Alaska Department of Transportation & Public Facilities
Alaska University Transportation Center

Improving Performance, Knowledge, and Methods to Provide Quality Service and Products

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13. ABSTRACT (Maximum 200 words) The objectives of this study were to educate staff about the impact of research in Alaska, enhance communication and coordination amongst stakeholders, and formulate a long-term research and implementation research plan for pavement and materials. Education begins with an overview of pavement design, construction and maintenance in Alaska since the 1900's through a series of webinars. Interviews with five state materials engineers were used to explore best practices. Finally, a workshop focused on developing a coordinated research program and improve implementation activities. The workshop provided a series of recommendations to The Alaska Department of Transportation and Public Facilities which will enhance the value of the departments research program.			
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic	m^3
		meters NOTE: volumes greater than 1000 L shall be		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inc h	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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Introduction

Under this project, an outreach effort on pavement structure performance was completed, including the use of embankments and how use relates to Design, Construction, and Maintenance, to

- Educate staff on successful and ready-for-practice research projects.
- Review technologies, solutions, and best practices resulting from research.
- Evaluate research deployment efforts and recommend any improvements including training, reporting, and dissemination.
- Review and evaluate policies, procedures, and/or practices. Note any inconsistencies with promoting best practices or innovation, and continuous improvement.

The objectives of this effort were to

1. Educate staff and receive feedback.
2. Enhance communication and coordination amongst stakeholders to strengthen necessary commitment for continuous improvement.
3. Formulate a long-term research and implementation plan for pavement and materials.

Five webinars were held to educate Alaska DOT&PF staff on completed pavement research both within the state and nationally and to discuss the implementation of that research. In some cases, national practices were compared with practices in Alaska. Each webinar highlighted a specific area of pavement research and implementation, in some cases going back to statehood.

Webinar 1 – Overview Pavements at 30,000 ft, 10,000 ft, 10 ft. Big Number Value of Assets, https://vimeo.com/123365132

Webinar 2 – Research and Pavement Design, Construction and Maintenance in Cold Regions (Roadway Embankments and Foundation)

Webinar 3 – Pavement Design, Construction, and Maintenance in High Traffic Volume Urban Environments

Webinar 4 – Pavement Design, Construction, and Maintenance Considerations in Rural Alaska, https://vimeo.com/128549069

Webinar 5 – Pavement Best Practices in Alaska: Innovation and New and Emerging Technologies, https://vimeo.com/130817349

In this report, an overview of each webinar is provided. Detailed slides from the webinars are found in Appendices A–E.

To learn how Alaska Materials organization compares with the materials organization of other states, materials engineers from five states—South Dakota, Louisiana, Connecticut, Montana, and Rhode Island—were interviewed. These states were recommended by the Alaska State Materials Engineer. A sixth webinar reported on those interviews. Detailed results of the materials engineer interviews are provided in Appendix F and summarized in the body of this report. The final report is also included as Appendix G. Survey questions were sent to attendees of the webinars. The survey results are included in Appendix H.

Finally, a workshop was held that focused on developing a coordinated pavement research program and improved implementation activities. The workshop is summarized in the body of the report.

Webinar 1: Overview Pavements at 30,000 ft, 10,000 ft, 10 ft. Big Number Value of Assets

This webinar provided a high-level overview of the development of pavement design, construction, and maintenance in Alaska since statehood. In 2013, the state owned 2737 miles of paved roads and 1573 miles of unpaved roads. While the state has seen a 39% increase in expenditures on pavements between 2006 and 2012, this is due to increases in construction costs. Even so, the quality of the pavement surface as measured by the International Ride Index (IRI) and the Pavement Serviceability Rating (PSR) has shown a slight improvement.

Pavement design, construction, and maintenance begin with an understanding of how materials perform in the environment in which they are placed. Engineers must understand the relationship between the load-carrying capacity of the materials, how the materials perform under load, how moisture affects material strength, and how temperature impacts material properties.

It is important to understand that each layer must be capable of carrying the load imposed upon it. Consequently, as one moves up in the pavement structure, the materials must be stronger and capable of withstanding higher stresses and strains. The surface course must also be able to withstand abrasion and environmental exposure, including ultraviolet light, rapid changes in temperature, and exposure to snow and ice.

Between statehood (1959) and the mid-1970s, the focus was to "get Alaska out of the mud." Pavement design was essentially prescriptive, consisting of 1.5 inches of pavement, 6 inches of base course, 6 inches of subbase and a minimum of 24 inches of clean borrow. This design worked well, but as traffic began to increase, a formal design method was needed.

Unfortunately, no design procedures that incorporated cold climates were available. For lack of a better option, the California R-value method was adopted. Beginning at the bottom of the pavement structure, layers were added so that the minimum gravel equivalent was above each layer.

In practice, designers worked to duplicate the old prescribed pavement structure.

In the mid-1970s, the Commissioner's office became dissatisfied with the pavement performance because many pavements were failing within a few years. Consequently, the first major pavement research project was commissioned to gain an understanding about pavement performance in Alaska. The study concluded that

- A 2-inch pavement thickness provided more uniform performance.
- Performance was correlated with maximum pavement deflection during the spring thaw.
- The material passing the 200 sieve (P200) was a good indicator of deflection and performance.
- P200 predicted performance better than frost classification.

From this research a new design method, the 1983 Excess Fines Method, was developed, essentially limiting the P200 in each layer of the pavement structure. The method had the limitation that it could not be used reliably on pavements that carried heavy trucks (more than 1 million Equivalent Single Axle Loadings). Consequently, as traffic increased, some of the major routes required implementation of a new pavement design procedure.

Mechanistic design was introduced by the Research Section in 1988 with PC-based software. While not required, the procedure was rapidly adopted for overlay design and higher volume roadways. In 1998, the software was updated with dual units and an improved interface. In 2003, the Alaska Flexible Pavement Design, a mechanistic design procedure based on the 1998 software was adopted as the department's pavement design procedure.

At the same time, a stabilized base policy was adopted. This was done at the direction of the Chief Engineer, who became frustrated by the premature failure of pavements because the fines in the base course were often higher than those specified.

In 2014, a Hard Aggregate Policy was put in place based on multiple research projects that showed the cost and performance benefits of inclusion of hard, coarse aggregate in pavement. The policy applies to all roadways with an AADT of 5000 ADT per lane or higher.

See Appendix A for presentation slides.

Webinar 2: Research and Pavement Design, Construction, and Maintenance in Cold Regions (Roadway Embankments and Foundation)

This webinar discussed 100 years of design, construction, and maintenance of roadways in Alaska and the lessons learned. As reviewed in the webinar, many of the lessons learned in the early 1900s still apply today. For example, Major Richardson observed in 1910, "A serious detriment to the making of a road in Alaska is the thawing of the ground beneath the moss. It has been the universal experience that whenever the moss is cut into, thawing immediately commences … ." David Esch showed how severe the impact of removing the moss is in his work during the mid-1980s. His work indicates that simply removing the moss can increase the summer surface temperature from 1°C to around 20°C.

Interestingly, Purington suggested a solution in 1905. He suggested that the moss be left intact in sections with poor drainage and that the surface be corduroyed with heavy brush or poles, on top of which should be a covering of gravel sufficient to provide the necessary insulation.

The Alaska Road Commission's experience with building on permafrost can be summarized as follows:

- Avoid permafrost when possible.
- Locate on south slopes when possible.

- Avoid wet side hills or slopes with water seeping.
- In fill areas, avoid disturbing the moss and corduroy over soft areas.
- In cut areas, employ staged construction using the thaw and cut method, and backfill with porous gravel.

Construction over permafrost changed little until construction of the Trans-Alaska Pipeline (1970s). The pipeline generated an interest in applying new technologies to construction over permafrost and understanding frost heave and reducing its impact. As a result, numerous studies were performed to understand permafrost and to characterize the properties of permafrost.

Initially, permafrost was characterized as thaw stable and thaw unstable. Later research showed that the way permafrost was formed provided greater insight into the properties of permafrost and the impacts of thawing it. Syngenetic permafrost, which is formed in thin layers of deposited material, can have between 50% and several hundred percent moisture content with very deep ice wedges. Epigenetic permafrost forms by soil freezing in place from the top down. Moisture contents typically range from 20% to 40%, with ice wedges rarely exceeding 5 meters in height.

Climate change is anticipated to have the greatest impact in discontinuous permafrost regions, which, unfortunately, are predominately areas of syngenetic permafrost.

Over the years, research has tried a number of solutions for building roadways over permafrost including insulation, pre-thawing, geosynthetics, thermosyphons, air convection embankments (ACE), and lightweight fill. All of these methods have worked under the right conditions, but each has limitations.

Insulation works best in areas where the mean annual surface temperature is freezing or below. Insulation should be placed about 3 feet below the ground surface to minimize the impact of differential settlement.

Pre-thawing is best used in discontinuous or sporadic permafrost regions where the permafrost is shallow and thin.

Geosynthetics have been successfully used to stabilize the core of the roadway, but have not been successful in stabilizing the side slopes.

Thermosyphons, while expensive, have proven to work in regions where winters are cold.

Air convection embankments have proven effective, but become expensive where rock is not readily available.

Lightweight fill has proven successful where the primary failure mechanism is ice-creep.

A number of techniques have been applied to roadway slopes. The key is to keep the slopes cold; hence, ACE, air convection pipes, and snow removal have proven most successful. Toe berms have not proven successful when the mean annual surface temperature of the slopes is above freezing. In areas where the mean annual surface temperature is below freezing, toe berms may be useful for slope stability.

There have been numerous research efforts to stabilize cut slopes including insulation, flattening of slopes, rock blankets, cutting vertical and allowing thaw to occur, and others. To date, only two of these ideas have proven effective. Rock blankets allow the slopes to thaw, but the rock stabilizes the slope. The vertical cuts are allowed to thaw and to establish a natural slope. Existing moss then covers the slopes providing natural insulation.

A new threat has emerged along the Dalton Highway. Frozen debris lobes (FDL), which consist of frozen soil, flow much like a glacier. One FDL is encroaching on the Dalton forcing the department to make plans to move the roadway away from the FDL. Research funded by USDOT is trying to understand how FDL work and predict where they may occur. More than a dozen FDL have been observed in the area.

The Federal Highway Administration (FHWA) and the Environmental Protection Agency (EPA) have funded studies to quantify the impact of climate change on Alaska's infrastructure. Thus far, it has been difficult to separate climate change from the impact of the infrastructure itself.

See Appendix B for presentation slides.

Webinar 3: Pavement Design, Construction and Maintenance in High Traffic Volume Urban Environments

Capacity typically controls the design of urban roadways with an AADT over 10,000. The following must be considered when planning for design, construction, and maintenance:

- Impacts on traffic
- Impacts on alternate routes
- Access to business
- Pedestrian and bicycle movements
- Construction noise
- Time of day

Traffic control affects all activities and can easily amount to 25% of the project costs in urban areas. These costs should rightly be included in the design life, maintenance strategies, preventative maintenance strategies, and project strategies. The initial design may well influence the selection of these strategies. The designer must recognize that the public has little tolerance for repeated repairs to urban roads and streets. For example, a pavement designed for milling and repaving will cost less and impact the public less than complete removal and replacement. A simple overlay may not be practical due to curb and gutter. Consequently, a perpetual pavement plan designed to maximize the life of the pavement structure while allowing the surface to be replaced quickly certainly has merit even though the initial cost may be higher. To implement such a plan, the strain at the bottom of the pavement layer must be limited. A 50-year design life generally accomplishes this. The Alaska Flexible Design Guide encourages a modified perpetual pavement for high volume urban roadways.

Pavement professionals must consider the needs of the public. In some cases, high construction when traffic is low is a desirable option.

The surface course must be resistant to plastic deformation (rutting), resistant to abrasion (studded tires), and resistant to environmental damage (oxidation and water). Plastic deformation can be minimized by using the right aggregate gradation along with the right asphalt cement in the right proportions. The department's hard aggregate policy should improve the ability of the surface to resist damage due to studded tires. The right asphalt mix helps improve environmental robustness.

Urban projects have the advantage of stable material sources, which allows successful mix designs to be reused. This provides the opportunity to characterize the materials more thoroughly and to correlate the materials with performance.

Recycled asphalt has value. Contractors will often include the value of RAP (reclaimed asphalt pavement) in their bids to gain advantage. Alaska specification allows up to 15% RAP. Research shows that 15% to 20% RAP can be included in the asphalt mix without negative impact on the final product. With care, it may be possible to use 50% RAP without harming the performance of the mix. However, the maximum amount of RAP must be confirmed for each mix.

It is important to keep the public aware of what is going on during the construction phase of the project. Be honest about the potential impacts. The public hates surprises.

Resurfacing triggers include

- Ruts exceeding ½ inch
- Excessive raveling due to low AC or oxidation
- Fatigue cracking over 20% of the wheel path
- Low friction (<0.40)
- Excessive roughness (IRI <170 as suggested by FHWA)

Life cycle costing is more important in urban areas. The traditional approach is to minimize the equivalent annual cost. This approach is sensitive to interest rates, input variables, anticipated life, and impact of maintenance. Each alternative is compared directly, and the lowest equivalent annual cost is selected.

An alternative method is to use the incremental cost analysis, which asks if the additional benefits are worth the incremental cost. The advantage of this approach is that a value is placed on the additional benefits, which must yield at least the minimum rate of return.

A third alternative is to use a service life approach. This approach assumes that the roadway can be repaired indefinitely. However, there is a life that minimizes the life cycle cost. This approach does not require that the user supply the life; rather the approach provides the life. Comparing the minimal life cycle cost for each alternative will yield the best alternative. However, the life may be different for each alternative.

In summary, pavement design in urban areas must include the impact to the public due to high traffic volumes. It is critical to think about preventative maintenance and rehabilitation strategies in design. Life cycle costing is important if the long-term budget of the pavement program is to be minimized.

See Appendix C for presentation slides.

Webinar 4: Pavement Design, Construction and Maintenance Considerations in Rural Alaska

Rural roads in Alaska are designed primarily for trucks. Alaska's rural roads have the following characteristics:

- Mostly truck routes, which control the pavement design
- Long distances, minimal services
- Primary transportation corridors
- Interstate standards to secondary standards design, depending on designation
- Materials generally more variable than urban
- Variable terrain
- Generally low traffic compared with urban
- Shoulders lacking still on some arterials, geometric design based on need than road function
- Capacity rarely an issue except in mountainous terrain where passing may be a problem

Sometimes rural roads are unpaved due to their low traffic volume. Unpaved roads must be designed to carry truck traffic, which requires careful attention to material strength, drainage, and cross slopes. Surface courses must be properly designed to maximize durability and minimize dust, which generally means high fines content, between 8% and 14%, ideally with some plasticity.

In the case of local roads, construction equipment, local delivery trucks, and school busses may control the design. The surface must be able to withstand fatigue, rutting, abrasion shoving, and raveling.

Available bound surfaces include

- Chip seals (AADT 800–2000)
- High float (AADT 400–2000)
- Hot asphalt pavements (AADT >2000

Chip seals and high float perform similarly. High float has the advantage of using a dense, graded material similar to D1; however, this material tends to be noisier. Maintenance and Operation regularly uses it for leveling and patching in permafrost areas. The life expectancy of a chip seal or high float surface is around 7 years.

Hot mix asphalt (HMA) provides increased structural capacity, good wear characteristics, a smooth surface, and an anticipated life of 15 years; it also tends to have lower maintenance costs than chip seals or high float.

General guidelines for HMA include

- Design using the Alaska Flexible Pavement Design Manual
- Design for truck traffic and size (Equivalent Single Axle Loadings, ESAL) in rural areas
- Know the available material and incorporate that knowledge into the design. Understand the properties of the materials intended for use
- Design for the material available, not the material preferred

Do not

- Use the materials in the general guidelines of the manual
- Select materials properties that minimize the asphalt thickness
- Require materials that are not available
- Expect the contractor to go the extra mile

Tools available to select materials properties

- Back calculation of layer moduli based on a falling weight deflectometer
- Field California bearing ratio or plate bearing tests
- Dynamic cone penetrometer
- Laboratory data
    - Resilient modulus
    - California Bearing Ratio
    - Unconfined compressive strength
- Last resort is the values in the manual

A properly designed pavement structure does not require load restrictions. Do not underestimate the cost of load restrictions. The cost of the damage done by one ESAL can cost 20 to 100 times that of a properly designed road.

Over the years, major transverse cracks have received much attention. In many cases, expensive materials have been used to reduce them with little success. In northern Alaska, major transverse cracks represent cracks in the embankment that reflect through the pavement. Research has shown that these cracks can easily move about 1 inch between summer and winter. Asphalt cannot be expected to absorb this level of strain. Saw cutting has proven helpful since cuts force the crack to be straight and in a predictable location.

Map or block cracking, however, is a function of the asphalt. The grade of asphalt or modification of the asphalt can often eliminate map cracking.

Think early about the rehabilitation strategy and maintenance of the pavement. Define what strategy may be employed: reclamation, overlay, or replacement. What might the timing be? If these issues are thought about in the design, life cycle costs can be reduced, thus reducing the long-term pavement costs.

The strategy will be affected by traffic volume and number of heavy trucks, foundations, available funding, or public pressure. Knowing these considerations will help in the selection of the right strategy. However, recognize that current design may well limit future options.

See Appendix D for presentation slides.

Webinar 5: Pavement Best Practices in Alaska: Innovation and New and Emerging Technologies

Webinar 5 reviewed six current research efforts within Alaska and their potential implications. The topics were

- Warm mix asphalt
- H2Ri wicking fabric
- Pavement preservation
- Intelligent compaction
- Micro-Deval
- Chemical stabilization

Warm mix asphalt offers the potential for reducing the mix and placement temperatures of hot mix asphalt without adversely affecting the performance of the asphalt concrete.

Pros:

- Reduces mix temperatures by 50°F to 100°F (10 to 38ºC)
- Reduces fuel costs
- Extends paving season
- Increases available haul distance
- Reduces compaction effort

Cons:

- Potential for increased moisture susceptibility
- Potential for adverse changes in asphalt cement properties

Four warm mix technologies:

- Water-based (foam)
- Organic (Sasobit)
- Chemical (Evotherm)
- Hybrid (Advera, synthetic zeolite)

Water-based and Sasobit have been used successfully in Alaska. At this time, water-based (foam) can be used within the existing specification and is the least expensive alternative. Tests with Sasobit show that the mixing temperature can be reduced by 15°C. The compaction temperature can be reduced by 13°C. However, PG 58-28 was altered to PG 76-16 with the addition of Sasobit. The increase in asphalt stiffness is likely due to the wax contained in Sasobit. The increased stiffness is expected to be detrimental in Interior Alaska because of increased temperature susceptibility of the mix, which tends to increase thermal cracking.

Interestingly, most contractors use warm mix asphalt not to reduce mixing temperatures, but to increase the time of haul and compaction. The department has not monitored the long-term performance of asphalt concrete using either of these technologies.

Alaska DOT&PF Maintenance has been fighting wet embankments for over 35 years. Wicking fabric (H2Ri) developed by TenCate for the Alaska market is proving effective in moving water out of the embankment. A test installation, funded by the department, UAF, and TenCate, at Beaver Slide on the Dalton Highway has proved that H2Ri was effective in moving water out of the embankment. Since the installation of H2Ri, the section has become completely stable. The university continues to test H2Ri through funding from USDOT, TenCate, and Alaska DOT&PF. To date, research has shown that the fabric works effectively in most soils, but it will not work in organic clays. Work is continuing on other clays. Silts do not appear to be a problem. Research has also shown that the fabric is capable of wicking water over 75 feet, but that the overlap system used to splice the fabric is inefficient. Researchers are working with TenCate to address this. Several publications are available that explain how the fabric works and provide information on its effectiveness.

The designer must be aware of a number of cautions, including these:

- Ensure that exposed fabric is not in water. If it is, it will suck water back into the embankment.
- Understand that soil permeability will limit the effectiveness of the wicking fabric.
- Consider carefully the choice to use the fabric in clay until ongoing research is complete.

Pavement preservation has become a national obsession, since it provides the opportunity to extend pavement life at a fraction of the cost of rehabilitation or reconstruction strategies. The FHWA has recognized the cost-effectiveness of preserving pavement by allowing the use of federal funding for pavement preservation. Research has shown that $1 in pavement preservation can save $10 later. Pavement preservation technologies include

- Seal coats
- Thin overlays
- Thin milling and overlay
- Crack sealing

The key to pavement preservation is timing. If applied too early, the cost-effectiveness goes down. If applied too late, pavement preservation may not be effective. Consequently, pavement preservation must be carefully planned, which requires the following:

- Knowledge of the performance curves for a pavement
- Development of a uniform strategy
- Careful performance monitoring
- Awareness of what is working and adjustments to what is not working
- Regular review and update of the strategy.

Intelligent compaction offers the ability for the roller operator to monitor compaction in real time and provides the operator with the ability to adjust roller patterns to achieve consistent compaction. Rollers are configured with GPS equipment that show the operator the roller patterns, feedback on the density of the mat, surface temperature, roller speed, and vibratory drum frequency.

Alaska DOT&PF tested intelligent compaction at the Sitka Airport. That testing showed the following:

Strengths:

- Real-time data pass counts to ensure full coverages.
- Real-time asphalt temperature to ensure proper compaction temperatures met.
- Recordings available immediately after the work shift.

- Ability to identify weak areas before paving.

Limitations:

- Still a new technology with expected growth pains.
- Large data sets sometimes overwhelming.
- Stiffness modulus/stiffness indices not correlated with density. These values are dependent on roller settings.
- No way to separate asphalt stiffness from underlying stiffness.

Micro-Deval testing (ASTM D7423 and AASHTO TP 58-00) was developed in France during the 1960s to measure aggregate abrasion resistance and durability. Subsequently, the Ontario Ministry of Transport found that the Micro-Deval was a good predictor of the performance of base course material and HMA aggregate. The Ontario specifications are shown in Table 1.

Table 1. Micro-Deval Specification for Coarse Aggregates in HMA (4)

Application		Maximum loss (%)
Asphalt wearing courses	premium[1]	5-15[3]
	secondary[2]	17
Asphalt base courses		21

Notes:
1. AADT > 2500 lane.
2. AADT < 2500 lane.
3. Varies with rock type (5% for igneous and metamorphic gravel; 10% for traprock, diabase and andesite; 15% for dolomitic sandstone, granitic meta-arkose and gneiss).

Oregon found that the Micro-Deval test is no better than the LA abrasion test in predicting studded tire wear. The Nordic abrasion is better for this.

In Alaska, 16 base course aggregates from around the state were studied, with these findings:

- Micro-Deval test data were more uniform than LA abrasion test data.
- Micro-Deval testing, along with LA and sodium sulfate tests, was more reliable than the Washington degradation test.
- The Micro-Deval test correlates best with the Washington degradation test.
- Micro-Deval testing is much quicker to perform and is not misled by clay.

Chemical stabilization of soils offers the promise of allowing the use of fine-grained soils where granular soils are not available, such as in Western Alaska. The literature indicates that chemical stabilizers can be used to improve the strength of fine-grained soils. However, little data are available to document the performance of chemical stabilizers. The focus of the Alaska study was on silts and sands typical in Alaska.

The study found that unconfined compressive strengths of 1100 psi in sand and 600 psi in silts can be achieved with chemical stabilizers. Moduli of 140 k for sand and 60 k for silt can be achieved.

Two field trials were constructed: one at Horseshoe Lake and one at Shishmaref. The project at Horseshoe Lake project stabilized windblown sand with a combination of plastic fibers and polymer stabilizers. The site has remained ungraded for 6 years, although the surface is becoming rough. This site could be easily resurfaced by adding a layer of sand and topically applying the polymer stabilizer.

The project at Shishmaref used beach sand along with a magnesium cement combined with a polymer stabilizer. A concrete truck was used to mix the sand with the chemicals and placed much like Portland cement. The material went down easily. However, after 2 years, surface spalling is occurring. It is not clear whether the surface spalling is due to the amount of water used or because of low cement content.

The project team visited a project in Tempe, Arizona, where a polymer stabilizer was topically applied to an aggregate surface road. After a year, the surface is performing well. However, there are plans to apply a light maintenance application of polymer annually.

Even with the problems at Shishmaref, these tests show that chemical stabilizers are likely to have a future in Alaska.

See Appendix E for presentation slides.

Webinar 6: Summary of Interviews with 5 State Materials Engineers and a History of the Alaska Statewide Materials Section

The purpose of this effort was to understand the policies, processes, organizational structures, and practices of departments similar to Alaska DOT&PF in other states. Five state Materials Engineers were interviewed:

Chris Abadie, P.E., Louisiana
Joe Feller, P.E., South Dakota
Colin Franco, P.E., Rhode Island
Robert G. Lauzon, Ph.D., P.E., Connecticut
Matthew Strizich, P.E., Montana

The details of the interviews are provided in Appendix F. While there was little agreement between the states, some interesting observations were made. These are summarized here, but the reader is encouraged to read the report to gain additional insight.

- Policies: 23 CFR 637 drives policies; beyond that, each state implements the policy differently.
- Organization: Many effective informal channels exist, but the formal location of Materials impacts its success. The location of Materials varies with each state.
- Organization: Three and a half out of five describe themselves as centralized.
- Organization (informal): Most states tend to have functional supervision of district labs.
- Specification development: Basic steps are similar; that is, changes are suggested by anyone and reviewed by a team, with review by interested parties in the department.
- QA function: Differing approaches, especially contractor QC.
- Disagreements: Resolved at the lowest level possible with a clear procedure for elevating. The organizational structure influences success
- Change: Final step—obtaining buy-in—is informal. Involve industry; communicate; involve many people.
- Research: Steps for project selection are similar; implementation process varies. Some states have a formal implementation process, while it seems others simply allow it to happen.

The Materials Engineers added a number of "other things" to the prepared questions, including

- Keys to success are the support of upper management, continuous communication, and mutual respect.
- A single pyramid organization leads to easy communication.
- Design reviews that include Materials can lead to development and implementation of new technologies.
- Education and training are essential and (in Rhode Island) are supported by top leadership.
- The process is an ever-evolving one; it is never static, due to new technologies, new materials, and new project delivery methods. A challenge is that Materials must keep up.
- It is essential to maintain contacts with other states, through AASHTO committees and the like.
- The line between materials testing and research is blurred at times. Both need attention and are equally important.
- When dealing with details of construction, things can get contentious, with Construction sometimes thinking that "minor details" are not important.

The Alaska State Materials Section was located on the UAF campus and was responsible for all standards prior to 1977. Statewide Materials was the only AASHTO-accredited materials laboratory in the state and, consequently, was responsible for assurance testing to ensure that the District Labs were in conformance. In addition, Statewide Materials was responsible for specialized testing such as of paint and steel, and specialized soil tests such as triaxial testing. Statewide Materials was responsible for engineering and materials-related research.

In 1977, Statewide Materials was moved to Anchorage and merged with the Central Region Laboratory. Research was split off and remained on the UAF campus.

When Statewide Materials was moved from the Central Region to Design and Engineering Services, it no longer had a laboratory associated with it. Each region had its own AASHTO-certified lab. Statewide Materials was responsible for the following:

- The Alaska test methods
- Qualified Products List
- Standard materials specifications
- Geotechnical, pavement and other materials-related manuals
- WAQTC program

There is no direct line of authority to regional Materials.

Materials-related specification development may be delegated to the Statewide Materials Engineer by the Chief Engineer, who often forms a working committee and seeks input from interested parties. The draft specification is posted for review by interested parties. Once consensus is developed, the final specification is prepared and adopted. This process is similar to the ones followed by the states interviewed and appears to work well.

Quality assurance for construction is handled by the regions.

WAQTC training is performed by the regions with qualification test protocols established by Statewide Materials.

Lab certification is by AASHTO with no oversight by Statewide Materials.

Statewide Materials is responsible for test methods and Quality Level Assurance (QLA) specifications.

Dispute resolution of test results is generally handled by the regions, using the dispute resolution process provided in the Standard Specification. Internal disagreements concerning materials may be mediated by the Statewide Materials Engineer. However, any decisions that bind the regions are issued by the Chief Engineer.

Statewide Materials works closely with the regions, contractors, and suppliers through Association of General Contractors, Asphalt Alliance, and the Concrete Alliance to reach consensus.

While Statewide Materials has no authority to require change, it often champions and facilitates change by working closely with all interested parties.

Materials Research follows the same process as the rest of the department. However, the Statewide Materials Engineer works with the Regional Materials Engineers to prioritize materials research.

Finally, while there is no direct line of authority to the Regional Materials sections, the Statewide Materials Engineer works closely with the Regional Materials Engineers. This is similar to other sections, such as Traffic and Safety.

See Appendix F for presentation slides and Appendix G for the summary of interviews.

Webinar Survey

A survey questionnaire that asked about the quality, format, and informational content of the webinars was sent to webinar attendees. Only three surveys were returned, unfortunately, but the responses were consistent.

The respondents indicated that the level of detail and the timeframe—1 to 1½ hours—was about right. When asked for three takeaways, each respondent had a different reply. In response to the question of how often the webinars should be offered, two suggested monthly and one suggested quarterly. All thought the time slot seemed appropriate, and all responded that they would recommend their peers watch the recorded webinars.

The consensus was that the webinars were valuable.

See Appendix H for survey results.

Workshop Summary

A workshop was held in Anchorage on December 14, 2015, to discuss future directions of materials research, implementation efforts, knowledge transfer, and recommended changes in policy. In attendance were

- Roger Healy, Chief Engineer
- Carolyn Morehouse, Chief of Research
- Jeff Currey, Northern Region Materials Engineer
- Bob Trousil, Southcoast Region Materials Engineer
- Jim Amundsen, CDE-CR Design/Engineering
- Tom Dougherty, CCO-Construction/Operations
- Ken Morton, CDE-CR Design/Engineering
- Billy Connor, Director Alaska University Transportation Center
- Larry Bennett, Ph.D., Bennett Engineering

Roger Healy began by discussing the loss of materials expertise, loss of continuity, and lack of documented history due to retirements and turnover. There is a glaring lack of transfer of knowledge to new employees. Consequently, duplication of effort and repeated mistakes are inevitable. Where innovation proves successful, that knowledge is not being passed on. One of the purposes of this workshop was to review the organization in an effort to find ways to improve knowledge transfer.

Carolyn Morehouse said she would like to see a more strategic approach to the program. In many cases, a research project considered high priority is started and becomes unimportant before its completion. This often happens because the research is focused on solving a problem faced by a design project that is completed before the research can be completed. Consequently, the champions no longer have an interest in the research. Ms. Morehouse will be working to eliminate this.

The attendees introduced themselves and gave a brief overview of their expectations. A few common themes emerged:

- Each year, innovative designs are tried outside the research program. However, once the project is completed, no mechanism is in place to document the performance, and no effort is made to inform others of the lessons learned.
- Research projects have little strategic direction.
- Better communication on common issues is needed between the regional and statewide offices. In most cases, regions do not know what other regions are doing.

The group turned its attention to four recommendations provided to them. Each recommendation was discussed, and consensus on whether to accept, reject, or modify the recommendation was reached.

Recommendation 1: Webinars

Based on responses from the webinar survey, webinars should be presented monthly or in alternate months and should be about 1 hour in length. The webinars should be recorded for future viewing. One of the respondents particularly liked the relaxed atmosphere of the webinar. The content should not be overly technical or detailed. Rather the information presented should be an overview of the topic. Topics need not necessarily be based on Alaska research, but could be a compilation of literature on a particular topic of interest.

Discussion

In general, the group supported the idea of webinars as a means of disseminating information. However, concern was expressed about making the webinars materials-centric. The group felt that the webinars should be focused on topics of current interest. While webinars might use information gleaned from sources outside the state, it is important that the webinars be focused on issues pertaining to Alaska. The group agreed that the webinars should be an overview with reference to information sources, not academic in nature. Webinars focused on case studies would be of particular interest.

Monthly webinars would be appropriate during the winter months, but should probably be suspended during the summer months.

Recording of webinars would be good, and they should be easily accessible.

Recommendation 2: Selection of Materials-Related Research

There appears to be a good working relationship between the Materials Engineers. Because of this, the opportunity to develop a unified materials research program is good. The Statewide Materials Engineer in consultation with the Regional Materials Engineers should continue to prioritize materials-related research. In addition, it would be useful for the Materials Engineers to identify research focus areas to guide the research rather than simply react to research ideas. It was suggested that the committee focus on the desired outcomes for this effort rather than individual research projects. The group felt this might be difficult.

While regions do work together, each region has unique needs that often do not translate to other regions. For example, permafrost is a critical issue for the Northern Region, but of no concern to the Southcoast Region. Experience has shown that when research focused on regional issues is considered by a statewide committee, the research morphs into something that no longer addresses the original issue. Consequently, the research is likely not supported by the region.

Mr. Healy stated that research is required to meet the needs of many customers. Unfortunately, funding simply does not allow all needs to be met. Research should coordinate those needs through periodic meetings. The role of Research is to identify needs and coordinate the prioritization of those needs.

Ms. Morehouse reiterated that, even though the regions have unique needs, a strategic approach to the research program is still needed. Regions should identify systemic issues and use those to select research needs rather than one-time design problems.

The Materials Engineers suggested that one of the greatest research needs is to document the performance of innovative designs and pass that knowledge to department staff. They agreed that this idea would be one of the most cost-effective research projects that Research could undertake, because the cost of constructing the test section has already been incurred.

Recommendation 3: Literature Search

It was suggested that before any research idea is accepted, a literature search be commissioned to determine if the solution already exists. If a solution is available, determine if it is in a form ready to use or if the existing body of knowledge needs additional work before implementation. In the past, the literature search is often done in parallel with the project. While the information found in the literature search may alter the research plan, it rarely replaces the proposed research even if there is duplication. Consequently, the literature search should be completed before committing to the research. It is further suggested that the literature search be conducted by a subject matter expert. Care should be taken to ensure the search is fair and unbiased. Research proposals must recognize the literature and show that the work is not duplicative. The expert task force should be provided copies of the literature search before reviewing the research proposal to determine if the research should go forward.

Ms. Morehouse agreed with this recommendation and stated that it has already been implemented. She also stated that there is a need to review research reported in the TRB journals and other national research. The Material Engineers felt that most of the research reported by the TRB is too academic to be implemented and that additional work would be required before implementation. Often the work must be "Alaskanized" before it becomes useful. Much of the research is too theoretical to be of much use.

The group agreed that there is a need to get the results of these literature searches into the hands of department staff. It was suggested that staff be taught how to find information on both local and national research. Many members of the workshop felt that staff simply do not know what is available to them.

Recommendation 4: Implementation

It was suggested that upon completion of research projects, Materials Engineers review materials-related research to determine if the research is ready for implementation, needs further work before implementation, or should not be implemented. Documentation of the decision and an outline of the necessary steps to follow, if any, should be provided.

While the group felt that implementation was important, it did not feel this decision should be made by Materials Engineers alone. The group felt that this effort should be collaborative between planning, design, construction, and maintenance. A major barrier to implementation strategy is related to budgetary implications. Some very positive research results may not have the budget support to implement them. One option is to look at a process followed by the Louisiana DOT, where a cost analysis is included in the implementation recommendation. This step requires disclosure of the cost of implementation and the benefits to be derived.

Several other issues were discussed:

- Timing of report reviews is important. Little time is available to review research reports during the summer months. Further, Materials Engineers would like a reasonable amount of time to review work products and fit that effort into their schedule.
- More effort is needed to prepare a good Executive Summary of each report, since it is what most people will read.
- More effort must be made to make staff aware of research products. The group approves of research bulletins, but feels the bulletins are not produced often enough.

- The need to be more visible in the "In Transit." Everyone reads this.

Open Discussion

The open discussion focused on making information available to staff when needed. The department is using Pinnacle as a software platform to disseminate information to staff, much like an electronic desk manual. Each group has its own desk manual within Pinnacle, typically not shared with others. Pinnacle allows the user to search for information, directives, and forms related to the individual's current work. It also allows management to provide clarification on any issue as required.

The group recommended research look into the viability of using Pinnacle as a platform for disseminating research results and implementation products.

Discussion of looking at past innovative projects and reviewing premature pavement failures continued. While the group agreed that this work is important, the question of who would accomplish it and how it would be funded needs resolution. It was suggested that Statewide Design and Engineering Services could facilitate this effort. Statewide Materials should take the lead on materials-related innovation in consultation with the regions. No matter who is responsible, it is important that everyone has access to the reports.

It was suggested that pavement-related projects could be funded under the pavement management project, since these data could be used to modify the pavement management inputs and models.

The discussion turned to implementation and the length of time required to begin research. Mr. Healy pointed out that improvements are driven by perception, which is reality to most of us. So it needs to be managed. Perception management can only be done by timely information in an understandable form. All agreed that this recommendation needs work.

Action Items

The following action items and persons responsible for them were agreed to by the group:

- Develop and schedule webinars on a variety of subjects. Consider case studies important. Responsible persons: T2 Staff
- Become more strategic by looking at long-term issues even though regional issues are different. This is expected to be an ongoing dialog. Responsible person: Carolyn Morehouse
- Fund follow-up efforts on innovative projects, including experimental features, long enough to get meaningful results. Responsible person: Roger Healy
- Implement report summaries of all research projects in a timely fashion. Responsible persons: Research Staff
- Look at Pinnacle as a platform for dissemination of research results. Responsible person: Carolyn Morehouse

- Consider Statewide Materials as a clearinghouse for lessons learned and work on common problems. Responsible persons: Roger Healy
- Work with report writers to ensure well-written Executive Summary and Summary and Conclusions report sections. Responsible persons: Research Staff
- Recognize that there is a budget component of implementation. Develop a process of evaluating the cost impacts and cost-effectiveness of implementation. The Louisiana model may be a good starting point. Responsible person: Carolyn Morehouse
- Establish a readily accessible method for department staff to ask questions of research staff and receive quick responses. Responsible persons: Research Staff
- Develop the ability within Statewide Materials to review premature pavement failures, determine the cause(s), and recommend appropriate changes to avoid repeated failures. Responsible persons: Roger Healy

Two items were noted that were not action items, but should be captured:

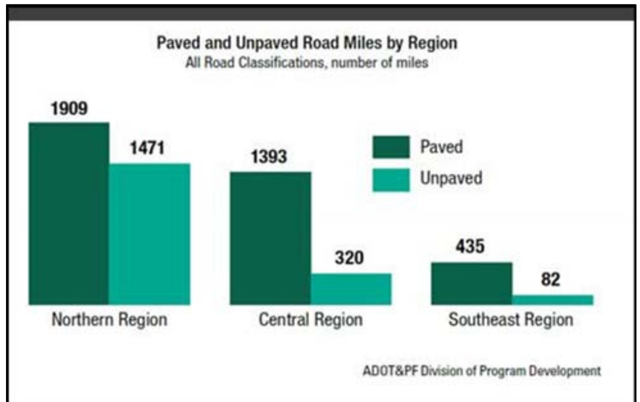
- Recognize the impact of perception and learn to manage it.
- Recognize that the workloads of report reviewers are seasonal and avoid review requests during the busiest periods—usually summer months. Make sure that sufficient time is provided for the reviewer to work the review into his/her schedule.

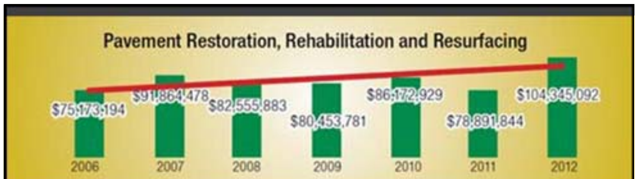
Appendix A

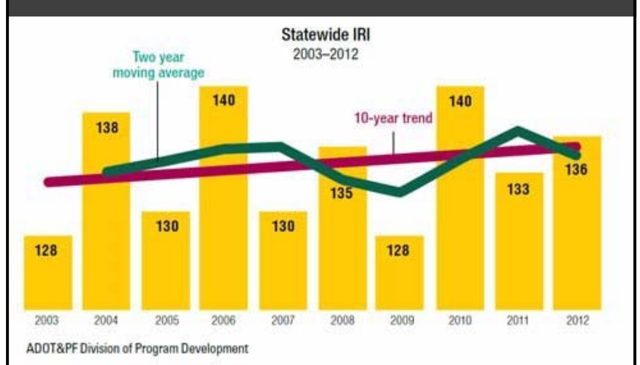
Webinar Series 1

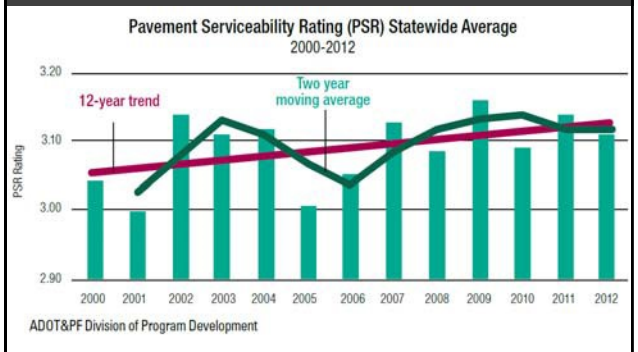
Overview of Pavement Design

Overview of Pavement Design









Source: DOT&PF 2013 Pavement Report

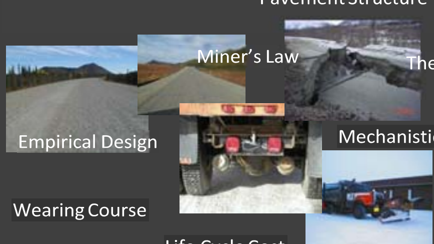
It's all about knowing how materials perform!

- Each layer must be capable of carrying load during all seasons
- The response of each material impacts all others
- Unbound layers deform under load
- Bound layers not only deform but also fatigue from both traffic and the environment.

- Now you are an expert.

Basic Concepts and Definitions

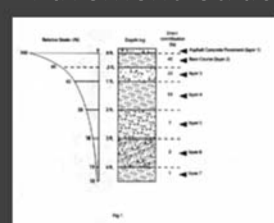
Pavement Structure



Wearing Course

Life Cycle Cost

Pavement Structure



The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and to distribute it to the roadbed.

Approximately 3 to 3.5 ft for highways and about 5 ft. for airports

Surface Course

The surface course may be comprised of unbound aggregate, asphalt concrete or Portland cement concrete. It must withstand traffic loadings, abrasion, the environment while protecting the base

Base Course

The layer or layers which support the surface course and reduces the stress on the subbase layer. Base course may be bound, unbound or stabilized.

Subbase

The layer immediately beneath the base and just above the subgrade. This layer reduces the stress on the subgrade to acceptable levels while supporting traffic loading. The thickness is a function of traffic and the material incorporated into the subbase.

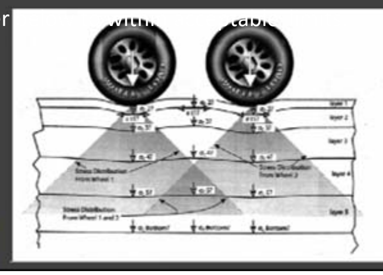
Subgrade

The top surface of the embankment or excavation upon which the pavement structure is constructed. The pavement structure reduces the stress on the subgrade to an acceptable level.

Putting it Together

Pavement Design

The pavement structure is objectively analyzed as a system of layers such that each layer reduces the load on the layer

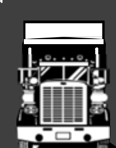


A Brief History of Pavement Design in Alaska

- Late 1950's Through Early 1970's Used a Standard Embankment.

Alaska moved to Empirical Designs in the early 1970's

- Limited to Materials, Climate, Traffic, etc. of that Experience
- Must be Constantly Reviewed and Updated
- AASHTO 1993 Design Guide is an example



1970's Used California R-Value Design (Similar to CBR methods)

- Basic Equation: GE=0.0032(TI)(100-R)
- Determine the R-value for each soil type available. (Similar to CBR value.)
- Starting at Bottom Determine the Gravel Equivalent (GE) required above that layer for the Traffic Index (TI) of the roadway.

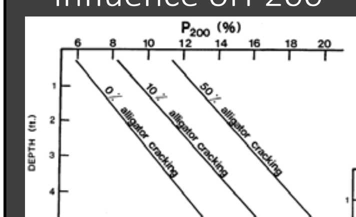
Designers worked to duplicate the old standard design

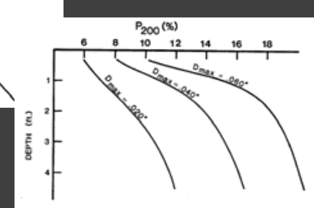
Mid 1970's Dissatisfaction of Pavement Performance

Study Conclusions

- 2" AC performance much more uniform that 1.5 "
- Performance was correlated with maximum pavement deflection during the spring thaw
- P200 is a good indicator of deflection and performance
- P200 better indicator of performance than frost classification.

Influence of P200





1983 Adopted Excess Fines Method

- Based on the relationship between pavement deflection and pavement performance.
- Based on the relationship between P200 and deflection
- Assumes Spring to be the controlling season
- Limited to ESALS < 1 million

Early 1980's Recognized the Advantages of Mechanistic Design

- Allows new materials without changing design method
- More flexibility in layer selection
- Allows analysis of complex traffic loading
- Allows for analysis of changes in legal load limits
- Allows design for seasonal and climate variation
- No maximum on traffic

1988 Introduced AKOD (Alaska Overlay Design)

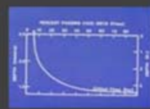
- Brought Mechanistic Design to the Desktop
- Automated the Design Process
- Allowed both new pavement design and overlay design
- The same software and methodology could be used for both highways and airports

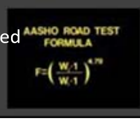
1998 AKOD98 Introduced

- Provided Design in Dual Units
- Improved User Interface
- Updated Performance Models

2003 Introduced Alaska Flexible Pavement Design (AKPFD)

- Enhances User Interface
- Increased Flexibility
- Provides Database of Materials Properties
- Updated Performance Models
- Provides Designer with Detailed Information
- Fully Documented



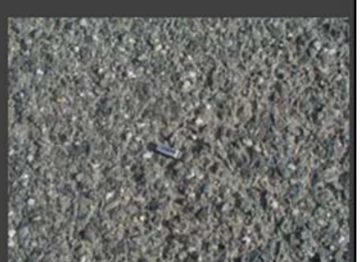


Things to Consider in Pavement Design

- Anticipated/Expected Performance
- Cost: Both First Cost and Life Cycle
- Impact on Maintenance
- Impact on the Public
- Available Materials - Be Realistic
- Constructability

Surface Course Selection

- Foundation
- Traffic
- Available Materials
- Climate
- Design Goals



Select a Surface Life Consistent with the Foundation

Don’t Let 10% Control the Design

Select Surface Capable of Surviving the Traffic

- Fatigue
- Rutting
- Abrasion
- Shoving
- Raveling

Available Materials

Ensure materials are available to construct the selected surface.

Climate

- Can the surface be placed within specification?
- Does climate favor a particular surface?

Design Goals

- Expected Life
- Expected Performance
- Rehabilitation Strategy
- System Goals
- Financial Goals

Surface Treatments

- Low Volume Roads
- Poor Foundations
- Requires good pavement structure
- Poor resistance to turning
- Typically 5 to 7 year life

Hot Mix Asphalt

- Provides increased structural capacity
- Good wear characteristics
- Smoothest surface
- Long life
- Generally low maintenance

Alaska Renewable Pavement

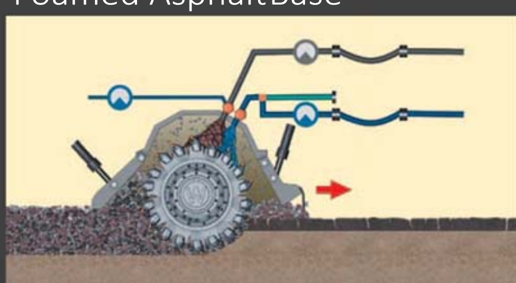
- Higher first cost
- Indefinite fatigue resistance
- Allows rapid lower cost resurfacing (shave and pave)
- Lower impact on public during rehab.

Stabilized Base Policy

- Found in Chapter 2 of the Pavement Design Manual Section 2.3.
- Requires the use of bound stabilization on all roadway project
- Exceptions
  - Gravel to Pavement project
  - Low ADT
  - Unstable foundations
  - A life-cycle cost analysis proves that it is not cost effective
  - Projects designed for other agencies

New Soil Stabilization Manual

Foamed Asphalt Base



Hard Aggregate Policy

- Hard Aggregate required on all roadways with AADT of 5000/lane or greater.
- Nordic Abrasion of 8% or less
- Based on work by Bruce Brunette and Quality Engineering Solutions.
- Is being incorporated into the Pavement Design Manual due in June 2015.

Appendix B
Webinar II
Construction and Maintenance in Cold Regions
(100 plus)

Construction and Maintenance in Cold Regions (100 plus years)

Road Map

› The Early Years
  – Early lessons in road and railroad construction
  – The construction of the Alaska Highway
› Design and Construction on Permafrost
  – Definitions
  – Problems and solutions
› Managing Frost Heave
› Impacts of Climate Change

The Early Years

› Alaska's transportation was driven by gold.
  – Everything was temporary
  – Streets rarely improved

Photo: Wikipedia

4/29/2015 3

Rivers and winter trails were the preferred

Smithsonian Institution Archives

4

Major Richardson's Vision (1910)

- Wagon roads would be all weather with crown and ditches, and when funding was available surfaced with gravel.
- Winter sled trails with suitable grades and width, but no drainage or surface improvements.
- Dog sled trails consisting of basic clearing and marking.

Roads and Trails 1918 (Alaska Archives)

Construction of the Richardson Highway

- Initially 5 ft wide pack trail from Valdez to Eagle was built by destitute prospectors looking for cash to get home.
- 1910: Major Richardson appointed by the Secretary of War to upgrade the trail to accommodate wagons.

Richardson noted: "A serious detriment to the making of a road in Alaska is the thawing of the ground beneath the moss. It has

Solution

Purington suggested:

That the moss be left intact in sections with poor drainage and that the surface be corduroyed with heavy brush or poles on top of which a covering of gravel sufficient to provide the necessary insulation. (1905)

Mechanization come to Alaska (1918)

- Engineers determined that 10% of the road could be maintained with tractor power.
- Tractors would help with the shortage of manpower.
- Tractors increased compaction improving the durability of roads.
- Road repairs reduce by 2/3 with tractors.

The 1920's Brings the automobile and aviation

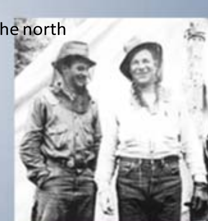
- The auto requires hard surfacing. Only 20 miles out of Fairbanks and Valdez supported the auto in 1923
  - By 1926 auto use had grown such that the auto represented 90% of the traffic on wagon roads.
  - Major James Steese recommended uniform standards including gravelling for the Richardson Highway
- Aviation require the construction of airfields in remote areas
  - Increased use of aviation reduced the need for roads, even today.
  - By 1932 there were 70 airfields carrying 6,637 passengers over 942,176 passenger miles and carried 496,680 lbs of mail.

WWII Brings the Alaska Highway

- Considered one of the greatest accomplishments in highway construction (1,477miles of pioneer road in 9 months at a cost of $28 million)
- Completion of an all weather road would take 3 more years at a cost of $87 million.
- Another $1 million was used to upgrade existing roads

Challenges

- No route existed
- No experience in building roads in the north
- Limited manpower
- Limited accommodations



Yet, the Army and Its Contractors Refused Help from the Alaska Road Commission

- Stripped vegetation from permafrost
- Crossed muskeg in winter because it required no clearing
- Lost several bridges at ice out

Melting Permafrost

THIS IS NO PICNIC

WORKING AND LIVING CONDITIONS ON THIS JOB ARE AS DIFFICULT AS THOSE ENCOUNTERED ON ANY CONSTRUCTION JOB EVER DONE IN THE UNITED STATES OR FOREIGN TERRITORY. MEN HIRED FOR THIS JOB WILL BE REQUIRED TO WORK AND LIVE UNDER THE MOST EXTREME CONDITIONS IMAGINABLE. TEMPERATURES WILL RANGE FROM 90 DEGREES ABOVE ZERO TO 70 DEGREES BELOW ZERO. MEN WILL HAVE TO FIGHT SWAMPS, RIVERS, ICE AND COLD. MOSQUITOES, FLIES AND GNATS WILL NOT ONLY BE ANNOYING BUT WILL CAUSE BODILY HARM. IF YOU ARE NOT PREPARED TO WORK UNDER THESE AND SIMILAR CONDITIONS DO NOT APPLY.

June 15, 1942 Bechtel-Price-Callahan

Alaska Road Commission Experience for Building on Permafrost (1950)

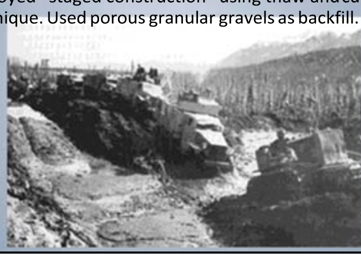
- Avoid permafrost when possible.
- Locate on south slopes when possible.
- Avoid wet side hills or slopes with water seeping.

In Fill Areas

- When moss is removed permafrost melted creating an impassible mire. Avoid disturbing moss.
  - Place material over undisturbed moss carefully. Even location parties were required to walk.
- Use corduroy over soft areas.

In Cut Sections

- Employed “staged construction” using thaw and cut technique. Used porous granular gravels as backfill.



Construction over Permafrost Changed Little Until

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The Pipeline Brought a New Interest In

- Applying new technologies to construction over permafrost
- Understanding and reducing the impact of frost heave

Defining Permafrost

- Soil frozen two or more years
- Ice Rich Permafrost: Frozen soil which contains enough ice to be unstable when melted.
- Ice Poor Permafrost: Frozen soil with little ice. Little impact when thawed.
- Thaw Stable Permafrost: Frozen soil that remains stable when thawed.
- Thaw Unstable Permafrost: Permafrost that looses strength when thawed.

Three Important Types of Permafrost

- Epigenetic: Permafrost formed from top down
- Syngeneic: Permafrost that was developed in layers
- Yedoma: Syngeneic permafrost that is mostly ice

Epigenetic Permafrost Formation

Video: Permafrost Frontier

Characteristics

- Gravel
  - Simply frozen aggregate with little impact of thawing
- Fine grained soil
  - Lensing from frost action
  - Typical moisture contents range from 20% to 40%
- Ice Wedges
  - 3 to 5 meters in height
  - Generally wide at top (up to about 10 meters)

Syngenetic Permafrost Formation

- Each year a thin layer of sediment is deposited
- The soil is frozen in the winter and thawed in the summer, but the bottom remains frozen
- As each layer is deposited, the thaw is further from the bottom.

Characteristics

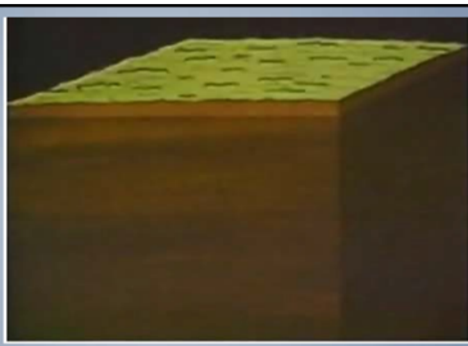
- Gravel similar to epigenetic permafrost
- Fine grained soils
  - Moisture contents routinely typically between 50% and several hundred %
  - May have large ice lenses
  - Bottom of permafrost typically epigenetic
- Ice Wedges
  - Typically 25 to 35 meters but could be theoretically larger
  - Thickness varies due to changes in climate or deposition

Yedoma is simply ice rich Sygenetic Permafrost

Areas where permafrost thawed and refroze

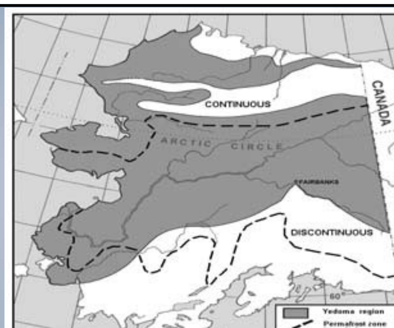
- Permafrost tends to have low moisture contents
- Taliks are common
- Where wedges are refilled, ice structure has lower solids and layers are typically horizontal.

Formation of Ice Wedges



Video:Permaffrost Frontier

Distribution of



Modified from Kanevskiy et al., 2011

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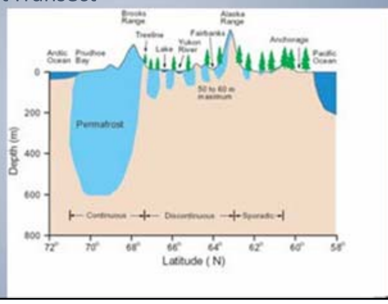
Permafrost Transect



Roads and Airfields on Permafrost

Construction Options

› Keep it frozen

› Thaw

› Remove and replace

› Live with the consequences

Differential Settlement

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Causes of Differential Settlement

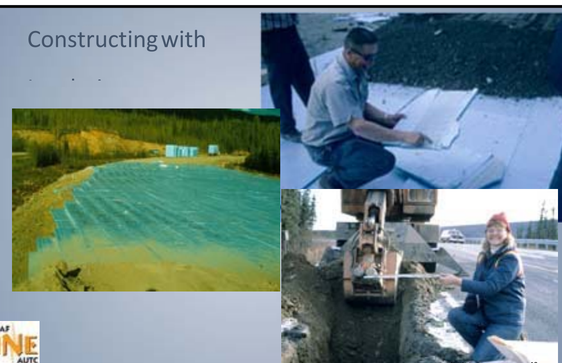
Solutions

- › Insulation
- › Pre-Thawing
- › Geosynthetics
- › Air Convection Embankments
- › Thermosyphons
- › Light Weight Fill

Insulation

- › Foamed Insulation tried first (rapidly became saturated)
- › Extruded Insulation (works well, low moisture absorption)
- › Expanded Insulation (works well, but lower R-value than extruded)

Constructing with



GUIDELINES FOR INSULATION USE

- Put as high in embankment as possible
- Differential Icing (place about 3 feet from surface)
- Less effective in areas where MASST above freezing
- Even so effective for reducing frost heave
- Commonly used in

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PRE-THAWING

- Effective when permafrost is shallow and thin
- Requires 2 to 5 years
- Relatively inexpensive
- Most effective in sporadic

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GEOSYNTHETICS

- Spanning Voids
- Increase bearing capacity of thawed soils
- Eliminate intrusion of fine soils into course soils

Spanning 12 foot void

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AIR CONVECTION

Basically a pile of

uniformly graded

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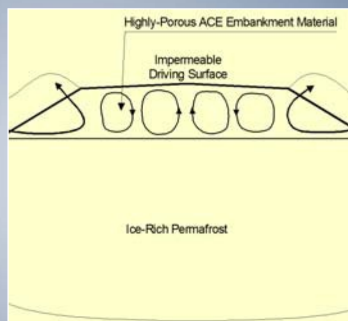
AIR CONVECTION

EMBANKEMENT

- Uses convection cells to



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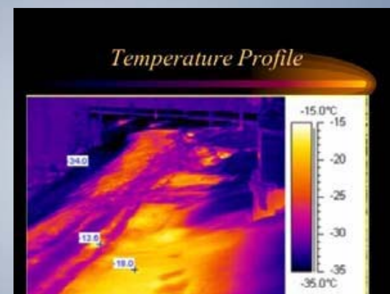
AIR CONVECTION

EMBANKEMENT

- Uses convection cells to transfer heat from permafrost upward



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THERMOSYPHONS

- Transfers heat from permafrost to air via phase change of liquid to gas
- Effective

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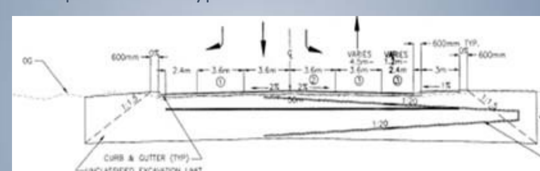
Hairpin Thermosyphon



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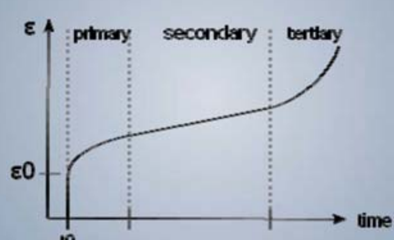
Hairpin Thermosyphons

Works well even in warming climate, but expensive.

Lightweight Fill Used to Reduce Creep

Creep in Ice



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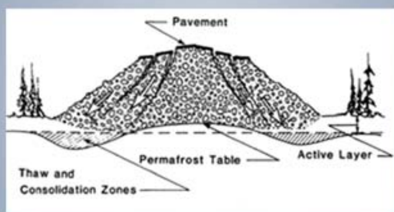
Shoulder Rotation

Cause of Shoulder Failures



The Key is to Keep the Fore Slopes Cold

- Toe Berms
- Shading
- Air convection

(photo: M. Kanevskiy)

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TOE BERM MYTHS

- Keeps underlying permafrost cold
- Reduces impact of snow berms
- Stabilizes embankment

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SHADING

- Reduced summer surface temperatures
- Reduces winter surface temperatures
- Limited application
- Expensive

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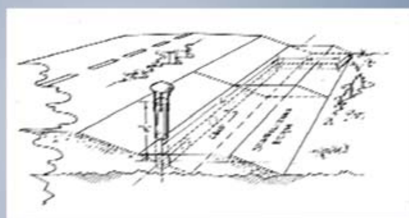
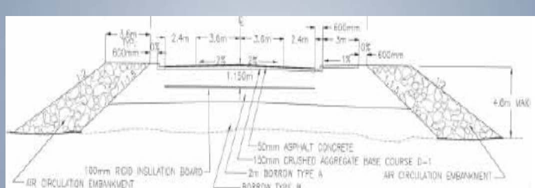
AIR DUCTS

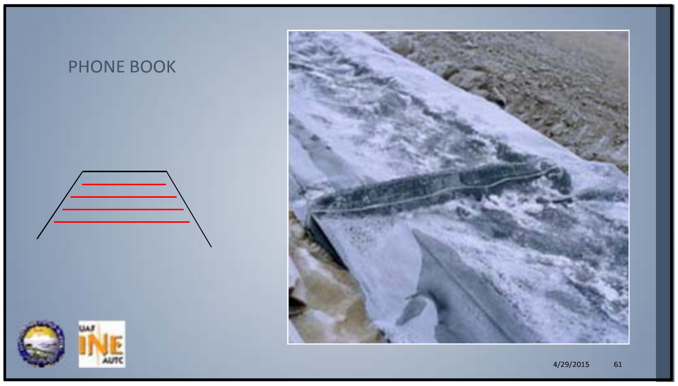
- Air Ducts cool the slopes



AIR CONVECTION SHOULDERS



Pillow Wrapping Geotextile


PHONE BOOK
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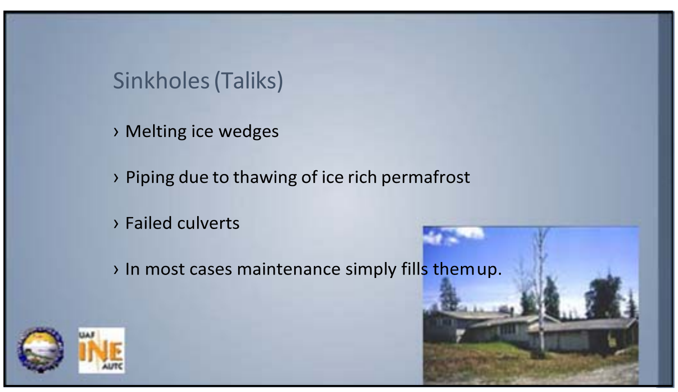
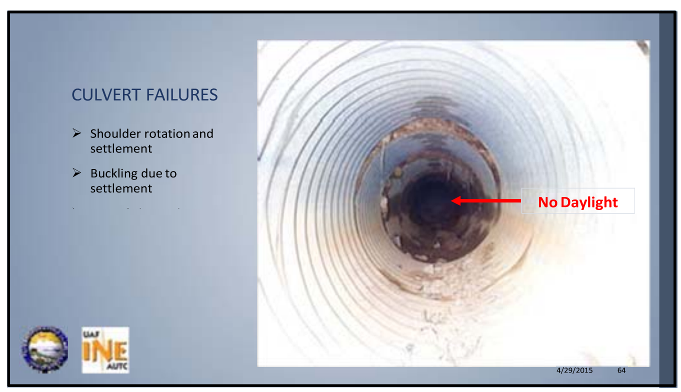
Sinkholes
Dip In Road


Sinkholes (Taliks)
› Melting ice wedges
› Piping due to thawing of ice rich permafrost
› Failed culverts
› In most cases maintenance simply fills them up.


CULVERT FAILURES
➢ Shoulder rotation and settlement
➢ Buckling due to settlement
No Daylight
4/29/2015
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Stabilizing Slopes

INSULATING SLOPES

- Slopes continue to thaw at a slower rate
- Insulation tends to be rigid which creates air voids behind it.

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LAYING SLOPES BACK

- Slopes thaw rapidly becoming unstable
- Slopes continue to flatten taking land behind them

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VERTICAL SLOPES

- Cut slopes vertical and allow vegetation to fold over slope as it thaws
- The most cost effective method of slope protection

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ROCK BLANKET

- Very flexible and conforms to differential settlement
- Filters water from thawing slopes
- Best used for ice wedges

WOODCHIPS

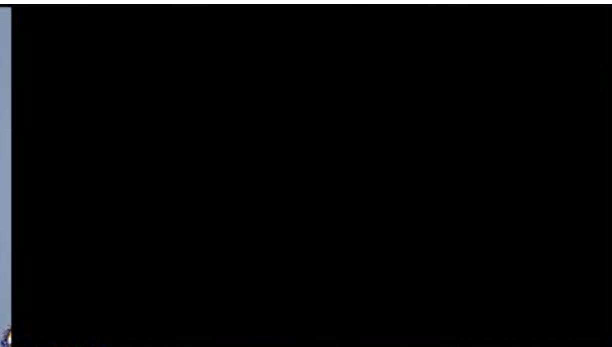
- Light weight
- Provides some insulation
- Filters water
- Flexible
- Degrades with time

A New Threat

Speed of Frozen Debris Lobes

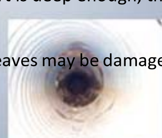
Managing Frost Heave in Roadways

- Differential Heaving
  - Water supply
  - Soil profile
  - Shading
  - Utilities and culverts

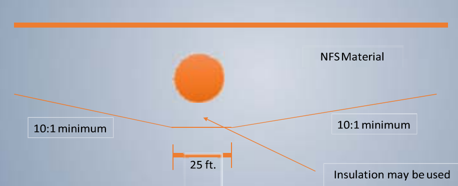


Heave over Culverts

- Initial heave may occur before rest of road leading to a hump
- In the spring thaw may occur early leaving a dip
- If the bedding of the culvert is deep enough, there will be a dip all winter.
- Culverts on ground that heaves may be damaged.



One Solution



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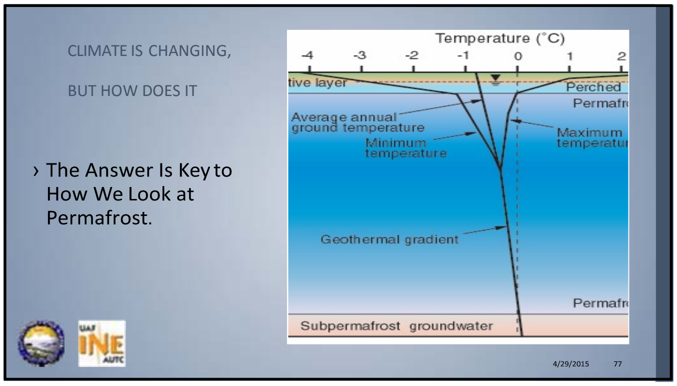
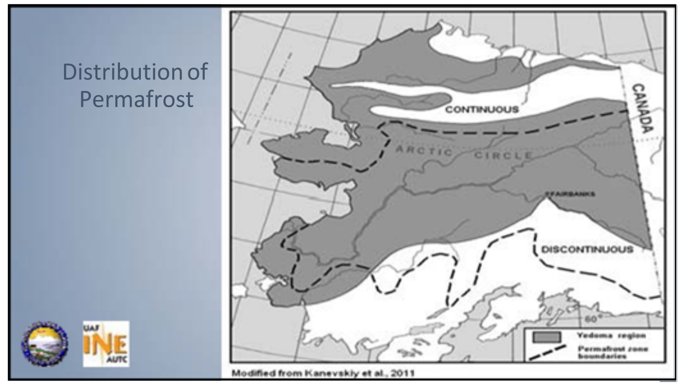

CLIMATE IS CHANGING,
BUT HOW DOES IT
› The Answer Is Key to How We Look at Permafrost.
Temperature (°C)
-4 -3 -2 -1 0 1 2
tive layer
Perched
Permafr
Average annual ground temperature
Minimum temperature
Maximum temperatu
Geothermal gradient
Permafr
Subpermafrost groundwater
4/29/2015 77


Distribution of Permafrost
CONTINUOUS
ARCTIC CIRCLE
CANADA
FAIRBANKS
DISCONTINUOUS
Yedoma region
Permafrost zone boundaries
Modified from Kanevskiy et al., 2011

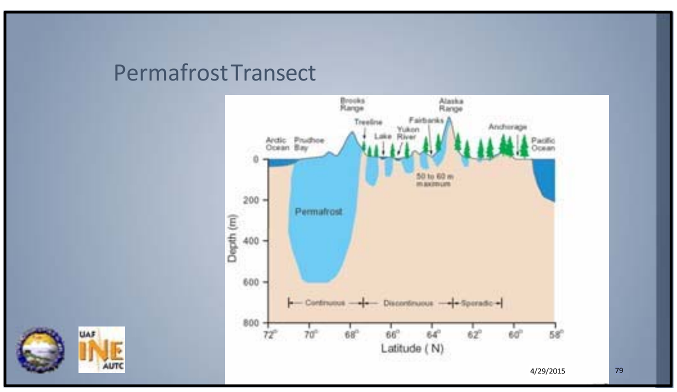

Permafrost Transect
Brooks Range
Alaska Range
Treeline
Fairbanks
Lake
Yukon River
Anchorage
Arctic Ocean
Prudhoe Bay
Pacific Ocean
50 to 60 m maximum
Permafrost
Depth (m)
0
200
400
600
800
Continuous
Discontinuous
Sporadic
72° 70° 68° 66° 64° 62° 60° 58°
Latitude (N)
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Photo by ToddParis
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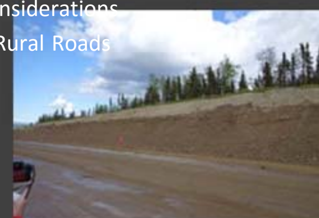
Appendix C
Webinar III
Construction and Maintenance Considerations in Rural Alaska

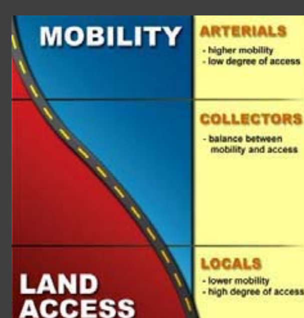
Construction and Maintenance Considerations in Rural Alaska

Road Map

- Functional Class Considerations
- Considerations for Rural Roads
- Unpaved Roads
- Paved Roads



Functional Classifications	
Rural Areas	**Federal-Aid Urban Areas (Urbanized & Small Urban)**
Interstate	Interstate
------------------------	Other Freeways & Expressways
Other Princpal Arterial	Other Princpal Arterial
Minor Arterial	Minor Arterial
Major Collector	Collector
Minor Collector	------------------------
Local Road	Local Street



Characteristics

- Major Truck Routes, trucks control the pavement design.
- Long Distances, minimal services
- Primary transportation corridors except for perhaps the Dalton.
- Designed to Interstate standards but mostly 2-lane

National Highway System: Alaska

Rural Design Focus on Trucks

Interstate	Long Haul Trucks (Double Bottom)
Other Principle Arterials	Long Haul Trucks
Minor Arterial	Mixed Truck
Major Collector	Mixed truck
Minor Collector	Mostly Delivery Trucks, School Busses
Local Road	Mostly Delivery Trucks, School Busses

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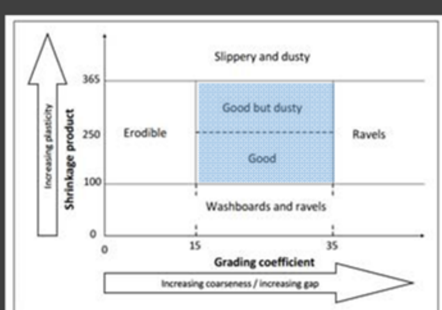
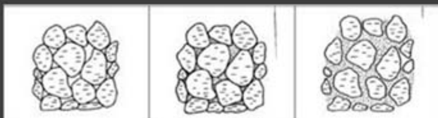
Rural Road Characteristics

- Materials generally more variable than Urban
- Variable terrain
- Generally low traffic compared to urban
- Generally higher speeds than urban
- Some arterials still lack shoulders
- Capacity rarely an issue but passing in mountains needs to be addressed. (Turnagain an exception)



Sieve	DOT&PF E-1 (a)	DOT&PF F-1 (a)	US Forest Service No 3. (b)	FHWA Grading F (b)	South Dakota (c)
1"	100	100	100	100	
3/4"	70-100	85-100		97-100	100
3/8"	50-85	60-100	60-100		
1/2"					
No. 4	35-65	50-85	50-85	41-71	50-78
No. 8	20-50	40-70			37-67
No. 10			40-70		
No. 40			24-45	-40	13-35
No.50	15-30	25-45			
No. 200	8-15	8-20	8-15	5-16	4-15
Plastic Index	10 max	10 max	4-9		4-12



Aggregate With No Fines	Aggregate With Sufficient Fines For Maximum Density	Aggregate With Great Amount Of Fines
Grain-to-grain contact	Grain-to-grain contact with increased resistance against deformation	Grain-to-grain contact destroyed, aggregate "floating" in soil
Variable density	Increased to maximum density	Decreased density
Pervious	Low permeability	Low permeability
Non-frost susceptible	Frost susceptible	Frost susceptible
High stability if confined, low if unconfined	Relatively high stability in confined or unconfined conditions	Low stability and low strength
Not affected by adverse water conditions	Not greatly affected by adverse water conditions	Greatly affected by adverse water conditions
Difficult to compact	Moderately difficult to compact	Not difficult to compact
Ravels easily	Good road performance	Dusts easily

Float Indicates low fines.

Too Many Fines Causes Muddy Roads Which Become Dusty When Dry

A Good Crown is Critical

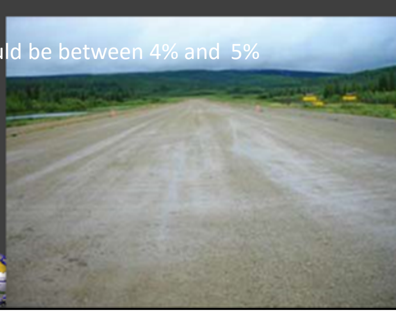
- Too Flat Causes ponding and increases potholes

A Good Crown is Critical

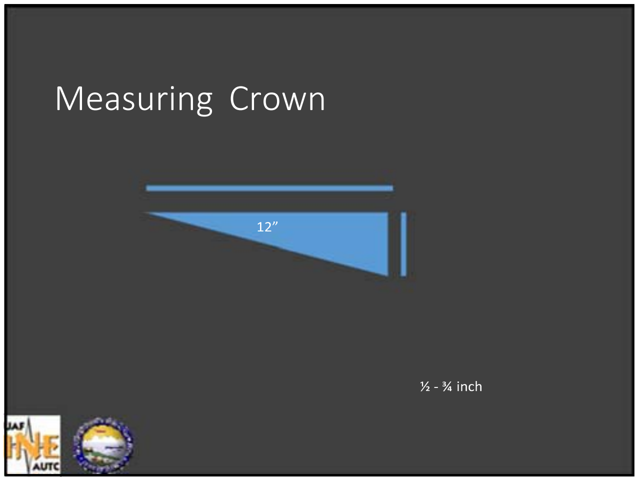
- Too Steep Causes Erosion

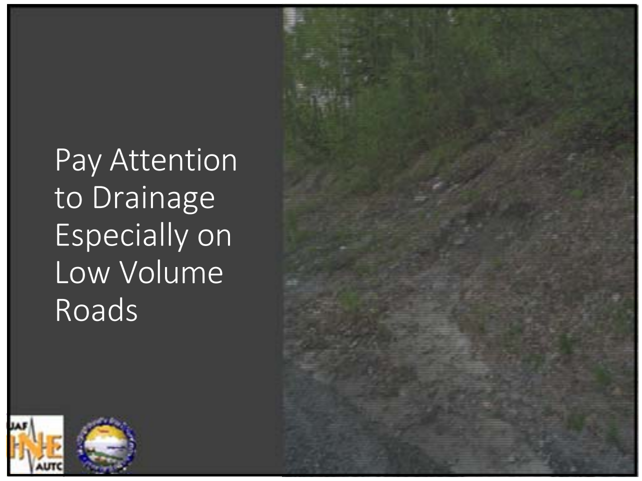
A Good Crown is Critical

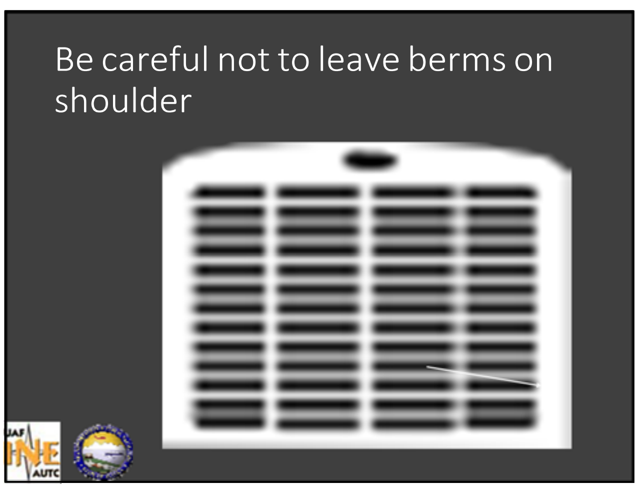
- Should be between 4% and 5%



Commercial Slope Meter


Measuring Crown
12”
½ - ¾ inch


Pay Attention to Drainage Especially on Low Volume Roads


Be careful not to leave berms on shoulder


Doing it Right
Material feathered to eliminate water ponding

$CaCl_2$ As a Palliative

- Most commonly used palliative in Alaska
- Application rate between 1 and 1.5% by weight
- Requires high fines (9 – 14%)
- Ineffective when RH falls below 35%
- Can be slippery during and after a rainfall
- Has a bitter taste
- A mucus irritant
- Can impact water quality
- $CaCl_2$ more than doubles the life of the surface course

Rural Paved Roads

- Designed for Trucks (ESALS)
- In the case of local roads must account for construction traffic, delivery trucks and school busses.
- Surfacing
  - Surface Treatments
    - Chip Seals
    - High Float
    - Fog Seals
  - Hot Mix Asphalt

Select Surface Capable of Surviving the Traffic

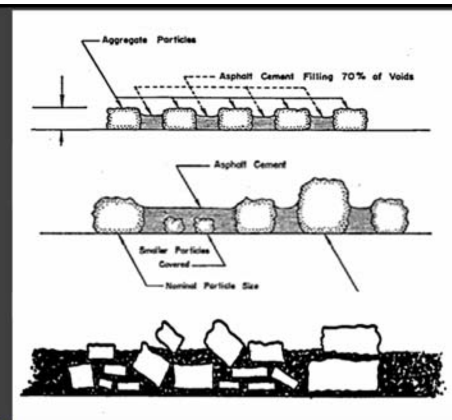
- Fatigue
- Rutting
- Abrasion
- Shoving
- Raveling

Surface Treatment Introduction

- Low volume roads (800 – 2000 ADT)
- Average Life: 7 years (some have lasted 30 years +)
- Adds no strength to roadway.
- Requires considerable expertise to place
- Cost highly variable due to lack of contractors

Chip Seals

- Start with proper aggregate
  - Washed, durable single sized cubical aggregate
  - Choker course should be ½ the size of the bottom course
  - Aggregate should be damp not wet
- Design the asphalt content
  - Typically Cationic Emulsion (positive charge on the asphalt)
  - First Layer AC: 0.35 - 0.51 gal/yd^2
  - Second Layer AC: 0.51 – 0.60 gal/yd^2



Chip Seals con’t

- Aggregate Application Rates
  - First Layer: 45 -50 lb/yd^2
  - Second Layer: 20 – 26 lb/yd^2
- Do not place in the rain, you are dealing with an emulsion
- Do not place after Aug 15 (Aug 1 in the North)
- Carefully calibrate all equipment before beginning
- Broom carefully

High Float Surface Treatments

Norwegian experience

- “Otta-surfacing” used by Norway beginning around 1970
  - Used dense graded surface course and medium cure cutback
  - Successfully experimented with CMS-2
  - Concluded Otta-surfacing cost effective compared to gravel roads, but not pavement
  - Used only for roads with AADT < 400

Canadian Experience

- Began use in around 1974
- Used modified base course
- HS350S High Float Emulsion
- High Float is very effective for the Alaska Highway where permafrost makes paving difficult.
- Life expectancy between 3 and 7 years mostly based on embankment life.
- To replace Canadians disk the existing surface and replace High Float

Alaskan Experience (1/2)

- Alaska Legislature required ADOT&PF investigate High Float in 1983
- First High Float placed in 1984
  - Three sites
  - Lack of experience resulted in difficulties
  - Distributers and spreaders were inadequate to handle the quantity of material to be placed.
  - Impacts of rain have a significant impact on stockpile moisture
  - Not recommended on grades >6% because HF tended to run
  - Brooming requires much more effort than chip seals
  - HF wicked into surface course better than CMS-2
  - Oil that reaches the surface can cause pickup and potholes

Alaska Experience (2/2)

- Noted Issues
  - Application rates difficult to determine
  - Few clues exists to ensure application rate is correct
  - There is a tendency to over oil the surface resulting in bleeding during hot weather.
  - There is a tendency to place too much cover aggregate
  - High Float cure time is a function of temperature, relative humidity and surface course. Late season paving a problem.

Current Practice

- Routinely used by M&O for level and patch activities
- Used on rural low volume roads where chips are expensive
- Select a gradation that provides room for the asphalt

Specifications

% Passing	
	Grading C
3/4	100
1/2	63-89
3/8	54-76
#4	36-56
#8	18-38
#16	12-30
#50	4-18
#200	0-5

Material	Estimate Application Rate	Tolerance
HFMS -2s	0.75 gal/yd^2	0.4 gal/yd^2
Cover Agg.	75 lb/yd^2	2.5 lb/yd^2

% Wear	AASHTO T-96	50 max
Deg. Value	ATM T-13	30 min
% Fracture	WAQTC TM-1	70 min
Sodium Sulfate Soundness	AASHTO T-104	9% max (5 cyles)
Thin/Elongated	AASHTO T-9	8% max
PI	AASHTO T - 90	3 max

Fog Seals

- A light coat of asphalt cement to an existing surface seal or HMA
- Used to correct
  - Oxidation
  - Raveling
  - Water infiltration

Gilsonite Products

- Have proven very effective for correcting segregation
- Will extend the life of a chip seal by locking the aggregate in place.

Hot Mix Asphalt

- Provides increased structural capacity
- Good wear characteristics
- Smoothest surface
- Long life (15 plus yrs.)
- Generally low maintenance

General Guidelines

- Pavement structure should be designed in accordance with the Alaska Flexible Pavement Design Manual.
- For most rural roads, trucks will control the design.
- Know the available material.
- Understand the properties of the materials you will use, i.e. modulus, durability, etc.
- Design for the material you have, not the material you wish you had.

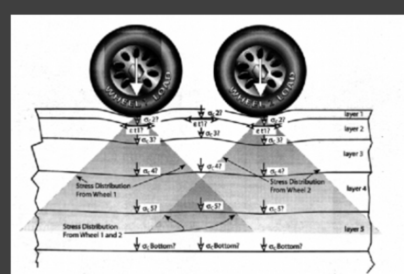
Don't

- Use general guidelines for materials properties in manual.
- Select materials properties that minimize asphalt thickness.
- Require materials that aren't available.
- Expect contractors to go the extra mile.

Tools to select materials properties

- Falling Weight Deflectometer Back Calculation Data.
- Field CBR or Plate Bearing Tests
- Dynamic Cone Penetrometer
- Laboratory Data
  - Resilient Modulus
  - CBR
  - Unconfined compression strength
- As a last resort use the values in the manual.

A properly designed pavement doesn't require load restrictions



Load Restrictions reduce damage but do not eliminate damage

Don't underestimate the cost of load restrictions: The cost of 1 ESAL can be 20 to 100 times that of a properly designed road.

Major Transverse Crack

Major Transverse Cracking in Rural Areas

- Represent cracks in the earth rather than the Asphalt.
- The same mechanism as the formation of ice wedges.
- Spacing about the same a polygonal ground in the area.
- Movement of about 1 inch seasonally common.
- No asphalt, no geosynthetic will stop them.
- Saw cutting has proven helpful

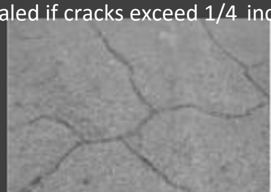
We also design for functional failure: permanent deformation in unbound layers

Fatigue Cracking

- Represents the cracking due to bending of the Asphalt Concrete layer. (Bottom up cracking)
- Looks like the back of an alligator or chicken wire.
- Number of cycles to failure estimated by the Asphalt Institute Equation. (strain, modulus, asphalt cement and temperature)

Map or Block Cracking

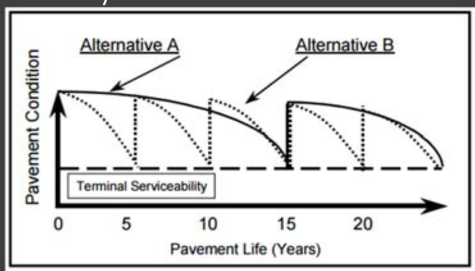
- Due to thermal stresses in asphalt
- About 1 foot blocks
- Grade of AC has large influence
- Should be sealed if cracks exceed 1/4 inch



Think about the rehabilitation and maintenance strategy early

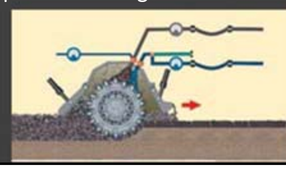
- What rehabilitation strategy will likely be used
  - Reclamation?
  - Overlay?
  - Remove and replace?
- How will it be maintained and at what cost?
  - Crack Sealing?
  - High Float?
- Life Cycle Cost vs First Cost

Life Cycle Cost of a Pavement



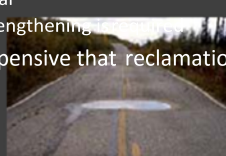
Full Depth Reclamation (meets stabilized base policy)

- Very Effective for thin AC
- Strategies
  - Reclaimer mixing AC and base 50/50
  - Foamed asphalt and asphalt emulsion
  - 1% Portland Cement
- Best to inject product during reclamation



Remove and replace

- Good strategy
  - when reconstruction is required
  - leveling course is required
  - grade is critical
  - Extensive strengthening
- Often more expensive that reclamation



Overlay

- Requires good timing
  - <20 % fatigue cracking
  - at lease 20% of life remaining
  - good grade
- Thickness should be
  - > 1.5 inches
  - > 2 times maximum aggregate size
- Interlayers may be effective in reducing reflective cracking.

About Selection of AC in Rural Areas

- Select grading according PG criteria
- Modified asphalt is better used in urban and high traffic areas.
- The grade of AC will affect fatigue and map cracking but will have no impact on major transverse cracks
- Proper HAC design will eliminate potential for rutting in rural areas.
- The right AC enhances durability/moisture damage and reduces load related cracking and rutting

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Questions

Questions?

Appendix D

Webinar Series IV

Construction and Maintenance Considerations in Urban Areas

Construction and Maintenance Considerations in Urban Areas

Pavement Webinar Series IV

Roadmap

- Considerations for design, construction and maintenance
- Design Life
- Maintenance and preservation strategies
- Failure modes
- Materials considerations
- Life Cycle costing

Capacity Typically Controls Design

Design, Construction and Maintenances Must Consider

- Impacts on Traffic
- Impacts on alternate routes
- Access to business
- Pedestrian Bicycle movements
- Construction noise
- Time of Day
- Others

Traffic Control Impacts All Activities

Traffic Control Can Be 25% of the Project Costs

- How does this impact the pavement design?
  - Design life?
  - Maintenance strategies?
  - Rehabilitation strategies?
  - Project scheduling?

Design Life?

- AKFPD minimum life: 15 years
- AADT> 5,000 with curb and Gutter 30 years for fatigue and 15 year for functional life (roughness and rutting)

Virginia Pavement Lives

FLEXIBLE PAVEMENT DESIGN

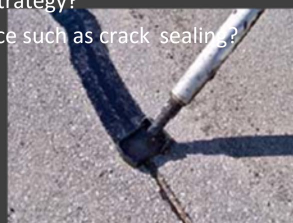
Design Variables

Pavement Design Life

Highway Classification	Initial Construction Design (Years)	Initial Overlay Design (Years)
Interstate	30	12
Divided Primary Route	30	12
Undivided Primary Route	20	10
High Volume Secondary Route	20	10
Farm to Market Secondary Route	20	10
Residential/Subdivision Street	20	10

Maintenance Strategies

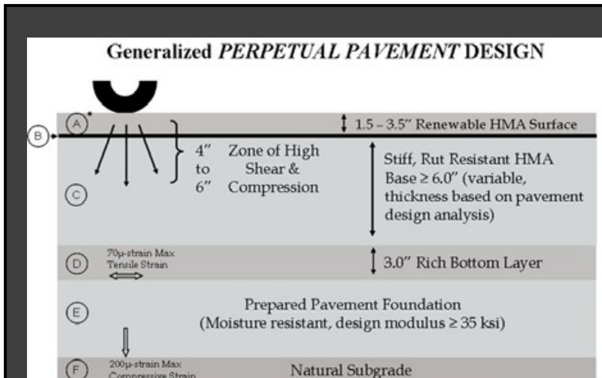
- Zero maintenance strategy?
- Minimal maintenance such as crack sealing?
- Surface seals?



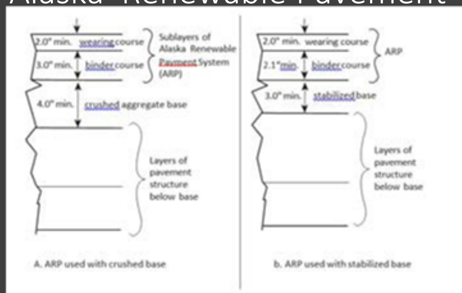
Rehabilitation Strategies

- Must be considered as part of design
  - Does traffic need to be on pavement at all times?
  - Day/Night requirements?
  - What is the anticipated mode of failure
    - Rutting
    - Fatigue
    - Oxidation
    - Thermal Cracking
  - Maintenance of traffic
  - Impact on business

Get in, Get out and Stay out!



Alaska Renewable Pavement



Alaska Renewable Pavement

- Goal: minimal impact on traffic
- Approximates perpetual pavement
  - Fatigue in bottom layers not likely.
  - Primary failure modes:
    - Rutting
    - Oxidation
    - Top down cracking
- Required for AADT's > 5k with curb and gutter and and AADT's > 10,000 without curb and gutter
- Only the top 1 ½ to 2 inches need be replaced over 30 plus years.

Useful Tips for ARP

- Increase the asphalt content up to .5% in the binder course. Increases fatigue life.
- Use durable, rut resistant mix for wearing course. Fatigue not likely a problem.
- Consider increasing fatigue life to 50 years. The additional cost is likely small or perhaps nothing.

Surface Course Requirement

- Resistant to plastic deformation (rutting)
- Resistant to abrasion (studded tires)
- Resistant to environmental damage (oxidation and water)

Plastic Deformation

- Causes
  - Low stability mix
  - Improper selection of Asphalt Cement
- Cures
  - Increase mix stability
    - Modify gradation
    - 2-face fracture
    - Crushed sand fraction
  - Use modified asphalt
    - Rubber
    - SBS

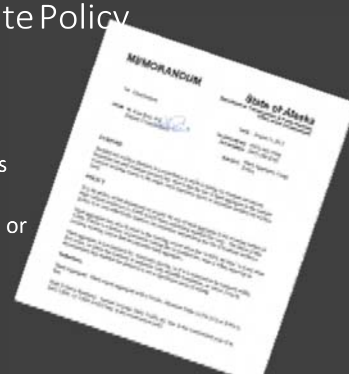
Studded Tire Wear

Hard Aggregate

- Standard practice in Scandinavia for many years.
- Affects only course aggregate
- First tried by Bruce Brunette in SE Region
  - Expected to double the life
  - Now approaching 2.5 times the life of conventional pavement
- Economic studies have shown that hard aggregate can be shipped from Seattle and still be cost effective.

Hard Aggregate Policy

- Use hard aggregate when AADT exceeds 5000
- Nordic Abrasion 8% or less


MEMORANDUM

State of Alaska

Materials Characterization

- Urban sources tend to be static
- Common to reuse mix designs and materials certifications
- Good opportunity to characterize materials in more detail.
- Correlation of materials with performance.

Recycled Asphalt Pavement

- RAP is valuable.
- Research shows 15 -20% RAP can be included without harm. Still no firm consensus above that.
- 50% becoming more common with appropriate mix design and clean RAP.
- Should new mix designs consider the use of HAP in future hot recycling?

Project Scheduling

- Keep affected parties aware of what is going on and how it affects them.
- Coordinate with other proje
- Schedule activities to minim pacts
  - Business
  - Peak hours

Milling and Paving Project

- Excellent candidates for night paving.
- Reduces traffic control costs and impact on public
- If previous project anticipated milling, traffic always on pavement.
- Milling and paving can be done the same night.

Resurfacing Triggers

- Ruts exceed ½ inch
- Excessive raveling due t
- Fatigue cracks exceed 2
- Low friction (<0.40)
- Excessive roughness
  - IRI>170, FHWA
  - Good ride IRI <90

Friction Interval	Crash Rate (injuries per million vehicle km)
< 0.15	0.80
0.15 – 0.24	0.55
0.25 – 0.34	0.25
0.35 – 0.44	0.20

Wallman and Astrom 2001

Life-Cycle Costing

- Uses engineering economy to compare alternatives over their lives.
- A better approach than first cost. Do nothing has the lowest first cost.
- Sensitive to
  - Interest rates (rate of return)
  - Input variables
  - Chosen life (FHWA recommends 35 yr. minimum)
  - Be realistic in what maintenance will do.

Interest Rate

- Often provided by policy.
- Inflation often ignored
  - Common to all alternatives
  - Uncertain future
- Does not have to be

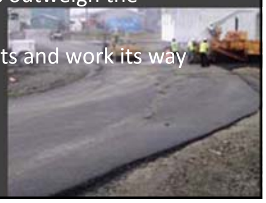
$$A = \frac{m\left[(1+r/n)^{nt}-1\right]}{r/n}$$

Considerations

- Costs to agency
  - Planning and design costs
  - First cost
  - M&O costs
- Costs to public
  - Delays
  - Vehicle M&O costs
  - Loss of Business

Incremental Cost Analysis

- Similar to Life Cycle Cost but rather than comparing alternatives based on present value or annual cost it asks if the additional benefits outweigh the additional cost.
- Begins with the lowest first costs and work its way up.
- Not intuitive to all.



Service Life Approach

- Determines the life at which an alternative has the lowest life cycle cost.
- Each alternative may have a different life and life cycle cost.
- Allows the owner to estimate when the pavement requires action by looking at the cost of action vs cost of delayed action.
- Allows detailed analysis of preservation strategies

Service Life

Advantages

- Known life not required
- Update strategies at any time
- Multiple strategies with different service lives comparable

Disadvantages

- More complex
- More difficult to understand

Summary

- Urban pavement controlled more by rutting and capacity than trucks.
- Consideration of rehabilitation and preservation strategies important at the design phase.
- Strategies must consider impacts on capacity and impact on local economy.
- Life cycle costing more important in urban areas than rural

Appendix E

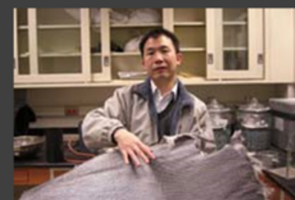
Webinar Series V

Innovation: New and Emerging Technologies

Innovation: New and Emerging Technologies

Pavement Best Practices in Alaska Webinar Five

Discussion Topics



- Warm Mix Asphalt
- H2Ri Wicking Fabric
- Pavement Preservation
- Intelligent Compaction
- Micro Deval
- Chemical Stabilization

Warm Mix Asphalt

- Pro's
  - Reduces mix temperatures by 50° to 100° F.
  - Reduces fuel costs
  - Extends paving season
  - Increases haul distance
  - Reduces compaction effort
- Cons
  - Potential for increased moisture susceptibility
  - Potential for adverse changes in asphalt cement properties

Warm Mix Technologies

- Water based (Foam)
- Organic (Sasobit)
- Chemical (Evotherm)
- Hybrids (Advera, synthetic zeolite)

Alaska Experience with Sasobit

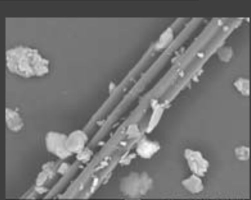
- Reduced mixing temperatures by 15° C
- Reduced compaction temperatures by 13° C
- Altered PG 58-28 to PG 76-16
- Slight increase in TSR
- No change in moisture damage
- Slight improvement in plastic deformation

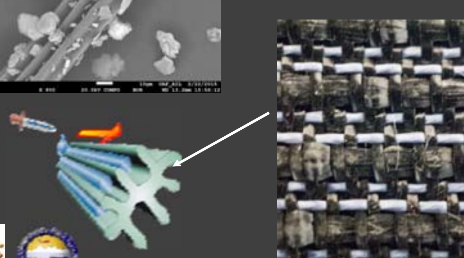
Alaska Experience with Foam

- Nothing in specifications prohibit its use
- Contractors using it on their own
- No noticeable change in ability to meet current specifications
- No studies to monitor long term performance

Tencate RH2i

- Designed to wick water using capillary forces.
- Uses capillary tubes made of tiny fibers seen here as blue stripes

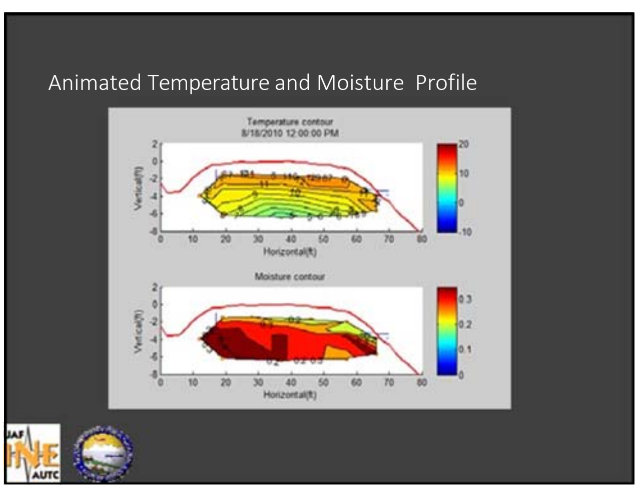




H2Ri will wick flat or uphill until water evaporates

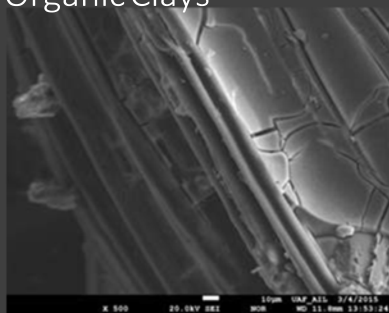

MOISTURE METER / THERMISTER STRING
APPROXIMATE DEGRADED GRANITE LAYER DEPTH
APPROXIMATE GROUND WATER
GRAVEL SURFACE COURSE
FILL PREVIOUSLY EXCAVATED FROM ROADWAY - PLACED AND COMPACTED
TENCATE WICKING FABRIC
INSITU SOIL
TRENCH EXCAVATED FOR PLACING INSTRUMENTATION
EAST


Installation
3ft
1ft


Animated Temperature and Moisture Profile
Temperature contour
8/18/2010 12:00:00 PM
Vertical(ft)
Horizontal(ft)
Moisture contour
Vertical(ft)
Horizontal(ft)


Comparison in Road Conditions
May 12, 2010
May 24, 2011
12

Avoid Organic Clays



Other Cautions

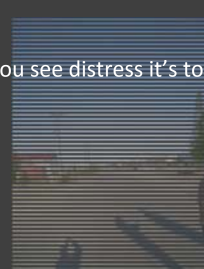
- Ensure exposed fabric is not in water
- Overlap moisture transfer appears to be inefficient
- Soil permeability will limit the effectiveness of the wicking fabric
- Be careful when using in clay

Pavement Preservation

- Action or actions that increase the life of a pavement
  - Seal coats
  - Thin overlays
  - Mill and fill
  - Crack sealing
- $1 in pavement preservation can save $10 later
- FHWA will participate in the cost

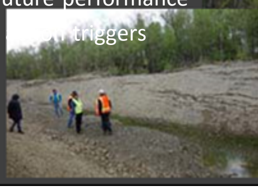
Timing is everything

- Once you see distress it's too late



Asset Management is the Key

- Track Assets
- Monitor performance
- Predict future performance
- Develop [illegible] triggers



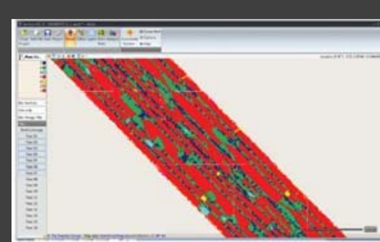
Plan from the beginning

- Everyone should know the stages of a pavement's life
- Develop a uniform strategy
- Monitor performance
- Know what is working
- Update strategy

Intelligent Compaction

- Use of technology to monitor compaction realtime and provide the operator with the ability to adjust roller patterns to achieve consistent compaction.

IC System (courtesy of Bomag)



Screenshot of project data in Veda data management software: Centerline, night two. Both rollers—vibe passes only, zoomed in to show pass counts (target is four vibe passes).

Bomag BCM05 System

Sitka Experience

- Strengths
  - Real time data pass counts to ensure full coverages
  - Real time asphalt temperature to ensure proper compaction temperatures are met
  - Records: temperature, coverages, speed, frequency. Problems with density can be tied to compaction efforts
  - Ability to identify weak areas before paving.

Sitka Experience

- Limitations
  - Still a new technology with growth pains
  - Large data sets can be overwhelming
  - Stiffness modulus/stiffness indicies do not correlate with density. These values are dependent on roller settings.
  - There is no way of separating asphalt stiffness from underlying stiffness.

Micro Deval ASTM D7423 & AASHTO TP58-00

- Developed in 1960's in France
- Measures abrasion resistance and durability between aggregate and steel balls
- Ontario Ministry of Transport found Micro Deval is a good predictor of performance of base course and HMA aggregate performance

Ontario Specification

Table 1. Micro-Deval Specification for Coarse Aggregates in HMA (4)

Application		Maximum loss (%)
Asphalt wearing courses	premium[1]	5-15[3]
	secondary[2]	17
Asphalt base courses		21

Notes:
1. AADT > 2500 lane.
2. AADT < 2500 lane.
3. Varies with rock type (5% for igneous and metamorphic gravel; 10% for traprock, diabase and andesite; 15% for dolomitic sandstone, granitic meta-arkose and gneiss).

Oregon Experience

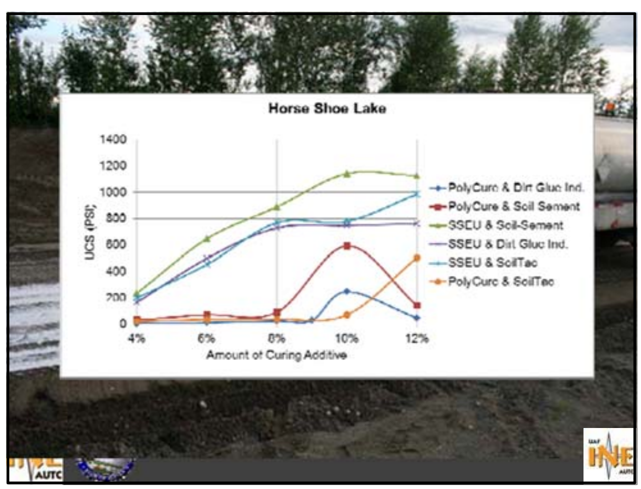
- Micro Deval is no better than LA abrasion in predicting damage d[...]ded tires.
- Nordic abrasion is a m[...] better test for th[...]s.

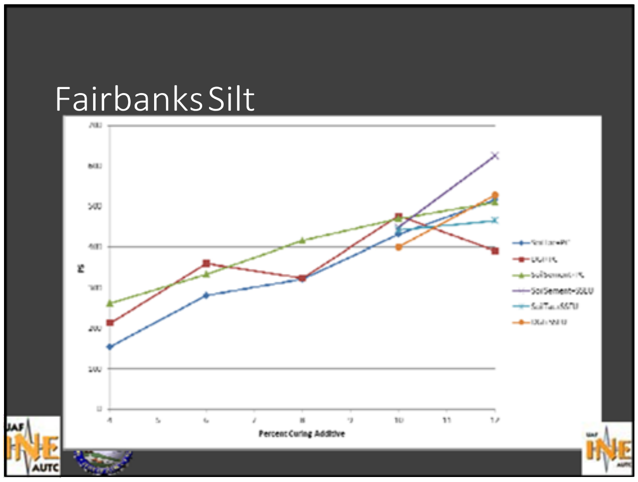
Alaska Study

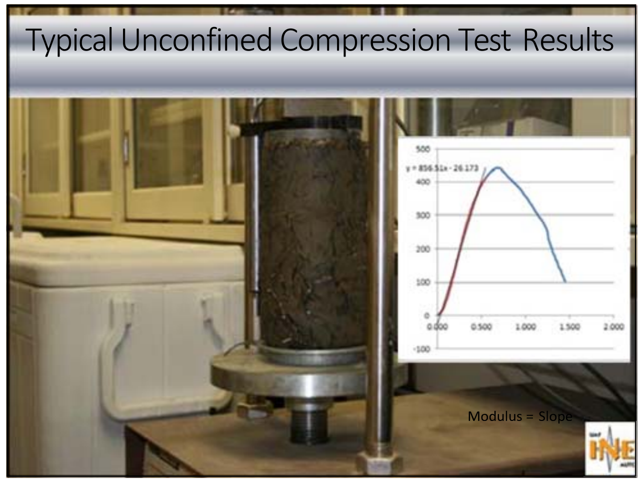
- 16 base course aggregates tested from around the state
- Test data more uniform than LA abrasion
- Micro Deval, along with LA and Sodium Sulfate test are more reliable than Washington Deg. Test
- Micro Deval Correlates best with Washington Deg
- Micro Deval is much quicker to perform and is not misled by clay.

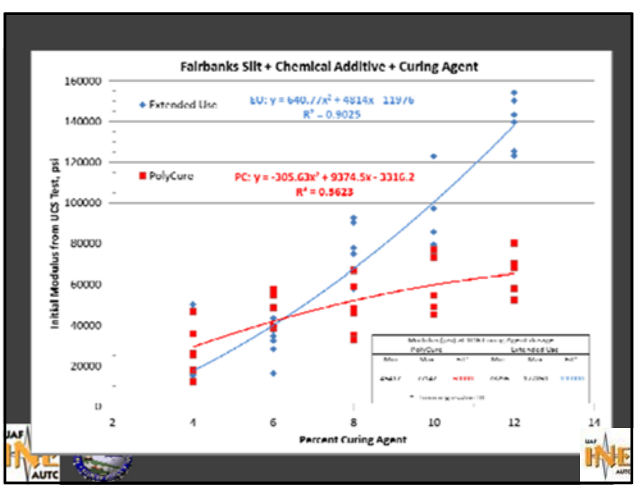
Chemical Stabilization

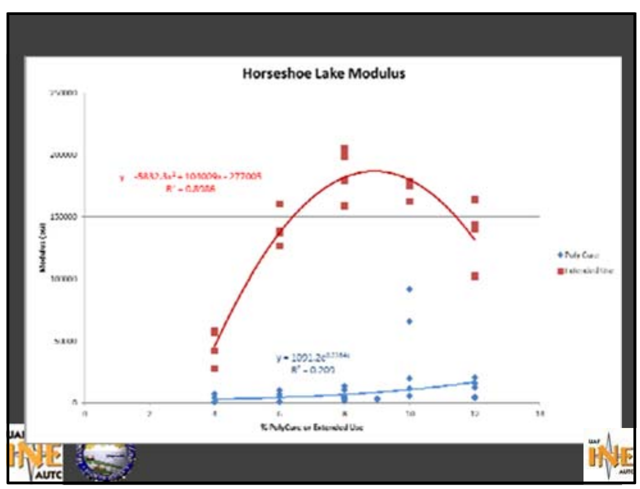
- Literature indicates chemical stabilizers can be used to improve the strength of fine grain soils
- Limited data are available to evaluate the performance of chemical stabilizers.
- This study focuses on typical Alaskan silts and sands.




Fairbanks Silt
Percent Curing Additive


Typical Unconfined Compression Test Results
y = 856.51x - 26.173
Modulus = Slope


Fairbanks Silt + Chemical Additive + Curing Agent
Extended Use
PolyCure
PC: y = -305.63x² + 9374.5x - 3316.2
R² = 0.5623
R² = 0.9025
Initial Modulus from UCS Test, psi
Percent Curing Agent


Horseshoe Lake Modulus

In the Field

Installation at Shishmaref Airport

- Material: Beach sand with high salt content
- Stabilizer: 2% Soil Sement, 8 % EU
- Temperature at placement: 40 F
- Mixed in concrete truck placed by hand
- Comments from M&O
  - Easy to work with
  - Like using local material
  - Performing well through

Installation in Tempe Arizona

- Stabilizer: SoilTac
- Material: Coarse gravelly sand
- Topically applied
- Performing well through the since applied (six months)

Questions?

Appendix F

Webinar Series VI

A Report on

Interviews with State Departments of Transportation Material Section Heads

A Report on

Interviews with State Department of Transportation Material Section Heads

Alaska DOT&PF

November 4, 2015

With thanks to

- Mike San Angelo
- Billy Connor
- Five interviewees

Purpose of the Study

"…understand the policies, processes, organizational structures and practices of similar departments in several other states…"

This morning we'll discuss …

- Some background on the Alaska DOT&PF Materials Section history, organization and policies
- The study, its process and participants
- The questions
- The responses
- Observations and comparisons based on the

The report on this study and the materials presented this morning are intended as background for a workshop on this topic to be held later in early December 2015.

DOT&PF

Materials Organization and Policies

History

- Statewide Materials @ UAF until 1978
  - Engineer of Tests, Geology, Foundations and Research at UAF. State Materials Engineer and Assistant, and Pavement Engineer in Juneau
  - Only AASHTO Certified Lab in State
  - Responsible for all standards
  - Visited Districts and projects to ensure conformance
  - Split samples to ensure consistent testing
  - Performed specialized testing such as paint, glass beads, steel
  - Performed specialized geotechnical investigations and design

Statewide Materials Moved

- Moved to Anchorage in 1978
  - Research split off
  - Merged with Central Region Lab
  - SME and assistant moved to Anchorage
  - State Geologist, Foundations Geologist, Engineer of Tests and Soils Engineer moved from Fairbanks to Anchorage
  - Central Region became AASHTO certified
  - Functions remained essentially the same

2001

State Materials and Central Region Materials Section Combined under supervision of State Materials Engineer

Both Geology Sections combined under supervision of State Geologist

2003 Statewide Materials Moved to Design and Engineering Services

- Statewide Materials Moved from Central Region to Headquarters
  - All lab testing left in regions. Each Region became AASHTO Certified
  - Responsible for ATM's, Approve Products List and Standard Materials Specifications, Geotechnical Manual, Pavement Design Manuals and other materials related manuals
  - Staff Includes
    - Statewide Materials Engineer
    - Statewide Pavement Engineer
    - Statewide Geologist and Foundations Engineer
    - Quality Assurance Engineer
    - WAQTC Coordinator
- No direct line of authority to Regional Materials

Policies that direct the materials section activities

- Work at the direction of Chief Engineer
- Standard test methods closely followed by all regions, in large part because they are AASHTO tests.
- Most of the standards in Section 700 followed.
- Regions feel free to modify the 401 Pavement Specifications to fit their needs.
  - Contractors complain
  - Allows experimentation (Good? Bad?) Rarely followed up with documented performance.
- Provide Geology, Geotechnical and Foundations services, but Regions are not required to use them.

Specification Development

- Process begins with the Chief Engineer and the Chief of Design and Construction Standards
  - Input from regions and other DE&S staff
- Draft Specifications Drafted with input from Regions and DE&S staff
  - Materials related specifications may be delegated to the Statewide Materials engineer
  - A working committee may be established
  - May include input from contractors and other interested parties
- Review by all interested parties
- Prepare final specification
- Adoption

Quality Assurance Function

- Quality Assurance for construction handled in the Region
- WAQTC training in Region. Training materials and qualification test protocols by Materials Sections
- Lab certification by AASHTO, no oversight by Statewide Materials
- Materials Section responsible for test methods and QLA specifications

Establishment of State Materials Engineers Committee

- Established under Deputy Commissioner Kemp
- Direction: "… bring more awareness and consensus in Materials…"
- Committee has made strides working together,

Disagreements

- Dispute resolution of test results generally handled by Region
- Regions use dispute resolution process in Standard Specifications
- Internal disagreements concerning materials may be mediated by Statewide Materials. Chief Engineer may issue decisions binding Regions after consultation with Materials Section
- Statewide works with Regions, contractors and suppliers through groups like AGC, Asphalt Alliance and Concrete Alliance to reach consensus.

Change Management

- Works with others to identify where changes need to be made.
- Works closely with Regions, Contractors and Suppliers to develop consensus.
- No authority to require change, but are often champions and facilitators.

Materials Research

- Research reports directly to the Chief Engineer
- Materials Section follow the same process as the rest of the Department
  - Submits research needs statements to Research Section
  - If successful, works with Research Section and/or others such as the University to develop a detailed proposal. Materials Section typically does not do the work themselves
  - Serve as champion, member of technical committee
  - Works with the performing agency and Research to implement research

The Interview Study -- Steps

- Identify one representative from the materials section of each of five state DOTs. Solicit their willingness to be interviewed.
- Contact them to set up interviews and distribute a background paper.
- Conduct telephone interviews – one hour ± each.
- Clarify responses, as needed.
- Prepare interview summaries.
- Prepare final report.
- Present this webinar.

The Study -- Participants

- Chris Abadie, P.E., Louisiana
- Joe Feller, P.E., South Dakota
- Colin Franco, P.E., Rhode Island
- Robert G. Lauzon, PhD, P.E., Connecticut
- Matthew Strizich, P.E., Montana

The Questions

- What are the policies that direct your Materials Section's activities, its relationships with other parts of the organization, and its decision-making process?
- Please provide a copy of the organization chart of the part of your agency that includes Materials. Please describe its salient features and indicate those informal relationships that are likely not represented by the chart.
- Please describe your process for specification development.

The Questions, page 2

- What role and process are used in carrying out the Quality Assurance function?
  - Contractor Quality Control
  - Independent Assurance
  - Verification
- By whom, and at what level, are disagreements between the Materials Section and other parts of the organization adjudicated?
- How do you go about managing change (such as revisions to concrete specifications or revisions to the approved products list criteria)? Who establishes change? By whom, and with what processes, are changes implemented?

The Questions, page 3

- With regard to materials research, by what methods do you establish a direction for the program? From where does this input come?
- By what process does your agency interpret and implement materials research results? Note that this question is related in part to question 6 about change management.
- What other things can you tell us about your Materials Section that might help fulfill the goal of our study?

First, let's look at some Materials Section Mission/Function Statements

It is the function of the Division of Materials Testing to predetermine if materials used by Contractors and the Connecticut Department of Transportation in the construction and maintenance of transportation facilities comply with the specification requirements and plans, and to perform investigational work on new materials and procedures constantly being proposed for use in the construction and maintenance of our transportation system.

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- The mission of the Materials and Testing Section is to develop, administer, and regulate the Department's Materials Quality Assurance Program, environmental evaluation programs, and the geotechnical exploration and testing programs in cooperation with our public and private partners.

The Materials Quality Assurance Program includes materials evaluation and design, materials specification development, and conformance programs. (Louisiana)

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The Materials Quality Assurance Program includes materials evaluation and design, materials specification development, and conformance programs. (Louisiana)

- Our Materials division assures that quality materials are designed properly and that all materials provided meet specifications for all of our projects and operations.
- Our staff in Materials takes the lead on specification review and writing of new specifications, distribution and recording of results, acceptance sampling and testing, process control sampling and testing, independent assurance sampling and testing, and the review of certificates of compliance. (Rhode Island)

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Our staff in Materials takes the lead on specification review and writing of new specifications, distribution and recording of results, acceptance sampling and testing, process control sampling and testing, independent assurance sampling and testing, and the review of certificates of compliance. (Rhode Island)

1. What are the policies that direct your Materials Section's activities, its relationships with other parts of the organization, and its decision☐ making process?

- All suggested the prime importance of 23 CFR 637, especially the requirement that the state have a central lab.
- Louisiana: standard specs; engineering directives; quality manuals for soils, asphalt materials, and concrete (available on-line)
- South Dakota: standard specs, Materials Testing

Policies, con'd

- Rhode Island: No materials manual as such, but website includes sections on Approved Products and Plants, Product Evaluation, Plant & Field Forms, Yearly Testing, and Master Schedule of Testing (for verification and assurance testing).
- Montana: FHWA requirements guide testing aspects of the Bureau's activities. Materials Manual contains Methods of Sampling and Testing, plus Materials Sampling, Testing and Acceptance Guide. AMRL & CCRL policies and procedures in order to maintain laboratory certifications. Basic engineering governed by common engineering practices. Bureau must make sure they meet project schedules and policies.

Policies, again

- Connecticut: Construction Manual: distinguishes between the responsibilities of district construction staff and the Division of Materials Testing; includes Minimum Testing Requirements for Acceptance and Assurance. Materials Testing Manual: organization, functions, and procedures performed by the division relating to sampling, testing, and inspection of materials incorporated into projects; procedures used to verify contractor test results and the department's independent assurance test programs

2. Please provide a copy of the organization chart of the part of your agency that includes Materials. Please describe its salient features and indicate those informal relationships that are likely not represented by the chart.

1. Centralized v. Decentralized
2. The Chart
3. Informal Relationships

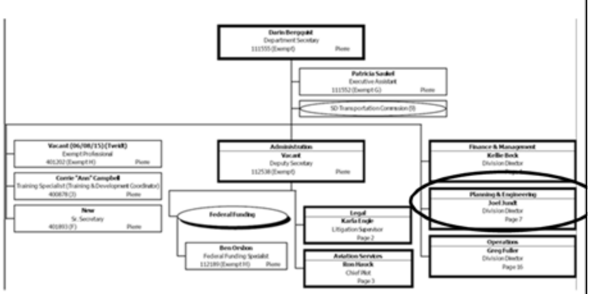
Centralized?

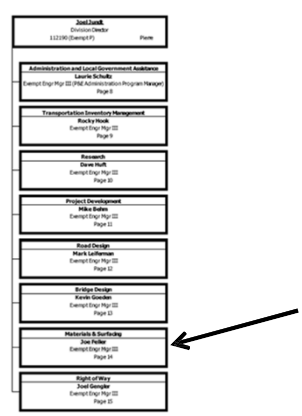
- Connecticut: One main headquarters for Construction and four districts; central lab & four satellite labs. Decentralized
- Louisiana: "Yes and yes" Basic Design, Specifications, Materials, and Research all centralized. Districts autonomous to some degree; report to Head of Operations at the state office. Central lab plus district labs. Purchasing and maintenance decentralized. Change orders over a certain limit must be approved by the Chief Engineer.
- More on Louisiana: Central lab: responsible for items supplied for construction; accredits district labs; responsible for environmental compliance (stormwater, wastewater et al); District labs: responsible for accreditation, certification and calibration.

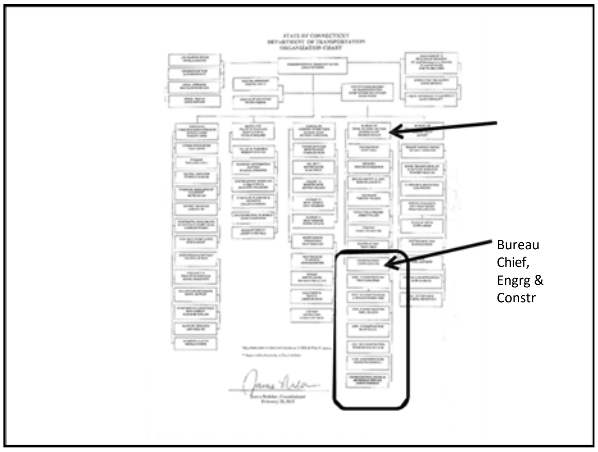
Centralized?, con'd

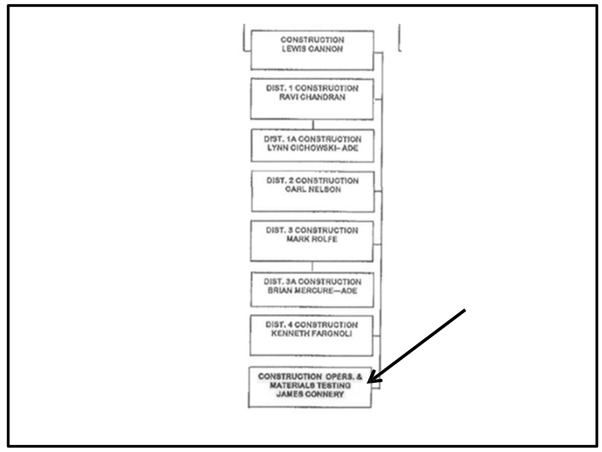
- Montana: Total DOT staff: 2000; 800 – 1000 in central office. Materials staff: 75 in the central office; 40 in districts. Districts responsible for maintenance and inspection. Centralized
- Rhode Island: One DOT center; no districts. Centralized
- South Dakota: Most design done in central office; majority of decisions made in the central office. All subject matter experts reside in the central office. Centralized

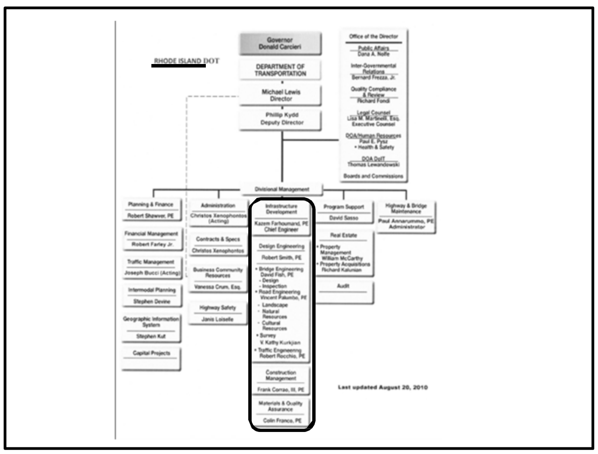
South Dakota

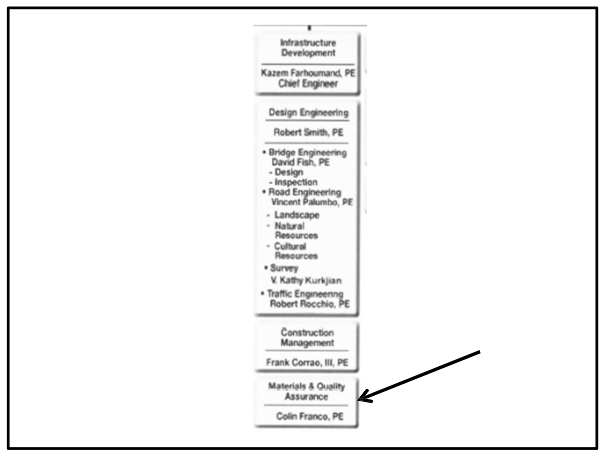








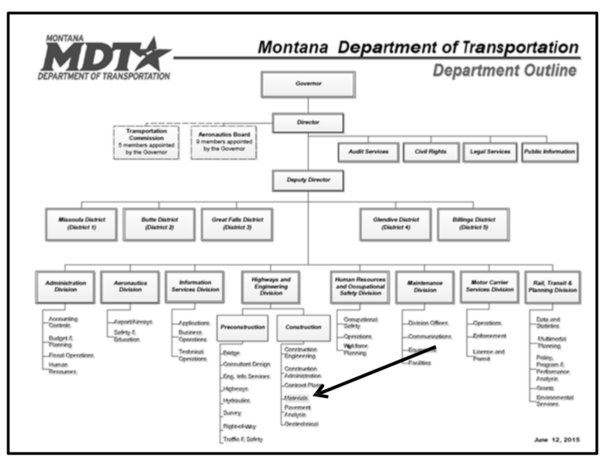


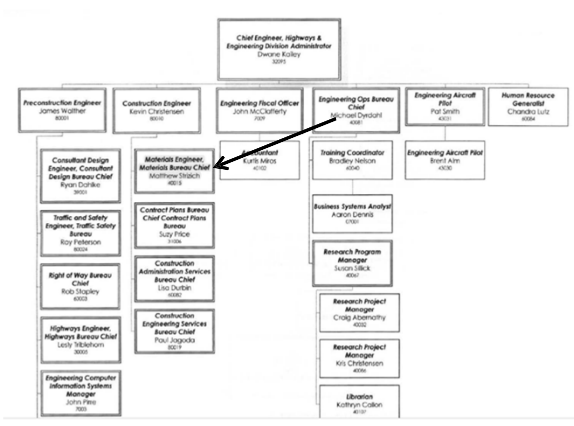


Louisiana

DOTD

- Administration
- Engineering
  - Construction
    - (Materials and Testing used to be here)
  - Research
    - Materials and Testing
    - (others)
  - (others)
- Multimodal
- Management and Finance
- Operations.





"Informal" Organizational Relationships

- Strong relationships with industry (Connecticut)
- Materials & Testing and Chief Construction Engineer(Louisiana)
- ⇨Functional supervision of district laboratories (Louisiana)

- About half of the Materials Bureau activities occur in Preconstruction and Planning (Montana)
- ⇨Materials Bureau directs how district labs operate. (Montana)

- Connections between research and outside groups such as AASHTO panels, university consortia, and various regional groups (Rhode Island)
- Close working relationships with Road Design, Bridge Design, Project Development, Research and all of the Division of Operations offices (South Dakota)
- ⇨Regional Materials personnel are Operations Division employees but work very closely with the Materials and

3. Please describe your process for specification development.

Spec development -- Louisiana

- Input from the districts, contractors, Materials, Design, and Research.
- Committee chair appointed; selects a task committee.
- Task committee then
  - Reviews the existing specification
  - Engages in lots of discussion
  - Prepares a draft new/revised specification
  - Posts the draft on DOT and industry websites
  - Receives comments and incorporates them, as appropriate
- Final approval by Chief Engineer

Spec development – South Dakota

- [Specifications engineer is part of the Division of Operations]
- Review teams established for specific subjects.
- Input received from both within and outside the department.
- Ultimately the subject matter expert is responsible for the new/revised specification's content.

Spec development – Rhode Island

Typical process:

- Design section suggests a change.
- Rough draft developed in-house between Design and Materials.
- Working committee (in-house plus FHWA) enhances the proposal.
- Senior Specification Committee (a permanent committee that includes legal and industry representatives) reviews and modifies the proposal, as appropriate.
- Final approval by the Chief Engineer.
- The new specification published as a #99 specification and used on a small number of projects.

Spec development -- Connecticut

"Special provision" (trial version):

- Need expressed (Construction, Design, or industry)
- Working group (could consist of Design, Construction, Materials, and Maintenance) provides input.
- Draft special provision developed
- If Design is satisfied with the draft, it is inserted into a contract.
- [Have discussed having their Standard Specification Committee review and approve before inserting the provision into a contract, but this is not done at this point.]
- After contract completed, special provision is either revised or left alone, and then proposed to become a Standard Specification.
- Reviewed by the Standard Specification Committee, tweaked if needed, approved, and made part of the

Spec development -- Montana

[Spec group under Construction Administration]

- Identification of a possibly needed spec change (by anybody – technician, designer, contractor, consultant, etc)
- Development of a suggested draft by the party suggesting the change
- Meeting with construction, specification writing and others, with a thorough review of the draft
- Transmittal to the spec group
- Distribution internally and externally (contractor organizations) for comments, & compilation of comments
- Review of comments by a new group
- Incorporation of any revisions

4. What role and process are used in carrying out the Quality Assurance function?
   - Contractor Quality Control
   - Independent Assurance
   - Verification

South Dakota Definitions

Definition. Acceptance samples and tests include the samples and tests used for determining the acceptability of the materials and workmanship which have been or are being incorporated in the project. They are the principal basis for determining the acceptability of the projects' materials and construction.

Definition. Independent assurance (IA) samples and tests are the samples taken, tests made, and other procedures performed for the expressed purpose of making independent checks on the reliability of the results of acceptance sampling and testing. They do not provide test results for acceptance.

Verification Methods. The methods by which the Department determines the acceptability of materials to be placed on the project include the following:

- A. Sampling and Testing – Some materials may require samples be taken and tests performed to determine that the material being certified is in conformity with the plans and specifications.

QA – Contractor Quality Control

- Louisiana: Districts are responsible to check contractor quality; also collect product certificates
- South Dakota: Only hot mix projects use QC/QA; contractor QC tests used for acceptance; area staff – QA tests to verify contractor QC
- Rhode Island: Only on major projects; contractor QC plan req'd, plus specialty plans as appropriate
- Connecticut: Contractor QC plan req'd for every project; annual qualification procedures for contractors

QA – Independent Assurance

- Louisiana: Assures equipment & personnel performing correctly (compaction, e.g.); also compare test results from different areas of state
- South Dakota: Area staff – acceptance testing; Region staff – independent assurance testing (hot mix on QA/QC projects, plus others)
- Rhode Island: Independent assurance twice a year using dedicated staff
- Connecticut: Combination of in-house and third-party procedures
- Montana: Check samples on many products by construction field staff & district labs; District labs check field lab equipment and procedures. Central Materials personnel check both district and construction field labs.

QA -- Verification

- Louisiana: Agency performs some acceptance tests (e.g., hot mix, to determine payment)
- South Dakota: Contractors' mix designs verified by central lab
- Rhode Island: DOT uses its own tests, not contractors' QC, for acceptance
- Connecticut: Verification by state forces
- Montana: Procedures & equipment verified through AMRL & CCRL; used for accreditation

5. By whom, and at what level, are disagreements between the Materials Section and other parts of the organization adjudicated?

- Louisiana: Contract disagreements – Must go through Project Engineer (= Chief Engr's rep); Internal disagreements-- no designated process; individual ways to approach this. Resolve at lowest possible; elevate if necessary
- South Dakota: Between subject matter experts and field staff; if needed, Materials chief discusses with Regional Engineer or Director of Operations

Disagreements, con'd

- Rhode Island: Small state, tight single pyramid centralized structure helps here; Materials & Construction both report to Chief Engineer – easy to talk; Monitoring and Evaluation section helps with disagreements.
- Connecticut: Org structure helps here too; Ops & Materials on same level; elevate to Bureau Chief if necessary
- Montana: Depends greatly on personal relationships; attempt to resolve at section or bureau level; elevate to Construction Engineer if necessary

6. How do you go about managing change (such as revisions to concrete specifications or revisions to the approved products list criteria)? Who establishes change? By whom, and with what processes, are changes implemented?

Few specific suggestions! Some ideas:

- Change is hard
- Usually resisted by many in the organization
- Takes a lot of time

Change, con'd

- Must be encouraged
- Encouragement and buy-in from the top is especially helpful.
- Frame changes in context of a pilot project
- Spec change procedures well defined and accepted
- Senior Spec Committee helpful
- Involve industry in spec changes

7. With regard to materials research, by what methods do you establish a direction for the program? From where does this input come?

Research process -- Louisiana

- Managed by LTRC and overseen by a RAC, which identifies overall needs that might lead to specific proposals
- Steps for project initiation:
  - Solicitation of research ideas
  - Submittal of ideas (from "creative, interested" employees, companies who make products, universities, etc.)
  - Ranking of ideas by the Research Advisory Committee (RAC) and preparation of research statements (by RAC) for ideas deemed worthy
  - Invitations for proposals
  - Receipt and ranking of proposals by RAC,
  - Approval of worthy proposals (to limit of funding available)

Research process – South Dakota

- Steps, through proposal initiation stage:
  - Ideas come from all over (internal, private industry, academia, etc).
  - Ideas evaluated by an internal research review panel; decide whether the idea is worthy enough to establish a technical panel to investigate the idea further.
  - Panel decides whether to develop a research statement.
  - If a research statement is developed, the panel

Research process – Rhode Island

- RAC from every part of its DOT, plus FHWA & URI: establish overall direction for research program and be part of the project selection process
- Steps:
  - Forum held by RIDOT, (contractors, URI & others): RIDOT presentations + workshops to study ideas & get buy-in
  - Researchers prepare brief problem statements – need, scope, overall budget.
  - Presentations of statements to the RAC
  - RAC selects apparently worthy projects.
  - Full-fledged proposals for surviving proposals
  - Review & selection by subject matter panels
  - Final approval by Chief Engineer and FHWA

Research process -- Connecticut

- Materials & Research used to be combined; Research now part of Planning
- Steps for typical pavement project:
  - Frequent meetings of Mtls Testing, Pvmt Mgmt &UConn CAP Lab (discuss progress of ongoing projects and new topics)
  - Other ideas from industry and from CDOT Design and Construction.
  - For new ideas deemed appropriate, Research gets involved, (they have the budget)
  - CAP Lab prepares proposal; submits it to the CDOT.
  - Project included in Research/Planning program and budget, if budget allows and they approve,
  - Most research carried out by CAP Lab
  - CAP Lab prepares a final report of findings.

Research process -- Montana

- Research was under Materials; now directly under Chief Engineer
- Steps:
  - Research suggestion defined on a one page form; can come from inside or outside MDT; if from outside, the suggestion must have an MDT sponsor.
  - Suggestions considered by the Research Review Committee (division administrators from throughout MDT)
  - If tentatively approved, another committee further defines objectives, scope and budget.
  - The Research Review Committee renders the final decision.
  - Most research is conducted by external organizations --universities, etc.

8. By what process does your agency interpret and implement materials research results? Note that this question is related in part to question 6 about change management.

There were several rather disparate responses, including:

- Required implementation plan in final report
- Importance of a champion
- Technical review panel & then research review board decision to implement
- Proposal requirement to answer: Does it solve a problem? Is it implementable?

9. What other things can you tell us about your Materials Section that might help fulfill the goal of our study?

Some "other things":

- Keys to success are the support of upper management, continuous communication, and mutual respect.
- A single pyramid organization leads to easy communication.
- Design reviews that include Materials can lead to development and implementation of new technologies.
- Education and training are essential and (in Rhode Island) are supported by top leadership.

"Other things," con'd

- This is an ever-evolving process; it is never static, due to new technologies, new materials, and new project delivery methods. A challenge is that Materials must keep up.
- It is essential to maintain contacts with other states, through AASHTO committees and the like.
- The line between materials testing and research is blurred at times. Both need attention and are equally important.
- When dealing with details of construction, things can get contentious, with Construction sometimes thinking that "minor details" are not important.

Observations

- Policies: 23 CFR 637 drives policies; beyond that, many differences
- Organization: Many effective informal channels exist, but the formal location of Materials impacts its success.
- Organization: 3 ½ of 5 describe themselves as centralized.
- Organization (informal): Functional supervision of district labs
- Specification development: Basic steps similar

Observations, con'd

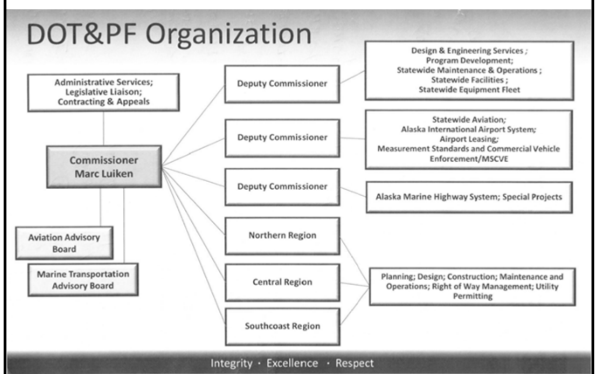
- QA Function: Differing approaches especially contractor QC
- Disagreements: Lowest level possible; clear procedure for elevating; org structure influences success
- Change: Final step – obtaining buy-in – is informal. Involve industry; communicate; involve lots of people
- Research: Steps for project selection similar; implementation process varies

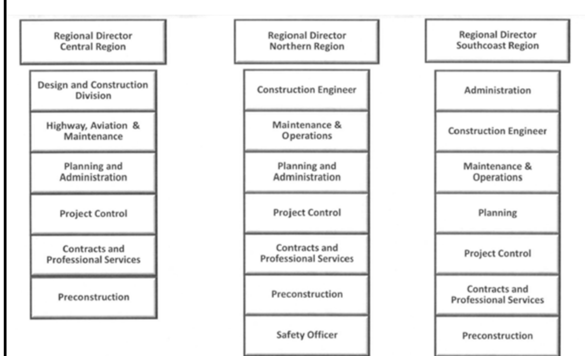
A few quick comparisons

State	Centralized?	Materials reports to	Mtls Manual?	Spec group location
CT	No	Construction (via Constr Ops & Mtls Testing)	Yes	Construction
LA	Partial	Engineering (via Research)	Yes	Engineering (via constr contracts & specs and up thru contracts unit)
MT	Yes	Construction	Yes	Constr Admin
RI	Yes	Chief Engineer	No(website)	
SD	Yes	Planning & Engineering	Yes	Operations

A few more quick comparisons

State	RAC?	Research location	Disagreement resolution
CT	Committee from Mtls, Pvmt Mgmt & CAP Lab	Planning	Lowest level first (informal); then elevate if needed.
LA	Yes (Internal & external members)	Engineering	Lowest level first (informal); then elevate if needed
MT	Research review committee (Internal)	Chief Engineer	Lowest level first(informal); then elevate if needed
RI	Yes (Internal & external)	Materials & Qual Assurance	Lowest level first (informal); then elevate if needed
SD	Research review panel (Internal)	Planning & Engineering	Lowest level first (informal); then elevate if needed





Written comments, please

- benco@alaska.net
- By tonight!

Appendix G

A Report on

Interviews with State Departments of Transportation Material Section Heads

Improving Performance, Knowledge, and Methods to Provide Quality Service and Products: Interviews with State Department of Transportation Materials Section Heads

A Study Prepared for

Alaska Department of Transportation and Public Facilities
and PacTrans

under
UAF Purchase Order No. P0494196
August 1, 2015

by

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October 14, 2015

Improving Performance, Knowledge, and Methods to Provide Quality Service and Products: Interviews with State Department of Transportation Materials Section Heads

Contents

Improving Performance, Knowledge, and Methods to Provide Quality Service and Products: Interviews with State Department of Transportation Materials Section Heads

Acknowledgements

The study reported herein was requested by the Alaska Department of Transportation and Public Facilities (DOT&PF and funded by DOT&PF and PacTrans. Special thanks to Michael San Angelo, P.E., Statewide Materials Engineer, Alaska Department of Transportation and Public Facilities (AKDOTPF), who selected and recruited the interviewees and provided helpful suggestions for interview questions, and to Billy Connor, P.E., Director, Alaska University Transportation Center, who contributed to the interview questions and provided helpful suggestions and support throughout the project. In addition, the contributions of our five interviewees must be acknowledged; without their willing cooperation, the project would not have been possible.

Executive Summary

A study of the organization and management of the Materials sections of five state departments of transportation was conducted through telephone interviews with the managers of those five sections. Topics included policies, specification development, the quality assurance function, handling of disagreements, section organization, change management, research project development and implementation of results, and other relevant remarks. Among the significant findings are the following: The importance of 23 CFR 637 in establishing policies, and the variation in individual states' policies based on that CFR; similar practices among the states in establishing and revising specifications; widely varying approaches to the quality assurance function, especially contractor quality control; basic agreement on the proper approach to adjudication of disagreements related to Materials; the importance of organizational structure, and the position of the Materials section in that structure, in that section's success in communicating with, and influencing, other parts of the organization; lack of consistent guidelines for achieving buy-in during the change management process; a fairly common approach to research needs assessment and project selection, but apparent variations in the implementation of research results. These findings and others are intended to assist the Alaska Department of Transportation and Public Facilities in its internal discussions regarding future directions for its Materials Section.

Introduction

The goal of this study was to assist in improving the performance of the Materials Section of the Alaska Department of Transportation and Public Facilities and the products of that section's efforts. To achieve this goal, one of the important tasks was to understand the policies, processes, organizational structures and practices of similar departments in several other states. To that end, this project conducted interviews with the heads of Materials sections in five other state departments of transportation. This report is a description of that process and a summary of the interviewees' responses. It will be used as the basis of a webinar for AKDOTPF supervisory staff and as a source document for a workshop to discuss options for the future of the Materials Section.

Data Collection Process

During July, August and September, 2015, the author held individual telephone interviews with Materials section heads from the Departments of Transportation of South Dakota, Louisiana, Connecticut, Montana and Rhode Island. The various state representatives were identified and recruited by Michael San Angelo, P.E., Statewide Materials Engineer, Alaska Department of Transportation and Public Facilities, and were selected to provide a variety of organization types and approaches to transportation materials management, as well as geographic dispersion. The author then contacted the selected individuals, arranged to telephone them for interviews, and provided advance information about the project and the topics and questions to be discussed. Scheduling during the busy summer season was a bit of a challenge, but, by September 15, all interviews were complete. Each interview lasted approximately one hour, after each of which summaries were prepared. In most cases, a few clarifications were requested and fulfilled by e-mail. A listing of the five interviewees is attached as Appendix A, and a copy of the material distributed prior to each interview is found in Appendix B. Each of the five was willing, interested, and very helpful; without their contributions, the project would not have been possible, of course.

Summary of Responses

In this section, we list each interview question and then summarize the responses of each interviewee.

Policies

1. What are the policies that direct your Materials Section's activities, its relationships with other parts of the organization, and its decision-making process?

All those interviewed mentioned the importance of 23 CFR 637 [Construction Inspection and Approval – Subpart B – Quality Assurance Procedures for Construction] and indicated that this regulation basically drives all related local policies. Of special importance to the Materials function is the requirement that every state have a central laboratory.

In addition to 23 CFR 637, Louisiana's Materials Engineer Administrator noted the importance, in directing his operation's policies, of standard specifications, engineering directives for such things as procedures and organizational flows, and quality manuals for three types of construction. These manuals, for soils, asphalt materials, and concrete, can be accessed through the website listed in Appendix D.

Policies of special note in South Dakota include the Standard Specifications, the Materials Testing and Inspection Certification Program Manual, the Materials Manual, and such internal policies as those that govern delegation of authority and project acceptance and final review.

Rhode Island's Associate Chief Engineer for Materials and Quality Assurance noted that, in addition to 23 CFR 637, the policy related to research, 23 CFR 420, is an important guide to a Materials section's activities. Although his section has no materials manual, their website (listed in Appendix D) provides all relevant policies and other guidance; its sections include Approved Products and Plants, Product Evaluation, Plant & Field Forms, Yearly Testing, and Master Schedule of Testing, the last of which is followed for verification and assurance testing.

Chapter 4 of Connecticut's Construction Manual (see Appendix D) covers material testing. It distinguishes between the responsibilities of district construction staff and the Division of Materials Testing. It includes Minimum Testing Requirements for Acceptance and Assurance, including assurance tests and sample requirements. It references the use of *SiteManager*. The division's Materials Testing Manual, also cited in Appendix D, describes the organization, functions, and procedures performed by the division relating to sampling, testing, and inspection of materials incorporated into department projects or State funded municipal projects. The procedures used to verify contractor test results and the department's independent assurance test programs are also described.

The Montana Materials Engineer noted that FHWA requirements guide the testing aspects of the Materials Bureau's activities. The Montana DOT Materials Manual (listed in Appendix D) contains Methods of Sampling and Testing, plus, in Section

600, Materials Sampling, Testing and Acceptance Guide; it references 23 CFR 637. The bureau must abide by AMRL (AASHTO Materials Reference Library) and CCRL (Cement and Concrete Reference Library) policies and procedures in order to maintain laboratory certifications. Internal DOT policies govern pavement management. Basic engineering is governed by common engineering practices. With respect to project delivery, the Materials Bureau must make sure they meet project schedules and policies. That is, their geotechnical engineers and surfacing design engineers must produce deliverables for project designs on schedules established for each job, so that the project can be let on time.

Specification Development

2. Please describe your process for specification development.

In Louisiana, a new specification book has been developed and will be published this year. The process begins with input from the districts, contractors, Materials, Design, and Research. A committee chair is then appointed, who then selects a task committee. This task force then

1. Reviews the existing specification
2. Engages in lots of discussion
3. Prepares a draft new/revised specification
4. Posts the draft on DOT and industry websites
5. Receives comments and incorporates them, as appropriate

Final approval is by the Chief Engineer, who has an executive committee but who also has ultimate approval authority.

South Dakota has also recently updated its specification book. The specifications engineer is part of the Division of Operations. Review teams are established for specific subjects. Input is received from both within and outside the department. Ultimately the subject matter expert is responsible for the new/revised specification's content.

The Materials and Quality Assurance section in Rhode Island is involved, at various stages of project development, in the review of materials-related aspects of project-specific specifications. They distinguish two specification types – standard (Materials is concerned mainly with 200 to 900 series.) and project-specific. The usual process is as follows:

1. The Design section suggests a change.
2. A rough draft is developed in-house between Design and Materials.
3. A working committee (in-house plus FHWA) enhances the proposal.

4. The Senior Specification Committee (a permanent committee that includes legal and industry representatives) reviews and modifies the proposal, as appropriate.
5. Final approval is by the Chief Engineer.
6. The new specification is published as a #99 specification and used on a small number of projects.
7. If found to be successful, the #99 designation is removed.

The Materials Testing section in Connecticut is often involved in specification development. A "special provision" at ConnDOT is a specification for a contract item that is specific to a project or small group of projects and as such has a limited life span. It is essentially a trial version for specialty items or new processes. For such provisions, the typical process is:

1. A need is expressed by Construction, Design, or industry.
2. A working group, which could consist of Design, Construction, Materials, and Maintenance, provides input. A designer is usually the lead, but for such materials items like Portland cement concrete, Materials would lead.
3. A draft special provision is developed.
4. If Design is satisfied with the draft, it is inserted into a contract.
5. [They have discussed having their Standard Specification Committee review and approve before inserting the provision into a contract, but this is not done at this point.]
6. After the contract is completed, the special provision is either revised or left alone, and is then proposed to become a Standard Specification. The lead person formally requests that the specification become a standard.
7. It is then be reviewed by the Standard Specification Committee, tweaked if needed, approved, and made part of the Supplemental Standard Specifications.
8. These supplemental specifications are issued every six months and include all the changes that were made to the Standards since their last publishing date.

In Montana, the specification group is under Construction Administration. The typical steps in developing a new or revised specification are as follows:

1. Identification of a possibly needed specification change (by anybody – technician, designer, contractor, consultant, etc)
2. Development of a suggested draft by the party suggesting the change
3. Meeting with construction, specification writing and others, with a thorough review of the draft
4. Transmittal to the specification group

5. Distribution internally and externally (contractor organizations) for comments
6. Compilation of comments
7. Review of comments by a new group
8. Incorporation of any revisions
9. Approval by the Construction Engineer
10. Publication

Quality Assurance Function

3. What role and process are used in carrying out the Quality Assurance function?
    a. Contractor Quality Control

In Louisiana, the districts are responsible for quality assurance as a check on contractor quality. On a project, the roadway inspector is responsible for seeing that contractor quality control is performed correctly. That inspector also collects product certificates.

Hot mix asphalt projects are the only projects in South Dakota that utilize QC/QA. The contractor performs the Quality Control testing, and these tests are used for acceptance. Area Office staff perform the Quality Assurance testing which is basically verifying the results of the QC tests.

Contractor quality control is specified only on major Rhode Island projects at this time. Specifications require the contractor to submit a QC plan plus specialty plans, as appropriate, such as a bridge deck erection QC plan. Materials and Quality Assurance then assures they follow it, including having personnel on site as needed.

The Connecticut Materials Testing Manual (see website link in Appendix D) covers all aspects of quality assurance, including contractor quality control. A contractor quality control plan is required for each project. Contractors must undergo annual qualification of procedures for such activities as hot mix asphalt and quarries.

The general attitude in Montana is that the Materials Bureau doesn't care what the contractor does; they don't prescribe methods. But they do hold contractors accountable.

b. Independent Assurance

In Louisiana, this includes assuring equipment and personnel are producing correctly (compaction, for example). Also, they have a responsibility for comparing test results from different areas of the state. They use either a split sample to compare two results or several samples at several sites statewide. The latter provides better guidance, although the project-based split sample approach is allowed under federal standards.

On a typical South Dakota project, Area office staffs perform acceptance testing and Region Materials staff performs independent assurance testing. Region Materials performs Independent Assurance tests on hot mix asphalt QC/QA projects, as well as other projects. If dispute resolution is necessary, the final say will come from the Central Materials Lab.

Rhode Island DOT performs independent assurance twice a year using dedicated staff. It is a cooperative effort. They test every tester and every test using split samples. They have gotten away from visual observation.

This function is carried out by a combination of third party and in-house procedures in Connecticut.

This function is defined in Montana's Materials Manual (Appendix D.) Check samples are taken and tested on many products by construction field staff and district laboratories. District laboratories check field laboratory equipment and procedures. Central Materials personnel check both district and construction field laboratories. Split samples are tested at defined intervals to check procedures and equipment.

c. Verification

The Louisiana Materials Sampling Manual (see website link in Appendix D) provides guidance for the district laboratory's collection of further samples. Some items require the agency to perform acceptance tests; an example is hot mix asphalt, wherein the results determine payment.

In South Dakota, this is the Quality Assurance function. Contractors furnish mix designs for structural concrete and Portland cement concrete pavement as well as asphalt concrete. These mix designs are verified by this Program's Central Materials Lab.

Rhode Island does not use quality control tests for acceptance. They do their own testing, which works very well.

Verification in Connecticut is performed by state forces, as described in their Materials Testing Manual (Appendix D).

As a check on Montana's procedures and equipment, they utilize AMRL (AASHTO Materials Reference Library) and CCRL (AASHTO's Cement and Concrete Reference Library). Typically, AMRL sends samples, and Montana DOT performs tests and sends results to AMRL. They are accredited through this procedure.

Disagreements

4. By whom, and at what level, are disagreements between the Materials Section and other parts of the organization adjudicated?

For disagreements about contracts in progress in Louisiana, the project engineer is the Chief Engineer's representative; all differences of opinion must go through the P E. If necessary, the issue is then elevated to the Chief Construction Engineer and then to the Chief Engineer.

For agreements within Louisiana's DOTD, there is no designated process but, rather, individual ways to approach this. The interviewee suggested trying to resolve the matter at the lowest level where it can be resolved. The idea is to keep discussions at the lowest possible level and then elevate if needed.

In South Dakota, such disagreements are usually adjudicated between subject matter experts and field staff. The attitude is, first, to try to follow the wording in the specifications. If that does not achieve success, the Materials chief discusses the matter with the Regional Engineer or the Director of Operations.

Personnel in Rhode Island are physically close to each other, which helps in minimizing and resolving disagreements. Most disagreements are interpersonal in nature, involving different, sometimes conflicting personalities. But, in general, the Associate Chief Engineer for Materials and Quality Assurance observes a minimal number of problems of the type considered by this question. It is important to recognize different viewpoints. The department's organizational structure is helpful in resolving disagreements of the type considered here, as both the Associate Chief Engineer for Materials and Quality Assurance and the head of Construction report to the Chief Engineer, so it is natural for them to sit down and talk. The Rhode Island DOT also has a Monitoring and Evaluation section that helps with disagreements.

Somewhat similar to Rhode Island, Connecticut's DOT organization is helpful in this kind of disagreement resolution. Construction Operations and Materials Testing is one of five divisions in the Office of Construction, which also includes the four district construction functions. Thus, the head of Operations and Materials Testing is on a par with the four district construction heads. When disagreements arise, they are resolved, if possible, at this level. If necessary, issues are elevated above this level to the Bureau Chief for Engineering and Construction.

In Montana, the resolution of such issues depends greatly on personal relationships. An attempt is always made to try to resolve the issue at the section or bureau level. If that fails, it is elevated to the Construction Engineer. Sometimes the best resolution is to agree to disagree and proceed. A disagreement between divisions, such as Preconstruction v. Construction, is elevated to the Chief Engineer.

Organizational Chart

5. Please provide a copy of the organization chart of the part of your agency that includes Materials. Please describe its salient features and indicate those informal relationships that are likely not represented by the chart.

Each interviewee provided helpful charts and helpful comments about them. In addition, we took the opportunity to discuss the extent to which the organization is centralized. There are, thus, three parts to each department's response to this question – 1) centralization/decentralization, 2) the charts themselves and their salient features relative to the Materials function, and 3) significant relationships not indicated on the charts. Please refer to the several charts in Appendix C. This discussion follows the alphabetical order of the charts in Appendix C.

The organization chart for Connecticut shows one main headquarters for Construction and four districts. Materials Testing is organized in the same way, with a central laboratory and four satellite laboratories. Thus, this organization tends toward being decentralized.

In Connecticut, the heads of each Construction district, plus the head of Construction Operations and Testing, all deport to the Construction chief, who is directly responsible to the Bureau Chef for Engineering and Construction. This Bureau Chief then reports to the Deputy Commissioner of Transportation. Within the Division of Materials Testing, there are three sections: 1) Project Support and Portland Cement Concrete, 2) Independent Assurance and Field Inspection, and 3) Hot Mix Asphalt, Chemical Testing, and Final Material Certification. For more details, please refer to the (somewhat fuzzy) second chart in Appendix C.

Not shown on these charts, Materials Testing in Connecticut has strong relationships with industry; they have found that these relationships are mutually beneficial.

In answer to the question about centralization v. decentralization, the Louisiana Materials Engineer Administrator answered, “Yes and yes!” They lean toward being centralized with varied levels of autonomy. Basic Design, Specifications, Materials, and Research are all centralized. Districts are autonomous to some degree; they report to Head of Operations at the state office. Purchasing is located within each district. There are district laboratories (as well as a central laboratory as required by 23 CFR 637). Area engineers have some authority; they report to the district administration but administer projects from the central office and districts. Maintenance is decentralized. Change orders over a certain limit must be approved by the Chief Engineer.

We were able to obtain an organization chart for Louisiana Materials and Testing by not for their overall Department of Transportation and Development (DOTD) organization. Details of the DOTD structure are described on their website (see Appendix D. for website references). The overall DOTD organization consists of five divisions: 1) Administration, 2) Engineering, 3) Multimodal, 4) Management and Finance, and 5) Operations. Materials and Testing is part of the Engineering Division. Whereas Materials and Testing used to report to Construction (within Engineering), they now report to the research group.

Appendix C includes the organization chart for Louisiana Materials and Testing. The following comments apply: The central laboratory is responsible for items that are supplied for construction. It accredits district laboratories, although they are moving toward private accreditation of district laboratories. Environmental compliance (storm water, wastewater, noise, vibration, underground storage tanks) is a central laboratory function. District laboratories are responsible for accreditation, certification and calibration.

Two informal relationships not shown on the Louisiana organization chart were noted: the relationship between Materials & Testing and the Chief Construction Engineer, and the functional supervision of district laboratories.

The Montana DOT is definitely a centralized organization. The department has between 800 and 1000 employees in its central office out of approximately 2000 total employees. About 40 Materials staff reside in districts and about 75 in the central office. There is some decentralization; most districts are responsible for maintenance and inspection.

We obtained seven very helpful organization charts for the Montana DOT, as shown in Appendix C. The first shows the location of the Materials Bureau within Construction. The second shows the reporting relationship of the Materials Bureau Chief to the Construction Engineer and thence to the Chief Engineer for the Highway and Engineering Division. The third identifies the three primary functions of the Materials Bureau: Pavement Analysis, Physical Testing, and Geotechnical. The remaining four show details of these three functions (one chart each for Pavement Analysis and Geotechnical, and two charts for the two components of Physical Testing – Testing and Inspection).

With regard to information not shown on the Montana charts, two items are significant. First, although technically within Construction, about half of the Materials Bureau activities occur in Preconstruction and Planning. Second, district laboratories do not fall officially under the Materials Bureau; laboratory supervisors are located within districts. However, the Materials Bureau directs how they operate.

The Rhode Island Department of Transportation is clearly centralized. Primarily due to the state's compact geography, there is one DOT center, and there are no districts.

Of the two Rhode Island charts in Appendix C, the first shows the overall DOT organization and indicates that Materials and Quality Assurance reports to the Chief Engineer of Infrastructure Development, on an equal basis with Design Engineering and Construction Management. Infrastructure Development, in turn, reports to the department's Deputy Director. Note that this chart is somewhat out of date, name-wise, since political changes have taken place since it was last published in 2010. The second chart shows the division's five functions: Materials Field Operations, Pavement Preservation, Product Evaluation, Research, and Materials Laboratory, with further details about each function's responsibilities and personnel.

One type of organizational relationship not shown on the Rhode Island charts is those between Research and outside groups such as AASHTO panels, university consortia, and various regional groups.

The South Dakota DOT is very centralized. The majority of decisions are made in the central office. Most all designs are performed in the central office, including right of way, road design, bridge design, and project finalization. All subject matter experts reside in the central office. This arrangement helps to provide consistency and to avoid districts operating as individual "kingdoms."

In South Dakota, as shown on the first of three charts in Appendix C, the Planning and Engineering Division reports directly to the Secretary of Transportation. Materials and Surfacing reports to the Division Director, on the same level as Research, Road Design, Project Development and four other functions. The third South Dakota chart identifies Materials and Surfacing's four primary responsibilities: Certification and Accreditation, Surfacing Plans, Geotechnical and Central Laboratory, with details on roles and personnel within each.

South Dakota's Materials and Surfacing program is involved in virtually all aspects of a project from programming to final acceptance, and, thus, has close working relationships with Road Design, Bridge Design, Project Development, Research and all of the Division of Operations offices. The program works continuously with the Operations Division, especially with the Area Offices and the Region Materials Offices. Regional Materials personnel are Operations Division employees; however, they serve more of an Independent Assurance role, and work very closely with the Materials and Surfacing program.

Change Management

6. How do you go about managing change (such as revisions to concrete specifications or revisions to the approved products list criteria)? Who establishes change? By whom, and with what processes, are changes implemented?

As expected, this question elicited a variety of responses but little in the way of concrete ideas. All agreed that change is hard and is usually resisted by many in the organization. Change takes a lot of time and must be encouraged. Encouragement and buy-in from the top is especially helpful. Individuals institute change.

The Louisiana representative suggested it is best to frame changes into the contract of a pilot project. Also, changes often occur through changes in specifications.

In South Dakota, Materials-related changes are identified and analyzed by subject matter experts. If justified, they are added to plans as required. Similarly, approved products changes are evaluated and managed by subject matter experts.

Rhode Island feels that change management works well and seamlessly, as exemplified in the discussion of their specification change procedure. The Senior Specification Committee is helpful in implementing change. It is important to involve industry in change, as a minimum by warning them that changes are coming. If industry is on board, "90% of the effort is complete."

The Connecticut interviewee referred to their procedure for specification development and then suggested that some changes are born from new knowledge and some from a problem or challenge.

The Montana Materials Engineer reiterated that many people simply hate change. He said it is essential to communicate and to involve lots of people in an attempt to get buy-in.

Materials Research

7. With regard to materials research, by what methods do you establish a direction for the program? From where does this input come?

This question generated a variety of responses. Of special interest is the identification of the typical steps in selecting and carrying out individual research projects. We had less success in learning about the management of the overall direction of research programs, although some helpful information is reported.

The Louisiana model for research was described as "excellent." Research is managed by the Louisiana Transportation Research Center (LTRC) and is overseen by a Research Advisory Committee (RAC). The LTRC research manual describes the RAC as follows:

> *Members of the RAC shall be appointed by the Director and be comprised of DOTD staff and field personnel, RPIC [Research Problem Identification Committee] chair, LTRC staff and an FHWA representative, with expertise appropriate to the technical areas included in the problem statements. The RAC shall be chaired by the LTRC Associate Director, Research. Each problem statement will be presented to the RAC by the RPIC chair or LTRC facilitator of the sponsoring RPIC. The problem statements will be evaluated based on research need or importance and implementation potential. A resulting priority list will be recommended.*

This committee gives overall direction to the research program and identifies overall needs that might lead to specific proposals.

The process for initiating individual research projects is roughly as follows:

1. Solicitation of research ideas
2. Submittal of ideas (from "creative, interested" employees, companies who make products, universities, etc.)
3. Ranking of ideas by the Research Advisory Committee (RAC) and preparation of research statements (by RAC) for ideas deemed worthy, including answers to: Does it solve a problem? Is it implementable?
4. Invitations for proposals
5. Receipt and ranking of proposals by RAC,
6. Approval of worthy proposals (to limit of funding available).

In South Dakota, the research program is not part of Materials and Surfacing; it is included under Planning and Engineering. The process, through the proposal invitation stage, is as follows:

1. Ideas come from all over (internal, private industry, academia, etc).

2. Ideas are evaluated by an internal research review panel; they decide whether the idea is worthy enough to establish a technical panel to investigate the idea further.
3. The panel then decides whether to develop a research statement.
4. If a research statement is developed, the panel usually invites proposals (unless it is a continuation of an existing project whose research team is still active or there is a single source).

Rhode Island utilizes a Research Advisory Committee (RAC) drawn from every part of its DOT, plus FHWA and the University of Rhode Island (URI), to establish an overall direction for its research program and to be part of the project selection process. The steps are as follows:

1. A forum is held by RIDOT, to which are invited contractors, URI and others. There are presentations of ideas by RIDOT, then workshops to study ideas and get buy-in. A report is produced with a spreadsheet to organize all the ideas.
2. Researchers prepare relatively brief problem statements – need, scope, overall budget.
3. Presentations are made of these statements to the RAC based on the problem statements.
4. The RAC selects apparently worthy projects.
5. Those that survive are turned into full-fledged proposals.
6. Subject matter panels review proposals and approve those judged worthy.
7. Final approval is given by the Chief Engineer and FHWA.

In Connecticut, Materials and Research used to be combined. Now Research is part of Planning. Here is an example of the steps utilized for pavement research –

1. Materials Testing (Office of Construction) and Pavement Management (Office of Engineering) staff meet with CAP Lab (Connecticut Advanced Pavement Laboratory at the University of Connecticut). These meetings happen fairly regularly to discuss progress of ongoing projects and new topics.
2. Some research ideas also come from industry and from CDOT Design and Construction.
3. If a new topic idea is deemed appropriate, Research (part of Planning) gets involved, because they have the budget.
4. CAP Lab prepares a proposal and submits it to the Department. The Department has an annual budget for this type of work at the University.
5. Research/Planning, if budget allows and they approve, includes the project in their program and budget.

6. Most research is then carried out by CAP Lab.
7. While most materials research is formally performed by CAP Lab, some smaller issues are investigated in-house. These tend to be issues related to testing materials for acceptance on active construction projects that the CAP Lab is not set up to perform.
8. CAP Lab prepares a final report of findings.

Research in Montana was formerly under Materials; now it is directly under the Chief Engineer. The steps, in brief, are as follows:

1. A research suggestion is defined on a one page form. These suggestions can come from inside or outside MDT; if from outside, the suggestion must have an MDT sponsor.
2. Suggestions are considered by the Research Review Committee (Consisting of division administrators from throughout MDT)
3. If the suggestion is tentatively approved, another committee further defines objectives, scope and budget.
4. The Research Review Committee then renders the final decision.
5. Most research is conducted by external organizations -- universities, etc.

Research Implementation

8. By what process does your agency interpret and implement materials research results? Note that this question is related in part to question 6 about change management.

The Louisiana Materials Engineer Administrator answered that "largely they are implemented when the stars are in alignment; that is, when designers recognize that the spec developed through research implementation projects is viable." Examples in his state include the use of polymer modified asphalt, the use of cement treated soils, high strength concrete, and the use of an inertial profiler to measure smoothness. He also noted that those preparing the research statements and ranking the proposals are asked to answer two key questions: Does it solve a problem? Is it implementable?

In South Dakota, recommendations are reviewed by the project's technical panel (which remains active throughout the project) and then passed to the research review board for final decision to implement.

The feeling in Rhode Island is that research must meet a need in order to be carried out. Often the researcher develops a proposed specification as a result of a research project.

The Connecticut Principal Engineer (Materials) emphasized the importance of having a champion. He then provided a helpful summary of the process that developed and implemented pavement wedge joints to replace butt joints for bituminous concrete paving:

> *Approximately seven years ago Maintenance, Construction, and Engineering all agreed that our pavement butt joints were not performing well. At a managerial level, the directive came down to look into alternatives and come up with a special provision (a revised standard primarily based on the existing) for new projects to use on a trial basis. Our Director of Research and Materials at the time was the champion. Industry was included in the group for the development of the special provision to make use of their experience and knowledge on the topic, and to avoid surprising them with something they were not prepared for. A special provision was drafted with several alternative construction methods and inserted into a paving project. CAP Lab provided field inspection and testing of the joints and recommended the notched wedge joint. After some success with the wedge joint, the existing standard for bituminous concrete paving was revised with the notched wedge as the preferred construction method.*
>
> *One of the challenges with this implementation process is that new projects have the revised standard while on-going projects have the old method. Contractually this can be dealt with, but there are times when both methods are in play which makes it interesting for groups such as ours who deal with all of the Department's projects simultaneously.*

In Montana, an implementation plan must be part of the research final report. Such a plan might suggest a specification change, field testing, or further research.

Other Comments

9. What other things can you tell us about your Materials Section that might help fulfill the goal of our study?

Here we simply list a wide variety of comments, some closely related to the overall topic and some not so close.

- Keys to success are the support of upper management, continuous communication, and mutual respect.

- A single pyramid organization leads to easy communication.
- Design reviews that include Materials can lead to development and implementation of new technologies.
- Education and training are essential and (in Rhode Island) are supported by top leadership.
- This is an ever-evolving process; it is never static, due to new technologies, new materials, and new project delivery methods. A challenge is that Materials must keep up.
- It is essential to maintain contacts with other states, through AASHTO committees and the like.
- The line between materials testing and research is blurred at times. Both need attention and are equally important.
- When dealing with details of construction, things can get contentious, with Construction sometimes thinking that "minor details" are not important.

Observations and Final Remarks

The purpose of this study was to learn about the organization and management of the Materials function in five state departments of transportation. We have uncovered a rather massive amount of information, as summarized in the preceding pages. Hopefully, some of these findings will be helpful to the Alaska DOTPF management as it considers the roles and responsibilities of the Materials part of the organization.

The intent here is not to recommend future directions for AKDOTPF's Materials Section. Those directions are expected to emerge from internal discussions using this paper as a source document. Nonetheless, it seems appropriate to offer some observations based on the interview findings, as a concluding section of this paper.

1. The request for information on "policies" that drive the section's activities resulted in a variety of interpretations of the term "policy." While all mentioned 23 CFR 637 as the basis for many highway-related policies, the list of other policies ranged from material manuals, standard construction specifications and testing schedules to engineering directives, engineering design practices and such internal policies as those governing delegation of authority. Thus, although CFRs establish and influence the functions of all Materials sections, the implementation task varies among the states.

2. While there are differences among state DOTs in the details of specification development, the basic steps are similar among those states studied. Material sections in Louisiana, Rhode Island and Connecticut are actively involved in many steps of the specification development process.
3. The states interviewed have differing approaches to quality assurance, especially contractor quality control. Also, they seem to interpret the terms independent assurance, verification and acceptance in various ways.
4. With regard to adjudication of disagreements, two agreed-upon principles emerged. First, attempt to resolve these situations at the lowest possible level initially, and second, have a clear policy/procedure for elevating unresolved disagreements upward through the organization. A DOT's organization structure influences the ease with which disagreements can be resolved. Rhode Island's single pyramid organization, plus the close proximity of its staff, tends to enhance communication success, including adjudication of controversy.
5. The extent to which a DOT is centralized is influenced to some extent by its geography. Rhode Island is heavily centralized, while a somewhat larger state, Connecticut, is quite decentralized. However, Montana considers itself to be mostly centralized. Varying conditions in different regions of a state also tend to lead toward decentralization. The decentralized nature of Alaska's DOTPF is clearly influenced by its geographic dispersion and the different emphases (urban/rural; different ground conditions) in its regions.
6. Informal relationships, not depicted on organization charts, are often influential in implementing programs, adjudicating disagreements, and the like. Nonetheless, the location of the Materials function within the formal organization has an impact on how effectively it conducts its business. In those organizations where Materials is on an equal level with such functions as Design and Construction, the Materials manager seems to have an easier time being recognized, being heard, and otherwise communicating with and influencing those counterparts.
7. The decentralized Alaska DOTPF organization seems to place its Materials function in a challenging situation. Whereas Planning, Design, Construction, Maintenance & Operations, Right of Way, and Utilities are primarily regional responsibilities, Materials is not named under any of the three regions' functions. Since the Statewide Materials function is part of Design and Engineering Services, neither is it called out on the summary statewide DOTPF organization chart.

8. The final step in the change management process – obtaining buy-in by affected parties – seems to be informal in all cases. For example, the process of writing new or revised specifications is generally well laid out, agreed upon and followed. But acceptance of the results lacks any codified process and is less assured. Suggestions for success include involvement of industry, clear and frequent communication, and participation by large numbers of staff in the development process.
9. The relationship between Materials and Research in state DOTs is changing, seemingly due to the realization that Materials research is only a part of the overall research program.
10. With regard to research management, the identification of research needs and the selection of projects generally follow similar steps among the five states. However, the implementation phase seems to vary significantly. Louisiana and Connecticut work hard to incorporate research results into projects on a trial basis, while other states rely on implementation plans in research reports.

Appendices

Appendix A. Persons Interviewed

Appendix B. Information Distributed to Interviewees Prior to Interviews

Appendix C. Organization Charts

Appendix D. Selected Website References

Appendix E. Selected Materials Section Mission/Function Statements

Appendix A. Persons Interviewed

Name	Date	Affiliation	Title	E-mail / Telephone
Chris Abadie, P.E.	July 24, 2015	Louisiana Department of Transportation and Development, Materials and Testing	Materials Engineer Administrator	Chris.Abadie@la.gov (225) 248-4131
Joe Feller, P.E.	July 21, 2015	South Dakota Department of Transportation, Materials and Surfacing	Chief Materials and Surfacing Engineer	joe.feller@state.sd.us (605) 773-3401
Colin Franco, P.E.	September 15, 2015	Rhode Island Department of Transportation, Materials and Quality Assurance	Associate Chief Engineer, Materials and Quality Assurance	colin.franco@dot.ri.gov (401) 222-3030
Robert G. Lauzon, PhD, P.E.	August 26, 2015	Connecticut Department of Transportation, Division of Materials Testing	Principal Engineer (Materials)	robert.lauzon@ct.gov (860) 258-0312
Matthew Strizich, P.E.	September 9, 2015	Montana Department of Transportation, Materials Bureau	Materials Engineer, Materials Bureau Chief	mstrizich@mt.gov (406) 444-6297

Appendix B. Information Distributed to Interviewees Prior to Interviews

Improving Performance, Knowledge, and Methods to Provide Quality Service and Products

Survey of State DOT Materials Sections

Introduction

The Alaska Department of Transportation and Public Facilities is embarking on a study whose goal is to improve the performance of its Materials Section and the products of that section's efforts. Of importance is the relationship of the Materials Section to other parts of the organization.

To achieve this goal, one of our tasks is to understand the policies, processes, organizational structures and practices of similar departments in several other states. We want to accomplish this task by interviewing officials within state transportation agencies, based on the following questions:

Interview Questions

1. What are the policies that direct your Materials Section's activities, its relationships with other parts of the organization, and its decision-making process?
2. Please describe your process for specification development.
3. What role and process are used in carrying out the Quality Assurance function?
    a. Contractor Quality Control
    b. Independent Assurance
    c. Verification
4. By whom, and at what level, are disagreements between the Materials Section and other parts of the organization adjudicated?
5. Please provide a copy of the organization chart of the part of your agency that includes Materials. Please describe its salient features and indicate those informal relationships that are likely not represented by the chart.
6. How do you go about managing change (such as revisions to concrete specifications or revisions to the approved products list criteria)? Who establishes change? By whom, and with what processes, are changes implemented?

7. With regard to materials research, by what methods do you establish a direction for the program? From where does this input come?
8. By what process does your agency interpret and implement materials research results? Note that this question is related in part to question 6 about change management.
9. What other things can you tell us about your Materials Section that might help fulfill the goal of our study?

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Appendix C. Organization Charts

Connecticut (2 pages)

Louisiana (1 page)

Montana (7 pages)

Rhode Island (2 pages)

South Dakota (3 pages)

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
ORGANIZATION CHART

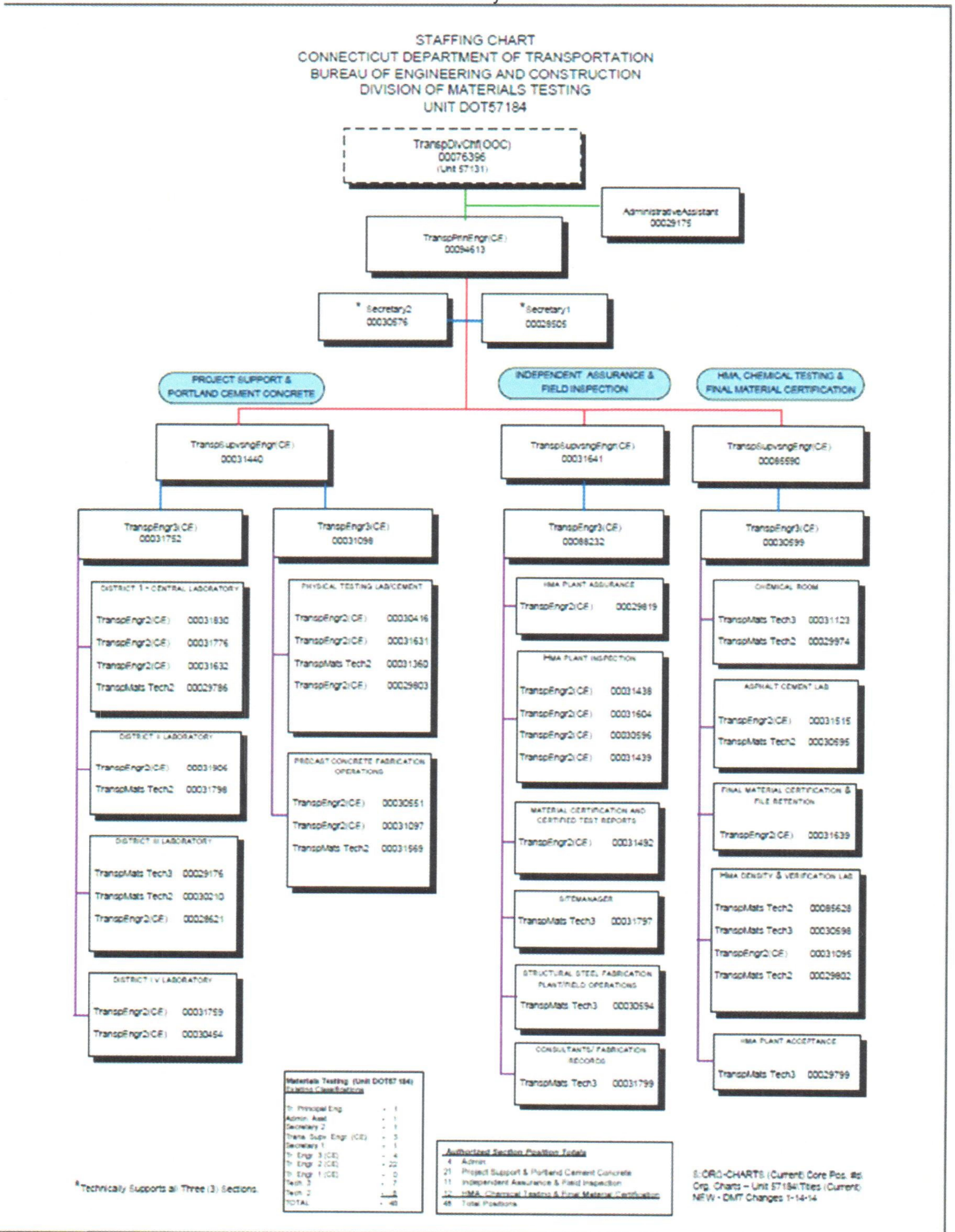
- **COMMISSIONER OF TRANSPORTATION** – JAMES REDEKER
  - LEGISLATIVE OFFICE – PAMELA SUCATO
  - COMMUNICATIONS – JUDD EVERHART
  - LEGAL SERVICES – DENISE RODOSEVICH
    - STATE TRAFFIC – DAVID SAWICKI
  - MANAGEMENT & TECHNOLGY SERVICES (IT, Staff Development, Security & Internal Audits) – CHERYL MALERBA
  - CONSULTANT SELECTION – DAVID MANCINI
  - EQUAL OPPORTUNITY & DIVERSITY – NANCY BRYANT**
  - SPECIAL ASSISTANT – RANDAL DAVIS
  - EXECUTIVE ASSISTANT – PETER YAZBAK
  - **BUREAU OF FINANCE & ADMINISTRATION** – BUREAU CHIEF ROBERT CARD
    - HUMAN RESOURCES – VICKI ARPIN
    - FINANCE – WALLACE LUGLI
      - CAPITAL SERVICES – PATRICIA HUSTUS
      - FINANCIAL MANAGEMENT & SUPPORT – MARK HAYES
      - BUDGET SERVICES – LORI KINIRY
    - CONTRACTS, AGREEMENTS & CONTRACT COMPLIANCE – CHARLES ROMAN
      - CONTRACT COMPLIANCE – DEBRA GOSS*
    - OPERATIONS & SUPPORT – VALERIE JOYNER
      - PROPERTY & FACILITIES SERVICES – DANIEL SMACHETTI
      - BUILDING MAINTENANCE – DAVID HARTLEY
      - PURCHASING & MATERIALS MANAGEMENT – SUZANNE DONLON
      - SUPPORT SERVICES – LISA FAZZINO
    - EXTERNAL AUDITS – GERALD DOBEK
  - **BUREAU OF POLICY & PLANNING** – BUREAU CHIEF THOMAS MAZIARZ
    - POLICY & PLANNING – ROBBIN CABELUS
      - ROADWAY INFORMATION SYSTEMS – MICHAEL CONNORS
      - COORDINATION, MODELING & CRASH DATA – MARIBETH WOJENSKI
      - STRATEGIC PLANNING & PROJECTS – COLLEEN KISSANE
      - ENVIRONMENTAL PLANNING – MARK ALEXANDER
      - HIGHWAY SAFETY – JOSEPH CRISTALLI
- **DEPUTY COMMISSIONER OF TRANSPORTATION, CHIEF OPERATING OFFICER** – ANNA BARRY
  - **BUREAU OF HIGHWAY OPERATIONS** – BUREAU CHIEF MICHAEL LONERGAN
    - TRANSPORTATION MAINTENANCE – CHARLES DRDA
      - DISTRICT 1 MAINTENANCE – ALAN WHITE
      - DISTRICT 2 MAINTENANCE – JEFFREY WILSON
      - DISTRICT 3 MAINTENANCE – JACK YEOMANS
      - DISTRICT 4 MAINTENANCE – COSMO IGNOTO
    - MAINTENANCE OPERATIONS – BART SWEENEY
      - MAINTENANCE PLANNING – JOHN DECASTRO
      - BRIDGE MAINTENANCE – RICHARD VAN ALLEN
      - EQUIPMENT & REPAIR – JAMES CHUPAS
      - HIGHWAY OPERATIONS – HAROLD DECKER
  - **BUREAU OF ENGR. & CONSTRUCTION** – BUREAU CHIEF THOMAS HARLEY
    - ENGINEERING – SCOTT HILL
      - BRIDGES – THEODORE NEZAMES
      - BRIDGE SAFETY & INSP. – ROBERT ZAFFETTI
      - HIGHWAYS – TIMOTHY WILSON
      - FACILITIES & TRANSIT – JAMES FALLON
      - TRAFFIC – CHARLES HARLOW
      - RIGHTS OF WAY – TERRY OBEY
    - CONSTRUCTION – LEWIS CANNON
      - DIST. 1 CONSTRUCTION – RAVI CHANDRAN
        - DIST. 1A CONSTRUCTION – LYNN CICHOWSKI- ADE
      - DIST. 2 CONSTRUCTION – CARL NELSON
      - DIST. 3 CONSTRUCTION – MARK ROLFE
        - DIST. 3A CONSTRUCTION – BRIAN MERCURE—ADE
      - DIST. 4 CONSTRUCTION – KENNETH FARGNOLI
      - CONSTRUCTION OPERS. & MATERIALS TESTING – JAMES CONNERY
  - **BUREAU OF PUBLIC TRANSPORTATION** – BUREAU CHIEF VACANT
    - TRANSIT & RIDESHARING – MICHAEL SANDERS
      - STATE TRANSIT DEVELOP. & SUPPORT SERVICES – RICARDO ALMEIDA
      - PLANNING & MARKETING – LISA RIVERS
      - CAPITAL PROJECTS IMPLEMENTATION – PHILIP SCARROZZO
      - REGULATORY & COMPLIANCE
      - PORTS & MARITIME – CHARLES BECK
    - RAIL – CARL JACKSON
      - DESIGN & CONSTRUCTION – JOHN BERNICK
      - RAIL OPERATIONS – RICHARD JANKOVICH

*Has direct access to the Commissioner on all DBE & Title VI matters

** Reports administratively to Cheryl Malerba

James Redeker, Commissioner
February 20, 2015

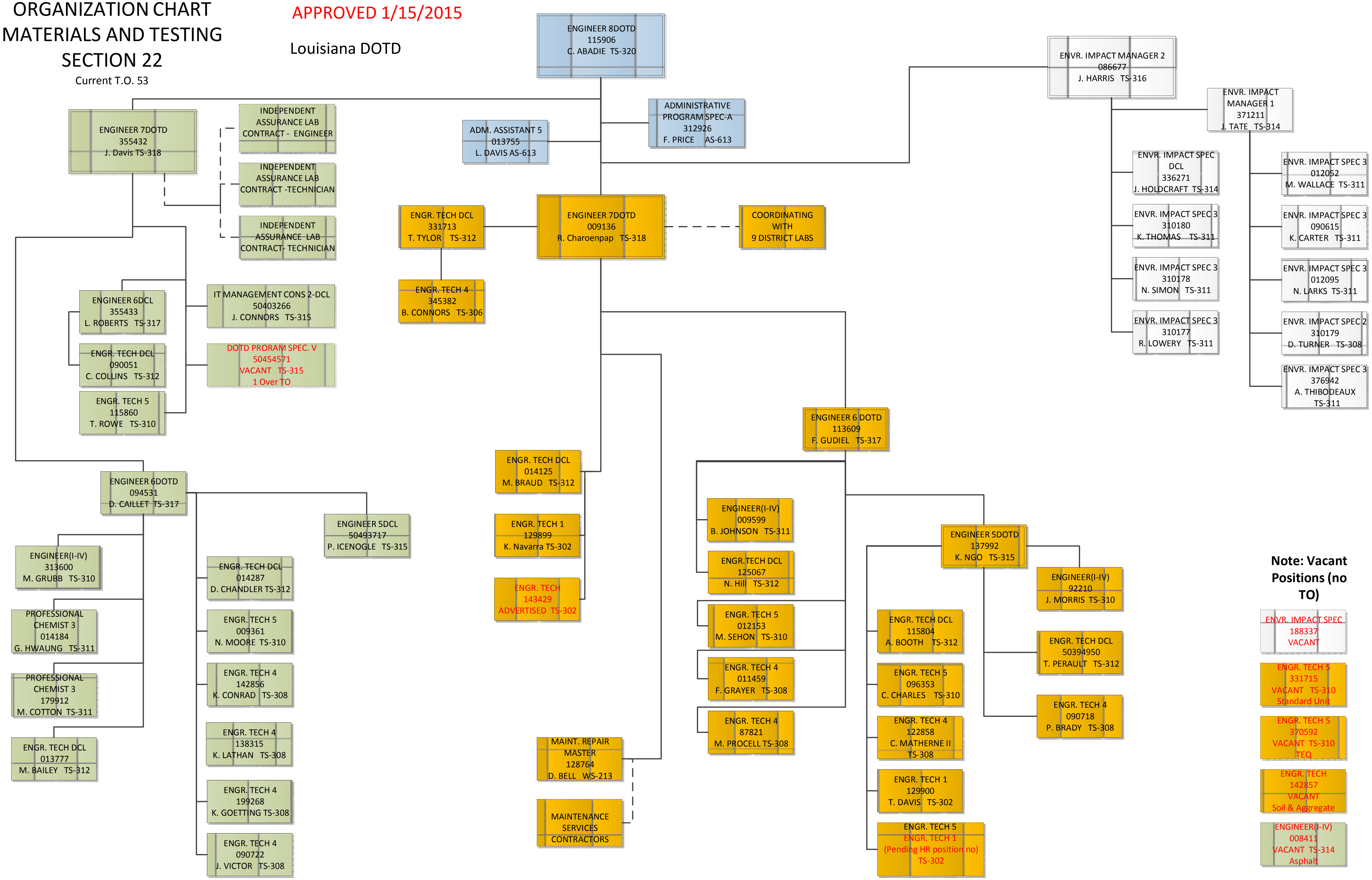
Figure 1.
ORGANIZATIONAL CHART
January 2015



ORGANIZATION CHART
MATERIALS AND TESTING
SECTION 22
Current T.O. 53

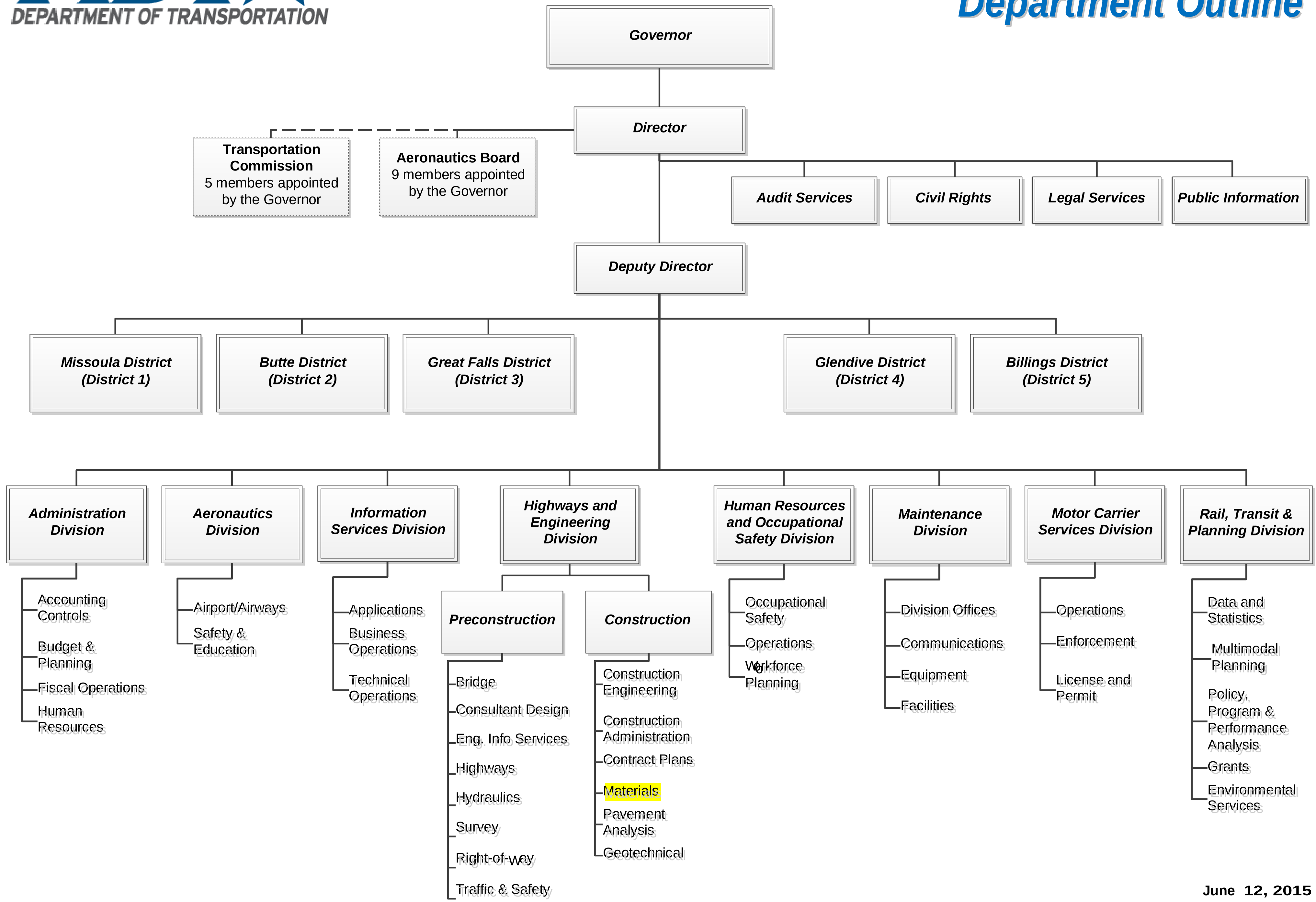
APPROVED 1/15/2015

Louisiana DOTD



Montana Department of Transportation

Department Outline



June 12, 2015

Highways & Engineering Division

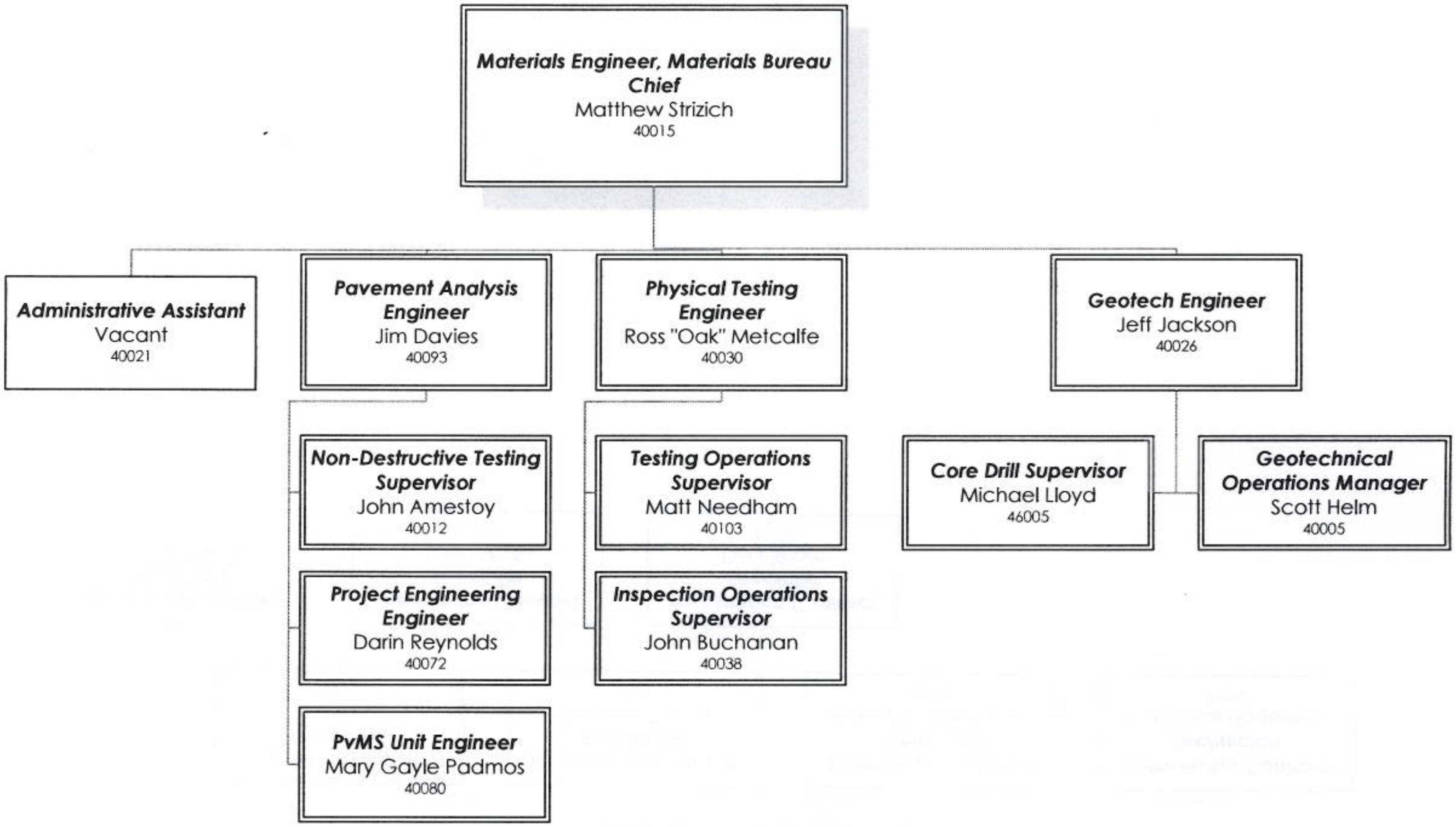
- ***Chief Engineer, Highways & Engineering Division Administrator*** – Dwane Kailey – 32095
  - ***Preconstruction Engineer*** – James Walther – 80001
    - ***Consultant Design Engineer, Consultant Design Bureau Chief*** – Ryan Dahlke – 39001
    - ***Traffic and Safety Engineer, Traffic Safety Bureau*** – Roy Peterson – 80024
    - ***Right of Way Bureau Chief*** – Rob Stapley – 60003
    - ***Highways Engineer, Highways Bureau Chief*** – Lesly Tribleborn – 30005
    - ***Engineering Computer Information Systems Manager*** – John Pirre – 7003
    - ***Bridge Engineer, Bridge Bureau Chief*** – Kent Barnes – 50025
  - ***Construction Engineer*** – Kevin Christensen – 80010
    - ***Materials Engineer, Materials Bureau Chief*** – Matthew Strizich – 40015
    - ***Contract Plans Bureau Chief Contract Plans Bureau*** – Suzy Price – 31006
    - ***Construction Administration Services Bureau Chief*** – Lisa Durbin – 60082
    - ***Construction Engineering Services Bureau Chief*** – Paul Jagoda – 80019
  - ***Engineering Fiscal Officer*** – John McClafferty – 7009
    - ***Accountant*** – Kurtis Miros – 40102
  - ***Engineering Ops Bureau Chief*** – Michael Dyrdahl – 40081
    - ***Training Coordinator*** – Bradley Nelson – 60040
    - ***Business Systems Analyst*** – Aaron Dennis – 07001
    - ***Research Program Manager*** – Susan Sillick – 40067
      - ***Research Project Manager*** – Craig Abernathy – 40032
      - ***Research Project Manager*** – Kris Christensen – 40086
      - ***Librarian*** – Kathryn Callon – 40107
  - ***Engineering Aircraft Pilot*** – Pat Smith – 43031
    - ***Engineering Aircraft Pilot*** – Brent Alm – 43030
  - ***Human Resource Generalist*** – Chandra Lutz – 60084

August 24, 2015

= Position Number

Highways & Engineering Division

Construction - Materials Bureau



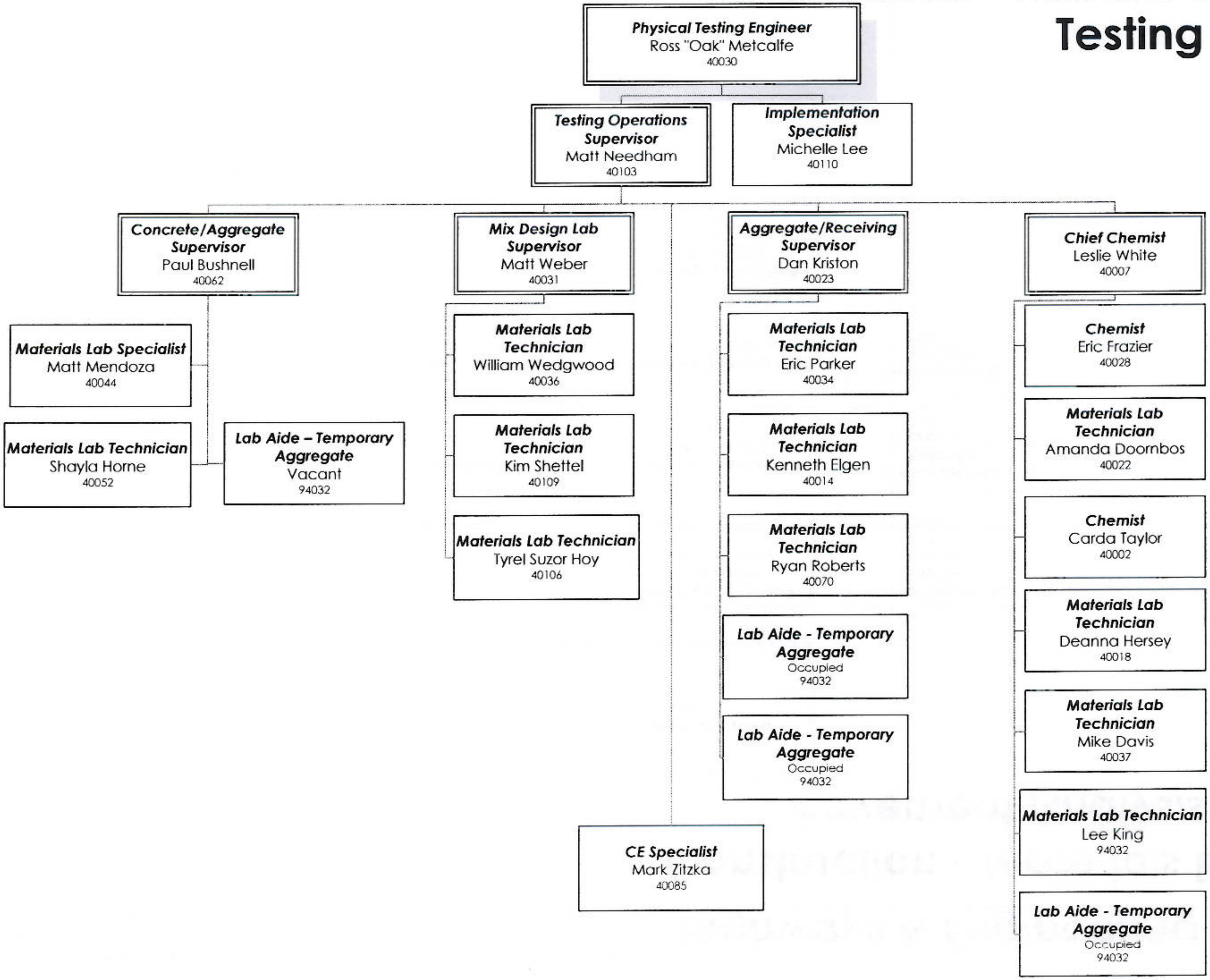
August 24, 2015
= Position Number

MDT

Highways & Engineering Division

Construction - Materials Bureau

Testing Section

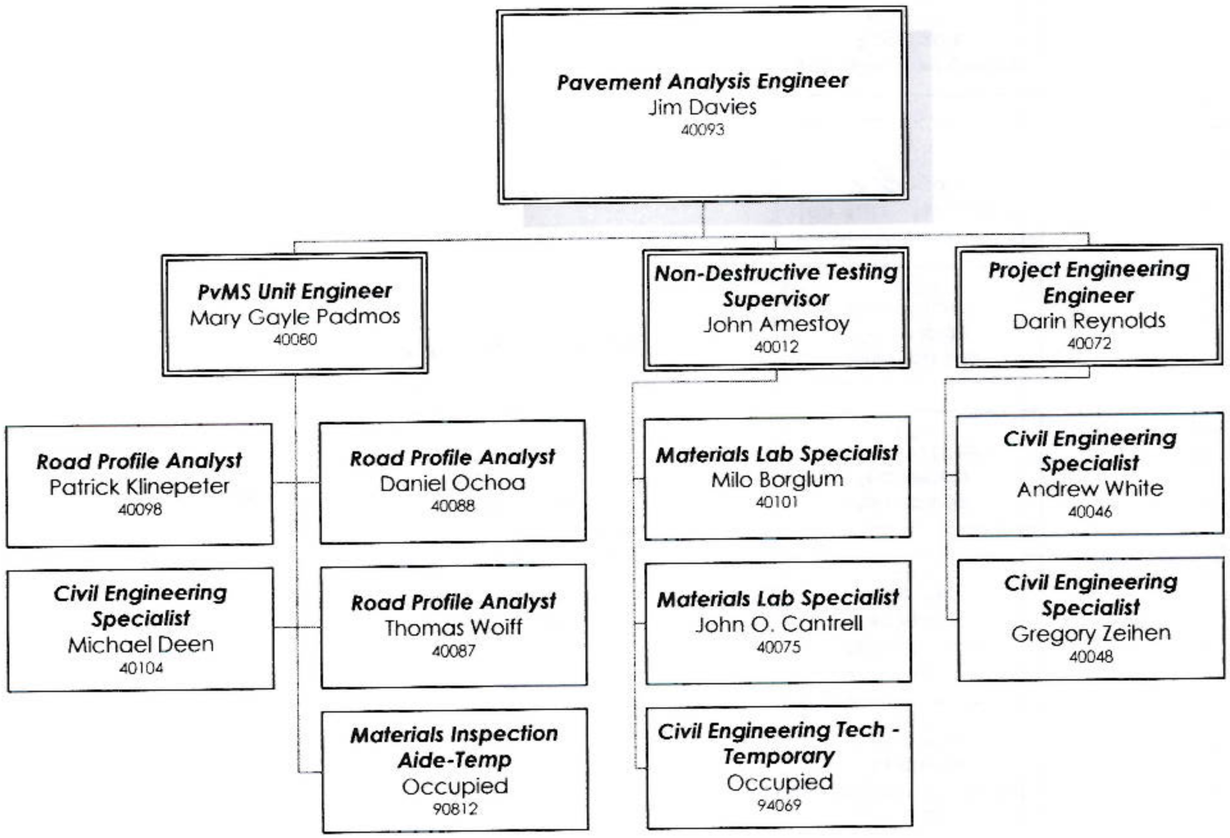


August 24, 2015
= Position Number

MDT

Highways & Engineering Division

Construction - Materials Bureau - Pavement Analysis Section

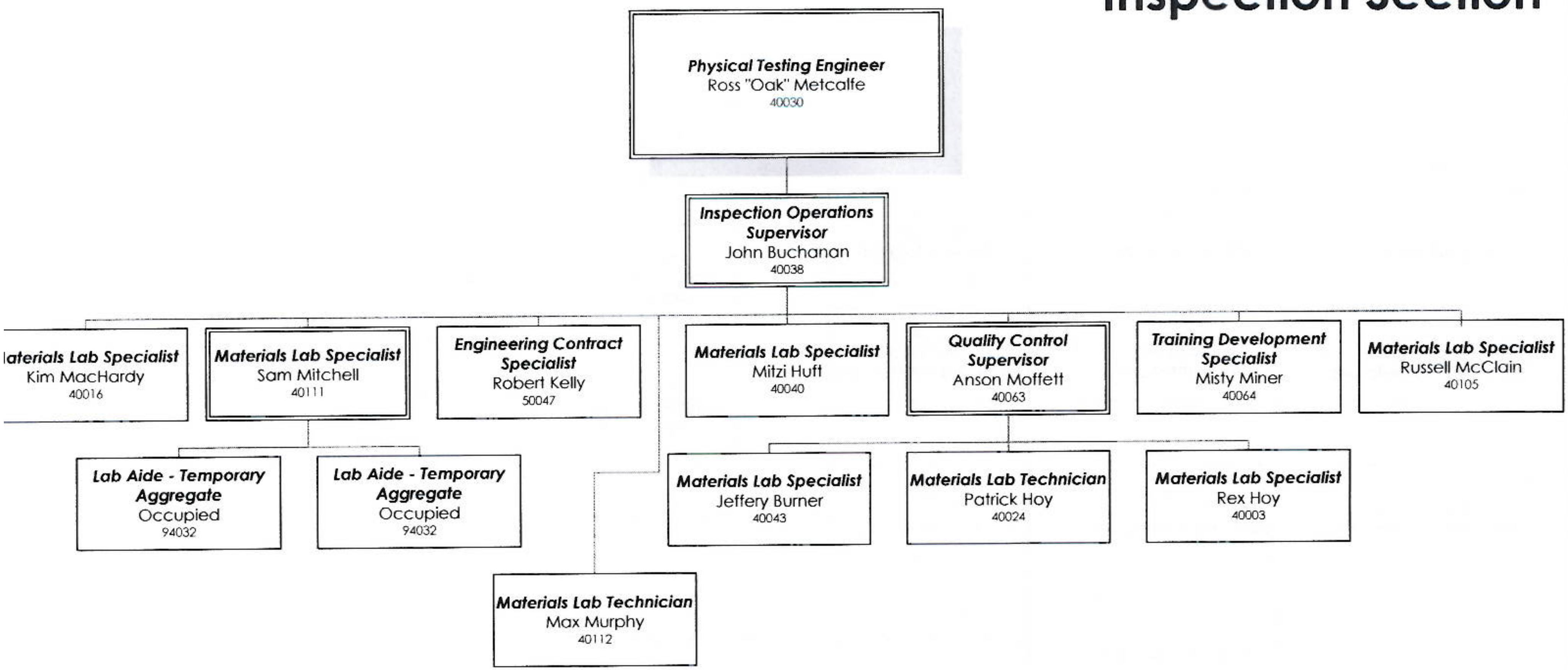


August 24, 2015
= Position Number

MDT

Highways & Engineering Division

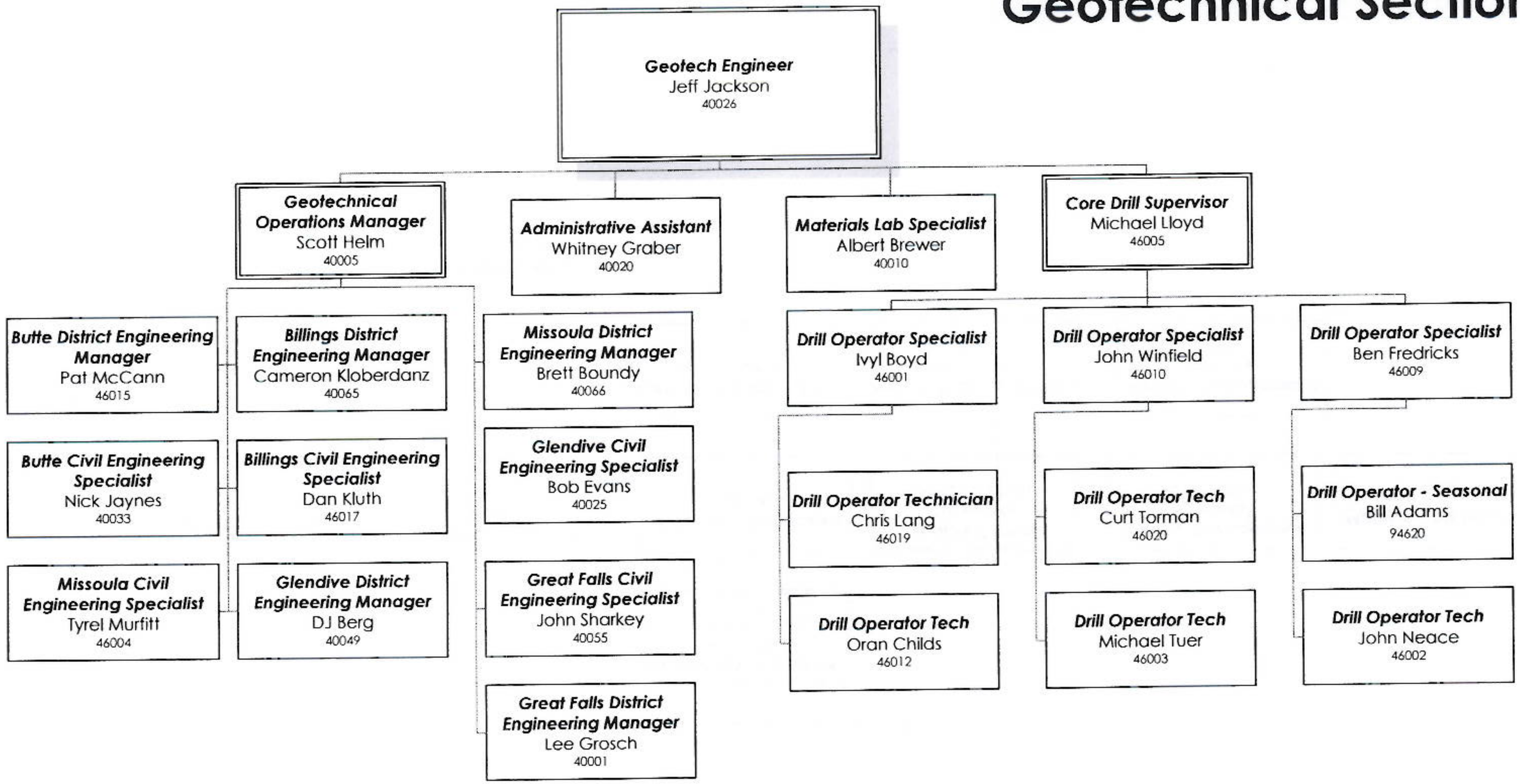
Construction – Materials Bureau – Inspection Section



August 24, 2015
= Position Number

Highways & Engineering Division

Construction - Materials Bureau - Geotechnical Section



August 24, 2015

= Position Number

RHODE ISLAND DOT

Governor
Donald Carcieri

DEPARTMENT OF TRANSPORTATION

Michael Lewis
Director

Phillip Kydd
Deputy Director

Office of the Director

- Public Affairs — Dana A. Nolfe
- Inter-Governmental Relations — Bernard Frezza, Jr.
- Quality Compliance & Review — Richard Fondi
- Legal Counsel — Lisa M. Martinelli, Esq. Executive Counsel
- DOA/Human Resources — Paul E. Pysz
  - Health & Safety
- DOA DoIT — Thomas Lewandowski
- Boards and Commissions

Divisional Management

Planning & Finance — Robert Shawver, PE

- Financial Management — Robert Farley Jr.
- Traffic Management — Joseph Bucci (Acting)
- Intermodal Planning — Stephen Devine
- Geographic Information System — Stephen Kut
- Capital Projects

Administration — Christos Xenophontos (Acting)

- Contracts & Specs — Christos Xenophontos
- Business Community Resources — Vanessa Crum, Esq.
- Highway Safety — Janis Loiselle

Infrastructure Development — Kazem Farhoumand, PE Chief Engineer

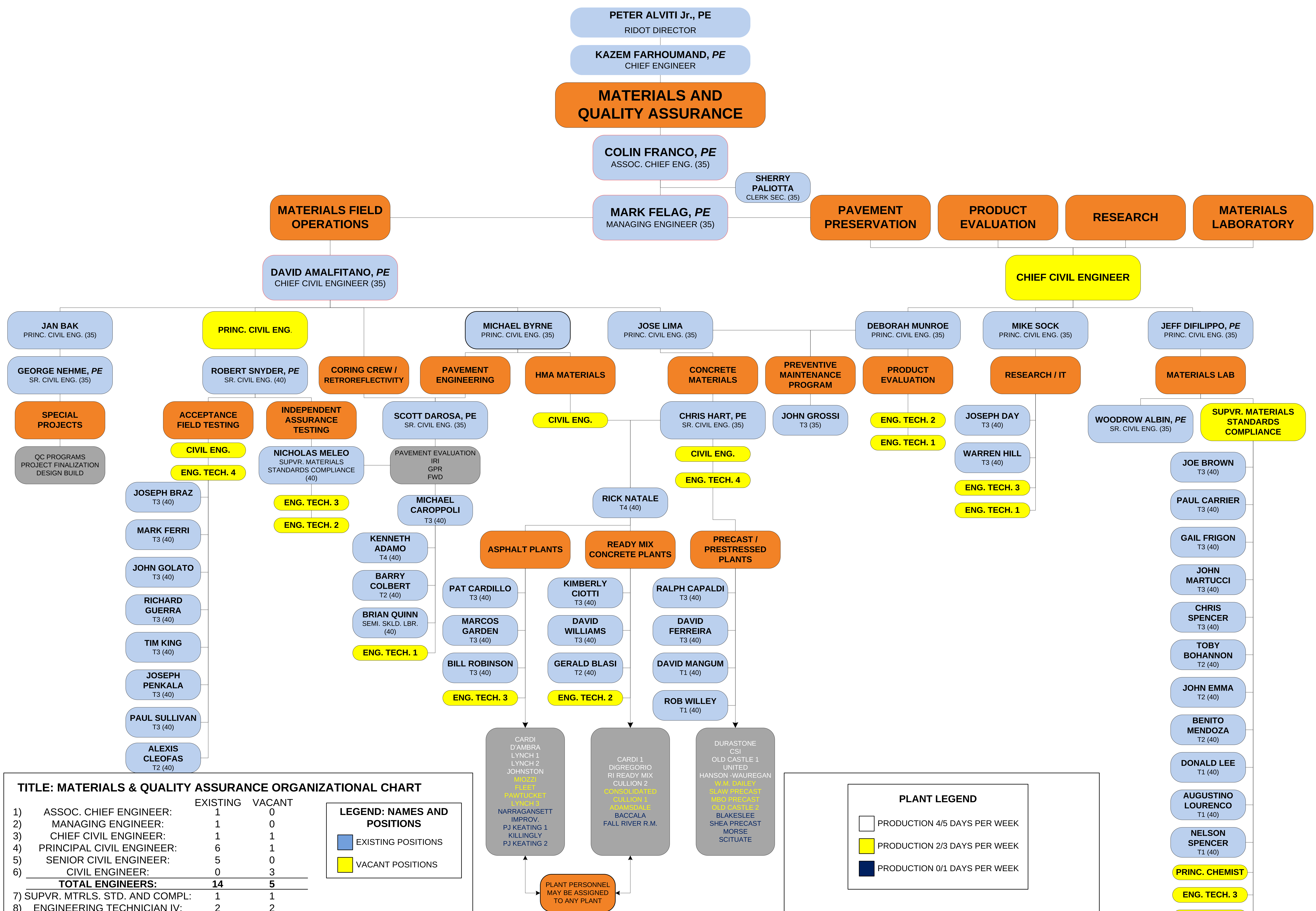
- Design Engineering — Robert Smith, PE
  - Bridge Engineering — David Fish, PE
    - Design
    - Inspection
  - Road Engineering — Vincent Palumbo, PE
    - Landscape
    - Natural Resources
    - Cultural Resources
  - Survey — V. Kathy Kurkjian
  - Traffic Engineering — Robert Rocchio, PE
- Construction Management — Frank Corrao, III, PE
- Materials & Quality Assurance — Colin Franco, PE

Program Support — David Sasso

- Real Estate
  - Property Management — William McCarthy
  - Property Acquisitions — Richard Kalunian
- Audit

Highway & Bridge Maintenance — Paul Annarummo, PE Administrator

Last updated August 20, 2010



TITLE: MATERIALS & QUALITY ASSURANCE ORGANIZATIONAL CHART

		EXISTING	VACANT
1)	ASSOC. CHIEF ENGINEER:	1	0
2)	MANAGING ENGINEER:	1	0
3)	CHIEF CIVIL ENGINEER:	1	1
4)	PRINCIPAL CIVIL ENGINEER:	6	1
5)	SENIOR CIVIL ENGINEER:	5	0
6)	CIVIL ENGINEER:	0	3
	TOTAL ENGINEERS:	**14**	**5**
7)	SUPVR. MTRLS. STD. AND COMPL:	1	1
8)	ENGINEERING TECHNICIAN IV:	2	2
9)	ENGINEERING TECHNICIAN III:	23	5
10)	ENGINEERING TECHNICIAN II:	6	4
11)	ENGINEERING TECHNICIAN I:	5	4
	TOTAL TECHNICIANS:	**37**	**16**
12)	PRINCIPAL CHEMIST	0	1
13)	CLERK SECRETARY:	1	0
14)	SEMI-SKILLED LABORER:	1	0

DATE: June 10, 2015

LEGEND: NAMES AND POSITIONS

- EXISTING POSITIONS (blue)
- VACANT POSITIONS (yellow)

PLANT LEGEND

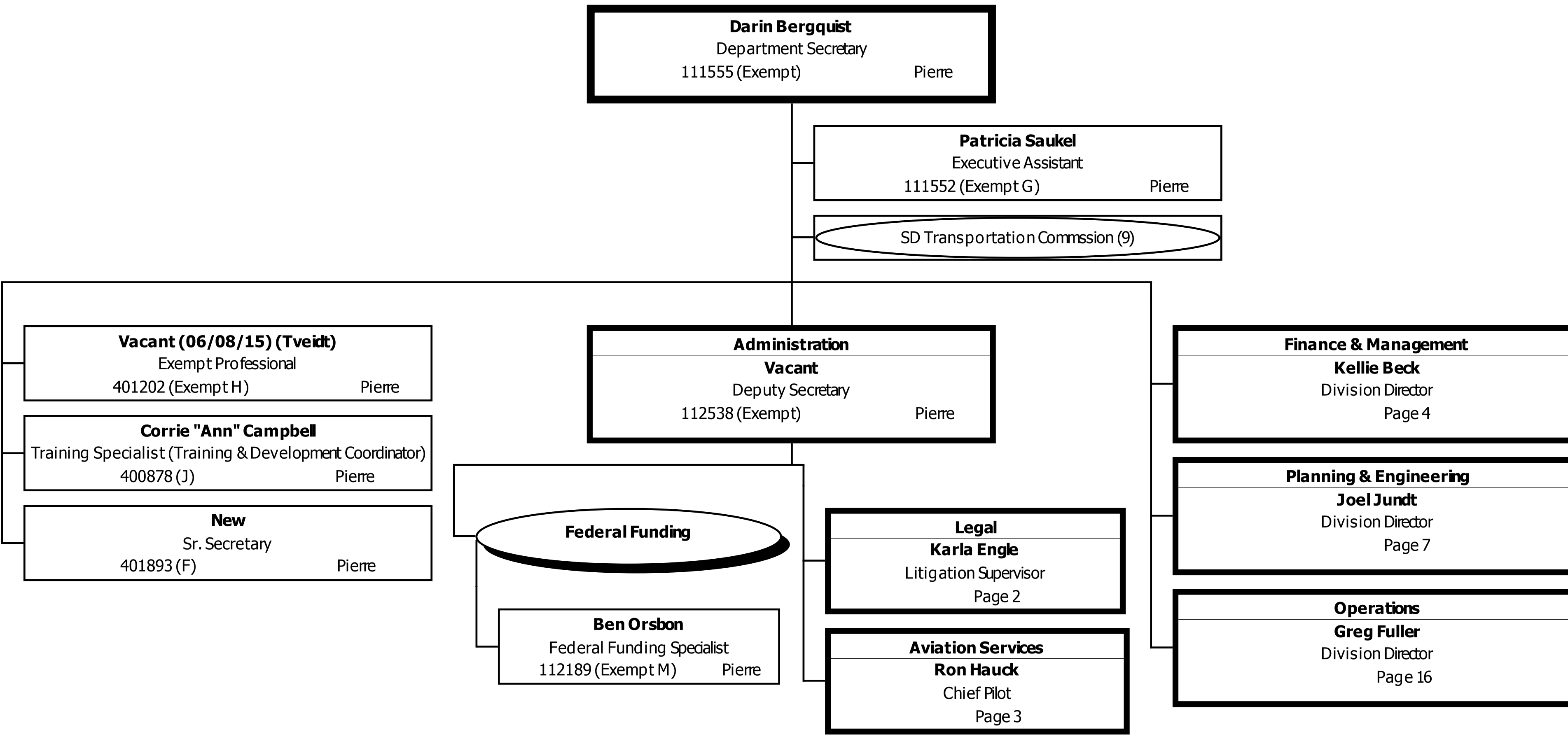
- PRODUCTION 4/5 DAYS PER WEEK (white)
- PRODUCTION 2/3 DAYS PER WEEK (yellow)
- PRODUCTION 0/1 DAYS PER WEEK (dark blue)

NUMBER OF PLANTS

ASPHALT PLANTS:	14
READY MIX CONCRETE PLANTS:	12
PRECAST/PRESTRESSED CONCRETE PLANTS:	11

SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION
OFFICE OF THE SECRETARY
(Center 11101 (FTE - 5.0; seasonal - 0.0))

07/08/2015



FTE: 5.0
Seasonal - 0.0

SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION
DIVISION OF PLANNING AND ENGINEERING - ADMINISTRATION AND LOCAL GOVERNMENT ASSISTANCE
(Center 111211 (FTE: 1.0 - See Page 8 for additional FTE in 111211)

07/08/2015

Joel Jundt
Division Director
112190 (Exempt P) Pierre

Administration and Local Government Assistance
Laurie Schultz
Exempt Engr Mgr III (P&E Administration Program Manager)
Page 8

Transportation Inventory Management
Rocky Hook
Exempt Engr Mgr III
Page 9

Research
Dave Huft
Exempt Engr Mgr III
Page 10

Project Development
Mike Behm
Exempt Engr Mgr III
Page 11

Road Design
Mark Leiferman
Exempt Engr Mgr III
Page 12

Bridge Design
Kevin Goeden
Exempt Engr Mgr III
Page 13

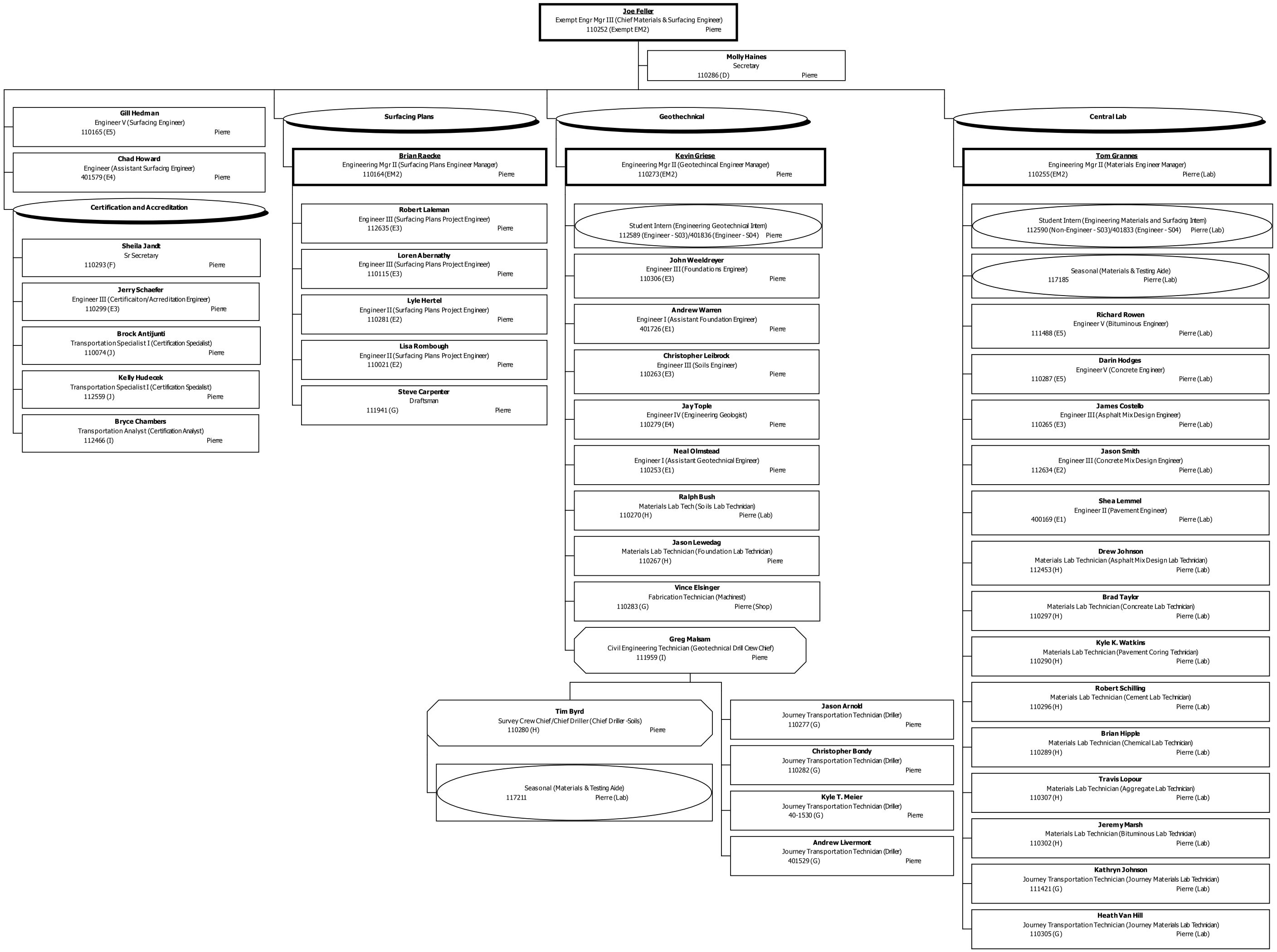
Materials & Surfacing
Joe Feller
Exempt Engr Mgr III
Page 14

Right of Way
Joel Gengler
Exempt Engr Mgr III
Page 15

FTE: 1.0 (Total FTE for 111211 is 6.0)
Seasonal - 0.0

SOUTH DAKOTA DEPARTMENT OF TRANSPORTATION
DIVISION OF PLANNING AND ENGINEERING - MATERIALS AND SURFACING (Engineering)
(Center 111234 (FTE - 42.0; seasonal - 2.5))

07/08/2015



FTE - 42.0
Seasonal - 2.5

Appendix D. Selected Website References

Connecticut

http://www.ct.gov/dot/site/default.asp (DOT)

http://www.ct.gov/dot/cwp/view.asp?a=1410&q=413148 (Office of Construction)

http://www.ct.gov/dot/cwp/view.asp?a=1410&Q=538842&PM=1 (Material Testing)

http://www.ct.gov/dot/lib/dot/documents/dconstruction/construction_manual/constmanual_ver2_2_jan11.pdf (Construction Manual)

http://www.ct.gov/dot/lib/dot/documents/dpublications/dmt-manual_2015_v7d.pdf (Materials Testing Manual)

http://www.ct.gov/dot/lib/dot/documents/dpublications/816/012004/2004_816_original.pdf (Standard Specifications; includes Standard Specification Committee)

http://www.cti.uconn.edu/caplab/contact-us (CAP Lab)

Louisiana

http://wwwsp.dotd.la.gov/Pages/default.aspx (DOTD)

http://wwwsp.dotd.la.gov/Inside_LaDOTD/Pages/default.aspx (Inside DOTD)

http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Pages/default.aspx (Engineering Division)

http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/default.aspx (Materials Lab)

http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/Menu_QAM.aspx (Quality Assurance Manuals)

http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Engineering/Materials_Lab/Pages/Menu_MSM.aspx (Materials Sampling Manual) http://www.ltrc.lsu.edu/pdf/research_man03.pdf (Research Manual)

Montana

http://www.mdt.mt.gov/ (DOT)

http://www.mdt.mt.gov/business/contracting/ (Manuals)

http://www.mdt.mt.gov/other/materials/external/materials_manual/mdt_materials_manual.pdf (Materials Manual)

http://www.mdt.mt.gov/research/ (Research program)

Rhode Island

http://www.dot.ri.gov/ (DOT)

http://www.dot.ri.gov/documents/doingbusiness/Bluebook.pdf (Standard Specifications)

http://dot.ri.gov/about/who/materials.php (Materials and Quality Assurance)

http://dot.ri.gov/documents/doingbusiness/materials/MST%202010%20Preamble%2009-14-12.pdf (Master Schedule of Testing)

South Dakota

http://www.sddot.com/ (DOT)

http://www.sddot.com/resources/Manuals/matlsmanual/MSTRPREF.pdf (Materials Manual)

http://sddot.com/resources/Manuals/matlsmanual/Mstp-Org&Fun.pdf (Materials and Surfacing Organization and Functions)

http://www.sddot.com/resources/manuals/ (Manuals, including Construction Manual sections) http://www.sddot.com/business/contractors/Specs/default.aspx (Standard Specifications)

Appendix E. Selected Materials Section Mission/Function Statements

Connecticut Division of Material Testing

It is the function of the Division of Materials Testing to predetermine if materials used by Contractors and the Connecticut Department of Transportation in the construction and maintenance of transportation facilities comply with the specification requirements and plans, and to perform investigational work on new materials and procedures constantly being proposed for use in the construction and maintenance of our transportation system.

Louisiana Materials and Testing Section

The mission of the Materials and Testing Section is to develop, administer, and regulate the Department's Materials Quality Assurance Program, environmental evaluation programs, and the geotechnical exploration and testing programs in cooperation with our public and private partners.

The Materials Quality Assurance Program includes materials evaluation and design, materials specification development, and conformance programs.

Rhode Island Materials and Quality Assurance Division

Our Materials division assures that quality materials are designed properly and that all materials provided meet specifications for all of our projects and operations.

Our staff in Materials takes the lead on specification review and writing of new specifications, distribution and recording of results, acceptance sampling and testing, process control sampling and testing, independent assurance sampling and testing, and the review of certificates of compliance.

Alaska

Statewide Materials supports the Department's mission by providing specialized technical expertise in materials and engineering services to all design, construction, and maintenance operations. Together the Statewide Materials Section is enhancing construction quality and improving transportation and public facilities throughout the State of Alaska.

Appendix H

Webinar Survey Results

Pavement Webinar Survey

1) Which webinar's did you attend? Select all that applied
   - ☐ 4/29/15 Research & Pavement Design Webinar - Construction and Maintenance in Cold Regions includes (roadway embankments and foundations)
   - ☑ 5/13/15 Research and Pavement Design Webinar - Construction and Maintenance in High Traffic Volume Urban Environments
   - ☑ 5/27/15 Research and Pavement Design Webinar - Construction and Maintenance Considerations in Rural Alaska
   - ☑ 6/10/15 Pavement Best Practices in Alaska Webinar - Innovation, New and Emerging Technologies

2) List the top 3 takeaways you got from the webinar(s) you attended.

   1. Wicking geosynthetic fabric doesn't work in clay soils. 2. Environmentally related pavem

3) Was the subject matter useful? Please add any additional information.

   Yes, I enjoyed the causal environment. It was similar to a Q & A session.

4) Was the subject matter presented at
   - ☑ About the right level of information
   - ☐ Too detailed
   - ☐ Not detailed enough

5) Was the subject matter useful?

   Yes

6) Was the length of the webinar
   - ☐ Too long
   - ☐ Too short
   - ☑ About right

7) Did the presenter provide appropriate answers to your questions? Describe what was or was not answered.

   Yes, he was able to explain why the wicking fabric wouldn't work in clay soils. When I wo

8) Were the webinars presented during an attractive time slot. If not, please suggest a better time

   Yes.

9) Should similar webinars be presented
   - ☐ Weekly
   - ☑ Monthly
   - ☐ Semi-monthly
   - ☐ Quarterly

10) These webinars were recorded. Would you recommend your peers watch them at a time of their choosing?

    Yes

11) Describe other technical webinars you would like to see?

    Any transportation related webinars (exp. Geometric design, geotechnical design (retainin

Pavement Webinar Survey

1) Which webinar's did you attend? Select all that applied
   - ☐ 4/29/15 Research & Pavement Design Webinar - Construction and Maintenance in Cold Regions includes (roadway embankments and foundations)
   - ☑ 5/13/15 Research and Pavement Design Webinar - Construction and Maintenance in High Traffic Volume Urban Environments
   - ☑ 5/27/15 Research and Pavement Design Webinar - Construction and Maintenance Considerations in Rural Alaska
   - ☑ 6/10/15 Pavement Best Practices in Alaska Webinar - Innovation, New and Emerging Technologies

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   - ☐ Too short
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Pavement Webinar Survey

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   - [x] 5/27/15 Research and Pavement Design Webinar - Construction and Maintenance Considerations in Rural Alaska
   - [x] 6/10/15 Pavement Best Practices in Alaska Webinar - Innovation, New and Emerging Technologies

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   - [ ] Too detailed
   - [ ] Not detailed enough

5) Was the subject matter useful?

   Yes

6) Was the length of the webinar
   - [ ] Too long
   - [ ] Too short
   - [x] About right

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9) Should similar webinars be presented
   - [ ] Weekly
   - [x] Monthly
   - [ ] Semi-monthly
   - [ ] Quarterly

10) These webinars were recorded. Would you recommend your peers watch them at a time of their choosing?

    Yes

11) Describe other technical webinars you would like to see?

    Any transportation related webinars (exp. Geometric design, geotechnical design (retainin

Appendix I

Materials Engineers Comments on Webinar Series VI

Comments from November 4 2015 webinar on Materials section interview project

1. A good environment exists between Statewide Materials and the regions; good synergy.
2. Meetings are very positive.
3. There is more consensus among the regions and statewide than implied on one of the AK DOTPF slides.
4. Billy will modify the slide.
5. There are differences among the regions, but there is much collaboration.
6. Southcoast Region Materials supports other functions at roughly 1/3 each – construction, design and O & M.
7. Materials is pretty diversified, which makes our job interesting.
8. The organization might be described as centralized in each region; that is, each regional organization is centralized.
9. Northern Region – similar to Southcoast – heavily involved in construction and M & O. Since Materials is in Preconstruction, there is more emphasis on project/design engineering.
10. They also collaborate with many non-DOTPF entities.
11. There is lots of sharing.
12. Carolyn comments -- We are certainly not Rhode Island!
13. Plans for workshop –
    a. Early December; date not yet decided
    b. Four hours
    c. Central region headquarters
    d. Discuss all the webinars in the "Quality Improvement for Materials" series
    e. Discussion of whom to invite
    f. Billy is preparing discussion points

Notes by Bennett
4nov2015