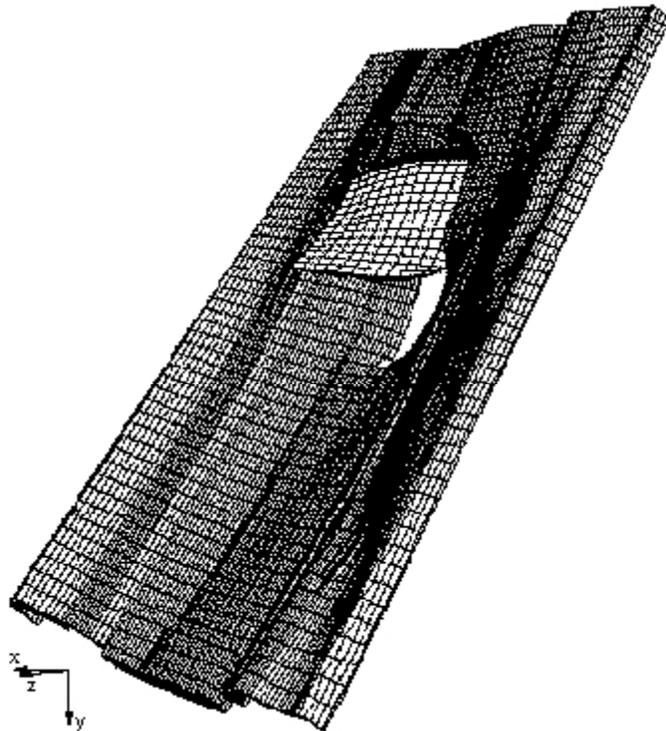


Transient Finite Element Analyses Developed to Model Fan Containment Impact Events

Research is underway to establish an increased level of confidence in existing numerical techniques for predicting transient behavior when the fan of a jet engine is released and impacts the fan containment system. To evaluate the predictive accuracy that can currently be obtained, researchers at the NASA Lewis Research Center used the DYNA 3D computer code to simulate large-scale subcomponent impact tests that were conducted at the University of Dayton Research Institute (UDRI) Impact Physics Lab.

In these tests, 20- by 40-in. flat metal panels, contoured to the shape of a typical fan case, were impacted by the root section of a fan blade. The panels were oriented at an angle to the path of the projectile that would simulate the conditions in an actual blade-out event. The metal panels were modeled in DYNA 3D using a kinematic hardening model with the strain rate dependence of the yield stress governed by the Cowper-Simons rule. Failure was governed by the effective plastic strain criterion.



Third curved sector UDRI test 2.5 msec after impact.

The figure shows the model of the fan blade and case just after impact. By varying the maximum effective plastic strain, we obtained good qualitative agreement between the model and the experiments. Both the velocity required to penetrate the case and the

deflection during impact compared well. This indicates that the failure criterion and constitutive model may be appropriate, but for DYNA 3D to be useful as a predictive tool, methods to determine accurate model parameters must be established.

Simple methods for measuring model parameters are currently being developed. In addition, alternative constitutive models and failure criteria are being investigated.

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