CISM Courses and Lectures

Series Editors:

The Rectors
Friedrich Pfeiffer - Munich
Franz G. Rammerstorfer - Wien
Jean Salençon - Palaiseau

The Secretary General
Bernhard Schrefler - Padua

Executive Editor
Paolo Serafini - Udine

The series presents lecture notes, monographs, edited works and proceedings in the field of Mechanics, Engineering, Computer Science and Applied Mathematics.
Purpose of the series is to make known in the international scientific and technical community results obtained in some of the activities organized by CISM, the International Centre for Mechanical Sciences.

International Centre for Mechanical Sciences

Courses and Lectures Vol. 543

For further volumes:
www.springer.com/series/76

Armando Di Nardo · Michele Di Natale · Anna Di Mauro

Water Supply Network District Metering Theory and Case Study

Springer

Armando Di Nardo
Michele Di Natale
Anna Di Mauro
Second University of Naples, Italy

ISSN 0254-1971
ISBN 978-3-7091-1492-6 ISBN 978-3-7091-1493-3 (eBook)
DOI 10.1007/978-3-7091-1493-3
Springer Wien Heidelberg New York Dordrecht London

All contributions have been typeset by the authors
Printed in Italy

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

PREFACE

A water supply network is the key link in the water distribution chain, because it allows for the distribution of the resource for civil, industrial and agricultural uses.

Reported by many sources, both in Italy and other countries (UNESCO, 1993, United Nation, 2000, 2002a and 2002b; National Geographic Italia, 2002; World Water Council, 2003; Ministero dell'Ambiente e della Tutela del Territorio, 2004 and 2005), the waste of water resources in supply networks is considerable.

The deterioration of these systems is due to many causes related to aging technology (average life of European water networks exceeds 30 years) and to negligence and poor organization of the various authorities in charge of ordinary and extraordinary management.

These reasons add to the essential complexity of the urban water distribution systems arising from many technical and scientific problems.

Among technical problems, it is worth mentioning:

- *poor knowledge of the actual plans due to the unplanned growth of the water system along with the urban sprawl, of the 1970's and 1980's;*
- *lack of digitalized plans and TIS (Territorial Information Systems);*
- *scarce availability of up-to-date and reliable databases;*
- *aging of supply networks and hydraulic devices (pipelines, gates, adjustment valves, special works, flow meters, pressure transducers, etc.);*
- *considerable physical and administrative water leakages;*
- *difficulty in defining the two leakage rates ("revenue" and "non-revenue" water);*
- *technological and operational backwardness due to the absence of modern systems of remote-controlling, and to the lack of intervention plans for both ordinary and extraordinary maintenance;*
- *non-compliance, in many countries, with local management "best practice";*
- *complexity of the procedure to carry out hydraulic checks in very large water systems;*

- *poor hydraulic performances (inadequate pressure, reduced resources during drought, poor quality, etc.);*
- *faulty planning of many water systems currently in operation;*

Among the scientific problems, it is worth mentioning:

- *non linear behavior of equations modeling the water distribution systems;*
- *presence of a very high number of variables which makes the application of optimization techniques particularly complicated;*
- *difficulty in defining cost functions due to the lack of data relating to the management of water services;*
- *difficulty in defining optimal criteria for district metering pursuant to management "best practice";*
- *low number of pilot sites;*
- *implementation of case studies on small water networks;*
- *lack of multi-scenario analyses relating to drought;*

Obviously, these issues, especially the technical ones, assume more or less importance depending on the international reality taken into account.

In many countries, as is the case in Italy, there is a clear need for modernization to reach standards of cost-effectiveness: by improving service, updating databases, billing consumptions regularly, creating multithematic TIS, using modern monitoring technologies and criteria and integrated systems to optimize the whole water system.

In order to do so, it is necessary to develop Decision Support Systems, DSS, (Loucks and da Costa, 1991; Loucks, 2000) which help managers by simplifying (thanks to remote controlling, optimization models and operational research) the complexity of water systems in term of hydraulics and customer satisfaction.

Indeed, besides achieving satisfactory hydraulic performance, a water supply company has to fulfill the needs that modern consumer societies demand, and rightly so, i.e., all those elements which make a company more competitive than another and which result from the maximum possible control of the whole system.

In this study two techniques are put forward to improve water supply system management: "Water District Metering (WDM)" and "Water Pressure Management (WPM)" with reference to leakage reduction.

Specifically, after a theoretical introduction of two techniques in Chapter 1 and Chapter 2, the study proposes the use of both techniques in tandem defining two tools for WDM design and WPM setting (Chapter 3). Water district metering and pressure management were already used in some other experiences, often using empirical approaches applied to small water networks.

In this study two original tools are proposed; they are based on heuristic and optimal criteria, arranged in design support methodologies to assist water network operators.

In Chapter 4 the two techniques are tested on a case study of the Monterusciello network in Pozzuoli (Italy) confirming the effectiveness of the approach presented.

The results illustrated in this monograph are part of a research work conducted by CIRIAM (Centro Interdipartimentale di Ricerca in Ingegneria Ambientale) of Seconda Università di Napoli (SUN).

Thanks to Annalisa Lama and Giovanni Francesco Santonastaso for their precious collaboration in the revision of the book.

Armando Di Nardo[1]*, Michele Di Natale*[2]*, Anna Di Mauro*[3]

[1]Assistant professor of Hydraulic Constructions at the Second University of Naples and Ph. D. in Engineering of Civil Networks and Territorial Systems with specializations in Hydraulics and Environment. He has published many papers in italian and international journals on optimization in the management of water resources.

[2]Full professor of Hydraulic Constructions and Dean of the Faculty of Engineering at the Second University of Naples. He has published many papers in italian and international journals on management and planning of water systems.

[3]Enviromental engineer with specialization in Hydraulics.

Contents