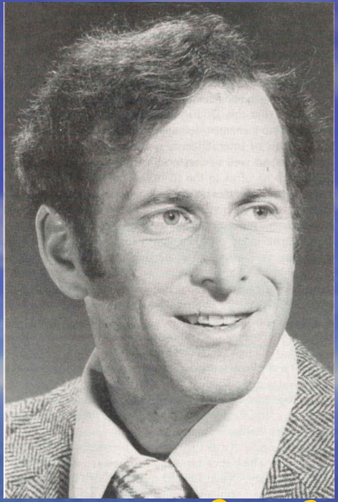
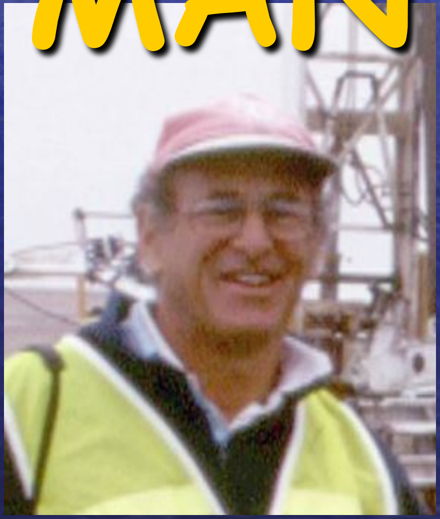


RENAISSANCE MAN



Richard E. Goodman Colloquium

U.C. Berkeley Faculty Club

January 14, 2006

Child Prodigy and Genius

- Dick came into the world the usual way on Christmas Day 1935, the second son of Pauline and Herbert Goodman, a middle class Jewish family in New York City. Herbert was a dentist and Pauline was a taskmaster.
- From thence onward, there was nothing usual about him; he was a piano virtuoso and all-around scholar.
- After just two years of high school, Dick faced a major decision: pursuing his love of music and the fine arts, or broadening his focus and studying science.
- He departed home for college at the tender age of 15

Animal House

Dick chose the University of Wisconsin, Madison during his freshman year in 1951-52, during the Korean War

He found acceptance in a lively Badger fraternity, where he was exposed to all kinds of new experiences …..

His tenure at Wisconsin ended abruptly with the arrival of his mother Pauline, who, after seeing his fraternal surroundings, decided to dis-enroll her son at the end of the academic year.

Onto Cornell University– the Berkeley of the East

- Dick opted for someplace more genteel and closer to home: Cornell University in Ithaca, New York
- Here he decided to major in geology, and, upon receiving his B.A. in 1955, he began working for renown air photo geologist Professor Don Belcher, shown here with Professor Ta Liang, years later.

Later, Dick would remark that even the walruses started looking attractive after three months in the Arctic without any women…..

- After graduation, Dick worked for the Corps of Engineers on the St. Lawrence Seaway for a year
- In the fall of 1956 he enrolled in graduate studies in civil engineering, working with B. K. Hough and Don Belcher
- During grad school he became entranced with the daughter of a Cornell history professor named Lillian (Sue) Gates … and sparks flew
- He took off 6 months during mid 1957 to work on Baffin Island for Don Belcher, and determined to marry Sue when he got back to Ithaca, in October 1957 … and more sparks flew
- He received his M.S. in engineering science in 1958

Berkeley & bleeding ulcers

Parker Trask (1899-1961) was from the old school of academia, who viewed doctoral students as indentured servants who needed humbling. He kept a special box filled with black rocks…..

- After a year of working in New York, Dick and Sue came to Berkeley in the fall of 1959 so Dick could pursue his doctorate working under Professor Parker Trask in the Department of Mineral Technology.
- He soon found himself in Herrick Hospital with bleeding ulcers, after Trask belittled him about his abilities and chances of succeeding

The Mentoring of Dan Moye

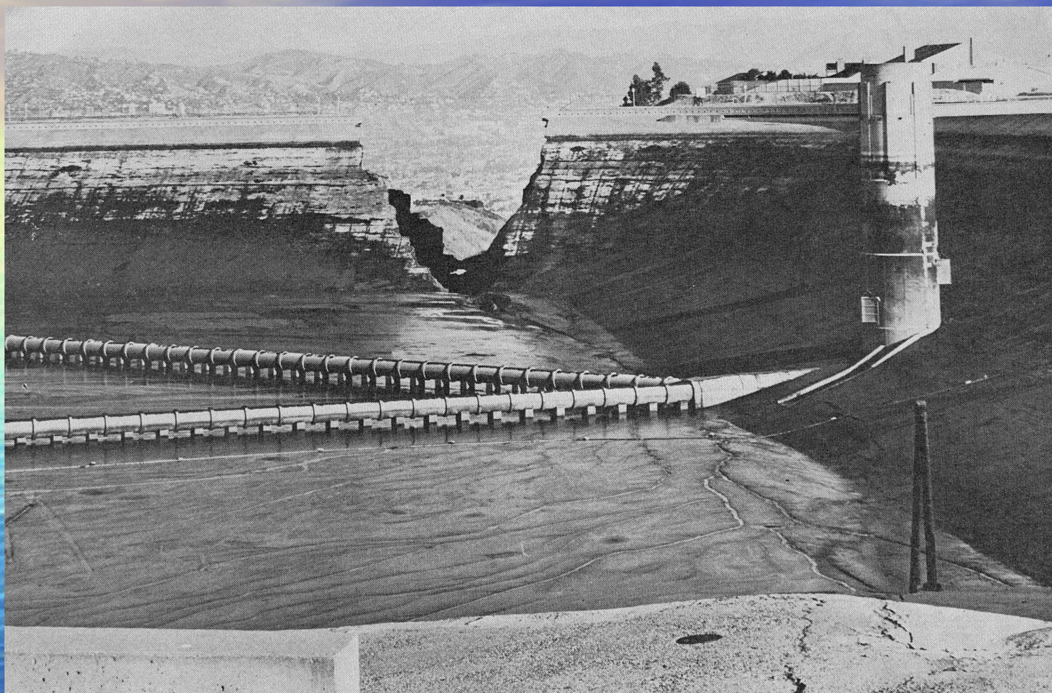
- Professor Task's untimely death at mid-semester created an emergency for the Berkeley Department of Mineral Engineering.
- Dept chair Ralph Hultman hired three of the best engineering geologists available on ¼ time appointments: Tom Lang, Roger Rhoads, and Tommy Thompson.
- They recommended that Dan Moye, Chief Geologist of the Australian Snowy Mtns Hydro Project be brought to Berkeley to teach during the 1962-63 academic year.
- Dan had an enormous impact on Dick, providing valuable insights on the practice of engineering geology. Dan was killed in a car crash in Australia in 1976.

H. Bolton Seed

A new mentor and field of study

- Dick labored to please Parker Trask, a complex figure fascinated by numbers and sedimentary processes…
- In 1961 Trask died unexpectedly and Dick suddenly found himself without a major field advisor
- Geotechnical engineering Professor Harry Seed agreed to take Dick on as his doctoral student

Advocate for geological engineering



Baldwin Hills Reservoir, Los Angeles, which failed last year causing extensive damage.

Geological Engineering

by RICHARD F. GOODMAN
Assistant Professor of Geological Engineering
University of California

Last year rock materials and geological data figured prominently in the design of an increased number of engineering works such as thin arch dams, embankment dams, concrete gravity dams, underground power stations, defense works, deep cuttings, and residential subdivisions. In response to the

were represented. During the summer, distinguished foreign panelists of the conference, including J. C. Jaeger, Leopold Muller, J. A. Talobre, J. L. Sarafim, and E. Hoek toured laboratories and universities and presented lectures.

The International Society of Rock Mechanics,

- In the February 1964 issue of Mining Engineering, Dick predicts the role that the emerging science of rock mechanics would play: "Engineering geology without rock mechanics fails to provide the designer of a large engineering work with quantitative answers to design questions."

EARLY ARTICLES ON SEISMIC SLOPE STABILTY 1964-66

Geological Society of America
Cordelleran Section Meeting

Seattle, March 27, 1964

Abstract

THE MECHANISM OF SLOPE FAILURE DURING EARTHQUAKES

by Richard E. Goodman, Assistant Professor of Geological Engineering,
University of California, Berkeley

Experiments with slopes of dense, dry, granular materials in a laboratory shaking table have demonstrated three modes of failure as a result of harmonic accelerations -- retrogressive failures, block glides over the entire slope, and localized block glides restricted to portions of the slope.

4736 March, 1966 SM 2

Journal of the
SOIL MECHANICS AND FOUNDATIONS DIVISION
Proceedings of the American Society of Civil Engineers

EARTHQUAKE-INDUCED DISPLACEMENTS IN SAND EMBANKMENTS

By R. E. Goodman,[1] A. M. ASCE, and H. Bolton Seed,[2] M. ASCE

INTRODUCTION

Reports of damage resulting from earthquakes include many examples of failures of banks of cohesionless materials. In the case of saturated loose cohesionless soils, liquefaction may occur due to the development of high pore-water pressures, but when the soil is dry or partially saturated, failure usually results from the sliding of a mass of soil near the surface with a resulting flattening of the over-all slope. Only the latter type of slide will be considered herein.

If the slope is initially steeper than the angle of friction of the soil in a loose condition, then failure usually develops in the form of a "sand run"; that is, a progressive deterioration of the slope originating at an isolated zone but extending throughout the surface as higher portions of the slope are

Dick's PhD dissertation dealt with earthquake-induced displacements in sand embankments due to liquefaction

He presented this work in both geology and civil engineering arenas, soon after the Great Alaska and Niigata earthquakes in 1964

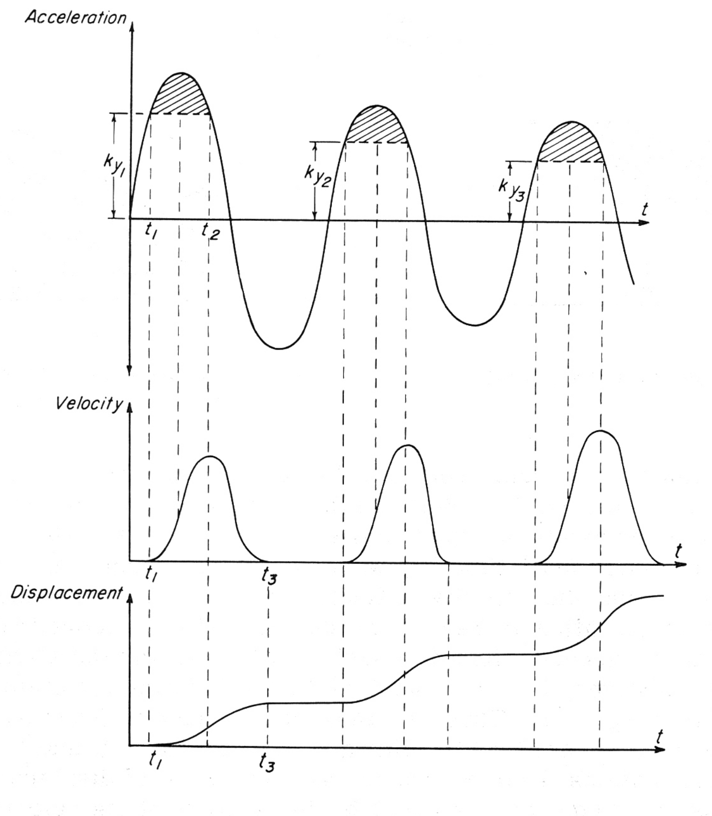
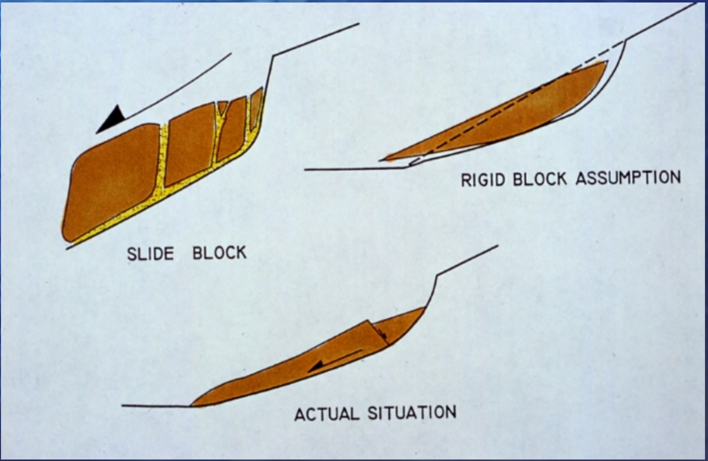


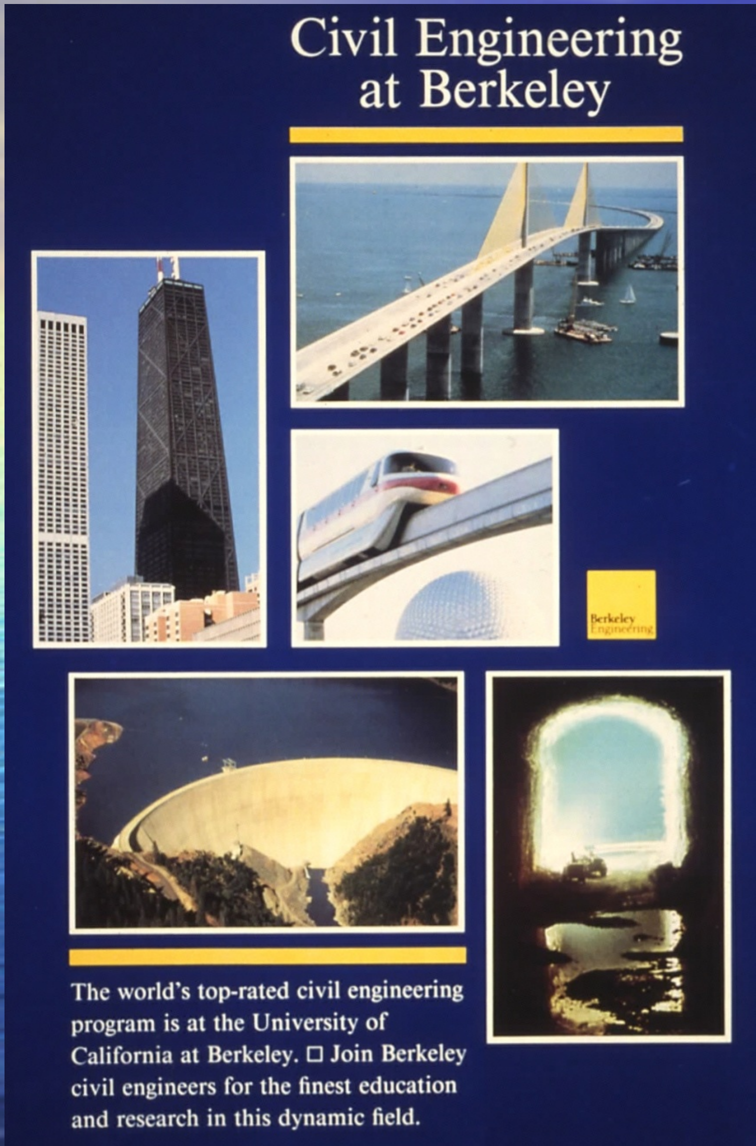
FIG. 8.—INTEGRATION OF ACCELEROGRAMS TO DETERMINE DOWNSLOPE DISPLACEMENTS



BORROWED CONCEPTS ?

- In the late summer of 1964 University of Illinois **Professor Nathan Newmark** visited Berkeley and was shown Dick's thesis work, which was completed, but not yet published.
- Newmark quickly prepared a similar article for publication, which "introduced" Dick's concept of yield accelerations for analyzing earthquake induced movements
- Newmark's article appeared in June 1965, while Dick's dissertation was not published until March 1966
- Newmark received the Rankine Lectureship for his article later that same year

Joining the world's most prestigious civil engineering program



- Upon completion of his doctorate in February 1964, Dick was offered a faculty position at Berkeley; joining Harry Seed, Jim Mitchell and Paul Witherspoon
- He set about establishing a fledgling geological engineering program which would eventually garner world wide acclaim

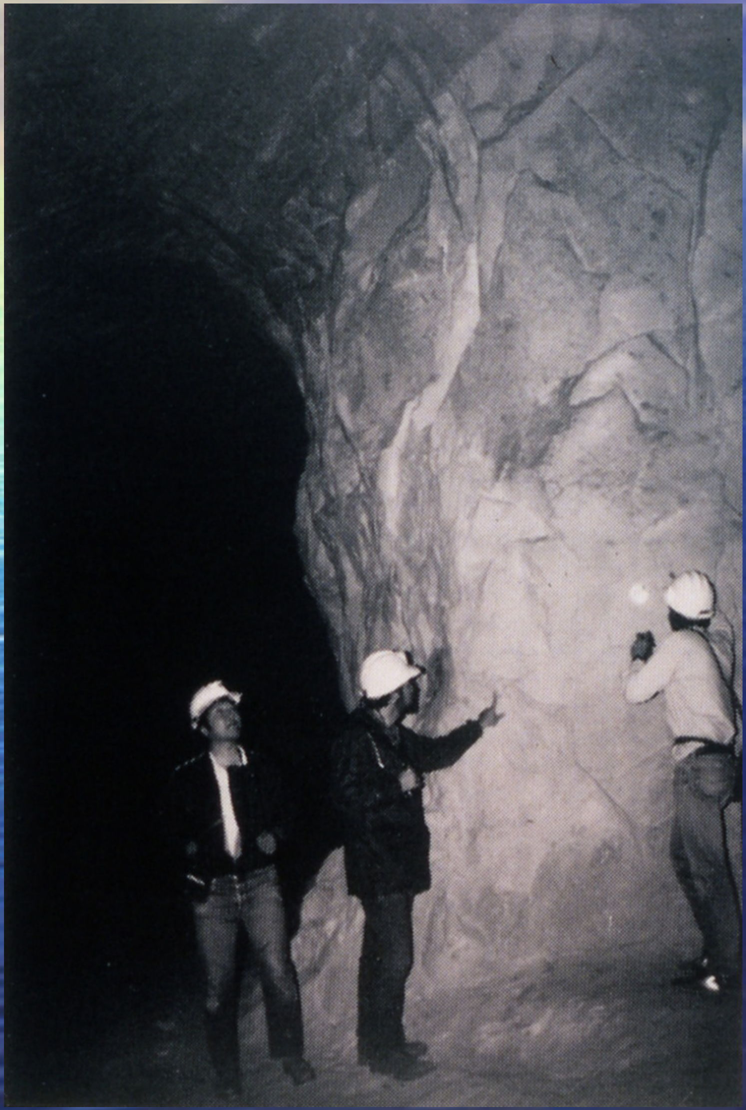
Establishing a High Visibility Program

- In 1966, Dick established himself as an industry leader by volunteering to serve as editor of The Engineering Geologist Newsletter of the Engineering Geology Division of GSA, which evolved into the AEG Bulletin, and later, Environmental and Engineering Geoscience.
- This notoriety drew students from across the country and overseas to come to Berkeley to work with him.
- In the 1960s he worked out of 475 Hearst Mining Building, shown here.

One thing was for certain: Dick loved Berkeley

- Dick always referred to the Sather Tower as "The Campanile", in deference to its Venetian prototype

First student thesis



- Hans Ewoldsen's work on the Domengine Sandstone in the room and pillar Hazel Atlas sand mine at Black Diamond Mines south of Antioch, completed in 1964
- After hauling all the heavy measurement devices and setting them up inside the mine, they returned one week to find everything stolen!

Pioneering work in a wide array of sub-disciplines

Short Notes

RICHARD E. GOODMAN
RICHARD A. APPUHN

MODEL EXPERIMENTS ON THE EARTHQUAKE RESPONSE OF SOIL-FILLED BASINS

Abstract: The motion of soil filling a model bedrock basin was observed during continuous vibration on a laboratory shaking table. The following factors were varied in different experiments: consistency of the soil; thickness of the soil fill; length-to-width ratio of the basin; and frequency and intensity of "bedrock" motion.

The shear-wave velocity was measured in place, and an empirical relationship was found between velocity and soil-water content. The response spectrum—a graph of magnification factor of "bedrock" displacement *versus* forcing frequency—was measured in and on the basin fill as the soil was forced into vibration by various frequencies and amplitudes of bedrock displacement.

Displacements and accelerations decreased for a given set of conditions with depth below the ground surface, and the amplitude of soil displacement increased as the fill deepened.

Surface motion increased as the soil consistency was softened by addition of water; this agreed with reports of many geologists who have examined damage patterns resulting from actual earthquakes. When the soil consistency became very soft, however, further addition of water caused the reverse effect, *i.e.*, the softer the soil, the lower the magnification of bedrock motion.

Soil displacements increased at a declining rate as the amplitude of displacement was increased in the "bedrock."

Geological Society of America Bulletin, v. 77, p. 1315–1326, 13 figs., 1 pl., November 1966

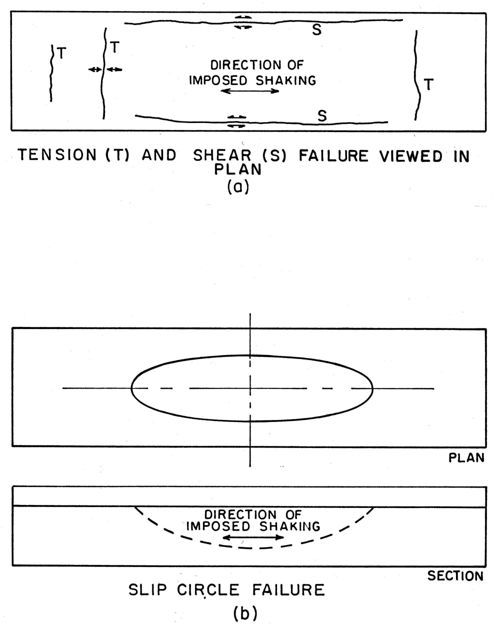
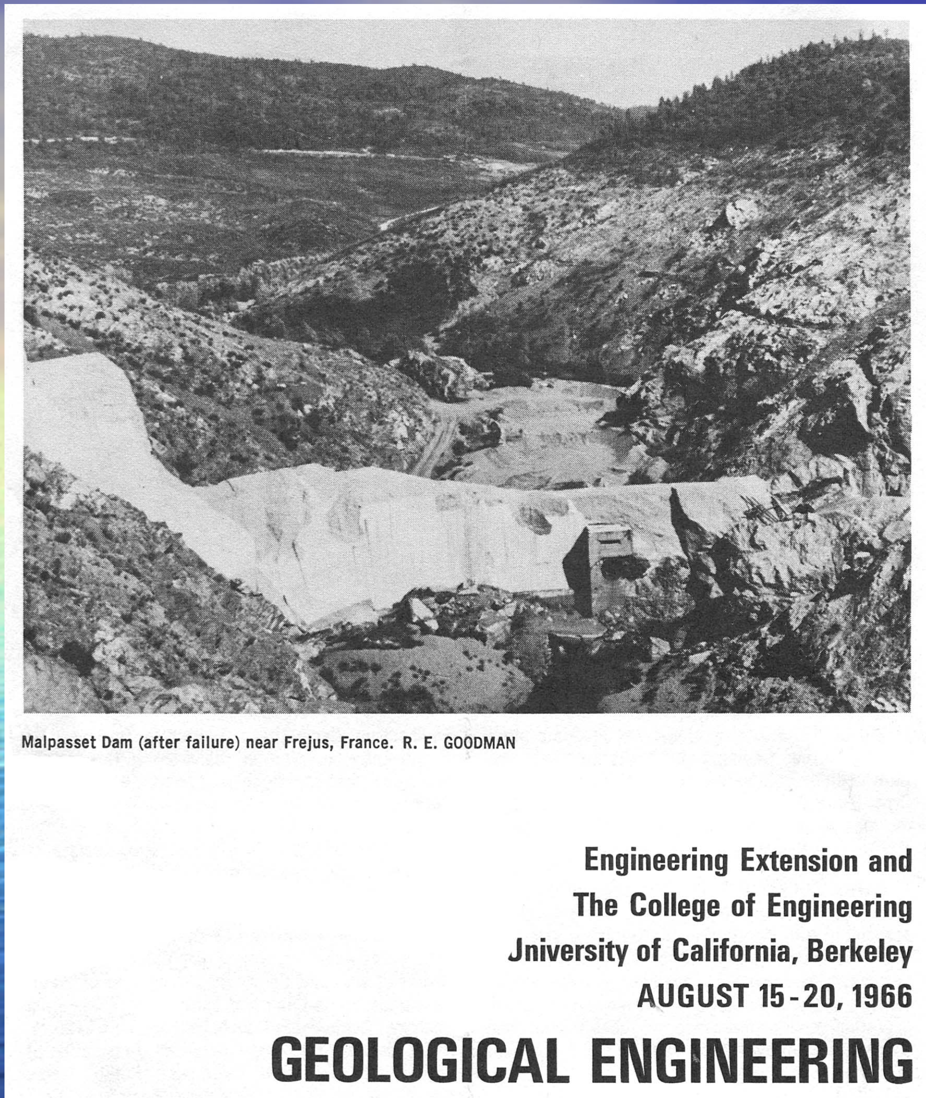


Figure 11. Types of failures which occurred in the model soil-filled basin during severe shaking

- Dick's GSA article on site response of soil-filled basins appeared in November 1966
- It was the first published work that demonstrated the 2D effect of basins on magnifying seismic energy due to wave impedance contrasts

Thinking outside the box to garner support for graduate students



Brochure for the first geological engineering short course in June 1966

- In 1965 Dick formed the non-profit tax-exempt Geological Engineering Foundation to host short courses as a means of generating income for support of grad students

Early rock mechanics articles

On the distribution of stresses around circular tunnels in non-homogeneous rocks

Quelques résultats concernant la distribution des contraintes au voisinage des tunnels circulaires en roches non-homogènes

Über die Spannungsverteilung um kreisrunde Tunnel in inhomogenem Gestein

by Richard E. Goodman
Assistant Professor of Geological Engineering, Department of Civil Engineering, University of California, Berkeley, California, U. S. A.

Summary

The effect of constructing tunnels in layered rocks as opposed to homogeneous rocks is discussed in this paper. The results represent solutions to plane strain boundary value problems using a finite element analysis. When a circular tunnel is excavated along a vertical contact between two rock types with different elastic moduli, the stresses are found to increase in the harder material while the softer rock is relatively destressed.

Résumé

Cet article traite des effets de la construction d'un tunnel à travers une roche présentant un plan de discontinuité dans ses paramètres mécaniques (par opposition à roche homogène).

Les résultats exposés ont été obtenus par analyse d'éléments finis, en supposant les déformations planes et les conditions aux limites connues; ils ne concernent que des ouvertures circulaires.

Zusammenfassung

Dieser Artikel befasst sich mit den Auswirkungen des Tunnelbaus in geschichtetem Gebirge (im Gegensatz zu homogenem Gebirge). Es ergeben sich Lösungen für das Problem der ebenen Dehnungsgrenzwert mit Hilfe der Analyse eines begrenzten Elements.

Wenn ein kreisrunder Tunnel entlang eines vertikalen Kontaktes zwischen Gesteinen mit verschiedenen E-Moduls hergestellt wird, lässt sich eine Zunahme des Druckes im

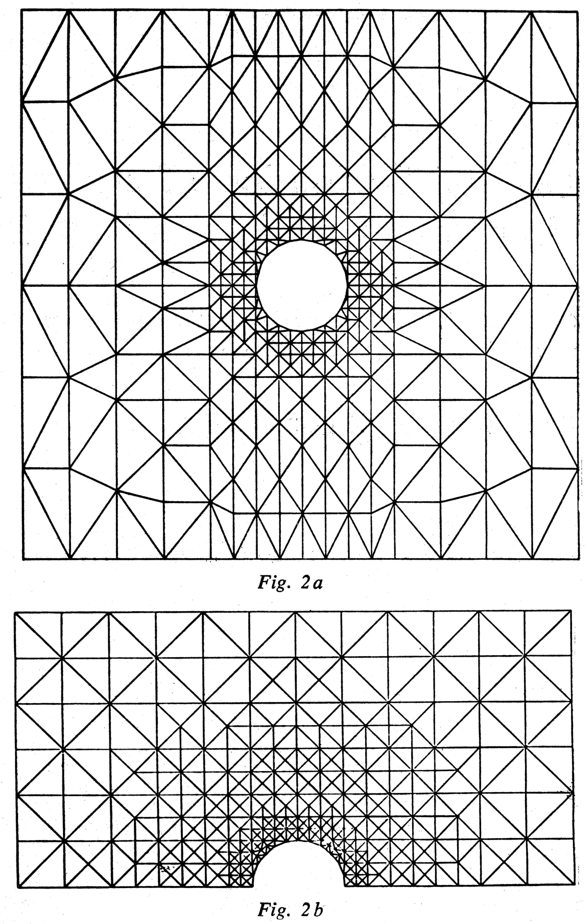


Figure 2 — Finite element meshes used in solving problems with layers of unlike material

- The International Society for Rock Mechanics was formed in 1962
- Dick's first rock mechanics article appeared in Vol. 1, No. 1 of the **Int'l Journal of Rock Mechanics & Mining Science** in 1963

R. E. Goodman C. Fairhurst N.J. Price J.C. Jaeger
A.M. Starfield P. Hackett N.G.W. Cook E. Hoek
Faculty, Rock Mechanics Short Course
University of Minnesota (1968)

(also, not pictured: W.F. Brace; T.A. Lang, M.D.G. Salamon)

The Design of "Room and Pillar" Structures in Competent Jointed Rock. Example: The Crestmore Mine, California

Construction de "chambres et pilliers" dans les roches competentes fissurées. Exemple de la mine Crestmore, Californie

Entwurf von „Kavernen und Bergfesten" Konstruktionen in geklüftetem Fels. Beispiel: die Crestmore Mine, Kalifornien

FRANCOIS E. HEUZÉ, Doctor of Engineering. Research Engineer in Geological Engineering, U.S.A.

RICHARD E. GOODMAN, Ph. D. Associate Professor of Geological Engineering, 472 Davis Hall, University of California, Berkeley, U.S.A. 94720.

Summary

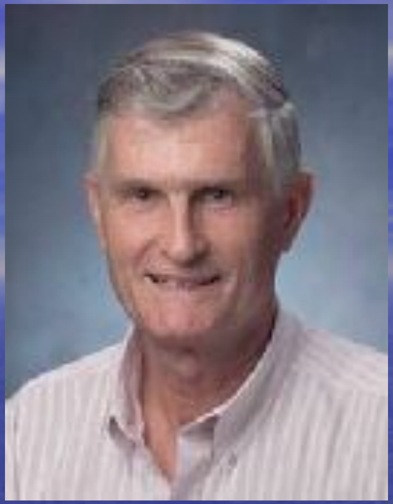
A comprehensive Rock Mechanics research project has been completed with respect to "Room and Pillar" mining at Crestmore, Caiifornia. Since the mine has been operating for an appreciable

Résumé

Une mine de marbre en „chambres et pilliers" à Crestmore, Californie, a été l'objet d'une étude approfondie de Mécanique des Roches. Etant donné que cette mine existait depuis plusieurs années,

Zusammenfassung

Eine umfassende Studie der Felsmechanik wurde im Gebiehe einer „Kavernen und Bergfesten" Mine im Crestmore, Kalifornien, abgeschlossen. Da diese Mine schon seit etlicher Zeit mit



Francois Heuze

- In the late 1960s Dick supervised Francois Heuze's research on the Crestmore Mine in Riverside, CA, a large room-and-pillar limestone mine. This article appeared at the 2nd IRSM Congress in Belgrade in 1970.

Visiting Scholar Tor Brekke

5937 May, 1968 SM 3

Journal of the
SOIL MECHANICS AND FOUNDATIONS DIVISION
Proceedings of the American Society of Civil Engineers

A MODEL FOR THE MECHANICS OF JOINTED ROCK

By Richard E. Goodman,[1] M. ASCE, Robert L. Taylor,[2] A. M. ASCE, and Tor L. Brekke[3]

INTRODUCTION

The decisive role of joints and seams in the behavior of rock en masse has long been recognized by engineers working with structures in rock. The stability of rock slopes and underground excavations are two major problems wherever the influence of the joints, rather than the rock type, may be completely dominant.

- Tor Brekke came to Berkeley as a visiting scholar from Trondheim, Norway during the 1966-67 academic year
- This is the pioneering article by Dick, Rob Taylor and Tor, which introduced joint elements in 1968

Dick's first patent: The Goodman Jack

Rudy de la Cruz

- Rudy de la Cruz worked with Dick in the late 1960s perfecting the borehole deepening method and use of the Goodman Borehole Jack
- He learned some interesting aspects about the English language in the deep south, where "ropa" and "rape" have a slightly different connotation!

The Goodman Jack was manufactured by Kinemetrics

Tor Brekke Joins the GE Program

- Tor turned down a faculty position at Illinois working with Ralph Peck to join Dick at Berkeley in 1969
- The geological engineering program now had two professors!
- The only similarity between the two men was that they were both color blind
- They only co-authored two papers in 25 years, in 1968 and '69

Tor could always be spotted in a crowd by his pipe

The structures, sanitary and geotechnical programs moved into the Davis Hall addition in 1969. Dick requested spaces at back of the old Engineering Materials Lab for his rock mechanics lab, housed in 485 Davis Hall, while occupying a new office in the hallway just north of it, in 476 Davis Hall. Dick, Paul Visca and Dave Rogers used to play catch football on the green between Davis and Evans Halls. One afternoon Rogers punted the ball over the green, onto the Hearst Mining Building !

Rock joints

R. E. Goodman[1]

Authorized Reprint from
Special Technical Publication 477
Copyright
American Society for Testing and Materials
1916 Race Street, Philadelphia, Pa. 19103
1970

The Deformability of Joints

REFERENCE: Goodman, R. E., **"The Deformability of Joints,"** *Determination of the* In Situ *Modulus of Deformation of Rock, ASTM STP 477,* American Society for Testing and Materials, 1970, pp. 174–196.

ABSTRACT: Recently developed procedures make it possible in cases with suitable geological conditions to assess the degree of safety and the probable displacements of excavations and foundations in discontinuous rock masses. In addition to geological data describing the geometrical system and mechanical data on the behavior of the rock, these analyses require data on the shear strength and deformability of the natural surfaces of weakness being considered. Several methods of sampling and testing joints and other discontinuities have been devised in Europe, and a large number of tests have been completed. Large shear machines have been used in Russia, England, Yugoslavia, and France for testing specimens up to 100 in.^{2} in area. In addition, a number of *in situ* block shear tests have been performed on naturally occurring discontinuities primarily by German, French, Yugoslavian, and Czechoslovakian geologists and engineers. The methods, results, and significance of these studies will be reviewed.

KEY WORDS: joints (junctions), geological faults, shear tests, rock mechanics, deformation, stiffness, drilling, sampling, evaluation, mechanical properties, foundations, rocks

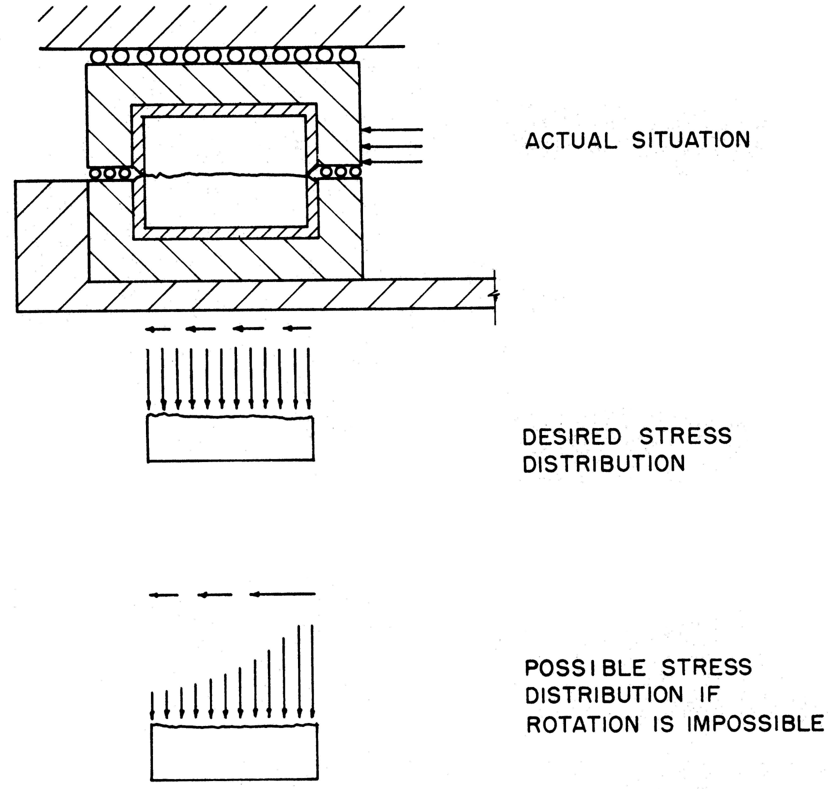


FIG. 5—*Stress distribution in a direct shear box.*

- Dick pioneered the constitutive modeling of rock joints, introducing the joint element to the finite element method. This article was published by ASTM in 1970.

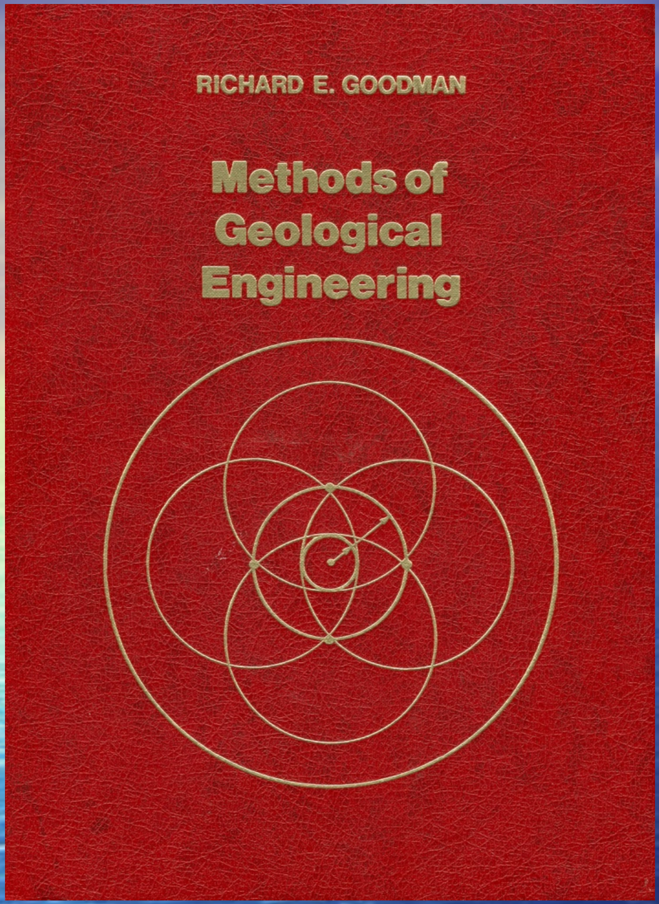
Guggenheim Fellowship 1972-73

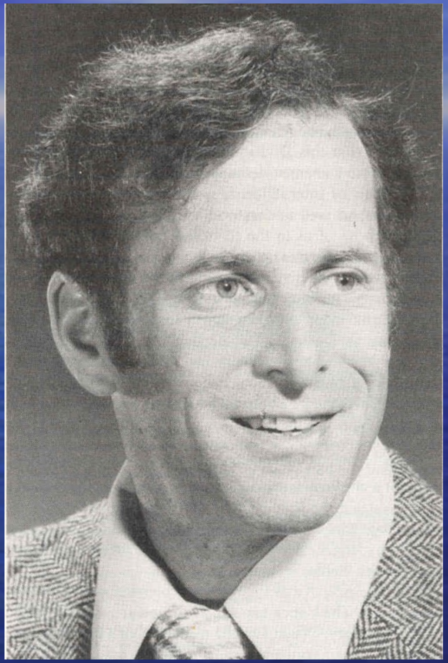
Imperial College in London

Skempton Building

- Dick took his family to Imperial College during the 1972-73 academic year, working with Professors Evert Hoek and John Bray
- Evert Hoek was a tremendous inspiration to Dick
- He also began writing his first book.

First Book wins the 1977 Burwell Award





Dick dedicated his first book to his mentor Dan Moye

- **Dick's first book** was published in the spring of 1976 without type setting by West Publishing of Minneapolis, to keep the price low for students. It was the first practical how-to book on rock mechanics and is still prized by those fortunate enough to own a copy

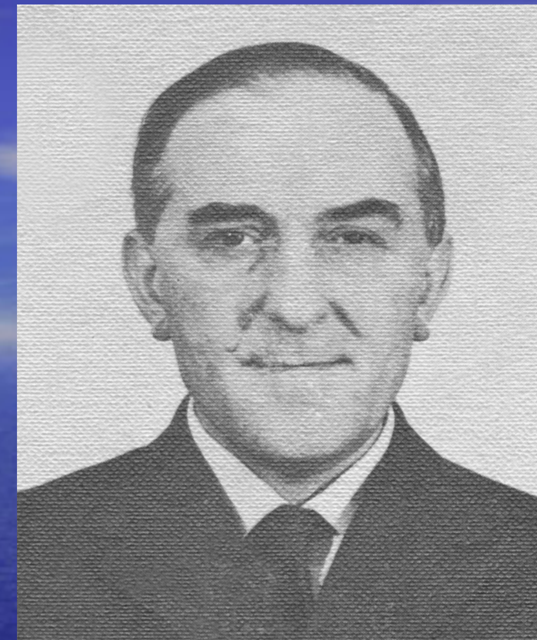
Reprinted from the
Proceedings of the Specialty Conference on
Rock Engineering for Foundations and Slopes
ASCE/Boulder, Colorado/August 15-18, 1976

TOPPLING OF ROCK SLOPES

Richard E. Goodman,[1] M. ASCE, and John W. Bray[2]

ABSTRACT

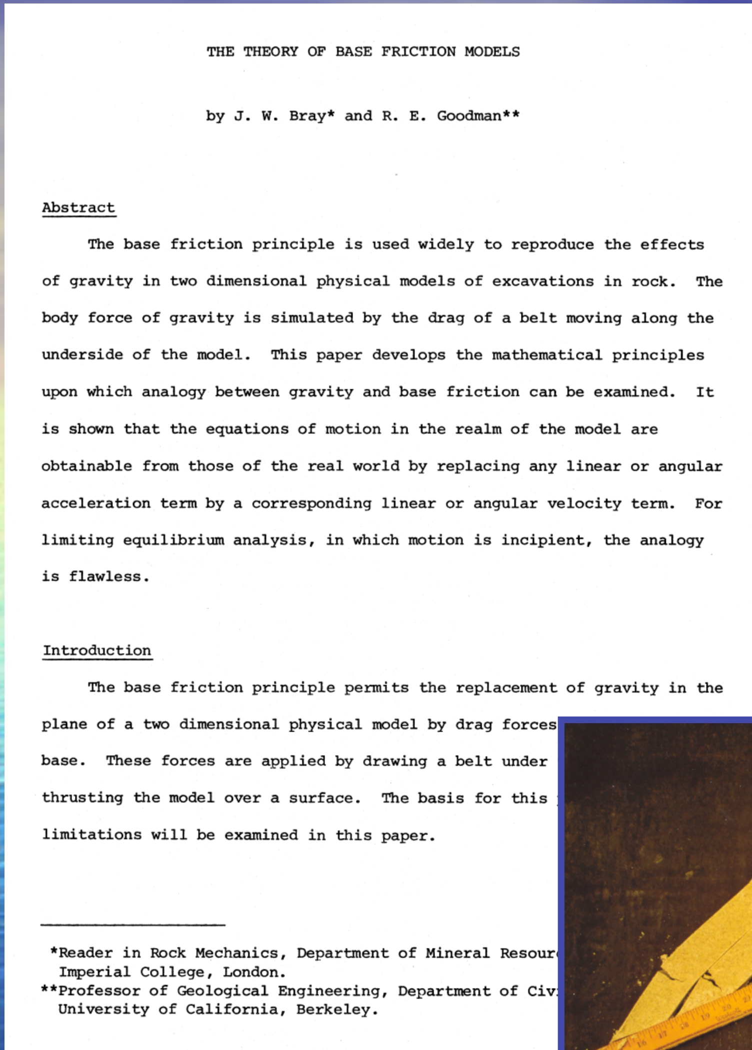
Toppling is a mode of failure of slopes cut in rock masses with regularly spaced layers or foliation. It occurs under gravity alone when the layers are inclined into the hill but can occur even when the layers dip towards the excavation if load is transferred from potentially sliding blocks above; the latter is a case of "secondary toppling." Toppling is common in slates and schists in open pits and in natural slopes, but it also occurs in steeply dipping thin-bedded sediments, in columnar-jointed volcanics, and in regularly-jointed granitics. A number of examples of topples of different types are discussed in this paper, and a limit equilibrium analysis is examined for the special case of block toppling on a stepped base; the product of this analysis is the required support force at the toe of the slope to achieve a specified factor of safety. A simple kinematic test on the stereographic projection is also suggested.



Intensely shy and private, **John Bray** was nonetheless a genius in deriving the mathematical formulas to solve kinematics problems

- During his **Guggenheim Fellowship** in London, Dick collaborated with engineering mechanics mathematician John Bray to write his first article on rock toppling, which appeared in 1976.

Base Friction Machine



THE THEORY OF BASE FRICTION MODELS

by J. W. Bray* and R. E. Goodman**

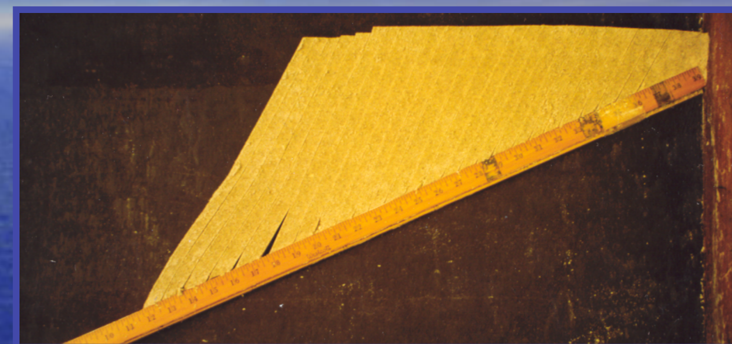
Abstract

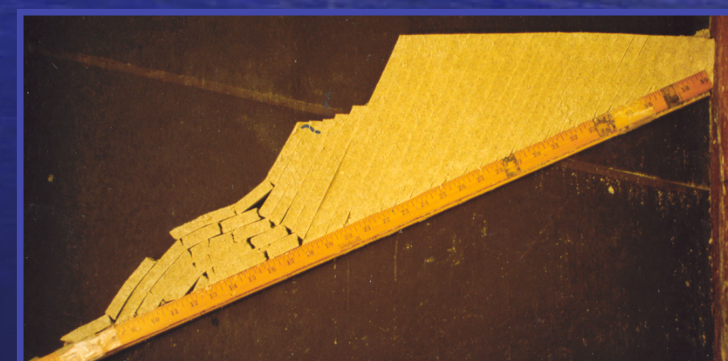
The base friction principle is used widely to reproduce the effects of gravity in two dimensional physical models of excavations in rock. The body force of gravity is simulated by the drag of a belt moving along the underside of the model. This paper develops the mathematical principles upon which analogy between gravity and base friction can be examined. It is shown that the equations of motion in the realm of the model are obtainable from those of the real world by replacing any linear or angular acceleration term by a corresponding linear or angular velocity term. For limiting equilibrium analysis, in which motion is incipient, the analogy is flawless.

Introduction

The base friction principle permits the replacement of gravity in the plane of a two dimensional physical model by drag forces base. These forces are applied by drawing a belt under thrusting the model over a surface. The basis for this limitations will be examined in this paper.

*Reader in Rock Mechanics, Department of Mineral Resour
Imperial College, London.
**Professor of Geological Engineering, Department of Civ
University of California, Berkeley.





- Dick and John Bray also collaborated on this 1976 article describing the merits of base friction machines to model block kinematics

Fascination with toppling

During an NSF sponsored raft trip through the Grand Canyon in the summer of 1976 Dick discovered a 300,000 m^3 topple in Vishnu Schist at Clear Creek.

Dick pulled a C14 sample from these terrace gravels

Gaining Outstanding Data, but Losing the Original Goodman Jack

14988 NOVEMBER 1979 GT11

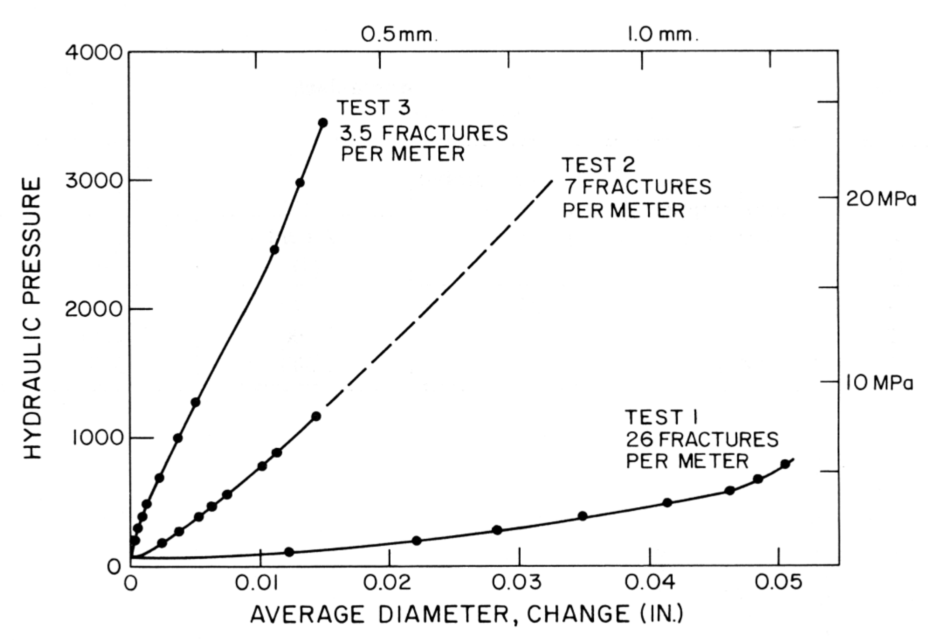
JOURNAL OF THE GEOTECHNICAL ENGINEERING DIVISION

Strength and Deformability of Highly Fractured Rock

By Jerome M. Raphael,[1] F. ASCE and Richard E. Goodman,[2] M. ASCE

Introduction

I ... existing dam
fou ... ne numerical
val ... cal modeling
of ... c conditions.
Th ... San Andreas
fau ... ured, perhaps

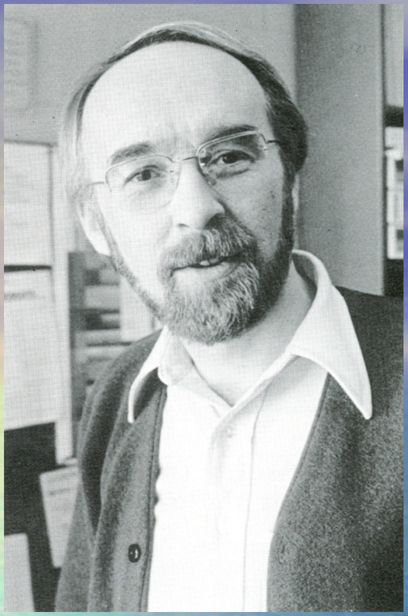


The original **Goodman Jack** was lost by **Dave Rogers** and **P.N. Sundaram** at Crystal Springs Dam in June 1977; after collecting some exciting deformational data, shown here.

Teton Dam piping studies

- Renaissance men are interested in everything.
- Following the failure of Teton Dam in June 1976, Dick supervised several laboratory studies of piping of loess through open joints, using a radial permeameter. The loess contained considerable quantities of gypsum.

1978-79 Sabbatical

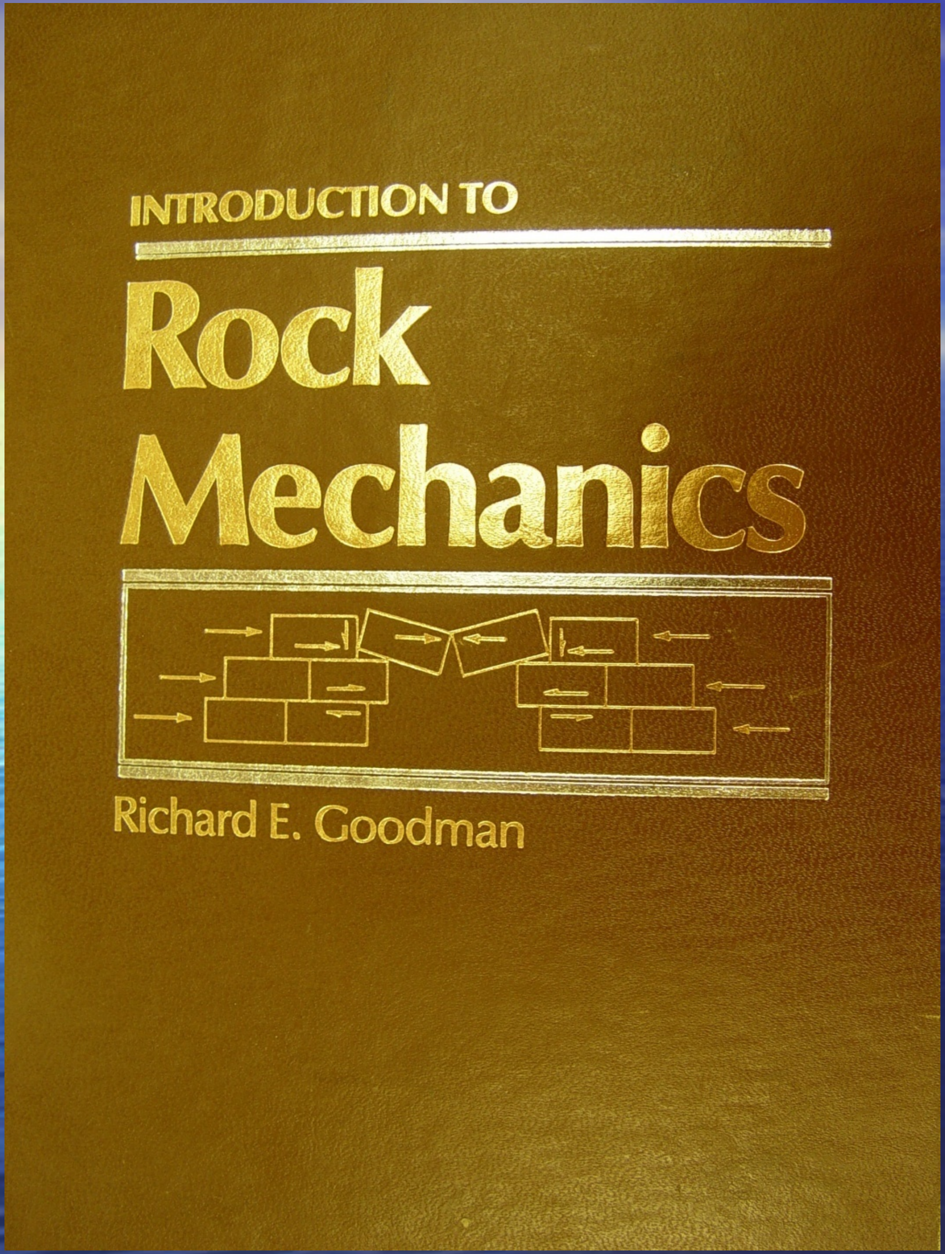


Fred Kulhawy

Ted Brown

- Dick worked with Fred Kulhawy at Cornell during the fall of 1978; and he returned wearing ties!
- He then went to Imperial College to work with Ted Brown during the winter-spring of 1979 academic year
- His graduate students wrote all the research progress reports that year!

Introduction to Rock Mechanics (1980)



The result of Dick's 1978-79 sabbatical was **Introduction to Rock Mechanics**, published by John Wiley in 1980

Dick's course lectures became much more organized; as he was forced to organize his thoughts while preparing the manuscript

Consultations for Republic of Columbia

In the 1970s Dick worked s a consultant on projects on the Magdelena, Cauca, and Guarno Rivers in Columbia and Venezuela; often including piece work for a starving grad students. These views show Chivor Dam, which had an exciting spillway excavation that exposed a fault.

ENGINEERING GEOLOGY

A Combination of Inseparable Fields

by Richard E. Goodman

Shortly after graduating from Cornell I was asked what I had studied as an undergraduate. "Geology? You're fifty years behind the times," was the response to my explanation. In these exciting times, when *geology, environment,* and *energy* are household words and trilobites are sold in Western drug stores, the attitude of the questioner seems incredible. Yet, in a sense, his judgment was right at the time: Job opportunity, which had once lured young men to the adventures of geological exploration in the American West, had diminished. The pendulum of interest and activity in geology had not yet swung back to a high position. As for me, I bided my time, acquiring a knowledge of civil engineering in preparation for what has unfolded as a fulfilling and stimulating profession.

Engineering geology, as this profession is called, is the modern embodiment of a long and close association of geology and civil engineering. It encompasses such diverse activities as evaluating hazards like eruptions, active faults, earthquakes, and landslides; finding optimal routes and sites for

highways, dams, bridges, n
plants, and other large stru
ing aggregates, rip-rap, an
struction materials; and '
the subsurface for the desig
rapid transit stations,
powerhouses, and other
facilities.

The planning and des
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best site and the best sch
large number of possible
Geological factors figure
in the selection process, bu
alternative is actually buil
penalties from accurate
gineering geology are ofte
What is not conjectural
engineering in rock requi
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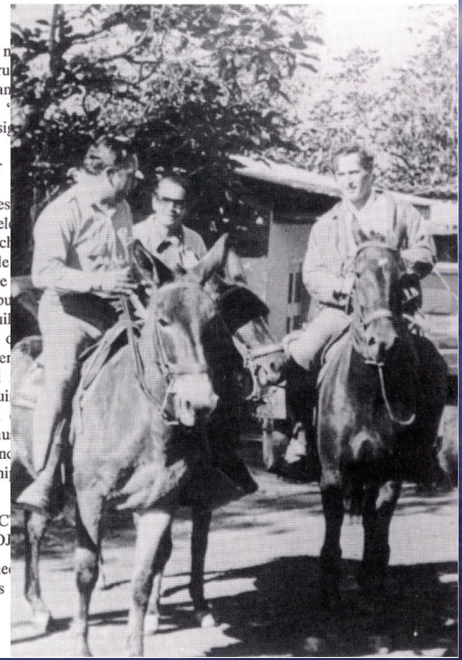
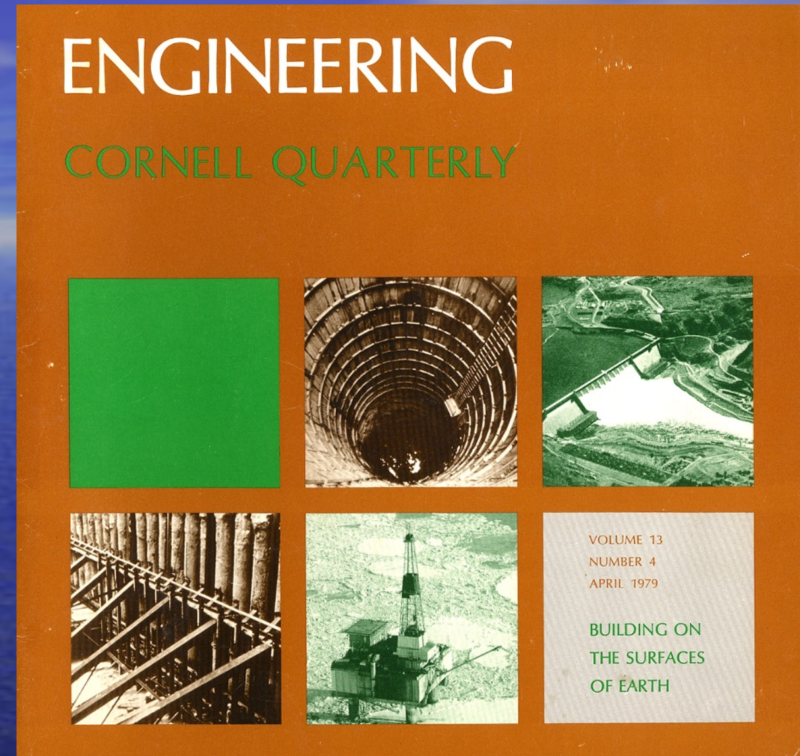
GEOLOGY AS A FAC
IN COLOMBIAN PROJ

The importance of engine
in planning and design is



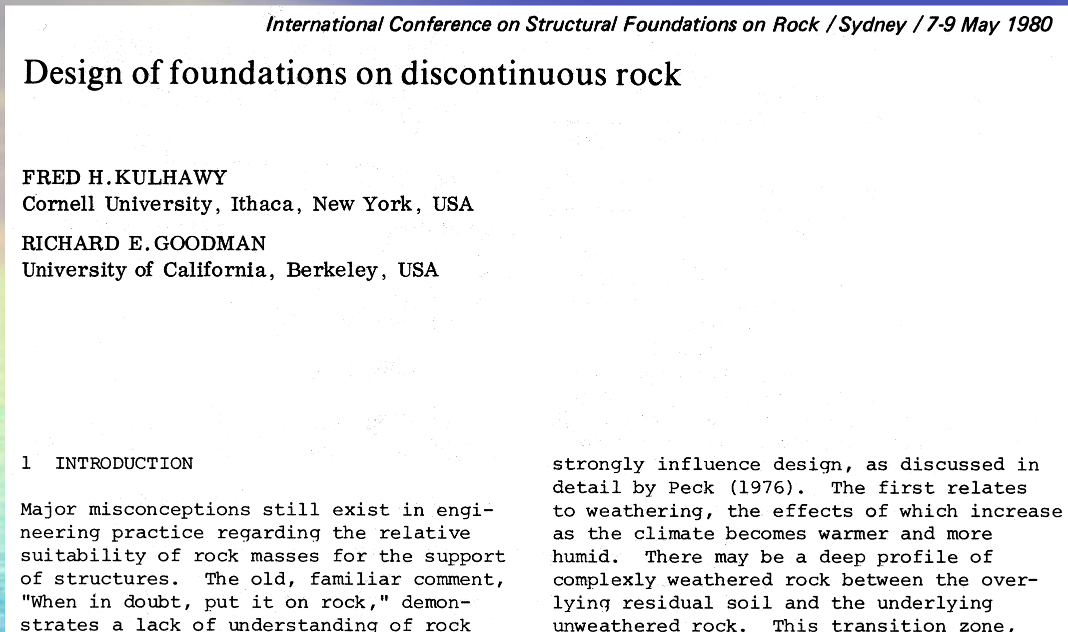


- **During his semester at Cornell in the Fall of 1978 Dick wrote an intriguing essay on his consulting work for hydroelectric projects in Columbia, which appeared in the April 1979 Cornell Engineering Quarterly**

Consulting Projects – 1980s

The Santa Barbara LNG terminal fault unloading model (at left) and PG & E's Scott Dam foundation (at right) were challenging projects that required development of new analytical models. The work on Scott Dam led to four PhD dissertations and the emergence of BIMROCK studies in the 1990s.

Design Practice Articles



International Conference on Structural Foundations on Rock / Sydney / 7-9 May 1980

Design of foundations on discontinuous rock

FRED H. KULHAWY
Cornell University, Ithaca, New York, USA

RICHARD E. GOODMAN
University of California, Berkeley, USA

1 INTRODUCTION

Major misconceptions still exist in engineering practice regarding the relative suitability of rock masses for the support of structures. The old, familiar comment, "When in doubt, put it on rock," demonstrates a lack of understanding of rock strongly influence design, as discussed in detail by Peck (1976). The first relates to weathering, the effects of which increase as the climate becomes warmer and more humid. There may be a deep profile of complexly weathered rock between the overlying residual soil and the underlying unweathered rock. This transition zone,

- One outcome of his 1978 sabbatical at Cornell was this 1980 article with Fred Kulhawy addressing to practical solutions of rock foundation problems in civil works projects

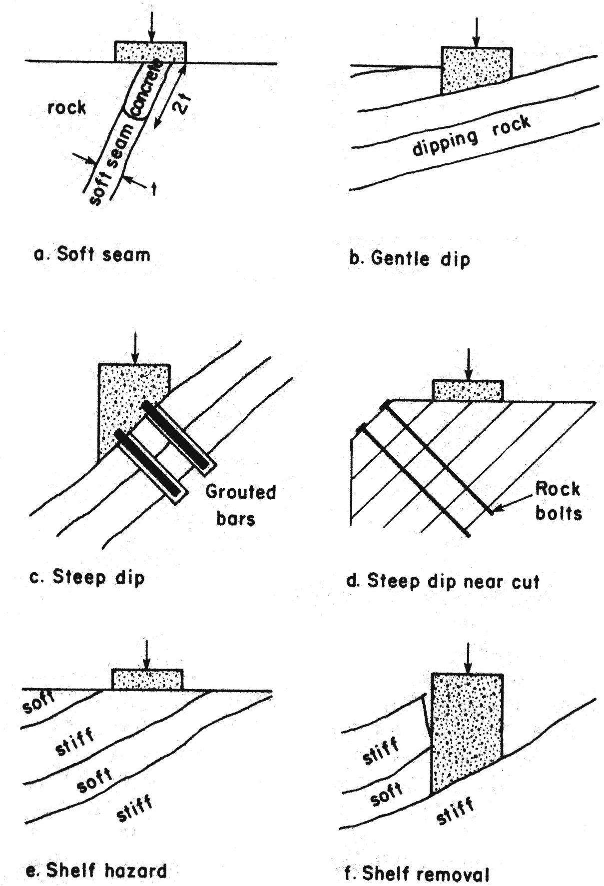
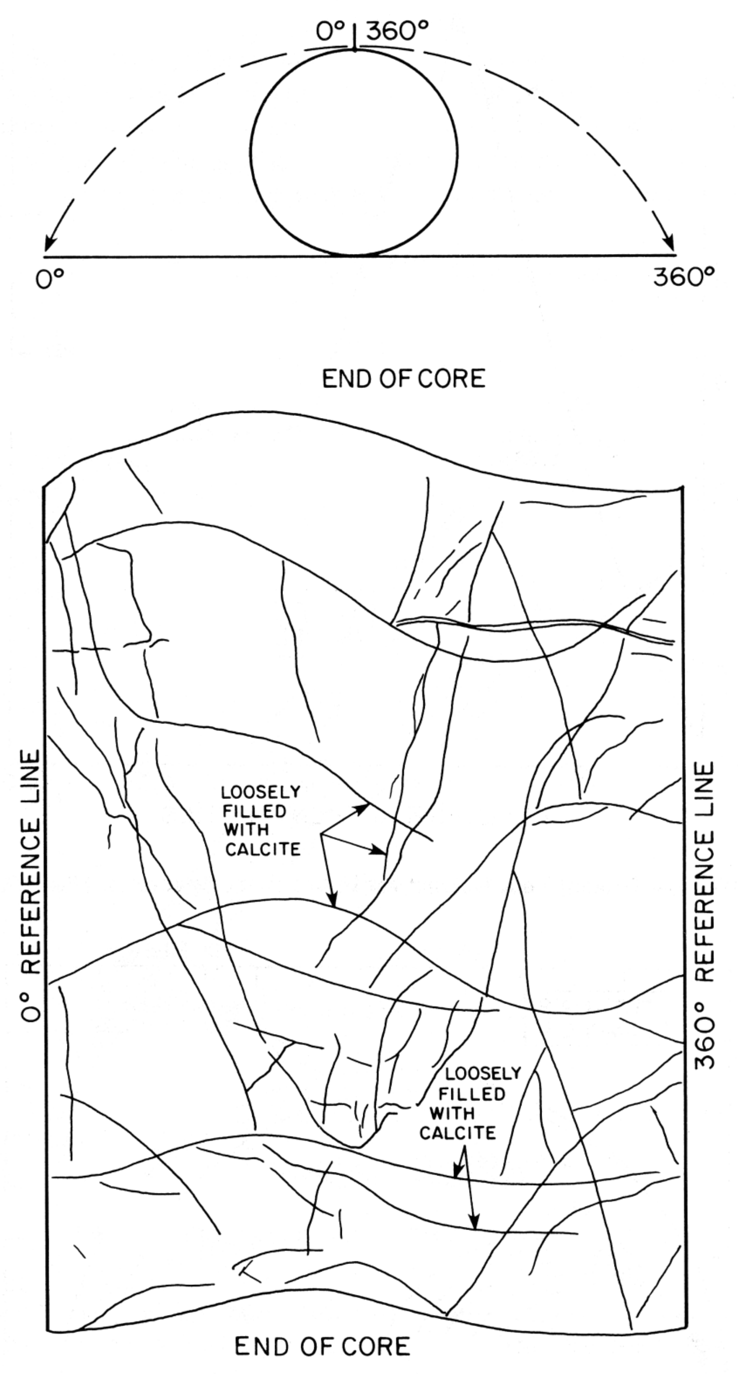


Fig. 1 Rock Foundation Contact Problems (After Sowers, 1979)



Establishing Industry Standards

Introduction to Rock Mechanics was soon adopted as the most popular text on the subject in America, quickly becoming an industry standard for rock engineering work.

Dick also received the AIME **Rock Mechanics Award** in 1976 and the 1984 **Basic Research Award** of the U.S. Committee on Rock Mechanics

Dick's memorable annual geological engineering field trips

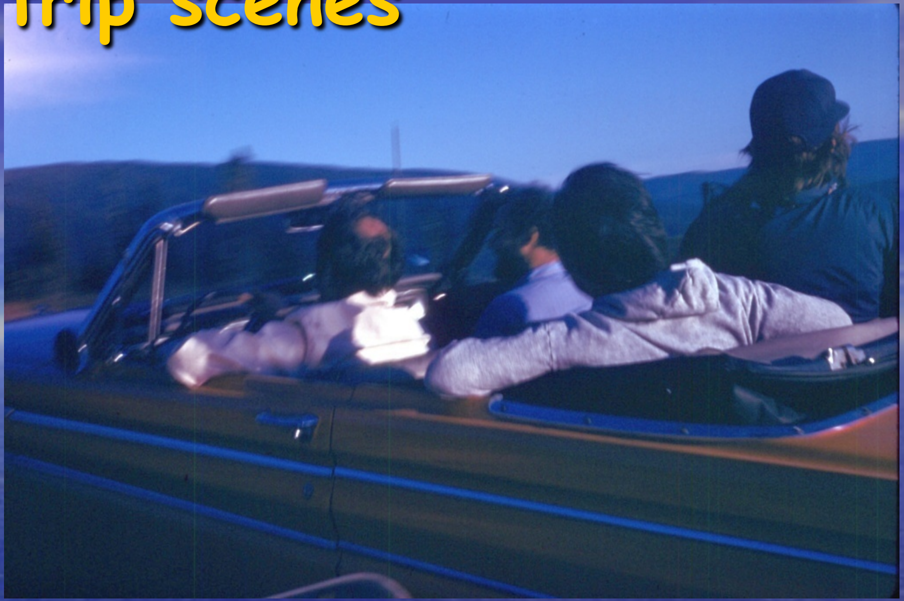
The Maestro


Toppling training by Rogers and Goodman

Dick had a simple operational plan on field trip stimulants: strong black coffee by day, and red wine by night

More field trip scenes

Morrow Point Dam

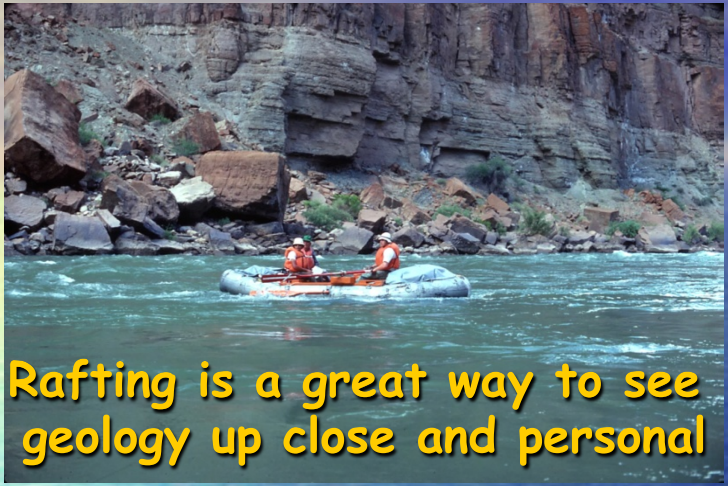


’64 Ford Fairlane convertible and Dick’s bald spot

Bushed puppies sleeping it off

Leaky abutment at Starvation Dam

Lodore Canyon-1977



Rafting is a great way to see geology up close and personal

Dick's Speedos

Mormon Travel Institute team

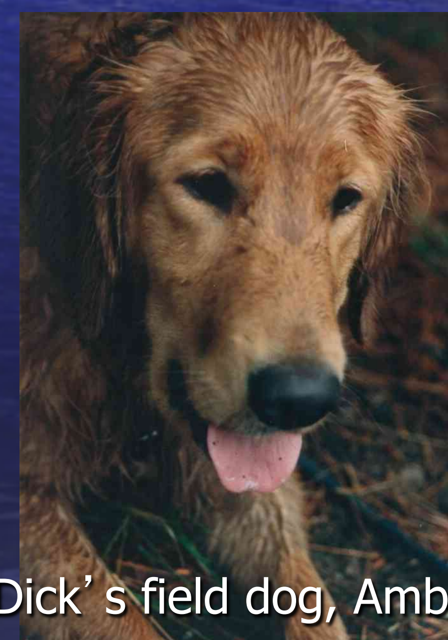
A "block mold"

Inspecting slope failures at Kennecott's Kimberly Open Pit Mine near Ely, Nevada

- **Dick**, **Greg Korbin**, **Tarcisio Celestino**, and **Rick Nolting** suit up for the day-long underground tour of Amax's Climax Molybdenum Mine near Leadville, Colorado, following the U.S. Symposium on Rock Mechanics at Keystone, CO (June 1977)

Dick and Sue have three beautiful daughters. Middle daughter Holly accompanied us on the 1979 GE field trip to Zion, Grand and Glen Canyons.

Highway geology from a convertible, trespass training, dog-tired days, and an astute observer of nature



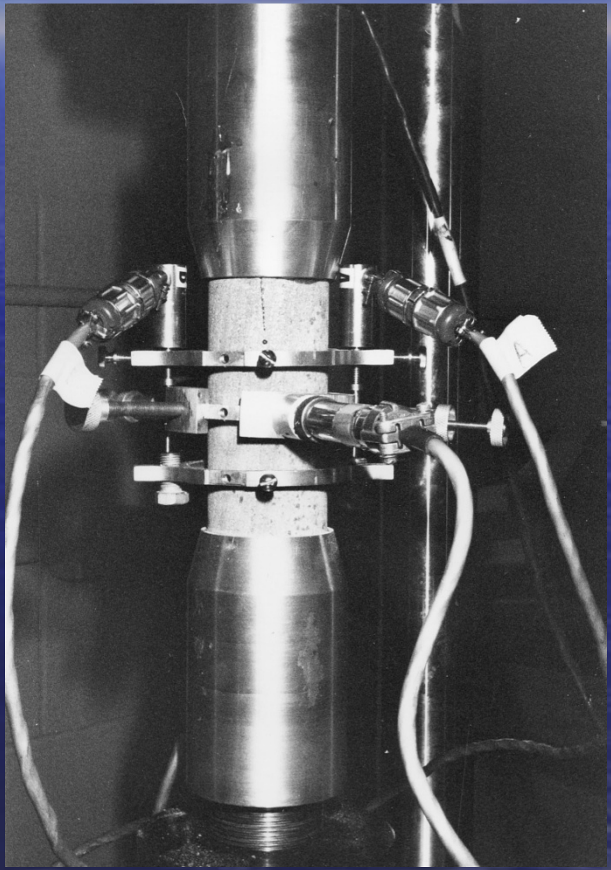
Dick's field dog, Amber

Bill Boyle and Dick checking out the AAPG Highway Geology Map

Inspiration Point in Zion Canyon was one of Dick's favorite hikes – 3000 feet straight up

Like fighter pilots, geological engineers talk block kinematics with their hands, explaining how one block interacts with another

The Rock Lab – Bastion of Experimental Mechanics



Experimentalists occupied the rock lab in 485 Davis Hall, along Hearst Avenue. This was a different culture from the theoretical modelers.

LAB MOLES

Anders Bro moved into the rock lab and never left

One day he lost a good portion of his scalp in the drill press while coring some samples ….

Anders showed all of us how to drill salt cores using kerosene and other useful life skills, not easily learned elsewhere

Experimentalists like to construct everything from scratch;

Anders lived for many years in a converted container trainer down in San Leandro. He cultivated a wonderful vegetable garden next to his lab

For seven years he tried to construct the perfect mechanical woman, but gave up…

During his last decade at Berkeley, Dick's physical models became increasingly sophisticated. Anders Bro's PhD thesis was 6 foot cube model of three mutually orthogonal joint suites, through which he excavated a tunnel, shown at upper right.

Dynamic keyblock modeling studies

The novel test at right was intended to ascertain whether dynamic wave energy would propagate downward and trigger movement of a keyblock, causing it to be displaced. Despite their careful efforts, no displacement was ever measured or observed.

The Gold Medal Flour Borehole Breakout Model

Int. J. Rock Mech. Min. Sci. & Geomech. Abstr. Vol. 25, No. 2, pp. 97–98, 1988
Printed in Great Britain

0148-9062/88 $3.00 + 0.00
Pergamon Press plc

Technical Note

Simulation of Borehole Breakouts in a Model Material

P. J. PÉRIÉ*
R. E. GOODMAN*
T. J. DOE†

The failure of rock around boreholes has been documented visually, and by borehole calipers, televiewers, and cameras. The result of rock breakage can be described accurately but we know of no observation of the process of failure.

Using a bag of common wheat flour and a length of metal tubing, one can observe the progression of failure around the hole as the bag is squeezed.

Figure 1 shows the required material: a 5 lb bag of flour and a piece of tubing. By "drilling" the tube into the bag and removing the flour, as shown on Figs 2 and 3, one obtains a smooth, round hole. The failure of this surface is induced by delicately squeezing the bag, so as to create a deviatoric horizontal stress in the material around the hole. At the onset of failure, featherlike spalling of material appears along a line parallel to the axis of the borehole as shown on Fig. 4. Finally, as more deformation is produced by further squeezing, a "dog ear" feature, typical of breakouts in rock, appears as shown on Fig. 5. The breakout in the model appears in the direction of minimum squeezing, confirming a relation widely held with regard to rocks.

* Department of Civil Engineering, University of California, Berkeley, CA 94720, U.S.A.
† Golder Associates, 4104 148th Avenue N.E., Redmond, WA 98052, U.S.A.

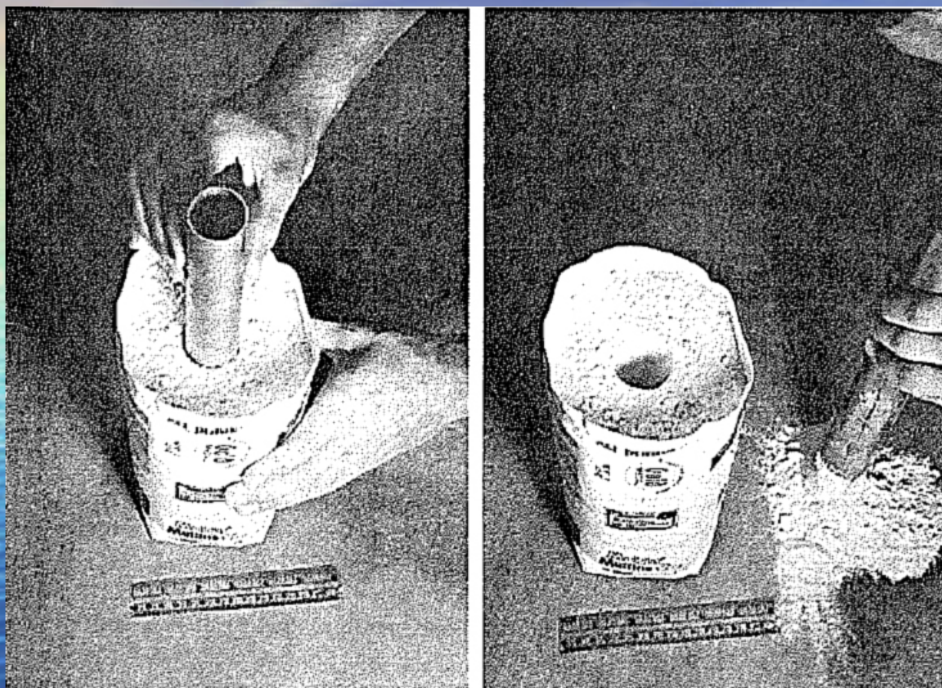
Received 12 *October* 1987.

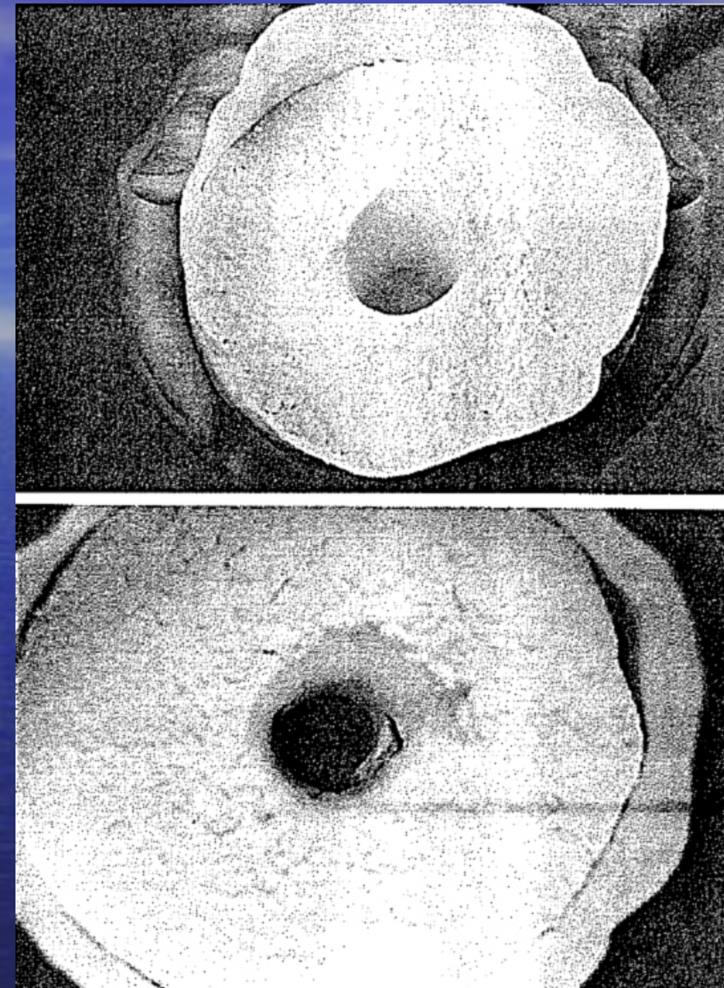
Fig. 1

Figs 2–5 overleaf

A follow-up to the base friction sand—salad oil mixtures developed for the base friction machine was this Technical Note on borehole breakout published in 1987

Physical Models





Much to his credit, Dick always recognized the value of physical models for teaching; and most his students benefited greatly from hours spent experimenting with physical models and the base friction machine.

Group photo of the Berkeley geotechnical program taken during 1981-82 academic year

Energy Needs provided a new source of research income in the late 1970's

LBL-11896

Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

ENERGY & ENVIRONMENT DIVISION

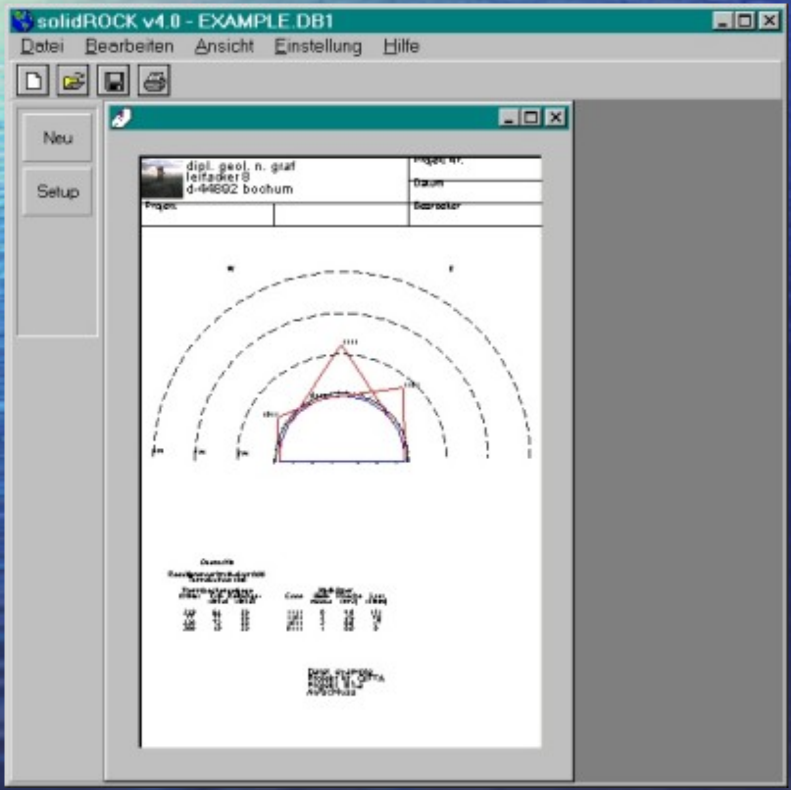
To be presented at the Implementation of Computer Procedures and Stress-Strain Laws in Geotechnical Engineering Conference at Virginia Polytechnic Institute, Blacksburg, VA, August 3-6, 1981

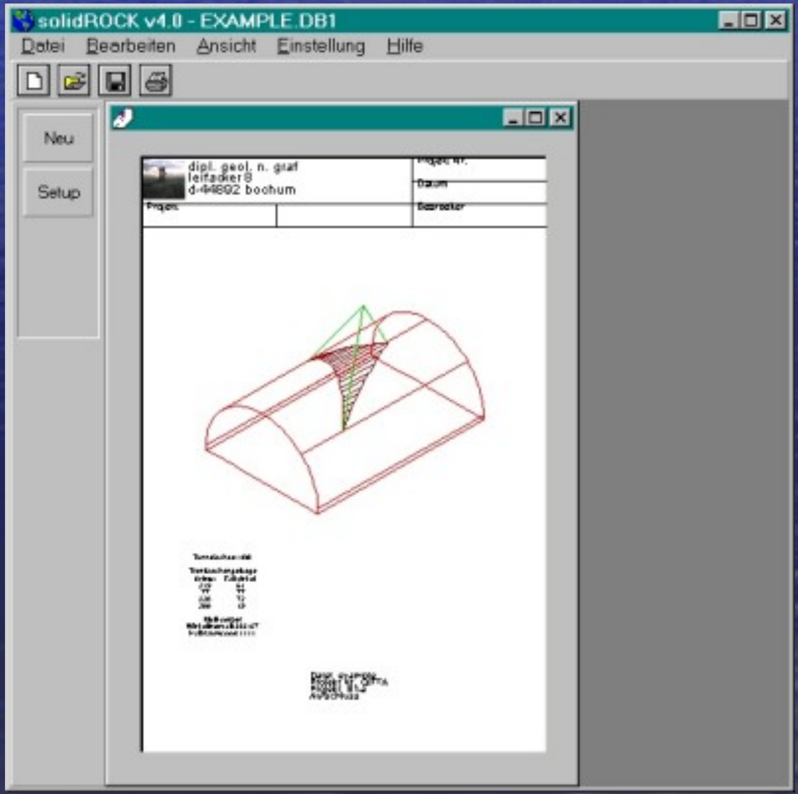
MODELING OF STATIC MINING SUBSIDENCE IN A NONLINEAR MEDIUM

J.L. Ratigan and R.E. Goodman

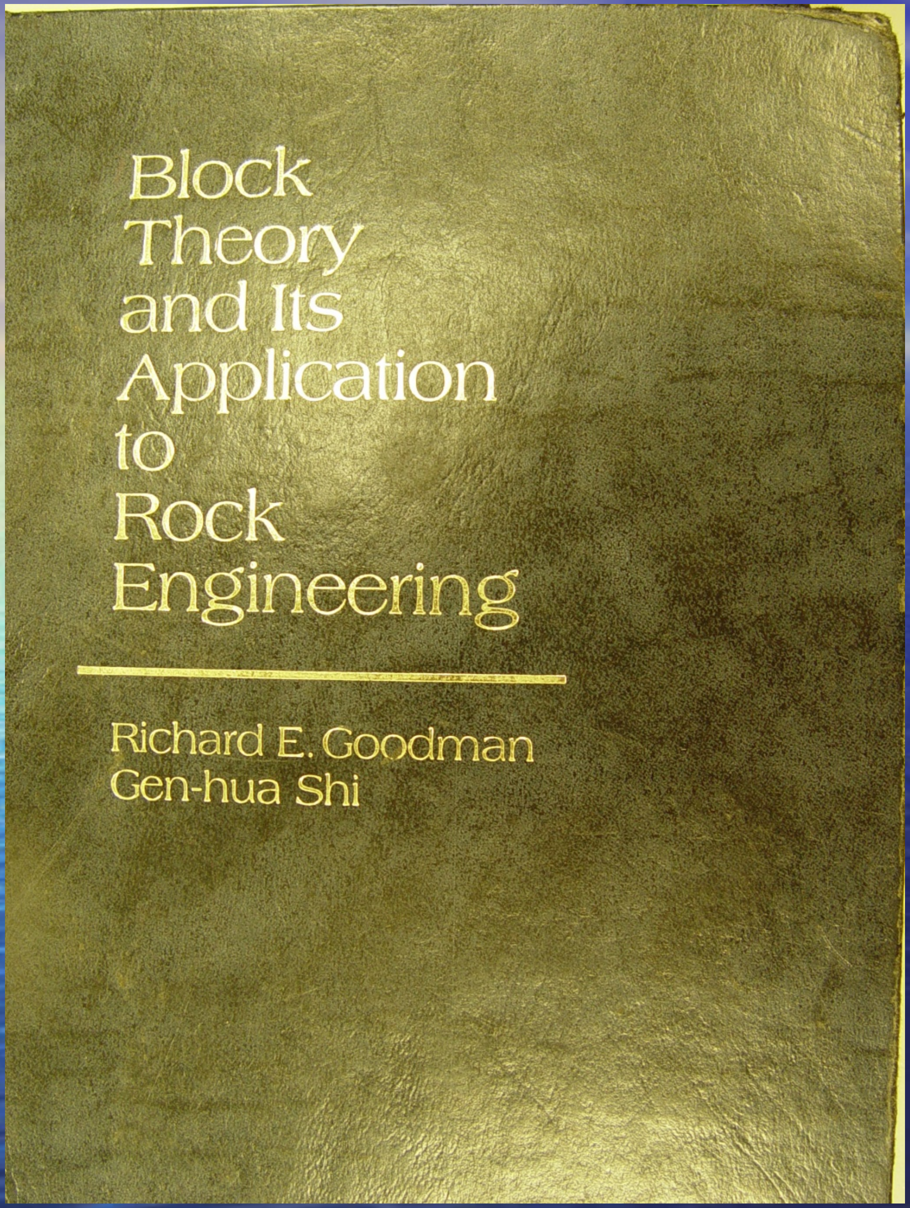
December 1980

In 1981 Chinese mathematician Gen-hua Shi visited Berkeley hoping to gain an audience with Professor Richard E. Goodman





The Block Theory book co-authored by Gen-Hua Shi was published by Prentice-Hall in 1984



The world's nicest scientist, Gen-hua Shi, survived several kidnapping attempts by PRC agents and some book burnings by angry wives…

Perfecting Block Theory

Matt Mauldon

Geh-hua Shi

Dick Goodman

In the early 1990s Matt Mauldon spearheaded the effort to quantify the various movement modes of block theory, enabling the analysis procedures to be automated; allowing block theory to be used by practioners world-wide. This resulted in Dick's section as the 1995 Rankine Lecturer; which would have made Harry Seed most proud.

Men in Tights: A Passion for Opera

UC BERKELEY
GEOTECHNICAL SOCIETY

440 Davis Hall, University of California, Berkeley, California 94720

Wednesday, February 15, 1984

12 Noon

471 Davis Hall

AN ENTERTAINMENT

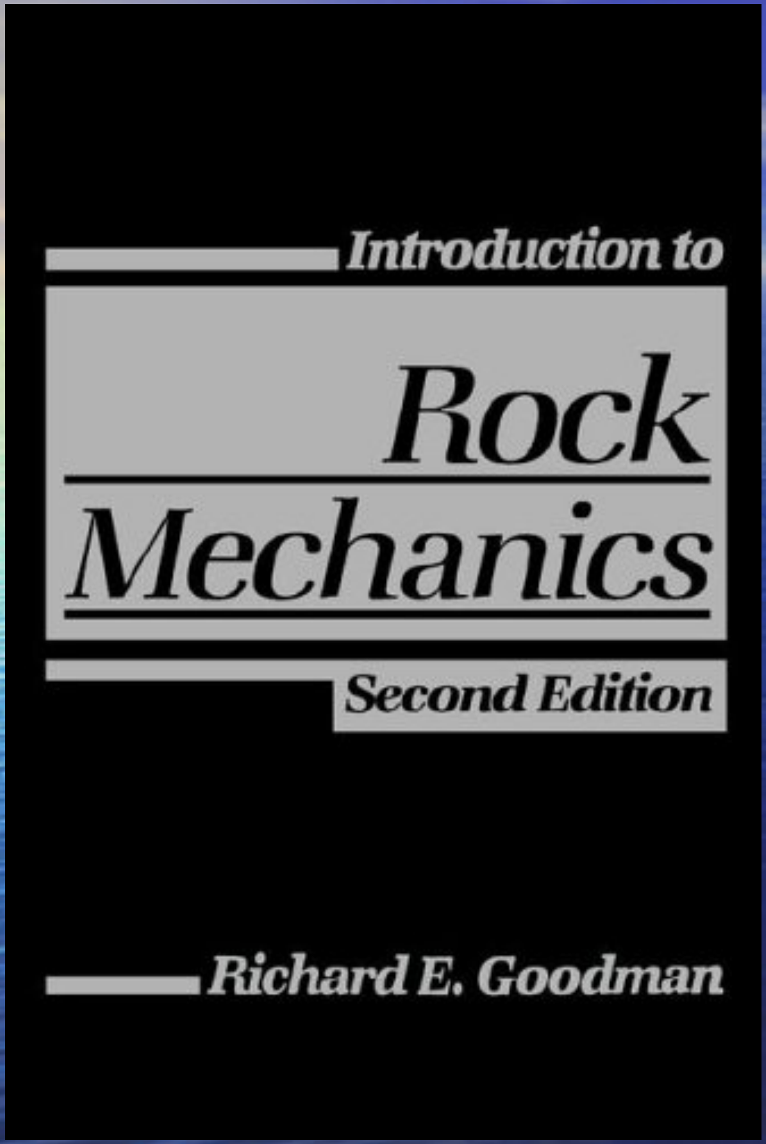
BY

Richard E. Goodman
Professor of Geological Engineering
University of California

Being a photographic account of some of the forty opera roles he has performed, together with some particular circumstances of same.

Dick played countless opera roles during his lifetime. In 1979 he founded the Berkeley Opera and most of his colleagues, students, and former students found themselves enrolled in some level of music and opera appreciation

Previous to this, I had always thought Rigoletto was a kind of pasta



Second Edition

The Second Edition of **Introduction to Rock Mechanics** appeared in 1989; and has continued to serve as an academic standard, earning Dick some handsome royalties, which he uses to support The Mendocino Council for the Arts.

Summer Short Courses

THE GEOLOGICAL ENGINEERING FOUNDATION
1847 YOSEMITE ROAD
BERKELEY, CALIFORNIA 94707

A NON-PROFIT TAX EXEMPT CORPORATION

Twelfth Short Course on Geological Engineering

September 7-14, 1982

Asilomar State Conference Grounds
Pacific Grove, California

PROGRAM

Tuesday, September 7:

1:00 pm - 6:00 pm	Registration and Reception

Wednesday, September 8:

8:30 am - 9:30 am	Functional Classification of Rock Types, Disc and Rock Masses
9:45 am - 10:45 am	Functional Classification of Rock Types, Disc and Rock Masses, cont'd.
11:00 am - 12:00 am	LAB: Geological and Engineering Geology Ma

THE GEOLOGICAL ENGINEERING FOUNDATION
1847 YOSEMITE ROAD
BERKELEY, CALIFORNIA 94707

A NON-PROFIT TAX EXEMPT CORPORATION

EIGHTEENTH SHORT COURSE ON GEOLOGICAL ENGINEERING

June 7-11, 1988

Granlibakken Conference Center
Tahoe City, California

<u>Tuesday, June 7:</u>

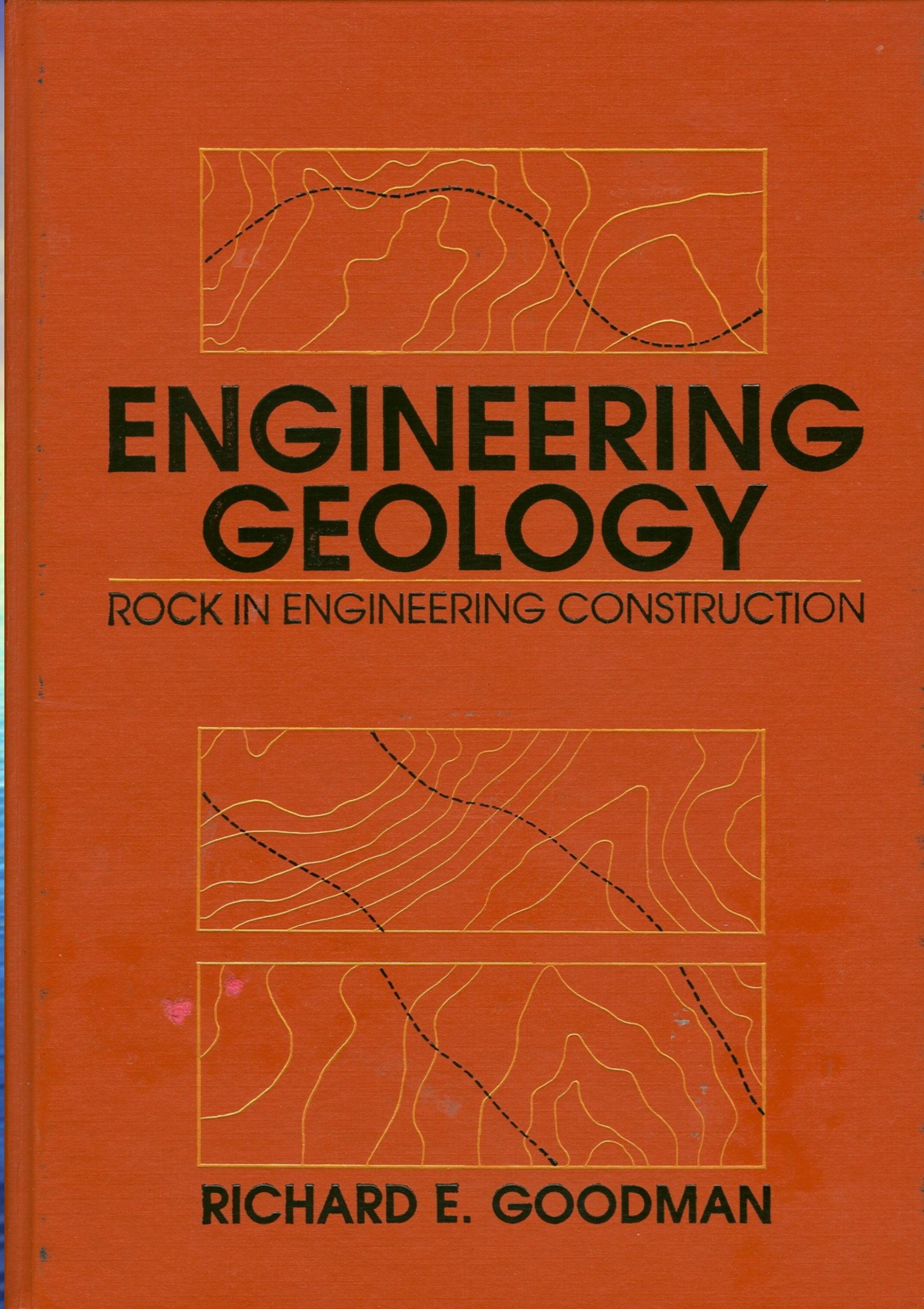
2:00 pm - 3:00 pm	Functional Classifications of Rock Types, Discontinuities, Rock Masses	Mr. Brekke
3:15 pm - 4:15 pm	Functional Classifications of Rock Types, Discontinuities, etc.	Mr. Brekke
4:30 pm - 5:30 pm	LAB: Geological and Engineering Geology Maps	Mr. Brekke

<u>Wednesday, June 8:</u>

Dick and Tor continued to sponsor geological engineering short courses up until they retired, in 1993-94.

Field Trip 1992 Granlibakken Conference in Lake Tahoe

Field Work: Dick applying load to slab of Sierra granite



Throughout his academic career Dick contemplated compilation of a quality text on engineering geology; not a glorified physical geology book.

Engineering Geology: Rock in Engineering Construction was published by John Wiley in 1993.

It is widely employed in geo-engineering programs in the United States and elsewhere; the University of Missouri uses it for their basic petrology course!

Association of Engineering Geologists
San Francisco Section

NEWSLETTER

November 1993

General Meeting Announcement

Tuesday, November 9, 1993

Joint Meeting with ASCE Geotechnical Group

Location: His Lordships Restaurant, Berkeley

Speaker: Dr. Richard Goodman, U.C. Berkeley

CASE HISTORIES OF FAILURES RELATED TO ROCK FOUNDATIONS

Dr. Goodman will present summaries of recent case histories of projects that suffered failures. These include: an arch bridge founded in schist (Caracas, Venezuela); penstocks founded in phyllites and volcanic rocks (California); arch dams founded on granite and gneiss (California, Wyoming, and Colorado); and

Dr. Goodman has been active as a consultant on diverse engineering projects since 1964. He explored and investigated many dam sites in Colombia and Venezuela, evaluated landslides and fault hazards and rock slopes in the U.S. and south America, performed studies for alignments of water supply and power tunnels,

San Francisco Section
AMERICAN SOCIETY OF CIVIL ENGINEERS

CIVIL ENGINEERING: *A PEOPLE-SERVING PROFESSION*

ASCE MEETING ANNOUNCEMENT
JOINT MEETING
GEOTECHNICAL GROUP
AND
ASSOCIATION OF ENGINEERING GEOLOGISTS

Topic: **PROBLEMS WITH ROCK FOUNDATIONS**

Speaker: Dr. Richard E. Goodman
Chairman, Geotechnical Engineering Group and
Nishkian Chair, Department of Civil Engineering
University of California, Berkeley

Program: Professor Goodman will present a summary of recent case histories dealing with projects that suffered failures. These include: an arch bridge founded in schist (Caracas, Venezuela); penstocks founded in phyllites and volcanic rocks (California); arch dams founded on granite and gneissic granite (California, Wyoming and Colorado); and foundations in pre-Cambrian granite (California).

This may be one of your last opportunities to hear from Professor Goodman, the "Terzaghi" of rock mechanics. The author of six textbooks, over 100 papers, and many professional society awards, Goodman will be retiring from U.C. Berkeley this year to devote his full attention to writing.

Date: **Tuesday, November 9, 1993**

Joint ASCE-AEG Lecture November 1993

The 1990s – A decade of honors

Richard E. Goodman

- Election to National Academy of Engineering (NAE) - 1991
- Elected to the Berkeley Committee on Committees in 1992
- Assumption of Cahill Chair in 1992; Head of Berkeley Geotechnical Engineering Program in 1993
- Recipient of the Berkeley Citation in 1994
- Rankine Lecturer of the British Geotechnical Society in 1995
- Archie Carter Publishing Award of ASCE in 1999
- Civil Engineering History and Heritage Award of ASCE in 2000
- H. Bolton Seed Medal and Lecturer of ASCE in 2000

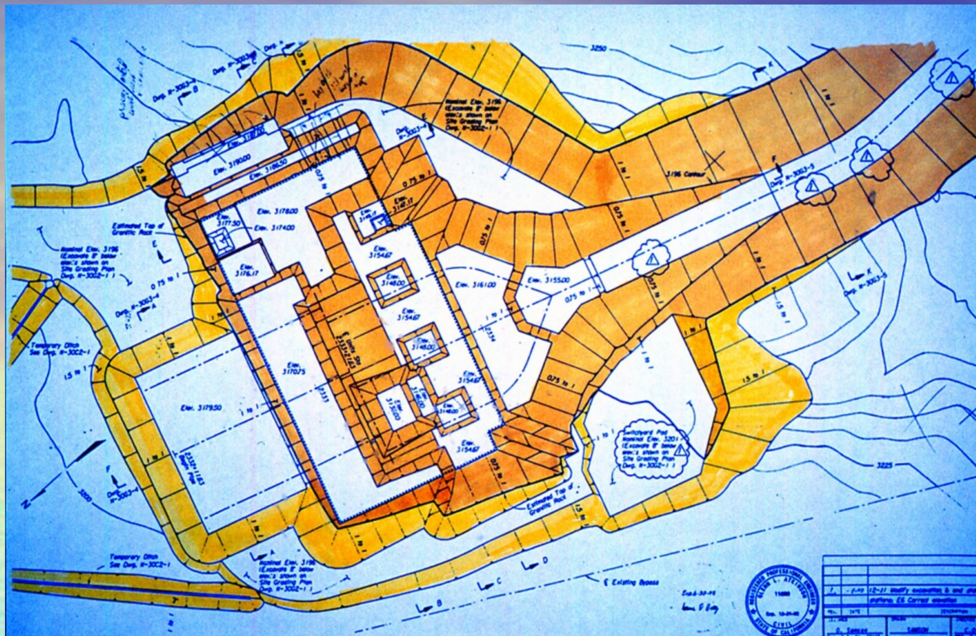
After Dick retired from Berkeley in 1994, he and Sue relocated from 715 Arlington Avenue to Pomo Lane in Mendocino, CA

Post-Retirement Consultations

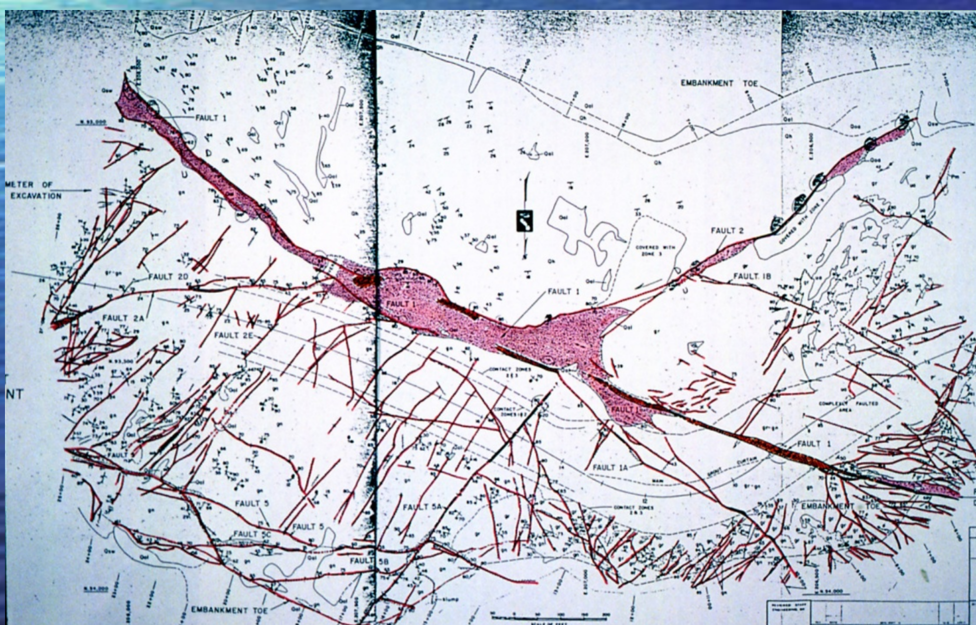
Pacoima Dam abutment

Dick served as a consultant on Pacoima arch dam; which was the world's highest dam until Hoover Dam. It was founded on extremely fractured rock, which recorded an acceleration of 1.3g in the 1971 San Fernando earthquake.

In the 1990's Dick began a series of consultations for the Bureau of Reclamation and, more recently, the Corps of Engineers, on block stability of foundations and abutments of many existing dams. These are some of the most geometrically complicated situations imaginable, which require three-dimensional modeling. This view shows Seminoe Dam in Wyoming.



One CA DWR project Dick found that geologic hazards like faults were "mitigated" through careful engineering geologic mapping.



The lesson he preached to us was that **no amount of careful mapping or instrumentation could be expected to save a flawed design!**

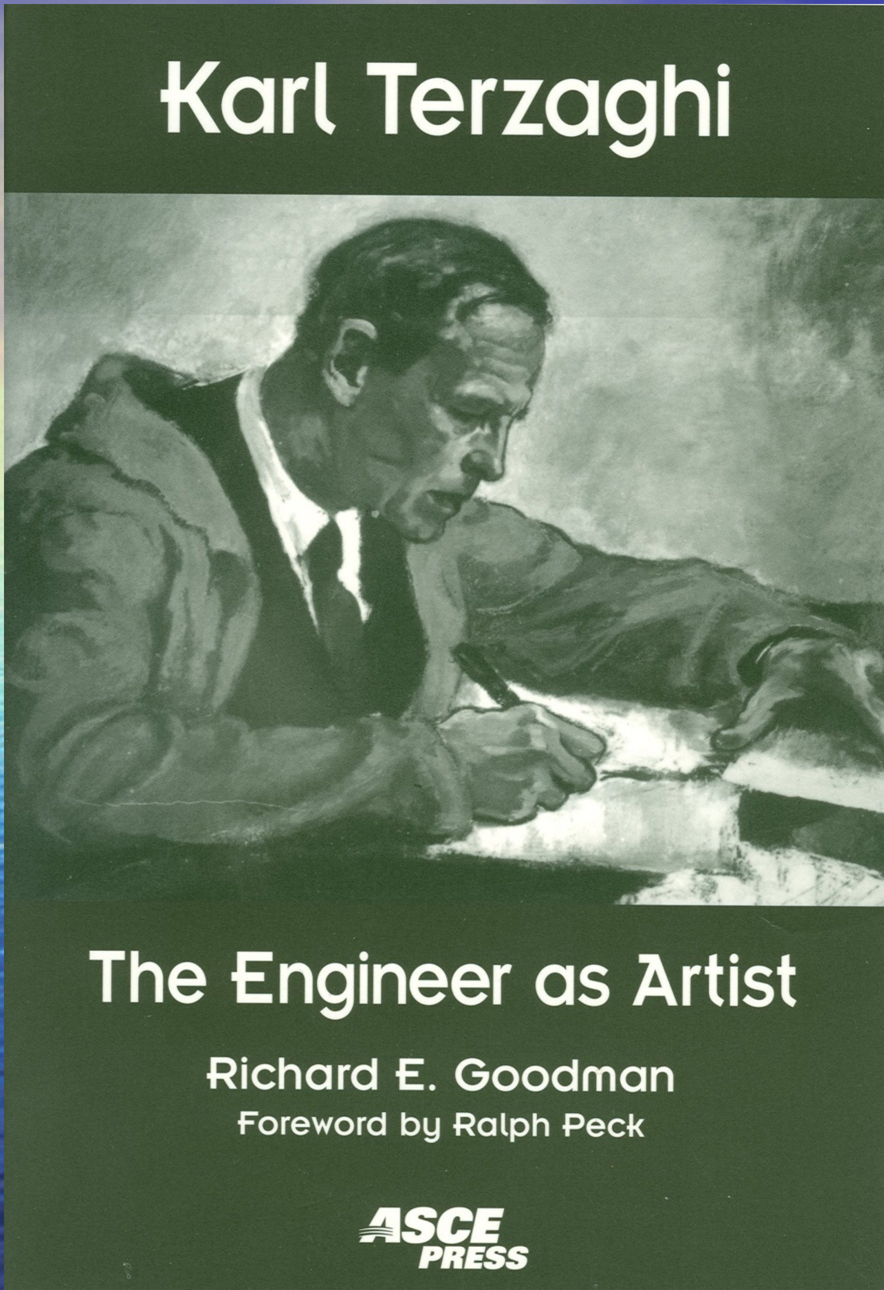
Dropping down bucket auger hole at Knockash Hill rock slide in San Francisco

Dick with Dale Marcum and John Wallace (left) and Stan Helenschmidt (above) at 18th Hole slide at Trump National Golf Course

Dick explaining toppling failure mechanisms in jointed phyllite at PG & E's Caribou Generating Station above the North Fork of the Feather River.

Dick demonstrating block kinematics on massive landslides of the Palos Verdes Peninsula, using planar blocks sliding on a field notebook

Dick standing on an emergent 120,000 year old marine terrace in southern California



KT: The Engineer as Artist (1999)

Dick, an artistic engineer himself, spent the better part of a decade researching an exquisite biography of soil mechanics pioneer Karl Terzaghi (1883-1963); which included interviews with Ruth Terzaghi, Ralph Peck and many others. He also deciphered Terzaghi's personal diaries in German, held by the Norwegian Geotechnical Institute in Oslo. The book won several awards.

Dick and Dr. Margaret Terzaghi-Howe, Karl Terzaghi's daughter, on the Clinch Mountain field trip in Tennessee in 1996 (photos by Matt Mauldon).

In Appreciation

Professor Richard E. Goodman

In honor of your 70th birthday

With gratitude for dedication to teaching, innovative research for over 40 years, and unequalled contributions to the fields of engineering geology and rock mechanics throughout your illustrious career.

Presented by

Your graduate students and colleagues

at the

Richard E. Goodman Colloquim
University of California - Berkeley Faculty Club
January 14, 2006