CASE STUDY

Improving Heating Boiler Acoustics at Viessmann: OptiStruct for Bead Pattern Optimization

Overview

Altair OptiStruct can be used to generate and optimize bead patterns for the effective design of sheet metal components. By using OptiStruct's topography and shape optimization methods, sheet thicknesses can be reduced significantly, leading to both reduced material and a lower overall cost.

Business Profile

Germany's Viessmann Werke GmbH is one of the world's leading manufacturers of household and industrial heating technology. The company strives to minimize environmental impact in every stage of the manufacturing process chain through the use of innovative product designs.

Challenge

During the development of a new generation of gas fired heating boilers, acoustical issues had to be resolved through design changes to the cover of the boiler (Figure 1). The stiffness of a structure can be increased in order to reduce noise levels, as was the goal for the boiler cover in this case. An initial approach involved an attempt to increase the structural stiffness of the cover through the integration of additional parts. An alternative approach began with a search for optimum bead patterns using Altair OptiStruct. The bead pattern concept won out as the preferred solution as it resulted in both less mass and fewer parts, ultimately leading to a lower total cost.

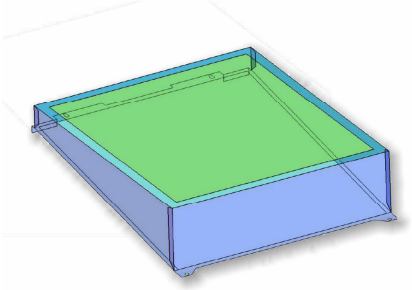

Figure 1 - Design space for topography optimization (green) of the cover.

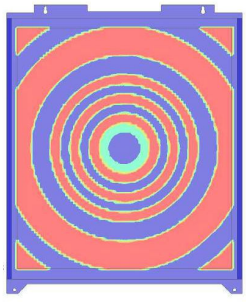

Figure 2 - The "pattern grouping" option of OptiStruct generated a circular bead structure as initial design proposal.

"Altair OptiStruct helped us to find an innovative and cost effective design solution in a very short period of time . Thanks to OptiStruct, the stiffness of the structure was significantly improved, leading to an acoustically superior heating boiler."

Andreas Schubert,
CAE Manager,
Viessmann GmbH, Germany

Solution

In order to generate the best possible bead pattern, the cover was optimized in a two-step optimization process:

- *Topography optimization* was used to generate the initial bead layout. The desired bead parameters (like bead width and height) had to be defined within the design space. OptiStruct generated a design proposal for the optimum pattern with respect to given design targets (Figure 2). The goal in the current project was to maximize the stiffness of the cover under specified load conditions. OptiStruct allows for the definition of desired bead pattern symmetries in order to generate designs which are easier to manufacture. Circular pattern grouping, one of the bead patterns offered by OptiStruct, generates patterns which consist of a number of circular beads; this option turned out to generate the best pattern for the given boiler cover design challenge.

- *Shape optimization* of the pre-optimized bead pattern was then employed to further improve component performance. Through the use of integrated morphing technology, it was very easy to parameterize the initial design for shape optimization, even without underlying CAD data. The width of various beads were chosen as design variables (Figure 3).

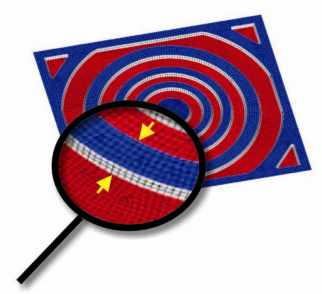

Figure 3 - Bead width was modified in a second optimization step.

Figure 4 - Prototype of the boiler with the optimized bead pattern on the cover.

Benefits

The new cover design for the “Vitopend 200” boiler series, greatly enhanced by Altair OptiStruct, went into production in 2005 (Figure 4). The following achievements were made by using optimization techniques in the design process:

Stiffness improvement of the cover: **+20% (compared to the alternative design concept)**
Part consolidation and cost reduction: **~30% (an assembly of 4 parts reduced to one)**