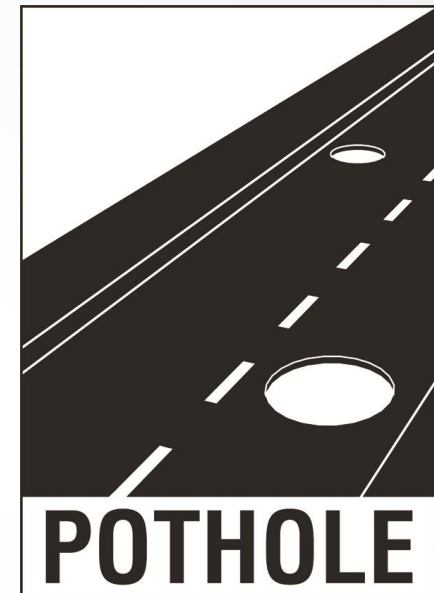


# Durable Pothole Repairs - POTHOLE

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## Co-ordinator

- Karlsruhe Institute of Technology (KIT-ISE), Institute of Highway and Railroad Engineering, Germany

## Members

- Danish Road Institute (DRI), Denmark
- Forum Des Laboratoires Nationaux Europeens De Recherche Routiere (FEHRL), Belgium
- Transport Research Laboratory (TRL), UK
- University of Zilina (UNIZA), Slovakia
- University of Twente (UT), Netherlands
- Slovenian National Building and Civil Engineering Institute (ZAG), Slovenia



Picture: CSIR

- All European countries have potholes
- Potholes cause increasing numbers of crashes, injuries and deaths
- How to repair them?
  - Many approaches only durable on short-term basis
  - Therefore not cost-effective



- Main objective to address the need of road agencies
  - Durable construction and maintenance methods
  - Repair damage occurs after hard winters
  - Repeated frost-thaw cycles
- Evaluation methods using existing European Standards
- Comparison with trial sites





- WP1 – Definition of the term “pothole” ✓
  - WP2 – Selection of tests and evaluation methods for use in the laboratory and in situ ✓
  - WP3 – Study of existing standards, techniques, materials & experience with them on the European Market ✓
  - WP4 – Evaluation of techniques and materials from existing trial sites ✓
- In Progress**
- WP5 – Laboratory testing of selected materials
  - WP6 – Life Cycle Cost and Benefit Analysis (LCCBA)
- WP7 – Development of guidelines including catalogues of materials – Final Report



## Pothole

A deterioration of the pavement surface in which the materials breaks down in a relatively short time and is lost causing a steep depression.

### Notes (1):

- Generally, potholes require rapid remedial action to maintain the safety of road users.
- Potholes will also need to be reinstated to maintain the functional requirements and comfort, but the requirement will be as immediate.
- Potholes will typically have a depth of at least 30 mm and an area equivalent to a diameter between 100 mm and 1 m with the values for a specific situation depending on several factors including the traffic speed and intensity, the type of vehicle (particularly the presence of bicycles and pedestrians) and the climate.

## Pothole

A deterioration of the pavement surface in which the materials breaks down in a relatively short time and is lost causing a steep depression.

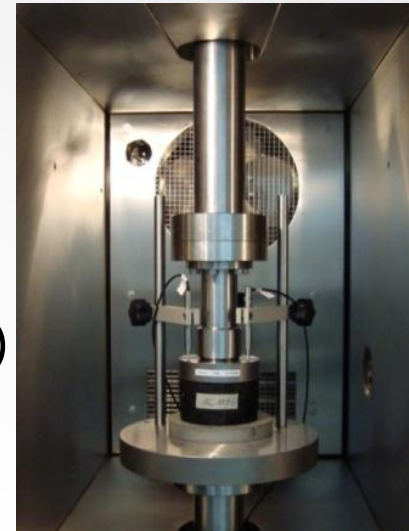


### Notes (2):

- Potholes can grow once they have emerged, but generally stop growing after a certain time. However, other potholes can after appear close to an existing one has appeared.
- Potholes can occur due to several mechanisms (such as fracture, attrition and seasonal), not all of which are fully understood.

## Principal requirements of the materials in order to ensure durability and the test methods to assess them

1. Standard properties for surfacing materials
2. ~~Compaction resistance (by conditions)~~ ~~Compaction resistance (by conditions)~~
3. ~~EN 12697-10 (stabilised) needed prior to traffic~~ ~~EN 12697-10 (stabilised) needed prior to traffic~~
4. ~~Dependence on material type or test to develop~~ ~~Dependence on material type or test to develop~~
5. ~~all steel ball depression test or indirect tensile test (ITT)~~ ~~all steel ball depression test or indirect tensile test (ITT)~~
6. ~~Adhesion (controlling the use of tack/bond coat)~~ ~~Adhesion (controlling the use of tack/bond coat)~~
6. ~~Humidity and/or freeze/thaw cycles (an adaptation of an existing non-asphalt test)~~ ~~Humidity and/or freeze/thaw cycles (an adaptation of an existing non-asphalt test)~~
- ⇒ ~~Brookfield evaluation/ data sheet~~ ~~Brookfield evaluation/ data sheet~~
- ⇒ Tests referred to in EN 13108 to the levels appropriate to the original specification





Study of existing standards, techniques, materials & experience with them on the European Market

- Two main elements of quality pothole repair:
  - Selection of material
  - Pothole repair techniques



## Study of existing standards, techniques, materials & experience with them on the European Market

- Different types of materials
  - Bitumen-based cold-mix materials
  - Bituminous hot mixed materials
  - Cement-based materials
- Different repair techniques:
  - Temporary repairs
  - Semi-permanent procedures
  - Permanent/ more durable repair





## Conclusions

- Materials and methods are similar in the different countries

- Materials (1):

A few test methods were found, but no requirements for properties.

Aggregate size of the repair material depends on the depth of the pothole.

Dense-graded asphalt materials is supposed to perform well at warm and hot temperatures.

Open-graded asphalt mixtures are normally more workable at freezing temperatures.

## Conclusions

- Materials (2):

Cold-mix materials as a temporary solution but can also be more durable with proper installation.

Limitations of cold-mix materials: It can't be compacted to the same level as hot-mix asphalts.

Hot-mix asphalt as a more durable solution.

Cement-based materials as fast-hardening solutions for rapid repair. But different deflections of surrounding asphalt leads to cracking at the joints and ingress of water. Therefore not recommended.

## Conclusions

- Pothole Repair techniques:

Cold-mix asphalts as an emergency method and often only possibilities due to low temperatures. But here are also different methods which lead to different durabilities.

Semi-permanent procedures: Use of hot or cold material with preparation of pothole.

Permanent/ more durable repair: Use of hot materials with preparation of pothole, including use of proper cleaning, preparation of edges and use of bond coat.



## Evaluation of techniques and materials from existing trial sites

- 3 trial sites
  - Denmark: in Tulso (2008/09)
  - Slovenia: in Ljuljana/Slovenia (1999, repaved 2011)  
New Trial Sites in Novo mesto & Nova Gorica (2012)
  - UK: Trial Site in UK, restrictions due to confidentiality agreements.  
but: existing approval scheme in the UK for materials that evaluates/ certifies materials



Trial site in Tulso





Spring 2011



Autumn 2011

Trial site in Ljuljana/Slovenia





Trial site in Novoe mesto and Nova Gorica

## Conclusions

- Different evaluations methods were used at the trial sites, a common evaluation system should be developed.
- This needs to involve different climate zones and different traffic classes according to the different conditions in Europe.
- Generic types of materials couldn't be divided in durability categories based on this evaluation because of great variations in the estimated durability.
- Suggestion of categorizing pothole repair materials in different durability categories.



	Hot-mixed asphalt	Cold-mixed asphalt	Cement-based materials	Synthetic binder
<b>Estimated durability</b>	Cat. I, Cat. II, Cat. III	Cat. I, Cat. II	Cat. I, Cat. II	Cat. I, Cat. II, Cat. III
Category I: Durability less than 1 year (short-term durability) Category II: Durability between 1-3 years (medium-term durability) Category III: Durability more than 3 years (long-term durability)				
<b>Ready for traffic</b>	Shortly after application	Shortly after application	Shortly after application	Shortly after application
<b>Possibility of recycling</b>	Yes	Yes	No	No
<b>Typical type of damage for the generic pothole repaired materials</b>	Cracks in repair, adhesion failure, immersed chippings	Loss of material, fretting	Cracks in repair, adhesion failure	Cracks in repair, adhesion failure, cracks in the pavement, loss of chippings, loss of material

## Typical damages



Cracks (hot asphalt)



Loss of material (cold asphalt)



## Typical damages



Failure of adhesion



Cracks

(Cement-based materials)



## WP 5: Laboratory testing of selected materials

- Currently in Progress
- Testing of materials
  - Basic testings: Aggregate gradation, binder content, air void content
  - Further testing of selected materials: compactability (workability), indirect tensile test (stiffness strength), water sensitivity, sensitivity to conditions (freeze/thaw)

## WP 6: LCCBA is in preparation

Thank you for your attention!

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