

Earthwork: What's a Cubic Yard?

Executive summary. A cubic yard is not a cubic yard when it comes to earthwork estimating and field operations. Know the difference to best estimate productions and to negotiate pricing in the field.

Estimating earthwork. Let's say you're at your daughter's soccer game and you've been asked to excavate a hole at the center of the field (after the game!). Say you have to dig a hole 100' long x 100' wide x 10' deep. The excavation volume in cubic yards (cy) follows:

$$\begin{aligned} 100 \text{ ft} \times 100 \text{ ft} \times 10 \text{ ft} &= 100,000 \text{ ft}^3 \\ 100,000 \text{ ft}^3 \times 1 \text{ cy}/27 \text{ ft}^3 &= 3,704 \text{ cy} \end{aligned}$$

Easy math, right? The excavation volume is 3,704 cy.

What is a cubic yard? Sounds like a trick question since we just solved for the volume in the preceding paragraph. However, as a construction professional you need to know the following terms as they exist in your area of the world:

- CY = cubic yard = usually just a "cubic yard" as calculated above
- ECY = embankment cubic yard = a cubic yard as it exists in an embankment made by your crew
- BCY = bank cubic yard = arguably identical to an ECY
- TCY = truck cubic yard = cubic yard as it exists in the back of a hauling truck after placed there by your excavator



Now, these acronyms vary across the country, are regional, and carry different meanings. So, the lesson here is not to take these for gospel, but to seek guidance from your chief estimator when estimating cost. And if you're running a job in the field, you better confirm their meanings in the estimate otherwise risk misunderstanding the productions estimated by huge percentages.

Why is understanding a cubic yard so important? It's critical to understand the life of excavated earth on a construction site. Let's go back to the 3,704 cy hole you excavated.

You were introduced to some of the general acronyms for earthwork volumes above. There are some additional terms and concepts to understand:

Scott Jennings, P.E., is the President of [SJ Construction Consulting, LLC](http://SJConstructionConsulting.com) (808) 271-5150. He is former owner of a heavy/civil construction company and now provides cost estimating, litigation support, and efficiency advice to contractors. He is also the founder of [Runjob Software, Inc.](http://RunjobSoftware.com) Download our QR scanner app: runjobsoftware.com/mobile/

- Swell = the increase in volume of earth when excavated or perhaps when water is added to it
- Fluff = similar to swell above, but usually not referring to expansion due to water
- Contraction/shrinkage = the decrease in volume of earth when compacted or when water escapes the void space of compacted fill through drying
- Overcompaction/overconsolidation = usually refers to earth which is in a condition thought to be beyond ideal/expected maximum compaction

The life of dirt on a construction site is a violent one! Say that we excavated this 3,704 cy hole and trucked the dirt down to one of the goals. Once we finished stockpiling the 3,704 cy of dirt you get out a wheel, a tape measure, or a survey instrument and measure the volume of dirt laying loose in the pile. It measures 4,260 cy, not 3,704 cy. What happened? This 15% increase in the volume is called swell and likely is the increase used from the soil's insitu condition to the condition in your hauler's trucks. In this case a cubic yard out of the ground swells or fluffs by 15%.

Then you loaded it all back into dump trucks and placed it back in the same hole at 90% optimal compaction (which is a realistic specification for soil in turf areas). But wait, it didn't all go back into the hole. How did 3,704 cy of earth just excavated, now not go back into the same hole? The answer is largely tied to the initial compaction of the soil before you touched it. Perhaps it was in an overconsolidated condition? Certainly is was in a condition greater than 90% of optimal compaction when your daughter started her match.



This analysis is a common one in earthwork – how much does a certain soil (silt, gravel, rock, clay) swell during transport, and then what is its capacity for compaction.

Tare volumes. Based on the concepts above only partially discussed, there then becomes a relationship to tare volumes. "Tare" is a fancy word for containers holding dirt: super dumps, belly dumps, ag cans, scrapers, semi-end dumps, end dumps, side dumps, tri-axes, truck 'n pups, and artics (short for articulated dump trucks, or offroaders) are all types of vehicles which move earth. And how much dirt they hold can be a con man's game. Be careful. You'll hear at bid time or out in the field that "our trucks hold 22 cubic yards", "13 bank yards", "it's a 5-yard dump", and "sideboards give it another couple yards". Maybe your scraper cans hold "17 yards" – well is this heaped, struck off, bank yards, swelled yards, what? You better know at bid time and you better know when you're counting loads in the field to obtain daily productions of earthmoving against your budget.

My story. I had a project in which we hired a company to produce a certain type of rock to be used for slope protection. Our rock producer hired a trucking company to haul the rock to us. The swell factor was big – he was taking native rock and breaking it down into 12” pieces. He and the trucker wanted to be paid by the cubic yards produced and then the truck cubic yards delivered, respectively. We disagreed with this approach as it was too subjective. I didn’t know how many cubic yards he started with and then produced for my project, and then the trucker had all different sizes of trucks. There was no discrete way of measuring anything in his operation.



What did I know?

I knew that I had to fill a hole of known volume. It was that known volume to which we negotiated. At the end of the project, we had filled a hole of a measurable volume for which we paid the supplier a unit price for “rock in place”. I prefer the ton as a unit of measure in any imported fill activity, but we had no ability to measure the weight of the rock in this remote location.

Work safe!