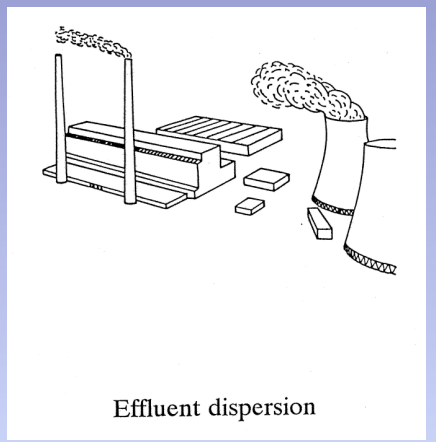
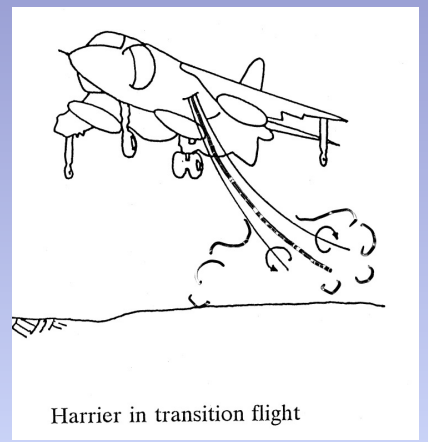
VORTICITY AND CIRCULATION WITHIN TWIN JETS ISSUING INTO A CROSSFLOW

Background

Jets issuing into a crossflow have numerous engineering applications. Such flows are dominated by a contra-rotating vortex pair, but what is their strength and decay mechanism?



Effluent dispersion

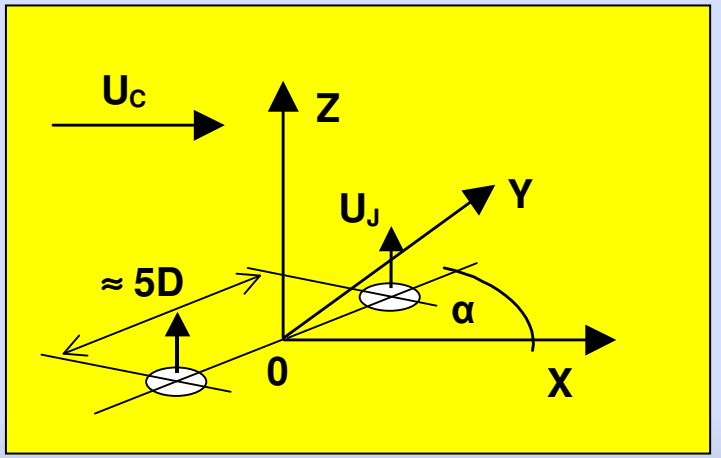


Harrier in transition flight

Two very different examples of a jet in a crossflow

Objective

To investigate role of turbulent vorticity transport between the vortices in the circulation decay in the downstream direction. To assess different methods for reliably defining this circulation.



Twin jet arrangement and coordinate system (α = stagger angle = 0^0, 45^o and 90^o, Jet ratio $R = U_J / U_C = 8$)

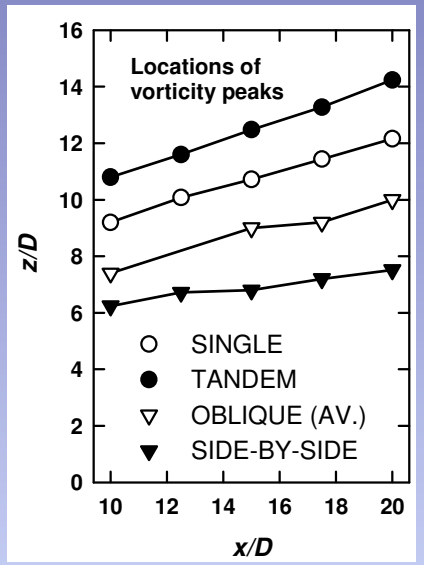
Research Carried Out

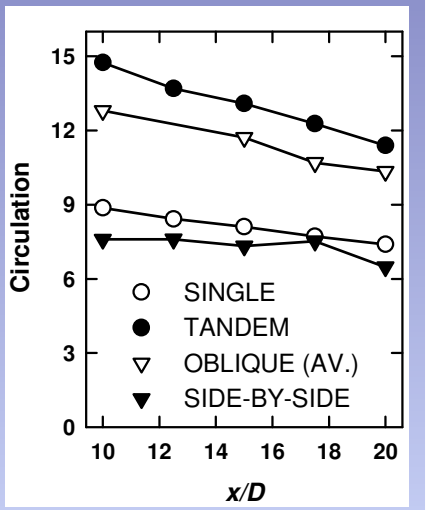
A wind tunnel study was carried out using twin jets with a single nozzle spacing of 5D. Mean velocity and turbulence data were acquired using crossed hot-wire anemometry.

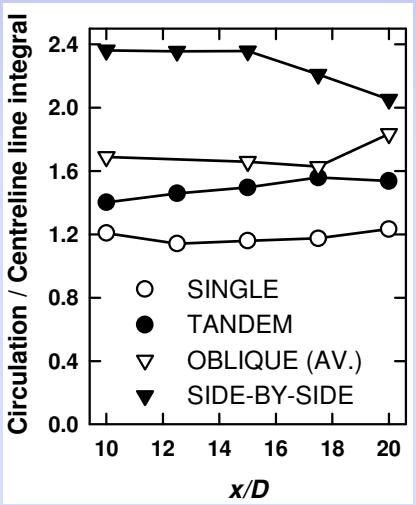
Key Findings

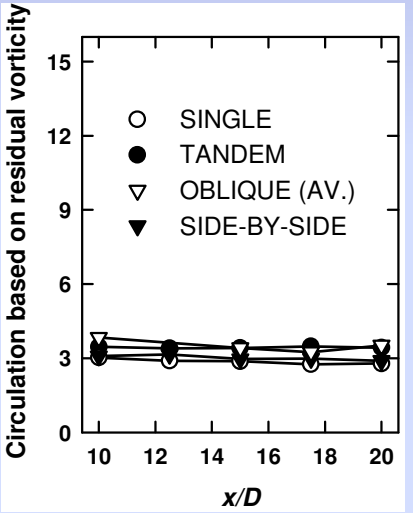
Tandem (in-line) jets have the greatest circulation, side-by-side jets the least. There is a strong correlation between turbulent vorticity transport and the circulation decay rate.

J Aero Eng (2006), J Wind Eng Ind Aero (2007)









Variation of circulation in the dominant vortex with downstream distance for different twin jet geometries, together with the single jet case, using different methods.