(EQUATION) [A-5-5]

- Let us integrate differential forces and moment from the leading edge to the trailing edge on both upper and lower surfaces:

$$N' = \int_{\mathrm{LE}}^{\mathrm{TE}} dN' = -\int_{\mathrm{LE}}^{\mathrm{TE}} [p_u \cos(\theta) + \tau_u \sin(\theta)] ds_u + \int_{\mathrm{LE}}^{\mathrm{TE}} [p_l \cos(\theta) - \tau_l \sin(\theta)] ds_l$$

$$A' = \int_{\mathrm{LE}}^{\mathrm{TE}} dA' = \int_{\mathrm{LE}}^{\mathrm{TE}} [-p_u \sin(\theta) + \tau_u \cos(\theta)] ds_u + \int_{\mathrm{LE}}^{\mathrm{TE}} [p_l \sin(\theta) + \tau_l \cos(\theta)] ds_l$$

$$M'_{\mathrm{LE}} = \int_{\mathrm{LE}}^{\mathrm{TE}} dM'_{\mathrm{LE}}$$

$$= \int_{\mathrm{LE}}^{\mathrm{TE}} \{[p_u \cos(\theta) + \tau_u \sin(\theta)]x - [p_u \sin(\theta) - \tau_u \cos(\theta)]y\} ds_u$$

$$+ \int_{\mathrm{LE}}^{\mathrm{TE}} \{[-p_l \cos(\theta) + \tau_l \sin(\theta)]x + [p_l \sin(\theta) + \tau_l \cos(\theta)]y\} ds_l$$

- Recall that the angle between the incoming freestream and the direction of the chord line is called, the **angle of attack** (AOA, or α). Using the relationship between body-attached coordinate system (normal (N)/axial (A) forces) and flow field coordinate system (lift (L)/drag (D) forces), it will result in lift and drag (per unit span), such that:

$$L' = N' \cos(\alpha) - A' \sin(\alpha)$$

$$D' = N' \sin(\alpha) + A' \cos(\alpha)$$