The Need for Lower Quality Basecourse on much of the Public Road Network

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Demand and Supply

• About 65,000 km of sealed road
• 26,000 km of this carries less than 1,000 vpd
  – Many are remote
• Much of nearby basecourse aggregate is marginal
• Aggregate deteriorates through
  – Traffic-induced wear
  – Chemical changes
• Roads deteriorate also through lack of traffic
• Greater focus on marginal aggregate is required to give effect to RMA
• Pricing does not favour use of abundant marginal material
Sealed Road Network and Demand

SH by ONRC ADT

Average Daily Traffic

Pct "Thin Surfaced" Network

<200
200 to 1000
1000 to 3000
3000 to 5000
5000 to 15000
15000 to 35000
>35000
Sealed Road Network and Demand

LA by ONRC ADT

Pct Sealed Network

Average Daily Traffic

- <200
- 200 to 1000
- 1000 to 3000
- 3000 to 5000
- 5000 to 15000
- 15000 to 35000
- >35000
Daily Traffic and Design Loading

- For a 25 year life, 5% HCV and 2% compound growth
  - 1,000 vpd ~ 420,000 ESA
  - 3,000 vpd ~ 1,300,000 ESA

- These very modest demands apply to a significant road length;
  - 1,000 vpd/420,000 ESA covers
    - 400 km of SH
    - 25,500 km of local roads
  - 3,000 vpd/1,300,000 ESA covers
    - 2,600 km of SH
    - 43,000 km of local roads
Why Look for Marginality?

- There are a high proportion of low volume roads on the network
- Utilising marginal materials preserves the high quality component of a non-renewable resource
- Under the Resource Management Act (Pt 2, s5)

5 Purpose
(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.
(2) In this Act, **sustainable management** means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while—
   (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
   (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
   (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.
Basecourse: Cost at site

Estimated Basecourse $/tonne (Truck and Trailer delivery)
City vs Regional

$/tonne

Cartage Distance (km)
Measures of Basecourse Quality

- Basecourse is subjected to
  - Traffic-induced mechanical demand
  - Deterioration resulting from "weathering" and properties of fines

- These two take place at different rates, depending on
  - (Heavy) traffic demand
  - Source and nature of aggregate

- But they are both measures of service life

- We tend to focus on the mechanical resistance, and avoid geochemical issues

- Our basecourse selection process is therefore unbalanced from a design perspective
Measures of Basecourse Quality

- Two possible, potential ways of ranking the two basecourse life-determinants for evaluation of sources:
  - The Repeated Load Triaxial Test (NZTA T/15)
    - Focus on test at Optimum Moisture Content– sample from two lots from source
    - Provides an assessment of endurable ESA
  - The Clay Index (NZS 4407 : 2015, Test 3.5)
    - Deduces proportion of expansive clay material
Combining Quality Measures: An Idea

![Graph showing quality measures comparison](image-url)
Physical Deterioration from *Lack of Traffic*

- In its just-placed state, an unbound granular base must satisfy NZTA B/2
  - Minimum limits on compacted dry density
- **Regular traffic helps to maintain compaction-induced internal compressive stresses**
  - This assists internal shear through friction
  - The rate of rut development is reduced
- In the absence of regular traffic and with rainfall and time, the base layer relaxes/des- stresses—loses density
  - Internal friction resistance decreases (Ingress of water/release of clays/fines)
  - Shear strength decreases
- Thus, *rutting potential develops from too-infrequent vehicle passage*
Physical Deterioration from *Lack of Traffic*

- The effect is mitigated through providing internal tensile strength in basecourse
  - Chemical prestress to prevent relaxation
  - In the absence of regular traffic-induced pre-stress
- Some materials have inherent cementing properties
  - E.g. Whanganui Shellrock
- Others can be endowed with tensile strength through modification/stabilising
  - A balanced approach needed
Conclusion

- Low-volume roads are a large proportion of the total ~64,000 sealed network in NZ
- RMA points to need to give marginal aggregates strong consideration
- Cost-minimisation does not result in scarce high-quality aggregate being conserved:
  - Market-driven pricing is short-term focussed
- Chemical deterioration as well as traffic deterioration should be considered
  - An interaction diagram of RLT and CI has potential
- Low volume roads may suffer from too few vehicles
  - Tensile strength in the base is needed to inhibit relaxation
- Optimal solution may be modified marginal aggregate as basecourse