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

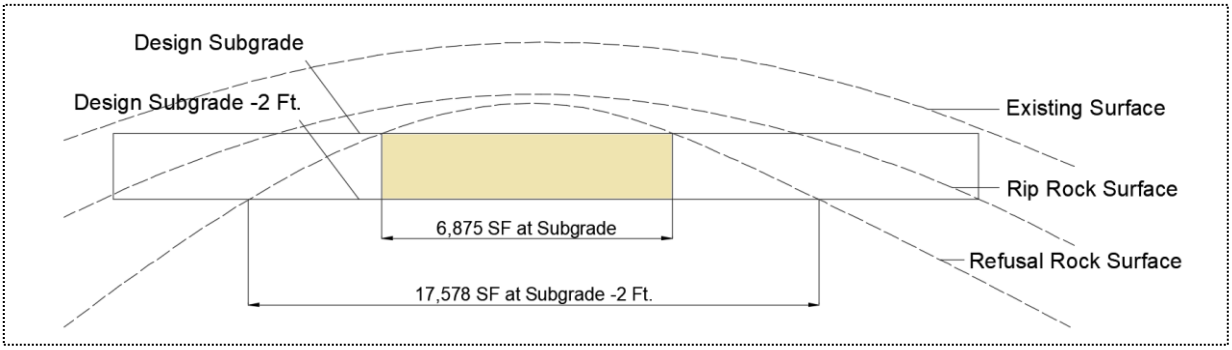
A simple "cut area" method for estimating a default rock undercut volume was discussed on pages 38 (***AGTEK 4D***) and 204 (***AGTEK 3D***) but that method could underestimate the actual undercut volume when rock must be removed to a specified depth below subgrade. Here's why . . .

**Subgrade vs. Existing** (from *Pine Rock Strata Complete.esw* file)

| | | Area | | | Volume | | Comp/Ratio | | Compact | | Export | Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total | Cut | Fill | OnGrade | Cut | Fill | Cut | Fill | Cut | Fill | -Import | Per .1 Ft |
| **Bldg Sub:** | **34,317** | **23,963** | **10,355** | **0** | **575** | **484** | | | **501** | **484** | **17** | |
| Soil | 17,972 | | | | 584 | | | | 509 | | 509 | |
| Rip Rock | 1,848 | | | | 42 | | | | 48 | | 48 | |
| Refusal | 0 | | | | 0 | | | | 0 | | 0 | |
| | | | **Total** | **Bldg:** | **1,201** | **484** | | | **1,058** | **484** | **574** | **126** |
| **Landscape** | **33,514** | **26,608** | **6,906** | **0** | **503** | **217** | **0.87** | **1.00** | **438** | **217** | **221** | |
| Soil | 16,526 | | | | 463 | | 0.87 | | 403 | | 403 | |
| Rip Rock | 5,094 | | | | 131 | | 1.15 | | 151 | | 151 | |
| Refusal | 1,855 | | | | 94 | | 0.00 | | 0 | | 0 | |
| | | | **Landscape** | **Total:** | **1,191** | **217** | | | **992** | **217** | **775** | **124** |
| **Street** | **14,371** | **14,371** | **0** | **0** | **250** | **0** | **0.87** | **1.00** | **218** | **0** | **218** | |
| Soil | 14,371 | | | | 763 | | 0.87 | | 664 | | 664 | |
| Rip Rock | 7,316 | | | | 188 | | 1.15 | | 216 | | 216 | |
| Refusal | 5,020 | | | | 492 | | 0.00 | | 0 | | 0 | |
| | | | **Street** | **Total:** | **1,693** | **0** | | | **1,098** | **0** | **1,098** | **53** |
| **Regions Total** | **82,202** | **64,942** | **17,261** | **0** | **1,328** | **701** | | | **1,157** | **701** | **456** | **303** |
| Suitable | Soil | 48,869 | | | 1,810 | | | | 1,576 | | 1,576 | |
| Suitable | Rip Rock | 14,258 | | | 361 | | | | 415 | | 415 | |
| Unsuitable | Refusal | 6,875 | | | 586 | | | | 0 | | 0 | |
| | | | **Regions** | **Total:** | **4,085** | **701** | | | **3,148** | **701** | **2,447** | **303** |

The horizontal area where **Subgrade** surface cuts into the **Refusal** (hard rock) surface (6,875 SF).

Tip: In order to avoid having any strata volumes misclassified as *Stripping Quantities* (see detailed discussion on pages 37 and 43-44), we will use the **Existing** surface (rather than **Stripped**) as the *Diff* surface for all volume calculations performed in this exercise.




Let's say the specifications stipulate that Refusal rock must be removed to a minimum depth of two feet below Subgrade. Applying the "cut area" method to the above Volume Report yields an undercut volume of 509 BCY (6,875 * 2 / 27), which corresponds to the above profile's shaded end area. Study the above profile for a moment. Do you see how we could be underestimating the rock undercut volume? The 6,875 SF Refusal Cut Area from the above Volume Report does not include the area of Refusal rock that is below Subgrade but still within two feet of Subgrade (our 509 BCY estimate is missing the "wedge" Refusal rock volume—immediately to the left and right of the profile's shaded end area). We will see this on the next page, but the Refusal rock undercut area is actually 17,578 SF. To avoid this underestimate, we need a better undercut estimating method (see next page).