

*Feasibility Study on Water Resources Development in
Rural Area in the
Kingdom of Morocco
Final Report
Volume VII Data Book
Data Book GC
Geology and Construction Material*

GC4 Test Pitting Log

List of Test Pit

Name of Dam Site	No.	Depth (m)	Location
N'Fifikh	P1	4.7	Left bank terrace at confluence of Oued Dalia and Al Meish
	P2	5.0	Right bank terrace: 600m upstream of dam site
	P3	1.0	Left bank talus: 200m upstream of dam site
	P4	4.0	Right bank terrace: 1.2km downstream of dam site
	P5	5.0	Left bank terrace: 1.8km downstream of dam site
Taskourt	P1	1.5	Riverbed: 400m downstream of dam site
	P2	1.5	Riverbed: center on contemplate dam axis
	P3	1.5	Riverbed: 1.3km upstream of dam site
	P4	1.5	Riverbed: 2.5km upstream of dam site
	P5	1.5	Riverbed: 4.5km upstream of dam site
Timkit (conducted in 1992)	PA1	3.0	Zone A (Riverbed on Oued n'Fer: 1.5 ~ 2.5km upstream of dam site)
	PA2	3.0	
	PA3	3.0	
	PA4	3.0	
	PA5	3.0	
	PA6	3.0	
	PB1	3.0	Zone B (Riverbed on right tributary Oued Ouarsad: 2 ~ 3km upstream of dam site)
	PB2	3.0	
	PB3	4.0	
	PB4	4.7	
	PB5	5.0	
	PB6	5.0	Zone N (Terrace in reservoir area)
	PB7	4.9	
	PB8	4.0	
	PN1	4.0	
PN2	5.0		
PN3	2.0		
PM4	5.0		
PN5	5.0		
PN6	4.8+1.0		
PN7	4.9		
Azghar	P1	3.0	1.0km upstream of dam site in the reservoir area
	P2	4.0	Left bank of right tributary confluence at just upstream of dam site
	P3	4.0	Valley bottom at dam site (center on dam axis)
	P4	5.0	Field of downstream area of dam site (Left bank)
	P5	1.5	On Oued Qarya, at the outlet from mountaneous area

LOG OF PIT

Projec	ES on Water Resources	Locatio	Left Bank Terrace at Confluence	Co-	
Ground		Top of Rock		Water	Nil
Dimension of	1.0x1.5x4.7	Date	Sep./200	Date	Sep./200
Logged				Contract	LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0	0.2	Top soil			
	0.9	Red-color Silty Clay with some			
1		Terrace Deposits Various-color Silty			
2					
3					
	3.7	Gravels & Cobbles with Boulder ($\phi > 30\text{cm}$)			
4	4.7				
5		Bedrock	Pit Completed		
6					
7					

GC4-2

LOG OF PIT

Projec	ES on Water Resources	Locatio	Right Bank Terrace 600	Co-	
Ground		Top of Rock		Water	Nil
Dimension of	1.0x1.5x5.0	Date	Sep./200	Date	Sep./200
Logged				Contract	LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Top soil			
	0.5	Gravels with Boulder in Clayey			
	0.8				
1		Terrace Deposits Yellowish Silty Clay with			
2					
3					
	2.7	Clay with Gravels bearing			
4	3.9				
		Gravels & Cobbles with Boulder ($\phi > 30\text{cm}$)			
5	5.0				
6		Bedrock	Pit Completed		
7					

LOG OF PIT

Project ES on Water Resources Location Left Bank Tals 200 Co- _____
 Ground Top of Rock Water Nil
 Dimension of 1.0x1.5x1.0 Date Sep./200 Date Sep./200
 Logged _____ Contract LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Top soil	█		
0.3		Colluvial deposits: Rock fragments in Silt & Clay			
1.0		Rock Bloes Disturbed by large Rock Bloes			
2					
3					
4					
5					
6					
7					

GC4-3

LOG OF PIT

Project ES on Water Resources Location Right Bank Terrace 1.2 Co- _____
 Ground Top of Rock Water Nil
 Dimension of 1.0x1.5x4.0 Date Sep./200 Date Sep./200
 Logged _____ Contract LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Reddish Clayey soil with some rock	█		
1.6		Yellowish Silty Clay with			
4.0		Bedrock			Pit Completed
5					
6					
7					

N'Fifik P5
Sheet 1 of

LOG OF PIT

Project	FS on Water Resources	Location	Left Bank Terrace 1.8 km	Co-	Water
Ground		Top of Rock			Nil
Dimension of	1.0x1.5x5.0	Date	Sep./200	Date	Sep./200
Logged				Contract	LPE

GC44

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Colluvial deposits: Red-color Gravelly Clayey soil			
1.6					
2	Terrace deposits: Yellowish Silty				
2.6					
3		Residual soil & Colluvial deposits: Silty soil with angular rock			
4.4					
5		Highly weathered bedrock			
Pit Completed					

Taskourt P1 - P5

Sheet 1 of
P1: 400m downstream from dam
P2: Center on contemplate dam
P3: 1.3 km upstream from dam
P4: 2.5 km upstream from dam
P5: 4.5 km upstream from dam

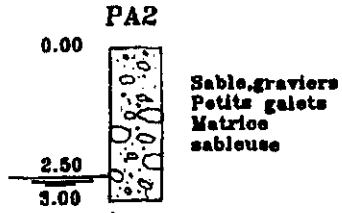
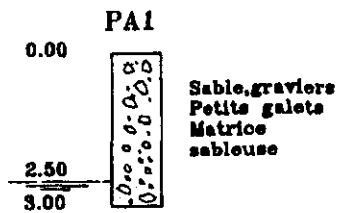
LOG OF PIT

Project	FS on Water Resources	Location	Center of Riverbed	Co-	Water
Ground		Top of Rock			Nil
Dimension of	1.0x1.5x1.5	Date	Oct./200	Date	Oct./200
Logged				Contract	LPE

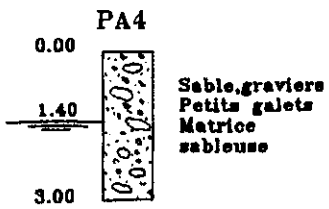
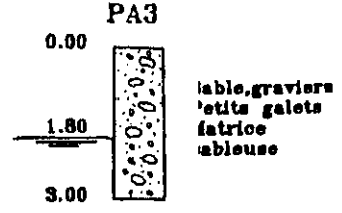
Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Alluvial deposits: Sands and			
1.5					
Pit Completed					

Timkit

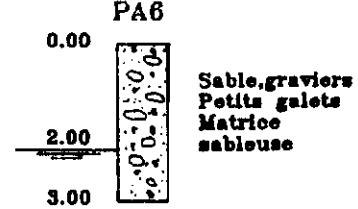
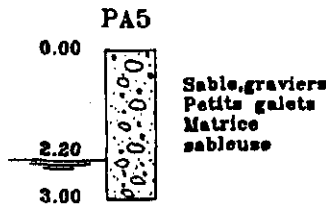
ALLUVIONS GROSSIERES ZONE A



0.00 - 2.50	86	12	2	98	-
2.50 - 3.00	77	20	3	74	-

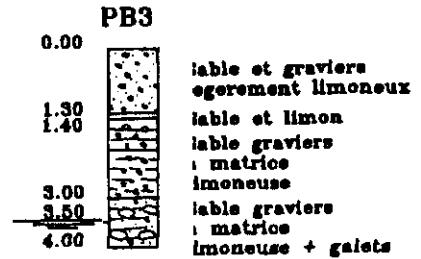
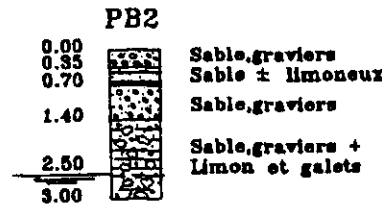
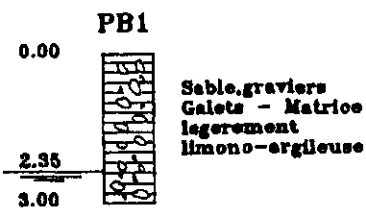


0.00 - 1.40	86	12	2	71	-
1.40 - 3.00	84	16	1	77	-



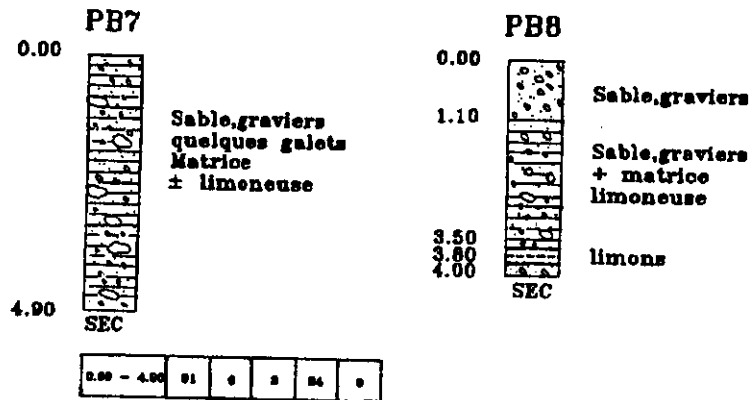
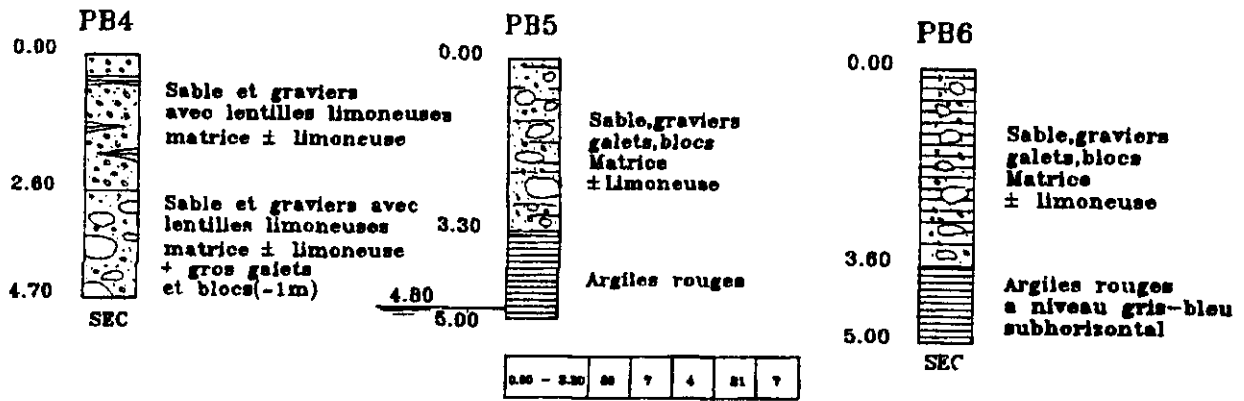
0.00 - 2.00	86	12	2	86	-
2.00 - 3.00	78	20	2	78	-

ALLUVIONS GROSSIERES ZONE B

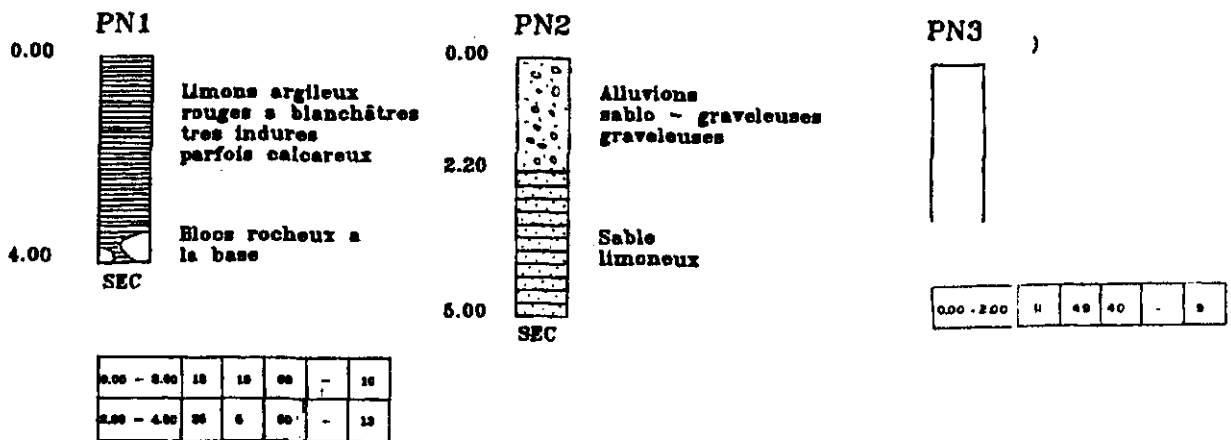


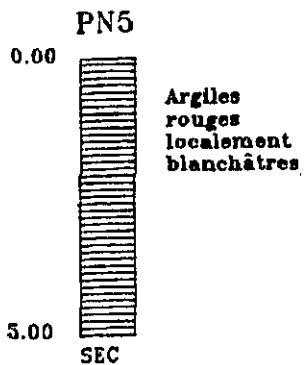
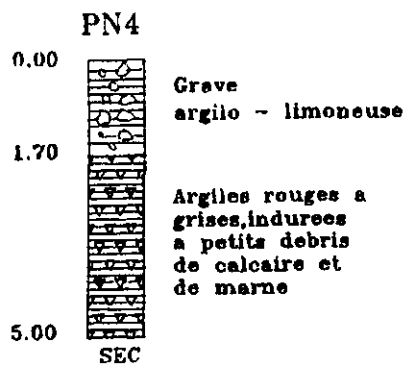
0.00 - 2.35	81	14	6	10	0
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0.00 - 1.30	86	7	7	10	10
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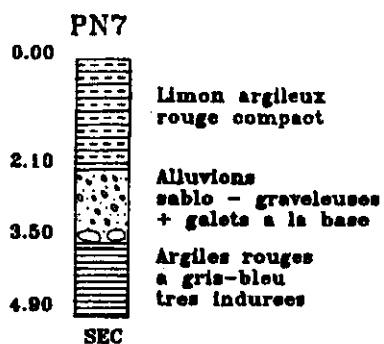
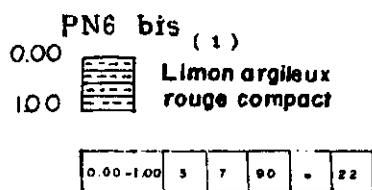
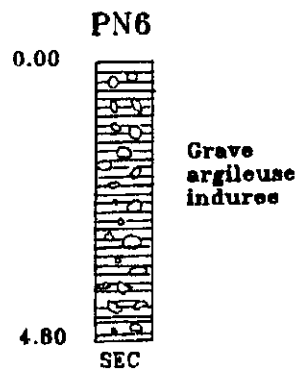


MATERIAUX FINS





0.00 - 1.00	1	8	88	-	81
1.00 - 2.00	8	35	87	-	35
2.00 - 3.00	8	8	84	-	88



0.00 - 2.00	8	84	72	-	8
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LOG OF PIT

Projec ES on Water Resources Location 10 km upstream from dam site Co-
Ground Top of Rock Water Nil
Dimension of 1.0x1.5x3.0 Date Oct./200 Date Oct./200
Logged Contract LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0	0.2	Top soil			
1		Yellowish Clayey soils			
2	1.8	Residual Yellowish Clayey soils	■		
3	3.0	Bedrock	■		Disturbed by hard rock
4					
5					
6					
7					

GC4-8

LOG OF PIT

Projec ES on Water Resources Location Left Bank of Right Branch confluence Co-
Ground Top of Rock Water Nil
Dimension of 1.0x1.5x4.0 Date Oct./200 Date Oct./200
Logged Contract LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Top soil			
1	0.7	Terrace deposits & Flood deposits:			
2		Silty Sands and			
3			■		
4	4.0	Bedrock			Pit Completed
5					
6					
7					

LOG OF PIT

Projec	ES on Water Resources	Locatio	Valley bottom at dam site	Co-	
Ground		Top of Rock		Water	Nil
Dimension of	1.8x1.5x4.0	Date	Oct./200	Date	Oct./200
Logged				Contract	LPE

GC4-9

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Cultivated soil			
0.9					
1		Colluvial deposits: Red-color Clayey	■		
1.6					
2		Sand & Gravels with red-color			
2.5					
3		Terrace deposits Sand & Gravels, Cobbles and			
4		Bedrock	Pit Completed		
5					
6					
7					

LOG OF PIT

Projec	ES on Water Resources	Locatio	Field of downstream area of	Co-	
Ground		Top of Rock		Water	Nil
Dimension of	1.8x1.5x4.7	Date	Oct./200	Date	Oct./200
Logged				Contract	LPE

Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Residual soils: Red-color Clayey soil with nodular			
0.6					
1		Extrusively weathered Marl: Greenish or bluish gray very soft and brittle rock fragments and residual	■		
2.1					
3		Highly weathered Marl: Greenish or bluish gray friable rock powder and rock fragments and	■		
4					
5			Pit Completed		
5.0					
6					
7					



Azghar

P5
Sheet 1 of

LOG OF PIT

Project ES on Water Resources Location On Oued Qarya, at the outlet Co-
Ground Top of Rock Water Nil
Dimension of 1.8x1.5x1.5 Date Oct./200 Date Oct./200
Logged _____ Contract LPE

GCA-10

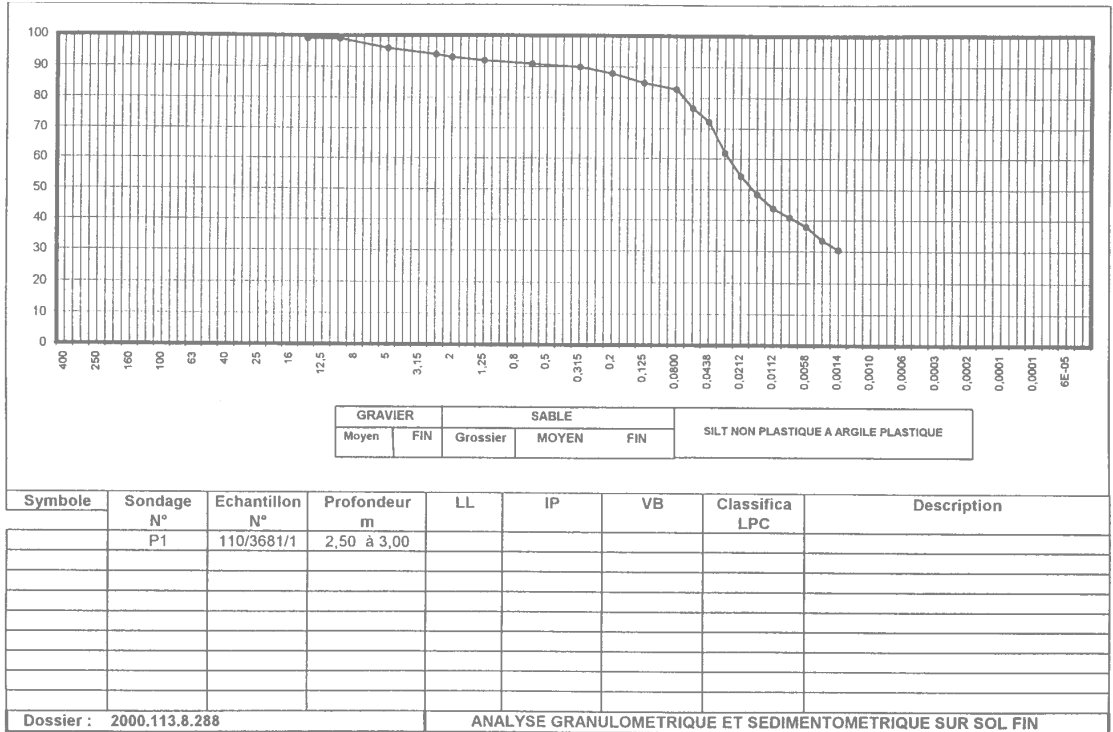
Depth (m)	Lithic Symbol	Description of Lithology	Sample for testing	Laboratory Identification	Remarks
0		Alluvial deposits:			
1		Sands and			
1.5		Pit Completed			
2					
3					
4					
5					
6					
7					

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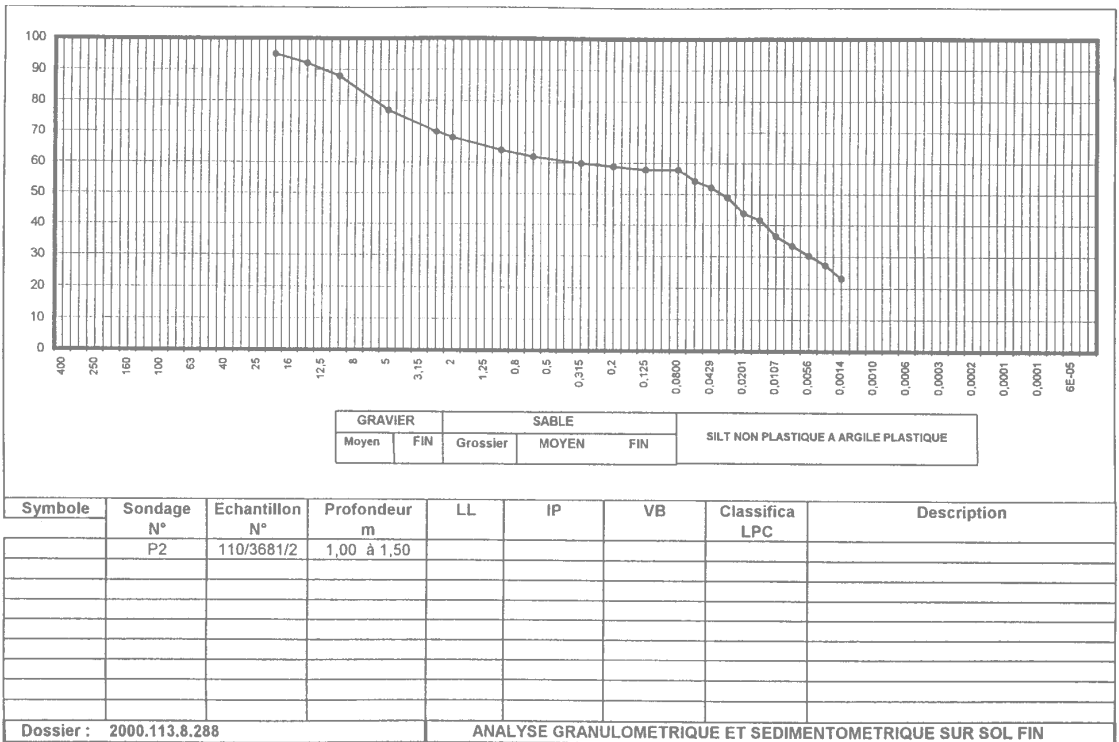
GC5 Laboratory Test Data

05 N'Fifikh Dam

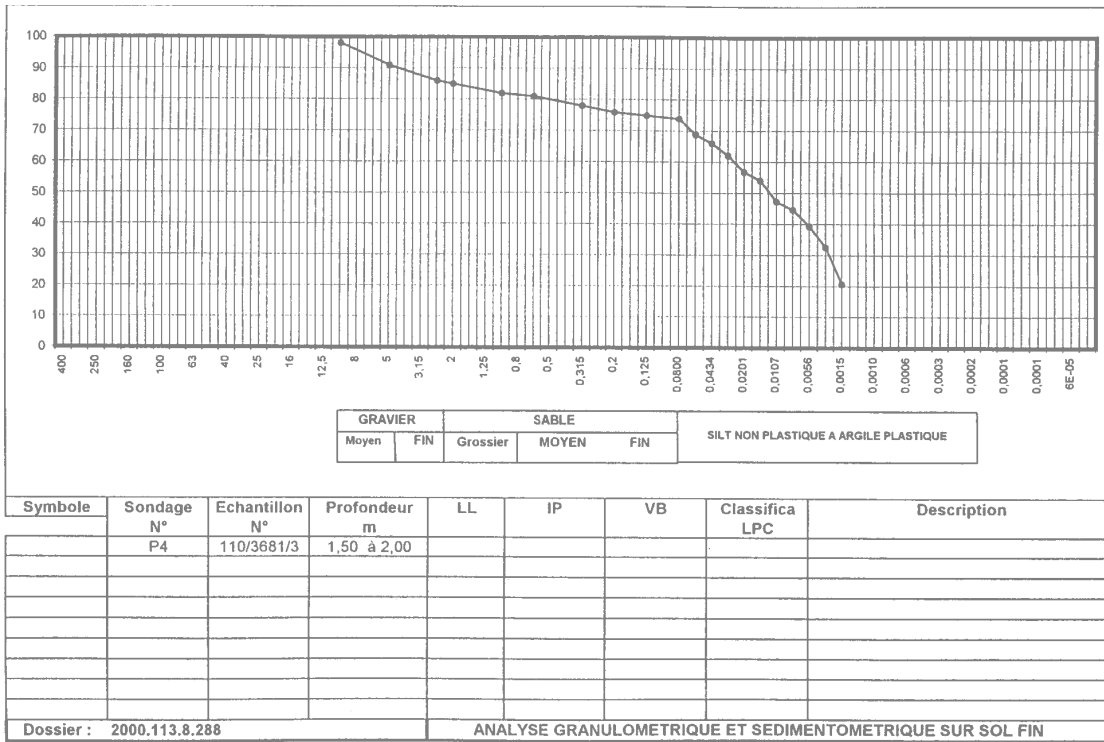
Grain Size Analysis Sample P1



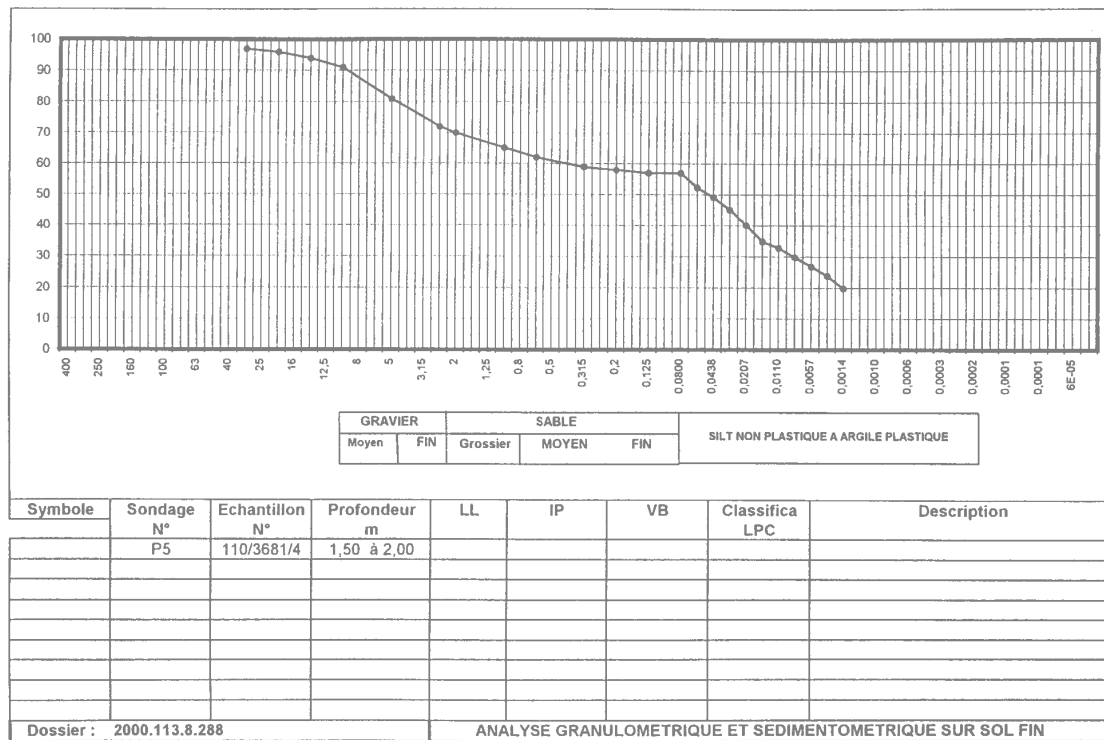
Sample P2



Sample P4

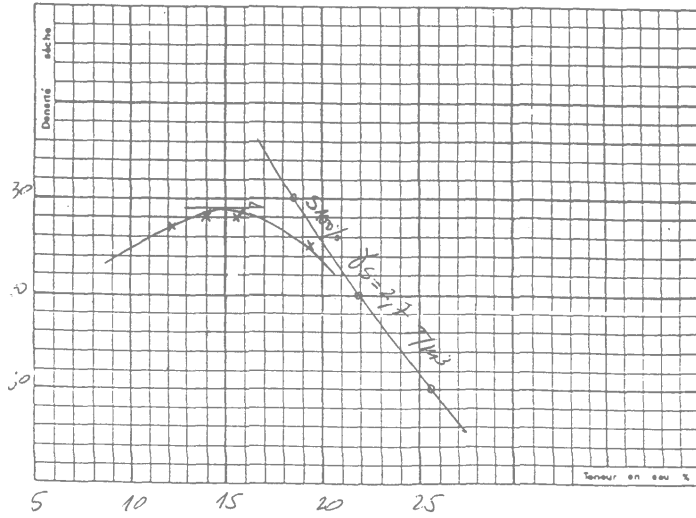


Sample P5



Proctor Compaction Test Sample P1

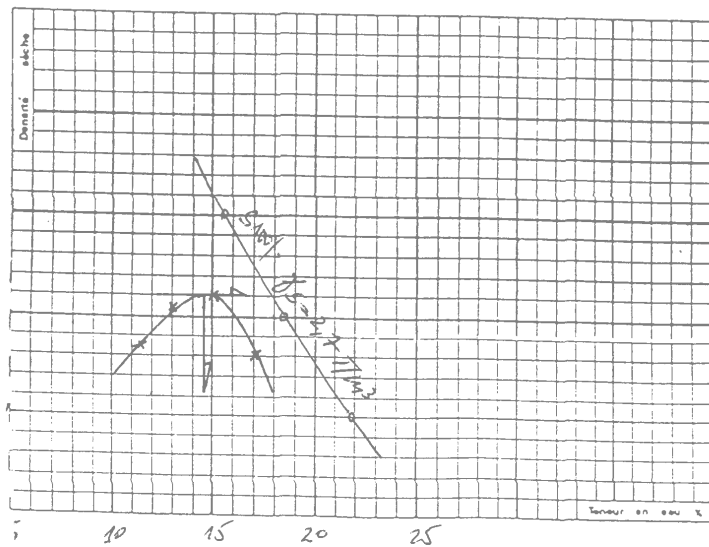
Dossier n° : 02113.6288
 Chantier : Brg. Ben Slimane N'FIKHA
 Référence échantillon : 11013681/1 P1 (2.50 / 13.00)



- Densité maximale : 1.79 T/m³
- Teneur en eau optimales : 15 %

Sample P2

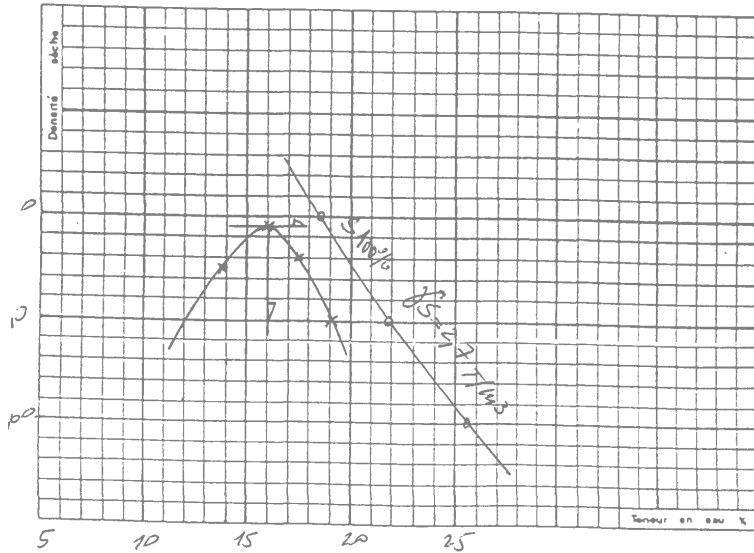
Dossier n° : 02113.6288
 Chantier : Brg. Ben Slimane N'FIKHA
 Référence échantillon : 11013681/2 P2 (2.00 / 14.50)



- Densité maximale : 1.82 T/m³
- Teneur en eau optimales : 14.5 %

Sample P4

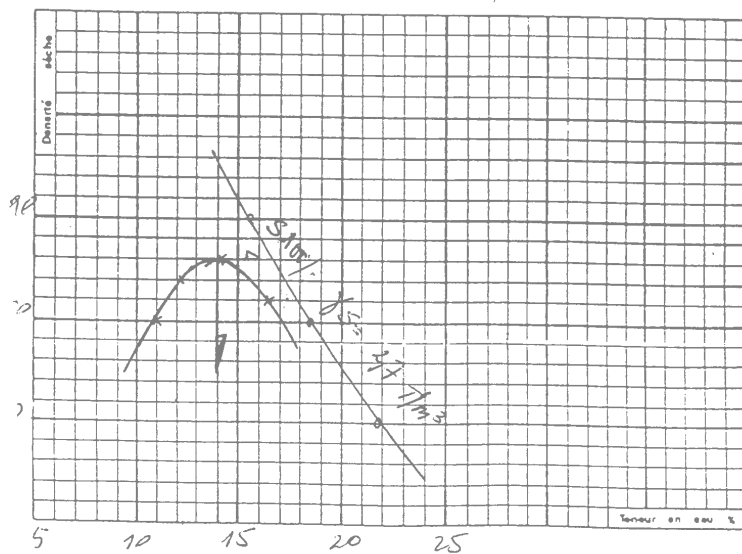
Dossier n° : 001133.283
 Chantier : Bivage Ben Suman NIFIKH
 Référence échantillon : 1103681/3 D4 (1.50/2.00)



- Densité maximale : 1.79 T/m³
- Teneur en eau optimales : 16 %

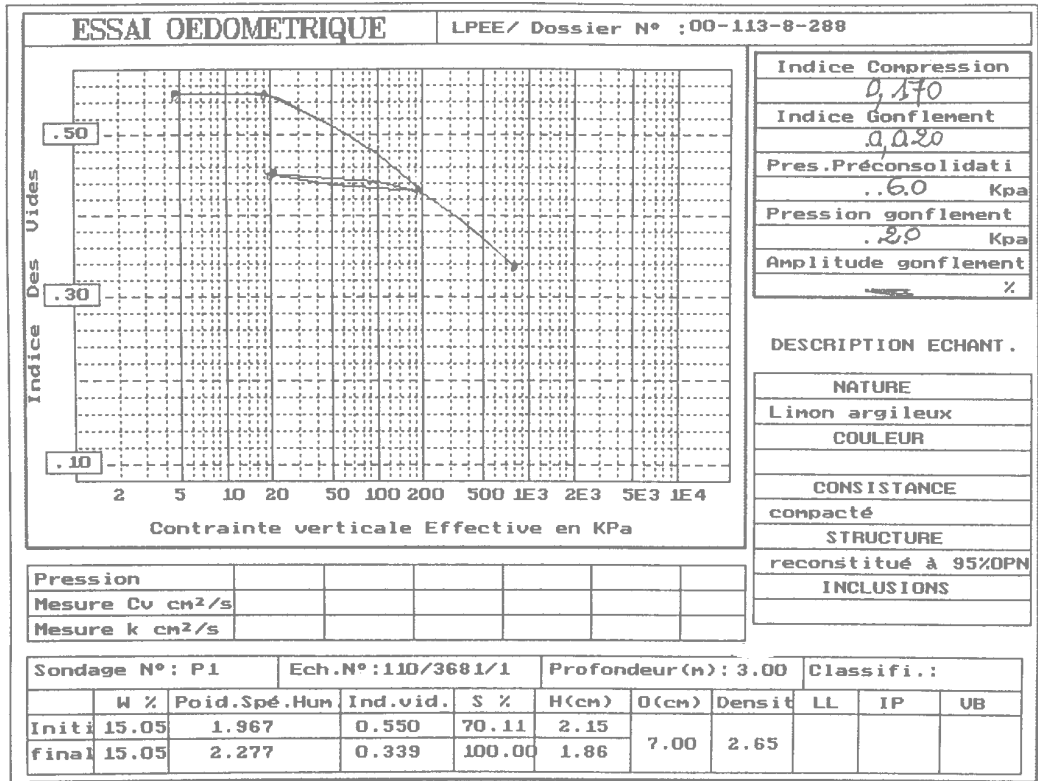
Sample P5

Dossier n° : 001133.0133
 Chantier : Bivage Ben Suman NIFIKH
 Référence échantillon : 1103681/4 D5 (1.50/2.00)

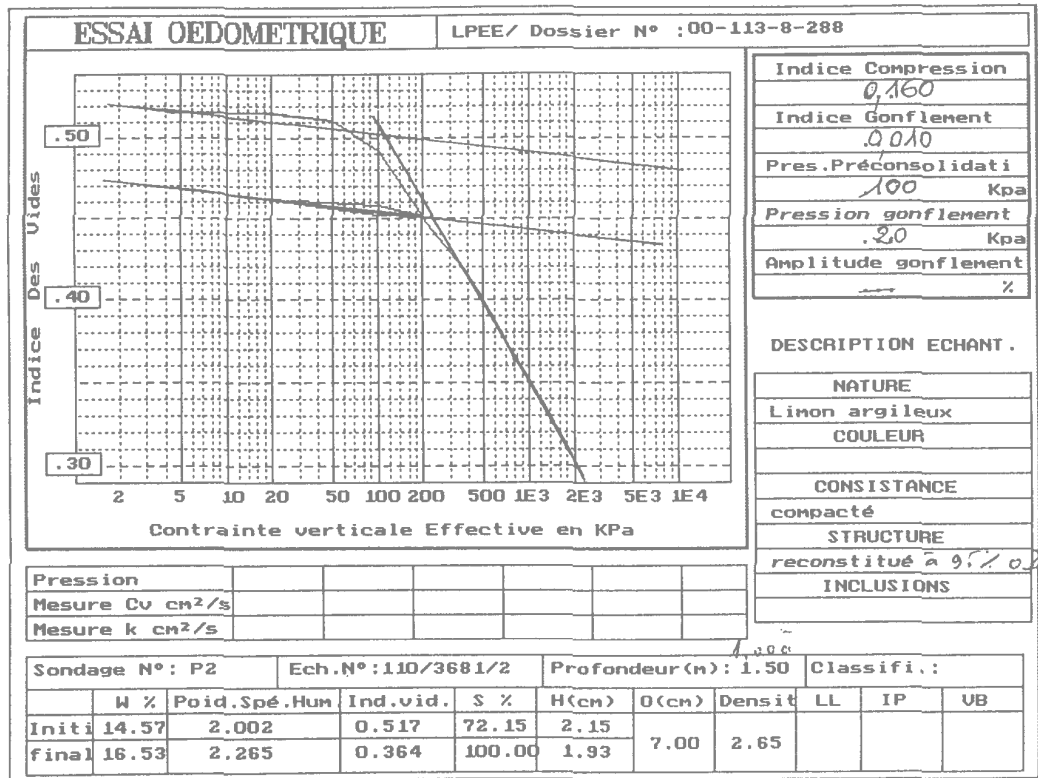


- Densité maximale : 1.86 T/m³
- Teneur en eau optimales : 14 %

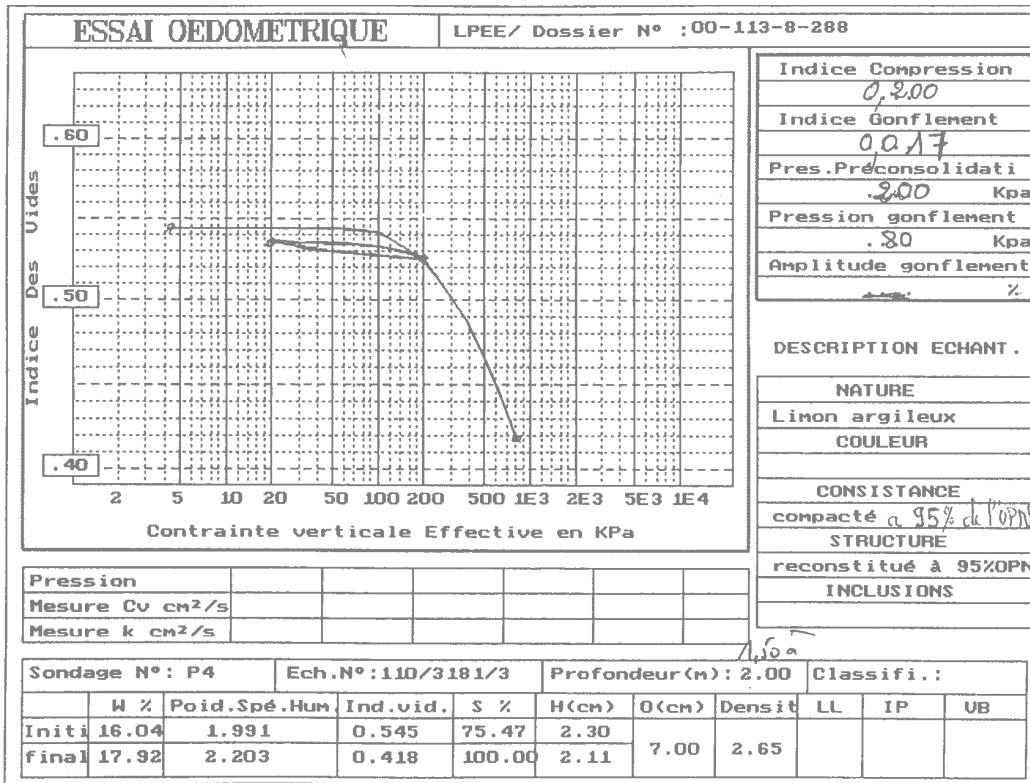
Consolidation Test Sample P1



Sample P2



Sample P4

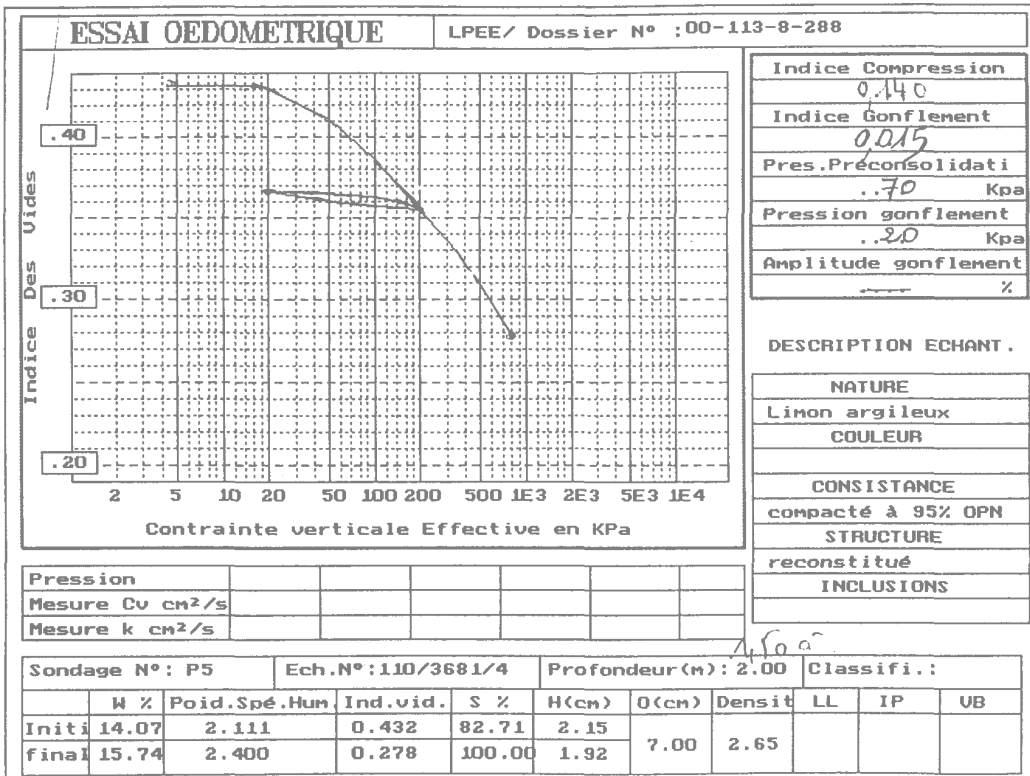


Indice Compression	0.200
Indice Gonflement	0.017
Pres.Préconsolidati	2.00 Kpa
Pression gonflement	.80 Kpa
Amplitude gonflement	%

DESCRIPTION ECHANT.

NATURE
Limons argileux
COULEUR
CONSISTANCE
compacté à 95% de l'OPN
STRUCTURE
reconstitué à 95%OPN
INCLUSIONS

Sample P5

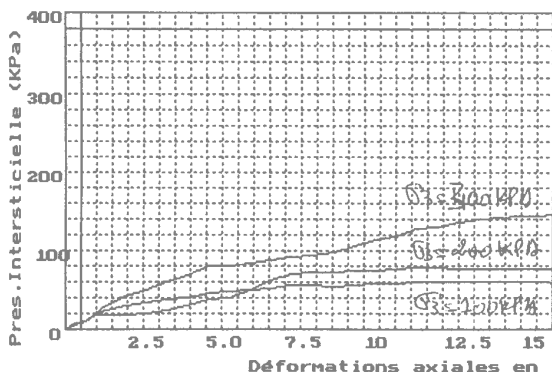
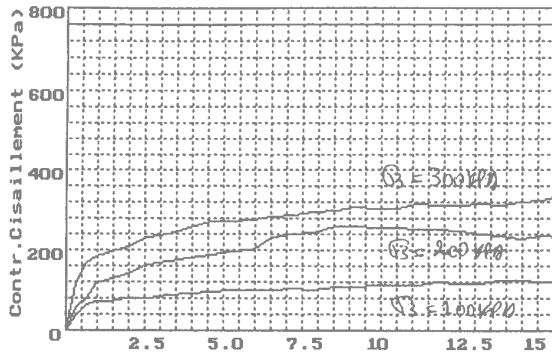


Indice Compression	0.140
Indice Gonflement	0.015
Pres.Préconsolidati	.70 Kpa
Pression gonflement	.20 Kpa
Amplitude gonflement	%

DESCRIPTION ECHANT.

NATURE
Limons argileux
COULEUR
CONSISTANCE
compacté à 95% OPN
STRUCTURE
reconstitué
INCLUSIONS

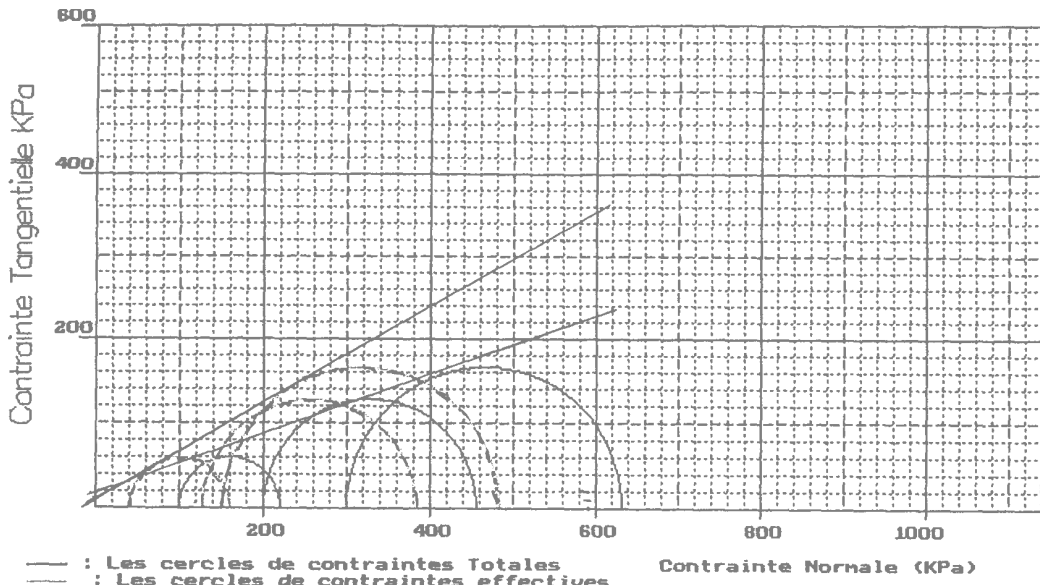
Triaxial Compression Test Sample P1



M.O. MSL4 -Essai: TCU+U-
 Dossier n°: 00-113-8-288
 Client : JICA
 Chantier : BARRAGE BEN SLIMANE NFIFIKH
 réf. échant: 110/3681/1 P4 2,50/3.00
 Date. écras: 13 / 11 / 2008
 Mode. ruptu: En Tonneau

Eprou.	N°	1	2	3
Contr. Normale (KPa)		100	200	400
Initial	w %	15.34	14.75	15.21
	densit. Kg/m3	1701	1717	1703
	Si %	70.5	69.6	70.1
Final	w %	20.41	18.49	17.78
	densit. Kg/m3	1721	1790	1805
	Sf %	96.9	98.2	96.8

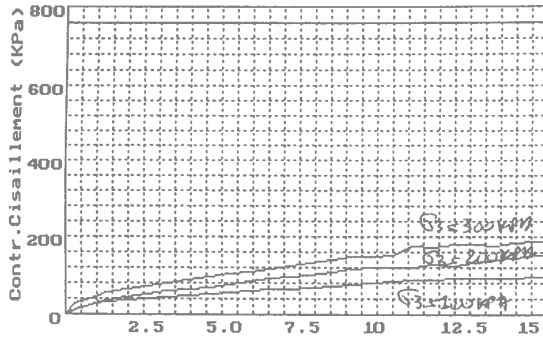
Observations :
 SOL RECONSTITUE à 95%
 de l'OPN



— : Les cercles de contraintes Totales
 - - - : Les cercles de contraintes effectives

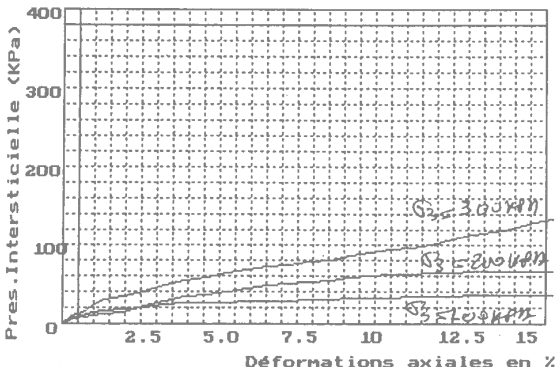
Mode opératoire MSL 4	ESSAI TCU+U
Dossier n° : 00-113-8-288	Cohésion Ccu == 20 kPa
Client : JICA	Ang. frott Ocu == 19°
chantier : BARRAGE BEN SLIMANE NFIFIKH	Cohésion C' == 10 kPa
Ref. échant : 110/3681/1 P4 2,50/3.00m	Ang. frott O' == 30°

Sample P2

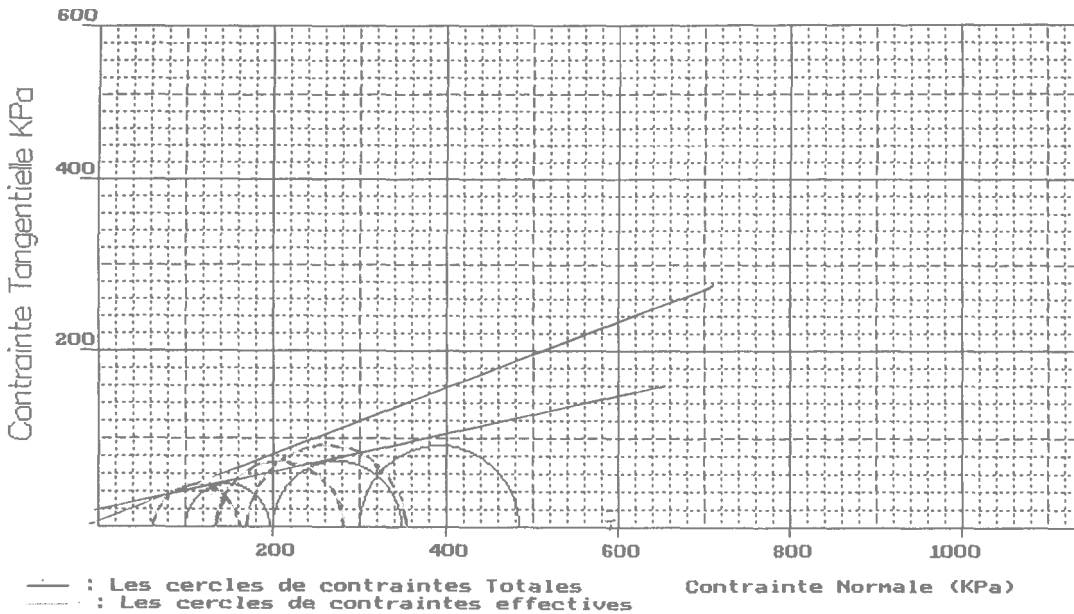


M.O. MSL4 -Essai: TCU+U-
 Dossier n°: 00-113-8-288
 Client : JICA
 Chantier : BARRAGE BEN SLIMANE (NFIFIKH)
 réf.échant: 110/3681/2 P2 1.00/1.50
 Date.écras: 14/11/2008
 Mode.ruptu: En Tonneau

Eprou.	N°	1	2	3
Contr. Normale (kPa)		100	200	300
Initial	w %	14.35	14.40	14.32
	densit. Kg/m ³	1734	1735	1737
	Si %	69.5	69.9	69.7
Final	w %	20.40	20.00	18.91
	densit. Kg/m ³	1738	1746	1755
	Sf %	99.5	98.8	94.8

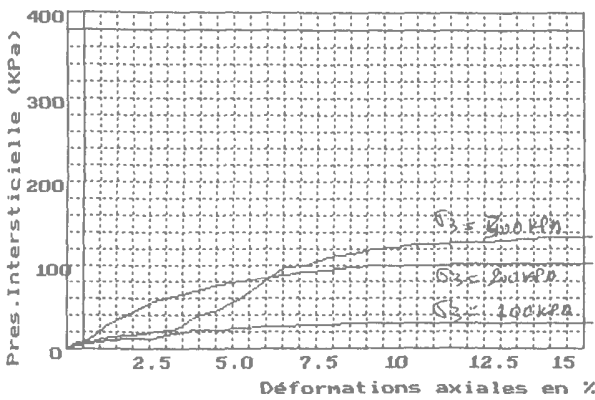
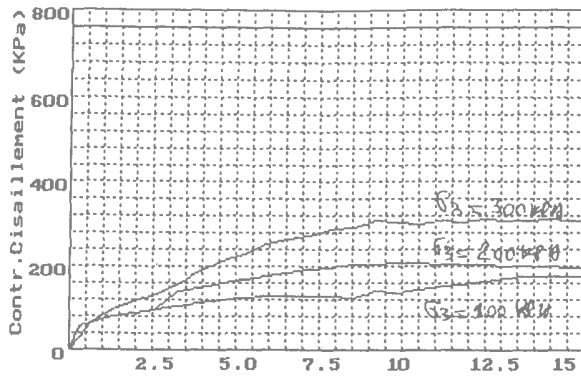


Observations :
 SOL RECONSTITUE a 95%
 de l'OPN



Mode opératoire MSL 4	ESSAI TCU+U
Dossier n° : 00-113-8-288	Cohésion C _{cu} = 20 kPa
Client : JICA	Ang.frott O _{cu} = 13°
chantier : BARRAGE BEN SLIMANE NFIFIKH	Cohésion C' = 10 kPa
Ref.échant : 110/3681/2 P2 1.00/1.50m	Ang.frott O' = 22°

Sample P4

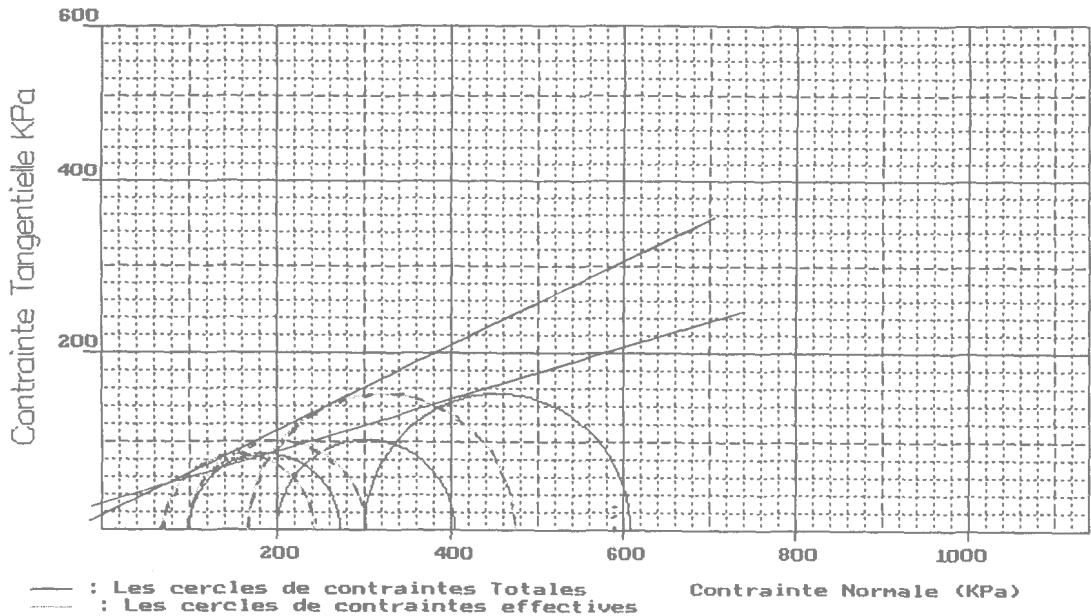


M.O. MSL4 -Essai: TCU+U-

Dossier n°: 00-113-8-288
 Client : JICA
 Chantier : BARRAGE BEN SLIMANE NFIFIKH
 réf.échant: 110/3681/3 P4 (1.50/2.00 m)
 Date.écras: 16 / 11 / 2000
 Mode.ruptu: En Tonneau

Eprou.	N°	1	2	3
Contr.Normale (KPa)		100	200	300
Initial	w %	15.86	15.71	15.66
	densit. Kg/m3	1708	1712	1713
	si %	73.7	73.5	73.4
Final	w %	18.69	18.98	18.78
	densit. Kg/m3	1750	1760	1762
	Sf %	93.0	95.9	95.2

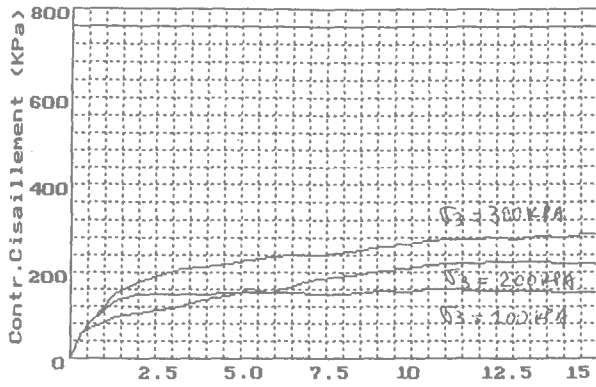
Observations :
 SOL RECONSTITUE à 95%
 de l'OPN



— : Les cercles de contraintes Totales
 - - - : Les cercles de contraintes effectives

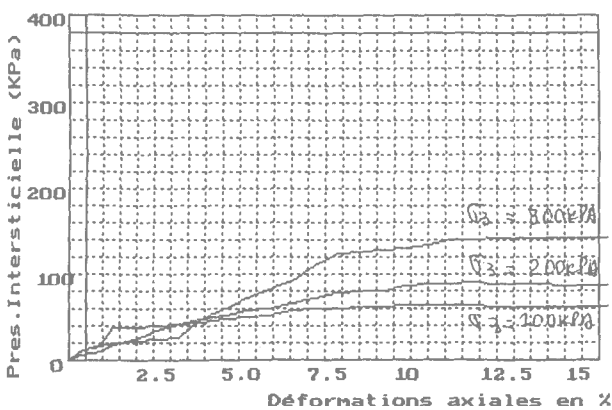
Mode opératoire MSL 4	ESSAI TCU+U
Dossier n° : 00-113-8-288	Cohésion Ccu = 30 KPa
Client : JICA	Ang.frott Ocu = 16°
chantier : BARRAGE BEN SLIMANE NFIFIKH	Cohésion C' = 15 KPa
Ref.échant : 110/3681/3 P4 1.50/2.00 m	Ang.frott O' = 2.5°

Sample P5

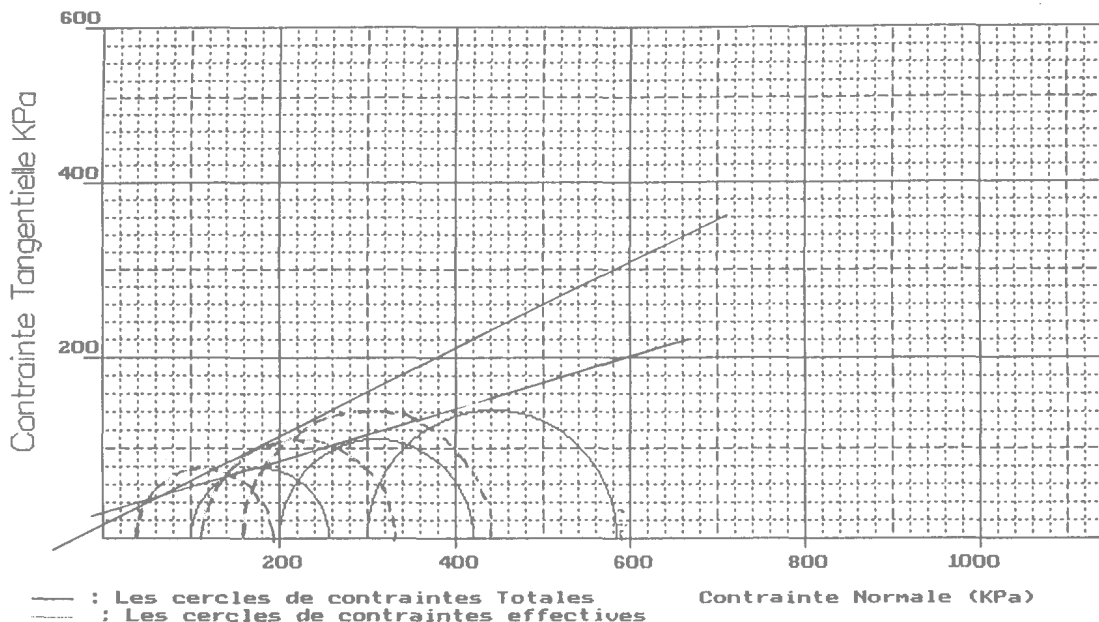


M.O. MSL4 -Essai: TCU+U-
 Dossier n°: 00-113-8-288
 Client : JICA
 Chantier : BARRAGE BEN SLIMANE NFJ
 réf.échant: 110/3681/4 P5 (1.50/2.00)
 Date.écras: 15 / 11 / 1999
 Mode.ruptu: En Tonneau

Eprou.	N°	1	2	3
Contr.Normale (KPa)		100	200	400
Initial	w %	14.49	14.26	14.59
	densit. Kg/m3	1769	1773	1769
	Si %	74.3	73.6	74.9
Final	w %	19.20	18.97	17.00
	densit. Kg/m3	1755	1766	1824
	Sf %	96.3	96.8	95.6



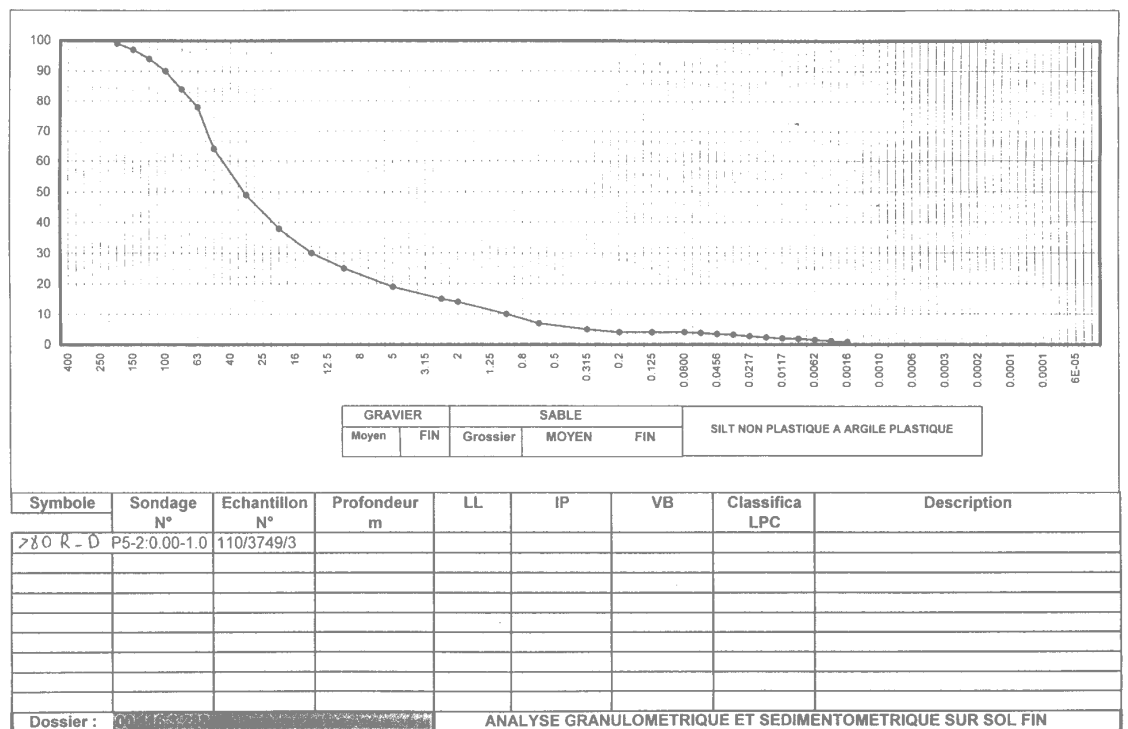
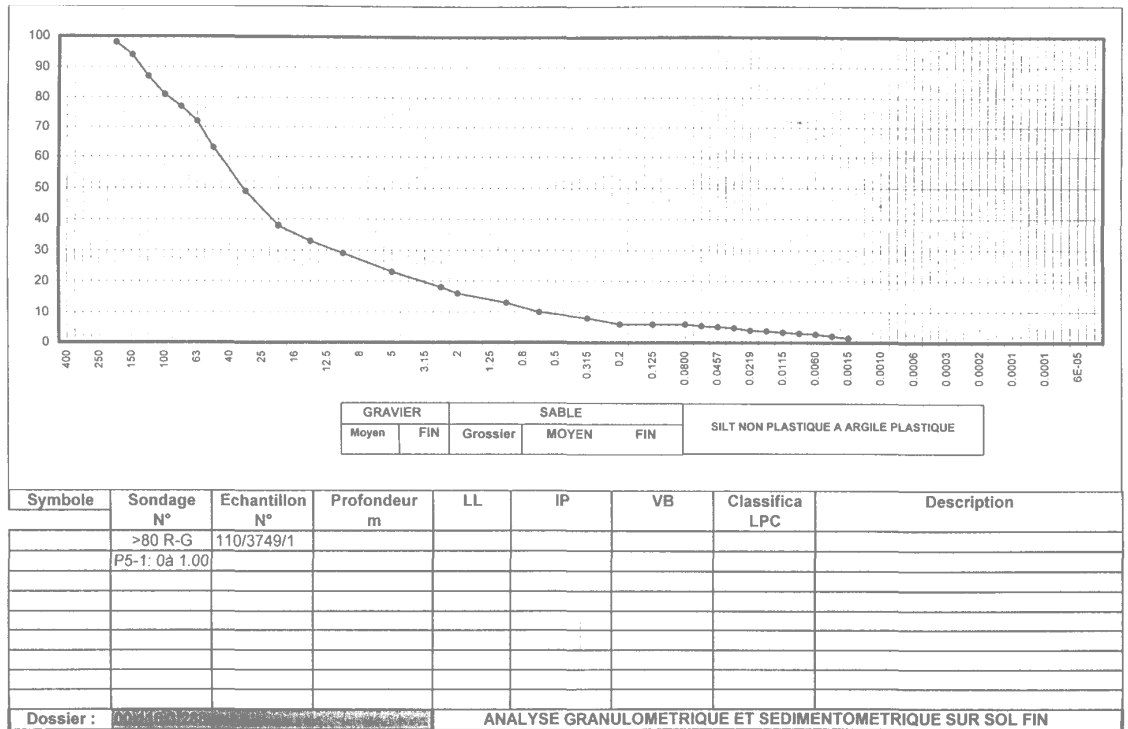
Observations :
 SOL RECONSTITUE



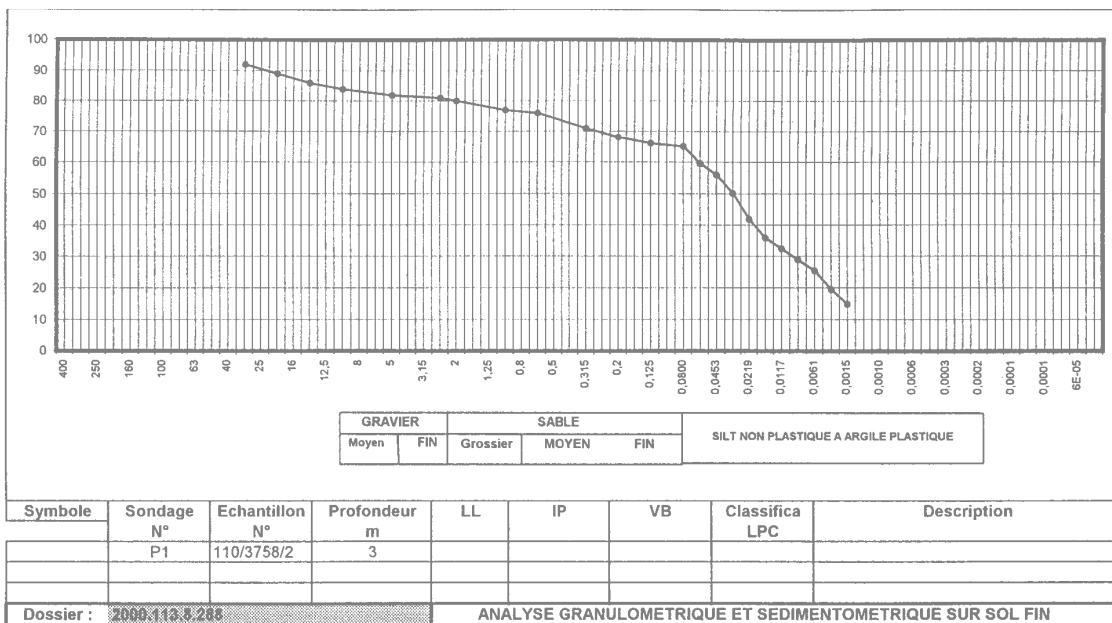
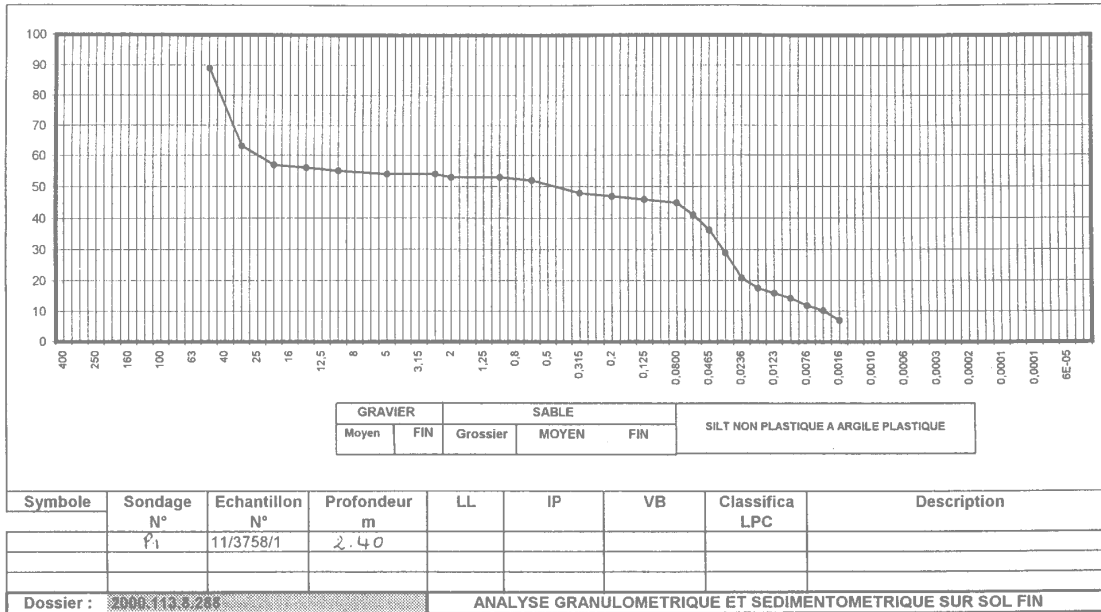
Mode opératoire MSL 4	ESSAI TCU+U
Dossier n° : 00-113-8-288	Cohésion Ccu = 30 KPa
Client : JICA	Ang.frott Ocu = 16°
chantier : BARRAGE BEN SLIMANE NFIFIKH	Cohésion C' = 15 KPa
Ref.échant : 110/3681/4 P5 1.50/2.00 m	Ang.frott O' = 26°

17 Azghar Dam

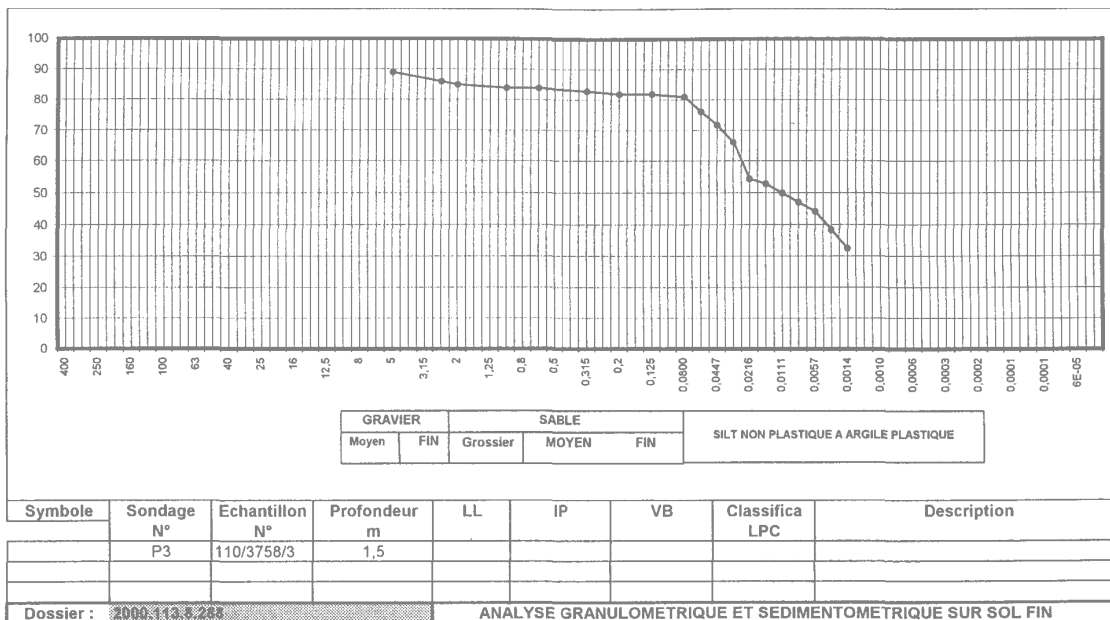
Grain Size Analysis Sample P5-1



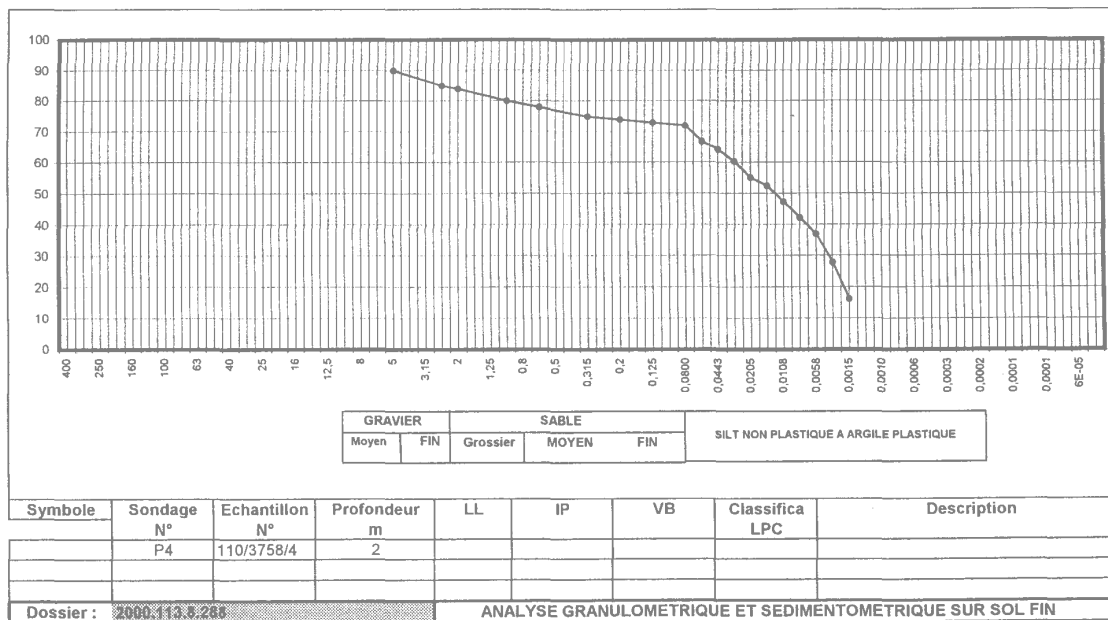
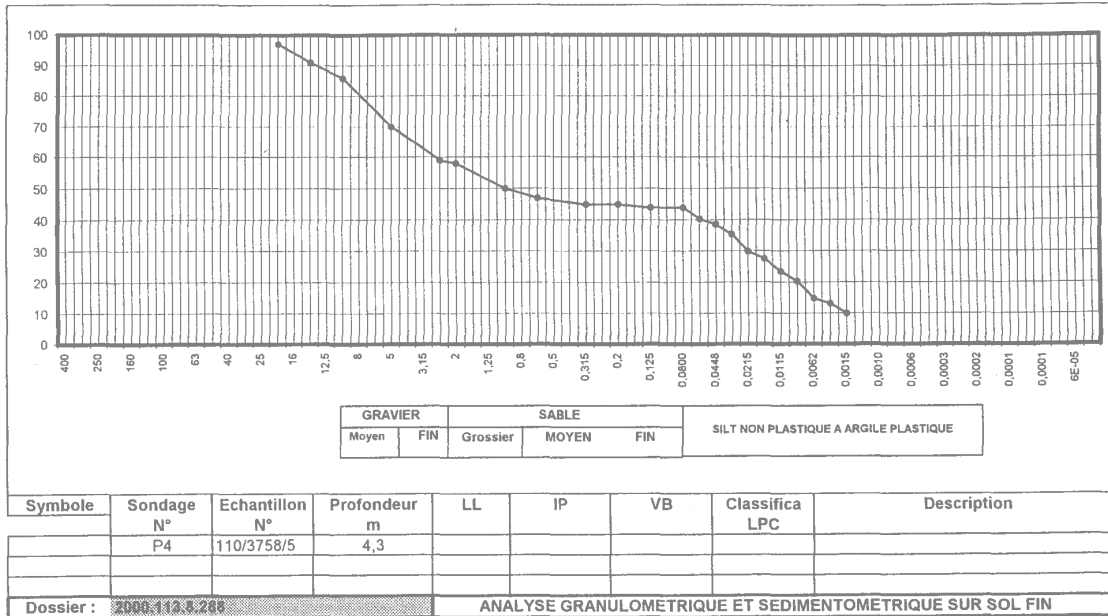
Sample P1



Sample P3

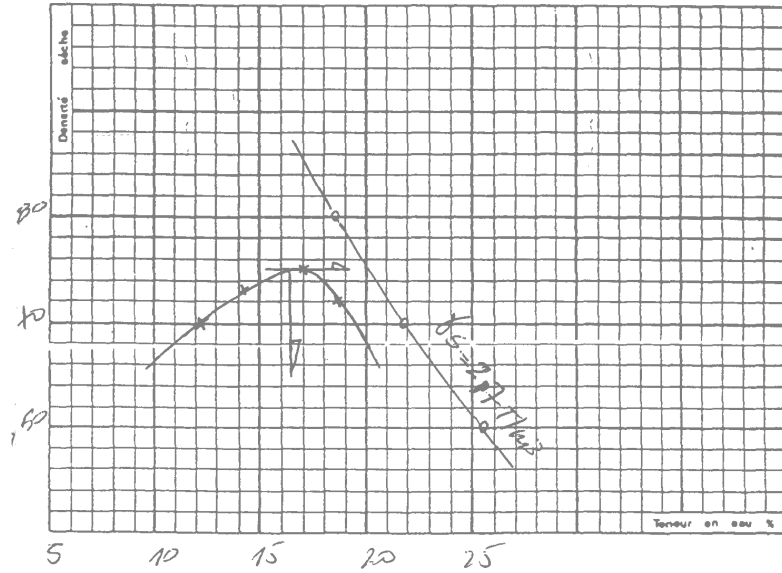


Sample P4



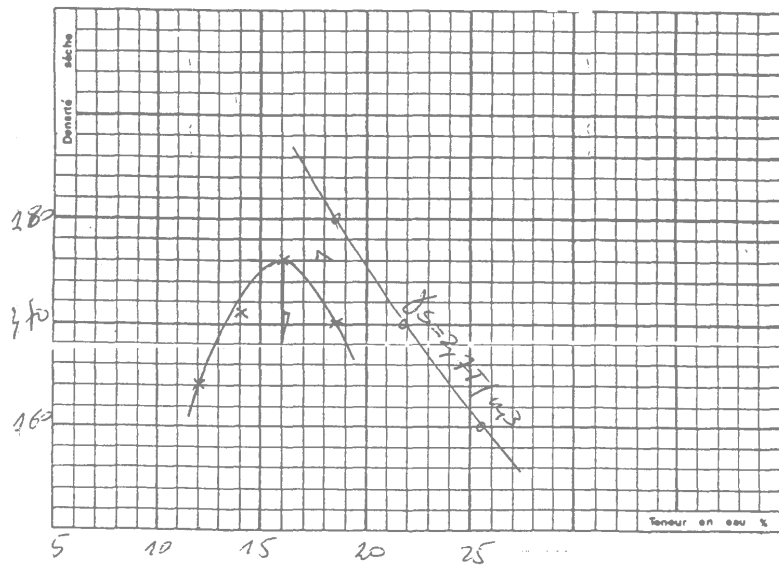
Proctor Compaction Test
Sample P1

Dossier n° : 001138288
 Chantier : Bauge Azofuar
 Référence échantillon : 110/3750/12 P1 (3,00)



- Densité maximale : 1.75 T/m³
- Teneur en eau optimales : 16.4 %

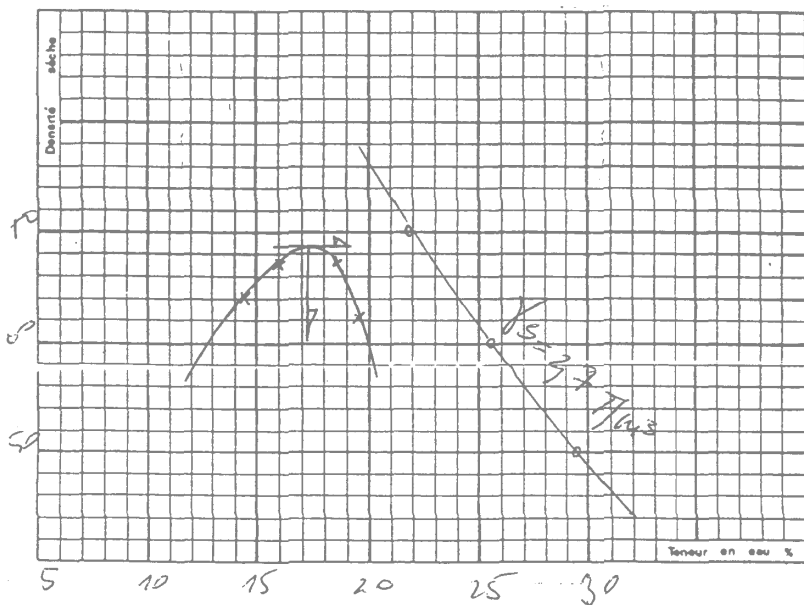
Dossier n° : 001138288
 Chantier : Bauge Azofuar
 Référence échantillon : 110/3750/12 P1 (3,40)



- Densité maximale : 1.76 T/m³
- Teneur en eau optimales : 16 %

Sample P3

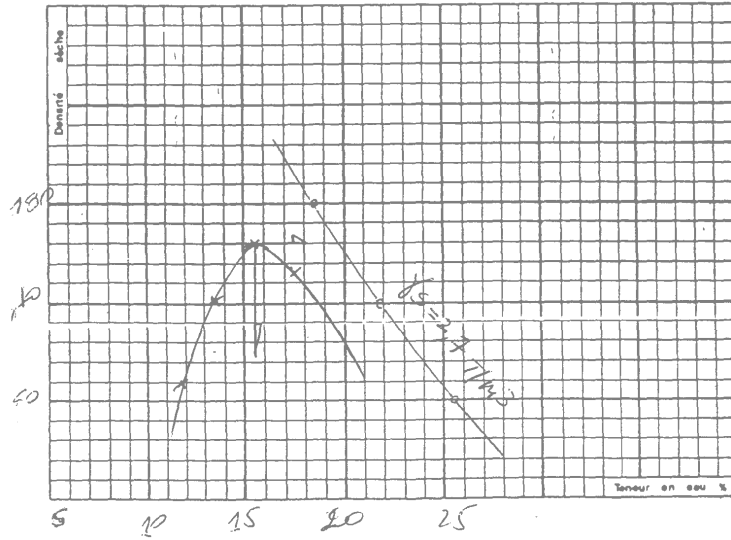
Dossier n° : 00 P3 B 288
 Chantier : Buisson / 30 char
 Référence échantillon : M3 / 158 / 3 / P3 (1,50)



- Densité maximale : 1.69 T/m³
- Teneur en eau optimales : 17.2 %

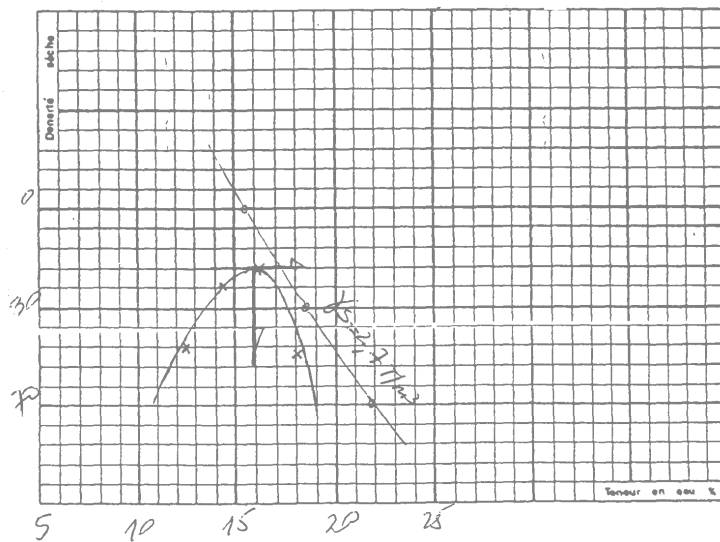
Sample P4

Dossier n° : OP 1159 280
 Chantier : B. J. A. 29/haur Ribot
 Référence échantillon : 110/5150/4 P4 (2,00)



- Densité maximale : 116 T/m³
- Teneur en eau optimales : 15,7 %

Dossier n° : OP 1138 282
 Chantier : B. J. A. 29/haur
 Référence échantillon : 110/5150/5 P4 (4,30)



- Densité maximale : 184 T/m³
- Teneur en eau optimales : 16 %