مراجعة Steel
رابعة انشاءات
٤ م/ رمزي

# Final Term Revision

# Part (2-A)

# Summary

# 2013-2014

# *Revision Content*

## *Summary For :-*

*1-General Lay out for truss bridge*

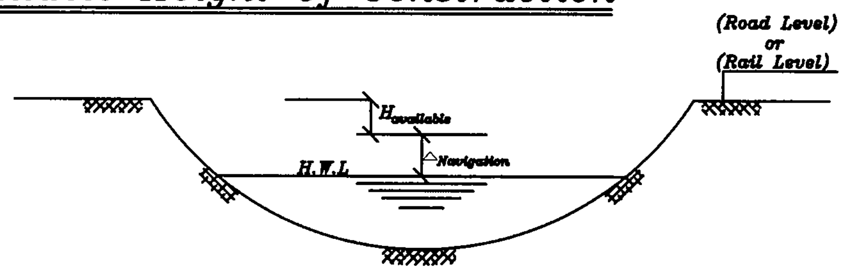
*2- Maximum forces in truss members*

*3-Design of truss members*

*4- Connection between truss members*

# 1-General Lay out

## Available Height Of Construction




$H_{available}$ = Road Level (Rail Level) − H.W.L − △Navigation

△Navigation(Given) , Road Level(Given) , H.W.L(Given)

$H_{available}$ ??

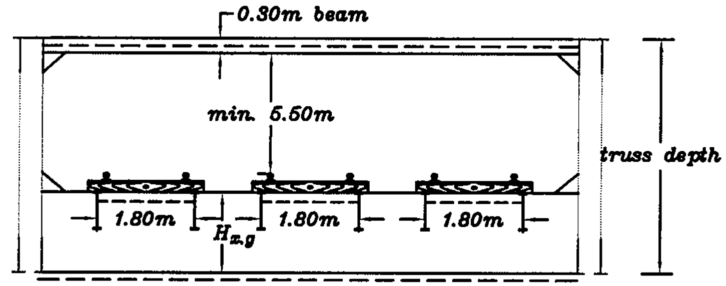
وعلى هذا يجب ان يكون $H_{Construction}$ اقل من او يساوى $H_{available}$

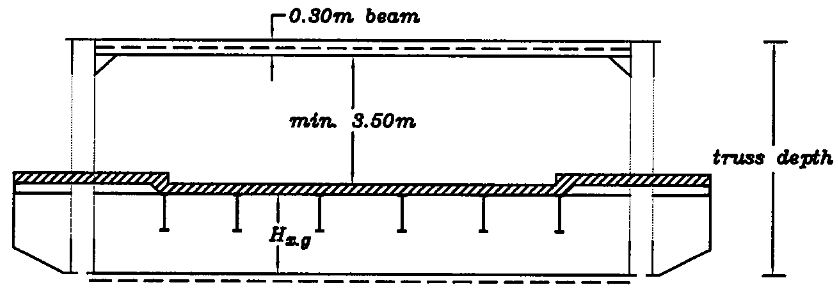
If $H_{deck} = \frac{Span\ (L)}{(8 \longrightarrow 12)} + X.00m \leq H_{available}$ , Use Deck Bridge
X.00m (Road way)

If $H_{deck} = \frac{Span\ (L)}{(8 \longrightarrow 12)} + X.00m > H_{available}$ , Use Pony Or through
X.00m (Road way)

من القوانين السابقه نستنتج انه اذا كان ارتفاع الكمره + X سم
اقل من الارتفاع المسموح (معطى فى المساله) يتم استعمال Deck Bridge
اما اذا كان اكبر يتم استعمال through Or Pony
ولكى يتم معرفه ما اذا كان الكوبرى through Or Pony

## How to Determine Wither the bridge is through or pony

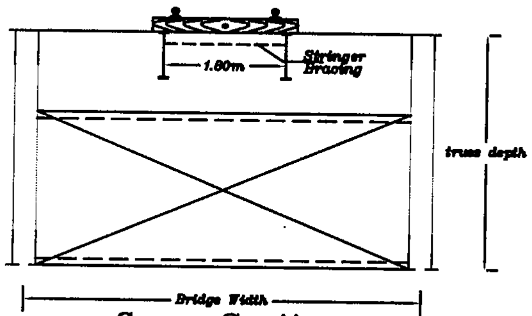


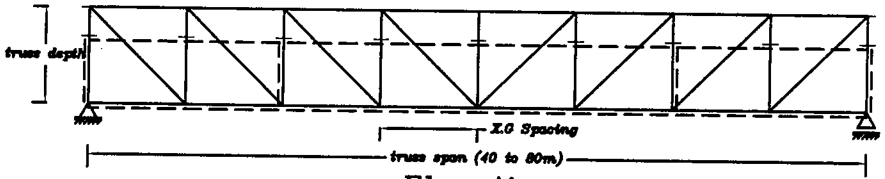

If $H_{truss}$ − 0.35(Rail) Or 0.3(Road) − 0.3(beam) − $H_{x.g} \geq$
3.50m (RoadWay) then use through bridge
5.50m (RailWay) then use through bridge

**If not use pony bridge**

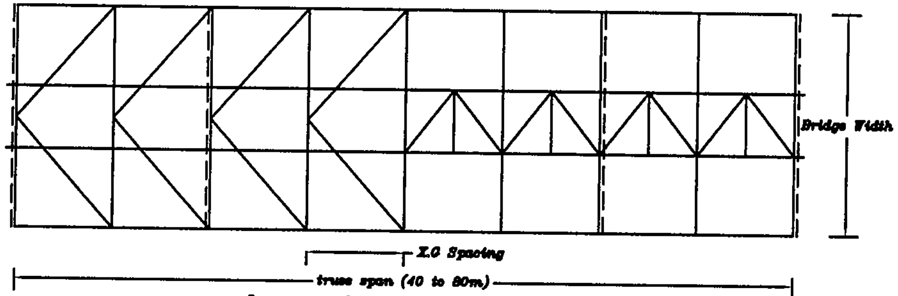
## truss deck bridge railway single track with Vertical Bracing



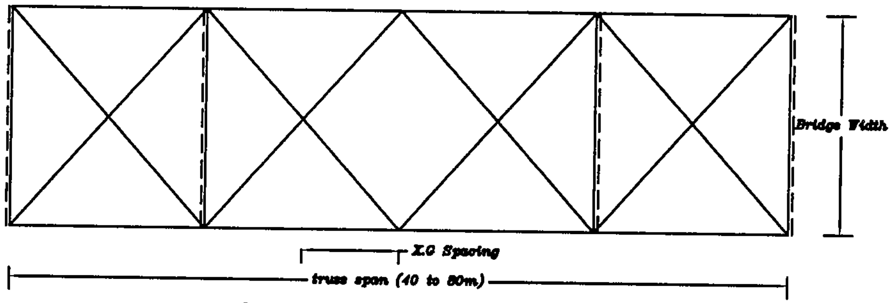

Cross Section




Elevation

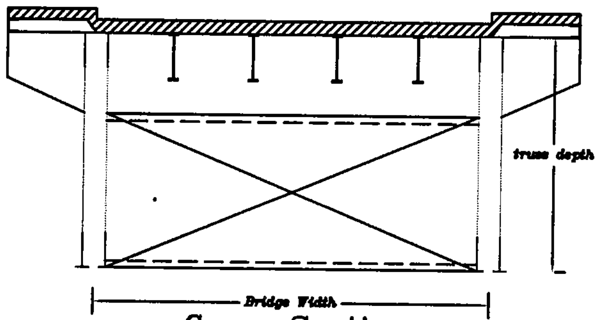



plan of upper bracing

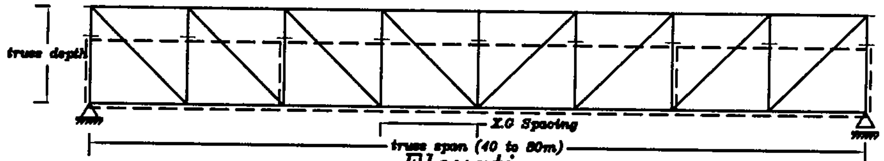



plan of lower bracing

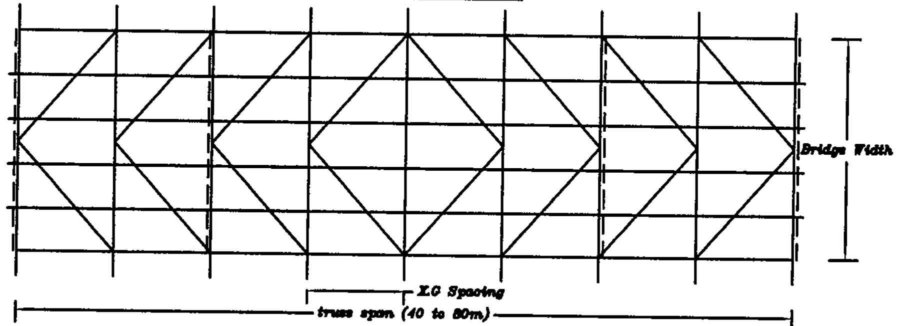
## truss deck bridge roadway with Vertical Bracing



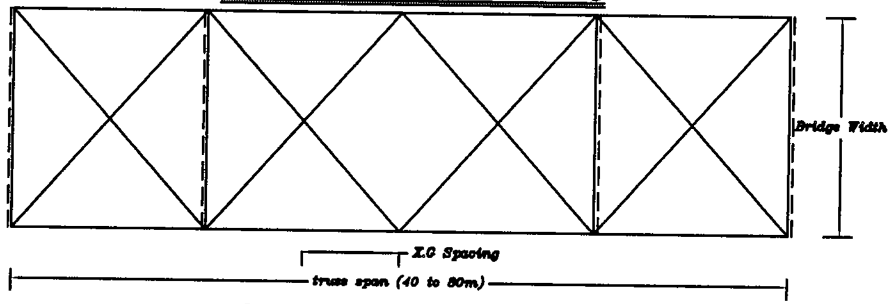

Cross Section




Elevation

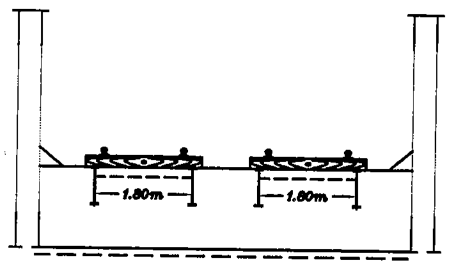



plan of upper bracing

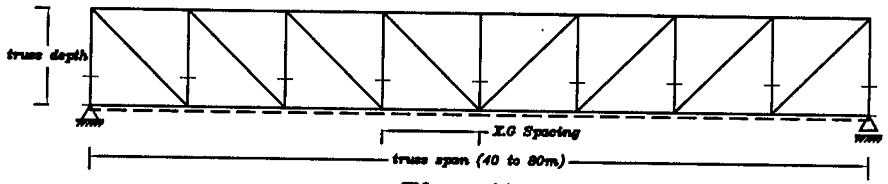



plan of lower bracing

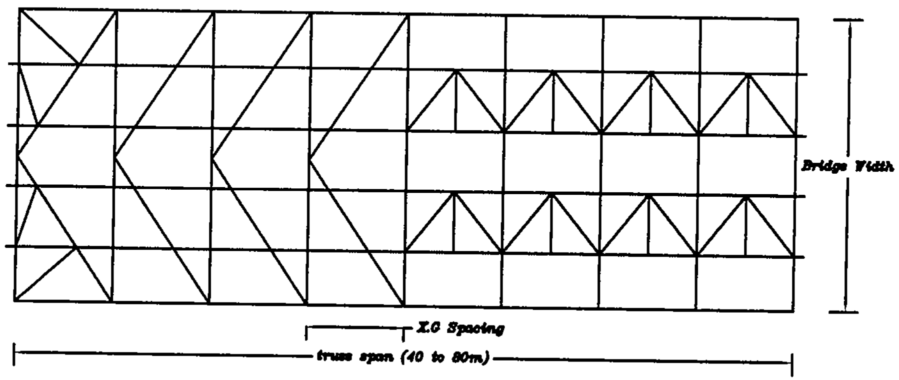
## truss Pony bridge railway Double track




Cross Section

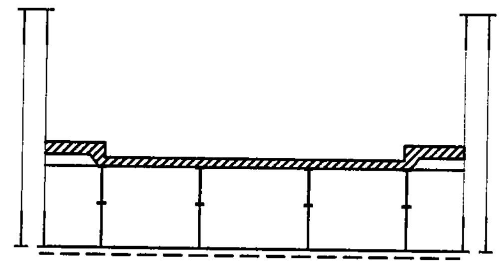



Elevation

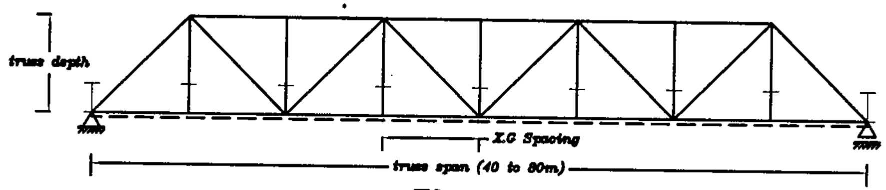



plan of lower bracing

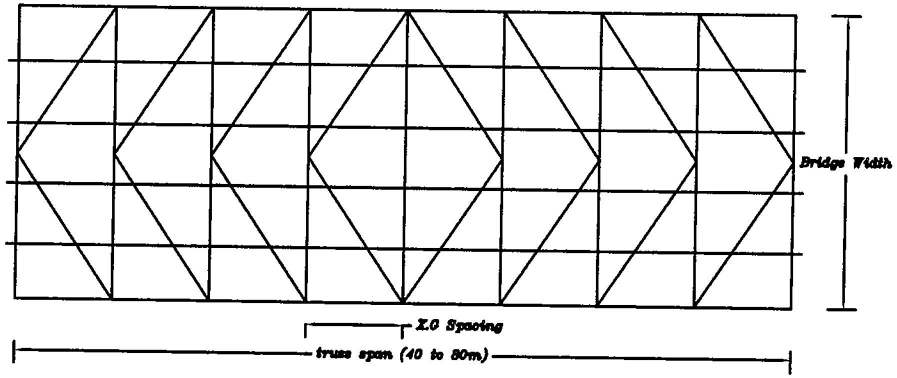
## truss Pony bridge road way



Cross Section



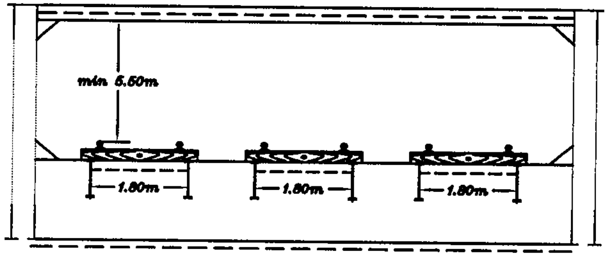

Elevation



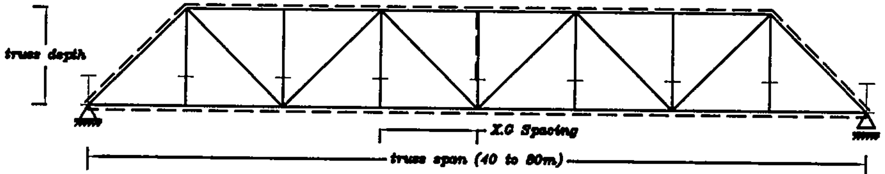

plan of lower bracing

هذا الشكل مفضل تماما لل Pony Bridge

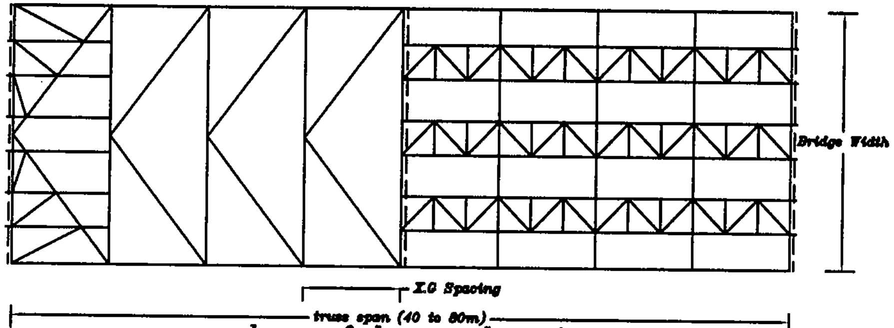
## truss through bridge rail way triple track (1)



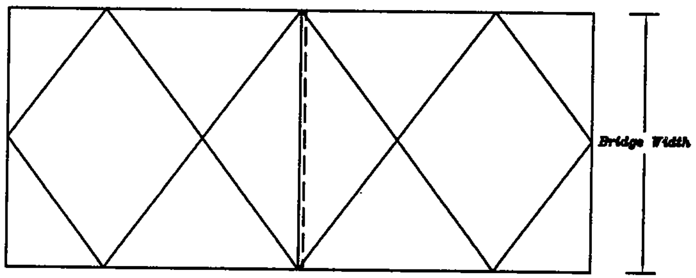

Cross Section




Elevation

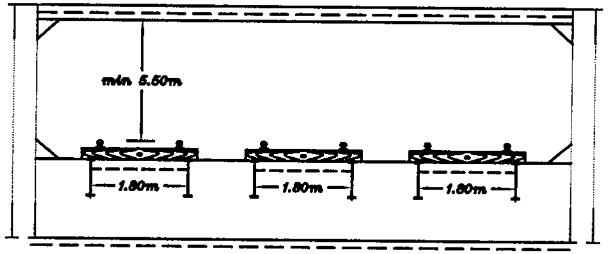



plan of lower bracing

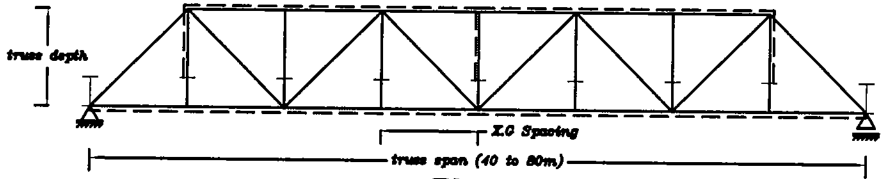



plan of upper bracing

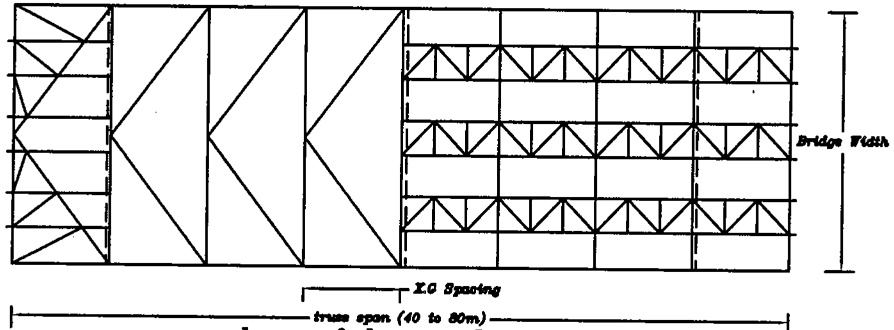
## truss through bridge rail way triple track (2)



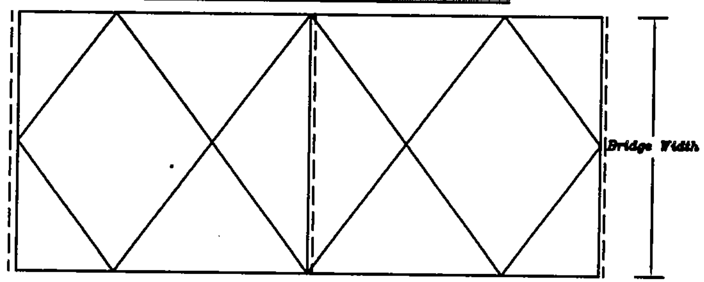

Cross Section




Elevation

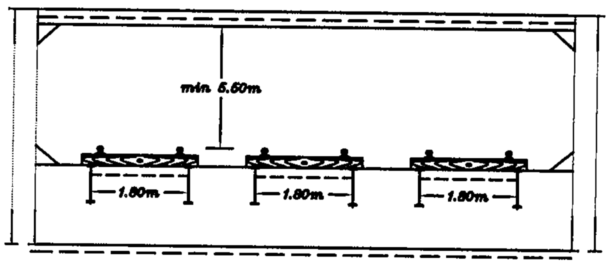



plan of lower bracing

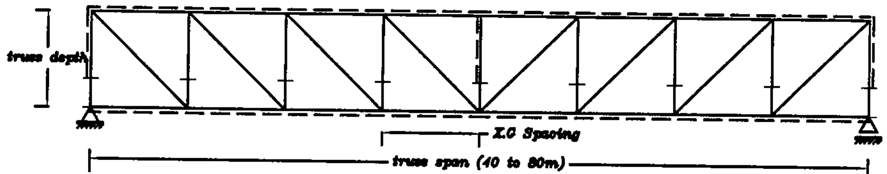



plan of upper bracing

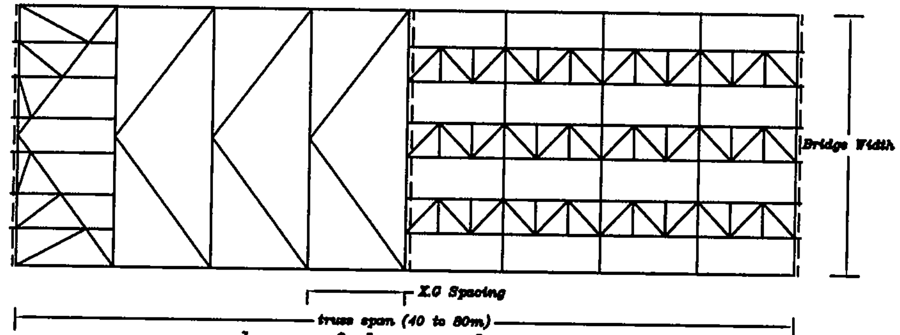
## truss through bridge rail way triple track (3)



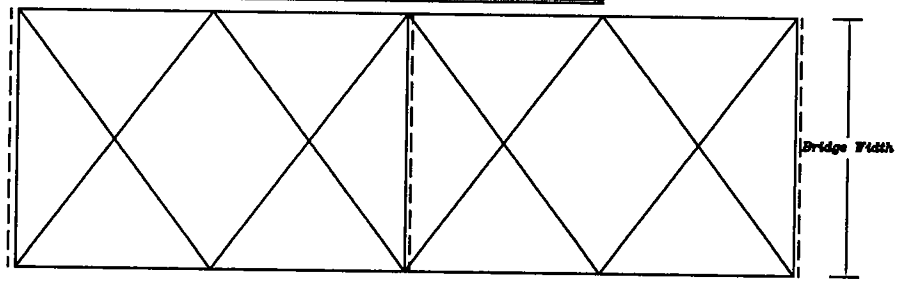

Cross Section




Elevation

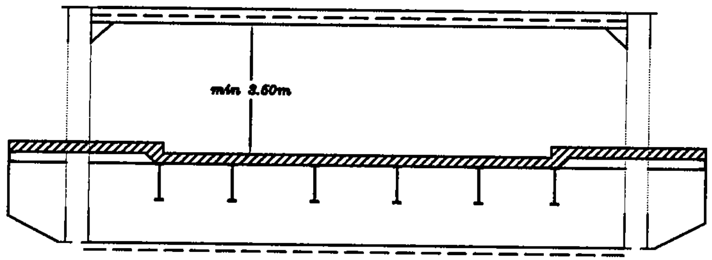



plan of lower bracing

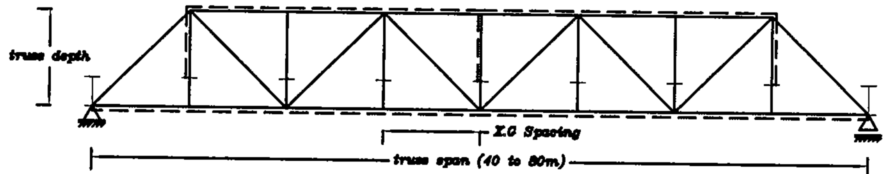



plan of upper bracing

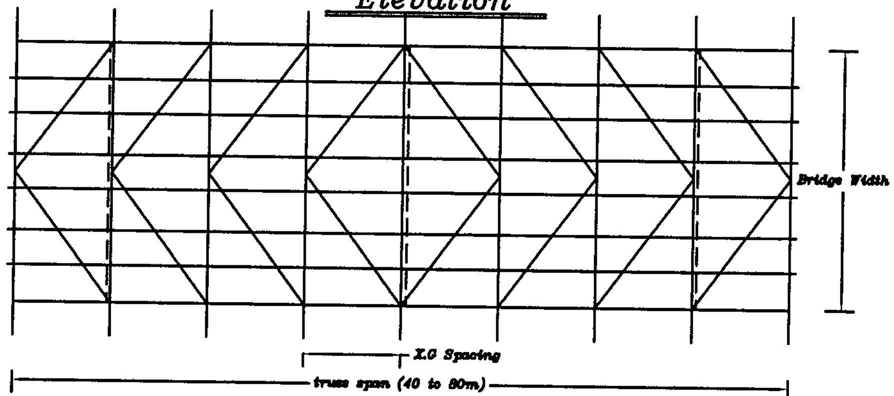
## truss through bridge roadway



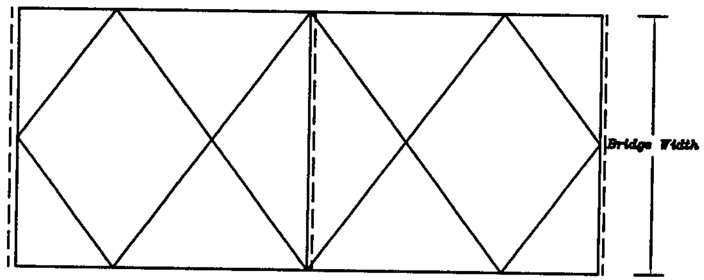

Cross Section




Elevation



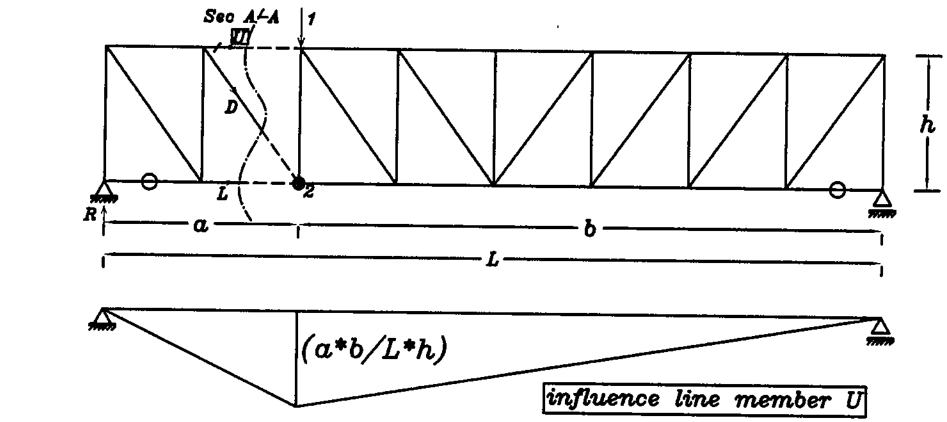

plan of lower bracing




plan of upper bracing

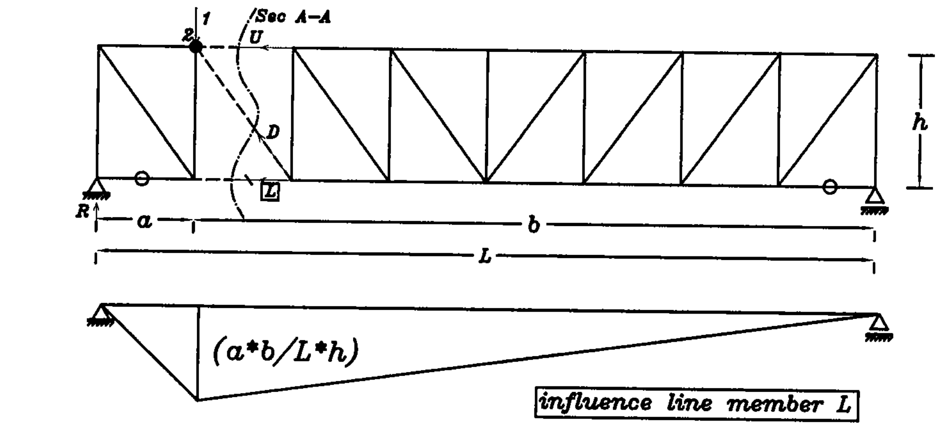
## 2-Maximum Forces in truss members

### a) Upper Chord (Comp.)



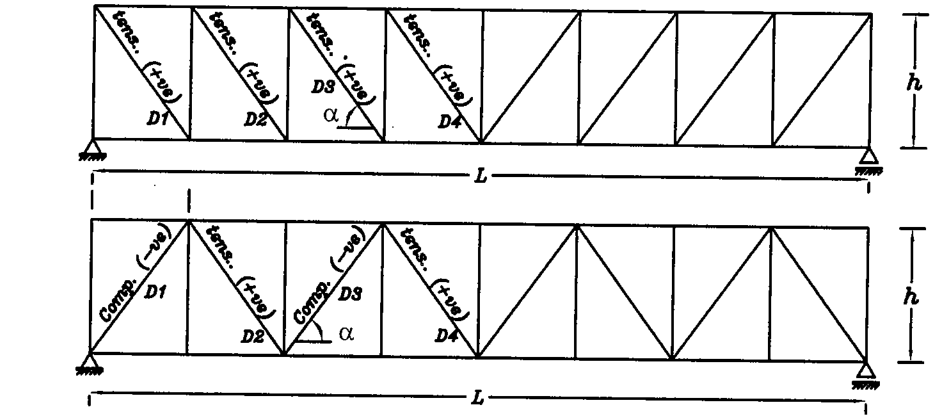
influence line member U

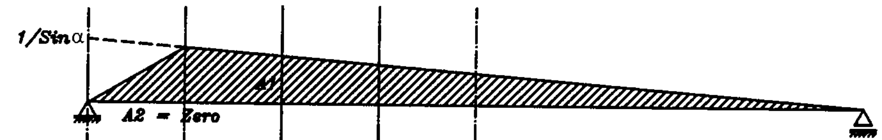
### b) Lower Chord (tension)



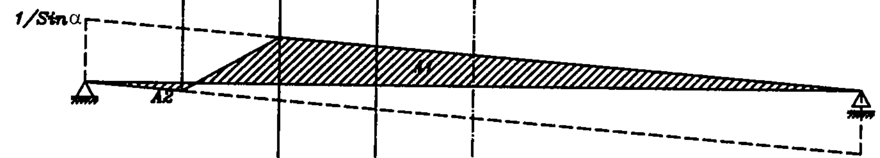
influence line member L

### c)I.L.Force For Diagonal Member

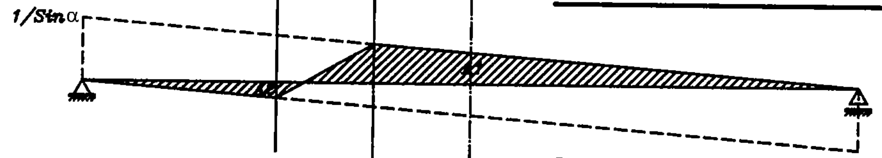


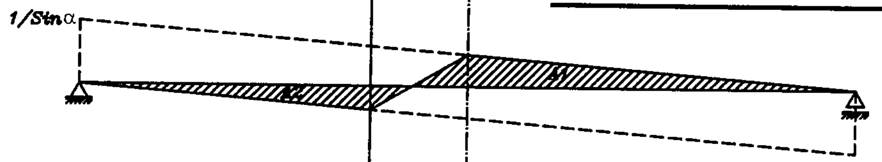
I.L.Force For Member D1



I.L.Force For Member D2



I.L.Force For Member D3

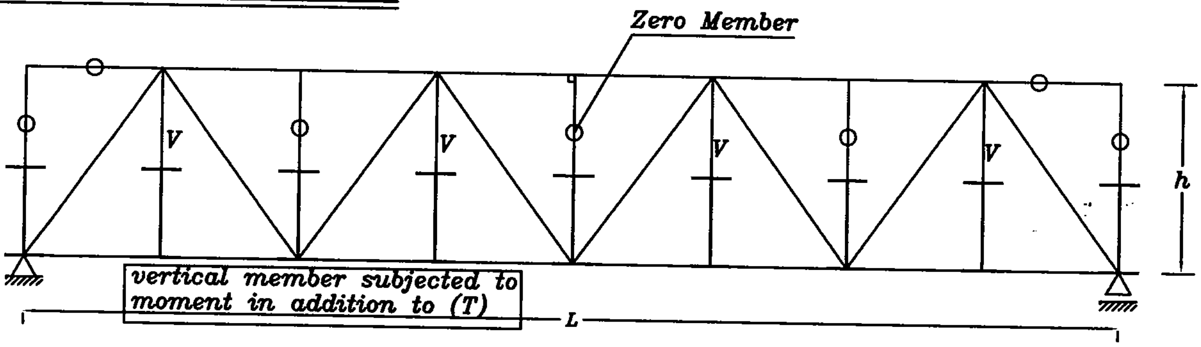


I.L.Force For Member D4

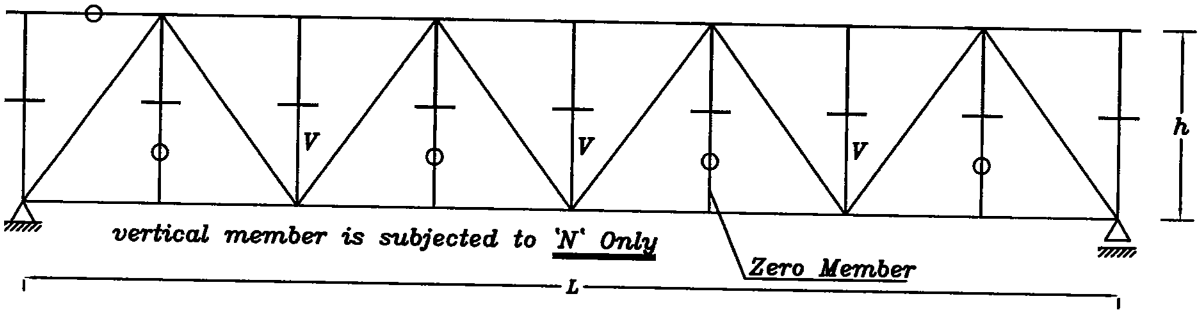
الاشارات الموضحة على الMembers تاتى نتيجة تحميل المساحة A1

# d–Calculating Force in Vertical Chord

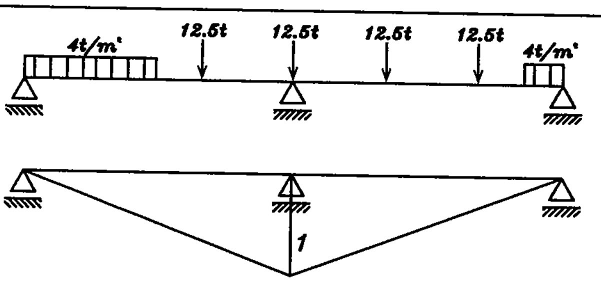
## d–i Warren truss




all Vertical member in pony bridge is **tension member**



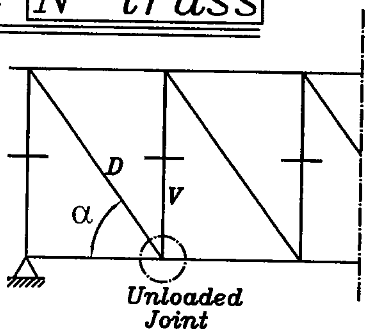

all Vertical member in Deck bridge is **Compression member**

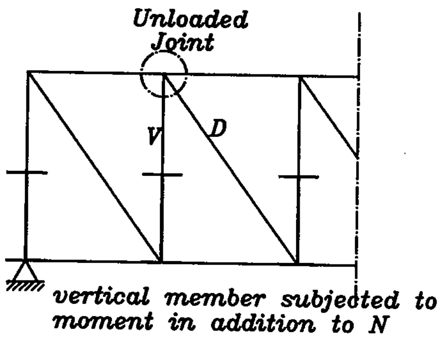



I.L.Force Vertical Member

**tension Or Compression**

## d–ii N–truss




$F_V = F_D * \sin\alpha$

if Diagonal member is tension then the vertical member is compression member

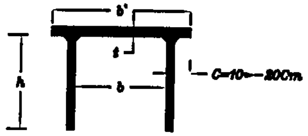
لاحظ انه يتم تحليل ال Joint التى ليس عندها X.G للحصول على ال Force داخل ال Vertical Member

# 6-Design of truss members

## a)Design Procedure Of Upper Chord

Upper Chord designed as a compression member

1)assume compression stress to be :




$F_c$ = 1.4t/Cm² For St.44

$F_c$ = 1.7t/Cm² For St.52

2)$F_c = \frac{max.\ force}{area}$

A=2ht+b'*t = .....Cm²  $h = \frac{Pannel\ length}{10 \longrightarrow 15}$

b=(0.75 ⟶ 1)h  For deck or through bridge

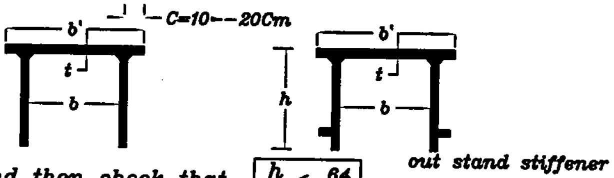
b=(1.00 ⟶ 1.25)h  For Pony bridge

b'= b+2*(10 ⟶ 20Cm)

### Checks

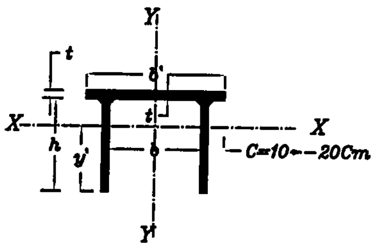
**1-Check Compactness**

$\frac{b}{t} \le \frac{64}{\sqrt{F_y}}$ , $\frac{C}{t} \le \frac{21}{\sqrt{F_y}}$ , $\frac{h}{t} \le \frac{30}{\sqrt{F_y}}$




if $\frac{h}{t} > \frac{30}{\sqrt{F_y}}$ use outstand and then check that $\boxed{\frac{h}{t} \le \frac{64}{\sqrt{F_y}}}$

**2-Check global buckling**




$y' = \frac{(2ht*0.5h)+b'*t(h+0.5t)}{2ht+b't}$ =.......Cm

$I_x = 2*\frac{t*h^3}{12} + 2*t*h*(y'-0.5h)^2$
$+b'*t*(y'-h-0.5t)^2$ = .....Cm⁴

$I_y = 2*t*h(0.5b+0.5t)^2 + \frac{t*b'^3}{12}$ = ........Cm⁴

A=b'*t+2*h*t

Calculate $r_x = \sqrt{\frac{I_x}{A}}$ =..........Cm  Calculate $r_y = \sqrt{\frac{I_y}{A}}$ =..........Cm

$\lambda_{in} = \frac{buckling\ length\ inplane\ =\ L_{in}}{raduis\ of\ gyration\ @\ x\ axis\ =\ r_x}$ ≯ 90 (RailWay) 110 (RoadWay)

$\lambda_{out} = \frac{buckling\ length\ outplane\ =\ L_{out}}{raduis\ of\ gyration\ @\ y\ axis\ =\ r_y}$ ≯ 90 (RailWay) 110(RoadWay)

**3-Check Compressive Stresses**

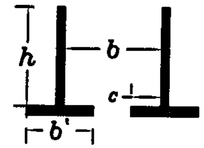
actual stresses = $f_{ca} = \frac{F_{D+LL+I}}{A}$ =........t/Cm² ≯ $F_c$

allwable stresses = $F_c = 1.6-8.5*10^{-5}*\lambda^2_{max}$  For St.44

allwable stresses = $F_c = 2.1-13.5*10^{-5}*\lambda^2_{max}$  For St.52

## b)Design Procedure Of Lower Chord

$h = \frac{Pannel\ length}{10 \longrightarrow 15}$




b=(0.75 ⟶ 1)h  For deck or through bridge

b=(1.00 ⟶ 1.25)h  For Pony bridge

b'=(1/2 ⟶ 2/3)b

1)assume tension stresses to be :

$F_{max} = \frac{F_{sr}}{1-\frac{T_{min}}{T_{max}}}$  Or  $0.58F_y$ → 1.6 t/Cm² St.44 ; 2.1 t/Cm² St.52

$F_t$ = Smallest of $F_{max}$ Or $0.58F_y$

2)$F_t = \frac{max.\ force\ T_{D+LL+I}}{area}$

get A = ...........Cm²

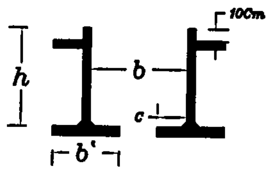
A=2*h*t+2*b'*t = .....Cm²  get t from this equation

### Checks

لايفضل عمل هذا ال check فى حالة ال tension

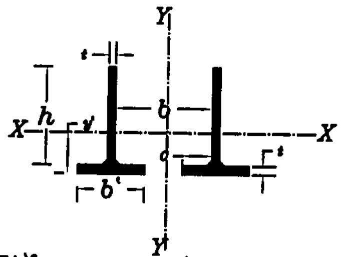
**1-Check Compactness**

$\frac{h}{t} \le \frac{30}{\sqrt{F_y}}$ , $\frac{C}{t} \le \frac{21}{\sqrt{F_y}}$ , C = b'/2




if $\frac{h}{t} > \frac{30}{\sqrt{F_y}}$ use stiffener and recheck $\boxed{\frac{h}{t} \le \frac{64}{\sqrt{F_y}}}$

**2-Check global buckling**




$y' = \frac{2*h*t*(0.5h+t)+2*b'*t(0.5t)}{2ht+2b't}$ =.......Cm

$I_x = 2*\frac{t*h^3}{12} + 2*t*h*(y'-(0.5h+t))^2$
$+2*b'*t*(y'-0.5t)^2$ = .....Cm⁴

$I_y = 2*t*h(0.5b+0.5t)^2 + 2*\frac{t*b'^3}{12} + 2*b'*t*(0.5b+0.5t)^2$ = ........Cm⁴

A=2*b'*t+2*h*t

Calculate $r_x = \sqrt{\frac{I_x}{A}}$ =..........Cm  Calculate $r_y = \sqrt{\frac{I_y}{A}}$ =..........Cm

$\lambda_{in} = \frac{L_{in}}{r_x}$ ≯ 160  $\lambda_{out} = \frac{L_{out}}{r_y}$ ≯ 160 (Railway) , 180(Roadway)

**3-Check Stresses**

**3-i)Check max. Stresses**

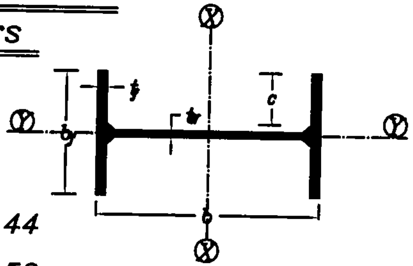
actual stresses = $f_t = \frac{T_{D+LL+I}}{A}$ =........t/Cm² ≯ $0.58F_y$

**3-ii)Check stress range**

$\frac{T_{max}-T_{min}}{A}$ = ........ ≯ $f_{sr}$

## c)Design Procedure Of Web members

### c–i as a Compression members



1)assume compression stresses to be :

$F_c = 1.1 t/Cm^2$ to $1.4 t/Cm^2$ For St.44

$F_c = 1.3 t/Cm^2$ to $1.7 t/Cm^2$ For St.52

2)$F_c = \frac{max.\ force\ F_{D+LL+I}}{area}$

$A = 2*b_f*t_f + b*t_w = ....Cm^2$ assume $\frac{b}{t_w} \le \frac{64}{\sqrt{F_y}}$

get $t_w$ from the previous equation

get $b_f*t_f = ....Cm^2$ assume $b_f = 20*t_f$ get $b_f$ & $t_f$ =.........Cm

### Checks

**1–Check Compactness**

$\frac{b-2t_f}{t_w} \le \frac{64}{\sqrt{F_y}}$ , $\frac{C}{t_f} \le \frac{21}{\sqrt{F_y}}$

**2–Check global buckling**

$I_x = \frac{t_w*d_w^3}{12} + 2b_f*t_f*(d_w/2+t_f/2)^2 = ......Cm^4$ Where $d_w = b-2*t_f$

$I_Y = 2*\frac{t_f*b_f^3}{12} = .......Cm^4$ $A = 2*b_f*t_f + (b-2t_f)*t_w = ....Cm^2$

Calculate $r_x = \sqrt{\frac{I_x}{A}}$ =..........Cm Calculate $r_Y = \sqrt{\frac{I_Y}{A}}$ =..........Cm

$\lambda_{in} = \frac{L_{in}}{r_Y} \ngtr 90$ $\lambda_{out} = \frac{L_{out}}{r_x} \ngtr$ 90(Rail) , 110(Road)

**3–Check Compressive Stresses**

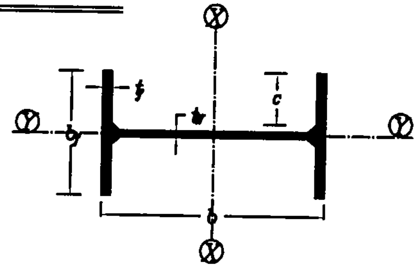
actual stresses = $f_{ca} = \frac{F_{D+LL+I}}{A}$ =.........$t/Cm^2 \ngtr F_c$

allwable stresses = $F_c = 1.6 - 8.5*10^{-5} * \lambda^2_{max.}$ For St.44

allwable stresses = $F_c = 2.1 - 13.5*10^{-5} * \lambda^2_{max.}$ For St.52

## c)Design Procedure Of Web members

### c–ii as a tension members



1)assume tension stresses to be :

$F_{max.} = \frac{F_{sr}}{1 - \frac{T_{min.}}{T_{max.}}}$ Or $0.58F_y$ → 1.6 $t/Cm^2$ St.44 ; 2.1 $t/Cm^2$ St.52

$F_t$ = Smallest of $F_{max.}$ Or $0.58F_y$

2)$F_t = \frac{max.\ force\ T_{D+LL+I}}{area}$

$A = 2*b_f*t_f + b*t_w = ....Cm^2$ assume $\frac{b}{t_w} \le \frac{64}{\sqrt{F_y}}$

get $t_w$ from the previous equation

get $b_f*t_f = ....Cm^2$ assume $b_f = 20*t_f$ get $b_f$ & $t_f$ =.........Cm

### Checks

لايفضل عمل هذا ال check في حالة ال tension

**1–Check Compactness**

$\frac{b-2t_f}{t_w} \le \frac{64}{\sqrt{F_y}}$ , $\frac{C}{t_f} \le \frac{21}{\sqrt{F_y}}$

**2–Check global buckling**

$I_x = \frac{t_w*d_w^3}{12} + 2b_f*t_f*(d_w/2+t_f/2)^2 = ......Cm^4$ Where $d_w = b-2*t_f$

$I_Y = 2*\frac{t_f*b_f^3}{12} = .......Cm^4$ $A = 2*b_f*t_f + (b-2t_f)*t_w = ....Cm^2$

Calculate $r_x = \sqrt{\frac{I_x}{A}}$ =..........Cm Calculate $r_Y = \sqrt{\frac{I_Y}{A}}$ =..........Cm

$\lambda_{in} = \frac{L_{in}}{r_Y} \ngtr 160$ $\lambda_{out} = \frac{L_{out}}{r_x} \ngtr$ 160(Rail) ,180(Road)

**3–Check Stresses**

**3–i)Check max. Stresses**

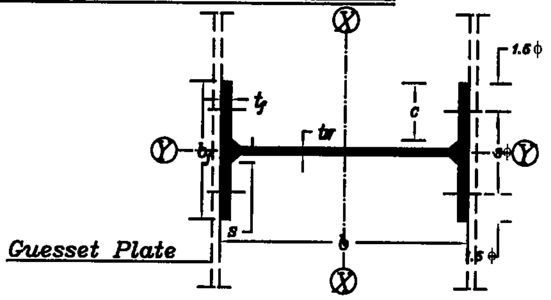
actual stresses = $f_t = \frac{T_{D+LL+I}}{A}$ =.........$t/Cm^2 \ngtr 0.58F_y$

**3–ii)Check stress range**

$\frac{T_{max.} - T_{min.}}{A}$ = ........ $\ngtr f_{sr}$

# d)Design Procedure Of Zero members

## d–i Web members




assume $\frac{b}{t_w} \leq \frac{64}{\sqrt{F_y}}$ (table2.1b) Code P.10

get $t_w$ from the previous equation =.......Cm $\not<$ 1.00Cm

get $b_f$ by assuming that there is only one row of bolts each side of the flange taking bolts $\phi$ 24

so $b_f = 6\,\phi + t_w + 2*S$

take $t_w = t_f$

### Checks

**1–Check Compactness**

$\frac{b-2t_f-2S}{t_w} \leq \frac{64}{\sqrt{F_y}}$ (table2.1b) Code P.10

$\frac{C \simeq b_f/2}{t_f} \leq \frac{21}{\sqrt{F_y}}$ (table2.1c) Code P.11

**2–Check global buckling**

$\lambda_{in} = \frac{\text{buckling length inplane} = L_{in}}{\text{raduis of gyration @ Y axis} = r_Y} \not> 90$ (RailWay), 110 (Roadway)

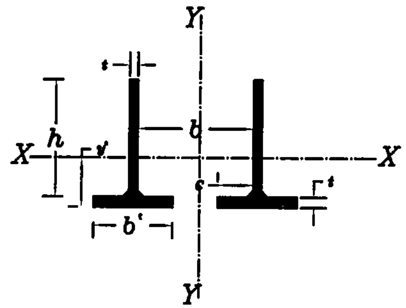
$\lambda_{out} = \frac{\text{buckling length outplane} = L_{out}}{\text{raduis of gyration @ X axis} = r_X} \not> 90$ (RailWay), 110 (Roadway)

(X–X axis مع outside) يجب ملاحظة ان المحاور معكوسه

(Y–Y axis مع inside)

# d)Design Procedure Of Zero members

## d–ii Lower Chord



take "t" the bigger Value of

$\frac{h}{t} \leq \frac{30}{\sqrt{F_y}}$ (table2.1c) Code P.12

$\frac{C}{t} \leq \frac{21}{\sqrt{F_y}}$ (table2.1c) Code P.11

$C = b'/2$

$h = \frac{\text{Pannel length}}{10 \longrightarrow 15}$

$b = (0.80 \longrightarrow 1)h$ For deck or through bridge

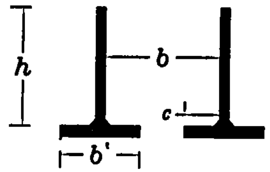
$b = (1.00 \longrightarrow 1.10)h$ For Pony bridge

$b' = (1/2 \longrightarrow 2/3)b$

### Checks

لايفضل عمل هذا ال check فى حالة ال tension

**1–Check Compactness**



$\frac{h}{t} \leq \frac{30}{\sqrt{F_y}}$ (table2.1c) Code P.12

$\frac{C}{t} \leq \frac{21}{\sqrt{F_y}}$ (table2.1c) Code P.11

$C = b'/2$

**2–Check global buckling**

$\lambda_{in} = \frac{\text{buckling length inplane} = L_{in}}{\text{raduis of gyration @ x axis} = r_x} \not> 90$ (RailWay), 110 (Roadway)

$\lambda_{out} = \frac{\text{buckling length outplane} = L_{out}}{\text{raduis of gyration @ y axis} = r_y} \not> 90$ (RailWay), 110 (Roadway)

# e)Design Procedure Of Vertical members

## e–i members subjected to (M+T)

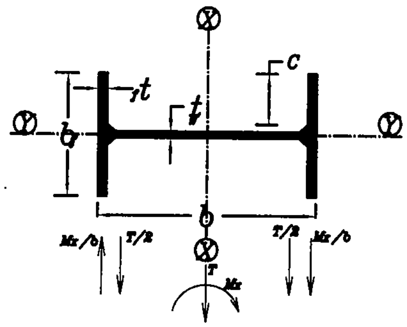
–if member is subjected to tension force

1)assume tension stresses to be :

$F_{max} = \frac{F_{sr}}{1-\frac{T_{min}}{T_{max}}}$ Or $0.58F_y$ → 1.6 t/Cm² St.44, 2.1 t/Cm² St.52

$F_t$ = Smallest of $F_{max}$ Or $0.58F_y$

Force in flange $= \frac{M_x}{b} + \frac{T}{2}$




2)$F_t = \frac{\text{Force in Flange}}{\text{area of one flange}}$

get A = ............Cm²

assume $b_f = 20*t_f$

get $b_f$ & $t_f$ =.........Cm

assume $\frac{b}{t_w} \le \frac{64}{\sqrt{F_y}}$ (table2.1b) Code P.10

get $t_w$ from the previous equation =.......Cm ≮ 1.00Cm

### Checks

**1–Check Compactness**

$\frac{b-2t_f}{t_w} \le \frac{64}{\sqrt{F_y}}$ , $\frac{C}{t_f} \le \frac{21}{\sqrt{F_y}}$

**2–Check global buckling**

$I_x = \frac{t_w*d_w^3}{12} + 2b_f*t_f*(d_w/2+t_f/2)^2$ =......Cm⁴ Where $d_w = b-2*t_f$

$I_y = 2*\frac{t_f*b_f^3}{12}$ = .......Cm⁴ $A = 2*b_f*t_f+(b-2t_f)*t_w$ =....Cm²

Calculate $r_x = \sqrt{\frac{I_x}{A}}$ =...........Cm Calculate $r_y = \sqrt{\frac{I_y}{A}}$ =...........Cm

$\lambda_{in} = \frac{L_{in}}{r_y} \ngtr 160$ $\lambda_{out} = \frac{L_{out}}{r_x} \ngtr$ 160(Railway) ,180(Roadway)

**3–Check Stresses**

**3–i)Check max. Stresses** (interaction eqn.)

$\frac{f_{ta}}{F_t} + \frac{f_{bx}}{F_t}A_1$ = .......$\ngtr$ 1

**3–ii)Check stress range**

$\frac{T_{max}-T_{min}}{A}$ = ........ $\ngtr f_{sr}$

# e)Design Procedure Of Vertical members

## e–ii members subjected to (M+N)

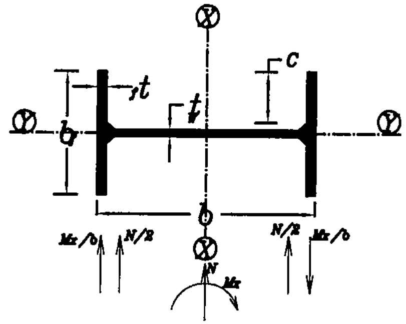
–if member is subjected to tension force

1)assume Compression stresses to be :

$F_c$ = 1.1t/Cm² to 1.4t/Cm² For St.44

$F_c$ = 1.3t/Cm² to 1.7t/Cm² For St.52

Force in flange $= \frac{M_x}{b} + \frac{N}{2}$




2)$F_c = \frac{\text{Force in Flange}}{\text{area of one flange}}$

get A = ............Cm²

assume $b_f = 20*t_f$

get $b_f$ & $t_f$ =.........Cm

assume $\frac{b}{t_w} \le \frac{64}{\sqrt{F_y}}$ (table2.1b) Code P.10

get $t_w$ from the previous equation =.......Cm ≮ 1.00Cm

### Checks

**1–Check Compactness**

$\frac{b-2t_f}{t_w} \le \frac{64}{\sqrt{F_y}}$ , $\frac{C}{t_f} \le \frac{21}{\sqrt{F_y}}$

**2–Check global buckling**

$I_x = \frac{t_w*d_w^3}{12} + 2b_f*t_f*(d_w/2+t_f/2)^2$ =......Cm⁴ Where $d_w = b-2*t_f$

$I_y = 2*\frac{t_f*b_f^3}{12}$ = .......Cm⁴ $A = 2*b_f*t_f+(b-2t_f)*t_w$ =....Cm²

Calculate $r_x = \sqrt{\frac{I_x}{A}}$ =...........Cm Calculate $r_y = \sqrt{\frac{I_y}{A}}$ =...........Cm

$\lambda_{in} = \frac{L_{in}}{r_y} \ngtr 90$ $\lambda_{out} = \frac{L_{out}}{r_x} \ngtr$ 90(Railway) ,110(Roadway)

**3–Check Stresses**

**3–i)Check max. Stresses** (interaction eqn.)

$\frac{f_{ca}}{F_c} + \frac{f_{bx}}{F_t}A_1$ = .......$\ngtr$ 1

## Buckling length in bridges

| member | | buckling | Deck | Pony |
|---|---|---|---|---|
| | Chord | $L_{in}$ | 0.85L | 0.85L |
| | | $L_{out}$ | 0.85L | $L_{out}=2.5\sqrt[4]{E*I_y*a*\delta}$ |
| N, W−truss | Vertical | $L_{in}$ | 0.70L | 0.70L |
| | | $L_{out}$ | 0.85L | 1.20L |
| | Diagonal | $L_{in}$ | 0.70L | 0.70L |
| | | $L_{out}$ | 0.85L | 1.20L |
| K−truss | Vertical | $L_{in}$ | 0.35L | 0.35L |
| | | $L_{out}$ | L | 1.20L |
| | Diagonal | $L_{in}$ | 0.90L | 0.90L |
| | | $L_{out}$ | 1.20L | 1.50L |
| X−truss | Vertical | $L_{in}$ | 0.70L | 0.70L |
| | | $L_{out}$ | 0.85L | 1.20L |
| | Diagonal | $L_{in}$ | 0.85L/2 | 0.85L/2 |
| | | $L_{out}$ | 0.75L | L |

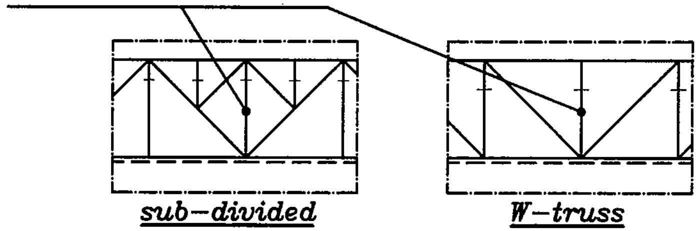
table (4.5) code p. 58,59

## How to get $F_{Sr}$

get no. of loading cycles of Railway bridges table (3.1b) Code P.40 then get $F_{Sr}$ from table (3.2) Code P.41 taking detail B

| member description | | No. | $F_{Sr}$ (t/Cm²) |
|---|---|---|---|
| Chord members (upper & lower) | | Over 2,000,000 | 1.12 |
| Web members (Vl. & Diag.) | double track | 200,000 | 2.80 |
| | single track | 500,000 | 2.00 |
| Web members Carry loads of X.G only | double track | 500,000 | 2.00 |
| | single track | Over 2,000,000 | 1.12 |

Web members Carry loads of X.G only

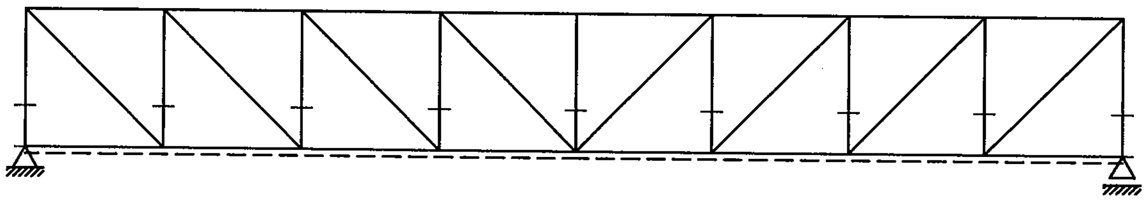



لاحظ انه N=200,000 لاتوجد فى الجداول ولكن يمكن استخراجها من المنحنيات الموجوده فى Code P.42 Figure(3.1)

N=200,000 $F_{Sr} = 2.8 t/Cm^2$

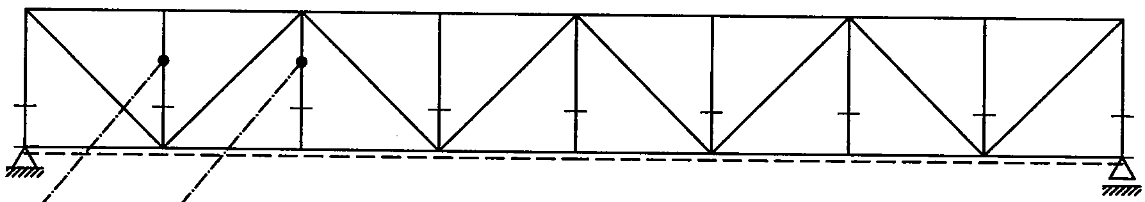
# Important Cases

## Case 1



all vertical members subjected to (M+N)

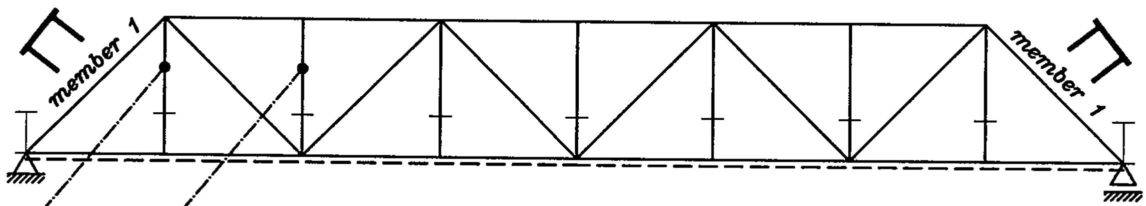
## Case 2



this member is subjected to moment only

this member is subjected to moment + tension

## Case 3



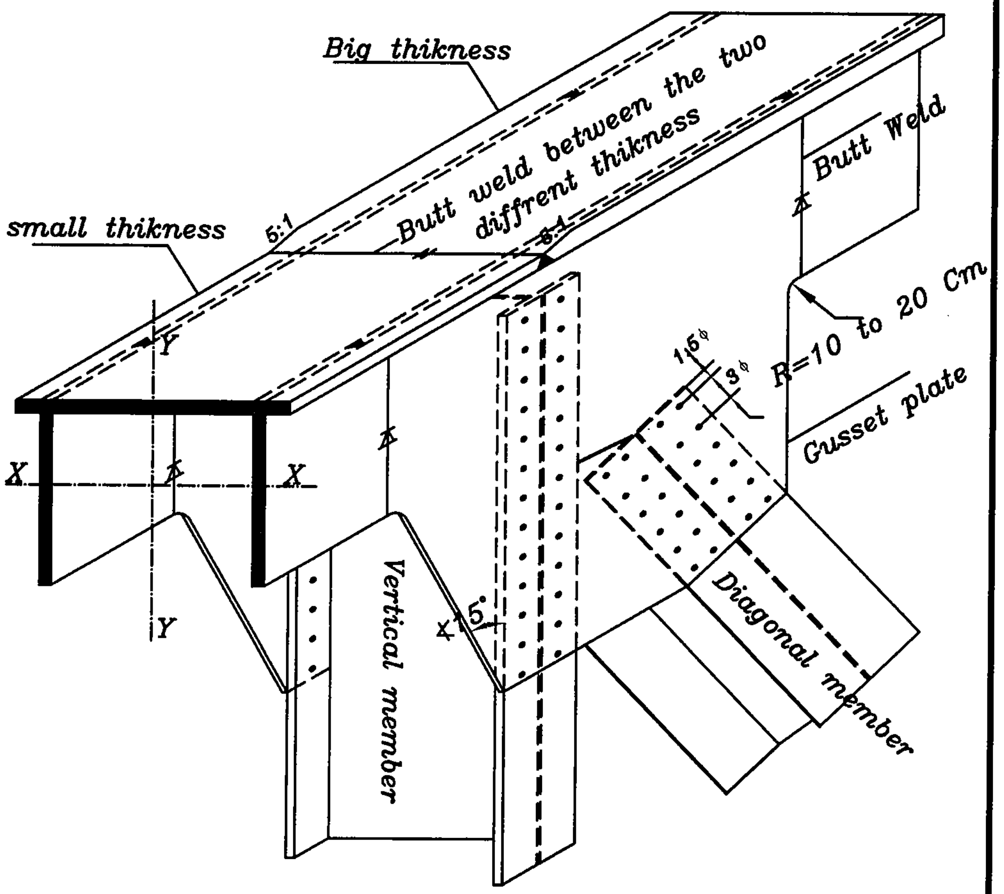

this member is subjected to moment + tension

this member is subjected to moment only

## Important note

member 1 is subjected to comp. force and it has a box sec. to get the force in this member use the last diagonal I.L and the force is Comp.

## 7-Connection between truss members of bridge




## design No. of bolts for the diagonal or the Vertical member

number of bolts per one flange = $\frac{Stress*area}{P_s * 2}$ (2 → 2 flanges)

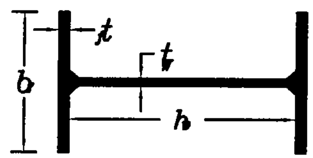
**For Compression member**

1) Where $F_c$:
- $\lambda < 100$ → $(2.1-13.5*10^{-5}\lambda^2)$ $St_{52}$
- $\lambda < 100$ → $(1.6-8.5*10^{-5}\lambda^2)$ $St_{44}$
- $\frac{7500}{\lambda^2}$ if $\lambda > 100$

2) area = area of cross section for diagonal or vertical

area = $b_f * t_f + h_w * t_w$

3) $P_s$ depend on bolt grade and diameter




**For tension member**

1) Where $F_t = 0.58F_y$

2) area = area of cross section for diagonal or vertical

area = $b_f * t_f + h_w * t_w$

3) $P_s$ = 7.22t (st.44) , 9.03t(st.52) for M27

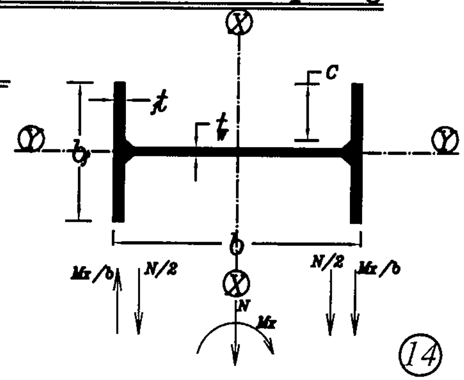
$P_s$ = 5.55t (st.44) , 6.94t(st.52) for M24

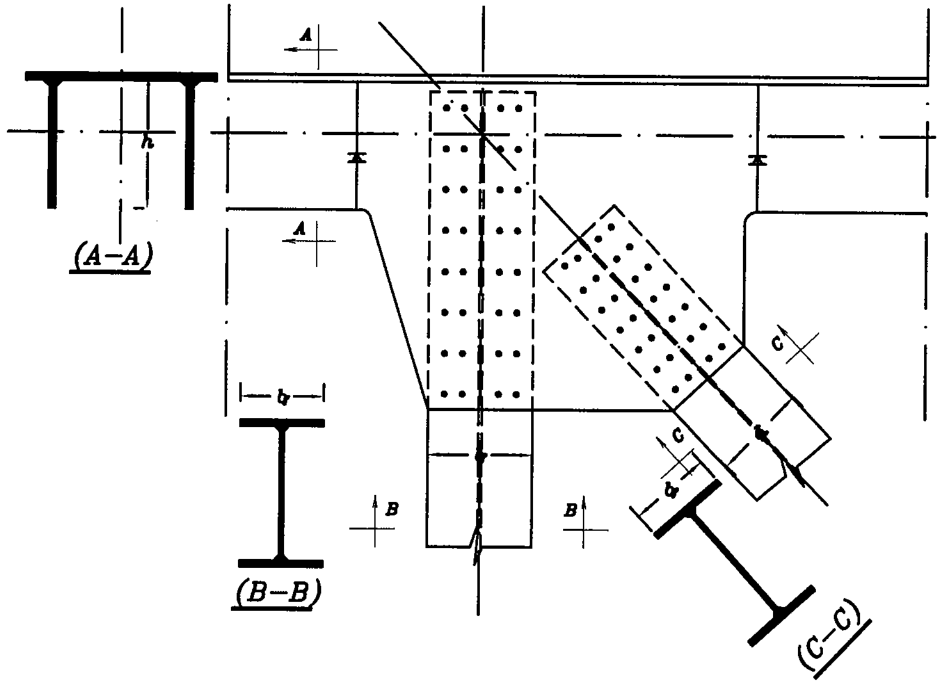
Code page 106

## design No. of bolts for the Vertcal in pony

number of bolts per one flange =

$$\frac{\frac{N}{2}+\frac{M}{b}}{P_s}$$

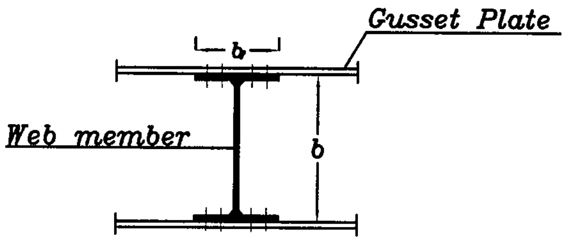




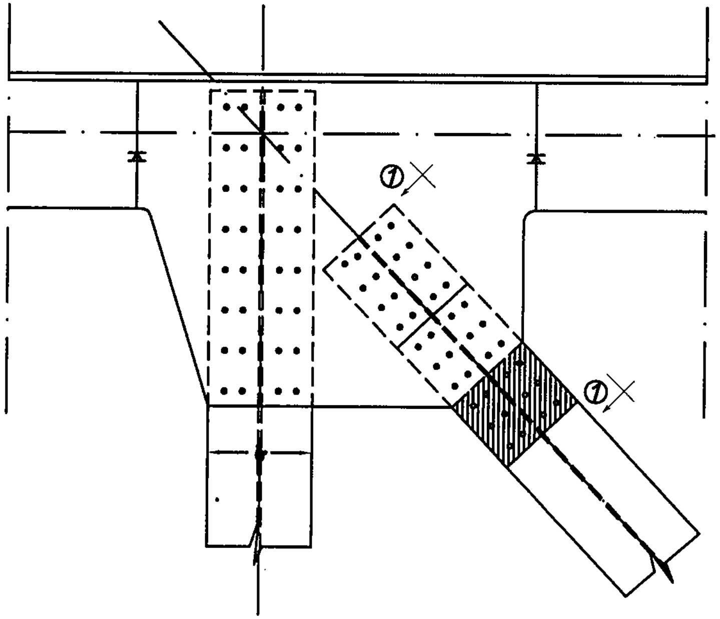

لاحظ انه يتم توزيع المسامير بحيث لايزيد عدد الصفوف عن ثمانية صفوف حتى لايتم تركيز القوه على المسامير الاماميه

<u>*note that*</u>

| | |
|---|---|
| $b_{f,min} = 2*3\phi + t_{r}$ | *Case of two Columns* |
| $b_{f,min} = 4*3\phi + t_{r}$ | *Case of Four Columns* |
| $b_{f,min} = 6*3\phi + t_{r}$ | *Case of Six Columns* |

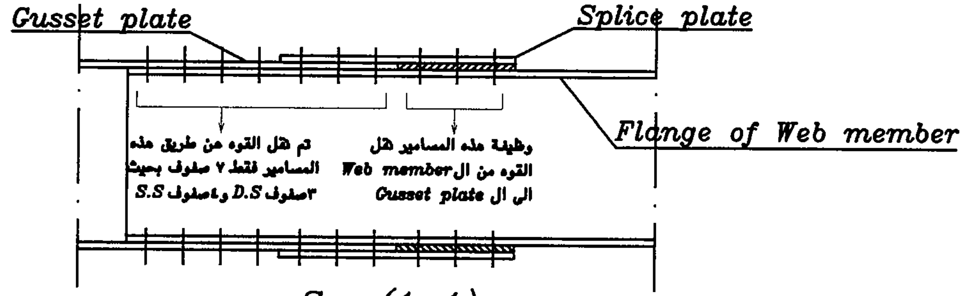



فى حالة عدم امكانية وضع المسامير على اقل من ٨ صفوف يتم استخدام *Splice plate* مع زيادة عدد المسامير ٢٠٪ وذلك بسبب ال *indirect force transfer*



$n_{splice}$ = 1.2*(no. of rows more than 8 – 8)

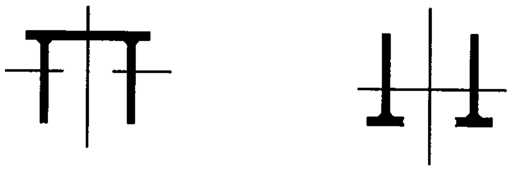
*the previous equation get no. of rows in splice*



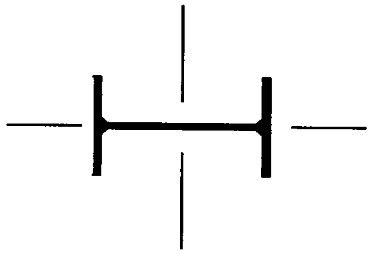

Sec (1–1)

# Steps of drawing

1) draw all center lines and then draw the chord members (upper & lower)



2) draw the vertical member ($b_f$ , $t_w$)



3) draw the diagonal as the vertical

4) calculate no. of bolts in the diagonal first and arrange it

5) draw the gusset plate then arrange the bolts in vertcal

6) draw the X.G on the vertical member

7) finally check the length of gusset plate fillet weld غير مهم

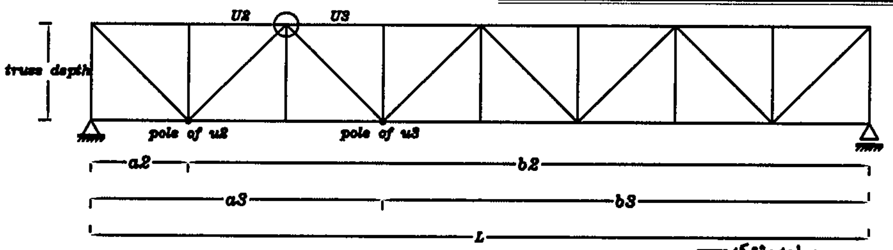
لاحظ انه تم تصميم وصله لكلا من Vertical & Diagonal مع ال gusset plate
وسوف يتم عمل Check على ان طول لحام ال gusset plate مع ال Flange
لل Chord member (upper or lower) هو طول لحام آمن

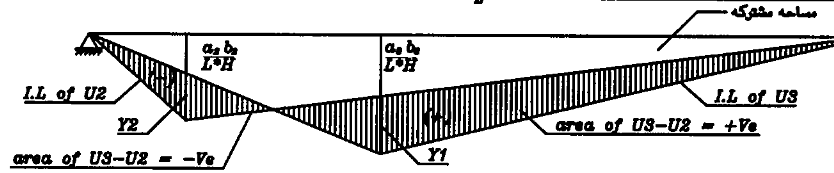
## design the fillet weld between G.pl & flange of upper & lower chord

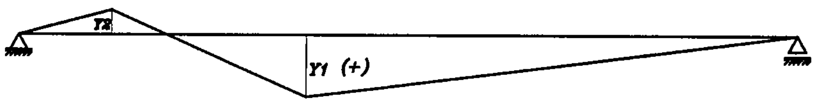
### 1)W-truss

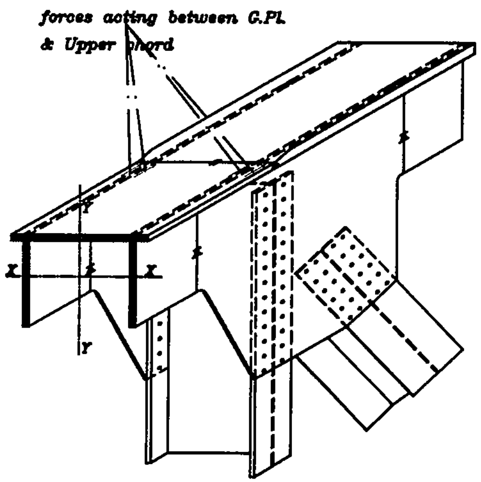
لاحظ انه هذه الخطوه هى تكمله لتصميم ال*Joint* وذلك للتاكد من ان طول لحام ال *Joint* كافى
وتعتبر القوى المؤثره على الحام هى فرق القوى الموجوده فى ال *Chord*

للحصول على فرق القوى يتم اتباع الاتى



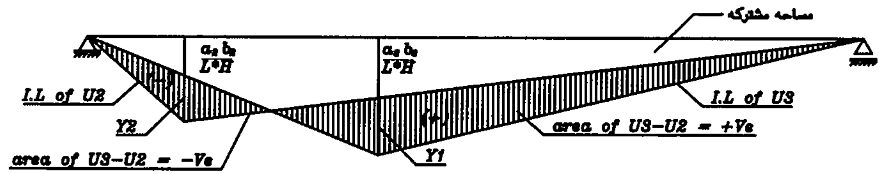



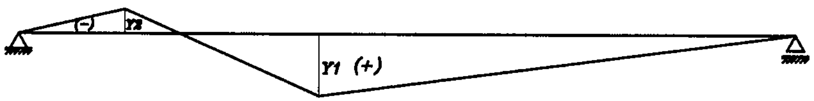




يتم عمل تصميم لل*Weld* والذى يربط بين ال*Gusset plate* و ال *Chord member* سواء كان *upper or lower chord*

وتعتبر القوى التى تؤثر على ال *Weld* هى فرق القوى بين ال *Chords*

وللحصول على فرق القوى فى حالة ال*W-truss* يتم طرح ال *I.L* لل*Chords* من بعض وذلك للحصول على اقصى فرق بين ال *two chords*



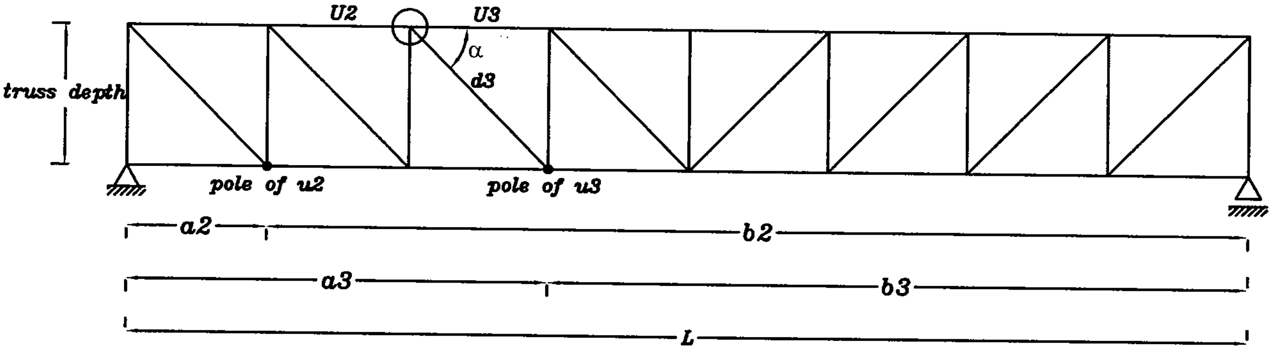




فيتم تحميل ال *I.L* كله *Dead loads*

ويتم تحميل الجزء ال + فقط بال *Live loads*

## *design the fillet weld between G.pl & flange of upper & lower chord*

## *2)N−truss*




في حالة ال *N−truss* يكون الفرق بين *U3−U2* هو عباره عن محللة ال*d3* *diagonal*

اى ان

*diffrence between U2 , U3 ( U3−U2 )* $= F_{d3} *\cos\alpha$

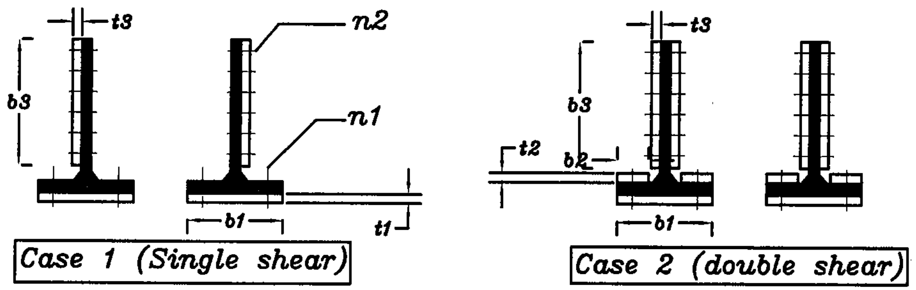
$$0.2F_u = \frac{force\ in\ flange}{area} = \frac{Froce\ in\ chord*(\frac{Area\ Flange}{Chord\ area})}{4 * S * L_{Weld}}$$

*get* $L_{Weld}$ *and* $L_{Weld}$ *must be smaller than* $L_{G.Pl}$

والهدف من ذلك هو التاكد من ان طول ال *G.pl.* فى الرسم كافى لربط ال *member* فد

## Bolted Field slpice
### i)Lower chord

يتم عمل وصلات فى ال Lower Chord وعلى مسافات لاتزيد عن ١٦ م




#### Case 1

number of bolts in one flange (n1) = $\frac{0.58F_y*(b_f*t_f)}{P_s}$

b1*t1 = bf*tf        b1 = bf    thus t1 = tf

number of bolts in one Web (n2) = $\frac{0.58F_y*(b_w*t_w)}{P_s}$

b3*t3 = $b_w*t_w$        b3 = $b_w$ −2Cm    (get t3)

#### Case 2

number of bolts in one flange (n1) = $\frac{0.58F_y*(b_f*t_f)}{P_s*2}$

b1*t1 = 0.5*bf*tf        b1 = bf    thus t1 = 0.5*tf

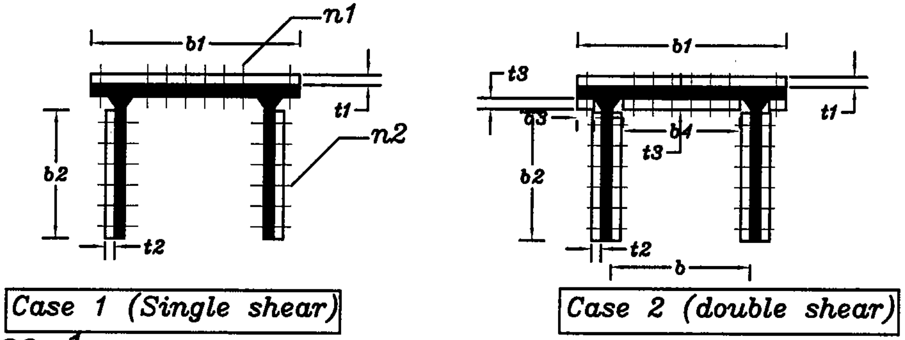
b2*t2 = 0.25*bf*tf        b2 = bf/2 −$t_w$/2 −2Cm    then get t2

number of bolts in one Web (n2) = $\frac{0.58F_y*(b_w*t_w)}{P_s*2}$

b3*t3 = 0.5 * $b_w*t_w$        b3 = $b_w$ −2Cm    (get t3)

## Bolted Field slpice
### ii)Upper chord

يتم عمل وصلات فى ال Upper chord وعلى مسافات لاتزيد عن ١٦ م




#### Case 1

number of bolts in one flange (n1) = $\frac{F_c*(b_f*t_f)}{P_s}$

b1*t1 = bf*tf        b1 = bf    thus t1 = tf

number of bolts in one Web (n2) = $\frac{F_c*(b_w*t_w)}{P_s}$

b2*t2 = $b_w*t_w$        b2 = $b_w$ −2Cm    (get t2)

#### Case 2

number of bolts in one flange (n1) = $\frac{F_c*(b_f*t_f)}{P_s*2}$

b1*t1 = 0.5*bf*tf        b1 = bf    thus t1 = 0.5*tf

b4*t3 = 0.50*bf*tf        b2 = b−4Cm , then get t3

number of bolts in one Web (n2) = $\frac{F_c*(b_w*t_w)}{P_s*2}$

b2*t2 = 0.5 * $b_w*t_w$        b2 = $b_w$ −2Cm    (get t2)