REQUEST FOR QUOTATION (THIS IS NOT AN ORDER)	THIS RFQ ☐ IS ☒ IS NOT A SMALL BUSINESS SET-ASIDE	PAGE 1 OF PAGES

1. REQUEST NO.	2. DATE ISSUED	3. REQUISITION/PURCHASE REQUEST NO.	4. CERT. FOR NAT. DEF. UNDER BDSA REG. 2 AND/OR DMS REG. 1	RATING
PR5087227	02/29/2016	PR5087227		

5a. ISSUED BY
GSO/Procurement

6. DELIVER BY (Date)

5b. FOR INFORMATION CALL (NO COLLECT CALLS)

NAME	TELEPHONE NUMBER	
	AREA CODE	NUMBER
Jay Thompson	+355	42247285

7. DELIVERY ☐ FOB DESTINATION ☒ OTHER (See Schedule)

8. TO:

a. NAME	b. COMPANY
Jay Thompson	Us Embassy

c. STREET ADDRESS
Rruga e Elbasanit

d. CITY	e. STATE	f. ZIP CODE
Tirane	AL	

9. DESTINATION

a. NAME OF CONSIGNEE
US Embassy

b. STREET ADDRESS
Rruga e Elbasanit

c. CITY
Tirane

d. STATE	e. ZIP CODE
AL	

10. PLEASE FURNISH QUOTATIONS TO THE ISSUING OFFICE IN BLOCK 5a ON OR BEFORE CLOSE OF BUSINESS (Date)
03/31/2016

IMPORTANT: This is a request for information and quotations furnished are not offers. If you are unable to quote, please so indicate on this form and return it to the address in Block 5a. This request does not commit the Government to pay any costs incurred in the preparation of the submission of this quotation or to contract for supplies or service. Supplies are of domestic origin unless otherwise indicated by quoter. Any representations and/or certifications attached to this Request for Quotation must be completed by the quoter.

11. SCHEDULE (Include applicable Federal, State and local taxes)

ITEM NO. (a)	SUPPLIES/ SERVICES (b)	QUANTITY (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)
	Construction Services as per the SOW				

12. DISCOUNT FOR PROMPT PAYMENT	a. 10 CALENDAR DAYS (%)	b. 20 CALENDAR DAYS (%)	c. 30 CALENDAR DAYS (%)	d. CALENDAR DAYS NUMBER	PERCENTAGE

NOTE: Additional provisions and representations ☐ are ☐ are not attached.

13. NAME AND ADDRESS OF QUOTER

a. NAME OF QUOTER

b. STREET ADDRESS

c. COUNTY

d. CITY	e. STATE	f. ZIP CODE

14. SIGNATURE OF PERSON AUTHORIZED TO SIGN QUOTATION

15. DATE OF QUOTATION

16. SIGNER

a. NAME (Type or print)	b. TELEPHONE AREA CODE
c. TITLE (Type or print)	NUMBER

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

FACILITY MANAGEMENT

STATEMENT OF WORK

Design/Build

Project Name:

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

DESIGN & BUILD

1. Project Owner: US Embassy Tirana, Albania.

2. Project Name: Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

3. Project Location and address: Rilindja Ridge Residences.

4. Project Description and work to be performed:

This is a scope of work (SOW) prepared for a Design/Build Contractor (D/B) to examine, design, and reconstruct the slope, ground, perimeter wall, and other systems damaged or distressed during the slope failure at the south side of Housing compound during the recent rainfall season. The work required under this contract consists of furnishing all professional services, labor, materials, apparatus, supplies, transportation, equipment, required insurance, and any other items, accessories, and services necessary to complete the design and reconstruction of the slope stabilization and adjacent areas. All work shall be in strict accordance with this specification and its attachments, applicable drawings, local regulations, permits, and Building Codes.

(a.)Perform a limited reconnaissance investigation, at the south side of the compound, take measurements and obtain necessary information at the location where the slope failure and erosion occurred. Our intention is to reconstruct the slope areas as noted in Attachment 1 to their original condition and prevent future similar failures.
(b.)Reconstruct the slope and portion of the perimeter wall, methodically, in a way, as to not undermine the foundations of the perimeter wall or cause damage and/or disturbance to nearby residences.
(c.)Perform in such a manner the proposed geotechnical reconnaissance to sufficiently characterize the extent of the failure areas, drainage and other issues relevant to the site and perimeter wall.
(d.)Develop and provide 60% design documents (including drawings, specifications, calculations and analysis for the methods chosen) necessary to stabilize the ground as well as restore the foundations of the perimeter wall as necessary. OBO will review this 60% design and provide input before the final 100% design is prepared.
(e.)Submit the 100% design package that incorporated all OBO review comments from previous submission.
(f.)Upon completion of design phase the engineer/contractor shall mobilize to do the required slope restoration.
(g.)Biweekly reports are required to be submitted to the U.S. Embassy/OBO by the engineer/contractor (D/B) as the project reconstruction proceeds and final inspection and completion report to the U.S. Embassy/OBO before final payment is made.
All work performed shall be warranted for a minimum period of 5-years free of defect and/or workmanship. Any deficiencies shall be corrected by the (D/B) at no expense to the U.S. Government.

5. Project Milestone:

Site Visit	(02/29/2016-03/04/2016)
PHASE I Pre-liminary Design Submission	(03/25/2016)
PHASE II Final Design Submission (After OBO Approved)	(___/___/_____)

Note: The BIDDING process will perform in two phases as listed below in item 5, annex 1 and the all project deliverables will submitted in according the annex 1

6. Design/Build WBS (Uniformat II/WBS)

Note: All the Construction Works listed as following are parts of Project:

- Landslide Surface = 600 m²
- Potential Landslide Surface (Should be protected)=282 m²
- Total Construction Site Surface: A= **882 m²**

A102003 **UNDERPINNING**
Underpinning is the provision of permanent support for existing buildings by extending their foundations to a new, lower level containing the desired bearing stratum. Assemblies include excavation, backfill, and underpinning materials.

G1030 **SITE EARTHWORK**
Included are assemblies and options for site work such as grading, excavation, filling, compaction, stabilization, etc.

G103001 **GRADING**
Grading is leveling or flattening of the site in preparation for landscaping or other site construction. Includes unlined storm water collection ponds.

G103004 **FILL & BORROW**
This is filling or replacing the material that was removed during excavation. Either the excavated material may be used or soil and sand may be hauled in from off-site. Filling to basements and foundations is not included in the subsystem.

G103006 **SOIL STABILIZATION**
This is stabilization of the soil-in-place by the addition of lime or cement.

G103007 **SLOPE STABILIZATION**
This is stabilization of the soil-in-place through the use of rip rap, gabions, slope paving, or other forms of soil armoring.

G103011 **TEMPORARY EROSION & SEDIMENT CONTROL**
Interim measures to minimize erosion during construction.

G20 **SITE IMPROVEMENTS**
This includes improvements such as parking lots, sidewalks, roadways, fencing, retaining walls, and landscaping.
G204002 **RETAINING WALLS AND FREESTANDING WALLS**

These are structures used to prevent the flow or lateral movement of soil. Assemblies exist for cast-in-place concrete retaining walls (Gabions Model).

G2050 **LANDSCAPING**
Assemblies are included that improve the appearance of the site by planting, seeding, and sodding.

G205001 **FINE GRADING & SOIL PREPARATION**
Fine grading of the site by hand or machine is required to prepare the soil for planting, seeding, or sodding.

7. Design Requirement Documents (Proposal Submission): Annex #1

Highlight X

Annex # 1

Drawing Submittal Requirements	US Embassy	Contractor	Level Required / Priority	Description / Note
PHASE I				
Context of the Requirement	X			Design/Build
Brief Description of the Request Services	X			The objectives of the present RFP are Design/Build
Standard/CODE	X	X	High	The Standards and Codes for Design/Build must preferable comply with US or otherwise National Standards and Regulations
Geotechnical Evaluation Report, 2000 by Dr. Eng. Albert Dimco (Attachment 2)	X			
Boundary & Topographic Survey • Existing site conditions • Site Layout Plan	X		High	Bidders should take all such data into consideration in preparing their proposal, and should be advised to further investigate the data as bidder consider appropriate.
Proposal Submission ***Draft Project / Preliminary Design** **(Attachment 1)** The above services, described, shall be presented in the engineer/contractor (D/B) proposal(s) on a fixed price basis, but with prices itemized separately for each category of service noted in the following section. We envision that the following steps should be taken to perform the work described above: 1.Site reconnaissance and mapping of the failure areas, drainage, etc: 2.Analysis of the slope to define the extent of failure surfaces: 3. Choose a method to stabilize the slope,	X	X	High	Note: Contractor is not limited to advice in his Technical Design Proposal.

perimeter wall as applicable and correct drainage. Due to success with the gabion retaining wall systems, in other parts of the compound, OBO recommends similar systems be used. A schematic concept of such a system is presented in Attachment 1; 4. Use an underpinning system capable of safely supporting the adjacent existing perimeter wall during and after the slope restoration. This underpinning system needs to fully described and designed; 6.Produce draft drawings and calculations (addressing the stability of the systems to be constructed) to be sent to OBO for review and comments; 7.Obtain permission from nearby owners to access the site and areas of reconstruction; 8.Obtain and coordinate, with U.S. Embassy personnel for access to the site, materials, equipment, and personnel at hours and days allowed; 9. Finalize drawings and proceed with the construction of the project utilizing methods outlined on the approved construction documents including field supervision as outlined in the previous section(s). In addition, the proposal shall include a schedule presenting the time required to perform the above services. All proposals will be rated using the rating criteria. Describe in Selection Criteria				
• **A list of the relevant projects.**		**X**	High	Do not list projects that proposed staff was not involved, even if your firm was.
• **Expected Duration Of Construction**	**X**		High	**90 Days**
• **Qualifications/Experience of the firm / References/Geological Engineer (Mandatory)**		**X**	High	
• **The minimum number of hard copies of Documents provided for bid purposes should be**		**X**	High	Two hard & Soft copy

• **Submitted date**		X	High	**03/25/2016**
• **Selection Criteria** The proposal shall include a description of the capabilities and qualifications of the firm, and the qualifications of the key personnel who will be working on this project. The selection will be based on the following criteria:				**(Score)**
(a) The firm's qualifications and experience on similar projects.				(20%)
(b) The qualifications and experience of proposed key project personnel.				(20%)
(c) Understanding of the project intent and proposed level of effort.				(15%)
(d) Facilities and equipment				(15%)
(e)Proposed time schedule				(15%)
(f) Proposed unit prices and total project cost				(15%)
All deliverables shall be submitted in **English.**				
PHASE II **Design Deliverables:** Upon project award, the D/B contractor shall deliver to U.S. Embassy/OBO the following documentation: **Technical Design:** a) A brief report outlining the findings of the initial site reconnaissance, slope failure mapping and reconstruction areas		X		
b) A 60% design of the proposed systems to be constructed, calculations and stability analysis, specifications and other information:		X		
c) A 100% final document incorporating OBO's technical comments made at 60% before proceeding with the construction phase:		X		
d) Biweekly progress reports; and, Final completion report and acceptance of the		X		

project reconstruction				
e) Submit two hard copies and one electronic (Adobe Acrobat pdf format) copy of each report along with digital photographs of the worksite.		X		
f) Prepare text reports in Microsoft Word, and spreadsheets using Microsoft Excel.		X		
g) Produce drawings on a sheet size appropriate for the scale and scope of this project. Minimum size shall be 280mm x 432mm. All project documents shall be in "hard metric." Computer aided design and drafting (CADD) is required for this project. CADD deliverables are required for this project – Autodesk AutoCAD, version 2000 format as a minimum. Compact Discs (CDs) or Digital Video Disks (DVDs) shall be provided to OBO in addition to drawings at each submittal.		X		
h) All deliverables shall be submitted in English.		X		
i) Any of the above reports may require re-submissions if necessitated by review comments by the Embassy.		X		
***(Project-Drawings)** • **Demolition Plan**: Indicate Landscape and existing vegetation • **Site Layout Plan:** Proposal footprint of Retain wall (Gabions) and Reinforcement Structure. • **Layout Dimensions** for all the Improvements include Reinforcement Structure, Gabions and the entire supported proposal infrastructure. • **Provide Earth Work Plan and section:** Showing of earth work activities include areas and volume of cut and fill, location Reinforcement structure and Gabions. *Borrow and Disposal Sites: As Appropriate, indicate borrow and disposal sites for fill or excavated materials and vehicle access routes to the sites. Identify any local permits that must be obtained. • **Reinforcement Structure Design:** *Plan, Elevations, Longitudinal and cross		X	High	Note: Contractor is not limited to advice in his Technical Design Proposal.

Section, reinforcements steel rebar size, *Technical Report of intervention methods to protect the wall. • **Retain Wall (Gabions)** *Site Plan footprint, Plan, Sections. *Technical Report of intervention methods to protect the land from sliding. • **Pedestrians walkway** *Site plan Footprint, Plan, Section • **Preparation Ground to seed with grass** *Site Plan Footprint, section details. • **Civil Details Drawings:**		X		
• **Technical Specifications according the constructions works (report).**		X	High	
• **Scheduling of Construction Progress Administration.**		X	High	
• **Person to Supervise the Work/Performance of the services required**		X	High	Project Site Manager
• **Proposal Deliverables**		X	High	Three (3) copies of the proposal presenting a fixed price basis, but with prices itemized separately for each category of service shall be delivered to the U.S. Embassy as

				noted in section Point of Contact by the due date specified.
All deliverables shall be submitted in **English.**				
Points of Contact	**American Embassy, FAC section,** Mr. Paul R. Bottse, Facility Manager. Telephone: + 355-68-201-6363 Email: BottsePR@state.gov **U.S. Department of State** **Foreign Building Operations** P.O. Box 12248, Rosslyn Station Arlington, VA 22219 Teleph.Num.:(703)875-6205 Vassilios K. Magginas, PE Fax Num:(703) 875-4548 Email: magginasvk@state.gov			

8. RESPONSIBILITIES AND PROJECT MANAGEMENT

1. **COR.** A Contracting Officers Representative (COR) will be assigned to ensure quality assurance goals are met. The Contractor shall provide the COR access to the site at all times.

2. **Point of Contact.** The COR will be the main point of contact for this Project. The Contractor shall report to the COR on (a) status of the Project, (b) changes in Schedule, (c) accidents and safety issues, (d) disruptions to utility services; and all other important information pertaining to the Project

3. **English Speaking Representative**. The Contractor will provide an English-speaking representative on-site during all working hours with the authority to make all decisions on behalf of the Contractor and subcontractors.

4. **Management Personnel.** The Contractor will staff the site, full-time, with a competent senior manager who shall perform project management. Remote project management is not an option. This individual shall keep a detailed written history of the project and shall update the Government weekly.

5. **Site Security.** The Contractor is responsible for on-site security as necessary to ensure no unauthorized access to their work sites. The Contractor is 100% responsible for securing their working materials and equipment. Any damage to facilities or infrastructure, which happens due to a lack of security, will be the responsibility of the Contractor to correct.

6. **Contractor's Temporary Work Center.** The Contractor will be permitted to use a designated area within the contract limits for operation of his construction equipment and office if warranted. If directed by the Contracting Officer, the

Contractor shall not receive additional compensation to relocate his operations. The Contractor is responsible for obtaining any required additional mobilization area above that designated. On completion of the contract, all facilities shall be removed from the mobilization area within 5 days of final acceptance by the Contractor and shall be disposed of in accordance with applicable host government laws and regulations. The site shall be cleared of construction debris and other materials and the area restored to its final grade. The Contractor is responsible for maintaining this area in a clear orderly manner.

7. **Contractor Staff Entrance:** The Contractor must abide by US Embassy security regulations related to the work including providing names of staff and vehicles one week prior to work is to be performed.

8. **Construction Materials:** The Contractor may not order any materials for the project until submittals are approved in writing from the Embassy.

9. The Contractor can work 7 days per week from 7am – 7pm.

10. The US Embassy will provide no materials for this project.
11. The Contractor shall commence work under this contract promptly, execute the work diligently, and achieve final completion and acceptance including final cleanup of the premises within the period specified.

9 RESPONSIBILITY OF THE CONTRACTOR

1. **Commencement, Prosecution, and Completion of Work**
The Contractor will be required to (a) commence work under this contract within five (5) working days after the date the Contractor receives the Notice to Proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than the proposed days in the schedule after NTP. The time stated for completion shall include final cleanup of the premises.

2. The Contractor shall be responsible for the professional quality, technical accuracy, and the coordination of all construction and other services furnished under this contract. The Contractor shall, without additional compensation, correct or revise any errors or deficiencies in its construction and other services.
3. The Contractor must follow all working safety regulations and provide their personnel with appropriate safety equipment like gloves, safety shoes, eye protection, etc

4. The contractor shall provide all technical safety rules in construction areas, protection barriers and safety signs such as temporary plastic fencing mesh, plastic tape, to notify the areas is under construction.
5. The storage place for inert and debris shall be contractor responsibility to set the place and transportation out of Embassy Compound.

6. The Contractor will provide all services as per statement of work and specifications. All construction requirements will conform approved project from US Embassy.
7. Prior the start (minimum of 5 working days) the contractor will supply names of all employees, all vehicles scheduled to enter the premises and a list of tools that will be used. This all need to be cleared with the Embassy security office.
8. Contractor must be able to provide written warranty for work in their submitted quote.

9. Contractor will clean and clear all work areas at the end of each day and on completion of the project. The contractor is responsible for the temporary storage and final removal of all waste and debris.

10. All damaged areas during the working process should be restored to its original condition by Contractor.

11. The Contractor shall identify a Project Site Manager who shall be responsible for the overall management of the project and shall represent the Contractor on the site during construction. The Project Site Manager shall be approved by the COR.

12. The Project Site Manager shall attend all project meetings, prepare Status Reports on the project and submit them to the COR. Status Reports shall contain meeting minutes, accomplishments, arising concerns and proposed solutions, any proposed changed orders, and any other pertinent information required to report the progress of performance.

13. All documentation produced for this project will become the ownership of the Embassy at the completion of this project.

14. The Contractor shall verify that all materials, equipment, and systems provide operational dependability. The Contractor assures the completed construction shall be easily maintained or replaced with readily available materials and services.

15. Any cost associated with services subcontracted by the Contractor shall be borne by and be the complete responsibility of the Contractor under the fixed price of this contract.
16. The Contractor is responsible for safety and shall comply with all local labor laws, regulations, customs and practices pertaining to labor, safety and similar matters. The Contractor shall promptly report all accidents resulting in lost time, disabling, or fatal injuries to the COR.

17. The Contractor shall be and remain liable to the Embassy in accordance with applicable law for all damages to the Embassy caused by the Contractor's negligent performance of any of the services furnished under this contract. The rights and

remedies for the Embassy provided for under this contract are in addition to any other rights and remedies provided by law.

10. Attachments

(a.) Project Idea (Attachment 1)

(b.) Geotechnical Evaluation Report, 2000 by Dr. Eng. Albert Dimco (Attachment2)

End of Scope of Work

Project Name

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

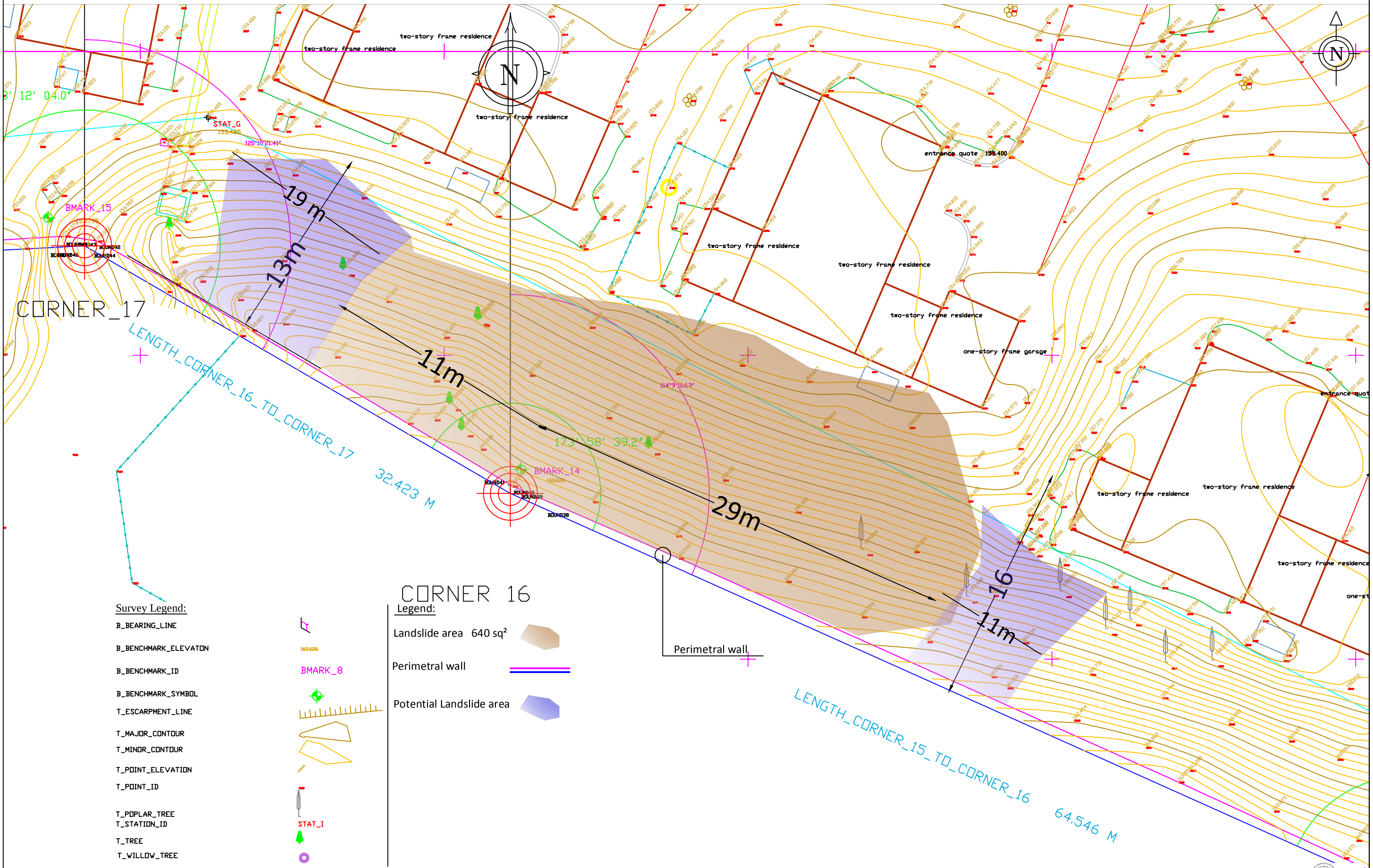
DESIGN & DRAWN BY: dt:1-25-2016

FACILITY MANAGEMENT

EMBASSY OF THE UNITED STATES

TIRANA-ALBANIA

EXISITING SITE PLAN



DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

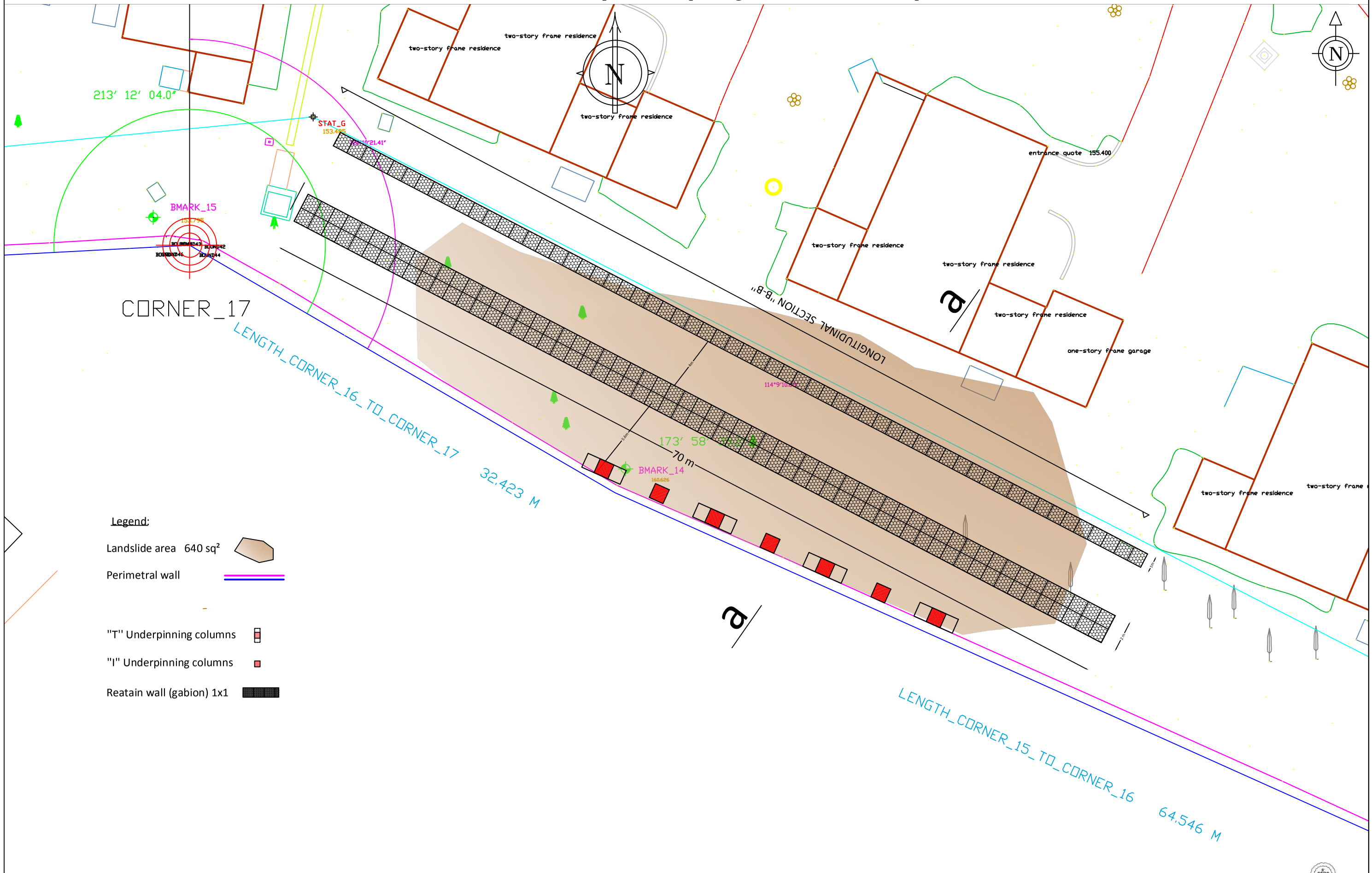
Drawing Title:

EXISTING SITE PLAN

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Existing

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

Proposal Underpinning colums and retain wall plan



DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

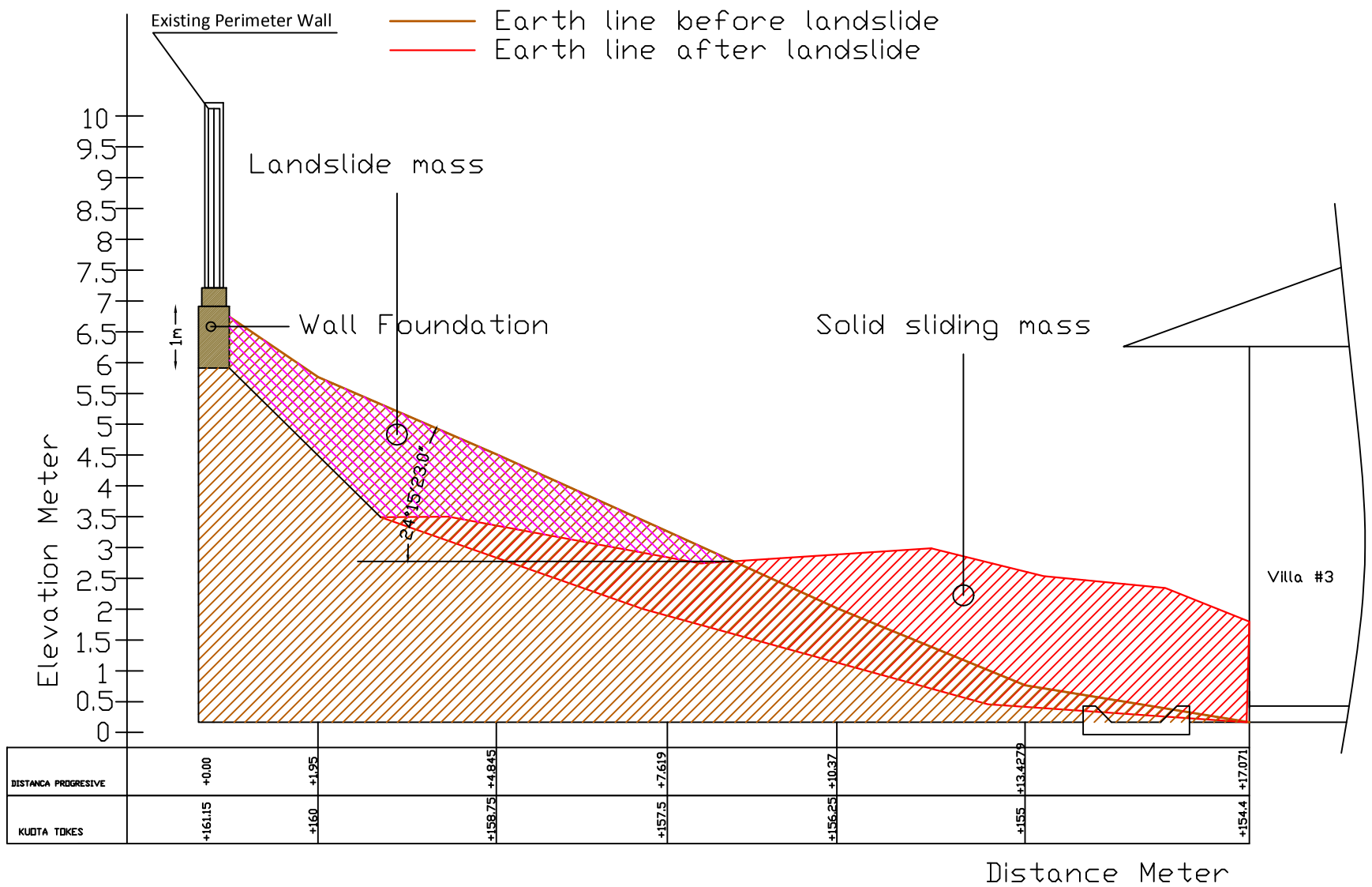
Drawing Title:

EXISTING SITE PLAN

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Concept

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

CROSS SECTION A-A



DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

Drawing Title:

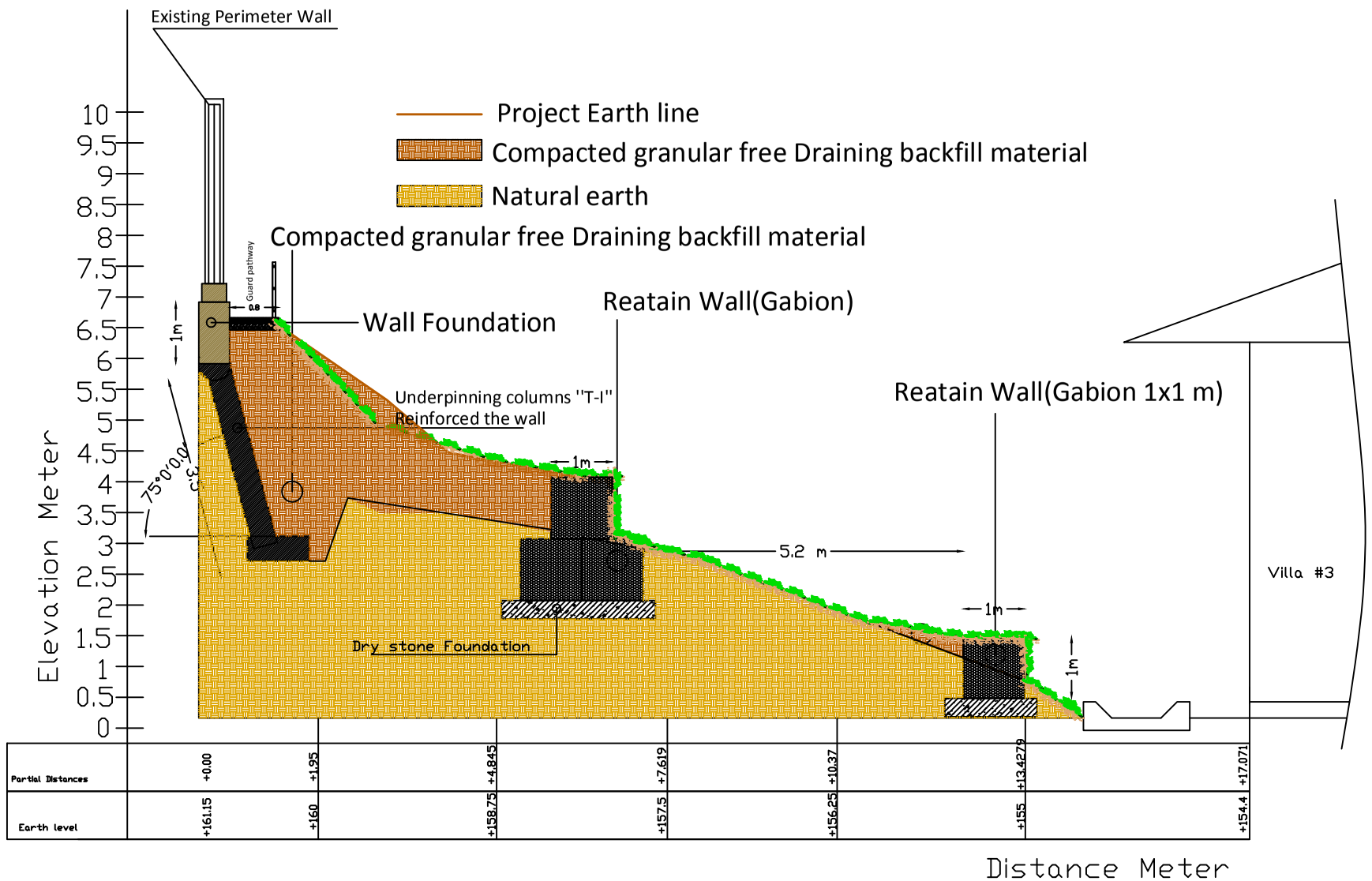
EXISTING SITE PLAN

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Existing

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

PROPOSAL CROSS SECTION A-A

PROPOSAL UNDERPINNING COLUMNS AND RETAIN WALL



Technical Proposal:

1.Underpinning (support) columns will reinforced the perimeter wall.
2.Retain wall (Gabions) proposed to avoid the landslide from the hill.
3.Retain wall dimensions shall be 1x1 m, steel net shall use and stone blocks.
4.The contractor shall return the site to its original condition.

DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

Drawing Title:

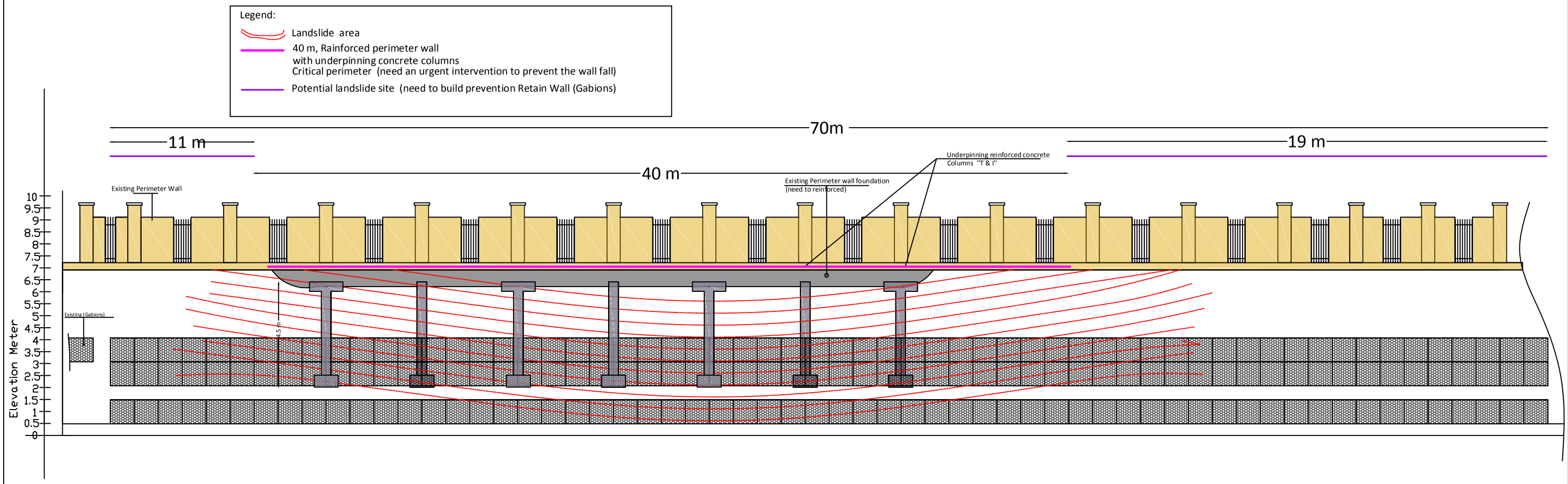
PROPOSAL SECTION

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Concept

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

LONGITUDINAL SECTION B-B

PROPOSAL UNDERPINNING COLUMNS AND RETAIN WALL



Gabions Model

Technical Proposal:

1.Underpinning (support) columns will reinforced the perimeter wall.
2.Retain wall (gabions) proposed to avoid the landslide from the hill.
3.Retain wall dimensions shall be 1x1 m, steel net shall use and stone blocks.
4.The contractor shall return the site to its original condition.

DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

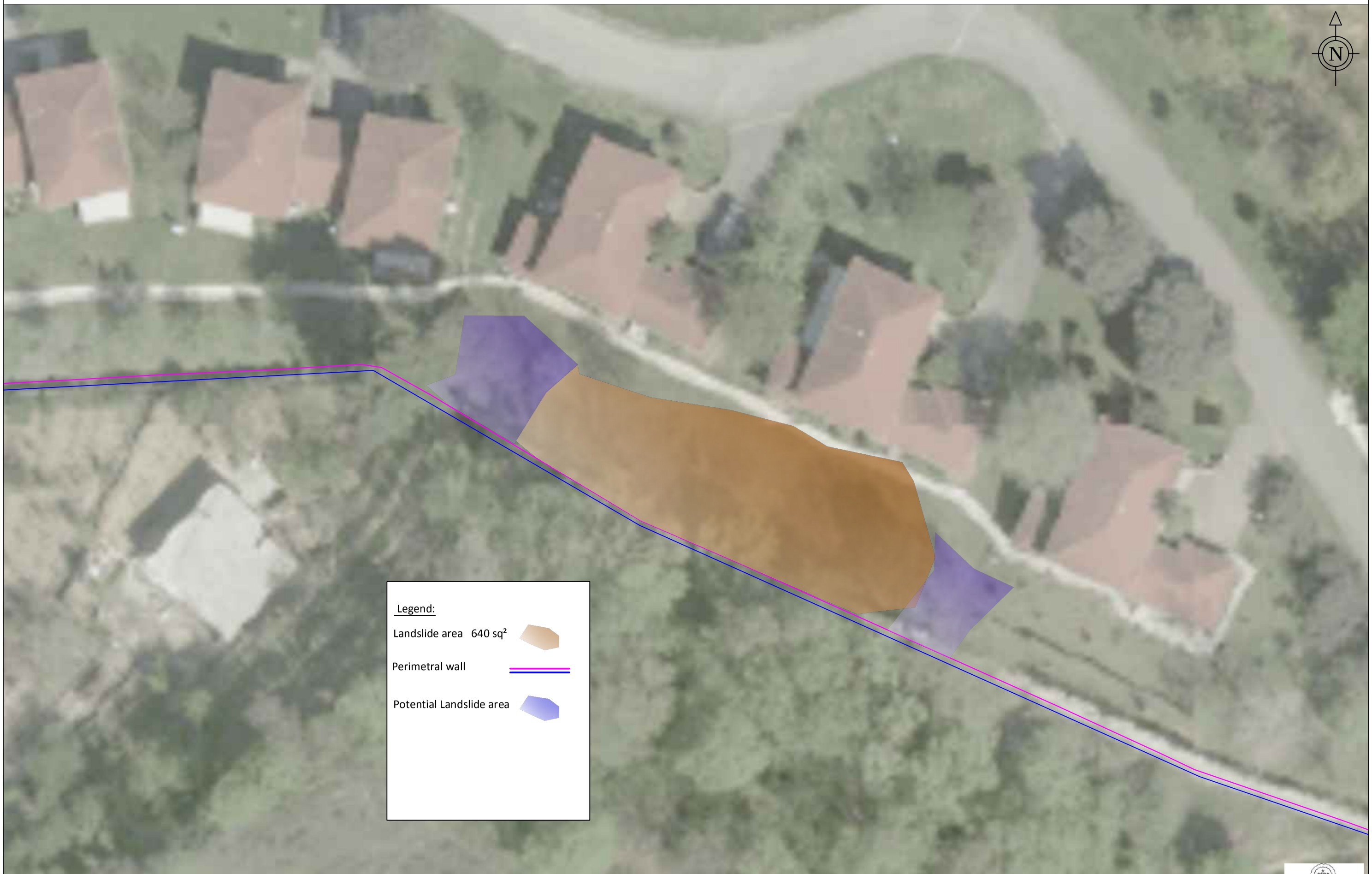
Drawing Title:

LONGITUDINAL SECTION B-B

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Concept

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

EXISITING SITE PLAN



DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

Drawing Title:

EXISTING SITE PLAN

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Existing

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

Site Pictures

Point 1

Point 2

Point 3

Point 4

DESIGN & DRAWN BY:

FACILITY MANAGEMENT

Project Location

Rilindja Ridge Compound

Project Title

Rilindja Ridge Perimeter Wall structure Reinforcement and Retain Wall (Gabions Model)

Drawing Title:

SITE PICTURES

Layout nr :01
Drawing scale 1:---
Design dt: 1-25-2016
Phase:Existing

EMBASSY OF THE UNITED STATES
TIRANA-ALBANIA

two-story frame residence
entrance quote 3154.294
two-story frame residence
two-story frame residence
two-story frame residence
213° 12' 04.0"
STAT_G
153.4
BMARK_15
153.795
CORNER_17
LENGTH_CORNER_16_TO_CORNER_17
32.423 M
BMARK_14
160.656
173° 58' 00.00"
10 m
LONGITUDINAL SECTION "B-B"
entrance quote 155.400
two-story frame residence
two-story frame residence
two-story frame residence
one-story frame garage
two-story frame residence
two-story frame residence
LENGTH_CORNER_15_TO_CORNER_16
64.546
N
N

Licence Nr. GJ.0024

AUTHOR

Dr. Eng. ALBERT DIMCO

REPORT ON THE GEOLOGICAL -ENGINEERING CONDITIONS OF "R.A.A." - TIRANA

TIRANA 2000

Dec 2000?
or
T... 2000?

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IV.2. EXPERIMENTAL WORKS

IV.3. LABORATORY TESTS

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INTRODUCTION

As ordered by the Tirana-based U.S. Embassy, the following geological-engineering and geo-technical studies were performed, in the course of the period December – January 2000, in the Residential Complex of Villas property of the U.S. Embassy, respectively the ground in the neighbourhood of the U.S. Ambassador's Villa. The area examined is situated on the left of the national road network Tirana-Elbasan, North of the National Martyrs' Cemetery. (Photo 1)

The principal task consisted in re-estimating the geological – engineering and geo-technical condition of the area in the neighbourhood of the U.S. Ambassador's Villa, in view of the fact that, two years following the construction of the villa and the tennis court, several cleavages have emerged. After conducting the initial examination related to the damage inflicted in the above-mentioned objects, the geological – engineering and geo-technical was drafted. With a view to determining the causes bringing about the damages in the villa and the tennis court, first and foremost in the course of compiling the study program, attention was focused on the probability of the existence of a gliding plan on that slope, secondly, the attention was focused on determining the probability of swelling and shrinkage for the clayey soils, part of the lythological composition of the study area. Therefore complex geological – engineering and geo-technical study works have been carried out in accordance with a well-defined methodology in line with the following type and volume:

- Geo-technical drills by taking samples 67.3 ml
- Test with penetrometer (SPT) 20
- Topographic works
- Piezometric pits 3 pieces
- Various analyses intended to determine the physical and chemical properties observed under laboratory conditions 20 sets

The report submitted successively focuses on: general data for the geological composition of the construction zone and the construction site, the hydro-geological conditions of the construction site, the methodologies of the geo-technical studies, the physical and mechanical properties of soils and bedrock, defects encountered in the relevant construction site, and the "R.A.A." Villa, conclusions and recommendations, and

the literature appended. The report is associated with photos, graphs and documentation of the works performed.

I – GENERAL DATA ON THE GEOLOGICAL CONSTRUCTION OF THE CONTRUCTION ZONE AND SITE

A short information about the geological construction of the zone and about the geological construction of the construction site is given in this chapter, within the general geological framework of the zone.

I.1. GEOLOGICAL CONSTRUCTION OF THE STUDY ZONE

From the ***geomorphologic*** point of view the study zone pertains to the Seaside Lowland in the area including the fields and the hill regions stretching between Lezha – Tirana, and Durres. This zone constitutes one of the largest regions for the Seaside Lowland. It is principally built on Mollasic terrigenous Neo-genous rocks constituting the hillside area, and the Quaternary rocks represented by the alluvial, marshy, lagoon and seashore deposits, principally building the lowland zone. Depending on the Neo-techtonical movements, the Tirana Plain possesses various altitudes. Tirana is situated approximately 170 m above sea level. The hills are in ranges, their East-side slopes being more inclined (about 20-35 degrees) than their respective West-side counterparts. In the direction of Tirana, they tend to become less inclined. The site examined is situated in one of those hills. From the geomorphological point of view the site examined is situated in the borderline area stretching between the lowland and hillside zone, tending towards the latter.

The climate of the study zone is of subtropical Mediterranean type characterised by a relatively short, mild and very humid winter, whereas summer is very hot and very dry. The sunny radiation for the Tirane region varies between the limits of 60.97 for January to 207.81 Kwh/m^2 per month for July. The general annual radiation in the Tirana city amounts to 1505 Kwh/m^2. The number of the sunny hours amounts to a total of 2589 hours annually. The wind movement direction in the Tirane region is Southwest-Northeast, its velocity varying between 2.8 to 3.0 m/s, rarely being higher. The air average temperature varies between the limits of 6.8^{0}C(January) to 28.8^0 C (August). The maximum temperature measured is 20.6^0 (January) and 39^0 C (August), as measured within a thirty-year time-span. The minimum temperature measured is -10.4^0 (January) and 10^0 C (August). The average monthly rate of the rainfall varies from 42 mm (July) to 174 mm (November), the average overall rate amounting to 1273.

From the ***geological*** point of view, as shown in the Tirane region geological map, the study zone is constructed by the Tortonian, and the Quaternary deposits (Picture 1). The Tortonian deposits constitute the bedrock for the Tirane city. They comprise the complete Mollasic geological cross-section, the depth being 2000-3000 m, composed of 5 principal strata distinct from one-another. In view of the fact that the bedrock for the entire Tirane graben and the surrounding hills is built up by the Mezez suite, its general features are provided in the following.

The Mezez suite constitutes the central part of the Tirana Synclinal and the major part of the bedrock for the foundation of the Tirana city and its surrounding hillside areas. It is represented by the knitting of siltystone, clays and sandy packets, thereby characterised by the emergence of clays, and siltystone. The Quartenarian depositions cover is situated on top of them. The siltystone and clayey knitting packets contain minerals pertaining to the Illyte and Montmorryllonite groups.

The Quaternarian depositions are represented by eluvial-deluvial facies, flood plain deposits, and aluvial facies. The study area, the site examined included, are composed of eluvial-deluvial facies, thereby covering the entire hillside area surrounding the Tirane city and the respective slopes, the depth being 0.5-2.0 m. The greatest concentration of the above-mentioned facies is encountered at the bottom of the hills and the negative sections of the relevant relief, wherein their depth amounts to 4.0-6.0 m. They are represented by subargilles of brown-yellow colour.

From the techtonical point of view, the Tirane region is composed of two structural storeys. The lower structural storey is techtonically complicated consisting of several synclinal and anti-clynal structures their general direction being Southeast-Northwest, the respective direction being displaced due to the techtonical disruptions possessing the amplitude amounting to 2000 m.

The upper structural storey represents a supra- positioned synclinal, the Mollasic, post-Tortonian depositions taking part in its construction. The synclinal is asymetric, possessing a relatively quiet Eastern wing, whereas the Western side is somewhat slopy, tending even towards overturning.

The history of the geological evolution for the region has testified to the effect that the latter has been subjected to powerful techtonical actions, present even nowadays due to the earthquake effects. According to the seismic regionalisation (Albanian regionalisation map 1: 500 000) the region is part of the zone prone to earthquakes amounting to a degree of 7 MSK-64.

1.2. THE GEOLOGICAL COMPOSITION OF THE CONSTRUCTION SITE

The construction site examined, wherein the existing two-storey villa of the American Ambassador is situated, is established on the alluvial-deluvial depositions, the latter being established on the bedrock of the Mezez suite. It is clearly evident from the works performed that the alluvial-deluvial covering crust is established on the claey-aleavrolytic depositions of the Mezez suite. According to the study works with drills performed, generalising cross-section of the alienated composed of the following lythological kinds, associated with the geological-lythological types (Picture 9,10,11,12,13) is provided from top to bottom direction:

- Light to average dusty subargilles, of yellowish brown, rust-spotted colour, with moisture, little or averagely compacted. That layer has the largest thickness in the S-2 drill, approximately 3.70 meter, the minimum thickness being in the drill S-5 amounting to about 1.9 meter.
- Heavy subargilles to greyish brown-spotted argilles, with moisture amounting to too much moisture, plastic and averagely compacted ones. Their thickness varies from 0.6 meter (S-1) to 3.2 meter (S-6).
- Average dusty plastic subargilles, of alluvial manifestation, of yellowish brown colour, with moisture, average to compacted. Their thickness varies from 1.2 meter (S-2) to 3.3 meter (S-7).
- The bedrock is represented by allevrolite argilles, of brown blue-spotted colour, with little moisture amounting to dry conditions, compacted, being in total extremely dusty. The bedrock is encountered in depth varying from 3.0 meter (S-1) to 7.10 meter (S-6) from the earth surface.

As described in the above, a gradual transition is evident in terms of composition and geo-technical condition of the layers as regards the study zone. They start from the earth crust initially with light dusty subargilles, well-processed due to the alienation processes, to proceed to medium to averagely compacted heavy subargilles, further encountering subargilles of alluvial manifestation, hence the alienated bedrock, finally concluding with fresh bedrock.

Within the framework of the geological-engineering works targeting the Seismic Microzoning for the Tirane city, the site examined is part of the zone VI 2a, the following being a geo-technical model:

0.0 – 5.5 meter	Light to heavy subargilles of brown-yellow colour, frequently possessing knittings of siltysand. The slope inclination is under 15 degrees.

5.5 meter – Bedrock represented by alevrolyte or sand argilles.

II – HYDROGEOLOGICAL CONDITIONS OF THE ZONE AND THE CONSTRUCTION SITE

Relying on the geological composition of the zone and the construction site the classification of the aquiferous complex has been performed. According to the age of the formations composing the zone and the construction site two aquiferous complex are identified:

1) the Quaternary aquiferous complex.
2) the radical formation mollasic aquiferous complex.

QUATERNARY AQUIFEROUS COMPLEX

There are two aquiferous levels in this complex:

a- *THE PHREATIC AQUIFEROUS LEVEL* is associated with contacting the conglomerates of weak cementation to the bedrock, and the contact between the elluvial-deluvial depositions with the bedrock. This level is characterised by inconsiderable water inflow. In specific areas, in instances of relief erosive deepening, those waters are drained even to the earth surface, thereby creating moistened zones. The general mineralisation varies from under 1gr/l; pH fluctuates between 7 to 7.4. The maximum hardness of these waters varies from 16 to 18^0, German scale, hence being non-aggressive to concrete.

b- *THE SUBARTESIAN PRESSURE AQUIFEROUS LEVEL* is characteristic of the Tirane Plain gravels. It is principally fed in by the Tirane river, and very little by the Lana river. It possesses high filtering qualities, the filtering coefficient being 50-200

m/day. The general mineralisation varies from 0.5 to 0.7 gr/l. The maximum hardness of these waters varies from 16 to 18^0, German scale. The chemical composition is of calcium and magnesium hydrocarbonate, hence being non-aggressive to concrete.

RADICAL FORMATION MOLLASIC AQUIFEROUS COMPLEX

This complex is associated with the sandy stones and conglomerates of Tortonian Springs of low water inflow tenths of litre per second.

Referring to the above-mentioned remarks, the geological and engineering works performed testify to the presence of ground waters belonging to phreatic waters, respectively and more concretely to the contact between the elluvial and delluvial depositions with the argilleous-alevrolitic formation of the Mezez suite. The ground water level after 24 hours was encounter as deep as 2.0 metre (S-6) to as deep as 3.63 m (S-2). Piezometeres of plastic composition, diameter 63 mm were employed in S-2, S-5, S-6 to measure the fluctuation of the ground water level depending on time. In the course of drilling underground water was encountered at greater depths. Hence, in S-2, it was encountered at 6.25 meter, in S-5 it was encountered at 3.30 meter, whereas in S-6 it was encountered at 3.60 meter. From the chemical analyses performed for these waters, we can see that the general mineralisation varies from 0.7 to 0.8 gr/l; hardness 18^0, German scale and pH around 7.2. It is of calcium hydrocarbonate type. The water is not aggressive to concrete. The ground water levels will be observed monthly within a one-year period.

III – PHYSICAL AND GEOLOGICAL PHENOMENA ENCOUNTERED IN THE TIRANA ZONE

Several physical and geological phenomena negatively affecting the constructional aspects are observable in the Tirane region and in the neighbourhood of the study site, the following being cases in point: alienation crust, land slides, swelling and ground cleavages during drying.

ALTERATION _Alteration crust is encountered everywhere over the bedrock of the Mezes suite. Due to the influence of the atmospheric agents the argilles and alevrolites pertinent

to this suite have been alienated on the surface, hence forming the alienation crust encountered as deep as 3.0 meter from the earth surface, rarely deeper.

LANDSLIDES as physical and geological phenomena are encountered mainly in the eluvial-deluvial depositions superimposed on the argillous-allevrolitic depositions of the Mezez suite. They are encountered South-wise and North-wise the Pulmonary Diseases Hospital (in the neighbourhood of the study site), on the Northern slope of the National Martyrs' Graveyard (the study site is situated at the bottom of the slope), on the left slope of the Lana river, in the former Auto-Tractor Mill, on the slopes of the Selite hills (Southeast of Tirana), etc. The elluvial-deluvial deposition serves as measure for the sliding body. The landslides are mainly of crawling type, the sliding level is not always clearly evident. Sometimes the landslides capture or affect even part of the partially peraerated bedrock. The depth of the sliding level, according to the geological analysis and the geo-physical measurements performed, is estimated to be 2 to 3.0 meters, rarely amounting to 5.0 meters.

SWELLING AND GROUND CLEAVAGES DURING DRYING This phenomenon is associated with the presence of Illite-Montmorillonite type argilles encountered in the upper part of the alienation crust. Following the thermal-differential tests performed it was observed that 80% of the argillaeous fraction is Illite-Montmorillonite type mineral, its colloidal activity being approximately 1. This phenomenon is directly observed in distorting the one-storeyed buildings having shallow foundations and light loads in their foundations (to the order of 0.4-0.5 kg/cm^2). Such phenomena have been encountered in several buildings near the Senior Citizens' Home (in the vicinity of the study site), in Mihal Grameno Quarter on the hills surrounding the Students' Campus (opposite the study site) etc. In these areas the depth of crust cleavages varies from 1.3 to 1.5 meter. Cleavages of walls, plaster, floors and ceilings encountered in several objects built in these areas are related to the phenomenon of swelling and drying of the elluvial-deluvial argilles. The mineralisation of argilles and allevrolites is of hydromocore and montmorillonite type, therefore they are sensitive to the atmosphere agents (water moistening, solar drying, or through the influence of other heat sources, freezing included).

IV – GEOTECHNICAL STUDY METHODOLOGY

The geotechnical studies were conducted according to the methodology determined by the technical codes applicable in Albania and other Europian countries with relevance to the geotechnical estimation of the geological environments and designing the engineering objects.

The principal types of the geotechnical workings carried out in the geological environment for the construction site were as follows:

- Exploration and topographical works
- Experimental works performed through employing the dynamic penetrometre (SPT), likewise establishing the piezometres.
- Laboratory works with respect to determining the physical and mechanical properties of soils and rocks existent in that environment.

IV.1. EXPLORATION WORKS

The exploration works employed in the construction site were the drilling works, whereas the topographic works are associated with determining the quotas for the drilling points' co-ordinates.

DRILLING WORKS The drilling works were established in line with the two principal profiles, thereby respecting the micro-geomorphology of the study site, as shown in the layout of works location (Drawing Nr. 14). There has been performed a total of 7 drills, in the site of the American Ambassador Villa, through taking undisturbed samples. The drilling of the boreholes was carried out at diameters of 110 mm. The maximum depth reached 10.80 m. The drills were performed with the motor drilling instrument (Photo 2). In the following table the depth of the drillings and the quotas for the borehole tops are provided. The following table provides data relevant to the depth of the drillings carried out, as well as the relative quotas for the respective drill as against the tennis court regarded as 170.0 m. The drillings are supported by the necessary documentation and the samples taken at every 0.5 drilling with a view to determining the physical and mechanical properties of the soils and rocks encountered in the study site.

Nr.	Name of Drill	Depth	Relative Quota
B1	Drill Nr.1	6.8	169.9
B2	Drill Nr. 2	10.80	169.18
B3	Drill Nr. 3	9.8	170.87
B4	Drill Nr. 4	9.5	152.93
B5	Drill.Nr. 5	10.2	164.79
B6	Drill Nr. 6	10.4	165.72
B7	Drill Nr. 7	9.8	159.35

IV.2. EXPERIMENTAL WORKS

The experimental works have consisted in the tests of the dynamic penetrometer (SPT). The dynamic penetrometer (SPT) tests have been carried out in all the lythological types of soils and rocks encountered in the study site. They have been performed in compliance with the technical condition ASTM 1589/68 "Penetration Test and Split-Barel Sampling of soil". (Photo 3). The geological documentation associated with laboratory test has been recorded after every interval the dynamic penetrometer has been effected. With respect to 5.0 m depth, the SPT tests have been performed at every meter. Further deeper, they have performed in line with the lythological changes of depositions.

IV.3. LABORATORY TESTS

The laboratory tests were performed on both the undisturbed and disturbed structure samples. Their target was to determine the values associated with physical and mechanical indicators of soils and the bedrock in the construction site.

IV.3.a. GRANULOMETRIC CONTENT

The granulometric content has been determined by means of the standard sieves series for the granules over 0.075 mm in diameter. Whereas for smaller granules the hydrometric approach has been employed (Photo 4). The test weight has been determined on the basis of the granules maximum diameter. The granulometric analysis contributed to map the granule distribution for all the samples obtained.

IV.3.b. Gravity density, bulk density and dry density

The gravity density is determined by employing the classical picnometer approach. Whereas the bulk density was determined by the ring method for a familiar volume (100 cm^3), and the picnometer method for the irregular and undisturbed structure samples. After determining the samples bulk density, following their drying at temperature 105^0 C, the dry density and humidity content were determined. The above parameters served to calculate the porosity, rate of porosity, humidity of saturation, degree of saturation etc.

IV.3.c. ATTEBERG LIMITS

The Atteberg limits serve to determine the liquidity limit (wl), plastic limit (wp) and the index of plasticity (Ip). The plastic limit has been determined by employing the classic method of thinning. Whereas the liquidity limit is determined by the penetrometre cone, WF 21600 Type (Photo 5) The Atteberg limits have been determined for granules having a diameter smaller that 0.4 mm.

The soil identification is effected on the basis of the granulometric content and ASTM (D 2487) classification.

IV.3.d. TESTS OF SHEAR RESISTANCE

Test of shear resistance have been performed with a view to determining the two principal indicators, respectively cohesion (c), and the angle of internal friction of soils on undisturbed structure samples. The Cassagrande box (Photo 6) was empoyed to determine these indicators. Test were performed with consolidation and draining (CD) and without consolidation and without draining (CU).

IV.3.e. COMPRESSION TESTS

The compression tests were performed through employing odometers with a view to determine the Module of Compression for the interval of loads 1 to 5.0 kg/cm^2 and the

index of compressibility (C_c), and index of swelling (Cg). The compression equipment is shown in the Photo 7.

IV.3.f. UNIAXIAL TESTS

The resistance in uniaxial compression has been determined in the undisturbed structure samples extracted during the drilling works. The samples prepared are cylindrical in shape their length being double their diameter (10 cm in length, 5 cm in diameter). Even the samples extracted by employing the Rymond type dynamic penetrometer (SPT). The equipment employed to perform the uniaxial test is shown in photo 8. The cohesion without consolidation and without draining (Cu) for the soils has been determined through performing this test.

V – LAYERS AND THEIR PHYSICAL AND MECHANICAL PROPERTIES

Based on the geological – lythological cross – sections and based on all the dates of exploration works the layers of the construction site are differentiated. The layers are marked in the geological – lythological cross – sections, from top-bottom, respectively 1,2,3,4 In the chapter of geological construction of construction site there are differentiated two zones that are different from each other in the geological-lythological cross-section.

For the construction aims for each layer the physical and mechanical properties are processed, separated in all the geological-lythological columns. The classification ASTM is used in the classification of soils. The bearing capacity for each layer according to their physical and mechanical properties of is given, based also on the "Technical code of projecting of foundations of constructions KTP-N-A-1983, of Republic of Albania. These are considered as normated loads.

Layer Nr.1 Yellowish brown, rust-spotted, with moist, plastic, dusty medium subclays to clays (Lean clay to fat clay CL-CH), slightly compressed. Being part of the alienation crust, they are characterised by variations of clayey and sand fraction content. According to the ASTM classification the soils of this layer are lean clay with sand (CL) They have the clayey fraction smaller that 0.002 mm, 18 – 42 %, dusty fraction 35-50 %, sand fraction up to 30 %(Fig. 34). The granulometric cover of this layer is given in picture 15. The physical and mechanical properties for this layer are as follows:

Granulometric content

Sand fraction (0.05 – 2.0 mm)		32 –14 %
Dusty fraction (0.05 – 0.002 mm)		56 – 64 %
Clay fraction < 0.002 mm		12 – 20 %
Specific density		2.69 – 2.71 gr/cm^3
Bulk density		1.93 – 2.04 "
Dry density		1.60 – 1.69 "
The liquidity limit	W_l	37.90 – 48 %
The plasticity limit	W_p	24.40 – 30.16 %
Index of plasticity	I_p	13.50 – 17.84 %
Colloidal activity	Ac	0.97 – 1.0
Natural humidity	W_n	18.2 – 22.3 %

Porosity	n	36.9 - 40.6 %
Index of porosity	e	0.58 – 0.68
Index of Compression	C_c	0.7 – 0.8
Index of Swelling	Is	0.46 – 0.48
Pressure of Swelling	σs	0.4 – 0.5
Module of Compression	E_{1-3}	55-89 kg/cm^2
Cohesion without draining, without consolidation	C_{uu}	0.45
Cohesion with draining, with consolidation	(C')	0.25 kg/cm^2
Angle of internal friction		16^0
SPT		12-14
Bearing capacity		1.5 kg/cm^2

Layer Nr.2 Heavy subclays up to dusty clays (Lean clay – CL), with grey colour, brown-spotted, plastic, averagely compacted. According to the ASTM classification they are classifiable as lean clay with sand (CL). The granulometric cover of this layer is given in picture 16. The physical and mechanical properties of this layer are as follows:

Granulometric content

Sand fraction	0.05 – 2.0 mm		32-20 %
Dusty fraction	0.05 – 0.002 mm		48-53 %
Clay fraction	< 0.002 mm		20-27.2 %
Specific density			2.713-2.728 gr/cm^3
Bulk density			1.89-1.97 "
Dry density			1.56-1.64 "
The liquidity limit		W_l	40.8 - 49.0 %
The plasticity limit		W_p	23.1 - 27.0 %
Index of plasticity		I_p	17.7-22.0%
Activity		Ac	0.9-0.95
Natural humidity		W_n	20.0-21.5 %
Porosity		n	39.0-41.8 %
Index of porosity		e	0.64-0.718
Module of Compression		E_{1-3}	83.0 - 95 kg/cm^2
Index of Compression		Cc	0.25 - 0.28
Cohesion with draining with consolidation		C'	0.25 kg/cm2

Angle of internal friction	$\phi' = 16^0$
SPT	13-21
Bearing capacity	1.8 – 2.0 kg/cm^2

Layer Nr.3 Average dusty subclays of elluvial appearance, yellowish brown colour, slightly plastic, compacted up to medium compacted. This layer is heterogeneous in terms of the granulation aspect, hence situated over the bedrock. It represents the partially alienated bedrock, as such it is hard to determine the granulation content or plasticity, due to disintegration difficulty. In addition, due to its own situation, poses difficulties as regards obtaining totally unspoilt structure samples. As regards physical properties, they are soft rocks. The physical and mechanical properties of this layer are as follows:

Specific density		2.695 gr/cm^3
Bulk density		1.95 gr/cm^3
Dry density		1.61 gr/cm^3
Natural humidity	W_n	21.1%
Porosity	n	40.3 %
Index of porosity	e	0.675
SPT		27 - 35
Module of Compression	E_{1-3}	104 kg/cm^2
Cohesion without draining, without consolidation	C'	0.45 kg/cm^2
Bearing capacity		2.2 kg/cm^2

Layer Nr. 4 The alienated bedrock represented by allevrolite clays, yellowish brown, sometimes tending to grey, highly compact (soft rock). The physical and mechanical properties for this formation are as follows:

Specific density		2.712 gr/cm^3
Bulk density		2.01 gr/cm^3
Dry density		1.71 gr/cm^3
Natural humidity	W_n	17.5 %
Porosity	n	36.9 %
Index of porosity	e	0.5847

Uniaxial compression resistance	25-37 kg/cm^2
Hauling resistance	1.7 – 3.2
SPT	45-48
Bearing capacity	> 3 kg/cm^2

In Picture (17-44) there are given the curves of compression serving to calculate the indicators of compression for layers 1-4, whereas in pictures 45-50 there are given the curves of swelling for layer 1.

In pictures 51-57 there are given the Logs of the drillings performed.

VI. DEFECTS IN THE CONSTRUCTION SITE AND "R.A.A" VILLA

As a result of observations made in the construction site and the "R.A.A" Villa, the defects noticed are mainly of cleavage type.

CONSTRUCTION SITE DEFECTS consist in cleavage due to drying manifested in various shapes. The shapes are polygonal, star-like, etc. They fraction the construction site into smaller fragments, as shown in the photos 9,10. The cleavage intensity amounts to 15 per m2. The cleavages do not have any particular orientation. The splitted parts have in several places a downward inclination. The depth of the cleavages measured by employing a metal rod of 0.8 cm in diameter, amounts to 74 cm, testifying to the effect that cleavages less than 0.8 cm in diameter are present even deeper. Within the framework of the geological-engineering regionalisation targeting and functional to the Seismic Microzoning of the Tirane city, the pits opened in these depositions testified to the effect that the cleavages due to drying are encountered as deep as 1.5 meter. On-site measurements concluded that the cleavages due to drying are as wide as 3.0 cm. Vegetation (trees) have verticality deviations, testimony of displacement of the soil mass at time intervals (Photo 11,12)

Construction site defects have been observed even in the tennis court. They have principally developed in the North-Northeast, South-Southwest orientations (photo 13, 14, 15), crossing through almost the entire tennis court. The cleavages in this tennis court are as much as 10 cm wide, their uninterrupted length varying from 1 to 10 meters. The cleavage depth measured with the metal rod amounts to 0.32 cm.

DEFECTS IN THE "R.A.A" VILLA

These defects are mainly encountered as cleavages on the floor and the connecting elements regarded as weak constructional parts. The main cleavages on the villa floor principally developed in the North-Northeast, South-Southwest orientations, being as wide as 3 cm. (photo 16, 17). The wall cleavages have an almost vertical orientation or 45 degree inclination (Photo 18, 19). Cleavages are encountered even in the fencing wall at an almost vertical angle, their width being almost 1 cm (Photo 20, 21). Observing the defects encountered in the villa, it is concluded that they have mainly developed on its Eastern side, less on its Western side, testimony of the solar radiation influence on the

clayey soils of the basement. No defects are observable on the Southern side of the villa, as well as all along its frontal part. Cleavages in the villa and the fencing wall have been manifested two years following completion of the construction work.

The "R.A.A" Villa has wood-type construction, the foundations are built on plinths for the four types employed (A,B,C,D) respectively 0.16, 0.25, 0.36, and 0.50 m2. The foundation dimensioning has been calculated for the earth surface permissible loads 1.5 kg/cm2. According to the project specifications the loads the plinth transmits to the basement is 4302 Pa or 0.04302 kg/cm2. The distance between the plinths in a row is 2.50 m, whereas the distance between rows varies from 1.5 to 2.50 meter. The plinth heads are connected with wood beams, the ground floor supported on them. The plinth basis distance from the earth surface is 0.915 meter. With the exception of the Southern side, corresponding to its entrance garden, the "R.A.A" Villa has no pavement.

Familiarity with the defects of the construction site and the building itself, the geological construction, the hydrogeological conditions and the geo-technical features of the layers participating in the lythological construction of the study site, made us identify the reasons by focus our principal attention on two probable aspects:

1- Probability of soil mass slide according to a possible plane.
2- Probability of emergence for the swelling phenomenon and drying for the alienation crust subargilles whereon the foundations of the building are established.

As regards the probability of the sliding phenomenon according to a possible plane for the elluvial-deluvial cover, the samples extracted through drilling works, as well as the depth of encountering the ground waters level have been documented by attaching special attention. The trees deflection, the obvious presence of a sliding plane, as shown in the geological-lythological cross-sections, as well as the presence of the ground waters level testify to the probable presence of this phenomenon.

The trees' distortion, especially those encountered on the Western side of the villa, has been due to the impetuous surface sliding in the course of the recent 40-45 years. Their deformation for the last 10-15 years is not observed, since the upper part of the trees have a vertical orientation. Other indicators of surface deformation, such as displacement of the object, soil, fencing wall, etc. have not been been observed. There has been noticed only a slight displacement, independent of the construction study site, beyond the fencing walls zone, near Drill Nr 4. Th slide plane has been encountered in six bore holes performed, as reflected in a zone of changeable thickness, likewise composed of average

to heavy subclays, with much moisture, softly plastic to fluid plastic. This horison almost coincides with the contact between the elluvial-deluvial depositions with the partially alienated part of the bedrock. Likewise, it coincides with the level of the underground waters, having a hydraulic gradient to the order of 0.04. In view of the fact that average to heavy subclays with a filtering coefficient less than that of the water-bearing level, are situated above this level, the underground waters is under pressure, hence elevated from 6.25 to 3.63 meter (S-2).

The falling plane for the gliding plane is 5 degrees.

The physical and mechanical properties for the gliding plane zone are as follows:

Specific density		2.72 gr/cm^3
Bulk density		1.76-1.80 gr/cm^3
Dry density		1.39-1.44 gr/cm^3
Porosity	n	48.3-46.7 %
Index of porosity	e	0.93-0.87
Natural humidity	W_n	26.8-24.6 %
Cohesion without draining, without consolidation		0.12-0.18 kg/cm^2
Angle of the remaining internal friction		8^0
Module of Compression	E_{t-3}	28-31 kg/cm^2

The gliding plane angle is less than the relief inclination angle. This angle is equal to or less than the relief gravity angle. On the other hand, the laboratory tests have shown that the saturated subclays have an internal friction angle of about 16 degrees, whereas the friction angle calculated according to the gliding plane is greater than the relief angle and that of the gliding plane. Under these circumstances, the gliding body is at the moment in an equilibrium situation. According to the relief micro-morphology, this equilibrium is better in the direction of the North-Northwest orientation.

The probability of swelling and drying for the elluvial-deluvial subclays is present and evident, arguable in view of the following data:

1. The subclays contain contain illite-montmorillonite mineral to the extent of 80 % of the clayey fraction, hence the colloidal activity around one.
2. The presence of subtropical climate with humid winter, and dry summer.
3. The presence of cleavages due to drying, as deep as 1.5 m.

4. The presence of swelling pressure to the order of 0.4-0.6 kg/cm^2
5. The presence of defects after the two summer-winter cycle.
6. The foundations are of the plynth-type with slight incastration depth (0.915 m).
7. The load of 0.043 kg/cm^2 over the plynth is smaller than the that of the swelling pressure.
8. There are no pavements for the buildings hence the difference of moisture underneath the basement can not be avoided.

With a view to estimating the phenomenon of swelling and drying, as well as determining the strength of swelling on the basement, samples extracted as deep as 2.0m from the earth surface have been studied. In addition to the analyses for the physical properties, the swelling tests have been performed. The value of the swelling pressure was determined analytically thanks to the data obtained. The mineralogical thermal-differential analyses concluded that the clayey fraction contains illite-montmorinollite mineral amounting to 80 %.

The granulometric analysis has shown that the clayey fraction varies from 12-20%. The plasticity limit varies from 24.4 to 30.2 %. Comparing these values to the natural humidity it is evident that soils are still capable of absorbing water until they reach the plasticity limit whereby the swelling capacity for the clays fall under zero. Based on the plasticity index, the average swelling potential for the subclays amounts to 5%, whereas according to the content of grains under 0.001 mm and the plasticity index, the subclays vary from the low to average swelling potential. According to the relationships between the dry density and the liquidity limit, the subclays manifest swelling capacities. Comparing the data for the liquidity limit W_l, and the idex of swelling (Is), it is graphically indicated that the pressure of swelling vries from 30 to 125 Kpa. Directly, through resorting to the edometric test, the respective pressure results to be of the order 0.4-0.6 kg/cm2, almost ten times as much as the load exerted by the object to the basement through the plynth 0.043 kg/cm2.

VII. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions have been reached following the generalisation of the geotechnical material obtained from the study construction site.

1 – The construction site within the framework of the geological-engineering regionalisation targeting the Seismic Microzoning for the Tirane city belongs to zone VI 2b, having a well-defined geo-technical model: 0.0-5.5 meter alienated crust, over 5.50 meter bedrock represented by allevrolite clays from the Mezez suite of the Tortonian age, whose main clayey ore is of hydromic-montmorillonite type.

2 – From the geo-morphological point of view the study site is situated on the Northern radius of the Sauk village hills, opposite the students' Campus, their relative inclination being about 6 degrees. From the climatic point of view the Tirane city has a subtropical climate, humid winter (the average annual fallout is 1273 mm), hot summer (the maximum average temperature 39 degrees).

3 – The geological construction of the study site is simple. As a result of the works performed the alienation crust is clearly evident moving from the surface further deeper. The deeper the weaker the alienation is. It is well-processed on the surface, hence gradually moving towards bedrock represented by the allevrolite clays. A series of layers, depending on the natural conditions and the geo-technical features, have been identified in the geological-lythological cross-sections as far as the bedrock. The Illyte-Montmorillonite minerals constitute about 80% of the clay minerals in these layers of the alienation crust.

4 – From the hydrogeological point of view the construction site contains ground waters. The under ground water level is initially in the depth 3.30 m, (D-5), in the depth 6.25 m (D-2), hence coinciding with the contact point between the alienation crust and the bedrock. After 24 hours the ground waters level was stabilised at depths varying from 2.0 m (D-6) to 3.63 m (D-2) from the earth level. The waters are of calcium hydrocarbonate type, hence non-aggressive to concrete.

5 – The geotechnical properties of the alienation crust, generally speaking are good, the bearing capacity varying from average to high. Through studying the geo-technical features, out attention is attracted by swelling and drying capacity of the first layer of the alienation crust, the swelling potential estimated to be as much as 5%, the swelling index varying from 0.46 to 0.48 , the swelling pressure varying

from 0.4 to 0.6. The cleavage depth in the study site amount to as much as 1.50 meter. The depth of cleavages on the site surface amounts to 3.0 cm, amounting to 10 cm in the tennis court.

6 – Studying the geological-lythological columns, a weak considerably humid zone representing a gliding plane with a five-degree inclination has been identified. This plane is associated with the ground waters level.

7 -The defects encountered in the villa are of cleavage type. As a result of observations made in the construction site and the "R.A.A" Villa, the defects noticed are mainly of cleavage type. They have principally developed in the North-Northeast, South-Southwest orientations crossing through almost the entire tennis court. The cleavages in this tennis court are as much as 10 cm wide, their uninterrupted length varying from 1 to 10 meters. They are situated mainly in its peripheral parts, in the asphalted area. Defects in the "R.A.A" Villa are mainly encountered as cleavages on the floor and the walls. The wall cleavages have an almost vertical orientation, rarely do they have a 45 degree inclination. The cleavages encountered on the floor have the North-Northeast, South-Southwest orientation, being as wide as 3 cm. The trees as old as 40-45 years have been mainly distorted in the lower parts, whereas in the upper part they have vertical inclination, testimony of the construction site stabilisation. The defects encountered in the object are mainly concentrated on those parts mostly exposed to the solar radiation. These defects have emerged after two winter-summer cycles, following completion of the construction work.

8 -The "R.A.A" Villa has wood-type construction, the foundations are built on plinths for the four types employed (A,B,C,D) respectively 0.16, 0.25, 0.36, and 0.50 m2. The foundation dimensioning has been calculated for the earth surface permissible loads 1.5 kg/cm2. According to the project specifications the loads the plinth transmits to the basement is 4302 Pa or 0.04302 kg/cm2. The distance between the plinths in a row is 2.50 m, whereas the distance between rows varies from 1.5 to 2.50 meter. The plinth heads are connected with wood beams, the ground floor supported on them. The plinth basis distance from the earth surface is 0.915 meter.

9 - Relying on the study data obtained it has resulted that the main reason for the damages inflicted and observable in the construction object is associated with the phenomenon of swelling and drying of argilles, therefore immediate

intervention is required with a view to preserving the uniformity of the moistened condition of the soil underneath the foundation. The immediate intervention at the initial stage intended to eliminate this phenomenon developed during the winter-summer cycle should consist in the following:

- The non-asphalted sections of the villa should be dug as deep as 2.0 meter, the surface width being 2.0-3.0 meter, the width decreasing further deeper, as shown on page 58. The dug-out portion should be filled in with clayey matter of non-swelling capacity, thereafter rammed by using heavy hammer at every 15 cm.
- The upper part, the rammed area should be covered with a thermal-insulating coating of asphalt 10-30 cm thick, or other thermal-insulating material. After that the pavement should be laid with pavement slabs
- The water-draining gutter should be built all along the intervention zone.

10 – As regards the tennis court the same intervention should be effected with a view to avoiding that phenomenon:

- Ramming the basement of the tennis court after the asphalt coating has been removed.
- Laying the tennis court with a layer of 20-30 cm-thick armoured concrete, further coated with bitumen.
- The tennis court dimensions should be extended by 2.0 meter more than the existing dimensions, the surface waters draining system should be constructed all around the tennis court.

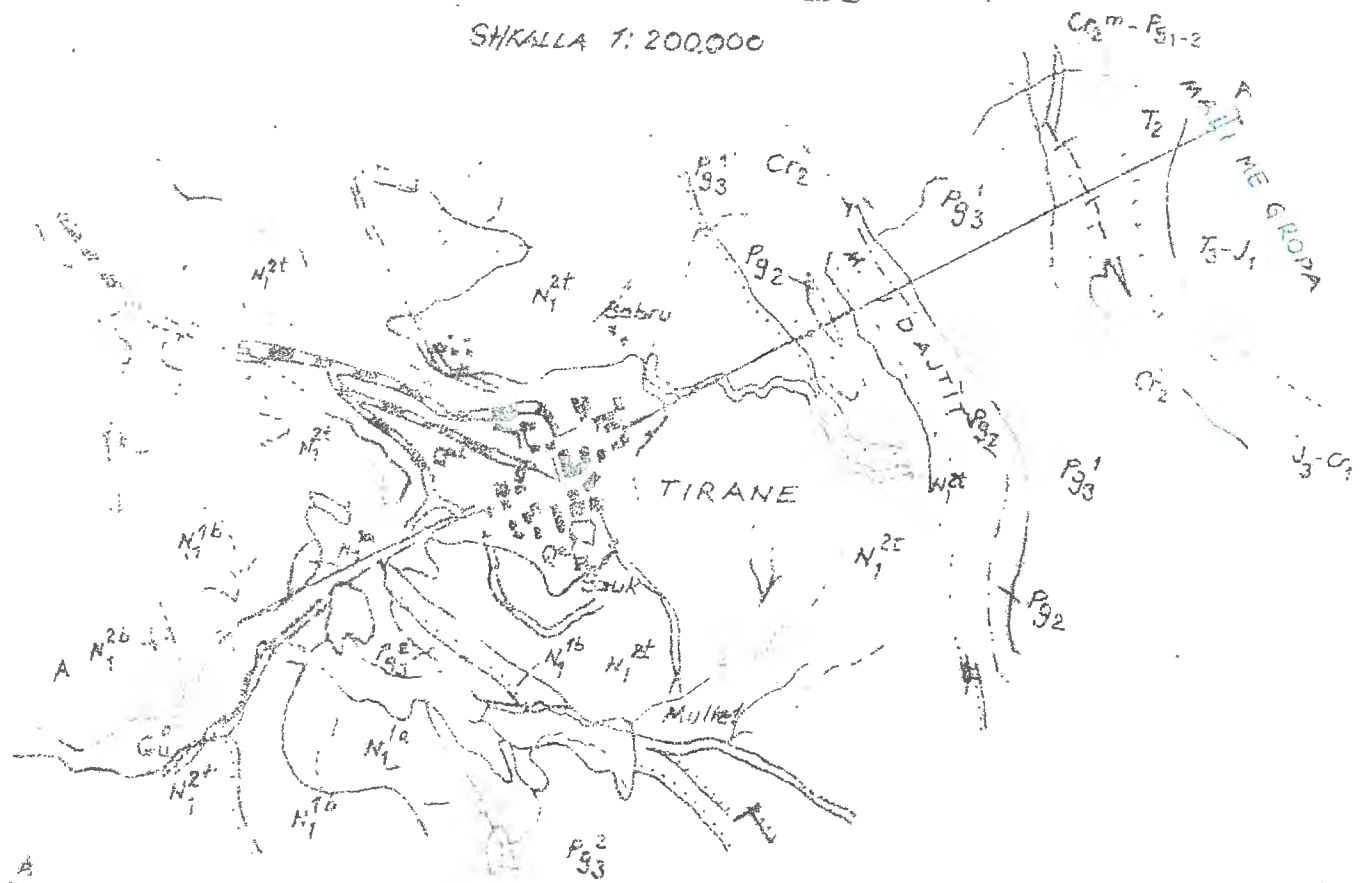
11 - As regards the fencing wall the intervention should be effected in the foundation base so as to increase the depth of plynth insertion (no less than 2.0 meter from the surface).

After the above-mentioned measures have been taken, the construction objects should remain under the observation of the author for this study. In the event of potential lingering defects, then there should be resorted to the second stage envisaging the protection of the object against the construction site gliding, by building two rows of wall with piles, one row established on the upper part of the tennis court, whereas the other being established on its lower part (near S-1) having

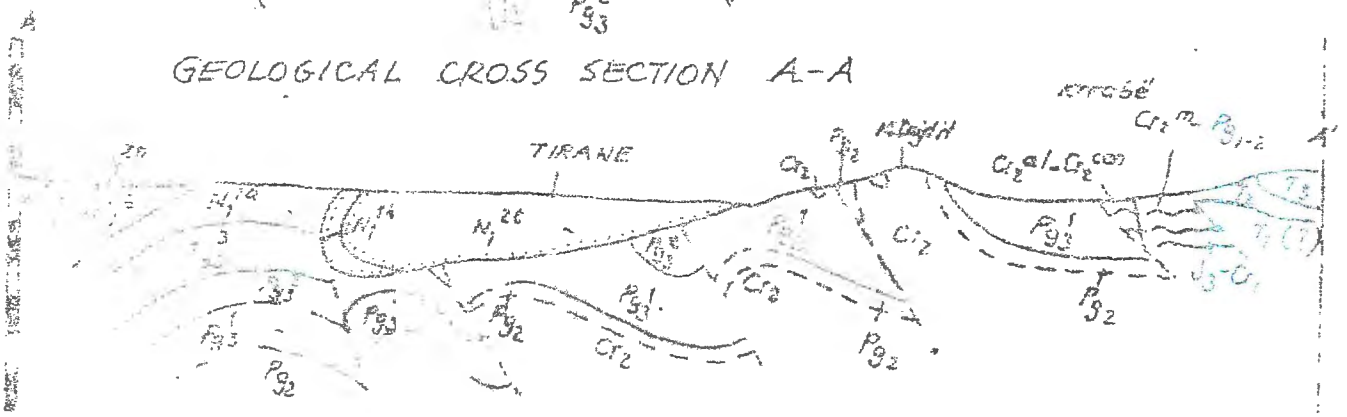
a North-Northeast —South-Southwest orientation. The depth of piles should exceed the sliding plane as shown on the geological-lythological cross-section.

The above-mentioned recommendations should be discussed with the construction designers' team, hence the author of this construction study should be supervisor for the implementation works.

SHKALLA 1: 200.000



GEOLOGICAL CROSS SECTION A-A



LEGJENDA:

- Q — Aluvione te hereshme dhe te zallishteve
- N_1^{2t} — Molase tortoniane. alevrolite, rranore, argjila
- N_1^{2k} — Rranore gelqerore hitotamike helvecian
- N_1^{2b} — Argjila alevrolite rranore, e gelqerore burdigalian
- N_1^{2a} — Flish akuitanian
- P_{g3}^{3} — Flish i oligocenit te siperm
- P_{g3}^{2} — Flish i oligocenit te mesem.
- P_{g3}^{1} — Flish i oligocenit te poshtem
- P_{g2} — Gelqerore eocenik
- P_{g1-2} — Flish me ndershtresa gelqeroresh - Kreshte
- Cr_2 — Gelqerore te kretakut te siperm.
- J_3-Cr_1 — Flish i hershem
- T_2 — Gelqeror me ndershtresa strofore e tufesh.
- T_3 — Gelqerore te triasikut te siperm
- Thyerje tektonike
- Kufi gjeologjik: a) normal b) transgresiv; c) me pushim
- Studying area

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA1(169.9)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT	DATA
Q4	167.5	2.4		2.4	Suargjila te lehta - te mesme pluhurore, kafe te verdha, me njolla ndryshku, me lageshti, plastike, pak deri mesatarisht te ngjeshura		
Q4	166.9	3		0.6	Suargjile t mesme - te renda pluhurore, me ngjyre kafe, me njolla ndryshku e blu, me lageshti, pak deri mesatarisht te ngjeshura		
Q4	165.9	4		1	Suargjila te mesme pluhurore me panje eluvjale, me ngjyre kafe te verdhe, me lageshti, plastike, mesatarisht deri te ngjeshura		
N_1^2t	163.1	6.8		2.8	Eluvjon i formacionit menjesor - argjila e alevrolite, me ngjyre kafe me njolla blu, me pak lageshti, te ngjeshura.		

Fig. 2

Ambasada

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA 2 (169.18)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT	DATA
Q4	165.48	3.7		3.7	Suargjila te lehta deri te mesme, me ngjyre kafe te verdhe, me njolla ndryshku, me lageshti, plastike, mesatarisht te ngjeshura	3.63	31.05.00
Q4	163.78	5.4		1.7	Suargjila te renda deri ne argjila, me ngjyre gri hiri, me njolla kafe, me lageshti deri me shume lageshti, plastike, pak deri mesatarisht te ngjeshura.		
Q4	162.58	6.6		1.2	Suargjila te mesme pluhurore, me pamje eluvjale, me ngjyre kafe te verdhe, me lageshti, plastike, mesatarisht deri te ngjeshura.		
N_1^2t	159.18	10.8		3.4	Eluvjon i formacionit rrenjesor - suargjila te lehta shume pluhurore, kafe te verdha, te ngjeshura.		

Fig 3

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA3 (170.87)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT DATA
Q4	169.3	..6		1.6	Suargjila te lehta - te mesme pluhurore, kafe te verdha, me njolla ndryshku, me lageshti, plastike, pak deri mesatarisht te ngjeshura	
Q4	167.4.	3.5		1.9	Suargjila t mesme - te renda pluhurore me ngjyre kafe, me njolla ndryshku e blu, me lageshti, pak deri mesatarisht te ngjeshura	
Q4	165.5	5.4		1.9	Suargjila te mesme pluhurore, me pamje eluvjale, me ngjyre kafe te verdhe, me lageshti, plastike, mesatarisht deri te ngjeshura	
N_1^2t	161.1	9.8		4.4	Eluvjon i formacionit rrenjesor - argjila e alevrolite, me ngjyre kafe me njolla blu, me pak lageshti, te ngjeshura.	

Fig. 4

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA4 (152.93)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT DATA
Q4	151.93	1		1	Mbushje - mbeturina ndertimi te perziera me suargjila te lehta, pak te ngjeshura	2.8 31.05.00
Q4	149.93	3		2	Suargjila te mesme pluhurore, kafe te celura, me breza te kalte., me lageshti, pak deri mesatarisht te ngjeshura	
Q4	148.23	4.7		1.7	Suargjila te renda eluvjale, me ngjyre kafe, me njolla ndryshku e konkrecione alevrolitike, mesatarisht deri te ngjeshura.	
N_1^2t	143.43	9.5		4.8	Ranore, me ngjyre kafe te kuqerremte, kompakte, te ngjeshur.	

Fig 5

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA5 (164.79)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT	DATA
Q4	162.8	1.9		1.9	Suargjila te lehta - te mesme pluhurore, kafe te verdha, me njolla ndryshku, me lageshti, plastike, pak deri mesatarisht te ngjeshura	2.1	31.05.00
Q4	161.	3.7		1.8	Suargjila t mesme - te renda pluhurore, me ngjyre kafe, me njolla ndryshku e blu, me lageshti, pak deri mesatarisht te ngjeshura		
Q4	159.2	4.8		1.1	Suargjila te mesme pluhurore, me pamje eluvjale, me ngjyre kafe te verdhe, me lageshti, plastike, mesatarisht deri te ngjeshura		
N_1^2t	154.6	10.2		5.4	Eluvjon i formacionit rrenjesor - argjila e alevrolite, me ngjyre kafe me njolla blu, me pak lageshti, te ngjeshura.		

Fig 6

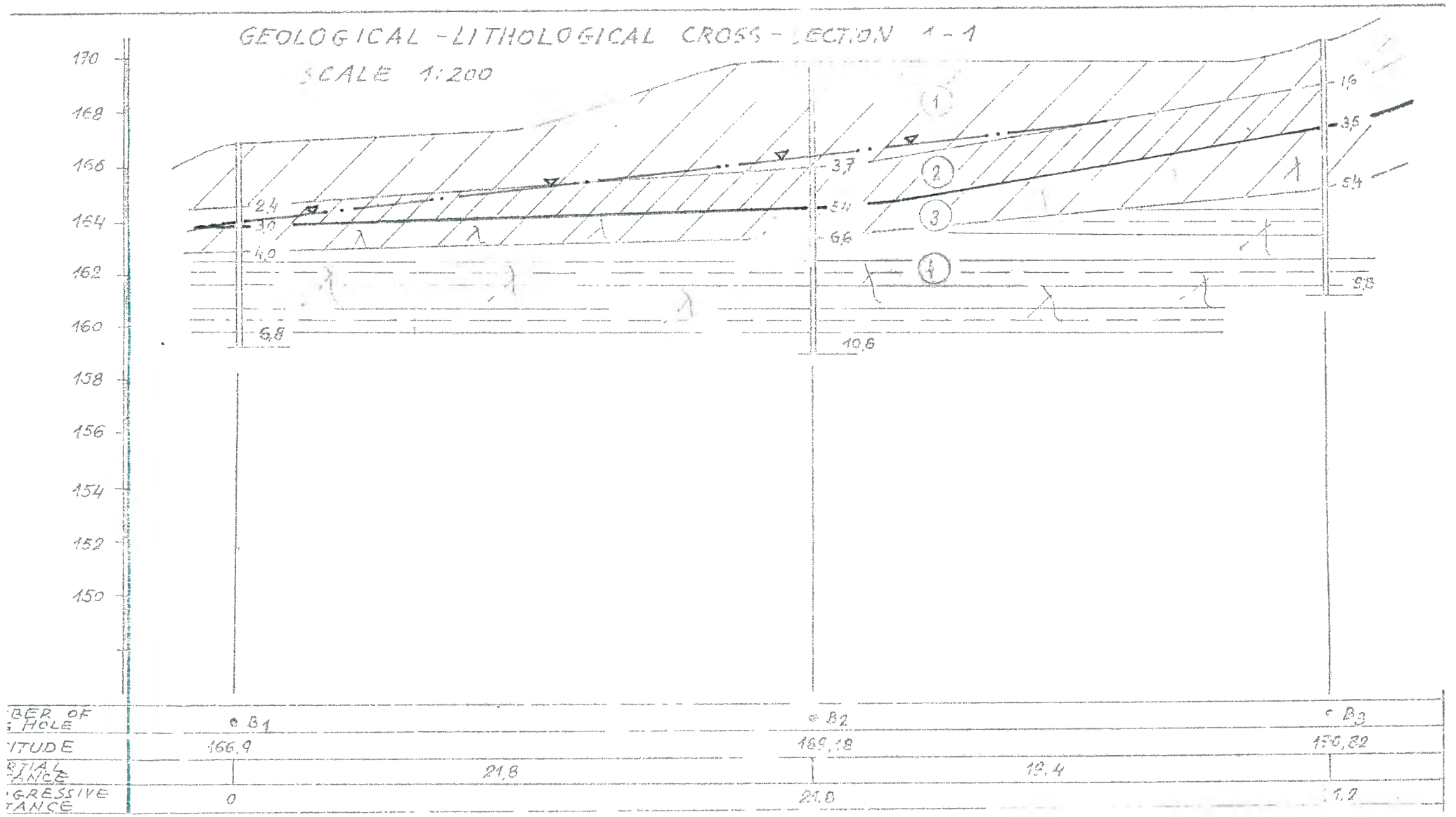
Ambasada

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA6 (165.72)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT	DATA
Q4	163.5	2.2		2.2	Suargjila te lehta - te mesme pluhurore, kafe te verdha, me njolla ndryshku, me lageshti, plastike, pak deri mesatarisht te ngjeshura	2.01	31.05.00
Q4	162	3.7		1.5	Suargjila t mesme-- te renda pluhurore, me ngjyre kafe, me njolla ndryshku e blu, me lageshti, pak deri mesatarisht te ngjeshura		
Q4	160.3	5.4		1.7	Suargjila te mesme pluhurore, me pamje eluvjale, me ngjyre kafe te verdhe, me lageshti, plastike, mesatarisht deri te ngjeshura		
N_1^2t	154.6	10.4		5	Eluvjon i formacionit rrenjesor - argjila e alevrolite, me ngjyre kafe me njolla blu, me pak lageshti, te ngjeshura.		

Fig 7

INDEKSI GJEOLOGJIK	KUOTA E SHTRESES	THELLESIA E SHTRESES	SONDA7 (159.35)	TRASHESIA E SHTRESES	PERSHKRIMI LITOLOGJIK	NIVELI I UJIT	DATA
Q4	158.6	0.8		0.8	Suargjila te lehta - te mesme pluhurore, kafe te verdha, me njolla ndryshku, me lageshti, plastike, pak deri mesatarisht te ngjeshura		
Q4	157.2	2.2		1.4	Suargjila t mesme - te renda pluhurore, me ngjyre kafe, me njolla ndryshku e blu, me lageshti, pak deri mesatarisht te ngjeshura		
Q4	156.8	2.6		0.4	Suargjila te mesme pluhurore, me pamje eluvjale, me ngjyre kafe te verdhe, me lageshti, plastike, mesatarisht deri te ngjeshura		
N_1^2t	149.6	9.8		7.2	Eluvjon i formacionit rrenjesor - argjila e alevrolite, me ngjyre kafe me njolla blu, me pak lageshti, te ngjeshura.		

Fig 8



LEGEND:

(1) LIGHT SILTYCLAY UP TO MEDIUM SILTYCLAY WITH BROWN UP TO YELLOW COLOUR MEDIUM COMPACTED

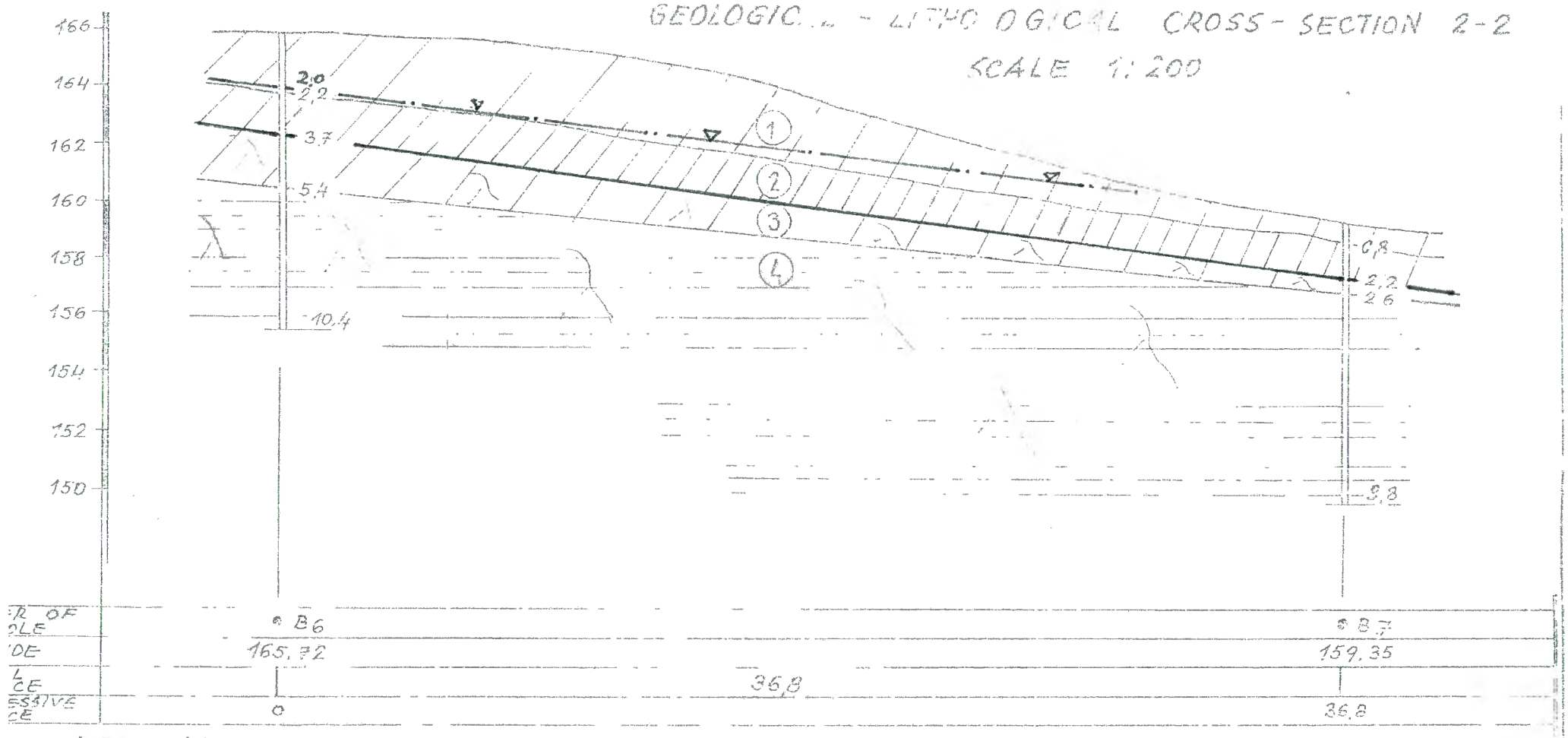
(2) HEAVY SILTY CLAY UP TO FAT CLAY, WITH GREEN COLOUR, WITH BROWN SPOTS, MEDIUM COMPACTED

(3) WEATHERING SILTYCLAY, WITH BROWN UP TO YELLOW COLOUR, MEDIUM COMPACTED UP TO COMPACTED

(4) WEATHERING BEDROCK - ALEUROLITE AND ARGILLITE COMPACTED.

UNDERGROUND WATER LEVEL.

FIG. 9



LEGEND:

1) LIGHT SILTYCLAY UP TO MEDIUM SILTYCLAY WITH BROWN UP TO YELLOW COLOUR MEDIUM COMPACTED

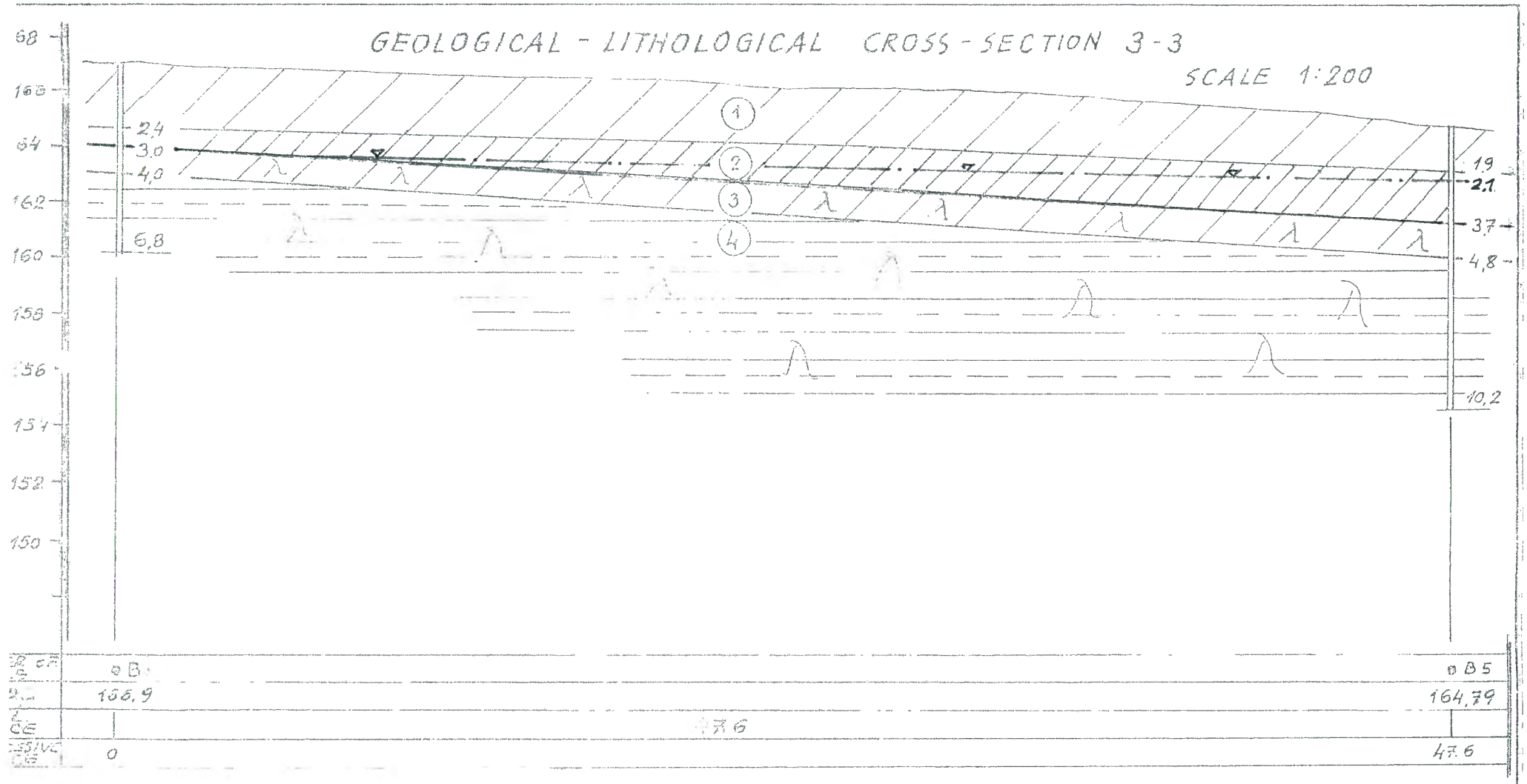
2) HEAVY SILTY CLAY UP TO FAT CLAY, WITH GREEN COLOUR, WITH BROWN SPOTS, MEDIUM COMPACTED.

3) WEATHERING SILTYCLAY, WITH BROWN UP TO YELLOW COLOUR, MEDIUM COMPACTED UP TO COMPACTED.

4) WEATHERING BEDROCK - ALEUROLITE AND ARGILLITE. COMPACTED

UNDERGROUND WATER LEVE

FIG. 10



LEGEND:

LIGHT SILTY CLAY UP TO MEDIUM SILTYCLAY WITH BROWN UP TO YELLOW COLOUR MEDIUM COMPACTED

HEAVY SILTY CLAY UP TO FAT CLAY, WITH YELLOW COLOUR, WITH BROWN SPOTS, MEDIUM COMPACTED

(3) WEATHERING SILTYCLAY, WITH BROWN UP TO YELLOW COLOUR, MEDIUM COMPACTED UP TO COMPACTED

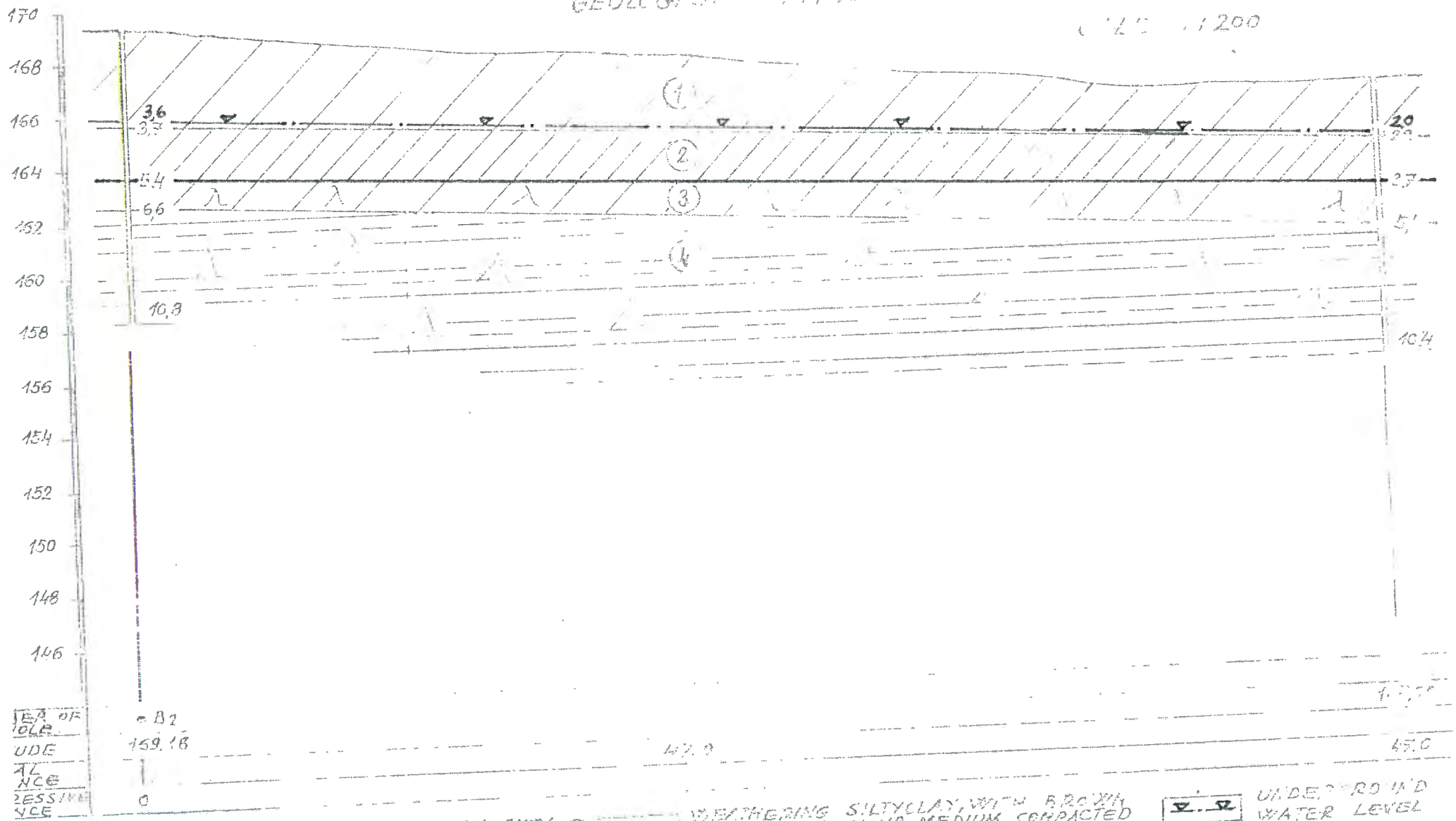
(4) WEATHERING BEDROCK - ALEUROLITE AND ARGILLITE COMPACTED.

UNDERGROUND WATER LEVEL.

FIG. 11

GEOLOGICAL - [illegible] 2055 - SECTION 1-4

SCALE 1:200



(1) LIGHT SILTYCLAY UP TO MEDIUM SILTY-CLAY, WITH BROWN UP TO YELLOW COLOUR MEDIUM COMPACTED.

(2) HEAVY SILTY CLAY UP TO FAT CLAY, WITH GREEN COLOUR, WITH BROWN SPOTS, MEDIUM COMPACTED

(3) WEATHERING SILTYCLAY, WITH BROWN UP TO YELLOW COLOUR, MEDIUM COMPACTED UP TO COMPACTED.

(4) WEATHERING BEDROCK - ALEUROLITE AND ARGILLITE, COMPACTED.

UNDERGROUND WATER LEVEL

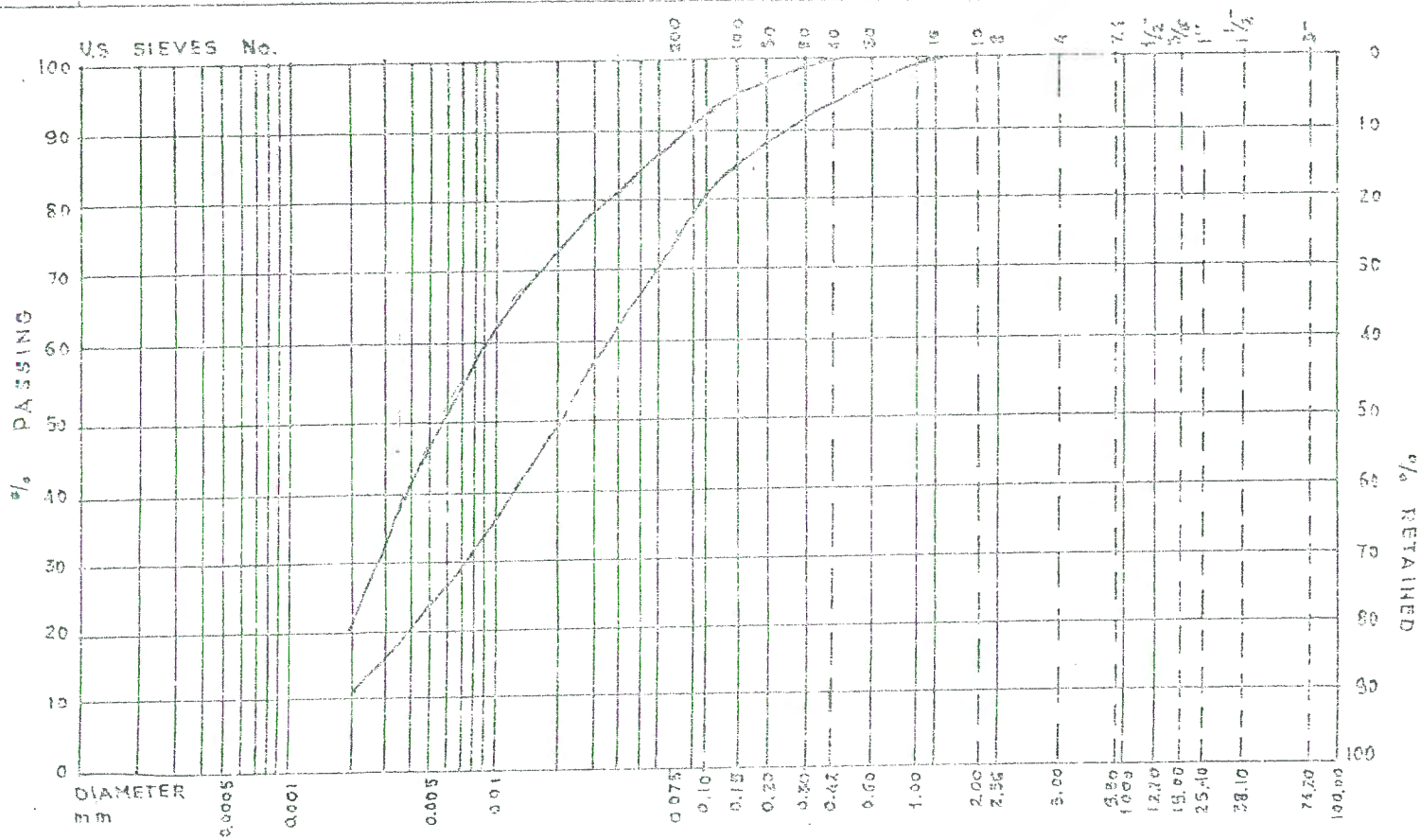
FIG. 2

169.03m
126°44'40"
S1
S5
S4
S6
S7
T/F = 168
T/F = 158.3
UNIT
L
169.6
169.754
170
167.8
168
167.7
167
165
164
166
163
162
161
160
159
158.1
157
156
155
169
102.10m
37.37m
89°44'16"
170°50'42"
58.41m
163°37'06"
162.5
164.5
165
166.5
168.5
6.21m

Fig.14

GRAIN SIZE DISTRIBUTION CURVE

ASTM	COLLOID	CLAY	SILT	SAND	GRAVEL
USCS	CLAY - SILT			SAND	GRAVEL
TEST	HYDROMETER			SIEVES	

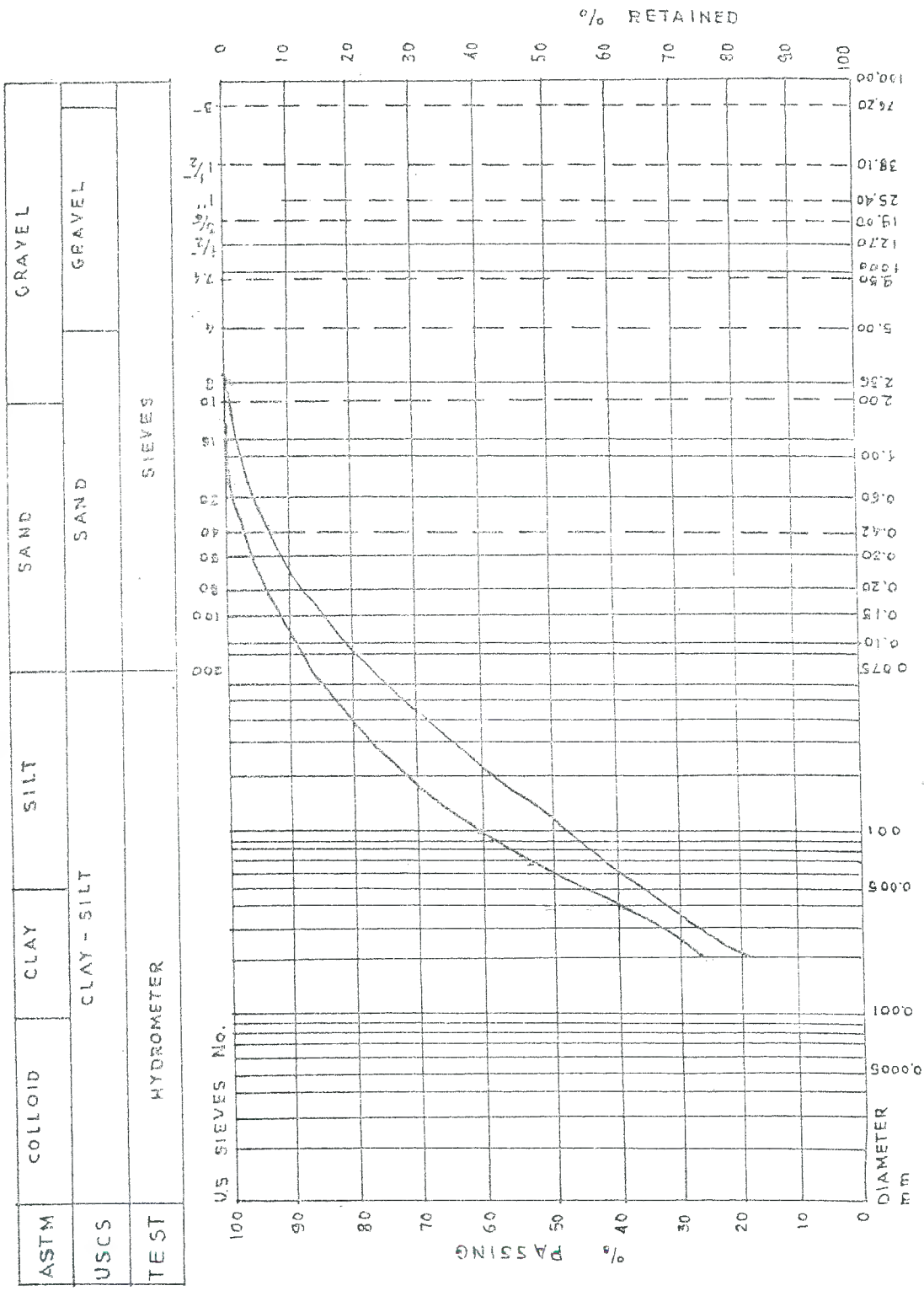


No.	SAMPLE	DEPTH (m)	$U = \frac{D_{60}}{D_{10}}$	ATTERBERG LIMITS LL	PL	IP	SPECIFIC GRAVITY G_s	NAT. WATER CONTENT w %	BULK DENSITY γ_b (Mg/m³)
—+—				37.3-48	24.4-30.2	13.5-17.6	2.70-2.73		
—▽—									
—○—									

REMARKS

Sphroso No. 1.

GRAIN SIZE DISTRIBUTION CURVE



No.	SAMPLE	DEPTH (m)	$U = \frac{D_{60}}{D_{10}}$	ATTERBERG LIMITS LL	PL	IP	SPECIFIC GRAVITY Gs	MAT. WATER CONTENT W %	BULK DENSITY γ_b (Kg/m³)
—●—									
—▽—									
—○—									

408-490 231-290 197-202,0

REMARKS shtresa Nr. 2.

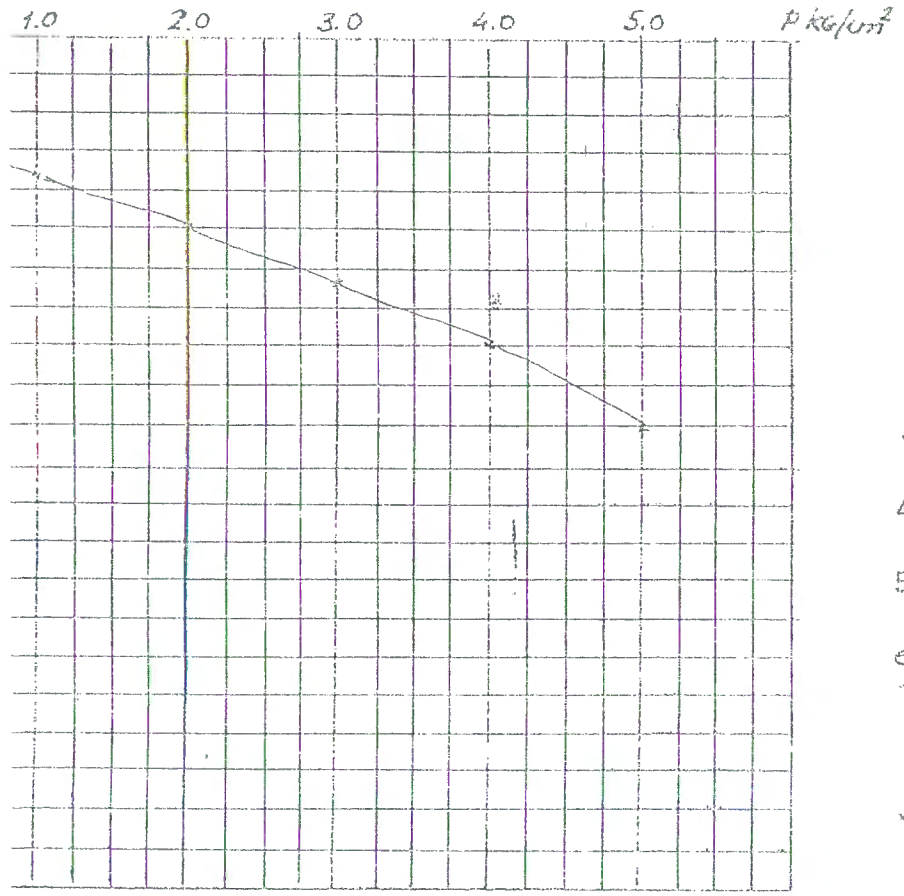
E_{1-3} kg/cm²	97.31
a_{1-3} cm²/kg	0.0173

BJEKTI

SONDA 1 (0.6-0.7)

SHA SPECIFIKE	γ	2.695 gr/cm³
SHA E VOLUMIT	Δ	1.96 "
SHA E VOL. TE SKELETIT	δ	1.60 "
GESHTIA	W	22.3 %
OROZITETI	n	40.6
EF. I POROZITETIT	e	0.6835
RADA E LAGESHTISE	G	0.88

h_0 mm	P kg/cm²	ULJE mm	e	S mm/m	α cm²/kg	E kg/cm
	0.0	–	0.6835	–		
	0.5	0.183	0.6712	7.32		
	1.0	0.292	0.6639	11.68	0.0196	85.89
	2.0	0.468	0.652	18.72	0.0119	141.47
	3.0	0.692	0.637	27.68	0.015	112.23
	4.0	0.914	0.622	36.56	0.015	112.23
	5.0	1.316	0.5949	52.64	0.0271	62.12



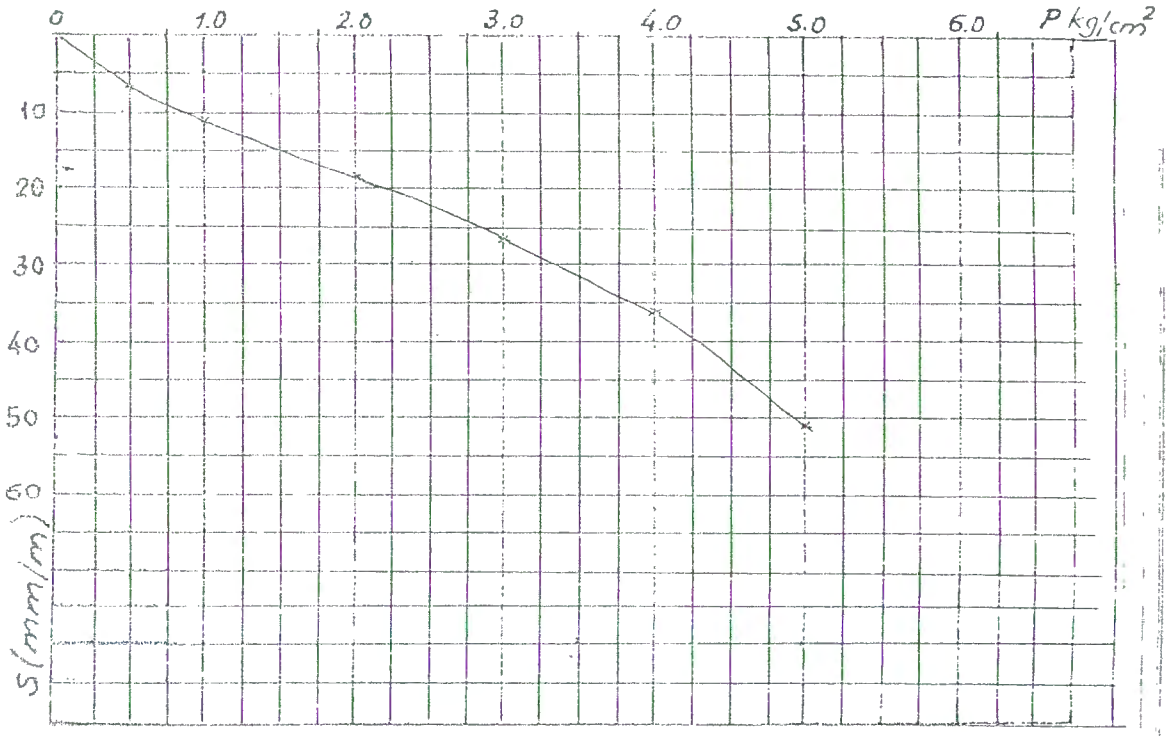


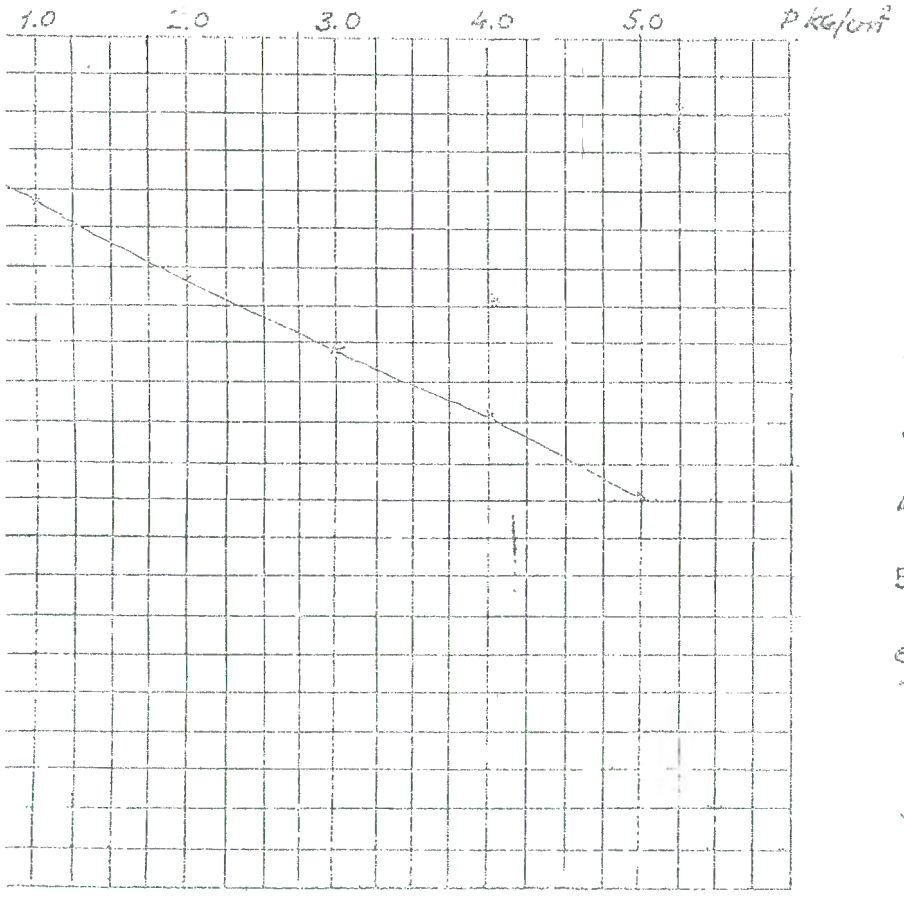
Fig. 17

E_{1-3} kg/cm²	72.49
a_{1-3} cm²/kg	0.02295

BJEKTI ..... SONDA 1 (1.0 - 1.10)

ESHA SPECIFIKE	γ	2.59 gr/cm³
ESHA E VOLUMIT	Δ	1.95 "
SH. E VOL. TE SKELETIT	δ	1.618
GESHTIA	W	20.5 %
OZITETI	n	39.9 %
ER. I POROZITETIT	e	0.6638
RADA E LAGESHTISE	G	0.83

h_0 mm	P kg/cm²	ULJE mm	e	S mm/m	α cm²/kg	E kg/cm
	0.0	–	0.6638	–		
	0.5	0.242	0.6477	9.68		
	1.0	0.417	0.6361	16.68	0.0277	60.06
	2.0	0.715	0.6163	28.60	0.0198	84.03
	3.0	0.987	0.5981	39.48	0.0182	91.41
	4.0	1.234	0.5817	49.36	0.0164	101.45
	5.0	1.516	0.563	60.64	0.0187	88.97



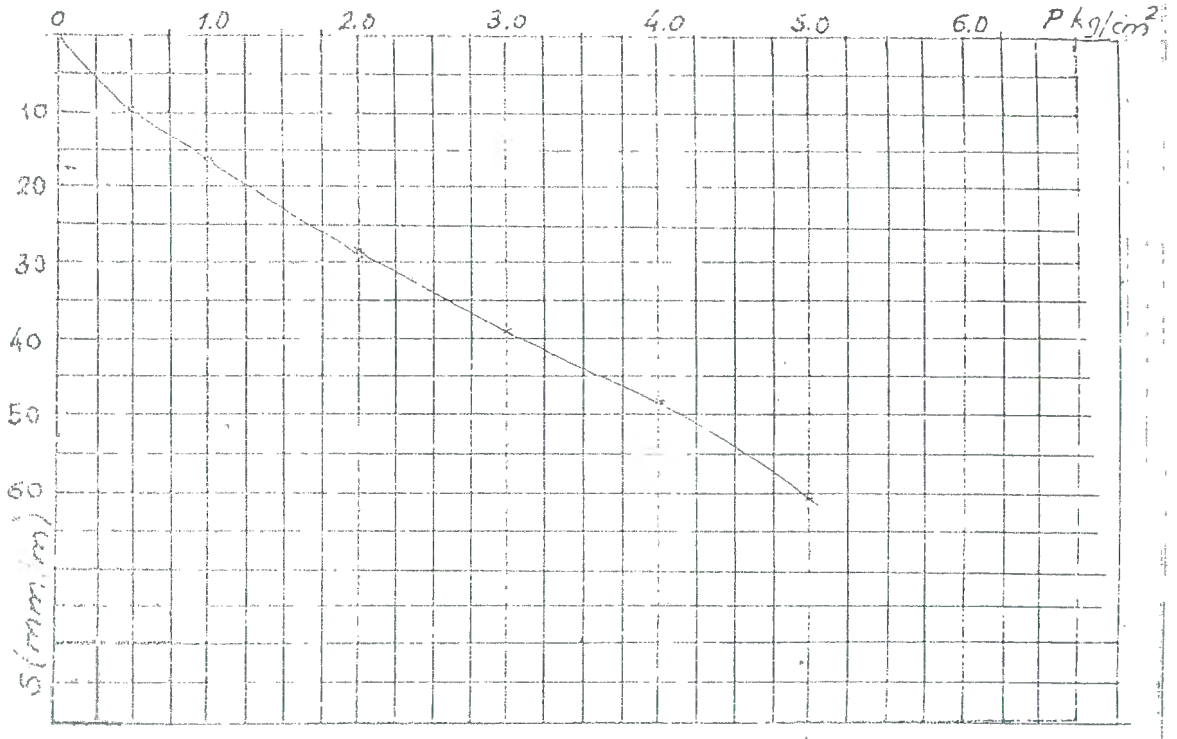


Fig. 18

E_{1-3} kg/cm²	55.79
a_{1-3} cm²/kg	0.0284

'JEKTI

SONDA 1 (1.8-1.9)

'SHA SPECIFIKE	γ	2.69 gr/cm³
SHA E VOLUMIT	Δ	2.94 "
SHA E VOL. TE SKELETIT	δ	1.698 "
GESHTIA	W	20.1 %
'ROZITETI	n	36.9 %
EF. I POROZITETIT	e	0.5847 "
'ADA E LAGESHTISE	G	0.93 "

h_o mm	P kg/cm²	ULJE mm	e	S mm/m	α cm²/kg	E kg/cm
	0.0	–	0.5847	–		
	0.5	0.342	0.5631	13.68		
	1.0	0.618	0.5456	24.72	0.0391	40.52
	2.0	1.108	0.5145	44.32	0.0311	50.95
	3.0	1.387	0.4968	55.48	0.0177	89.53
	4.0	1.764	0.4729	70.56	0.0239	66.30
	5.0	2.162	0.4477	86.48	0.0252	62.88

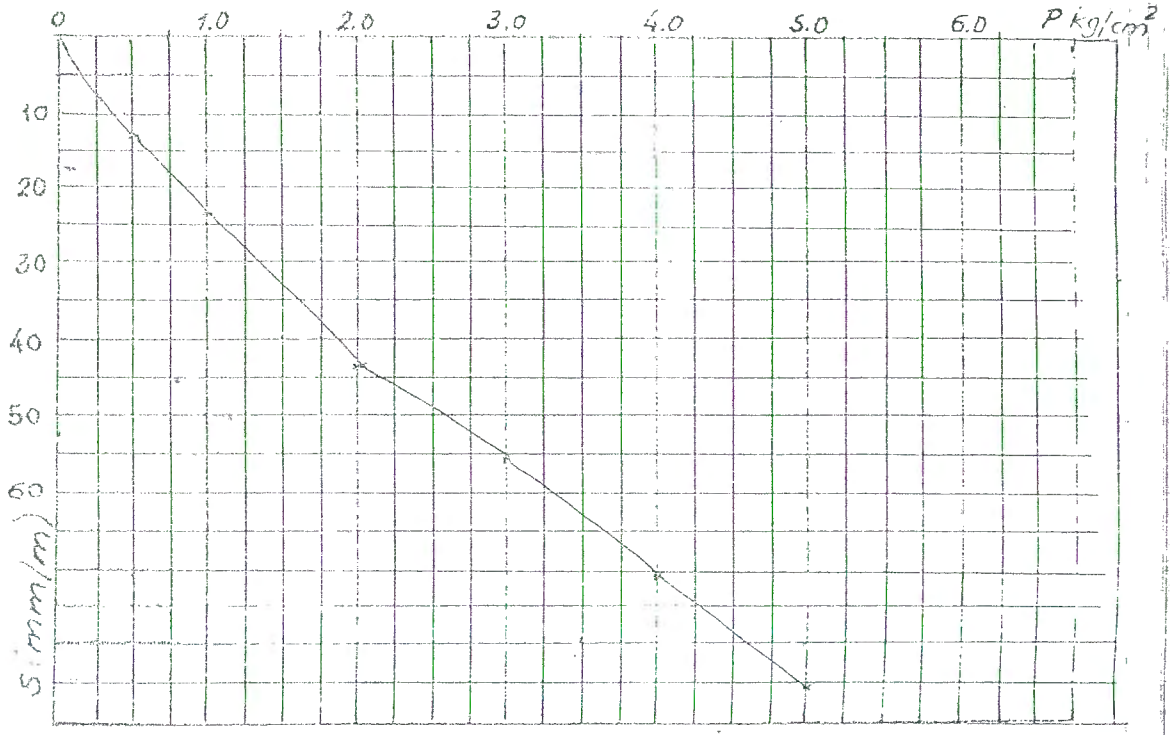


Fig. 19

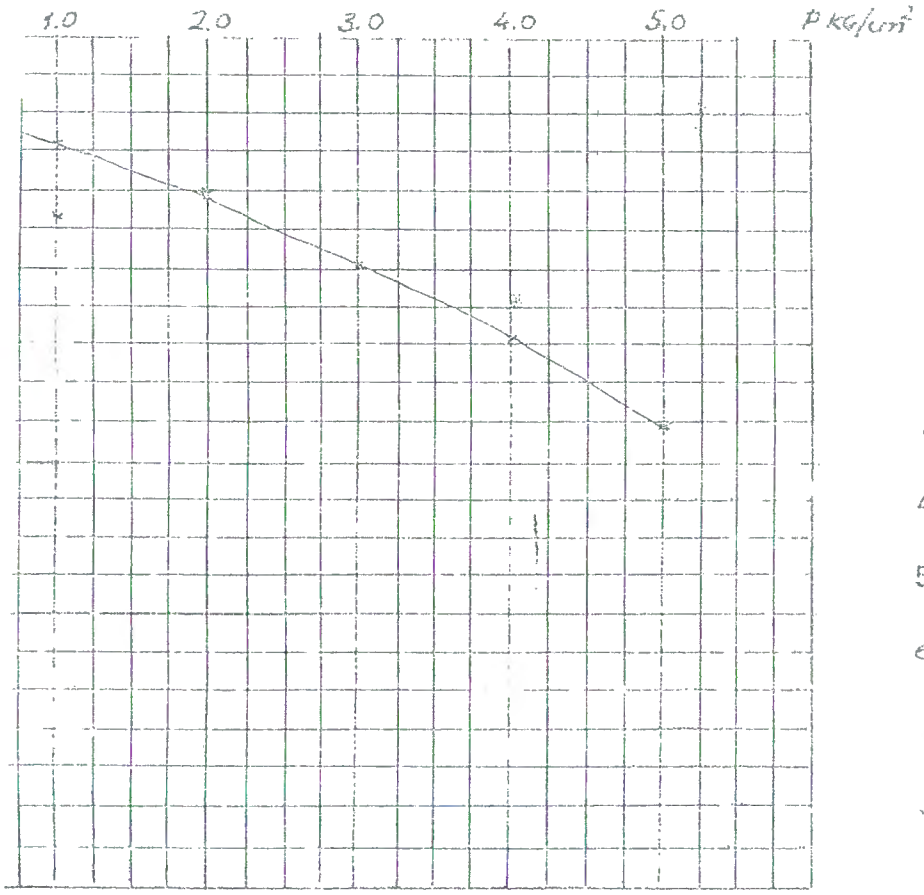
E_{1-3}	kg/cm²	82.27
a_{1-3}	cm²/kg	0,0206

RJEKTI

SONDA 1 (2.30-2.40)

SHA SPECIFIKE	γ	2.695
SHA E VOLUMIT	Δ	1.92
SHA E VOL. TE SKELETIT	δ	1.59
GESHTIA	W	20.7%
OROZITETI	n	41.0%
EF. I POROZITETIT	e	0.6949
RADA E LAGESHTISE	G	0.80

h_0 mm	P kg/cm²	ULJE mm	e	S mm/m	α cm²/kg	E kg/cm
	0.0	-	0.6949	-		
	0.5	0.335	0.679	9.44		
	1.0	0.328	0.6727	13.12	0.0223	76.59
	2.0	0.512	0.6603	20.48	0.0124	136.68
	3.0	0.794	0.6412	31.76	0.0191	88.73
	4.0	1.088	0.6213	43.52	0.0199	85.17
	5.0	1.436	0.5977	57.44	0.0236	71.81



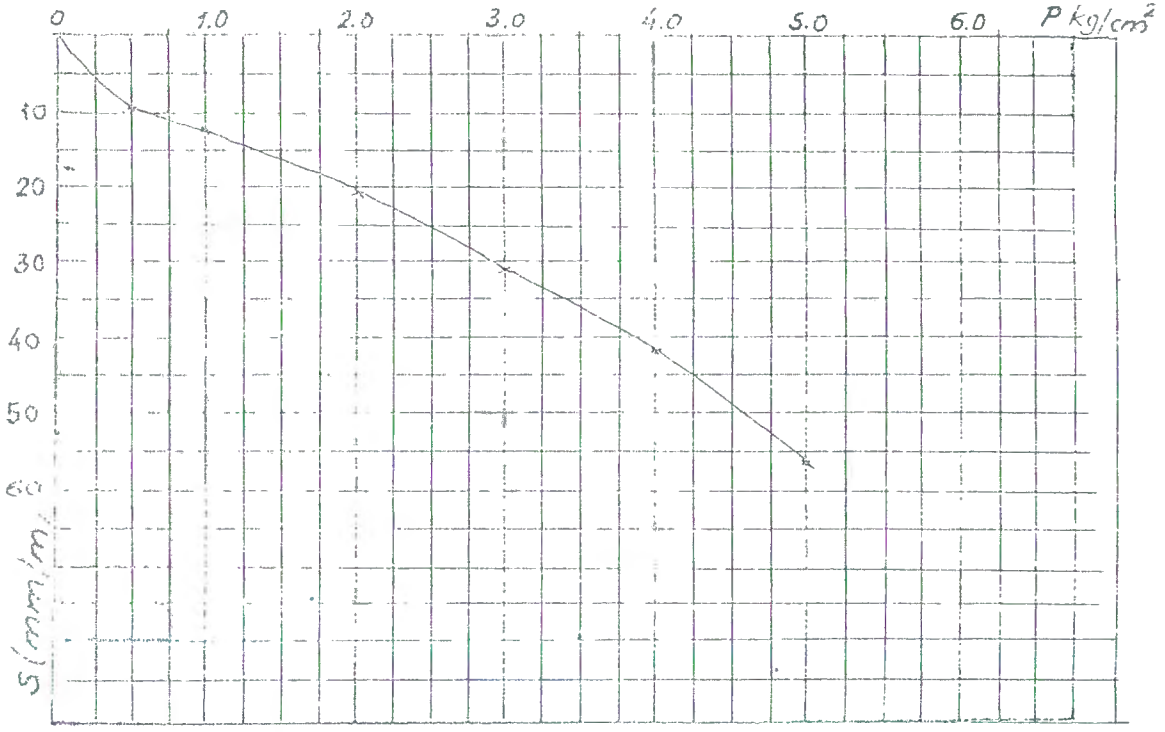


Fig 20

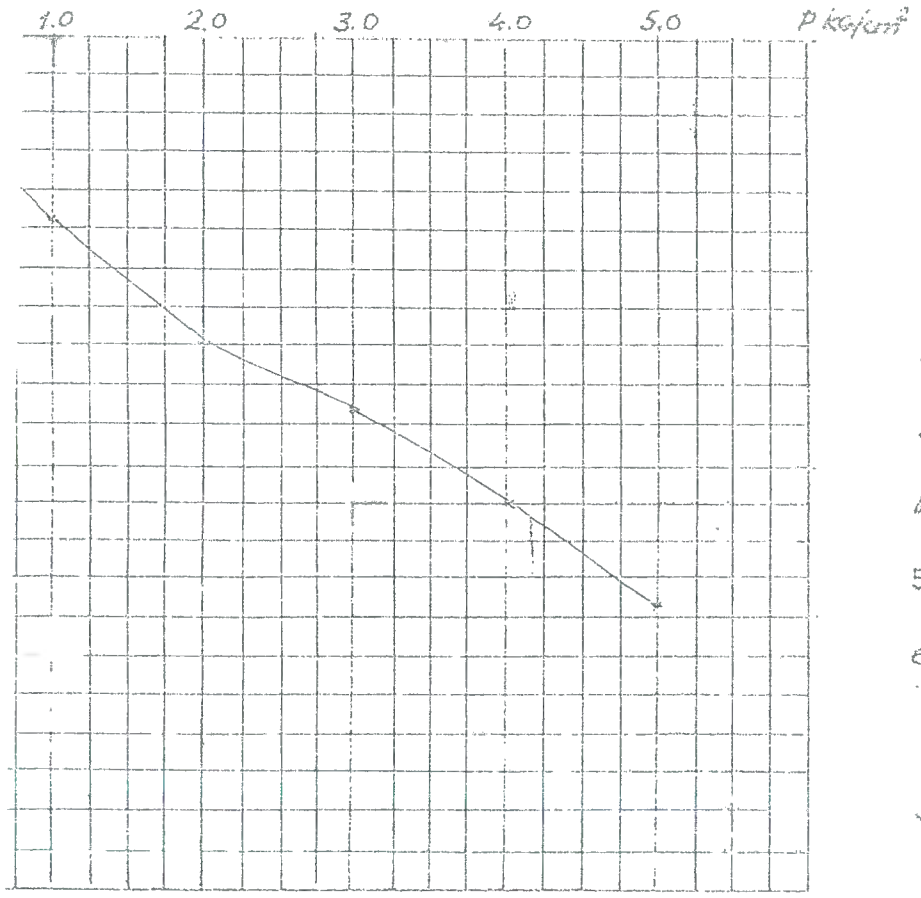
E_{1-3}	kg/cm^2	58.06
a_{1-3}	cm^2/kg	0.0283

JEKTI

SONDA 2(1.0-1.10)

SHA SPECIFIKE	γ	2.69 gr/cm^3
SHA E VOLUMIT	Δ	1.936 -"-
SHA E VOL. TE SKELETIT	δ	1.637 -"-
GESHTIA	W	18.2 %
POROZITETI	n	39.14 %
EF. I POROZITETIT	e	0.6431
RADA E LAGESHTISE	G	0.76

h_0 mm	P kg/cm^2	ULJE mm	e	S mm/m	α cm^2/kg	E kg/cm
	0.0	-	0.6431	-		
	0.5	0.328	0.6216	13.12		
	1.0	0.606	0.6033	24.24	0.0398	41.28
	2.0	1.098	0.577	43.92	0.0323	50.86
	3.0	1.354	0.5542	54.16	0.0168	97.80
	4.0	1.716	0.530	68.64	0.0238	69.03
	5.0	2.138	0.5027	85.52	0.0277	59.31



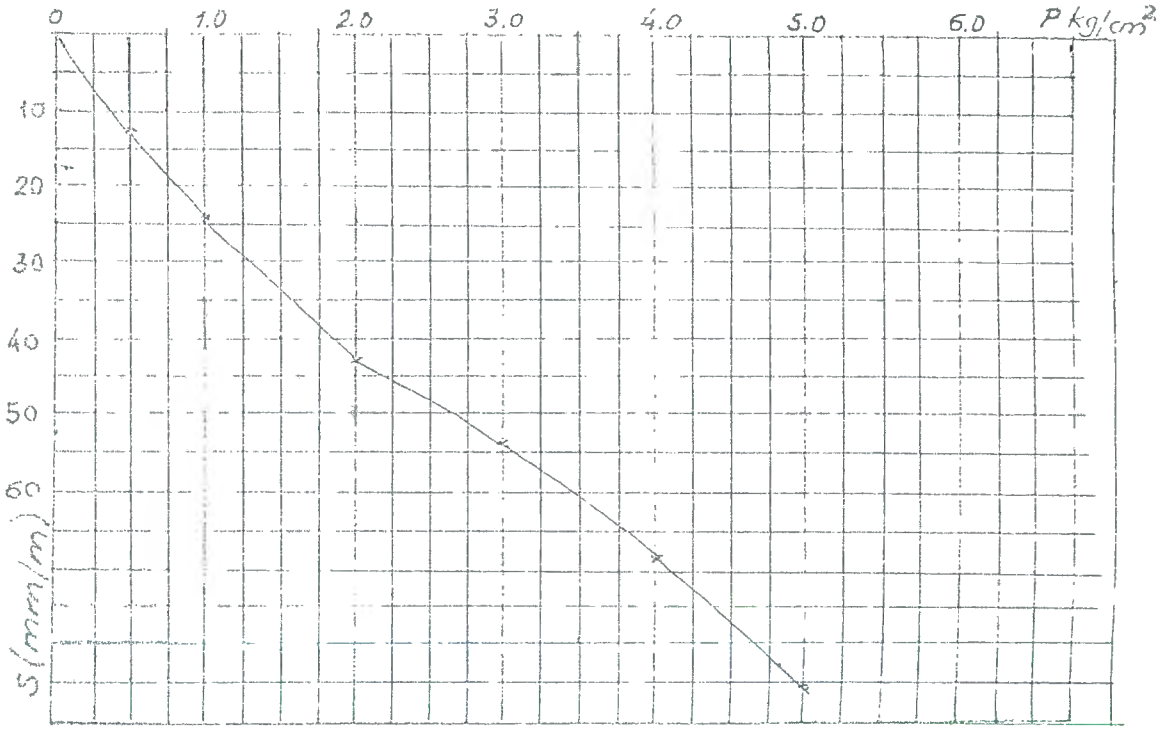


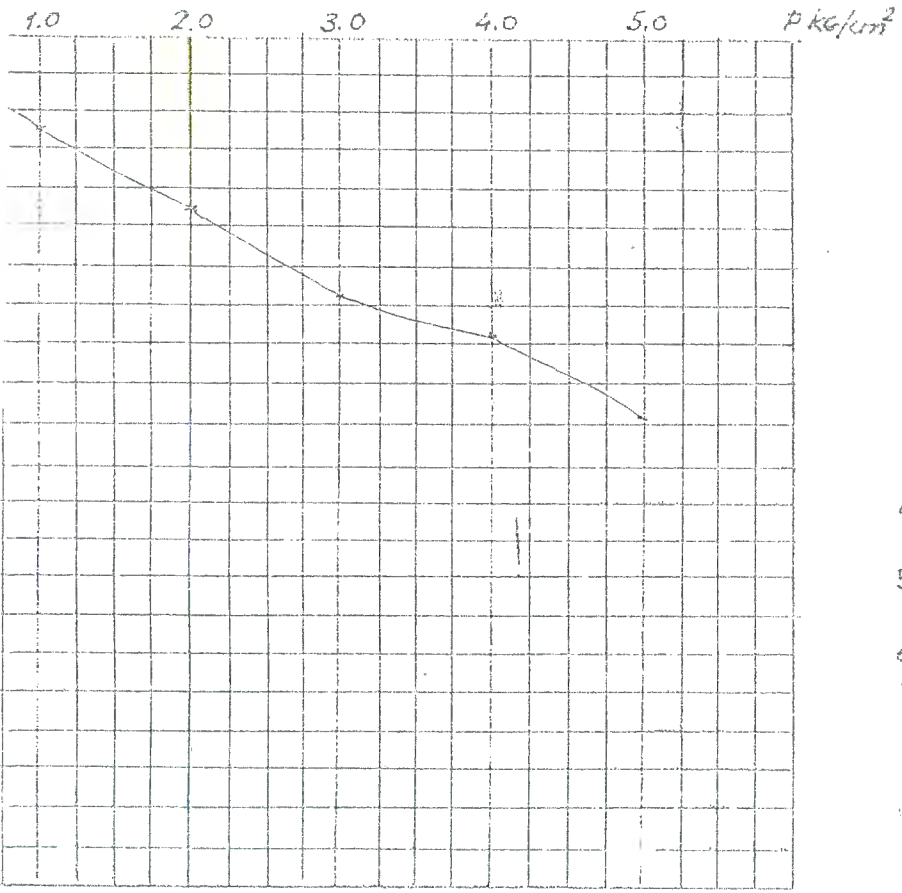
Fig. 21

E_{1-3} kg/cm²	63.19
a_{1-3} cm²/kg	0.0254

JEKTI SONDA 2(3.3 - 3.40)

SHA SPECIFIKE	γ	2.695
SHA E VOLUMIT	Δ	2.01
SHA E VOL. TE SKELETIT	δ	1.68
GESHTIA	W	19.3 %
OROZITETI	n	37.7 %
EF. I POROZITETIT	e	0.6051
RADA E LAGESHTISE	G	0.86

h_o mm	P kg/cm²	ULJE mm	e	S mm/m	α cm²/kg	E kg/cm
	0.0		0.6051	-		
	0.5	0.292	0.5864	11.68		
	1.0	0.468	0.5751	18.72	0.03	53.5
	2.0	0.791	0.5544	31.64	0.0207	77.54
	3.0	1.116	0.5335	44.64	0.0209	76.79
	4.0	1.284	0.5227	51.36	0.0108	148.62
	5.0	1.588	0.5032	63.52	0.0195	82.31



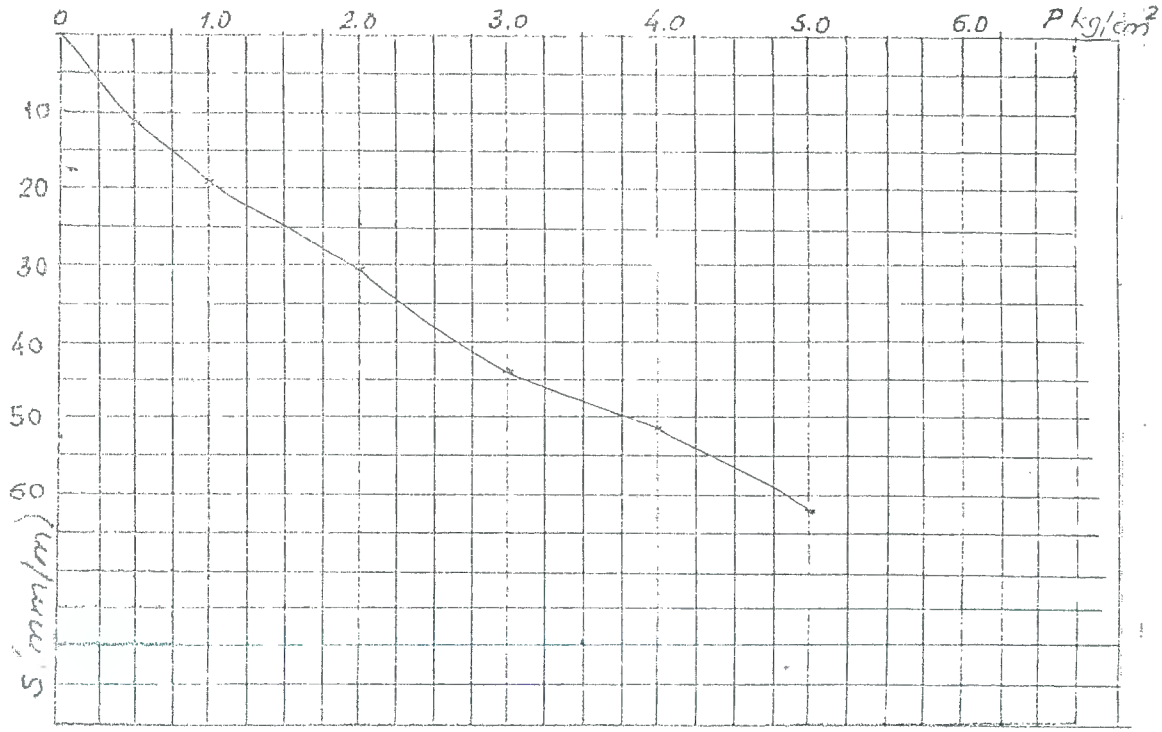


Fig. 22

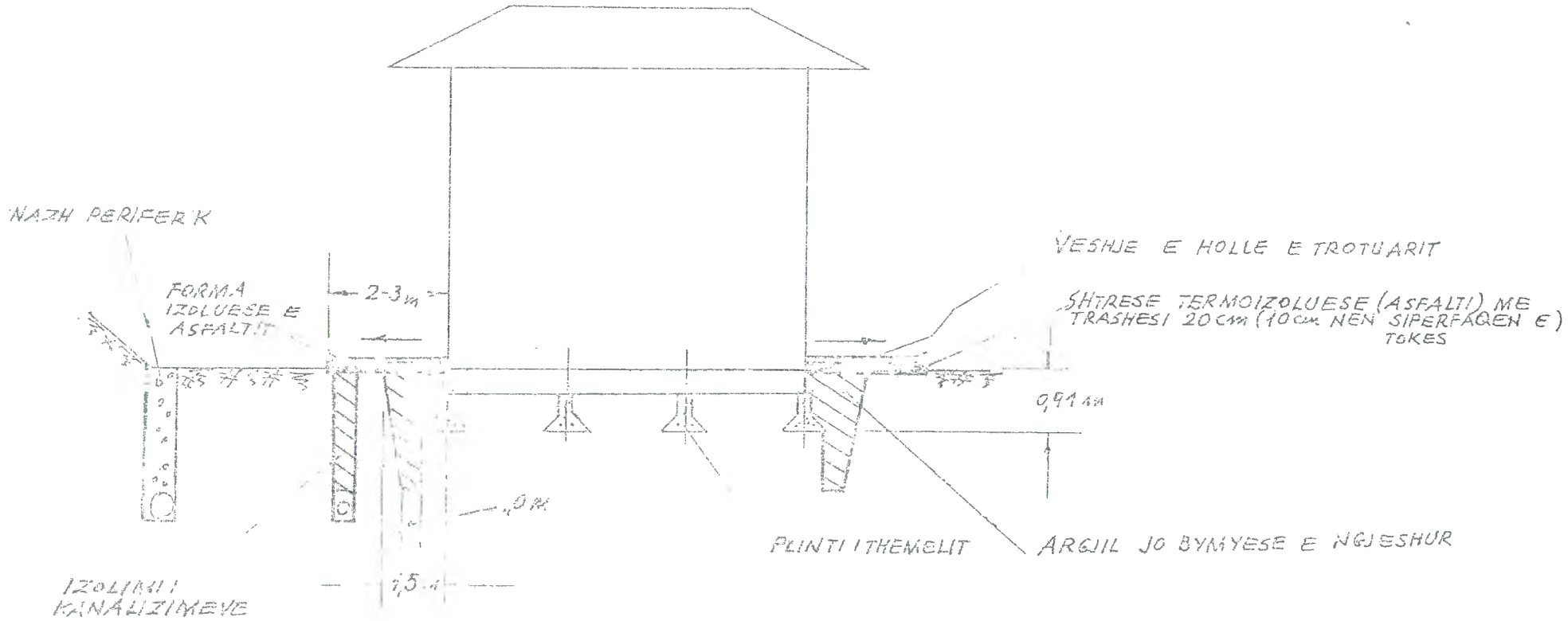


FIG. 58 REKOMMENDED MEASUREMENTS TO PROTECT HUMIDITY IN THE FOUNDATIONS