**Problem 3 – *32 points***

The smoke stack located on the North side of Moench Hall is supported in part by a cable. The cable is attached to the stack at point A and to the roof of Moench at point D, with coordinates (0, -100, 60) ft. During a storm, a 40-mph-wind blowing from the southwest exerts a force, $\vec{F}$ = (150 $\hat{i}$ - 400 $\hat{j}$) lb, on the stack at point C (80 ft above the ground). Answer the questions below. (Neglect the weight of the smokestack.)
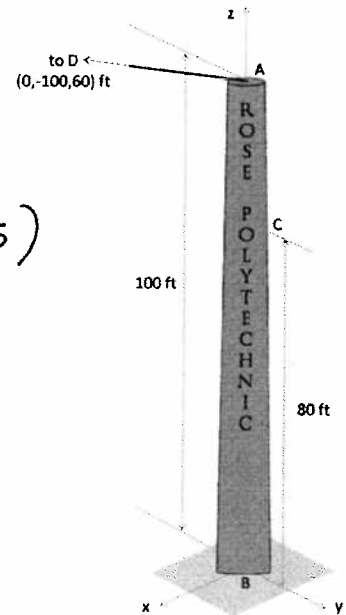
(a) Draw the free body diagram of the smoke stack during the storm. $(12 \, pts)$
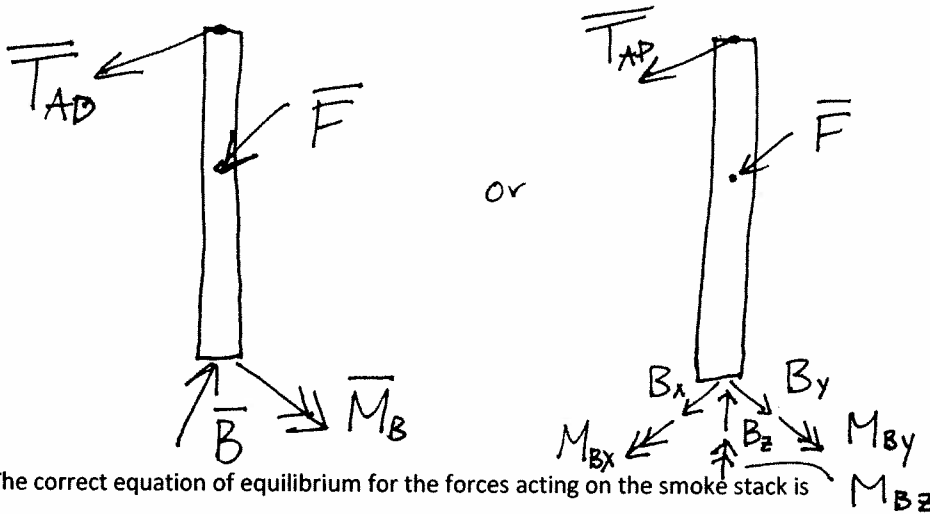
The correct equation of equilibrium for the forces acting on the smoke stack is

$$\Sigma F = \vec{T}_{AD} + \vec{B} + \vec{F} = 0.$$

(b) $\vec{T}_{AD}$ should be written as

4pts

   i. $\vec{T}_{AD} = T_{AD}(0\,\hat{i} - 0.8575\,\hat{j} + 0.5145\,\hat{k})$

   ii. $\vec{T}_{AD} = T_{AD}(0\,\hat{i} + 0.9285\,\hat{j} + 0.3714\,\hat{k})$ → -2pt for wrong signs

   iii. $\vec{T}_{AD} = T_{AD}(0\,\hat{i} - 0.7071\,\hat{j} + 0.7071\,\hat{k})$

   iv. $\vec{T}_{AD} = T_{AD}(0\,\hat{i} - 0.9285\,\hat{j} - 0.3714\,\hat{k})$

   v. $\vec{T}_{AD} = T_{AD}(0\,\hat{i} - 100\hat{j} + 60\,\hat{k})$

   vi. None of these (explain) _____

(c) $\vec{F}$ should be written as   (all or nothing)

4pts

   i. $\vec{F} = 427$ lb

   ii. $\vec{F} = 150\,\hat{i}$ lb

   iii. $\vec{F} = 150\hat{i} - 400\,\hat{j}$ lb

   iv. $\vec{F} = -400\,\hat{j}$ lb

   v.   None of these (explain) _____

The correct equation of equilibrium for the moments acting about point B at the base of the smoke stack is:

$$\sum \vec{M}_B = \vec{r}_{BA} \times \vec{T}_{AD} + \vec{r}_{BB} \times \vec{B} + \vec{r}_{BC} \times \vec{F} + \vec{M}_B = 0$$

(d) $\vec{r}_{BA}$ should be written as

i. $\vec{r}_{BA} = 0\,\hat{\imath} - 100\,\hat{\jmath} + 100\,\hat{k}$

4 pts   ii. $\vec{r}_{BA} = 0\,\hat{\imath} + 0\,\hat{\jmath} + 100\,\hat{k}$ (all or nothing)

iii. $\vec{r}_{BA} = 0\,\hat{\imath} + 0\,\hat{\jmath} + 80\,\hat{k}$

iv. $\vec{r}_{BA} = 0\,\hat{\imath} - 100\,\hat{\jmath} - 40\,\hat{k}$

v.   None of these (explain)_____

(e) $\vec{r}_{BB}$ should be written as

4 pts   i. $\vec{r}_{BB} = 0\,\hat{\imath} + 0\,\hat{\jmath} + 0\,\hat{k}$ (all or nothing)

ii. $\vec{r}_{BB} = 0\,\hat{\imath} - 100\,\hat{\jmath} - 40\,\hat{k}$

iii. $\vec{r}_{BB} = 0\,\hat{\imath} + 0\,\hat{\jmath} + 80\,\hat{k}$

iv. $\vec{r}_{BB} = 0\,\hat{\imath} - 100\,\hat{\jmath} + 100\,\hat{k}$

v.   None of these (explain)_____

(f) $\vec{r}_{BC}$ should be written as

i. $\vec{r}_{BC} = 0\,\hat{\imath} + 0\,\hat{\jmath} - 80\,\hat{k}$ → −2pt for wrong sign

ii. $\vec{r}_{BC} = 0\,\hat{\imath} + 0\,\hat{\jmath} - 20\,\hat{k}$

4 pts   iii. $\vec{r}_{BC} = 0\,\hat{\imath} + 0\,\hat{\jmath} + 80\,\hat{k}$

iv. $\vec{r}_{BC} = 0\,\hat{\imath} - 100\,\hat{\jmath} + 100\,\hat{k}$

v.   None of these (explain)_____