

Bank protection at the outer side of curved channels by an undulated concrete wall.

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ABSTRACT

In many valleys of the Alps and Pyrenees the lack of space in urban area between the river and the buildings and infrastructures obliges to protect the banks by walls against lateral erosion. Smooth walls are endangered by scouring of their foundation especially at the outer bank in river bends. A possibility to avoid wall's failure is to construct an undulated concrete wall with the purpose to increase the form roughness and reduce the flow velocities as well as depth of scour close to the wall. Such undulated wall can also increase the stability against overturning. Furthermore along an undulated wall rather rich bed morphology occurs improving conditions for fishes.

In this context experimental tests were performed in a 90° curved 1 m wide channel with an undulated wall at the outer bank. For trapezoidal undulations (0.1 m deep and 0.33 m long), three discharges (150, 180 and 210 l/s) and bed slopes (0.35, 0.5 and 0.7%) with a wide grain size distribution of the bed sediments ($d_m = 8.7\text{mm}$) were tested. The following parameters for subcritical flow conditions were studied: bed topography, water level, sediment transport, longitudinal flow velocities and grain sorting across the bend.

Based on the experimental results two scour holes were identified. Compared to the case of a smooth wall without undulations, the depth of the two scour holes was significantly reduced. The reduction was at about 20% at the first hole and 40% (but quite variable) at the second one.

The scour position was also influenced by the undulations. Compared to the smooth wall the two scour holes were shifted 10° downstream (first scour hole was at 45° and the second one at about 1m downstream the bend).

The sediment transport was slightly lower with the undulations than without them. The undulated wall also influenced the water surface. With the smooth wall, stationary surface waves of rather high amplitude were observed. With the undulations this waves were replaced by waves of lower amplitude.

After the tests the transversal grain sorting process at the bend is quite significant. At the outer bank the mean diameter is at about 2.5 d_m and at the inner bank is about 0.8 d_m . Similar results were obtained with the smooth wall.