Structural Condition Assessment of Reinforced Base-Course Pavement
USCOE ERDC/CRREL and NHDOT

Summary

The US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) teamed with the New Hampshire DOT (NHDOT) to perform a structural condition assessment of three distinct pavement sections. The report, released in November 2015, presents the results of a 4-year study focused on a 2-mile section of Pickering road in Rochester, New Hampshire. There were three distinct pavement sections. The northernmost section contained TX160 geogrid within the base course. The southernmost section contained a woven geotextile separator between the subgrade and the subbase layer. The intermediate section included both the TX160 geogrid in the base course and the woven geotextile separator between the subgrade and subbase layers. The study location was within a region of the country, which experiences freeze-thaw conditions. In this regard, the pavement sections in this study experienced 1162.4°C freezing degree-days for the winter of 2014-2015. This remains the regions highest number of degree freezing days recorded over the past 15 years. Seasonal structural assessment consisted of falling weight deflectometer (FWD) testing on all pavement sections. Based on the seasonal back-calculated moduli for 2014 and 2015 values the TX160 stabilized pavement section provided higher moduli than the other sections. The report goes further and states that aggregate layer thickness can be reduced to 33%-42% if the base course is stabilized with TriAx geogrid. The authors' conclusions state, "This higher stiffness should allow the pavement to withstand many more traffic repetitions before fatigue cracking develops; and the geogrid should minimize the influence on thermal cracking."

Construction, Evaluation and Performance Assessment

The New Hampshire Department of Transportation constructed the Rochester New Hampshire Pickering road project in the summer of 2011 on a two-mile section of Pickering Road in Rochester, from Quaker lane to 1,000 feet south of England Road. The project was constructed in three phases. Phase one from England Road to Tebbetts Road. Phase 2 from Tebbetts Road to Quaker Lane, and Phase 3 involved reconstructing 1,000 feet of Pickering Road south of England Road. The completion date of October 14, 2011 was reported on the NHDOT website (http://www.nh.gov/dot/media/nr2011/nr080811rochester.htm).

In 2014, NHDOT drilled nine borings to verify the thickness of the pavement structure. The test borings went to a depth of between 6 and 6.5 feet below the pavement surface. Asphalt, base, subbase and subgrade materials were sampled at this time. Based on the test borings the asphalt layer thickness varied from 5 to 6 inches.

To evaluate frost penetration the NHDOT installed frost tubes. This equipment was used to monitor frost and thaw depths in the pavement. The weather information as shown in Figure 1 was utilized in determining when the frost tubes required measurement. The maximum frost depths measured were 42 to 45 inches during the 2014-2015 winter. This information was necessary to establish the appropriate time for FWD testing. Additionally, probes were installed in the pavement sections to monitor moisture and temperatures at depth. This provided valuable insight into values used for back-calculation.

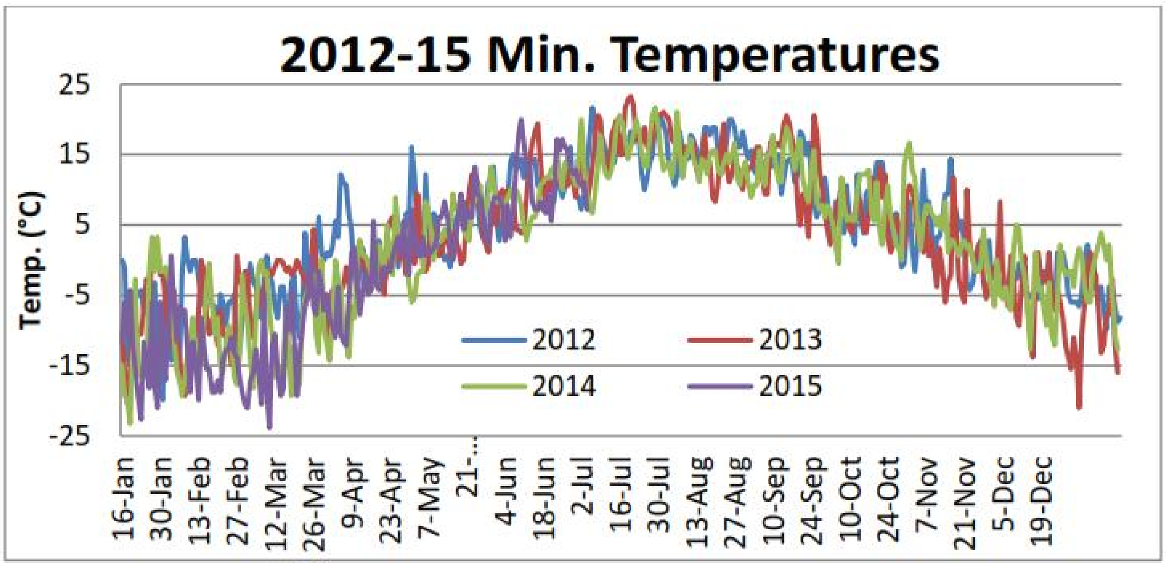

Figure 1 – Minimum recorded temperatures from 2012-1015

Results

The USCOE CRREL conducted FWD testing from April 2014 to April 2015. Results from the March 17, 2015 tests are shown in Figure 2. To relate the unstabilized and stabilized sections the authors' conducted a back-calculation analysis to estimate the equivalent thickness of the stabilized base course. The results of this analysis are found in Table 1.

From Table 1 the authors' concluded that an 18 to 19 in. range of unstabilized base course is equivalent to a range of 8 to 11 in. of TriAx stabilized base course. Further, the authors' noted that for the conditions associated with this study location the TX160 stabilized base course indicated a significant performance increase.

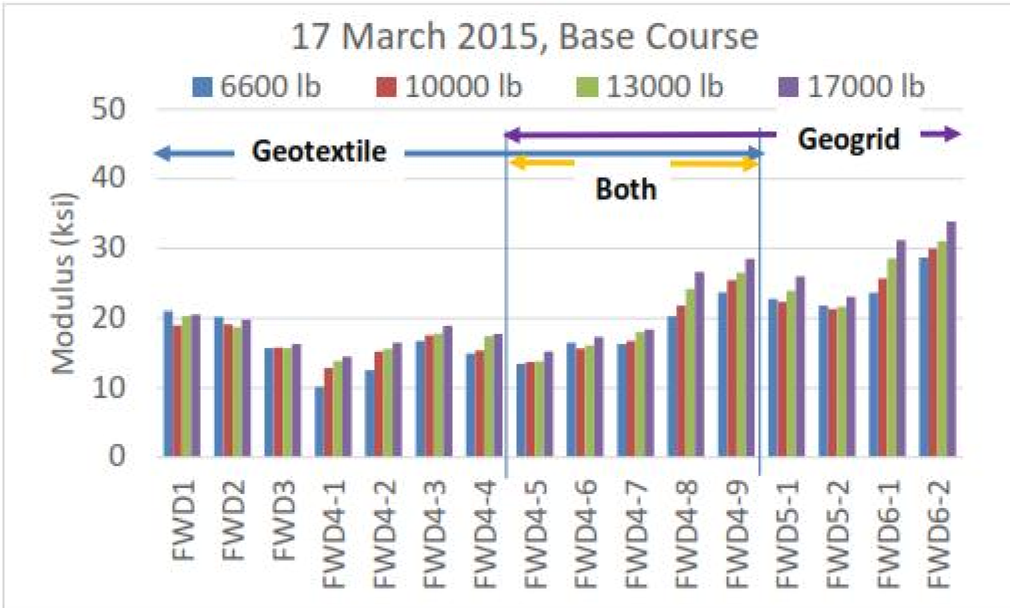

Figure 2 – Average values of back-calculated moduli for four loads.

Test Section		Base-Course Layer Thickness, in.		3 April 2014 Moduli (ksi)	1 April 2015 Moduli (ksi)	27 October 2014 Moduli (ksi)
Non-reinforced Base Course (Geotextile at subgrade)	FWD4-1	18	Actual thickness	7	8	16
	FWD4-2			7	8	17
	FWD4-3	19		11	10	19
	FWD4-4			9	8	18
Reinforced Base Course (Geogrid in base course & geotextile at subgrade)	FWD4-5	12	Equivalent or modified thickness	6	4	17
	FWD4-6			8	4	17
	FWD4-7			8	6	15
	FWD4-8			11	5	18
	FWD4-9	11		9	8	20

Table 1 – Unstabilized and TriAx stabilized base-course equivalent thickness and moduli values.

Considerations

After a 4-year study, the road section stabilized with a Tensar TriAx geogrid outperformed those sections containing a geotextile alone. Findings show that 8-11 inches of base course, stabilized with Tensar TX160, is equal to 18-19 inches of unstabilized base course. This is a 33-42% reduction in aggregate.

Many agencies in northern states deal with heavy freeze-thaw cycles. This study demonstrates the effectiveness of a TriAx geogrid stabilized section to improve performance under these conditions.

This study demonstrates the importance of monitoring climatic conditions and moisture within a pavement structure. The modulus values change over the different seasons and with different moisture contents. Frozen soils can lead to inaccurate measurements if not accounted for. Testing, measuring and understanding the support values of a section are critical for accurate interpretation.