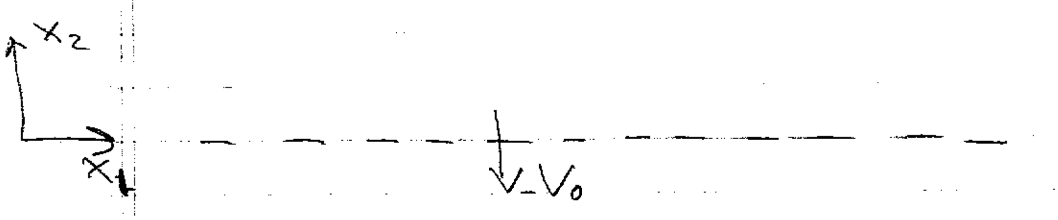
$\longrightarrow U_0$

<u>NS-Example</u> Eric, Here is example I did



Viscous flow over flat plate w/suction

Problem statement:

$u_1(x_2=0)=0 \qquad u_1(x_2=\infty)=U_0$

$u_2(x_2=0)=-V_0$

$p=$ const

fully developed (infinite in x_1)

incomp, steady

equations

(A) mass $\cancel{\frac{\partial u_1}{\partial x_1}}^{\,0 \text{ fully developed}} + \frac{\partial u_2}{\partial x_2} = 0$

(B) x-mom $\cancel{\frac{\partial u_1}{\partial t}}^{\,0 \text{ steady}} + \cancel{u_1 \frac{\partial u_1}{\partial x_1}}^{\,0 \text{ fully developed}} + u_2 \frac{\partial u_2}{\partial x_2} = \cancel{-\frac{1}{\rho}\frac{\partial p}{\partial x_1}}^{\,0 \text{ pressure grad}} + \nu \frac{\partial^2 u_1}{\partial x_2^2} + \cancel{\nu \frac{\partial^2 u_1}{\partial x_1^2}}^{\,0, \text{ fully dev}}$

(A) $\Rightarrow u_2 = C$ evaluate at $x_2=0$ gives $u_2=-V_0$ everyw

Then (B) is $-V_0 \frac{\partial u_1}{\partial x_2} = \nu \frac{d^2 u_1}{d x_2}$

integ $\Rightarrow \frac{d u_1}{d x_2} + \frac{\nu}{V_0} u_1 = C$

1st order inhomog equation:

particular solution, $u_1 = \frac{C V_0}{\nu}$

homogeneous solution:

$$u_1 = Be^{-\frac{\nu}{V_0} x_2}$$

So general solution is

$$u_1 = Be^{-\frac{\nu}{V_0} x_2} + C$$

$u_1(x_2 = \infty) = U_0 \Rightarrow C = U_0$

$u_1(x_2 = 0) = 0 \Rightarrow B = -U_0$

so $u_1 = U_0\left(1 - e^{-\nu/V_0 \, x_2}\right)$

interesting to look at cases $\nu = 0$

$V_0 = 0$

$V_0 = \infty$

$\nu = \infty$