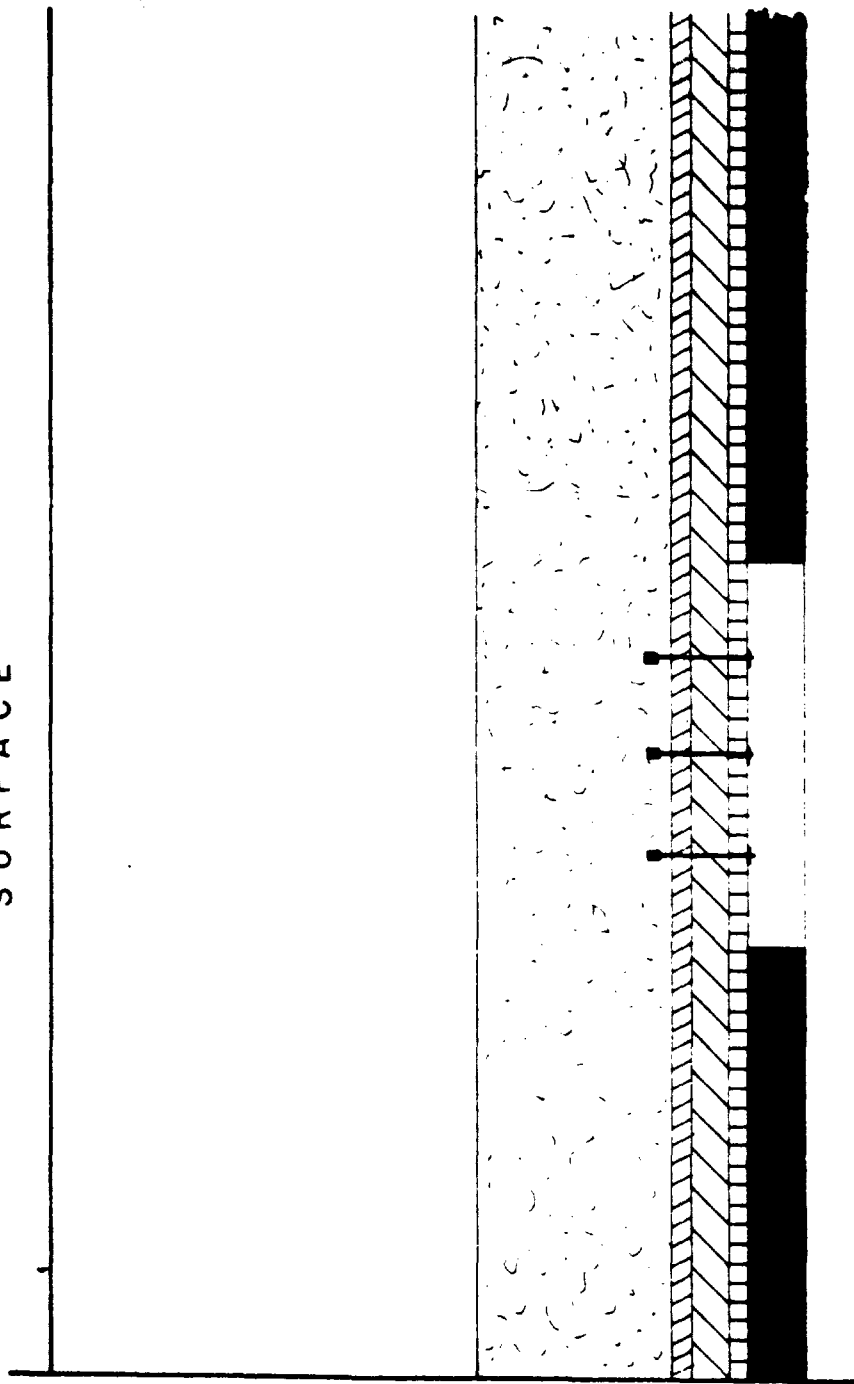


SURFACE



COAL MINE

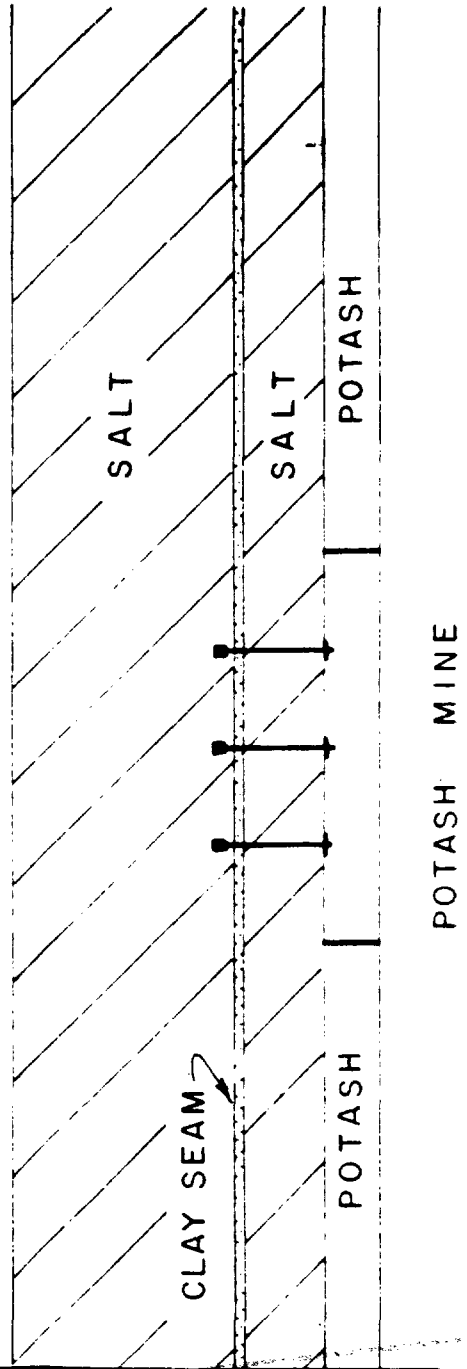
BEFORE THE
OIL CONSERVATION COMMISSION
State of West Virginia

Cole No. _____ E.C. No. 143

Submerged No. _____

Hearing Date _____

SURFACE



5000

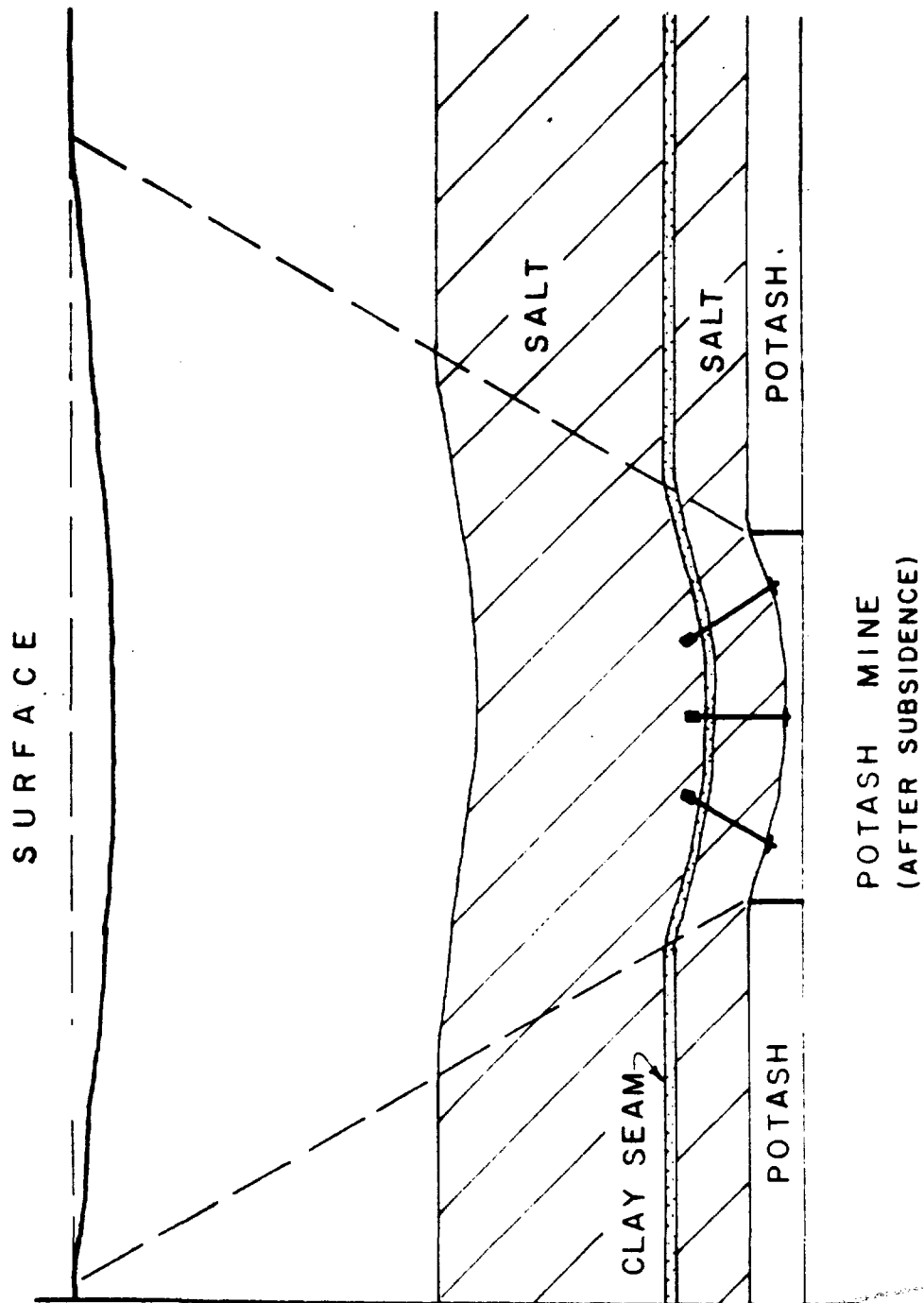
OIL CO. OF CALIF.

Case No. _____

Sub No. _____

Reading _____

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GROSVENOR ENGINEERING
SEPTEMBER 1992

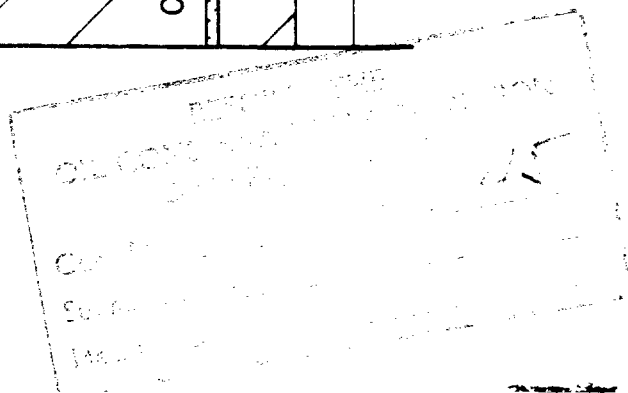
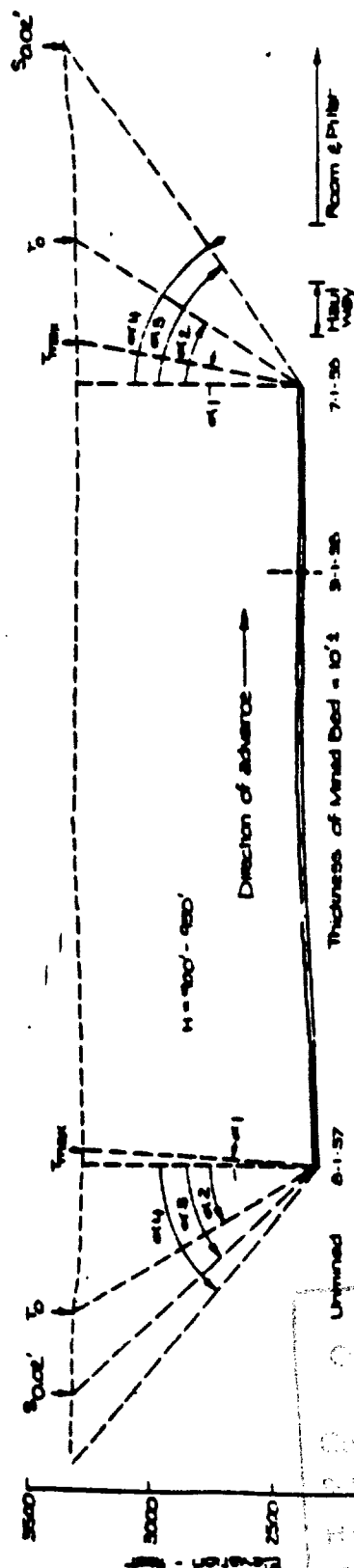
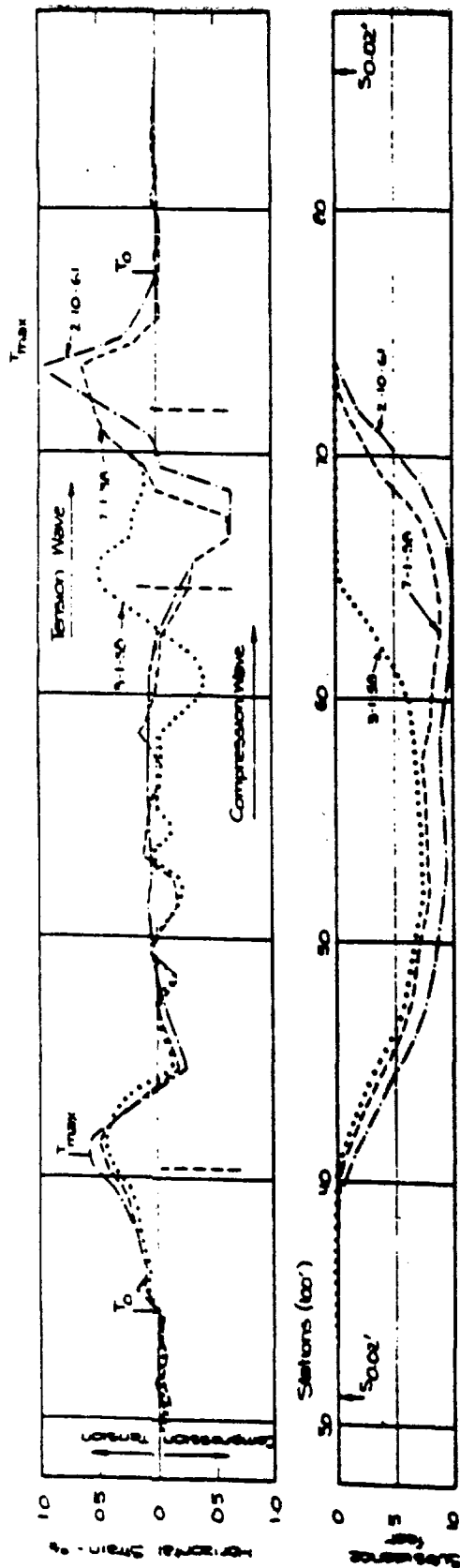


Figure 4-2

PROFILE OF SUBSIDENCE
AND HORIZONTAL STRAIN

(after Dacre, 1961)



	α_1	α_2	α_3	α_4	Horizontal
Left side - Unmined Area	-3°	31°	42°	>49°	910'
Right side - Room & Pillar Area	10°	32°	53°	56°	1550'
Series of Angle	T_{max}	T_0	50.02'	Limit	

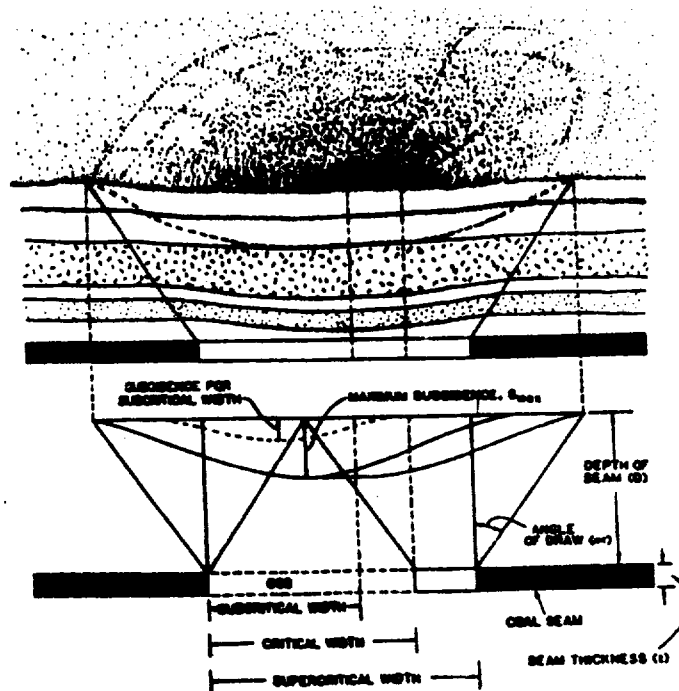
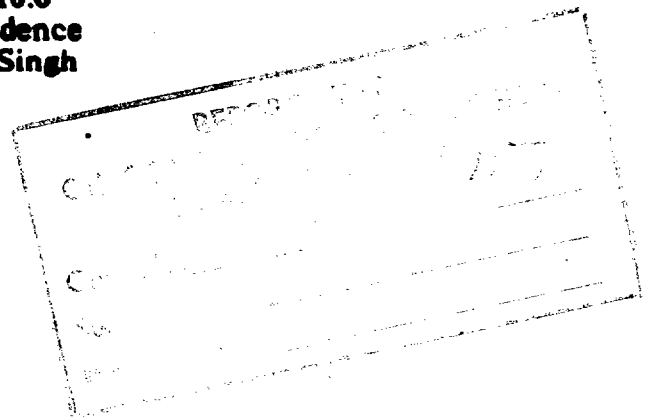


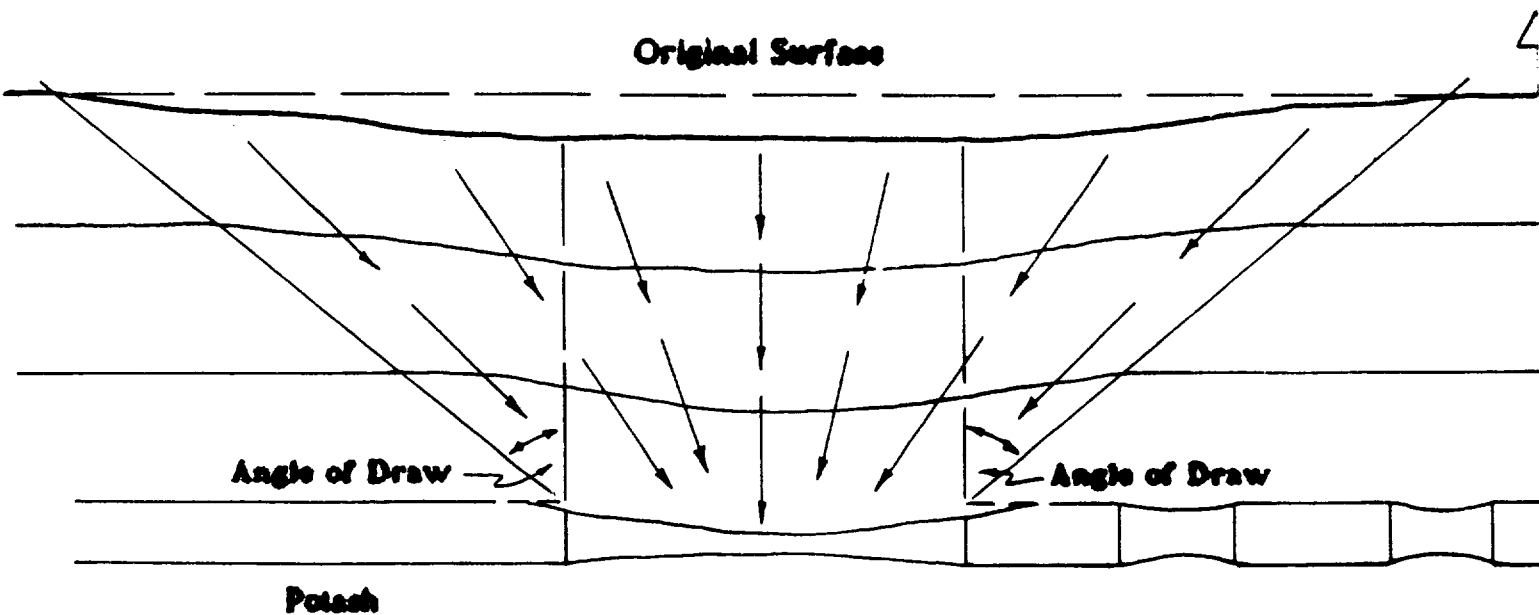
Fig. 10.6.4. Influence of extraction width on subsidence.

SME MINING ENGINEERING HANDBOOK

2nd Edition Vol 1
Howard L. Hartman, Senior Editor

Chapter 10.6
Mine Subsidence
Madan M. Singh





(Not to Scale)

Angle of Draw - References

- | | | | |
|----|--|---|------------|
| 1. | Miller and Piorson (1988)
(United States Potash Mine) | - | 51° to 39° |
| 2. | Deere (1961)
(U. S. Borax Mine) | - | 42° to 35° |
| 3. | Golder (1979) | - | 45° to 25° |

Grosvener Engineering Company
September 1992

ILLEGIBLE

BEFORE THE OIL CONSERVATION COMMISSION	
Case No. _____	17
Submitted _____	
Hearing Date _____	

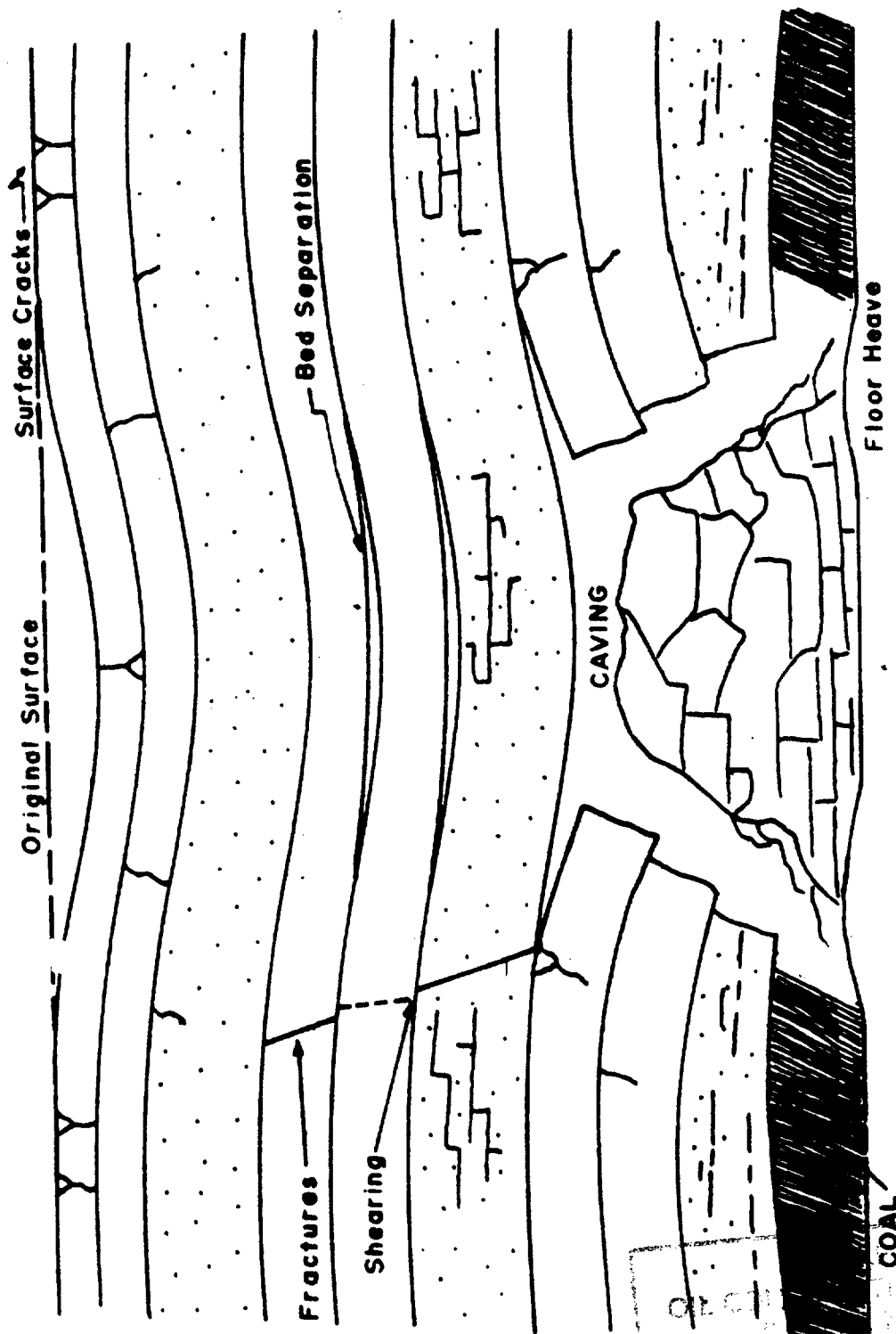
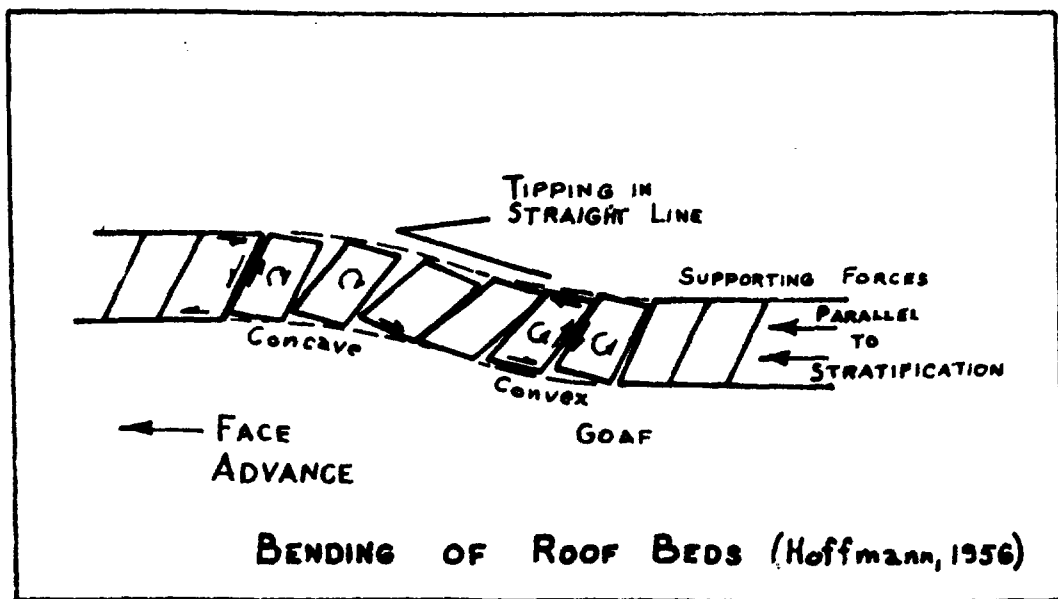


Figure 27- Strata Deformation and Development
Subsidence Trough from Underground Mining
(after Shadbolt, 1977)

Source:

"Criteria for Determining When A Body of Surface Water Constitutes A Hazard to Mining"
Engineers International, Inc., 1979, for U. S. Bureau of Mines

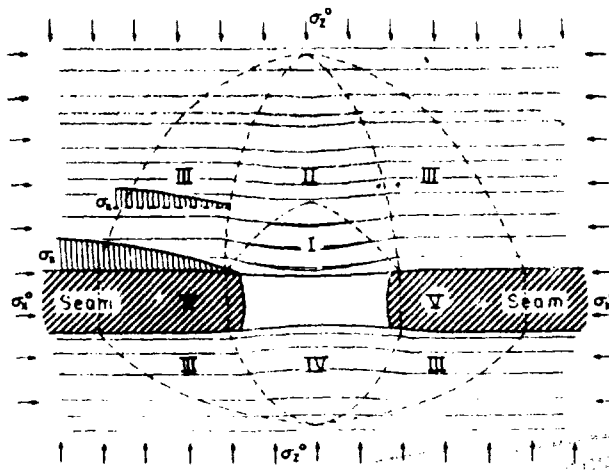


From:

Rock Mechanics Handouts
Mining 321
John F. Abel, Jr.

DEPT	
OIL CONSERV	
Serial	30
Case No.	
By	
Date	

FIG. 3 — DISTURBANCE PRODUCED BY
EXCAVATION IN LAYERED STRATA



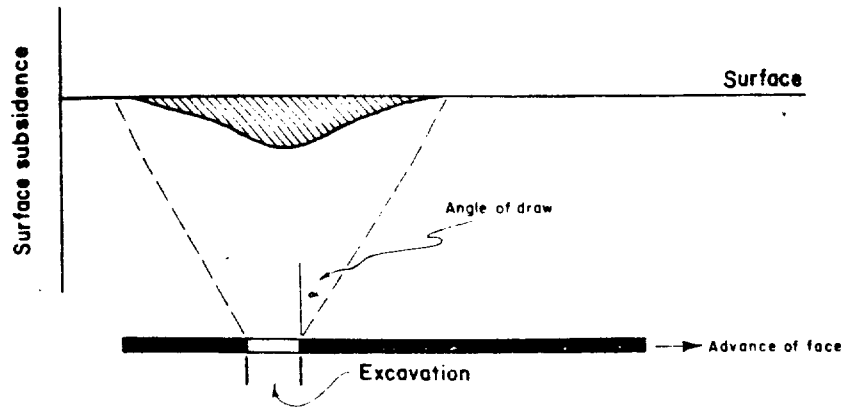
- Zone I - Bed separation occurs due to differential sag and buckling.
- Zone II - Layers sag but without bed separation. Gravity acts to develop sag in Zones I & II.
- Zone III - Horizontal and vertical pressures build up to their undisturbed values.
- Zone IV - Floor heave (uplift) occurs without bed separation.
- Zone V - Seam expands towards excavation because of release of horizontal stress at the ribs

Adapted From:

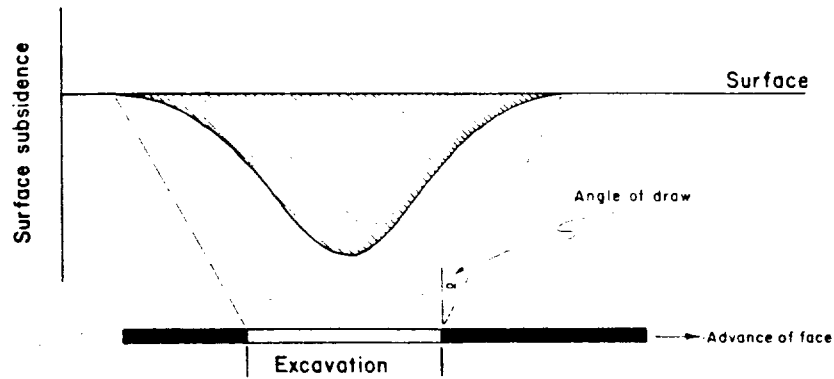
Engineering and Mining Journal
A McGraw-Hill Publication
February 1974

p.81 "Roofbolting in Horizontally Laminated Rock"
C. Fairhurst and B. Singh

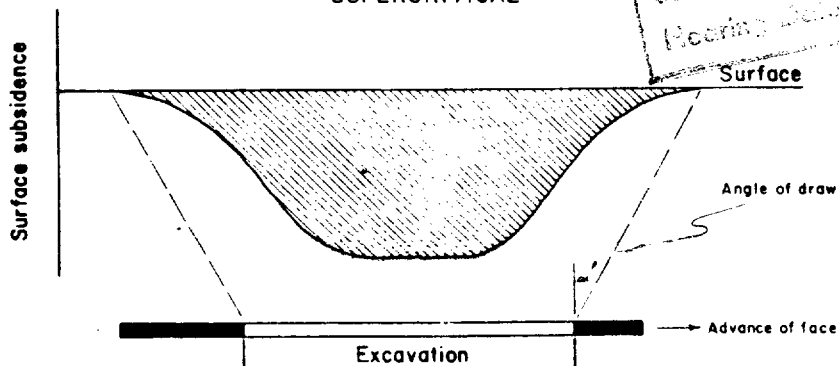
SUBCRITICAL



CRITICAL



SUPERCritical



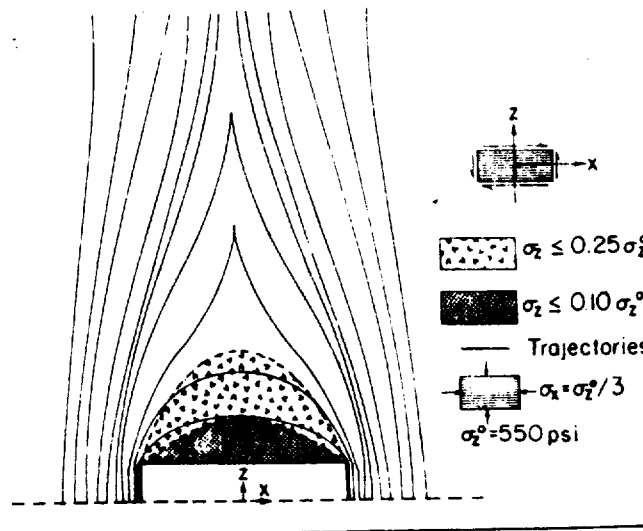
BEFORE THE
EXCAVATION
COMPLETION
SUBCRITICAL
CRITICAL
SUPERCRITICAL

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Progress of subsidence with advance of excavated area. (After Reilensmann)

TRAJECTORIES OF PRINCIPAL STRESS AROUND A RECTANGULAR OPENING IN A MEDIUM OF LOW SHEAR MODULUS

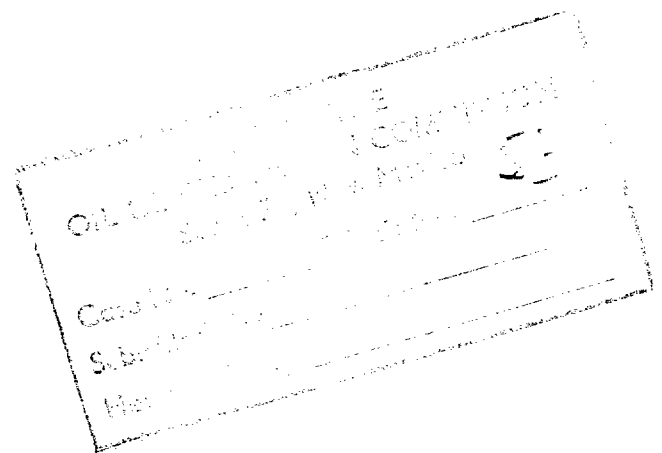
(Axes of anisotropy are vertical -- Z,
and horizontal -- X, Y)



From:

Engineering and Mining Journal
A McGraw-Hill Publication
February 1974

p.81 "Roofbolting in Horizontally Laminated Rock"
C. Fairhurst and B. Singh



LEASE CHRONOLOGY

54

1. FEDERAL - 3.5% of the value of K_2O product
@ the Point of shipment through
Feb. 26 1982

- Feb 26 1982 through June 1, 1986
Sliding Scale:

- @ 10% grade K_2O or less
- 2% Royalty Rate
- @ 17.09% grade K_2O or more
- 5% Royalty Rate
- @ 10% - 17.09% grade K_2O
Royalty is calculated by the
formula

$$2\% + [(\%K_2O - 10\%K_2O) \times 0.4237]$$

- @ 16% grade K_2O Royalty is
4.54%

- June 1 1986 and renewed
every 2 years - Federal
Royalty Rate has been
2%

State - Through Jan 1 1984

State Calculated Royalty
@ 5% of the value of Product

However the Value was
set @ \$17.65 per K_2O Ton
Posted Field Price.

When compared to Federal
Royalty Rates, State effective
Rate was only 1% and Federal
Rate was @ 3.5%

January 1984

State Royalty Rate was
changed to the same sliding
scale Rate used by Federal.

January 1984 - June 1986

State & Federal Rates were
identical Except for some State
Leases @ a special 2% Rate (Thompson April 1985)
June 1986 - Present - Federal Rates
Have been lower @ 2%

54A

EXHIBIT 54A - SIMPLIFIED ROYALTY CALCULATIONS

I. BASIS: 10,000 ORE TONS MINED

II. ASSUMPTIONS: 14.5% K₂O, 80% MILL RECOVERY, 62% K₂O PRODUCT GRADE (= 98.1% KCl), VARIOUS SELLING PRICES

III. PRODUCTION:

A. K₂O TONS IN ORE = $10,000 \times 14.5\% = 1,450$

B. PRODUCT TONS = $10,000 \times 14.5\% \times 80\% \div 62\% = 1,871$

IV. STATE ROYALTIES

A. BEFORE JAN. 1, 1984 - BASED ON VALUE OF K₂O TONS IN THE ORE MINED. STATE ASSIGNED UNIT VALUE OF \$17.65 PER K₂O TON IN ORE. ROYALTY RATE WAS 5% OF THIS VALUE.

ROYALTY PAID (THIS EXAMPLE) $1,450 \times \$17.65 \times 5\% = \$1,280$

B. AFTER JAN. 1, 1984 TO PRESENT* - BASED ON GRADE SALES VALUE OF PRODUCT AND SLIDING SCALE RATE BASED ON ORE,

1. SALES VALUE OF PRODUCT

AT \$20/TON $\times 1,871 \text{ TONS} = \$37,420$ (LATE 60's)

\$40 $\times 1,871 \text{ " } = \$74,840$ (MID 70's)

\$60 $\times 1,871 \text{ " } = \$112,260$ (EARLY 80's)

\$80 $\times 1,871 \text{ " } = \$149,680$ (EARLY 90's)

2. ROYALTY RATE

FORMULA: $2\% + ((\% \text{ K}_2\text{O} - 10\%) \times 0.42377)$

EXAMPLE: $2\% + ((14.5\% - 10\%) \times 0.42377) = 3.907\%$

3. ROYALTY PAID (AT VARIOUS UNIT PRICES)

AT \$20/TON = $\$37,420 \times 3.907\% = \$1,462$

\$40/TON = $\$74,840 \times \text{" } = \$2,924$

\$60/TON = $\$112,260 \times \text{" } = \$4,386$

\$80/TON = $\$149,680 \times \text{" } = \$5,848$

EX 54A - (CONTINUED)

C. * ON A CASE BY CASE BASIS, AND OWING TO DEMONSTRABLE FINANCIAL HARDSHIP, THE STATE LAND OFFICE COULD GRANT ROYALTY RELIEF. THIS RELIEF WAS GRANTED TO SEVERAL COMPANIES IN THE MID 1980'S DOWN TO A RATE OF 2%.

ROYALTY PAID

AT \$20/TON = \$37,420 x 2% = \$748

\$40/TON = \$74,840 x 2% = \$1,497

\$60/TON = \$112,260 x 2% = \$2,245

\$80/TON = \$149,680 x 2% = \$2,994

V FEDERAL ROYALTIES

A. PRIOR TO FEB. 26, 1982 FEDERAL LEASES CALLED FOR 5% ROYALTY PAYMENTS, BUT THE INDUSTRY NEGOTIATED RATES DOWN TO 3.5%, BASED ON SALES VALUE OF PRODUCT

ROYALTY PAID (AT VARIOUS UNIT PRICES)

AT \$20/TON = (FROM IV B.1.) \$37,420 x 3.5% = \$1,310

\$40/TON = 74,840 x " = \$2,619

\$60/TON = 112,260 x " = \$3,929

\$80/TON = 149,680 x " = \$5,239

B. FEB. 26, 1982 TO JUNE 1, 1986 - SLIDING SCALE ROYALTY RATE BASED ON ORE GRADE AND APPLIED TO SALES VALUE.

ROYALTY PAID - SAME AS IV B.3.

C. JUNE 1, 1986 TO PRESENT. BLANKET REDUCTION TO ALL PRODUCERS TO 2% OF SALES VALUE, REDUCTION RENEWED BI-ANNUALLY WITH LATEST RENEWAL EXPIRING DEC. 31, 1993.

ROYALTY PAID - SAME AS IV C.

EX 54A - (CONTINUED)

VII SUMMARY - SAMPLE ROYALTY PAYMENTS - BASED ON
ASSUMPTIONS AND SELLING PRICE TIMINGS SHOWN AT IV B 1

DATE	#/T	STATE		FEDERAL	
			% of SALES VAL		% of SALES VAL
LATE-60's	20	\$1,280	3.4%	\$1,310	3.5%
MID-70's	40	\$1,280	1.7%	\$2,619	3.5%
MID-'82	60	\$1,280	1.1%	\$4,386	3.9%
MID-'84	60	\$4,386	3.9%	\$4,386	3.9%
MID '86	60	\$4,386 (some at 2%)	3.9%	\$2,245	2.0%
CURRENT	80	\$5,848	3.9%	\$2,994	2.0%