9 (cont)

b) bolt shear strength

$$\frac{R_n}{\Omega} = 6(14.4) = \underline{86.4^k}$$

bearing & tearout

$$\frac{R_n}{\Omega} = \frac{1}{2}\left(2(27.2) + 4(60.9)\right) = \underline{149^k}$$

Bolt shear still controls

$$\frac{R_n}{\Omega} = 86.4^k$$

10. a) Bolt shear

$$\phi R_n = 4(27.0) = \underline{108^k}$$

Bearing & tearout

$$L_c = 1.5 - \frac{1}{2}\left(\frac{7}{8} + \frac{1}{16}\right) = 1.03 \text{ in.} < 2\left(\frac{7}{8}\right) = 1.75 \text{ in.}$$

Tearout $\quad 1.2(1.03)\left(\frac{3}{4}\right)(58) = 53.8^k$

Bearing $\quad 2.4\left(\frac{7}{8}\right)\left(\frac{3}{4}\right)(58) = 91.4^k$

$$\phi R_n = 0.75\left(53.8 + 3(91.4)\right) = \underline{246^k}$$

Shear w bolt controls

$$\phi R_n = \underline{108^k}$$

10 (cont.)

b) bolt shear

$$\frac{R_n}{\Omega} = 4(18.0) = \underline{72^k}$$

Bearing + Tearout

$$\frac{R_n}{\Omega} = \frac{1}{2}\left(53.8 + 3(91.4)\right) = \underline{164^k}$$

Bolt shear controls

$$\frac{R_n}{\Omega} = \underline{\underline{72.0^k}}$$

11. a) The change from prob 10 is to 8 bolts

bolt shear $= 4(33.8) = \underline{\underline{135^k}}$

This still controls

b) For ASD

bolt shear $= 4(22.5) = \underline{\underline{90.0^k}}$

This still controls

12.

a) Bolt shear.

6 bolts in double shear - 3/4 in. A325-N

$\phi R_n = 6\left(2(15.4)\right) = \underline{191^k}$

BEARING & TEAROUT

The two 1/2 in. plates are the same as one 1in. plate

$L_c = 1.25 - \frac{1}{2}\left(\frac{3}{4} + \frac{1}{16}\right) = 0.844\text{in} < 2d$

END BOLTS

$1.2(0.844)(1.0)(58) = 58.7^k$

INTERIOR BOLTS

$2.4\left(\frac{3}{4}\right)(1.0)(58) = 104^k$

$\phi R_n = 0.75\left(2(58.7) + 4(104)\right) = \underline{400^k}$

Bolt shear controls. $\phi R_n = \underline{191^k}$

b) Bolt shear

$\frac{R_n}{\Omega} = 6\left(2(10.6)\right) = \underline{127^k}$

Bearing & tearout

$\frac{R_n}{\Omega} = \frac{1}{2}\left(2(58.7) + 4(104)\right| = \underline{267^k}$

Bolt shear controls $\frac{R_n}{\Omega} = \underline{127^k}$

13.

a) Bolt shear 3/4 in. A325-N

$\phi R_n = 4(15.9) = \underline{63.6^k}$

Bearing & Tearout

$L_c = 1.25 - \frac{1}{2}\left(\frac{3}{4} + \frac{1}{16}\right) = 0.844 \text{ in.} < 2d$

$1.2(0.844)\left(\frac{1}{2}\right)(58) = 29.4^k$

$2.4\left(\frac{3}{4}\right)\left(\frac{1}{2}\right)(58) = 52.2^k$

$\phi R_n = 0.75\left(29.4 + 3(52.2)\right) = \underline{140.^k}$

Bolt shear controls $\phi R_n = \underline{\underline{63.6^k}}$

b) Bolt shear

$\frac{R_n}{\Omega} = 4(10.6) = \underline{42.4^k}$

Bearing & Tearout

$\frac{R_n}{\Omega} = \frac{1}{2}\left(29.4 + 3(52.2)\right) = \underline{93.0^k}$

Bolt shear controls $\frac{R_n}{\Omega} = \underline{\underline{42.4^k}}$

14.

a) Bolt shear 3/4 in. A325-N

$\phi R_n = 3(15.9) = \underline{47.7^k}$

Bearing & tear out

$L_c = 1.5 - \frac{1}{2}\left(\frac{3}{4} + \frac{1}{16}\right) = 1.09 \text{ in.} < 2d$

$1.2(1.09)\left(\frac{3}{8}\right)(58) = 28.4^k$

$2.4\left(\frac{3}{4}\right)\left(\frac{3}{8}\right)(58) = 39.2^k$

$\phi R_n = 0.75\left(28.4 + 2(39.2)\right) = \underline{80.1^k}$

Bolt shear controls $\phi R_n = \underline{47.7^k}$

b) Bolt shear

$\frac{R_n}{\Omega} = 3(10.6) = \underline{31.8^k}$

Bearing & tear out

$\frac{R_n}{\Omega} = \frac{1}{2}\left(28.4 + 2(39.2)\right) = \underline{53.4^k}$

Bolt shear controls $\frac{R_n}{\Omega} = \underline{31.8^k}$

15.

a) Bolt shear 3/4 in -A325-N

$\phi R_n = 6(15.9) = \underline{95.4^k}$

BEARING & Tearout

$L_c = 1.25 - \frac{1}{2}(3/4 + 1/16) = 0.844$

$1.2(0.844)(3/4)(58) = 44.1^k$

INTERIOR BOLTS

$2.4(3/4)(3/4)(58) = 78.3^k$

$\phi R_n = 0.75(2(44.1) + 4(78.3)) = \underline{301^k}$

Bolt shear controls, $\underline{\underline{\phi R_n = 95.4^k}}$

b) Bolt shear

$\frac{R_n}{\Omega} = 6(10.6) = \underline{63.6^k}$

Bearing & Tearout

$\frac{R_n}{\Omega} = \frac{1}{2}(2(44.1) + 4(78.3)) = \underline{201^k}$

Bolt shear controls $\underline{\underline{\frac{R_n}{\Omega} = 63.6^k}}$

16.

a) Bolt shear 3/4 in. A490-N

$\phi R_n = 8(19.9) = 159^k$

Bearing & Tearout WT flange thickness $t = 0.515$ in

$L_c = 1.5 - \frac{1}{2}(3/4 + 1/16) = 1.09$ in. $< 2d$

$1.2(1.09)(0.515)(65) = 43.8^k$

Interior Bolts

$2.4(3/4)(0.515)(65) = 60.3^k$

$\phi R_n = 0.75\left(2(43.8) + 6(60.3)\right) = \underline{337^k}$

Bolt shear controls $\phi R_n = \underline{\underline{159^k}}$

b) Bolt shear

$\frac{R_n}{\Omega} = 8(13.3) = \underline{106^k}$

Bearing & Tearout

$\frac{R_n}{\Omega} = \frac{1}{2}\left(2(43.8) + 6(60.3)\right) = \underline{225^k}$

Bolt shear controls $\frac{R_n}{\Omega} = \underline{\underline{106^k}}$