Guidance for the selection of pothole repair options

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ABSTRACT

Potholes are a major problem in many parts of the world. The approach to the repair of these defects is varied because they occur on different types of road and their causes can be very different. As a result, many different techniques and products are offered for the repair of potholes, all of which have advantages and disadvantages. The relative effectiveness of the different techniques and products can vary from site to site. This paper describes a Scottish study that aims to provide a consistent approach to selecting a pothole repair material or technique from treatments currently available. The new guidance is based on consultation with a range of practitioners from Scottish road authorities involved in repairing potholes. The resulting discussions and information gathering led to the development of ideas for the selection process outlined in the guide. A simple procedure utilising flowcharts has been developed to assist users to identify an appropriate pothole material or technique to treat potholes located in different situations. Whilst it is impossible to identify the unique "best" option for each situation, it is intended that the guidance will lead to the most appropriate option being selected.

Keywords: Asphalt, Durability, Maintenance, Patching, Repair method

1. INTRODUCTION

A pothole has been defined as a deterioration of the pavement surface in which the material breaks down in a relatively short time and is lost causing a steep depression [1]. The occurrence of potholes attracts a significant amount of media attention and raises public concern about the condition of roads. In Scotland, road authorities spend a significant amount of their road maintenance budgets on the repair of potholes. The approach to the repair of these defects is wide-ranging because they occur on different types of road and their causes can be very different. Consequently, many different techniques and products are offered for the repair of potholes. This paper describes a study to develop a consistent approach to selecting a pothole repair material or technique to treat defects located in different situations. The study was based on consultations with a range of practitioners from Scottish road authorities involved in repairing potholes. A procedure utilizing flowcharts has been developed to select the most appropriate option and it is intended that savings in the cost of pothole repairs will follow.

2. CONSULTATION AND INFORMATION GATHERING

Over the duration of the study, three quarters of Scotland's local road authorities took some part in the study through responding to an electronic questionnaire, attending meetings or participating in a facilitated workshop. A summary of the consultation process and the information collected is described below.

2.1 Desk study

A literature review was carried out to identify research into the development and repair of potholes. It highlighted that potholes are a major problem in many parts of the world. They are generally regarded by both road authorities and the public as one of the least desired pavement distresses as they can potentially damage vehicles and put road users safety at risk. Depending on the severity of the defect, pothole maintenance response times are usually quite short. Highway authorities are forced to make emergency repairs to restore safety. Emergency pothole repairs do not last long if the methods and materials used are unsuitable for the existing lay down conditions.

The primary factors which combine to cause potholes are surface cracking, water infiltration and loading from traffic. Potholes can result from other causes such as diesel spillage and mechanical damage, but the majority of defects are caused by water being allowed to access a poorly maintained road. It was also noted that an increasing number of heavy vehicles are using roads that were not designed to carry high vehicle loads resulting in increased levels of pavement deterioration.

There is a perception by some that pothole repairs can be undertaken by unskilled labour. It is essential that inspectors are trained to identify and assess potholes and operatives are suitably trained to make best use of new materials and technologies.

2.2 Consultation

A questionnaire was emailed to individuals associated with managing road repairs across the 32 Local Authorities in Scotland. Responses highlighted that a broad and diverse range of materials and techniques were being used. The authorities' expectations of the service life of the products and techniques revealed some disparities. Contact details were used to set up meetings to collect additional information. Meetings were held with individuals involved with the management and supervision of pothole repairs. Individuals' experience of using materials and techniques and the rationale for their specific use were discussed. Arrangements were made to see some of the materials and techniques being used in the field (Figure 1). This provided the opportunity to discuss the materials and techniques in more detail with both managers and operators. Techniques and materials viewed in operation included hot mix asphalt, thermal patching, spray patching and a range of cold applied materials, including water setting.

Figure 1: Examples of repair techniques: mini planer, thermal patching and jet patching.

2.3 Workshop

Scottish local road authorities were invited to a facilitated workshop in February 2015. Delegate's views on a range of topics were collected through the use of facilitated workgroups. The delegates were asked a range of questions and some of the key findings included the following:

- pothole repairs are an all year activity;
- causes include poor joint construction, reinstatements and the inappropriate use of pothole repair materials;
- some road authorities prefer to use one or two options in all situations;
- strategies range from preventative to reactive depending on available budgets;
- increased funding is needed in some areas owing to a legacy of poor pavement construction; and
- selection of pothole repair materials and techniques is not seen as an engineering discipline.

Delegates were in general agreement that guidance on the various factors that need to be considered when selecting pothole repair options would be useful.

3. GUIDANCE ON THE SELECTION OF POTHOLE REPAIR OPTIONS

3.1 Approach

The discussions and information gathering described above, led to the development of ideas for a selection procedure and guide [2]. It was highlighted that many different techniques and products are offered for the repair of potholes, and they all have advantages and disadvantages dependent on the location of the defect. The approach adopted was to set out the principal options for repairing potholes and provide guidance on their use through a series of flowcharts. The flowcharts ask various questions and default values based on best practice are provided. However, it is acknowledged that some or all of these values or criteria may be changed by the user to suit the local situation or policy.

3.2 Repair options

The principal repair options identified as part of the study were as follows:

- chippings and emulsion;
- hot mix asphalt;
- thermal patching /joint repair;
- spray patching;
- cold applied asphalt (subdivided into regular, premium and water setting);
- resin-based mixtures; and
- concrete and hydraulically bound mixtures.

The typical technique used to repair a pothole with each of the options is described in the guide. Tables are also provided to highlight a range of factors that should be considered when selecting an option. An example for thermal patching is shown in Table 1.

Table 1: Guidance on factors to be considered with thermal patching

<table>
<tr><td colspan="2">Benefits
Existing material is reused and matches material present.
Generally classified as a permanent repair.
Seamless repair.</td><td>Limitations
Specialised equipment needed and durability dependent on rejuvenator and its even distribution.
Not suitable for dry bound roads, i.e. requires a minimum asphalt thickness of 25mm.</td><td>Supply
Bagged additional mixture.</td></tr>
<tr><td>Material shelf life
No issues.</td><td colspan="2">Resources required
Van incorporating heater unit and boiler, hand roller, shovel, rake, bitumen rejuvenator, bagged 6 mm material and two operative plus traffic management.</td><td>Sustainability
Essentially, in-situ recycling.
Minimal additional replacement material required.</td></tr>
<tr><td colspan="4">Proprietary examples Nuphalt (Nu-Phalt) and Minuteman (Kasi Infrared Europe)</td></tr>
</table>

3.3 Relative costs

The different techniques described above cost different amounts to carry out effectively. However, the cost of repairing potholes is not just the cost of the repair technique but is dependent on a number of factors, including the following:

a) Repair technique chosen.
b) Accessibility of the site.
c) Traffic management required (which can vary with the repair technique and the type of road).
d) Number of pothole repairs to be undertaken in the locality at that time.
e) Distance from the works depot (particularly for techniques requiring hot mixed material).
f) Time (day/night, weekday/weekend, winter/summer, etc.).

The aim of this study was to assist the user to select the most appropriate system for a specific situation.

3.4 Flowcharts

Flowcharts are intended to manage the process of selecting the most appropriate repair option. The guide includes six flowcharts. The starting point for all selections asks whether the defect is a pothole or substantial road repair. Following confirmation that the defect is a pothole, the first flowchart (Figure 2) directs the user to one of five different flowcharts for the pothole repair depending on the traffic and location (Strategic Urban, Strategic Rural, Non-strategic Urban and Non-strategic Rural) and/or to a flowchart for temporary pothole repairs. The concept is to decide on the type of pothole repair required, assess whether it can be completed in adequate time and, if not, then to identify an appropriate temporary repair option with a planned permanent solution to follow.

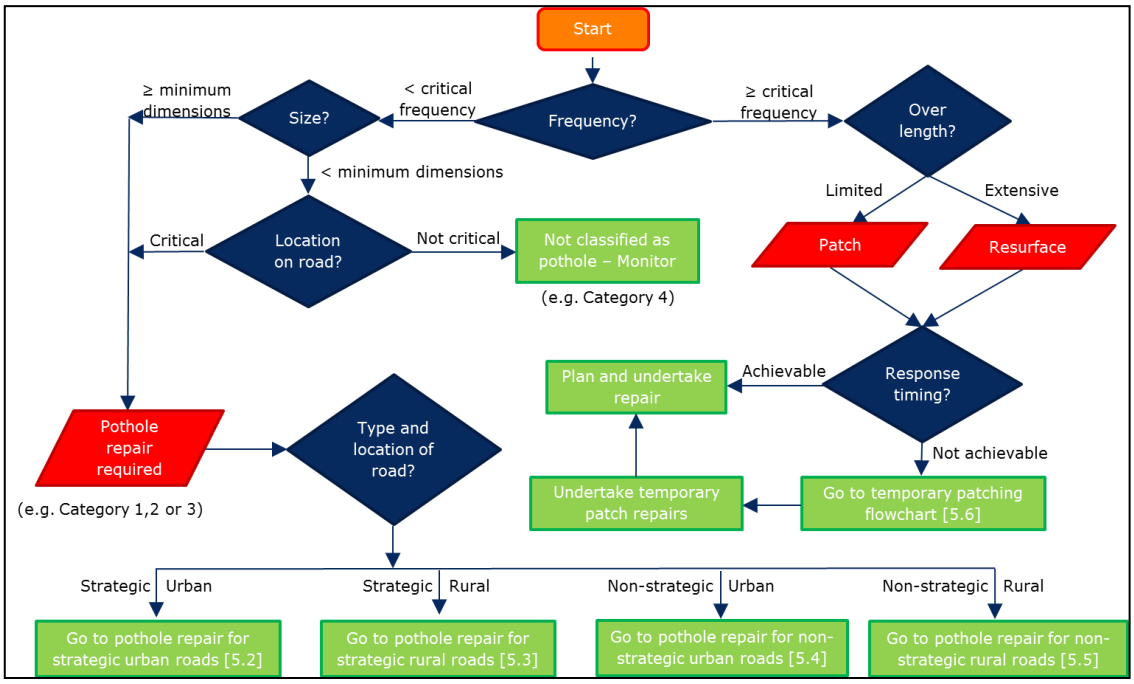

Figure 2: Pothole or substantial road repair?

The guide provides information that should be considered when a decision is required, i.e. represented in the flowchart as a dark blue diamond. The idea behind each question is described and where relevant a default value or criterion is given. It is appreciated that some authorities may wish to change these default values or criteria to suit their local situation. Questions used in the flowcharts are deliberately more qualitative than quantitative in order to allow for local situations, particularly any existing contractual arrangements.

As an example, the question "Frequency?" in Figure 2 relates to the frequency of the defect. Guidance on this question starts with the description of a pothole and whether the defect being assessed is localized or a defect within an area of failed surfacing. It is recommended that if the frequency of defects is less than a critical frequency, it will be treated as a localized pothole. If the frequency of defects is greater than a critical frequency it is treated as a symptom of a failing surfacing (see Figure 3). It is proposed to set the default critical value as three defects per 40m² (for a 3.65m wide road, this measure represents a length of 11m), but it is appreciated that this number and/or the area to be considered can be changed to suit local conditions and/or maintenance policies.

Figure 3: Pothole or substantial road repair?

Figure 4 shows the flowchart for selecting pothole repairs on strategic urban roads. The decision process includes factors related to response times and the severity of the defect. It is recognised that the response times required for this type of road will often affect the ability to select a permanent repair option first time. The 'Life of surfacing?' question explores whether the material has a limited expected life. Reasons can include new traffic calming schemes or developments as well as the surfacing nearing the end of its serviceable life. Guidance on the expected service lives of different repair techniques is given based on local authority responses collected during the study.

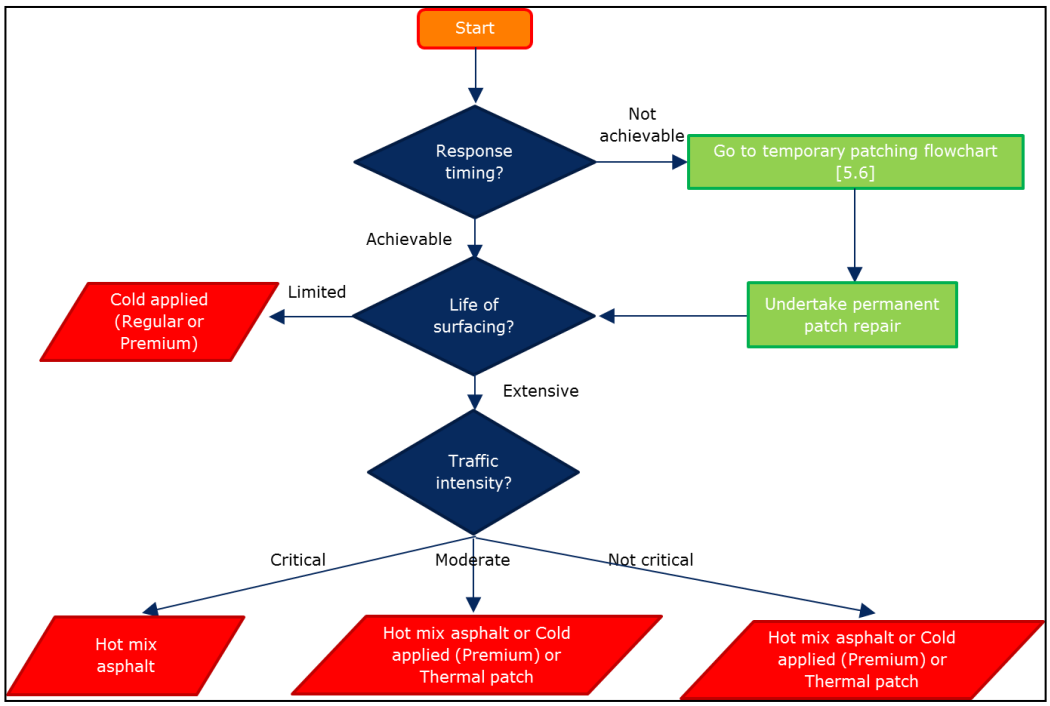

Figure 4: Pothole repair for Strategic Urban roads

4. SUMMARY

This study was based on consultations with a range of practitioners from Scottish road authorities involved in repairing potholes. In general, the repair of pot holes is not considered as an engineering discipline and often leads to poor end results. As a consequence, the need for a consistent approach to selecting a pothole repair material or technique to treat defects located in different situations was identified. A guide has been produced that sets out the principal options for repairing potholes before describing a procedure for selecting an appropriate option for different situations using a series of flowcharts. There are default values for the various questions asked in those flowcharts, but other values can be used to reflect the local situation or policy. In adopting a more consistent approach it is expected that savings in the cost of pothole repairs will follow.

ACKNOWLEDGEMENTS

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