Cooling with system

New design method resulted in a unique generation of axial high static pressure fans

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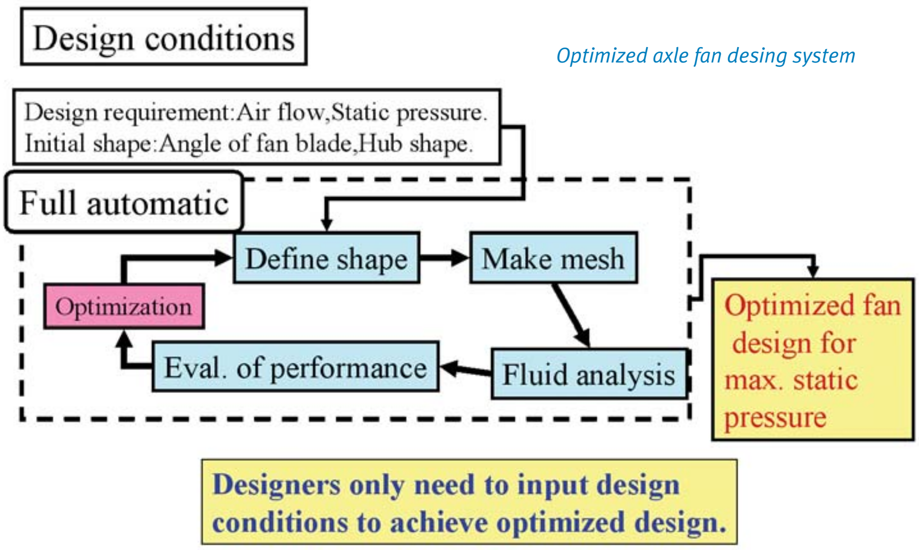


Optimized axle fan desing system

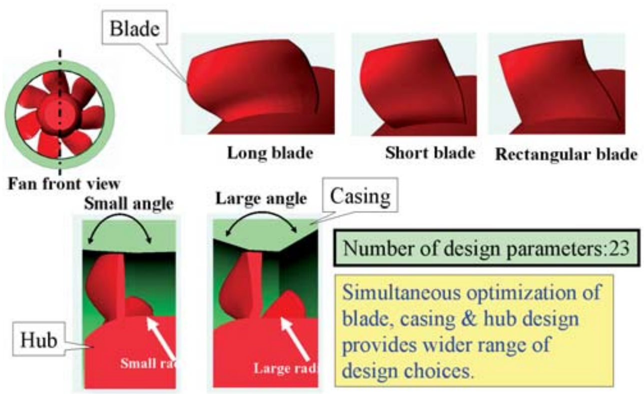
Market trends for equipment where cooling is required, are constantly becoming higher-density and miniaturized in design. Such equipment requires quality fans with high static pressure capabilities, which are optimized to raise the cooling efficiency. For high static pressure applications, diagonal flow fans, (which exhaust in a centrifugal direction) or 2 axial fans mounted in series are usually considered. However, disadvantages may occur due to the direction of air-flow, physical size and cost.

Keeping up with these demands using traditional design methods, involves the time consuming approach of manufacturing and the testing of many trial samples.

More recently, new techniques, such as Computational Fluid Dynamics (CFD) have been introduced to assist in the design process. However, when using CFD, it is necessary to understand the complexities of axial fan design which have been refined over many years. Therefore, the important point is how CFD is mastered. In recognition of this fact, Japan Servo has developed the Fan Optimization Design System, which combines all the strengths of CFD with an Optimization Technique to model a new design offering the desired characteristics. Now, Axial Fans can be rapidly designed to meet both high level performance requirements and specific application demands. Using this system, Japan Servo has developed the G-Series Axial Fan, which is a unique design, not seen before.

Fan Optimization Design System (FODS)

Since one of the objectives of FODS is to allow easy use by the Designer, the CFD function has been



Definition of shape and selection of parameters

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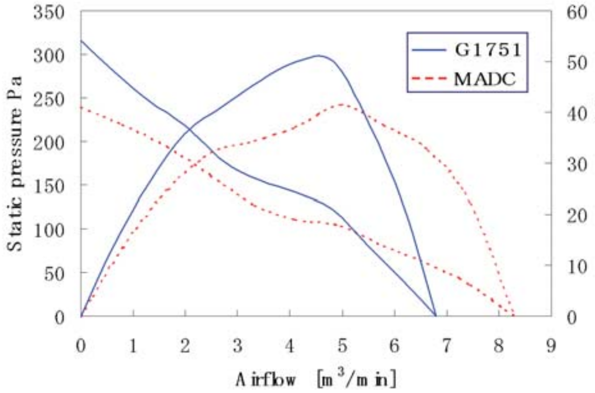

Comparison of G1751 and MADC

covertly incorporated into all levels of the design system. The Designer inputs the initial form parameters and general specifications, as outlined in Fig.1

As an integral part of the optimization process, CFD then calculates the static pressure efficiency from the brake shaft power, static pressure and air-flow. The maximum calculated value of the static pressure efficiency is used to determine the optimized form required. Japan Servo has combined CFD and the Optimization Technique so as to produce a fully automatic modeling tool which continually repeats this calculation loop selecting the next most suitable data range until the optimum form with highest static pressure efficiency is simulated.

There is a trade-off between the calculation time and accuracy. The higher number of lattices analyzed, the greater the accuracy, but longer calculation time is taken. The first important criteria is to balance the calculation time and accuracy so as to achieve the optimized result in the shortest time.

The design system has been proven to have high reliability by checking the air performance (flow vs. static pressure), flow velocity distribution and the pressure distribution for many models.

The general procedure of CFD is as follows:

1. Model creation and form definition
2. Formation/creation of an analysis lattice (mesh)
3. Performance and physical parameter set-up
4 Analysis execution

Form definition

The contours of an impeller and venturi are complicated 3-dimensional forms, which incorporate years of design know-how. In order to utilize the Optimization Technique, these 3-dimensional forms are translated into numerical parameters. Using the performance data and dimensional analysis of conventional fans and then translating this information into numerical parameters, Japan Servo has been able to construct a comprehensive data file. This allows a total of 23 individual parameters, which are key factors in the fan performance, to be addressed during the design process, (Fig. 2).

(1) Creation of the Analysis Lattice: The inputs of 23 individual numerical parameters, derived from the form definition creates a direct analysis lattice. The number of lattices, their size and surface finish can be adjusted if required. The creation of a lattice for a single impeller takes less than 60 seconds.

(2) Fluid Analysis: Using CFD software, analysis of the required parameters is carried out. During analysis, the system rewrites the macro code automatically from the specified design points, e.g. required air-flow, static pressure, etc. Complete analysis takes around 30 minutes. The results are stored as part of the Optimization Technique for future use.

(3) Optimization: The Simulated Annealing (SA) method has been adopted for the optimization technique. Combined with Japan Servo's broad knowledge of applications, highly reliable and accurate analysis can now be rapidly conducted.

By using the FODS, Japan Servo has developed a new design of axial fan, which offers high static pressure performance (Fig.3).

The G1751M fan (dia.172mm x 51mm), has the same dimensions as the standard MADC series, but offers high static pressure performance and improved efficiency, (Fig.4).

The fan optimization design system for the completely new G1751 took 7 days for complete analysis, resulting in the entire development period of the product being substantially shortened. Today, the range of 172mm sized G1751 fan consists of 5 different types with an air performance that go up to 840Pa. Also available are smaller sized fans, like sq120x38mm (G1238-series) with 520Pa; sq92x38mm (G0938-series) with 490Pa and the sq80x38mm.

The DC fans and blowers of Japan Servo can have functions that send an alarm signal when the fan motor revolutions slow down (lock detection, pulse output, speed detection). Also Variable speed operation is possible by means of a PWM input

signal, resulting in further reduction of the power consumption and noise, as requested during idling.