

Soil Stabilization For Peeled Road

Soil stabilization supplemented with cement reclaims this washed out Bethlehem street.

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A wall of water 7 feet to 8 feet high rushed through Sunset Drive, leaving a roadway that resembled a dry riverbed.

receives a new hot mix overlay. When a retention pond filled to capacity and overflowed, the high water funneled onto these streets and flowed downhill gaining volume and speed as it entered the western part of Sunset Drive.

Sunset Drive is a quite small neighborhood of single homes with gently sloping properties.

What happened next has never been witnessed before in this busy semi-rural municipality. A wall of water 7 feet to 8 feet high rushed through Sunset Drive taking everything in its path – pool equipment, small trees, shrubs, and cars. What was left of the roadway resembled a dry riverbed. The asphalt had been ripped off the base material and that base material in some areas was undercut 2 feet to 3 feet. This exposed manholes and water valves; the remnants of the asphalt and other material lay on the roadway.

In an effort to restore the road, the Public Works Director Mr. Richard

In the autumn of 2004 Bethlehem Township, Pa., became one of many victims of Hurricane Charley. The torrential rains that fell caused many of the local retention ponds and levees to fill to capacity. During the summer months a number of township roadways had received total reconstruction through a process called Cold In-Place Recycling. The process is a reconstruction of the in-place old deteriorated asphalt materials to make a new black asphalt base, which then

Grubb contacted E.J. Breneman, West Lawn, Pa., for recommendations. According to Breneman's Mike Polak, the initial site visit was devastating.

"When you see an old lady sitting on a bucket separating destroyed family photos from salvageable ones into piles, it really makes you think of how much damage a storm like this can do. Not only to the physical things like the roadway but to the heartache of those who may have lost something that can not be replaced."

Polak realized that the roadway needed attention quickly. The asphalt was mixed with soil and rock and with areas undercut by 2 feet. Cold in-place recycling was out of the question. Soil stabilization was the next best solution.

Stabilization is the process of preparing subbase soils to provide a higher load-bearing capacity, so they can better withstand heavy traffic stress. Stabilization involves pulverizing and mixing the soils thoroughly, with suitable binders, so that after proper compaction and curing the soil is more dense (stable) and provides for a stronger base as desired. Proper stabilization of the subbase soil, followed by appropriate compaction, is a major contribution to the integrity and longevity of the finished project. One factor contributing to this is the fact that weather and frost resistance is much improved. Stabilization techniques provide the same results in the case of rehabilitation (recycling)



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of older, deteriorated roads, runways or parking lots.

Portland Cement Soil Stabilization works both chemically and physically to improve and stabilize poor soils. Its effect on both granular and clay soils is excellent. Portland cement is a fine powdered hydraulic binder. It consists primarily of calcified lime compounds, mixed with silica, alumina and iron oxide. When mixed with water, cement will set and harden both in air and under water. Cement (which can be applied either dry or as a slurry) is used to treat both granular and silty clay soils in subgrades or base materials.

Cement works both chemically and physically to improve and stabilize poor soils. Its effect on both granular and clay soils is excellent. In granular soils it binds the material together in a process similar to soil cement, but at a lower compressive strength than is required for true soil cement. In clay soils, through a process know

as hydrolysis, cement reacts chemically with the clays to reduce plasticity index (P.I.). Strength gain occurs as the cement/soil mixture hydrates. During these processes of hydrolysis and hydration, Calcium Hydroxide Ca

(OH) 2 is released. This chemical is more reactive than ordinary lime, and converts the clay to the calcium form, intensifying flocculation of micron-sized particles. The dissolved silica and alumina subsequently combine with calcium ions and precipitate cementitious material.

Cement stabilization also increases the shrinkage limit as well as the compressive strength of the soil in question. Stability and load bearing capacity of a soil layer depends on two factors – the internal friction and cohesion of the soil particles. The higher the internal friction, the better the cohesion, and consequently, the greater the load bearing capability of the soil layer. Internal friction is influenced by particle shape, particle size (gradation) and compaction.

Cohesion depends on the soil type, i.e. clay, sand, muck, etc. If the friction is too low, or cohesion inadequate, heavy traffic will deform the soil layer which, in turn, affects the finished project. Substandard friction and/or cohesion of the soil must, therefore, be improved. This is accomplished by adding a chemical binder to the soil to cause the particles to meet the desired properties of friction and cohesion.

The advantages of stabilization are numerous:

- Allows the use of otherwise unsuitable in-place soils.
- Eliminates the need and expense of excavating and removing unsuitable soils, since no soil exchange is necessary.
- Eliminates the cost of transporting and placing new, more costly materials at the job site.
- Reduces costs by the "mixing in-place" process.
- Reduces overall construction time, thereby enabling roads and/or runways to be opened to traffic more quickly.



When the roadway was graded and compacted to the rough shape of the new profile the metered additive spreader delivered the Portland cement in its dry form at 6 percent to the surface of the roadway.

was established using 6-percent Portland cement by weight of the material. The original concrete gutter pans over the years had been blacktopped over at nearly all the residents drive ways. This material was graded away and into the roadway as it was severely cracked. The reclaimer then pulverized the existing materials in-place to a depth of 10 inches. The material that was reclaimed was of a gradation no greater than 1.5 inches and was excellent for mixing.

After the reclamation was complete some of the excess material was used to backfill the undercut areas and compacted. The grader also graded all material away from the concrete gutter pan so the reveal was 3 inches along all edges. Leaving this reveal allowed the Bethlehem Township Public Works Paving crew room to lay a new 3-inch-thick hot mix asphalt as a wearing surface.

When the roadway was graded and compacted to the rough shape of the new profile the metered additive spreader delivered the Portland cement in its dry form at 6 percent to the surface of the roadway. The spreader is equipped with a skirting around the feed auger so as to keep

the dry cement from getting air born. The reclaimer then mixes the dry cement, the soils and water together.

The right moisture content in the mix is required to enable the additive to react and work with the soil to stabilize and strengthen. The material after mixing is then compacted using both padfoot roller and smooth drum roller to get the required density. A motor grader then cuts the compacted material to its final grade. The smooth drum roller then compacts any disturbed area.

The final stage of the project is the application of a prime coat; normally a diluted asphalt emulsion. The coat solidifies the surface and keeps the dust particles down. It also stops the normal heat evaporation of the moisture in the mix from taking place too fast. It is also important that once the mixing of the Portland cement, soil and the water takes place that the whole project then has to be moving forward so time is available for compaction and grading. The material will start harden within hours of the mixing.

The final operation on Sunset Drive was the application of a 3-inch hot mix super pave asphalt. ■

Sunset Drive Reconstruction

Two soils samples were taken and tested for what chemical additive was most suitable for this particular roadway. A mix design



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