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BUSINESS CENTER – HCE™ Powered by Trimble

Modeling Overexcavation Requirements Version 2.20

Using the Takeoff Module in BC-HCE version 2.20, you can account for the work involved in meeting the specified requirements for foundational soil density through the use of *overexcavation*, thereby computing the associated earth volume. Overexcavation is a means of addressing circumstances in which a specified density must be achieved within the in situ earthen materials to a specified depth beneath a structure, or beneath the material layers associated with an area-based site improvement that is partially or wholly in cut. When the specified soil densification depth exceeds the depth of influence of the compaction equipment in use, the in situ materials are often excavated to the required depth, and then replaced in layered lifts, each of which can be compacted and tested in order to document the density that has been achieved.

This subject matter is conceptually illustrated in Figure 1 below, in consideration of the terminology found within the Overexcavation command.

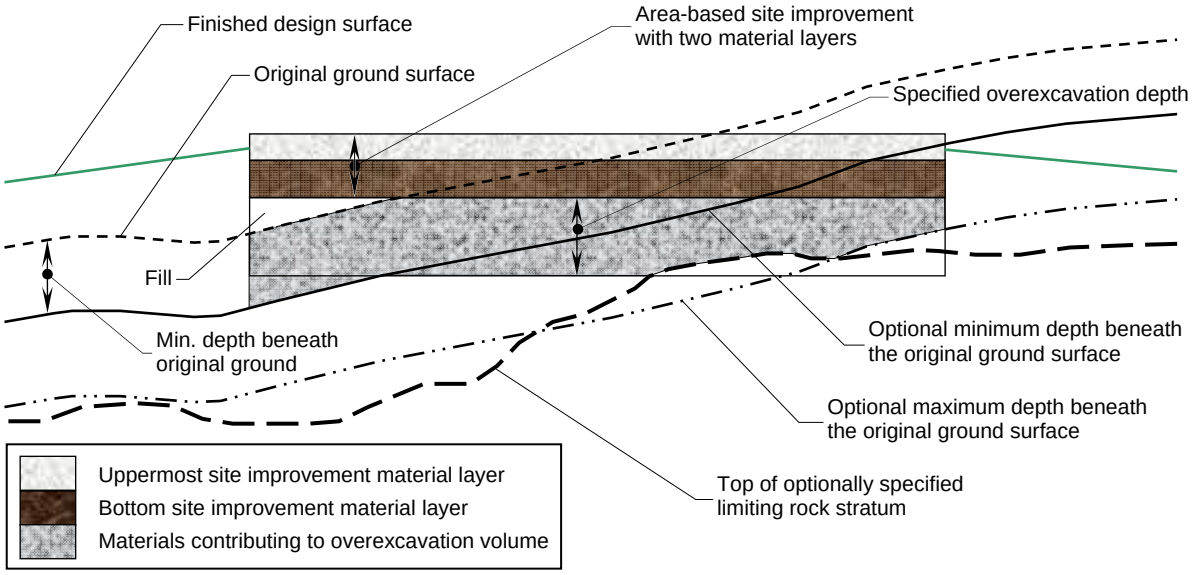

Figure 1 – Overexcavation Parameters and Typical Results

The Overexcavation command, shown in Figure 2 below, lets you designate the *specified overexcavation depth*. It represents the nominal depth that you plan to overexcavate, beneath the structure or its related material layers, into the earthen materials that comprise and are otherwise accounted for in the Mass

Earthwork Analysis. You can optionally designate that the overexcavation be extended to a specified minimum depth beneath the original ground surface, if necessary, in order to assure that all in situ materials that are shallower than that depth beneath the original ground are compacted appropriately. You can further optionally designate a maximum depth beneath the original ground, beyond which the specifications may assume the in situ soils to be at a suitable density, and therefore beyond which overexcavation is not deemed necessary. Finally, you can limit the overexcavation to preclude the need to excavate beneath the upper surface of a designated in situ earthen material stratum. This might often be used in order to account for rock and other dense materials to which the required density specification does not apply.

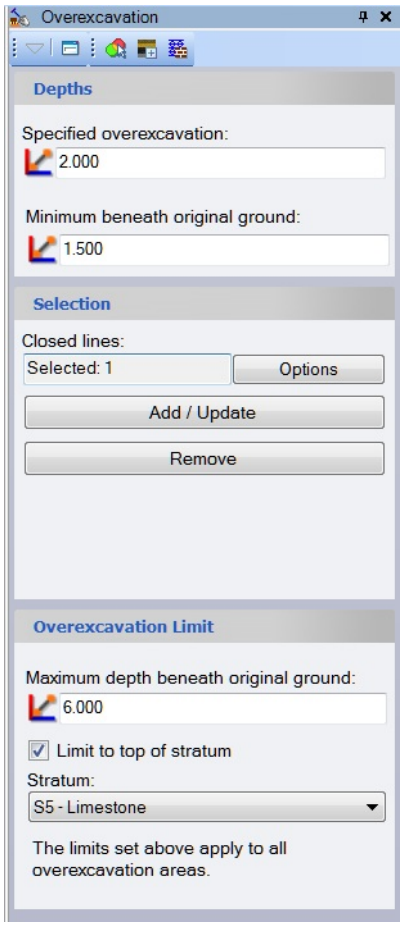

Figure 2 – Overexcavation Command

Determining the Specified Overexcavation Depth

It must be noted that the contract specifications may typically designate a minimum depth beneath applicable structures, within which a specified minimum soil density must be achieved and documented. That *depth of densification* is likely to be specified as opposed to the nominal overexcavation depth itself. The actual excavation depth required to achieve the specified densification will depend on the depth of influence of the particular compaction equipment that one plans to employ. As an example, if the depth to which the specified soil density must be achieved and documented is 36 inches, and the compaction equipment is capable of achieving that density to a depth of 12 inches below grade, the actual required depth of overexcavation is effectively 24 inches. It is therefore important to understand that Figure 1 is intended to represent the depth of actual overexcavation required, based on the parameters entered in executing the Overexcavation command, and it does not reflect the depth to which the density can be expected to be achieved in that case. By entering 24 inches (2.0 feet) in the above example as the *specified overexcavation depth*, the bank volume of material to actually be overexcavated will be reported.

The specified overexcavation depth in comparison to the specified compaction depth is conceptually illustrated in Figure 3 below, along with the depth of influence of the compaction equipment.

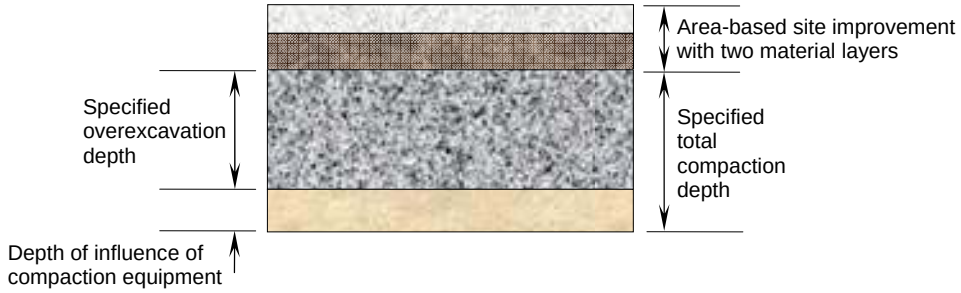

Figure 3 – Depth of Overexcavation Compared to Total Compaction Depth

Determining the Minimum Depth Beneath Original Ground

Figure 1 on page 1, conceptually illustrates an intuitive appreciation of the data fields associated with the Overexcavation command. However, it fails to fully acknowledge the depth of influence of the compaction equipment, as shown in Figure 3. That example illustrated in Figure 1 is further refined in Figure 4 below, to depict the means through which both the specified overexcavation depth and minimum depth beneath the original ground should reflect the depth of influence of the compaction equipment.

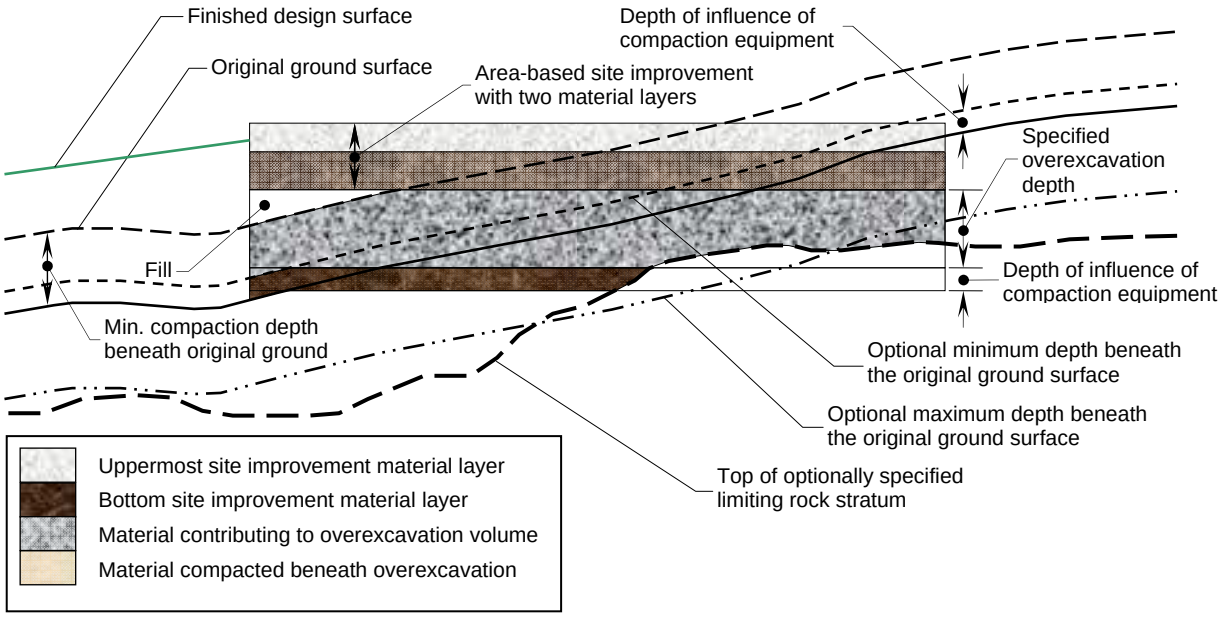

Figure 4 – Overexcavation Parameters and Typical Results

Referring back to Figure 1 on page 1, you will note that at the left edge of the structure there is an additional triangular shaped portion of the cross-section of the overexcavation volume, which must be excavated in order to maintain the specified minimum depth beneath the original ground. However, the *specified overexcavation depth* has been noted, as shown in Figure 3, as being the specified total compaction depth, minus the depth of influence of the compaction equipment. Taking into account that depth of influence, as the bottom of the noted additional excavation is compacted, the influence of the compaction equipment will be deeper than required by the specified minimum depth beneath the original ground. Therefore, in addition to subtracting the depth of influence of the compaction equipment from the specified total compaction depth, as shown in Figure 3, that value should also be subtracted from the specified minimum depth beneath the original ground for which compaction and testing is required, in order to account for the influence of the compaction equipment.

As you can see in Figure 4, the line drawn with short dashes represents the *minimum depth beneath the original ground surface*, the depth of which is the minimum compaction depth beneath the original ground, minus the depth of influence of the compaction equipment. Still, at the extreme left edge of the structure, that surface continues to require that the overexcavation be increased slightly beyond the

structure bottom, in order to meet the specification related to the minimum depth beneath the original ground within which a compactive effort must be applied.

Summary Data Entry Determinations

The discussion within the previous two sections can be summarized by the following example, and by referring to the user interface for the Overexcavation command, the applicable portion of which is shown again here in Figure 5.

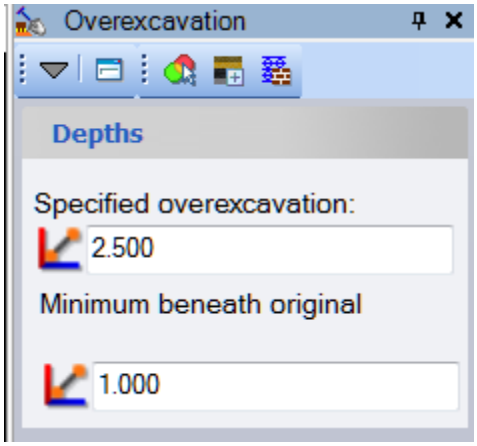

Figure 5 - Overexcavation Command

Suppose that the project specifications require that the in situ soils beneath the imported material layers associated with a particular structure, be compacted to a minimum density and to a minimum depth of 36 inches (3 feet) beneath the lowermost material layer associated with that site improvement. Achievement of that condition must be documented through testing. The equipment that will be used to achieve that compaction is known to be effective within the expected soils to a depth of at least 6 inches. Additionally, the specifications demand that the noted soil densification occur at least to a depth of 18 inches (1.5 feet) beneath the original ground surface. The determination as to which of those requirements controls, and where, will be dependent on the relationship between the elevation of the finished site improvement and that of the original ground surface.

Given the 6 inch (0.5 foot) depth of influence of the compaction equipment, the *specified overexcavation (depth)* should be entered as 2.50 feet (3.0 – 0.5), as shown in Figure 5. As a result, in consideration of that factor, 2.50 feet of soil will be overexcavated from those areas where that consideration controls. The resulting surface will then be compacted until the specified density is achieved to a depth of at least 6 inches, and the necessary density testing is completed. The material that had been excavated as a result of this process will then be placed back into fill, within multiple 6 inch lifts, each one being compacted and tested as required.

Again, in consideration of the 6 inch depth of influence of the compaction equipment, the *minimum (depth) beneath original (ground)* should be entered as 1.00 feet (1.5 – 0.5), as shown in Figure 5. In any area in which the above described nominal overexcavation depth does not result in an overexcavation greater than that depth beneath the original ground, additional overexcavation may be require to assure that the soils are compacted to a depth of at least 18 inches beneath the original ground.

In summary, in order to account for the capability of the planned compaction equipment, the depth of its influence should be subtracted from the nominal depth beneath the structure to which the specified density must be achieved in arriving at the specified overexcavation depth. It should also be subtracted from the minimum compaction depth beneath the original ground surface in arriving at the minimum depth of overexcavation beneath that surface. In following this practice, the reported overexcavation volume will be that of the materials that are actually to be excavated and replaced. Additionally, the Overexcavation surface that is created when generating the Mass Earthwork Analysis portion of a Takeoff Report will be that of the bottom of the excavation, as opposed to the bottom of the volume of

soil to be densified, thereby enabling that surface to be used for staking and machine control operations if desired.

Volume Reporting and Connection to the Mass Earthwork Analysis

The Overexcavation portion of a Mass Earthwork Analysis does not currently address the effects of shrinkage as the soils are densified through this process. The presence of overexcavation boundaries in the model produces a section on that topic within the Mass Earthwork Analysis portion of a Takeoff Report, but any effects that those overexcavation operations may have on mass earthworks, such as the need to make up that shrinkage volume, are not reflected within the Mass Earthwork Analysis itself.