MAIN MENU

→ Change Variable Values
→ Change Constraints (for Optimal Solution)
  → ~~x~~
  → # joists
  → Account for self-weight
  → Account for Joist Weight
    +(• method of joist-weight determination)

} SCREEN SHOULD ALWAYS DISPLAY OPTIMAL SOLUTION

→ Specify lookup table (B483)
→ Alter Display
  → Display Forces
  → Display Section Members

} SHOULD ALWAYS DISPLAY OVERALL MASS

→ Load Saved Configuration.
→ View Formulae
→ Display Calculations

} → DYNAMIC?
• SHOWN IN WORD...? OR...?

→ VIEW COMPARATIVE RESULTS
  → Shows all the masses of Trusses by Truss Types (& configurations)
    → Can "zoom in" (select) a configuration (type) for more detail?
  → Can alter constraints / The variable which is being tested...
  → Can switch from viewing table-form results to graph results

(or just ask for graph pop-up)

MASSES OF TRUSS

	VAR VAL 1	VAR VAL 2	VAR VAL 3
Parker			
Warren			
etc.			

} CAN HAVE MULTIPLE VARIABLES? (along top Rows)

} maybe there's a way I can mathematically determine a % factor for each variable (x, # joists, etc) how important it is

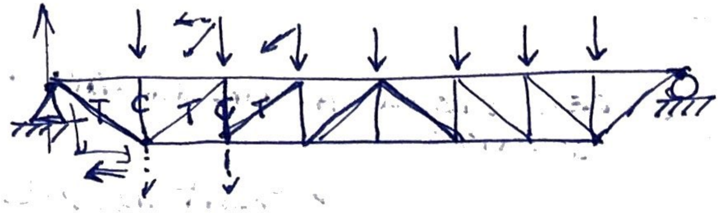
* Can display by Truss type (results for a bunch of diff. variables)
OR by variable val (results for different Truss types / configurations)

→ Export any table to CSV/Excel?
→ Export Charts to matLab?
→ Export
  • Charts
  • Tables
  • Calculations

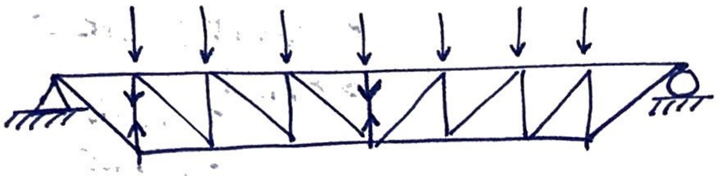
} Word?

→ Save Configuration
  ⇒ always saves w/o overwriting previous configs
  ⇒ always loads most recent configuration save
  ⇒ option in menu to load a diff conf & recalc.

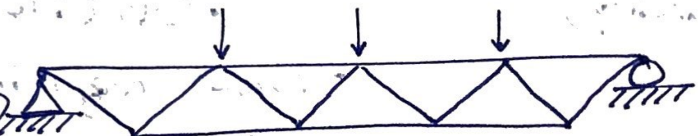
PRATT



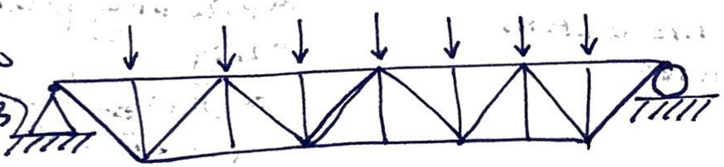
HOWE



WARREN (no vert.)



WARREN (verts)



~~NOT SURE I CAN SOLVE, B/C $\vec{F}_s$ @ ENDS ARE STRS DOWN INTO COLUMNS → so, no real way to predict what other two are doing? I think? → Method of Sections?~~

NO, I'M AN IDIOT — THE $\vec{F}_f$ IS ACTING DIRECTLY DOWNWARD @ JOINTS

(has no horizontal component — ∴ don't need to count cross-members when trying to find a joint w/ only 2 connections)

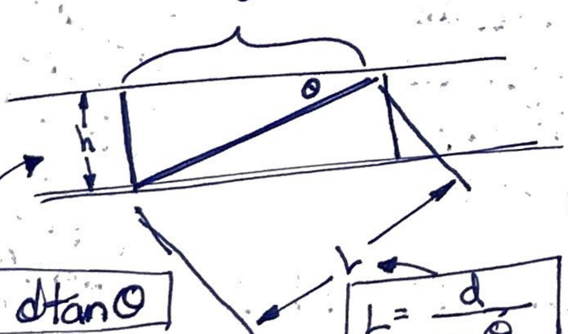
QUESTIONS

- Are we going to need to account for self-weight of joists?
  → In that vein, are we going to need to determine the optimal design for the joists?

OTHER OPTIMIZATIONS

~~SA~~

$d = \text{span}/(\#\text{ joists}+1)$



$\boxed{h = d\tan\theta}$

$\boxed{L = \frac{d}{\cos\theta}}$

→ ∡(°) ≈ height of Truss

- constrained $40° \le \alpha \le 50°$
- unconstrained

→ # TRUSSES (0 – ∞), INSTEAD OF 13 exactly

- accounting for material usage/ efficiency of joists

(& not accounting for ~?)

ARE WE ALLOWED TO USE DIFFERENT HSS SECTION MEMBERS FOR ~~DIFFEREN~~ EVERY SINGLE TRUSS MEMBER? OR ARE WE REQUIRED TO USE SAME HSS MEMBER SECTION FOR ALL DOWN-LEFT DIAGONAL MEMBERS — AND THEN SAME FOR ALL DOWN/RIGHT & VERTICAL ETC?

UNCONSTRAINED

→ Calculate for # JOISTS 1st

• Calculate Loads on JOIST → Figure out Optimal Design for JOIST

OPTIMIZED

• Calculate Loads on Truss members ⟹ Masses ⟹ Mass of Truss

⟹ For different Δxs.

SET JOIST MASS/DESIGN

" "

" "

⊛ ALGORITHM TO GRAPH ANALYZE 3D MATRIX, DETERMINE "LOW POINT" GIVEN CONSTRAINTS

⊛ SEE IF WE CAN 3D-GRAPH SURFACE IN MATLAB?

ALL DONE 4 EACH TRUSS-TYPE.

TRUSS TYPE

Δxs

compare Δx

compare # joists

compare # joists.

compare Δ TRUSS TYPE.

If want to know optimal # joists optimal for all Δxs & vice versa

TO OPTIMIZE THIS, WE SIMPLY SAY, y = mass of TRUSS / of joists as well

x = variable being ~~tested~~ (Δx, # joists)

IN ORDER TO ANALYZE EITHER OR (while other held constant) → SHOULD CREATE 3D MATRIX

⊛ THIS BECOMES DISCREET VALUES NOT CONTINUOUS FUNCTION

⟹ THINK IT WILL END UP JUST BEING RE-INTERPRETING (we solve) Δxs

This will create a continuous curve represent a discreet value

NO ... can support → reqs

yes, initial # dead load + mass of truss @ that point.

PULL FROM THIS RESULTS FOR 13 JOISTS

⊛ WOULD REALLY LIKE TO SEE ⊛ <ALGEBRAIC> ⊛ Eqns → 1) (Forces → Mass) (Δx) → Solve for optimal (non-iterative / numeric)

2) (CAN DETERMINE ~~TRUSS~~ MEMBER SECTIONS FROM TABLE

e.g. BY → Creating Eqn which calculates ~~##~~ CROSS-SECTIONAL AREA REQUIRED / HSS CODE FROM ~~[illegible]~~ T-f Calculated In Truss (selecting < HSS)

$f(x) = \sum$ (MASSES OF MEMBER SECTIONS REQ'D TO SUP DEAD LOAD)

Can create curve → $\frac{\delta}{\delta x} = (0)$ → solve

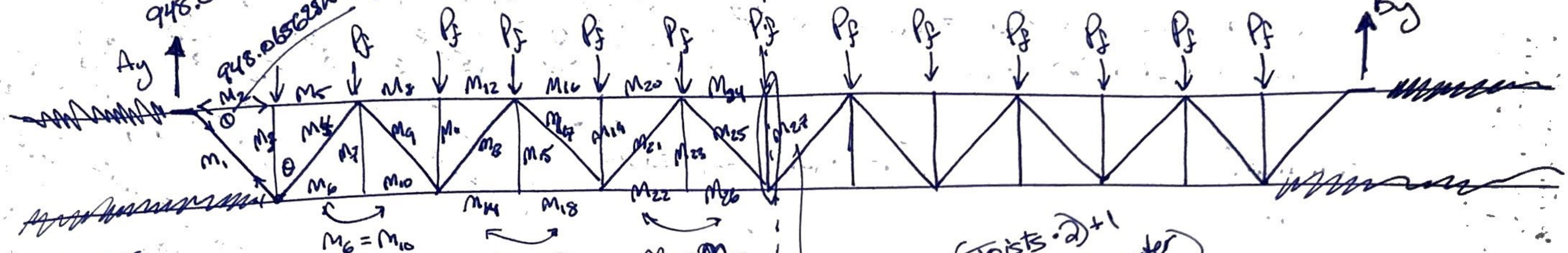
lookup table from lookups Eqn. → Calculate Mass → Do for each member & add up.

% of TOTAL DEADLOAD ~~[illegible] + MASS OF~~ TRUSS

y = Additional $\vec{F}$ required to be supported

⊛ THIS MAY BE DIFFERENT @ DIFFERENT POINTS ON THE TRUSS? → DO WE APPLY ~~#~~ INDIVIDUAL LOADS @ PINS (JOISTS) TO DETERMINE DIFF?

$P_f = 145.856285\,kN \qquad A_y = \frac{1}{2} \cdot 13 \cdot P_f = 6.5 P_f$
$= 948.065625\,kN$



$M_6 = M_{10}$ $\qquad M_{14} = M_{18}$ $\qquad M_{22} = M_{26}$

create algorithmic general form representation of this.

$\sin 45 = \frac{948...}{H}$

$|\vec{F}_{m_1}| = \frac{948.065625\,kN}{\sin(45°)}$

$\boxed{= 1{,}340.76726\,kN\,(T)}$

$|\vec{F}_{m_2}| = 948.065625\,kN\,(C)$

DOES THIS APPLY TO M_2 & M_5?? (I don't think so)

\# members = ~~# joists~~ (Joists · 2) + 1 (for center joist) (½ Truss)

✱ Check this pattern for diff. #s joists & diff truss types.

$145.85625\,kN \times 13/2 = 948.065625\,kN$

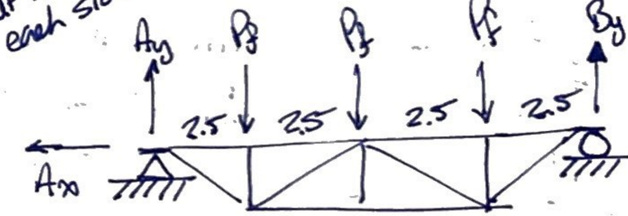
✱ → LOOKING LIKE WARREN TRUSS w/o VERTICALS IS GONNA BE OPTIMAL FOR EVERYONE.

Q) CAN WE OPTIMIZE OUR DESIGN BY REMOVING ZERO FORCE MEMBERS FROM THE TRUSS?

✱ FOR FBDs FOR PRELIMINARY REPORT
→ DOES HE ONLY WANT A SAMPLE (like the example FBDs in PDF?)
→ OR DOES HE WANT ENTIRE TRUSS DESIGN SHOWN (since all the forces will be different in different (but ||) members across the truss?

✱ These go w/ question about being limited to choosing truss designs from the 4 shown in pdf.

$\therefore A_y = B_y = \frac{\sum P_{f_i}}{2}$ (Half the force on each side)



since $\sum \vec{F}_x = \phi$

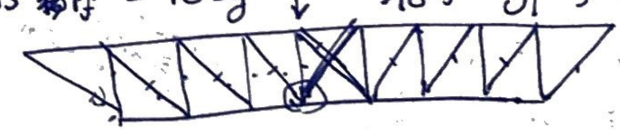
$|\vec{A}_x| = \phi$

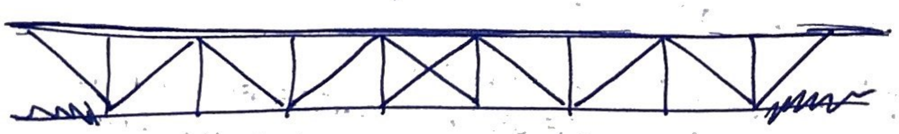
$\sum \vec{F}_y$
$3P_f = A_y + B_y$
$3P_f = A_y + (1.5P_f)$
$1.5P_f = A_y$

This is doable

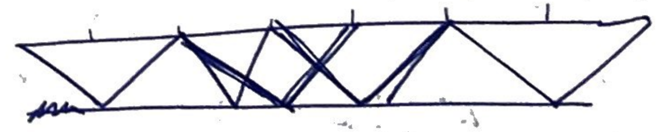
$M_A = (0)|\vec{A}_y| - P_f(2.5) - P_f(5) - P_f(7.5) + B_y(10)$

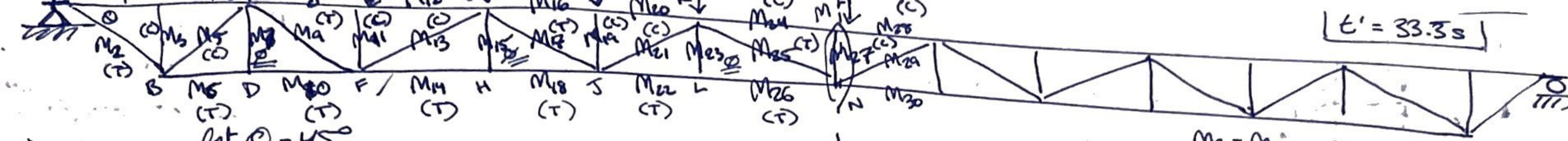
$15 P_f = 10 B_y \rightarrow \frac{15}{10} P_f = B_y \,|\, 1.5P_f = B_y$





????
V. odd design.





$\boxed{t' = 33.3s}$

let $\theta = 45°$

$A_x = \emptyset$

$A_y = 6.5 P_f$
$= 6.5(145.85625 kN)$
$= 948.065625 kN$

$\frac{M_{2x}}{\cos\theta} = M_2$

$\frac{|M_{2x}|}{\cos\theta} = \frac{948.065625 kN}{\cos(45°)}$

$\boxed{M_2 = 1{,}340.76726 kN \text{ (T)}}$

$|M_1| = |M_2|\cos\theta$
$= (1340.76726 kN)(\cos(45°))$

$\boxed{M_1 = -948.065625 kN \text{ (C)}}$

$|M_3| = |P_f|$ (C)
$= 145.85625 kN$ (C)

$|M_4| = |M_1|$

$\boxed{M_4 = 948.065625 kN \text{ (C)}}$

TENSION/COMPRESSION PATTERN 2 (CHECK)

- ONLY VERTICALS w/ diagonal @ Bottom F have
- ALL Top Lateral = Compression
- ALL Bottom Lateral = Tension
- ??? ALL Diagonals ∥ to outside diagonal = Tension? ALL ⊥ diagonals = compression?

(B)

$M_{2x} = 948.065625 kN$ (T)

$\boxed{M_{3(y)} = -145.85625 kN \text{ (C)}}$

$M_5 = \frac{M_{5x}}{\cos 45°} \rightarrow M_{5y} + M_3 + M_{2y} = \emptyset$

$M_{5y} + (-145.85625) + (948.065625) = \emptyset$

$M_{5y} = -802.209375 kN$ (C)

$\cos\theta = \frac{M_{5y}}{M_5} \rightarrow M_5 = \frac{M_{5y}}{\cos\theta}$
$= 1{,}134.49538 kN$ (C)

$= \frac{-(M_{2x} + M_3)}{\cos 45°}$

$= \frac{-(948.065625 + (-145.85625))}{\cos 45°}$

$\boxed{M_5 = -1{,}134.49538 kN \text{ (C)}}$

Q DO WE HAVE TO SHOW EVERY MEMBER? OR ARE WE OKAY TO ONLY CALCULATE ½ THE TRUSS?

$M_6 + M_{5x} + M_{2x} = \emptyset$ $= M_1$

$M_6 + (M_5\cos\theta) + (M_2\cos\theta) = M_6 + (-802.209375 kN) + (948.065625 kN)$

$\boxed{M_6 = 1{,}750.275 kN \text{ (T)}}$

~~$M_6 = 145.85625 kN$ (C)~~

(C)

$M_4 + M_8 + M_{5(x)} + M_{9(x)} = \emptyset$

$M_{5(y)} + M_7 + M_{9(y)} - 145.85625 = \emptyset$

$(802.209375) + (\emptyset) + M_9\cos 45 - 145.85625 = \emptyset$

$\boxed{M_9 = 928.223491 kN \text{ (T)}}$

$M_{9(y)} = 656.353125 kN$ (T) $= M_{9(x)}$

$(948.065625) + M_8 + 656.353125 + 802.209375 = \emptyset$

$\boxed{M_8 = -2{,}406.62813 kN \text{ (C)}}$

$M_6 = M_{10}$ $M_1 = M_{41}$
$M_{14} = M_{18}$ $M_8 = M_{12}$
$M_{22} = M_{26}$ $M_{16} = M_{20}$
$\boxed{M_{24} = M_{28}}$

Across mirror

ALL VERTICALS = COMPRESSION

(D) $M_{10} = M_6$

$\boxed{M_{10} = 1{,}750.275 kN \text{ (T)}}$

(E) $M_{12} = M_8$

$\boxed{M_{12} = 2{,}406.62813 kN \text{ (C)}}$

$\boxed{M_{11} = 145.85625 kN \text{ (C)}}$ $(= P_f)$

(F) $M_{13(y)} + M_{11} + M_{9(y)} = \emptyset$

$M_{13(y)} + (-145.85625) + (656.353125) = \emptyset$

$\boxed{M_{13(y)} = -510.496875 kN \text{ (C)}}$

$\boxed{M_{13} = \frac{M_{13(y)}}{\cos\theta} = -721.951604 kN \text{ (C)}}$

$M_{10} + M_{14} + M_{9(x)} + M_{13(x)} = \emptyset$

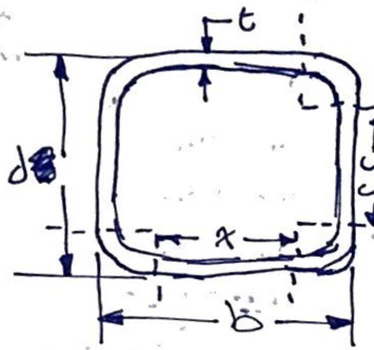
$(-1{,}750.275) + M_{14} + (656.353125)$
$+ (-510.496875) = \emptyset$

$\boxed{M_{14} = 2{,}917.125 kN \text{ (T)}}$

HSS $d \times b \times t$

r_o = outer corner radius

r_i = inner corner radius.



Cross-Sectional Area

$y = (d - 2r_o)2t$

$x = (b - 2r_o)2t$

Area of y-section & x-section

$yt = (d - 2r_o)t$

$xt = (b - 2r_o)t$

But 2 sides for each

$2t(d - 2r_o + b - 2r_o)$

$2t(d + b - 4r_o)$

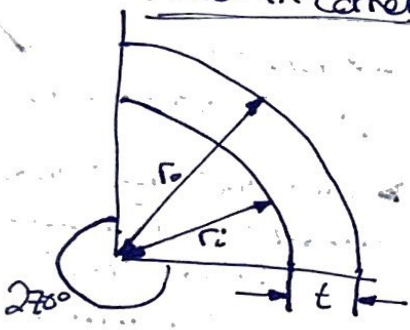
Total Area of Straight Sections =

$= 2(d - 2r_o)t + 2(b - 2r_o)t$

$= 2t(d - 2r_o + b - 2r_o)$

$\boxed{= 2t(d + b - 4r_o)}$ ✓

Area in Corners



Area of 1 corner

$= \frac{1}{4}(\pi r_o^2 - \pi r_i^2)$

$= \frac{\pi}{4}(r_o^2 - r_i^2)$

But There are 4 corners

∴ Area of ALL corners = 4(Area of 1 corner)

$\boxed{= \pi(r_o^2 - r_i^2)}$ ✓

$t = r_o - r_i$

$t - r_o = -r_i$

$\boxed{r_o - t = r_i}$

Taking HSS 102x102x6.4 as an example

THEN TOTAL AREA OF SECTION

$= \Sigma \text{Area}_{corners} + \text{Area}_{sides}$ (~~sections~~)

$= 2t(d + b - 4r_o) + \pi(r_o^2 - r_i^2)$; we know: 1) Total Area, 2) $r_o - r_i = t$

$\therefore \boxed{r_i = r_o - t}$ ✓

$(2320\,mm^2) = 2t(d + b - 4r_o) + \pi(r_o^2 - (r_o - t)^2)$ ✓

$A(mm^2) = 2td + 2tb - 8tr_o + \pi(r_o^2 - (r_o^2 - 2r_o t + t^2))$ ✓

$-r_o^2 + 2r_o t - t^2$

$= 2td + 2tb - 8tr_o + \pi(\cancel{r_o^2} - \cancel{r_o^2} + 2r_o t - t^2)$ ✓

$= 2td + 2tb - 8tr_o + 2\pi r_o t - \pi t^2$

$(r_o - t)(r_o - t)$

$r_o^2 - r_o t - t r_o + t^2$

$(r_o^2 - 2r_o t + t^2)$

$-2td - 2tb + \pi t^2$

$-2t(d + b - \frac{\pi}{2}t)$ ✓

$A(mm^2) - 2td - 2tb + \pi t^2$ ✓ ✓ ✓

$= 2\pi r_o t - 8tr_o$

$= r_o(2\pi t - 8t)$

$r_o = \frac{A(mm^2) - 2td - 2tb + \pi t^2}{2\pi t - 8t}$

$= 2t(\pi - 4)$

where $r_i = r_o - t$;

HSS $d \times b \times t$

$r_o = \frac{A(mm^2) - 2t(d + b - \frac{\pi}{2} \ldots}{2(\pi - 4t)}$

$= \frac{2320 - 2(6.4)(204 - \frac{\pi \ldots}{2} \ldots}{2(\pi - 4(6.4))}$

$= \frac{2320 - 12.8(204 - \frac{16\pi}{5})}{2(\pi - 25.6)}$

$= \frac{2320 - 12.8(193.946904)}{2(-22.4584073)}$

$= \frac{2320 - 2482.52037}{-44.9168146}$

$= \frac{-162.52037}{-44.9168146}$

$= 3.61825235\,mm$

(G) $M_{12} + M_{13}(x) + M_{16} + M_{17}(x) = \emptyset$

$M_{15} + M_{17}(y) + M_{13}(y) - P_f = \emptyset$

$(\emptyset) + M_{17}(y) + (510.496875) - (145.85625) = \emptyset$

$M_{17}(y) = -364.640625\text{ kN (T)}$

$\boxed{M_{17} = \frac{M_{17}(y)}{\cos 45^\circ} = -515.679717\text{ kN (T)}}$

$(2{,}406.62813) + (510.496875) + M_{16} + (+364.640625) = \emptyset$

$\boxed{M_{16} = -3{,}281.76563\text{ kN (C)}}$

(H) $M_{14} = M_{18}$

$\boxed{M_{18} = (2{,}917.125\text{ kN})\text{(T)}}$

(I) $M_{16} = M_{20}$

$\boxed{M_{20} = 3{,}281.76563\text{ (C)}}$

$M_{19} = |P_f|\text{ (C)}$

$\boxed{M_{19} = (145.85625\text{ kN})\text{ (C)}}$

(J) $M_{17}(y) + M_{21}(y) + M_{19} = \emptyset$

$(364.640625) + M_{21}(y) + (-145.85625) = \emptyset$

$\boxed{M_{21}(y) = -218.784375\text{ kN (C)}}$ $\boxed{M_{21} = \frac{M_{21}(y)}{\cos\theta} = 309.40783\text{ kN (C)}}$

$M_{22} + M_{18} + M_{17}(x) + M_{21}(x) = \emptyset$

$M_{22} + (-2917.125) + (-364.640625) + (-218.784375) = \emptyset$

$\boxed{M_{22} = 3{,}500.55\text{ kN (T)}}$

(K) $M_{21}(y) + M_{25}(y) + M_{23} - P_f = \emptyset$

$(218.784375) + M_{25}(y) + (\emptyset) - (145.85625) = \emptyset$

$\boxed{M_{25}(y) = 72.928125\text{ kN (T)}}$

$\boxed{M_{25} = \frac{M_{25}(y)}{\cos\theta} = 103.135943\text{ kN (T)}}$

$M_{24} + M_{20} + M_{21}(x) + M_{25}(x) = \emptyset$

$M_{24} + (3{,}281.76563) + (218.784375) + (72.928125) = \emptyset$

$\boxed{M_{24} = -3{,}573.47813\text{ kN (C)}}$

(L) $M_{26} = M_{22}$

$\boxed{M_{26} = 3{,}500.55\text{ kN (T)}}$

(M) ~~$M_{24} = M_{28}$ (mirror)~~

~~$\boxed{M_{28} = 3{,}573.47813\text{ kN (C)}}$~~

not necessary

$M_{27} = |P_f|\text{ (C)}$

$\boxed{M_{27} = 145.85625\text{ kN (C)}}$

$\boxed{\equiv \text{FULL SOLUTION}}$

$\boxed{\$12.61}$

$C_r = \varphi f \sigma_y A$, $\varphi = 0.9$ ——— $T_r = \varphi \sigma_y A$, $\varphi = 0.9$

$\sigma_y = 370$ MPa ——— $\sigma_y = 370$ MPa

A = cross-sectional area (mm^2) ——— A = cross-sectional area (mm^2)

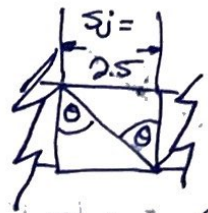
$$\boxed{\begin{aligned} f &= \frac{1}{(1+\lambda^{2n})^{1/n}} , \quad n = 1.34 \\ \lambda &= \sqrt{\frac{\sigma_y}{\sigma_e}} \\ \sigma_e &= \frac{\pi^2 E}{(KL/r)^2} \end{aligned}}$$

$E = 200{,}000$ MPa

, $K = 1$

L = <length of Truss Member>

r = $\underbrace{\text{"radius of gyration" (mm)}}_{\text{FOUND IN TABLE}}$



$\therefore C_r = T_r f$

Horizontals = 2.5m

$\boxed{\text{Verticals} = \frac{S_j}{\tan\theta}}$

$\boxed{\text{Diagonals} = \frac{S_j}{\sin\theta}}$

(31m span, 13 joists $\rightarrow \frac{31}{14} = 2.5$m)

$\frac{\cancel{m}}{1000 \text{ mm}} \left(\frac{1}{1000}\right)$ · ANS

CALCULATE FOR HORIZONTAL/VERTICAL MEMBERS ($\theta = 45°$ $\therefore |H| = |V| = 2.5$m (13 JOISTS)) $\Rightarrow$ $L = 2.5$m

HSS 51X51X6.4 $\quad r = 17.6$ mm $\quad A = 1030.0$ mm^2

$T_r = \varphi \sigma_y A$

$= (0.9)(370\text{MPa})(1030.0\text{mm}^2) \div 1000$ N/kN

$\boxed{T_r = 342.99 \text{ kN}}$

$C_r = T_r \cdot f$

$= (342.99\text{ kN})\left(\frac{1}{(1+\lambda^{2n})^{1/n}}\right)$

$= 342.99\text{kN} \cdot \left(\frac{1}{\left(1+\left(\sqrt{\frac{\sigma_y}{\sigma_e}}\right)^{2n}\right)^{1/n}}\right)$

$= 342.99\text{kN} \cdot \left(\frac{1}{\left(1+\left(\sqrt{\frac{\sigma_y}{\frac{\pi^2 E}{(KL/r)^2}}}\right)^{2n}\right)^{1/n}}\right)$

$= 342.99\text{kN} \cdot \left(\frac{1}{\left(1+\left(\sqrt{\frac{(370\text{MPa})}{\frac{\pi^2(200{,}000\text{MPa})}{((1)(2.5\text{m})/(17.6\text{mm}))^2}}}\right)^{2(1.34)}\right)^{\frac{1}{1.34}}}\right)$

$= 342.99\text{ kN} \cdot (0.99999996)$ ← ridiculous modifier.

IF YOU CHANGE 2.5m → 2,500mm, you get 0.235442676.

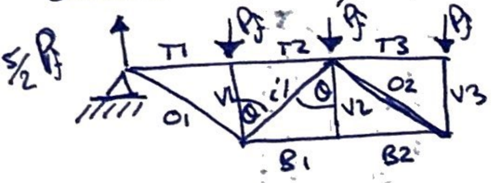
$= 342.99$ kN ← which is exactly what's happening in the software.

TOY GAMES /
ALTERNATE JOISTS

$P_f = 145.85625\,kN$

$\theta = 45°$

Warren Truss w/ Verticals



$\boxed{V_2 = \varnothing}$

$O_{1y} = \frac{5}{2}(-P_f)$

$= 364.640625\,kN$

only need components temporarily

$\boxed{O_1 = \frac{O_{1y}}{\cos\theta} = 515.679717\,kN\ (T)}$

$O_{1x} = O_1 \sin\theta = 364.640625\,kN$

$\boxed{T_1 = -O_{1x} = 364.640625\,kN\ (C) = T_2}$

$\boxed{V_1 = P_f = 145.85625\,kN\ (C)}$

$i_{1(y)} = -(O_{1(y)} + V_1)$

$= -(364.640625\,kN - 145.85625\,kN)$

$= -218.784375\,kN\ (C)$

$\boxed{i_1 = \frac{i_{1(y)}}{\cos\theta} = 309.40783\,kN\ (C)}$

$i_{1(x)} = i_1 \sin\theta = 218.784375\,kN\ (C)$

$\boxed{B_1 = -(i_{1(x)} + O_{1(x)}) = -(-218.784375\,kN - 364.640625\,kN) = 583.425\,kN\ (T) = B_2}$

$O_{2(y)} = -(i_{1(y)} + V_2 + P_f)$

$= -(218.784375\,kN + (\varnothing) - 145.85625\,kN)$

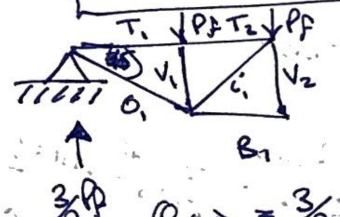
$= -72.928125\,kN\ (T)$

$\boxed{O_2 = \frac{O_{2(y)}}{\cos\theta} = 103.135943\,kN\ (T)}$

$O_{2(x)} = O_2 \sin\theta = 72.928125\,kN\ (T)$

$\boxed{T_3 = -(T_2 + i_{1(x)} + O_{2(x)}) = -(364.640625 + (218.784375) + 72.928125) = -656.353125\,kN\ (C)\ (= T_4)}$

$\boxed{V_3 = P_f = 145.85625\,kN\ (C)}$



$\boxed{V_1 = 145.85625\,kN\ (C) \quad V_2 = \varnothing}$

$O_{1(y)} = \frac{3}{2}(P_f)$

$= \frac{3}{2}(145.85625)$

$= 218.784375\,kN\ (T)$

$\boxed{O_1 = \frac{O_{1(y)}}{\cos\theta} = 309.40783\,kN\ (T)}$

$O_{1(x)} = O_1 \sin\theta = 218.784375\,kN$

$\boxed{T_1 = |O_{1(x)}| = 218.784375\ (C) = T_2}$

$i_{1(y)} = -(O_{1(y)} + V_1) = -(218.784375 - 145.85625) = -72.928125\,kN$

$\boxed{i_1 = \frac{i_{1(y)}}{\cos\theta} = 103.135943\,kN\ (C)}$

$i_{1(x)} = i_1 \sin\theta = 72.928125\,kN$

$\boxed{B_1 = -(O_{1(x)} + i_{1(x)}) = -(-364.640625 - 72.928125) = 437.568750\,kN\ (T)\ (= B_2)}$

$\cancel{O_{2(y)} = -(i_{1(y)} + P_f + V_3) = -(72.9281 - 145.85625)} = 72.928125\,kN$

LOOKS LIKE PATTERN HOLDS FOR WARREN TRUSSES W/ VERTICALS.

$B_1 = O_1 \sin\theta + i_1 \sin\theta$

$=$

OVERARCHING DATA STRUCTURE
(HIERARCHICAL / LEVEL DESIGN)

Type of Problem

TRUSS TYPES

ANGLE (∡)

(ie. what optimal solution are you looking for?)

The reason ∡ comes beneath Truss Types is b/c we only care which Truss Type is optimal if the Truss Type is optimal → we don't care if optimal ∡ is different for diff. Truss Types.

TYPE OF PROBLEM (Break Down)

- Based on Problem Constraints

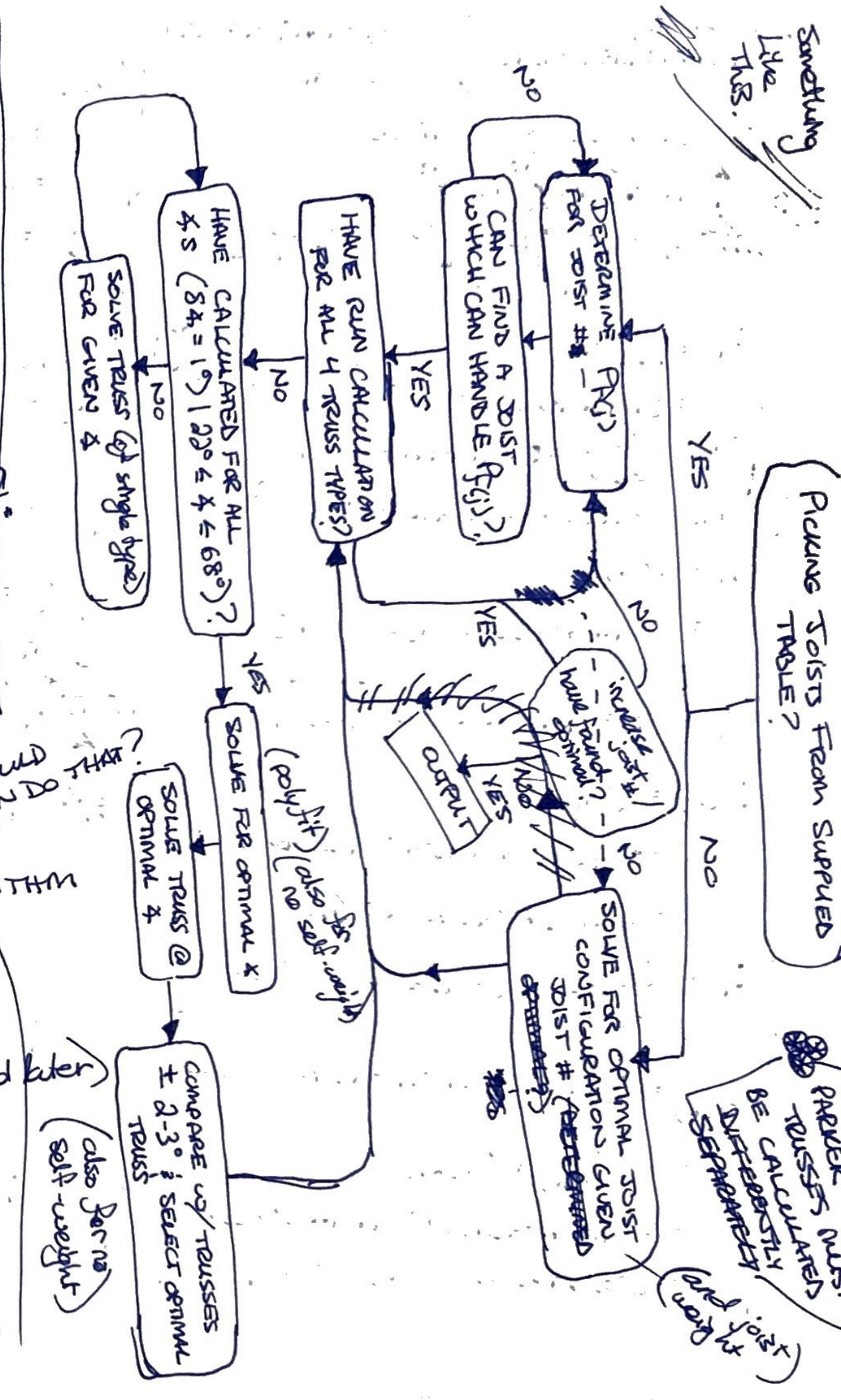
(2) ie → Accounting for Self-weight of Truss/Joists? → Always Do this?

(2) → Picking joists from supplied table? Or Treating them as separate Truss optimization Problems? → How would we even do that?

→ Then Run for optimal # Joists ⇒ ALGORITHM

⇒ Store Result for 13 joists.

SINCE THE 1ST ITERATION ALWAYS REQUIRES THAT WE NOT ACCOUNT FOR SELF-WEIGHT OF JOISTS / TRUSS ⇒ WE SIMPLY STORE THAT RESULT (can be accessed later)



T P_f T T

V V

O_1

$P_f \frac{5}{2}$ B_1 B_2

center transverse load.

⊛ NO VERTICAL MEMBERS UNUSED.

$$O_{1(y)} = -P_f\left(\tfrac{5}{2}\right)$$
$$= (145.85625)\left(\tfrac{5}{2}\right)\ (T)$$
$$= 364.640625\ kN\ (T)$$

$$\boxed{O_1 = \frac{O_{1(y)}}{\cos\theta} = 515.679717\ kN\ (T)}$$ ✓

$$\boxed{T_1 = O_1 \sin\theta\ (C) = 364.640628\ (C)}$$ ✓

$$\boxed{V_1 = O_{1(y)}\ (C) = (364.640625\ kN)\ (C)}$$ ✓

$$O_{2(y)} = -(V_1 + P_f)$$
$$= 145.85625 - 364.640625$$
$$= 218.784375\ (T)$$

$$\boxed{O_2 = \frac{O_{2(y)}}{\cos\theta} = 309.40783\ kN\ (T)}$$ ✓

$$T_2 = -(T_1 + O_{2(x)})$$
$$= -364.640625 - O_2 \sin\theta$$
$$= -364.640625 - (218.784375\ kN)$$

$$\boxed{T_2 = -583.425\ (C)}$$ ✓

$$\boxed{B_1 = O_{1(x)}\ (T) = 364.640625\ kN\ (T)}$$ ✓

$$\boxed{V_2 = O_{2(y)}\ (C) = 218.784375\ kN\ (C)}$$ ✓

$$B_2 = (O_{2(x)} + B_1)\ (T)$$
$$= 218.784375 + 364.640625$$

$$\boxed{B_2 = 583.425\ kN\ (T)}$$ ✓

? ? Q ? ? WHY DO WE HAVE TO CHECK IF $(KL/r)^2 \leq 200$???

NOT EVEN EXPLAINED → COME ON.

~~$T_3 = O_{3(x)} + T_2$~~

$$O_{3(y)} = V_2 - P_f = 72.928125$$

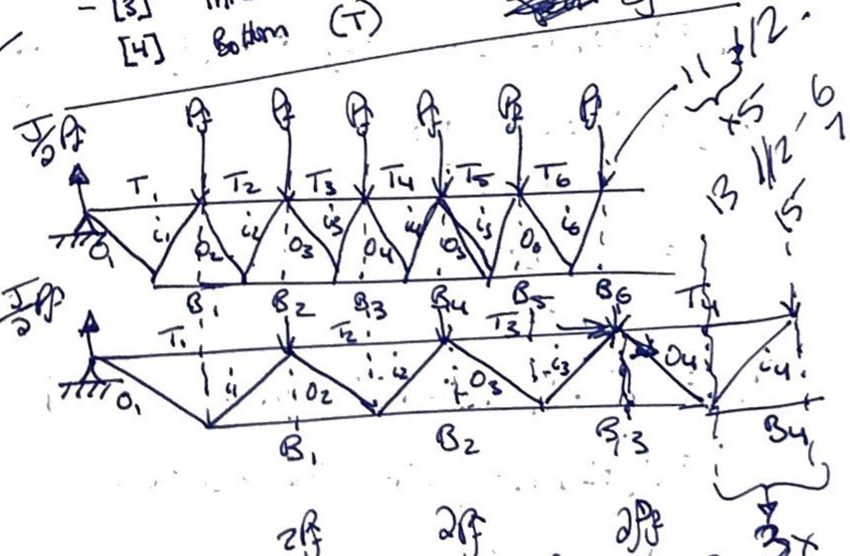
$$\boxed{O_3 = \frac{O_{3(y)}}{\cos\theta} = 103.135943\ kN\ (T)}$$ ✓

$$T_3 = O_{3(x)} + T_2 = O_3 \sin\theta + T_2$$
$$= 103.135943 \sin(45^\circ) + (583.425)$$

$$\boxed{T_3 = 656.353125\ (C)}$$ ✓

$$\boxed{V_3 = P_f = 145.85625\ kN\ (C)}$$ ✓

i			S_j
[0]	Top	(C)	L-d
[1]	outer	(T)	L-v
[2]	Vertical	(C)	L-d
[3]	Inner	(C)	
[4]	Bottom	(T)	S_j



$$O_1 = \frac{JP_f}{2\cos\theta} \qquad O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta} = \boxed{\frac{J-4}{2\cos\theta}P_f}$$

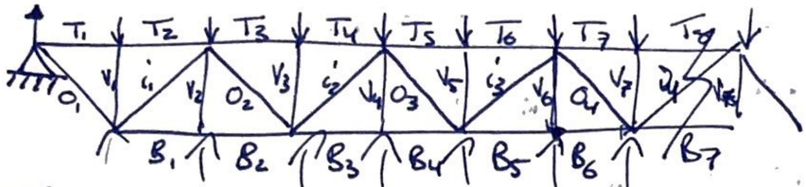
$$i_1 = 0$$

$$\boxed{T_1 = O_1\sin\theta \rightarrow \frac{J}{2}P_f\tan\theta}$$

$$B_1 = O_1\sin\theta + i_2\sin\theta$$
$$= 2O_1\sin\theta \rightarrow JP_f\tan\theta$$

$$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$$
$$= \tfrac{J}{2}P_f\tan\theta + \tfrac{J}{2}P_f\tan\theta + \frac{J-4}{2}P_f\tan\theta$$

$$\boxed{T_2 = \tfrac{1}{2}P_f\tan\theta(3J-4)}$$



$B_6 = B_5$

$$O_4 = \frac{i_3\cos\theta - P_f}{\cos\theta} = \frac{(J-12)P_f}{2\cos\theta}$$

$$T_7 = T_6 + i_3\sin\theta + O_4\sin\theta$$
$$= \tfrac{1}{2}P_f\tan\theta\big((5J-20)+(J-10)+(J-12)\big)$$
$$= \tfrac{1}{2}P_f\tan\theta\,(7J-42)$$

$\frac{J}{2}P_f$

$$O_1 = \frac{JP_f}{2\cos\theta}$$

B_6.

$$T_1 = \tfrac{J}{2}P_f\tan\theta = T_2$$

$$V_1 = P_f$$

$$i_1 = \frac{O_1\cos\theta - P_f}{\cos\theta} = \frac{(J-2)P_f}{2\cos\theta}$$

$$B_1 = O_1\sin\theta + i_1\sin\theta$$
$$= \tfrac{1}{2}P_f\tan\theta\,(J + J-2)$$
$$\boxed{B_1 = \tfrac{1}{2}P_f\tan\theta\,(2J-2)} \rightarrow \boxed{B_2}$$

$$O_2 = \frac{i_1\cos\theta - P_f}{\cos\theta} = \frac{(J-4)P_f}{2\cos\theta}$$

$$T_3 = T_2 + i_1\sin\theta + O_2\sin\theta \longrightarrow T_4$$
$$= \tfrac{1}{2}P_f\tan\theta\,\big(J+(J-2)+(J-4)\big)$$
$$= \tfrac{1}{2}P_f\tan\theta\,(3J-6)$$

$V_2 = \emptyset$

$V_3 = P_f$

$V_4 = \emptyset \quad V_5 = P_f \quad V_6 = \emptyset \quad V_7 = P_f$

$$i_2 = \frac{O_2\cos\theta - P_f}{\cos\theta} = \frac{(J-6)P_f}{2\cos\theta}$$

$$B_3 = B_2 + O_2\sin\theta + i_2\sin\theta$$
$$= \tfrac{1}{2}P_f\tan\theta\,\big((2J-2)+(J-4)+(J-6)\big) \quad \boxed{B_3 = \tfrac{1}{2}P_f\tan\theta\,(4J-12)}$$

$$O_3 = \frac{i_2\cos\theta - P_f}{\cos\theta} = \frac{(J-8)P_f}{2\cos\theta}$$

$$i_4 = \frac{O_4\cos\theta - P_f}{\cos\theta} = \frac{(J-14)P_f}{2\cos\theta}$$

$$T_5 = T_4 + i_2\sin\theta + O_3\sin\theta$$
$$= \tfrac{1}{2}P_f\tan\theta\,\big((3J-6)+(J-6)+(J-8)\big)$$
$$= \tfrac{1}{2}P_f\tan\theta\,(5J-20)$$

$B_4 = B_3$

$\cancel{i_3}\ O_3$

$$i_3 = \frac{O_3\cos\theta - P_f}{\cos\theta} = \frac{(J-10)P_f}{2\cos\theta}$$

$T_6 = T_5$

$$B_5 = B_4 + O_3\sin\theta + i_3\sin\theta$$
$$= \tfrac{1}{2}P_f\tan\theta\,\big((4J-12)+(J-8)+(J-10)\big)$$
$$\boxed{B_5 = \tfrac{1}{2}P_f\tan\theta\,(6J-30)}$$

$$B_7 = B_6 + O_4\sin\theta + i_4\sin\theta$$
$$= \tfrac{1}{2}P_f\tan\theta\,\big((6J-30)+(J-12)+(J-14)\big)$$
$$= \tfrac{1}{2}P_f\tan\theta\,(8J-56)$$

$xJ - x \quad 1 \quad \emptyset$

$\tfrac{1}{2}P_f\tan\theta\,(2J-2)$ / B_1 (J) T_1

$\downarrow$ / 2 B_2 $\downarrow$ $xJ-2x$ T_2

$xJ-3x$ $(4J-12)$ 3 / B_3 $(3J-6)$ T_3

$\downarrow$ / B_4 $\downarrow$ $xJ-4x$ T_4

$xJ-5x$ $(6J-30)$ 5 4 / B_5 $(5J-20)$ T_5

$\downarrow$ / B_6 $\downarrow$ T_6

$xJ-7x$ $(8J-56)$ 7 6 / B_7 $(7J-42)$ T_7

$\downarrow$ B_8 $\downarrow$ $xJ-6x$

$$O_1 = \frac{J P_f}{2\cos\theta}$$

$$i_1 = O_1$$

$$\boxed{T_1 = \frac{J}{2} P_f \tan\theta}$$

$$B_1 = O_1 \sin\theta + i_1 \sin\theta$$

$$= 2 O_1 \sin\theta$$

$$= \cancel{2}\left(\frac{J}{\cancel{2}} P_f \tan\theta\right)$$

$$O_2 = \frac{i_1 \cos\theta + P_f}{\cos\theta}$$

$$= \frac{J-2}{2\cos\theta} P_f$$

$$T_2 = T_1 + i_1 \sin\theta + O_2 \sin\theta$$

$$= \tfrac{1}{2} P_f \tan\theta \left(J + J + (J-2)\right)$$

$$\boxed{T_2 = \tfrac{1}{2} P_f \tan\theta \,(3J-2)}$$

$$B_2 = B_1 = B_3 \ldots \text{etc.} \checkmark \quad B_3$$

$$i_2 = O_2$$

$$O_3 = \frac{i_2 \cos\theta - P_f}{\cos\theta}$$

$$= \frac{\left(\left(\frac{J-2}{2}\right) - \left(\frac{2}{2}\right)\right) P_f}{\cos\theta}$$

$$\boxed{O_3 = \frac{\left(\frac{J-4}{2}\right) P_f}{\cos\theta}}$$

$$T_3 = T_2 + i_2 \sin\theta + O_3 \sin\theta$$

$$= \tfrac{1}{2} P_f \tan\theta \left((3J-2) + (J-2) + (J-4)\right)$$

$$\boxed{T_3 = \tfrac{1}{2} P_f \tan\theta \,(5J-8)}$$

B_3

$$i_3 = O_3$$

$$O_4 = \frac{i_3 \cos\theta - P_f}{\cos\theta}$$

$$= \frac{(J-6) P_f}{2\cos\theta}$$

$$T_4 = T_3 + i_3 \sin\theta + O_4 \sin\theta$$

$$= \tfrac{1}{2} P_f \tan\theta \left((5J-8) + (J-4) + (J-6)\right)$$

$$\boxed{T_4 = \tfrac{1}{2} P_f \tan\theta \,(7J-18)}$$

$$\left(\tfrac{1}{2} P_f \tan\theta\right) \begin{array}{c} (J) \\ \downarrow \\ (3J-2) \\ \downarrow \\ (5J-8) \\ \downarrow \\ \underbrace{(7J-18)}_{\text{regular.}} \end{array} \qquad \begin{array}{c} (J) \\ \downarrow \\ (3J-4) \\ \downarrow \\ (5J-16) \\ \downarrow \\ \underbrace{(7J-36)}_{\text{short}} \end{array}$$

$i_2 = O_2 \rightarrow \left(\frac{J-4}{2\cos\theta} P_f\right)$

$\boxed{B_2 = B_1 = J P_f \tan\theta} \rightarrow B_3$

$O_3 = \frac{i_2 \cancel{\sin\theta} - 2P_f}{\cos\theta}$

$= \frac{\left(\frac{J-4}{2} - \frac{4}{2}\right) P_f}{\cos\theta}$

$= \frac{(J-8) P_f}{2\cos\theta}$

$T_3 = T_2 + i_2 \sin\theta + O_3 \sin\theta$

$= \frac{1}{2} P_f \tan\theta \left((3J-4) + (J-4) + (J-8)\right)$

$\boxed{T_3 = \frac{1}{2} P_f \tan\theta\,(5J-16)}$

$i_3' = O_3 \rightarrow \left(\frac{(J-8)P_f}{2\cos\theta}\right)$

$O_4 = \frac{i_3 \cos\theta - 2P_f}{\cos\theta}$

$= \frac{\left(\frac{J-8}{2} - \frac{4}{2}\right) P_f}{\cos\theta}$

$O_4 = \frac{(J-12) P_f}{2\cos\theta}$

$T_4 = T_3 + i_3 \sin\theta + O_4 \sin\theta$

$= \frac{1}{2} P_f \tan\theta \left((5J-16) + (J-8) + (J-12)\right)$

$= \frac{1}{2} P_f \tan\theta\,(7J-36)$

$T_4 = \frac{1}{2} P_f \tan\theta\,(7J-36)$

0+0+0

0+0+4

$\frac{16+8+12}{36.}$

$T_1 = \frac{1}{2} P_f \tan\theta\,(J)$

$T_2 = \frac{1}{2} P_f \tan\theta\,(3J-4)$ 4+4+8

$T_3 = \frac{1}{2} P_f \tan\theta\,(5J-16)$

$T_i = \left(\frac{1}{2} P_f \tan\theta\right)(\text{no\_joists} + 2i(\text{no\_joists}) - 4^{i} * \text{bool}(i)$

$T_i = \left(\frac{1}{2} P_f \tan\theta\right)(\text{no\_joists}(1+2i)^{i} - \cancel{4^{i} * \text{bool}(i)}$

$\boxed{T_i = \left(\frac{1}{2} P_f \tan\theta\right)(\text{no\_joists}(1+2i) - (\text{previous value}) + 8 \text{ generally}}$

but 4 on second iteration, $\emptyset$ on 1st.

$T_i = \left(\frac{1}{2} P_f \tan\theta\right)$

$T_i = \left(\frac{1}{2} P_f \tan\theta\right)$ $P_f \rightarrow$

$i \rightarrow 0 \rightarrow 2 \rightarrow 4 \rightarrow 6$

$i{-}1 \quad i{-}3 \quad i{-}5$

$\frac{i}{2} \rightarrow 1 \rightarrow 2 \rightarrow 3$

$\times 1$

$(\text{round}(\#\text{joists}/2) \div 2) = i$

000	— $\emptyset$		4	8	
+0 0 4	— 4	12	12	8	
+4 4 8	— 16	20	20		
+16 8 12	— 36	28			
+36 12 16	— 64				

−8 −8 −8

0, 2, 4

8 joists $\emptyset$ → 15 joists

7 poles → 13 joists

Both have T_4

6 poles → 11 joists

5 poles → 9 joists

both have only T_3

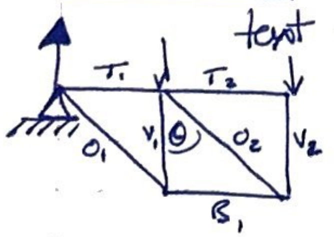
$2 \times i$ if $\frac{\#\text{joists}}{2}$

LECTURE 4 → "INTRODUCTION TO THE DESIGN PROCESS"

text — (THINKING LIKE AN ENGINEER [Ch 3])

$P_f = 145.85625\ kN$

HOW?



$O_{1(y)} = \frac{3}{2} P_f = 218.784375\ kN$

$$\boxed{O_1 = \frac{O_{1(y)}}{\cos\Theta} = 309.40783\ kN}\ (T)$$

$$\boxed{T_1 = O_1 \sin\Theta\ (C) = 218.784375\ kN}$$

$V_1 = O_{1(y)}$

$$\boxed{V_1 = O_{1(y)}\ (C) = 218.784375\ kN}$$

$B_1 = T_1$

$$\boxed{B_1 = T_1\ (T) = 218.784375\ kN\ (T)} = B_2?$$ (balanced same way O_2 is, across mirror line?)

$O_{2(y)} = V_1 + P_f$
$= (218.784375\ kN)(C) - 145.85625\ kN$
$O_{2(y)} = 72.928125\ kN\ (T)$

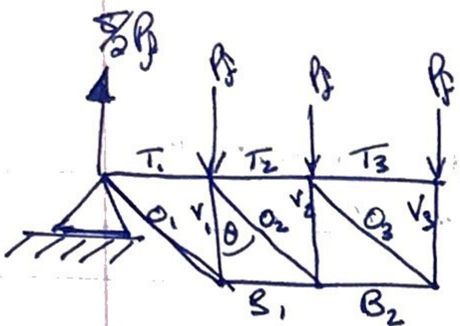
$$\boxed{O_2 = \frac{O_{2(y)}}{\cos\Theta} = 103.135943\ kN\ (T)}$$

$V_2 = -P_f$? (O_2 balanced by O_3 across central transverse axis?)

$T_2 = O_2 \sin\Theta + T_1$
$= 72.928125\ kN + 218.784375\ (C)$

$$\boxed{T_2 = 291.7125\ kN\ (C)}$$

NO, THERE'S A PROBLEM HERE → THERE IS NOTHING BALANCING V_2 @ BOTTOM POINT! → NO, O_2 & O_3 ARE BOTH IN TENSION & ACT TOGETHER UPWARD (THEY'RE BOTH EXACTLY ½ OF P_f)



$$\boxed{\begin{aligned} V_3 &= P_f \text{ (C)} \\ &= 145.85625 \text{ kN (C)} \end{aligned}}$$

$O_{1(y)} = \frac{5}{2}P_f = 364.640625 \text{ kN}$

$$\boxed{O_1 = \frac{O_{1(y)}}{\cos\theta} = 515.679717 \text{ kN (T)}}$$

$B_1 = T_1$

$$\boxed{\begin{aligned} T_1 &= O_1 \sin\theta \text{ (C)} \\ &= 364.640625 \text{ kN (C)} \end{aligned}}$$

$$\boxed{\begin{aligned} B_1 &= T_1 \text{ (T)} \\ &= 364.640625 \text{ kN (T)} \end{aligned}}$$

$V_1 = O_{1}y$

$$\boxed{V_1 = O_{1(y)} = 364.640625 \text{ kN (C)}}$$

$$\begin{aligned} O_{2(y)} &= \overset{(=V_1)}{O_{1(y)}} - P_f \\ &= 218.784375 \text{ kN (T)} \end{aligned}$$

Iterable Loop ...

$$\boxed{O_2 = \frac{O_{2(y)}}{\cos\theta} = 309.40783 \text{ (T)}}$$

$$\boxed{\begin{aligned} T_2 &= T_1 + O_2\sin\theta = 583.425 \text{ kN (C)} \\ &= 364.640625 \text{ kN} + 218.784375 \text{ kN} \end{aligned}}$$

$B_2 = T_2$

$$\boxed{\begin{aligned} B_2 &= B_1 + O_2 \sin\theta \text{ (T)} \\ &= 364.640625 + 218.784375 \\ &= 583.425 \text{ (T)} \end{aligned}}$$

$V_2 = O_{2}y$

$$\boxed{V_2 = O_{2(y)} \text{ (C)} = 218.784375 \text{ kN (C)}}$$

2nd Iteration

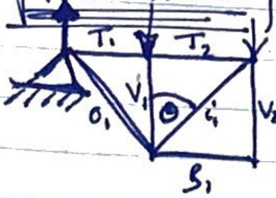
$$\begin{aligned} O_{3(y)} &= V_2 - P_f \text{ (T)} \\ &= 218.784375 - 145.85625 \text{ (T)} \\ &= 72.928125 \text{ kN (T)} \end{aligned}$$

$$\boxed{O_3 = \frac{O_{3(y)}}{\cos\theta} = 103.135943 \text{ kN (T)}}$$

$$\boxed{\begin{aligned} T_3 &= T_2 + O_3\sin\theta \\ &= 416.208597 \text{ kN (C)} \end{aligned}}$$

* It looks like there's a loop we can run over $O_{2(y)}$ → based off $\left(\frac{(\text{no\_joists})}{2}\right)P_f$ → there's a lot of equivalencies here → seems everything else based off this.

PRATT TRUSS



$\boxed{V_2 = \phi}$

$\boxed{V_1 = P_f}$

$O_{1(y)} = P_f\left(\frac{3}{2}\right)$

$= 218.784375\,kN\,(T)$

$\boxed{O_1 = \frac{O_{1(y)}}{\cos\theta} = 309.40783\,kN\,(T)}$

$\boxed{T_1 = O_1\sin\theta = 218.784375\,kN\,(C)}\ \boxed{= T_2}$

$T_2 = T_1$

$i_{1(y)} = O_{1(y)} - V_1$

$= \frac{3}{2}P_f - P_f$

$= \frac{1}{2}P_f$

$= 72.928125\,kN\,(C)$

$\boxed{i_1 = \frac{i_{1(y)}}{\cos\theta} = 103.135943\,(C)}$

$B_1 = T_1 + i_{1(x)}$

$= 218.784375 + 103.135943\sin(45^\circ)$

$\boxed{B_1 = 291.7125\,(T)}$

$\boxed{T_2 = T_1}$

$B_2 = i_2\sin\theta + B_1$

$= 72.928128\,kN + 583.425\,kN$

$\boxed{B_2 = 656.353125\,kN\,(T)}$

$T_3 = T_2 + i_1\sin\theta$

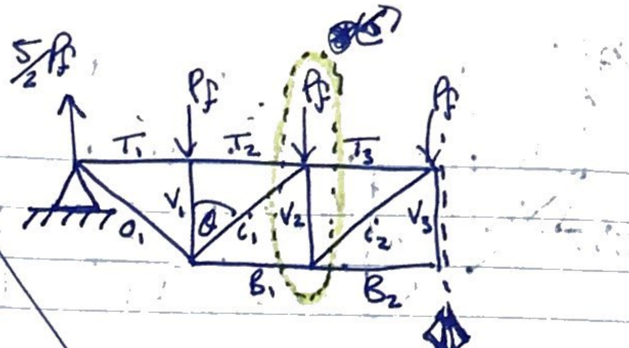
$= T_1 + i_1\sin\theta$

$= 364.640625\,kN + 309.40783\sin(45^\circ)$

$\boxed{T_3 = 584.425\,kN\,(C)}$ ✓

$\boxed{T_3 = B_1}$

Vertical IN TENSION!



$\boxed{V_1 = P_f\ (C) = 145.85625\,kN\,(C)}$

$\boxed{V_3 = \phi}$

$\boxed{O_1 = \frac{O_{1(y)}}{\cos\theta} = \frac{\frac{5}{2}P_f}{\cos\theta} = 515.679717\,kN\,(T)}$

$i_{1(y)} = O_{1(y)} - V_1$

$= \frac{5}{2}P_f - P_f$

$= \frac{3}{2}P_f$

$= 218.784375\,kN\,(C)$

(C) $\boxed{i_1 = \frac{i_{1(y)}}{\cos\theta} = 309.40783}$

$\boxed{T_1 = O_{1(x)} = O_1\sin\theta = 364.640625\,kN\,(C)}$

$B_1 = T_1 + i_1\sin\theta$

$= 364.640625 + 309.40783\sin\theta$

✓ $\boxed{B_1 = 583.425\,kN\,(T)}$

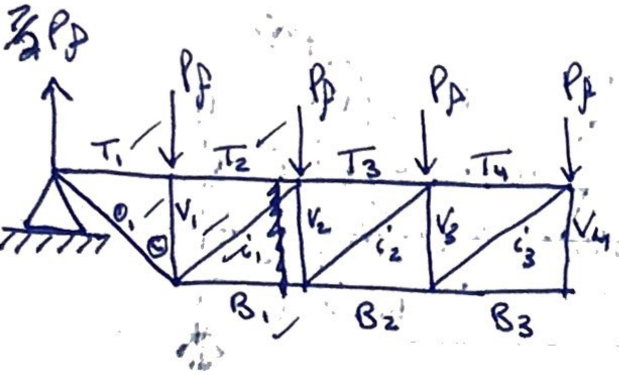
$V_2 = i_{1(y)} - P_f$

$= \frac{3}{2}P_f - P_f$

$= \frac{1}{2}P_f$

$\boxed{V_2 = 72.928125\,kN\,(T)}$

$\boxed{i_2 = V_2/\cos\theta = 103.135943\,kN\,(C)}$



$\boxed{\text{PRATT}}$

$\boxed{V_1 = P_f\,(C) = 145.85625 \text{ kN } (C)}$

$\boxed{V_4 = \varnothing}$

$O_{1(y)} = \frac{7}{2}P_f = 510.496875\ (T)$

$\boxed{O_1 = \frac{O_{1(y)}}{\cos\theta} = 721.951604 \text{ kN } (T)}$

$T_1 = \left(\frac{\frac{7}{2}P_f}{\cos\theta}\right) * \sin\theta = \frac{7}{2}P_f \tan\theta$

$\boxed{T_1 = 510.496875\ (C)}$

$\boxed{T_2 = T_1\ (C)}$

$i_{1(y)} = O_{1(y)} - V_1$

$= \frac{7}{2}P_f - P_f$

$= \frac{5}{2}P_f$

$= 364.640625 \text{ kN } (C)$

$\boxed{i_1 = \frac{i(y)}{\cos\theta} = 515.679717\ (C)}$

$B_1 = T_1 + i_1 \sin\theta$

$= \frac{7}{2}P_f \tan\theta + \left(\frac{5}{2}P_f\right)\tan\theta$

(T) $\boxed{B_1 = \tan\theta\,(6P_f)\ldots}$

$\boxed{B_1 = 875.1375 \text{ kN } (T)}$

$V_2 = i_1 \cos\theta - P_f$

$= \frac{5}{2}P_f - P_f$

$= \frac{3}{2}P_f$

$\boxed{V_2 = 218.784375 \text{ kN } (T)}$

$T_3 = T_2 + i_{1(x)}$

$= T_2 + i_1 \sin\theta$

$= \left(\frac{7}{2}P_f \cdot \tan\theta\right) + \frac{5}{2}P_f \tan\theta$

$= 6P_f \cdot \tan\theta$

$= B_1$

$T_3 = B_1$

$\boxed{T_3 = 875.1375\ (C)}$

$i_{2(y)} = V_2$

$i_2 = \frac{V_2}{\cos\theta} \rightarrow \frac{\frac{3}{2}P_p}{\cos\theta}$

$\frac{(i_1 \cos\theta - P_f)}{\cos\theta}$

$= i_1 - \frac{P_f}{\cos\theta}$

$\boxed{i_2 = 309.40783 \text{ kN } (C)}$

$B_2 = i_2 \sin\theta + B_1$

$= \left(\frac{V_2}{\cos\theta}\right)\sin\theta + 6P_f \tan\theta$

$= V_2 \tan\theta + 6P_f \tan\theta$

$= \frac{3}{2}P_f \tan\theta + 6P_p \tan\theta$

$= \frac{15}{2}P_f \tan\theta$

$\boxed{B_2 = 1{,}093.92188 \text{ kN } (T)}$

$V_3 = i_2 \cos\theta - P_f$
$= V_2 - P_f$
$= \frac{3}{2}P_f - P_f$

$$\boxed{\begin{aligned} V_3 &= \tfrac{1}{2}P_f \ (T) \\ &= 72.928125 \text{ kN } (T) \end{aligned}}$$

$T_4 = i_2 \sin\theta + T_3$
$= V_2 \tan\theta + (B_1)$ ← $6P_f \tan\theta$
$= \frac{15}{2}P_f \tan\theta$
$= B_2$

$\boxed{T_4 = B_2}$

$$\boxed{T_4 = 1{,}093.92188 \text{ kN } (C)}$$

$i_{3(y)} = V_3 \ (C)$

$i_3 = \frac{V_3}{\cos\theta} = \frac{V_2 - P_f}{\cos\theta}$

$= \frac{(i_1 \cos\theta - P_f) - P_f}{\cos\theta}$

$= \frac{(\frac{5}{2}P_f - P_f) - P_f}{\cos\theta}$

$= \frac{\frac{1}{2}P_f}{\cos\theta}$

$$\boxed{i_3 = 1{,}031.35943 \text{ kN } (C)}$$

$B_3 = B_2 + i_3 \sin\theta$

$= \frac{15}{2}P_f \tan\theta + \frac{1}{2}P_f \tan\theta$

$= 8P_f \tan\theta$

$$\boxed{B_3 = 1{,}166.85 \text{ kN } (T)}$$

FIRST OF ALL

→ have to adjust HSS assignment (T/C) check to fit some encoded whatever in each Truss (since Pratt Trusses have verticals in Tension — like assholes)

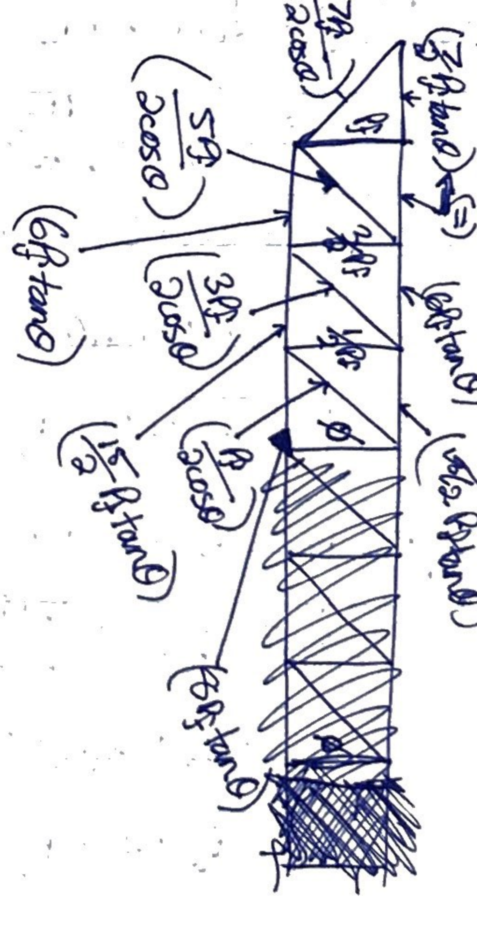
→ May want to rewrite force-matrix calculation algorithm (analyze lef 4 patterns)

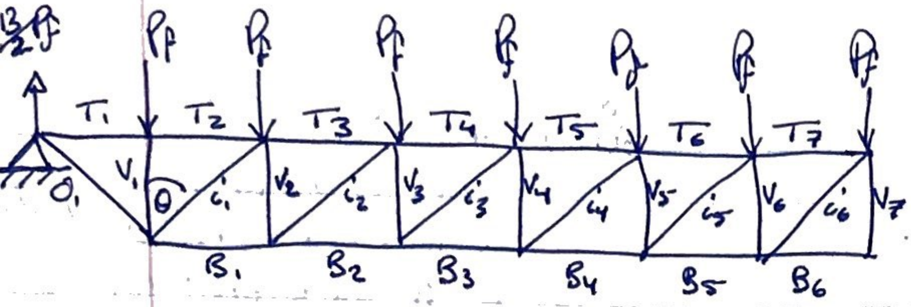
→ Need to account for $\emptyset F$ members...

→ omit from design?

→ use lightest HSS?

??





$O_1 = \dfrac{13 P_f}{2\cos\theta}$

$T_2 = T_1$ $\quad T_1 = \frac{13}{2} P_f \tan\theta = T_2$

$V_1 = P_f \;/\; V_7 = \varnothing$

$i_1 = \dfrac{O_{1(y)} - V_1}{\cos\theta} = \dfrac{\frac{13}{2} P_f - P_f}{\cos\theta} = \dfrac{11 P_f}{2\cos\theta}$

$B_1 = T_1 + i_1 \sin\theta = \frac{13}{2} P_f \tan\theta + \frac{11}{2} P_f \tan\theta = 12 P_f \tan\theta$

$V_2 = \frac{13}{2} P_f - 2(P_f) = \frac{9}{2} P_f$

$T_3 = B_1$ $\quad T_3 = i_1 \sin\theta + T_2 = \frac{11}{2} P_f \tan\theta + \frac{13}{2} P_f \tan\theta = 12 P_f \tan\theta = B_1$

$i_2 = \dfrac{V_2}{\cos\theta} = \dfrac{9 P_f}{2\cos\theta}$

$B_2 = B_1 + i_2 \sin\theta$

$\quad = 12 P_f \tan\theta + \frac{9}{2} P_f \tan\theta = \frac{33}{2} P_f \tan\theta$

$V_3 = i_2 \cos\theta - P_f = \frac{9}{2} P_f - P_f = \frac{7}{2} P_f$

$T_4 = B_2$ $\quad T_4 = i_2 \sin\theta + T_3 = \frac{9}{2} P_f \tan\theta + 12 P_f \tan\theta = \frac{33}{2} P_f \tan\theta = B_2$

$i_3 = \dfrac{V_3}{\cos\theta} = \dfrac{7 P_f}{2\cos\theta}$

$B_3 = B_2 + i_3 \sin\theta = \frac{33}{2} P_f \tan\theta + \frac{7}{2} P_f \tan\theta = 20 P_f \tan\theta$

$V_4 = i_3 \cos\theta - P_f = \frac{7}{2} P_f - P_f = \frac{5}{2} P_f$

$$T_5 = T_4 + i_3 \sin\theta$$
$$= \tfrac{33}{2} P_f \tan\theta + \tfrac{7}{2} P_f \tan\theta$$
$$= 20 P_f \tan\theta = B_3$$

$T_5 = B_3$

$$i_4 = \frac{V_4}{\cos\theta} = \frac{5P_f}{2\cos\theta}$$

$$B_4 = B_3 + i_4 \sin\theta$$
$$= 20 P_f \tan\theta + \tfrac{5}{2} P_f \tan\theta$$
$$= \tfrac{45}{2} P_f \tan\theta$$

$$V_5 = i_4 \cos\theta - P_f$$
$$= V_4 - P_f$$
$$= \tfrac{5}{2} P_f - P_f$$
$$= \tfrac{3}{2} P_f$$

$$T_6 = i_4 \sin\theta + T_5$$
$$= \tfrac{5}{2} P_f \tan\theta + 20 P_f \tan\theta$$
$$= \tfrac{45}{2} P_f \tan\theta = B_4$$

$T_6 = B_4$

$$i_5 = \frac{V_5}{\cos\theta} = \frac{3P_f}{2\cos\theta}$$

$$B_5 = i_5 \sin\theta + B_4$$
$$= \tfrac{3}{2} P_f \tan\theta + \tfrac{45}{2} P_f \tan\theta$$
$$= 24 P_f \tan\theta$$

$$V_6 = i_5 \cos\theta - P_f = \tfrac{3}{2} P_f - P_f$$
$$= \tfrac{1}{2} P_f$$

$$T_7 = i_5 \sin\theta + T_6$$
$$= V_5 \tan\theta + \tfrac{45}{2} P_f \tan\theta$$
$$= \tfrac{48}{2} P_f \tan\theta = 24 P_f \tan\theta$$
$$= B_5$$

$\tfrac{3}{2} P_f$

$$i_6 = \frac{V_6}{\cos\theta} = \frac{P_f}{2\cos\theta}$$

$$B_6 = i_6 \sin\theta + B_5$$
$$= V_6 \tan\theta + 24 P_f \tan\theta$$
$$= \frac{P_f \tan\theta}{2} + \frac{48}{2} P_f \tan\theta$$
$$= \tfrac{49}{2} P_f \tan\theta$$

Interesting.

* Happens to be $(\#\text{joists}/2 + 1)^2$
(ie. # joists involved when you calculate ½ the truss)

$\boxed{V_7 = \emptyset}$

13 joists.

TOP → $\tfrac{13}{2} P_f \tan\theta$ → = → $\tfrac{24}{2} P_f \tan\theta$ → $\tfrac{33}{2} P_f \tan\theta$ → $\tfrac{40}{2} P_f \tan\theta$ → $\tfrac{45}{2}$ ...

(1) (2) (3) (4)

∅ 11 9 7 5 3

OUTER → $\frac{13 P_f}{2\cos\theta}$ →

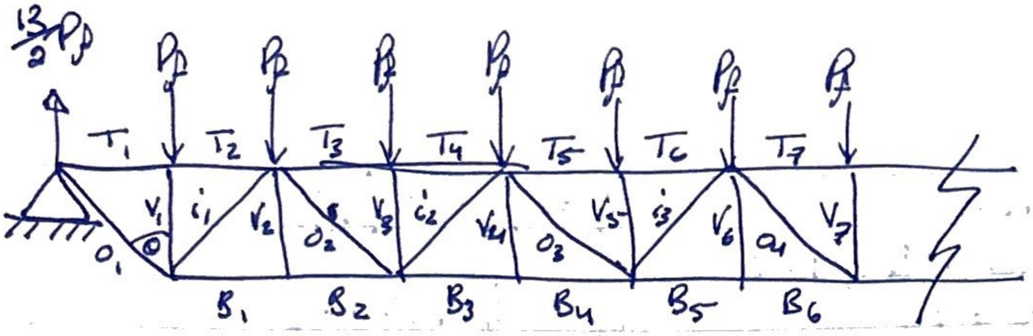
VERTICALS → P_f → $\tfrac{9}{2} P_f$ → $\tfrac{7}{2} P_f$ → $\tfrac{5}{2} P_f$ → $\tfrac{3}{2} P_f$ → $\tfrac{1}{2} P_f$ → ∅

INNERS → * → $\frac{11 P_f}{2\cos\theta}$ → $\frac{9 P_f}{2\cos\theta}$ → $\frac{7 P_f}{2\cos\theta}$ → $\frac{5 P_f}{2\cos\theta}$ → $\frac{3 P_f}{2\cos\theta}$ → $\frac{P_f}{2\cos\theta}$

BOTTOMS → $\tfrac{24}{2} P_f \tan\theta$ → $\tfrac{33}{2} P_f \tan\theta$ → $\tfrac{40}{2} P_f \tan\theta$ → $\tfrac{45}{2} P_f \tan\theta$ → $\tfrac{48}{2} P_f \tan\theta$ → $\tfrac{49}{2} P_f \tan\theta$

9 7 5 3 1

WARREN TRUSS w/ VERTICALS



$$O_1 = \frac{13P_f}{2\cos\theta}$$

$$T_1 = \frac{13}{2}P_f\tan\theta$$

$$i_1 = (O_1\cos\theta - V_1) \div \cos\theta$$

$$= \left(\frac{13}{2}P_f - P_f\right) \div \cos\theta$$

$$i_1 = \cancel{\frac{11}{2}P_f}\ \frac{11P_f}{2\cos\theta}$$

$$B_1 = O_1\sin\theta + i_1\sin\theta$$

$$= \frac{13}{2}P_f\tan\theta + \frac{11}{2}P_f\tan\theta$$

$$= \frac{24}{2}P_f\tan\theta \quad (12P_f\tan\theta)$$

$$O_2 = (i_1\cos\theta - P_f) \div \cos\theta$$

$$= \left(\frac{11}{2}P_f - P_f\right) \div \cos\theta$$

$$O_2 = \cancel{\frac{9}{2}P_f}\ \frac{9P_f}{2\cos\theta}$$

$$T_3 = i_1\sin\theta + T_2 + O_2\sin\theta$$

$$= \frac{11}{2}P_f\tan\theta + \frac{13}{2}P_f\tan\theta + \frac{9}{2}P_f\tan\theta$$

$$= \frac{33}{2}P_f\tan\theta$$

$$i_2 = \frac{O_2\cos\theta - V_3}{\cos\theta} = \frac{7P_f}{2\cos\theta}$$

$$B_3 = B_2 + i_2\sin\theta$$

$$= \frac{24}{2}P_f\tan\theta + \frac{7}{2}P_f\tan\theta$$

$$= \frac{31}{2}P_f\tan\theta$$

$$T_7 = T_6 + i_3\sin\theta + O_4\sin\theta$$

$$= \cancel{\frac{45}{2}}P_f\tan\theta\left(\frac{45}{2} + \frac{3}{2} + \frac{1}{2}\right) = \frac{49}{2}P_f\tan\theta$$

$$V_2 = V_4 = V_6 = \varnothing$$

$$V_1 = V_3 = V_5 = V_7 = P_f$$

$$T_2 = T_1,\ T_4 = T_3,\ T_6 = T_5$$

$$B_2 = B_1,\ B_4 = B_3,\ B_6 = B_5$$

$$\cancel{T_5 = i_2\sin\theta + T_4}$$

$$O_3 = \frac{i_2\cos\theta - P_f}{\cos\theta}$$

$$= \frac{\frac{7}{2}P_f - P_f}{\cos\theta}$$

$$O_3 = \frac{5P_f}{2\cos\theta}$$

$$T_5 = T_4 + i_2\sin\theta + O_3\sin\theta$$

$$= \frac{33}{2}P_f\tan\theta + \frac{7}{2}P_f\tan\theta + \frac{5}{2}P_f\tan\theta$$

$$= \frac{45}{2}P_f\tan\theta$$

$$i_3 = \frac{O_3\cos\theta - V_5}{\cos\theta}$$

$$= \frac{\frac{5}{2}P_f - P_f}{\cos\theta}$$

$$i_3 = \frac{3P_f}{2\cos\theta}$$

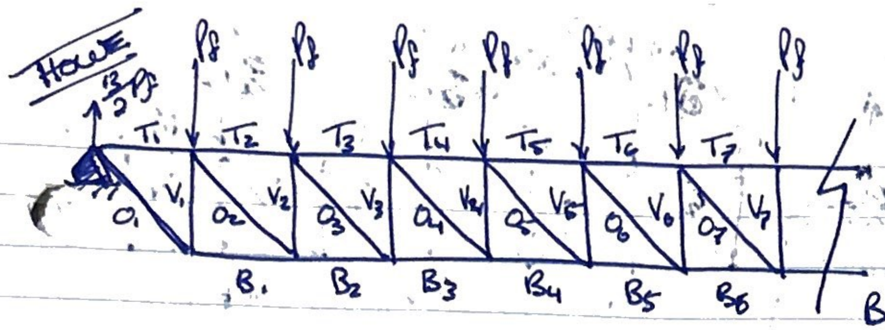
$$B_5 = B_4 + O_3\sin\theta + i_3\sin\theta$$

$$= \frac{31}{2}P_f\tan\theta + \frac{5}{2}P_f\tan\theta + \frac{3}{2}P_f\tan\theta$$

$$B_5 = \frac{39}{2}P_f\tan\theta$$

$$O_4 = \frac{i_3\cos\theta - P_f}{\cos\theta}$$

$$O_4 = \cancel{[illegible]}\ \frac{P_f}{2\cos\theta}$$



$$O_1 = \frac{13 P_f}{2\cos\theta}$$

$$T_1 = \frac{13}{2} P_f \tan\theta$$

$$V_1 = \tfrac{13}{2} P_f$$

$$B_1 = T_1 = \tfrac{13}{2} P_f \tan\theta$$

$$O_2 = \frac{V_1 - P_f}{\cos\theta} = \frac{\tfrac{13}{2} P_f - P_f}{\cos\theta} = \frac{11 P_f}{2\cos\theta}$$

$$T_2 = T_1 + O_2 \sin\theta$$

$$= \tfrac{13}{2} P_f \tan\theta + \tfrac{11}{2} P_f \tan\theta$$

$$T_2 = \tfrac{24}{2} P_f \tan\theta$$

$$B_2 = B_1 + O_2 \sin\theta$$

$$= \tfrac{13}{2} P_f \tan\theta + \tfrac{11}{2} P_f \tan\theta$$

$$= \tfrac{24}{2} P_f \tan\theta$$

$$\boxed{B_2 = T_2}$$

$$V_2 = O_2 \cos\theta$$

$$= \tfrac{11}{2} P_f$$

$$O_3 = \frac{V_2 - P_f}{\cos\theta} = \frac{\tfrac{11}{2} P_f - P_f}{\cos\theta}$$

$$= \frac{9 P_f}{2\cos\theta}$$

$$T_3 = T_2 + O_3 \sin\theta$$

$$= \tfrac{24}{2} P_f \tan\theta + \tfrac{9}{2} P_f \tan\theta$$

$$T_3 = \tfrac{33}{2} P_f \tan\theta$$

$$B_3 = B_2 + O_3 \sin\theta = \left(\tfrac{24}{2} + \tfrac{9}{2}\right) P_f \tan\theta$$

$$= \tfrac{33}{2} P_f \tan\theta = T_3$$

$$V_3 = O_3 \cos\theta$$

$$= \tfrac{9}{2} P_f$$

$$O_4 = \frac{V_3 - P_f}{\cos\theta}$$

$$= \frac{7 P_f}{2\cos\theta}$$

$$T_4 = T_3 + O_4 \sin\theta$$

$$= \tfrac{33}{2} P_f \tan\theta + \tfrac{7}{2} P_f \tan\theta$$

$$= \tfrac{40}{2} P_f \tan\theta$$

$$V_4 = O_4 \cos\theta$$

$$= \tfrac{7}{2} P_f$$

$$B_4 = B_3 + O_4 \sin\theta$$

$$= \tfrac{33}{2} P_f \tan\theta + \tfrac{7}{2} P_f \tan\theta$$

$$B_4 = \tfrac{40}{2} P_f \tan\theta$$

$$= T_4$$

$$O_5 = \frac{V_4 - P_f}{\cos\theta} = \frac{\tfrac{7}{2} P_f - P_f}{\cos\theta}$$

$$= \frac{5 P_f}{2\cos\theta}$$

$$T_5 = T_4 + O_5 \sin\theta$$

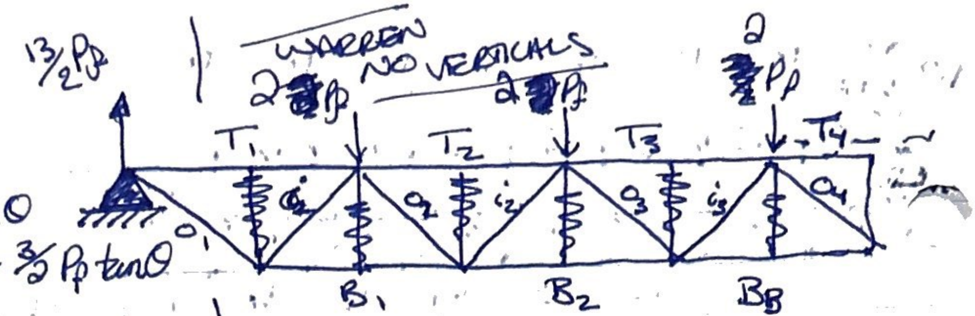
$$= \tfrac{40}{2} P_f \tan\theta + \tfrac{5}{2} P_f \tan\theta$$

$$= \tfrac{45}{2} P_f \tan\theta$$

$$V_5 = O_5 \cos\theta = \tfrac{5}{2} P_f$$

$$B_5 = T_5 = \tfrac{45}{2} P_f \tan\theta$$

$$O_6 = \frac{V_5 - P_f}{\cos\theta} = \frac{3 P_f}{2\cos\theta}$$



$$T_6 = T_5 + O_6\sin\theta$$
$$= \tfrac{45}{2}P_f\tan\theta + \tfrac{3}{2}P_f\tan\theta$$
$$= \tfrac{48}{2}P_f\tan\theta$$

$$V_6 = O_6\cos\theta$$
$$= \tfrac{3}{2}P_f$$

$$B_6 = T_6 = \tfrac{48}{2}P_f\tan\theta$$

$$O_7 = \frac{V_6 - P_f}{\cos\theta} = \frac{P_f}{2\cos\theta}$$

$$T_7 = T_6 + O_7\sin\theta$$
$$= \tfrac{48}{2}P_f\tan\theta + \tfrac{1}{2}P_f\tan\theta$$
$$= \tfrac{49}{2}P_f\tan\theta$$

$$V_7 = P_f$$

$$T_4 = T_3 + i_3\sin\theta + O_4\sin\theta$$
$$= \tfrac{49}{2}P_f\tan\theta + \tfrac{5}{2}\sim + \tfrac{P_f}{2}\tan\theta$$
$$= \tfrac{55}{2}P_f\tan\theta$$

$$O_1 = \frac{13P_f}{2\cos\theta}$$

$$T_1 = \tfrac{13}{2}P_f\tan\theta$$

$$i_1 = O_1 = \frac{13P_f}{2\cos\theta}$$

$$B_1 = i_1\sin\theta + O_1\sin\theta$$
$$= 2O_1\sin\theta$$
$$= 2T_1$$

$$B_1 = 13P_f\tan\theta$$

$$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$$
$$= \frac{9P_f}{2\cos\theta}$$

$$T_2 = T_1 + i_2\sin\theta + O_2\sin\theta$$
$$= P_f\tan\theta\left(\tfrac{13}{2} + \tfrac{13}{2} + \tfrac{9}{2}\right)$$
$$= \tfrac{35}{2}P_f\tan\theta$$

$$i_2 = O_2 \rightarrow \frac{9P_f}{2\cos\theta}$$

$$B_2 = B_1 = B_3 \rightarrow 13P_f\tan\theta$$

$$O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta}$$
$$\frac{5P_f}{2\cos\theta}$$

$$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$$
$$= \tfrac{35}{2}P_f\tan\theta + \tfrac{9}{2} + \tfrac{5}{2}$$

$\frac{43?}{2}$

$$= \tfrac{49}{2}P_f\tan\theta$$

$$i_3 = O_3 \rightarrow \frac{5P_f}{2\cos\theta}$$

$$O_4 = \frac{i_3\cos\theta - 2P_f}{\cos\theta}$$
$$= \frac{P_f}{2\cos\theta}$$

49

WARREN w/ VERT

(1) (2) (3) (4) (5) (6) (7)

TOP → $\frac{13}{2}P_f\tan\theta \rightarrow = \rightarrow \frac{33}{2}P_f\tan\theta \rightarrow = \rightarrow \frac{45}{2}P_f\tan\theta \rightarrow = \rightarrow \frac{49}{2}P_f\tan\theta$

20 12 4

8 8

OUTER → $\frac{13P_f}{2\cos\theta} \rightarrow \frac{9P_f}{2\cos\theta} \rightarrow \frac{5P_f}{2\cos\theta} \rightarrow \frac{P_f}{2\cos\theta}$

INNER → $\frac{11P_f}{2\cos\theta} \rightarrow \frac{7P_f}{2\cos\theta} \rightarrow \frac{3P_f}{2\cos\theta}$

VERTICAL → $P_f \rightarrow 0 \rightarrow P_f \rightarrow 0 \rightarrow P_f \rightarrow 0 \rightarrow$ * Goes down by $\boxed{P_f}$ ea. time.

BOTTOM → $\frac{24}{2}P_f\tan\theta \rightarrow = \rightarrow \frac{31}{2}P_f\tan\theta \rightarrow = \rightarrow \frac{39}{2}P_f\tan\theta \rightarrow =$

7 8

TOP + BOTTOM → $\frac{13}{2} \rightarrow \frac{24}{2} \rightarrow \frac{31}{2} \rightarrow \frac{33}{2} \rightarrow \frac{39}{2} \rightarrow \frac{45}{2} \rightarrow \frac{49}{2}$

(T) (B) (B) (T) (B) (T) (T)

- can't see much of a pattern between top & bottom, to be honest.

PRATT

(1) (2) (3) (4) (5) (6) (7)

TOP → $\frac{13}{2}P_f\tan\theta \rightarrow = \rightarrow \frac{24}{2}P_f\tan\theta \rightarrow \frac{33}{2}P_f\tan\theta \rightarrow \frac{40}{2}P_f\tan\theta \rightarrow \frac{45}{2}P_f\tan\theta \rightarrow \frac{48}{2}P_f\tan\theta$

11 9 7 5 3

2 2 2 2

OUTER → $\frac{13P_f}{2\cos\theta}$

INNERS → $\frac{11P_f}{2\cos\theta} \rightarrow \frac{9P_f}{2\cos\theta} \rightarrow \frac{7P_f}{2\cos\theta} \rightarrow \frac{5P_f}{2\cos\theta} \rightarrow \frac{3P_f}{2\cos\theta} \rightarrow \frac{P_f}{2\cos\theta}$

VERTICALS → $P_f \rightarrow \frac{9}{2}P_f \rightarrow \frac{7}{2}P_f \rightarrow \frac{5}{2}P_f \rightarrow \frac{3}{2}P_f \rightarrow \frac{1}{2}P_f \rightarrow \emptyset$

BOTTOM → $\frac{24}{2}P_f\tan\theta \rightarrow \frac{33}{2}P_f\tan\theta \rightarrow \frac{40}{2}P_f\tan\theta \rightarrow \frac{45}{2}P_f\tan\theta \rightarrow \frac{48}{2}P_f\tan\theta \rightarrow \frac{49}{2}P_f\tan\theta$

9 7 5 3 1

2 2 2 2

HOWE

(1) (2) (3) (4) (5) (6) (7)

TOP → $\frac{13}{2}P_f\tan\theta \rightarrow \frac{24}{2}P_f\tan\theta \rightarrow \frac{33}{2}P_f\tan\theta \rightarrow \frac{40}{2}P_f\tan\theta \rightarrow \frac{45}{2}P_f\tan\theta \rightarrow \frac{48}{2}P_f\tan\theta \rightarrow \frac{49}{2}P_f\tan\theta$

11 9 7 5 3 1

2 2 2 2 2

OUTERS → $\frac{13P_f}{2\cos\theta} \rightarrow \frac{11P_f}{2\cos\theta} \rightarrow \frac{9P_f}{2\cos\theta} \rightarrow \frac{7P_f}{2\cos\theta} \rightarrow \frac{5P_f}{2\cos\theta} \rightarrow \frac{3P_f}{2\cos\theta} \rightarrow \frac{P_f}{2\cos\theta}$

INNERS - - - 2 - - - 2 - - - 2 - - - 2 - - - 2 - - - 2 - - -

VERTICALS $\frac{13}{2}P_f \rightarrow \frac{11}{2}P_f \rightarrow \frac{9}{2}P_f \rightarrow \frac{7}{2}P_f \rightarrow \frac{5}{2}P_f \rightarrow \frac{3}{2}P_f \rightarrow P_f$

1 1 1 1 1 1/2

b/c it's split between the 2 halves of the truss?

BOTTOM → $T_1 \rightarrow T_2 \rightarrow T_3 \rightarrow T_4 \rightarrow T_5 \rightarrow T_6 \rightarrow \cancel{T_7}$

WARREN NO VERTICALS

4 4 4 4 4

24 20 16 12 8 4

(1) (2) (3) (4) (5) (6) (7)

TOP → $\frac{13}{2}P_f\tan\theta \rightarrow \frac{37}{2}P_f\tan\theta \rightarrow \frac{57}{2}P_f\tan\theta \rightarrow \frac{73}{2}P_f\tan\theta \rightarrow \frac{85}{2}P_f\tan\theta \rightarrow \frac{93}{2}P_f\tan\theta \rightarrow \frac{97}{2}P_f\tan\theta$

(SHORT) $(\frac{13}{2}P_f\tan\theta) \rightarrow \frac{35}{2}P_f\tan\theta \rightarrow \frac{49}{2}P_f\tan\theta \rightarrow \frac{55}{2}P_f\tan\theta$

22 14 6

8 8

OUTER → $\frac{13P_f}{2\cos\theta} \rightarrow \frac{11P_f}{2\cos\theta} \rightarrow \frac{9P_f}{2\cos\theta} \rightarrow \frac{7P_f}{2\cos\theta} \rightarrow \frac{5P_f}{2\cos\theta} \rightarrow \frac{3P_f}{2\cos\theta} \rightarrow \frac{P_f}{2\cos\theta}$

(SHORT) → $\left(\frac{13P_f}{2\cos\theta}\right) \rightarrow \left(\frac{9P_f}{2\cos\theta}\right) \rightarrow \left(\frac{5P_f}{2\cos\theta}\right) \rightarrow \left(\frac{P_f}{2\cos\theta}\right) \rightarrow$ / →

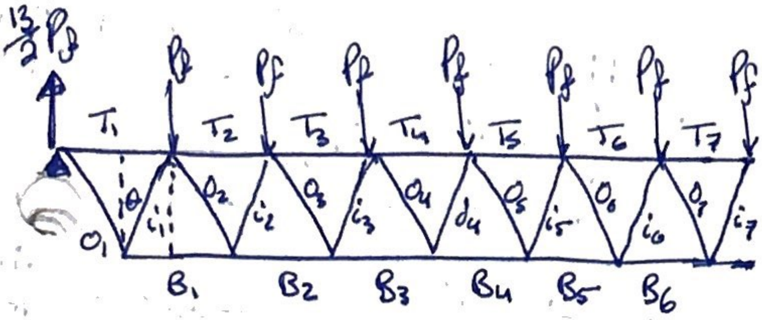
INNER → $\frac{13P_f}{2\cos\theta} \rightarrow \frac{11P_f}{2\cos\theta} \rightarrow \frac{9P_f}{2\cos\theta} \rightarrow \frac{7P_f}{2\cos\theta} \rightarrow \frac{5P_f}{2\cos\theta} \rightarrow \frac{3P_f}{2\cos\theta} \rightarrow$ / →

(SHORT) → $\left(\frac{13P_f}{2\cos\theta}\right) \rightarrow \left(\frac{9P_f}{2\cos\theta}\right) \rightarrow \left(\frac{5P_f}{2\cos\theta}\right) \rightarrow$ / →

VERTICALS → - →

BOTTOM → $\frac{26}{2}P_f\tan\theta \rightarrow = \rightarrow = \rightarrow = \rightarrow = \rightarrow = \rightarrow =$

(SHORT) → $\frac{26}{2}P_f\tan\theta \rightarrow = \rightarrow =$



$O_1 = \frac{13 P_f}{2\cos\theta}$ (T)

$T_1 = \frac{13}{2} P_f \tan\theta$ (c)

$i_1 = O_1$ (c) $\longrightarrow \frac{13 P_f}{2\cos\theta}$

$B_1 = O_1\sin\theta + i_1\sin\theta$

$= \frac{26}{2} P_f \tan\theta$

$O_2 = \frac{i_1\cos\theta - P_f}{\cos\theta}$

$= \frac{11}{2} P_f \div \cos\theta \rightarrow \frac{11 P_f}{2\cos\theta}$

$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$

$= P_f\tan\theta\left(\frac{13}{2} + \frac{13}{2} + \frac{11}{2}\right)$

$T_2 = \frac{37}{2} P_f\tan\theta$

$i_2 = O_2 \rightarrow \frac{11 P_f}{2\cos\theta}$

$\boxed{B_2 = B_1 = B_3 = B_4 = B_5 = B_6 = \frac{26}{2} P_f \tan\theta}$ ✓

$O_3 = \frac{i_2\cos\theta - P_f}{\cos\theta} = \frac{9 P_f}{2\cos\theta}$

$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$

$= \frac{37}{2} P_f\tan\theta + \frac{11}{2} P_f\tan\theta + \frac{9}{2} P_f\tan\theta$

$T_3 = \frac{57}{2} P_f\tan\theta$

$i_3 = O_3 \longrightarrow \frac{9 P_f}{2\cos\theta}$

$O_4 = \frac{i_3\cos\theta - P_f}{\cos\theta}$

$= \frac{7 P_f}{2\cos\theta}$

$T_4 = T_3 + i_3\sin\theta + O_4\sin\theta$

$= \frac{57}{2} P_f\tan\theta + \frac{9}{2} + \frac{7}{2}$

$= \frac{73}{2} P_f\tan\theta$

$i_4 = O_4 \longrightarrow \frac{7 P_f}{2\cos\theta}$

$O_5 = \frac{i_4\cos\theta - P_f}{\cos\theta}$

$= \frac{5 P_f}{2\cos\theta}$

$T_5 = T_4 + i_4\sin\theta + O_5\sin\theta$

$= P_f\tan\theta\left(\frac{63}{2} + \frac{5}{2} + \frac{7}{2}\right)$

$= \frac{75}{2} P_f\tan\theta$

$i_5 = O_5 \rightarrow \frac{5 P_f}{2\cos\theta}$

$O_6 = \frac{i_5\cos\theta - P_f}{\cos\theta}$

$= \frac{3 P_f}{2\cos\theta}$

$T_6 = T_5 + i_5\sin\theta + O_6\sin\theta$

$= P_f\tan\theta\left(\frac{75}{2} + \frac{5}{2} + \frac{3}{2}\right)$

$= \frac{83}{2} P_f\tan\theta$

$i_6 = O_6 \longrightarrow \frac{3 P_f}{2\cos\theta}$

$O_7 = \frac{i_6\cos\theta - P_f}{\cos\theta}$

$= \frac{1 P_f}{2\cos\theta}$

$T_7 = T_6 + i_6\sin\theta + O_7\sin\theta$

$= P_f\tan\theta\left(\frac{83}{2} + \frac{3}{2} + \frac{1}{2}\right) = \frac{87}{2} P_f\tan\theta$

$i_7 = O_7$

so it's (no_joists less joists already passed) × (member # (counted from left))

$\frac{49}{7} = 7$

$\frac{48}{6} = 8$

$\frac{45}{5} = 9$

$\frac{40}{4} = 10$

$\frac{33}{3} = 11$

$\frac{24}{2} = 12$

$\frac{13}{1} = 13$.

10?

13(1) → 12(2) → 11(3)

(no_joists - calcs complete) # calcs curr. calc.

TOP

COMMON

$\boxed{\frac{1}{2} P_f \tan\theta}$

HOWE → 13, 24, 33, 40, 45, 48, 49

PRATT → 13, 24, 33, 40, 45, 48, X

WARREN(V) → 13, =, 33, =, 45, =, 49

WARREN(NV) → 13, 37, 57, 73, 85, 93, 94

(short) → 13, 35, 49, 55

these don't really follow the pattern.

BOTTOM

COMMON

$\boxed{\frac{1}{2} P_f \tan\theta}$

→ 13, 24, 33, 40, 45, 48

HOWE HAS IDENTICAL TO TOP Fs

PRATT

→ 24, 33, 40, 45, 48, 49. (same as HOWE top) just missing 13.

No Idea.

these are shared

WARREN(V) → $\boxed{24, =}$ 31, =, 39, =

unique to warren(V)

me

JOISTS ×2?

(× common)

WARREN(∅) → 26, =, =, =, =, =, =

(short) → 26, =, =

unique to warren(∅)

WRONG

OUTERS

COMMON

$\boxed{\frac{P_f}{2\cos\theta}}$

HOWE → 13, 11, 9, 7, 5, 3, 1

PRATT → 13 ———

WARREN(V) → 13, —, 9, —, 5, —, 1

WARREN(∅) → 13, 11, 9, 7, 5, 3, 1

(short) → 13, —, 9, —, 5, —, 1

INNERS

COMMON

$\boxed{\frac{P_f}{2\cos\theta}}$

HOWE → ———

PRATT → 11, 9, 7, 5, 3, 1

WARREN(V) → —, 11, —, 7, —, 3

WARREN(∅) → 13, 11, 9, 7, 5, 3, —

(short) → 13, —, 9, —, 5, — so

COMPRESSION / TENSION ENCODING.

FIX REPEATING VALUES / ZEROS? (OR JUST FIND PATTERN & NOTE IT SOMEWHERE?)

$\frac{P_f}{2\cos\theta} \cdot (13, 11, 9, 7, 5, 3, 1)$ <PROGRAM

ALL diagonals values for all trusses.

Evaluate for all 4 Truss types, given a certain θ.

VERTICALS

$\frac{13}{2}P_f\tan\theta \mid \frac{24}{2}P_f\tan\theta \mid \frac{33}{2}P_f\tan\theta \mid \frac{40}{2}P_f\tan\theta \mid \frac{45}{2}P_f\tan\theta \mid \frac{48}{2}P_f\tan\theta \mid \frac{49}{2}P_f\tan\theta$

common

$\boxed{P_f}$

$\frac{13}{2}P_f \mid \frac{11}{2}P_f \mid \frac{9}{2}P_f \mid \frac{7}{2}P_f \mid \frac{5}{2}P_f \mid \frac{3}{2}P_f \mid \frac{1}{2}P_f \mid 1P_f \mid \emptyset P_f$

all vertical values 4 all.

TOP values for
- Howe
- Pratt
- Warren(V)

→ Warren NV done by unique algorithm

Bottom values for Howe & Pratt

Warren unique

HOWE → $\frac{13}{2}, \frac{11}{2}, \frac{9}{2}, \frac{7}{2}, \frac{5}{2}, \frac{3}{2}, 1$

PRATT → $1, \frac{9}{2}, \frac{7}{2}, \frac{5}{2}, \frac{3}{2}, \frac{1}{2}, \emptyset$

WARREN(V) → $1, \emptyset, 1, \emptyset, 1, \emptyset, 1$

WARREN($\emptyset$) →

(short) →

13 ⟶ 13
37 ⟶ +11, ÷2 → 24
57 ⟶ +9, ÷2 → 33
73 ⟶ +7, ÷2 → 40
85 ⟶ +5, ÷2 → 45
93 ⟶ +3, ÷2 → 48
94 ⟶ +4, ÷2 → 49

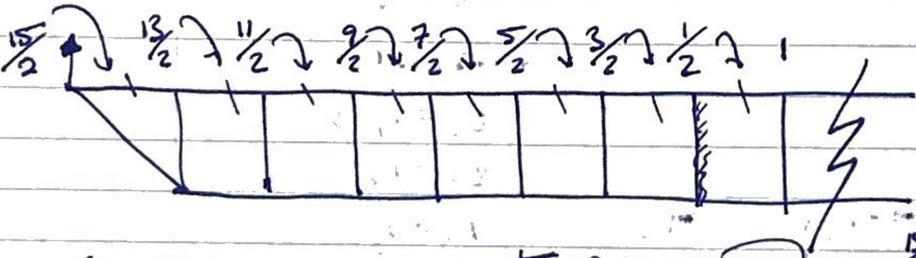
original pattern: 13, 24, 33, 40, 45, 48, 49

that's a little weird

⊛ → This B Warren, No Verticals ⟶ the Short version runs 13 → 35 → 49 → 55

→ Figure THAT shit out.

⊛⊛ → YEAH... NOT SURE I'M GONNA FIND A PATTERN FOR WARREN.



15(1) → 15
14(2) — 28
13(3) — 39
(12)(4) → 48
11(5) → 55
10(6) → 60
9(7) → 63
8(8) → 64

$T_1 = \frac{15}{2}P_f\tan\theta$

$T_2 = \frac{28}{2}P_f\tan\theta$

$T_3 = \frac{39}{2}P_f\tan\theta$

$T_4 = \frac{48}{2}P_f\tan\theta$

$T_5 = \frac{55}{2}P_f\tan\theta$

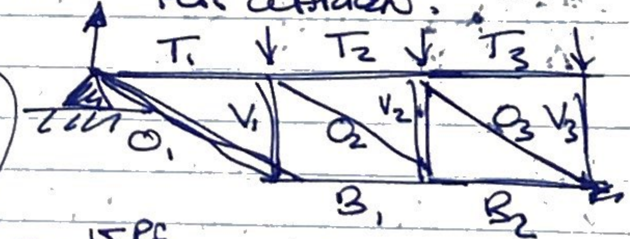
$T_6 = \frac{60}{2}P_f\tan\theta$

$T_7 = \frac{63}{2}P_f\tan\theta$

$T_8 = \frac{64}{2}P_f\tan\theta$

?

LOOKS GOOD.



$O_1 = \frac{15P_f}{2\cos\theta}$

$T_1 = \frac{15}{2}P_f\tan\theta$

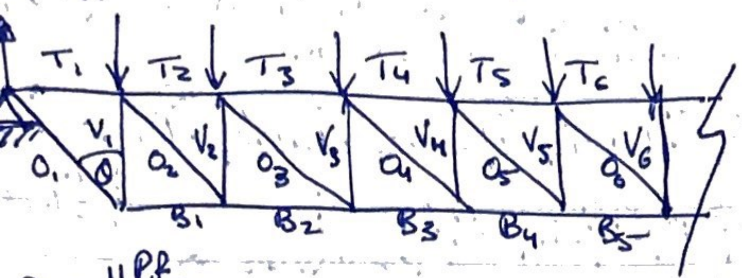
$V_1 = \frac{15}{2}P_f$

$B_1 = T_1 \rightarrow \frac{15}{2}P_f\tan\theta$

$O_2 = \frac{V_1 - P_f}{\cos\theta} = \frac{13P_f}{2\cos\theta}$

$T_2 = T_1 + O_2\sin\theta$

$= \frac{28}{2}P_f\tan\theta$



$O_1 = \frac{11 P_f}{2\cos\theta}$

$V_1 = 11/2\, P_f$

$\boxed{T_1 = 11/2\, P_f \tan\theta}$

$O_2 = \frac{V_1 - P_f}{\cos\theta} = \frac{9P_f}{2\cos\theta}$

$T_2 = T_1 + O_2 \sin\theta$

$= P_f \tan\theta\,(11/2 + 9/2)$

$\boxed{T_2 = 20/2\, P_f \tan\theta}$

$B_1 = \underset{(T_1)}{O_1 \sin\theta} = T_1$ ✓

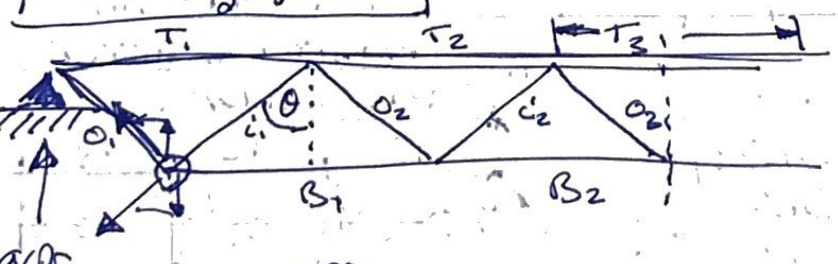
$V_2 = O_2 \cos\theta = 9/2\, P_f$

$O_3 = \frac{V_2 - P_f}{\cos\theta} = \frac{7P_f}{2\cos\theta}$

$T_3 = T_2 + O_3 \sin\theta$

$= \left(20/2 + 7/2\right) P_f \tan\theta$

$\boxed{T_3 = 27/2\, P_f \tan\theta}$



$O_1 = \frac{9P_f}{2\cos\theta}$

$B_1 = O_1 \sin\theta + i_1 \sin\theta$

$= 2O_1 \sin\theta$

$= 9 P_f \tan\theta$

$\boxed{i_1 = O_1}$

$\left(\frac{1}{2} P_f \tan\theta \cdot 18\right) \leftarrow = \#$ joints x 2.

PREDICTION

$T_6 = \frac{36}{2} P_f \tan\theta$

$T_5 = 35/2\, P_f \tan\theta$

$T_4 = 32/2\, P_f \tan\theta$

$T_3 = 27/2\, P_f \tan\theta$ ✓

$T_2 = 20/2\, P_f \tan\theta$ ✓

$T_1 = 11/2\, P_f \tan\theta$ ✓

PREDICTION

$O_2 = \frac{9P_f}{2\cos\theta}$ ✓

$O_3 = \frac{7P_f}{2\cos\theta}$ ✓

$O_4 = \frac{5P_f}{2\cos\theta}$

$O_5 = \frac{3P_f}{2\cos\theta}$

$O_6 = \frac{P_f}{2\cos\theta}$

PREDICTION

$V_2 = 9/2\, P_f$ ✓

$V_3 = 7/2\, P_f$

$V_4 = 5/2\, P_f$

$V_5 = 3/2\, P_f$

$V_6 = P_f$

PREDICTION

$B_1 = T_1$ ✓

$B_2 = T_2$

$B_3 = T_3$

$B_4 = T_4$

$B_5 = T_5$

2θ

V_1 V_3

B_1 B_2 4

$$V_7 = P_f = 145.85625\ \text{kN}\ (C)$$

HOWE

$$O_1 = \frac{\frac{13}{2}(145.85625\ \text{kN})}{\cos(45)}$$

$$\boxed{O_1 = 1{,}340.76726\ \text{kN}\ (T)}$$

$$T_1 = O_1 \sin\theta$$
$$= 1340.7626\ \text{kN} \cdot \sin 45$$

$$\boxed{T_1 = 948.065625\ \text{kN}\ (C)}$$

$$\boxed{V_1 = \tfrac{13}{2} P_f = 948.065625\ \text{kN}\ (C)}$$

$$\boxed{B_1 = T_1}\ (T)$$

$$O_2 = \frac{V_1 - P_f}{\cos\theta}$$

$$\boxed{O_2 = 1{,}134.49538\ \text{kN}}\ (T)$$

$$V_2 = O_2 \cos\theta$$

$$\boxed{V_2 = 802.209375\ \text{kN}\ (C)}$$

$$T_2 = T_1 + O_2 \sin\theta$$

$$\boxed{T_2 = 1{,}750.275\ \text{kN}\ (C)}$$

$$O_3 = \frac{V_2 - P_f}{\cos\theta} =$$

$$\boxed{O_3 = 928.223491\ \text{kN}\ (T)}$$

$$V_3 = O_3 \cos\theta$$

$$\boxed{V_3 = 656.353125\ \text{kN}\ (C)}$$

$$\boxed{B_2 = B_1 + O_2 \sin\theta = T_2\ (T)}$$

$$T_3 = T_2 + O_3 \sin\theta$$

$$\boxed{T_3 = 2{,}406.62812\ \text{kN}\ (C)}$$

$$\boxed{B_6 = T_6}$$

$$O_4 = \frac{V_3 - P_f}{\cos\theta}$$

$$\boxed{O_4 = 721.957604\ \text{kN}\ (T)}$$

$$T_4 = T_3 + O_4 \sin\theta$$

$$\boxed{T_4 = 2{,}917.\cancel{12386}\ 125\ \text{kN}\ (C)}$$

$$V_4 = O_4 \cos\theta$$

$$\boxed{V_4 = 510.496875\ \text{kN}\ (C)}$$

$$\boxed{B_3 = T_3\ (T)}$$

$$O_5 = \frac{V_4 - P_f}{\cos\theta}$$

$$\boxed{O_5 = 515.679717\ \text{kN}\ (T)}$$

$$T_5 = T_4 + O_5 \sin\theta$$

$$\boxed{T_5 = 3{,}281.76563\ \text{kN}\ (C)}$$

$$V_5 = O_5 \cos\theta$$

$$\boxed{V_5 = 364.640625\ \text{kN}\ (C)}$$

$$\boxed{B_4 = T_4}$$

$$O_6 = \frac{V_5 - P_f}{\cos\theta}$$

$$\boxed{O_6 = 309.40783\ \text{kN}\ (T)}$$

$$T_6 = T_5 + O_6 \sin\theta$$

$$\boxed{T_6 = 3{,}500.55708\ \text{kN}\ (C)}$$

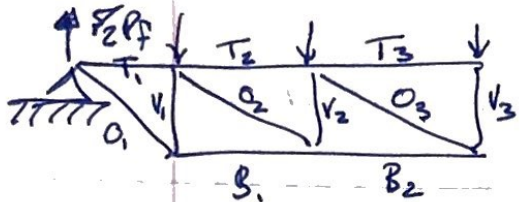
$$V_6 = O_6 \cos\theta$$

$$\boxed{V_6 = 218.784375\ \text{kN}\ (C)}$$

$$\boxed{B_5 = T_5\ (T)}$$

$$\boxed{O_7 = \frac{V_6 - P_f}{\cos\theta} = 103.135943\ \text{kN}\ (T)}$$

$$\boxed{T_7 = T_6 + O_7 \sin\theta = 3{,}573.4852}$$



$\boxed{\theta = 45^\circ}$

$$O_1 = \frac{\frac{5}{2}P_f}{\cos\theta}$$

$\boxed{O_1 = 515.679717\,kN\,(T)}$

$\boxed{V_1 = O_1\cos\theta = \tfrac{5}{2}P_f = 364.640625\,kN\,(C)}$

$\boxed{T_1 = O_1\sin\theta = 364.640625\,kN\,(C)}$

$\boxed{O_2 = \frac{V_1 - P_f}{\cos\theta} = 309.40783\,kN\,(T)}$

$\boxed{T_2 = T_1 + O_2\sin\theta = 583.425\,kN\,(C)}$

$\boxed{B_1 = O_1\sin\theta = T_1\ (T)}$

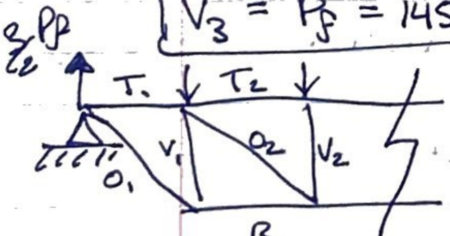
$\boxed{V_2 = O_2\cos\theta = 218.784375\,kN\,(C)}$

$\boxed{O_3 = \frac{V_2 - P_f}{\cos\theta} = 103.135943\,kN\,(T)}$

$\boxed{T_3 = O_3\sin\theta + T_2 = 656.353125\,kN\,(C)}$

$\boxed{B_2 = O_2\sin\theta + B_1 = T_1 + O_2\sin\theta = T_2\ (T)}$

$\boxed{V_3 = P_f = 145.85625\,kN\,(C)}$



$\boxed{\theta = 45^\circ}$

$\boxed{V_2 = P_f = 145.85625\,kN\,(C)}$

$\boxed{O_1 = \frac{\frac{3}{2}P_f}{\cos\theta} = 309.40783\,kN\,(T)}$

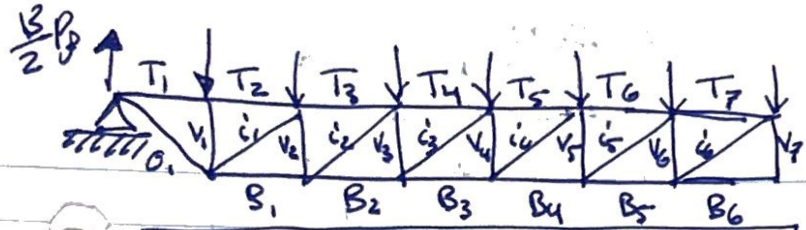
$\boxed{V_1 = O_1\cos\theta = \tfrac{3}{2}P_f = 218.784375\,kN\,(C)}$

$\boxed{T_1 = O_1\sin\theta = 218.784375\,kN\,(C)}$

$\boxed{O_2 = \frac{V_1 - P_f}{\cos\theta} = 103.135943\,kN\,(T)}$

$\boxed{T_2 = T_1 + O_2\sin\theta = 291.7125\,kN\,(C)}$

$\boxed{B_1 = O_1\sin\theta = T_1\ (T)}$



$\boxed{\theta = 45^\circ}$

$\boxed{V_7 = \emptyset}$

PRATT

$$\boxed{O_1 = \frac{\frac{\sqrt{3}}{2}P_f}{\cos\theta} = 1{,}340.76726 \text{ kN (T)}}$$

$$\boxed{T_1 = O_1\sin\theta = 948.065625 \text{ kN (C)}}$$

$$\boxed{V_1 = P_f = 145.85625 \text{ kN (C)}}$$

$$\boxed{i_1 = \frac{O_1\cos\theta - V_1}{\cos\theta} = 1{,}134.49537 \text{ kN (C)}}$$

$$\boxed{T_2 = T_1}$$

$$\boxed{B_1 = O_1\sin\theta + i_1\sin\theta = 1{,}750.27499 \text{ kN (T)}}$$

T

$$\boxed{V_2 = i_1\cos\theta - P_f = 656.353119 \text{ kN (T)}}$$

$$\boxed{T_3 = T_2 + i_1\sin\theta = 1{,}750.27499 \text{ kN (C)}}$$

$$\boxed{i_2 = \frac{V_2}{\cos\theta} = 928.223483 \text{ kN (C)}}$$

$$\boxed{B_2 = B_1 + i_2\sin\theta = 2{,}406.62811 \text{ (T)}}$$

T

$$\boxed{V_3 = i_2\cos\theta - P_f = 510.496869 \text{ (T)}}$$

$$\boxed{T_4 = i_2\sin\theta + T_3 = 2{,}406.62811 \text{ kN (C)}}$$

$$\boxed{i_3 = \frac{V_3}{\cos\theta} = 721.951596 \text{ kN (C)}}$$

$$\boxed{B_3 = i_3\sin\theta + B_2 = 2{,}917.12498 \text{ kN (T)}}$$

T

$$\boxed{V_4 = i_3\cos\theta - P_f = 364.640619 \text{ kN (T)}}$$

$$\boxed{T_5 = i_3\sin\theta + T_4 = 2{,}917.12498 \text{ kN (C)}}$$

$$\boxed{i_4 = \frac{V_4}{\cos\theta} = 515.679709 \text{ kN (C)}}$$

$$\boxed{B_4 = i_4\sin\theta + B_3 = 3{,}281.7656 \text{ kN (T)}}$$

T

$$\boxed{V_5 = i_4\cos\theta - P_f = 218.784369 \text{ kN (T)}}$$

$$\boxed{T_6 = i_4\sin\theta + T_5 = 3{,}281.7656 \text{ kN (C)}}$$

$$\boxed{i_5 = \frac{V_5}{\cos\theta} = 309.407822 \text{ kN (C)}}$$

$$B_5 = B_4 + i_5\sin\theta$$

$$\boxed{B_5 = 3500.54997 \text{ kN (T)}}$$

T

$$V_6 = i_5\cos\theta - P_f$$

$$\boxed{V_6 = 72.9281191 \text{ kN (T)}}$$

$$T_7 = i_5\sin\theta + T_6$$

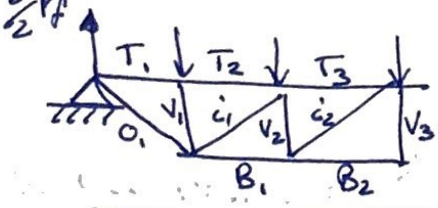
$$\boxed{T_7 = 3500.54997 \text{ (C)}}$$

$$i_6 = \frac{V_6}{\cos\theta}$$

$$\boxed{i_6 = 103.135935 \text{ kN (C)}}$$

$$B_6 = B_5 + i_6\sin\theta$$

$$\boxed{B_6 = 3{,}573.47809 \text{ kN (T)}}$$



$\boxed{\theta = 45°}$

$\boxed{V_3 = \emptyset}$

$$\boxed{O_1 = \frac{\frac{5}{2}P_f}{\cos\theta} = 515.679717\,kN\ (T)}$$

$$\boxed{T_1 = O_1 \sin\theta = 364.640625\,kN\ (C)}$$

$$\boxed{V_1 = P_f = 145.85625\,kN\ (C)}$$

$$\cancel{i_1 = \frac{O_1\cos\theta - V_1}{\cos\theta} = 218.784375\,kN\ (C)}$$

$$\cancel{B_1 = O_1 \sin\theta = T_1}$$

$$\cancel{B_1 = O_1 \sin\theta + i_1 \sin\theta =}$$

$$\boxed{i_1 = \frac{O_1\cos\theta - V_1}{\cos\theta} = 309.40783\,kN\ (C)}$$

$$\boxed{B_1 = O_1 \sin\theta + i_1 \sin\theta = 583.425\,kN\ (T)}$$

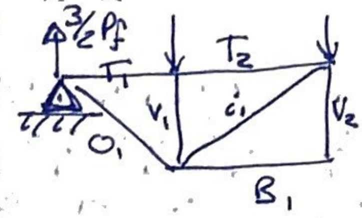
$$\boxed{T_2 = T_1}$$

$$\boxed{V_2 = i_1 \cos\theta - P_f = 72.9281247\,kN.\ (T)}$$

$$\boxed{T_3 = i_1 \sin\theta + T_2 = 583.425\,kN\ (C)}$$

$$\boxed{i_2 = \frac{V_2}{\cos\theta} = 103.135943\,kN\ (C)}$$

$$\boxed{B_2 = B_1 + i_2 \sin\theta = 656.353125\,kN\ (T)}$$



$$O_1 = \frac{\frac{3}{2}P_f}{\cos\theta}$$

$$\boxed{O_1 = 309.40783\,kN\ (T)}$$

$$T_1 = O_1 \sin\theta$$

$$\boxed{T_1 = 218.784375\,kN\ (C)}$$

$$\boxed{V_1 = P_f = 145.85625\,kN\ (C)}$$

$$\boxed{T_2 = T_1}$$

$$i_1 = \frac{O_1\cos\theta - V_1}{\cos\theta}$$

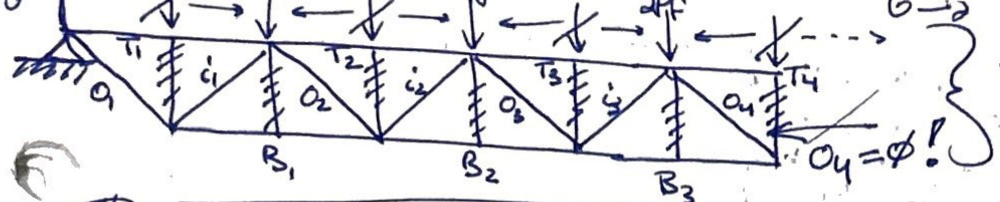
$$\boxed{i_1 = 103.135943\,kN\ (C)}$$

$$B_1 = O_1 \sin\theta + i_1 \sin\theta$$

$$\boxed{B_1 = 291.712499\,kN\ (T)}$$

$$\boxed{V_2 = \emptyset}$$

$$\boxed{\theta = 45°}$$



"SHORT" DESIGN

~~(not sure how Profs want us to structure this yet—I'll ask.)~~

~~WARREN_∅~~

THIS IS HOW YOU CALCULATE WARREN_∅, HAS TO BE, SINCE IF YOU DO IT THE 'OTHER' WAY, WE HAVE NO HSS SECTIONS WHICH CAN HANDLE THE TENSILE/COMPRESSIVE LOADS

$$\boxed{O_1 = \frac{\frac{13}{2}P_f}{\cos\theta} = 1{,}340.76726\text{ kN (T)}}$$

$$\boxed{T_1 = O_1\sin\theta = 948.065625\text{ kN (C)}}$$

$$\boxed{i_1 = O_1 \text{ (C)}}$$

$$\boxed{B_1 = O_1\sin\theta + i_1\sin\theta = 1{,}896.13124\text{ kN (T)}}$$

$$\boxed{O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta} = 928.223486\text{ kN (T)}}$$

$$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$$

$$\boxed{T_2 = 2{,}552.48437\text{ kN (C)}}$$

$$\boxed{i_2 = O_2}$$

$$\boxed{B_2 = B_1 + O_2\sin\theta + i_2\sin\theta = 3{,}208.83748\text{ kN (T)}}$$

$$\boxed{O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta} = 515.679712\text{ kN (T)}}$$

$$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$$

$$\boxed{T_3 = 3{,}573.47811\text{ kN (C)}}$$

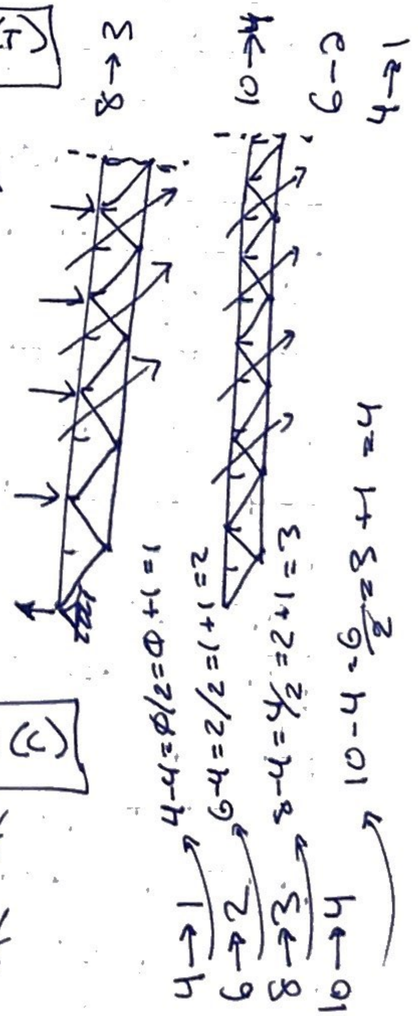
$$\boxed{i_3 = O_3}$$

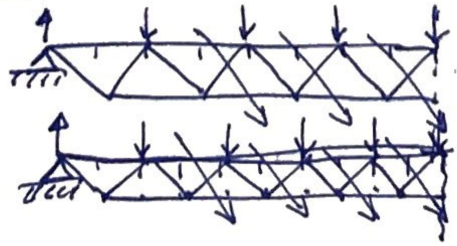
$$B_3 = B_2 + O_3\sin\theta + i_3\sin\theta$$

$$\boxed{B_3 = 3{,}938.11872\text{ kN (T)}}$$

$$\boxed{O_4 = \frac{i_3\cos\theta - 2P_f}{\cos\theta} = 103.135938\text{ kN (T)}}$$

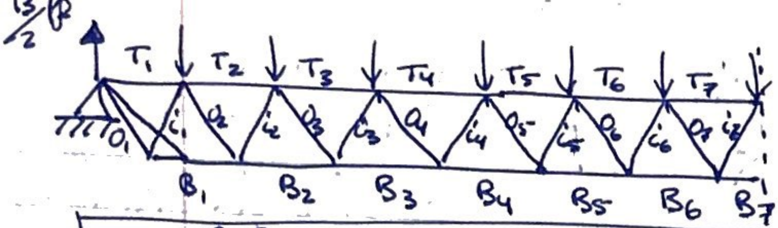
$$\boxed{T_4 = T_3 + i_3\sin\theta + O_4\sin\theta = 4{,}011.04685\text{ kN (C)}}$$





$7/2 = 3.5$

$9/2 = 4.5$



$\theta = 45°$ } "LONG" DESIGN

$$\boxed{O_1 = \frac{\frac{13}{2} P_f}{\cos\theta} = 1{,}340.76726 \text{ kN (T)}}$$

$$\boxed{i_1 = O_1}$$

$$\boxed{T_1 = O_1 \sin\theta = 948.065625 \text{ kN (C)}}$$

$$\boxed{B_1 = O_1 \sin\theta + i_1 \sin\theta = 1{,}896.13124 \text{ kN (T)}}$$

$$\boxed{O_2 = \frac{i_1 \cos\theta - P_f}{\cos\theta} = 1{,}134.49537 \text{ kN (T)}}$$

$$T_2 = T_1 + i_1 \sin\theta + O_2 \sin\theta$$

$$\boxed{T_2 = 2{,}698.34062 \text{ kN (C)}}$$

$$\boxed{i_2 = O_2}$$

$$B_2 = B_1 + O_2 \sin\theta + i_2 \sin\theta$$

$$\boxed{B_2 = 3{,}500.54998 \text{ kN (T)}}$$

$$\boxed{O_3 = \frac{i_2 \cos\theta - P_f}{\cos\theta} = 928.223483 \text{ kN (T)}}$$

$$T_3 = T_2 + i_2 \sin\theta + O_3 \sin\theta$$

$$\boxed{T_3 = 4{,}156.90311 \text{ kN (C)}}$$

$$\boxed{i_3 = O_3}$$

$$B_3 = B_2 + O_3 \sin\theta + i_3 \sin\theta$$

$$\boxed{B_3 = 4{,}813.25622 \text{ kN (T)}}$$

$$\boxed{O_4 = \frac{i_3 \cos\theta - P_f}{\cos\theta} = 721.951596 \text{ kN (T)}}$$

$$T_4 = T_3 + i_3 \sin\theta + O_4 \sin\theta$$

$$\boxed{T_4 = 5{,}323.75310 \text{ kN (C)}}$$

$$\boxed{i_4 = O_4}$$

$$B_4 = B_3 + O_4 \sin\theta + i_4 \sin\theta$$

$$\boxed{B_4 = 5{,}834.24996 \text{ kN (T)}}$$

$$\boxed{O_5 = \frac{i_4 \cos\theta - P_f}{\cos\theta} = 515.679709 \text{ kN (T)}}$$

$$T_5 = T_4 + i_4 \sin\theta + O_5 \sin\theta$$

$$\boxed{T_5 = 6{,}198.89059 \text{ kN (C)}}$$

$$\boxed{i_5 = O_5}$$

$$B_5 = B_4 + O_5 \sin\theta + i_5 \sin\theta$$

$$\boxed{B_5 = 6{,}563.5312 \text{ kN (T)}}$$

$$O_6 = \frac{i_5 \cos\theta - P_f}{\cos\theta}$$

$$\boxed{O_6 = 309.407822 \text{ kN (T)}}$$

$$\boxed{i_6 = O_6}$$

$$B_6 = B_5 + O_6 \sin\theta + i_6 \sin\theta$$

$$\boxed{B_6 = 7{,}001.09994 \text{ kN (T)}}$$

$$O_7 = \frac{i_6 \cos\theta - P_f}{\cos\theta}$$

$$\boxed{O_7 = 103.135935 \text{ kN (T)}}$$

$$T_7 = T_6 + i_6 \sin\theta + O_7 \sin\theta$$

$$\boxed{T_7 = 7{,}074.02807 \text{ kN (C)}}$$

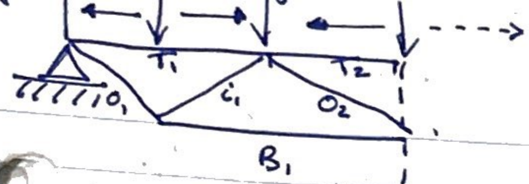
$$T_6 = T_5 + i_5 \sin\theta + O_6 \sin\theta$$

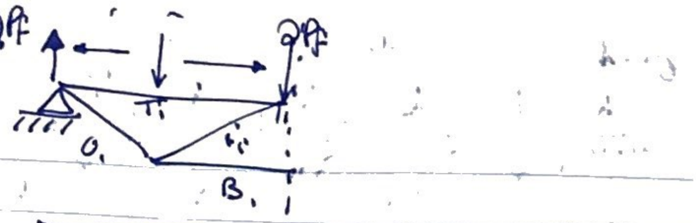
$$\boxed{T_6 = 6{,}782.31558 \text{ kN (C)}}$$

$$\boxed{i_7 = O_7}$$

$$B_7 = B_6 + O_7 \sin\theta + i_7 \sin\theta$$

$$\boxed{B_7 = 7{,}146.95618 \text{ kN (T)}}$$





$$\boxed{O_1 = \frac{\frac{5}{2}P_f}{\cos\theta} = 575.679717 \text{ kN (T)}}$$

$$\boxed{T_1 = O_1 \sin\theta = 364.640625 \text{ kN (C)}}$$

$$\boxed{i_1 = O_1}$$

$$B_1 = O_1\sin\theta + i_1\sin\theta$$

$$\boxed{B_1 = 729.28125 \text{ kN (T)}}$$

$$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$$

$$\boxed{O_2 = 103.135943 \text{ kN (T)}}$$

$$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$$

$$\boxed{T_2 = 802.209374 \text{ kN (C)}}$$

$$\boxed{O_1 = \frac{\frac{3}{2}P_f}{\cos\theta} = 309.40783 \text{ kN (T)}}$$

$$T_1 = O_1\sin\theta$$

$$\boxed{T_1 = 218.784375 \text{ kN (C)}}$$

$$\boxed{i_1 = O_1}$$

$$B_1 = O_1\sin\theta + i_1\sin\theta$$

$$\boxed{B_1 = 437.568749 \text{ kN (T)}}$$

QUESTION

ARE WE SUPPOSED TO ADD THE $\frac{1}{2}P_f$ @ JOIST 1 INTO THE R^n $\vec{F}$ @ THE SUPPORT COLUMN?!

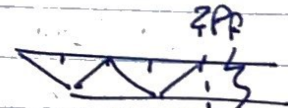
($\vec{F}$s WON'T BALANCE UNLESS YOU DO)

5 joists = OK

3 joists

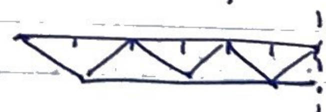
8 joists = OK

7 joists

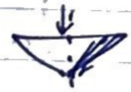


9 joists = OK

11 joists



1 joist = OK



$$\boxed{2x+1 \mid x \% 2 = \emptyset}$$

$$\boxed{2x+1 \mid x \% 2 = 1}$$

NEED TO ADJUST ALGORITHM FOR THIS

no_joists = $2x+1$

$$\left(\frac{\text{no\_joists} - 1}{2}\right) = x \quad \%2 = \emptyset.$$

$$O_1 = \frac{\frac{5}{2}P_f}{\cos\theta} \qquad T_1 = \frac{5}{2}P_f\tan\theta$$

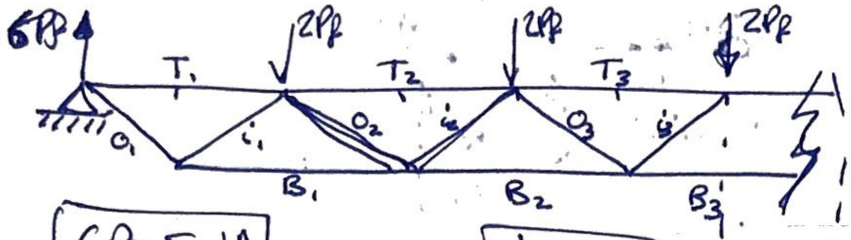
$$i_1 = O_1 \qquad B_1 = 2O_1\sin\theta = 2T_1$$

$$O_2 = \frac{O_1\cos\theta \ \frac{5}{2}P_f - 2P_f}{\cos\theta} \qquad \boxed{\frac{P_f}{2\cos\theta}}$$

$$T_2 = 2\left(\frac{5}{2}P_f\tan\theta\right) + \frac{1}{2}P_f\tan\theta$$

$$\cancel{O_1 = \frac{3P_f}{\cos\theta}} \quad \cancel{i_1 = O_1} \quad \cancel{T_1 = 3P_f\tan\theta} \quad \cancel{B_1 = 6P_f\tan\theta} \quad \cancel{O_2 = \frac{P_f}{\cos\theta}} \quad \cancel{T_2 = \frac{?}{2}P_f\tan\theta?}$$

$= \frac{11}{2}P_f\tan\theta$



$\vec{F}_{R^n} = 5P_f$? or $6P_f$

$\boxed{6P_f \text{ Sol}^n}$

$\boxed{O_1 = \frac{6P_f}{\cos\theta}}$

$\boxed{i_1 = O_1 = \frac{6P_f}{\cos\theta}}$

$\boxed{T_1 = O_1 \sin\theta = 6P_f \tan\theta}$

$\boxed{B_1 = 2O_1 \sin\theta = 12P_f \tan\theta}$

$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_2 = \frac{6P_f - 2P_f}{\cos\theta} = \frac{4P_f}{\cos\theta}}$

$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$

$= 6P_f\tan\theta + 6P_f\tan\theta + 4P_f\tan\theta$

$\boxed{T_2 = 16P_f\tan\theta}$

$\boxed{i_2 = O_2}$

$B_2 = B_1 + O_2\sin\theta + i_2\sin\theta$

$= 12P_f\tan\theta + 2(4P_f\tan\theta)$

$\boxed{B_2 = 20P_f\tan\theta}$

$O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta}$

$= \frac{4P_f - 2P_f}{\cos\theta}$

$\boxed{O_3 = \frac{2P_f}{\cos\theta}}$ X wrong b/c $O_3 = i_3$? $i_3\cos\theta \to P_f$

$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$

$= P_f\tan\theta(16 + 4 + 2)$

$\boxed{T_3 = 22P_f\tan\theta}$

$\boxed{i_3 = O_3}$

$B_3 = B_2 + O_3\sin\theta \cdot 2$

$\boxed{B_3 = \cancel{24}P_f\tan\theta}$

$\boxed{5P_f \text{ Sol}^n}$

$\boxed{O_1 = \frac{5P_f}{\cos\theta}}$

$\boxed{T_1 = 5P_f\tan\theta}$

$\boxed{i_1 = O_1}$

$\boxed{B_1 = 2O_1\sin\theta = 10P_f\tan\theta}$

$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_2 = \frac{3P_f}{\cos\theta}}$

$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$

$\boxed{T_2 = 13P_f\tan\theta}$

$\boxed{i_2 = O_2}$

$B_2 = B_1 + 2O_2\sin\theta$

$\boxed{B_2 = 16P_f\tan\theta}$

$O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_3 = \frac{P_f}{\cos\theta}}$ → CORRECT

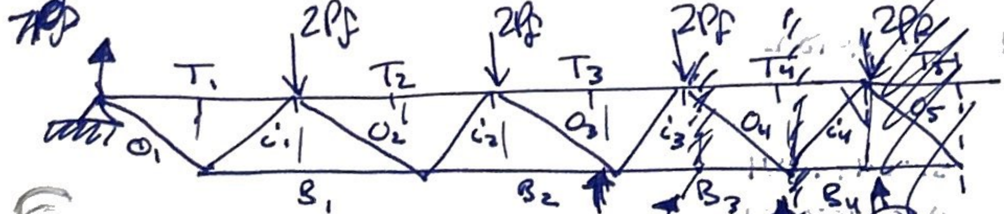
$\boxed{i_3 = O_3}$

$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$

$\boxed{T_3 = 17P_f\tan\theta}$

$B_3 = B_2 + 2O_3\sin\theta$

$\boxed{B_3 = 18P_f\tan\theta}$



$\boxed{O_1 = \frac{7P_f}{\cos\theta}}$ $\varnothing$ — 9 — 11 — 13 — 15

1 — 11

$2x+1 = \text{no\_joists}$

$\left(\frac{J-1}{2}\right)\%2 \rightarrow P_f \rightarrow 0$

$\boxed{T_1 = 7P_f \tan\theta}$

$\boxed{i_1 = 0}$

$\boxed{P_f + i(2P_f)}$

3Pf

$5P_f + (i^2(-2))$

$B_1 = 2O_1\sin\theta$

$\boxed{B_1 = 14P_f \tan\theta}$

$B_4 = B_3 + 2O_4\sin\theta$

$T_5 = T_4 + i_4\sin\theta + O_5\sin\theta$

15//2 int(7/2) + 1

$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_2 = \frac{5P_f}{\cos\theta}}$ Pf Pf

Pf-2

13//2 → 6/2 = 3 + 1

$P_f + \boxed{P_f + P_f - 2}$

$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$

$\boxed{T_2 = 19P_f \tan\theta}$

11//2 → 5 — 3

9//2 → 4 — 3

15 — 4

13 — 4

11 — 3

9 — 3

$\boxed{i_2 = O_2}$

$B_2 = B_1 + 2O_2\sin\theta$

$\boxed{B_2 = 24P_f \tan\theta}$

$P_f + i(2P_f)$

$P_f(1+2i)$

$P_f + P_f + P_f - 2$

$\boxed{\begin{matrix}P_f - 2\\ P_f - 4\end{matrix}}$ -4

Pf+Pf+Pf-2 ; Pf-2, Pf-4 ; Pf-4, Pf-6 ; Pf-6, Pf-8 … -2, -4, -4, -6, -12

3x-4

16x-2

7x-2

4x-2

9x-2

for i in range(no_joists//2//2+1)

$O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_3 = \frac{3P_f}{\cos\theta}}$ → $\boxed{P_f + P_f + P_f - 2}$ (Pf-2) (Pf-4)

$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$

$\boxed{T_3 = 27P_f \tan\theta}$

$\boxed{i_3 = O_3}$

$B_3 = B_2 + 2O_3\sin\theta$

$\boxed{B_3 = 30P_f \tan\theta}$

2x-2i, 2x-4, -4, -4, -8

Pf+Pf+Pf-2, Pf-2, Pf-4, Pf-4, Pf-6

$T_4 = T_3 + i_3\sin\theta + O_4\sin\theta$

$\boxed{T_4 = 31P_f \tan\theta}$

$O_4 = \frac{i_3\cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_4 = \frac{P_f}{\cos\theta}}$

!!!

T_i GENERAL EQ^n

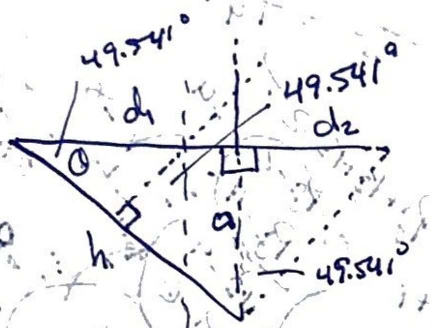
$\boxed{P_f + i(2P_f) - 2i^2}$

for i in range(int(no_joists//2//2))

!!!

"TYP" → Typical Dimension

0.0403832 3.06472684
0.0488902641 0.06453231
+ 0.0672176491
0.1161079 m



$\cos\theta = \frac{d_1}{h}$

$d_1 = h\cos\theta$

$\sin\theta = \frac{a}{h}$ $a = h\sin\theta$

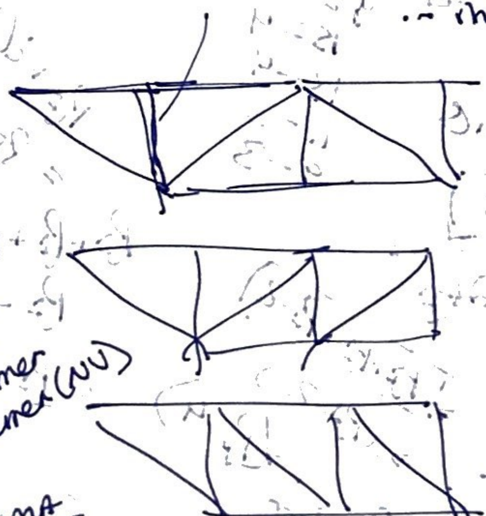
$\tan\theta = \frac{d_2}{a}$ $\sin\theta = \frac{\left(\frac{d_2}{\tan\theta}\right)}{h}$

$a = \frac{d_2}{\tan\theta}$ $h\sin\theta = \frac{d_2\cos\theta}{\sin\theta}$

$\boxed{\frac{h\sin^2\theta}{\cos\theta} = d_2}$

(or) $h\tan\theta\sec\theta$

... interesting.



$\sin\theta = \frac{2.5}{x}$

$x = \frac{2.5}{\sin\theta}$

minima [$\cancel{x}$ wt ; ← Howe
$\cancel{x}$ wt ← Pratt
$\cancel{x}$ wt] ← Warren
$\cancel{x}$ wt ← Warren (NV)

MINIMA

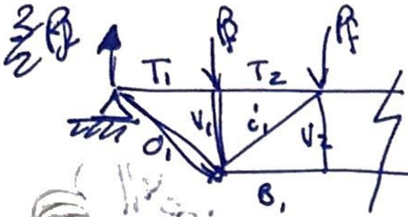
1st Dim → Truss Type

2nd Dim → $\underbrace{\cancel{x} \text{ vs. weight.}}_{\text{(1 value each)}}$

? 3rd Dim →

vert = 21.5
horz = 35

aspect → 1 : $\underbrace{1.62790698}$



$$\boxed{O_1 = \frac{3/2\,P_f}{\cos\theta} = 309.40783\,kN\ (T)}$$

$$\boxed{T_1 = O_1\sin\theta = 218.784375\,kN\ (C)}$$

$$\boxed{V_1 = P_f = 145.85625\,kN\ (C)}$$

$$i_1 = \frac{O_1\cos\theta - V_1}{\cos\theta}$$

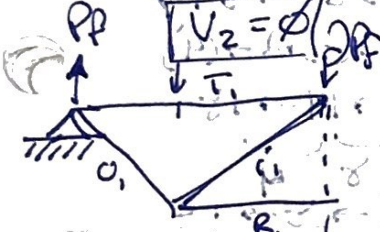
$$\boxed{i_1 = 103.135943\,kN\ (C)}$$

$$\boxed{T_2 = T_1}$$

$$B_1 = O_1\sin\theta + i_1\sin\theta$$

$$\boxed{B_1 = 291.712495\,kN\ (T)}$$

$$\boxed{V_2 = \emptyset}$$



$$\boxed{O_1 = \frac{P_f}{\cos\theta} = 206.271887\,kN\ (T)}$$

$$\boxed{i_1 = O_1}$$

$$\boxed{T_1 = O_1\sin\theta = 145.85625\,(C)}$$

$$\boxed{B_1 = 2O_1\sin\theta = 291.7125\,kN\ (T)}$$

$$O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta}$$

$$\boxed{O_3 = 206.271893\,kN\ (T)}$$

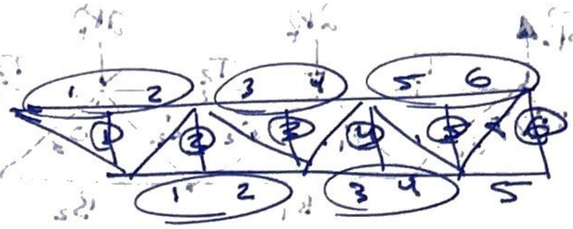
$$\boxed{i_3 = O_3}$$

$$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$$

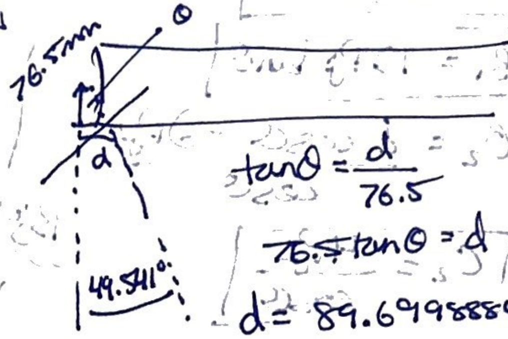
$$\boxed{T_3 = 2{,}479.55627\,kN\ (C)}$$

$$B_3 = B_2 + 2O_3\sin\theta = \cancel{3{,}208.83757}\ (T)$$

$$\boxed{2{,}625.41257\ (T)}$$



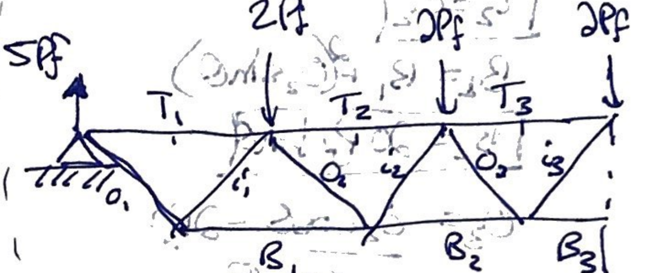
3xO,
3xI



$$\tan\theta = \frac{d}{76.5}$$

$$76.5\tan\theta = d$$

$$d = 89.6998884$$



$$\boxed{O_1 = \frac{5P_f}{\cos\theta} = 1{,}031.35944\ (T)}$$

$$\boxed{T_1 = O_1\sin\theta = 729.28125\ (C)}$$

$$\boxed{i_1 = O_1}$$

$$\boxed{B_1 = 2O_1\sin\theta = 1{,}458.5625\,kN\ (T)}$$

$$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$$

$$\boxed{O_2 = 618.8156\ (T)}$$

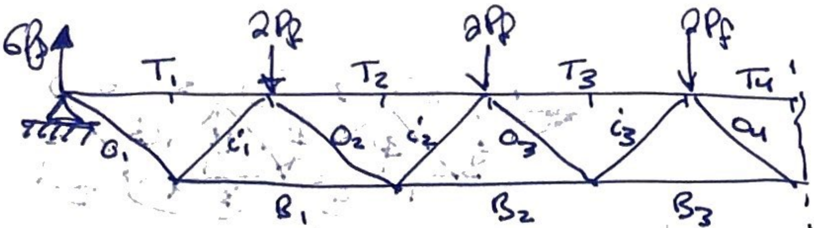
$$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$$

$$\boxed{T_2 = 1{,}896.13126\ (C)}$$

$$\boxed{i_2 = O_2}$$

$$B_2 = B_1 + O_2\sin\theta * 2$$

$$\boxed{B_2 = 2{,}333.7\ (T)}$$



$O_4 = \emptyset$

$\boxed{O_1 = \frac{6P_f}{\cos\theta}}$ $\boxed{i_1 = O_1}$

$\boxed{T_1 = 6P_f \tan\theta}$

$\boxed{B_1 = 12 P_f \tan\theta}$

$O_2 = \frac{i_1 \cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_2 = \frac{4P_f}{\cos\theta}}$

$T_2 = T_1 + i_1 \sin\theta + O_2 \sin\theta$

$\boxed{T_2 = 16 P_f \tan\theta}$

$\boxed{i_2 = O_2}$

$B_2 = B_1 + 2(O_2 \sin\theta)$

$\boxed{B_2 = 20 P_f \tan\theta}$

$O_3 = \frac{i_2 \cos\theta - 2P_f}{\cos\theta}$

$\boxed{O_3 = \frac{2P_f}{\cos\theta}}$

$T_3 = T_2 + i_2 \sin\theta + O_3 \sin\theta$

$\boxed{T_3 = 22 P_f \tan\theta}$

$\boxed{i_3 = O_3}$

$B_3 = B_2 + 2 \cdot O_3 \sin\theta$

$\boxed{B_3 = 24 P_f \tan\theta}$

$O_4 = \emptyset$

$= \frac{i_3 \cos\theta - 2P_f}{\cos\theta}$

$= 0/\cos\theta$

$\boxed{O_4 = 0}$

$T_4 = T_3 + i_3 \sin\theta + O_4 \sin\theta$ (no joists // 2)

$\boxed{T_4 = 24 P_f \tan\theta}$

Pf factor; +2Pf factor − 2; +2(Pf factor) − 2 − 2; +2(Pf factor) − 2 − 2

8 joists

TOP → $P_f \tan\theta$ → 6 → 16 → 22 → 24

÷ (6) 1 → (2)+4 → 3+(4) → 4

1 → 2.67 → 3.67 → 4

−6 $\emptyset$ → 10 → 16 → 18

10 4 6 4 2

OUTER $\frac{P_f}{\cos\theta}$ → 6 → 4 → 2 → $\emptyset$

INNER " " " "

BOTTOM $P_f \tan\theta$ → 12 → 20 → 24 →

÷ 6 (2) → (3)+2 → (4)

−6 6 → 14 → 18

8 4

−12 $\emptyset$ → 8 → 12

8 4

11 joists

TOP → $P_f \tan\theta$ → 5 → 13 → 17

8 4

÷ 5 1 → 2(+3) → 3(+2)

−5 0 → 8 → 12

8 4

OUTER → $\frac{P_f}{\cos\theta}$ → 5 → 3 → 1

INNER → ''''''''

BOTTOM → $P_f \tan\theta$ → 10 → 16 → 18

6 2

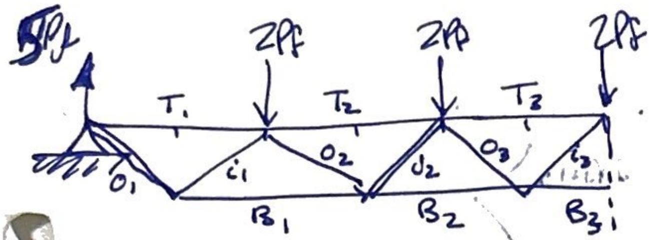
÷5 2 → 3(+1) → 3(+3)

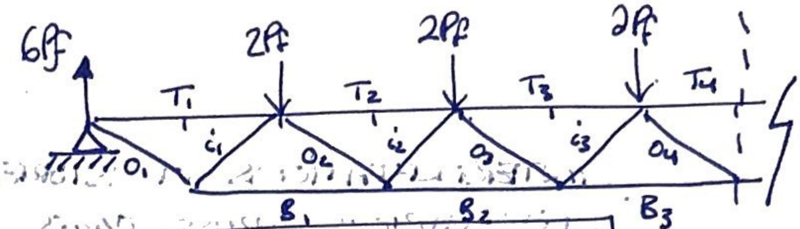
−5 5 → 11 → 13

6 2

÷10 (1) → (1)+6 → (1)+8

−10 $\emptyset$ → 6 → 8





11 joists

$$\boxed{O_1 = \frac{5P_f}{\cos\theta}}$$

$$\boxed{T_1 = 5P_f \tan\theta}$$

$$\boxed{i_1 = O_1}$$

$$B_1 = O_1 \sin\theta \cdot 2$$

$$\boxed{B_1 = 10P_f \tan\theta}$$

$$O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta}$$

$$\boxed{O_2 = \frac{3P_f}{\cos\theta}}$$

$$T_2 = T_1 + i_1\sin\theta + O_2\sin\theta$$

$$\boxed{T_2 = 13P_f \tan\theta}$$

$$\boxed{i_2 = O_2}$$

$$B_2 = B_1 + 2O_2\sin\theta$$

$$\boxed{B_2 = 16P_f \tan\theta}$$

$$O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta}$$

$$\boxed{O_3 = \frac{P_f}{\cos\theta}}$$

$$\boxed{i_3 = O_3}$$

$$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$$

$$\boxed{T_3 = 17P_f \tan\theta}$$

$$B_3 = B_2 + 2O_3\sin\theta$$

$$\boxed{B_3 = 18P_f \tan\theta}$$

13 joists

$$\boxed{O_1 = \frac{6P_f}{\cos\theta} = 1{,}237.63132\text{ kN (T)}}$$ ✓

$$\boxed{T_1 = 6P_f\tan\theta = 875.1375\text{ kN (C)}}$$ ✓

$$\boxed{i_1 = O_1}$$ ✓

$$\boxed{B_1 = 2O_1\sin\theta = 1{,}750.275\text{ kN (T)}}$$ ✓

$$\boxed{O_2 = \frac{i_1\cos\theta - 2P_f}{\cos\theta} = 825.087546\text{ kN (T)}}$$ ✓

$$\boxed{T_2 = T_1 + i_1\sin\theta + O_2\sin\theta = 2{,}333.7\text{ kN (C)}}$$ ✓

$$\boxed{i_2 = O_2}$$ ✓

$$\boxed{B_2 = B_1 + 2O_2\sin\theta = 2{,}917.125\text{ kN (T)}}$$ ✓

$$\boxed{O_3 = \frac{i_2\cos\theta - 2P_f}{\cos\theta} = 412.543772\text{ kN (T)}}$$ ✓

$$T_3 = T_2 + i_2\sin\theta + O_3\sin\theta$$

$$\boxed{T_3 = 3{,}208.8375\text{ kN (C)}}$$ ✓

$$\boxed{i_3 = O_3}$$ ✓

$$B_3 = B_2 + 2O_3\sin\theta$$

$$\boxed{B_3 = 3{,}500.55\text{ kN (T)}}$$ ✓

$$\boxed{O_4 = \frac{i_3\cos\theta - 2P_f}{\cos\theta} \quad O_4 = \emptyset}$$ ✓

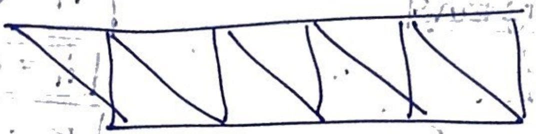
$$T_4 = T_3 + i_3\sin\theta + O_4\sin\theta$$

$$\boxed{T_4 = 3{,}500.55\text{ kN (C)}}$$ ✓

INTERPRETATIONS OF STORED DATA FOR VARIOUS TRUSS TYPES

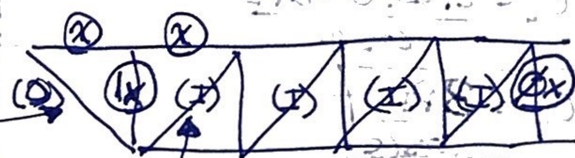
HOWE

... TOP — all #s
... OUTERS — all #s
Ø INNERS — <NONE>
... VERTICALS — all #s
..Ø BOTTOM — all #s



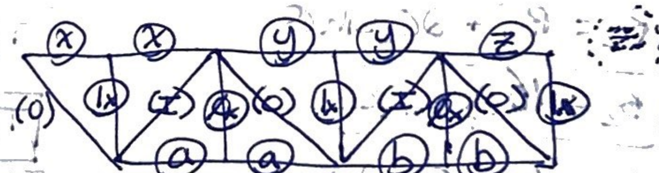
PRATT

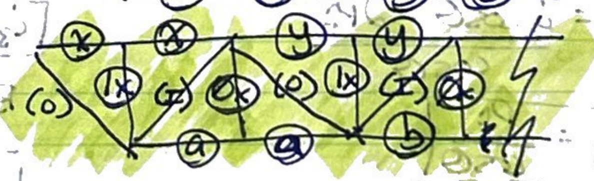
x-x... TOP — 1st x2 — all #s
1x ↔ OUTERS — 1x — <NONE>
1...Ø VERTICALS → all #s — +Ø
1
↔ 1x..... INNERS — <NONE> — all #s
..Ø BOTTOM — all #s



WARREN_V

1/2 TOP — each x2
(1/2) OUTERS — alternating
Ø VERTICALS — 1 — Ø <repeat>
(1/2) INNERS — alternating
1/2 BOTTOM — each x2



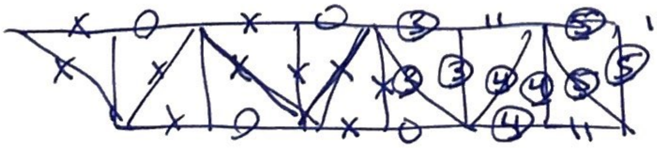


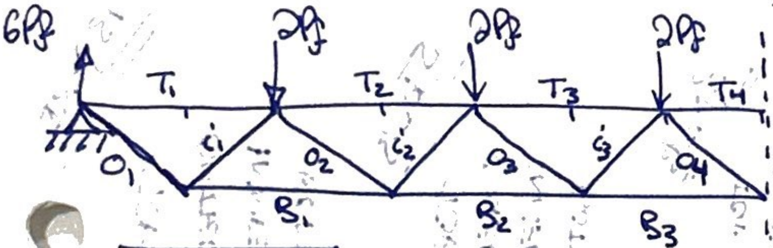
WARREN_Ø

NVM

Algorithm to Assign HSS sections to members becomes insanely complicated w/ checks / modifiers etc. if you do this (above) → just generate arrays explicitly storing all Fs for all member = WAY BETTER, EASIER

(not much loss to runtime also)





$\boxed{O_1 = \frac{6P_f}{\cos\Theta}}$

$\boxed{T_1 = 6P_f \tan\Theta}$

$\boxed{i_1 = O_1}$

$B_1 = 2O_1 \sin\Theta$

$\boxed{B_1 = 12 P_f \tan\Theta}$

$O_2 = \frac{i_1 \cos\Theta - 2P_f}{\cos\Theta}$

$\boxed{O_2 = \frac{4P_f}{\cos\Theta}}$

$T_2 = T_1 + i_1 \sin\Theta + O_2 \sin\Theta$

$\boxed{T_2 = 16 P_f \tan\Theta}$

$\boxed{i_2 = O_2}$

$B_2 = B_1 + 2O_2 \sin\Theta$

$\boxed{B_2 = 20 P_f \tan\Theta}$

$O_3 = \frac{i_2 \cos\Theta - 2P_f}{\cos\Theta}$

$\boxed{O_3 = \frac{2P_f}{\cos\Theta}}$

$T_3 = T_2 + i_2 \sin\Theta + O_3 \sin\Theta$

$\boxed{T_3 = 22 P_f \tan\Theta}$

$\boxed{i_3 = O_3}$

$B_3 = B_2 + 2O_3 \sin\Theta$

$\boxed{B_3 = 24 P_f \tan\Theta}$

$O_4 = \frac{i_3 \cos\Theta - 2P_f}{\cos\Theta}$

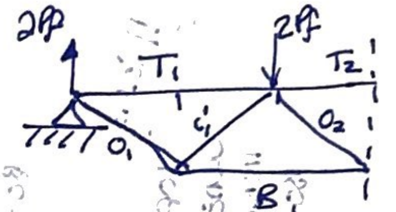
$\boxed{O_4 = \frac{\emptyset}{\cos\Theta}}$ ✓✓✓

$T_4 = T_3 + i_3 \sin\Theta + O_4 \sin\Theta$

$\boxed{T_4 = 24 P_f \tan\Theta}$

O_4 MUST BE A $\emptyset$ F MEMBER!

THIS IS CORRECT!



$\boxed{O_1 = \frac{2P_f}{\cos\Theta}}$

$\boxed{T_1 = 2P_f \tan\Theta}$

$\boxed{i_1 = O_1}$

$B_1 = 2O_1 \sin\Theta$

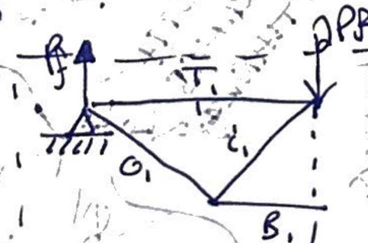
$\boxed{B_1 = 4P_f \tan\Theta}$

$O_2 = \frac{i_1 \cos\Theta - 2P_f}{\cos\Theta}$

$\boxed{O_2 = \emptyset}$

$T_2 = T_1 + i_1 \sin\Theta + O_2 \sin\Theta$

$\boxed{T_2 = 4P_f \tan\Theta}$



$\boxed{O_1 = \frac{P_f}{\cos\Theta}}$

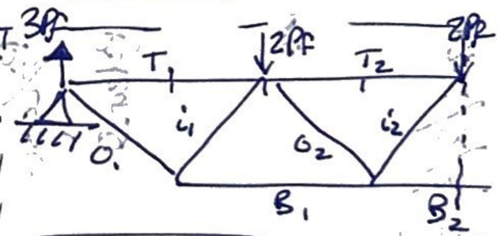
$\boxed{T_1 = P_f \tan\Theta}$

$\boxed{i_1 = O_1}$

$B_1 = 2O_1 \sin\Theta$

$\boxed{B_1 = 2P_f \tan\Theta}$

✓



$\boxed{O_1 = \frac{3P_f}{\cos\Theta}}$

$\boxed{T_1 = 3P_f \tan\Theta}$

$\boxed{i_1 = O_1}$

$B_1 = 2O_1 \sin\Theta$

$\boxed{B_1 = 6P_f \tan\Theta}$

$O_2 = \frac{i_1 \cos\Theta - 2P_f}{\cos\Theta}$

$\boxed{O_2 = \frac{P_f}{\cos\Theta}}$

$T_2 = T_1 + i_1 \sin\Theta + O_2 \sin\Theta$

$\boxed{T_2 = 7P_f \tan\Theta}$

$\boxed{i_2 = O_2}$

$B_2 = B_1 + 2O_2 \sin\Theta$

$\boxed{B_2 = 8P_f \tan\Theta}$

13 joists

6·1 — $6 \cdot 2 + 4$ — $6 \cdot 3 + 4$ — 6·4

(1) 10 (2) 8 (3) 2 (4)

TOP → $6P_f \tan\theta$ → $16P_f \tan\theta$ → $22P_f \tan\theta$ → $24P_f \tan\theta$

OUTER → $6P_f/\cos\theta$ → $4P_f/\cos\theta$ → $2P_f/\cos\theta$ → $\emptyset$

INNER → " → " → " → ~~"~~

BOT → $12P_f \tan\theta$ → $20P_f \tan\theta$ → $24P_f \tan\theta$ →

$P_f \tan\theta$ 6 → 16 → 22 → 24

$P_f/\cos\theta$ 6 → 4 → 2 → $\emptyset$

" " "

$P_f \tan\theta$ 12 → 20 → 24

13//2 → 6/2 = 3

5 joists

2·1 8 2·2 4

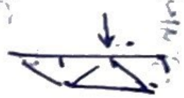
TOP → $2P_f \tan\theta$ → $4P_f \tan\theta$ →

OUTER → $2P_f/\cos\theta$ → $\emptyset$

INNER → " → ~~"~~ → "

BOT → $4P_f \tan\theta$

5//2 → 2/2 = 1



2 → 4

2 → $\emptyset$

" →

4 →

3 joists

1·1

TOP → $P_f \tan\theta$ →

OUTER → $P_f/\cos\theta$ →

INNER → " →

BOT → $2P_f \tan\theta$ →

3//2 → 1

CHECK PRATT / TRUSS ALGORITHM FOR RESULTS FOR 1 JOIST?? ✓

BOTH WARRENS I THINK

PRECALC: OUTER + INNER (CONCURRENT)

SEQUENTIAL CALC TOP/BOT

NOPE I SOLVED IT CUZ GOD :)

$2x + 1 = \#$ joists

$x \% 2 = \emptyset$ → 4x outer, 3x inner } 13 joists

$= 1$ → 3x outer, 3x inner } 11 joists.

7 joists

3·1 — $3 \cdot 2 + 1$

TOP → $3P_f \tan\theta$ → $7P_f \tan\theta$ →

OUTER → $3P_f/\cos\theta$ → $P_f/\cos\theta$ →

INNER → " → " →

BOT → $6P_f \tan\theta$ → $8P_f \tan\theta$

2

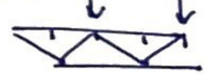
$P_f \tan\theta$ 3 → 7

$P_f/\cos\theta$ 3 → 1

" "

$P_f \tan\theta$ ~~8~~6 → 8

7//2 → 3



5J → 2x outer, 1x inner

3J → 1x outer, 1x inner

/2 round ↑

11 joists

5·1 — $5 \cdot 2 + 3$ — $5 \cdot 3 + 2$

TOP → $5P_f \tan\theta$ → $13P_f \tan\theta$ → $17P_f \tan\theta$

OUTER → $5P_f/\cos\theta$ → $3P_f/\cos\theta$ → $P_f/\cos\theta$

INNER → " → " "

BOT → $10P_f \tan\theta$ → $16P_f \tan\theta$ → $18P_f \tan\theta$

6 2

5 → 13 → 17

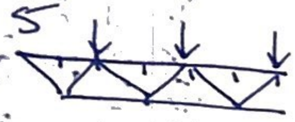
5 → 3 → 1

" " "

10 → 16 → 18

1/2/3/5/7/11/13/17

11//2 → 5



9J → 3x outer, 2x inner

7J → 2x outer → 2x inner.

$\times 3$ (18?)

$P_f \text{ factor} \rightarrow 3P_f\text{ factor} - 2 \rightarrow 5P_f\text{ factor} - \cancel{6} \rightarrow 7P_f\text{ factor} - 10$

$\boxed{6 \rightarrow 16 \rightarrow 22 \rightarrow 24}$ ✓

$\boxed{5 \rightarrow 13 \rightarrow 17}$ ✓

$2P_f\text{ factor} \rightarrow \overset{4\ (-24)}{4P_f - 2} \rightarrow \overset{6\ (-12)}{6P_f - 8} \rightarrow \overset{8\ (-36)}{8P_f - 18}$

$i = 4$

$12 \rightarrow 20 \rightarrow 24$

$10 \rightarrow 16 \rightarrow 18$ ✓

$+4$

$10(-4)$

$\cancel{-2 \rightarrow -8 \rightarrow -18}$

$B_5 = 2P_f^R - 4 \ldots$
$2P_f^R - 8$
$2P_f^R - 12 \ldots \rightarrow 2P_f^R - 16 \ldots$
$2P_f^R - 8) \rightarrow 2P_f^R$
$2(P_f^R - 4(10)$

TOP $-2 \rightarrow -8 \rightarrow -18$ (6, 10)

BOTTOM $-4 \rightarrow -12 \rightarrow (-36)$? (8, 24; 16)

$10P_f^R$

for i in range(...):
factor += i

for i in range(
round(no_jobs // 2 / 2)

$(2+2i)P_f^R$

$\boxed{2(i+1)P_f^R}$ $\boxed{-4 * \text{factor}}$

$B_1 = 2P_f^R$ | $2P_f^R$ | $-4(0)$ | $i = 0$

$B_2 = 2P_f^R$
$+ 2(P_f^R - 2) \rightarrow 2P_f^R - 4$, (-4) | $\downarrow +1$ $4P_f^R$ | $-4(1)$ | $i = 1$

$B_3 = 2P_f^R$
$2(P_f^R - 2) \rightarrow 2P_f^R - 4$
$2(P_f^R - 4) \rightarrow 2P_f^R - 8$ | $\downarrow +2$ $6P_f^R$ | $-4(3)$ | $i = 2$

$3(-4)$

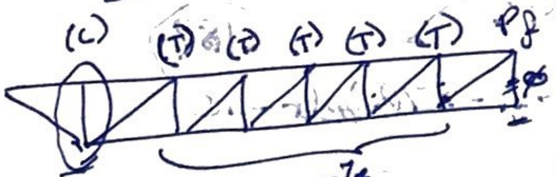
$B_4 = 2P_f^R$
$2(P_f^R - 2) \rightarrow 2P_f^R - 4$
$2(P_f^R - 4) \rightarrow 2P_f^R - 8$
$2(P_f^R - 6) \rightarrow 2P_f^R - 12$ $6(-4)$ | $\downarrow +3$ $8P_f^R$ | $-4(6)$ | $i = 3$

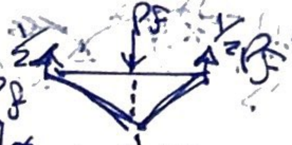
$1 \rightarrow \phi$

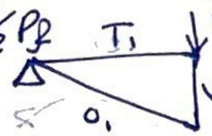
$11 // 2 = \text{round}(5/2) \rightarrow 3$
$9 // 2 = 4/2 \rightarrow 2$
$15 // 2 = \text{round}(7/2) \rightarrow 4$
$13 // 2 = 6/2 \rightarrow 3$
$7 // 2 = \text{round}(3/2) \rightarrow 2$

15 jobs $\rightarrow$ 4
13 jobs $\rightarrow$ 3
13 jobs $\rightarrow$ 3
11 jobs $\rightarrow$ 3
9 " $\rightarrow$ 2
$7 \rightarrow 2$
$5 \rightarrow 1$
$3 \rightarrow 1$

PRATT

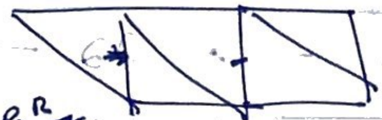






$V_1 = P_f$

$O_1 = \frac{\frac{1}{2}P_f}{\cos\theta}$



$\boxed{O_1 = 103.135943\ kN\ (T)}$

$T_1 = O_1 \sin\theta$

$\boxed{T_1 = 72.928125\ kN\ (C)}$

y-values

$x=y$ 1, 2, 3, 4, 5
1 1 1 1 → 1st order <linear>

$y=x^2$ 4, 9, 16, 25, 36
5 7 9 11
2 2 2 → 2nd order <quadratic>

$y=x^3$ 8 27 64 125 216
19 37 61 91
18 24 30
6 6 → 3rd order. <cubic>

$2 * S_j$

$2 * S_j$

$2 * 2 * S_j$

no_joints
dimensions → angle
S_j
Diag
Vert (Vert_Bot/Horz)
(Bot/Horz)
m_weights
m_forces (members)
m_sections
total_weight
→ type

t_count = 0
elapsed_time = 0

Change weight Calculation (/member) Algorithm to Account for this

$\boxed{37.85^\circ}$