1. **A Novel Experimental Work and Study on Flow and Energy Dissipation over Stepped Spillways**

**ABSTRACT**

In this study, a novel experimental work was used to study the flow over the stepped spillways and energy dissipation. This novel work was an attempt to increase energy dissipation on stepped spillways since it not include stilling basin and have less cost compared with traditional spillways. So, in this paper, to investigate the increasing of energy dissipation of flow over stepped spillways of different step shapes, a twelve physical plywood models have been built. Experiments have been carried out for different types of step shapes: - plain steps, steps have half cut, inclined end sill steps normal to downstream slopes of stepped face, and steps have a rough surface using crushed gravel. Three downstream slopes of stepped face (θ = 30 o, 50 o, and 70 o) were tested with spillway having constant number of steps and constant height. In total, 144 experiments were done, the hydraulic parameters of flow over the models were measured and the energy dissipation of flow was calculated. Experimental results showed that the energy dissipation of flow on inclined end sill, and rough steps are more than the plain one. While the experiments result on the cutting steps showed that the energy dissipation is less than the plain one. With decreasing the downstream slopes of the stepped spillway face, the energy dissipation is increased. In addition, when compared with traditional spillways the case of rough steps and steps with inclined end sill can be used to increase the relative energy dissipation on plain steps by about 19 % and about 18 % respectively for small angle of spillway face since the stepped spillways more effective than traditional spillways by 10 %. Therefore, double that means that the affectivity of stepped spillway was approximately. On the other side, the energy dissipation increased at low discharges by 0.1 % when using the cutting steps but decreased by 13 % with larger discharges. In summary, the flow energy dissipation decreases with increasing the flow rate, and the roughed step spillway surface is more effective compared to the other spillway surfaces at low or high flow rate. According to the flow types, the range of Nappe, Transition, and Skimming will increase for all the forms of steps that used compare with plain step.