

March 2, 2010

File: 09-010

Jim Rowland, P.E., Project Manager
Matanuska-Susitna Borough
Planning and Design
350 East Dahlia Avenue
Palmer, Alaska 99645

RE: Geotechnical Recommendations for Parks Highway Connections: Museum Drive

Dear Mr. Rowland:

This letter presents HDL's geotechnical recommendations for the construction of the Parks Highway Connections Museum Drive roadway alignment. The geotechnical recommendations are based on the draft "Geotechnical Report for Parks Highway Connections: Museum Drive" dated March 2, 2010.

The project consists of new roadway construction of an east-west connector between Museum Drive and Sylvan Road in the Matanuska-Susitna Borough. In general, the soils encountered in the 20 borings advanced during the field study consisted of gravelly sands and sandy gravels. The majority of the subgrade soils have low fines contents (percent passing the #200 sieve). The frost susceptibility ranges from none to medium. A few thin pockets of sandy silt that are highly frost susceptible were encountered along the alignment. A peat bog area at the east end of the alignment was also observed (Stations 104+00 to 109+00).

Recommendations have been developed for this new roadway construction based on the findings of geotechnical studies along the alignment. The recommendations address the pavement structural section design, general recommendations for site construction and culvert placement, and mitigation design options for the roadway section through the peat bog at the east end of the alignment.

Structural Section Design Between Stations 10+00 and 104+00

The Alaska Flexible Pavement Design Manual (ADOT&PF, 2004) was followed for the performance analysis, and design of the asphalt pavement thickness and structural section for the project. The manual recommends the use of the ADOT&PF's Excess Fines Method. The project design life for the structural section is 20 years. Periodic maintenance and rehabilitation of the asphalt pavement should be expected over the 20-year design life of the structural section. Kinney Engineering has provided the traffic analysis for the new roadway. Based on different planned traffic usage, equivalent single axle loads (ESALs) have been estimated at 394,400 and 317,300, between Sylvan Road to Vine Road and Vine Road to Museum Drive, respectively. Two roadway sections were evaluated based on these estimated traffic volumes. The resulting structural section from the Excess Fines Method for the alignment between Stations 10+00 to 104+00 is the same because the supporting soils and the ESAL values are similar enough, with respect to future damage and pavement deflections, to allow for the use of the same structural section. The output of the excess fines design software is presented in Figure 1. Type A material is to be used where additional material below this structural section is required to meet grade.

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The general structural section recommendation for Stations 10+00 to 104+00 is as follows:

Thickness (in.)	Material Type
2	Asphalt Concrete Pavement
6	Base Course Material
18	Select Type A Material
12 (min.)	Type A Material (as needed to meet grade)

Structural Section Materials and Construction Considerations

The materials specified for the structural section should meet the gradation requirements per ADOT&PF Standard Specifications for Highway Construction.

Prior to placement of the roadway embankment fill, the vegetative mat and organic surface soils should be removed. The supporting in-situ soils found along the alignment will be suitable as supporting subgrade soils for the embankment structural section. Before placing the structural section, the surface of the subgrade should be ripped, moisture conditioned, and proof rolled to create a firm, unyielding surface to support the placed materials. We recommend that subgrade soils within the pavement support zone be compacted to at least 95 percent of their maximum dry density based on the Modified Proctor Method (ASTM D1557). The base course and selected material should be placed in maximum 8-inch loose lifts and compacted to 95 percent of the maximum dry density (ASTM D1557), including base preparation.

The performance of the road is controlled by the details of construction and the quality of the materials that must be selected on-site or imported to the site and placed and compacted to develop the needed embankment and structural section. Quality control inspection is strongly recommended during support soil and asphalt placement to ensure that the intent of the specifications be met.

The use of culverts will likely be required for several sections along the alignment, including the sections adjacent to Vine Road and the section adjacent to existing Museum Drive in the peat bog area. These culverts will require seating on firm unyielding foundation materials in order to provide adequate transfer of stresses and reduce settlement, which would result in poor performance of the culvert. Culverts placed in the peat bog area should be installed after a stable embankment is constructed in order to reduce differential settlements. Care should be taken when backfilling adjacent to the culverts to ensure proper seating and compaction.

Peat Mitigation Recommendation Between Stations 104+00 and 109+00

This section discusses the project recommendations for the section of roadway located at the east end of the alignment connecting to the existing Museum Drive. The proposed alignment will cross a peat bog in this area. The geotechnical field study located and measured the existence and approximate depths of a deposit of peat and soft soils (refer to the peat contour map presented in Figure 11 of the geotechnical soils report, under separate cover). It should be noted that no samples were collected in this area and it is unknown whether these peaty deposits consist entirely of peat or a mixture of peat and soft soils. Therefore, where the recommendations refer to the soils in this area as "peat" there may be

a mixture of peat and soft soils. The peat reaches depths of approximately 90 inches or 7.5 feet. These deposits, if left unmitigated, will not provide adequate support of the roadway embankment. Total and differential settlements have been estimated to be up to 18 inches over the 20-year design life of the roadway section. Several alternatives have been evaluated for mitigation and are presented below:

Peat Removal and Replacement

The most common option for mitigation is complete removal of the peat and soft soils to the depths encountered. Below this layer there will likely be firm granular material as found elsewhere along the alignment. Removal of the peat and soft soils at depths greater than 4 feet may be difficult due to the site conditions. The peat is highly saturated and free water in this area was found at the surface. Therefore, dewatering or other measures accounting for the groundwater will likely be necessary to maintain an open working area. For preliminary planning purposes, estimation of the permeability coefficient for the peat is about 2 to 0.002 ft/min.

Once the peat and organic materials have been removed, granular soils will need to be prepared in similar fashion to those along the rest of the alignment. The replacement fill materials should consist of Type A aggregates meeting the gradation requirements per ADOT&PF Standard Specifications for Highway Construction. This fill should be placed in 12-inch loose lifts and compacted to 95 percent of the maximum dry density (ASTM D1557) up to the bottom of the grade for the structural section. The section for Stations 10+00 to 104+00 can then be constructed.

Surcharging for Consolidation

Due to the significant depths of peat and soft soils found in the roadway alignment, removal and replacement may not be cost effective. A second alternative is to surcharge the embankment zone in order to consolidate the soft peaty soils. This will consolidate the soft subgrade and minimize future differential settlements between the existing Museum Drive road embankment and the new roadway embankment. A minimum surcharge thickness of 4 feet above the proposed finished grade should be applied to the road embankment section, resulting in 7 feet of fill placement. Figure 2 presents the estimated consolidation rates of the peat and soft soils under varying loading conditions. In this figure the "Maintained Grade Roadbed" consolidation curve represents the approximate settlement from placing the required 3-feet of structural section and then maintaining the required grade by adding fill material to offset the continuing settlement. The surcharging period was selected as 100 days, or approximately 3 months, to accomplish surcharging in one summer. Settlement, due to the placement of fill to meet the proposed grade plus the additional surcharge, is expected to be about 16 inches to 21 inches.

The embankment fill and surcharge should not be placed greater than 4 feet in depth per week at areas where placement will be directly on the peat. This will allow the peat time to consolidate under the new load and limit failure of the peat. Prior to fill placement, a non-woven geotextile should be placed on the surface of the existing ground in order to prevent migration of the fill material into the peat layer below. The fill should be placed and compacted to 95 percent of the Modified Proctor maximum dry density (ASTM D1557). Lifts should be limited to 12-inch loose lifts. However, the first lift over the geotextile should be 18-inches loose thickness and compacted. If the lift cannot be compacted to 95 percent of the Modified Proctor maximum dry density without pumping and failure of the peat, then the compaction effort should be stopped and the lift rolled to a level surface. An additional lift should be placed and compaction effort resumed. A Modified Proctor maximum dry density of 90 percent is acceptable on this second lift if it also starts to pump.

The peat will start to consolidate immediately as the load is applied. Care should be taken to measure the amount of fill that is placed so that a maximum of 4 feet per week is achieved and that the overall thickness of the surcharge is achieved.

After the 3-month surcharge period it is estimated that the contractor will need to remove 3 feet of surcharge material in order to meet grade. However, the structural section will still need to be constructed. Therefore, it is recommended that the contractor uses Select Type A aggregate as fill material for the upper 4.5 feet of surcharging fill. After the 3-month surcharge period and excess surcharge materials are removed, the base course should be placed and compacted as specified previously.

Geogrid-Reinforced Embankment

The use of geogrid geosynthetics is another alternative to those detailed above. The geogrid provides subgrade improvement at the interface of soft soils such as the peat and can decrease the impact on the new roadway structural section. This roadway section can be built on the existing subgrade without removal or significant surcharging. The tradeoff comes with potential for differential settlements and rutting to depths of 1 to 2 inches and more prevalent potholing. This may result in higher maintenance costs over the life of the roadway. During construction there may be some consolidation of the underlying soils as well. This will likely be up to 1 foot in the areas with the deepest peat deposits.

Using Tensar International Corporation’s SpectraPave 3 Software, analysis of the structural section including Tensar geogrid products was performed. The structural section thickness (approximately 3 feet to achieve grade) used in the analysis is the same as that specified for Stations 10+00 to 104+00. The resulting structural section requires 2 layers of Tensar BX 1200 to be placed within the structural section as detailed below. Then the fill should be placed and compacted to 95 percent of the Modified Proctor maximum dry density (ASTM D1557). Lifts should be limited to 12-inch loose lifts and should consist of Select Type A aggregates. However, the first lift over the geotextile should be 18-inches loose thickness and compacted. The first lift can be constructed using Type A aggregate. If the lift cannot be compacted to 95 percent of the Modified Proctor maximum dry density without pumping and failure of the peat, then the compaction effort should be stopped and the lift rolled to a level surface. An additional lift should be placed and compaction effort resumed. A Modified Proctor maximum dry density of 90 percent is acceptable on this second lift if it also starts to pump.

Thickness (in.)	Material Type
2	Asphalt Concrete Pavement
6	Base Course Material
6	Select Type A Material
-	Tensar BX 1200
12	Select Type A Material
12 (min.)	Type A Material (as needed to meet grade)
-	Tensar BX 1200 and non-woven geotextile

Lightweight Embankment Fill

The use of light-weight fill, such as geofoam, was evaluated as a possibility for reducing the cost of removal and replacement and as a faster solution to surcharging. However, due to the lack of significant embankment thickness (only 3 feet), some peat would need to be removed for the inclusion of light-weight fill. Under the current site conditions light-weight fill is not as effective as the previous two options.

Closure and Limitations

The recommendations in this letter are based on site conditions as they presently exist and further assume that the exploratory test holes and peat probes are representative of the subsurface conditions throughout the site, that is, that the subsurface conditions everywhere are not significantly different from those disclosed by the field exploration. If during construction, subsurface conditions different from those encountered in the exploratory test holes are observed or appear to be present beneath excavations, advise us at once so we can review these conditions and our recommendations.

If substantial time has elapsed between submission of this letter and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, we recommend that this letter be reviewed to determine the applicability of the discussion of the recommendations contained herein considering the time lapse or changed conditions.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples or advancing test holes. Such unexpected conditions frequently require additional expenditure to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

Sincerely,
HATTENBURG DILLEY & LINNELL, LLC



John D. Thornley, P.E.
Geotechnical Engineer

Reviewed by,
HATTENBURG DILLEY & LINNELL, LLC



Lorie M. Dilley, Ph.D., P.E., C.P.G.
Principal Geotechnical Engineer



Attachments:

- | | |
|-----------|-----------------------------|
| Figure 1: | Excess Fines Method Results |
| Figure 2: | Consolidation Estimates |

Excess Fines Method - Parks Highway Connections: Museum Drive

PROJECT INFORMATION

Project Name: Parks Highway Connections: Museum Drive
 Project Number: 09-010
 Designer: J. Thomley
 Date: 10/8/2009 8:43:12 AM

TRAFFIC
 ESALS: 394400
 AADT:

UNITS
 Metric
 English

SOLUTION
 Predicted Deflection: .033 in.
 Pavement Thickness: 2 in

SOILS DATA

LAYER No.	Depth Interval	Thickness in.	P200(%)
1	0- 6	6	6
2	6- 24	18	6
3	24- 36	12	10
4	36- 42	6	60
5			
6			
7			

Compute

Figure 1. Parks Highway Connections: Museum Drive Excess Fines Method Results.

Parks Highway Connections: Museum Drive Peat & Soft Soil Consolidation

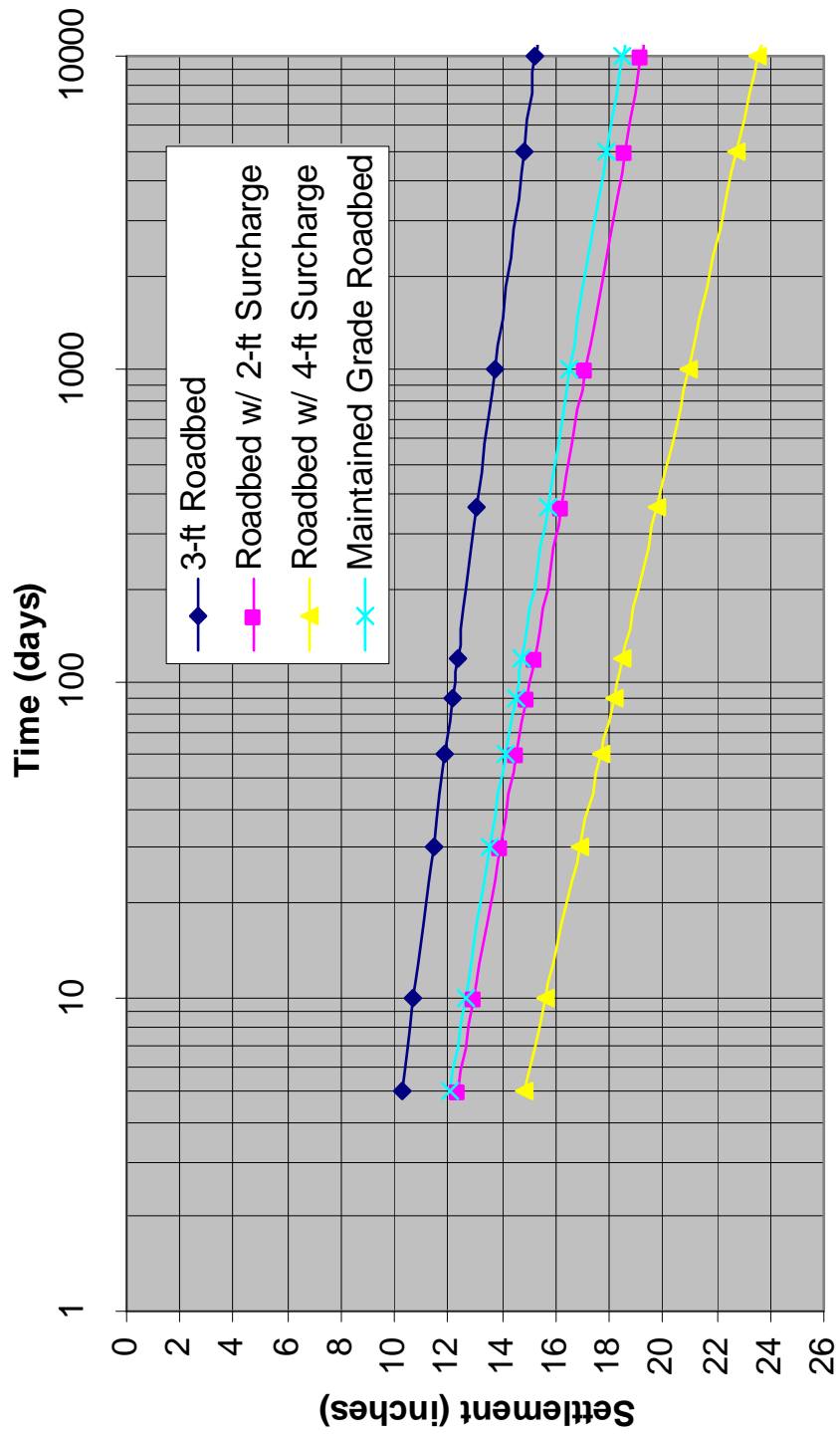


Figure 2. Consolidation under Various Loading Conditions.