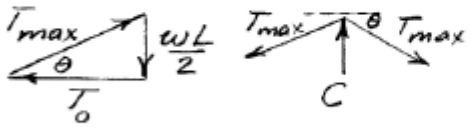
E36 Spring 2005
Homework 10 Solutions
5/139,144,149,154,158

5/139 $L = 4200$ ft, $h = 470$ ft, $w = \frac{21,300}{2} = 10650$ lb/ft for each cable

$$T_0 = \frac{wL^2}{8h} = \frac{10650(4200)^2}{8(470)} = \underline{50.0(10^6)\text{ lb}}$$



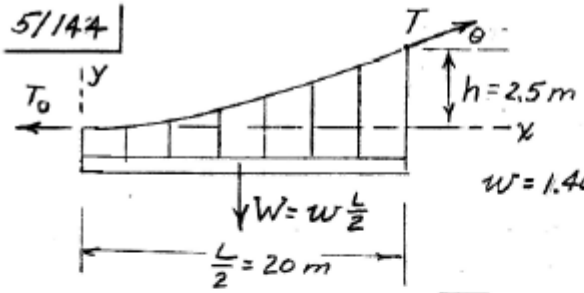
$C = 2T_{max}\sin\theta$

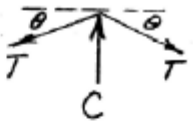
$= 2\left(\frac{wL}{2}\right) = wL$

$= 10650(4200)$

$= \underline{44.7(10^6)\text{ lb}}$

5/144





$w = 1.400(9.81) = 13.73$ kN/m

From Eq. 5/15b, $T = \frac{wL}{2}\sqrt{1 + (L/4h)^2}$

$= \frac{13.73(40)}{2}\sqrt{1 + \left[\frac{40}{4(2.5)}\right]^2} = 1133$ kN

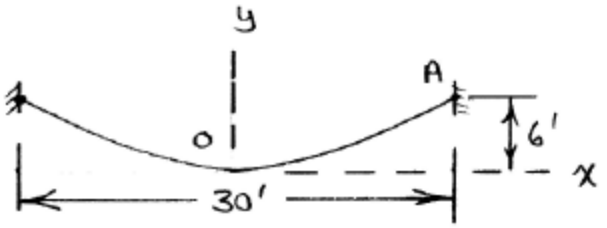
$T^2 = W^2 + T_0^2$, $T_0 = \sqrt{(1132)^2 - [(13.73)(20)]^2} = 1099$ kN

$\frac{dy}{dx} = \tan\theta = \frac{w(L/2)}{T_0} = \frac{13.73(20)}{1099} = 0.250$, $\theta = 14.04°$

$\Sigma F_y = 0$ at support; $2T\sin\theta - C = 0$

$C = 2(1133)\sin 14.04° = \underline{549\text{ kN}}$

***5/149**



Eq. 5/19, from O to A: $6 = \frac{T_0}{\mu}\left[\cosh\frac{\mu}{T_0}(15) - 1\right]$

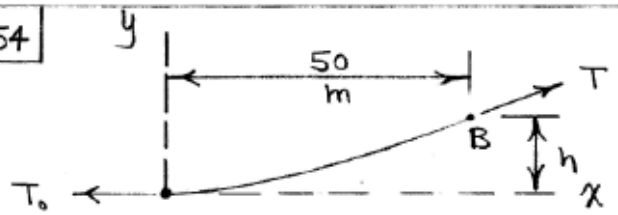
By numerical or graphical means, $\frac{T_0}{\mu} = 19.68\ \text{m}$

Eq. 5/20: $s = \frac{L}{2} = \frac{T_0}{\mu}\sinh\frac{\mu x}{T_0}$

$\therefore L = 2\left(\frac{T_0}{\mu}\right)\sinh\frac{\mu}{T_0}15$

$= 2(19.68)\sinh\frac{15}{19.68} = \underline{33.0\ \text{ft}}$

***5/154**



$\mu = 50\ \frac{\text{N}}{\text{m}}$

Eliminate T_0 between Eqs. 5/21 & 5/22 to get $T = (T - \mu y)\cosh\frac{\mu x}{T - \mu y}$

At B: $T = (T - 50h)\cosh\frac{50(50)}{T - 50h}$

or $T = \beta\cosh\frac{2500}{\beta}$ $\quad (\beta = T - 50h)$

For minimum T, $\frac{dT}{d\beta} = \cosh\frac{2500}{\beta} - \frac{1}{\beta}\sinh\frac{2500}{\beta}$

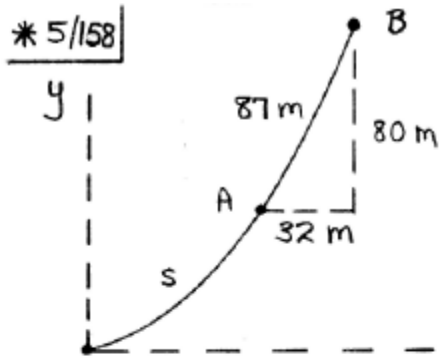
Numerically solve: $\beta = 2084\ \text{N}$ $\quad = 0$

$T = 2084\cosh\frac{2500}{2084} = 3772\ \text{N}$

$\beta = T - 50h$: $\quad 2084 = 3772 - 50h$, $\underline{h = 33.8\ \text{m}}$

(Note: $\beta = T_0$!)

*** 5/158**



$\mu = 2(9.81) = 19.62$ N/m

Eq. 5/19: $y = \frac{T_0}{\mu}\left(\cosh\frac{\mu x}{T_0} - 1\right)$

A: $y_A = \frac{T_0}{\mu}\left(\cosh\frac{\mu x_A}{T_0} - 1\right)$

B: $y_A + 80 = \frac{T_0}{\mu}\left(\cosh\frac{\mu}{T_0}(x_A + 32) - 1\right)$

Eq. 5/20: $s = \frac{T_0}{\mu}\sinh\frac{\mu x}{T_0}$

A: $s = \frac{T_0}{\mu}\sinh\frac{\mu x_A}{T_0}$

B: $s + 87 = \frac{T_0}{\mu}\sinh\frac{\mu}{T_0}(x_A + 32)$

Numerical solution: $x_A = 24.0$ m, $y_A = 12.30$ m

$\frac{T_0}{\mu} = 25.2$ m, $s = 27.8$ m

$T_0 = 25.2\,(19.62) = 495$ N

$T_A = T_0 + \mu y_A = 495 + 19.62(12.30) = \underline{736\text{ N}}$

$T_B = T_0 + \mu y_B = 495 + 19.62(92.3) = \underline{2310\text{ N}}$