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Laboratory Evaluation of Energy Dissipation in the Combined Structure of the Vertical Drop with Gabion

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Today, the use of stone materials, especially gabions, for easy access and abundance for the construction of rockfill dams, filtration, and stilling basin is increasing. In this study, first, the hydraulic flow by combining the gabion structure with a vertical drop and then the effect of porosity and length of the gabion structure on the energy dissipation values were investigated. For two modes of simple vertical drop and gabion, a total of 260 experiments including two heights of 15 and 20 cm drop, three porosities of 40, 45, and 50 percent, and eight different gabion lengths with a flow range of 150 to 800 liters per minute were performed. The results showed that in all the studied models, with increasing the relative critical depth parameter of the flow, the energy dissipation decreases and the downstream relative depth increases. The integration of the gabion structure caused the energy dissipation and the downstream Froude number to increase and decrease, respectively. On average, in all models, the use of gabions increased 57% of the energy dissipation of the current compared to the simple vertical drop and reduced the range of the Froude number from 3.5-8.7 to 0.52-2.5. The flow regime passing through the vertical drop gabion physical models includes inflow, transient, and overflow, of which the Inflow regime plays a Major contribution in energy dissipation. For a constant relative length, increasing the porosity of the gabion structure increases the volume of water passing through the porous medium and the energy dissipation of the flow, in contrast for a constant porosity, increasing the relative length of the gabion structure has little effect on the energy dissipation. On average, in vertical drop gabion with 50% porosity compared to 40% porosity, the downstream relative depth increased by 15%.

Keywords: Vertical drop, Gabion, Additional Structures, Energy dissipator, Flow Regime, Froude Number

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