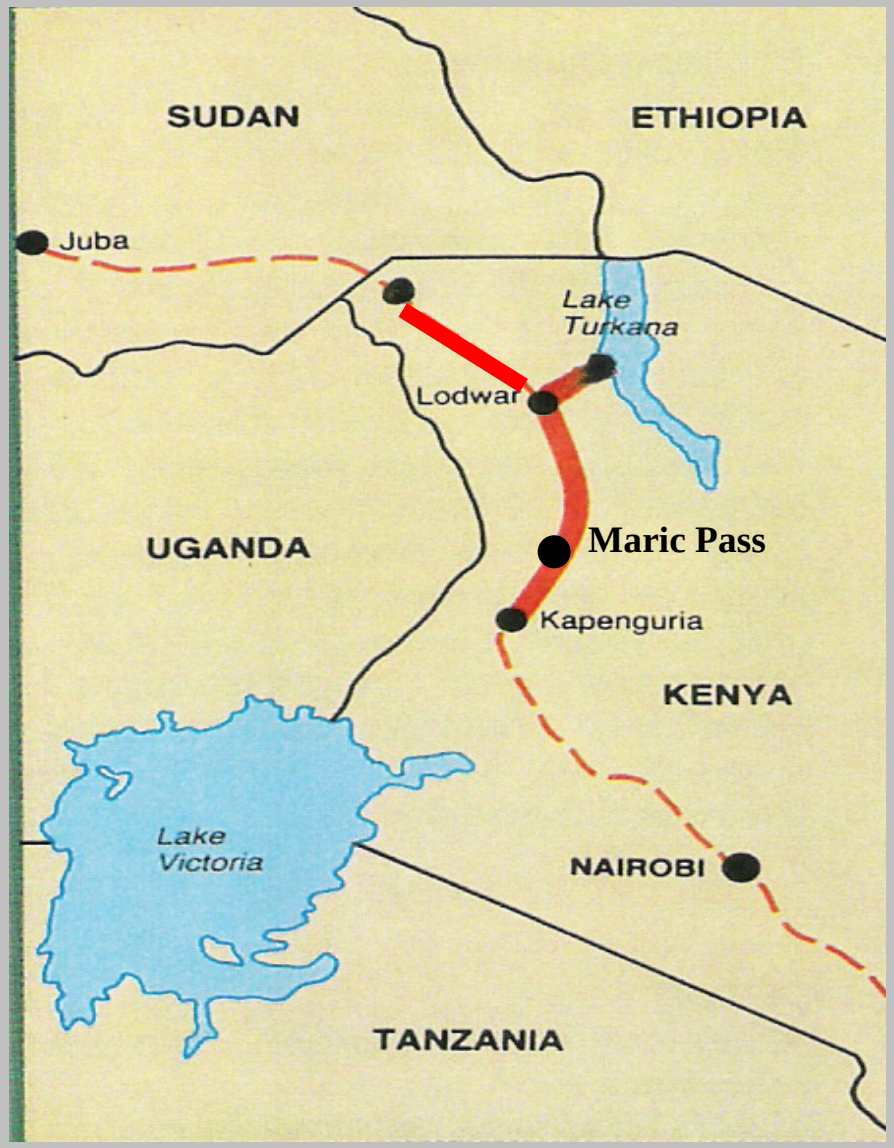
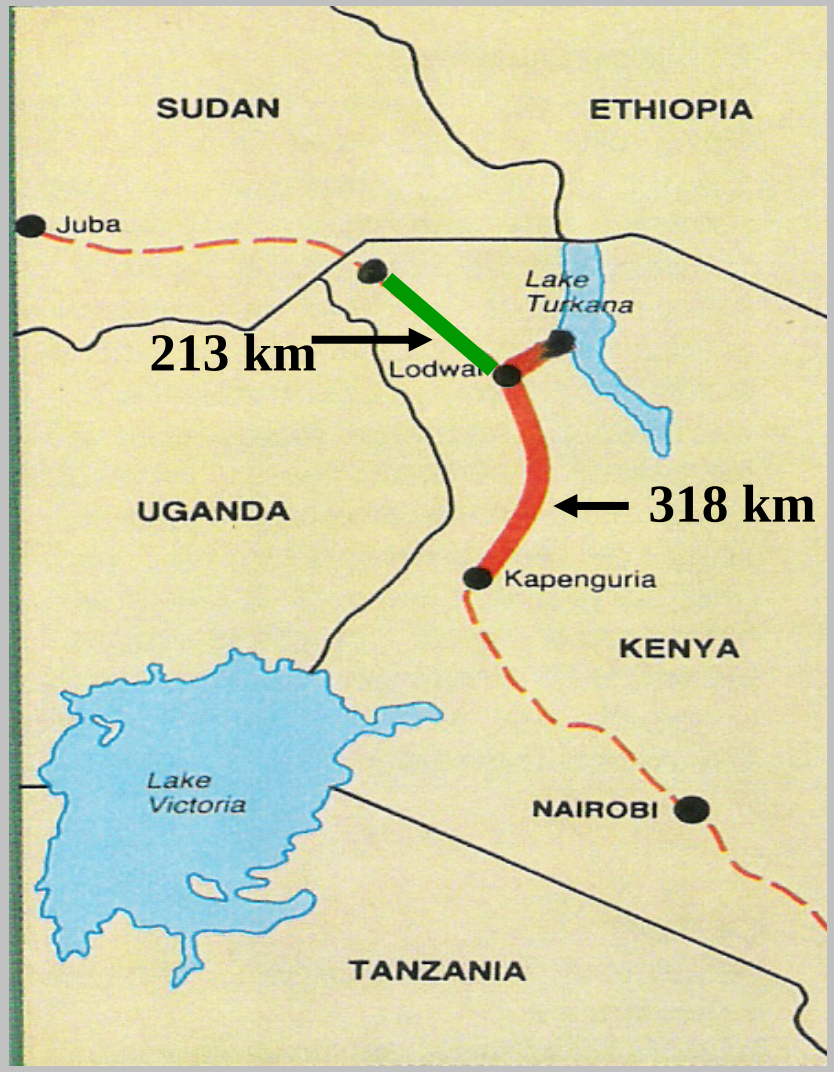


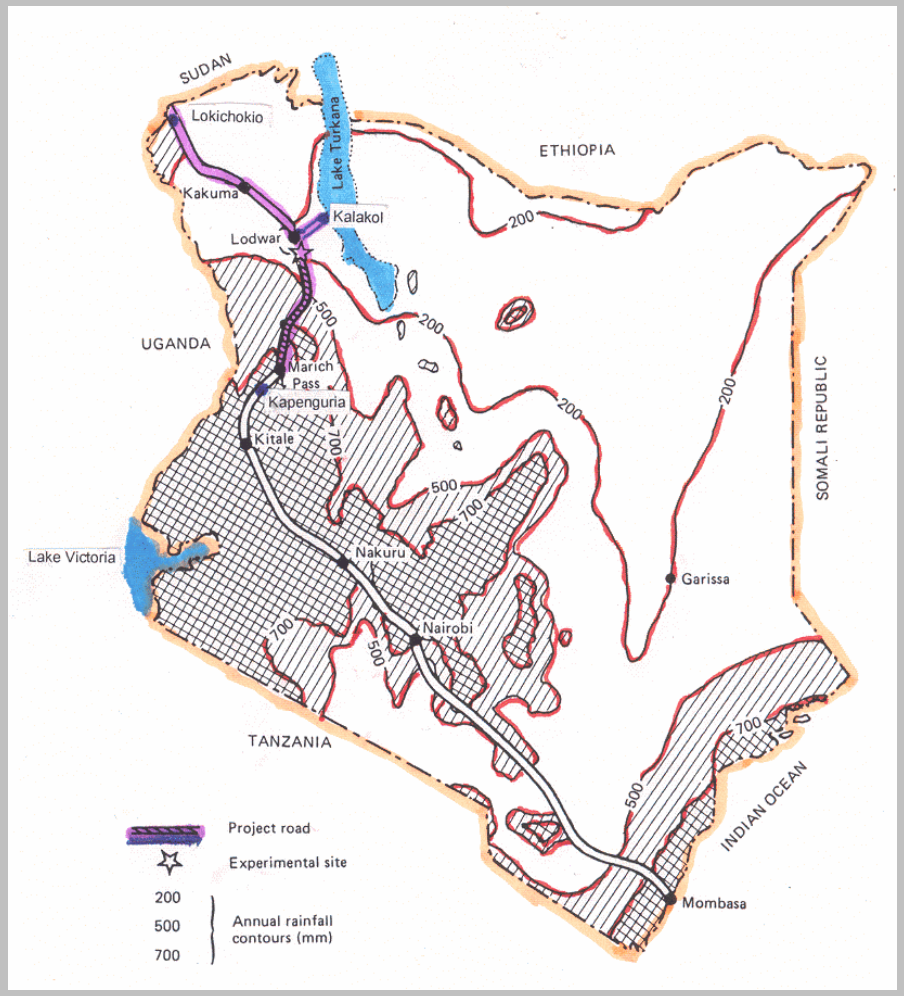
Case Histories (2)

By C. Overby,
Consultant

The project area (1)



The project area (2)



The road sections Lodwar-Kalokol and Marich Pass-Lodwar were initially constructed as gravel roads.

After carrying out various surfacing trials (Otta seal, sand seal and chip seals) it was decided to surface these two road sections with a double Otta seal using screened quartzitic natural gravel.

Brief summary of construction phases.

Phase A	Lodwar-Kalokol	Gravel road	57 km	1974-76
Phase B	Marich Pass-Lodwar	Gravel road	197 km	1975-77
Phase C	**Kapenguria-Marich Pass**	**Bitumen road (double Chip seal)**	**64 km**	**1977-84**
Phase D	Lodwar-Kalokol	Bitumen road (double Otta seal)	57 km	1985-86
Phase D	Marich Pass-Lodwar	Bitumen road (double Otta seal)	197 km	1980-84
	Lodwar-Lokichokio	**Bitumen road (double Chip seal)**	**213 km**	**1986-89**

First built as a gravel road.

Approximate 1988 construction costs of the various sections of road to a bituminous standard

Phase C: Kapenguria - Marich Pass; 5.9 mill Ksh/km ~ 100 %

Phase D: Marich Pass - Lodwar – Kalokol; 0.9 mill Ksh/km ~ 15 %

Lodvar – Lokichokio; 2,5 – 3.5 mill Ksh/km ~ 40 – 60 %

Marich Pass – Lodvar

General (1)

The road consists of a natural gravel pavement, 20 - 30 cm thick, under a double Otta seal with a 5.5 m surfaced width and 25 - 50 cm wide gravel shoulders. The road was first constructed as a gravel road between 1975-77 and later improved to a bituminous standard between 1980-84 using a double Otta Seal (no prime applied). Much of the earth works and pavement layers were constructed using “dry compaction” methods in which the materials were compacted at their in situ moisture content that varied between 0% and 2% in relation to the optimum moisture content of 6% to7% or even more.

Marich Pass – Lodvar

General (2)

The road section Marich Pass-Lodwar

is characterised by a “non standard” pavement structure utilising naturally occurring quartzitic clayey gravels (PI < 20) as base course (soaked CBR > 30) obtained from borrow sources close to the alignment. Surfacing seal, double Otta seal using graded screened graded aggregate.

Marich Pass – Lodvar - Kolakol

Sealing operations

Marich Pass - Lodvar

Performance (1) *

The bitumen surfaced road has been in service for more than 24 years with a minimum of maintenance and has carried more than double its design life of 1 million ESAs.

It is noteworthy that, apart from the surfacing, much of the pavement structure is still intact, with relatively little structural deformation of the base and subbase layers.

Marich Pass - Lodvar

Performance (2)

Condition February 2006 after more than 24 years in service.

Sections of the badly deteriorated road surfacing and shoulders (left) and other sections of the same with much of the pavement structure still being intact and the graded shoulders providing an alternative roadway (right).

Marich Pass - Lodvar

Performance (3)

Condition February 2006 after more than 24 years in service.

Sections of the road with no maintenance (left) and with maintenance (right) illustrating the substantial benefits of carrying out simple, routine, maintenance to extend the service life of the road.

Marich Pass - Lodvar

Condition February 2006 after more than 24 years in service.

Performance (4)

The same road but being regularly maintained, although not with a reseal.

Lodvar - Kolakol

General:

The 6.5 km wide surfaced road (double Otta seal – no prime) with a 75 cm gravel shoulders is about 57 km in length.

Constructed in 1985/86.

The subbase material was obtained from the road side and was used to lift the road to an average height of about 75 cm above ground level.

The base course was a naturally occurring quartzitic gravel of about 70 mm in thickness with a PI < 20 (soaked CBR > 30) obtained from borrow sources close to the alignment.

Lodvar - Kolakol

Performance (1)

The road has been in service for more than 22 years with a minimum of maintenance (no resealing) and is still in generally good condition.

The surfacing has remained in very good condition and there have been very few signs of distress – typically a few potholes and one major washout that have remained unattended.

The traffic carried to date is much lower than on the Marich Pass - Lodwar road with an estimated ESAs loading of about 0, 2 - 0, 3 million.

Lodvar - Kolakol

Performance (2)

Condition February 2006 after more than 20 years in service.

The Lodwar-Kalokol road looking towards Kalokol and showing the excellent condition of the pavement and surfacing after more than 20 years in service with practically no maintenance.

The double Otta seal surfacing constructed from screened quartzitic gravel obtained from adjacent to the road alignment

Lodvar - Lokichokio

General:

The Lodwar-Lokichokio road was constructed between 1986-89

with a 20 cm natural gravel subbase

15 cm crushed stone base under

a primed double bituminous surface treatment. The road is 6.0 m wide with 75 cm wide gravel shoulders – a traditional pavement structure of the time.

Lodvar - Lokichokio

Performance:

Lodwar-Loktiaung: **This section of the road is approximately 70 km long and exhibits some surface ravelling and potholes. The pavement is generally sound although along some sections of the road there are signs of rutting in both the inner and outer wheel paths. A few areas of the pavement and surfacing have failed and, in general, the road is in need of resealing or appropriate strengthening to carry increasing levels of commercial traffic bound for Lokichokio and Southern Sudan.**

Lokitaung – Lockichokio: **This section of road towards Lockichokio is about 140 km long and has been resealed recently and re-marked over most of its length. The road is in good condition, although it exhibits a relatively high roughness level compared with the section from Lodwar to Lokitaung. The following photographs illustrate the current (February 2006) condition of both road sections.**

Lodvar - Lokichokio

Condition February 2006

The Lodwar-Lokichokio road looking towards Lokichokio and showing the generally good condition of the pavement albeit with some ravelling of the surfacing.

The double chip seal crushed basalt.

Drainage structures

General:

These roads traverse an area with numerous streams and gullies. In addition, sheet flow after intense rainfall is common along those sections of the road where the terrain is very flat. Thus, according to the design report, 182 culverts and 47 drifts were constructed along the Marich Pass-Lodwar-Kalokol road. (In average 1 culvert or drift for each 1,1 km)

Performance:

After more than 22-24 years in service, most of the drifts and culverts have performed well. However, there were a number of instances of washouts and scour on the down-stream end of drifts and at culvert outlets.

Examples of well designed drifts along the Marich Pass-Lodwar road in which the bottom of the drift, forming the road surface is exactly at the level of the river bed – a requirement for good performance.

Examples of poorly designed drainage structures along the Marich Pass – Lodwar road. Insufficient depth of the downstream skirt has resulted in extensive scour of the drift (left) and a washout at a culvert outlet along the Lodwar-Kalokol road.

Lessons learned (1)

General: *

There are a number of lessons to be learned from the field visit that cover a range of technical matters including road surfacings;

pavement materials;

compaction techniques;

drift and culvert design and maintenance issues.

Nonetheless, both sections have provided similar levels of service in the same prevailing environment (traffic, climate, terrain, etc) but *at significantly different construction and, importantly, life-cycle costs*.

Lessons learned (2)

Surfacing:

***Double Chip seal*: The double Chip seals used between Kapenguria - Marich Pass and Lodwar - Lockichokio have been in service between 18 - 20 years and, apart from a few short sections that require reconstruction, have generally performed satisfactorily.**

However, the entire length of road is now in need of urgent maintenance in terms of pothole patching and subsequent resealing.

The section between Lokitaung and Lockichokio has already been resealed with a double chip seal.

Lessons learned (3)

Surfacing:

Otta seal: **The double Otta seal that was used for the Marich Pass-Lodwar and Lodwar- Kalakol roads has been in service for 22 years and has performed exceptionally well where maintenance has been carried out (e.g. the last 60 km towards Lodwar). In contrast, where no maintenance has been carried out carried out (e.g. the first 137 km from Marich Pass towards Lodwar), the surfacing has deteriorated badly although the base has generally remained intact. Thus, it can be concluded that the double Otta seal, using relatively inexpensive, "non-standard" screened gravel, can provide a cost-effective bituminous surfacing for use in semi-arid areas such as Turkana and, when properly maintained, can provide a very long service life even for relatively high levels of traffic.**

Lessons learned (4)

Pavement layers:

The road sections between Kapenguria - Marich Pass and Lodwar - Lockichokio were both constructed with a crushed stone base over a natural gravel subbase, while the Marich Pass - Lodwar and the Lodwar - Kalakol sections were both constructed with naturally occurring quartzitic gravels in both the subbase and base layers of the pavement. In addition, in general, both layers were dry compacted.

The difference in costs between these two pavement types which employ different design and construction technique is substantial – of the order of 2.5 – 3.5 times higher for the crushed stone base.

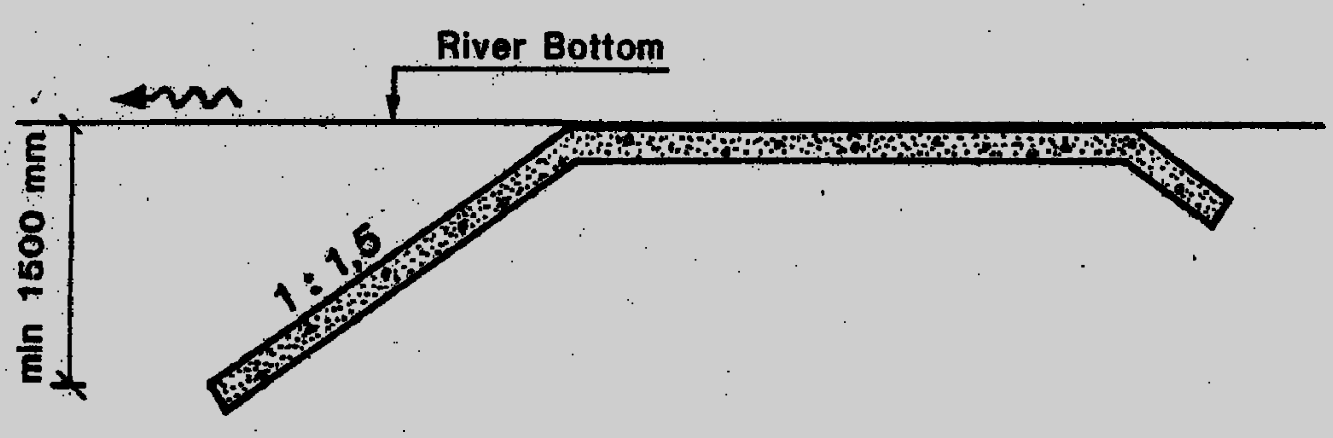
These road sections provide invaluable surfacing and pavement structure information that could be used to determine their life-cycle costs in similar environments as the basis for using this information to develop case histories for reference by other practitioners.

Lessons learned (5)

Drifts: *

Some 47 drifts were constructed between Marich Pass - Lodwar - Kalokol and Lodwar-Lockichokio.

Those drifts that were constructed NOT in level with the stream/river bed either silted up or experienced serious erosion down stream, totally exposing the skirt and, in some cases, the underside of the drift.



Lessons learned (6)

Maintenance: *

The serious lack of any maintenance activities for the last 10-15 years (apart from the Lokitaung-Lockichokio section and partly along the Lodwar-Kalokol section) has resulted in much of the remaining sections of part of the total length of the roads falling into a very critical condition.

Traffic loading of more than 2,0 million ESAs in contrast to the design traffic loading of 1,0 million ESAs

Conclusion

In conclusion, the exposure to the history and performance of these roads enhanced the fact that naturally occurring materials (high PI and low CBR) can be used appropriately in the provision of durable, Low-volume sealed roads.

Moreover, such materials may well not comply with traditional specifications which have generally emanated from technology and research carried out in Europe and in the USA over 40 years ago in very different environments. Thus, the history of these roads may well act as catalyst for adoption of more appropriate, regional research-driven, road designs and specifications as promoted by the SADC Guideline on Low-volume Sealed Roads.

There is a need for a more systematic write up of road projects as case histories to supplement and enhance the guidance given in the SADC Guideline on Low-volume sealed roads through the provision of practical examples.

So, Ladies and gentlemen where are we going, how many times do we have to re-invent the wheel