# Geological Investigation for the Broadlands Hydropower Project

Appendix

# **CHAPTER 3**

LABORATORY TESTS

# Quantity of Laboratory Test for the Broadlands Hydropower Project

No.	Items	ASTM No.	Unit	Quantity
Phas	e1			
1	Concrete Aggregates (from test pits sample)			
1.1	Sieve analysis of aggregates	ASTM C136	samples	2
1.2	Specific gravity and water absorption (fine)	ASTM C128	samples	2
1.3	Specific gravity and water absorption (coarse)	ASTM C127	samples	2
1.4	Clay lumps and friable particles in aggregate	ASTM C142	samples	2
1.5	Soundness tests by sodium sulfate	ASTM C88	samples	2
1.6	Abrasion test of coarse aggregate by Los Angeles machine	ASTM C535	samples	2
1.7	Chemical (Alkali) reactivity test	ASTM C289	samples	2
2	Rock (from drilling-core sample)			
2.1	Water absorption and bulk specific gravity	ASTM C127	samples	6
2.2	Unconfined compression and Poisson's ratio	ASTM D2938	samples	6
2.3	Ultra-sonic wave velocity	ASTM D2845	samples	6
2.4	Soundness tests by sodium sulfate	ASTM C88	samples	2
2.5	Chemical (alkali) reactivity test	ASTM C289	samples	2
3	Test Pitting and Sampling (includes Geodetic Measurement)	nos.	2	
Phase	e <b>2</b>			
1	Concrete Aggregates (from test pits sample)			
1.1	Sieve analysis of aggregates	ASTM C136	samples	2
1.2	Specific gravity and water absorption (fine)	ASTM C128	samples	2
1.3	Specific gravity and water absorption (coarse)	ASTM C127	samples	1
1.4	Clay lumps and friable particles in aggregate	ASTM C142	samples	2
1.5	Soundness tests by sodium sulfate	ASTM C88	samples	1
1.6	Abrasion test of coarse aggregate by Los Angeles machine	ASTM C535	samples	1
1.7	Chemical (Alkali) reactivity test	ASTM C289	samples	1
2	Rock (from drilling-core sample)			
2.1	Water absorption and bulk specific gravity	ASTM C127	samples	18
2.2	Unconfined compression and Poisson's ratio  ASTM D2938		samples	20
2.3	Ultra-sonic wave velocity ASTM D2845		samples	18
2.4	Soundness tests by sodium sulfate ASTM C88		samples	1
2.5	Chemical (alkali) reactivity test	ASTM C289	samples	1
2.6	Abrasion test of coarse aggregate by Los Angeles machine	ASTM C535	samples	1
3	Test Pitting and Sampling (includes Geodetic Measuremen	t)	nos.	2



Our Ref: CB/EPC/LAB/04C

TEST CERTIFICATE NO: DRL/AT/2003060

Issued By:

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division CECB, No.11, Jawatte Road, Colombo 05.

Assured To:

Jica Study Team

Electric Power Development Co., Ltd

Nippon Koel Co., Ltd.

Project:

Broadlands Hydropower Project

Job Requested:

Testing of Aggregates, Rock & Soil samples from Broadlands Hydropower Project.

Job Ref:

DRL/2/011

Tested for:

1) Concrete Aggregates (from test pit samples)

- 1.1) Sieve Analysis of Coarse Aggregates, Fine Aggregates & Soil samples
- 1.2) Specific gravity and water absorption (Fine)
- 1.3) Specific gravity and water absorption (Coarse)
- 1.4) Clay lumps and friable particles in (Coarse & Fine) Aggregates
- 1.5) Soundness tests by sodium sulphate
- 1.6) Abrasion test of Aggregate by Los Angeles machine
- 1.7) Chemical (Alkali) reactivity test
- 2.) Rock (from drilling core samples)
  - 2.1) Water absorption and bulk specific gravity
  - 2.2) Unconfined compression and Poisson's ratio
  - 2.3) Ultra-sonic wave velocity
  - 2.4) Soundness tests by sodium sulphate
  - 2.5) Chemical (Alkali) reactivity test

Results:

As tabulated in pages 02-05.



## 1.1) Results of Sieve Analysis of Coarse Aggregates, Fine Aggregates & Soil Samples

Sample Description	Φ 60% (mm)	Ф 30% (mm)	Φ 10% (mm)	Cu	Cc
TP-2(Coarse Aggregates)	10.600	10.300	10.100	1.050	0.991
River Sand	0.370	0.220	0.120	3.083	1.090
TP-1 (Soil)	2.800	0.510	-	-	-
TP-2 (Soil)	4.300	1.100	0.280	15.357	1.005

## 1.2) Results of Specific Gravity and Water Absorption of Fine Aggregates

Sample Description	Bulk	Bulk Specific	Apparent	Water
	Specific	Gravity	Specific	Absorption
	Gravity	(SSD* Basis)	Gravity	(%)
River Sand	2.541	2.562	2.594	0.802

<sup>\*</sup>SSD- Saturated-Surface-Dry Basis

#### 1.3) Results of Specific Gravity and Water Absorption of Coarse Aggregates

	Bulk	Bulk Specific	Apparent	Water
Sample Description	Specific	Gravity	Specific	Absorption
	Gravity	(SSD* Basis)	Gravity	(%)
TP-1(Coarse Aggregates)	2.476	2.540	2.646	2.596
TP-2(Coarse Aggregates)	3.013	3.027	3.054	0.445

<sup>\*</sup>SSD- Saturated-Surface-Dry Basis

#### 1.4) Results of Clay Lumps and Friable Particles in (Coarse & Fine) Aggregates

	Particle Size	Percentage of Clay Lumps and
Sample Description	(mm)	Friable Particles
		(%)
	4.75-9.5	0.17
TP-2(Coarse Aggregates)	9.5-19.0	0.58
	19.0-38.1	0.10
River Sand	>1.18	27.5

Reported By:

R.M.K.R.Bandara / Laboratory Engineer

Checked By: ...

Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias Engineer In Charge

B.M.A.P.Mapa`
Project Manager Laboratory
& Site Investigation Unit

Date: 12-02-2003.



# 1.5) Results of Soundness Tests by Sodium Sulphate of Aggregates

	Soundness of Rock	
Sample Description	sample	
	(Loss in weight) %	
TP-1(Coarse Aggregates)	1.52	
TP-2(Coarse Aggregates)	0.22	

## 1.6) Results of Loss Angeles Abrasion Test of Aggregates

	Los Angeles Abrasion Value (%)			
Sample Description	100	500		
	Revolutions	Revolutions		
TP-1(Coarse Aggregates)	22.18	65.77		
TP-2(Coarse Aggregates)	8.61	30.18		

## 1.7) Results of Chemical (Alkali) Reactivity Test of Aggregates

Sample Description	Quantity of Dissolved Silica (Sc)	Quantity of Reduction in Alkalinity (Rc)
	mmol/L	mmol/L
TP-1(Coarse Aggregates)	2.90	60
TP-2(Coarse Aggregates)	4.42	30

Reported By:

R.M.K.R.Bandara / Laboratory Engineer

Checked By: A.S.

S.S.I.Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias

Engineer In Charge

Project Manager Laboratory

& Site Investigation Unit

Date :

12-02-2003.



## 2.1) Results of Water Absorption and Bulk Specific Gravity of Rock Samples

Bore Hole No.	Rock Type	Depth (m)	Bulk Specific Gravity	Bulk Specific Gravity (SSD* Basis)	Apparent Specific Gravity	Water Absorption (%)
MB 1	Charnokitik- gneiss	24.49-25.00	2.638	2.641	2.645	0.091
MB 3	Biotite rich gneiss	22.00-22.38	3.071	3.072	3.074	0.035
DT 1	Calk-gneiss	19.45-19.85	2.871	2.895	2.939	0.815
MT 3	Garnet rich biotite gneiss	14.31-14.76	2.813	2.815	2.818	0.059
MT 2	Quartzite	32.56-33.00	2.624	2.625	2.628	0.051
MT 1	Quartz rich feldspathic gneiss	34.93-35.35	2.581	2.600	2.631	0.727

<sup>\*</sup>SSD- Saturated-Surface-Dry Basis

## 2.2) Results of Unconfined compression and Poisson's Ratio of Rock Cores

Rock Type	Bore Hole No.	Depth (m)	Unconfined Compressive Strength ( N/mm²)
Charnokitik-gneiss	MB 1	24.49-25.00	65.66
Biotite rich gneiss	MB 3	22.00-22.38	38.52
Calk-gneiss	DT 1	19.45-19.85	12.99
Garnet rich biotite gneiss	MT 3	14.31-14.76	17.05
Quartzite	MT 2	32.56-33.00	35.37
Quartz rich feldspathic gneiss	MT 1	34.93-35.35	65.99

Reported By: Sancher

R.M.K.R.Bandara / Laboratory Engineer

Checked By

S.S.I.Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias Engineer In Charge

B.M.A.P.Mapa
Project Manager Laboratory
& Site Investigation Unit

Date :

*12-02-2003*.



## 2.3) Results of Ultra-Sonic Wave Velocity of Rock Cores

Rock Type	Bore Holc No.	Depth (m)	Pulse Travel Time Observed (µs)	Pulse Velocity ( km/s)
Charnokitik-gneiss	MB 1	24.49-25.00	15.8	6.8
Biotite rich gneiss	MB 3	22.00-22.38	16.2	6.0
Calk-gneiss	DT 1	19.45-19.85	49.5	2.2
Garnet rich biotite gneiss	MT 3	14.31-14.76	22.7	4.9
Quartzite	MT 2	32.56-33.00	26.3	4.1
Quartz rich feldspathic gneiss	MT 1	34.93-35.35	42.1	2.6

# 2.4) Results of Soundness Tests by Sodium Sulphate of Rock Samples

Rock Type	Sample No.	Bore Hole No. & Location	Soundness of Rock Sample (Loss in weight) %
Charnokitik formation	01	MB 1/16.00-16.15, MB 4/21.66-21.82m, MB 3/5.46-5.67m, CT 1/14.60-14.75m	3.72
Gneissic formation	02	MB 2/30.00-30.13m MB 3/47.20-47.37m, MB 1/39.42-39.55m, MB 4/9.28-9.44m,	8.18

## 2.5) Results of Chemical (Alkali) Reactivity Test of Rock Samples

Rock Type	Bore Hole No.	Depth (m)	Quantity of Dissolved Silica (Sc) mmol/L	Quantity of Reduction in Alkalinity (Rc) mmol/L
Charnokitik-gneiss	MB 2	11.00-11.21	3.53	30
Garnetiferrous biotite gneiss	CT 2	7.15-7.30	0.71	165

Reported By: ...

R.M.K.R.Bandara / Laboratory Engineer

Checked By:

I.Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias Engineer In Charge

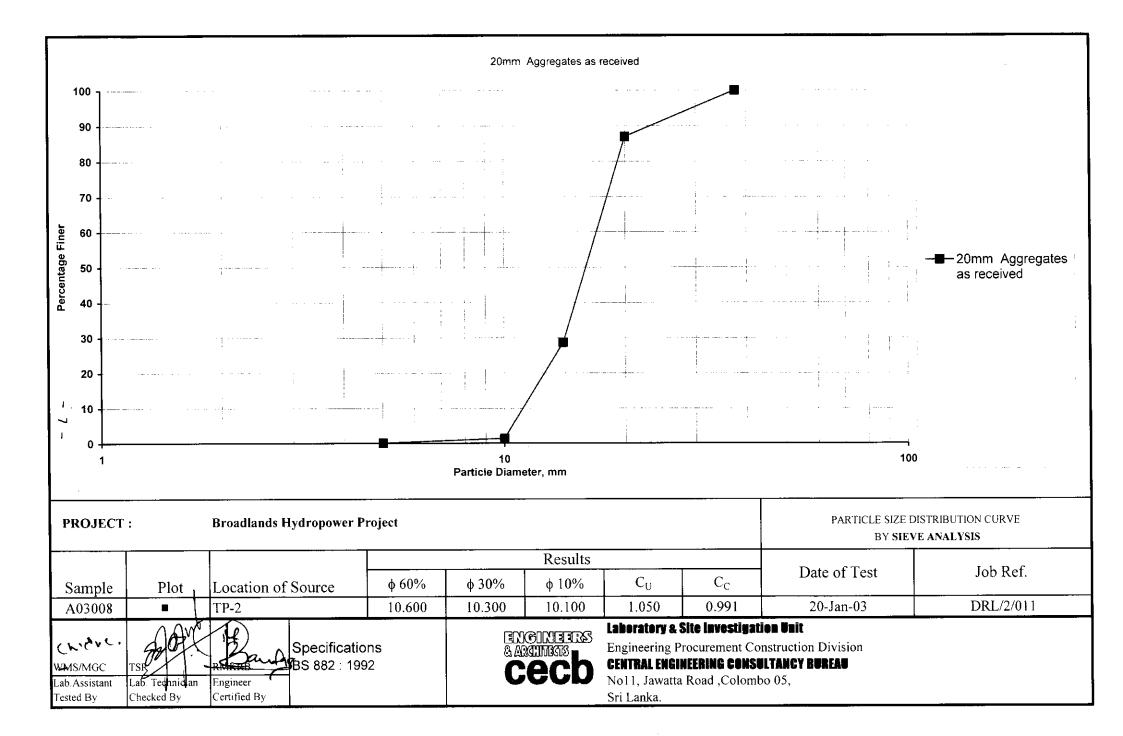
B.M.A.P.Mapa
Project Manager Laboratory
& Site Investigation Unit

Date: 12-02-2003.

# Particle Size Analysis Data (sieve analysis) -20mm Aggregates

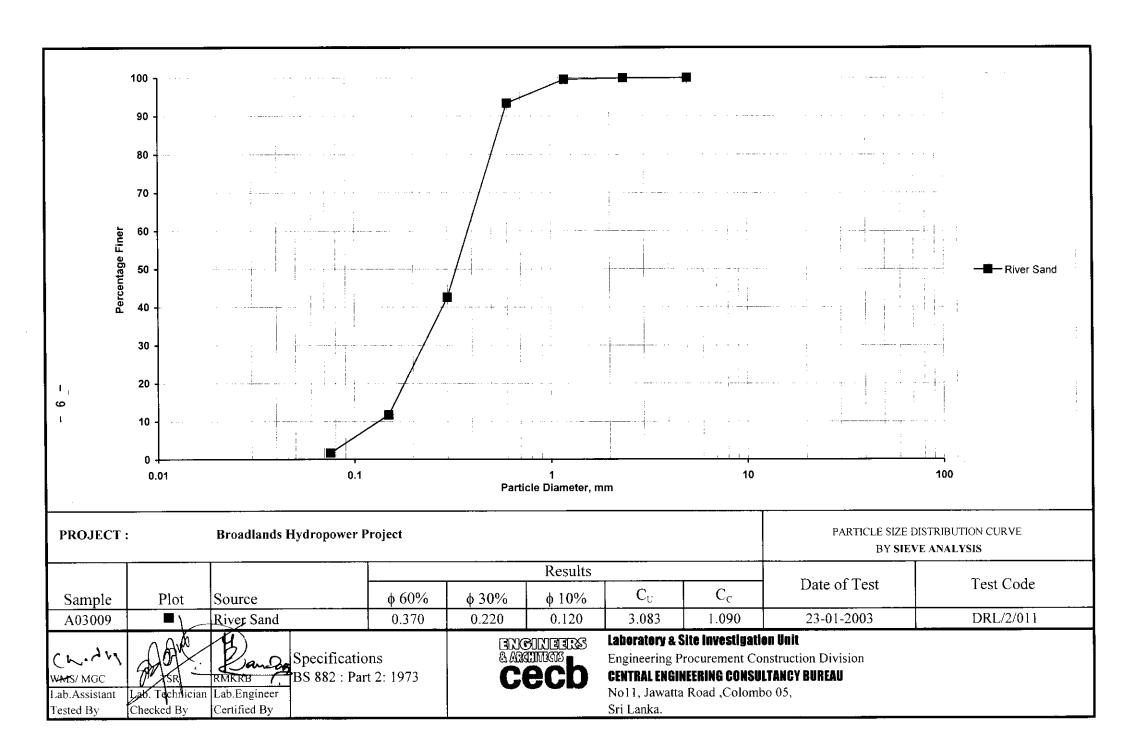
Sample No:S1	Mass Retained	Percentage	Percentage
mm	g	Retained (%)	Passing(%)
37.5	0.00	0.00	100.00
20	260.56	13.03	86.97
14	1,165.90	58.30	28.68
10	544.11	27.21	1.47
5	26.95	1.35	0.12
Pan	2.48	0.12	0.00
Sample Weight	2,000.00		





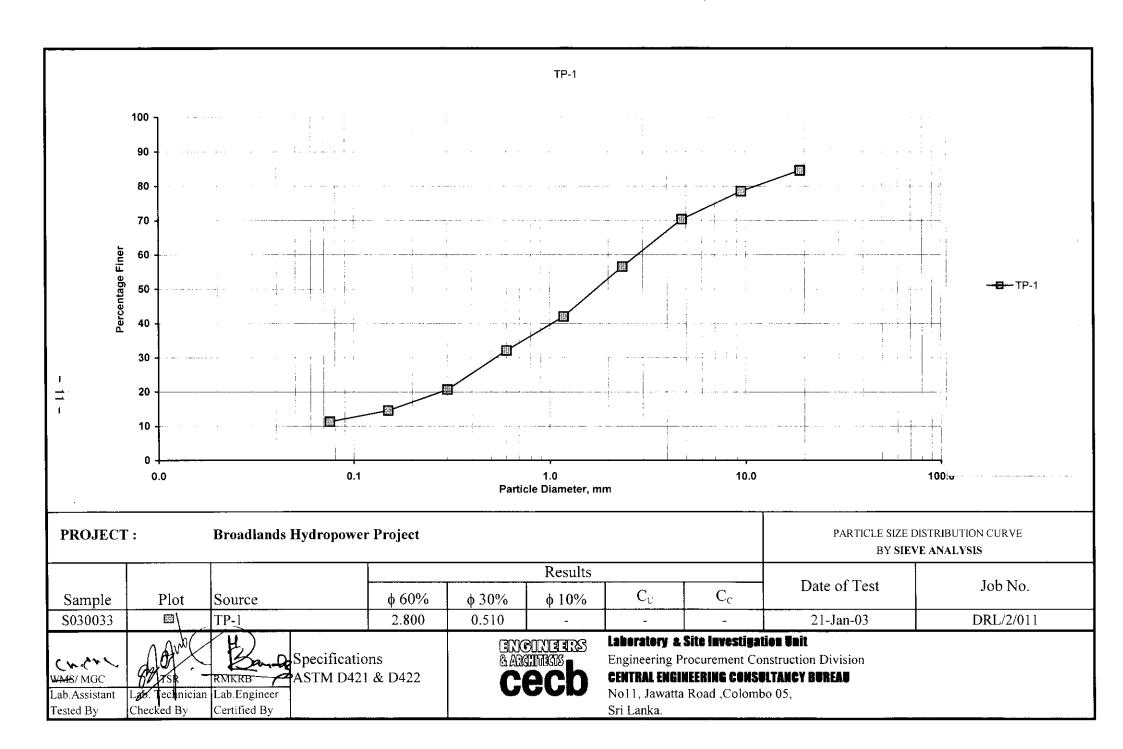
# Particle Size Analysis Data (sieve analysis)- River Sand from Broadland

River Sand		•	
Sieve size	Mass Retained	% Retained	% Passing
mm	g		
5	0.00	0.00	100.00
2.36	0.67	0.03	99.97
1.18	7.61	0.38	99.59
0.600	124.48	6.22	93.36
0.300	1,015.40	50.77	42.59
0.150	617.10	30.86	11.74
0.075	199.76	9.99	1.75
Pan	34.98	1.75	
Sample Weight	2000		



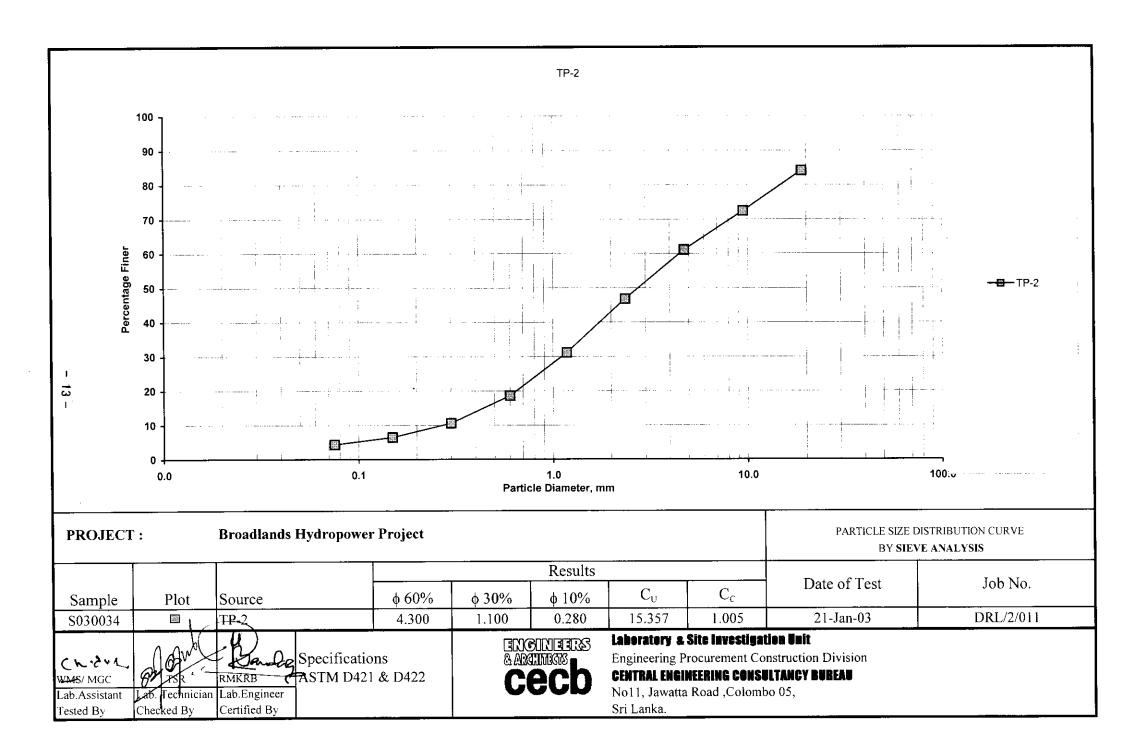
# Particle Size Analysis Data (sieve analysis)

TP-1			
Sieve size	Mass Retained	% Retained	% Passing
mm	g		
50.0	0.00	0.00	100.00
37.5	204.89	7.21	92.79
28.0	92.87	3.27	89.53
19.0	139.85	4.92	84.61
9.5	172.11	6.05	78.55
4.75	233.86	8.23	70.33
2.36	392.39	13.80	56.53
1.18	414.20	14.57	41.96
0.600	280.20	9.86	32.10
0.300	325.49	11.45	20.65
0.150	174.64	6.14	14.51
0.075	91.00	3.20	11.31
Pan	759.19	26.70	
Sample Weight	2843.08		



# Particle Size Analysis Data (sieve analysis)

TP-2			
Sieve size	Mass Retained	% Retained	% Passing
mm	g		
50.0	0.00	0.00	100.00
37.5	157.62	6.39	93.61
28.0	156.19	6.33	87.28
19.0	77.20	3.13	84.16
9.5	289.75	11.74	72.41
4.75	279.20	11.31	61.10
2.36	353.66	14.33	46.77
1.18	385.32	15.61	31.16
0.600	310.25	12.57	18.58
0.300	196.93	7.98	10.60
0.150	101.92	4.13	6.47
0.075	52.66	2.13	4.34
Pan	498.11	20.18	
Sample Weight	2467.8		



Sample Test Code A030009	SPECIFIC GRAVITY & WATER ABSORPTION OF FINE AGGREGATES	Our Reference CB/EPC/LAB/04DR1.
Date of Report	Specification No: ASTM C128	
PROJECT.	Dura dlanda Hudnanaway Project	

PROJECT: Broadlands Hydropower Project

Location of the Sample	River sand	
Date of Test	27-Jan-03	

Sample No.			1	2	Average
Wt. in Air of Oven Dry Sample	(g)	A	495.4	496.6	
Wt. in Air of Saturated Surface Dry Sample	(g)	D	500.0	500.0	
Wt.of Picnometer Filled with Water	(g)	В	2,691.0	2,691.0	
Wt.of Picnometer Filled with Sample & Water to Calibration Mark	(g)	С	2997	2,994.6	
Bulk Specific Gravity $\frac{A}{B+D-C}$	_	-	2.554	2.529	2.541
Bulk Specific Gravity  (Saturated-Surface-Dry)  D  B+D-C			2.577	2.546	2.562
Apparent Specific Gravity $\frac{A}{B+A-C}$	·- <u>-</u>		2.616	2.573	2.594
Absorption % $\frac{D-A}{A}$ 100	)%		0.927	0.677	0.802

Remarks :

MGC
Lab.Assistant
Tested By

Charker

Charker

Eab.Technician
Checked By
Checked By
Checked By
Checked By

Engineering Programment Construction

Engineering Procurement Construction Division CENTRAL ENGINEERING CONSULTANCY BUREAU

Noll, Jawatta Road, Colombo 05,

A03007		CIFIC GRAVITY & WATER ABSORPTION Our Reference OF COARSE AGGREGATES CB/EPC/LAB/04DRL						
23/01/2003	Specification No. ASTM C127-77							
PROJECT :								
Location of the S	Sample	TP-1			<u>.</u>			
Date of Test		21-01-2003						
Size of Aggregat	es	20mm						
			<del></del>	<u> </u>	2	Avamaga		
Sample No.				11	<u> </u>	Average		
Rock Type								
Wt in Saturated	Surface Dry	(g)	Α	582.2	584.8			
Wt in Air of Ove	n Dry Sample	(g)	В	567.9	569.6			
Wt of Sample in	Water	(g)	С	351.5	356.1			
Bulk Specific Gr	avity	$= \frac{B}{A - C}$		2.462	2.490	2.476		
Bulk Specific Gr (Saturated-Surfa		= <u>A</u> A - C		2.524	2.557	2.540		
Apparent Specif		$= \frac{B}{B - C}$		2.625	2.668	2.646		
Absorption %	=	$=\frac{A - B}{B} *100\%$		2.520	2.672	2.596		
Remarks :								

		CW CW.	TSR	Bandag
		Lab.Assistant Tested By	Lab. Technician Checked By	Engineer <b>)</b> Certified By
Date of Test 21/01/2003	EKCINEERS & ARIMGIS	Engineering Procur	Investigation Unit ement Construction Division NEERING CONSULTANC	
Job Code DRL/2/011		No 11, Jawatta Roa Sri Lanka.	d, Colombo 05,	

Sample Test Code A03008	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES						
Date of Report			W 0105 55				
23/01/2003	Specification	No: ASTI	M C127-77				
PROJECT :	Broadlands Hyd	ropower Project					
Location of the S	Sample	TP-2				<u></u>	
Date of Test		21-01-2003					
Size of Aggregate	es	20mm					
Sample No.	<u></u>	,		1	2	Average	
Rock Type							
Wt in Saturated S	Surface Dry	(g)	1 A	1,793.8	1,838.4		
Wt in Air of Ove	n Dry Sample	(g)	В	1,786.0	1,830.1		
Wt of Sample in	Water	(g)	С	1,200.4	1,231.7		
Bulk Specific Gr	avity =	B A - C		3.010	3.016	3.013	
Bulk Specific Gr (Saturated-Surface	•	A - C		3.023	3.030	3.027	
Apparent Specif		B - C		3.050	3.058	3.054	
Absorption %	=	A - B *100	)%	0.437	0.454	0.445	
Remarks :							
				\ \ \	_/		
		Lal	MGC b. Assistant	Lab. Te	SR chnician	RMKRB Engineer	
D ( 070		<del> </del>	ested By		ted By	Certified By	
Date of Test 21/01/2003		77.66611116		e Investigation rement Construc			

Sri Lanka.

No 11, Jawatta Road, Colombo 05,

Job Code

DRL/2/011

CENTRAL ENGINEERING CONSULTANCY BUREAU

Test code

CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES

(Coarse Aggregates)

Our Reference

A030008

Date of Test 30-Jan-2003

Specification No:

ASTM C 142

CB/EPC/LAB/04/DRL

**PROJECT:** 

**Broadlands Hydropower Project** 

**Location Reference of the Sample:** 

TP2

**Description:** 

Concrete Aggregates (Coarse)

Size of Particles Making Up Test Sample (mm)	Dry Weight of Test Sample (g)	Size of Sieve for Removing Residue of Clay Lumps and Friable Particles (mm)	Weight of Particles Retained on Designated Sieve (g)	Percentage of Clay Lumps & Friable Particles %
4.75-9.5	1237.3	2.36	1235.2	0.17
9.5-19.0	2493.5	4.75	2479.1	0.58
19.0-38.1	2378.1	4.75	2375.7	0.10
>38.1	_	4.75	-	-

داريه

Lab.Assistant Tested By Lab. Technician Checked By Engineer Certified By eccp angings engineers

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No11,Jawatta Road,Colombo 05,

# Test code A030009

# CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES

(Fine Aggregates)

Our Reference
CB/EPC/LAB/04/DRL

Data of Too

Date of Test 30-Jan-2003

**Specification No:** 

**ASTM C 142** 

**PROJECT:** 

Broadlands Hydropower Project

**Location Reference of the Sample:** 

River sand

Size of Particles Making Up Test Sample (mm)	Dry Weight of Test Sample (g)	Size of Sieve for Removing Residue of Clay Lumps and Friable Particles (mm)	Weight of Particles Retained on Designated Sieve (g)
>1.18	54.38	0.85	39.426

Percentage of Clay Lumps and Friable Particles =  $\frac{27.50}{\%}$  %

MGC
Lab.Assistant

ab.Assistant Lab.Technician
Tested By Checked By

Engineer
Certified By

Cecb

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No11,Jawatta Road,Colombo 05, Sri Lanka.

Sample Test Code A03007	SOUNDNESS TEST OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
<b>Date</b> 30-Jan-2003	Specification No: ASTM C88	
PROJECT: B	roadlands Hydropower Project	

Location	of the Sample	TP-1

Weight of Sample Passing 37.5mm and Retained on 19.1mm	(g)	1498.97
Weight of Sample Retained on 19.1mm after test	(g)	1476.24
Weight loss after test	(g)	22.73
Soundness of Rock Sample (Loss in Weight)	(%)	1.52

Solution Used

Sodium Sulphate

No. of Cycles

5

Tested at:

Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.

Engineer Certified By

ENCINEERS Job No. DRL/2/011

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05,

Sample Test Code		SOUNDNESS TEST	Our Reference
A03008	OF (	COARSE AGGREGATES	CB/EPC/LAB/04DRL
<b>Date</b> 30/Jan/2003	Specification No:	ASTM C88	
PROJECT :	Broadlands Hydropo	wer Project	
Location of the S	ample TP-		

Weight of Sample Passing 19.1mm and Retained on 12.5mm	(g)	702.21
Weight of Sample Retained on 12.5mm after test	(g)	700.64
Weight loss after test	(g)	1.57
Soundness of Rock Sample (Loss in Weight)	(%)	0.22

Solution Used

Sodium Sulphate

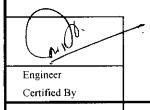
No. of Cycles

5

Tested at:

Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

**Job No.** DRL/2/011

# Sample Test Code A03007

## LOS ANGELES ABRASION TEST

Our Reference CB/EPC/LAB/04DRL

Date of Report 23-Jan-2003

Specification No: ASTM C131/76

#### SUPPLIER:

## **Broadlands Hydropower Project**

Location Reference of the Sample	TP-1	
Description of sample	19mm aggregates	
Type of Fraction	19.0mm-9.5mm	
Quarry Location		

Passing	Retained	Weight (g)
19.0mm	12.5mm	2500
12.5mm	9.5mm	2500
No. of steel s	pheres used	11 nos.

ITCM	100	500
ITEM	REVOLUTIONS	REVOLUTIONS
Wgt .of sample before (g)	5000.00	5000.00
Wgt. Of sample retained on 1.7mm sieve after test (g)	3890.80	1711.60
Wgt of sample passing 1.7mm sieve (g)	1109.20	3288.40
LOS ANGELES ABRASION VALUE	22.18%	65.77%

WMS/MGC/UM Lab.Assistant Tested By

Lat. Technician Checked BY

RMKRB ( Engineer Certified BY

Date of Test 17-Jan-03

Job Code DRL/2/011



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No. 11, Jawatta Road, Colombo 5,

# Sample Test Code A03008

# LOS ANGELES ABRASION TEST

Our Reference
CB/EPC/LAB/04DRL

Date of Report 23-Jan-2003

Specification No: ASTM C131/76

SUPPLIER:

**Broadlands Hydropower Project** 

Location Reference of the Sample	TP-2	
Description of sample	19mm aggregates	
Type of Fraction	19.0mm-9.5mm	
Quarry Location		

Passing	Retained	Weight (g)
19.0mm	12.5mm	2500
12.5mm	9.5mm	2500
No. of steel s	pheres used	11 nos.

ITEM	100	500
ITEM	REVOLUTIONS	REVOLUTIONS
Wgt .of sample before (g)	5000.00	5000.00
Wgt. Of sample retained on 1.7mm sieve after test (g)	4569.50	3491.20
Wgt of sample passing 1.7mm sieve (g)	430.50	1508.80
LOS ANGELES ABRASION VALUE	8.61%	30.18%

VMMS/MGC/UM Lab.Assistant Tested By

ab. Teahnician Checked BY

Engineer Certified BY

Date of Test 17-Jan-03

Job Code DRL/2/011



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No. 11, Jawatta Road, Colombo 5,

	OF AGGREGATES (	Our Reference CB/EPC/LAB/04DRL	
<b>Date</b> 9-Feb-2003	Specification No:	ASTM C-289	
PROJECT: B	roadlands Hydropower Project		
Type of Sample	TP-1 (Coarse Aggre	egates)	
Quantity	m sieve and be retained on a 150r y of Dissolved Silica (Sc) y of Reduction in Alkalinity(Rc)	2.90 mmol/L 60.00 mmol/L	·
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Engineer Certified By

Job No.

DRL/2/011

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Tested at: Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.

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100

ENCONEERS BRIMINGS

25

Quantity Sc Disserved Silica (millimeter per litre)

7.5 10

Laboratory & Site Investigation Unit

250

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Aggregie Considered Gelegendus

1000

500 750

No 11, Jawatta Road, Colombo 05, Sri Lanka.

iample Test Code		TENTIAL AL					Our Reference CB/EPC/LAB/04DR
A030008	<u> </u>	F AGGREGAT	. ES (Cr	LEMICA	T ME	100)	CB/EPC/LAB/04DR
Date							
9-Feb-2003	:	Specification No:	AST	M C-289			
PROJECT: B	roadland	s Hydropower Pr	oject				
Type of Sample		TP-2 (Coarse	Aggregat	es)			
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		rived Silica (Sc) action in Alkalinity(I	Rc)	30.		mol/L	
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		CONTINUAL CO	CE	NTRAL ENG	GINEERIN	G CONSULTA	ANCY BUREAU
Job No.				11. Jawatta R	toad, Colom	bo 05,	
DRL/2/011			Sri	Lanka.			

Sample Test Code A03016	SPECIFIC GRAVITY & WATER ABSORPTION OF ROCK CORES	Our Reference CB/EPC/LAB/04DRL
Date of Report 11-Feb-03	Specification No: ASTM C127	

**Broadlands Hydropower Project** 

Location of the Sample	MB 1/depth 24.49-25.00m	
Rock Type	Charnokitik-gneiss	
Particle Size	20-5 mm	

Sample No.		•	1	2	Average
Wt in Saturated Surface Dry	(g)	Α	901.3	838.8	
Wt in Air of Oven Dry Sample	(g)	В	900.8	837.7	
Wt of Sample in Water	(g)	С	559.0	522.1	
Bulk Specific Gravity	$=\frac{B}{A - C}$		2.632	2.645	2.638
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	$= \frac{A}{A - C}$		2.633	2.648	2.641
Apparent Specific Gravity	$= \frac{B}{B - C}$		2.635	2.654	2.645
Absorption %	$=\frac{A - B}{B} *100\%$		0.051	0.131	0.091

Remarks :

chibi Li MGC RMKRB / Lab.Assistant Lab Technician Lab.Engineer Checked By Tested By Certified By Date of Test Laboratory & Site Investigation Unit ENGULEERS 07-Feb-03 Engineering Procurement Construction Division CENTRAL ENGINEERING CONSULTANCY BUREAU Job No. No 11, Jawatta Road, Colombo 05, Sri Lanka. DRL/2/011

Sample Test Code A03017	SPECIFIC GRAVITY & WATER ABSORPTION OF ROCK CORES	Our Reference CB/EPC/LAB/04DRL
Date of Report	Specification No: ASTM C127	

**Broadlands Hydropower Project** 

Location of the Sample	MB 3/depth 22.00-22.38m	
Rock Type	Biotite rich gneiss	
Particle Size	20-5 mm	

Sample No.			1	2	Average
Wt in Saturated Surface Dry	(g)	A	955.5	1,062.5	
Wt in Air of Oven Dry Sample	(g)	В	955.2	1,062.1	
Wt of Sample in Water	(g)	С	643.7	717.5	
Bulk Specific Gravity	$= \frac{B}{A - C}$		3.064	3.079	3.071
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> A - C		3.064	3.080	3.072
Apparent Specific Gravity	$= \frac{B}{B - C}$		3.066	3.082	3.074
Absorption %	$=\frac{A - B}{B} *100\%$		0.031	0.038	0.035

Remarks:

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Cherr.	TSR TSR	Banka
Lab.Assistant	Lab Technician	Lab.Engineer
Tested By	Checked By	Certified By
Data of Tost		Labarat

Date of Test 07-Feb-03

Job No. DRL/2/011 Laboratory & Site Investigation Unit

Engineering Procurement Construction Division
CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05,

Sample Test Code A03018	SPECIFIC GRAVITY & WATER ABSORPTION OF ROCK CORES	Our Reference CB/EPC/LAB/04DRL
Date of Report	Specification No: ASTM C127	

PROJECT: Broadlands Hydropower Project

Location of the Sample	DT 1/depth 19.45-19.85m
Rock Type	Calk-gneiss
Particle Size	25-3 mm

Sample No.			1	2	Average
Wt in Saturated Surface Dry	(g)	A	940.7	621.5	
Wt in Air of Oven Dry Sample	(g)	В	935.5	614.9	
Wt of Sample in Water	(g)	С	621.2	403.1	
Bulk Specific Gravity	$= \frac{B}{A - C}$		2.928	2.815	2.871
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> A - C		2.944	2.845	2.895
Apparent Specific Gravity	$= \frac{B}{B - C}$		2.976	2.903	2.939
Absorption %	$=\frac{A - B}{B} *100\%$		0.556	1.073	0.815

Remarks:

MGC TSR RMKRB
Lab.Assistant Cab.Technician Lab.Engineer
Tested By Checked By Certified By

Date of Test 07-Feb-03

Job No. DRL/2/011 Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05,

Sample Test Code	SPECIFIC GRAVITY & WATER ABSORPTION OF ROCK CORES	Our Reference CB/EPC/LAB/04DRL
Date of Report	Specification No: ASTM C127	

**Broadlands Hydropower Project** 

Location of the Sample	MT 3/depth 14.31-14.76m
Rock Type	Garnet rich biotite gneiss
Particle Size	25-4 mm

Sample No.			1	2	Average
Wt in Saturated Surface Dry	(g)	A	960.2	784.7	
Wt in Air of Oven Dry Sample	(g)	В	959.8	784.1	
Wt of Sample in Water	(g)	С	616.5	508.0	
Bulk Specific Gravity	$= \frac{B}{A - C}$		2.793	2.834	2.813
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> A - C		2.794	2.836	2.815
Apparent Specific Gravity	= B B - C		2.796	2.840	2.818
Absorption %	$= \frac{A - B}{B} *100$	%	0.042	0.077	0.059

Remarks:

		,
Chib.	SSR SSR	RMKRB 2
Lab.Assistant	Lab.Technician	Lab.Engineer
Tested By	Checked By	Certified By
D . CT .		

Date of Test 07-Feb-03

Job No. DRL/2/011 enconeers Arainas Arainas Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05,

Sample Test Code	SPECIFIC GRAVITY & WATER ABSORPTION	Our Reference
A03020	OF ROCK CORES	CB/EPC/LAB/04DRL
Date of Report	Specification No: ASTM C127	

**Broadlands Hydropower Project** 

Location of the Sample	MT 2/depth 32.56-33.00m
Rock Type	Quartzite
Particle Size	22-5 mm

Sample No.			1	2	Average
Wt in Saturated Surface Dry	(g)	A	787.4	774.6	
Wt in Air of Oven Dry Sample	(g)	В	787.1	774.1	
Wt of Sample in Water	(g)	С	489.4	477.6	
Bulk Specific Gravity	$= \frac{B}{A - C}$		2.642	2.606	2.624
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> A - C		2.643	2.608	2.625
Apparent Specific Gravity	$= \frac{B}{B - C}$		2.644	2.611	2.628
Absorption %	$=\frac{A - B}{B} *100\%$		0.038	0.065	0.051

Remarks :

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ch.d.v	ON SR	Ban RMK	RB	
Lab.Assistant	Lab. Technician	Lab.Eng	-	
Tested By	Checked By	Certifie	d By	
Date of Test 07-Feb-03				ory & Site Investigation Unit ing Procurement Construction Division
			CENTR	AL ENGINEERING CONSULTANCY BUREAU
Job No.			No 11, J	awatta Road, Colombo 05,
DRL/2/011			Sri Lank	a.

Sample Test Code A03021	SPECIFIC GRAVITY & WATER ABSORPTION OF ROCK CORES	Our Reference CB/EPC/LAB/04DRL
Date of Report	Specification No: ASTM C127	

**Broadlands Hydropower Project** 

Location of the Sample	MT 1/depth 34.93-35.35m
Rock Type	Quartz rich feldspathic gneiss
Particle Size	25-5 mm

Sample No.				1	2	Average
Wt in Saturated Surface Dry	(g		Α	854.8	765.0	
Wt in Air of Oven Dry Sample	(g	)	В	849.5	758.7	
Wt of Sample in Water	(g	;)	С	523.4	473.2	
Bulk Specific Gravity	$= \frac{B}{A - C}$			2.563	2.600	2.581
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	$= A \over A - C$			2.579	2.621	2.600
Apparent Specific Gravity	$= \frac{B}{B - C}$			2.605	2.657	2.631
Absorption %	$= \frac{A - B}{B} *100$	0%		0.624	0.830	0.727

Remarks :

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Ch. MCC	William .	Jan Dang RMKRB	
Lab.Assistant	Lab. Technician	Lab.Engineer	
Tested By	Checked By	Certified By	· · · · · · · · · · · · · · · · · · ·
Date of Test 07-Feb-03	6.400	∭(33.65) ∭(33)  Engineer	ory & Site Investigation Unit ing Procurement Construction Division AL ENGINEERING CONSULTANCY BUREAU
Job No.		No 11, Ja	awatta Road, Colombo 05,
DRL/2/011		Sri Lank	a.

Sample Code	
A030010-15	
Date of Report	

# COMPRESSION TEST ON ROCK SAMPLES

Our Reference
CB/EPC/LAB/04DRL

**PROJECT:** 

3-Feb-2003

**Broadlands Hydropower Project** 

GEOLOGICAL NAME OF ROCK SAMPLE	BORE HOLE NO.  & DEPTH (m)	DIAMETER (mm)			LENGTH OF SAMPLE (mm)			WEIGHT OF SAMPLE	LOAD AT FAILURE	UNCONFINED COMPRESSIVE STRENGTH		
		i	2	3	MEAN	1	2	3	MEAN	(g)	(kN)	(N/mm2)
Charnokitic gneiss	MB1/24.49-24.68 (S.No.2)	49.8	49.8	49.8	49.8	108.5	108.5	109.1	108.7	560.99	128.00	65.66
Biotite rich gneiss	MB3/22.00-22.15 (S.No.2)	54.5	54.5	54.6	54.5	98.6	98.6	98.8	98.7	718.2	90.00	38.52
Calk-gneiss	DT1/19.68-19.85 (S.No.2)	49.5	49.5	49.5	49.5	111.5	111.4	111.3	111.4	616.03	25.00	12.99
Garnet rich biotite gneiss	MT3/14.58-14.76 (S.No.1)	<b>4</b> 9.6	49.6	49.7	49.6	112.8	112.8	112.9	112.8	629.7	33.00	17.05
Quartzite	MT2/32.86-33.00 (S.No.2)	49.5	49.4	49.5	49.5	109.7	109.1	109.9	109.6	551.05	68.00	35.37
Quartz rich feldspathic gneiss	MT1/35.08-35.25 (S.No.2)	54.5	54.5	54.5	54.5	110.9	110.9	111.1	111.0 <sub>-</sub>	690.9	154.00	65.99

MGC TSR RMKRB

Lab.Assistant Lab.Technician Lab. Engineer Checked By Certified By

Date of Test 29-Jan-2003

Job Ref: DRL/2/011



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No. 11, Jawatta Road, Colombo 5, Sri Lanka.

	DETERMINATION OF ULTRASONIC PULSE VELOCITY OF ROCK CORE SAMPLES	Our Reference CB/EPC/LAB/04DRL
Date of Report 23-Jan-2003	Specification No: ASTM D 2845-1983	
PROJECT:	Broadlands Hydropower Project	<u> </u>

Serial No.	1	2	3	4	5	6
Bore hole No.	MB1	МВЗ	DT1	МТЗ	MT2	MT1
Depth of extraction	24.49-24.68	22.00-22.15	19.68-19.85	14.58-14.76	32.86-33.00	35.08-35.25
Length as received (mm)	108	98	110	112	108	110
Weight as received (g)	559.33	716.02	616.48	627.80	549.62	688.88
Oven dry weight (g)	559.03	715.75	613.31	627.59	549.12	688.29
Observed diameter (mm)	50	55	49	50	50	55
Density (kg/m³)	2648	3103	2914	2886	2621	2685
Pulse travel time observed (4s)	15.8	16.2	49.5	22.7	26.3	42.1
Pulse velocity (km/s)	6.8	6.0	2.2	4.9	4.1	2.6

0.04

0.03

0.09

0.09

0.51

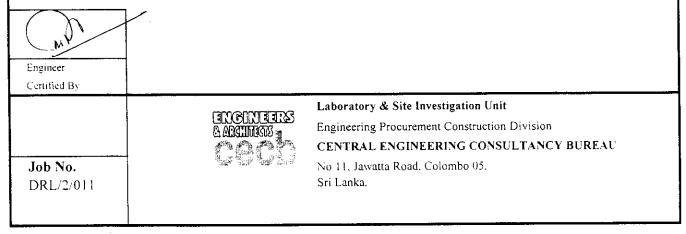
Tested at:

Water content (%) (% oven dry basis)

National Building Research Organisation

0.05

Colombo-05, Sri Lanka.



	SOUNDNESS TEST OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
<b>Date</b> 30-Jan-2003	Specification No: ASTM C88	
PROJECT :	Broadlands Hydropower Project	

Weight of Sample Passing 9.5mm and Retained on 4.75mm	(g)	322.00
Weight of Sample Retained on 4.75mm after test	(g)	310.02
Weight loss after test	(g)	11.98
Soundness of Rock Sample (Loss in Weight)	(%)	3.72

Solution Used

Sodium Sulphate

No. of Cycles

5

Tested at:

Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.



Job No.
DRL/2/011

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

	SOUNDNESS TEST OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
<b>Date</b> 30/Jan/2003	Specification No: ASTM C88	
PROJECT :	Broadlands Hydropower Project	<del>-</del>
Sample No.		

Weight of Sample Passing 19.1mm and Retained on 12.5mm	(g)	998.00
Weight of Sample Retained on 12.5mm after test	(g)	916.41
Weight loss after test	(g)	81.59
Soundness of Rock Sample (Loss in Weight)	(%)	8.18

Solution Used

Sodium Sulphate

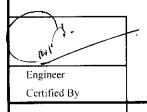
No. of Cycles

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Tested at:

Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.



Job No.

DRL/2/011

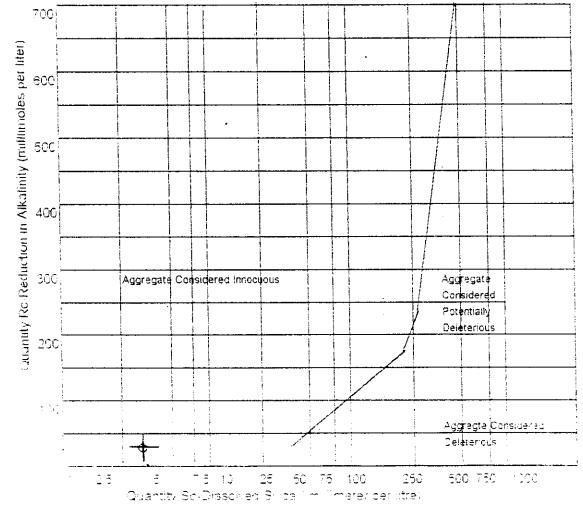
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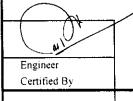
Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

# POTENTIAL ALKALI-SILICA REACTIVITY Our Reference OF AGGREGATES (CHEMICAL METHOD) CB/EPC/LAB/04DRL Date **ASTM C-289** Specification No: 9-Feb-2003 PROJECT: **Broadlands Hydropower Project** Type of Sample Sample No.01 (Rock Core) This test method covers chemical determination of the potential reactivity of an aggregate with Scope arkailes in portland cement concrete as indicated by the amount of reation during 24h at 36C between 1N Sodium Hydroxide solution and aggregate that has been crushed and sieved to pass a 300mm, sieve and be retained on a 150mm sieve Quantity of Dissolved Silica (Sc) 3.53 mmol/L Quantity of Reduction in Alkalinity(Rc) 30,00 mmcl/L 700 600





Job No.

DRL/2/011

Tested at: Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.

ENGINIERS AMINAS COLUMNIERS Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05. Sri Lanka.

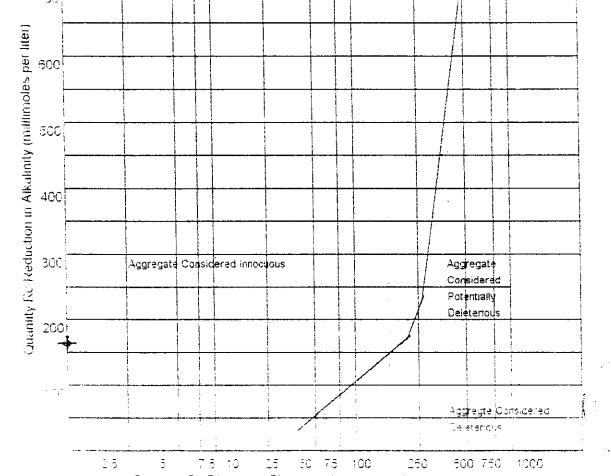
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# POTENTIAL ALKALI-SILICA REACTIVITY Our Reference OF AGGREGATES (CHEMICAL METHOD) CB/EPC/LAB/04DRL Date Specification No: **ASTM C-289** 9-Feb-2003 PROJECT: **Broadlands Hydropower Project** Sample No.02 (Rock Core) Type of Sample

Scope

This test method covers chemical determination of the potential reactivity of an aggregate with alkalies in portland cement concrete as indicated by the amount of reation during 24h at 80C between 1N Sodium Hydroxide solution and aggregate that has been crushed and sieved to pass a 300mm, sieve and be retained on a 150mm sieve

		ssolved Sil			0.71	mmol/L	
<u> Quar</u>	ntity of Re	duction in	Alkalinity(Ro	)	165.00	mmoi/L	
					· · · · · · · · · · · · · · · · · · ·		
700						1	
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600							
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Quantit, Bo-Dissolved Siros - millimeter per litte,

Engineer Certified By

Engineering & Laboratory Services (Pvt) Ltd. Tested at:

Boralesgamuwa, Sri Lanka.

ENCINEERS & ARCHINEGES :

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05. Sri Lanka.

DRL/2/011

Job No.



Fig 12: Soundness by Sodium Sulphate - Test in Progress



Fig 13: Clay Lumps and Friable Particles- Test in Progress

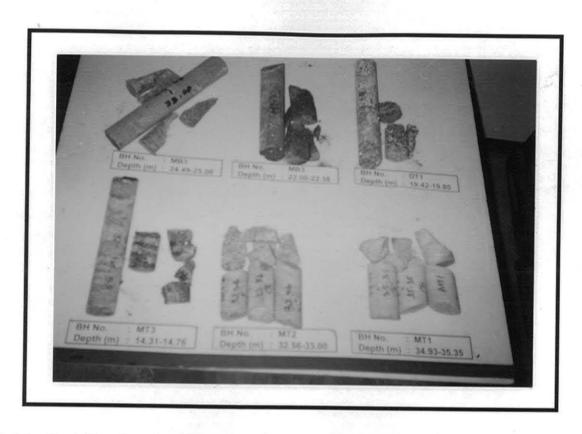


Fig 14: Rock Core Samples Selected for Testing of Water Absorption and Specific Gravity , Unconfined Compressive Strength and Ultra Sonic Wave Velocity

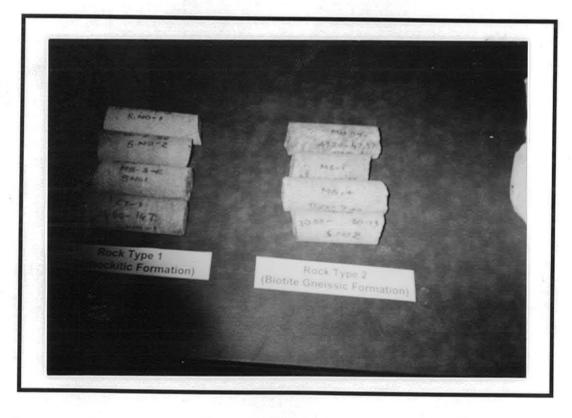


Fig 15: : Rock Core Samples Selected for Testing of Soundness by Sodium Sulphate and Chemical (Alkali) Reactivity



Our Ref: CB/EPC/LAB/04C

TEST CERTIFICATE NO: DRL/AT/2003386

Issued By:

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division CECB, No.11, Jawatte Road, Colombo 05.

Assured To:

Jica Study Team

Electric Power Development Co., Ltd

Nippon Koel Co., Ltd.

Project:

Broadlands Hydropower Project-Phase II

Job Requested:

Testing of Aggregates & Rock samples from Broadlands Hydropower Project.

Job Ref:

DRL/3/007

Tested for:

1) Concrete Aggregates (from test pit samples)

1.1) Sieve Analysis of Aggregates

1.2) Specific gravity and water absorption (Fine)1.3) Specific gravity and water absorption (Coarse)

1.4) Clay lumps and friable particles in (Coarse & Fine) Aggregates

1.5) Soundness tests by sodium sulfate

1.6) Abrasion test of Coarse Aggregate by Los Angeles machine

1.7) Chemical (Alkali) reactivity test

#### 2.) Rock (from drilling core samples)

2.1) Water absorption and bulk specific gravity

2.2) Unconfined compressive Strength of Rock Cores

2.3) Ultra-sonic wave velocity

2.4) Soundness tests by sodium sulfate

2.5) Chemical (Alkali) reactivity test

2.6) Abrasion test of Coarse Aggregate by Los Angeles machine

Results:

As tabulated in pages 02-07.



# 1.1) Results of Sieve Analysis of Aggregates

Sample Description	Φ 60% (mm)	Φ 30% (mm)	Φ 10% (mm)	Cu	$C_{c}$
TP-3	1.100	0.420	0.160	6.875	1.002
TP-4	0.190	0.081	-	-	

# 1.2) Results of Specific Gravity and Water Absorption of Fine Aggregates

Sample D	escription	Bulk Specific Gravity	Bulk Specific Gravity (SSD* Basis)	Apparent Specific Gravity	Water Absorption (%)
TP-3(Fine	Aggregates)	2.286	2.376	2.511	3.92
TP-4(Fine	Aggregates)	2.144	2.320	2.602	8.20

\*SSD- Saturated-Surface-Dry Basis

# 1.3) Results of Specific Gravity and Water Absorption of Coarse Aggregates

Sample Description	Bulk Specific Gravity	Bulk Specific Gravity (SSD* Basis)	Apparent Specific Gravity	Water Absorption (%)
TP-3(Coarse Aggregates)	2.717	2.731	2.756	0.523

\*SSD- Saturated-Surface-Dry Basis

# 1.4) Results of Clay Lumps and Friable Particles in (Coarse & Fine) Aggregates

Sample Description	Particle Size (mm)	Percentage of Clay Lumps and Friable Particles (%)
	4.75-9.5	13.71
	9.5-19.0	3.36
TP-3(Coarse Aggregates)	19.0-38.1	3.25
	>38.1	1.72
TP-3(Fine Aggregates)	>1.18	5.84

Reported By:

A.J.Emmanuel / Laboratory Engineer

Checked By:

S.S.H.Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias

Engineer In Charge Laboratory

B.M.A.P.Mapa

Project Manager Laboratory

Date:



## 1.5) Results of Soundness Tests by Sodium Sulphate of Aggregates

	Soundness of Aggregate
Sample Description	sample
	(Loss in weight) %
TP-3(Coarse Aggregates)	10.1

### 1.6) Results of Loss Angeles Abrasion Test of Aggregates

	Los Angeles Abrasion Value (%)		
Sample Description	100	500	
	Revolutions	Revolutions	
TP-3(Coarse Aggregates)	21.40	56.51	

### 1.7) Results of Chemical (Alkali) Reactivity Test of Aggregates

	Quantity of	Quantity of Reduction
Sample Description	Dissolved Silica (Sc)	in Alkalinity (Rc)
	mmol/L	mmol/L
TP-3(Coarse Aggregates)	8.2	35.00

Reported By: ABR

A.J.Emmanuel / Laboratory Engineer

Checked By:

S.J. Kodagoda / Coordinator - Testing and Analysis

Certified By ..

A.A.Virajh Dias

Engineer In Charge Laboratory

B.M.A.P.Mapa / Project Manager Laboratory

Date : 28-10-2003.



# 2.1) Results of Water Absorption and Bulk Specific Gravity of Rock Samples

Bore Hole No.	Rock Type	Depth (m)	Bulk Specific Gravity	Bulk Specific Gravity (SSD* Basis)	Apparent Specific Gravity	Water Absorption (%)
MB-5	Charnokitic-gneiss	2.12-2.28	2.648	2.658	2.676	0.404
MB-5	Charnokitic-gneiss	2.26-3.45	2.650	2.658	2.673	0.326
MB-5	Charnokitic-gneiss	3.45-3.60	2.638	2.647	2.662	0.348
MB-5	Charnokitic-gneiss	5.00-5.59	2.658	2.667	2.681	0.334
MB-5	Quartz rich garnet biotite gneiss	22.00-22.18	2.603	2.629	2.673	1.011
MB-5	Quartz rich garnet biotite gneiss	22.18-22.32	2.607	2.633	2.678	1.023
MT-6	Quartz rich garnet biotite gneiss	39.34-39.68	2.795	2.809	2.833	0.472
MT-6	Quartz rich garnet biotite gneiss	39.48-39.68	2.684	2.697	2.719	0.474
MT-6	Quartz rich garnet biotite gneiss	39.68-39.82	2.832	2.846	2.872	0.500
MT-6	Quartz rich garnet biotite gneiss	39.40-39.98	2.690	2.702	2.724	0.461
MT-7	Biotite gneiss	46.18-46.31	3.042	3.052	3.074	0.341
MT-7	Biotite gneiss	46.31-46.41	3.064	3.071	3.087	0.242
MT-8	Biotite gneiss	56.20-56.40	2.865	2.870	2.881	0.195
MT-8	Biotite gneiss	56.40-56.60	2.661	2.667	2.676	0.208
TR-1	Biotite gneiss	10.16-10.49	2.662	2.685	2.725	0.877
TR-1	Biotite gneiss	18.38-18.83	3.058	3.080	3.125	0.705
BQ-2	Granitic gneiss	16.32-16.73	2.585	2.606	2.642	0.842
BQ-2	Granitic gneiss	18.00-18.39	2.582	2.606	2.644	0.913

\*SSD- Saturated-Surface-Dry Basis

Reported By:

A.J.Emmanuel / Laboratory Engineer

Checked By:

LKodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias

Engineer In Charge Laboratory

B.M.A.P.Mapa

Project Manager Laboratory

Date :



## 2.2) Results of Unconfined compressive Strength of Rock Cores

	I	1	
Bore			Unconfined
Hole	Rock Type	Depth	Compressive
No.		(m)	Strength
			( N/mm <sup>2</sup> )
MB-5	Charnokitic-gneiss	5.73-5.83	92.51
MB-5	Charnokitic-gneiss	9.00-9.10	74.87
MB-5	Charnokitic-gneiss	9.52-9.62	51.81
MB-5	Charnokitic-gneiss	22.00-22.38	136.13
MT-6	Quartz rich garnet biotite gneiss	39.00-39.10	85.21
MT-6	Quartz rich garnet biotite gneiss	39.46-39.56	48.90
MT-6	Quartz rich garnet biotite gneiss	39.58-39.68	55.90
MT-6	Quartz rich garnet biotite gneiss	39.68-39.78	63.05
MT-7	Biotite gneiss	29.64-29.75	70.42
MT-7	Quartz rich biotite gneiss	46.00-46.11	93.12
MT-8	Biotite gneiss	51.43-51.54	107.30
MT-8	Quartz rich biotite gneiss	74.76-74.86	69.86
TR-1	Biotite gneiss	10.00-10.15	69.95
TR-1	Biotite gneiss	18.90-19.00	42.02
BQ-1	Quartzo feldspathic gneiss	17.10-17.24	50.93
BQ-1	Quartzo feldspathic gneiss	17.39-17.75	54.69
BQ-1	Impure quartzite	20.60-22.75	26.88
BQ-2	Granitic gneiss	22.52-22.62	10.19
BQ-2	Granitic gneiss	22.62-22.72	55.31
BQ-2	Granitic gneiss	22.90-23.00	71.79

Reported By:

A.J.Emmanuel / Laboratory Engineer

Checked By:

S.S.I.Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A. Virajh Dias

Engineer In Charge Laboratory

B.M.A.P.Mapa Project Manager Laboratory

Date :



## 2.3) Results of Ultra-Sonic Wave Velocity of Rock Cores

Bore Hole No.	Depth (m)	Rock Type	Diameter (mm)	Length (mm)	Ultrasonic Pulse Velocity (km/s)
MB 5	5.73-5.83	Charnokitic-gneiss	49.80	99.92	6.891
MB 5	9.00-9.10	Charnokitic-gneiss	49.62	101.20	7.845
MB 5	9.52-9.62	Charnokitic-gneiss	49.72	101.28	7.558
MB 5	22.00-22.38	Charnokitic-gneiss	49.62	100.58	7.396
MT 6	39.00-39.10	Quartz rich garnet biotite gneiss	50.00	100.92	8.010
MT 6	39.46-39.56	biotite gneiss	49.62	102.62	7.029
MT 6	39.58-39.68	biotite gneiss	49.60	96.80	5.500
MT 6	39.68-39.78	Quartz rich garnet biotite gneiss	49.52	100.22	4.494
MT 7	29.64-29.75	Quartz rich biotite gneiss	54.72	111.00	6.000
MT 7	46.00-46.11	Biotite gneiss	54.40	111.80	7.260
MT 8	51.43-51.54	Biotite gneiss	54.30	111.10	7.032
MT 8	74.76-74.86	Quartz rich biotite gneiss	54.42	92.00	6.301
BQ 1	17.10-17.24	Quartzo feldspathic gneiss	54.42	114.20	6.880
BQ 1	17.39-17.50	Quartzo feldspathic gneiss	54.40	109.00	6.566
BQ 1	20.60-22.75		54.38	65.20	7.581
BQ 2	22.52-22.62		49.80	100.20	3.976
BQ 2	22.62-22.72		50.30	100.82	4.272
BQ 2	22.90-23.00	Granitic gneiss	49.96	101.54	3.982

Reported By: ...

A.J.Emmanuel / Laboratory Engineer

Checked By: .

S.H.Kodagoda / Coordinator - Testing and Analysis

Certified By

A.A.Virajh Dias Engineer In Charge Laboratory B.M.A.P.Mapa
Project Manager Laboratory

Date :



### 2.4) Results of Soundness Tests by Sodium Sulphate of Rock Samples

Bore Hole No.	Rock Type	Soundness of Rock sample (Loss in weight) %
BQ-2	Granitic gneiss	0.4

## 2.5) Results of Chemical (Alkali) Reactivity Test of Rock Samples

Bore Hole No.	Rock Type	Quantity of Dissolved Silica (Sc) mmol/L	Quantity of Reduction in Alkalinity (Rc) mmol/L
BQ-2	Granitic gneiss	2.57	26.00

## 2.6) Results of Loss Angeles Abrasion Test of Aggregates

Bore Hole	n 1 m	Los Angeles Abrasion Value (%)			
No.	Rock Type	100	500		
- 101		Revolutions	Revolutions		
BQ-2	Granitic gneiss	12.21	48.04		

Reported By: ...

A.J.Emmanuel / Laboratory Engineer

Checked By: ,.

S.I.Kodagoda / Coordinator - Testing and Analysis

Certified By ........................

Date :

A.A.Virajh Dias

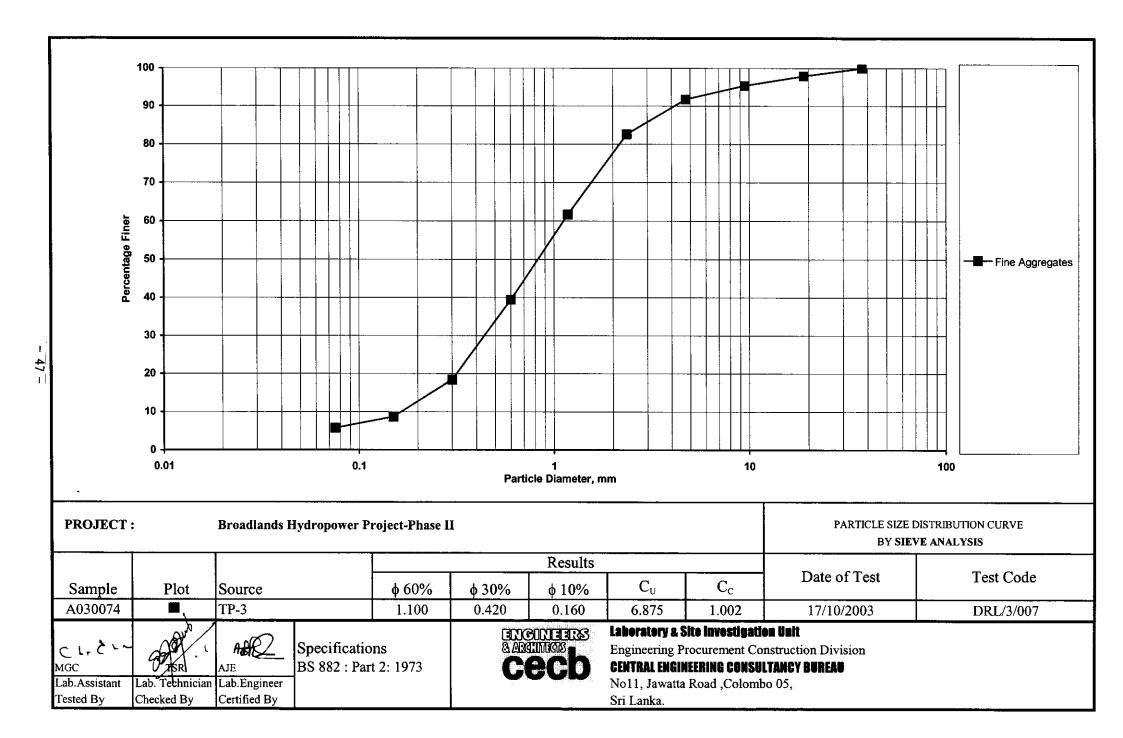
*28-10-2003*.

Engineer In Charge Laboratory

B.M.A.P.Mapa Project Manager Laboratory

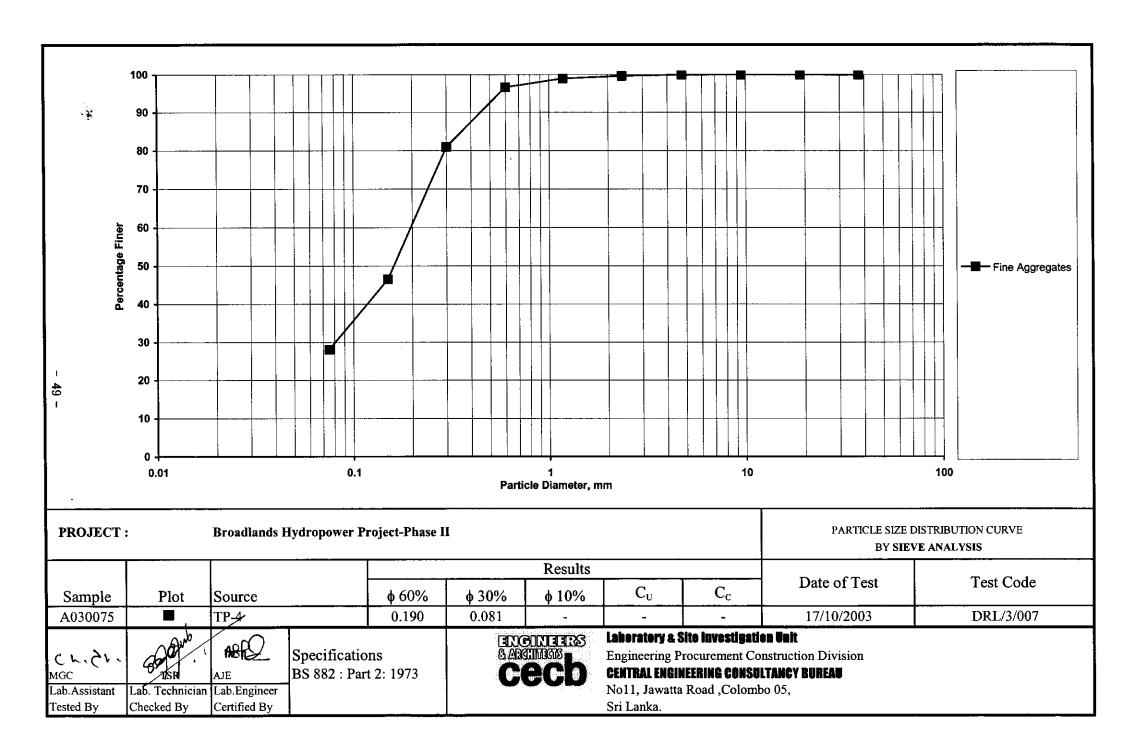
# Particle Size Analysis Data (sieve analysis)- Fine Aggregates

TP-3			
Sieve size	Mass Retained	% Retained	% Passing
mm	g		
37.5	0.00	0.00	100.00
19	33.82	2.07	97.93
9.5	41.14	2.52	95.41
4.75	59.34	3.63	91.77
2.36	149.33	9.15	82.63
1.18	341.74	20.93	61.69
0.6	362.99	22.24	39.46
0.3	343.42	21.04	18.42
0.15	158.75	9.72	8.70
0.075	47.67	2.92	5.78
Pan	94.30	5.78	
Sample Weight	1632.5		



# Particle Size Analysis Data (sieve analysis)- Fine Aggregates

<b>TP4</b>						
Sieve size	Mass Retained	% Retained	% Passing			
mm	8	a digensia dan bankan bankan ba	Litera Manuscrita			
37.5	0.00	0.00	100.00			
19	0.00	0.00	100.00			
9.5	0.00	0.00	100.00			
4.75	0.00	0.00	100.00			
2.36	3.88	0.32	99.68			
1.18	8.22	0.69	98.99			
0.6	27.83	2.32	96.67			
0.3	187.81	15.68	80.99			
0.15	412.02	34.40	46.58			
0.075	221.50	18.49	28.09			
Pan	336.44	28.09				
Sample Weight	1197.7					



Sample Test Code A030074	SPECIFIC GRAVITY & WATER ABSORPTION OF FINE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
Date of Report 27-Oct-03	Specification No: ASTM C128	
PROJECT :	Broadlands Hydropower Project-Phase II	

1. Divadiands Hydropower Project Phase 22

Location of the Sample	TP-3(Fine Aggregates)
Date of Test	16-Oct-03

Sample No.	1	2	Average		
Wt. in Air of Oven Dry Sample	(g)	A	480.8	481.5	
Wt. in Air of Saturated Surface Dry Sample	(g)	D	500.0	500.0	
Wt.of Picnometer Filled with Water	(g)	В	1,806.7	1,806.7	
Wt.of Picnometer Filled with Sample & Water to Calibration Mark	(g)	С	2092.1	2,100.2	
Bulk Specific Gravity $\frac{A}{B+D-C}$	•		2.240	2.332	2.286
Bulk Specific Gravity  (Saturated-Surface-Dry)  D  B + D - C			2.330	2.421	2.376
Apparent Specific Gravity $\frac{A}{B+A-C}$	-		2.461	2.561	2.511
Absorption % $\frac{D - A}{A}$ 100%	,		3.998	3.842	3.920

Remarks :

CL, ELL	2. 1 Gauge	AJE	Engineering Procurement Construction Division CENTRAL ENGINEERING CONSULTANCY BUREAU
Lab. Assistant Tested By	Lab.Technician Checked By	Engineer Certified By	No11,Jawatta Road,Colombo 05, Sri Lanka.

Sample Test Code	SPECIFIC GRAVITY & WATER ABSORPTION	Our Reference
A030075	OF FINE AGGREGATES	CB/EPC/LAB/04DRL
Date of Report 27-Oct-03	Specification No: ASTM C128	

**PROJECT:** 

**Broadlands Hydropower Project-Phase II** 

Location of the Sample	TP-4(Fine Aggregates)
Date of Test	16-Oct-03

Sample No.			1	2	Average
Wt. in Air of Oven Dry Sample	(g)	A	461.3	463.0	
Wt. in Air of Saturated Surface Dry Sample	(g)	D	500.0	500.0	
Wt.of Picnometer Filled with Water	(g)	В	1,806.7	1,806.7	
Wt.of Picnometer Filled with Sample & Water to Calibration Mark	(g)	С	2079.1	2,102.0	
Bulk Specific Gravity $\frac{A}{B+D-C}$		•	2.027	2.262	2.144
Bulk Specific Gravity  (Saturated-Surface-Dry)  D  B + D - C	_		2.197	2.443	2.320
Apparent Specific Gravity $\frac{A}{B+A-C}$	-		2.442	2.761	2.602
Absorption % D-A 1009	<b>)</b> /		8.401	7.994	8.197

Remarks:

MGC Lab.Assistant Tested By

F Lab. Technician

Checked By

Engineer

Certified By

ৰ্মনোম্ব্ৰাস্ত Laboratory & Site investigation Unit

Engineering Procurement Construction Division CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030074	SPECIFIC (	TION	Our Referen CB/EPC/LAB/04D				
Date of Report							
17/Oct/2003	Specification	n No:	ASTM C	.127-77			
PROJECT :	Broadlands Hyo	dropower Pi	roject - P	hase II			
Location of the S	Sample	TP-3					·····
Date of Test		26-Sep-03		<u> </u>			
Size of Aggregat	tes	20mm					
-88 -8						<u> </u>	
Sample No.			·		1	2	Average
Rock Type	-						
Wt in Saturated	Surface Dry		(g)	A	1,297.3	1,295.6	
Wt in Air of Ove	en Dry Sample		(g)	В	1,291.3	1,288.1	
Wt of Sample in	Water		(g)	С	823.8	819.8	
Bulk Specific G	ravity	$= \frac{B}{A - C}$	_		2.727	2.707	2.717
Bulk Specific G (Saturated-Surfa		= <u>A</u> A - C			2.740	2.723	2.731
Apparent Speci		B - C	_		2.762	2.751	2.756
Absorption %	±	A - B	-*100%		0.465	0.582	0.523
		A - B		į		<u>.                                    </u>	

		MGC Lab.Assistant Tested By	TSR Lab. Technician Checked By	AJE Engineer Certified By
Job No. DRL/3/007	ENGINEERS & ARCHILLOUS (+1 2 (+ 1)	Laboratory & Site Engineering Procur	Investigation Unit ement Construction Division NEERING CONSULTANC	

Test code

CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES

Our Reference

A030074

Date of Test 19/Oct/2003 (Coarse Aggregates)

**Specification No:** 

ASTM C 142

CB/EPC/LAB/04/DRL

**PROJECT:** 

**Broadlands Hydropower Project - Phase II** 

**Location Reference of the Sample:** 

TP-3

**Description:** 

Aggregates (Coarse)

Size of Particles Making Up Test Sample (mm)	Dry Weight of Test Sample (g)	Size of Sieve for Removing Residue of Clay Lumps and Friable Particles (mm)	Weight of Particles Retained on Designated Sieve (g)	Percentage of Clay Lumps & Friable Particles %	
4.75-9.5	1200	2.36	1035.5	13.71	
9.5-19.0	2200	4.75	2126.01	3.36	
19.0-38.1	3200	4.75	3096.01	3.25	
>38.1	3900	4.75	3833	1.72	

CL.Z.	2.1 family	AJE
Lab.Assistant	₹ Lab.Technician	Engineer
Tested By	Checked By	Certified By



Laboratory & Site Investigation Unit
Engineering Procurement Construction Division
CENTRAL ENGINEERING CONSULTANCY BUREAU
No11, Jawatta Road, Colombo 05,

Sri Lanka.

Test code

CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES

Our Reference

A030074

Date of Test 19/Oct/2003

Specification No:

(Fine Aggregates)
o: ASTM C 142

CB/EPC/LAB/04/DRL

**PROJECT:** 

Broadlands Hydropower Project-Phase II

**Location Reference of the Sample:** 

TP-3 (Fine Aggregates)

Size of Particles Making Up Test Sample (mm)	Dry Weight of Test Sample (g)	Size of Sieve for Removing Residue of Clay Lumps and Friable Particles (mm)	Weight of Particles Retained on Designated Sieve (g)		
>1.18	50	0.85	47.08		

Percentage of Clay Lumps and Friable Particles = 5.84 %

MGC TSR AJE

Lab.Assistant Jab.Technician Engineer

Tested By Checked By Certified By

CCCD BARGHRADA CCCCD

Laboratory & Sito Investigation Unit
Engineering Procurement Construction Division
GENTRAL ENGINEERING CONSULTANCY BUREAU

# SOUNDNESS TEST OF COARSE AGGREGATES

Our Reference CB/EPC/LAB/04DRL

Date

24/Oct/2003

Specification No: ASTM C 88-90

PROJECT: Broadlands Hydropower Project-Phase II

Type of Sample TP 3(Coarse aggregates)

Sieve size (mm)	Grading of original sample %	Weight of test fraction before test	Percentage passing designated sieve after test	Weighted percentage loss
37.5-19.0	51.5	1502	10.0	5.2
19.0-9.5	37.4	1000	13.2	4.9

Total

10.1

Rounded off val

10

(to the nearest whole number)

#### Sieve Analysis

Mass Retained (g)	Cumulative Mass Retained (g)	Cumulative Percentage Retained	Passing Observed
150	150.0	4.11	95.89
1699	1849.0	50.70	49.30
180	2029.0	55.63	44.37
990	3019.0	82.78	17.22
374	3393.0	93.04	6.96
157	3550.0	97.34	2.66
85	3635.0	99.67	0.33
	Retained (g) 150 1699 180 990 374 157	Retained (g)         Cumulative Mass Retained (g)           150         150.0           1699         1849.0           180         2029.0           990         3019.0           374         3393.0           157         3550.0	Retained (g)         Cumulative Mass Retained         Cumulative Fercentage Retained           150         150.0         4.11           1699         1849.0         50.70           180         2029.0         55.63           990         3019.0         82.78           374         3393.0         93.04           157         3550.0         97.34

Total mass of dry sample: 3647g

Engineer Certified By

Job No.

DRL/3/007

Tested at National Building Research Organisation Jawatte Road, Colombo 5.

ENGINEERS 8/ARCHITICOS

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030074	LOS ANGELES ABRASION TEST	Our Reference CB/EPC/LAB/04DRL
Date of Report	LOS ANGELES ABRASION TEST	
23/Oct/2003	Specification No: ASTM C131/76	

SUPPLIER:

Broadlands Hydropower Project - Phase II

Location Reference of the Sample	TP-3	
Description of sample	19mm aggregates	
Type of Fraction	19.0mm-9.5mm	

Passing	Retained	Weight (g)
19.0mm	12.5mm	2500
12.5mm	9.5mm	2500
No. of steel s	11 nos.	

MEM TO THE REPORT OF THE PERSON OF THE PERSO	100 REVOLUTIONS	500
Wgt .of sample before (g)	5000.00	5000.00
Wgt. Of sample retained on 1.7mm sieve after test (g)	3930.00	2174.70
Wgt of sample passing 1.7mm sieve (g)	1070.00	2825.30
LOS ANGELES ABRASION VALUE	21.40%	56.51%

**18**2 MGC Lab.Assistant Checked BY Tested By

Engineer Certified BY

Date of Test 26-Sep-03

Job Code DRL/3/007



Laboratory & Site Investigation Unit

**Engineering Procurement Construction Division** 

CENTRAL ENGINEERING CONSULTANCY BUREAU

No. 11, Jawatta Road, Colombo 5,

Sri Lanka.

# Sample Test Code A030074 OF AGGREGATES (CHEMICAL METHOD) Date 24/Oct/2003 PROJECT: Broadlands Hydropower Project-Phase II

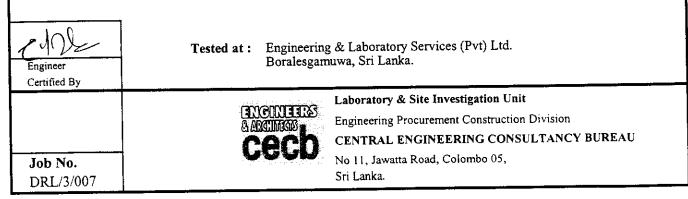
TP 3(<50mm size Coarse aggregate)

### Scope

Type of Sample

This test method covers chemical determination of the potential reactivity of an aggregate with alkalies in portland cement concrete as indicated by the amount of reaction during 24h at 80C between 1N Sodium Hydroxide solution and aggregate that has been crushed and sieved to pass a 300mm sieve and be retained on a 150 mm sieve.

C	luanti	ty of	Dissolv	ed S	Silic	a (Sc)						8.2		mm			
C	Quanti	ty of	Reducti	on ir	1 A	kalinity(	₹¢)					35.00		mm	ol/l		
700					+							,		$\frac{1}{1}$		-	
600	<del></del>				-	· · · · · · · · · · · · · · · · · · ·								$\prod$			
500 500 400 200																	
400		-												•			
300			Aggregate	Con	side	red Innocuo	xus		_						regate		
200								:				· /		Pot	entially eteriou		
100										<b>+</b>	1						
					]   	_			<u>-</u>			·- ·- ·- ·- · · · · · · · · · · · · · ·			gregte ieterio		sidered
	1	2.5	5	<u> </u>		i 10 antity Sc	25 25		0 7		100		10			750	1000



Sample Test Code A030078	SPECIFIC	GRAVITY OF COARS				TION	Our Reference CB/EPC/LAB/04DR
Date of Report 17/Oct/2003	Specification	on No:	ASTM	C127-77			
PROJECT :	Broadlands Hy	dropower Pr	oject -	Phase II		·	
Location of the S	ample	MB-5/dept	h 2.12-	2.28m			
Date of Test		16-Oct-03					
Size of Aggregate	es	20mm			<u> </u>		
				<del> 1</del>	1	T 2	T A
Sample No.		·			1	2	Average
Rock Type				Charnok	itic gneiss		
Wt in Saturated S	Surface Dry		(g)	A	359.0	311.7	
Wt in Air of Over	n Dry Sample		(g)	В	357.1	310.8	
Wt of Sample in	Water		(g)	С	224.5	194.0	
Bulk Specific Gra	avity	$= \frac{B}{A - C}$	•		2.655	2.641	2.648
Bulk Specific Gra (Saturated-Surface		= A A - C	•		2.669	2.648	2.658
Apparent Specif		$= \frac{B}{B - C}$			2.693	2.660	2.676
Absorption %		$= \frac{A - B}{B}$	*100%	Ó	0.538	0.270	0.404
Remarks :							
				MGC	D. d. Co	SR SR	AL C
				Assistant sted By	f Lab. Te Check	chnician ced By	Engineer Certified By
Job No. DRL/3/007	Constitution of the Consti	NGINEERS Architects	Enginee	ering Procur	Investigation ement Constru NEERING CO	ction Division	

Sri Lanka.

No 11, Jawatta Road, Colombo 05,

Sample Test Code A030078	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
Date of Report 17/Oct/2003	Specification No: ASTM C127-77	
PROJECT :	Broadlands Hydropower Project - Phase II	

Location of the Sample	MB-5/depth 2.26-3.45m	
Date of Test	16-Oct-03	
Size of Aggregates	20mm	

Sample No.				1	2	Average
Rock Type			Charnok	itic gneiss		
Wt in Saturated Surface Dry		(g)	A	425.1	292.6	
Wt in Air of Oven Dry Sample		(g)	В	423.7	291.6	
Wt of Sample in Water		(g)	С	265.6	182.2	
Bulk Specific Gravity	$= \frac{B}{A - C}$			2.657	2.642	2.650
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= A A - C		-	2.666	2.651	2.658
Apparent Specific Gravity	$= \frac{B}{B - C}$			2.680	2.665	2.673
Absorption %	$= \frac{A - B}{B} * 1$	100%		0.323	0.329	0.326

Remarks:

	Cr.d-~	2. L. Grand	ADE AJE
	Lab.Assistant Tested By	£ Lab. Technician Checked By	Engineer Certified By
T 1 37	I -ltown 0 Cita	I-vestigation Unit	

Job No. DRL/3/007

ENGINEERS &VARCHITEGIS ### Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030078	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
Date of Report 17/Oct/2003	Specification No: ASTM C127-77	
<b>_</b>	D. H. J. IV. J. Deciset Disco II	

**PROJECT:** 

Remarks:

**Broadlands Hydropower Project - Phase II** 

Location of the Sample	MB-5/depth 3.45-3.60m	
Date of Test	16-Oct-03	
Size of Aggregates	20mm	

Sample No.				1	2	Average
Rock Type			Charnok	itic gneiss		
Wt in Saturated Surface Dry		(g)	A	399.4	313.5	
Wt in Air of Oven Dry Sample		(g)	В	398.3	312.2	
Wt of Sample in Water		(g)	С	249.1	194.6	
Bulk Specific Gravity =	B A - C			2.650	2.626	2.638
Bulk Specific Gravity = (Saturated-Surface-Dry Basis)	A - C			2.657	2.637	2.647
Apparent Specific Gravity =	B - C			2.669	2.655	2.662
Absorption % =	A - B	*100%		0.274	0.423	0.348

( h 2 - ~	D. L. Gamage	ASIQ
MGC	TSR	AJE

Lab.Assistant Tested By

Job No.
DRL/3/007
ENGI

Laboratory & Site Investigation Unit

**Engineering Procurement Construction Division** 

CENTRAL ENGINEERING CONSULTANCY BUREAU

& Lab. Technician

Checked By

Engineer

Certified By

Sample Test Code A030078	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES					Our Refer CB/EPC/LAB/0	
Date of Report 17/Oct/2003	Specification No: ASTM C127-77						
PROJECT :	Broadlands Hy	dropower Pr	oject - ]	Phase II			
Location of the S	ample	MB-5/dept	th 5.00-	5.59m			···
Date of Test		16-Oct-03					
Size of Aggregate	es	20mm					• ***
Sample No.				<u> </u>	<del>-</del> 1	2	Average
Sample No.				<u> </u>		<u> </u>	Tivelage
Rock Type				Charnoki	itic gneiss		
Wt in Saturated S	Surface Dry		(g)	A	594.0	440.6	
Wt in Air of Ove	n Dry Sample		(g)	В	592.0	439.2	
Wt of Sample in	Water		(g)	С	370.9	275.7	
Bulk Specific Gra	avity	$= \frac{B}{A - C}$	•		2.653	2.662	2.658
Bulk Specific Gra (Saturated-Surface		= A A - C	•		2.662	2.671	2.667
Apparent Specific		= B B - C	-		2.677	2.686	2.681
Absorption %	-	A - B B	-*100%	-	0.338	0.330	0.334
Remarks :							
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	Lab.Assistant Tested By	5 Lab. Technician Checked By	Engineer Certified By
Job No	Laboratory & Site	Investigation Unit	··

DRL/3/007

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030078	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL
Date of Report 17/Oct/2003	Specification No: ASTM C127-77	3550_
PROJECT :	Broadlands Hydropower Project - Phase II	

	- I
Location of the Sample	MB-5/depth 22.00-22.18m
Date of Test	16-Oct-03
Size of Aggregates	20mm

Sample No.			1	2	Average
Rock Type		Quartz r	rich garnet bi	otite gneiss	
Wt in Saturated Surface Dry	(g)	A	451.9	350.7	
Wt in Air of Oven Dry Sample	(g)	В	447.2	347.3	
Wt of Sample in Water	(g)	С	278.8	218.2	
Bulk Specific Gravity	$= \frac{B}{A - C}$		2.584	2.621	2.603
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> A - C		2.611	2.647	2.629
Apparent Specific Gravity	$= \frac{B}{B - C}$		2.656	2.690	2.673
Absorption %	$=\frac{A - B}{B} *100\%$	)	1.047	0.976	1.011
Remarks :		<del></del>	-		

C L C C L L	D. P. Crownerge TSR	ALC AJE
Lab.Assistant	f Lab. Technician	Engineer
Tested By	Checked By	Certified By

Job No. DRL/3/007

ENGINEERS 874RCHITEGIS 64 C G C Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

A030078	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES						
Date of Report 17/Oct/2003	Specificatio	n No:	ASTM	C127-77			
PROJECT :	Broadlands Hy	dropower Pro	ject - ]	Phase II			
Location of the S	ample	MB-5/deptl	1 22.18	-22.32m			
Date of Test	<u>-</u>	16-Oct-03					
Size of Aggregate	es	20mm					
Sample No.					1	2	Average
Rock Type				Quartz ri	ch garnet bi	otite gneiss	
Wt in Saturated S	Surface Dry		(g)	A	428.7	289.0	
Wt in Air of Ove	n Dry Sample		(g)	В	424.4	286.0	
Wt of Sample in	Water		(g)	С	264.9	179.9	
Bulk Specific Gr	avity	$= \frac{B}{A - C}$			2.591	2.623	2.607
Bulk Specific Gr (Saturated-Surfac	-	= <u>A</u> A - C			2.617	2.650	2.633
Apparent Specif		$= \frac{B}{B - C}$			2.660	2.696	2.678
Absorption %	=	A - B B	*100%		1.011	1.035	1.023
Remarks :			-				

		Chron.	D. J. Games	AJE_
		Lab.Assistant Tested By	f Lab. Technician Checked By	Engineer Certified By
Job No.	न्यातामानस्य स्थानसम्बद्धाः	Laboratory & Site	Investigation Unit	
DDI /2/007		Engineering Proper	roment Construction Division	

DRL/3/007

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030079	SPECIFIC	GRAVITY OF COARS				TION	Our Reference CB/EPC/LAB/04DRI	
Date of Report 17/Oct/2003	Specification	ı No:	ASTM	C127-77				
PROJECT :	Broadlands Hyd	lropower Pro	ject - l	Phase II				
Location of the S	Sample	MT-6/depth	1 39.34	-39.68m				
Size of Aggregat	es	20mm						
Sample No.					1	2	Average	
Rock Type				Quartz ri	ch garnet bi	otite gneiss		
Wt in Saturated	Surface Dry		(g)	A	343.2	332.9		
Wt in Air of Ove	en Dry Sample		(g)	В	341.6	331.4		
Wt of Sample in	Water		(g)	С	220.9	214.6		
Bulk Specific Gr	avity =	B A - C			2.791	2.799	2.795	
Bulk Specific Gr (Saturated-Surfa		= A A - C			2.805	2.812	2.809	
Apparent Specif		В			2.829	2.836	2.833	
Absorption %		A - B B	*100%		0.480	0.465	0.472	
Remarks :			_					
				, ( <sup>2</sup> , ~		SR SR	ALSO AJE	· •
			Lab.	Assistant sted By		chnician ced By	Engine Certified	

ENGINEERS STANHLIGE LCL

Job No.

DRL/3/007

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030079	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES						Our Reference CB/EPC/LAB/04D	
Date of Report 17/Oct/2003	Specification	n No: A	ASTM	C127-77				
PROJECT:	Broadlands Hyd	dropower Pro	ject -	Phase II				
Location of the S	ample	MT-6/depth	39.48	-39.68m				
Date of Test		16-Oct-03						
Size of Aggregat	es	20mm		· · ·				
Sample No.					1	2	Average	
Rock Type				Quartz r	ich garnet bi	otite gneiss		
Wt in Saturated S	Surface Dry		(g)	A	533.9	421.0		
Wt in Air of Ove	n Dry Sample		(g)	В	531.5	418.9		
Wt of Sample in	Water		(g)	С	336.1	264.7		
Bulk Specific Gr	avity	$= \frac{B}{A - C}$			2.688	2.681	2.684	
Bulk Specific Gr (Saturated-Surface	•	= A A - C			2.700	2.694	2.697	
Apparent Specif	ic Gravity =	B - C	•		2.721	2.717	2.719	
Absorption %	=	A - B *	*100%		0.452	0.497	0.474	

Remarks :

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Lab.Assistant Tested By	£ Lab. Technician Checked By	Engineer Certified By

Job No. DRL/3/007



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030079	SPECIF	C GRAVITY OF COAR				TION	Our Referen
Date of Report		· · · · · · · · · · · · · · · · · · ·	:				
17/Oct/2003	Specifica	tion No:	ASTM	C127-77			
PROJECT:	Broadlands I	Iydropower Pr	oject -	Phase II			
Location of the S	ample	MT-6/dept	h 39.68	-39.82m			
Date of Test	diipi-	16-Oct-03		***			
Size of Aggregat	es	20mm					
Sample No.	<del></del>			[	1	2	Average
Rock Type			N 1	Quartz r	ich garnet bi	otite gneiss	•
Wt in Saturated S	Surface Dry		(g)	A	488.0	525.4	
Wt in Air of Ove	n Dry Sample		(g)	В	485.3	523.1	
Wt of Sample in	Water		(g)	С	311.8	345.6	
Bulk Specific Gr	avity	$= \frac{B}{A - C}$	-		2.754	2.909	2.832
Bulk Specific Gr (Saturated-Surface	•	= <u>A</u> A - C	•		2.769	2.922	2.846
Apparent Specif		$= \frac{B}{B - C}$	-		2.796	2.948	2.872
Absorption %	· · · · · · · · · · · · · · · · · · ·	= A - B B	*100%		0.550	0.449	0.500
Remarks :							
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100000000			1	Assistant ted By	f Lab. Tec		Engineer Certified By
Job No. DRL/3/007		ENGINEERS Aprilitions	Enginee	ring Procur	Investigation ement Construct NEERING CO	ction Division	

Sri Lanka.

No 11, Jawatta Road, Colombo 05,

Sample Test Code A030079	SPECIFIC	Our Referenc CB/EPC/LAB/04DR				
Date of Report 17/Oct/2003	Specification	on No: ASTI	M C127-77			
PROJECT:	Broadlands Hy	dropower Project	- Phase II			
Location of the S	ample	MT-6/depth 39.4	10-39.98m			
Date of Test		16-Oct-03				
Size of Aggregat	es	20mm			<del></del>	
Sample No.				1	2	Average
Rock Type		Quartz rich garnet biotite gneiss				
Wt in Saturated S	Surface Dry	(g)	A	691.7	514.8	
Wt in Air of Ove	n Dry Sample	(g)	В	688.7	512.3	
Wt of Sample in	Water	(g)	С	435.5	324.5	
Bulk Specific Gr	avity	$= \frac{B}{A - C}$		2.688	2.691	2.690
Bulk Specific Gr (Saturated-Surface	•	= <u>A</u> A - C		2.700	2.705	2.702
	C-Diy Dasis)	В		2.720	2.727	2.724
Apparent Specif	ic Gravity	= <u>B - C</u>		2.720	2.727	

Remarks
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 Lab.Assistant Tested By	Lab. Technician Checked By	Engineer Certified By

Job No. DRL/3/007

ENGINEERS & Parchine (1) Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030080		GRAVITY & OF COARSE A			TION	Our Referen	
Date of Report	G 100 10	N. ACT	NA (1145 55				
17/Oct/2003	Specification	1 No: ASI	M C127-77				
PROJECT :	Broadlands Hyd	Iropower Project	- Phase II				
Location of the S	ample	MT-7/depth 46.	18-46.31m			<u>-</u>	
Date of Test		16-Oct-03			-		
Size of Aggregate	es	20mm					
Sample No.				1	2	Average	
Rock Type			Biotite g	· · · · · · · · · · · · · · · · · · ·	<u> </u>	<u> </u>	
Wt in Saturated S	Surface Dry	(g		541.2	397.1		
Wt in Air of Ove		(g		539.1	395.9		
Wt of Sample in	Water	(g	) с	363.7	267.1		
Bulk Specific Gra	avity =	$=\frac{B}{A-C}$		3.038	3.046	3.042	
Bulk Specific Gra (Saturated-Surface		= <u>A</u> A - C		3.050	3.055	3.052	
Apparent Specif		B - C		3.074	3.074	3.074	
Absorption %	=	A - B *100	)%	0.378	0.303	0.341	
Remarks :							
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		Lab.Assistant Tested By	Lab. Technician Checked By	Engineer Certified By		
Job No. DRL/3/007	ENGINEERS &yarchinegas "all	Laboratory & Site Investigation Unit  Engineering Procurement Construction Division  CENTRAL ENGINEERING CONSULTANCY BUREAU				
	The Advantage of the Ad	No 11, Jawatta Road Sri Lanka.	a, Colombo V3,			

Sample Test Code A030080		RAVITY & WATER ABSORPTION COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL	
Date of Report 17/Oct/2003	Specification N	o: ASTM C127-77		
PROJECT :	Broadlands Hydro	power Project - Phase II		
Location of the S	Sample N	1T-7/depth 46.31-46.41m		
Date of Test				

Sample No.			1	2	Average	
Rock Type			Biotite gneiss			
Wt in Saturated Surface Dry	(g)	A	482.1	405.5		
Wt in Air of Oven Dry Sample	(g)	В	481.2	404.3		
Wt of Sample in Water	(g)	С	324.9	273.7		
Bulk Specific Gravity = -	B A - C		3.059	3.068	3.064	
Bulk Specific Gravity = (Saturated-Surface-Dry Basis)	A A - C		3.065	3.077	3.071	
Apparent Specific Gravity = -	B B - C		3.078	3.095	3.087	
Absorption % = -	A - B *100%		0.202	0.282	0.242	
Remarks :			••-			

20mm

		Cha-C MGC	D. L. Grands	AJE
_		Lab.Assistant Tested By	d Lab. Technician Checked By	Engineer Certified By
Job No.	zaren/harren	Laboratory & Site	Investigation Unit	

DRL/3/007

Size of Aggregates

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Sample Test Code A030081	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES					Our Reference CB/EPC/LAB/04DR		
Date of Report 17/Oct/2003	Specification	on No: AST	M C127-77					
		dropower Project						
Date of Test				. <del></del>				
Size of Aggregates 20mm								
Sample No.				1	2	Average		
Rock Type		Biotite (	gneiss					
Wt in Saturated Surface Dry (g)			) A	663.6	462.0			

Sample No.				1	2	Average
Rock Type			Biotite gneiss			
Wt in Saturated Surface Dry	(g	g)	Α	663.6	462.0	
Wt in Air of Oven Dry Sample	(g	g)	В	662.6	460.9	
Wt of Sample in Water	(g	g)	С	435.0	299.2	
Bulk Specific Gravity	$= \frac{B}{A - C}$			2.899	2.831	2.865
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> <u>A - C</u>			2.903	2.838	2.870
Apparent Specific Gravity	$= \frac{B}{B - C}$			2.911	2.851	2.881
Absorption %	$= \frac{A - B}{B} *10$	0%		0.146	0.243	0.195

Remarks:

		Critra MGC	D. J. Frank	AJE		
		Lab.Assistant Tested By	f Lab. Technician Checked By	Engineer Certified By		
Job No.		Laboratory & Site	Investigation Unit			
DDI /2/007	(a)	Engineering Procurement Construction Division				

DRL/3/007

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05,

Sri Lanka.

A030081 SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES						Our Reference CB/EPC/LAB/04DR	
Date of Report 17/Oct/2003	Specification	on No:	ASTM	C127-77			
PROJECT :	Broadlands Hy	dropower Pro	ject -	Phase II			
Location of the S	ample	MT-8/depth	56.40	-56.60m			
Date of Test		16-Oct-03	1				
Size of Aggregat	es	20mm					
Sample No.					1	2	Average
Rock Type			Biotite gneiss				
Wt in Saturated S	Surface Dry		(g)	A	686.4	382.8	
Wt in Air of Ove	n Dry Sample		(g)	В	685.4	381.8	
Wt of Sample in	Water		(g)	С	429.5	239.0	
Bulk Specific Gr	avity	$= \frac{B}{A - C}$			2.668	2.654	2.661
Bulk Specific Gr (Saturated-Surface		$= \frac{A}{A - C}$			2.672	2.662	2.667
Apparent Specif	ic Gravity	B - C			2.679	2.674	2.676
Absorption %	=	$=\frac{A-B}{B}$	*100%	b	0.146	0.270	0.208

CLZL-	2.1. Ground	APP 2
Lab.Assistant	£ Lab. Technician	Engineer
Tested By	Checked By	Certified By

ENGINEERS 8 YARCHITECTS Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

Sample Test Code A030116	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES	Our Reference CB/EPC/LAB/04DRL	
Date of Report 28/Oct/2003	Specification No: ASTM C127-77		
PROJECT :	Broadlands Hydropower Project - Phase II		

Location of the Sample	TR-1/depth 10.16-10.49m
Date of Test	23-Oct-03
Size of Aggregates	20mm

Sample No.				1
Rock Type			Bioti	te gneiss
Wt in Saturated Surface Dry		(g)	A	829.7
Wt in Air of Oven Dry Sample		(g)	В	822.5
Wt of Sample in Water		(g)	С	520.7
Bulk Specific Gravity	$=\frac{B}{A-C}$			2.662
Bulk Specific Gravity = (Saturated-Surface-Dry Basis)	A - C			2.685
Apparent Specific Gravity =	B - C			2.725
Absorption % =	A - B	*100%		0.877
Remarks :				

CLO.~	TSR	AJE
Lab.Assistant	£ Lab. Technician	Engineer
Tested By	Checked By	Certified By



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

Sample Test Code A030115	SPECIFIC	TION	Our Reference CB/EPC/LAB/04DRL				
Date of Report 28/Oct/2003	Specification	on No: AST	M C127-77	1			
PROJECT:	Broadlands Hy	dropower Project	- Phase I	[			,
Location of the S	Sample	TR-1/depth 18.3	88-18.83m				
Date of Test		23-Oct-03					
Size of Aggregat	es	s 20mm					
Sample No.				1	2	Average	
Rock Type			Biotite gneiss				
Wt in Saturated S	Surface Dry	(g)	A	1,890.5	1,188.1		

Sample No.			1	2	Average
Rock Type	Biotite gneiss				
Wt in Saturated Surface Dry	(g)	A	1,890.5	1,188.1	
Wt in Air of Oven Dry Sample	(g)	В	1,877.7	1,179.5	
Wt of Sample in Water	(g)	С	1,277.4	801.8	
Bulk Specific Gravity	$= \frac{B}{A - C}$		3.063	3.053	3.058
Bulk Specific Gravity (Saturated-Surface-Dry Basis)	= <u>A</u> A - C		3.084	3.076	3.080
Apparent Specific Gravity	$= \frac{B}{B - C}$		3.128	3.123	3.125
Absorption %	$=\frac{A - B}{B} *100\%$		0.681	0.728	0.705
Remarks :			<del></del>		

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MGC	T <del>SR</del> -	AJE
Lab.Assistant	→ Lab. Technician	Engineer
Tested By	Checked By	Certified By



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

Sample Test Code A030076						Our Refer CB/EPC/LAB/0	
Date of Report 17/Oct/2003	Specification	n No:	ASTM	C127-77	·-		
PROJECT :	Broadlands Hye	lropower Pro	ject - l	Phase II			
Location of the S	Sample	BQ-2/depth	16.32	-16.73m			
Size of Aggregat	es	20mm					
Sample No.					1	2	Average
Rock Type		ı		Granitic	gneiss		
Wt in Saturated	Surface Dry		(g)	A	387.2	375.0	
Wt in Air of Ove	n Dry Sample		(g)	В	383.5	372.3	
Wt of Sample in	Water	-	(g)	С	238.0	231.7	
Bulk Specific Gr	avity	$= \frac{B}{A - C}$			2.570	2.599	2.585
Bulk Specific Gr (Saturated-Surfa		$= A$ $A_i - C$			2.595	2.618	2.606
Apparent Specif		B - C	· <del>-</del>		2.636	2.648	2.642
Absorption %	=	A - B	*100%	>	0.973	0.712	0.842
Remarks :						-	

		Ch.C.	T. J. FSR	ALE AJE		
		Lab.Assistant Tested By	Lab. Technician Checked By	Engineer Certified By		
Job No. DRL/3/007	ENGINEERS BARGHIMANS OF CUSTO	Laboratory & Site Investigation Unit  Engineering Procurement Construction Division  CENTRAL ENGINEERING CONSULTANCY BUREAU  No 11, Jawatta Road, Colombo 05,  Sri Lanka.				

A030076	SPECIFIC GRAVITY & WATER ABSORPTION OF COARSE AGGREGATES					Our Reference CB/EPC/LAB/04DF	
ate of Report 17/Oct/2003	Specificatio	n No: ASTM	I C127-77				
PROJECT : I	Broadlands Hy	dropower Project -	Phase II				
Location of the Sa	mple	BQ-2/depth 18.00	)-18.39m				
Date of Test		16-Oct-03					
Size of Aggregate	S	20mm					
Sample No.			T	1	2	Average	
Rock Type			Granitic	gneiss			
Wt in Saturated St	ırface Dry	(g)	A	417.6	330.2		
Wt in Air of Oven	Dry Sample	(g)	В	413.5	327.5		
Wt of Sample in V	Vater	(g)	С	257.6	203.3		
Bulk Specific Gra	vity	$= \frac{B}{A - C}$		2.584	2.580	2.582	
Bulk Specific Gra (Saturated-Surface		= A A - C		2.610	2.601	2.606	
Apparent Specific		$=\frac{B}{B-C}$		2.652	2.637	2.644	
Absorption %	=	A - B	%	0.989	0.837	0.913	
Remarks :	··						

		CL.Cu.	D. L. Germage	ABEC AJE
		Lab.Assistant Tested By	£ Lab. Technician Checked By	Engineer Certified By
Joh No	CONTRACTOR AND CONTRA	Laboratory & Site	Investigation Unit	



Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

Sample Test Code
A030097-0114, 117&118

Date of Test

# COMPRESSION TEST ON ROCK SAMPLES (Soaked Samples)

Our Reference CB/EPC/LAB/04DRL

**PROJECT:** 

17-Oct-2003

**Broadlands Hydropower Project - Phase II** 

Geological Name of rock Sample	Bore Hole No. & Depth (m)	Diameter (mm)				Le	Length of Sample (mm)		ple	Weight of Sample Before Soaked	Load at Faliure (kN)	Unconfined Compressive Strength
	(an)	. 1	2	3	MEAN	1	2	3	MEAN	(g)	(MIV)	(N/mm <sup>2</sup> )
Quartzo feldspathic gneiss	BQ-1(17.10- 17.24)	54.5	54.2	54.2	54.3	114.0	113.6	113.9	113.8	751.20	117.93	50.93
Quartzo feldspathic gneiss	BQ-1(17.39- 17.75)	54 2	54.2	54.9	54.4	108.6	108.7	109.2	108.8	700.50	127.28	54.69
Impure quartzite	BQ-1(20.60- 22.75)	54.2	54.3	54.4	54.3	65.1	65.2	65.3	65.2	417.69	62.26	26.88
Granitic gneiss	BQ-2(22.52- 22.62)	49.8	49.9	50.5	50.1	99.2	99.8	99.9	99.6	504.15	20.06	10.19
Granitic gneiss	BQ-2(22.62- 22.72) BQ-2(22.90-	50 0	50.0	50.0	50.0	101.3	101.5	102.0	101.6	508.03	108.60	55.31
Granitic gneiss	23.00) MB-5(5.73-	49 9	49.9	49.9	49.9	101.5	101.5	101.6	101.5	513.40	140.40	71.79
Chamokitic gneiss	5.83) MB-5(9.00-	50 0	50.0	50.1	50.0	101.0	102.0	102.0	101.7	516.17	181.89	92.51
Chamokitic gneiss	9.10) MB-5(9.52-	49.8	49.8	49.9	49.8	101.0	101.0	101.5	101.2	519.30	146.03	74.87
Charnokitic gneiss	9.62) MB-5(22.00-	49,1	49.5	49.6	49.4	101.2	101.5	101.6	101.4	519.32	99.29	51.81
Charnokitic gneiss	22.38) MT-6(39.46-	49.7	49.7	49.7	49.7	99.8	101.0	101.1	100.6	512.89	264.10	136.13
Quartz rich garnet biotite gneiss	39.56) MT-6(39.00-	49,2	49.5	49.5	49.4	102.1	102.4	102.8	102.4	560.59	93.72	48.90
Quartz rich garnet biotite gneiss	39.10) MT-6(39.68-	49,2	49.8	49.9	49.6	101.1	101.1	100.6	100.9	607.00	164.87	85.21
Quartz rich garnet biotite gneiss	39.78) MT-6(39.58-	49.5				110.0		110.3	110.1	514.38	121.67	63.05
Quartz rich garnet biotite gneiss	39.68) MT-7(46.00-	49,6	†	49.9		96.0	96.3	96.3	96.2	499.79	108.60	55.90
Biotite gneiss	46.11) MT-7(29.64-	54.5						111.5		796.30	218.03	93.12
Quartz rich biotite gneiss	29.75) MT-8(51.43-		54.6					111.9		685.60	164.87	70.42
Biotite gneiss	51.54) MT-8(74.76-		T		54.5			92.0	91.5	800.70 563.71	250.61 162.98	107.30 69.86
Quartz rich biotite gneiss	74.86) TR-1(10.00- 10.15)		54.5 54.4			91.1	91.5		110.8	693.50	162.98	69.95
Biotite gneiss Biotite gneiss	TR-1(18.90- 19.00)				54.3				111.1		97.43	42.02

MGC
Lab. Assistant
Tested By
Checked By
Cartified By

Date of Test 20-Oct-2003

> Job No. DRL/3/007

ENGINEERS &ARCHIEGE

Laboratory & Site Investigation Unit

**Engineering Procurement Construction Division** 

CENTRAL ENGINEERING CONSULTANCY BUREAU

No. 11, Jawatta Road, Colombo 5, Sri Lanka.

	DETERMINATION OF ULTRASONIC PULSE VELOCITY OF ROCK CORE SAMPLES	Our Reference CB/EPC/LAB/04DRL
Date of Report 23/Jan/2003	Specification No: ASTM D 2845-1983	
PROJECT :	Broadlands Hydropower Project-Phase II	

No.	Identifi	cation	Diameter (mm)	Length (mm)	Ultrasonic Pulse Velocity (km/s)
	Bore Hole No.	Depth (m)	(		
1	MB 5	5.73-5.83	49.80	99.92	6.891
2	MB 5	9.00-9.10	49.62	101.20	7.845
3	MB 5	9.52-9.62	49.72	101.28	7.558
4	MB 5	22.00-22.38	49.62	100.58	7.396
5	MT 6	39.00-39.10	50.00	100.92	8.010
6	MT 6	39.46-39.56	49.62	102.62	7.029
7	MT 6	39.58-39.68	49.60	96.80	5.500
8	MT 6	39.68-39.78	49.52	100.22	4.494
9	MT 7	29.64-29.75	54.72	111.00	6.000
10	MT 7	46.00-46.11	54.40	111.80	7.260
11	MT 8	51.43-51.54	54.30	111.10	7.032
12	MT 8	74.76-74.86	54.42	92.00	6.301
13	BQ 1	17.10-17.24	54.42	114.20	6.880
14	BQ 1	17.39-17.50	54.40	109.00	6.566
15	BQ 1	20.60-22.75	54.38	65.20	7.581
16	BQ 2	22.52-22.62	49.80	100.20	3.976
17	BQ 2	22.62-22.72	50.30	100.82	4.272
18	BQ 2	22.90-23.00	49.96	101.54	3.982

Tested at: University of Moratuwa

Department of Civil Engineering

Moratuwa, Sri Lanka

Ref: CE/GA/17/ST/2003/128

Engineer Certified By

**Job No.** DRL/3/007



Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

#### SOUNDNESS TEST OF COARSE AGGREGATES

Our Reference CB/EPC/LAB/04DRL

Date

24/Oct/2003

Specification No: ASTM C 88-90

PROJECT: Broadlands Hydropower Project-Phase II

Type of Sample BQ 2(Coarse aggregates)

Sieve size (mm)	Grading of original sample %	Weight of test fraction before test	Percentage passing designated sieve after test	Weighted percentage loss
37.5-19.0	53.9	1500	0.10	0.1
19.0-9.5	42.9	1000	0.80	0.3

Total

0.4

Rounded off val

(to the nearest whole number)

#### Sieve Analysis

Test sieve (mm)	Mass Retained (g)	Cumulative Mass Retained (g)	Cumulative Percentage Retained	Passing Observed
37.5	-	•	-	-
25.0	1451	1451	44.67	55.33
19.0	301	1752	53.94	46.06
12.5	1017	2769	85.25	14.75
9.5	374	3143	96.77	3.23
4.75	85	3228	99.38	0.62
Pan	12	3240	99.75	0.25

Total mass of dry sample: 3248g

Engineer Certified By

Tested at National Building Research Organisation Jawatte Road, Colombo 5.

ENGINEERS GARCHITEGIST

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

Job No.

No 11, Jawatta Road, Colombo 05,
DRL/3/007

Sri Lanka.

# POTENTIAL ALKALI-SILICA REACTIVITY Our Reference OF AGGREGATES (CHEMICAL METHOD) Date 24/Oct/2003 Specification No: ASTM C-289 PROJECT: Broadlands Hydropower Project-Phase II

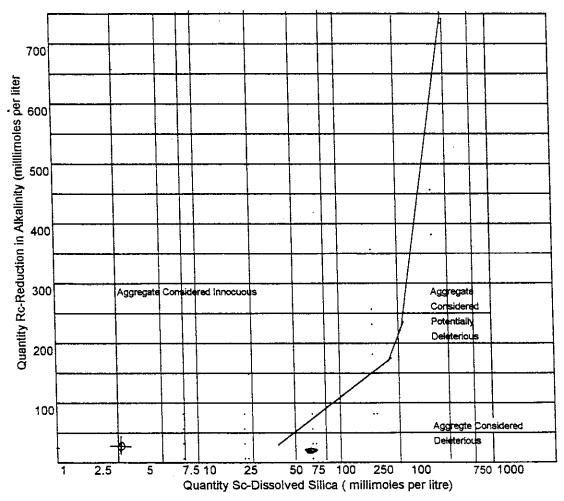
#### Scope

Type of Sample

This test method covers chemical determination of the potential reactivity of an aggregate with alkalies in portland cement concrete as indicated by the amount of reaction during 24h at 80C between 1N Sodium Hydroxide solution and aggregate that has been crushed and sieved to pass a 300mm sieve and be retained on a 150 mm sieve.

Quantity of Dissolved Silica (Sc)	2.57	mmol/i
Quantity of Reduction in Alkalinity(Rc)	26.00	mmol/t

BQ 2(<50mm size Coarse aggregate)



Engineer Certified By

Tested at: Engineering & Laboratory Services (Pvt) Ltd.

Boralesgamuwa, Sri Lanka.

ENGINEERS:

Laboratory & Site Investigation Unit

Engineering Procurement Construction Division

CENTRAL ENGINEERING CONSULTANCY BUREAU

No 11, Jawatta Road, Colombo 05, Sri Lanka.

Job No. DRL/3/007

#### Sample Test Code A030076

#### LOS ANGELES ABRASION TEST

Our Reference CB/EPC/LAB/04DRL

Date of Report 23/Oct/2003

Specification No: ASTM C131/76

SUPPLIER:

Broadlands Hydropower Project - Phase II

Location Reference of the Sample	BQ-2
Description of sample	19mm aggregates
Type of Fraction	19.0mm-9.5mm

Passing	Retained	Weight (g)
19.0mm	12.5mm	2500
12.5mm 9.5mm		2500
No. of steel s	pheres used	11 nos.

	100 REVOLUTIONS	500 REVOLUTIONS
Wgt .of sample before (g)	5000.00	5000.00
Wgt. Of sample retained on 1.7mm sieve after test (g)	4389.30	2597.80
Wgt of sample passing 1.7mm sieve (g)	610.70	2402.20
LOS ANGELES ABRASION VALUE	12.21%	48.04%

MGC
Lab.Assistant
Tested By
Checked BY
Checked BY
Checked BY
Certified BY

Date of Test 17-Oct-03

Job Code DRL/3/007



Laboratory & Site Investigation Unit

**Engineering Procurement Construction Division** 

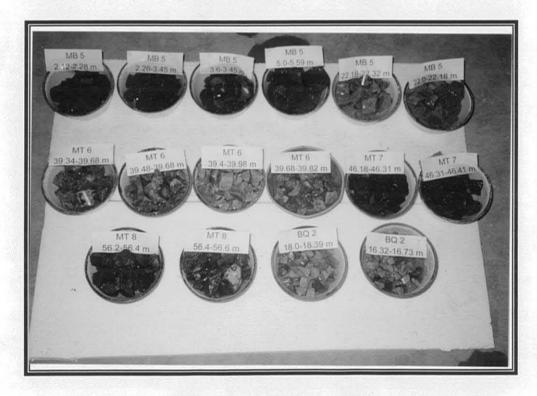
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Sri Lanka.



Photograph 7: Coarse and Fine Aggregate samples from TP4



Photograph 8: Core samples used for testing 'specific gravity and water Absorption'



Photograph 9: Core samples used for testing 'unconfined compression' and 'ultra sound wave velocity'



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TEST PIT NO: TP 1

Location:		Coordinates:	Coordinates:						
as given :	Kithulgala	Eastern E:	164535	Date Started:	11-Nov-0				
Reduced le		Northern N:	197920	Date Finished:	17/11/200				
Depth	Mosaic Log	Soil Profile of the N	Northern Direction	E	Description				
0.55m		WR	POO, O,	and browith sor  Modera angular diamete	and rounded 0.5m to 0.7 r boulders with graves s seems to be old river be				
1.8m 2.1m		( WR	WR	Modera boulder diamete	•				
	W	Silty Sand & Gravel WR Weathered Rock	iew 3	Fig. 2- Fig. 3-	raphs  Back ground of TP 1  TP1 - View 2  TP1 - View 2  TP1 - View 3				
Legend	;	Sand, sandy soil, silt etc.		Logged by:	Checked by:				
3		Gravel, sandy gravel including	boulders	AAVD	BMAPM				
		Clayey sand, clay etc.  Highly moderately weathered  Fresh rock		SHEET NO	): 1 of 2				



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TEST PIT NO: TP 1

PROJE	<u>CT:</u>	Geote	chnical Investigation	ons for the Broadla	nds Hydro	power Pi	roject	
Location	:		Coordinates:					
as given	; Kithu	lgala	Eastern E:	164535	Date S	e Started:		-Nov-02
Reduced			Northern N:	197920	Date I	inished:	17/	11/2002
Depth	Mosaic Log		Soil Profile of th	ne Eastern Direction	n	De	scription	
0.55m			WR S	ROOP OF THE PARK O		and brown with some Moderatel angular ar diameter	loose, yellowis in silty sand, sand e gravel; many roo ly decompose and rounded 0.5m boulders with seems to be old	mixture ots d sub to 0.75m gravel.
1.8m 2.1m			wr °			Moderate boulders diameter	-	l large n soil:
	W	WR	s	View 3		Fig. 2- TF Fig. 3- TF Fig. 4- TF	ck ground of TP	
Legend	:	Gra Cla Hig	id, sandy soil, silt etc.  evel, sandy gravel includ yey sand, clay etc.  hly/moderately weather  sh rock		Logged by AAV		Checked by:  BMAPM 2 of	2



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TEST PIT NO:

TP 2

ocation:	Coordinates:			
given ; Kithulgala	Eastern E:	164527	Date Started:	11-Nov-02
educed level:	Northern N:	197937	Date Finished:	17/11/2002
Mosaic Log	Soil Profile of the N	Northern Direction		escription
.16m .46m	WR		silty sangravel; n  Moderat angular a diameter Deposits deposit.	ellowish brown and brow d, sand mixture with some nany roots ely to Fresh rock; su and rounded 0.5m to 0.75n boulders with grave seems to be old river be
	N N FR/WR	Tew 3	Photogr Fig 15- Fig. 6- 7	Back ground of TP 2
W Legend:	Sand, sandy soil, silt etc. Gravel, sandy gravel including	Silty Sand & G	ravel	TP2 - View 2 TP2 - View 3 Checked by: BMAPM



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TEST PIT NO: TP 2

PROJECT:	Geotechnical Investigations for the Broadlands Hydropower Project
----------	---

	ECT :	Geotechnical Investigat			
Location	1:	Coordinates:			
as giver	: Kitulga	la Eastern E:	164527	Date Started:	11-Nov-02
Reduced	level:	Northern N:	Date Finished:	17/11/2002	
Depth	Mosaic Log	Soil Profile of	the Eastern Direction	D	escription
0.16m				silty san gravel; r	d, sand mixture with some
0.57m				angular diameter	tely to Fresh rock; sultand rounded 0.5m to 0.75m to 0.75
1.6m			WR	/ \	ock boulders embedded i meter exceeds 1.2m
		View 2		Photog	
		FR/WR			Back ground of TP 2  TP2 - View 2
	W	FR / WR	Filty Sand & 0	Gravel	TP2 - View 2 TP2 - View 3
		s			
Legen	d:	Sand, sandy soil, silt etc.		Logged by:	Checked by:
		Gravel, sandy gravel incl Clayey sand, clay etc. Highly / moderately weat Fresh rock		AAVD SHEET NO	BMAPM  2: 2 of 2



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TP 3 TEST PIT NO:

# FEATURE / PROJECT : Geotechnical Investigations for the Broadlands Hydropower Project

ocation:		Coordina	tes:		<del></del>	0.0.0
as given ; Kalugala		Eastern E:		164471.608m	Date Started:	9-Sep-0
teduced level:	105m	Northern	N:	197932.447m	Date Finished:	12-Sep-0
Depth Mosaic Log		Soil Pr	ofile of the P	Northern Direction	n Descri	ption
0.32					sand (10% of coarse) Medium to coarse	nined yellowish brown se grains available) grained yellowish brown se grains & Quartz particles rich)
0.45	·-/				Fine to medium gra	
0.57		10			Medium to coarse	grained yellowish brown se grains & Quartz particles rich)
1.01		0				e grained brown sand ins & tree roots available)
1.36			90-	700	Fine to medium gr	
1.50			WR	80	Fine to very coarse g cobbles,pebbles & moderately weath	ins and tree roots available) rained brown sand with gravels, tree roots available. (Fresh to cred boulders embeded in soil) oulder is 30 cm& angular shaped)
2.00	<u></u>		N			
		View 1	O WA		Photographs  Photograph -1	- Back ground of TP 3
		lly sand			Photograph-2	
w	with or pebble	obbles & sis		/iew/2 (WR/FR E	Photograph-3	
	V					
Legend:	Sai	nd, sandy so	S il, silt etc.	F	Logged by:	Checked by:
	Cla	vev sand, cl	gravel including ay etc.	rock boulder zone	SHEET NO	



LABORATORY & SITE INVESTIGATION UNIT INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

**TP 3 TEST PIT NO:** 

#### FEATURE / PROJECT : Geotechnical Investigations for the Broadlands Hydropower Project

Location: Coordinates:			Coordinates:			
as given ; Kalugala		ala	Eastern E:	164471.608	m Date Started:	9-Sep-03
Reduced level: 105m			Northern N:	197932.447	m Date Finished:	12-Sep-03
	<b>5</b> 0					
Depth	Mosaic Log		Soil Profile of	the E-W Directio	n	
De	Me				Description	
0.38					Fine to medium grained yel sand (10% of coarse grains	
0.52					Medium to coarse grained sand (high% of coarse grains d	
0.52					Fine to medium grained bro (5% of coarse grains and to	
1.01					Fine to very coarse grained (high% of coarse grains & tree	
1.36		00	40		Fine to medium grained bro	
1.75			44	gal-	Fine to very coarse grained bro	
2.00		00	WR/FR	0.0	moderately weathered boul (Max. diameter of boulder is 8	ders embeded in soil)
			View WR/FR	1	Photographs	
			Gravelly sand with cobbles & pebblels		Photograph 1- Back g	ground of TP 3
١	/iew 2				Photograph-3 TP3 - V	
•	N	Tou	/ WR/F	R S	Photograph-2 TP3 - \	liew 2
			WE			
			WB			
Legend		Grav	l, sandy soil, silt etc. el, sandy gravel includin ey sand, clay etc.	ig bould <del>er</del> s	Logged by: Checke	d by: SRMS
		High	ey sand, cray etc. ily / moderately weathere a rock	ed rock boulder zone	SHEET N 2	of 2



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TEST PIT NO: TP 4

## FEATURE / PROJECT : Geotechnical Investigations for the Broadlands Hydropower Project

Location:		Coordinates:			
as given ; Kalugala		Eastern E:	164335.926m		9-Sep-03
Debth Port of the control of the con	103m	Northern N:  Soil Profile of the	Northern Direction	Fine grain with som Medium (High % o	Description  led,brown,clayey silty sand lee organic matters grained light brown silty sand if quartz grains & tree roots avilable) nedium grained yellowish red d with some tree roots
0.85 1.25 1.50 1.90 2.00	J	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		red silty Fine to n silty san  Fine grain with som Fine to n sand with Fine grain	to medium grained yellowish sand with some tree roots nedium grained orange red d with some tree roots ned, brown, clayey silt lee tree roots nedium grained brown silty in some tree roots ned, reddish brown, clayey silt neems to be old river deposit)
W		Clayey silt	View 2	Photogr	raph 4- Back ground of TP 4 raph 5- TP4 - View 1 raph 6- TP4 - View 2
Legend:	Grav Clay High	l, sandy soil, silt etc. el, sandy gravel including ey sand, clay etc. ily / moderately weathered n rock		Logged by: FIMLKR SHEET NO	Checked by: SRMS : 1 of 2



LABORATORY & SITE INVESTIGATION UNIT CENTRAL ENGINEERING CONSULTANCY BUREAU

TEST PIT NO: TP 4

# FEATURE / PROJECT: Geotechnical Investigations for the Broadlands Hydropower Project

_ocation:		Coordinates:			
as given ; Kalugala		Eastern E: 164335.		Date Started:	9-Sep-03
Reduced level:	103m	Northern N:	198024.552m	Date Finished:	12-Sep-03
0.20 Westic F 0.62		Soil Profile of the	E-W Direction	Fine grained with some Medium gra (High % of q Fine to measilty sand Very fine to	Scription  Jorown, clayey silty sand organic matters ained light brown silty sand uartz grains & tree roots avilable) dium grained yellowish red with some tree roots o medium grained yellowish
0.83 1.23 1.50	); \-	· \	\	Fine to me silty sand with some Fine to me sand with s	and with some tree roots dium grained orange red with some tree roots  I,brown,clayey silt tree roots dium grained brown silty some tree roots I,reddish brown,clayey silt
2.00	<u>)</u> /	₩ WR	· · · · · ·	(Deposit see	ms to be old river deposit)
S		Clayey silt	riew 2 N	Photograp	oh 6- TP4 - View 1 oh 5- TP4 - View 2
Legend:		E l, sandy soil, silt etc rel, sandy gravel including		ogged by	Checked by:
	Clay High	ey, samy graver mending ey sand, clay etc. ily / moderately weathered h rock		SHEET NO	2 of <b>2</b>



Fig 01: Back ground of TP1

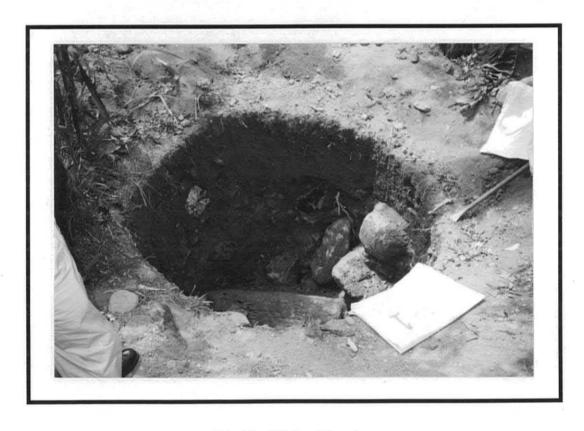


Fig 02: TP 1 - View 1

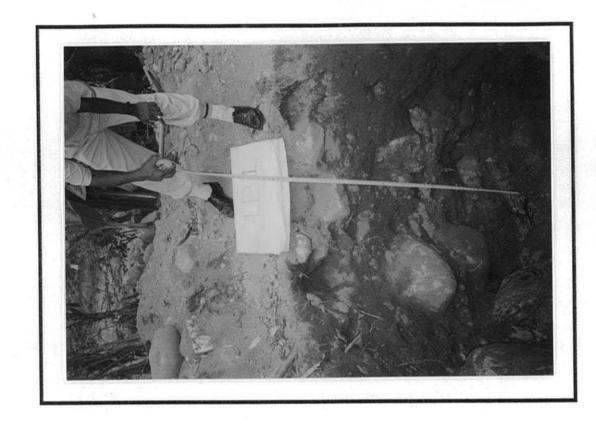




Fig 03: TP 1 - View 2



Fig 05: Back ground of TP 2

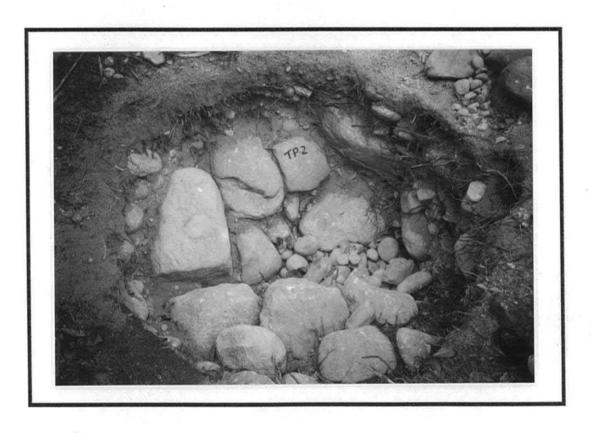


Fig 06: TP 2 – View 2

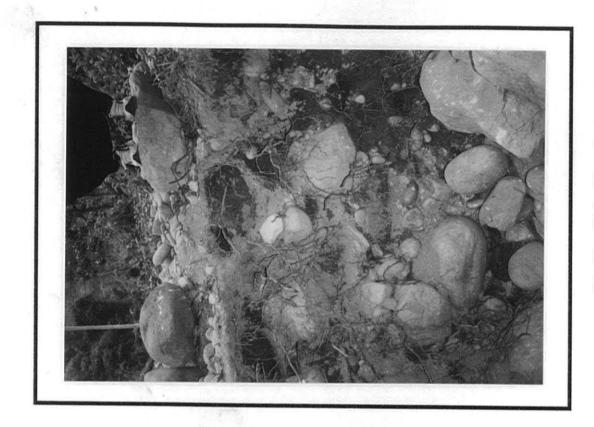


Fig 08: TP 2 - View 3

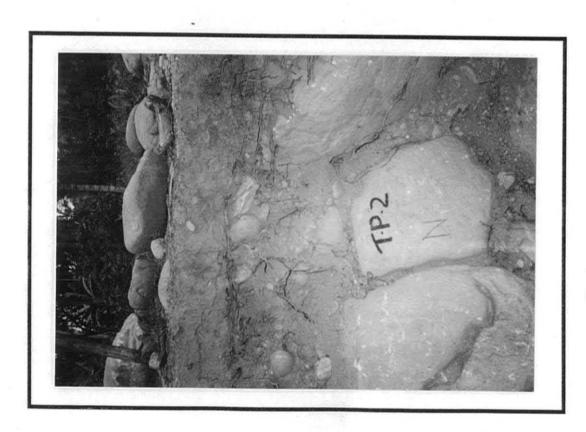


Fig 07: TP 2 - View 2



Fig 09: Coarse Aggregates from TP1

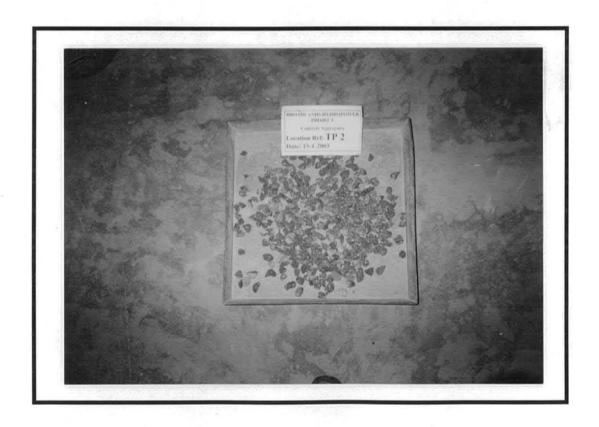


Fig 10: Coarse Aggregates from TP2



Fig 11: Collection of River Sand



Photograph 1: Back ground of TP3



Photograph 2: View of TP3 in N-S direction



Photograph 3: View of TP3 in E-W direction



Photograph 4: Back ground of TP4



Photograph 5: View of TP4 in N-S direction



Photograph 6: View of TP4 in E-W direction