Sheet N2 · Numerical validation

Three pipes in series (Wylie & Streeter, example 3-7)

Source : E. B. Wylie, V. L. Streeter, Fluid Transients, McGraw-Hill, 1978, example 3-7, program C-1 and results C-2

1. The question

At junctions between pipes of different diameters, the wave is partly reflected. Does CBELIER reproduce the book heads at the three sections, up to the 806 m peak?

2. The case

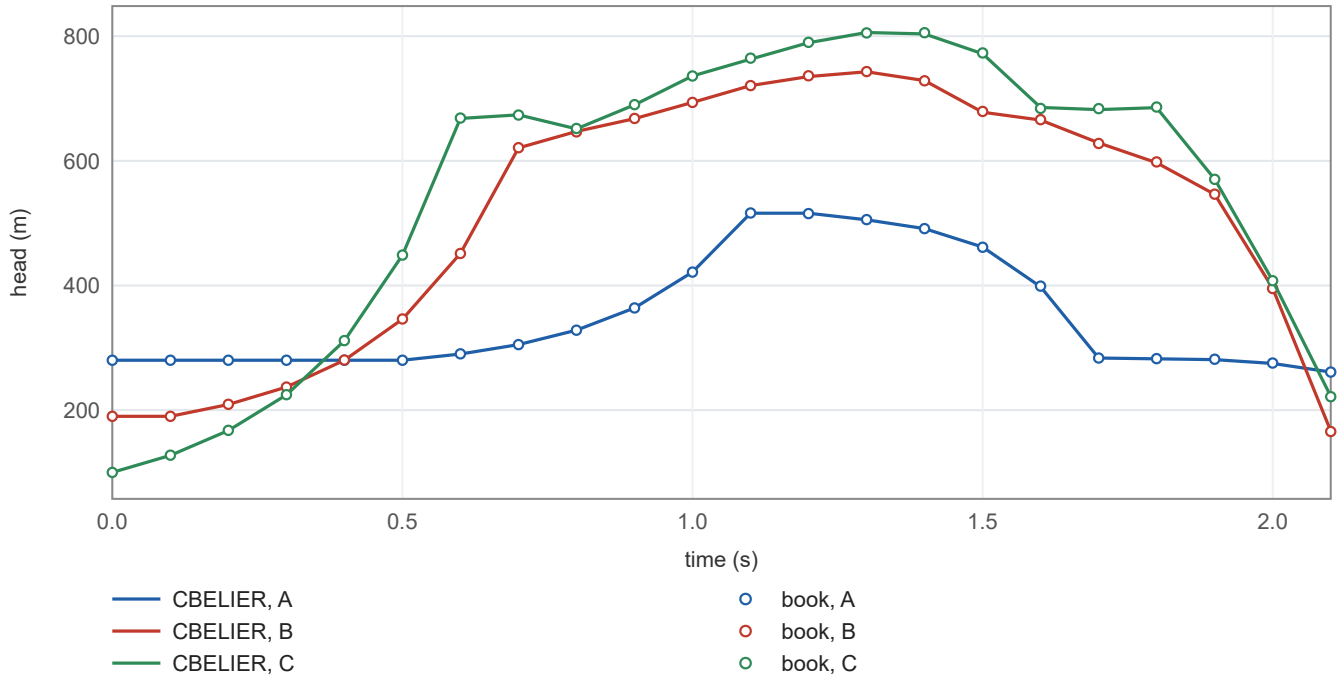


Three pipes in series (351, 483 and 115 m; 0.30, 0.20 and 0.15 m) carry 0.2 m³/s towards a valve closed in 1.8 s. With the book's 0.1 s step, CBELIER adjusts the wave speeds exactly like the book's program (1,170, 1,207.5 and 1,150 m/s).

3. Data and status

Data	Value	Status
Lengths	351; 483; 115 m	PUBLISHED
Diameters	0.30; 0.20; 0.15 m	PUBLISHED
Friction factors f	0.019; 0.018; 0.018	PUBLISHED
Wave speed; time step	1,200 m/s; 0.1 s	PUBLISHED
Initial flow; head at the valve	0.2 m³/s; 100 m	PUBLISHED
Closure law (TAU column of fig. C-2)	1.8 s	READ FROM FIGURE
Roughnesses giving f at nominal flow	—	DERIVED

4. Results



Heads at sections A, B and C: CBELIER (lines) and book values (circles).

5. Differences

Indicator	CBELIER	Reference	Difference
Maximum head at the valve (C)	806.0 m	805.8 m	0.0 %
Maximum difference, 3 sections × 22 instants	1.95 m	—	0.24 % of peak

All three sections follow the book within less than 0.25 % of the peak. The mesh is identical to that of the book's program, which confirms the wave-speed adjustment.

6. Limitations and assumptions

- Numerical validation.
- The book heads are read from a scanned listing (22 instants).
- The book keeps f constant, CBELIER recomputes it at every step: this is the likely source of the residual difference.

Computation: CBELIER engine 3c.26, 2026-11-06. Re-run with every release by the verification suite (verification/qv1). Alfa Wamane engineering consultancy — cbelier.alfawamane.ma