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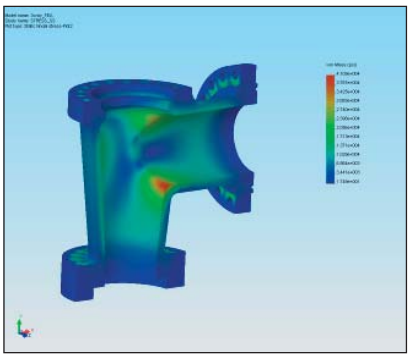
NORTON CAST PRODUCTS

FLOWSERVE

3D Modelling Reduces Lead Times and Improves Standard Compliance

Flowserve Flow Control Division is a global supplier of high performance control valves. The Valtek control products division supplies specifically designed and manufactured valves with high reliability, long-life, part inter-changeability, and ease of maintenance – all resulting in superior life cycle costs. Despite the fact that Flowserve employ 3D modelling in their product design, it is not used to its full potential due to difficulties in transferring data to foundries and pattern shops. Therefore, it became vital to Flowserve's business that they identify a software package that would facilitate not only free data transfer to their suppliers, but also the improved production of patterns and core boxes direct from the 3D model. Cti's experts were able to provide all the advice and training required.



Key project objectives

- select a suitable Finite Element Analysis (FEA) package compatible with existing modelling software
- compare the stress outputs of FEA with empirical calculation in terms of accuracy, activity time and compliance with the Pressure Equipment Directive (PED)
- evaluate a 'foundry friendly' modelling package, which will allow unambiguous data interchange between the valve designer, the foundry and its selected master pattern shop
- produce CNC machined patterns and core boxes, measuring aspects such as cost, time of manufacture and resultant casting accuracy
- collect cost savings associated with the machining of valves manufactured from CNC generated patterns and core boxes
- evaluate the variances in terms of financial impact on total manufacturing cost of the initiative, as this is the best impetus for change.

Industrial impact

- the valve designer has purchased a compatible FEA package
- the users of this software have received underpinning in-house training from Cti associated with the use of FEA as an analytical and design tool.
- computer generated FEA have been used to satisfy the PED requirements for a number of valves as an alternative means of satisfying the inspection authority
- a number of sets of pattern equipment have been manufactured using CNC patternmaking technologies
- pattern equipment build times have reduced by 40%, although the costs associated with its procurement have remained at similar levels to traditional techniques
- casting accuracies associated with the pattern joint line, core and core print location and consistency of wall thickness have all been realised
- the overall time of delivering the finished valve body to Flowserve has been reduced from twelve to eight weeks.

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Why was this work necessary?

Flowserve has an international reputation for manufacturing high reliability, long-life valves which are readily interchangeable and easy to maintain. As with all UK based valve manufacturers, Flowserve valve products are bespoke requiring a high degree of foundry flexibility in terms of alloy and product weight. As a global company, commodity carbon steel valves are sourced from around the world at attractive prices, especially since cast valves are supplied fully machined as a quality assurance measure.

For non-commodity valves the standard valve designs, which originate from the USA, are modified to meet the specific application. The company has employed 3D modelling for some time to aid valve design. The utilisation of 3D modelling has been limited by the availability of a partner foundry that can use the available data to further enhance the supply chain.

From a design perspective, Flowserve do not fully exploit the full benefits of the 3D model. This comment can be exemplified by the fact that compliance of traditional valve designs with PED has been achieved using hand calculations rather than FEA. The obvious benefit of using FEA to meet the PED requirement of certain valve configurations as an alternative to empirical methods meant that this became a key deliverable of the ICT Carrier initiative.

The other part of this project looked into the practicality of using the same 3D model to improve the foundry performance. Following discussions between the partners, it was generally agreed that the foundry process that would give most benefit would be patternmaking. Therefore, the benefits of CNC patternmaking, measured in terms of reduction in time, geometric conformity and total pattern equipment cost were assessed.

Key steps on the road to success

Successful implementation of the project findings relied on a number of factors being in place:

- a dedicated project team composed of multi-disciplined personnel with the desire to implement change
- support from senior management within the supply chain prepared to invest in 3D technology
- the provision of time for personnel to fully investigate and gain the understanding behind the successful implementation of 3D modelling
- willingness to test these new manufacturing concepts on real products
- the availability within the casting supply chain of pattern making partners with the capability of accepting 3D models for the creation of 3D surface geometries and cutter paths required for pattern manufacture.

Selection of a 3D modelling package

To help the foundry select the software package, a number of criteria assessments were developed on their behalf:

- capable of creating non-analytical surfaces
- the ability to model complex parts, both as solids and surfaces
- a wide selection of data transfer interfaces, which are user friendly
- cost effective
- low maintenance cost
- quality operator training and on-going technical support
- e-drawing capability

Benefits realised and future developments

Following the introduction of an integrated 3D modelling and FEA software package, it was found that there were significant improvements in certain areas of the manufacturing process. Machined patterns led to improved dimensional accuracy, core fit and, therefore, casting finish. The resulting reduction in post-casting machining, along with the reduced risk of ‘sample’ or ‘first-off’ scrap and improved turnaround in patternmaking has led to significantly reduced time to market.

In terms of costs, although the costs of the machined patterns is higher than conventional ones, their use leads to the benefit of reduced casting weight (i.e. less material) and reduced post-casting operations.

Having implemented this technology, it now provides the potential for further development. For example, the models generated could be used in the following areas:

- casting simulation / work flow simulation
- CAM for finish fettling and final machining
- fluid dynamics analysis
- FEA analysis

The success of this is reliant upon the availability of the 3D model and the partners having common modelling platforms to transfer and import data in native formats.

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