

Tree Root Protection Using Cellweb TRP®

Fact Sheet 1: Use of Cellweb TRP® in Root Protection Areas (RPA's)



Introduction

Cellweb TRP® is a cellular confinement system that confines aggregate materials and makes them stronger. This behaviour allows the depth of pavement construction to be reduced. It also minimises compaction of soils below road pavements constructed using the Cellweb TRP® tree root protection system. Cellweb TRP® is used around the world to provide cost effective road and railway construction, as well as Tree Root Protection.

Cellular confinement was developed by the US Army Corps of Engineers during the 1970s to allow construction of roads for military equipment quickly and easily using whatever local soil material was available (especially across beaches). Since then the method has been developed and it is now routinely used in road and rail construction as well as in tree root protection. There is an extensive research base that demonstrates the performance of cellular confinement and it is a method of pavement construction that is recognised by the US Federal Highways Administration.

Characteristics of Cellweb TRP®

Pokharel et al (2009) stated that about one fifth of pavement failures in the US occur due to either weak subgrades or inefficient load transfer from the sub-base. Cellweb TRP® can improve the strength of road pavement construction to deal with these problems. It is a three dimensional interconnected honeycomb of cells made from HDPE. The cells are filled with aggregate sub-base and laterally confine the material when it is loaded, thus increasing the bearing capacity of the layer. This results in a thinner layer of aggregate being required to achieve the same performance.

It also allows uncompacted open graded aggregate to be used in the sub-base construction which is a vital part of any tree root protection system.

Cellweb TRP® is available in a range of height and aspect ratios to suit different load applications.

Use of Cellweb TRP® in RPAs

The use of Cellweb TRP® tree root protection system for building roads, car parks and other vehicular pathways includes a sub-base infill material of clean angular stone which does not need to be compacted. This immediately provides a layer of material that will absorb compaction energy applied to the top of materials placed over it. Compaction of soils by construction machinery does not extend to a great depth. This is the reason why earthworks materials are normally placed in thin layers because compaction only occurs in the top few hundred mm at most. With the lightweight compaction plant used on most development sites the maximum depth that compaction will extend to is between 150mm and 200mm. Thus, if an 80mm layer of asphalt is placed over a 150mm deep Cellweb TRP® system the compaction reaching the base of the construction and the natural soil will be minimal. This effect was demonstrated by Lichter and Lindsey (1994) where a trial area was trafficked by a front-end loader and only suffered significant compaction of the soil to a depth of 100mm.

The use of Cellweb TRP® also spreads the wheel loads from traffic. There has been extensive research published on the performance of these systems from the original work by the US Army Corps of Engineers (Webster 1981) to more recent studies such as that by Emersleben and Meyer (2008).



Figure 1 - In situ density test prior to construction of pavement

The research shows that Cellweb TRP® acts as a stiff raft to distribute wheel loads and reduce their magnitude at the base of the construction by 30% to 36% (without any asphalt or other surfacing). Once the surface is taken into account, the pressure applied by traffic to soil below roads or pavements constructed using no-dig methods will be significantly reduced and thus compaction will also be reduced. Note, compaction is not prevented but it is reduced, thus maintaining the soil bulk density at levels that are suitable for tree root growth.

The effectiveness of the Cellweb TRP® no-dig construction in reducing soil compaction has been demonstrated in trials carried out by the Environmental Protection Group Limited. Two parking bays were constructed over a fine sand soil, one with a Cellweb TRP® cellular confinement sub-base. The parking bays were surfaced with asphalt and then used by cars for four weeks on a daily basis. It is well known that compaction of soils occurs in the first few passes of a vehicle, so the maximum adverse effects on compaction of soil below the pavement should have been achieved. In situ density tests were carried out on the sand below the pavement before and after construction (Figure 1).



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Figure 2 - Cellweb TRP® in construction.



Figure 3 - In situ density tests post-trafficking.

The results in Figure 4 show that compaction of the soil below the Cellweb TRP® pavement was noticeably lower than that below the normal pavement. The increase in compaction below the normal pavement is similar to the increase found on a number of construction sites by Alberty et al (1984).

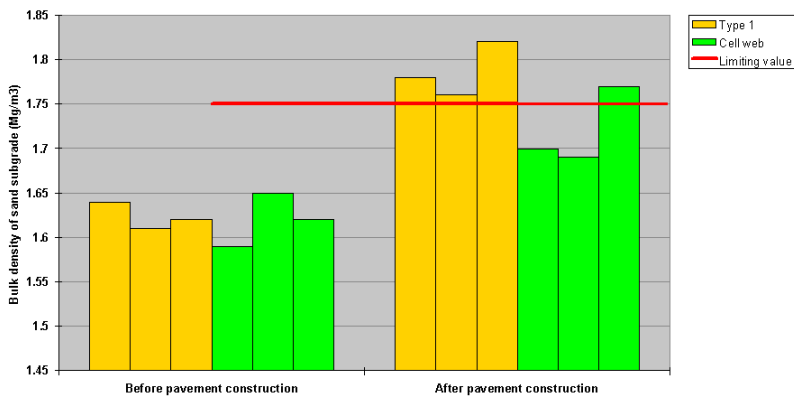


Figure 4 Comparison of soil compaction below pavements

The use of layers of uncompacted material has also been shown by others to reduce compaction of natural soil by construction plant (Lichter and Lindsay 2004). However, these were temporary layers intended to be removed after construction was finished and they are not suitable for incorporation into a permanent car park surface. Nonetheless, it does demonstrate the effectiveness of no-dig techniques using Cellweb TRP®. It is important to note that the specific properties of cellular confinement systems (eg material type, strength, welding at joints, perforations, etc) will affect how each one behaves in trials such as this. Therefore the results are only applicable to the Cellweb TRP® system.

Note

So called tree root protection systems that use Type 1 sub-base or any similar material that requires compaction will not prevent compaction of soils around the tree roots. Type 1 is also not very permeable to air and water and will limit the availability to roots. Therefore geogrid reinforced Type 1 is not suitable for tree root protection.

References

- Alberty CA, Pellet HM and Taaylor DH (1984). Characterisation of soil compaction at construction sites and woody plant response. *Journal of Environmental Horticulture*, 2, 48-53.
- Lichter J M and Lindsay P A (1994). The use of surface treatments for the prevention of soil compaction during site construction. *Journal of Arboriculture* 20 (4) July 1994.
- Pokharel SK, Han R, Parsons RL, Qian Y, Leshchinsky D and Halahmi I (2009). Experimental study on bearing capacity of geocell-reinforced bases.
- Emersleben A and Meyer N (2008) The Use of Geocells in Road constructions over Soft Soil: Vertical Stress and Falling Weight Deflectometer Measurements. EuroGeo4, Edinburgh, Scotland.
- Webster S L (1981). Investigation of beach sand trafficability enhancement using sand-grid confinement and membrane reinforcement concepts. Geotechnical Laboratory, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. Technical Report GL-79-20(2), February, 1981.

