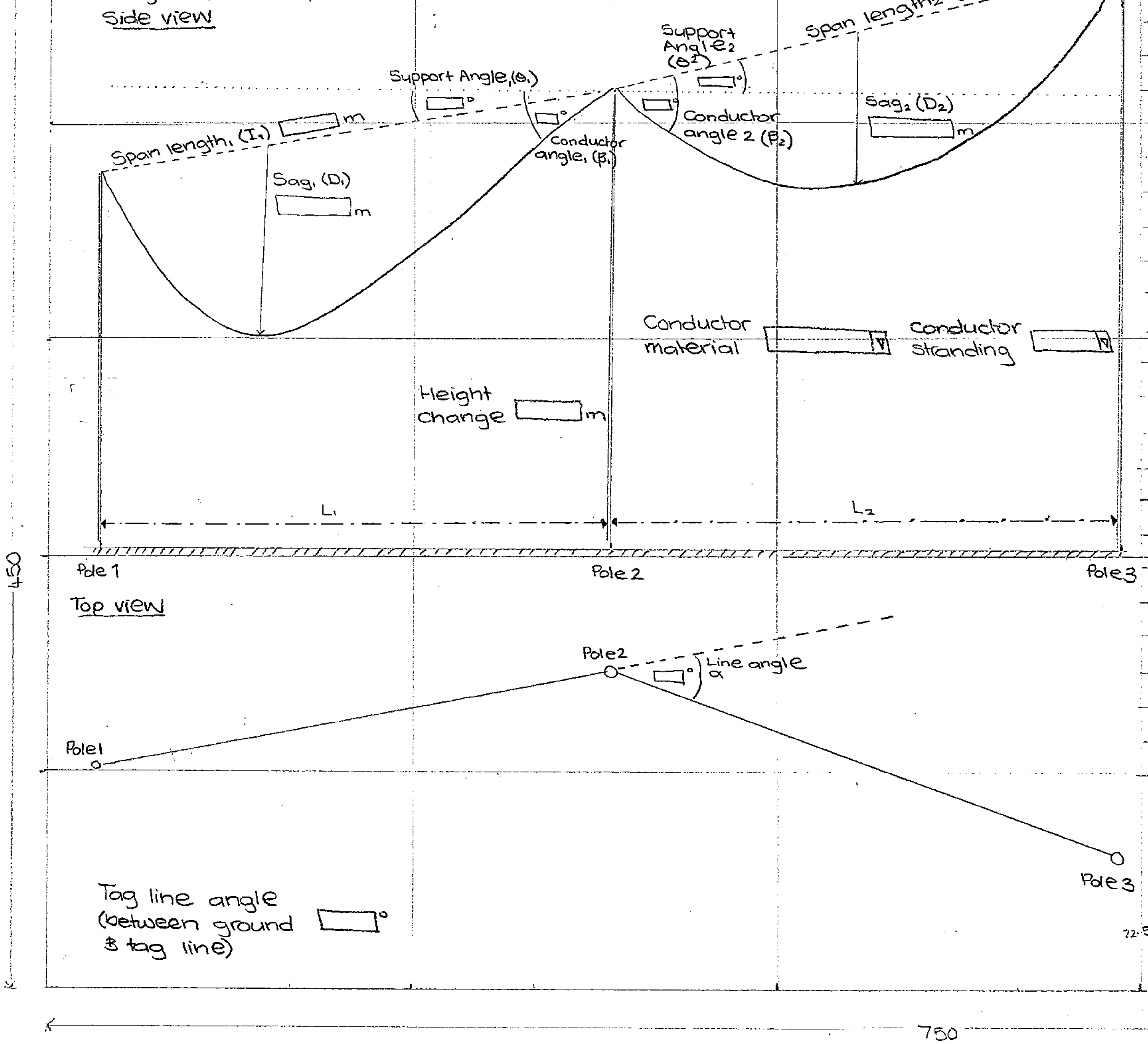
*CODING NOTE:
If sag inputted, disable input fields for conductor angle & vice versa



INITIAL CONDITIONS	units
% of UTS	
Sag 1	metres
Tension1(T_{i1})	kg
Tension 2 (T_{i2})	kg
Tension 3 (T_{i3})	kg
Tension 4 (T_{i4})	kg
Sag 2	metres
Resultant Force (RF)+25%	kg
Horizontal Force (HF) + 25%	kg
Vertical Force (VF) + 25%	kg
FINAL CONDITIONS	
Scenario	
Sufficient sag?	
% of UTS	
Sag 1	metres
Tension 1 (T_{f1})	kg
Tension 2 (T_{f2})	kg
Tension 3 (T_{f3})	kg
Tension 4 (T_{f4})	kg
Sag 2	metres
Resultant Force (RF)+25%	kg
Horizontal Force (HF) +25%	kg
Vertical Force on rig +25%	kg
Tag line Force + 25%	kg
Vertical Force (VF) +25%	kg

[31] Scenario

[30] IF $\theta_1 = \theta_2 = \theta$ then "level"

elseif $\theta_1 < 0$ AND $\theta_2 < 0$ then "Hilltop"

elseif $\theta_1 > 0$ AND $\theta_2 > 0$ then "Valley"

elseif $\theta_1 = -\theta_2$ then "Level slope"

elseif $\theta_1 + \theta_2 < 0$ AND $\theta_1 \geq 0$ AND $\theta_2 < 0$

OR $\theta_1 + \theta_2 < 0$ AND $\theta_2 \geq 0$ AND $\theta_1 < 0$ then "Hilltop slope"

elseif $\theta_1 + \theta_2 > 0$ AND $\theta_1 > 0$ AND $\theta_2 \leq 0$

OR $\theta_1 + \theta_2 > 0$ AND $\theta_2 > 0$ AND $\theta_1 \leq 0$ then "Valley Slope"

FINAL CONDITIONS

[162] $h_1 = -[SL_1 \sin\theta_1]$

initial height difference

$L_1 = SL_1 \cos\theta_1$

$L_2 = SL_2 \cos\theta_2$

$SL_1 = I_1$

$SL_2 = I_2$

Catenary constant (c)

[101] $c_1 = \frac{L_1^2}{8D_1}$ [108] $c_2 = \frac{L_2^2}{8D_2}$

Conductor Length (S)

$S_1 = I_1 + \frac{L_1^4}{24c_1^2 I_1}$ $S_2 = I_2 + \frac{L_2^4}{24c_2^2 I_2}$

$S_{total} = S_1 + S_2$

Conductor weight

Conductor weight $= S_1 \times W$ W=conductor mass (look up table)

Conductor force

conductor force = conductor weight × 9.8067 ← acceleration due to gravity

INITIAL CONDITIONS

Sag

[100] $D_1 = \frac{L_1 \tan\theta_1 - h_1}{4} = \frac{(I_1\cos\theta_1)(\tan\theta_1) - h_1}{4}$

[107] replace with $_2$ as required for D_2

Low point of conductor

[128] LP_1 = IF h_1=initial_height_difference, >0

THEN $\left(\frac{L_1}{2} + c_1\right) * \text{ASINH}\left[\frac{|h_1|}{2c_1\left|\sinh\left(\frac{L_1}{2c_1}\right)\right|}\right]$

ELSE $\left(\frac{L_1}{2} - c_1\right) * \text{ASINH}\left[\frac{|h_1|}{2c_1\left|\sinh\left(\frac{L_1}{2c_1}\right)\right|}\right]$

find LP_2 by changing all to x_2 references [143]

Tension

[133] $T_1 = W * c_1 * \cosh\left[\frac{L_1 - LP_1}{c_1}\right]$

[135] $T_2 = W * c_1 * \cosh\left[\frac{LP_1}{c_1}\right]$

[148] $T_3 = W * c_2 * \cosh\left[\frac{L_2 - LP_2}{c_2}\right]$

[150] $T_4 = W * c_2 * \cosh\left[\frac{LP_2}{c_2}\right]$

Horizontal tension (T_{Hx})

[104] $T_{H1} = c_1 * W$

[111] $T_{H2} = c_2 * W$

Vertical force (V_{Fx})

[154] $V_{F1} = \sqrt{T_1^2 - T_{H1}^2}$

[155] $V_{F2} = \sqrt{T_2^2 - T_{H1}^2}$

[158] $V_{F3} = \sqrt{T_3^2 - T_{H2}^2}$

[159] $V_{F4} = \sqrt{T_4^2 - T_{H2}^2}$

Conductor Length from pole (CL_x)

[131] $CL_1 = S_1 - \left(c_1 * \sinh\left[\frac{L_1 - LP_1}{c_1}\right]\right)$

[146] $CL_2 = S_2 - \left(c_2 * \sinh\left[\frac{L_2 - LP_2}{c_2}\right]\right)$

Vertical Force (VF)

[165] $VF = CL_1 * W + CL_2 * W$

[166] $VF + 25\% = VF \times 1.25$ (units = kg)

Horizontal Force (HF)

[169] $HF = (c_1 * W_1 + T_{H2}) * \sin\left(\frac{\alpha}{2} * \frac{\pi}{180}\right)$

[170] $HF + 25\% = HF \times 1.25$

Resultant force (RF)

[168] $RF + 25\% = \left[\sqrt{VF^2 + HF^2}\right] \times 1.25$

	F	G	H	I	
2	[redacted]				L_1 = horizontal
3	[redacted]	[redacted]	110	[redacted]	L_1 or SL_1
	[redacted]	[redacted]	-8	[redacted]	θ_1
5	[redacted]	[redacted]	2	[redacted]	β_1
	[redacted]	[redacted]			
7	[redacted]	[redacted]	[redacted]	[redacted]	D_1
	[redacted]	[redacted]	90	[redacted]	L_2 or SL_2
	[redacted]	[redacted]	-10	[redacted]	β_2
10	[redacted]	[redacted]	8	[redacted]	θ_2
11	[redacted]	[redacted]			L_2 = horizont.
12	[redacted]	[redacted]	[redacted]	[redacted]	D_2
13	[redacted]	[redacted]	0	[redacted]	α
14	[redacted]	[redacted]	GS	7/3/40	
15	[redacted]	[redacted]	0	[redacted]	H
16	[redacted]	[redacted]	45	[redacted]	

Initial Conditions			
% of UTS		=B173	
Sag 1		=B100	metres
Tension 1 (T1)		=B133	kg
Tension 2 (T2)		=B135	kg
Tension 3 (T3)		=B150	kg
Tension 4 (T4)		=B148	kg
Sag 2		=B107	metres
RF + 25%		=B168	kg
HF + 25%		=B170	kg
VF + 25%		=B166	kg

→ IF conductor Angle 1 is blank, true = Sag ~~dr~~ else $\left\{\left[\text{span\_length\_1} * \cos\left(\frac{\text{support\_angle\_1} \times \pi}{180}\right)\right] * \tan\left(\frac{\text{conductor\_angle\_1} \times \pi}{180}\right) - \text{span length\_1} * \sin\left(\frac{\text{conductor\_angle\_1} \times \pi}{180}\right)\right\} / 4$

26 lines

Final Conditions			
Scenario		=B80	
Sufficient Sag?		=B250	
% of UTS		=IF(B193="No","-"	
Sag 1		=B185	metres
Tension 1 (T1)		=B207	kg
Tension 2 (T2)		=B209	kg
Tension 3 (T3)		=B224	kg
Tension 4 (T4)		=B224	kg
Sag 2		=B190	metres
RF + 25%		=B242	kg
HF + 25%		=B244	kg
VF on rig + 25%		=B241	kg
Tag line + 25%		=B246	kg
VF + 25% (check)		=B240	kg

$\boxed{202}$ LP_{F_1} = IF $HR_1 > 0$ THEN $\frac{L_1}{2} + C_{12} * \sigma$

ELSE $\frac{L_1}{2} - C_{12} * \sigma$

Tension

$$T_1 = W \times C_{12} \times \left[\frac{e^{\frac{L_1 - LP_{F_1}}{C_{12}}} + e^{-\left(\frac{L_1 - LP_{F_1}}{C_{12}}\right)}}{2}\right]$$

$$T_2 = W \times C_{12} * \left[\frac{e^{\frac{LP_{F_1}}{C_{12}}} + e^{-\left(\frac{LP_{F_1}}{C_{12}}\right)}}{2}\right]$$

$$T_3 = T_4 = W \times C_{12} \times \left[\frac{e^{\frac{LP_{F_2}}{C_{12}}} + e^{-\frac{LP_{F_2}}{C_{12}}}}{2}\right]$$

$$\boxed{206} = \frac{e^{\frac{L_1 - LP_{F_1}}{C_{12}}} + e^{-\left(\frac{L_1 - LP_{F_1}}{C_{12}}\right)}}{2}$$

Sag

$$\boxed{185}\ D_{F_1} = \frac{L_1^2}{8C_{12}}$$

$$\boxed{190}\ D_{F_2} = \frac{L_2}{8C_{12}}$$

$$\boxed{178}\ C_{12} = \sqrt{\frac{\dfrac{L_1^4}{\underbrace{\left[\frac{L_1}{\cos(\text{atan}(\frac{-HR_1}{L_1}))}\right]}_{B74}} + \dfrac{L_2^4}{\underbrace{\left[\frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))}\right]}_{B95}}}{24 \times \left\{S_1 + S_2 - \left[\frac{L_1}{\cos(\text{atan}(\frac{-HR_1}{L_1}))}\right] - \left[\frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))}\right]\right\}}}$$

$$\boxed{197} = \frac{e^{\frac{L_1}{2C_{12}}} - e^{\frac{-L_1}{2C_{12}}}}{2}$$

$$\boxed{198}\ \gamma = \frac{|HR_1|}{2C_{12} \times \left|\frac{e^{\frac{L_1}{2C_{12}}} - e^{\frac{-L_1}{2C_{12}}}}{2}\right|}$$

$$\boxed{199}\ \sigma = \text{Ln}\left(\gamma + \sqrt{\gamma^2 + 1}\right)$$