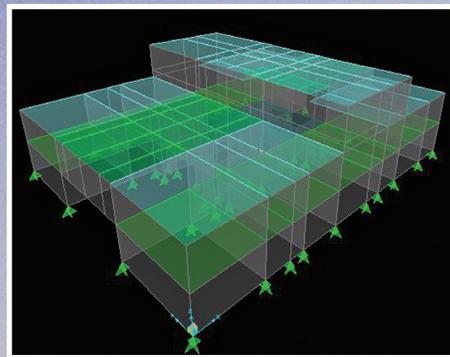
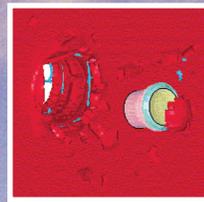
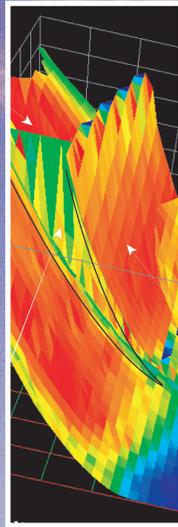


Infrastructure & Geotechnical Engineering Services

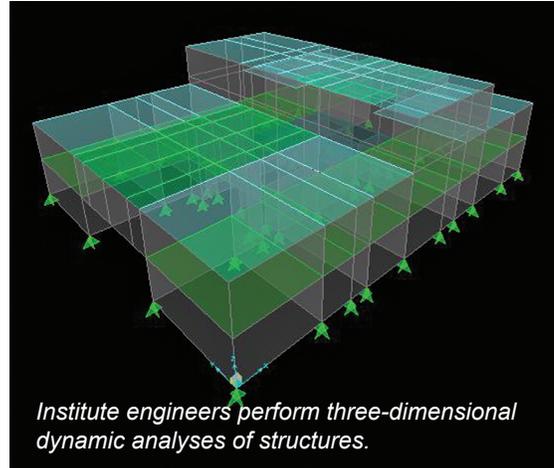


Southwest Research Institute®
San Antonio, Texas

Infrastructure & Geotechnical Engineering Services

Founded in 1947 as an independent, nonprofit research and development organization, Southwest Research Institute® provides a significant research, engineering and testing resource for industry, business and government. With 11 technical divisions, SwRI® uses a multidisciplinary, integrated approach to solving complex problems in science and applied technology. The Geosciences and Engineering Division is internationally recognized for innovative solutions to complex problems in the earth, material and planetary sciences and allied engineering disciplines. SwRI creates multidisciplinary teams to solve client problems within a framework of risk assessment, system studies and regulatory analyses. As part of a long-held tradition, patent rights arising from sponsored research at the Institute are often assigned to the client. SwRI generally retains the rights to Institute-funded advancements.

Southwest Research Institute (SwRI) provides effective solutions to a broad range of infrastructure and geotechnical engineering problems, including design analyses, nondestructive evaluations and testing to support developing new facilities and infrastructure, as well as retrofitting and reconstructing existing systems. Experienced in numerical modeling, risk assessment, and laboratory and field investigations, Geosciences and Engineering Division scientists and engineers solve diverse scientific and engineering problems for government and industry.



Institute engineers perform three-dimensional dynamic analyses of structures.

SwRI has an international reputation for its expertise in:

- Physical and earth sciences
- Material science and engineering
- Hazard and risk assessment
- Environmental science and engineering
- Regulatory interpretation, implementation and compliance demonstration

Our comprehensive services encompass:

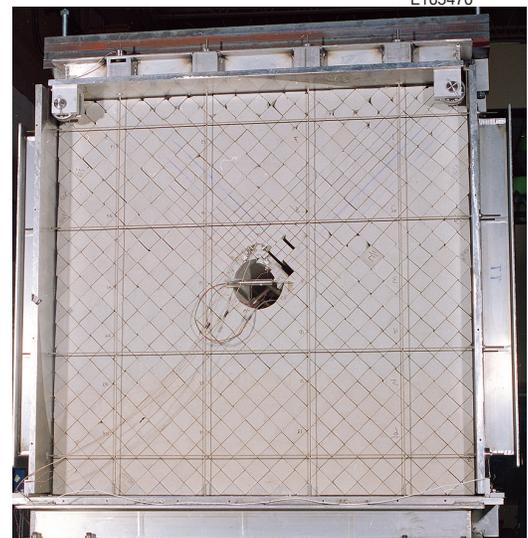
- Seismology
- Geotechnical Engineering
- Civil Structural Engineering
- Transportation Engineering
- Underground and Dam Engineering
- Geotechnical Material Characterization
- Risk Assessment

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An Institute laboratory experiment measured deformations around a scale-model underground excavation subjected to earthquake ground motion. The results improved understanding about how repeated seismic events affect tunnel stability, and helped build confidence in computational methods used to predict stability.

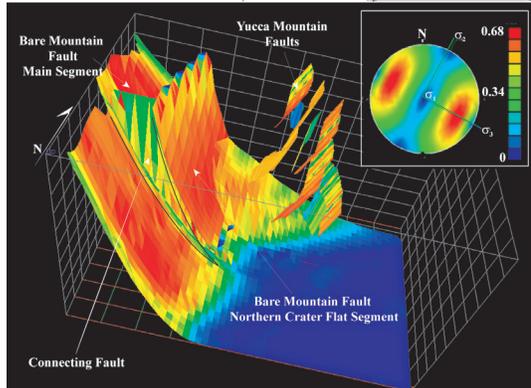
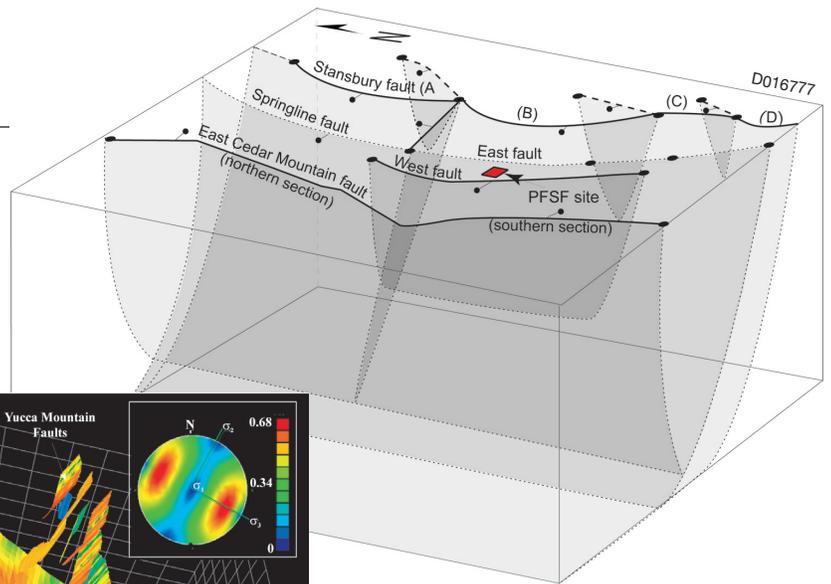


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Seismology

Institute engineers are experienced in applying structural geology, geophysics, neotectonics, geodesy and paleoseismology to:

- Identification of active faults
- Seismic source characterization
- Ground motion attenuation
- Seismic hazard assessment
- Fault displacement hazard assessment



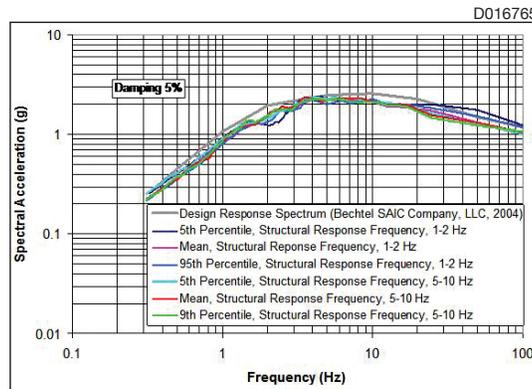
Using Institute-developed 3DStress® software, seismologists and geologists study the slip tendency of fault surfaces.

Institute scientists have developed three-dimensional configurations of faults based on an alternative rupture model and interpretations of normal fault growth from overlapping echelon fault segments to assess seismic hazards.

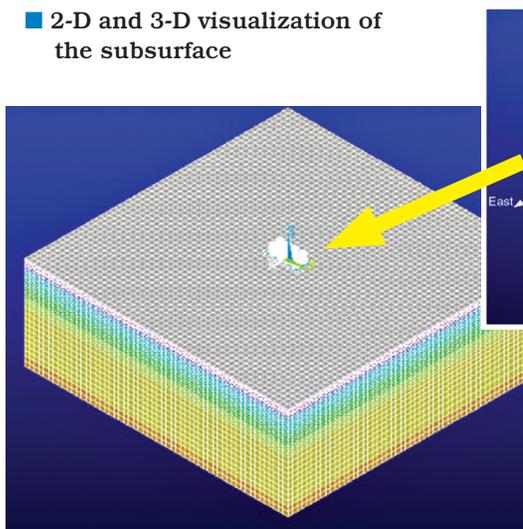
Geotechnical Engineering

Experience and expertise in soil mechanics and foundation engineering is used in:

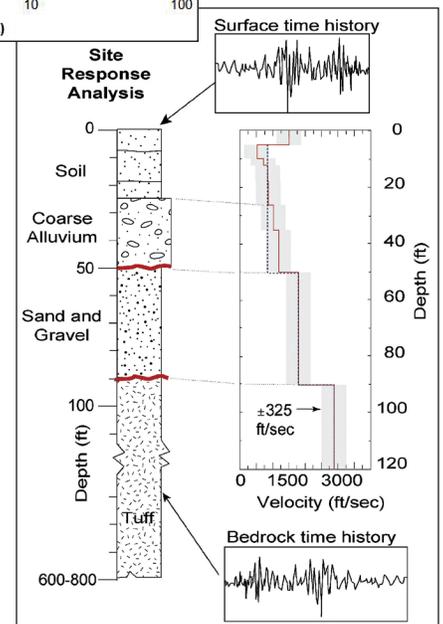
- Geotechnical investigation
- Geophysical site characterization
- Foundation investigation
- Site-specific seismic response analysis
- Liquefaction assessment
- Slope stability analyses
 - ◆ Long-term stability (static conditions)
 - ◆ Dynamic stability during seismic event
 - ◆ Numerical stress-deformation analysis
 - ◆ Slope stability monitoring
- 2-D and 3-D visualization of the subsurface



SwRI site-specific response analyses evaluate free-field ground motion and response spectra for design of surface structures.



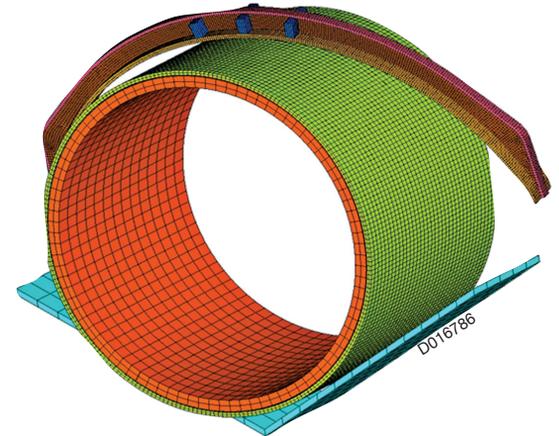
Institute engineers developed a finite element model of free-standing cylindrical casks on a concrete pad embedded in deep soil deposits and performed time domain soil-structure interaction analyses to study geometrical stability of storage dry casks under earthquake conditions.



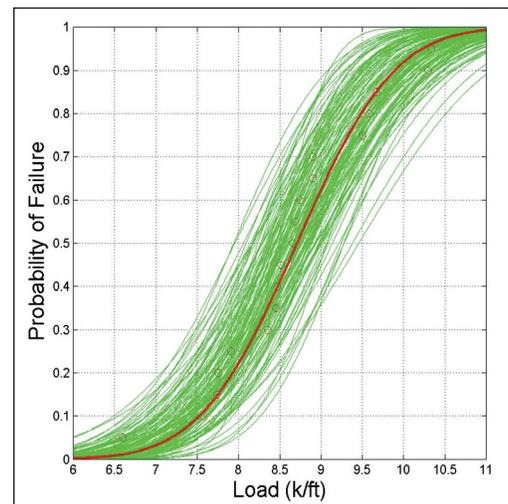
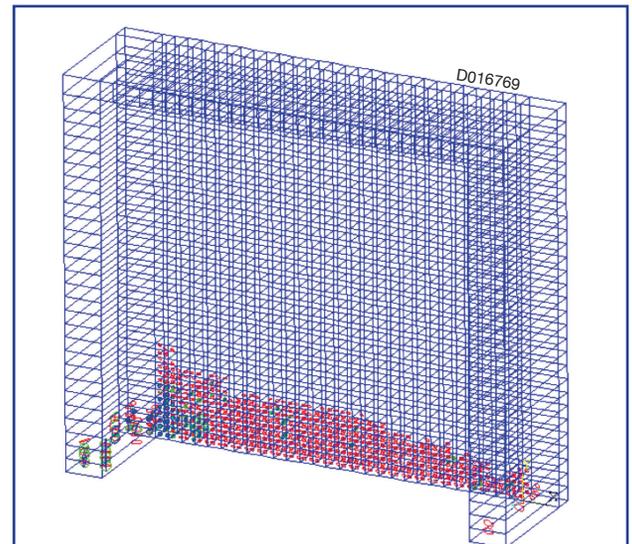
Civil Structural Engineering

SwRI engineers use advanced numerical modeling and design principles to analyze and test:

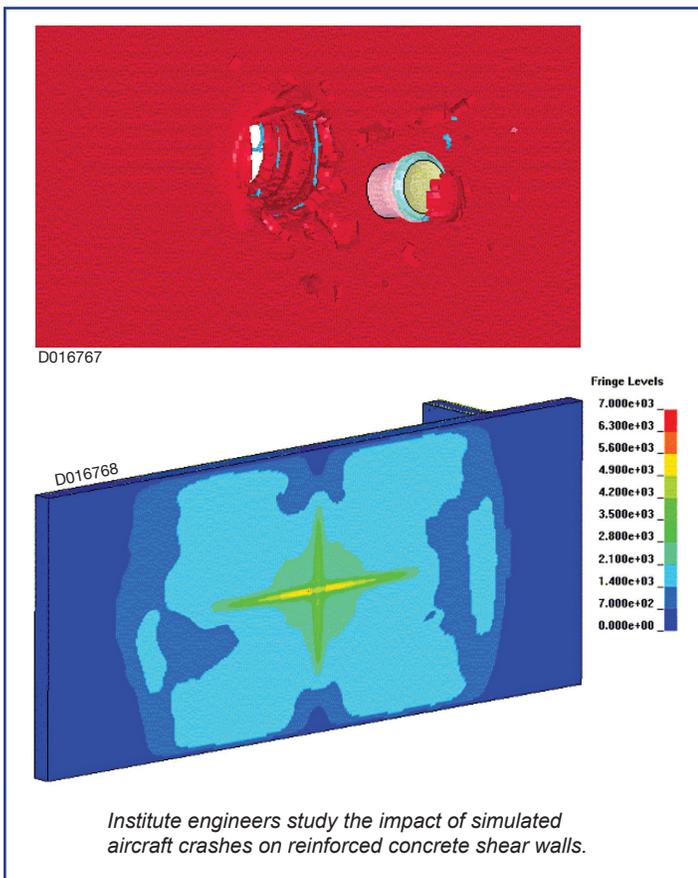
- Reinforced concrete and steel structures
 - ◆ Nonlinear static and dynamic analyses
 - ◆ Seismic analysis
 - ◆ Soil-structure interaction analysis
 - ◆ Impact and explosive load analysis
 - ◆ Fragility curves for structural and non-structural components
 - ◆ Structural design assessment
- Impact and penetration of reinforced concrete structures
- Coupled mechanisms affecting nuclear-waste containers (such as, effect of stress corrosion cracking on mechanical failure of the evaluated system)
- Nonlinear and time-dependent behavior of complex alloys
- Full-scale dynamic and quasi-static performance of structural systems
 - ◆ Earthquake
 - ◆ Blast
 - ◆ Wind and wave
- Full-scale behavior of buried structures or pipelines
- Experimental modal analyses of dynamic systems for verification of analytical models
- Simulation of large-scale laboratory testing



Institute engineers developed finite element modeling of drip shield and waste package interaction in geologic disposal tunnels.



SwRI engineers generate seismic fragilities for structural systems such as shear wall to assess the seismic risk.



Institute engineers study the impact of simulated aircraft crashes on reinforced concrete shear walls.

Transportation Engineering

Engineers at SwRI provide solutions in pavement engineering and structural performance, including:

- Pavement material modeling and characterization
 - ◆ Asphaltic concrete
 - ◆ Composite materials
 - ◆ Polymers
- Bridges and abutments
 - ◆ Structural analyses
 - ◆ Geotechnical analyses
 - ◆ Soil-structure interactions
 - ◆ Barrier impact analyses



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SwRI engineers evaluate geotechnical and structural aspects of bridges and overpass structures.

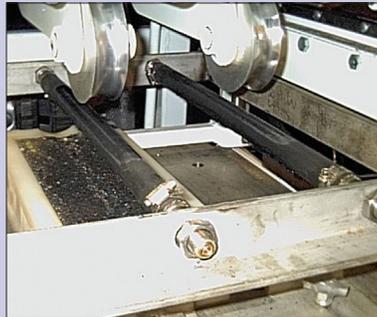
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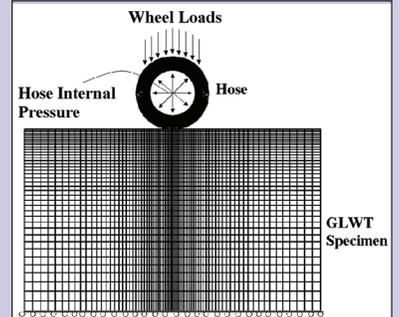
Crash tests of side safety devices, including crash cushions, median barriers and bridge railings, are conducted to determine effects of errant vehicles impacting fixed objects.

- Structural applications for asphalt concrete
 - ◆ Rutting of roadway from repetitive wheel loads
 - ◆ Georgia Loaded Wheel Tester simulations
 - ◆ Simulation of large-scale laboratory testing

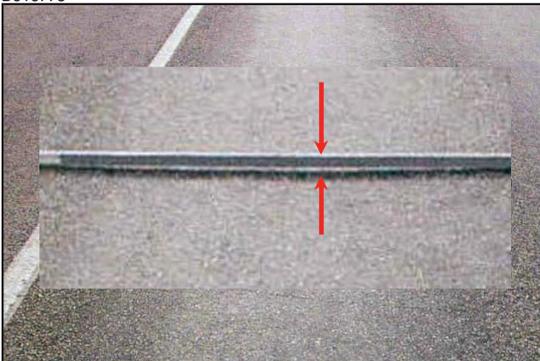
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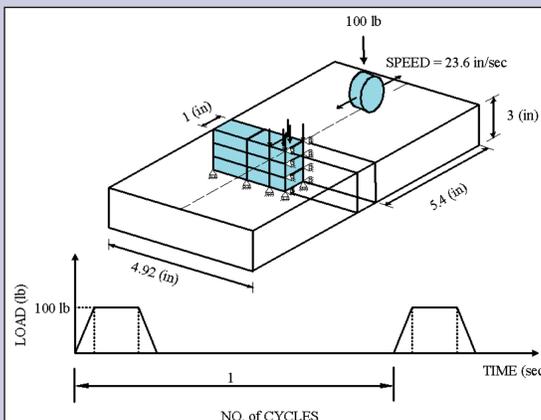
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D016773



Repetitive wheel loads cause roadway wheel rutting.



Using finite element analysis, Institute engineers use multi-axial, long-term simulation models to evaluate pavement life.

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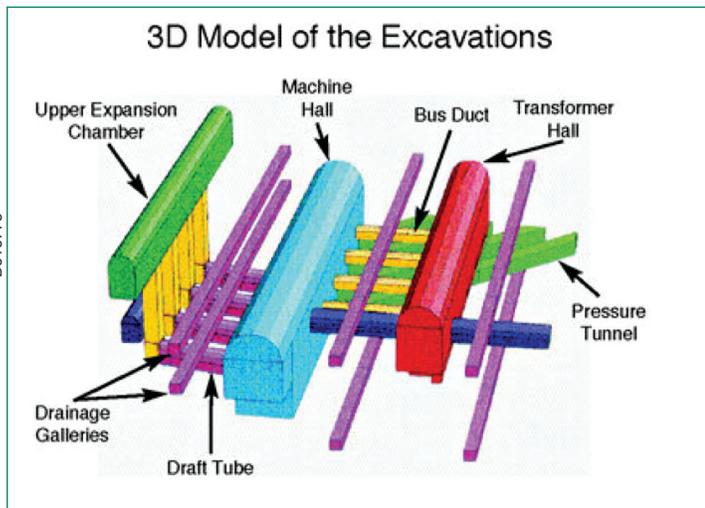
Underground and Dam Engineering

The Institute comprehensively evaluates underground excavation stability and design of support systems for mines, transportation tunnels and large underground caverns. Institute experience encompasses the application

of numerical modeling to analyze concrete and rock-fill dams. Field experience and laboratory facilities enable staff to provide a wide range of investigations and assessments.

Underground Stability Analysis

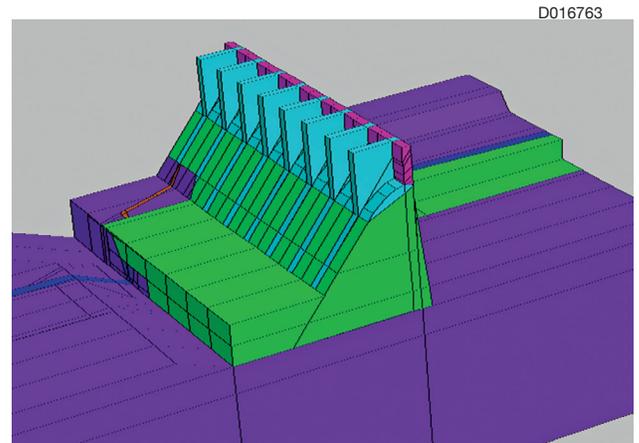
- Soil and rock mass classification and characterization
- Laboratory measurement of rock properties
- Numerical modeling using continuum, discontinuum and particle flow modeling methods
- Monitoring for instability prediction and estimation of damage zone



SwRI engineers have experience applying numerical modeling to the design of underground excavations for hydro-power projects.

Dam Analysis

- Static and dynamic stability assessment of concrete, earthen and rock-fill dams
- 2-D and 3-D modeling using continuum, discontinuum and particle flow methods
- Modeling construction and reservoir loading cycles
- Seepage and effective stress analysis
- Dynamic rock and soil-structure interaction
- Instrumentation planning, monitoring and model verification analysis

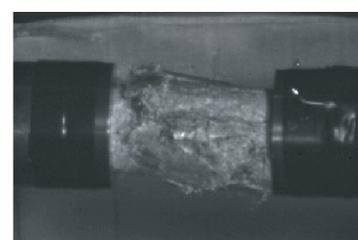
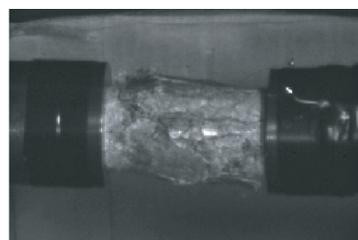
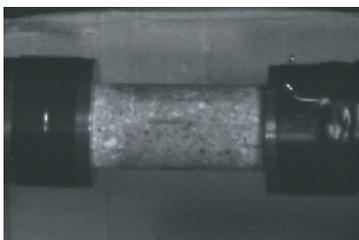


Modeling concrete dams assists engineers studying the stability of foundations.

Geotechnical Material Characterization

SwRI routinely conducts tests to characterize the mechanical properties and response of geotechnical materials such as rock and concrete, as well as metals, polymers and composites. The Institute has test facilities and experienced staff to conduct:

- Deformation response: stress-strain curves
- Static and dynamic triaxial tests
- Development of constitutive model parameters



Institute engineers conducted high-strain-rate compression tests to determine dynamic behavior of volcanic tuff.

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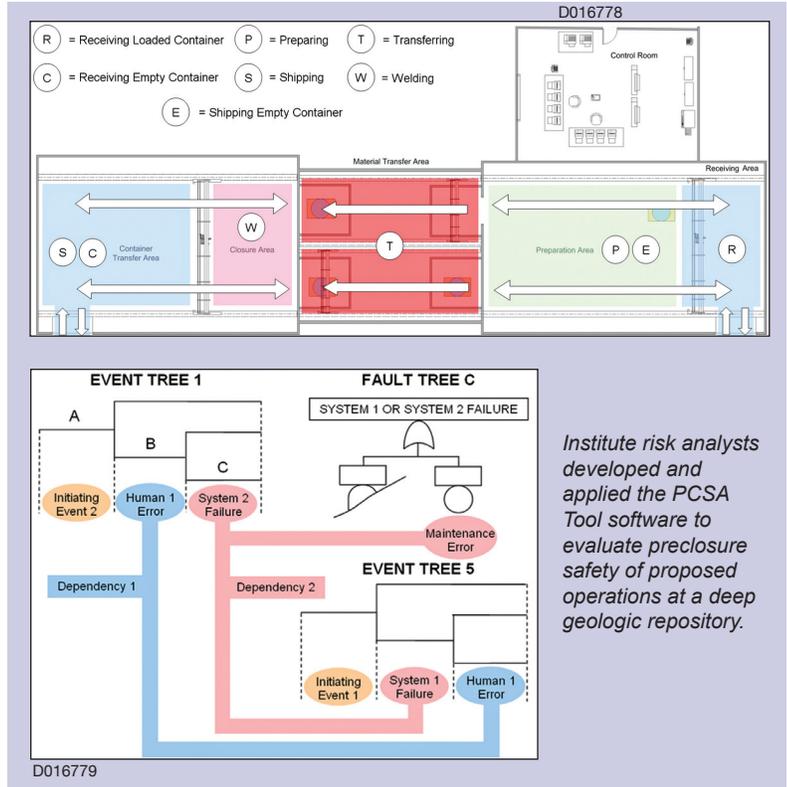
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Risk Assessment

Reliability assessment of structures, earth works and geotechnical designs is an emerging technology. SwRI has a comprehensive understanding of industry needs and priorities, as well as the technologies and expertise to meet those needs. Risk assessment services for the structural and geotechnical areas encompass:

- System risk analysis
 - ◆ Facility safety analysis
 - ◆ Natural and operational hazard analysis
 - ◆ System modeling and event sequence analysis
 - ◆ Reliability of active and passive systems
 - ◆ Uncertainty analysis
- Seismic risk analysis
 - ◆ Seismic probabilistic risk assessment
 - ◆ Fragility of structures at a specific limit state
 - ◆ Annual probability of failure or seismic performance
 - ◆ System modeling and seismic sequence analysis
- Seismic margin assessment
 - ◆ Evaluation of High Confidence Low Probability of Failure (HCLPF) capacity
 - ◆ Plant system modeling and seismic margin
 - ◆ Plant vulnerability assessment
- Reliability of geotechnical design
 - ◆ Soil and rock slopes
 - ◆ Tunnels
 - ◆ Support systems

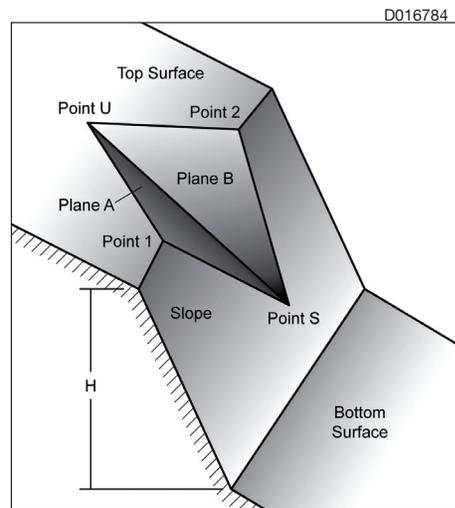


Institute risk analysts developed and applied the PCSA Tool software to evaluate preclosure safety of proposed operations at a deep geologic repository.

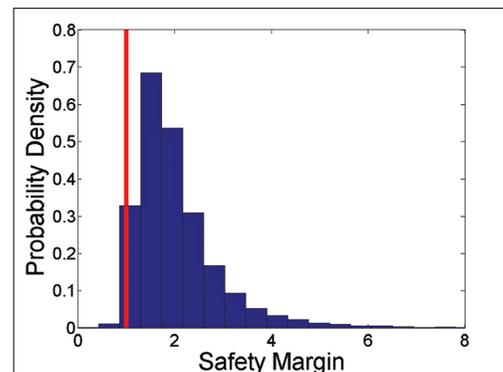


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Institute engineers developed an efficient probabilistic model for risk assessment of rock slopes and other geotechnical applications.



D016784



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Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies more than 1,200 acres and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,300 employees who perform contract work for industry and government clients.

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the public through innovative
science and technology**

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For more information, please contact:



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