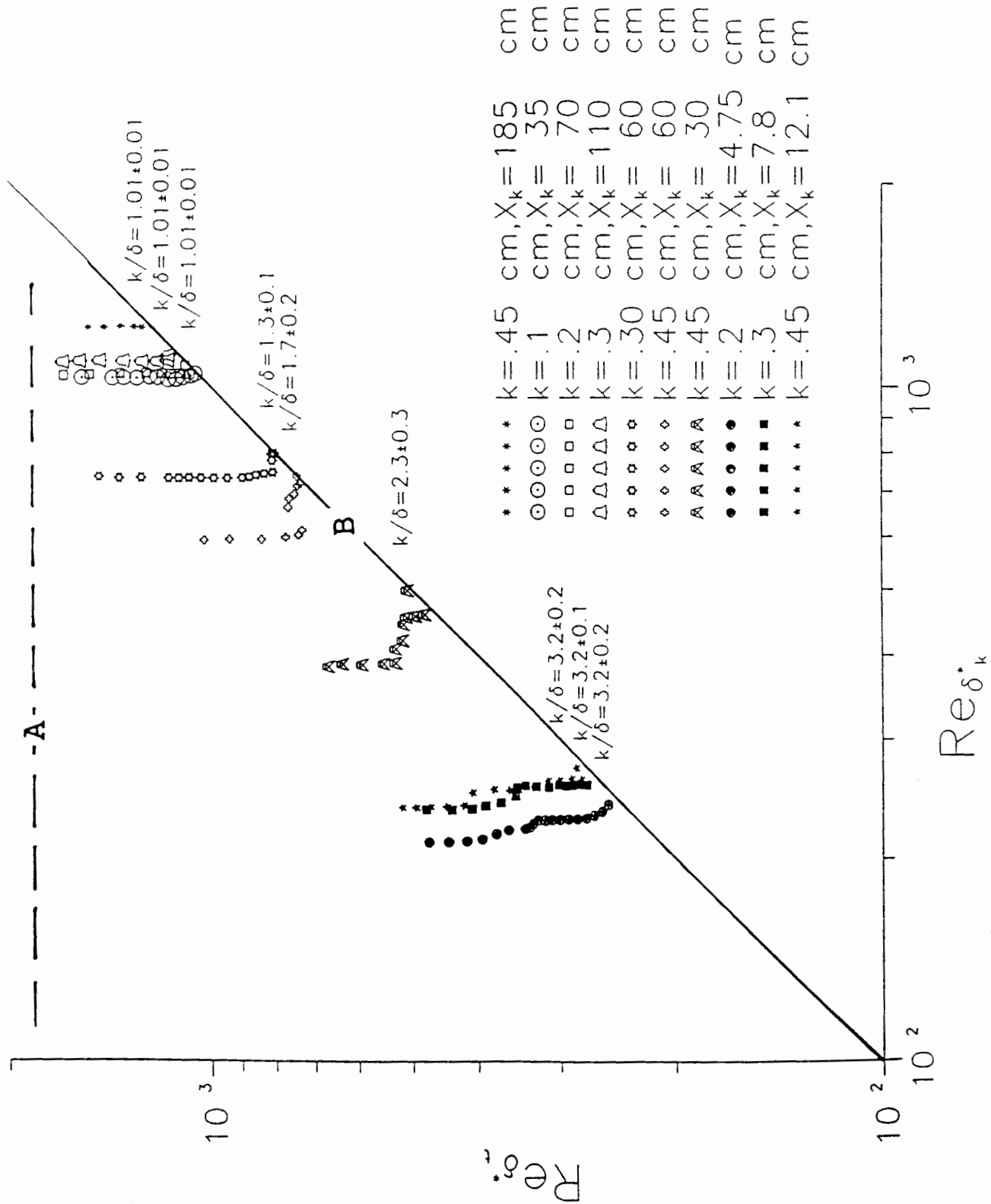


Initiation of Turbulent Spots in a Laminar Boundary Layer by Rigid Falling Particulates

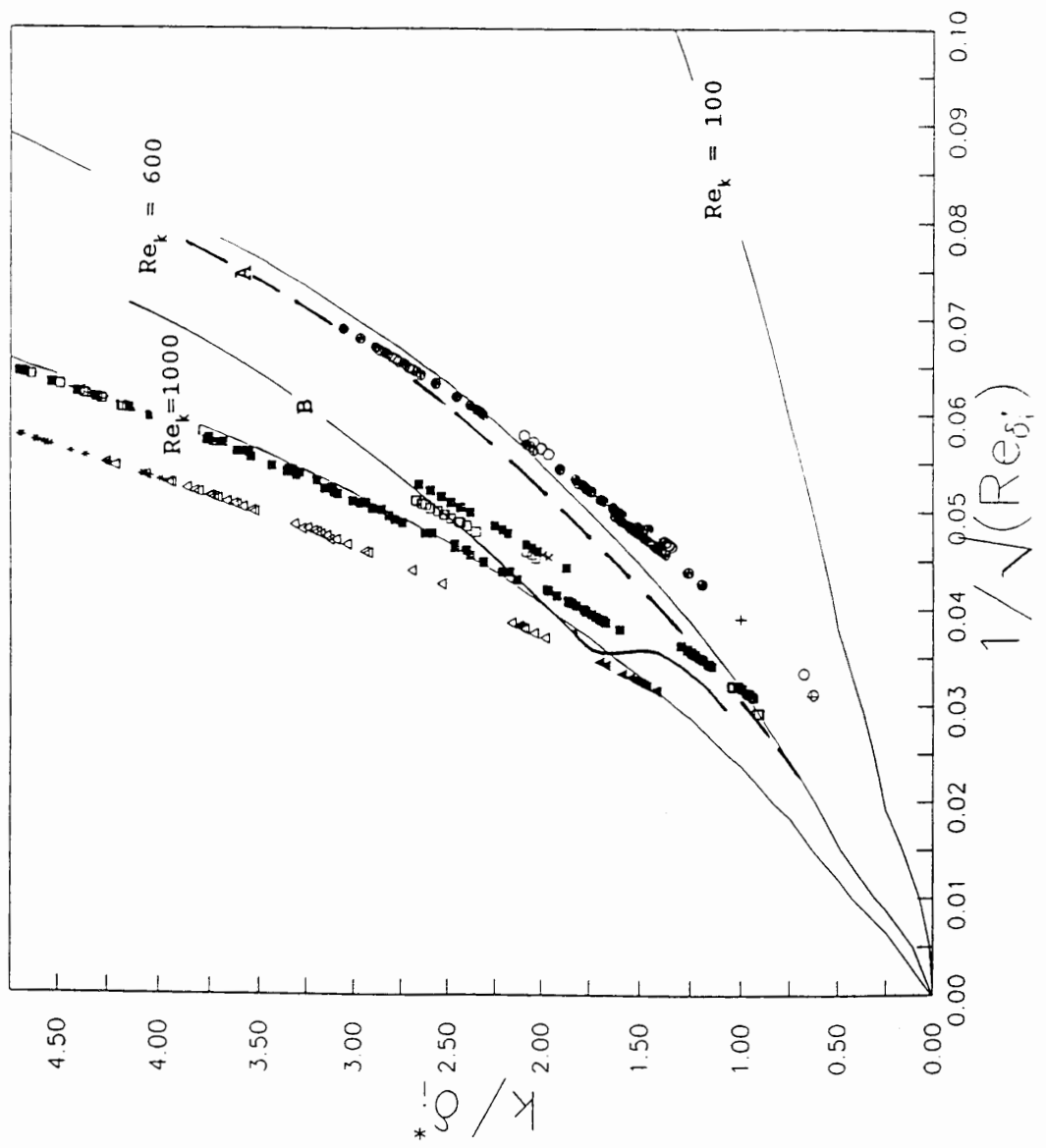
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A transitional laminar boundary layer is developed on a 1m wide 5m long flat plate in a 0.6m deep water channel with a freestream velocity of 15-50cm/s. A particulate dispenser under computer control ejects individual particles having diameters of $\frac{1}{8}\delta$ into the free stream. The particulates are introduced with an initial velocity of U_∞ in the direction of the free stream. They have differing specific gravities of 1.03-2.7 which introduces an additional non-dimensional parameter relating the time taken to traverse the boundary layer to the convective time scale. The particulates produce a wake in the upper region of the boundary layer as they sink towards the wall. Visualization data taken over the range $5 \cdot 10^4 < Re_x < 5 \cdot 10^5$ indicate that turbulent spots are produced by the disturbances due to the wake rather than by the particulates themselves. This suggests that the spot formation process in this case may be inviscid in nature and may not be strongly influenced by the presence of the wall.

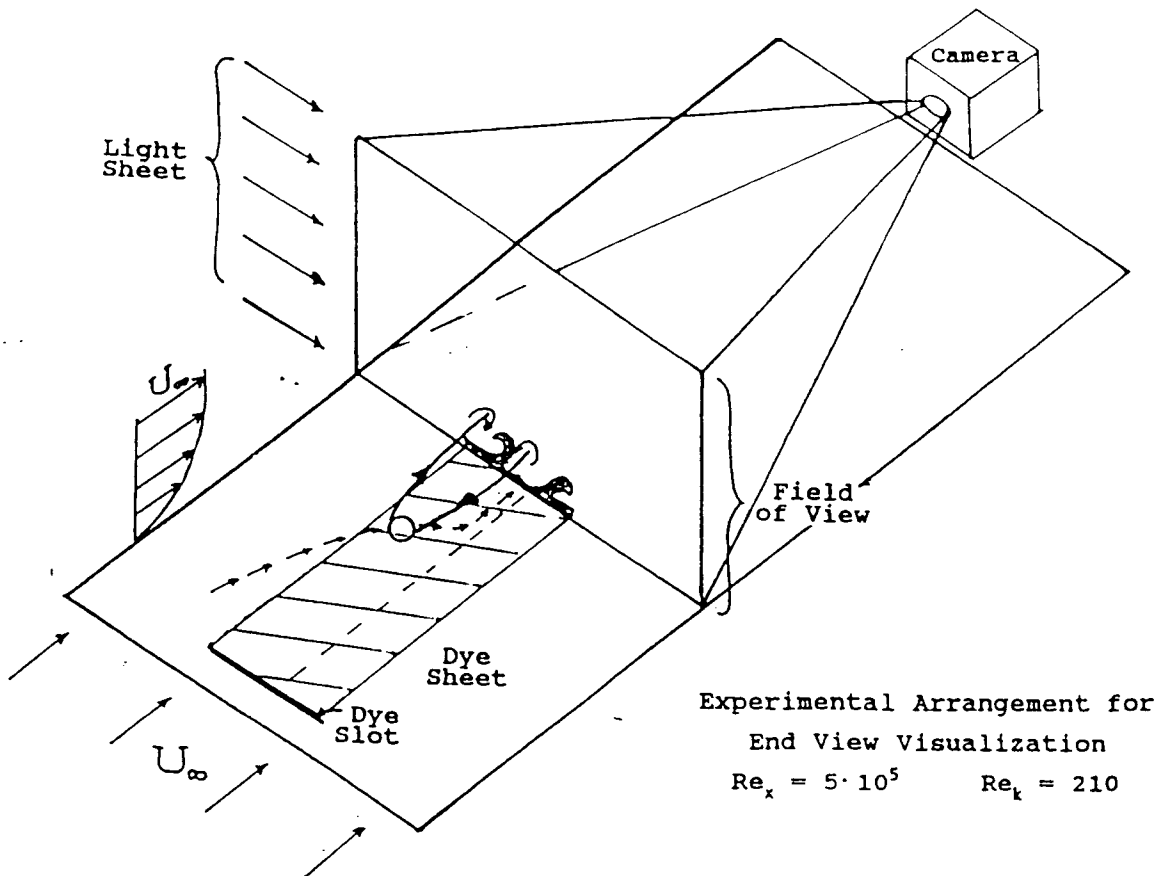
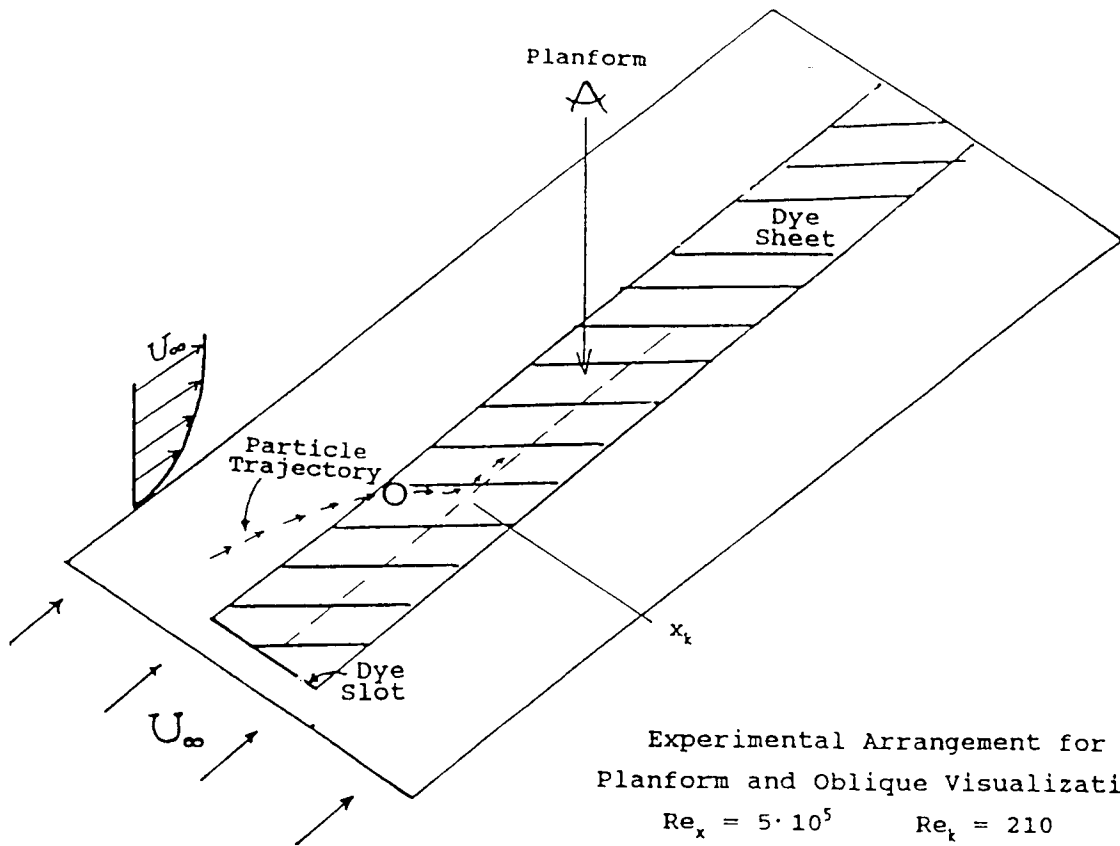
TRANSITION LOCATIONS FOR A FIXED SPHERE

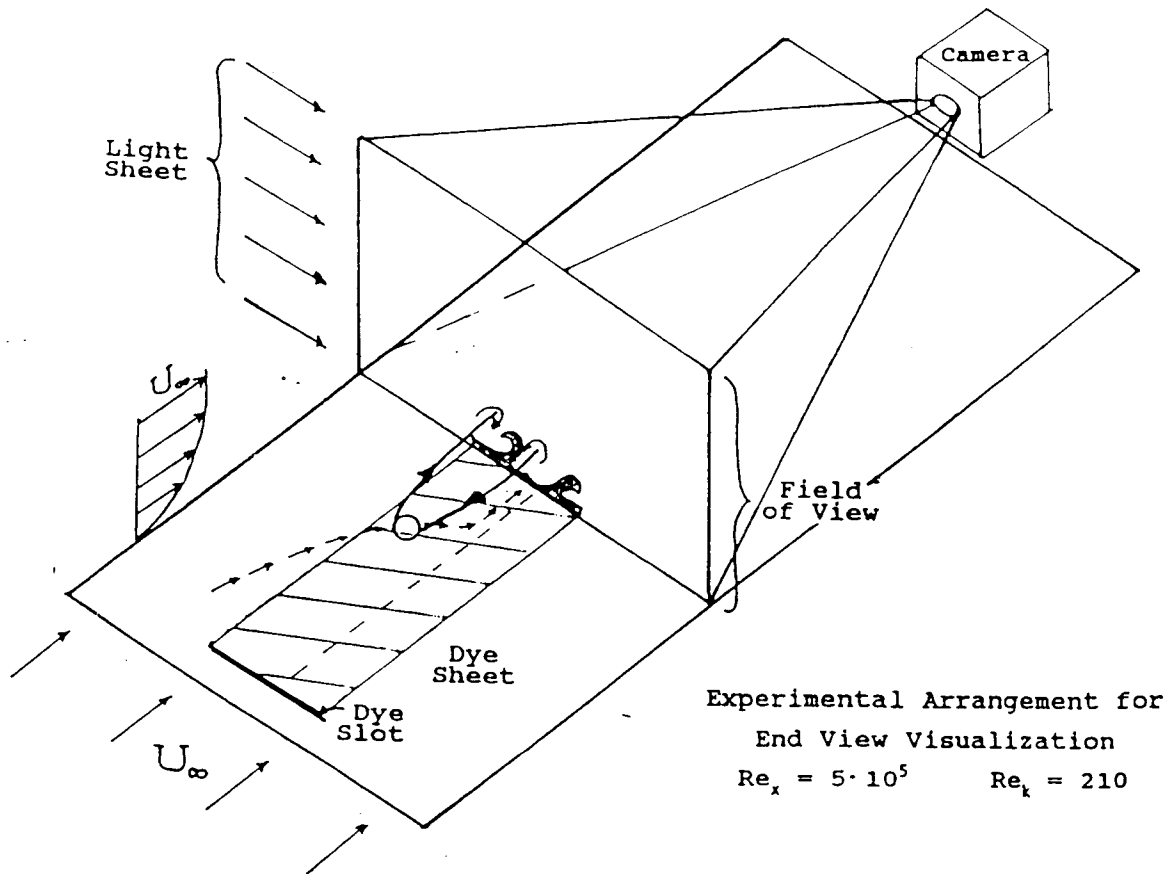
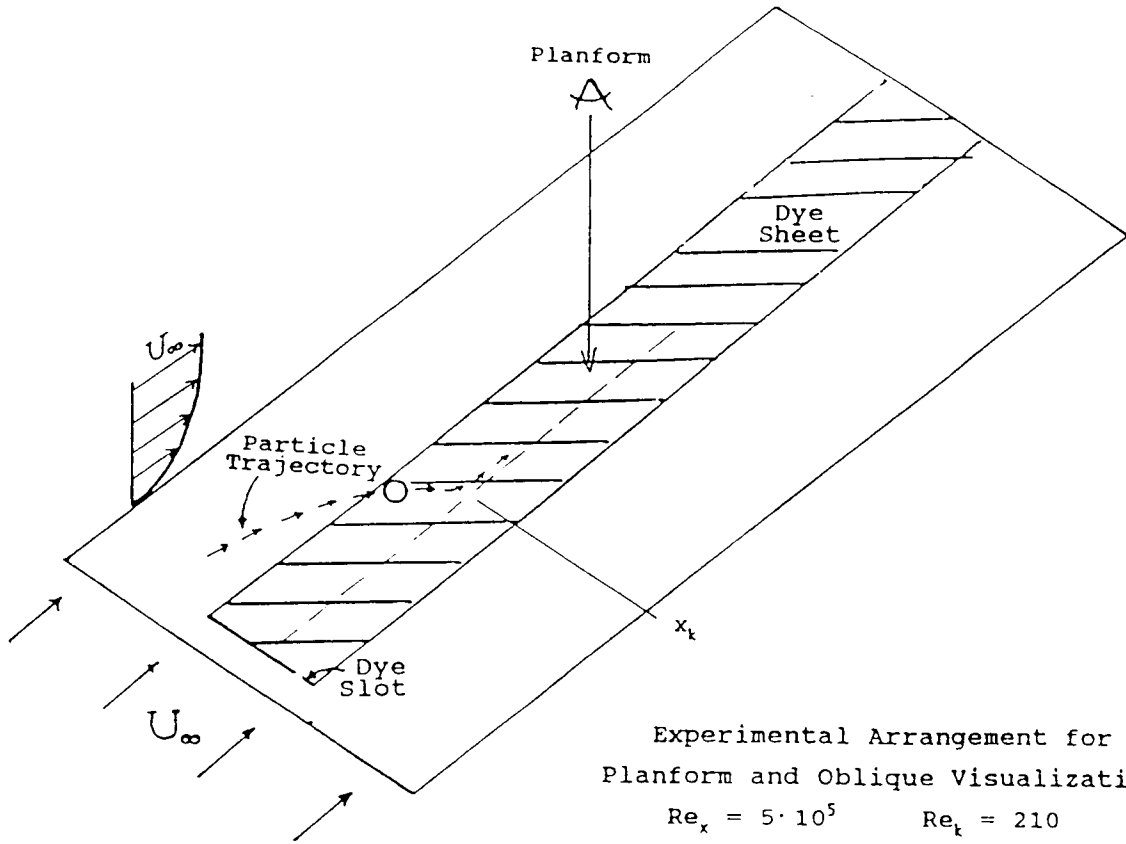


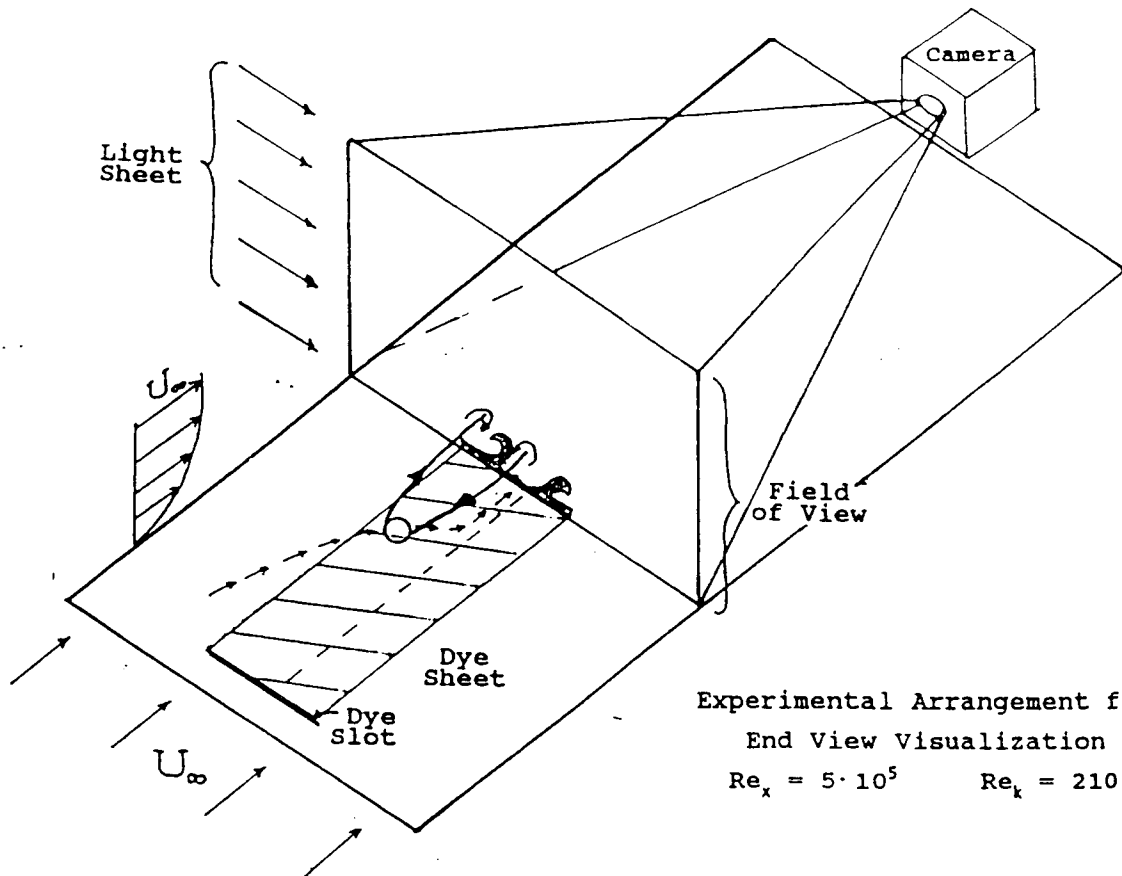
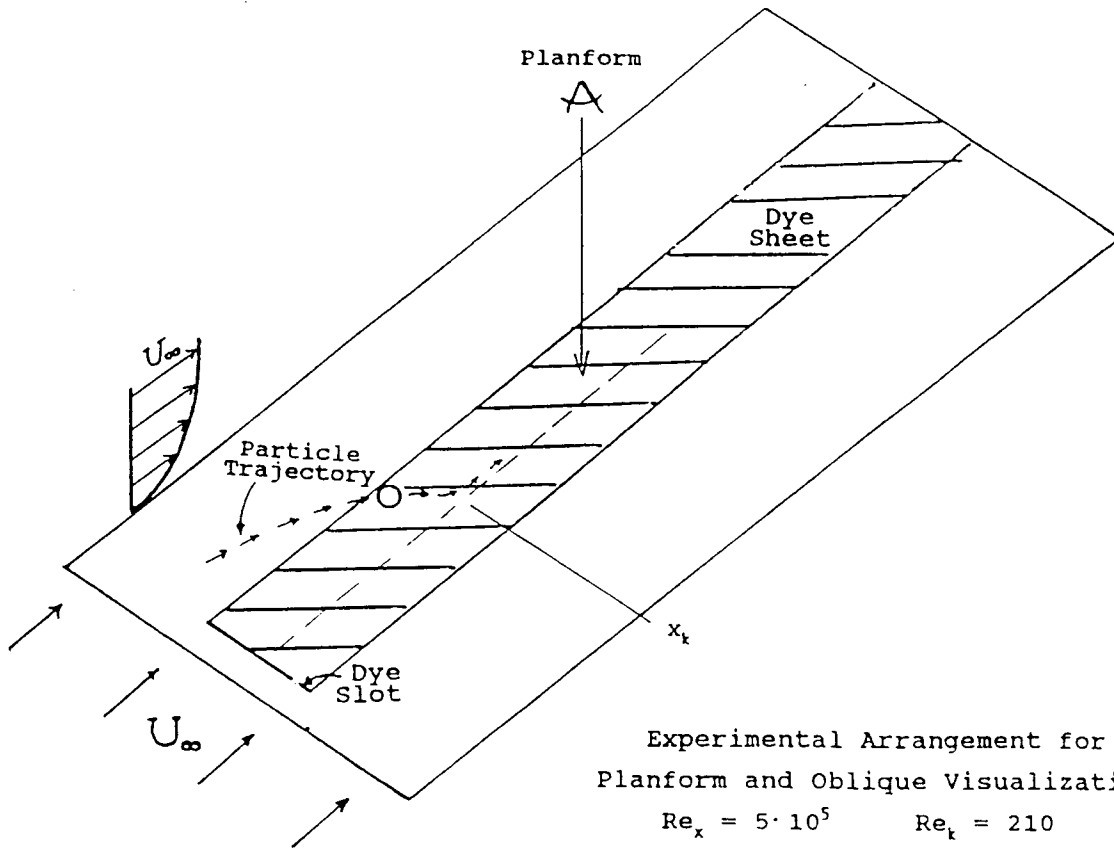
TRANSITION LOCATIONS FOR FALLING SPHERES



○	$U_\infty = 20$	cm/s	ACETATE
□	$U_\infty = 30$	cm/s	ACETATE
△	$U_\infty = 40$	cm/s	ACETATE
+	$U_\infty = 20$	cm/s	GLASS
x	$U_\infty = 30$	cm/s	GLASS
*	$U_\infty = 40$	cm/s	GLASS
⊙	$U_\infty = 20$	cm/s	POLY
⊠	$U_\infty = 30$	cm/s	POLY
▲	$U_\infty = 40$	cm/s	POLY







CONCLUSIONS

- Transition with a fixed particle with $k \leq \delta^*$ is characterized by Re_k alone.
- Moving particulates produce additional unsteady vortical disturbances which are not correlated by Re_k .
- Transition may be induced by the particle's wake and not by the particulate directly.

- The parameter

$$\frac{\tau_H}{t_\delta} = \frac{(\gamma-1)(\gamma+\frac{1}{2}) \cdot g \cdot d^4}{18^2 \cdot \nu^2 \cdot \delta} = (\gamma+\frac{1}{2}) \frac{d}{\delta} Re_d$$

appears to govern the disturbance strength and transition.