Department for Transport

Traffic Advisory Leaflet 5/14
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Using temporary backfill at road works

This is one in a series of Traffic Advisory Leaflets providing guidance on methods of working and innovative techniques aimed at reducing traffic congestion due to road works. The series is aimed at utility companies, highway authorities, contractors, equipment suppliers and others involved in road (or street) works. Each leaflet in this series is based on research carried out by TRL Limited on behalf of the Department for Transport and Transport for London.

Introduction

There are occasions where it is sometimes necessary to immediately reinstate an excavation to open roads to traffic at peak times during the overall site occupation period. Reinstating with temporary backfill (see Figure 1) is one way of achieving this and is a useful alternative in certain circumstances to road plates. Both techniques have their advantages and disadvantages and the choice of which to use will depend on the site-specific circumstances.

This leaflet gives guidance on the use of temporary backfill and discusses the factors to be taken into account when deciding whether it is appropriate for any given site. Guidance on the use of road plates can be found in TAL 6/14 *Using road plates at road works*.

Where there is a need to effect an immediate reinstatement, the Specification for the Reinstatement of Openings in Highways (SROH) allows excavations to be backfilled on a temporary basis using excavated or other materials that may not comply with its requirements for interim or permanent reinstatements. SROH requires that granular, cohesive and cement bound materials are properly compacted in 100-150 mm layers and are topped with bituminous surfacing a minimum of 40 mm thick. For deep lifts up to 350 mm from the surface it may be appropriate to use self levelling/compacting materials such as pea shingle to provide a thicker lift and a much speedier operation.

SROH states that such an immediate reinstatement should be re-excavated and reinstated, to the appropriate interim or

Figure 1 - Temporarily backfilled excavation

permanent reinstatement standard within 10 working days unless agreed otherwise by the Authority. However, the objective should be to remove temporary backfill in as short a time as possible. Restricting the deformation at the surface to within the limits of the SROH for the expected service period of the temporary backfill is key.

Owing to the time required to place and remove temporary backfill, it is likely to be most useful when a relatively small volume of material is required and it can be left in place for several days. For shorter periods, road plates may be more appropriate. Using temporary backfill is suitable:

- during delays encountered during emergency or planned works (e.g. waiting for specialist staff or equipment to arrive);
- on weekdays if work is limited to weekends;
- at weekends and public holidays if work is restricted to weekdays;
- for special events (e.g. parades, market days) when road plates may not be appropriate.

It may be possible to use excavated unbound material as temporary backfill provided it has not been contaminated by material from another layer. Where excavated material is not suitable, materials such as granular Type 1 material, sharp sand, single sized aggregate, or recycled material with similar properties can be used. As the reinstatement is temporary, unbound material can be used in place of much of the bound layer.

Advantages and disadvantages

Temporary backfill has a number of advantages:

- it does not require special materials (e.g. plates, rapid curing materials);
- it does not require special plant (where an excavator is used for its removal);
- although best suited to smaller excavations, it can be used for excavations of any size;
- it can be used where plates may be impracticable - see Figure 2 for example;
- it can easily accommodate excavations that vary in width along their length that might otherwise require a range of road plate sizes;
- ride quality can be better than that provided by road plates as long as settlement is acceptable;
- it is not as susceptible to traffic generated noise as road plates are;
- the apparatus is protected;
- there is no threat from vandalism or theft (e.g. removal of plates);
- no operations are required to bed and fix plates to the road surface and there are no concerns about plates being disturbed by traffic.

Some disadvantages of using temporary backfill are that:

- it takes longer to place and remove than road plates so it is less suited to very short term temporary reinstatements;
- it could cause damage to temporary bracing across the excavation;
- it is less suited to use in large excavations;
- it needs to be monitored if in place for any time.

Figure 2 - Excavation where road plates are impracticable

Potential uses

An excavation can be completely backfilled before the apparatus is installed (as shown in Figure 3) although a considerable amount of temporary material could be required. Alternatively, temporary backfill can be used to partially fill an excavation where the apparatus, bedding, surround, and some permanent backfill is in place - see Figure 4.

Figure 3 - Excavation completely backfilled with temporary material

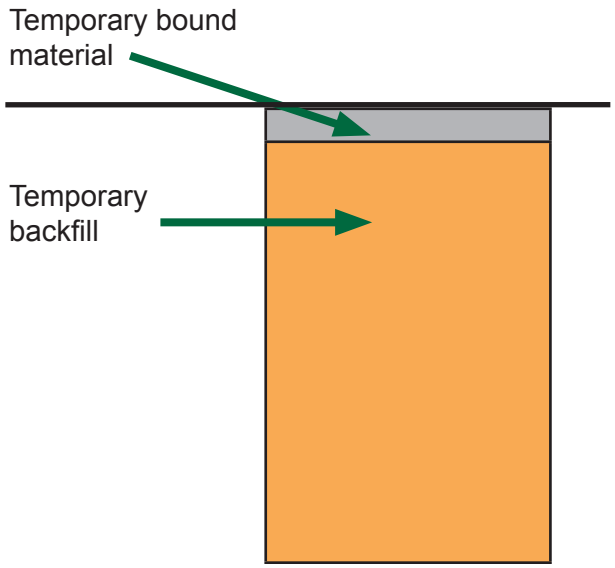
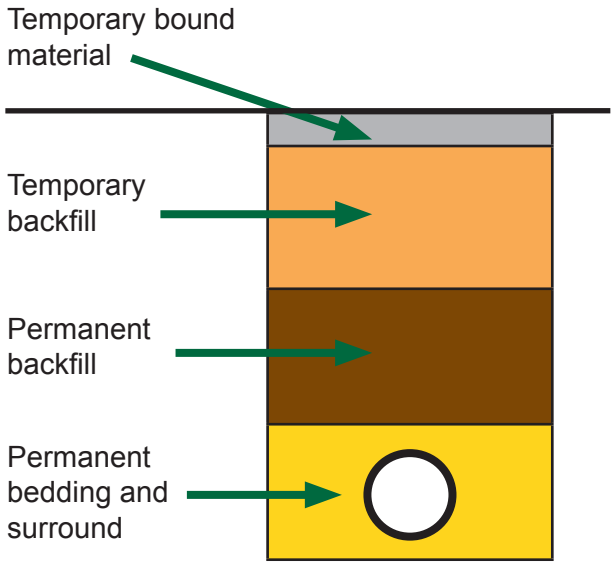


Figure 4 - Excavation partially backfilled with temporary material



Partial backfilling can be useful where:

- the surface layers have been removed but there is insufficient time to start working on the apparatus - for example, where an existing pavement quality concrete layer has resulted in excavation taking longer than expected;
- there is insufficient time left after repairing apparatus to reinstate the excavation to a permanent standard.

Use of temporary backfill

The main factors that need to be considered for temporary backfill are:

- Trench volume, depth and shoring;
- Materials and their availability;
- The effect on apparatus or any temporary bracing;
- Placement and compaction;
- Deformation of the temporary surface under trafficking;
- Removal and storage;
- Asphalt specification and layer thickness;
- Plant available, e.g. excavator bucket (Figure 5) or vacuum extractor.

Figure 5 - Clamshell bucket depositing temporary backfill

Trench volume, depth and shoring

The size of excavation that can be temporarily backfilled will depend on the time available for placement, compaction and removal, and the speed with which these operations can be carried out using the plant available. Typically, it is likely that it would need to be possible to place and compact the backfill and return the site to traffic within 2 hours for the use of temporary backfill to be practicable. Similarly, its removal and the resumption of work would need to be possible within the same time frame.

Shoring can be removed when temporary backfill is placed or it can be trimmed and left in place. The designer of the shoring should be consulted to determine which is appropriate and whether is necessary to remove any bracing that might be damaged by temporary backfill under trafficking.

Materials and their availability

Ideally, temporary backfill material should be easily sourced and available at short notice.

The performance of an immediate reinstatement is dependent on the materials used, the form of construction and the amount of trafficking it is expected to sustain. Two trials were carried out by TRL on reinstatements in 2 m x 2 m x 1.5 m deep excavations to investigate these factors.

The first trial was on two reinstatements using granular Type 1 backfill. Both were overlaid with a 60 mm thick layer of 6 mm asphaltic concrete dense surface course, one using hot mix material, the other using cold lay material. Maximum deformation at the surface after 28,320 passes of a 40kN wheel load was less than 1 mm for the hot mix surfacing and 10 mm for the cold lay surfacing. After a further 13,216 passes at 55 kN, which gave a total number of wheel passes equivalent to 5 days trafficking on a road designed for 60 million standard axles (msa), the deformation of both reinstatements had increased by less than 0.5 mm. The cold lay material remained relatively soft until it had been subjected to a number of load passes, indicating a susceptibility to secondary compaction.

The second trial was on two reinstatements, one using sharp sand and the other using 10 mm pea shingle. Both were overlaid with 300 mm of granular Type 1 material and a 50 mm hot mix asphalt surface course. The maximum deformation after 33,147 passes of a 40kN wheel load (equivalent to 5 days trafficking for a 50 msa design) were 15 mm and 26 mm, respectively.

Table 1 summarises these results.

	Composition of temporary reinstatement	Surface deformation
Trial 1	Granular type 1 backfill overlaid with 60 mm hot mix asphalt surfacing material	~1 mm after equivalent of 5 days trafficking on 60 msa design road
	Granular type 1 backfill overlaid with 60 mm cold lay asphalt surfacing material	10 mm after equivalent of 5 days trafficking on 60 msa design road
Trial 2	Sharp sand backfill overlaid with 300 mm granular Type 1 material and 50 mm hot mix asphalt surface course	15 mm after equivalent of 5 days trafficking on a 50 msa design road
	10 mm pea shingle overlaid with 300 mm granular Type 1 material and 50 mm hot mix asphalt surface course	26 mm after equivalent of 5 days trafficking on a 50 msa design road

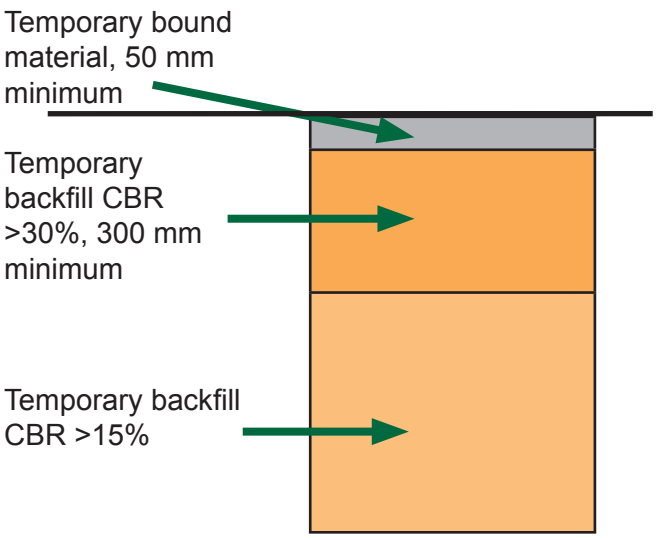
Table 1 - Summary of trial results

In all cases, the total deformation was within the limits specified in the SROH (which for openings of more than 1 m wide, is 1.5% of the unbound depth or 35 mm, whichever is greater).

Based on the findings of the trials, the recommended minimum thicknesses and material properties for the construction of immediate reinstatements of similar depth to the excavations tested are as shown in Figure 6. It is recommended that the minimum surfacing thickness is 50 mm and that the top 300 mm of temporary backfill is a material with a CBR >30% (e.g. granular Type 1 material). The lower layer of temporary backfill should be material with a CBR >15%, but there will be less settlement if a material with a compacted CBR >30% is used.

If different materials are used for temporary backfill, care should be taken to minimise mixing of the materials during removal as this may limit their potential for re-use in other applications.

Figure 6 - Recommended minimum layer thicknesses



Effect on apparatus

Apparatus should be protected with a bed/surround as usual. It is possible that apparatus could be subject to higher loading in an immediate reinstatement than in an interim or permanent reinstatement, due to differences in load dispersal characteristics. However, TRL is unaware of any reports of apparatus being damaged in this way.

Placement and compaction

Temporary backfill can be placed and compacted in the same way as permanent backfill. Some materials such as sand and single sized aggregate are quicker to compact than granular Type 1 material, while 10mm pea shingle is effectively self-levelling/compacting.

Where pea shingle was used in the trials, it was placed in one layer then compacted and levelled with a “wacker” plate - see Figure 7. The trials demonstrated that there was more settlement with materials that took less time to place and/or compact (and had a lower CBR), although the deformations recorded were within the limits specified in the SROH for the amount of trafficking applied.

Measures should be introduced to ensure adequate compaction of all types of temporary backfill so that it:

- has sufficient load bearing capacity to prevent excessive rutting and break-up of the asphalt surfacing;
- limits the load applied to the apparatus;
- adequately supports the sides of the excavation.

The benefit of materials with a high CBR, such as granular Type 1 material, will not be realised unless they are adequately compacted. Particular care must be taken to ensure that the top layer of temporary backfill is fully compacted.

Figure 7 - Compaction of pea shingle during trials

Settlement

The trials showed that some types of temporary backfill may be prone to excessive settlement if in place for a long time. Immediate reinstatements should therefore be inspected on a regular basis. The inspection frequency should be determined by taking into account the type of material used and the amount of trafficking it is taking.

Settlement can be reduced by applying a surcharge thickness such as shown in Figure 8. However, remedial action may still be required with some types of temporary backfill to restore ride quality and limit the noise generated when vehicles cross an uneven surface. Asphalt ramps may be required if settlement results in a step at the interface between the pavement and the reinstatement.

Figure 8 - Surcharge thickness applied to limit deformation

Removal and storage

The time taken to remove all plant and materials from site following an immediate reinstatement and return it when work continues needs to be taken into account. This, and the time taken install and remove the immediate reinstatement will determine whether using temporary backfill is practicable.

Temporary backfill can be removed by excavator but vacuum extraction is also practicable providing the production rate of the vacuum extraction plant and the cost of equipment hire are appropriate for the works. Typical vacuum extraction rates range from about 1 m^3/h to over 6 m^3/h, depending on the plant used. Where appropriate, the removed temporary material can be stored nearby for use in the permanent reinstatement or as temporary backfill for other excavations.

Asphalt specification and layer thickness

It is recommended that hot mixed asphalt is used for the surface course of immediate reinstatements whenever possible, and especially for large reinstatements that will be subject to heavy braking or acceleration. The minimum thickness should be not less than 50mm.

SROH specifies a minimum thickness of 40mm for cold lay surfacing materials in immediate reinstatements. Although this was not tested, it is estimated that it would only be suitable for small reinstatements in lightly trafficked areas with free flowing traffic.

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Recommended further reading

- Specification for the Reinstatement of Openings in Highways. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/11042/sroh.pdf
- Specification for Highway Works. http://www.dft.gov.uk/ha/standards/mchw/vol1/
- Manual handling. (The Health & Safety Executive). http://www.hse.gov.uk/toolbox/manual.htm
- The safe use of vehicles on construction sites: A guide for clients, designers, contractors, managers and workers involved with construction transport. (The Health & Safety Executive). http://www.hse.gov.uk/pubns/books/hsg144.htm
- BD 21/01 The Assessment of Highway Bridges and Structures. http://www.dft.gov.uk/ha/standards/dmrb/vol3/section4/bd2101.pdf
- HD 27/04 Pavement Construction Methods. http://www.dft.gov.uk/ha/standards/dmrb/vol7/section2/hd2704.pdf
- The Construction (Design and Management) Regulations. http://www.legislation.gov.uk/uksi/2007/320/contents/made
- New Roads and Street Works Act 1991. http://www.legislation.gov.uk/ukpga/1991/22/contents
- The Street Works (Records) (England) Regulations 2002. http://www.legislation.gov.uk/uksi/2002/3217/pdfs/uksi_20023217_en.pdf
- The Construction Plant-hire Association publications. http://www.cpa.uk.net/publications/
- BS 5975:2008+A1:2011 Code of practice for temporary works procedures and the permissible stress design of falsework. http://shop.bsigroup.com/ProductDetail/?pid=000000000030240690
- BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. http://shop.bsigroup.com/ProductDetail/?pid=000000000030258086

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