

UNPAVED ROAD DESIGN, CONSTRUCTION & MAINTENANCE

Prof Phil Paige-Green
Mr Gerrie van Zyl

Paige-Green Consulting (Pty) Ltd, Pretoria

(TSHWANE UNIVERSITY OF TECHNOLOGY)

Mycube Asset Management Systems, Cape Town

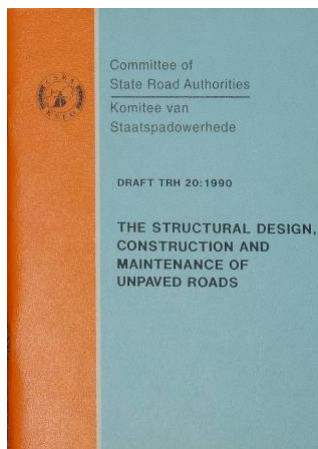


South African
Road Federation

ON-LINE
NOVEMBER 2020



Background



TRH 20 published in 1990

Draft for upgrading

CSIR (with Gerrie Van Zyl) appointed to
revise and improve in 2008

Completed in 2009

Basis of this course

Approved by RCB as TRH

Approved by COTO July 2016

Still not "released"



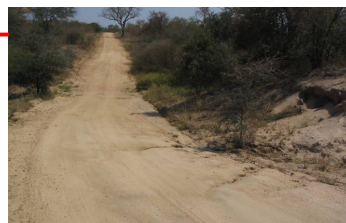
Course content

- 1 Introduction
- 2 Performance
- 3 Design
- 4 Construction
- 5 Maintenance
- 6 Management
- 7 Investigation & maintenance measure selection
- 8 Safety aspects
- 9 Rehab, improvement and upgrading



Course content

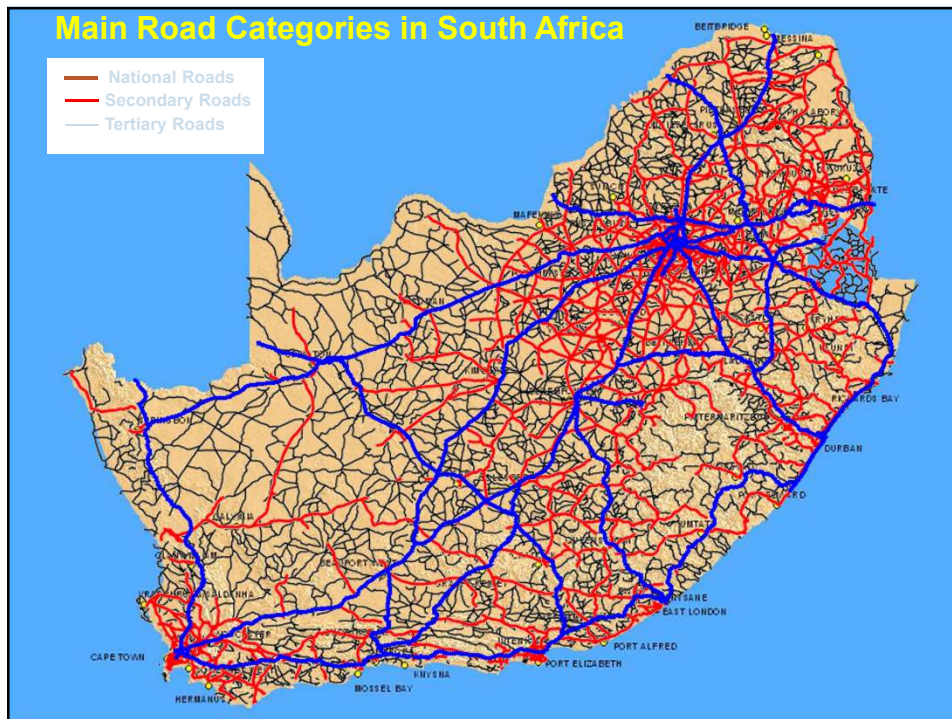
- 1 **Introduction**
- 2 Performance
- 3 Design
- 4 Construction
- 5 Maintenance
- 6 Management
- 7 Investigation & maintenance measure selection
- 8 Safety aspects
- 9 Rehab, improvement and upgrading



1 INTRODUCTION

1.1 Background

- Economic well-being of any country is a function of the road network
- Access and mobility require improved network
- Agricultural, mining, forestry and tourist industries depend on good all-weather road network
- SA has about 750 000 km of road of which about 600 000 km are unsealed
- Some carry more than 1000 vpd
- Unlikely to ever seal even a small percentage of these
- Current statistics and condition



Road Network With Condition Data Available

Authority	Paved		Gravel		Total		
	Length	Data	Length	Data	Length	Data	% Data
SANRAL	16,170	16,170	0	0	16,170	16,170	100
Provinces - 9	48,176	47,088	136,640	103,733	184,816	150,820	82
Metros - 9	51,682	40,737	14,461	1,789	66,143	42,527	64
Municipalities	37,691	10,866	302,158	2,124	339,849	12,990	4
Total	153,719	114,861	453,259	107,646	606,978	222,507	
% Data	75		24		37		

If the extent and condition of the network are not known,
how do you make sound road investment decisions.

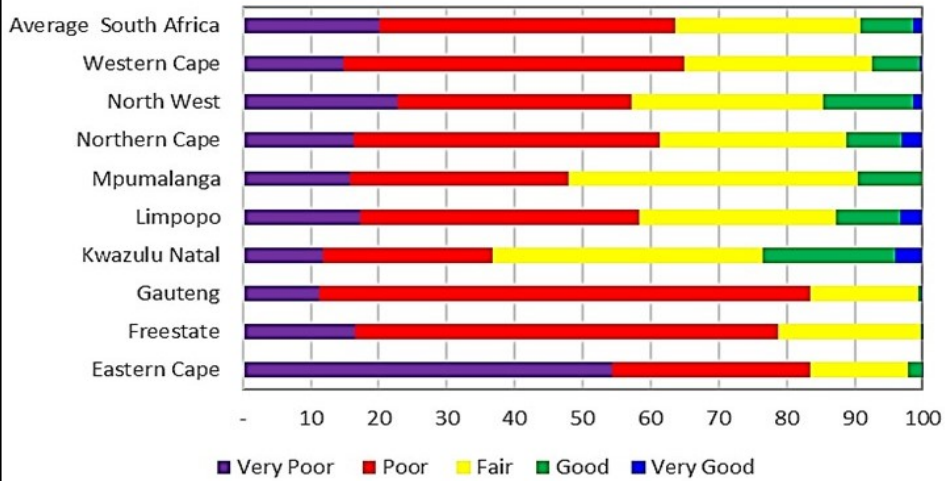


Gravel – Provincial (2004-2008)

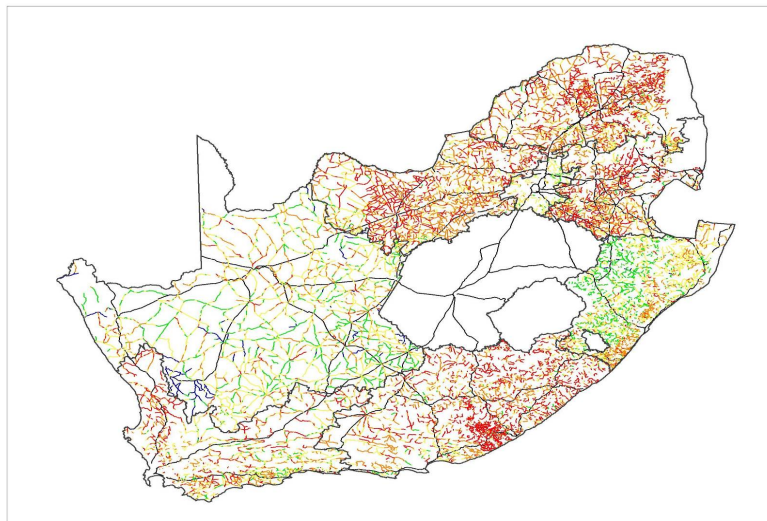


Gravel Network Condition Summary 2013

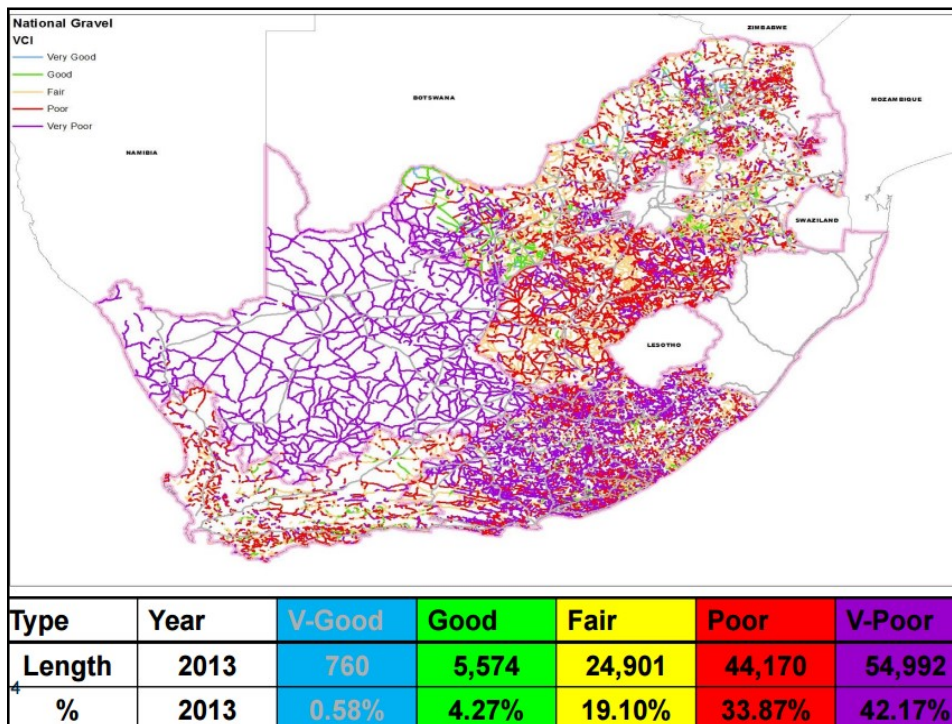
Unpaved Road Condition (2013)



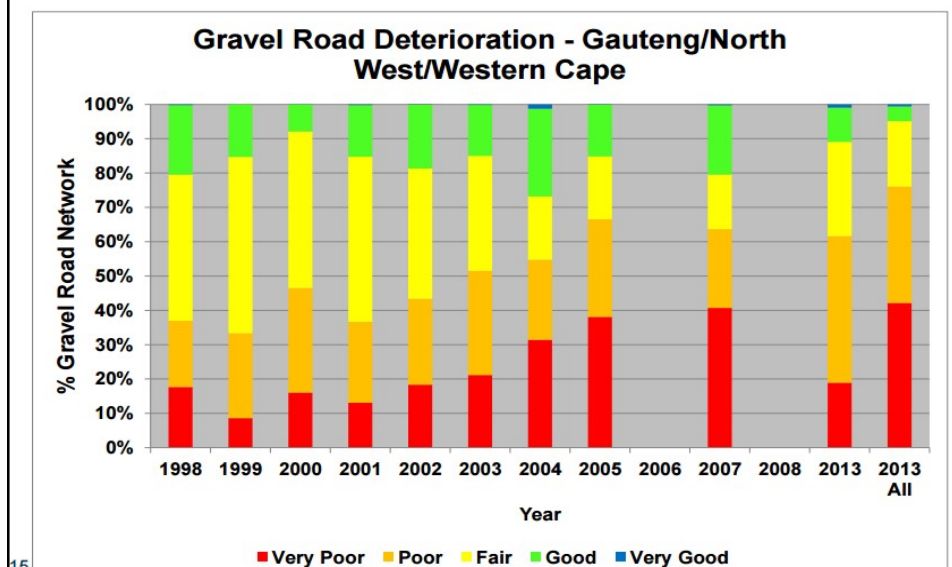
Gravel – Provincial



Type	Year	V-Good	Good	Fair	Poor	V-Poor
Length	2004-08	1,981	13,863	35,344	33,219	19,327
%	2004-08	1.91%	13.36%	34.07%	32.02%	18.63%



Gravel Road Deterioration - Provincial



1 INTRODUCTION

1.1 Background (cont)

- Many unsealed roads designed with little technical input
 - Nearest available material
 - Irrespective of properties
 - No formation or shaping
 - No effective drainage
 - Little construction control
- Need to minimise material use (sustainability requirements)
- Document addresses these problems
 - More for rural roads than urban
 - Fundamentally similar (drainage and access differ)
- Many references (> 60)

1 INTRODUCTION

1.2 Definitions/development (evolution) of roads

- Humans need to move
- *Tracks* – between “home” and water, food, security
 - Game tracks
 - Dedicated “routes”



1 INTRODUCTION

1.2 Definitions/development

- Use by vehicles (often large quantity of non-motorised traffic)
- Tracks widened
- *Earth tracks*
 - < 5 vpd
 - Impassable when wet



1 INTRODUCTION

1.2 Definitions/development

- Vehicle growth
- Tracks wear down
- Maintenance required (grader)
- *Earth road*
 - **Un-engineered** - In situ materials
 - Vegetation cleared
 - May be lightly compacted
 - **Engineered**
 - Rudimentary side-drains
 - Periodic maintenance



1 INTRODUCTION

1.2 Definitions/development

Maintenance problems develop

Localised addition of gravel to patch



1 INTRODUCTION

1.2 Definitions/development

- Vehicle growth increases
- Maintenance problems increase
- Import gravel
- *Gravel road*
 - Imported materials
 - Selected quality
 - Properly compacted
 - Designed drainage
 - All weather passability
 - Regular maintenance



1 INTRODUCTION

1.2 Definitions/development

- Unpaved roads
 - No bituminous, concrete or block paved surfacing
 - Includes earth, gravel roads and treated (with chemicals)
 - Not "dirt" roads



1 INTRODUCTION

1.2 Shoulders

- Unpaved shoulders are basically gravel roads
- Lower traffic usually
- Content of this course applies in most respects
- Same safety problems if material is incorrect !



1 INTRODUCTION

1.3 Classification

- Classification system useful for:
 - Consistent treatment of roads in a network
 - Communication among engineers, administrators and users
- Various systems developed depending on specific application
 - Purpose
 - Traffic
 - Expected Level of Serviceability
 - Environment (rural or urban)
 - Others
- SA network classified on functional basis and significance
 - Focus on service provided
 - Importance in terms of location in the road system
 - Contribution to achieving economic objectives

1 INTRODUCTION

1.3 Classification

- SA classification is a high level strategic classification
- Does not replace provincial road authorities systems
- These are either
 - Hierarchical (trunk, major, minor), or
 - Functional related to connectivity (provincial, district, access)
- Do not differentiate between sealed and unsealed
- RISFSA (unsealed mostly 3, 4 or 5)

Strategic functional road classification (RISFSA)

Class	Strategic function
1 Primary distributor	High mobility roads with limited access for rapid movement of large volumes of people, raw materials, manufactured goods and agricultural produce, of national importance
2 Regional distributor	Relatively high mobility roads with lower levels of access for the movement of large volumes of people, raw materials, manufactured goods and agricultural produce of regional importance in rural and urban areas
3 District distributor	Moderate mobility with controlled higher levels of access for the movement of people, raw materials, manufactured goods and agricultural produce in rural and urban areas, of regional importance
4 District collector	High levels of access and lower levels of mobility for lower traffic volumes of people, raw materials, manufactured goods and agricultural produce in rural and urban areas of local importance
5 Access roads	High access and very low mobility routes for the movement of people and goods within rural and urban areas
6 Non-motorized access ways	Public rights of way for non-motorized transport providing basic and dedicated movement

Need to be able to relate required geometric design standard and Levels of serviceability to various road classes (Sec 6.2)

1. INTRODUCTION

1.4 Traffic

Generally light (> 1000 vpd unusual and unacceptable)

Described as “lightly trafficked” or “low volume”

No standard definition

- Should relate to not only number of vehicles, but also composition and type as well as road function

AASHTO – very low volume roads < 400 vpd

Most in Africa < 200 vpd

Mostly used for access



1. INTRODUCT



1.4 Traffic

Effect of cars and trucks is similar

Cars faster – more whip-off and dust

Trucks slower – compact the material – improve the road

- Wet weather – overstressing – significant deterioration
- NB Unloaded trucks – more damage – mine and haul roads



1. INTRODUCTION



1.4 Traffic

Can be cost-effective to seal at relatively low traffic levels (< 100 vpd)

Sabita SuperSurf

Course mainly applicable to roads with < 200 vpd (< 60 heavies)

Principles probably valid up to 400 light vpd

NB: Non motorised traffic

Mainly safety aspects (width, curves, etc.)

NB: Faster vehicles on better roads



1. INTRODUCTION

1.5 Basic Economic Principles

For economic comparison of alternatives

Fundamental concept is benefit : cost analysis

Benefits:

- Fuel and time savings because of lower roughness
- Reduced dust and maintenance on paved roads
- Reduced accidents, etc.
- Social and environmental

Costs (life cycle costing)

- Construction
- Maintenance (routine and periodic)
- Rehabilitation
- Road user costs
- Salvage value (-ve cost)



1. INTRODUCTION

1.5 Basic Economic Principles

Analyse in terms of “economic” costs (exclude taxes, subsidies, duties, etc)

Discount over analysis period

Can determine

- Present worth of costs (PWOC)
- Benefit/cost ratio
- Internal rate of return
- Net present value



More difficult for unpaved roads than paved roads

- Dynamic unpaved roads – changing quality resulting from traffic and weather – maintenance needs variable



1. INTRODUCTION

1.5 Basic Economic Principles

Difficult to put a monetary value on various other issues:

- Cost of dust in residential areas
- Improved comfort for commuters
- Environmental and sustainability costs
- NB: Non-renewable resources (gravel and water!)

What proportion of VOC savings should authority be expected to offset by increased construction and maintenance costs?

Other impacts such as stimulation of economy in a region resulting from improved access !



1. INTRODUCTION

1.6 Design of unsealed roads

Entire chapter

Primary objectives of the design are to provide:

- sufficient material to protect the subgrade (in situ material) from deformation under traffic (structural or engineering aspects)
- a suitably safe and comfortable wearing course for movement of vehicles with passengers and goods (functional)
- sufficient passability in dry and wet weather without excessive dust, roughness or maintenance (functional)

Related to material quality

Chapter 3



1. INTRODUCTION

1.7 Construction of unsealed roads

Providing adequate material for a wearing course will not ensure good performance

Construction must be of high quality

Subgrade preparation, material placement and compaction, and drainage provision must be carefully supervised and controlled

Chapter 4



1. INTRODUCTION

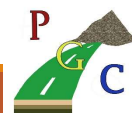
1.8 Maintenance of unsealed roads

Appropriate, timely and high quality maintenance is essential for the road to continue to provide required service

Lack of maintenance will result in deterioration

- Increased road user costs
- Difficult to restore road to good condition
- Increased maintenance costs

Chapter 5



1. INTRODUCTION

1.9 Management of unsealed roads

Decision making process

Rapid increase in computing power in 1980s

Computer-based management systems advanced significantly

Compulsory by law in SA now (funds allocated)

Information systems allow better decision making



1. INTRODUCTION

1.9 Management of unsealed roads

Inventory → condition → needs and inputs → resources → action

TMH 9 Part E)– comparable and consistent condition descriptions

Unsealed roads are a compromise between no road and a sealed road

Drivers thus need to adapt to conditions and road user costs will always be higher than on sealed roads

Safety usually worse (higher risks)

Chapter 6 & 7



1. INTRODUCTION

1.10 Companion documents

- The document should be used in conjunction with a number of other documents
- TMH 1 (1979 & 1986) Standard methods for testing materials
- TMH 5 (1981) Sampling methods for road construction materials
- TMH 12 (2000) Standard visual assessment manual for unsealed roads
- TMH 9 Part A and E (2013) Standard visual assessment manual: Unpaved roads
- TMH 22 (2013) Road Asset Management Manual
- TRH 5 (1977) Statistical concepts of quality assurance
- TRH 14 (1985) Guidelines for road construction materials
- SANS 3001 test methods (replacing TMH 1)
- COLTO (1998) Standard Specs for Roads and Bridges



SUMMARY

Status quo

General overview of document

Get into individual technical chapters of the document

