *Bearing.*

$$w = \frac{Q}{al}$$

$$M_b = \frac{wd^2}{2}$$

- *Thickness required base plate.*

$$t_b = \sqrt{\frac{6M_b}{(b - \phi)F_b}}$$

where M_b is greater moment from bending or bearing.

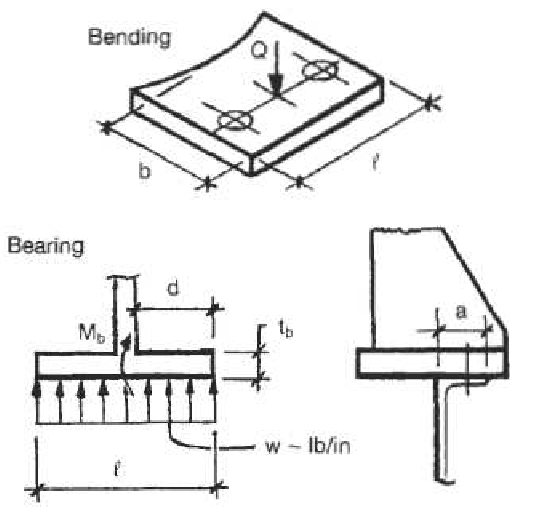

Figure 3-65. Loading diagram of base plate with one gusset.

Double Gusset

- *Bending.* Assume to be between simply supported and fixed.

$$M_b = \frac{Ql}{6}$$

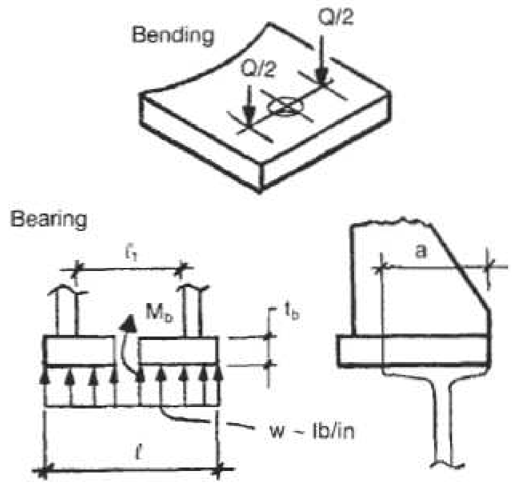

Figure 3-66. Loading diagram of base plate with two gussets.

- *Bearing.*

$$w = \frac{Q}{al}$$

$$M_b = \frac{wl_1^2}{10}$$

- *Thickness required base plate.*

$$t_b = \sqrt{\frac{6M_b}{(b - \phi)F_b}}$$

where M_b is greater moment from bending or bearing.

Compression Plate

Single Gusset

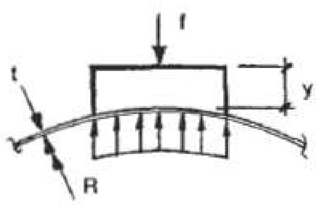

Figure 3-67. Loading diagram of compression plate with one gusset.

$$f = \frac{Qe}{h}$$

$$K = \frac{E_y t}{R^2}$$

Assume thickness t_c and calculate I and Z:

$$I = \frac{t_c y^3}{12}$$

$$Z = \frac{t_c y^2}{6}$$

$$\beta = \sqrt[4]{\frac{K}{4E_s I}}$$

$$M_x = \frac{f}{4\beta}$$

$$f_b = \frac{M_x}{Z} \quad < 0.6F_y$$

Note: These calculations are based on a beam on elastic foundation methods.

Double Gusset

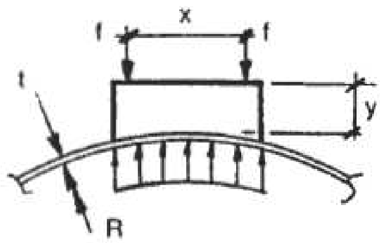

Figure 3-68. Loading diagram of compression plate with two gussets.

$$f = \frac{Qe}{2h}$$

$$K = \frac{E_v t}{R^2}$$

$$I = \frac{t_c y^3}{12}$$

$$Z = \frac{t_c y^2}{6}$$

$$\beta = \sqrt[4]{\frac{K}{4E_s I}}$$

$$M_x = \frac{f}{4\beta}[1 + (e^{-\beta x}(\cos \beta x - \sin \beta x))]$$

βx is in radians. See Procedure 5-2.

$$f_b = \frac{M_x}{Z} < 0.6F_y$$