Physical model experiments on the Sihl River culverts at Zurich main station

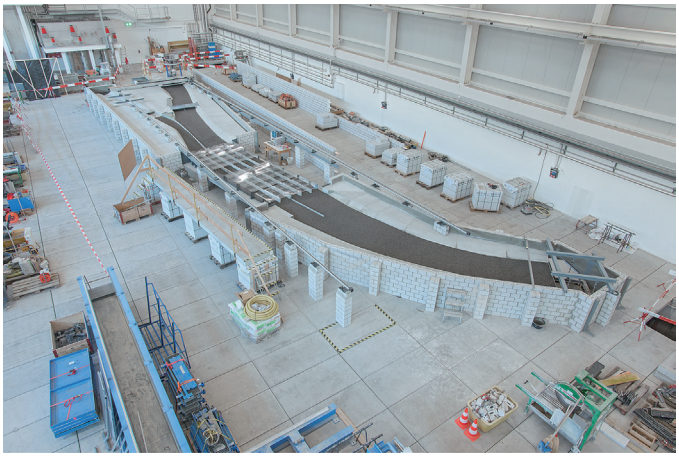

Fig. 1: Scale model of the River Sihl and the culverts at Zurich main station

Fig. 2: View of the representation of Zurich main station in acrylic glass, seen from the confluence with 'Schanzengraben'

Essential parts of downtown Zurich are located on the alluvial fan of the Sihl River. In the 20th century, the Sihl River was strongly integrated into the urban infrastructure.

At Zurich main station, the Sihl River crosses the station building in an intermediate floor through 5 culverts with a length of 190 m and a clear opening of 12 m x 3 m each. It passes underneath the station's main tracks while two underground railway stations are situated under the river bed.

Beside the limitation of the river's flow capacity by the culvert dimensions, this specific situation enhances driftwood and floating debris accumulations and induces a prompt discharge capacity reduction in case of deposits in the culverts.

The estimated potential damage for extreme flood events is remarkable as Zurich main station is an important hub for the national and international railway network. Furthermore, the inundation of large parts of the city center and of the surrounding railway infrastructure contributes to an estimated potential damage of 5.5 billion CHF. During the 30-year flood event of August 2005, the city narrowly escaped high damages, an event that pointed out existing deficits in flood protection and the need for action.

In order to plan effective control measures for future flood events, basic data on the discharge capacity of the culverts at Zurich main station are essential. Additionally, the risk of driftwood accumulations at the culverts and possible erosion or sedimentation processes of the river bed have to be assessed. To that end, the VAW was commissioned by the AWEL (Office of Waste, Water, Energy and Air of the Building Department, Canton of Zurich) and the SBB (Swiss Federal Railways) with physical model investigations at a scale of 1:30.

The physical model reproduces nearly 1 km of the Sihl River, leading to model dimensions of 30 m x 6.7 m. The main river bed of the Sihl is represented on both sides of the main station, including several bridges and the river confluence with 'Schanzengraben', a moat which originates in Lake Zurich. The 5 culverts as well as adjacent parts of the railway station are represented in acrylic glass for better visualization of the main processes. The model is equipped with a movable bed to accurately reproduce sediment transport processes during flood events. Flow and sediment hydrographs of different flood scenarios can be reproduced.

The main goal of the investigations is the exact determination of the culverts' discharge capacity for different flood scenarios. Furthermore, the physical model serves to investigate optimization possibilities of the culvert design to increase the discharge capacity.

Keywords:	Flood risk, flood protection, erosion, sedimentation, drift wood, laboratory experiment, physical hydraulic model test
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