Introduction & Summary of Performance Through Previous Reporting

This is the sixth and final report in an annual series describing the performance of a wood chip roadway embankment located about 10 miles west of Fairbanks on the Parks Highway. Preceding annual reports were issued: 10/30/90 (by Matthew Reckard, DOT&PF Research Section), 9/12/91 (by R.L. McHattie), 12/21/92 (by R.L. McHattie), 2/18/94 (by R.L. McHattie), and 3/10/95 (by R.L. McHattie).

The site was inspected for the previous reporting (2/18/94) on October 6, 1994. The section's performance was evaluated visually and in terms of ride performance, ie, driver comfort at the legal speed limit. A set of pavement deflection data was obtained, during the springtime period of 1993 and the fall of 1994.

Although the top of the wood chip embankment had undergone little apparent subsidence since construction, the pavement structure was in need of much repair by the end of 1993. In some areas, development of pavement fatigue (alligator) cracking had greatly accelerated during 1993. The level of
cracking degraded from moderate to severe between the fall of 1992 and fall of 1993. The rapid increase in severity and total area of cracking was accompanied by development of very deep wheelpath ruts. Longitudinal shoulder-cracking was present but not extensive. From the driver's perspective, most of the wood chip section continued to perform fairly well in terms of ride smoothness although some of the ruts had become deep enough to influence steering. Several hundred feet of the south (Anchorage) end of the experimental section was patched in 1992 and again in 1993.

**Performance After 9th Year of Service**

The Experimental Feature was most recently inspected on September 28, 1995, approximately 9 years after construction was completed. The experimental section was examined and photographed to record visual signs of distress, and deflection information obtained in the fall of 1994 was analyzed as part of the 1995 evaluation.

Sets of pavement deflection measurements were obtained several times during the spring of 1993 and again in the fall of 1994. All measurements were taken using a Dynatest, Model 8000, Falling Weight Deflectometer (FWD) at 6 locations within the limits of the wood chip fill and 4 locations just beyond the wood chip fill. The FWD was set to produce a 25 millisecond impact loading of about 9,000 pounds - a normal testing mode. Deflection testing was done during the fall of 1994, for the purpose of evaluating the elastic stiffness of the wood chip fill and the overlying pavement structure when modulus values were at a maximum (deflection data from the spring of 1993 was used to characterize the pavement structure and wood chips during the weakest time of the year). As done previously for the springtime data, deflection data was analyzed using the computer program "ELMOD," supplied by Dynatest Inc., and elastic modulus values for both the granular pavement structure and wood chip subgrade were determined.

Springtime modulus values for the approximately 24 inches of mineral aggregate pavement structure ranged between about 20,000 and 40,000 psi. Springtime modulus values for the underlying wood chips were found to be very low, ranging between about 5,000 and 9,000 psi. Fall modulus values ranged between 30,000 and 60,000 psi for the mineral aggregate portion of the pavement structure, and apparent values of between 6,000 and 15,000 psi for the underlying wood chips.

The test section is in need of reconstruction. Deflection data has shown that the pavement structure is simply too soft to withstand normal highway traffic - a fact made visually evident by the present condition of the asphalt concrete pavement surface. Almost the entire test section is now severely alligator cracked and deeply rutted. Rutting ranges from slight to depths greater than about 3 inches. By September of 1995, more than two thirds of the test section had received full-width patching, and much of the patched area was severely alligator cracked. Moreover, much of the remaining unpatched
area now requires patching. Two performance characteristics have remained essentially unchanged during the past year. This includes longitudinal shoulder-cracking (minor) and ride roughness (acceptable). Photos are attached to this report which show the general surface condition of the Experimental Section as of September 1995.

A centerline survey was done to quantify the amount of gross settlement that has occurred throughout the length of the test section since construction. Since there has been little visually obvious settlement of the roadway surface during the 9 years since the most recent construction, analysis of the centerline data proved rather startling. Settlement measurements and data analysis were performed by Dr. Tom Kinney, a University of Alaska Professor, as part of another research project. The summary from a brief report written by Dr. Kinney is as follows:

"From visual observation and driving the road in the summer of 1995, the road appears to be performing well for an Alaskan highway. There is some obvious settlement but no abrupt elevation changes, no major cracks forming and no detrimental lateral differential settlement. The surface elevation data indicate that there is a fairly constant rate of settlement which is fairly uniform throughout the area. There has been up to 4 feet of settlement over the period since reconstruction. The *Soundex measurements indicate that there is little, if any, compression in the upper 25 feet (of the roadway embankment) The *slope indicator data indicate that there is significant lateral movement below a point. From this data one would have to conclude that the subgrade materials (foundation soils) are settling and spreading laterally. Comparing this data to the data prior to reconstruction, it is interesting to note that the rate of centerline settlement since reconstruction is not significantly different than it was prior to reconstruction, but that the road performance is better because the settlement is more uniform."

*Sondex casing and slope indicator casing was installed as part of another research project. Probes are placed within these casings which measure, respectively, compression of materials and horizontal displacements within materials over the lengths of the casings.

The lightweight wood chip fill material removed as mush as 20 % of the original embankment weight from the plastically-deforming permafrost foundation soils. This magnitude of overall weight reduction was accomplished even though the (then existing) road surface had to be brought up about 10 feet in elevation. During the design process it was thought that this significant weight reduction would, in turn, significantly reduce future subsidence. The reason/s that the high subsidence rate has continued despite such drastic weight reduction are not known at the present time. The additional research necessary to understand the continuing failure rate is outside of the scope of this Experimental Feature study.

mb

cc: Dave McCaleb, P.E., Regional Pre-Construction Engineer
Jim Elieff, P.E., Highway Design Group Chief
EXPERIMENTAL WOOD CHIP FILL
PHOTOS TAKEN 9/28/95 PARKS HIGHWAY, ALDER CREEK (-MILE 349.3)

VIEW LOOKING TOWARD ANCHORAGE DIRECTION FROM FAIRBANKS-BOUND LANE

VIEW LOOKING TOWARD ANCHORAGE DIRECTION FROM ANCHORAGE-BOUND LANE:
SHOWS LONGITUDINAL CRACKING AND RUTTING
Memorandum

TO: Gene Rehfield
   Coordinator, Experimental Features
   DOT&PF, Headquarters

DATE: February 18, 1994

THRU: Paul W. Misterek, P.E.
   Technical Services Engineer

FROM: Robert L. McHattie, P.E.
   Geotechnical Engineer
   Northern Region

FILE No.: 244N

PHONE: 451-2236

SUBJECT: Experimental Features,
   Annual Report for
   AK 8801

STATE OF ALASKA
Department of Transportation & Public Facilities

TO: Gene Rehfield
   Coordinator, Experimental Features
   DOT&PF, Headquarters

DATE: February 18, 1994

THRU: Paul W. Misterek, P.E.
   Technical Services Engineer

FROM: Robert L. McHattie, P.E.
   Geotechnical Engineer
   Northern Region

FILE No.: 244N

PHONE: 451-2236

SUBJECT: Experimental Features,
   Annual Report for
   AK 8801

PARKS HIGHWAY RECONSTRUCTION
IR-OA4-3(5)
WOOD CHIP EMBANKMENT FILL
EXPERIMENTAL FEATURE - AK 8801

Introduction & Summary of Performance Through Previous Reporting

This is the fourth report in an annual series describing the performance of a wood chip roadway embankment located about 10 miles west of Fairbanks on the Parks Highway. Preceding annual reports were issued: 10/30/90 (by Matthew Reckard, DOT&PF Research Section), 9/12/91 (by R.L. McHattie) and 12/21/92 (by R.L. McHattie).

The site was inspected for the previous reporting on November 25, 1992. The section's performance was evaluated visually and in terms of ride performance, i.e., driver comfort at the legal speed limit. Damage appeared to have worsened only slightly since the fall of 1991. The wood chip fill was described as looking and performing much like a normal earthen embankment structure.

Ride performance in the northbound lane remained fairly smooth (northbound = toward Fairbanks) and was rated "highly acceptable" except for a shallow dip located at the south end of the northbound lane. Cracking in the northbound lane could be neither seen nor felt at full, highway driving speeds.

Ride performance of the southbound lane was altered by maintenance patching on about 50 percent of the length of the lane. Patching smoothed out a single, severe dip which occurred at the south end of the southbound lane. Ride performance of the unpatched portion of the southbound lane remained "highly acceptable." Cracking in the southbound lane was not noticeable at full, highway driving speeds.

During a walking examination of the experimental section, fatigue cracking and moderate rutting were visible in both lanes. A combination of longitudinal and alligator wheelpath cracking was present in more than 50 percent of the northbound lane (only a slight increase from 1991). Less than half of the unpatched portion of the southbound lane exhibited cracking. In the cracked areas of both lanes, rut depths were generally less than ½ inch. Except for the patched area, the surface condition in 1992 was about the same
Performance After 7th Year of Service

The Experimental Feature was most recently inspected on September 16, 1993, approximately 7 years after construction was completed. The experimental section was carefully examined and photographed to record visual signs of distress. Deflection testing was done during April and May of 1993 to evaluate the condition of the pavement structure relative to adjoining segments of non-wood-chip embankment.

Although the wood chip embankment has undergone little subsidence since construction, the pavement structure is now in need of much repair. In some areas of the wood chip fill, development of pavement fatigue (alligator) cracking has greatly accelerated in the past year. Photo No.1 (attached) views the experimental section from the Fairbanks end; it shows extensive wheelpath cracking across the entire length of the experimental section. Photo No.2 views the length of the experimental section from across the patched area at the Anchorage end. The level of cracking has degraded from moderate to severe since the fall of 1992. The rapid increase in severity and total area of cracking has been accompanied by development of some very deep wheelpath ruts. Longitudinal shoulder cracking is present but not extensive. Photo No.3, a view toward Anchorage taken at about the middle of the section, shows alligator cracking in both lanes and some of the longitudinal shoulder cracking. Within a portion of the northbound lane, the inner wheelpath exhibits a rut depth of more than 3 inches (see Photo No.4). From the driver's perspective most of the wood chip section continues to perform fairly well in terms of ride performance although some of the ruts are now deep enough to influence steering. Several hundred feet of the south (Anchorage) end of the experimental section was patched in 1992 and again in 1993. This patch is by far the most noticeable area of pavement roughness of the experimental section as of this reporting.

A set of pavement deflection measurements was obtained during each week of a 6-week period (April 16 - May 21) during the spring of 1993. For each data set, measurements were taken using a Model 8000 Dynatest Falling Weight Deflectometer (FWD) at 6 locations within the limits of the wood chip fill and 4 locations just beyond the wood chip fill. The FWD was set to produce a 25 millisecond impact loading of about 9,000 pounds - a normal testing mode. Deflection data was analyzed using the computer program "ELMOD," supplied by Dynatest Inc. Elastic modulus values for the pavement structure and subgrade were determined for each deflection location and for each of the 5 testing dates. The analytical results presented in the following table represent worst-case conditions encountered during the entire test period. Modulus values for approximately 24 inches of mineral aggregate pavement structure ranged between about 20,000 and 40,000 psi; such values are in the low-average range for similar materials placed on a normal subgrade. The 14,000 psi aggregate modulus at location No.4 is anomalously low and the reason for the low value is not known at this time.

Modulus values for the wood chips are very low, ranging between 5,000 and 9,000 psi. For perspective, these modulus values are similar to and perhaps slightly higher than typical elastic moduli for the higher strength polystyrene (board) insulation products such as those used in Alaskan road construction. Locations No.3 and No.8 where the wood chip modulus is significantly higher, ie, 13,000 and 16,000 psi respectively, represent conditions at the ends of the wood chip fill where the layer thickness of the wood chips has tapered close to zero. These modulus values can be used directly as spring-season input values in a mechanistic pavement design method such as the computer program "AKOD" (a DOT&PF design tool for non-standard pavement engineering problems).
MODULUS VALUES @ DEFLECTION TEST LOCATIONS
(based on worst-case spring 1993 data)

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<th>LOCATION</th>
<th>SELECT AGG. MODULUS (PSI)</th>
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<th>RELATIVE PVMT. LIFE</th>
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<td>0.4</td>
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<td>23,000</td>
<td>13,000</td>
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<tr>
<td>10*</td>
<td>20,000</td>
<td>14,000</td>
<td>0.5</td>
</tr>
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</table>

* measurements not taken on wood chip fill
** measurements taken on wood chip fill

In addition to springtime modulus values it remains necessary to determine wood chip modulus values that can be used for the summer/fall season. Deflection test data will be collected during August or September of 1994 and analyzed along with the above data to determine the degree to which the strength of the wood chip fill is seasonally affected. As with the spring 1993 data, modulus values derived from the 1994 testing will be available for use in mechanistic pavement design modeling.

During the fall of 1994, driving and visual evaluations will be repeated, deflection testing will be done and another set of photos will be obtained.

It is apparent that for future designs of wood chip fills, the overlying pavement structure must be strengthened. Strengthening can be achieved by: increasing the thickness of the mineral fill over the wood chips, stabilizing some or all of the mineral fill overlay, and/or by adding a high-modulus geosynthetic tensile reinforcement to the pavement structure.

**Cost for this Reporting**

A total of about 48 hours of my time was required for analysis and report preparation. The FY 1994 expenditure is approximately $2,700 to date, charged against Ledger Code 30869442.

Attachments: as stated
RLM/mb
PHOTO #1. VIEW SOUTH (ANCHORAGE DIRECTION) - LOOKING ACROSS WOOD CHIP FILL FROM NORTH END OF SECTION @ STATION 1114+25

PHOTO #2. VIEW NORTH (FAIRBANKS DIRECTION) - LOOKING ACROSS WOOD CHIP FILL FROM SOUTH END OF SECTION @ STATION 1104+75
PHOTO #3. VIEW SOUTH FROM MIDDLE OF EXPERIMENTAL SECTION - LONGITUDINAL SHOULDER CRACKING & ALLIGATOR CRACKING OF WHEELEPATH

PHOTO #4. VIEW SOUTH FROM MIDDLE OF EXPERIMENTAL SECTION - SEVERE ALLIGATOR CRACKING AND RUTTING OF WHEELEPATH
**EXPERIMENTAL PROJECT REPORT**

<table>
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<th>EXPERIMENTAL PROJECT</th>
<th>CONSTRUCTION PROJ. NO.</th>
<th>LOCATION</th>
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<td>CONSTRUCTION PROJ. NO.</td>
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<tr>
<td>AK8801</td>
<td>IR-OA4-3(5)</td>
<td>Parks Highway</td>
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**EVALUATION FUNDING**

- CONSTRUCTION

**NEED NO.**

- Yes

**PROPRIETARY FEATURE**

- No

**SHORT TITLE**

Wood Chips as Lightweight Fill

**THIS FORM**

- DATE
  - 01/93
- REPORTING
  - ANNUAL

**KEY WORDS**

- KEY WORD 1: Earthwork
- KEY WORD 2: Embankment
- KEY WORD 3: Material
- KEY WORD 4: Sawdust

**CHRONOLOGY**

- DATE WORK PLAN
  - 02/88
- DATE FEATURE CONSTRUCTED
  - 07/87
- EVALUATION SCHEDULED
  - 12/91
- EVALUATION EXTENDED
  - 12/95
- DATE EVALUATION TERMINATED

**QUANTITY & COST**

- QUANTITY OF UNITS
  - 24391
- UNITS
  - C.Y.
- UNIT COST
  - $30.00

**AVAILABLE REPORTS**

- CONSTRUCTION REPORT
  - Yes
- PERFORMANCE REPORT
  - Yes
- FINAL REPORT
  - Yes

**EVALUATION**

- CONSTRUCTION PROBLEMS
  - SLIGHT
- PERFORMANCE
  - MARGINAL

**APPLICATION**

- The original high embankment suffered up to a foot of settlement annually from induced creep in the ice-rich permafrost foundation soils. The embankment was rebuilt with as much as 20 feet of wood chips. Trafficability of the chip embankment during construction was a problem. The new embankment is about 30% lighter; settlements to date have been reduced by about 40%.

**REMARKS**

- Interim report attached. Charges for 1991 interim report $1,450.00
- Interim Report attached. Charges for 1992 Interim report $1,140.00
Memorandum

State of Alaska
Department of Transportation & Public Facilities

To: Timothy W. Mitchell
Coordinate, Experimental Features
DOT&PF, Headquarters

DATE: December 21, 1992
FILE No.: 244N
PHONE: 451-2236

Subject: 1992 Evaluation of Wood Chips as a Lightweight Fill -- Experimental Feature Project AK88-01

Thru: Paul W. Misterek, P.E.
Technical Services Engineer

From: Bob McHattie, P.E.
Geotechnical Engineer
Northern Region

INTRODUCTION/BACKGROUND

The subject experimental section was constructed as part of Construction Project IR-OA4-3(5). This is the third report in an annual series, as required by our participation in FHWA's Experimental Features in Construction program. I wrote the previous interim report, a DOT&PF memorandum addressed to you and dated 9/12/91. That report referenced the first one prepared by Matthew Reckard, formerly of the DOT&PF Research Section.

A summary of the 9/12/91 interim report will provide background for this year's observations:

The site was visited on August 27th of 1991, at which time driving and walking inspections were done and photographs were taken.

At the legal speed limit (55 mph), the riding characteristics of the roadway were found to be "highly acceptable." A slight sag, visually noticeable at one location on the surface of the embankment, could barely be felt by the driver. Sight distance remained excellent and photos showed almost no evidence of the embankment settlement visible to the eye.

At walking speed, problems with the pavement's structural performance were becoming noticeable, with fatigue cracking and rutting visible in both lanes. The northbound lane exhibited considerably more damage than the opposing lane. A dense pattern of wheelpath longitudinal cracks had developed on about 40 to 50 percent of the area of the northbound lane and perhaps 25 percent of the southbound lane. Wheelpath longitudinal cracks were also developing into the interconnected pattern of fatigue cracks known as "alligatoring." Although vehicle control was not yet influenced by these pavement cracks (and ruts), the pavement surface appeared quite open (permeable). Ruts were beginning to develop in the wheelpaths where cracking was most dense, but rut depths did not exceed $\frac{1}{4}$ inch in most places.

1992 WORK

The site was inspected on November 25, 1992. Both driving and walking inspections were done, similar to last year's evaluation. A series of photos was also taken.

Overall, damage appears to have worsened only slightly since last year.
At driving speed, the northbound lane of the experimental section remains fairly smooth (northbound = toward Fairbanks). I would rate the quality of ride barely lower than last year; in qualitative terms, the condition remains very good. A shallow dip is present at the south end of the northbound lane. The dip can barely be felt at the speed limit of 55 mph. Ride performance through the remaining length of the northbound lane continues to be highly acceptable. Cracking in the northbound lane can be neither seen nor felt at full, highway driving speeds.

Ride performance of the southbound lane of the experimental section has been altered by maintenance work done during the summer of 1992. About 50 percent of the length of the lane was patched. Mike Blanning, Fairbanks area asphalt crew foreman, explained that the patching was done in order to smooth out a single, severe dip which occurred at the south end of the southbound lane. It was impossible to determine if the dip had actually formed within the experimental section, or immediately south of it. Painted marks indicating the exact limits of the experimental section could not be seen because of the snowy shoulders. Mr. Blanning indicated that the patch extends a considerable distance away from the actual dip location, as a way of smoothing, ie, feathering-out from the area of the repair. The point here is that much of the patched area in the experimental section does not represent a failed pavement condition. The ride quality of the unpatched portion of the southbound lane remains, as last year, highly acceptable. Cracking in the southbound lane is not noticeable at full, highway driving speeds.

A walking examination of the experimental section found conditions very similar to last year, in the unpatched areas of both lanes. Since none of the patched area has yet cracked or rutted, the following comments refer only to unpatched areas of the experimental section. Fatigue cracking and moderate rutting was visible in both lanes. A combination of longitudinal and alligator cracking is present in more than 50 percent of the northbound lane (a slight increase from last year). Of the unpatched portion of the southbound lane, less than half is cracked. The cracked areas of both lanes are only moderately rutted. As last year, rut depths generally do not exceed the accepted moderate/severe threshold of \( \frac{1}{4} \) inch.

A series of photos was taken to continue this form of annual documentation. These photos, together with those obtained in previous years, will be presented in the final report as a pictorial record of section’s performance with time.

Except for the unusual flexibility of the pavement structure, the light weight wood chip fill is performing like a normal embankment. There is nothing visually obvious to suggest that it is of anything but standard construction. For future fills of this type, the pavement structure can be stiffened in several ways. Stiffening can be achieved by: increasing the thickness of the mineral fill overlay, increasing the stabilizer content of the fill overlay, and/or by adding geosynthetic tensile reinforcement.

**PROPOSED WORK FOR FY 1993**

The section will be deflection tested during April and May of 1993, to characterize its weakest springtime structural condition. Another set of deflection tests will be performed sometime in the late summer or fall. The
summer/fall data will indicate maximum structural properties of the wood chip fill with respect to vehicle loadings.

During the fall of 1993, driving and walking evaluations will again be done, and another set of photos will be obtained.

Assuming that the construction project’s vertical control points (TBMs) can be found and are still usable, centerline elevations will be obtained at 50 foot intervals through the section. These elevations will be plotted along with as-built elevations to show cumulative settlements over 7 years since construction.

**COSTS ASSOCIATED WITH THIS REPORTING**

Work associated with this interim report included examination of the project site and reporting (this memo). A total of 19 hours was required for this effort. So far, expenditures for this project in FY 1993 total $1,140.
**Experimental Project Report**

**Experimental Project No.**
- State-Year-Number: AK8801
- CONSTRUCTION PROJ. NO.: IR-OA4-3(5)

**Location:** Parks Highway

**Evaluation Funding:**
- CONSTRUCTION

**Proprietary Feature:**
- Yes

**Short Title:** Wood Chips as Lightweight Fill

**This Form Reporting:**
- Date: 01/92
- Annual

**Key Words:**
- KEY WORD 1: Earthwork
- KEY WORD 2: Embankment
- KEY WORD 3: Material
- KEY WORD 4: Sawdust

**Chirnoology:**
- Date Work Plan Approved: 02/88
- Date Feature Constructed: 07/87
- Evaluation Scheduled Until: 12/91
- Evaluation Extended Until: 12/95
- Date Evaluation Terminated:

**Quantity & Cost:**
- Quantity of Units: 24391
- Units: C.Y.
- Unit Cost: $30.00

**Available Reports:**
- Construction Report: Yes
- Performance Report: Yes
- Final Report: Yes

**Evaluation:**
- Construction Problems: Slight
- Performance: Marginal

**Application:**

**Remarks:**
The original high embankment suffered up to a foot of settlement annually from induced creep in the ice-rich permafrost foundation soils. The embankment was rebuilt with as much as 20 feet of wood chips. Trafficability of the chip embankment during construction was a problem. The new embankment is about 30% lighter; settlements to date have been reduced by about 40%.

Charges for 1991 interim report $1,450.00
Memorandum

To: Timothy W. Mitchell
Coordiinator,
Experimental Features
DOT&PF, Headquarters

Thru: Paul W. Misterek, P.E.
Chief, Engineering Services I

From: Bob McHattie, P.E.
Geotechnical Engineer
Northern Region

DATE: September 12, 1991
FILE No.: 244N
PHONE: 451-2236

SUBJECT: Annual Evaluation of Wood Chips as a Lightweight Fill -- Experimental Feature Project AK88-01

INTRODUCTION/BACKGROUND

The subject experimental section was constructed as part of Construction Project IR-OA4-3(5). I designed the experimental section. The previous Interim Report, by Matthew Reckard, was completed in October of 1990, and issued by the (now defunct) DOT&PF Statewide Research Section. The previous interim report contained: a brief project history, a construction report, an outline of field monitoring, and a discussion of findings as of October, 1990.

Observation of this experimental feature was officially assigned to me on May 1, 1991; funds for evaluation were made available as of July 30, 1991. Matthew Reckard passed along his project files and a computer disk containing data concerning his most recent work on the project. Mr. Reckard also passed along a file of information from Dave Esch, which contained somewhat older data from the Alder Creek - including a presentation paper concerning the methodology used for the design. Original field books were not transferred with either of these files, thus making it difficult to resume annual field measurements from the existing data base.

A short recap of the previous interim report will provide background for the most recent observations. The following Introduction Section was extracted from Mr. Record's report:

The Parks Highway just west of Ester near Fairbanks was built in 1975 across permafrost soils in the Alder Creek Valley. The embankment height ranges from about 20 to 50 feet in this area. Eight foot high by 20 foot wide stabilizing berms were built along the lower part of the embankment slopes. Subsequent observations of the road showed large and continuous settlements; in one location the road was sinking almost a foot annually. Temperature data indicated permafrost had not thawed. The movement appeared to be due to creep of the underlying ice-rich soils under the weight of the embankment.

The subsidence at Alder Creek caused a large dip in the road over the years. The sag was long and gentle enough that ride quality was not greatly affected, but it resulted in reduced sight lines and locally excessive grades.

Part of the embankment was removed and replaced with up to 20 feet of wood chips in fall of 1986. This was intended to restore the original road elevation while reducing the loading on the foundation soils. The installation is the first reported use in North America of a wood chip layer to serve as a lightweight fill over permafrost. It has been monitored as an "Experimental Construction Feature" to assess embankment movement, densities, wood chip
temperatures, and overall performance of the installation.

Previous work has included the monitoring of: 1) vertical and horizontal displacement references (nails in the roadway, stakes in the sideslopes and natural ground, settlement plates and a settlement casing), 2) ground temperatures, 3) lateral displacements of the embankment mass (slope inclinometer measurements) and 4) road surface deflections (Falling Weight Deflectometer measurements). It was noted that the embankment continues to settle and spread, although at a rate about 40% less than that noted before the reconstruction. Annually, maximum subsidence at the centerline still exceeds 6 inches and ground surface displacements, beyond the embankment toe, approach 5 inches vertically and 2 inches horizontally. "Some fatigue cracking" was observed on the roadway's paved surface.

Falling Weight Deflectometer data and settlement casing data were not included with the files given to me. Findings, based on the latest acquisition of these data were also not discussed in the previous interim report.

1991 WORK

The project site was visited on August 27th. I visually observed the area of the experimental feature on this date and obtained a series of 13 photographs (35mm). I walked the entire length of both lanes of the experimental section, visually examining the condition of the pavement. Rutting and cracking were obvious. The section was also driven at full highway speed in order to obtain an "average driver's" impression of roadway performance.

No specific measurements (using installed instrumentation) were taken during this visit. The value of future measurements will, in fact, somewhat depend on locating and interpreting existing field data.

I found both the slope inclinometer and temperature measurement casings open at the road surface. These had been sheared off by traffic action. This provides additional evidence that consolidation of the embankment materials has continued to occur since construction. The open casings probably have collected a considerable amount of debris; it will be difficult to differentiate apparent shortening of the casing caused by filling, from actual shortening of the casing caused by consolidation and subsequent vehicle-caused breakage. The collapsible settlement casing is open at the surface; it might still be used for differentiating between embankment consolidation and foundation settlement. In order to determine the amount of embankment consolidation since construction, it will be necessary to locate field data previously obtained from the settlement casings. Overall, total settlement of the roadway surface remains minor compared with the amount (up to about 10 feet) which accumulated prior to reconstruction.

The driving condition of the pavement surface remains highly acceptable. At the normal highway speed of 55mph, I noticed no bumps or other negative characteristics, with respect to vehicle operation. Also, at speed, the visual impression of the roadway is very good. The slight sag in the surface of the embankment is brought to the attention of the driver mostly by the appearance of the guardrail, a sensitive indicator of variations in road profile. Sight distance remains excellent.
At walking speed, problems with the pavement's structural performance are becoming quite noticeable. The photos taken on 8/27/91 provide excellent documentation of cracks and rutting which have developed within the experimental section. The photos show almost no evidence of the embankment settlement which has occurred. The northbound lane exhibits considerably more damage than the opposing lane. In relative terms, the northbound lane has perhaps twice as much surface damage.

Three distinctly different types of longitudinal cracking (centerline, wheelpath and shoulder cracks) have developed across the pavement surface. Centerline and shoulder cracking is the least widespread and also least severe. A dense pattern of wheelpath longitudinal cracks exists on about 40 to 50 percent of the area of the northbound lane and perhaps 25 percent of the southbound lane. Wheelpath longitudinal cracks are also undergoing obvious further development into the interconnected pattern of fatigue cracks commonly called "alligatoring."

Although vehicle control is not yet influenced by the existing pavement cracks (and ruts), the pavement surface does appear quite open (permeable). Future traffic, combined with saturation of the pavement structure by surface water intrusion, will probably accelerate cracking. We can learn more about the structural effects of water intrusion through Falling Weight Deflectometer data which will be collected spring and fall of 1992.

Ruts are beginning to develop in wheelpath areas where cracking is most dense. Rutting remains fairly shallow, with rut depths not exceeding \( \frac{1}{4} \) inch in most places. Careful examination of rut shape finds that they tend to be abnormally "V"-shaped (instead of the more normal "U"-shape). This shape characteristic is also indicated in the 8/27/91 photos. This suggests that the ruts formed due to a simple lack of structural support, along a linear zone. The most common mechanisms behind rut formation include insufficient stability of the asphalt concrete, the abrasive action of studs and plastic deformation within unbound layers of the pavement structure - each of these usually produces the familiar, broad "U"-shaped rut. There is also evidence that cracking preceded rutting within the experimental section, since cracks appear without ruts, but ruts do not appear without cracking. If correct, this conclusion (along with evidence supplied by the unusual rut shape) supports the idea that cracking occurs primarily because the core of the embankment mass is spreading, rather than due to an underdesigning of the pavement structure. Identification of the failure mechanism will have bearing on the future design of similar embankments on permafrost foundations. Based on these observations, it appears that it may be necessary to add tensile reinforcement, eg, geotextiles, geogrids, etc., to the embankment core.

**COSTS ASSOCIATED WITH THIS REPORTING**

Work associated with this interim report included: 1) study of file documents transferred to me by Matthew Reckard, 2) field examination of the project site and 3) report writing (this memo). A total of 25 hours was required for this effort. The project expenditure for 1991 is $1,450.
MEMORANDUM

TO: Bob McHattie
Technical Engineer I
Northern Region

FROM: Rod Platzke
Chief of Design
Northern Region

STATE OF ALASKA
Department of Transportation & Public Facilities

DATE: May 1, 1991
FILE NO: 25PA
TELEPHONE NO: 451-2273
SUBJECT: Project Assignment

You are hereby assigned as project manager on Experimental Feature project AK88-01 (Wood Chips as Lightweight Fill) at Alder Creek on the Parks Highway.

Please meet with Matt Reckard to review the project and transfer files.

hw


cc: John D. Martin, P.E., Chief of Planning & Research
Paul Misterek, Engineering Services Group Chief
Matt Reckard, Research Engineer
Stephen C. Sisk, P.E., Director, Design & Construction

STATEWIDE RESEARCH

MAY 1 1991
RECEIVED
November 16, 1990

Re: Light weight road fill material

Mr. Albert H. Rein
Manager, Pipeline and Civil Maintenance
Alyeska Pipeline Service Company
1835 South Bragaw Street
Anchorage, Alaska 99512

Dear Mr. Rein:

As I said in our phone call yesterday, your request to Keith Gerken for information about our use of wood chips and other lightweight road fill material was forwarded to me.

A wood chip fill was used during the reconstruction of part of the Parks Highway near Fairbanks in 1986 and 1987. We have been monitoring the performance of the fill as part of our Experimental Features in Construction program. I am enclosing a report I wrote last month entitled "Wood Chips as a Lightweight Fill" which summarizes the results to date. I am also enclosing a copy of a paper by Bob McHattie and Dave Esch entitled "Embarkment Failure from Creep of Permafrost Foundation Soils" which discusses the embankment performance prior to reconstruction. That paper was presented at the Fifth International Conference on Permafrost at Trondheim, Norway in 1988. Both reports contain some information about the reconstruction project itself. We have additional information (raw data, photos, etc.) about the fill both before and after reconstruction in our office; let me know if you have specific needs.

I am also enclosing a photocopy of a short article which appeared in Roads and Bridges Magazine last August. It discusses the use of polystyrene for embankment construction in Norway. We had a videotape at one time about plastic foam embankments in Scandinavia. I cannot locate that now, but I believe we obtained it through Steve Francis of Western Insulfoam in Anchorage (279-9407). Perhaps he could be of help to you. I hope the enclosed information is helpful.

Sincerely,

Matthew K. Reckard, P.E.
Senior Research Engineer

nrg
Enclosures: as stated
November 6, 1990

Re: Experimental Feature Project AK88-01

Mr. Charles W. Seslar  
Structural Engineer  
Federal Highway Administration  
P.O. Box 21648  
Juneau, Alaska 99802-1648

Dear Chuck:

Enclosed please find an interim report on the subject project, which is an evaluation of the wood chip fill at Alder Creek built in 1986 and 1987 as part of Construction Project IR-OA4-3(5). A draft of the report was reviewed by DOT&PF's resident engineer for the project, the regional geotechnical engineer, and several design engineers.

The lightweight fill appears to have decreased but not halted the creep of ice rich subsoils. At our primary monitoring cross section, fill weight was reduced about 30% and creep seems to have been reduced about 40% to date. Ground movements remain substantial and progressive: maximum centerline settlements exceed half a foot annually and "undisturbed" ground beyond the toe of the embankment continues to move about that much outwards and upwards. The beginnings of some pavement distress (cracking) was observed this summer on the fill.

The scheduled end of the monitoring period is next fall. Due to the onset of cracking and the continuing ground movements, we would like to extend the monitoring period until 1994. Your approval of this extension is requested.

The extended monitoring is also contingent on the availability of additional monitoring funds; I am presently trying to arrange for these.

Sincerely,

Matthew K. Beckard, P.E.  
Experimental Features Coordinator

nrg  
Enclosures as stated
### EXPERIMENTAL PROJECT REPORT

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#### EVALUATION FUNDING
- [ ] HP&R
- [ ] DEMONSTRATION
- [X] CONSTRUCTION
- [ ] IMPLEMENTATION

#### PROPRIETARY FEATURE?
- [ ] YES
- [ ] NO

#### SHORT TITLE
- [52] Wood Chips as a Lightweight Fill

#### DATE REPORTING
- MO. YR.: 10-90

#### KEY WORDS
- [145] Earthwork
- [167] Embankment
- [189] Material
- [211] Sawdust

#### CHRONOLOGY

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#### QUANTITY OF UNITS
- (Rounded to whole numbers)
- 124391

#### AVAILABLE EVALUATION REPORTS
- [X] Construction
- [X] Performance
- [ ] Final

#### CONSTRUCTION PROBLEMS
- [ ] NONE
- [X] SLIGHT
- [ ] MODERATE
- [ ] SIGNIFICANT
- [ ] SEVERE

#### PERFORMANCE
- [ ] EXCELLENT
- [ ] GOOD
- [ ] SATISFACTORY
- [ ] MARGINAL
- [ ] UNSATISFACTORY

#### APPLICATION
- [ ] ADOPTED AS PRIMARY STD.
- [ ] PERMITTED ALTERNATIVE
- [ ] ADOPTED CONDITIONALLY
- [ ] PENDING
- [ ] REJECTED
- [ ] NOT CONSTRUCTED

#### REMARKS
- The original high embankment suffered up to a foot of settlement annually from induced creep in the ice-rich permafrost foundation soils. The embankment was rebuilt with as much as 20 feet of wood chips. Trafficability of the chip embankment during construction was a problem. The new embankment is about 30% lighter; settlements to date have been reduced by about 40%.
WOOD CHIPS AS A LIGHTWEIGHT FILL

Experimental Feature Project AK88-01
built as part of
Construction Project IR-OA4-3(5)

INTERIM REPORT

by
Matthew Reckard, P.E.
Experimental Features Coordinator
Alaska Department of Transportation and Public Facilities
Statewide Research Section

October, 1990
Introduction

The Parks Highway just west of Ester near Fairbanks was built in 1975 across permafrost soils in the Alder Creek valley. The embankment height ranges from about 20 to 50 feet in this area. Eight foot high by 20 foot wide stabilizing berms were built along the lower part of the embankment slopes. Subsequent observations of the road showed large and continuous settlements; in one location the road was sinking almost a foot annually. Temperature data indicated permafrost had not thawed. The movement appeared to be due to creep of the underlying ice-rich soils under the weight of the embankment.

The subsidence at Alder Creek caused a large dip in the road over the years. The sag was long and gentle enough that ride quality was not greatly affected, but it resulted in reduced sight lines and locally excessive grades.

Part of the embankment was removed and replaced with up to 20 feet of wood chips in the fall of 1986. This was intended to restore the original road elevation while reducing the loading on the foundation soils. The installation is the first reported use in North America of a wood chip layer to serve as a lightweight fill over permafrost. It has been monitored as an "Experimental Construction Feature" to assess embankment movement, densities, wood chip temperatures, and overall performance of the installation.

Construction

Bids were opened August 16, 1986. The low bidder, H&H Contractors, Inc. of Fairbanks, was awarded the construction contract. Malcolm Pearson served as DOT&PF’s Resident Engineer on the project.

24,367 cubic yards of the existing embankment were removed as unclassified excavation at a contract unit price of $3. This was about $5 per cubic yard less than borrow (at $4 per ton). Had all of the material excavated at the Alder Creek fill been usable elsewhere the result would have been a savings to the project of about $122,000 for this part of the work. Only about 1/4 of the material was reused, however, mostly to cover the sideslopes of the wood chip fill. Consequently the subexcavation resulted in a net cost to the project of about $25,000.

24,391 cubic yards of wood chips were used in the fill. The engineer’s estimate for the chips had been $20 per cubic yard; the contract price was $30. This was the first time such materials had been used in road construction in Alaska, which may account for the higher price. Production figures indicate that a $20 price may be a reasonable expectation for future projects.

The wood chips were about 1” square by 1/4” thick. They were initially made from green timber. Chip production with this wood proved difficult, and the stockpiled material had to be ventilated to prevent excessive heat buildup. The source material was therefore changed; most of the chips were made from relatively dry, fire-killed spruce trees.
It was difficult for traffic to drive on the newly placed chips, and an 18" layer of borrow was placed as a driving course when the wood fill was about halfway completed. Traffic then drove on the borrow in one lane while the wood fill was completed in the other. It is recommended that such a measure be incorporated in the design of any future installations.

The completed wood chip fill was covered with a layer of borrow type A. This served as the driving surface for the '86-'87 winter. The following summer this borrow was observed to have severe soft spots, excessive fines, and contamination from wood chips which had worked their way up through the gravel. Falling Weight Deflectometer measurements confirmed that the embankment had inadequate strength.

Extra Work Order No. 8 was then issued altering the original design and increasing costs. One to two feet of the borrow type A was removed and a geotextile separator placed to contain the wood chips. New borrow type A was then placed and covered with another geotextile separator. 6" of crushed aggregate base course, 6" of asphalt treated base, and 2" of hot asphalt pavement completed the embankment.

As-built plan, profile, and cross-section drawings of the reconstructed area are shown in Attachment A. Parts of the Extra Work Order documentation are included as Attachment B. The extra work cost about $54,000, as shown in the documents. Most of this was needed to strengthen the soft, compressible embankment and similar measures would probably be required on future wood chip installations. About 20% of the extra work was associated with removal and replacement of the degraded and contaminated fill. This should not be necessary on future jobs.

Total project costs attributable to the wood chip fill were about $811,000, including the cost of the extra work order and the net cost of the excavation. The cost of using wood chips in the design would have been about half this much (around $409,000) if

☐ the unit price for the chips had been $20,
☐ all of the unclassified excavation had been usable on the project, and
☐ removal and replacement of borrow by extra work order had not been needed.

**Monitoring Program**

Nails were placed on the pavement centerline every 50 feet between stations 1100 and 1123 (see Attachment A plan and profile sheets). Their elevations have been surveyed every fall beginning in 1987.

Additional monitoring facilities were placed at station 1110+40 (approximately the area of worst subsidence prior to reconstruction). These facilities include:

☐ 27 settlement plates (in the ground) and 5 nails (in the pavement) forming a cross-section which extends about 225 and 180 feet to the north and south of the road
centerline respectively. The elevations of these points have been surveyed annually and the lateral distance between them measured.

☐ A slope indicator casing extending to a depth of 73 feet. This has been used to measure lateral displacements within the embankment annually.

☐ A plastic pipe filled with antifreeze extending to a depth of about 72 feet. A thermistor can be lowered into this pipe to record ground temperature profiles.

☐ A collapsible casing surrounded at intervals by wire rings. The location of the rings can be detected by a device lowered into the casing, thereby allowing layer thickness to be determined. Comparison of successive measurements allows layer consolidation to be calculated.

☐ Thirteen Falling Weight Deflectometer tests were performed on the wood chip embankment during September, 1990.

Results To Date

Figure 1 shows the results of the centerline surveys. The greatest settlement (about one half foot per year) is located at approximately station 1109. This is within the area rebuilt with wood chips, as shown in the figure. Settlement appears to be continuing, but at a lesser rate than before reconstruction (when the road was sinking nearly a foot annually in the worst area). Settlement rates outside of the wood chip area are similar to that prior to reconstruction. The areas of little settlement around stations 1102 and 1120 were originally built (in 1975) with plastic foam insulation.

Figure 2 shows the elevation changes over the past three years at station 1110+40. All of the surveyed points beyond the toes of the embankment are continuing to heave, while all of the points within the embankment continue to sink. The heaving appears to extend beyond the range of the surveyed cross section, at least on the right (south) side of the embankment.

Figure 3 shows the lateral movement over the past three years at station 1119+40. Points near the road centerline - which moved downwards more than a foot - have moved outwards little. Points from around the stabilizing berms outwards, on the other hand, have moved outwards an average of over three quarters of a foot.

Figure 4 shows the lateral movements over the three years prior to reconstruction at a cross section 40 feet from the currently monitored one. The curves in Figures 3 and 4 are very similar, although the vertical scale has been compressed in the latter. This shows that recent lateral movements, like the vertical ones, are similar to but smaller in magnitude than those before reconstruction.
Figure 5 shows the results of the 1987 to ’89 slope indicator measurements. The graph indicates that the soil creep is fairly uniform between about 20 feet from the surface and the bottom of the hole. The azimuth (resolved direction of movement) indicates that the bottom of the slope indicator tube has moved out (away from centerline) and downhill (towards the valley bottom) in almost equal amounts. The graph implies that the creep continues below the bottom of the hole, 72 feet from the surface. The slope indicator boring log, shown in Figure 6, shows that this is more than 25 feet below original ground level. The creep rate appears somewhat less in the top 20 feet - i.e. within the wood chip fill - although this is less apparent in the more recent data.

Table 1 contains temperature data taken on five occasions since April 1988. The data are graphed in Figure 7. The data show that temperatures tend to increase closer to the surface, implying a positive heat flow into the ground (i.e. the soil is warming). Little melting of permafrost is indicated, however; the data show the depth of thaw has only increased from about 35 feet to about 36 over the monitored period. The boring log (Figure 6) shows the original ground surface at 46 feet. Thus it appears the permafrost present prior to road construction has remained intact.

The logged interface with original ground (46 feet below the surface) is at an elevation of about 613 feet above sea level. The original ground elevation at this location shown in the original (1973) construction plans was about 623 feet. The log thus corroborates previous survey data and indicates that between original construction and 1987 the original ground subsided about 10 feet.

**Discussion**

The wood chips occupy about half of the embankment cross section at station 1110+40. The total weight of the embankment there is about 30% less than if the fill were entirely gravel. Ground movements - downward and outward near centerline and upward and outward beyond the toes of the embankment - appear to have been reduced by approximately 40% since the embankment was rebuilt with wood chips.

Even so, the movements remain substantial. Centerline subsidence at station 1109 exceeds six inches annually. Ground surface movement outside of the embankment approaches five inches outward and two inches upwards annually. Some fatigue cracking has been observed in the last year, mostly in the northbound lane (which carries most of the heavy truck traffic).

It is difficult to assess the physical or economic effectiveness of the wood chip fill until it becomes clear when - or whether - the embankment needs to be rebuilt once again. Given this and the magnitude of the continuing ground movements, it is recommended that the evaluation of the wood chip fill be extended for at least another four years.
Alder Ck. Wood Chip Fill
Settlement at Centerline

(October 1987 = 0)

Wood chips

Roadway Station
Alder Ck. Wood Chip Fill
Settlement at Sta. 1110+40 X-Section

Figure 2

Elevation Change (feet)

Distance from Centerline (feet)
Alder Ck. Wood Chip Fill
Horizontal Movements at Sta. 1110+40

Outward Movement, 1987-90 (feet)

Distance from Centerline (feet)
Alder Ck. Wood Chip Fill
Horizontal Movements at Sta. 1110+00

Outward Movement, 1983–86 (feet)

Distance from Centerline (feet)
PARKS HWY., ALDER CK. WOOD CHIP FILL

 Movements between 1987 & 89 (resolved)

 Indicated azimuth of movement is in degrees clockwise from A+ direction

 Resultant lateral displacement (inches)

 Depth from surface (feet)

 □ 1987-88  +  1987-89 (w/azimuth)
SOIL DESCRIPTION

Surface Elevation: UNKNOWN

VERY STIFF, BROWN AND TAN SILT WITH TRACE FINE GRAVEL BELOW 40 FT.
FROZEN BELOW 40 FT., Non. Vic. 3%

YELLOW-BROWN AND GRAY-BROWN SCHIST TAILINGS FILL

DARK GRAY SILT WITH ABUNDANT ORGANICS AND THIN PEAT LAYER. FROZEN.
Non.

TAN AND BROWN SILT CHANGING TO DARK GRAY SILT BELOW 51 FT. FROZEN. Non.

MASSIVE ICE, < 5 ft. ML

GRAY SILT, FROZEN, Non. ISOLATED Vic. < 5 ft.

BOTTOM OF BORING
Boring Completed: 12/27/87

LEGEND

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<td>Organic Content</td>
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Note: The stratification lines represent the approximate boundaries between soil types and the transition may be gradual.

State Of Alaska, D.O.T.
Alder Creek Slope Indicator Installation
Fairbanks, Alaska

LOG OF BORING NO. 8-5 CONT
12/27/87

K9175

SHANNON & WILSON, INC.
GEOTECHNICAL CONSULTANTS

FIG. 6 (cont.)
### TABLE 1

**Alder Creek Thermistor Probe Hole**

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#### 20–Apr–88

**Probe #101**

#### 14–Jul–88

**Probe #101**

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Probe #102

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![Alder Creek Thermistor Probe Hole](image)

**Figure 7**
ATTACHMENT A

PLAN, PROFILE, AND CROSS SECTION SHEETS
AS-BUILT PLANS

ALDER CREEK RECONSTRUCTION SECTION
BONANZA CREEK
RECONSTRUCTION SECTION

Station 2+161+50 to 2+173+00

All excavation and embankment work, to top of Borrow Type A, in Reconstruction Area will
commence no later than Sept. 30, 1966 and be completed

ALDER CREEK
RECONSTRUCTION SECTION

Station 4+000+00 to 4+172+00

STU "M" 1105+00 8" "M" 114+00 ONLY

BONANZA CREEK
PIPE PLACEMENT DETAIL

DETAIL A
Typical Bath Site

AS-BUILT PLANS
Initial E:
Date 6-21-66
ATTACHMENT B

EXTRA WORK ORDER #8
The above designated contract is hereby modified in the manner described below. This order is supplemental to the above Contract, which is, by reference made a part hereof. All terms, conditions, and provisions of the Contract, except as specifically modified herein, remain unchanged and in full force and effect.

Acceptance of this Extra Work Order constitutes agreement to terms the terms, and prices stated.

ACCEPTED:  
H&H Contractors Inc.  
Contractor  
Peter Stimson  
Contractor Representative  
Date 7/15/87  

RECOMMENDED:  
John H. Patterson P.E., Const. Group Chief  
Issued:  
David L. McCaleb P.E., Regional Group Chief  
Date 7/15/87  

DESCRIPTION

The "sawdust embankment" in the Alder Creek reconstruction section between, approximately, stations 1104+75 and 1114+25 is modified as delineated herein and on Attachment A to this extra work order.

Existing Borrow Type A which does not meet specifications shall be removed 19 feet on either side of centerline a minimum thickness of 1 foot, up to a maximum of 2 feet. All material shall be removed as directed by the Engineer.

All excavation limits shall be confirmed in the field by the Engineer and are subject to minor modifications as required. Reconstruction of the subcut and surfacing layers shall be as shown on the attached typical section.

Excavation, Borrow Type "A", Geotextile, C-1, and CSS-1 shall be paid for at contract unit prices.

Establish New Item: 307(4) Emulsified Asphalt Treatment of Base

Description: Item 307(4) Emulsified Asphalt Treatment of Base shall consist of blending crushed aggregate base course with CSS-1, spreading material to an approved line and grade and initial breakdown rolling.

Materials & Equipment: Aggregate for treated base shall be C-1. Asphalt for treated base shall be CSS-1. The treated base shall be mixed as specified in 307-3.01 subparagraphs 1 and 3. The treated base shall be spread with a self propelled paving machine. Automatic slope and grade control will be required. Compaction shall be as specified in 401-3.12 Method 2, Conformance Strips. Surface tolerance shall be 3/8" maximum using a 10 foot straight edge.

Method of Measurement: Item 307(4) will not be measured directly for payment except as noted below.

Basis of Payment: Item 307(4) will be paid for on a Time and Materials basis in accordance with Section 109-1.05. This shall be complete compensation for all labor and equipment required to mix, spread, and break down the asphalt treated base in excess of that work required under existing bid items.

This work will cause the following estimated changes in quantities:

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<th>Unit</th>
<th>Price</th>
<th>Quantity</th>
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<td>203(5A)</td>
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<td>301(1)</td>
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Items not mentioned shall not be affected.

Contract time is increased by 4 calendar days.

Contract Amount is increased by $54,065.50+.
Degradation and subsidence of Borrow "A" material directly over the "sawdust" embankment began to become apparent in late June. Samples taken at the time of placement of the Borrow Type "A" indicate the material did conform to the specifications. Further samples from this area show that degradation and subsidence are continuing. The removal of the out of specification Borrow Type "A" is necessary as confirmed by the Regional Materials Engineer. Bob McHattie, Geotechnical Engineer for the region designed the modifications shown on the attached typical based on his research into the problem. It is my opinion that the material degraded as a result of movement in the sawdust embankment. Since the embankment was constructed in conformance to the plans and specifications, the Department should bear the responsibility for additional work required to reconstruct the upper layers of the Borrow Cap to bring them back to line, grade and gradation.
Costs considered incidental to the C-1 Item, i.e. flagging, spreading material with a motor patrol grader and compaction in excess of breakdown were not included in the Force Account Estimate. The Design Section concurs with the above change.

Attachments: Quantity Computation Sheets
Force Account Cost Backup Sheet
Materials Gradations
McHattie Memo dated 7/13/87
# Experimental Project Report

**Experimental Project No.**

- **State Year Number Sup.**: AK 88-01
- **Construction Proj. No.**: IR-OA4-3(5)
- **Location**: Parks Hwy.

**Evaluation Funding**

- 1 ☐ HP&R
- 3 ☐ Demonstration
- 48 ☒ Construction
- 4 ☐ Implementation

**Need No.**

- 49

**Proprietary Feature?**

- ☐ Yes
- ☒ No

## Short Title

Wood Chips as a Lightweight Fill

## Key Words

- **Key Word 1**: Earthwork
- **Key Word 2**: Embankment
- **Key Word 3**: Material
- **Key Word 4**: CapFill

## Unique Word

- 255

## Chronology

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<td>4 C.V. 8 LUMP SUM</td>
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## Available Evaluation Reports

- ☐ Construction
- ☐ Performance
- ☐ Final

## Evaluation

**Construction Problems**

- ☐ None
- ☒ Slight
- ☐ Moderate
- ☒ Significant
- ☐ Severe

**Performance**

- ☐ Excellent
- ☐ Good
- ☐ Satisfactory
- ☒ Marginal
- ☐ Unsatisfactory

## Application

- 1 ☐ Adopted as Primary Std.
- 2 ☐ Permitted Alternative
- 3 ☐ Adopted Conditionally
- 4 ☐ Pending
- 5 ☐ Rejected
- 6 ☐ Not Constructed

(Explain in Remarks if 3, 4, 5, or 6 is checked)

## Remarks

The original high embankment suffered up to a foot of settlement annually from induced creep in the ice-rich permafrost foundation soils. The embankment was rebuilt with as much as 20 feet of wood chips. Trafficability of the chip embankment during construction was a problem.
**EXPERIMENTAL PROJECT REPORT**

**EXPERIMENTAL PROJECT**

- **STATE YEAR NUMBER**:
  - A K 8 8 - 0 1

- **CONSTRUCTION PROJ. NO.**:
  - IR-OA4-3(5)

- **LOCATION**:
  - Parks Hwy.

**EVALUATION FUNDING**

- 1 [ ] HP&R
- 2 [ ] CONSTRUCTION
- 3 [ ] DEMONSTRATION
- 4 [ ] IMPLEMENTATION

**NEEP NO.**:

**proprietary feature?**

- [ ] YES
- [ ] NO

**TITLE**

Wood Chips as a Lightweight Fill

**DATE**

- **MO.**:
  - 0
- **YR.**:
  - 6

**Reporting**

- 1 [ ] INITIAL
- 2 [ ] ANNUAL
- 3 [ ] FINAL

**KEY WORDS**

- **KEY WORD 1**:
  - Eartheork
- **KEY WORD 2**:
  - Embankment

- **KEY WORD 3**:
  - Material
- **KEY WORD 4**:
  - Sawdust

- **UNIQUE WORD**:

**PROPRIETARY FEATURE NAME**

- 233
- 235
- 235

**CHRONOLOGY**

- **Date Work Plan Approved**:
  - **MO.**:
    - 2
  - **YR.**:
    - 8
- **Date Feature Constructed**:
  - **MO.**:
    - 07
  - **YR.**:
    - 87

- **Evaluation Scheduled Until**:
  - **YR.**:
    - 91

- **Date Evaluation Terminated**:
  - **YR.**:
    - 93

**QUANTITY OF UNITS**

- **Units**
  - 1 [ ] LIN. FT.
  - 2 [ ] S.Y.
  - 3 [ ] S.Y.-IN.
  - 4 [ ] C.Y.

- **Lump Sum**
  - [ ] YES

- **Date of Units**
  - **Units**
    - 1
  - **130,000**

- **Available Evaluation Reports**

- **CONSTRUCTION**
- **PERFORMANCE**
- **FINAL**

**CONSTRUCTION PROBLEMS**

- [ ] NONE
- [ ] SLIGHT
- [ ] MODERATE
- [ ] SIGNIFICANT
- [ ] SEVERE

**PERFORMANCE**

- [ ] EXCELLENT
- [ ] GOOD
- [ ] SATISFACTORY
- [ ] MARGINAL
- [ ] UNSATISFACTORY

**APPLICATION**

- [ ] ADOPTED AS PRIMARY STD.
- [ ] PERMITTED ALTERNATIVE
- [ ] ADOPTED CONDITIONALLY

**APPLICATION**

- [ ] PENDING
- [ ] REJECTED
- [ ] NOT CONSTRUCTED

**REMARKS**

- The original high embankment suffered up to a foot of settlement annually from induced creep in the ice-rich permafrost foundation soils. The embankment was rebuilt with as much as 20 feet of wood chips. Trafficability of the chip embankment during construction was a problem.
February 5, 1988

John Martin, Chief
of Planning
Northern Region, Alaska DOT&PF
Fairbanks, Alaska

Dear Mr. Martin:

We have reviewed the work plan for the experimental feature "Wood Chips as Lightweight Fill" and find it satisfactory. It is approved.

Past experience with permafrost has shown that movement may continue for many years past the proposed cut-off date in late 1991. Accordingly, if the data is not conclusive, you may wish to continue observations until you have enough data to predict final stability.

Sincerely yours,

Barry F. Morehead
Division Administrator

By: Charles W. Seslar
Structural Engineer

RECEIVED
FEB 10 1988
DOTPF RESEARCH SECTION
December 18, 1987

Re: New Experimental Features Projects

Mr. Charles Seslar
Structural Engineer
Federal Highway Administration
P.O. Box 21648
Juneau, Alaska 99802

Dear Chuck:

As we discussed on the telephone two days ago, I am submitting under cover of this letter initial reports for a new "Experimental Feature in Highway Construction" project and a work plan for another.

The new project is actually an ongoing HPR Research project (No. 86-7) which will now also be included in the experimental features program. It is entitled "Geotextile Reinforcement over Permafrost". The principal construction features being evaluated under this project are reinforced embankments at Milepost 330 on the Parks Highway (the "Bonanza Creek" site) and at Gakona Junction on the Richardson Highway (the "Big Timber" site). I have assigned experimental project number AK87-03A to the former and AK87-03B to the latter; an initial form 1461 report is enclosed for each. Your office should already have a copy of the approved project proposal; if not, let me know and I will send one.

The work plan is for a proposed project entitled "Wood Chips as Lightweight Fill". The recently reconstructed Parks Highway embankment at Alder Creek (about 10 miles west of Fairbanks), which incorporated up to 20 feet of wood chip fill, would be monitored under this project. Please review the proposal and let us know if it has your approval. Once approved, we will assign it a project number and submit an initial form 1461 report.

Please let me know if you need any further information.

Sincerely,

Matthew Reckard
Experimental Features Coordinator

Enclosures
Wood Chips As Lightweight Fill

Experimental Feature Work Plan

Constructed under Parks Highway, Mile 325 to Ester
Federal Project Number IR-OA4-3(5)
State Project Number 63370

Work Plan Prepared by David Esch, Research Engineer

Background and Purpose

The Parks Highway near Fairbanks and just west of Ester was newly constructed across the permafrost soils in the Alder Creek valley in 1975. Subsequent observations of the 35 foot high road embankment in this area indicated that excessive creep-related settlements were occurring, and that they had averaged as much as 1 foot per year. To raise the road surface back to its original elevation while significantly reducing the loading on the foundation soils, a portion of the original embankment was removed in 1986 and replaced with a thickness of up to 20 ft. of wood chips, produced from relatively dry fire-killed trees. An intensive monitoring system had been installed in 1982 to determine the type and causes of the embankment movements at this location. This system of multiple movement reference plates, a "Slope-Indicator" casing, and a temperature logging casing was necessarily destroyed during the 1986 reconstruction of the embankment, leaving no good means of monitoring the performance of the new embankment. This installation was the first reported use in North America of a wood chip layer to serve as a lightweight fill over permafrost.

The post-reconstruction monitoring and evaluation of this wood chip fill material, and of the embankment in which it was placed, will be done
and reported on as an "Experimental Construction Feature" evaluation by staff of the DOT&PF Research Section. Under this evaluation program, the long-term movements, densities, and temperatures in the wood chip embankment area will be measured and analyzed periodically. Observations and analyses over a four year period will provide data for making recommendations on the future use of this method of construction.

Project Scope

This experimental feature evaluation will involve the monitoring of subsurface temperatures, and surface and subsurface (slope-indicator) movements in the area of the wood chip fill installation made in 1986 and 1987. Original construction was on project IR-0A4-3(5); Parks Highway Mile 325 to Ester, between Stations 1105 and 1114.

Initially, observations will be made at least annually on one 73 ft. deep "Slope Indicator" casing, one 60 ft. deep temperature measurement casing, and a series of movement reference plates and nails. All monitoring points were placed across a typical cross-section of the wood chip embankment and the adjacent undisturbed forest at approximate roadway Station 1110. These monitoring installations were placed in the fall of 1987 and the first reference observations were made at that time. A draft technical paper titled "Embankment Failure from Creep of Permafrost Foundation Soils" by R. McHattie and D. Esch is appended herewith to provide any necessary pre- and re-construction information.

Method of Evaluation

1) Annual elevation and lateral movement surveys of a series of pavement nails and settlement plates will be used to observe the post reconstruction movements and to compare them with movements prior to the wood chip fill replacement.
2) Periodic (at least annual) slope-indicator movements will be measured in a vertical casing placed through the east shoulder of the roadway near Station 1110+40. This data will indicate the depths at which movements are occurring. A second slope indicator casing may be installed through the southeast side toe-berm if funds allow.

3) Periodic (semi-annual at minimum) embankment temperatures will be measured in a temperature monitoring casing installed through the west roadway shoulder at Station 1110+40.

4) Wood chip layer thickness changes will be measured electronically from wire rings placed on vertically compressible settlement casings which were installed in both roadway shoulder borings.

**Reporting**

The pre-construction and wood chip reconstruction histories of this experimental embankment have been documented and reported by McHattie and Esch (copy attached).

Monitoring of the embankment for a four-year period is considered necessary to provide for valid conclusions on the long-term performance. Surveys each fall season through the fall of 1991 will provide the necessary performance data for preparation of a final report, which will include the following:

- Embankment movement plots
- Wood chip layer temperature observations
- Wood chip layer compression data
- Recommendations for future use

No interim reports are planned unless significant conclusions are reached before the end of the observation period.