Progress in the Modelling of Turbulent Transport

by

B.E. Launder

Corrigenda

p.1.1, line 11: for "hydrodynamics" read "hydrodynamic"

line 15: insert comma after "stresses"

p.1.4, line 21: for "receomendations" read "recommendations"

p.1.10, line 4 : for [25] read [24]

p.1.11, line 1 : for "Townsend's [16]" read "Townsend's [18]"

p.1.13, line 9 : for "Bradshaw [20]" read "Bradshaw [21]"

p.1.14, line 12: for "trends" read "trend"

footnote : for "paper [101]" read "paper [109]"

p.1.15, line 5 : in column 2 replace "-" by "1.0*"

p.1.16, line 1 : for "type (1.8)" read "type (1.8)*" and add the footnote: '*The value 1.0 rather than 0 appears in Table 1.2 because equation (1.2) was used for the dissipation terms'.

p.1.17, line 1: for "ref [19]" read "ref [20]"

line 9: for "Reynolds [22]" read "Reynolds [27]"

p.2.10, line 25: delete "numerical"

p.2.14, line 13: replace "0.075" by "0.125"

p.4.2, line 8 : for "approcah" reac "approach"

line 12,

13: insert hyphens after "local" and "wall"

p.4.3, line 17: the sentence beginning "It may be seen ...." should not be a new paragraph

p.4.12, line 10: insert "purposes" after "practical"

p.4.13, line 17: replace "causing marked rise" by "halting the decrease"

p.4.13, line 22: replace "more or less uniform" by "gradually rising"

p.4.14, line 11: replace "laminar" by "turbulent"

p.5.2, line 20: for "3.0" read "-3.0"

p.5.5, line 12: for "reverse" read "retain"

p.5.6, line 2 : for "$\overline{u_i \frac{D\delta}{Dt}} = \overline{\delta \frac{Du_i}{Dt}}$" read "$\overline{u_i \frac{D\delta}{Dt}} + \overline{\delta \frac{Du_i}{Dt}}$"

p.5.8, line 5 : for "Table 1.1" read "Table 1.2"

p.5.9, line 7 : for "C_1'" read "$C_{1\delta}'$"

p.5.9, line 18: for" c_1'' and c_1''' "read "$c_{1\delta}''$ and $c_{1\delta}''$ "

p.5.11,line 21: for "jet wake" read "jet/wake"

p.5.14,line 15: for "argument" read "arguments"

p.6.1, line 14: for "6.3" read "6.4"

p.6.5, : insert equals sign between the left hand and centre sketches

p.6.6, line 14: for "cling" read "grasp"

p.6.7, line 18: for "ε" read "ε_δ"

p.6.9, line 5 : for "ecloses" read "encloses"

p.6.11,line 22: for "Rotta [109]" read "Rotta [108]"

p.6.12,line 7 : for "related" read "relates"

p. R5, ref 69 : for "Asme" read "ASME"

p. R5, ref 73 : for "initial" read "final"

for "538" read "527"

p.R6, ref 85 : replace present entry by:

Sparrow, E.M. and Black, A.W. 'Experiments on turbulent heat transfer in a tube with circumferentially varying thermal conditions' ASME J. Heat Trans, 89, 258, 1967.

p.R6, ref 90 : for "1974" read "67, 1975"

p.R7, ref 100 : for "Sharma" read "Sharma, B.I."

p.R7, ref 109 : insert this new reference:

Herring, J. 'Approach of axisymmetric turbulence to isotropy' Phys. Fluids, 17, 859, 1974.

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Abstract

The report has been written to accompany a series of six lectures delivered at the Von Karman Institute in March 1975. The aim of the lectures was to provide a survey of the current state-of-the-art in the modelling of turbulent transport as practised by the author's group at Imperial College. The report is divided into six sections each covering the material of one lecture. The first two sections are concerned with the provision of a second-order closure based on the solution of transport equations for the Reynolds stresses and the turbulent energy dissipation rate. Various simpler versions of these closures are developed in section 3, of which the most widely used and tested are turbulence models based on just two scalar-properties of turbulence (usually the turbulence kinetic energy and its dissipation rate) where local values are found from transport equations.

The problem of low Reynolds number turbulence is examined in section 4, considering both the complete second-order closure and the two-equation model. Section 5 develops a second-order closure for heat transport based on the solution of transport equations for the turbulent heat flux and for the square of the temperature fluctuations.