

StormTank[®] Urban Root System Cover Requirements

Background

With the move into subsurface soil cells, Brentwood has received questions on the cover limitations. In these applications, systems need to be located closer to the surface to provide benefit for the root structure. To provide a better understanding of these details, primarily cover depths and requirements, Brentwood has developed this document.

Design

Cover Limitations

One of the biggest differences an engineer will notice is that Brentwood is allowing an 8" cover (4" concrete and 4" aggregate) in the Urban Root System application versus our standard of 24" minimum cover for stormwater storage applications. There are a couple factors that play into this consideration:

1. Systems are installed under sidewalks, plazas, etc. and not parking or driving lanes
2. Utilizing service load condition instead of strength load condition
3. HS-20 versus HS-25 vehicular loads

It is important to remember that these installations are not subjected to continual truck traffic or construction vehicle traffic but primarily serve as pedestrian throughways. Because of this, the cover requirements match the considerations of most manufacturers – service load condition. Service load condition is what the standard vehicles on the road produce, not considering factors for passing traffic, impact from surface degradation, etc. The final mentioned criteria of HS-20 versus HS-25 is to ensure a similar comparison to other manufacturers on the market.

Cover Materials

The next consideration to the cover depths are the materials being utilized. In the standard stormwater application, Brentwood recommends 24" of angular aggregate as the minimum cover. This requirement is based on testing data and the AASHTO LRFD for Bridge Design calculations for strength load conditions.

In designing cover, it is important to remember that flexible and rigid pavements perform differently and have different load distribution rates. The first thing noticeable in the images below, is how the rigid pavement does not flex around contact point to the higher degree that flexible pavement does.

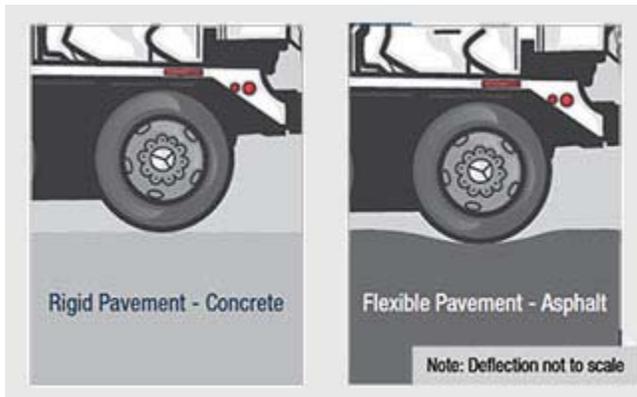
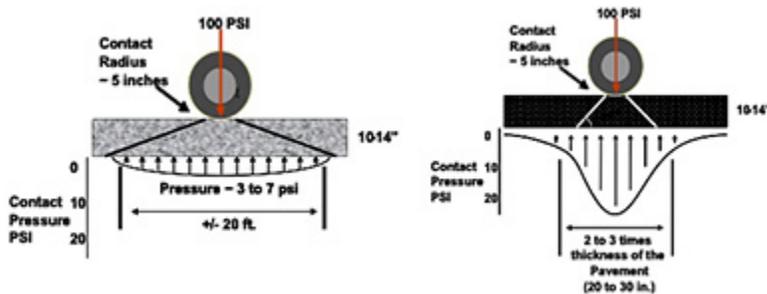


Image from Cemex Concrete (<http://www.cemex.com/ProductsServices/images/PavementsGraphic4.jpg>)

The second noticeable item is that the rigid pavement provides a much higher load distribution spread than a flexible surface. Because of this reduction, the illustration below shows how the rigid pavement provides nearly 10x wider distribution and 10 psi less pressure applied to the surface below. Additionally, there is a noticeable difference in the pressure cover, with the rigid pavement generating a much more uniform pressure compared to the high peak of the flexible pavement pressure.



Images provided from Cemex Concrete (<http://www.cemex.com.eg/Concrete/BenefitConcrete.aspx>)

Reinforcing

The final element that people ask about is the reinforcing illustrated in our standard details. This reinforcing is the inclusion of welded-wire-fabric (WWF), commonly referred to as welded-wire-mesh, and a manually placed and sized rebar system. One may wonder why this is being recommended...

This recommendation comes from years of experience in concrete slab, driveway apron, and sidewalk design and installation. The illustration below is an expansion on the previous image that shows surface deformation. In this image, you can see as the wheel load is applied, the surface below is deformed, causing tension and compression in the pavement. Concrete is well-suited to handle these compression forces but has limited resistance to tension, which can lead to things like cracking and long-term deterioration.

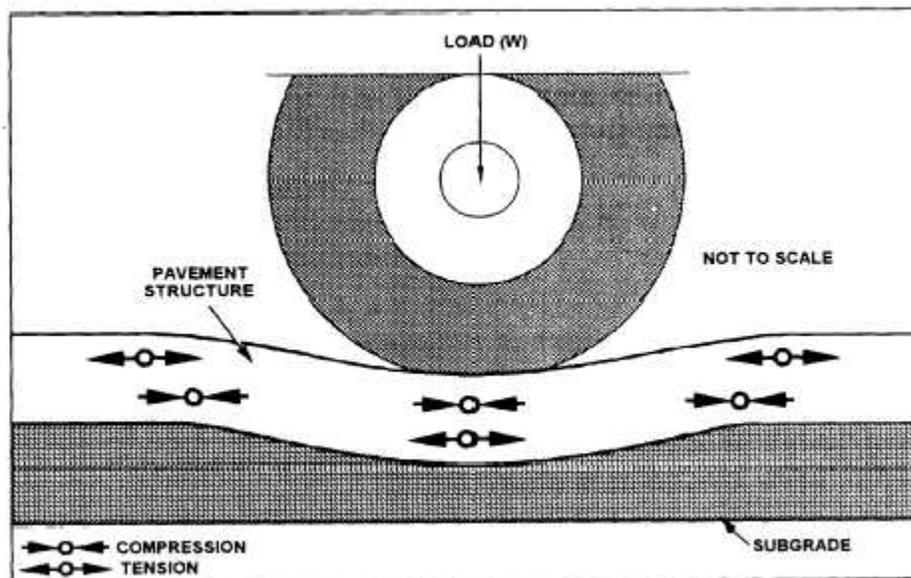


Image from (http://enginemechanics.tpub.com/14081/img/14081_465_1.jpg)

It is this tension element of the deformation and goal to reduce cracking that has led to the recommendation to include WWF, not to enhance the vertical load distribution. This combination of materials (concrete and WWF) provides both the compression and tension resistance to account for any deflection, whether it be settlement of the stone below or movement in the concrete (shrink, etc.).

Conclusion:

As always, it is Brentwood's intention to provide a superior product as well as the technical expertise required to educate the engineer, contractor, and owner to provide the best end result. In doing so, every application must be considered individually, based on site limitations, project requirements, and performance expectations. Through the extensive testing and knowledge, the cover requirements of 8" minimum cover (4" concrete with WWF and 4" angular aggregate) has been established for the Urban Root System application but can be altered by a licensed professional to account for local differences in sites, installation practices, etc.