



**JAPAN INTERNATIONAL
COOPERATION AGENCY
J I C A**

**THE DETAILED DESIGN STUDY ON THE WATER
TRANSBASIN SCHEMES FOR CHONE-PORTOVIEJO
RIVER BASINS**

**GEOLOGICAL - GEOTECHNICAL
INVESTIGATIONS REPORT**

VOLUME IV

FEBRUARY 1994



JAPAN INTERNATIONAL COOPERATION AGENCY
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DETAILED DESIGN STUDY ON THE TRANSBASIN WATER
PROJECT FOR THE CHONE-PORTOVIEJO RIVER BASINS

REPORT ON GEOLOGICAL-GEOTECHNICAL RESEARCH

VOLUMEN IV

Table of Contents

10.	CONCRETE AGGREGATES
10.1	Purpose and Scope of the Investigations
10.2	Works Performed and Results Obtained
10.2.1	Field Sampling
10.2.2	Laboratory Analysis of Aggregates
10.2.3	Simple Compression Tests for Concrete
11.	APPENDIXES
11.1	Results of Laboratory Tests
11.2	Results of Simple Compression Tests for Concrete



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DETAILED DESIGN STUDY ON THE TRANSBASIN WATER
PROJECT FOR THE CHONE-PORTOVIEJO RIVER BASINS

REPORT ON GEOLOGICAL-GEOTECHNICAL RESEARCH

10. CONCRETE AGGREGATES

10.1 PURPOSE AND SCOPE OF THE INVESTIGATIONS

One of the main objectives of this study is to determine the optimum or most recommended sources of construction materials, including concrete aggregates, analyzing their fundamental aspects such as: quality of said materials and their reserves.

Towards this end, we have performed laboratory tests on the materials from quarries or mines selected by JICA in order to determine their properties and, in turn, test several concrete mixtures starting from the proportions provided by the contractor performing simple compression tests in cylindrical test tubes prepared with said mixtures and submitted to an adequate curing process obtaining the resistances at 7 and 28 days.

10.2 WORKS PERFORMED AND RESULTS OBTAINED

10.2.1 Field Sampling

Sampling was performed at selected quarries with sufficient amounts to perform the laboratory tests indicated and the different mixtures for testing of the breaking of cylinders.

The quarries and type of material are as follows:

- Coarse aggregates from the San Carlos Quarry on the Oro River.
- Fine aggregate from the Picoaza Basalt Quarry (crushed sands).



- Fine aggregate from the San Pablo River in Quevedo
- Fine aggregate from the San Jacinto beaches

Samples taken were sent to the laboratories of ADITEC, ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA. in Quito for the performance of the different tests both on aggregates as well as mixtures.

10.2.2 Laboratory Analysis

The amount and type of tests performed are shown in the following table 10.1



CUADRO (TABLE) 10.1

ENSAYOS DE LABORATORIO SOBRE AGREGADOS (LABORATORY TEST FOR AGGREGATES)							
TIPO DE ENSAYOS (TYPE OF TEST)	AGREGADOS GROSOS SAN CARLOS (COARSE AGGREGATE)			AGREGADOS FINOS (FINE AGGREGATES)			TOTAL
	3/8"-3/4" G1	3/4"-1" G2	1"-1 1/2" G3	SAN PABLO QUEVEDO # 1	SAN JACINTO # 2	CANTERAS BASALTICAS # 3	
1. Granulometría (tamiz) (Grain size analysis sieve)	1	1	1	1	1	1	6
2. Gravedad Especifica y Absorción de agua - finos (Specific Gravity and water absorption fine aggregate)	-	-	-	2	2	2	6
3. Gravedad especifica y absorción de agua - gruesos (Specific Gravity and water absorption - coarse aggregates)	2	2	2	-	-	-	6
4. Impureza orgánica (Organic impurity)	-	-	-	2	2	2	6
5. Ensayo de desgaste al sulfato de sodio (Soundness test with sodium sulphate)	1	1	1	1	1	1	6
6. Ensayo de abrasión Los Angeles (Los Angeles abrasion test)	2	2	2	-	-	-	6
7. Ensayo de reactividad química (Chemical alkali reactivity)	1	1	1	1	1	1	6



Laboratory test results for the coarse aggregates are summarized in the Table No 10.2.

CUADRO (TABLE) 10.2

RESULTADOS DE LABORATORIO - AGREGADO GRUESO (TEST RESULTS - COARSE AGGREGATE)					
TIPO DE ENSAYOS (TYPE OF TEST)	TAMIZ (SIEVE SIZE)		CANTERA SAN CARLOS		
			PASA (PASSES) (%)		
			G-1 3/8" - 3/4"	G-2 3/4" - 1"	G-3 1" - 1 1/2"
Granulometría - tamiz (Grain size analysis - sieve)	3"		100,00	100,00	100,00
	2"		100,00	100,00	100,00
	1 1/2"		100,00	100,00	100,00
	1"		100,00	98,59	40,02
	3/4"		98,45	42,80	6,33
	1/2"		57,21	3,21	3,12
	3/8"		32,30	1,76	2,40
	Nº 4		5,76	1,02	1,15
Gravedad específica y Absorción de agua (Specific gravity and water absorption)	M-1	Ge.	2,478	2,541	2,523
		Ab.	4,71	3,52	2,77
	M-2	Ge.	2,437	2,505	2,648
		Ab.	4,49	3,41	3,04
Ensayo de desgaste al sulfato (Soundness test with sodium sulphate)	x		5,59	6,29	5,59
Ensayo de Abrasión Los Angeles (Los Angeles abrasion test)	x	M-1	17,80	16,40	16,70
		M-2	17,00	17,00	16,10
Ensayo de Reactividad Química (Chemical - alkali reactivity test)			inocuo	inocuo	inocuo



Laboratory test results for fine aggregates are summarized in the Table No 10.3.

CUADRO (TABLE) 10.3

RESULTADOS DE LABORATORIO - AGREGADO FINO (TEST RESULTS - FINE AGGREGATE)					
TIPO DE ENSAYOS (TYPE OF TEST)	TAMIZ (SIEVE SIZE)	PASA (PASSES) (%)			
		Nº 1 ARENAS SAN PABLO QUEVEDO	Nº 2 ARENAS SAN JACINTO	Nº 3 ARENAS CANTERAS BASALTICAS	
Granulometría (tamiz) (Grain size analysis - sieve)	3/8"	100,00	100,00	100,00	
	Nº 4	99,82	100,00	99,72	
	Nº 8	98,72	100,00	87,73	
	Nº 16	96,15	100,00	65,81	
	Nº 30	89,10	100,00	50,58	
	Nº 50	42,31	92,29	27,58	
	Nº 100	8,33	7,22	3,93	
	Modulo Fin.	1,66	1,00	2,65	
Gravedad específica y absorción de agua (Specific gravity and water absorption)	M-1	Ge.	2,574	2,059	2,333
		Ab.	2,25	1,16	3,80
	M-2	Ge.	2,596	2,147	2,337
		Ab.	2,19	1,26	3,59
Impureza orgánica (Organic impurity) Aceptable (sí o no)	M - 1	NO	SI	SI	
	M - 2	NO	SI	SI	
Ensayo de desgaste al sulfato (Soundness test with sodium sulphate)	%	8,40	6,80	6,56	
Ensayo de Reactividad Química (Chemical (alkali) reactivity test)		inocuo	inocuo	inocuo	



10.2.3 Concrete Tests

For the study of concrete 6 types of concrete were prepared with the basic proportions provided by JICA, and each type of concrete was tested with three different fine aggregates, thus obtaining a total of 18 different mixtures.

From each mixture, 6 cylinders were prepared for resistance tests of which 3 broke seven days after curing and 3 after 28 days.

The proportions used for the different mixtures were provided by JICA as per Table No 10.6 and readjustments based on the results of the slump test.

The number of mixtures and amounts of cylinders prepared are shown in the Table No 10.4.

CUADRO (TABLE) 10.4

TIPO DE MEZCLA (TYPE OF MIX)	CANTIDAD DE MEZCLAS (QUANTITIES OF MIXES)			TIEMPO CURADO (CURING TIME)		TOTAL CILINDROS (SAMPLES)
	ARENAS QUEVEDO	ARENAS SAN JACINTO	ARENAS BASALTICAS	7 DIAS	28 DIAS	
	A - 1	6	6	6	9	
A - 2	6	6	6	9	9	18
B - 1	6	6	6	9	9	18
B - 2	6	6	6	9	9	18
B - 3	6	6	6	9	9	18
B - 4	6	6	6	9	9	18

Average results of the fracture tests for the different mixtures with curing times of 7 and 28 days are shown in the summary Table No 10.5.



CUADRO (TABLE) 10.5

TIPO DE MEZCLA (TYPE OF MIX)	RESISTENCIA PROMEDIO A LA COMPRESION SIMPLE (kg/cm ²) (AVERAGE COMPRESSIVE STRENGTH)					
	TIPO DE ARENA (TYPE OF SAND)					
	QUEVEDO		SAN JACINTO		BASALTICA	
	7 DIAS	28 DIAS	7 DIAS	28 DIAS	7 DIAS	28 DIAS
A - 1	87	166	113	191	94	166
A - 2	52	108	67	108	74	139
B - 1	102	203	122	192	117	212
B - 2	87	145	81	130	75	143
B - 3	62	135	60	93	62	125
B - 4	40	85	34	62	42	83

Results of the tests are shown in Appendix No 11.

Table Mix Proportions of Concrete Test

Concrete Type	Cement (kg)	Sand (kg)	Gravel (kg)	W/C (%)	S/A (%)	Air (%)	Total Weight (kg)	Gravel (mm)		Total Gravel (kg)	Cement (kg)	Total Weight (kg)
								0-15	15-25			
A-1	25	10-14	5.0	52	37	147	283	699	584	584	584	584
A-2	25	10-14	5.0	66	40	165	250	748	550	551	551	551
B-1	40	8-12	4.5	52	33	147	283	628	417	417	417	417
B-2	40	8-12	4.5	61	35	150	246	674	409	410	410	410
B-3	40	8-12	4.5	66	36	151	229	697	405	405	405	406
B-4	40	8-12	4.5	76	38	155	204	740	395	395	395	395

- (1) Specific Gravity Sand : 2.65 Gravel : 2.60 Cement : 3.15
- (2) Water reducing or air entrained agent Should be used to get high Air Content (4.5 - 5.0 %)
- (3) Fineness Modulus F.M : 2.80
- (4) Compressive Strength f_{28} = -113 + 214 C/W (kg/cm²)
 A-1 (f_{28} = 300 kgf), A-2 (f_{28} = 210 kgf), B-1 (f_{28} = 300 kgf), B-2 (f_{28} = 240 kgf), B-3 (f_{28} = 210 kgf) and B-4 (f_{28} = 170 kgf)
 A-1 (W/C = 52 %), A-2 (W/C = 66 %), B-1 (W/C = 52 %), B-2 (W/C = 61 %), B-3 (W/C = 66 %) and B-4 (W/C = 76 %)



11. APPENDIXES



11.1 LABORATORY TESTS RESULTS



GRAIN SIZE ANALYSIS (SIEVE)

6-1
6-15

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRASYASE MANABI
 DESCRIPTION: COARSE AGGREGATE G-1
 NORM: ASTM C-136
 MASS OF SAMPLE: 9810.00
 DATE: 27-DEC-93

ORDER BY: HIDROSUELOS
 TESTED BY: F. MAYANQUER
 CALCULATED BY: E. ORTEGA
 APPROVED BY: Ing. E. Ortega

SCREEN ANALYSIS

SCREEN No.	OPENING (mm)	PARCIAL WEIGHT RETAINED	ACCUMUL. WEIGHT RETAINED	(%) RETAINED	(%) PASSING ASTM LIMITS
3"	76.1	0.00	0.00	0.00	100.00
2"	64.0	0.00	0.00	0.00	100.00
1 1/2"	38.1	0.00	0.00	0.00	100.00
1"	25.4	0.00	0.00	0.00	100.00
3/4"	19.0	152.00	152.00	1.55	98.45
1/2"	12.7	4046.00	4198.00	42.79	57.21
3/8"	9.51	2443.00	6641.00	67.70	32.30
#4	4.76	2604.00	9245.00	94.24	5.76
PASSING No 4		565.00	565.00		
SUM:		9810.00	9810.00		

REMARKS: FINENESS MODULUS: 3/4"

ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.

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392

ADITIVOS TECNICOS ECUATORIANOS 15.15

STRUCTURE: TRASYASE MANABI
 DESCRIPTION: COARSE AGGREGATE G-2
 NORM: ASTM C-136
 MASS OF SAMPLE: 13686.00
 DATE: 27-DEC-93

ORDER BY: MIDROSUELOS
 TESTED BY: F. MAYANQUER
 CALCULATED BY: L. ORTEGA
 APPROVED BY: Ing. L. Ortega

SCREEN ANALYSIS

SCREEN No.	OPENING (mm)	PARCIAL WEIGHT RETAINED	ACCUMUL. WEIGHT RETAINED	(%) RETAINED	(%) PASSING ASTM LIMITS
5"	76.1	0.00	0.00	0.00	100.00
2"	64.0	0.00	0.00	0.00	100.00
1 1/2"	38.1	0.00	0.00	0.00	100.00
1"	25.4	193.00	193.00	1.41	98.59
3/4"	19.0	7636.00	7829.00	57.20	42.80
1/2"	12.7	5418.00	13247.00	96.79	3.21
3/8"	9.51	198.00	13445.00	98.24	1.76
#4	4.76	101.00	13546.00	98.98	1.02
PASSING No 4		140.00	140.00		
SUM:		13686.00	13686.00		

REMARKS: FINENESS MODULUS: 3.53

ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.

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393

25-00

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRAVASE MANABI
 DESCRIPTION: COARSE AGGREGATE G-3
 NORM: ASTM C-136
 MASS OF SAMPLE: 19206.00
 DATE: 27-DEC-93

ORDER BY: HIDROSUELOS
 TESTED BY: F. MAYANQUER
 CALCULATED BY: L. ORTEGA
 APPROVED BY: Ing. L. Ortega

SCREEN ANALYSIS

SCREEN No.	OPENING (mm)	PARCIAL WEIGHT RETAINED	ACCUMUL. WEIGHT RETAINED	(%) RETAINED	(%) PASSING ASTM LIMITS
3"	76.1	0.00	0.00	0.00	100.00
2"	64.0	0.00	0.00	0.00	100.00
1 1/2"	38.1	0.00	0.00	0.00	100.00
1"	25.4	11519.00	11519.00	59.98	40.02
3/4"	19.0	6472.00	17991.00	93.67	6.33
1/2"	12.7	615.00	18606.00	96.88	3.12
3/8"	9.51	140.00	18746.00	97.60	2.40
#4	4.76	240.00	18986.00	98.85	1.15
PASSING No 4		220.00	220.00		
SUM		19206.00	19206.00		

REMARKS: FINENESS MODULUS: 1 1/2"

ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.

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384

ADITIVOS TECNICOS ECUATORIANOS

ORDER BY: HIDROSUELOS
 DESCRIPTION : SAND # 1
 LOCALIZATION : QUEVEDO NINE
 NORM: INEN 696
 MASS OF SAMPLE: 780.00

WORK: TRASYASE MANABI
 CALCULATED BY: L. Ortega
 TESTED BY: F. Mayanque
 APPROVED BY: Ing. Luis Ortega
 DATE: JANUARY 11TH, 1994

SCREEN ANALYSIS

SCREEN No	OPENING (mm)	PARCIAL WEIGHT RETAINED	ACCUMUL. WEIGHT RETAINED	PERCENT. RETAINED (%)	PERCENT. PASSES (%)	REQUISITO (%) QUE PASA
3/8"	9.51	0.00	0.00	0.00	100.00	100
No 4	4.76	3.00	3.00	0.38	99.62	95-100
No 8	2.00	7.00	10.00	1.28	98.72	80-100
No 16	0.84	20.00	30.00	3.85	96.15	50-85
No 30	0.42	55.00	85.00	10.90	89.10	25-60
No 50	0.25	365.00	450.00	57.69	42.31	10-30
No 100	0.149	265.00	715.00	91.67	8.33	2-10
PASSING No 100		65.00	65.00			
SUM:		780.00	780.00			

REMARKS: Sun & retained 165.77
 Fineness Modulus = (Sun & retained)/100
 Fineness modulus : 1.66

ADITIVOS TECNICOS ECUATORIANOS S.A. SUCURSAL QUITO

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385

ADITIVOS TECNICOS ECUATORIANOS

ORDER BY: HIDROSUELOS
 DESCRIPTION : SAND # 2
 LOCALIZATION : SAN JACINTO MINE
 NORM: INEH 696
 MASS OF SAMPLE: 1219.00

STRUCTURE: TRASYASE MANABI
 CALCULATED BY: L. Ortega
 TESTED BY: F. Mayanquer
 APPROVED BY: Ing. Luis Ortega
 DATE: JANUARY 11TH, 1994

SCREEN ANALYSIS

SIEVE SIZE	OPENING (mm)	PARCIAL WEIGHT RETAINED	ACCUMUL. WEIGHT RETAINED	PERCENT. RETAINED (%)	PERCENT. PASSES (%)	% PASSUBG ASTM LIMITS
3/8"	9.51	0.00	0.00	0.00	100.00	100
No 4	4.76	0.00	0.00	0.00	100.00	95-100
No 8	2.00	0.00	0.00	0.00	100.00	80-100
No 16	0.84	0.00	0.00	0.00	100.00	50-85
No 30	0.42	0.00	0.00	0.00	100.00	25-60
No 50	0.25	94.00	94.00	7.71	92.29	10-30
No 100	0.149	1037.00	1131.00	92.78	7.22	2-10
P A S A No 100		88.00	88.00			
SUMA:		1219.00	1219.00			

REMARKS: Sum % retained 100.49
 Fineness modulus = (sum % retained)/100
 Fineness modulus : 1.00

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ADITIVOS TECNICOS ECUATORIANOS

ORDER BY: HIDROSUELOS
 DESCRIPTION : SAND # 3
 LOCALIZATION : BASALTICA MINE
 NORM: INEN 696
 MASS OF SAMPLE: 926.00

ORDER BY: TRASYASE MAKABI
 CALCULATED BY: L. Ortega
 TESTED BY: F. Mayanquer
 APPROVED BY: Ing. Luis Ortega
 DATE: JANUARY 11TH, 1994

SCREEN ANALYSIS

SCREEN NO.	OPENING (mm)	PARCIAL WEIGHT RETAINED	ACCUMUL. WEIGHT RETAINED	PERCENT RETAINED (%)	PERCENT PASSES (%)	% PASSING ASTM LIMITS
3/8"	9.51	0.00	0.00	0.00	100.00	100
No 4	4.76	2.60	2.60	0.28	99.72	95-100
No 8	2.00	111.00	113.60	12.27	87.73	80-100
No 16	0.84	205.00	316.60	34.19	65.81	50-85
No 30	0.42	141.00	457.60	49.42	50.58	25-60
No 50	0.25	213.00	670.60	72.42	27.58	10-30
No 100	0.149	219.00	889.60	96.07	3.93	2-10
PASSING No 100		36.40	36.40			
SUM:		926.00	926.00			

REMARKS: Sum % retained : 264.64

Fineness modulus : (sum % retained)/100

Fineness modulus :

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397



**SPECIFIC GRAVITY AND WATER ABSORPTION
COARSE AGREGATE**

A D I T É C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

ORDER BY: HIDROSUELOS
 DESCRIPTION: *Gr (3/8" - 3/4") Gr*
 SAMPLE: 01
 INF. No 0: 8588
 NORM: ENEN 857

STRUCTURE: TRASYASE MANABI
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. L. ORTEGA
 DATE: DECEMBER 22TH, 1993

 SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

$$G_s = \frac{A}{B - C}$$

$$G_{s5} = \frac{B}{B - C}$$

$$G_{ea} = \frac{A}{A - C}$$

$$A_b = \frac{B - C}{A} \times 100$$

MASS OF SATURATED SAMPLE WITH DRY SURFACE AREA

B = 3287.00 gr.

MASS OF DRY SAMPLE

A = 3139.00 gr.

MASS OF SAMPLE SUBMERGED IN WATER

C = 2020.00 gr.

BULK SPECIFIC GRAVITY

G_s = 2.478

SPECIFIC GRAVITY SATURATED WITH DRY SURFACE AREA

G_{s5} = 2.594

APARENT SPECIFIC GRAVITY

G_{ea} = 2.805

% OF ABSORPTION

A_b = 4.71

ACTIVOS TÉCNICOS ECUATORIANOS CIA. LTDA.

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389

A D I T E C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

ORDER BY: HIDROSUELOS
 DESCRIPTION: G/ (3/8" - 3/4") G/
 SAMPLE: #2
 INF. No B: 8389
 NORM: INEM 857

STRUCTURE: TRAVASE MANABI
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. E. ORTEGA
 DATE: DECEMBER 22TH, 1993

SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

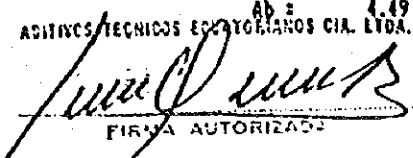
$$G_s = \frac{A}{B - C}$$

$$G_{ss} = \frac{B}{B - C}$$

$$G_{sa} = \frac{A}{A - C}$$

$$A_b = \frac{B - C}{A} \cdot 100$$

MASS OF SATURATED SAMPLE WITH DRY SURFACE AREA	B = 3599.00 gr.
MASS OF DRY SAMPLE	A = 3253.00 gr.
MASS OF SAMPLE SUBMERGED IN WATER	C = 2064.00 gr.
BULK SPECIFIC GRAVITY	G _s = 2.437
SPECIFIC GRAVITY SATURATED WITH DRY SURFACE AREA	G _{ss} = 2.546
APARENT SPECIFIC GRAVITY	G _{sa} = 2.736
% OF ABSORPTION	A _b = 4.49

ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.

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400

A D I T E C - CONCRETE LABORATORY
 ACUÑA 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

ORDER BY: HIDROSUELOS
 DESCRIPTION: G2 (3/4" - 1") G2
 SAMPLE: 01
 INF. No #: 8390
 NORM: INEN 857

STRUCTURE: TRASVASE MANABI
 TESTED BY: W. AYERVE
 CALCULATED BY: ING. L. ORTEGA
 DATE: DECEMBER 22TH, 1995

SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

$$G_s = \frac{A}{B - C}$$

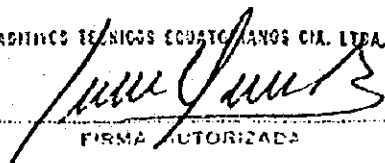
$$G_{ss} = \frac{B}{B - C}$$

$$G_{sa} = \frac{A}{A - C}$$

$$A_b = \frac{B - C}{A} \cdot 100$$

MASS OF SATURATED SAMPLE WITH DRY SURFACE AREA	B = 3173.00 gr.
MASS OF DRY SAMPLE	A = 3065.00 gr.
MASS OF SAMPLE SUBMERGED IN WATER	C = 1967.00 gr.
BULK SPECIFIC GRAVITY	G _s = 2.541
SPECIFIC GRAVITY SATURATED WITH DRY SURFACE AREA	G _{ss} = 2.631
APARENT SPECIFIC GRAVITY	G _{sa} = 2.791
% OF ABSORPTION	A _b = 3.52

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A D I T E C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

ORDER BY: HIDROSUELOS
 DESCRIPTION: 02 (3/4" - 1") G2
 SAMPLE: #2
 INF. No #: 8391
 NORM : INEN 057

STRUCTURE: TRASVASE MANABI
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. L. ORTEGA
 DATE : DECEMBER 22TH, 1993

SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

$$G_s = \frac{A}{B - C}$$

$$G_{ss} = \frac{B}{B - C}$$

$$G_{ea} = \frac{A}{A - C}$$

$$A_b = \frac{B - C}{A} \times 100$$

MASS OF SATURATED SAMPLE WITH DRY SURFACE AREA

B = 3279.00 gr.

MASS OF DRY SAMPLE

A = 3171.00 gr.

MASS OF SAMPLE SUBMERGED IN WATER

C = 2013.00 gr.

BULK-SPECIFIC GRAVITY

G_b = 2.505

SPECIFIC GRAVITY SATURATED WITH DRY SURFACE AREA

G_{ss} = 2.590

APARENT SPECIFIC GRAVITY

G_{ea} = 2.738

% OF ABSORPTION

A_b = 3.41

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401

A O I T E C - CONCRETE LABORATORY
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 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

ORDER BY: MIDROSUELOS
 DESCRIPTION: G3 (1" - 1 1/2") G3
 SAMPLE: #1
 INF. No #: 8386
 NORM: INEN 857

STRUCTURE: TRAVASE MANABI
 TESTED BY: W. AYERRE
 CALCULATED BY: ING. L. ORTEGA
 DATE: DECEMBER 22TH, 1993

SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

$$G_s = \frac{A}{B - C}$$

$$G_{ss} = \frac{B}{B - C}$$

$$G_{sa} = \frac{A}{A - C}$$

$$A_b = \frac{B - C}{A} \times 100$$

MASS OF SATURATED SAMPLE WITH DRY SURFACE AREA

B = 2851.00 gr.

MASS OF DRY SAMPLE

A = 2767.00 gr.

MASS OF SAMPLE SUBMERGED IN WATER

C = 1806.00 gr.

BULK SPECIFIC GRAVITY

G_s = 2.648

SPECIFIC GRAVITY SATURATED WITH DRY SURFACE AREA

G_{ss} = 2.728

APARENT SPECIFIC GRAVITY

G_{sa} = 2.879

% OF ABSORPTION

A_b = 3.04

AGITINDS TECNICOS ECUATORIANOS CIA. LTDA.

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482

A D I T E C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 592-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

ORDER BY: HIDROSUELOS
 DESCRIPTION: G3 (1' - 1 1/2') G3
 SAMPLE: 82
 INF. No 8: 8387
 NORM: INEN 857

STRUCTURE: TRAVASE MANABI
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. L. ORTEGA
 DATE: DECEMBER 22TH, 1993

SPECIFIC GRAVITY AND ABSORPTION OF COARSE AGGREGATE

$$G_e = \frac{A}{B - C}$$

$$G_{es} = \frac{B}{B - C}$$

$$G_{ea} = \frac{A}{A - C}$$

$$A_b = \frac{B - C}{A} \times 100$$

MASS OF SATURATED SAMPLE WITH DRY SURFACE AREA

B = 3565.00 gr.

MASS OF DRY SAMPLE

A = 3469.00 gr.

MASS OF SAMPLE SUBMERGED IN WATER

C = 2190.00 gr.

BULK SPECIFIC GRAVITY

$G_b = 2.523$

SPECIFIC GRAVITY SATURATED WITH DRY SURFACE AREA

$G_{es} = 2.593$

APPARENT SPECIFIC GRAVITY

$G_{ea} = 2.712$

% OF ABSORPTION

$A_b = 2.77$

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403



**SPECIFIC GRAVITY AND WATER ABSORTION
(FINE AGREGATE)**

404

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 GUAYAQUIL. TELF. 254-021, 254-160

STRUCTURE : TRASYASE MANABI
 DESCRIPTION : BASALTICA SAND
 SOURCE : PICOAZA MINE
 SAMPLE # : 1
 NORM : INEN 856
 INF. # : 1886

ORDER BY: HIDROSUELOS
 TESTED BY : N. Ayarva
 CALCULATED BY : Ing. L. Ortega
 APPROVED BY : Ing. L. Ortega
 DATE : DECEMBER 22TH, 1993

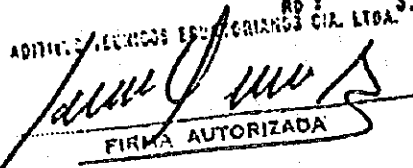
SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE

$G_s = \frac{A}{500 - M_a}$

$G_{es} = \frac{B}{500 - M_a}$

$G_{sa} = \frac{A}{500 + M_a - M_{msd}}$

MASS OF VOLUMETRIC FLASK	$M_a =$	165.90
MASS OF: VOLUMETRIC FLASK + WATER + SAMPLE	$M_{msd} =$	724.60
MASS OF SAMPLE SATURAD SURFACE DRY	$B =$	100.00
MASS OF DRY SAMPLE	$A =$	96.34
MASS OF WATER ADDED TO VOLUMETRIC FLASK	$M_a =$	458.70
BULK SPECIFIC GRAVITY	$G_s =$	2.333
SPECIFIC GRAVITY OF SATURATED WITH SURFACE DRY AREA	$G_{es} =$	2.421
APARENT SPECIFIC GRAVITY	$G_{sa} =$	2.560
% OF ABSORPTION		

ADITIV. TECNOS ESTRUCTURAS C.A. LTDA. 3.80

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405

A D I T E C - CONCRETE LABORATORY
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 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

STRUCTURE : TRASVASE MANABI
 DESCRIPTION : BASALTICA SAND
 SOURCE : PICORAZA MINE
 SAMPLE # : 2
 NORM : INEN 856
 INF. # : 1887

ORDER BY: HIDROSUELOS
 TESTED BY : W. Ayarve
 CALCULATED BY : Ing. L. Ortega
 APPROVED BY : Ing. L. Ortega
 DATE : DECEMBER 22TH, 1993

 SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE

$$G_s = \frac{A}{500 - M_a}$$

$$G_{ss} = \frac{B}{500 - M_a}$$

$$G_{sa} = \frac{A}{500 + M_a - M_{wa} + A}$$

MASS OF VOLUMETRIC FLASK	$M_a =$	165.90
MASS OF: VOLUMETRIC FLASK + WATER + SAMPLE	$M_{wa} =$	724.60
MASS OF SAMPLE SATURAD SURFACE DRY	$B =$	100.00
MASS OF DRY SAMPLE	$A =$	96.53
MASS OF WATER ADDED TO VOLUMETRIC FLASK	$M_a =$	458.70
BULK SPECIFIC GRAVITY	$G_s =$	2.337
SPECIFIC GRAVITY OF SATURATED WITH SURFACE DRY AREA	$G_{ss} =$	2.421
APARENT SPECIFIC GRAVITY	$G_{sa} =$	2.552
% OF ABSORPTION	$A_b =$	3.59

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406

A D I T E C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO, TELF. 502-073, 543-684
 GUAYAQUIL, TELF. 254-021, 254-160

STRUCTURE : TRASYASE MANABI
 DESCRIPTION : SAN JACINTO SAND
 SOURCE : MINE
 SAMPLE # : 1
 NORM : INEN 856
 I.F.# : 1838

ORDER BY: HIDROSUELOS
 TESTED BY : M. Ayervo
 CALCULATED BY : Ing. L. Ortega
 APPROVED BY : Ing. L. Ortega
 DATE : DECEMBER 22TH, 1993

SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE

$$G_s = \frac{A}{500 - M_a}$$

$$G_{ss} = \frac{B}{500 - M_a}$$

$$G_{sa} = \frac{A}{500 + M_w - M_{wa} + A}$$

MASS OF VOLUMETRIC FLASK

$M_a = 169.00$

MASS OF VOLUMETRIC FLASK + WATER + SAMPLE

$M_{wa} = 721.00$

MASS OF SAMPLE SATURAD SURFACE DRY

$B = 100.00$

MASS OF DRY SAMPLE

$A = 98.85$

MASS OF WATER ADDED TO VOLUMETRIC FLASK

$M_w = 452.00$

BULK SPECIFIC GRAVITY

$G_s = 2.059$

SPECIFIC GRAVITY OF SATURATED WITH SURFACE DRY AREA

$G_{ss} = 2.083$

APARENT SPECIFIC GRAVITY

$G_{sa} = 2.110$

% OF ABSORPTION

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[Signature]
 ENGEN. AUTORIZADO

407

A D I T E C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

STRUCTURE : TRASYASE MANABI
 DESCRIPTION : SAN JACINTO SAND
 SOURCE : NINE
 SAMPLE # : 2
 NORM : INEN 856
 INF. # : 1889

ORDER BY: HIDROSUELOS
 TESTED BY : M. Ayarve
 CALCULATED BY : Ing. L. Ortega
 APPROVED BY : Ing. L. Ortega
 DATE : DECEMBER 22TH, 1993

SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE

$$G_s = \frac{A}{500 - M_b}$$

$$G_{es} = \frac{B}{500 - M_b}$$

$$G_{ea} = \frac{A}{500 + M_b - K_{wa} + A}$$

MASS OF VOLUMETRIC FLASK	M _b :	169.00
MASS OF: VOLUMETRIC FLASK + WATER + SAMPLE	M _{bw} :	723.00
MASS OF SAMPLE SATURAD SURFACE DRY	B :	100.00
MASS OF DRY SAMPLE	A :	98.76
MASS OF WATER ADDED TO VOLUMETRIC FLASK	M _a :	454.00
BULK SPECIFIC GRAVITY	G _s :	2.147
SPECIFIC GRAVITY OF SATURATED WITH SURFACE DRY AREA	G _{es} :	2.174
APARENT SPECIFIC GRAVITY	G _{ea} :	2.206
% OF ABSORPTION		1.26

ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.
 FIRMADA AUTOMÁTICAMENTE

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A D I T E C - CONCRETE LABORATORY
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 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

STRUCTURE : TRASYASE MAKABI
 DESCRIPTION : SAND QUEVEDO
 SAMPLE # : 1
 NORM : INEN 856
 INF.# : 1890

ORDER BY: HIDROSUELOS
 TESTED BY : M. Ayarve
 CALCULATED BY : Ing. L. Ortega
 APPROVED BY : Ing. L. Ortega
 DATE : DECEMBER 22TH, 1995

SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE

$$G_s = \frac{A}{500 - M_a}$$

$$G_{ss} = \frac{B}{500 - M_a}$$

$$G_{sa} = \frac{A}{500 + M_a - M_{sd} + A}$$

MASS OF VOLUMETRIC FLASK	M _a = 157.70
MASS OF: VOLUMETRIC FLASK + WATER + SAMPLE	M _{sd} = 719.70
MASS OF SAMPLE SATURAD SURFACE DRY	B = 100.00
MASS OF DRY SAMPLE	A = 97.80
MASS OF WATER ADDED TO VOLUMETRIC FLASK	M _w = 462.00
BULK SPECIFIC GRAVITY	G _b = 2.574
SPECIFIC GRAVITY OF SATURATED WITH SURFACE DRY AREA	G _{ss} = 2.632
APARENT SPECIFIC GRAVITY	G _{sa} = 2.732
% OF ABSORPTION	Ab = 2.25

ACTIVOS TÉCNICOS ECUATORIANOS CIA. LTDA.
[Signature]
 FIDELIA ALCORIZACA

409

A D I T E C - CONCRETE LABORATORY
 Acuña 357 y 10 de Agosto. 2do. Piso
 QUITO. TELF. 502-073, 543-684
 GUAYAQUIL. TELF. 254-021, 254-160

STRUCTURE : TRASYASE MANABI
 DESCRIPTION : QUEVEDO SAND
 SAMPLE # : 2
 NORM : INEN 856
 INF. # : 1891

ORDER BY: HIDROSUELOS
 TESTED BY : M. Ayerve
 CALCULATED BY : Ing. L. Ortega
 APPROVED BY : Ing. L. Ortega
 DATE : DECEMBER 22TH, 1993

 SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATE

$$G_s = \frac{A}{500 - M_a}$$

$$G_{ss} = \frac{B}{500 - M_b}$$

$$G_{sa} = \frac{A}{500 + M_b - M_{wb} + A}$$

MASS OF VOLUMETRIC FLASK	M _b = 157.70
MASS OF: VOLUMETRIC FLASK + WATER + SAMPLE	M _{wb} = 720.00
MASS OF SAMPLE SATURAD SURFACE DRY	B = 100.00
MASS OF DRY SAMPLE	A = 97.86
MASS OF WATER ADDED TO VOLUMETRIC FLASK	M _a = 462.30
BULK SPECIFIC GRAVITY	G _s = 2.596
SPECIFIC GRAVITY OF SATURATED WITH SURFACE DRY AREA	G _{ss} = 2.653
APARENT SPECIFIC GRAVITY	G _{sa} = 2.752
% OF ABSORPTION	A _b = 2.19

LABORATORIO TECNICO ESCATORIANOS CIA. LTDA.

[Handwritten Signature]
 F. MA. S. S. S. S.

410



ORGANIC IMPURITY

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Avenida 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 547-230, 543-684
GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRASYASE MANABI
LOCALIZATION: MANABI
DESCRIPTION : QUEVEDO SAND
SAMPLE # : 1
NORM : ASTM C-40
INF. No. : 1882

ORDER BY: HIDROSUELOS
TESTED BY: F. MAYANQUER
APPROVED BY: ING. LUIS ORTEGA
DATE: DECEMBER 22TH, 1993

ORGANIC CONTENT

COLOR: DARK YELLOW

ACCEPTABLE YES []

NO [X]

REMARKS: IN THE COLORIMETRIC ANALYSIS A 3 % SODIUM HIDROXIDE SOLUTION WAS USED

APPROVED BY
ADITIVOS TECNICOS E INGENIEROS CIA. LTDA.

[Handwritten Signature]
FIRM: _____

412

ADITEC - CONCRETE LABORATORY
Avenida 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 547-230, 543-694
GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRASYASE MANABI
LOCALIZATION: MANABI
DESCRIPTION : QUEVEDO SAND
SAMPLE # : 2
NORM : ASTM C-40
INF. No. : 1883

ORDER BY: HIDROSUELOS
TESTED BY: F. MAYANQUER
APPROVED BY: ING. LUIS ORTEGA
DATE: DECEMBER 22TH, 1993

ORGANIC CONTENT

COLOR: REDISH YELLOW

ACCEPTABLE YES []
NO [X]

REMARKS: IN THE COLORIMETRIC ANALYSIS A 3 % SODIUM HYDROXIDE SOLUTION WAS USED

APPROVED BY
ADITIVOS TECNICOS LABORATORIOS CIA. LTDA.

[Signature]
FIRMA AUTOGRAFICA

413

ADITEC - CONCRETE LABORATORY
ACUÑA 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 547-230, 543-684
GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRASYASE MANABI
LOCALIZATION: MANABI
DESCRIPTION : SAN JACINTO SAND
SAMPLE # : 1
NORM : ASTM C-40
INF. No. : 1880

ORDER BY: HIDROSUELOS
TESTED BY: F. MAYANQUE
APPROVED BY: ING. LUIS ORTEGA
DATE: DECEMBER 22TH, 1993

ORGANIC CONTENT

COLOR:

CRISTALINE

ACCEPTABLE

YES [X]

NO []

REMARKS: IN THE COLORIMETRIC ANALYSIS A 3 % SODIUM HIDROXIDE SOLUTION WAS USED

APPROVED BY ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.


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414

ADITEC - CONCRETE LABORATORY
Avenida 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 547-230, 543-694
GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRASYASE MANABI
LOCALIZATION: MANABI
DESCRIPTION : SAN JACINTO SAND
SAMPLE # : 2
NORM : ASTM C-40
INF. No. : 1881

ORDER BY: HIDROSUELOS
TESTED BY: F. MAYANQUER
APPROVED BY: ING. LUIS ORTEGA
DATE: DECEMBER 22TH, 1993

ORGANIC CONTENT

COLOR: CRISTALINE

ACCEPTABLE YES [X]

NO []

REMARKS: IN THE COLORIMETRIC ANALYSIS A 3 % SODIUM HIDROXIDE SOLUTION WAS USED

APPROVED BY
ADITIVOS TÉCNICOS ECUATORIANOS C.A. LTDA.

[Handwritten Signature]
SIGNATURE

415

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Avenida 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 547-230, 543-684
GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRASYASE MANABI
LOCALIZATION: MANABI
DESCRIPTION : BASALTICA SAND
SAMPLE # : 1
NORM : ASTM C-40
INF. No. : 1884

ORDER BY: HIDROSUELOS
TESTED BY: F. KAYANQUER
APPROVED BY: ING. LUIS ORTEGA
DATE: DECEMBER 22TH, 1993

ORGANIC CONTENT

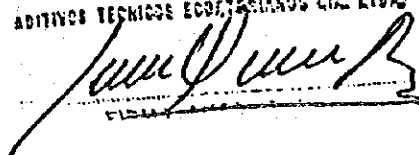
COLOR: CRISTALINE

ACCEPTABLE YES [X]

NO []

REMARKS: IN THE COLORIMETRIC ANALYSIS A 3 % SODIUM HYDROXIDE SOLUTION WAS USED

APPROVED BY
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416

ADITEC - CONCRETE LABORATORY
Avenida 557 y 10 de Agosto, 2do. Piso
QUITO TELF. 547-230, 543-684
GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRASYASE MAKABI
LOCALIZATION: MAKABI
DESCRIPTION : BASALTICA SAND
SAMPLE # : 2
NORM : ASTM C-40
INF. No. : 1885

ORDER BY: MIDROSUELOS
TESTED BY: F. MAYANQUE
APPROVED BY: ING. LUIS ORTEGA
DATE: DECEMBER 22TH, 1995

ORGANIC CONTENT

COLOR: CRISTALINE

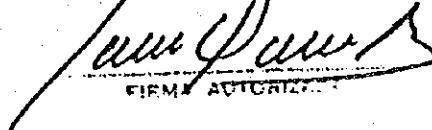
ACCEPTABLE YES [X]

NO []

REMARKS: IN THE COLORIMETRIC ANALYSIS A 3 % SODIUM HIPOXIDE SOLUTION WAS USED

APPROVED BY

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417



SOUNDNESS TEST WITH SODIUM SULPHATE

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRASYASE MANABI
 DESCRIPTION: COARSE AGGREGATE
 SAMPLE: G1
 NORM: ASTM C-88

ORDER BY: HIDROSUELOS
 TESTED BY: F.MAYANQUER
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: JANUARY 17TH, 1994

SULFATE ACCION DURABILITY

SODIUM SULFATE SOLUTION

$$\% \text{ PARCIAL RETAINED} = \frac{\text{PARCIAL RETAINED WEIGHT} \cdot 100}{\text{TOTAL WEIGHT}}$$

$$\% \text{ PASSING} = \frac{\text{INITIAL MASS} - \text{RETAINED MASS AFTER ESSAY} \cdot 100}{\text{INITIAL MASS}}$$

$$\% \text{ PARCIAL WEAR} = \frac{\% \text{ PARCIAL RETAINED} \cdot \% \text{ PASSES}}{100}$$

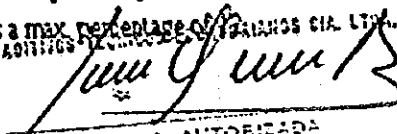
# MESH SIZE		% PARCIAL RETAINED OF AGGREGATE (*)	MASS OF THE FRACTIONS		% PASSING MESH MORE FINE	% OF WEAR PARCIAL
			BEFORE ESSAY	AFTER ESSAY		
2 1/2"	2"	0.00				
2"	1 1/2"	0.00				
1 1/2"	1"	0.00				
1"	3/4"	1.55	495.00	488.00	1.41	0.02
3/4"	5/8"	41.24	670.00	637.00	4.93	2.03
5/8"	3/8"	24.90	330.00	303.00	8.18	2.04
3/8"	#4	26.54	300.00	283.00	5.67	1.50
TOTAL						5.59

% OF THE TOTAL WEAR = SUM(% PARCIAL RETAINED)

(*) THIS VALUE IS CALCULATED IN REFERENCE TO THE ORIGINAL SCREEN ANALYSIS OF THE AGGREGATE

REMARKS: The aggregate has a total wear percentage of 5.59%

It complys with the norm, that specifies a max. percentage of


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ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRÁNSVASE MANABI
 DESCRIPTION: COARSE AGGREGATE
 SAMPLE: G2
 NORM: ASTM C-88

ORDER BY: HIDROSUELOS
 TESTED BY: F.MAYANQUER
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: JANUARY 17TH, 1994

SULFATE ACCION DURABILITY

SODIUM SULFATE SOLUTION

$$\% \text{ PARCIAL RETAINED} = \frac{\text{PARCIAL RETAINED WEIGHT} \cdot 100}{\text{TOTAL WEIGHT}}$$

$$\% \text{ PASSING} = \frac{\text{INITIAL MASS} - \text{RETAINED MASS AFTER ESSAY} \cdot 100}{\text{INITIAL MASS}}$$

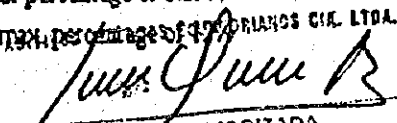
$$\% \text{ PARCIAL WEAR} = \frac{\% \text{ PARCIAL RETAINED} \cdot \% \text{ PASSES}}{100}$$

# MESH SIZE		% PARCIAL RETAINED OF AGGREGATE (*)	MASS OF THE FRACTIONS		% PASSING MESH MORE FINE	% OF WEAR PARCIAL
PASSING	RETAINED		BEFORE ESSAY	AFTER ESSAY		
2 1/2"	2"	0.00				
2"	1 1/2"	0.00				
1 1/2"	1"	1.41	1005.00	880.00	12.44	0.18
1"	3/4"	55.79	495.00	458.00	7.47	4.17
3/4"	1/2"	39.59	670.00	641.00	4.33	1.71
1/2"	3/8"	1.45	330.00	298.00	9.70	0.14
3/8"	#4	0.74	300.00	265.00	11.67	0.08
TOTAL						6.21

$$\% \text{ OF THE TOTAL WEAR} = \text{SUM}(\% \text{ PARCIAL RETAINED})$$

(*) THIS VALUE IS CALCULATED IN REFERENCE TO THE ORIGINAL SCREEN ANALYSIS OF THE AGGREGATE

REMARKS: The aggregate has a total wear percentage of 6.29%
 It complys with the norm, that specifies a maximum percentage of 10%.


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420

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRASVASE MANABI
 DESCRIPTION: COARSE AGGREGATE
 SAMPLE: G3
 NORM: ASTM C-88

ORDER BY: HIDROSUELOS
 TESTED BY: F.MAYANQUER
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: JANUARY 17TH, 1994

SULFATE ACCION DURABILITY

SODIUM SULFATE SOLUTION

$$\% \text{ PARCIAL RETAINED} = \frac{\text{PARCIAL RETAINED WEIGHT} \cdot 100}{\text{TOTAL WEIGHT}}$$

$$\% \text{ PASSING} = \frac{\text{INITIAL MASS} - \text{RETAINED MASS AFTER ESSAY} \cdot 100}{\text{INITIAL MASS}}$$

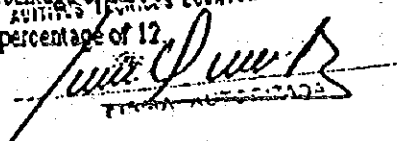
$$\% \text{ PARCIAL WEAR} = \frac{\% \text{ PARCIAL RETAINED} + \% \text{ PASSES}}{100}$$

# MESH SIZE		% PARCIAL RETAINED OF AGGREGATE (*)	MASS OF THE FRACTIONS		% PASSING MESH MORE FINE	% OF WEAR PARCIAL
PASSING	RETAINED		BEFORE ESSAY	AFTER ESSAY		
2 1/2"	2"	0.00				
2"	1 1/2"	0.00				
1 1/2"	1"	59.98	1005.00	956.00	4.88	2.92
1"	3/4"	33.70	495.00	462.00	6.67	2.25
3/4"	5/8"	3.20	670.00	611.00	8.81	0.28
5/8"	3/8"	0.73	330.00	310.00	6.06	0.04
3/8"	#4	1.25	300.00	278.00	7.33	0.09
TOTAL						5.59

$$\% \text{ OF THE TOTAL WEAR} = \text{SUM}(\% \text{ PARCIAL RETAINED})$$

(*) THIS VALUE IS CALCULATED IN REFERENCE TO THE ORIGINAL SCREEN ANALYSIS OF THE AGGREGATE

REMARKS: The aggregate has a total wear percentage of 5.59%
 It complies with the norm, that specifies a max. percentage of 12


 LUIS ORTEGA
 TECNICO AGREGADO

421

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRASVASE MANABI
 DESCRIPTION: sand of river - *Quevedo*
 SAMPLE: SAND #1
 NORM: ASTM C-88

ORDER BY : HIDROSUELOS
 TESTED BY : F.MAYANQUER
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: JANUARY 17TH, 1994

SULFATE ACCION DURABILITY

SODIUM SULFATE SOLUTION

$$\% \text{ PARCIAL RETAINED} = \frac{\text{PARCIAL RETAINED WEIGHT} \cdot 100}{\text{TOTAL WEIGHT}}$$

$$\% \text{ PASSING} = \frac{\text{INITIAL MASS} - \text{RETAINED MASS AFTER ESSAY} \cdot 100}{\text{INITIAL MASS}}$$

$$\% \text{ PARCIAL WEAR} = \frac{\% \text{ PARCIAL RETAINED} \cdot \% \text{ PASSES}}{100}$$

# MESH SIZE		% PARCIAL RETAINED OF AGGREGATE (*)	MASS OF THE FRACTIONS		% PASSING MESH MORE FINE	% OF WEAR PARCIAL
			BEFORE ESSAY	AFTER ESSAY		
3/8"	#4	0.38	100.00	82.10	17.90	0.07
#4	#8	0.90	100.00	85.40	14.60	0.13
#8	#16	2.56	100.00	90.70	9.30	0.24
#16	#30	7.05	100.00	94.80	5.20	0.37
#30	#50	46.79	100.00	89.50	10.50	4.91
#50	#100	33.97	100.00	92.10	7.90	2.68
Pass #100		8.34				
TOTAL						8.40

$$\% \text{ OF THE TOTAL WEAR} = \text{SUM}(\% \text{ PARCIAL RETAINED})$$

(*) THIS VALUE IS CALCULATED IN REFERENCE TO THE ORIGINAL SCREEN ANALYSIS
 OF THE AGGREGATE

REMARKS: The aggregate has a total wear percentage of 8.40%
 It complys with the norm, that specifies a max. percentage of 10%
 ECUATORIANOS CIA. LTDA.

[Signature]
 FIRMA AUTORIZADA

422

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRASYASE MANABI
 DESCRIPTION: SAN JACINTO MINE
 SAMPLE: SAND #2
 NORM: ASTM C-88

ORDER BY: HIDROSUELOS
 TESTED BY: FMAYANQUER
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: JANUARY 17TH, 1994

SULFATE ACCION DURABILITY

SODIUM SULFATE SOLUTION

$$\% \text{ PARCIAL RETAINED} = \frac{\text{PARCIAL RETAINED WEIGHT} \cdot 100}{\text{TOTAL WEIGHT}}$$

$$\% \text{ PASSING} = \frac{\text{INITIAL MASS} - \text{RETAINED MASS AFTER ESSAY} \cdot 100}{\text{INITIAL MASS}}$$

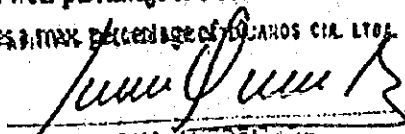
$$\% \text{ PARCIAL WEAR} = \frac{\% \text{ PARCIAL RETAINED} + \% \text{ PASSES}}{100}$$

# MESH SIZE		% PARCIAL RETAINED OF AGGREGATE (*)	MASS OF THE FRACTIONS		% PASSING MESH MORE FINE	% OF WEAR PARCIAL
			BEFORE ESSAY	AFTER ESSAY		
3/8"	#4	0.00				
#4	#8	0.00				
#8	#16	0.00	0.00	0.00	0.00	0.00
#16	#30	0.00	0.00	0.00	0.00	0.00
#30	#50	7.71	100.00	89.00	11.00	0.85
#50	#100	85.07	100.00	93.00	7.00	5.95
Pass #100						
TOTAL						6.80

$$\% \text{ OF THE TOTAL WEAR} = \text{SUM}(\% \text{ PARCIAL RETAINED})$$

(*) THIS VALUE IS CALCULATED IN REFERENCE TO THE ORIGINAL SCREEN ANALYSIS OF THE AGGREGATE

REMARKS: The aggregate has a total wear percentage of 6.80%
 It complies with the norm that specifies a max. percentage of 10.00%.


 FIRMA AUTORIZADA

423

ADITIVOS TECNICOS ECUATORIANOS

STRUCTURE: TRASVASE MANABI
 DESCRIPTION: BASALTICA MINE
 SAMPLE: SAND #3
 NORM: ASTM C-88

ORDER BY: HIDROSUELOS
 TESTED BY: F.MAYANQUER
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: JANUARY 17TH, 1994

SULFATE ACCION DURABILITY

SODIUM SULFATE SOLUTION

$$\% \text{ PARCIAL RETAINED} = \frac{\text{PARCIAL RETAINED WEIGHT} \cdot 100}{\text{TOTAL WEIGHT}}$$

$$\% \text{ PASSING} = \frac{\text{INITIAL MASS} - \text{RETAINED MASS AFTER ESSAY} \cdot 100}{\text{INITIAL MASS}}$$

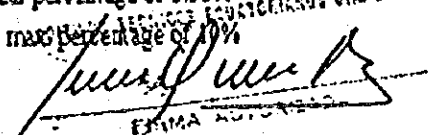
$$\% \text{ PARCIAL WEAR} = \frac{\% \text{ PARCIAL RETAINED} \cdot \% \text{ PASSES}}{100}$$

# MESH SIZE		% PARCIAL RETAINED OF AGGREGATE (*)	MASS OF THE FRACTIONS		% PASSING MESH MORE FINE	% OF WEAR PARCIAL
			BEFORE ESSAY	AFTER ESSAY		
3/8"	#4	0.28	100.00	70.20	29.80	0.08
#4	#8	11.99	100.00	85.30	14.70	1.76
#8	#16	21.92	100.00	97.40	2.60	0.57
#16	#30	15.23	100.00	95.00	5.00	0.76
#30	#50	23.00	100.00	92.30	7.70	1.77
#50	#100	23.65	100.00	93.20	6.80	1.61
Pass #100		3.93				
TOTAL						6.56

% OF THE TOTAL WEAR = SUM(% PARCIAL RETAINED)

(*) THIS VALUE IS CALCULATED IN REFERENCE TO THE ORIGINAL SCREEN ANALYSIS OF THE AGGREGATE

REMARKS: The aggregate has a total wear percentage of 6.56%
 It complys with the norm, that specifies a maximum percentage of 10%


 LUIS ORTEGA
 INGENIERO

424



LOS ANGELES ABRASSION TEST

425

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASYASE MANABI
SAMPLE : G-1 (81)
NORM ASTM C 131
INF.No. 1874

ORDER BY: HIDROSUELOS
TESTED BY: L. ORTEGA
CALCULATED BY: ING. LUIS ORTEGA
DATE: 22-Dic-94

ABRASION TEST USING LOS ANGELES TESTING MACHINE

$$C = \frac{(A-B)}{A} \times 100$$

GRADATION: B

INITIAL MASS OF SAMPLE

A: 5000.00 gr

RETAINED MASS IN # 12 MESH AFTER
500 REVOLUTIONS

B: 4110.00 gr

WEAR PERCENTAGE

C: 17.80

REMARKS: The aggregates complys with the norma.

ADITIVOS TECNICOS ECUATORIANOS CIA LTDA.

FIRMADO AUTORIZADO

426

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASYASE NAKABI
SAMPLE : G-1 (82)
NORM ASTM C 131
INF.No. 1877

ORDER BY: HIDROSUELOS
TESTED BY: L. ORTEGA
CALCULATED BY: ING. LUIS ORTEGA
DATE: 22-Dic-94

ABRASION TEST USING LOS ANGELES TESTING MACHINE

$$C = \frac{(A-B)}{A} \times 100$$

GRADATION: A

INITIAL MASS OF SAMPLE

A: 5000.00 gr

RETAINED MASS IN # 12 MESH AFTER
500 REVOLUTIONS

B: 4150.00 gr

WEAR PERCENTAGE

C: 17.00

REMARKS: The aggregates complys with the norm.

ADITECS TECNICOS ECUATORIANOS CIA. LTDA.


FIRMA AUTORIZADA

428

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASVASE MARABI
SAMPLE : G-2 (81)
NORM ASTM C 131
INF.No. 1875

ORDER BY: HIDROSUELOS
TESTED BY: L. ORTEGA
CALCULATED BY: ING. LUIS ORTEGA
DATE: 22-Dic-94

ABRASION TEST USING LOS ANGELES TESTING MACHINE

$$C = ((A-B)/A) * 100$$

GRADATION: A

INITIAL MASS OF SAMPLE

A: 5000.00 gr

RETAINED MASS IN # 12 MESH AFTER
500 REVOLUTIONS

B: 4180.00 gr

WEAR PERCENTAGE

C: 16.40

REMARKS: The aggregates complys with the norm.

ADITEC TÉCNICOS ECUATORIANOS CIA. LTDA.

[Handwritten Signature]
EJMS

428

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRAYASE MAXABI
SAMPLE : G-2 (12)
NORM ASTM C 131
INF.No. 1878

ORDER BY: HIDROSUELOS
TESTED BY: L. ORTEGA
CALCULATED BY: ING. LUIS ORTEGA
DATE: 22-Dic-94

ABRASION TEST USING LOS ANGELES TESTING MACHINE

$$C = ((A-B)/A) \times 100$$

GRADATION: A

INITIAL MASS OF SAMPLE

A: 5000.00 gr

RETAINED MASS IN # 12 MESH AFTER
500 REVOLUTIONS

B: 4150.00 gr

WEAR PERCENTAGE

C: 17.00

REMARKS: The aggregates complys with the norm.

INGENIEROS TÉCNICOS ECUATORIANOS S.A. SUCURSAL
[Signature]
FIRMADO

428

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASYASE MANABI
SAMPLE : G-3 (41)
NORM ASTM C 131
INF.No. 1876

ORDER BY: HIDROSUELOS
TESTED BY: L. ORTEGA
CALCULATED BY: ING. LUIS ORTEGA
DATE: 22-Dic-94

ABRASION TEST USING LOS ANGELES TESTING MACHINE

$$C = ((A-B)/A) * 100$$

GRADATION: 3

INITIAL MASS OF SAMPLE

A: 10000.00 gr

RETAINED MASS IN # 12 MESH AFTER
1000 REVOLUTIONS

B: 8390.00 gr

WEAR PERCENTAGE

C: 16.10

REMARKS: The aggregates complys with the norma.

ADITIVOS TECNICOS ECUATORIANOS CIA. LTDA.

FIRMA AUTOGRAFICA

430

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASYASE MAKABI
SAMPLE : G-3 (82)
NORM ASTM C 131
INF.No. 1879

ORDER BY: HIDROSUELOS
TESTED BY: L. ORTEGA
CALCULATED BY: ING. LUIS ORTEGA
DATE: 22-Dic-94

ABRASION TEST USING LOS ANGELES TESTING MACHINE

$$C = ((A-B)/A) * 100$$

GRADATION: 3

INITIAL MASS OF SAMPLE

A: 10000.00 gr

RETAINED MASS IN # 12 MESH AFTER
1000 REVOLUTIONS

B: 8350.00 gr

WEAR PERCENTAGE

C: 16.70

REMARKS: The aggregates complys with the norma. that specifies a max. percentage of 40.

REVISIONES 22/12/94 13:00 HRS. L. ORTEGA

Luis Ortega
INGENIERO AUTORIZADO

431



0

CHEMICAL ALKALI REACTIVITY

0

0

432

ADITEC - LABORATORIO DE NORMIGONES
 Avda 357 y 10 de Agosto, 2do. Piso
 QUITO TELF. 547-230, 543-684
 GUAYAQUIL TELF. 232-769, 234-160

STRUCTURE : TRASYASE MAKABI
 DESCRIPTION : COARSE AGGREGATE
 NORM : ASTM (C-289) - (C128-81)

ORDER BY : HIDROSUELOS
 TESTED BY : F. MAYANQUER
 APPROVED BY : ING. LUIS ORTEGA
 DATE : JANUARY 24TH, 1994

POTENTIAL REACTIVITY OF AGGREGATES
 ::::::::::::::::::::::::::::::

SAMPLE ::::::::::		DISOLVED SILICA	ALCALINITY REDUCTION
		Sc (milimol/l)	Ac (milimol/l)
COARSE A. 1	G-1	65.31	138.41
		59.42	145.72
		60.21	156.21
COARSE A. 2	G-2	68.30	122.31
		67.41	131.24
		52.21	145.36
COARSE A. 3	G-3	51.72	139.58
		59.43	148.34
		63.24	157.25

REMARKS: This aggregates are considered innocuous because they cause an expansion in the mortar of less than 0.1 % in one year when used with a cement that contains 1,38 % of alcal

ADITEC TECNICOS ECUATORIANOS CIA. LTDA.

[Handwritten Signature]
 FIRMA AUTORIZADA
 ::::::::::::::::::::::

433

ADITEC - LABORATORIO DE HORMIGONES
 Avda 357 y 10 de Agosto, 2do. Piso
 QUITO TELF. 547-230, 543-684
 GUAYAQUIL TELF. 232-769, 254-160

STRUCTURE : TRANSVASE MAKABU
 DESCRIPTION : SAND
 NORM : ASTM (C-269) - (C128-81)

ORDER BY : HIDROSUELOS
 TESTED BY : F. MAYANQUER
 APPROVED BY : ING. LUIS ORTEGA
 DATE : JANUARY 24TH, 1994

POTENTIAL REACTIVITY OF AGGREGATES

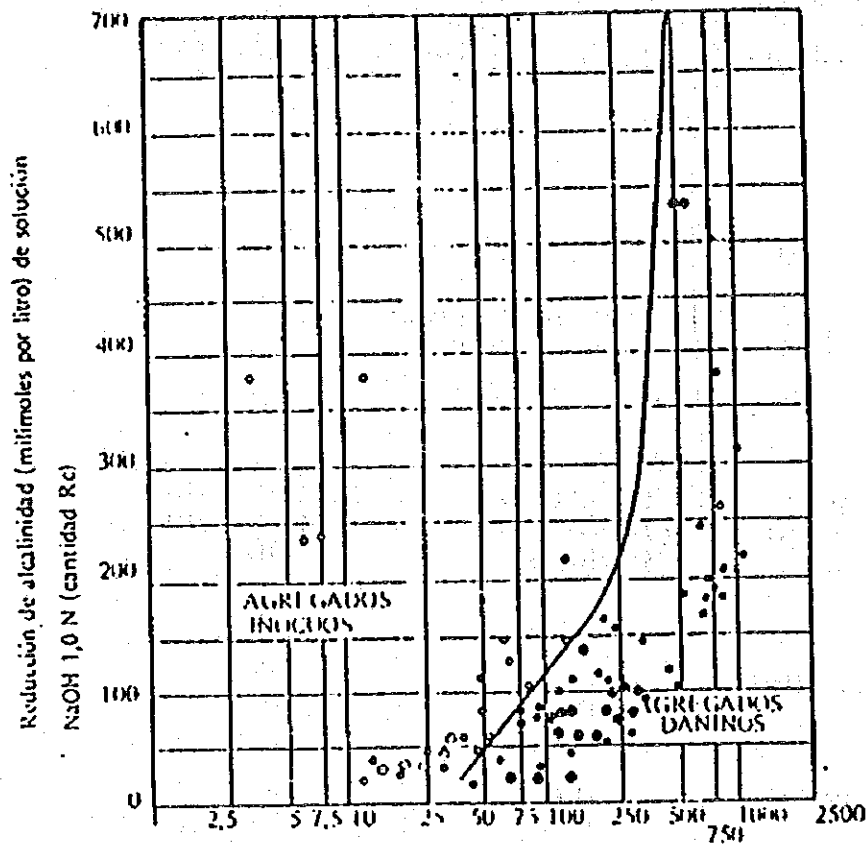
SAMPLE sands	DISSOLVED SILICA Sc (milimol/l)	ALCALINITY REDUCTION Rc (milimol/l)
SAN JACINTO	17.98	505.37
	18.65	406.38
	22.64	343.86
BASALTICA	51.62	161.51
	67.93	119.83
	59.27	265.71
QUEVEDO	33.30	354.28
	34.63	338.65
	34.96	270.92

REMARKS: This aggregates are considered innocuous because they cause an expansion in the mortar of less than 0.1 % in one year when used with a cement that contains 1,38 % of alcal

ADITEC TÉCNICAS ECUATORIANAS CIA. LTDA.

[Handwritten Signature]
 FIRMA AUTORIZADA

434



Sílice disuelta en agregado mineral comprendido entre los límites 300 μ m y 150 μ m (milimoles por litro) por una solución de NaOH 1,0N (cantidad S_c).

- Agregados que causan en el mortero una expansión mayor de 0,1 % en un año cuando se usan con cemento que contiene 1,38 % de alúmina.
- Agregados que causan en el mortero una expansión menor de 0,1 % en un año bajo las mismas condiciones.
- ⊙ Agregados para los cuales no se dispone de datos sobre la expansión del mortero pero que son dañinos según el examen petrográfico.
- ⊙ Agregados para los cuales no se dispone de datos sobre la expansión del mortero pero que son inocuos según el examen petrográfico.
- Línea divisoria entre agregados dañinos y no dañinos.

FIGURA 2 Ilustración de la división entre agregados inocuos y dañinos en base al ensayo de reducción en alcalinidad.



11.2 CONCRETE TESTS RESULTS

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: IRASVASE MANABI
 LOCALIZATION: SAND FROM QUEVEDO NINE
 NORM ASTM C 39
 INF.No. 8340

ORDER BY: HIDROSUELOS
 TESTED BY: W. AYERVE
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: 12-Jan-94

COMPRESSIVE STRENGTH IN KG/CM2

Cilind. #	MOLDING DATE	DATE OF ESSAY	DAYS	IDENTIFICATION	SLUMP (CM)	STRENGTH Kg	COMPRESSIVE STRENGTH		DIAMETER OF CIL.	AVERAGE 3 CIL.
							Kg/cm2			
1	31-Dec-93	07-Jan-94	7	A-1	14	15500	85	15.20		
3	31-Dec-93	07-Jan-94	7	A-1	14	16300	90	15.20		
5	31-Dec-93	07-Jan-94	7	A-1	14	15800	87	15.20		87
7	01-Jan-94	08-Jan-94	7	A-2	10	9200	51	15.20		
9	01-Jan-94	08-Jan-94	7	A-2	10	9500	52	15.20		
11	01-Jan-94	08-Jan-94	7	A-2	10	9600	53	15.20		52
13	01-Jan-94	08-Jan-94	7	B-1	10	18800	104	15.20		
15	01-Jan-94	08-Jan-94	7	B-1	10	18000	99	15.20		
17	01-Jan-94	08-Jan-94	7	B-1	10	18600	103	15.20		102
19	01-Jan-94	08-Jan-94	7	B-2	12	16800	93	15.20		
21	01-Jan-94	08-Jan-94	7	B-2	12	16200	89	15.20		
23	01-Jan-94	08-Jan-94	7	B-2	12	14100	78	15.20		87
25	01-Jan-94	08-Jan-94	7	B-3	12	11600	64	15.20		
27	01-Jan-94	08-Jan-94	7	B-3	12	10900	60	15.20		
29	01-Jan-94	08-Jan-94	7	B-3	12	11300	62	15.20		62
31	01-Jan-94	08-Jan-94	7	B-4	8	6900	38	15.20		
33	01-Jan-94	08-Jan-94	7	B-4	8	7200	40	15.20		
35	01-Jan-94	08-Jan-94	7	B-4	8	7600	42	15.20		40

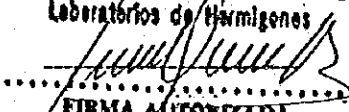
TESTING EQUIPMENT:

a) Compression testing machine: Controls S.P.A Italy - 300 Tn. capacity

CONCRETE MIXING:

- a) Concrete was machine mixed as prescribed in A.S.T.M Method C-192
 b) Slump tests: ASTM C-143

REMARKS:

APPROVED BY
 Aditivos Térmicos Ecuatorianos C. L.
 Laboratorios de Hormigones


 FIRMA AUTORIZADA

437

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASVASE MANABI
 LOCALIZATION: SAND FROM QUEVEDO MINE
 NORM ASTM C 39
 INF.No. 8525

ORDER BY: HIDROSUELOS
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: 04-Feb-94

COMPRESSIVE STRENGTH IN KG/CM2

Cilind. #	MOLDING DATE	DATE OF ESSAY	DAYS	IDENTIFICATION	SLUMP (CM)	STRENGTH Kg	COMPRESSIVE STRENGTH Kg/cm2	DIAMETER OF CIL.	AVERAGE 3 CIL.
2	31-Dec-93	28-Jan-94	28	A-1		44400	245	15.20	
4	31-Dec-93	28-Jan-94	28	A-1		30400	168	15.20	
6	31-Dec-93	28-Jan-94	28	A-1		29500	163	15.20	165
8	01-Jan-94	29-Jan-94	28	A-2		20000	110	15.20	
10	01-Jan-94	29-Jan-94	28	A-2		18900	104	15.20	
12	01-Jan-94	29-Jan-94	28	A-2		19800	109	15.20	108
14	01-Jan-94	29-Jan-94	28	B-1		36400	201	15.20	
16	01-Jan-94	29-Jan-94	28	B-1		37100	204	15.20	
18	01-Jan-94	29-Jan-94	28	B-1		26800	148	15.20	203
20	01-Jan-94	29-Jan-94	28	B-2		26400	145	15.20	
22	01-Jan-94	29-Jan-94	28	B-2		26300	145	15.20	
24	01-Jan-94	29-Jan-94	28	B-2		26100	144	15.20	145
26	01-Jan-94	29-Jan-94	28	B-3		24700	136	15.20	
28	01-Jan-94	29-Jan-94	28	B-3		22800	126	15.20	
30	01-Jan-94	29-Jan-94	28	B-3		24300	134	15.20	132
32	01-Jan-94	29-Jan-94	28	B-4		13800	76	15.20	
34	01-Jan-94	29-Jan-94	28	B-4		15000	83	15.20	
36	01-Jan-94	29-Jan-94	28	B-4		15700	87	15.20	82

TESTING EQUIPMENT:

a) Compression testing machine: Controls S.P.A Italy - 300 Tn. capacity

CONCRETE MIXING:

- a) Concrete was machine mixed as prescribed in A.S.T.M Method C-192
 b) Slump tests: ASTM C-145

REMARKS:

APPROVED BY
 Activos Técnicos Ecuatorianos C. L.
 Laboratorio de Hormigones

.....
 FIRMA AUTORIZADA

438

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRAVASE MANABI
 LOCALIZATION: SAND FROM SAN JACINTO M
 NORM ASTM C 39
 IKF.No. 8342

ORDER BY: HIDROSUELOS
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: 12-Jan-94

COMPRESSIVE STRENGHT IN KG/CM2

Cilind. #	MOLDING DATE	DATE OF ESSAY	DAYS	IDENTIFICATION	SLUMP (CM)	STRENGT Kg	COMPRESSIVE STRENGH Kg/cm2	DIAMETER OF CIL.	AVERAGE 3 CIL.
73	04-Jan-94	11-Jan-94	7	A-1	14	21000	116	15.20	
75	04-Jan-94	11-Jan-94	7	A-1	14	20100	111	15.20	
77	04-Jan-94	11-Jan-94	7	A-1	14	20400	112	15.20	111
79	04-Jan-94	11-Jan-94	7	A-2	10	12200	67	15.20	
81	04-Jan-94	11-Jan-94	7	A-2	10	12700	70	15.20	
83	04-Jan-94	11-Jan-94	7	A-2	10	11900	66	15.20	68
85	04-Jan-94	11-Jan-94	7	B-1	10	21000	116	15.20	
97	04-Jan-94	11-Jan-94	7	B-1	10	22700	125	15.20	
89	04-Jan-94	11-Jan-94	7	B-1	10	22700	125	15.20	122
91	04-Jan-94	11-Jan-94	7	B-2	12	15600	86	15.20	
93	04-Jan-94	11-Jan-94	7	B-2	12	13600	75	15.20	
95	04-Jan-94	11-Jan-94	7	B-2	12	14700	81	15.20	81
97	04-Jan-94	11-Jan-94	7	B-3	11	11400	63	15.20	
99	04-Jan-94	11-Jan-94	7	B-3	11	11000	61	15.20	
101	04-Jan-94	11-Jan-94	7	B-3	11	10100	56	15.20	66
103	04-Jan-94	11-Jan-94	7	B-4	12	6400	35	15.20	
105	04-Jan-94	11-Jan-94	7	B-4	12	5700	31	15.20	
107	04-Jan-94	11-Jan-94	7	B-4	12	6300	35	15.20	34

TESTING EQUIPMENT:

a) Compression testing machine: Controls S.P.A Italy - 300 Tn. capacity

CONCRETE MIXING:

- a) Concrete was machine mixed as prescribed in A.S.T.M. Method C-192
 b) Slumptests: ASTM C-143

REMARKS: _____

APPROVED BY
 Aditivos T6cnicos Ecuatorianos C. L.
 Laboratorios de Hom6genos

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 FIRMA AUTORIZADA

438

ADITEC - CONCRETE LABORATORY
Acuña 357 y 10 de Agosto, 2do. Piso
QUITO TELF. 502-073, 543-684
GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRAVASE MANABI
 LOCALIZATION: SAND FROM SAN JACINTO M
 NORM ASTM C 39
 INF.No. 8524

ORDER BY: HIDROSUELOS
 TESTED BY: W. AYERVE
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: 4-Feb94

 COMPRESSIVE STRENGTH IN KG/CM²

Cilind. #	MOULDING DATE	DATE OF ESSAY	DAYS	IDENTIFICATION	SLUMP (CM)	STRENGTH Kg	COMPRESSIVE STRENGTH Kg/cm ²	DIAMETER OF CIL.	AVERAGE 3 CIL.
74	04-Jan-94	01-Feb-94	28	A-1		34500	190	15.20	
76	04-Jan-94	01-Feb-94	28	A-1		34800	192	15.20	
78	04-Jan-94	01-Feb-94	28	A-1		34800	192	15.20	191
80	04-Jan-94	01-Feb-94	28	A-2		19700	109	15.20	
82	04-Jan-94	01-Feb-94	28	A-2		19500	107	15.20	
84	04-Jan-94	01-Feb-94	28	A-2		19400	107	15.20	108
86	04-Jan-94	01-Feb-94	28	B-1		35200	194	15.20	
88	04-Jan-94	01-Feb-94	28	B-1		34500	190	15.20	
90	04-Jan-94	01-Feb-94	28	B-1		32400	179	15.20	188
92	04-Jan-94	01-Feb-94	28	B-2		22500	124	15.20	
94	04-Jan-94	01-Feb-94	28	B-2		24600	136	15.20	
96	04-Jan-94	01-Feb-94	28	B-2		23400	129	15.20	130
99	04-Jan-94	01-Feb-94	28	B-3		17300	95	15.20	
100	04-Jan-94	01-Feb-94	28	B-3		17000	94	15.20	
102	04-Jan-94	01-Feb-94	28	B-3		16600	91	15.20	94
104	04-Jan-94	01-Feb-94	28	B-4		11100	61	15.20	
106	04-Jan-94	01-Feb-94	28	B-4		11600	64	15.20	
108	04-Jan-94	01-Feb-94	28	B-4		11100	61	15.20	62

TESTING EQUIPMENT:

a) Compression testing machine: Controls S.P.A Italy - 300 Tn. capacity

CONCRETE MIXING:

- a) Concrete was machine mixed as prescribed in A.S.T.M Method C-192
 b) Slump tests: ASTM C-143

REMARKS: _____

Agencia Técnica de Estudios y Análisis C. L.
 Laboratorio de Hormigones
 FIRMADA AUTORIZADA

440

ADITEC - LABORATORIO DE HORNIGONES
 Acuña 357 y 10 de Agosto, 2do. Piso
 QUITO TELF. 502-073, 543-684
 GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASYASE MANABI
 LOCALIZATION: BASALT MINE SAND
 NORM ASTM C 39
 INF.No. 8341

ORDER BY: HIDROSUELOS
 TESTED BY: W. AYERVE
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: 12-Jan-94

COMPRESSIVE STRENGTH IN KG/CM2

Cilind. #	MOLDING DATE	DATE OF ESSAY	DAYS	IDENTIFICATION	SLUMP (CM)	STRENGTH Kg	COMPRESSIVE STRENGTH Kg/cm2	DIAMETER OF CIL.	AVERAGE 3 CIL.
37	03-Jan-94	10-Jan-94	7	A-1	14	16800	93	15.20	
39	03-Jan-94	10-Jan-94	7	A-1	14	17000	94	15.20	
41	03-Jan-94	10-Jan-94	7	A-1	14	17100	94	15.20	94
43	03-Jan-94	10-Jan-94	7	A-2	14	13800	76	15.20	
45	03-Jan-94	10-Jan-94	7	A-2	14	13400	74	15.20	
47	03-Jan-94	10-Jan-94	7	A-2	14	12900	71	15.20	74
49	03-Jan-94	10-Jan-94	7	B-1	13	20800	115	15.20	
51	03-Jan-94	10-Jan-94	7	B-1	13	22200	122	15.20	
53	03-Jan-94	10-Jan-94	7	B-1	13	20600	114	15.20	117
55	03-Jan-94	10-Jan-94	7	B-2	13	14000	77	15.20	
57	03-Jan-94	10-Jan-94	7	B-2	13	13400	74	15.20	
59	03-Jan-94	10-Jan-94	7	B-2	13	13500	74	15.20	75
61	03-Jan-94	10-Jan-94	7	B-3	12	11000	61	15.20	
63	03-Jan-94	10-Jan-94	7	B-3	12	11100	61	15.20	
65	03-Jan-94	10-Jan-94	7	B-3	12	11500	63	15.20	62
67	03-Jan-94	10-Jan-94	7	B-4	12	7500	41	15.20	
69	03-Jan-94	10-Jan-94	7	B-4	12	7500	41	15.20	
71	03-Jan-94	10-Jan-94	7	B-4	12	7800	43	15.20	42

TESTING EQUIPMENT:

a) Compression testing machine: Controls S.P.A Italy - 300 Tn. capacity

CONCRETE MIXING:

- a) Concrete was machine mixed as prescribed in A.S.T.M Method C-192
 b) Slump tests: ASTM C-143

REMARKS:

APPROVED BY
 Aditivos Técnicos Ecuatorianos C. L.
 Laboratorio de Hornigones

[Signature]
 FIRMA AUTORIZADA

441

ADITEC - LABORATORIO DE HORMIGONES
 Acuña 357 y 10 de Agosto, 2do. Piso
 QUITO TELF. 502-073, 543-684
 GUAYAQUIL TELF. 254-021, 254-160

STRUCTURE: TRASYASE MANABI
 LOCALIZATION: SAND FROM BASALT MINE
 NORM ASTM C 39
 INF.No. 8526

ORDER BY: MIDROSUELOS
 TESTED BY: M. AYERVE
 CALCULATED BY: ING. LUIS ORTEGA
 DATE: 04-Feb-94

COMPRESSIVE STRENGHT IN KG/CN2

Cilind. #	MOLDING DATE	DATE OF ESSAY	DAYS	IDENTIFICATION	SLUMP (CM)	STRENGHT Kg	COMPRESSIVE STRENGH Kg/cm2	DIAMETER OF CIL.	AVERAGE 3 CIL.
38	03-Jan-94	31-Jan-94	28	A-1		30400	168	15.20	
40	03-Jan-94	31-Jan-94	28	A-1		29900	165	15.20	
42	03-Jan-94	31-Jan-94	28	A-1		30200	166	15.20	166
44	03-Jan-94	31-Jan-94	28	A-2		24300	134	15.20	
46	03-Jan-94	31-Jan-94	28	A-2		25100	138	15.20	
48	03-Jan-94	31-Jan-94	28	A-2		26200	144	15.20	139
50	03-Jan-94	31-Jan-94	28	B-1		41000	226	15.20	
52	03-Jan-94	31-Jan-94	28	B-1		35600	196	15.20	
54	03-Jan-94	31-Jan-94	28	B-1		38700	213	15.20	212
56	03-Jan-94	31-Jan-94	28	B-2		26000	143	15.20	
58	03-Jan-94	31-Jan-94	28	B-2		25900	143	15.20	
60	03-Jan-94	31-Jan-94	28	B-2		26100	144	15.20	143
62	03-Jan-94	31-Jan-94	28	B-3		22500	124	15.20	
64	03-Jan-94	31-Jan-94	28	B-3		22300	123	15.20	
66	03-Jan-94	31-Jan-94	28	B-3		23300	128	15.20	125
68	03-Jan-94	31-Jan-94	28	B-4		15600	86	15.20	
70	03-Jan-94	31-Jan-94	28	B-4		14200	78	15.20	
72	03-Jan-94	31-Jan-94	28	B-4		15500	85	15.20	83

TESTING EQUIPMENT:

a) Compression testing machine: Controls S.P.A Italy - 300 Tn. capacity

CONCRETE MIXING:

- a) Concrete was machine mixed as prescribed in A.S.T.M Method C-192
- b) Slump tests: ASTM C-143

REMARKS:

APPROVED BY
 Aditivos Técnicos Ecuatorianos C. L.
 Laboratorio de Hormigones

[Handwritten Signature]

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442



11.3 CEMENT CHARACTERISTICS

CARACTERISTICAS DEL CEMENTO ROCAFUERTE TIPO 1E

RESIST.A LA COMPRESION: (kg/cm2)

3 días	105
7 días	165
28 días	225

DENSIDAD: 3.01 gr/cm3

CONSISTENCIA NORMAL (A/C): 28 %

TIEMPO DE FRAGUADO:

METODO: VICAT

Tiempo Inicial: 95 min
Tiempo Final: 370 min

444

5. REQUISITOS DEL CEMENTO PORTLAND IE

5.1 Químicos. Cumplirá con los requisitos químicos, aplicables, descritos en la Tabla 2.

TABLA 2. Requisitos químicos.

PARAMETRO	Óxido de magnesio (MgO) % Máx.	Trióxido de azufre (SO ₃) % Máx.	Pérdida por calcinación %
REQUISITO	5	4	5
METODO DE ENSAYO	INEN 192	INEN 203	INEN 160

5.2 Físicos. Cumplirá con los requisitos físicos descritos en la Tabla 3.

TABLA 3. Requisitos físicos.

PARAMETRO	REQUISITO	METODO DE ENSAYO
Finura	*	INEN 489
Expansión en autoclave % máx.	0,50	INEN 196
Contracción autoclave % máx.	0,20	INEN 200
Tiempo de fraguado, Vicat		
Inicial, mín. (min)	45	
final, máx. (min)	420	INEN 158
Contenido de aire del mortero, % máx. de volumen	12	INEN 195
Resistencia a la compresión, mín. en MPa		INEN 488
3 días	11,0	
7 días	18,0	
28 días	24,2	
Expansión del mortero ** % máx.		ASTM C 227
14 días	0,020	
8 semanas	0,060	

* Para cualquiera de los casos ya sea la cantidad retenida por tamizado húmedo en 45µm o la superficie específica por el aparato de permeabilidad de aire, cm²/g, deben ser informados.

** El ensayo de expansión del mortero es un requisito opcional, aplicado solamente cuando lo requiere el comprador y no debe ser requerido a menos que el cemento vaya a utilizarse con áridos de reacción alcalina

1 MPa = 10,1972 kg/cm²

445



Centro Técnico del Hormigón

CEMENTO

Marca: Rocafuerte Tipo IE

Procedencia: C.Blanco

Fecha de Recepción:

Lab. No.:

ANÁLISIS QUÍMICO			CARACTERÍSTICAS FÍSICAS												
Pérdida al Fuego	3.0	%	Retenido Tamiz 45 um(#325)	11.6											
SiO ₂	27.2	%	Retenido Tamiz 75 um(#200)												
Al ₂ O ₃	5.2	%	Superficie Específica	428	m ² /g										
Fe ₂ O ₃	3.1	%	Pasta Normal (a/c)		g/g										
CaO	54.8	%	Inicio de Fraguado	169	min										
MgO	1.1	%	Final de Fraguado	366	min										
K ₂ O	0.2	%	Falso Fraguado												
Na ₂ O	0.4	%	Aire en el Mortero												
SO ₃	2.7	%	Expansión Autoclave												
CaO Libre		%	Morteros (a/c)		g/g										
Residuo Insoluble		%	Fluidez del Mortero												
Alcalinos Totales (Na ₂ O+0.658K ₂ O)		%													
<u>COMPOSICIÓN POTENCIAL</u>			<table border="1"> <thead> <tr> <th>EDAD DIAS</th> <th>RESISTENCIA A LA COMPRESIÓN MPa</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>5.7</td> </tr> <tr> <td>3</td> <td>12.7</td> </tr> <tr> <td>7</td> <td>18.5</td> </tr> <tr> <td>28</td> <td>27.0</td> </tr> </tbody> </table>			EDAD DIAS	RESISTENCIA A LA COMPRESIÓN MPa	1	5.7	3	12.7	7	18.5	28	27.0
EDAD DIAS	RESISTENCIA A LA COMPRESIÓN MPa														
1	5.7														
3	12.7														
7	18.5														
28	27.0														
CaS		%													
C ₂ S		%													
C ₃ A		%													
C ₄ AF		%													
MODULO HIDRAULICO															

OBSERVACIONES

VTO. BNO. LABORATORIO

Leandro Carrizo, Ing. Civil
 Jefe de Laboratorio
 Centro Técnico del Hormigón

446

JICA