UPGRADING RURAL ROADS

Parliamentary Portfolio Committee on Transport:

22 May 2012

Dr Phil Paige-Green
CSIR Built Environment
Many thousands of km of unsealed roads exist in South Africa (> 500 000) Mostly in rural and poorer areas – important for access to the economy Do not provide all-weather passability Costly to maintain Still give numerous problems
Background to unsealed roads

- 1982-1989 – CSIR carried out a major project sponsored by DoT
- Evaluated performance of 110 sections of road in old Transvaal and Namibia
- Developed performance-related material specifications
- Published in a Technical Recommendation for Highways (TRH 20 : 1990)
- Only properly implemented in early 2000s
Performance

• Many different types of performance problems
• Related to material properties and construction
• Have significant effect on:
  • Safety and comfort
  • Road user cost
  • Maintenance cost and requirements
Main activities required

- Grader blading – restore smoothness/shape
- Regravelling – restore gravel thickness
- Roadside – drains and vegetation

Requires good management

- Maintenance Management Systems
- Few active in South Africa
- Require specialist input
- CSIR recently developed a simple one for low-volume roads
Probably the biggest current problem

- 150 mm of gravel usually lasts 6 – 10 years
- Must be replaced
- Requires large quantities of selected gravel
  - 1200 m$^3$ or 2280 tonnes /km
  - Re-gravel once every 10 years (60 000 000 m$^3$)
  - Soccer field 10.25 km high
  - Fill Cullinan Diamond Mine every 15 months
- Sources running out
- Poorer material = worse performance
- We can’t go on digging holes like this each year
Costs of unsealed roads vary considerably with location, quality of road, etc.

- Cumulative costs over time (discounted)
- Construction, blading, regravelling
- Other costs may include dust palliation, spot regravelling, etc.
- Grass and drains are common to all roads

**Optimum annual maintenance expenditure**

- **Regravelling**
  - R120 000 /km x 50 000 km (per year)
  - R6 000 000 000
- **Blading**
  - R340 /km x 4 x 500 000 km x 10/yr
  - R6 800 000 000
- **TOTAL /yr**
  - R12.8 billion

**Typical costs**

- **Construction**
  - R250 000 /km
- **Regravelling**
  - R120 000 /km
- **Blading**
  - > R340 /km (width)
Far outweigh agency/authority costs

- Include
  - Vehicle operating, time, accident costs, etc.
- Vehicle operating costs
  - Fuel
  - Tyres
  - Maintenance
  - Depreciation
- Time – dominates and not usually taken into account
- Accidents – more on unsealed roads
- Environmental – pollution, etc.
- Social – access to facilities, dust in homes, etc.
- GDP – overall economy - damage to goods, non-delivery, etc.
Good material selection

- Using the TRH 20/COLTO specification
  - Difficult to locate these days
  - Can take a long time – regulatory requirements
  - Implemented in W Cape, Gautrans, Namibia
  - Should make wider use
  - Significant benefits

Good construction

- Major benefits if the road is built properly

Change in philosophy

- Road behaviour is different
- Reduce routine maintenance
- Reshape after 2 – 2.5 years
Alternative methods of stabilization

- Many alternative stabilizers/treatments
  - More than 50 marketed in South Africa

- Have researched a number of these
  - Research very seldom sponsored by supplier
  - Can have marginal benefits
  - Costly

- Two products have been used quite widely
  - Dust palliatives but do improve performance and reduce maintenance for light traffic
  - They both need periodic replenishment
Alternative methods of stabilization

- Developed Agrément certification process
  - Checks fundamental properties and performance
  - Provides certificate after meeting certain laboratory and field performance criteria
  - *No guarantee* but affords some confidence
  - Only one product certified so far
  - Not a chemical stabilizer but a cement additive
  - Certification will assist decision-makers
On-going research

- Different alternative stabilizers
- Liaising with consultants/authorities doing similar experiments
- Mixed results (traffic, climate, topography, drainage, etc.)
- General perception of little confidence in most of these products
- Needs considerably more research and should obtain certification

NB: Still gravel roads

- Rather conserve the imported materials
OTHER ALTERNATIVES

Sealing (surfacing)

- Conserves the material for at least 20 years
- Much reduced road-user costs
- Can be more cost-effective over 20-year life
- Developed software to assess this (Sabita, 2004)
- Have implemented on a number of roads
  - Provinces (Limpopo – Gundo Lashu, KZN, E Cape, Gauteng)
  - Forest industry
  - Private/mines
Role of CSIR

- From 1989 to present
- Actively involved in low-volume sealed roads
- Investigated 57 such roads (1990 – 1994)
  - Marginal materials, thin structures, upgraded gravel roads
- Guidelines were developed (RR/92/466/2)
  - Not widely implemented
  - Conservatism?
- Mostly by CSIR and some innovative practitioners and authorities
- Currently developing a more user-friendly guideline (Basic Access Road project) including additional data and experience
- Restricted funding available for this
FILLING THE GAP

Cost

Quality of Service

80% of Road Network

Quality Gap

20%

Sealed Low Volume Roads

Surfaced High Geometric Standards

Surfaced Highway

Track

Graded

Gravel

Engineered Gravel
Innovative designs

- Optimise use of underlying conditions
- Use existing gravel road as far as possible
- Design road based on penetration test results
Need appropriate surfacings

- New Sabita document produced recently
- Developed by Consultant and CSIR
- Specific for low volume roads
- Appropriate for the situation
- Lower cost than conventional seals?
- Based more on life-cycle costs
Two particular surfacing types should be assessed more

Sand seal
- Widely used in Kruger National park (900 km)
- Uses renewable resource

Otta seal
- Developed by Norwegians
- Use on more than 75% of Secondary roads in Botswana (> 1600 km)
Is there any higher risk of failure than using conventional designs?

No:

• We use this process for rehabilitation of major highways (TRH 12)

Provided that:

• The process is understood and followed properly

• Good maintenance practices and management are followed

  • Local failures are inevitable
  • Must be maintained immediately
  • Local labour/skills
Are there any other risks associated with such roads?

Possibly

• Speeding is a risk – more accidents?
• Appropriate warning signs
• Traffic calming measures

Communities generally prefer an appropriate low volume sealed road to an unpaved road
Critical component of the process

- Implement proper/appropriate management systems
- Actually compulsory by law
  - Asset register
  - Requires regular assessment of the roads
- Facilitates systematic planning and budgeting
- Small Local Authority Pavement Management System (SLAPMS)
  - Simplified PMS for small local authorities
  - Reduced data collection requirements
  - Spreadsheet system of analysis
Finalisation of research

- Complete guidelines currently being produced (December 2012)
- Implement where possible (pilot scale)
- Refine the design catalogues (climate, topography, etc.) through back-analysis
- Develop wider skills base at CSIR for continued research and implementation
- Still lots of gaps!
Technology transfer

- Have presented numerous courses (SARF) on unsealed road design, maintenance and management (since 2008)
- Attended by hundreds of delegates
- Presented one SARF course on the LVR design process (March 2012)
- 18 people attended
- Not a satisfactory response
Implementation

- Publicise Basic Access Road guideline
- Needs intervention from Government (National, provincial or local) to stimulate its use and implementation
- Increase Agrément certification
- Work with consultants and authorities
- Ensure proper construction and control
- Monitor afterwards
- Train contractors
- We will have some failures – usually localised But we will have more successes
- Learn from the failures – investigate fully
SUMMARY

• We can not seal all 500 000 km of unsealed roads in SA
• Need to prioritise and manage the unsealed road network carefully to ensure that optimum use is made of limited resources
• Use best materials and construction for unsealed roads
• Use alternative stabilizers where appropriate
• Upgrade to sealed standard where appropriate
• Can produce more cost-effective rural roads
• Need to study each road individually
Thank you