SUBMITTED TO : Engr. Amjad Islam

SUBMITTED By : SHAH SAWAR

ID-NO : 7712

Subject : STEEL Structure

Date : 25. Aug. 2020

Question#01:

Design Philosophies;

A generall 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

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 fy, Say one half
- This is equivalent to

$$FOS = \text{Resistance, } R / \text{Effect of load, } Q$$
$$= f_y / 0.5 f_y$$
$$= 2$$

Mathematicall description of ASD

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

R_n = Resistance or Strength of the component being design

ϕ = Resistance Factor or Strength Reduction Factor

γ = over load or load factors

$\frac{\gamma}{\phi}$ = Factor of Safety FOS

Q_i = Effect of applied loads

LRFD;

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

Strength of Materials

1) It consider the variability not only in resistance but also in effects of loads
2) 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 then the effect of factored loads acting on the Structure

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

Scanned with CamScanner

where;

R_n = Resistance or Strength of component being designed

Q_i = Effect of applied loads

n = Takes into account ductility, redundancy and operational important

ϕ = Resistance factor or Strength Reduction factor

γ = overload or load factors

$\frac{\gamma}{\phi}$ = Factor of safety

Advantages of Using Allowable Stress Design:

Following are some advantages of Allowable Stress design method

1- Elastic analysis for loads become Compatible for design

2- old famous book are according to this method

3- Experienced engineers are used to this method

4- In Past it was the only method for design purpose

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

Dis-advantages of Using ASD Method:

1) 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

2) ASD does not give reasonable measure of strength, which is more fundamental measure of resistance then is allowable stress

3) Another drawback in ASD is that safety is applied only stress level. loads are considered to be deterministic (without variation)

Advantages of LRFD:

1) LRFD accounts for both variability in resistance and load
2) It achives fairly uniform levels of safety for different limit states

Dis-Advantages of LRFD:

1) Its disadvantages is change in design philosophy from previous method

Q#02:-

Types of Connections;

Slip critical connections;

The force by friction connections transmitts produced b/w the faying surfaces by the clamping action of the bolts

→ slip-critical connections are recommended for joints subjected to stress reversal, severe stress fluctuation, Impact, vibration or where slip is objectionable

→ Slip critical connection become bearing type connection after the slip occurs so every slip critical connection is essentially a bearing type connection also

Bearing type connections:

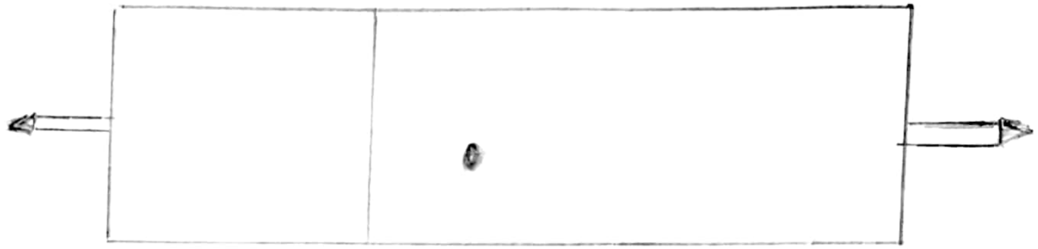
Load is transferred by shearing and bearing on the bolt.

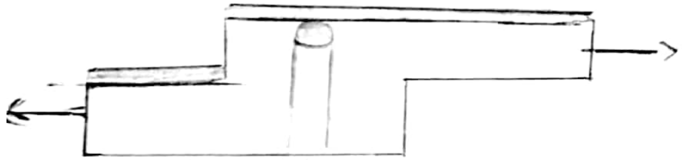
(2) Capacity in shear depends on weather shear plane intersects the body of bolt or threaded portion

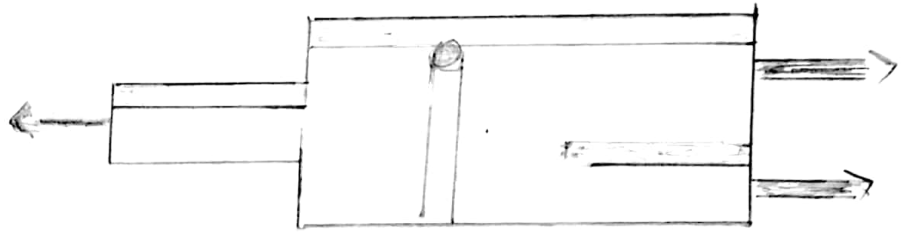
(3) Bearing type connection is most widely used generall type connection in which the load is resisted by the bolt body without any friction b/w faying surfaces.

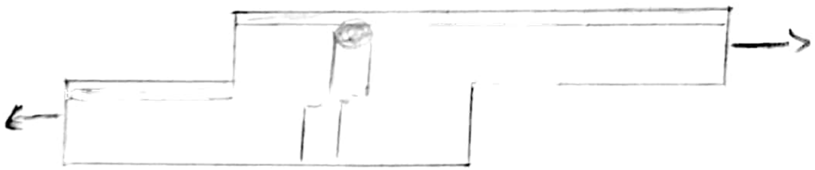
Shear failure of Bolts:

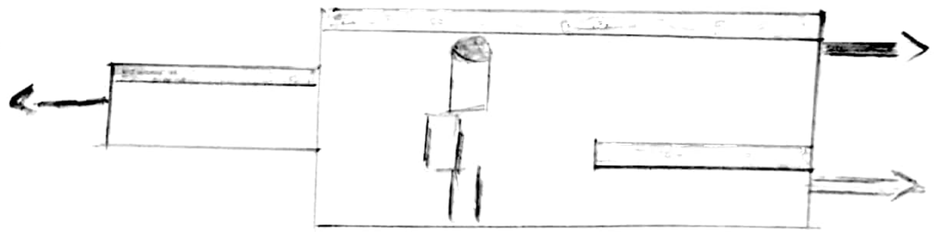
The shear stress in bolt may exceed the working shear stress in the bolt. Shear stresses are generated because the plates slip due to applied forces.





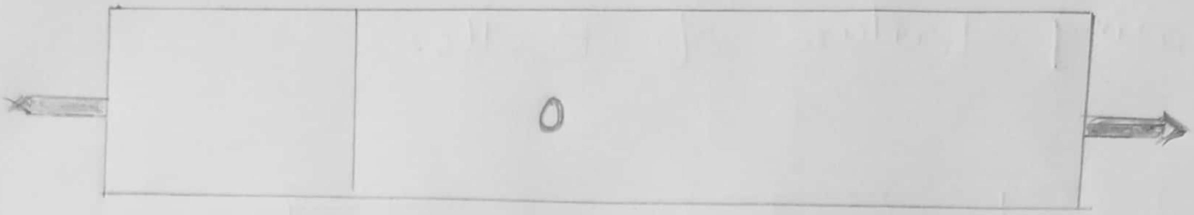


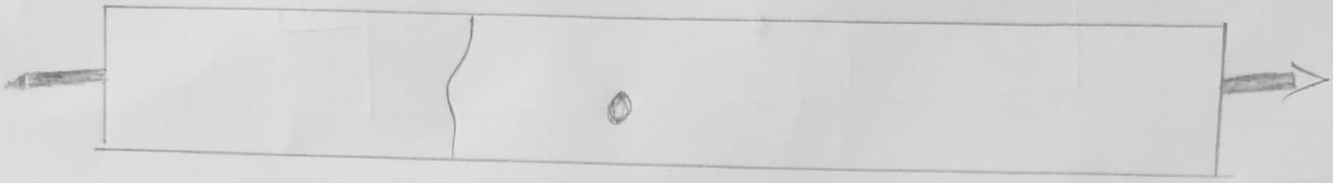


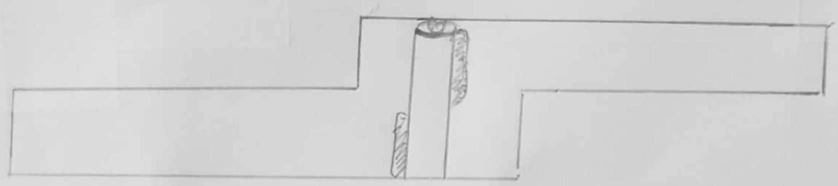


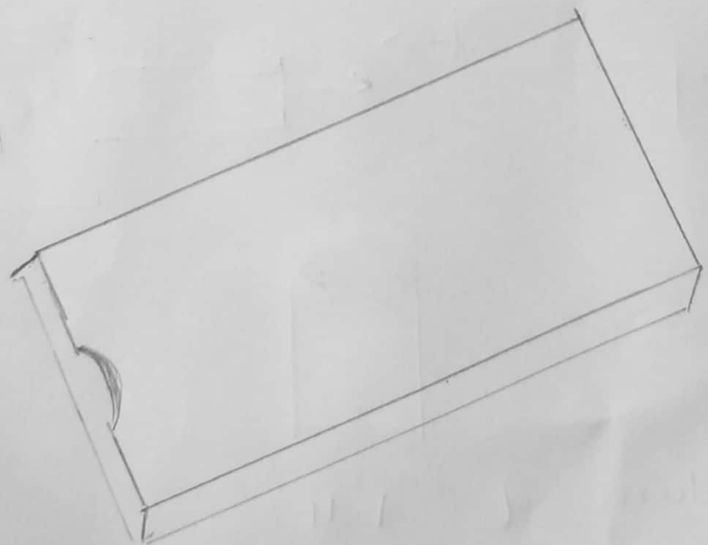
Bearing failure of plates :

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





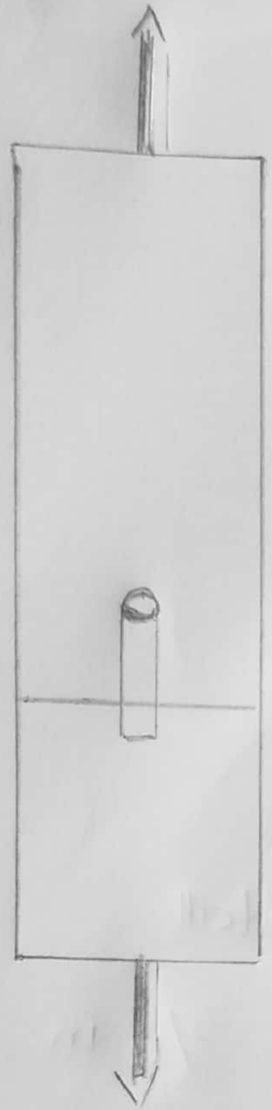




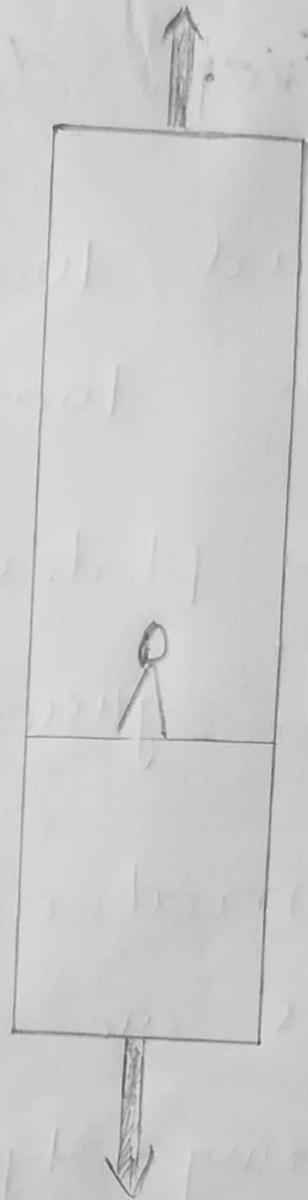
Tension or Tearing failure of plates:

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 plates



Shearing Failure
edge of plate



Transverse
Tension failure.

Question # 03:

Given Data:

Dead load = 130K

Live load = 265K

Two plates C10 x 30

1" gusset plate

All material is A36 Steel.

Bolts are A325 with 3/4 in dia

Bearing type connection

Threads excluded from Shear Plane

Use three lines of bolts.

ASD Method

Required data:

No: of Bolts required = ?
Appropriate layout

Solution:

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

⇒ Bolt Design:

For 3/4" dia bolts

Area = $\pi/4 (D^2) = \pi/4 (3/4)^2$

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 = Area × F_v
= 0.4418 × 30
= 13.25 k per shear surface

As there are two shear surface per bolts

⇒ No: 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

⇒ For Channel

$R_p = d \cdot t\, F_p$

$t_w = 0.673$

$R_p = 3/4 \times 0.673 \times 69.6$

$R_p = 35.13K$ for Single bearing Surface

As there are 15 bolts So 30 Surfaces

Capacity:

30×35.13

$= 1053.9\,K > 395K$ [OK]

⇒ For Gusset plate

$R_p = d t F_p$

$= 3/4 \times 1 \times 69.6$

$R_p = 52.2$

Capacity:

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

[okay]

Spacing:- For $\frac{3}{4}$" dia bolts min. edge distance from table 2.8 = $1\frac{1}{4}$"

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

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

So $= 1.13$ in < 1.25"

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

→ Centre to Centre distance

$L = 3d$

$= 3(3/4)$

$L = 2.25$"

Channel

$$L_e = \frac{2P}{F_u t}$$

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

$P = 24.4k$

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

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

$$\boxed{P = 31.7k}$$

Scanned with CamScanner

As the bolts are arranged in Three rows and five bolts per row

Capacity:

$$2(3\times 24.4 + 12\times 31.7)$$

$$= 907.2K > 395K \quad [ok]$$

Gusset Plate:

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

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

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

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

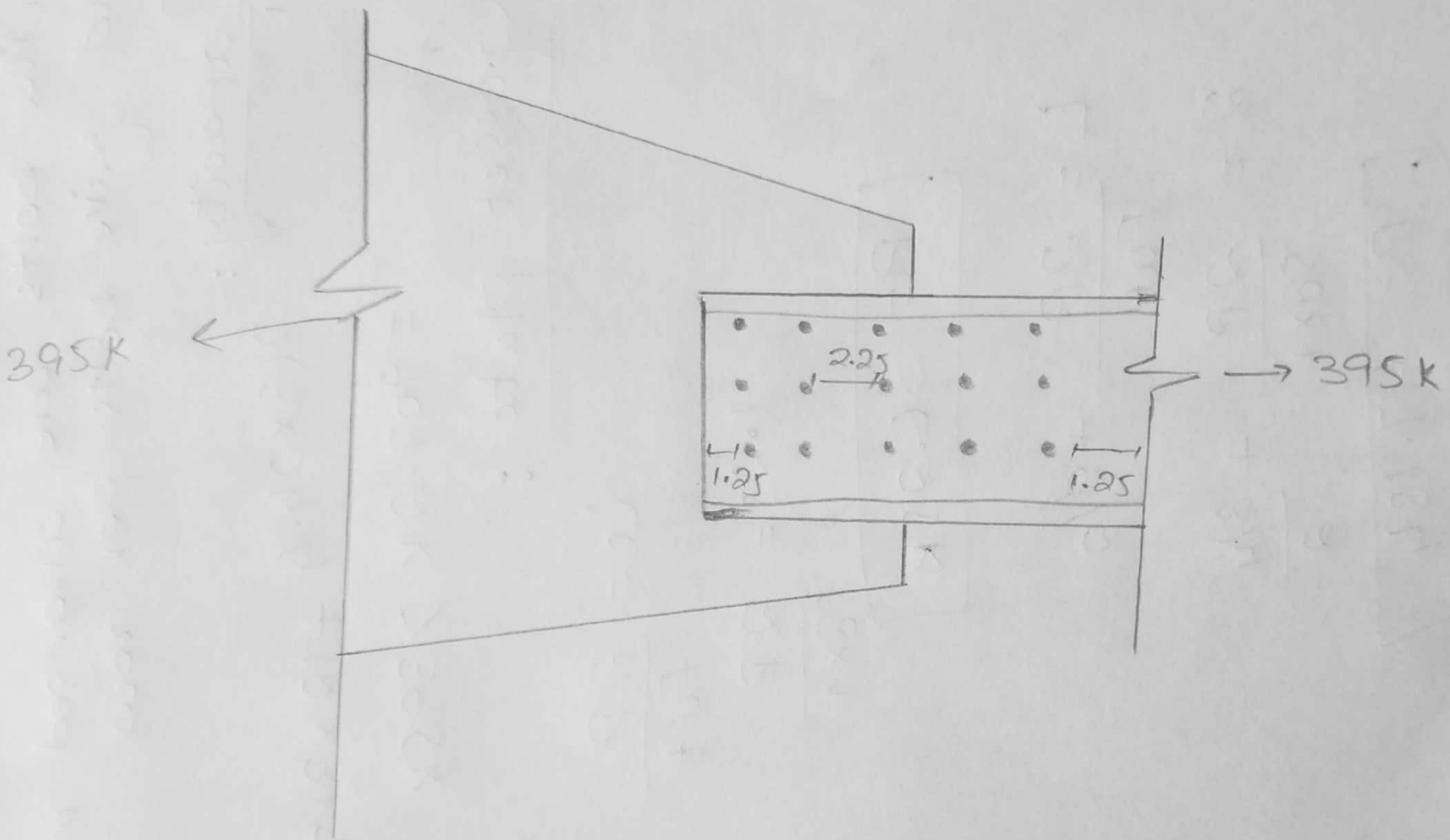
$$2 = \frac{2P}{58\times 1} + \frac{3/4}{2}$$

$$\boxed{P = 47.134}$$

Capacity:

$$3\times 36.25 + 12\times 47.134$$

$$674.358K > 395K \quad [ok]$$


395K
2.25
1.25
1.25
395K