Seminar on Maintenance of Asphalt Pavements

Asphalt Patching

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Agenda

1. Asphalt Pavement Patching and Maintenance Objectives
2. SHRP / LTPP
   - SHRP Studies & Results
   - Manual of Practice
3. Conventional Patching Program
   - Materials
   - Equipment
   - Procedure
Agenda

4. Alternative Innovations
   - Self Contained Patch Unit
   - Spray Injection Patching
   - Infrared Patching

5. Patching ‘oil & chip” Roads

6. Utility Cuts / Trench Restoration
Deterioration / Rehabilitation Relationship

75% Time

40% Quality Drop

17% Time
Deferring Maintenance Equals Increased Costs

Then

Why Do We Defer?
Maintenance Objectives vs. Asphalt Patching

- Recognize Distress
- Understand Causes
- Know Proper Materials
- Know Proper Steps
- Consider Repair to be Permanent
Maintenance Objectives vs. Asphalt Patching

Do It Right the First time
WATER, WATER, WATER

Need to take care of all water problems first!

Only then will all other repairs be cost effective!
Types – Distresses - Repairs

- Fatigue (alligator cracks)
- Potholes
- Depressions
- Slippage
- Rutting
- Corrugation/Shoving
- Edge Deterioration

- Patching
  - Full-Depth Patching
  - Partial Depth Patching
  - Surface (Temporary) Patching
- Scratch / Leveling Courses (prep for overlay)
- Milling
Types – Distresses - Repairs

- Cracking
- Raveling
- Bleeding
- Polishing
- Crack Sealing
- Seal Coats / Surface Treatments
  - Chip Seals
  - Slurry Seals
  - Microsurfacing
  - NovaChip
- Milling
2 Main Elements of Asphalt Patching

- Material Selection
- Repair Procedures

“For each agency, different combinations of materials & procedures will produce optimum cost effectiveness.”
Pothole Patching Program

- 1. Set-up for Safety
- 2. Marking
- 3. Cutting
- 4. Cleaning
- 5. Tacking
- 6. Filling
- 7. Compacting
- 8. Edge Sealing
- 9. Cleanup
Factors Effecting # of Steps in Pothole Repair

- Safety & rideability (existing conditions)
- Level of traffic
- Variety of pavement types
- Time of year
- Resources - personnel, materials, equipment
- Management philosophy (or knowledge)
- Time until overlay or rehab
- Tolerance of public
Production vs Quality

Trade-offs must be balanced!
Federal Highway Administration

Strategic Highway Research Program

Long Term Pavement Performance
SHRP Studies

- H-105 Innovative Materials & Equipment for Pavement surface Repair
- H-106 Innovative Materials Development & Testing
- FHWA Long-Term Monitoring (LTM) of Pavement Maintenance Materials Test Sites


http://www.fhwa.dot.gov/pavement/pub_listing.cfm?areas=LTPP
“Bituminous hot mix has shown the longest service life of all materials when it is placed using permanent procedures in a dry hole.”

SHRP
Materials and Procedures for Repair of Potholes in Asphalt-Surfaced Pavements

Report No. FHWA-RD-99-168

http://www.fhwa.dot.gov/pavement/pub_listing.cfm?areas=LTPP
“The patching operations described in this manual can be performed in any weather.”

“The materials and procedures discussed are for cold-mix stockpiled materials and for spray-injection patching devices”

“The goal of winter patching is to restore rideability and safety as quickly as possible (not to repair the distress permanently)”
“The use of hot-mix asphalt concrete, although recognized as a preferred alternative for patching operations, is not covered in this manual.”
Materials

- Conventional Cold Mixes
- Proprietary Cold Mixes
- Spray Injection

......an agency must verify the quality of materials used........
SHRP Manual Repair Techniques

1. Throw-and-roll
   - Place material in hole
   - Compact with truck tires
   - Open to traffic

Figure 1. Throw-and-roll procedure—material placement.

Figure 2. Throw-and-roll procedure—compaction of patch.
2. Semi-permanent repair
- Remove water & debris
- Square up sides, vertical cuts
- Place mix
- Compact - device smaller than patch
- Open to traffic
3. Spray injection

- Blow out water & debris
- Spray tack on sides & bottom
- Blow asphalt & aggregate into hole
- Cover patch with aggregate layer
- Open to traffic
Asphalt Patching Programs

- Conventional Patching
  - Materials
  - Equipment
  - Procedures
Conventional Asphalt Patching Program

Materials:
1. Conventional Hot-Mix
2. Cold Stockpile Mix
3. Tack
4. Edge Seal
Conventional Hot Mix

Stone or Crushed Gravel + Sand + Asphalt Cement

Heat and mix in plant @ 380° F
Cold Stockpile Mix

3/8 in. Stone or Crushed Gravel

+ Sand

+ Emulsion or Cutback

Heat and mix in plant @ 140°F
Asphalt Patching Program

Cold Mix Requirements
a. Pliable in stockpile
b. Cannot drain in stockpile
c. Easy to shovel & compact
d. Retain asphalt coating
e. Stable under traffic
Asphalt Patching Program

Opposing Demands
- gradation
- aggregate shape
- asphalt binder
- binder content
Asphalt Patching Program

Cold Stockpile Mix
Asphalt Patching Program

Tacking

Emulsions:
- SS-1
- SS-1h

Can be used on damp surface
Apply with brush or spray
Use with hot-mix asphalt only
Asphalt Patching Program

Tacking

Cutbacks:

- Winter Use Only
- Brush or Spray
Asphalt Patching Program

Edge Sealing

Emulsions
- SS-1, SS-1h

Cutback
- RC-250, RC-800

Asphalt Cement
- AC-20
Asphalt Patching Program

- 1. Set-up for Safety
- 2. Marking
- 3. Cutting
- 4. Cleaning
- 5. Tacking
- 6. Filling
- 7. Compacting
- 8. Edge Sealing
- 9. Cleanup
Asphalt Patching Program

Marking
- form of communication
- excess cutting costs materials & crew hours
- insufficient cutting means poor repair
- may need to modify original marking
Marking: May include several adjacent potholes or deteriorated areas
Asphalt Patching Program

Marking: Does not have to be square or rectangle
Asphalt Patching Program

Cutting

- remove all weak, deteriorated area
- cut....
  “vertical sides”
Asphalt Patching Program

Vertical Sides for Confinement:

Confinement

Shoving
Asphalt Patching Program

Vertical Sides for Compaction:
Asphalt Patching Program

Cutting Equipment

- Air compressor
- Hydraulic Breaker
- Gasoline Powered Breaker
- Milling Machines
- Saws
Cutting Equipment

Jack Hammer – Air Compressor

Hydraulic Breaker
Cutting Equipment

Gasoline-Powered Breaker

Milling Machines
Cutting Equipment

Concrete Saw

Carborundum Saw
Asphalt Patching Program

Cutting

- leave firm material around repair
- do not outline area to be cut with cutting tool, begin at center of hole

Do NOT Rock!

Edge of Hole
Begin at Center
Asphalt Patching Program

Modification of Marking

Original Mark

Poor Bond
Remove
Asphalt Patching Program

Cutting Bits
- Sharp bits improve production
- Sharp bits do less damage
- Exchange dull bits
Asphalt Patching Program

Cleaning
- remove loose material
- remove water
- pay attention to corners
- use air if available
- otherwise stiff broom
Remove Failed Pavement

Remove To Sound Material
Asphalt Patching Program

- Sometimes the problem may not be evident on the surface.
- Remove water
- Additional drainage may be required to solve this problem.
Asphalt Patching Program

- Replace with good material similar to the material in the original pavement
- Deteriorated aggregate base or subbase material plus subgrade soils may need to be replaced
Asphalt Patching Program

- Testing for quality control may be required
Asphalt Patching Program

Tacking
- tack for hot mix only
- let cure
  - emulsions - water evaporates
  - cutback - thinner evaporates
Tacking

YES! Spray

YES! Brush

NO! Pour

Thick

Puddle

Bead
Asphalt Patching Program

Filling

- Shovel or dump material directly in hole
- Tamp material into edges and corners with square-edge shovel
- Max. lift - 3 inches
Asphalt Patching Program

Filling: Use a lute (no garden rakes)

Segregation

Tamp

Maximum Lift 3”
Asphalt Patching Program

Equipment: Hotboxes, maintainers, reclaimers
Hot asphalt feed at shovel level for easy access
“The Reclaimer”
Heats cooled hot-mix for reuse
Asphalt Patching Program

- Large patches demand large equipment
Asphalt Patching Program

Compaction

- most important
- poor compaction will give depression under traffic
- poor compaction will cause raveling and shoving
Asphalt Patching Program

Compaction Equipment

- Vibratory plate
- Portable vibratory drum
- Self-propelled roller
- Gasoline powered
- Hand tamper
Vibratory Plate
Portable Vibratory Roller
Self-propelled
‘The larger the patch, the larger the compaction equipment needed for proper compaction & rideability’
Gasoline Powered

Hand Tamp
Asphalt Patching Program

- For deep patches, each layer (subgrade, subbase, base, paving) requires compaction!
Asphalt Patching Program

Compaction

ROLLER RIDES ON SPILL OUTSIDE HOLE
Asphalt Patching Program

Compaction

Step 1. Pinch against edges
Step 2. Roll patch
Asphalt Patching Program

Compaction

Bridging

Follow Pavement Ruts
Asphalt Patching Program

Final Compaction

1/4"

Good Compaction
Asphalt Patching Program

Edge Sealing

- keeps water out
- avoid excess seal material
- do not edge seal cold mix
- blot if necessary
Rutting

*Causes*

- Consolidation or lateral movement of the *subgrade, aggregate base, and/or asphalt layers* under traffic.
- Insufficient design thickness.
- Lack of compaction.
- Weakness caused by moisture.
- Movement of the mixture under heavy wheel loads.
Rutting: Weak Base /Subgrade

Rutting in the Subgrade or Subbase

original profile

weak subgrade or underlying layer

asphalt layer

subgrade deformation
Need to Reconstruct
(or fill rut & overlay or mill & overlay to increase pavement thickness)

original profile

asphalt layer

weak subgrade or underlying layer

subgrade deformation
Rutting: Weak Asphalt Pavement

original profile

Consolidation

weak asphalt layer

original profile

weak asphalt layer

Plastic Flow
Need for Scratch & Leveling or Milling

A scratch course is used to fill ruts before placing an overlay
Need for Scratch & Leveling or Milling

A Leveling Course provides a level uniform platform for new paving and insures uniform density throughout the mat.
Need for Scratch, Leveling or Milling

Material milled off prior to placing overlay
If you do not Scratch, Level or Mill…

Failure to scratch, level, or mill prior to placing the overlay results in areas of greater thickness and will lead to ……………..
Failure to Scratch, Level or Mill

... reoccurrence of rutting
Need for Milling & then overlay

Plastic flow material

Lift delineation
Asphalt Patching Programs

- Innovations
  - Self-Contained Pothole Patching Vehicles
  - Asphalt Spray Injection Patching
  - Asphalt Infrared Patching
Self-Contained Pothole Patching Units
Self-Contained Pothole Patching Unit
Cut out deteriorated material (vertical sides)
Remove all loose material
Blow out remaining fine material, dust
Apply tack – watch the overspray!
Fill with hot-mix asphalt from hot box
Compact patch
What’s your Goal?

Nice permanent patch!
Infrared Asphalt Heater
Asphalt Patching Program

- Infrared Asphalt Patching
  - Surface distress repair
  - Soften existing asphalt area with infrared heat, rake in new material as needed, and compact
  - Eliminates cutting out and hauling away deteriorated material
  - Eliminates tack coating
  - Result is a seamless repair
Infrared Asphalt Heaters

Hot-box

Joint Heaters
The infrared heating unit is lowered to within 6\" of the pavement.
The infrared heat penetrates the existing asphalt approximately 2".
Having heated the area to be repaired, the softened asphalt is raked and cleared of impurities.
Hot asphalt is added to and blended with the original asphalt.
The edges are rolled first to bond the new asphalt with the original asphalt. The entire area is then compacted.
The repair becomes a seamless part of the original asphalt.
Asphalt Spray Injection Patching

- Cleans, tacks, fills and compacts with a one-person operation
- Eliminate ‘cold patch’
- Year-round emergency adverse weather patching
- Improved productivity and safety
- Used for both asphalt and cement concrete pavements
Spray Patchers
*Trailer
*Truck Mounted
*Self-Contained
Blow out all loose material
Apply emulsion tack
Fill with aggregate /emulsion mix (No compaction needed)
Finish with a fine cover aggregate if needed
Finished spray patch
Patching ‘Oil & Chip’ Roads

- Build-up “Oil & Chip” Roads
  - more flexible type pavement
  - hot-mix may be too “rigid”
Alternate #1

Remove loose material from edges with appropriate hand tools & remove all debris from hole.

Asphaltic Surface

Base Layer

PIECRUST OR PANCAKE PAVEMENT
Alternate #1

Place cold mix material (in max. 6" lifts), compact

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Asphaltic Surface

Base Layer

PIECRUST OR PANCAKE PAVEMENT
Alternate #2

Place unbound aggregate to this level

Asphaltic Surface

Base Layer

PIECRUST OR PANCAKE PAVEMENT
Alternate #2

Place alternate layers of asphalt and aggregate flush with adjacent surfaces
- compact each layer

Asphalitic Surface

Base Layer

PIECRUST OR PANCAKE PAVEMENT
Utility Cuts / Trench Restoration

Proper Restoration is Necessary!!!

- Infrastructure Investment
- Safety
- Liability
- Public Relations
Utility Cuts / Trench Restoration

The GOAL is to restore your street or road to its Original Condition!
Backfilling

Material

- Fine Aggregate to Protect Facility
- Aggregate Backfill - Select Granular Material
- Flowable-Fill
Backfilling

- Flowable-Fill
  (Controlled Low-Strength Material – CLSM)
  (Low Density Backfill)
  A blend of cement, sand, water, plus fly ash, designed as a low strength, flowable material for backfill and other uses
  Delivered by cement concrete trucks
Backfilling

Flowable-Fill Advantages

- Self leveling, filling all voids
- No placing in lifts, no compaction needed
  - less equipment
- Designed to allow for re-excavation
- Load bearing capacity typically higher than compacted granular backfill
- Requires less field inspection
Backfilling

- Flowable-Fill Spec
  - Develop specification
  - Many State DOTs now have spec
Backfilling

Excavated Material for Reuse

- 3” Maximum Size
- Not Water Saturated
- Readily Compacted 6 to 8 inch layers – proper moisture content
- No Puddling
Backfilling

- Inspection to insure compacting in layers
- Density tests:
  - 95% density – define test method
  - Permittee responsible for testing
  - Large projects or deep trenches
Paving Restoration

- ‘In-kind’ Restoration
- Final Cut - Shelf Back 6 to 12 inches for Clean Edge
- Compacted Asphalt Layers of 3 inches maximum
- Tack Coat - Emulsions
- Edge Seal - Emulsions
Typical Final Restoration (Asphalt Base)

- Asphalt Wearing Course
- Asphalt Base
- Existing
- Asphalt Surface
- Asphalt Base
- 1’-0” Typ.
- Select Granular Material
- Insulating Material
Multiple Excavations

- 4+ in 100 Linear Feet of Road
- Overlay total area of all travel lanes affected
- May require milling prior to overlay
Steel Plates
Maintaining Traffic

- Temporary Plates:
  - Steel protection plates / prefab light weight plates
  - Sized to provide adequate bearing at plate edges
  - Securely anchored
  - Sufficient thickness to carry heavy traffic
  - Exposed plate edges feathered with asphalt

- Length of use could dictate milling bearing area & setting plate level with street surface
Pre-fab Plates

H20 Load Rated
Skid Resistant diamond plate surface
Orange color for visibility
Lightweight – carried by one or two people
Different sizes up to 4’x 8’
Pre-fab Plates

Pre-fab Plates converted to Trench Shoring
Temporary Restoration

- Necessary - wintertime
- Required - anytime
- Typical Standard

- 2” Min. Asphalt Material
- Select Granular Material
- Insulating Material
Other Requirements

- Test Holes (4 Inch Diameter or Less)
  - Backfill to Meet Existing Materials and Seal
- No equipment with metallic treads allowed on road surface or surfaced shoulder
- Minimum depth of cover (e.g. 3 feet from road surface)
Is your goal temporary patching?

‘Throw and go’

‘Throw and roll’
Summary

- Meet your goals and expectations
- Use appropriate materials
- Use proper procedures
- Work safely

?’s Discussion!
Thank You!

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