

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

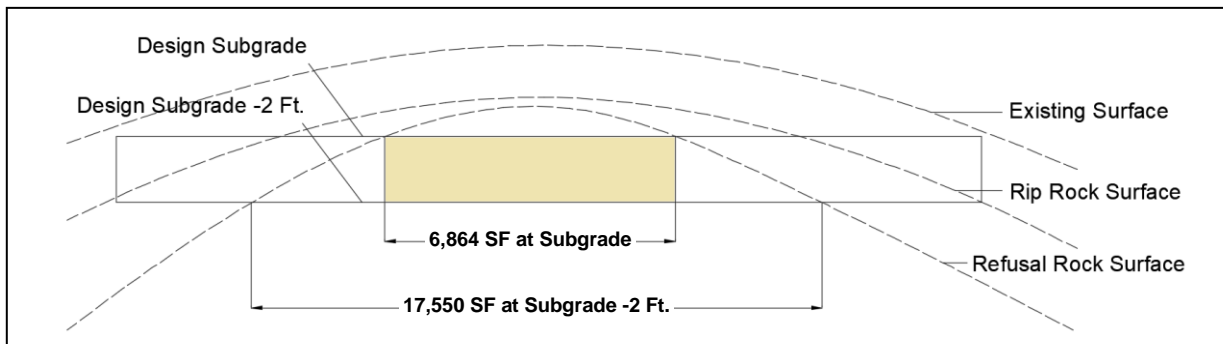
A simple *Cut Area* method for estimating a default rock undercut volume was discussed on pages 44 (*AGTEK 4D*) and 224 (*AGTEK 3D*) but that method could underestimate the actual undercut volume when rock must be removed to a specified depth below subgrade. Here's why . . .

Subgrade vs. Existing [from Pine Rock Strata Complete.esw file]

Name	Total	Cut	Area Fill	OnGrade	Volume		Comp/Ratio		Compact		Export -Import	Change Per 0.1 ft
					Cut	Fill	Cut	Fill	Cut	Fill		
<b>Bldg Sub:</b>	<b>34,317</b>	<b>23,982</b>	<b>10,335</b>	<b>0</b>	<b>577</b>	<b>484</b>			<b>503</b>	<b>484</b>	<b>19</b>	
Soil		17,989			588				512		512	
Rip Rock		1,854			42				48		48	
Refusal		0			0				0		0	
<b>Total Bldg:</b>					<b>1,207</b>	<b>484</b>			<b>1,063</b>	<b>484</b>	<b>579</b>	<b>126</b>
<b>Landscape</b>	<b>33,514</b>	<b>26,611</b>	<b>6,904</b>	<b>0</b>	<b>502</b>	<b>217</b>	<b>0.87</b>	<b>1.00</b>	<b>437</b>	<b>217</b>	<b>220</b>	
Soil		16,470			453		0.87		394		394	
Rip Rock		5,036			128		1.15		147		147	
Refusal		1,822			85		0.00		0		0	
<b>Landscape Total:</b>					<b>1,168</b>	<b>217</b>			<b>978</b>	<b>217</b>	<b>761</b>	<b>124</b>
<b>Street</b>	<b>14,371</b>	<b>14,371</b>	<b>0</b>	<b>0</b>	<b>252</b>	<b>0</b>	<b>0.87</b>	<b>1.00</b>	<b>219</b>	<b>0</b>	<b>219</b>	
Soil		14,371			770		0.87		670		670	
Rip Rock		7,346			191		1.15		220		220	
Refusal		5,042			500		0.00		0		0	
<b>Street Total:</b>					<b>1,713</b>	<b>0</b>			<b>1,109</b>	<b>0</b>	<b>1,109</b>	<b>53</b>
<b>Regions Total</b>	<b>82,202</b>	<b>64,964</b>	<b>17,239</b>	<b>0</b>	<b>1,331</b>	<b>701</b>			<b>1,159</b>	<b>701</b>	<b>458</b>	<b>303</b>
Suitable Soil		48,830			1,811				1,576		1,576	
Suitable Rip Rock		14,236			361				415		415	
Unsuitable Refusal		6,864			585				0		0	
<b>Total:</b>					<b>4,088</b>	<b>701</b>			<b>3,150</b>	<b>701</b>	<b>2,449</b>	<b>303</b>

This is the horizontal area where the **Subgrade** surface cuts into the **Refusal** (hard rock) strata surface (6,864 SF).

**Tip:** In order to avoid having any strata volumes misclassified as *Stripping Quantities* (see detailed discussion on pages 43 and 49-50), we'll use the **Existing** surface (rather than **Stripped**) as the **Diff** surface for all volume calculations in this exercise.



Let's say the specifications stipulate that Refusal rock must be removed to a minimum depth of two feet below design subgrade. Applying the *Cut Area* method to the above volume report yields an undercut volume of **508 BCY** (6,864 x 2 / 27), which corresponds to the above profile's shaded end area. Studying the above profile for a moment, we can see how we would be underestimating the rock undercut volume by using the report's *Cut Area*. The reported 6,864 SF Refusal *Cut Area* does not include the area of Refusal rock that's below subgrade but still within two feet of Subgrade (our 508 BCY estimate is missing the triangular "wedge" Refusal rock volume—immediately to the left and right of the profile's rectangular shaded end area). We'll see this on the next page, but the Refusal rock undercut area is actually 17,550 SF. So, to avoid this underestimate, we need a better undercut estimating method (see next page).