

LOW VOLUME SEALED ROADS – THE MALAWI EXPERIENCE

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Abstract

Effective and efficient all year round rural roads accessibility has remained a major challenge to meaningful social-economic growth for most African countries and Malawi is no exception. Being a country whose major transport mode is roads, it has always been the desire of the Malawi Government to ensure that all designated public roads are accessible all year round but this has always been an impossible target on unpaved roads which serve most of the rural masses.

Despite continuous and regular maintenance interventions on unpaved roads and the fact that traffic levels using these roads are relatively low, such roads remain a challenge to road users and the environment. It is on this understanding that the issue of gradual upgrading to paved standard of such roads becomes a viable solution. Unfortunately, associated costs of this undertaking to conventional standards are prohibitive, and this is coupled with the fact that financial resources are never sufficient. One possible way of dealing with this challenge is the consideration of upgrading such roads using a simplistic approach – Low Volume Sealed Roads.

This paper is aimed at sharing the Malawi experience with the rest of Africa on how roads constructed using simplistic approaches have evolved and performed. The paper also presents a platform on which further undertakings in this regard can be achieved with a high level of confidence. The paper further presents challenges that have and continue to be faced in the implementation of this non-conventional approach to upgrading of unpaved roads to paved standard.

Through this paper, it is expected that a new way of thinking amongst players in the road sector will be generated towards a cost effective upgrading of low volume traffic roads, which will go a long way in facilitating economic growth in developing countries in Africa and probably beyond.

1 THE MALAWI DESIGNATED PUBLIC ROAD NETWORK

The designated public road network in Malawi is 15,451 kilometres of which 76% is unpaved. Studies that were carried out a few years ago showed that there is an additional 9,500 kilometres of unpaved roads that qualifies to be part of the designated public road network. A process that will eventually lead to the absorption of this additional road network is in its final stages. This unpaved road network is the one that services most of the rural transportation requirements. Ironically, the rural setup in Malawi is the one that acts as the financial base for the economy through subsistence and commercial farming. The unpaved road network is unfortunately characterized by a number of factors that are detrimental to social and economic growth of the country and this is applicable to many of the African developing countries. Some of these factors are:-

- a) Seasonal accessibility due to high sensitivity of these roads to weather and traffic;
- b) Long travel times as good riding conditions on these roads cannot be sustained;
- c) High vehicle operating costs due to poor riding condition;
- d) High recurrent maintenance costs to the road agencies;
- e) Continuous use of gravel which, unfortunately, is a non-renewable resource and becomes wasted through weather and traffic factors; and
- f) Environmental unfriendliness (dust pollution to air and water) which has negative effects to the adjoining communities and the environment at large.

These negative factors are, however, almost non-existent when it comes to the paved road network, although it has its own setbacks such as increased traffic accidents and high capital investment (initial and periodic). A whole life cycle cost comparison of the two network types has revealed that it is advantageous by far to have paved roads as opposed to unpaved. It would therefore seem advantageous to any country's economy if most of the roads were paved. Unfortunately, this seems not to be possible due to the high initial investment costs associated with conventional paved roads. One question that remains to be answered is whether it is possible to gradually upgrade these unpaved roads using simplistic approaches which are embraced in the Low Traffic Volume Sealed Roads philosophy. To a larger extent, it seems the answer to this question is more of a "yes" than a "no". For one to appreciate this, it only requires an insight of what has happened before – the existence of paved roads constructed using simplistic approaches either knowingly or unknowingly. By going through past records or taking a closer look at some of our old roads, most of our countries will come to the realization that some of our paved roads came into existence through upgrading of existing unpaved roads using simplistic approaches that cannot be backed by normal engineering philosophy and principles.

2 LOW VOLUME SEALED ROADS IN THE MALAWI

2.1 Existence of older generation Low Volume Sealed Roads in the Malawi

Most of the designated public roads in Malawi are more than 40 years old. As such, the past 6 years or so have seen a number of paved roads depicting signs of ageing through the occurrence and recurrence of potholes. This has on a number of occasions forced the Roads Authority in Malawi to rehabilitate such paved roads more especially in the major urban areas of the country. Through these rehabilitation works, it has been surprisingly discovered that most of

the urban paved roads which have remained intact and in use for over 20 years with reasonably increasing high traffic levels were built as Low Volume Sealed Roads. On most of these roads, a granular base of about 100mm was placed directly on the sub-grade (i.e. the existing natural materials) and then paved with either surface dressing or asphalt concrete – a very simplistic approach to paving of earth roads that has surprisingly withstood the test of time. From such revelations, it has been concluded beyond doubt that the Low Volume Sealed Roads philosophy has been practiced in Malawi dating as back as over 20 years ago. However, what is lacking is a proper record of this initiative. This lack of records has unfortunately worked to the disadvantage of the road sector, since that knowledge has not been made available as a reference point for implementation of similar projects with a reasonable level of confidence.

2.2 New generation Low Volume Sealed Roads (LVSR) in Malawi

In recent years, the Roads Authority in Malawi has upgraded a number of unpaved roads to paved standard using the Low Volume Sealed Roads philosophy with an outstanding level of success. These are a living testimony of new generation Low Volume Sealed Roads which we would like to use as a solid base for further upgrading of unpaved roads serving the rural masses in the country.

2.2.1 Underlying Principle

As pointed out earlier, most of the designated public unpaved roads in Malawi are over 40 years of age. The interesting aspect is that these roads, which were constructed using existing materials within the road corridor, were reasonably well engineered in terms of horizontal and to some extent vertical alignments. Even if the existing horizontal and vertical alignments were compromised in one way or another, there are always means and ways of mitigating that especially through installation of road signs. With the passage of time, the existing formations of these roads have been highly consolidated due to self weight, traffic loading and many other factors. This is the main reason why these roads are able to carry heavy traffic without deformation, except on isolated sections where drainage issues have not been adequately considered. These two factors, namely **consolidation** (which goes far beyond conventional compaction), and **reasonable geometric configuration**, are a very stable platform upon which Low Volume Sealed Roads in Malawi have capitalized with great success. The picture below is a typical earth road that has been in use for over 40 years.



Figure 1: Typical Earth (>40 yrs old)

2.2.2 The Upgrading of Unpaved Roads using a Simplistic Approach

Based on the factors discussed under 2.2.1 above, the Roads Authority in Malawi went ahead to upgrade a number of earth roads as Low Volume Sealed Roads through a simplistic approach. Under this approach, the horizontal alignments and overall widths of the existing unpaved roads were not changed. The construction procedure involved **grading and proof-rolling** of existing road platforms so that they act as sub-base for the final paved road. Thereafter, a **gravel base layer** was placed on top and compacted to 98% MDD followed by a **Cape Seal** (19 millimetres stone chippings and a 10 millimetre slurry seal) using a simplified rather than the conventional bid document. The following picture is a demonstration of these three main upgrading activities:



Figure 2: Typical LVSR (6 yrs old) – 150mm Gravel placed direct on existing earth road

The gravel used was of minimum 60% soaked CBR. Other necessary ancillary works such drainage structures were provided so as to prevent premature damage of the newly sealed roads. Under this approach, the Roads Authority in Malawi has upgraded about 20 kilometres of earth roads with carriageway width ranging from 4 to 6 metres in various parts of the country during the period 2001 to 2005.

The following three pictures show typical examples of road sections that have been upgraded using the Low Volume Sealed Roads simplistic approach. In this particular example, the Low Volume Sealed Road section connects to a conventionally upgraded section. It should be noted that this particular road is now carrying an Average Daily Traffic of 250 vehicles.



Figure 3: Low Volume Sealed Road after 9 years being in use



Figure 4: Conventionally Upgraded (4 yrs old) and Low Volume Sealed Road (9 yrs old) Road Sections connection



Figure 5: Ntchisi Conventional (4 yrs old) and Low Volume Sealed Road (9 yrs old) Road Sections connection

2.2.3 Adoption of Appropriate Standards and Specifications – Cost Efficiency

The Low Volume Sealed Roads that Malawi has recently constructed were based on a simplified bidding document and targeted medium scale local contractors. The major work items were only five namely: **rehabilitate roadway and side drains, formation of embankment from local borrow, gravel road base formation to 98% MDD, prime and place chip seal and slurry sealing.**

Through this approach, the roads were constructed at a kilometre-cost of about US\$90,000. It is projected that at the current road works' construction rates, similar Low Volume Sealed Roads can be constructed at an average cost of around US\$150,000 per kilometre. This is against the current average upgrading rates which are hovering around US\$500,000 per kilometre under the conventional approach. It will be observed that huge savings were realized on these roads because of the following factors:-

- a) The use of global as opposed to discrete activities which could have too numerous for the same final product;
- b) The use of small scale contractors as opposed to the large and well established ones whose profits and overhead margins are, in most cases, on the higher side; and
- c) Minimal compensation events as the upgrading works followed existing road platforms.

2.2.4 Evaluation of Technical Performance on the Recently Constructed Low Volume Sealed Roads

Until a year ago when Malawi become a participating member in AFCAP activities, not much evaluation was done on the recently constructed new generation Low Volume Sealed Roads for the purpose of establishing their performance and as an objective approach to the possible rolling-out of such projects. However, pavement layer strength analysis was conducted on a 7 kilometres road network through DCP testing. The tests that were conducted at 6 different points within the area network showed that the original earth road layers (now acting as sub-bases) had derived CBR values ranging from 53% to 78% whereas the gravel base derived CBRs ranged from 90% to 145%. At the time of construction of these roads, which are now 6 years old, the laboratory sample CBR values at 95% and 98% of compaction were 68% and 81% respectively, whereas on the actual roads, the CBR values ranged from 60% to 70% at 98% compaction.

Theoretically, these roads should have failed long time ago, especially considering that the sub-base materials appear to fall below the standard 80% CBR. On the contrary, this has not been the case and the base material seems to have improved in strength with the passage of time. Since this was the first set of test results, no conclusions were made as to why the roads were performing well under such a theoretically weak engineering foundation.

3 CHALLENGES BEING FACED IN THE UPGRADING OF EARTH ROADS TO LOW VOLUME SEALED ROADS

The upgrading of earth roads to Low Volume Sealed Roads in Malawi has and continues to be faced with a number of challenges some of which are:-

a) Acceptance by the General Public

The general public is still of a general belief that any upgrading of an earth road should always be done to Class I Standard. Anything to the contrary is viewed as betrayal of the beneficiary communities, lack of capacity to design and implement upgrading projects amongst the Roads Authority personnel, or indeed some sort of corruption amongst the players involved. This is one of the challenges that Roads Authority in Malawi is trying address by trying to convince the general public that not all roads can be constructed to one standard.

b) Acceptance by the Construction Industry

The construction industry, especially consultants, is not willing to embrace the Low Volume Sealed Roads philosophy. They feel this approach is a high risk undertaking on their part. As such, when given an assignment in this regard, they usually deviate towards the conventional approach, contrary to the Terms of Reference. In the absence of a standard design procedure for upgrading this type of road to paved standard, design consultants will continue being defensive of what they think can work based on their earlier conventional design experience.

c) Lack of Funding

Just like other road infrastructure interventions, funding is always a major challenge in most of the African developing countries. The Low Volume Sealed Roads undertaking in Malawi is facing a similar challenge. Unless there is a deliberate policy towards this area by either Government or indeed cooperating partners, Malawi is not going to gain much with this initiative whose impact at rural community level and indeed the country at large is huge. The lack of tangible performance data of such roads could be one the factors hampering Government, and indeed potential donors, in showing interest and starting to fund this initiative at a larger scale.

4 LESSONS LEARNT

a) Applicability of Low Volume Sealed Roads Philosophy

The performance of Low Volume Sealed Roads in Malawi so far suggests that this approach can confidently be applied even to medium traffic volume roads. Coincidentally, most of the unpaved roads in Malawi fall within this category meaning that most of the roads in the country could be paved under this Low Volume Sealed Roads approach, thereby reducing the overwhelming recurrent maintenance requirements.

b) Evaluation and Monitoring Record Keeping

Currently, the Roads Authority cannot confidently explain why the existing Low Volume Sealed Roads have performed so well technically from the time they were constructed to date due to lack of regular and well recorded evaluation and

monitoring data. This scientific information is essential if the current barriers and myths against this unpaved roads upgrading approach are to be overcome.

5 WAY FORWARD

Having seen the existing situation regarding Low Volume Sealed Roads in Malawi, it is very clear that there is need for a proper assessment of the situation on the ground if this initiative is going to offer one solution to the problems being faced at rural level when it comes to road transport. Fortunately enough, Malawi is now a participating member of AFCAP. Immediately after becoming a member, we initiated a project entitled "Performance Review of Design Standards, Technical Specifications and Bidding Documents for Low Volume Sealed Roads in Malawi". This project is in progress through a consultant engaged by AFCAP. The preliminary results of the study are very encouraging and will eventually go a long way in putting the work that has so far been done in Malawi in the limelight for an objective and acceptable approach to Low Volume Sealed Roads not only in Malawi but even beyond.

6 CONCLUSION

The issue of Low Volume Sealed Roads has been talked about for a long time as one possible solution towards effective and efficient rural accessibility. It is now high time for practitioners in this regard to come up with one voice as to how this philosophy, which has already been put into practice, can change the approach to rural accessibility. There is no doubt that this is a workable undertaking, and it should be embraced by all those concerned with the road sector. Most importantly, stakeholders need to be made aware that under the prevailing circumstances where financial resources are always not sufficient, workable initiatives like this one, which is capable of achieving the desired results, should be given a chance to flourish.

Keywords: Low volume sealed roads, design standards, Cape Seal, local contractors