(EQUATION) [A-5-4]

- Let us consider, first, the upper (u) surface: i.e., the location "*A*." The normal (in **coordinate *y* direction**) and axial (in **coordinate *x* direction**) forces (per unit span) on the upper surface at a location *s* (where a differential surface area *ds* is defined) is:
  $dN'_u = -p_u ds_u \cos(\theta) - \tau_u ds_u \sin(\theta)$
  $dA'_u = -p_u ds_u \sin(\theta) + \tau_u ds_u \cos(\theta)$
- Similarly, on the lower (l) surface: i.e., the location "*B*," the normal and axial forces (per unit span) can be described as:
  $dN'_l = p_l ds_l \cos(\theta) - \tau_l ds_l \sin(\theta)$
  $dA'_l = p_l ds_l \sin(\theta) + \tau_l ds_l \cos(\theta)$
- These forces will generate the moment (per unit span) at the leading edge. Note that the pitching moment is defined as pitch-up "positive" and pitch-down "negative" as:
  $$(dM'_u)_{LE} = -dN'_u\, x + dA'_u\, y$$
  $$= -[-p_u ds_u \cos(\theta) - \tau_u ds_u \sin(\theta)]x + [-p_u ds_u \sin(\theta) + \tau_u ds_u \cos(\theta)]y$$
  $$= [p_u \cos(\theta) + \tau_u \sin(\theta)]x\, ds_u + [-p_u \sin(\theta) + \tau_u \cos(\theta)]y\, ds_u$$
  $$(dM'_l)_{LE} = -dN'_l\, x + dA'_l\, y$$
  $$= -[p_l ds_l \cos(\theta) - \tau_l ds_l \sin(\theta)]x + [p_l ds_l \sin(\theta) + \tau_l ds_l \cos(\theta)]y$$
  $$= [-p_l \cos(\theta) + \tau_l \sin(\theta)]x\, ds_l + [p_l \sin(\theta) + \tau_l \cos(\theta)]y\, ds_l$$
- Adding upper (u) and lower (l) surface contributions of differential forces and moments will result in the differential forces and the moment generated at the leading edge (per unit span), such that:
  $dN' = dN'_u + dN'_l$
  $dA' = dA'_u + dA'_l$
  $(dM')_{LE} = (dM'_u)_{LE} + (dM'_l)_{LE}$