मानकः पथप्रदर्शकः

COMPENDIUM OF INDIAN STANDARDS

METHODS FOR THE MEASUREMENT OF SEDIMENTS

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Table of Contents

CHAPTER 1

Introduction

Sediment transport is a critical process in open channel flow, affecting river morphology, reservoir capacity navigation, and infrastructure stability.

Use Standard:

IS 15359 : 2003 Hydrometric determinations - Measurement of suspended sediment transport in tidal channels

Type of Sampler	• IS 317:1970
Measurement OF Sediment	• IS 4890:1968 • IS 16696:2018 • IS 6339:2013 • IS 5359:1987 • IS 16222:2018

Factors influencing transport:

Fluid velocity and flow characteristics: Stronger currents and higher flow velocities lead to greater sediment transport.

Sediment size and type: Smaller particles are more easily transported.

Slope and gradient: Steeper slopes and channels encourage sediment movement.

Presence of vegetation: Vegetation can help stabilize sediment and reduce transport.

Chapter 2

Classification of Sediments

Bed Load

Bed load consists of particles sliding, rolling or saltating, but remaining essentially in contact with the bed

It is the dominant form of sediment transport for larger particles (settling velocity too large for suspension)

The bed-load flux qb is the volume of non-suspended sediment crossing unit width of bed per unit time.

Use Standard:

IS 6339 : 2013 Hydrometry - Sediment in streams and canals - Determination of concentration, particle size distribution and relative density

Suspended Load

Suspended load consists of finer particles carried in suspension by turbulent fluid flow. For coarser sediment, suspended load does not occur and all sediment motion is bed load. Significant suspended load only occurs if turbulent velocity fluctuations are larger than the settling velocity.

Wash Load

The finest sediment particles (typically less than 0.00195 mm) that are transported in suspension by a river or stream, remaining in suspension even when water flow is minimal or absent.

Chapter 3. Importance of Sediment Measurement

Estimation of reservoir life:

This involves determining how long a reservoir can effectively store water before sedimentation (the accumulation of sediment) significantly reduces its capacity. This estimation is crucial for planning and maintenance of water storage facilities.

- **IS 5477-1 (1999):** This IS code provides guidelines for fixing reservoir capacities, including methods for estimating sedimentation.
- **Design and maintenance of hydraulic structures:**

This includes the design, construction, and upkeep of various structures that manage water flow, such as dams, canals, and weirs. Proper design and maintenance ensure the structural integrity and efficiency of these structures.

- **1S: 6532 - 1972** Design, Installation, Observation and Maintenance of Uplift Pressure Pipes for hydraulic structures on permeable foundations

Flood forecasting and river training:

This involves predicting flood events and implementing measures to manage and channel river flows, reducing the risk of flooding and damage.

Environmental impact studies:

This entails evaluating the potential environmental consequences of water resource projects, ensuring that they are undertaken sustainably.

Chapter 4. Overview of Measurement Techniques

Direct Measurement: Depth-Integrating Samplers: These samplers are lowered and raised at a uniform rate, collecting water and sediment samples as they move through the water column.

Point-Integrating Samplers: These samplers are positioned at a specific point within the water column and collect a sample by opening and closing a valve to control sampling time.

Bed load Samplers: Bed load samplers are designed to capture sediment moving along the stream bottom, including material that is rolling, sliding, or bouncing (saltation).

Indirect Method

Turbidity Meter: IS: 3025 (Part 10) - 1984

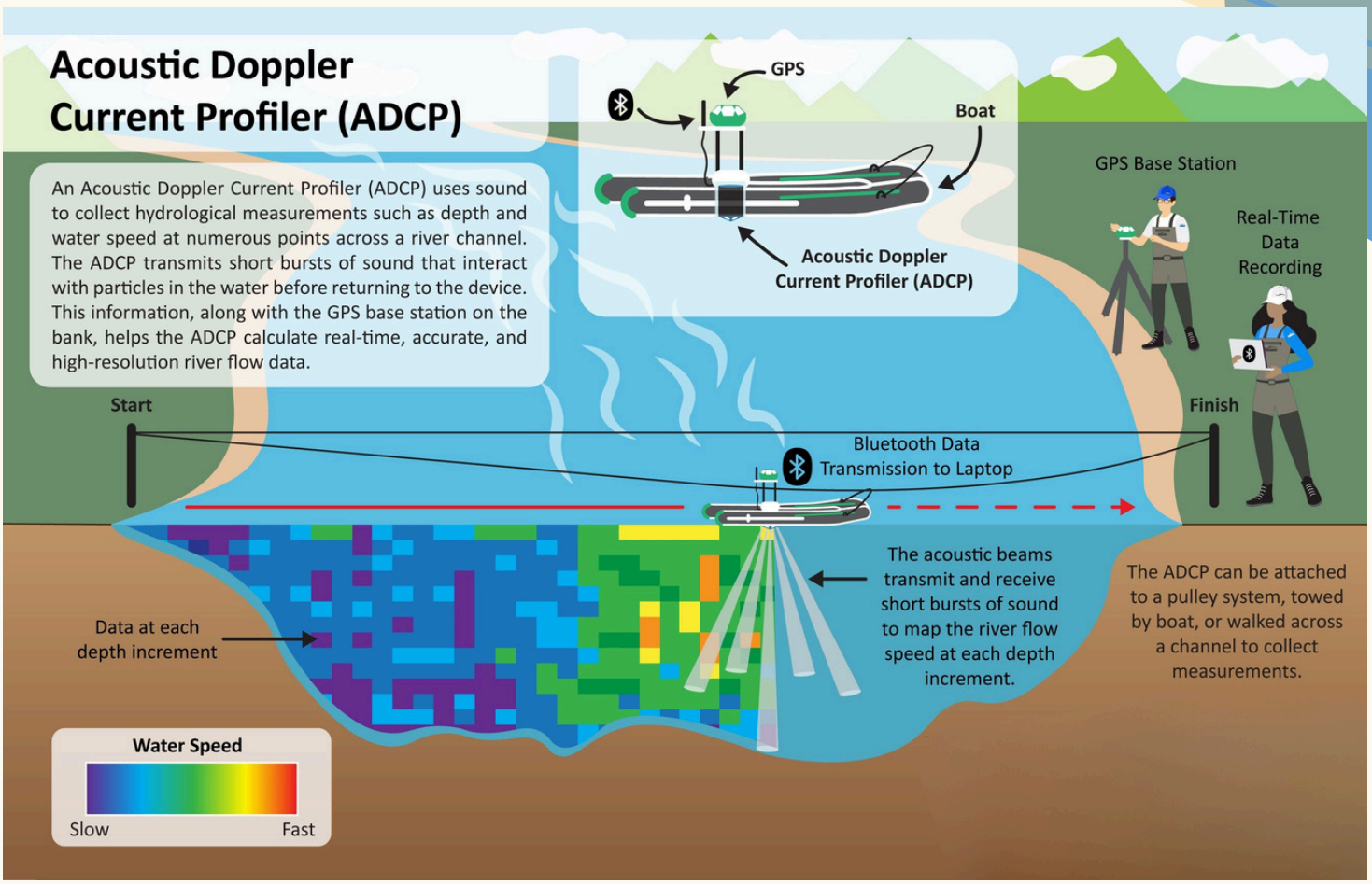
Turbidity, which is the cloudiness or haziness of a fluid caused by suspended particles.

Applications: Used in water quality monitoring, industrial processes, and various other applications where understanding the cloudiness of a fluid is important.

Principle: Turbidity meters operate on the optical principle of scattering, where light is scattered by suspended particles within the fluid.

Acoustic Doppler Current Profiler (ADCP): ISO 24578:2021

Water current velocity, direction, and depth in the water column. ADCPs use the Doppler effect, where the frequency of an acoustic pulse changes.


Acoustic Doppler Current Profiler (ADCP)
An Acoustic Doppler Current Profiler (ADCP) uses sound to collect hydrological measurements such as depth and water speed at numerous points across a river channel. The ADCP transmits short bursts of sound that interact with particles in the water before returning to the device. This information, along with the GPS base station on the bank, helps the ADCP calculate real-time, accurate, and high-resolution river flow data.
GPS
Boat
Acoustic Doppler Current Profiler (ADCP)
GPS Base Station
Real-Time Data Recording
Start
Finish
Bluetooth Data Transmission to Laptop
The acoustic beams transmit and receive short bursts of sound to map the river flow speed at each depth increment.
Data at each depth increment
The ADCP can be attached to a pulley system, towed by boat, or walked across a channel to collect measurements.
Water Speed
Slow
Fast


TURB 355 IR
TURBIDIMETER
WTW

Chapter 5
Equipment and Instruments

These samplers, like the model (also known as the US DH-48 sampler), collect water samples at various depths within the water column as they are lowered and raised. This provides a representative sample of the water's composition across the water depth.

Use Standard:

IS 3917:1966 Scoop type bed material samplers
IS 5542:1969 Guide for storm analysis

Point-integrating samplers:

These samplers, like the USGS FISP approved water-quality samplers, collect samples at a specific depth, allowing for the measurement of the concentration of a particular parameter (e.g., suspended sediment) at that depth.

Bed load samplers:

Samplers like the Halley-Smith sampler are designed to collecta sediment particles moving along the streambed.

Suspended sediment samplers:

These samplers, like the US DH-74 sampler, collect samples containing fine particles that are suspended in the water column. They are commonly used to monitor suspended sediment load and its impact on water quality.

Laboratory glassware and sieves:

These tools are used to analyse collected samples in the laboratory. Glassware, such as beakers and flasks, is used for measuring volumes and performing various chemical and physical analyses. Sieves, with different mesh sizes, are used to separate particles based on size, providing information about sediment grain size distribution.

Chapter 6
Sampling Procedures Referencing

Site Selection:

Choose sites away from areas where water flow is heavily influenced by bends, where different water bodies meet (confluences), or where turbulence is high. These areas can skew sample results due to localized mixing or contamination.

Use Standard:

IS 3917 : 2003 Scoop type bed material samplers and
IS 4890 : 1968 Methods for measurement of suspended sediment in open channels

Verticals and Points:

Collect samples at various depths across the water body's cross-section to get a representative view of the water column's composition. This is crucial for understanding stratification and variations in water quality that may occur at different depths.

Frequency:

Determine the appropriate sampling frequency based on the study's goals. Seasonal sampling can capture changes related to climate cycles, while event-based sampling (e.g., during heavy rainfall) can assess the impact of specific events on water quality.

Sample Handling:

Proper labelling, sealing, and preservation are essential to ensure the collected samples accurately reflect the water's composition. Labelling should clearly identify the sample location, date, and any relevant details. Sealing prevents contaminationand leakage, while proper preservation techniques (e.g., refrigeration, use of specific preservatives) help maintain the sample's integrity until analysis.

Chapter 7

Laboratory Analysis of Sediments

Grain Size Analysis: This involves determining the proportion of different particle sizes within a sediment sample.

Used Standard:

IS 2720 (Part 4): 1985 Methods of test for soils: Part 4 grain size analysis,

IS 15527 : 2020 Hydrometry - Measurement in Meandering River and in Streams with Unstable Boundaries Laboratory Analysis of Sediments

Wet Sieving: Used for coarser materials (larger than 75 microns) where the sample is washed through a series of sieves to separate particles by size.

Hydrometer or Pipette Analysis: Used for finer materials (smaller than 75 microns) where the particles are suspended in a liquid, and their settling velocity is measured over time.

Evaporation Method: The sediment is dried completely, and the remaining solid weight is measured to determine the sediment concentration.

Filtration Method: A filter is used to separate the sediment from the water, and the weight of the sediment retained on the filter is used to determine the concentration**.**

Sediment Density and Specific Gravity:

These properties describe the density and mass of the sediment compared to water.

Chapter 8

References

Indian Standards

S. No	IS Number	Title
1	IS 3917:1966	Specification for Sampler for Determination of Concentration of Suspended Sediment
2	IS 5542:1969	Specification for Bed Load Samplers
3	IS 4890:1981	Code of Practice for Field Studies in River Sedimentation
4	IS 2720 (Part 4)	Methods of Test for Soils – Grain Size Analysis
5	IS 13365:1992	Sediment concentration measurement techniques
6	IS 15527:2004	Guidelines for sedimentation survey of reservoirs
7	IS 16696:2018	Sediment data collection and processing – Guidelines
8	IS 15359:2003	Classification and Identification of Soil for General Engineering
9	IS 16222:2014	Guidelines for sediment transport studies in streams and rivers