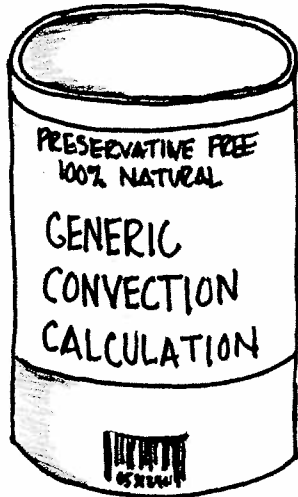


HOW TO PERFORM A

III - Natural Convection



1. BECOME AWARE of THE GEOMETRY.
2. SPECIFY THE APPROPRIATE REFERENCE TEMPERATURE & FIND THE PROPERTIES

USUALLY THE FILM TEMPERATURE

$$T_f = \frac{T_s + T_\infty}{2}$$



3. CALCULATE THE GRASHOF &/OR RAYLEIGH NUMBER(S)

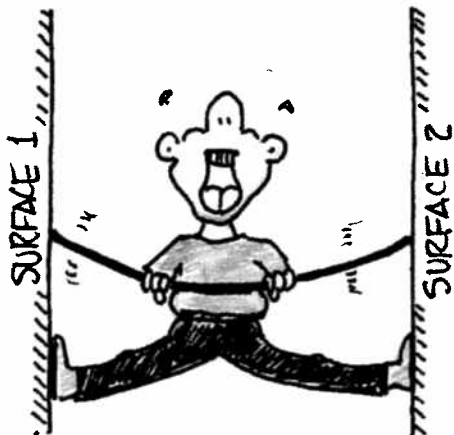
$$Gr \equiv \frac{g\beta(T_s - T_\infty)\delta^3}{\nu^2} \quad Ra \equiv Gr * Pr$$

4. SELECT THE APPROPRIATE NUSSELT CORRELATION.



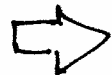
ASSUMED B.C. ON MOST CORRELATIONS IS $T_s = \text{CONST.}$

What to do if $q = \text{constant}$?



ENCLOSURES

DO ABOVE 4 STEPS W/
THESE CHANGES



2E. USE $T_{AV} = \frac{T_{s,1} + T_{s,2}}{2}$

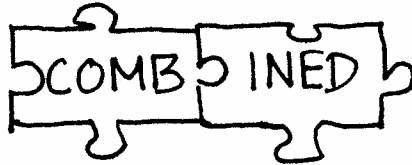
3E. USE $(T_{s,1} - T_{s,2})$ TO FIND Gr &/OR Ra .

... THEN...

5E. FIND $k_{EFF} = k_{FLUID} Nu$ & THEN TREAT THE ENCLOSED SPACE AS A SOLID SUBJECT TO S-S, 1-D CONDUCTION (w/ $k_{SOLID} = k_{EFF}$)



COMBINE ONE PART FORCED CONVECTION WITH ONE PART NATURAL CONVECTION...



FORCED & NATURAL CONVECTION

IF

THEN

$$\frac{Gr}{Re^2} < 0.1$$

ONLY FORCED CONVECTION IS IMPORTANT

$$\frac{Gr}{Re^2} > 10$$

ONLY NATURAL CONVECTION IS IMPORTANT

$$0.1 < \frac{Gr}{Re^2} < 10$$

BOTH ARE IMPORTANT AND YOU NEED \rightarrow

$$Nu_{COMBINED} = (Nu_{FC}^n \pm Nu_{NC}^n)^{1/n}$$

FORCED ONLY

+ IF NC "HELPS"
- IF NC "HURTS"

NATURAL ONLY