



The integrity of a lining system depends largely on the condition of the prepared subgrade.

One of the most critical components for a successful lining installation is a properly prepared subgrade, since it forms the founding surface for the lining system. The short and long term integrity of the lining system depends on the condition of the prepared subgrade. This Tech Note discusses some key items to consider when evaluating the acceptability of a prepared subgrade.

Most soil materials can be used in a prepared subgrade. Both locally available fill materials as well as imported processed materials can be used. Fine grained, non-cohesive soils, such as sand or silty sand and most cohesive soils, such as clayey-silt glacial till, can be used as subgrade construction materials.

The prepared surface should be uniform, well compacted, and free of sharp rock fragments or stones, large stones and other deleterious matter such as tree roots, construction debris and metallic objects. The surface should not have any natural or foreign object that protrudes above the surface of the subgrade. In a number of instances, the locally available source of fill is limited to coarse grained, non-cohesive soil such as pit run gravel. In addition, sometimes the area to be lined lies within a coarse grained deposit. Although these materials can be graded and compacted to a uniform and level subgrade surface, this surface should receive further treatment by the application of a finer material, such as sand, to form a cushion or bedding for the lining system. The bedding material should be a minimum of 150 mm (6") thick and should be compacted. This bedding thickness may have to be increased depending on local site conditions. Where bedding sand is not available, a non-woven geotextile may be used as an alternative.

Fine grained, cohesive clay soils can also be used as a subgrade construction material. Native clayey-silt or silty-clay glacial tills are often found in lining subgrades. These materials can be worked, graded, compacted and trimmed to create a smooth, level and competent surface, however, all angular and sharp rocks or stones should be removed from the surface or picked out of the prepared subgrade. Smooth, rounded stones less than 50 mm (2") may remain within the prepared subgrade, however, these should be driven into the clay subgrade by applying a compactive effort so that these do not protrude above the finished surface.



Tech Note: Subgrade Preparation

The general rule of thumb is that all stones and rocks, regardless of shape and size, and clay lumps that lie above the subgrade surface should be removed.

The prepared subgrade should be compacted in accordance with design specifications and standard engineering practice. Generally this means that the subgrade should be compacted to a minimum 95% of maximum dry density according to the standard Proctor test (ASTM D698). The design of a prepared subgrade should carefully consider load bearing requirements, the amount of subgrade deformation expected, and whether or not local differential settlement may occur. Deformation of a subgrade beneath a lining system can result in excessive stresses in the liner material which, in turn, may cause the lining system to fail and leak. As a minimum, the subgrade should be firm and unyielding, and should be compacted to a level that permits the movement of construction equipment, liner deployment equipment, and other related traffic without causing rutting and/or deformation of the surface.

Compaction is especially important around pipe penetrations and concrete appurtenances. Often the piping is added after the earthworks are completed and compaction around the piping is done by a different method than that of the overall earthworks. The use of different compaction techniques can lead to differential settlement at the pipe penetration which can cause lining system failure.

Final grading and the finished condition of the prepared subgrade is another important issue. The surface should be levelled and prepared to a uniform finish free of abrupt or sharp changes in grade. The surface should not include pockets or voids of any kind and should not be rutted or contain soil windrows along the surface. In addition, the surface should be free of frost lumps and ice. The use of a cushion of bedding sand or a geotextile cushion should be considered if other methods are not feasible. The prepared subgrade should also be shaped and graded to facilitate surface drainage both prior to, and during the installation of the lining system.

Care must be taken to maintain the prepared subgrade following completion. Vehicular traffic on the completed subgrade should be limited. Marks or ruts left in the subgrade by vehicular traffic should be repaired as soon as possible. The subgrade should be protected from desiccation, flooding and freezing. Standing water should be removed so that the earthwork does not become saturated (or frozen in cold weather). A frozen subgrade, which is not unsuitable in itself, can be covered with a bedding layer if the removal of small frost lumps is not practical. Again a geotextile cushion layer could be used to correct an imperfect surface.

On projects that involve Contain Enviro Services construction crews, the subgrade will be inspected upon arrival at site. Our project supervisors will inspect the condition of the subgrade and direct corrective actions and activities to bring the subgrade to a suitable condition for lining (including dewatering) which are the responsibility of the owner or the general contractor.

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