# Multiphysics

# Optimising and accelerating aircraft design and stress analysis with MSC Apex and DFC software

By Zak Fourie, Structural Consultant Engineer, Paramount Aerospace Industries

n 2009, Paramount Aerospace Industries worked with Aerosud, a South African aeronautical design and production company, to create the Advanced High-performance Reconnaissance Light Attack (AHRLAC) aircraft. Designed in Africa for low-cost operations, AHRLAC was envisioned as a cost-effective, multi-role surveillance and counter-insurgency aircraft with a modern and sophisticated design and advanced sensor and mission systems.

By coupling MSC Apex with the DFC software from Accentus Aero, engineers were able to build a link between CAD designs and certification-ready stress reports. After the initial testing phase, MSC Apex emerged as the core tool for preparing analysis jobs for MSC Nastran. It provides a GUI to assign structural properties such as joint data and material, and to extract loads. DFC software was then used to generate the calculation files, analyse structures, and interpret results.

> "Thanks to MSCOne, we have access to MSC Apex which accelerated the FEA modelling of advanced aerostructures and assemblies. What took months to build models with just a little bit of structural detail, now took weeks for models that had CAD-like representative detail. Structural detail and manufacturing design principles weren't an obstacle anymore."

Zak Fourie, Structural Consultant Engineer, Paramount Aerospace Industries



Figure 1: The main AHRLAC wing structure modelled in MSC Apex.

# Challenge:

Given the advanced geometries and load cases of the AHRLAC aircraft design and its purpose, using traditional calculations for structural analysis was nearly impossible. The CAD geometries needed to be accurately modelled for meshes, connectors, materials, and boundary conditions so that rapid and accurate answers could be achieved by the engineering team to validate aircraft designs.

In addition, Paramount Aerospace was a customer of the MasterKey licensing system, which meant they did not have access to the latest analysis software, including MSC Apex. Building a full finite element analysis (FEA) model using the MasterKey system was going to take longer than the engineering team had available. They needed results, together with a flexible user interface that enabled them to interpret MSC Nastran answers quickly and easily with a minimal amount of training.

## Solution:

Paramount Aerospace Industries migrated to MSC**One** giving its engineering team access to the full set of Hexagon Design and Engineering software portfolio. This accelerated their stress analysis activities and workflows. Paramount's engineers could duplicate the designed assemblies and parts in MSC Apex, and then generate the required meshes, assembly connections, material characteristics, loads and constraints. MSC Apex was the core tool used for preparing analysis jobs for MSC Nastran while providing a nice, userfriendly interface. Using MSC Apex's parts-and-assemblies approach to a finite element model enabled the Paramount engineers to efficiently model their aircraft. The finite element models for parts and assemblies could be modelled as a complete structure.

Paramount went beyond the MSC Apex-enabled accelerated workflow. It used the new DFC software to generate calculations from the loads it extracts from MSC Nastran. DFC also enabled the engineers to visualize reserve factor (RF) maps of each part.



Figure 2: A section of the AHRLAC wing CAD model imported directly into MSC Apex.

Aerosud used the open-source customisation capabilities in MSC Apex. Using the built-in Python programming language, it built DFC software, a post-processing and results interpretation toolset. DFC helped the engineers to structure their analyses while applying the correct calculation techniques to the appropriate geometries, meshes and structures.

DFC extracts the internal loads generated by MSC Nastran and organizes the finite element data by part or by section, depending on the engineer's requirement and modelling preferences. It uses the load extraction data in the applicable calculation relevant to the part or structure involved to generate a Reserve Factor (RF). The RF calculation is then published and linked to a stress report and certification-ready documentation. All documentation is traceable and can be reviewed by fellow and independent engineers.

### **Results:**

Using MSC Apex with DFC software for MSC**One** emphasised the value of the licensing system for creating CAE models. Paramount's engineers could now focus on model generation to create DFC models. Then, structural engineers could test the stress results. This expedited the engineering stress analysis workflow by removing the need for the stress engineers to generate FEA models. Instead, they could use their time to interpret the stress results, recommending improvements and certifying the new aircraft design. "For one engineer, the entire wing assembly structure modelling task took less than 3 months. Linking it with DFC and creating automatic analyses and calculation files took less than 6 months. This was unprecedented and was a very welcome acceleration in development time."

Zak Fourie, Structural Consultant Engineer, Paramount Aerospace Industries

This combination of Hexagon's Design and Engineering software and DFC software (part of the MSC**One** XT licensing system) enabled an aircraft OEM to streamline structural analyses and accelerate development. With these tools, certification-ready stress analyses can be reduced from years down to months.

### About Paramount Aerospace Industries

Paramount Group was formed in South Africa in 1994 with the bold goal of helping African governments better protect their countries. Today, they're a global corporation, leading the way in global defense and aerospace innovation.

Paramount has more than 3000 employees worldwide, working with sovereign governments across five continents and manufacturing in Africa, Asia, and the Middle East.

The AHRLAC aircraft is currently in production and has generated massive interest worldwide.

### About DFC Software & Accentus Aero

DFC software has been developed and used by Aerosud for more than 20 years in its aerostructure and aircraft interior projects. The commercial version of DFC is now available through Accentus Aero, a company founded by the lead designer of DFC software. The solution is also available within the MSC**One** XT partner program.

Optimising aircraft design and stress analysis. Learn more about CAE: hexagon.com