Best Practices for Thin Lift Asphalt Production/Construction

Thinlay Discussion Items
- Thinlay Definition
- Production
  - Moisture
  - Cold Feed
- Construction
  - Tack Coat
  - Paver Operation
  - Compaction
  - Temperature

Thinlays
- Thin hot mix asphalt (HMA) layer
  - Standard Thinlay – 1” to 1.5”
  - Ultra Thinlay - 1” or less
- Thinlays utilize a small nominal maximum aggregate size
  - 4.75 to 9.5 mm is typical
- NAPA refers to them as "ThinlaySTM"

Thinlay Advantages
1. Long service life and low life cycle cost
2. Maintain grade and slope with minimal drainage impact
3. Engineering approach to materials selection and design
4. Withstand heavy traffic and high shear stresses
5. Smooth surface
6. No loose stone after construction
7. No curing time to delay opening
8. Low tire-pavement noise generation
9. Minimal impact to overhead clearances
10. No special equipment required for placement

Thinlay Production

Thinlay Plant Items
- Production
  - Moisture
    - Impact
    - Mitigation / Management
  - Cold Feed
    - Calibration
Thinlay Aggregate Moisture Issues

Water Quantities on a Stockpile During a Rain Event

- The amount of water falling on a stockpile during a rain event is very significant.
  - Example: 100 ft. x 100 ft. stockpile will collect 26 tons of water after a 1” rainfall event.
- Highlights the critical need to keep water out of the stockpile!

<table>
<thead>
<tr>
<th>Stockpile Footprint</th>
<th>Approximate Dimensions, ft</th>
<th>Water Tonnage After Given Rainfall Events</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>5000</td>
<td>100 x 100</td>
<td>1.3</td>
</tr>
<tr>
<td>10000</td>
<td>150 x 150</td>
<td>2.6</td>
</tr>
<tr>
<td>15000</td>
<td>125 x 125</td>
<td>2.0</td>
</tr>
<tr>
<td>20000</td>
<td>140 x 140</td>
<td>2.6</td>
</tr>
<tr>
<td>25000</td>
<td>160 x 160</td>
<td>3.3</td>
</tr>
<tr>
<td>30000</td>
<td>175 x 175</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Aggregates (fines) used in Thinlays will likely be more prone to moisture retention.

- Water retention is maximized with well graded fine aggregate with high minus 200 content (i.e., screenings).
- Variable stockpile moisture can result in variable mix binder content and potential mix volumetric property and performance issues.
- More frequency moisture testing should be conducted due to the potential impact.
- Careful attention should be paid to the stockpile moisture contents and the potential for fines adhering to the cold feed belts.
- Fines collecting on the belt can result in mix dust (P200) variability which can have significant impact on volumetrics and performance.

Plant Moisture Setting and Actual Moisture Content

- Ideally, the plant moisture setting (PMS) matches the actual moisture content (AMC) of the aggregate/recycle blend.
- If the actual moisture content is greater than the plant moisture setting...
  - Plant thinks the difference is aggregate and adds too much binder
- If the actual moisture content is lower than the plant moisture setting...
  - Plant thinks the difference is moisture and adds too little binder

<table>
<thead>
<tr>
<th>PMS &gt; AMC = High Binder %</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMS &lt; AMC = Low Binder %</td>
</tr>
</tbody>
</table>

Moisture Content Management Solutions

1. Paved - Sloped Stockpile Areas
   - Benefit / Cost Decision Process
2. Covered Stockpiles
   - Benefit / Cost Decision Process
3. Loadout Best Practices
   - Always follow!

Moisture Content Management Solutions

All possible solutions should be evaluated to determine their potential benefit.
Paved – Sloped Stockpile Areas

- Benefits
  - Lowers drying costs
  - Increases production capacity
  - Lowers paving costs
  - Decreases material loss
  - Lowers equipment and electrical power costs
  - Reduces penalties from segregation and gradation problems
  - Lowers maintenance cost for loader

Covered Stockpiles - Types

- Covered stockpiles is a more active approach at managing stockpile moisture
  - Eliminate the moisture from entering the stockpile
- Variety of covering options
  - Clear span
  - Pole barn

Loader Techniques to Minimize Moisture

- Loadout from the dry side of the stockpile
  - High side of sloped area closest to cold feed
- Insert bucket above the ground (~1 to 2 ft.) to minimize moisture
  - Notice 1 ft. may not be high enough based on example below

Thinlay Cold Feed Systems

- High percentage of fine in Thinlays may require splitting the material into multiple bins.
  - Accurate calibration is a must
- Bin feed issues may occur with material with high minus No. 200 and moisture
  - Bridging or Clumping
    - Potential solutions
      - Vibrators
      - Pre screen fines with large clumps
      - Loader operator must gently place product in bin

Cold Feed Systems

- Thinlay Construction
Thinlay Construction Discussion Items

- Tack Coat / Placement Rate
- Paver Operation
- Compaction
- Temperature

Tack Coat Importance – Thinlay

- Adequate bond is critical (especially for Thinlays) between pavement layers to ensure all layers respond to loading as a single composite pavement structural system.
- If any layer(s) is not adequately bonded to other layers, the layer has to act independently and the potential for pavement distress is increased.
- A great comparison of a pavement structure is plywood. Delaminated plywood has little strength.

Recommended Emulsion Tack Coat Rates

<table>
<thead>
<tr>
<th>Emulsion Condition</th>
<th>Residual Asphalt, gal/yd²</th>
<th>Applied Unstabilized Emulsion, gal/yd²</th>
<th>Applied Stabilized Emulsion, gal/yd²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry or Delay</td>
<td>Clean the surface</td>
<td>Clean the surface</td>
<td>Clean the surface</td>
</tr>
<tr>
<td>New Asphalt</td>
<td>0.05–0.08</td>
<td>0.04–0.08</td>
<td>0.08–0.12</td>
</tr>
<tr>
<td>Cold Aged Asphalt</td>
<td>0.04–0.06</td>
<td>0.04–0.06</td>
<td>0.05–0.10</td>
</tr>
<tr>
<td>Stabilized Asphalt</td>
<td>0.04–0.06</td>
<td>0.04–0.07</td>
<td>0.06–0.15</td>
</tr>
<tr>
<td>PCC</td>
<td>0.04–0.08</td>
<td>0.06–0.09</td>
<td>0.08–0.19</td>
</tr>
</tbody>
</table>

Placement Rate and Rolldown

- Generally, the placement rate for Thinlays should be at least 3 times the nominal maximum aggregate size of the mixture.
  - 4.75 = "5/8" minimum
  - 9.5 = "1" minimum
- Roll down will be typical of most dense graded mixes.
  - Could be greater for higher binder content, less angularity mixes (i.e., more natural sand).
Paver Operation

- Paver should maintain excellent grade control to prevent bridging and tearing of the mat.
- As with any mix, paver speed should be established based on material delivery and compaction requirements.

Thinlay Compaction

Compaction and Density

- In-place density may not be specified for some Thinlays due to the thin placement thickness.
- Experience has shown that Thinlays can be impermeable at in-place density levels which are typically lower than standard dense graded mixes.
- Some agencies will specify an designated roller pattern and possibly roller type and number in lieu of a density requirement.

State DOT Method of Specifying Density for Thin Overlays

- Density specifications vary widely for thin overlays.
  - % control strip (4, 9%)
  - % lab density (4, 9%)
  - % theoretical max density, Gmm, (19, 43%)
  - Not specified (0, 18%)
  - Roller/Passes specified (0, 21%)

Roller Guidance

- Static steel wheeled roller is commonly used
- Vibratory steel wheeled can be used with care
  - Low amplitude and high frequency is preferred in order not to break aggregate
- Pneumatic rollers are used on a limited basis

Vibratory Roller Guidance (Vibs per Ft.)

- Vibratory rollers are used, match speed and frequency to achieve the target vibs per ft. for smoothness.
Density Measurement

- If density is required, it can be obtained with either core or nuclear/non nuclear gauges
- Concerns
  - Cores
    - With the thin placement thickness it can be very difficult to obtain a core without damage.
  - Gauges
    - Thin lift gauges can be used but they must be calibrated frequently.
    - Gauges may read underlying layer density as part of the Thinlay.

Thinlay Cooling Rate

- Thinlay mixes WILL cool faster than thicker mixes.
- MultiCool 3.0 Pavement Cooling Program can quickly determine the time available for compaction. 
  

  **Cooling rates are increased for thin lifts.**
  - At 70F surface/air temp, the mix temperature of a 0.5” lift drops from 300 to 175 in 6 minutes. [7, 11, and 16 minutes for a 0.75”, 1”, and 1.5” lifts, respectively]
  - Increase difficulty getting density at ultra thin rates <1”
  - Temperature cooling profiles should be determined for projects in order to assist with construction sequencing and roller pattern setup.

Thinlay References


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Thoughts and Questions?