



AfCAP
Africa Community Access Partnership



Protocols for Improving the Proficiency of Material Testing Laboratories in Mozambique

Report on Workshop to Discuss Protocols on
Sample Preparation and Testing for the First PTS
Round (Final)



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Cover Image: Scenes from the workshop.

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ReCAP Completion Report Template

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Acronyms, Units and Currencies

10% FACT	10 % Fines Aggregate Crushing Test
\$	United States Dollars
AASHTO	American Association of State Highway and Transport Officials
ACV	Aggregate Crushing Value
AFCAP	Africa Community Access Partnership
AIV	Aggregate Impact Value
ALD	Average Least Dimension
ANE	Administração Nacional de Estradas; National Road Administration
ARMFA	African Road Maintenance Fund Association
ASCAP	Asia Community Access Partnership
BS	British Standard
CBR	California Bearing Ratio
CDS	Civil Design Solutions
CSIR	Council for Scientific and Industrial Research
DCP	Dynamic Cone Penetrometer
DFID	Department for Further International Development
DIMAN	Directorate of Maintenance
DIPLAN	Directorate of Planning
DIPRO	Directorate of Projects
DN	Number of mm penetration per blow of a DCP
EU	European Union
FACT	Fines Aggregate Crushing Test
FI	Fineness Index
FM	Fineness Modulus
FWD	Falling Weight Deflectometer
GM	Grading Modulus
GPS	Global Positioning System
ISO	International Standards Organisation's
INNOQ	Instituto Nacional de Normalização e Qualidade
LL	Liquid Limit
LMetc	Learning Matters etc
LNEC	Laboratório Nacional de Engenharia Civil (Portugal)
LS	Linear Shrinkage
LVR	Low Volume Road
MCA	Millennium Challenge Account
MDD	Maximum Dry Density
NLA	National Laboratory Association
NP	Non Plastic
OMC	Optimal Moisture Content
PMU	Project Management Unit
PI	Plasticity Index
PL	Plastic Limit
PT	Proficiency Testing
PTS	Proficiency Testing Scheme
ReCAP	Research for Community Access Partnership
RL	Reference Laboratory
RTFOT	Rolling Thin Film Oven Test
SA	South Africa
SADCAS	Southern African Development Community Accreditation Service
SANAS	South African Accreditation Service
SANS	South African National Standards
SE	Sand Equivalent
SC	Steering Committee
SP	Slightly Plastic

TMH Technical Methods for Highways
UK United Kingdom (of Great Britain and Northern Ireland)
UKAid United Kingdom Aid (Department for International Development, UK)

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1 Introduction

1.1 Background to the Project

The Africa Community Access Partnership (AfCAP) is providing a range of support to Mozambique. This support includes the development of design guidelines for low volume roads and the evaluation of existing road experimental sections constructed previously in Mozambique.

The validity of research on roads in Mozambique and the region depends on the reliability of laboratory test results. As a result, AfCAP is supporting the implementation of a pilot project for Proficiency Testing in selected laboratories. The overall objective is to establish laboratory testing in Mozambique that is “in line with international practices and standards and test results that can be used with confidence”¹.

The Proficiency Testing Scheme (PTS) will work towards determining a baseline for the precision limits for each specific test included in the project. The baseline will be used to assess laboratory capacity and identify where the constraints lie and where specific training and other interventions may be required. It is expected that participating laboratories will ultimately become accredited to the International Standards Organisation’s standard ISO/IEC 17025.

The Mozambique PTS project is a pilot project for Mozambique and for a possible AfCAP regional initiative to support capacity development in materials laboratory testing through a PTS process.

1.2 Objectives

The objectives of the assignment are as follows:

- To identify the repeatability and reproducibility (precision limits) of the principal test methods currently being carried out in Mozambican laboratories; evaluate the existing testing competence of laboratories in Mozambique.
- Determine how the test results of the Mozambican laboratories compare with those of internationally accredited (ISO/IEC 17025) laboratories and included these laboratories as independent controls in the baseline survey and PTS pilot.
- Identify where interventions are needed for improving test results and the type of intervention required.
- Design and manage a pilot PTS and transfer knowledge and expertise to Mozambican laboratory personnel on how to implement a PTS and to evaluate the test results obtained.

¹ Terms of Reference.

- Keep ANE and sector stakeholders fully informed on project implementation and outcomes in order for precision limits of tests to be included in relevant National Standards for Roads in Mozambique.

1.3 Approach

The approach to the project implementation focuses on the following key objectives:

1. To ensure that ANE and LEM are the leaders of the research process.
2. To ensure effective linkages with parallel and associated project initiatives.
3. Establish linkages between the participating laboratories.

The purpose of establishing linkages between the participating laboratories is to promote the concept of a self-supporting network of laboratories, with a joint commitment to quality and reliability of results.

1.4 Participating laboratories

The laboratories that are participating in the first round of the pilot PTS are as follows:

1. LEM
2. ANE Maputo
3. ANE Nampula
4. ANE Manica
5. ANE Inhambane
6. JJR (Maputo - private)
7. Soil-Lab (Maputo - private)
8. Geoma (Maputo – private)
9. Letaba Laboratory (Nelspruit - private)
10. SoilCo Laboratory (Pinetown - private).

1.5 Materials for First Round

The materials to be used in the first round of the PTS are as follows:

1. Crushed granular materials from the JJR quarry.
2. “Plastic” material sample brought from Inhambane (< 0.425mm)
3. Red sand from ANE’s Maracuene borrow pit.
4. Aggregate material from the JJR quarry (concrete stone)

1.6 Purpose of this Report

This report describes the project workshop and practical session held from 13th to 15th June 2017. It follows the initial visit to the participating laboratories by the CDS Materials Testing Expert (see report dated 2nd June 2017). The draft protocol for conducting the first round of the PTS pilot is included in Annex B and the protocol for sample preparation in Annex C.

2 Workshop Programme and Objectives

2.1 Objectives

The objectives of the workshop were to:

1. Discuss the draft protocol for the first round of the PTS with the eight Mozambican laboratories that are participating in the pilot scheme.
2. Assist ANE/LEM with the sampling and preparation of the sample splitting for the first round of the PTS.

2.2 Programme

The workshop was conducted at the ANE and LEM premises in Maputo. Most of the delegates also participated in the collection of aggregate and crushed granular samples from the JJR quarry near Maputo on 12th June. A presentation of the protocol was made at the ANE conference room on the morning of the 13th June (see attendance list in Annex A). Preparation of aggregate samples was carried out in the afternoon at LEM, with most of the participants from the morning session in attendance. On 14th and 15th June, samples were prepared of crushed granular material (from JJR quarry) and the “PI material” obtained by ANE from Inhambane.

All eight of the Mozambican participating laboratories were represented at the workshop. The two South African laboratories were not represented.

2.3 Presentation and Discussion

The PowerPoint presentation used by the CDS Materials Testing Expert is included in Annex D. It describes the components of the first round of the PTS pilot and includes recommendations for the approach to be adopted by the participating laboratories.

The following points arose from the discussion during the formal workshop session:

- Definition of terms such as “fine sand” and “fine fine sand” were requested (these are standard definitions included in SANS documentation)
- It may be necessary to change some of the English terms and acronyms used in the protocol (e.g. “Can Not Be Determined – CBD” and “NULL”) to Portuguese terms. ANE should make their own decision on the most appropriate terms when translating the protocols.
- For the first round of the PTS pilot the participating laboratories should carry out the testing using their current methods and practices; they should not alter their existing practice in any way.
- For the second round of the PTS it is likely that the laboratories will be required to use the same test method. However, this might introduce additional factors such as the need to procure equipment (e.g. metric sieve sizes).

- Each of the four materials for the first round of the PTS is being split into 16 samples to be distributed as follows:
 - Eight of the samples to the Mozambique laboratories
 - Two of the samples to the South African laboratories
 - Six samples to LEM for homogeneity and stability testing.

2.4 Sample Preparation and Distribution

The crushed granular material, “PI material” and aggregate were successfully split into the required 16 portions during the practical session during the workshop.



Figure 2.1: Processing the Granular Material



Figure 2.2: Bagged Samples ready for Distribution

The red sand material from the Maracuene borrow pit will be obtained by ANE/LEM and samples prepared in the week of 19th June 2017. The sample preparation is expected to follow the procedures demonstrated during the workshop. CDS/LMetc experts will not be present.

After preparation of the samples the bags are/will be sealed and marked and delivered to the respective laboratories using available transport. The ANE Inhambane representatives will carry the samples for Manica and Nampula to Maxixe for later collection by Manica and from there by Nampula.

CDS/LMetc will assist ANE to liaise with the South African laboratories for transport of their samples. ANE will arrange any documentation needed by officials at the border.

2.5 Testing and Analysis of Results

ANE will translate the testing protocol into Portuguese and distribute it to the participating laboratories. The deadline for receipt of results from the testing will be set as 24th July 2017.

The Materials Testing Expert is expecting to visit Maputo in the second week of August 2017 (to be confirmed) to assist ANE/LEM with the analysis of the PTS results. Thereafter a plan will be developed for the second round of the PTS pilot with training inputs as identified for the participating laboratories.

2.6 Participant Evaluation

The workshop was reviewed by the participants using a simple questionnaire. The results are given in Annex E. It is evident that the workshop was very well received.

Specific comments from the participant feedback included:

- Lack of an interpreter to assist with English/Portuguese translation
- Logistical constraints for participants from outside Maputo and with the field work at the JJR quarry
- Request for more similar events.

Annex A: Attendance at PTS Workshop

ANE
ADMINISTRAÇÃO NACIONAL DE ESTRADAS

WORKHOP1 - PROJECTO DE PROFICIÊNCIA DE TESTAGEM DE MATERIAIS

LOCAL: SALA DE CONFERÊNCIAS DA ANE - MAPUTO

DATA: 13.06.2017

HORA: 09.00h

REGISTO DE PARTICIPANTES

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Annex B: Testing Protocol for First Round of PTS

**Protocols for Testing
Gravel Samples
(Indicator, OMC/MDD & CBR)
&
Aggregates Samples
(Grading, FI, ALD, ACV & 10% FACT)**

Compiled by:

Barry Pearce

Approved By:

Hilario Tayob

1. Sample Description

1.1. The samples are distributed to the participating laboratories via courier packed in plastic bags and are referenced as follows:

1.1.1.	ANE Crushed Granular Sample	Pilot Round 1-1/2017
1.1.2.	ANE PI Sample	Pilot Round 1-2/2017
1.1.3.	ANE Borrow Pit Sample	Pilot Round 1-3/2017
1.1.4.	ANE Aggregate Sample	Pilot Round 1-4/2017

2. Instructions

- 2.1. Treat all samples as you would treat any routine sample received in your laboratory
- 2.2. The samples provided do not present a safety hazard other than being extremely heavy and should be handled with care to prevent injury.
- 2.3. Split down the individual field samples to representative laboratory samples, ensuring that the samples are as representative as possible.
- 2.4. Please make use of the following abbreviations in the submission of your results
 - 2.4.1. CBD - where the soil is NP or SP for the LL and PL determinations
 - 2.4.2. NP - non-plastic for the PI value
 - 2.4.3. SP - slightly-plastic for the PI value
 - 2.4.4. NULL - where no value is submitted should you not be able to undertake the test method
 - 2.4.4.1. Do not fill in a zero (0) as it'll be taken as a determined value and included for statistical analysis.
- 2.5. Carry out the following testing on the 4 samples as detailed below;

2.5.1. Crushed granular sample approx. 100 kg. Ref: Pilot Round 1-1/2017

2.5.1.1. Tests to be conducted on this sample include

- 2.5.1.1.1. Grading
- 2.5.1.1.2. Liquid Limit (LL)
- 2.5.1.1.3. Plastic Limit (PL)
- 2.5.1.1.4. Linear Shrinkage (LS)
- 2.5.1.1.5. Maximum Dry Density (MDD) & Optimum Moisture Content (OMC)
- 2.5.1.1.6. California Bearing Ratio (CBR)

2.5.1.2. The sample consists of 3 bags that will need to be mixed together before starting any sampling.

2.5.1.3. Remove the grading sample first once mixed together and use the remaining sample to undertake the OMC/MDD and CBR

2.5.1.4. Conduct the Liquid Limit, Plastic Limit, Linear Shrinkage and Plasticity Index determination from the material obtained from the grading analysis.

2.5.1.5. Results must be entered on Form A.

- 2.5.1.5.1. Please report the full reference for the test method used as requested on the form above each method result (e.g. AASHTO T89-94 or TMH1 A7 or SANS GR40 or BS 1377 Part 2 etc).

2.5.1.5.2. Fill in the sieve opening sizes used for the grading analysis along with the percentage passing each sieve.

2.5.2. PI (-0.425 mm only) approx. 500 g Ref: Pilot Round 1-2/2017

2.5.2.1. Tests to be conducted on this sample include

2.5.2.1.1. Liquid Limit (LL)

2.5.2.1.2. Plastic Limit (PL)

2.5.2.1.3. Linear Shrinkage (LS)

2.5.2.2. Conduct the Liquid Limit, Plastic Limit, Linear Shrinkage and Plasticity Index determination from the material as supplied.

2.5.2.3. Results must be entered on Form B

2.5.2.3.1. Please report the full reference for the test method used as requested on the form above each method result e.g. AASHTO T89-94 or TMH1 A2-A4 or SANS GR10 or BS 1377 Part 2 etc .

2.5.3. Borrow pit sand approx. 100 kg Ref: Pilot Round 1-3/2017

2.5.3.1. Tests to be conducted on this sample include

2.5.3.1.1. Grading

2.5.3.1.2. Liquid Limit (LL)

2.5.3.1.3. Plastic Limit (PL)

2.5.3.1.4. Linear Shrinkage (LS)

2.5.3.1.5. Maximum Dry Density (MDD) & Optimum Moisture Content (OMC)

2.5.3.1.6. California Bearing Ratio (CBR)

2.5.3.2. Remove the grading sample first and use the remaining sample to undertake the OMC/MDD and CBR

2.5.3.3. Conduct the Liquid Limit, Plastic Limit, Linear Shrinkage and Plasticity Index determination from the material obtained from the grading analysis.

2.5.3.4. Results must be entered on Form C

2.5.3.4.1. Please report the full reference for the test method used as requested on the form above each method result e.g. AASHTO T89-94 or TMH1 A1 (a) or SANS GR1 or BS 1377 Part 2 etc.

2.5.4. Aggregate sample approx. 25 kg Ref: Pilot Round 1-4/2017

2.5.4.1. Tests on the single sized Aggregate sample are to include

2.5.4.1.1. Aggregate grading

2.5.4.1.2. ALD by direct measurement

2.5.4.1.3. Flakiness Index (FI)

2.5.4.1.4. ACV

2.5.4.1.5. 10 % FACT

2.5.4.2. The participating laboratory must first remove a single representative sample from the aggregate sample for the aggregate grading, FI & ALD and then use the remainder of the single sized aggregate sample to undertake the ACV & 10% FACT methods.

2.5.4.3. Results must be entered on Form D

2.5.4.3.1. Please report the full reference for the test method used as requested on the form above each method results e.g. AASHTO T27 or TMH1 B4 or SANS AG1 or BS 882 etc.

- 2.6. Only **one (1) full set of results** is required on each report sheet obtained from the 4 samples as supplied.
- 2.7. The results should reach Eng Tayob at ANE via e-mail.
- 2.8. Should you have any queries with regards to what is required, please contact Eng Tayob at ANE tayobh1@gmail.com

Form A

Measurement Result Form Crushed granular sample Pilot Round 1-1/2017

Laboratory		Analyst	
------------	--	---------	--

IMPORTANT:

1. Report individual results for each test undertaken.
2. Report the results to the correct decimal place as detailed in the method used.
3. Ensure your units correspond to those as given on this test result form.
4. Please indicate whether the apparatus you make use of is fully automatic or manual where applicable.
5. If NO result is submitted please report as NULL, do not leave space blank.

1. Sieve analysis Test Results

Sieve analysis		% passing
<i>Test method used:</i>		
<i>Please fill in sieves sizes as used for the grading analysis</i>		
Percentage Passing (%)	Sieve size	
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%
		%

Form A (continued)

Sieve analysis - Soil mortar calculations	
<i>Test method used:</i>	
GM	
Coarse sand	%
Coarse sand ratio	
Coarse fine sand	%
Fine fine sand	%
Fine sand	%
Medium fine sand	%
Soil mortar	%

2. Atterberg Results

<i>Test method used:</i>	
Liquid Limit	%
Plastic Limit	%
Linear Shrinkage	%
Plasticity Index	%

3. OMC & MDD

<i>Test method used:</i>	
Compaction hammer (<i>circle the correct apparatus as used</i>)	<i>Automatic / manual</i>
OMC	%
MDD	

Form A (continued)

4. CBR Test Results

<i>Test method used:</i>			
CBR press (<i>circle the correct apparatus as used</i>)			<i>Automatic / manual</i>
CBR measurement device (<i>circle the correct apparatus as used</i>)			<i>Load cell/Proving Ring</i>
Hygroscopic Moisture content			%
Mould	A	B	C
% Swell	%	%	%
% of MDD	%	%	%
Dry Density	kg/m ³	kg/m ³	kg/m ³
CBR value @ 100 %			
CBR value @ 95 %			
CBR value @ 90 %			

Laboratory Supervisor:.....

Date:

Form B

Measurement Result Form

PI (-0.425 mm only)

Pilot Round 1-2/2017

Laboratory		Analyst	
------------	--	---------	--

IMPORTANT:

1. Report individual results for each test undertaken.
2. Report the results to the correct decimal place as detailed in the method used.
3. Ensure your units correspond to those as given on this test result form.
4. Please indicate whether the apparatus you make use of is fully automatic or manual where applicable.
5. If NO result submitted please report as NULL, do not leave space blank.

1. Atterberg Results

<i>Test method used:</i>	
Liquid Limit	%
Plastic Limit	%
Linear Shrinkage	%
Plasticity Index	%

Laboratory Supervisor:.....

Date:

Form C

Measurement Result Form Borrow pit sand Pilot Round 1-3/2017

Laboratory		Analyst	
------------	--	---------	--

IMPORTANT:

1. Report individual results for each test undertaken.
2. Report the results to the correct decimal place as detailed in the method used.
3. Ensure your units correspond to those as given on this test result form.
4. Please indicate whether the apparatus you make use of is fully automatic or manual where applicable.
5. If NO result submitted please report as NULL, do not leave space blank.

2. Sieve analysis Test Results

Sieve analysis	% passing
<i>Test method used:</i>	
Mass of dry sample used for Grading	g
<i>Please fill in sieves sizes as used for the grading analysis</i>	
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%

Form C (continued)

Sieve analysis - Soil mortar calculations	
<i>Test method used:</i>	
GM	
FM	
Coarse sand	%
Coarse sand ratio	
Coarse fine sand	%
Fine fine sand	%
Fine sand	%
Medium fine sand	%
Soil mortar	%

3. Atterberg Results

<i>Test method used:</i>	
Liquid Limit	%
Plastic Limit	%
Linear Shrinkage	%
Plasticity Index	%

4. OMC & MDD

<i>Test method used:</i>	
Compaction hammer (<i>circle the correct apparatus as used</i>)	<i>Automatic / manual</i>
OMC	%
MDD	kg/m ³

Form C (continued)

5. CBR Test Results

<i>Test method used:</i>			
CBR press (<i>circle the correct apparatus as used</i>)			<i>Automatic / manual</i>
CBR measurement device (<i>circle the correct apparatus as used</i>)			<i>Load cell/Proving Ring</i>
Hygroscopic Moisture content			%
Mould	A	B	C
% Swell	%	%	%
% of MDD	%	%	%
Dry Density	kg/m ³	kg/m ³	kg/m ³
CBR value @ 100 %			
CBR value @ 95 %			
CBR value @ 90 %			

Laboratory Supervisor:.....

Date:

Form D

Measurement Result Form Aggregate sample Pilot Round 1-4/2017

Laboratory		Analyst	
------------	--	---------	--

IMPORTANT:

1. Report individual results for each sample tested.
2. Report the results to the correct decimal place as detailed in the method.
3. Ensure your units correspond to those as given on this test result form.
4. If NO result submitted please report as NULL, do not leave space open.

Single sized aggregate sample results

TEST DESCRIPTION	RESULT 1
<i>Test method used:</i>	
Mass of dry sample used for Grading	g
<i>Please fill in sieves sizes as used for the grading analysis</i>	% passing
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%

Form D (continued)

Single sized aggregate sample results (continued)

<i>Test method used:</i>	
Average Least Dimension (ALD) (direct measurement)	mm
Mass of sample used	g
Number of particles counted	N°

<i>Test method used:</i>	
Flakiness Index (FI)	%
Mass of sample used	g

<i>Test method used:</i>	
Aggregate Crushing Value (ACV)	%
Mass of sample used	g

<i>Test method used:</i>	
10% Fines Aggregate Crushing Test (10% FACT) (<i>dry method only</i>)	kN
Mass of sample used	g

Laboratory Supervisor:

Date:

Annex C: Sampling Splitting and Preparation Protocol for First Round of PTS

LEM-ANE PTS pilot program
Ref 1-4 Jun2017

Aggregate Sampling and Preparation Instructions for distribution

Aggregate testing:
Instructions to the Preparation Participant
Please read all instructions carefully prior to commencing

- 1 These instructions describe the preparation of the participants secondary or laboratory samples for the aggregate tests –.
 - 1.1 Grading, FI & ALD, ACV & 10% FACT minimum of 25 kg
 - 1.1.1 Fraction to be used for the ACV & 10% FACT will be communicated to all participants by ANE / LEM
- 2 The samples are prepared for:
 - 2.1 The participating laboratories from which the results will be used for the inter-laboratory comparison analysis.
 - 2.2 Results from the participating laboratories will be accepted and analysed using the consensus mean and robust statistics to evaluate the results.
 - 2.3 LEM is appointed to undertake homogeneity and stability testing on 6 of the prepared samples
 - 2.3.1 Homogeneity testing to be undertaken on 3 samples at the same time as their sample is tested to determine the consistency of the samples as distributed to the participating laboratories.
 - 2.3.2 Stability testing will be undertaken on the remaining 3 samples at one month intervals (i.e. July, August & September of 2017) to determine how stable the material over a period of 4 months.
- 3 Obtain one (1) separate *representative sample* for the material:
 - 3.1 A single sized 14 mm – 20 mm aggregate with a minimum mass of 400 kg + 5 %
- 4 Splitting the samples into representative samples
 - 4.1 Ensuring that the samples are as representative as possible is critical for comparative results to be meaningfully analysed.**
 - 4.2 Ensure the sample complies to the correct mass required to obtain 25 kg samples for the amount of participants in the round plus the additional samples.
 - 4.2.1 If the sample size is too small, discard the sample and collect a new sample
 - 4.2.2 If the sample size is too large, reduce the sample size to an acceptable size through coning and quartering.
 - 4.3 Single sized aggregate sample
 - 4.3.1 Broom the samples into a heap.
 - 4.3.2 Divide the material in half using a suitably sized riffler.
 - 4.3.2.1 Ensure the riffle openings allow the largest size to fall through without causing any blockages to facilitate easy of riffling.
 - 4.3.2.2 Alternate the split material into the 2 piles to ensure representativeness is maintained due to differences in the pans content.
 - 4.3.3 Continue riffling down the material until the correct amount of sub-samples are obtained from each half to ensure representative secondary or laboratory samples of a approx. 12.5 kg each.
 - 4.3.4 Recombine 2 samples (1 from each half) to obtain 1 representative sample per participant of a minimum of 25 kg.

LEM-ANE PTS pilot program
Ref 1-4 Jun2017

Aggregate Sampling and Preparation Instructions for distribution

- 5 Packaging
 - 5.1 Single sized Sample to be placed in a black plastic bag of dims l x b x h with a minimum thickness of xxx μm
 - 5.1.1 Place the sand/dust fraction in a plastic bag of dimension 250 mm x 350 mm by 75 micron. With the sample in the bottom of the bag, roll the bag closed over itself to create a thicker protective covering to the sample. Tape the bag closed with packing tape. Place the sample into the same bag as the single sized aggregate. Label as the sand/dust sample with an indelible marker.
 - 5.2 Flatten all three (3) samples into the bottom of the bag and secure with a cable tie of at least 4.8 mm width.
 - 5.3 Place the sample bag inside a second bag & secure with a second cable tie.
 - 5.4 Place the 2 bags & the sample into a plastic woven sample bag of dims l x b x h with a minimum thickness of xxx μm to ensure maximum protection during transportation.
- 6 Label each secondary sample with the following information:
 - 6.1 Preparation date
 - 6.2 "ANE/LEM PTS scheme"
 - 6.3 "Round 1-4 / 2017"
 - 6.4 Sample number, which is a combination of the scheme, date and type: e.g. ANE/LEM 15/1-4/2017 provided by Carlos
- 7 Labelling
 - 7.1 Place a label **inside** the 1st sample bag with the sample.
 - 7.2 Place a 2nd label on the outside for the plastic woven bag for identification purposes.
 - 7.2.1 This information can also be written on the bag itself as against using a label.
- 8 If you are also participating in the testing select one (1) secondary samples for your own use.
- 9 At random, select six (6) secondary samples for homogeneity and stability testing.
- 10 The couriers, arranged by the ANE/LEM office, will collect the samples at your laboratory for shipping to the participating laboratories.
 - 10.1 A weigh bill will be supplied by the ANE/LEM from the courier company that will need to be attached to the outer side of the sample bag with the delivery address.
 - 10.2 A representative from the ANE/LEM will be present on the collection day to assist in the dispatching of the samples and attaching of the weigh bills to the samples.
- 11 Keep any remaining prepared laboratory samples in storage for at least 6 months.

LEM-ANE PTS pilot program
Ref 1-1 & 1-2 Jun2017

Gravel Sampling and Preparation Instructions for distribution

Crushed material & borrow pit sand testing round:
Instructions to the Preparation Participant
Please read all instructions carefully prior to commencing

- 1 These instructions describe the preparation of participants secondary or laboratory samples for the crushed granular tests –.
 - 1.1 Grading, Atterberg, MDD & CBR Minimum of 100 kg.
 - 1.1.1 **NB! This is provided in 3 separate bags that need to be combined into 1 sample & then split for the grading & MDD/CBR testing**
- 2 The samples are prepared for:
 - 2.1 The participating laboratories from which the results will be used for the inter-laboratory comparison analysis.
 - 2.2 Results from the participating laboratories will be accepted and analysed using the consensus mean and robust statistics to evaluate the results.
 - 2.3 LEM is appointed to undertake homogeneity and stability testing on 6 of the prepared samples
 - 2.3.1 Homogeneity testing to be undertaken on 3 samples at the same time as their sample is tested to determine the consistency of the samples as distributed to the participating laboratories.
 - 2.3.2 Stability testing will be undertaken on the remaining 3 samples at one month intervals (i.e. July, August & September of 2017) to determine how stable the material over a period of 4 months.
- 3 Obtain one (1) *representative sample* of crushed primary or field sample gravel or sand of about 1 600 kg + 5 % that has
 - 3.1 A determinable PI OR
 - 3.2 That is non-plastic (NP) or slightly-plastic (SP).
 - 3.3 The material type required will be indicated for each round.
- 4 Splitting the sample into representative samples
 - 4.1 **Ensuring that the samples are as representative as possible is critical for comparative results to be meaningfully analysed.**
 - 4.2 Ensure the sample complies to the correct mass required to obtain 100 kg samples for the amount of participants in the round plus the additional samples.
 - 4.2.1 If the sample size is too small, discard the sample and collect a new sample
 - 4.2.2 If the sample size is too large, reduce the sample size to an acceptable size through coning and quartering.
 - 4.3 Spread the primary sample on a non-absorbent, smooth surface. Rake it in order to obtain an even air dry moisture content over 24 hrs.
 - 4.4 If there is a coarse aggregate fraction > 20 mm, sieve the entire sample thru a 20 mm sieve to separate the coarse fraction from the finer fractions.
 - 4.4.1 For sand fractions this operation should not be necessary due to the fineness of sand samples.
 - 4.5 Broom the coarse and fine samples into separate heaps.
 - 4.6 Divide each of the 2 heaps in half using a suitably sized riffler.
 - 4.6.1 The riffler sizes will differ for the 2 heaps.

LEM-ANE PTS pilot program

Ref 1-1 & 1-2 Jun2017

Gravel Sampling and Preparation Instructions for distribution

- 4.6.2 Ensure the riffle openings allow the largest size to fall through without causing any blockages to facilitate easy of riffling.
- 4.6.3 Alternate the split material into the 2 piles to ensure representativeness is maintained due to differences in the pans content
- 4.7 Continue riffling down the material until the correct amount of sub-samples are obtained from each half to ensure representative secondary or laboratory samples of approx. 50 kg each.
- 4.8 Recombine 2 samples (1 from each half) to obtain 1 representative sample per participant of a minimum of 100 kg.
 - 4.8.1 As the sample is heavy, the sample can be split into 3 bags of approx. 35 kg each.
 - 4.8.2 2 of the bags can be made up of the 2 halves of the fine material with coarse aggregate placed on top of the fines to prevent them from tearing the bags,
 - 4.8.3 The 3rd bag can be filled with the last fines fraction of approx. 35 kg.
 - 4.8.4 Ensure the participants are aware that the 3 bags are to be combined into a single sample before commencing their internal laboratory splitting and testing.**
- 5 Packaging
 - 5.1 Split the gravel sample into 3 approximately equal portions.
 - 5.2 Place each portion of the sample in a plastic bag of dims l x b x h with a minimum thickness of xxx µm
 - 5.3 Flatten the sample portion into the bottom of each bag and secure with a cable tie of at least 4.8 mm width.
 - 5.4 Place the sample bag inside a second bag & secure with a second cable tie.
 - 5.5 Place the 2 bags & the sample portion into a plastic woven sample bag of dims l x b x h with a minimum thickness of xxx µm to ensure maximum protection during transportation.
 - 5.6 Each participant will receive 3 bags which will need to be recombined to undertake the testing.
- 6 Label each secondary sample with the following information:
 - 6.1 Preparation date
 - 6.2 "ANE / LEM PTS Scheme"
 - 6.3 "Round 1-1 / 2017"
 - 6.4 Sample number, which is a combination of the scheme, date and type: e.g. ANE/LEM 15/1-1/2017 provided by Carlos
- 7 Labelling
 - 7.1 Place a label **inside** the 1st sample bag with the sample portion.
 - 7.2 Ensure all 3 bags have labels in them.
 - 7.3 Place a 2nd label on the outside of each of the plastic woven bag for identification purposes.
 - 7.3.1 This information can also be written on the bag itself as against using a label.
- 8 If you are also participating in the testing select one (1) secondary samples for your own use.
- 9 At random, select six (6) secondary samples for homogeneity and stability testing.
- 10 The couriers, arranged by the ANE/LEM office, will collect the samples at your laboratory for shipping to the participating laboratories.
 - 10.1 A weigh bill will be supplied by the ANE/LEM from the courier company that will need to be attached to the outer side of the sample bag with the delivery address.
 - 10.2 A representative from the ANE/LEM will be present on the collection day to assist in the dispatching of the samples and attaching of the weigh bills to the samples.

Keep any remaining prepared laboratory samples in storage for at least 6 months.

Annex D: Workshop Presentation



 Research for Community Access Partnership




Protocolos Para o Melhoramento da Proficiência da Testagem dos Materiais nos Laboratorios em Moçambique

Workshop para Técnicos dos Laboratorios Seleccionados

Amostras de Saibro (Indicador, OMC/MDD & CBR)
 Amostras de Agregado (Granulometria, FI, ALD, ACV & 10% FACT)


Civil Design Solutions in association with Learning Matters etc






INSTRUÇÕES cont...

- Na submissão dos seus resultados use as seguintes abreviaturas:
 - CBD – Quando os solos forem NP ou SP e para a determinação dos Limites de liquidez – LL – ou Limites de Plasticidade –LP
 - NP - Não Plástico, para valores de IP
 - SP - Ligeiramente Plásticos para valores do IP
 - NULL - Quando não existem valores disponíveis e não se puder realizar o método de teste recomendado)
 - Não preencher com valor zero (0) dado que pode ser considerado como um valor calculado e ser incluso na análise estatística




Private and confidential



CONTENTS

Instruções:

▪ ANE Crushed Granular Sample	Pilot Round 1-1/2017
(Amostra granular britada)	
▪ ANE PI Sample	Pilot Round 1-2/2017
(Amostra para PI ou IP)	
▪ ANE Borrow Pit Sample	Pilot Round 1-3/2017
(Amostra de Câmara de empréstimo)	
▪ ANE Aggregate Sample	Pilot Round 1-4/2017
(Amostra de agregado)	
▪ Submissão de Relatório final	



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AMOSTRA GRANULAR BRITADA

Ref: Pilot Round 1-1/2017


Approx. 100 kg

Amostra granular britada Approx. 100 kg

- Ensaios a serem executadas com base na amostra incluem)
 - Grading (**Granulometria**)
 - Liquid Limit (LL) - (**Limite de Liquidez**)
 - Plastic Limit (PL) – (**Limite de Plasticidade**)
 - Linear Shrinkage (LS) – (**Retração Linear**)
 - Maximum Dry Density (MDD) & Optimum Moisture Content (OMC) (**Baridade Seca Máxima – MDD & Teor Ótimo de Humidade - OMC**)
 - California Bearing Ratio (CBR) (**CBR**)




Private and confidential




INSTRUÇÕES

- Cuide da amostra como o faria com qualquer amostra rotineira que recebesse em seu laboratório
- As amostras fornecidas não apresentam qualquer perigo de segurança, fora de serem extremamente pesadas e
 - Devem ser manuseadas com cuidado para evitar lesões
- Repartir e agrupar as amostras de campo para torna-las representativas
 - Garantir que as mesmas sejam mais representativas o quanto possível



Private and confidential




CRUSHED GRANULAR SAMPLE

Ref: Pilot Round 1-1/2017

- Primeiro, retire a amostra para a análise granulométrica
- Use a restante amostra para os ensaios de OMC/MDD e CBR
- Após a análise granulométrica, use o mesmo material para a obtenção do LP e LL, LS e o IP (ou PI)

Os resultados deverão ser preenchidos no formulário A

- Indique as referências completas das metodologias usadas, conforme requerido no formulário acima, para cada resultado,
- Ex: AASHTO T89-94 ou TMH1 A7 ou SANS GR40 ou BS 1377 Parte 2 etc)
- Preencha as dimensões dos peneiros usados na análise granulométrica, com as respectivas percentagens passadas pelos peneiros



Private and confidential

Form A	
Measurement Result Form	
Crushed granular sample Pilot Round 1-1/2017	
Laboratory	Analyst
IMPORTANT:	
1. Report individual results for each test undertaken.	
2. Report the results to the correct decimal place as detailed in the method used.	
3. Ensure your units correspond to those as given on this test result form.	
4. Please indicate whether the apparatus you make use of is fully automatic or manual	
5. If NO result is submitted please report as NULL, do not leave space blank.	
1. Sieve analysis Test Results	
Sieve analysis	% passing
Test method used:	
Please fill in sieve sizes as used for the grading	
Sieve size	%
20.0	%
19	%
13.2	%
etc	%
etc	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%
	%

GRADING

Test method critical

- AASHTO, TMH1, BS, ASTM, etc.
- Sieves sizes used & % passing
- Fill in info as per test method requirements
- Units (as filled in on form)
- Accuracy of reported value

– 1; 0,1; 0.01; 0,001

ÍNDICE DE PLASTICIDADE (PI) (-0.425 mm ONLY)	
Ref: Pilot Round 1-2/2017	
Approx. 500 g	
– Tests to be conducted on this sample include (Os testes a serem efectuados incluem:)	
– Liquid Limit (LL) - (Limite de Liquidez - LL)	
– Plastic Limit (PL)- (Limite de Plasticidade - LP)	
– Linear Shrinkage (LS) - (Retração Linear - LS)	

Approx. 500 g

- Tests to be conducted on this sample include (Os testes a serem efectuados incluem:)
- Liquid Limit (LL) - (Limite de Liquidez - LL)
- Plastic Limit (PL)- (Limite de Plasticidade - LP)
- Linear Shrinkage (LS) - (Retração Linear - LS)

Form A (continued)	
Sieve analysis - Soil mortars calculations	
Test method used	
CBM	
Coarse sand	%
Coarse sand ratio	%
Coarse fine sand	%
Fine sand	%
Medium fine sand	%
Soil mortar	%
2. Atterberg Results	
Test method used	
Liquid Limit	%
Plastic Limit	%
Linear Shrinkage	%
Plasticity Index	%
3. OMC & MDD	
Test method used	
Compaction hammer (circle the correct apparatus as used)	Automatic / <input checked="" type="checkbox"/> Manual
OMC	%
MDD	kg/m ³

Soil Mortar, Atterberg & OMC/MDD

Test method used

- AASHTO, TMH1, BS, ASTM, etc.
- Accuracy of reported value
- 1; 0,1; 0.01; 0,001
- LL & PL
- either % or CBD
- Couldn't Be Determined
- LS & PI
- %, NP or SP
- OMC & MDD
- Circle either automatic or manual
- MDD in kg/m³

PI (-0.425 mm ONLY)	
Ref: Pilot Round 1-2/2017	
<ul style="list-style-type: none"> • Com base no material disponibilizado, proceda a determinação do LL, LP, LS e o IP) • Os resultados devem ser registados no formulário B 	
–Por favor, indique as referências completas da metodologia usadas, conforme requerido no formulário acima, para cada resultado,	
–Ex: AASHTO T89-94 ou TMH1 A7 ou SANS GR40 ou BS 1377 Part 2, etc)	

PI (-0.425 mm ONLY)

Ref: Pilot Round 1-2/2017

- Com base no material disponibilizado, proceda a determinação do LL, LP, LS e o IP)
- Os resultados devem ser registados no formulário B
- Por favor, indique as referências completas da metodologia usadas, conforme requerido no formulário acima, para cada resultado,
- Ex: AASHTO T89-94 ou TMH1 A7 ou SANS GR40 ou BS 1377 Part 2, etc)

Form A (continued)	
1. CBR Test Results	
Test method used	
CBR stress (circle the correct apparatus as used)	Automatic / <input checked="" type="checkbox"/> Manual
CBR measurement device (circle the correct apparatus as used)	Load cell / <input checked="" type="checkbox"/> Reaction Cap
Moisture: Moisture content	%
Moist	%
% Small	kg/m ³
% of MDD	kg/m ³
Dry Density	kg/m ³
CBR value @ 100%	%
CBR value @ 95%	%
CBR value @ 80%	%
Laboratory Supervisor:	
Date:	

CBR

Test method used

- AASHTO, TMH1, BS, ASTM, etc.
- Accuracy of reported value
- 1; 0,1; 0.01; 0,001
- CBR
- Circle either automatic or manual
- Circle either proving ring or load cell
- Fill in all info for A, B & C moulds
- % of MDD – 100 %, 95 %, 90 %
- Actual DD (kg/m³) for each mould
- Signature & date

Form B	
Measurement Result Form	
PI (-0.425 mm only) Pilot Round 1-2/2017	
Laboratory	Analyst
IMPORTANT:	
1. Report individual results for each test undertaken.	
2. Report the results to the correct decimal place as detailed in the method used.	
3. Ensure your units correspond to those as given on this test result form.	
4. Please indicate whether the apparatus you make use of is fully automatic or manual where applicable.	
5. If NO result submitted please report as NULL, do not leave space blank.	
1. Atterberg Results	
Test method used:	
Liquid Limit	%
Plastic Limit	%
Linear Shrinkage	%
Plasticity Index	%
Laboratory Supervisor:	
Date:	

Atterberg

- Test method used
- AASHTO, TMH1, BS, ASTM, etc.
- Accuracy of reported value
- 1; 0,1; 0.01; 0,001
- LL & PL
- either % or CBD
- Couldn't Be Determined
- LS & PI
- %, NP or SP
- Signature & date

Área de Câmara de Empréstimo
Ref: Pilot Round 1-3/2017

UKaid

Approx. 100 kg

- Os testes a serem efectuados incluem:
- Granulometria
 - Liquid Limit (LL) – **Limite de Liquidez (LL)**
 - Plastic Limit (PL) – **Limite de Plasticidade (LP)**
 - Linear Shrinkage (LS) – **Retração Linear (LS)**
 - Maximum Dry Density (MDD) & Optimum Moisture Content (OMC) - **Baridade Seca Máxima - MDD & Teor Optimo de Humidade - OMC**
 - California Bearing Ratio (CBR) – **(CBR)**

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Soil Mortar, Atterberg & OMC/MDD

Form C (continued)

Sieve analysis - Soil mortar calculations

Test method used	
Date	
Test	
Operator name	
Operator initials	
Test location	
Test date	
Medium description	
Test method	

2. Atterberg Results

Test method used	
Operator name	
Operator initials	
Test location	
Test date	
Medium description	
Test method	

3. OMC & MDD

Test method used	
Compaction hammer (circle the correct apparatus as used)	Automatic
OMC	
MDD	

- Test method used
 - AASHTO, TMH1, BS, ASTM, etc.
- Accuracy of reported value
 - 1; 0,1; 0,01; 0,001
- LL & PL
 - either % or CBD
 - Couldn't Be Determined
- LS & PI
 - %, NP or SP
- OMC & MDD
 - Circle either automatic or manual
 - MDD in kg/m³

ÁREA DE CÂMARA DE EMPRÉSTIMO
Ref: Pilot Round 1-3/2017

UKaid

- Primeiro, Retire a amostra para a análise granulométrica
- Use a restante amostra para os ensaios de OMC/MDD e CBR
- Após a análise granulométrica, use o mesmo material para a análise dos LP e de LL, LS e IP
- Os resultados devem ser registados no formulário B
 - Por favor, indique as referências completas da metodologia usadas, conforme requerido no formulário acima, para cada resultado,
 - Ex: AASHTO T89-94 ou TMH1 A7 ou SANS GR40 BS 1377 Part 2 etc)

Private and confidential

CBR

Form C (continued)

1. CBR Test Results

Test method used	
CBR press (circle the correct apparatus as used)	Automatic
CBR measurement device (circle the correct apparatus as used)	Automatic
Geotechnical Report Number	
Operator name	
Operator initials	
Test location	
Test date	
Dry Density	kg/m ³
CBR value @ 100%	
CBR value @ 95%	
CBR value @ 90%	
Operator name	
Date	

- Test method used
 - AASHTO, TMH1, BS, ASTM, etc.
- Accuracy of reported value
 - 1; 0,1; 0,01; 0,001
- CBR
 - Circle either automatic or manual
 - Circle either proving ring or load cell
- Fill in all info for A, B & C moulds
 - % of MDD – 100 %, 95 %, 90 %
 - Actual DD (kg/m³) for each mould
- Signature & date

GRADING

Form C

Measurement Result Form

Borrow pit sand Pilot Round 1-3/2017

UKaid

1. Report individual results for each test undertaken.

2. Report the results to the correct decimal place as detailed in the method used.

3. Round up or down as appropriate to the nearest integer on this test result form.

4. Please indicate whether the apparatus you make use of is fully automatic or manual where applicable.

5. If MDD result is submitted please report in MDD, do not leave space blank.

3. Sieve analysis Test Results

Test method used	
Operator name	
Operator initials	
Test location	
Test date	
Medium description	
Test method	

- Test method critical
 - AASHTO, TMH1, BS, ASTM, etc.
- Sieves sizes used & % passing
- Fill in info as per test method requirements
 - Units (as filled in on form)
 - Accuracy of reported value
 - 1; 0,1; 0,01; 0,001

Private and confidential

AGGREGATE SAMPLE
Ref: Pilot Round 1-4/2017

UKaid

Approx. 25 kg

- Incluir a testagem das amostras de dimensão uniforme)
 - Aggregate grading - **(Granulometria do agregado)**
 - ALD by direct measurement - **(ALD por medição directa)**
 - Flakiness Index (FI) - **(Índice de Lamelação)**
 - ACV
 - 10 % FACT

Private and confidential

AMOSTRA DE AGREGADO
Ref: Pilot Round 1-4/2017

- Da amostra global do agregado, remover uma porção representativa, para análise granulométrica, FI & ALD e
- Use o agregado de dimensão uniforme remanescente, para obter o ACV & 10% FACT)
- Os resultados deverão ser preenchidos no formulário D
 - Por favor, indique as referências completas da metodologia usadas, conforme requerido no formulário acima, para cada resultado,
 - Ex: AASHTO T27 ou TMH1 B4 ou SANS AG1 ou BS 882, etc

SUBMISSÃO DE RELATÓRIO FINAL

- Apenas uma (1) planilha completa de resultados é requerida por cada relatório obtido das 4 amostras fornecidas
- Os Resultados deverão ser enviados ao Eng. Tayob, por e-mail
- Para qualquer questão, queiram contactar o Eng. Tayob por e-mail tayob1@gmail.com

Form D
Measurement Result Form
Aggregate Sample Pilot Round 1-4/2017

GRADING

- Test method critical
 - AASHTO, TMH1, BS, ASTM, etc.
- Sieves sizes used & % passing
- Fill in info as per test method requirements
 - Units (as filled in on form)
 - Accuracy of reported value
 - 1; 0,1; 0,01; 0,001

Form D (continued)

Single sized aggregate sample results (continued)

ALD, FI, ACV/10% FACT

- Test method
 - AASHTO, TMH1, BS, ASTM, etc
- Accuracy of reported value
 - 1; 0,1; 0,01; 0,001
- ALD
 - Mass of sample used
 - Particles counted
- FI
 - Mass of sample used
- ACV & 10% FACT
 - Mass of each sample used
 - ACV & 10% FACT only on dry samples
- Sign & date

Annex E: Workshop Participant Evaluation

The participant evaluation (number of responses) is summarised in the table below, along with a reproduction of any specific comments made.

	Good	Reasonable	Poor
Overall organisation	7	2	0
Classroom session 12th June			
Presentation by consultant	18	1	0
Discussion session	17	2	0
Sample preparation at laboratory	18	1	0

Presente Workshop, esta bem
 organizada no contexto do laboratório
 Rio, esta sendo bom, o consultor
 é comunicativo,
 Tem boas ideias, consegue se
 adaptar bem, e recomendar
 a nossos laboratórios
 Precisam, os colegas também
 participar.

O Workshop apresenta resultados
 positivos. Gostaria que este
 processo continue para outros
 laboratórios por forma a enja
 chegar os colegas que não puderam
 cá vir participar.

futuramente para outro treinamento do género deve existir uma formalidade de Organização seja no que respecta a metodologia, distribuição de material didático e Saída do Campo em tempo e hora disponível. Deve ser divulgado o horário da concentração e deve ser respeitado

o horário.

Noto alguma desorganização deste Workshop no tocante a

- Horário de Saída do campo
- Trabalho no material colhido
- Workshop & Organização

É muito bom para que os laboratórios tenham um método de Trabalho anível de África.

Muito importante para a melhoria da qualidade dos laboratórios.
- Deve haver mais seminários

Para a disseminação de toda a informação na íntegra, devia haver um tradutor/interprete de inglês-português, visto que um bom domínio é sempre inglês.

Sugiro a produção de artificiais para o presente workshops.

O seminário vai permitir
melhorar a nossa prática
e uniformização de métodos de
Trabalho nos nossos setores

— A viagem de Nampula
para Maputo e vice-versa
foi muito espartaca pelo que
não foi participar nos tra-
balhos no 1º dia e no
último.
— Que o dia de regresso esteja
dependente do participante sem
que afecte as contas do condutor