Stork Fokker Aerospace

The Airbus A380 breaks all records at Stork Fokker Aerospace.

OVERVIEW

This year, the presentation of the Airbus A380 made global headlines. The commercial airliner is breaking all records: the most passenger seats, the largest aircraft, the most power, the largest wingspan-the list goes on. This latest example of supreme, cutting edge technology has a Dutch touch with the involvement of Stork Fokker Aerospace. Stork also saw its own records broken in the process-a new Linux computational cluster had to manage the enormous computation and data processing involved.

Stork Fokker's innovative knowledge was employed to produce the Airbus A380. The company delivers the lightweight 'Glare,' a fiberglass and aluminum laminate for the topside of the body, and the so-called 'J-Nose,' the fixed wing leading edge. Lightweight thermoplastic composites are used for the J-Nose, an important part of the wing that is designed, tested, and produced in Hoogeveen in the Netherlands. Stork Fokker Aerospace in Hoogeveen had delivered thermoplastic composite Airbus components before—the J-Noses for the Airbus A340 (the forerunner of the A380) were made out of the same material.

Plastic composites have the advantage of being repairable, light in weight, and can be welded. The plastic composites Stork uses for the manufacturing of the J-Nose can be molded into practically any form. Once it is shaped a certain way, it is still easy to reset. The J-Nose that Stork manufactures is 20 to 25 percent lighter than those using conventional materials, yet still meets all strength requirements. Moreover, Stork can manufacture the J-Nose with fewer larger parts, which ultimately equals a better product.

STORK FOKKER EMPLOYS ITS LARGEST COMPUTATIONAL MODELS EVER

The manufacturing of the J-Nose for the Airbus 380 was nothing new for Stork Fokker. However, what was groundbreaking was the gigantic size of the model—it was the largest model Stork Fokker had ever worked with. According to Wydo van de Waerdt, stress engineer with Stork Fokker Aerospace and one of those responsible for the calculations of the J-Nose's strength and rigidity, the sheer size of the A380 made it difficult to work with this model. "The A380 wing is so large that linear calculations no longer suffice. Linear methods assume that displacements are relatively small; however this assumption does not work for the A380 wing. To get even more out of the constructions, non-linear calculation methods were required for the design model. This meant however that we needed to work with larger calculations."

Indeed, these calculations were the largest computational models Stork Fokker Aerospace had ever used. "We subdivided these models into more than 200,000 elements each, containing stretch, tension, and replacement data," said Van de Waerdt. "The enormous size of the computation and data processing involved meant we had to purchase a new computation server to complete the computations within a reasonable amount of time."

LARGE CALCULATIONS PUSH THE LIMITS

The calculations for the J-Nose models not only made heavy demands on the hardware, but also pushed the limits of the software used. A number of the stress engineers working for Stork Aerospace used Excel. Others, including Van de Waerdt, used Mathcad. "The computations were so large that they exceeded the capabilities of Excel," said Van de Waerdt. "Excel simply did not have enough worksheets for all of the elements and computations. Mathcad's matrix size is many times that of Excel. Using Mathcad, we were able to make all of our calculations in one or two steps at the most, whereas

CUSTOMER SUCCESS PROFILE

Stork Fokker Aerospace
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Challenge:

Managing the large computation models and intense data processing required to produce the primary components of the Airbus 380

Strategy:

Using Mathcad's capabilities to document, manage, and trace the large and complex calculations involved throughout the development process

Results:

Increased efficiency from start to finish as well as improved manageability and traceability of the critical calcuations involved in creating materials for the Airbus 380

with Excel we would have needed tens of steps."

Size, clarity, manageability, and traceability are incredibly important to Van de Waerdt when using software like Mathcad. "We have now computerized the complete analysis of certain elements. The calculations can therefore be immediately adjusted for small changes, and herein lies the power of this software," said Van de Waerdt. And changes occur often. Stork Fokker Aerospace is responsible for the J-Nose's entire manufacturing process, from the drawing board up to, and including, the latest specifications after test flights and the final manufacturing. "From the design stage to final production we go through various checking phases and the model becomes more and more precise," continued Van de Waerdt. "After every adjustment, it is possible to reuse the existing data and apply the minor changes in the recalculation. Mathcad automatically adjusts all data to accommodate these changes, so that we don't need to enter everything again and again, which saves us enormous amounts of time."

Using Mathcad, Van de Waerdt benefits from the faster calculation of the maximum load on the bolts used for the J-Nose. A huge number of bolts, which can be rapidly calculated based on one computation with some minor adjustments for each separate bolt, results in a tremendous increase in efficiency. "Mathcad makes it possible to computerize these types of calculations. Moreover, it makes large amounts of data easier to manage," said Van de Waerdt. "Everything can be traced and is readily comprehensible."

STORK FOKKER BENEFITS FROM TRACEABILITY

Traceability is vital to aircraft construction. If one element does not meet specific requirements, it must be adjusted. With the help of Mathcad, the Stork Fokker team can trace calculations in a simple and easy manner. "Calculations have been made for each element separately," said Van de Waerdt. "As soon as one of the 200,000 elements does not meet the requirements, it can be immediately retrieved from the database data." These data can also be traced quickly within the graphs made using Mathcad. "One deviation or defect is immediately and clearly noticeable. Because the elements have been calculated separately and can be traced, we can quickly establish where the problem is."

The advantages of Mathcad have not gone unnoticed. The Airbus A380 computations were used as a test case and the software was successful. "Together with the responsible parties we are now looking to introduce this on a broader scale within Stork Fokker," said Van de Waerdt.

The use of thermoplastic composites in aircraft construction took an enormous leap in the last few years. Because Stork started using them early, the company has extensive experience with this new application. The processing of composites is engineering- and labor-intensive, so Stork Fokker Aerospace's expertise comes in handy to process the composites most efficiently. As Stork Fokker Aerospace works on designing parts for the cargo model of this aircraft (the A380 Freighter), in addition to manufacturing parts for the A380, the company will continue to use Mathcad for many more of its calculations in the future. And as the aircraft industry continues to develop, the use of Mathcad is increasingly becoming a sheer necessity.