

Developing Accurate Estimates on Excavation Projects Pg 1

How can one engineer, three competing general contractors, and a dozen excavating contractors all come up with different numbers in an earthwork take-off of the same project?

The fundamental problem is usually not the method of calculation (average end method, grid method, digitized or CAD import), rather what needs to be calculated. Below is a list of some common mistakes made during earthwork estimating.

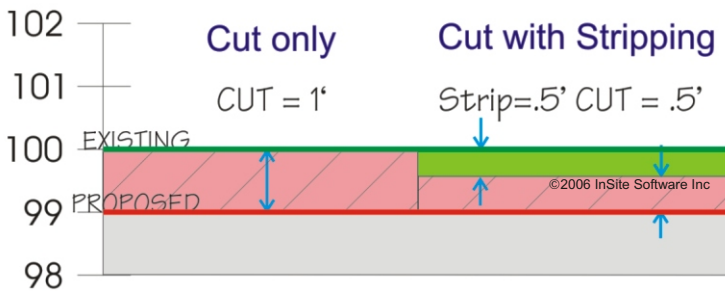
1. Inaccurate topographic data. A 2 inch elevation error across a 900,000 square foot retail center will produce a yardage miscalculation of almost 5600 yards. The access to accurate surveying equipment such as robotic total stations and GPS equipment makes spot checking the existing topography for discrepancies much easier and less costly. Short changing a site with poor quality topo data will generally create problems throughout the entire job.



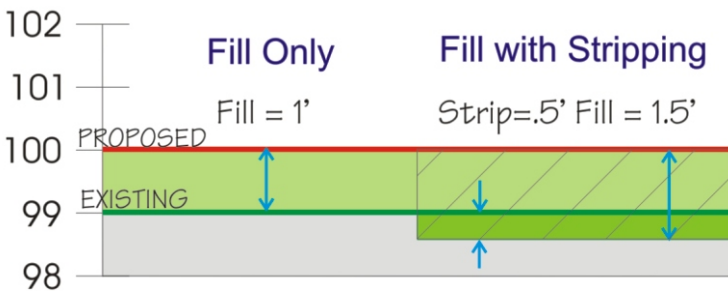
2. Calculating cut & fill from existing grade.

Calculating Cut & Fill by comparing existing and proposed will almost always guarantee incorrect earthwork quantities. If the site has topsoil and demolition (ex. removal of old walks and paved areas, building slabs) these values must be subtracted from existing before the cut and fill quantities are calculated.

In a cut area cross section shown below, if the stripping



isn't deeper than the cut, the amount of excavation isn't changed, but these two must be separated to obtain realistic costs.

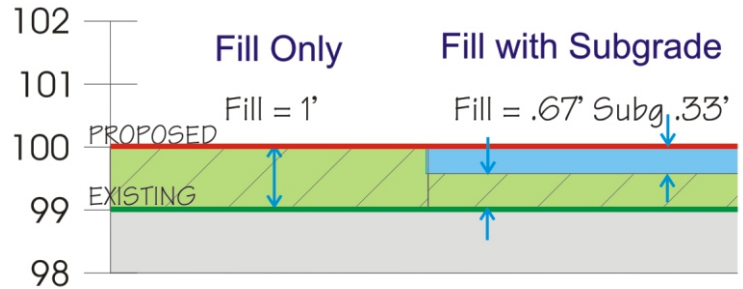


In the fill cross section above, the stripping process will increase fill in some cases by as much as the stripping.

3. Calculating cut & fill to proposed grade.

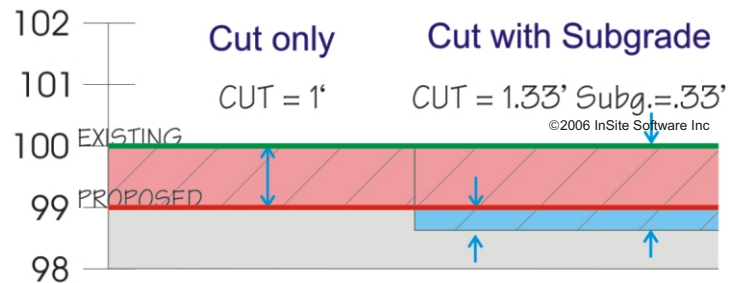
Calculating the earthwork quantities from the bottom of stripping and demolition to the proposed grade in paving areas, building pads and topsoil replacement footprints will guarantee inaccurate numbers. Each of these features has a large effect on the earthwork volumes.

Consider a topsoil replacement requirement of 4 inches.



In a fill area, the amount of regular fill will be reduced by the 4 inches of topsoil respread, but the cost of keeping the fill and topsoil respread separated will increase the cost of the project.

In a cut area, the site needs to be over excavated by 4 inches to leave room for the topsoil placed later. Cut & fill



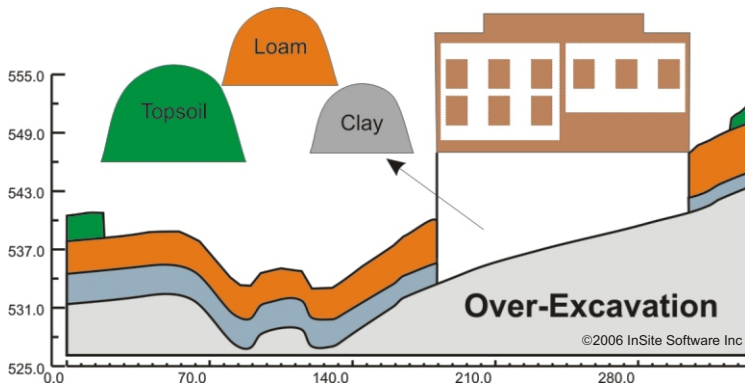
calculations need to be done to the bottom of the paving footprint and building slab.

Earthwork calculations comparing only existing and proposed are almost never correct.

Calculating stripping and demolition, and then calculating the volume of material from the bottom of stripping to the bottom of subgrade is the correct way to calculate cut and fill numbers.

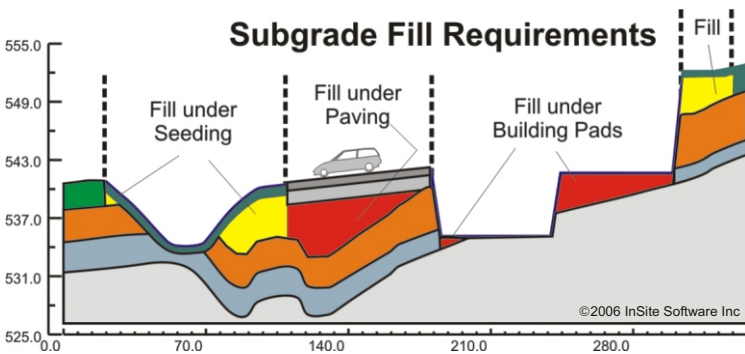


4. Neglecting over-excavation. Many times native materials are inadequate for structural stability. The site must be over excavated to allow for placement of structural fill for load bearing features like paving and building pads. Specifications can require excavation to a certain strata (as shown), or a minimum amount of fill be



placed below the subgrade. This over-excavated material can either be moved to non-structural fill areas or hauled off site.

5. Ignoring the quality of on-site material. The quality of excavated material plays a major part in the cost of site development. Often, sites are designed to minimize soil import or export, but without regard to the quality of the stripped and excavated material. The material generated from the cut operation may not be suitable for the fill requirements. In the illustration below, the fill under structural areas (red) might require an



import, and the site may yield more poor quality material than will fit in the non-structural areas (yellow). An expensive haul-off and/or an expensive import would be the result.

It will be far less expensive to remove poor quality materials with a design that lowers the site, than replace the poor material with structural fill. While this cannot always be achieved within the sites' design goals (drainage, aesthetics, etc.), a generous number of soil borings or test pits will allow for an accurate prediction of the quality of the cut. Knowledge of material quality will prevent un-anticipated cost overruns in the project.

6. Shrinkage and expansion. Soils in their natural undisturbed state will normally expand when excavated and shrink when used as fill. It is the loss of material due to shrinkage that can affect a site "balance" tremendously. A 100,000 yard "balanced site" that does

1. Bank 100%



2. Expanded (i.e. 130% of Bank)



3. Compacted (i.e. 88% of Bank)



not take a 10 % material shrinkage into consideration will be short 10,000 yards of material when excavated and re-compacted. Shrinkage of 10-20 % or more is not unusual.



These are just a few examples factors affecting site quantity. A good design which incorporates best use of material and minimum movement, is a winner for everyone involved in site development. There is no substitute for excavation experience in local conditions when calculating sitework quantities.