THE SOUTH AFRICAN POTHOLE PROBLEM

TEST AND MEASUREMENT 2012 CONFERENCE

NATIONAL LABORATORY ASSOCIATION

DURBAN
5 September 2012

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CSIR Built Environment
2010 – THE YEAR OF THE POTHOLE !
INTRODUCTION

• During the 2009 /2010 rainy season there was an unprecedented development of potholes
• Continued in the 2010/2011 wet season
• Significant media coverage and claims against authorities
• Nothing new – problem for a long time but not to the same extent
• Not unique to South Africa
• UK estimate more than £10 b of pothole costs and repairs
• Australia – need to increase maintenance expenditure by R9b /y for next 15 years
• Northern hemisphere has a slightly different problem – spring thaw
INTRODUCTION

- Water is the primary cause
- Needs access into pavement
- Dry or cracked surfacing
- Reduced and/or delayed maintenance will cause a marked increase in potholes in next few years
- Bituminous seals are more prone to potholing than concrete roads with reduced maintenance
- Lack of preventative maintenance is biggest problem
INTRODUCTION

- Although there are ongoing repairs of potholes, they are often ineffective
- Only the surficial aspects are addressed in most cases and not the root causes
- This leads to the necessity to redo patching repeatedly
- This is not cost-effective
- Also not very attractive to the public
- Need to ensure that repairs are effective and economic
- Guidelines were developed
WHY A POTHOLE GUIDELINE?

• Started in Parliament (April 2010)
• CEO had to explain that CSIR doesn’t fix potholes – we do research
• Try to solve or reduce the problem

What is covered?
WHAT ARE POTHOLES?
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WHAT ARE POTHOLES?
• Value of SA roads – R1 trillion
• Paved roads – R800 billion
• Significant asset that needs preservation
• Potholes estimated to cost road users R50 billion/year
• Can also cause other damage!
POTHOLES CAN CAUSE DAMAGE IF NOT AVOIDED
What is the cost of bad roads to the economy?

- 6th Annual State of Logistics Survey for South Africa 2009
- Deteriorating roads have a significant cost to the economy
- Through increased maintenance and operating costs and thus increased logistics costs (already 14.7% of GDP) to companies
- The percentage of bad and very bad roads in the secondary road network (delivery roads) in SA increased from 8% in 1998 to 20% in 2008
Cost of bad roads to the economy

- Vehicle maintenance and repair costs can increase by up to 121% for a truck on a road with a bad condition rating
- Company logistics can increase by 10%
- Therefore we can’t afford the continued deterioration of our road network

Why are they deteriorating?

- Primarily because of a lack of preventative maintenance
- Exacerbated by:
  - Higher numbers of heavy trucks
  - Possibly wetter conditions - global climate change
Prevention of potholes

- Keep seal “alive” – do not allow to age excessively
- Seal cracks regularly
- Patch properly – trained and dedicated teams
Summary

- Carry out preventative and proactive (not reactive) maintenance
- Implement a well-controlled maintenance programme
- Attend to roads with old seals (dry bitumen)
- Repair potholes as soon as possible
- Use well-trained teams
Aimed at engineers, maintenance supervisors, etc.

Content
- Introduction
- Causes of potholes
- Classification and management
- Repair/correction of potholes
- Quality control
- Conclusions

Highlights
- Considerably more detail than non-technical
Causes of potholes

- Different between asphalt and thin seals
- Will affect repair procedure
Classification

- Need to identify cause and extent of the problem
- Simple classification system developed
### Table 1: Key to decision process for repair of potholes

<table>
<thead>
<tr>
<th>Key</th>
<th>Defect</th>
<th>Repair action</th>
<th>Go to</th>
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<tbody>
<tr>
<td>1</td>
<td>Surfacing is asphalt</td>
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<td>Surfacing is thin bituminous seal</td>
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<td>2</td>
<td>Pothole is deeper than asphalt wearing course</td>
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<td>Bottom of pothole is within asphalt wearing course</td>
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<td>Pothole caused by cracking due to fatigue of asphalt</td>
<td>Shallow asphalt (HMA or cold mix)</td>
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<td>Pothole caused by localised surface water ingress with no associated</td>
<td>Deep repair after sub-soil drainage installation</td>
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<td>crocodile cracking</td>
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<td>Pothole has exposed an unstabilized base</td>
<td>Medium depth asphalt repair</td>
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<td>Pothole has exposed a stabilized base</td>
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<td>5</td>
<td>Pothole is not associated with cracks</td>
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<td>Pothole is associated with cracks</td>
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<td>8</td>
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<td>6</td>
<td>Pothole affects seal and top of base only (&lt; 50 mm)</td>
<td>Shallow surface repair</td>
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<td>Pothole extends &gt; 50 mm into base</td>
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<td>Pothole affects only the base</td>
<td>Medium depth repair</td>
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<td>Pothole extends below the base</td>
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<td>Pothole does not affect entire pavement structure (only base and subbase)</td>
<td>Medium depth or deep repair</td>
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<td>Pothole is the result of saturated subgrade or support</td>
<td>Deep repair after sub-soil drainage installation</td>
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<td>Pothole is the result of poor material – no evidence of excessive subsoil water</td>
<td>Deep repair</td>
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<td>10</td>
<td>Top of base has carbonated and is weak</td>
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<td>Top of base has not carbonated excessively and is still strong</td>
<td>Shallow surface repair</td>
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<td>11</td>
<td>Pothole is associated with crocodile cracking</td>
<td>Deep repair</td>
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<td></td>
<td>Pothole is not associated with crocodile cracking</td>
<td>Medium depth repair</td>
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[CSIR Logo]

[www.csir.co.za]
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<td>6</td>
<td>Pothole affects seal and top of base only (&lt; 50 mm)</td>
<td><img src="image1.png" alt="Image" /></td>
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<td><strong>Shallow-surface repair</strong></td>
<td><img src="image3.png" alt="Image" /></td>
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<td>Pothole affects only the base</td>
<td><img src="image5.png" alt="Image" /></td>
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<td><strong>Medium-depth repair</strong></td>
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<td>Pothole does not affect entire pavement structure (only base and sub-base)</td>
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<td>10</td>
<td>Top of base has carbonated and is weak</td>
<td><img src="image17.png" alt="Image" /></td>
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<td><strong>Shallow-surface repair</strong></td>
<td><img src="image19.png" alt="Image" /></td>
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<td>Pothole is associated with crocodile cracking</td>
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<td><strong>Deep repair</strong></td>
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# Pothole Identification and Classification

Inspector .................................. Weather .................................. Date ..................................

<table>
<thead>
<tr>
<th>Road No.</th>
<th>Location</th>
<th>Surfacing type</th>
<th>Layers affected</th>
<th>Crocodile cracking</th>
<th>Surface deformation</th>
<th>Subgrade saturated</th>
<th>Stabilized base</th>
<th>Carbonation of base</th>
<th>Action</th>
<th>Comments</th>
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**Codes:**
- Surfacing type: A – asphalt, TS – Thin seal
- Layers affected: S – Surfacing only, B – Surfacing and base, SB – Surfacing, base and subbase
- Surface deformation (mounding, rutting, shearing, etc) stabilized base, Crocodile cracking: Subgrade saturated, carbonation of base: Yes/No

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Potholes need to be filled and repaired to maintain a good riding quality
One method!
• Essential to solve the underlying problem before repair
• We need to identify and classify the pothole causes first
• Only then can we produce a long-lasting repair
Methods

- Shallow asphalt repair
- Medium-depth asphalt
- Deep repair (asphalt) with subsoil drainage
- Shallow surface repair (thin seals)
- Medium-depth repair (thin bituminous seals)
- Deep repair (thin bituminous seals)
- Deep repair (thin bituminous seals) with subsoil drainage
REPAIR OF POTHOLES

- Classify type of repair
- Mark out area with chalk, paint or crayons
- Must include failed and some sound area, i.e., pothole and associated cracking, spalling, etc
- Mark with straight lines – neater than irregular and poor round patches
- Preferably cut with a diamond saw (some teams are almost as good with picks!)
- Remove failed material to the required depth – pick, spade and jackhammer if necessary
REPAIR OF POTHOLES

• Depth of excavation will be a function of the type of repair
• Hole must be meticulously cleaned before repair
• All loose and unbonded material must be removed
• Also material that has been affected by the pothole (de-densified, sheared or wet)
• Try and avoid the edges of the excavated hole being in the wheel-paths – rather make it a little wider
REPAIR OF POTHOLEs

• Most patches will be rectangular with sides parallel to the edge of the road
• Recommended for patches larger than 1m in dimension
• For smaller patches diamond-shaped patches are more effective
• Reduce effect of tyre impact and potential to crack
• Join between patch and existing road is most vulnerable area
• Geosynthetic sealing strip recommended
• Or else normal crack sealing compound (modified bitumen)
MATERIALS FOR FILLING POTHOLES

Usually use hot-mix asphalt (HMA) or cold-mix asphalt (CMA)

- HMA is more effective for larger potholes and localised “reconstruction” – needs to be close to asphalt source
  - Large enough quantity to be cost-effective
  - Close enough to retain working temperature
- Best to replace the bulk of the pothole with natural or treated materials to reduce costs
- Use HMA only for upper portion
MATERIALS FOR FILLING POTHOLES

Hot-mix asphalt (HMA)

- Must comply with current specifications
- COLTO Section 4203
- Minimum working temperature must be adhered to (varies with mix but usually > 135°C)
- Continuously graded will have low permeability
- Good tack coat covering entire patched area
- Should not be thicker than about 75 mm or thinner than 20 mm
MATERIALS FOR FILLING POTHOLES

Cold-mix asphalt (CMA)

- The most commonly used patching material
- Usually comes in bags (25 to 40 kg) from commercial sources
- Cannot be supplied in bulk (uses bitumen emulsion or cut-back bitumen that will lose volatiles)
- Specified shelf-life – difficult to work if old (or cold)
- Permeability critical – must be as low as possible and decreases with compaction
MATERIALS FOR FILLING POTHOLES

Cold-mix asphalt (CMA)

- Numerous suppliers
  - Wide variety of properties
  - No general recommendations on which to use are made in the Guideline
  - Agrément certification recommended
  - Specifies some basic requirements
  - Properties could change with time
  - 3 applications in progress and about 10 in the pipeline
  - Contractor must use a product that:
    - He/she is comfortable with
    - Will give a good strong, durable patch
    - Is approved by the Client
    - Not necessarily the cheapest!
Medium depth asphalt

- Potholes deeper than asphalt thickness and base
- If larger than 0.5 m², may be more economical to replace some of the asphalt with crushed stone, gravel or treated material

Method

- Similar to shallow patch described previously if using only asphalt
- If using gravel, etc:
  - Place in prepared hole to required depth after moistening edges and base with water
  - Remember bulking factor (± 30%)
  - Compact to required density at about OMC (sausage test) in layers < 100 mm
- Apply emulsion to top of layer and sides
- Compact CMA or HMA into hole
QUALITY CONTROL

- Current problem is quality of repairs
- Frequently needs to be redone
- Use of system described should avoid this
- Still needs to be done properly
- Prepared a “kit” of required tools to assist
QUALITY CONTROL

- Field test kit
ROLE OF NLA

- Identification and classification of potholes
- Testing, development and proving of patching materials
- Quality assurance of patching materials
- Quality assurance of actual repair
  - Densities, sealing of "joins, overall finish, etc"
Summary

• Hope that this document assists with reduction of the problem
• Freely available – no excuse (www.csir.co.za/pothole_guides)
Thank you

(NB: No giraffes were injured or hurt in the preparation of this presentation)