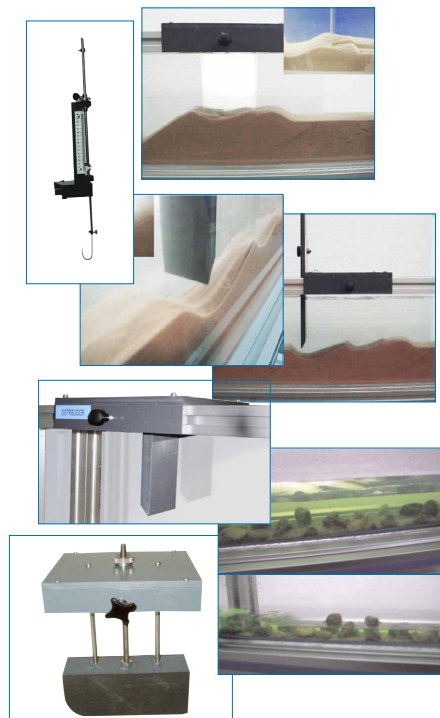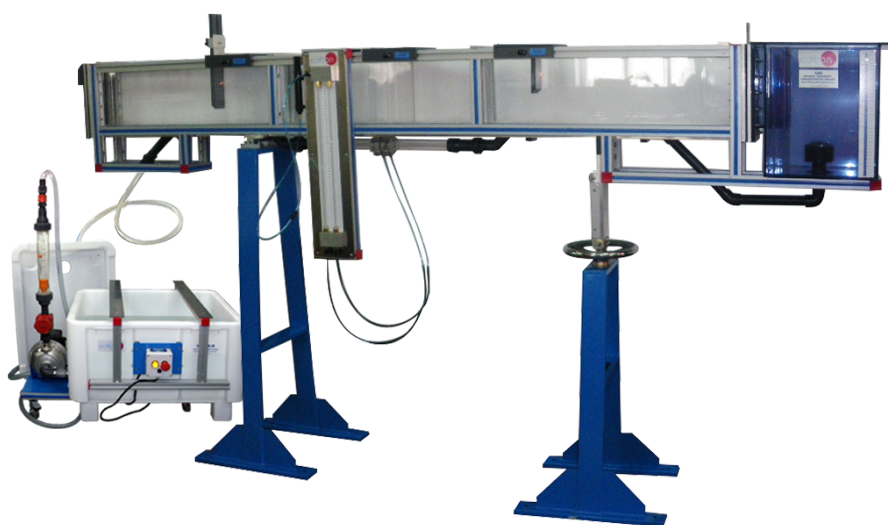# Sediment Transport Demonstration Channel

CAS

Some available accessories

GENERAL DESCRIPTION

The EDIBON Sediment Transport Demonstration Channel "CAS" allows demonstration of the full range of bedforms that arise in a mobile bed as the slope and / or flow are increased.

This unit can play a useful role in any course concerting the mechanics of open channel flow and sediment transport.

The unit consist of an inclinable channel mounted on a base plate, supported by two supports, with a discharge tank and recirculating pump. This tank is in the basic hydraulic feed system "FME00/B" that contains the recirculating pump.

The channel sides are transparent allowing the observation of bed profile changes, and a section of one side is provided with graphical grid markings to permit quantitative assessments to be made of bedform dynamics.

A water level gauge is included to measure the head over the channel discharge weir and therefore to deduce flow rates from a calibration chart. For demonstrating scour effects of structures on rivers beds, solids models, as an adjustable undershot weir and bridge pier are supplied.

To start a demonstration, sand is placed along the channel bed, between the inlet tank and the overfall discharge weir. Water is circulated around the system at one of the flow rates. The slope of the channel is adjustable.
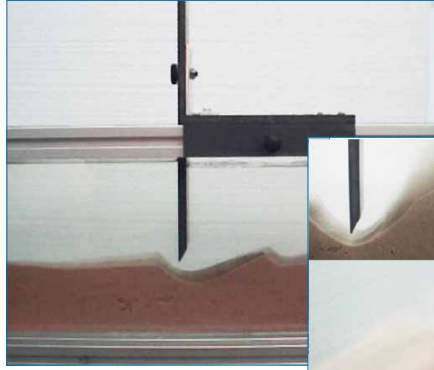
Available accessories

CFRM. Level Gauge for Measurement of the Water Height (Hook and Point Gauge)
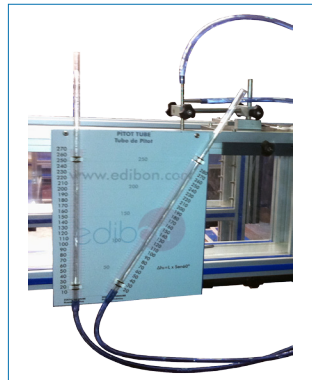

CFPS. Single bridge pier

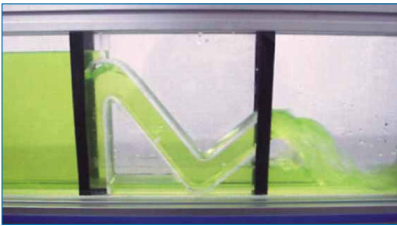CFPR. Adjustable Undershot Weir

CFDA. Sand distributor

CFTP. Pitot tube and manometer board

CFVDG. Broad and thin crested weirs

CFSDL. Syphon spillway
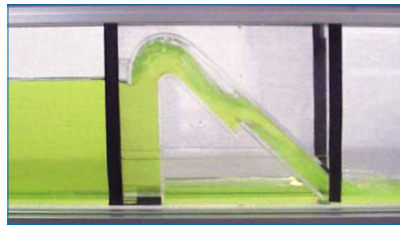
CFSDS. Air regulated syphon

CFVC. Crump weir
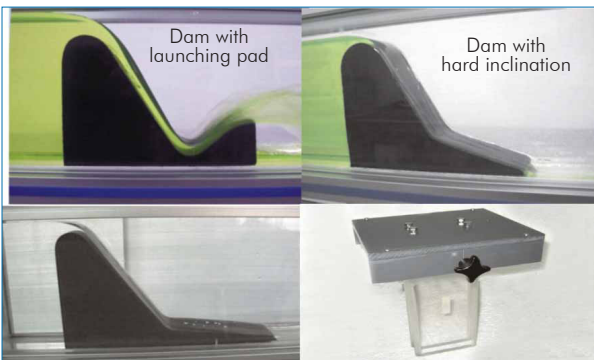
Dam with launching pad
Dam with hard inclination
CFPVP. Dams spillway and flow splitters (3 different models of dams)
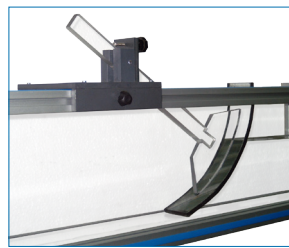
CFCVR. Vertical Flat Gate and Radial Gate

CFCA. Culvert fitting

CFVEN. Venturi flume

CFPLR. Artificial roughened bed (3 different models)

CFFS. False floor sections

Detail of some bedforms and effects on beds of different structures
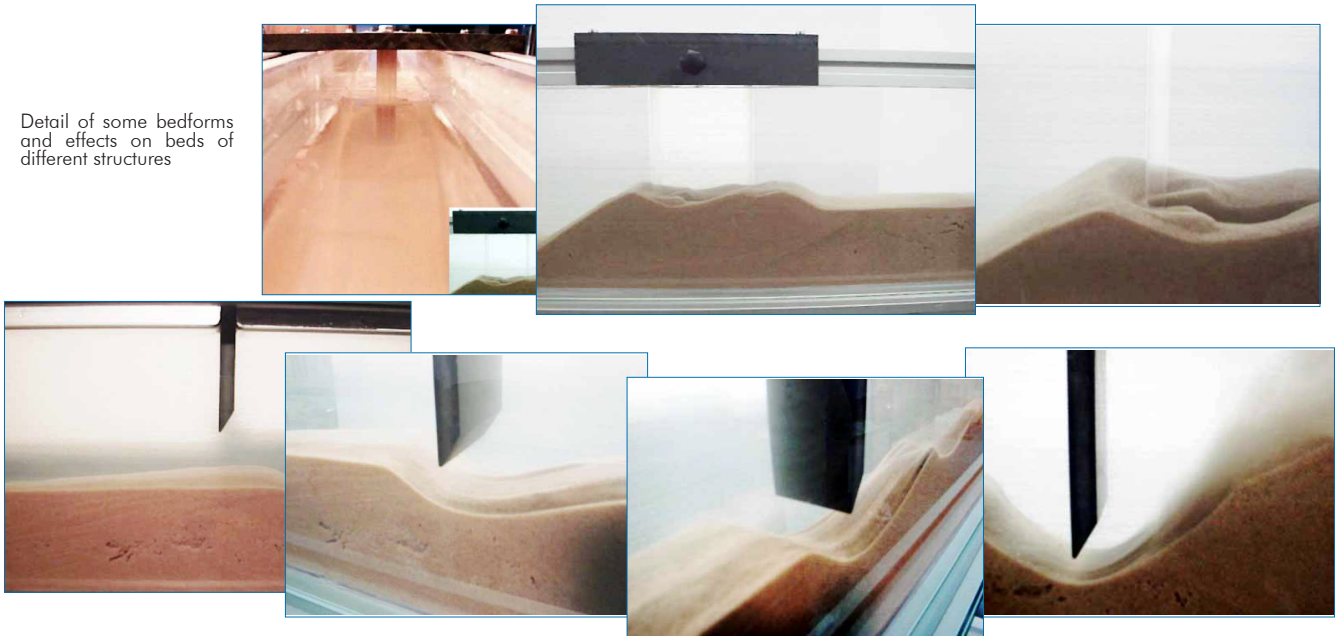
SPECIFICATIONS

Transparent, inclinable flow channel through which water can be recirculated by a pump over a mobile bed to demonstrate the whole range of bed forms from incipient particle movement to bed wash-out.

Anodized aluminum structure and supports in painted steel.

Transparent, inclinable flow channel through which water can be recirculated by a pump over a mobile bed to demonstrate the whole range of bed forms from incipient particle movement to bed wash-out.

Channel of rectangular section with transparent walls.

Channel section: 80 mm, lenght: 2.5 m.

The channel is assembled on two supports, with a system to control the inclination of the channel. Channel slope: adjustable between 0 % – 10 %.

The unit is self-contained and it can be installed with easiness, and it has a complete range of profiles.

Inlet tank (capacity: 38 l), with stilling of flow and with drain valve.

Pipes. Diaphragm flow meter.

Sediment filter in tank and inlet section.

Manometric tubes panel. It is formed by two methacrylate tubes of 500 mm of length, with a graduated panel. Hand pump.

The grain diameter of the sediment oscillates among 0.1 – 0.3 mm.

Accessories included:

CFRM. Level gauge for measurement of the water height (hook and point gauges), to calibrate the overshot weir.

CFDA. Sand distributor.

CFPR. Adjustable undershot weir.

CFPS Single bridge pier.

CFCV. Vertical flat gate.

The speed of discharge can be selected by means of the valve that is placed in the Basic Hydraulic Feed System "FME00/B".

Basic Hydraulic Feed System "FME00/B":

Centrifugal pump: 0.37 KW, 30 – 80 l/min at 20.1 – 12.8m, single-phase 220V/50Hz or 110V/60Hz.

Stainless steel impeller. Tank capacity:140 l approx. Flowmeter. Membrane type flow adjusting valve. Safety differential switch.

Cables and accessories, for normal operation.

Manuals: This unit is supplied with the following manuals: Required Services, Assembly and Installation, Starting-up, Safety, Maintenance & Practices Manuals.

Optional accessories:

CFTP.   Pitot tube and manometer board.

CFVDG. Broad and thin crested weirs. (One broad weir and 2 thin weirs)

CFCVR. Vertical flat gate and radial gate.

CFSDL.   Syphon spillway.

CFPVP. Dams spillway (3 different models) and flow splitters.

CFCA.   Culvert fitting.

CFVC.   Crump weir.

CFVEN.   Venturi flume.

CFSDS.   Air regulated syphon.

CFFS.   False floor sections.

CFPLR.   Artificial roughened bed (3 different models).

EXERCISES AND PRACTICAL POSSIBILITIES

Flow over a mobile sand-bed

(bedforms associated with increasing flow intensity and sediment transport rate)

1.- Lower Regime (bedforms exhibed):
  - Plane- bed (no motion).
  - Ripples and dunes.
  - Washed- out dunes.
  - Ripples.
  - Dunes.

2.- Upper Regime(bedforms exhibed):
  - Plane- bed (with motion).
  - Chutes and pools.
  - Anti- dunes.
  - Breaking anti- dunes.
  - Standing waves.

Flow over fixed, gravel-bed

3.- Although the channel can not transport gravel, this can be used to investigate flow resistance in gravel and polder- bed rivers.

4.- We can calculate the flow resistance coeficients, using equations such as those of Bray, Limerinos, Hey, Lacey, Thompson and Campbell and Bathurst and the results compared to the actual values obtained by observation.

Flow structures

5.- We can examine the structure of turbulence in the flow, using dye injection, interesting for the dune bedform configuration and clearly demonstrates separation on the lee face.

Fixed, smooth bed flow:

(the channel may be used without sediment on the bed to demonstrate several flow phenomena and equations)

6.- Rapid, super- critical flow- dominance of intertial over gravity forces, shock waves from flow obstructions.

7.- Turbulence.

8.- Governing equations of open channel flow-Reynold's number, Froude number, continuity, Bernoulli's equation, weir equations.

9.- Tranquil, sub-critical flow- movement of surface waves upstream against flow.

10.-Hydraulic jump- transition from super to sub critical flow, air entrainment, mixing.

11.- Flow measurement- using sharp crested weirs.

Bedform hysteresis:

12.-If the discharge in the channel changes quickly, there is no sufficient time for bedforms to adjust to the new flow regime. Hence, if a flood hydrograph is simulated by increasing and then decreasing the discharge, different depths will occur for the same discharge on the rising and falling limbs.

Data collection and numerical evaluation(computational work):

13.-In addition to illustrating flow and sediment phenomena, we can use the channel for basic data collection and numerical evaluation of the following:

- Flow resistance:

  Manning, Chezy and Darcy-Weisbach fricion factors for several bedform configuration.

- Bedform prediction:

  Velocity-Hjulstrom diagram.

  Suspended load-movement by suspension.

  Shields parameter-Bogardi diagram.

  Stream power-Simons and Richarson charts.

  Boundary shear stress-Leeder chart.

- Initiation of motion:

  Shields diagram.

  Hjulstrom's curve.

Mechanics of sediment transport

14.-We can observe the movement of grains, starting from a plane-bed with no motion, on the following:
  - Initiation of motion.
  - Trajectory of initial motion.
  - Movement by rolling and sliding (contact load).
  - Movement by hopping (saltation load).
  - Movement by suspension.

Depositionary features and facies

15.-We can observe the deposition of sediment load and the resulting patterns of grains within the sand body may be identified.

Local scour

16.-Scour under boils and vortices in the flow is observed under both the lower and upper regime bedforms. Obstructions may be introduced to represent bridge piers, sills, revetments, etc, and the resulting pattern of scour examined.

Other possible practices:

17.-Behaviour study of the connection to the drain of a channel with sendiment.

18.-Turbulence study by means coloration.

19.-Calculation of water flow.

REQUIRED SERVICES

- Electrical supply: single-phase, 220 V/50 Hz or 110 V/60 Hz.
- Water supply and drainage.
- Sand and gravel.

DIMENSIONS AND WEIGHTS

CAS:
  - Dimensions: 3600 x 1000 x 1700 mm approx.
  - Weight: 250 Kg approx.

CFTP.   Pitot tube and manometer board.

CFVDG.   Broad and thin crested weirs. (One broad weir and 2 thin weirs)

CFCVR.   Vertical flat gate and radial gate.

CFSDL.   Syphon spillway.

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CFSDS.   Air regulated syphon.

CFFS.   False floor sections.

CFPLR.   Artificial roughened bed (3 different models).

CAS/ICAI. Interactive Computer Aided Instruction Software System:
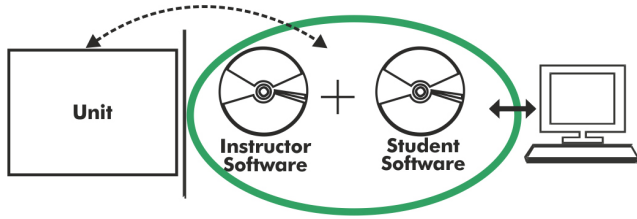
With no physical connection between unit and computer, **this complete software package consists of an Instructor Software (EDIBON Classroom Manager -ECM-SOF) totally integrated with the Student Software (EDIBON Student Labsoft -ESL-SOF).** Both are interconnected so that the teacher knows at any moment what is the theoretical and practical knowledge of the students.
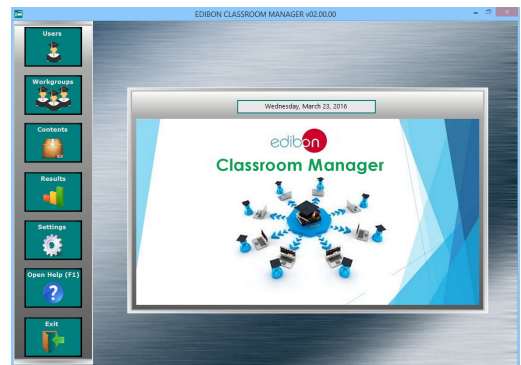

Instructor Software

- ECM-SOF. EDIBON Classroom Manager (Instructor Software).

ECM-SOF is the application that allows the Instructor to register students, manage and assign tasks for workgroups, create own content to carry out Practical Exercises, choose one of the evaluation methods to check the Student knowledge and monitor the progression related to the planned tasks for individual students, workgroups, units, etc... so the teacher can know in real time the level of understanding of any student in the classroom.

Innovative features:

- User Data Base Management.
- Administration and assignment of Workgroup, Task and Training sessions.
- Creation and Integration of Practical Exercises and Multimedia Resources.
- Custom Design of Evaluation Methods.
- Creation and assignment of Formulas & Equations.
- Equation System Solver Engine.
- Updatable Contents.
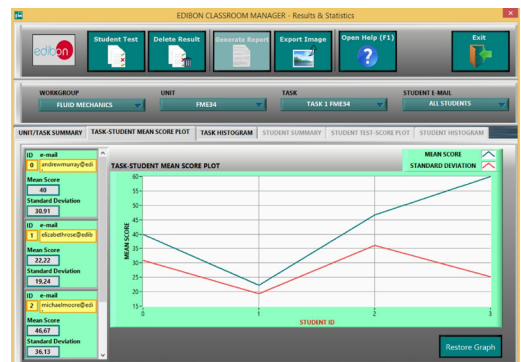- Report generation, User Progression Monitoring and Statistics.

ECM-SOF. EDIBON Classroom Manager (Instructor Software) Application Main Screen
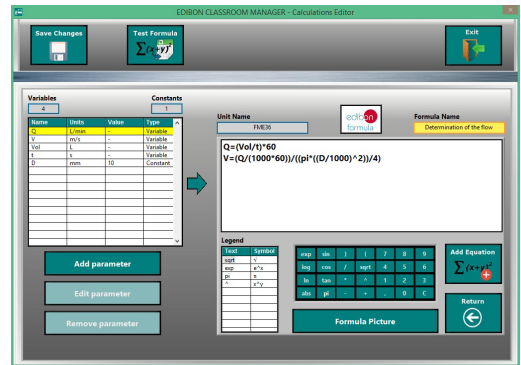
ECAL. EDIBON Calculations Program Package - Formula Editor Screen
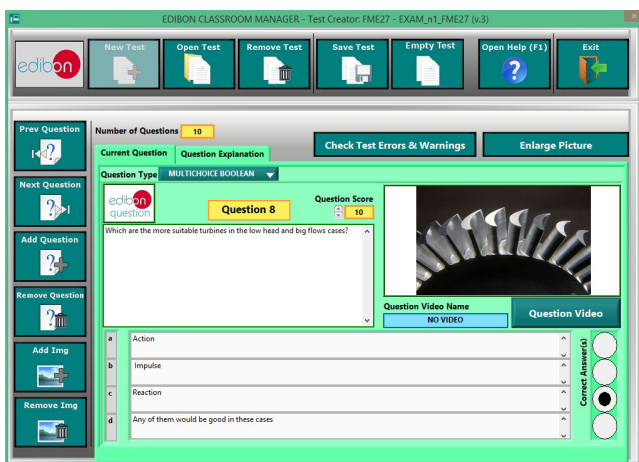
ETTE. EDIBON Training Test & Exam Program Package - Main Screen with Numeric Result Question

ERS. EDIBON Results & Statistics Program Package - Student Scores Histogram

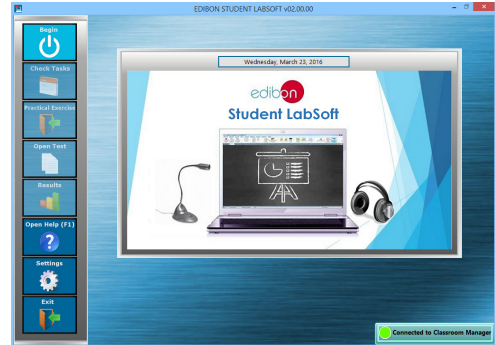## - ESL-SOF. EDIBON Student Labsoft (Student Software).

ESL-SOF is the application addressed to the Students that helps them to understand theoretical concepts by means of practical exercises and to prove their knowledge and progression by performing tests and calculations in addition to Multimedia Resources. Default planned tasks and an Open workgroup are provided by EDIBON to allow the students start working from the first session. Reports and statistics are available to know their progression at any time, as well as explanations for every exercise to reinforce the theoretically acquired technical knowledge.

Innovative features:

• Student Log-In & Self-Registration.

• Existing Tasks checking & Monitoring.

• Default contents & scheduled tasks available to be used from the first session.

• Practical Exercises accomplishment by following the Manual provided by EDIBON.

• Evaluation Methods to prove your knowledge and progression.

• Test self-correction.

• Calculations computing and plotting.

• Equation System Solver Engine.

• User Monitoring Learning & Printable Reports.

• Multimedia-Supported auxiliary resources.

For more information see **ICAI** catalogue. Click on the following link:
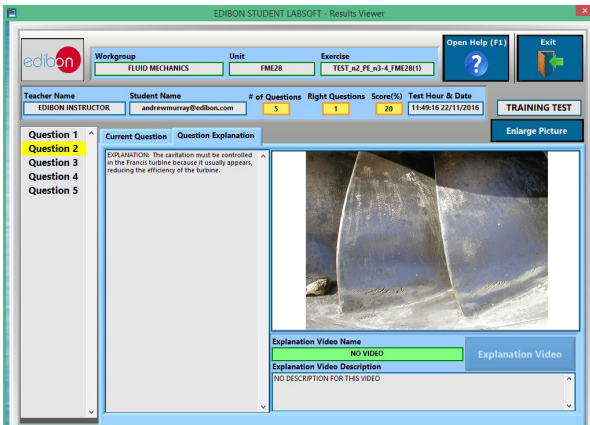
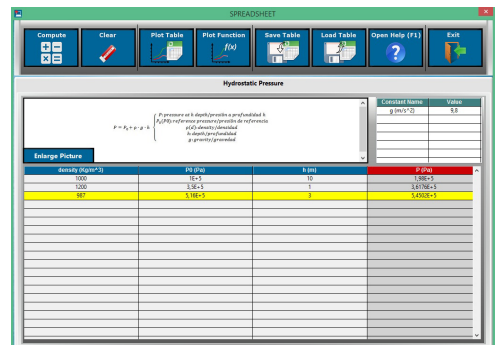www.edibon.com/en/files/expansion/ICAI/catalog

ESL-SOF. EDIBON Student LabSoft (Student Software)
Application Main Screen
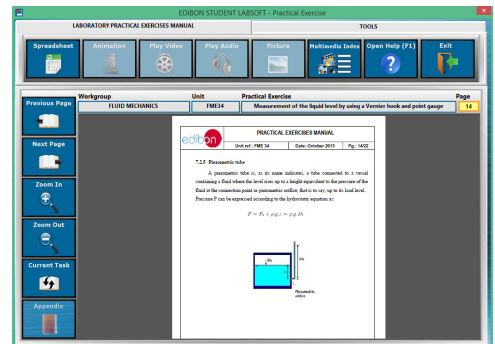
EPE. EDIBON Practical Exercise Program Package Main Screen

ERS. EDIBON Results & Statistics Program Package - Question Explanation

ECAL. EDIBON Calculations Program Package Main Screen

✱ Specifications subject to change without previous notice, due to the convenience of improvement of the product.

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REPRESENTATIVE: