Physical experiments to reduce the flood risk caused by driftwood in the Aare River at the Matteschwelle in Berne

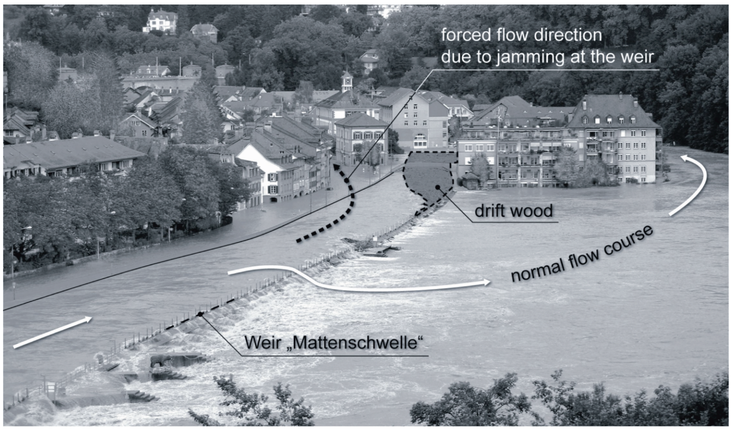

Fig. 1: Matteschwelle Berne during the 2005 flood (picture: K+H).

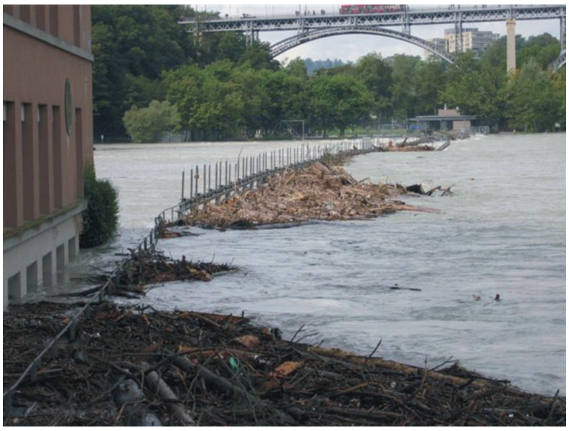

Fig. 2: Driftwood accumulation during the 2005 flood at the Matteschwelle in Berne; view against the flow direction (picture: TAB)

During the flood event in 2005, the central part of the city Berne the so called Mattequartier was heavily affected. Large quantities of driftwood (up to 1'200 m^3) were partly blocking the existing weir, which lead to a decreased discharge capacity and increased water levels in the Aare river. A substantial part of the Aare discharge left its natural bed and forced its way through the Mattequartier (Fig. 1). As one of the immediate measures the VAW was assigned to examine a new planned driftwood retention and rerouting system in that area designed as a skimming wall parallel to the existing weir.

The hydraulic model has been built on a 1:50 scale, leading to an overall length of approximately 25 m. The model is equipped with a movable bed and constant sediment input. Driftwood is supplied manually based on observations of the past events. Focus of the study is the functionality of the newly planned driftwood concept and the interaction with the river bed alterations. Furthermore, fundamental insight to transport characteristics of driftwood in river bends will be achieved.

After calibrating the model, the 2005 flood with a discharge of 605 m^3/s and a driftwood carpet of approximately 4'000 m^2 could be represented very well. Especially the observed driftwood accumulation at the different positions along the weir represented the reality surprisingly well (see Fig. 2 and 3).

Fig. 3: Driftwood accumulation in the physical model along the weir, representing the 2005 flood; view against the flow direction.

Fig. 4: Hydraulic model with driftwood retention and rerouting system designed as a skimming wall parallel to the existing weir.

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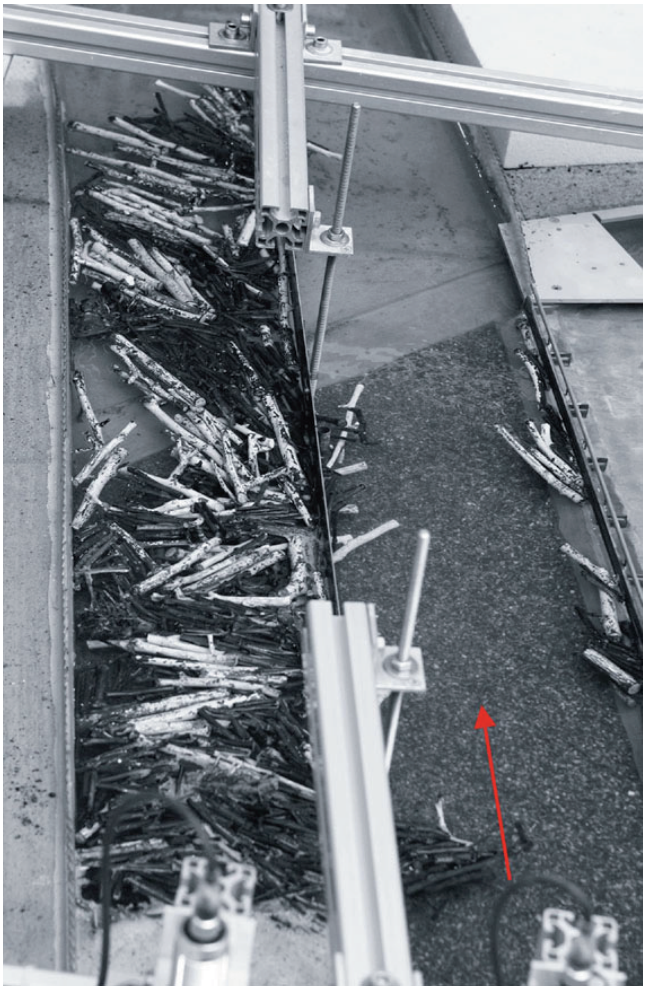

Fig. 5: Top view on the hydraulic model showing the efficiency of the installed driftwood skimming wall.

Subsequently, the model has been extended with a driftwood retention and rerouting system designed as a skimming wall parallel to the weir (see Fig. 4). Experiments showed that the water levels can be reduced, but additional scouring problems occurred influencing the stability of the existing weir, the left river bank and the construction itself.

Fig. 5 shows the efficiency of the installed system. Approximately 60 % of the driftwood is collected behind the skimming wall and transported downstream towards the power station in a well controlled manner. In this dead end of the river the transport stops and the wood forms a carpet covering the complete surface area between left river bank and the skimming wall. This measure leads to a significant water level drop compared to the maximum water levels observed during the 2005 flood. As an alternative measure to the driftwood skimming wall, elevated side walls on the left river bank are currently analyzed. Additional experiments to test the behavior of the system in case of extreme flood events will be performed.

Keywords: driftwood, flood risk, physical experiments
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