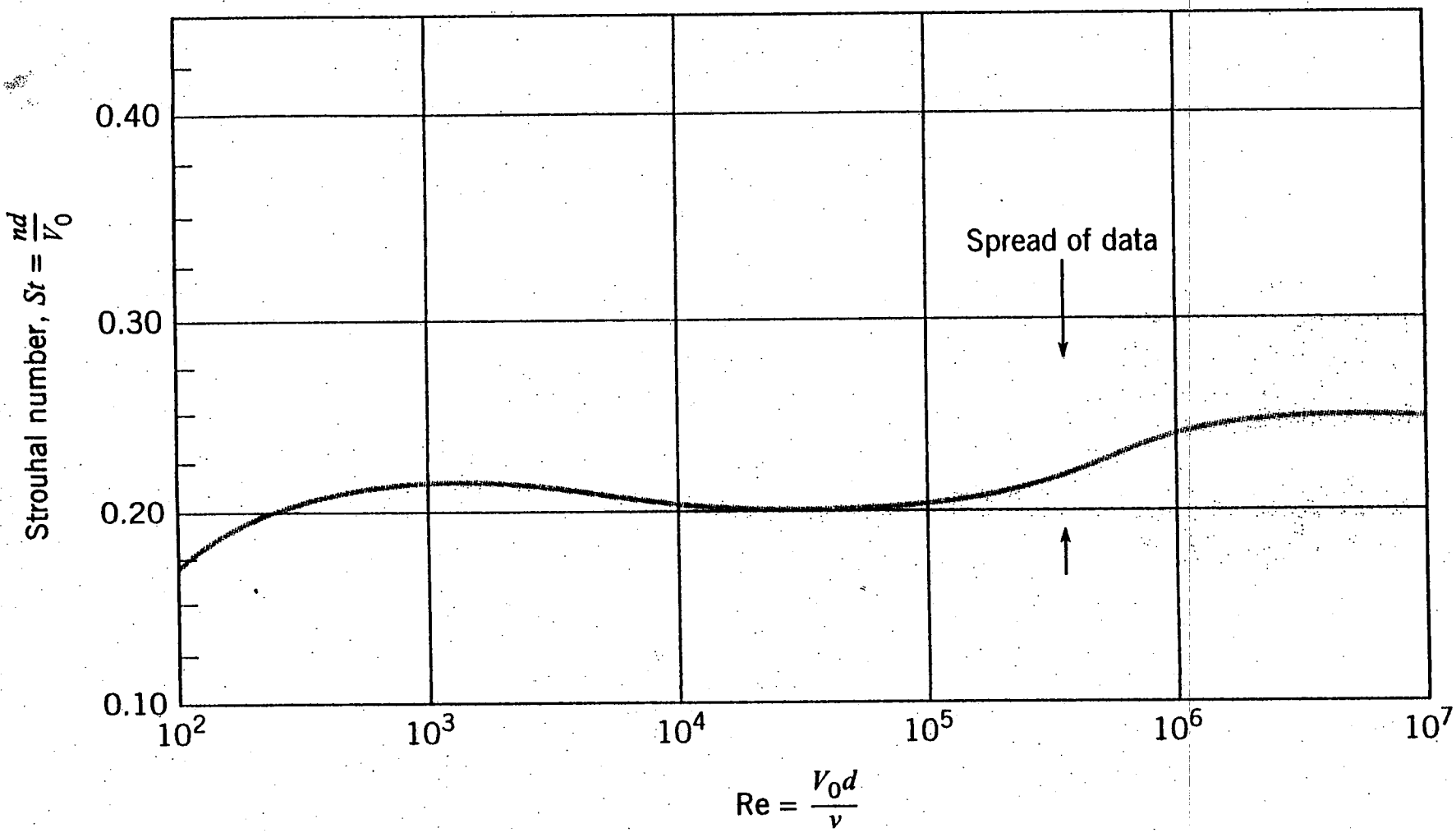
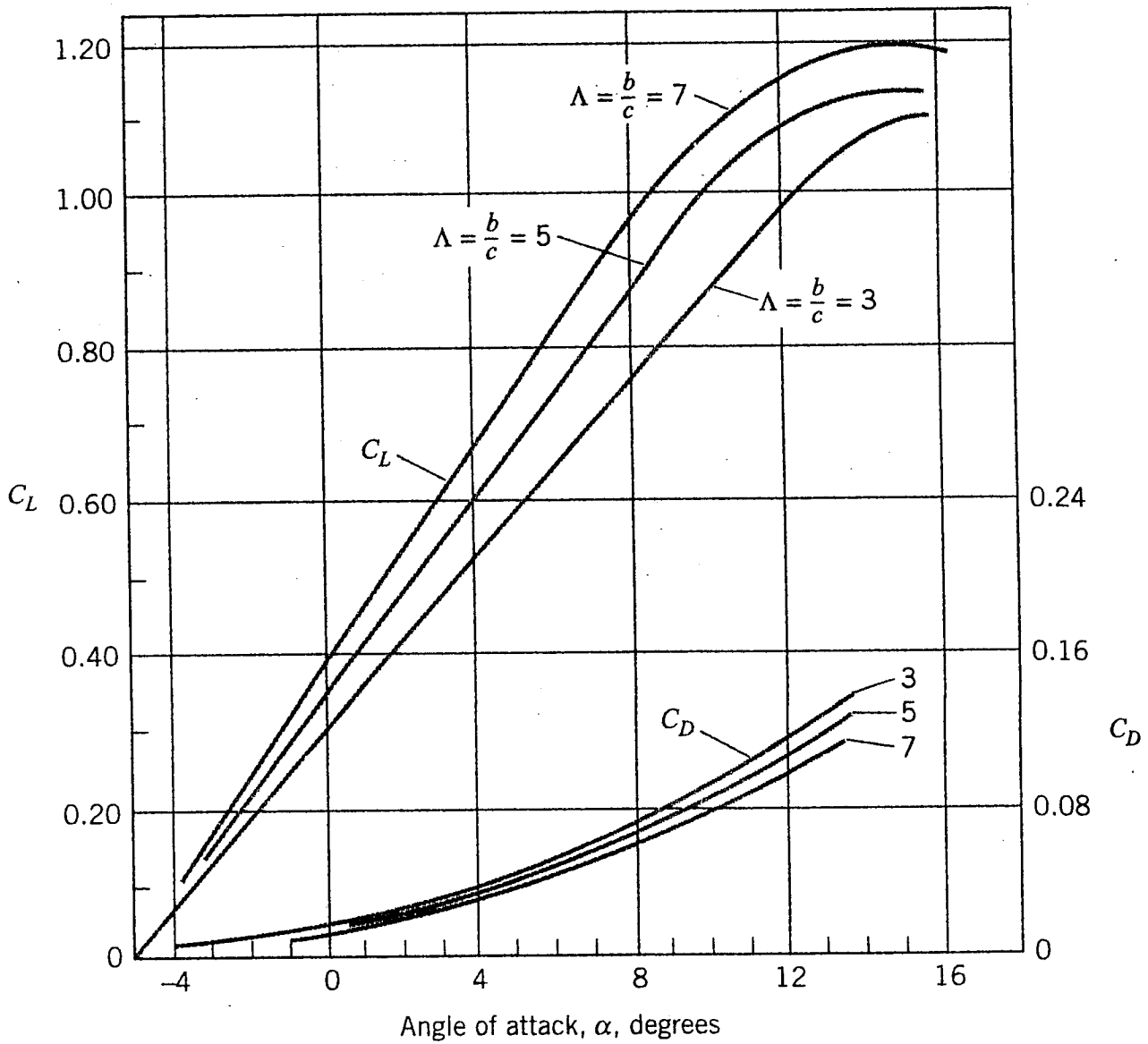
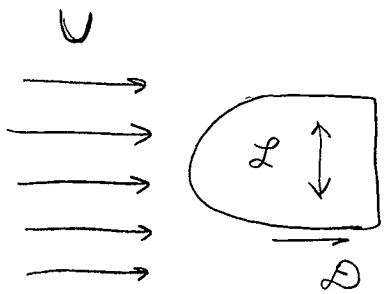

0.40
0.30
0.20
0.10
Strouhal number, $St = \frac{nd}{V_0}$
Spread of data
10^2
10^3
10^4
10^5
10^6
10^7
$\mathrm{Re} = \frac{V_0 d}{\nu}$

FIGURE 11.23

Coefficients of lift and drag for three wings with aspect ratios of 3, 5, and 7. [After Prandtl (25)]

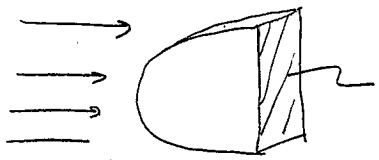


I. DEFINED



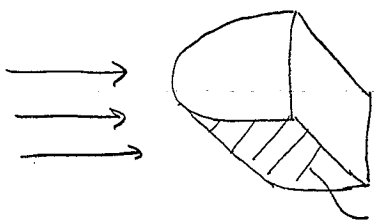
A. DRAG

1. in same direction as flow
2. composed of pressure and friction
3. $\mathcal{D} = \frac{1}{2}\rho C_D A U^2$
   a. C_D from charts, tables
   b. A is the PROJECTED area the flow 'hits'



B. LIFT

1. $\perp$ to flow (not necessarily object)
2. composed of pressure and friction
3. $\mathcal{L} = \frac{1}{2}\rho C_L A U^2$
   a. C_L from charts, tables
   b. A is that area over which $\mathcal{L}$ acts



II. SOLVING PROBLEMS

A. DETERMINE

1. fluid properties (ρ, ν, maybe μ)
2. geometry (for calculation of A)
3. C_D or C_L

a. determine correct chart

1. calculate X-axis (e.g. $\mathbb{R}e$)

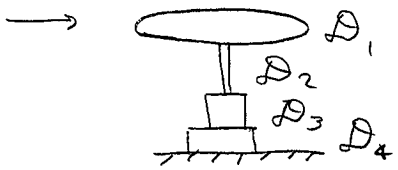
2. read C_D or C_L

b. determine correct table

c. DOCUMENT SOURCE!

B. SOLVE PROBLEM

1. YOU CAN ADD SEPARATE SHAPES



C. TERMINAL VELOCITY

1. DRAW F.B.D.

2. FORMULATE $\Sigma F_{vertical} = 0$

3. USUALLY ITERATIVE IF

a. $C_D = \phi(\mathbb{R}e) \Rightarrow C_D = \phi(V)$
V unknown

b. guess a C_D

repeat

c. find V from ... Σ eqn

d. find $\mathbb{R}e$

e. with $\mathbb{R}e$, find new C_D

III. ALTERNATING SHEDDING VORTICES (A.S.V.)

A. WE CAN CALCULATE FREQUENCY OF SHEDDING

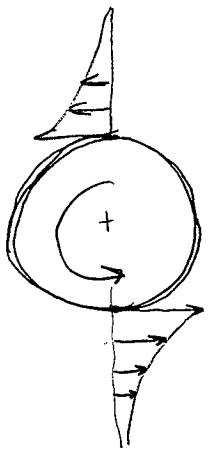
1. use $St = \phi(\mathbb{R}e)$

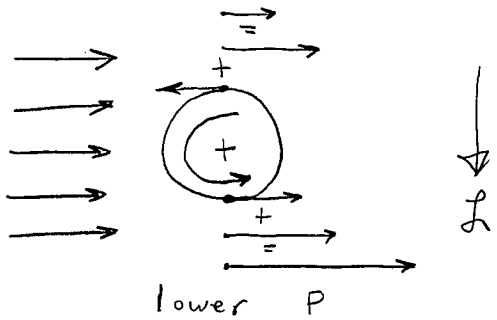
2. solve for n

B. WE CANNOT FIND L DUE TO A.S.V.

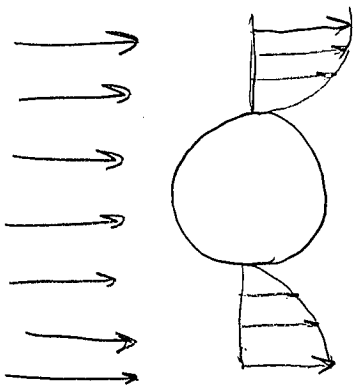
IV. LIFT DUE TO SPIN

A. FLOW FIELD DUE TO SPIN ONLY





B. FLOW FIELD DUE TO APPROACH FLOW ONLY



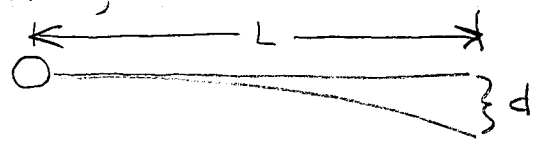
SUM OF 2 SHOWN ABOVE - SHOWS → V IN FLUID AROUND BODY

C. PRODUCES LATERAL FORCE, $\mathcal{L}$ (LIFT)

D. DETERMING DEFLECTION DISTANCE, d

1. determine flight time, t

$t = L/V$



2. determine $\mathcal{L}$

3. determine lateral acceleration, $a_L = \frac{\mathcal{L}}{m}$

4. determine $d = \frac{1}{2} a_L t^2$