7722 Mid term Examination Summer 2020 (1)

Name : Mushtaq Ahmad

ID NO # : 7722

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Instructor : Engr. Amjad Islam

Subject : Stee Structure.

Q NO # 01 ?

General Statement of design philosophies:

A general Statement assuming Safety in Engineering de design.

Resistance (of material & x-section ≥ Effect of applied load ——— 1

In Eq (1) it is Essential that both ~~design~~ 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.

* When partical loading reaches its limit, failure is the assumed result, i.e → the loading condition become failure modes, such a condition is referred to as limit state and it can be define as

* "A limit state is a condition beyond which a structural system or a structural component cease to fulfill the function for

which it is designed".

Example of limit State for Structure with Girder includes:

1. Deflection
2. cracking
3. fatigue.
4. Flexure
5. Shear
6. Torsion
7. Buckling
8. Settlement
9. Bearing
10. Stability.

ASD ⇒ Safety in design is obtained by specifying that the effect of the load should produce Stress that is a fraction of the Yield Stress "fy" say one half.

FOS = Resitance "R / effect of load Q

= fy / 0.5 fy

= 2.

* Methemelical description of ASD

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

ASD :- combined dead load and Live load treats them in the Same way.

ASD merit: (1) Elastic analysis for load become compatible for design.

② Experience Engineering are used to this method.

③ In past it was the only method for design purpose.

④ this method is included in Aisc-05 Specifications as an alternate method.

Demerits ASD

① latest research and Literature is very limited

② Same factor of Saftey is used for different load.

③ Filure mode is not directly predicted

⑤ the filure mode can not be observed.

LRFD

Saftey in the design is obtained by Specifying that the reduced nominal Strength of a design Structure is less than the effect of factor load acting on the Structure

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

LRFD:- LRFD is more rational

as different factor of safety can be assigned to different loadings such as Dead load, live load, Earthquake load and Impact loads.

LRFD merits

① LRFD accounts for both Variability in resistance and load

② It achived fairly uniform factor of safety for different limit state

③ it provids a rational and consistant method design.

LRFD Demerits

* ① it is disadvantages is change in design philosophy from varius method.

② it required an understanding of the basic concept of probability and statistics

③ it required availability of sufficent statistica data and probabilistic design algorithms to make adjustment in resistance factor to meet individu situation

Q NO#02 typs of bolt connection in Steel Structure

① Slip-critical connection

→ Connection transmit the force by friction produced between the faying surface by the clamping action of the bolt.

↳ Slip-critical connection are recomanded for joints to stress reversal, Serve Stress function impact, vibration or where slip is objectionable-

② Bearing type connection

load is transmit by shearing and bearing on the bolt. capacity in shear depends on whether shear plane intersects the body of the bolt or threaded portion.

in the bearing type connection in which the load is resisted by the bolt body without any friction btween fying surface.

Failure in bolt connection

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~~① Shearing failure of bolt.~~

~~② Bearing failure of plate bolt.~~

~~③ Tearing failure of edge of plate.~~

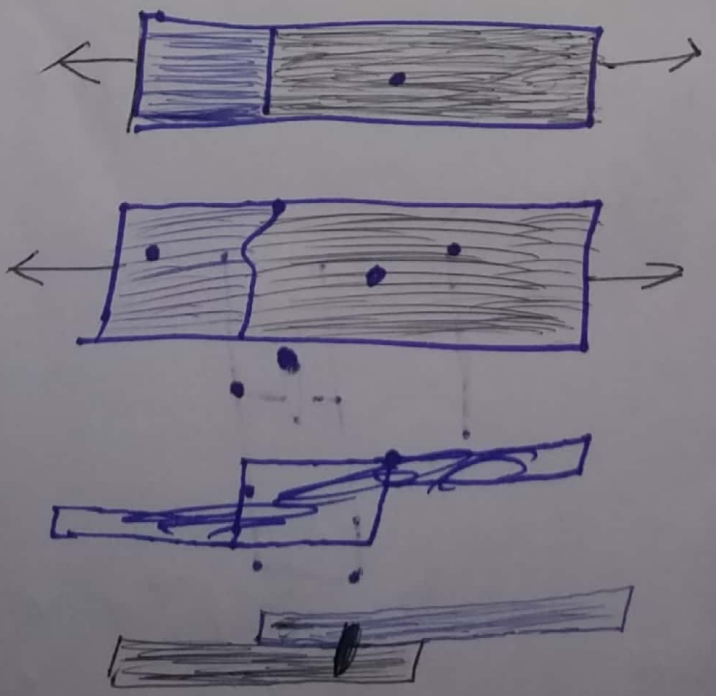
① Shear failure of bolt

② Bearing failure of bolt

③ Tension failure of bolt.

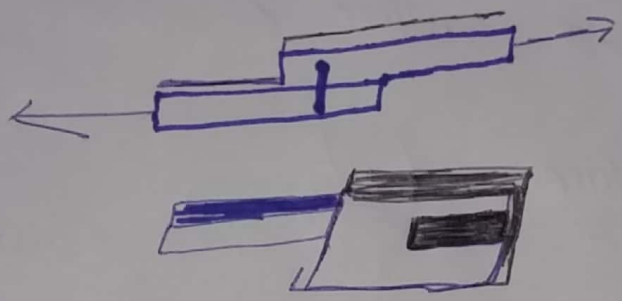
① Bearing failure of bolt

if the connected plates are made of high strength steel than failure of bolt can take place by bearing of the plates on the bolt.



② Shearing failure of bolt

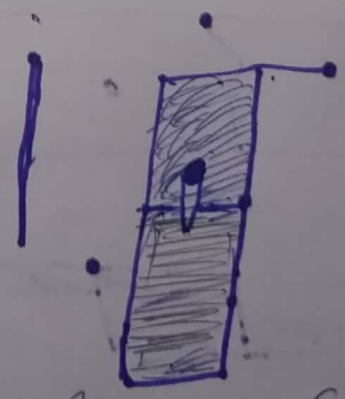
= = = failure of membring being connected due to fracture or or block Shear - edge - tearing or fracture of the connected plate of between two bolt holes.



③ tension failure of bolt

= = = tension failure of bolt connection to elongate to surface from each other that provides clamping force of a joint wher torque measure of the twisting force.

transverse tension failure



Shearing failure edge of plate.

Q No #03:

Given data: D.L = 130 K.

L.L = 265 K

C10 X 30

gusset plate thickness 1 inch

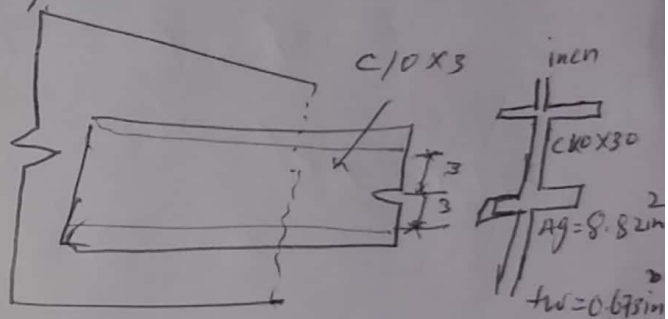
Bolt dia = 3/4 inch

A-325, A-36 steel.

three bolts lines.

Required? no of bolts = ?

Using ASD = ?



Soln:

Sol:→

① finding total service load = D.L + L.L

= 130 + 265 = 395 Kips

② Bolts Design: for 3/4 dia.

Area = 0.4418 in² (nominal area)

Fv = 30 ksi (Shear strength of bolt in single shear table 2-11)

Rv = 0.4418 X 30

Rv = 13.25 kips / shear surface

↳ resistance effect by single shear.

As there are two shear surface per bolt.

No of bolt $= \frac{395}{2 \times 13.25} = 14.90 \simeq$ **15 bolt**

③ Bearing:

$F_p = 1.2 f_u$

$F_p = 1.2 \times 58$

$$\boxed{F_p = 69.6 \text{ ksi}}$$

$\Rightarrow l_e = 1\frac{1}{2}d$

$l_e = 3d$ (table 2-9)

Channel

$R_p = d \cdot F_p = \frac{3}{4} \times 0.673 \times 69.6$

$R_p = 35.13$ kips (single bearing surface of channel)

For bolt these are 30 bearing surface

So;

Capacity $= 30 \times 35.13$

$= 1053.9 \geq 395$ kips.

Gusset plate $R_p = dt F_p$

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

$$\boxed{R_p = 52.2 \text{ kips}}$$ single bearing surface of gusset plate.

For gusset plate these are 15 bearing surfaces

Capacity = 15×52.2

$= 783 > 39.5$ kips

OK

(4) Spacing

End distance Shear edge = $1\frac{1}{4}$ minimum

End distance = $1\frac{1}{2}d = 1.13$ in $\leq 1\frac{1}{4}$ in (table 2-8, 2-9)

Center to center distance = $3d = 2\frac{1}{4}$ in

→ As we can see that R_p for both channel and gusset plate is considably greater than required consider minimum End distance of $1\frac{1}{4}$ in and the minimum between connection spacing of 2 in

$le = \frac{2P}{fut} = 1.25$ [$t = 0.673$, table 1-5 AISC manual]

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

$P = 24.4$ kips

P to -

$$l = \frac{2P}{fut} + \frac{d}{2}$$

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

$$P = 31.7 \text{ kips}$$

$$\text{Capacity} = 2(3 \times (24.4) + 12(31.7))$$

$$\text{Capacity} = 907.2 > 395 \text{ kips OK}$$

Gusset plate

$$le = \frac{2P}{fut} = 1.25 =$$

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

$$P = 36.25 \text{ kips}$$

$$l = \frac{2P}{fut} + \frac{d}{2} \Rightarrow 2 = \frac{2P}{58 \times 1} + \frac{3/4}{2}$$

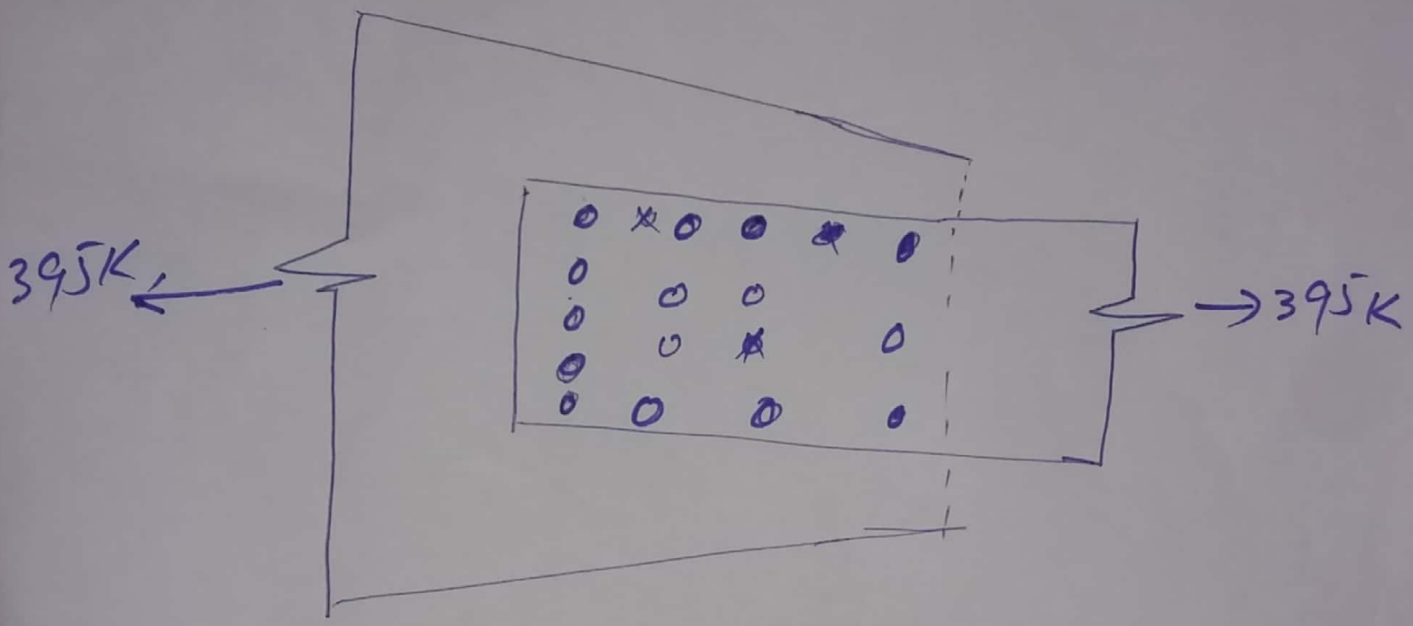
$$P = 47.13 \text{ kips}$$

$$\text{Capacity} = (3 \times (36.25) + 12(47.13))$$

$$\text{Capacity} = 674.31 > 395 \text{ kips}$$

OK

So use 15 bolt in 3 rows 13
Of five with End distance 1 1/4 in
and center to center distance
Spacing of 2in



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