SACRAMENTO MTS
• **US82** Connects the Town of Alamogordo, Holloman Air Force Base, and White Sands Missile Range with the Village of Cloudcroft and A Major Route US285 to the East.

• The Mountain Range is Over 10,000 ft. High and Subjected to Snowfall and Freeze in the Winter.
• The Road Was Built In the Early Fifties.

• Rockfall Catchment Is Non-Existing or Very Narrow.

• This Terrain is Rocky and Very Costly to Blast or Excavate.

• Road Cuts Were Mostly Made in Unfavorably Orientation with Respect to Dip Angles.
GEOLOGY

• The Sacramento Mountains Range is Located in the Basin and Range Province of Southern New Mexico. It is Primarily an Uplift of Large Faulted Blocks of Anticlines and Synclines.

• It Comprises Quaternary Alluvial/Pediment thin Deposits That overlies Very Massive and Mostly competent Paleozoic Sedimentary Rocks of Limestone, sandstone and Shale.
Geologic Map of US82 Rock Mitigation Project

San Andres Limestone

Yeso Fm
EXISTING CONDITIONS

• The Project Includes Four Road Cuts Extend From MP 14.2 to MP 15.2.
• Gabion Wall and Concrete Barriers were Place Some Thirty Years Ago As Fallen Rocks Catchment.
• Gabions Were Placed on Top of Standard Concrete Barriers.
• Over time, Rocks filled the Space Behind the Barriers and the Walls and Spilled Over Into the Narrow Shoulder and the Driving Lanes.
• The Concrete Barriers Started to Deteriorate and Chip off which will Later Undermine the Gabion Stack.
GEOTECHNICAL INVESTIGATION

- These Cuts Were Rated “A” and “B” Using Oregon Rockfall Rating System.

- Rockfall Analysis Using Colorado Rockfall Simulation Program (CRSP) Was done.

- The Analysis Showed That Rocks Pass the Catchment Walls Into the Roadway.

- A 1’ to 5’ Thick Layer of Severely Fractured and Closely Jointed San Andres Limestone Overlies Variegated and Very Erodible Yeso Shale and weak Sandstone.
Cut # 1 Description

- Rock fall priority rating: B
- Length: 121 feet.
- Average height: 66 feet.
- Rock formation: Yeso limestone, sandstone and shale.
- Average slope cut angle: 60-90 Deg.
- Rock competency: incompetent, closely jointed and fractured.
- Proposed mitigation method: new gabion wall.
- Detour: available.
- The unfavorable characteristics of this cut are: lack of good catchment ditch and Large difference in erosion rates.
Cut # 2 Description

- Rock fall priority rating: A
- Length: 298 feet.
- Average height: 82 feet.
- Rock formation: Yeso limestone, sandstone and shale.
- Average slope angle: 40-60 Deg.
- Rock competency: incompetent, Loose, closely jointed and fractured.
- Proposed mitigation method: gabion replacement.
- Detour: available.
- The unfavorable characteristics of this cut are: lack of good catchment ditch and Large difference in erosion rates.
Cut # 3 Description

- Rock fall priority rating: A
- Length: 446 feet
- Average height: 26 feet
- Rock formation: San Andres Limestone and Yeso S.S and Shale
- Average slope angle: 45-60 Deg.
- Rock competency: Incompetent, fractured, Loose and closely jointed.
- Proposed mitigation method: Concrete barriers.
- Detour: available.
- The unfavorable characteristics of this cut are: lack of good catchment ditch and different erosion rates.
Cut 4 Description

- Rock fall priority rating: A
- Length: 440 feet
- Average height: 60 feet
- Rock formation: San Andres limestone and Yeso shale.
- Average slope angle: 20-80 Deg.
- Rock competency: incompetent, closely jointed and fractured.
- Proposed mitigation method: place new gabion.
- Detour: available.
- The unfavorable characteristics of this cut are: Lack of good catchment ditch and large difference in erosion rates.
MITIGATION

• Aggressive Scaling and lay Slope Back Slightly as Much as the R.O.W Allows.

• New Gabion Walls Were Built In Three Locations and Concrete Barriers Placed In front of the Gabion Wall at about 2 Feet Spacing as Protection For the baskets and possibly as a Second Catchment.

• Replacing the Old Concrete Barrier With A New One in One Location.

• The Wire Mesh Baskets Were Selected to the State Standards. Double Twisted of 1.75mm Diameter Galvanized Steel Wire With A Diamond Shape Openings 2.5”x1.5”.

• Cubic Basket 3’x3’x3’.
CONSTRUCTION

• The Cuts Were Scaled.

• The Ground Was Prepared For the Foundation by Excavating 3 feet Below Grade and Placing One foot Thick Granular Soil.

• Soil Was Compacted to 95% of Optimum Moisture Content of 10%.

• The Ground Surface For the Foundation Was Finished at 6 Degrees Slope Towards the Face of the Cut.

• The First Row of Baskets Placed 2 Feet Below Ground Surface and Stacked with an Offset of ½ Basket Width with Respect to the One Below. The Stepped Side Is facing The Cut.

• The Embedment and the Tilt Were Intended to Resist the Sliding and the Overturning Forces Against the Wall.

• Rocks Were Hand-Placed in the Baskets.
GENERAL NOTES

1. Internal connecting wires are to be of sufficient length to span the length, width, and height of each gabion.
2. Internal connecting wires, lacing wires and gabion mesh shall be galvanized.
3. Internal connecting wires are secured by all gabions 30° to 60°. Loops or loops 2½ in 4 in. when used.
4. Preformed splices (if cage or 9 gage) are an acceptable alternative to internal connecting wires. Splices shall be directed by the project manager at 1 in. points.
5. Place mesh on the end gabion cell first, and continue by placing adjacent gabin cell.
6. For gabion openings refer to the Table "Standard Gabion Sizes".
7. A joint connection must be made where any panel edge meets another panel. This includes adjacent gabion baskets, individual panels within a gabin, or mixed panels. All joint connections shall be made using standard tie wires.

ALTERNATE JOINT CONNECTION PROCEDURES MAY BE USED PROVIDED THE ALLOWABLE STRESS OF THE MATERIAL IS NOT EXCEEDED. A FLEXIBLE STRESS RELIEF TIE WIRE IN A JOINT IS RECOMMENDED. JOINT CONNECTION PROCEDURES ARE USED. NO CONSTRUCTION SHALL SUBMIT TO THE PROJECT MANAGER WITHOUT FIRST RECEIVING SURVEY. THE ALTERNATE JOINT CONNECTIONS WILL MEET THE MINIMUM STRESS RELIEF REQUIREMENTS.

DETAILS OF 9 GAGE INTERNAL CONNECTING WIRES

<table>
<thead>
<tr>
<th>STANDARD 9 GAGE INTERNAL CONNECTING WIRES</th>
</tr>
</thead>
<tbody>
<tr>
<td>LENGTH FT</td>
</tr>
<tr>
<td>8-3/4</td>
</tr>
<tr>
<td>10-3/4</td>
</tr>
<tr>
<td>12-3/4</td>
</tr>
</tbody>
</table>

Typical Flat Layout of Gabion Basket

Typical Assembled Gabion Basket

NEW MEXICO STATE HIGHWAY & TRANSPORTATION DEPARTMENT

GABION
BASKET DETAILS
Rock Fall Simulation of US 82 MP 14.2

Before
5’ High gabion wall will stop 90% of fallen rocks.

After
Rock Fall Simulation of US 82 MP 14.4

Before
5’ high gabion wall will stop 90% of falling rocks.

After
Rock Fall Simulation of US 82 MP 15.2

Before
3’ High gabion wall stops 93% of fallen rocks.

# 4 After
Would this wall work?