File Kaiser Sunnyside
ACT/007/007 #2

0041

KAISER COAL

**KAISER COAL CORPORATION**
**Sunnyside Coal Mines**
P.O. Box D
Sunnyside, Utah 84539
Telephone (801) 888-4421

RECEIVED
JUL 03 1986
DIVISION OF
OIL, GAS & MINING

June 30, 1986

Pamela Grubaugh-Littig
Division of Oil, Gas & Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RE: Twinshaft Geotechnical Analysis

Dear Ms. Grubaugh-Littig

Please find enclosed (3) three copies of the information requested in your letter of June 2, 1986.

Sincerely,
Kaiser Coal Corporation

Douglas C Pearce
Mine Engineer

File ACT/007/007 #2

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

RECEIVED
JUL 03 1986
DIVISION OF
OIL, GAS & MINING

May 9, 1986

Kaiser Steel Corporation
P.O. Box D
Sunnyside, UT 84539

Gentlemen:

As you have requested we have completed the stability analysis for the restored slope at the Twin Shaft Site at the Kaiser Steel Mining Facilities near Sunnyside, Utah. It is our understanding that the state and federal regulations require that each mine facility be restored as nearly as possible to its original configuration at the termination of the use of that facility. We also understand that the regulatory agencies require that each restored slope have a factor of safety of at least 1.5.

The purpose of this investigation was to determine the factor of safety of the restored slope. The drilling of a test hole at the slope location would have been expensive and would not have contributed greatly to a knowledge of the characteristics of the material at the site. A visual observation of the site indicates that the material within the slope is predominantly granular type soils. A photograph depicting the characteristics of the slope in the vicinity of the Twin Shaft Site is shown in Figure No. 1 . The results of the particle size distribution analysis performed on the representative sample obtained from the cut slope are presented in Figure No. 2. It will be observed from Figure No. 2 that approximately 62 percent of the sample consists of sand and gravel size particles while the remainder of the sample is predominantly silty type soils. A profile showing the existing cut slope of the site is presented in Figure No. 3, along with the proposed reclaimed profile.

A stability analysis was performed for this site using the shear strength parameter shown in Figure No. 3. It will be observed that a factor of safety of 1.6 was obtained for the restored slope. The stability was performed using the computer

program developed at the University of California, Berkeley. The program follows Spencer's Method which satisfies both force and equilibrium. It is our opinion that the shear strength parameters used for this analysis are reasonable and that the restored slope will have an adequate factor of safety.

If you have any questions pertaining to the information contained herein, please notify our office.

Sincerely,

ROLLINS, BROWN, AND GUNNELL, INC.

Ralph L Rollins

Ralph L. Rollins

SLS/arb

Enclosures

Program STABR -- Version 2.84 (MS-DOS)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

TWIN SHAFT SLOPE STABILITY

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 5 |
| NUMBER OF SOIL LAYER BOUNDARIES | 2 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = .00, .00

UNIT WEIGHT OF WATER = .00

SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 490.0, 85.0) WITH FINAL GRID OF 10.0

ALL CIRCLES TANGENT TO DEPTH, 700.0,

GEOMETRY

| | | | | | |
|---|---|---|---|---|---|
| SECTIONS | .0 | 150.0 | 290.0 | 367.0 | 546.0 |
| T. CRACKS | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| W IN CRACK | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| BOUNDARY 1 | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| BOUNDARY 2 | 800.0 | 800.0 | 800.0 | 800.0 | 800.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 200.0 | 33.0 | 125.0 |

PORE PRESSURE DATA

COORDINATES OF EQUI-PRESSURE LINES

| | | | | | |
|---|---|---|---|---|---|
| SECTIONS | .0 | 150.0 | 290.0 | 367.0 | 546.0 |
| LINE 1 | 800.0 | 800.0 | 800.0 | 800.0 | 800.0 |

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

TWIN SHAFT SLOPE STABILITY

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 700.0 | 615.0 | 490.0 | 85.0 | 1.608 | 1.566 |
| 2 | 700.0 | 615.0 | 470.0 | 85.0 | 1.611 | 1.561 |
| 3 | 700.0 | 635.0 | 490.0 | 65.0 | 1.606 | 1.564 |
| 4 | 700.0 | 615.0 | 510.0 | 85.0 | 1.631 | 1.596 |
| 5 | 700.0 | 595.0 | 490.0 | 105.0 | 1.612 | 1.570 |
| 6 | 700.0 | 635.0 | 480.0 | 65.0 | 1.608 | 1.562 |
| 7 | 700.0 | 645.0 | 490.0 | 55.0 | 1.606 | 1.564 |
| 8 | 700.0 | 635.0 | 500.0 | 65.0 | 1.609 | 1.571 |
| 9 | 700.0 | 625.0 | 490.0 | 75.0 | 1.607 | 1.565 |
| 10 | 700.0 | 645.0 | 480.0 | 55.0 | 1.608 | 1.563 |
| 11 | 700.0 | 655.0 | 490.0 | 45.0 | 1.606 | 1.564 |
| 12 | 700.0 | 645.0 | 500.0 | 55.0 | 1.608 | 1.569 |
| 13 | 700.0 | 655.0 | 490.0 | 45.0 | 1.609 | 1.563 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14 | 700.0 | 685.0 | 490.0 | 35.0 | 1.608 | 1.564 |
| 15 | 700.0 | 655.0 | 500.0 | 45.0 | 1.606 | 1.568 |
| 16 | 700.0 | 665.0 | 480.0 | 35.0 | 1.610 | 1.564 |
| 17 | 700.0 | 665.0 | 500.0 | 35.0 | 1.606 | 1.567 |
| 18 | 700.0 | 645.0 | 500.0 | 55.0 | 1.608 | 1.569 |
| 19 | 700.0 | 645.0 | 480.0 | 55.0 | 1.608 | 1.563 |
| 20 | 700.0 | 675.0 | 500.0 | 25.0 | 1.605 | 1.567 |
| 21 | 700.0 | 665.0 | 510.0 | 35.0 | 1.610 | 1.575 |
| 22 | 700.0 | 675.0 | 490.0 | 25.0 | 1.607 | 1.565 |
| 23 | 700.0 | 685.0 | 500.0 | 15.0 | 1.605 | 1.567 |
| 24 | 700.0 | 675.0 | 510.0 | 25.0 | 1.608 | 1.573 |
| 25 | 700.0 | 685.0 | 490.0 | 15.0 | 1.607 | 1.565 |
| 26 | 700.0 | 695.0 | 500.0 | 5.0 | 1.605 | 1.567 |
| 27 | 700.0 | 685.0 | 510.0 | 15.0 | 1.607 | 1.571 |
| 28 | 700.0 | 695.0 | 490.0 | 5.0 | 1.608 | 1.566 |
| 29 | 700.0 | 695.0 | 510.0 | 5.0 | 1.606 | 1.571 |
| 30 | 700.0 | 675.0 | 510.0 | 25.0 | 1.608 | 1.573 |
| 31 | 700.0 | 675.0 | 490.0 | 25.0 | 1.607 | 1.565 |

F.S. MINIMUM= 1.605 FOR THE CIRCLE OF CENTER ( 500.0, 15.0)

ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

RBG
RECEIVED
JUL 03 1986
DIVISION OF
OIL, GAS & MINING

May 9, 1986

Kaiser Steel Corporation
P.O. Box D
Sunnyside, UT 84539

Gentlemen:

As you have requested we have completed the stability analysis for the restored slope at the Twin Shaft Site at the Kaiser Steel Mining Facilities near Sunnyside, Utah. It is our understanding that the state and federal regulations require that each mine facility be restored as nearly as possible to its original configuration at the termination of the use of that facility. We also understand that the regulatory agencies require that each restored slope have a factor of safety of at least 1.5.

The purpose of this investigation was to determine the factor of safety of the restored slope. The drilling of a test hole at the slope location would have been expensive and would not have contributed greatly to a knowledge of the characteristics of the material at the site. A visual observation of the site indicates that the material within the slope is predominantly granular type soils. A photograph depicting the characteristics of the slope in the vicinity of the Twin Shaft Site is shown in Figure No. 1 . The results of the particle size distribution analysis performed on the representative sample obtained from the cut slope are presented in Figure No. 2. It will be observed from Figure No. 2 that approximately 62 percent of the sample consists of sand and gravel size particles while the remainder of the sample is predominantly silty type soils. A profile showing the existing cut slope of the site is presented in Figure No. 3, along with the proposed reclaimed profile.

A stability analysis was performed for this site using the shear strength parameter shown in Figure No. 3. It will be observed that a factor of safety of 1.6 was obtained for the restored slope. The stability was performed using the computer

program developed at the University of California, Berkeley. The program follows Spencer's Method which satisfies both force and equilibrium. It is our opinion that the shear strength parameters used for this analysis are reasonable and that the restored slope will have an adequate factor of safety.

If you have any questions pertaining to the information contained herein, please notify our office.

Sincerely,

ROLLINS, BROWN, AND GUNNELL, INC.

Ralph L. Rollins

SLS/arb

Enclosures

Program STABR -- Version 2.84 (MS-DOS)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

TWIN SHAFT SLOPE STABILITY

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 5 |
| NUMBER OF SOIL LAYER BOUNDARIES | 2 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = .00, .00

UNIT WEIGHT OF WATER = .00

SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 490.0, 85.0) WITH FINAL GRID OF 10.0

ALL CIRCLES TANGENT TO DEPTH, 700.0,

GEOMETRY

| | | | | | |
|---|---|---|---|---|---|
| SECTIONS | .0 | 150.0 | 290.0 | 367.0 | 546.0 |
| T. CRACKS | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| W IN CRACK | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| BOUNDARY 1 | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| BOUNDARY 2 | 800.0 | 800.0 | 800.0 | 800.0 | 800.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 200.0 | 33.0 | 125.0 |

PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | |
|---|---|---|---|---|---|
| SECTIONS | .0 | 150.0 | 290.0 | 367.0 | 546.0 |
| LINE 1 | 800.0 | 800.0 | 800.0 | 800.0 | 800.0 |

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

TWIN SHAFT SLOPE STABILITY

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| 5 | 700.0 | 595.0 | 490.0 | 105.0 | 1.612 | 1.570 |
| 6 | 700.0 | 635.0 | 480.0 | 65.0 | 1.608 | 1.562 |
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| 12 | 700.0 | 645.0 | 500.0 | 55.0 | 1.608 | 1.569 |
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ROLLINS, BROWN AND GUNNELL, INC.
PROFESSIONAL ENGINEERS

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JUL 03 1986
DIVISION OF
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May 9, 1986

Kaiser Steel Corporation
P.O. Box D
Sunnyside, UT 84539

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If you have any questions pertaining to the information contained herein, please notify our office.

Sincerely,

ROLLINS, BROWN, AND GUNNELL, INC.

Ralph L. Rollins

Ralph L. Rollins

SLS/arb

Enclosures

Program STABR -- Version 1.04 (MS DOS)

BISHOP MODIFIED AND/OR ORDINARY METHOD OF SLICES

TWIN SHAFT SLOPE STABILITY

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 5 |
| NUMBER OF SOIL LAYER BOUNDARIES | 2 |
| NUMBER OF PORE PRESSURE LINES | 1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = .00, .00

UNIT WEIGHT OF WATER = .00

SEARCH IS BASED ON BISHOP MODIFIED METHOD

SEARCH STARTS AT CENTER ( 490.0, 85.0) WITH FINAL GRID OF 10.0

ALL CIRCLES TANGENT TO DEPTH, 700.0,

GEOMETRY

| | | | | | |
|---|---|---|---|---|---|
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| T. CRACKS | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| W IN CRACK | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| BOUNDARY 1 | 500.0 | 560.0 | 638.0 | 665.0 | 750.0 |
| BOUNDARY 2 | 800.0 | 800.0 | 800.0 | 800.0 | 800.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 200.0 | 33.0 | 125.0 |

PORE PRESSURE DATA
COORDINATES OF EQUI-PRESSURE LINES

| | | | | | |
|---|---|---|---|---|---|
| SECTIONS | .0 | 150.0 | 290.0 | 367.0 | 546.0 |
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TWIN SHAFT SLOPE STABILITY

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| 8 | 700.0 | 635.0 | 500.0 | 65.0 | 1.609 | 1.571 |
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| 11 | 700.0 | 655.0 | 490.0 | 45.0 | 1.606 | 1.564 |
| 12 | 700.0 | 645.0 | 500.0 | 55.0 | 1.608 | 1.569 |
| [illegible] | [illegible] | [illegible] | 490.0 | 45.0 | 1.609 | 1.563 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 15 | 700.0 | 655.0 | 500.0 | 45.0 | 1.606 | 1.568 |
| 16 | 700.0 | 665.0 | 480.0 | 35.0 | 1.610 | 1.564 |
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F.S. MINIMUM= 1.605 FOR THE CIRCLE OF CENTER ( 500.0, 15.0)