

By Paul Dvorak

## A new FEA element can adjust itself

A newly developed quad element lets aircraft designers cut the amount of manual tweaking once needed for some of the 200 FEA load cases they deal with. The new element transforms from one able to carry tension with shear, to one for tension only. And depending on other loads, a third transformation is possible.

The elements come in handy for wing and fuselage sections, for example, which are allowed to buckle slightly in normal flight operation. "The wrinkling changes the way the structure carries load", says Tony Abbey, technical director of **Noran Engineering**, developer of the FEA program NEiNastran in Westminster, Calif. "For example, pull on the diagonals of a piece of paper and wrinkles form along the load path. The problem was that a normal element cannot predict how a load should change its behavior.

"And depending on whether such skin elements are in shear, tension, or compression, they had to be manually adjusted," says Mark Beyer, a senior engineering specialist at **Cessna**. The element formulations are now automatic. As loads change in a nonlinear solution they trigger a change in the element formulation.

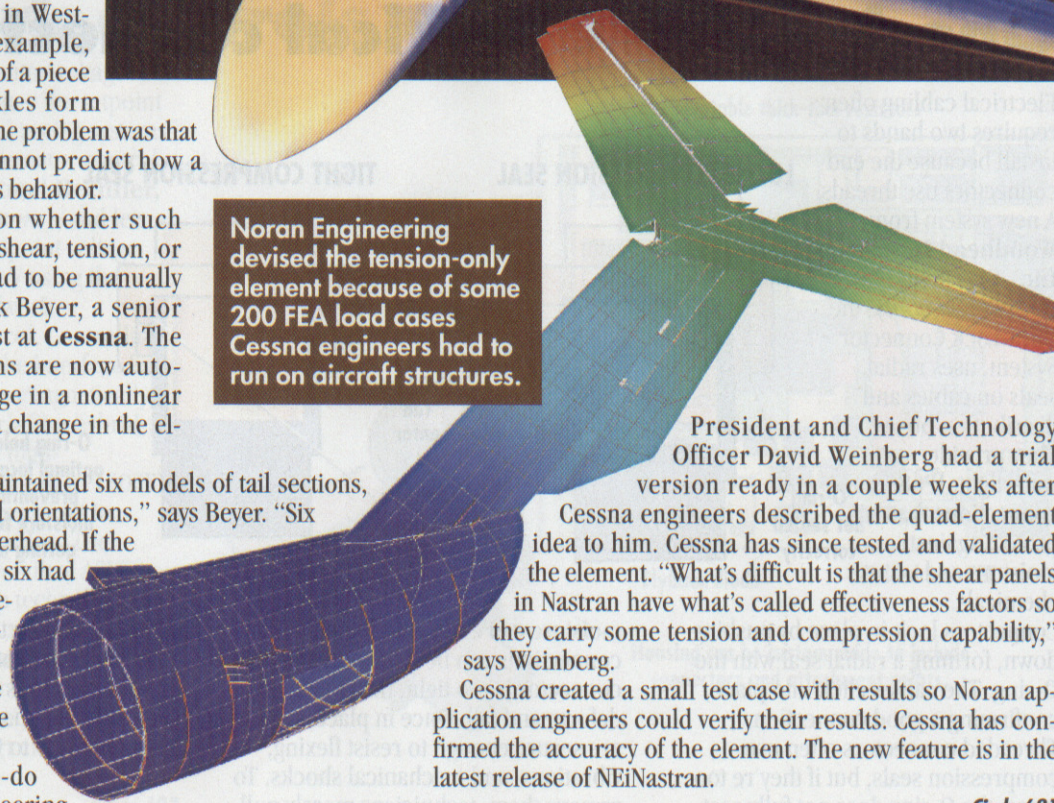
"At one time we maintained six models of tail sections, each for different load orientations," says Beyer. "Six models are a lot of overhead. If the geometry changed, all six had to change. The new element reduces the tail-section count to one."

Other FEA software developers placed the element-modification work low on their to-do list. But Noran Engineering



The Cessna Citation Mustang will benefit from the multicharacter finite element.

Noran Engineering devised the tension-only element because of some 200 FEA load cases Cessna engineers had to run on aircraft structures.



President and Chief Technology Officer David Weinberg had a trial version ready in a couple weeks after Cessna engineers described the quad-element idea to him. Cessna has since tested and validated the element. "What's difficult is that the shear panels in Nastran have what's called effectiveness factors so they carry some tension and compression capability," says Weinberg.

Cessna created a small test case with results so Noran application engineers could verify their results. Cessna has confirmed the accuracy of the element. The new feature is in the latest release of NEiNastran.

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