

## FLUIDS AT REST AND IN MOTION

**J.M. Jordaan**

*Water Utilisation Division, University of Pretoria, Pretoria, South Africa*

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### Summary

A view is given of the main classes of fluid behavior from hydrostatics to hydrodynamics. The principles by which such behavior may be analyzed are cited, and various methods of theoretical and experimental analysis of fluid problems are outlined.

A number of cases dealing with the understanding of fluid behavior phenomena and practical problem solving methods conclude the chapter.

### 1. Introduction

In the universe there is no question of absolute rest. Everything everywhere is in constant motion with respect to everything else, on the grand scale and also on the minute scale. Only on a planetary surface such as the earth's, where human beings reside, can the concept of an absolute state of rest be visualized. This immediately excludes the surfaces and interiors of *water bodies*, such as oceans, lakes and rivers, or the weather systems of the atmosphere.

A fluid at rest is anyway only a clearly defined concept, if it is a liquid substance confined in a closed container at rest, situated on the fixed part of the earth's surface, e.g. a reservoir or closed water vessel. Otherwise, fluid is in motion, or is capable of being set in motion by the slightest disturbance. Take as example a subtle movement applied to an open container holding a liquid, such as a cup filled with water.

The concept of a fluid comprises both liquids and gases (for instance, the atmosphere or air and water vapor envelope surrounding the globe). For the purpose of considering hydraulic equipment and structures, however, the fluid being considered will be constrained to liquids, mainly water, with some gases and solids also present therein to a less or more degree. Water is, after all, the essence of life, and it is necessary to understand its physical nature and behavior.

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### **Biographical Sketch**

**Jan Jordaan** was born in 1932 in Cape Town, and raised in Bloemfontein and Pretoria, South Africa. He obtained his B.Sc. Eng. Civil at the University of the Witwatersrand, Johannesburg in 1952, and joined the Irrigation Department of South Africa, now known as the Department of Water Affairs and Forestry. While on study leave from 1953 to 1958, he obtained the SM Degree at the University of Wisconsin, USA and the CE and Sc.D. Degrees at the Massachusetts Institute of Technology, USA. After completing his post-graduate studies, he returned to South Africa, resuming work with the Department of Water Affairs in Pretoria until 1959. He then joined the South African Council for Scientific and Industrial Research as a Research Officer until 1963, being involved with mainly coastal engineering research and its applications.

Subsequently, he worked for the US Naval Civil Engineering Laboratory, Port Hueneme, California, until mid 1965 as a Hydraulic Research Engineer on ocean wave research. Thereafter he joined the University of Hawaii as Associate Professor in coastal engineering and tsunami research, from 1965 to 1968. He occupied the same position at the University of Delaware from 1968 to 1969. He thereupon resumed employment with the Department of Water Affairs, Pretoria, where he was active in hydraulic engineering design for the major part of 28 years until his retirement in 1997 as Chief Engineer Design Services. During this period he was assigned to the P.K. le Roux Dam and the Van der Kloof Canals Construction Project for two years; and for seven years in Namibia (then South West Africa) in the branch of the same Department, as Chief Engineer, Investigations, dealing with aspects of water resources, hydrology and construction.

In 1985 and 1987 he was temporarily seconded to the Department of Foreign Affairs, and acted as Technical Assessor in Bolivia for the Misticuni Hydroelectric and Water Supply Project for Cochabamba Department. He was also sent on foreign duty in Grenoble, France in connection with their model studies of the Lesotho Highlands Water and Power Project. He also visited Britain, Spain, Portugal, Germany, Norway, The Netherlands, Hungary, Egypt and the Sudan, China and Taiwan in connection with official duties.

He is a registered Professional Engineer in South Africa, a Fellow of the South African Institution of Civil Engineers, Member of the American Society of Civil Engineers, Fellow Member of the Indian Association of Hydrologists, Roorkee, and Member of the International Association of Hydraulic Engineering and Research. From 1989 until 1998 he was part-time Professor of Hydraulic Engineering in the Department of Civil Engineering of the University of Pretoria, and thereafter until end 2000 has been attached as a part-time guest professor at the Water Utilisation Division of the same University.

His major publications include a chapter in "Advances in Hydrosience", 1970, Academic Press, USA, on laboratory experiments with impulsively generated water waves; a chapter co-authored with Prof. J. Williams in "Tsunamis in the Pacific Ocean", edited by Prof. W.M. Adams, East-West Center Press, Honolulu, Hawaii, USA; co-authorship of "Water in our Common Future", COWAR, UNESCO, 1993; editorship of the SANCOLD volume: "Large Dams and Water Systems in South Africa", 1994; and co-authorship with Dr Dan. Batuca of Romania of the book: "Silting and Desilting of Reservoirs", 2000, Balkema Publishers, Rotterdam, The Netherlands.