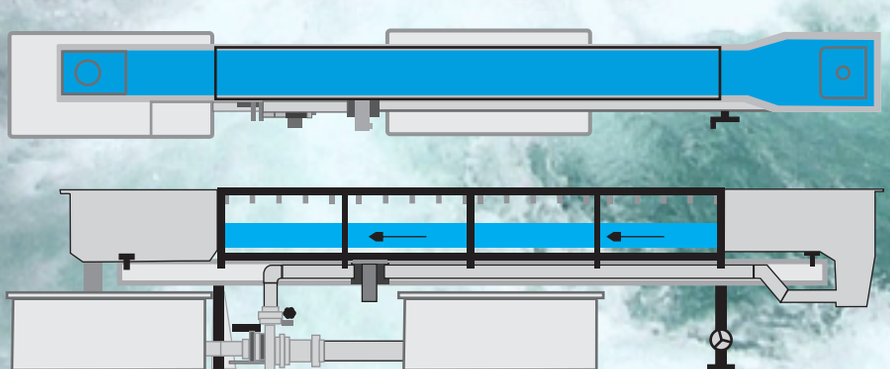
Flumes for Teaching & Research Studies



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Engineering Growth Connection

K.C. ENGINEERS LIMITED

AN ISO 9001:2015 CERTIFIED COMPANY

Achieve the Extra Ordinary

LABORATORY FLUMES
FOR TEACHING & RESEARCH STUDIES

SPECIALIZED STANDARD FLUME WITH EXCLUSIVE FEATURES

Introduction

K.C. ENGINEERS LIMITED has been designing open channel facilities (sometimes referred to as flumes) and supply to hydraulic laboratories throughout the world. There are general comments about the design, flexibility and accuracy of flumes in order to assist those embarking on the specifying purchase of flumes for advanced studies or research. Some structural design key features of KC experimental Flume are given below:

Major Design Key Features

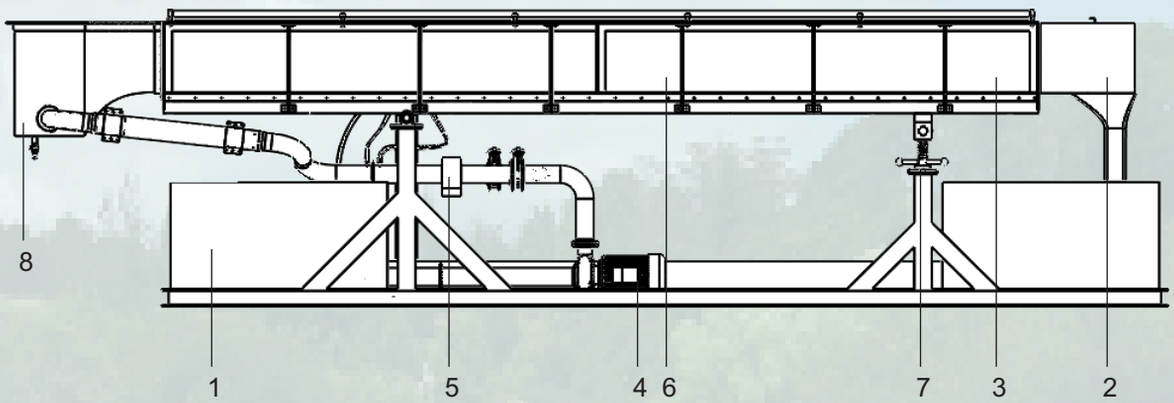
- ✓ Accurate for education and research projects.
- ✓ Fabricated high precision stainless steel channel bed
- ✓ Floor space requirements reduced to a minimum
- ✓ Close tolerances specified and achieved
- ✓ Designed for clear visibility: Transparent toughened glass sides which is extremely strong, abrasion & scratch resistant, dimensionally stable, does not deform and is inherently safe.
- ✓ Non-corroding, durable materials used throughout for water contacting surfaces.
- ✓ Open circuit or re-circulating sediment load.
- ✓ Precision screw jacks provide accurate slope adjustment with minimum effort.
- ✓ Adjustable instrument rail with positioning scales are fitted over the whole working length
- ✓ Best measuring Instruments like Level gauge, velocity meter, Pitotstatic tube and manometer tube set etc.
- ✓ KC Experimental flumes having a comprehensive range of accessories, instruments and models.
- ✓ Wave generation options
- ✓ Easily useable with guiding instruction manuals.
- ✓ Experimental flume can be extended stepwise by 2.5m by adding an extension element for enlargement purpose.
- ✓ Computer Control, Data Acquisition card and specialized KC Software Packages based on LabVIEW, for controlling various parameters involved in the process.

Customizable Key Features

Depending on customer requirements, channels can be designed to incorporate the following numerous design features associated with Flume:

- ✓ Choice of working section materials (glass, metal)
- ✓ Choice of working length.
- ✓ Self-contained or laboratory supplied water.
- ✓ Open circuit or re-circulating sediment load.

TECHNICAL DETAILS
OF LABORATORY FLUME



1) Water Tank, 2) Outlet Element, 3) Toughened Glass, 4) Pump, 5) Flow Rate Sensor, 6) Experimental Section, 7) Inclination adjustment, 8) Inlet element

The dimensions of the flume like Length, Width, Height are the principal features which effects both the functional suitability and the cost of a channel. We are providing different flumes with different range of width and depth given in table below:-

Product Code	Width, mm	Depth, mm	Various Lengths in multiple of 2.5 m	
			Minimum Length, m	Maximum Length, m
KCFM-404	80	250	2.5	5.0
KCFM-405	100	250	2.5	5.0
KCFM-406	150	350	2.5	5.0
KCFM-407	200	450	2.5	7.5
KCFM-414	250	450	4.0	10
KCFM-408	300	450	5.0	12.5
KCFM-409	400	600	5.0	15.0
KCFM-410	410	500	7.5	15.0
KCFM-411	600	600	7.5	15.0
KCFM-412	600-2000	800-1500	12	30.0

Note: Overall Length is longer than the working section defined.

Detail For Experimental Flume

Structural Features

- Rigidity against Deformation
- Inclination Arrangement

Closed Water Circuit Features

- Inlet and outlet discharge tank
- Pump water flow circulation System
- Flow measurement and variation

Instrumentation

- Instrument Carrier
- Level Gauge
- Velocity Measurement

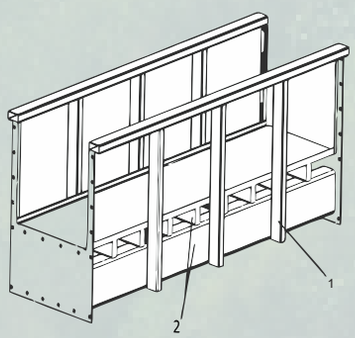
Experimental Accessories

- Wave generator and beach
- Sedimentation feeder, feed controller and sediment trap

Structural Features

Rigidity Against Deformation:

The materials of construction are of paramount importance, not only for the durability and longevity required of an expensive piece of equipment, but also suitability for purpose. For all experimental flumes we can state that, with careful design, the maximum deviation from the ideal geometric shape for flatness and torsion is 0.1% of the length. As shown in fig. Bottom element of the experimental section, reinforced with SS rectangular tubes (denoted by 2) Raw Material is purchased by the branded company like TATA or equivalent company to increase stiffness against bending and torsion. The rigidity of the elements of the experimental section against water pressure is ensured by the welded frame (denoted by 1).

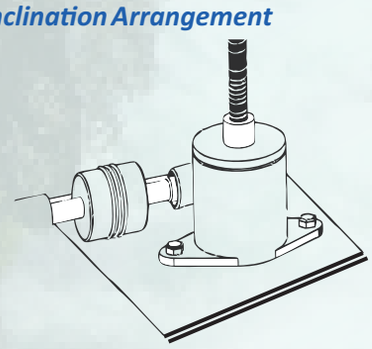


1) Side supporting element

2) Bottom supporting elements

*Professional enables engineers to determine mechanical resistance, Flume durability of every part is analyzed in SOLID WORKS simulation with the consideration of high FOS.

Inclination Arrangement



Jacking System

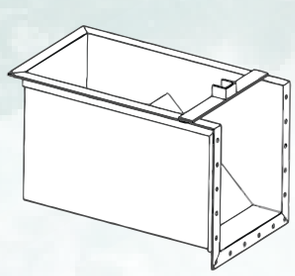
Many areas of study require or are enhanced by using flumes with a tilting capability. This mostly translates into positive slope but sometimes there is the requirement for negative slope. The most important aspect of a tilting flume is retaining the integrity of the working section, i.e., maintaining tolerances.

For Tilting phenomena, flumes need jacks to change its slope and can be done by chain drive and hydraulic lifting phenomenon. It can be done manually or electrically. Long flumes need a series of jack station to change the slope. Some other features such as indicators for setting slope and soft bearing to limit noise are included.

Closed Water Circuit Features

Inlet and outlet discharge tank

In all experimental flumes, the inlet element is designed for optimum flow so that the flow is less turbulent as it enters the experimental section. The outlet element of all experimental flumes contains a plate weir. A maximum of two elements can be removed from this weir, so that two damming heights are available to choose from. The method of controlling the level of water with in the flume has great importance and can be done through a weir at the discharge tank. The weir is flap type and can be adjusted at the different angles to obtain different height or level of water by the help of rope.



Outlet Tank with Weir

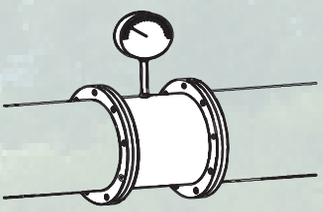
Pump water flow circulation System

Centrifugal Pump

The centrifugal pump is separated from the experimental section in both experimental flumes and is mounted on its own foundation. It is connected to the piping to the inlet element via a hose. This ensures that there is no transmission of vibrations between the experimental section and the pump. In the small KC experimental flume the vibrations that occur are negligible, so the pump is integrated in one of the experimental flume's supports.

Flow measurement and variation

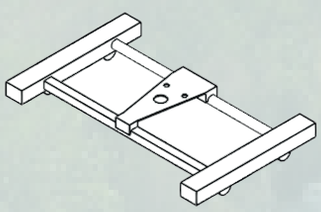
During the experiment, we can work on different flows (flow rates) which can be achieved by adjusting the handle of butterfly valve and measured by an electronic or mechanical flow measuring device.



Flow Measuring System

Instrumentation

Instrument Carrier



Instrument Carrier / Trolley

During the experiment, we use many kind of accessories and to measure position transverse to the direction of flow, we need measuring equipment like pointer gauge at different location which can be achieved by movement of instrument carrier or trolley. Instrument carrier has movement on the complete flume and pointer gauge has the movement on complete length of the instrument carrier with both longitudinal & transverse movement and position lock.

Level Gauge & Velocity Measurement

Accessory for measuring purpose: It is important to know the discharge depth for many experiments in open channel flow. The discharge depth can be measured using the level gauge. Level gauge may simple or digital.

The core element of flume is a probe tip or a hook. The instrument travels vertically. The discharge depth is directly read on a digital display. The probe tip is made in way enabling to easily observe when the tip touches the water surface. Determination of discharge velocity in the experimental flume with the help of velocity meter. The core element of the velocity meter is an impeller that is rotated by the flow. The speed of the impeller is proportional to the flow velocity. The flow velocity is read directly from the digital display.

Velocity Meter

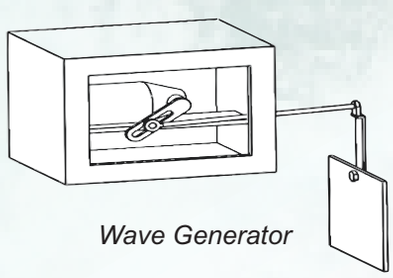
Level Gauge

Experimental Accessories

(1) Wave generator and beach:

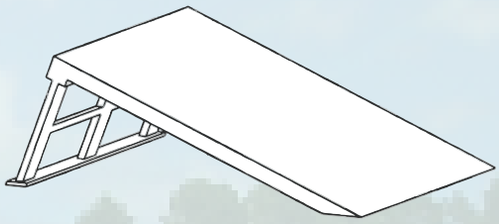
"Waves carry energy, but no mass"

The study of wave effects is an important field in coastal protection and design of offshore systems. The K.C. ENGINEERS manufactured simple, regular, flap-type wave generator designed to be mounted on the flume discharge tank. The waves are generated by the reciprocating motion of the weir attached at the end of the linkage.



Wave Generator

Wave absorption beach is used to reduce the effect of reflected waves. We can observe wave reflection at the end of a flume with the various beach simulations and it is possible to compare the behaviour of the same waves on different beds.

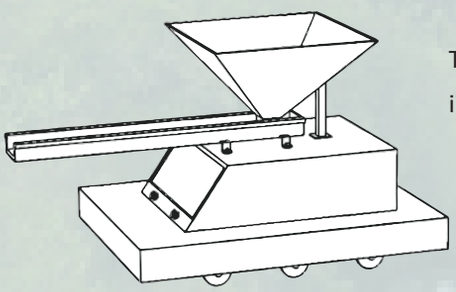


Beach

(2) Sedimentation feeder, feed controller and sediment trap

Feeders are used to feed the sediment in the working section. K.C. ENGINEERS designed two type of feeder's.

(I) Vibrating conveyor type sediment feeder

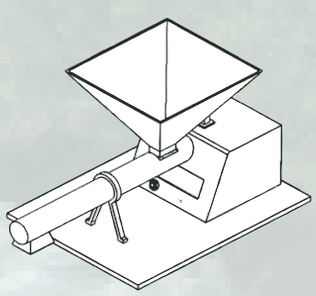


Vibrating Conveyor Sediment Feeder

The sediment feeder essentially consists of a vibrating conveyor, via which sediment is introduced into the experimental section.

(ii) Screw conveyor type sediment feeder

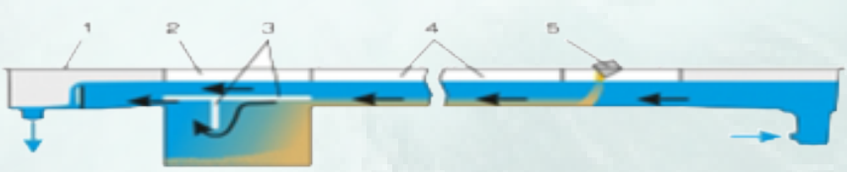
This feeder essentially consists of a screw conveyor, via which sediment is evenly introduced into the experimental section. The feeder can be mounted above the inlet of the experimental section.



Screw Conveyor Sediment Feeder

Sediment Trap

The purpose of the sediment trap is to separate sediment from the flow to prevent entering of sediment in pump or flow meter. The sediment trap is mounted between experimental section and outlet element.



Operational, Construction & Designing Details

Utilities Required

- Electricity supply: 440V AC, 50 Hz, required Earth voltage should be less than 5 volts.
- Water Supply: Initial fill.
- Laboratory drain.
- Pump consumption: 7.5kw

Material of Construction

The material of construction have importance, not only for the durability and longevity of equipment, but also for suitability of experimentations. Many flumes are used for sediment transport studies and therefore the used materials for contact with the sediment have abrasion resistance.

Clarity of flow visualization is also an important factor but water containing harsh particles, such as sediment, will quickly damage any soft material. This is why all flumes are constructed with toughened glass, may be a small length or full length working sections. Toughened glass is also used because of its safety feature. For example, if the glass panel break in an unlikely event then it will break into small harmless cubes instead of dangerous sharp corners. Wherever possible all the components in contact with water are made of non corroding materials, such as glass, GRP or stainless steel. Pumps are usually of cast iron but where sediment is involved, we recommend the use of special pumps.

Experimental Models & Instrumentations

A comprehensive range of experimental models and measuring instruments is available for selection. These provide the basis for a large number of practical experiments in open channel. Wherever possible non-corroding materials have been used to reduce maintenance time and increase the working life of the models.

Optional Accessories

1. Sluice gate	12. Venturi flume	21. Frictional Block
2. Radial gate	13. Parshall flume Culvert	22. Vibrating piles
3. Set of plate weir four type	14. Trapezoidal flume	23. Close Sediment Circuit
4. Broad - crested weir	15. Sill	24.Sediment Trap
5. Crump weir	16. Culvert	25.Sediment Feeder
6. Siphon weir	17. Set of piers, seven profiles	26. Wave Generator
7. Air Regulated Syphon weir	18. Flume bottom with pebble stone	27.Set of Beaches
8. Rake	17. Hump Weir	
9. Ogee-crested weir with pressure measurement	18. Spillway	
10. Ogee-crested weir with two weir outlets	19. Standing Wave Flume	
11. Elements for energy dissipation	20. Dam Spillway	

*The details of some of the listed accessories are as under:

Sluice Gate

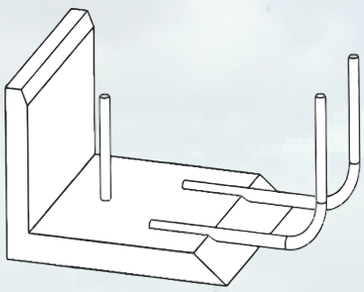
Sluice gates are movable control structures. The water flows under the gate. A sluice gate is a vertical wall causing backwater in the flume. Sluice gates are often used to ensure a minimum upstream discharge depth at varying discharge, e.g. for shipping.

Sluice Gate

Radial Gate

Radial floodgates are part of movable control structures and are normally used together with fixed control structures to adjust the flow according to the necessity. The water flows under the gate. The core element of a radial gate is a wall with the shape of a segment of a circle. The gate causes backwater in the flume.

Set of Plate Weirs

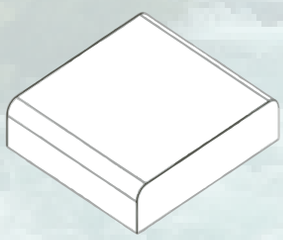


Set of Plate Weirs

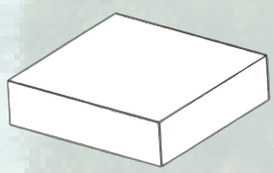
Sharp-crested weirs are control structures causing a defined backwater. Additionally, they are often used to determine the discharge of an open channel. Set of weirs contains four different plate weirs as sharp-crested weirs. The fundamentals of flow over sharp-crested weirs are demonstrated with the rectangular weir with optional aeration. The other weirs are typical measuring weirs with defined openings: the opening of the Thomson weir is triangular, the opening of the Rehbock weir is rectangular and for the Cipoletti weir, it's trapezoidal. Plate Weir use for Mounting block, for a range of interchangeable plate weir that are included in the supply: Sharp crested weir.

Broad Crested Weirs

Broad crested weirs have a lower discharge capacity for the same water load than sharp-crested weirs. They are most frequently used as level control structures, although they can also be calibrated and used as flow measurement structures. Broad-crested weirs are control structures. Often, submerged overfall prevails so that the weir is fully submerged in the downstream water. Under certain conditions, broad-crested weirs can be used as measuring weirs. Free and submerged overfall can be clearly demonstrated. The effect of the sharp-edged or rounded weir crest on the nappe is easily observable.



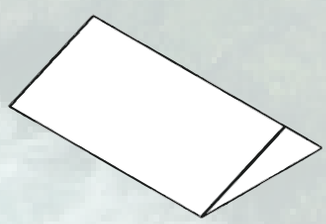
Weir with Round Corner



Weir with Sharp Corner

Crump Weir

Crump weirs are control structures. It is a weir with triangular longitudinal profile, triangular transverse profile and smooth slopes. It is normally used as sill to reduce the flow rate and prevent erosion.



Crump Weir

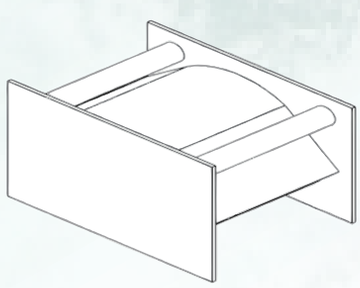
Syphon Spillway

Syphon Spillway

One way to regulate the water level in a channel is by using syphons. Syphon weirs are part of fixed weirs. They are installed as spillways in reservoirs and have a high specific discharge capacity.

Air Regulating Syphon

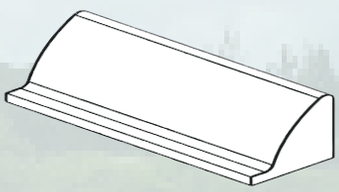
One way to regulate the water level in a channel is by using syphons. Syphon weirs are part of fixed weirs. They are installed as spillways in reservoirs and have a high specific discharge capacity. When the level exceeds a specific height water flows through the syphon, being the upstream level regulated.



Rake

Rakes are used in hydroelectric power plants and in wastewater treatment plants to retain coarse material that may damage the plant. Similar to piers, rakes constrict the flow cross-section possibly leading to backwaters. Depending on the bar spacing, the bar profile and the bar inclination, the backwater may be little or considerable.

Ogge With Pressure Measurement



The pressure distribution along the downstream side of the weir are studied with Ogge Weir. Eight pressure measuring points included in the downstream side of the weir and determination of discharge and head.

Ogge Weir With Two Outlet Weir

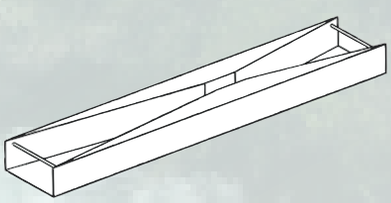
Ogee-crested weirs are fixed weirs and form part of control structures. A flow transition to supercritical discharge occurs during flowing over the weir body. At the end of the weir downstream side, the supercritical discharge has a high flow energy.

Element of energy Dissipation

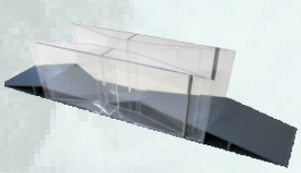
The flow acquires kinetic energy during its descent. Kinetic energy dissipation is achieved by applying different measures: generation of hydraulic jump, impact or roughness increase

Venturi Flume

Venturi flume has a contracted section called throat, downstream of which follows a flared transition section designed to restore the stream to its original width. It is an open channel counterpart of a Venturi meter, which is used for measuring discharge in open channels.



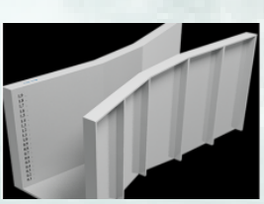
Parshall Flume



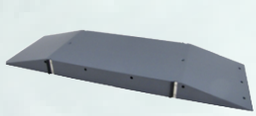
The two most common methods of determining the discharge of a flume are flow-measuring flumes and measuring weirs. In both methods, there is a fixed relationship between discharge depth and discharge capacity.

Trapezoidal Flume

Trapezoidal flumes are one type of flow-measuring flumes. The flow cross-section is triangular or trapezoidal with smooth walls. In contrast to Parshall flumes, they often have a smaller pressure head loss for the same discharge and are more suitable for small discharges.



Sill



Sills are used to reduce the flume slope to decrease erosion processes at the flume bottom. Usually, they are designed as a step downstream.

Culvert

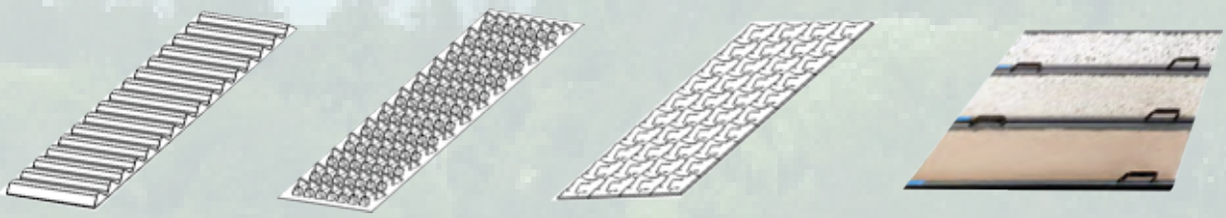
Culverts are crossing structures in running waters and allow the passage of water. They may be pipes that are laid under a road, allowing the flume to cross. full flow through culvert and partially filled culvert according to design.

Set of Piers, Seven Profiles

Obstacles in flumes reduce the flow cross-section. This may lead to backwaters upstream of the obstacles. Set of piers contains several piers with different profiles typical for bridge piers. The discharge behaviour with little reduction of cross-section is studied with a single pier.

Pebble Bottom or Roughened Bed

The flow behavior in a river depends particularly on slopes and the roughness of the base of the channel. Three different roughened beds and pebble bottom are used to observe discharge through roughness.

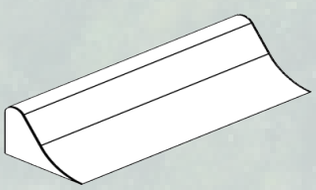


Hump Weir

Single pressure tapping at apex, which is extensively used in the environmental monitoring programme. The hump weir has a higher discharge capacity per unit width which is reflected through the large value for the discharge coefficient for the hump weir.

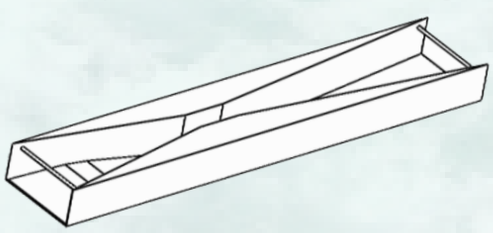
Spillway

The spillway is type of fixed weir. Its body is made of non-corrosive material and locked in a place in the measuring section.



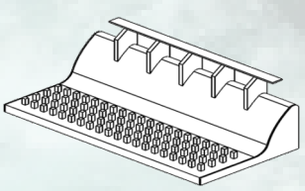
Standing Wave Flume

A standing wave flume is a structure in a channel which has a narrowed throat having a raised floor or hump at the bottom. The downstream of the throat section is followed by a flared transition section designed to restore the stream to its original width.



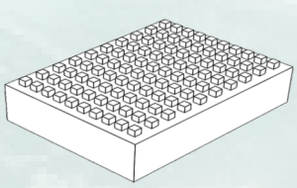
Dam Spillway Models

Complete with the following interchangeable downstream sections : spillway toe



Friction Block

A friction blocks having rough surface made of non corroding material.



Vibrating Piles

Drilling platforms usually stand in the water on piles. Flowing water exerts forces on the part of the piles that is located under water, possibly causing vibrations. The vibrations can lead to component failure. In vibration of a single pile observation of a Karman vortex street, effect of the od diameter.

Measuring Instruments

1. Level Gauge
2. Digital Level Gauge
3. Velocity Meter
4. Pitot Static Tube
5. Ten tube manometers
6. Electronic Ten Tube pressure measurement
7. Instrument Carrier

Other Accessories :

1. System for data acquisition and automation
2. Electrical inclination adjustment
3. Extension element of the experimental flume
4. Water Tank

Customized Flumes

We are also supplying customized flumes. Many of these flumes are installed in Education and Research Institutes. Two of them are described below :

1. Hydraulic Flume : Supplied to Indian Institute of Technology Madras (IITM), Chennai with following dimensions :

Length, mm	Width, mm	Height, mm
15000	900	1000

2. Hydraulic Flume : Supplied to Shiv Nadar University, Gautam Budh Nagar, Noida, U.P. with following dimensions :

Length, mm	Width, mm	Height, mm
7000	300	500

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