
**Estimation of sediment deposition
in reservoir using one dimensional
simulation models**

*Estimation du dépôt de sédiments dans le réservoir en utilisant des
modèles de simulation à une dimension*



This document is a preview generated by EBS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Definitions	2
4 Units of measurement	2
5 Principles of quasi-unsteady sediment modelling	2
6 Principles of unsteady flow models	2
6.1 General	2
6.2 Governing equations	3
6.3 Numerical techniques for solution of governing equations	6
6.3.1 Explicit finite-difference methods	7
6.3.2 Implicit finite-difference methods	7
6.3.3 Finite element methods	7
6.3.4 Finite volume methods	8
6.4 Sediment transport	8
7 Data requirements	10
7.1 Selection of model boundaries	12
7.2 Cross-section data	12
7.2.1 General	12
7.2.2 Manning's n values	13
7.2.3 Movable bed and dredging	13
7.3 Stage data	13
7.4 Velocity data	13
7.5 Discharge data	13
7.6 Lateral inflows and withdrawals	14
7.7 Sediment data	14
8 Formulation, calibration, testing and validation of models	15
8.1 Formulation of numerical models	15
8.1.1 Hydrology	15
8.1.2 Geometry	16
8.1.3 Selection of transport equation	16
8.1.4 Bed mixing and armoring algorithm	16
8.2 Preliminary tests	16
8.3 Computational grid and time step	17
8.4 Convergence testing	18
8.5 Boundary and initial conditions	18
8.6 Calibration	18
8.7 Validation	19
8.8 Predictive simulation	20
8.9 Sensitivity testing	20
8.10 Specific models	20
9 Uncertainties	21
9.1 Model parameters	21
9.2 Data for model development, testing and application	21
9.3 Governing equations	22
9.4 Numerical approximations to governing equations	22
Annex A (normative) Models and case studies	24
Bibliography	25

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 113, *Hydrometry*, Subcommittee SC 6, *Sediment transport*.

Introduction

Storage reservoirs built across rivers or streams lose their capacity on account of deposition of sediment. Surveys indicate that world-wide reservoirs are losing their storage capacity, at an annual rate of about one percent, due to accumulation of sediments. The impacts of sedimentation on the performance of the reservoir project are manifold. Some of the important aspects are the following:

- a) reduction in live storage capacity of the reservoir;
- b) accumulation of sediment at or near the dam may interfere with the functioning of water intakes and hence is an important parameter in deciding the location and level of various outlets;
- c) increased inflow of sediment into the water conveyance systems and hence to be considered in the design of water conductor systems, desilting basins, turbines, etc;
- d) sediment deposition in the head reaches may cause rise in flood levels;
- e) the location and quantity of sediment deposition affects the performance of the sediment sluicing and flushing measures used to restore the storage capacity.

Hence, prediction of sediment distribution in reservoirs is essential in the following:

- a) feasibility studies during planning and design of various components of new projects;
- b) performance assessment of existing projects.

The most simple and earliest models to predict the sedimentation processes in reservoirs are the empirical ones. The trap-efficiency curves derived from records of existing reservoirs are among the most commonly used empirical methods. Recently, due to better understanding of the fundamentals of reservoir hydraulics and morphology, along with the rapid growth of computational facilities, development and application of mathematical models have become a normal practice.

Compared to empirical methods, the mathematical approach of the sediment distribution enables more time and space dependent and more accurate modelling. A large number of mathematical models have been developed during the past few decades. Flow in the reservoir can be represented by the basic equations for conservation of momentum and mass of water and sediment.

Estimation of sediment deposition in reservoir using one dimensional simulation models

1 Scope

This Technical Report describes a method for estimation/prediction of sediment deposition within and upstream of a reservoir using numerical simulation techniques through one-dimensional flow and sediment transport equations.

Numerical simulation models for predicting sediment distribution are applicable for reservoirs, where the length of the reservoir greatly exceeds the depth and width and the reservoir has a significant through flow.

This Technical Report includes the theoretical basis and fundamental assumptions of the technique and provides a summary of some numerical methods used to solve the unsteady flow and sediment transport equations. Also provided are details on the application of the model, including data requirements, procedures for model calibration, validation, testing, applications and identification of uncertainties associated with the method. This Technical Report does not provide sufficient information for the development of a computer program for solving the equations, but rather is based on the assumption that an adequately documented computer program is available.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 748, *Hydrometry — Measurement of liquid flow in open channels using current-meters or floats*

ISO 772, *Hydrometry — Vocabulary and symbols*

ISO 1100-2, *Hydrometry — Measurement of liquid flow in open channels — Part 2: Determination of the stage-discharge relationship*

ISO 2425, *Hydrometry — Measurement of liquid flow in open channels under tidal conditions*

ISO 2537, *Hydrometry — Rotating-element current-meters*

ISO 3454, *Hydrometry — Direct depth sounding and suspension equipment*

ISO 4363, *Measurement of liquid flow in open channels — Methods for measurement of characteristics of suspended sediment*

ISO 4364, *Measurement of liquid flow in open channels — Bed material sampling*

ISO 4365, *Liquid flow in open channels — Sediment in streams and canals — Determination of concentration, particle size distribution and relative density*

ISO 4373, *Hydrometry — Water level measuring devices*

ISO 6416, *Hydrometry — Measurement of discharge by the ultrasonic (acoustic) method*

ISO 18365, *Hydrometry — Selection, establishment and operation of a gauging station*

ISO/TS 3716, *Hydrometry — Functional requirements and characteristics of suspended-sediment samplers*

ISO/TR 9212, *Methods of measurement of bedload discharge*