Name:: Tauseef Ali

I.D:: 7701

Section:: B

Subject:: Steel Structure

Submitted to:: Amjid- Aslam

Date:: 25/8/2020.

## Question #1

**General statment of design philiosphies:-**

* A general statment assuming Safety in engineering design.

Resistance (of material & x-Section) ≥ affect of applied load → (1)

→ In equation 1 It is essential that both side are evaluated for some condition e.g if effect of load is to produce compressive stress on soil, that It should be compared with bearing capacity of soil.

**Allowable stress design ASD:.**

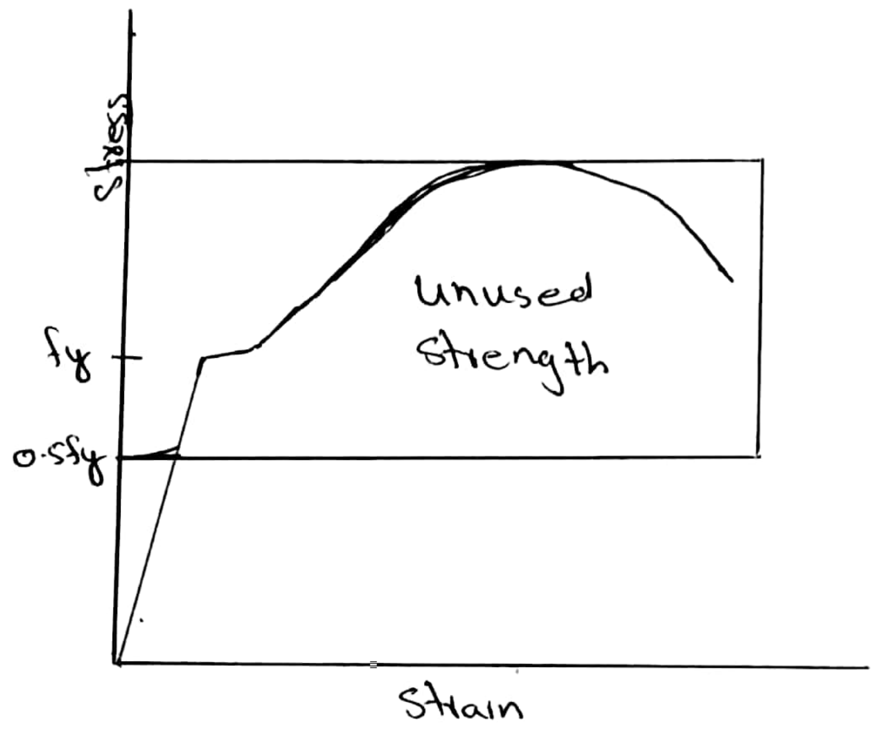
Safety in design is Obtained by specifying, that the effect of the load should produce

Stresses that is the fraction of the yield stress fy, Say one half

FDS = Resistance, R / effect of load, Q

$= f_y / 0.5 f_y$

$= 2$




**Mathematical of ASD:.**

$$\frac{\phi R_n}{\gamma} \geq \sum Q_1$$

Rn = Resistance of ~~Shear~~ strength of the component being design

$\phi$ = Resistance factor or strength reduction factor.

$\gamma$ = over load or load factor.

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

$Q_1$ = effect of applied load.

## LRFD :-

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

Strength of material

- It consider the variability not only in resistance but also in the effect of load.

- It provide measure of Safety related to probality 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 load acting on the structure

$$\phi R_n \geq n \sum \gamma Q_1$$

$R_n$ = resistance

$Q$ = effect of applied load

$n$ = Takes into account ductility.

$\phi$ = strength reduction factor.

$\gamma$ = over load or load factor.

$\gamma/\phi$ = factor of safety.

## Advantages of ASD

following are some Advantages stress design method.

* Elastic analysis for load become compatible for design.
* old famous book are according to the method.
* Experienced engineers are used to this method.
* In past, it was the only method for design purpose.
* This method is included in AISC-05 Specification are as alternate method,

## Dis advantages of ASD:-

* Implied the ASD method is the assumption that the stress in the membre is zero before any load is applied i-e no residual stress exist from forming the members.

* ASD does not give reasonable measure of strength which is more fundamental measure of resistance that is allowable stress.

* Another draw back in ASD is that Safety is applied only to stress load, load are considered to determine (with out variation)

## Advantage of LRFD

* LRFD account for both variability in resistance and load,

* It achieves fairly uniform load of Safety for different limit states.

## dis advantages of LRFD

* It's dis advantages is change in design philosophy from previous method.

# Q #2

## Type of bolted connection:

* **Slip- critical connection:**

- connection transmits the force by friction produced between the faying Surfaces by the clamping action of the bolts.

- slip- critical connection are recommended for Joint Subject to stress reversal, severe stress fluctuation, impact, vibrations- or where slip is objectionable.

→ slip critical connection becomes bearing type connection after the slip occure so every slip critical connection is essentially a bearing type connection also.

## Bearing type Connection:

→ load is transferred by shearing and bearing on bolt.

→ Capacity is shear depend on wheather

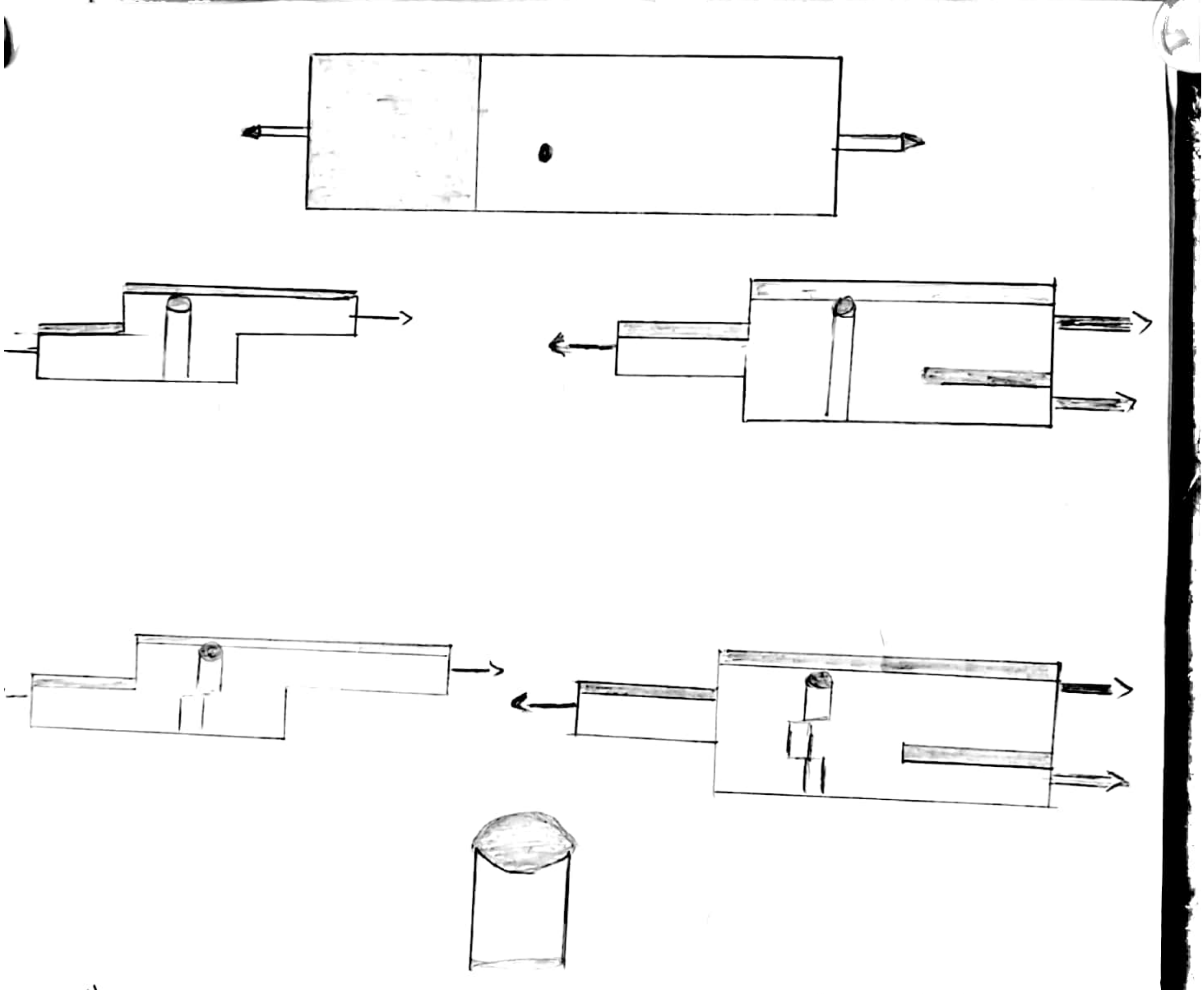
Shear plane intersects the body of bolts or threaded portion.

→ Bearing type connection is the most widely used general type connection in which the load is resisted by the bolt with out any friction between faying surfaces.

## Type of failure

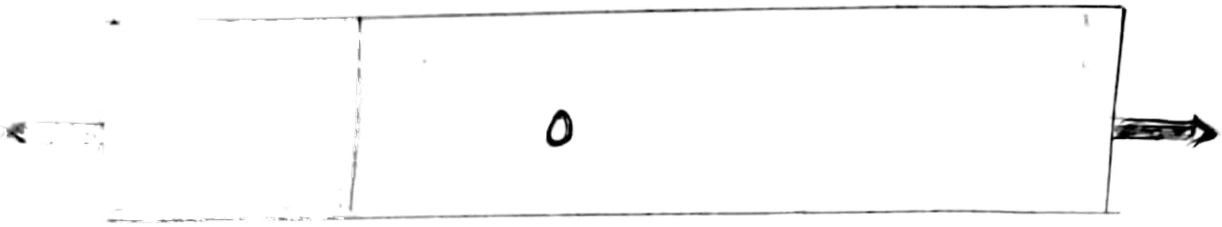
* **Shearing failure of bolts:-**

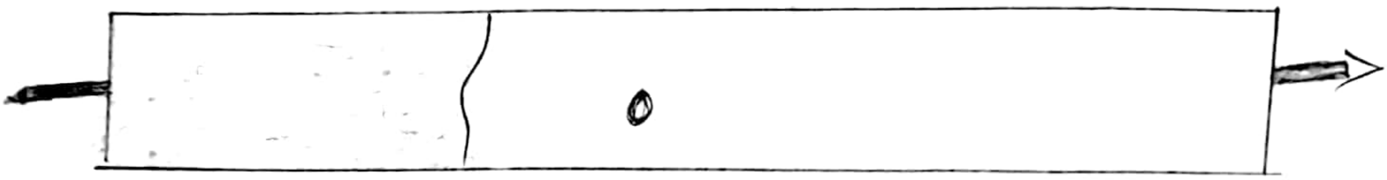
The shear stress in the bolts may exceed the working shear stress in the bolt shear stresses are generated because the plate slip due to applied load.

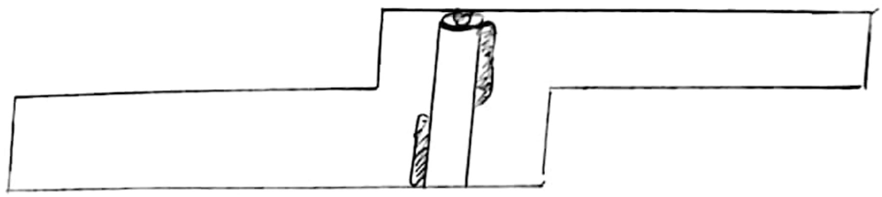


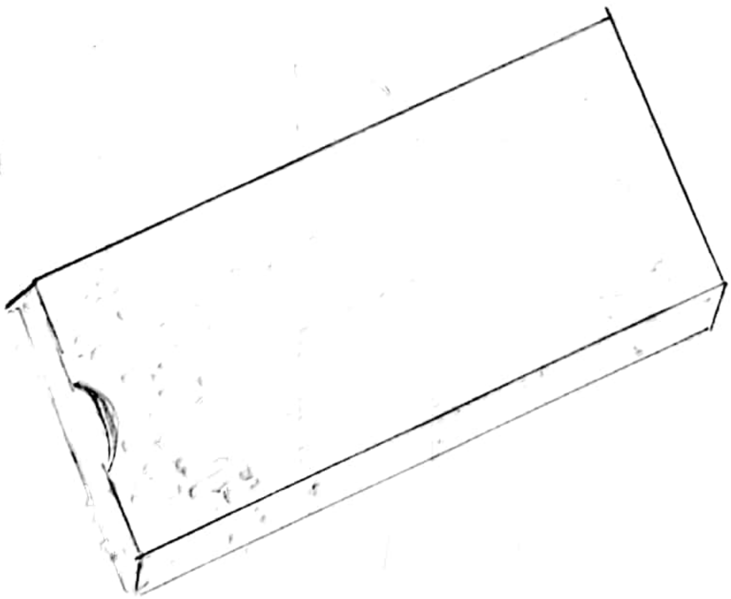
## Bearing failure of plate:-

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



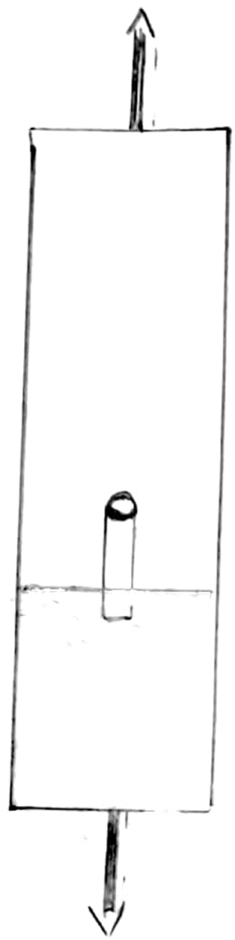




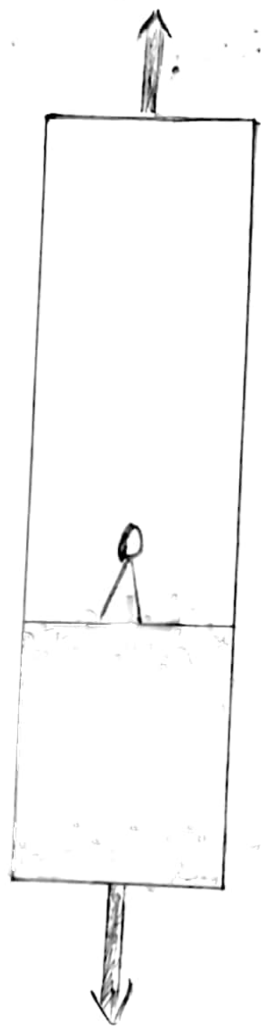


## Tension or tearing failure of plate.

The tensile stress in the plate at the net cross-section may exceed the working tensile stress. Tearing failure occurs when bolts are stronger then the plate



Shearing Failure edge of plate



Transverse Tension failure.

# Q#3

## Given Data:-

Dead load = 130K
live load = 265K.
Two plate $C_{10x30}$
1" gusset plate
All material is A 36 steel
Bolt are $A_{325}$ with 3/4 in dia
Bearing type connection.
Threads excluded from shear plane used three lines of bolts
ASD method

## Required:-

numbre of bolt required = ?
Appropriate, layout

## Solution:-

Design force

$$= DL + L.L$$

$$= 130 + 265$$

$$= 395K$$

⇒ Bolt design

for $3/4''$ dia bolt

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

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

## Shear design

Shear strength of bolts when treads are excluded from shear planes from table.

$f_v = 30 \text{ ksi}$

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

As there are two shear surface per bolt

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

$$= \frac{395}{2 \times 3.25}$$

$$\boxed{= 14.90}$$

**So 15 bolt**

## Bearing:.

Bearing strength, $f_p = 1.2 f_u$

$f_u = 58$

$F_p = 1.2 \times 58$

$$F_p = 69.6 \text{ Ksi}$$

⇒ for channel, $R_p = d \cdot t \cdot f_p$

$t_w = 0.673$

$R_p = 35.13 K$

for single bearing surface.

$R_p$ ~~= 35~~.13

As there are 15 bolt so 30 surface

## Capacity:.

$= 30 \times 35.13$

$= 1053.9K > 395K$

OK

for gusset plate

$R_p = d t f_p$

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

$$R_p = 52.2$$

## Capacity:.

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

OK

## Spacing:.

for $3/4''$ dia bolts min edge distance from table 2-8 $= 1\frac{1}{4}''$, 1.25'

Also

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

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

$= 1.13 \text{ in} < 1.25''$

edge ~~so~~distance, $L_e = 1\frac{1}{4}$ or $1.25''$

⇒ Centre to centre distance

$L = 3d$

$= 3 (3/4)$

$L = 2.25''$

## Channel

$L_e = \frac{2p}{f_u t}$

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

$p = 24.4\,K$

$$L = \frac{2p}{f_u t} + \frac{d}{2}$$

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

$$\boxed{p = 31.7\,K}$$

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

Capacity.

$$2(3 \times 24.4 + 12 \times 3.17$$

$$= 907.2\,K > 395\,K$$

ok

Gusset plate

$$L_e = \frac{2p}{f_u t}$$

$$1.25 = \frac{2p}{58 \times 1}$$

$$\boxed{P = 36.25\,K}$$

$$L = \frac{2P}{f_u t} + \frac{d}{2}$$

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

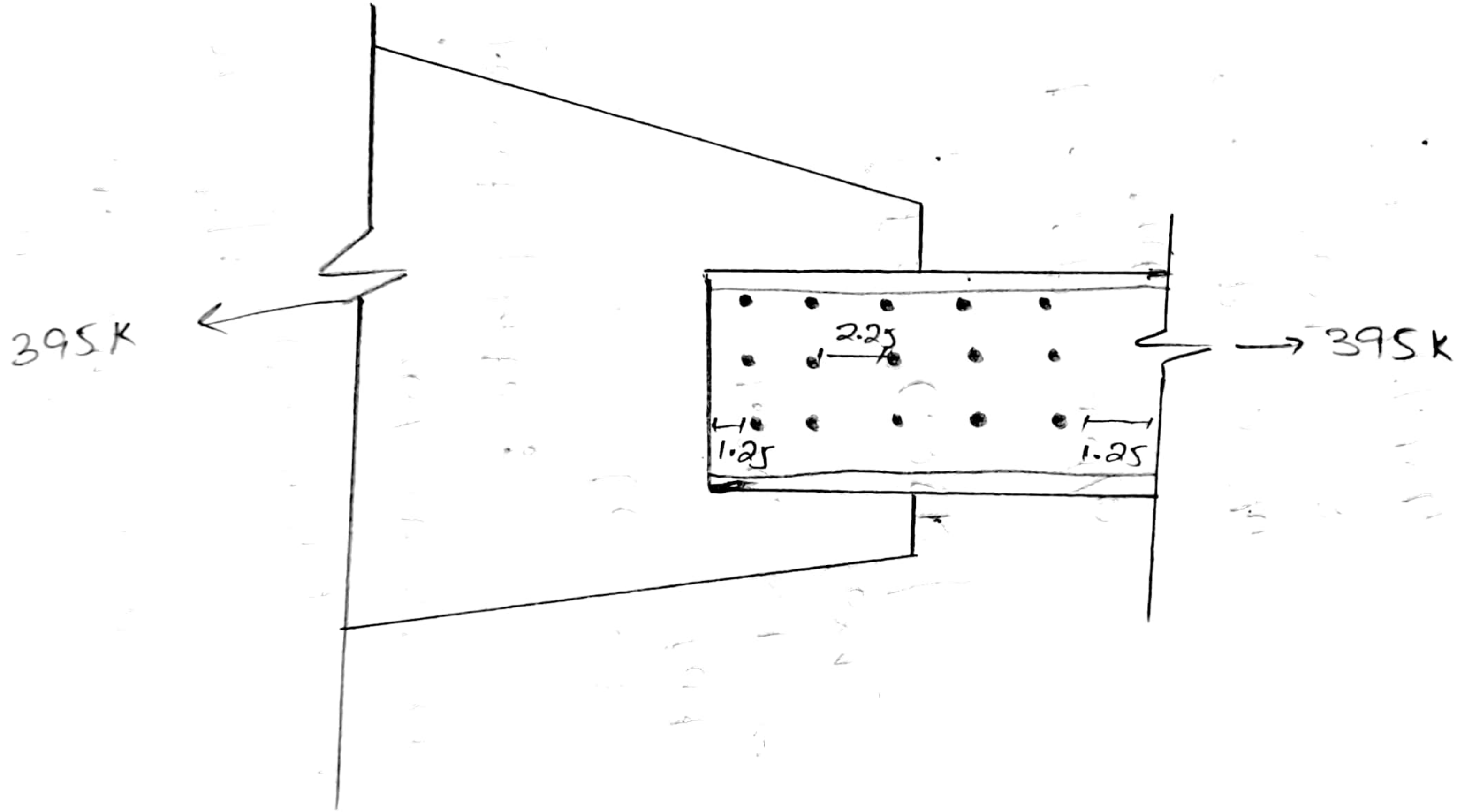
$$\boxed{P = 47.134}$$

Capacity:-

$3 \times 36.25 + 12 \times 47.134$

$674.358K > 395K$

ok.


395K
2.25
1.25
1.25
395K