Book Review:

Buoyancy Effects in Fluids

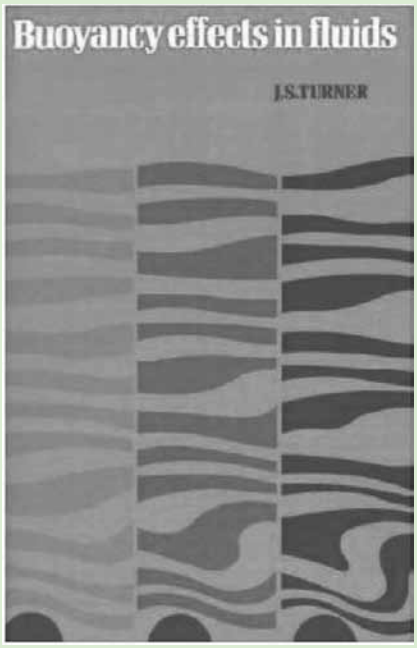
J. S. Turner (2001)
London, UK: Cambridge University Press
412 pp.

At first sight, it may appear rather odd to see the above title being reviewed in an architectural journal. After all, the name of the book seems to suggest its association with the world of science and mathematics rather than that of architecture. Further, it was first published nearly forty years ago, with the latest edition being almost a decade old, and so should be considered out-of-date.

But there are good reasons for reviewing this seemingly irrelevant, out-of-date title. First of all, the book is—despite its name—in fact as relevant to architecture as it is to science and mathematics. Indeed, it may even be argued that, for graduate students and researchers in certain areas of architecture, this book is indispensible. Additionally, notwithstanding its age, the book is as relevant today as it was decades ago, even though its use—or indeed its existence—has not always been known by architecture students or academics. This review, then, hopes to reintroduce to the world of architecture a classic which it has long overlooked.

To do that, it is necessary first to appreciate the book as it was originally intended. As its title suggests, the book was written first and foremost for scientists and mathematicians in the field of fluid mechanics. Its readership spans a range of disciplines, from meteorology and oceanography to geology, hydrology and various branches of engineering. Often regarded as authoritative, it has been referred to extensively in science and mathematics literature and classrooms.

So, why has the book enjoyed so enduring popularity? A main reason for this is probably that, throughout its long life, the book has always managed to keep up-to-date. In a nutshell, the book deals with basic concepts underlying flow



phenomena which are driven by buoyancy, a force arising as a result of variations of density in a fluid subject to gravity. Over the last forty years or so, these basic concepts have not changed a great deal, and although the field of fluid mechanics has enjoyed quite rapid growth in recent times, much of the growth has been in literature related to applications rather than basic concepts themselves. This is reflected in the fact that since its first publication in 1973, the book underwent just one revision, and a minor one at that: corrections—mainly on typographical errors—were made and its bibliography was extended in 1979.

But all these do not answer the question of why a fluid mechanics book, so popular and respected amongst scientists and mathematicians, should be of any interest to readers with an architectural background. To answer this question, one needs to look beyond the common, superficial perception of architecture as an art of producing appealing form, and to embrace the notion that it is also a science of optimising performance of environments for living. It is from this latter perspective that fluid mechanics becomes central to architectural design and control. This is because thermal comfort and indoor air quality depend greatly on how air moves and advects heat, vapour and pollutants in and around buildings, which in turn affects the buildings' energy consumption. Optimising comfort and energy performance, therefore, is not merely a matter of adding equipment such as fans or air-conditioning units to the buildings, but also involves ensuring appropriate location and control of such equipment as well as appropriate building geometry, such as the right window size and ceiling height, to facilitate effective air movement and heat, vapour and pollutant transport.

And it is in the design and control of air movement within and around buildings that the book comes into its own. Unique in its genre of technical text, it gives a comprehensive overview of the fundamentals of how to control air flows and associated propagation of heat, vapour and pollutants under the influence of buoyancy, such as may arise as a result of heat generated by occupancy, solar radiation or seasonal temperature differences between indoor and outdoor air. Constructed in ten chapters, the book covers topics pertinent to understanding outdoor air flows in urban environments; the effects of building shapes on air movement around buildings and their impacts on indoor air flows; the formation of temperature structures and wind velocity profiles in outdoor environments subject to heating by urban heat islands; the development of interior temperature structures in spaces subject to cooling/heating by sources such as occupants, sun patches, chilled ceilings, heated floors and air-conditioning; interactions between layers of cold and warm air in thermally stratified interior environments induced by heating/cooling or by movement of occupants; and the transport of heat, vapour and pollutants associated with the above indoor and outdoor air movements and temperature structure formations.

Notwithstanding its broad coverage of a highly technical subject, the book is surprisingly accessible. It assumes basic knowledge in mathematics and fluid mechanics normally covered at the undergraduate or early graduate level in more technical architectural courses, but no other specialised background. To cater for readers with different interests, each chapter is largely self-sufficient, but with helpful cross-chapter references, to allow readers to consult selectively the parts of the book that are relevant to their work, without losing the broader picture of the subject; any reader new to the field will find the first chapter on rudimentary concepts especially useful. Moreover, the book is written with emphasis on providing a clear conceptual understanding: even though equations are provided to aid discussion throughout, flow principles can often be understood with little or no recourse to the mathematics. Comprehension is greatly facilitated by precisely written text, clear diagrams and beautiful photographs of flow processes—that last evidently reflecting the author's interest in laboratory modelling—all making the book enjoyable even to readers with little quantitative inclination. Its pocket size also makes it ideal to be carried around and dipped in and out of at moments of convenience.

The book is not without its downside, however, especially from the point of view of readers with an architectural background. Firstly, it is not straightforward: discussions and references are usually presented in the context of meteorology, geology, oceanography or hydrology, rather than architecture, and making a link between certain flow processes and architectural applications does sometimes require a great degree of lateral thinking. In addition, depth of coverage is at times sacrificed for breadth: there are times when one wishes the book to go deeper into particular flow aspects, only to be compelled to be content with relatively broad overviews. In such situations, finding further information—especially if it involves modern applications—using the bibliography as a guide, is not entirely without complications, since, as mentioned earlier, the bibliography was last updated in 1979 and contains no work written afterwards. External aids, such as Google Scholar, are likely to be needed to carry out more complete literature research.

Nonetheless, all in all, this is a great title with packs so much punch for its size. And what it lacks is more than compensated by what it offers. A companion which can be consulted throughout one's career, it is definitely recommended for technically minded architectural students, academics and professionals alike.

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