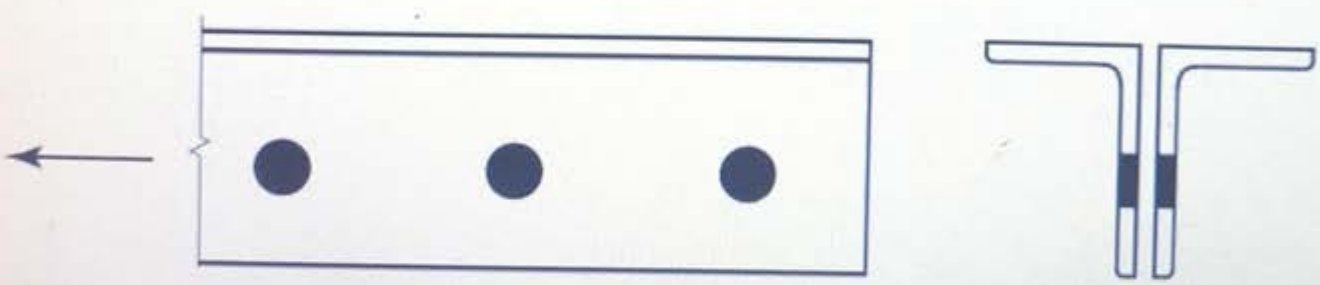
ENCE 437

Exam 1 - Problem 1

The tension member shown in the figure is 2L 3 x 2 ½ x ¼ , and is A36 steel. Member load are: service dead load of 14 kips and service live load of 34 kips. It is connected to 1-inch-thick gusset plate with ¾ -inch-diameter bolts through the long legs along a typical located gage line. Spacing and edge distance along the gage line are 2 ¼ inches. Member length is 10 ft.

Check the adequacy of the member against all design requirements.



ENCE437

Exam 1 - Question 2

Explain/Comment on the following (**Answer with no more than 3 lines**):

1- Effects of seismic load on buildings.

2- Live load factor is greater than dead load factor.

3- Ultimate/LRFD design is actually a limit states design. Why is it expressed in plural form (states)?

4- Nominal strength of member (R_n)?

5- Why are there limits on deformations of tension members?

6- Dead and live load factors in the Jordanian Code are greater than those in LRFD.

7- Yield design criterion.

8- Bolt holes are made greater than bolt diameter.

Calculations are made for one angle.

$A_2 = 1.32\ in^2$ [Table 1-7 : Page (43)]

$d_{hole} = \frac{3}{4} + \frac{1}{16} + \frac{1}{16} = \frac{7}{8}$ "

$A_n = 1.32 - (\frac{7}{8})(\frac{1}{4}) = 1.101\ in^2$

$\bar{X} = 0.653$" [Table 1-7 : page (44)]

$\ell = 2.25 + 2.25 = 4.5$" $\Rightarrow U = 1 - \frac{0.653}{4.5} = 0.855$

$A_e = 0.855\,(1.101) = 0.941\ in^2$

ϕP_n (yield) $= 0.9\,(36)(1.32) = 42.77$ kips
ϕP_n (rupture) $= 0.75\,(58)(0.941) = \underline{40.93}$ kips

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$A_{gv} = 3(2.25)(\frac{1}{4}) = 1.687\ in^2$, $A_{nv} = \left(3(2.25) - 2.5(\frac{7}{8})\right)(\frac{1}{4}) = 1.140\ in^2$

$A_{nt} = \left((3 - 1.75) - \frac{1}{2}(\frac{7}{8})\right)(\frac{1}{4}) = 0.203\ in^2$

$\phi R_n = \min \begin{cases} 0.75\,[0.6\,(58)(1.140) + (1)(58)(0.203)] = 38.58 \text{ kips} \\ 0.75\,[0.6\,(36)(1.687) + (1)(58)(0.203)] = \underline{36.17} \text{ kips} \end{cases}$

$L = 10\ ft = 120$", r_{min} (of double angle) $= 0.940$" [Table 1-15 Page (109)]

$\frac{L}{r_{min}} = \frac{120}{0.940} = 128 < 300$ ok, no servicebly problems.

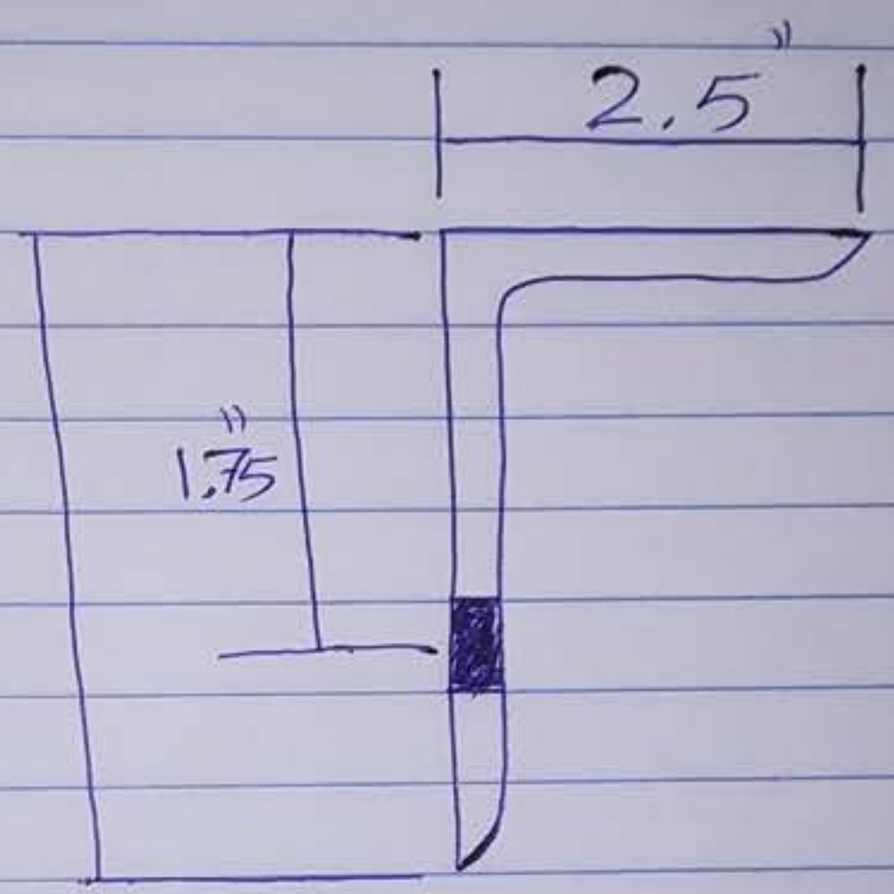
$P_u = 1.2(14) + 1.6(34) = 71.2$ kips
$\phi P_n = 2(36.17) = 72.3$ kips [For double angles]
$\phi P_n > P_u \Rightarrow$ Strength is adequate (✓)

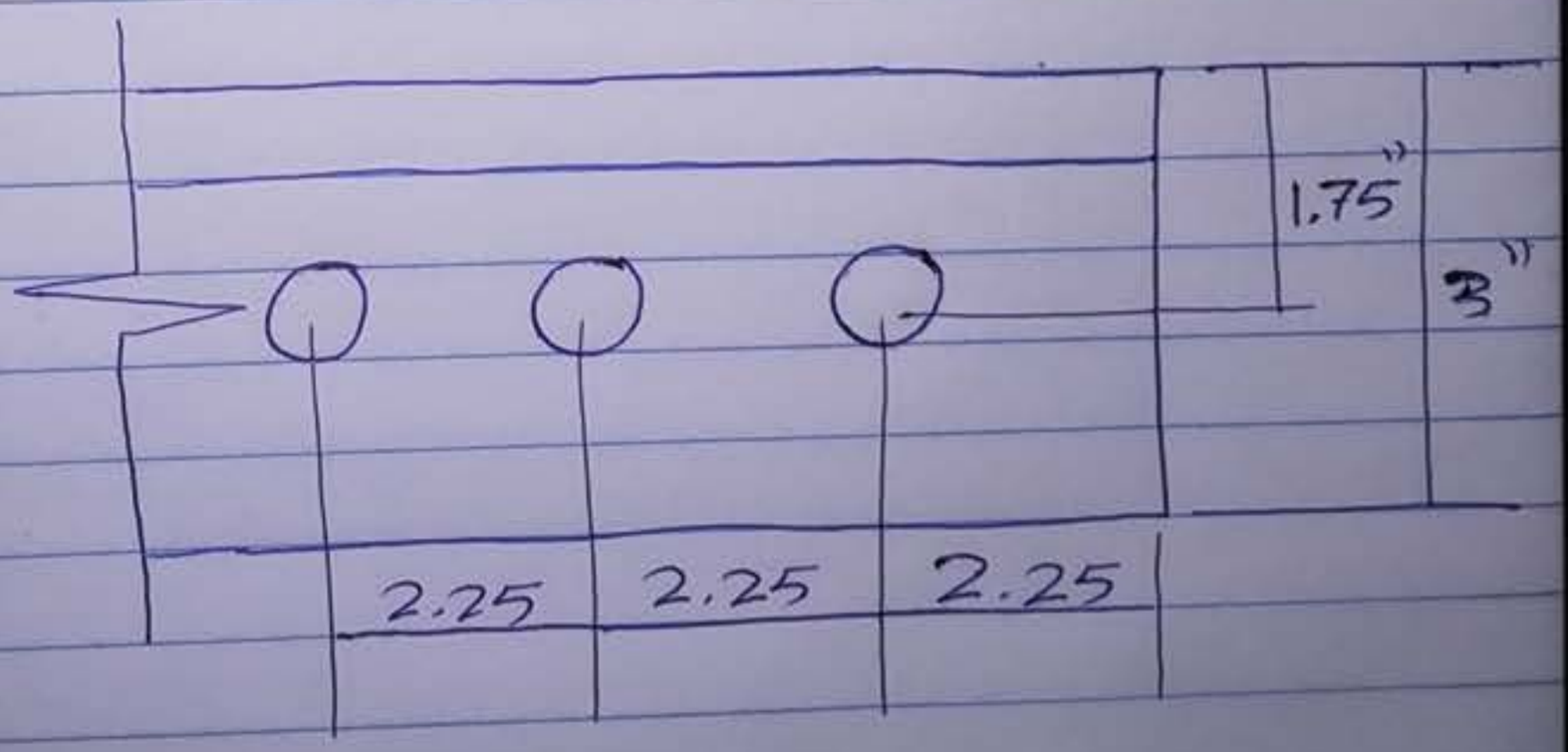
0.7

r =

: 2 (1.16 + 1.32(0)) . 2 (1.16)

1.75" is a workable gage value obtained from Figure (3.24) in the book (Page (71))





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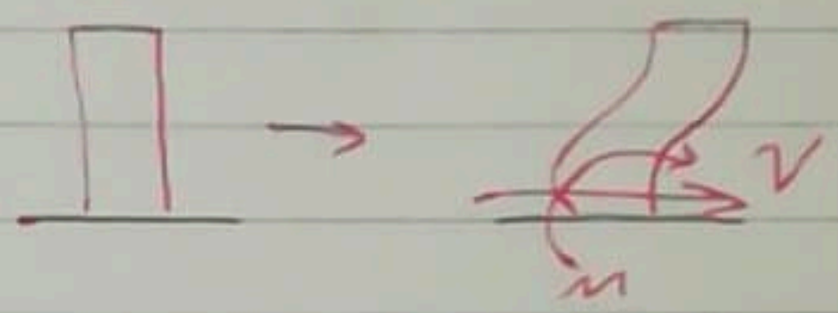
1] Seismic impact causes a structure to move at an arbitrary motion, which could be divided into Vertical forces (Small effects), & horizontal ~~effe~~ forces (significant impact). The horizontal forces force the structure to move not as a rigid body, which shifts the upper segments relative to the lower segments of the structure, and thus, the ground columns are subjected to additional shear forces.



2] Live loads possess higher uncertainty in predicting their magnitudes and location, as compared to dead loads. A higher value of load factors accounts for this uncertainty.

3] Because the (LRFD) design is based upon the evaluation of all modes of failure (states), as well as the requirements to assure proper serviceability (deflection control).

4] R_n is the expected (available) strength of the member, provided all the specifications (manufacturing, installation, geometry) are met.

5] To control & limit the shape, geometry, sagging and vibration of the structural members, since otherwise, the structure won't utilized for its original function.

6] Because in Jordan, the quality control over the materials, specifications, construction process and occupancy regulations is considered poor as compared to America's (AISC)/(LRFD).

7] Same answer as (5) exactly

8] To facilitate bolt installation within the connection. Also, to overcome misalignment of multiple plates in the connection