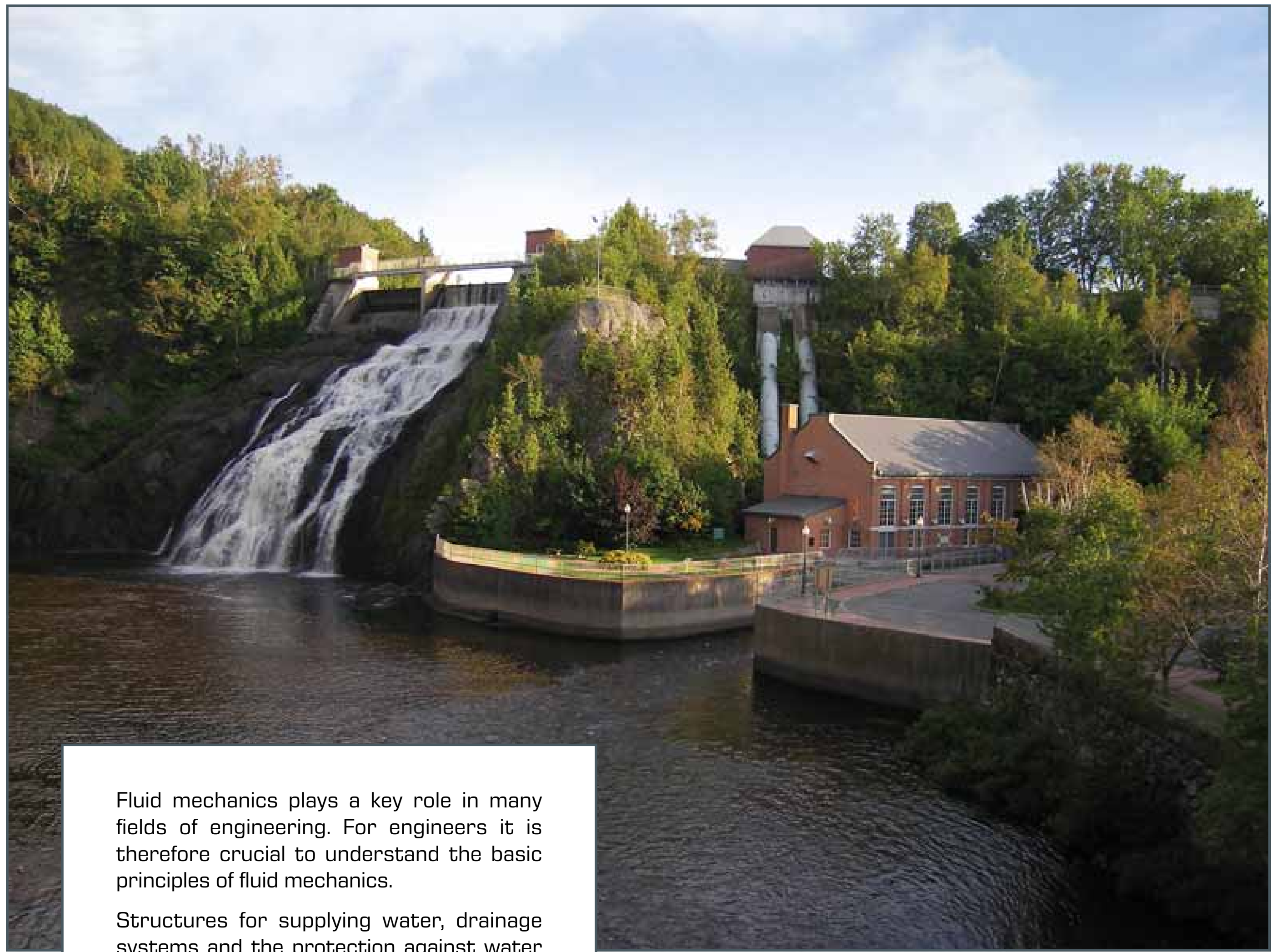
Teaching and learning systems for the field of hydraulics for civil engineering



Fluid mechanics plays a key role in many fields of engineering. For engineers it is therefore crucial to understand the basic principles of fluid mechanics.

Structures for supplying water, drainage systems and the protection against water all fall within the scope of civil engineering. Certain areas from the overall field of fluid mechanics are of secondary importance in the civil engineering curriculum, such as the basic principles of compressible flow. To take this fact into account, in addition to our **catalogue 4 "Fluid mechanics"** we have compiled a self-contained **catalogue 4b "Hydraulics for civil engineering"**. The teaching and experimentation systems specifically consider the training needs of civil engineering.

Catalogue 4b is divided into two sections. The first section contains general principles of fluid mechanics that are relevant to multiple disciplines, such as basic equations, such as the continuity and Bernoulli equations, pipe flow and turbomachines. The second section covers the specific topics for civil engineering with a focus on hydraulic engineering. This section looks at open-channel flow, open-channel sediment transport and flow through porous media.

The subsections are preceded by information pages containing basic knowledge. These pages explain the technical and physical relationships in a way that is simple to understand, making it easy to jump into each subject area. The corresponding GUNT devices then facilitate the practical demonstration and investigation of the relationships.

Learning objectives of "hydraulics for civil engineering"		GUNT products
Hydrostatics	■ communicating vessels, pressure on flat surfaces, buoyancy, hydraulic paradox ■ floating stability	**HM 115, HM 150.06**
Hydrodynamics	■ continuity equation, energy considerations (Bernoulli) ■ principle of linear momentum ■ laminar/turbulent flow, Reynolds number ■ potential flow, streamlines	**HM 150.07, HM 150.08, HM 150.18, HM 150.10, HM 150.21**
Discharge from openings	■ horizontal flow from a tank ■ vertical flow from a tank ■ discharge under a gate	**HM 150.09, HM 150.12, HM 160 – HM 163 and accessories**
Turbomachines	■ centrifugal pumps ■ turbines	**HM 150.04, HM 150.16, HM 150.19, HM 150.20**
Discharge with free water level	■ flow formulae ■ relationship between specific energy and depth of discharge ■ flow transition ■ uniform and non-uniform discharge ■ change in cross-section ■ control structures (free and submerged overfall)	**HM 160 – HM 163 and accessories**
Determining discharge in an open channel	■ measuring weirs ■ velocity measurement ■ tracer method	**HM 156, HM 143, HM 160 – HM 163 and accessories**
Transient movement of water	■ in closed pipes (mass vibration) ■ with free surface: reservoir retention ■ with free surface: positive and negative surges, transient open-channel flow involving friction ■ with free surface: filling and emptying locks, tidal flow	**HM 156, HM 143, HM 160 – HM 163 and accessories**
Waves	■ deep and shallow water waves ■ changing waves	**HM 160 – HM 163 and accessories**
Sediment transport	■ types of sediment transport ■ formulae for estimating transported masses	**HM 166, HM 140, HM 168, HM 142**
Flow through porous media, groundwater flow	■ groundwater flow, aquifers ■ groundwater levels ■ Darcy's law, coefficient of permeability ■ lowering of groundwater ■ filters (gravel filters, geotextile filters) ■ seepage under structures ■ seepage through dams	**HM 152, HM 165, HM 167, HM 169, HM 145, HM 141, CE 116**