

INTERNATIONAL WORKSHOP, Kenya.

Nairobi 28th February – 1st March 2006

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A brief of the Otta Seal

Otta Seals

What is it ?

- ▶ **An Otta Seal is formed by placing graded aggregate on a relatively thick film of comparatively soft binders which, on rolling and trafficking, can work its way upwards through the aggregate interstices.**
- ▶ **In this manner, the graded aggregate relies on both mechanical interlocking and bitumen binding for its strength - a bit like a bituminous premix.**

Mechanism of Performance of Surfacing Types

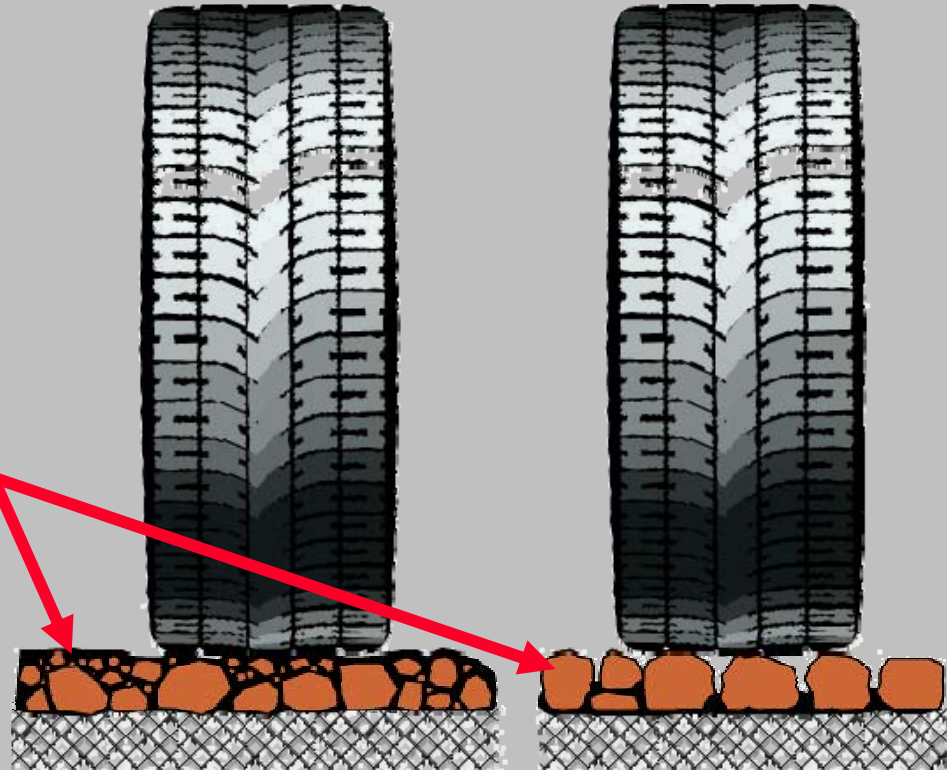
Single Otta Seal (0-16 mm)
Thickness 16 - 20 mm



Single Chip Seal (13,2 mm)
Thickness = ALD 8 to 10 mm



Under trafficking, the seal acts as a stress-dispersing mat comprised of a bitumen/aggregate admixture – a mechanism of performance which is quite different to that of Category B surfacings.



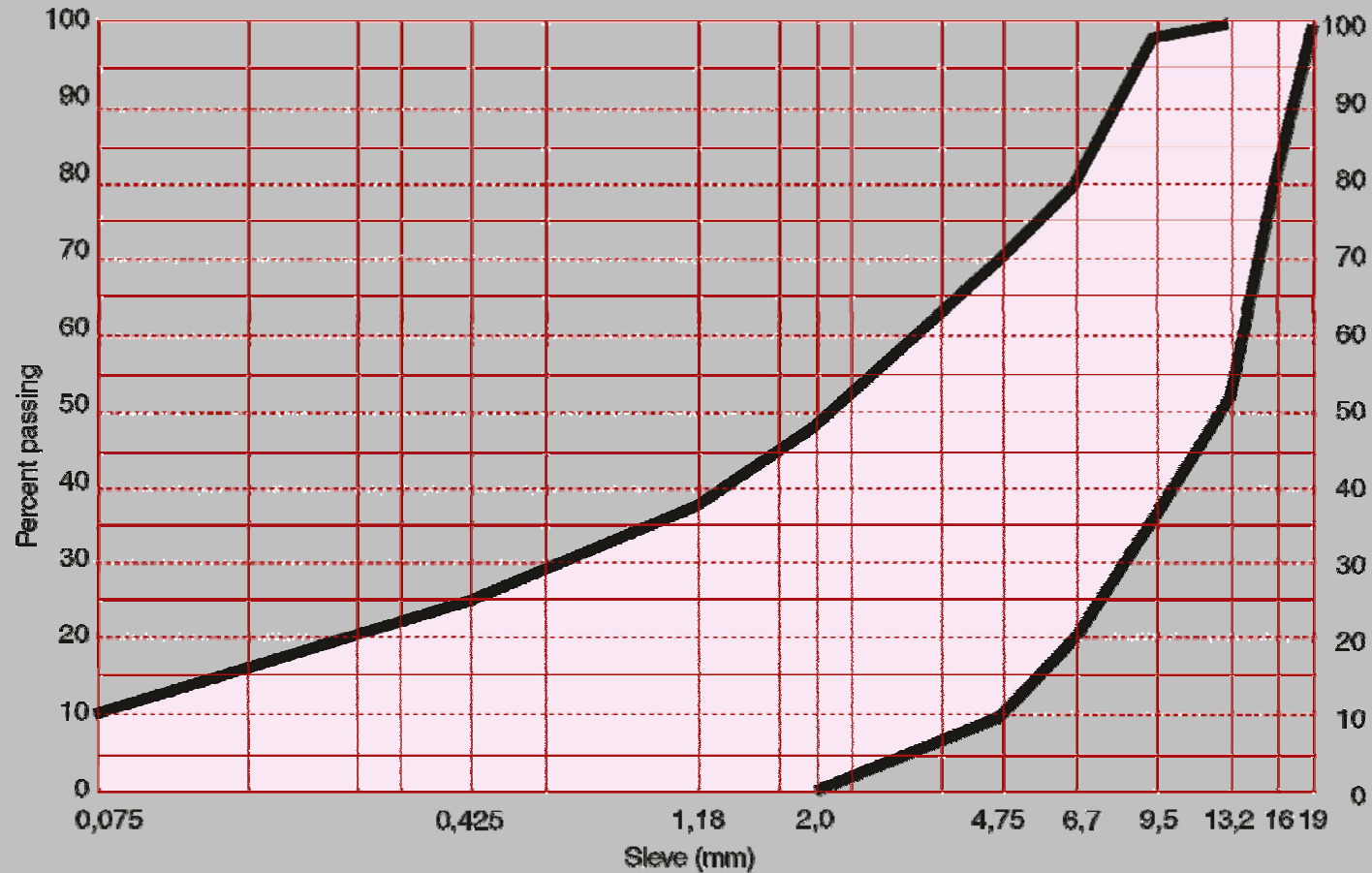
Performance Characteristics (1)

- ▶ **The texture of an Otta Seal is playing a vital role in it's performance.**
- ▶ **The dense textures as formed by many particles thick layer of aggregates where the interstices are filled with comparatively soft bitumen has been found to be very durable.**

Performance Characteristics (2)

- ▶ **Often preferred on roads with low bearing capacity due to its flexible behaviour.**
- ▶ **It seems that the close-texture grading as formed by the Otta Seal concept is less susceptible to binder ageing than a chip seal.**

Grading Requirements



Aggregate used in Otta Seals



Thickness of an single Otta seal.



Otta Seals

Why ?

Economy

- ▶ **Construction cost**
- ▶ **Maintenance life time costs**

Construction costs

- **Reduced cost in aggregate production**
- **Hauling cost is reduced because of utilization of local materials**
- **In most cases prime is omitted**
- **In many cases surfacing operations costs are reduced**

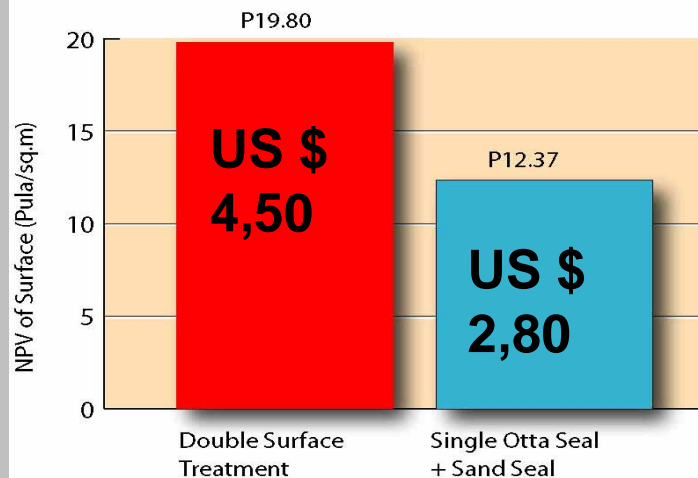
In general, this gives a cost saving in the magnitude of 20%. However, savings in the order of 35 - 40% have been reported.

Maintenance Intervention Life - cost comparison (1)

Life expectancy, activities and construction costs	Otta Seals		Double Chip Seal
	Single + sand cover	Double	
Life expectancy (years)	11	15	7
Maintenance activities	Reseal after 10 years. Road marking 3 times.	None	Fog sprays after 4 and 16 years. Reseal after 8 and 12 years. Road marking after each intervention (4 times).
Initial relative cost of construction	1.0	1.2	1.2

Maintenance Intervention Life-cycle cost comparison (2)

Cost Comparison: DST and Single Otta Seal + Sand



Cost ratio:
Otta Seal: DST = 0.60

For Botswana the cost savings in comparison with:

- Single Otta Seal with Sand cover Seal
- Double Chip seal

* **COST RATIO 0.60**

Over a period of 15 years, it has conservatively being estimated a saving of about US\$ 124 millions which roughly is estimated to be similar to the cost of a new trunk road standard 600 km long.

Otta Seals

How ?

- ▶ **Design**
- ▶ **Construction**
- ▶ **The maturation of
Otta Seals**

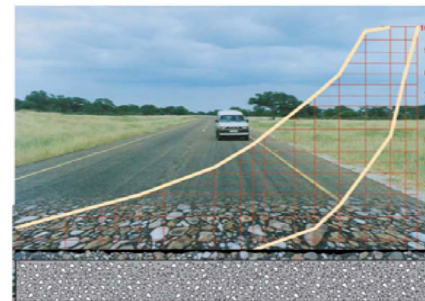
Publication no 93 from NPRA

no 93
Publication



Norwegian Public Roads
Administration

A Guide to the Use of Otta Seals



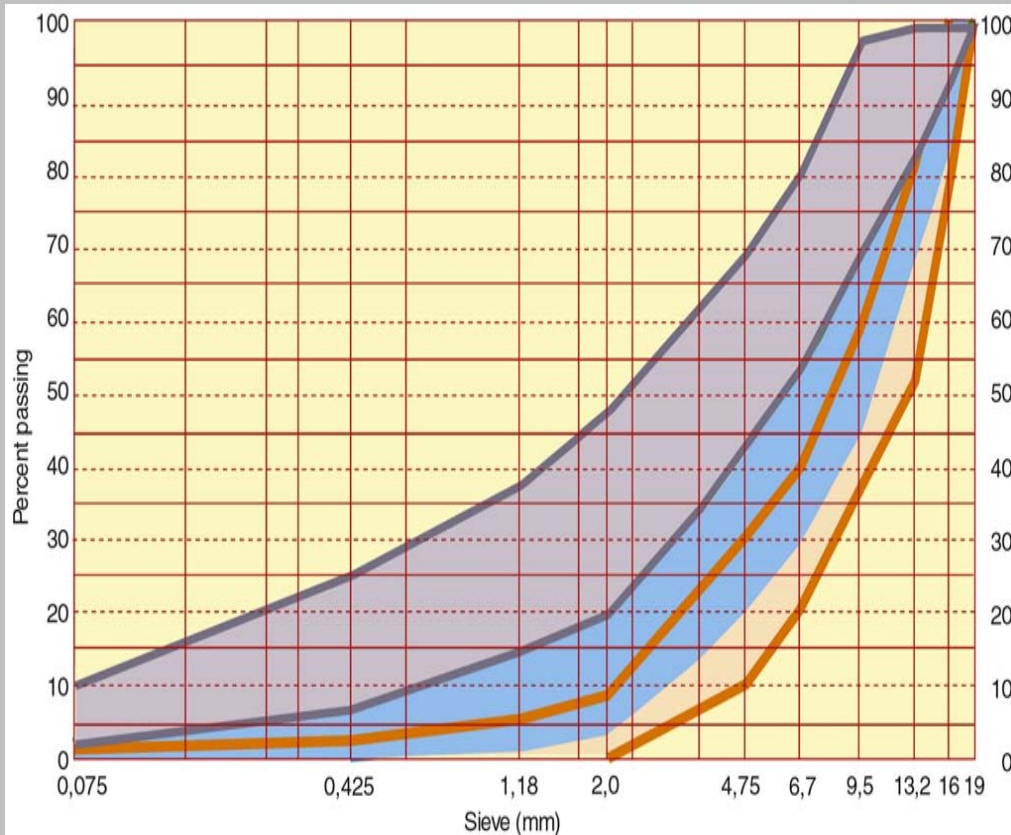
Road Technology Department (NRRL)

Pavement Strength

Like all other bituminous surface treatments, an Otta Seal will not contribute significantly to the structural strength of the pavement.

The pavement layers and drainage must therefore be adequately designed and constructed to withstand the expected traffic loading through its design life.

General Grading and Strength Requirements



AADT	Best suited grading
Less than 100	"Open"
100 - 1000	"Medium"
More than 1000	"Dense"

Aggregate strength requirements	Vehicles per day at the time of construction		BS Test Designation
	< 100	> 100	
Min. Dry 10% FACT	90 k N	110 k N	BS 812
Min. Wet/Dry strength ratio	0,60	0,75	

Binders

Type of binders of paramount importance.

Correct viscosity range:

Normally MC 3000 or MC 800
but also pen. bitumen grade 150/200

**80/100 pen. bitumen grade
shall NEVER be used.**

**Unless cut back to 150/200
v.grade using engine oil,
used or new.**

**All cutting back can easily
be carried out on site
providing certain safety
measures are applied.**

Binders, cutting back on site to required viscosity



The appropriate type of binder and viscosity may be obtained by cutting back with engine oil and power paraffin on site.

Bitumen Hot Spray Rates

Traffic level at time of construction (AADT)	Hot spray rates (l/m ²)
< 100	1,8 – 2,2
100 - 500	1,8 – 2,0
> 500	1,6 – 1,8

Prime

I wonder if this priming is necessary, after all they are putting down an Otta Seal ??



On a calcareous type of base and on stabilised bases (cement/lime) prime is required.

Construction (1)



Preparatory work prior to sealing operations.

Construction (2)

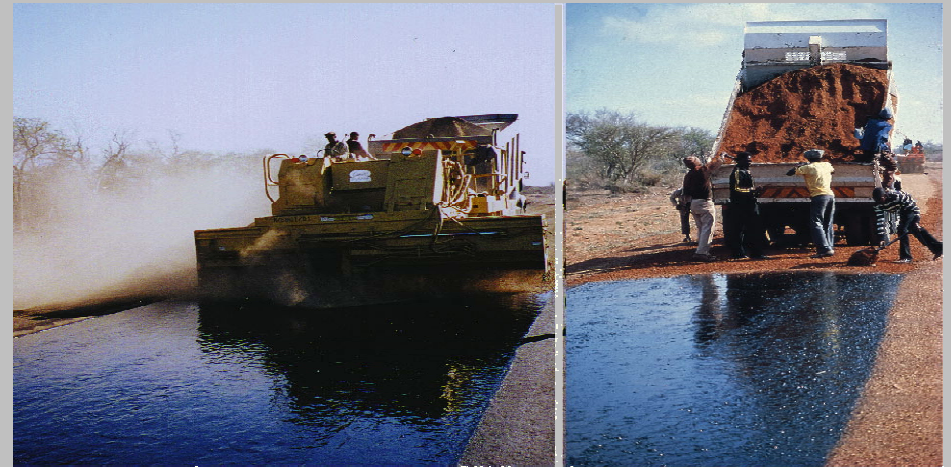


Light watering of the broomed base before spraying, the binder will enhance the bond between the surfacing and the base layer.

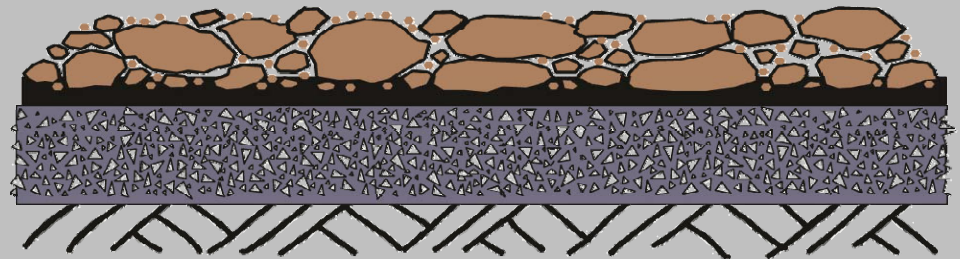
Fines and dust are allowed in an Otta Seal



Spreading of Aggregate



Aggregate application

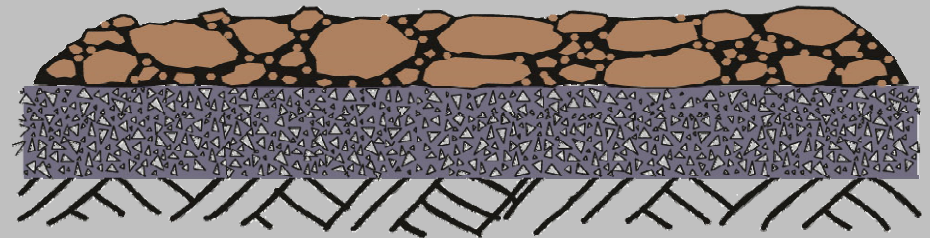


A wide range of aggregates can be used, fines included. Both mechanical chip-spreaders and Labour Based Methods can be used in the spreading of aggregate.

Rolling of Aggregate



Rolling



Excessive rolling with pneumatic tyre rollers is essential to achieve a good result. Sufficient rolling in the construction of Otta Seals can not be over-emphasised.

The Situation Immediately after Construction



The Situation After 1 - 2 weeks



3 - 4 weeks after Construction, some Excessive Aggregate has been Dislodged by Traffic



Sweeping back Dislodged Aggregate is a part of the "After Care Work".



Some Fatty up in the Wheel paths form a Normal part of the Curing process



The Situation Immediately after Construction, but after 8 – 10 weeks the situation changes.



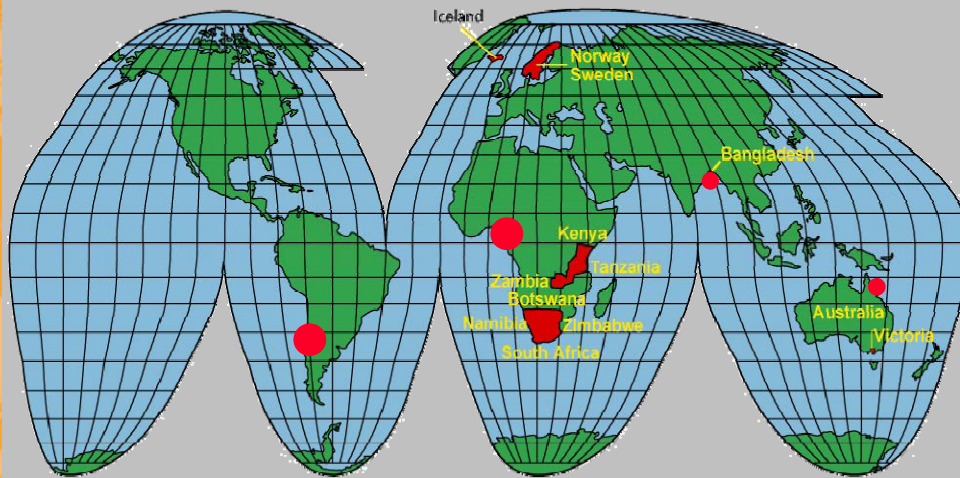
8 - 10 week after Construction



The Otta Seal Matrix



Where have the Otta Seal been used ?



Mali ??????????????

Country	Length	Comments
Norway	4000 km	In 1985 the figure was 12000 km
Sweden	4000 km	
Iceland	2000 km	
Kenya	500 km	
Botswana	3000 km	
Zimbabwe	80 km	Inclusive several trials
South Africa	One trial, 2 km	About 100 km to be Otta Sealed in 1999-2000
Bangladesh	20 km +	Only labour based methods used
Australia (Victoria)	Two trials ~2,2 km	
Namibia	Trial	
Tanzania	100 km	
Zambia	15 km	

For Tanzania and Zambia a number of road projects are planned with Otta Seal in 2003/04.

**Chile about 10 -15 km ...
and Ghana 6 km**

Conclusions

Has developed from being an economical “maintenance seal” to a fully fledged bituminous surfacing with no other limitations regarding traffic than one would apply to other sprayed bituminous surfacings.



Conclusions

The Otta seal method is an example of the innovative use of local, often marginal quality materials, in combination with appropriate bituminous binders to produce a durable surfacing.

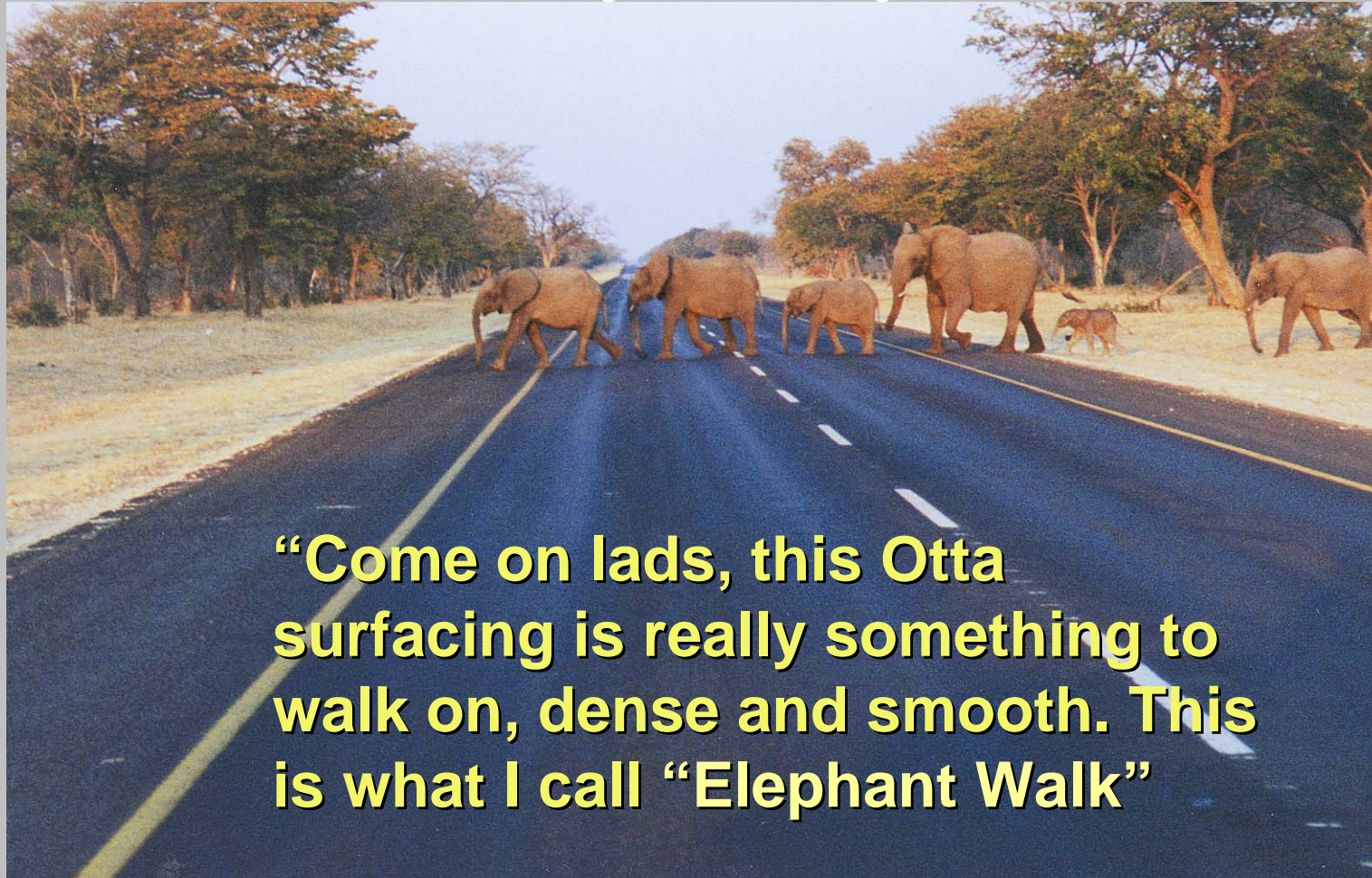


Conclusions

The Otta Seal has proved to be a very cost-effective surfacing and its use has under many circumstances allowed construction of roads under very unfavourable conditions, where conventional bituminous sprayed surfacings would have been too expensive or not possible at all.



The End, thank you for your attention



“Come on lads, this Otta surfacing is really something to walk on, dense and smooth. This is what I call “Elephant Walk”