

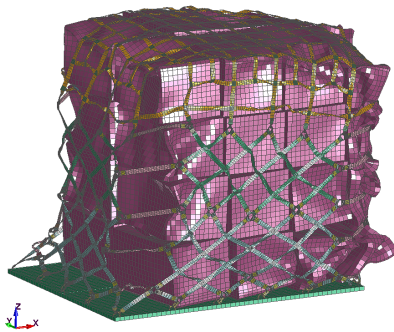
Transportation Analysis

Keeping Things "In-Their-Place" Whether Over Land, Sea, Air or Space

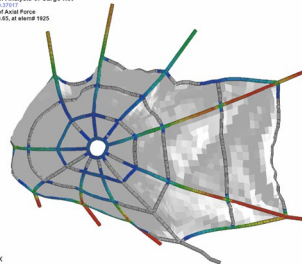
Welcome to our overview of Predictive Engineering's FEA nonlinear consulting services for transportation simulation. Over the years we have analyzed the transport of cargo, jet engines, pressure vessels, humans (anthropomorphic test devices or ATD's), composite containers, submarines and of course, electronic equipment on barges, ships, planes and rockets (space).

We hope you enjoy this tour of our FEA consultants experience in strapping, chaining, bolting, seat-belt'ing objects for all sorts of transportation incidents.

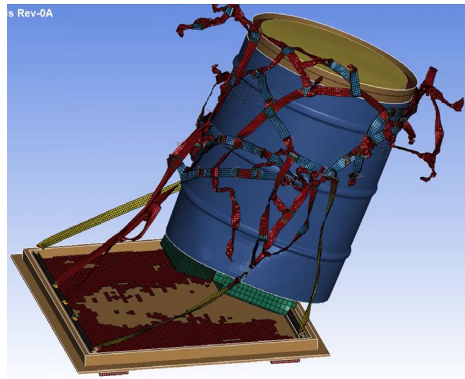
Air Force Cargo Net 9g Crash Simulation
 Time = 1



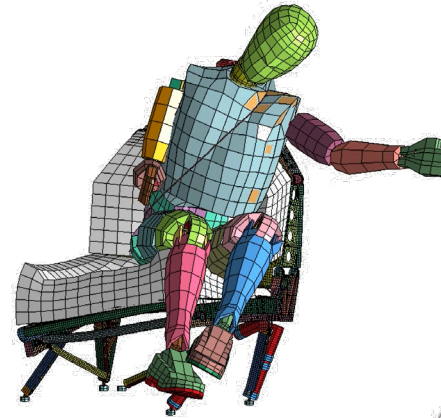
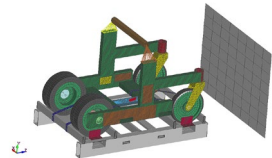
16g Crash Analysis of Cargo Net
 Date: 12/12/11
 Continuum of Aired Force
 Case#1119.02, at start 1805



Rev-0A



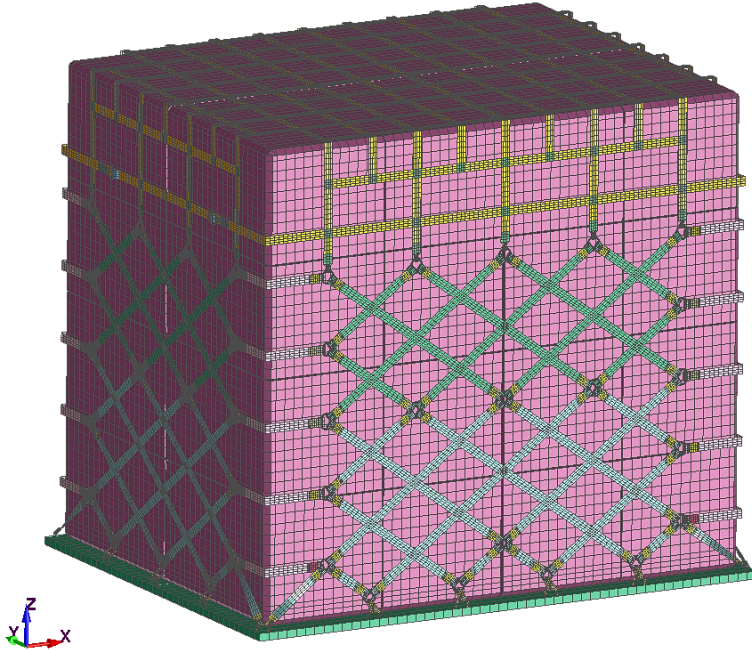
RealRover - Bigger Straps Should be Used - Transportation Simulation



Transportation Analysis – Keeping Things Attached Whether Over Land or Air

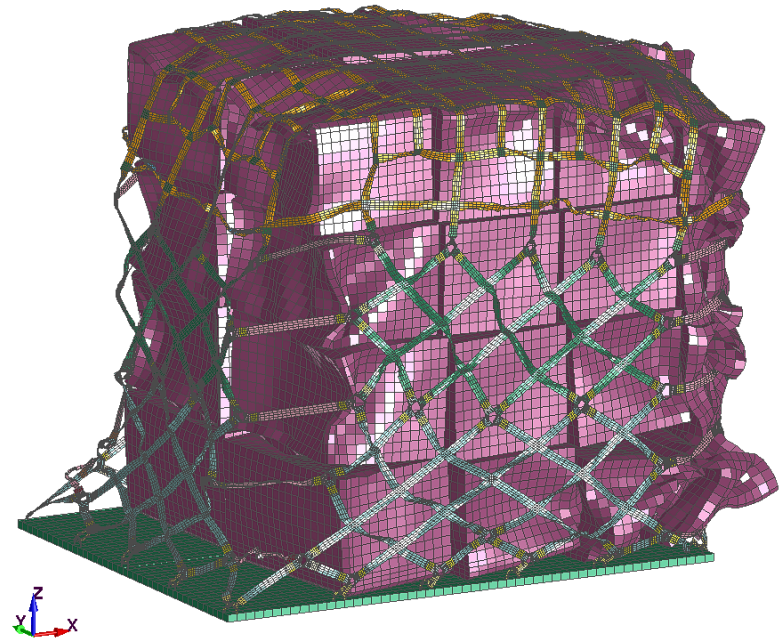
Air Force Cargo Net 9g Crash Simulation

Time = 0



Air Force Cargo Net 9g Crash Simulation

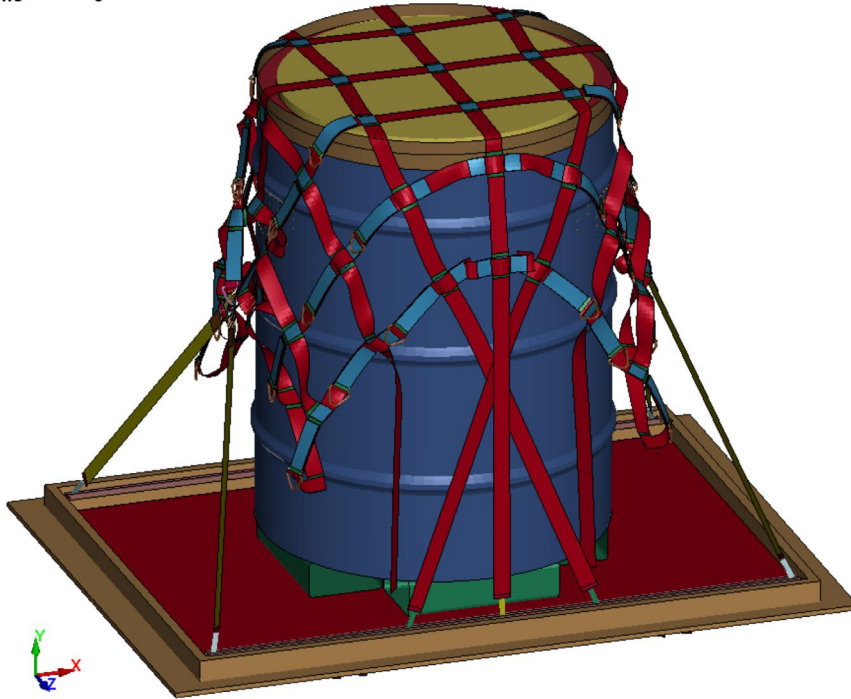
Time = 1



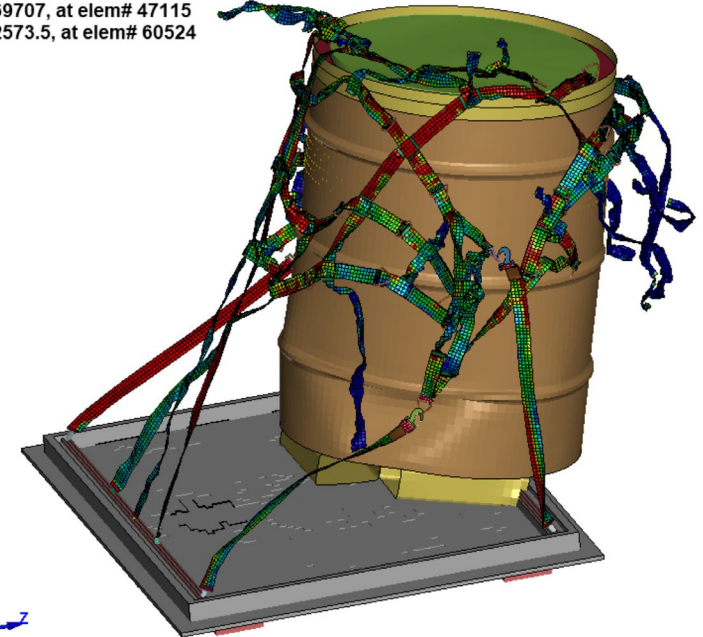
Our client was developing a new cargo strapping system to increase the carrying capacity of loose cargo per pallet and wanted to digitally prototype new designs prior to testing. Predictive Engineering's nonlinear FEA consulting services was able to simulate several new designs quickly and send the "winner" off to sled testing at 9g.

Land Transportation: 60 mph Barrel

Land Transportation: 60 mph Hazardous Waste Barrel
Time = 0

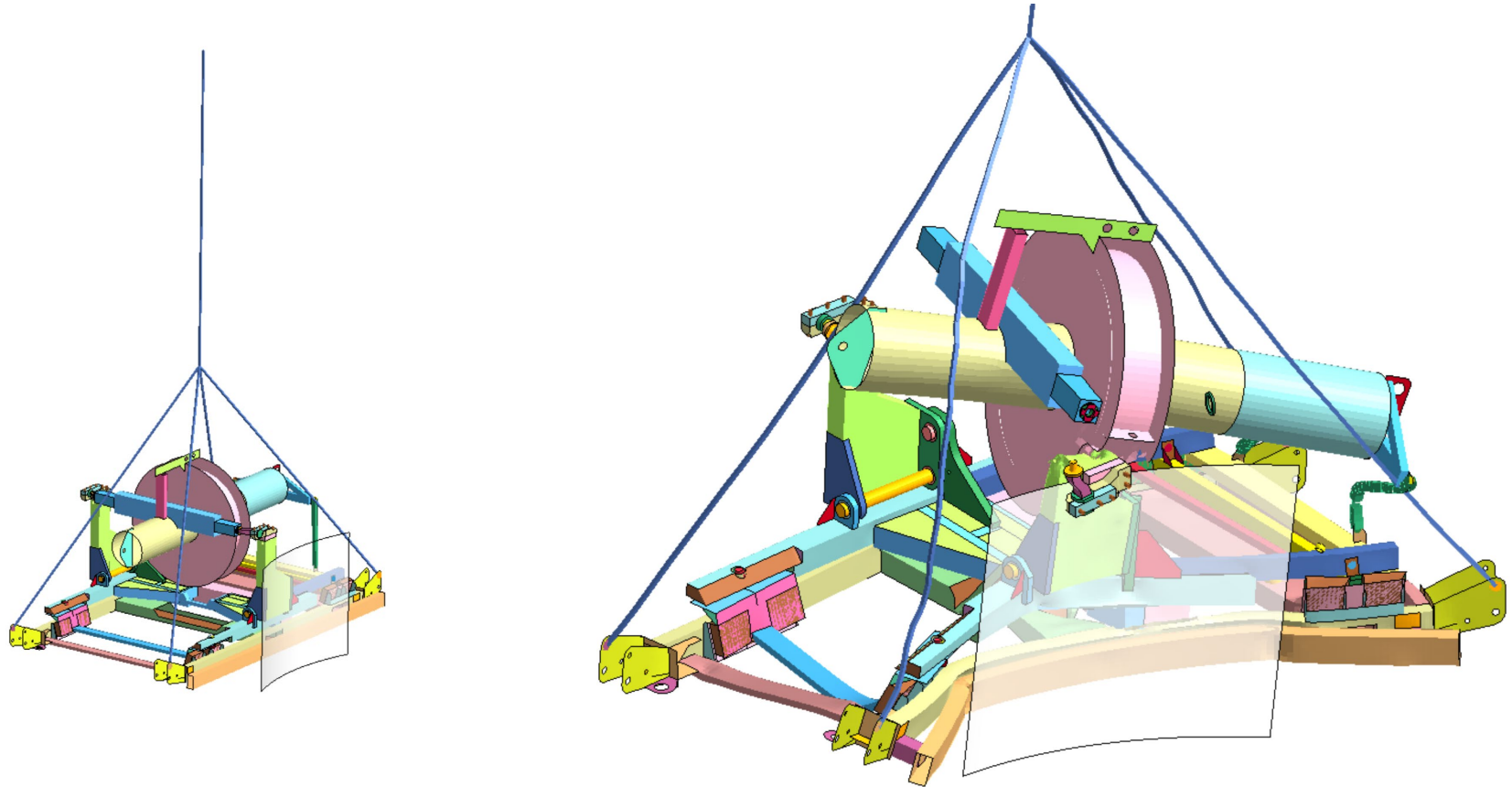


Land Transportation: 60 mph Hazardous Waste Barrel
Time = 0.1045
Contours of Effective Stress (v-m)
max IP. value
min=2.69707, at elem# 47115
max=42573.5, at elem# 60524



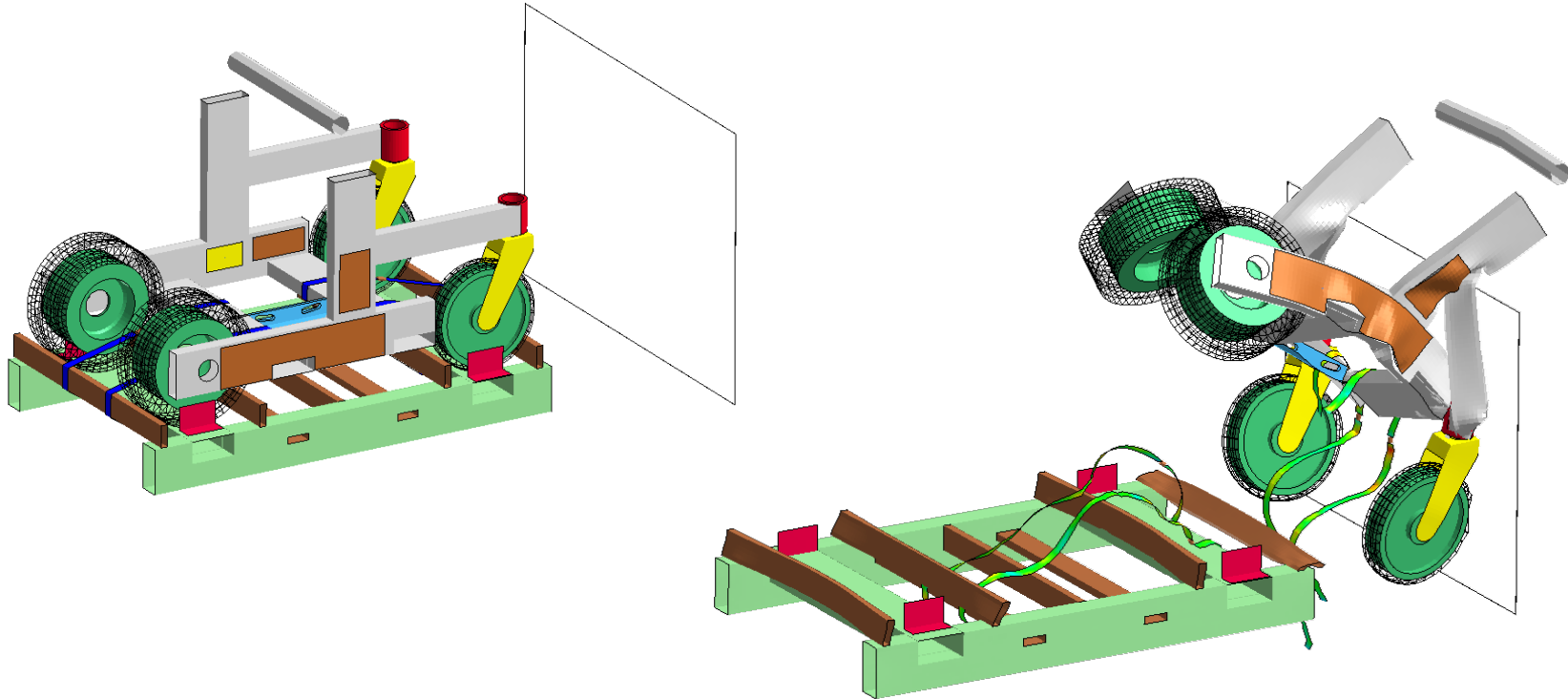
Land transportation at 60 mph provides its own set of challenges; especially so in the transport of hazardous wastes. The simulation work showed that standard polyester ratchet straps were not sufficient to restrain a 55-gallon drum upon deceleration from 60 mph.

Land and Air Transportation: Jet Engine Cradle Surviving 9g Side Hit



Side impact simulation of jet engine transportation cradle: Our client was required to demonstrate that their transportation cradle could safely transport jet engine cores over land and in the air. Our nonlinear impact simulation showed that it could easily handle 1.5g but at 9g problems occurred.

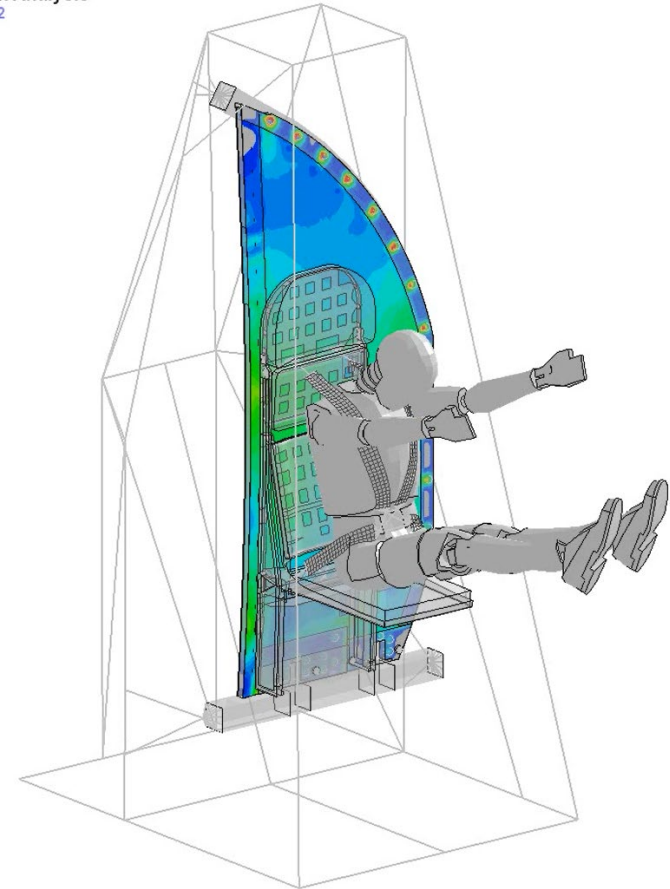
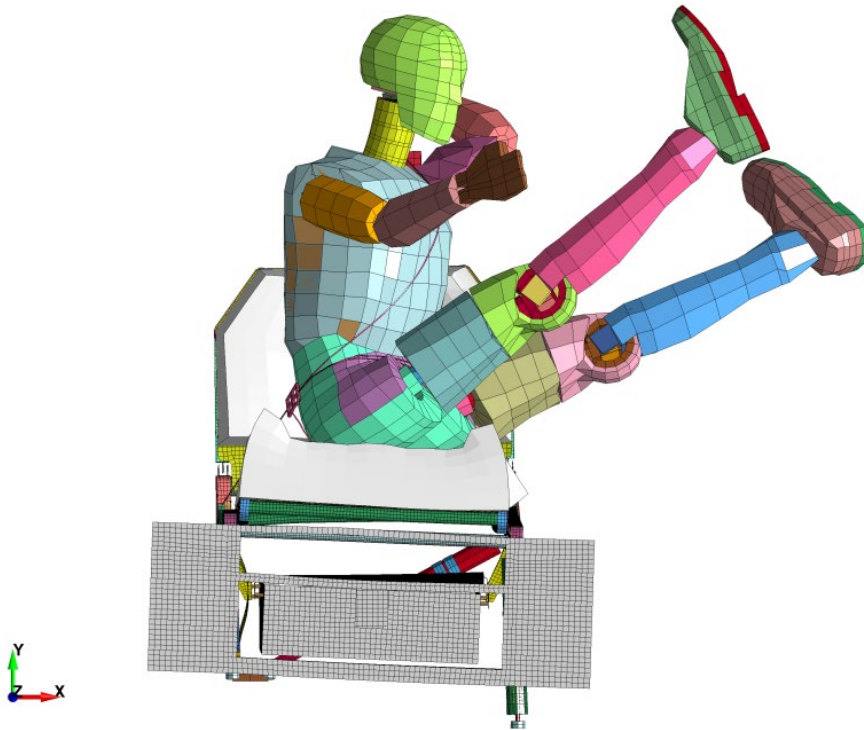
Land Transportation: Truck Transport



Truck transport of cargo requires specific strapping arrangements per the Federal Motor Carrier Safety Administration (FMCSA) under 393.100-114 Protection Against Shifting and Falling Cargo. Our client's strapping arrangement easily met this requirement but they were curious what would happen at emergency stops from 55 mph. Our nonlinear, transient dynamic FEA model presented clear-cut results.

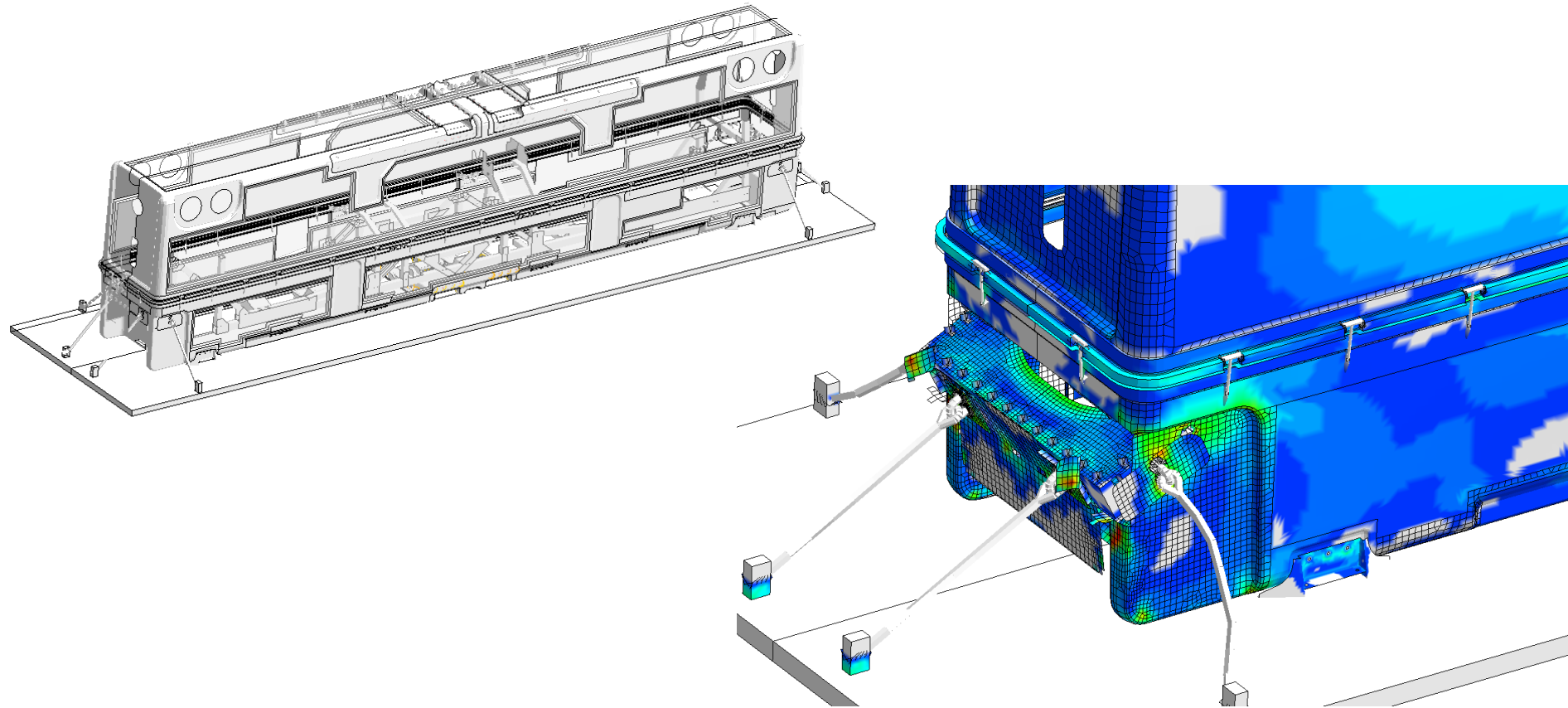
Air Transportation: ATD's

at Analysis
i2



What we know without a doubt, please keep your seatbelt fastened when you are flying. The standard 16g seat test ensures that you will stay in your seat – even if you don't survive the crash.

Air, Land and Rail Transportation: Composite Container with Built-In Reinforcements



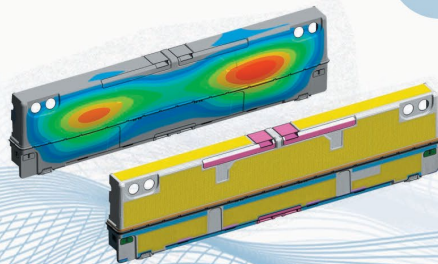
Composite containers provide lightweight protection for world-wide deployment of sensitive flying objects. This container was virtually tested under PSD (air transport), drop test, rail impact and pressurization analysis. Predictive's nonlinear FEA consultants were able to demonstrate, after a few design iterations, that the container would pass all tests and it did!

Predictive Engineering – The Advantage of Getting it Right the First Time

FINITE ELEMENT ANALYSIS
Predictive Engineering

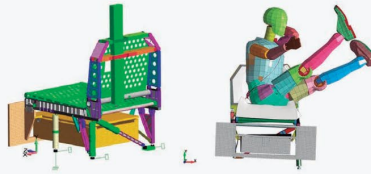
Finite element analysis consulting services, software, training and technical support.

- Composites, Pressure Vessels, Vibration.
- **NASTRAN**: Linear Dynamics.
- **LS-DYNA**: Drop-test, Impact, Burst Analysis.
- **STAR-CCM+**: CFD Thermal/Flow Analysis.



Project Examples

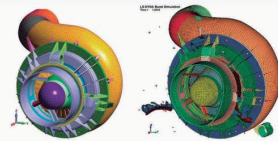
FAA 16G SLED TEST VERIFICATION



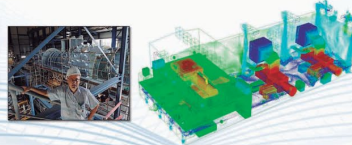
STRESS AND VIBRATION ANALYSIS OF SATELLITES



LS-DYNA TURBINE BURST SIMULATION



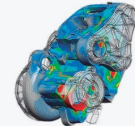
CFD STUDY ON CO-GENERATION POWER PLANT BUILDING



Our Services

FEA

Predictive Engineering brings to bear more than 20 years of finite element analysis FEA consulting experience in solving the most difficult mechanical engineering analysis challenges. Our validated experience ranges from transmissions to submarines to satellites.



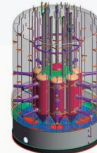
TRANSIENT NONLINEAR

At Predictive Engineering, we pride ourselves on the ability to idealize complex structures and systems into predictive numerical models. Our nonlinear, static and transient dynamic work has been validated against strain-gauges, drop and sled test results, accelerometers, crack growth and fracture and in extreme service environments.



ASME-BPVC

From seismic to buckling to cyclic service (fatigue), Predictive can assist in verifying the most challenging pressure vessel designs. Our hard-earned experience allows us to safely classify tanks and vessels as "fit-for-service" that would typically have required extensive redesign or re-work.



CFD

Our expertise in computational fluid dynamics (CFD) comes from hundreds of thermal-fluid projects in medical, aerospace, marine, HVAC (data centers), civil and automotive. This experience gives us the capability to quickly optimize and provide accurate digital prototypes.



We welcome your inquiries on how we can help your business get it right the first time.