Information To Build On
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December 23, 2009

Mr. Steve Merritt
C.S.S. Technology
P.O. Box 549
Tolar, Texas 76476

Re: Shelman Trail Sub-Grade Testing

Dear Sir:

Attached herewith please find the engineering report on the subject project which was carried out in accordance with our proposal. Mr. Anderson has signed and sealed the report. We have included a picture file with the report which is part of the report.

It has been our pleasure to serve you on this project and we look forward to serving you on future projects.

Sincerely

Tom Zatopek
Branch Manager

Attach: Shelman Trail Sub-Grade Testing incl/ picture file

SHELMAN TRAIL SUB-GRADE TESTING

PURPOSE: The purpose of the sub-grade testing performed on December 15, 2009 was to evaluate the condition of a sub-grade placed in March of 2009 and treated with Roadbond en1.

BACKGROUND:

The City of Fort Worth has had considerable difficulty in maintaining the 1900 block of Shelman Trail. There are large diameter trees in one section of the block and their root structure appears to be impacting the asphalt/flex base pavement structure.. The problem got substantially worse when the City sought to replace the paving in the area of the trees. The tree roots reacted negatively to the lime treated sub-grade and attempted to heal themselves by taking in water. This caused extensive cracks to develop in the pavement. The City agreed to test Roadbond en1 at this location providing it was made available without cost. Roadbond en1 does not require the high levels of alkalinity that lime needs in order to be effective. In fact, the pH level is close to neutral. The base course of Shelman Trail is a mined material of gravel mixed in a high P.I. clay and had been previously lime treated. The existing asphalt and base course was pulverized and Roadbond en1 was mixed in at standard rates (1 gal concentrate per 30 c.y. of material). After compaction at close to optimum moisture, the en1 treated base course was overlaid with approximately 2.5-inches of asphalt. The placement date was March 1,2009. It was paved on March 10. Traffic was allowed to run directly on the compacted, but unpaved sub-grade for about nine days. No rutting was observed except in one small area found to be unusually wet. Subsequent investigation found a tree root wicking moisture into the sub-grade. That root was removed and no further problems were experienced.

CURRENT CONDITION

The current condition of the test section is excellent. There are a few very fine cracks in the area of the trees which are too fine to rout and seal. These very fine cracks were apparently caused by clay shrinkage due to water demand by the tree roots. Outside the area of the trees, the condition of the test section is near perfect (See picture #1 &#4). There is no rutting or stress cracking anywhere in the test section.

TESTING SETUP

Three locations were marked in the area treated with Roadbond en1, two of which were in an area bounded by trees. The third location was marked outside the wooded area. A forth location was marked outside the Roadbond en1 treated area. The locations were cored with a coring rig through the asphalt overlay. The asphalt core was then removed to expose the base course. The coring rig uses water to cool the bit and a small amount of the water reaches the material to be tested. A shop vacuum was used to minimize the amount of water reaching the base course. A Drop Cone Penetrometer (DCP) was then

used to measure the strength of the Roadbond treated base course. The DCP is designed to mimic a 140 lb. hammer driving a split spoon sampler and has been found to have a high degree of correlation with test results using the larger and heavier rig. A sample was then taken from the base course for moisture analysis. Location K-1 was not sampled below the base course due to the proximity of a water service line, but all other locations were sampled below the base course. The holes were patched with "asphalt patch" following completion of testing.

TEST RESULTS

The asphalt at location K-1(1921 Shelman Trail) was 2.5 inches thick. The blow count on the base course in location K-1 was 27 blows. Using charts published for the 140# hammer, this indicates a bearing capacity of approximately 10,000 lbs. per square foot (psf).

The asphalt at location K-2 (1913 Shelman Trail) was 2.5 inches thick. The blow count on the base course was 28 blows. This would indicate a bearing capacity of approximately 10,500 psf. The blow count on the second layer was 19 blows (8000 psf). The count on the third layer was 12 blows (6000 psf). Moisture levels in the first two 6-inch increments were 9.4%.

The asphalt at location K-3 (1908 Shelman Trail), outside the wooded area, was 2.5 inches thick. The blow count on the base course was forty-four (44). That is equivalent to approximately 13,000 psf. The blow count on the second layer was 26 blows (9500 psf), but dropped sharply to 4 blows in the third layer which was untreated and contained no aggregate. The four blow reading in the untreated soil is equivalent to about 3000 psf, the lowest value available for input into the WINPAS street design program for sub-grade. This compares to other tested locations in similar soils. The moisture levels in the base course material averaged 10%. The moisture level in the 12" to 18" level was 17.9%.

The asphalt at location K-4 (1905 Shelman Trail), outside the test area, was 2.5 inches thick. The blow count was 26 (about 9500 psf). The blow count on the second layer was 24 (about 9000 psf). The presence of a large rock prevented getting a blow count on the third layer. See Picture #3 for test location and to note recent crack sealing. The moisture level in the base course was 8.4%.

EVALUATION

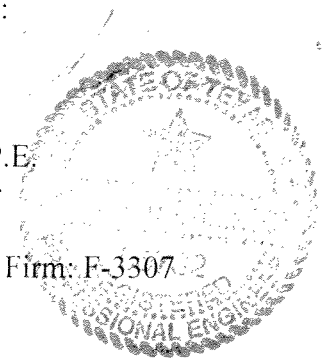
The base course under all pavement was mined aggregate road base in a high P.I. clay. The bearing capacity of all samples was excellent. The likely cause of the original failure was the activity of the tree roots when placed in the highly alkaline environment of the limed sub-grade. Roadbond en1 does not cause that reaction and I would not anticipate any further difficulty in that section of street. Although Road bond en1 is frequently used with both lime and cement, I would not recommend that combination in any area where tree roots extend into the street structure. The location of the drip line of the tree is a good indication of where the roots are. The test results indicate that the bearing capacity of the Roadbond Treated section is equal to or better than the lime treated aggregate base course originally installed. I estimate the remaining service life of Shelman Trail to be in excess of 15 years. I used the WINPAS pavement design program to make this estimate.

The U.S. Army Corp of Engineers recommends California Bearing Ratios (CBR) of between 50 to 80 for road base course with the value and the thickness being determined by traffic loading. Blow counts of the DCP are sometimes converted to CBR using the following formula:

Log CBR=2.067-1.01(log PR) where PR is the blow count converted to millimeters per blow.

The CBR value of the base course at K-1 would be approximately 72 using that formula, certainly adequate for a residential street.

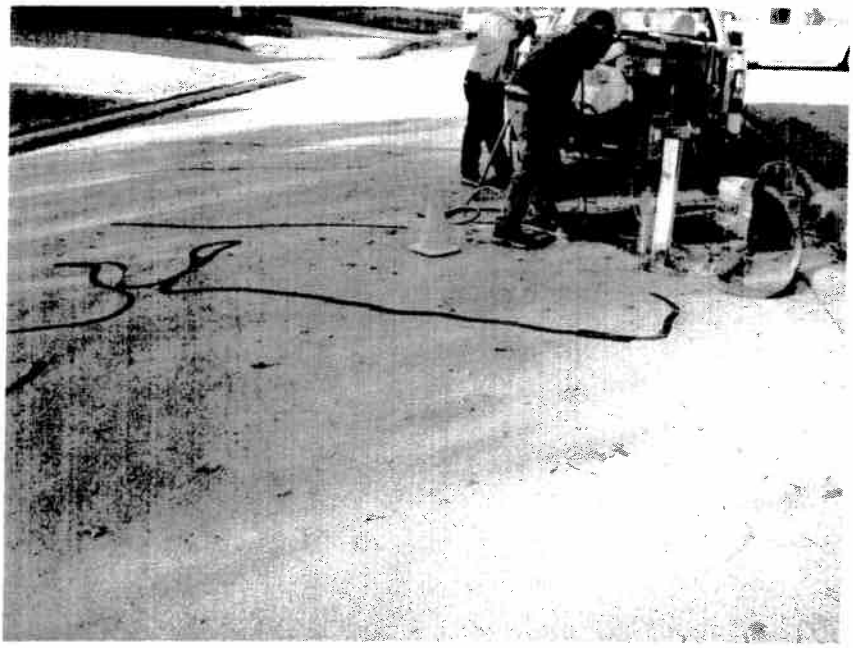
Respectfully Submitted:



James Roy Anderson, P.E.
Senior Project Engineer

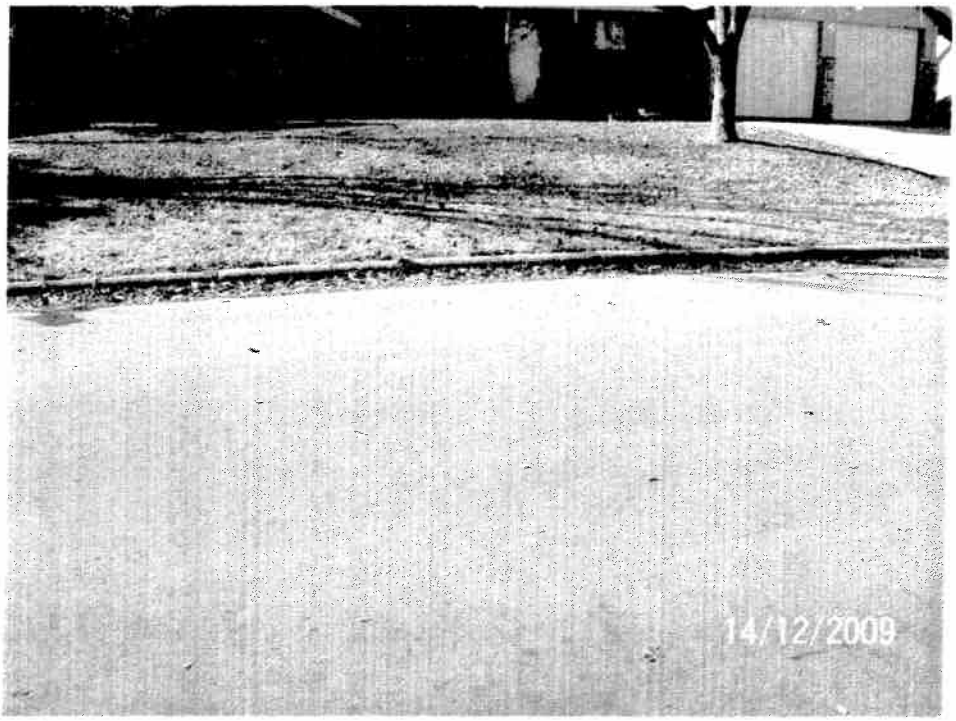
Registered Engineering Firm: F-3307

Picture #1-Roadbond en1 treated area-Near perfect condition.



Picture #2-Sample taken from untreated area-recently crack sealed with asphalt.

Picture #3-Untreated area-Note extensive shrinkage cracking. No trees in this area.



Picture #4-K-3 location-Blow count was 44. No trees in this area.