Snow Passage Effects on Open Cross-Flow Turbine Performance

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Abstract

Small-scale hydraulic power generation is gaining attention as a decentralized energy source with low environmental impact and high disaster resilience. In Japan, snow accumulation in cold regions can be carried downstream, affecting microhydraulic turbine performance. This study conducted field experiments using spherical snowballs to simulate these effects, aiming to develop a highly efficient open-type cross-flow turbine with reduced sensitivity to snowball interference (Figure 1). A snowball was introduced upstream, and power fluctuations and snowball behavior were observed. Results showed that when the snowball diameter matched the rotor blade spacing, power output briefly dropped but quickly recovered. However, larger snowballs caused a sharp decline, with varying recovery times. Compression, fragmentation, and discharge of snowballs by the blades contributed to output fluctuations. These findings offer insights for designing microhydraulic turbines resilient to snow and ice.

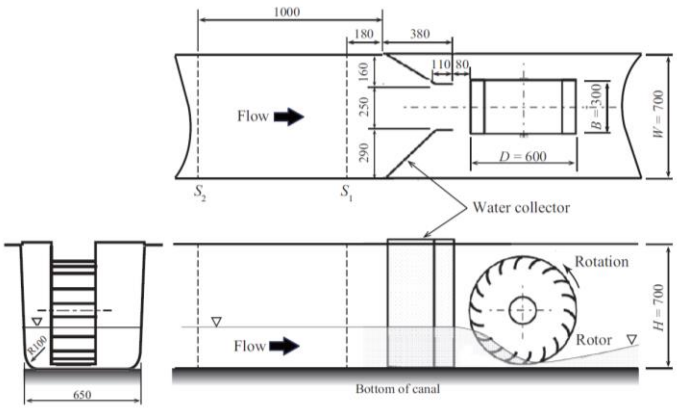

Figure 1 Geometry and dimensions of the open-type cross-flow hydraulic turbine

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