Concrete Pavement Management and Repair

Making The Most of Your Concrete Assets

In The Beginning....



And then there was mud!.....



So we built roads....



And then we gained knowledge....



And then we developed equations....



And built more roads.....



Until we encountered "THE ULTIMATE QUESTION!"

How do we maintain these pavements that have carried traffic many times in excess of their design lives?



Priorities Have Shifted

- Maintain the present system
- Minimize traffic disruptions
- Increase safety
- Address operator comfort
 - Reduce Roughness
 - Reduce Noise
- Save money

THE ANSWER

Can we use Pavement Preservation to extend the life of our concrete pavement?

 $\mathbf{\hat{o}}$ List



PCCP Preservation Techniques

- Full-depth repair
- Partial-depth repair
- Slab stabilization
- Retrofitting dowels
- Cross-stitching longitudinal cracks/joints
- Diamond grinding
- Joint & crack resealing

How do preventive *treatments differ from routine/reactive treatments?*



Same treatments ...different TIMING!

Rehabilitation Timing



Purpose of CPP

- Used early when pavement has little deterioration.
 - Repairs isolated areas of distress.
 - Repairs some construction defects.
 - Manages the rate of deterioration.



Expected Benefits

- Preservation of investment
 - Improved pavement performance
 - Long term cost savings/leveling
- Maintain a high level of service
 - Increased safety
 - Greater customer satisfaction

Preserving the Investment

- Keep water out!
- Reduce debris infiltration into joints or cracks
- Minimize dynamic loads

SMOOTH PAVEMENTS LAST LONGER!

Rough Pavement







Diamond Grinding



What is Diamond Grinding?

- Removal of thin surface layer of hardened PCC using closely spaced diamond saw blades;
- Results in smooth, level pavement surface;
- Longitudinal texture with desirable friction and low noise characteristics;
- Frequently performed in conjunction with other CPR techniques, such as full-depth repair, dowel bar retrofit, and joint resealing.
- Comprehensive part of any PCC Pavement Preservation program;



Diamond Grinding Cutting Head



Diamond Grinding Grinding Machine



Diamond Grinding Grinding Process



Diamond Grinding Finished Product



Diamond grinding can provide a 65% to 70% improvement over the pre-grind profile!



Diamond Grinding Demonstration of Construction Process



Advantages of Diamond Grindin

- Cost competitive;
- Enhances surface friction and safety;
- Can be accomplished during off-peak hours with short lane closures and without encroaching into adjacent lanes;
- Grinding of one lane does not require grinding of the adjacent lane;
- Does not affect overhead clearances underneath bridges;
- Blends patching and other surface irregularities into a consistent, identical surface;
- Provides a low noise surface texture!



SR 202 56st WB PCCP Grinding

Prepared by Larry Scofield Preliminary Draft 6/6/03



1



Noise Levels By Surface Type

104.9	Random Transverse (Wisconsin)
102.5	Uniform Transverse (ADOT-3/4'')
99.1	Longitudinal (ADOT-3/4")
95.5	Whisper Grind

Surface Characteristic Research

- CALTRANS Diamond Grinding Research
- WSDOT Safety Research
- National Concrete Pvmt Technology Center
- Purdue Tire Pavement Testing Apparatus
- ACPA Sound Intensity Testing
- California and Arizona PCCP SI Testing
- NITE Sound Intensity Testing (CALTRANS)

Effectiveness of Diamond Grinding -CALTRANS

- Diamond grinding was first used in California in 1965 on a 19-year old section of I-10 to eliminate significant faulting
- CALTRANS has determined that the average life of a diamond ground pavement surface is 17 years and that a pavement can be ground at least three times without affecting pavement structurally. See IGGA.net for full report



MODOT- Safer, Smoother, Sooner

- MODOT initiates Safer, Smoother, Sooner program in 2005 2007
- The initiative invests \$400 million on 2,200 miles
- Improve customer satisfaction through
 - Safer pavements
 - Smoother ride quality
 - Quiet ride quality
- Approx 8,000,000 sq yds let in 1st Qtr 2005
- See IGGA.Net for MODOT's BMP on diamond grinding new PCCP

LOAD TRANSFER RESTORATION

Dowel Bar Retrofit



Load Transfer Restoration

- Placement of load transfer devices across joints or cracks of existing pavements
- Candidate projects
 - Poor load transfer (< 70 %)</p>
 - Pumping
 - Faulting
 - Corner breaks


Purpose of Load Transfer Restoration

- Reestablish load-transfer across joints or cracks
 - Load-transfer is a slab's ability to transfer part of its load to its neighboring slab
- Used in JRC and JPC pavements to limit future faulting



Load Transfer = 100% (Good)

Performance of DBR Concrete Pavement Under HVS Loading by CALTRANS, UC Davis and UC

- Tested two retrofitted PCCPs under a Heavy Vehicle Simulator (HVS) aka accelerated loading frame
- HVS results demonstrated large improvement in LTE and decrease in vertical deflections
- DBR sections not damaged by HVS loading, unlike control section
- DBR less sensitive to temp changes than control section
- Total of 11,000,000 ESALS applied to DBR sections without failure occurring

Berkelev

Ten-Year Performance of DBRApplication ...by WASHDOT

- First production DBR project completed in Washington in 1992
- WASHDOT has retrofitted 225 miles since 1992
- Subject DBR sections still maintain average LTE of 70% to 90%
- Determined that carbide roto-milling is NOT a viable alternative for diamond grinding
- Based on 10 yr results, DBR is considered a successful alternative for rehabilitation of aging PCCPs in WS

Undersealing/Slab Jacking





Pressure insertion of flowable material beneath the PCC slab



Slab Jacking

Used for Sub Grade Repair of Soil collapse Poor Compaction

Faulted - Longitudinal





Deep consolidation or Poor compaction
Flooding or Erosion
Overloading
Loss of Fines Pumping





Performance

- Short- and long-term reductions in pavement deflections
- Most effective on pavements with little structural damage
- Cost effective alternative to remove and replace when slabs are in good condition

Full-Depth Patching Operations



Full-Depth Repair

- Purpose
 - Restore structure
 - Restore ride
- Used for:
 - Joint deterioration
 - Transverse cracking
 - Longitudinal cracking
 - Broken slabs & corner breaks

Pre-cast Pavement Panels



Insitu Full Depth Repair



Sizing a Patch

- Go beyond deterioration
- Remember to check for below-surface spalling
- Minimum length 6 feet
- Adjust as necessary
- Combine closely spaced patches

Combine Patches!!





Load Transfer

Jointed Pavements:

- 1.5 inch dowels
- At least 7 inches of embedment on either side
- Minimum of 4 dowels in each wheelpath
- Corrosion resistance necessary if deicing chemicals will be used

Performance of Full-Depth Repairs

- Can provide 20 or more years of service when properly designed and constructed
- High-early strength materials allow early opening to traffic and limited lane closures

Partial-Depth (Joint Spall) Patching Operations



Partial Depth Repairs

- Repairs deterioration in the top 1/3 of the slab.
- Generally located at joints, but can be placed anywhere surface defects occur.















Trunk Highway 53 Ramp Duluth, MN - 1994



2008-03-05

Joint/Crack Resealing

- Application of a sealant material in concrete pavement joints and cracks
- Purpose
 - Minimize moisture infiltration
 - Prevent intrusion of incompressibles
- Sealant Materials
 - Rubberized asphalt
 - Silicone

Performance of Joint Resealing

- Original sealant typically requires resealing after 5 to 12 years
- Resealing required every 5 to 8 years thereafter
- Regular resealing may extend pavement life
 5 to 6 years
- Most beneficial on pavements that are not badly deteriorated



Good Candidate Pavements for Preventive Maintenance

- Minimal distress (extent and severity)
- Relatively young in age
- *Minor* functional problems
- Few historical problems with similar projects

Colorado Project # IM 0701-169 Rifle to Silt, Garfield County

Existing PCCP History

• I-70, Rifle to Silt, MP 86.5 to MP 97

 Only section of PCCP along I-70 from West of Denver to Utah border.

Portland Cement Concrete Pavement

- Consisted of only one project which included base and PCCP placement
- Construction from November 1975 to November 1976.
- PCCP was selected over ACP as there were oil shortages and the cost of asphalt skyrocketed.

PCCP Condition Prior to Restoration

- Cracked / broken concrete slabs
- Exposed aggregate surface
- Wheel Rutting (wear)
 - 25% of the existing pavement had average rutting of 5/16" to 3/8"

Settlement in drive lane at the edge of traveled way

- Settlement of up to one inch below the adjacent shoulder slab
- Surface runoff pooling at the edge of the traveled way
- Minor faulting

Faulted Panel


Existing Pavement Condition



Existing Pavement

Wheel Path Rutting



2008-03-05

Concrete Pavement Restoration Project Scope

- Remove and replace broken and cracked concrete slabs
- Re-establish a uniform textured surface
- Remove rutting/reduce significant rutting drainage improvement
- Feather the outside shoulder drainage improvement
 - Removing lip at edge of traveled way, allowing positive runoff flow
- Reduce noise

Salient Items of Work

- Grinding & Texturing Concrete Pavement
- Concrete Pavement (Full Depth Patching)
- Rumble Strip
- Epoxy Pavement Marking

330,000 SY 1,200 SY 22,500 LF 985 GAL

Contract Amount \$1,797,384





Full Depth Patching





2008-03-05





Ride Specification

75 % Improvement (I)

Improved Smoothness

IM 0701-169 Rifle to Silt, Garfield County <u>East Bound</u>



IM 0701-169 Rifle to Silt, Garfield County <u>West Bound</u>

Improved Smoothness





- Many available treatments for PCC pavements
- Each has advantages and limitations
- Performance and cost vary with given conditions
- Applying the right treatment to the right pavement *at the right time*
- No universal method available
- Take advantage of local contractor experience
- IGGA ready to assist

Visit Us on the Web

International Grooving and Grinding Association

• <u>igga.net</u>

American Concrete Pavement Association

• pavement.com



