Name : Salman Abdullah Khan

ID : 7772

Subject : Steel Structure

Date : 25/Aug/2020

Submitted to Sir Engr Amjid Islam

Q1:-

Design Philosphies

- A general statement assuming Safety in engineering design

  Resistance (of materials & x section) ≥ Effect of applied load — (1)

- In eq (1) 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.

- When particular 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 defined as.

- A limit state is a condition beyond which a structural system or a structural component ceases to fulfill the function for which it is design.

Allowable Stress Design (ASD)

- Safety in the design is obtained by specifying, that the effect of the load should produced stresses that is a fraction of the yield stress f_y, say one half.

- This is equivalent to:

FOS = Resistance R / Effect of load, Q

$= f_y / 0.5 f_y$

$= 2$

Mathematical Description of ASD

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

R_n: Resistance or Strength of the Component being designed

ϕ: Resistance Factor or Strength Reduction Factor

γ: Overload or Load Factors

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

Q_i : Effect of applied loads.

Draw backs

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

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

- Another draw is ASD is that Safety is applied only to stress level. Loads are considered to be deterministic (without variation).

LRFD

- To overcome the deficiencies of ASD, the LRFD method is based on: Strength of Materials.
- It considered the variability not only in resistance but also in the 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

Q_i = Effect of Applied loads.

n = Takes into account, ductility, redundancy and operational imp,

ϕ = Resistance Factor or strength Reduction Factor

γ = Overload or load Factor.

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

Advantages

- LRFD accounts for both variability in resistance and load.
- It achieves fairly uniform levels of safety for different limit states.

Disadvantages

- It's disadvantage is change in design philosophy from previous method.

Qno 2:

Ans:

Bolts:

Bolted Connection are used when it is necessary to faston two elements tighting together, especially to resist shear and bending ~~to~~ ~~as~~ in Column and beam Connections.

Types of Bolted Connections:

⇒ Slip Critical Connection:

- Connection transmit the force by friction produced between 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.
- The clamping force applied to the bolts brings the two members close enough So that appreciable friction is produced between them which is then responsible for resisting the load. The more the clamping force the more is the friction and strong is the Connection but the clamping force need not be greater than tensile strength of the bolt.

⇒ **Bearing type Connection**

- Load is transferred by shearing and bearing on the bolt.

⇒ Capacity in shear depend on whether shear plane intersects the body of bolt or threaded portion.

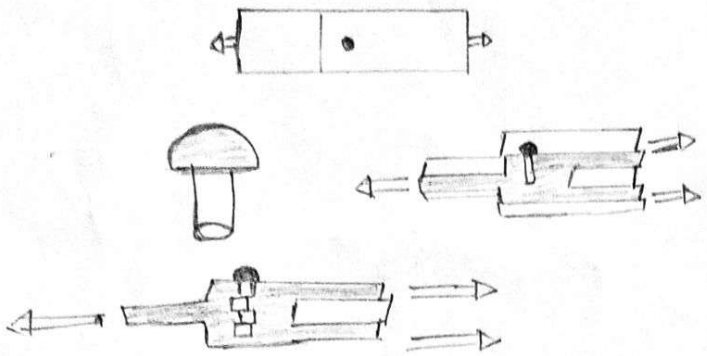
Types of Failures

⇒ Shearing Failure of Bolts.

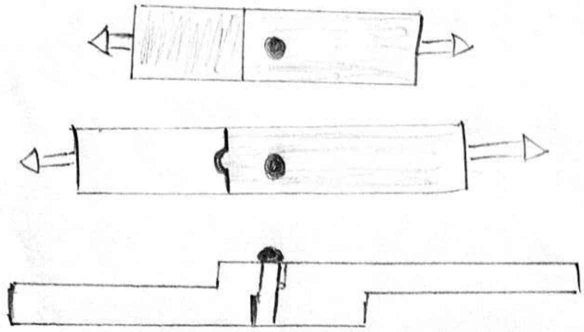
⇒ Bearing Failure of plate

⇒ Tearing failure at edge of plate

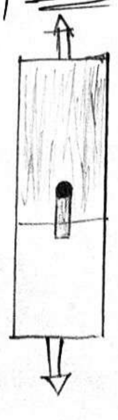
(1) Shearing Failure of Bolts:



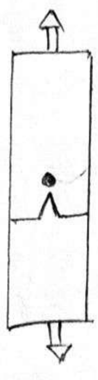
(2) Bearing Failure of Plate:



Tearing Failure at the edge of plate:



Shearing Failure edge of plate



Transverse Tension Failure

Question no 3 ⑧

Given Data

Dead load = 130k

Live load = 265k

Sectio = C10x30

Gusset plate = 1 in

Bolts diameter = 3/4 in

A 325, A36

three bolts lines

Required:

No of bolts = ?

Capacity using ASD = ?

Solution

1) Finding total Servic load

$= 130 + 265 = 395$ kips

(2) Bolts Design:

For 3/4 dia

Area = 0.4418 in² (Nominal Area)

$F_v = 30$ ksi (shear strength of bolt in single shear Table 2-11)

$R_v = 0.4418 \times 30$

$R_v = 13.25$ kips/shear surface

↳ Resistance offered by a single in shear.

As there are two shear surface per bolt

No of bolts $= \frac{395}{2 \times 13.25} = 14.90 \approx 15$ bolts

(3) Bearing

$F_P = 1.2 F_v$ (specification allowable stream)

$F_P = 1.2 \times 58$

$F_p = 69.6$ ksi

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

$L = 3d$ (Table 2-9)

Channel

$R_p = d\,t\,F_p = 3/4 \times 0.673 \times 69.6$

$R_p = 35.13$ kips (Single bearing Surface of channel)

For bolts there are 30 bearing Surface so;

Capacity = 30×35.13

$= 1053.9 > 395$ kips

Gusset plate

$R_p = d\,t\,F_p$

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

$R_p = 52.2$ kips (Single bearing Surface of gusset plate)

For gusset plate there are 15 bearing Surface so;

Capacity = 15×52.2

$= 783 > 395$ kips ok

(4) Spacing

End distance sheared 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 and 2-9)

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

As we can see that L_p for both channel and gusset plate is considerally greater than required. Consider minimum end distance of 1 1/4 in and the minimum between connection spacing 2 min

$$L_e = \frac{2P}{F_u t} = 1.25$$

[t = 0.673 from table 1-5 AISC Manual]

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

$$P = 24.4 \text{ kips}$$

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

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

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

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

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

Gusset

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

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

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

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

Capacity = $(3 \times (3.625) + 12\,(47.13))$

Capacity = $674.31 > 345$ kips ok

So use 15 bolts in 3 rows of five with End distance $1\frac{1}{4}$ in and Center to Center Spacing of 2 in