

# DEVELOPMENT OF A CONTRACTOR- AND LABOUR-FRIENDLY CONCEPT FOR CONSTRUCTION OF LOW VOLUME SEALED ROADS

Jon Hongve  
AFCAP Consultant

Østveien 645  
3145 Tjøme  
Norway

# THE GUNDO LASHU PROGRAMME IN SOUTH AFRICA

- DESIGNED AS A GRAVEL ROAD REHABILITATION PROGRAMME
- 24 CONTRACTORS TRAINED IN TRADITIONAL LABOUR-BASED METHODS FOR CONSTRUCTION OF GRAVEL ROADS
- IT WAS SOON REALIZED THAT GOOD QUALITY WEARING COURSE GRAVEL COULD HARDLY BE FOUND
- THE REHABILITATED ROADS WOULD THEREFORE DETERIORATE RAPIDLY UNDER RELATIVELY HIGH TRAFFIC (UP TO 400 VPD) AND HEAVY SEASONAL RAINSTORMS

# THE GUNDO LASHU PROGRAMME IN LIMPOPO PROVINCE, SOUTH AFRICA

- CASE STUDY ON ALTERNATIVES TO GRAVEL WEARING COURSES
  - Treatment of local materials (chemical, bitumen,) high construction cost but lower life cycle cost
  - Dust reduction, more environmentally friendly
  - Reduction in VOC of 23% significant to rural communities
- RESULTED IN CHANGE TO UPGRADING ALL PROJECT ROADS TO PAVED ROAD STANDARD

# THE GUNDO LASHU PROGRAMME IN LIMPOPO PROVINCE, SOUTH AFRICA

- CONSTRUCTION METHODS NEEDED TO CHANGE AND CONTRACTORS TO BE RE-TRAINED IN NEW METHODS
- VERY DIFFICULT PROCESS WITH A LOT OF SUB-STANDARD WORK DURING THE FIRST SUBSEQUENT CONTRACTS
- CONSULTANTS ALSO NOT CONVERSANT WITH NEW METHODS AND APPROPRIATE DESIGN FOR LVSR, GUIDANCE ON DESIGN PRINCIPLES REQUIRED

## AFCAP

### **TRADITIONAL METHODS USING DITCH MATERIAL TO FORM THE CAMBER**

THE METHOD WOULD  
HAVE TO CHANGE FOR  
CONSTRUCTION OF  
PAVED ROADS. GRAVEL  
ROADS CAN BE REPAIRED  
BY BLADING. PAVED  
ROADS NEED A SOUND  
FOUNDATION TO  
PRESERVE THE HIGHER  
CAPITAL INVESTMENT.



# THE GUNDO LASHU PROGRAMME IN LIMPOPO PROVINCE, SOUTH AFRICA

- TRAINING OF CONTRACTORS & CONSULTANTS WAS CARRIED OUT IN CO-OPERATION WITH CSIR
- SHUTTERS WERE INTRODUCED TO CONTROL LAYER THICKNESS AND COMPACTION AND TO PROVIDE A SMOOTH RIDING SURFACE

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### **FIRST TRIALS WITH SHUTTERS AND COMPOSITE EMULSION TREATED BASE**

THE CONSTRUCTION METHOD IS SIMPLE AND IS EASILY GRASPED BY THE CONSTRUCTION TEAMS. EXCELLENT QUALITY CAN BE ACHIEVED AND QUALITY CONTROL IS SIMPLIFIED.



## AFCAP

### COMPOSITE ETB

50 MM LOOSE ETB IS PLACED ON TOP OF 100 MM LOOSE NATURAL OR CEMENT TREATED BASE MATERIAL. THEN THE WHOLE 150 MM LOOSE LAYER IS COMPACTED AS ONE TO A 100 MM COMPACTED BASE LAYER.



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# SURFACING TRIALS

OTTA SEAL AND SAND SEAL

# OTTA SEAL

- OTTA SEAL HAS BEEN PROVEN TO BE AN EXCELLENT SEAL FOR LOW VOLUME SEALED ROADS
- SELECTED FOR THE FIRST TRIALS
- MORE LABOUR FRIENDLY AND LESS COSTLY THAN CONVENTIONAL CHIP SEALS
- CAN CONTRIBUTE TO LOCAL EMPLOYMENT

## AFCAP

### **SCREENING OF LOCALLY AVAILABLE GRAVEL SOURCES TO BE USED AS OTTA SEAL AGGREGATES**

THIS WILL CONTRIBUTE  
TO EMPLOYMENT  
CREATION. IN SOUTH  
AFRICA HOWEVER, THIS  
WAS FOUND TO BE  
UNECONOMICAL DUE TO  
THE AVAILABILITY OF  
CRUSHED AGGREGATES IN  
MOST PLACES



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### **CRUSHED AGGREGATES SPOTTED ALONG THE ROAD TO BE SPREAD BY LABOUR**

SATISFACTORY RESULTS  
CAN BE ACHIEVED BY  
MANUAL SPREADING OF  
AGGREGATES. A DRAG  
BROOM MAY BE USED TO  
AID IN THE DISTRIBUTION  
OF THE AGGREGATES



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**THE "CHIPPIE"  
DEVELOPED IN  
SOUTH AFRICA**

THIS GREATLY IMPROVED  
THE AGGREGATE SPREAD  
RATE AND SURFACE  
REGULARITY OF THE  
OTTA SEAL



# OTTA SEAL

- OTTA SEAL was FOUND NOT TO BE THE IDEAL SEALING OPTION FOR LB PROJECTS BECAUSE:
  - HOT BITUMEN IS USED, POTENTIAL HAZARD FOR INEXPERIENCED PERSONNEL
  - DEPENDENT ON LARGE BITUMEN DISTRIBUTERS, OFTEN TRAVELLING MORE THAN 300 KM ONE WAY TO SITE
  - 1-1.5 KM OF BASE MUST BE READY FOR SPRAYING WHEN DISTRIBUTOR ARRIVE
  - FREQUENT PROBLEMS WITH DISTRIBUTOR, BREAKDOWN, MALFUNCTIONING

# OTTA SEAL

- CONTRACTORS STRUGGLED WITH
  - CURING OF CEMENT TREATED BASE
  - BASE DETERIORATION AND EXPENSIVE REPAIRS BEFORE SEALING
  - OVERALL QUALITY OF THE WORKS

# SAND SEAL

- LIMITED TRIAL WITH SAND SEAL ON NATURAL GRAVEL BASE
- STOOD UP WELL UNDER LIGHT TRAFFIC
- REQUIRES MOTORIZED BITUMEN SPRAYER AND WELL TRAINED OPERATOR TO ACHIEVE UNIFORM SPREAD RATE
- CAN BE AN ECONOMICAL SOLUTION ON VERY LOW VOLUME ROADS

## AFCAP

### **SPRAYING TACK COAT FOR SAND SEAL**

CHEAP AGGREGATES LIKE  
RIVER SAND OR CRUSHER  
DUST CAN BE USED  
MAKING THIS AN  
ECONOMICAL SOLUTION  
ON VERY LOW VOLUME  
ROADS WITH MAINLY  
LIGHT VEHICLES



# THE MIXED CONSTRUCTION APPROACH

# MIXED CONSTRUCTION APPROACH

- BASED ON THE EARLY EXPERIENCES, PLANT BASED PREPARATION OF SUB-GRADE AND SUB-BASE WAS ADOPTED. This:
  - ENABLED EMERGING CONTRACTORS TO GET OUT OF THE GROUND QUICKLY, AND
  - TO CONSTRUCT A SOUND FOUNDATION FOR THE UPPER PAVEMENT

# MIXED CONSTRUCTION APPROACH

- PROMOTION OF ETB: TO SOLVE MANY OF THE PROBLEMS THE CONTRACTORS WERE EXPERIENCING
- TO DEVELOP EMULSION BASED "SEAL AS YOU GO" TECHNIQUES TO BETTER CORRESPOND WITH THE PACE OF CONSTRUCTION
- TO ENCOURAGE DESIGN OF "THIN PAVEMENTS" BASED ON BETTER USE OF LOCALLY AVAILABLE MATERIALS

## ADVANTAGES OF ETB

- MANY IN TERMS OF PERFORMANCE:
- PROVIDES A "WATER PROOF" CAPPING TO THE LOWER PAVEMENT
- CONSTRUCTION METHODS EASILY GRASPED BY CONSTRUCTION TEAMS
- QUALITY CONTROL GREATLY SIMPLIFIED
- REMOVES MANY OF THE PROBLEMS FACED BY CONTRACTORS

**CONTROLLED  
MIXING OF ETB IN  
MIXING PANS**

BATCHING BOXES AND  
MEASURING CANS WILL  
ENSURE CORRECT MIX  
PROPORTIONS OF THE  
ETB. THOROUGH MIXING  
IN THE PANS IS EASILY  
CONTROLLED. THE  
TEAMS QUICKLY LEARN  
TO CHECK FOR CORRECT  
MOISTURE CONTENT



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**TRANSPORT OF  
READY ETB MIX TO  
THE FRONT OF THE  
CONSTRUCTION**



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THE ETB IS  
SCREEDED LEVEL  
WITH THE TOP OF  
THE SHUTTER AND  
COVERED WITH  
PLASTIC TO REDUCE  
EVAPORATION  
UNTIL  
COMPACTION IS  
DONE



## AFCAP

**A MEDIUM SIZED  
(1.5 – 2 TON) SIT-  
ON ROLLER WILL  
GIVE GOOD  
COMPACTION OF  
THE BASE LAYER.  
THE USE OF  
PEDESTRIAN  
ROLLERS FOR BASE  
COMPACTION  
SHOULD BE  
DICOURAGED**



# ETBDESIGN

- COMMON MIX PROPORTIONS INCLUDE 1.5-2.5% EMULSION AND 1% CEMENT
- LIME MAY BE ADDED IF MATERIAL HIGHLY PLASTIC
- CEMENT ONLY TO AID IN CURING, NOT TO INCREASE FINAL STRENGTH
- CBR TESTING OF ETB DIFFER FROM NORMAL TESTING PROCEDURES
  - 70% OF WATER MUST BE LOST BEFORE SOAKING AND CBR TESTING

# COLD MIX ASPHALT

- PENETRATION SEAL DEVELOPED TO RETAIN SOME OF THE ADVANTAGES OF THE OTTA SEAL
  - REQUIRES MOTORIZED BITUMEN SPRAYERS AND WELL TRAINED OPERATOR FOR UNIFORM EMULSION SPREAD RATES
  - GRADED AGGREGATES CAN BE SPREAD BY HAND OR USING THE CHIPPIE
- GENERIC COLD MIX ASPHALT NEEDED FOR PUBLIC TENDERS

# COLD MIX ASPHALT

- GENERIC COLD MIX ASPHALT USING BASICALLY THE SAME INGREDIENTS AS THE PENETRATION SEAL
- AT FIRST MIXED IN CONCRETE MIXERS
- QUALITY CONTROL GREATLY SIMPLIFIED
- EASILY GRASPED BY CONSTRUCTION TEAM
- EXCELLENT FINISH ACHIEVED
- PERFORM WELL ON CEMENT TREATED BASE AS WELL AS COMPOSITE ETB
- PURPOSE MADE MIXING PANS BETTER SUITED FOR COLD MIX ASPHALT

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### **MIXING PAN FROM 2MM STEEL PLATE CAN BE PRODUCED BY LOCAL FUNDIS**

WITH THE PANS THE  
PROBLEM OF CAKING OF  
THE FINES IN THE  
CONCRETE MIXERS IS  
AVOIDED.

THE PANS ARE EASY TO  
CLEAN, CAN BE STACKED  
INTO EACH OTHER AND  
TRANSPORTED ON THE  
BACK OF A PICK-UP



## AFCAP

### **THOROUGH MIXING AND GOOD COATING IS EASILY ACHIEVED**

RECOMMENDED BATCH  
VOLUME IS 40-50 LTR  
THE READY MIX SHOULD  
HAVE A WET LOOK TO IT,  
ALMOST LIKE A THICK  
SOUP, WHEN THE MIX  
PROPORTIONS ARE  
CORRECT



## AFCAP

**SPREADING TO  
EVEN THICKNESS IS  
CONTROLLED BY  
20MM GUIDE RAILS**



## AFCAP

A DENSE MIX  
GIVING A TIGHT  
SURFACE TEXTURE  
MUCH LIKE THE  
CONVENTIONAL  
OTTA SEAL



**AFCAP**

**EXCELLENT  
COMPACTED FINISH  
IS ACHIEVED**



# COLD MIX DESIGN

- CSIR/ILO GUIDELINE A GOOD STARTING POINT
- ON SITE TRIALS NECESSARY TO DETERMINE OPTIMUM MIX PROPORTION AND EMULSION CONTENT
- MAXIMUM FINES CONTENT WILL VARY WITH AMBIENT TEMPERATURE
  - TOO MUCH FINES -> HIGH TEMPERATURES -> DRY MIX -> INADEQUATE COATING OF COARSE FRACTIONS
- A COARSE MIX TAKES LESS EMULSION DUE TO LESS SURFACE AREA TO BE COATED

# LIGHT PAVEMENTS FOR LVSRs

- THE CONCEPT LENDS ITSELF TO COST EFFECTIVE CONSTRUCTION OF LIGHT PAVMENTS FOR LVSR.
- NEED FOR REVISION OF STANDARDS AND SPECS IN MANY COUNTRIES TO INCORPORATE LATEST RESEARCH AND EXPERIENCES
- IN-SITU STRENGTH OF NON-CONVENTIONAL MATERIALS MUST BE EFFECTIVELY UTILIZED IN THIN PAVEMENT DESIGN
- DCP A VERY USEFUL TOOL FOR MEASURING IN-SITU CBR AND COMPACTION

# A CONTRACTOR- AND LABOUR FRIENDLY CONCEPT

- ETB AND COLD MIX ASPHALT
  - REDUCES OR ELIMINATES PROBLEMS DURING CONSTRUCTION
  - PROVIDES WATER PROOFING OF THE PAVEMENT
  - HIGH CONSTRUCTION STANDARDS EASILY AHCIEVED
  - QUALITY CONTROL GREATLY SIMPIFIED
  - HIGH LABOUR INPUT
  - NEED FOR SPECIALIZED PLANT AND EQUIPMENT (PAVERS, BITUMEN DISTRIBUTERS ETC.) ELIMINATED

# SUCCESS STORIES

- GUNDO LASHU, SOUTH AFRICA
- ILO ROADS PROJECT ACEH AND NIAS, INDONESIA
- PEMBA RURAL ROADS PROJECT, TANZANIA
- ROADS 2000 PROGRAMME, KENYA
  - ROAD E1158 NYANGERA – UNHANYA/NYENYA BEACH
  - ROAD 415 MAKENZIE – KANDARA, CENTRAL PROVINCE, KENYA (PROMISING TRIALS)
- WHERE NEXT?