1.0 Introduction

One thing sadly missing in our construction industry is clarity of expression. This means being precise in our language, as it is the pathway to a clearer understanding of the topic under discussion.

This concept is particularly applicable to the subject of earthworks. Cost estimating of earthworks is a greatly disregarded aspect of construction, even though almost every construction project features some earthworks.

2.0 Precision Lost

The most effective way to be more precise in Earthworks lies in taking care to express the units involved more exactly. To our way of thinking, the term ‘m3’ should be consigned to the rubbish bin of history. It is such a vague term that causes a lot of confusion in our industry. It is the equivalent of saying ‘dollar’ in an international setting such as Hong Kong, and then not stating which dollar you are referring to: is it HKD, or USD, or AUD?. And it happens far too frequently!

3.0 Precision Regained

We offer what we believe are far more precise alternatives to ‘m3’: these are the acronyms LCM, BCM and CCM.

John learnt the importance of this concept from another person’s mistakes, someone he considers to be so much smarter also. Sometimes it’s good to learn from your own mistakes – it’s even better (and cheaper) to learn from someone else’s mistakes.

The terms we recommend all earthworks estimators ought to adopt are these:
LCM - Loose Cubic Metres

BCM - Bank Cubic Metres

CCM – Compacted Cubic Metres

**LCM**: The best way to visualize LCM is to picture soil in the back of a truck or, even better, in the conical stockpile at the end of a stacker conveyor. This is the idealized version of LCM. As we proceed with this discussion, you will realize that LCM may be a ‘partial’ condition rather than the ideal – but this small complication can be managed with densities.

**BCM**: This describes *undisturbed* soils, in the ground. We believe the term ‘bank’ is itself a bit misleading but we are stuck with it – probably thanks in part to the Caterpillar Handbook. Open-cut miners will always refer to soil quantities as ‘bcms’, but we like to think of it as ‘undisturbed’ cubic metres.

**CCM**: This describes soil after it has it is compacted. Once again the *degree of compaction* needs to be established, and this is achieved with the help of densities, and density ratios.

The above units cover a majority of situations the estimator is likely to confront when estimating earthworks. Nevertheless, there are other valid units that can play a role, particularly ‘tonnes’.

### 4.0 Densities

As we hinted at earlier, the relationship between the units listed above is to found in densities. In other words, the soil densities in the three different situations need to be established. Some, or even all of these densities may be found in the tender documents, or via soils laboratory test reports in the general vicinity of a project, or even by having special tests taken if the earthworks component of the tender is sufficiently significant. One important rule to adhere to is to ensure the soils densities adopted (they will usually have to be averaged across a small site) are on a common basis: the
densities are all expressed as ‘dry’ or ‘wet’. What we are trying to establish here is a common platform for comparisons: tonnes / lcm, tonnes / bcm and tonnes / ccm. When these densities are established, such relationships as swell or shrinkage factors between LCM, BCM, and CCM are automatically established. Again we say…ensure the densities are all dry or all wet. We prefer using ‘dry’, since maximum dry density (MDD) is a figure commonly known to laboratories and is a good starting point.

For example – suppose the densities for BCM and LCM have been established, perhaps in the order of 1.85 t/bcm (dry) and 1.50 t/lcm (dry). Then:

Swell factor = 1.85/1.50 = 1.23

We will deal further with such terms as swell factor when we move onto machine production estimating.

5.0 Shades of Grey

Life would be simple - the highest form of sophistication, according to Leonardo da Vinci, if all there was to know about such matters could be covered by the three terms above. However, the reader needs to be aware that often intermediate situations arise. One example is found in the stockpiling of materials. John says…”when I was a boy engineer, I would immediately apply this new and hard-won knowledge of material densities and confidently assert the volume a stockpile would occupy. However, it didn’t take long for me to discover that unless the stockpile is being formed by a stacker conveyor (or perhaps something that floats like a hovercraft) trucks or scrapers, or a bulldozer pushing up a stockpile will be running all over the stockpile as they dump their loads. Hence the actual density of materials in the stockpile will be somewhat greater than first thought.”

We therefore need to apply our judgment to assessing just what the new density might be. It will be lighter than the original t/bcm, but will be
somewhat greater than the t/lcm that had been established originally. Another minor example is in the re-spreading of topsoil – the effect of machinery working over the top of a layer of topsoil is to partially compact the materials as it is placed and trimmed.

6.0 Conclusion

The vagaries mentioned above should not be allowed to overwhelm anybody. It just means that sometimes judgment has to be applied in the never-ending attempt at finding the most correct answer. After all, we are ‘estimating’, meaning that there is no exact answer.

The key point is to recognise the importance of adopting appropriate units of measurement when working with earthworks quantities so that we can match “apples with apples”.