

Sediment Monitoring and Abrasion Testing Laboratory



Sponsored by :
Ministry of New and Renewable Energy
Government of India
and
DRIP Project - Central Water Commission



Department of Hydro and Renewable Energy
Indian Institute of Technology Roorkee

Sediment Monitoring and Abrasion Testing Laboratory

The information about the sediment properties are required for mitigation or proper handling of hydro-abrasive erosion issues due to growing focus of hydropower in Himalayan region. Hydro-abrasive erosion depends on sediment concentration, size, shape and mineralogical composition. The consideration of hydro-abrasive erosion issue is required in both planning stage of a hydropower project as well as the maintenance and renovation of existing hydropower plant. To study and mitigate the hydro-abrasive issues in Himalayan region, a laboratory with state of the art instrumentation is established at AHEC, IIT Roorkee with support from the Ministry of New and Renewable Energy, Govt. of India and Dam Rehabilitation and Improvement Project (DRIP), Central Water Commission.

Objective

- o Research and analysis of suspended sediment flow and its impact on hydropower components.
- o Sediment depository for Himalayan region where hydropower plants are prone to hydro-abrasive erosion.
- o Research data base of hydro-abrasive erosion and its effect on components of hydropower plants-turbines, penstock etc.
- o Development of a knowledge centre to educate and train personnel to handle erosion issues effectively.

Research Areas

- o Design and improvement of sediment settling basins
- o Sediment flow dynamics and sediment flow models
- o Validation and development of hydro-abrasive erosion models
- o Relation of sediment parameters with hydro-abrasive erosion
- o Effect of hydro-abrasive erosion on efficiency reduction
- o Development of methods for quantifying suspended sediment
- o Designing turbine blades and other components for less erosion

Activities

- o Identification of hydro-abrasive erosion affected hydropower plants in India.
- o Collection of suspended sediment samples from hydro-abrasive erosion affected hydropower plants for laboratory analysis in AHEC, IIT Roorkee.
- o Continuous measurement of suspended sediment properties at hydro-abrasive erosion affected hydropower plants.
- o Measurement of hydro-abrasive erosion in hydropower plants.
- o Measurement of efficiency loss due to hydro-abrasive erosion in hydropower plants.
- o Suspended sediment measurement before and after desilting tank to measure desilting efficiency at a plant.
- o Sediment measurement in river reaches with potential of hydropower development to assess the erosive potential and its future implications.

Hydro-abrasive erosion test rig

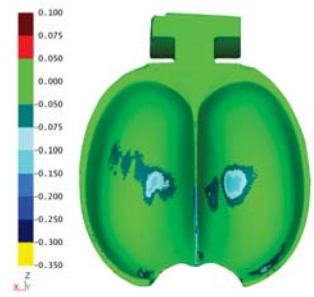
To conduct erosion experiments on different materials/coatings and develop hydro-abrasive erosion models, a circulatory test rig is available along with a stirrer for well mixing of sediments. In this set-up, two Pelton turbines having different designs were already tested. The Pelton wheels had detachable features for ease of dismantling the buckets to measure erosion. The model Pelton turbine had 6 different materials namely 13Cr-4Ni, 16Cr-5Ni, 16Cr-4Ni martensitic steel, bronze, 13Cr-4Ni with plasma sprayed Cr₂O₃ coating and 13Cr-4Ni with WC-Co-Cr HVOF coating. A set of Pelton buckets for different material was sponsored by Andritz Hydro for erosion testing. The set-up has the provision to conduct erosion tests for both Francis and Kaplan turbine models in addition to Pelton turbine model.

Research Projects

Monitoring hydro-abrasive erosion, suspended sediments and efficiency reduction for optimal operation –

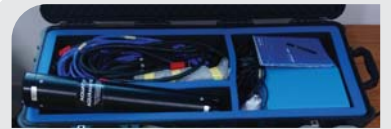
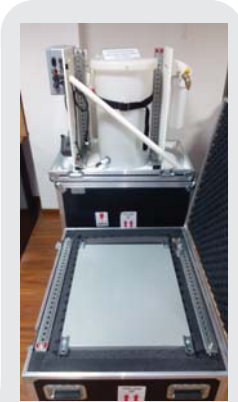
1. Allain Duhangan Hydropower Plant (2×96 MW) with Pelton turbines (Completed)
2. Baira Siul Hydropower Plant (3×60 MW) with Francis turbines (Ongoing)





Facilities

- **Online Laser Diffraction Sediment Sensor (LISST-Infinite)**
Make: Sequoia, USA
Measuring parameters: Sediment size and concentration continuously
Specification: PSD: 32 log-spaced size classes, 2.5 to 500 μm size range, SSC: Up to 30,000 ppm (mg/l)
- **Online Multi-frequency Acoustic Sensor (Both AQUAscat 1000R & AQUAscat 1000S Models)**
Make: Aquatek, UK
Measuring parameters: Sediment size and concentration continuously
Specification: PSD: 20 μm to 500 μm
SSC: 0.01 g/l to 20 g/l over 1 m
- **Portable Online Turbidity and Suspended Solids Sensor (Solitax)**
Make: Hach, USA
Measuring parameters: Turbidity and suspended sediment concentration continuously
Specification: (0.001 to 4000) NTU, 0.001 mg/L to 50 g/l)
- **Online Turbidity and Suspended Solids Sensor for use in Open Channels (VisoTurb 700 IQ)**
Make: xylem (YSI), USA
Measuring parameters: Turbidity and Total suspended solids (TSS)
Specification: Turbidity: Up to 4000 NTU/FNU
TSS: Up to 400 g/L
- **Sediment Size and Shape Analyser (Camsizer XT)**
Make: Retsch Technology GmbH, Germany
Measuring parameters: Sediment size and shape distributions
Specification: PSD: 1 to 3000 μm
Shape: Aspect ratio, roundness etc.



- **3D Scanner System Tripod Based (COMET L3D) - Camera, Positioning System, Additional Field of View, Geomagic Design X Software**

Make: Carl Zeiss Optotechnik GmbH, Germany

Measuring parameters: 3D Scanning of turbine and other plant components for erosion and analysis of scanned components

Specification: Recommended part size range: 0.1 to 4 m, Accuracy: 20 μm

- **Portable Hand Held 3D Scanner (HandySCAN 700)**

Make: Creaform Inc., Canada

Measuring parameters: Erosion in turbine and other plant components

Specification: Resolution: 50 μm

Recommended part size range: 0.1 to 4 m

- **Surface Roughness Tester (SurfTest SJ-411)**

Make : Mitutoyo Pvt. Ltd., Japan

Measuring parameters: Surface roughness, Effect of erosion in turbine and other plant components

Specification: Measuring range: X-axis 25 mm, Z-axis 800 μm , Resolution: 0.000125 μm

- **Sieve Analyser (Analysette 3 Pro)**

Make: Fritsch GmbH, Germany

Measuring parameters: Sediment size analysis

Specification: Both dry and wet sieving, Precision sieves: 20 μm to 1 mm

- **Portable Laser Diffraction Sediment Sensor (LISST Portable XR)**

Make: Sequoia, USA

Measuring parameters: Sediment size distribution and concentration

Specification: PSD: 0.34 to 500 μm size range in 44 log-spaced size classes

SSC: 30 to 1,900 mg/l

- **Portable Laser Diffraction Sediment Sensor (LISST Portable)**

Make: Sequoia, USA

Measuring parameters: Sediment size and concentration

Specification: PSD: 32 log-spaced size classes, 1.25 to 250 μm size range

SSC: Up to 5,000 ppm (mg/l)



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