OpenFlume

Quick Start Guide

An interactive numerical flume for open-channel hydraulics

FREE EDITION

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openflume.vercel.app

What is OpenFlume?

OpenFlume is a **numerical flume that runs in your web browser**. You change the discharge, slope, roughness or a structure, and the water surface, energy line and flow regime update instantly. It is designed for students and instructors of open-channel hydraulics, with the aim of letting you *see* the theory that you calculate by hand.

- **Nothing to install:** open **openflume.vercel.app** on a computer, tablet or phone.
- **Works offline:** the whole app is a single HTML file, so you can keep a copy and use it without internet.
- **Verified:** the results have been checked against analytical solutions and textbook methods (Manning, Bélanger, direct step, Stoker dam break).
- **Export:** every tab exports inputs, results and profiles to CSV or Excel for your own calculations and charts.

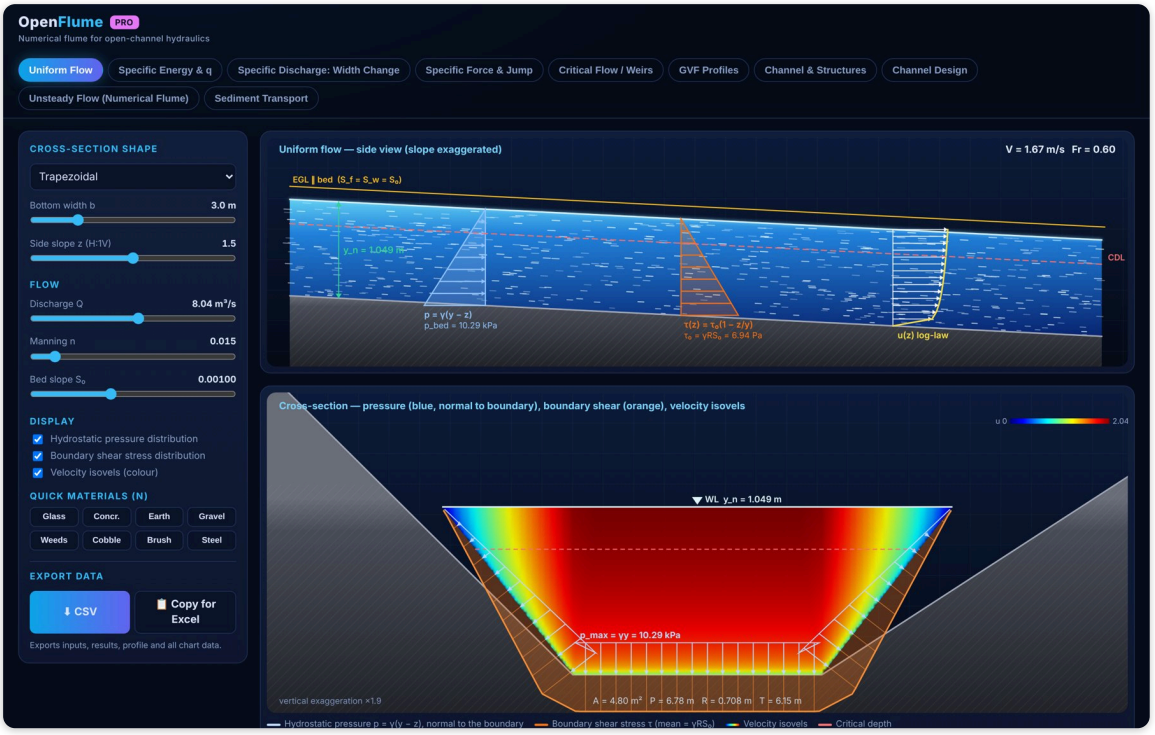
Free and full editions

Free edition	Full edition (Pro)
Uniform Flow Specific Energy & q	Everything in the free edition, plus: width change & choking · specific force & hydraulic jump · critical flow & weirs · GVF profiles · channels with gates and weirs (steady and unsteady) · channel design · unsteady flow and dam break · sediment transport and bedforms

The interface in 1 minute

1. **Tabs** (top): each tab is one topic. Locked tabs (🔒) open the full edition.
2. **Controls** (left): sliders and menus for discharge, geometry, roughness and slope. Results update as you move a slider.
3. **Scene** (top right): the animated flow. The colour of the water shows the regime: **blue = subcritical** (Fr < 1), **orange/red = supercritical** (Fr > 1).
4. **Lines:** energy grade line (EGL, yellow), normal depth line (NDL, green dashed), critical depth line (CDL, red dashed).
5. **Results panel** (below the scene): every computed quantity, with units.
6. **Export:** `⬇ CSV` downloads a file; `Copy for Excel` copies the table so you can paste it directly into Excel.

> **Tip**
>
> Many items in the scene can be dragged with the mouse or a finger: the bed step, water surfaces, gates and weirs. The cursor changes when something can be dragged.

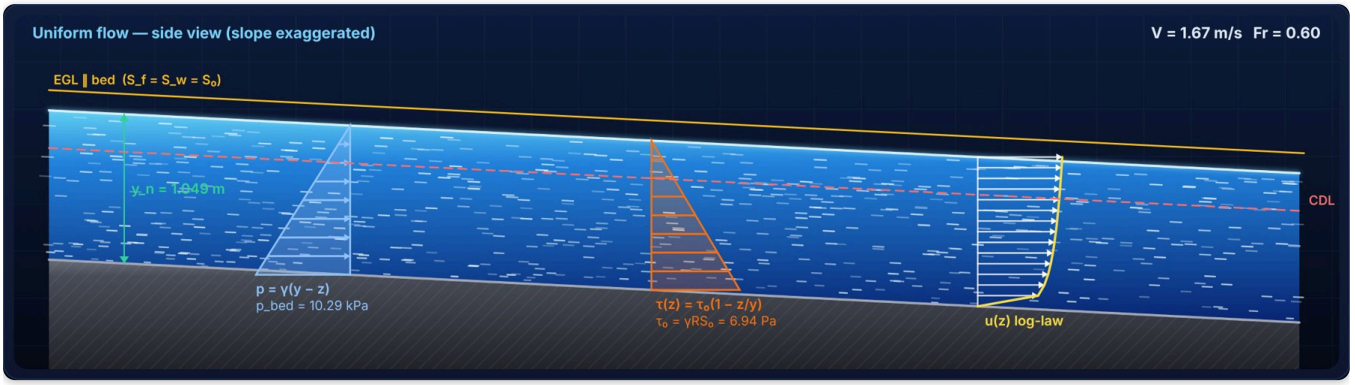


The OpenFlume window: tabs at the top, controls on the left, the flow scene and charts on the right.

Example 1: Uniform flow in a trapezoidal canal

In uniform flow the depth, velocity and area are constant along the channel, and the energy line, water surface and bed are parallel ($S_f = S_w = S_0$). The depth is the **normal depth y_n**, found from Manning's equation:

$$Q = (1/n) \cdot A \cdot R^{2/3} \cdot S_0^{1/2}, \quad A = (b + z\,y)\,y, \quad P = b + 2y\sqrt{(1+z^2)}, \quad R = A/P$$



Uniform Flow tab: hydrostatic pressure (blue), shear stress (orange) and the log-law velocity profile.

Worked example

A trapezoidal concrete canal has b = 3.0 m, side slope z = 1.5 (H:V), n = 0.015, S_0 = 0.001 and carries Q = 8.04 m³/s. Find the normal depth, velocity, Froude number and mean bed shear stress.

1. Solve Manning by trial: y_n = **1.049 m** → A = 4.800 m², P = 6.784 m, R = 0.708 m.
2. V = Q/A = 8.04/4.80 = **1.674 m/s**.
3. Hydraulic depth D = A/T = 4.800/6.148 = 0.781 m → Fr = V/√(gD) = **0.605**, so the flow is **subcritical**.
4. Mean shear stress $\tau_0 = \gamma R S_0$ = 9810 × 0.708 × 0.001 = **6.94 Pa**.
5. Critical depth y_c = 0.785 m and critical slope S_c = 0.00291 > S_0, so the slope is **mild**.

Check in OpenFlume: Uniform Flow → Trapezoidal → set b, z, Q, n, S_0. The results panel shows the same values.

Try it

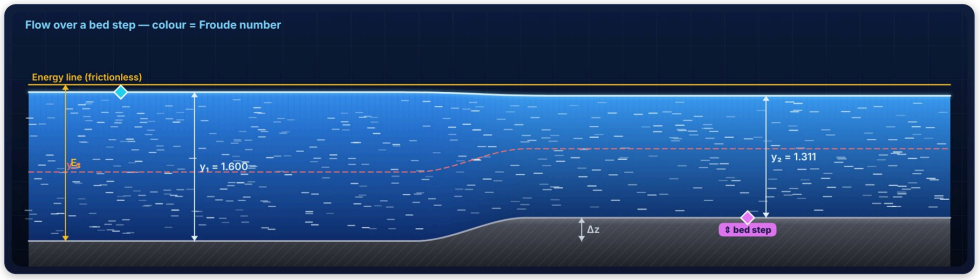
Click the **Earth** and **Weeds** buttons (quick materials). How much does y_n rise? Increase S_0 until Fr = 1: this slope is the critical slope.

Example 2: Specific energy and a bed step

Specific energy is the energy measured from the channel bed. For a rectangular channel with unit discharge q = Q/b:

> $E = y + q^2/(2g\,y^2), \quad y_c = (q^2/g)^{1/3}, \quad E_{min} = 1.5\,y_c$

For each $E > E_{min}$ there are two **alternate depths**: one subcritical and one supercritical. A step in the bed of height Δz reduces the available energy, $E_2 = E_1 - \Delta z$. If Δz is larger than $E_1 - E_{min}$, the flow **chokes**.



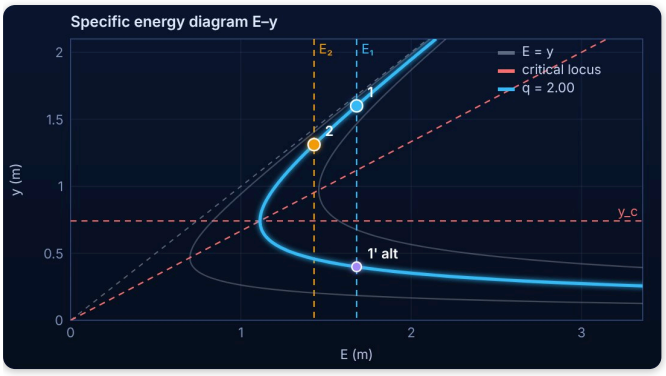
Specific Energy tab: subcritical flow over a raised bed step. The water surface drops over the step.

Worked example

Flow with q = 2.0 m²/s and depth y_1 = 1.60 m approaches a smooth step Δz = 0.25 m. Find the depth on the step and the maximum step height before choking.

1. $y_c = (2^2/9.81)^{1/3}$ = **0.742 m**, E_{min} = 1.112 m.
2. $E_1 = 1.60 + 2^2/(2 \cdot 9.81 \cdot 1.60^2)$ = **1.680 m**; Fr_1 = 0.316 (subcritical).
3. $\Delta z_{max} = E_1 - E_{min}$ = **0.567 m**. Since 0.25 < 0.567, there is no choking.
4. $E_2 = 1.680 - 0.25 = 1.430$ m → solve $y + q^2/(2gy^2) = 1.430$ on the subcritical branch: y_2 = **1.311 m**.
5. Water surface change = $(y_2 + \Delta z) - y_1$ = **−0.039 m**: the surface *drops* over a rise in the bed.

Check in OpenFlume: Specific Energy → q = 2, y_1 = 1.6, Δz = 0.25. Watch the point move along the E–y curve.



The E–y diagram: the operating point moves left as the step takes energy away.

Try it

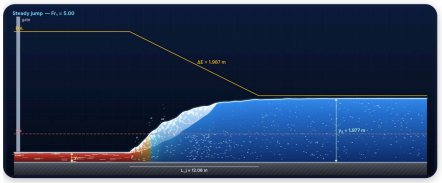
Drag the step up past Δz_{max} = 0.567 m and watch the flow choke: the upstream depth rises so the flow can pass over the step at critical depth.

Exporting to Excel

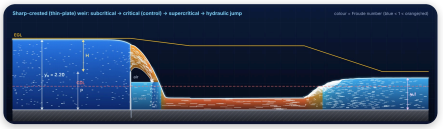
1. Set up your case in any tab.
2. Click ⬇ **CSV** to download a file, or **Copy for Excel** and paste it (Ctrl+V) into a sheet.
3. You get the inputs, all results, the full water-surface profile (x, depth, velocity, Froude number, energy) and the data behind every chart.

Students can use this to compare their hand calculations with OpenFlume. For example, they can compute a backwater curve with the direct step method and plot it beside the OpenFlume profile.

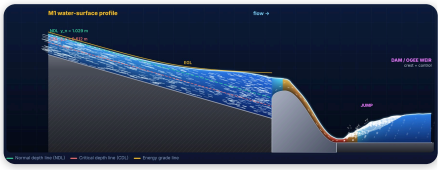
What's in the full edition



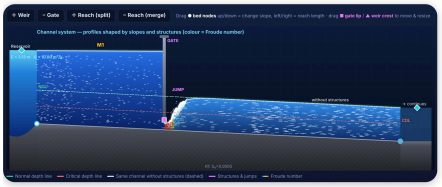
Hydraulic jump: sequent depth, losses and length



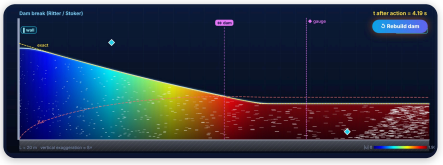
Sharp-crested, broad-crested and ogee weirs



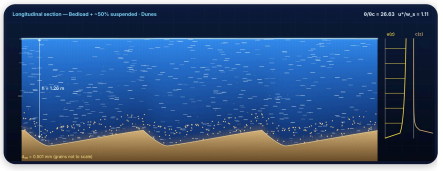
All 12 GVF profiles with real structures



Channels with gates, weirs and slope breaks



Unsteady flow: surges and dam break



Sediment transport and bedforms

Get full access

The full edition also includes the **OpenFlume Manual & Workbook**, with theory, worked examples and exercises for every tab.
Visit **openflume.vercel.app** and click any 🔒 tab, or contact Prof. Amro Elfeki (elfekiamr@gmail.com) for course and university licences.