Mark Christianson

ITASCA Consulting Group, Inc.
An Itasca International Company

Principal Engineer

Expertise	Mining Engineering, Rock Mechanics, Rock Mechanics Instrumentation, Numerical Modeling
Education	M.S. (Geological Engineering/Rock Mechanics), 1977 B.S. (Geological Engineering, with high distinction), 1975 University of Minnesota
Professional Affiliations	Member, International Society for Rock Mechanics

Professional Experience

	Itasca Consulting Group, Inc., Minneapolis, Minnesota
2000 – Present	*Principal Engineer*
1981 – Present	*Senior Geological Engineer*
1978 – 1985	*University of Minnesota, Department of Civil & Mineral Engineering* *Research Associate*
1977 – 1978	*Occidental Research Corporation, Irvine, California* *Mining Research Engineer*
1974 – 1977	*University of Minnesota, Department of Civil & Mineral Engineering* *Research Assistant/Research Fellow*

Project Experience

Field Research in Civil Engineering: Installation, data reduction and analysis for inclinometers, extensometers and piezometers monitoring the rock mass surrounding a nuclear power plant; review of uniaxial and triaxial rock-swell test data for foundation design for the plant; contribution to the rock mechanics section of the final safety-analysis report for a nuclear power plant.

Field Research in Mining: Installation, monitoring and analysis of roof-convergence instrumentation designed to predict and prevent collapse in several coal mines in Virginia, Kentucky and Colorado; conducted on-site studies of coal mine roof reconsolidation by injection of resin foams into highly broken mine roofs; conducted research and development concerning proposed horizontal drilling technology used to remove methane gas from tabular coal deposits.

Numerical Analysis for Civil Engineering: Review of modeling rock base movements and overturning forces for hydropower dam; seismic analysis of the 25 Stone Buddha group at Hakone, Japan; analysis of thermal stresses in an LNG storage tank; analysis of consolidation mechanics and surface subsidence in the North Sea oil fields; analysis of jointed block-test results for the Rockwell International Basalt Waste Isolation Project; design sensitivity studies of nuclear waste facilities in bedded salts for the Office of Nuclear Waste Isolation.

Numerical Analysis for Mining: Modeling of displacements and pillar stability for kimberlite pipes in a diamond mine; Calculation of sill pillar factors of safety for an underground gold mine. 3D slope stability for an open pit gold mine; modeling of pillar stability and rock burst potential for underground copper mines;

development of pillar and roadway design guidelines for underground limestone mines; numerical modeling of room closures due to pillar creep in carnallite deposits in Brazil and Thailand; modeling of the response of a roadway pillar to expanded mining operation in a rock quarry; mine stability analysis of proposed mining methods in copper deposits in northern Minnesota for the U.S. Bureau of Mines; analysis of movements in a rock ridge at limestone quarry; review of modeling and instrumentation data during development of a waste water reservoir.

Numerical Modeling for Nuclear Waste Disposal: Thermal-mechanical modeling of a nuclear waste repository in bedded tuffs; numerical modeling of site potential for underground isolation of nuclear wastes at the Savannah River Plant in South Carolina; assistance in rock-mechanics design reviews for the Nuclear Regulatory Commission on the U.S. Department of Energy studies performed in connection with deep underground isolation of radioactive waste in basalt, tuff and salt media. Simulation of the behavior of lithophysal tuff in uniaxial and biaxial loading conditions. Modeling the results of the Mighty North experiment using *3DEC*. Simulation of the effects of large-scale earthquakes on natural fractures intersecting nuclear-waste storage holes; performed 2D and 3D time creep convergence modeling of placement rooms and shaft stations for the WIPP project. Conducted 3D time creep displacement modeling of the intermediate scale creep test at WIPP.

Rock Mechanics Lab Testing: Review of potash creep-test procedures and results for a potash exploration project in Thailand.

Software Development: Product manager for *UDEC* (Universal Distinct Element Code) and *3DEC*. Development of distinct-element and finite-difference computer codes; design and development of a computer program, based on distinct-element methods, used to predict waste dilution in sublevel open stoping; development of a microcomputer-based expert system to provide capital cost estimates for plant construction; development and application of a computer code to predict fracture paths in rock due to tailored pulsed loading; implementation of the Barton-Bandis joint model incorporating non- linear normal and shear behavior and history-based normal and shear reversal behavior in Itasca's computer code *UDEC*; development of computer codes to aid in predicting the thermal-mechanical behavior of underground openings containing stored nuclear waste; training of client organizations in the operation of the codes and coordination of code modifications and updates for Itasca's codes, *FLAC* (Fast Lagrangian Analysis of Continua), *UDEC* , *3DEC* (3-Dimensional Distinct Element Code), *FLAC3D* (Fast Lagrangian Analysis of Continua in 3 Dimensions), *PFC2D* (Particle Flow Code in 2 Dimensions) and *PFC3D* (Particle Flow Code in 3 Dimensions); customization of client computers for Itasca's codes.