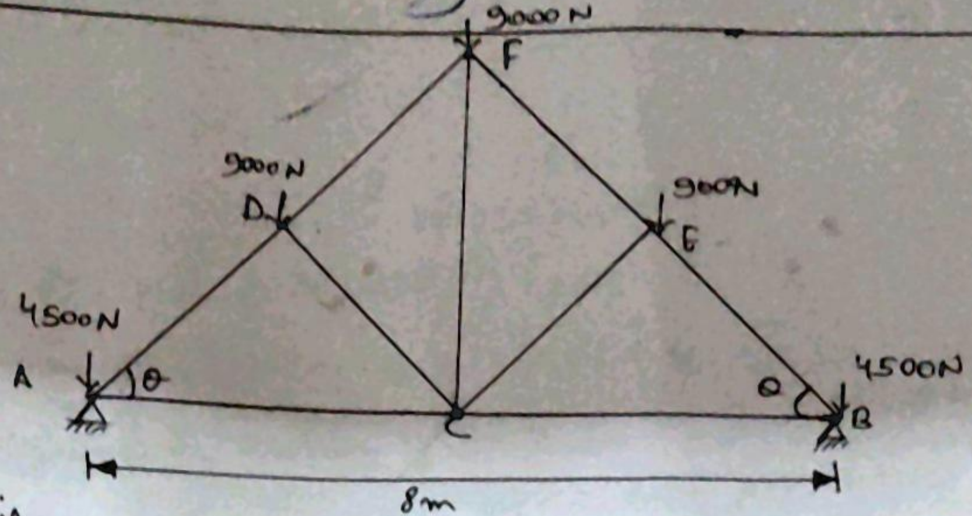
Name – Arun kumar Harijan
Roll no – 12001320034
Subject – Steel Design Sessional
Department – Civil (Group-Y)



Force analysis

Due to Symmetry section R_A and R_B is same

$$R_A = R_B = 1800N \text{ or } 18\,kN$$

For angle:- $\tan\theta = 2/4 \Rightarrow \theta = \tan^{-1}(1/2) = 26°34'$

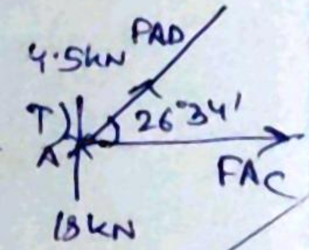
Joint (A):-

$\Sigma H = 0:\ F_{AC} + F_{AD}\cos 26°34' = 0$

$\therefore F_{AC} = -(-30.185) \times \cos 26°34' = 26.998\,kN\ (T)$

$\Sigma V = 0:\ F_{AD}\sin 26°34' + 18 = 4.5$

$$F_{AD} = \frac{-13.5}{\sin 26°34'} = -30.185\,kN\ (c)$$



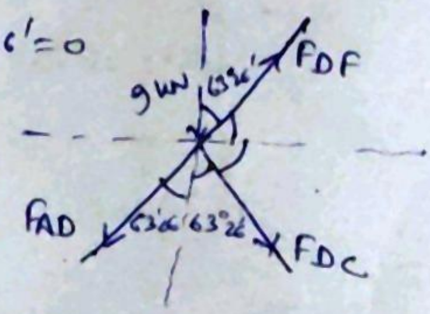
Joint D

$\Sigma H = 0$

$F_{AD}\sin 63°26' - F_{DF}\sin 63°26' - F_{DC}\sin 63°26' = 0$

$\Rightarrow F_{DF} + F_{DC} = F_{AD}$

$\Rightarrow F_{DF} + F_{DC} = -30.185\,kN$ —(i)



$\Sigma V = 0$:, $F_{DF}\cos 63°26' - F_{DC}\cos 63°26' - F_{AD}\cos 63°26' - 9 = 0$

$\Rightarrow (F_{DF} - F_{DC})\cos 63°26' = 9 - 13.5$

$\Rightarrow F_{DF} - F_{DC} = \dfrac{-4.5}{\cos 63°26'}$

$\Rightarrow F_{DF} - F_{DC} = -10.062\ kN$ — (ii)

Adding eqⁿ (i) and (ii) we get

$\Rightarrow 2F_{DF} = -40.247$

$\Rightarrow F_{DF} = \dfrac{-40.247}{2} = -20.124\ kN\ (C)$

∴ From eqⁿ (i), putting the value of F_{DF}

$F_{DC} = -30.185 + 20.124 = -10.061\ kN\ (C)$

Due to symmetric section of truss, the forces will be

$F_{AC} = F_{BC} = 26.998\ kN\ (T)$

$F_{AD} = F_{BE} = -30.185\ kN\ (C)$

$F_{DC} = F_{EC} = -10.061\ kN\ (C)$

$F_{DF} = F_{EF} = -20.124\ kN\ (C)$

$F_{CF} = 9\ kN\ (T)$

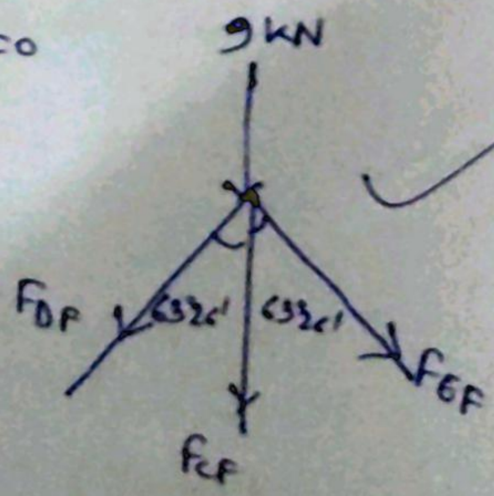
Joint 5

$\Sigma V = 0$, $F_{CF} + F\cos 63°26' + F_{EF}\cos 63°26' + 9 = 0$

$\Rightarrow F_{CF} + (-20.124 \times 2 \times \cos 63°26') + 9 = 0$

$\Rightarrow F_{CF} - 18 + 9 = 0$

$\Rightarrow F_{CF} = 9\ kN\ (T)$



esign of top chord members :-

Design load = Maximum of F_{AD} and F_{DF}

$= 30.187$ kN (compression)

length of the member $= \frac{\sqrt{2^2+4^2}}{2} = \sqrt{5} = 2.24$ m [∵ Partially restaind against bending]

Effective length of members, $l = 0.85 l = 0.85 \times 2.24$

$= 1.904$ m

Assuming a single angle section 60×60×6mm, $f_y = 250 N/mm^2$

Properties from steel table

$a = 6.84 cm^2 = 684 mm^2$, $r_{nn} = 1.82$ cm $= 18.2$ mm

Slenderness ratio $= \frac{l}{r_{nn}} = \frac{1.904 \times 1000}{18.2} = 104.61$

Permissible stress for slenderness ratio $= 104.61$

$\sigma_{ac} = 80 - \frac{80-72}{110-100} \times (104.61 - 100)$

$= 80 - 3.69 = 76.31 N/mm^2$

Induced compressive stress

$\sigma_{ac}', cal = \frac{30187}{684} = 44.13 N/mm^2$

As $\sigma_{ac, cal} < \sigma_{ac}$ Permissible, Hence safe

Bottom Chord members

Design load = 27kN (Tensile

Selecting single angle section 60×60×6mm

$a = 684 mm^2$

using 12mm diameter rivets

Gross diameter rivets

Gross diameter of rivets $= 12 + 1.5 = 13.5$ mm

Net Area of connected leg, $A_1 = (b - nd) \times t$

$= (60 - 1 \times 13.5) \times 6$

$A_1 = 279 mm^2$

...a of outstanding leg, $A_2 = b \times t = 60 \times 6 = 360\ mm^2$

$$K_1 = \frac{3A_1}{3A_1 + A_2} = \frac{3 \times 279}{3 \times 279 + 360} = \frac{837}{1197} = 0.7$$

∴ Effective area of angle section, $A_{net} = A_1 + kA_2$

$= 279 + 0.7 \times 360$

$A_{net} = 531\ mm^2$

∴ Strength of the member $= \sigma_{at} \times A_{net} = 150 \times 531 = 79.65\ kN$ ∵ > 27 kN

Provide single angle section 60×60×6 mm in all other members

Design of riveted connections

Use gusset plate of thickness = 8 mm

The rivet are in single shear

Shearing strength of rivet in one shear $= \frac{\pi}{4} D^2 \times T$

$= \frac{\pi}{4} \times 13.5^2 \times 100$

$= 14313.9 N$

Bearing strength of rivet $= d \times t \times \sigma_t$

$= 13.5 \times 6 \times 300 = 24.3\ kN$

Rivet value = safe load per rivet

= least of (i) & (ii) = 14313.9 N

Maximum load at any joint = 30187 N

∴ No of rivets required $= \frac{30187}{14313} = 2.1 \approx 3$

Provide 3 - 12 mm ϕ of rivet to connect each member.

Kore...

i) Advantage and disadvantages welded connection

ii) What are the different types of failure of a rivet

iii) Diff between lap and butt joint

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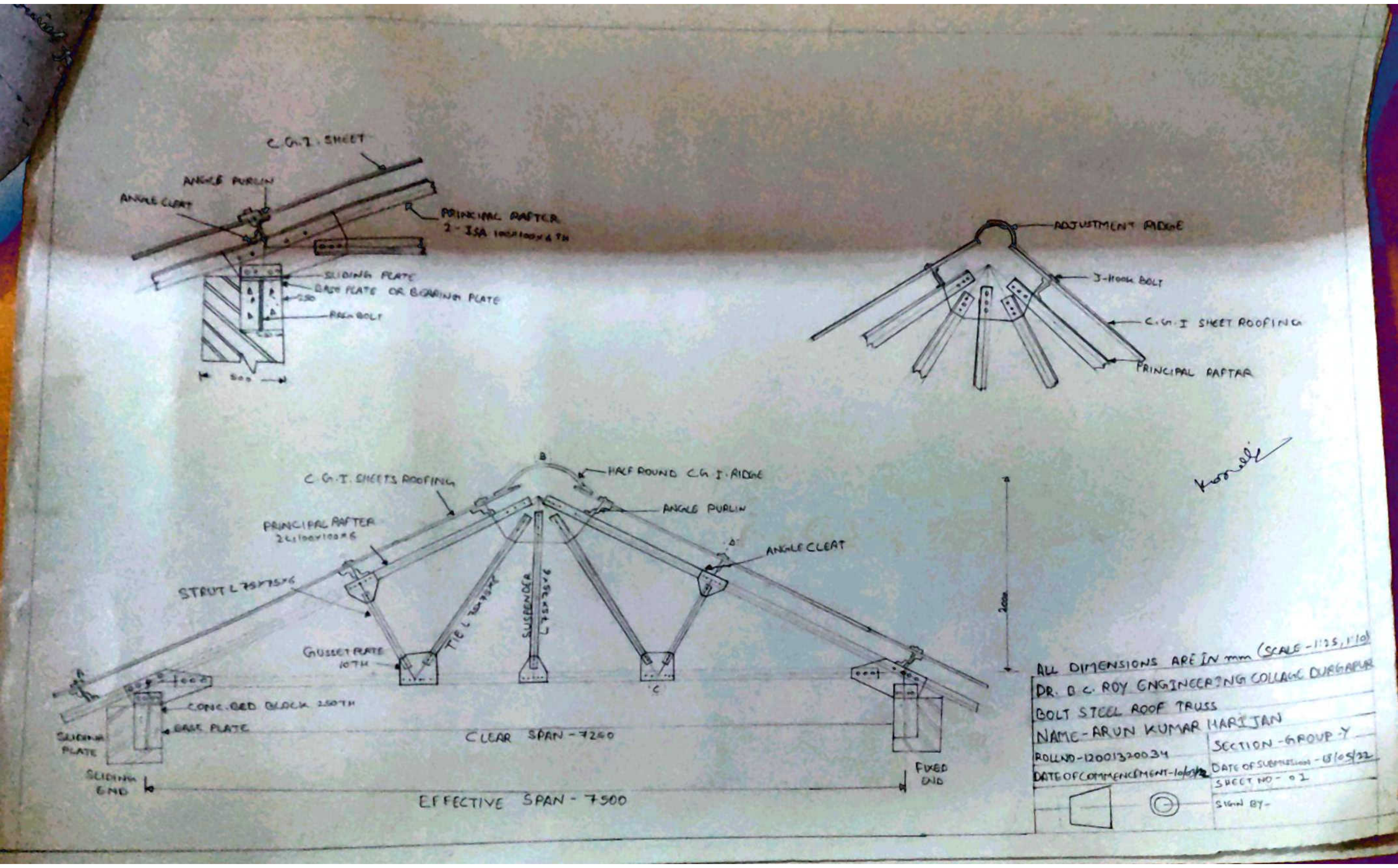
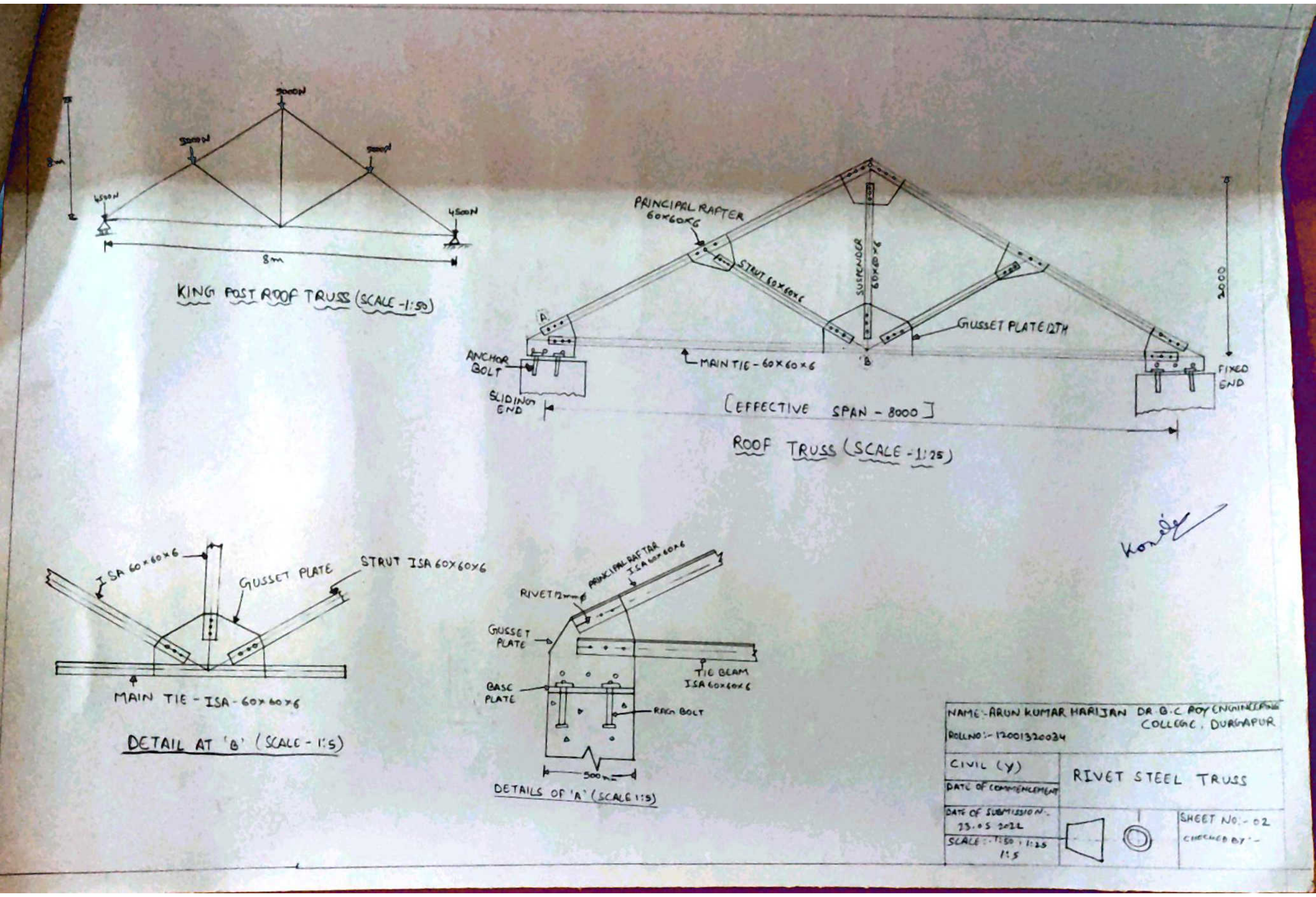
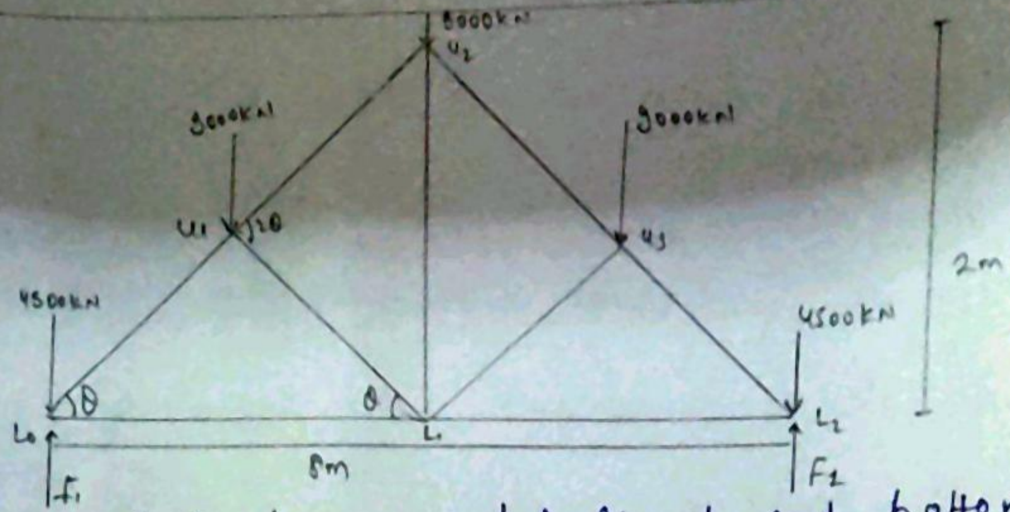
i) welded joint has high strength, sometimes more


C.G.I. SHEET
ANGLE PURLIN
ANGLE CLEAT
PRINCIPAL RAFTER
SLIDING PLATE
BASE PLATE OR BEARING PLATE
ADJUSTMENT RIDGE
J-HOOK BOLT
C.G.I SHEET ROOFING
PRINCIPAL RAFTAR
C.G.I. SHEETS ROOFING
HALF ROUND C.G.I. RIDGE
ANGLE PURLIN
PRINCIPAL RAFTER
ANGLE CLEAT
STRUT L 75X75X6
SUSPENDER
GUSSET PLATE 10TH
CONC. BED BLOCK
BASE PLATE
SLIDING PLATE
SLIDING END
CLEAR SPAN - 7260
FIXED END
EFFECTIVE SPAN - 7500
2000
ALL DIMENSIONS ARE IN mm (SCALE - 1:25, 1:10)
DR. B.C. ROY ENGINEERING COLLAGE DURGAPUR
BOLT STEEL ROOF TRUSS
NAME - ARUN KUMAR HARIJAN
SECTION - GROUP - Y
ROLL NO - 12001320034
DATE OF COMMENCEMENT - 10/03/22
DATE OF SUBMISSION - 13/05/22
SHEET NO - 02
SIGN BY -


5000N
5000N
5000N
4500N
4500N
8m
KING POST ROOF TRUSS (SCALE - 1:50)
PRINCIPAL RAFTER 60X60X6
STRUT 60X60X6
SUSPENDER 60X60X6
GUSSET PLATE 12TH
ANCHOR BOLT
MAIN TIE - 60X60X6
SLIDING END
FIXED END
2000
[EFFECTIVE SPAN - 8000]
ROOF TRUSS (SCALE - 1:25)
ISA 60X60X6
GUSSET PLATE
STRUT ISA 60X60X6
MAIN TIE - ISA - 60X60X6
DETAIL AT 'B' (SCALE - 1:5)
RIVET 12mm
PRINCIPAL RAFTER ISA 60X60X6
GUSSET PLATE
TIE BEAM ISA 60X60X6
BASE PLATE
RAG BOLT
500mm
DETAILS OF 'A' (SCALE 1:5)
NAME:- ARUN KUMAR HARIJAN
DR. B.C ROY ENGINEERING COLLEGE, DURGAPUR
ROLL NO:- 12001320034
CIVIL (Y)
RIVET STEEL TRUSS
DATE OF COMMENCEMENT
DATE OF SUBMISSION:- 23.05.2022
SCALE:- 1:50, 1:25, 1:5
SHEET NO:- 02
CHECKED BY:-

Name - Aniket Kr. Singh
Roll no- 12001319031
Subject - Steel Design Sessional
Department- Civil (Group-X)



Let the Angle between top Chord and bottom Chord member be

$$\tan\theta = \frac{U_2L_1}{L_0L_1} = \frac{2}{4} = \frac{1}{2}$$

$$\theta = 26.56°$$

$$2\theta = 2 \times 26.56° = 53.13°$$

In $\Delta L_0 M U_1$ $\quad \sec\theta_s = \frac{L_0U_1}{L_0M}$

$$L_0U_2 = L_0M \sec\theta$$

$$= 2 \times \sqrt{\frac{5}{2}} = \sqrt{5}\ m$$

$$L_0 \cdot U_2 = \sqrt{2^2 + 4^2} = 2\sqrt{5}\ m$$

$$\sin\theta = \frac{U_2L_1}{L_0U_2} = \frac{2}{2\sqrt{5}} = \frac{1}{\sqrt{5}}$$

$$\cos\theta = \frac{L_0L_1}{L_0U_2} = \frac{4}{2\sqrt{5}} = \frac{2}{\sqrt{5}}$$

$\sin 2\theta = 2\sin\theta \cos\theta = 2 \times \frac{1}{\sqrt{5}} \times \frac{2}{\sqrt{5}} = \frac{4}{5} = 0.8$

$\cos 2\theta = \cos^2\theta - \sin^2\theta = \frac{4}{5} - \frac{1}{5} = \frac{3}{5} = 0.6$

Total vertical loads on the truss, $W = 4500 + 3 \times 9000 + 4500$
$= 36000 N$

As the loads on the truss are symmetrical

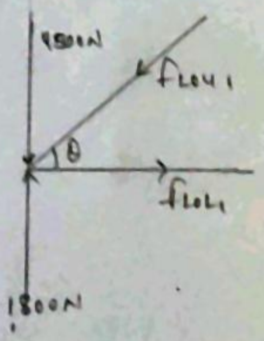
$\therefore$ Reaction at supports $= R_1 = R_2 = \frac{W}{2}$
$= \frac{36000}{2} = 18000 N$

- Analysis of truss :-

Joint L0 :-

Resolving vertically

$F_{L0U1} \sin\theta + 4500 = 18000$



$F_{L0U1} \times \frac{1}{\sqrt{5}} = 18000 - 4500$

$F_{L0U1} \times \frac{1}{\sqrt{5}} = 13500 N$

$F_{L0U1} = 13500\sqrt{5} N$
$= 30187 N$ (Compression)

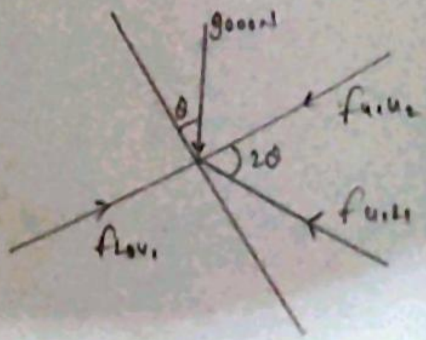
Resolving horizontally

$F_{L0L1} = F_{L0U1} \cos\theta$
$= 13500\sqrt{5} \times \frac{2}{\sqrt{5}} = 27000 N$
(Tensile)

(ii) Joint U_1 :-

Resolving the forces perpendicular to the roof

$f_{U_1L_1}\sin 2\theta = 9000\cos\theta$



$f_{U_1L_1}\times 0.8 = 9000\times\frac{2}{\sqrt{5}}$

$f_{U_1L_1} = \frac{9000\times 2}{0.8\times\sqrt{5}}$

$= 10062.31N$ (Comp)

Resolving parallel to the roof

$f_{U_1L_1}\cos 2\theta + f_{U_1U_2} + 9000\sin\theta = f_{LoU_1}$

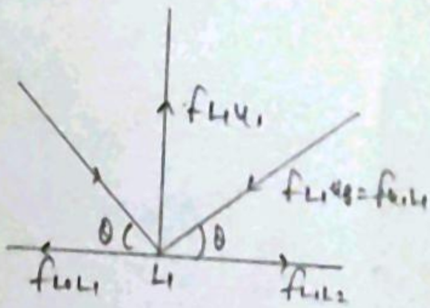
$10062.31\times 0.6 + f_{U_1U_2} + 900\times\frac{1}{\sqrt{5}} = 13500\sqrt{5}$

$6037.39 + f_{U_1U_2} + 4024.92 = 30186.92$

$f_{U_1U_2} = 20124.61N$ (Comp)

(iii) Joint L_1 :-

Resolving vertically



$f_{L_1U_1} = 2\times f_{L_1U_1}\sin\theta$

$= 2\times 10062.31\times\frac{1}{\sqrt{5}}$

$= 9000N$ (Tensile)

(3) Design of top chord member :-

Design load = Max^m of $f_{L_1U_1}$ and $f_{U_1U_2}$

$= 30187N$ (Comp)

Length of member, $L_{OU_1} = \sqrt{5} = 2.24m$

Effective length of members $L = 0.85 = 2.24$

(i.e. partially restrained against lateral bending)

$L = 1.904 m$

Assuming a single angle section 80x60x6 mm,

$f_y = 250 N/mm^2$ Properties from steel table,

$a = 6.84 cm^2 = 684 mm^2$, $r_{xx} = 1.82 cm = 18.2 mm$

Slenderness ratio $= \frac{l}{r_{xx}} = \frac{1.904 \times 1000}{18.2} = 104.61$

Permissible stress for slenderness ratio $= 104.61$

$$= 80 - \frac{(80 - 72)}{(110 - 100)} \times (104.61 - 100)$$

$$= 80 - 3.69 = 76.31 N/mm^2$$

Induced compressive stress,

$$= 30187/684$$

$$= 44.18 N/mm^2$$

(ii) Bottom Chord Members:-

Design load $= 27000 N$ (tensile)

Select single angle section 80x60x6 mm

$a = 684 mm^2$

Use 12 mm diameter rivets

Gross diameter of rivet $= 12 + 1.5 = 13.5 mm$

Net area of connected leg, ~~$A = 68$~~

$A_1 = (b - nd) \times t$

$A_1 = (60 - 1 \times 13.6) \times 6$

$A_1 = 279 \text{ mm}^2$

Area outstanding leg, $A_2 = b \times t = 60 \times 6 = 360 \text{mm}^2$

$$k_1 = \frac{3A_1}{3A_1 + A_2}$$

$$= \frac{3 \times 279}{3 \times 279 + 360} = \frac{837}{1197} = 0.7$$

∴ Effective Area of angle section,

$A_{net} = A_1 + kA_2$

$= 279 + 0.7 \times 360$

$A_{net} = 531 \text{ mm}^2$

∴ Effective area of Angle section,

$A_{net} = A_1 + kA_2$

$= 531 \text{ mm}^2$.

∴ Strength of the member $= \sigma_{at} \times A_{net}$

$= 150 \times 531$

$= 79650 \text{N} > 27000 \text{N}$

Hence safe

Provide single angle section 60×60×6 mm in all other members.

Vasanth

Design of riveted Connection :-

Use gusset Plate of thickness = 8mm

The rivets are in single shear

Shearing strength of rivet in single shear = $\frac{\pi}{4} \times D^2 \times \sigma_{vf}$

$= \frac{\pi}{4} \times (13.5)^2 \times 100$

$= 14313.9 \text{ N}$

Bearing Strength of rivet = $d \times t \times \sigma_{pf}$

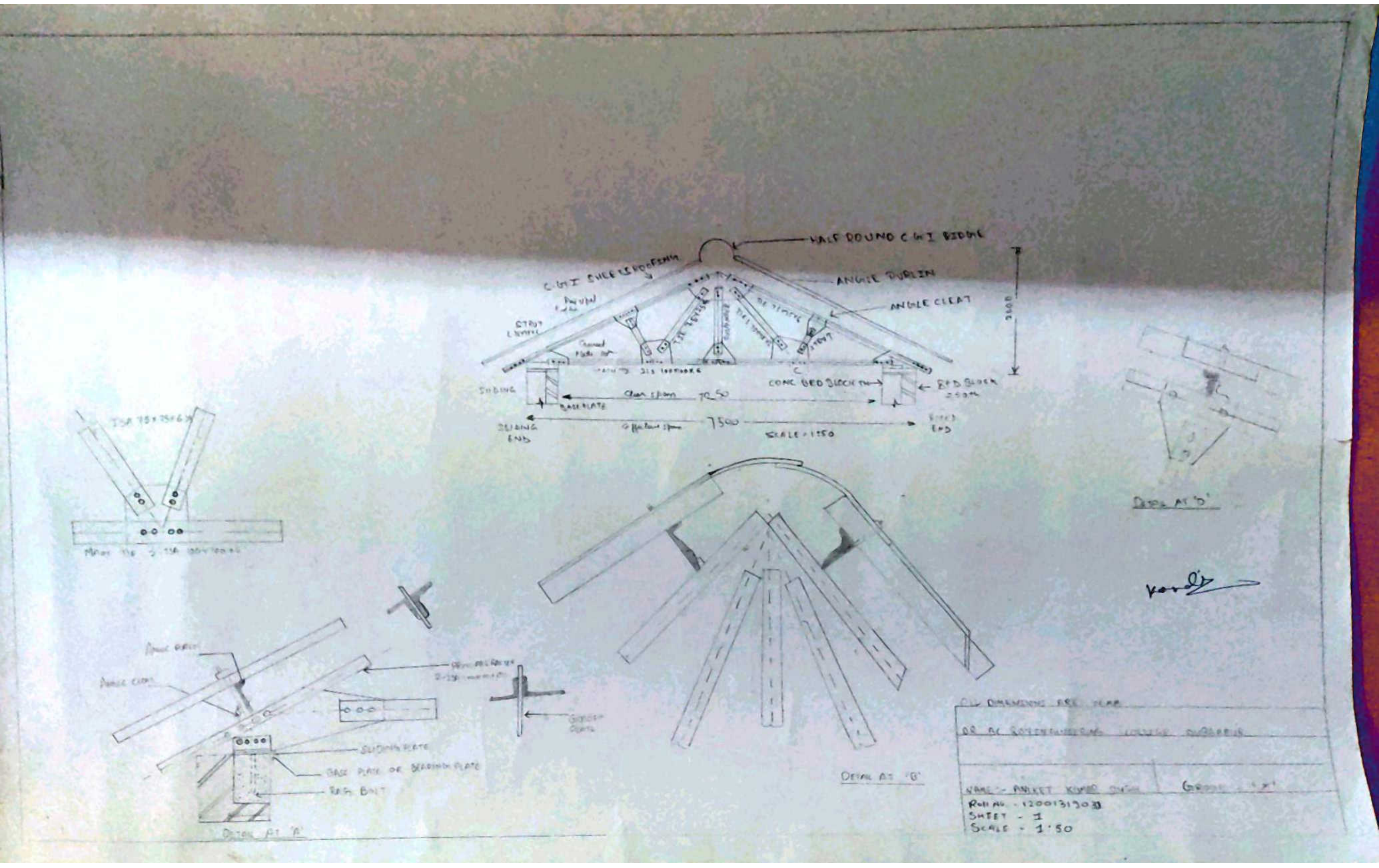
$= 13.5 \times 6 \times 300 = 24300 \text{ N}$

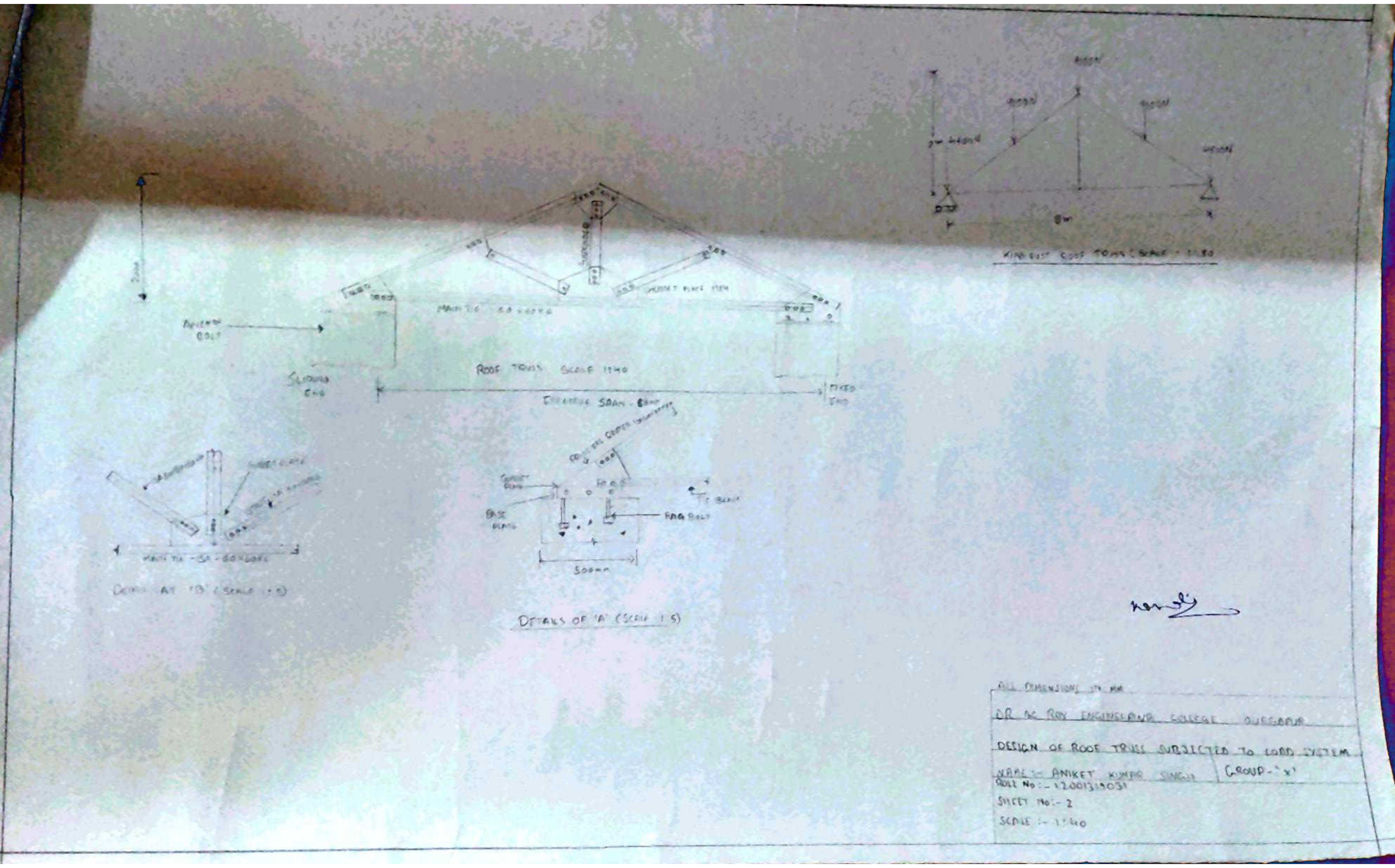
Rivet values = Safe load per unit rivet

= Least of (i) and (ii).

Max^m load in any Joint = $\frac{30187}{14313.9} = 2.1$

Provide 3-12mm ϕ rivets to connect each member.


HALF ROUND C.G.I RIDGE
ANGLE PURLIN
ANGLE CLEAT
SIDING
CONC BED BLOCK
7500
SCALE - 1:50
DETAIL AT 'D'
DETAIL AT 'B'
DETAIL AT 'A'
SLIDING PLATE
BASE PLATE OR BEARING PLATE
SHEET - 1
SCALE - 1:50


ROOF TRUSS SCALE 1:40
DETAILS OF 'A' (SCALE 1:5)
500mm
ALL DIMENSIONS IN MM
DR BC ROY ENGINEERING COLLEGE DURGAPUR
DESIGN OF ROOF TRUSS SUBJECTED TO LOAD SYSTEM
NAME :- ANIKET KUMAR SINGH
GROUP - 'X'
ROLL No :- 12001319031
SHEET No :- 2
SCALE :- 1:40