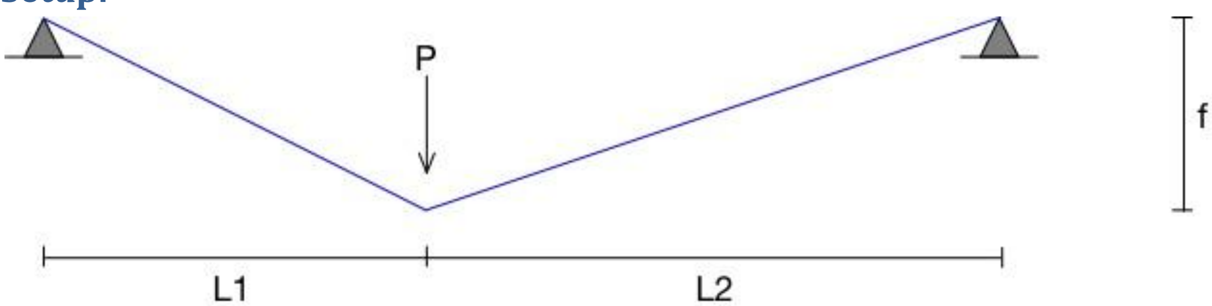
Cable, Single Concentrated Load

Setup:



Total span is L = L1 + L2

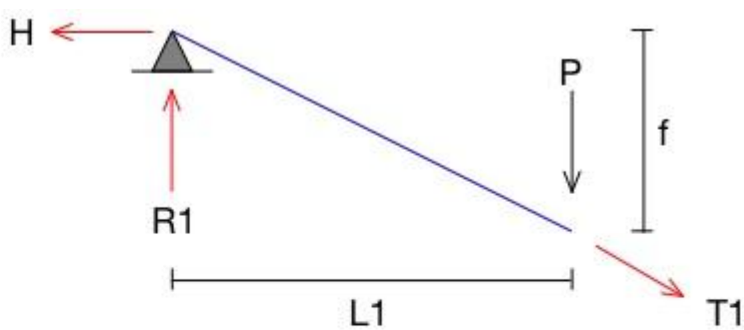
P is the only load; it can include dead load, live load, other loads …. For now, ignore self weight of cable.

f is the sag of the cable. f is the vertical distance from chord joining the support points to the point where the load P is applied.

Compute vertical reactions R1 and R2 at supports. Positions of R1 and R2 are shown in the next two graphics. Report R1 and R2 in terms of P, L1, L2 and L.

R1 =	P L2 / L
R2 =	P L1 / L

Free Body, Left portion of Cable:



This is called portion '1'. It has horizontal extent L1. There are two reactions at the support. The vertical reaction is R1. The horizontal reaction is H. Cable tension is T1. H is equal to the horizontal component of T1.

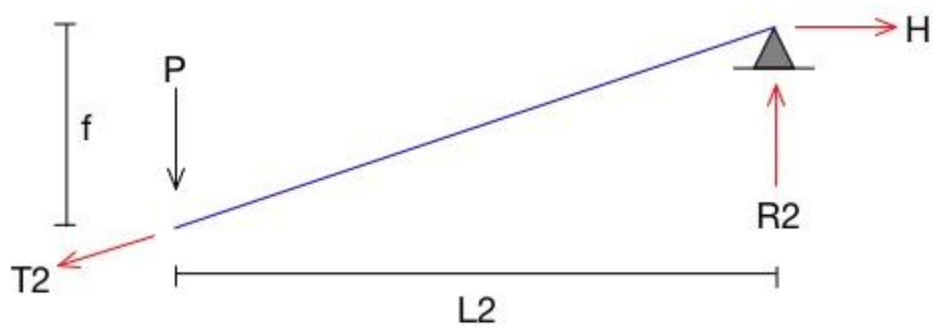
Use a moment balance at the free body cut (at P) to get a relation among H, R1, f, and L1. Then plug in for R1 to get a relation among H, P, L1, L2, L, and f.

Relation (H, R1, L1, f)	Hf = R1 L1
Relation (H, P, L1, L2, L, f)	Hf = P L1 L2 / L

Get a relation for cable tension T1 in terms of H, and R1. Then plug in for R1, plug in for H, and get T1 in terms of P, L1, L2, L, and f.

T1 (H, R1)	T1 = sqrt[H^2 + R1^2]
T1 (P, L1, L2, L, f)	T1 = sqrt[{P L1 L2 / L / f}^2 + {P L2 / L}^2] T1 = P L2 / L sqrt[{L1 / f}^2 + 1]

Free Body, Right portion of Cable:



This is called portion '2'. It has horizontal extent L2. There are two reactions at the support. The vertical reaction is R2. The horizontal reaction is H. Cable tension is T2. H is equal to the horizontal component of T2.

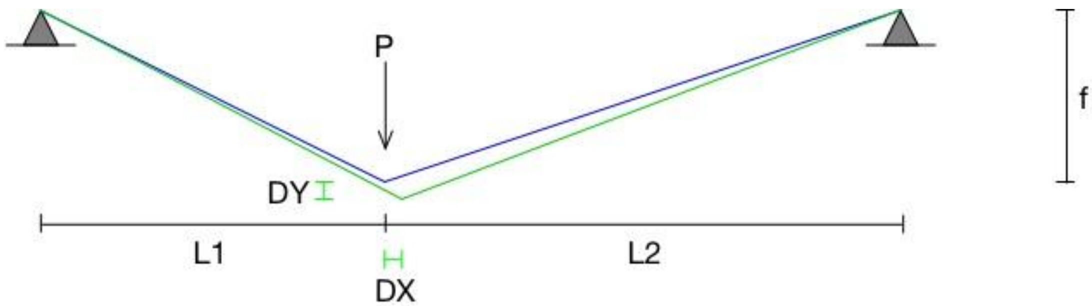
Use a moment balance at the free body cut (at P) to get a relation among H, R2, f, and L2. Then plug in for R2 to get a relation among H, P, L1, L2, L, and f.

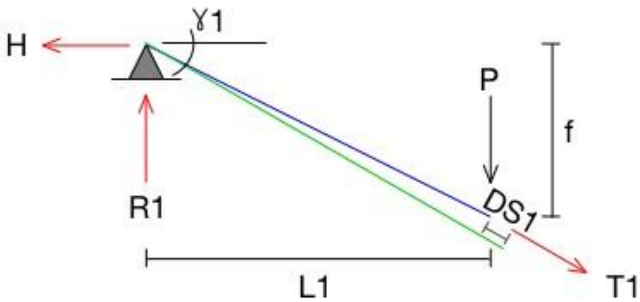
Relation (H, R2, L1, f)	Hf = R2 L2
Relation (H, P, L1, L2, L, f)	Hf = P L1 L2 / L

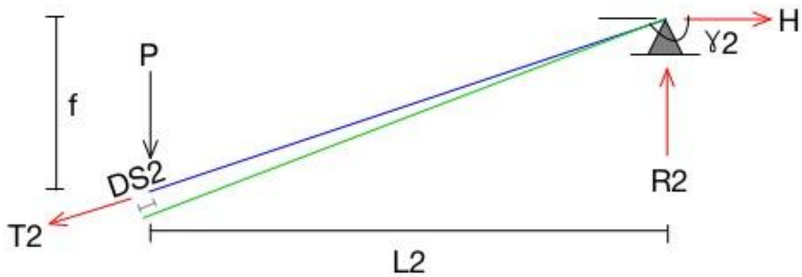
Get a relation for cable tension T2 in terms of H, and R2. Then plug in for R2, plug in for H, and get T2 in terms of P, L1, L2, L, and f.

T2 (H, R2)	T2 = sqrt[H^2 + R2^2]
T2 (P, L1, L2, L, f)	T2 = sqrt[{P L1 L2 / L / f}^2 + {P L1 / L}^2] T2 = P L1 / L sqrt[{L2 / f}^2 + 1]

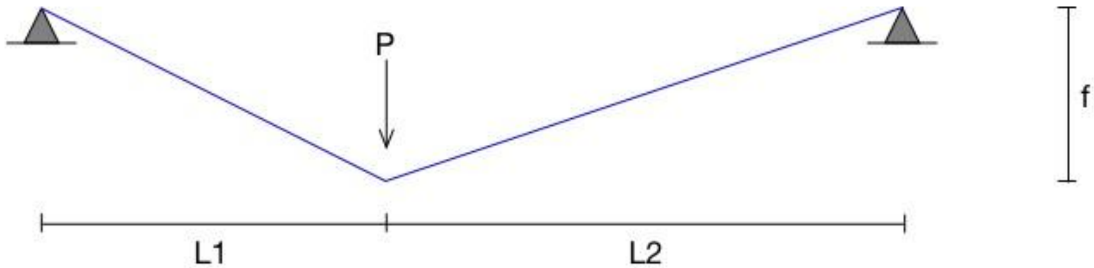
Displacements







Example



Force

L ft	100
L1 ft	32
L2 ft	68
f ft	8
PD k	5
PL k	15
P k	20
Pu k	44

R1 k	13.6
R2 k	6.4
H k	54.4
T1 k	56.1
T2 k	54.8
TU k	123

Strand	1 - 1/16”
Tn tn	69
Tn k	138
A in2	0.677
E ksi	24,000

Deflection – Due to Live Load

S1 ft	32.98
S2 ft	68.47
$\gamma 1$	-0.245
$\gamma 2$	-3.024

P Defl k	15
DT1 k	42.1
DT2 k	41.1
DS1 in	1.025
DS2 in	2.08

DX in	-1.08
DY in	-8.56