

**DEERE & AULT**  
**CONSULTANTS, INC.**

April 19, 2007

Mr. Ken Lambrecht  
Hall-Irwin Construction  
301 Centennial Drive  
Milliken, Colorado 80543

**Re: Slope Stability Analysis for the Heit Pit Slurry Wall; D&A Job No. CG-0134.017.00**

Dear Mr. Lambrecht:

This letter summarizes Deere & Ault's (D&A) slope stability analysis of the Heit Pit slurry wall located in Weld County, Colorado. The Heit Pit slurry wall, once constructed, will have a length of approximately 6,700 linear feet and an area of approximately 229,700 square feet. The slope stability analysis utilizes setback information determined during the permitting process to analyze the slopes for stability during mining and reclamation.

Hall-Irwin supplied D&A with copies of Division of Mining and Geology (DMG) permitting information prepared in August of 2003 by Banks and Gesso, LLC. The drawing entitled, "Technical Revision 1 to: Exhibit C-3: Mining Plan Map," dated August 6, 2003 depicts the typical setback from the highwall to the slurry wall as 30 feet, and the minimum setback of the mine highwall from the Lupton Bottom Ditch and irrigation ditch serving the property as 40 feet. We utilized this information in Models 1 and 2 of our analyses. We also evaluated alternative cross-sections in an effort to maximize slope stability and water storage capacity. The slope configuration developed and presented in this letter was a 12-foot setback between the slurry wall and top edge of the gravel mine and a mine slope of 3:1 (horizontal to vertical). The setback from the top of the mine slope and the adjacent ditch, fence, or property line was maintained at 40 feet or greater. In addition, the setback from the slurry wall to the Lupton Bottom Ditch's west top of bank was set at 45 feet.

### **ANALYSIS**

#### **Maximum Highwall Slope near Slurry Wall Station 11+00**

For the maximum highwall, with the depth to bedrock reaching up to 45, the analysis shows that the mine highwall slope of 0.5:1 (horizontal to vertical) modeled using the DMG permit alignment may be stable, but fails to meet the minimum factor of safety of 1.2 for structures 40-foot or beyond the mining limits during construction as shown in Model 1. The model indicates that the highwall is unstable for the slurry wall (factor of safety < 1.0) offset of 30 feet and could possibly be damaged during mining as shown in Model 2. Mining the highwall to a 3:1 slope as shown in Model 3, appears to be stable with a setback as small as 12 feet from the highwall to the slurry wall and would meet the final reclamation slope at the end of mining.

**Average Highwall Slope near Slurry Wall Station 41+00**

Subsurface bore hole information obtained by Tetra Tech RMC in February 2005 revealed the thick clay lens shown in the cross-section near slurry wall station 41+00. D&A analyzed this configuration as the worst case analysis for the average highwall configuration of Heit Pit. The average highwall height for the Heit Pit is approximately 25 plus or minus 3 feet. The analysis shows that the slopes modeled using the DMG permitting cross-section meet the minimum factor of safety for structures outside of the 40-foot setback, as well as the slurry wall set 30 feet back from the highwall (Models 4 and 5). Mining the highwall to a 3:1 slope as shown in Model 6, appears to be stable with a setback as small as 12 feet from the highwall to the slurry wall. The 3:1 highwall could be left in place eliminating the need for construction of reclamation slope at the end of mining.

**RESULTS**

Several highwall model configurations were analyzed for slope stability using the computer software Slope W. A summary of the results of our analysis is shown on the below:

| <i>Model</i> | <i>Station</i>                | <i>Condition Analyzed</i>  | <i>Calculated<br/>Factor of<br/>Safety</i> | <i>Minimum Factor<br/>of Safety</i> |
|--------------|-------------------------------|--|--|-------------------------------------|
| 1            | Station 11+00 Max<br>Highwall | 30 Foot Offset to Slurry Wall<br>0.5:1 Highwall Slope (Banks and Gesso)<br>Factor of Safety at Ditch       | 1.1  | 1.2                                 |
| 2            | Station 11+00 Max<br>Highwall | 30 Foot Offset to Slurry Wall<br>0.5:1 Highwall Slope (Banks and Gesso)<br>Factor of Safety at Slurry Wall | 0.9  | 1.2                                 |
| 3            | Station 11+00 Max<br>Highwall | 12 Foot Offset to Slurry Wall<br>3:1 Highwall Slope<br>Factor of Safety at Slurry Wall                     | 2.5  | 1.2 Construction<br>1.5 Long Term   |
| 4            | Station 41+00 Min<br>Highwall | 30 Foot Offset to Slurry Wall<br>0.5:1 Highwall Slope (Banks and Gesso)<br>Factor of Safety at Ditch       | 1.6  | 1.2                                 |
| 5            | Station 41+00 Min<br>Highwall | 30 Foot Offset to Slurry Wall<br>0.5:1 Highwall Slope (Banks and Gesso)<br>Factor of Safety at Slurry Wall | 1.3  | 1.2                                 |
| 6            | Station 41+00 Min<br>Highwall | 12 Foot Offset to Slurry Wall<br>3:1 Highwall Slope<br>Factor of Safety at Slurry Wall                     | 2.6  | 1.2 Construction<br>1.5 Long Term   |

Printouts of each slope stability model run are attached for your reference.

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### RECOMMENDATIONS

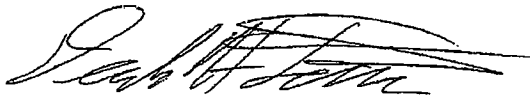
The slurry wall alignment as currently designed and staked in the field has a 45-foot setback from the Lupton Bottom Ditch and a 12-foot setback from the slurry wall to the mine highwall. Our analysis indicates that this configuration should provide an adequate factor of safety for the slurry wall during mining and during reservoir operation if the mine highwall is excavated to a 3:1 or flatter slope. This excavated slope can then be left as is for the final reclamation.

The slurry wall setbacks vary from 50 feet off the proposed Duke Energy gas line along the north side of the site to 30 feet off the property/fence line on the west and south sides of the site. Our analysis indicates that these slurry wall setbacks and a mine slope of 3:1 or flatter starting at least 12 feet from the slurry wall should provide an adequate factor of safety for the slurry wall and adjacent structures during mining and long-term reservoir operations.

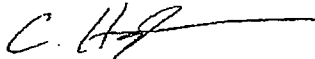
When you have had an opportunity to review this report, please call with your comments and questions. Adjustments can be made in the proposed alignment if appropriate and/or additional analyses can be completed.

Sincerely,

DEERE & AULT CONSULTANTS, INC.



Derek H. Foster, P.E.  
Project Engineer



Colby J. Hayden, P.E.  
Principal, Project Manager

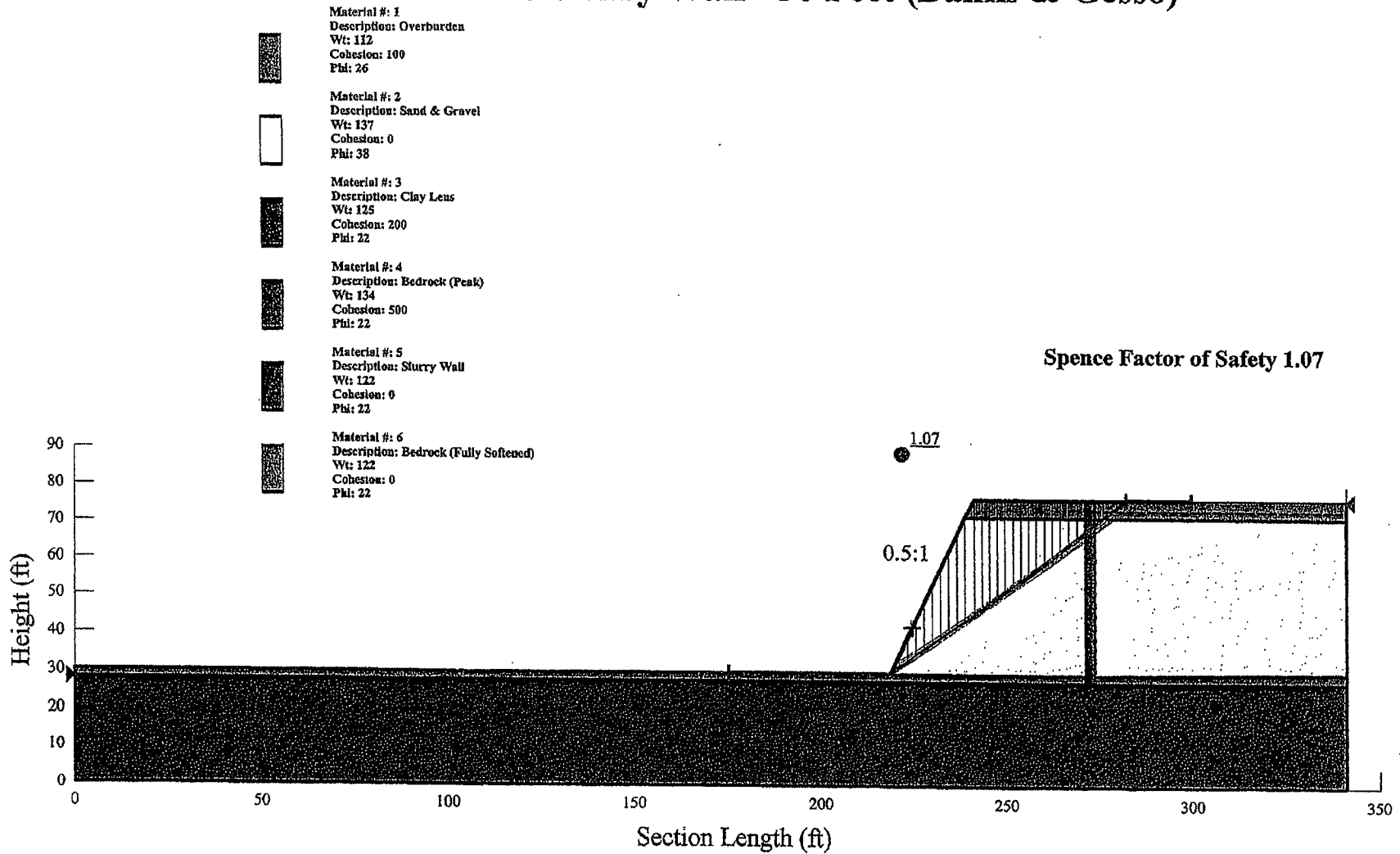
DHF:sp

Attachments

# Model 1

## Heit Pit Slurry Wall

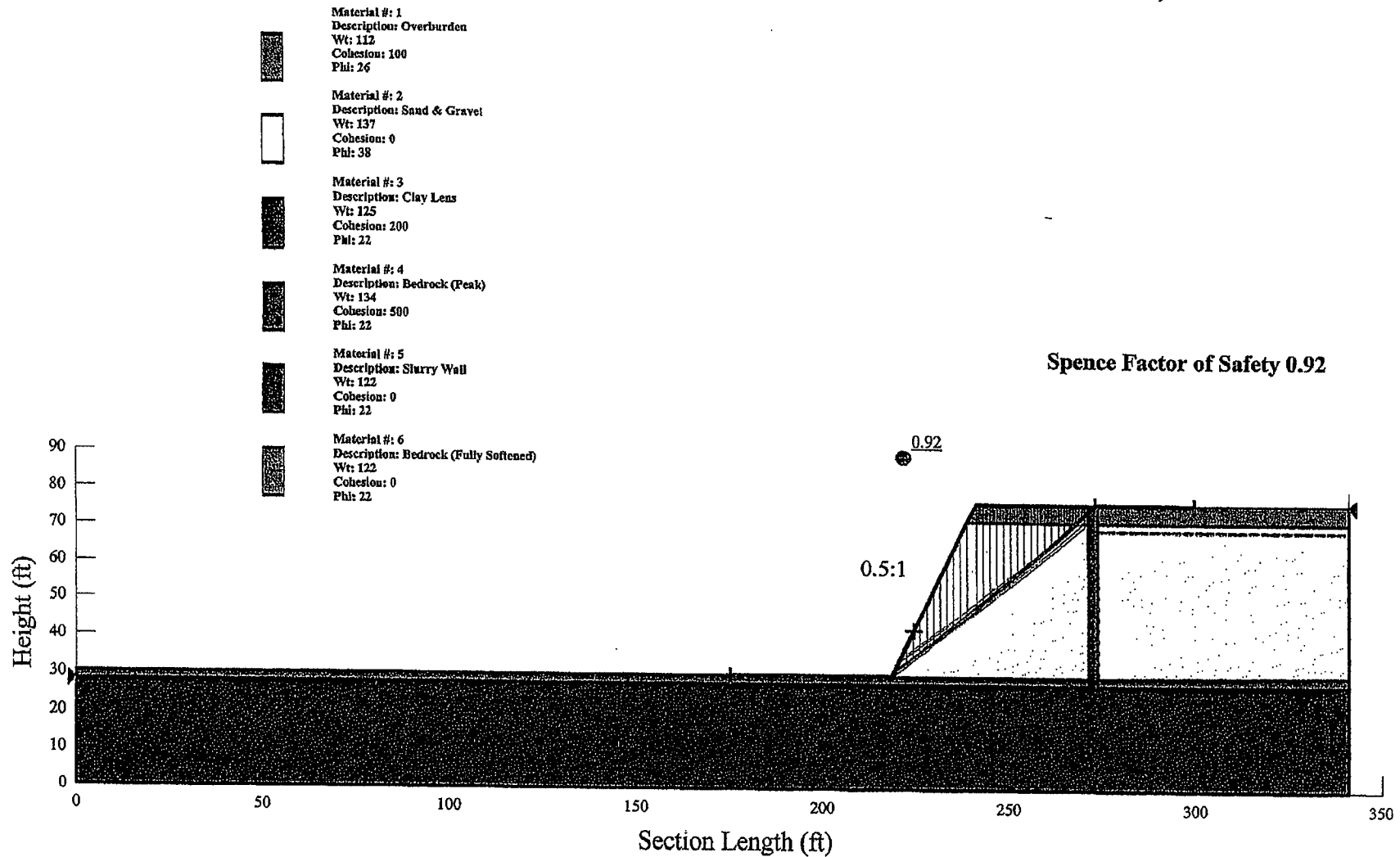
### Station 11+00 Offset to Slurry Wall - 30 Feet (Banks & Gesso)



## Model 2

### Heit Pit Slurry Wall

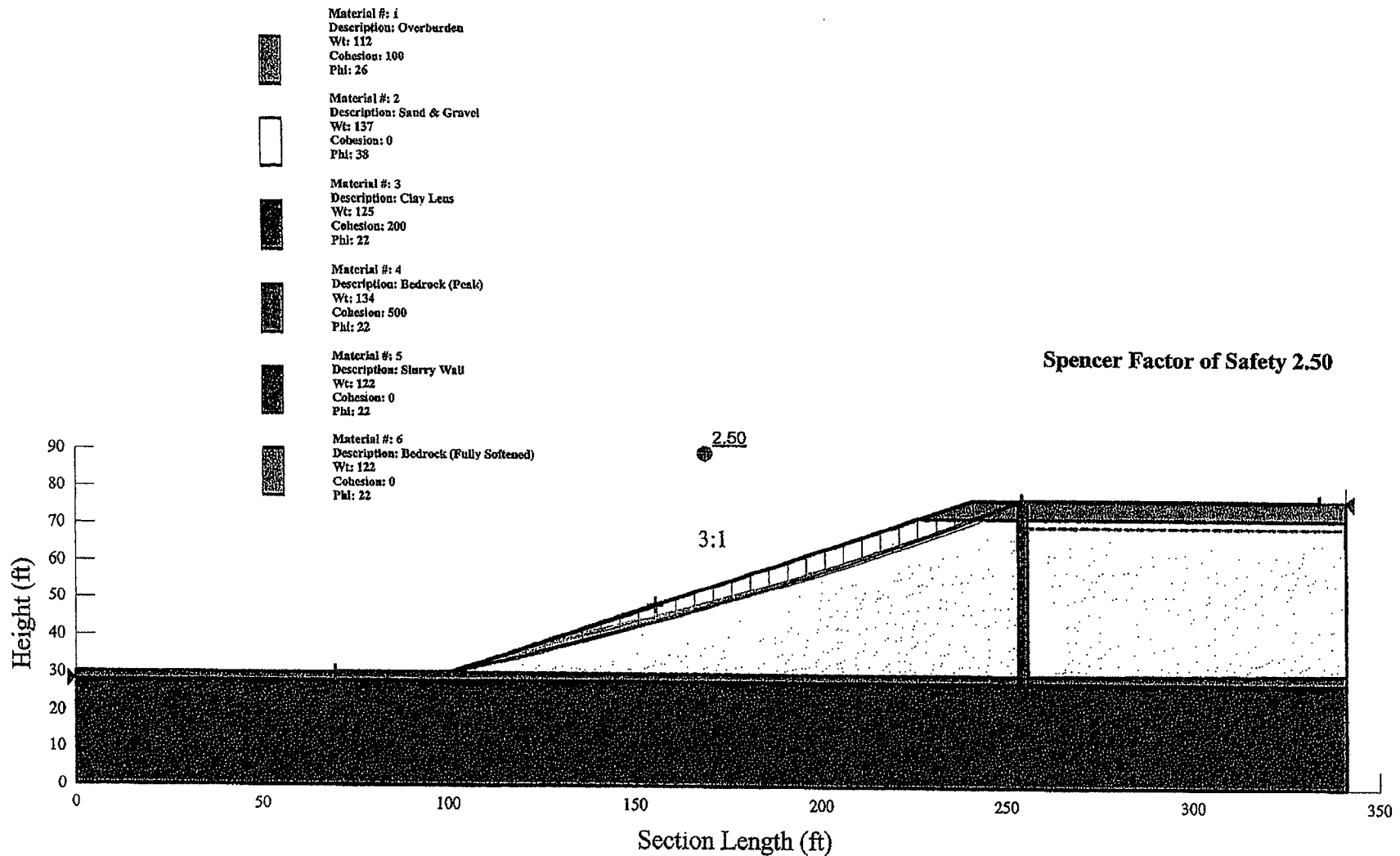
### Station 11+00 Offset to Slurry Wall - 30 Feet (Banks & Gesso)



## Model 3

### Heit Pit Slurry Wall

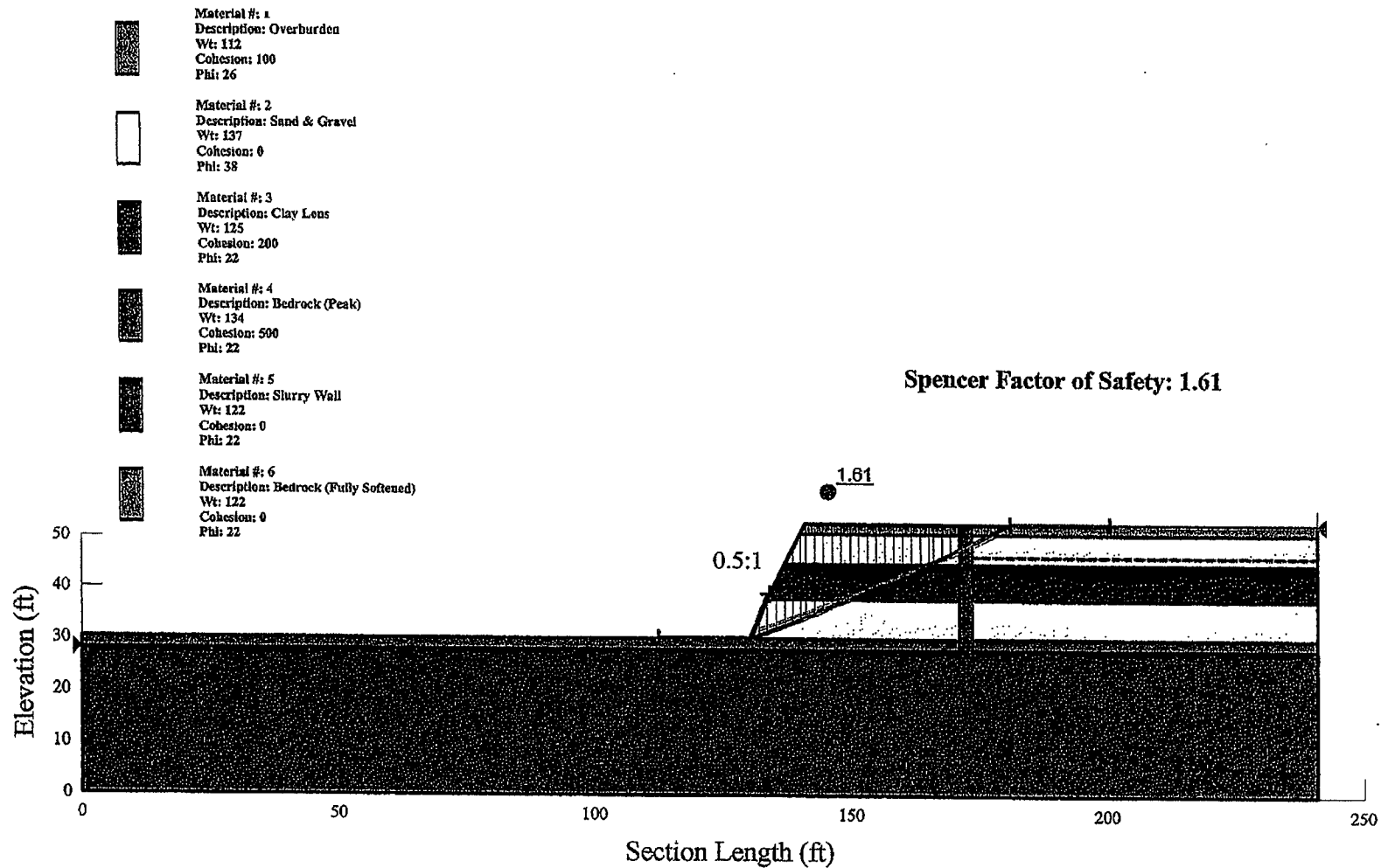
### Station 11+00 Offset to Slurry Wall - 12 Feet 3:1



## Model 4

### Heit Pit Slurry Wall

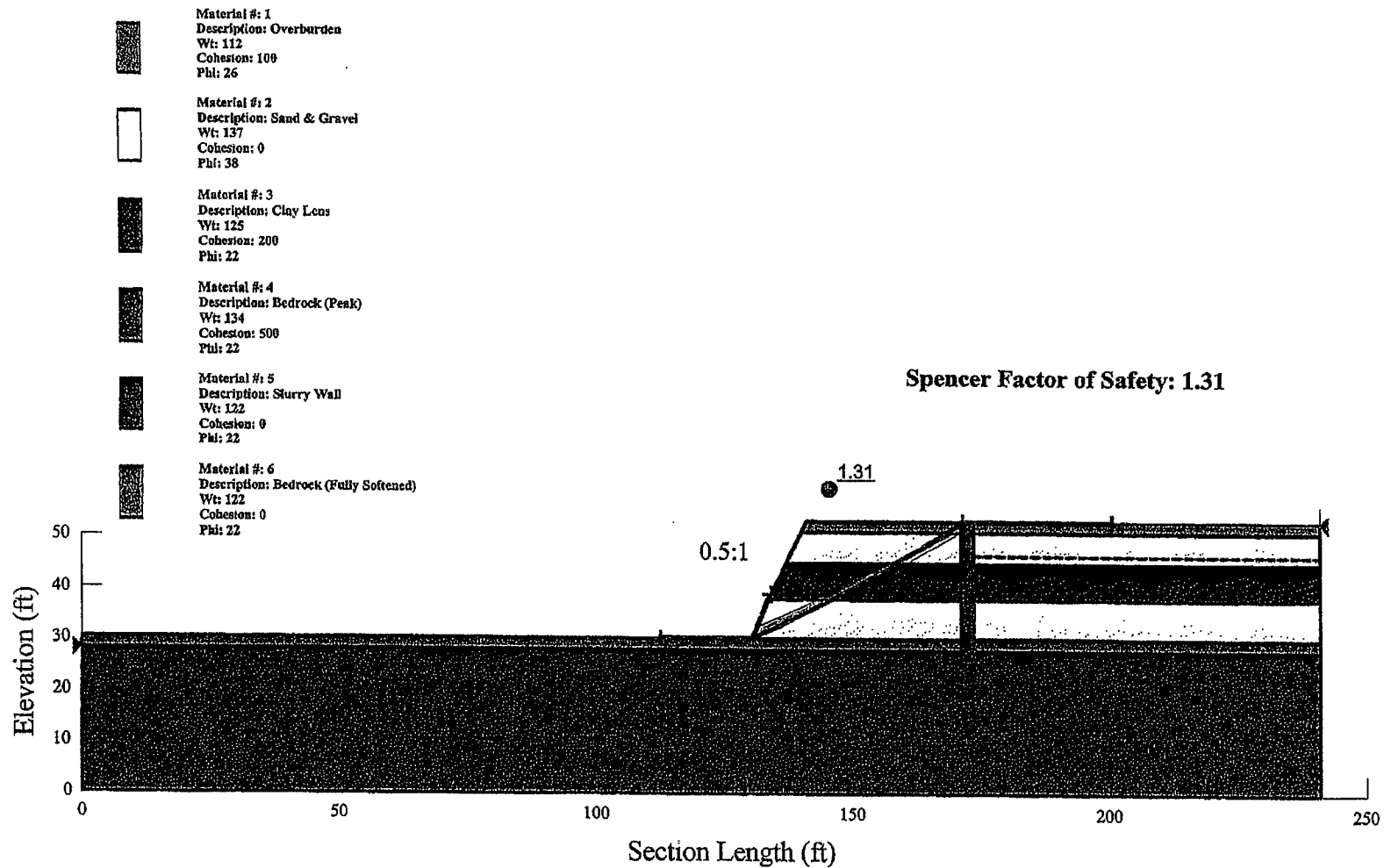
### Station 41+00 Offset to Slurry Wall - 30 Feet (Banks & Gesso)



## Model 5

### Heit Pit Slurry Wall

### Station 41+00 Offset to Slurry Wall - 30 Feet (Banks & Gesso)





## Model 6

### Heit Pit Slurry Wall

### Station 41+00 Offset to Slurry Wall - 12 Feet 3:1

