TWENTIETH-CENTURY EARTHEN BUILDINGS OF SARDINIA: ARCHAEOMETRY AND CONSERVATION

VOL. II

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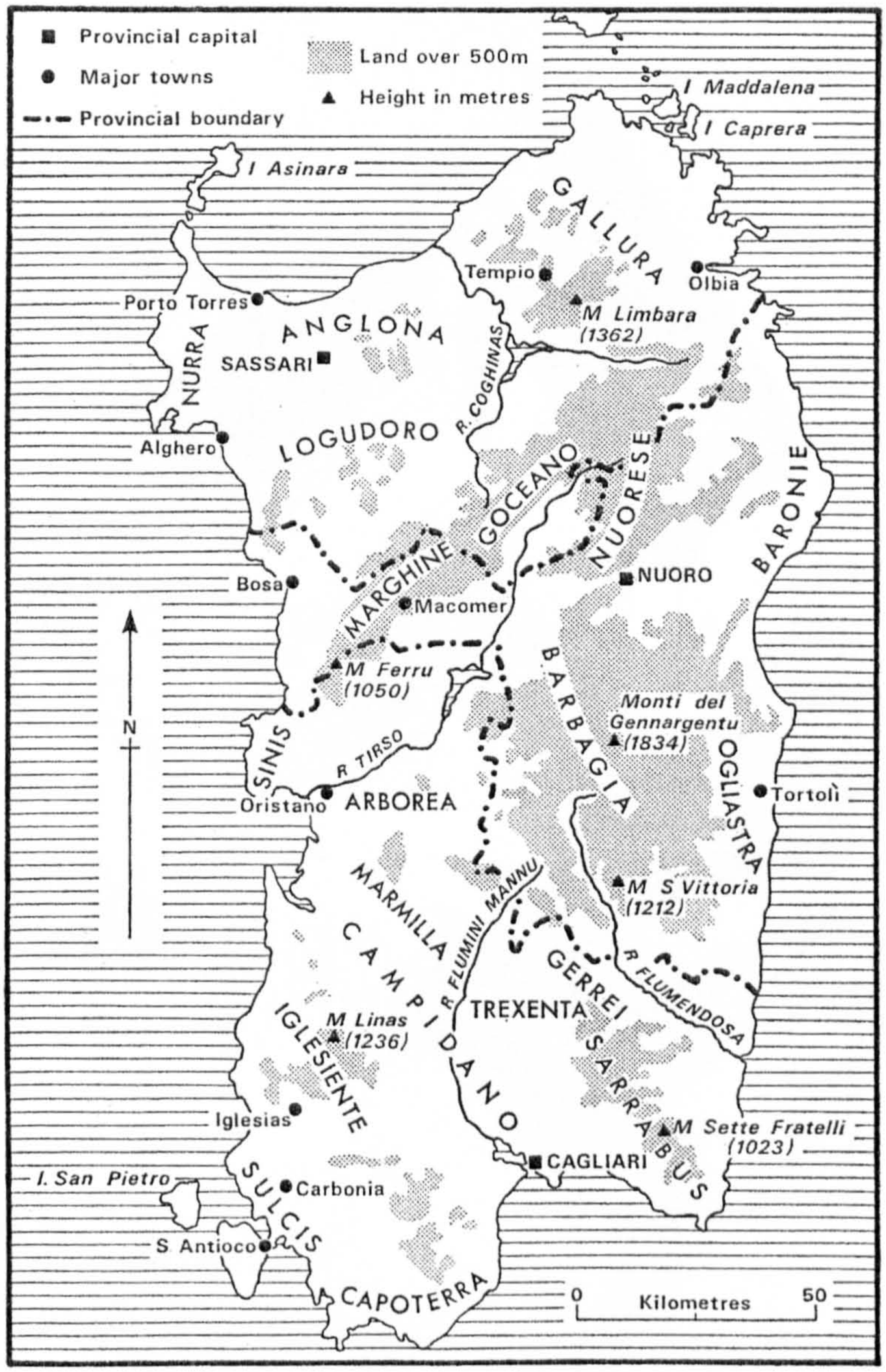
This thesis is submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy

The University of York
Department of Archaeology
Centre for Conservation

The King's Manor, September 2001

ILLUSTRATIONS
CHAPTER 1



SARDINIA: RELIEF, RIVERS, TOWNS, REGIONS

Fig. 1.1. Map of Sardinia showing Campidano, the area under examination, which stretches from Oristano to Cagliari (after King 1975, 14)

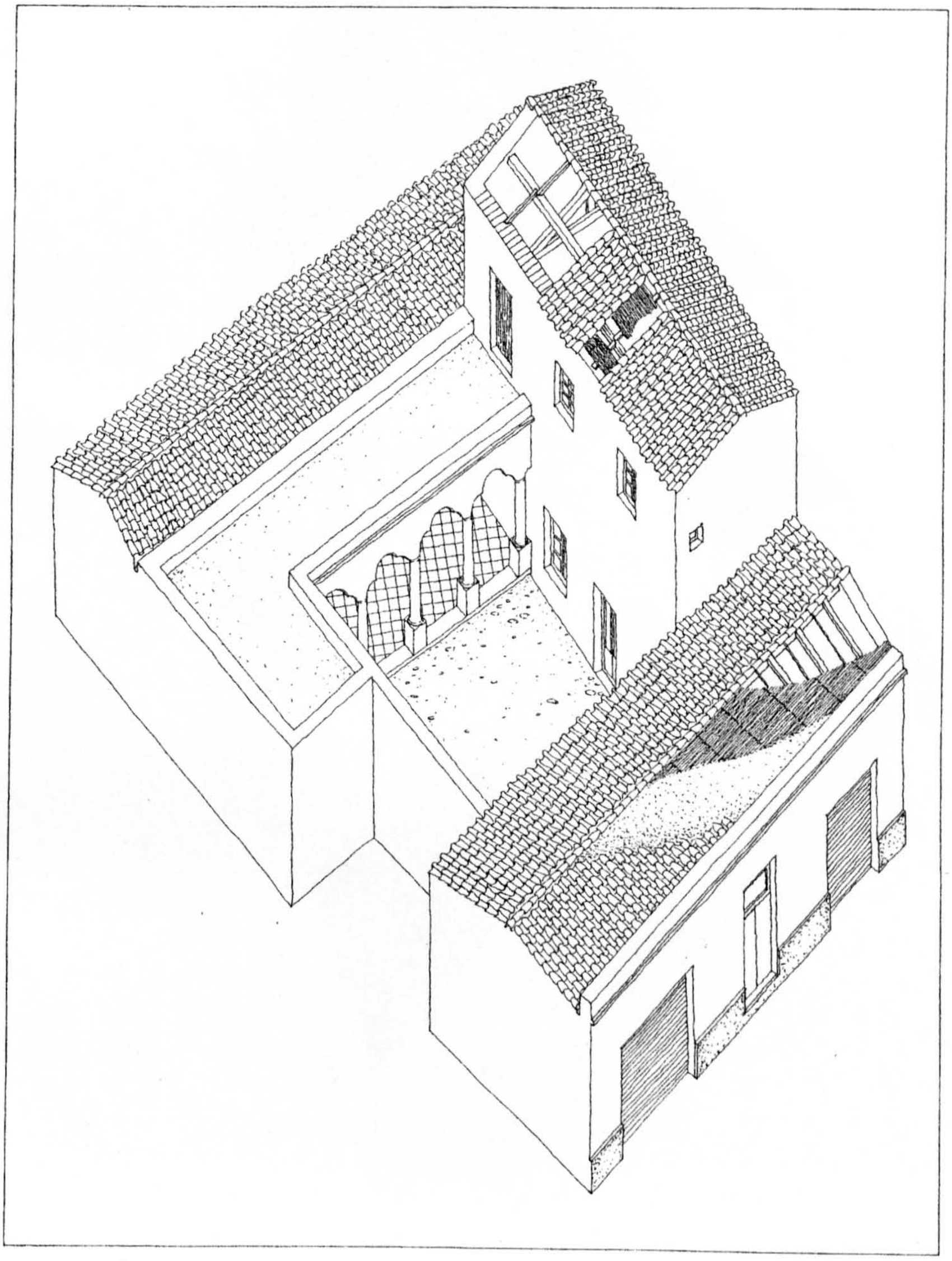


Fig. 1.2. Axonometric view of a *làdiri* farmhouse showing 1960's alterations. Quartucciu (Cagliari)

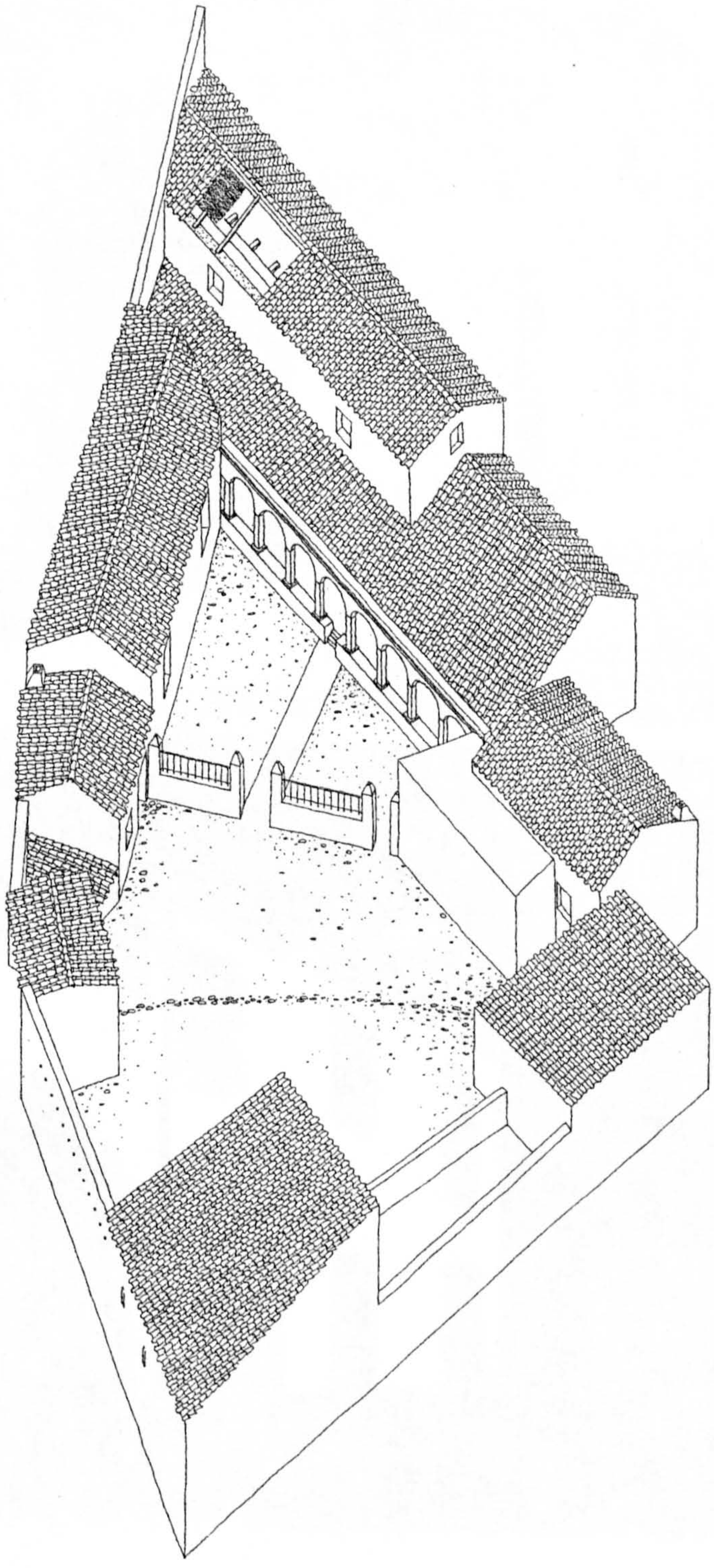
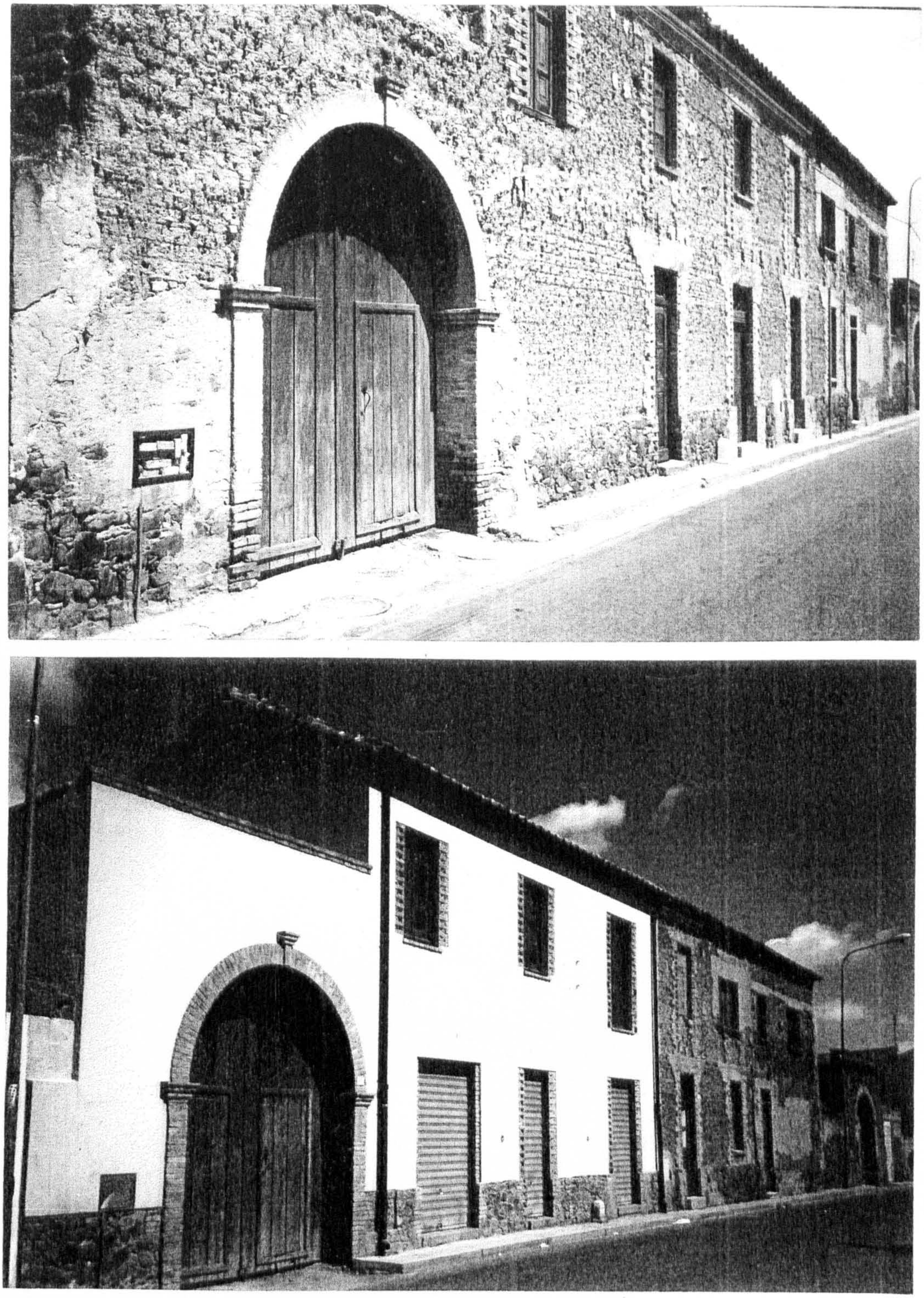
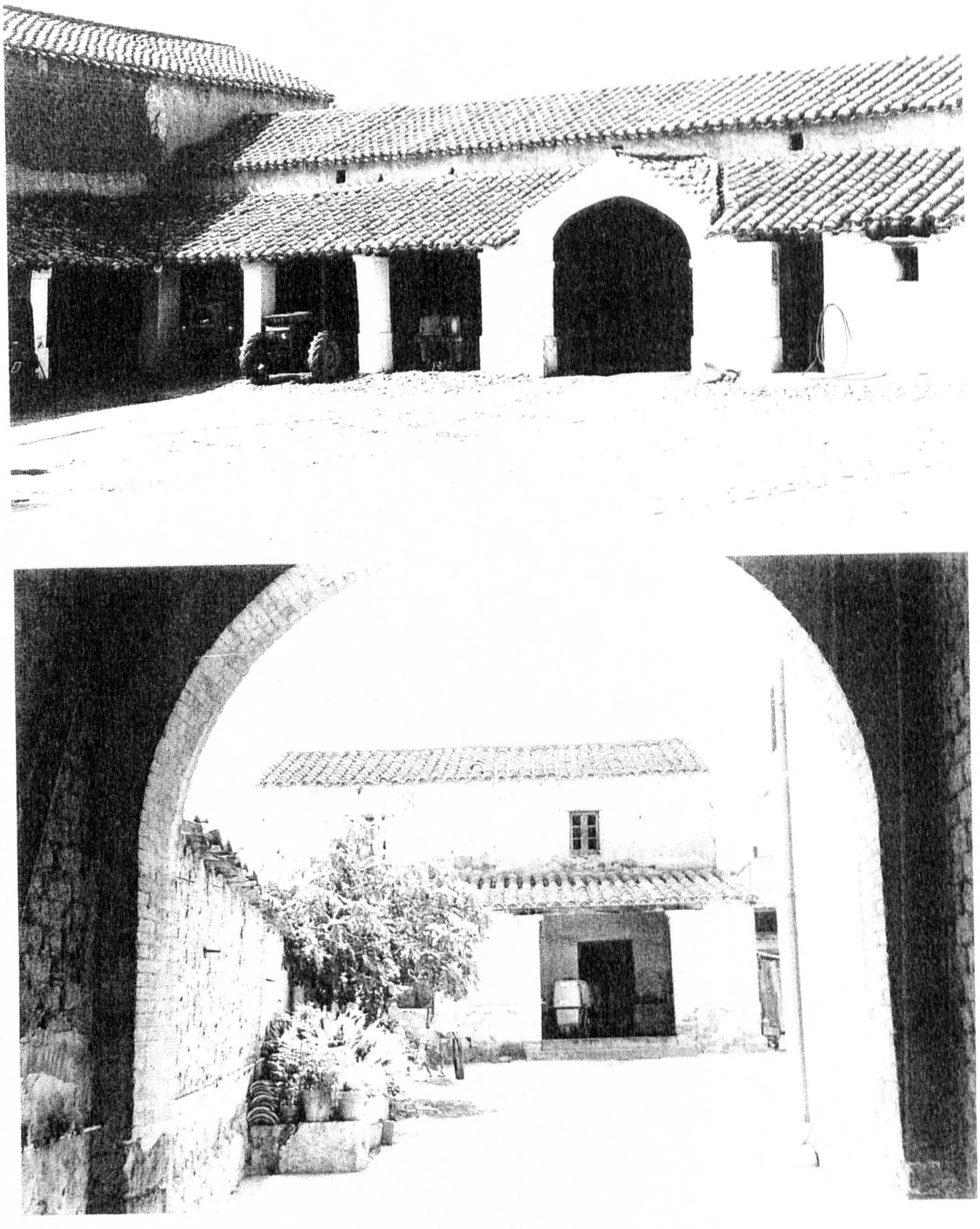


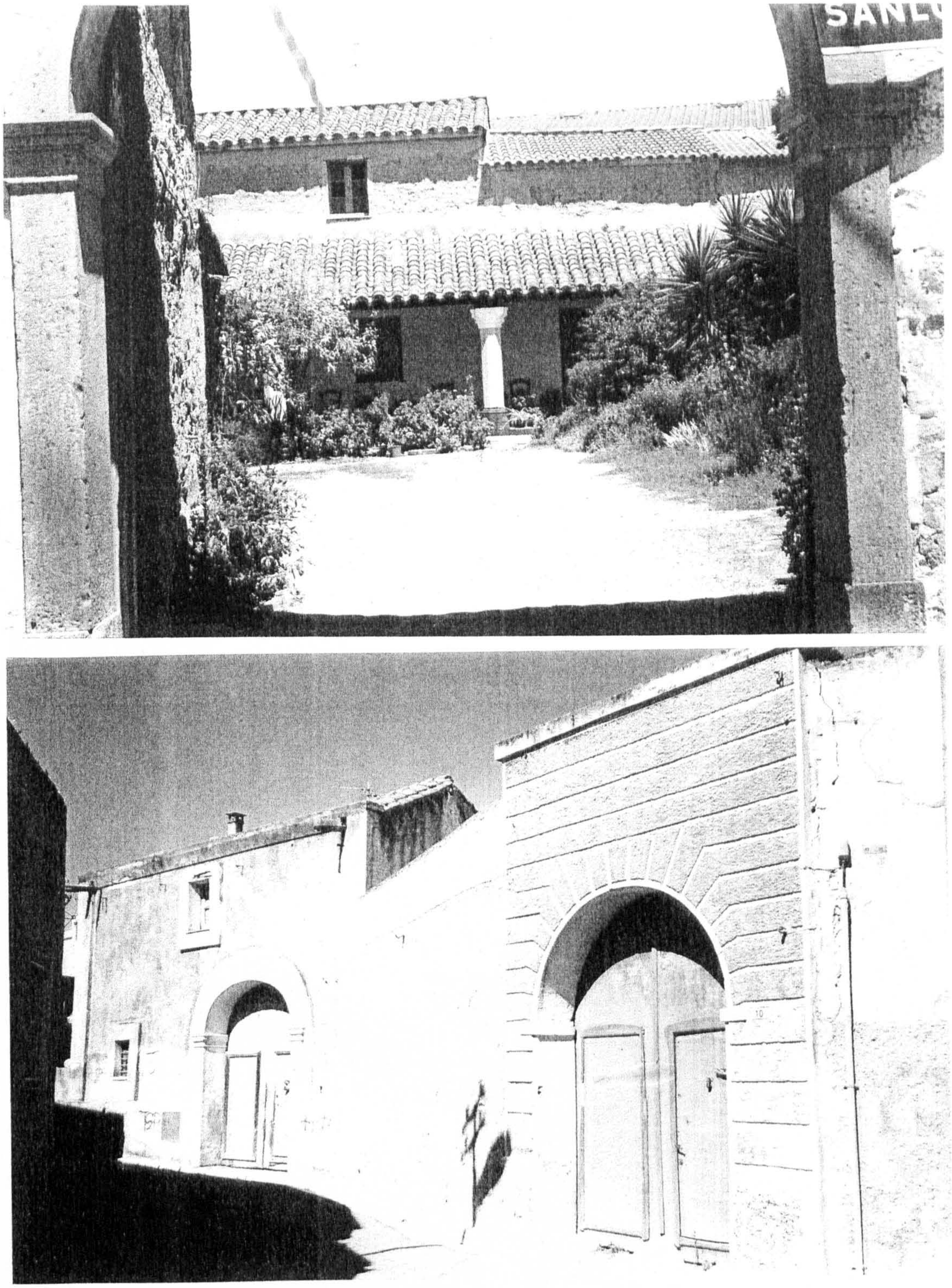
Fig. 1.3. Axonometric view of a *làdiri* farmhouse (Sinnai, Cagliari). The residential part of the complex is that characterised by the loggia, whilst the remaining cellules are functional buildings for storing farming equipment and goods



Figs. 1.4. and 1.5. Palazzo type building before and after conservation (Vallermosa, Cagliari)



Figs. 1.6 and 1.7. Courtyard farmhouses in Ussana and Samassi



Figs. 1.8 and 1.9. Courtyard farmhouses in Samassi and Monserrato

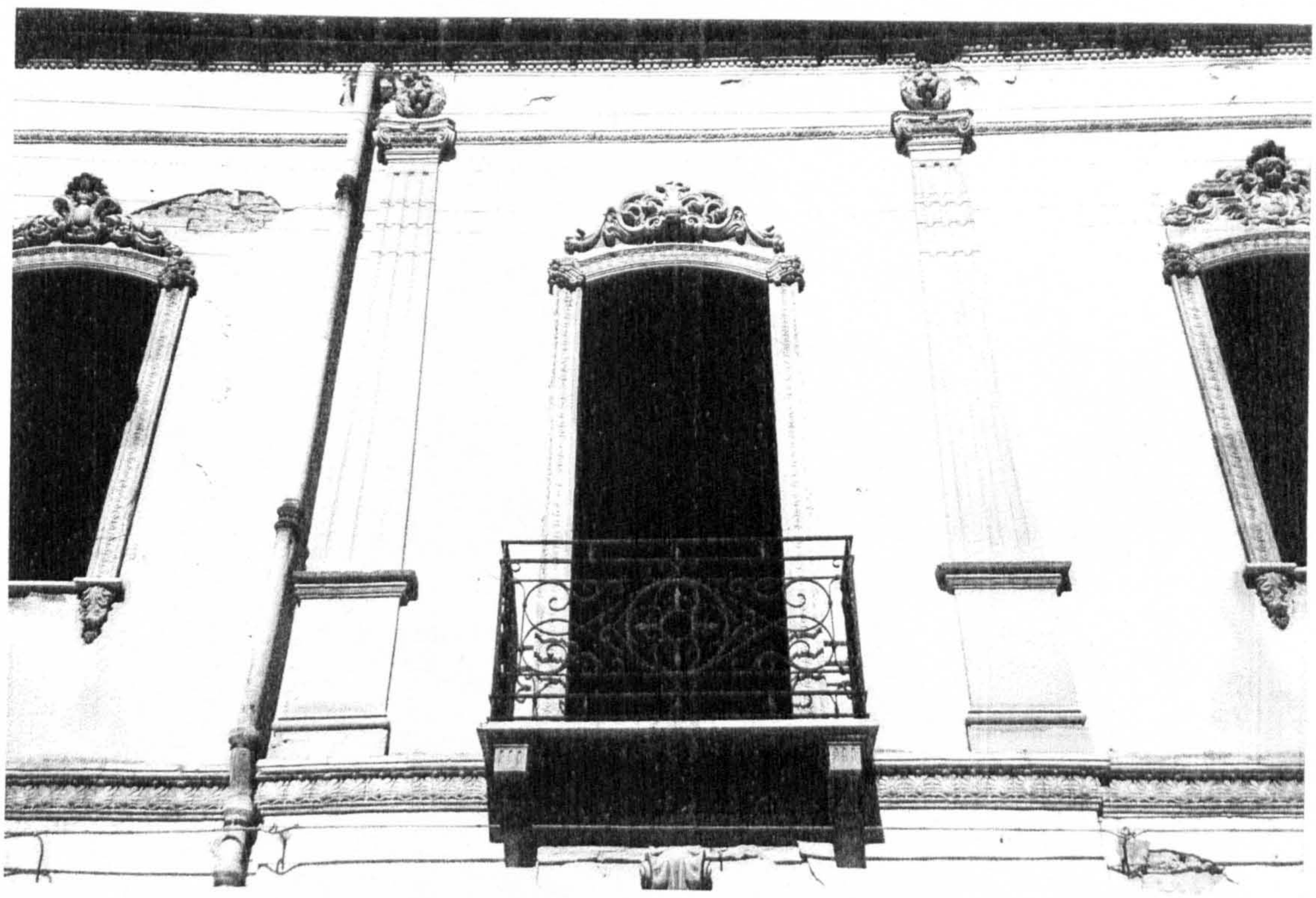
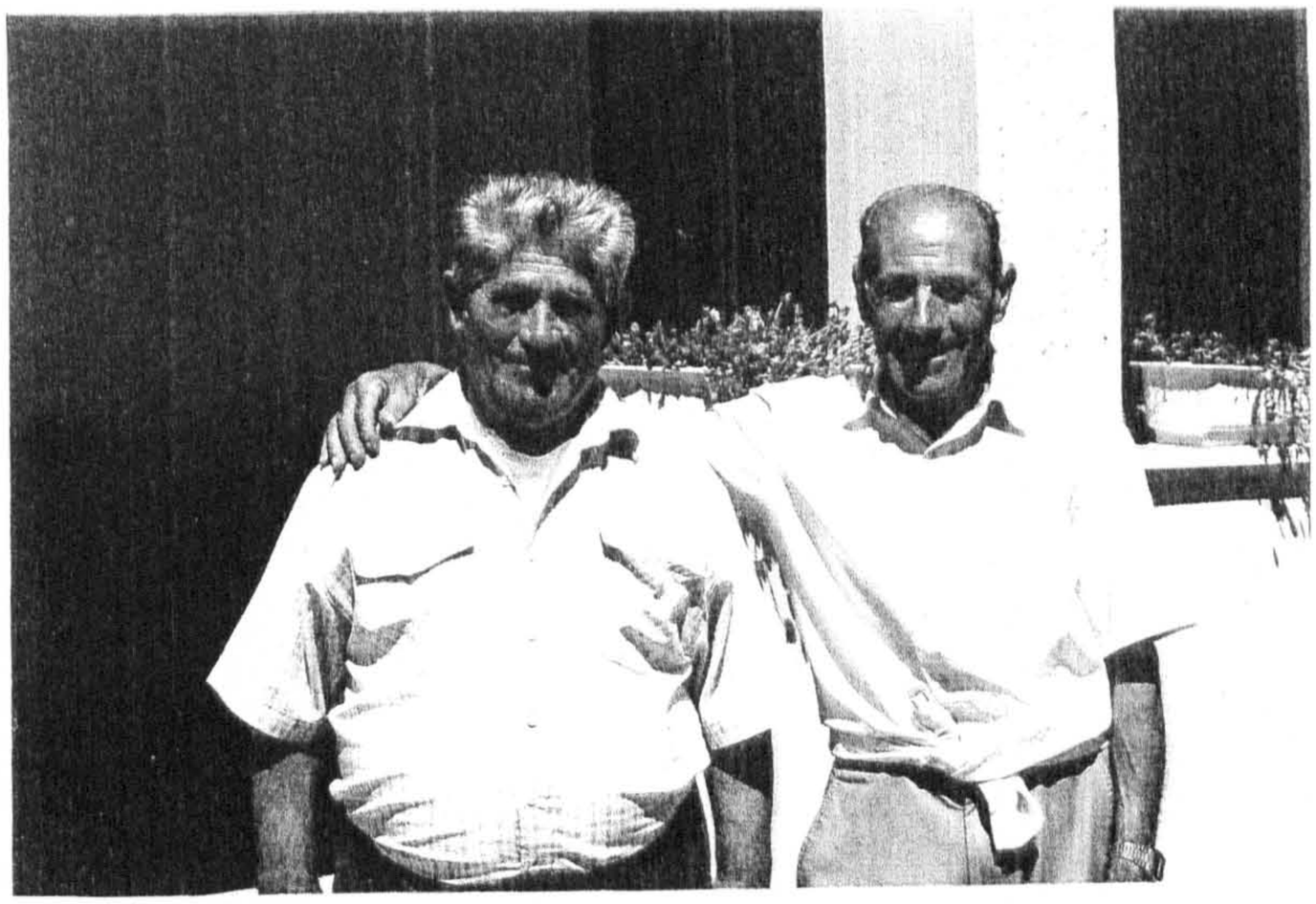
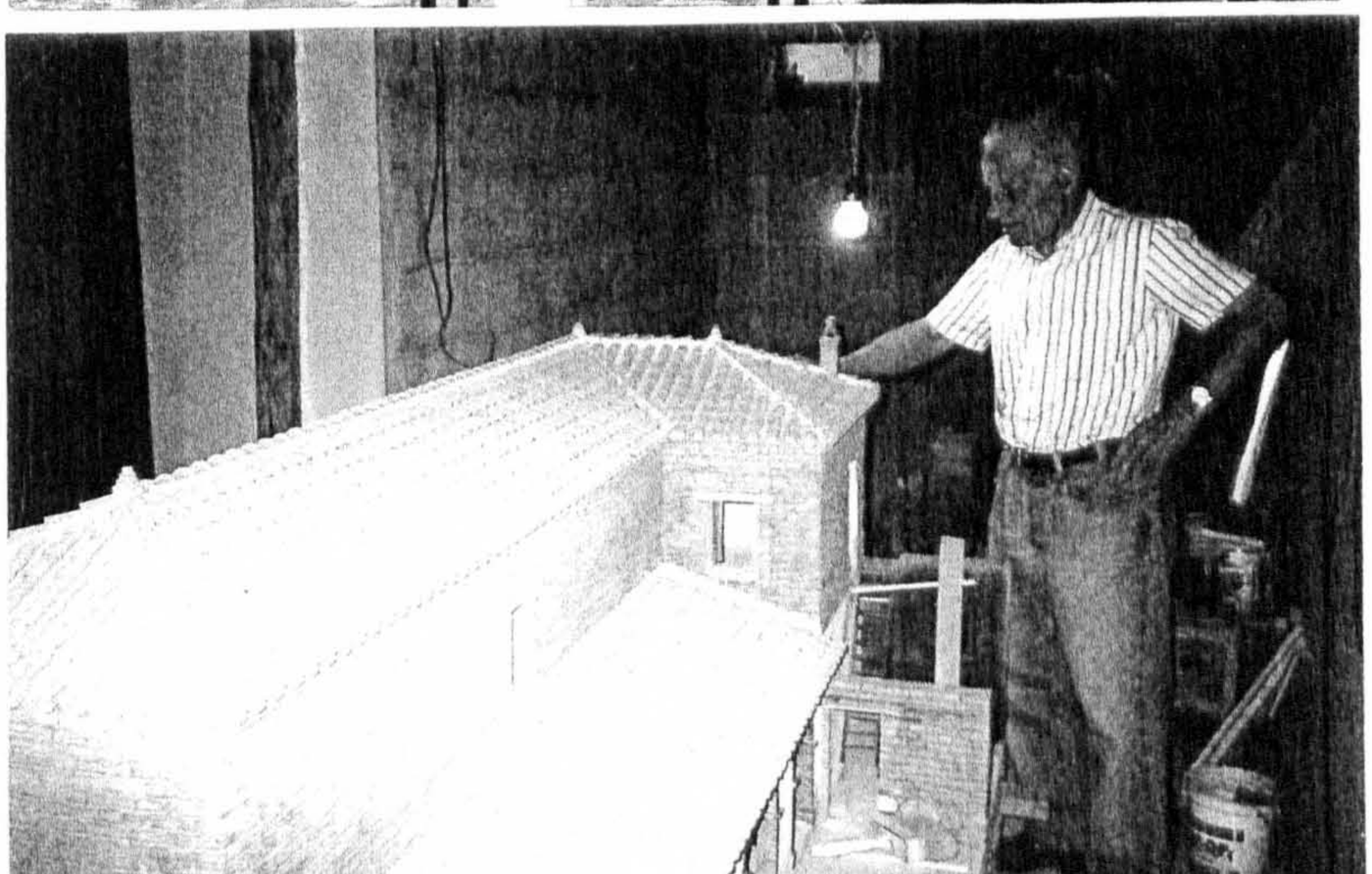
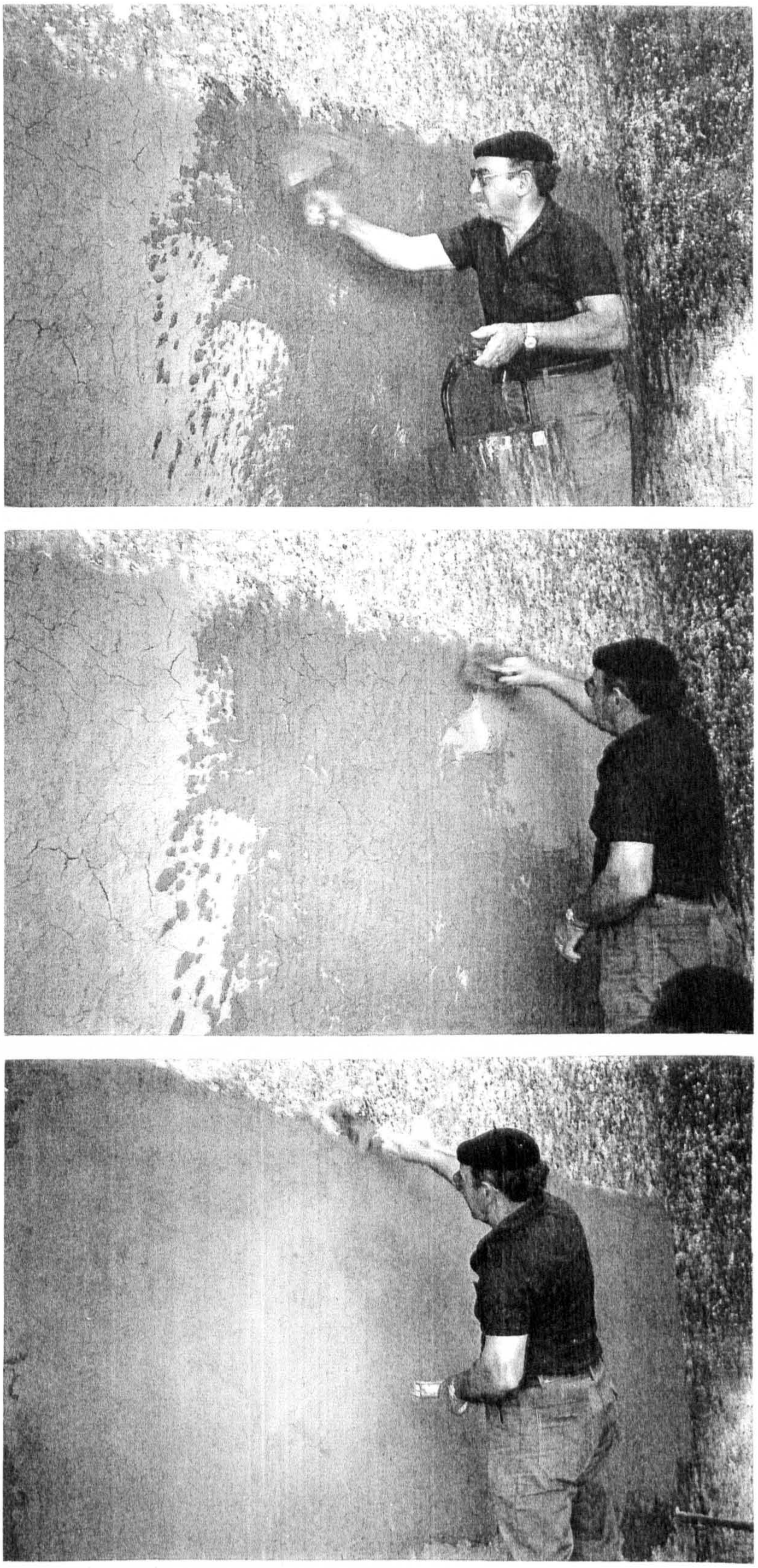


Fig. 1.10. Palazzo building showing terracotta decorations, mouldings, and wrought iron. Probably dating late 1800 (Via Crimea 138, Selargius, Cagliari)





Figs. 1.11, 1.12, and 1.13. Picture illustrating some of the Master Craftsmen interviewed by the author: Pierino Casula and Lino Pillosu (Nuraminis), Luigi Garau (Cabras), and Efisio Vacca (Samassi)



Figs 1.14, 1.15, and 1.16. Master Craftsman Dante Sotgia during a workshop on mud plasters held in Villamassargia (Cagliari)

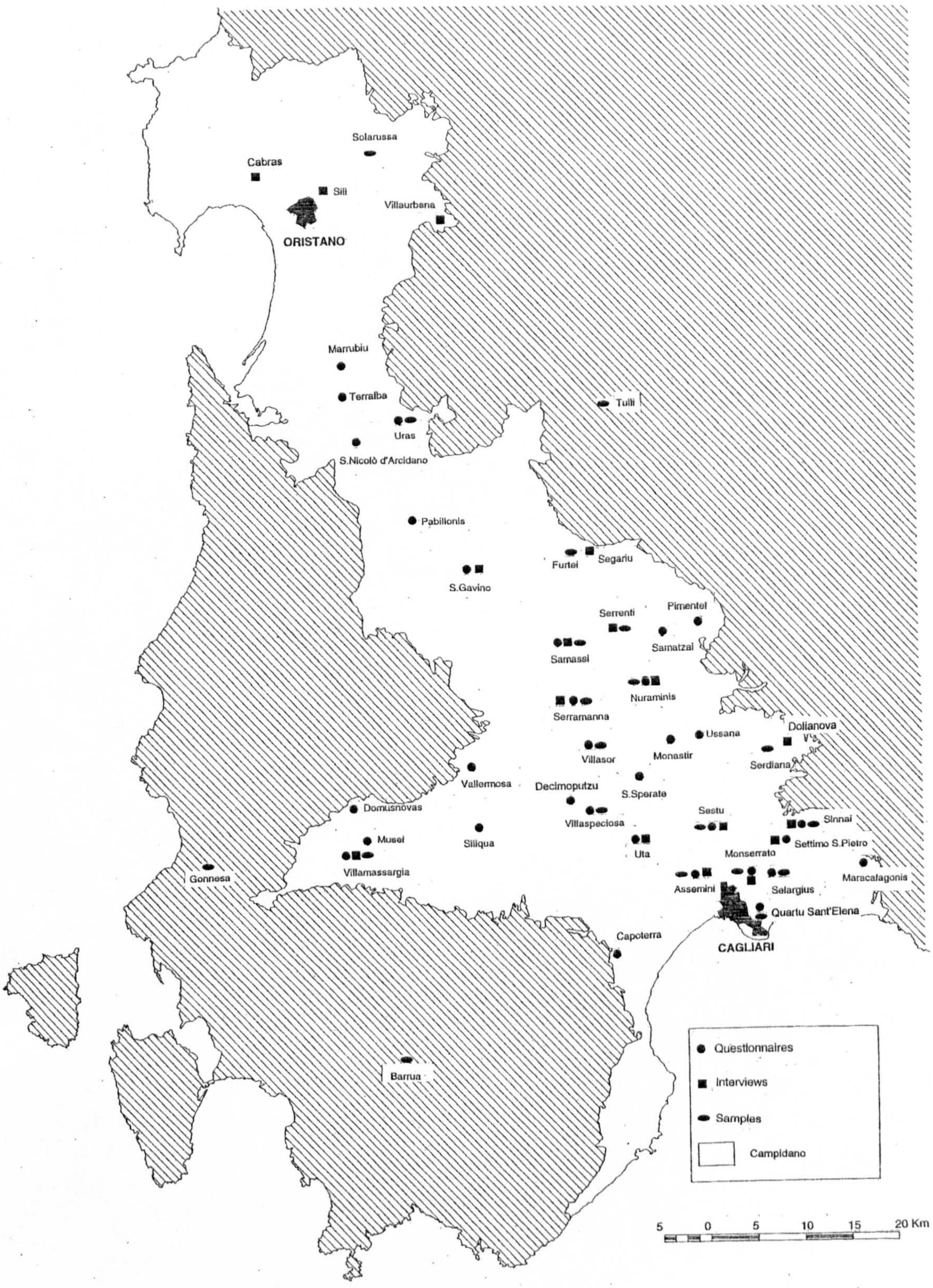


Fig. 1.17. Map of Campidano showing location of villages where the questionnaire was carried out, where the interviews with craftsmen were undertaken, and where samples were collected

ILLUSTRATIONS
CHAPTER 2

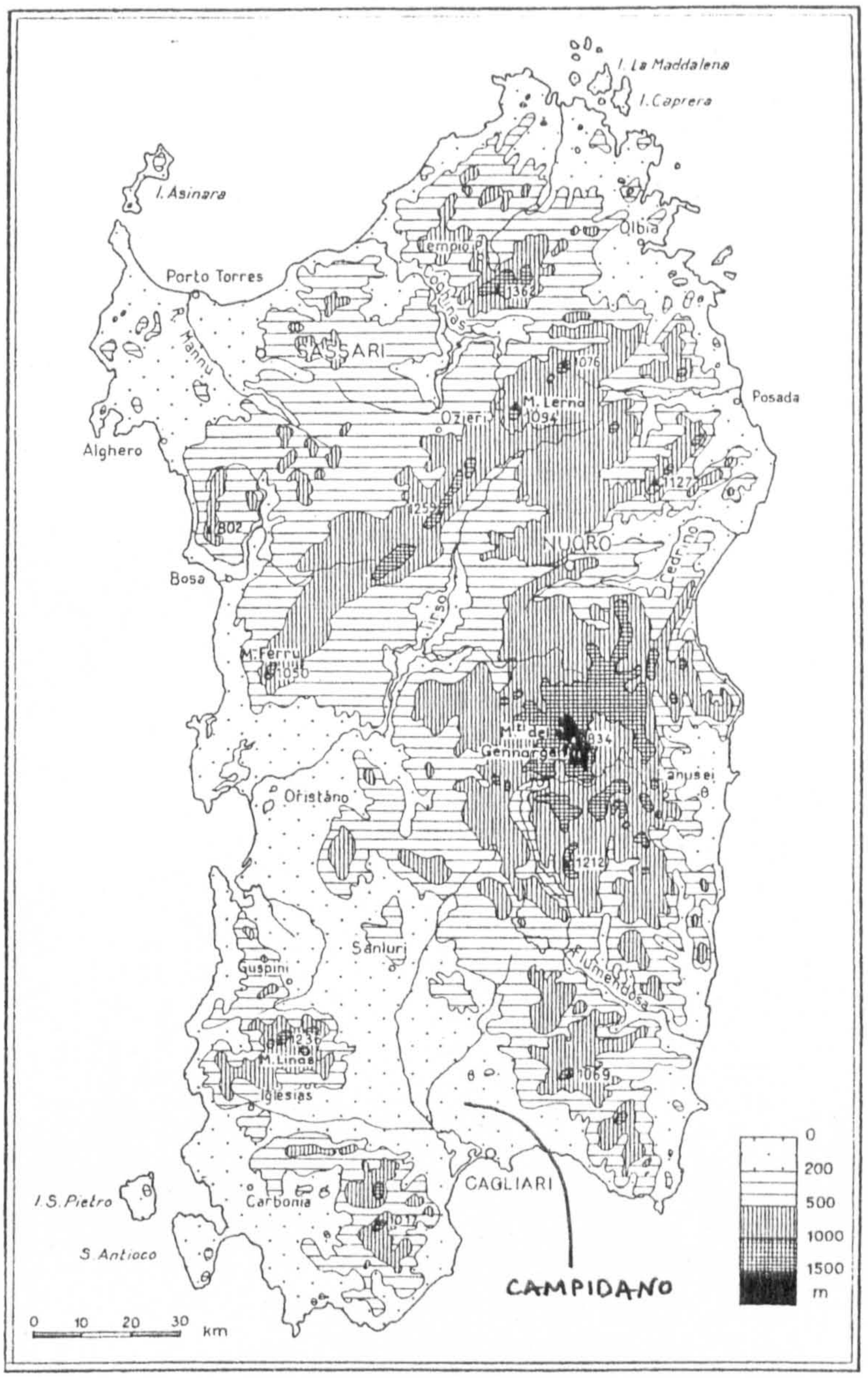


Fig. 2.1. The relief of Sardinia (after Mori 1972, 31)

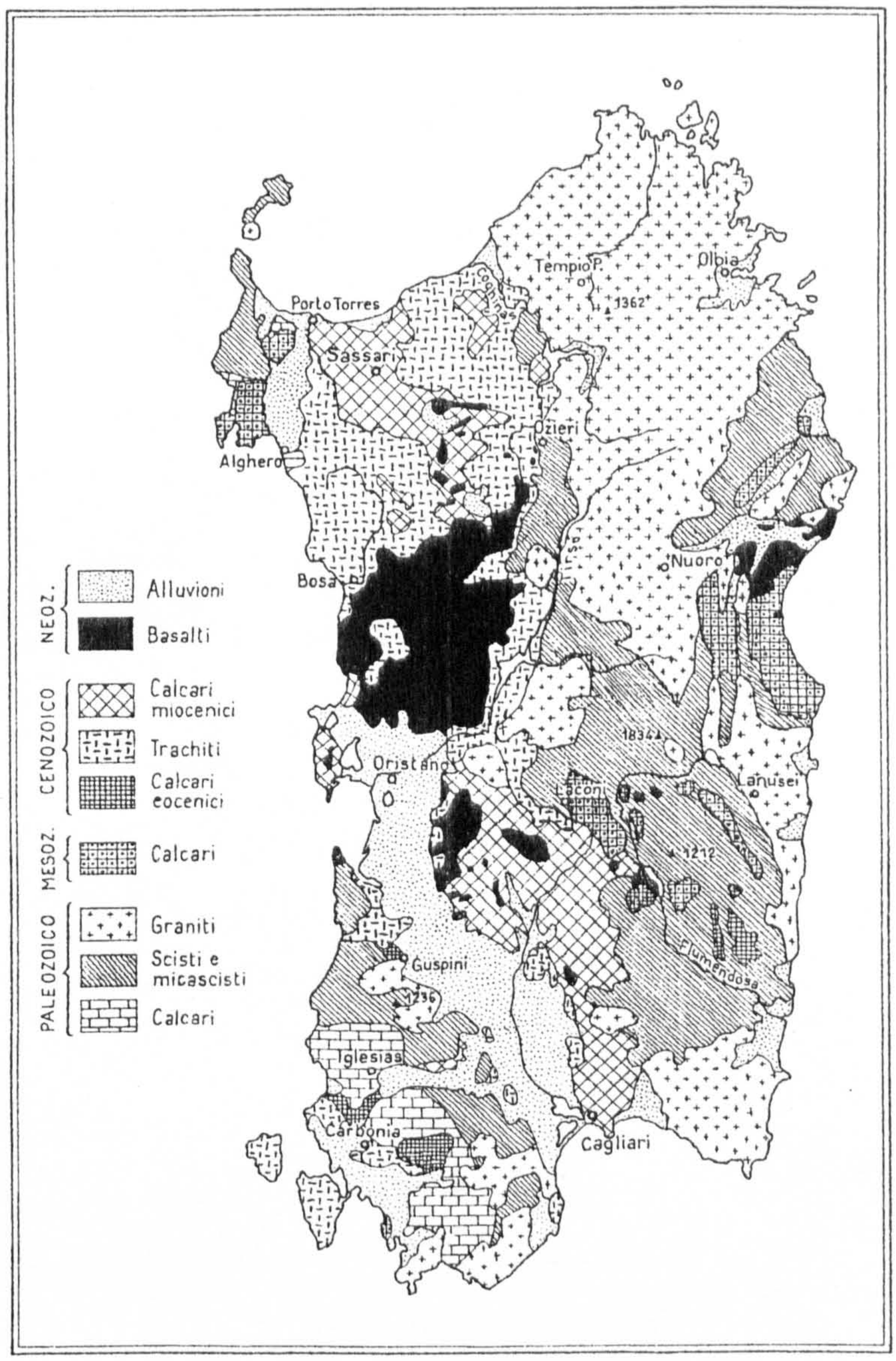


Fig. 2.2. The geology of Sardinia (after Mori 1972, 28). From top to bottom: alluvial soils, basalts, Miocene limestone, trachytes, Eocene limestone, limestone, granite, schists and micaschists, limestone

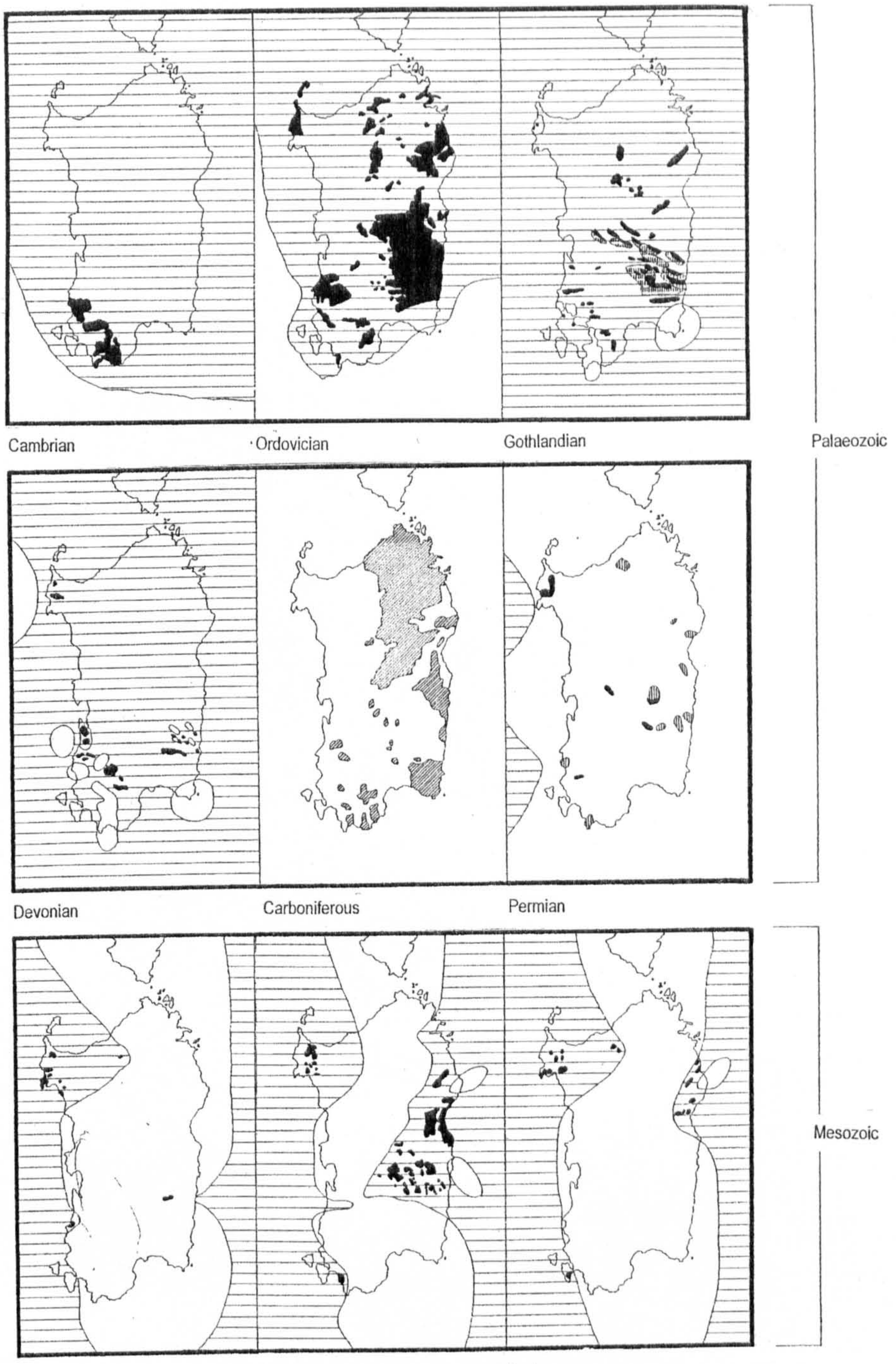
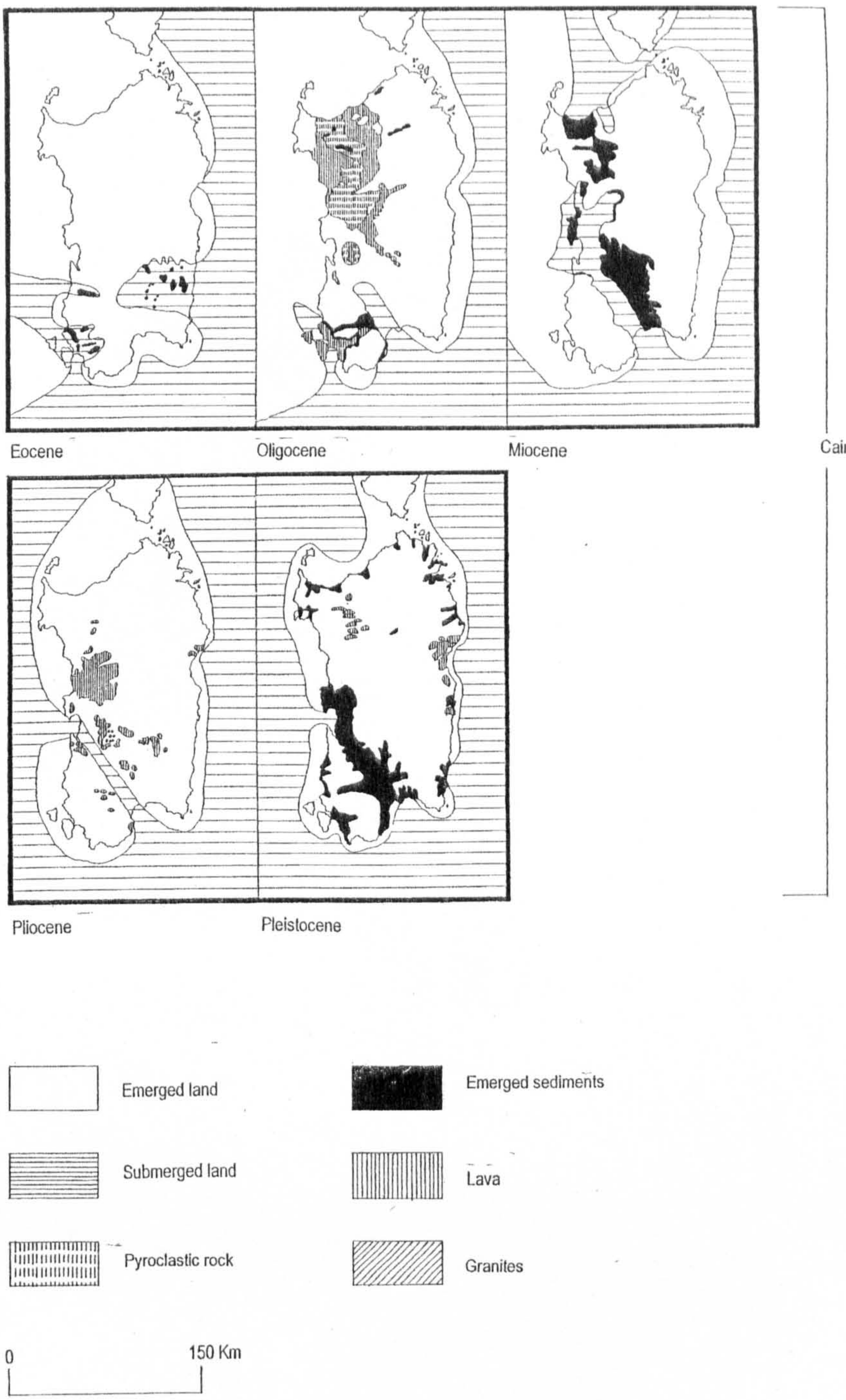


Fig. 2.3. The geological evolution of Sardinia (after Vardabasso, 1972). See also Fig. 2.4



The evolution of Sardinia in the geological eras (after Vardabasso, 1972)

Fig. 2.4. The geological evolution of Sardinia (after Vardabasso, 1972). See also Fig. 2.3

Municipio d'Iglesias

Si avvisa che, per misura di incolumità pubblica, dal giorno 25 corrente e dalle ore 10 alle 12. si procederà dall' ingegnere comunale ad una visita tecnica ai balconi ed alle persiane che danno alle pubbliche vie.

Dalla Residenza munipale, li 22 Settembre 1906.

p. IL SINDACO
I. SANFILIPPO

Fig. 2.5. This poster was circulated by the mayor of the Commune of Iglesias to 'Inform the citizens that because of safety reasons, on 25 September from 10 to 12 am the communal engineer will inspect those balconies and windows which face a public street' (author's translation). The document is kept in the Archivio Storico di Iglesias (ASI 1906b)

ILLUSTRATIONS
CHAPTER 3

Fig. 3.1. Craftsman Mario Schirru extracting soil for *làdiri* making (San Sperate 1951)

Fig. 3.2. Craftsman Mario Schirru moving mixed soil to the moulding area (San Sperate 1950-51)

Fig. 3.3. Craftsman Mario Schirru moulding *làdiri* bricks (San Sperate 1951)

Fig. 3.4. Craftsmen Alessandro Schirru, Quisintano Schirru, Mario Schirru, and their father, while turning *làdiri* bricks for even drying (San Sperate 1950-51)

Fig. 3.5. Ready-to-use *làdiri* bricks after drying (Alessandro Schirru, Don Pala, Mario Schirru, San Sperate 1950-51)

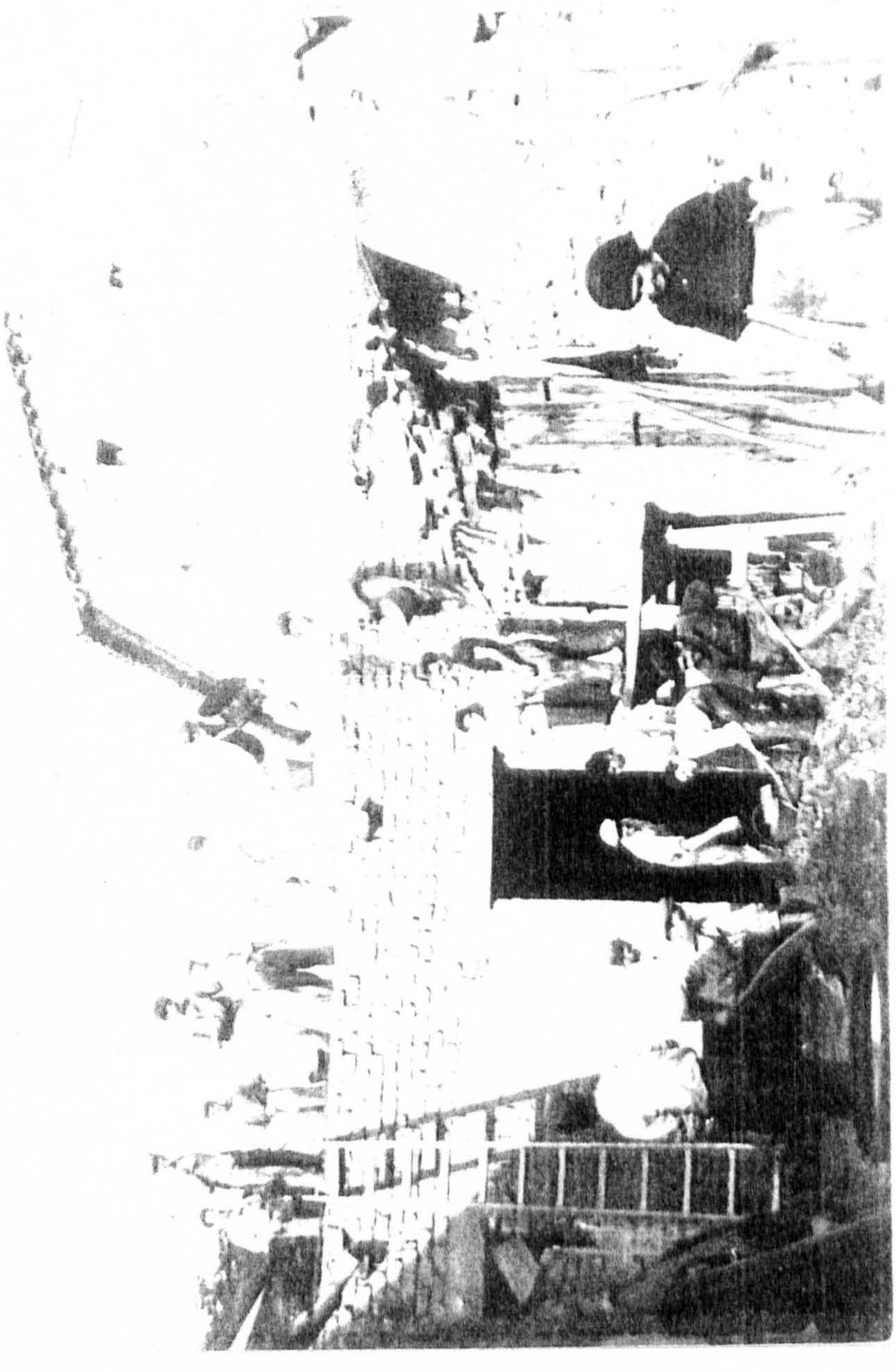
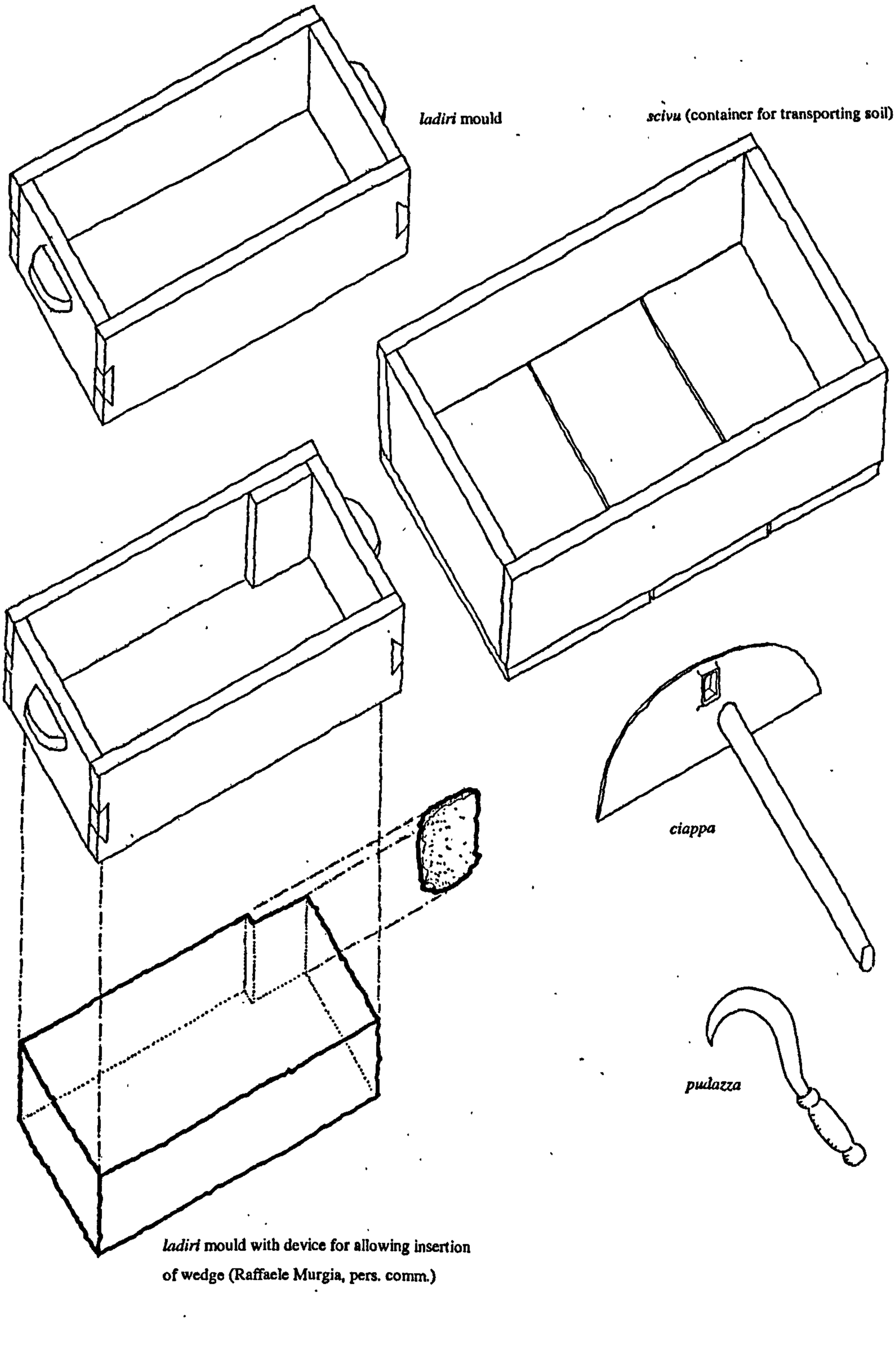


Fig. 3.6. The construction of upper floors was an activity which could involve eighteen craftsmen (San Sperate 1951)



ladiri mould with device for allowing insertion of wedge (Raffaele Murgia, pers. comm.)

Fig. 3.7. The tools employed for the manufacturing of *làdiri* bricks

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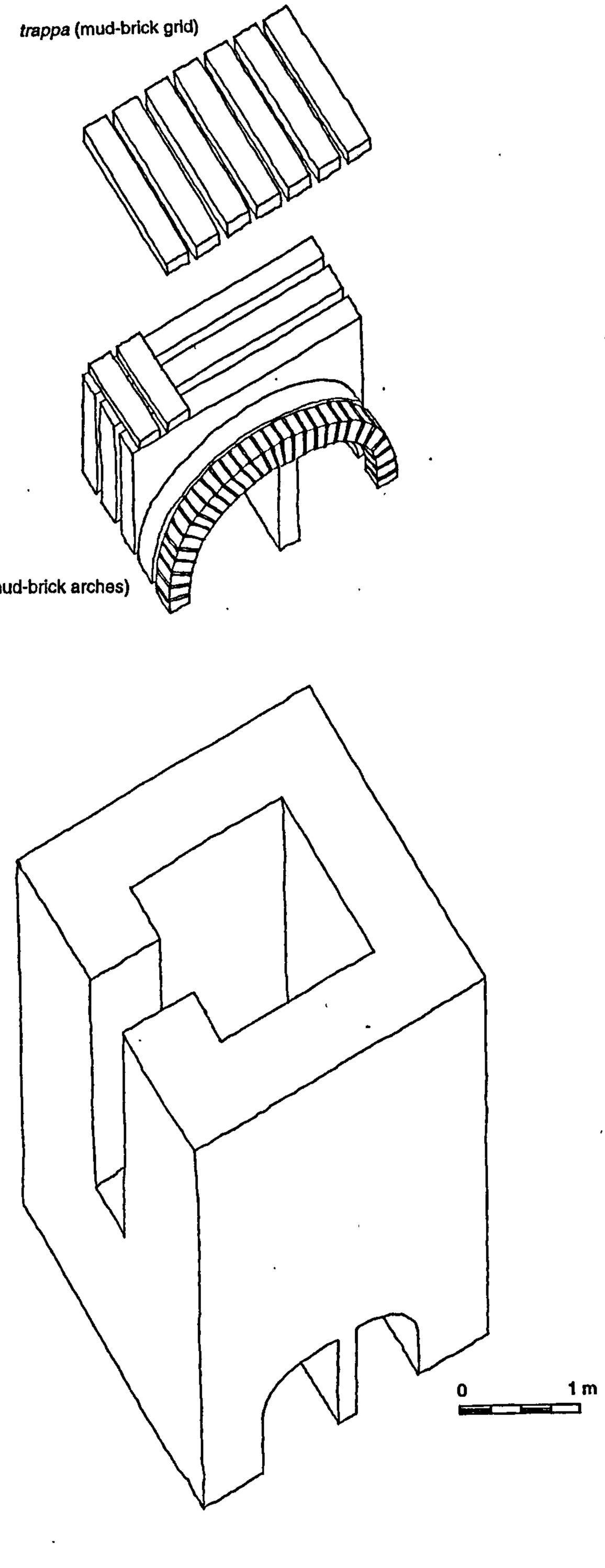


Fig. 3.8. The construction of the kiln for firing roof tiles as explained to the author by the craftsmen of Silì (Oristano)

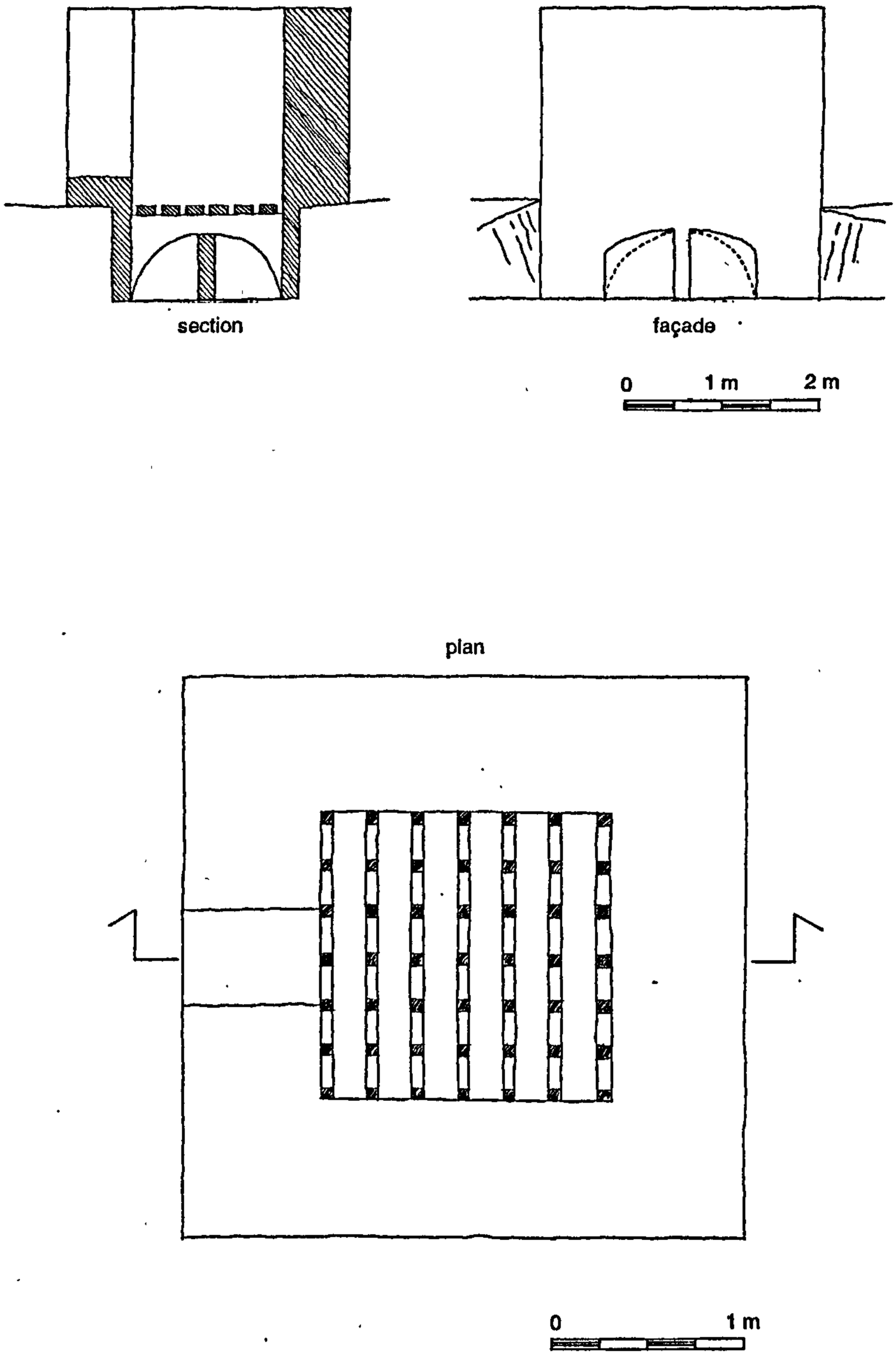


Fig. 3.9. Plan, section, and main elevation of the kiln used in Silì (Oristano) as explained by local craftsmen

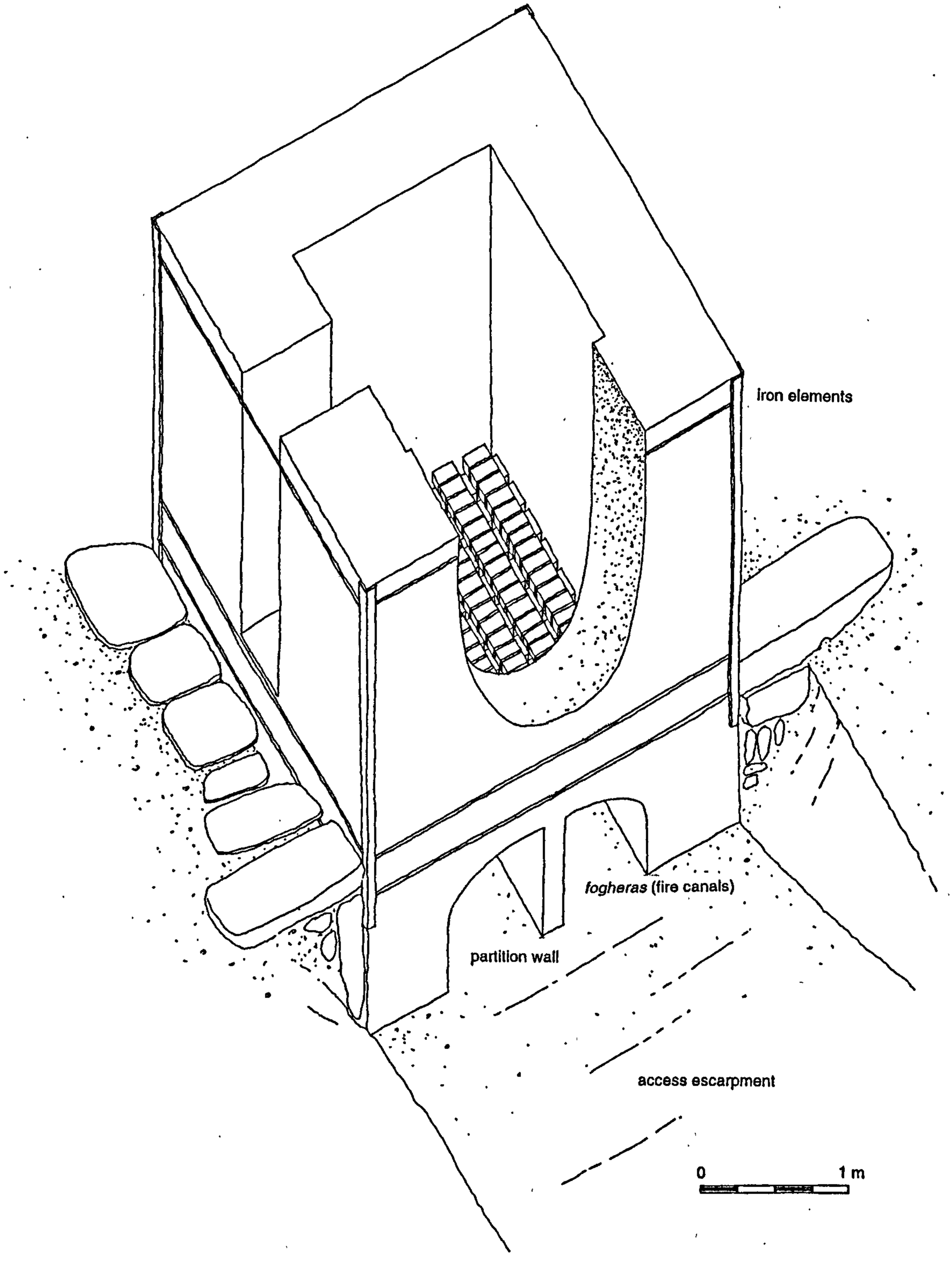


Fig. 3.10. Axonometric view of the furnace used in Sill (Oristano) for firing roof tiles and bricks

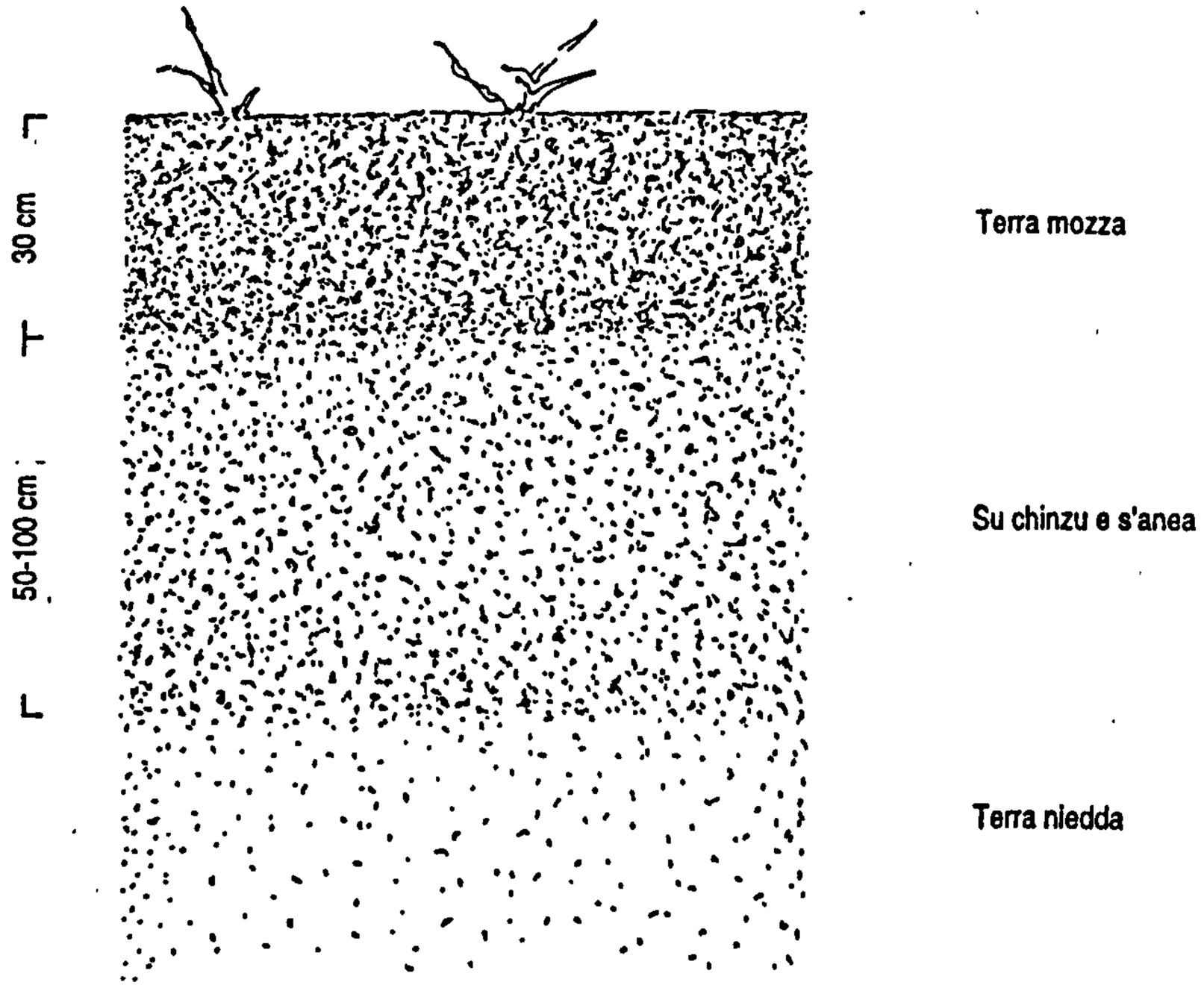


Fig. 3.11. Profile (vertical section) of the alluvial soil of the region around Silì (Oristano) indicating the 'terra niedda', the best soil for tile making

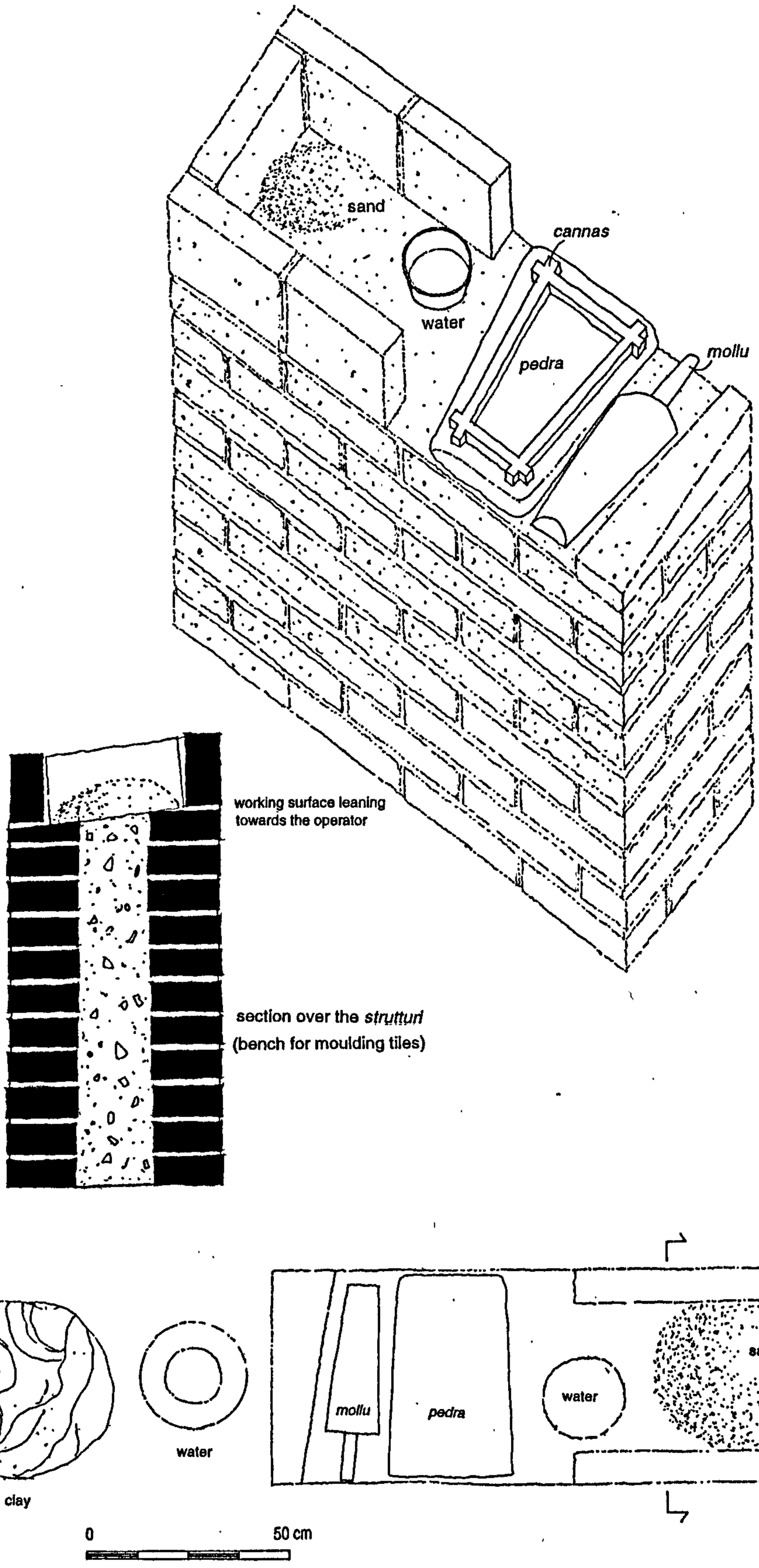
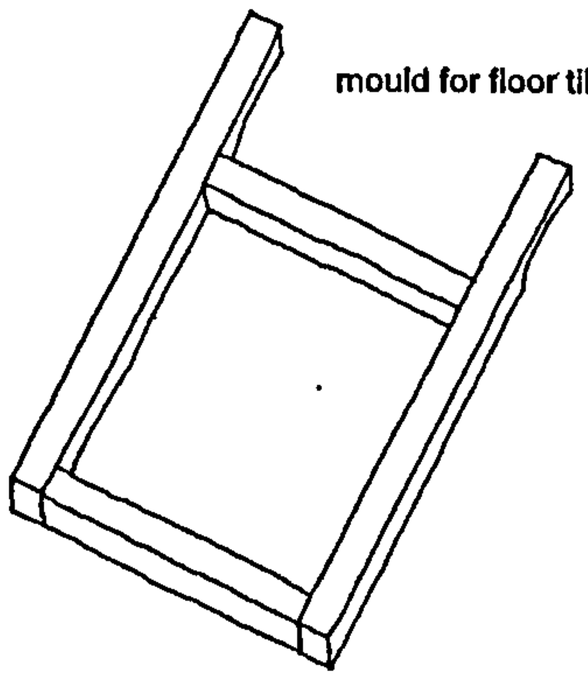
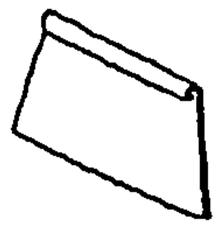


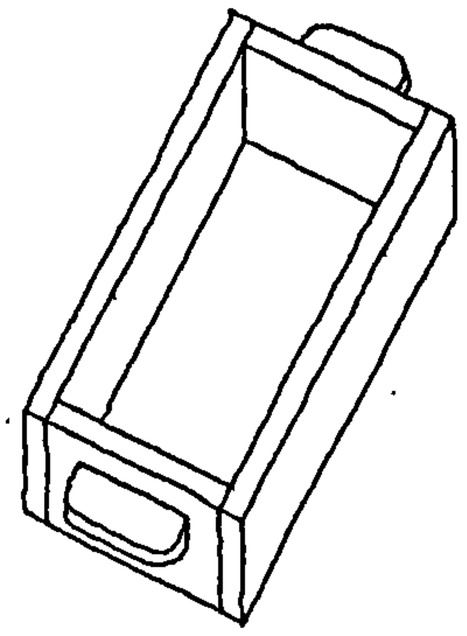
Fig. 3.12. The *strutturi*, the bench for tile making in use in Silì (Oristano)



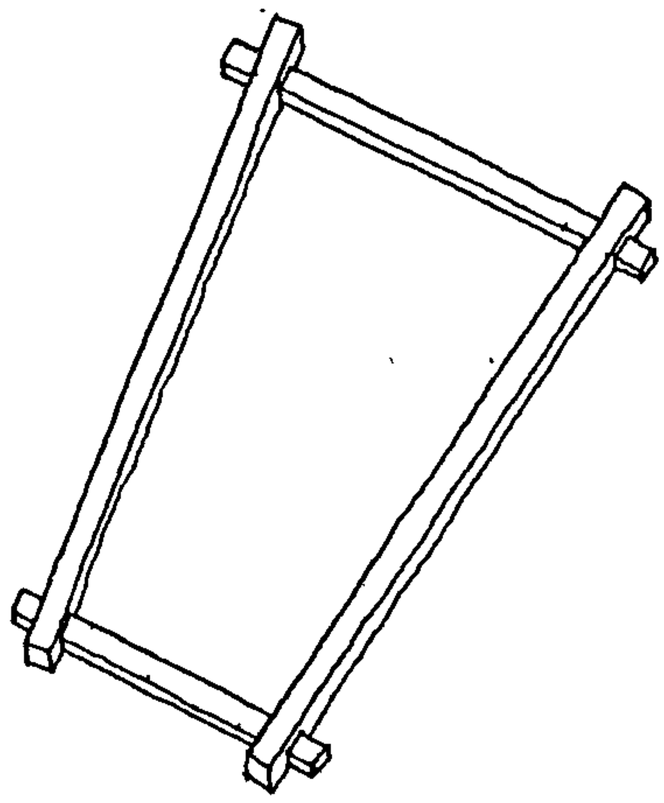
mould for floor tiles



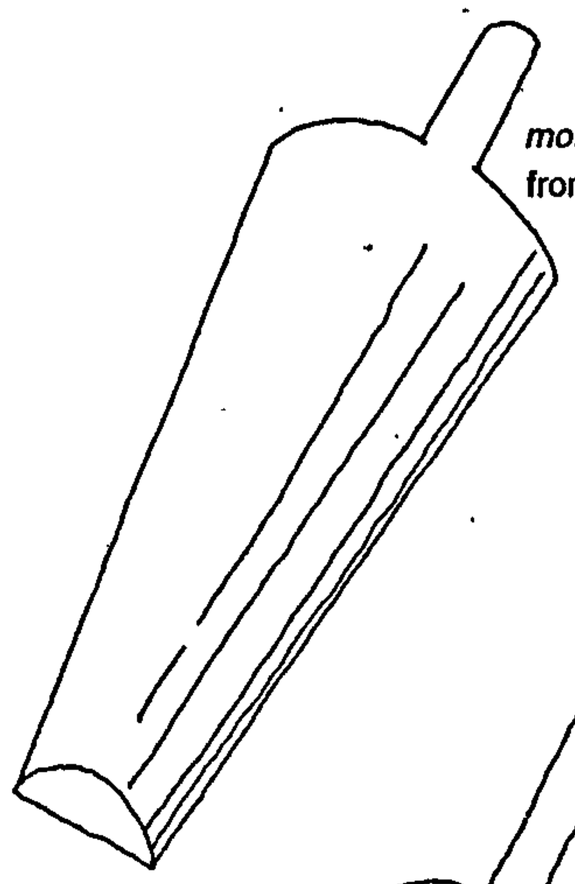
arrisigadori (scraper)



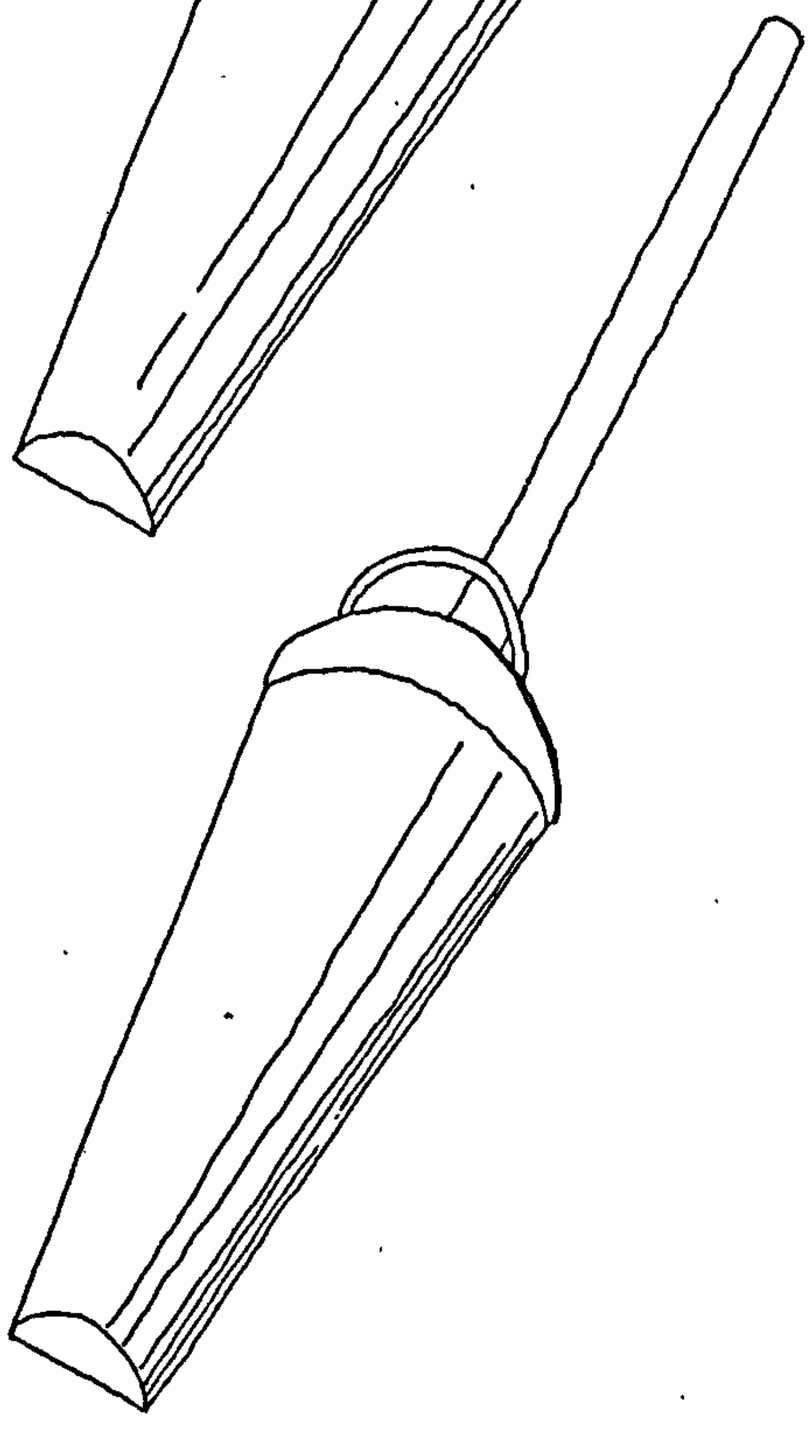
sestu (mould for fired bricks)



cannas (washing-off frame for roof tiles)



mollu (splayer for roof tiles) from Segariu



mollu (splayer for roof tiles) from Assemini

0 1cm

Fig. 3.13. Tools for the making of tiles, roof tiles, and fired bricks

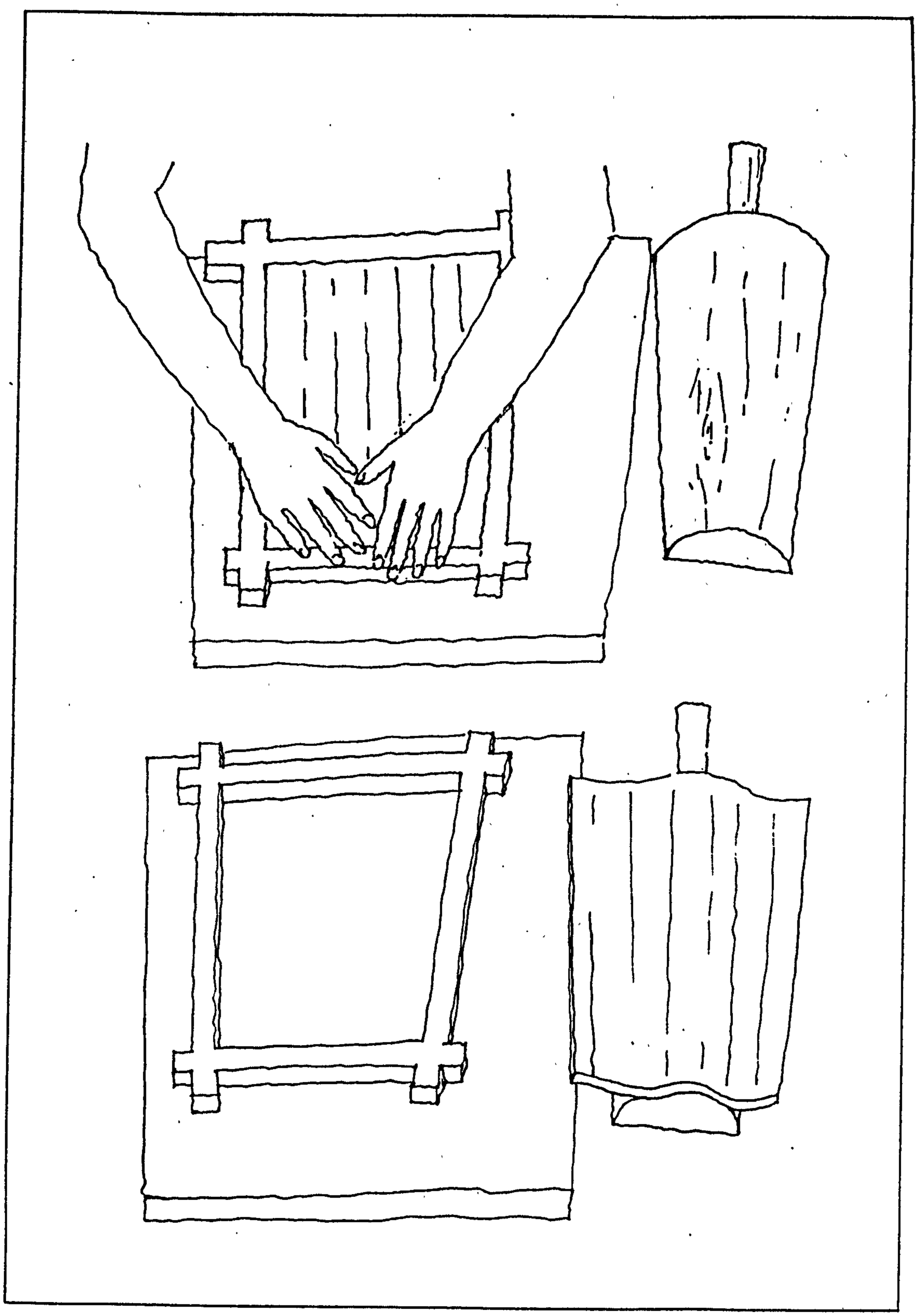


Fig. 3.14. Figure illustrating roof tile moulding

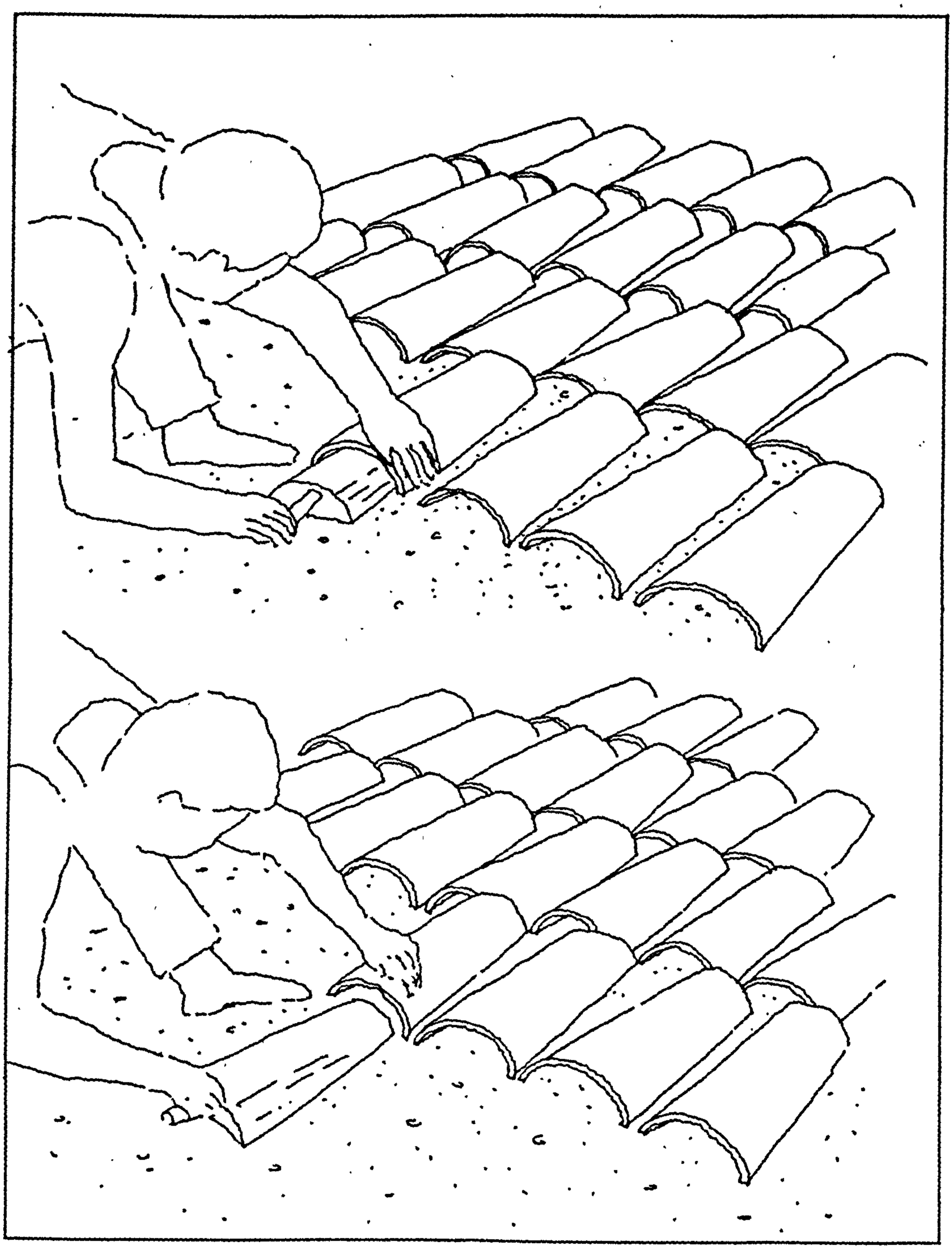


Fig. 3.15. Figure illustrating roof tile drying

Fig. 3.16, 3.17, and 3.18. Figures illustrating the process of roofing a *làdiri* house in Assemini: lime screed over the cane sarking, the completed process from the inside of the building, and final layer of roof tiles showing the device known as *ponti* (bridge). The device consisted in the employment of broken roof tiles and lime mortar for avoiding lateral swinging of roof tiles

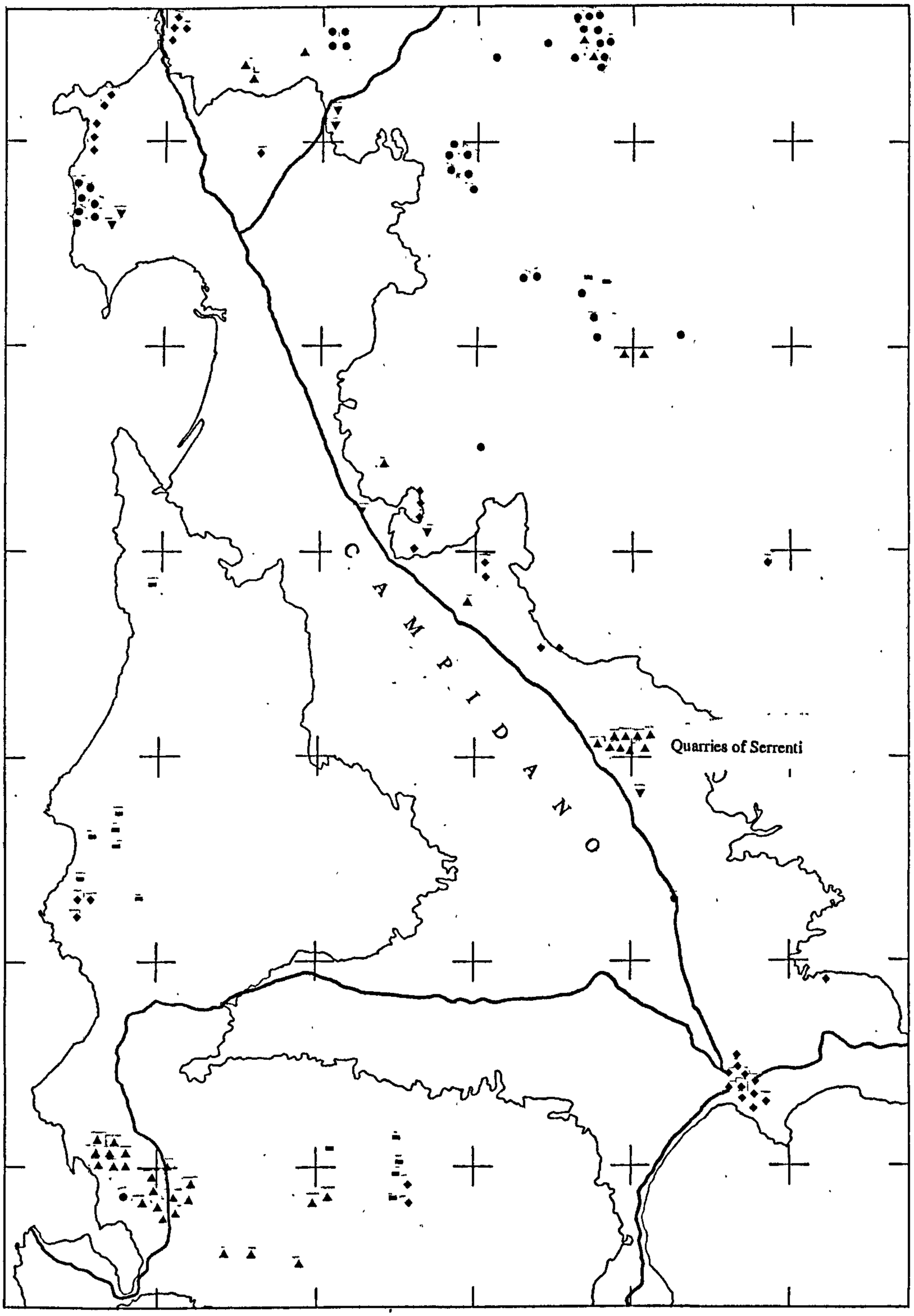
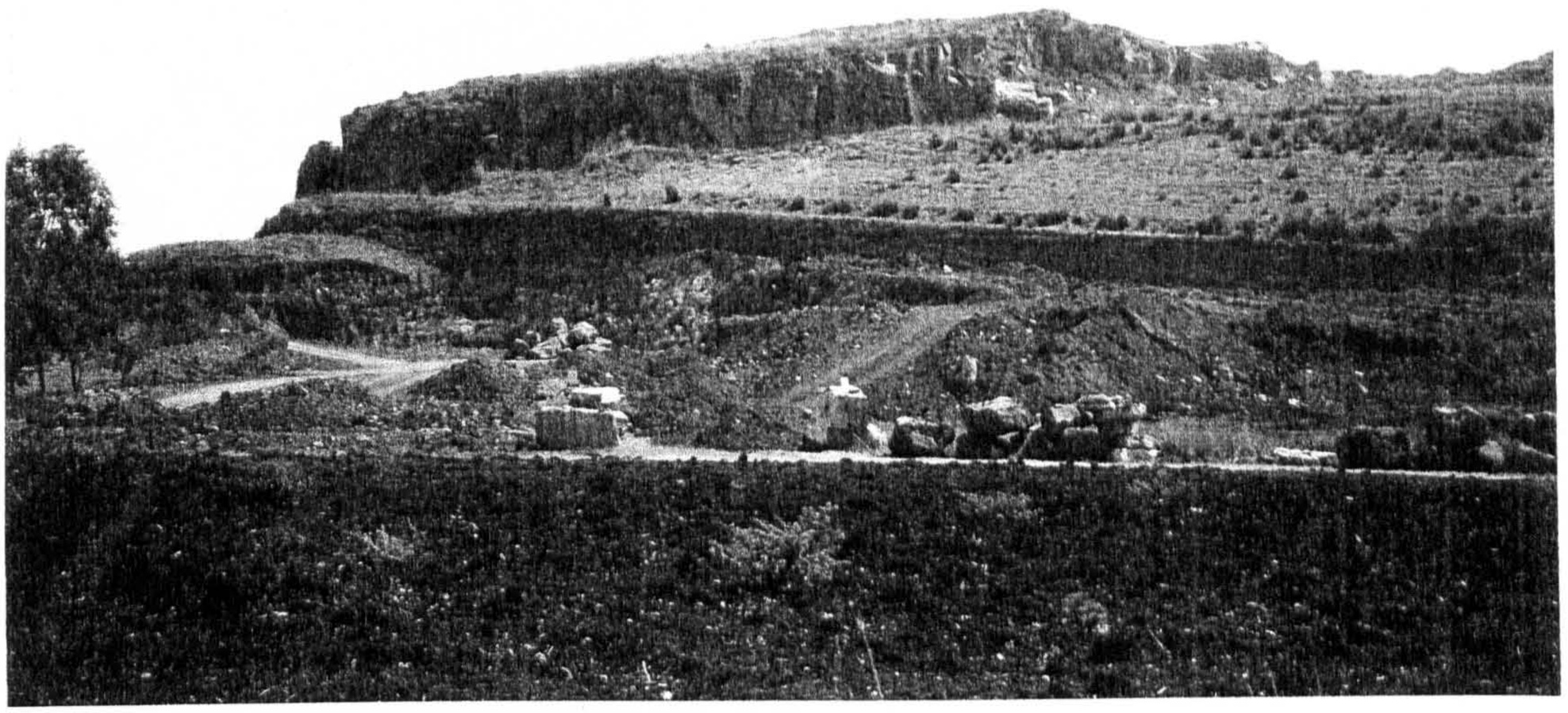


Fig. 3.19. Map of Campidano showing location of stone quarries (after Pili 1999). Symbols: ▬ marble and limestone, ● pyroclastic rock, ◆ sedimentary rock, ▲ extrusive acid rock, ▼ extrusive basic rock



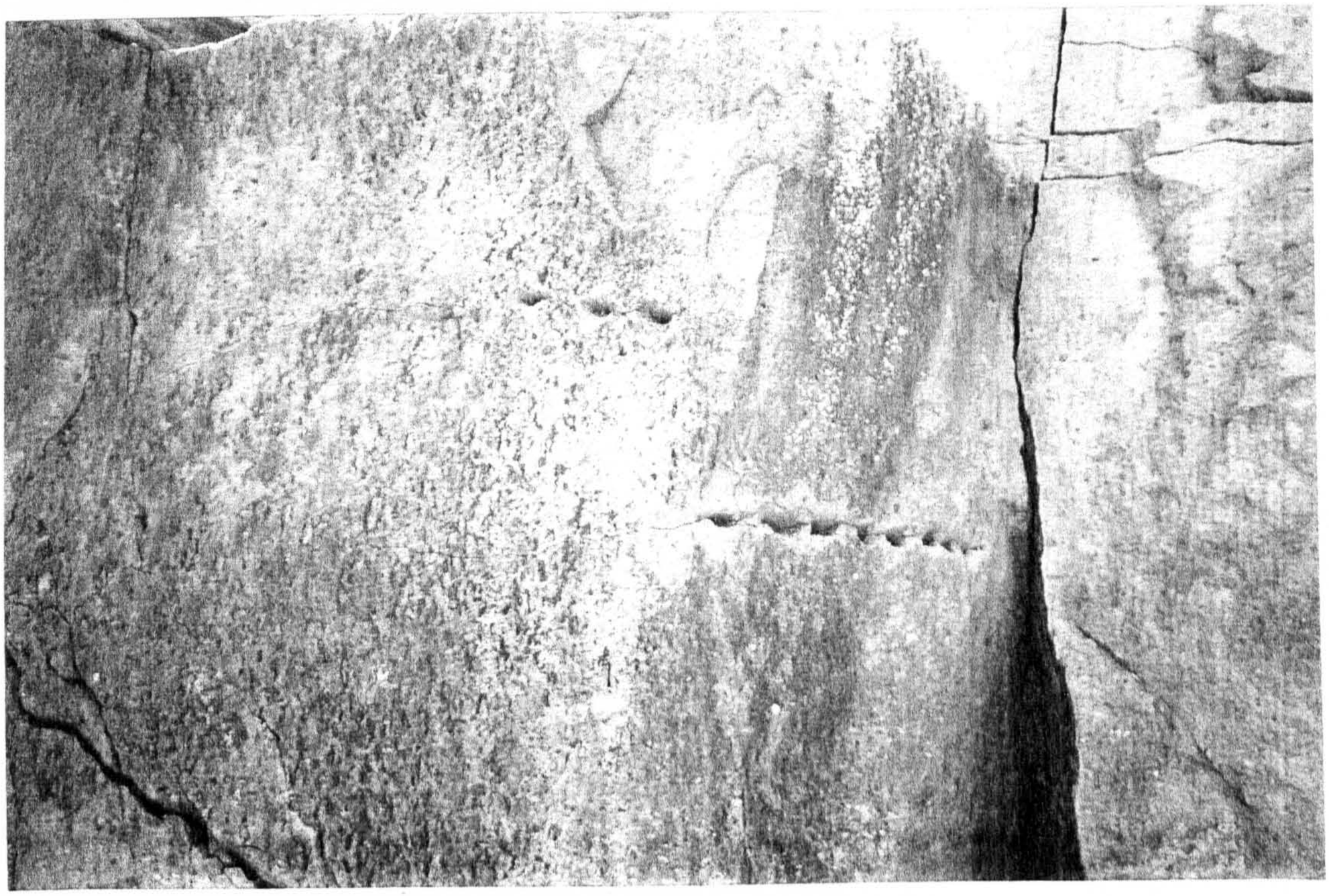


Fig. 3.20. The quarry of Monte Atzorcu near Serrenti (Cagliari)

Fig. 3.21. Archaeology in the quarry: extraction of this rock was started, but then abandoned

Fig. 3.22, 3.23, and 3.24. Master Mason Antonio Argiolas showing splitting of a sample of the stone of Monte Atzorcu (Serrenti, Cagliari) by means of traditional methods

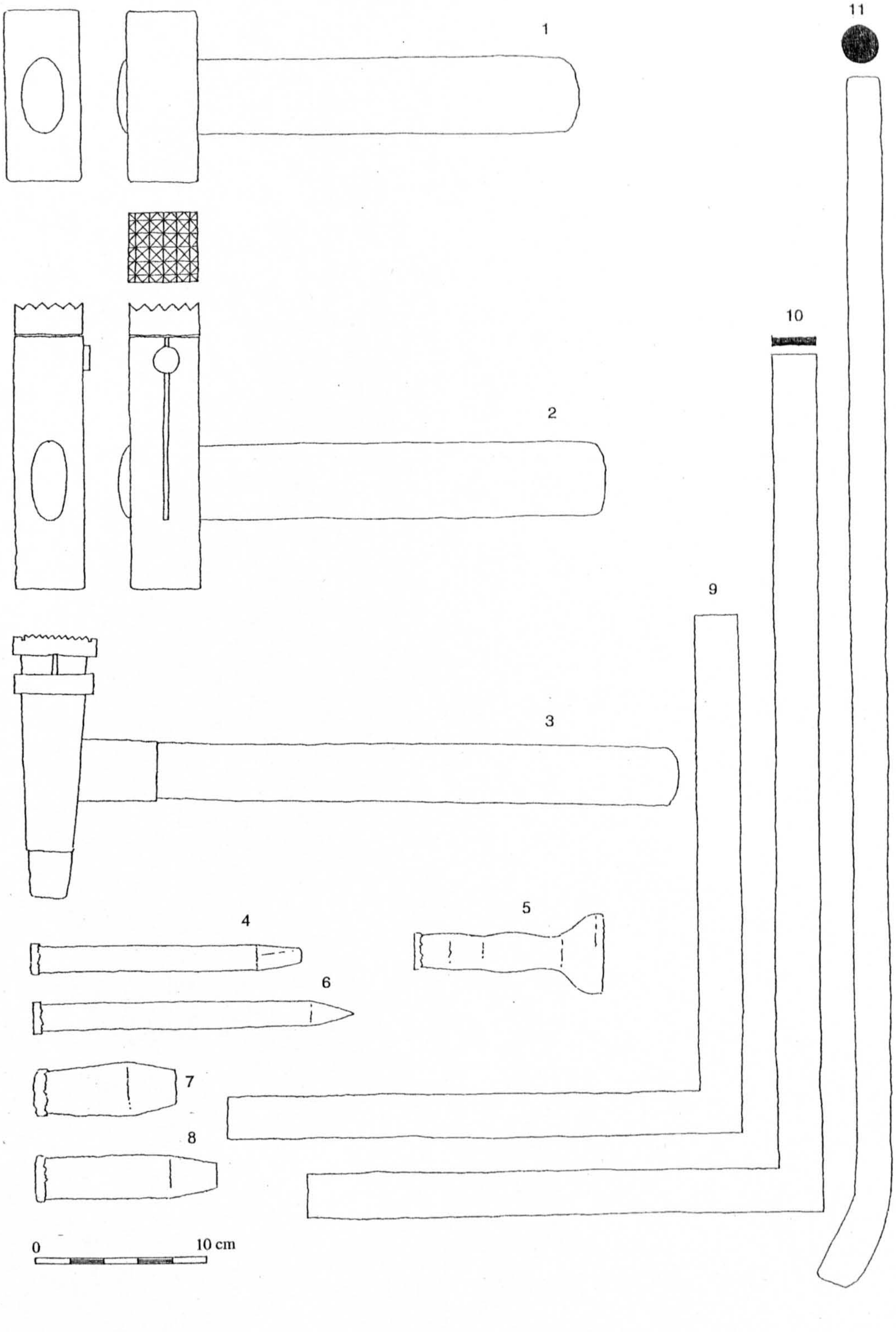
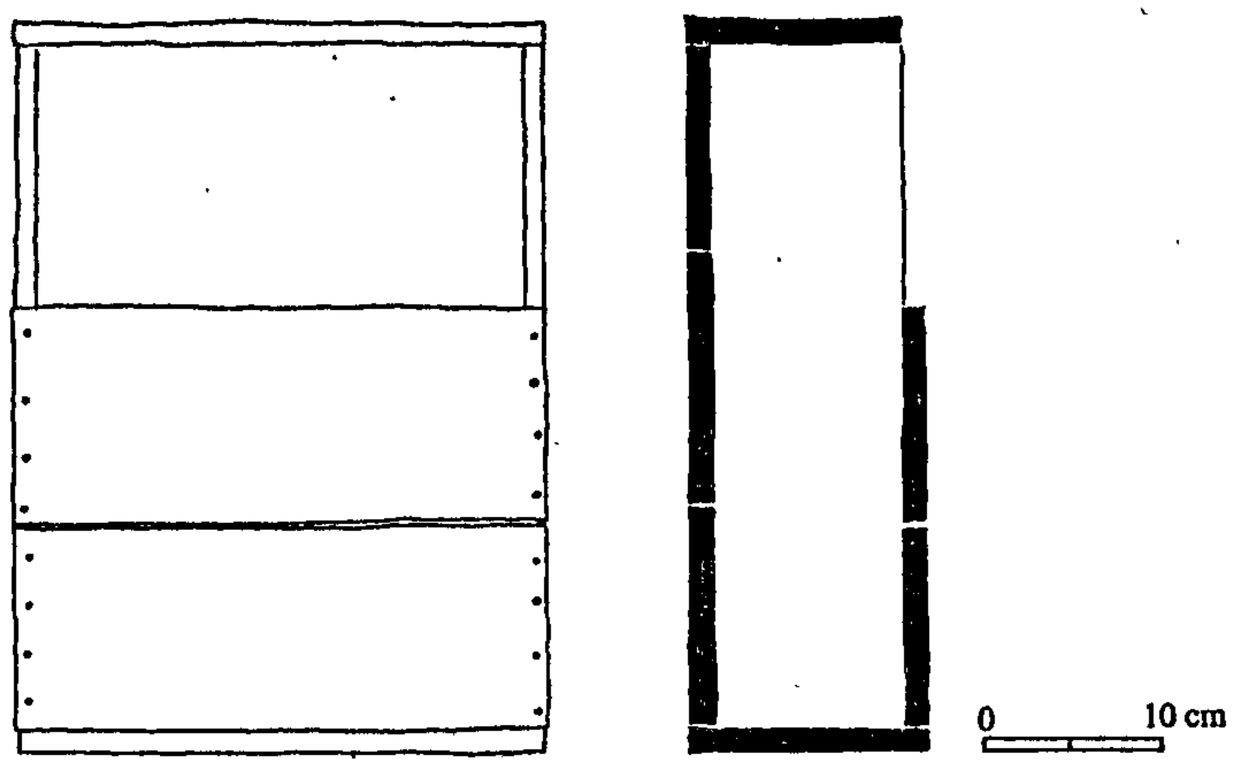
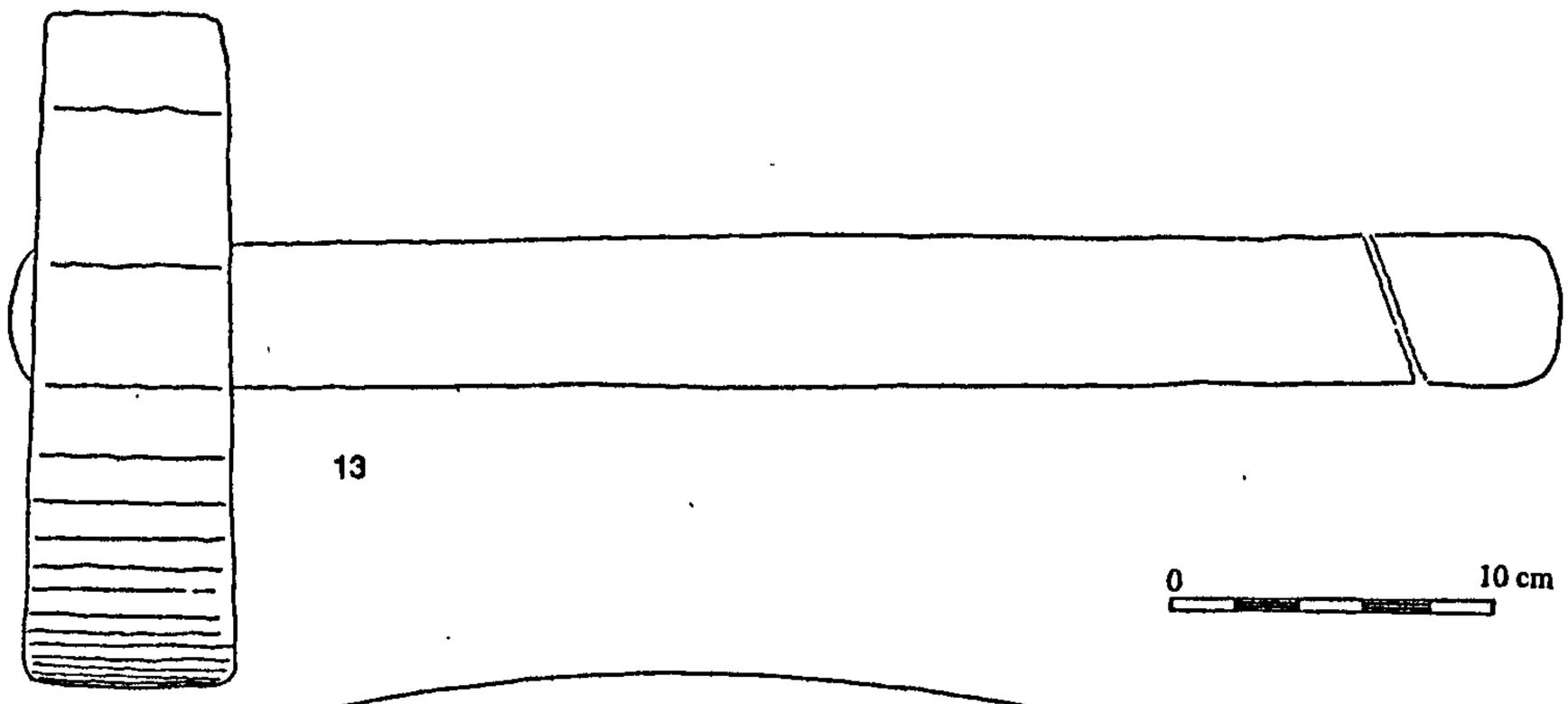


Fig. 3.25. Tools for quarrying and for dressing stone as surveyed in Serrenti (Cagliari): (1) sledge, (2) bush hammer, (3) bush hammer, (4) steel chisel, (5) steel pitching tool, (6) punch, (7) coping wedges, (8) steel chisel, (9) small steel square, (10) large steel square, (11) pry-bar





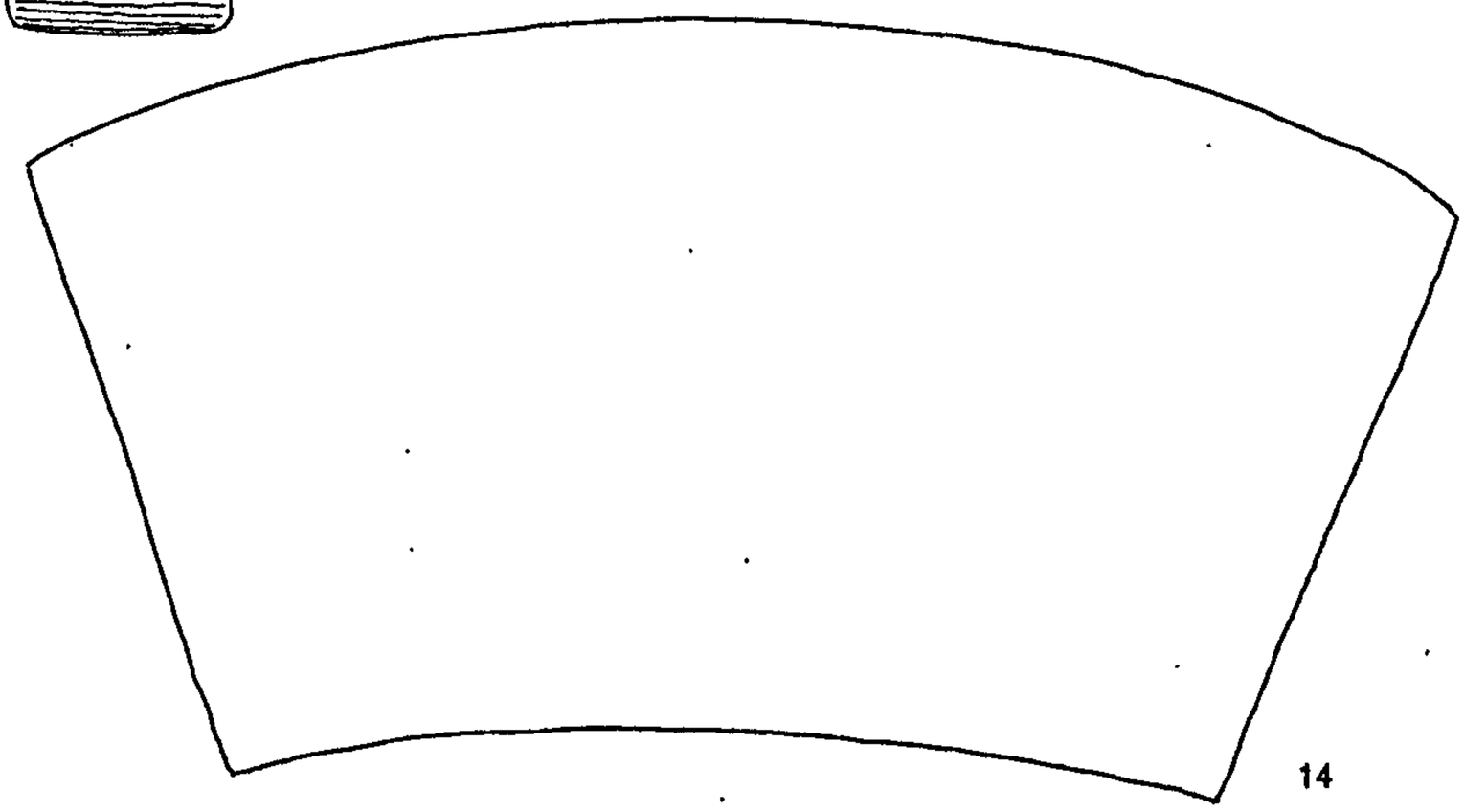
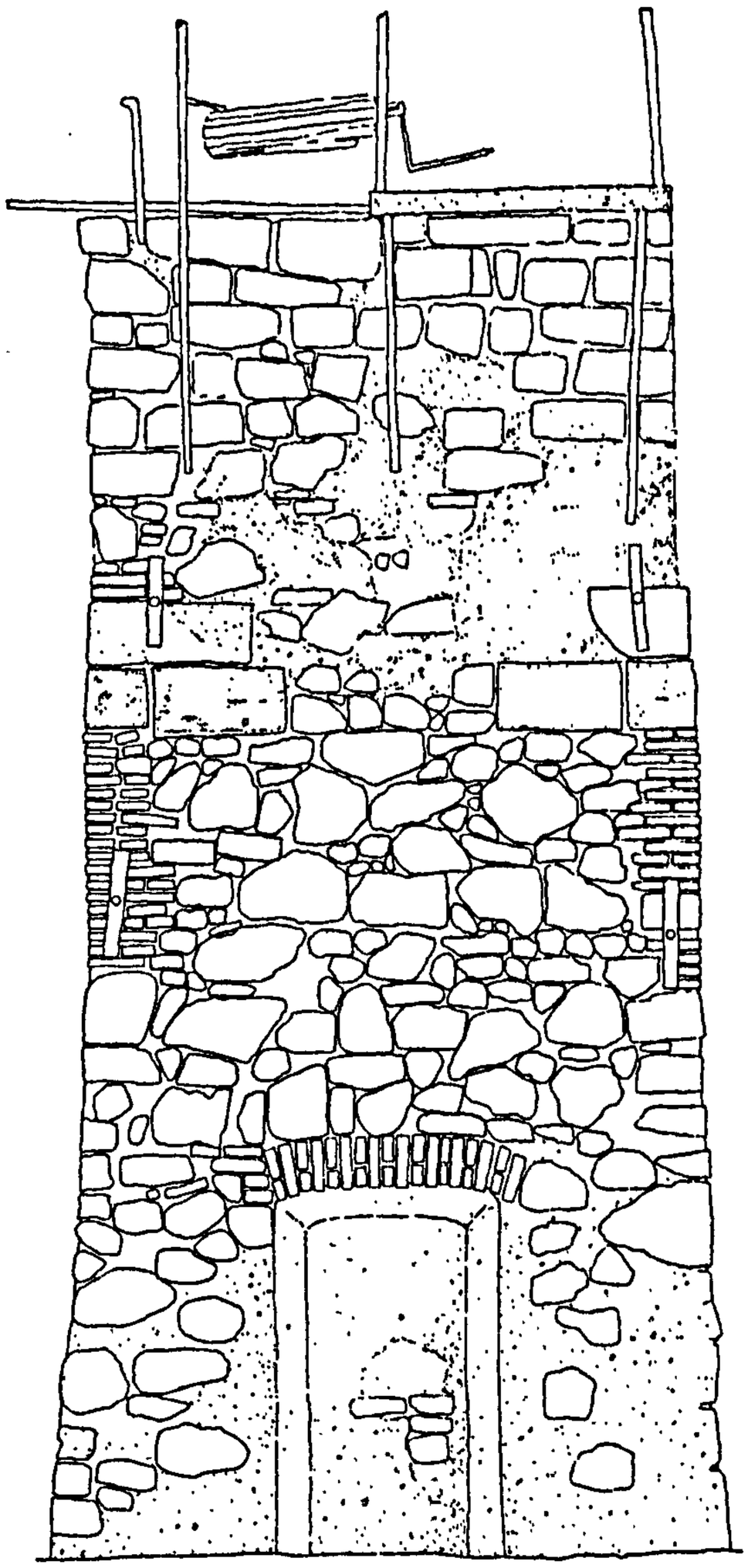


Fig. 3.26. Tools for quarrying and for dressing stone as surveyed in Serrenti (Cagliari): (12) wooden box for storing tools, (13) heavy sledge, (14) cardboard templates



Lime kiln in Via Roma, Nuraminis	
Situation	Flare kiln
Building material	limestone and lime mortar (exterior), refractory bricks with dimensions 20x11x6 cm (interior)
Internal diametre (bottom)	1.3 m
Internal diametre (top)	1.3 m
Height	5.5 m
Volume	7.3 cubic metres
Fuel	pit coal
Firing time	two days and three nights
Percent of impurities in limestone	3 3 %

Fig. 3.27. Shaft kiln for lime burning located in Via Roma, Nuraminis (Cagliari). Main elevation

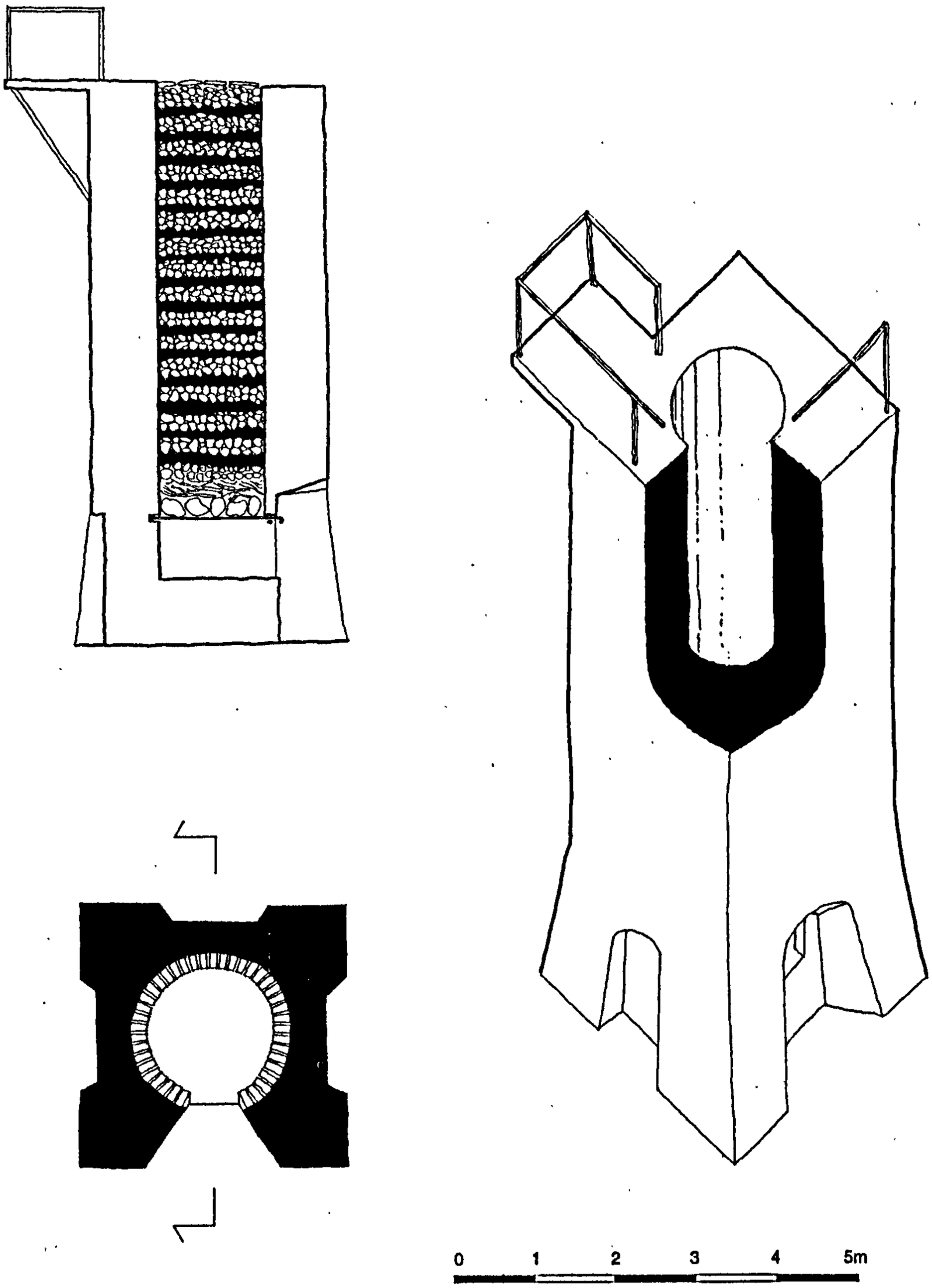


Fig. 3.28. Shaft kiln for lime burning located in Via Roma, Nuraminis (Cagliari). Section, plan and axonometric view

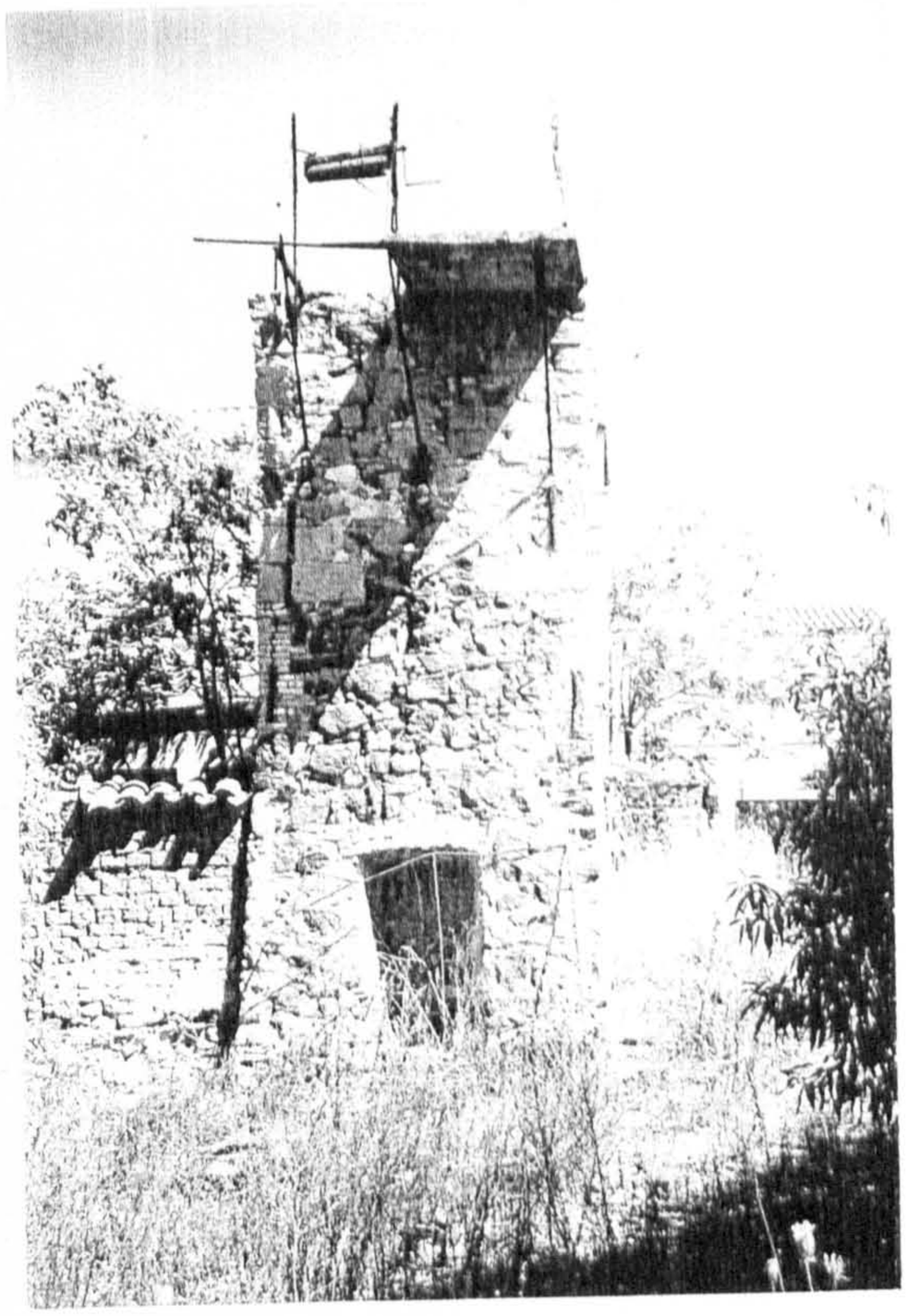
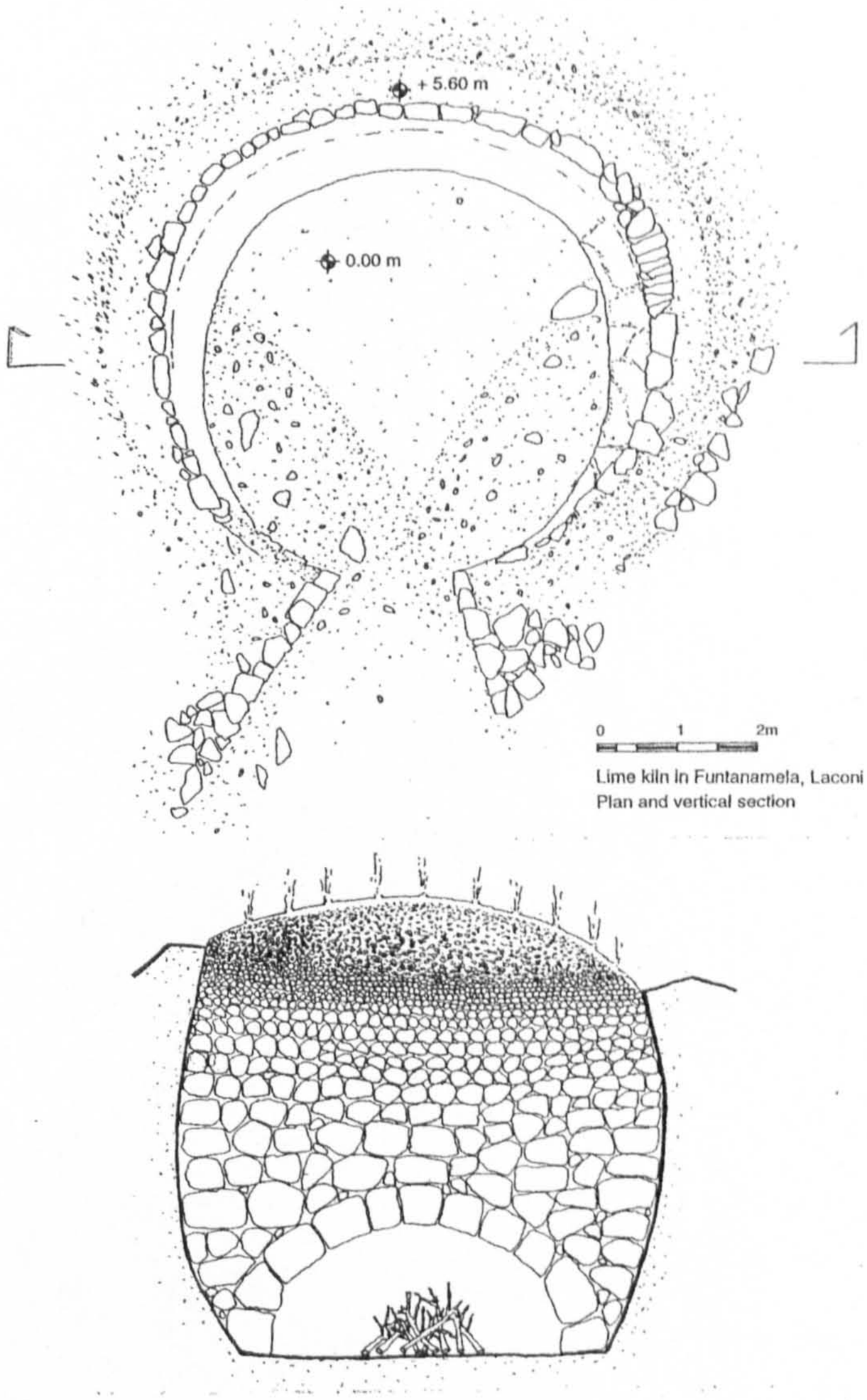


Fig. 3.29. Shaft kiln for lime burning located in Via Roma, Nuraminis (Cagliari). Main elevation

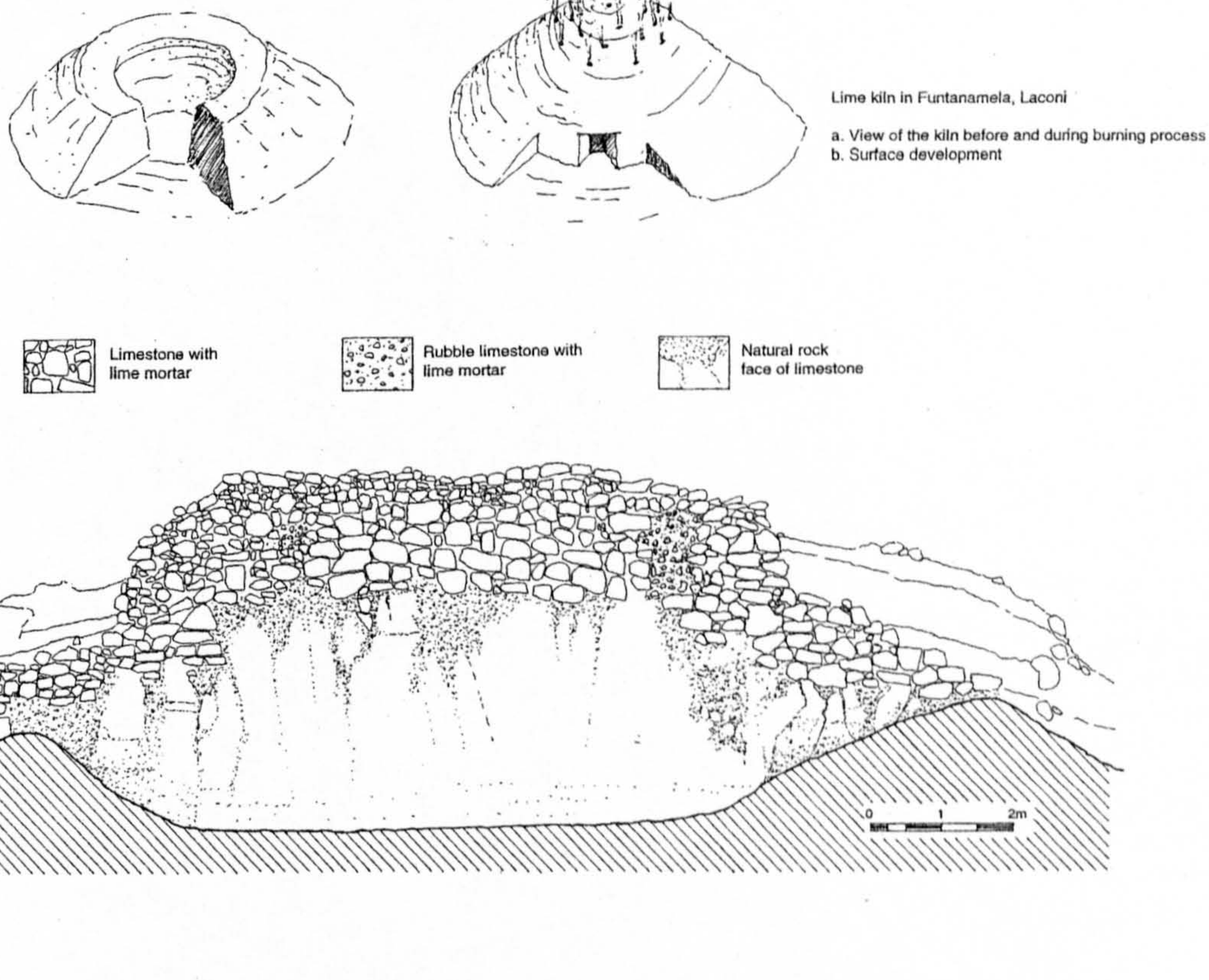
Fig. 3.30. Hillside kiln for lime burning located in Funtanamela (Laconi, Nuoro)



Lime kiln in Funtanamela, Laconi
Plan and vertical section

Lime kiln in Funtanamela, Laconi	
Situation	hillside kiln
Building material	natural rock face, limestone and lime mortar
Internal diametre (bottom)	4.5 m
Internal diametre (top)	5.5 m
Height	5 m
Volume	132.9 cubic metres
Fuel	kindling
Firing time	eight days and eight nights

Fig. 3.31. Hillside kiln for lime burning located in Funtanamela (Laconi, Nuoro): plan and section



Lime kiln in Funtanamela, Laconi

a. View of the kiln before and during burning process
b. Surface development

Fig. 3.32. Hillside kiln for lime burning located in Funtanamela (Laconi, Nuoro)

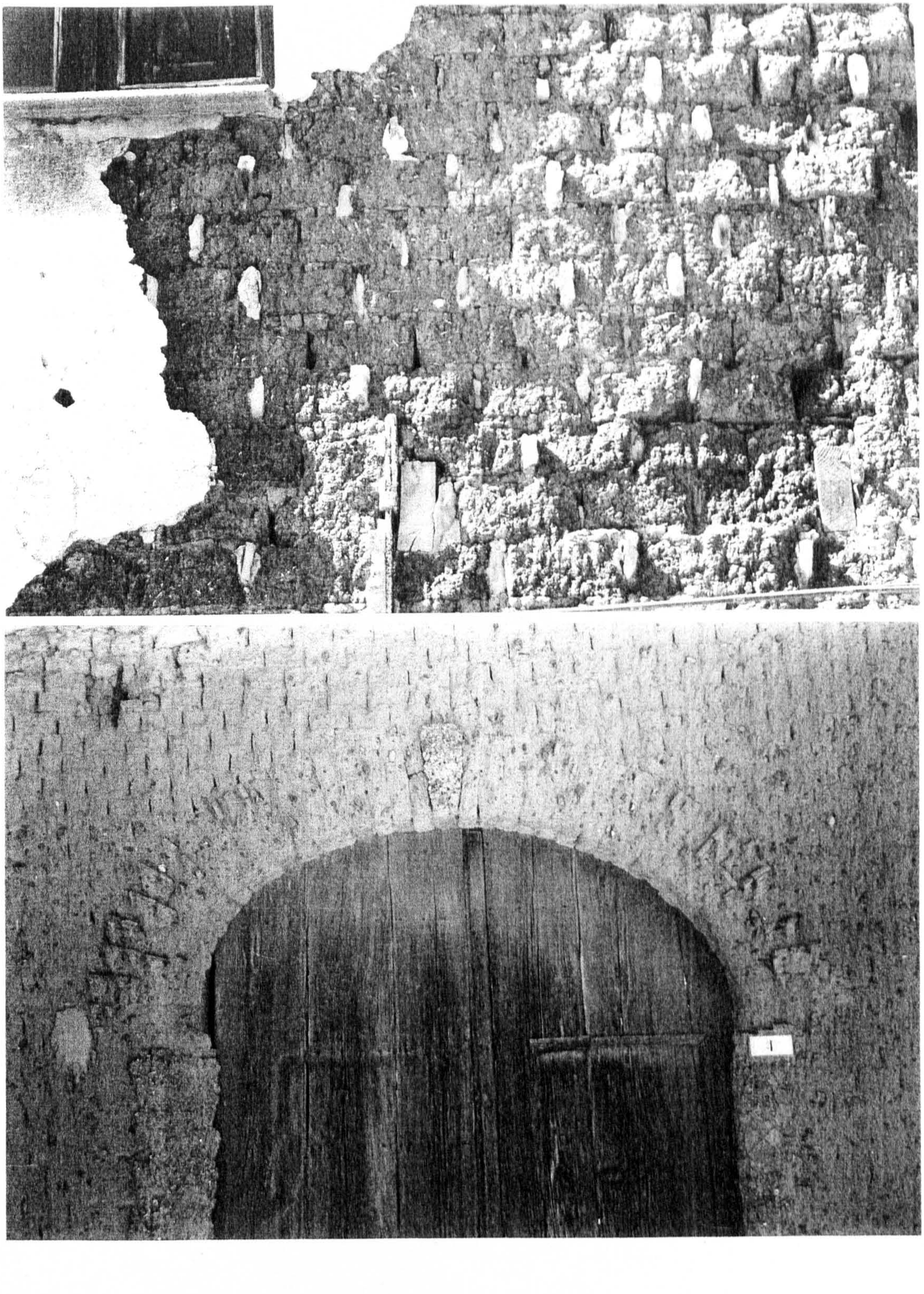
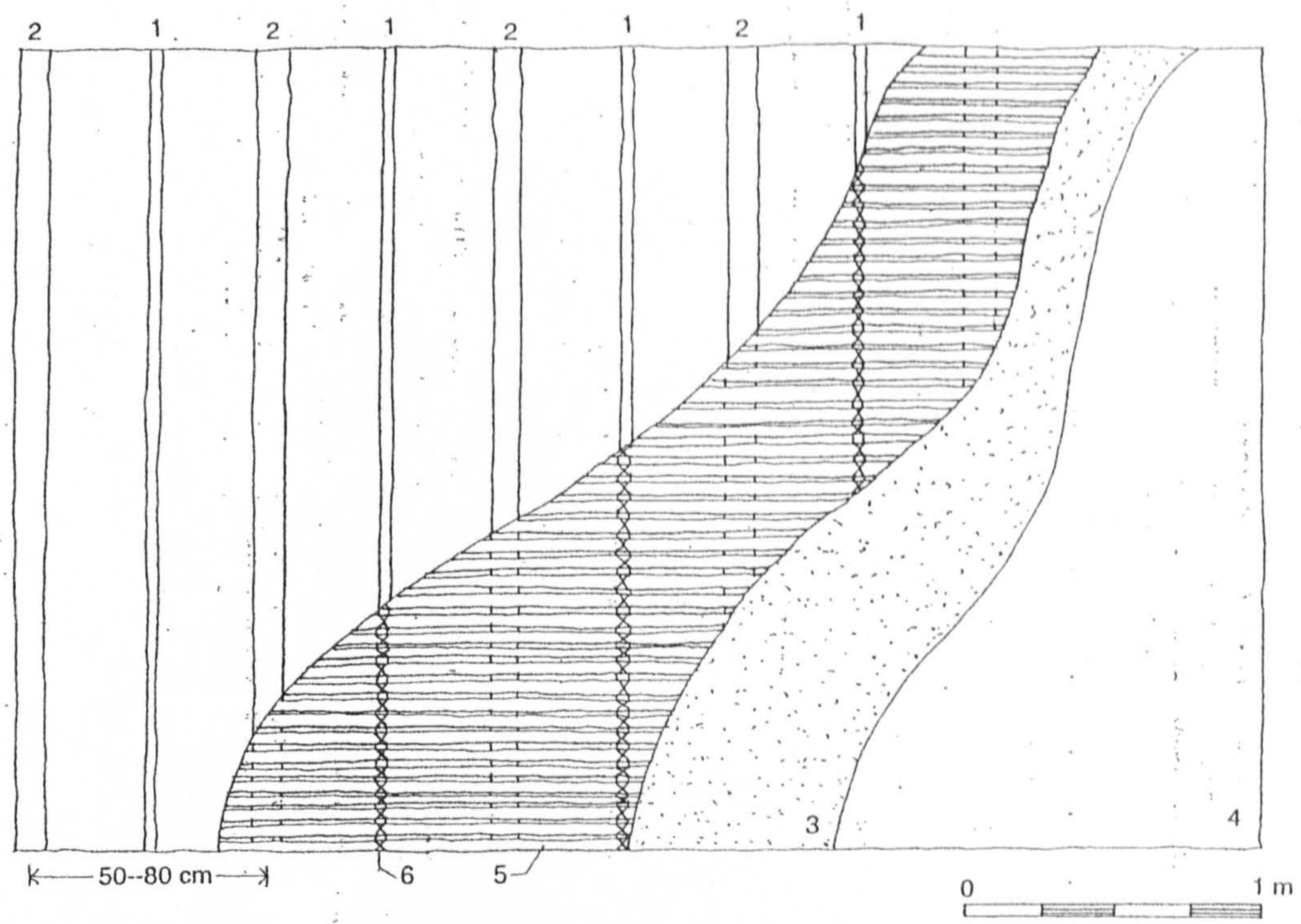


Fig. 3.33 and 3.34. Insertion of broken tiles or flat stones in the vertical joints (*cummussura*) of the *làdiri* wall (top, Nuraminis, Cagliari) and in the joints of the *làdiri* arch (bottom, San Sperate, Cagliari) in order to form a lathing system. This device had the advantage of allowing the lime render to grip on the protruding wedges



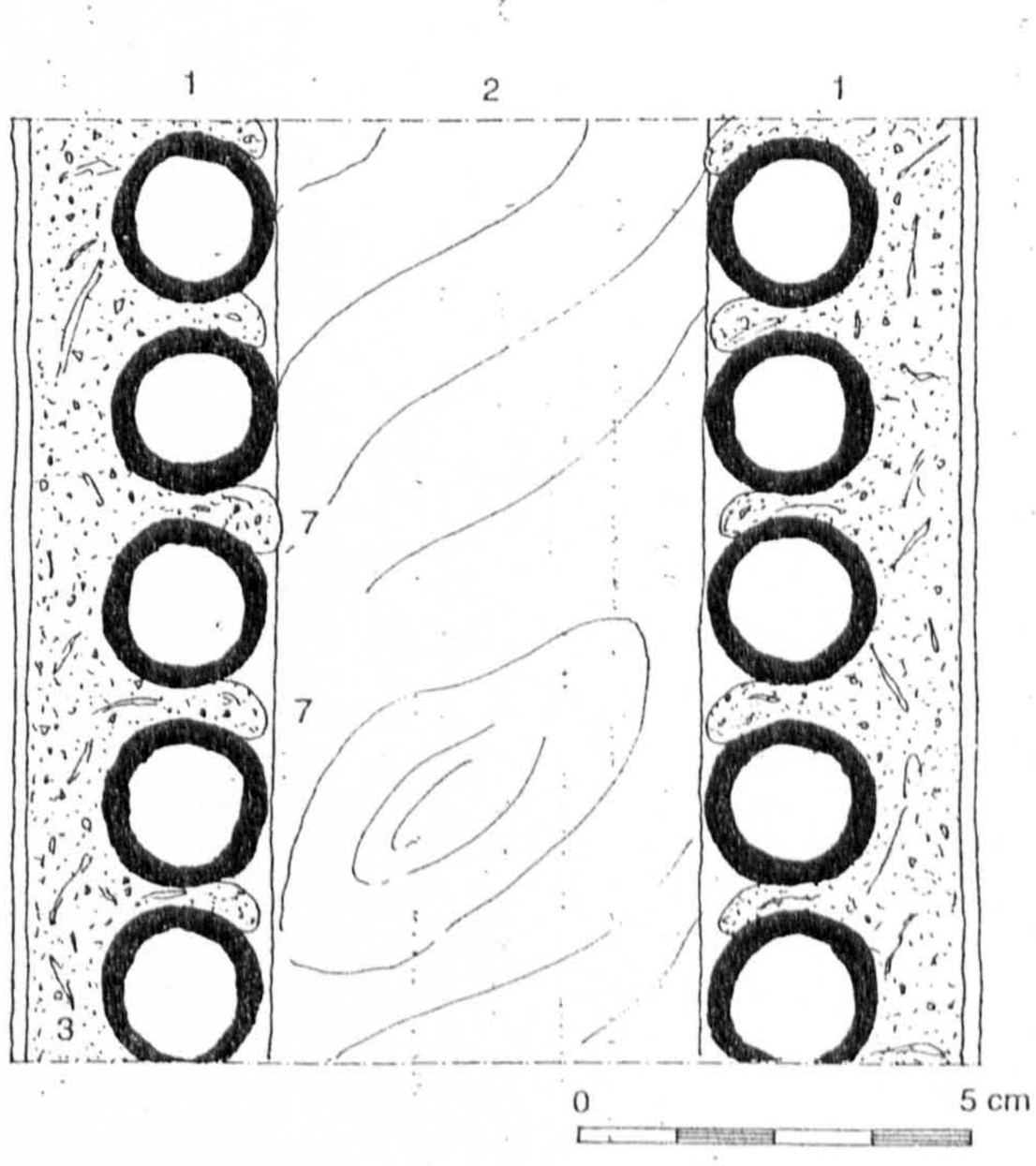
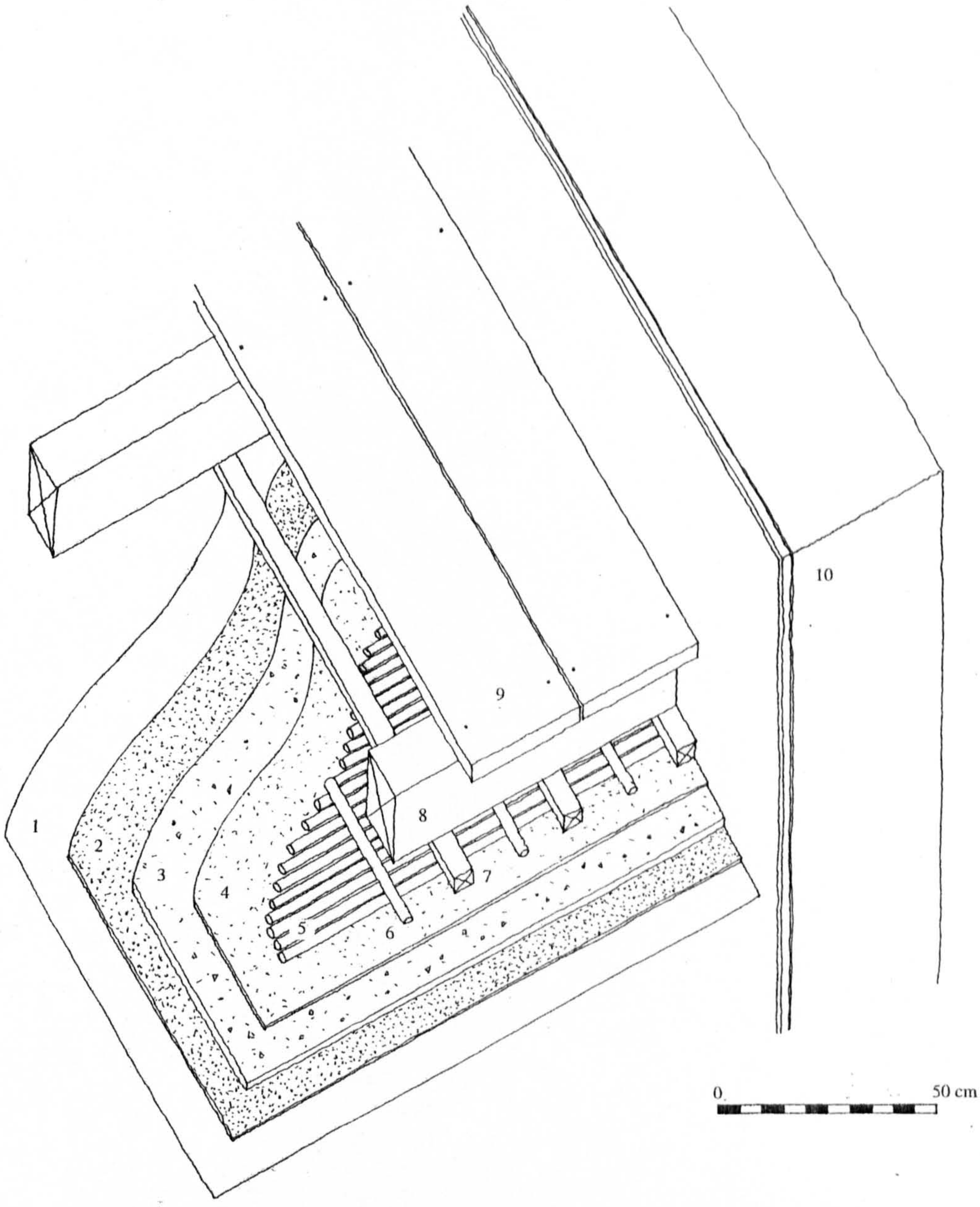


Fig. 3.35. *Tabicu* partitions: (1) timber post fixed to the ceiling and to the floor with nails and wedges, (2) main cane (*canna maistra)*, (3) mud and straw coat, (4) limewash layer, (5) cane sarking, (6) cane sarking fixed to the master cane with rush, (7) mud coat forming a key between two canes



1. Limewash
2. Skim coat
3. Scratch coat
4. Lime slurry
5. Cane sarking
6. Master cane
7. Lath
8. Floor joists
9. Floor boards
10. Mud brick wall

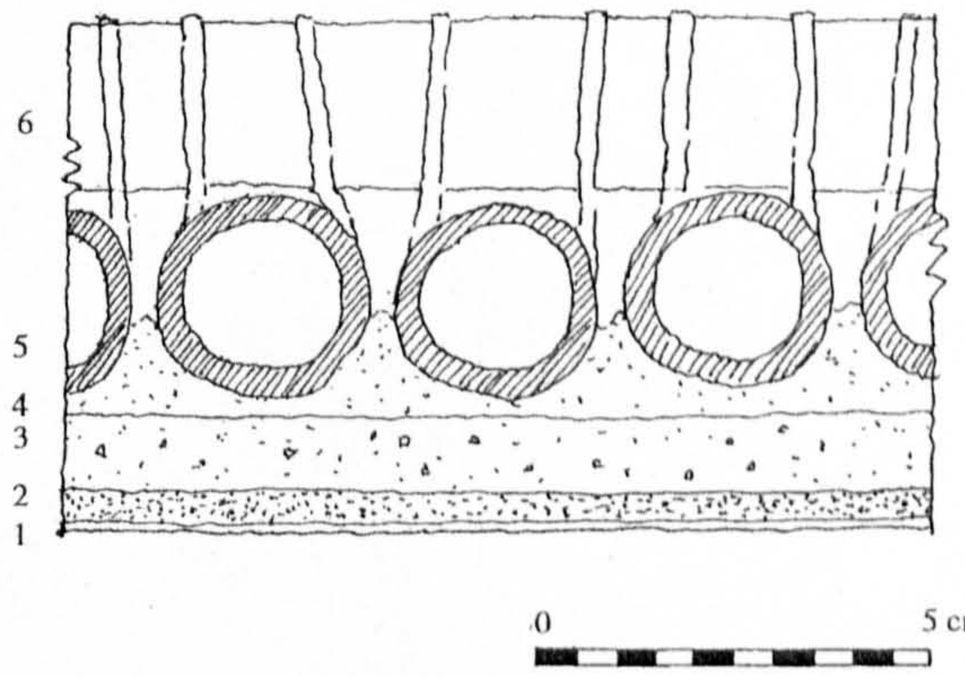


Fig. 3.36. Axonometric view and section of a ceiling

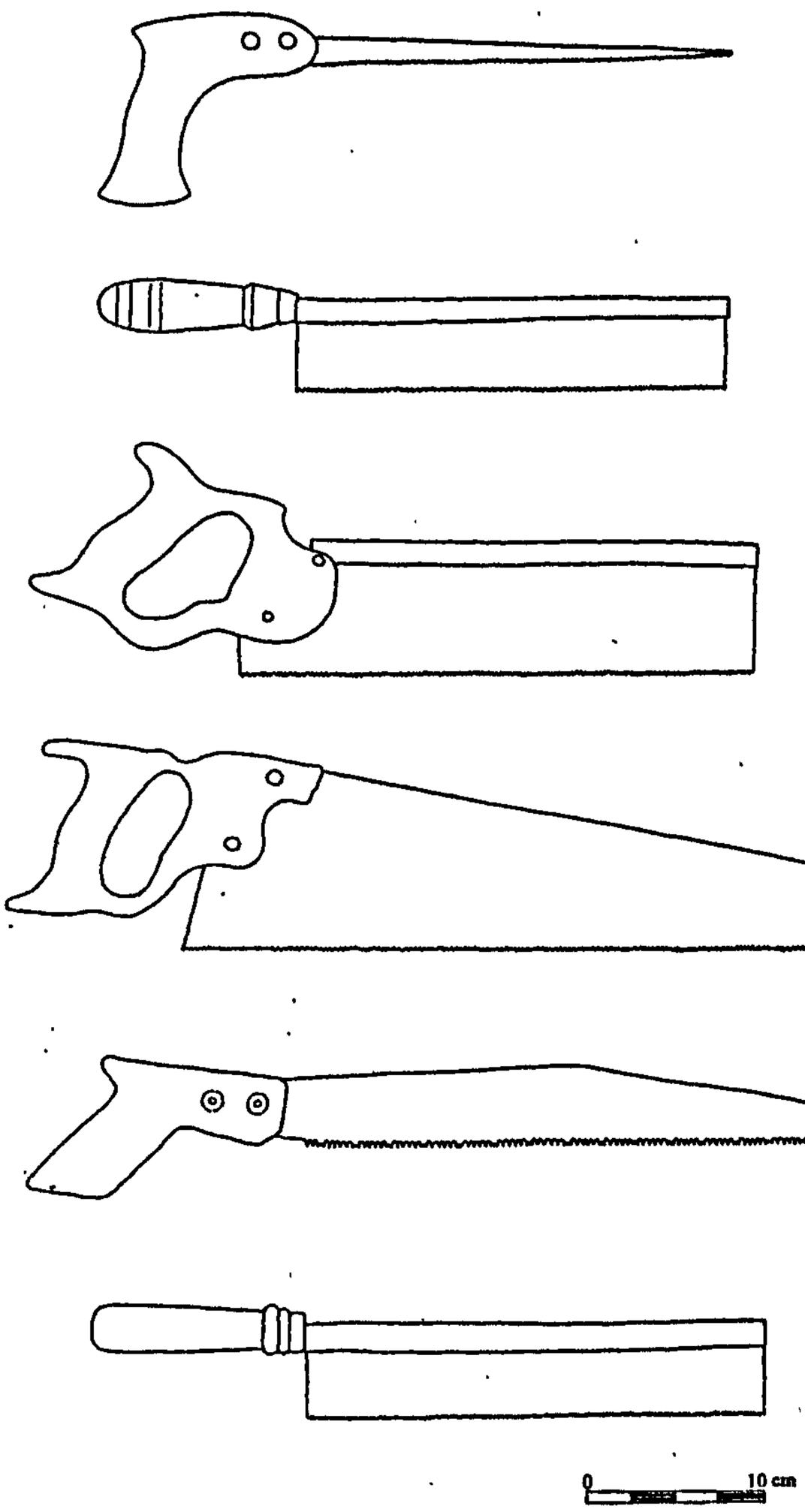


Fig. 3.37. Miscellaneous tools for timber cutting

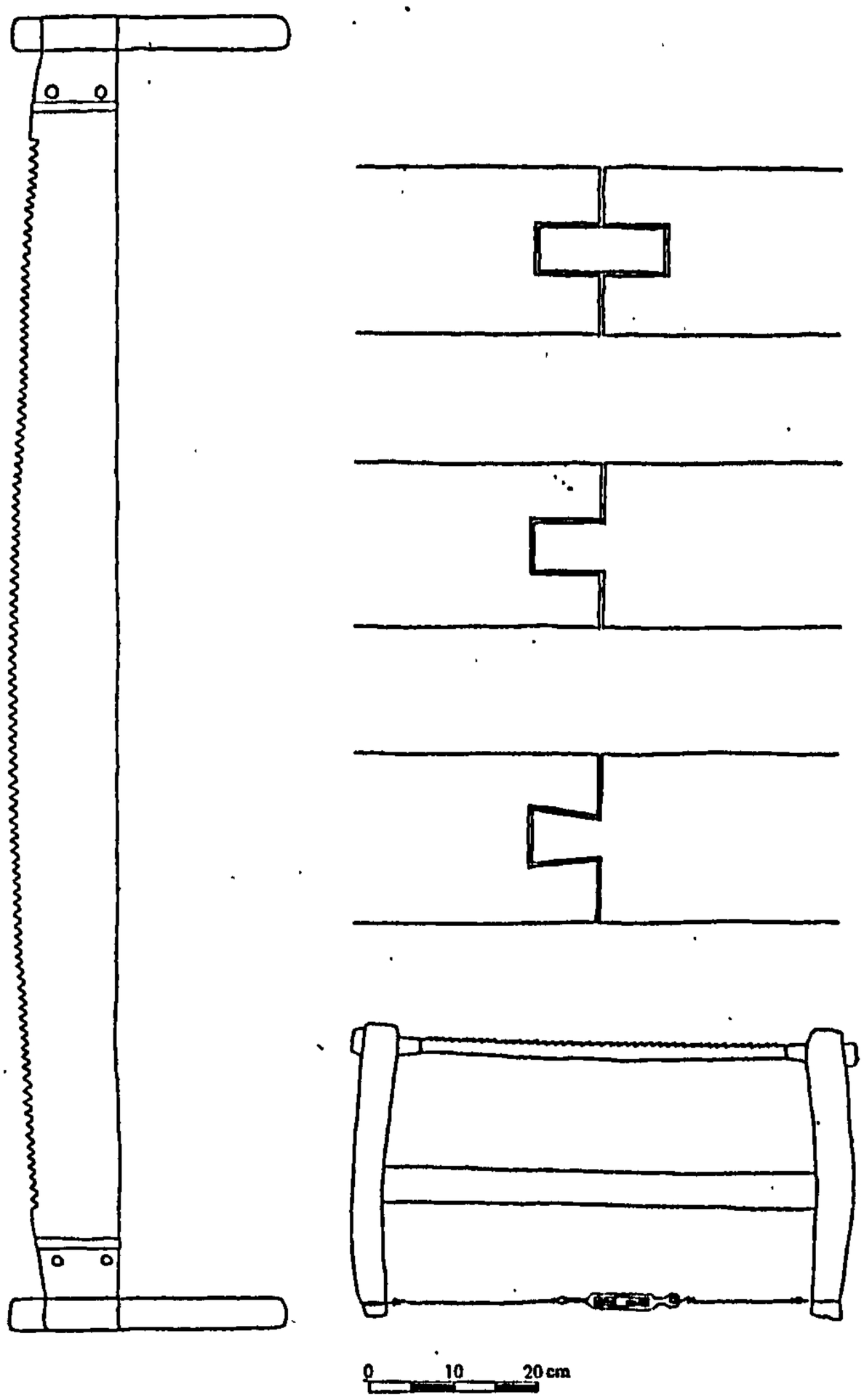


Fig. 3.38. Tools for timber cutting and scarf joints in use in Tortolì: scarf with square and vertical abutments, bridled scarf joint, and dovetail joint

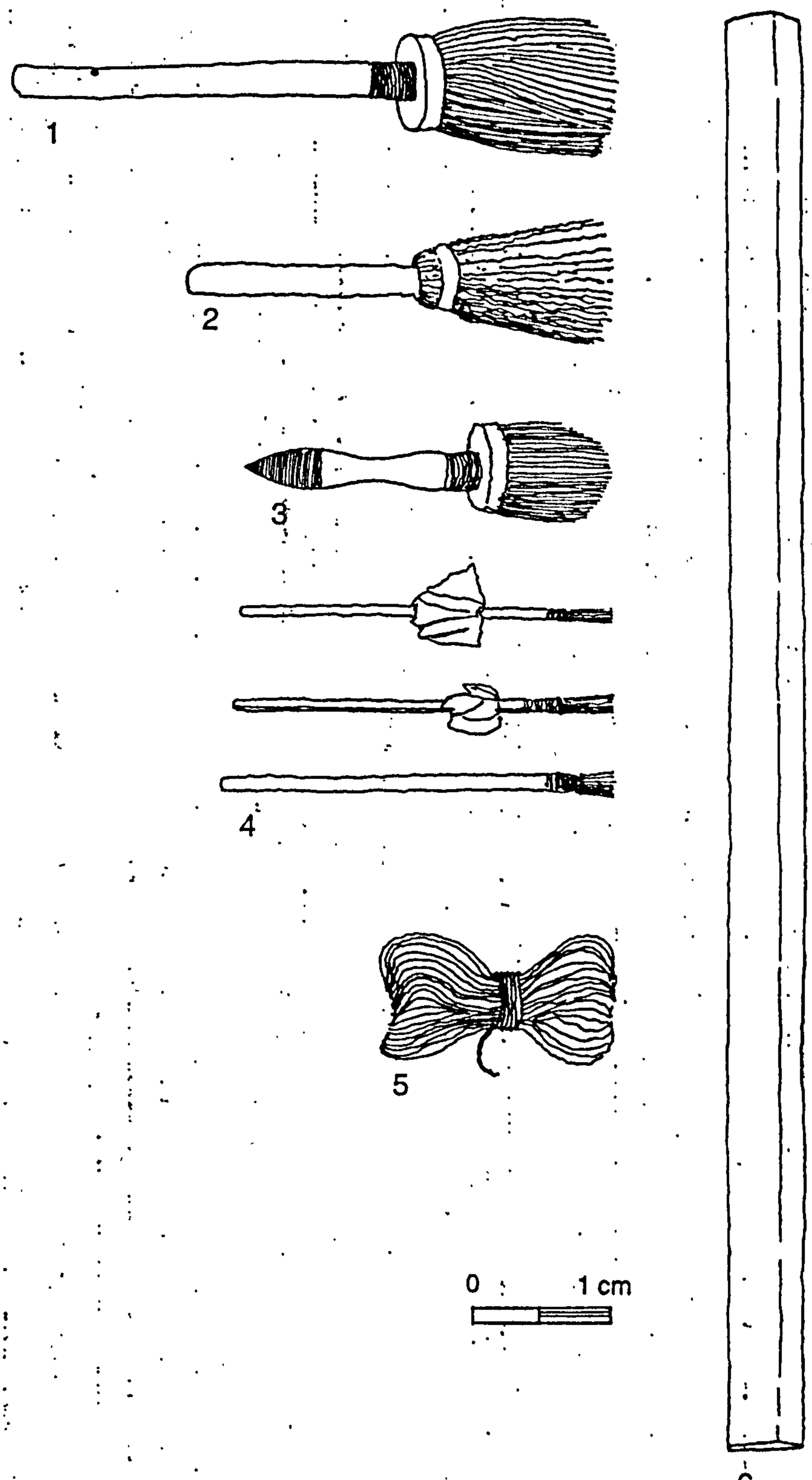


Fig. 3.39. Tools for wall decoration: (1) limewashing brush made of *tampico* hair, (2) limewashing brush made of palm tree hair, (3) ground brush for the application of oil paint on windows, doors and portals, (4) bristle brushes for decorative work showing anti-dripping device, (5) string, (6) ruler

Fig. 3.40. Cover of leaflet showing imported brushes in use in Sardinia (Rivarolo, Genoa, first half of the twentieth century)

ILLUSTRATIONS

CHAPTER 4

QUESTIONNAIRE ANALYSIS AND FREQUENCY DISTRIBUTIONS

Table 4.1. Table showing year of construction of buildings tackled by the questionnaire

Time frame	Count	Percent
1479-1700 (Spanish domination)	1	0.3
1701-1860 (Savoy domination)	15	5.3
1861-1900 (End of Savoy domination - Turn of the century	10	3.5
1901- 1940 (Turn of the century - Start of the second world war)	60	20.8
1941-1945 Second world war	5	1.7
1945-1960 (End of second world war - End of mud-brick making in Sardinia)	26	9
Date unknown	171	59.4
Total	288	100

Table 4.2. Table illustrating names and year of activity of the craftsmen who built the dwellings for which the information was collected through the questionnaire. Not all names of the craftsmen were known by inhabitants

Name of craftsman	Village	Year of activity
Filippo Secci	Selargius	1910
Raimondo Caddeo	S. Gavino	1924
Carmine Serra	Terralba	1927
Pietro Melis	Pabillonis	1928
Francesco Serra	Villasor	1930
Mario Marongiu	Decimoputzu	1931
Virgilio Deidda	Terralba	1938
Angelo Prinzis	Musei	1940
Antonio Saba	Sestu	1940
Antonio Farris	Sestu	1945
Francesco Firinu	Villaspeciosa	1945
Antonio Pascalis	S. Gavino	1946
Silvio Mura	S. Nicolò D'Arcidano	1947
Giulio Porcu	Vallermosa	1948
Graziano Bullita	Sestu	1949
Gesuino Bullita	Sestu	1949
Marino Bullita	Sestu	1949
Francesco Maxia	Musei	1949
Giulio Cuccu	Vallermosa	1949
Aldo Montis	S. Gavino	1950
Mario Angei	S. Gavino	1950
Igino Spiga	Sestu	1950
Teodoro Musiu	Sestu	1950
Antonio Saba	Sestu	1950
Remigio Portas	Musei	1951
Antonio Orrù	S. Gavino	1953
Evaristo Scanu	S. Gavino	1954
Efisio Mura	Marrubiu	1956

Table 4.3. Table illustrating the popularity of use of modern materials (synthetic paints, cement) and of traditional materials (lime, earth) in the conservation of traditional buildings of Campidano today

Repair methods	Count	Percent
Modern materials	172	59.7
No repair carried out since construction	65	22.6
Traditional materials	43	14.9
Unknown	8	2.8
Total	288	100

Table 4.4. Table showing the number of buildings protected by historic centre regulation

Protection	Count	Percent
Yes	137	47.6
No	85	29.5
Unknown	66	22.9
Total	288	100

Table 4.5. Table illustrating the location of lavatory facilities

Location	Count	Percent
In the building	192	66.6
Outside the building	63	21.8
N/A	33	11.4
Total	288	100

Table 4.6. Table showing materials used for the construction of plinths

Materials	Count	Percent
Stone	238	82.6
Fired brick	6	2.1
Concrete	4	1.4
Unknown	40	13.9
Total	288	100

Table 4.7. Table illustrating the main symptoms of decay of plinths (total number is not 288 because several plinths were found to be affected by more than one symptom). Percentages were calculated using 288 as a total number of plinths

Decay symptom	Count	Percent
Rising damp	188	65.2
Cracking	49	17
Erosion of joints	40	13.8
Decomposition of joints	14	4.8
Stains (internal)	10	3.4
Ground level change	6	2.1
Vegetation growth (external)	4	1.3
N/A	21	7.2

Table 4.8. Table illustrating materials used for the construction of walls

Materials	Count	Percent
Mud brick	202	70.1
Fired brick and mud brick	16	5.6
Concrete block and mud brick	15	5.3
Stone and mud brick	13	4.5
Concrete and mud brick	5	1.7
N/A	37	12.8
Total	288	100

Table 4.9. Table showing main symptoms of decay of walls

Decay symptom	Count	Percent
Cracks (major and minor)	62	21.5
Decomposition	27	9.3
Rising damp over plinth level	26	9
Basal erosion	14	4.7
Rodent damage	12	4.2
Collapse	12	4.2
Stains	7	2.4
Vegetation growth	7	2.4
Leaning walls	1	0.3
N/A	120	41.7
Total	288	100

Table 4.10. Table showing the type of coating system (interior and exterior)

Materials	Count	Percent
Lime plaster	123	42.7
Cement plaster	115	39.9
Mud plaster	19	6.6
Tile cladding	1	0.4
Unknown	30	10.4
Total	288	100

Table 4.11. Table showing the type of interior and exterior wall paint

Materials	Count	Percent
Synthetic paint	182	63.2
Limewash	63	21.9
Unknown	43	14.9
Total	288	100

Table 4.12. Table showing main decay symptoms of all types of coats (a more detailed analysis is illustrated on Table 40, 41 and 42).
Total number is not 288 because several coats were found to show no symptoms, and also because several coats were found to have more than one symptom.

Decay symptom	Count	Percent
Flaking/scaling	97	33.6
Erosion	40	13.8
Cracking	29	10
Decomposition	19	6.6
Stains (internal)	5	1.7
Vegetation growth (external)	2	0.7
Missing plaster	1	0.3
No symptom	132	45.8

Table 4.13. Table showing materials used for the construction of wall corners

Materials	Count	Percent
Mud brick	186	64.6
Fired brick	17	5.9
Concrete block	12	4.2
Concrete	10	3.5
Stone	9	3.1
Unknown	54	18.7
Total	288	100

Table 4.14. Table illustrating main decay symptoms of wall corners

Decay symptom	Count	Percent
Cracks (major and minor)	24	8.3
Erosion of joints between bricks	10	3.5
Edge detachment	9	3.1
N/A	16	5.6
No symptom	229	79.5
Total	288	100

Table 4.15. Tables showing materials used for the construction of rough door openings

Materials	Count	Percent
Mud brick	150	52.1
Fired brick	52	18
Concrete	31	10.8
Stone	11	3.8
Concrete block	8	2.8
Unknown	36	12.5
Total	288	100

Table 4.16. Table showing the level of decay of joinery and ironmongery of doors

Level of decay	Count	Percent
Low	183	63.5
Moderate	51	17.7
High	8	2.8
N/A	46	16
Total	288	100

Table 4.17. Table illustrating materials used for the construction of rough window openings

Materials	Count	Percent
Mud brick	156	54.2
Fired brick	47	16.3
Concrete	27	9.4
Stone	13	4.5
Concrete block	6	2.1
Unknown	39	13.5
Total	288	100

Table 4.18. Table illustrating materials used for the construction of window frames

Material	Count	Percent
Original timber	95	33
New timber	40	13.9
Alluminum	13	4.5
PVC	9	3.1
Original timber + alluminum	43	14.9
Original timber + new timber	20	6.9
Original timber + PVC	3	1.1
Other	65	22.6
Total	288	100

Table 4.19. Table showing the decay level of the joinery and ironmongery of windows

Level of decay	Count	Percent
Low	164	56.9
Moderate	72	25
High	19	6.6
N/A	33	11.5
Total	288	100

Table 4.20. Table showing portal shapes

Shape	Count	Percent
Round arch	46	16
Concrete lintel	40	13.9
Three-centred arch	17	5.9
Timber lintel	7	2.4
N/A (buildings with no portal)	178	61.8
Total	288	100

Table 4.21. Table showing materials used for the construction of portals' spandrels and abutments
(110 is the total number of tackled buildings that were characterised by an entrance portal)

Materials	Count	Percent
Mud brick	43	39.1
Concrete	30	27.3
Fired brick	14	12.7
Stone	14	12.7
Concrete block	8	7.3
Unknown	1	0.9
Total	110	100

Table 4.22. Table showing materials used for the construction of portal plinths
(total number is not 110 because some portals plinths were found to have been built with more than one material)

Materials	Count	Percent
Stone	42	38.1
Concrete	35	31.8
Fired brick	25	22.7
Mud brick	8	7.2
Cement block	4	3.6

Table 4.23. Table showing materials used for the construction of portal arches

Materials	Count	Percent
Stone	36	32.7
Fired brick	29	26.4
Concrete	20	18.2
Mud brick	7	6.4
Concrete block	3	2.7
Unknown	15	13.6
Total	110	110

Table 4.24. Table illustrating materials used for the construction of portals doors

Materials	Count	Percent
Original timber door	83	75.4
New metal door	22	20
New timber door	5	4.6
Total	110	100

Table 4.25. Table showing façade decorative elements
Total number is not 288 because several buildings were found to have more than one decoration type

Description	Count	Percent
Floor string course	18	6.3
Moulding	9	3.1
Pilaster	4	1.4
Stuccowork	3	1
Terracotta	3	1
N/A (no façade decoration)	270	93.7

Table 4.26. Façade decorative patterns: condition report
Percentages are calculated using 18 as the total number of buildings characterised by decorative elements

Level of decay	Count	Percent
High	0	0
Moderate	6	33.3
Low	5	27.8

Table 4.27. Analysis of ambulatories shapes

Shapes	Count	Percent
Posts and beam	44	15.3
Three-centered arch	14	4.9
Round arch	5	1.7
N/A (buildings without ambulatory)	225	78.1
Total	288	100

Table 4.28. Table showing materials used for the construction of ambulatory walls
Total number is not 288 because the number of buildings characterised by an ambulatory was found to be 63

Materials	Count	Percent
Concrete	34	54
Fired brick	11	17.5
Mud brick	10	15.9
Stone	3	4.8
Cement block	1	1.5
Unknown	4	6.3
Total	63	100

Table 4.29. Table illustrating materials for the construction of ambulatory plinths
Total number is not 288 because the number of buildings characterised by an ambulatory was found to be 63

Materials	Count	Percent
Concrete	36	57.1
Fired brick	17	27
Stone	6	9.5
Mud brick	2	3.2
Unknown	2	3.2
Total	63	100

Table 4.30. Table showing level of decay of ambulatories
Total number is not 288 because the number of buildings characterised by an ambulatory was found to be 63

Level of decay	Count	Percent
Low	47	74.6
Moderate	14	22.2
High	2	3.2
Total	63	100

Table 4.31. Table showing shapes of roofs

Shape	Count	Percent
Pitched roof	254	88.2
Flat roof	3	1
Unknown	31	10.8
Total	288	100

Table 4.32. Table showing materials used for the construction of the structural elements of roofs

Materials	Count	Percent
Timber	200	69.4
Concrete	57	19.8
Unknown	31	10.8
Total	288	100

Table 4.33. Table indicating materials used for roofing

Materials	Count	Percent
Traditional roof tile	167	58
Corrugated iron	50	17.4
Pan tile	31	10.8
Unknown	40	13.8
Total	288	100

Table 4.34. Table showing decay symptoms of roof structures
Total number is not 288 because several roofs were found showing no symptoms

Decay symptom	Count	Percent
Water ingress	91	31.6
Nests (birds, redents)	67	23.3
Damp ingress	29	10.1
Vegetation growth	16	5.5
N/A	28	9.7

Table 4.35. Table showing type of descendants

Location	Count	Percent
External to the wall	241	83.7
In the wall	4	1.4
N/A	43	14.9
Total	288	100

Table 4.36. Table illustrating the level of decay of descendants

Level of decay	Count	Percent
Low	172	59.7
Moderate	56	19.5
High	16	5.5
N/A	44	15.3
Total	288	100

Table 4.37. Analysis of courtyards paving systems

Materials	Count	Percent
Concrete paving	194	67.4
Earth	42	14.6
Cobble	22	7.4
Fired brick	15	5.3
N/A	15	5.3
Total	288	100

Table 4.38. Table showing classification of coats and their porosity

	Degree of porosity of coats	Wall material	Coat type (int. and ext.)	Wall paint (int. and ext.)	Count
A	High	*Làdiri*	mud	limewash	4
B	High	*Làdiri*	lime	limewash	41
C	Low	*Làdiri*	cement	limewash	10
D	Low	*Làdiri*	cement	synthetic	70
E	Medium	*Làdiri*	mud	synthetic	10
F	Medium	*Làdiri*	lime	synthetic	53

Table 4.39. Table illustrating decay symptoms of *ladiri* walls in function of the coat type

Decay symptom	A	B	C	D	E	F
Basal erosion	0 (0%)	14 (34.1%)	0 (0%)	2 (2.8%)	0 (0%)	1 (1.9%)
Wall decomposition	0 (0%)	8 (19.5%)	10 (100%)	1 (1.4%)	0 (0%)	1 (1.9%)
Cracks (min. and maj.)	0 (0%)	14 (34.1%)	3 (30%)	18 (25.7%)	1 (10%)	11 (20.7%)
Stains on wall	1 (25%)	2 (4.9%)	0 (0%)	0 (0%)	0 (0%)	1 (1.9%)
Vegetation on wall	0 (0%)	3 (7.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Wall collapse	0 (0%)	9 (21.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Leaning wall	0 (0%)	0 (0%)	10 (100%)	0 (0%)	0 (0%)	0 (0%)
Rising damp	1 (25%)	8 (19.5%)	1 (10%)	6 (8.6%)	1 (10%)	3 (5.7%)
Rodents damage	0 (0%)	6 (14.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table 4.40. Table showing external plaster decay

Decay symptom	Lime	Cement	Mud
Erosion	22 (17.9%)	12(10.4)	5 (26.3%)
Decomposition	11 (8.9%)	7 (6.1%)	1 (5.3%)
Cracks	16 (13%)	10 (8.7%)	3 (15.8%)
Stains	3 (2.4%)	0 (0%)	1 (5.3%)
Vegetation	1 (0.8%)	0 (0%)	1 (5.3%)
Complete detachment	1 (0.8%)	0 (0%)	0 (0%)
Partial detachment	47 (38.2%)	42 (36.5%)	7 (36.8%)

Table 4.41. Plaster rough data

Plaster decay	A	B	C	D	E	F
Plaster decomposition	0 (0%)	6 (14.6%)	0 (0%)	4 (5.7%)	1 (10%)	1 (1.9%)
Plaster stains	0 (0%)	2 (4.9%)	0 (0%)	0 (0%)	1 (10%)	0 (0%)
Plaster detachment	2 (50%)	23 (56%)	10 (100%)	26 (37.1%)	3 (30%)	53 (100%)

Table 4.42. Plaster decay (external) in function of time

Time span (T)	Lime	Cement	Mud	Tiles	Total
1900<T<1939	41%	51.7%	7.1%	0%	99.8%
1940<T<1960	42.8%	48.5%	8.5%	0%	99.8%

Table 4.43. Number of cases showing rising damp by capillary action at plinth level as affected by the courtyard paving system

Covering material for courtyards pavings	Count / Percent
Concrete	133 (70.7%)
Earth	23 (12.2%)
Cobble	14 (7.4%)
Fired brick/tiles	0 (0%)

Table 4.44. Table representing those buildings located in the historic centre and protected by conservation regulation, in order to check if they have been repaired with traditional materials

Conservation work	Count	Percent
With traditional materials	25	18.2
With modern materials	75	54.7
No conservation carried out	34	24.8

Table 4.45. Roof: nature of decay

Decay symptom	Sardinian roof tiles	Corrugated iron	Pan tiles
Water ingress	65 (38.9%)	14 (28%)	2 (6.4%)
Damp ingress	25 (15%)	3 (6%)	0 (0%)
Nests (birds, rodents)	53 (31.7%)	11 (22%)	2 (6.4%)
Vegetation	15 (10%)	0 (0%)	0 (0%)

Table 4.46. Table illustrating list of interviews with craftsmen and practitioners. The village/town indicates where the interview was undertaken.

Name	Skill	Village/Town	Date of interview
Diego Agattau	engineer	Pirri	30 September 1998
Antonio Argiolas	stone mason	Serrenti	7 September 1999
Daniela Aru	architect	Cagliari	25 August 2000
Antonio Atza	traditional carpenter	Dolianova	1 September 1999
Antonio Atzori	tile maker	Sili	10 September 1998
Giovanni Atzori	wall painter	Monserrato	19 August 1999
Ubaldo Badas	Director, Archaeological Museum of Villanovaforru	Villanovaforru	3 September 1999
Fabrizio Cadeddu	Engineer	Cagliari	15 March 2000, August 2000, January 2001
Mariano Carta	tile and ladiri maker	Villaurbana	10 September 1998
Ruggero Carboni	tile maker	Sili	10 September 1998
Sarah Carruthers	Carruthers Conservation, Pertshire	York	13 March 1998
Luciano Casula	master craftsman	Assemini	9 September 1998, 24 August 1999
Pierino Casula	master craftsman	Nuraminis	8 September 1998, 30 August 1999
Rodolfo Ciucciomei	traditional craftsman, Cagliari	Sestu	27 October 1998
Mark Clitherow	traditional craftsman	York	22 January 1998
Giorgio Corongiu	stone mason	Serrenti	18 August 1999
Venanzio Curreli	master craftsman	San Gavino	18 August 1999
Ignazio Garau	architect, Cagliari	Villamassargia	11 June 1998
Luigi Garau	traditional craftsman	Cabras	24 October 1998
Richard Harris	Research Director, Downland Open Air Museum, Singleton	York	10 March 1998 (*)
John Hurd	Conservator, Swaby	York	9 February 1998 (*) 13 January 1999 8 February 1999 18 May 1999 (**) 4 April 1999 21 February 2000 (*)
Rob Ley	Traditional craftsman, Lincolnshire	York	18 May 1999 (**)
Alessandro Liggi	master craftsman	Samassi	3 October 1998
Ignazio Madeddu	tile maker	Sili	24 October 1998
Angelico Medda	ladiri maker	Serramanna	17 August 1999
Giuseppe Medda	stone mason	Serrenti	14 August 1999

Salvatore Medda	master craftsman	Settimo San Pietro	14 March 2000
Elvio Murgia	master craftsman	Serramanna	17 August 1999
Raffaele Murgia	master craftsman	Dolianova	1 September 1999
Salvatore Murgia	kiln builder	Sili	6 November 1999
Gesuè Muscas	master craftsman	San Sperate	25 August 1999
Luigi Nioi	tile maker	Assemini	24 September 1997, 16 June 1998
Lucio Ortu	architect	Cagliari	March 2000, 24 August 2000, 7 January 2000
Salvatore Pibiri	tile maker	Segariu	7 September 1998
Lino Pillosu	lime burner	Nuraminis	8 September 1998, 30 August 1999
Salvatore Porcu	wall painter	Monserrato	25 October 1998
Claudio Puggioni	tile maker	Sili	6 November 1998
Erminio Putzu	quarryman	Serrenti	14 August 1999
Gilberto Quarneti	consultant, Venice	Cagliari	19 June 1998 (***)
Enrico Sanna	lime burner	Nuraminis	16 August 1999
Luciano Sanna	tile maker	Sili	6 November 1998
Giulia Setzu	engineer	Cagliari	23 August 2000
Dante Sotgia	master craftsman	Villamassargia	11 June 1998, 13 June 1998, 25 August 1999
Miriam Spano	engineer	Cagliari	23 August 2000
Pietro Spano	tile maker	Sili	6 November 1998
Benigno Spina	ladiri maker	Assemini	24 August 1999
Antonio Tiddi	master craftsman	Sinnai	15 March 2000
Pietro Tiddia	stone mason	Serrenti	16 August 1999
Angelo Tratzi	tile maker	Sili	6 November 1998
Carlo Tronchetti	Director, Archaeological Museum of Cagliari	Cagliari	9 March 2000
Elvio Usai	tile maker	Assemini	24 September 1997
Efisio Vacca	master craftsman	Samassi	10 June 1998
Alceo Vado	Architect	Selargius	23 August 2000
Albino Zuddas	wall painter	Monserrato	28 October 1999
Dr Bruce Walker	Architect	York	21 February 2000 (*)
John Warren	Consultant, Sussex	York	23 February 2000 (*)

(*) Lecture, Centre for Conservation, Department of Archaeology, University of York.

(**) Seminar, *Repair Methods for Earthen Buildings: the State of the Art*. Event organised by the author at the Centre for Conservation, Department of Archaeology, University of York.
(***) Seminar, *L'Architettura Bioecologica per il Rispetto dell'Ecosistema, Informazione e Sensibilizzazione*, Hotel Caesar's, Cagliari

Table 4.47. List of villages where the questionnaire was completed

Name of village	*Number of completed questionnaires*
Assemini	1
Capoterra	1
Decimoputzu	16
Domusnovas	2
Maracalagonis	8
Marrubiu	3
Monastir	3
Monserrato	10
Musei	14
Nuraminis	8
Pabillonis	7
Pimentel	4
Quartu S.Elena	4
S.Gavino	33
S.Nicolò d'Arcidano	18
S.Sperate	3
Samassi	13
Samatzai	5
Selargius	7
Serdiana	12
Serramanna	7
Sestu	15
Settimo S.Pietro	2
Siliqua	6
Sinnai	11
Terralba	13
Uras	14
Ussana	12
Uta	9
Vallermosa	10
Villamassargia	8
Villasor	5
Villaspeciosa	4
Total number of completed questionnaires:	**288**

Other villages visited include: Cabras, Collinas, Dolianova, Donori, Elmas, Furtei, Gesturi, Gonosfanadiga, Guasila, Guspini, Lunamatrona, Mogoro, Quartucciu, Sanluri, Sardara, Segariu, Serrenti, Tuili, Villacidro, Villamar, Villanovaforru, Villanovafranca.

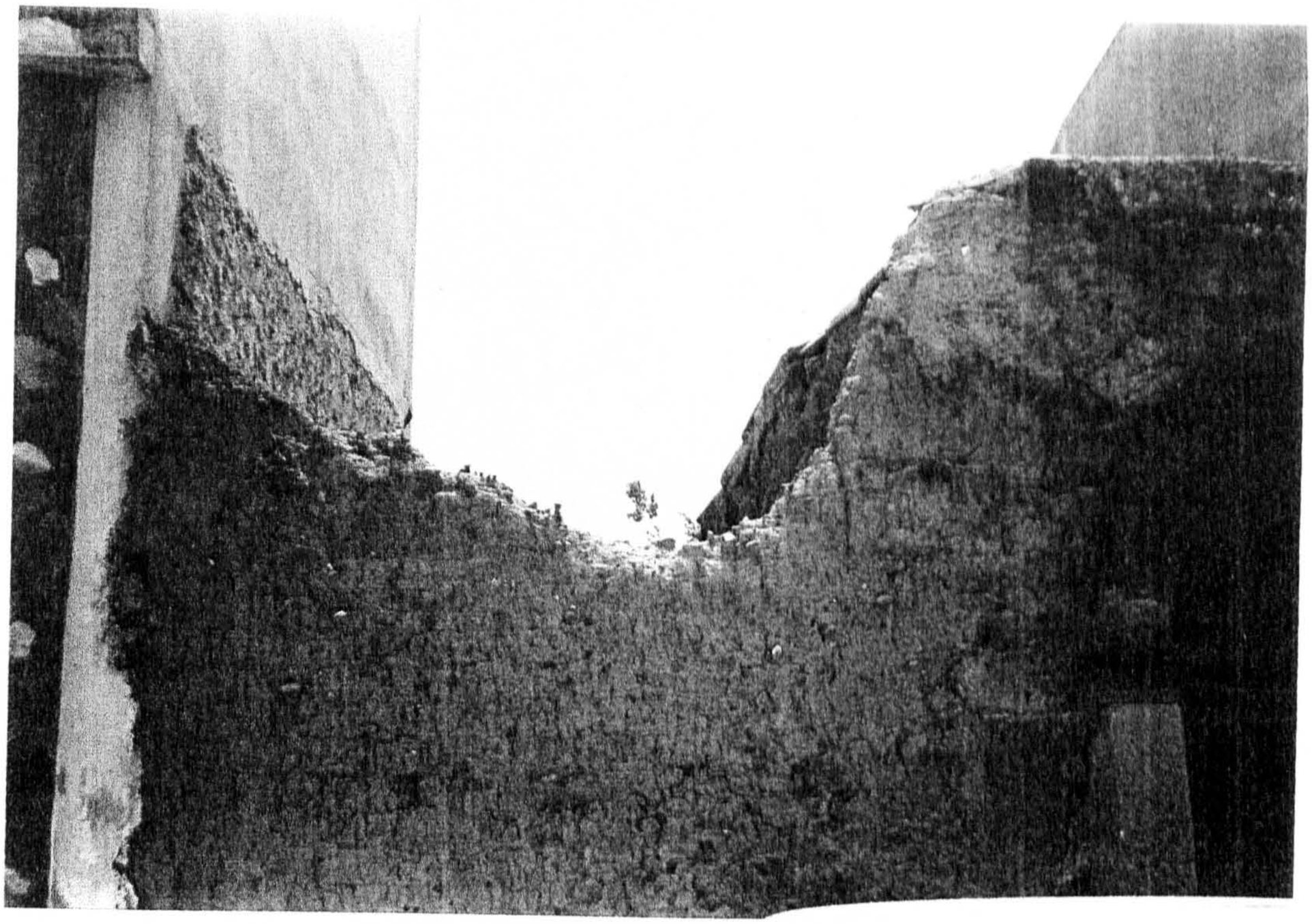


Fig. 4.1. Wall erosion caused by lack of maintenance of coping tiles (San Sperate, Cagliari)

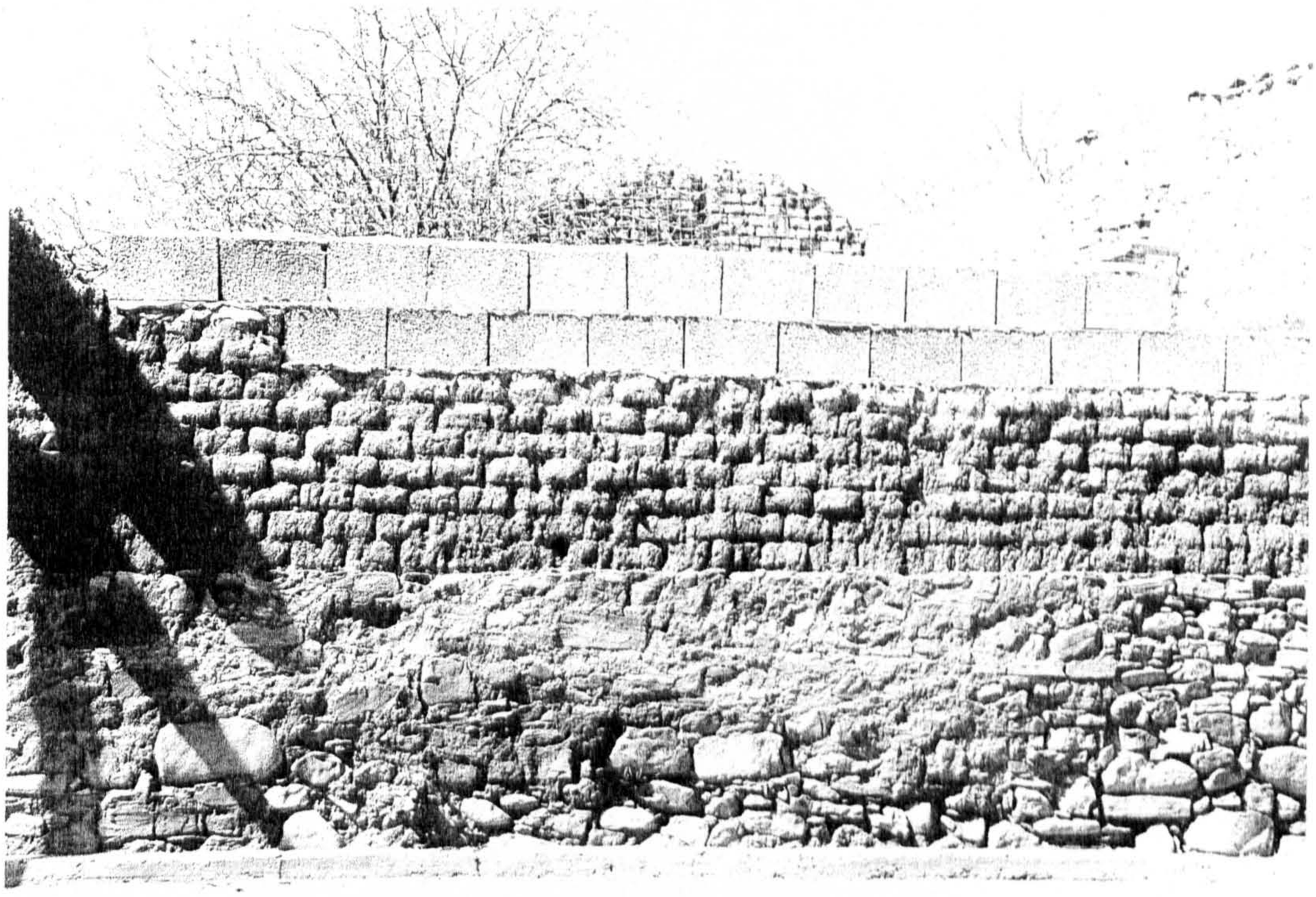


Fig. 4.2. The three building materials of contemporary Campidano: cement blocks, *làdiri*, and stone (Ussana, Cagliari)

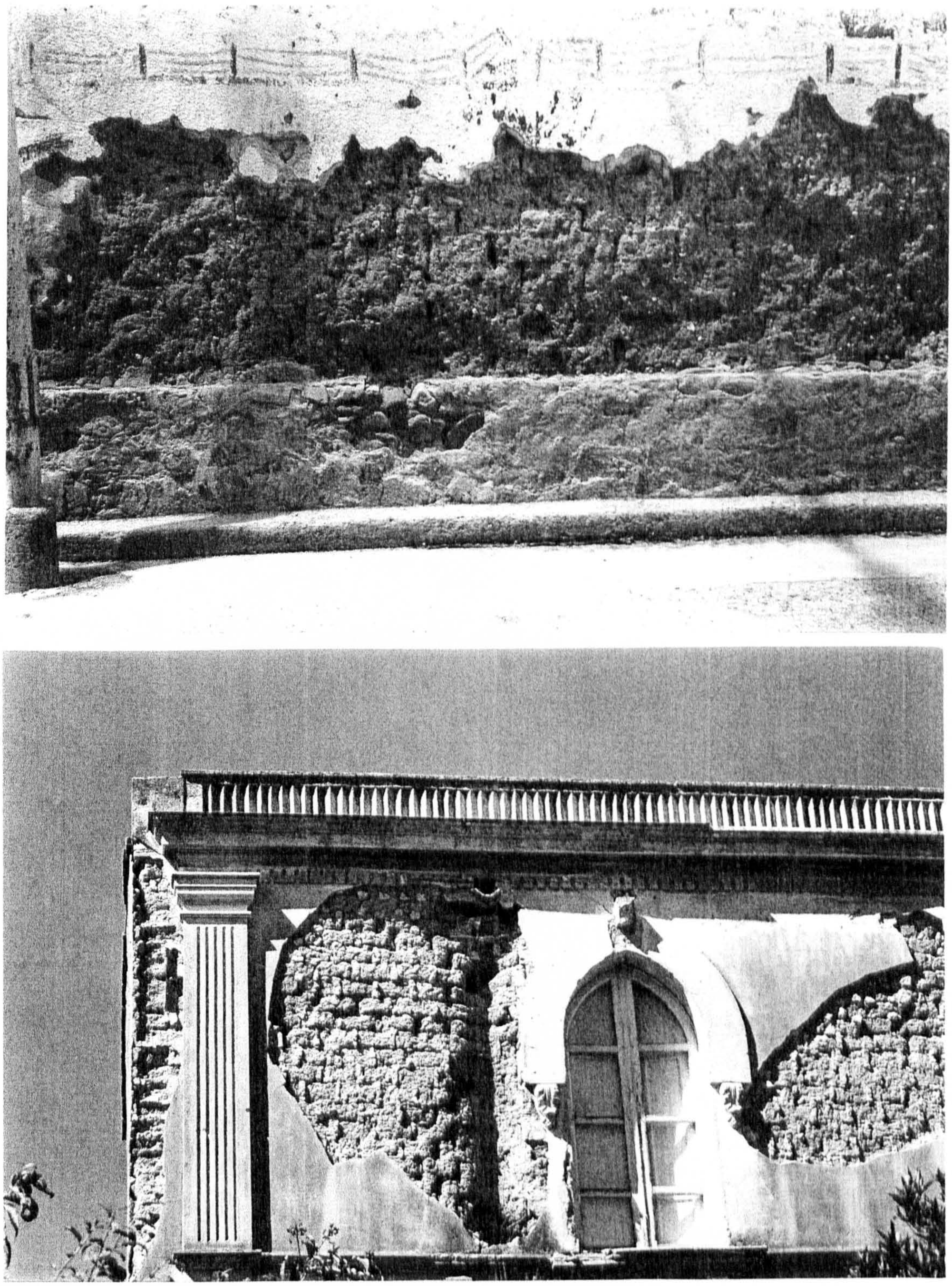


Fig. 4.3. Rising damp at plinth level (San Sperate, Cagliari)

Fig. 4.4. Lack of maintenance of gutters is causing serious erosion to this building located in Samatzai (Cagliari)

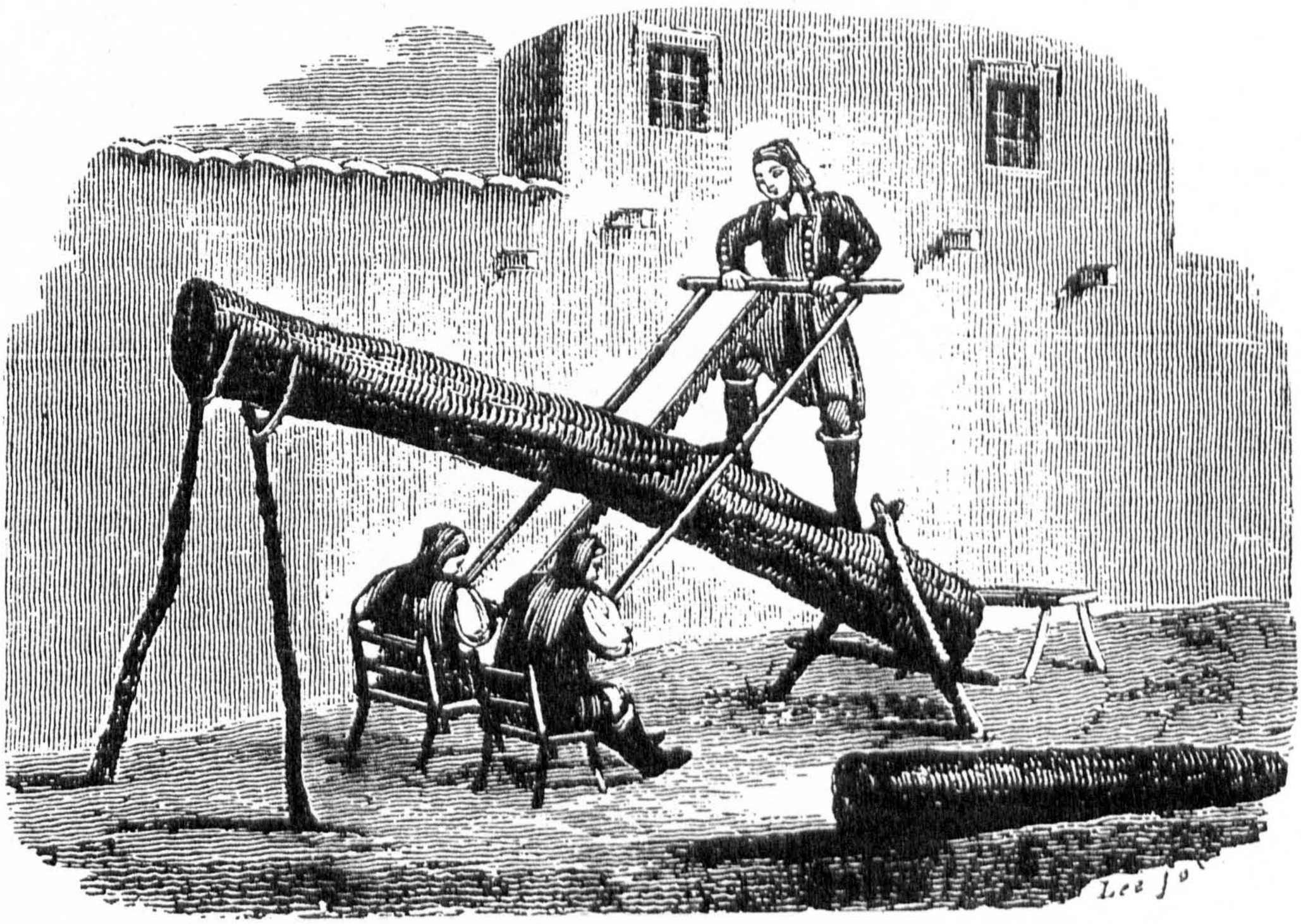
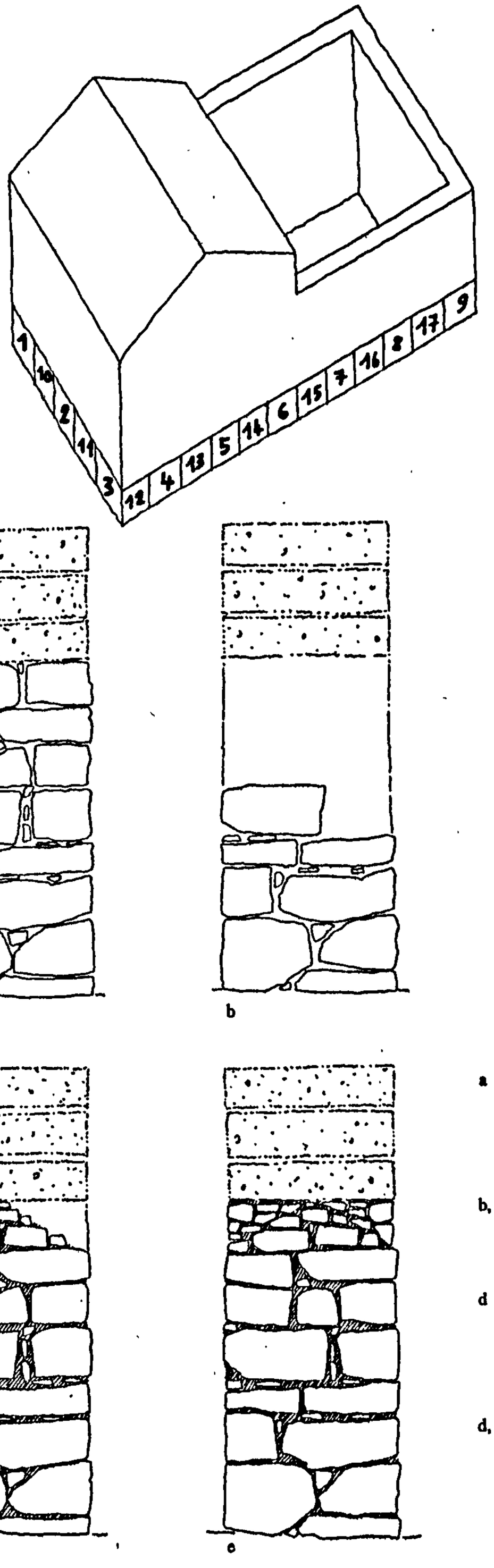


Fig. 4.5. Engraving from *Sketch of the Present State of the Island of Sardinia* (Smyth 1998, 161)

ILLUSTRATIONS
CHAPTER 5



a plinth affected by either deep erosion, or rising damp, or salt attack

b, c plinth stones are removed without need of shoring

d the plinth is rebuilt with the same (or similar) stone and new mortar

d, e the last stone course is built with battered faces on both sides and packed in with tile or stone wedges

Fig. 5.1. Traditional repair method for stone plinths affected by either deep erosion of joints, or rising damp, or salt attack

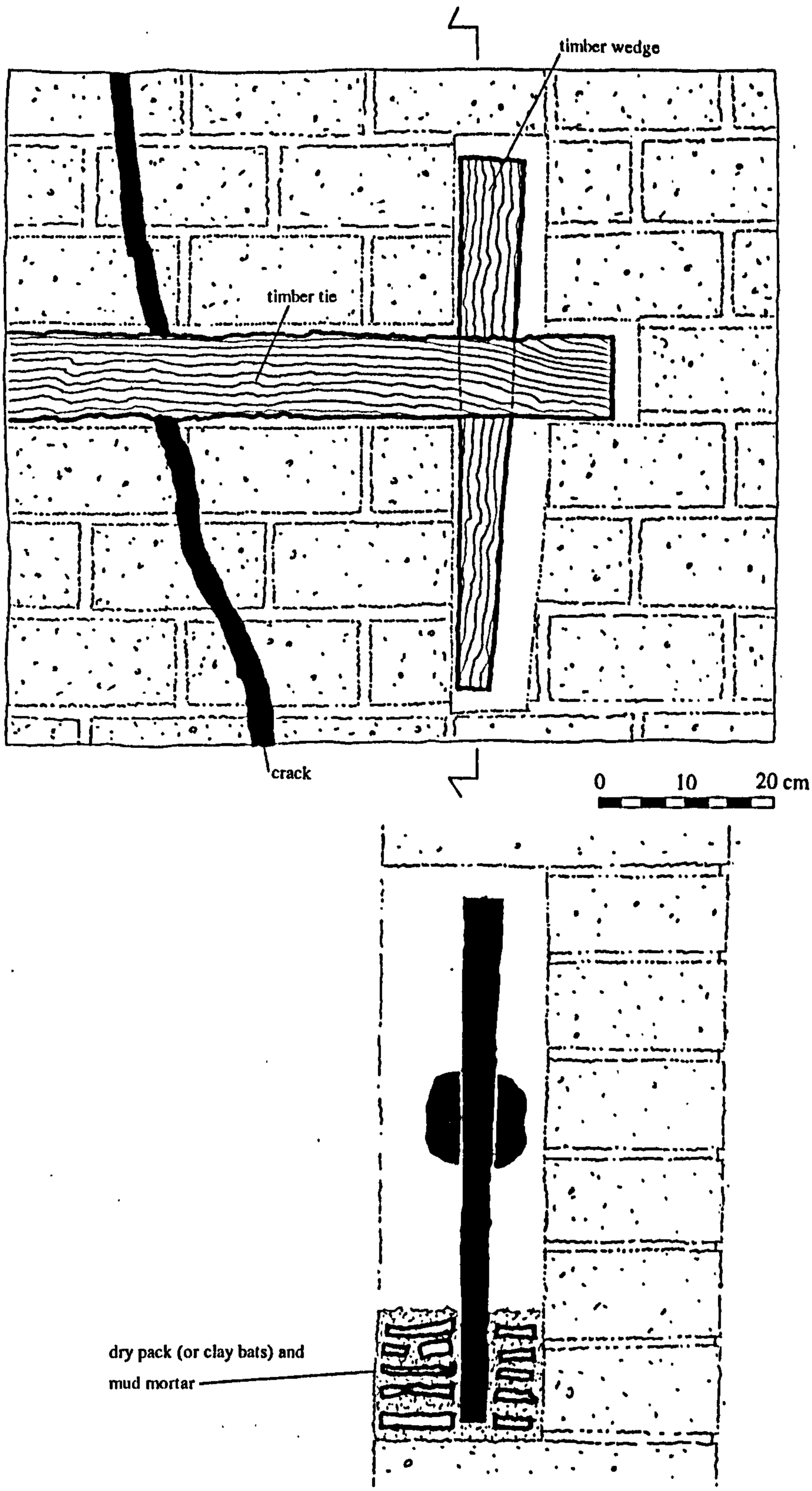
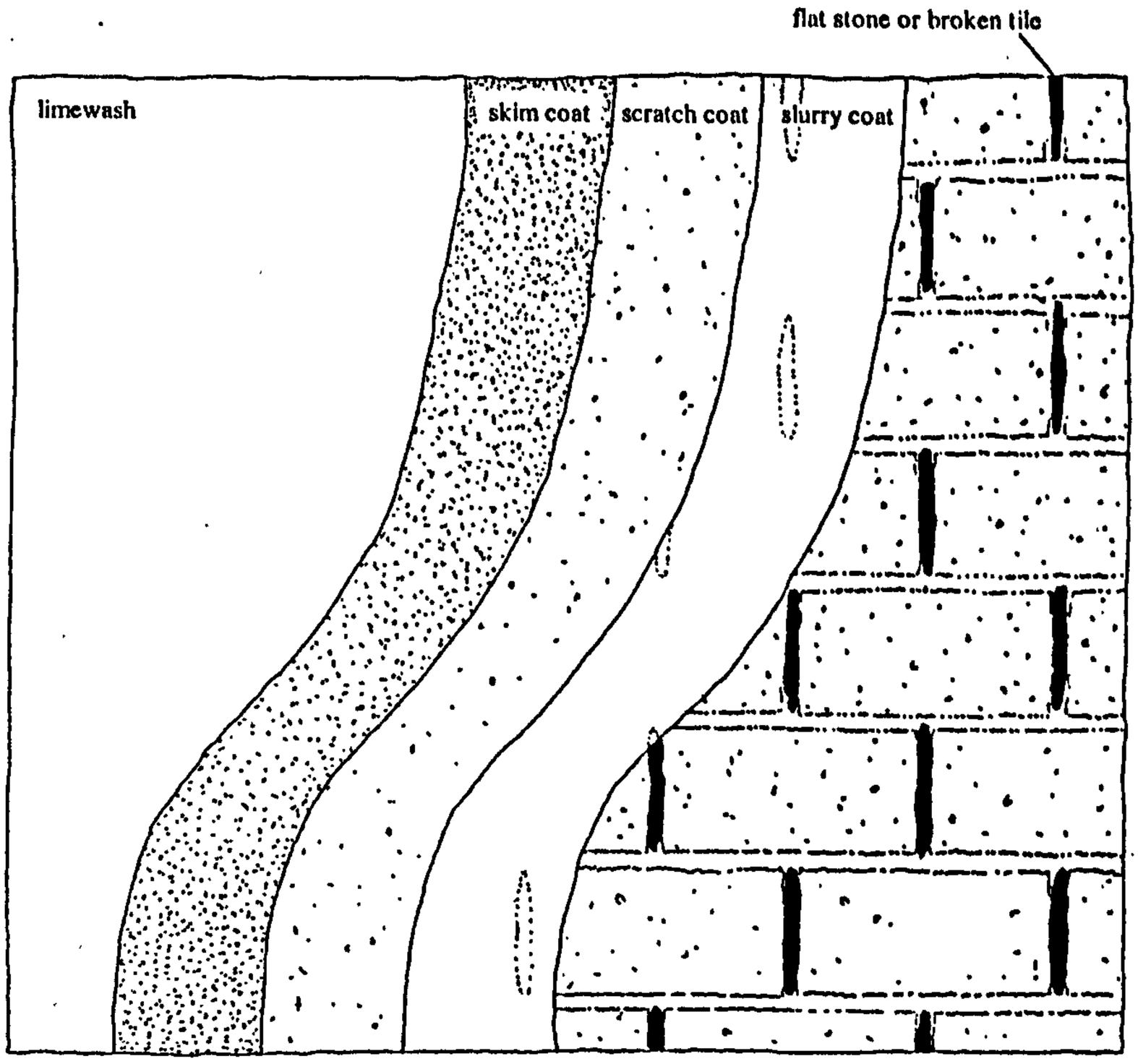
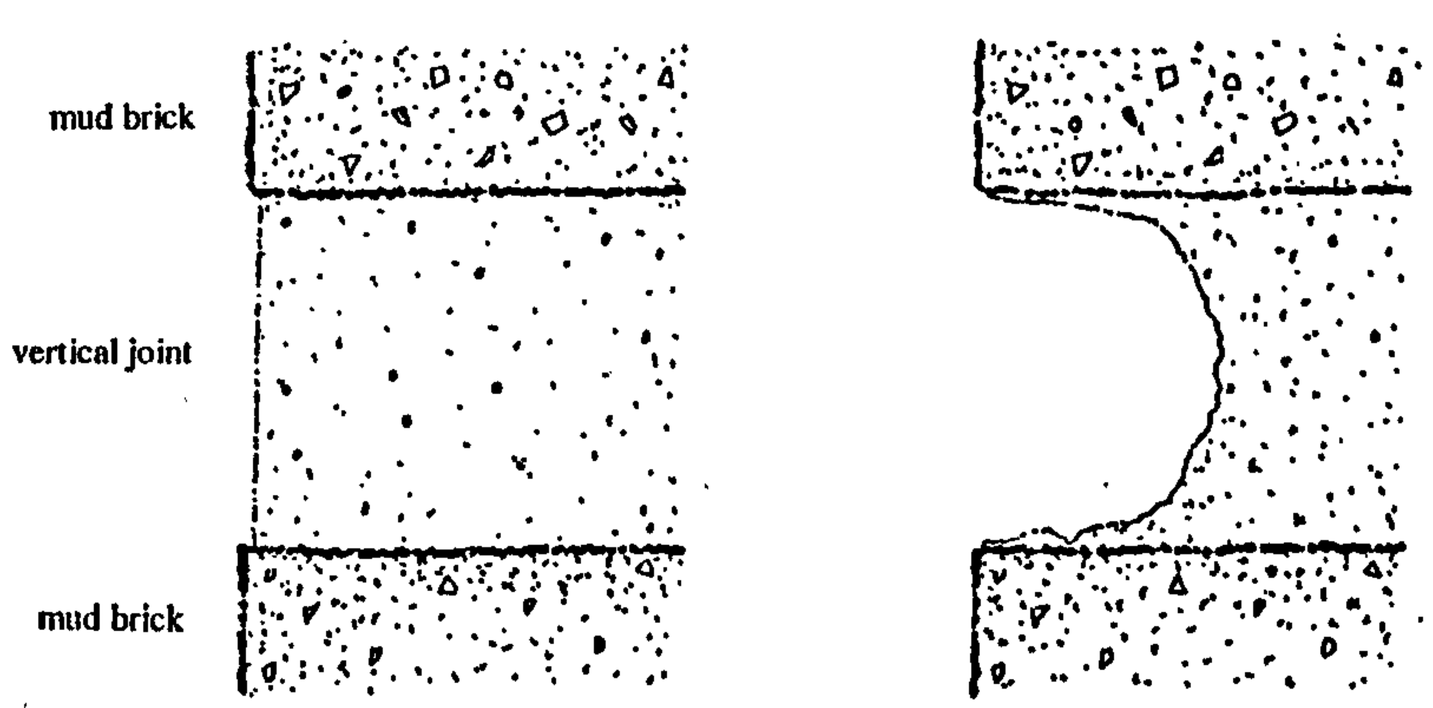


Fig. 5.2. Traditional method for repairing structural cracks





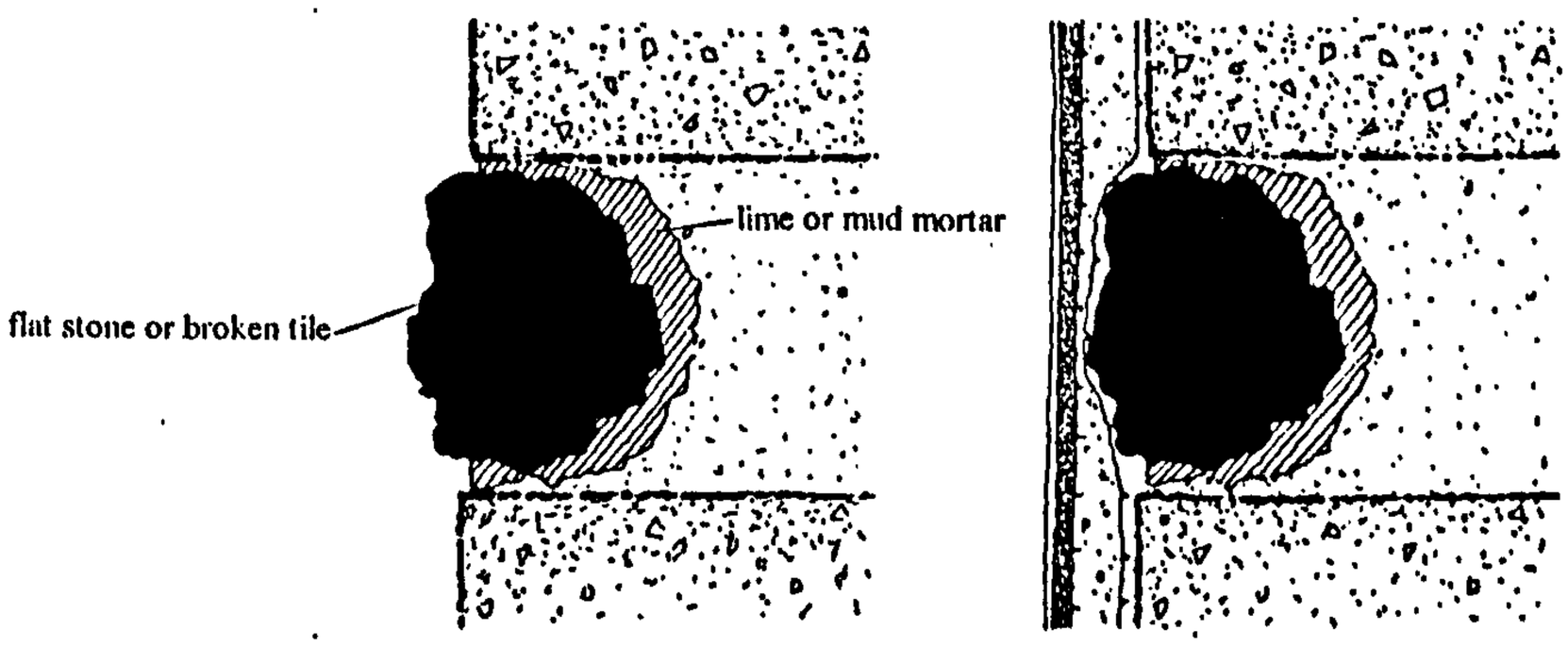


Fig. 5.3. Traditional method for the re-rendering of slightly eroded *làdiri* walls

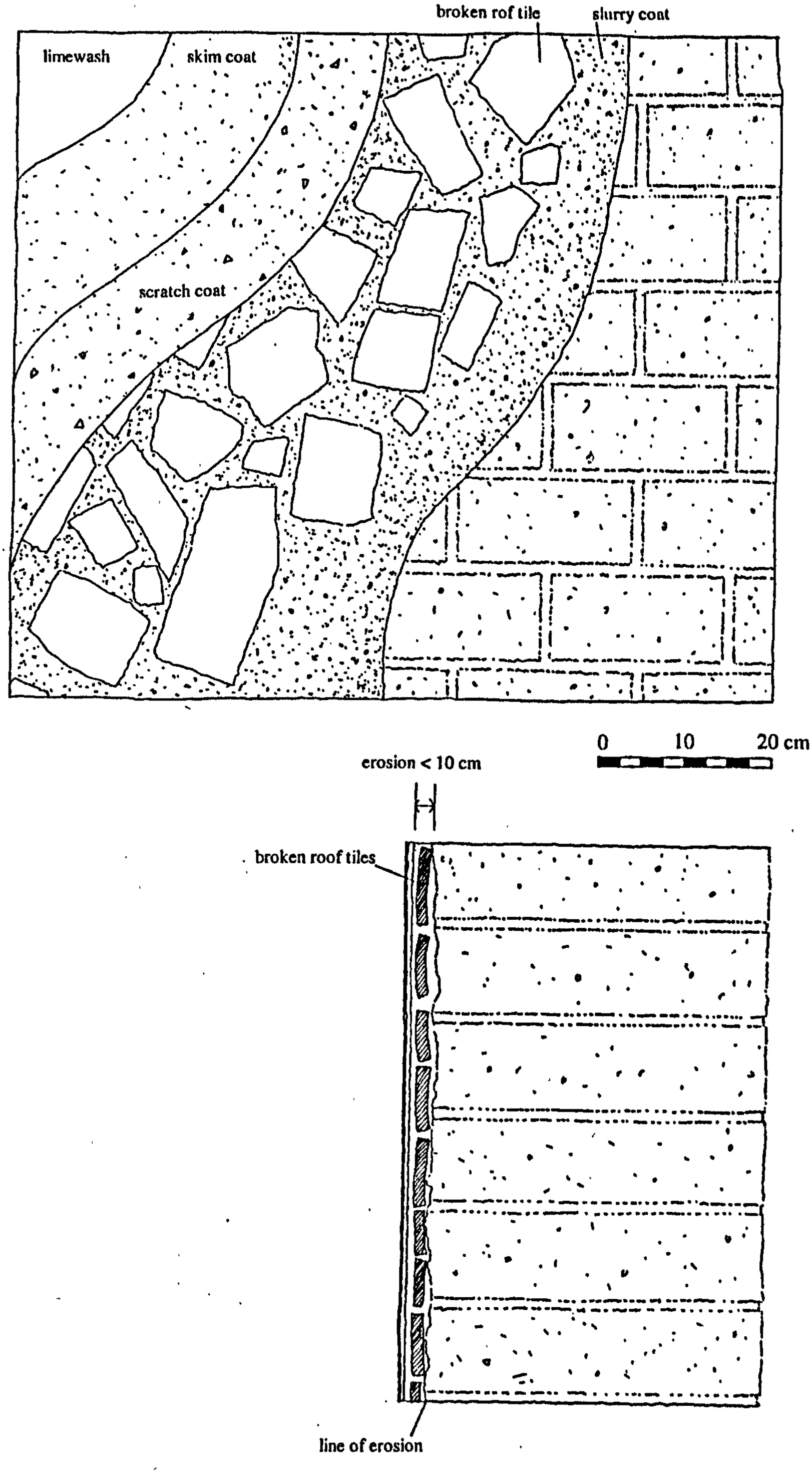


Fig. 5.4. Traditional method for the repair of shallow erosion (<10cm) of *làdiri* walls

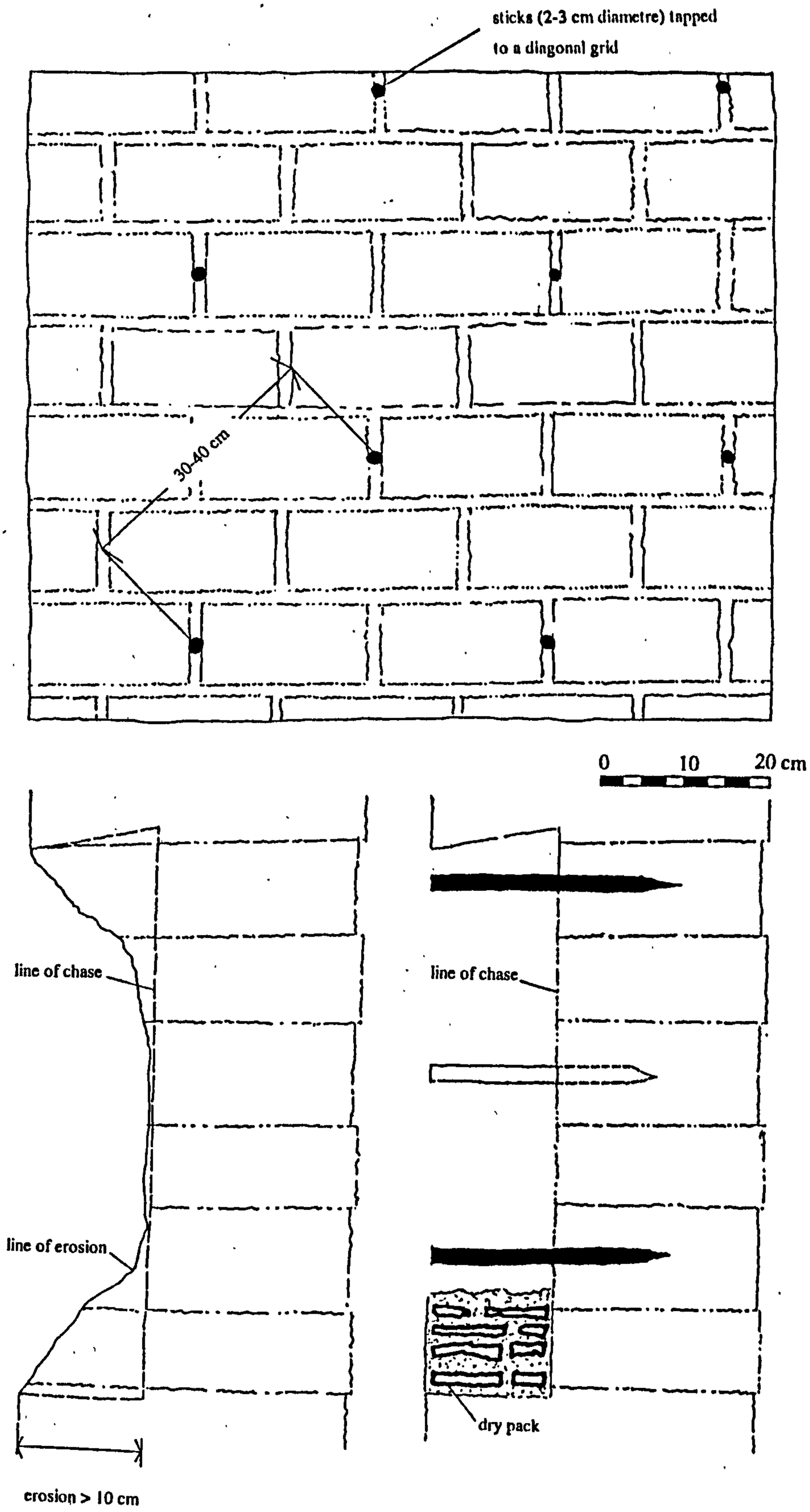


Fig. 5.5. Traditional method for repairing deeply eroded *làdiri* walls

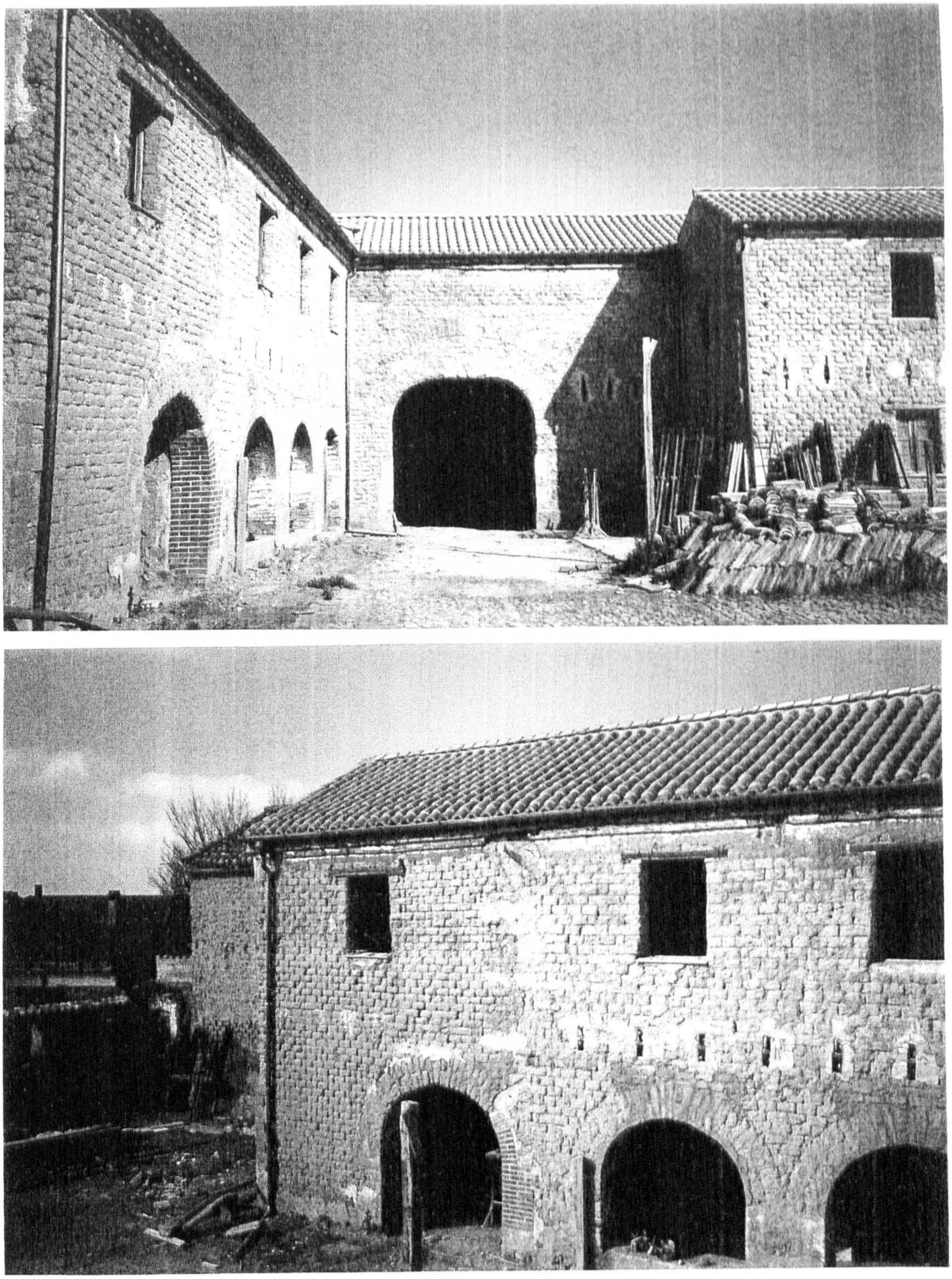
Fig. 5.6. Traditional method for replacing decayed mud bricks as carried out by Master Craftsman Efisio Vacca (Casa Piras, Samassi), see also Fig. 5.7 (Copyright photograph: Soprintendenza ai Beni Ambientali, Architettonici, Artistici, e Storici di Cagliari e Oristano)

Fig. 5.7. Traditional method for replacing decayed mud bricks as carried out by Master Craftsman Efisio Vacca (Casa Piras, Samassi), see also Fig. 5.6 (Copyright photograph: Soprintendenza ai Beni Ambientali, Architettonici, Artistici, e Storici di Cagliari e Oristano)

ILLUSTRATIONS
CHAPTER 6

CASE STUDY A

CASA CADONI-ARCAIS
SERRAMANNA



Figs. 6.1. Casa Cadoni Arcais, Serramanna (Cagliari). North wing seen from the courtyard showing entrance portal

Figs. 6.2. Casa Cadoni Arcais, Serramanna (Cagliari). West wing showing anchoring of floor joists and roof trusses by means of steel ties bedded in cement mortar

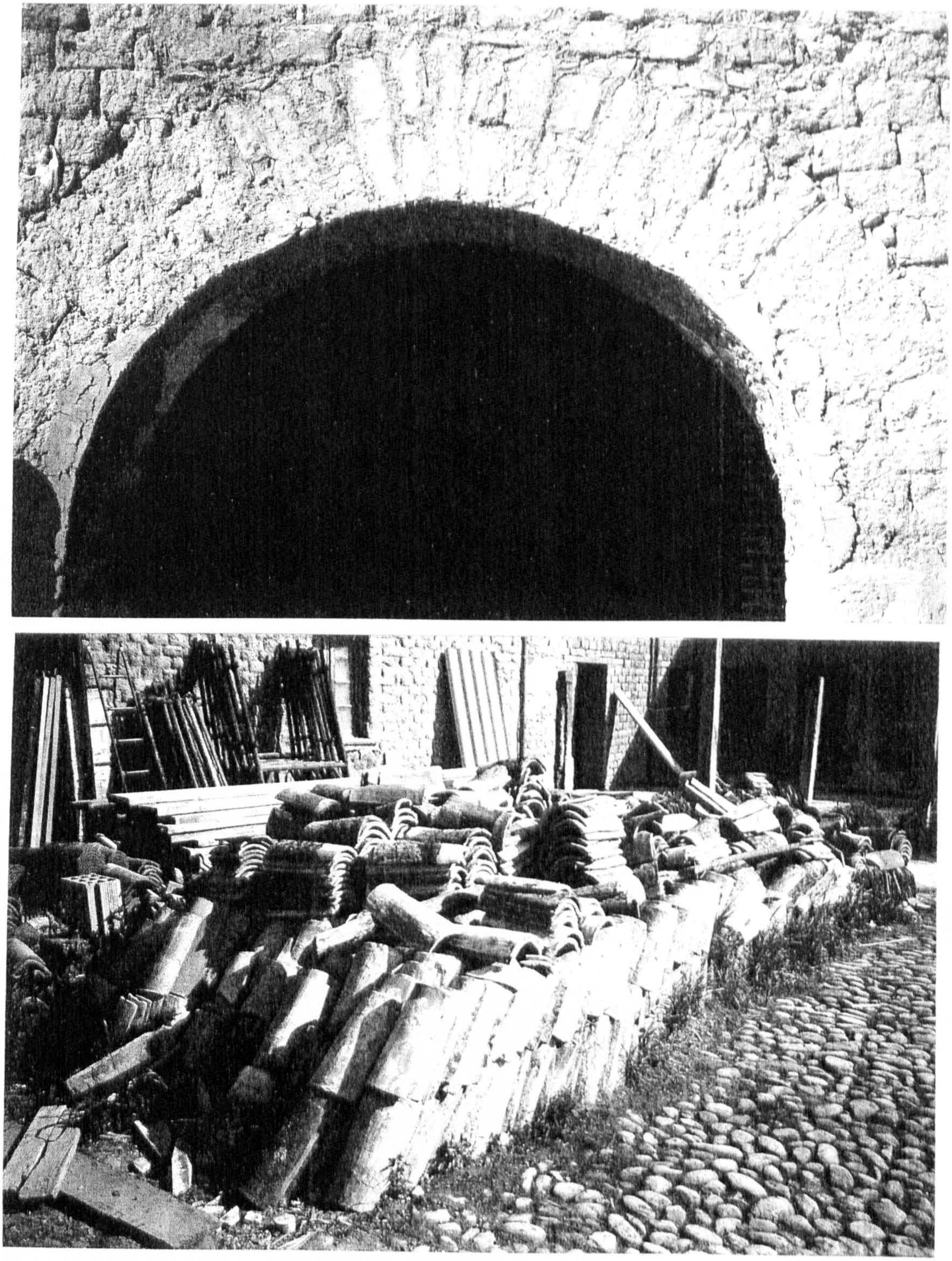


Fig. 6.3. Casa Cadoni Arcais, Serramanna (Cagliari). Picture illustrating employment of new *làdiri* brick (on the right hand side of the picture) for replacing decayed fabric

Fig. 6.4. Casa Cadoni Arcais, Serramanna (Cagliari). Sound historic roof tiles were removed, stacked, and replaced by new tiles

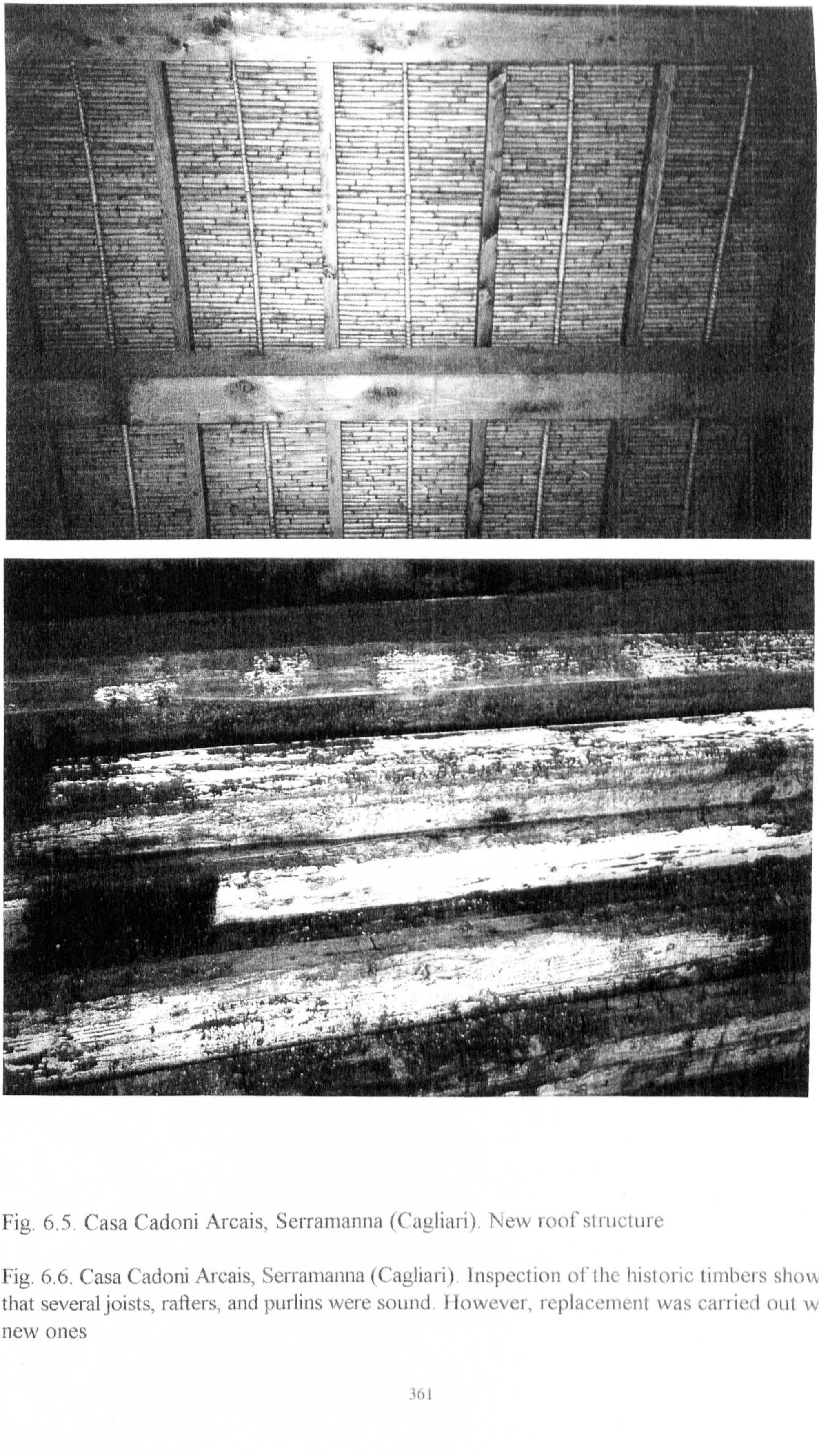
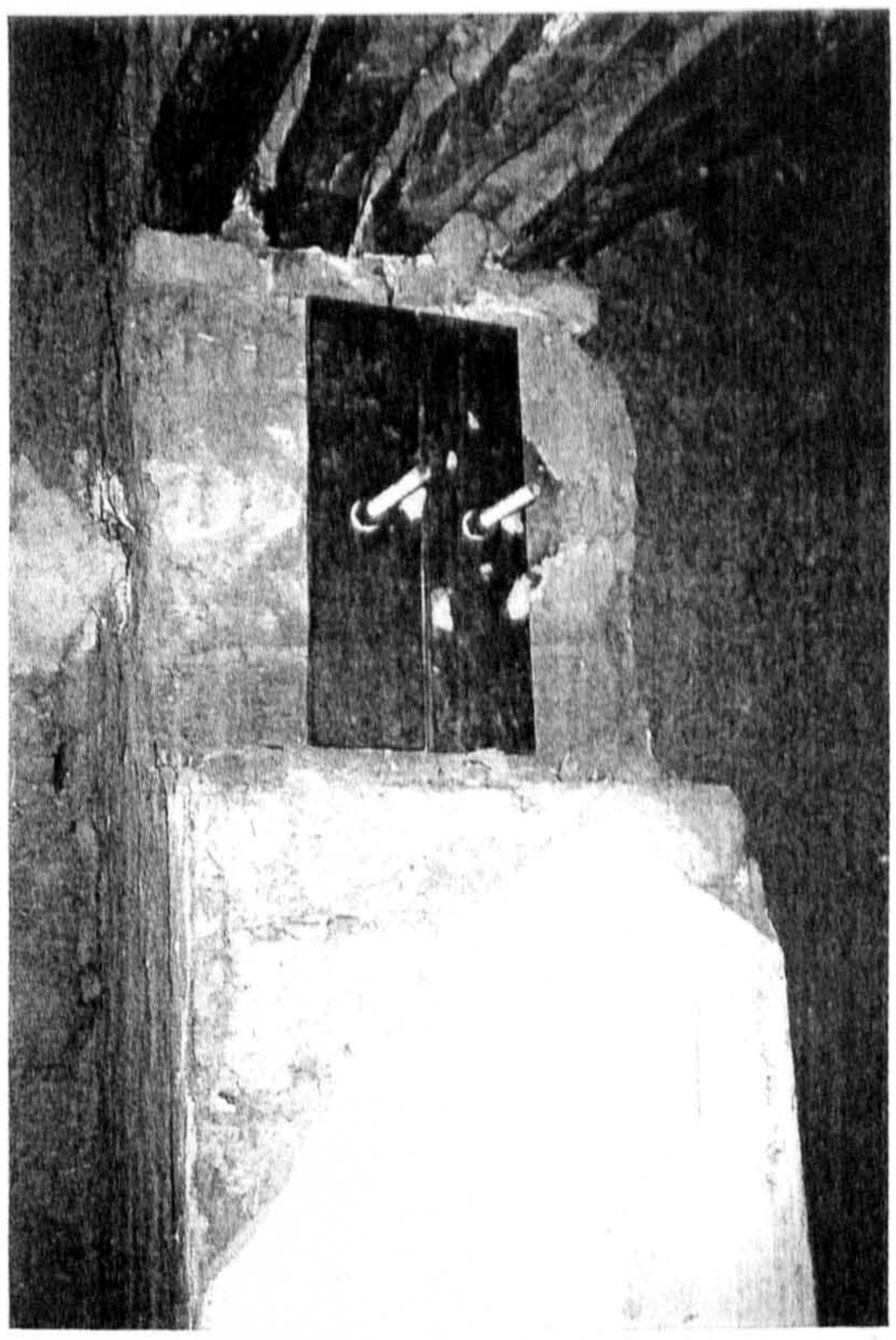


Fig. 6.5. Casa Cadoni Arcais, Serramanna (Cagliari). New roof structure

Fig. 6.6. Casa Cadoni Arcais, Serramanna (Cagliari). Inspection of the historic timbers showed that several joists, rafters, and purlins were sound. However, replacement was carried out with new ones



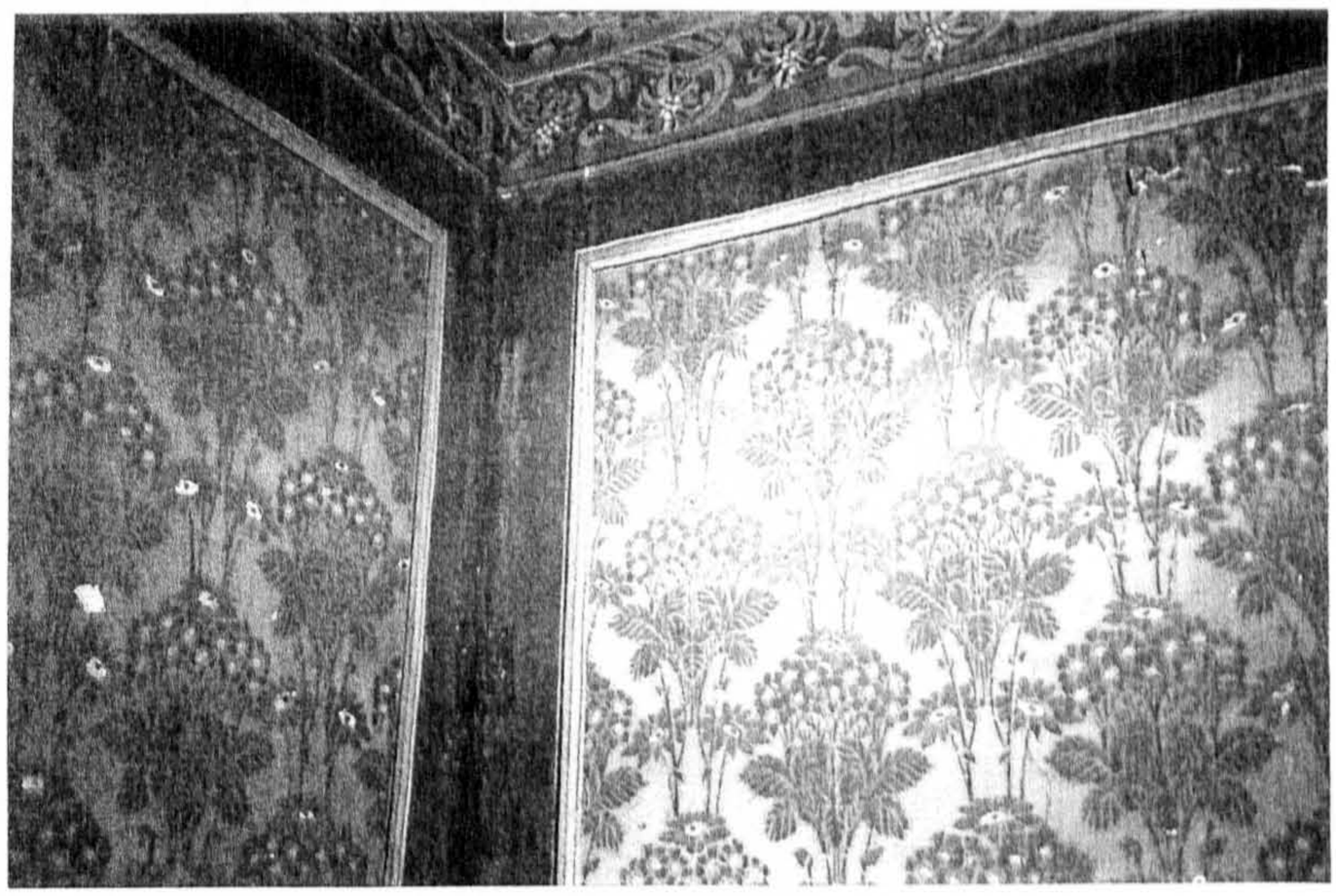


Fig. 6.7. Casa Cadoni Arcais, Serramanna (Cagliari). Several steel keys were inserted in the *làdiri* fabric where the building showed structural deficiencies

Fig. 6.8. Casa Cadoni Arcais, Serramanna (Cagliari). Turn-of-the-century stencil decoration in the most important room of the building to be conserved by a specialist conservator

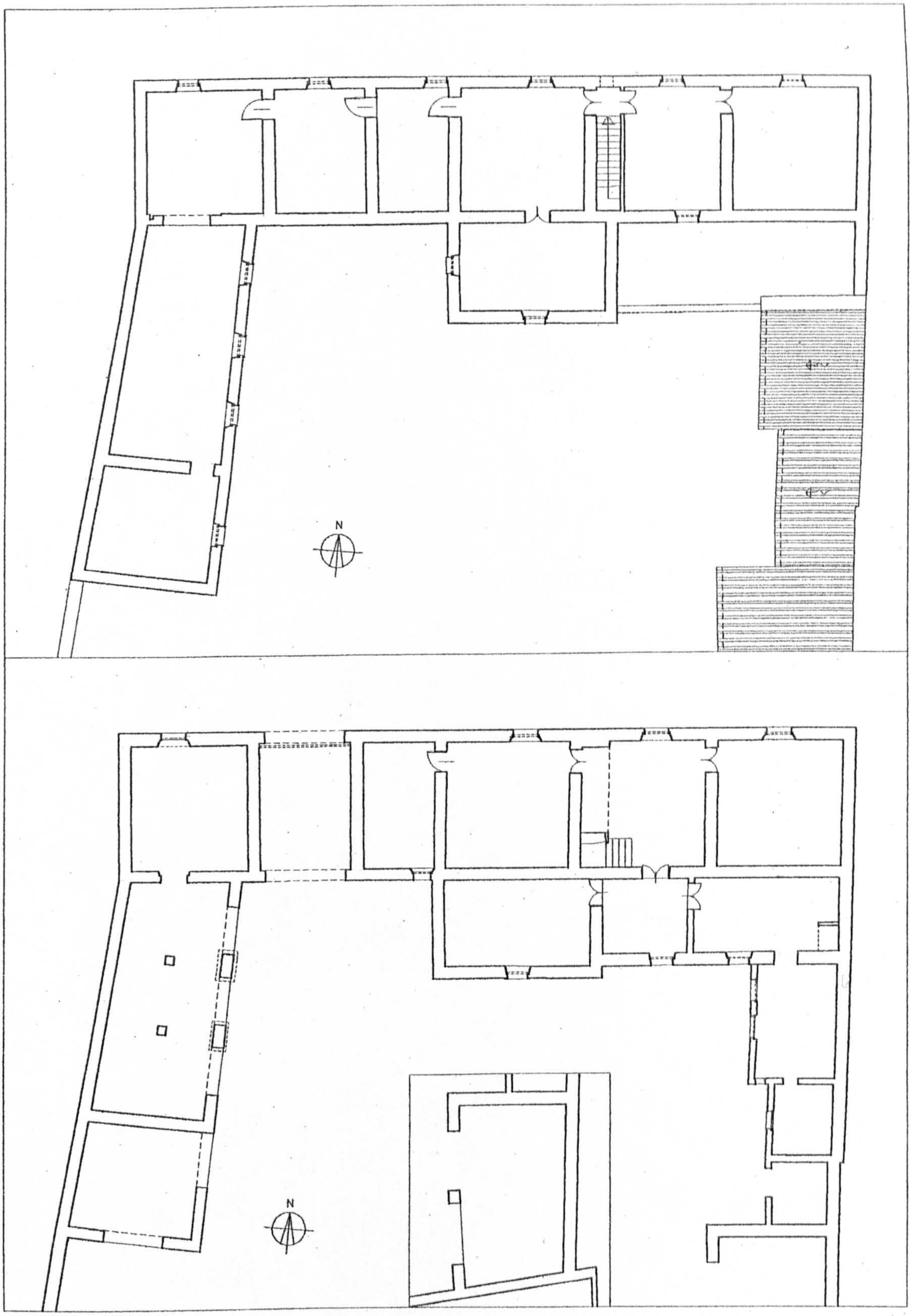


Fig. 6.9. Casa Cadoni Arcais, Serramanna (Cagliari). Plans of ground floor and first floor.
Copyright: Lucio Ortu and Carlo Pillola

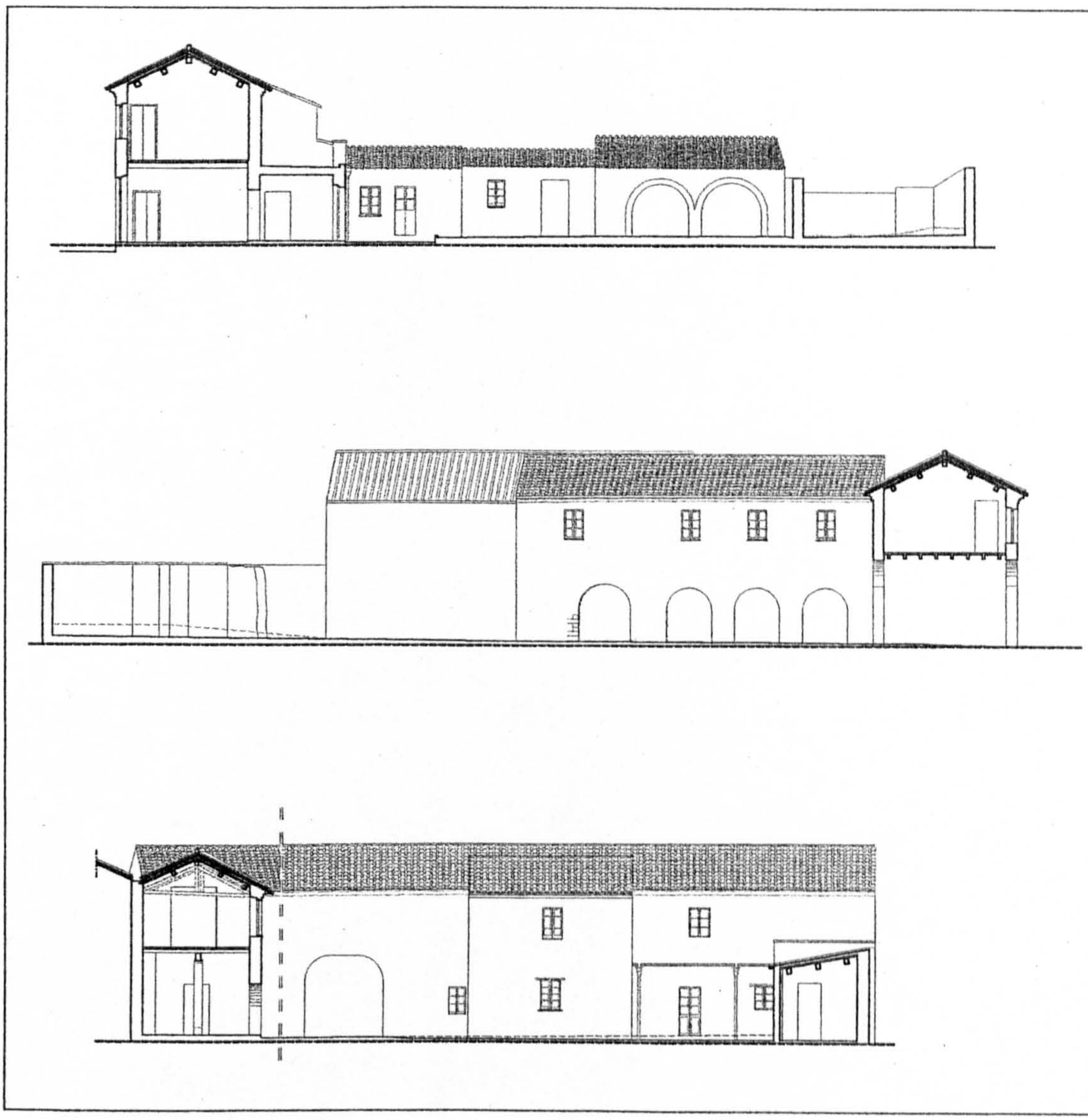
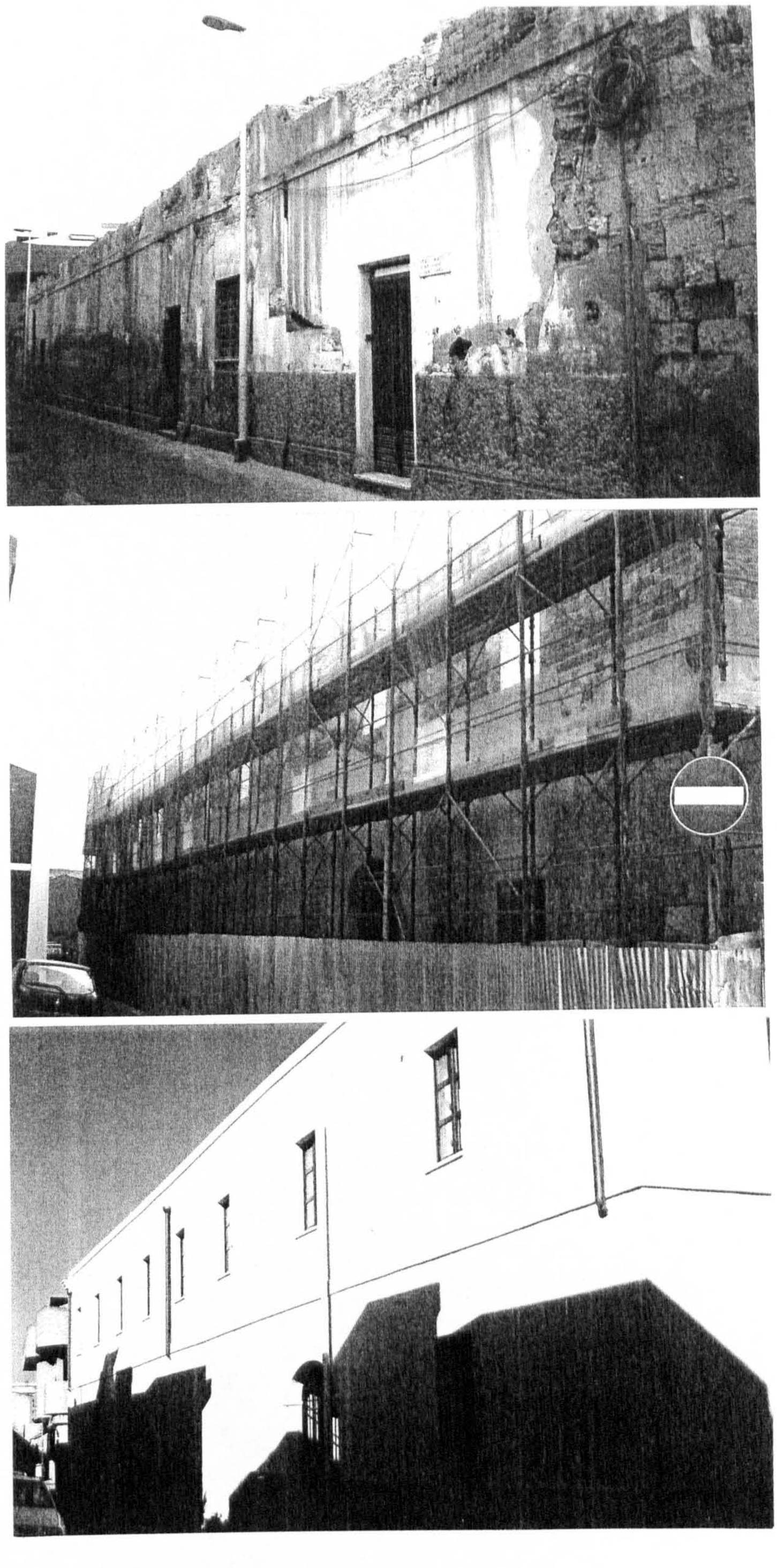


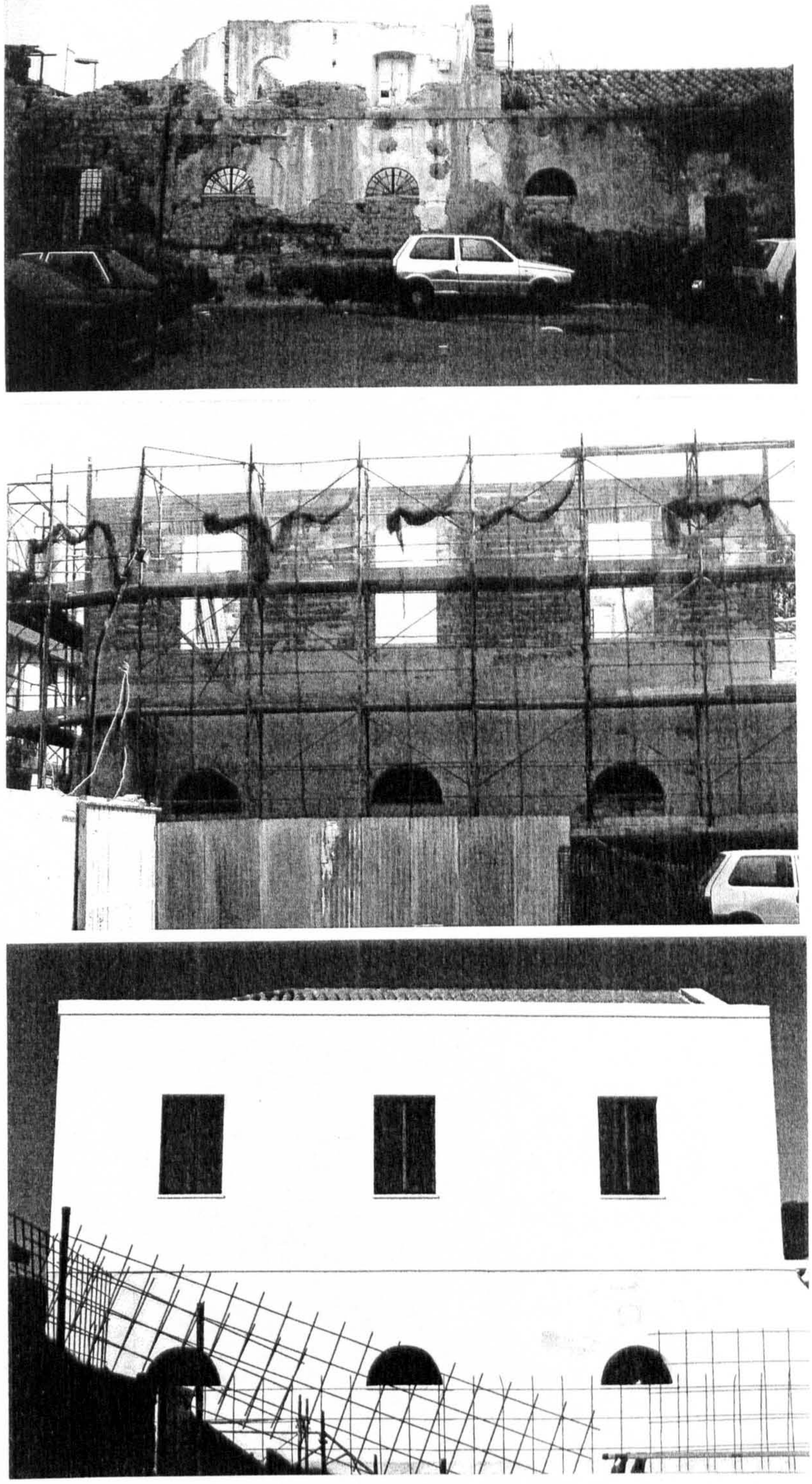
Fig. 6.10. Casa Cadoni Arcais, Serramanna (Cagliari). Sections through courtyard. Copyright: Lucio Ortu and Carlo Pillola

CASE STUDY B

CARABINIERI BARRACKS
QUARTU SANT'ELENA



Figs. 6.11, 6.12, and 6.13. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Pictures showing reconstruction of upper floor after demolition (wing facing Via Caserma)



Figs. 6.14, 6.15, and 6.16. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Pictures showing reconstruction of upper floor after demolition (wing facing car park)

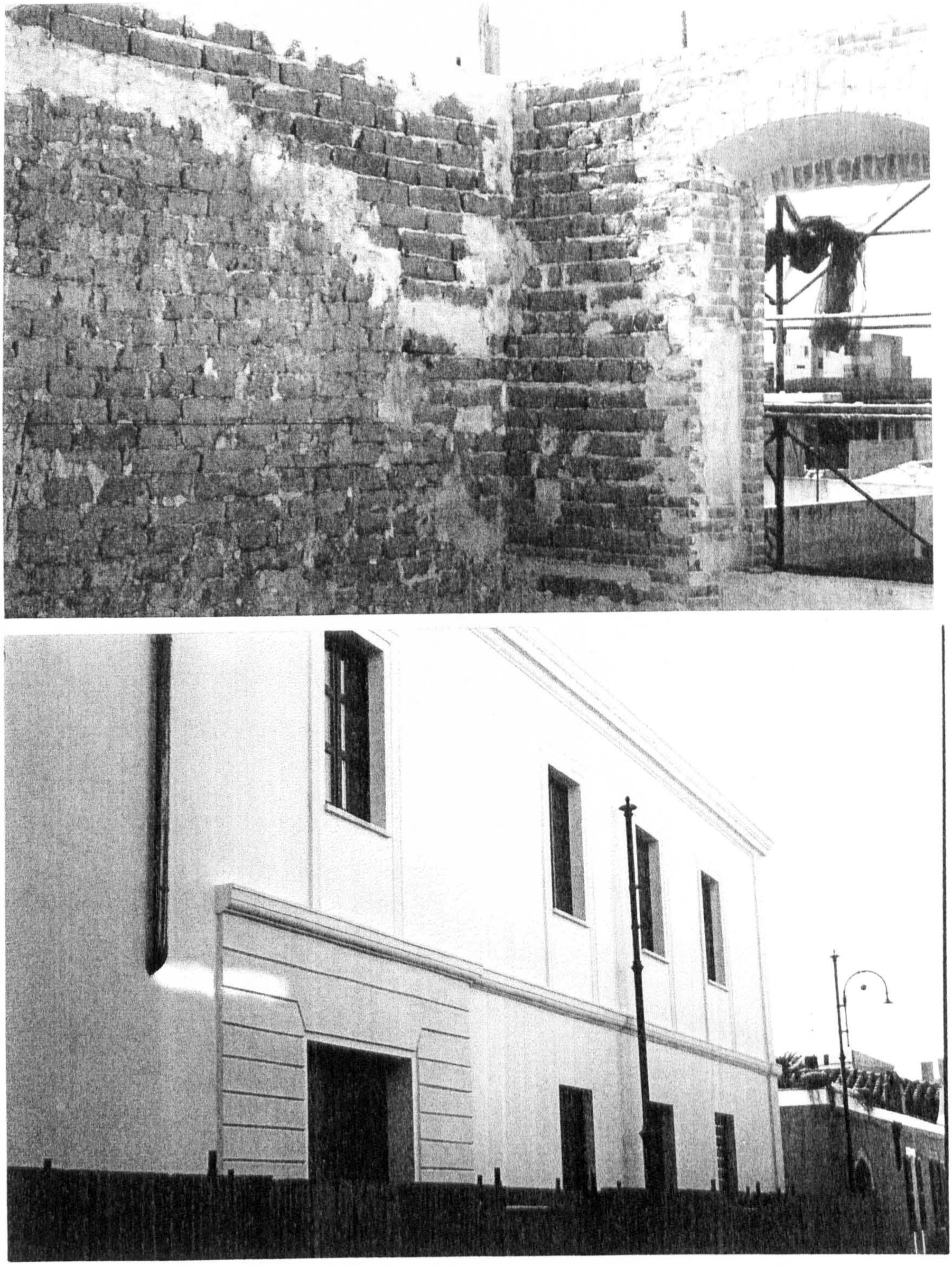
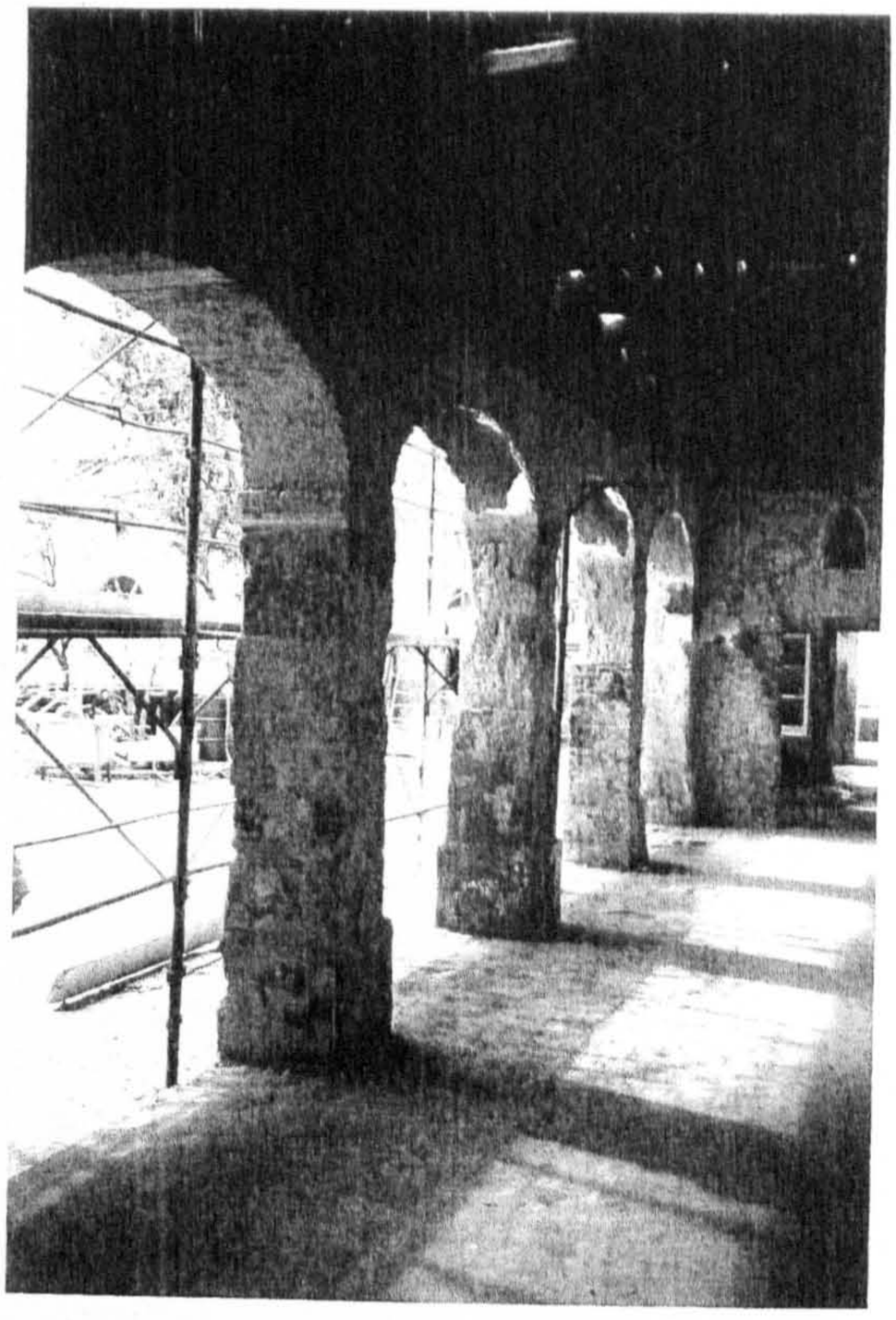


Fig. 6.17. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Picture showing old *làdiri* fabric (left hand side) and new *làdiri* fabric (right hand side)

Fig. 6.18. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Picture showing reconstructed upper floor after demolition (wing facing Via Roma)



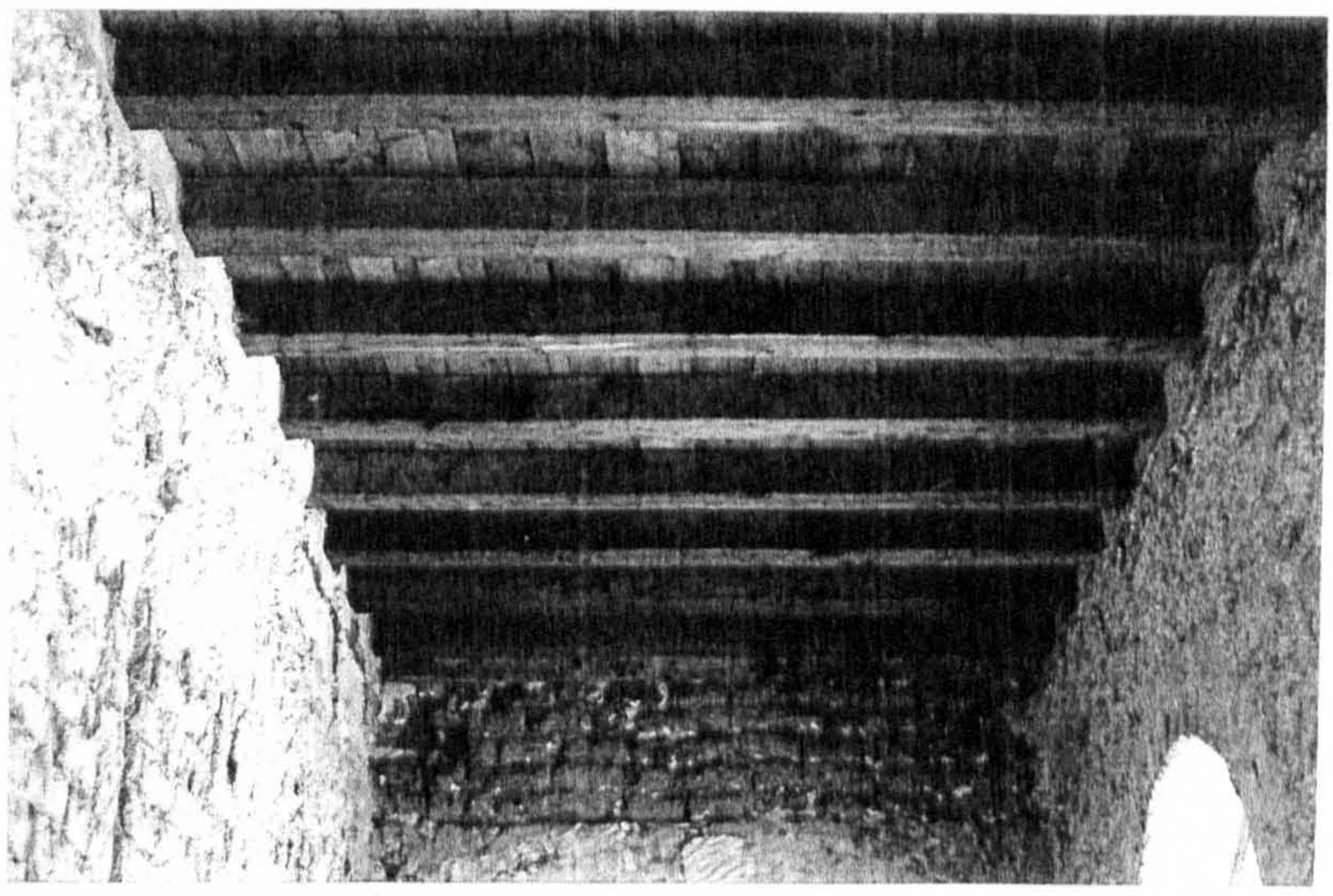
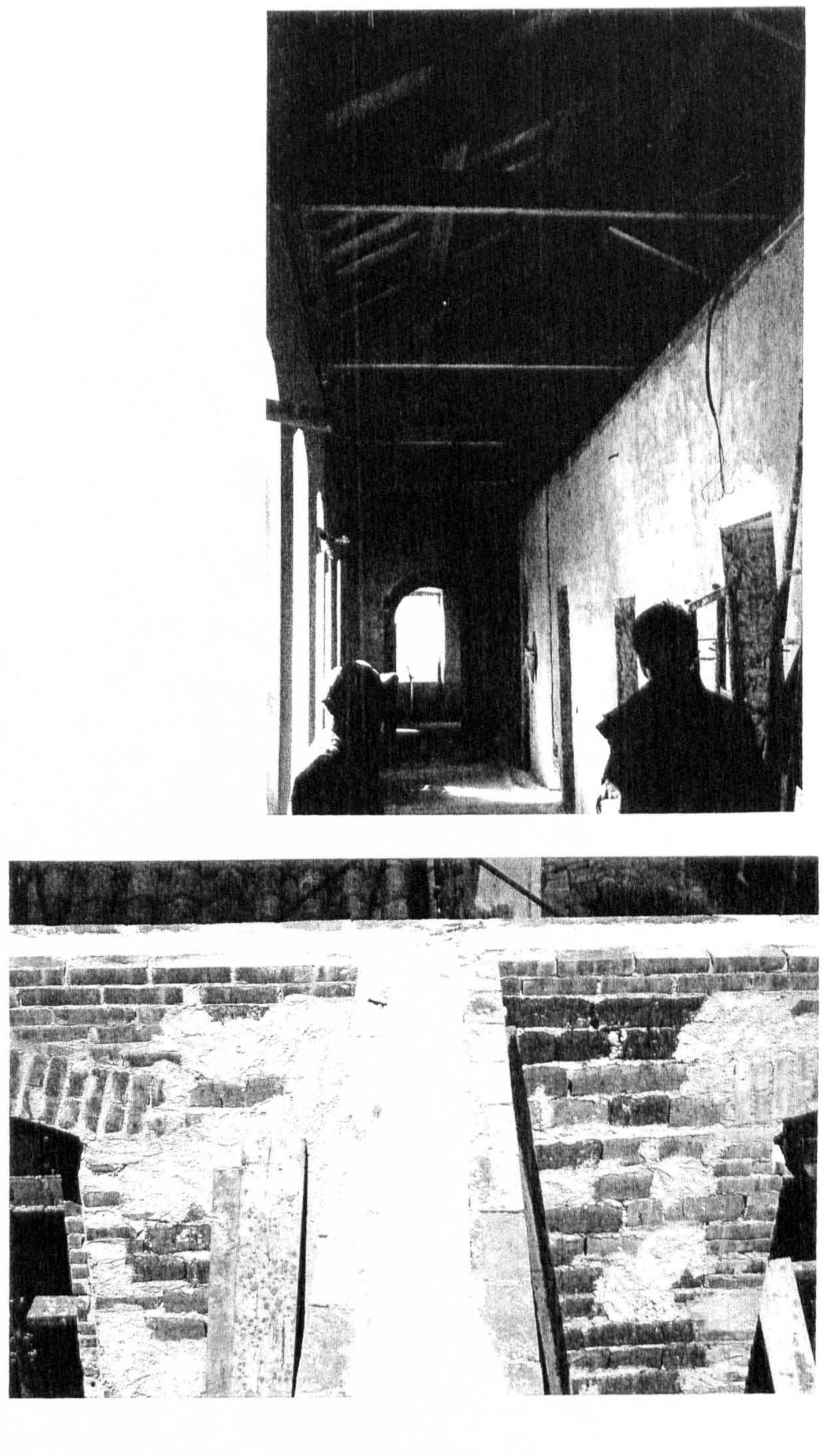
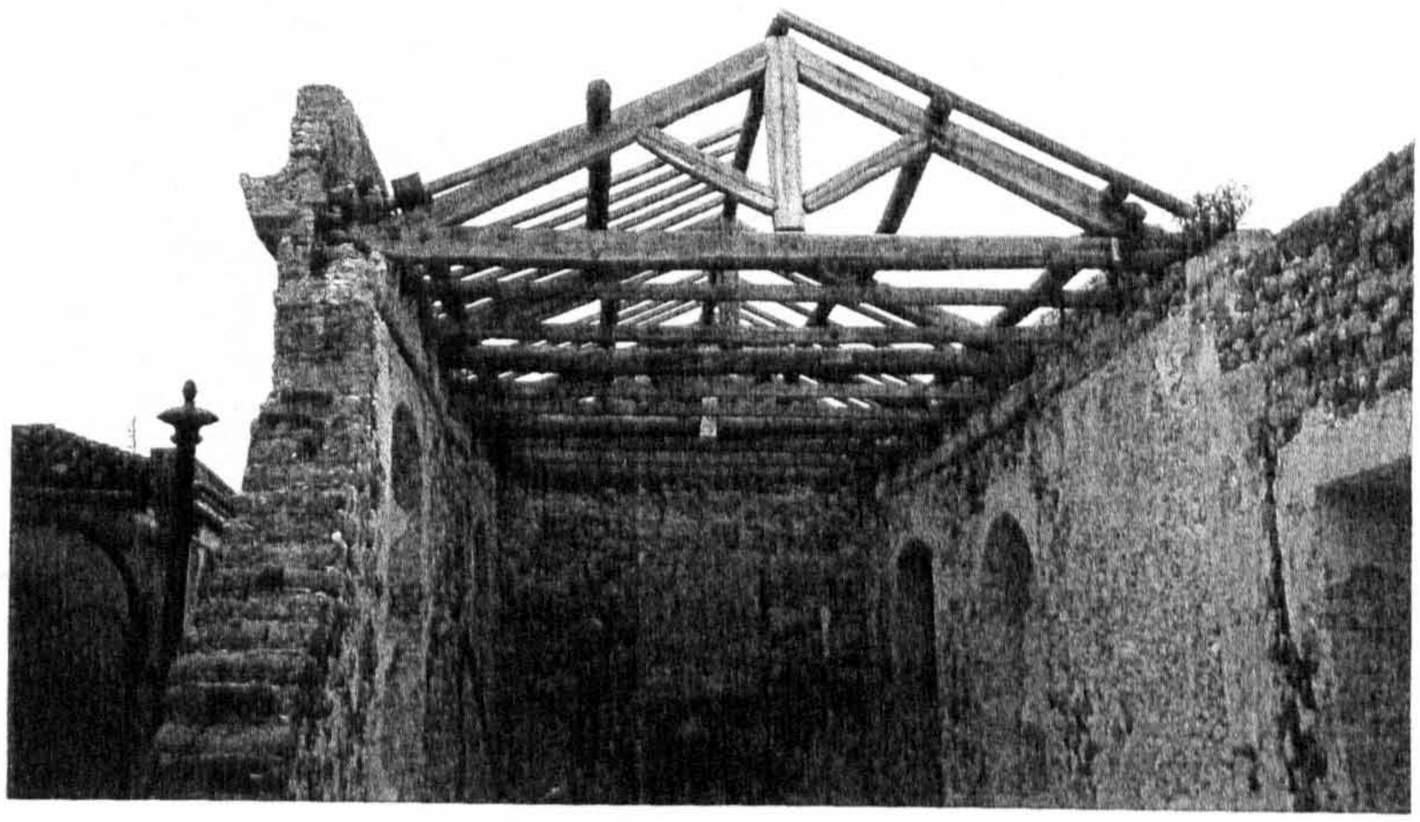


Fig. 6.19. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. View of the loggia showing derelict ceiling

Fig. 6.20. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. View of the new floor structure over the loggia (compare with Fig. 6.17)



Figs. 6.21 and 6.22. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Ring beams made of fired bricks, iron rods, and lime mortar were used to tie together the *làdiri* walls before mounting the roof structure



Figs. 6.23 and 6.24. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Inspection of the historic timbers showed that several joists, rafters, and purlins were sound. However, replacement was carried out with new ones. Fig. 6.22 shows the derelict state of many timbers due to exposure to the elements after demolition of the upper floor was carried out

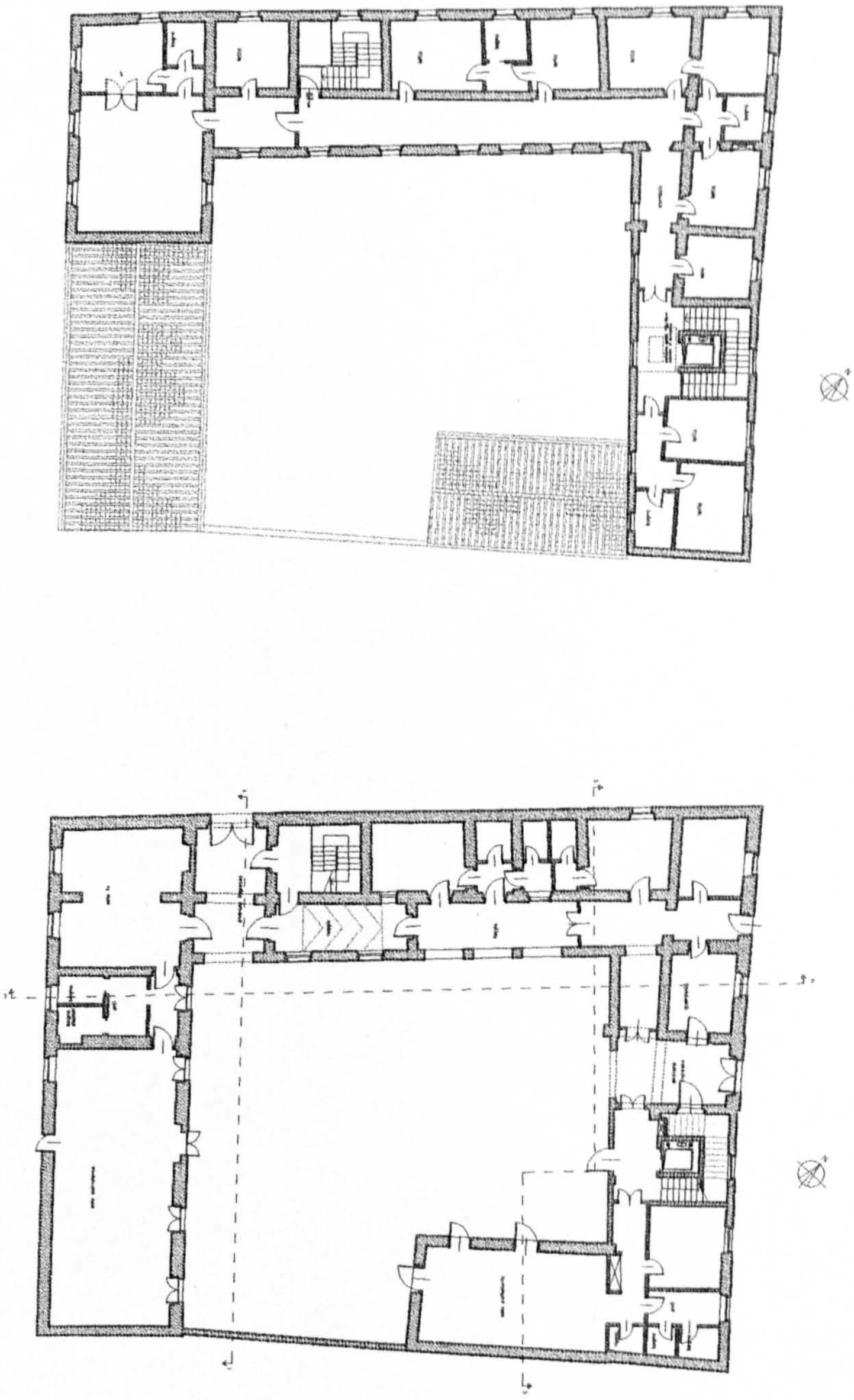


Fig. 6.25. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Plans of ground floor and first floor. Copyright: Fabrizio Cadeddu

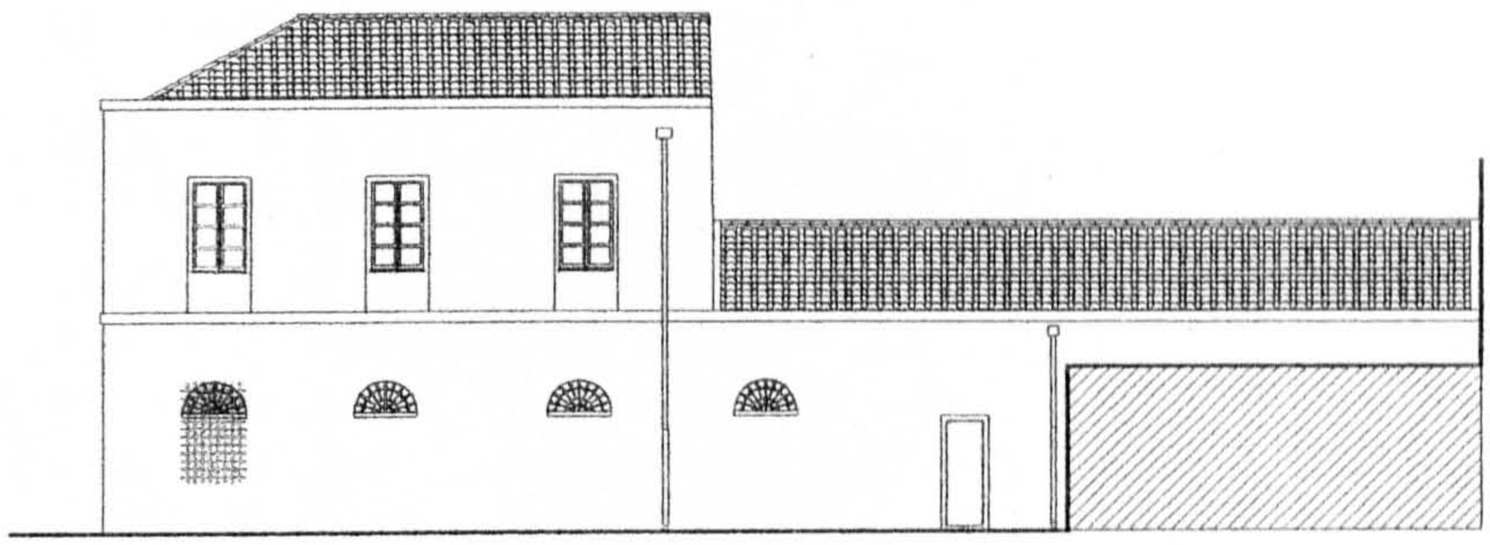


Fig. 6.26. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Main elevations. Copyright: Fabrizio Cadeddu

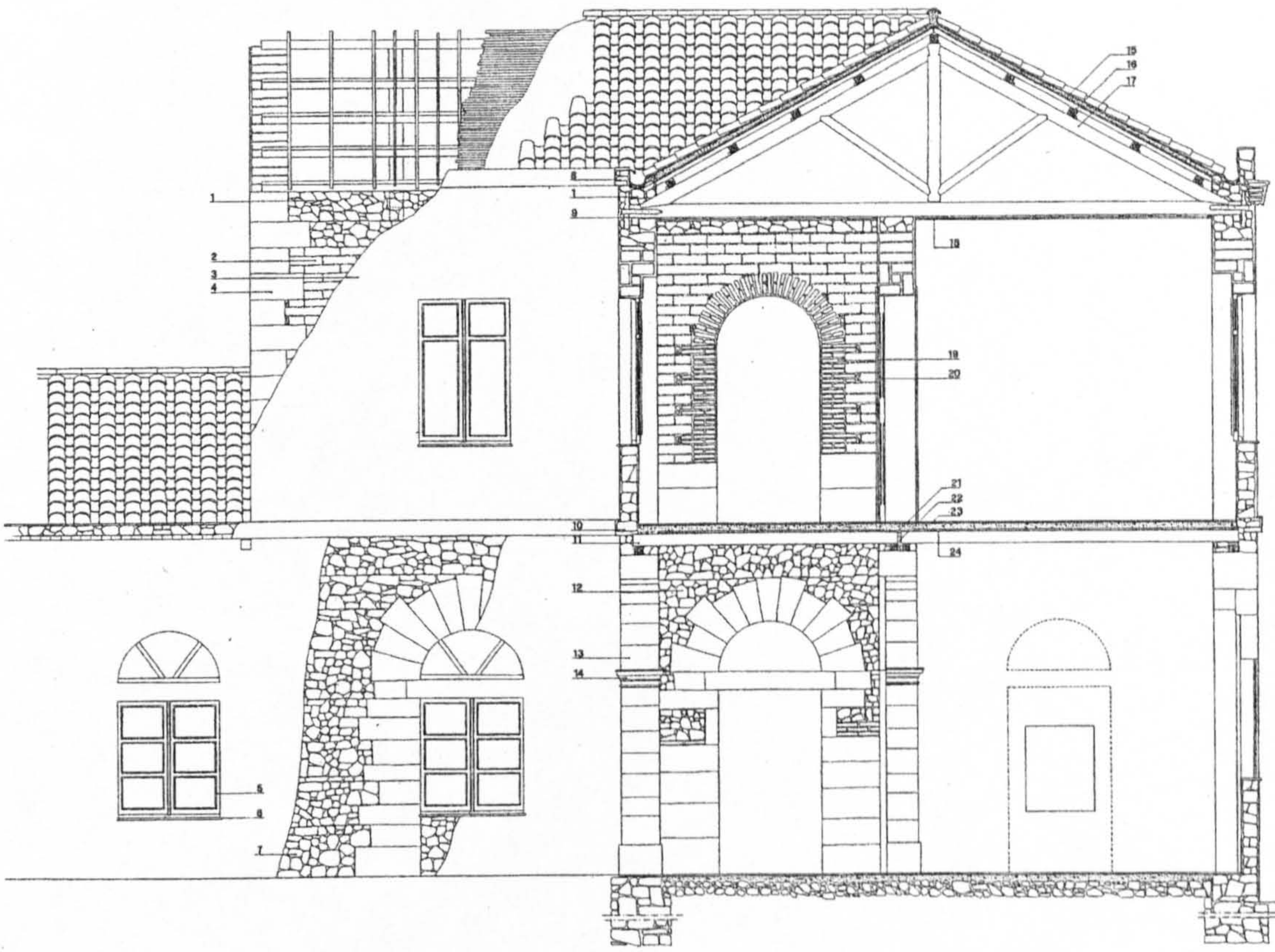


Fig. 6.27. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Drawing showing details and condition of the building before conservation. Copyright: Fabrizio Cadeddu

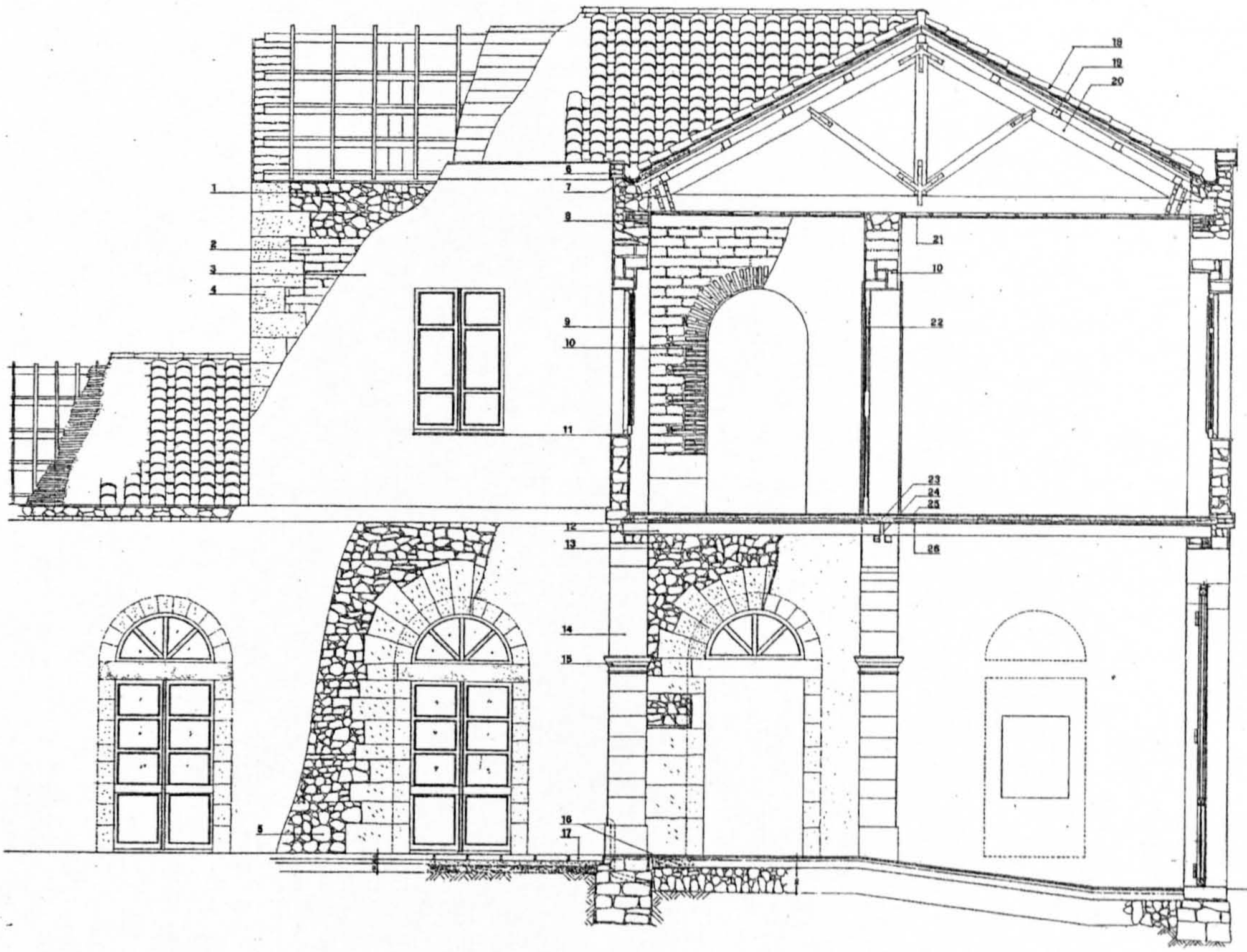
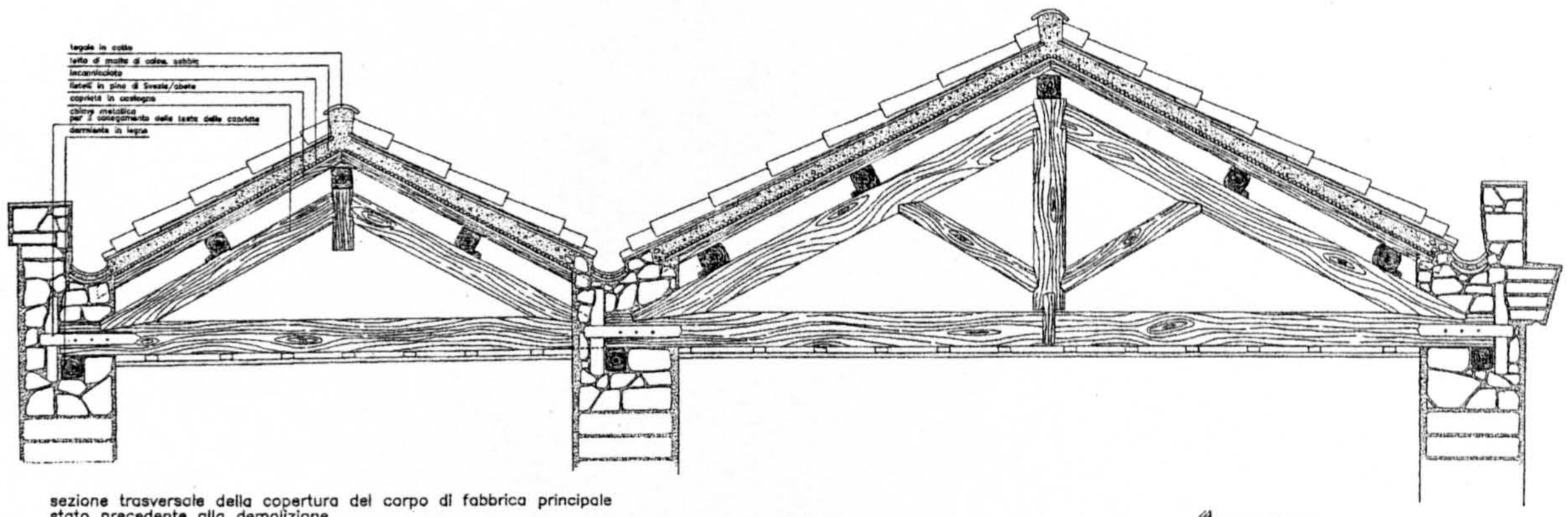
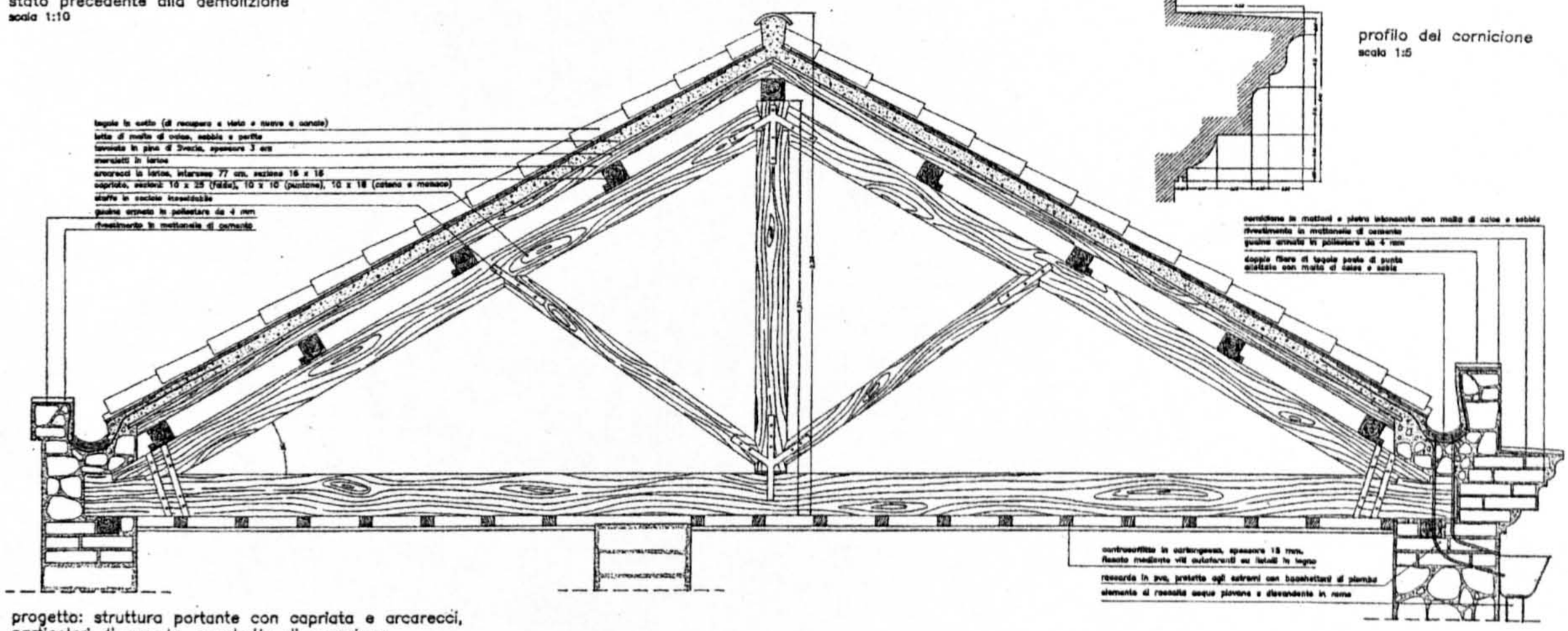


Fig. 6.28. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Drawing showing details of the building after conservation. Copyright: Fabrizio Cadeddu



sezione trasversale della copertura del corpo di fabbrica principale
stato precedente alla demolizione
scala 1:10

profilo del cornicione
scala 1:5



progetto: struttura portante con capriata e arcarecci,
particolari di gronda, pacchetto di copertura
scala 1:10

Fig. 6.29. Carabinieri Barracks, Quartu Sant'Elena, Cagliari. Drawing showing details of roof structure after replacement and conservation occurred. Copyright: Fabrizio Cadeddu

ILLUSTRATIONS
CHAPTER 7

EXPERIMENTAL ANALYSIS OF *LADIRI* SAMPLES

TABLES, FIGURES, AND CHARTS

Table 7.1. Table showing soil colour of the atlas samples after comparison with the *Munsell® Soil Colour Chart* (Anon. 2000)

Sample name	Soil colour name	Munsell colour notation
Gonnesa 3	dark yellowish brown	10 YR 4/4
Samassi 8	brown	10 YR 5/3
Samassi A2	light brownish grey	10 YR 6/2
Serramanna 2	yellowish brown	10 YR 5/4
Serrenti 2	light yellowish brown	10 YR 6/4
Sinnai 3	pale brown	10 YR 6/3
Uras 3	light brownish grey	10 YR 6/2
Villamassargia 4	pale brown	10 YR 6/3
Villasor 2	light yellowish brown	10 YR 6/4

Table 7.2. Table illustrating soil colour of the case studies samples after comparison with the *Munsell® Soil Colour Chart* (Anon. 2000)

Sample name	Soil colour name	Munsell colour notation
Case Study A3	very pale brown	10 YR 7/3
Case Study A4	very pale brown	10 YR 7/4
Case Study B5	light brownish grey	10 YR 6/2
Case Study B6	pale brown	10 YR 6/3

Table 7.3. Table showing particle size distribution of the atlas samples, together with their pH level

Sample name	Percent moisture	Percent gravel	Percent sand	Percent silt	Percent clay	pH
Gonnesa 3	1.7	3.8	57	12.4	26.8	7.2
Samassi 8	1.8	6.7	54.3	14.2	24.8	7
Samassi A2	1.8	0.2	55	13.3	31.5	6.6
Serramanna 2	3.1	5	67.4	22.3	4.7	6.1
Serrenti 2	1.7	3.3	55.2	11.6	29.9	7
Sinnai 3	0.9	13.8	58.1	16.6	11.5	6.1
Uras 3	1.7	17.7	50.4	23.2	8.7	6.8
Villamassargia 4	1	3.4	59.7	9.4	27.5	6.5
Villasor 2	1.1	9.5	69.3	11.8	9.4	7.7
Average	**1.5**	**7.0**	**58.5**	**15**	**19.5**	**6.8**

Table 7.4. Table showing particle size distribution of the case study samples, together with their pH level

Sample name	Percent moisture	Percent gravel	Percent sand	Percent silt	Percent clay	pH
Case study A3	1.6	3.8	62.6	10.4	23.2	7.6
Case study A4	5.7	11.2	40.7	21.5	26.6	7.3
Case study B5	2	12.1	62.1	14.7	11.1	7.2
Case study B6	2.5	4.8	66.8	2.4	26	7.1

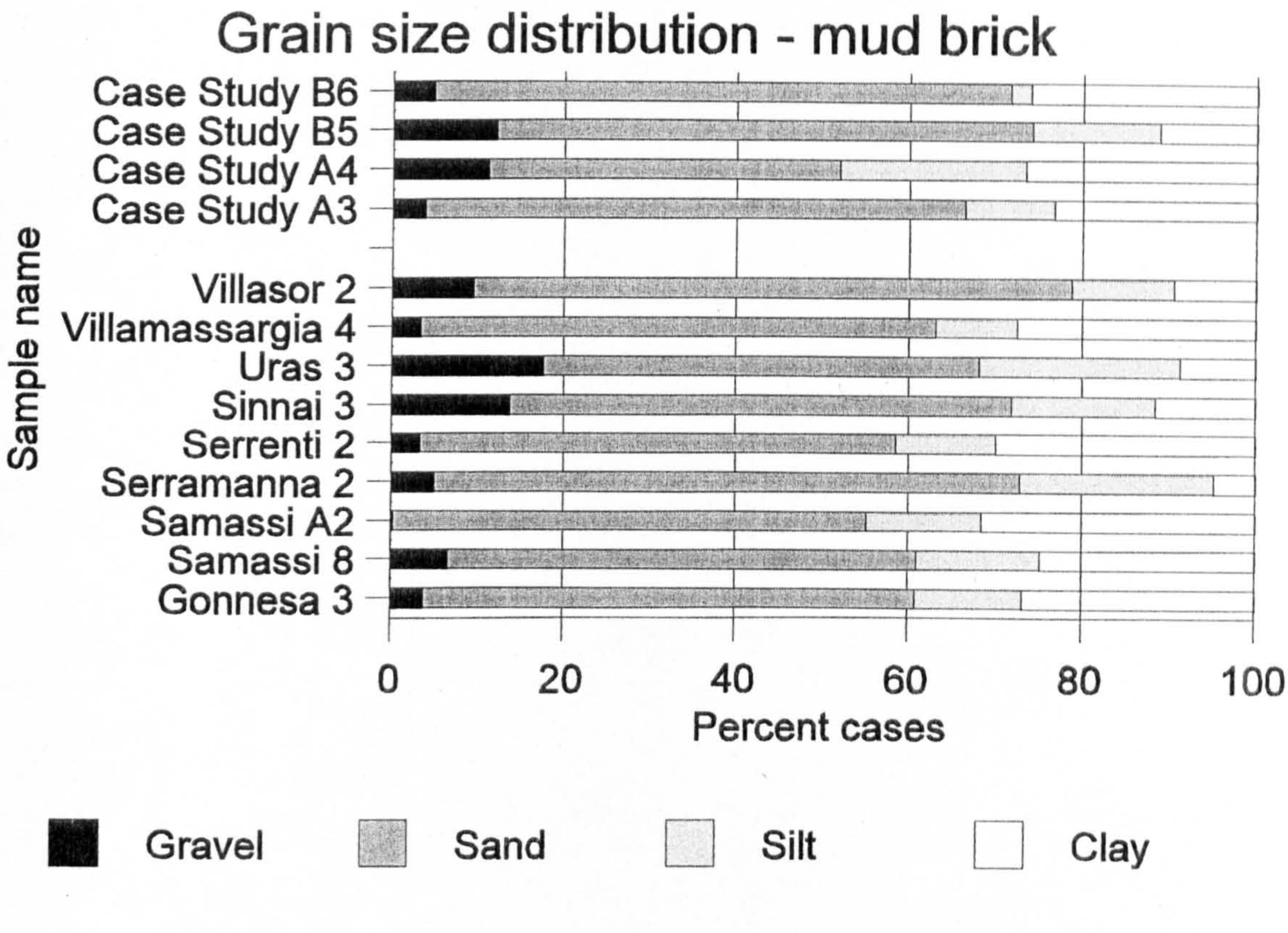


Chart 7.1. Bar chart showing grain size distribution of both atlas samples and case study samples. The chart illustrates a predominance of well-graded loams

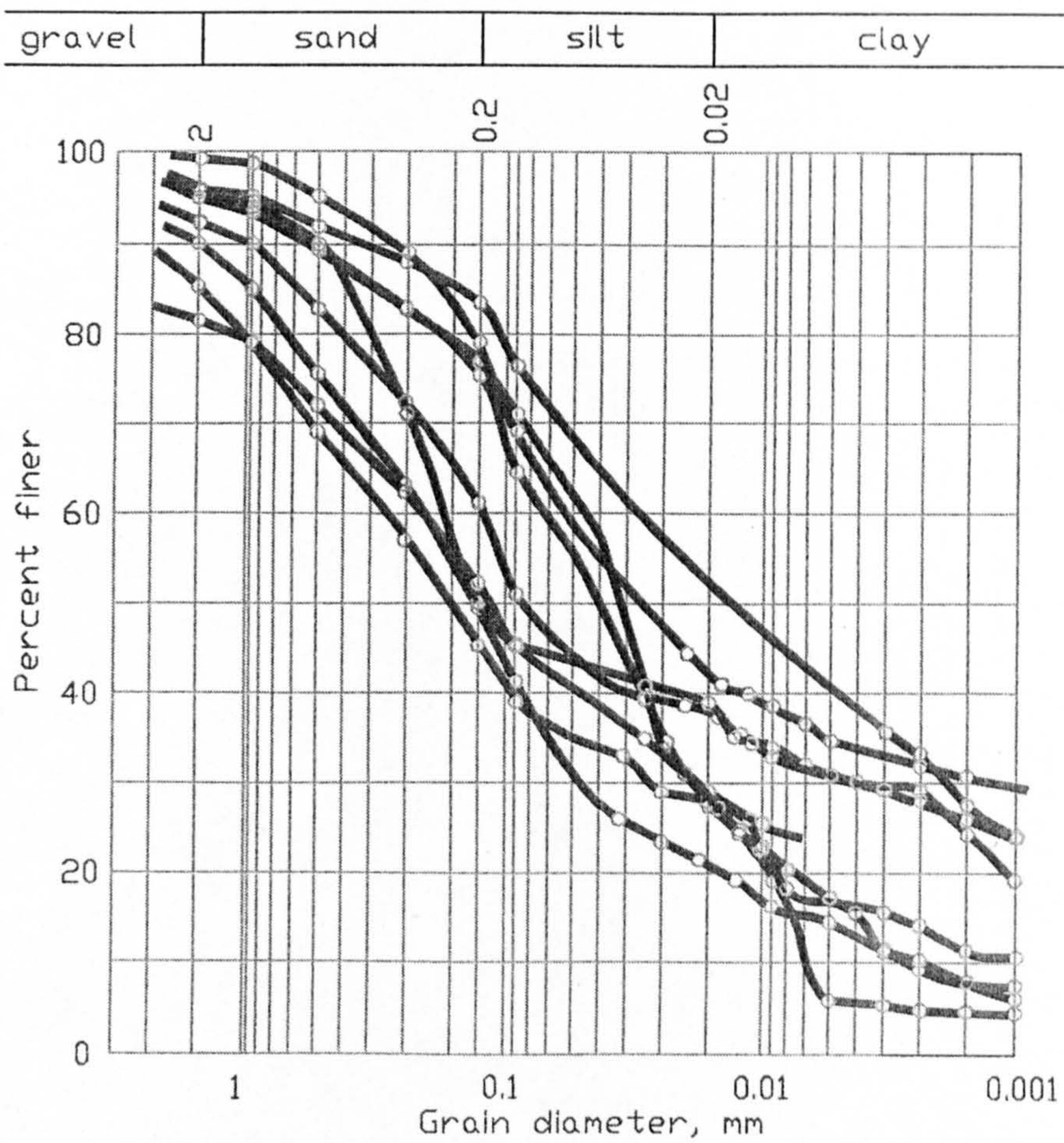


Fig. 7.1. Figure illustrating particle size distribution curves of the nine samples forming the atlas. Individual studies of the distribution curves of every sample can be read in the datasheets

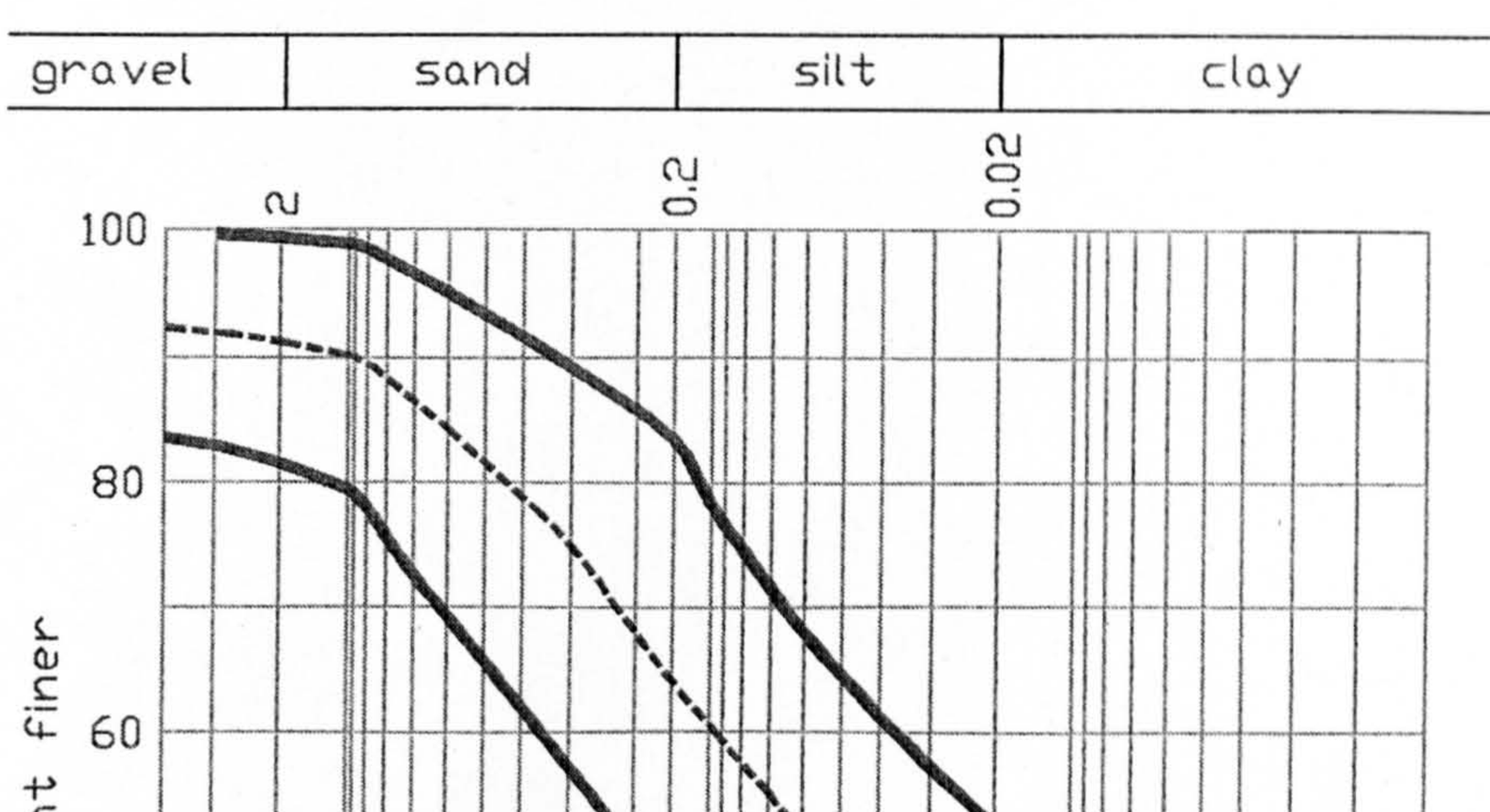


Fig. 7.2. Figure illustrating the outline of the curves on Fig. 7.1, with the minimum curve, the maximum curve, and the ideal curve

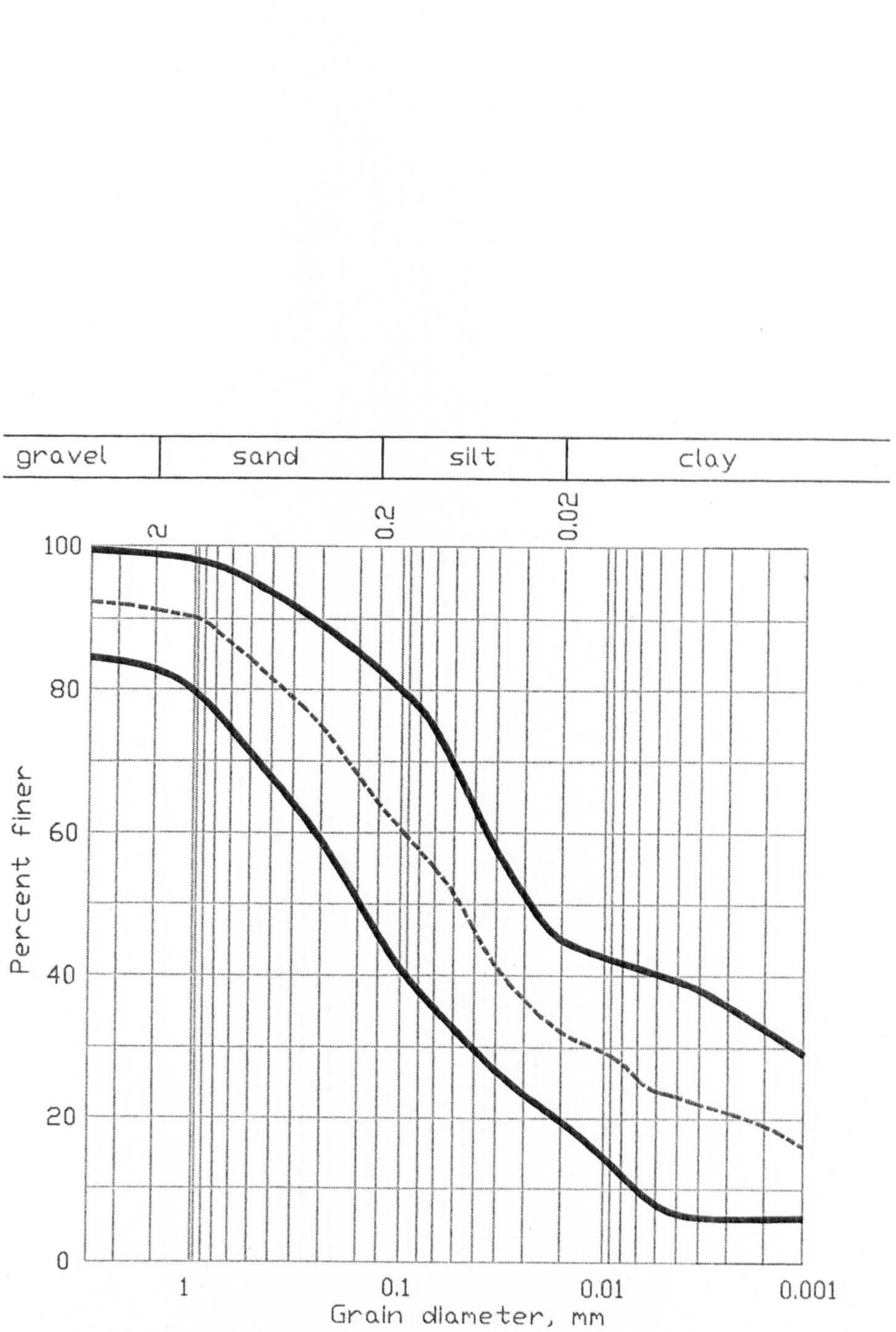


Fig. 7.3. Figure showing the recommended zone based on Fig. 7.2

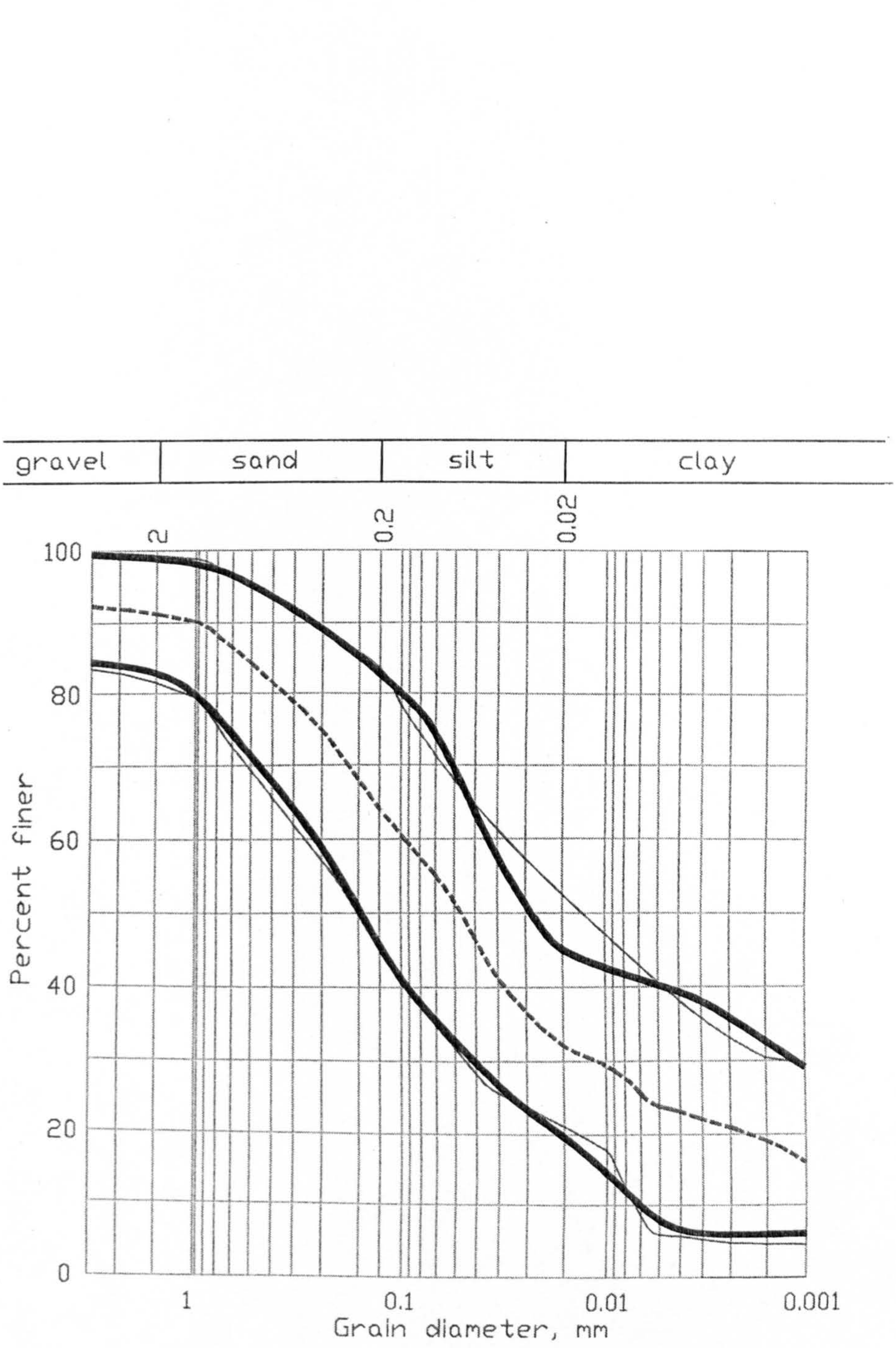


Fig. 7.4. Figure showing overlapping of the two zones on Fig. 7.3 and Fig. 7.4

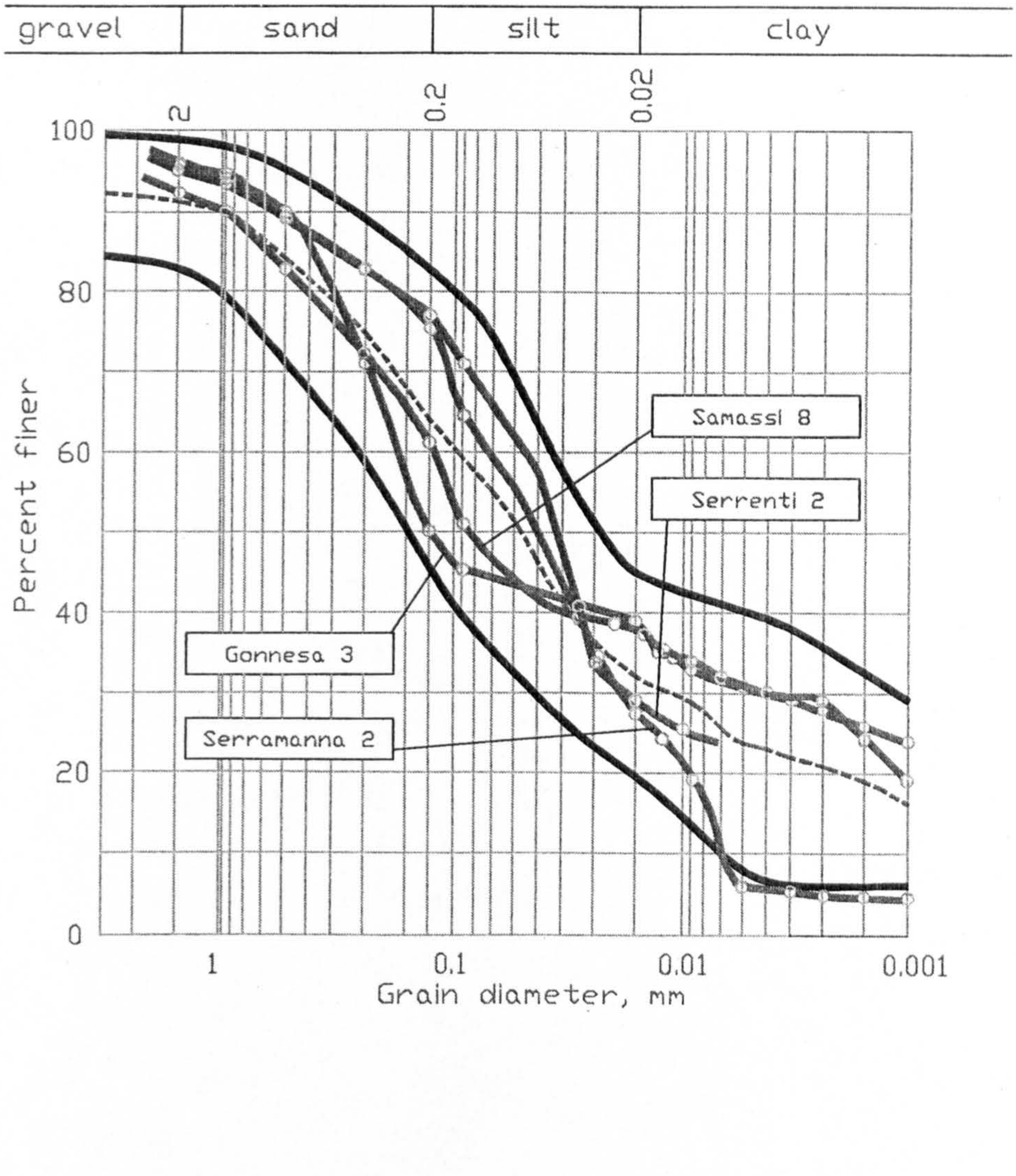


Fig. 7.5. Figure showing comparison of the particle size distribution of four of the atlas samples with the recommended zone

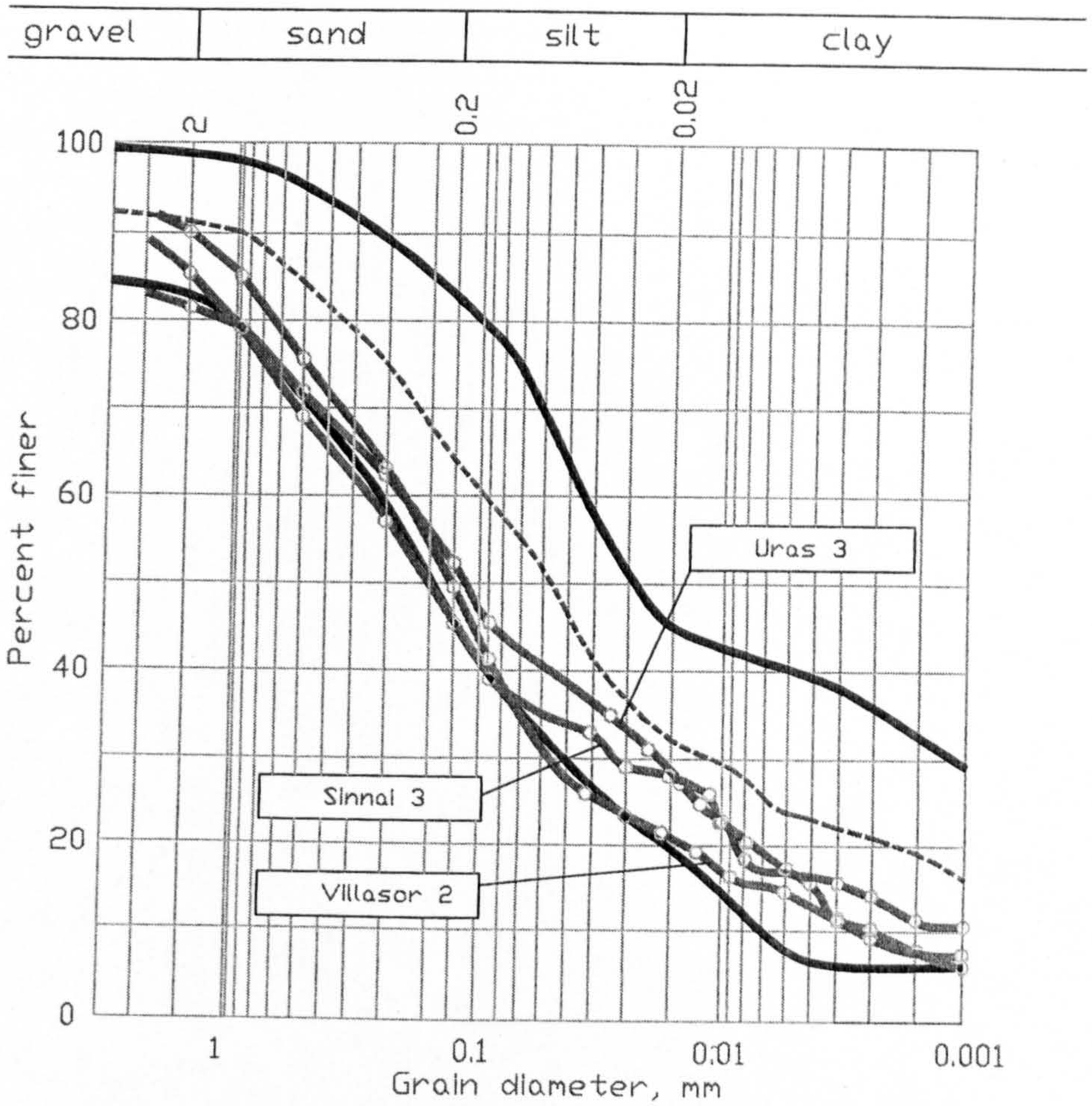


Fig. 7.6. Figure showing comparison of the particle size distributions of three of the atlas samples with the recommended zone

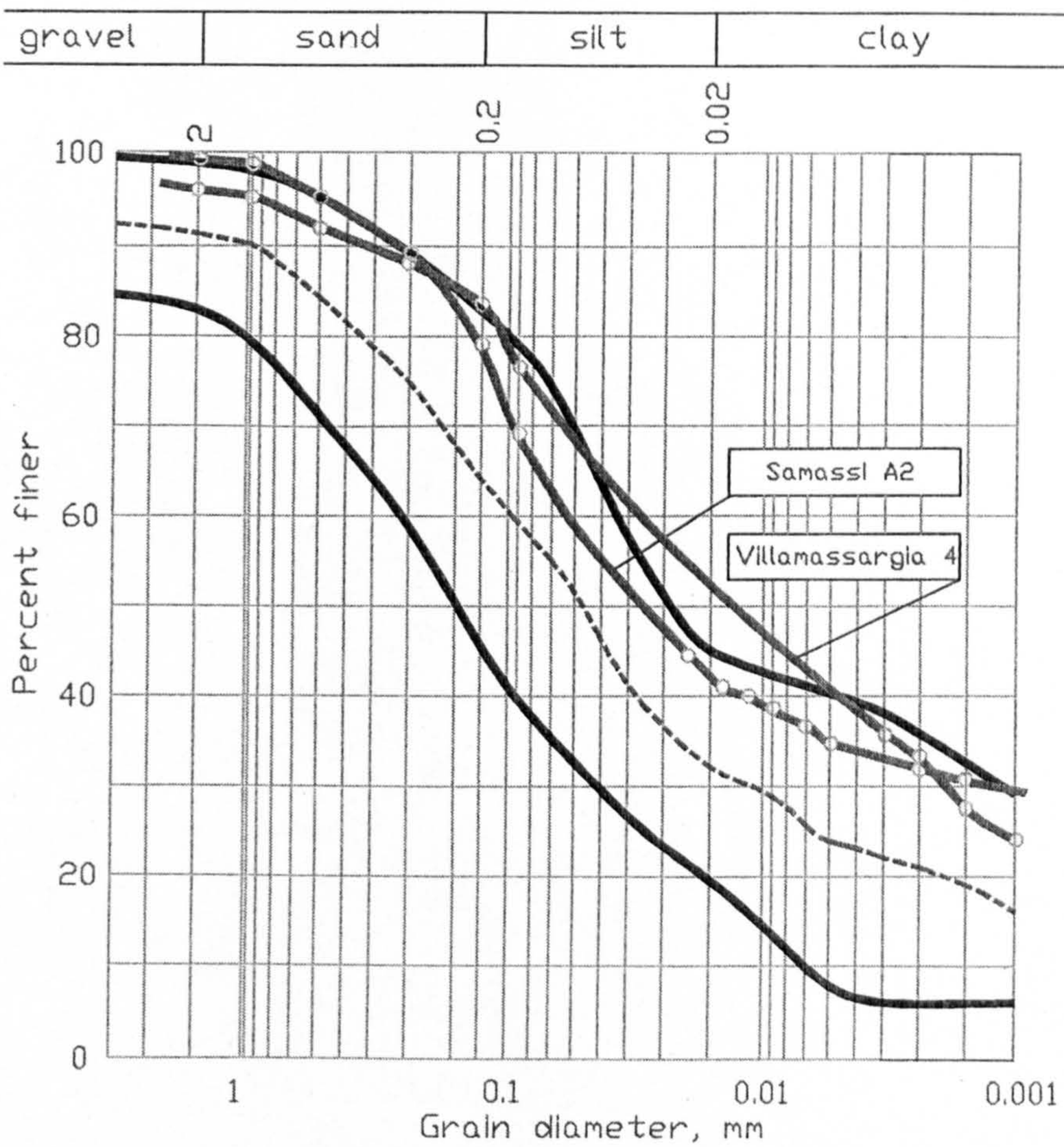


Fig. 7.7. Figure showing comparison of the particle size distributions of two of the atlas samples with the recommended zone

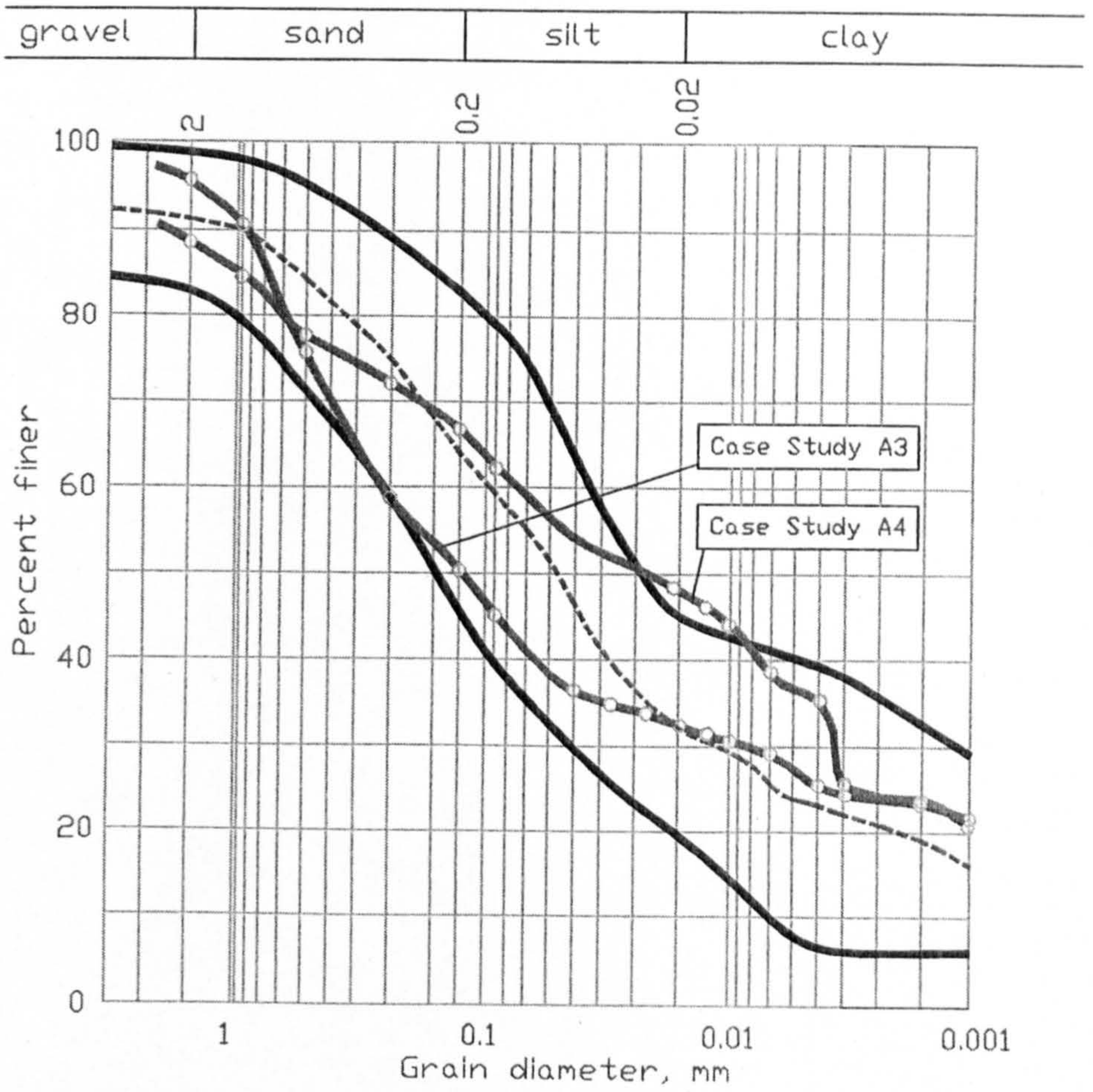


Fig. 7.8. Figure showing comparison of the recommended zone with the particle size distributions of the two samples of Case Study A

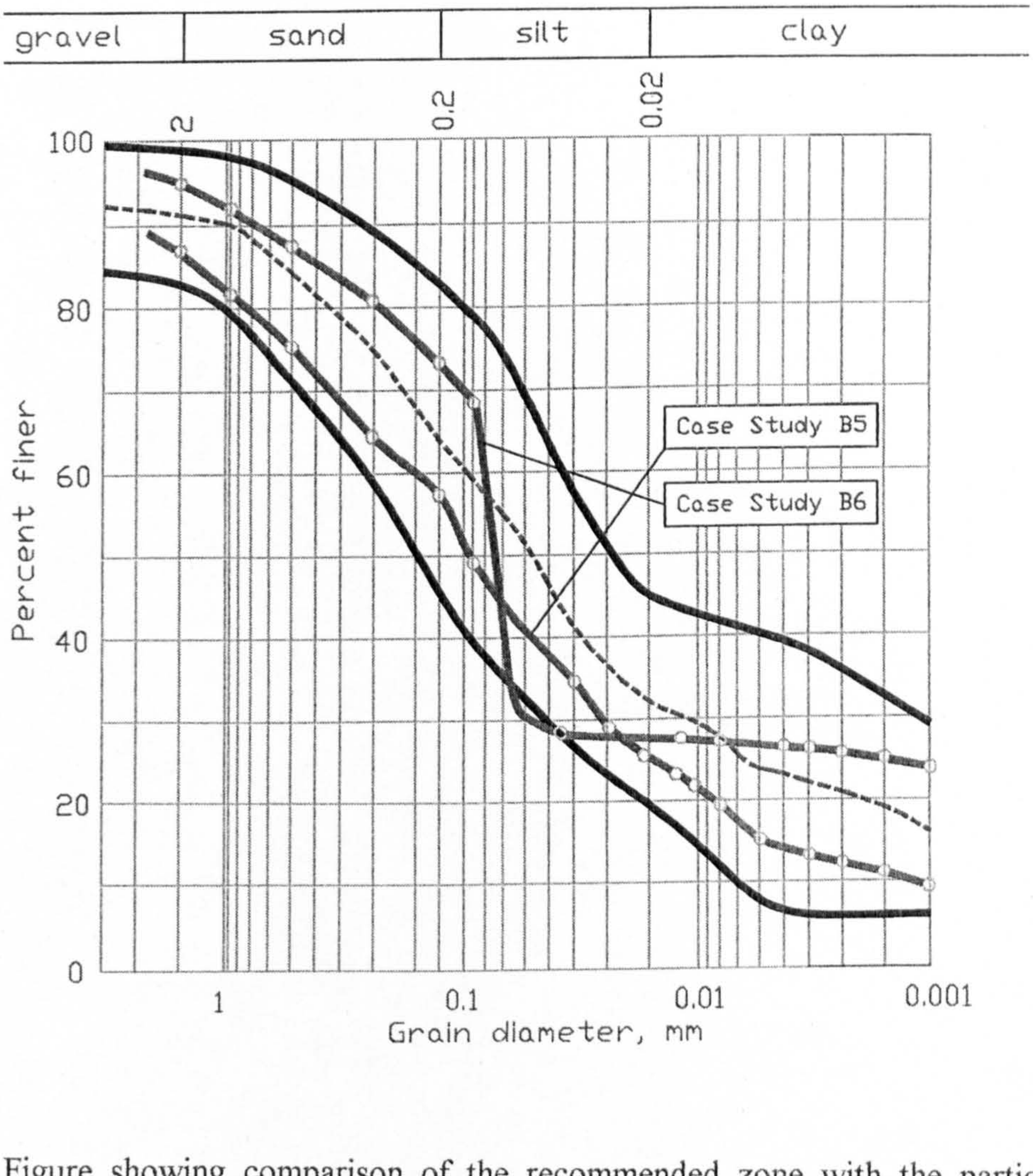


Fig. 7.9. Figure showing comparison of the recommended zone with the particle size distributions of the two samples of Case Study B

Table 7.5. Table showing carbonates content of the atlas samples

Sample name	Dry weight before dissolution (gr)	Dry weight after dissolution (gr)	Carbonate content (%)
Gonnesa 3	15.7	14.7	6.4
Samassi 8	10.1	9.4	6.9
Samassi A2	22.1	21.5	2.7
Serramanna 2	9.5	8.8	7.3
Serrenti 2	10	8.9	11
Sinnai 3	11.2	10	10.7
Uras 3	8.4	8.2	2.4
Villamassargia 4	6.7	6.7	0
Villasor 2	8.6	7.6	11.6

Table 7.6. Table showing carbonates content of the case study samples

Sample name	Dry weight before dissolution (gr)	Dry weight after dissolution (gr)	Carbonate content (%)
Case Study A3	12.5	11.2	10.4
Case Study A4	5.6	3.9	30.3
Case Study B5	7.5	6.7	10.6
Case Study B6	8.3	6.9	16.9

Chart 7.2. Bar chart showing visual comparison of the results of Table 7.5 and of Table 7.6

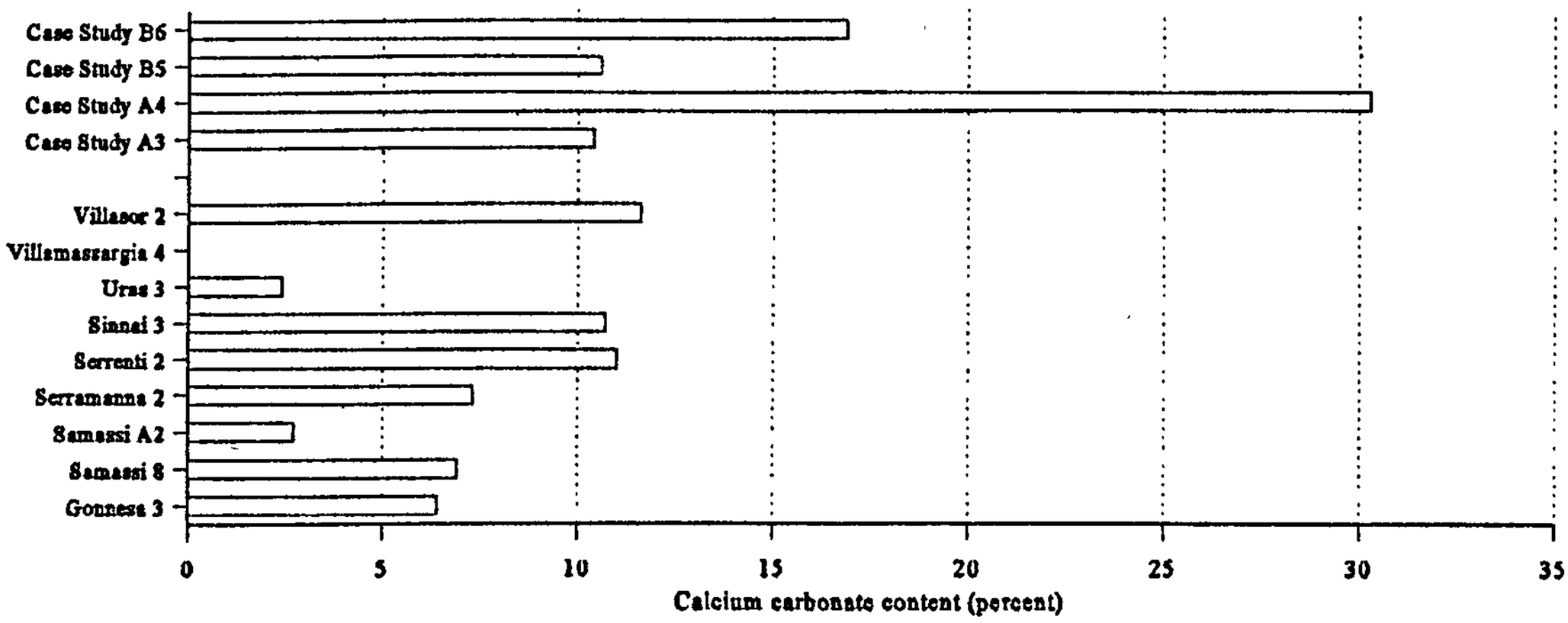


Table 7.7. Table showing liquid limit of soils calculated for the atlas and for the case study samples (Wn = water content expressed as a percentage of the oven-dried soil)

Sample name	Number of blows	Wet weight (gr)	Dry weight (gr)	Wn (%)	Liquid limit
Gonnesa 3	22 78 57	9.9 12.2 9.9	8.5 10.6 8.6	16.5 16 15.1	16.7
Samassi 8	72 29 27	12.9 9.4 13.4	10.9 8.1 11.2	18.3 16 19.6	17.9
Samassi A2	45 17 20	19.5 16.2 15.6	15 12.2 11.9	30 32.8 31.1	31.1
Serramanna 2	10 24 35	7.9 10.8 13.9	6.2 9 11.3	27.4 20 22.5	23.8
Serrenti 2	50 34 13	7.9 6.5 8.7	6.2 5.1 6.7	27.4 27.5 29.9	27.7
Simnai 3	10 24 35	9.1 8.9 11	7.4 7.2 9	22.3 23.6 22.2	18.9
Uras 3	10 20 45	24.4 17.4 16.5	19 13.7 13.2	28.1 27 25	26.6
Villamassargia 4	25 72 14	15.9 11.4 15	11.7 8.6 11.8	35.9 32.6 27.1	32.5
Villasor 2	5 37 29	8.9 10 9.8	7.1 8.3 8.1	25.3 20.5 21	25.1
Case study A3	13 16 56	8.2 10.4 10	6.6 8.4 8.2	24.2 23.8 21.9	22.5
Case study A4	60 68 30	8.8 10.3 13.7	7 8.1 10.8	25.7 27.2 26.8	25.7
Case study B5	35 37 17	12.1 12.7 8.2	9.1 1.5 6.3	33 33.1 30.1	32.5
Case study B6	59 38 24	8.2 7.9 5.2	6 5.7 3.5	36.7 38.6 48.6	46.3

Table 7.8. Table showing plastic limit of the atlas and of the case study samples

Sample name	Wet weight (gr)	Dry weight (gr)	Plastic limit	Plasticity index
Gonnesa 3	13.4	11.9	'11.6	5.1
Samassi 8	15.3	13.2	15.9	2
Samassi A2	13	10.6	22.6	8.5
Serramanna 2	8.1	6.6	22.7	1.1
Serrenti 2	7.2	5.7	26.3	1.4
Sinnai 3	10.4	8.8	18.2	0.7
Uras 3	8.2	6.7	22.3	4.3
Villamassargia 4	8.5	6.9	23.2	9.3
Villasor 2	9.2	7.7	19.5	5.6
Case study A3	11.9	10.3	15.5	7
Case study A4	7.9	6.5	21.5	4.2
Case study B5	5.5	4.4	25	7.5
Case study B6	12.4	10.1	22.7	23.6

Table 7.9. Table showing results of the Atterberg limits

Sample name	Type of soil	Activity	Cohesion	Expansion
Gonnesa 3	sandy clay loam	not active	not cohesive	low
Samassi 8	sandy clay loam	not active	not cohesive	low
Samassi A2	sandy clay loam	not active	slightly cohesive	low
Serramanna 2	sandy loam	not active	not cohesive	low
Serrenti 2	sandy clay loam	not active	not cohesive	low
Sinnai 3	sandy loam	not active	not cohesive	low
Uras 3	sandy loam	not active	not cohesive	low
Villamassargia 4	sandy clay loam	not active	slightly cohesive	low
Villasor 2	sandy loam	not active	not cohesive	low
Case Study A3	sandy clay loam	not active	not cohesive	low
Case study A4	sandy clay loam	not active	not cohesive	low
Case study B5	sandy loam	not active	slightly cohesive	low
Case study B6	sandy clay loam	average activity	very cohesive	medium

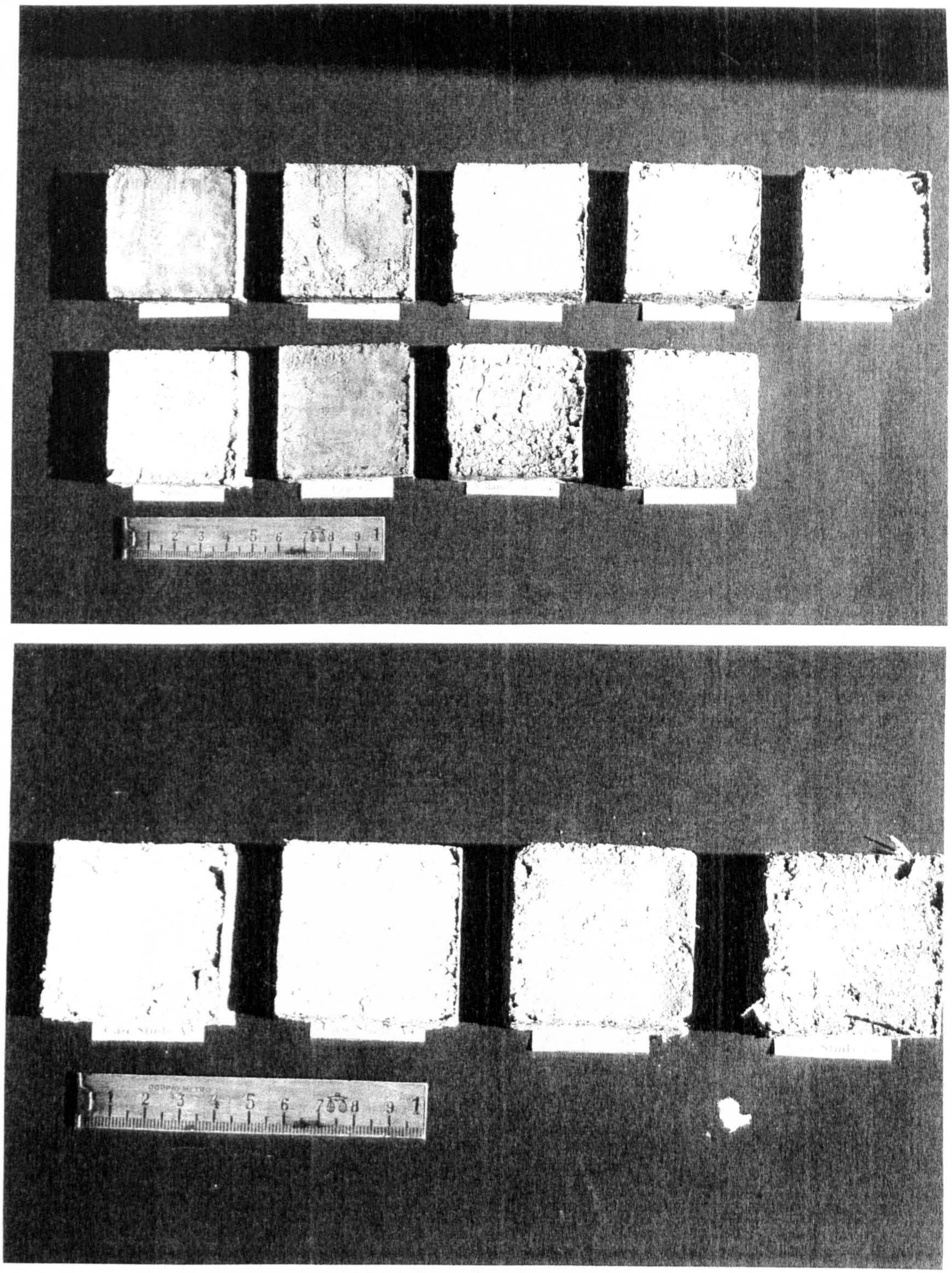


Fig. 7.10. Figure showing prisms of soil employed in the physical tests. From left to right, top to bottom: Gonnesa 3, Samassi 8, Samassi A2, Serramanna 2, Serrenti 2, Sinnai 3, Uras 3, Villamassargia 4, Villasor 2, Case Study A3, Case Study A4, Case Study B5, Case Study B6

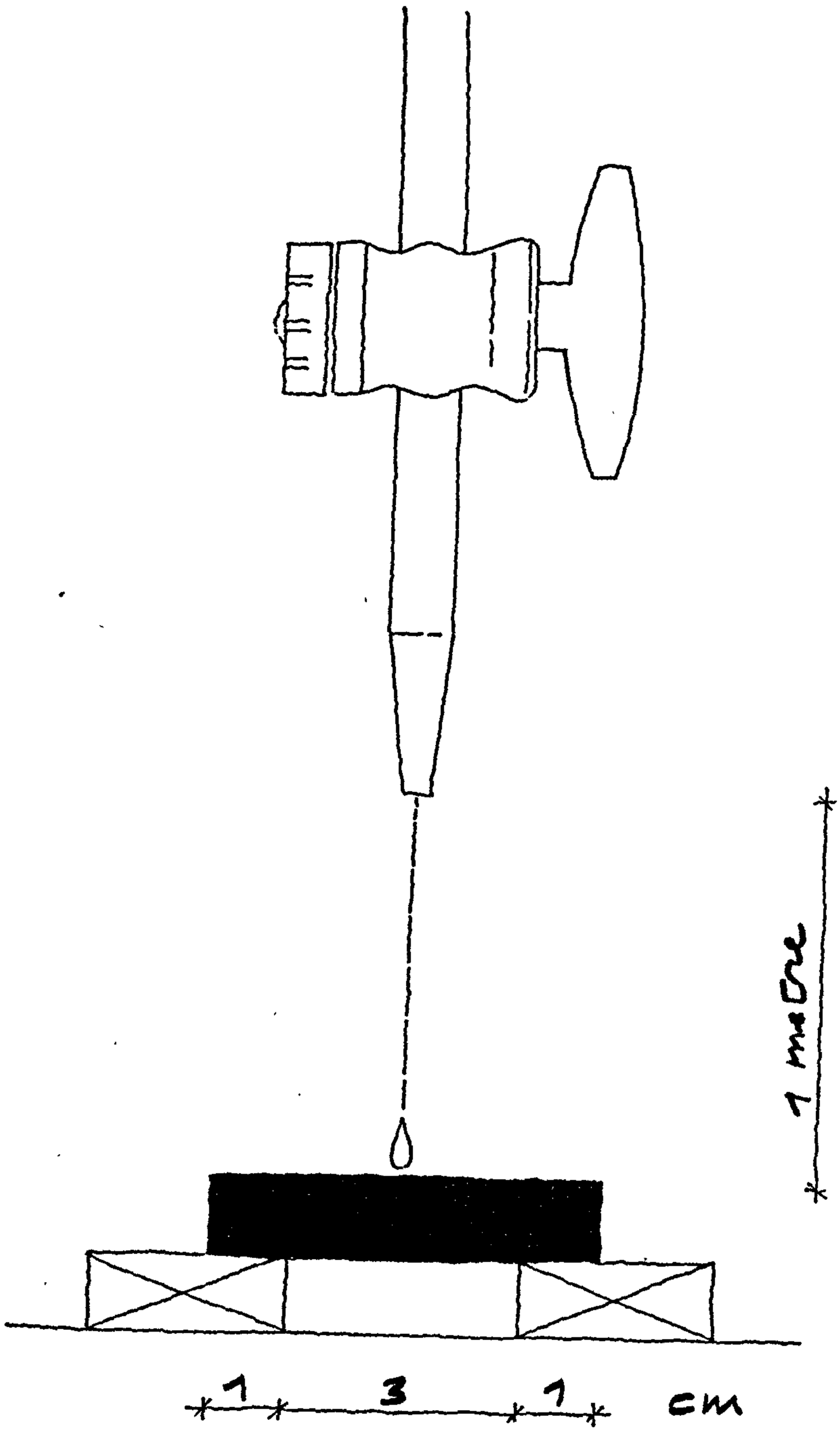


Fig. 7.11. Figure showing device employed for the erosion tests

Table 7.10 and Table 7.11. Erosion test
The two tables show the results of the erosion test which was carried out to *ladiri* samples. The first column on each table shows the name of the sample, and the second shows the shrinkage of cubes after drying; columns from three to nine show the perforation depth (mm) at elapsed times (min), and column ten shows the time needed for a complete perforation (min). Finally, a description of the shape of the sample after complete perforation is given following the classification: through circular perforation (A), through lateral perforation (B), through fracture perforation (C), and surface erosion after 6 hours (D).

Table 7.10. Atlas samples

Sample name	min mm	min mm	min mm	min mm	min mm	min mm	min mm	Perforation time (min)	Shape
Gonnesa 3	4 1	28 6	50 8	75 10	110 11	144 14	180 17	280	B
Samassi 8	20 5	40 8	60 10	90 11				136	C
Samassi A2	20 6	40 10	60 16	90 18				137	C
Serramanna 2	7 4	16 8	28 9	45 12				52	B
Serrenti 2	16 2	28 4	45 7	60 11	80 12	105 13	180 15	296	A
Sinnai 3	6 5	12 9	22 10	38 11	60 12			70	B
Uras 3	6 4	15 6	26 8	40 9	75 9			106	A
Villamassargia 4	6 6	15 7	26 8	40 9	75 12	120 15		166	C
Villasor 2	5 6	10 8	20 11	40 12	50 13			79	A

Table 7.11. Case studies samples

Sample name	min mm	min mm	min mm	min mm	min mm	min mm	min mm	Perforation time (min)	Shape
Case Study A3	10 3	20 6	35 7	60 9	90 10	130 11	180 14	>360 min	D
Case Study A4	10 2	20 4	40 8	80 9	160 10	210 13	270 15	>360 min	D
Case Study B5	5 9	10 10	20 11	30 13	45 18			54	A
Case Study B6	10 9	20 10	40 11	80 13	160 14	210 18		237	A

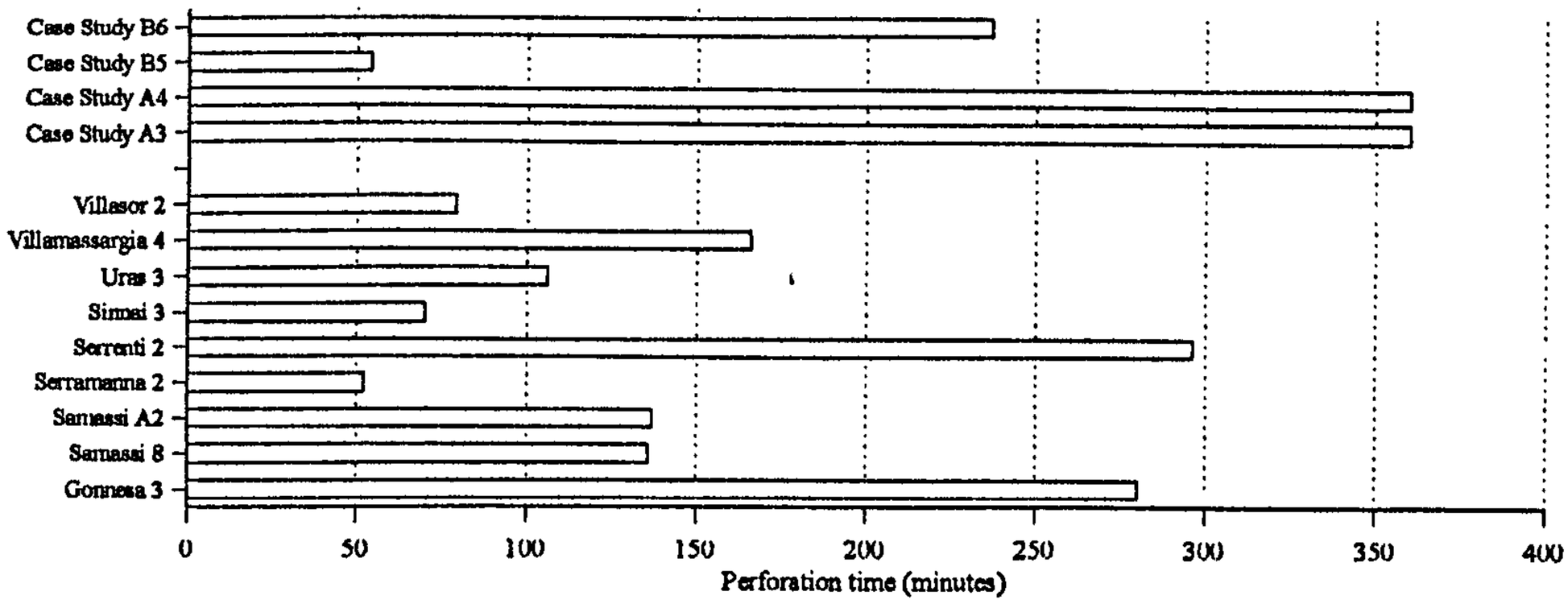
Table 7.12. Atlas samples. Erosion test. The table illustrates that seven samples out of nine show that their perforation time is proportional to the clay content

Sample name	Perforation time (min)	Straw content	Clay content
Serrenti 2	296	no straw	29.9
Gonnesa 3	280	no straw	26.8
Villamassargia 4	166	traces of straw	27.5
Samassi A2	137	straw and woody fibres	31.5
Samassi 8	136	traces of straw	24.8
Uras 3	106	traces of straw and woody fibres	8.7
Villasor 2	79	no straw	9.4
Sinnai 3	70	traces of straw and woody fibres	11.5
Serramanna 2	52	a lot of chopped straw	4.7

Table 7.13. Case studies samples. Erosion test

Sample name	Perforation time (min)	Straw content	Clay content
Case Study A3	>360 min	a lot of chopped straw	23.2
Case Study A4	>360 min	a lot of chopped straw	26.6
Case Study B6	237	a lot of chopped straw	26
Case Study B5	54	traces of woody fibres	11.1

Chart 7.3. Chart showing the erosion activity in function of the perforation time



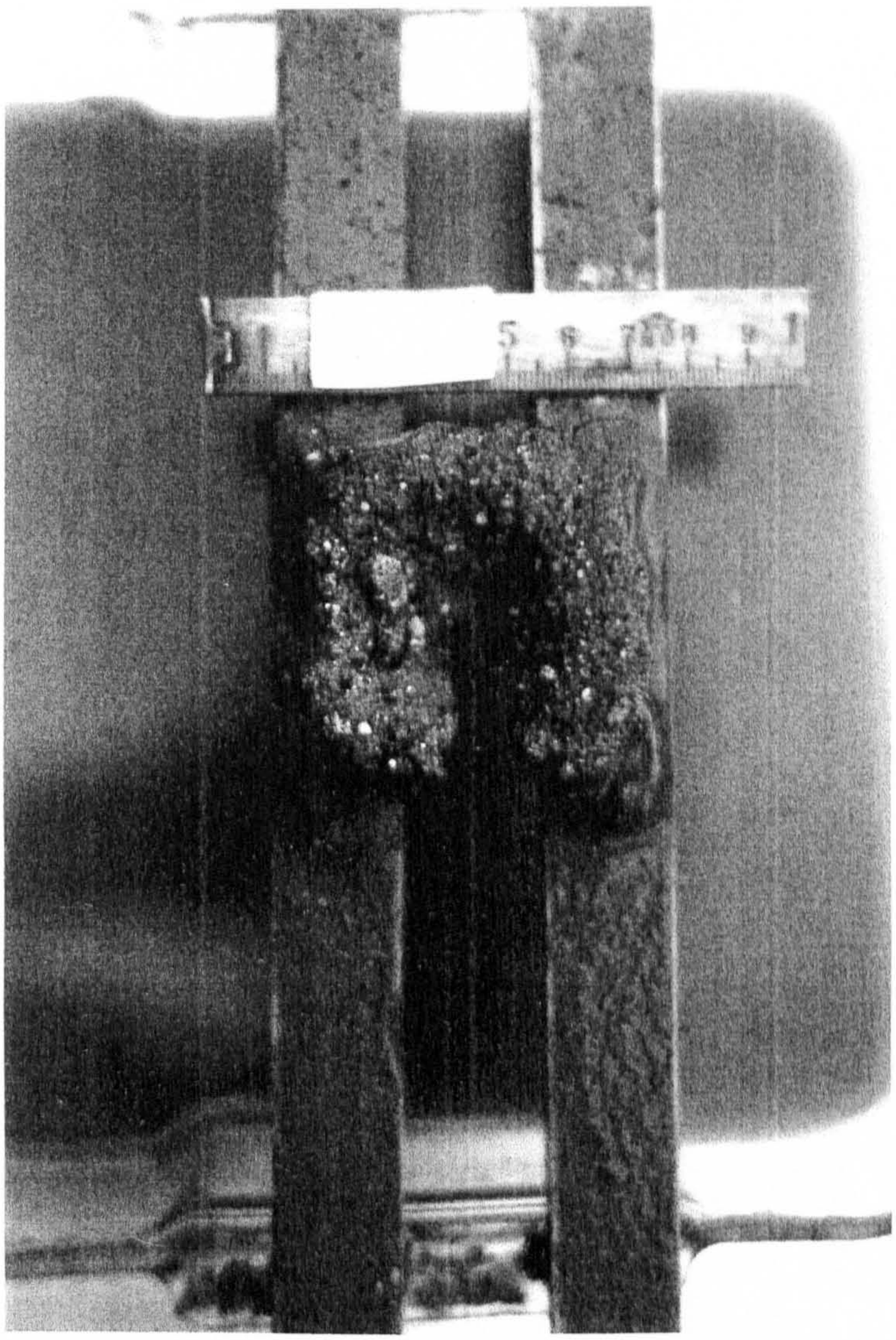


Fig. 7.12. Figure showing sample Gonnesa 3 after complete perforation (erosion test)

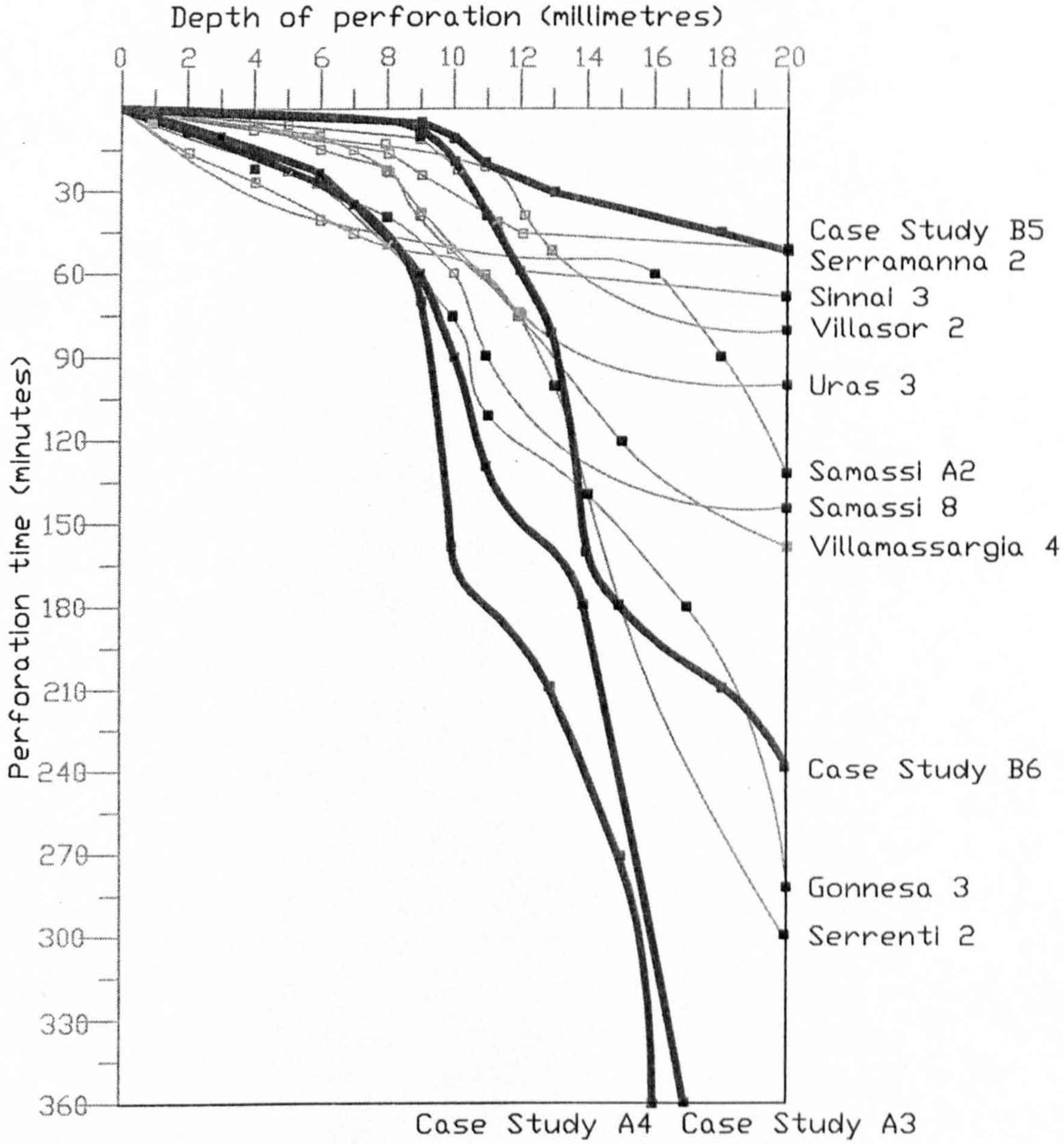


Fig. 7.13. Figure showing perforation time in function of the depth of perforation

Table 7.14 and Table 7.15. Wetting and drying test

Table 7.14. Table showing weight loss after one cycle of wetting and drying (atlas samples)

Sample name	Initial weight (gr)	Final weight (gr)	Weight loss (%)	Cracking	Contour scaling	Flaking
Gonnesa 3	98.1	88.9	9.4	slight	slight	no
Samassi 8	90.1	60.0	33.4	/	gross	yes
Samassi A2	71.8	60.8	15.3	/	gross	yes
Serramanna 2	70.6	37.6	46.7	/	gross	yes
Serrenti 2	84.2	70.3	16.5	slight	gross	no
Sinnai 3	87.8	57.9	34.1	slight	gross	yes
Uras 3	86.4	73.8	14.6	slight	gross	no
Villamassargia 4	87.5	73.1	16.5	slight	slight	no
Villasor 2	83.9	65.1	22.4	slight	gross	yes

Table 7.15. Table showing weight loss after one cycle of wetting and drying (case studies samples)

Sample name	Initial weight (gr)	Final weight (gr)	Weight loss (%)	Cracking	Contour scaling	Flaking
Case Study A3	91.1	86.3	5.3	slight	/	no
Case Study A4	78.4	72.9	7.0	slight	slight	no
Case Study B5	58.1	48.8	16.0	/	gross	yes
Case Study B6	65.1	33.4	48.7	/	gross	yes

Table 7.16. Wetting and drying test. Table showing that six samples out of nine are characterised by a weight loss due to wetting and drying which is inversely proportional to the clay content (atlas samples)

Sample name	Percent clay	Weight loss (%)
Gonnesa 3	26.8	9.4
Uras 3	8.7	14.6
Samassi A2	31.5	15.3
Serrenti 2	29.9	16.5
Villamassargia 4	27.5	16.5
Villasor 2	9.4	22.4
Samassi 8	24.8	33.4
Sinnai 3	11.5	34.1
Serramanna 2	4.7	46.7

Table 7.17. Wetting and drying test. Table showing weight loss due to wetting and drying and the correspondent clay content of the case study samples

Sample name	Percent clay	Weight loss (%)
Case Study A3	23.2	5.3
Case Study A4	26.6	7.0
Case Stydy B5	11.1	16.0
Case Study B6	26	48.7

Fig. 7.14. Figure showing prisms after one cycle of wetting and drying. From left to right, top to bottom: Gonnesa 3, Samassi 8, Samassi A2, Serramanna 2, Serrenti 2, Sinnai 3, Uras 3, Villamassargia 4, Villasor 2, Case Study A3, Case Study A4, Case Study B5, Case Study B6

Case Study A4 Case Study B5 Case Study B6

Fig. 7.15. Figure showing blow-up of samples Sinnai 3, Uras 3, and Villamassargia 4 after wetting and drying (next page)

Fig. 7.16. Figure showing blow-up of samples Case Study A4, Case Study B5, and Case Study B6 after one cycle of wetting and drying (next page)

Table 7.18. Atlas samples. Shrinkage test.
The table illustrates that seven out of nine samples are characterised by a shrinkage proportional to the clay content

Sample name	Percent clay	Shrinkage (%)
Samassi A2	31.5	7.8
Villasor 2	9.4	4
Serrenti 2	29.9	3.9
Samassi 8	24.8	3.9
Villamassargia 4	27.5	2
Serramanna 2	4.7	2
Gonnesa 3	26.8	0
Sinnai 3	11.5	0
Uras 3	8.7	0

Table 7.19. Shrinkage test Table showing shrinkage and the correspondent clay content of the case study samples

Sample name	Percent clay	Shrinkage (%)
Case Study A3	23.2	4%
Case Study A4	26.6	11.6%
Case Study B5	11.1	0%
Case Study B6	26	13.5%

Chart 7.4. Chart showing shrinkage of atlas and case stuy samples

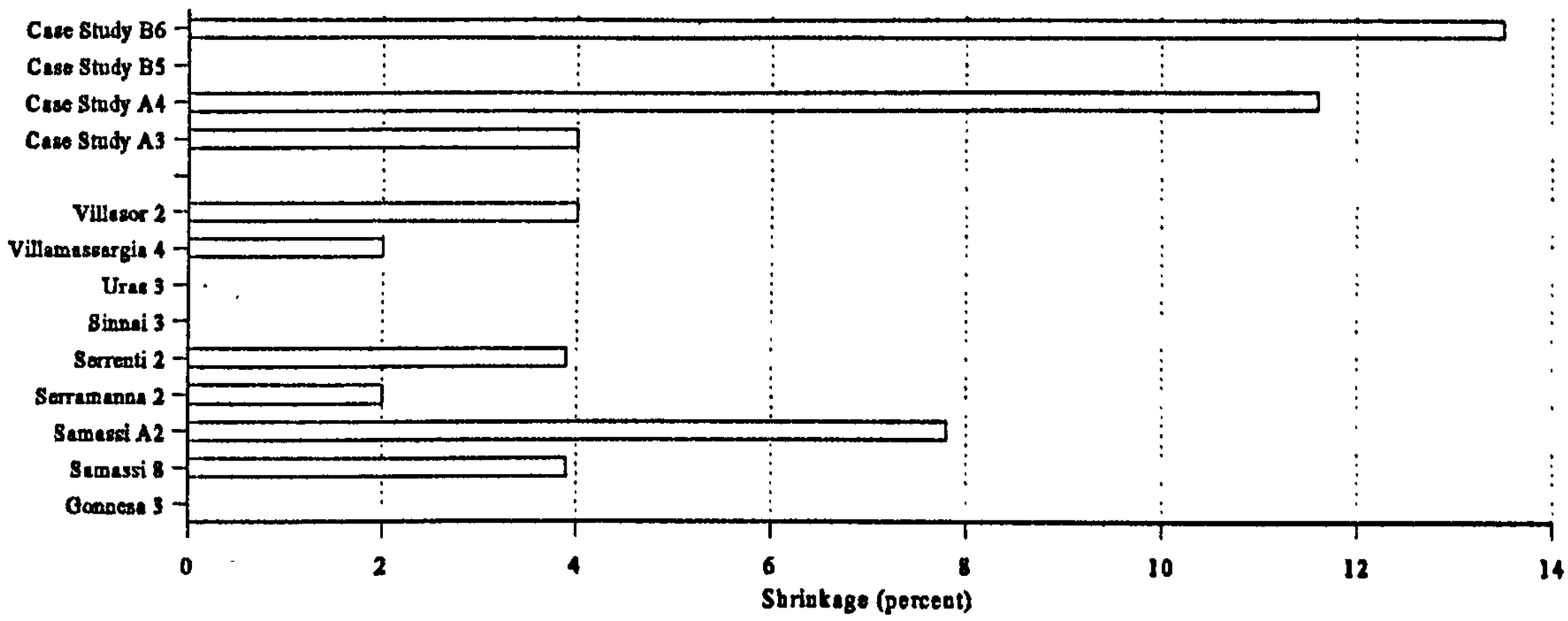


Table 7.20 and Table 7.21. Abrasion test

Table 7.20. Table showing performance of atlas samples to abrasion

Sample name	Sample weigth before abrasion (gr)	Abraded surface (square cm)	Sample weight after abrasion (gr)	Coefficient of abrasion (gr/cm^2)
Gonnesa 3	100.5	25	99.8	0.03
Samassi 8	95.7	24.01	92.6	0.13
Samassi A2	77.1	23.04	74	0.13
Serramanna 2	83.4	24.5	72.5	0.44
Serrenti 2	88.4	24.01	86.3	0.09
Sinnai 3	95.6	25	89.5	0.24
Uras 3	89.1	25	88.2	0.02
Villamassargia 4	89.5	24.5	88.7	0.03
Villasor 2	87.5	24	83.7	0.16

Table 7.21. Table showing performance of sase studies samples to abrasion

Sample name	Sample weigth (gr)	Abraded surface (square cm)	Abraded materials (gr)	Coefficient of abrasion (gr/cm^2)
Case Study A3	95.3	24	92.5	0.12
Case Study A4	82	22.08	80	0.09
Case Study B5	78.5	25	60	0.74
Case Study B6	70.2	21.62	66.7	0.16

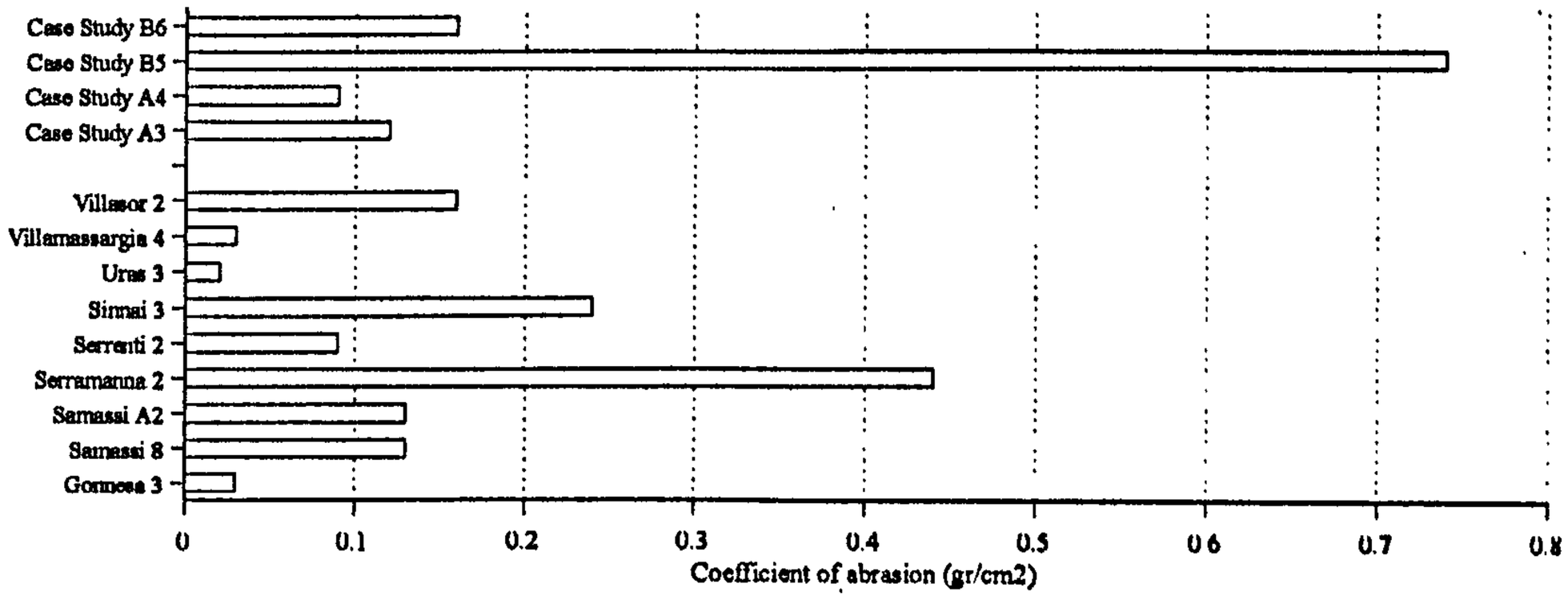
Table 7.22. Abrasion test. Table showing that five out of nine samples are characterised by a coefficient of abrasion inversely proportional to the clay content

Sample name	Percent clay	Coefficient of abrasion (gr/cm^2)
Serramanna 2	4.7	0.44
Sinnai 3	11.5	0.24
Villasor 2	9.4	0.16
Samassi 8	24.8	0.13
Samassi A2	31.5	0.13
Serrenti 2	29.9	0.09
Villamassargia 4	27.5	0.03
Gonnesa 3	26.8	0.03
Uras 3	8.7	0.02

Table 7.23. Table showing relationship between the coefficient of abrasion of case studies samples and their clay content

Sample name	Percent clay	Coefficient of abrasion (gr/cm^2)
Case Study A3	23.2	0.12
Case Study A4	26.6	0.09
Case Study B5	11.1	0.74
Case Study B6	26	0.16

Chart 7.5. Chart showing performance of samples to the abrasion test



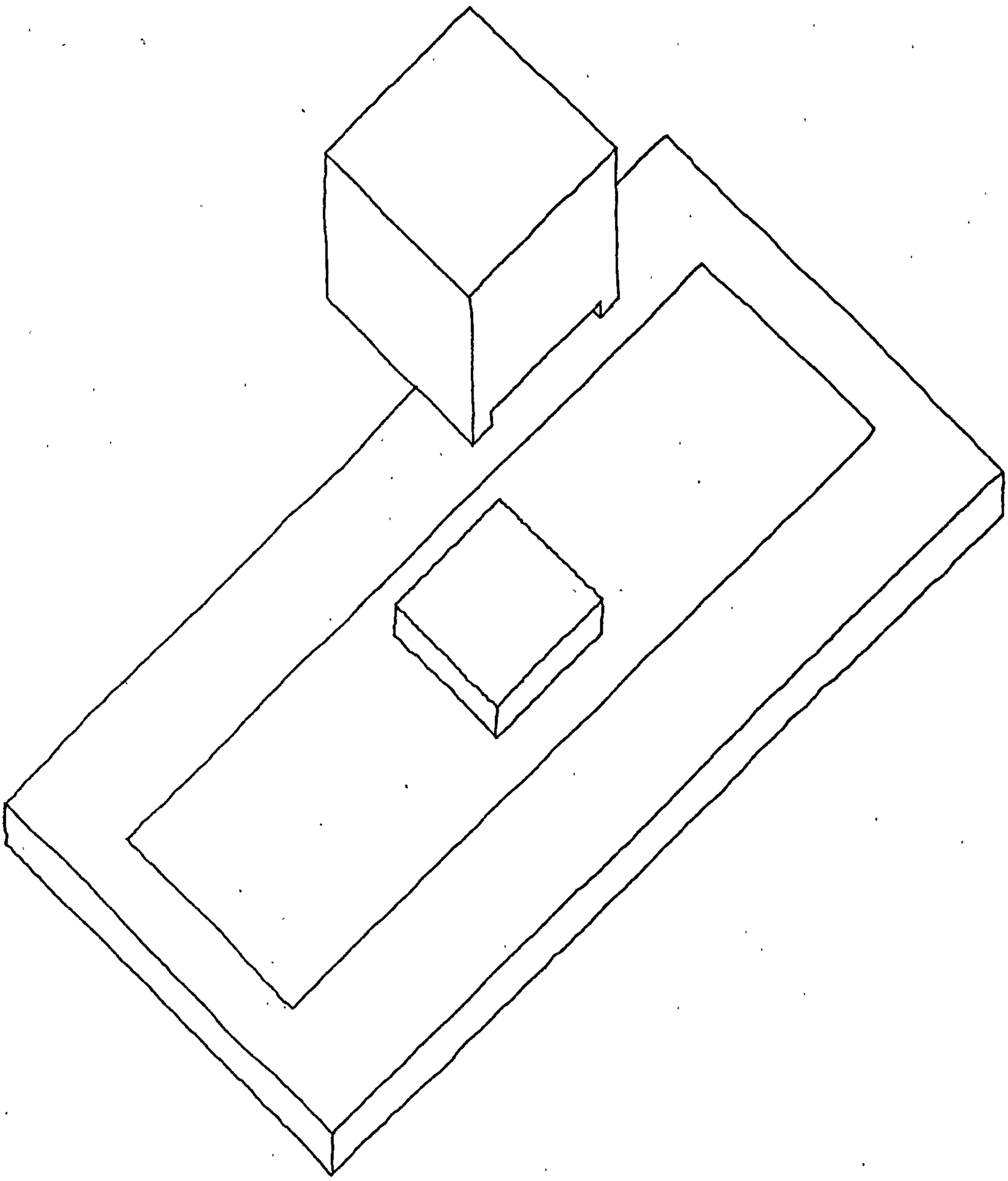


Fig. 7.17. Figure showing device employed for the abrasion test

Tables 7.24 and 7.25. Comparative analysis of physical tests

Table 7.24. Recapitulation of the results of the physical tests for *ladiri* (atlas) samples. Results in the last columns are given so that 1 is the best performing soil and 10 is the worst performing one.

Sample name	Erosion	Wetting and drying	Shrinkage	Abrasion	RESULTS
Gonnesa 3	very slow	very slight failure	high	very low	3
Samassi 8	slow	slight failure	low	very low	8
Samassi A2	slow	very slight failure	low	very low	5
Serramanna 2	medium	medim failure	low	medium	10
Serrenti 2	very slow	very slight failure	very low	very low	1
Sinnai 3	medium	slight failure	very low	low	9
Uras 3	slow	very slight failure	very low	very low	2
Villamassargia 4	slow	very slight failure	very low	very low	2
Villasor 2	medium	slight failure	very low	very low	6

Table 7.25. Recapitulation of the results of the physical tests for *ladiri* (case studies) samples. Results in the last columns are given so that 1 is the best performing soil and 10 is the worst performing one.

Sample name	Erosion	Wetting and drying	Shrinkage	Abrasion	RESULTS
Case study A3	very slow	very slight failure	low	very low	2
Case study A4	very slow	very slight failure	high	very low	3
Case study B5	medium	very slight failure	very low	high	7
Case study B6	very slow	medium failure	very high	very low	4

Table 7.26. Checklist for characterisation and physical tests. Yes answers mean that the replacement soil will be sacrificial towards the historic one. No answers mean that the replacement soil will not be sacrificial towards the historic one.

	Case Study A		Case Study B	
	YES	**NO**	**YES**	**NO**
Soil colour	✓		✓	
pH	✓		✓	
Particle size distribution	✓		✓	
Carbonates content		✓		✓
Atterberg limits	✓			✓
Erosion	✓			✓
Wetting and drying	✓		✓	
Shrinkage	✓		✓	
Abrasion		✓		✓
TOTAL	**7**	**2**	**5**	**4**

EXPERIMENTAL ANALYSIS OF LIME RENDERS

TABLES, FIGURES, AND CHARTS

Table 7.27. Interior lime render, scratch coat. Table illustrating percent values of carbonate and aggregate after dissolution in hydrochloric acid and sieving (values seldom total 100 because of presence of water-soluble salts)

Sample name	Moisture (%)	Carbonate (%)	Gravel (%)	Sand (%)	Silt and clay (%)
Barrua 1	0.4	29.3	16.0	54.3	0
Gonnesa 1	0.5	23.0	0.4	76.0	0
Samassi 7	2.7	39.7	1.3	55.3	0
Sestu 1	1.1	53.4	1.3	44.2	0
Villamassargia 2	0.4	29.9	5.2	64.5	0
Average	**1.0**	**35.0**	**4.8**	**58.9**	**0**

Table 7.28. Interior lime render, skim coat. Table illustrating percent values of carbonate and aggregate after dissolution in hydrochloric acid and sieving (values seldom total 100 because of presence of water-soluble salts)

Sample name	Moisture (%)	Carbonate (%)	Gravel (%)	Sand (%)	Silt and clay (%)
Cagliari 1	1.5	24.3	0.5	73.5	0
Cagliari 2	1.9	22.5	0.4	71.5	0
Musei 1	0.5	31.4	0	67.9	0
Samassi 1	0	16.2	2.9	80.8	0
Samassi 5	0.6	24.2	6.0	68.6	0
Serramanna 3	1.0	23.4	0.2	75.4	0
Villasor 3	0.2	14.3	3.7	81.5	0
Average	**0.8**	**22.3**	**1.9**	**74.1**	**0**

Table 7.29. Exterior lime render, scratch coat. Table illustrating ercent values of carbonate and aggregate after dissolution in hydrochloric acid and sieving (values seldom total 100 because of presence of water-soluble salts)

Sample name	Moisture (%)	Carbonate (%)	Gravel (%)	Sand (%)	Silt and clay (%)
Assemini 1	0.1	20.9	0.2	76.1	2.7
Gonnesa 2	0	25.4	2.1	68.5	3.9
Furtei 1	1	39.1	2.8	52.3	3.9
Barrua 2	1.4	28.7	10.5	54.8	0.4
Sinnai 1	1.4	26.7	1.1	71.1	0.6
Uras 1	0.4	15.2	6.1	66.6	1.8
Solarussa 1	0	19.4	8.1	62.7	0
Serrenti 1	0	15.7	23.6	57.4	0.6
Serramanna 1	1.5	25	16.6	54.4	0.5
Samassi 4	0.4	19.7	7.8	69.1	0.5
Average	**0.5**	**23.5**	**7.8**	**63.2**	**1.4**

Table 7.30. Exterior lime render, skim coat. Table illustrating percent values of carbonate and aggregate after dissolution in hydrochloric acid and sieving (values seldom total 100 because of presence of water-soluble salts)

Sample name	Moisture (%)	Carbonate (%)	Gravel (%)	Sand (%)	Silt and clay (%)
Barrua 3	7.4	24	7.4	51.8	0
Nuraminis 2	0.5	29.1	3.5	66.4	0
Sinnai 2	0.5	24.1	0.2	74.5	0
Uras 2	0	31	0	68.5	0
Villasor 1	1.3	22.4	1.3	75.5	0
Average	**1.9**	**26.1**	**2.4**	**67.3**	**0**

Table 7.31. Lime renders, Case Study A. Table illustrating percent values of carbonate and aggregate after dissolution in hydrochloric acid and sieving

Sample name	Moisture (%)	Carbonate (%)	Gravel (%)	Sand (%)	Silt and clay (%)
Case Study A1	0.4	24.7	6.3	67.4	0
Case Study A2	3	65.3	0	0	0
Case Study A5	0.5	17.3	12.9	69.7	0

Table 7.32. Lime renders, Case Study B. Table illustrating percent values of carbonate and aggregate after dissolution in hydrochloric acid and sieving

Sample name	Moisture (%)	Carbonate (%)	Gravel (%)	Sand (%)	Silt and clay (%)
Case Study B1	0.5	24.7	0.3	75	0
Case Study B2	0.5	33.9	0.6	65.5	0
Case Study B3	0	22.0	0.3	77.2	0
Case Study B7	0.5	12.8	2.2	74.6	0.1
Case Study B8	0	23.9	0.2	73.5	0

Table 7.33. Table illustrating average percent values of ratios for every cathegory of lime coat. Aggregate is condidered as the totality of gravel, sand, silt, and clay

Category	Ratio between lime and aggregate	Simplified ratio
Interior scratch coat	35.1 : 63.9	**1 : 1.8**
Interior skim coat	22.5 : 76.6	**1 : 3.4**
Exterior scratch coat	24.3 : 75.1	**1 : 3.1**
Exterior skim coat	26.7 :71.3	**1 : 2.7**

Table 7.34. Exterior lime render, scratch coat. Table illustrating sand void ratio and porosity of render

Sample name	Sand void ratio	Porosity (render)	Percent carbonate
Assemini 1	38.7	22.1	20.9
Gonnesa 2	28	23.7	25.4
Furtei 1	28.9	/	39.1
Barrua 2	37.5	29	28.7
Sinnai 1	34.4	26.6	26.7
Uras 1	35.7	/	15.2
Solarussa 1	32.3	/	19.4
Serrenti 1	29	/	15.7
Serramanna 1	33.3	/	25
Samassi 4	38.8	26.9	19.7
Average	**33.6**	**25.7**	**23.5**

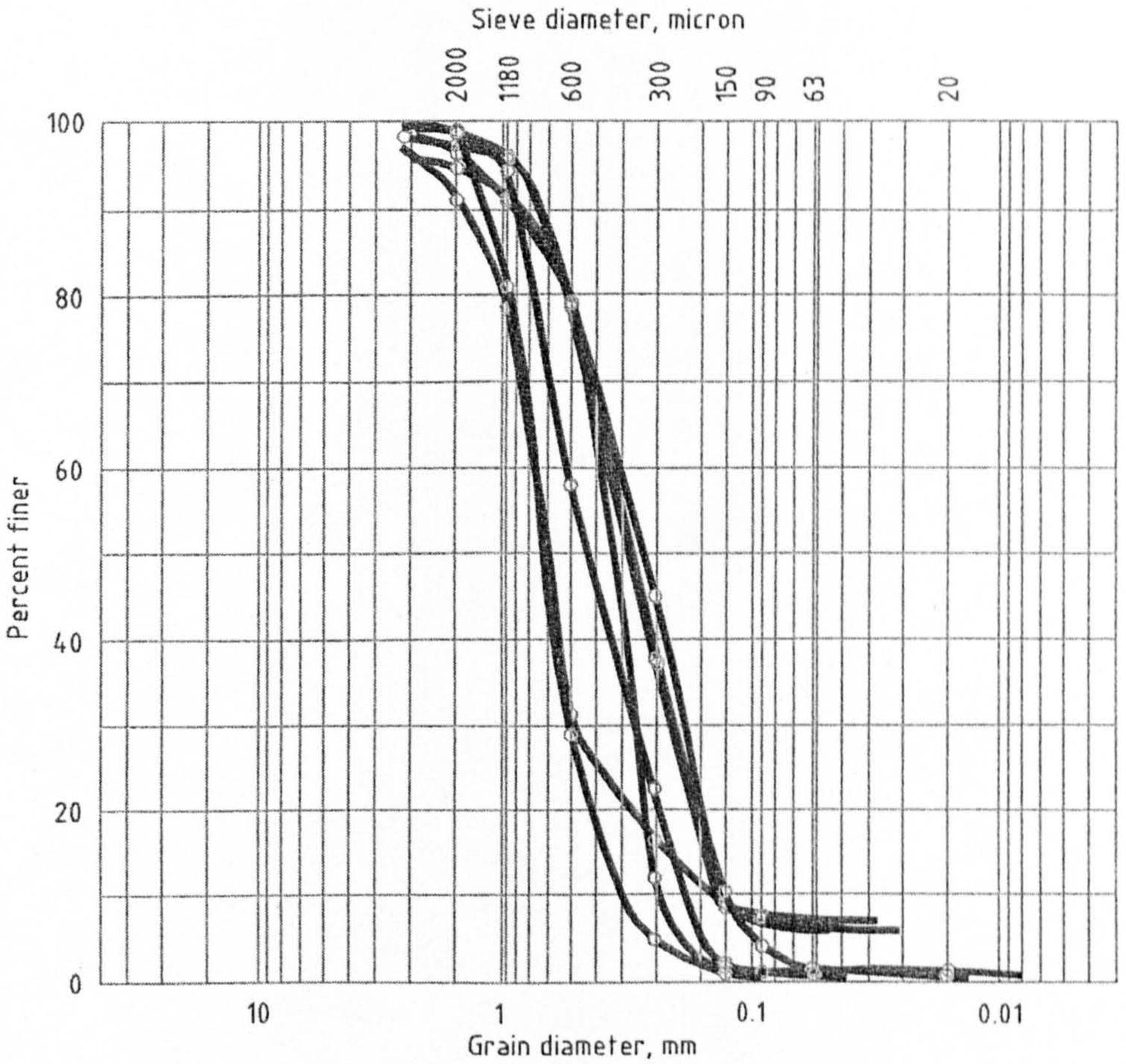


Fig. 7.18. Interior lime render, skim coat. Figure illustrating particle size distribution of the seven samples

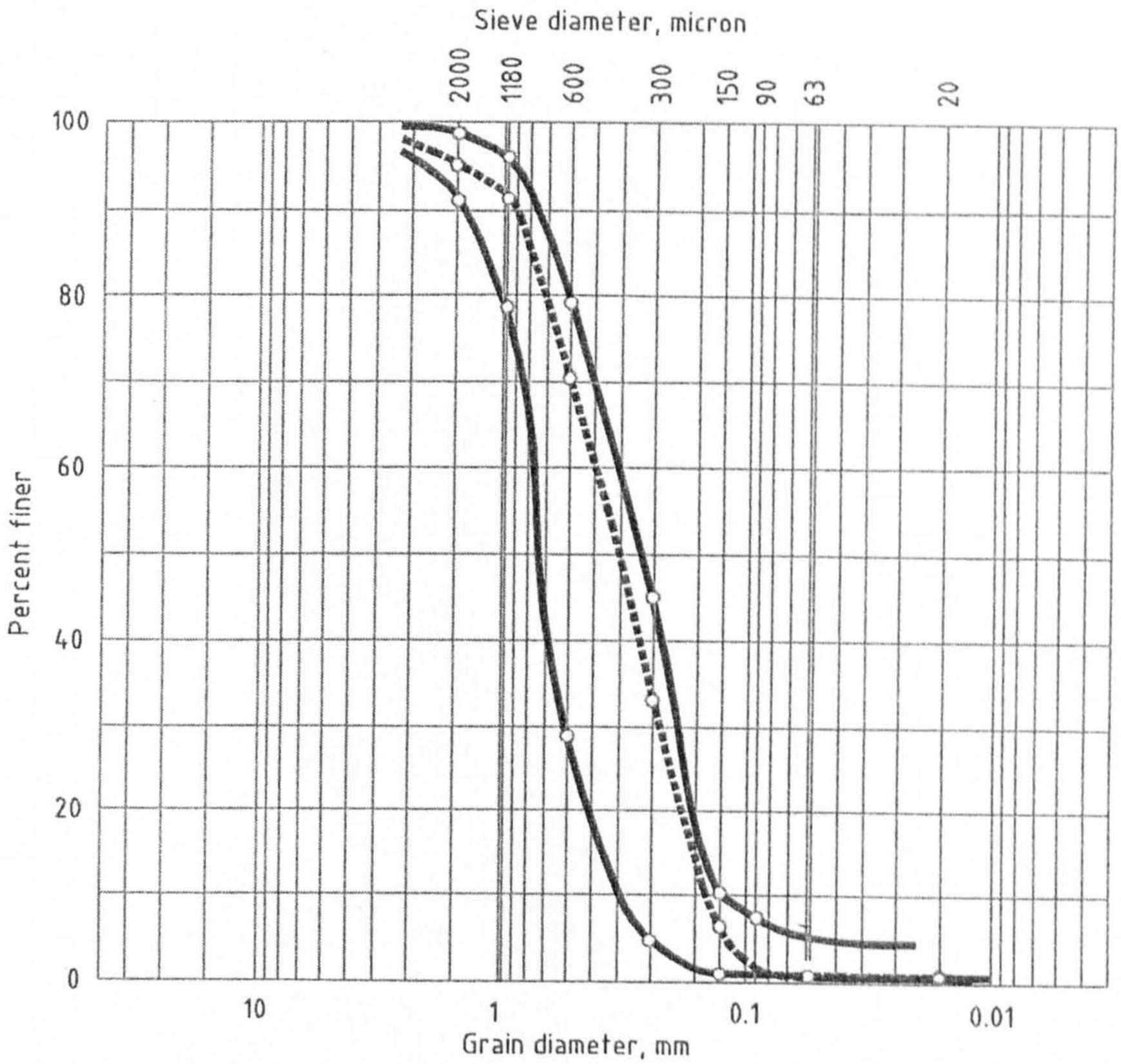
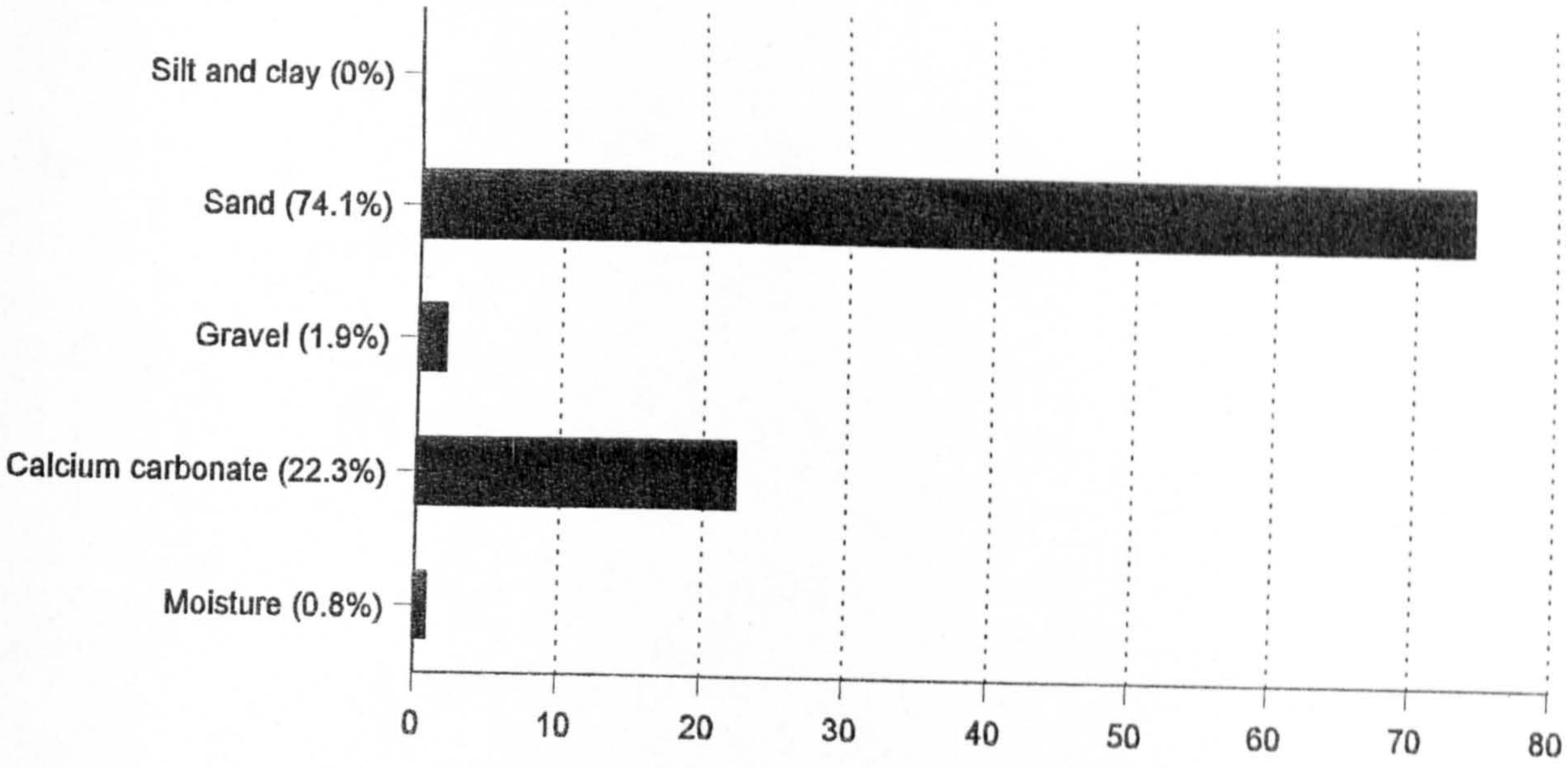


Fig. 7.19. Interior lime render, skim coat. Figure illustrating the outlines of the curves on Fig. 7.18, together with the minimum curve, the maximum curve, and the ideal curve



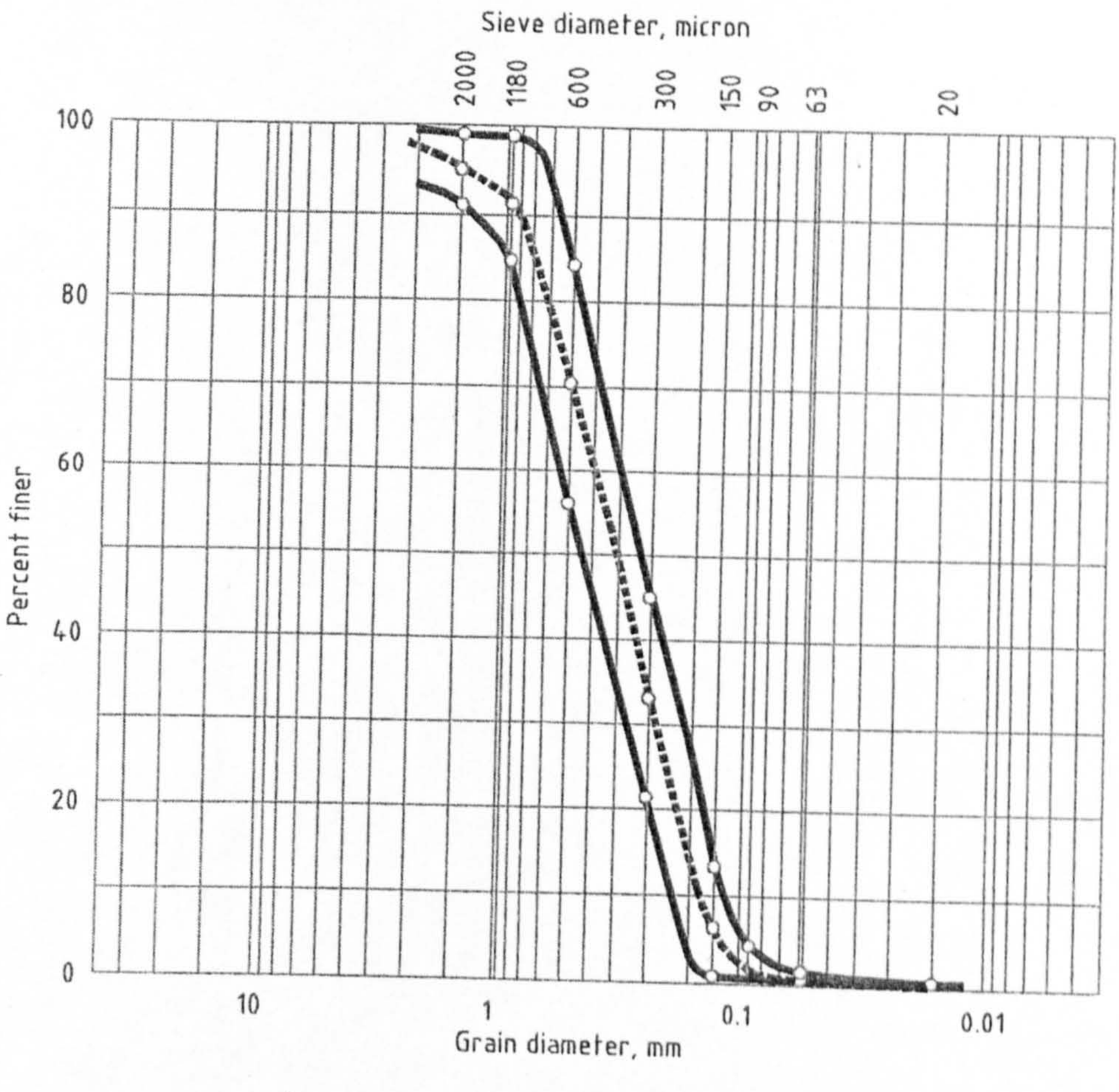


Chart 7.6. Chart showing average percent values of the seven interior skim coats

Fig. 7.20. Interior lime render, skim coat. Figure showing recommended zone based on Fig. 7.19

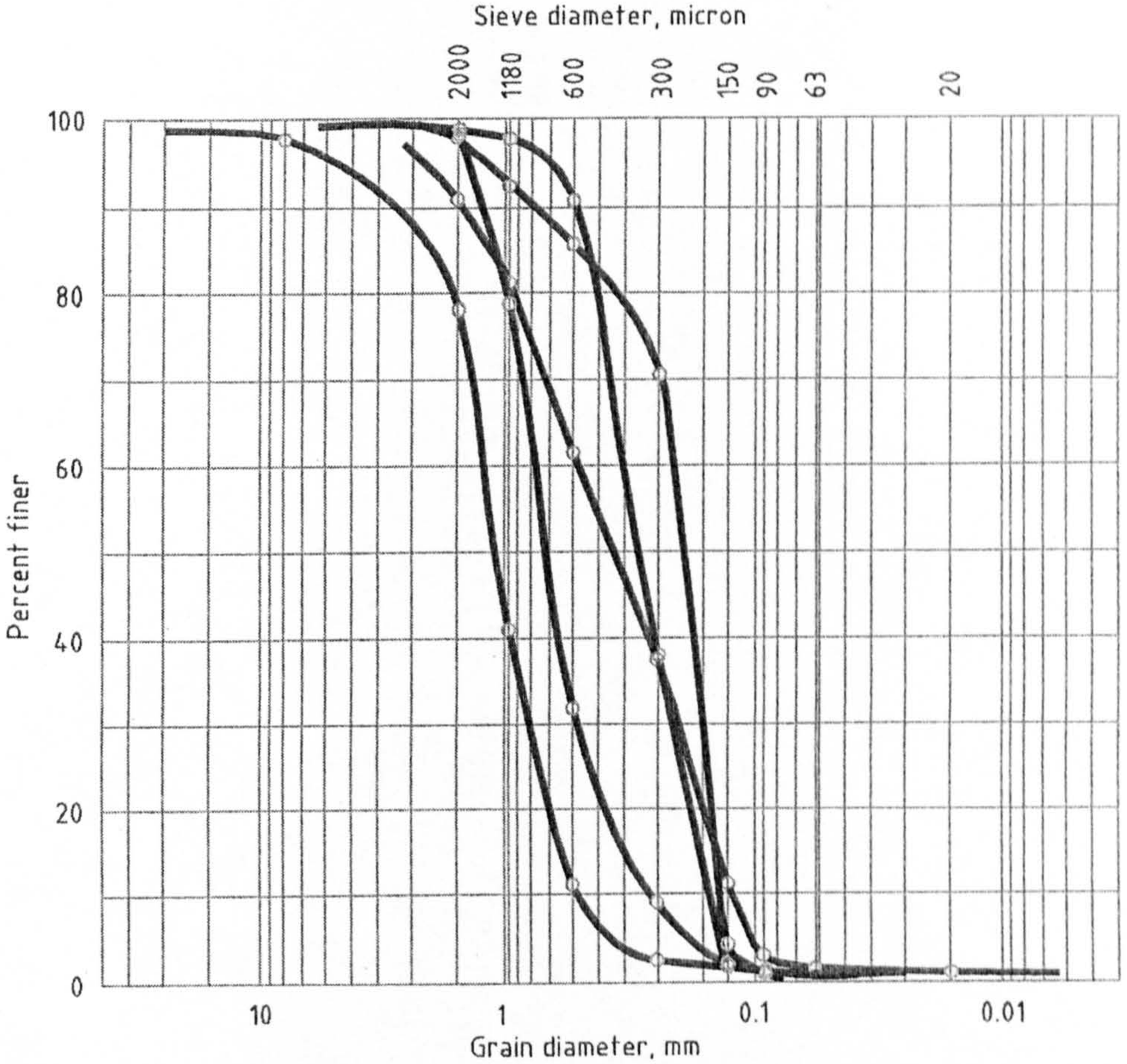


Fig. 7.21. Interior lime render, scratch coat. Figure showing particle size distribution of the five samples

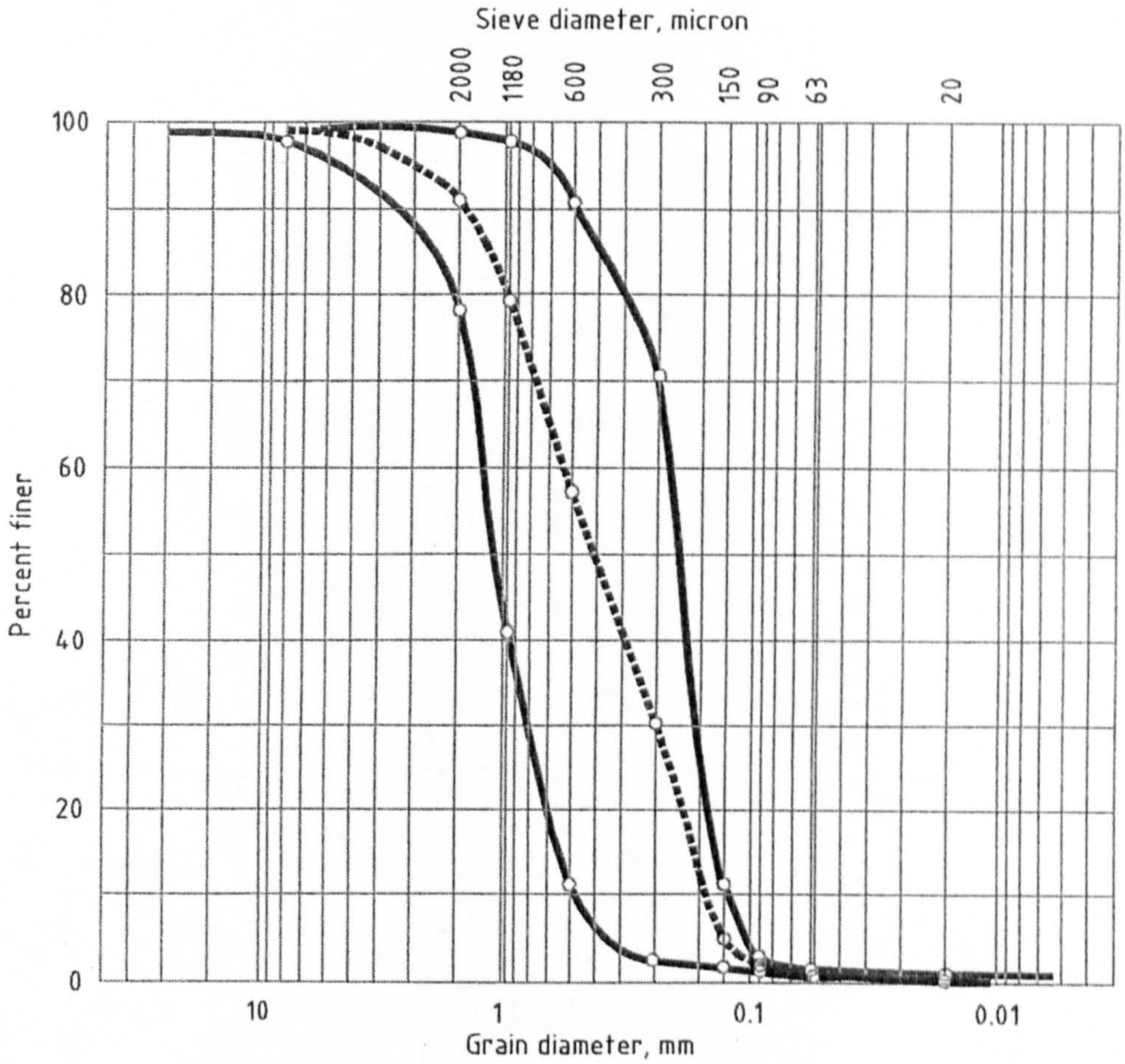
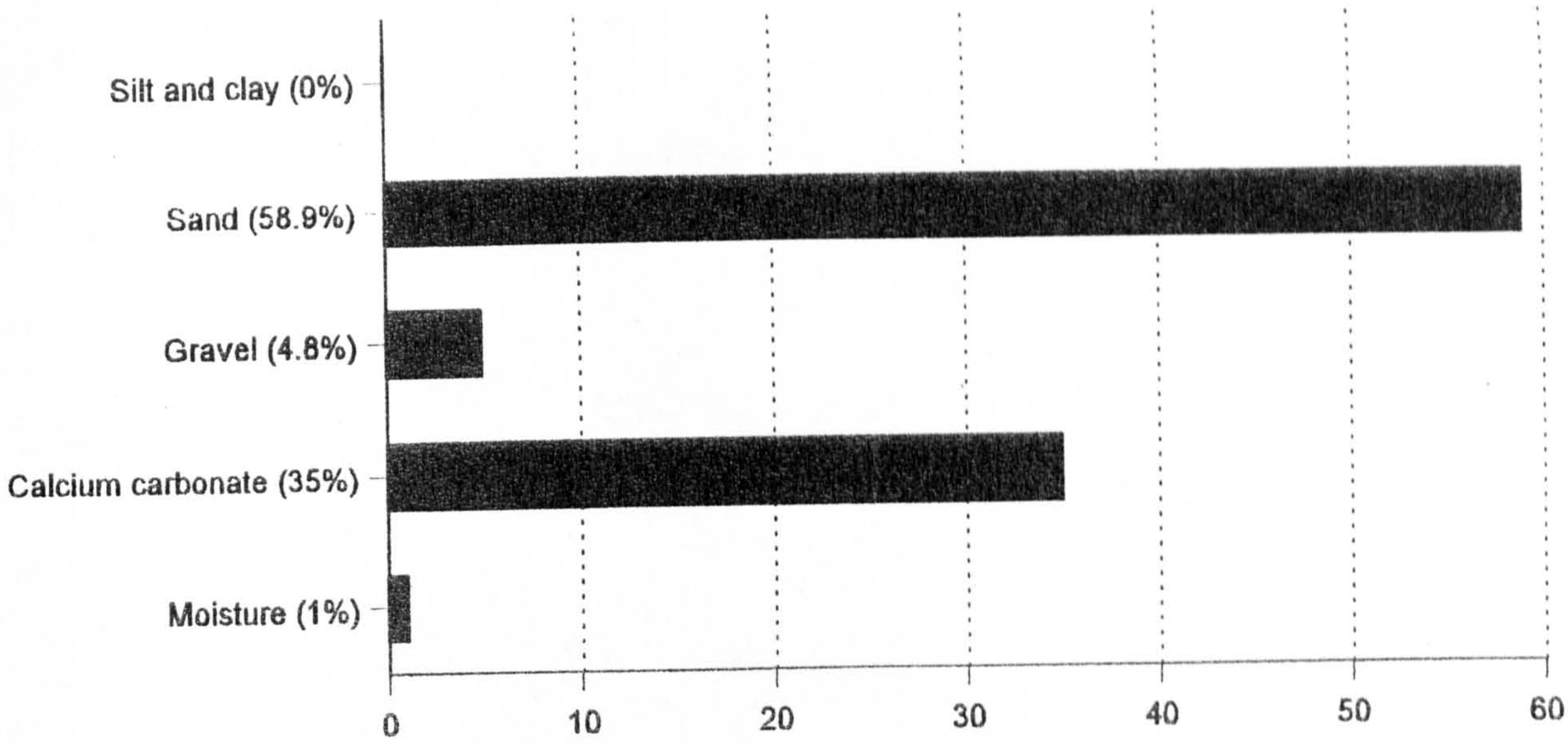


Fig. 7.22. Interior lime render, scratch coat. Figure illustrating the outlines of the curves on Fig. 7.21, together with the minimum curve, the maximum curve, and the ideal curve



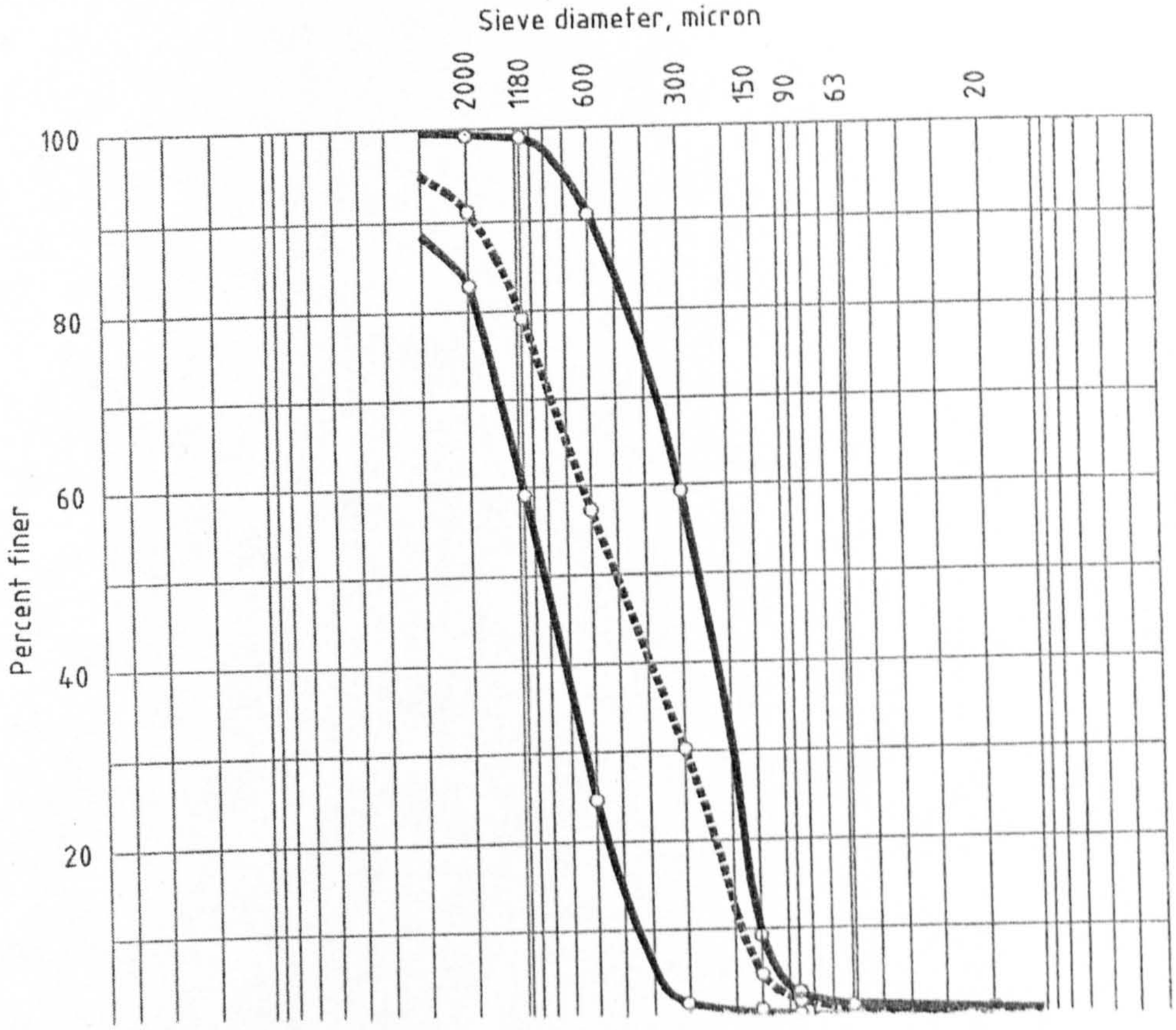


Chart 7.7. Chart showing average percent values of the five interior scratch coats

Fig. 7.23. Interior lime render, scratch coat. Figure showing recommended zone based on Fig. 7.22

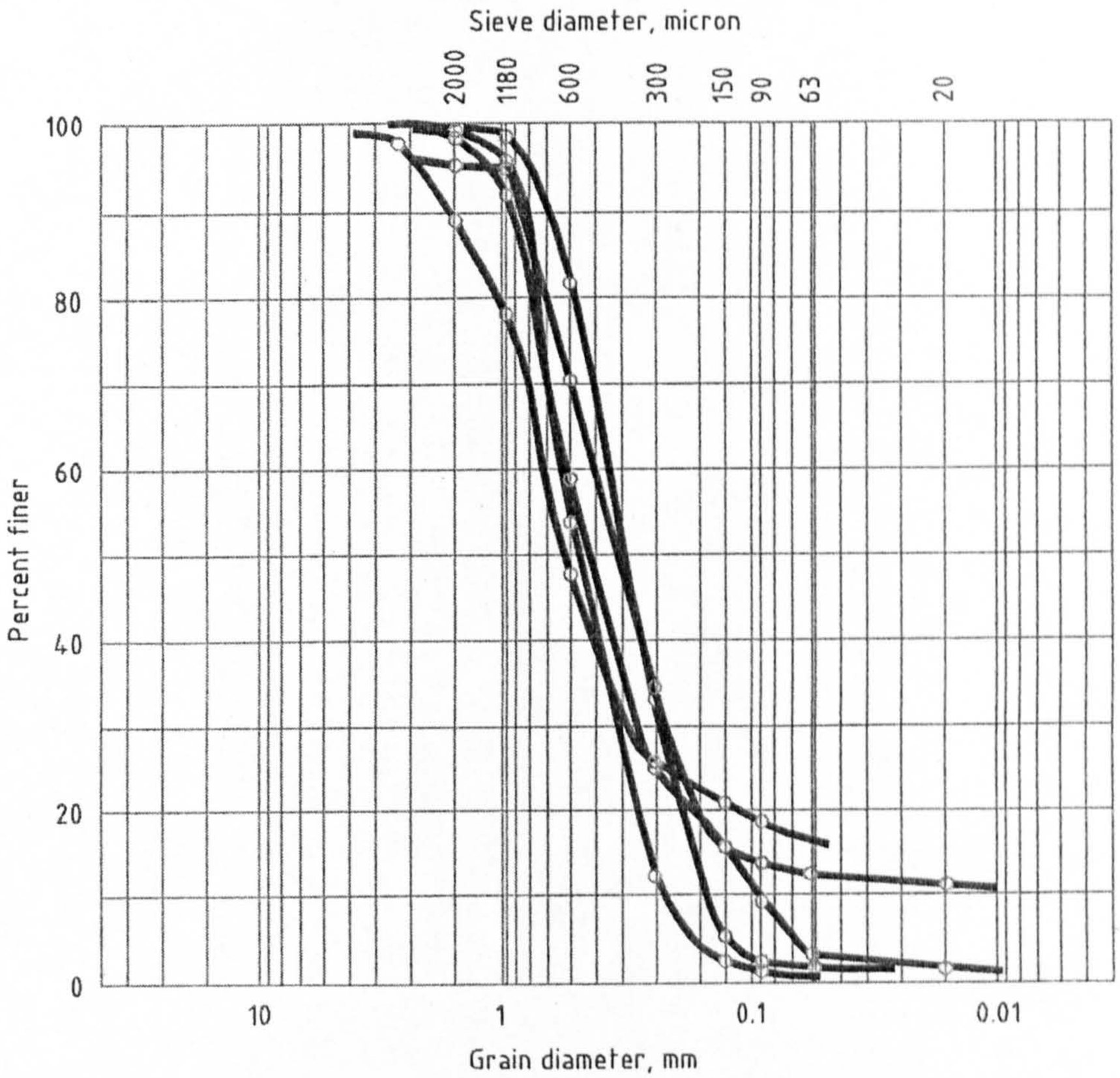


Fig. 7.24. Exterior lime render, skim coat. Figure showing particle size distribution of the five samples

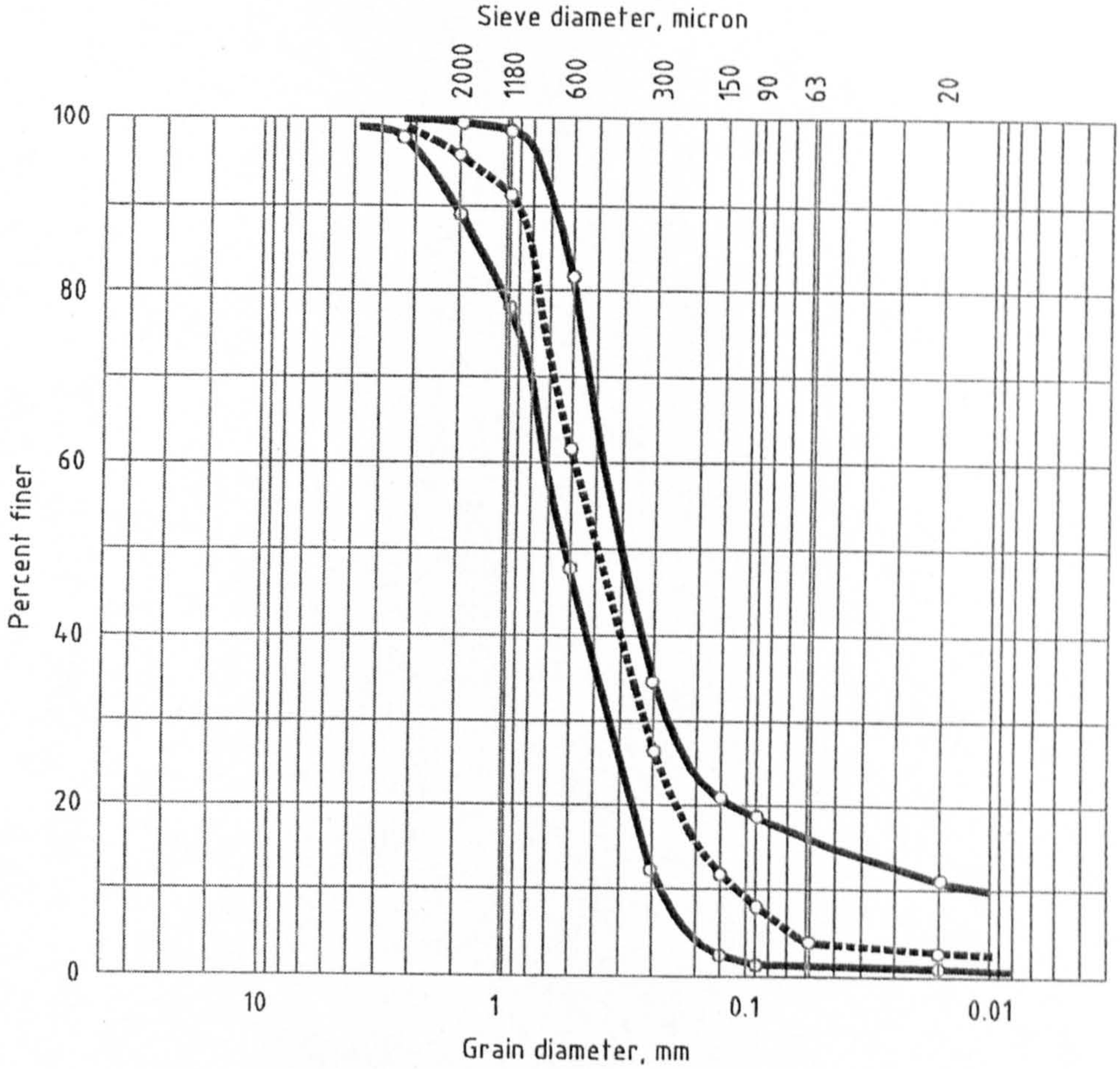
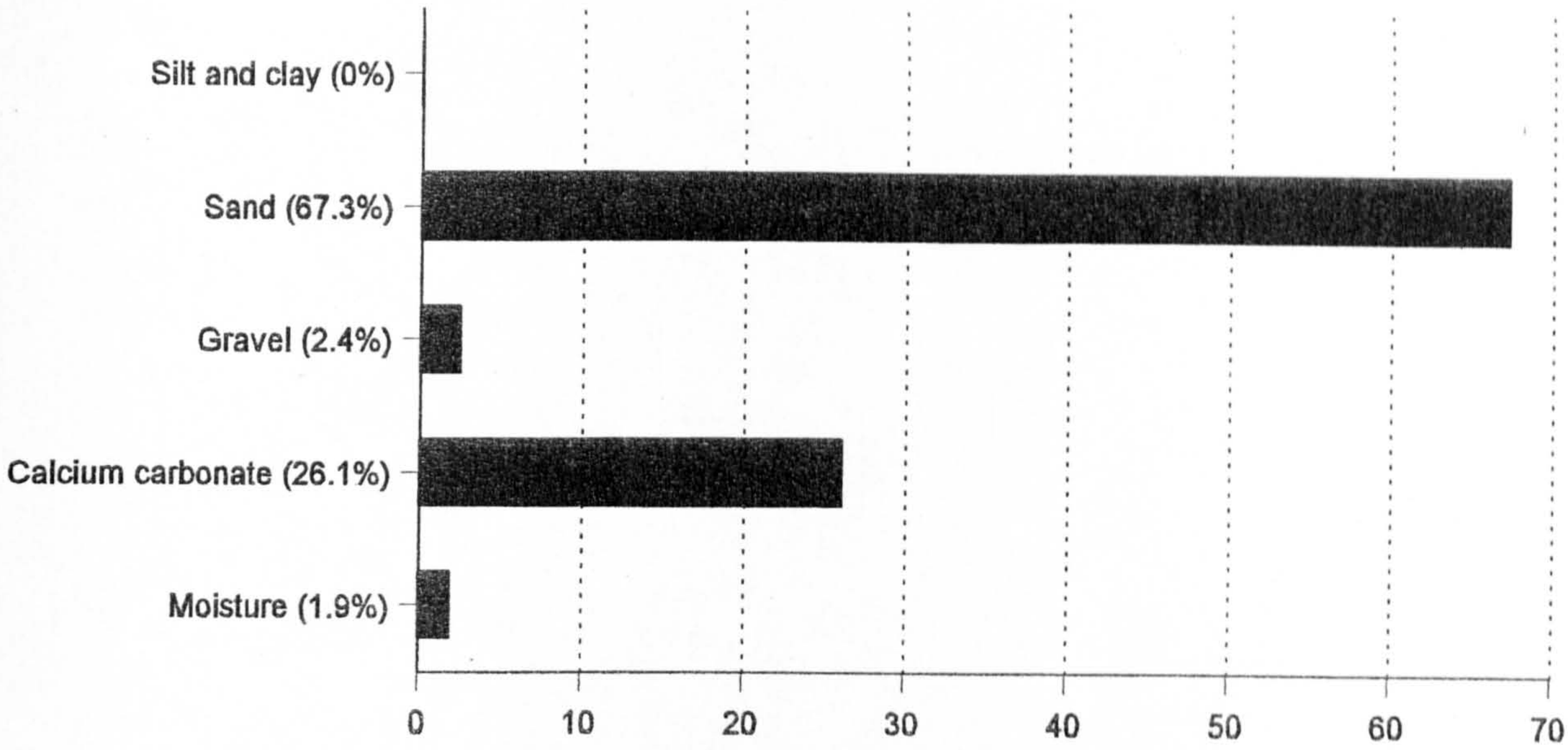


Fig. 7.25. Exterior lime render, skim coat. Figure illustrating the outlines of the curves on Fig. 7.24, together with the minimum curve, the maximum curve, and the ideal curve



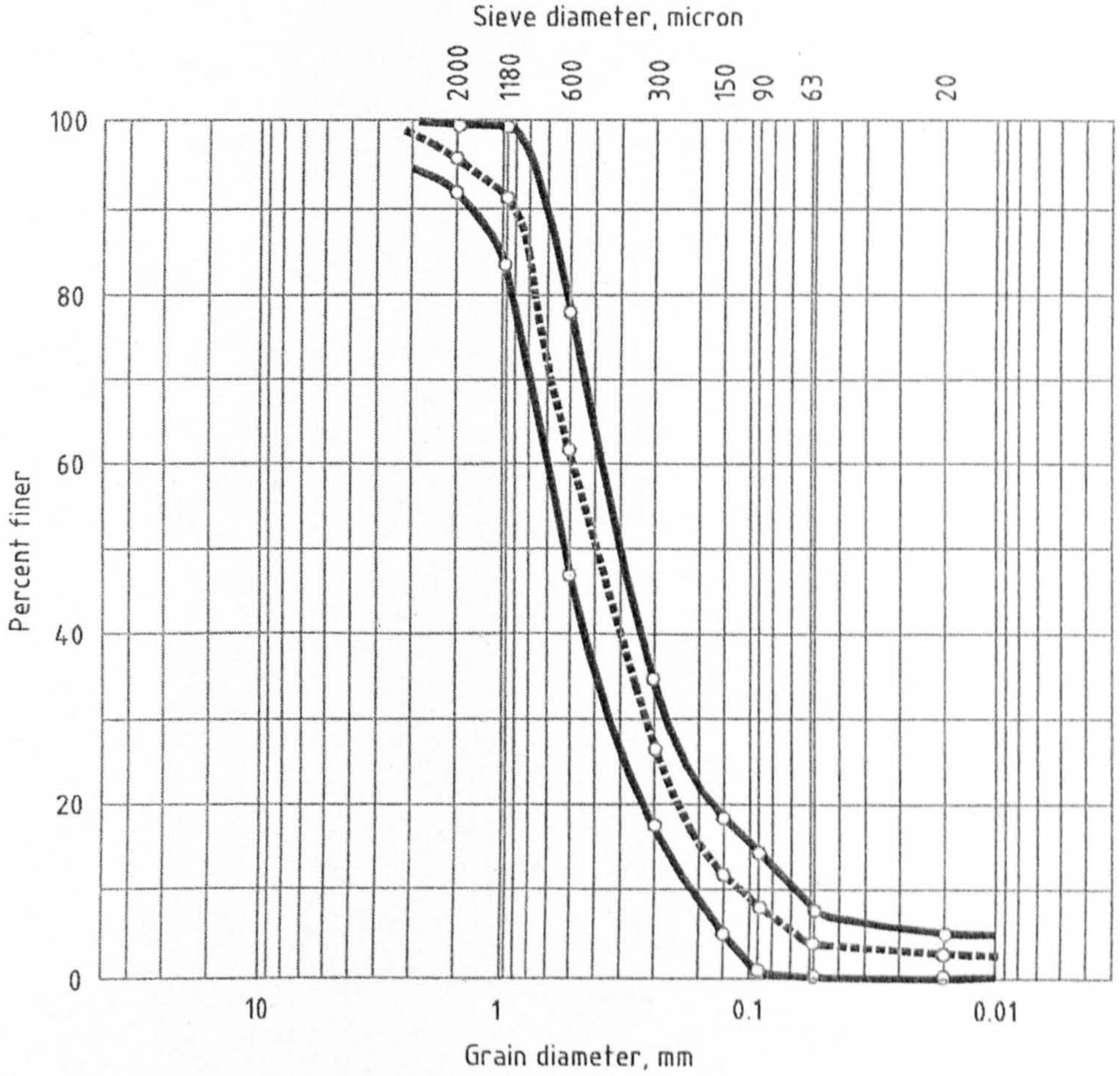


Chart 7.8. Chart showing average percent values of the five exterior skim coats

Fig. 7.26. Interior lime render, skim coat. Recommended zone based on Fig. 7.25

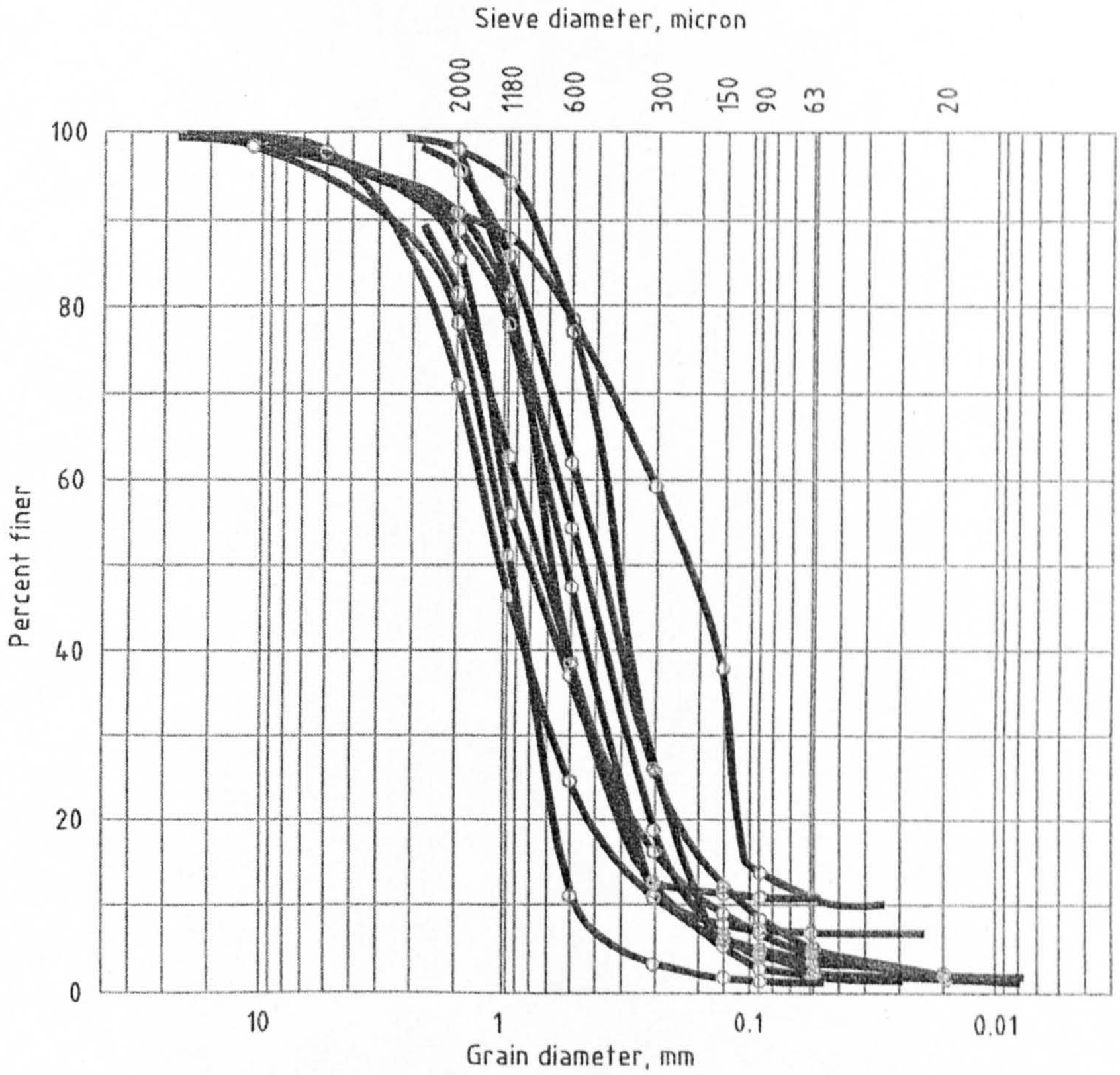


Fig. 7.27. Exterior lime render, scratch coat. Particle size distribution of the ten samples

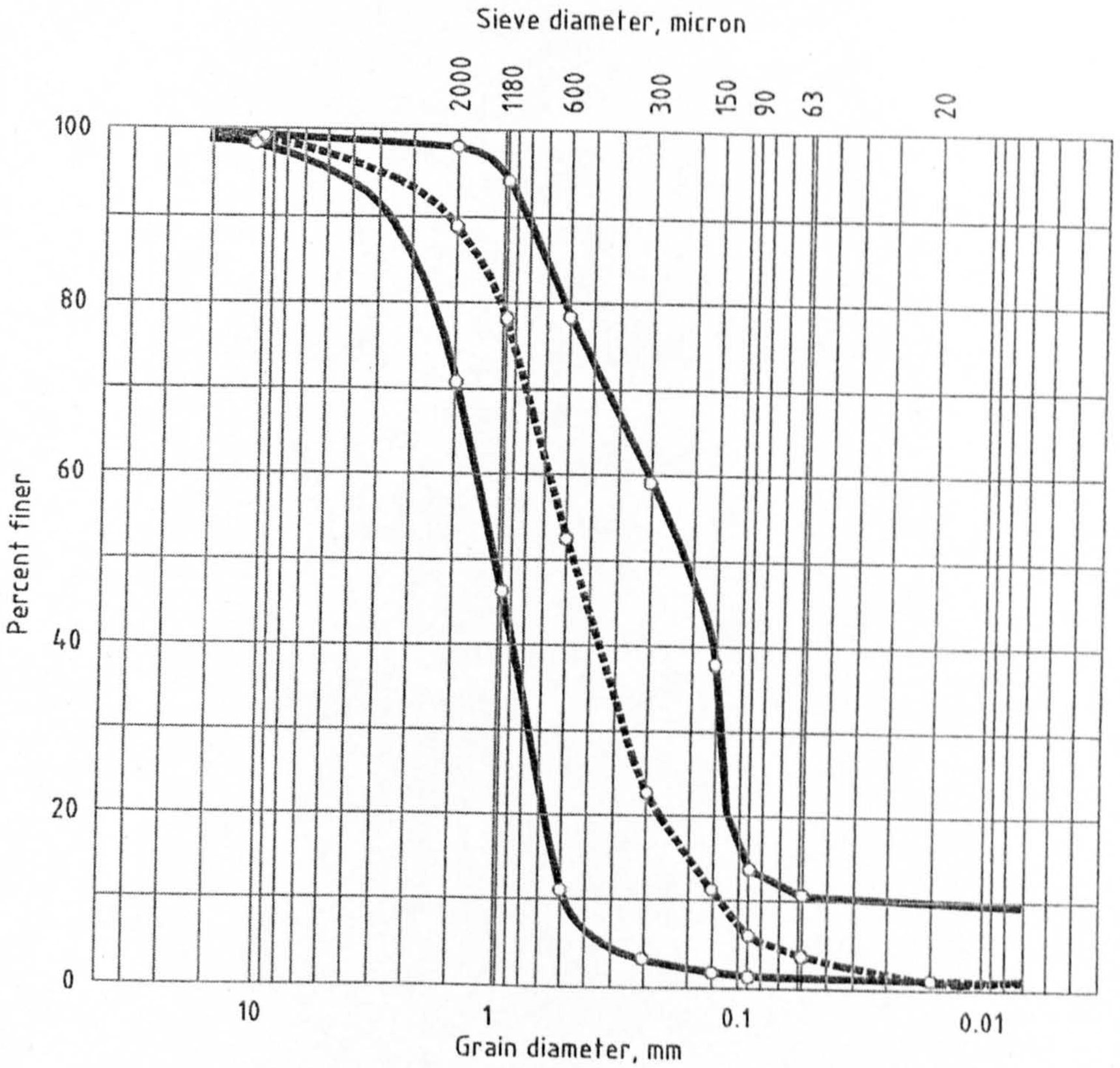
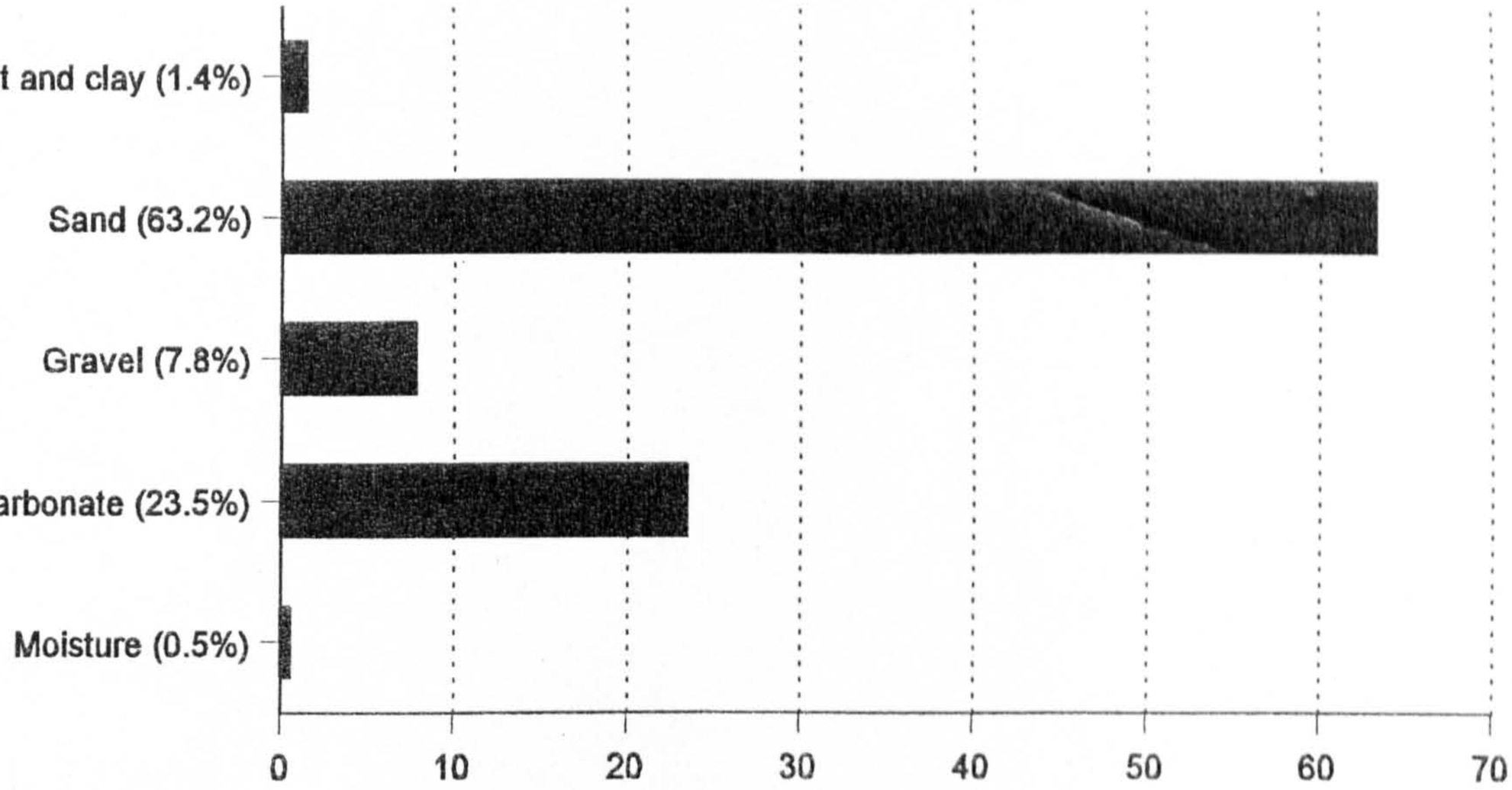


Fig. 7.28. Exterior lime render, scratch coat. Figure illustrating the outlines of the curves on Fig. 7.27, together with the minimum curve, the maximum curve, and the ideal curve



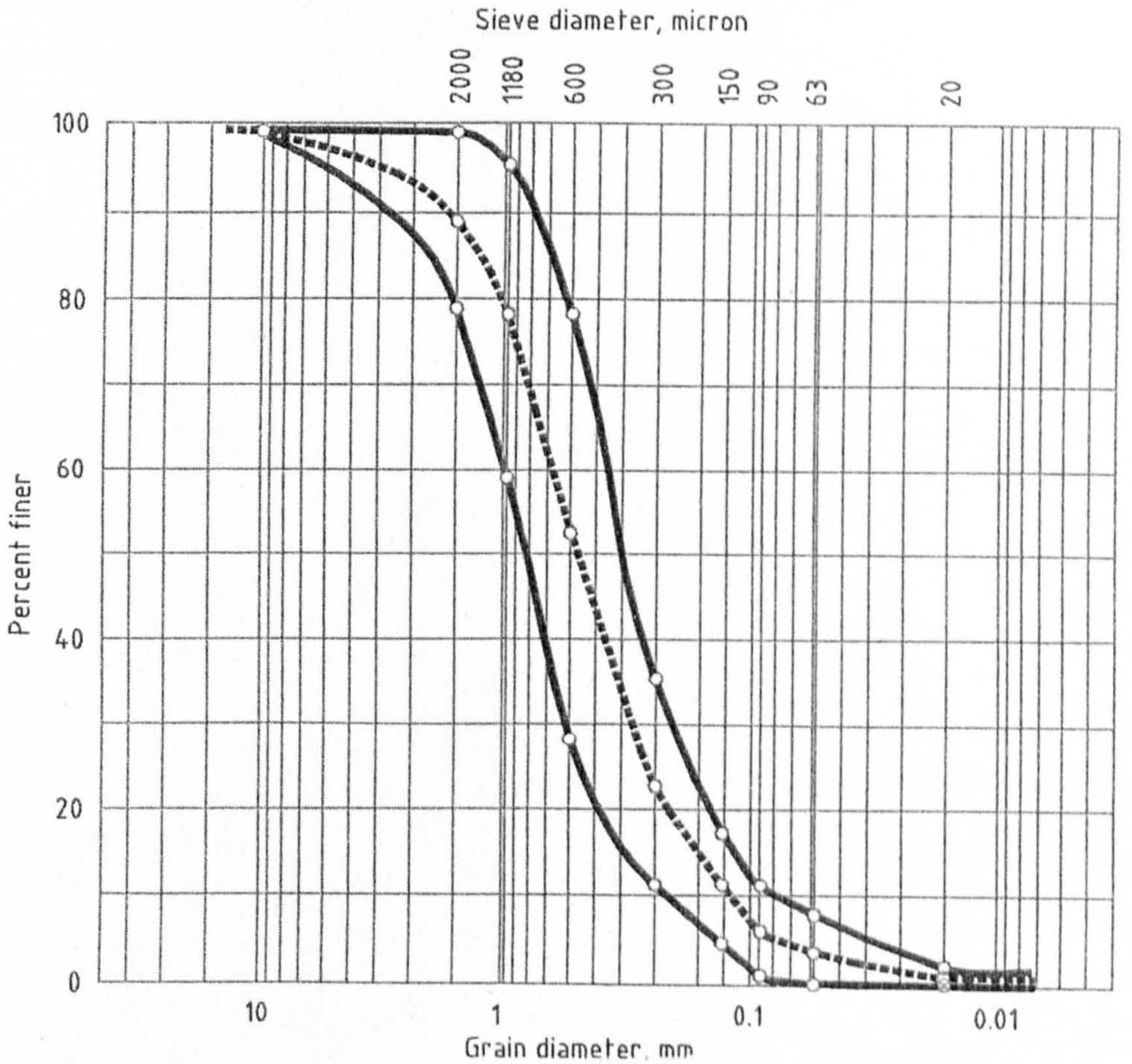


Chart 7.9. Chart showing average percent values of the ten exterior scratch coats

Fig. 7.29. Interior lime render, scratch coat. Figure showing recommended zone based on Fig. 7.28

Table 7.35. Table showing porosity test of exterior lime renders (scratch coats)

Sample name	Wo	Ws	Vp	Va	% Porosity
Assemini 1	30.2	34.4	4.2	19	22.1
Sinnai 1	50.5	59.0	8.5	32	26.6
Samassi 1	27.5	31.8	4.3	16	26.9
Gonnesa 2	22.5	26.3	3.8	16	23.7
Barrua 2	17.0	19.9	2.9	10	29
Average	/	/	/	/	**25.7**

Wo = weight of the sample after drying (gr)
Ws = weight of the sample after saturation (gr)
Vp = weight of pores = volume of pores = Ws-Wo (gr, ml)
Va = apparent volume (ml)

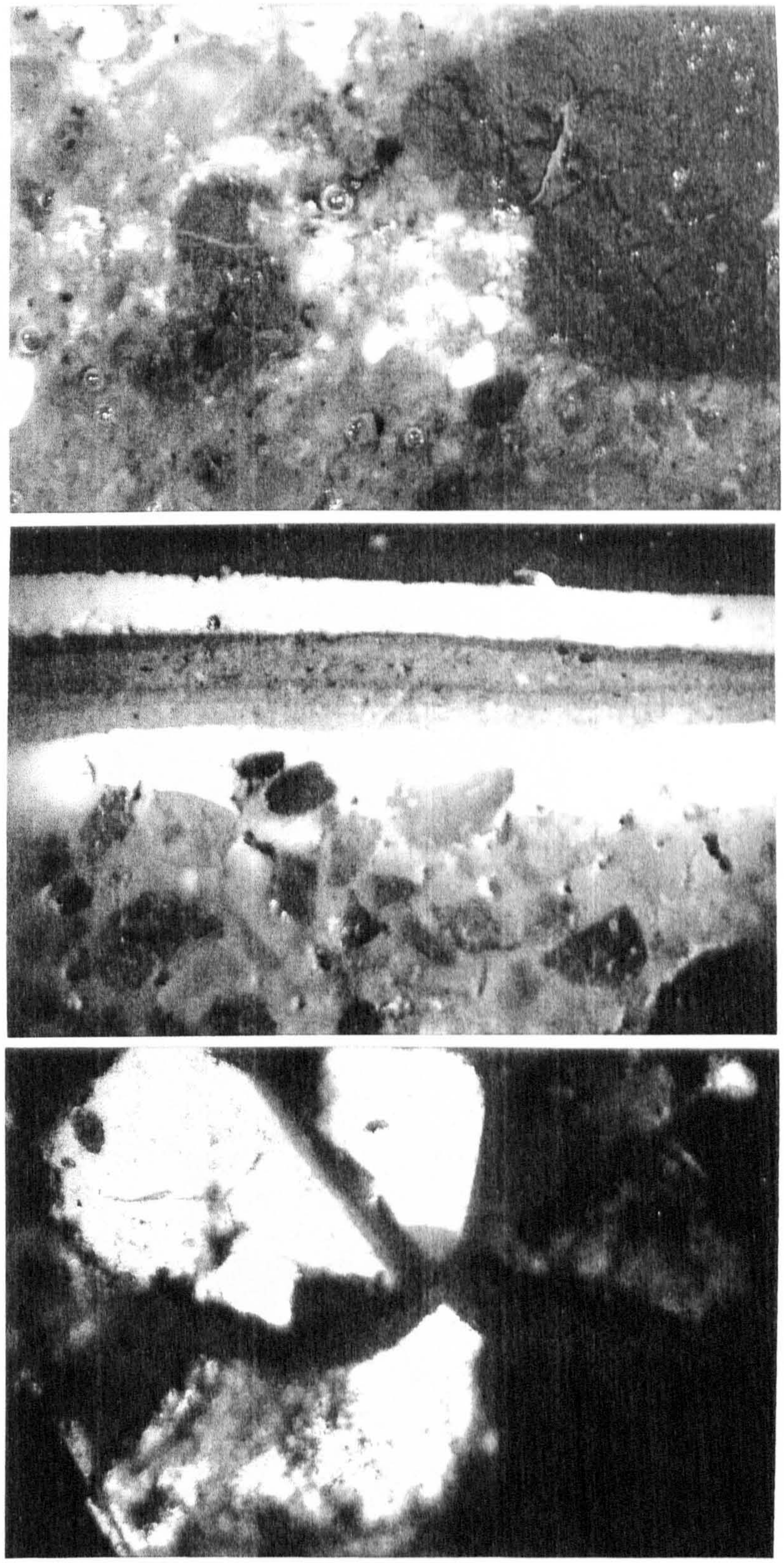


Fig. 7.30. Micrograph of sample Gonnesa 2 showing the pozzolanic aggregate (*cocciopesto*) which gives the render hydraulic properties
Fig. 7.31. Micrograph of interior lime render showing several layers of limewash (Casa Piras, Samassi).
Fig. 7.32. Micrograph of aggregate of the sample discussed in Fig. 7.31 under polarizing light, showing predominance of quartz aggregate

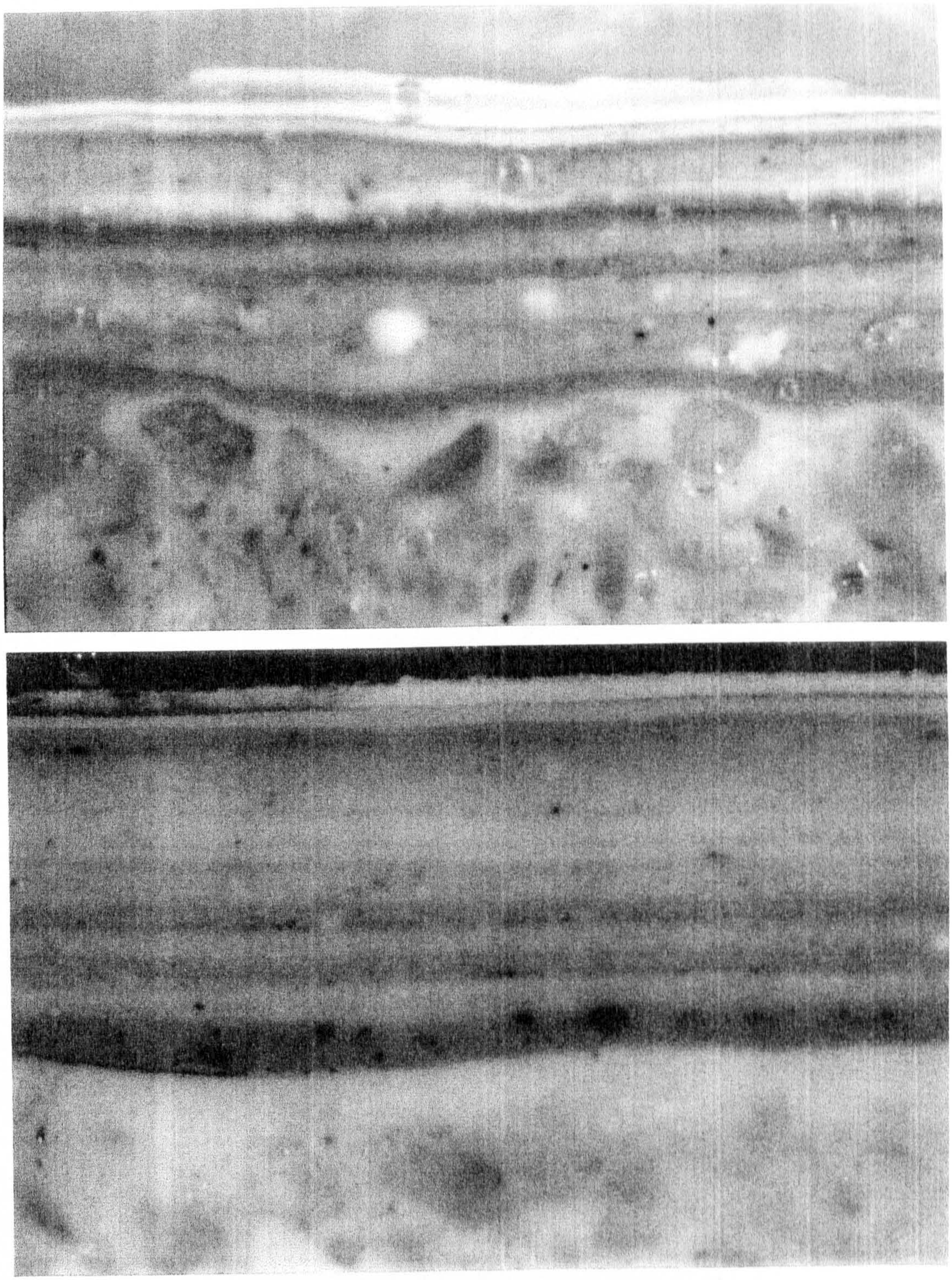


Fig. 7.33. Micrograph of interior lime render showing several layers of limewash (Case Study B)
Fig. 7.34. Micrograph of interior lime render showing several layers of limewash (Case Study B)

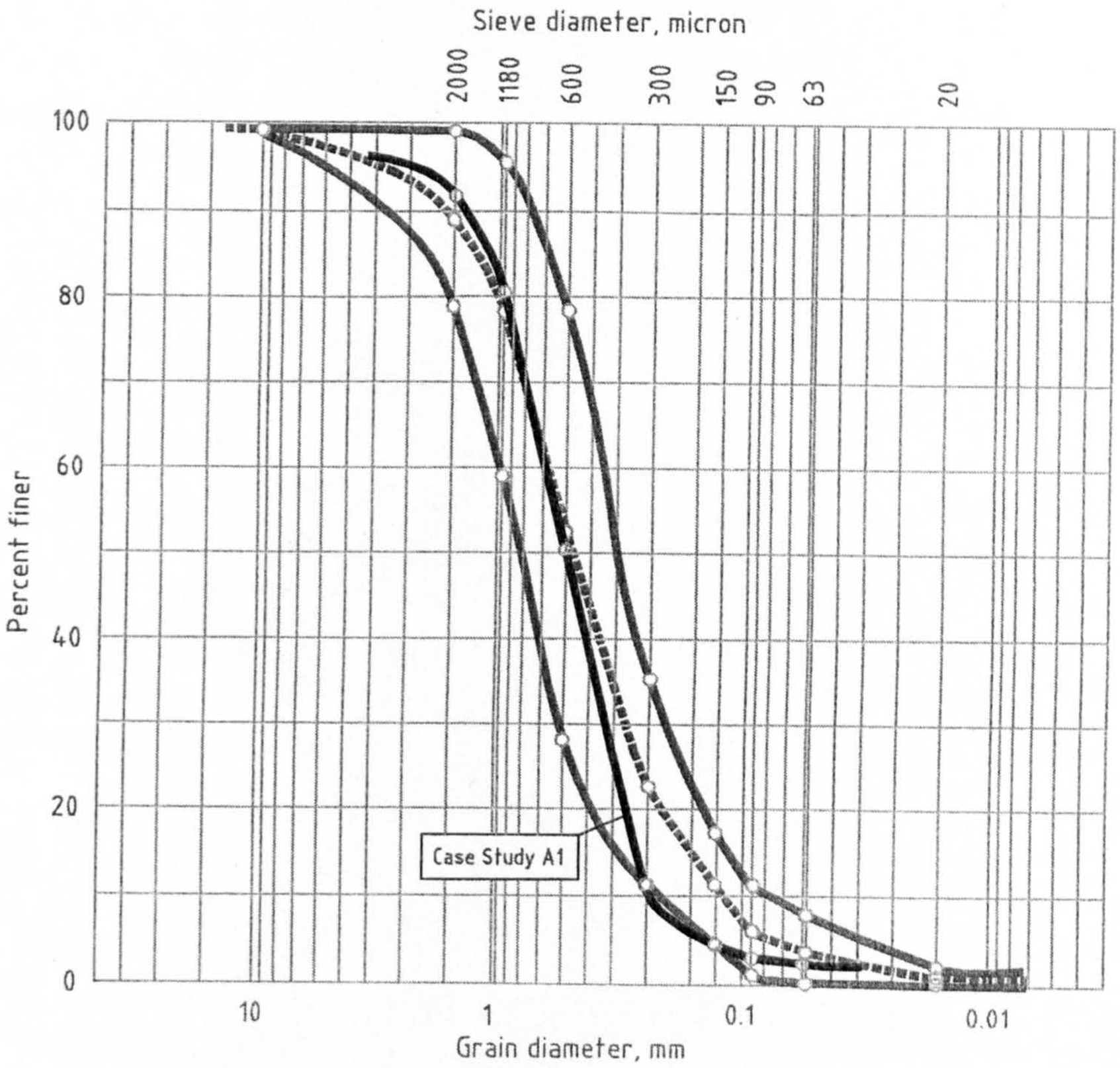


Fig. 7.35. Figure showing comparison of the particle size distribution of Case Study A1 with the recommended zone for external scratch coats

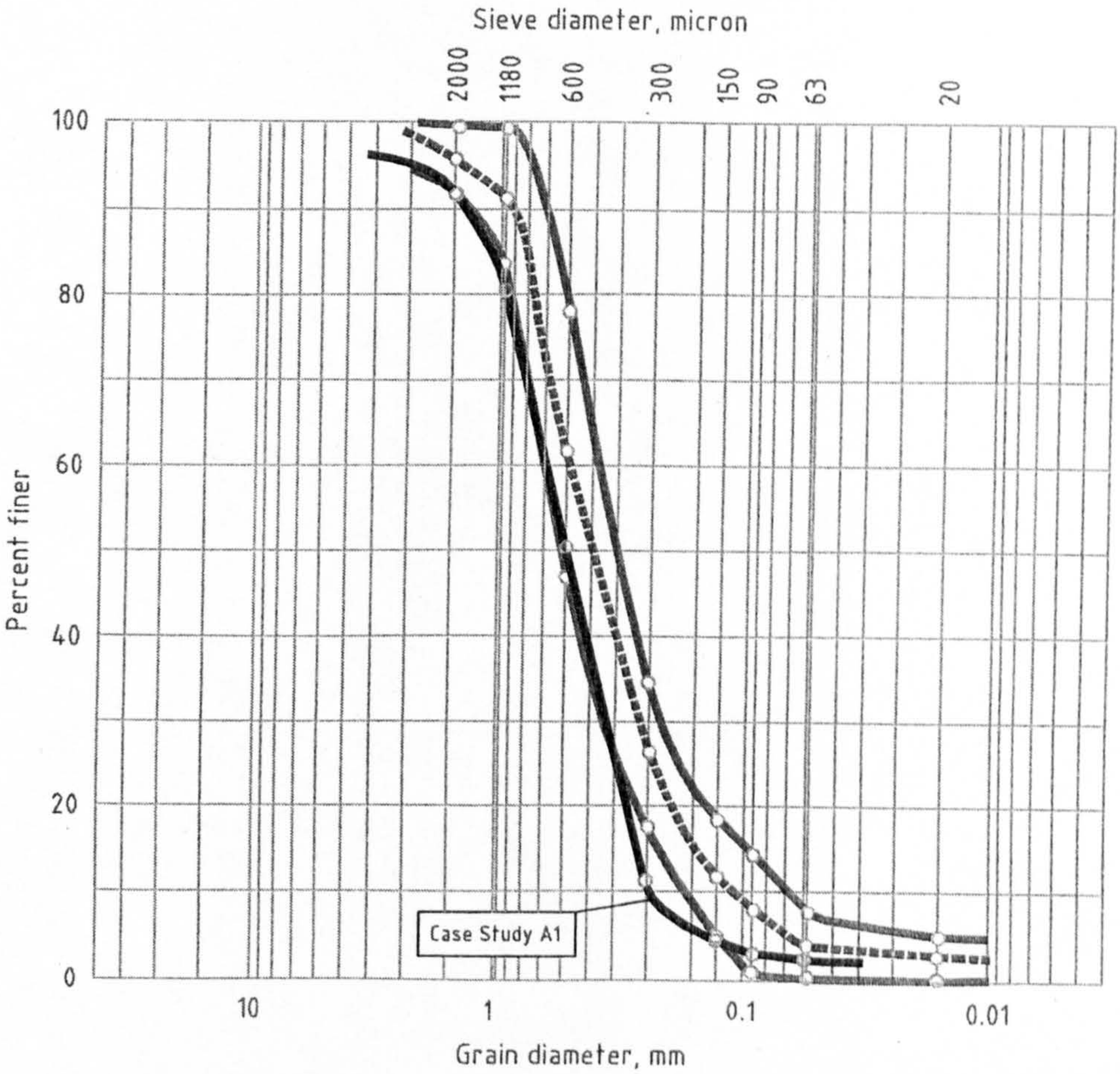


Fig. 7.36. Figure showing comparison of the particle size distribution of Case Study A1 with the recommended zone for external skim coats

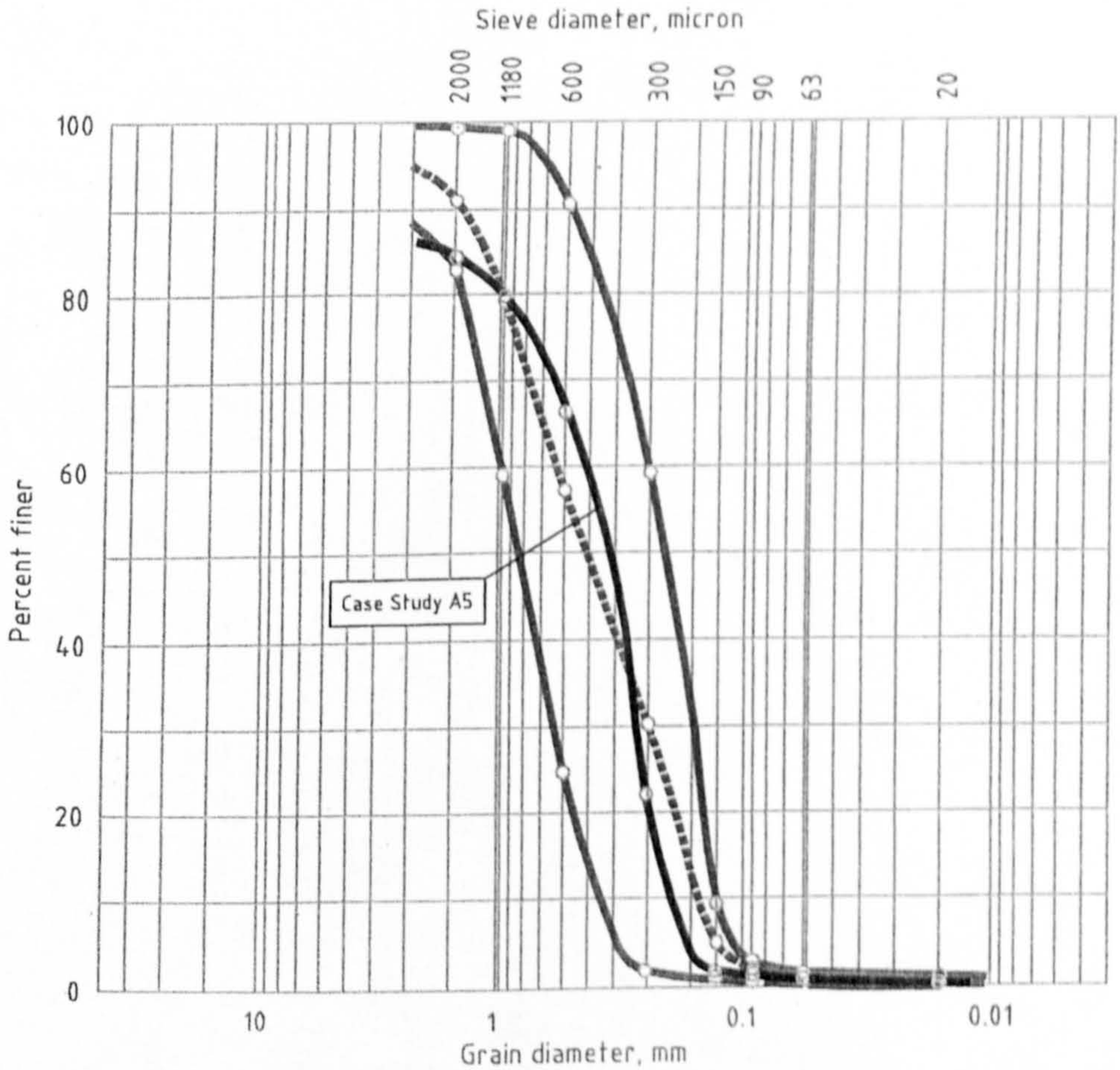


Fig. 7.37. Figure showing comparison of the particle size distribution of Case Study A5 with the recommended zone for interior scratch coats

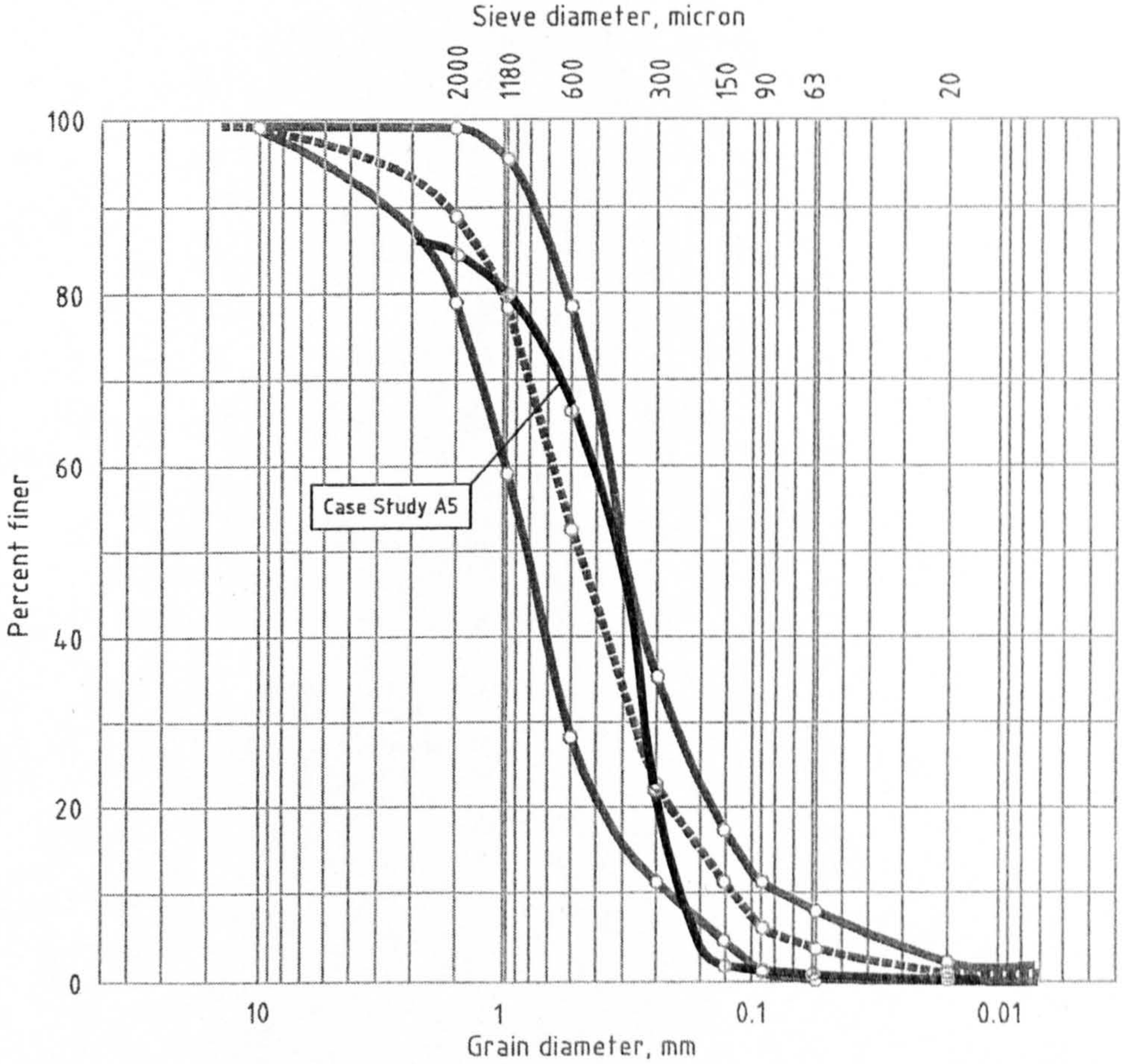


Fig. 7.38. Figure showing comparison of the particle size distribution of Case Study A5 with the recommended zone for exterior scratch coats

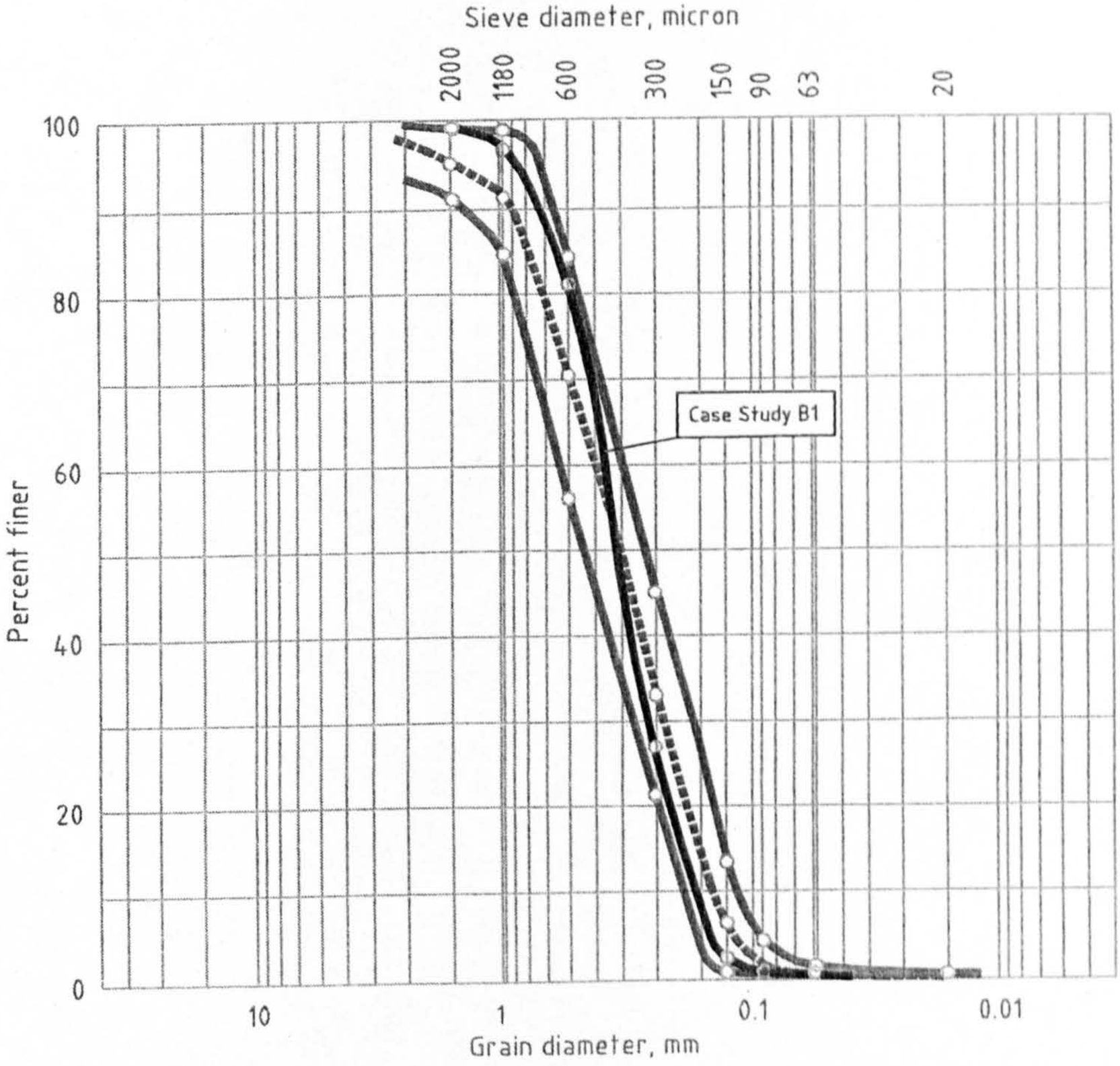


Fig. 7.39. Figure showing comparison of the particle size distribution of Case Study B1 with the recommended zone for interior skim coats

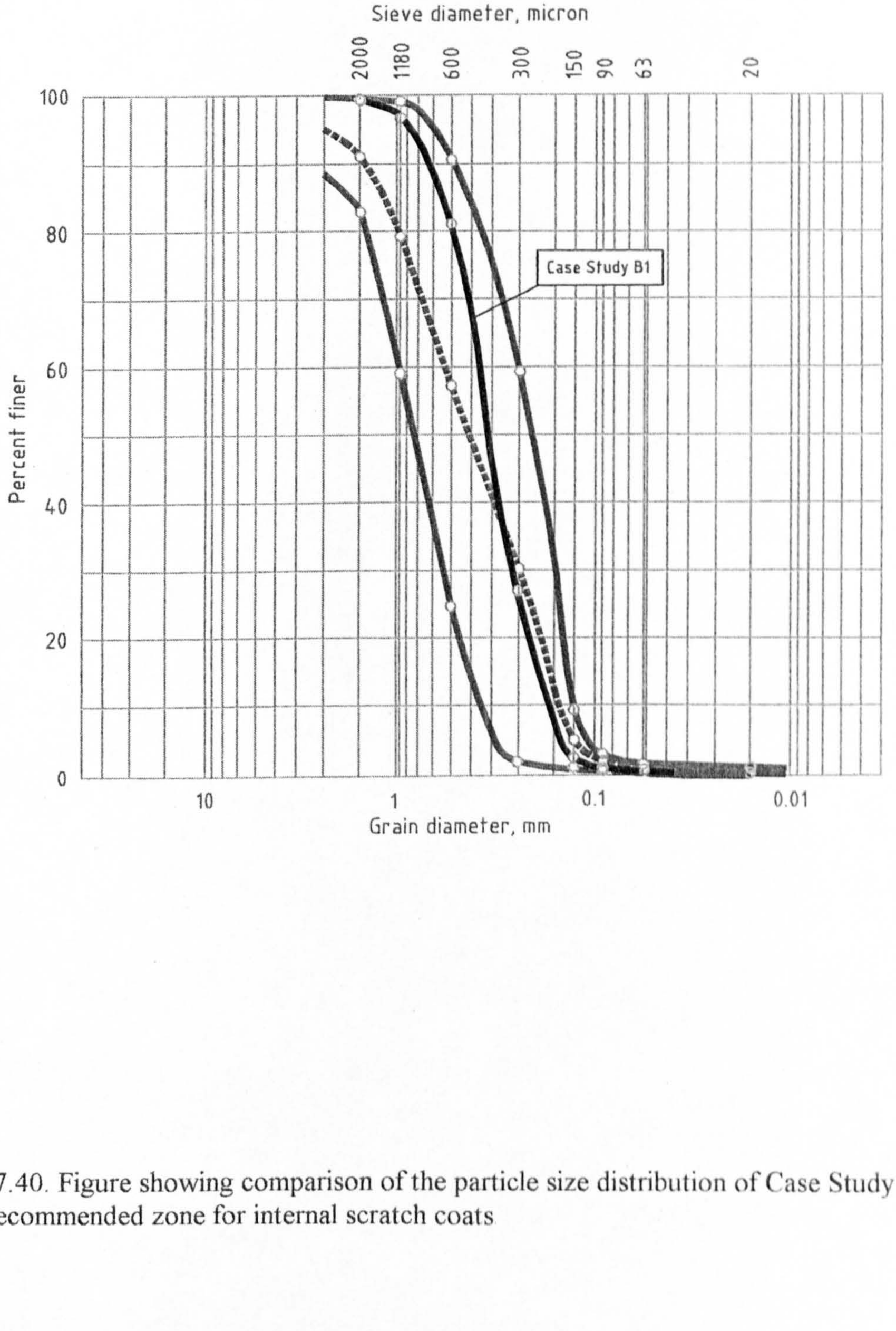


Fig. 7.40. Figure showing comparison of the particle size distribution of Case Study B1 with the recommended zone for internal scratch coats

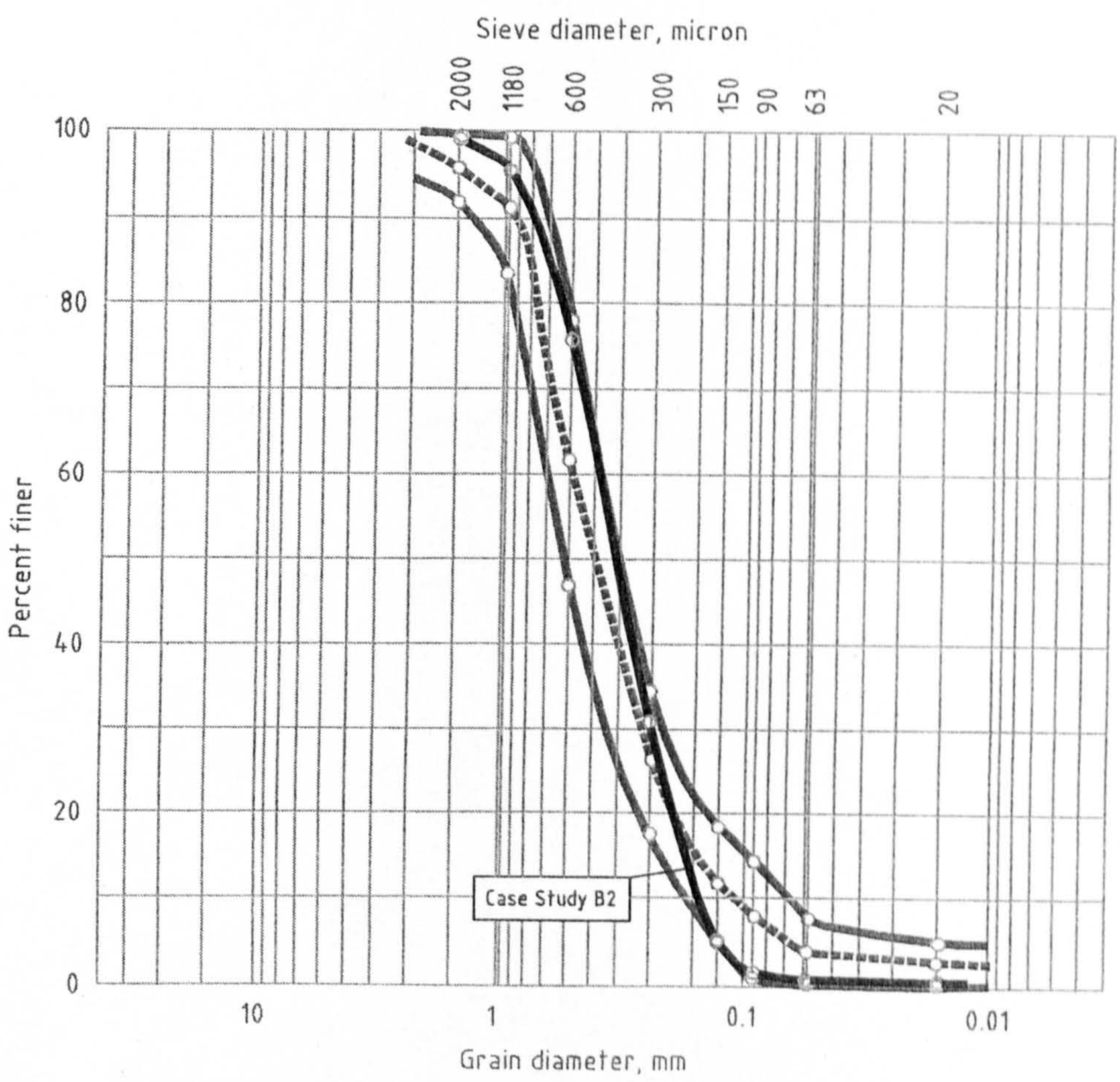


Fig. 7.41. Figure showing comparison of the particle size distribution of Case Study B2 with the recommended zone for external skim coats

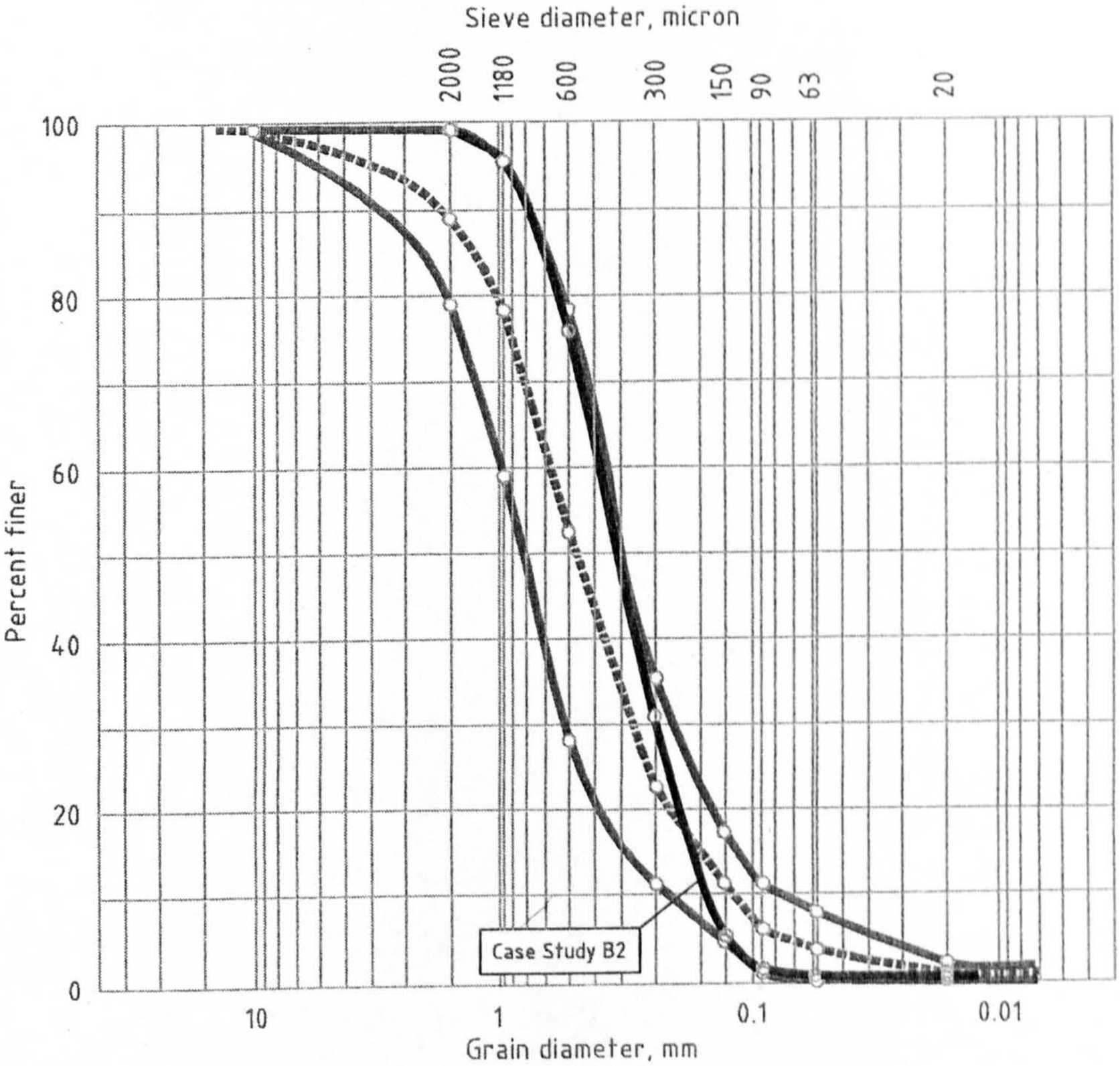


Fig. 7.42. Figure showing comparison of the particle size distribution of Case Study B2 with the recommended zone for external scratch coats

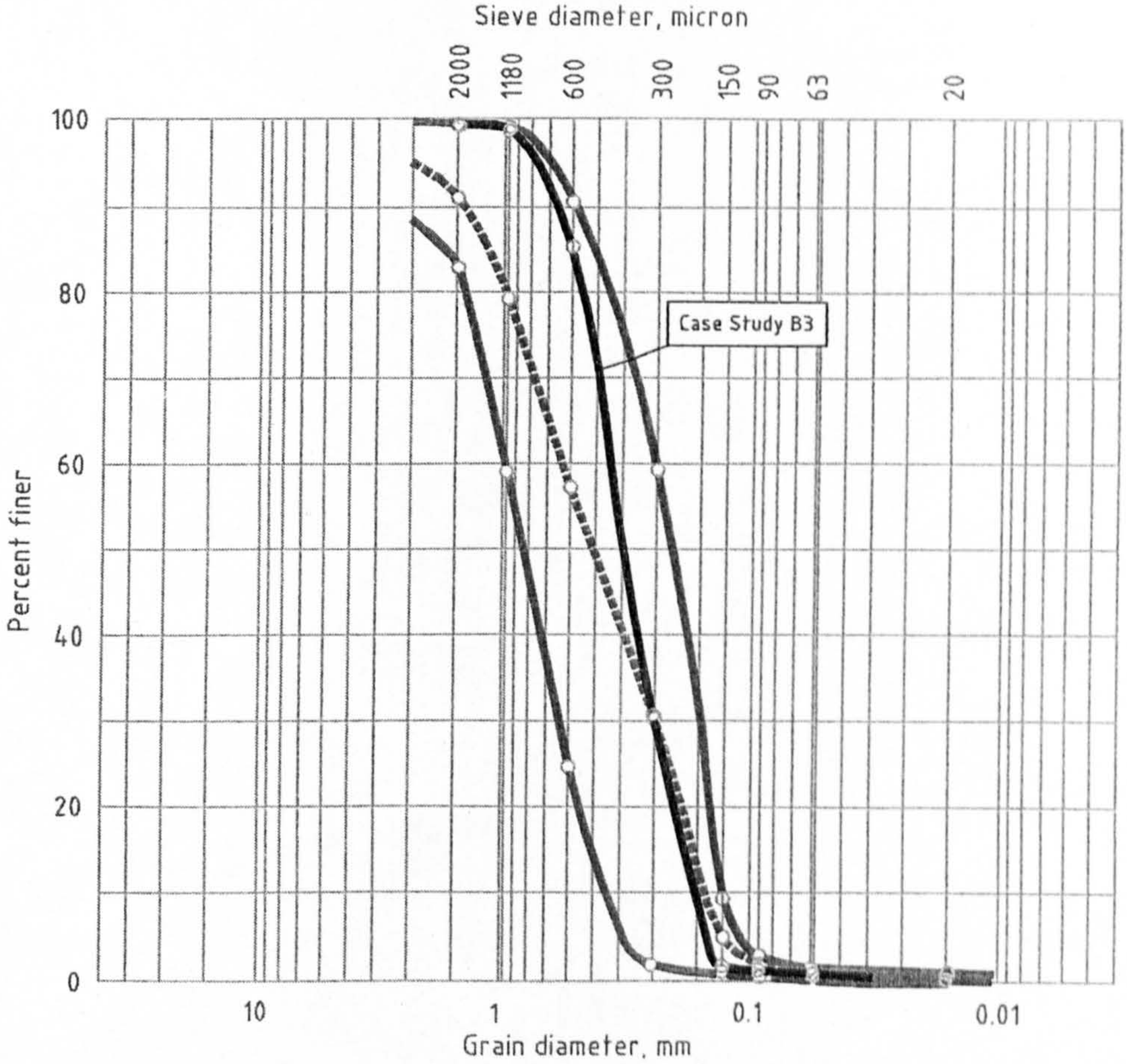


Fig. 7.43. Figure showing comparison of the particle size distribution of Case Study B3 with the recommended zone for internal scratch coats

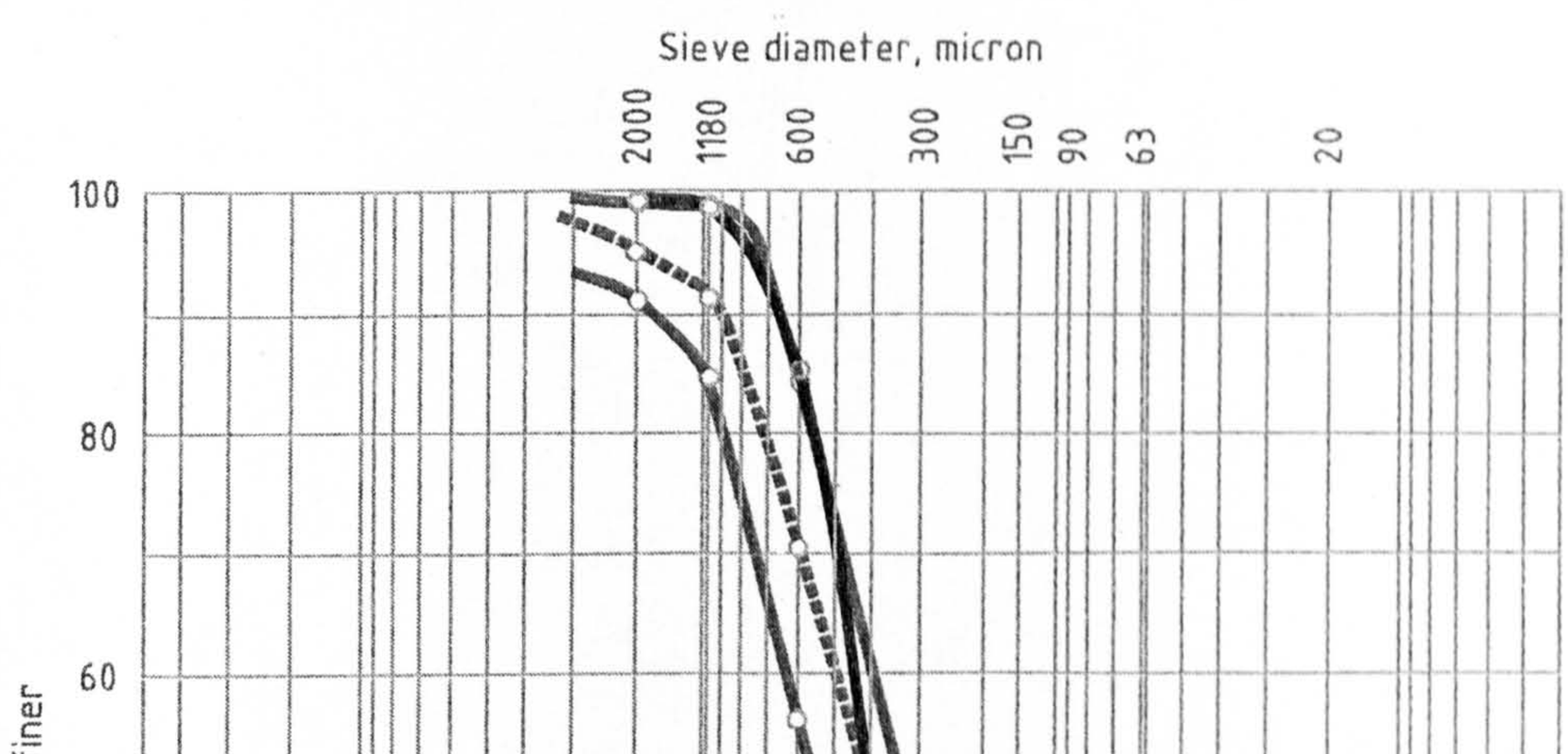


Fig. 7.44. Figure showing comparison of the particle size distribution of Case Study B3 with the recommended zone for internal skim coats

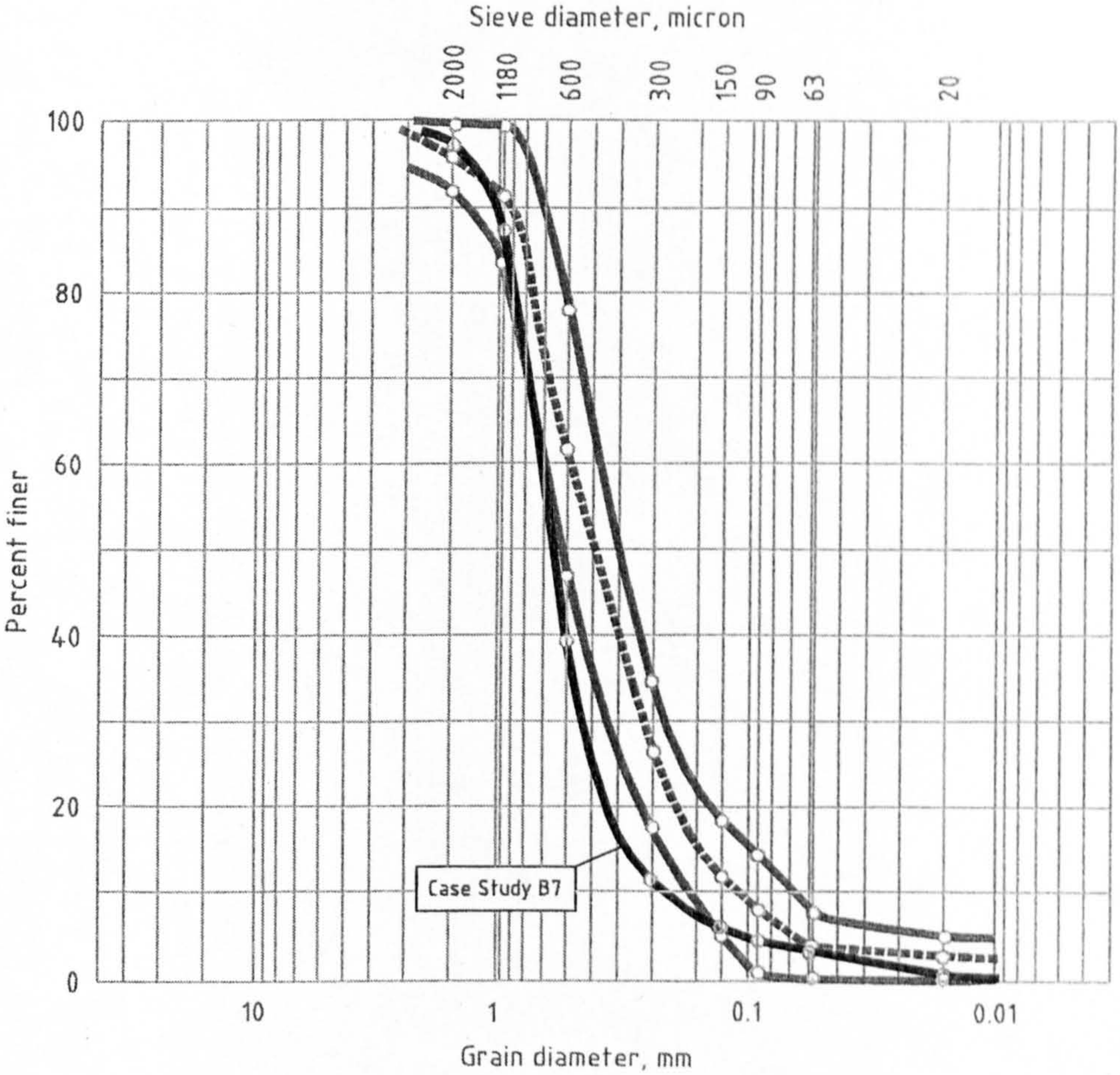


Fig. 7.45. Figure showing comparison of the particle size distribution of Case Study B7 with the recommended zone for external skim coats

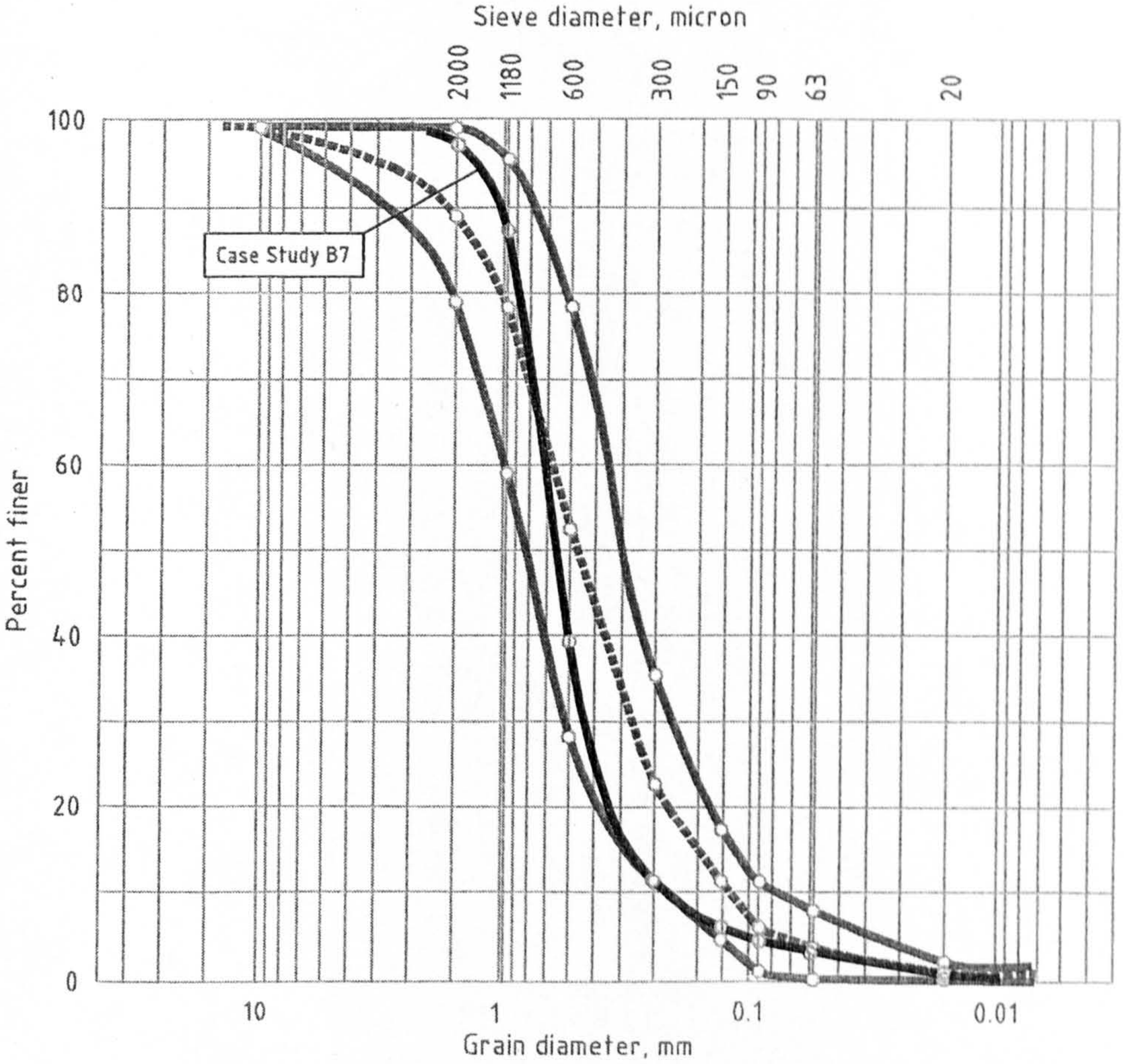


Fig. 7.46. Figure showing comparison of the particle size distribution of Case Study B7 with the recommended zone for external scratch coats

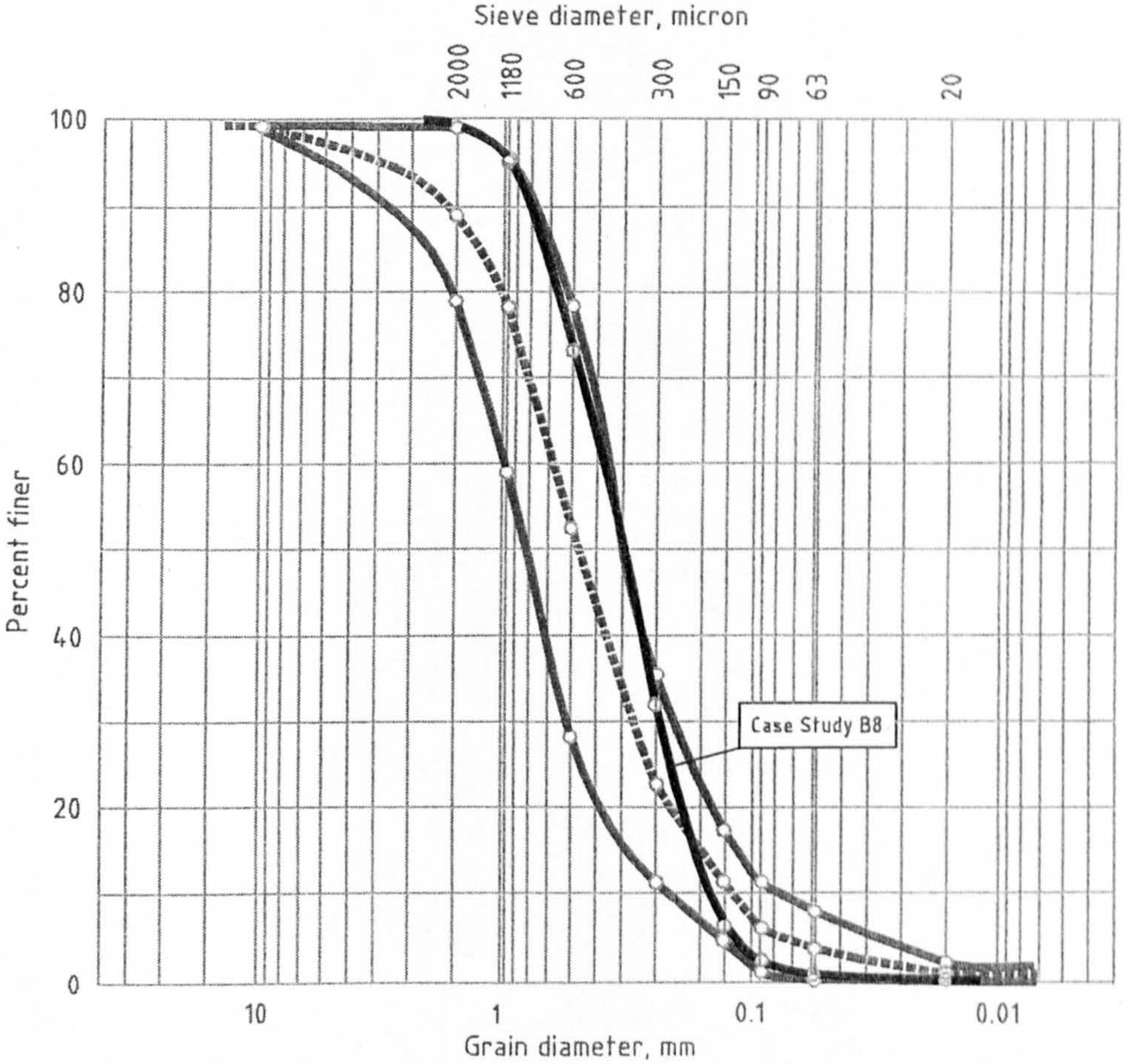


Fig. 7.47. Figure showing comparison of the particle size distribution of Case Study B8 with the recommended zone for external scratch coats

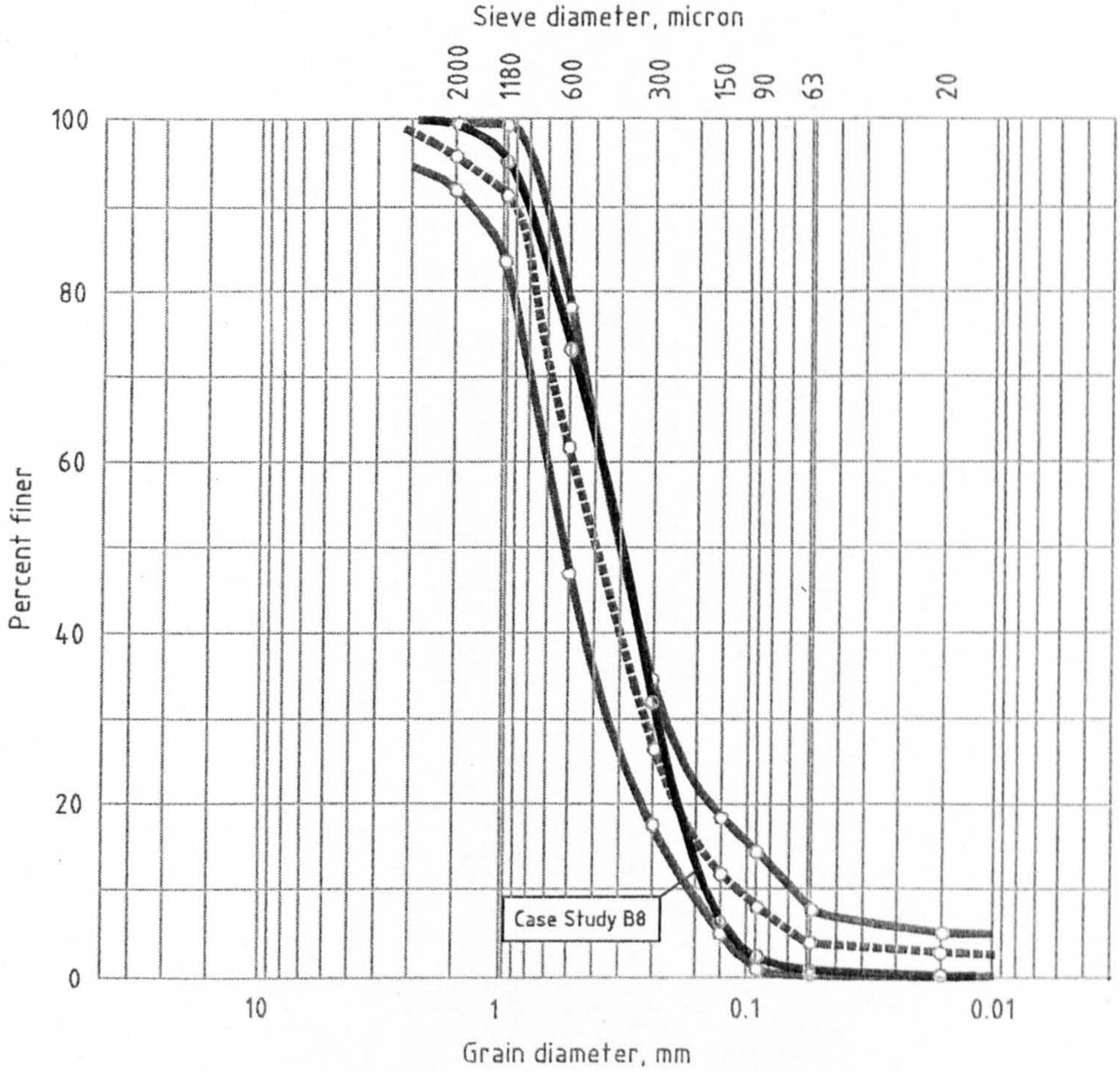


Fig. 7.48. Figure showing comparison of the particle size distribution of Case Study B8 with the recommended zone for external skim coats

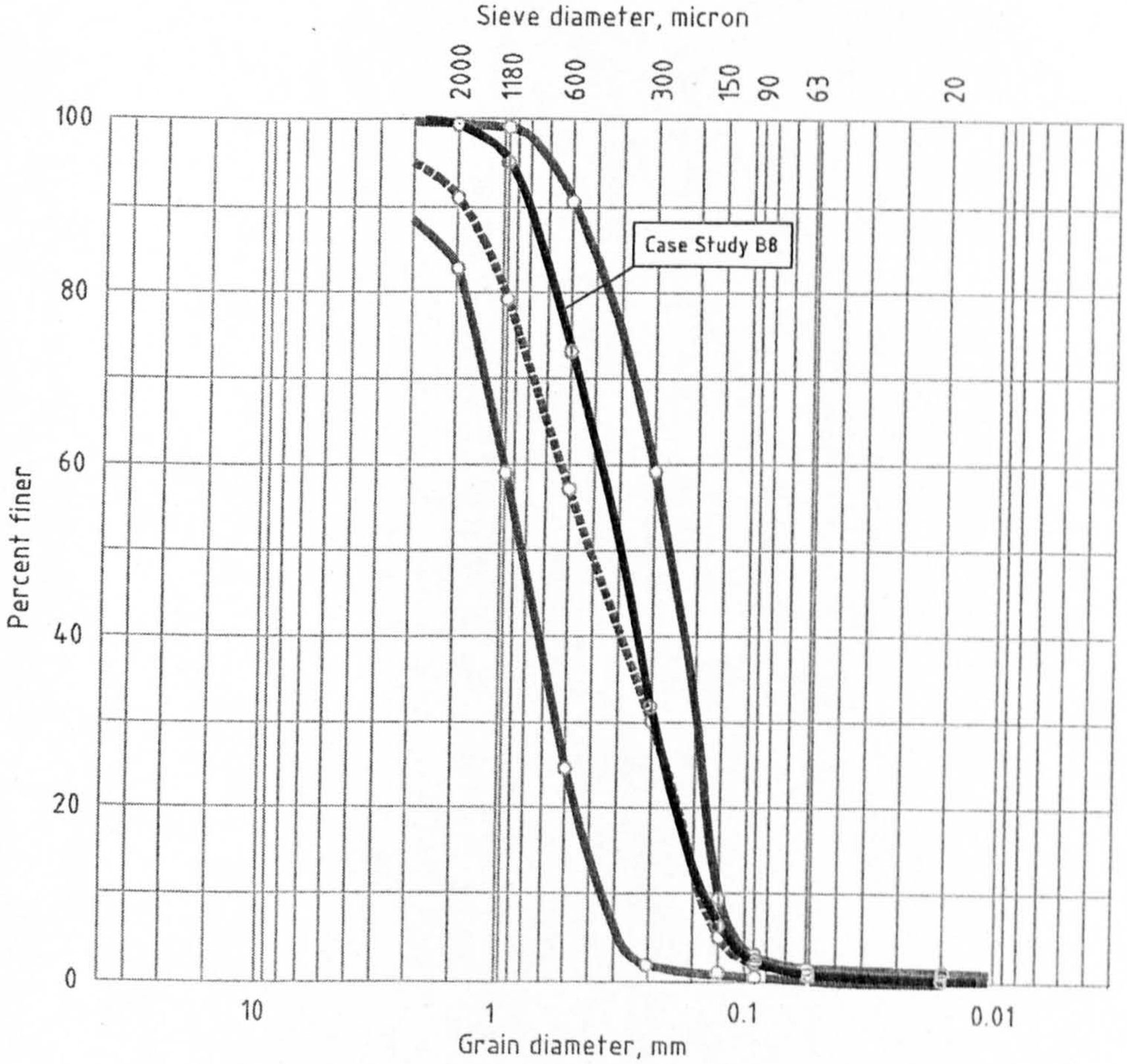


Fig. 7.49. Figure showing comparison of the particle size distribution of Case Study B8 with the recommended zone for interior scratch coats

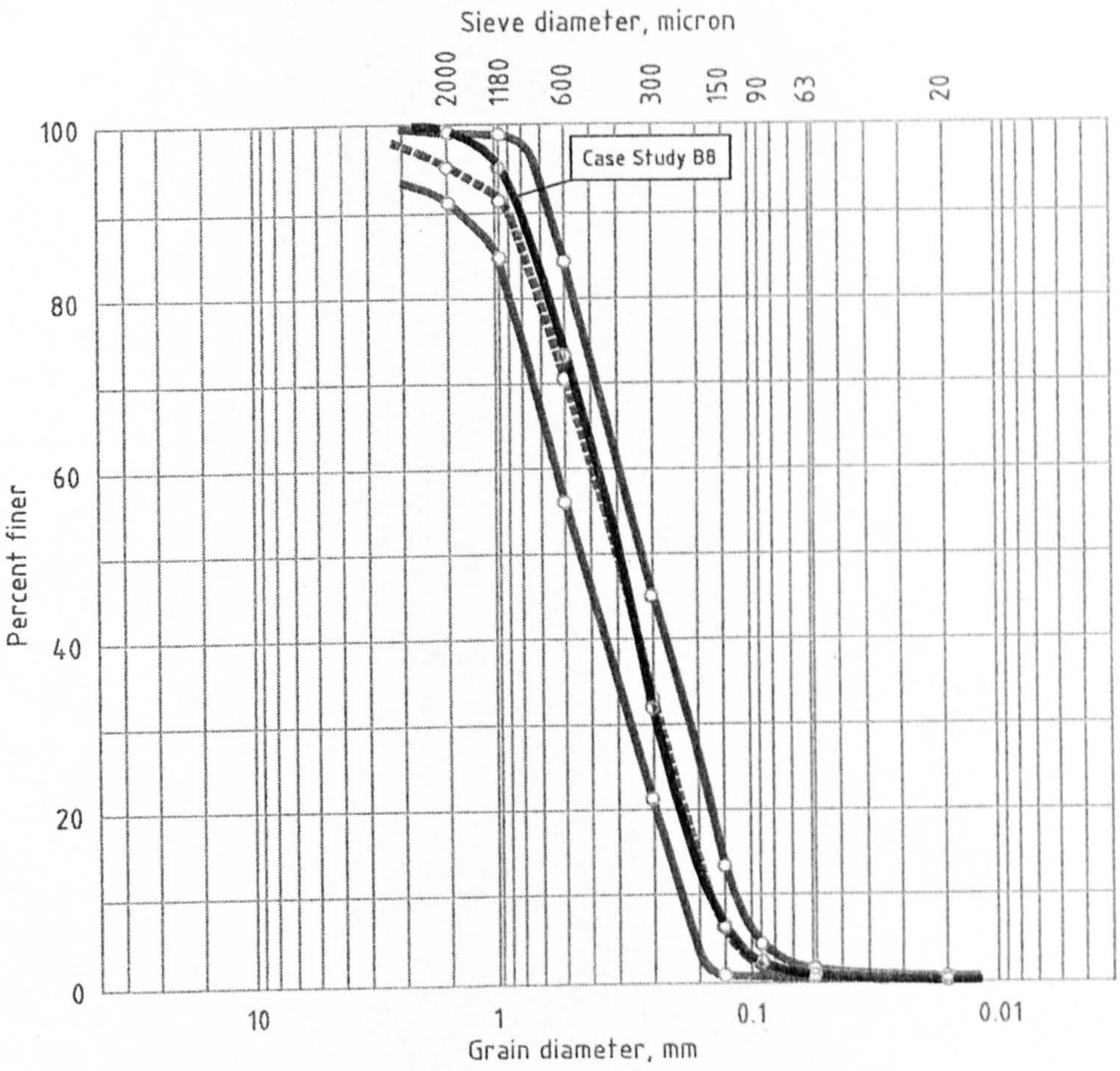


Fig. 7.50. Figure showing comparison of the particle size distribution of Case Study B8 with the recommended zone for interior skim coats

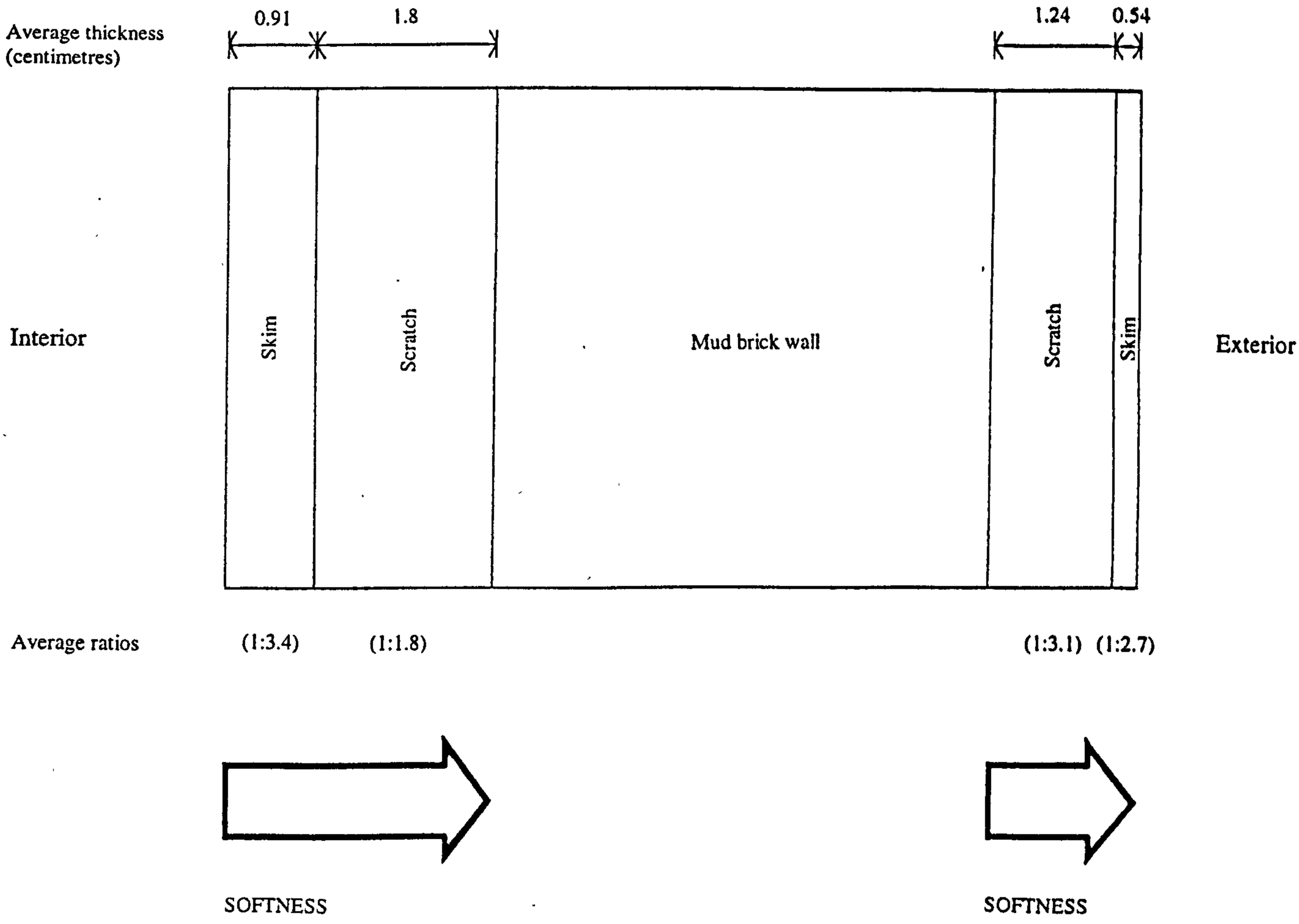


Fig. 7.51. Figure showing section through mud brick wall (drawing not in scale). The figure illustrates that internal and external lime renders are characterised by an increasing softness from the interior to the exterior of the building. In so doing, moisture is allowed to be driven outside the building.

DATASHEETS
Chapter 7

DATASHEETS
Atlas of *làdiri* samples

Sample: Gonnesa 3

Location: Gonnesa, Sardinia
Orientation: north-east
Soil description from pedological map (after Arangino et al, 1986): typic palexeralfs, derived from loose slightly cemented sands. Deep soils (depth > 100 cm), from sandy and clayey texture, and average soluble salt presence
Sample weight before drying: 146.8 gr
Sample weight after drying: 145.4 gr
Percent moisture: 0.9 %
Munsell® soil colour notation and colour name: HUE 10YR, 4/4, dark yellowish brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	7.5	5.1	45.5
150 microns	30.6	21	50.6
300 microns	26.8	18.4	71.6
600 microns	6.4	4.4	90
1180 microns	2.7	1.8	94.4
2000 microns	5.6	3.8	96.2

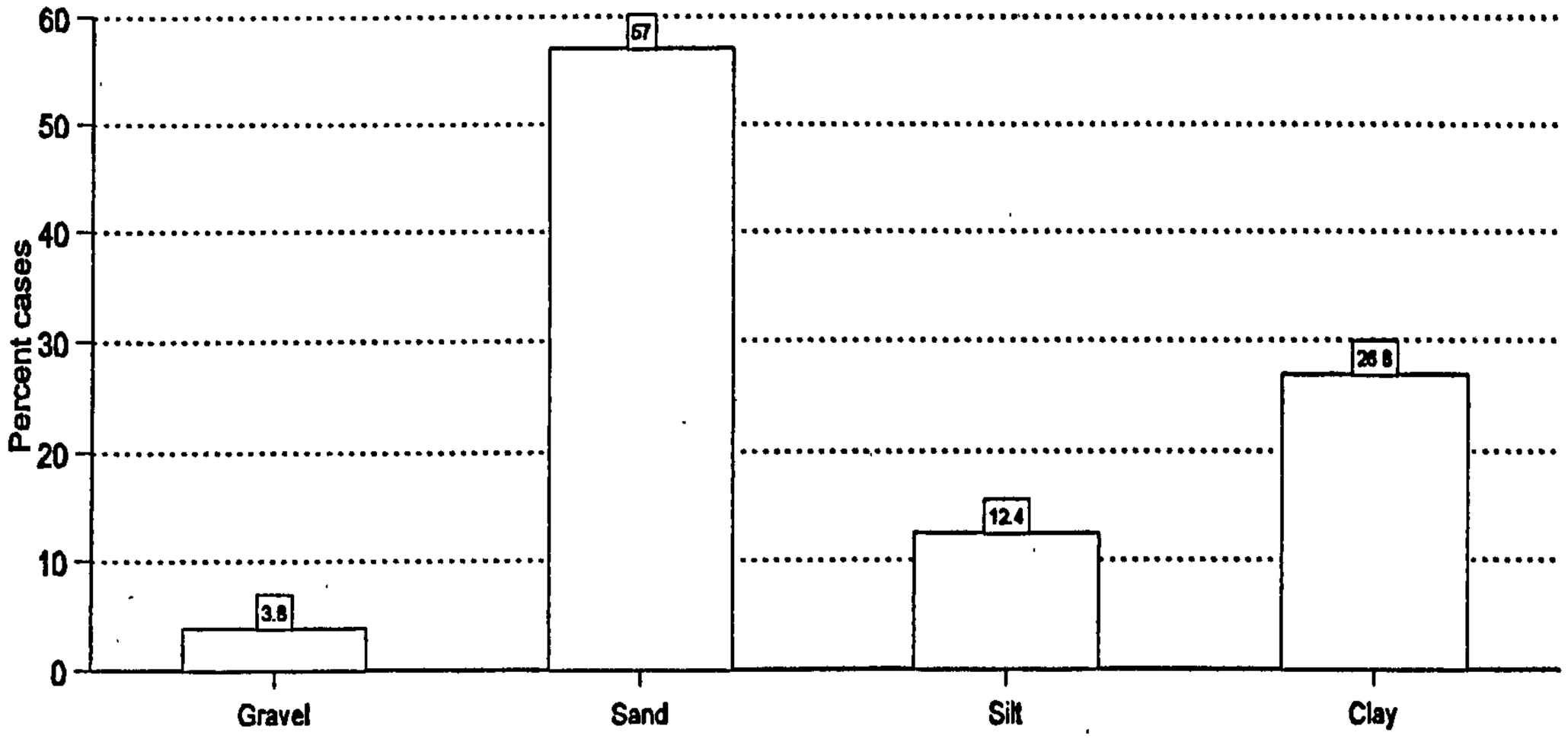
Particle description (> 90 micron)
Particle size: the gravel range is not well represented
Particle shape: well rounded, with high sphericity
Colour: ochre, pink and dark grey
Organic material: no significant organic matter

HYDROMETER METHOD

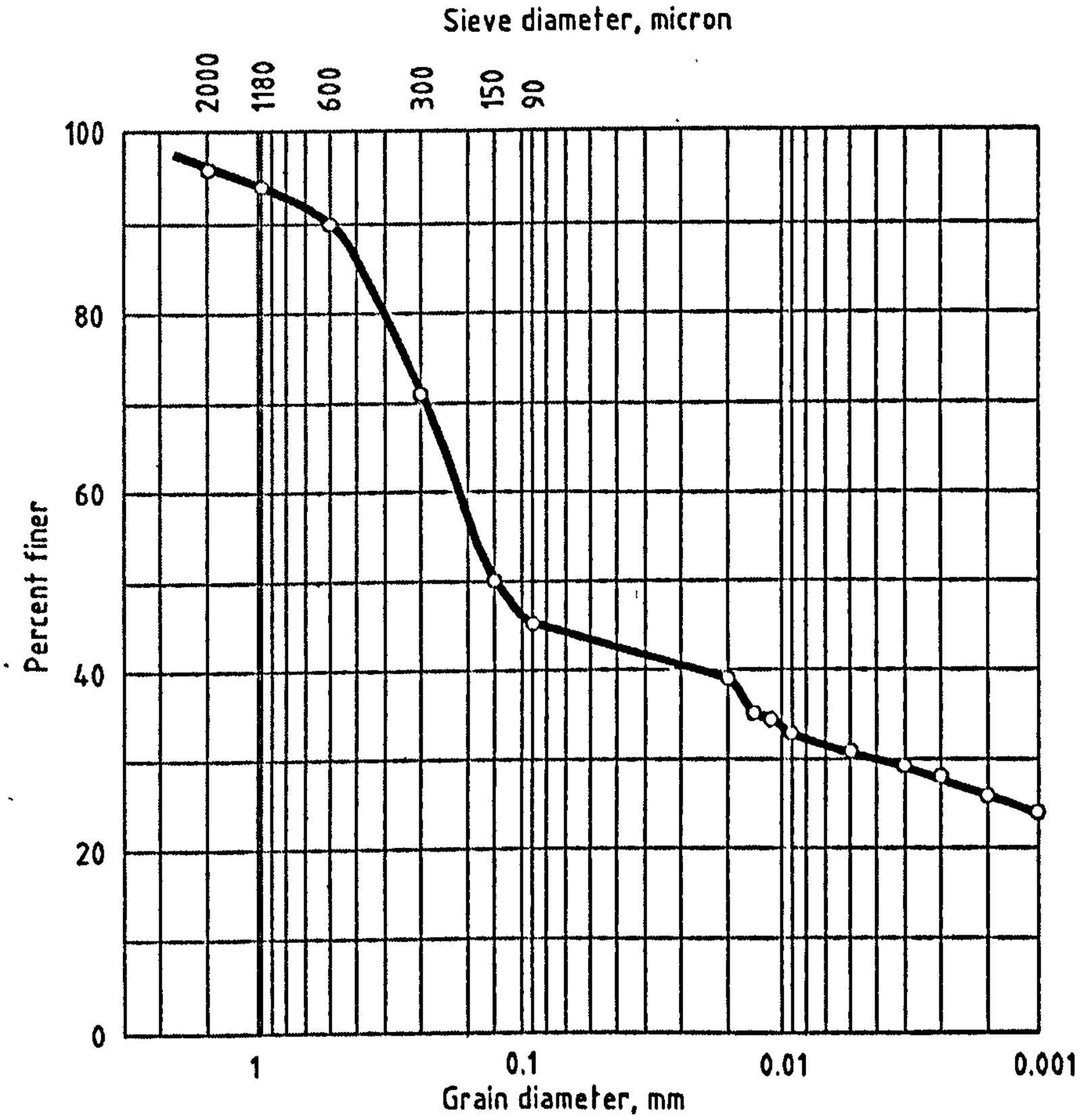
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	23	64	61.7	41.9	66	/	/	0.013	/
2	23	60	57.7	39.2	62	6.5	3.25	0.013	0.023
4	23	55	52.7	35.8	57	7	1.75	0.013	0.017
8	23	54	51.7	35.1	56	7.1	0.887	0.013	0.012
15	22	52	49.4	33.5	54	7.4	0.493	0.0131	0.009
30	21	49	46.2	31.4	51	7.9	0.263	0.0133	0.006
65	20	47	44	29.9	49	8.3	0.127	0.0134	0.004
125	19	45	41.7	28.3	47	8.6	0.068	0.0136	0.003
245	18	43	39.5	26.8	45	8.9	0.036	0.0138	0.002
433	18	40	36.5	24.8	42	9.4	0.021	0.0138	0.001
1395	19	36	32.7	22.2	38	10.1	0.007	0.0136	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Samassi 8

Location: Casa Piras, Samassi, Sardinia. Back wall
Orientation: south
Soil description from pedological map (after Arangino et al, 1986): xerofluvents vertic, formed after recent alluvion.
Deep soil (depth > 100 cm), with clayey texture and no traces of soluble salts
Sample weight before drying: 127.4 gr
Sample weight after drying: 125.1 gr
Percent moisture: 1.8 %
Munsell® soil colour notation and colour name: IIUE 10YR, 5/3, brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	12.8	10.1	52.2
150 microns	14.7	11.6	62.3
300 microns	11.6	9.1	73.9
600 microns	9.1	7.1	83
1180 microns	4.1	3.2	90.1
2000 microns	8.6	6.7	93.3

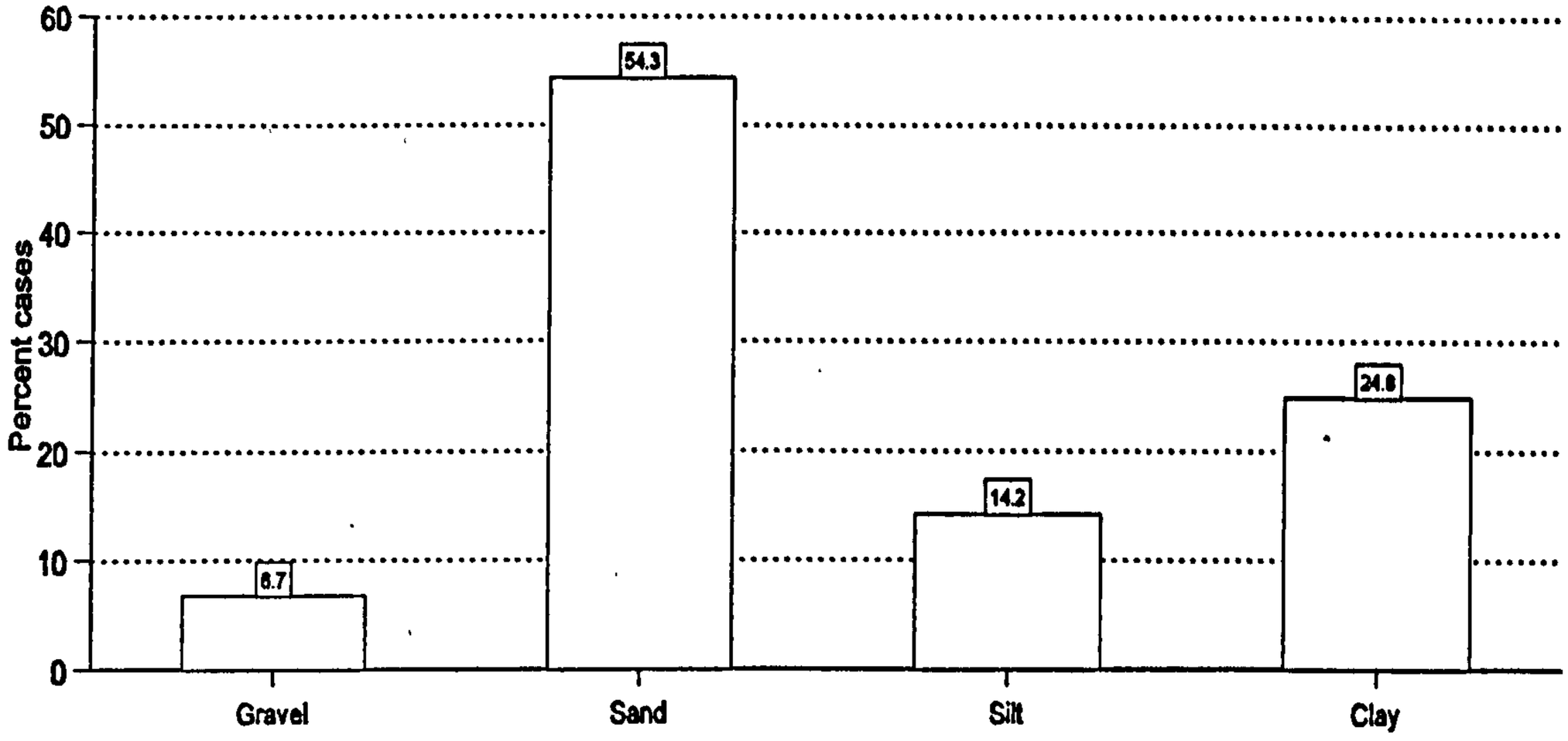
Particle description (> 90 micron)
Particle size: the range between pebbles and gravel is not represented
Particle shape: low sphericity, from sub-rounded to very angular
Colour: ochre, pink and white
Organic material: traces of straw

HYDROMETER METHOD

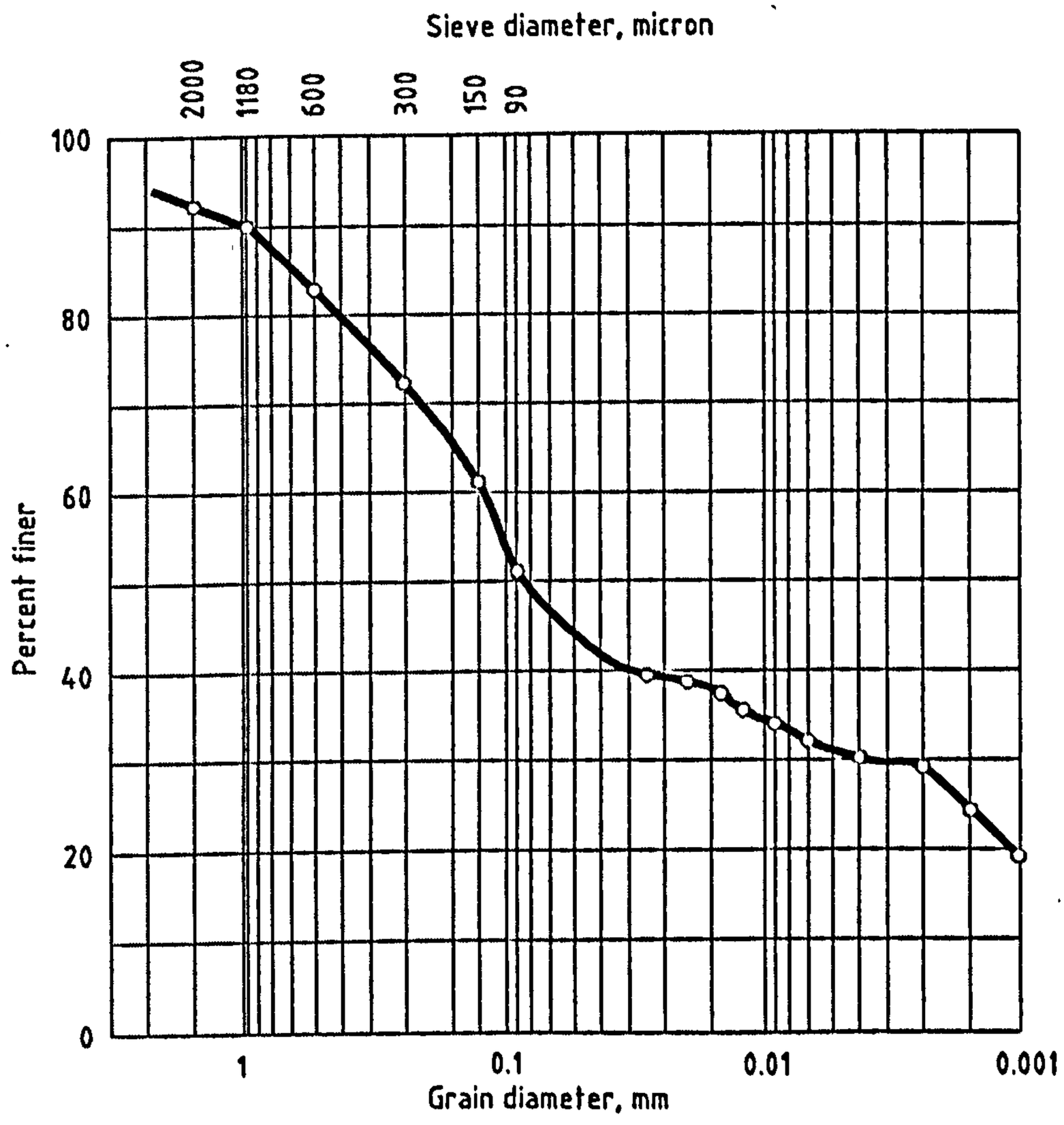
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	22	53	50.4	39.8	55	7.3	7.3	0.0131	0.035
2	22	52	49.4	39	54	7.4	3.7	0.0131	0.025
4	22	51	48.4	38.2	53	7.6	1.9	0.0131	0.018
8	22	48	45.4	35.8	50	8.1	1.012	0.0131	0.013
15	22	46	43.4	34.2	48	8.4	0.56	0.0131	0.009
30	21	44	41.2	32.5	46	8.8	0.293	0.0133	0.007
60	20	42	39	30.8	44	9.1	0.151	0.0134	0.005
120	19	39	37.7	29.7	41	9.6	0.08	0.0136	0.003
270	18	35	31.5	24.8	37	10.2	0.037	0.0138	0.002
470	18	33	29.5	23.3	35	10.5	0.022	0.0138	0.002
1390	18	28	24.5	19.3	30	11.4	0.008	0.0138	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Samassi A2

Location: Via Trieste 8, Samassi, Sardinia. External side of boundary wall
Orientation: west
Soil description from pedological map (after Arangino et al, 1986): xerofluvents vertic, formed after recent alluvion.
Deep soil (depth > 100 cm), with clayey texture and no traces of soluble salts
Sample weight before drying: 112.7 gr
Sample weight after drying: 110.6 gr
Percent moisture: 1.8 %
Munsell® soil colour notation and colour name: HUE 10YR, 6/2, light brownish gray

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	12.1	10.9	68.8
150 microns	10.9	9.8	79.7
300 microns	6.8	6.1	89.5
600 microns	2.1	3.9	95.6
1180 microns	0.4	0.3	99.5
2000 microns	0.3	0.2	99.8

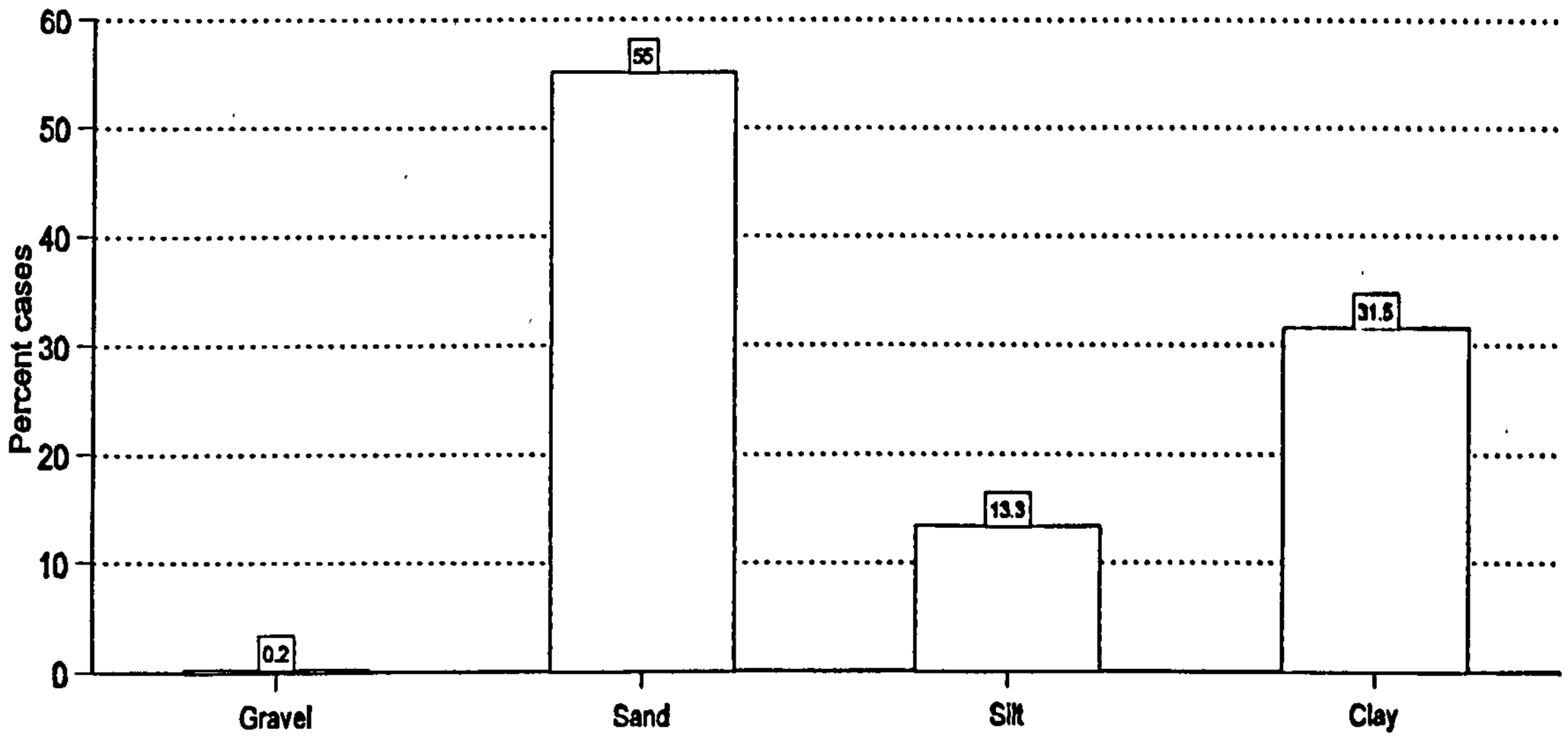
Particle description (> 90 micron)
Particle size: fine, with no gravel
Particle shape: low sphericity, from subrounded to angular
Colour: white shells, quartz, dark grey
Organic material: woody and straw fibres

HYDROMETER METHOD

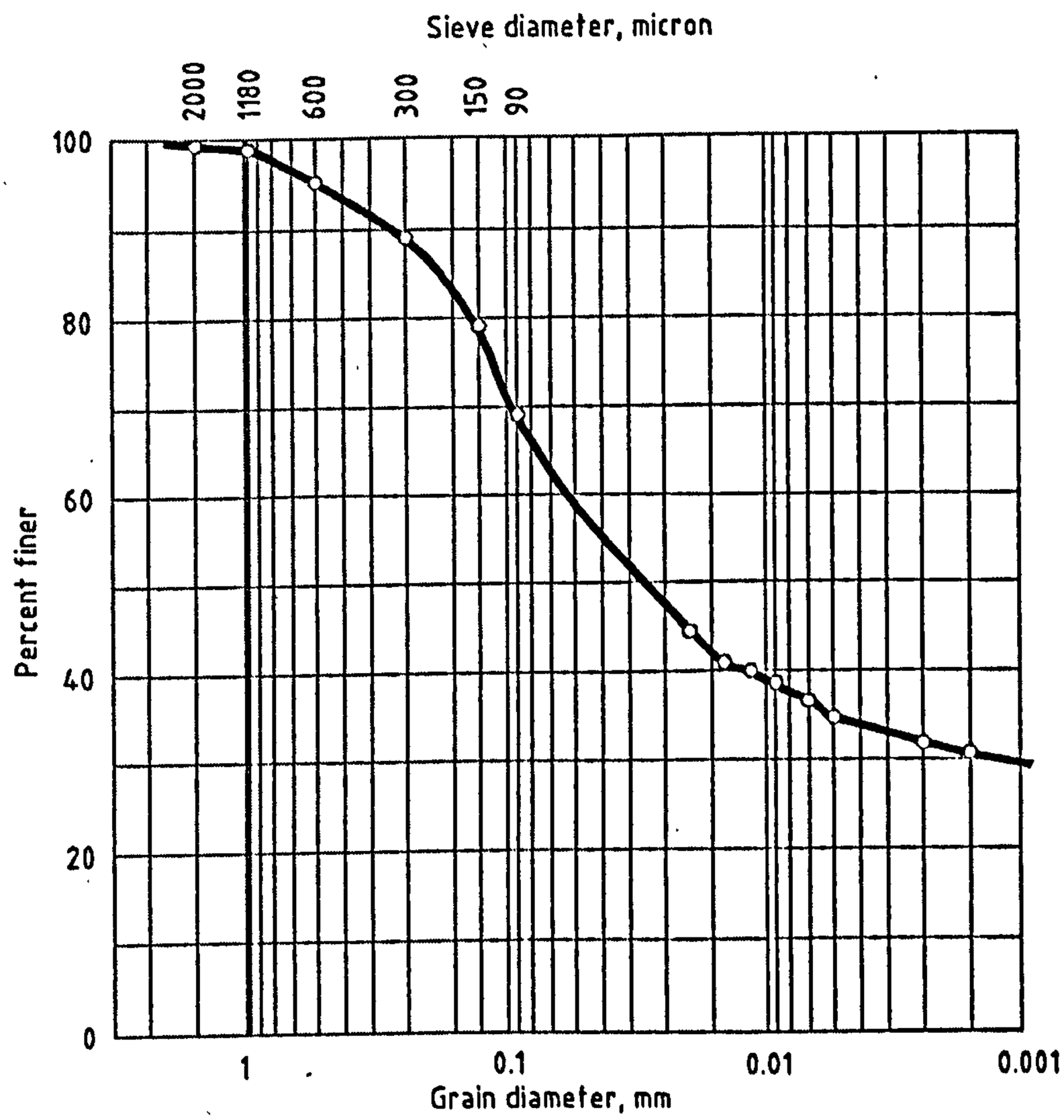
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	22	60	57.4	51	62	/	/	0.0131	/
2	22	53	50.4	44.8	55	7.3	3.65	0.0131	0.025
4	22	49	46.4	41.2	51	7.9	1.975	0.0131	0.018
8	21	48	45.2	40.2	50	8.1	1.012	0.0133	0.013
15	21	46	43.2	38.4	48	8.4	0.56	0.0133	0.009
30	21	44	41.2	36.6	46	8.8	0.293	0.0133	0.007
60	20	42	39	34.7	44	9.1	0.151	0.0134	0.005
135	19	40	36.7	32.6	42	9.4	0.069	0.0136	0.003
240	18	39	35.5	31.5	41	9.6	0.04	0.0138	0.002
480	18	31	27.5	24.4	33	10.9	0.022	0.0138	0.002
1410	20	12	9	8	14	14	0.009	0.0134	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Serramanna 2

Location: Via dell'Angelo, Serramanna, Sardinia. Ground floor, external facade, 1.7 metres from ground level. Building under demolition
Orientation: west
Soil description from pedological map (after Arangino et al, 1986): calcixerollic xerochrepts. Deep soil (depth > 100 cm), with clayey texture and no content of soluble salts
Sample weight before drying: 137 gr
Sample weight after drying: 132.7 gr
Percent moisture: 3.1 %
Munsell® soil colour notation and colour name: HUE 10YR, 5/4, yellowish brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	15.2	11.4	64.4
150 microns	10.9	8.1	75.8
300 microns	8.1	6	83.9
600 microns	4.5	3.3	89.9
1180 microns	2.5	1.8	93.2
2000 microns	6.7	5	95

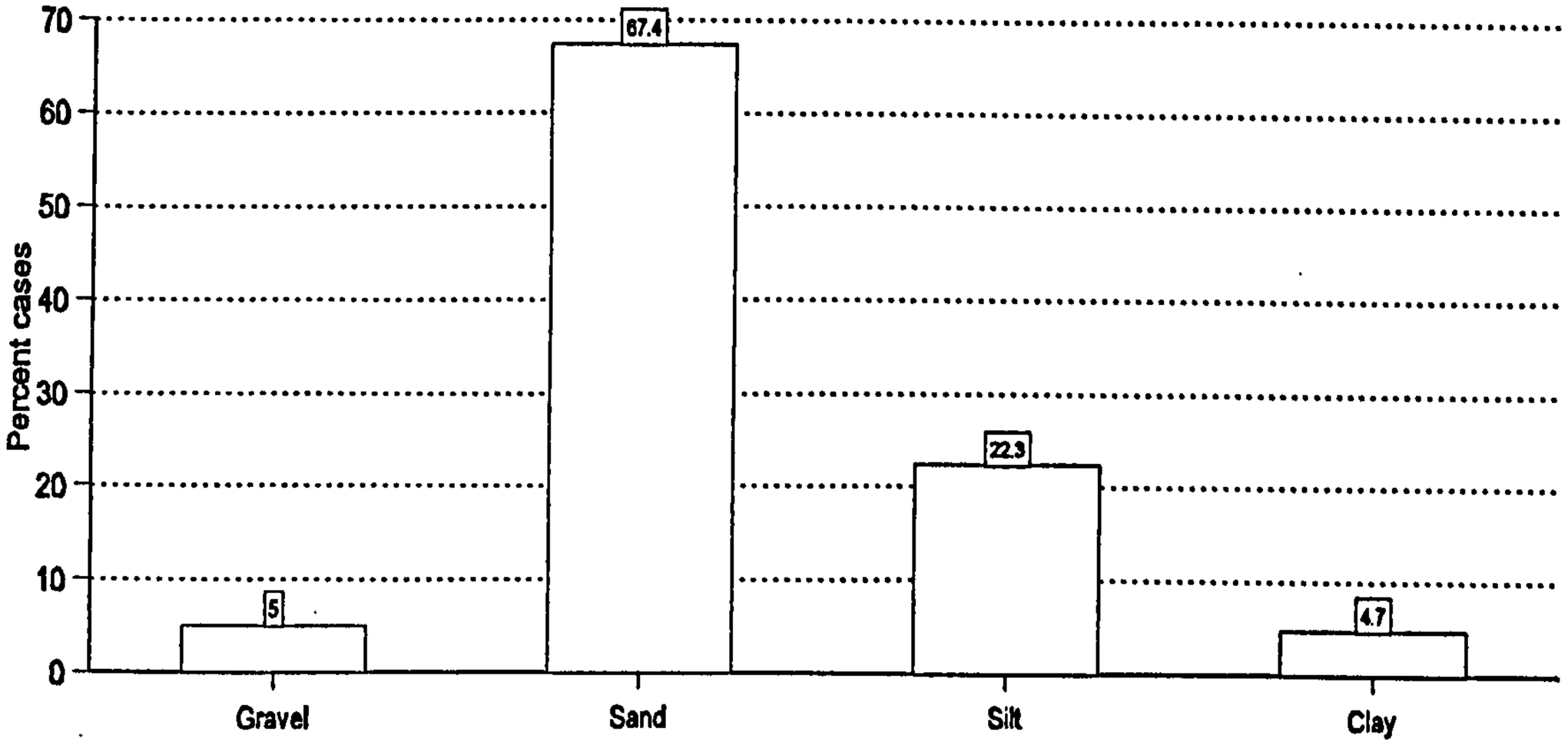
Particle description (> 90 micron)
Particle size: the range between pebbles and gravel is not present
Particle shape: fine sand, except for some lumps of lime mortar
Colour: grey and ochre
Organic material: a lot of chopped straw

HYDROMETER METHOD

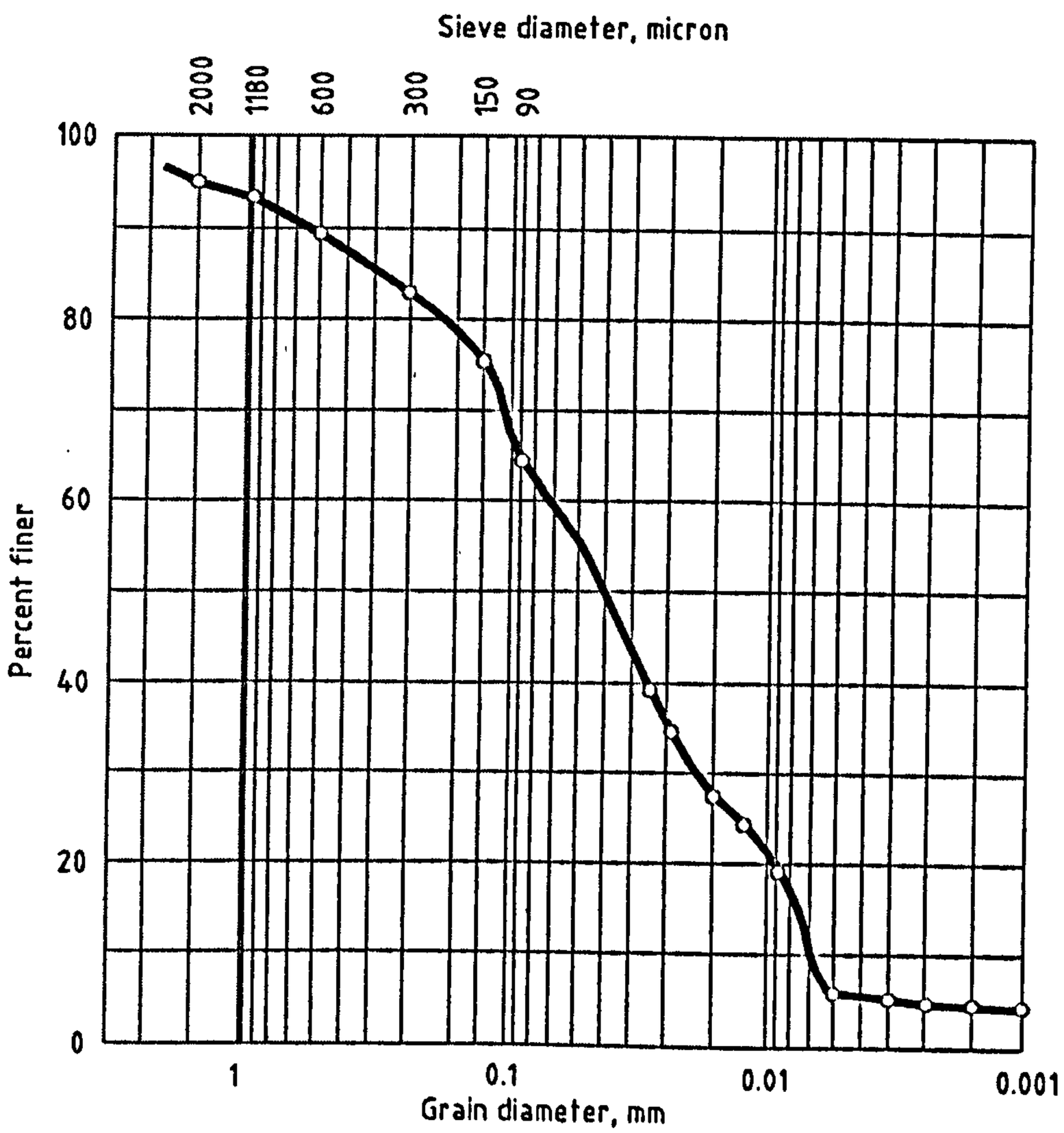
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	22	56	53.4	39.5	58	6.8	6.8	0.0131	0.034
2	22	46	43.4	34.1	48	8.4	4.8	0.0131	0.037
4	22	40	37.4	27.6	42	9.4	2.35	0.0131	0.020
8	22	36	33.4	24.7	38	10.1	1.262	0.0131	0.014
23	21	29	26.2	19.3	31	1.2	0.486	0.0133	0.009
60	20	11	8	5.9	13	14.2	0.236	0.0134	0.006
135	21	10	7.2	5.3	12	14.3	0.105	0.0133	0.004
250	22	9	6.4	4.7	11	14.5	0.058	0.0131	0.003
490	22	9	6.4	4.7	11	14.5	0.029	0.0131	0.002
1420	23	9	6.7	4.9	11	14.5	0.010	0.013	0.0013

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Serrenti 2

Location: Serrenti, Sardinia. Ground floor, external facade, 1.2 metres from ground level
Orientation:
Soil description from pedological map (after Arangino et al, 1986): typic xerochrepts, derived from acid rocks. Soil varies from very deep (> 100 cm) to medium depths between 100 cm and 50 cm. Sandy and clayey texture, with no trace of soluble salts
Sample weight before drying: 135.7 gr
Sample weight after drying: 133.3 gr
Percent moisture: 1.7 %
Munsell® soil colour notation and colour name: HUE 10YR, 6/4, light yellowish brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	7.6	5.7	71.8
150 microns	8	6	77.5
300 microns	7.7	5.7	83.5
600 microns	6.4	4.8	89.2
1180 microns	3.7	2.7	94
2000 microns	4.5	3.3	96.7

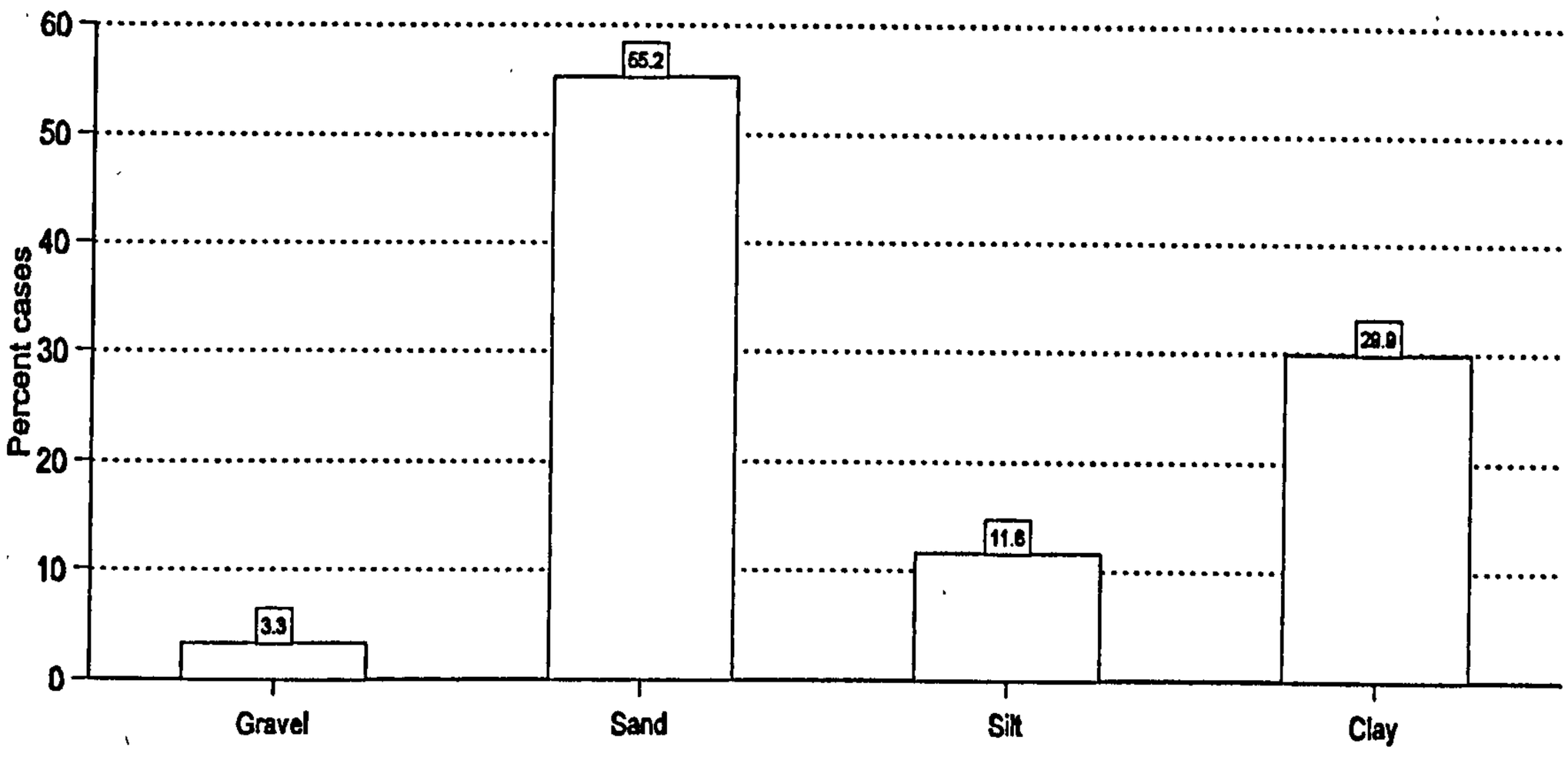
Particle description (> 90 micron)
Particle size: well graded
Particle shape: from subangular with high sphericity to angular with low sphericity
Colour: white, dark grey, white quartz, ochre
Organic material: no trace of organic matter

HYDROMETER METHOD

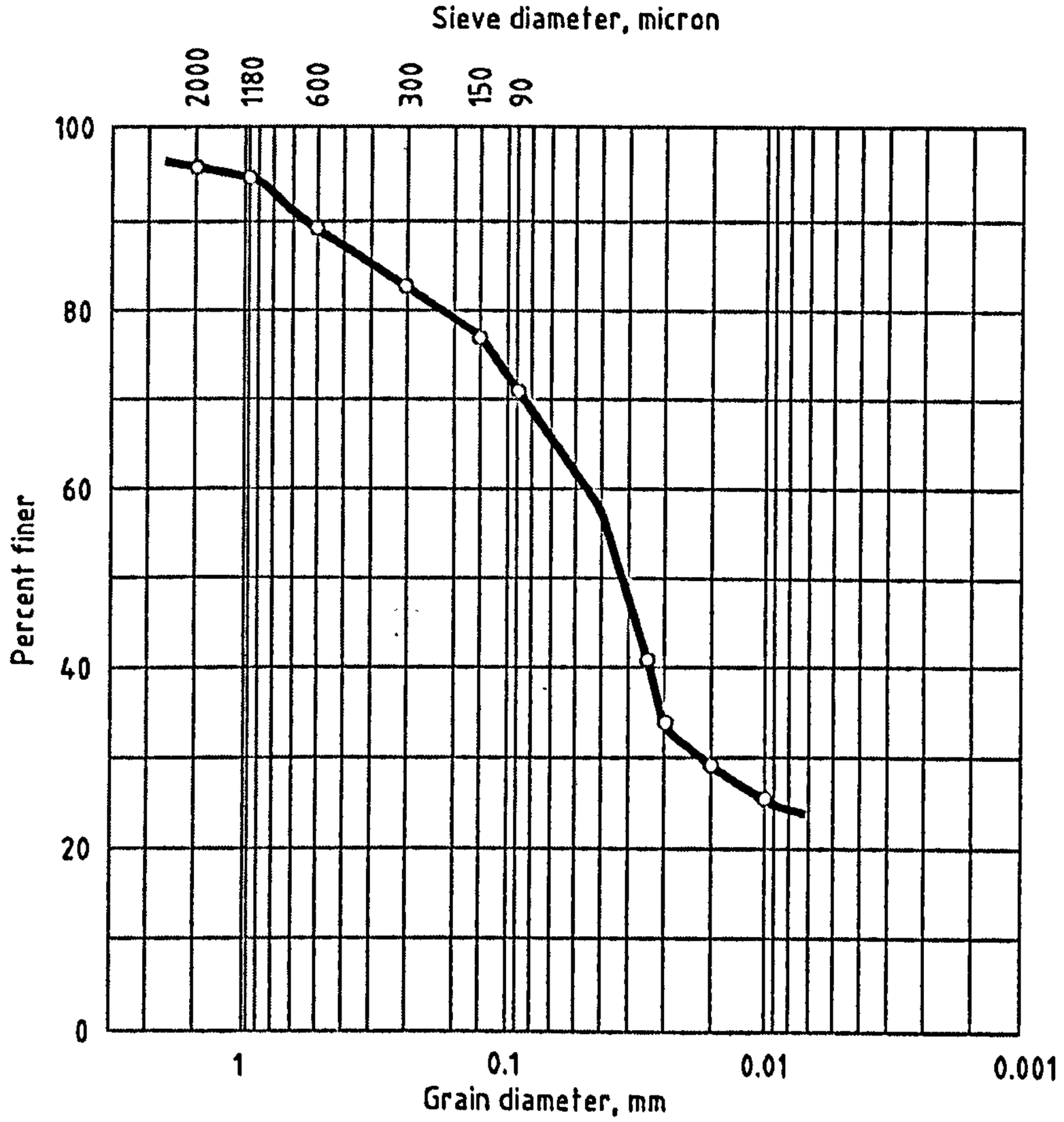
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	23	67	64.7	47.8	69	/	/	0.013	/
2	23	66	63.7	47.1	68	/	/	0.013	/
4	23	65	62.7	46.3	67	/	/	0.013	/
8	23	64	61.7	45.6	66	/	/	0.013	/
15	22	62	59.4	43.9	64	/	/	0.0131	/
30	21	59	56.2	41.5	61	/	/	0.0133	/
60	20	54	51	40.2	56	7.1	0.118	0.0134	0.035
120	19	49	45.7	33.8	51	7.9	0.065	0.0136	0.003
270	18	44	40.5	29.9	46	8.8	0.032	0.0138	0.002
470	18	39	35.5	26.2	41	9.6	0.020	0.0138	0.001
1390	18	32	28.5	21	34	10.7	0.007	0.0138	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Sinnai 3

Location: Via Funtaneddas 106, Sinnai, Sardinia. Ground floor, external facade, 1.5 metres from ground level
Orientation: north-west
Soil description from pedological map (after Arangino et al, 1986): typic xerochrepts, derived from marl and calcareous marl. Soil varies from very deep (> 100 cm) to medium depths between 100 cm and 50 cm. Sandy and clayey texture, with no trace of soluble salts
Sample weight before drying: 100 gr
Sample weight after drying: 99.1 gr
Percent moisture: 0.9 %
Munsell® soil colour notation and colour name: HUE 10YR, 6/3, pale brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	6.5	6.5	39.3
150 microns	11.1	11.2	45.8
300 microns	12.6	12.2	57
600 microns	10.6	10.6	69.1
1180 microns	6.5	6.5	79.7
2000 microns	13.7	13.8	86.2

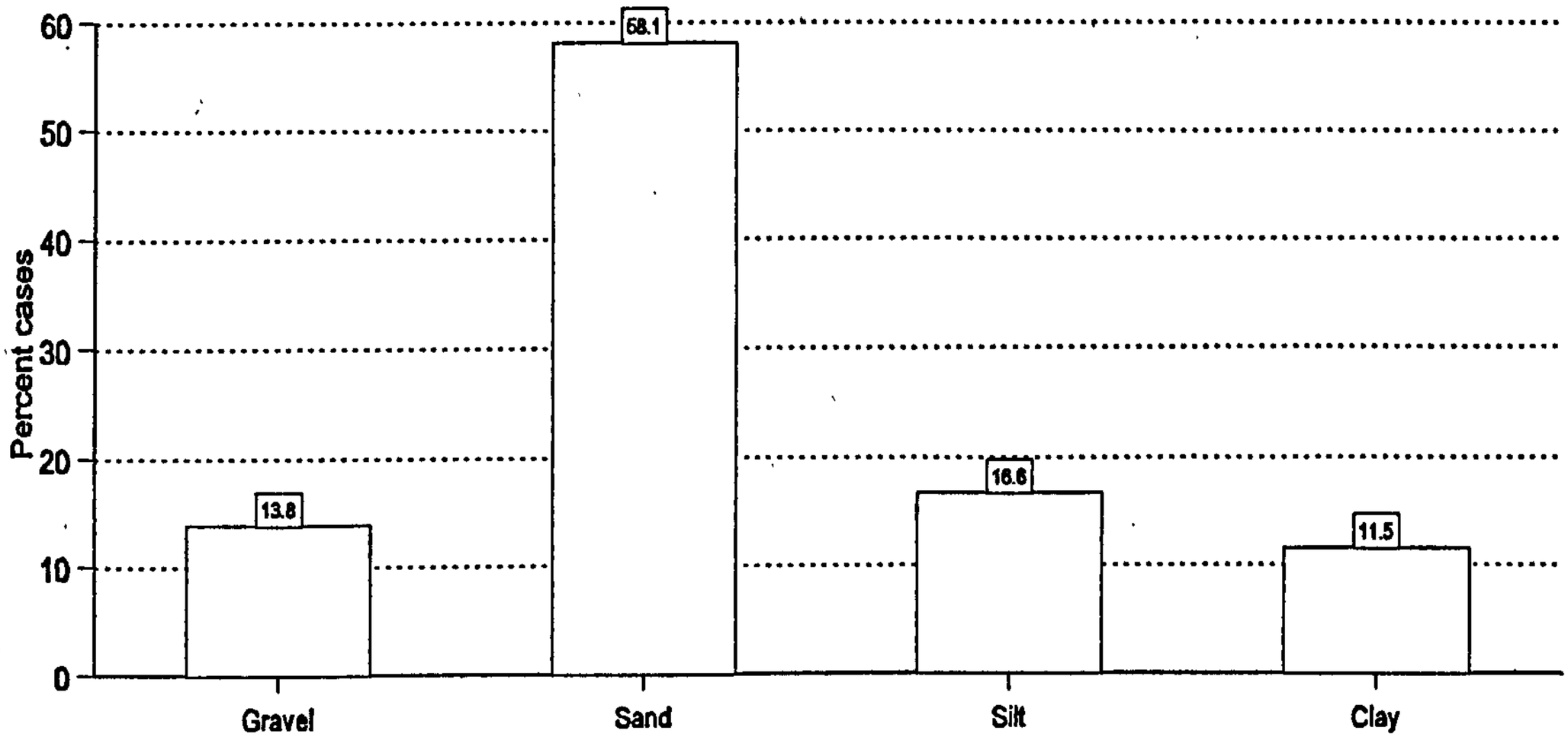
Particle description (> 90 micron)
Particle size: the range between pebbles and gravel is not well represented
Particle shape: low sphericity, from very angular to subangular
Colour: pink, dark grey, quartz, traces of lumps oflime mortar
Organic material: traces of woody fibres

HYDROMETER METHOD

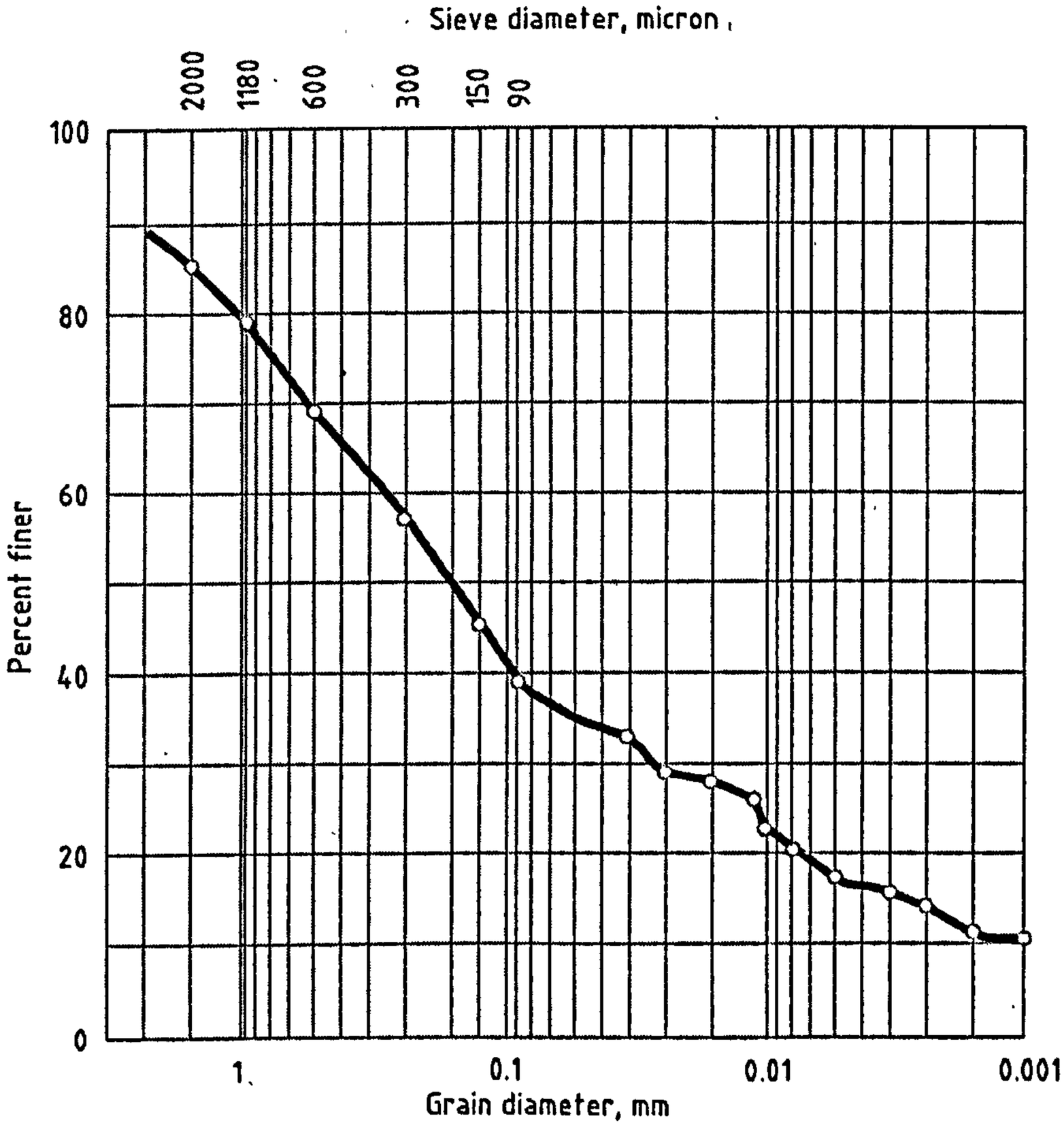
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1/2	23	42	39.7	39.3	44	9.1	18.2	0.013	0.055
1	23	36	33.7	33.3	38	10.1	10.1	0.013	0.041
2	23	32	29.7	29.4	34	10.7	5.35	0.013	0.03
4	22	31	28.4	28.1	33	10.9	2.725	0.0131	0.021
8	22	29	26.4	26.1	31	11.2	1.4	0.0131	0.015
15	21	27	24.2	23.9	29	11.5	0.766	0.013	0.011
30	21	24	21.2	20.8	26	12.0	0.4	0.0133	0.008
60	20	21	18	17.8	22	12.7	0.211	0.0134	0.006
120	19	19	15.7	15.5	21	12.9	0.107	0.0136	0.004
240	19	17	13.7	13.5	19	13.2	0.055	0.0136	0.003
480	19	15	11.7	11.5	17	13.5	0.028	0.0136	0.002
1545	20	14	11	10.8	16	3.7	0.008	0.0134	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Uras 3

Location: Via Eleonora / Vico Eleonora (Post Office back yard), uras, Sardinia. Ground floor
Orientation: north-east
Soil description from pedological map (after Arangino et al, 1986): palexerafis aquic, formed after ancient alluvion.
Deep soil (depth > 100 cm), from sandy and clayey texture, and average soluble salt presence
Sample weight before drying: 142.5 gr
Sample weight after drying: 140.5 gr
Percent moisture: 1.7%
Munsell® soil colour notation and colour name: HUE 10YR, 6/2, light brownish grey

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	9.3	6.6	46.7
150 microns	14.1	10	53.3
300 microns	13.3	9.4	63.3
600 microns	9.5	6.7	72.7
1180 microns	4.2	2.9	79.4
2000 microns	24.9	17.7	82.3

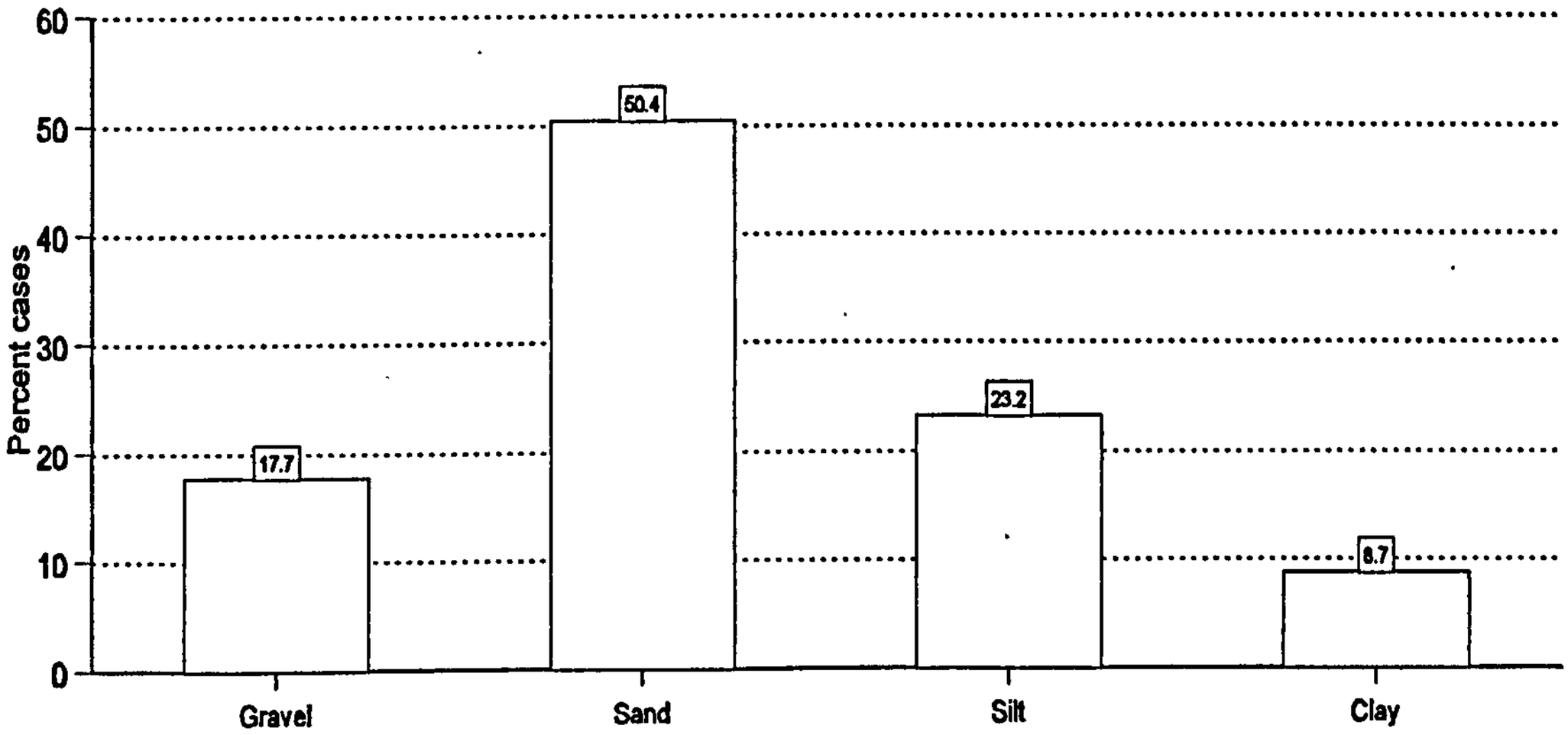
Particle description (> 90 micron)
Particle size: the range between pebbles and gravel is not present
Particle shape: high sphericity, from subrounded to well-rounded
Colour: white, quartz-like grains, grey grains, brick dust
Organic material: traces of woody and straw fibres

HYDROMETER METHOD

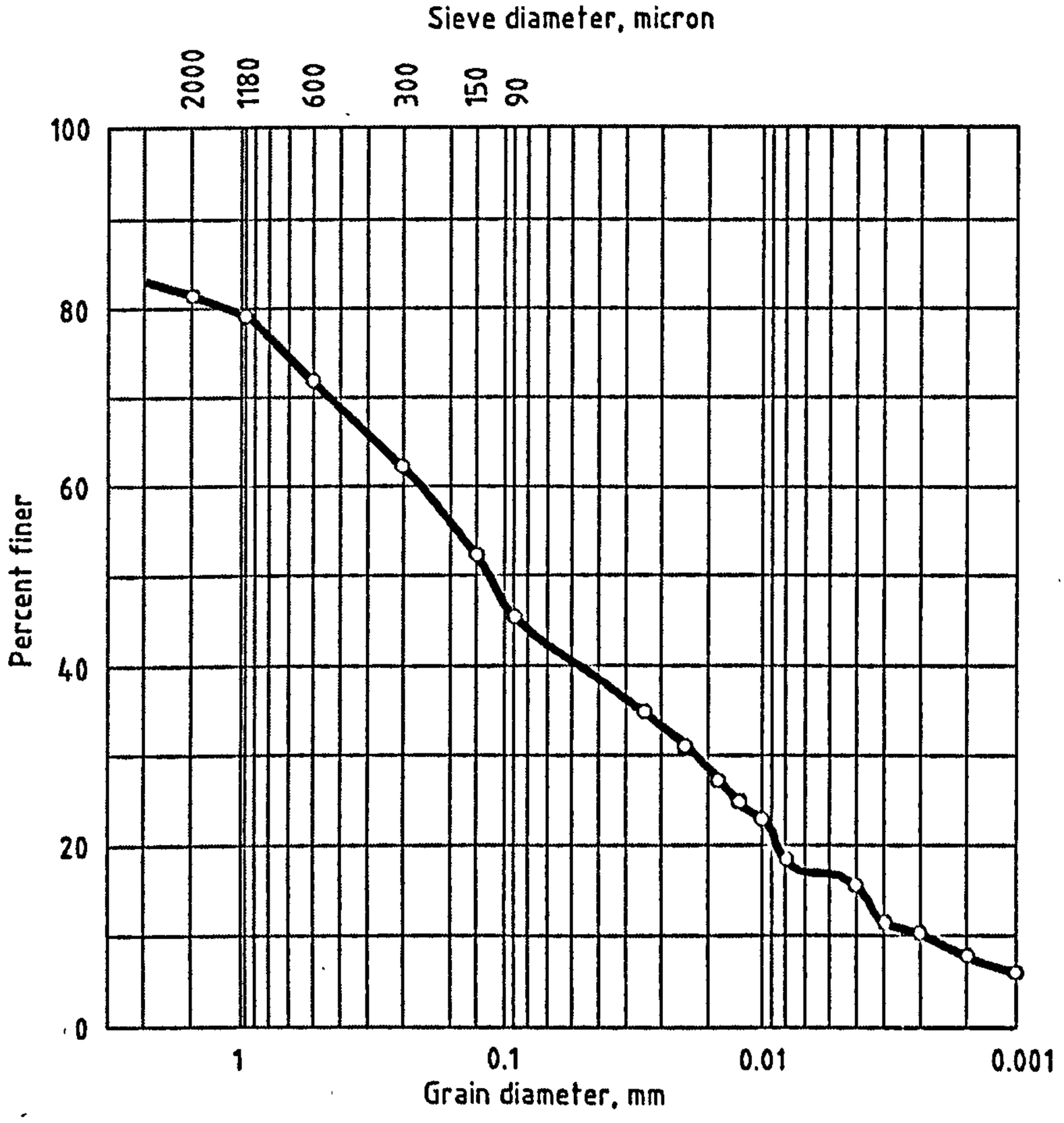
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	23	53	50.7	35.4	55	7.3	7.3	0.013	0.035
2	23	48	45.7	31.9	50	8.1	4.05	0.013	0.026
4	23	42	39.7	27.7	44	9.1	2.275	0.013	0.0190
8	23	39	36.7	25.6	41	9.6	1.2	0.013	0.014
15	22	34	33.4	23.3	36	10.4	0.693	0.0131	0.010
30	22	29	26.4	18.4	31	11.2	0.373	0.0131	0.008
65	21	25	22.2	15.5	27	11.9	0.183	0.0133	0.005
125	19	21	17.7	12.3	23	12.5	0.1	0.0136	0.004
245	18	19	15.5	10.8	21	12.9	0.052	0.0138	0.003
434	18	16	12.5	8.7	18	13.3	0.03	0.0138	0.002
1395	19	13	9.7	6.7	15	13.2	0.009	0.0136	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Villamassargia 4

Location: Casa Fenu, Villamassargia, Sardinia. Ground floor
Orientation: south
Soil description from pedological map (after Arangino et al, 1986): lithic xerorthents, derived from sandstone.
Depth < 50 cm, with sandy and clayey texture and no content of soluble salts
Sample weight before drying: 149.8 gr
Sample weight after drying: 148.2 gr
Percent moisture: 1%
Munsell® soil colour notation and colour name: HUE 10YR, 6/3, pale brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	9.4	6.2	77
150 microns	8.3	5.5	83.2
300 microns	5.5	3.6	88.7
600 microns	4.2	2.8	92.3
1180 microns	2.2	1.5	95.1
2000 microns	5.2	3.4	96.6

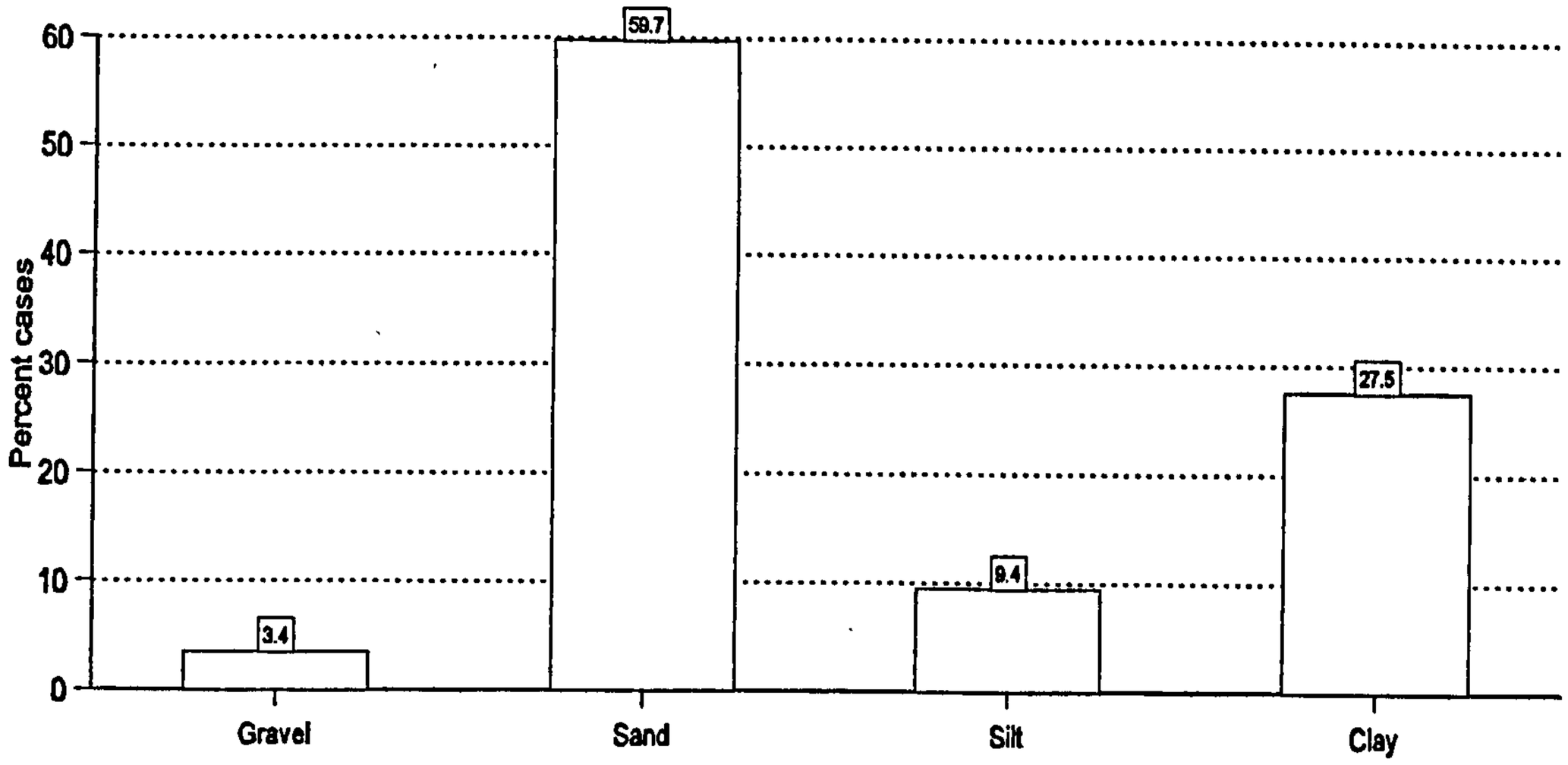
Particle description (> 90 micron)
Particle size: well graded
Particle shape: rounded with high sphericity
Colour: grey and ochre sand grains, traces of brick dust
Organic material: traces of straw

HYDROMETER METHOD

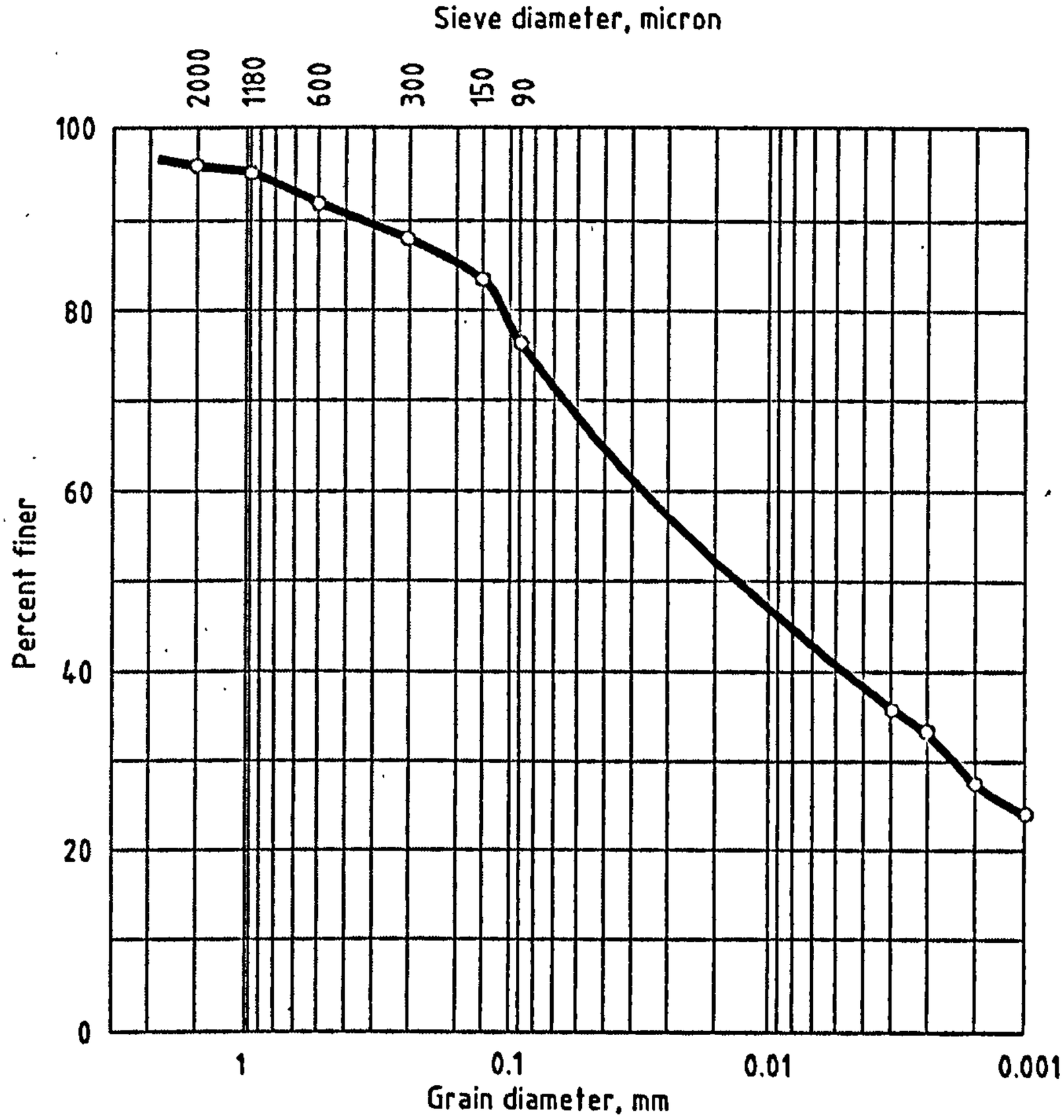
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	22	70	57.4	/	72	/	/	0.0131	/
2	22	68	64.4	/	70	/	/	0.0131	/
4	22	67	64.4	/	69	/	/	0.0131	/
8	22	66	63.4	/	68	/	/	0.0131	/
15	21	65	62.2	/	67	/	/	0.0133	/
30	21	62	59.2	/	64	/	/	0.0133	/
60	20	56	56	36.9	58	6.8	0.113	0.0134	0.004
120	20	51	51	33.6	53	7.6	0.063	0.0134	0.003
265	19	45	41.7	27.5	47	8.6	0.033	0.0136	0.002
450	19	41	37.7	24.8	43	9.2	0.020	0.0136	0.001
1620	18	32	18.5	12.2	34	10.7	0.006	0.0138	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Villasor 2

Location: Via Eleonora d'Arborea 17, Villasor, Sardinia. 1.2 metres from gound level
Orientation: south
Soil description from pedological map (after Arangino et al, 1986): xerofluvents vertic, formed after recent alluvion.
Deep soil (depth > 100 cm), with clayey texture and medium content in soluble salts
Sample weight before drying: 122.6 gr
Sample weight after drying: 121.2 gr
Percent moisture: 1.1 %
Munsell® soil colour notation and colour name: HUE 10YR, 6/4, light yellowish brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	9.6	7.8	42.1
150 microns	17.1	14	49.9
300 microns	15.3	12.5	63.9
600 microns	11.3	9.2	76.4
1180 microns	6	4.9	85.6
2000 microns	11.6	9.5	90.5

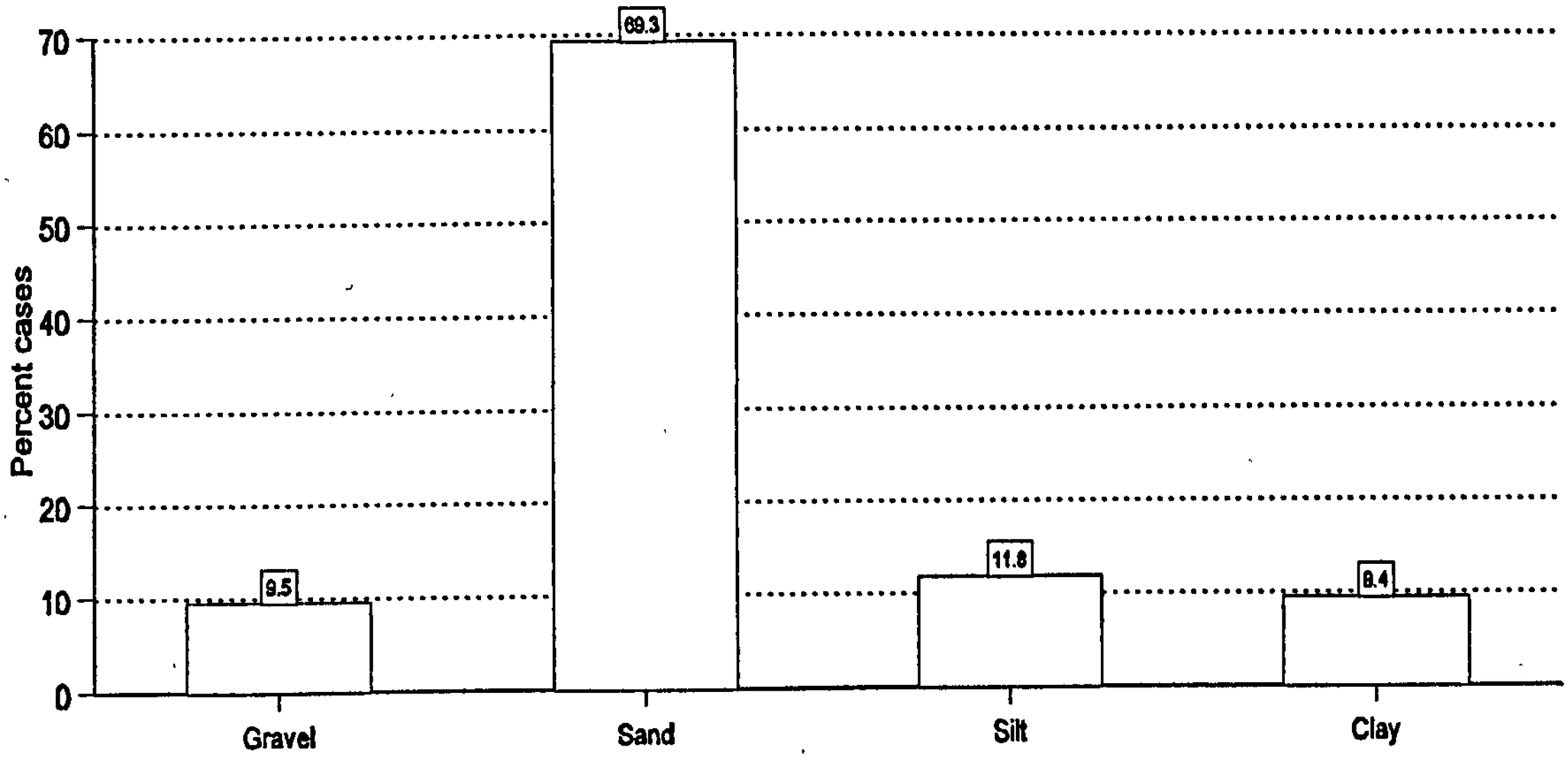
Particle description (> 90 micron)
Particle size: well graded
Particle shape: from subangular with high sphericity to angular with low sphericity
Colour: pink, white and grey
Organic material: no trace of organic matter

HYDROMETER METHOD

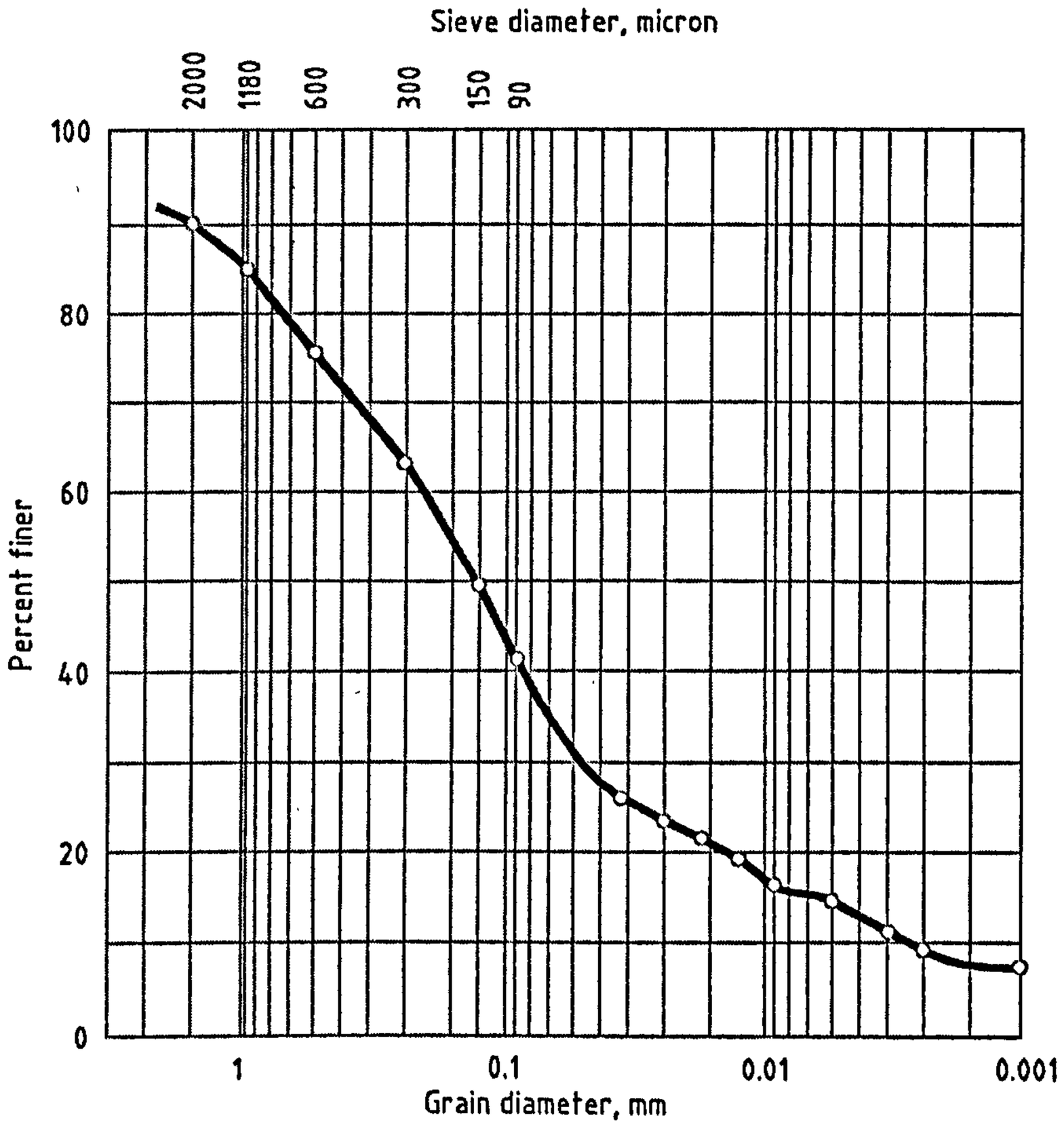
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	21	36	33.2	26.8	38	10.1	10.1	0.0133	0.042
2	21	33	30.2	24.4	35	10.5	5.25	0.0133	0.304
4	21	29	26.2	21.2	31	11.2	2.8	0.0133	0.022
8	21	27	24.2	19.6	29	11.5	1.437	0.0133	0.015
23	21	22	19.2	15.5	24	12.4	0.539	0.0133	0.009
60	20	18	18	14.5	20	13	0.216	0.0134	0.006
135	19	17	13.7	11	19	13.2	0.097	0.0136	0.004
250	19	15	11.7	9.4	17	13.5	0.054	0.0136	0.003
490	19	15	11.7	9.4	17	13.5	0.027	0.0136	0.002
1420	22	13	10.4	8.4	15	13.8	0.009	0.0131	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



DATASHEETS
Case Studies: *làdiri* samples

Sample: Case study A3

Location: Casa Cadoni-Arcais, Serramanna, Sardinia. Sample of historic mud brick
Orientation: south
Soil description from pedological map (after Arangino et al, 1986): calcixerollic xerochrepts. Depth > 100 cm, with clayey texture and no content of soluble salts
Sample weight before drying: 121.8 gr
Sample weight after drying: 119.8 gr
Percent moisture: 1.6 %
Munsell® soil colour notation and colour name: HUE 10YR, 7/3, very pale brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	5.4	4.4	46.1
150 microns	9.4	7.7	50.5
300 microns	21.8	17.8	58.2
600 microns	18.7	15.5	76
1180 microns	5.7	4.7	91.5
2000 microns	4.7	3.8	96.2

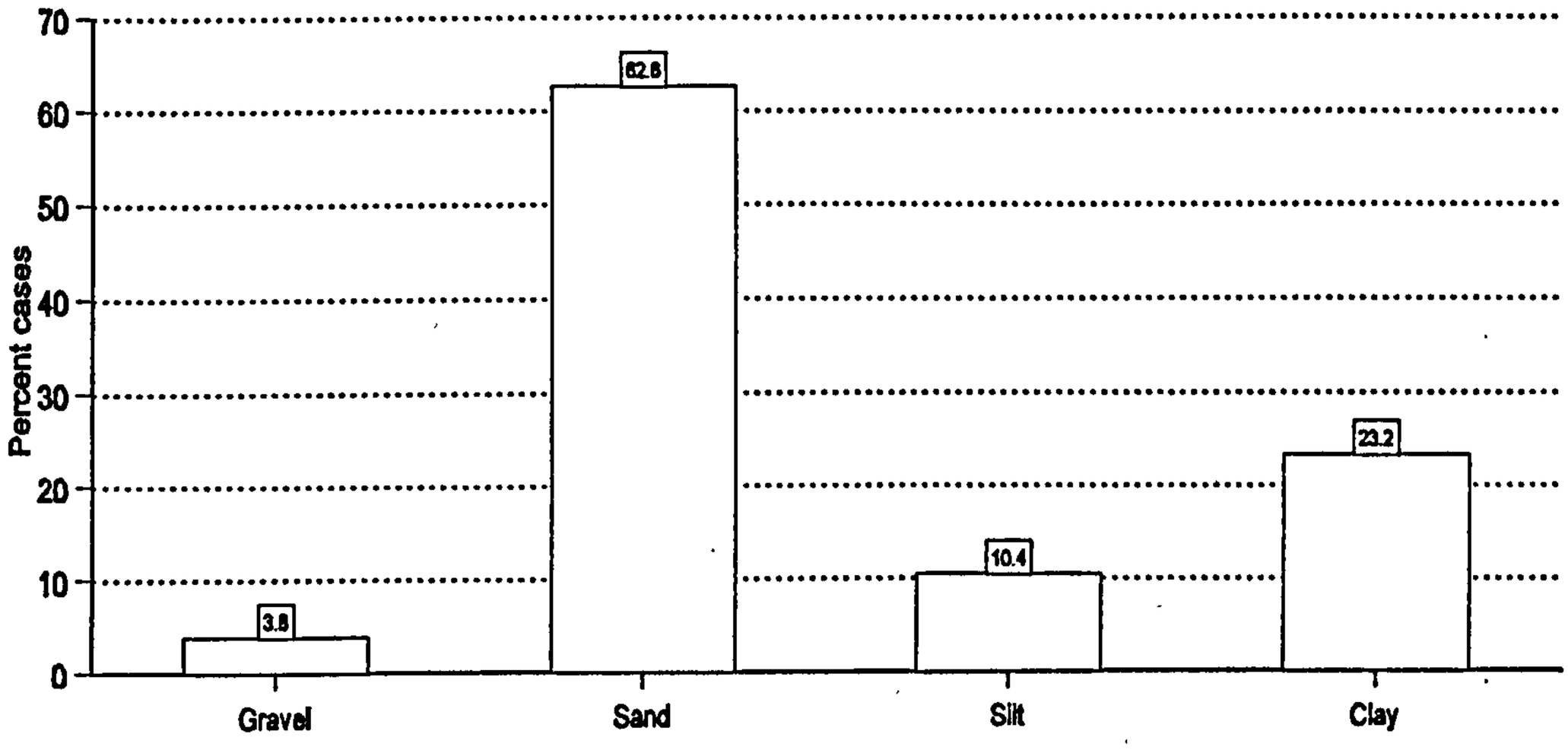
Particle description (> 90 micron)
Particle size: well graded
Particle shape: subrounded with high sphericity
Colour: white, gray and yellow grains
Organic material: lots of chopped straw

HYDROMETER METHOD

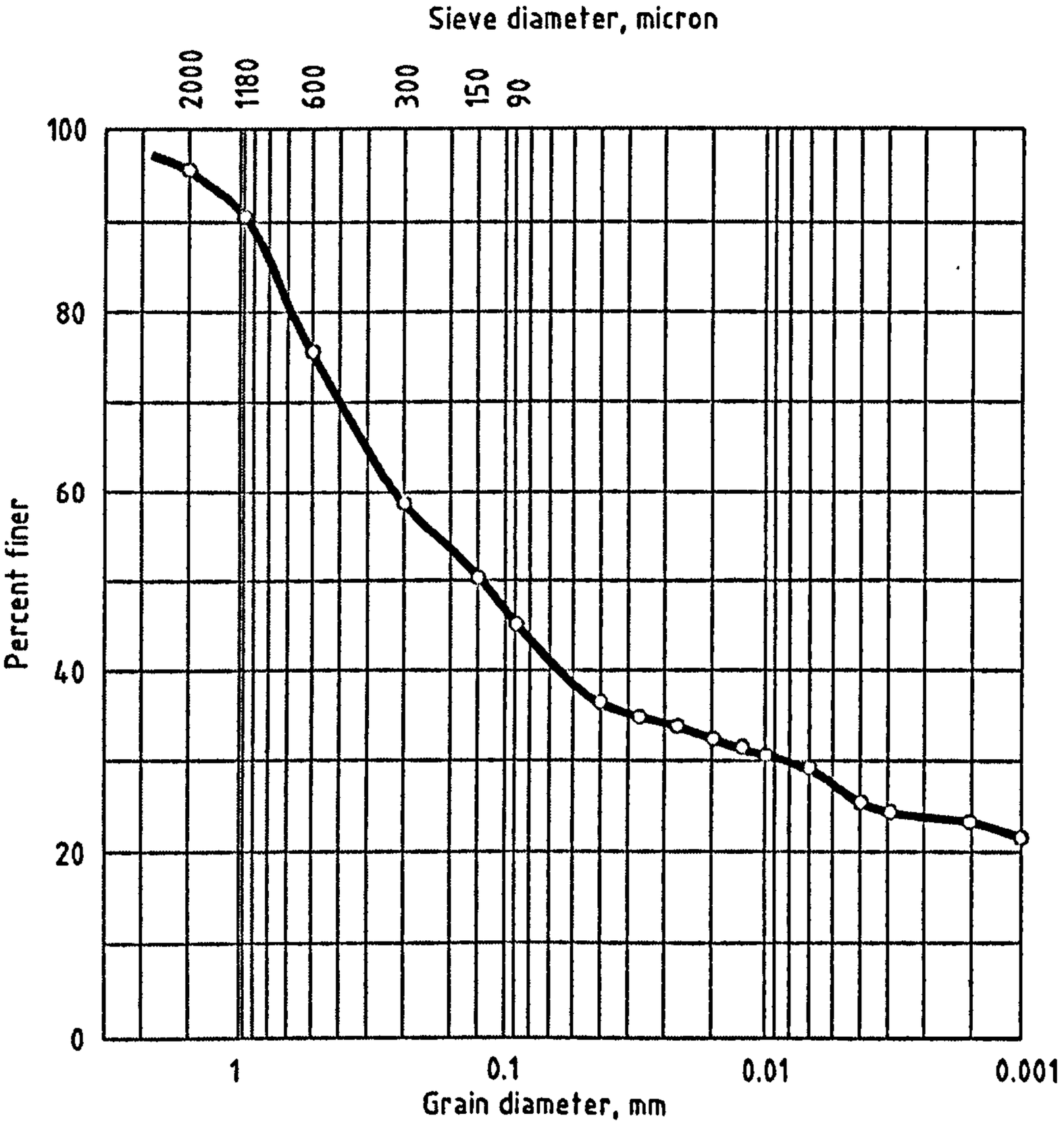
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. °C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1/2	20	49	46	37.7	51	7.1	14.1	0.0134	0.050
1	20	46	43	35.2	48	8.4	8.4	0.0134	0.038
2	20	45	42	34.4	47	8.6	4.3	0.0134	0.027
4	20	44	41	33.6	46	8.8	2.2	0.0134	0.0198
8	20	42	39	31.9	44	9.1	1.137	0.0134	0.014
15	20	40	37	30.3	42	9.4	0.626	0.0134	0.010
30	19	39	35.7	29.2	41	9.6	0.32	0.0136	0.007
60	19	35	31.7	25.9	37	10.2	0.17	0.0136	0.005
120	18	33	29.7	24.3	35	10.5	0.087	0.0138	0.004
240	17	32	28.3	23.2	34	10.7	0.044	0.014	0.002
480	17	23	19.3	15.8	25	12.2	0.025	0.014	0.002
1380	22	11	8.4	6.8	13	14.2	0.010	0.0131	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Case study A4

Location: Casa Cadoni-Arcais, Serramanna, Sardinia. Sample of new mud brick
Orientation: N/A
Soil description from pedological map (after Arangino et al, 1986): DA AGGIUNGERE
Sample weight before drying: 119 gr
Sample weight after drying: 112.2 gr
Percent moisture: 5.7 %
Munsell® soil colour notation and colour name: HUE 10YR, 7/4, very pale brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	5	4.4	62.8
150 microns	5.7	5	67.2
300 microns	6.7	5.9	72.2
600 microns	6.7	5.9	78.1
1180 microns	5.5	4.8	84
2000 microns	12.6	11.2	88.8

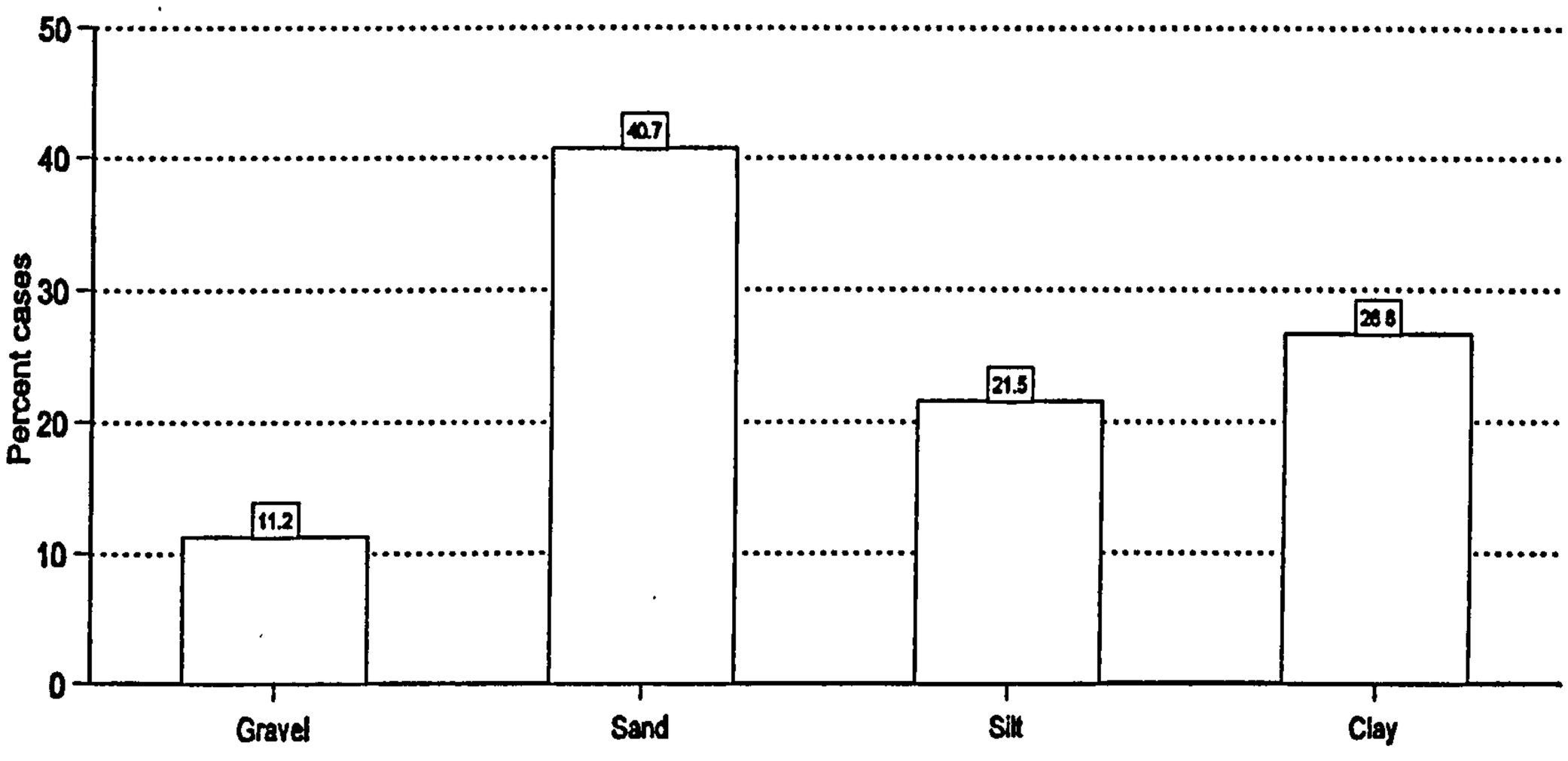
Particle description (> 90 micron)
Particle size: well graded sand
Particle shape: from subangular to angular, with high sphericity
Colour: pink, white, yellow, with inclusion of pebble-size lumps of lime mortar
Organic material: lots of chopped straw

HYDROMETER METHOD

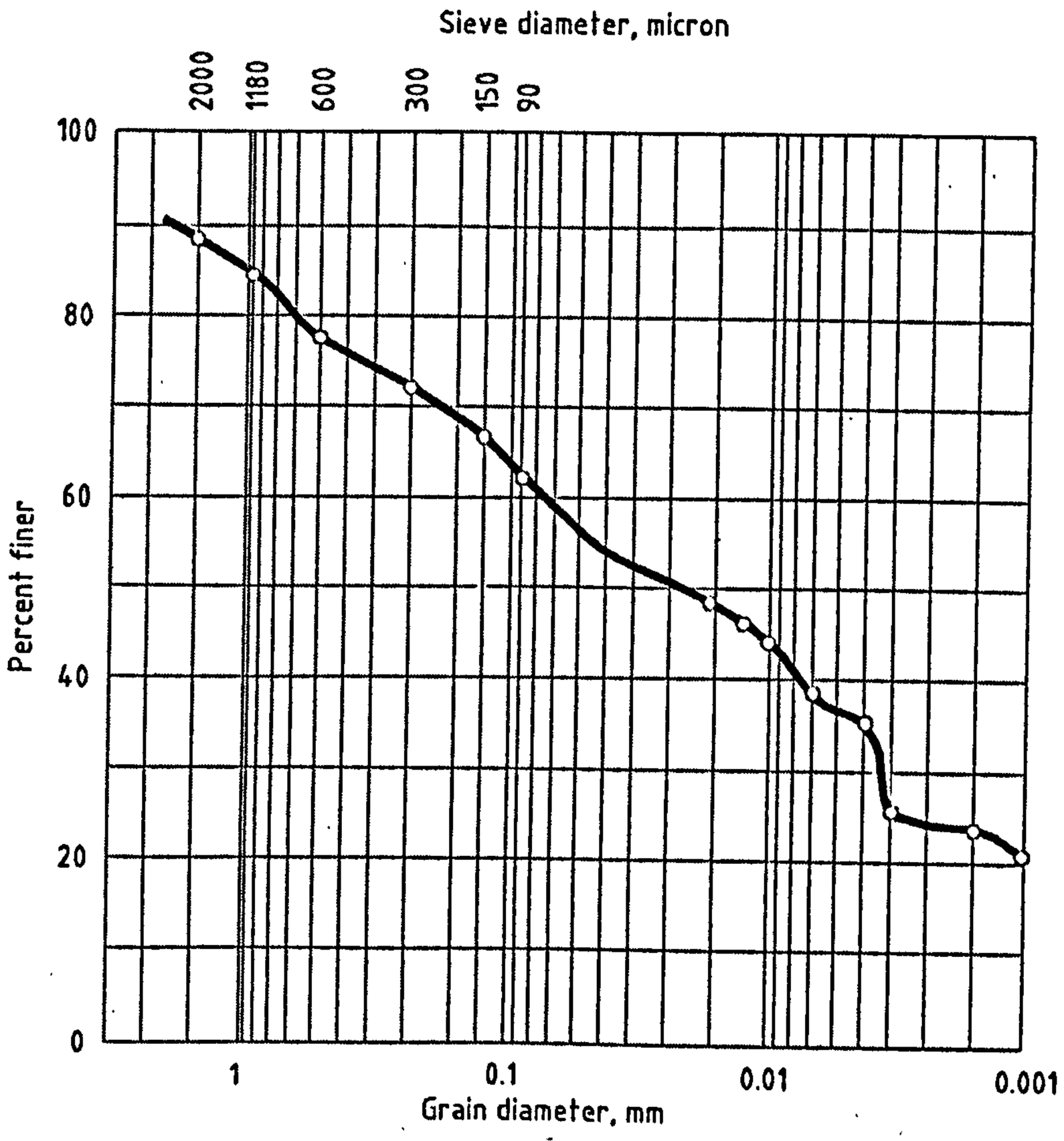
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. °C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1/2	23	64	61.7	54.2	66	/	/	0.013	/
1	23	60	57.7	50.7	62	/	/	0.013	/
2	23	57	54.7	48.1	59	6.6	3.3	0.013	0.023
4	23	55	52.7	46.3	57	7	1.75	0.013	0.017
8	22	53	50.4	44.3	55	7.3	0.912	0.0131	0.012
15	22	50	37.4	32.9	52	7.8	0.52	0.0131	0.009
30	21	46	43.2	38	48	8.4	0.28	0.0133	0.007
60	20	42	39	34.3	44	9.1	0.151	0.0134	0.005
120	19	33	29.7	26.1	35	10.5	0.087	0.0136	0.004
240	17	34	30.3	26.6	36	10.4	0.043	0.014	0.002
480	17	31	27.3	24	33	10.9	0.022	0.014	0.002
1545	18	27	23.5	20.6	29	11.5	0.007	0.0138	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Case study B5

Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia. First floor, south wall of corridor, 1.50 m from ground level. Sample of historic mud brick
Orientation: South
Soil description from pedological map (after Arangino et al, 1986): calcic palexeralfs, petrocalcic palexeralfs. Derived from a process of soil re-calcification due to climatic reasons (increasing aridity and long evaporation periods). Depth > 100 cm, with sandy and clayey texture and no content of soluble salts
Sample weight before drying: 103.4 gr
Sample weight after drying: 101.3 gr
Percent moisture: 2 %
Munsell® soil colour notation and colour name: HUE 10YR, 6/2, light brownish grey

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	9.7	9.5	49.3
150 microns	6.3	6.1	58.8
300 microns	11.1	10.8	64.9
600 microns	7.4	7.2	75.7
1180 microns	5.2	5	82.9
2000 microns	12.4	12.1	87.9

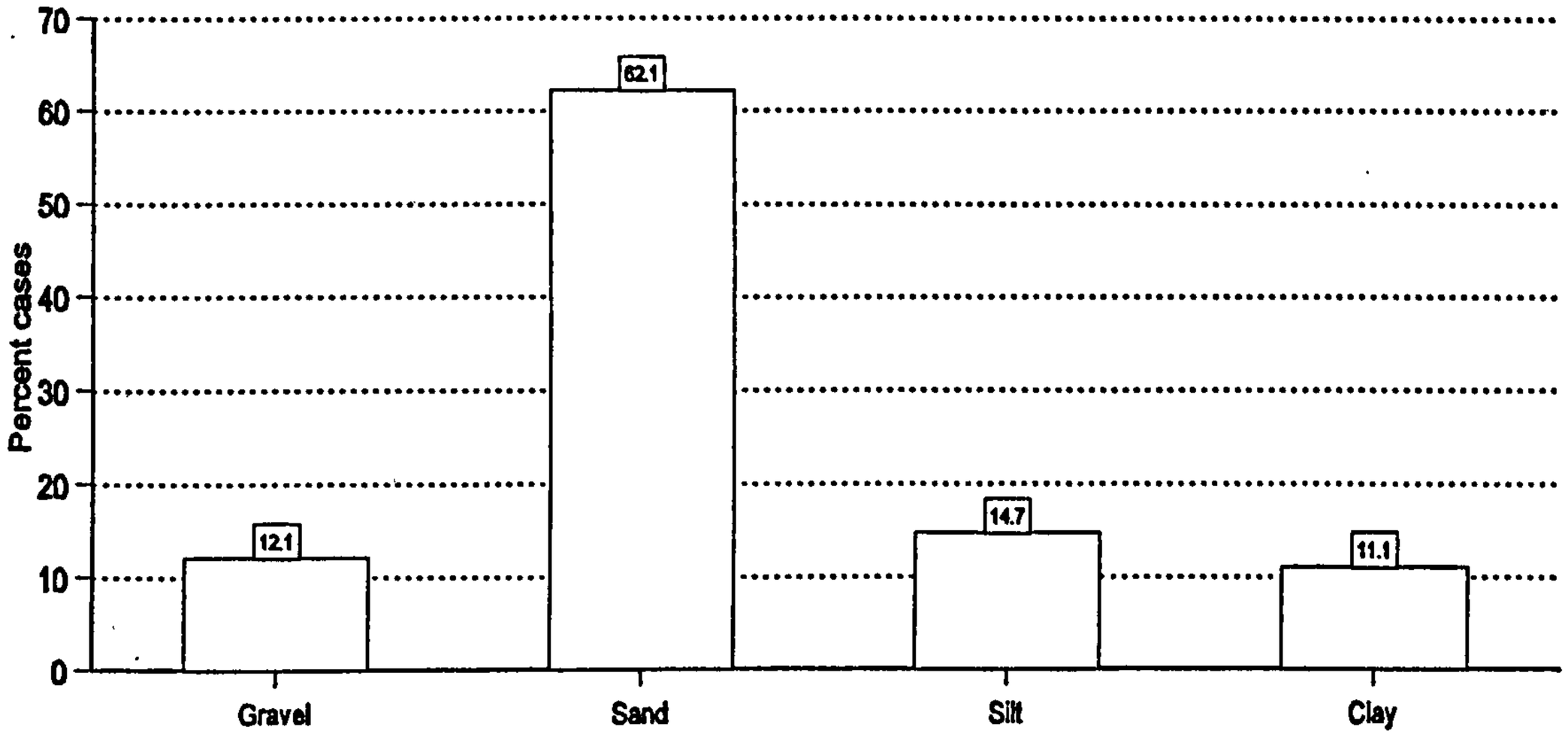
Particle description (> 90 micron)
Particle size: well graded sand
Particle shape: angular with high sphericity
Colour: white, pink, grey
Organic material: traces of woody fibres

HYDROMETER METHOD

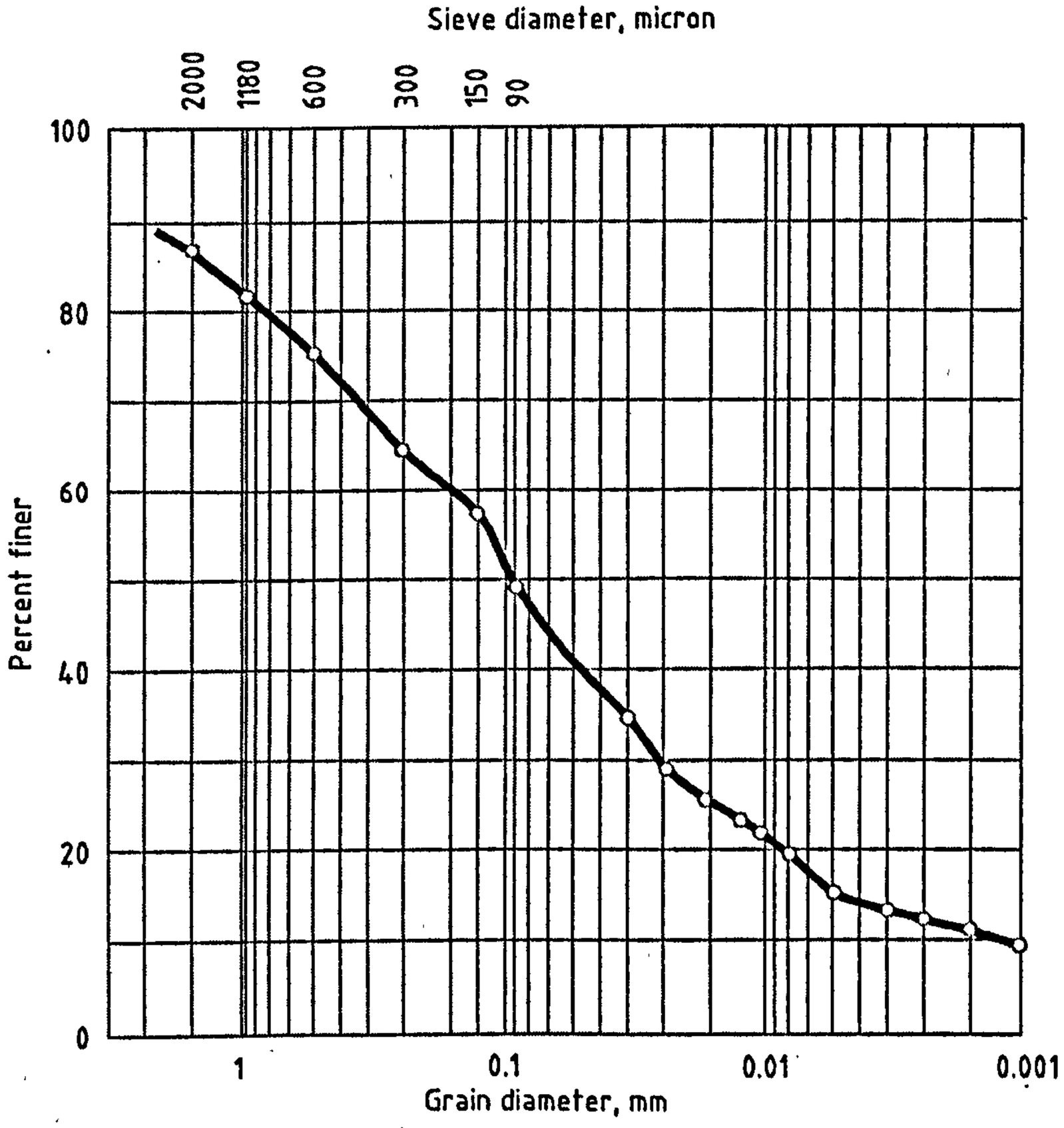
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. °C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1	23	38	35.7	34.6	40	9.7	9.7	0.013	0.040
2	23	33	30.7	29.7	35	10.5	5.25	0.013	0.029
4	23	29	26.7	25.8	31	11.2	2.8	0.013	0.021
8	23	27	24.7	23.9	29	11.5	1.437	0.013	0.015
15	23	25	22.7	22	27	11.9	0.793	0.013	0.011
30	22	23	20.4	19.7	25	12.2	0.406	0.0131	0.008
60	21	20	17.2	16.6	22	12.7	0.211	0.0132	0.006
135	19	18	14.7	14.2	20	13	0.096	0.0136	0.004
240	18	17	13.5	13	19	13.2	0.055	0.0138	0.003
480	18	15	11.5	11.1	17	13.5	0.028	0.0138	0.002
1410	20	13	10	9.7	15	13.8	0.009	0.0134	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



Sample: Case Study B6

Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia. First floor, corridor, south wall, 1.50 m from ground level. Sample of new mud brick
Orientation: south
Soil description from pedological map (after Arangino et al, 1986): /
Sample weight before drying: 258.3 gr
Sample weight after drying: 251.8 gr
Percent moisture: 2.5 %
Munsell® soil colour notation and colour name: IIUE 10YR, 6/3, pale brown

SIEVING METHOD

Sieve size	Weight retained	Percentage retained	Percentage passing
90 microns	13.6	5.4	68.3
150 microns	17.5	6.9	73.7
300 microns	17.3	6.9	80.6
600 microns	11.4	4.5	87.5
1180 microns	8.1	3.2	92
2000 microns	12.1	4.8	95.2

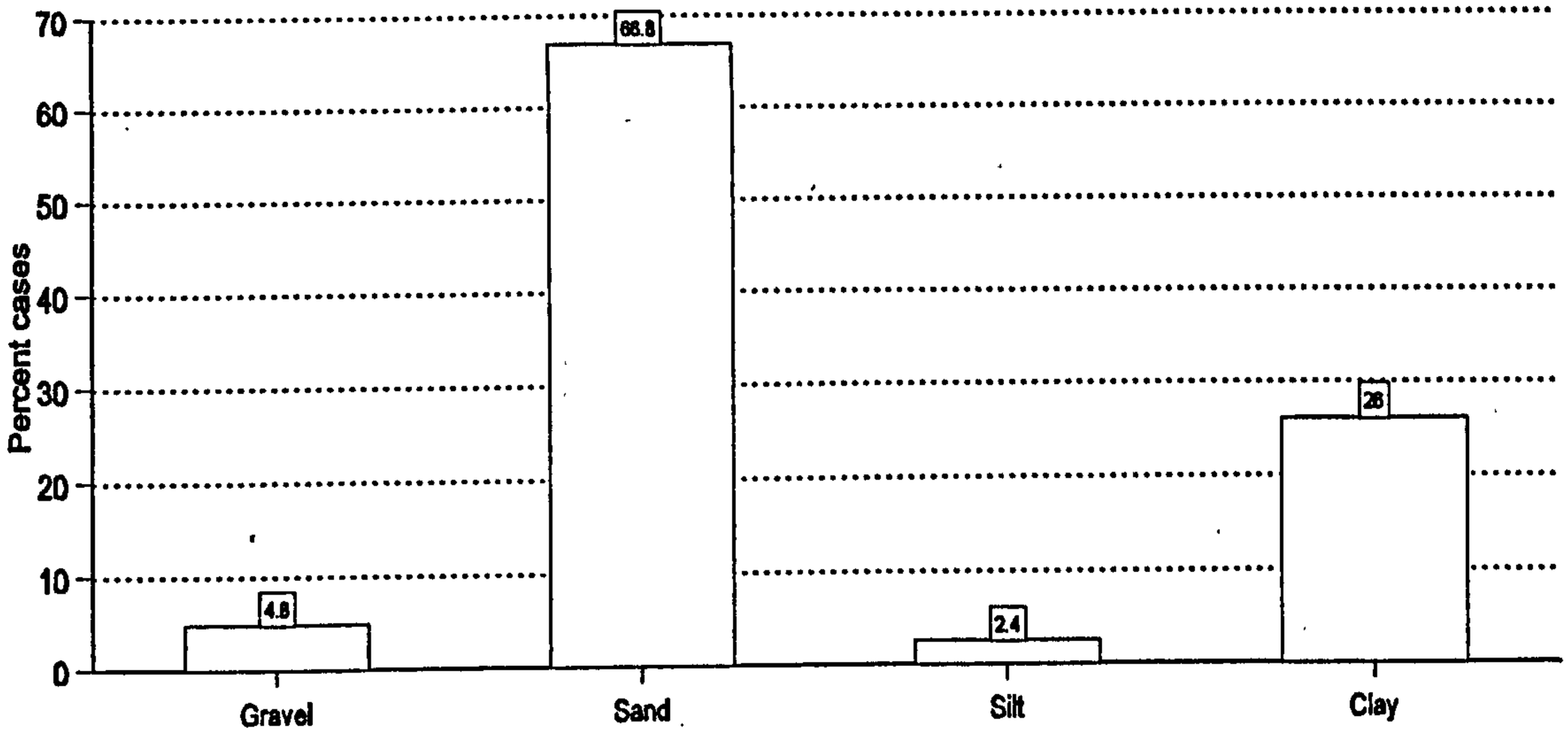
Particle description (> 90 micron)
Particle size: well graded
Particle shape: from subrounded to subangular, with low sphericity
Colour: white, grey, brown
Organic material: a lot of chopped straw

HYDROMETER METHOD

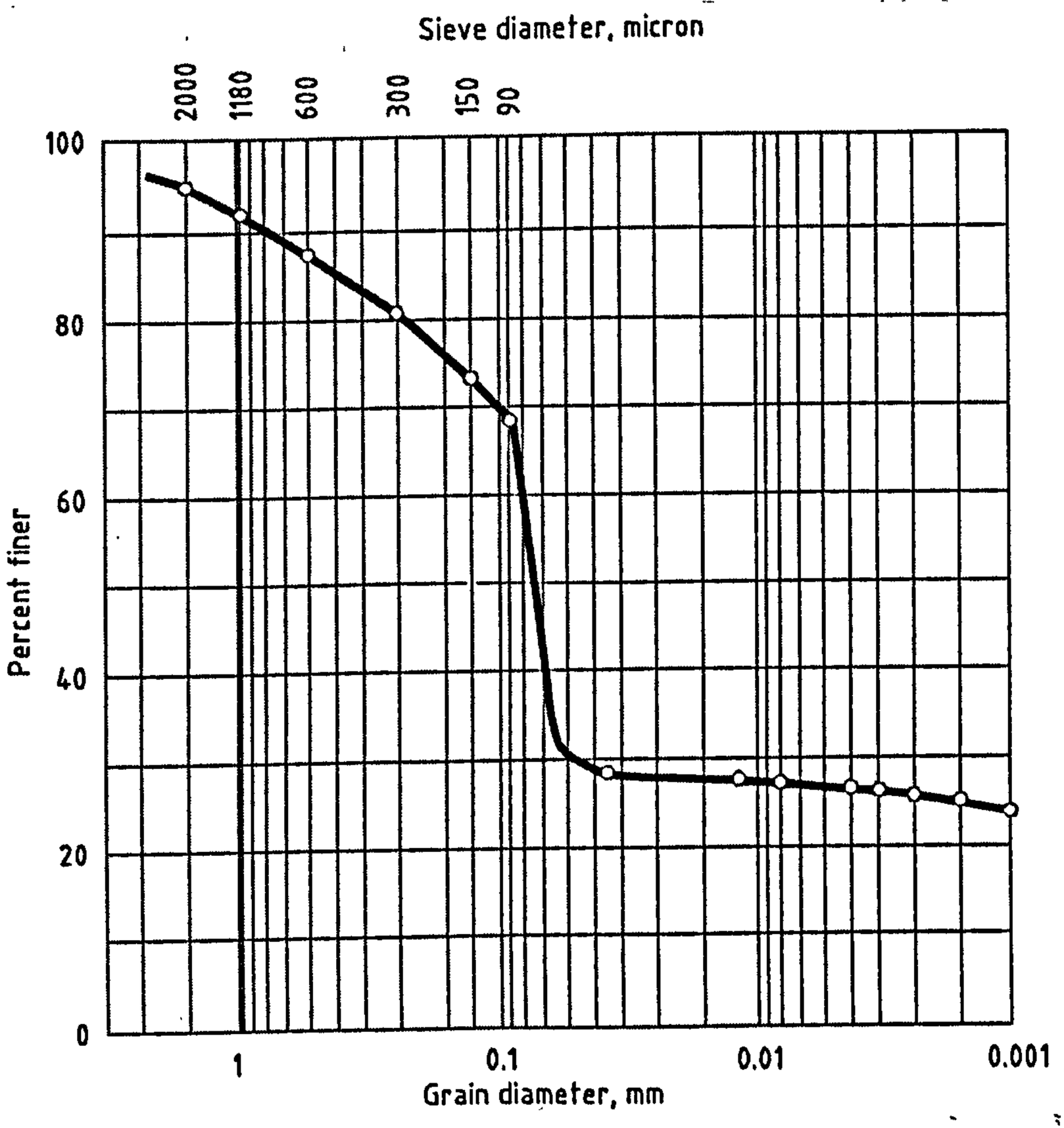
Hydrometer No: ASTM 152H
Dispersing agent: Calgon (4% in 1000 ml)
Meniscus correction: 2.0

Elapsed time t (min)	Temp. °C	Actual Hydr. Reading Ra	Corr. Hydr. Reading Rc	% Finer	Hydr. Corr. Only for Meniscus R	L	L/t	K	D (mm)
1/2	17	77	73.3	28.8	79	3.3	6.6	0.014	0.035
4	17	76	72.3	28.4	78	3.5	0.875	0.014	0.013
10	17	75	71.3	28	77	3.7	0.374	0.014	0.008
23	17	74	70.3	27.6	76	3.8	0.165	0.014	0.005
40	17	73	69.3	27.2	75	4	0.1	0.014	0.004
80	17	71	67.3.	26.4	73	4.2	0.0525	0.014	0.003
160	17	70	66.3	26	72	4.4	0.0275	0.014	0.002
255	17	68	64.3	25.2	70	4.8	0.0188	0.014	0.001
531	17	64	60.3	23.7	66	5.5	0.010	0.014	0.001

PERCENT VALUES



PARTICLE SIZE DISTRIBUTION



DATASHEETS

Atlas of samples of lime renders

(interior scratch coats)

Sample: Barrua 1

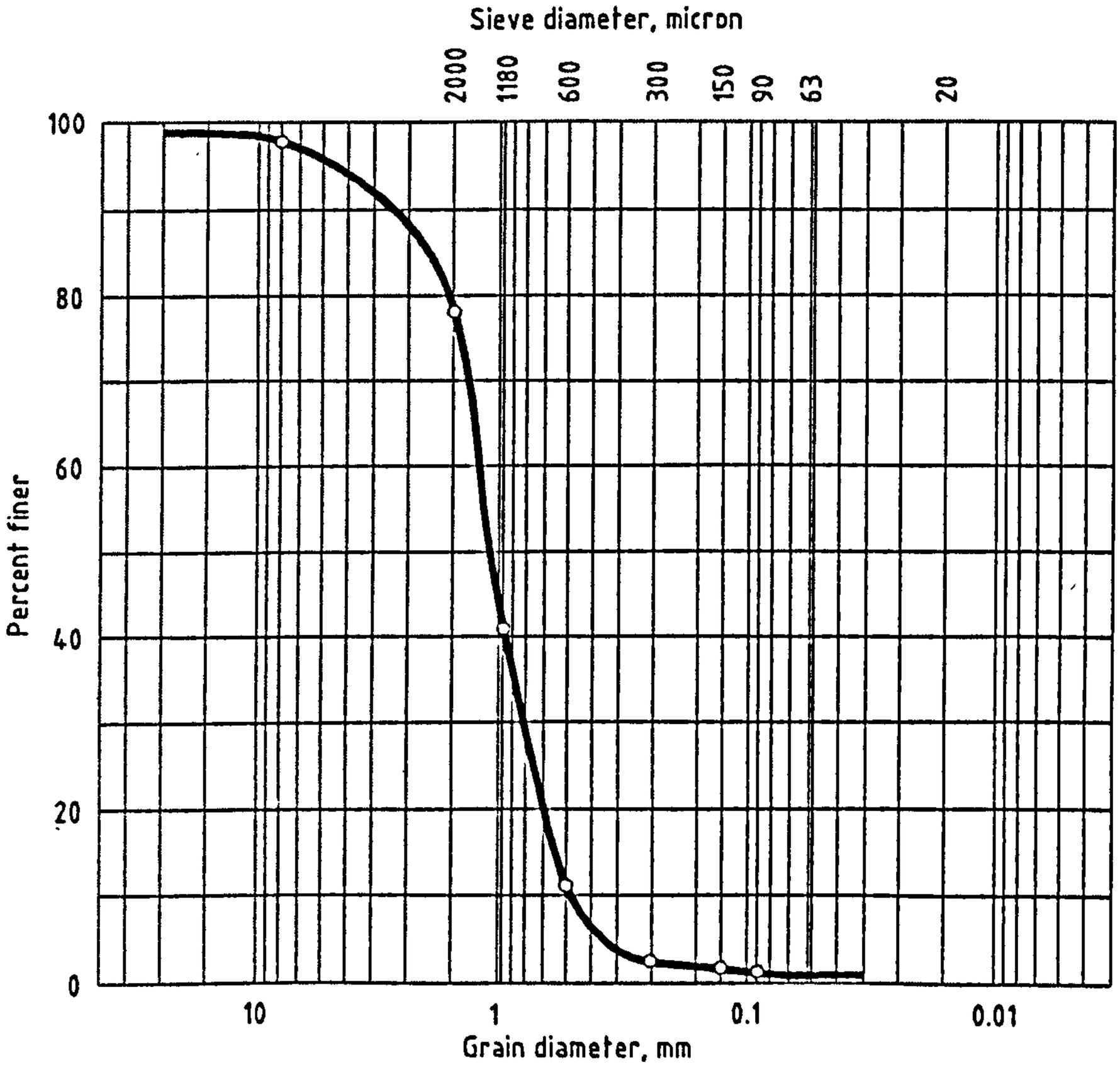
Visual description: interior lime scratch coat on mud brick, limewashed with three layers of white wash visible from bottom to top: (1) White and cohesive, (2) white and soft, and (3) white and cohesive
Sand description: quartziferous sand from granite, white and pink quartz
Date and weather condition: September 1998, dry
Location: Casa Fodde, Barrua, Sardinia, ground floor
Orientation: east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 25 gr
Sample weight after drying: 24.9 gr — Percent moisture: 0.4 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 17.6 gr — Percent carbonate: 29.3 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.1 gr	0.5	0.3
150 microns	0.2 gr	1.1	0.8
300 microns	1.6 gr	9	1.9
600 microns	5.6 gr	31.8	10.9
1180 microns	6.1 gr	34.6	42.7
2000 microns	4.0 gr	22.7	77.3
Total	17.6 gr		

Particle size distribution:



Sample: Sestu 1

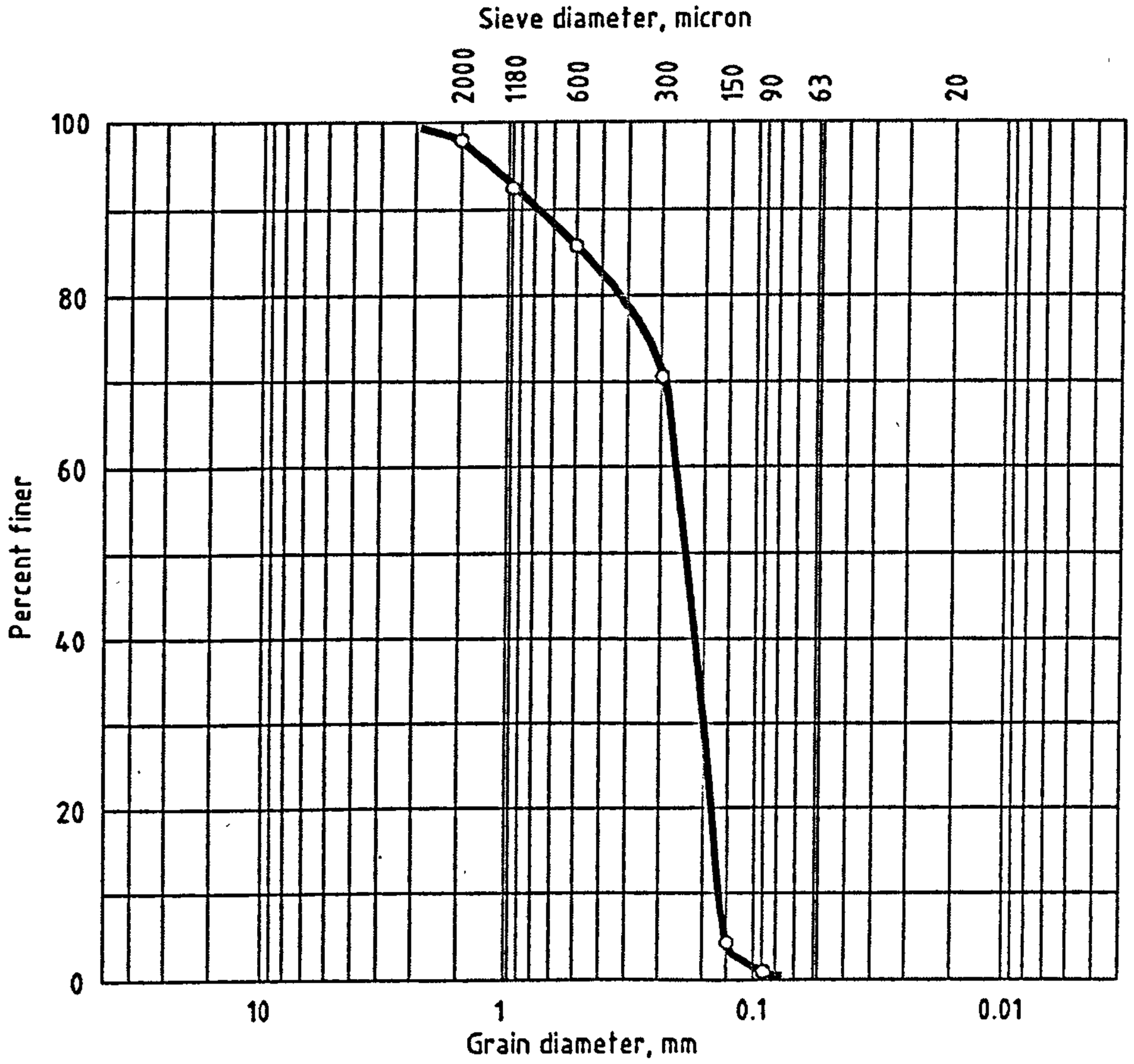
Visual description: interior lime scratch coat on mud brick. Three coats of limewash are visible, from top to bottom: pale blue, blue and white
Average coat thickness: 2.36 cm
Sand description: brown
Date and weather condition: February 2000, dry
Location: demolished building in Via San Gemiliano 36, Sestu, Sardinia. 1.2 m from ground level
Orientation: west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 77.9 gr
Sample weight after drying: 77.0 gr — Percent moisture: 1.1 %
Weight loss: 0.9 gr
Sample weight after dissolution in acid: 35.9 gr — Percent carbonate: 53.4 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	1 gr	2.7	0.6
150 microns	24.2 gr	67.4	3.3
300 microns	5.8 gr	16.1	70.7
600 microns	2.5 gr	6.9	86.8
1180 microns	1.2 gr	3.3	93.7
2000 microns	1.1 gr	3	97
Total	35.8 gr		

Particle size distribution:



Sample: Villamassargia 2

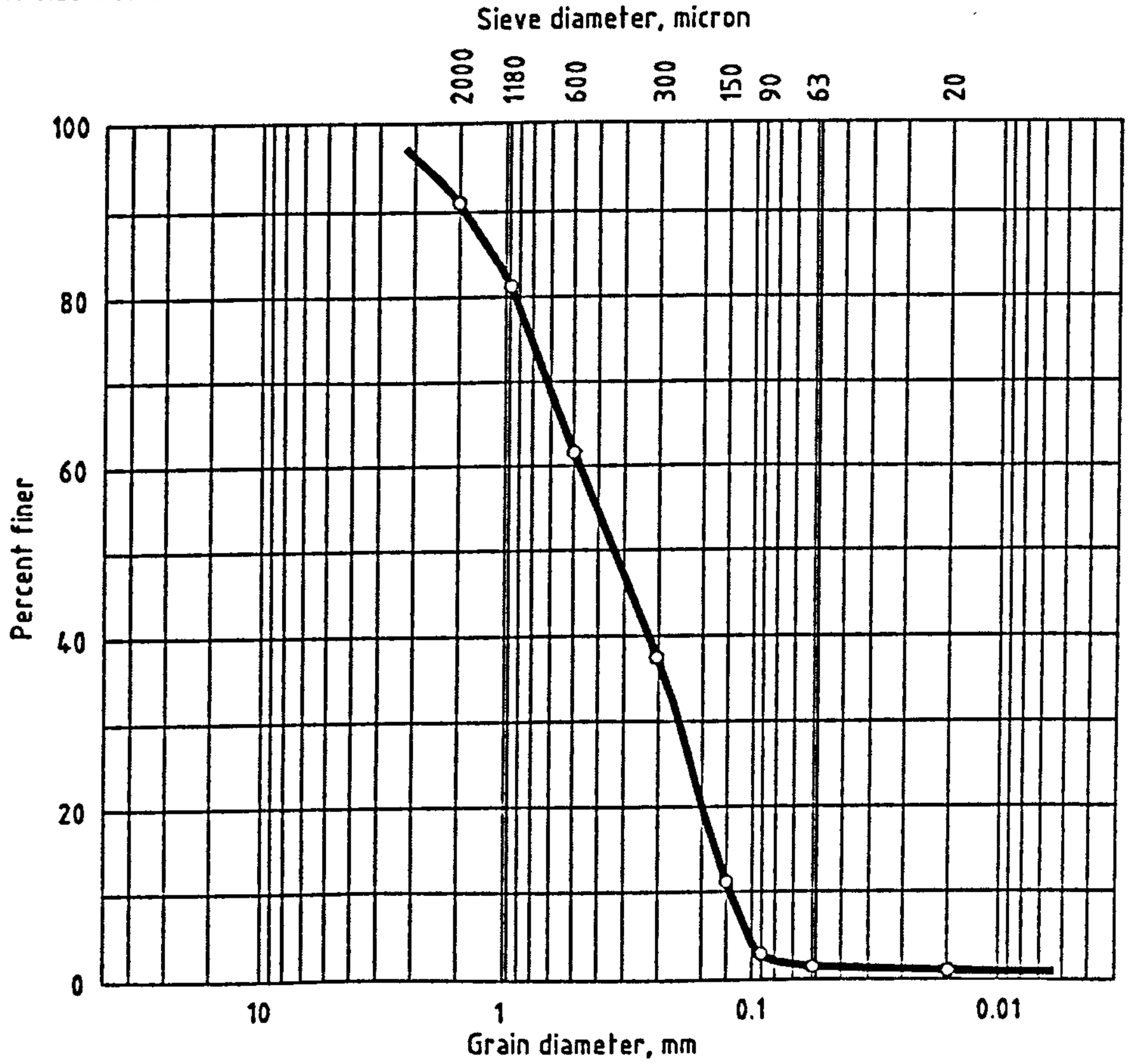
Visual description: interior lime scratch coat on mud brick. Two layers of limewash are visible from bottom to top: (1) white, (2) green
Sand description: pink-brown, no silt or clay
Date and weather condition: September 1998, dry
Location: Casa Fenu, Villamassargia, Sardinia. First floor
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 26.8 gr
Sample weight after drying: 26.7 gr — Percent moisture: 0.4 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 18.7 gr — Percent carbonate: 29.9 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.1 gr	0.5	0.5
63 microns	0.5 gr	2.6	1
90 microns	2.0 gr	10.6	3.6
150 microns	4.1 gr	21.9	14.2
300 microns	5.2 gr	27.8	36.1
600 microns	3.4 gr	18.1	63.9
1180 microns	2.0 gr	10.6	82
2000 microns	1.4 gr	7.4	92.6
Total	18.7 gr		

Particle size distribution:



Sample: Gonnesa 1

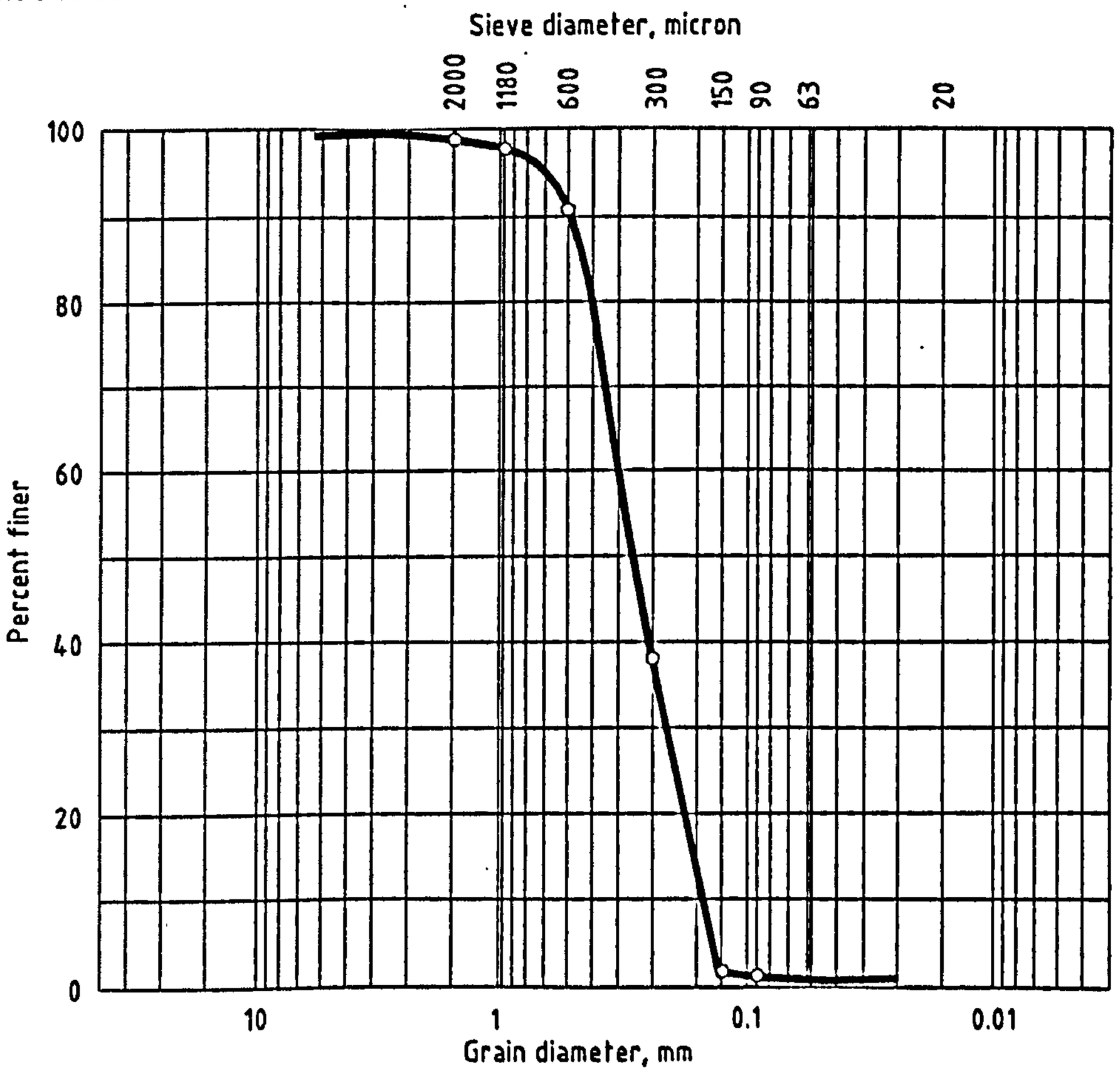
Visual description: interior lime scratch coat on mud brick. Three layers of limewash are visible from bottom to top: (1) pink-salmon, (2) white, and (3) blue
Sand description: quartziferous sand, white, brown and grey
Date and weather condition: September 1998, dry
Location: Gonnesa, Sardinia. Ground floor
Orientation: west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20.5 gr
Sample weight after drying: 20.4 gr — Percent moisture: 0.5 gr
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 15.7 gr — Percent carbonate: 23.0 gr

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.3 gr	1.9	0.3
150 microns	5.3 gr	33.7	2.2
300 microns	8.6 gr	54.7	35.9
600 microns	1.3 gr	8.2	90.6
1180 microns	0.1 gr	0.6	98.8
2000 microns	0.1 gr	0.6	99.4
Total	15.0 gr		

Particle size distribution:



Sample: Samassi 7

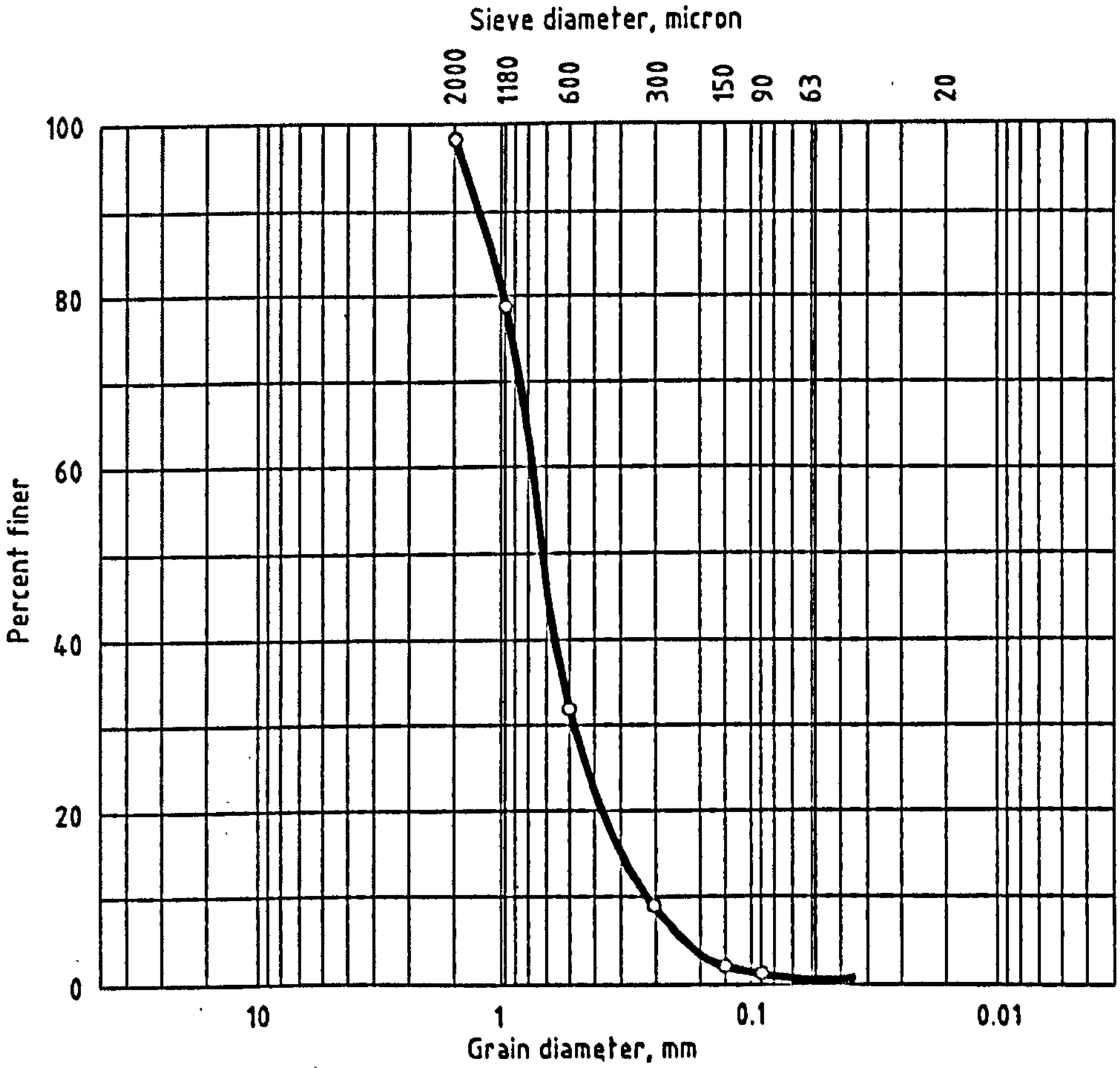
Visual description: interior lime scratch coat on stone plinth
Sand description: pink-brown, no clay or silt
Date and weather condition: March 1999, dry
Location: Casa Piras, Samassi, Sardinia. Ground floor, plinth level
Orientation: north-west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 21.5 gr
Sample weight after drying: 20.9 gr — Percent moisture: 2.7%
Weight loss: 0.6 gr
Sample weight after dissolution in acid: 12.6 gr — Percent carbonate: 39.7%

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.2 gr	1.6	3.1
150 microns	0.5 gr	4	4.7
300 microns	3.5 gr	27.8	8.7
600 microns	5.4 gr	42.9	36.5
1180 microns	2.3 gr	18.2	79.4
2000 microns	0.3 gr	2.4	97.6
Total	12.0 gr		

Particle size distribution:



DATASHEETS

Atlas of samples of lime renders

(interior skim coats)

Sample: Villasor 3

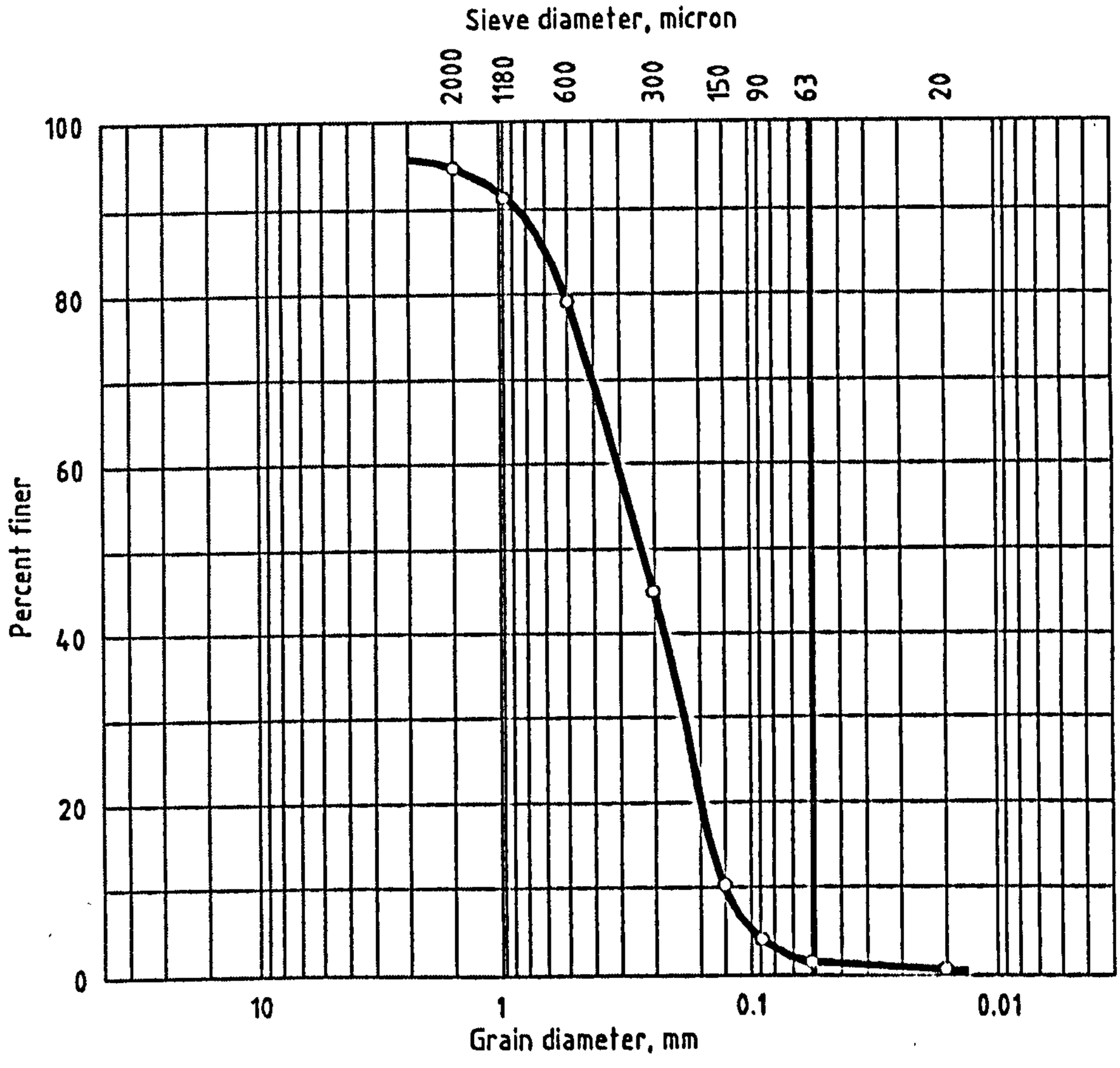
Visual description: interior lime skim coat. Eigth layers of limewash are visible, from top to bottom: white (3 layers), red, pink, yellow, green and pale blue
Sand description: brown, ochre and grey
Average coat thickness: 1.32 cm
Date and weather condition: dry, February 2000
Location: demolished building in Via Cagliari 32, Villasor, Sardinia. 1.2 metres from ground level
Orientation: east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 50.2 gr
Sample weight after drying: 50.1 gr — Percent moisture: 0.2 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 42.9 gr — Percent carbonate: 14.3 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.4 gr	0.9	0.6
63 microns	0.9 gr	2	1.5
90 microns	2.9 gr	6.7	3.5
150 microns	15 gr	34.9	10.2
300 microns	14.9 gr	34.7	45.1
600 microns	4.9 gr	11.4	79.8
1180 microns	1.9 gr	4.4	91.2
2000 microns	1.9 gr	4.4	95.6
Total	42.8 gr		

Particle size distribution:



Sample: Serramanna 3

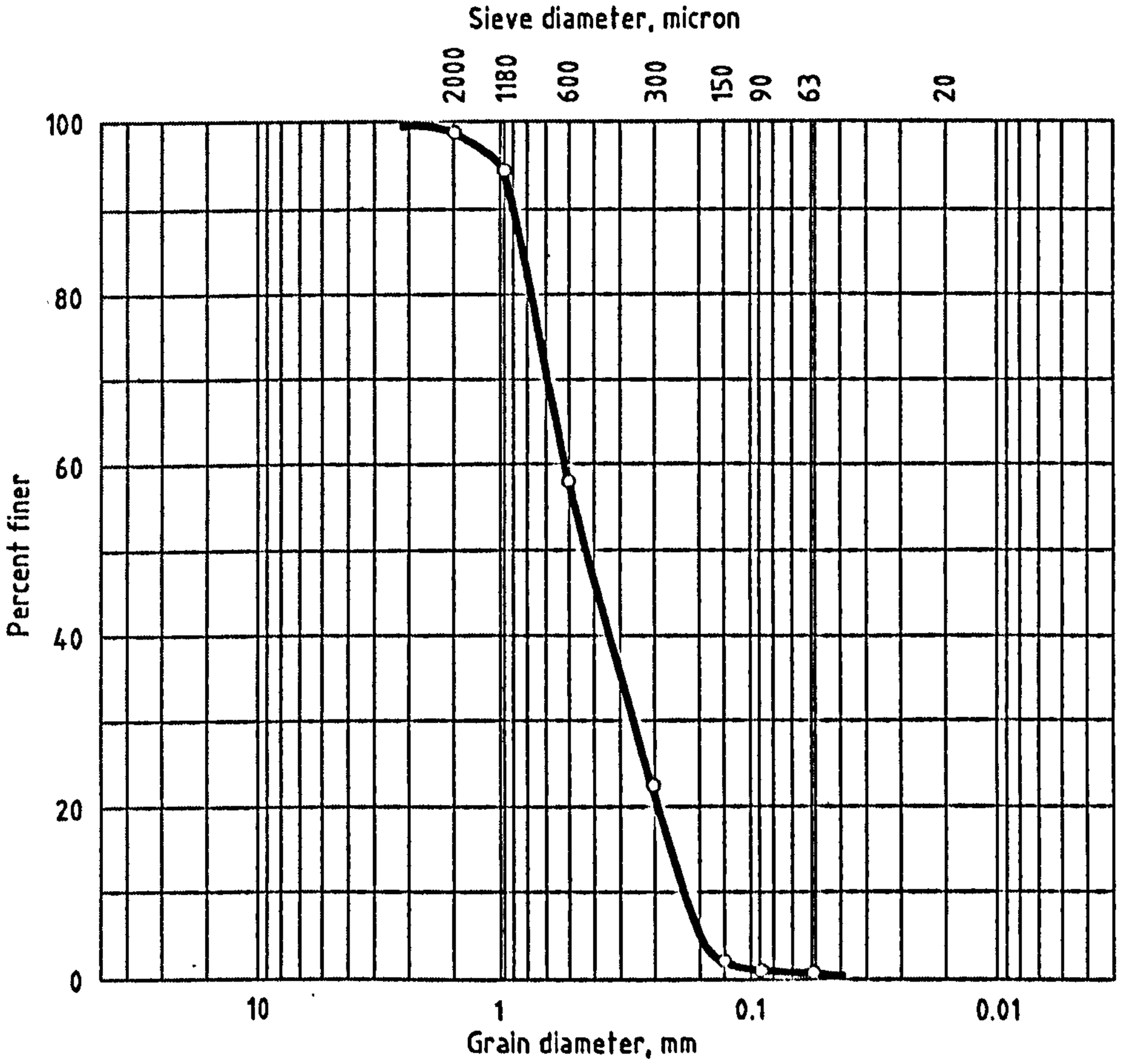
Visual description: interior lime skim coat. Four layers of limewash are visible from top to bottom: yellow, green, pale green and grey
Sand description: yellow, ochre, white, dark grey
Average coat thickness: 1.25 cm
Date and weather condition: dry, February 2000
Location: Casa Vargiu, Serramanna, Sardinia. 0.50 m from gound level. Kitchen, under window cill
Orientation: north

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 49.3 gr
Sample weight after drying: 48.8 gr — Percent moisture: 1 %
Weight loss: 0.5 gr
Sample weight after dissolution in acid: 37.4 gr — Percent carbonate: 23.4 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.2 gr	0.5	0.1
90 microns	0.7 gr	1.8	0.6
150 microns	7.6 gr	20.4	2.4
300 microns	13.5 gr	36.1	22.8
600 microns	13.4 gr	35.8	58.9
1180 microns	1.9 gr	5	94.7
2000 microns	0.1 gr	0.3	99.7
Total	37.4 gr		

Particle size distribution:



Sample: Musei 1

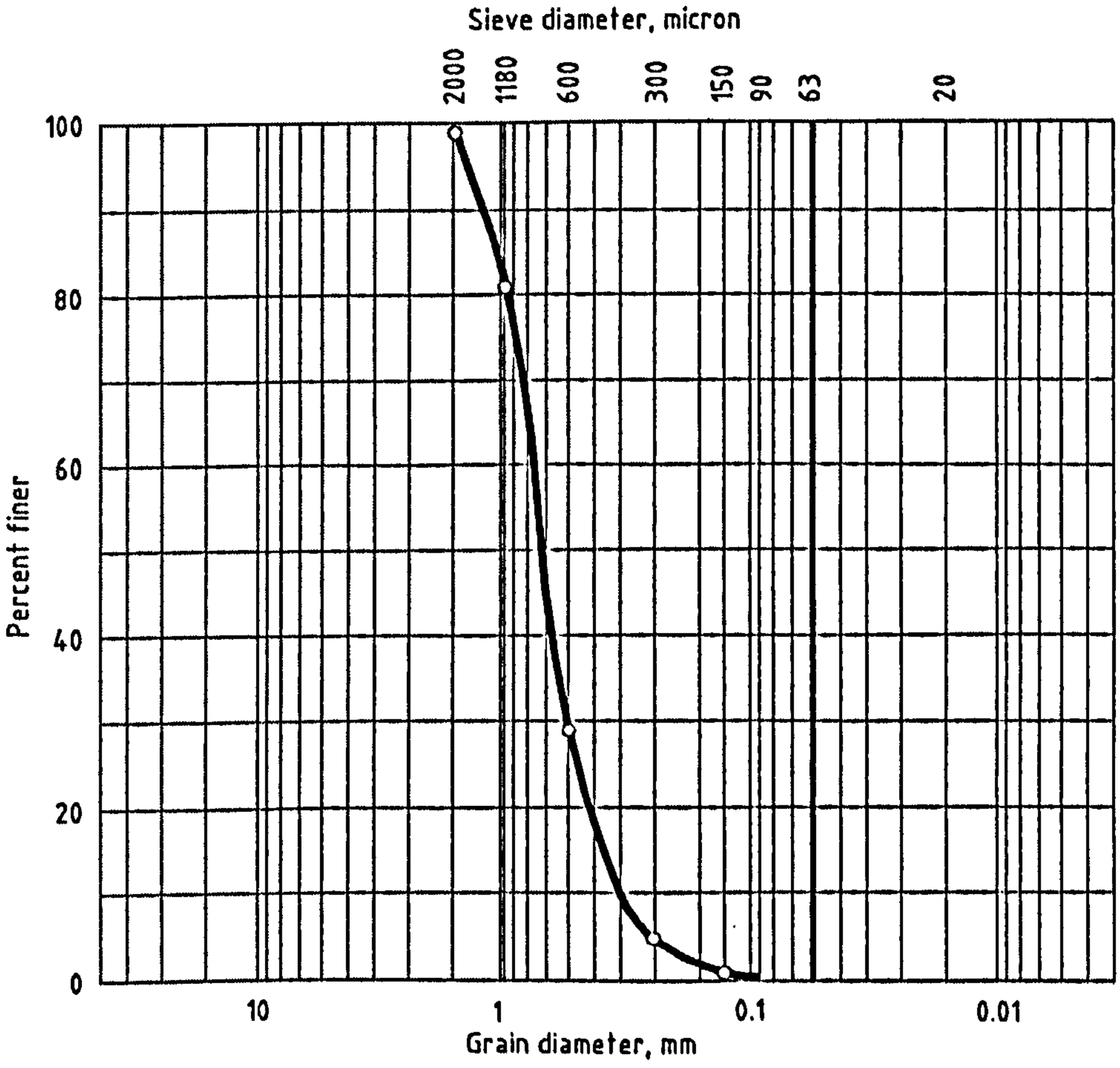
Visual description: interior lime skim coat
Sand description: brown, white and ochre
Average coat thickness: 1.1 cm
Date and weather condition: dry, February 2000
Location: Via Domusnovas 24, Musei, Sardinia. 1.2 metres from ground floor
Orientation: north

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 72.4 gr
Sample weight after drying: 72.0 gr — Percent moisture: 0.5 %
Weight loss: 0.4 gr
Sample weight after dissolution in acid: 49.4 gr — Percent carbonate: 31.4 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	2.1 gr	4.2	0.6
150 microns	12 gr	24.2	4.8
300 microns	25.7 gr	52	29
600 microns	9 gr	18.2	81
1180 microns	0.4 gr	0.8	99.2
2000 microns	/	/	/
Total	49.2 gr		

Particle size distribution:



Sample: Cagliari 2

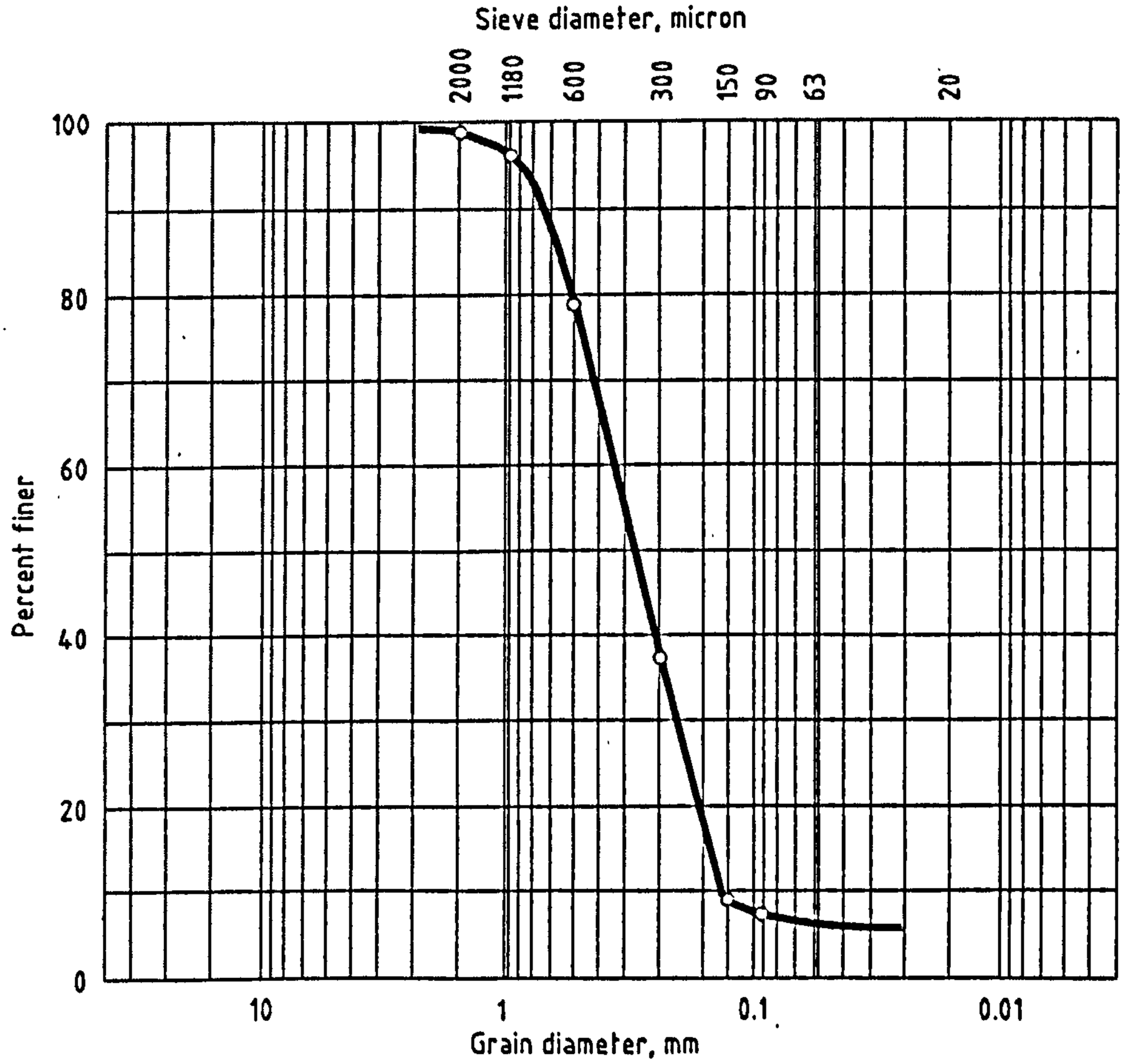
Visual description: interior lime skim coat, limewashed with eight layers of limewash from bottom to top: (1) white, (2) light blue, (3) yellow, (4) orange, (5) white, (6) green, (7) dark green, and (8) white
Sand description: quartziferous sand, white, blaak and grey
Date and weather condition: March 1999, dry
Location: Casa Lintas, Via S. Giovanni 143, Cagliari, Sardinia. First floor
Orientation: south-west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20.4 gr
Sample weight after drying: 20.00 gr — Percent moisture: 1.9 gr
Weight loss: 0.4 gr
Sample weight after dissolution in acid: 15.5 gr — Percent carbonate: 22.5 gr

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.1 gr	0.6	0.4
150 microns	6.1 gr	39.3	1
300 microns	6.0 gr	43.8	40.3
600 microns	2.2 gr	14.1	84.1
1180 microns	0.2 gr	1.2	98.2
2000 microns	0.1 gr	0.6	99.4
Total	15.5 gr		

Particle size distribution:



Sample: Samassi 5

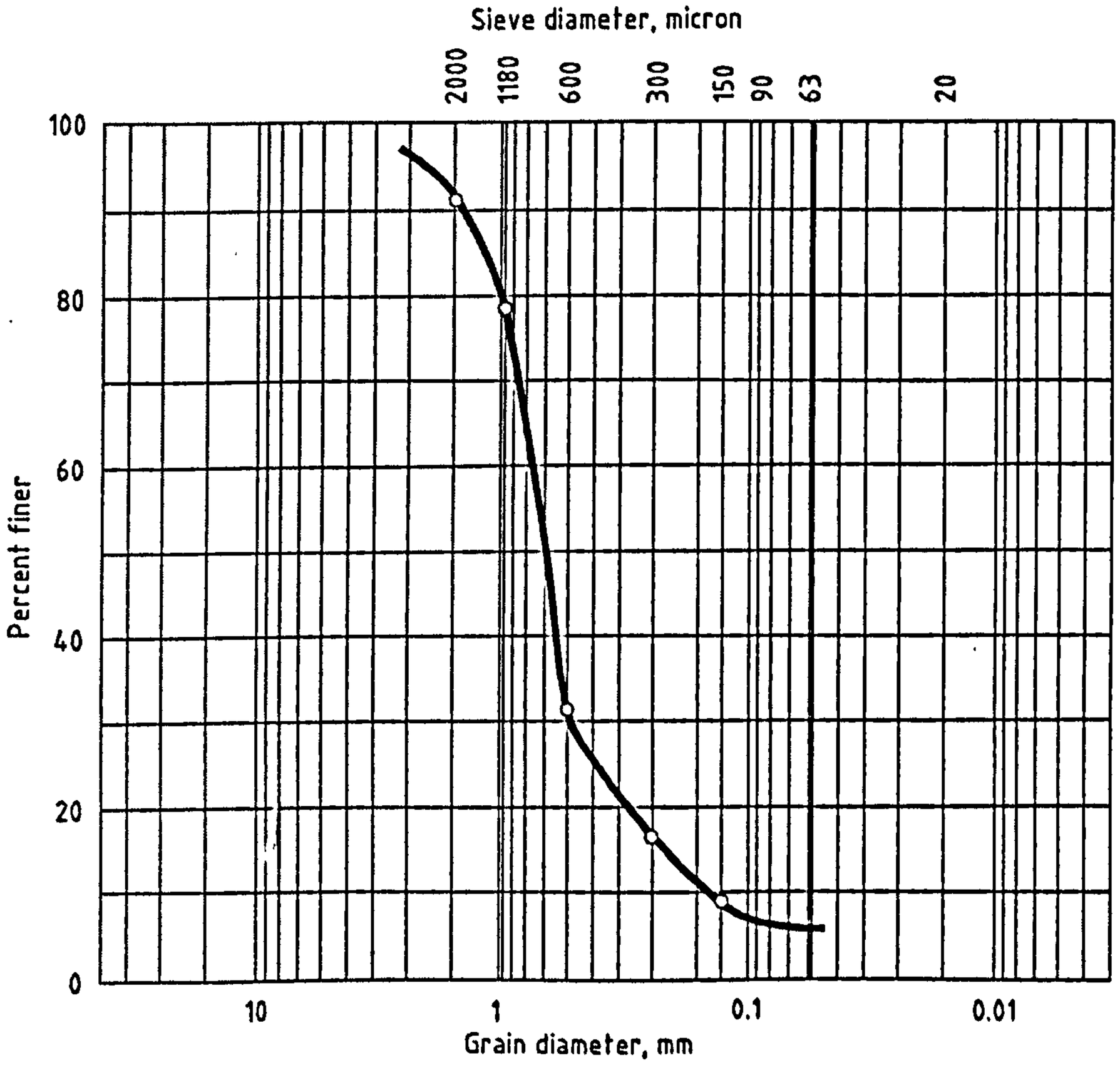
Visual description: interior lime skim coat applied on a lime:clay based render (Samassi 2). Three layers of limewash from bottom to top: (1) brown-red, (2) green-blue, and white
Sand description: quartziferous brown sand and small amount of mica
Date and weather condition:
Location: Casa Piras, via Gobetti, Samassi, Sardegna. Ground floor, central front room, plinth level
Orientation: north-east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 16.6 gr
Sample weight after drying: 16.5 gr — Percent moisture: 0.6%
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 12.5 gr — Percent carbonate: 24.2%

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	/	/	/
150 microns	1 gr	8	8.8
300 microns	1.7 gr	13.6	16.8
600 microns	6 gr	48	30.4
1180 microns	1.7 gr	13.6	78.4
2000 microns	1 gr	8	92
Total	11.4 gr		

Particle size distribution:



Sample: Samassi 1

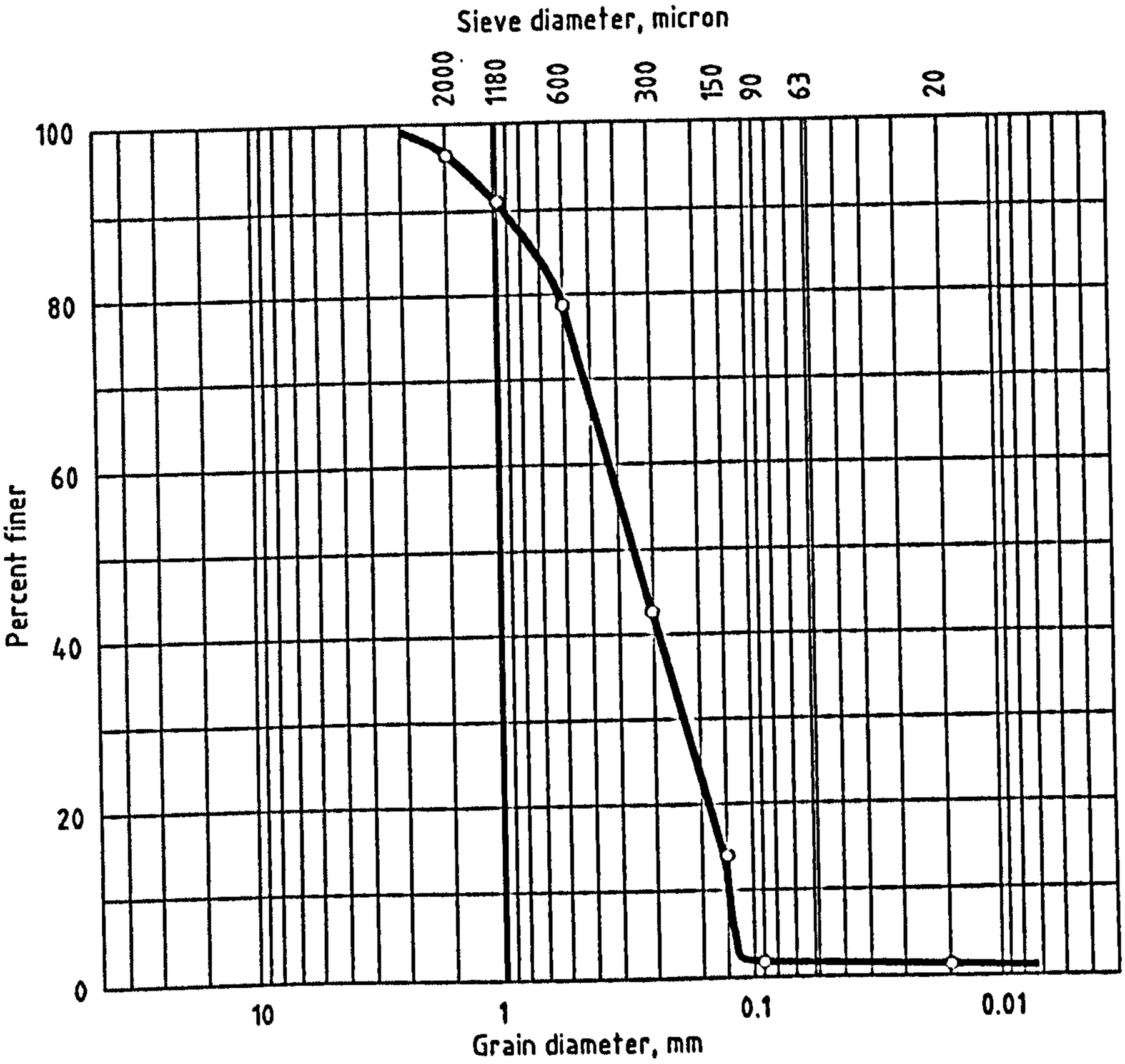
Visual description: interior lime skim coat applied on a clay-based plaster (Samassi 6). Limewash layers: (1) blue, (2) light brown, (3) white, and (4) green.
Sand description: brown-ochre, no sign of silt or clay
Date and weather condition: March 1999, dry
Location: Casa Piras, Samassi, Sardegna. First floor, staircase corridor, sample taken at 1.2 meters above the floor (plinth level)
Orientation: north-east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 13.6 gr
Sample weight after drying: 13.6 gr — Percent moisture: 0
Weight loss: 0
Sample weight after dissolution in acid: 11.4 gr — Percent carbonate: 16.2 gr

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.1 gr	0.8	0.1
63 microns	/	/	/
90 microns	1.5 gr	13.1	0.9
150 microns	3.4 gr	29.8	14
300 microns	3.8 gr	33.3	43.8
600 microns	1.6 gr	14	77.3
1180 microns	0.6 gr	5.2	91.3
2000 microns	0.4 gr	3.5	96.5
Total	11.4 gr		

Particle size distribution:



Sample: Cagliari 1

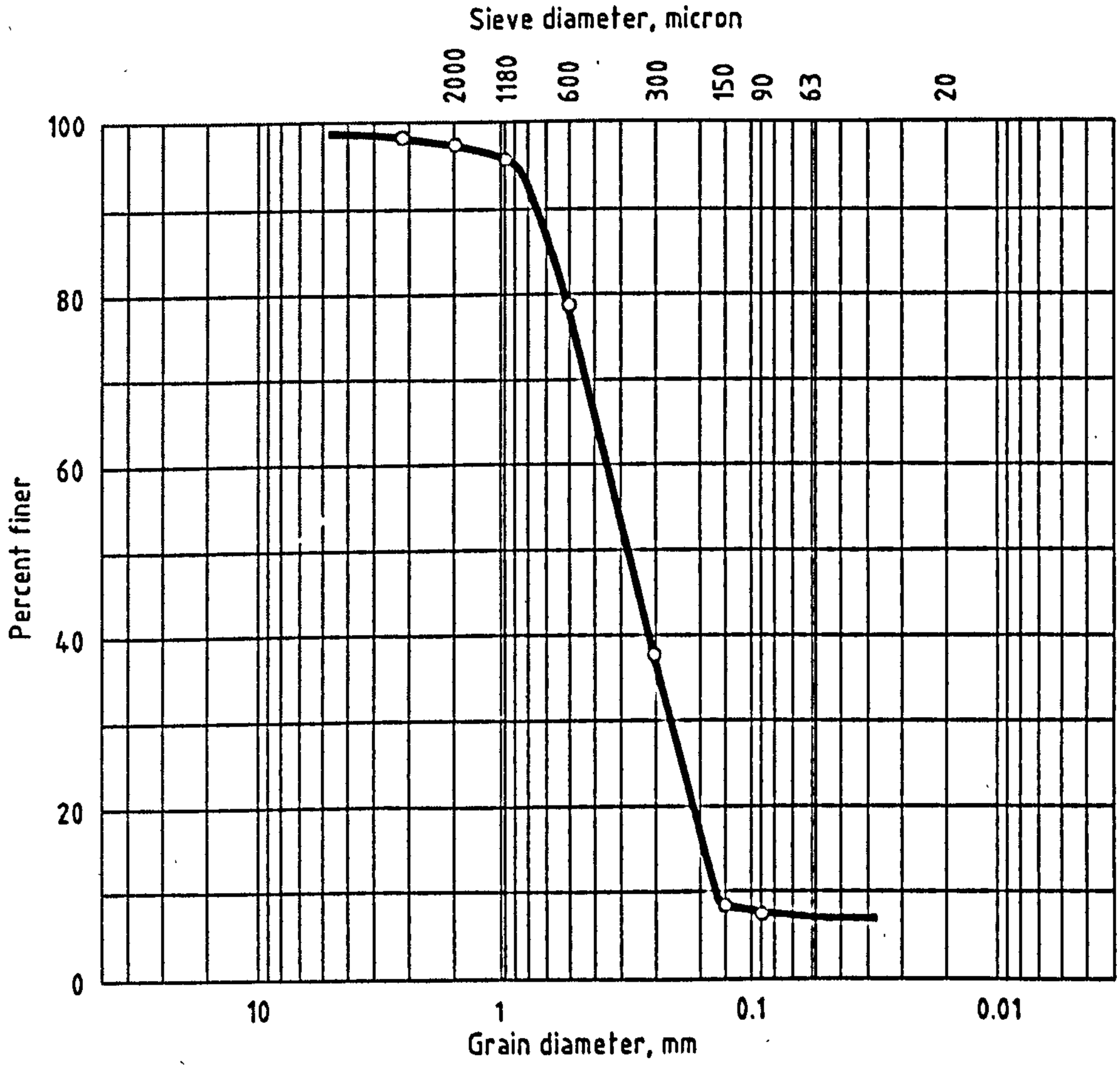
Visual description: interior lime skim coat on tufa masonry. Three layers of limewash are visible from bottom to top: (1) White, (2) dark blue, and (3) light blue
Sand description: quartziferous grey sand, probably purchased from the local beach Poetto
Date and weather condition: March 1999, dry
Location: Casa Lintas, Via S Giovanni 143, Cagliari, Sardinia. First floor
Orientation: south-west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 19.6 gr
Sample weight after drying: 19.3 gr — Percent moisture: 1.5 %
Weight loss: 0.3 gr
Sample weight after dissolution in acid: 14.9 gr — Percent carbonate: 24.3 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.2 gr	1.4	8.4
150 microns	3.9 gr	27.5	9.8
300 microns	7.6 gr	53.5	37.3
600 microns	2.3 gr	16.2	79.6
1180 microns	0.5 gr	3.5	95.8
2000 microns	0.1 gr	0.7	99.3
Total	14.6 gr		

Particle size distribution:



DATASHEETS

Atlas of samples of lime renders

(interior scratch coats)

Sample: Solarussa 1

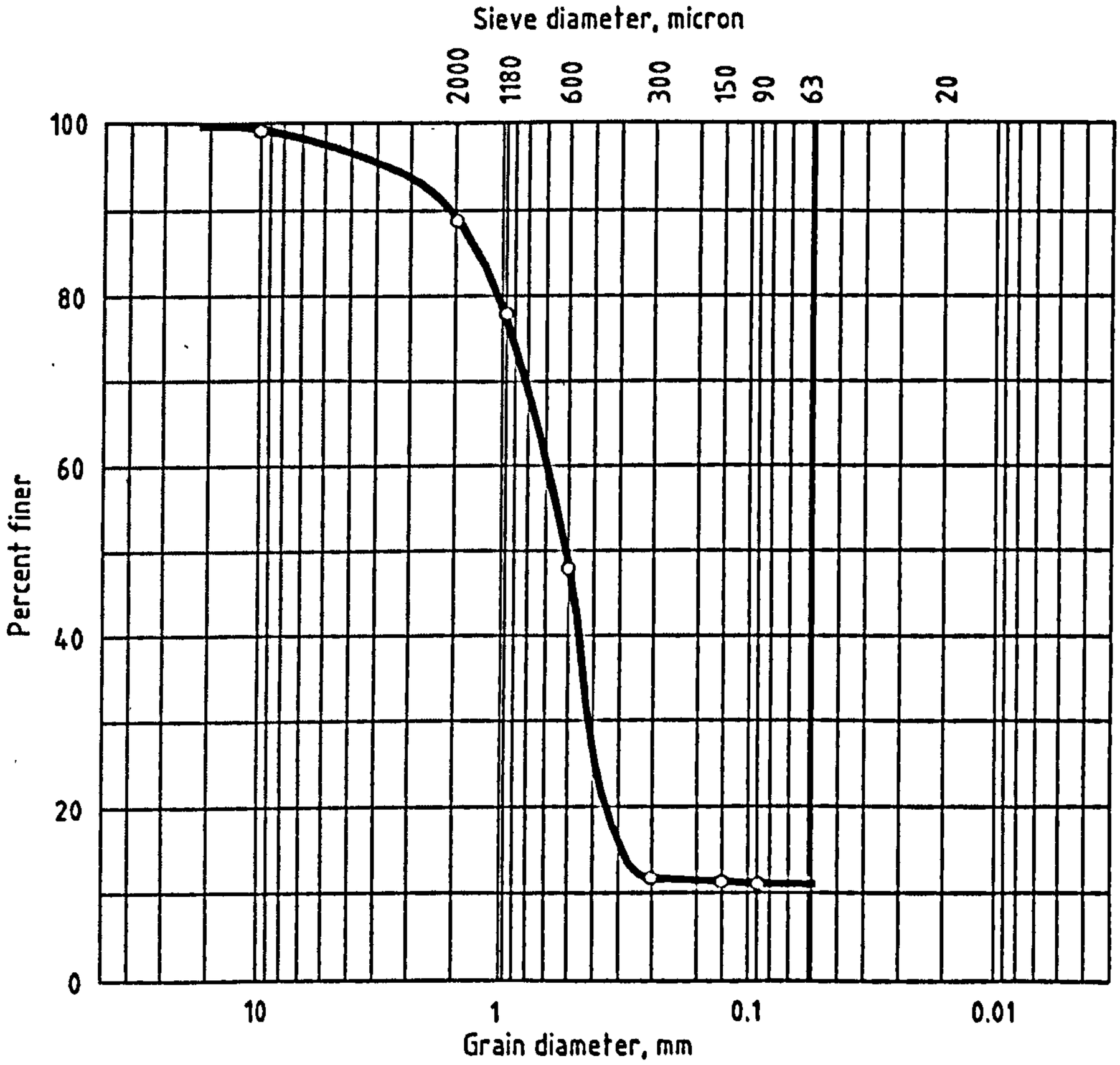
Visual description: exterior lime scratch coat on mud brick. One layer of white limewash is visible
Sand description: quartz and small amounts of mica
Date and weather condition: September 1998, dry
Location: Casa Sanna, Solarussa, Sardinia. Ground floor, external side of boundary wall, central section, plinth level (1.2 metre from the ground level)
Orientation: west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 29.3 gr
Sample weight after drying: 29.3 gr — Percent moisture: 0
Weight loss: 0
Sample weight after dissolution in acid: 23.6 gr — Percent carbonate: 19.4 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.1 gr	0.4	10.5
150 microns	0.3 gr	1.2	10.9
300 microns	8.6 gr	36.4	12.1
600 microns	6.5 gr	29.2	48.5
1180 microns	2.9 gr	12.2	77.7
2000 microns	2.4 gr	10.1	89.9
Total	20.8 gr		

Particle size distribution:



Sample: Serrenti 1

Visual description: exterior lime scratch coat on mud brick
Sand description: coarse, pink and yellow quartz, no sign silt or clay
Date and weather condition: September 1998, dry
Location: Serrenti, Sardinia. Ground floor, external facade, 1.2 metres from ground level
Orientation:

DISSOLUTION IN HYDROCHLORIC ACID

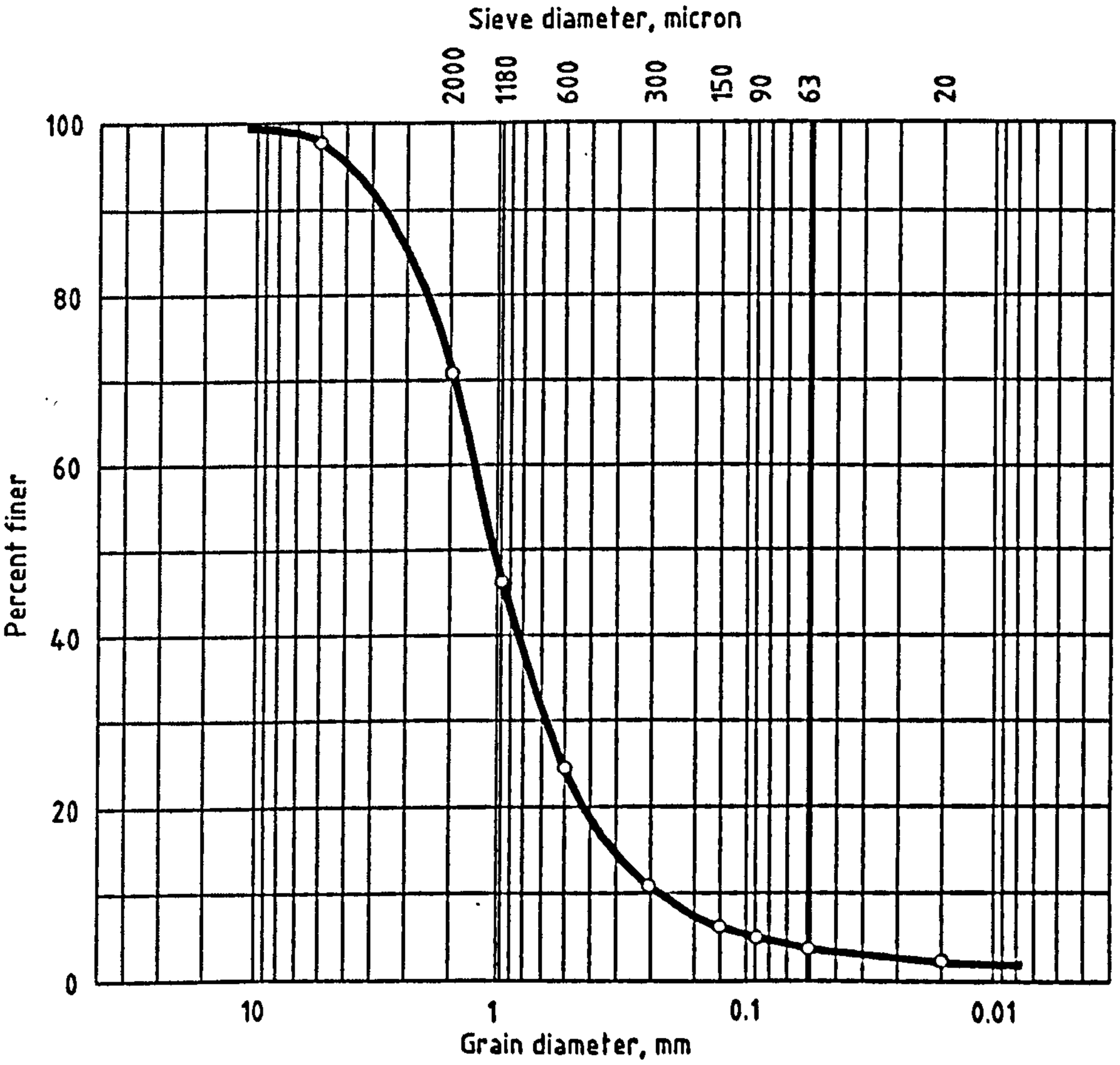
Sample size before drying: 22.8 gr
Sample weight after drying: 22.8 gr
Weight loss: 0
Sample weight after dissolution in acid: 19.2 gr

Percent moisture: 0

Percent carbonate: 15.7 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.025 gr	0.1	3.3
63 microns	0.1 gr	0.5	3.4
90 microns	0.7 gr	3.6	3.9
150 microns	1 gr	5.2	7.5
300 microns	2.2 gr	11.4	12.7
600 microns	4.3 gr	22.3	24.1
1180 microns	4.9 gr	25.5	46.4
2000 microns	5.4 gr	28.1	71.9
Total	18.6 gr		

Particle size distribution:



Sample: Serramanna 1

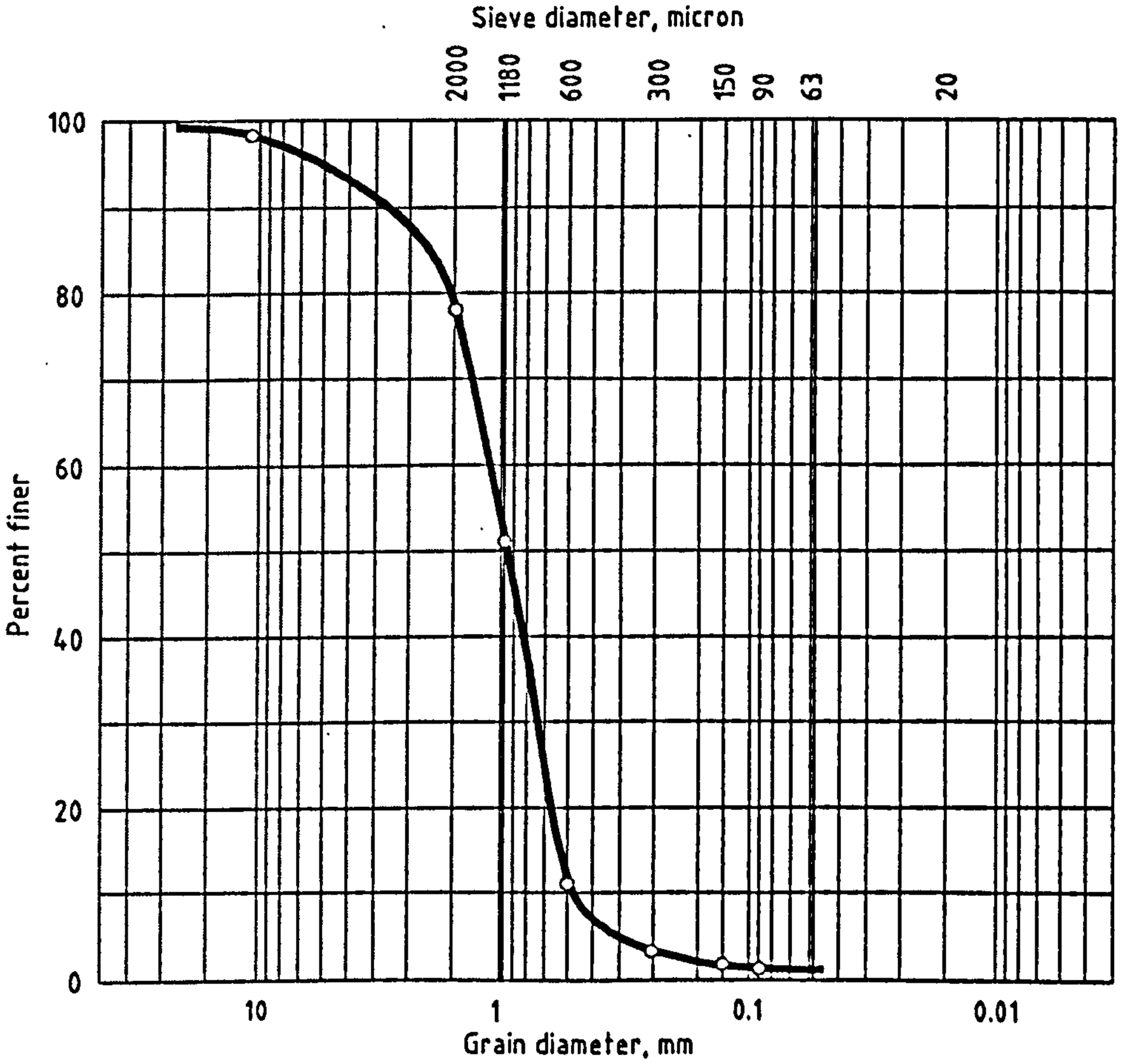
Visual description: exterior lime scratch coat on mud brick. One coat of white limewash is visible
Sand description: pink, dark grey, brown
Date and weather condition: September 1998, dry
Location: Via dell'Angelo, Serramanna, Sardinia. Ground floor, external facade, 1.7 metres from ground level. Building under demolition
Orientation: west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20.4 gr
Sample weight after drying: 20.1 gr — Percent moisture: 1.5 %
Weight loss: 0.3 gr
Sample weight after dissolution in acid: 15.0 gr — Percent carbonate: 25 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.1 gr	0.6	2.8
90 microns	0.2 gr	1.3	3.4
150 microns	1.1 gr	7.3	4.7
300 microns	3.7 gr	24.7	12
600 microns	3.9 gr	26	36.7
1180 microns	2.2 gr	14.7	62.7
2000 microns	3.4 gr	22.6	77.4
Total	14.6 gr		

Particle size distribution:



Sample: Samassi 4

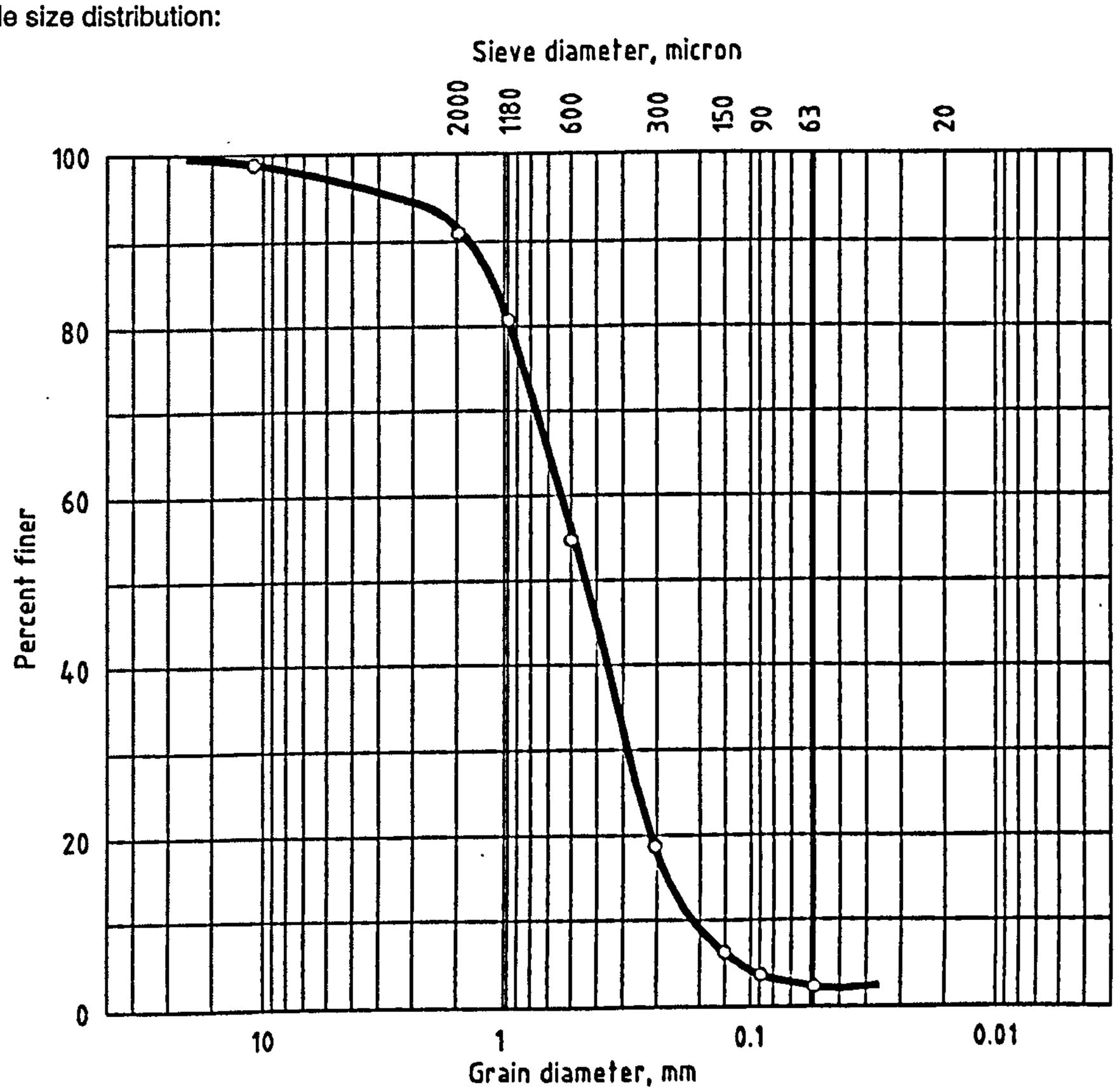
Visual description: exterior lime scratch coat on mud brick. One coat of white limewash is visible
Sand description: pink-brown, no sign of clay or silt
Date and weather condition: March 1999, dry
Location: Casa Piras, Via Gobetti, Samassi, Sardinia. Ground floor, plaster on filled-in central window
Orientation: north-west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20.4 gr
Sample weight after drying: 20.3 gr — Percent moisture: 0.4 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 16.3 gr — Percent carbonate: 19.7 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.1 gr	0.6	3.3
90 microns	0.4 gr	2.4	3.9
150 microns	2 gr	12.2	6.3
300 microns	6.1 gr	37.4	18.5
600 microns	4.1 gr	25.1	55.9
1180 microns	1.5 gr	9.2	81
2000 microns	1.6 gr	9.8	90.2
Total	15.8 gr		

Particle size distribution:



Sample: Gonnesa 2

Visual description: external scratch coat on mud brick
Sand description: quartsiferous ochre sand. Crushed tile is also present as aggregate (*cocclo pesto*)
Date and weather condition: September 1998, dry
Location: Gonnesa, Sardinia
Orientation: north- east

DISSOLUTION IN HYDROCHLORIC ACID

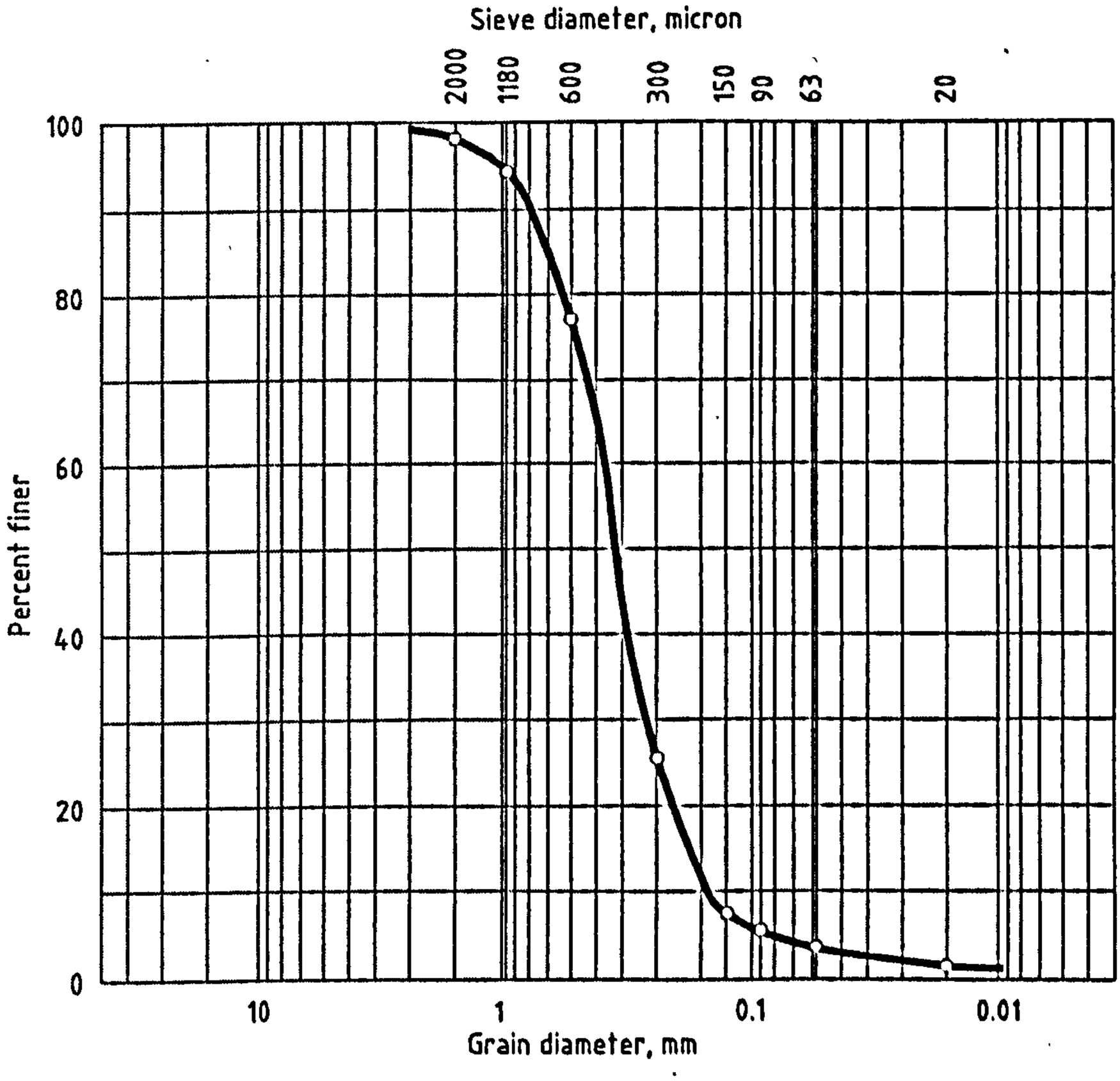
Sample size before drying: 52.7 gr
Sample weight after drying: 52.7 gr
Weight loss: 0
Sample weight after dissolution in acid: 39.3 gr

Percent moisture: 0

Percent carbonate: 25.4 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	0.1 gr	0.2	0.5
20 microns	1.4 gr	3.5	0.7
63 microns	0.6 gr	1.5	4.2
90 microns	0.9 gr	2.2	5.7
150 microns	7.5 gr	19	7.9
300 microns	19.7 gr	50.1	26.9
600 microns	7 gr	17.8	77
1180 microns	1 gr	2.5	94.8
2000 microns	1.1 gr	2.7	97.3
Total	39.3 gr		

Particle size distribution:



Sample: Assemini 1

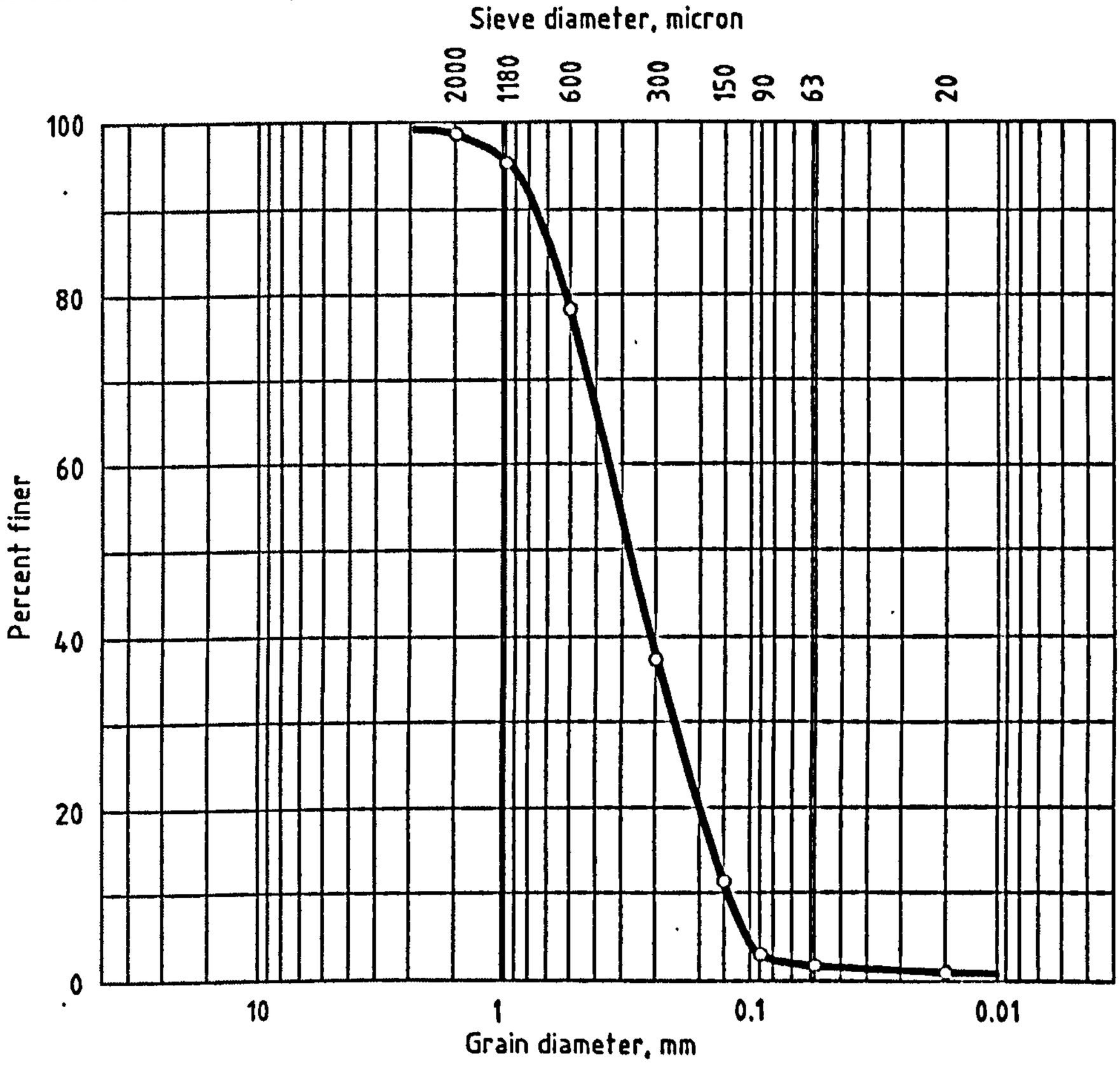
Visual description: exterior lime scratch coat on mud brick. One white layer of limewash is visible
Sand description: white, mainly quartz
Date and weather condition: September 1998, dry
Location: Casa Cooperativa Sant'Andrea, Assemini, Sardinia
Orientation: north

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 57.8 gr
Sample weight after drying: 57.8 gr — Percent moisture: 0.1 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: — Percent carbonate: 20.9 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.6 gr	1.3	0.4
63 microns	1 gr	2.1	1.7
90 microns	3.4 gr	7.4	3.8
150 microns	12.2 gr	26.6	11.2
300 microns	18.5 gr	40.4	37.8
600 microns	8.2 gr	17.9	78.2
1180 microns	1.7 gr	3.7	96.1
2000 microns	0.1 gr	0.2	99.8
Total	45.7 gr		

Particle size distribution:



Sample: Furtei 1

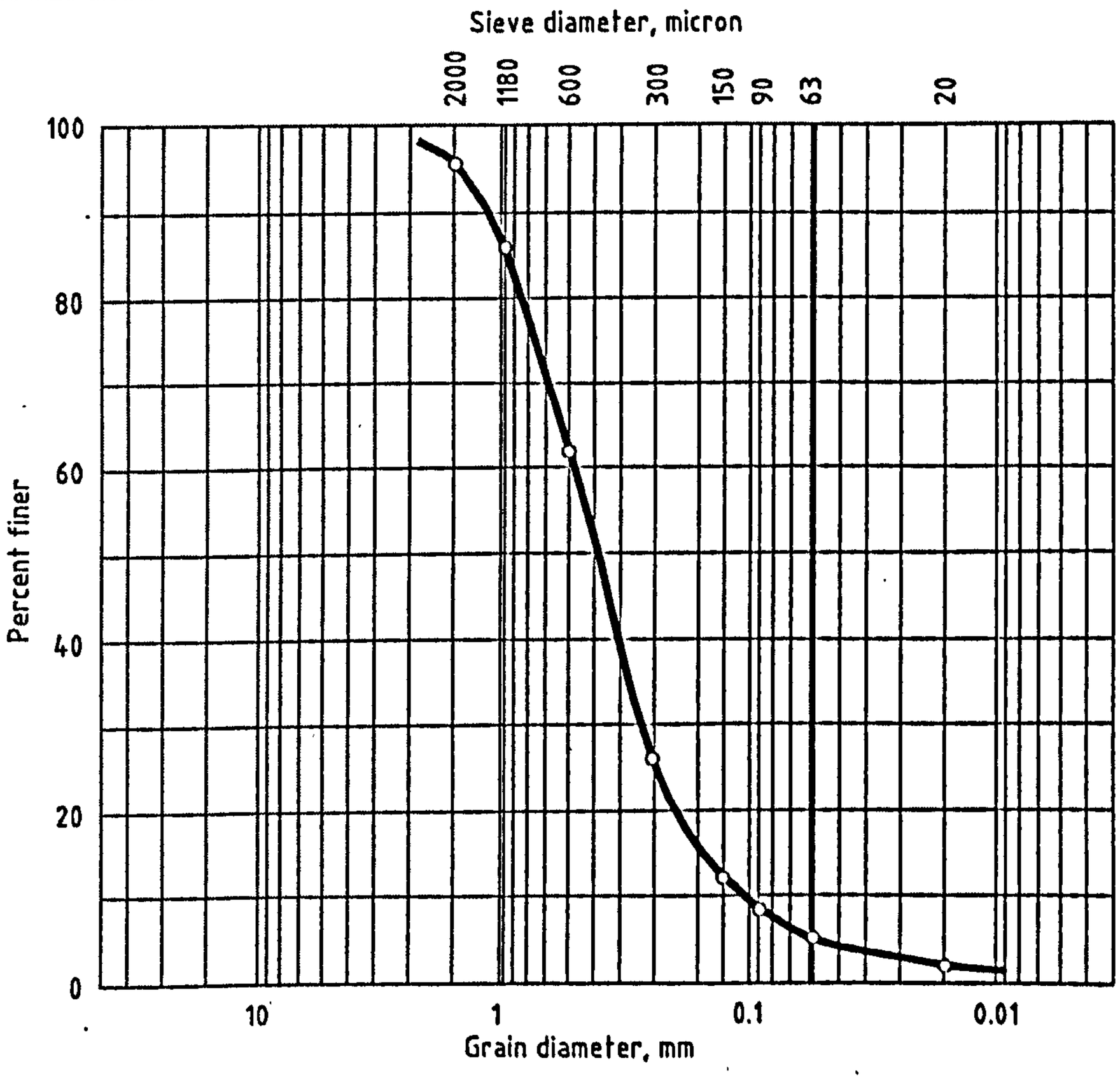
Visual description: external lime scratch coat on stone. Three coats of limewash are visible, from top to bottom: (1) white, (2) blue and (3) ochre with splashes of red
Sand description: grey and yellow
Date and weather condition: September 1998, dry
Location: south of Furtei, ground floor, external facade, 1.2 metres. Furtei, Sardinia
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 84.1 gr
Sample weight after drying: 83.2 gr — Percent moisture: 1.0 %
Weight loss: 0.9 gr
Sample weight after dissolution in acid: 50.7 gr — Percent carbonate: 39.1 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	0.1 gr	0.1	2.5
20 microns	1.9 gr	3.7	2.6
63 microns	1.3 gr	2.5	6.3
90 microns	2 gr	3.9	8.8
150 microns	7.6 gr	14.9	12.7
300 microns	17.6 gr	34.7	27.6
600 microns	12.5 gr	24.6	62.3
1180 microns	4.3 gr	8.4	86.9
2000 microns	2.4 gr	4.7	95.3
Total	49.7 gr		

Particle size distribution:



Sample: Barrua 2

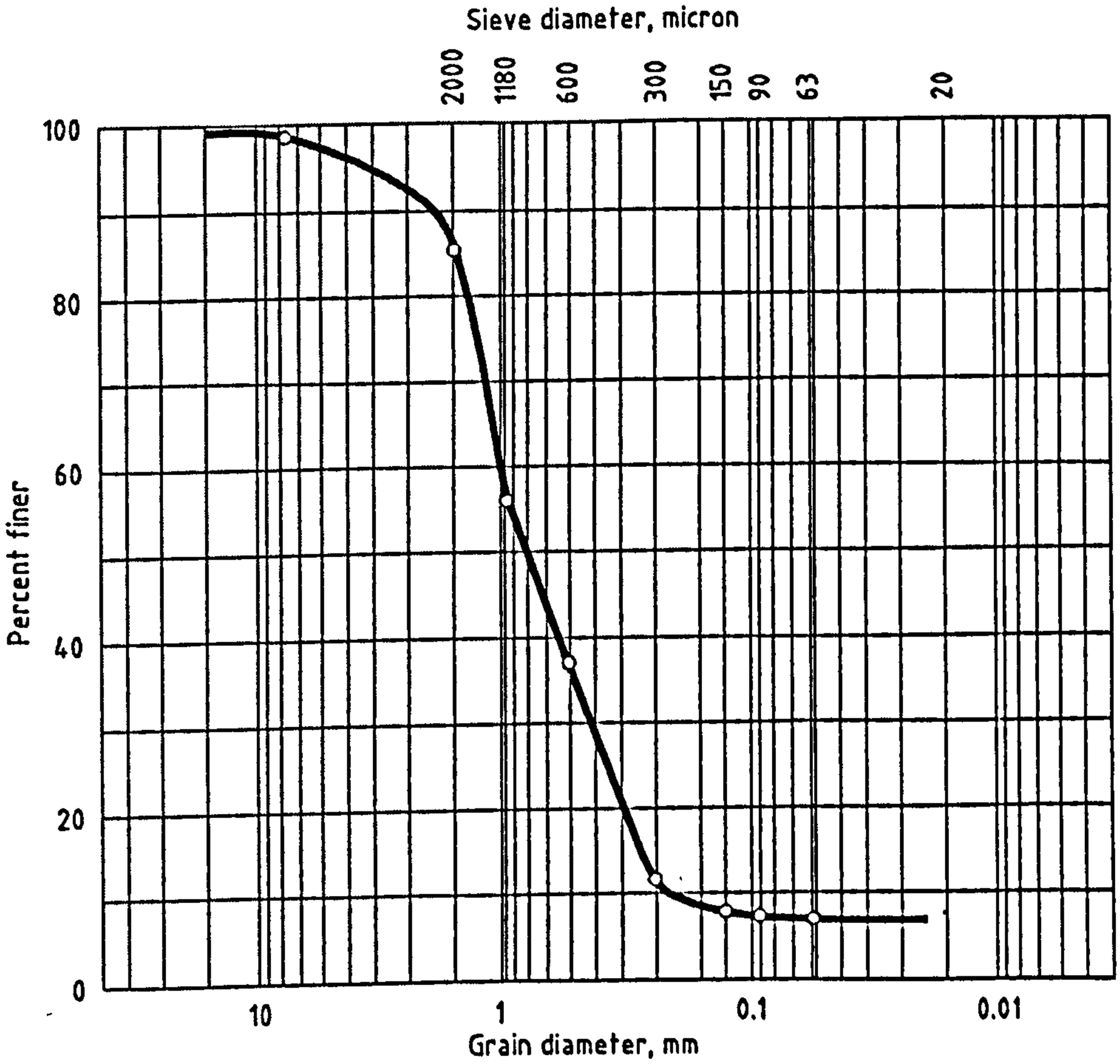
Visual description: exterior lime scratch coat on mud brick
Sand description: quartziferous sand from granite, white and pink quartzs
Date and weather condition: September 1998, dry
Location: Casa Fodde, Barrua, Sardinia. Ground floor
Orientation: east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20.8 gr
Sample weight after drying: 20.5 gr — Percent moisture: 1.4%
Weight loss: 0.3 gr
Sample weight after dissolution in acid: 14.6 gr — Percent carbonate: 28.7%

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.1 gr	0.6	6.6
90 microns	0.2 gr	1.3	7.2
150 microns	1.1 gr	7.5	8.5
300 microns	3.0 gr	20.5	16
600 microns	4.0 gr	27.3	36.5
1180 microns	3.1 gr	21.2	63.8
2000 microns	2.2 gr	15	85
Total	13.7 gr		

Particle size distribution:



Sample: Sinnai 1

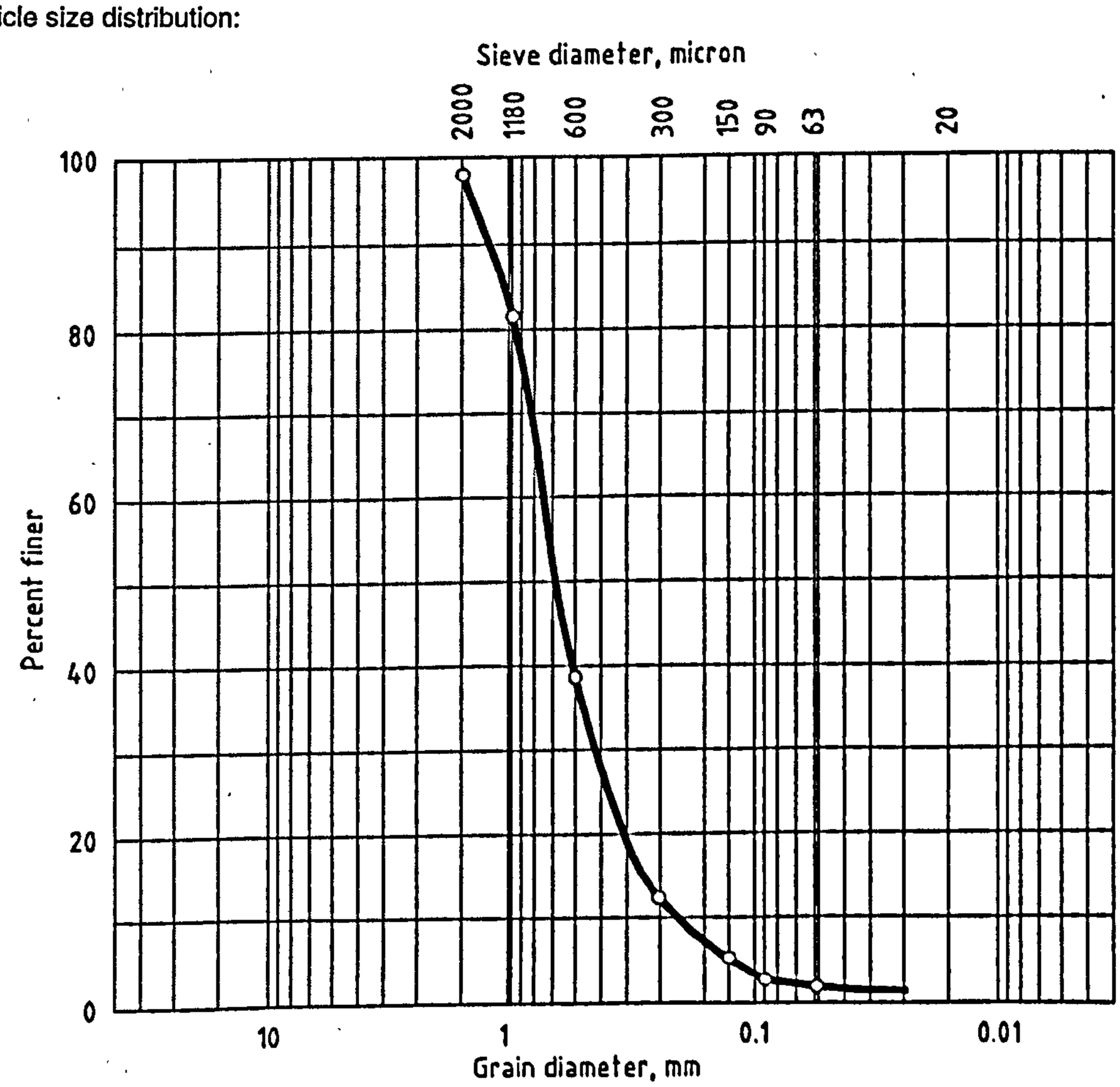
Visual description: exterior lime scratch coat on stone plinth
Sand description: thin, no sign of silt or clay
Date and weather condition: September 1998, dry
Location: Via Funtaneddas 106, Sinnai, Sardinia. Ground floor, external facade, 1.5 metres from the ground
Orientation: north-west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 28.4 gr
Sample weight after drying: 28.0 gr — Percent moisture: 1.4 gr
Weight loss: 0.4 gr
Sample weight after dissolution in acid: 20.7 gr — Percent carbonate: 26.7 gr

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.1 gr	0.4	0.5
63 microns	0.1 gr	0.4	0.9
90 microns	0.9 gr	4.3	1.3
150 microns	1.8 gr	8.6	5.6
300 microns	5.1 gr	24.6	14.2
600 microns	9.2 gr	44.4	38.8
1180 microns	3.2 gr	15.4	83.2
2000 microns	0.3 gr	1.4	98.6
Total	20.7 gr		

Particle size distribution:



Sample: Uras 1

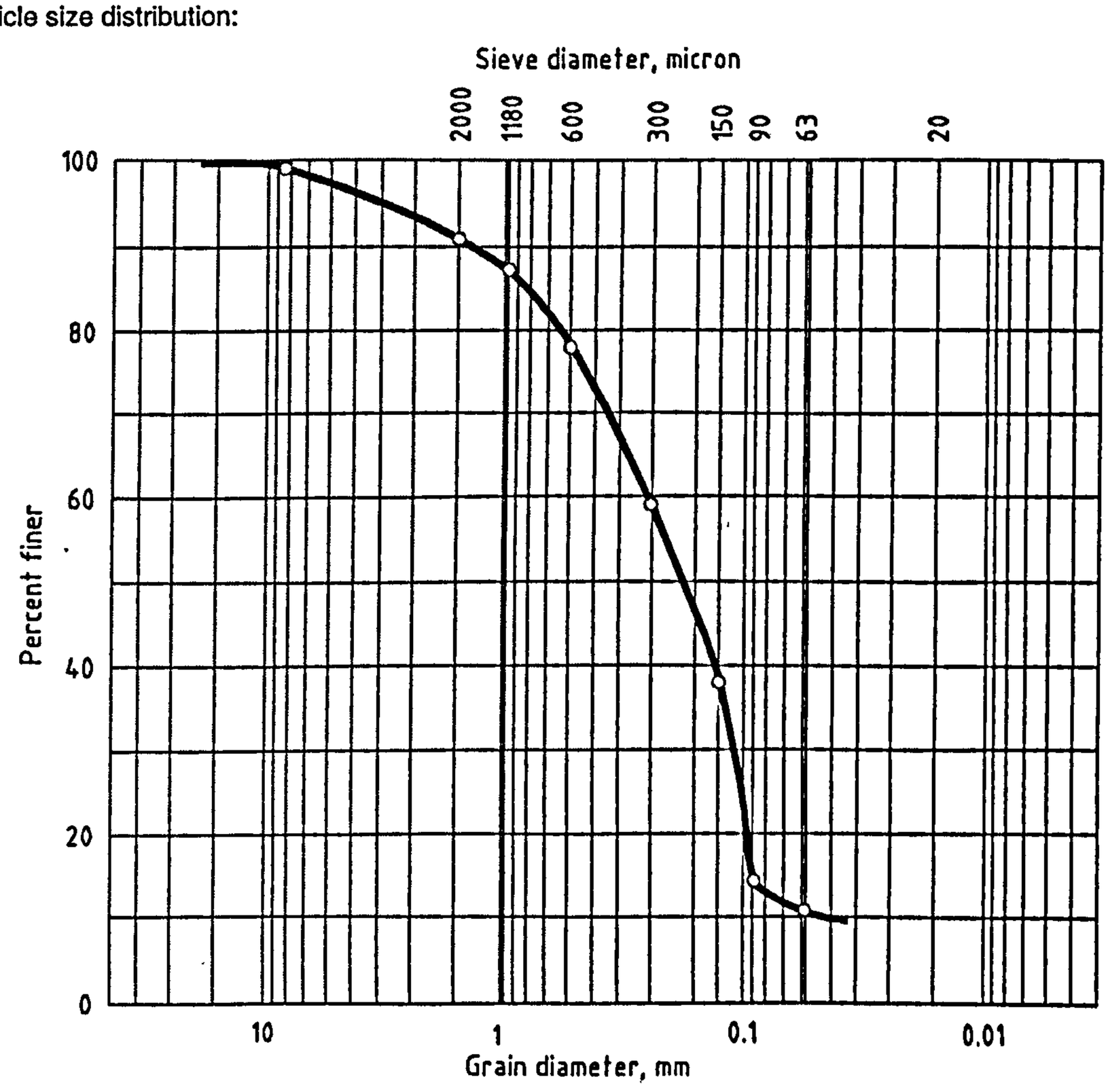
Visual description: exterior lime scratch coat on mud brick
Sand description: thin
Date and weather condition: September 1998, dry
Location: Via Eleonora / Vico Eleonora (Post Office back yard), Uras, Sardinia. Ground floor, external facade, 1.2 metres from the ground
Orientation: north-east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 27.6 gr
Sample weight after drying: 27.5 gr — Percent moisture: 0.36 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 23.3 gr — Percent carbonate: 15.2 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.5 gr	2.1	11.9
90 microns	5.7 gr	24.4	14
150 microns	4.8 gr	20.6	38.4
300 microns	4 gr	17.1	59
600 microns	2.7 gr	11.5	76.1
1180 microns	1.2 gr	5.1	87.6
2000 microns	1.7 gr	7.3	92.7
Total	20.6 gr		

Particle size distribution:



DATASHEETS

Atlas of samples of lime renders

(exterior skim coats)

Sample: Barrua 3

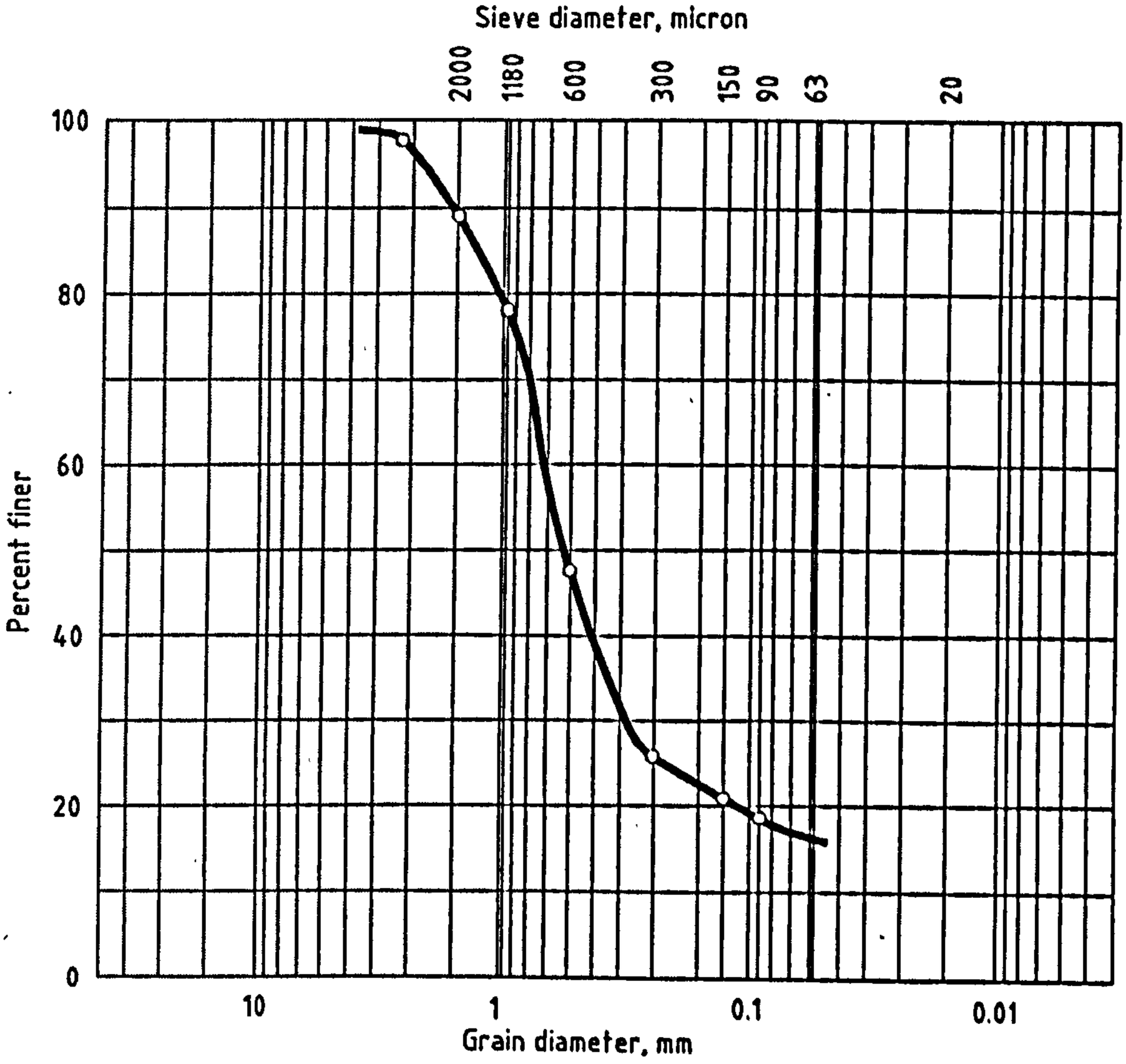
Visual description: exterior lime skim coat on Barrua 2
Sand description: quartziferous sand from granite, white and pink quartz
Date and weather condition:September 1998, dry
Location: Casa Fodde, Barrua, Sardinia. Fround floor
Orientation: east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 2.7 gr
Sample weight after drying: 2.5 gr — **Percent moisture: 7.4 %**
Weight loss: 0.2 gr
Sample weight after dissolution in acid: 1.9 gr — **Percent carbonate: 24 %**

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.1 gr	5.2	16.1
150 microns	0.1 gr	5.2	21.3
300 microns	0.4 gr	21	26.5
600 microns	0.6 gr	31.5	47.5
1180 microns	0.2 gr	10.5	79
2000 microns	0.2 gr	10.5	89.5
Total	1.6 gr		

Particle size distribution:



Sample: Villasor 1

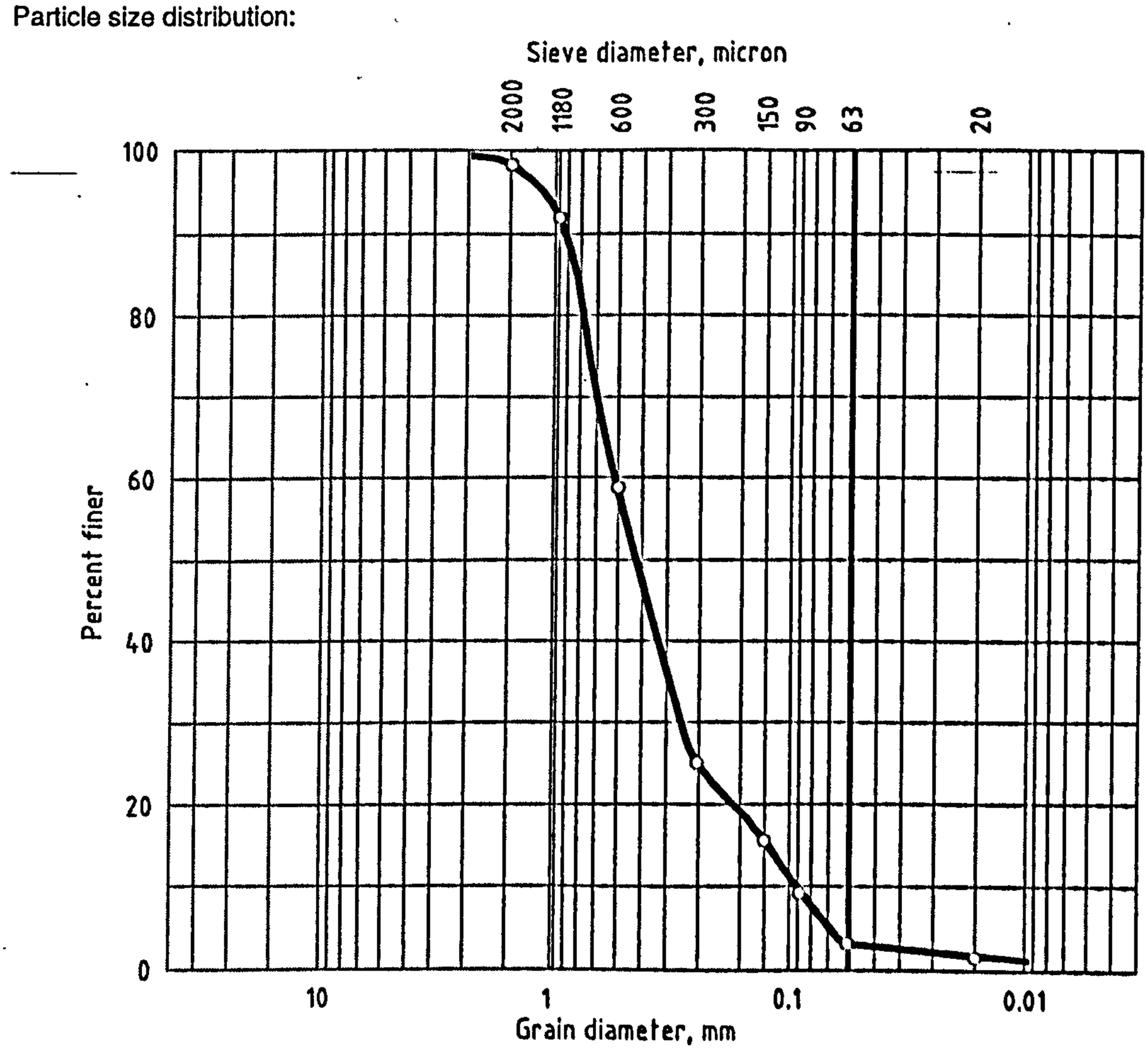
Visual description: exterior lime skim coat
Sand description: ochre, white, dark grey, brown
Average coat thickness: 0.62 cm
Date and weather condition: dry, February 2000
Location: Via Elenonora D'Arborea 17, Villasor, Sardinla. 1.2 m from ground level
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 38.4 gr
Sample weight after drying: 37.9 gr — **Percent moisture: 1.3 %**
Weight loss: 0.5 gr
Sample weight after dissolution in acid: 29.4 gr — **Percent carbonate: 22.4 %**

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.4 gr	1.3	1.7
63 microns	2 gr	6.7	3
90 microns	1.9 gr	6.4	9.7
150 microns	2.9 gr	9.8	16.1
300 microns	10 gr	34	25.9
600 microns	9.5 gr	32.3	59.9
1180 microns	1.8 gr	6.1	92.2
2000 microns	0.5 gr	1.7	98.3
Total	29.0 gr		

Particle size distribution:



Sample: Nuraminis 2

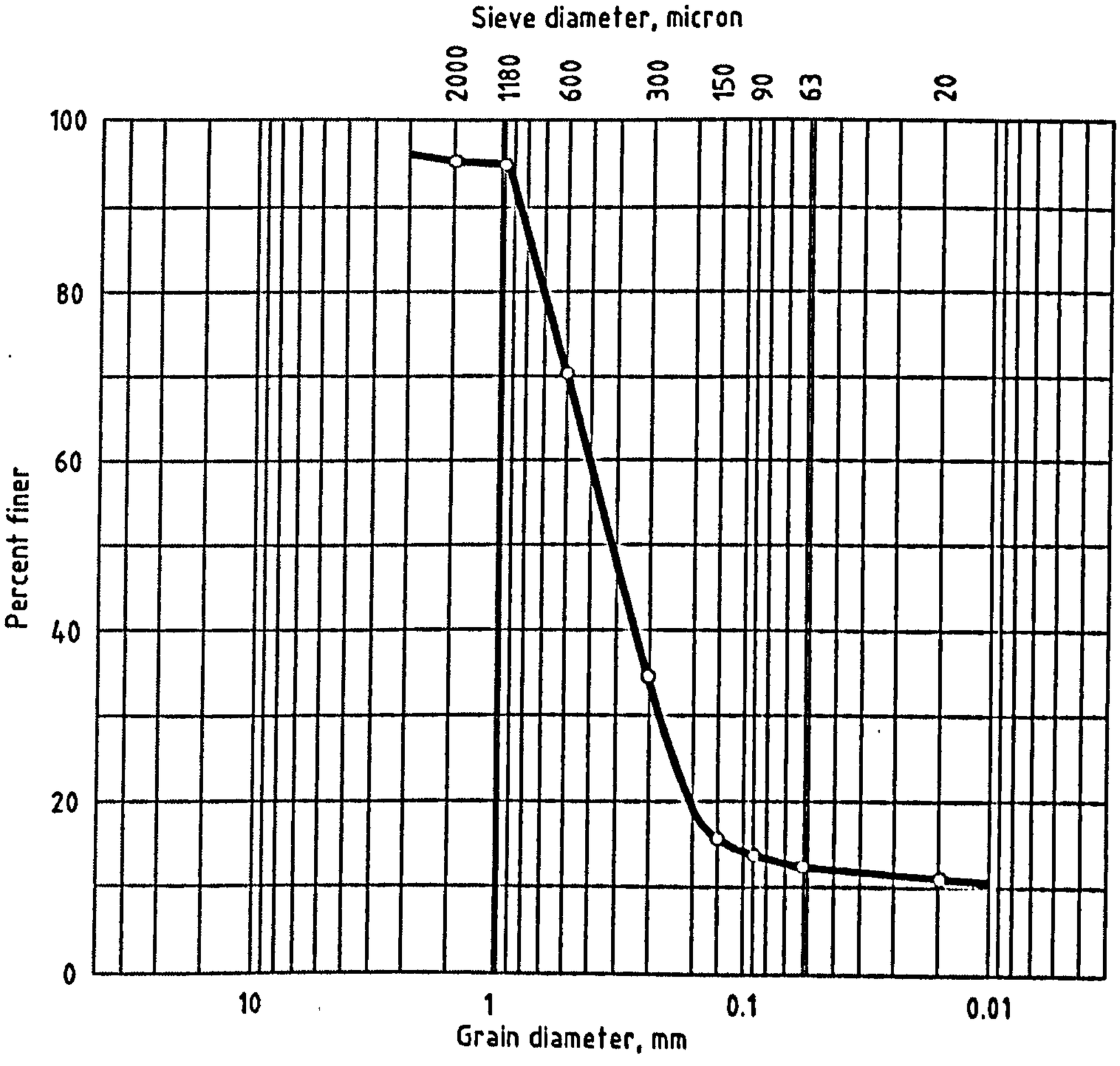
Visual description: exterior lime skim coat
Sand description: brown, grey and ochre
Average coat thickness: /
Date and weather condition: February 2000, dry
Location: Via Chiesa 7, Nuraminis, Sardinia. 1.2 m from ground level
Orientation: east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 37.0 gr
Sample weight after drying: 36.8 gr — Percent moisture: 0.5 %
Weight loss: 0.2 gr
Sample weight after dissolution in acid: 26.1 gr — Percent carbonate: 29.1 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.1 gr	0.3	11.8
63 microns	0.3 gr	1.1	12.1
90 microns	0.7 gr	2.6	13.2
150 microns	5 gr	19.1	15.8
300 microns	9.3 gr	35.6	34.9
600 microns	6.4 gr	24.5	70.5
1180 microns	2.8 gr	0.1	95
2000 microns	1.3 gr	4.9	95.1
Total	25.9 gr		

Particle size distribution:



Sample: Sinnai 2

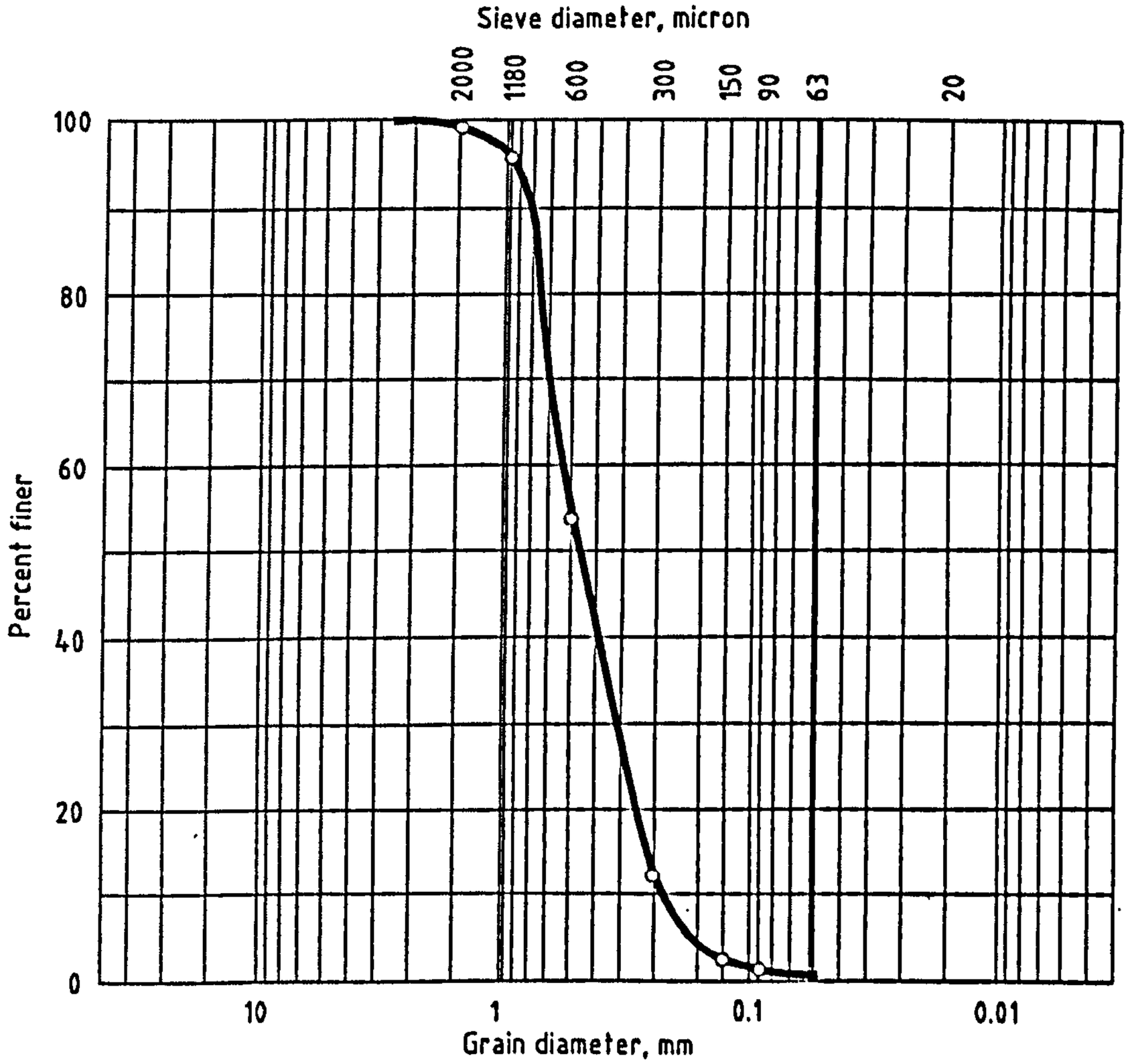
Visual description: exterior lime skim coat on Sinnai 1. Two coats of limewash are visible from bottom to top: (1) white, and (2) brown-pink
Sand description: thin, no sign of clay and silt
Date and weather condition: September 1998, dry
Location: Via Funtaneddas 106, Sinnai, Sardinia. Ground floor, external facade, 1.5 metres from the ground
Orientation: north-west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20 gr
Sample weight after drying: 19.9 gr — Percent moisture: 0.5 %
Weight loss: 0.1 gr
Sample weight after dissolution in acid: 15.1 gr — Percent carbonate: 24.1 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	/	/	/
90 microns	0.1 gr	0.7	1
150 microns	1.9 gr	12.6	1.7
300 microns	6.0 gr	39.7	14.3
600 microns	6.1 gr	40.4	54
1180 microns	0.8 gr	5.3	94.4
2000 microns	0.05 gr	0.3	99.7
Total	14.95 gr		

Particle size distribution:



Sample: Uras 2

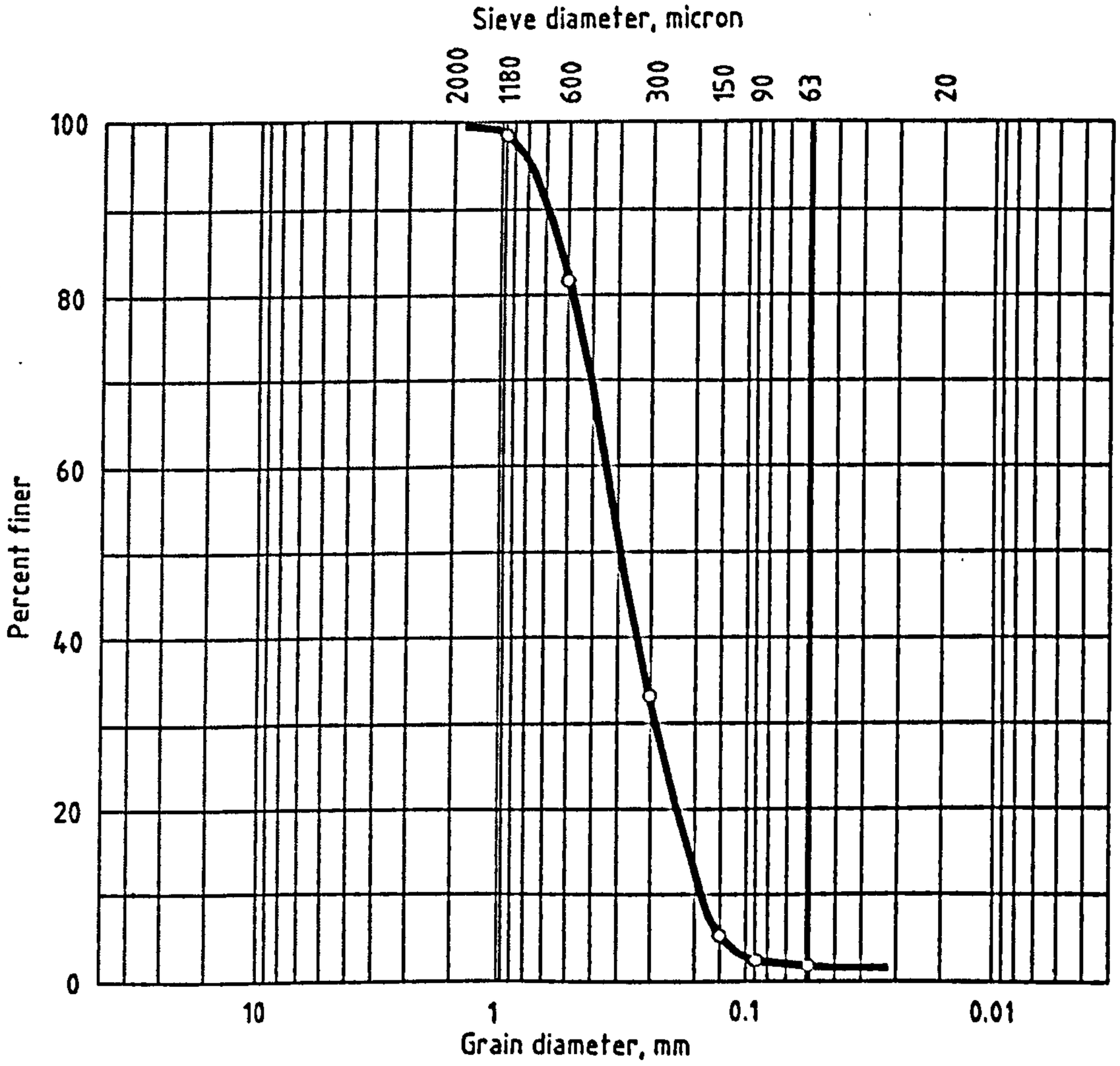
Visual description: exterior lime skim coat on Uras 1. One layer of white limewash is visible
Sand description: thin, pink and yellow
Date and weather condition: September 1998, dry
Location: Via Eleonora / Vico Eleonora (Post Office back yard), Uras, Sardinia. Ground floor, external facade, 1.2 metres from the ground
Orientation: north-east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 20 gr
Sample weight after drying: 20 gr — Percent moisture: 0
Weight loss: 0
Sample weight after dissolution in acid: 13.8 gr — Percent carbonate: 31 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.1 gr	0.7	0.3
90 microns	0.6 gr	4.3	1
150 microns	3.9 gr	28.2	5.3
300 microns	6.8 gr	49.2	33.5
600 microns	2.3 gr	16.6	82.7
1180 microns	0.1 gr	0.7	99.3
2000 microns	/	/	/
Total	13.8 gr		

Particle size distribution:



DATASHEETS
Case Study A: samples of lime renders

Sample: Case Study A1

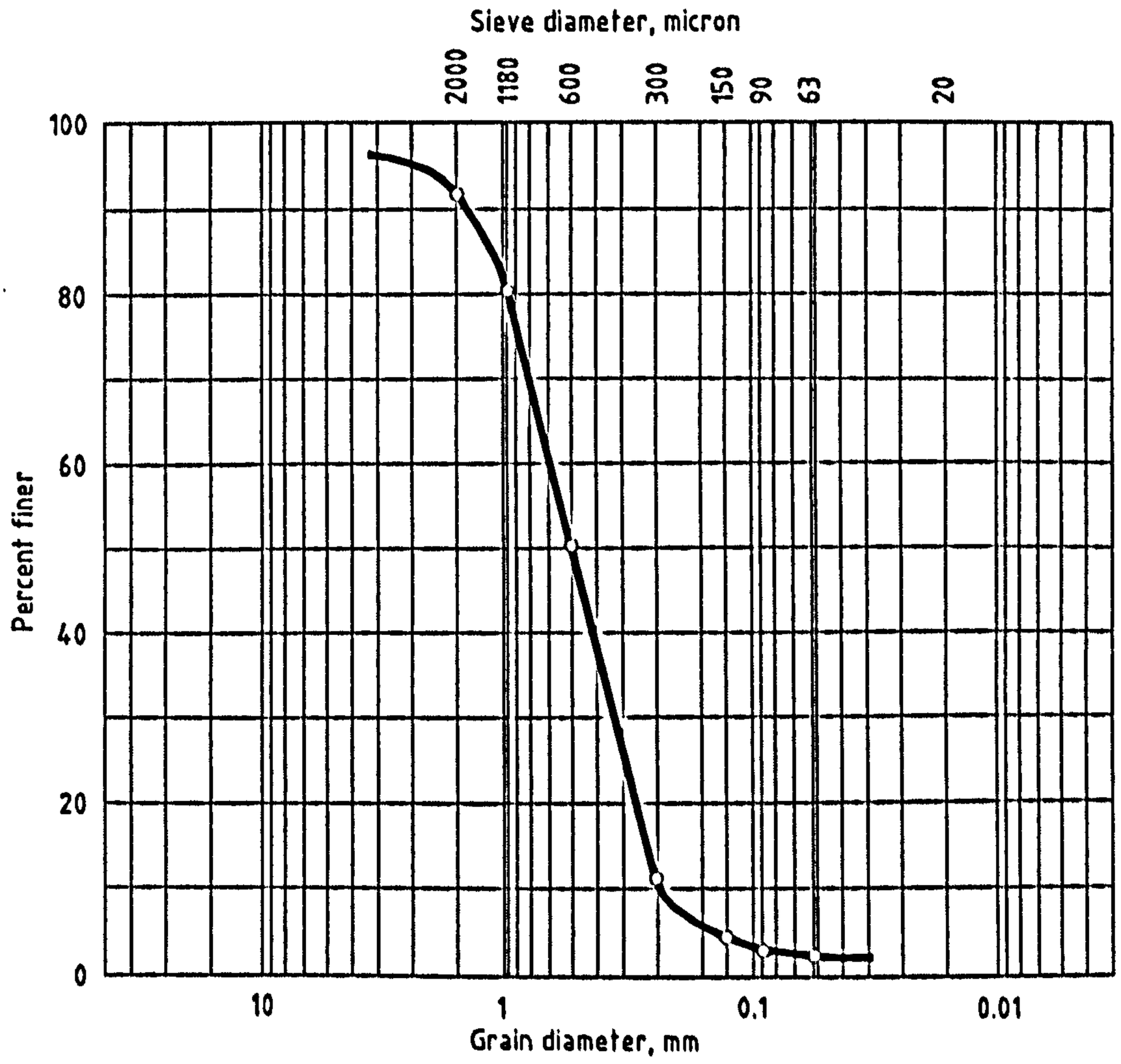
Visual description: Exterior lime skim coat. Two layers of limewash are visible from top to bottom: white and pale ochre
Sand description: pink, ochre, brown, grey and white
Average coat thickness: 0.79 cm
Date and weather condition: dry, February 2000
Location: Casa Cadoni-Arcais, Serramanna, Sardinia. Two metres from gound level, main facade, blocked window in proximity of the portal
Orientation: west

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 43.1 gr
Sample weight after drying: 42.9 gr — Percent moisture: 0.4 %
Weight loss: 0.2 gr
Sample weight after dissolution in acid: 32.3 gr — Percent carbonate: 24.7 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.1 gr	0.3	2.4
90 microns	0.5 gr	1.5	2.7
150 microns	2.3 gr	7.1	4.2
300 microns	12.6 gr	39	11.3
600 microns	9.8 gr	30.3	50.3
1180 microns	3.6 gr	11.1	80.6
2000 microns	2.7 gr	8.3	91.7
Total	31.6 gr		

Particle size distribution:



Sample: Case Study A2

Visual description: interior lime skim coat. One layer of limewash is visible: white background with blue decoration
Sand description: after dissolution in hydrochloric acid, the only residual matter was a clayey aggregate together with a lot of chopped straw. No sand was found in the sample
Average coat thickness: 0.36 cm
Date and weather condition: January 2001, dry
Location: Casa Cadoni-Arcais, Serramanna, Sardinia. Historic lime render located under the staircase, 80 cm from ground level
Orientation: north

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 19.9 gr
Sample weight after drying: 19.3 gr — Percent moisture: 3%
Weight loss: 0.6 gr
Sample weight after dissolution in acid: 6.7 gr — Percent carbonate: 65.3%

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan			
20 microns			
63 microns			
90 microns			
150 microns			
300 microns			
600 microns			
1180 microns			
2000 microns			
Total			

Particle size distribution: N/A

Sample: Case Study A5

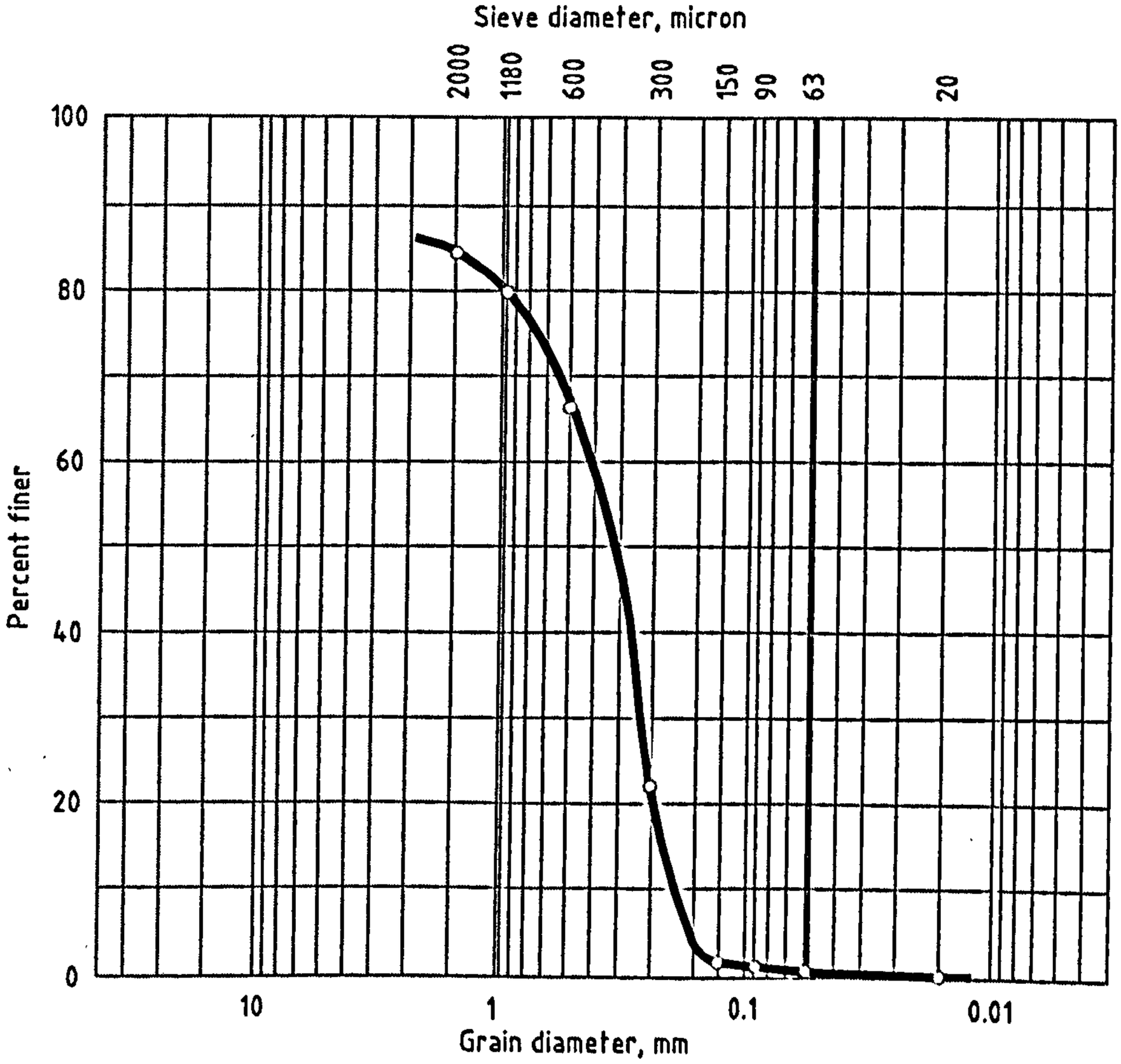
Visual description: this lime render sample is representative of the mix employed for internal and external re-rendering
Sand description: grey, ochre, and white
Average coat thickness: 1.43 cm
Date and weather condition: January 2001, dry
Location: Casa Cadoni-Arcais, Serramanna, Sardinia. Stables, two metres from ground level, internal side of wall
Orientation: east

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 58.1 gr
Sample weight after drying: 57.8 gr — Percent moisture: 0.5%
Weight loss: 0.3 gr
Sample weight after dissolution in acid: 47.8% — Percent carbonate: 17.3%

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.2	0.4	0.2
63 microns	0.3	0.6	0.6
90 microns	0.4	0.8	1.2
150 microns	9.9	20.7	2
300 microns	21.4	44.8	22.7
600 microns	6	12.5	67.5
1180 microns	2.1	4.4	80
2000 microns	7.5	15.6	84.4
Total	47.8		

Particle size distribution:



DATASHEETS
Case Study B: samples of lime renders

Sample: Case Study B1

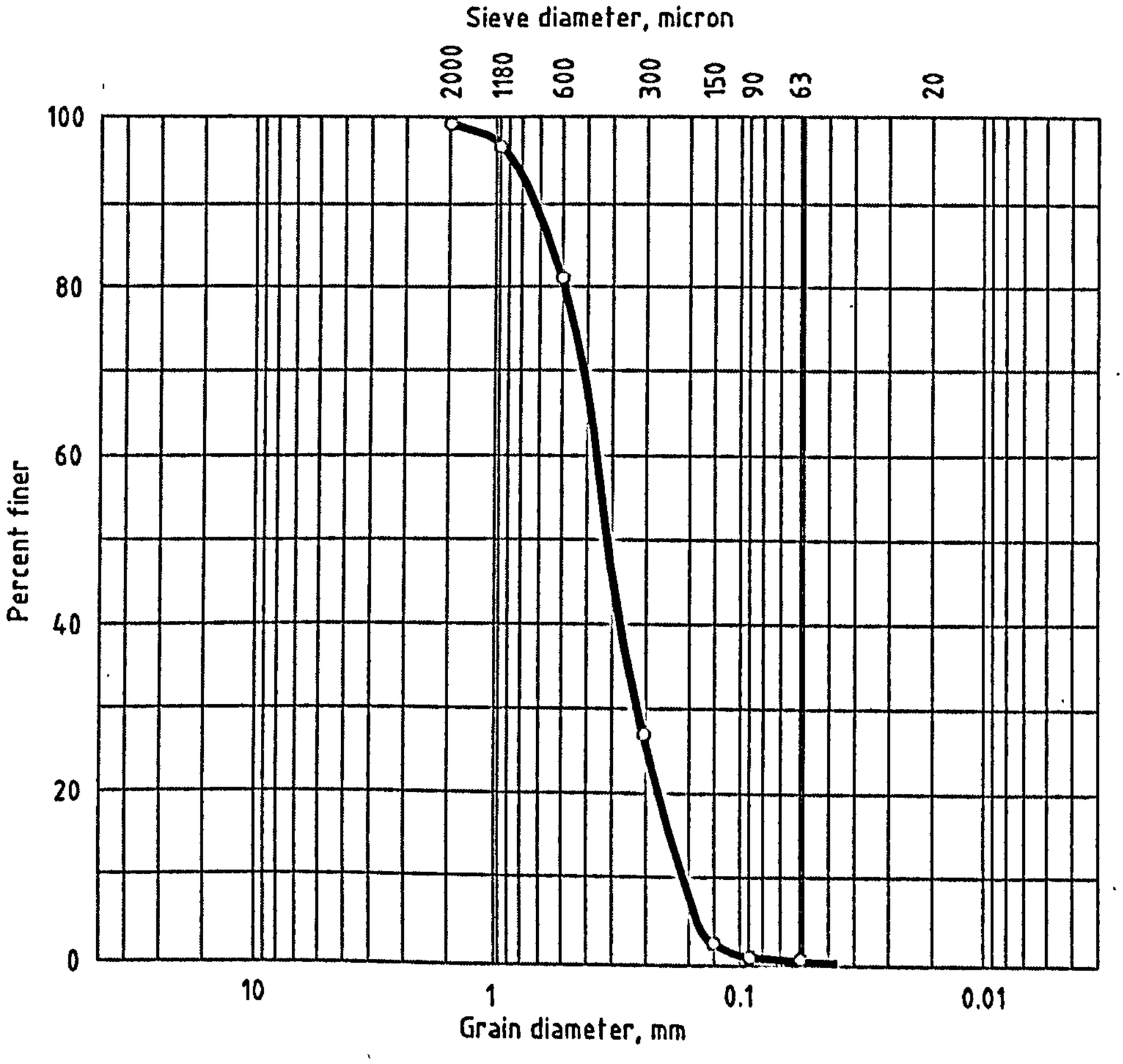
Visual description: interior lime skim coat . Eleven layers of limewash are visible from top to bottom: white, pink, grey, red-orange, grey (three layers), red-orange, salmon, white, salmon
Sand description: white, pink, grey. Fine sand most probably quarried from the local beach of Poetto
Average coat thickness: 0.53 cm
Date and weather condition: dry, February 2000
Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia. First floor, south wall of corridor, 1.50 m from floor level
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 39.4 gr
Sample weight after drying: 39.2 gr — Percent moisture: 0.5 %
Weight loss: 0.2 gr
Sample weight after dissolution in acid: 29.5 gr — Percent carbonate: 24.7 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 microns	0.1 gr	0.3	0.4
90 microns	0.4 gr	1.3	0.7
150 microns	7.5 gr	25.4	2
300 microns	15.9 gr	53.8	27.4
600 microns	4.8 gr	16.2	81.2
1180 microns	0.7 gr	2.3	97.4
2000 microns	0.1 gr	0.3	99.7
Total	29.5 gr		

Particle size distribution:



Sample: Case Study B2

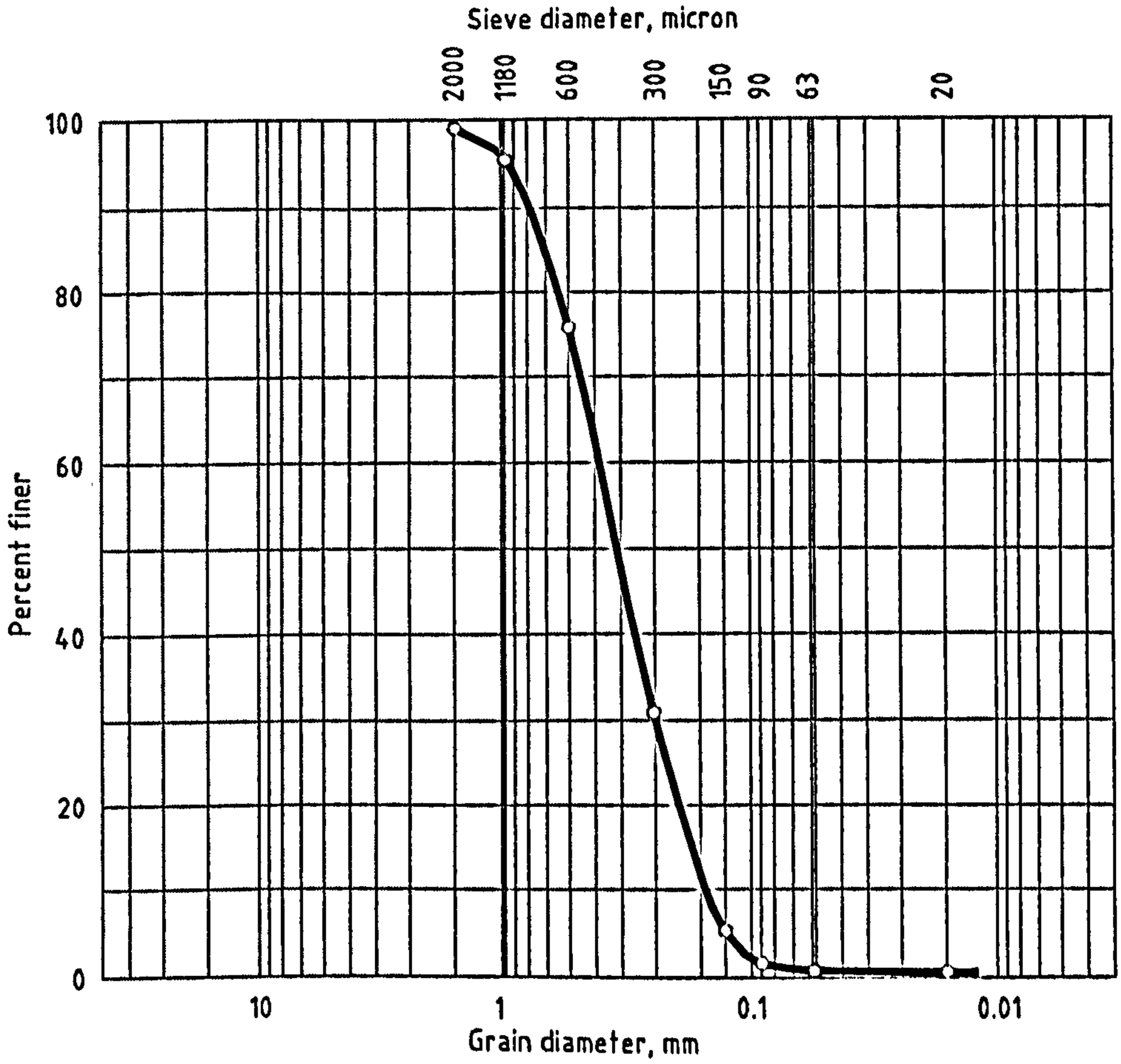
Visual description: exterior lime render. Four layers of limewash are visible from top to bottom: white, pale green, white and ivory
Sand description: ochre, white and pink
Average coat thickness: 1.76 cm
Date and weather condition: dry, February 2000
Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia. Ground floor, south wall, 1.50 m from ground level
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 52.4 gr
Sample weight after drying: 52.1 gr — Percent moisture: 0.5 %
Weight loss: 0.3 gr
Sample weight after dissolution in acid: 35.2 gr (with salts), 34.4 gr (without salts)
Percentage of salts: 1.5 % — Percent carbonate: 33.9 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.1 gr	0.2	0.6
63 microns	0.2 gr	0.5	0.8
90 microns	1.6 gr	4.6	1.3
150 microns	8.7 gr	25.2	5.9
300 microns	15.7 gr	45.6	31.1
600 microns	6.6 gr	19.1	76.7
1180 microns	1.2 gr	3.4	95.8
2000 microns	0.3 gr	0.8	99.2
Total	34.4		

Particle size distribution:



Sample: Case Study B3

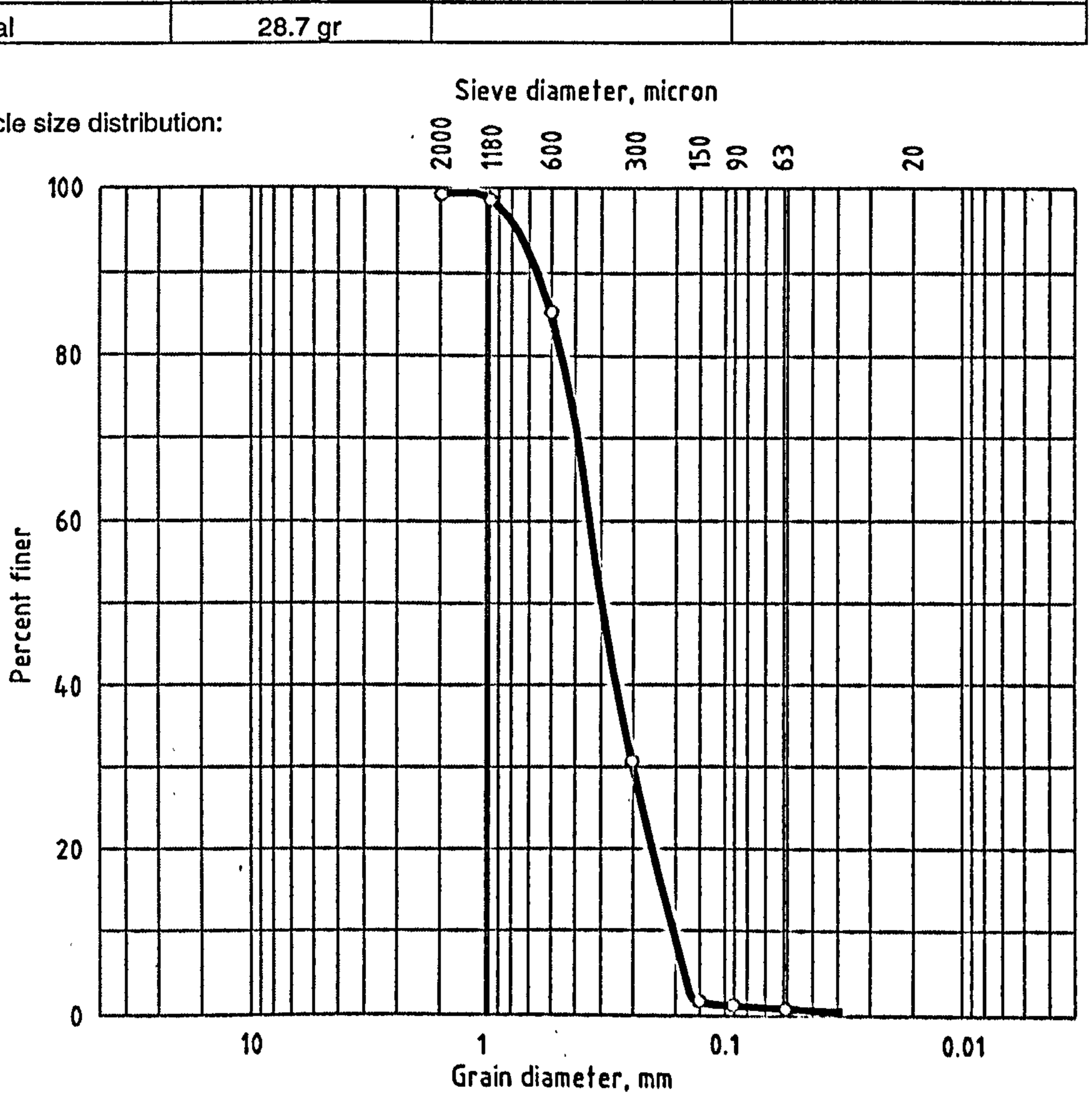
Visual description: interior lime skim coat. Several layers of limewash are visible form top to bottom: white, green, grey, peach, pale yellow (several layers), yellow, light red, yellow and light red
Sand description: quartsiferous, pink, yellow and white. Fine sand most probably quarried from the local beach of Poetto
Average coat thickness: 0.64 cm
Date and weather condition: dry, February 2000
Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia. Room between corridor and far room facing south. 1.5 m from ground level
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 36.8 gr
Sample weight after drying: 36.8 gr — Percent moisture: 0%
Weight loss: 0
Sample weight after dissolution in acid: 28.7 gr — Percent carbonate: 22.0 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	/	/	/
63 micron	0.1 gr	0.3	1.1
90 microns	0.3 gr	1	1.4
150 microns	8.4 gr	29.2	2.4
300 microns	15.6 gr	54.3	31.6
600 microns	3.6 gr	12.5	85.9
1180 microns	0.4 gr	1.3	98.4
2000 microns	0.1 gr	0.3	99.7
Total	28.7 gr		

Particle size distribution:



Sample: Case Study B7

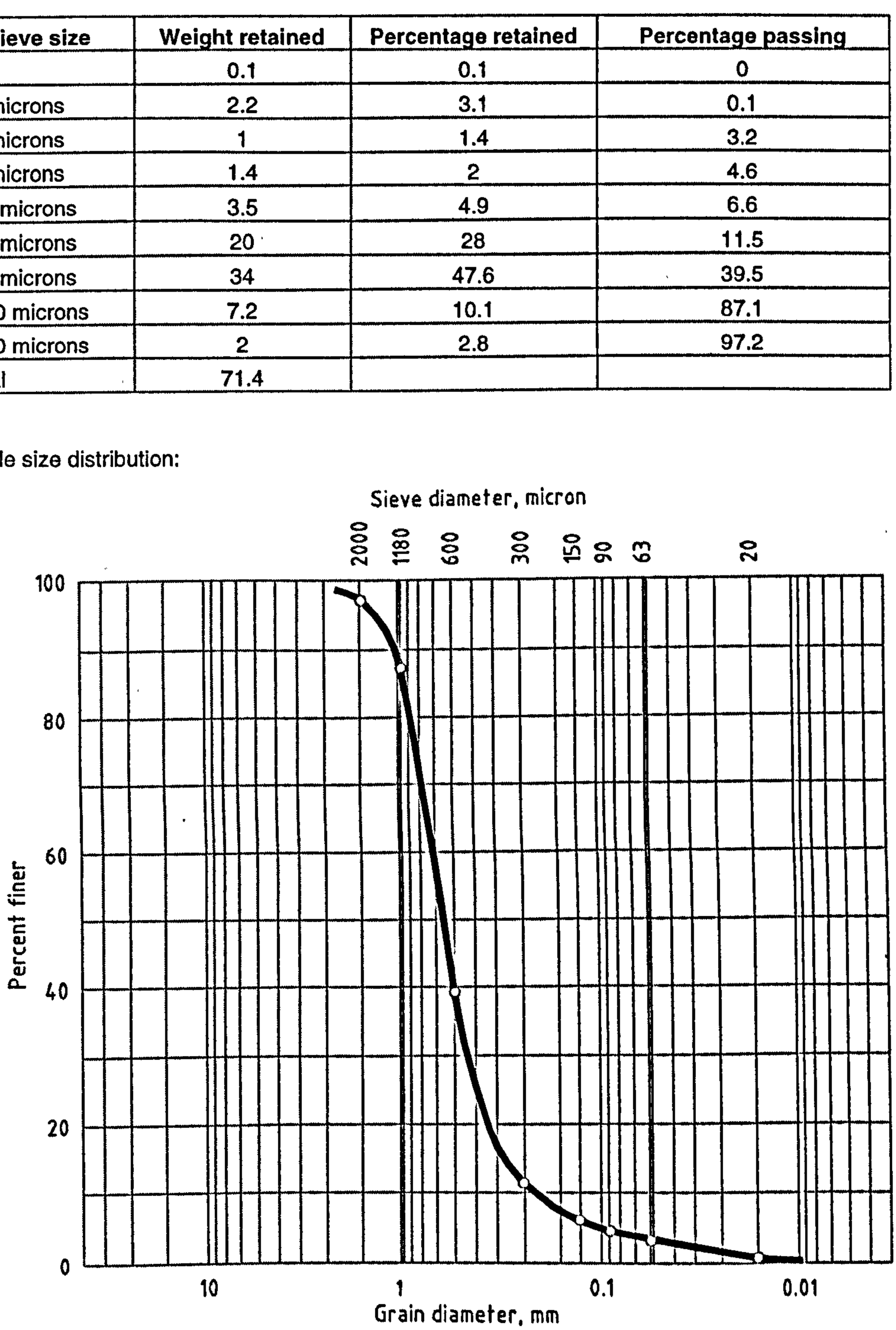
Visual description: external lime scratch coat, one layer of white lime wash is visible
Sand description: white and ochre
Average coat thickness: 1.49 cm
Date and weather condition: January 2001, dry
Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia. Historic lime render on wall opposite parking lot, 1.5 m from ground level
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 93.2 gr
Sample weight after drying: 92.7 gr Percent moisture: 0.5 gr
Weight loss: 0.5 gr
Sample weight after dissolution in acid: 80.8 gr (with salts), and 71.4 gr (without salts)
Percent carbonate: 12.8 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	0.1	0.1	0
20 microns	2.2	3.1	0.1
63 microns	1	1.4	3.2
90 microns	1.4	2	4.6
150 microns	3.5	4.9	6.6
300 microns	20	28	11.5
600 microns	34	47.6	39.5
1180 microns	7.2	10.1	87.1
2000 microns	2	2.8	97.2
Total	71.4		

Particle size distribution:



Sample: Case Study B8

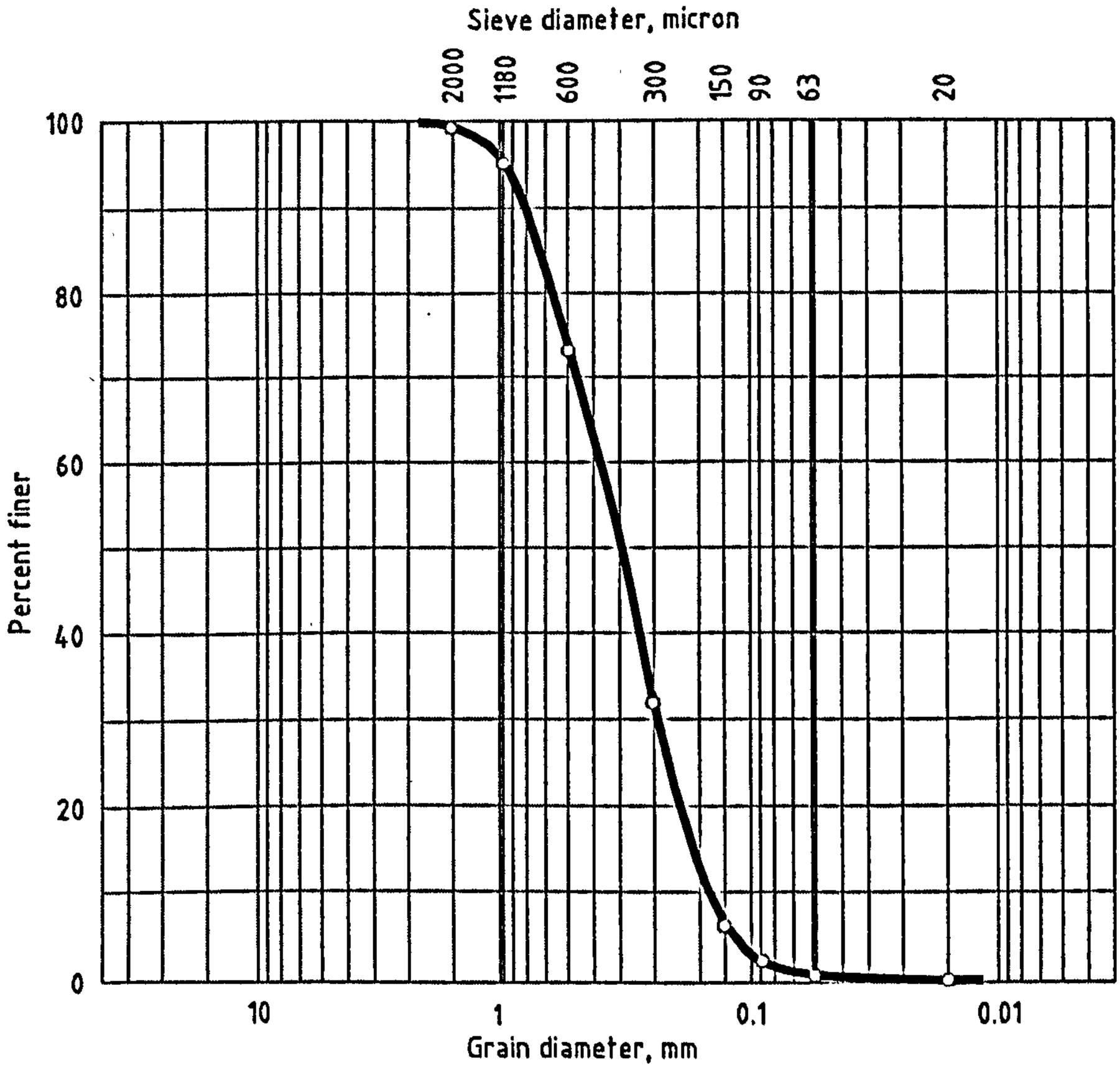
Visual description: external lime coat (replacement render)
Sand description: dark and light grey, ochre, and white
Average coat thickness: 0.92 cm
Date and weather condition: January 2001, dry
Location:dark and light grey, ochre, and white New lime render on wall opposite parking lot, 1.5 m from ground level
Orientation: south

DISSOLUTION IN HYDROCHLORIC ACID

Sample size before drying: 54 gr
Sample weight after drying: 54 gr Percent moisture: 0 %
Weight loss: /
Sample weight after dissolution in acid: 41.1 gr (with salts) and 39.8 gr (without salts)
Percent carbonate: 23.9 %

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.3	0.8	0
63 microns	0.4	1	0.8
90 microns	1.9	4.8	1.8
150 microns	10.2	25.6	6.6
300 microns	16.3	41	32.2
600 microns	8.8	22	73.2
1180 microns	1.8	4.5	95.2
2000 microns	0.1	0.3	99.7
Total	39.8		

Particle size distribution:



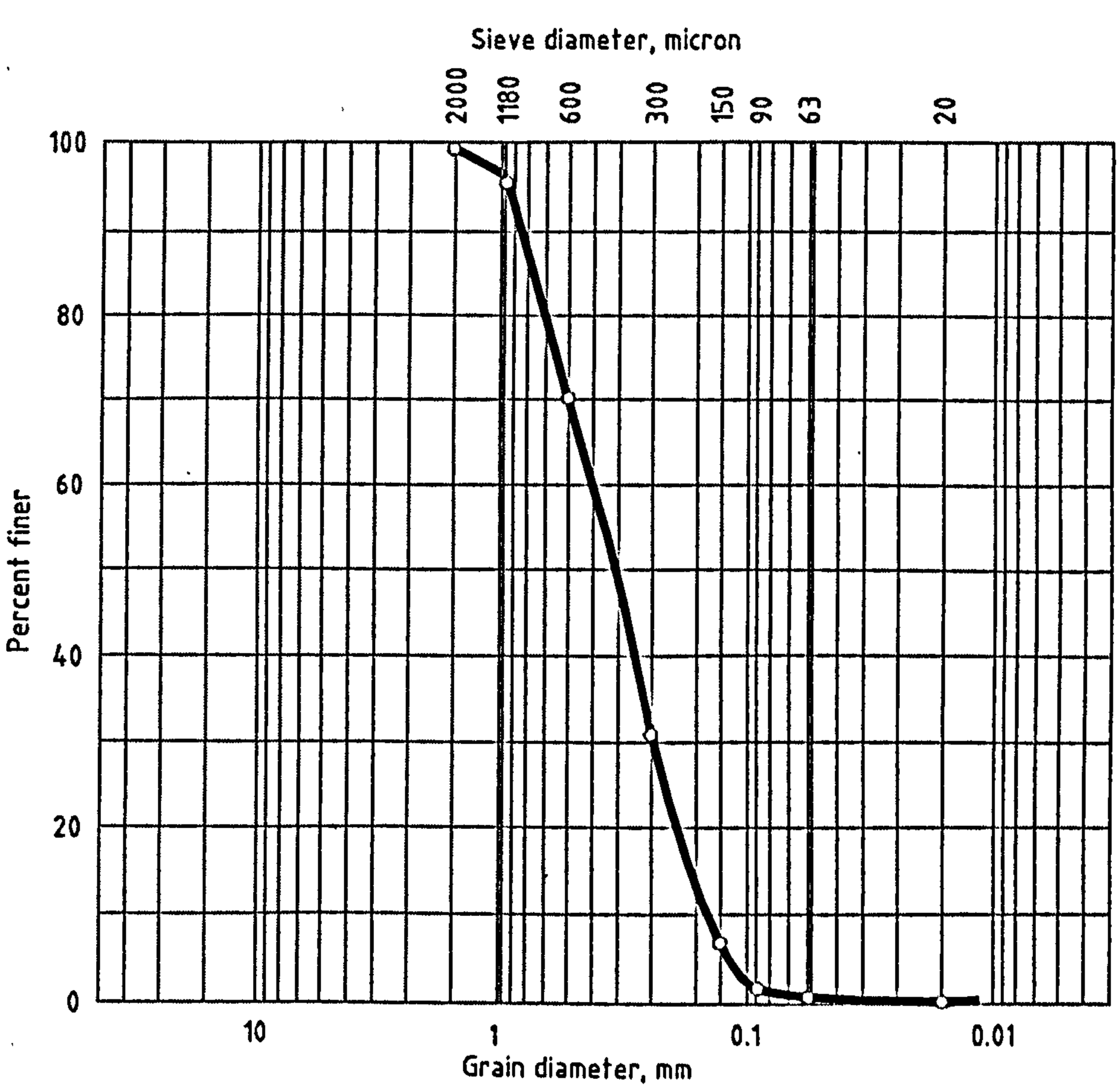
Sample: Case Study B9

Visual description: sample of fine sand collected in the site and used as aggregate for the replacement of lime renders
Sand description: dark and light grey, ochre, and white
Average coat thickness: N/A
Date and weather condition: January 2001, dry
Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia
Orientation: N/A

Sample weight after drying: 90.9 gr

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.4	0.4	0.5
63 microns	1	1.1	0.9
90 microns	5.2	5.7	2
150 microns	21.8	23.9	7.7
300 microns	35.1	38.6	31.6
600 microns	24.2	26.6	70.2
1180 microns	2.8	3.1	96.8
2000 microns	0.1	0.1	99.9
Total	90.6		

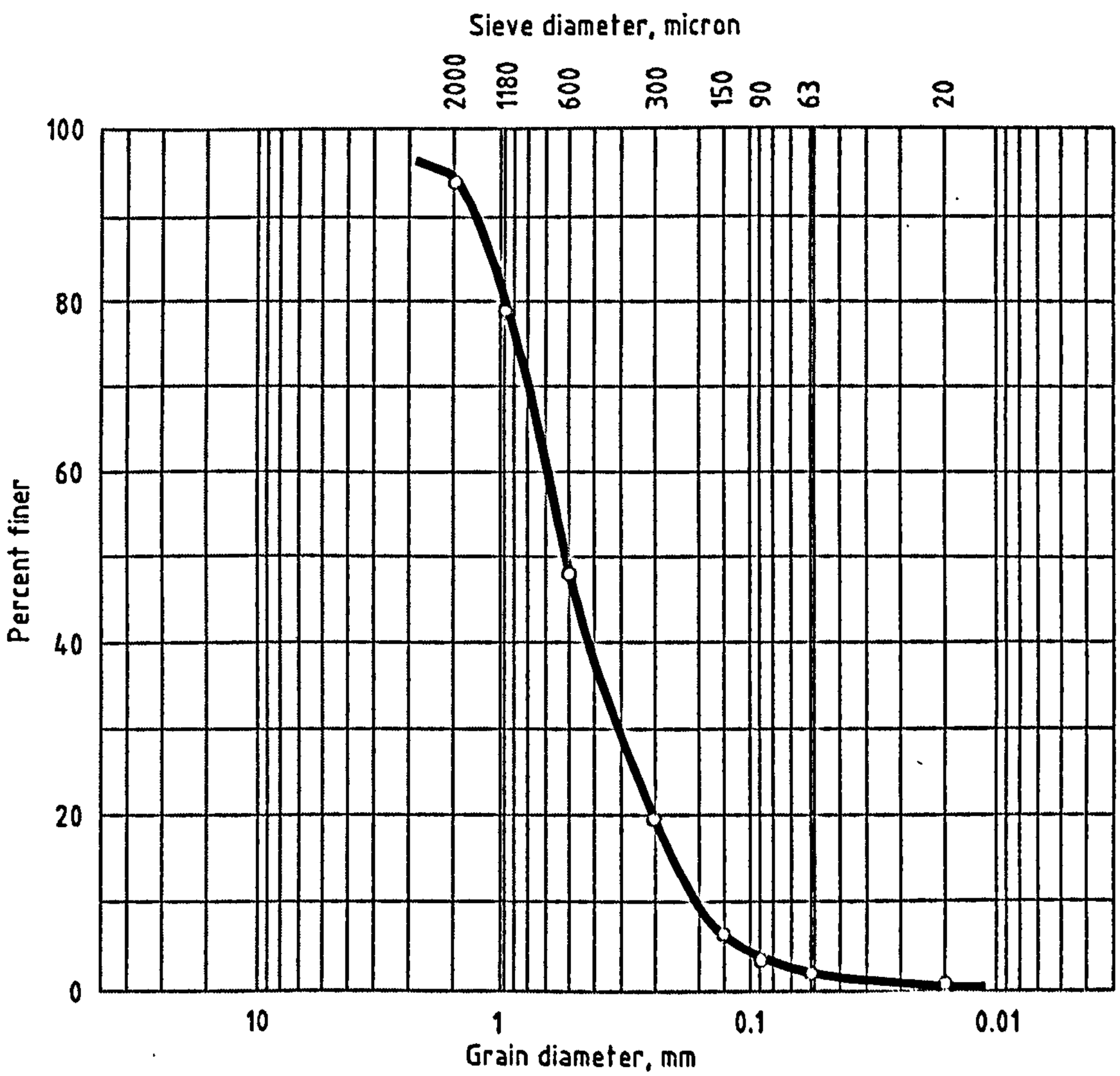
Particle size distribution:



Sample: Case Study B10

Visual description: sample of coarse sand collected in the site and used as aggregate for the replacement of lime renders
Sand description: dark and light grey, ochre, and white
Average coat thickness: N/A
Date and weather condition: January 2001, dry
Location: Ex Caserma Carabinieri, Via Roma, Quartu Sant'Elena, Sardinia
Orientation: N/A

Sample weight after drying: 94.3 gr

Sieve size	Weight retained	Percentage retained	Percentage passing
Pan	/	/	/
20 microns	0.9	0.9	0.4
63 microns	1.4	1.5	1.3
90 microns	3.8	4	2.8
150 microns	12.4	13.1	6.8
300 microns	26.8	28.4	19.9
600 microns	29.2	30.8	48.3
1180 microns	15	15.8	79.1
2000 microns	4.8	5.1	94.9
Total	94.3		

Particle size distribution: