

COLLOQUIUM

Group: Engineering Fluid Dynamics

As part of his MSc thesis assignment

R.A. Verschoof

will give a presentation, entitled:

Optimization of Axial Flow Fans with respect to Performance and Noise Reduction

Date: Friday May 9, 2014

Time: 09:30

Room: Horstgebouw N.109

Summary:

Axial fans are characterized by a large mass flow of gas and a small pressure ratio. The goal of this research project is to develop axial fans (without diffuser blades) with increased efficiency and lower noise levels.

Firstly, an existing design method has been developed further, such that it combines aerodynamic performance as well as basic noise characteristics. This design method is coupled to a genetic optimization method in order to optimize the fan design with respect to noise, efficiency and the generated pressure difference. The sound pressure level dB(SPL) is calculated using a model by Fukano et al. (1976). In their model, the dB(SPL) is a function of the fan diameter, the number of blades and the angular speed of the fan, as well as the chord and thickness of the blades.

Secondly, three designs have been generated. In these designs reversed flow at the hub has been mitigated by a larger blade curvature at the hub ('prototype straight' design, 'prototype swept' design) or by a larger hub diameter ('prototype high static efficiency' design). The 'straight' and 'swept' designs have the same best-efficiency-point, but the 'swept' design should result in less produced sound than the 'straight' design. The third design, the "high static efficiency" design, has a straight blade and is designed for a high total-to-static efficiency.

The performance of the three designs has been validated using results of numerical simulations based on the Reynolds-averaged Navier-Stokes equations. The CFD simulations show promising results for the efficiency and pressure difference. Furthermore the CFD results provide details of the flow through the fan.

Thirdly, an extensive CFD parameter study has been performed for the 'prototype straight' design, in which the influence of tip gap, number of blades and pitch angle has been investigated. Minimizing the tip gap would increase the efficiency. Adding more blades is a way to increase the pressure difference and volume flow, although every additional blade introduces more friction losses. Pitching the blades changes its behavior: the best-efficiency-point shifts and the performance curves are shifted. Pitching the blades is a way to utilize a blade design in multiple types of fans, e.g. high-pressure, high-efficiency or high-volume fans.

Assessment committee:

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d.d. _____