NAME HAMZA KHAN

ID 7782

Subject Steel Structure.

Submitted to Engr Amjad Islam

DATE 25/aug/2020

X ——— X ——— X ——— X

Q#1

Ans: General Statement of design Philosophies:

A general statement assuming safety in Engineering design.

Resistance (of materials & X-Section) ≥ Effect of applied loads. — (1)

In eq (1), it is essential that both sides are evaluated for same conditions e.g if effect of load is to produce compressive stress on soil, then it should be compared with bearing capacity of soil.

Breif note on ASD & LRFD:

Allowable Stress design (ASD):

- Safety in the design is obtained by specifying that the effect of the loads should produce stresses that is a fraction of the yield stress f_y, say one half.
- This is equivalent to

FOS = Resistance, R / Effect of load, Q

$= f_y / 0.5 f_y$

$= 2$

Mathematical Description of ASD.

$$\frac{\phi R_n}{\gamma} \geq \Sigma Q_i$$

R_n = Resistance or Strength of the Component being designed.

ϕ = Resistance factor or Strength Reduction factor.

γ = Overload or Load factors.

$\frac{\gamma}{\phi}$ = factor of Safety FS.

Q_i = Effect of applied Loads

* LRFD:

- To overcome the deficiencies of ASD, the LRFD method is based on:

Strength of Materials.

- it is Considers the Variability not only in resistance but also in the effects of load.

- it Provides measure of Safety related to Probability of failure.

- Safety in the design is obtained by Specifying that the reduced nominal Strength of a designed Structure is less than the effect of factored loads acting on the Structure.

$$\phi R_n \geq n \sum \gamma Q_i$$

Advantages of Using Allowable Stress Design method.

1. Old famous books are according to this method.

2. Experienced Engineers are used to this method.

3. Elastic analysis for loads became compatible for design.

4. In past it was the only method for design purposes.

5. This method is included in AISC-05 specifications as an alternate method.

DRAWBACKS:

- Implied in the ASD method is the assumption that the stress in the member is zero before any loads are applied i.e no residual stresses exist from forming the members.

- ASD does not give reasonable measure of strength, which is more fundamental measure of resistance than is allowable stress.

ADVANTAGES

- LRFD Accounts for both variability in resistance & load.
- it achieves fairly uniform levels of safety for different limit states.

DISADVANTAGES

- it's disadvantages is change in design philosophy from previous method.

Q2 Write brief note on types of bolted connections in steel structures Also explain failures in bolted connections, with help of figures.

TYPES OF CONNECTIONS:-

Slip-Critical connections:-

Connection transmits the force by friction produced between the faying surfaces by the clamping action of bolts.

⇒ Slip-critical connection are recommended for joints subjected to stress reversil severe stress fluctuation, impact, vibration or where slip is objectionable

⇒ Slip-critical connection becomes bearing type connection after the slip occurs so every slip critical connection is essentially a bearing type connection also.

BEARING TYPE CONNECTION:-

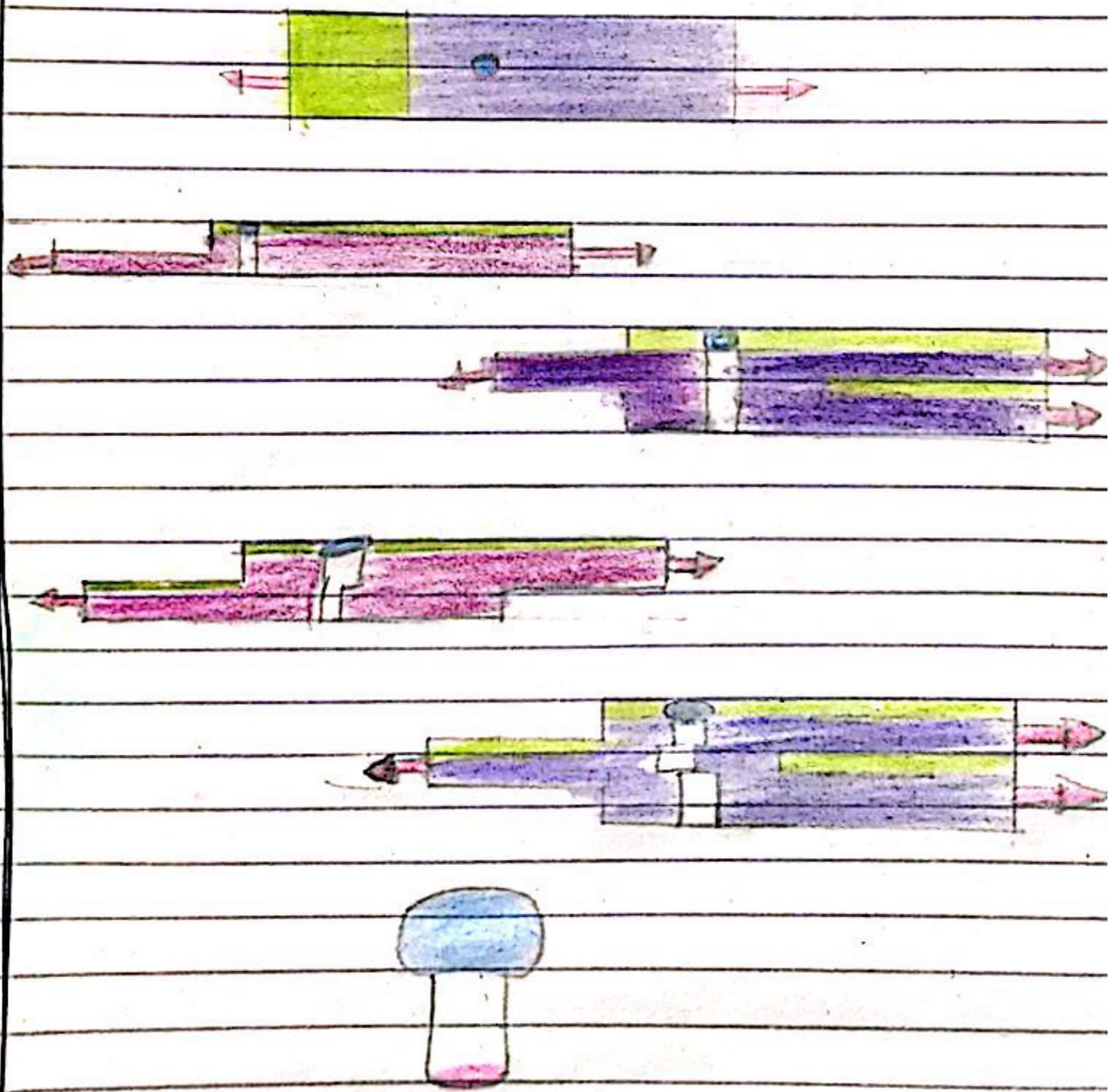
Load is transferrd by shearing and bearing on bolt.

⇒ Capacity in shear depends on wheather

Shear plane intersects the body of bolt or threaded portion.

Bearing type connection is most widely used general type connection in which the load is resisted by the bolt body without any friction btw faying surfaces.

SHEARING FAILURE OF BOLTS

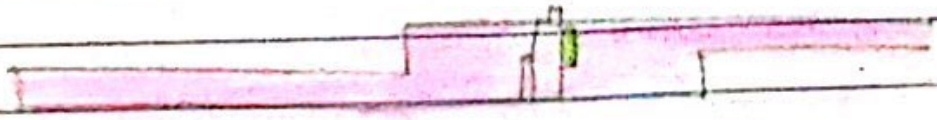


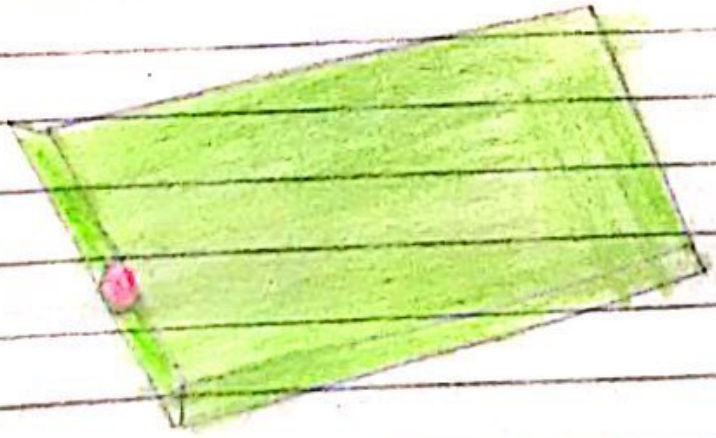
SHEAR FAILURE OF BOLTS:-

The Shear stress in the bolt may exceed the working shear stress generated because the plates slip due to applied forces.

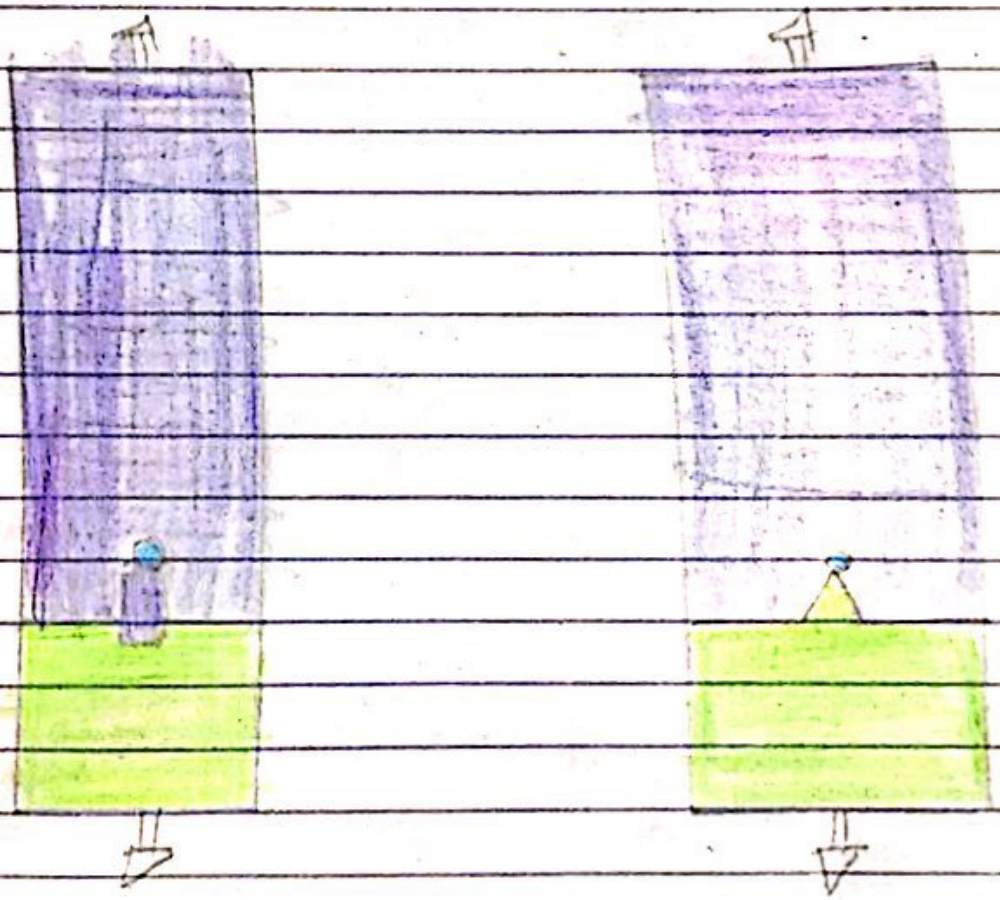
BEARING FAILURE OF PLATE

The plate may be crushed when the bearing stress in the plate exceeds the working bearing stress.





TEARING FAILURE AT EDGE OF PLATE:-



Shearing failure edge plate Transverse tensi

TENSION OR TEARING FAILURE:-

The tensile stress in plate at the net cross-section may exceed the working tensile stress. Tearing failure occus when both bolts are stronger than plates.

Q#3

Ans: Given DATA:

Dead Load = 130 K
Live load = 265 K
Two Plates $C_{10 \times 30}$
1" gusset Plate
All materials is A36 Steel
Bolts are A325 with 3/4 in dia. Bearing type Connection
Threads excluded from Shear Plate
Use three lines of Bolts.

"ASD Method"

Required:

Number of bolts required = ?
Appropriate, Layout.

Sol:

Design force = D.L + L.L
= 130 + 265
= 395 K

⇒ Bolt Design:

for $\frac{3}{4}$" dia bolts

$$\text{Area} = \frac{\pi}{4}(D^2) \Rightarrow \frac{\pi}{4}\left(\frac{3}{4}\right)$$

$$\text{Area} = 0.4418\ in^2$$

Shear Design:

Shear Strength of bolts when threads are excluded from shear plane.

from table

$$F_v = 30\ ksi$$

$$R_v = \text{Area} \times F_v$$
$$= 0.4418 \times 30$$
$$= 13.25K \quad \text{per shear surface}$$

→ As there are two shear surfaces per bolt.

$$\Rightarrow \text{number of bolts} = \frac{\text{Design force}}{2 \times R_v}$$

$$= \frac{395}{2 \times 13.25}$$
$$= 14.90$$

So ⇒ 15 bolts.

Bearing

Bearing Strength, $F_p = 1.2 F_u$

$F_u = 58$

$F_p = 1.2 \times 58$

$F_p = 69.6$ ksi

$\Rightarrow$ For Channel, $R_p = d.t\, F_p$

$t_w = 0.673$

$R_p = 35.13K$

for single bearing surface

As there are 15 bolts so 30 surfaces.

Capacity:

30×35.13

$= 1053.9K > 395K$ ok

$\Rightarrow$ for gusset Plate.

$R_p = d\, t\, F_p$

$= \frac{3}{4} \times 1 \times 69.6$

$R_p = 52.2$

Capacity:

$15 \times 52.2 = 783\,K > 395\,K$

OK

Spacing:

for $\frac{3}{4}$" dia bolts min. edge → 1.25"

distance from table 2.8 = $1\frac{1}{4}$"

Also

End distance = $1\frac{1}{2}d$

$= 1\frac{1}{2}\left(\frac{3}{4}\right)$

$= 1.13" \text{ m} < 1.25"$

So

Edge distance, $Le = 1\frac{1}{4}$ in or 1.25"

⇒ Centre to Centre distance

$L = 3d$

$= 3(3/4)$

$L = 2.25"$

Channel

$Le = 2P/Fut$

$1.25 = \frac{2 \times P}{58 \times 0.673}$

$P = 24.4\ K$

$$\Rightarrow L = \frac{2P}{Fut} + \frac{d}{2}$$

$$2 = \frac{2P}{58 \times 0.673} + \frac{3/4}{2}$$

$$P = 31.7\ K$$

As the bolts are arranged in three rows and five bolts per row.

Capacity:

$$2(3 \times 24.4 + 12 \times 31.7) = 907.2K > 395K$$

OK

Gusset Plate

$$Le = \frac{2P}{Fut}$$

$$1.25 = 2P/58 \times 1$$

$$P = 36.25K$$

$$L = \frac{2P}{Fut} + d/2$$

$$2 = 2P/58 \times 1 + 3/4/2$$

P = 47.134

Capacity:

$3 \times 36.25 + 12 \times 47.134$

$674.358\ K > 395\ K$

OK.