AustStab Construction Tips

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Skidsteer stabilisers

Introduction

In the 1990s, VicRoads and industry representatives worked on the development of the small-scale patrol-patching machine shown in the Figure 1. This machine uses a 600 mm-profile head mounted on a skidsteer. A 200 litre water tank, water pump and spray system has also been incorporated onto the skidsteer. The outcome of this project was a report by VicRoads titled *Small Scale Patrol Patching using the Skid Steer Stabilisation Process* (VicRoads, 1996) which highlighted the features of the short term maintenance treatment.

However, since the preparation of that report, skidsteer stabilisation has been used, not just for small scale patching but also for large rehabilitations works. As the process has been applied to situations it was not designed for, there have been frequent signs of early distress of the material and inappropriate conclusions being drawn about its performance (AustStab, 2003).

Figure 1 View of skidsteer patrol patcher.

This equipment has also been used for shoulder stabilisation where the shoulder has been sealed to reduce maintenance costs and enhance road safety, however this equipment is not suitable for long shoulder widening stabilisation where the reconstructed shoulder is to form part of a widened existing pavement, subject to heavy loading.

This construction tip provides a background to the process of skidsteer stabilisation

and outlines its limitations. Similar to standard road stabilisation practices, inadequate site investigation work, use of the wrong binder and poor specifications all increase the likelihood of this maintenance treatment failing. The following construction tip should be used to get the best performance from small scale patching as a short term maintenance treatment.

Investigation of pavement distress

Similar to insitu stabilisation of the full road width, a site investigation of the pavement materials and cause of pavement distress is essential to establish whether thin patching will be an appropriate short term treatment. A patch in the base layer is no solution to a weak subgrade and repairing the subgrade may be required, especially if the area of weak subgrade constitutes a small section of a roadway which will be designated for full width rehabilitation at a later date. It is more economical to repair the weak subgrade spots during patching to improve production rates when full width rehabilitation works are undertaken. Information for repairing subgrade materials is covered in an AustStab technical note (AustStab, 2004).

Adding 3% of GP or GB cement without investigating the treated material characteristics and the cause of the distress may seem to be a good short term solution but may also lead to block cracking. Selecting an appropriate binder and application rate may provide longer than 12 month use of the patch. Refer to the Austroad stabilisation mix guide for more details (Austroads, 2001).

Should you remove the seal or asphalt prior to stabilisation?

This is a common question asked by practitioners using the process for the first time. A seal can be successfully incorporated into the stabilised material provided the seal does not constitute several course correction layers that results in a 'seal' thickness greater than 25% of the final stabilisation depth. It would not be uncommon to incorporate thin layers of asphalt (≤ 25 mm) into the stabilised material provided that the layer thickness and trimming is given consideration in the patching layer configuration.

Skidsteer stabilisation is not appropriate if more than 25 mm of asphalt wearing course is in the patch area and the use of conventional stabilisation equipment is required. Also refer to AustStab's construction tip on stabilisation patch widths (AustStab, 2000b).

Process

The success of the stabilisation process is dependent upon the uniform mixing of binder and existing pavement materials. Due to the power and mixing limitations of the skidsteer and attachment, two pass mixing may be required. The first pass consists of pulverisation and moisture control, and the second pass involves mixing of the binder and a further moisture adjustment if required. It should be noted, however that two pass mixing is not always appropriate due to weak material breaking down, creating an excess of fines, and the fact that any repair is only interim in nature in any case.

Moisture control can be introduced through the mixing chamber or by spraying onto the surface.

In the first stage, the pulverisation allows the compacted granular material to become loose to allow better mixing efficiency when the binder is incorporated. After the first

stage mixing operation, the depth of the mixing can be verified by stringlines, inspection holes or survey methods[1]. Any excess material at this stage can be removed to allow for the required finished level.

When using powder binders, a light roll of a smooth drum roller is recommended before the bags are positioned and the binder is raked onto the surface (see Figure 2). Raking a binder on a loose surface will reduce the uniformity of the spread rate. If a mechanised spreader is used, the light roll before spreading may not be required.

Figure 2 Better uniformity is likely to be achieved with raking or brooming on a firm rather than loose surface.

If a mechanised spreader is used, small mats providing an area of about 0.5m^2 should be used to verify the application rate. These can be placed onto the rolled surface before the binder is spread from the bag. The binder application rate should be measured at the start of the shift and at each group of patches.

Mix the binder with the pulverised material and adjust for moisture[2] to achieve compaction limits. Good work practices should be adopted to avoid bulldozing the binder in the mixing chamber such that lower and higher application rates occur at the start and end of the mixing run respectively.

After mixing, compaction commences immediately using the appropriate equipment to achieve the required compactive effort of 97% relative density at standard compaction.

Trimming the surface may occur with either a skidsteer bucket attachment or grader. Excess material should be disposed of appropriately and not incorporated into a section of the patch (Austroads, 2003) or the next patch[3].

When using cementitious binder, curing by light spraying of the surface is required until the primerseal is applied to the pavement.

Equipment used

This equipment usually can only stabilise the top 150 to 200 mm of base material for

[1] Not a common process due to the high costs.
[2] Whilst it is recommended that water is introduced in the first pass, the operator may identify dry areas that require additional water in the second pass.
[3] In some cases approval by the supervisor may be given to incorporating stabilised material into the adjacent untreated patch provided the working time of the binder is not exceeded.

a series of distressed areas which are less than 20 m^2 and to provide an immediate short-term solution (see Figure 3). The main equipment used for the project are:

- Skidsteer with sufficient hydraulic power to drive attachments efficiently and not under strain.
- Attachments to the skidsteer, including profiler unit with internal spray bar, water tank, bucket and steel broom.
- Smooth drum roller at a width less than the patch width[4].
- Water cart where town water is not readily available.
- Grader (optional)

It is preferred for the water sprays in the attachment to have individual taps to allow the water to be turned off in the overlap mixing region to minimise the potential for a longitudinal cracking to appear or problems with sealing in the overlapped region.

Figure 3 View of skidsteer and smooth drum roller system for small pavement patch repairs.

Current limitations with plant and process

The success of the process is better achieved when the limitations have been identified and these are listed as:

- Lack of testing of pavement material to establish best binder type and content[5].
- If the thickness of the stabilised material is about 120 to 160 mm, too much binder is added and soft subgrades will result in cracking under heavy axle loading, especially when the patches are in wheel paths.
- Repairing the subgrade is subsequently not carried out resulting in ongoing risks of pavement distress.
- Full compaction of the layer is limited by the width of the patch and size of roller. Difficulty in rolling adjacent to the edge of the patch leads to distress along the edge of the patch. Careful selection in rollers and rolling patterns will overcome this potential problem.
- Whilst 3 tonne rollers were initially recommended, it is becoming clear that heavier rollers (typically 6 or more tonnes) are essential on many patches.
- Due to the mixing limitations of the profiling head, the ends of the work may be

[4] The roller width may be greater than the patch width provided the mixed material after compaction will be higher than the surrounding finished surface level. The excess material will require trimming prior to sealing such that poor ride quality is reduced.
[5] Common to all forms of stabilisation.

poorly mixed leading to weak zones and this has to be addressed by the operator.
- The location of the patch within the pavement can lead to moisture problems if moisture is moving laterally in the pavement and this results in distress adjacent to the patch.

It is not recommended to increase the binder dosage to 'dry' the pavement material as this is likely to lead to low strength stabilised materials.

Specification

All too often practitioners may consider small works do not require a specification, however all maintenance and rehabilitation treatments require a specification. A good outcome for road construction can only be achieved by a specification that has appropriate end product limits and construction tolerances to match equipment type and the construction environment.

Suggested end product limits for skidsteer patching are detailed in Table 1. Different tolerances are used for skidsteer patching as opposed to full scale stabilisation as the work has a short pavement life and an expectation of lower construction costs should take into consideration less accurate application of binder and mixing depth.

Ride quality limits are not commonly used for patching as the edges of the patches have to match existing levels that may cause inherent roughness. However, the surface profile limitation should minimise the impact roughness due to surface depressions or risers.

Table 1 End product limits for specifications using skidsteer patching equipment.

End product	Unit of measurement	Tolerance	Assessment remark
Binder application rate	kg/m^2	±20%	Use both small mats and average mass over patch area
Stabilised depth	mm	-10 to +20	Mixing depth checked against edges of existing pavement materials. Depth readings taken at edges and middle of patch width, and at least every 10 m
Relative compaction	%	-2%	One reference density per patch[A] and use of sand replacement or NDG device for insitu density measurement.
Surface profile	mm	5 mm	No variation in depth over a 3 m straight edge.
NOTE: A. If it is known that several patches have similar material, it is common to use the same reference density.			

Summary

There have been numerous projects in Australia where small scale patching has proven to be both economically and technically feasible, and it appears that some Councils and state road authorities will continue to develop the decision model for its application. It should be viewed as an effective tool for short term rehabilitation of distressed areas, bearing in mind the limitations discussed above, until a more permanent solution is available.

State Road and Local Government authorities should recognise the limitations of using

the attachments on skidsteer equipment, and use the appropriate equipment and specifications to meet the desired life of the treatment rather than road funding budgets.

Base layer patching by the use of skidsteer devices is limited by the condition of the subgrade support and drainage. It is recommended that subgrade repairs and installation of subsoil drains are carried out at the patching stage so that when the programmed rehabilitation takes place at a later date it can be carried out in a shorter time frame.

The cost of this temporary patching is very high per square metre when compared to conventional stabilisation work and this should be recognised and considered carefully in the maintenance planning stage. Joining small irregular patches will reduce construction costs and also lead to better performance.

Traffic control and road user costs are becoming major cost components in road maintenance activity and it may be appropriate to complete a large patch with specialised equipment rather than a series of small patches with a skidsteer process. Finally, using the appropriate construction equipment and skilled operators for road stabilisation provides the best outcome for road maintenance.

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