Vista™ - Visual Turbomachinery Analysis

Vista™ CPD – centrifugal and mixed-flow pump preliminary design

Pump design advantages

- Impeller and volute design in a single preliminary design tool.

- Very simple to operate. Options are kept to the essential and choices are clear.

- Simple, but essential graphical output keeps the user easily informed as to the progress of the design.

- Data requirements kept to a minimum so that the designer can get the design process off to a fast start, and then move quickly to an optimum preliminary design.

- Extremely short run-times allow many candidate designs to be assessed in a short time.

- Built-in loss correlations obtain accurate efficiencies for each design.

- One-button launch of 3D geometry in ANSYS® BladeModeler™ from standalone Vista CPD.

  or

  full integration of Vista CPD in ANSYS® BladeModeler™ within Workbench 11 and 12.

- Thoroughly tested and validated ensuring rugged and reliable performance.

- Continuing addition of new facilities and PCA's established fast-response user support.

Overview

Preliminary design, sometimes called 'sizing', remains an essential first step in the design of any turbomachine. Since the 1990's CFD methods have become widely available and increasingly applied to turbomachine design. For several years this growth of CFD in turbomachinery has embraced pump design, at least where the pump efficiency is of critical importance. But despite immense progress in the applicability and accuracy of CFD systems, it is widely acknowledged that a poor pump preliminary design cannot easily be remedied by subsequent analysis of a more advanced type. Used together, however, a good preliminary design method and an advanced CFD tool can complement each other very effectively in the pump design process.
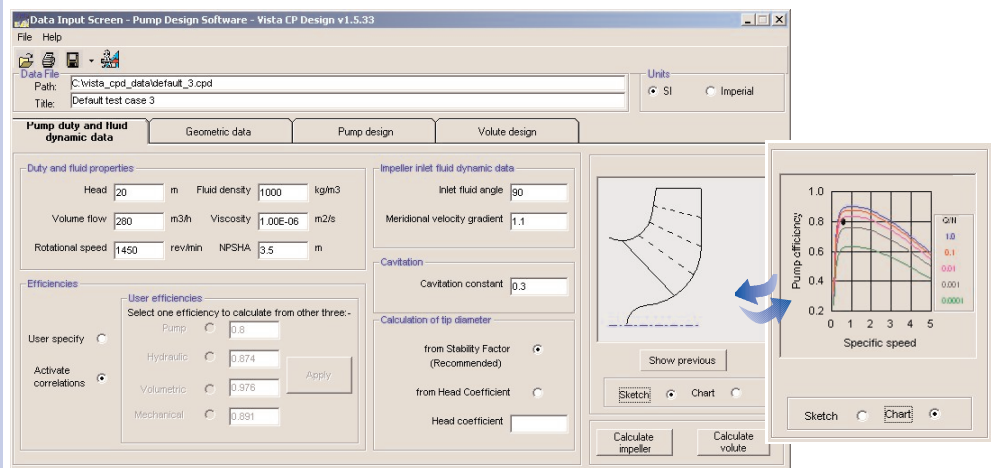

Fig. 1 Vista CPD user interface showing the impeller design tool

For preliminary design of centrifugal and mixed-flow pumps, PCA has developed a simple yet powerful code, Vista™ CPD, which enables the pump designer to move from initial ideas about the pump's basic duty to a full 3D geometry launch within a few minutes. The preliminary design includes both impeller and volute. Vista CPD is available as a standalone design tool but it is also integrated in ANSYS® BladeModeler™ within Workbench 11 and 12.

Impeller and volute design

Vista CPD first designs the impeller (Fig 1). The impeller dimensions and the fluid conditions at impeller exit are then used to initiate the design of the volute (Fig 2). This is effectively a nascent 3D volute geometry that can be transferred rapidly to a full 3D solid model within a CAD system.

Fig. 3 Vista TF solution for a centrifugal compressor
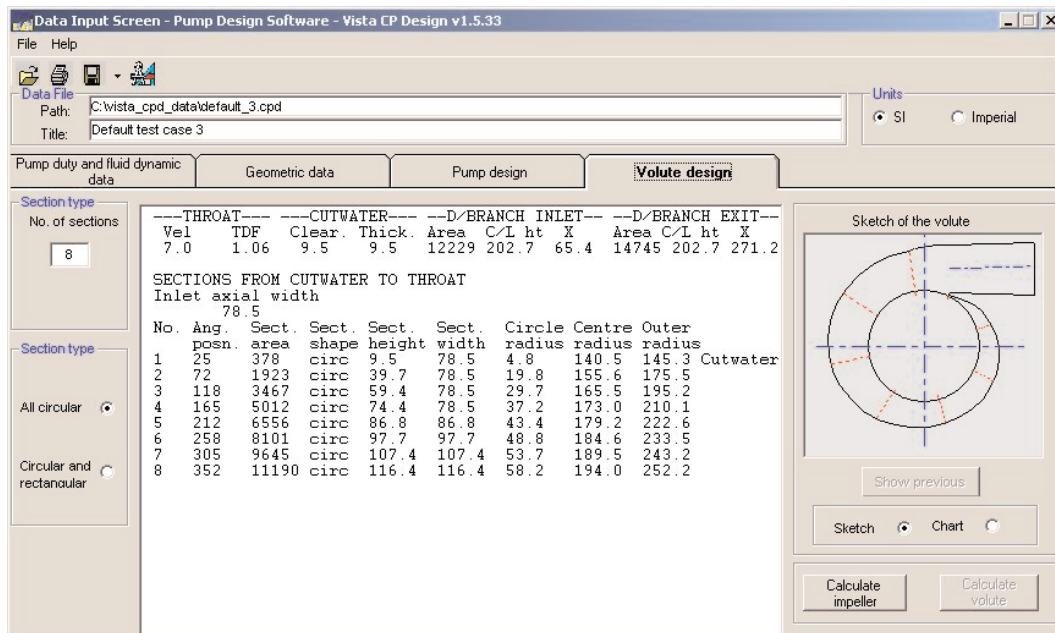
Volute design automatically matched to impeller design

Figure 2 shows:

■ an end-view of the volute design.

■ the volute design results page

Keeping it simple for the user

In common with all the Vista tools, one of the essential aims of VistaᵀᴹCPD development has been to free the user from the burden of excessive data preparation. The scope of the code has been kept within bounds consistent with this approach, avoiding over-sophistication that would cost the user dearly in data preparation time. This is especially beneficial at the very beginning of a new design when the designer may know little more than the required head, volume flow, a speed constraint and perhaps one or two geometric constraints.

There is also appropriate use of default data settings in Vista CPD; the default settings can be reliably used in the early phases of design, again avoiding irksome and unnecessary data preparation and entry.

Efficiency prediction

The user may specify the pump efficiency or, alternatively, select an option for the code to access its own internal loss correlations from which a reliable estimate of the pump efficiency will follow, which is then used in the design of the machine. The efficiency correlation is displayed graphically – see the inset picture in Fig 1.

VistaᵀᴹCPD and ANSYS® BladeModelerᵀᴹ

Vista CPD is available as a standalone program but it is also integrated into ANSYS® BladeModelerᵀᴹ within Workbench 11 and 12, so that it may be used to generate an optimised 1D pump design before moving rapidly to a full 3D geometry model and subsequent CFD analysis. In its standalone form, VistaᵀᴹCPD has an option to launch ANSYS® BladeModelerᵀᴹ .
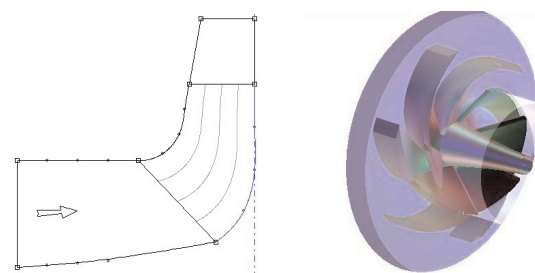

Fig. 3 Instantly-launched 3D geometry in BladeModelerᵀᴹ.

Choice of units

Vista CPD has a choice of units system – either SI or Imperial.

Graphic display

Vista CPD has simple but useful graphic displays to augment the numerical results. The graphs of the efficiency correlations may be replaced by thumbnail sketches of both the meridional shape of the impeller and an end-view of the volute.