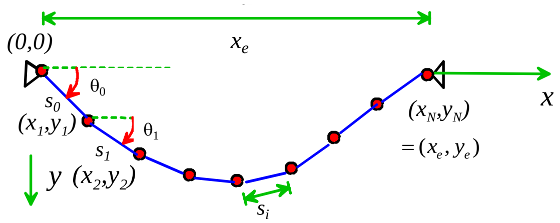
Elastic Cable, Modulus E, Area A



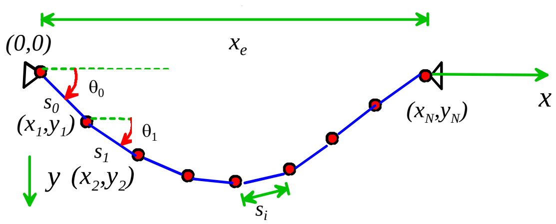
Divide into N segments of length s_i, original length $s=L_0/N$

$$x_1 = s_0\cos\theta_0, \quad x_2 = x_1 + s_1\cos\theta_1 \;\; .... \;\; x_i = x_{i-1} + s_{i-1}\cos\theta_{i-1}$$
$$y_1 = s_0\sin\theta_0, \quad y_2 = y_1 + s_1\sin\theta_1 \;\; .... \;\; y_i = y_{i-1} + s_{i-1}\sin\theta_{i-1}$$
$$x_N = x_e \quad y_N = y_e$$
$$V_0^g = -\frac{1}{2}\omega s y_1 \quad V_1^g = -\frac{1}{2}\omega s(y_1+y_2) \;\; ..... \;\; V_i^g = -\frac{1}{2}\omega s(y_i+y_{i+1})$$

Vary θ_i AND s_i minimize the total gravitational and elastic energy

$$V = \sum_{i=0}^{N-1}\left[\frac{1}{2}k(s_i - L_0/N)^2 - \frac{\omega s}{2}(y_i + y_{i+1})\right]$$

Elastic Cable, Self + Distributed Load w_0



$$V_0^g = -\frac{1}{2}\omega s_0 y_1 \quad V_1^g = -\frac{1}{2}\omega s_1(y_1+y_2) \;\; ..... \;\; V_i^g = -\frac{1}{2}\omega s_i(y_i+y_{i+1})$$
$$V_0^L = -\frac{1}{2}w_0 x_1 y_1 \quad V_1^L = -\frac{1}{2}w_0(x_2-x_1)(y_2+y_1) \;\; ..... \;\; V_i^L = -\frac{1}{2}w_0(x_{i+1}-x_i)(y_i+y_{i+1})$$

Vary θ_i AND s_i minimize the total energy

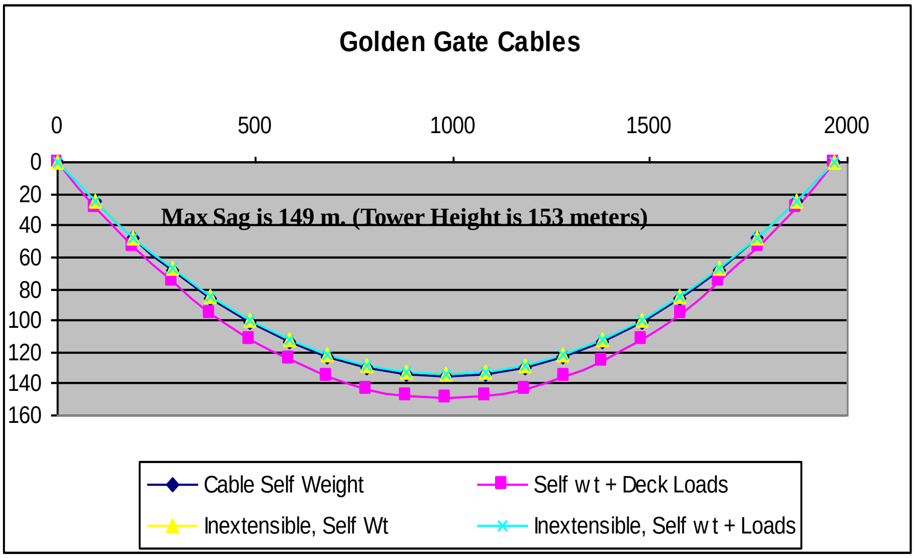
$$V = \sum_{i=0}^{N-1}\left[\frac{1}{2}k(s_i - L/N)^2 - \frac{1}{2}\left[\omega s_i + w_0\left(x_{i+1}-x_i\right)\right](y_i + y_{i+1})\right]$$

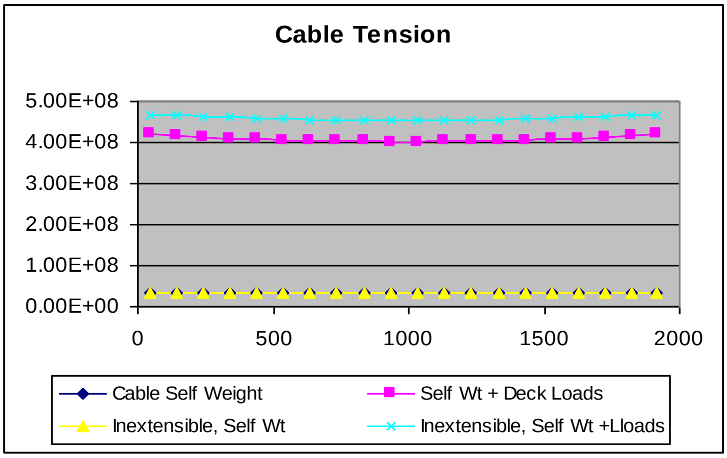
Golden Gate Approximate Bridge Data

- Cable Diameter: 0.92 m
- Modulus E=200GPa
- Wt./length=8295 N/m
- Length 1,990 m
- Span 1,966 m
- Dead load 55000 N/m
- Max Live load 57,000 N/m
- Tower Ht. above deck: 152 m

- Cable Yield Load $=\sigma_y A = 8.4\times10^8$N

http://www.goldengatebridge.org





Max tension:
4.5×10^8 N (Inextensible Cable)
4.1×10^8 N (Elastic Cable)

Yield Tension is 8.3×10^8 N