Prof. A.W. Date
Lec-15

$$\frac{d}{dx}\left(\delta_2^2 U_e^{5.17}\right) = \delta_2^2 \cdot 5.17 \cdot U_e^{4.17}\frac{dU_e}{dx} + U_e^{5.17}\cdot\frac{d\delta_2^2}{dx}$$

$$\frac{1}{\nu U_e^{4.17}} = 5.17\cdot\frac{\delta_2^2}{\nu}\frac{dU_e}{dx} + \frac{U_e^2}{\nu}\cdot\frac{d\delta_2^2}{dx} = 0.44$$

$$K(x) = \frac{\delta_2^2}{\nu}\frac{dU_e}{dx}$$

$$U_\infty = c x^m$$

$$K = \frac{\delta_2^2}{\nu}\frac{dU_\infty}{dx}$$

$$= \frac{\delta_2^2}{\nu} c m x^{m-1}$$

$$= [c x^m] \cdot \frac{\delta_2^2}{x} \cdot \frac{m}{\nu} \cdot$$

$$= \frac{U_\infty}{\nu} \cdot \frac{\delta_2^2}{x} \cdot m \cdot$$

$$= \frac{U_\infty x}{\nu} \cdot \left(\frac{\delta_2}{x}\right)^2 \cdot m$$

$$= \left(\frac{\delta_2}{x}\right)^2 \cdot R_x \cdot m$$

$$= {\delta_2^*}^2 (m)\, m$$

$$\delta_2^* = \frac{\delta_2}{x} R$$

$$F(K) = \frac{U_\infty}{2} \frac{d(\delta_2^*)^2}{dx} = 0$$

$$= (1+m)\,\delta_2^{*2}(m)$$

$$S = \frac{\delta_2}{\delta_4} = \frac{\delta_2}{\mu U_\infty / \tau_{wx}}$$

$$= \frac{\delta_2 \tau_{wx}}{\mu U_\infty}$$

$$= \delta_2 \frac{K \cdot \partial U / \partial x|_0}{\mu U_\infty}$$

$$= \frac{\delta_2}{2} \cdot Re^{1/2}$$

$$\frac{u_0}{\nu}\delta_2\frac{d\delta_2}{dx} + \frac{u_0\delta_2}{\nu}\cdot\frac{1}{u_0}\frac{du_0}{dx}\cdot\delta_2\left[2+\frac{\delta_1}{\delta_2}\right]$$

$$= \frac{\tau_w}{\rho u_0^2}\cdot\frac{u_0\delta_2}{\nu}\left(2+\frac{\delta_1}{\delta_2}\right) + \frac{v_w}{u_0}\cdot\frac{u_0\delta_2}{\nu}$$

$$\frac{u_0}{2\nu}\cdot\frac{d\delta_2^2}{dx} + \frac{\delta_2^2}{\nu}\frac{du_0}{dx} = \frac{\delta_2}{\delta_4} + \frac{v_w\delta_2}{\nu}$$

$$\frac{u_0}{\nu}\frac{d\delta_2^2}{dx} = 2\left[\frac{v_w\delta_2}{\nu} + \frac{\delta_2}{\delta_4} - \frac{\delta_2^2}{\nu}\frac{du_0}{dx}\left(2+\frac{\delta_1}{\delta_2}\right)\right]$$

$$\lambda = \frac{\delta^2}{\nu}\frac{du}{dx}$$

$$K = \lambda\left(\frac{\delta_2}{\delta}\right)^2$$

$$\delta_4 = \frac{\mu U_\infty}{\tau_{wx}} = \frac{\mu U_\infty}{\mu \frac{\partial u}{\partial y}\Big|_{y=0}}$$

$$\frac{\partial u}{\partial y}\Big|_{y=0} = U_\infty \left[\frac{\delta}{\delta+Vw^*}\right]\left[\frac{2}{\delta} + V_w'' x_0 + \frac{\lambda}{\delta}\cdot\frac{1}{\delta}\right]$$

$$= \frac{U_\infty}{\delta}\left[\frac{\delta}{\delta+Vw^*}\right]\left[2+\frac{\lambda}{\delta}\right]$$

$$\delta_4 = \frac{U_\infty}{\frac{U_\infty}{\delta}\left[\frac{\delta}{\delta+Vw^*}\right]\left(2+\frac{\lambda}{\delta}\right]}$$

$$\frac{\delta_4}{\delta} = \frac{\delta+Vw^*}{\lambda+12}$$

$\lambda = -12$ represents separation

$$u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = u_\infty \frac{du_\infty}{dx} + \nu\frac{\partial^2 u}{\partial y^2}$$

at $y = 0$

$$v_w \frac{\partial u}{\partial y}\Big|_{y=0} = u_\infty \frac{du_\infty}{dx} + \nu \frac{\partial^2 u}{\partial y^2}\Big|_{y=}$$

$$\nu \frac{\partial^2 u}{\partial y^2}\Big|_{y=0} = v_w \frac{\partial u}{\partial y}\Big|_{y=0} - u_\infty \frac{du_\infty}{dx}$$