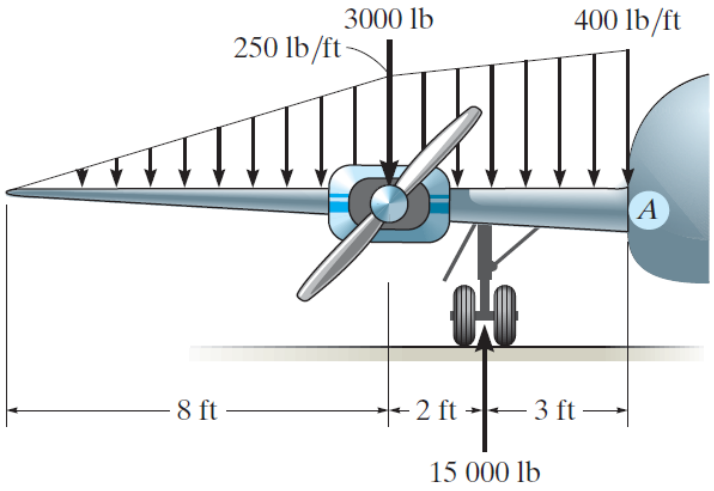
problem 6-38

6–38. The dead-weight loading along the centerline of the airplane wing is shown. If the wing is fixed to the fuselage at A, determine the reactions at A, and then draw the shear and moment diagram for the wing.



Prob. 6–38

beam

```
u = symunit;
x = sym('x');
E = sym('E');
I = sym('I');

old_assum = assumptions;
clearassum;
args = {'mode' 'factor'};
wf1 = findpoly(1, 'thru', [0 0], [8*u.ft -250*u.lbf/u.ft], args{:});
wf2 = findpoly(1, 'thru', [8*u.ft -250*u.lbf/u.ft], ...
                          [13*u.ft -400*u.lbf/u.ft], args{:});

b = beam; %(lbf,ft)
b = b.add('reaction', 'force', 'Ra', 13*u.ft);
b = b.add('reaction', 'moment', 'Ma', 13*u.ft);
b = b.add('applied', 'force', -3000*u.lbf, 8*u.ft);
b = b.add('applied', 'force', 15000*u.lbf, 10*u.ft);
b = b.add('distributed', 'force', wf1, [0 8]*u.ft);
b = b.add('distributed', 'force', wf2, [8 13]*u.ft, [false true]);
b.L = 13*u.ft;
```

elastic curve

```
[y(x,E,I) dy(x,E,I) m v w r] = b.elastic_curve(x, 'factor'); %#ok
y
```

y(x, E, I) =

$$\begin{cases} -\dfrac{25\ (x^5 - 27480\ x\ \text{ft}^4 + 5272\ \text{ft}^5)}{96\ \text{E}\ \text{I}}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \le 8\ \text{ft} \\ -\dfrac{3\ x^5 + 5\ x^4\ \text{ft} + 5920\ x^3\ \text{ft}^2 - 143360\ x^2\ \text{ft}^3 + 1063565\ x\ \text{ft}^4 - 3051429\ \text{ft}^5}{12\ \text{E}\ \text{I}}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \in (8\ \text{ft}, 10\ \text{ft}] \\ -\dfrac{(x - 13\ \text{ft})^2\ (3\ x^3 + 83\ x^2\ \text{ft} - 22429\ x\ \text{ft}^2 + 159459\ \text{ft}^3)}{12\ \text{E}\ \text{I}}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ 10\ \text{ft} < x \end{cases}$$

```
dy
```

dy(x, E, I) =

$$\begin{cases} \dfrac{125\ (5496\ \text{ft}^4 - x^4)}{96\ \text{E}\ \text{I}}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \le 8\ \text{ft} \\ -\dfrac{5\ (3\ x^4 + 4\ x^3\ \text{ft} + 3552\ x^2\ \text{ft}^2 - 57344\ x\ \text{ft}^3 + 212713\ \text{ft}^4)}{12\ \text{E}\ \text{I}}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \in (8\ \text{ft}, 10\ \text{ft}] \\ -\dfrac{5\ (x - 13\ \text{ft})\ (3\ x^3 + 43\ x^2\ \text{ft} - 13889\ x\ \text{ft}^2 + 122099\ \text{ft}^3)}{12\ \text{E}\ \text{I}}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ 10\ \text{ft} < x \end{cases}$$

```
m
```

m(x) =

$$\begin{cases} -\dfrac{125\ x^3}{24}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \le 8\ \text{ft} \\ -\dfrac{5\ (3\ x^3 + 3\ x^2\ \text{ft} + 1776\ x\ \text{ft}^2 - 14336\ \text{ft}^3)}{3}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \in (8\ \text{ft}, 10\ \text{ft}] \\ -\dfrac{5\ (3\ x^3 + 3\ x^2\ \text{ft} - 7224\ x\ \text{ft}^2 + 75664\ \text{ft}^3)}{3}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ 10\ \text{ft} < x \end{cases}$$

```
v
```

v(x) =

$$\begin{cases} -\dfrac{125\ x^2}{8}\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \le 8\ \text{ft} \\ -5\ (3\ x^2 + 2\ x\ \text{ft} + 592\ \text{ft}^2)\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ x \in (8\ \text{ft}, 10\ \text{ft}] \\ -5\ (x - 28\ \text{ft})\ (3\ x + 86\ \text{ft})\ \dfrac{\text{lbf}}{\text{ft}^2} & \text{if}\ \ 10\ \text{ft} < x \end{cases}$$

```
w
```

w(x) =

$$\begin{cases} -\frac{125\,x}{4}\ \frac{\text{lbf}}{\text{ft}^2} & \text{if } x \le 8\ \text{ft} \\ -10\ (3\,x + \text{ft})\ \frac{\text{lbf}}{\text{ft}^2} & \text{if } 8\ \text{ft} < x \end{cases}$$

reactions

```
Ra = r.Ra %#ok
```

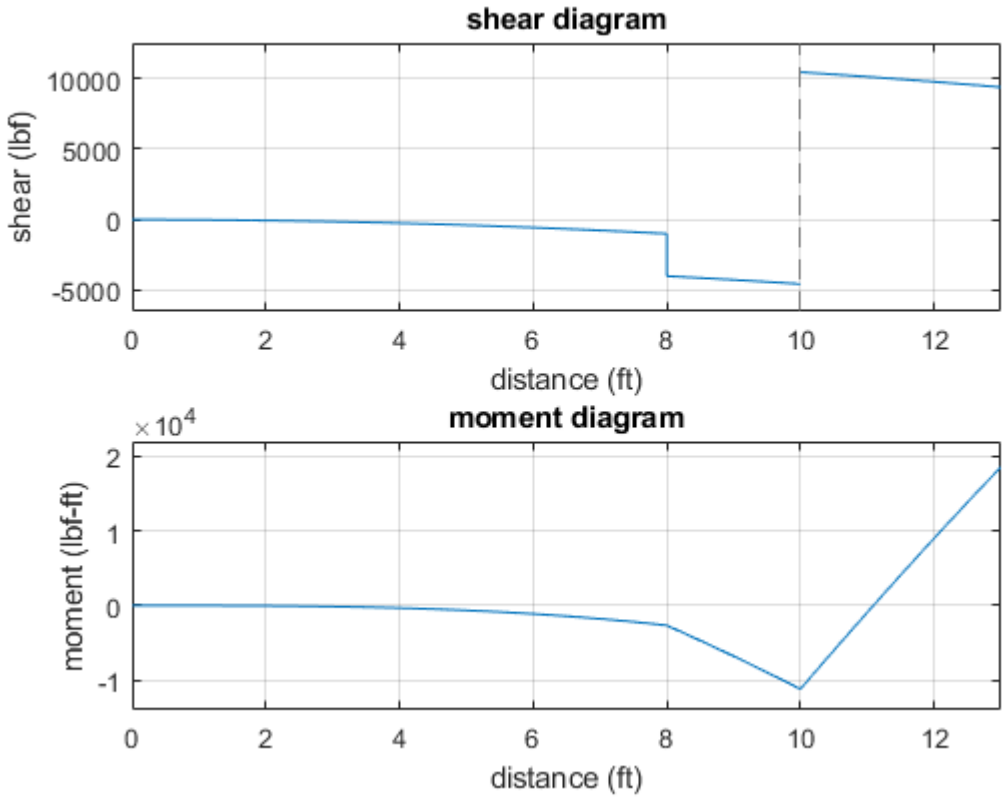
Ra = −9375 lbf

```
Ma = vpa(r.Ma, 7) %#ok
```

Ma = 18583.33 ft lbf

shear and moment diagram

```
beam.shear_moment(m, v, [0 13], {'lbf' 'ft'});
subplot(2,1,1);
axis([0 13 -6500 12500]);
subplot(2,1,2);
axis([0 13 -14000 22000]);
```



clean up

```
setassum(old_assum);
clear args old_assum Ra Ma;
```