



FINITE ELEMENT ANALYSIS

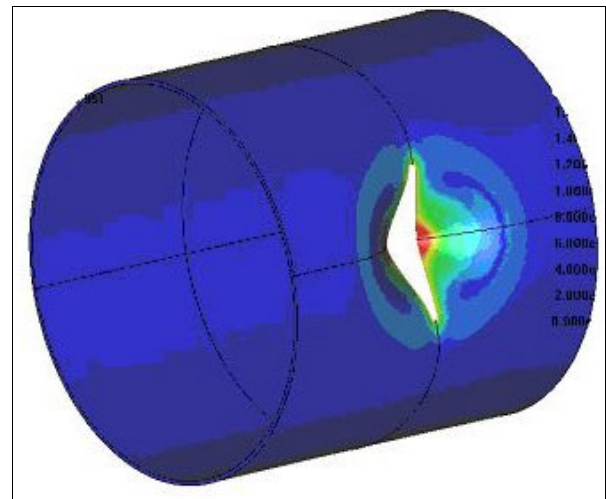
Baker Engineering and Risk Consultants, Inc. (BakerRisk) has comprehensive experience in the use of Finite Element Analysis (FEA) in complex structural and fluid-structure dynamics applications. The company utilizes industry-accepted FEA software packages LS-DYNA and ADINA, which are capable of handling complex applications involving irregular geometries, nonlinear material properties, fracture, contact surfaces, variable loading histories, and non-uniform boundary conditions.

BakerRisk's expertise is based on the use of FEA in a large number of engineering applications related to impulsive loading. A representative list of these applications includes:

- Prediction of structural systems response to blast loading
- Simulation of dynamic (shock) testing of structural components
- Determination of active instrumentation requirements for dynamic testing
- Simulation of structural response to dynamic loading in support of accident investigation reconstruction
- Assessment of damage to process equipment from postulated terrorist threats
- Verification of charge weight capacities of blast test chambers

LS-DYNA is a general-purpose finite element code for analyzing the large deformation dynamic response of structures, including structures coupled to fluids. The main solution methodology is based on explicit time integration, which is better suited for qualitative response estimates and is capable of handling less numerically stable problems. Many material models (more than 100

constitutive models and 10 equation of states) are available to represent a wide range of material behavior, including elasticity, plasticity, visco-elasticity, visco-plasticity, composites, thermal effects, and rate dependence. The code also has a host of contact algorithms.



Example of FEA Application Showing Storage Tank Rupture from Terrorist Threat

ADINA is also used for solving a wide variety of problems in structural, thermal and fluid flow analysis. The code is capable of performing both the explicit and implicit integration required for transient dynamic analysis applications. It is typically used for its implicit formulation capability where the problems are characteristically more stable numerically, and when more exact solutions are warranted. ADINA is also capable of structural response characterization using frequency domain analysis. Basic linear analysis can be performed effectively for structures, and nonlinear effects can be included to account for geometric and material nonlinearities and contact conditions. Incompressible or compressible flows can be solved for fluids, and the full interaction of fluid flows with structures can be analyzed as well.



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About BakerRisk

Baker Engineering and Risk Consultants, Inc. is one of the world's leading explosion analysis, structural design, and risk engineering companies. BakerRisk provides comprehensive consulting, engineering, laboratory and range testing services to government agencies and private companies who are involved with dangerous, highly hazardous, reactive, or explosive materials.



Blast Effects & Explosion Testing



Dynamic Structural Analysis and Design



Risk Engineering



Process Safety



Incident Investigations



Reactive Chemicals Testing & Management Systems

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BakerRisk's expertise in the use of FEA for a large number of engineering applications can be seen in some of the examples shown below:

Structural Response

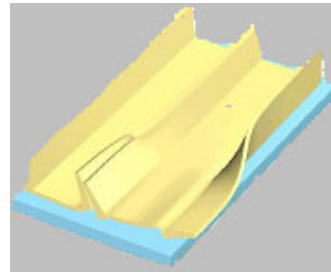
Provide pretest structural response predictions to range test blast loads to achieve desired structural damage levels. Validate brittle and ductile material model responses to test results.



Masonry Wall Testing Blast Response Prediction (left) and Testing (right)

Component Damage Simulation

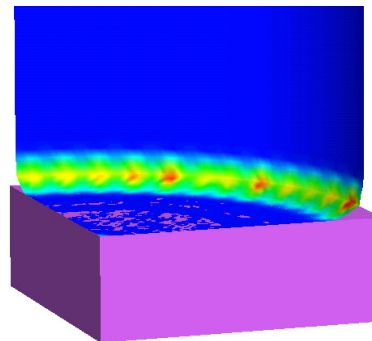
Accident investigation reconstruction by estimating blast parameters required to match observed damage indicators.



Support Fixture in which a 105 mm Projectile Accidentally Exploded

Tank Response

Estimate internal blast loads required to match observed tank damage. Blast pressures can then be used to support root-cause determination in accident investigations.



Atmospheric Tank Response due to Over-Pressurization