



**Hansen and Associates, Inc.**  
Consulting Engineers & Land Surveyors

April 19, 2012

**Michael Tuttle**  
Weber Center  
2380 Washington Blvd., Suite 240  
Ogden, UT 84401

**Subject: The Sanctuary – Retaining Walls Analysis**

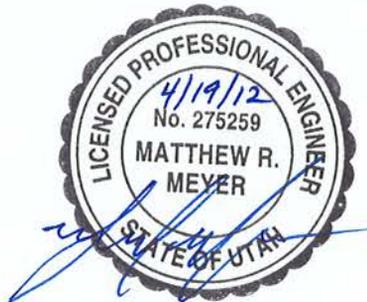
Dear Mr. Tuttle,

Earthtec Engineering, Inc. and Hansen and Associates have analyzed the stability of the retaining walls at the main entrance to The Sanctuary development. A copy of the project drawings and Earthtec's global stability analysis are included. Earthtec concluded the walls, as constructed, are stable. The project drawings show the addition of planters in areas where the walls exceeds the maximum recommended height. With the construction of these planters, it is our opinion that the walls will be in compliance with manufacturer's installation requirements.

Respectfully;  
Hansen and Associates, Inc.

A handwritten signature in blue ink, appearing to read 'Matthew Meyer', is written over the typed name.

Matthew Meyer, PE  
Job No. 07-129





## **Earthtec Engineering, Inc.**

133 North 1330 West  
Orem, Utah - 84057  
Phone (801) 225-5711  
Fax (801) 225-3363

1596 W. 2650 S. #108  
Ogden, Utah - 84401  
Phone (801) 399-9516  
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April 3, 2012

Tim Charlwood  
PO Box 980400  
Park City, UT 84098

**Re: Global Stability Analysis  
The Sanctuary  
Huntsville, Utah  
Project No. 12-0086G**

Mr. Charlwood:

As you requested, we have completed our global stability analysis for the existing Redi-Rock walls for the subject site. Our scope of work included review of drawings provided by Hansen Associates, engineering analyses, and the preparation of this report.

### **Plan Review and Information Gathering**

Based on our review of the drawings provided by Hansen and Associates, the existing Redi-Rock walls at the entrance to the Sanctuary Subdivision consist of a single tier about 9 to 12 feet high with a batter angle of 4 degrees. The walls retain an approximately 30% to 45% slope up to approximately 1000 feet high. The walls are embedded a minimum of 12 inches into the soils, and we understand that some areas are planned to receive rock facing or planter boxes in front of the walls approximately 2 to 3 feet high. A water storage tank is located above the wall at approximately Station 25+65.

A geotechnical report<sup>1</sup> was previously prepared for the subdivision by Earthtec Testing and Engineering, P.C., dated August 23, 2007. This report was reviewed as part of our analysis. Based on the referenced report, the soils retained by the walls consist of silt with sand (ML). A direct shear test was performed on this material as part of the referenced study.

### **Stability Analyses**

Our engineering analyses focused on evaluating the global stability of the existing Redi-Rock walls. Based on tests performed by the Earthtec Testing and Engineering, P.C. contained within the referenced geotechnical study, the silt with sand has an internal friction angle of 33 degrees and a cohesion value of 205 psf. Accordingly, we estimated the following parameters for use in the stability analyses:

<sup>1</sup> "Geotechnical Study, Golden Eagle Ranch, Huntsville, Utah," ETE Job No. 07-1950, August 23, 2007.

Material	Internal Friction Angle (degrees)	Apparent Cohesion (psf)	Saturated Unit Weight (pcf)
On-Site Silt with Sand	33	205	136
Redi-Rock Blocks	0 (or 45)	9000 (or 0)	150

For the seismic (pseudostatic) analysis, a peak horizontal ground acceleration of 0.33g for the 2% probability of exceedance in 50 years was obtained for site (grid) locations of 41.284 degrees north latitude and -111.723 degrees west longitude. To model sustained accelerations at the site, one-third to one-half of this value is typically employed. Accordingly, a value of 0.18g was used as the pseudostatic coefficient for the stability analysis.

We evaluated the global stability of the wall using the computer program *XSTABL*. This program uses a limit equilibrium (Bishop's modified) method for calculating factors of safety against sliding on an assumed failure surface and evaluates numerous potential failure surfaces, with the most critical failure surface identified as the one yielding the lowest factor of safety of those evaluated. The wall configuration and topography at Station 25+65 was utilized for our analysis, including a 1000 psf load for the water storage tank. The configuration analyzed consisted of a 10 foot tall Redi-Rock wall retaining a 30% to 45% slope extending 1000 feet above the wall. Typically, the required global minimum factors of safety are 1.5 for static conditions and 1.1 for seismic (pseudostatic) conditions. The results of our analyses indicate that the existing Redi-Rock wall meets these requirements. The slope stability data is attached as Figures 1 and 2.

### Conclusions and Recommendations

Based on the results of our analyses, the Redi-Rock walls at this site are globally stable as configured. Note that wall movements or even failure can occur if the walls are undermined or the backfill soils become saturated. Therefore, we recommend that irrigation lines not be placed within the backfill or directly on top of the wall. Surface drainage at the bottom and top of the walls should also be directed away from the wall. The property owner and the owner's representatives should be made aware of the risks should these or other conditions occur that could saturate or erode/undermine the soil behind the wall.

### Closure

The conclusions and recommendations presented in this report are based on the information provided, our experience with similar conditions, and assumptions made by Earthtec Testing and Engineering, P.C. at the time of the referenced geotechnical study, which we assume to be accurate and correct. If conditions are different during construction than presented herein, please advise us so that any appropriate modifications can be made. Our observations, analyses, conclusions and recommendations were conducted within the limits prescribed by our client, with the usual thoroughness and competence of the engineering profession in the area. No other warranty or representation, either expressed or implied, is intended in our proposals, contracts or reports.

Global Stability Analysis  
The Sanctuary  
Huntsville, Utah  
Project No. 12-0086G

Page 3

We appreciate the opportunity of providing our services on this project. If we can answer questions or be of further service, please call.

Respectfully;  
**EARTHTEC ENGINEERING, INC.**



Andrew M. Harris, P.E.  
Engineering Manager

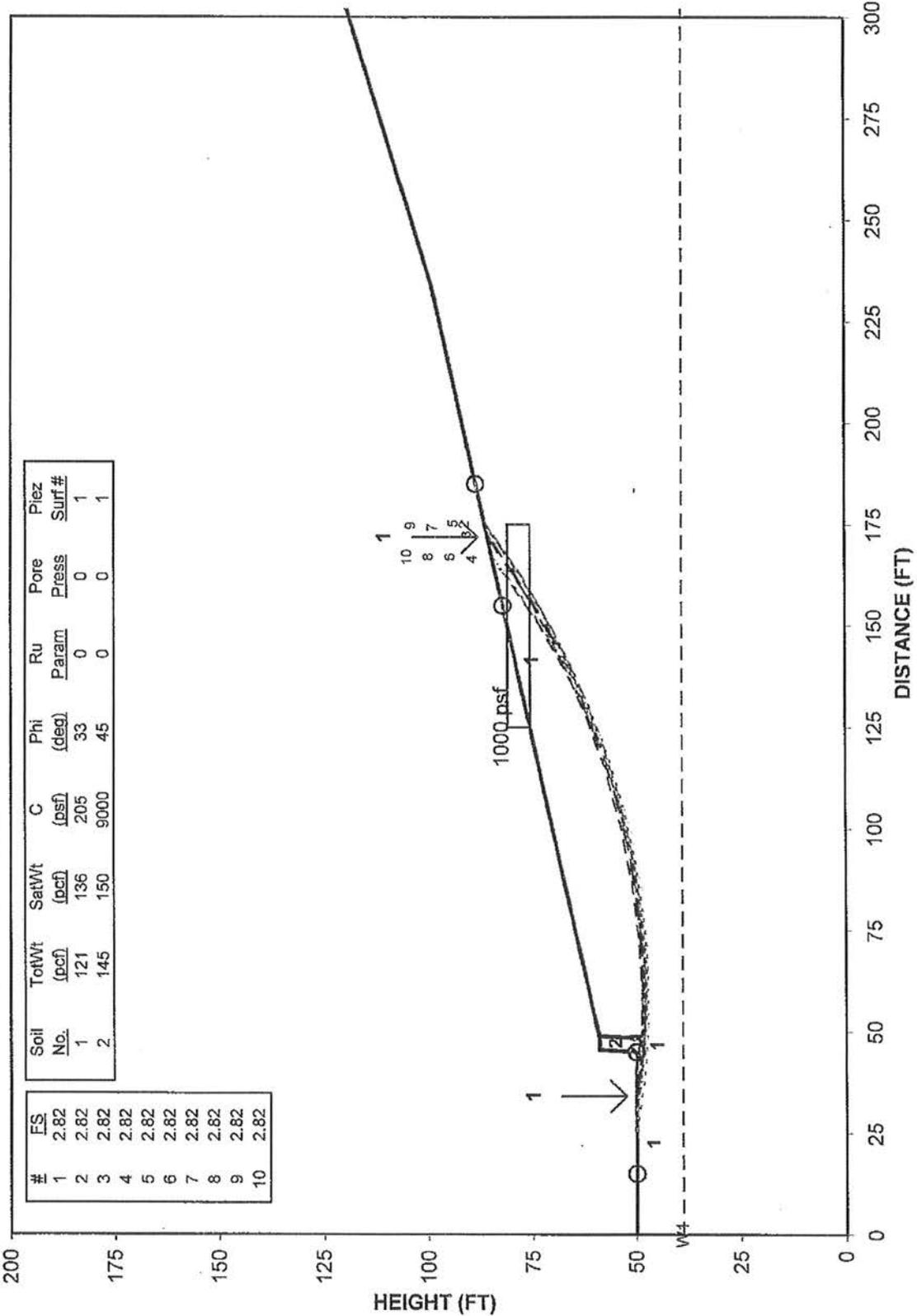


Attachments: Figures 1 and 2, Stability Results

**Earthtec**

# STABILITY RESULTS

The Sanctuary Static  
 Ten Most Critical Surfaces. 071950 .OPT Run By: Earthtec 4-02-12

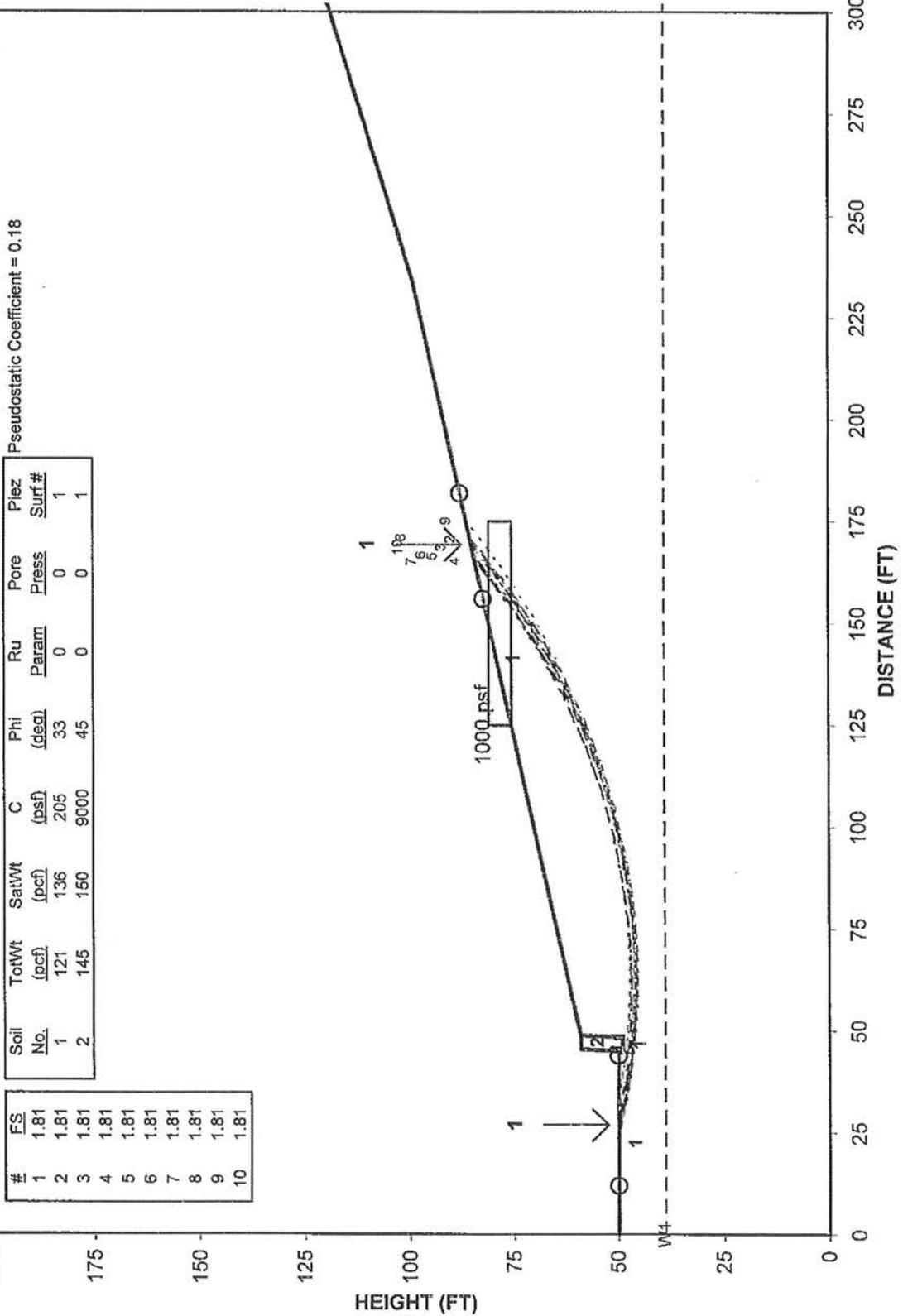


# STABILITY RESULTS

The Sanctuary Seismic  
 Ten Most Critical Surfaces. 071950S.OPT Run By: Earthtec 4-02-12

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez Surf #
1	121	136	205	33	0	0	1
2	145	150	9000	45	0	0	1

#	FS
1	1.81
2	1.81
3	1.81
4	1.81
5	1.81
6	1.81
7	1.81
8	1.81
9	1.81
10	1.81



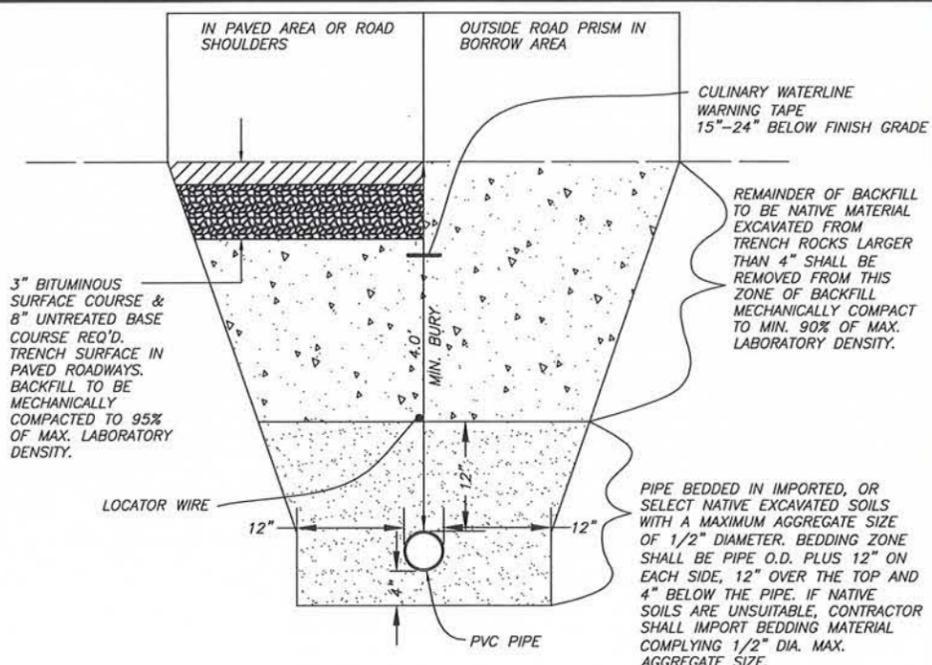
PROJECT NO.: 12-0086G



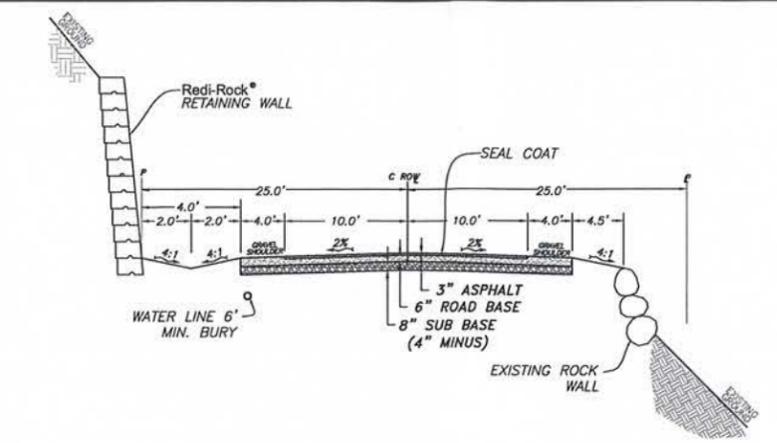
FIGURE NO.: 2



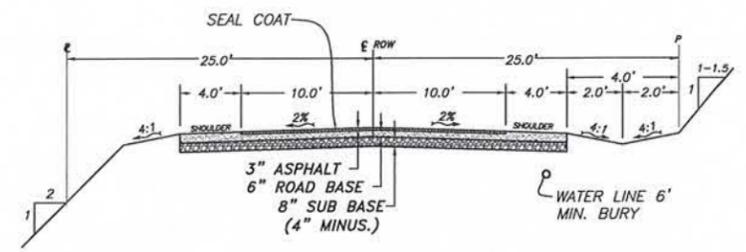
N:\2007\07-129 Sanctuary\drawings\07-129pp REV 4-10-12 - 7.dwg, 4/19/2012 9:21:17 AM, 1:107.288, 117



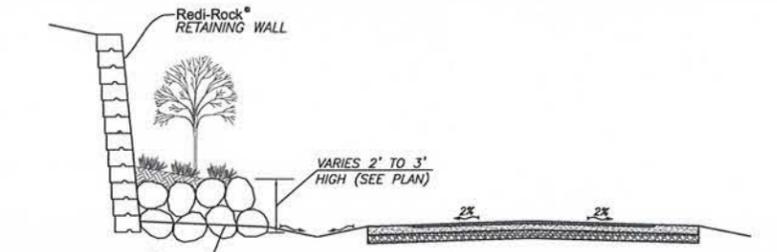
**TYPICAL TRENCH SECTION**  
SCALE: NONE



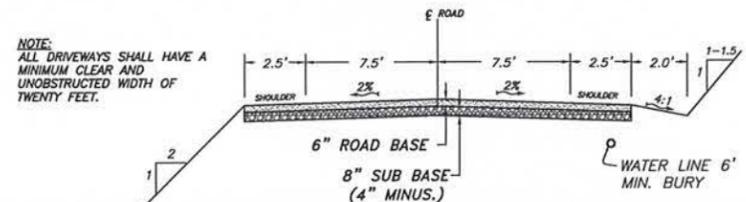
**TYPICAL STREET SECTION DETAIL W/Redi-Rock WALL DETAIL**  
SCALE: NONE Not for Construction



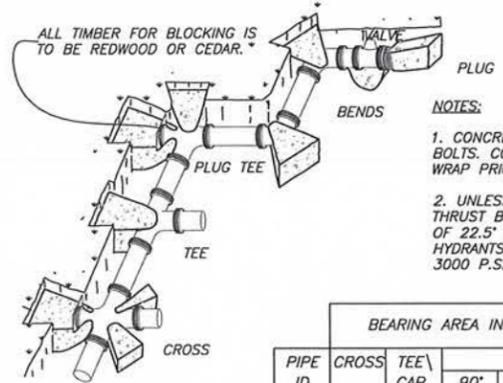
**TYPICAL PRIVATE ROADWAY SECTION**  
MAXIMUM SLOPE = 12%  
SCALE: NONE



**TYPICAL CROSS SECTION PLANTER WALL DETAIL**  
SCALE: NONE



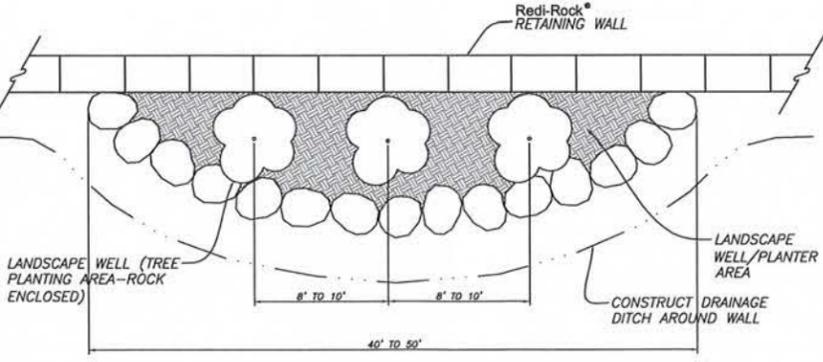
**20' WIDE PRIVATE DRIVEWAY TYPICAL STREET SECTION**  
MAXIMUM SLOPE = 15%  
SCALE: NONE



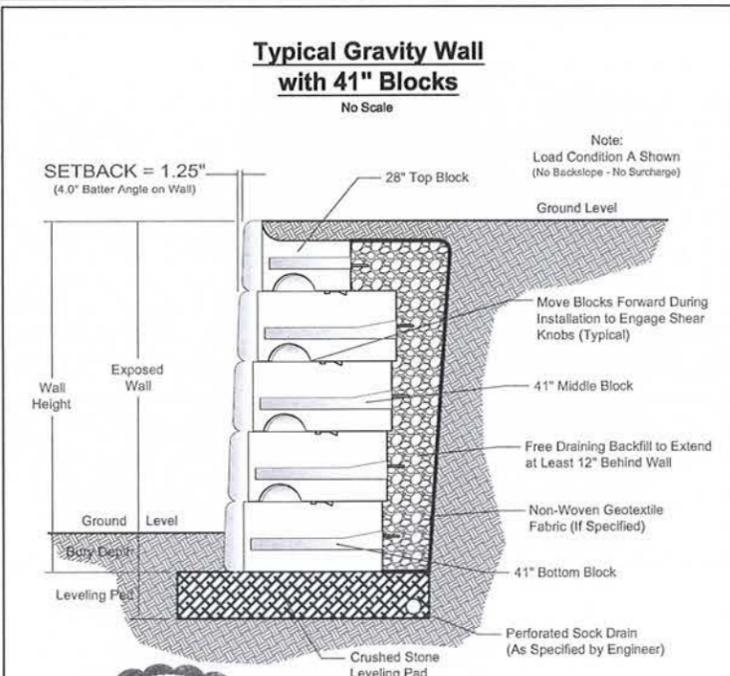
- NOTES:**
1. CONCRETE SHALL NOT BE PLACED AROUND JOINTS AND BOLTS. COVER ALL METAL CONTACT AREAS WITH A POLY WRAP PRIOR TO CONCRETE PLACEMENT.
  2. UNLESS OTHERWISE SPECIFIED BY THE ENGINEER, THRUST BLOCKS SHALL BE CONSTRUCTED AT ALL BENDS OF 22.5° AND GREATER AND BEHIND ALL TEES, FIRE HYDRANTS, AND PLUGS. THEY SHALL BE CONSTRUCTED OF 3000 P.S.I. CONCRETE OR BETTER.

PIPE ID	CROSS	TEE CAP	BEARING AREA IN SQUARE FEET				CONC./CU. YDS.		
			90°	45°	22.5°	11.25°	45°	22.5°	11.25°
4"	2	2	2	1	1	1	1.0	0.5	0.5
6"	2	3	4	2	1	1	1.5	1.0	0.5
8"	3	5	7	4	2	1	2.5	1.5	1.0
10"	4	8	10	6	3	1	4.0	2.5	1.5
12"	5	10	14	8	4	2	5.0	3.0	1.5
16"	10	20	24	12	7	4	8.5	4.5	2.5
18"	12	24	30	16	10	5	11.0	6.0	3.0
20"	14	28	40	20	12	6	14.0	8.0	4.0

**THRUST BLOCKING DETAIL**  
SCALE: NONE



**TYPICAL PLAN VIEW PLANTER WALL DETAIL**  
SCALE: NONE



**Typical Gravity Wall with 41" Blocks**  
No Scale

Note:  
Load Condition A Shown  
(No Backslope - No Surcharge)

SETBACK = 1.25"  
(4.0° Batter Angle on Wall)

Wall Height

Exposed Wall

Ground Level

Leveling Pad

Bury Depth

Crushed Stone Leveling Pad

Perforated Sock Drain (As Specified by Engineer)

41" Bottom Block

Non-Woven Geotextile Fabric (If Specified)

Free Draining Backfill to Extend at Least 12" Behind Wall

41" Middle Block

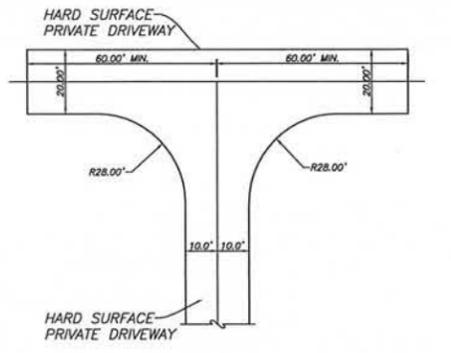
28" Top Block

Move Blocks Forward During Installation to Engage Shear Knobs (Typical)

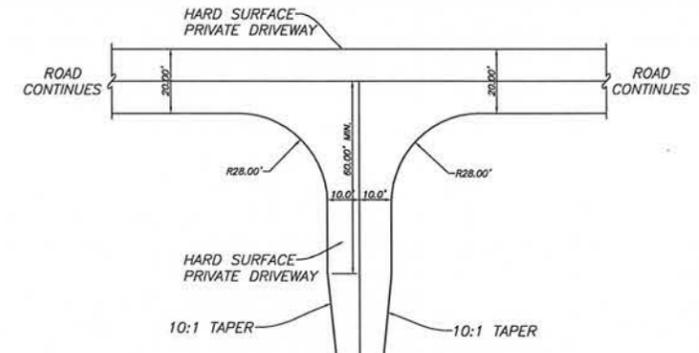


See Redi-Rock.com for Detailed Section Drawings of Each Condition Shown in the Design Charts

DESIGNED BY	J. JOHNSON	12/08/06	Redi-Rock® International, LLC
CHECKED BY			
APPROVED BY			
SCALE	NO SCALE		
SHEET NO.		1 OF 1	



**DEAD END HAMMER HEAD**  
NOT TO SCALE



**STANDARD ROADWAY HAMMER HEAD**  
NOT TO SCALE

**NOTE:**  
FIRE TRUCK TURN AROUND IN RESIDENTIAL DRIVEWAY/GARAGE AREAS SHALL BE PROVIDED AS SHOWN AND HAVE A MINIMUM HARD SURFACE AREA FOR A VEHICLE TURNING RADIUS OF 28 FEET OF GREATER. IN LIEU OF A CIRCULAR TURN AROUND, AN APPROVED HAMMER HEAD TURN AROUND MAY BE USED.

Professional Engineer Seal for Matthew R. Meyer, State of Utah, License No. 275259, dated 4/19/12.

**HANSEN & ASSOCIATES, INC.**  
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Drawn By: MJB Date: 9/29/2010  
Designed By: SRM  
Checked By: [Signature]  
Approved By: [Signature]  
Scale: NTS  
Drawing File: 07-129PP.dwg  
JOB NUMBER: 07-129

**THE SANCTUARY**  
A PART OF SECTION 3 & 4, 17N, R2E, AND  
A PART OF SECTION 34, 17N, R2E, SLB&M  
WEBER COUNTY, UTAH

PLAN & PROFILE FOR

SHEET  
**10**  
OF  
**10**  
SHEETS