

8 Introduction to Turbulence Models

- 8.1 Approaches to closure. Eddy diffusivity defined in terms of local turbulence intensity and length scale.
- 8.2 Equations for (i) the kinetic energy of the mean motion and for (ii) the mean kinetic energy associated with the turbulent fluctuations (the turbulence intensity k). Significance of the various terms.
- 8.3 Modeling of the terms in the k -equation outside viscous sublayers: the Reynolds stresses, the dissipation function, and the flux terms.
- 8.4 A calibration of the empirical constants: application of the k -equation in the constant shear layer (an analytical solution). Wall boundary condition on k .
- 8.5 An equation for ϵ . Wall boundary conditions.
- 8.6 Application of the k -epsilon model in some simple cases where analytical solutions are obtained:
- (i) Decaying uniform turbulence
 - (ii) Decaying convected turbulence
 - (iii) See Problems
- 8.7 The k -epsilon model applied to more complex flows: some comparisons with experiments.
- 8.8 Effect of thermal stratification (heat flux) on turbulence. The Richardson number and the Monin-Obukhov length scale. Damping and amplification of turbulence by thermal stratification.
- 8.9 Thermally stratified turbulent shear flows.

References, new and old:

- Pope. Chapters 4, 10, and some of 11.
- Chen & Yaw. *Fundamentals of Turbulence Modeling*, Taylor & Francis, 1998.
- Libby. *Introduction to Turbulence*, Taylor & Francis, 1996.
- Jones, and Launder. *Int. J. Heat Mass Transfer*, **15** (1972): 301.
- Jones, and Launder, *Int. J. Heat Mass Transfer*, **16** (1973): 1119.
- Bradshaw, Cebeci, and Whitelaw. *Engineering Calculation Methods for Turbulent Flow*. Academic Press, 1981.
- Rodi. *Turbulence models and their applications in hydraulics – "a state of the art review"*, Int. Assoc. for Hydraulics Research, Delft (1984).
- Rodi, *Engineering Turbulence Modelling and Experiments 3*. Elsevier 1996.
- Bradshaw (Editor), Chaps. 1 & 5, *Turbulence*, Springer (1978).
- Monin & Yaglom. Vol. I. MIT Press, 1979: 373–393, 393 ff.