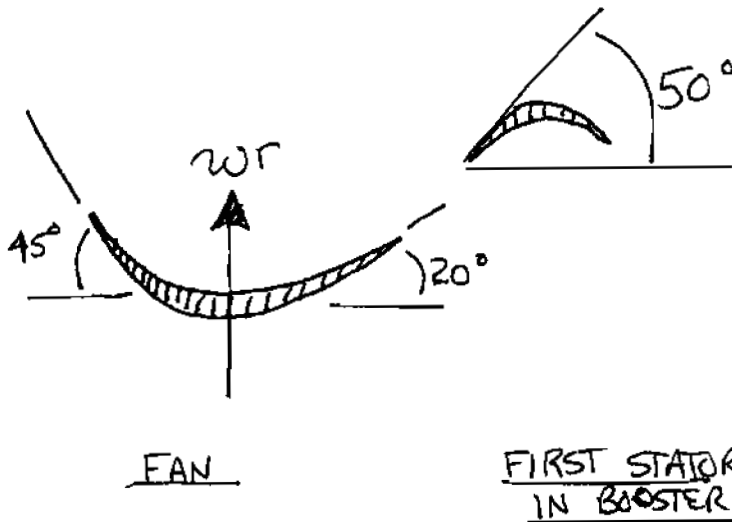


UNIFIED PROPULSION P7 SOLUTIONSWAIT-2 2006

THE MOST CONVENIENT WAY TO OBTAIN THE BLADE ANGLES IS TO SIGHT ALONG THE BLADE (THROUGH THE PLEXIGLASS).

THIS IS WHAT I CAME UP WITH:



NOTE: • THE RADIUS IS ABOUT 16" AT ENTRANCE TO THE BOOSTER

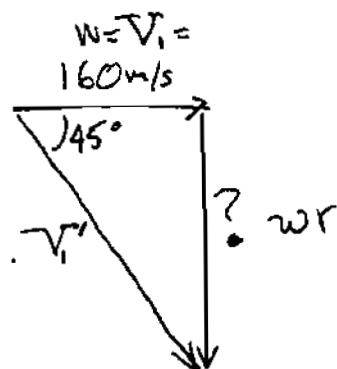
• THE TIP RADIUS IS 30"

THERE ARE TWO WAYS TO ESTIMATE THE BLADE SPEED:

- 1) FLOW SHOULD BE ROUGHLY ALIGNED WITH FAN BLADE LEADING EDGE (OR A SMALL + ANGLE OF ATTACK) — IF NOT, FLOW WILL SEPARATE
- 2) FLOW WILL LEAVE FAN TRAILING EDGE AT METAL ANGLE AND MUST ROUGHLY LINE UP WITH STATOR BLADE LEADING EDGE ANGLE (OR A SMALL + ANGLE OF ATTACK)

FOR ESTIMATE 1):

AXIAL VELOCITY $\rightarrow M = 0.5 \approx 160 \text{ m/s}$

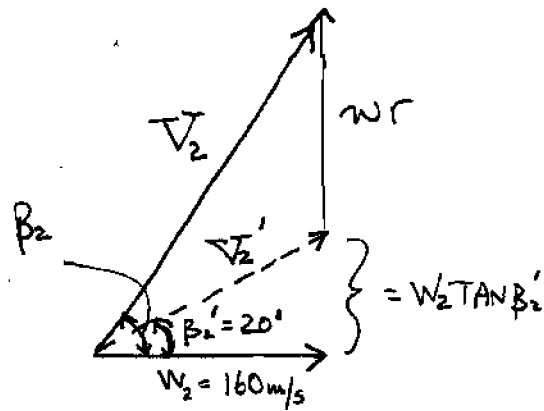


SO WHAT w_r WILL GIVE ROUGHLY A 45° FLOW ANGLE INTO THE FAN?

$$\underline{w_r = 160 \tan 45^\circ = 160 \text{ m/s}}$$

FOR ESTIMATE 2):

WHAT ωr
GIVES A β_2 OF
ABOUT 50° ?



$$\frac{\omega r + 160 \tan 20^\circ}{V_2} = \tan \beta_2$$

$$160 \tan 50^\circ - 160 \tan 20^\circ = \omega r = 132 \text{ m/s}$$

SINCE $r \approx 0.4 \text{ m}$ THEN $\omega \approx 394 \text{ rad/s}$ (ESTIMATE 1)

$\omega \approx 325 \text{ rad/s}$ (ESTIMATE 2)

$\omega \text{ rad/s} \rightarrow$ CONVERT TO RPM

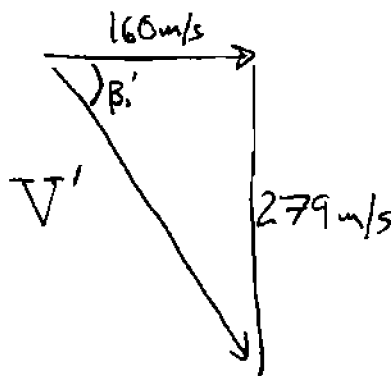
$$394 \frac{\text{rad}}{\text{s}} \cdot \frac{60 \text{ s}}{\text{min}} \cdot \frac{\text{rev}}{2\pi \text{ rad}} = 3760 \text{ RPM}$$

$$325 \frac{\text{rad}}{\text{s}} \cdot \frac{60 \text{ s}}{\text{min}} \cdot \frac{\text{rev}}{2\pi \text{ rad}} = 3100 \text{ RPM}$$

b) IF WE TAKE IT AS 3500 RPM, $\omega = 366.5 \text{ rad/s}$

TIP RADIUS = 0.76 m SO TIP SPEED IS 279 m/s

(NOTE, THIS IS
WHY THE BLADES
ARE TWISTED,
SINCE β'
CHANGES WITH
RADIUS)



$$V' = \sqrt{160^2 + 279^2}$$

$$= 322 \text{ m/s}$$

ABOUT $M \approx 1$
RELATIVE TO THE
FAN