Fact Sheet

CRREL'S REFRIGERATED FLUME

CRREL's flume is situated in a room where the temperature can be refrigerated down to –25° F. The flume is 2 by 4 feet in cross section and 120 feet long. It can tilt from +2° to –1° slope, have a flow capacity of nearly 14 cubic feet per second, and have a refrigerated bottom. Some other studies conducted in the flume are the formation of ice covers and frazil ice, the hydraulics of ice-covered rivers, the formation of ice jams, and the effect of ice covers on sediment transport and scour.

PREVIOUS RESEARCH STUDIES

- Basic research of frazil ice process and control
- Effect of ice covers on sediment transport and scour
- Effects of frazil ice on a fish's respiratory system
- Effect of waves on ice formation process

Testing the effects of frazil ice on a fish's respiratory system.

EXISTING AMENITIES

Flume

- 120 ft long by 4 ft wide; 2-ft-high glass side panels
- Tilting bed from +2º to –1º slope
- Recirculating sediment
- Super cooling ramp to cool water before it enters the flume, increasing the usable length of the flume for frazil ice studies
- Recirculating glycol in the bed to either refrigerate or heat the bed
- Heated louver gates or adjustable weir at the tailbox or downstream end of the flume to control water level

Wave Maker

- Paddle type for regular waves

Carriages

- Instrumentation carriage: A rack and pinion drive moves the carriage up and down the flume or X-axis. A lead screw on the front edge of the carriage is used to move the attached instrument across the flume or Y-axis. Both axes have a computer-controlled motor with shaft encoders on each axis for closed-loop position feedback. Communication (10-pair shielded low voltage instrumentation cable, network, and coax video) and power (120 and power for the respective motors) is brought onto the carriage via festoon.
- Work platform: This is a robust carriage designed for instrumentation that would be manually positioned before taking data. For the sediment work, a bed level system is attached to this carriage.

Refrigeration

- Recirculated ammonia refrigeration system can refrigerate the room to –25 ºF (–31ºC) using two zones or eight units
- Computer controlled with archiving of 15 minute data to document freezing environment
- Continuous operation of air units with hot gas defrost when unit efficiency falls below effect level

Instrumentation

- Thermistors for temperature measurement
- Laser for bed profiling
- Pressure sensors for monitoring water levels and waves
- Sontek acoustic Doppler velocimeter capable of measuring both the mean flow and turbulence in three directions

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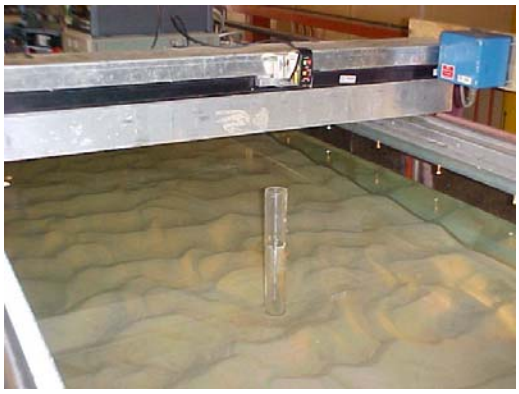

Effects of an ice cover on scour at bridge piers.

Data Acquisition Systems

- Hart Scientific high-resolution temperature sensing system
- 0.001ºC (0.01ºC accuracy), 10 channels
  - 2 SPRTs NBS traceable
  - Calibration by comparison method for up to 8 thermistors
- Lab View high-resolution multi-function I/O
  - 16 bit 100 Khz A/D, 16 SE or 8 Diff channels
  - Programmable gain 1, 2, 5, 10, 20, 50, 100
  - 2 ANA output channels +/– 10 Vdc, or 0–10 Vdc
  - 8 I/O channels TTL compatible
  - 4 slot expander chassis to increase channel density with MUX
  - Signal conditioning for RTDs, thermistors, millivolt. Voltage, current, strain gauges
  - Pressure, flow, temperature, force, moment, event triggering, and near-real-time, automated, process documentation, including video and summary data to WEB

Recirculation Pumps

- P16, 1850 gpm (0.12 m^3/s) with closed loop feedback system, including frequency drive on the pump, Fisher Porter NIST traceable magnetic flow meter with 1/4 % accuracy and Fisher-Porter controller. Pump is rubber-lined to recirculate sediment.
- P17, 4000-gpm (0.25 m^3/s) rubber-lined pump for sediment that is currently configured using external control valves

Water Management

- Water drawn from a reservoir in the basement of the facility is cooled using submerged refrigeration coils or heated using an inline shell and tube heat exchanger.
- Air bubblers are used to agitate the water in the reservoir to keep the sediment in suspension and ensure that the water is isothermal.
- Sand filtration system is used to maintain water quality; if required, additional filtration can be done using cartridge filter.

Miscellaneous

- Monorail with 2-½ ton (22.2 kN) crane on the center line of the flume
- Wind current generated by two independent fans resting on rails

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