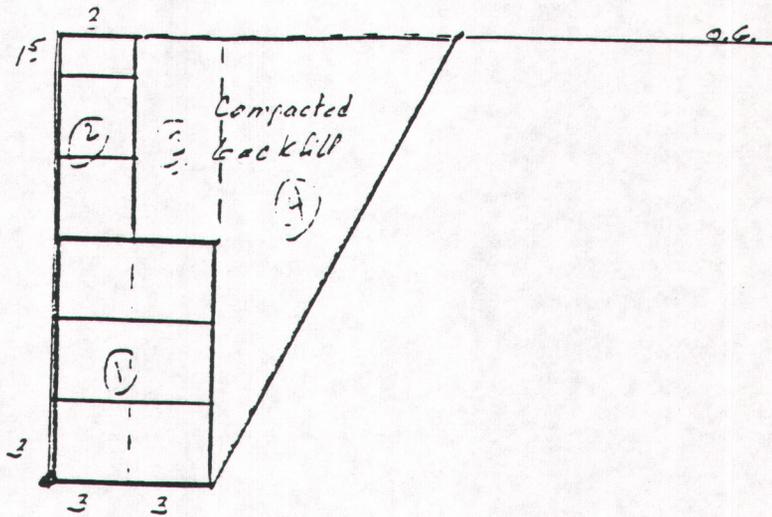


**Appendix 5-17**

**Road Expansion (within permit area)**

**Safety Factor, Drawings**



Given:

Wire baskets

$\gamma = 112 \text{ lb/ft}^3$

Section ①	$l = 6'$	$x = 0$	Slope 1 (Square)
	$h = 9'$	$y = 0$	
Section ②	$l = 3'$	$x = 0$	Slope 1
	$h = 7.5'$	$y = 9$	

Compacted Backfill

$\gamma = 137 \text{ lb/ft}^3$  Gr material  $\phi = 34^\circ$   
 $\tan \phi = .67$

Section ③	$l = 3$	$x = 3$	Slope 1
	$h = 7.5$	$y = 9$	
Section ④	$l = 9$	$x = 6$	Slope 2 (Triangle)
	$h = 16.5$	$y = 0$	

Estimation:  $1/6 = 9.5^\circ$   
 friction factor = 0.67 ( $\tan \phi$ )  
 Top of wire = 16.5 ft  
 Pressure @ Top = 0  
 Pressure @ Bottom =

$p = \gamma z \tan^2 (45 - 1/2 \phi)$   
 $p = 137 z (.28)$   
 $p = 38.7 z$   
 when  $z = 16.5$   $p = \underline{\underline{640}}$

Limit condition = 5.2  
 Safety = 9.3



#### 4.0 HAUL ROAD DESIGN

In accordance with recommendations by Genwal, the haul road was designed as a flexible pavement structure with a 5-year design life. The AASHTO Interim Guide for the Design of Pavement Structures (1972) was used as the design procedure.

The following assumptions were made for the flexible pavement design:

1. The serviceability index of the road is 2.0 (recommended value for highways with low traffic volumes). The serviceability index of a pavement is defined as the lowest index that will be tolerated before resurfacing or reconstruction becomes necessary. The factors used to calculate the serviceability index include the slope variance along the wheel path, the depth of the wheel path rut, the area of asphalt which has cracked, and the area of asphalt which has been patched (Oglesby and Hicks, 1982). In comparison, a serviceability index of 2.5 is used for the interstate system where high velocity and high volume traffic is expected.
2. The native soil classifies as a good subgrade material and has a minimum California Bearing Ratio of 10% of standard at 0.1-inch penetration.
3. The empty weight of the tractor/trailer vehicles is 38,940 lbs and the loaded weight is 129,000 lbs. Therefore, the payload is 90,060 lbs. The axle loadings are as presented in Appendix D (from Genwal).
4. 1,000,000 tons of coal are hauled from the mine annually (Genwal). Therefore, with a payload of 90,060 lbs, 22,207 empty and loaded rigs will drive the road annually (85 trucks daily).
5. Load contributions through passenger cars and light trucks are negligible.

The haul road design procedures and calculations are presented in Appendix B. From these calculations, recommended combinations of pavement and road base thicknesses for various Marshall Stability values are presented in Table 4-1.

TABLE 4-1

Recommended Pavement Thicknesses for Various Marshall Stability Values

Marshall Stability Value of Pavement (lbs) <sup>(a)</sup>	Recommended Pavement Thickness (inches)	Recommended Road Base Thickness (Total) (inches)
1200	6.5	8.0
1500	6.0	7.0
1800	5.5	7.0
2100	5.0	7.0
2400	4.5	8.0

(a) Minimum Marshall Stability Value which can be consistently produced by the asphalt plant.

The Marshall Stability is a laboratory test conducted on the asphalt to determine the flexural strength. Marshall stability values generally range between 1000 pounds for parking lots to more than 2500 pounds for good interstate pavements. Selection of the design Marshall Stability should be based on the minimum value which can be consistently achieved by the asphalt producer. The road should be constructed of plant mix asphalt rather than road mix to achieve a higher Marshall Stability and, consequently, a lesser pavement thickness.

According to Table 4-1, 7 to 8 inches of road base (total) are required to preclude failure of the subgrade soil. According to Genwal, approximately 8 inches of road base have currently been placed along the haul road and compacted with repeated passes of haul trucks. Therefore, additional road base is not required for structural purposes. Additional road base should be placed and compacted, however, to even the roadbed prior to placing the asphaltic surface.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

This report represents an expression of opinions and recommendations based on field observations, laboratory analyses, and professional judgement. It is recommended that a geotechnical or geological engineer be on site during construction of the haul road to allow adequate field decisions to be made regarding local conditions.

In accordance with recommendations by Genwal, the haul road was designed as a flexible pavement structure with a 5-year design life. The AASHTO Interim Guide for the Design of Pavement Structures (1972) was used as the design procedure. Actual conditions which significantly deviate from the assumptions listed in Section 4.0 may render the design inadequate and in need of revision.

Recommended combinations of pavement and road base thicknesses for various Marshall Stability values were provided in Table 4-1. The road should be constructed of plant mix asphalt rather than road mix. Selection of the Marshall Stability value should be based on the minimum value which the asphalt plant can consistently produce. The pavement should be placed and compacted in accordance with standard construction practices.

For structural purposes, it is not necessary to place additional road base along the haul road if the nominal thickness of the existing road base is approximately 8 inches. However, it may be necessary to place additional road base to even the roadbed prior to placing the asphaltic surface.

Road base material should have a minimum CBR value of 48% of standard at 0.1-inch penetration and should conform to the AASHTO A-1 soil requirements. Road base should be compacted to a minimum of 96% of the modified Proctor density (132.8 pcf at 6.9% moisture from Table 3-1). All materials larger than 2 inches in diameter should be removed from the base course material to promote more

Genwal Coal Company  
Crandall Canyon Mine

Flexible Pavement Haul Road Design  
November 9, 1990

effective compaction and to avoid stress concentrations which can cause local shear failure of the asphaltic pavement.

## 6.0 REFERENCES

- AASHTO. 1972. Interim Guide for Design of Pavement Structures. NCHRP Report 128.
- Davis and Doelling. 1977. Coal Drilling at Trail Mountain, North Horn Mountain, and Johns Peak Areas, Wasatch Plateau. Utah Geological and Mineral Survey Bulletin 112. Salt Lake City, Utah.
- EarthFax Engineering, Inc. 1990. Storage Pad Slope Stability Analysis at the Crandall Canyon Mine, Emery County, Utah. Project report prepared for Genwal Coal Company, Huntington, Utah.
- Oglesby, C.H., and R.G. Hicks. 1982. Highway Engineering. John Wiley & Sons, New York, New York.
- Utah Department of Transportation. 1979. State of Utah Standard Specifications for Road and Bridge Construction. Utah Department of Transportation, Salt Lake City, Utah.