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# Study on failure of an ecological tunnel gate caused by jet-flow from air vents

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## Abstract

This paper presents analysis of water jet flow state in an ecological tunnel in an abnormal condition and failure analysis of a temporary blocking gate of the ecological tunnel. Analysis consists of the determination of the hydrodynamic pressure on the gate by using experimental test and computational fluid dynamics, the calculation of stress distribution under different operating conditions using finite element method, and a simplified fatigue analysis. Results show that the water jet flow induces a vortex downstream the blocking gate, and under the large displacement and large dynamic stress the damage of gate begins with the local material failure and spreads to total damage with sandwich panel.

*Keywords:* Ecological tunnel, Gate failure, Dynamic water pressure, Fatigue crack

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## 1. Introduction

Radial and flat gates are commonly used gate types in hydropower plants among many others. Radial gate is predominately adopted as control gate in dams as less hoisting capacity is required than vertical-lifting gate. Meanwhile, it has simpler operating mechanics and low possibility of trash jamming in wheels. Since the radial gate trunnions extend downstream and sufficient space is needed, the maintenance or emergency gate in front is usually a flat gate. Considering the cost and space requirement, the maintenance and emergency gate is usually same one in practical engineering. Working under high water head, fast opening or closing speed in water flow, the maintenance and emergency gate's operational condition is worse than the control gate. Recently, the

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