Mid term paper
of
Steel structures

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Ans.①

The general statement of design philosophies is that the resistance must be greater than or equal to applied loads and with some Factor of safety.

i-e

Resistance ≥ Effect of Applied loads

ASD (Allowable stress design)

safety in the design is obtained by specifying, that the effect of the loads should produce stresses that is a fraction of the yeild stress fy, say one half.

i-e

$$FOS = \text{Resistance, R} / \text{Effect of load}$$

$$= \frac{fy}{0.5fy}$$

$$= 2$$

Load & Resistance Factor Design :-

To overcome the deficiencies of ASD, the LRFD method is based on Strength of materials

* It considers the variability not only in resistance but also in the effects of load.
* It provide measure of safety related to probability of failure.

LRFD advantages :-

* It accounts for both variability in resistance & load
* It acheives fairly uniform level of safety for different limit state.

ASD advantages :-

The design is quite simpl

LRFD disadvantage :-

Its disadvante is chang in design philosophy from previous meth

ASD disadvantage :-

It only accounts stress le

(2)

Ans:- Types of bolted connections:-

(1) slip-critical connections:-

This connection transmit the force by friction produced between the faying surfaces by the clamping action of the bolts.

These are recommended for joints subjected to stress reversal, severe stress fluctuation, impact, vibration or where slip is objectionable.

2) Bearing type connections:-

Here the load is transfered by shearing and Bearing on the bolt.

capacity in Shear depends on whether shear plane intersects the body of bolt or threaded portion.

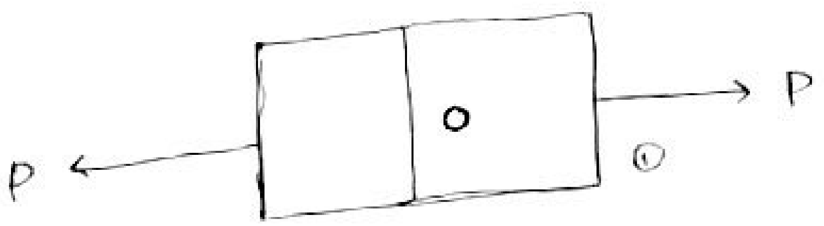
It is most widely used general type of connection in which the load is resisted by the bolt body without any friction between the faying surfaces.

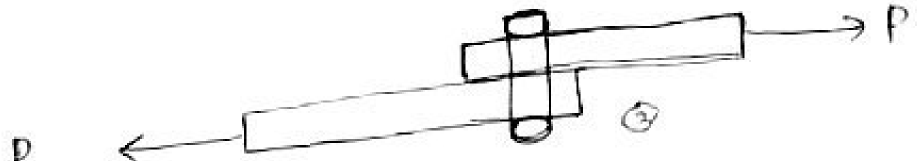
Types of connection failures

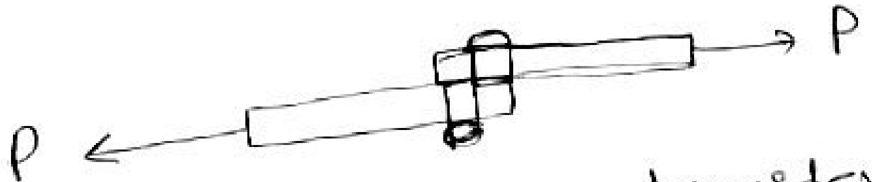
These are

1) Shearing failure of bolt
2) Bearing failure of plate
3) Tearing failure at edge of plate.

i) Shearing failure of bolts:-



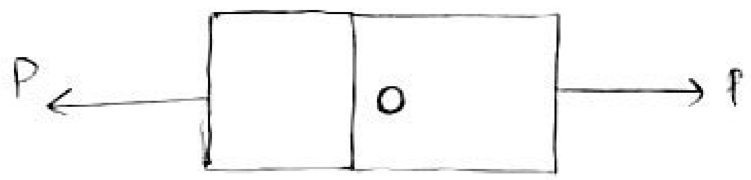


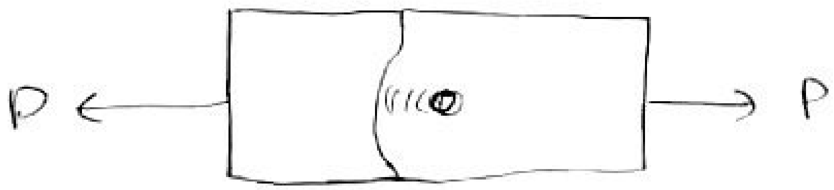


Here the load is transfor by the shearing of bolts and here shering stress exceeds the shear strength of bolts. Thats why the bolts fails in shear. It may be single or double shear.

② Bearing failure of plate:-

This is a failure of plate and the bearing stresses induced on the plate exceeds the bearing strength of the plate and hence failure of the connection occur and known as bearing failure of plate as shown.

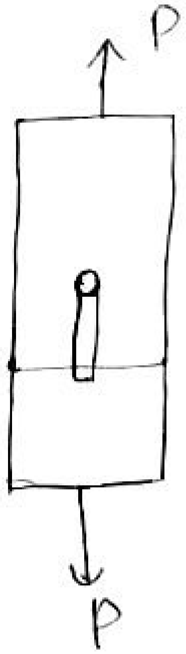




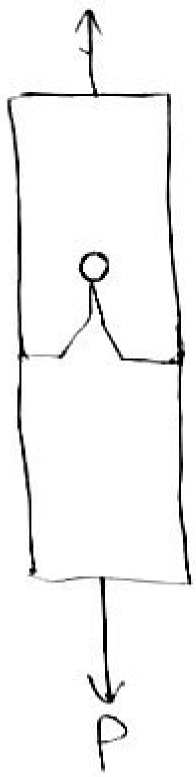
Due to this failure a gap is produced between the bolts and the surface of plate (In bearing)

(3) Tearing of plate at the edges

This failure may be due to shear or tranverse tension failure of the plate. Here the stresses exceeds the shear strength of the plates and hence the plates are sheared at the edge. as shown



Shearing failure



Transverse tension failure.

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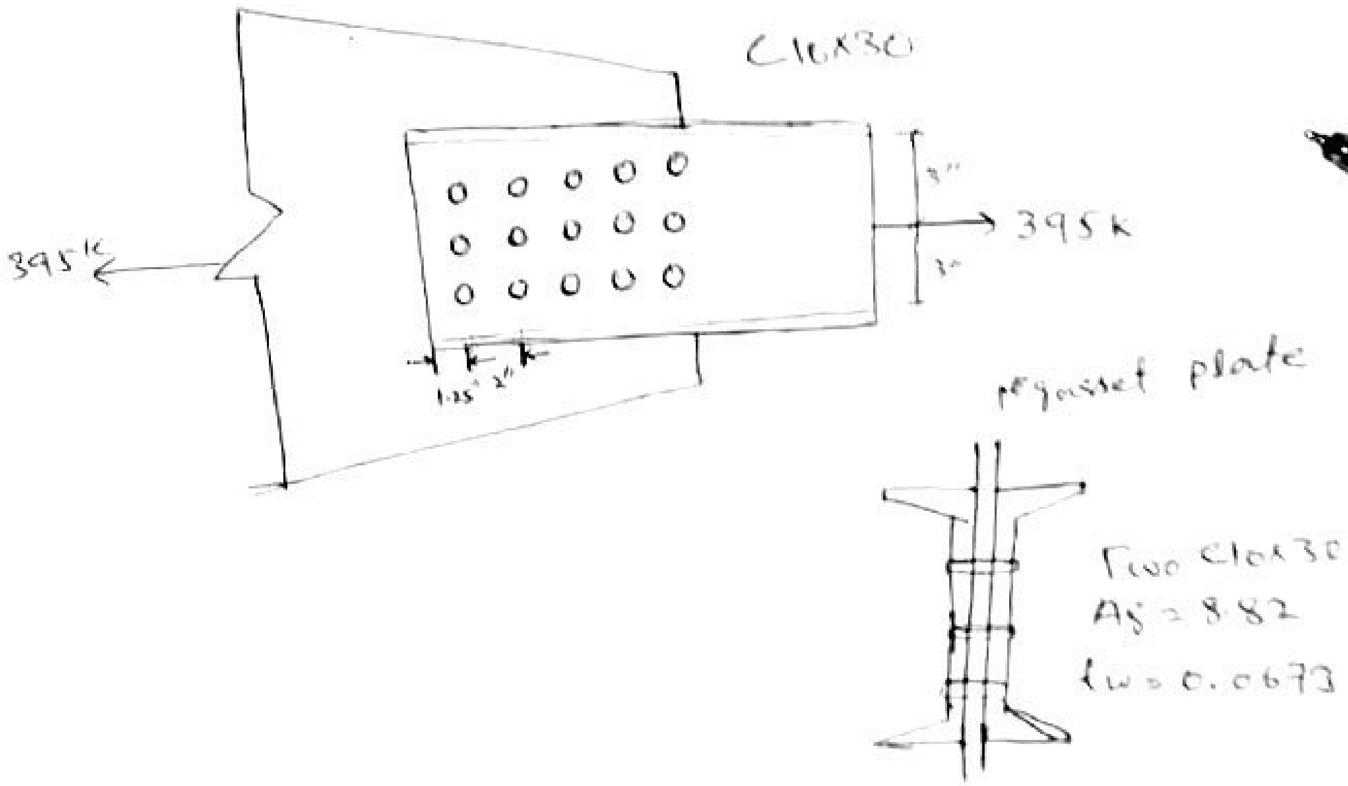
Ans:-



ASD method:-

sol:-

Design force

= 130 + 265

= 395 K

Bolt Design: for $\frac{3}{4}$ in dia bolts

A = 0.4418 in^2 (Area)

Fv = 30 ksi

Rv = 0.4418 x 30 = 13.25 K/shear surface

As the bolts are in double shear

$\Rightarrow$ No. of bolts $= \frac{395}{2 \times 13.25}$

$= 14.9$

$= 15$ bolts

(3) Bearing

$F_p = 1.2 F_u$

$= 1.2 \times 58$

$= 69.6$ KSI

Also

$L_e = 1\frac{1}{2}d$ (From table)

$L = 3d$

Channel:

$R_p = d t F_p$

$= \frac{3}{4} \times 0.673 \times 69.6 = 35.13$ K

For bolts there are 30 surfaces, so

capacity $= 30 \times 35.13 = 1053.9 > 395$ K

Gusset plate

$$R_p = d t F_p$$

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

$$= 52.2 \text{ K}$$

For gusset there are 15 bearing surfaces, so

$$\text{capacity} = 15 \times 52.5$$

$$= 783 > 395 \text{ K}$$

(4) Spacing

End distance, sheared edge: $1\frac{1}{4}$ in min

End distance: $1\frac{1}{2}d = 1.13$ in $\leq 1\frac{1}{4}$ in

centre-centre spacing $= 3d = 2\frac{1}{4}$ in

since Rp for both channel and gusset is very larger than reaquired. conside the min end distance of $1\frac{1}{4}$ in and the min between-connecter spacing of 2 in

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

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

$$\Rightarrow P = 24.4\ K$$

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

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

$$\Rightarrow P = 31.7$$

$$\text{capacity} = 2(3 \times 24.4 + 12 \times 31.71)$$
$$= 907.44 > 395\ K$$

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

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

$$\Rightarrow P = 36.25\ K$$

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

$$\Rightarrow 2 = \frac{2P}{F_u t} + \frac{3/4}{2}$$

$$\Rightarrow P = 47.13$$

$$\text{capacity} = 3 \times 36.25 + 12 \times 47.13$$

$$= 674.31 > 395\text{ K}$$

There fore 15 bolts in three row of five are adequate with end distance of $1\frac{1}{4}$ in & 2" c/c.