

Modeling Vertically-Staged Earthwork Rock Undercut Volumes (Subtraction Method) (Cont.)

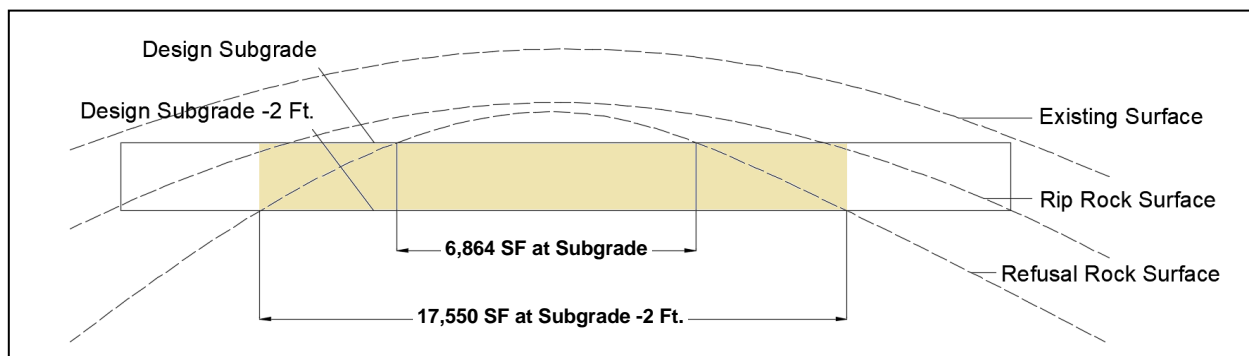
After completing the manipulations and volume calculations in Steps 1-21, we can apply the subtraction method to the individual strata material cut volumes documented on our last two volume reports (pages 161 and 162) to determine all estimated undercut volumes. For each strata undercut material, we subtract the original **Subgrade** cut volumes (on the Page 162 volume report) from the corresponding **Subgrade -2 feet** cut volumes (on the Page 161 volume report). The resulting net undercut volumes are presented in the right-most column of the recap table below.

In this example, a total undercut of 1,288 BCY is required so that no Refusal Rock remains within two feet of Subgrade (the shaded end area in the profile below). The 1,288 BCY of undercut consists of 796 BCY Refusal Rock, 380 BCY Rip Rock, 112 BCY Soil, and 0 BCY Stripped Material. Although identical Refusal undercut volumes result here and in Step 6 (796 BCY), Steps 7-21 were required to avoid overestimating the volumes of overlying Rip Rock and Soil undercut. Recall that applying the subtraction method to the Rip Rock volumes initially reported on pages 158 and 159 resulted in 1,221 BCY of Rip Rock undercut (1,582 BCY on the page 159 report, less 361 BCY on the page 158 report) when the actual expected volume is only 380 BCY. Limiting the volume calculations to the actual undercut area is critically important when quantifying the incidental undercut materials (Rip Rock and Soil in this example) overlying the specified Refusal rock removal.

Remember: (1) the **1,288 BCY** total undercut is in addition to this site's cut/fill volumes reported on page 158, (2) the undercut materials must be replaced with **1,288 CCY** of suitable backfill to return the undercut area to plan Subgrade and (3) the accuracy of strata cut volumes is limited by the available (and often insufficient) geotechnical data.

Strata Material*	Cut Volumes to Subgrade -2 Feet (Page 161 Report)	-	Cut Volumes to Plan Subgrade (Page 162 Report)	=	Net Undercut Volumes (BCY)
Stripped Material	242	-	242	=	0
Soil	918	-	806	=	112
Rip Rock	736	-	356	=	380
Refusal Rock	1,381	-	585	=	796
Total					1,288

* Note: The above recap was compiled in Excel—it is not an AGTEK-generated report



Tips: Because it's somewhat labor-intensive (21 steps in the above example), using the subtraction method for estimating a rock undercut when the undercut is resulting simply from the inability to remove rock neatly to Subgrade may not be the best use of time. If the much quicker *Cut Area* method (described on pages 44 and 224) is good enough for a rough quantity estimate, save some time with the *Cut Area* method. Also, AGTEK offers other tools and methods that could be applied to the above undercut example (see the *Variable-Depth Removal of Expansive Clay* example beginning on page 165—it requires a lot of steps, too, but does offer the advantage of retaining all data in one AGTEK job file). Finally, AGTEK's *Blast Rock Surface Modeling* video at www.agtek.com/video.html?id=210 documents yet another approach to modeling and quantifying a rock undercut (it's a bit more complicated and involves quite a few steps, but all data manipulations and calculations are performed in a single job file).