Altair | ProductDesign

case study

Aircraft Carrier Alliance

Creating a Structurally Efficient Design for the Queen Elizabeth Aircraft Carrier

When making key decisions at the concept and preliminary design phases of a naval ship project, the designer is often obliged to work with limited data on the major structural design drivers for the vessel. This can lead to a largely subjective design approach which can result in inefficiency and even structural problems being locked-in from the start. To solve any issues, increased material use, weight and unnecessary complexity, as well as high design and manufacture costs can be introduced to the end product. To evaluate the potential of simulation-driven design under the unique requirements of naval ship design, the ACA partnered with Altair ProductDesign.

solution

The goal of the project was to apply optimization technology to help drive efficient, right first time design solutions to a series of structural regions of the vessel. One area of interest was the aircraft carrier's flight control (FLYCO) module. The FLYCO module structure is comprised of a large glazed area supported between an upper and lower sponson structures. These sponson structures are required to meet natural frequency and deflection targets and are therefore subject to the complex interactions of mass and stiffness.

Topology optimization was first employed to identify the optimum global positioning of stiffening webs within the package envelope of the module. This was followed by a further round of topology optimization to identify the optimum load paths within those webs, such that openings could be cut without compromising structural performance. Finally, size and shape optimization was employed to fine-tune the plate thicknesses and opening sizes to minimize mass and design complexity while meeting design targets.

result

The redesigned FLYCO module structure met the natural frequency, deflection, stress and buckling targets while being 16% lighter than a traditional design, used fewer parts and resulted in reduced fabrication cost. The collaboration demonstrated that simulation-driven design can provide benefits to ship structural design and manufacturing through cost reduction, mass reduction, and improved structural performance and efficiency.

"Together with Altair, a number of opportunities were identified to use HyperMesh and OptiStruct for the analysis of local structures and identification and removal of redundant material, leading to weight and cost saving benefits."

Aircraft Carrier Alliance, Official Statement