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Technical Note

EMBANKMENT/LANDSLIP REPAIR USING EXPANDED POLYSTYRENE

1. INTRODUCTION

This note provides guidance on the application of a cost effective technique for the repair of slip sites on roads using ultra lightweight expanded polystyrene (EPS) fill. It is intended particularly for situations where the road formation, originally constructed as a sidling cut and fill, has been lost or partially lost due to a landslide. It is applicable for all types of roads from minor gravel roads to major arterial roads.

2. WHAT IS AN EPS SLIP SITE REPAIR?

Conventional remedial treatments for slip sites on roads involve removal of the failed material and its reconstruction with compacted fill, placed behind a retaining structure often of high cost. The EPS treatment involves unloading the slip area and using ultra lightweight EPS foam blocks to reinstate the road formation. The treatment, once in place, provides a long-term low maintenance solution for the repair of slip sites.

The cross section (see Fig 1) shows how the system works.

When repairing a slip site with EPS, the original formation width is reinstated using EPS to replace displaced soil. The EPS is placed behind retaining panels supported on light-duty soldier piles (LDSP) which are to be tied to suitable anchors installed either at the table drain opposite to the slip or beneath the existing pavement. Where hard rock is present and a high cost is involved to install the LDSP into the rock to achieve the required fixity, a second tie-back near the base of the LDSP can be designed to provide the required toe restraint in lieu of casting the LDSP into hard rock. A suitable pavement layer, incorporating cement treated crushed rock (Ref. 1), is placed directly over the EPS.

3. ADVANTAGES OF USING EPS

The technology offers the following advantages:

- Potential cost and construction time savings, where conventional methods would have required significant structural works.
- Minimum duration of road closures compared with conventional methods which could involve delays of several months, with significant disruption to local communities, commerce and tourism.
- Minimal impact on the environment in sensitive areas as the construction works do not require the use of heavy plant.
- The ability to use environmentally sympathetic treatments such as hardwood logs for the vertical face of the retaining structures.
- Most of the works can be carried out from within the existing roadway or within the slip area.
- Most repairs can be carried out with a relatively small construction crew, requiring the following plant:
  - an excavator fitted with a rotary drilling head and a swivel bucket;
  - backhoe;
  - tip truck; and
  - light compaction equipment.
- The EPS blocks can be trimmed to size on site using a chainsaw.
- Because EPS is largely inert (in comparison with a conventional earth fill) and smaller volume of excavation is required, the construction works with EPS have a lower possibility of causing pollution (turbidity) in waterways within the catchment.
- Short construction period that is possible with the EPS option means that, during the reconstruction stage, there is less disruption to the activities of any sensitive fauna nearby.

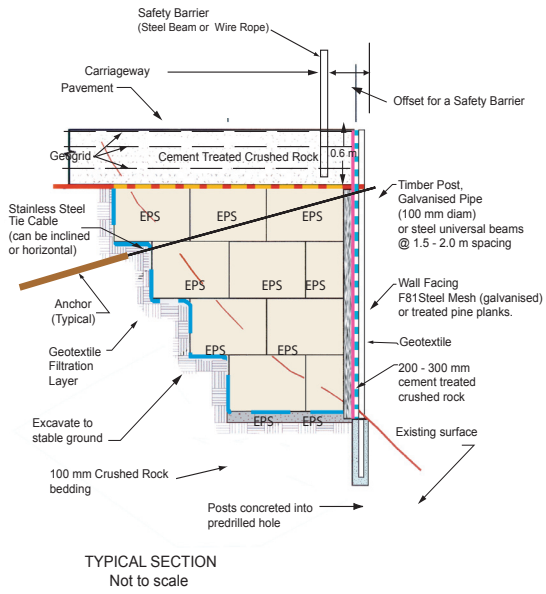

Figure 1: Typical Crossection of EPS Repair

4. APPLICABILITY TO A PARTICULAR SITE

The basic assumptions underlying the design are:

- The original road formation was constructed as sidling cut and fill.
- All (or most) of the fill has slumped away leaving the remaining cut section of the road intact and stable.
- Only minor trimming/benching is needed to create a stable platform for placement of the EPS blocks.
- All of the road fill requires reinstatement.
- Fixity for the LDSP can be achieved by drilling and concreting the LDSP into natural soil or weak rock.

If any of the above assumptions do not apply, then it may not be possible to use EPS for the slip site repair. In these cases, specialist advice should be sought from a qualified geotechnical consultant.

5. DESIGN CONSIDERATIONS

The following items need to be considered when designing the repair of a slip site using EPS:

- The specific grade of EPS selected must take into account the traffic loading. Grade M (Ref. 2) is generally used close to the surface where loading is greatest.
- All EPS blocks should be trimmed such that the top and bottom of the blocks as placed are flat.
- The risk of damage to the EPS posed by fuel spills should be low.
- The risk of damage to the EPS and the retaining structure in bushfire prone areas should be low.
- Wall facing can be selected to suit aesthetic requirements. Galvanised steel mesh with geotextile and cement treated crushed rock (CTCR), treated pine panels, lightweight concrete panels and recycled guard rail have been used.
- LDSP may consist of steel or timber posts or equivalent.
- The design of the anchorage system for the LDSP is dependent on the height and width of reinstatement work. A geotechnical engineer with appropriate experience should be consulted where the wall height is greater than 3m.
- Once constructed, lateral pressure on a correctly installed EPS backfilled retaining wall should be insignificant (Ref. 3). However, a suitable tie-back and anchorage system similar to that illustrated in Figure A is needed in order to retain the EPS and to provide stability to the LDSP during construction.
- Safety barriers must not be fixed to the LDSP. If required, they can be accommodated within the works by providing additional formation width. The services of a geotechnical engineer and structural engineer should be sought when safety barriers are to be incorporated into the works.
- Because of ultra light weight, the potential lifting of the EPS (buoyancy) due to the likely presence of groundwater should be eliminated by providing an appropriate drainage system.

6. REQUIREMENTS FOR GEOTECHNICAL ENGINEERING INPUT

Because a slip site repair may involve a retaining wall supporting up to 8m of EPS fill, it is essential that the site be assessed and design details checked by an engineer with relevant experience to ensure that the design assumptions for the solution are valid. This would normally comprise a detailed site inspection, and in some instances, a geotechnical investigation to determine the subsurface material and groundwater conditions and a field survey to define the natural surface profile above and below the road at the slip location. Both local and global slope instability calculations may also be required.

7. FURTHER DEVELOPMENT

Design and construction using EPS in embankments is undergoing continuous development. GeoPave contact officers nominated below should be advised of all EPS repairs carried out. It is expected that further developments will be made in the application of the technique for staged repair under traffic, and for general embankment widening works.

8. REFERENCES

- VicRoads Specification Section 815 - Cement Treated Crushed Rock for Subbase Pavement
- AS 1366 part 3-1982 Rigid Cellular Polystyrene
- VicRoads Research Project No.TR168, “Low Cost Road Slip Repair Using Polystyrene”

9. CONTACT OFFICERS

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