SIMPLE CONNECTIONS

INTRODUCTION - CHAP J

- Connections are a critical element in the design
- Failures usually occur at connections, not members themselves
- Structural engr. are responsible for all designs, details, drawings, & specifications.
  - designs → member
  - details → connections

COMMON CONNECTIONS

- RIVETS (obselete, but exist in old structures)
- Bolts (high-strength or structural bolts)
- Welds

WELDS

Advantage

- lower fab. cost
- simple design / detail
- few or no holes

Disadvantages

- Requires skilled labor
- Inspections may be necessary, difficult, costly
- heat effects

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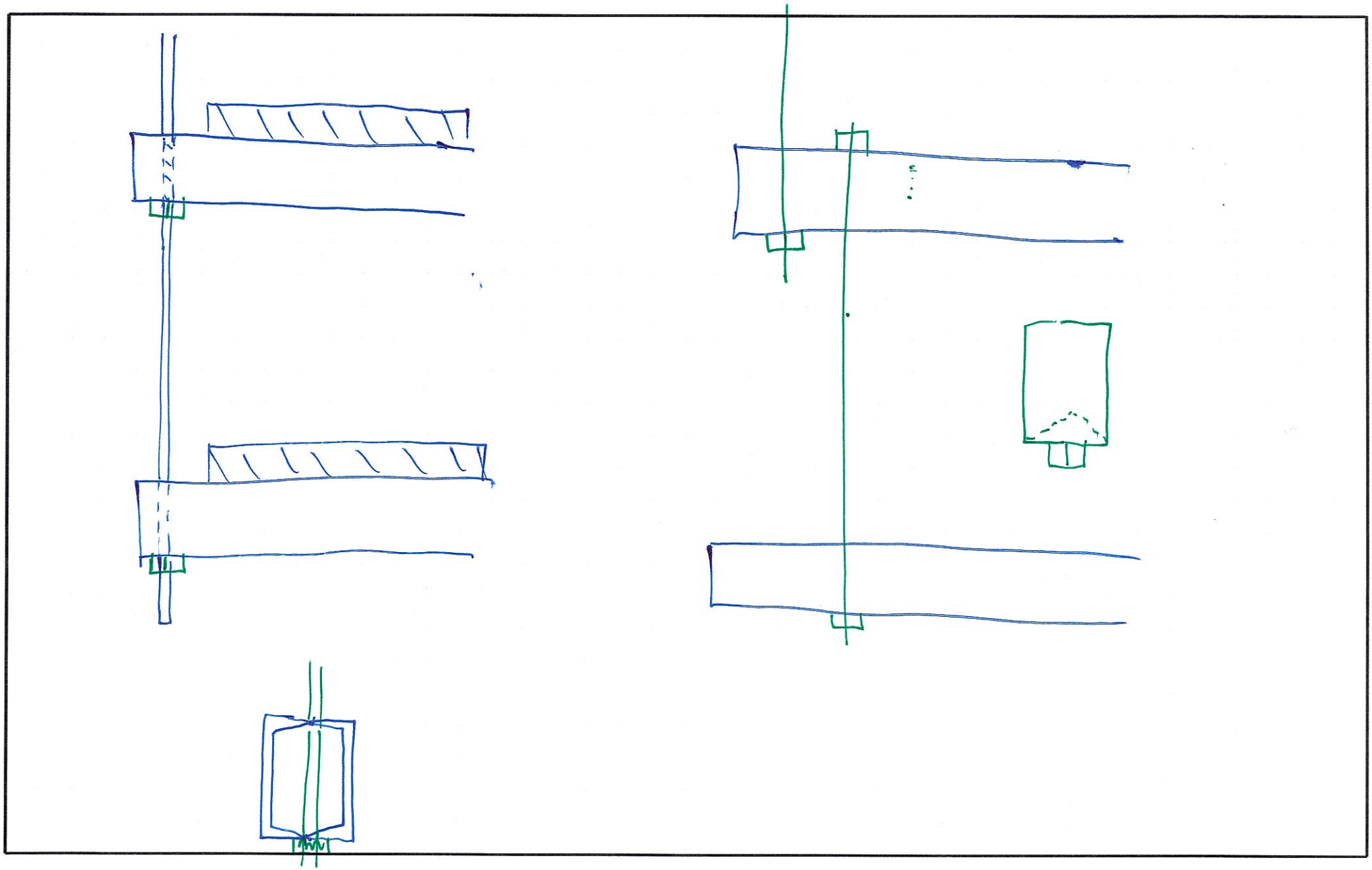

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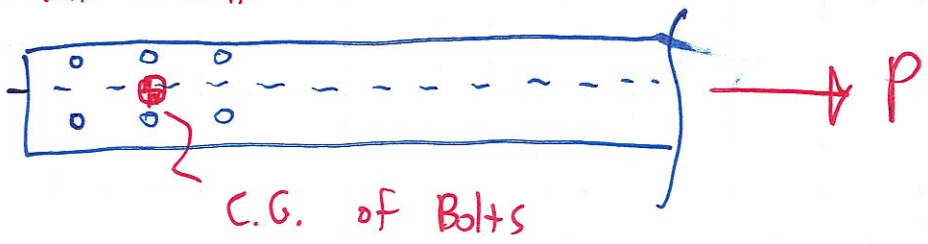
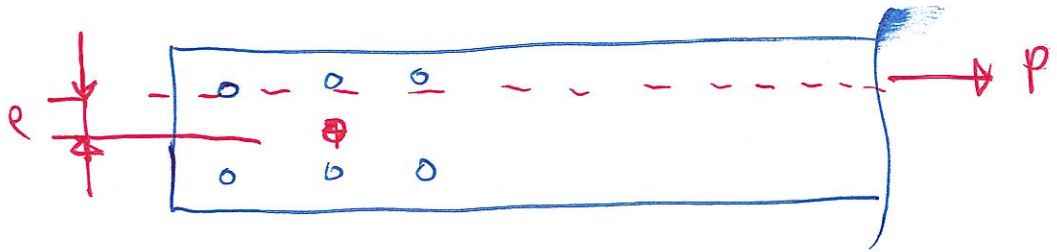
SIMPLE CONNECTIONS

- line-of-action of the resultant forces pass through the CG of the bolt group/pattern (or weld)
- Each "part" is assumed to resist an equal share of the applied load (weld or bolt)



ECCENTRIC CONNECTION

- line-of-action of resultant force does not pass through CG
- load is not equally shared by each part



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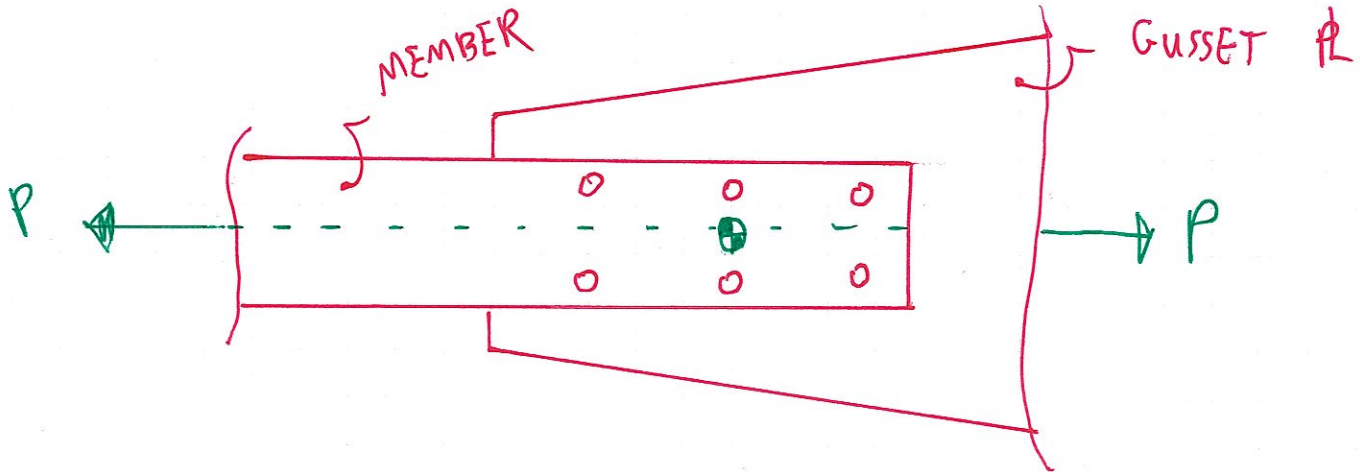
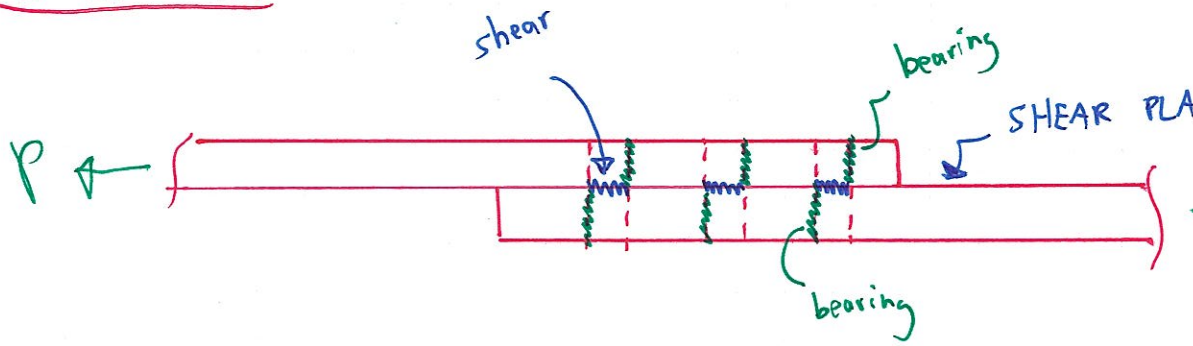
BOLTED SHEAR CONNECTION: (SIMPLE): FAILURE MODES



$$A_{bolt} = \frac{\pi}{4}(d_{bolt})^2$$

SINGLE SHEAR



$$f_v = \frac{P}{(6\ \text{bolts})(A_{bolt})} = \frac{P}{nA_{bolts}}$$

n = # bolts in shear

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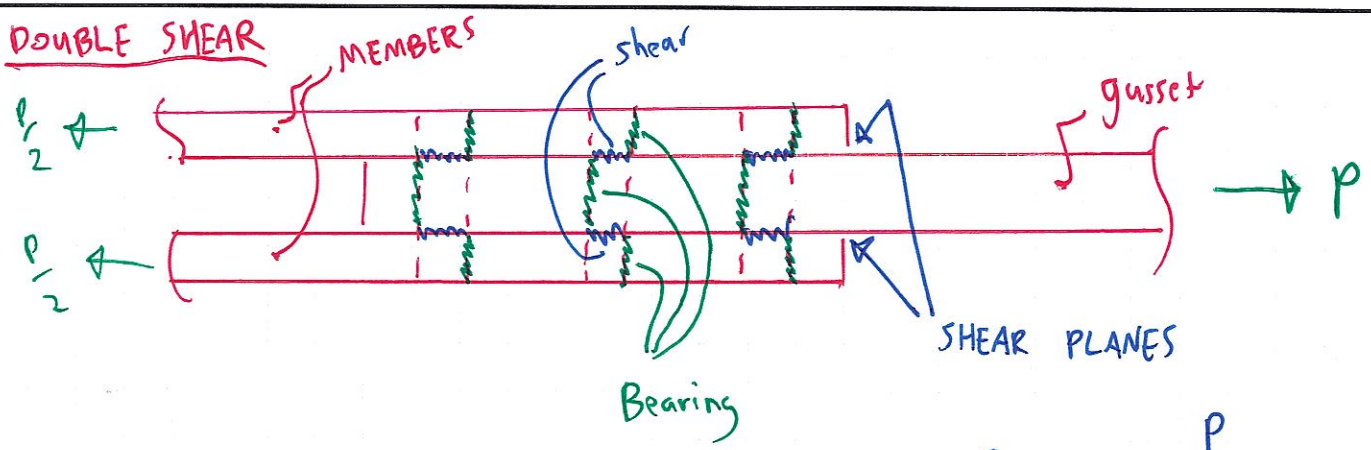
DOUBLE SHEAR



$$f_v = \frac{P}{(6\ \text{bolts})(2\ \text{planes})\,A_{bolt}} = \frac{P}{12A_{bolts}}$$

POSSIBLE FAILURE MODES

1) BOLT SHEAR ← Start Here
2) BEARING STRENGTH f (pl thickness, spacing, edge distance, bolt diam.)
3) GSy
4) NSR
5) BSR

} TENSION FAILURE MODES

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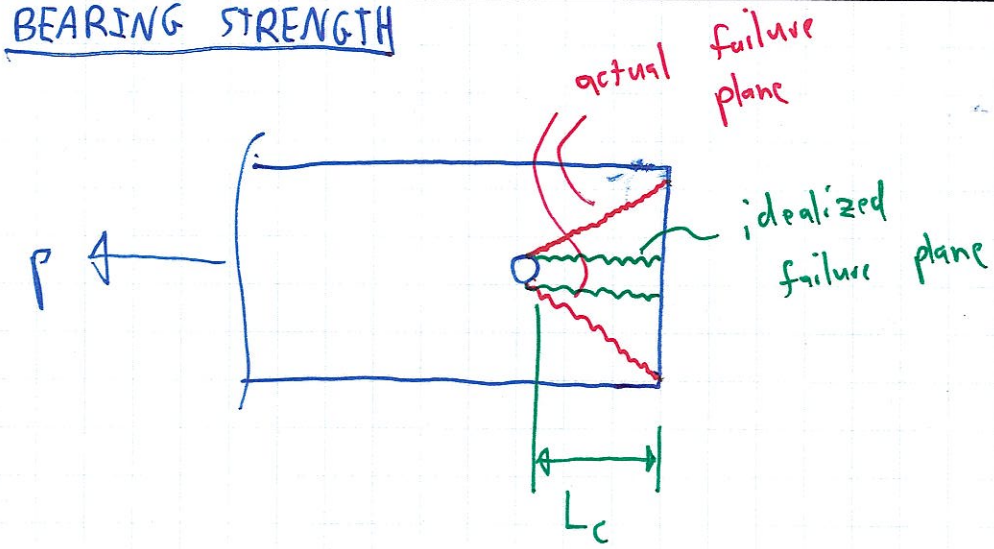
BEARING STRENGTH



$$\frac{R_n}{2} = 0.6 f_u L_c t$$

fracture shear strength

$$R_n = 1.2 f_u L_c t$$

where t = thick. of pl

* Spacing & edge dist. requirements

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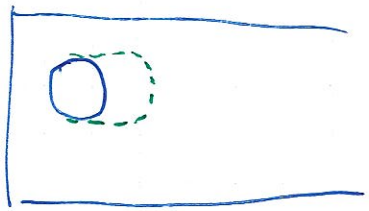
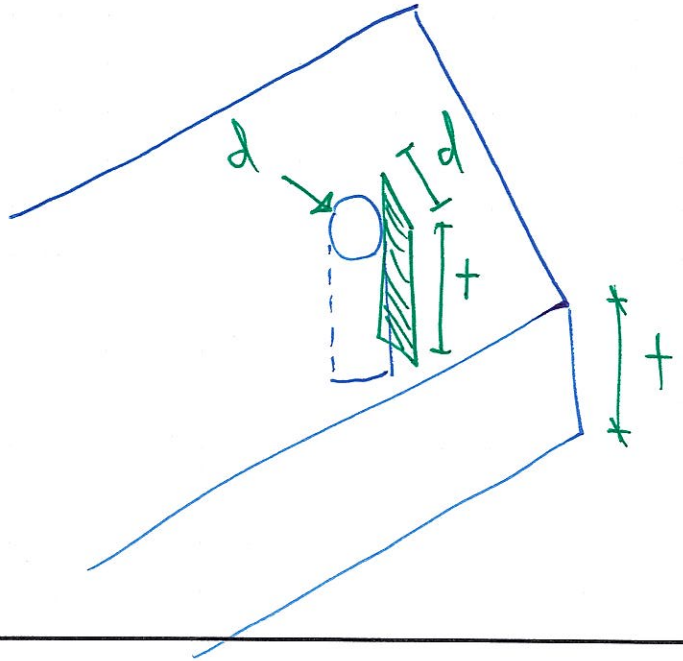
Also want to limit excessive deformation of the hole

$R_n = 2.4\, d\, t\, f_u$

bearing area

"limit hole deformation to $\frac{1}{4}$" or less"





$$R_n = \underline{1.2 f_u L_{ct}} \le \underline{2.4\, d\, t\, f_u} \quad \text{* smaller controls}$$

($J3-6c) ($J3-6a)

If deformation of the part is not critical

$R_n = 3.0\, d\, t\, f_u$

$\phi R_n \ge P_u$; $\phi = 0.75$ for fracture

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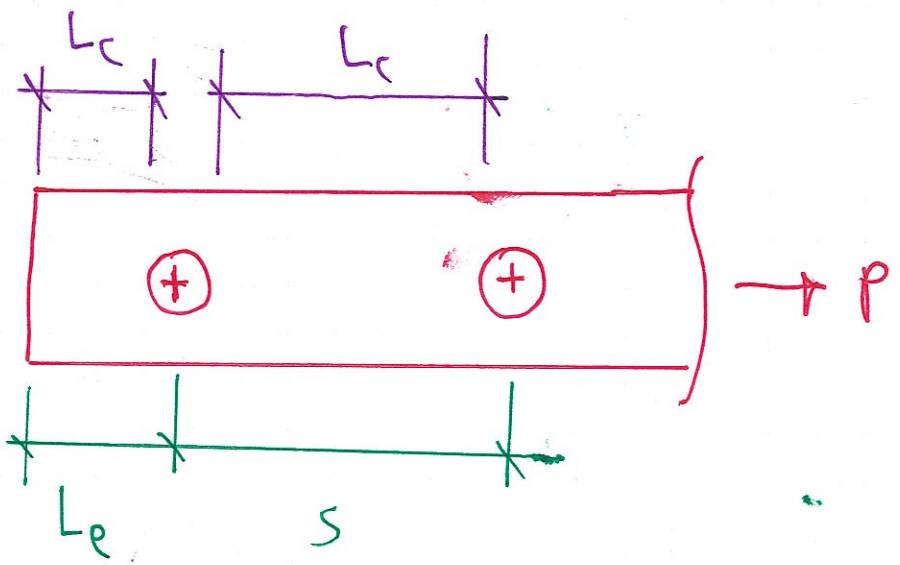
HOLE SPACINGS



for edge: $L_c = L_e - \frac{h}{2}$

interior: $L_c = S - h$

$h = d_{hole} - \frac{1}{16}$" for damage

L_e = Table J3.4, p16.1-132 for min. edge distance

$S \rightarrow s \geq 2\frac{2}{3}d$ and preferred $s \geq 3d$

↑ diam. of bolt

"for wrench access" (AISC p16.1-130)

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SUMMARY:

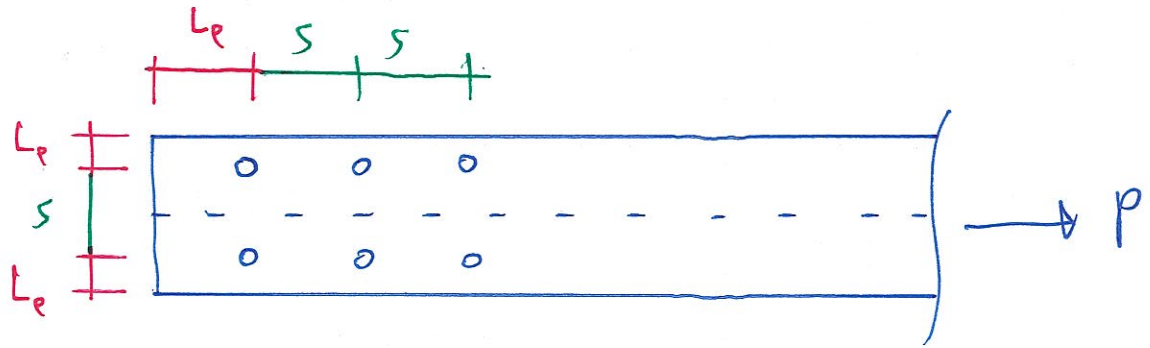
1) BEARING STRENGTH

$$\phi R_n = 0.75\left(1.2 L_c t f_u\right) \leq 0.75\left(2.4 d t f_u\right)$$

2) MIN. SPACING: EDGE DISTANCE IN ANY DIRECTION (transverse to load also)

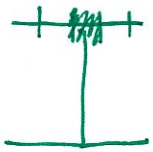
$L_e \rightarrow$ Table J3.4

$s \geq 2\frac{2}{3} d$ (prefer 3d)



*for angles remember to check gage distances

Table 1-7A, pl-52



See Ex 7.1, segui p384

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