Sheet V1 · Verification

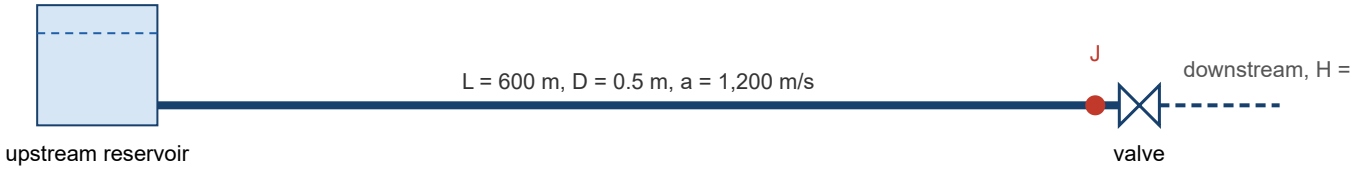
Instantaneous closure: Joukowsky pressure rise and 4L/a period

Source : Analytical solution (Joukowsky) and independently written reference MOC (verification/cvb/run_cvb.js, cases CV-001 and CV-002)

1. The question

When a valve closes at once, the pressure rise equals a·V0/g and lasts 2L/a. Does CBELIER reproduce both values, and the whole curve of a separately written reference computation?

2. The case

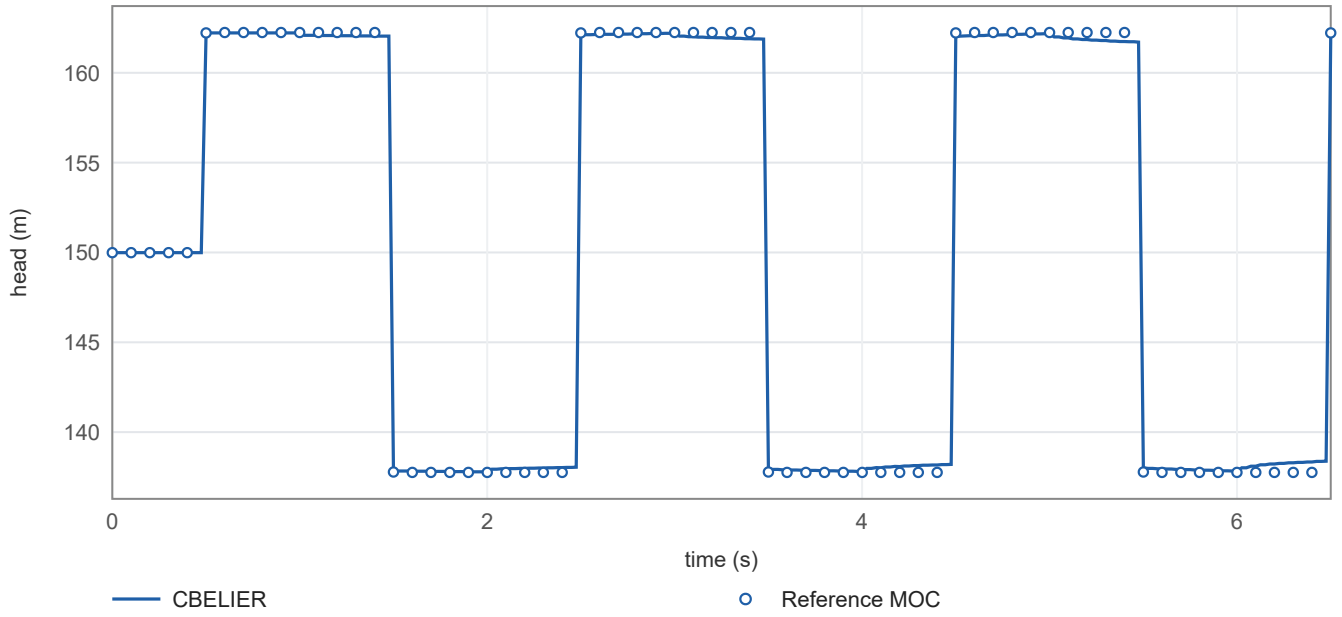


A reservoir feeds a 600 m pipe closed abruptly by a valve at t = 0.5 s. The initial velocity is small (0.10 m/s) so that friction, which CBELIER cannot switch off, stays negligible. The head at the valve is compared with the Joukowsky formula and with a frictionless method-of-characteristics computation written independently of the engine.

3. Data and status

Data	Value	Status
Pipe: length, diameter	600 m; 0.50 m	DEFINED
Wave speed a	1,200 m/s	DEFINED
Upstream reservoir; downstream of the valve	150 m; 100 m	DEFINED
Initial velocity V0 (small: friction negligible)	0.10 m/s	DEFINED
Mesh: 20 reaches, Courant number = 1	20	DEFINED
Reference: separately written frictionless MOC (same scheme)	—	DEFINED

4. Results



Head at the valve: CBELIER (line) and frictionless reference MOC (circles, one point in four).

5. Differences

Indicator	CBELIER	Reference	Difference
Pressure rise ΔH (V0 = 0.10 m/s)	12.24 m	12.23 m	0.1 %
Plateau duration (2L/a = 1.00 s)	0.975 s	1.000 s	1 time step
RMS difference to the reference curve	2.00 % ΔH	—	tolerance 2 %
Suite check (higher velocity)	102.31 m	101.63 m	0.7 %

The pressure rise and the plateau duration are reproduced; the 2 % RMS difference comes from the steep fronts, where a one-step shift is enough. At a higher velocity the difference to Joukowsky rises to 0.7 %: this is the expected effect of friction.

6. Limitations and assumptions

- Textbook case: it proves that the code solves the equations correctly, not that it represents a real network.
- Friction cannot be switched off in CBELIER: the initial velocity is chosen small to make it negligible.

Computation: CBELIER engine 3c.27, 2026-11-07. Re-run with every release by the verification suite (verification/qv1). Alfa Wamane engineering consultancy — cbelier.alfawamane.ma