| | F | G | H | I | |
|---|---|---|---|---|---|
| 2 | Input | | | | $L_1$: horizontal |
| 3 | Span L1 | | 110 | metres | $L_1$ or $SL_1$ |
| 4 | 1 | Support Angle S | -8 | degrees | $\theta_1$ |
| 5 | 2 | Conductor Angle | 2 | degrees | $\beta_1$ |
| 6 | OR | | | | |
| 7 | 3 | Sag S1 | | metres | $D_1$ |
| 8 | Span L2 | | 90 | metres | $L_2$ or $SL_2$ |
| 9 | 4 | Conductor Angle | -10 | degrees | $\beta_2$ |
| 10 | 5 | Support Angle S2 | 8 | degrees | $\theta_2$ |
| 11 | OR | | | | $L_2$ - horizontal |
| 12 | 6 | Sag S2 | | metres | $D_2$ |
| 13 | 7 | Line Angle | 0 | degrees | $\alpha$ |
| 14 | | Conductor Type | GS | 7/3.40 | |
| 15 | | Height Change | 0 | m | $\pm H$ |
| 16 | | Tag Line Angle | 45 | deg | $\gamma$ |

| Initial Conditions | | | |
|---|---|---|---|
| % of UTS | | =B173 | |
| 20 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 |

10 lines

check cell.

| Final Conditions | | | |
|---|---|---|---|
| 30 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 |
| 40 RF + 25% | | =B242 | kg |
| HF + 25% | | =B244 | kg |
| VF on rig + 25% | | =B241 | kg |
| Tag line + 25% | | =B246 | kg |
| VF + 25% (check) | | =B240 | kg |

[44] [240] $VF+25\% = \left([205]*W + [220]*N\right) \times 1.25$

Horizontal force $VF = \left([205]*W + [220]*N\right)$

$HF = 2(c_{12}*W) * \sin\left(\frac{\alpha}{2} * \frac{\pi}{180}\right)$

[41] [244] $HF+25\% = HF \times 1.25$

$= 1.25\left[2(c_{12}*W) * \sin\left(\frac{\alpha}{2} \times \frac{\pi}{180}\right)\right]$

[40] [242] $RF+25\% = \sqrt{(HF^2 + VF^2)} * 1.25$

[245] Tag line $VF = \frac{HF}{\tan((90-\beta) * \frac{\pi}{180})} = \left[\frac{2c_{12}W \sin\left(\frac{\alpha}{2} * \frac{\pi}{180}\right)}{\tan((90-\beta) * \frac{\pi}{180})}\right]$

[246] [43] Tag line $+25\% = \frac{\text{Tag line VF}}{\sin((90-\beta) * \frac{\pi}{180})} * 1.25$

[241] [42] Vertical Force on rig $+25\% = (VF + \text{Tagline VF}) * 1.25$

$VF \text{ on rig} + 25\% = \left[[205]*W + [220]*W + \frac{2 * c_{12} * W * \sin\left(\frac{\alpha}{2} * \frac{\pi}{180}\right)}{\tan(90-\beta * \frac{\pi}{180})}\right]$

[241] %UTS IF $T_2 > T_3$ THEN $\frac{T_2 * 9.8067}{\text{Conductor UTS} * 100}$ ELSE $\frac{T_3 * 9.8067}{\text{conductor UTS} * 100}$

↑ look up value

Is there enough slack? (Theoretical)

[193] IF $\left[(S_1+S_2) - \frac{L_1}{\cos(\text{atan}(\frac{-HR_1}{L_1}))} - \frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))}\right] > 0$

THEN "YES" ELSE "NO"

ie % UTS cannot return numeric value

[248] IF %UTS = "ERROR" THEN "NO"

ELSE IF %UTS ≤ 30 THEN "YES"

ELSE "NO"

[250] [32] IF [248] returns "YES" AND [193] returns "YES"; THEN return "YES"

ELSE return "NO"

Low Point of Conductor

[207] $LP_{F_1}$ = IF $HR_1 > 0$ THEN $\frac{L_1}{2} + c_{12} * \sigma_1$ ELSE $\frac{L_1}{2} - c_{12} * \sigma_1$ } [217] can be calculated for span 2 similarly

Tension

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

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

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

[206] $= \frac{e^{\frac{L_1 - LP_{F_1}}{c_{12}}} + e^{-\left(\frac{L_1 - LP_{F_1}}{c_{12}}\right)}}{2}$ COSH

[203] $\frac{e^{\left(\frac{L_1 - LP_{F_1}}{c_{12}}\right)} - e^{-\left(\frac{L_1 - LP_{F_1}}{c_{12}}\right)}}{2}$ SINH

Conductor Length

Pole 1 → Pole 2

[177] $\frac{B74}{\cos(B75)} = \frac{L_1}{\cos(\arctan(\frac{-HR_1}{L_1}))}$

[188] $= \frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))} + \frac{L_2^4}{24 c_{12}^2 * \left[\frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))}\right]}$

[183] $= \frac{L_1}{\cos(\arctan(\frac{-HR_1}{L_1}))} + \frac{L_1^4}{24 c_{12}^2 * \left[\frac{L_1}{\cos(\arctan(\frac{-HR_1}{L_1}))}\right]}$

i.e. see! Similar

Pole 2 → X1

[20E] = [183] − [204]

[204] = [178] * [203]

$= c_{12} * \left[\frac{e^{\frac{L_1 - LP_{F_1}}{c_{12}}} - e^{-\left(\frac{L_1 - LP_{F_1}}{c_{12}}\right)}}{2}\right]$

∴ [205] $= \frac{L_1}{\cos(\arctan(\frac{-HR_1}{L_1}))} + \frac{L_1^4}{24 c_{12}^2 * \left[\frac{L_1}{\cos(\arctan(\frac{-HR_1}{L_1}))}\right]} - c_{12}\left[\frac{e^{\frac{L_1 - LP_{F_1}}{c_{12}}} - e^{-\left(\frac{L_1 - LP_{F_1}}{c_{12}}\right)}}{2}\right]$

[220] same as [205] with all values for pole/2 Span

GO TO TOP OF PAGE!

Sag

[5] $D_{F_1} = \frac{L_1^2}{8 c_{12}}$

[0] $D_{F_2} = \frac{L_2}{8 c_{12}}$

[178] $c_{12} = \sqrt{\frac{\frac{L_1^4}{\left[\frac{L_1}{\cos(\text{atan}(\frac{-HR_1}{L_1}))}\right]} + \frac{L_2^4}{\left[\frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))}\right]}}{24 \times \left\{S_1 + S_2 - \left[\frac{L_1}{\cos(\text{atan}(\frac{-HR_1}{L_1}))}\right] - \left[\frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_2}))}\right]\right\}}}$

[178] [B78] [B93]

[7] $= \frac{e^{\frac{L_1}{2c_{12}}} - e^{\frac{-L_1}{2c_{12}}}}{2}$

[8] $\gamma_1 = \frac{|HR_1|}{2 c_{12} \times \left|\frac{e^{\frac{L_1}{2c_{12}}} - e^{\frac{-L_1}{2c_{12}}}}{2}\right|}$

[199] $\sigma_1 = \text{Ln}\left(\gamma_1 + \sqrt{\gamma_1^2 + 1}\right)$

* $\gamma_2$ & $\sigma_2$ can be calculated with $HR_2$ and $L_2$ values [213] [214]

| | F | G | H | I | |
|---|---|---|---|---|---|
| 2 | **Input** | | | | $L_1$: horizontal |
| 3 | Span L1 | | 110 | metres | $L_1$ or $SL_1$ |
| 4 | 1 | Support Angle S1 | -8 | degrees | $D_1$ |
| 5 | 2 | Conductor Angle 1 | 2 | degrees | $\beta_1$ |
| 6 | OR | | | | |
| 7 | 3 | Sag S1 | | metres | $D_1$ |
| 8 | Span L2 | | 90 | metres | $L_2$ or $SL_2$ |
| 9 | 4 | Conductor Angle 2 | -10 | degrees | $\beta_2$ |
| 10 | 5 | Support Angle S2 | 8 | degrees | $\alpha_2$ |
| 11 | OR | | | | $L_2$ - horizontal |
| 12 | 6 | Sag S2 | | metres | $D_2$ |
| 13 | 7 | Line Angle | 0 | degrees | $\alpha$ |
| 14 | | Conductor Type | GS | 7/3.40 | |
| 15 | | Height Change | 0 | m | $\pm H$ |
| 16 | | Tag Line Angle | 45 | deg | $\beta_3$ |

| | | | | |
|---|---|---|---|---|
| 20 | **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 |

10 lines

check cell.

| | | | | |
|---|---|---|---|---|
| 30 | **Final Conditions** | | | |
| ✓ | Scenario | | =B80 | |
| ✓ | Sufficient Sag? | | =B250 | |
| ✓ | % of UTS | | =IF(B193="No","-" | |
| ✓ | Sag 1 | | =B185 | metres |
| ✓ | Tension 1 (T1) | | =B207 | kg |
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| ✓ | Tension 4 (T4) | | =B224 | kg |
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| 40 ✓ | RF + 25% | | =B242 | kg |
| ✓ | HF + 25% | | =B244 | kg |
| ✓ | VF on rig + 25% | | =B241 | kg |
| ✓ | Tag line + 25% | | =B246 | kg |
| ✓ | VF + 25% (check) | | =B240 | kg |

[44] [240] $\therefore VF + 25\% = \left(\boxed{205} * W + \boxed{220} * W\right) * 1.25$

$VF = (\boxed{205} * W + \boxed{220} * W)$

Horizontal force

$HF = 2(C_{12} * W) * \sin\left(\frac{\alpha}{2} * \frac{\pi}{180}\right)$

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$= 1.25\left[2(C_{12} * W) * \sin\left(\frac{\alpha}{2} * \frac{\pi}{180}\right)\right]$

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[247] %UTS IF $T_2 > T_3$ THEN $\frac{T_2 \times 9.8067}{\text{Conductor UTS} * 100}$ ELSE $\frac{T_3 * 9.8067}{\text{conductor UTS} * 100}$

↑ look up value

[193] IF $\left[(S_1+S_2) - \frac{L_1}{\cos(\text{atan}(\frac{-HR_1}{L_1}))} - \frac{L_2}{\cos(\text{atan}(\frac{-HR_2}{L_1}))}\right] > 0$ THEN "YES" ELSE "NO"

ie % UTS cannot return numeric value

[248] IF %UTS = "ERROR" THEN "NO"
ELSE IF %UTS ≤ 30 THEN "YES"
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[250] [32] IF [248] returns "YES" AND [193] returns "YES", THEN return "YES"
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Low Point of conductor

[209] $LP_{F_1} =$ IF $HR_1 > 0$ THEN $\frac{L_1}{2} + C_{12} * \sigma_1$ ELSE $\frac{L_1}{2} - C_{12} * \sigma_1$ } [217] can be calculated for span 2 similarly

Tension

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

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

[203] $= \frac{e^{\left(\frac{L_1 - LP_{F_1}}{C_{12}}\right)} - e^{-\left(\frac{L_1 - LP_{F_1}}{C_{12}}\right)}}{2}$ SINH

Conductor Length

Pole 1 → Pole 2

[177] $\frac{B74}{\cos(B75)} = \frac{L_1}{\cos(\arctan\left(\frac{-HR_1}{L_1}\right))}$

[163] $= \frac{L_1}{\cos(\arctan\left(\frac{-HR_1}{L_1}\right))} + \frac{L_1^4}{24 C_{12}^2 * \left[\frac{L_1}{\cos(\arctan\left(\frac{-HR_1}{L_1}\right))}\right]}$

[188] $= \frac{L_2}{\cos(\text{atan}\left(\frac{-HR_2}{L_2}\right))} + \frac{L_2^4}{24 C_{12}^2 * \left[\frac{L_2}{\cos(\text{atan}\left(\frac{-HR_2}{L_2}\right))}\right]}$

i.e. see! Similar

Pole 2 → X1

[205] = [183] − [204]

[204] = [178] * [203]

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

$\therefore$ [205] $= \frac{L_1}{\cos(\arctan\left(\frac{-HR_1}{L_1}\right))} + \frac{L_1^4}{24 C_{12}^2 * \left[\frac{L_1}{\cos(\arctan\left(\frac{-HR_1}{L_1}\right))}\right]} - C_{12}\left[\frac{e^{\frac{L_1 - LP_{F_1}}{C_{12}}} - e^{-\left(\frac{L_1 - LP_{F_1}}{C_{12}}\right)}}{2}\right]$

[220] same as [205] with all values for pole/2 Span

see top of page 1

Sag

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

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

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

[E79] [E95]

[197] $= \frac{e^{\frac{L}{2C_{12}}} - e^{\frac{-L}{2C_{12}}}}{2}$

[198] $\gamma_1 = \frac{|HR_1|}{2 C_{12} \times \left|\frac{e^{\frac{L}{2C_{12}}} - e^{\frac{-L}{2C_{12}}}}{2}\right|}$

[199] $\sigma_1 = \text{Ln}\left(\gamma_1 + \sqrt{\gamma_1^2 + 1}\right)$

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