Finally, rearranging and including Eq (2) gives

$$\frac{\partial P}{\partial t}+u\frac{\partial P}{\partial x}+\rho a_s^2\frac{\partial u}{\partial x}$$
$$=\frac{a_s^2}{C_pT}\left[1+\frac{T}{z}\left(\frac{\partial z}{\partial T}\right)_P\right]\frac{\Omega+Wu}{A} \quad (4)$$

$$\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+\frac{1}{\rho}\frac{\partial P}{\partial x}=-\frac{W}{\rho A}-g\sin\theta \quad (5)$$

$$\frac{\partial T}{\partial t}+u\frac{\partial T}{\partial x}+\frac{a_s^2}{C_p}\left[1+\frac{T}{z}\left(\frac{\partial z}{\partial T}\right)_P\right]\frac{\partial u}{\partial x}$$
$$=\frac{a_s^2}{C_pP}\left[1-\frac{P}{z}\left(\frac{\partial z}{\partial P}\right)_T\right]\frac{\Omega+Wu}{A} \quad (6)$$

Book review

Convection Heat Transfer

A. Bejan

This text is one of three relatively recently published textbooks dealing with the subject of convection heat transfer. As with the other texts, the book starts by presenting the fundamental laws of conservation of mass, momentum and energy as well as the second law of thermodynamics. Rather than utilizing a generalized control volume and Reynold's transport theorem, the laws are developed from examining a differential control volume in cartesian coordinates. While this leads to easier understanding of the concept by the student, a clear understanding of the stress tensors is lacking and the students may have difficulty in their form in other coordinate systems.

After the first chapter, the text progresses from specialized laminar boundary layer problems to laminar duct flows, natural convection and natural convection in enclosures. The development of laminar boundary layer heat transfer problems in Chapter 2 starts with a general discussion from a physical viewpoint and progresses to integral solutions and then similarity solutions. Practically nothing is presented except for the flat plate solutions, thus the instructor or student will be left to develop the extension to more practical conditions. There are no developments which account for wall suction or blowing on logical extensions to multiphase flows such as film boiling or condensation and so the second chapter is weak in its presentations.

Chapter 3 on laminar duct flow problems introduces first the hydrodynamic entrance length problem prior to going on to fully developed flows. The integral solution between two parallel plates due to Sparrow is discussed but not the more accurate techniques due to L. S. Han or Langhaar. In discussing the heat transfer in ducts, the author starts from the fully developed flow, fully developed temperature profile cases as per Kays and Crawford instead of developing the solutions from the Graetz type problems from where it could be seen that the fully developed solutions come either from the particular solutions or lowest eigenvalues for the case of constant wall temperature of these more general solutions. The thermally developing solutions are also lightly treated and variable thermal properties are totally ignored.

Chapter 4 deals with natural convection and again some classical solutions for a vertical flat plate are introduced, but here discussion of problem formulation for both integral and similarity solutions are more complete. The author makes a false statement concerning lack of understanding of length scales in contemporary research. Such scales have been clearly pointed out by S. Ostrach and B. Gebhart among others. Both high and low Prandtl number solutions for constant wall temperature and constant heat flux are presented. The author also discusses the effects of thermally stratified flows, but erroneously reports the lack of a similarity solution. The existence of such a solution was recently reported by Kulkarni, Jacobs and Hwang, International Journal of Heat and Mass Transfer (1986). Other topics covered include conjugate problems, vertical channel flow and combined natural and forced convection and surprisingly a two-phase problem, gravity driven film condensation, which was lacking in Chapter 2. The latter was only weakly represented by the early pioneering work of Nusselt (1916). The excellent pioneering work of Andrea Acrivos on combined free and forced convection was ignored.

Chapter 5 is a relatively complete treatment of laminar natural convection in closed cells. Some forty pages long, this chapter is an obvious favourite subject of the author who frequently references his own work.

Chapter 6 deals with transition to turbulence and is a good treatment of a topic totally disregarded in most texts. The author is, thus, to be congratulated for its inclusion.

Chapter 7 and 8 on turbulence are reasonably well presented for both forced and free convection. However, the roughly 80 pages seems quite short to treat all aspects of this most important topic of convection heat transfer in a text where two chapters and 73 pages are devoted to flow and heat transfer in porous media!

Despite this book's obvious shortcomings as a textbook in convection heat transfer, it should provide a useful reference source. This is particularly true in the areas of porous media heat transfer which is an area of increasing interest and broadening application.

Harold R. Jacobs
Pennsylvania State University, USA

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