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Section# B

Subject # Steel Structure

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Q1

What is General statment of design philosphies? Write brief note on ASD & LRFD. Also merit & Demerits.

Ans:-

A General statment assuming safety in engineering design.

Resistance { of materials & x-section } ≥ Effect of applied loads. ①

In equation one it is essential that both sides are evaluated for same condition. e.g. if effect of load is to produce compressive stress on soil, Then it should be compared with bearing capacity of soil.

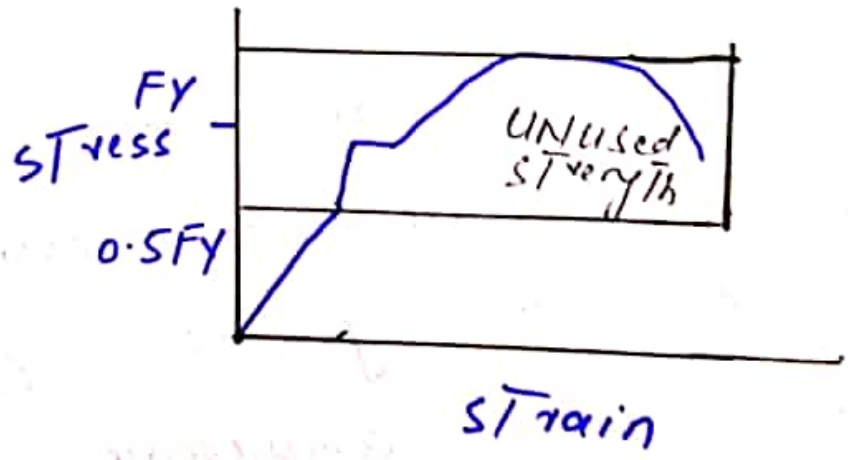
⇒ Allowable stress Design (ASD)

- safety in the design is obtained by specifying that the effect of the loads should be produced stresses that is a fviction of the yeld stress fy, say one half
- This is equivlant to

FOS : Resistance R / effect of load . Q

$= fy / 0.5 fy$

$= 2.$



ASD (contd)

Mathemtical Description OF ASD.

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

R_n = Resistance or strength of the component being designed.

ϕ = Resistance factor or strength Reduction factor.

γ = Overload or load Factors

γ/ϕ = Factor of safety FS

Q_i = Effect of applied loads.

→ LRFD

TO overcome OF deficiencies OF ASD, the LRFD method is based on : **strength OF materials**

=> it consider the variability not only the resistance but also in effect 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.

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

R_n = Resistance or strength OF the component being designed.

Φ_i = Effect of applied loads.

η = Takes into account ductility, redundancy and operational imp.

ϕ = Resistance factor or load strength Reduction factor

γ = Overload or load factors

γ/ϕ = Factor of safety.

- Advantages of using Allowable stress design methods.

1// Elastic analysis for loads become compatible for design.

2// old famous books 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 specifications as an alternate method.

- **DRAW backs :-**

=> Implied in the ASD method is the assumption that the stress is the member of zero before any loads are applied i-e. residual stresses exist from forming the members.

- ASD Does not Give reasonable measure of designed strength. which is more Fundamental measure of resistance than is allowable stress.

- Another Draw back in ASD is that

Safety is applied only to stress level. loads are considered to be deterministic. (without variation).

- Advantages or Merit :-

⇒ LRFD accounts for both variability in resistance and load.

⇒ it achieve fairly uniform levels of safety for different limit states.

⇒ Disadvantages or Demerit :

- it's disadvantage is change in design philosphy from previous method.

Q2 Write note on Note on Types Also explain its Failure.

Ans There are three basic types.

1// slip critical

2// pretensioned

3// snug tight.

1// slip critical connection :-

This type of joint is similar to a pretensioned joint except that Failure is assumed to occur when the applied load is greater than the friction force and thus slip does not occur between the faying surface.

- As with pretioned joints. slip critical

are used for joints subjected to cyclical load or Fatigue loads.

- They should also be used in connection that have slotted holes parallel to the direction of the load or in connections that use a combination of welds and bolts along the same faying surface.

- The amount of pretension or clamping force for a slip-critical bolt is the same that was used for pretensioned joints.

2.8- SNug-TiGhT connection:-

It occur when the bolts are in direct bearing and the piles of a connection are in firm contact.

- This can be accomplished by the full

effort of a worker using a spud wrench. which is an open-ended approximately 18 in long.

- A snug-tight joint can be specified for most simple shear connection as well as tension only connections.
- Snug-tight joints are not permitted for connection supporting not static loads. nor are they permitted with A 490 bolts loaded in tension.
- There are generally no need to limit the joints.

3/ Pretensioned Connection :-

⇒ A pretensioned connection joint has greater amount of clamping force

than the sunlight condition and therefore provide a greater degree of slip-resistance in the joint.

- pretensioned joints are used for joints that are subject to cyclical loads or fatigue loads.
- They are also required for joints A490 bolts in tension.
- Some specific examples of connections where pretensioned joint should be specified are

=> column splices in buildings with high height to which width ratios.

=> Connection within the load path of the lateral force resisting system.

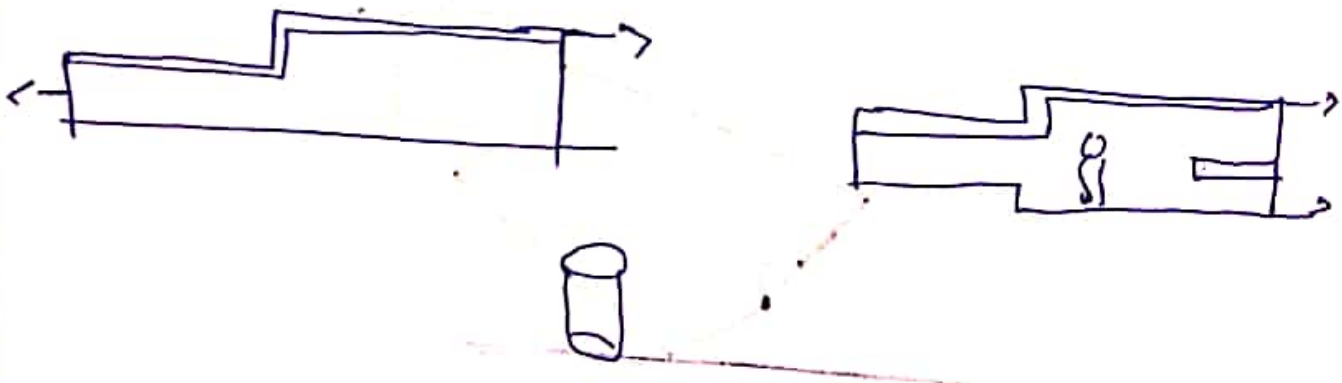
- Failure in bolted connection :-

=> Types of Failure :-

~~Shear~~

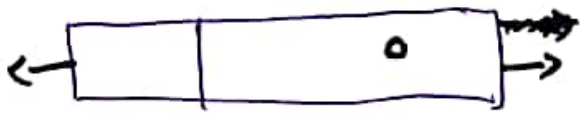
=> Shearing failure of bolts

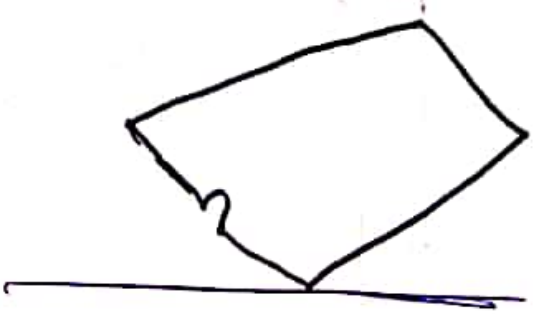
The shaer stress in the bolt may exceed the working shaer stress in the bolt. Stresses are generated because the plates slip due to applied forces.



2- Bearing Failure of plate :

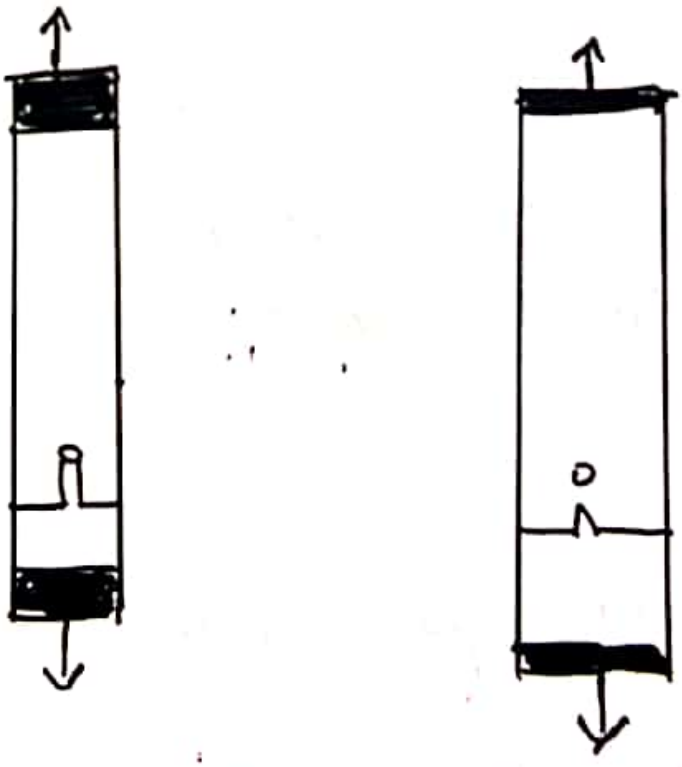
The plate may be crushed when the bearing stress in the plate exceeds the working bearing stress.





Tearing Failure at the edge of plate.

The Tensile stress in the plate at the cross - section may exceed the working tensile stress tearing failure across (when bolts are stronger than the plates.



Q3

Given Data :-

Dead load = 130 k

live load = 265 k

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 : Asp method.

Required :-

Number of bolts required = ?

Appropriate layout

Solution:-

=> Bolt Design:

For 3/4" dia bolts

Area = $\frac{\pi}{4}(D^2)$ => $\frac{\pi}{4}(3/4)$

Area = $0.4418\ in^2$

Shaer Design :-

shaer streyth OF bolts when threads are excluded From shaer plane from tastle.

FV = 30 KSI

RV = Area x FV

= 0.4418 x 30

= 13.25 K per shear surface.

-> As There are two shear surface per bolts.

→ Number of bolts :-

Design Force = 2 × hv

= 395 / 2 × 13.25

= 14.90

So 15 bolts :-

Bearing :-

Bearing strength, FP = 1.2 FU

FU = 58

FP = 1.2 × 58

FP = 69.6 ksi

⇒ For channel, Rips = dit FP

$t_w = 0.673$

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

$= R_p \ 35.13 K.$

For single bearing surface

As there are 15 bolts so 30 surface.

⇒ Capacity :-

⇒ 30×35.13

⇒ $1053.9K > 395K$ OK

⇒ For Gusset plate :-

$R_p = dt \ FP$

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

$R_p = 52.5$

=> Capacity :-

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

=> Spacing :-

For 3/4" dia bolts edge distance

From table 2.8 = $1\frac{1}{4}$"

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

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

$= 1.13 in < 1.25$".

So

edges distance $Le = 1\frac{1}{4}$". 1.25"

=> Centre to Centre distance :-

$L = 3d$

$L = 3(3/4$

$L = 2.25''$.

CHannel :

$l_e = 2P / F_{ut}$

$1.25 = \frac{2 \times P}{58 \times 0.673}$ $\Rightarrow P = 24.4K$.

$L = \frac{2P}{F_{ut}} + \frac{d}{2} = 2 - \frac{2P}{58 \times 0.673} + 3/4/2$.

$P = 31.7\ K$

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

⇒ Capacity :-

$2(3.24.4 + 12 \times 31.7)$

$= 907 + 2K > 395K$

O/K.

⇒ Bursst plate :-

$l_e = 2P / F_{ut} \Rightarrow 1.25 = \frac{2P}{58 \times 1}$

$P = 36.25K.$

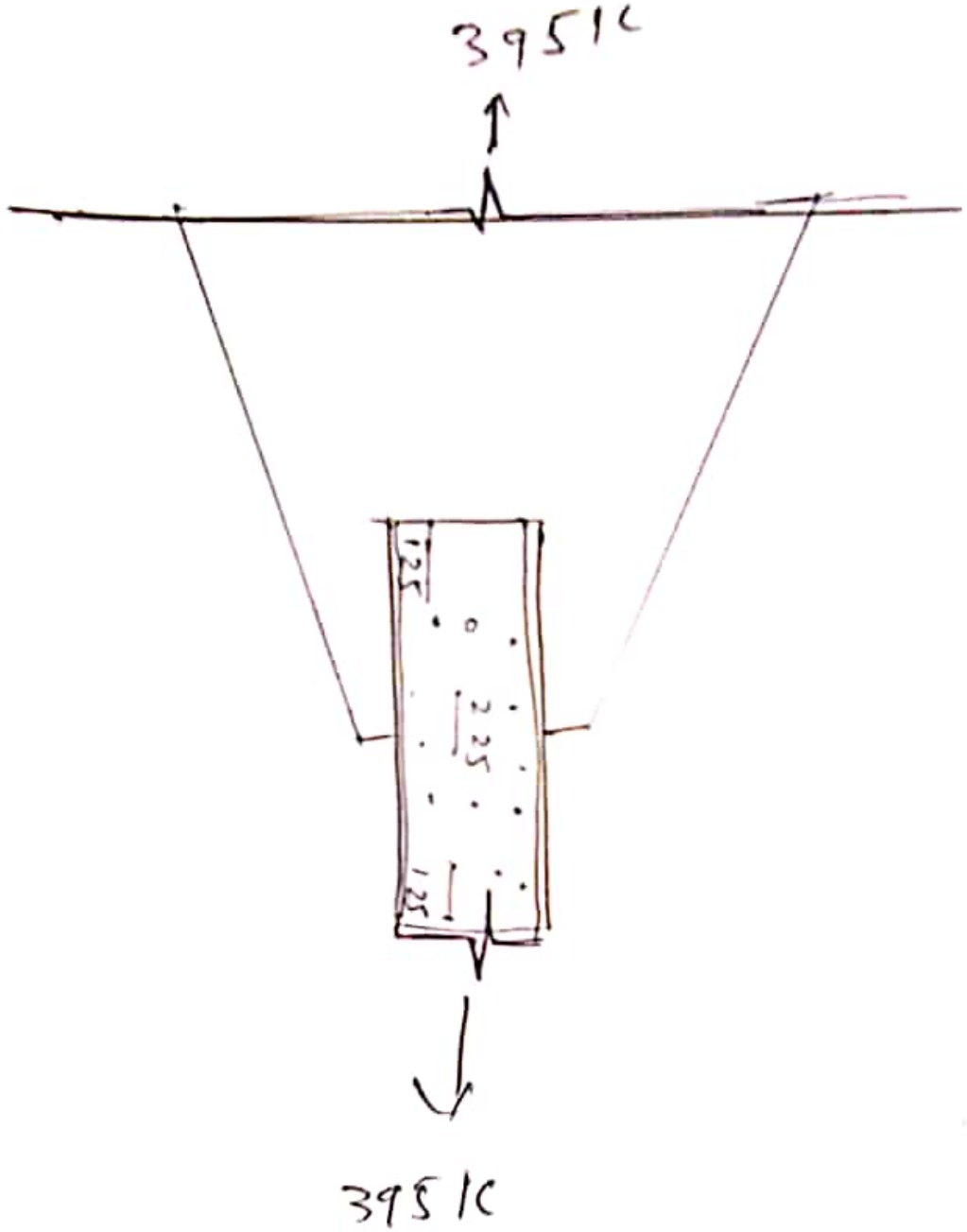
$L = \frac{2P}{F_{ut}} + \frac{d}{2} \Rightarrow 2 = \frac{2P}{58 \times 1} + \frac{3/4}{2}$

capacity :

$3 \times 36.25 + 10 \times 47.134$

$= 674.358 K > 395 K$

O/K



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