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

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# 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 REHABILTATED ROADS WOULD THEREFORE DETERIORATE RAPIDLY UNDER RELATIVELY HIGH TRAFFIC (UP TO 400 VPD) AND HEAVY SEASONAL RAINSTORMS

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# 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 communties
- RESULTED IN CHANGE TO UPGRADING ALL PROJECT ROADS TO PAVED ROAD STANDARD

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# 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

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# 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.

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# 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.

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## 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

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# 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

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# 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

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# 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

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# OTTA SEAL

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

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# 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

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## 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

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# THE MIXED CONSTRUCTION APPROACH

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# 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

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# 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 ENCCOURAGE DESIGN OF ”THIN PAVEMENTS” BASED ON BETTER USE OF LOCALLY AVAILABLE MATERIALS

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# 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

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## CONTROLLED MIXING OF ETB IN MIXING PANS

BATCHING BOXES AND MAESURING 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

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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

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# 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

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# 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

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# 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

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## 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

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

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

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## EXCELLENT COMPACTED FINISH IS ACHIEVED

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# 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

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# 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

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# 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

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# 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?