Bituminous surfacings for temporary deviations

MANUAL 9
MAY 1992

SOUTHERN AFRICAN BITUMEN AND TAR ASSOCIATION

BITUMINOUS SURFACINGS FOR TEMPORARY DEVIATIONS

Manual 9
May 1992

ISBN 0 620 167343

SABITA

Published by the
SA Bitumen and Tar Association
P O Box 6946
Roggebaai 8012

SOUTHERN AFRICAN BITUMEN AND TAR ASSOCIATION

Preface

The Southern African Bitumen and Tar Association began its needs driven Asphalt Research Programme in 1988 by means of an Asphalt Research Strategy Task Force (AREST). This task force established a number of directions for research based upon the needs of industry and its clients.

The need for adequate selection criteria for the surfacing of temporary deviations was identified and addressed as part of the *Appropriate Standards for Effective Bituminous Seals* research project with the CSIR Division of Roads and Transport Technology.

The project has provided valuable and new insights into the use and selection of bituminous materials in rural, urban and developing communities.

The findings are based upon sound and accepted economic evaluation techniques. Performance criteria have been determined in the region of southern Africa through interviews and the assessment of actual field performance.

Manual 9: Bituminous surfacings for temporary deviations provides practitioners with a concise and easily used method for selecting appropriate and cost effective surfacings for deviations and temporary accesses.

This manual fills a need identified at AREST in 1988 and is part of the ongoing implementation strategies of Sabita's Asphalt Research Programme.

Acknowledgments

Many individuals associated with the asphalt and bituminous surfacing industry, its clients and consulting engineers in southern Africa have contributed towards this manual and their assistance is acknowledged.

Special acknowledgment is due to:

CSIR Division of Roads and Transport Technology

Project Leader	S.J. Emery	Consultant,	DRTT, CSIR
	L.R. Sampson		DRTT,CSIR
	G. van Zyl		DRTT,CSIR
	P. Paige-Green		DRTT,CSIR
	T.J. Lewis		Tvl Roads Department
	H.P.J. van der Westhuizen		Tvl Roads Department
	D. Burger		van Niekerk, Kleyn and Edwards

List of manuals published by Sabita

Manual 1	Construction of bitumen rubber seals
Manual 2	Bituminous products for road construction
Manual 3	Test methods for bitumen rubber
Manual 4	Specifications for rubber in binders
Manual 5	Manufacture and construction of hot-mix asphalt
Manual 6	Interim specification for bitumen rubber
Manual 7	**SURF+** Economic warrants for surfacing roads
Manual 8	Bitumen safety handbook
Manual 9	Bituminous surfacings for temporary deviations
Manual 10	Appropriate standards for bituminous surfacings
Manual 11	Labour enhanced construction for bituminous surfacings
Manual 12	Methods and procedures - Labour enhanced construction for bituminous surfacings
Manual 13	LAMBS - The design and use of large aggregate mixes for bases
Manual 14	GEMS - The design and use of granular emulsion mixes

Contents

1. INTRODUCTION

1.1 *Background*

The guidelines contained in this document are based on the findings of a part of the SABITA-sponsored research project "Appropriate Standards for Effective Bituminous Seals". The background information required to produce this document is contained in the report "Recommendations on the Suitability and use of Appropriate Surfacings for Temporary Deviations"[3].

The temporary deviations study consisted of interviews, field investigations and cost/benefit analyses of deviations.

1.2 *Scope*

This document is aimed at providing guidelines for the justification for bituminous surfacings and the selection of surfacings for temporary deviations, particularly in situations where a cost analysis would not be appropriate or possible. The guidelines in this document are applicable to both the rural situation and the urban situation where a deviation is laid on a temporary pavement structure.

Suitable surfacings for temporary deviations are given and a selection method for deciding on the most suitable surfacing type for particular applications is presented. This selection method is based on the economic costs associated with each surfacing type. The factors that are considered in the selection process are : traffic volume, duration of the deviation, length of the deviation, surfacing costs, surfacing life, the ability to reseal the deviation and the limitations on the use of certain surfacings.

1.3 *Interviews*

The current practice by road authorities with respect to temporary deviations was reviewed and it was found that no formal guidelines exist for the decision on surfacing type for temporary deviations. This lack of guidelines could lead to the situation where only the longer temporary deviations receive a comprehensive design and cost analysis in order to decide on

an appropriate surfacing, and the surfacing of shorter deviations will be decided by an ad-hoc approach.

Gravel deviations were found to be used quite extensively even at sites with relatively high traffic volumes. Surfacings currently used for surfaced temporary deviations include dust palliatives, sand seals, single seals with various nominal stone sizes, double seals and premix. Modified binders have also been used recently.

1.4 *Field work*

Actual temporary deviation sites were visited in order to assess the performance of the various surfacings. One major experiment[7] found that modified binders give very good performance on temporary deviations. The pavement strength was seen to be a major influence on the durability of the surfacing, due to the generally weak pavements encountered on temporary deviations.

1.5 *Cost benefit analysis*

Life cycle costs were determined for six surfacing types, in order to determine the most economical surfacing for any temporary deviation. The surfacings chosen were typical deviation surfacings that represent the spectrum of surfacings likely to be used on deviations. Life cycle costing was done in terms of direct costs (construction and maintenance costs) and economic costs (construction, maintenance, vehicle operating, accident and time costs). The life cycle costs obtained were compared for each of 27 situations of differing traffic volumes, expected surfacing costs and expected surfacing lives.

2. FACTORS AFFECTING JUSTIFICATION FOR EITHER GRAVEL OR BITUMINOUS SURFACING FOR TEMPORARY DEVIATIONS

It is justified to surface a temporary deviation if the costs over the duration of the temporary deviation are reduced by doing so. The justification of surfacing temporary deviations involves the consideration of several factors which include:

- The traffic volume at the site
- The duration of the deviation
- The length of the deviation
- The expected surfacing construction costs
- Whether direct costs (maintenance and construction costs) or economic costs (maintenance, construction and road user costs) are to be considered.

This analysis is purely economic but it must be borne in mind that there is a large difference in norms between urban and rural areas:

- Dust is often not acceptable in urban areas
- Higher quality is expected in urban areas i.e. rough surfaces are not acceptable
- The accessibility of premix plants is greater in urban areas.

In urban areas these factors may overide economic considerations and lead to a decision to use bituminous surfacings even at sites where gravel surfacings would be economically justified.

2.1 *Traffic volume*

For temporary deviations of short duration, at low traffic volumes gravel surfacings will be less expensive than bituminous surfacings. As the traffic volume increases bituminous surfacings will become relatively less expensive than gravel.

2.2 *Duration of the temporary deviation*

Since most gravel deviations cost more to maintain than surfaced deviations the longer the duration of the deviation the more likely that the surfaced option will be less expensive.

2.3 *Length of the temporary deviation*

Since most construction equipment will be on site for the main works, the only difference between the cost of short and long deviations will be the difference in cost of hauling and spraying the bitumen. Short temporary deviations, where small loads of bitumen are sprayed, will bear a relatively high cost per m^2 for

this. This will tend to inflate the surfacing costs for short deviations. It may be practical, with adequate preplanning to ensure that short deviation sections are sprayed from full loads.

2.4 *Expected surfacing construction costs*

The surfacing construction costs will vary for a particular surfacing depending on the size of the contract and distance from suppliers. An analysis of 27 job types showed that costs will be low for jobs in an urban area close (20 km) to suppliers, medium in a rural area far (150 km) from suppliers and high in a remote area very far (300 km) from suppliers. The size of contract was found not to be a factor influencing the category (low, medium or high) of surfacing costs. The higher the surfacing construction costs, the longer the duration at which gravel surfacings remain justified.

By preplanning it may often be possible to use on-site materials for deviation surfacings. This situation would favour the use of the low cost category.

If costs are available for surfacings at the deviation site then Table 2.1 can be used to determine the category (low, medium or high) of surfacing costs.

Table 2.1:
CATEGORY OF SURFACING CONSTRUCTION COST

COST CATEGORY	SURFACING COST - PRIMED (EXCEPT DP) (1991 R per m²)				
	DP	S1	MOD S1	S2	PREMIX
LOW	< 1.98	< 3.05	< 3.40	< 4.59	< 9.99
MEDIUM	1.98 to 2.46	3.05 to 3.81	3.40 to 4.19	4.59 to 5.65	9.99 to 11.35
HIGH	> 2.46	> 3.81	> 4.19	> 5.65	>11.35

DP	Dust palliative	S1	Single seal
MOD S1	Modified bit single seal	S2	Double seal
PREMIX	Premix 25mm		

If costs are not available they can be estimated using the distance from suppliers of bitumen and aggregate. If the distance is short (20 km) costs will be low, if the distance is long (150 km) costs will be medium and if the distance is very long (300 km) costs will be high. Interpolate between the three distances to find the expected surfacing costs.

2.5 *Direct costs or economic costs*

In the cost/benefit analyses both direct costs (maintenance and construction costs) and economic costs (maintenance, construction and road user costs) were considered. The engineer should determine which one of direct costs or economic costs will be most appropriate to use.

3. FACTORS AFFECTING BITUMINOUS SURFACING TYPE

Once a bituminous surfacing has been justified, its selection involves the consideration of several factors which include:

- The traffic volume at the site
- The duration of the temporary deviation
- The expected surfacing life
- The ability to reseal the deviation
- Limitations to the use of particular surfacings
- Urban or rural area

3.1 *Traffic volume*

Low traffic volumes will tend to favour the less expensive surfacings such as dust palliatives and single seals as these will have the ability to stand up to light traffic for a reasonable length of time. As the traffic volume increases, more expensive surfacings will tend to be economically viable.

3.2 *Duration of the temporary deviation*

In general the least expensive bituminous surfacing with a life greater than the duration of the deviation will be the most economically viable.

3.3 *Expected surfacing life*

The expected surfacing life will be determined by the expected pavement strength and behaviour and expected quality of construction. Deviations with longer durations will tend to favour the use of surfacings with longer expected lives. The surfacing life should be equal to the average life used in this study if there is an adequate pavement structure. An adequate structure would be one designed to carry the cumulative traffic expected on the deviation (for example a TRH 4 design). For light (less than 1000 vpd) traffic volumes this would be a pavement with a DSN_{800}, measured by dynamic cone penetrometer, greater than 88. Expected surfacing life will be below average or above average if the pavement structure is for some reason weaker or stronger than that required.

3.4 *Ability to reseal the deviation*

In general the original surfacing must last for the duration of the deviation. This will limit the choice of surfacing to those surfacings having a probable life equal to or longer than the duration. This limit will not apply if it is possible to accommodate traffic while resealing is undertaken. Deviations on rural roads and high traffic volumes may exclude the possibility of resealing during the life of the deviation unless traffic can be accommodated safely and without disruption and thus require risk-free surfacings.

3.5 *Recommendations on surfacing type*

Some surfacing types will perform better than others in certain environments. The surfacing type indicated in this guide may need to be reconsidered for high stress environments if premature failure will result in large costs being incurred through rerouting traffic and resealing after failure. It may be necessary to use a stronger surfacing type to lower the risk of failure.

Before a surfacing is chosen the following limiting factors should be considered:

- maintenance environment
- section gradients
- climate and drainage
- presence of intersections/turning trucks

- acceptability of premature failure
- pavement support and basecourse material

4. SELECTION OF APPROPRIATE SURFACING

4.1 *Method*

The selection of the most appropriate and cost effective surfacing type for a temporary deviation is done using the following steps:

Step 1 Whether a gravel or a bituminous surfaced deviation is justified is determined by using Table 4.1.

Table 4.1
DURATION FOR JUSTIFICATION OF SURFACED TEMPORARY DEVIATION

TRAFFIC	DIRECT COSTS Maintenance & Construction	ECONOMIC COSTS Maintenance, construction and road user costs
500 vpd	7[a]Months	3[d]Months
2 500 vpd	4[b]Months	1[e]Month
10 000 vpd	2[c]Months	1 Month

a 8 months if surfacing costs are high
4 months if surfacing costs are low
17 months for 100 m deviation
9 months for 300 m deviation

b 5 months if surfacing costs are high
2 months if surfacing costs are low
17 months for 100 m deviation
6 months for 300 m deviation

c 3 months if surfacing costs are high
5 months for 100 m deviation
3 months for 300 m deviation

d 2 months if surfacing costs are low
6 months for 100 m deviation

e 2 months for 100 m deviation

Step 2 The most appropriate and cost effective surfacing for a temporary deviation is selected from Table 4.2.

Table 4.2: **RECOMMENDED SURFACING TYPE**

DURATION OF TEMPORARY DEVIATION (MONTHS)	TRAFFIC VOLUME		
	500 vpd	2 500 vpd	10 000 vpd
1	GRAVEL (DP)	DP	DP
2	GRAVEL (DP)	DP[a]	S1[b]
3	DP	S1[b]	S1
4	DP[a]	S1	MOD S1[e]
5	S1[b]	S1	S2[f]
6	S1[b]	S1[c]	S2[f]
7	S1	S1[d]	S2[a]
8 to 9	S1	MOD S1[e]	S2[a]
10 to 12	S1	S2[f]	S2
13 to 24	S1[c]	S2	S2

a S1 if below average life expected
b DP if above average life expected
c MOD S1 if below average life expected
d S2 if below average life expected
e S2 if below average life expected
S1 if above average life expected
f MOD S1 if above average life expected

DP	Dust palliative	S1	Single seal
MOD S1	Modified bit single seal	S2	Double seal
PREMIX	Premix 25mm		

Step 3 If the surfacing is subjected to high stress certain surfacing types are recommended in preference to others (Table 4.3).

Table 4.3: **LIMITATIONS ON SURFACING TYPES**

SURFACING TYPE	IS SURFACING SUITABLE GIVEN CONDITIONS BELOW (YES/NO)			
	No maintenance capability	Steep gradient	Wet climate or bad drainage	Turning trucks i.e. intersections
Dust palliative	No	No	No	No
Single seal[a]	No	No	Yes	No
Double seal	Yes	Yes[b]	Yes	Yes
Cape seal	Yes	Yes[b]	Yes	Yes
Premix	Yes	Yes[c]	Yes	Yes

a with or without modified binder
b maximum suggested gradient = 10-12 %
c maximum suggested gradient = 16-18 %

Step 4 For most temporary deviations it will be unacceptable or impossible to reseal during the period of the temporary deviation. The risk of surfacing failure must be reduced in these situations and surfacings requiring resealing during the period of the deviation cannot be considered. For these situations the appropriate surfacing should be selected from Table 4.4.

Table 4.4:
RECOMMENDED SURFACING TYPE TO ENSURE NO RESEAL NEEDED

DURATION OF TEMPORARY DEVIATION (MONTHS)	TRAFFIC VOLUME		
	500 vpd	2 500 vpd	10 000 vpd
1	GRAVEL (DP)	DP	DP
2	GRAVEL (DP)	S1	S1
3	DP	S1	S1
4 to 5	S1	S1	S2
6	S1	MOD S1	S2
7	S1	S2	PREMIX
8 to 9	S1	S2	PREMIX
10 to 12	S1	PREMIX	PREMIX
13 to 24	MOD S1	PREMIX	PREMIX

DP	Dust palliative	S1	Single seal
MOD S1	Modified bit single seal	S2	Double seal
PREMIX	Premix 25mm		

4.2 *Worked example*

Example: A temporary deviation 2 kilometres long, is to be constructed alongside a road under rehabilitation. The duration of the deviation will be eight months. The traffic counts indicate the traffic volume to be 2350 vehicles per day, including construction traffic. Suppliers of bitumen and aggregate are approximately 125 kilometres from the site. It is expected that the deviation pavement structure will be relatively strong due to good quality control. There is no possibility of resealing the deviation during its time in use. What surfacing would be appropriate ?

Before the steps 1 to 4 are followed it is necessary to determine the traffic volume, duration of the deviation, length of the deviation, surfacing costs, surfacing life, and the ability to resurface the deviation.

Traffic volume
The expected traffic volume on the deviation is 2 350 vpd. By interpolating between the three categories of traffic volume used in this guide (500 vpd, 2 500 vpd or 10-000 vpd), 2 500 vpd would be most appropriate.

Duration of the deviation
In this example the deviation will be in use for eight months.

Length of the deviation
In this example the deviation is 2 kilometres long.

Surfacing costs
By refering to section 2.4 the category of costs can be determined. In this example the distance from suppliers is closest to 150 km and therefore costs will be medium.

Surfacing life
In this example the surfacing would be expected to have an above average life because of good quality construction and pavement structure.

Ability to resurface
In this example the surfacing must last for the duration of the deviation.

Step 1
Using the traffic volume, length of the deviation and expected surfacing costs, from Table 4.1 it can be determined whether it can be economically justified to surface the deviation. If it is not economically justified to surface the deviation it may be justified for reasons of safety or public opinion, especially in urban areas.

In the above example, from Table 4.1, surfacing the deviation can be justified.

Step 2
Using the traffic volume, duration and expected surfacing life determined previously, the appropriate surfacing can be selected from Table 4.2.

In the above example, from Table 4.2, the most appropriate surfacing would be a single seal.

Step 3
The surfacing chosen in step 2 can be checked against Table 4.3 and if it is not suitable a stronger surfacing can be chosen.

In the above example there are no limitations on the chosen surfacing.

Step 4
The ability to reseal the deviation must also be considered. If resealing is not possible during the duration of the deviation the surfacing chosen should be checked against Table 4.4. If Table 4.4 recommends a stronger surfacing type then this surfacing is more appropriate.

In the above example resealing was not possible. Table 4.4 recommends a double seal as the most appropriate surfacing.

Solution

A double seal 13/6 would be the most appropriate surfacing for this temporary deviation

5. REFERENCES

1 CENTRAL ECONOMIC ADVISORY SERVICES Manual on the benefit-cost analysis of public sector projects. CEAS Draft Manual, Pretoria, 1988.

2 DEVELOPMENT BANK OF SOUTHERN AFRICA. Draft guidelines on the economic evaluation of rural roads in the developing areas of Southern Africa. Contract report No. DPVT/C-59.1, DRTT, CSIR, Pretoria, 1985.

3 EMERY, S, VAN HUYSSTEEN, S and WESSELS, M. Appropriate standards for effective bituminous seals: Recommendations on the suitability and use of appropriate surfacings for temporary deviations. SABITA ARP 91/1, CSIR Tech. note RDT/16/91, DRTT, CSIR, Pretoria, 1991.

4 NATIONAL INSTITUTE FOR TRANSPORT AND ROAD RESEARCH Structural design of interurban and rural road pavements TRH4, CSIR, Pretoria, 1985.

5 NATIONAL INSTITUTE FOR TRANSPORT AND ROAD RESEARCH Guidelines for road construction materials TRH14, CSIR, Pretoria, 1985.

6 NATIONAL INSTITUTE FOR TRANSPORT AND ROAD RESEARCH Surfacing seals for rural and urban roads and compendium of design methods for surfacing seals used in the Republic of South Africa. Draft TRH3, CSIR, Pretoria, 1986.

7 NINHAM SHAND INC. TR 51/2 Burgersdorp to Aliwal North Bypass Experiment Report. Report No 1772/4832, for CPA Roads and Traffic Administration Branch, Cape Town, 1991.

8 SOUTHERN AFRICAN BITUMEN AND TAR ASSOCIATION. Economic warrants for surfacing roads: Manual 7. ISBN 0-7988-4803-0, Pretoria, 1989.

9 TPA, ROADS BRANCH. Construction circular K20 of 1988 contract unit prices: road and bridge work. Pretoria, 1988.

10 WOLFF, H. Appropriate standards state-of-the-art report: temporary seals for deviations. SABITA ARP 88/1, CSIR Tech. note LVRN/5/89, DRTT, CSIR, Pretoria, 1989.

11 WRIGHT, B, EMERY, S, WESSELS, M and WOLFF, H. Appropriate standards for effective bituminous seals: cost comparisons of paved and unpaved roads. SABITA ARP 88/1, CSIR Tech. note RDT/1/90, DRTT, CSIR, Pretoria, 1990.

SABITA Manual 9. Bituminous surfacings for temporary deviations

SABITA

ORDINARY MEMBERS

ABE Industrial Products (Pty) Ltd
African Bitumen Emulsions (Pty) Ltd
Akasia Asphalt (Pty) Ltd
Bewloc (Pty) Ltd
Bill Maycock Surfaces (Pty) Ltd
Blitz Asphalt (Pty) Ltd
BP Southern Africa (Pty) Ltd
Caltex Oil SA (Pty) Ltd
Concor Roads (Pty) Ltd
Engen Marketing Ltd
Felbitem (Pty) Ltd
Javseal (Pty) Ltd
Much Asphalt (Pty) Ltd
Petrocol (Pty) Ltd
Premier Road Surfacing (Pty) Ltd
Protea Asphalt (Pty) Ltd
Rand Roads (Pty) Ltd
Roadfix Marketing (Pty) Ltd
Road-Tech Binders (Pty) Ltd
Shell South Africa (Pty) Ltd
Sonap Petroleum (SA) (Pty) Ltd
Tosas (Pty) Ltd
Trek Petroleum (SA) (Pty) Ltd
Vialit (Pty) Ltd
Wolton Gray & Son (Pty) Ltd
Zebra Bituminous Surfacings cc

ASSOCIATE MEMBERS

Hippo Quarries Ltd
Kaytech
Ready Mix Materials (Pty) Ltd
Suprachem (Pty) Ltd
The Synthetic Latex Co (Pty) Ltd

Cover printed on recycled paper

BLACKSHAWS