EMULSION TREATED BASE IN MOZAMBIQUE

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EMULSION TREATED BASE IN MOZAMBIQUE

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Background

- Mozambique has a long coastline which is about 2000km and most areas close to the coast are covered in coastal sand. In many areas the coastal sands extend well inland and this is mainly the only soil found in these areas. This makes road provision a serious challenge for the National Road Administration (ANE), the practitioners and the financiers.

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Background

- Eight out of ten provinces are affected. Road construction materials are scarce and in most areas they are actually non-existent. ANE is left with very little option other than using the locally available sand for the construction of roads.
- Most unpaved roads are built with a sand wearing course which in most cases only lasts less than six months except in cases where traffic is very low where regravelling cycles could reach 1 to 1.5 years. This brings into question the sustainability of Mozambique's rural road network.

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Background

- A research was carried out by TRL in collaboration with ANE for a period of 4 years on Engineering Standards and Life-Cycle Costing for Low Volume Unpaved Roads. This project revealed a serious performance deficiency of the unpaved rural road network. In brief the performance was found to be very poor with average gravel loss of about 70mm per year. Some roads had gravel loss figures above 100mm per year.
- This is unsustainable!!!!!.

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The Project

The project involves a number of aspects:

- Selection of surfacing options for each section
- Design of surfacing
- Construction of the emulsion treated sand base
- Construction of untreated sand base
- Construction of surfacing (slurry seal, sand seal, double surface dressing, single surface dressing)
- Monitoring for performance assessment and evaluation
- Preparation of specifications and work norms
- Development of maintenance strategy

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The project

- The project was carried out in two phases. Phase 1 involved the design and construction of embankments including the construction of culverts. Apparently the design of culverts was a little unique in that the inlets and outlets are designed to be at the same level so that water can flow either way depending on which side of the road receives more rain.

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The project

- Phase 2 involves the design and construction of further increases in the height of embankments, untreated sand subbase and emulsion treated sand base and low cost surfacing.
- The main objective of this project is to develop specifications and work norms for use of coastal sands in road building

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Design of ETB:

- The design for the ETB is a little complex. There are two approaches to it.

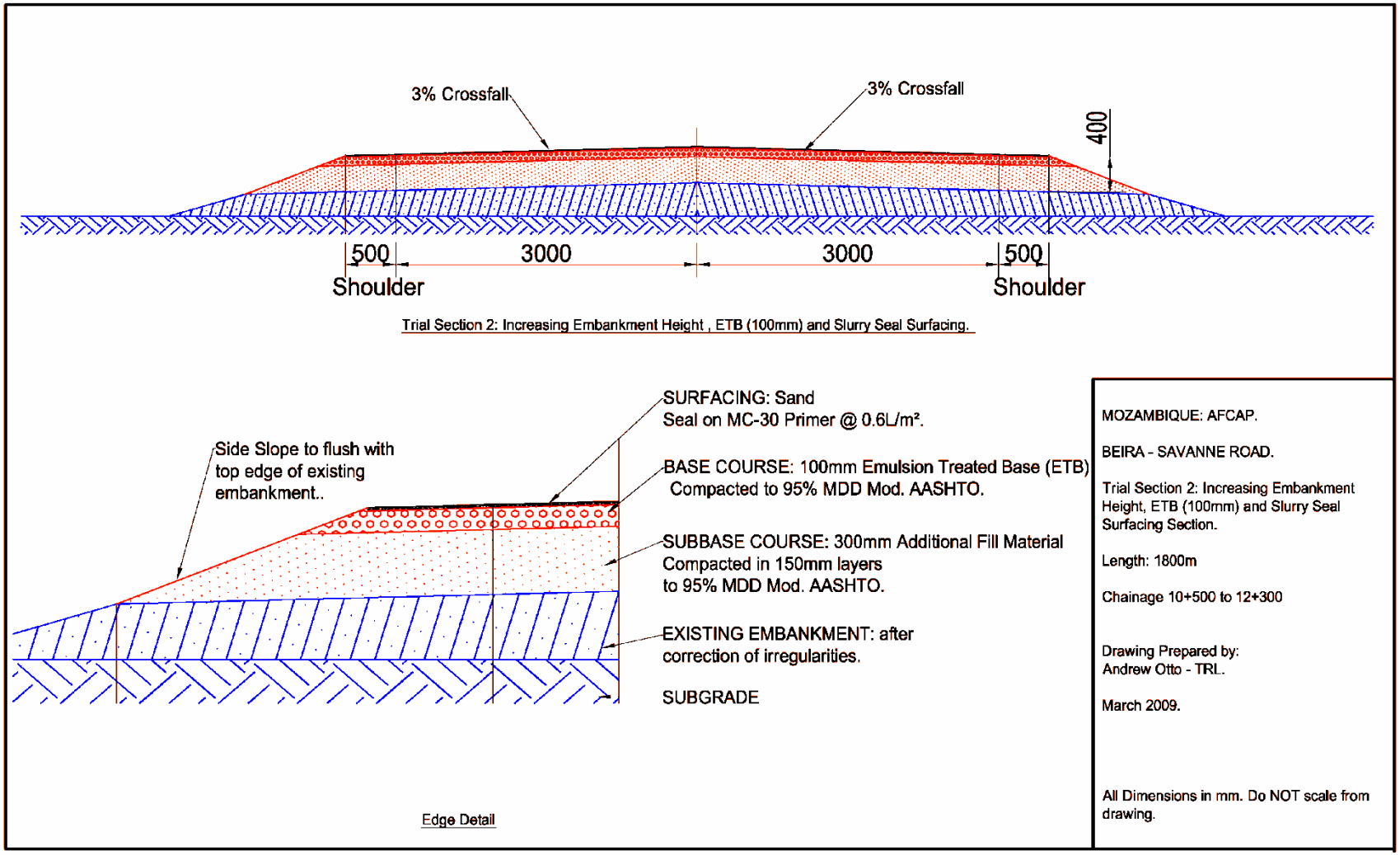
The maintenance layer design

The structural design

-The first design option assumes that adequate structural strength is provided for in the pavement layers underlying the ETB and that the ETB provides a capping layer for the pavement that is less sensitive to moisture.

-The second approach assumes the proper functionality of a base layer that should have adequate strength to disperse the load.

ETB Design


3% Crossfall
3% Crossfall
400
500
3000
3000
500
Shoulder
Shoulder
Trial Section 2: Increasing Embankment Height , ETB (100mm) and Slurry Seal Surfacing.
SURFACING: Sand
Seal on MC-30 Primer @ 0.6L/m².
Side Slope to flush with
top edge of existing
embankment..
BASE COURSE: 100mm Emulsion Treated Base (ETB)
Compacted to 95% MDD Mod. AASHTO.
SUBBASE COURSE: 300mm Additional Fill Material
Compacted in 150mm layers
to 95% MDD Mod. AASHTO.
EXISTING EMBANKMENT: after
correction of irregularities.
SUBGRADE
Edge Detail
MOZAMBIQUE: AFCAP.
BEIRA - SAVANNE ROAD.
Trial Section 2: Increasing Embankment Height, ETB (100mm) and Slurry Seal Surfacing Section.
Length: 1800m
Chainage 10+500 to 12+300
Drawing Prepared by:
Andrew Otto - TRL.
March 2009.
All Dimensions in mm. Do NOT scale from drawing.

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Testing

1. Sieve analysis of the sand (one test for the white sand and one test for the red sand)
2. Atterberg limits (one test for the white sand and one test for the red sand)
3. Mix the sand for further tests unless there are significant differences in results in tests (1) and (2).
4. Proctor tests: use Mod. AASHTO to obtain maximum dry density (mdd_u) and optimum moisture (OMC_u) of untreated sand.
5. CBR test: carry out soaked CBR tests at 95% mdd_u Mod. AASHTO (CBR_u).

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Testing

6.ETB without filler: Treat samples with 2%, 4% and 6% emulsion.

7.Compact to 95% Mod AASHTO at or slightly less than Optimum Fluid Content (OFC). OFC = OMC_u = bitumen in emulsion + water in emulsion and moisture in sand. Cure the moulded samples (100mm diameter x 68mm) for 72hrs at 40°C. Take some samples and carry out unsoaked CBR tests (CBR_{dry}). The other samples shall be soaked in water for 24hrs at 25°C before carrying out CBR tests (CBR_{wet}).

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Testing

8. ETB with filler: Treat samples with 2%, 4% and 6% emulsion. Add 0.6 to 0.8% cement filler to the sand before adding emulsion. Aim to achieve 0.8% filler and the filler shall not exceed 1%. Compact to 95% Mod AASHTO at or slightly less than Optimum Fluid Content (OFC). OFC = OMC_u = bitumen in emulsion + water in emulsion and moisture in sand. Cure for 72hrs at 40°C. Carry out unsoaked CBR tests (CBR_{Fdry}) and Indirect Tensile Strength (ITS_{Fdry}) on some samples. Soak the other samples for 24hrs at 25°C and carry out CBR tests (CBR_{Fwet}) and Indirect Tensile Strength tests (ITS_{Fwet}). The moulded samples for the ITS shall be 100mm in diameter and 68mm in height .

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ETB Construction

There are two main approaches in the construction of ETB especially for low volume roads.

In-situ mixing

Plant mixing

In-situ mixing is generally problematic in that it takes great effort to achieve a homogeneous mix and sometimes it's never good enough. Usually this can be carried out using a grader and disc harrows. It is not an easy process as emulsion becomes sticky after it breaks i.e. the bitumen separates with the water.

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ETB Construction

Plant mixing is the most recommended approach. Plant mixing produces a homogenous mix which leads to better performance. For large scale operations large automated mixing plants can be used. For small works concrete mixers can be adequate.

The process involves feeding the soil and the emulsion into the plant and setting the mix proportion stipulated to achieve the required bitumen content (usually between 4% and 6%).

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ETB Construction

After mixing, the ETB is transported and dumped, spread and compacted. It is important to determine the breaking time of the emulsion after mixing and use of stable grades of emulsion are recommended for situations where the process is likely to take long.

SS60 emulsion will be used for the ETB mix. The coastal sand that will be stabilised has a very fine grading and it falls outside the recommended grading envelope for ETB. There will be more trial sections which will include the structural design described above which involves the use of a filler (cement) at less than 1% cement content.

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ETB Construction

Construction is underway and a substantial part of the earthworks have been completed up to subbase level. The laboratory design of the ETB is also underway in ANE laboratory.

The bitumen content will also be varied to trial 2%, 4%, and 6% bitumen content.

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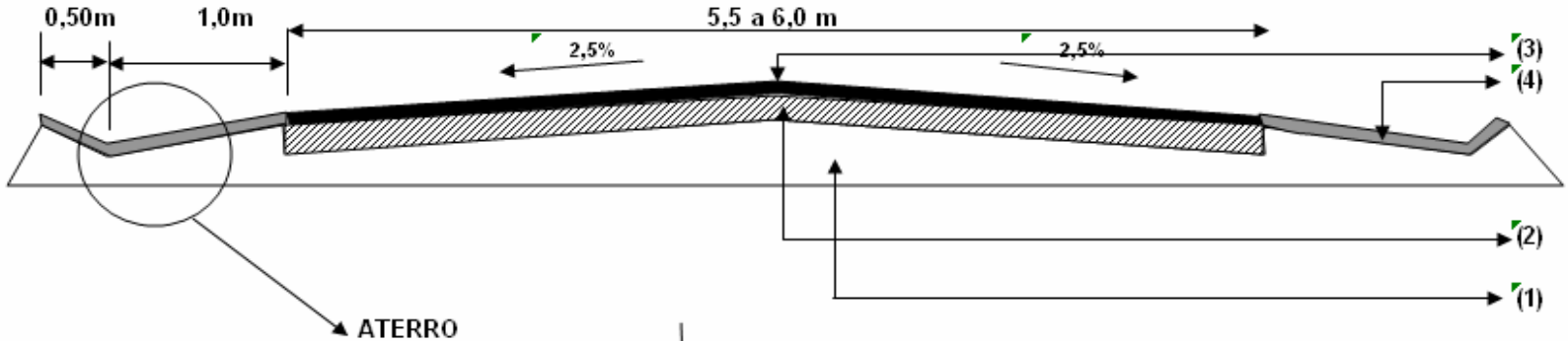
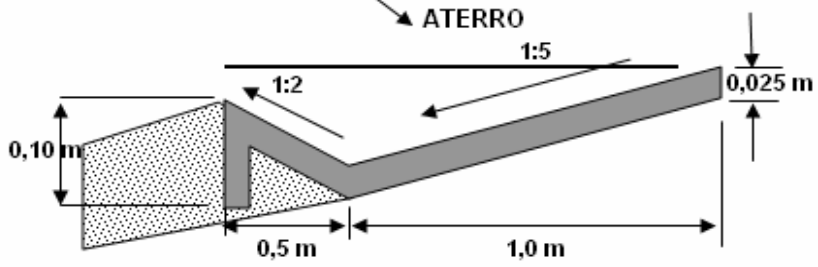
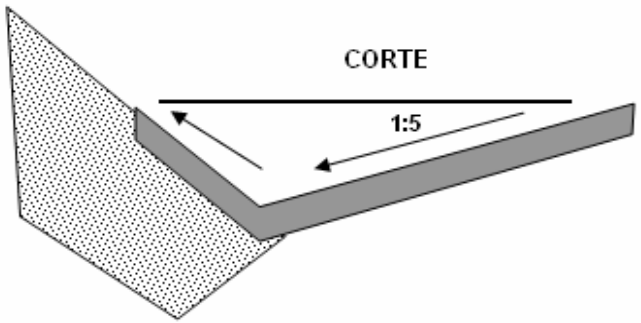
Past Experience - CROSS SECTION OF S.T.E. SECTIONS







ESPECIFICAÇÕES

(1)	IN-SITU S/GRADE	Material in situ compactado a > 93% Mod AASHTO (proof rolling)
(2)	S.T.E. BASE	Material in-situ + 9lt/m2 SS60 0,075m espessura > 98% Mod AASHTO densidade - enrequecimento topo
(3)	REVESTIM.	aREIA = 1,2 lt/m2 SS70 + 6-8 lt/m2 se areia do rio <6,7mm Rega colagem 0,6lt/m2 of 50/50 SS60+água Slurry seal = areia natural graduada + 1,5% OPC + 145 to 165 lt of SS60/m3 minimo de 4mm espessura
(4)	DRENO REVESTIDO	Material in-situ 9% SS60 emulsão 25mm espessura

The past experience

The past experience

- **MIXING) OF THE MATERIAL**

AFCAP

Past experience

OFF-LOADING MIXED S.T.E.

SPREADING MIXED S.T.E. MEXT TO TRANSVERSAL JOINT

AFCAP

Conclusions

- The ongoing research is very important to ANE and the road sector in general and the outputs are eagerly awaited. If successfully accomplished with the necessary specifications and work norms properly documented in a manual the benefit to the road sector will be significant even for the high volume roads.

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- Thank you for the attention!

- Muito Obrigado!