Engineering
UPDATE©

MEA MARINO ENGINEERING ASSOCIATES, INC. • Issue 28

AIRPORT PAVEMENT SUBBASE AND SUBGRADE PREPARATION DIFFICULTIES

In a competitive bid scenario the contractor has to make certain assumptions regarding the effort required to construct the subbase/subgrade as specified. Designers often times do not, however, give sufficient thought to constructability when specifying the required subbase/subgrade. Little data is normally provided to the contractor on difficulties which may be encountered, implying to some that no “out of the ordinary” installation problems will be encountered.

An MEA investigation where airport pavement difficulties in Oklahoma were encountered, exemplifies the above and is discussed herein. The project involved the construction of a taxiway and connecting staging area. The taxiway and staging area required 12.5 in. and 7 in. of reinforced concrete. Along the 50 ft. shoulders, 2 in. of hot asphalt concrete was specified. Beneath all pavement areas a 6 in. subbase at 100% compaction or more was required. All soil subgrade and fill required greater than 95% compaction. All subbase stone and subgrade compaction was to be performed within 2% of the optimum water content.

Problems began during pavement construction when the prepared subgrade became wet from precipitation. This resulted in egregious softening and swelling, which destabilized the overlying subbase. The potential for swelling and softening can be seen in constructed pavement with the swelling heave differential of about 1.3 in. between the concrete and asphalt pavement (see Figure 1).

FIGURE 1: DIFFERENTIAL HEAVE OF 1.3 IN. FROM SUBGRADE SWELLING BETWEEN THE TAXIWAY

To investigate whether the subgrade specifications would be problematic during construction, a series of strength tests (i.e. CBR tests) were run on compacted site clay subgrade samples. The results, which are shown in Figure 2, were consistent with the difficulties encountered in the field. When the clay soil subgrade was exposed to moisture it became extremely unstable when prepared to within the specified moisture and compaction range and actually showed better performance at greater moistures.

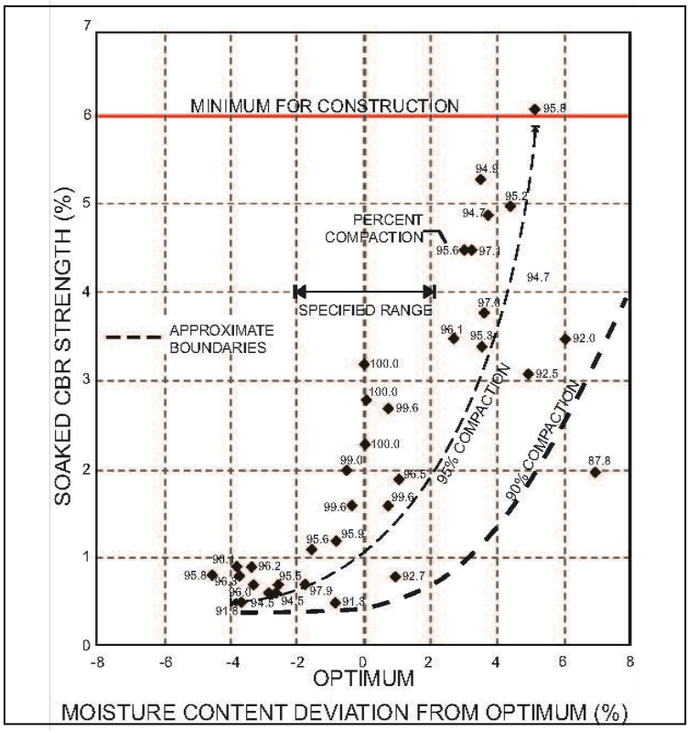

FIGURE 2: MOISTURE CONTENT RELATIVE TO OPTIMUM PLOTTED AGAINST THE SOAKED CBR VALUE FOR ALL COMPACTED SAMPLES

As a result of the degradation of the red subgrade soil during construction, it became difficult to install the subbase stone to the specified conditions. The project engineer,

however, identified the wrong target. He contended that the subbase was discolored by the contractor during installation of the subbase and consequently contaminated with the red clay subgrade. From laboratory tests it was found that discoloration was not, in fact, a good measure of contamination. Mixtures of the subbase stone and the red subgrade soil showed that even with the addition of only 0.5% of the subgrade soil, discoloration was achieved (see Figure 3). The subbase stone used by the contractor typically had 7-9% fines and 20% was allowed in the specifications. Consequently, the discolored subbase stone could fall well within the range of the fines allowed and therefore was not a good measure of significant contamination and rejection of the subbase material.

LESSON LEARNED:

Oftentimes, construction subbase/subgrade issues are not sufficiently addressed in the plans and specifications. Foresight into pavement preparation constructability issues during design can significantly mitigate disputes, claims, delays and the final cost, especially with respect to large projects such as the one mentioned above.

FIGURE 3: PHOTOGRAPH SHOWS DISCOLORATION TEST RESULTS: SUBGRADE FINES ADDED TO THE SPECIFIED BASE ROCK USED ON PROJECT AT PERCENTAGES BY TOTAL DRY WEIGHT OF: 0.5% (UPPER LEFT); 1.0% (UPPER RIGHT); 2.0% (LOWER LEFT); AND 4.0% (LOWER RIGHT). CONTROL SAMPLE (0% FINES ADDED) IS IN THE MIDDLE.

Other Engineering UPDATES of Interest:

UPDATE 29: Hangar Slab Assessment for Poor, As-Built Subbase/Subgrade Conditions

UPDATE 7: Soil Provides Poor Road Construction Support

UPDATE 12: Investigation of a Roadway Failure

ABOUT MEA: Marino Engineering Associates, Inc. focuses on engineering research, practice and expert evaluations and is licensed in 25 states in the U.S. Our projects primarily have an emphasis on Geotechnical Engineering, however, we also have significant experience in projects involving transportation, subsidence engineering, laboratory testing, training, and geophysical exploration. Gennaro G. Marino, Ph.D., P.E., D.GE is president and principal engineer of Marino Engineering Associates, Inc., and has been a licensed professional engineer since 1984. To obtain additional information on MEA, one can also visit our website at www.meacorporation.com.

FOR MORE INFORMATION: There is a significant amount of additional information that is available on the above subject. For more information, please contact MEA at the address listed below.

MARINO ENGINEERING ASSOCIATES, INC.
1370 MCCAUSLAND AVENUE, ST. LOUIS, MISSOURI 63117
PH: 314.833.3189 FAX: 314.833.3448
http://www.meacorporation.com