Design, Build and Test of an Axial Flow Hydrokinetic Turbine with Fatigue Analysis

by

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Abstract

OpenProp is an open source propeller and turbine design and analysis code that has been in development since 2007 by MIT graduate students under the supervision of Professor Richard Kimball. In order to test the performance predictions of OpenProp for axial flow hydrokinetic turbines, a test fixture was designed and constructed, and a model scale turbine was tested. Tests were conducted in the MIT water tunnel for tip speed ratios ranging from 1.55 to 7.73. Additional code was also written and added to OpenProp in order to implement ABS steel vessels rules for propellers and calculate blade stress. The blade stress code was used to conduct a fatigue analysis for a model scale propeller using a quasi-steady approach.

Turbine test results showed that OpenProp provides good performance predictions for the on-design operational condition but that further work is needed to improve performance predictions for the off-design operational condition. Fatigue analysis results show that reasonable estimates of propeller blade fatigue life can be obtained using a relatively simple method. Calculated blade stress distributions agree with previously published data obtained with more sophisticated and time consuming calculation techniques.

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