APPENDIX
E

HARDNESS TEST

CONCRETE STRESS STRENGTH TEST SHEET (1/34)

Date: 28 June 1999

Facility No: 1	Raw Water Pumping Station
Structure Member: 1 – CW	Column – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 43 Cube Compressive Strength, W_m = 469 kg/cm^2 Cylinder Compressive Strength, Z_m = 399 kg/cm^2

Schmidt Hammer Test Result

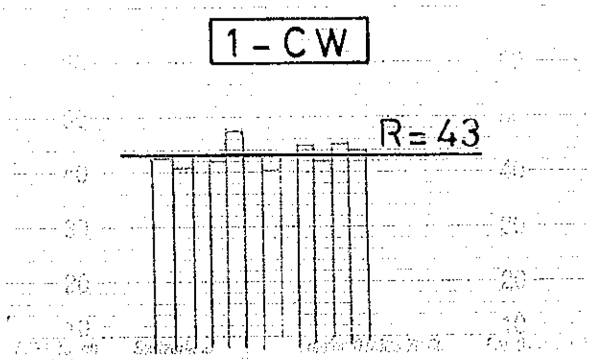
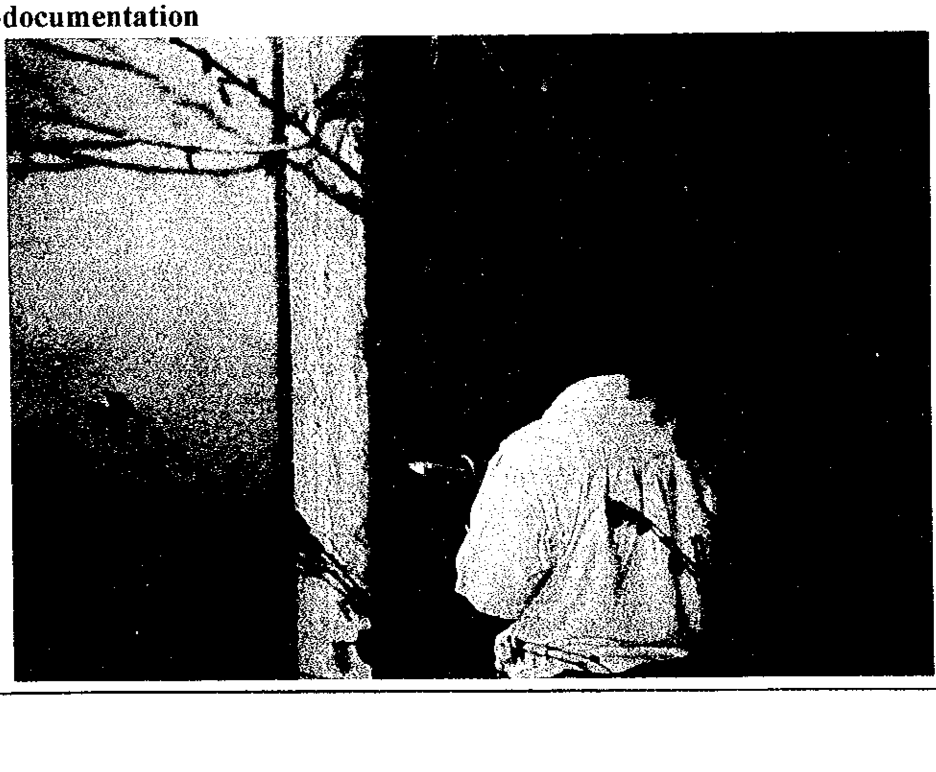


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (2/34)

Date: 28 June 1999

Facility No: 1	Raw Water Pumping Station
Structure Member: 1 – CE	Column – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 41 Cube Compressive Strength, W_m = 432 kg/cm^2 Cylinder Compressive Strength, Z_m = 367 kg/cm^2

Schmidt Hammer Test Result

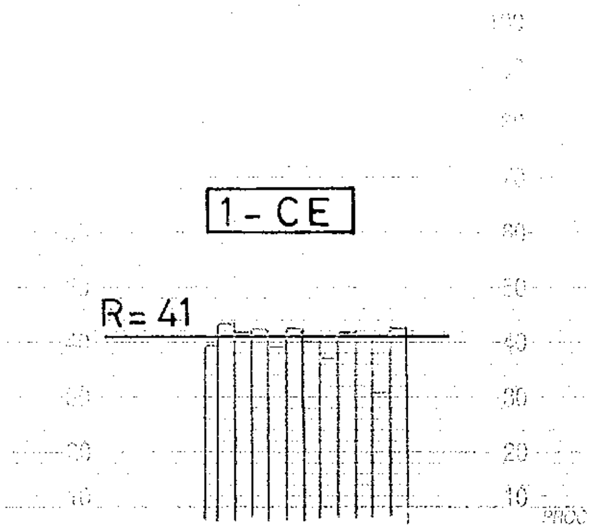
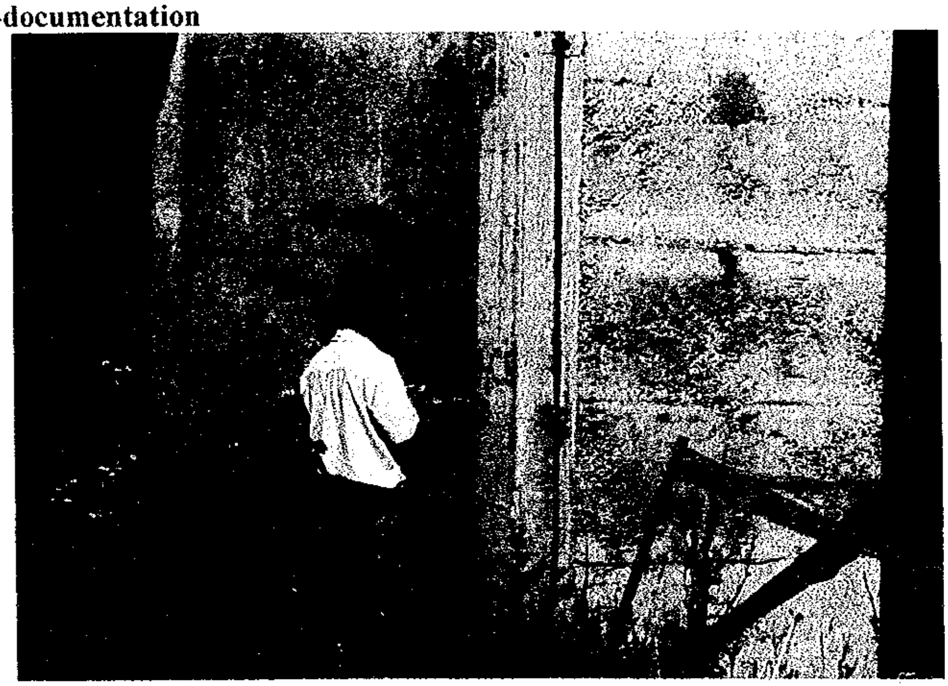


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (3/34)

Date: 28 June 1999

Facility No: 1	Raw Water Pumping Station
Structure Member: 1 – CNE	Column – Northeast Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 44 Cube Compressive Strength, W_m = 488 kg/cm^2 Cylinder Compressive Strength, Z_m = 415 kg/cm^2

Schmidt Hammer Test Result

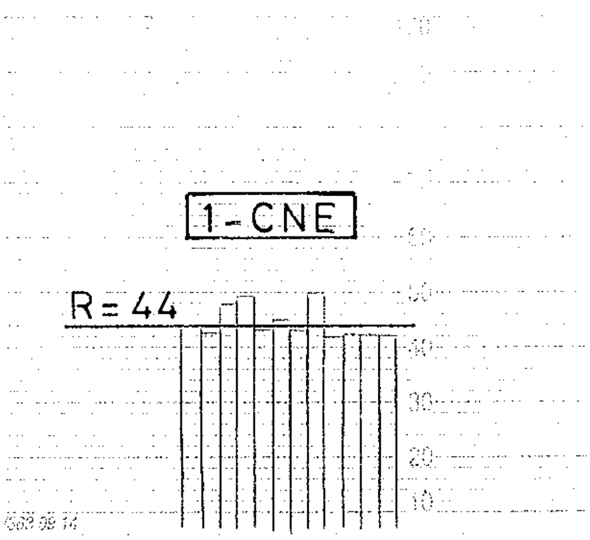


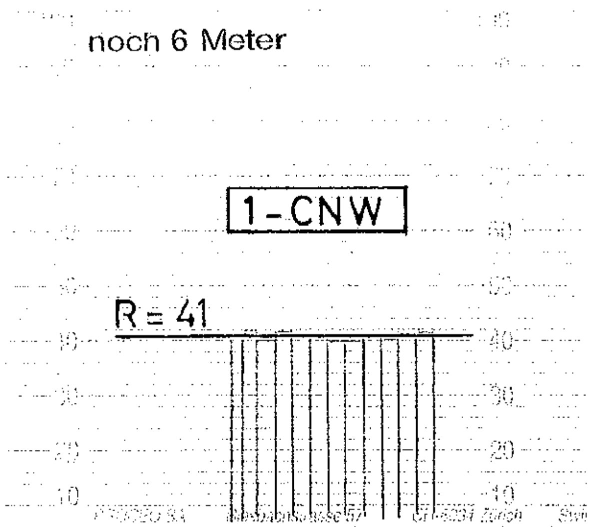
Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (4/34)

Date: 28 June 1999

Facility No: 1	Raw Water Pumping Station
Structure Member: 1 – CNW	Column – Northwest Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 41 Cube Compressive Strength, W_m = 432 kg/cm^2 Cylinder Compressive Strength, Z_m = 367 kg/cm^2

Schmidt Hammer Test Result



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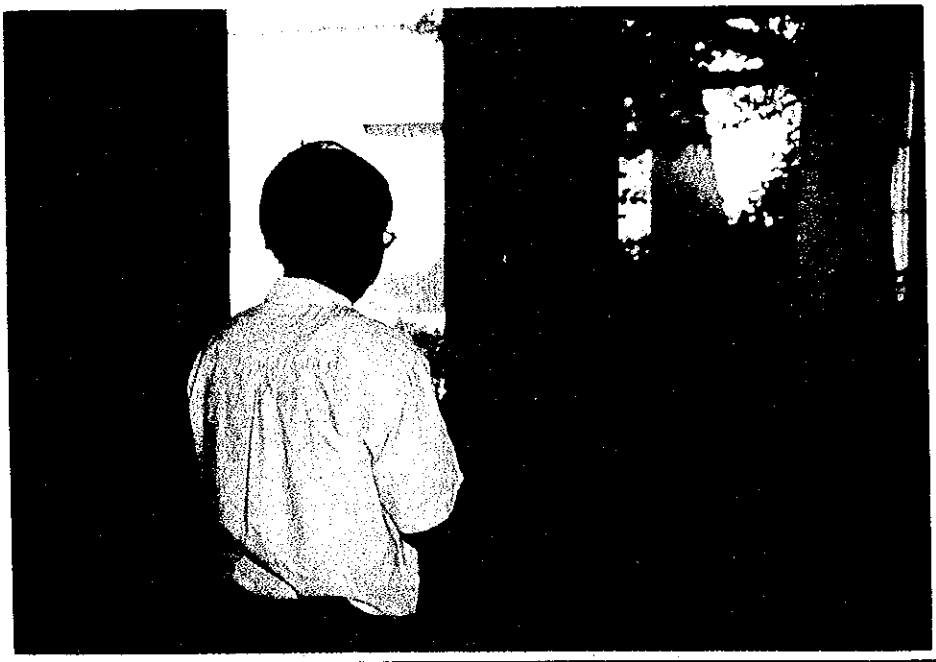


CONCRETE STRESS STRENGTH TEST SHEET (5/34)

Date: 21 June 1999

Facility No: 2	Screening Station
Structure Member: 2 – EW	External Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 45 Cube Compressive Strength, W_m = 507 kg/cm^2 Cylinder Compressive Strength, Z_m = 431 kg/cm^2

Schmidt Hammer Test Result

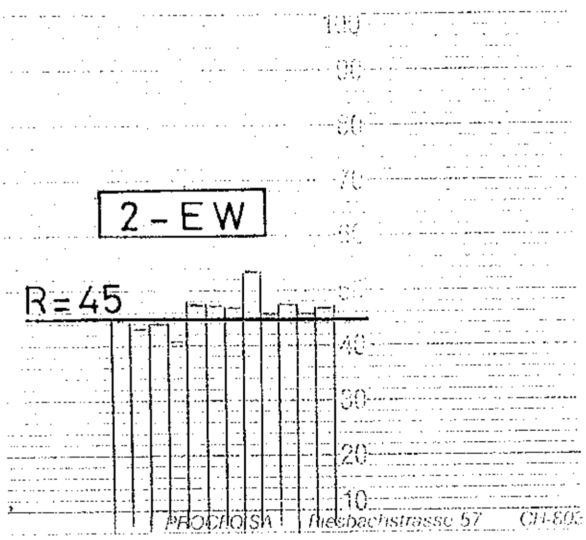
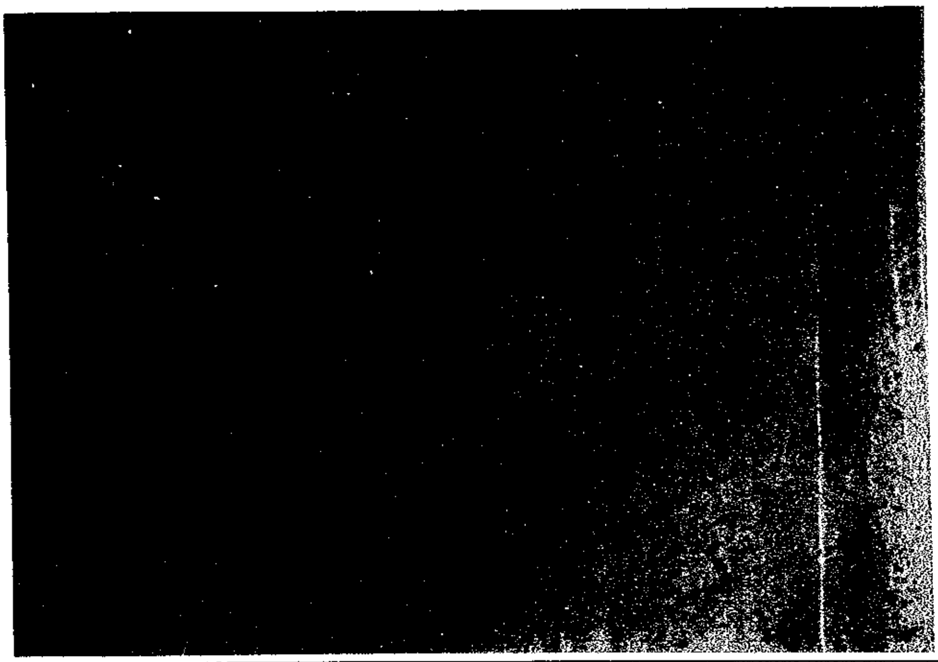


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (6/34)

Date: 21 June 1999

Facility No: 2	Screening Station
Structure Member: 2 – F	Floor Slab
Schmidt Hammer Test Value	Mean Rebound Number, N = 39 Cube Compressive Strength, W_m = 395 kg/cm^2 Cylinder Compressive Strength, Z_m = 336 kg/cm^2

Schmidt Hammer Test Result

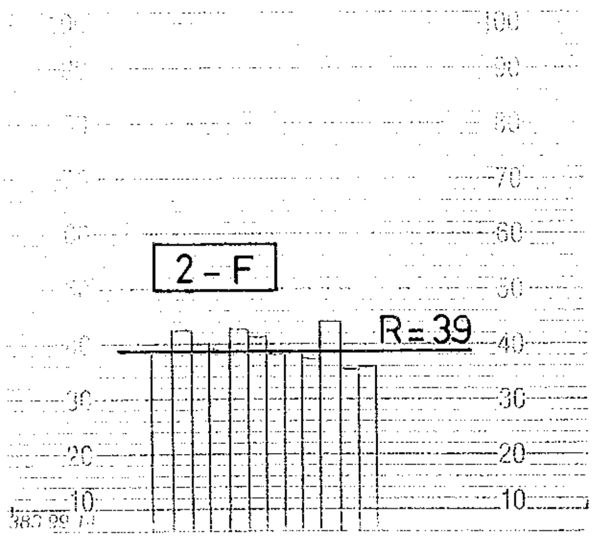


Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (7/34)

Date: 21 June 1999

Facility No: 3	Aerated Grit Chamber
Structure Member: 3 - EW	External Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 55 Cube Compressive Strength, W_m = 703 kg/cm^2 Cylinder Compressive Strength, Z_m = 598 kg/cm^2

Schmidt Hammer Test Result

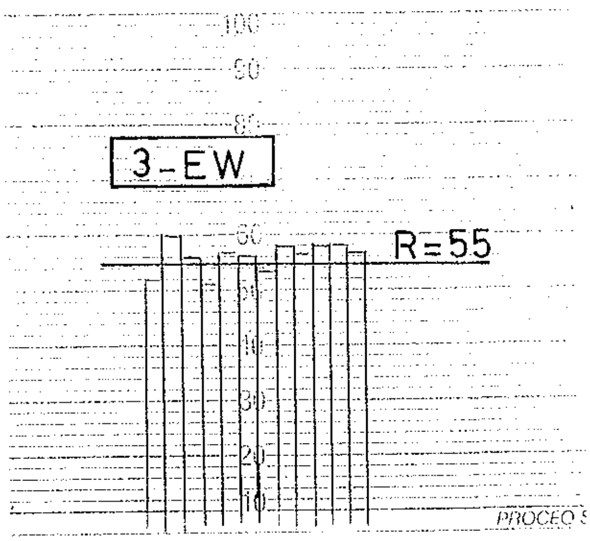
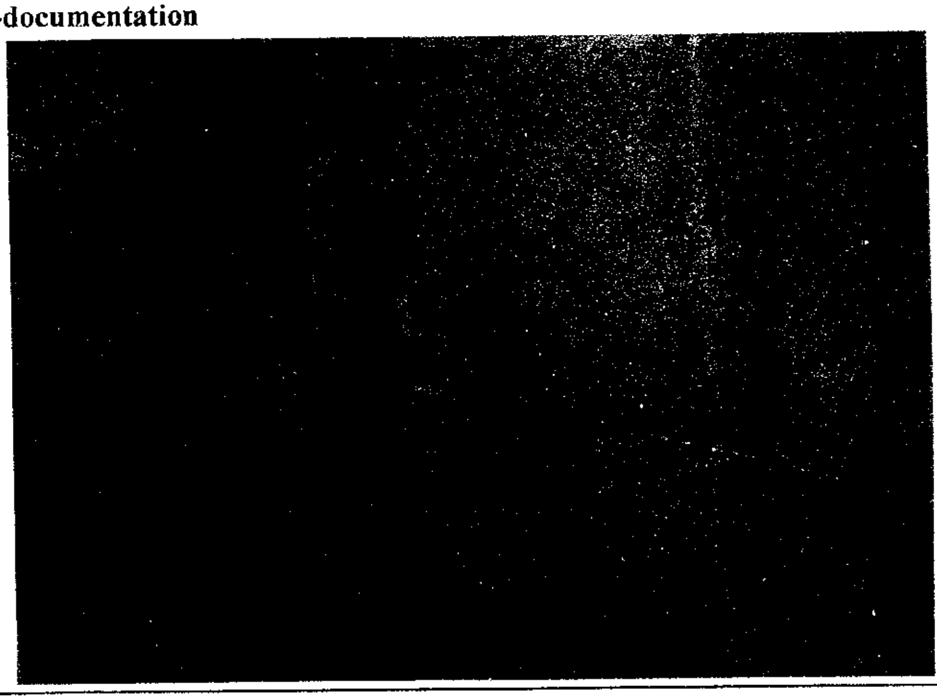


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (8/34)

Date: 17 June 1999

Facility No: 3	Aerated Grit Chamber
Structure Member: 3 – 2I	Internal Wall No. 2
Schmidt Hammer Test Value	Mean Rebound Number, N = 48 Cube Compressive Strength, W_m = 565 kg/cm^2 Cylinder Compressive Strength, Z_m = 480 kg/cm^2

Schmidt Hammer Test Result

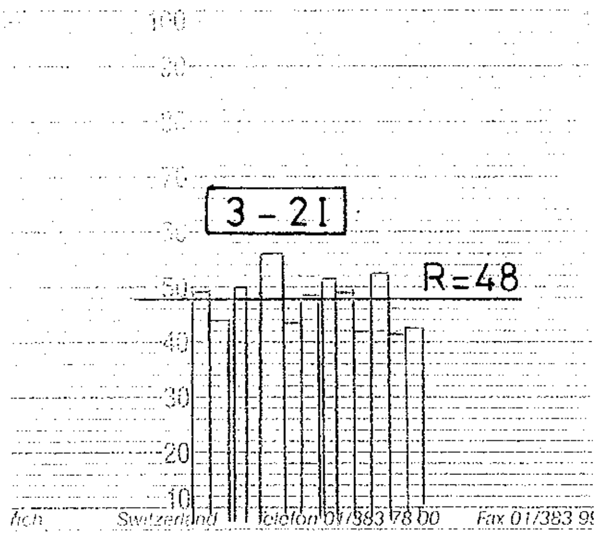


Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (9/34)

Date: 18 June 1999

Facility No: 4 - 1	Primary Sedimentation Tank No. 1
Structure Member: 4 – 1EN	External Wall – North Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 37 Cube Compressive Strength, W_m = 360 kg/cm^2 Cylinder Compressive Strength, Z_m = 306 kg/cm^2

Schmidt Hammer Test Result

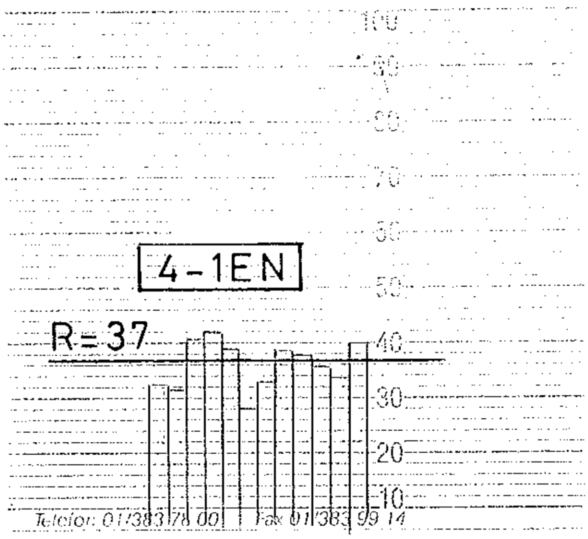
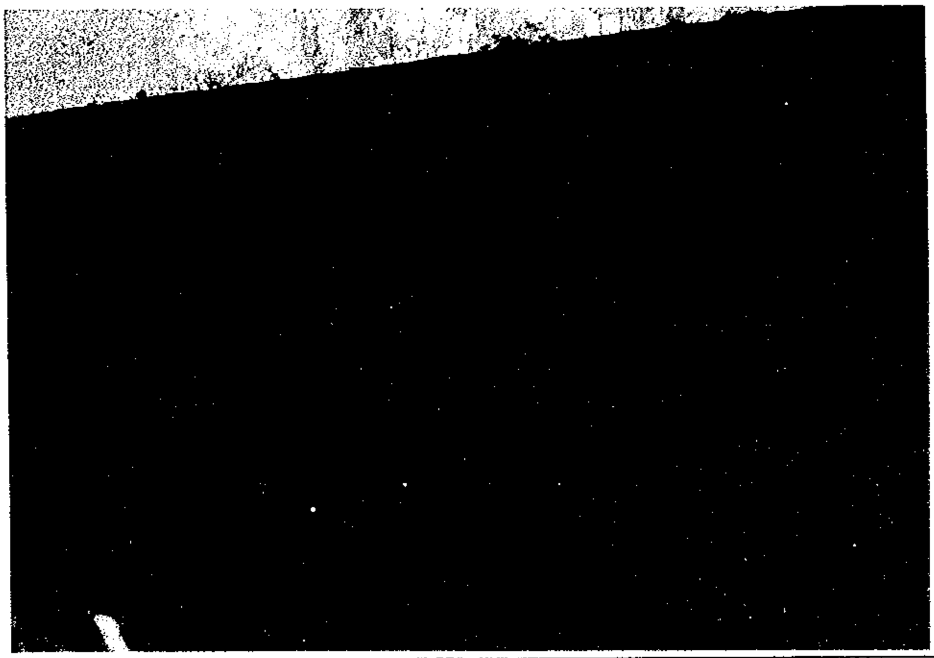


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (10/34)

Date: 18 June 1999

Facility No: 4 - 1	Primary Sedimentation Tank No. 1
Structure Member: 4 – 1IW	Inner Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 39 Cube Compressive Strength, W_m = 395 kg/cm^2 Cylinder Compressive Strength, Z_m = 336 kg/cm^2

Schmidt Hammer Test Result

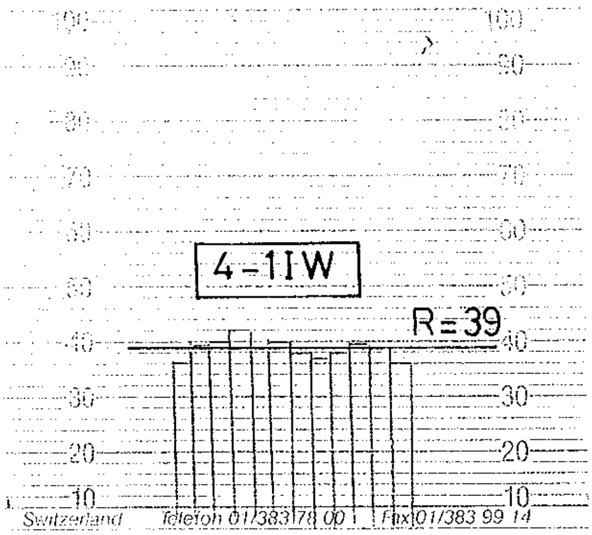
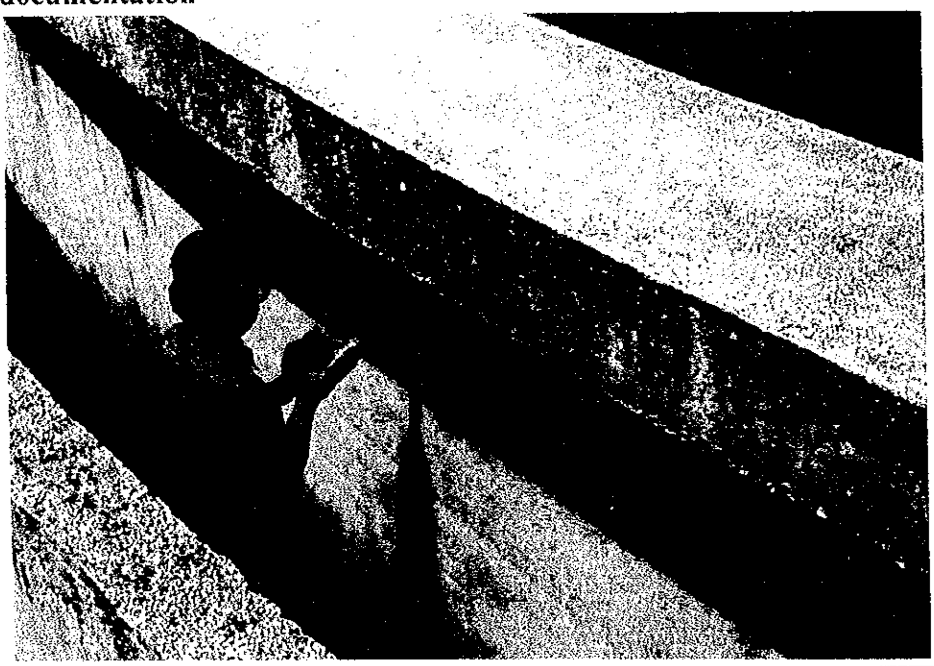


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (11/34)

Date: 18 June 1999

Facility No: 4 - 2	Primary Sedimentation Tank No. 2
Structure Member: 4 – 2EE	External Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 36 Cube Compressive Strength, W_m = 342 kg/cm^2 Cylinder Compressive Strength, Z_m = 291 kg/cm^2

Schmidt Hammer Test Result

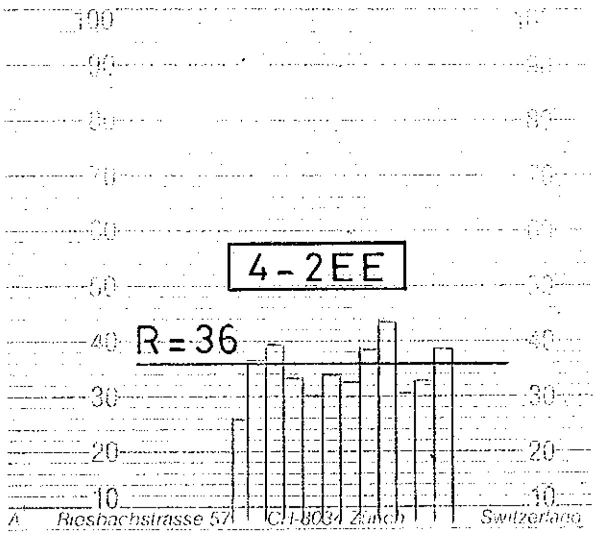


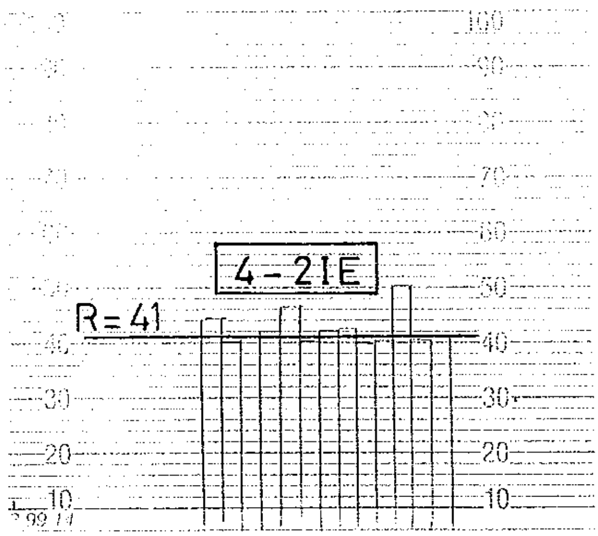
Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (12/34)

Date: 18 June 1999

Facility No: 4 - 2	Primary Sedimentation Tank No. 2
Structure Member: 4 – 2IE	Inner Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 41 Cube Compressive Strength, W_m = 432 kg/cm^2 Cylinder Compressive Strength, Z_m = 367 kg/cm^2

Schmidt Hammer Test Result



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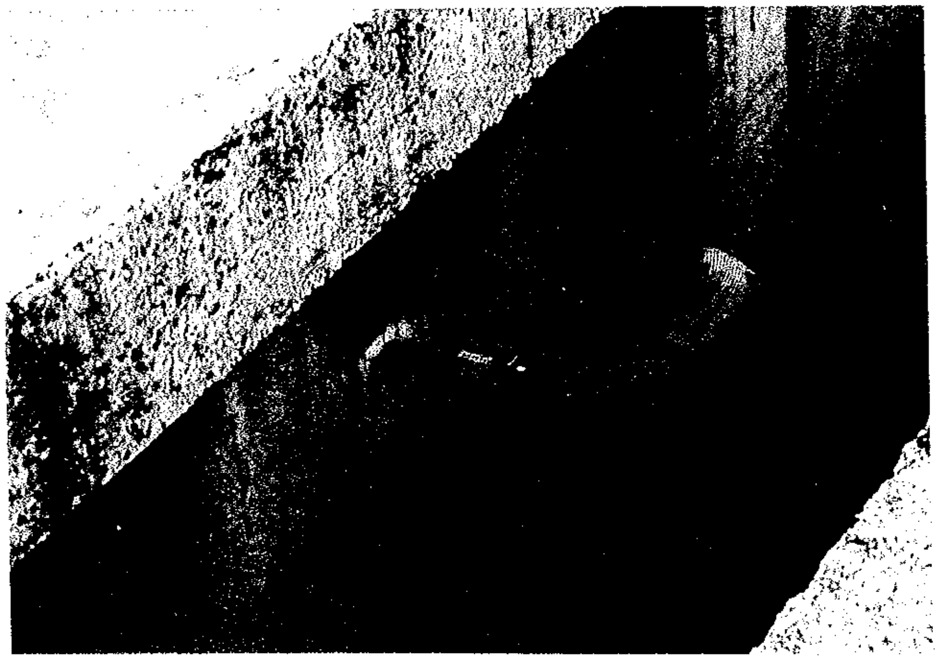
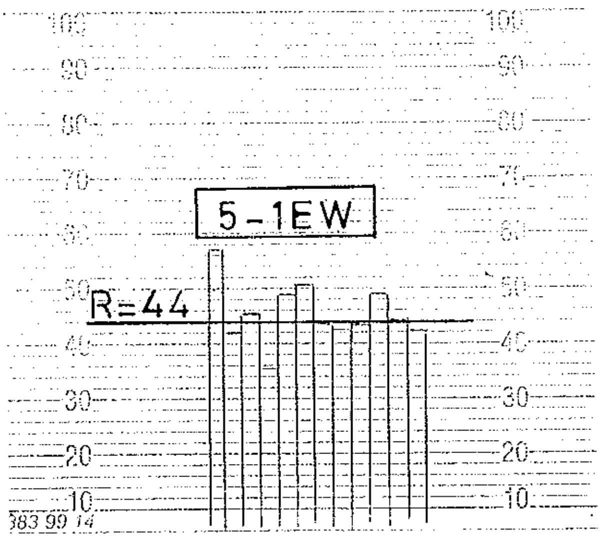


CONCRETE STRESS STRENGTH TEST SHEET (13/34)

Date: 21 June 1999

Facility No: 5	Aeration Tank
Structure Member: 5 – 1EW	External Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 44 Cube Compressive Strength, W_m = 488 kg/cm^2 Cylinder Compressive Strength, Z_m = 415 kg/cm^2

Schmidt Hammer Test Result



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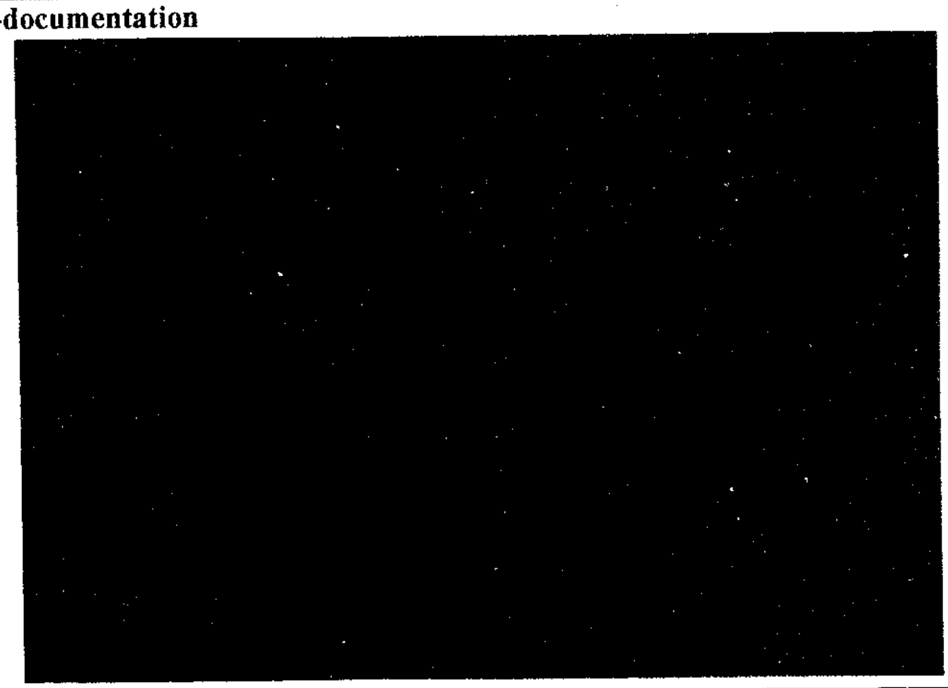
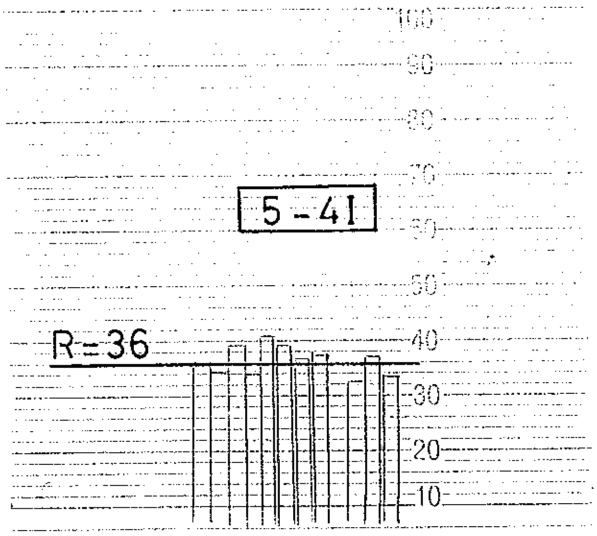


CONCRETE STRESS STRENGTH TEST SHEET (14/34)

Date: 17 June 1999

Facility No: 5	Aeration Tank
Structure Member: 5 – 4I	Inner Wall No. 4
Schmidt Hammer Test Value	Mean Rebound Number, N = 36 Cube Compressive Strength, W_m = 342 kg/cm^2 Cylinder Compressive Strength, Z_m = 291 kg/cm^2

Schmidt Hammer Test Result



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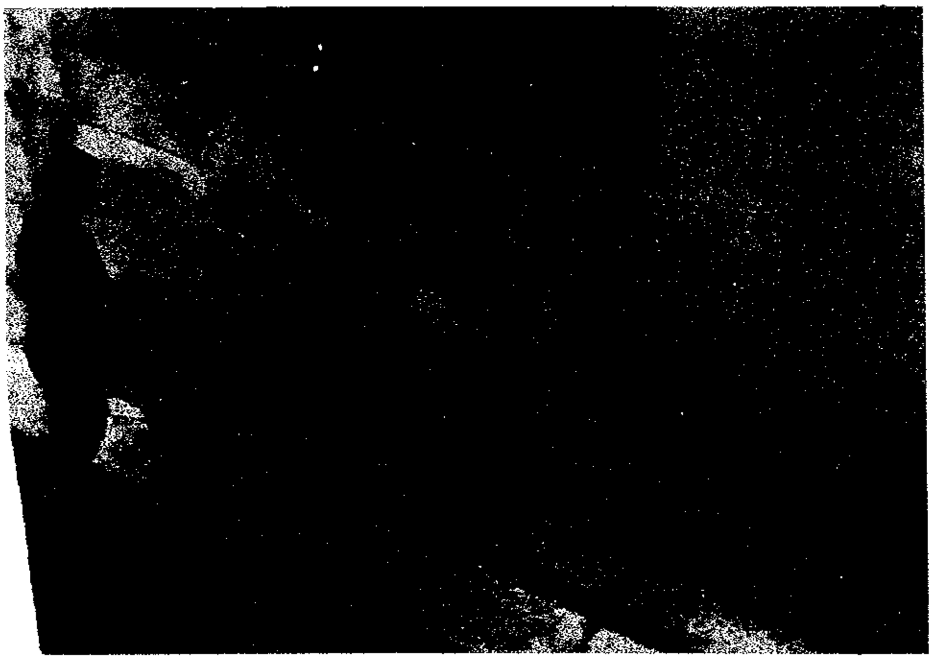
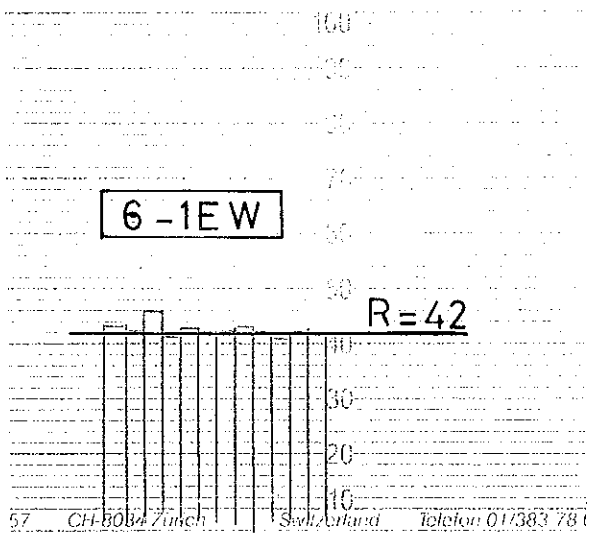


CONCRETE STRESS STRENGTH TEST SHEET (15/34)

Date: 21 June 1999

Facility No: 6 - 1	Final Sedimentation Tank No. 1
Structure Member: 6 – 1EW	External Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 42 Cube Compressive Strength, W_m = 450 kg/cm^2 Cylinder Compressive Strength, Z_m = 383 kg/cm^2

Schmidt Hammer Test Result



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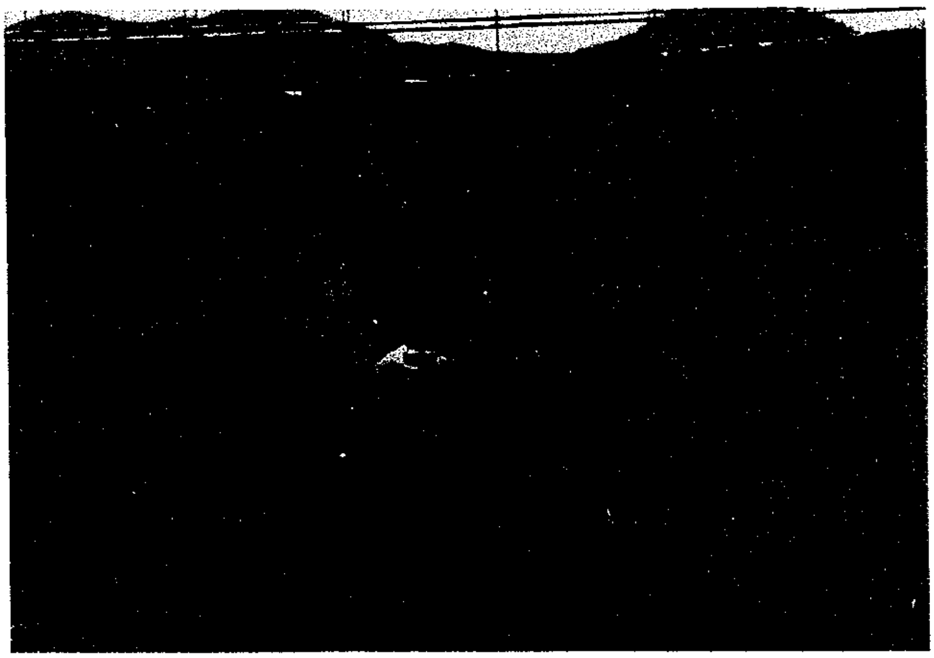
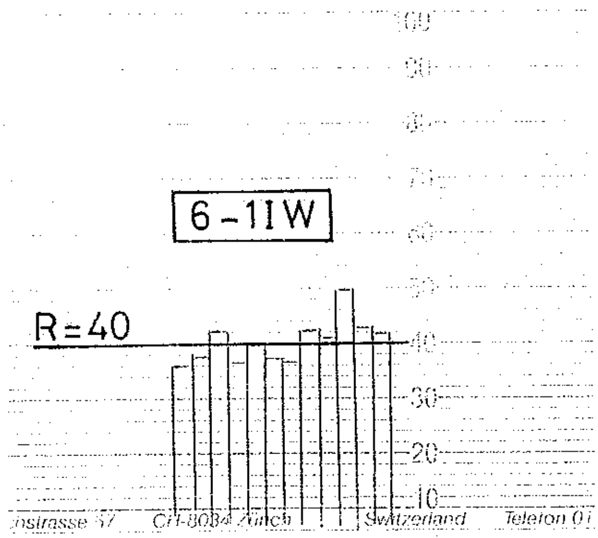


CONCRETE STRESS STRENGTH TEST SHEET (16/34)

Date: 17 June 1999

Facility No: 6 – 1	Final Sedimentation Tank No. 1
Structure Member: 6 – 1IW	Inner Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 40 Cube Compressive Strength, W_m = 413 kg/cm^2 Cylinder Compressive Strength, Z_m = 351 kg/cm^2

Schmidt Hammer Test Result



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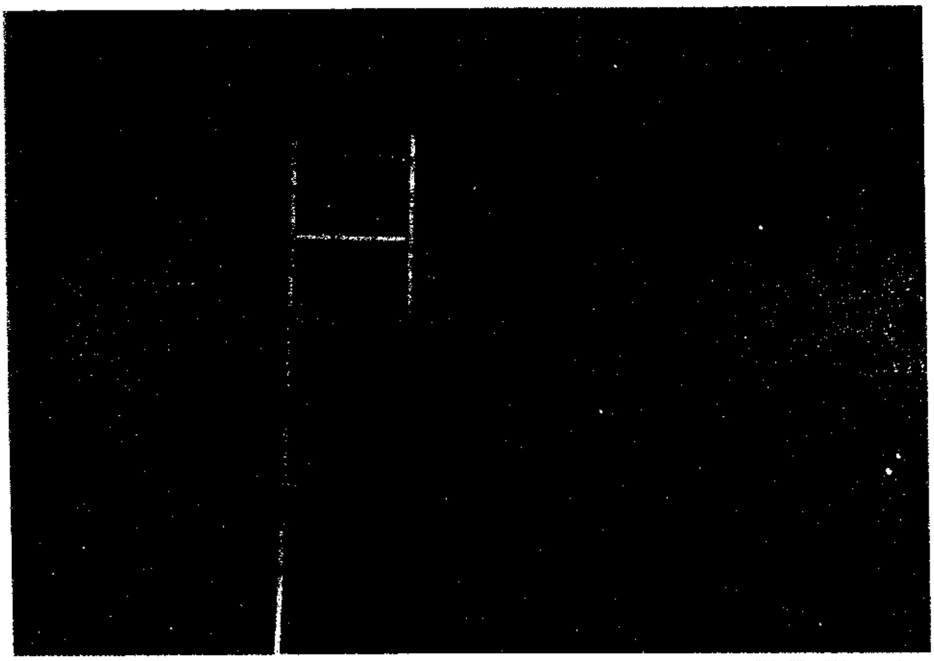
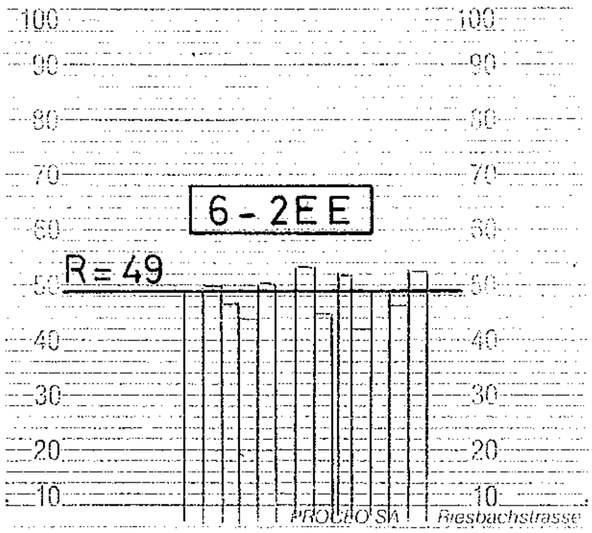


CONCRETE STRESS STRENGTH TEST SHEET (17/34)

Date: 21 June 1999

Facility No: 6 - 2	Final Sedimentation Tank No. 2
Structure Member: 6 – 2EE	External Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 49 Cube Compressive Strength, W_m = 584 kg/cm^2 Cylinder Compressive Strength, Z_m = 496 kg/cm^2

Schmidt Hammer Test Result



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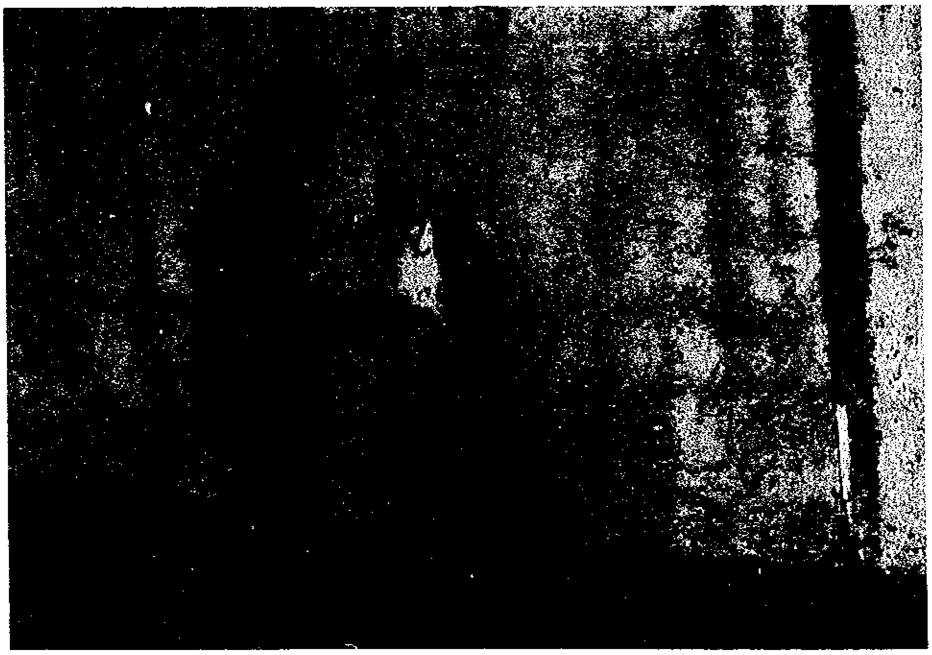


CONCRETE STRESS STRENGTH TEST SHEET (18/34)

Date: 21 June 1999

Facility No: 6 - 2	Final Sedimentation Tank No. 2
Structure Member: 6 – 2IE	Inner Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 43 Cube Compressive Strength, W_m = 469 kg/cm^2 Cylinder Compressive Strength, Z_m = 399 kg/cm^2

Schmidt Hammer Test Result

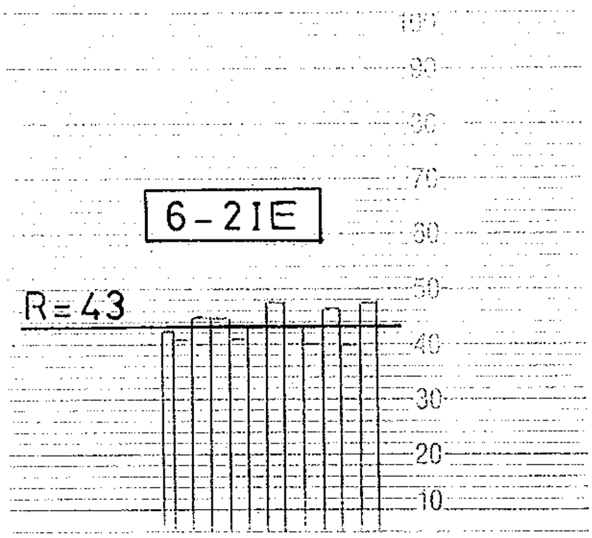
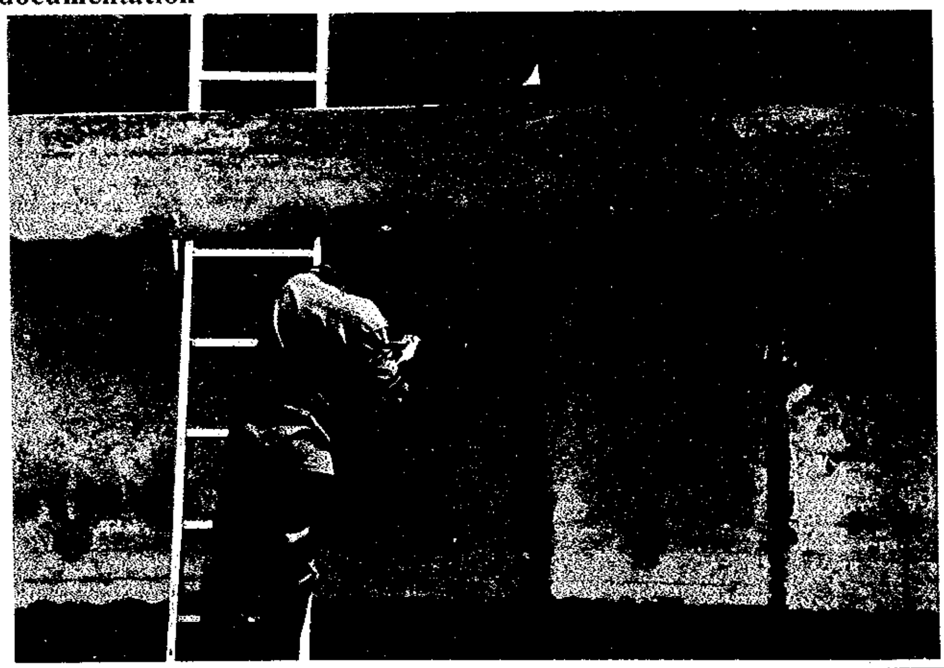


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (19/34)

Date: 21 June 1999

Facility No: 6 - 3	Final Sedimentation Tank No. 3
Structure Member: 6 – 3EW	External Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 41 Cube Compressive Strength, W_m = 432 kg/cm^2 Cylinder Compressive Strength, Z_m = 367 kg/cm^2

Schmidt Hammer Test Result

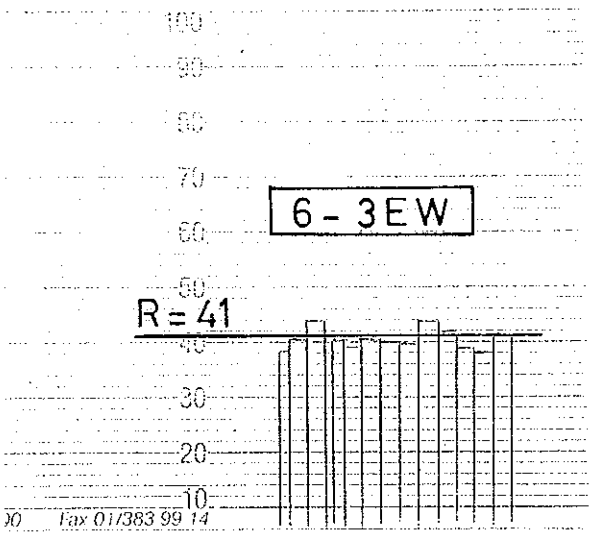


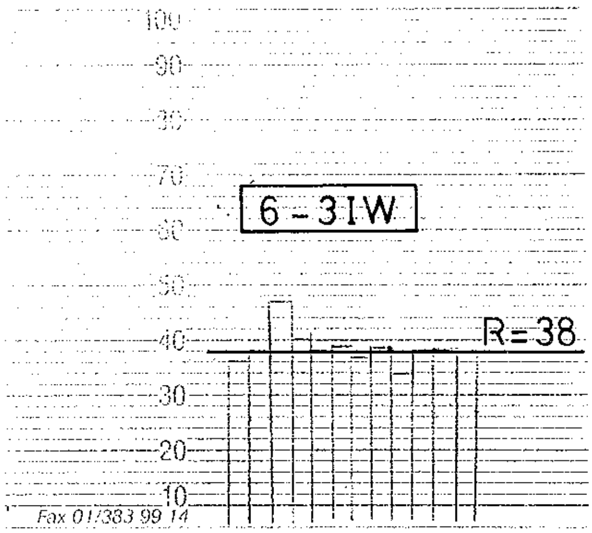
Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (20/34)

Date: 21 June 1999

Facility No: 6 - 3	Final Sedimentation Tank No. 3
Structure Member: 6 – 3IW	Inner Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 38 Cube Compressive Strength, W_m = 377 kg/cm^2 Cylinder Compressive Strength, Z_m = 320 kg/cm^2

Schmidt Hammer Test Result



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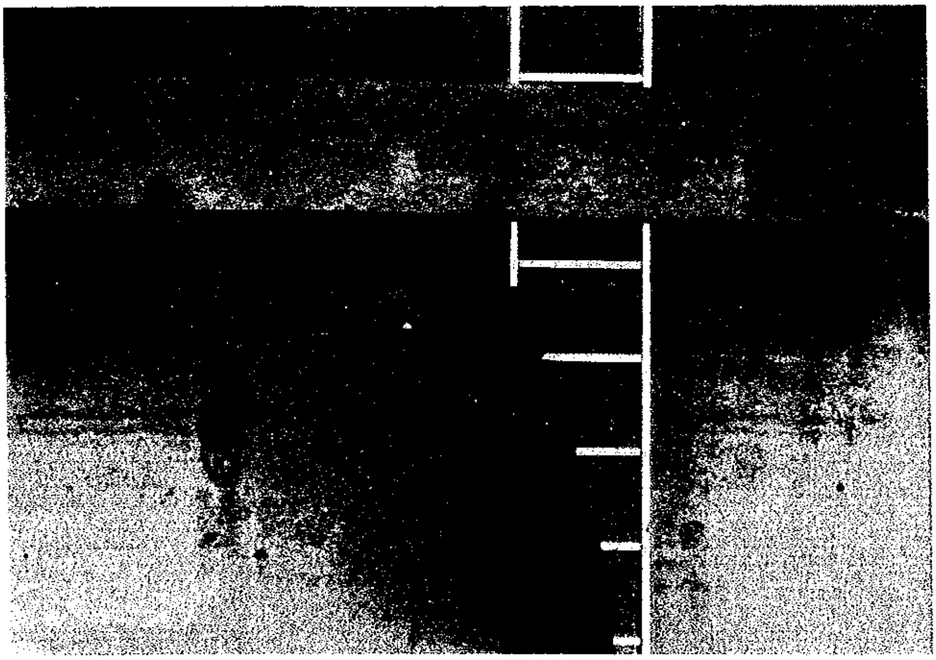


CONCRETE STRESS STRENGTH TEST SHEET (21/34)

Date: 21 June 1999

Facility No: 6 - 4	Final Sedimentation Tank No. 4
Structure Member: 6 – 4EE	External Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 51 Cube Compressive Strength, W_m = 623 kg/cm^2 Cylinder Compressive Strength, Z_m = 530 kg/cm^2

Schmidt Hammer Test Result

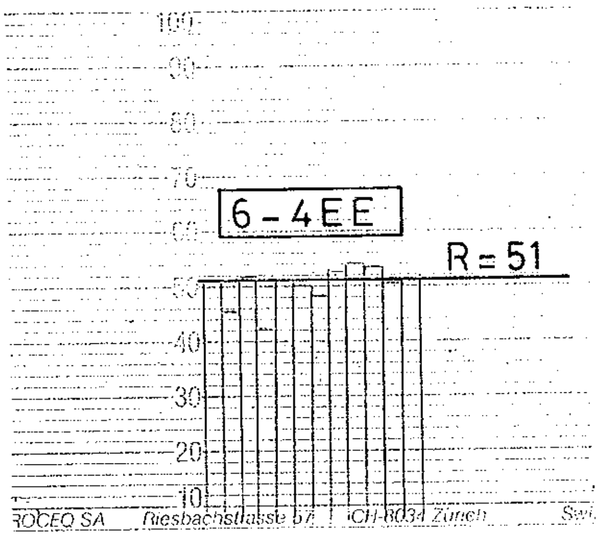
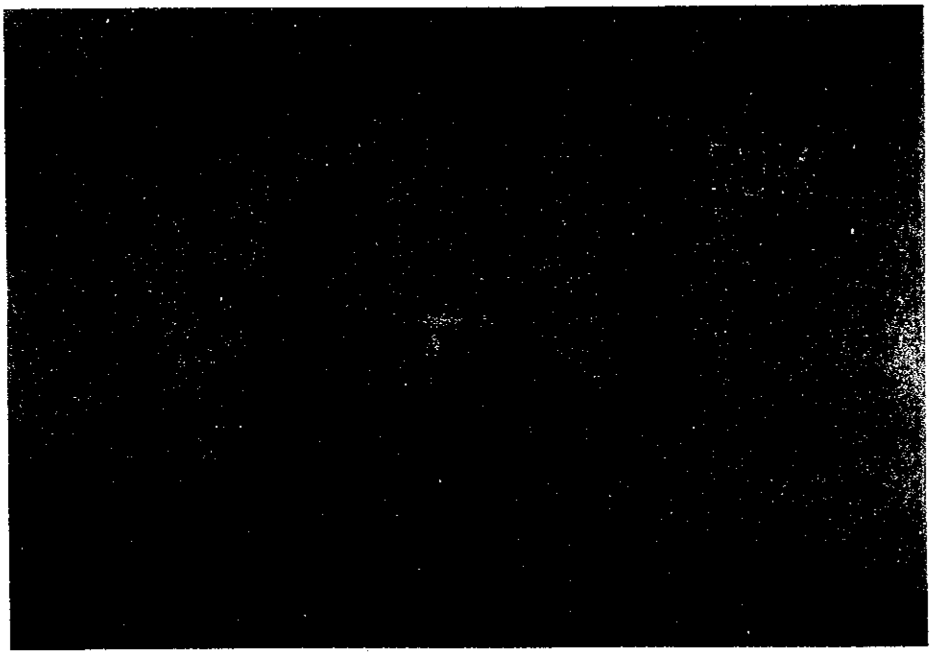


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (22/34)

Date: 21 June 1999

Facility No: 6 - 4	Final Sedimentation Tank No. 4
Structure Member: 6 – 4IE	Inner Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 39 Cube Compressive Strength, W_m = 395 kg/cm^2 Cylinder Compressive Strength, Z_m = 336 kg/cm^2

Schmidt Hammer Test Result

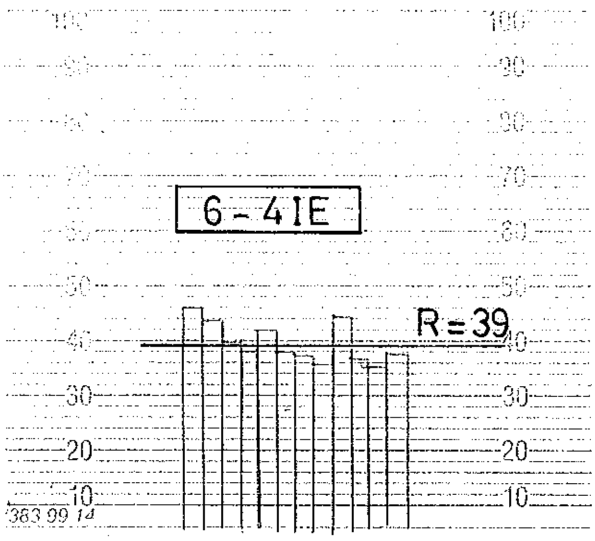
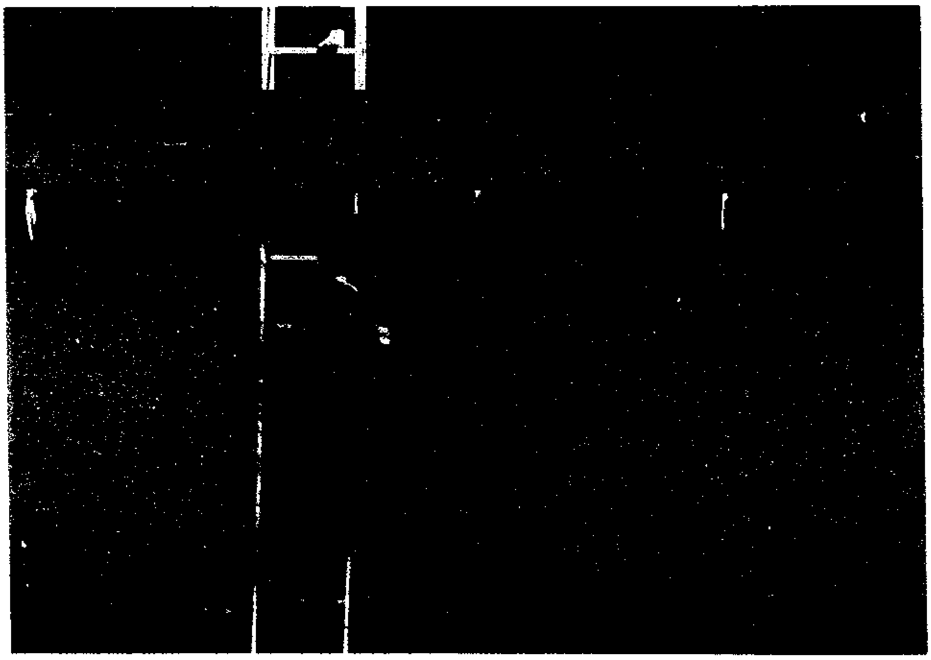


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (23/34)

Date: 28 June 1999

Facility No: 8	Recycled Sludge Pumping Station
Structure Member: 8 – CNE	Column – Northeast Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 42 Cube Compressive Strength, W_m = 450 kg/cm^2 Cylinder Compressive Strength, Z_m = 383 kg/cm^2

Schmidt Hammer Test Result

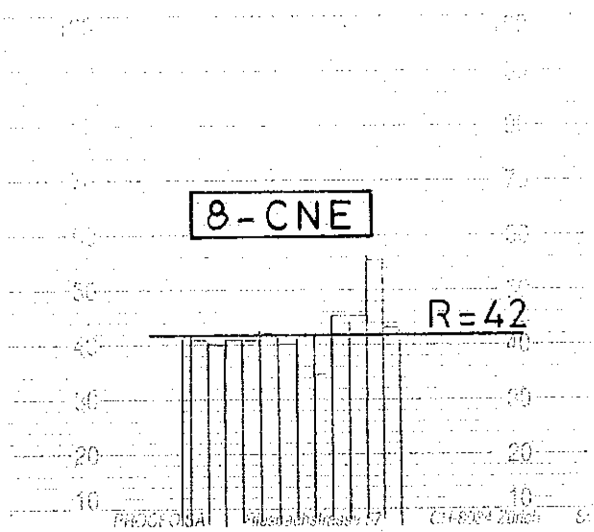
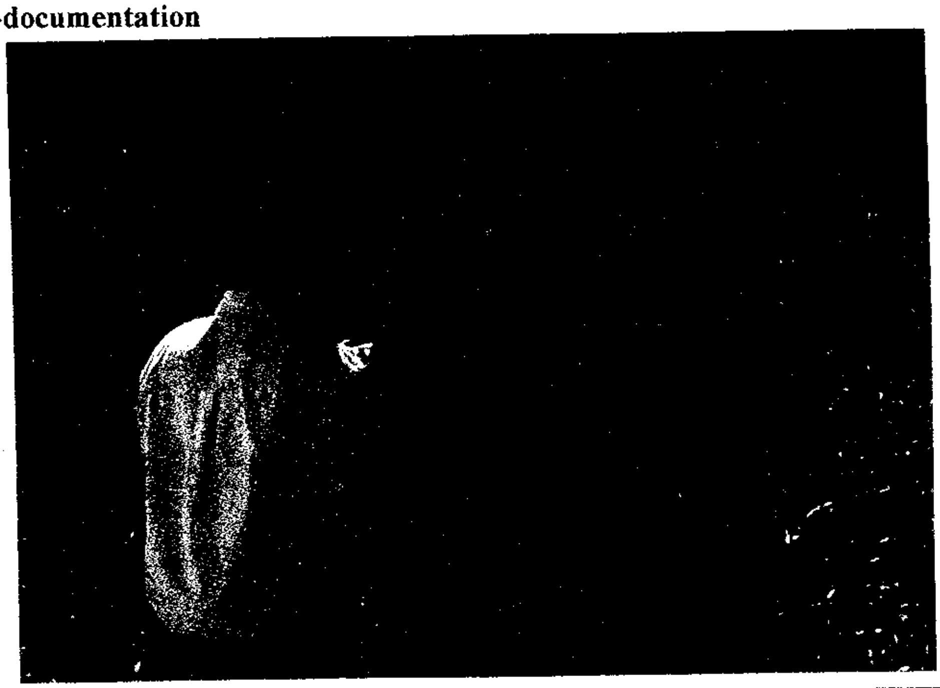


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (24/34)

Date: 28 June 1999

Facility No: 8	Recycled Sludge Pumping Station
Structure Member: 8 – CNW	Column – Northwest Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 44 Cube Compressive Strength, W_m = 488 kg/cm^2 Cylinder Compressive Strength, Z_m = 415 kg/cm^2

Schmidt Hammer Test Result

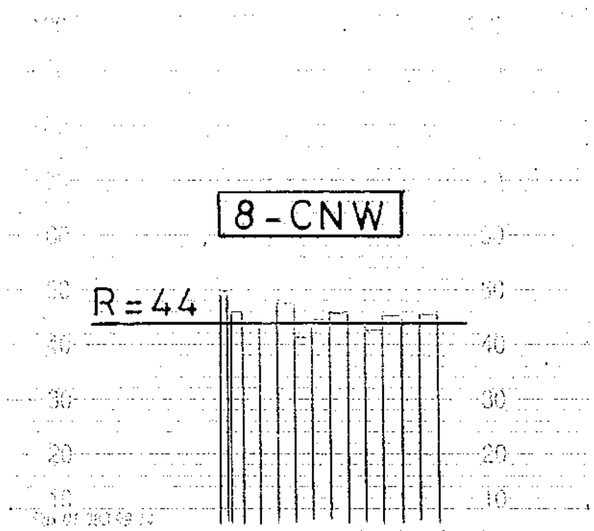


Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (25/34)

Date: 21 June 1999

Facility No: 10 - 1	Sludge Thickener No. 1
Structure Member: 10 –1EN	External Wall – North Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 39 Cube Compressive Strength, W_m = 395 kg/cm^2 Cylinder Compressive Strength, Z_m = 336 kg/cm^2

Schmidt Hammer Test Result

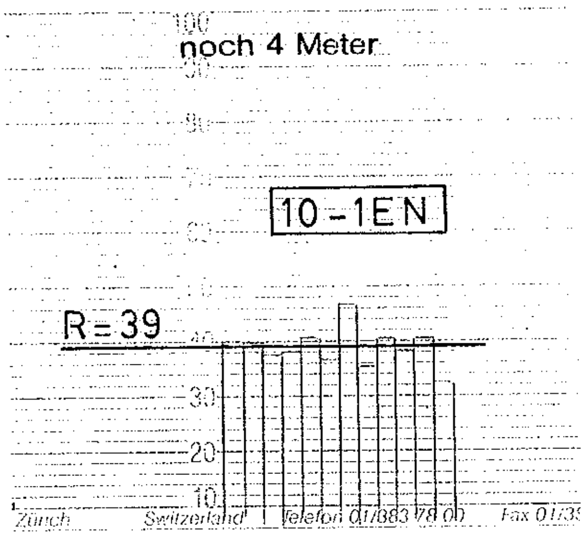
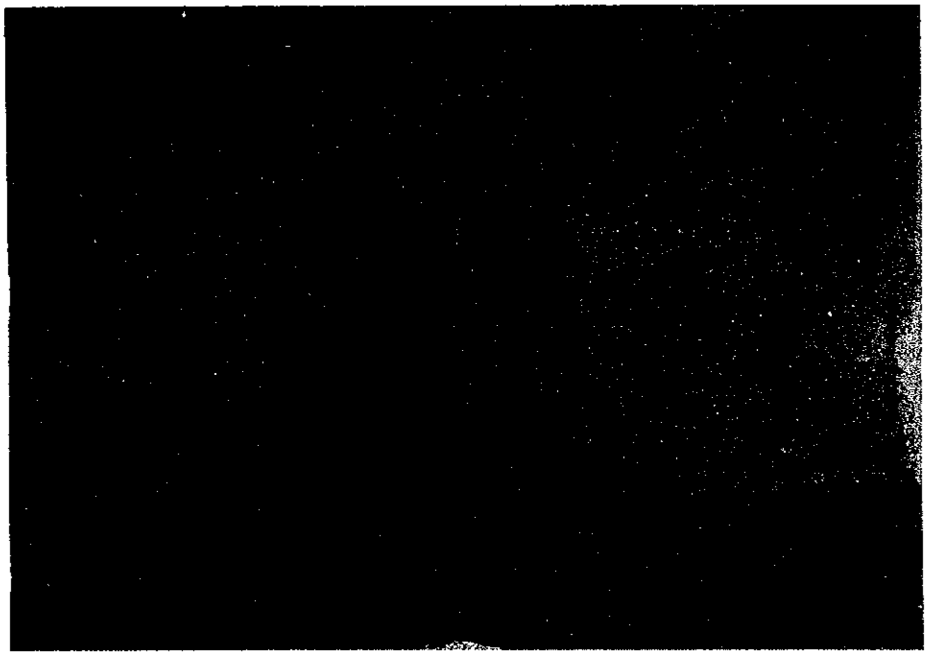


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (26/34)

Date: 17 June 1999

Facility No: 10 - 1	Sludge Thickener No. 1
Structure Member: 10 – 1IN	Inner Wall – North Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 41 Cube Compressive Strength, W_m = 432 kg/cm^2 Cylinder Compressive Strength, Z_m = 367 kg/cm^2

Schmidt Hammer Test Result

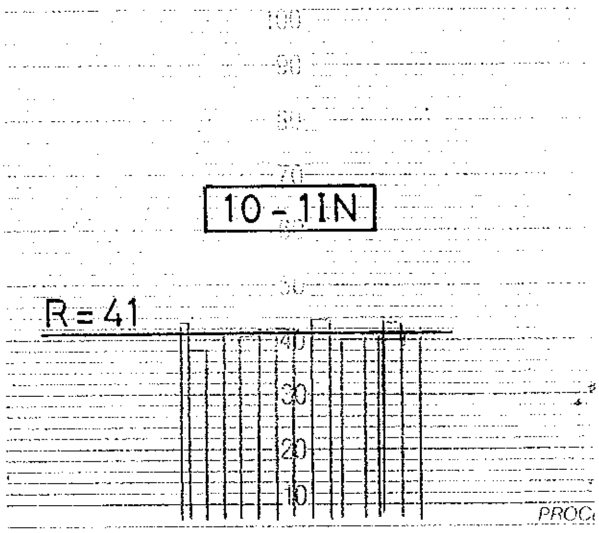


Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (27/34)

Date: 21 June 1999

Facility No: 10 - 2	Sludge Thickener Tank No. 2
Structure Member: 10 – 2ES	External Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 49 Cube Compressive Strength, W_m = 584 kg/cm^2 Cylinder Compressive Strength, Z_m = 496 kg/cm^2

Schmidt Hammer Test Result

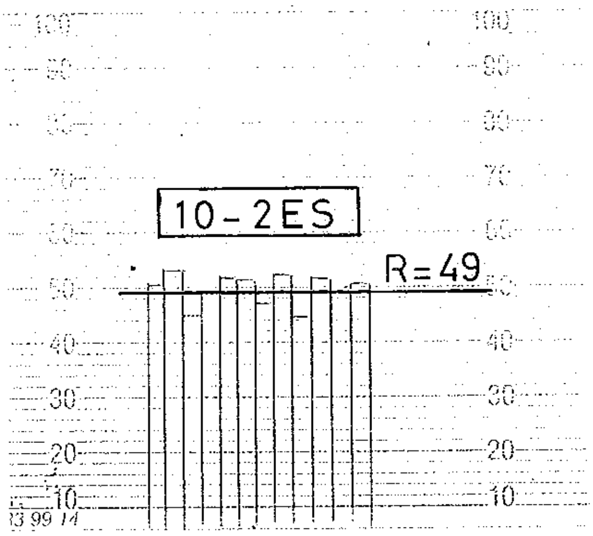


Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (28/34)

Date: 17 June 1999

Facility No: 10 - 2	Sludge Thickener No. 2
Structure Member: 10 – 2IW	Inner Wall – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 41 Cube Compressive Strength, W_m = 432 kg/cm^2 Cylinder Compressive Strength, Z_m = 367 kg/cm^2

Schmidt Hammer Test Result

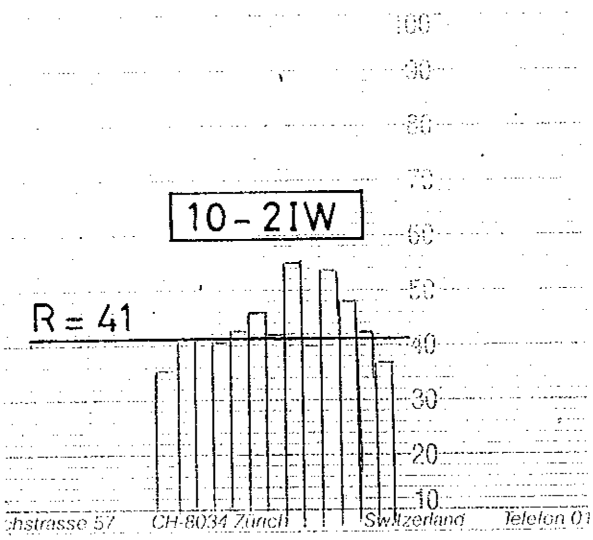
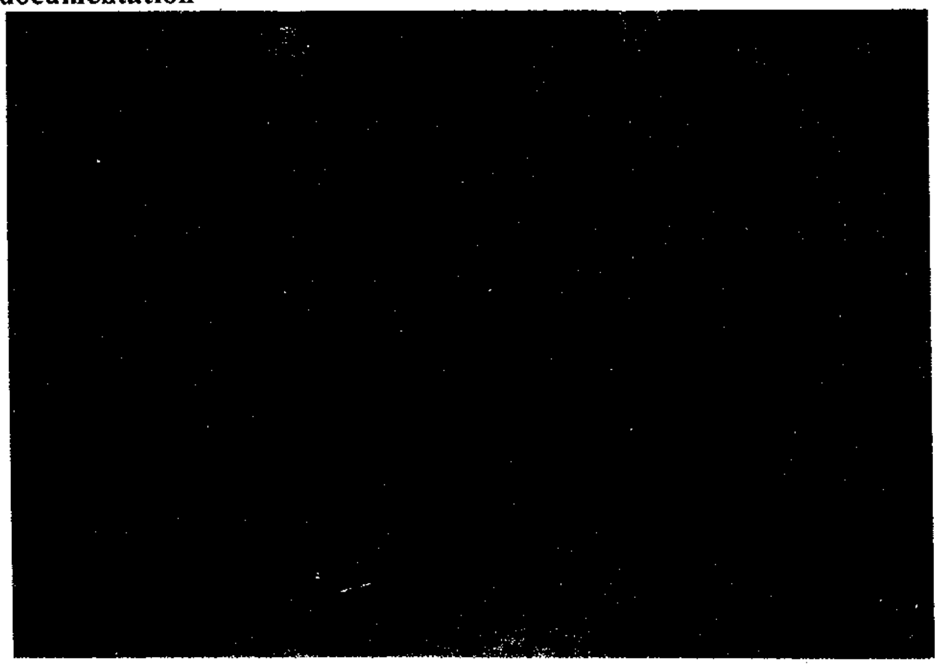


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (29/34)

Date: 21 June 1999

Facility No: 15	Gas Storage Tank
Structure Member: 15 – EN	External Wall – North Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 44 Cube Compressive Strength, W_m = 488 kg/cm^2 Cylinder Compressive Strength, Z_m = 415 kg/cm^2

Schmidt Hammer Test Result

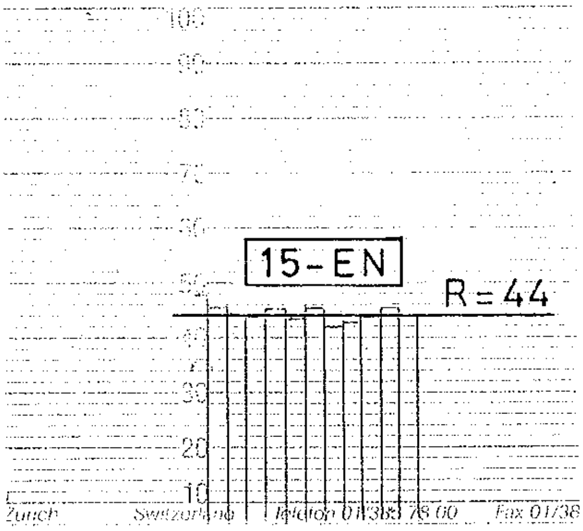
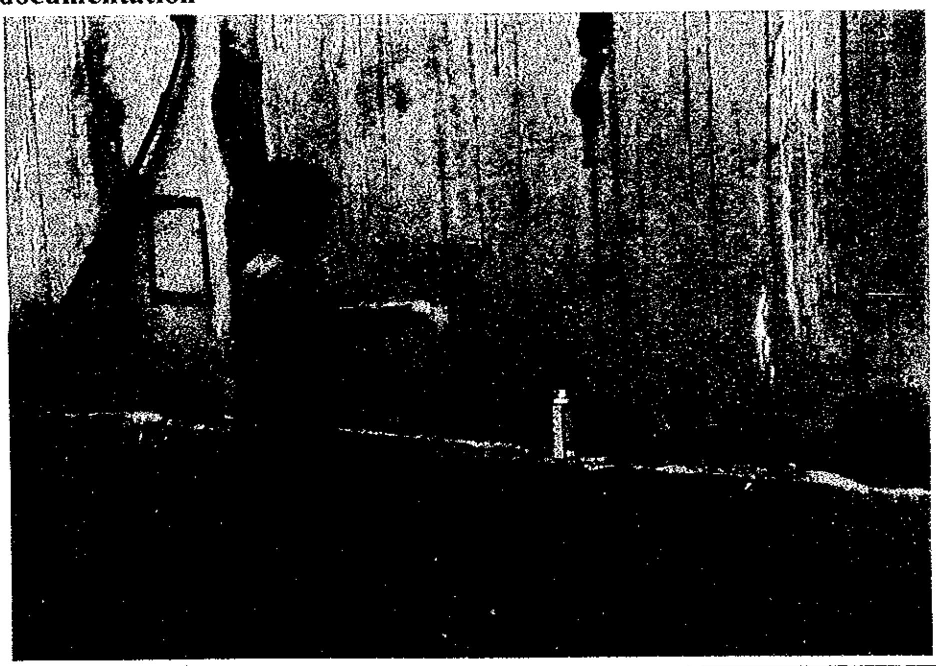


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (30/34)

Date: 21 June 1999

Facility No: 16	Homogenised Sludge Holding Tank
Structure Member: 16 – EN	External Wall – North Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 44 Cube Compressive Strength, W_m = 488 kg/cm^2 Cylinder Compressive Strength, Z_m = 415 kg/cm^2

Schmidt Hammer Test Result

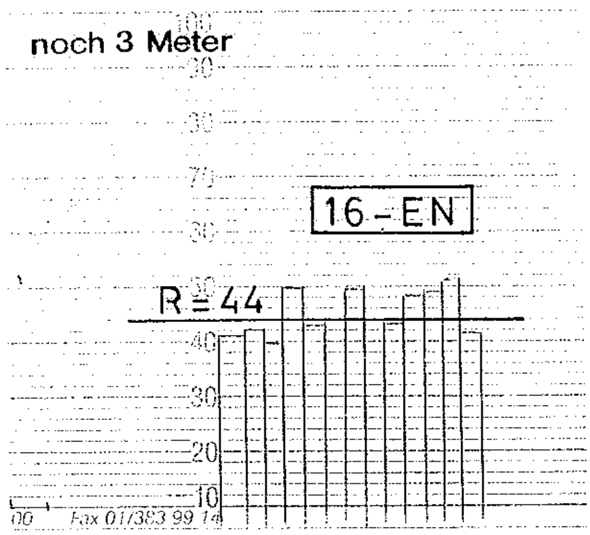


Photo-documentation

CONCRETE STRESS STRENGTH TEST SHEET (31/34)

Date: 21 June 1999

Facility No: 16	Homogenised Sludge Holding Tank
Structure Member: 16 – IE	Inner Wall – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 55 Cube Compressive Strength, W_m = 703 kg/cm^2 Cylinder Compressive Strength, Z_m = 598 kg/cm^2

Schmidt Hammer Test Result

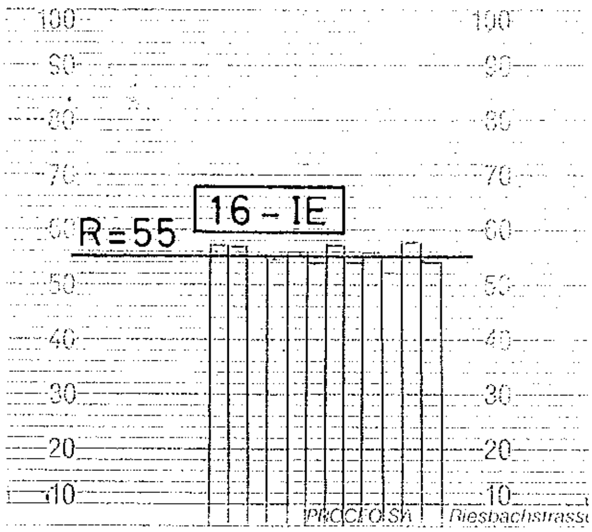
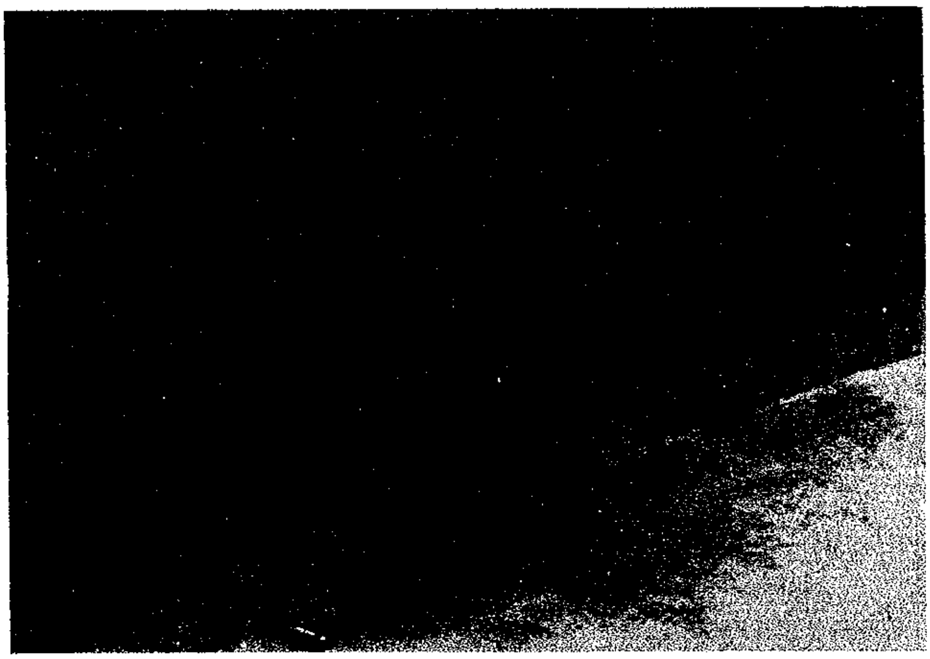


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (32/34)

Date: 21 June 1999

Facility No: 18	Sludge Dehydration
Structure Member: 18 – CW	Column – West Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 49 Cube Compressive Strength, W_m = 584 kg/cm^2 Cylinder Compressive Strength, Z_m = 496 kg/cm^2

Schmidt Hammer Test Result

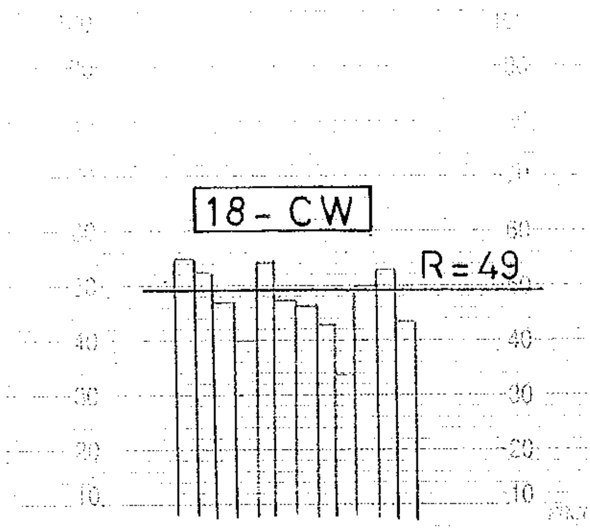
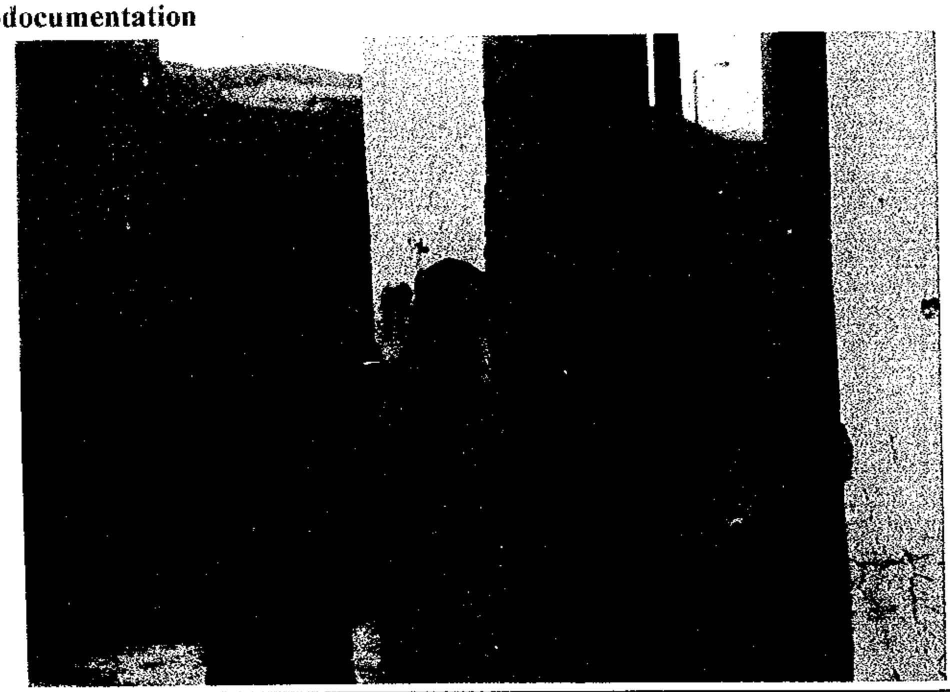


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (33/34)

Date: 28 June 1999

Facility No: 18	Sludge Dehydration
Structure Member: 18 – CE	Column – East Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 40 Cube Compressive Strength, W_m = 413 kg/cm^2 Cylinder Compressive Strength, Z_m = 351 kg/cm^2

Schmidt Hammer Test Result

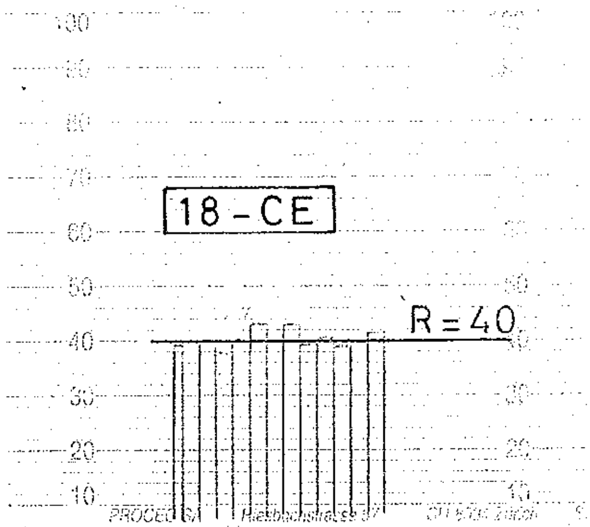
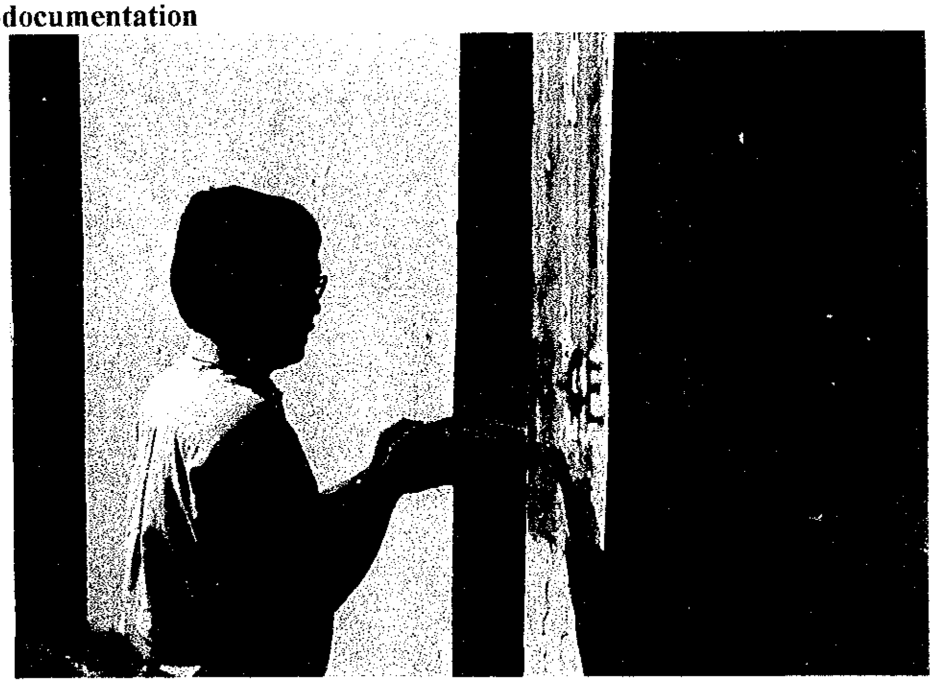


Photo-documentation



CONCRETE STRESS STRENGTH TEST SHEET (34/34)

Date: 28 June 1999

Facility No: 23	Administration Building
Structure Member:23 – CSW	Column – Southwest Side
Schmidt Hammer Test Value	Mean Rebound Number, N = 48 Cube Compressive Strength, W_m = 565 kg/cm^2 Cylinder Compressive Strength, Z_m = 480 kg/cm^2

Schmidt Hammer Test Result

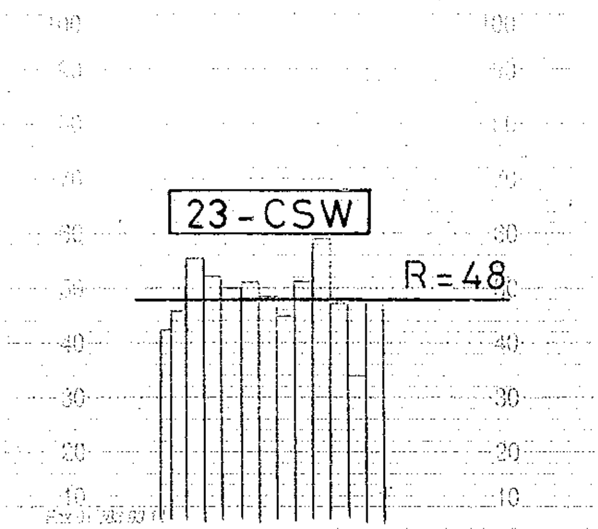
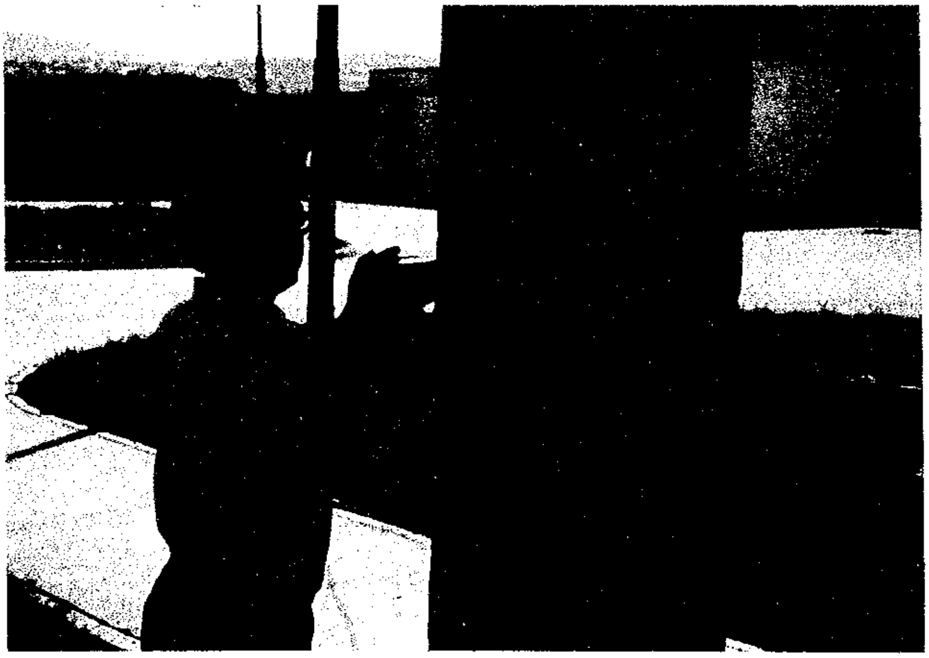


Photo-documentation



APPENDIX
F

IMK MATERIAL TEST REPORT

INSTITUT ZA MATERIJALE I KONSTRUKCIJE GRAĐEVINSKOG FAKULTETA U SARAJEVU

imk

INSTITUTE FOR MATERIALS AND STRUCTURES FACULTY OF CIVIL ENGINEERING UNIVERSITY OF SARAJEVO

Ul. Stjepana Tomića br.5.

Stjepana Tomića st. N°.: 5

N° 103-3/99

ELABORATE

ON TESTS ON THE WORK ON THE OBJECTS AERATION TANK, AERATION GRIT CHAMBER AND PIPELINE AS PART OF THE FILTER OF WASTE WATERS COMPLEX SARAJEVO

Made by

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Acting Director

M.Sc. Davorin Končarić, Civil Enginner

Sarajevo, July 1999

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1. INTRODUCTION

Based on the Contract No. 102-2/99, dated June 14, 1999 concluded between USB KEDLY from Sarajevo, as orderer and Institute for Materials and Structures Faculty of Civil Engineering in Sarajevo, as performer, this Institute performed research works on three objects that are part of the Filter of Waste Water Complex Sarajevo. Detail examination of bearing structure, graphical and photo recording of damages, establishing of mechanical characteristcs of the built in material of the Object Aeration Tank (Structure No. 5) and Aeration Grit Chamber (Structure No. 3), visual examining of underground pipeline on four open locations with establishment of geometrical and mechanical characteristics of the basic material of the pipeline were performed.

Works on the field were realized during the period between June 7 and June 21, 1999.

Following people from the Institute were working on the realization of the examining works on the Object, testing of the build in material and producing of the elaboration:

- M. Sc. Muhamed Madžarević Civil Engineer
- Emir Muhlisić Civil Engineer
- Omer Bardak Mechanical Technician
- Fikret Dulaš Mechanical Technician
- Pero Josipović High Qualified Worker
- Salko Sirčić Laboratory Technician
- Omer Pindžo Laboratory Technician

Translation of the Elaborate done by Ivana Lončarić.

Drafts of both Objects with basic dimensions were given further in text.

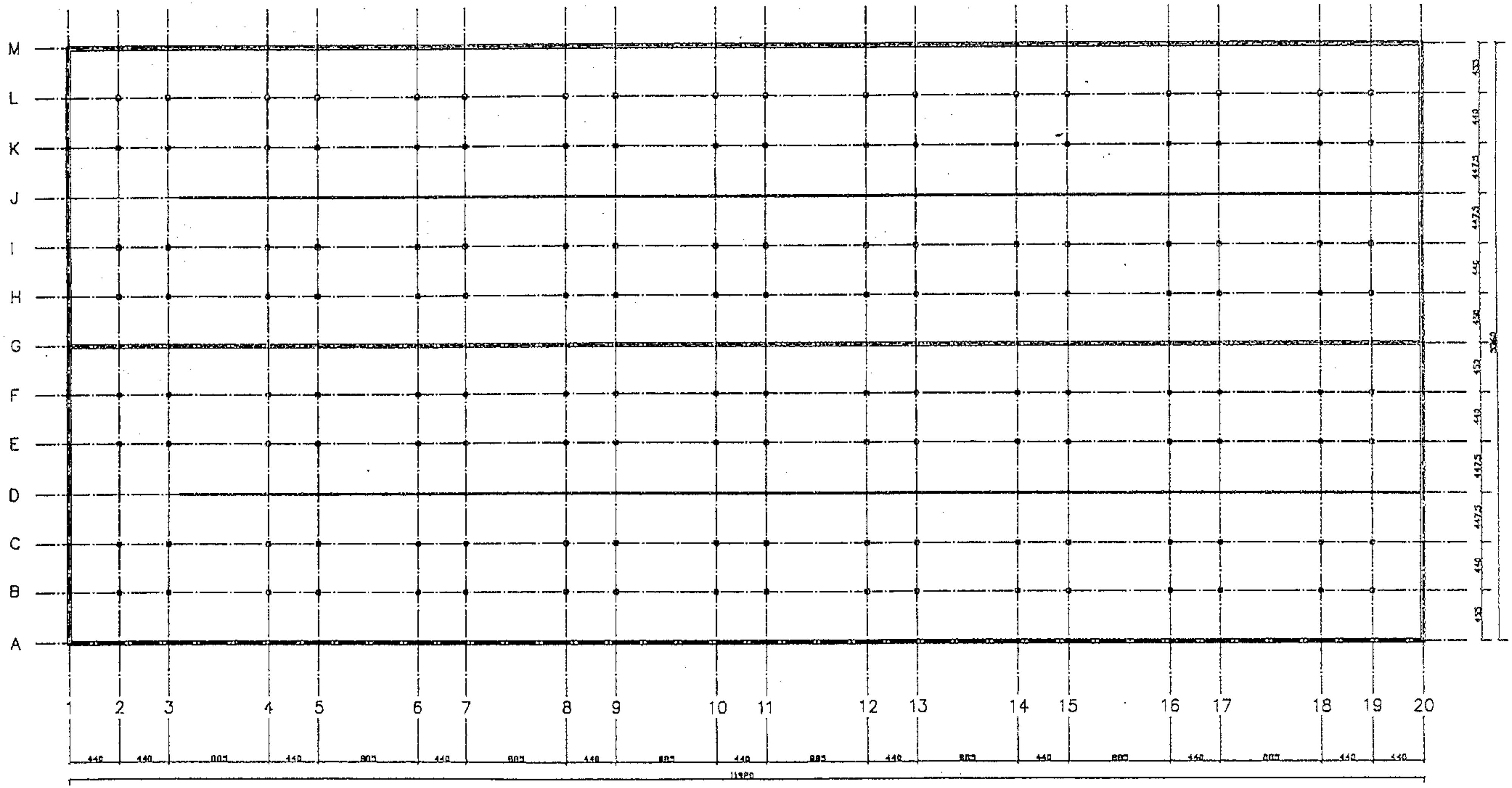
2. DESCRIPTION OF THE DAMAGE

In order to determine the scope and character of damages on bearing structures of the Objects, detailed visual examination, graphical and photo recording of characteristic damages were performed as it is shown in Appendices 1 and 6 in this Elaborate.

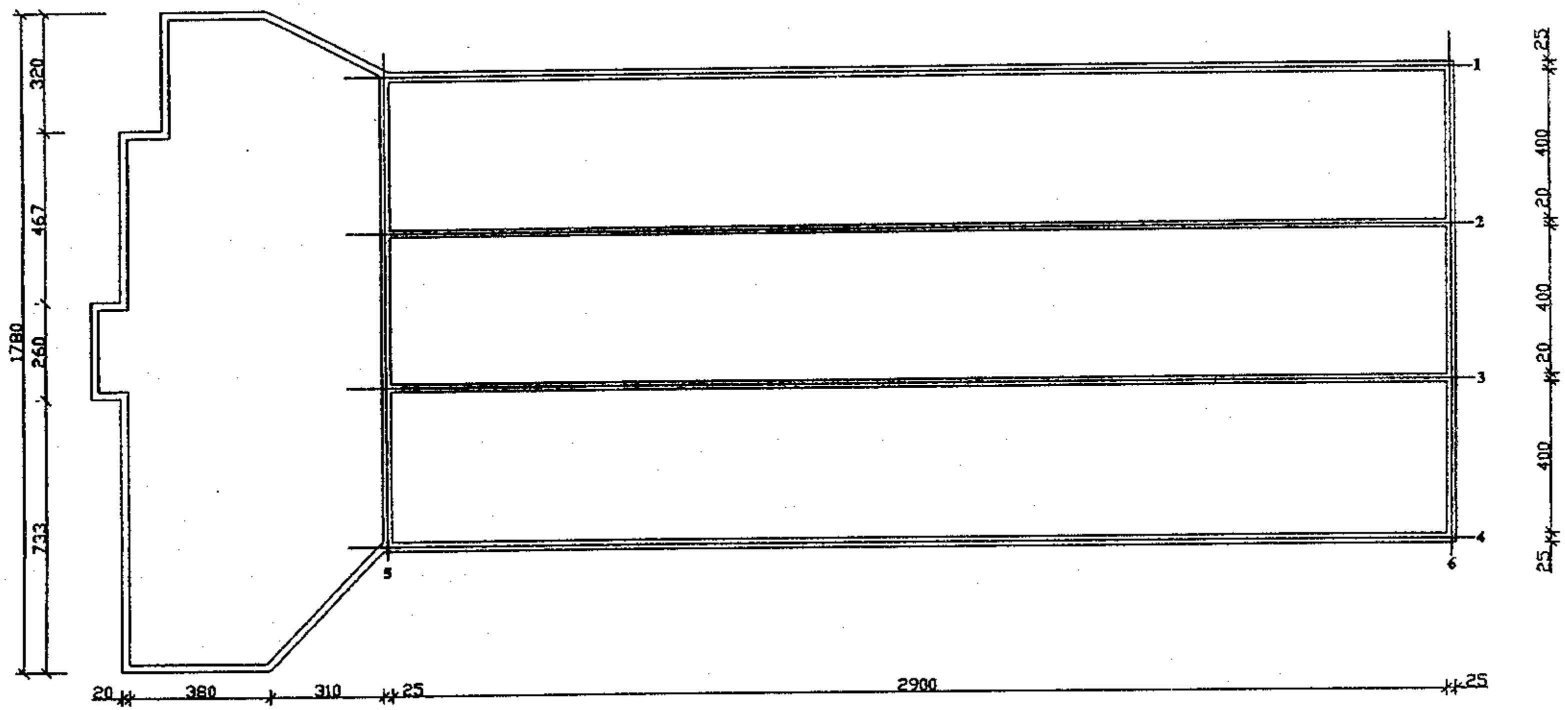
2.1. AERATION TANK

This Object is characterized by the damages of the walls and columns.
Regarding the walls from the inner side, on various places the longitudinal reinforcement is visible, as well as the signs of corrosion on more localities of reinforcement that went through the protecting layer of concrete. It is obvious that it is question about insufficient protecting layer. Above these damages certain number mostly vertical cracks wide less than 1 mm are visible.
From the outer side of the object abovementioned damages were not noticed. But, here we find the characteristic places where the cracks were supposedly sanified when noticed during the pre war exploatation of the Object. Sanifying was supposedly performed with epoxid pitch and on some placed the leaking of the water was concluded.

STRUCTURE AERATION TANK - HORIZONTAL VIEW



STRUCTURE AERATED GRIT CHAMBER - HORIZONTAL VIEW



Columns in the Object are directly supported to the bottom plate, and it is usually participated as structure elements that hold structure on which the aerators are put up. Damages that are concluded on the columns can be generally divided into two groups. Columns with the damage i.e. with the protecting layer of the concrete fallen off belong to the first group. Reinforcement on those places is visible, exposed to the atmosphere impact, i.e. to the impact of the environment and in more or less scope is corroded. In this group we could classify the following columns: B18, C 18, B17, C17, B16, C16, B11, C11, F3, E12, F12, E13, F13, E14, F14, E15, F15, E16, F16, E17, F17, E18, F18, E19, F19, H14, I14, H13, H12, I12, H11, H10, H5, L3, L9, K11, L11, K13 and K15.
In the second group the columns that have protecting layer of the concrete could be classified but from one side or the other the signs of corrosion of the reinforcement that penetrated through the surface of the columns can be noticed. The following columns can be classified in this group: B15, B14, C14, B13, C12, B12, B10, C10, B9, C9, B8, C8, C7, B5, C5, B4, C4, B3, B2, E2, F2, E3, E7, E9, F9, E10, F10, H19, I19, H18, I18, H17, I13, H8, I8, H7, I7, I6, H4, I4, I2, L2, L12, L15, K17, L18, L19, H18, I16, H16, I15, H15, I11, I10, H9, I9, I5, H3, I2, H2, K2, K3, K4, K5, L4, L5, K6, K7, L6, L7, K8, K9, L8, K10, L10, K12, L13, K14, L14, K16, L16, L17, K18 and K19.
On the biggest number of the columns the damages are only on one side. This is the consequence of the fact that those where concrete on the other place in horizontal position and the side that was turned down has smaller protecting layer of the concrete because during the concrete process the necessary distancers were not built in.
On the other columns no damages were noticed.

2.2 AERATED GRIT CHAMBER

From the outer side the similar damages were noticed as from the outer side the above-described Object but those are less expressed. Regarding the walls from the inner side, damages of the protecting layer of the concrete were not noticed. There are some mostly vertical cracks wide up to 1 mm and on few placed closing of the cracks possibly noticed before, similar as at the outer side. On few placed the leak of the water through structure dilatation that are usually sealed with the tire seal are concluded.

In general, it can be said that the scope and the character of the usual damages on the both Objects, with certain sanify intervention is not of that kind that can jeopardize safety, stability and functionality of the Object.

2.3. PIPELINE

By visual examination of the pipeline on four open locations as well as based on the examining of the specimen immediately after extraction, and after their processing it can be concluded that on the locations that were treated with this examination the degree of the corrosion of the basic material is insignificant, i.e. did not have impact on the reduction of the thickness of the pipeline, and therefore, did not have an impact on the functionality nor capacity of the pipeline.

3. TEST RESULTS OF THE MECHANICAL CHARACTERISTICS OF THE BUILT IN CONCRETE

In order to determine the quality of the built in concrete in the elements of the mentioned Objects Structures, extraction, processing and testing of cylinder concrete specimens with diameter of 100 mm were performed.

Extraction of the specimens from the Structure No.5 was performed during the period between the June 7 and June 21, and from the Structure No.3 on June 16 and June 17, 1999.

Concrete specimens were extracted mechanically, with tubes with diamond crowns and processed in shape of cylinder with diameter app. 100 mm and height app. 100 mm.

Extraction and testing of cylinder specimens were performed in accordance with the Regulations standard JUS U.M1.048 (Concrete - additional proving of the quality of the built in concrete).

In sum, 54 concrete specimens were extracted. From the Aeration Tank Structure 42 specimens were extracted, 9 specimens from outer longitudinal walls (walls in axes A and M), 3 specimens from outer transversal walls (walls in axes 1 and 20), 6 specimens from middle longitudinal wall (wall in axis G) and 12 specimens from bottom plate. From Aerated Grit Chamber structure 12 specimens in sum were extracted, 2 specimens from longitudinal walls (walls in axes A, B, C, D), 1 specimen from transversal wall in axis 2, and 3 specimens from bottom plate.

Testing of the specimens were performed at Institute on June 24, 1999.

Based on the performed tests on individual objects and by individual structure elements the following values of characteristic strength of the concrete and moment brand of the concrete were concluded:

N°	STRUCTURE	STRUCTURE ELEMENT	CHARACTERISTIC STRENGHT OF CONCRETE f_{bk} [N/mm^2]	MOMENT BRAND OF THE CONCRETE
1.	AERATION TANK	WALLS	32,69	**MB 30**
2.		BOTTOM PLATE	27,18	**MB 25**
3.	AER. GRIT CHAMBER	WALLS	31,70	**MB 30**
4.		BOTTOM PLATE	35,80	**MB 35**

4. TEST RESULTS OF MECHANICAL CHARACTERISTICS OF THE BUILT IN REINFORCEMENT

In order to determine the mechanical characteristics of the built in reinforcement in the elements of the mentioned Objects, extraction, processing and testing were performed the method of destroying of the reinforcement specimens from the walls, as well as from the bottom plates of the bothe Objects.

Taking of the reinforcement specimen was performed on June 17 and June 21, 1999.

Therefore, in total 6 series of three specimens were tested. Specimen A1 and A2 are from the wall of the Object structure No.5. From the parts of the reinforcement from the specimen of the concrete from the bottom plate the mini test glasses were made and marked as specimen A3. Specimens of the reinforcement A4 and A5 are extracted from the walls of the Object Structure No.3 while from the concrete specimens extracted from the bottom plate specimen A6 was formed. On this specimen mini test glasses could not be made, therefore tests were performed with "BRINELL" method, while the rest of the specimens (A1-A5) were processed and afterwards the tests were performed on the universal device (Amsler device).

By visual examination of the reinforcement specimen immediately after the extraction, and after their processing it can be concluded that the degree of the corrosion is insignificant, i.e. it did not have impact on reduction of the cross section, i.e. on the capacity of the tested bars.

Testing of the specimen was performed at the Institute on June 24, 1999.

According to test results of mechanical characteristics of built in reinforcement in elements of Structure Object Aeration Tank (Structure No. 5) and Aeration Grit Chamber (Structure No. 3) it can be concluded that the built in reinforcement has mechanical characteristics, that by Article 71. Regulation of Technical Normative for Concrete and Reinforcement, has the following nominal values:

- REINFORCING STEEL **GA 240/360**

- stress on limits of big elongation........................ f_{av} = **240** N/mm^2
- strength on spanning.. f_{az} = **360** N/mm^2
- percentage of elongation in breaking.................... ε_{10} = **18** %

- REINFORCEMENT **MAG 500/560**

- stress on limits of big elongation........................ f_{av} = **500** N/mm^2
- strength on spanning.. f_{az} = **560** N/mm^2
- percentage of elongation in breaking.................... ε_{10} = **6** %

5. TEST RESULTS OF Ph VALUE OF THE CONCRETE

In order to determine the Ph value of the concrete built in the elements of the mentioned Objects structures tests were performed at seven locations of the Object Structure Aeration tank and three locations of the Object Structure Aeration Grit Chamber.

Tests were performed on June 15 and June 21, 1999.

Based on the performed test following is concluded:

- Acid, i.e. aggressive environemnt on walls of the Objects can be concluded at the depth of app. 1,5 cm from the surface of the concrete, while deeper the environment is basic.
- Regarding the bottom plates, acid environment is concluded on depth of app. 1 cm from the surface of the concrete.
- Since the testing of the Ph was performed only on one column it is hard to make a general conclusion. But, taking into the consideration the described state of the columns, it is clear that the depth of the aggressive environment depends on the degree of the damage and on some places it is bigger than 2 cm.

6. TEST RESULT OF THE MECHANICAL CHARACTERISTICS OF THE BASIC MATERIAL OF THE PIPELINE

In order to determine the mechanical characteristics as well as the geometrical dimension of materials of which the underground pipeline is made of, extraction, processing and testing of four specimens from the different location were performed with method of destroying.

Taking of the specimens was performed on June 29, 1999.

Testing was performed on June 30, 1999 with "BRINELL" method.

The nominal diameter is determined and the thickness of the tube as follows:

- C1..... ∅ 230 x 5.5 mm
- C2..... ∅ 160 x 3.5 mm
- C3......∅ 230 x 5.5 mm
- C4......∅ 220 x 7 mm.

Based on the performed tests, in accordance with the Standard JUS C.B0.500, the basic material that the pipeline is made of as part of the Filter of Waste Waters Complex - Sarajevo can be classified as class of the steel: C.0561; i.e. technical mark CN 36-B_2 - general structure steel middle stiffness.

7. CONCLUSIONS WITH SUGGESTIONS

According to performed testing the following is concluded:

7.1. By visual testing of the Object Aeration Tank significant damages of protecting layer of concrete from the inner side of walls and especially on columns, were noticed. This was confirmed by testing of Ph values of the built in concrete. Regarding the walls from the outer side, on some places the leaking of the water was noticed on the places that were probably sanified before.

7.2. At the Object Aeration Grit Chamber the damages were noticed but in less scope than on the previous Object. The word is about some number of vertical crack approx. 1 mm width, as well as on places where the sanifying was probably performed before.

7.3. On the Object Pipeline visual testing was limited only on four locations where the digging was performed. On these locations the degree of corrosion of basic material was insignificant and does not influence the functionality, nor the bearing capacity of the pipeline.

7.4. By the testing of the concrete built in the Objects Aeration Tank and the Aeration Grit Chamber it was established that the characteristic strength of concrete depending on structure element of each object stays in limits $f_{bk} = 27{,}18 - 35{,}80\ N/mm^2$, i.e. the moment brand of concrete was established **MB25 -MB 35.**

7.5. Testing the reinforcement built in the Objects Aeration Tank and the Aeration Grit Chamber it was established that the degree of corrosion is insignificant and did not have an impact on reducing the cross section i.e. on the bearing capacity of individual bars. Testing the mechanical characteristics it was established that tested reinforcement has characteristics that correspond to the nominal values for reinforcing steel **GA 240/360** and to the welded reinforced grid (mesh) **MAG 500/560**.

7.6. Testing the Pipeline in total on four locations, the basic material can be ranged in the high quality class of steel **Č.0561**, i.e. in technical mark **ČN 36-B_2** - general structure steel of medium stiffness.

7.7. In order to bring the Object into the function it is necessary to perform the sanifying. Sanifying should be preceded by the development of control calculation of object for current state taking into the consideration the established mechanical characteristics of the built in materials, as well as the impacts of all exploiting load, according to current regulations and standards that are in relation with this kind of structure. According to control calculation the project of sanifying would be made. If it reveals that no structure sanifying is necessary, the sanifying should be reduced on closing the determined cracks and strengthening the protecting layer of concrete. For this purposes it is possible to purchase different kind of materials from more manufacturers on our market. One of them is TKK Srpenica, Slovenia and some of their materials were controlled and attested by this Institute.

Sarajevo, July 13, 1999.

Made by:

M.Sc. Muhamed Madžarević, Civ. Eng.

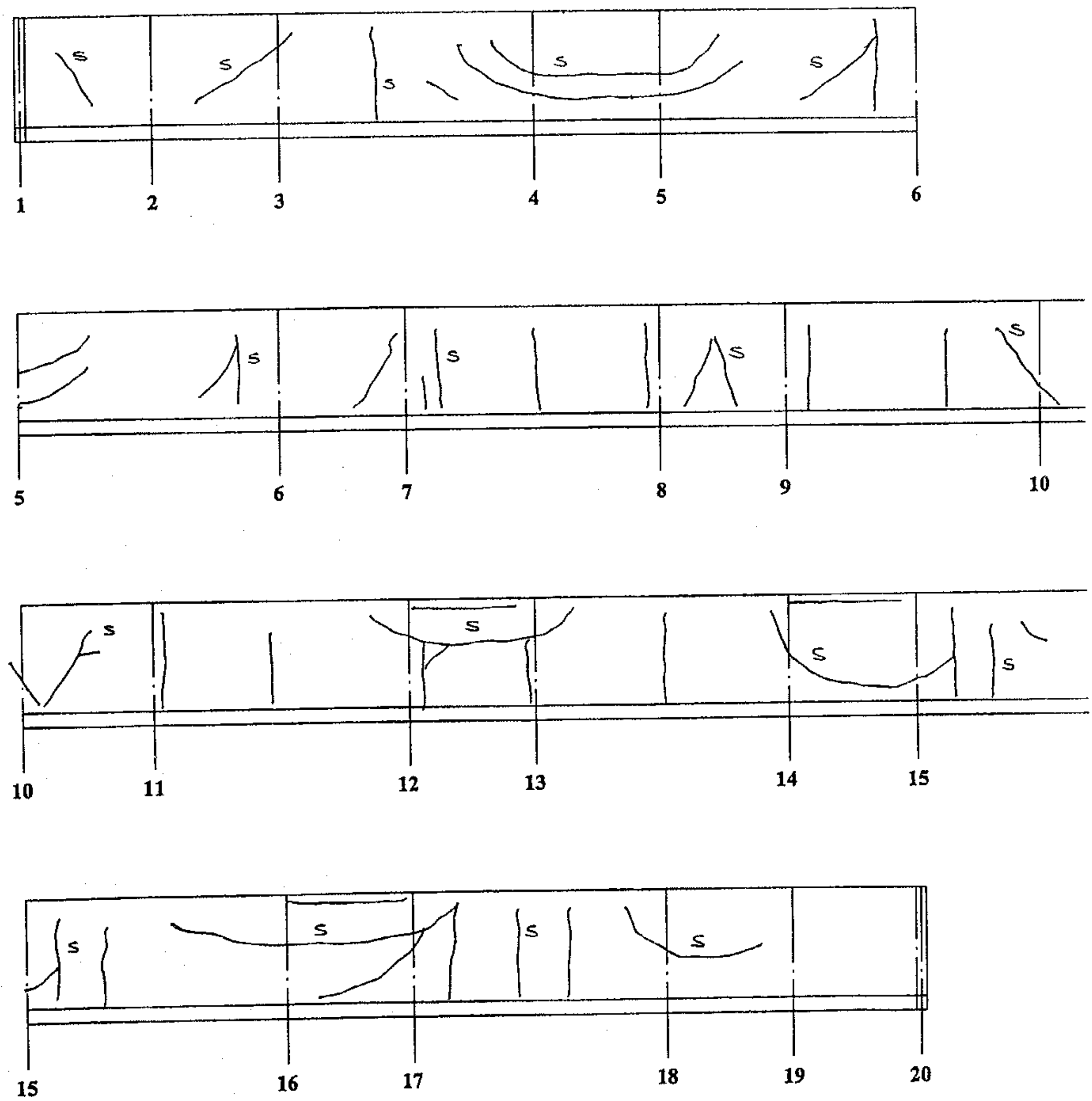
GRAPHICAL RECORDING OF CHARACTERISTIC DAMAGES OF THE WALS OF STRUCTURE OBJECT N^{O} 5 AND 3 AS PART OF WASTE WATERS FILTER COMPLEX-SARAJEVO

APPENDIX 1

Sarajevo, July 1999

STRUCTURE N°5 - WALL IN AXIS A

OUTSIDE VIEW

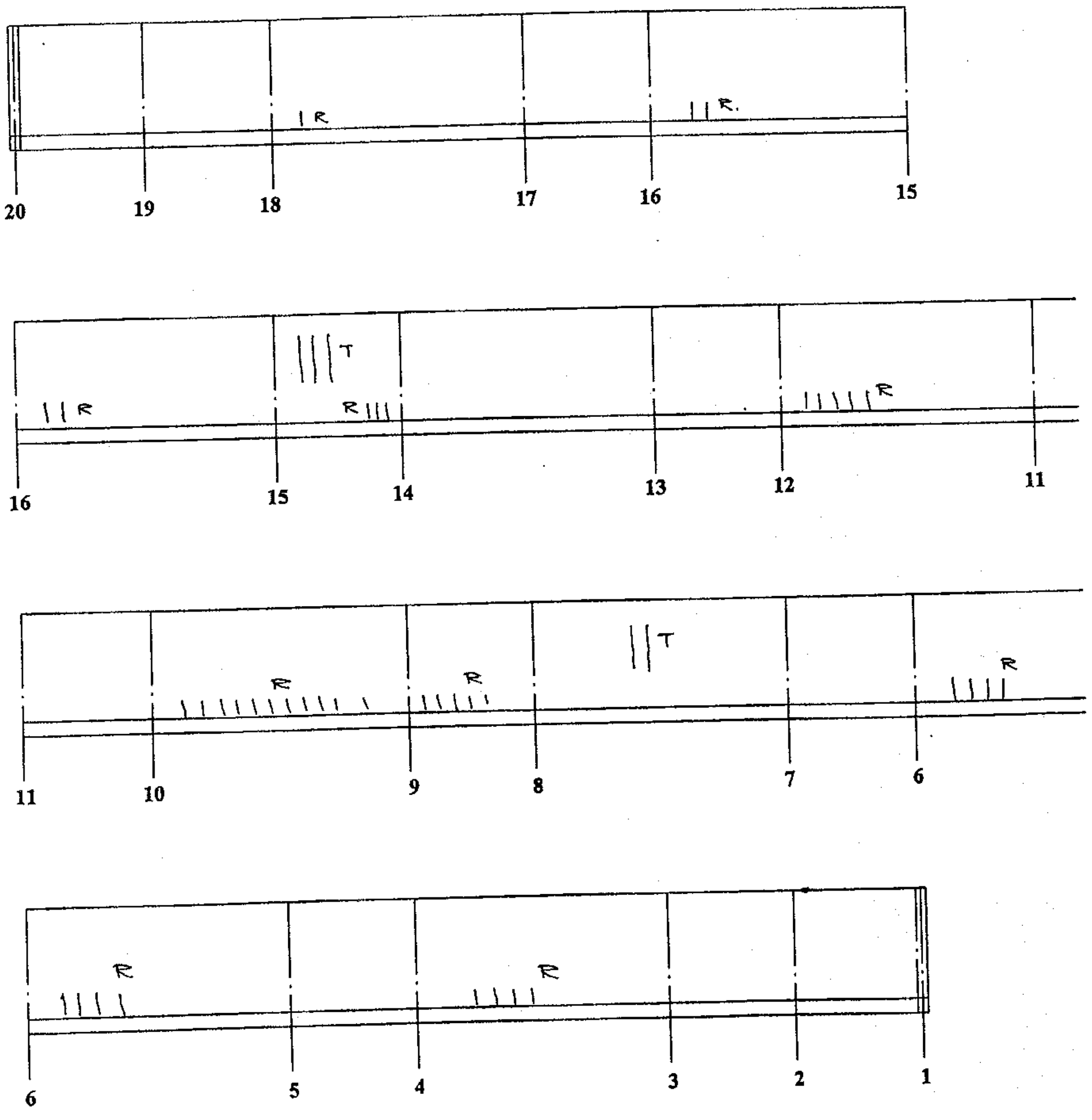


T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N°5 - WALL IN AXIS A

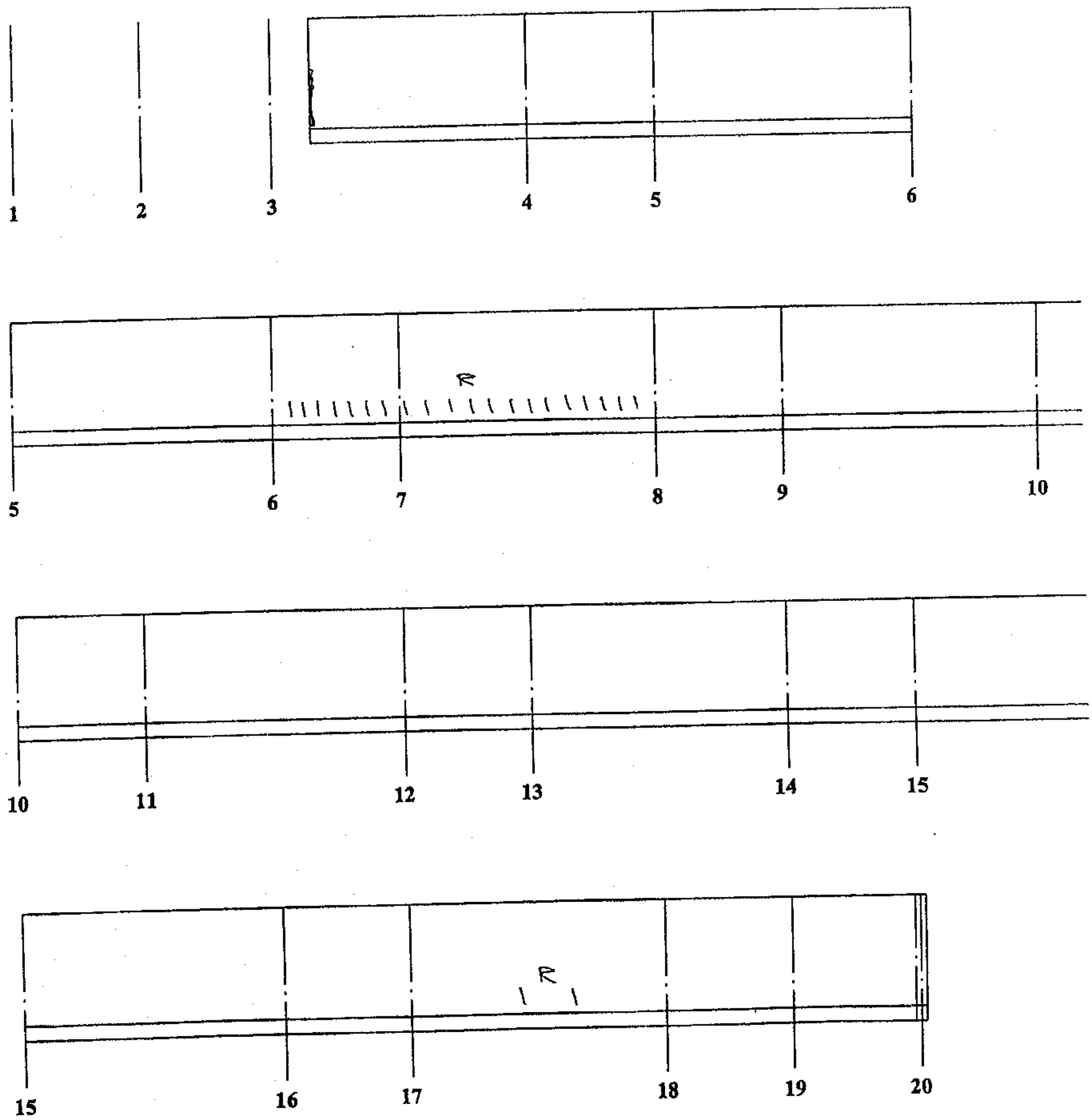
INSIDE VIEW



T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N°5 - WALL IN AXIS D
VIEW FROM THE SIDE OF AXIS C

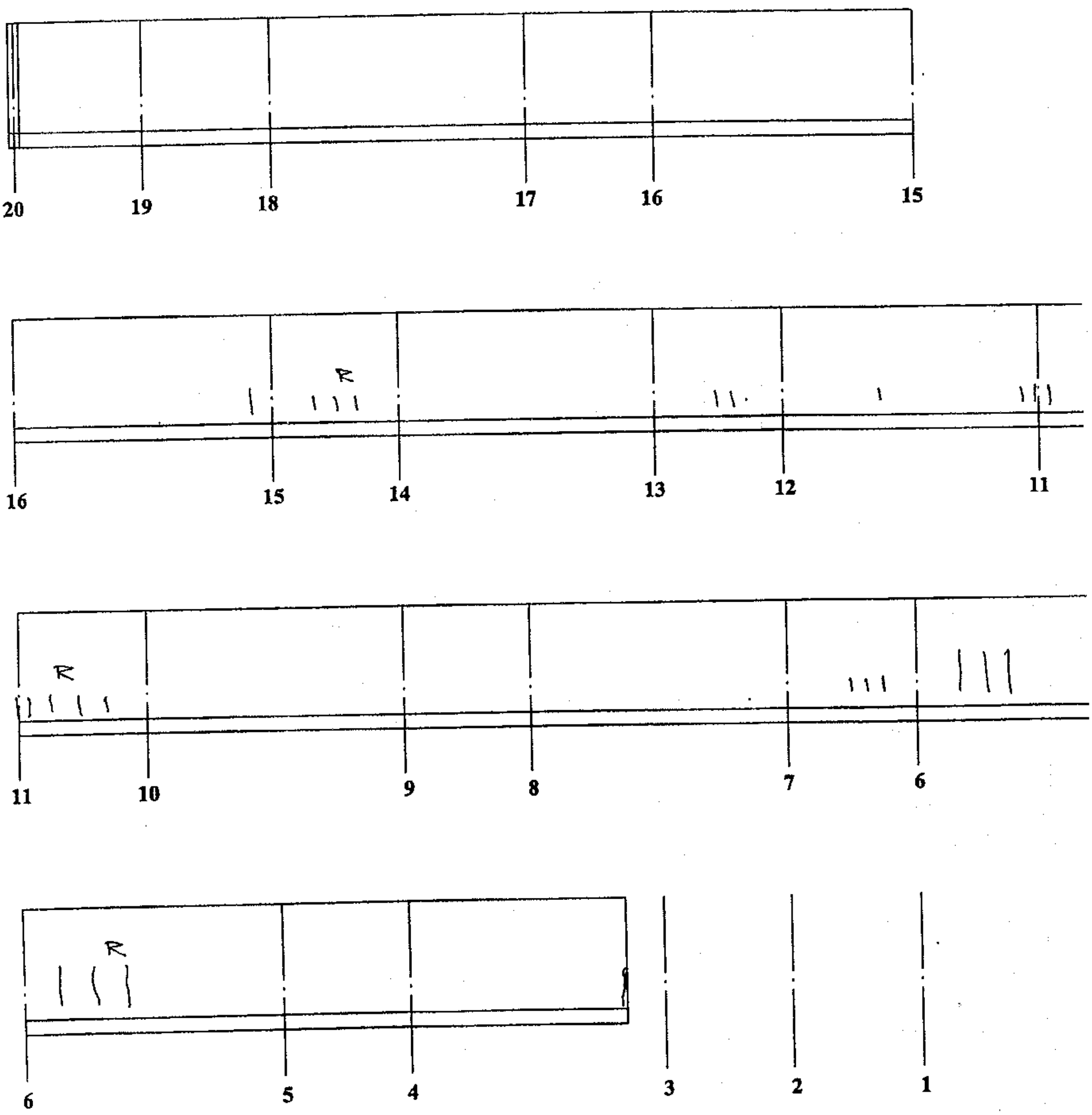


T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N°5 - WALL IN AXIS D

VIEW FROM THE SIDE OF AXIS E

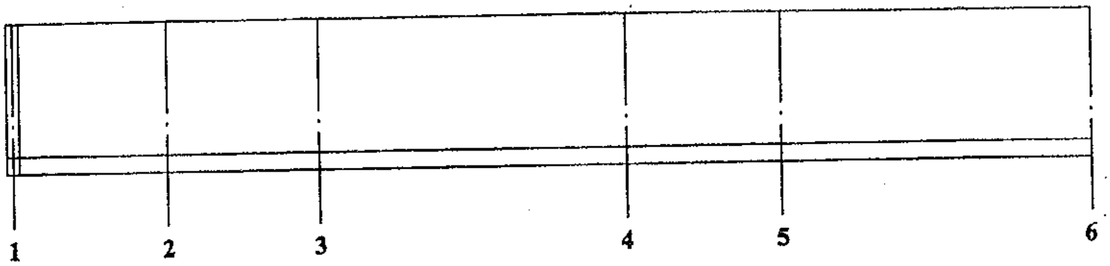


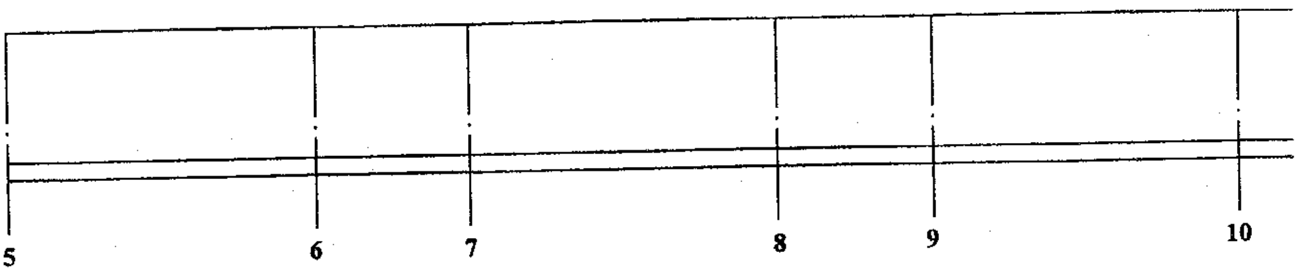
T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

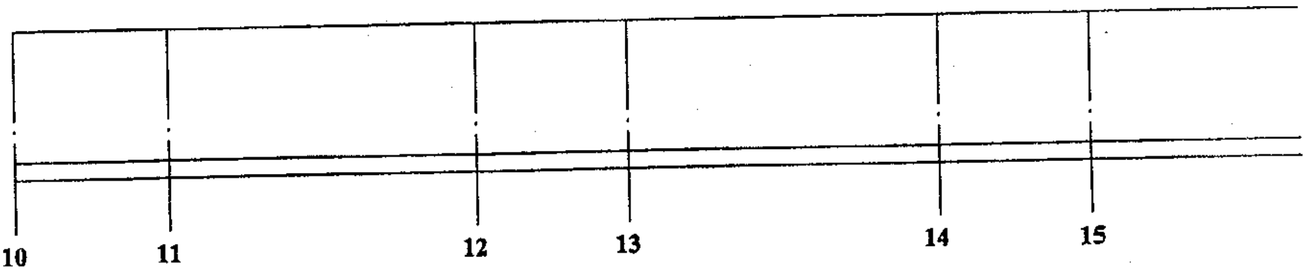
C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

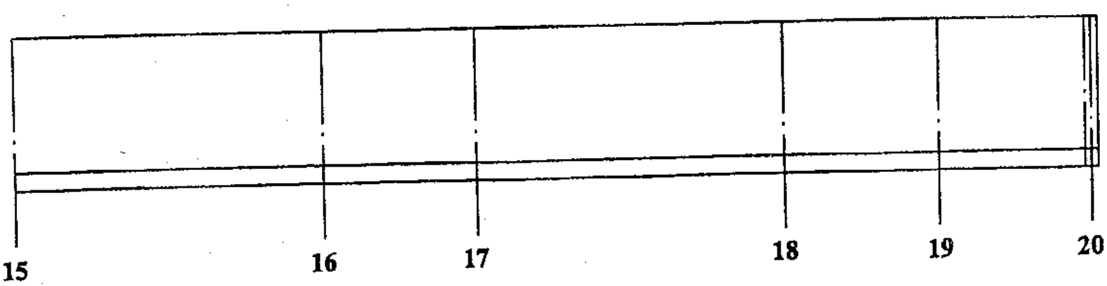
STRUCTURE N°5 - WALL IN AXIS G

VIEW FROM THE SIDE OF AXIS F





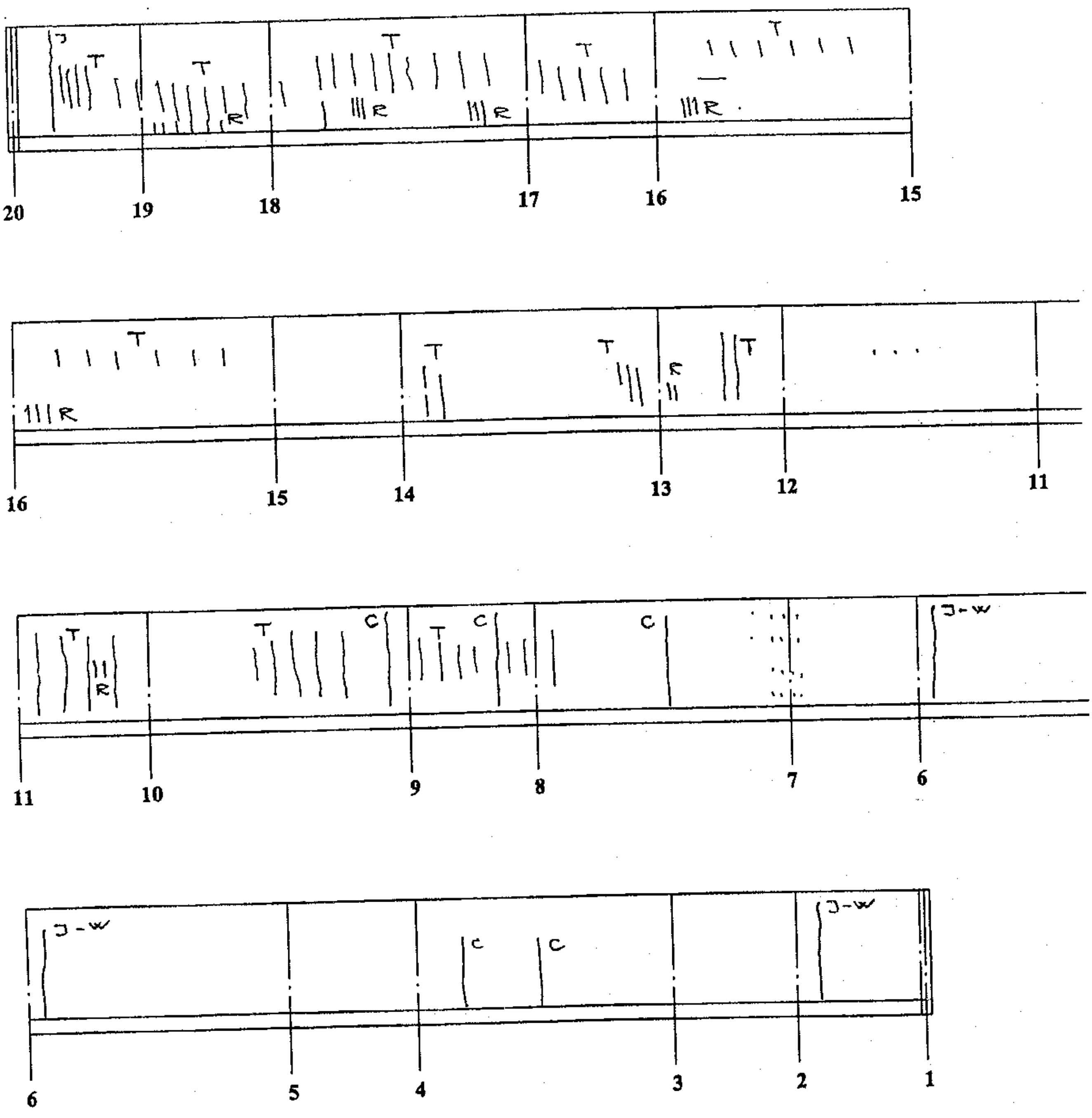




On this wall only wet joints are noticed.

STRUCTURE N°5 - WALL IN AXIS G

VIEW FROM THE SIDE OF AXIS H

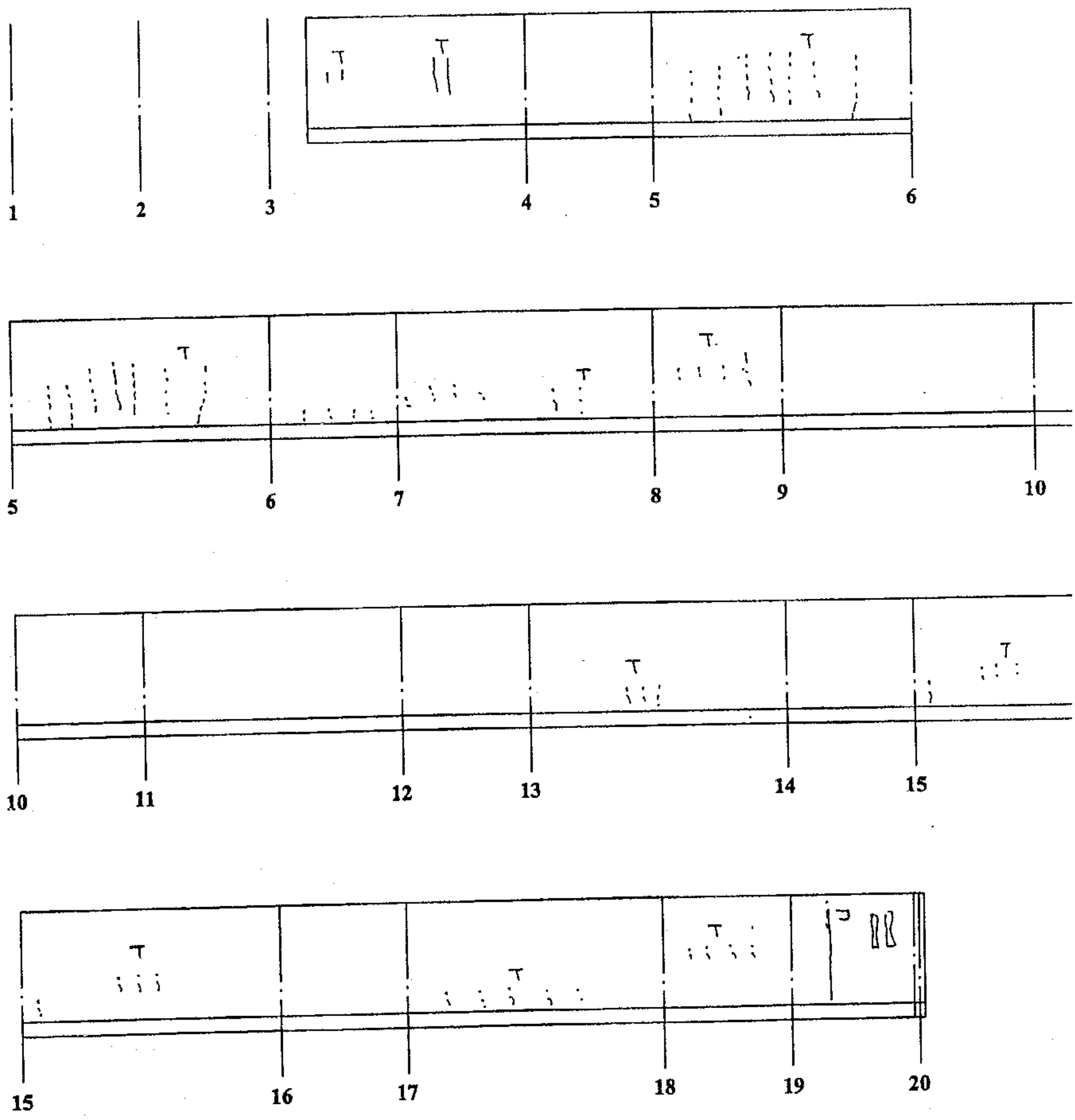


T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N°5 - WALL IN AXIS J

VIEW FROM THE SIDE OF AXIS I

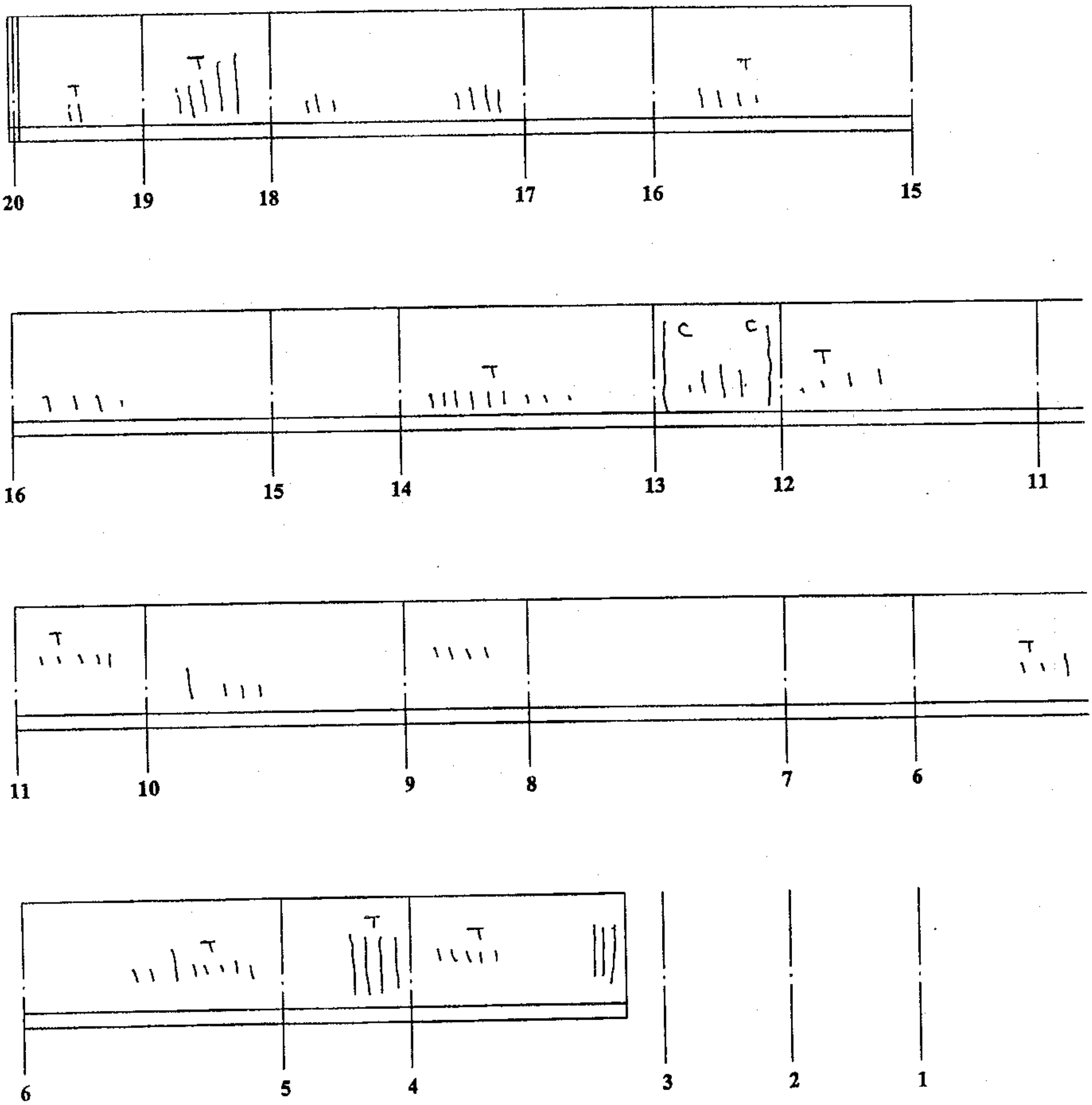


T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N°5 - WALL IN AXIS J

VIEW FROM THE SIDE OF AXIS K

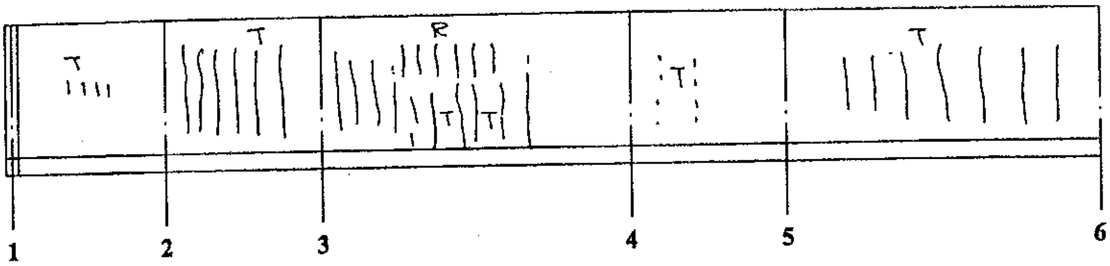


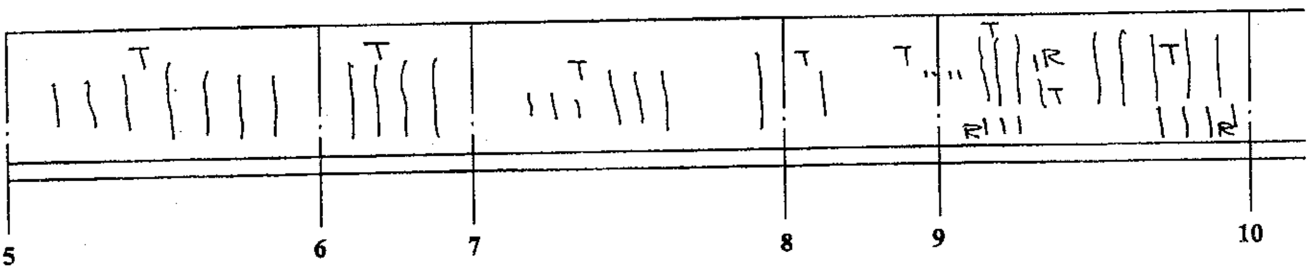
T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

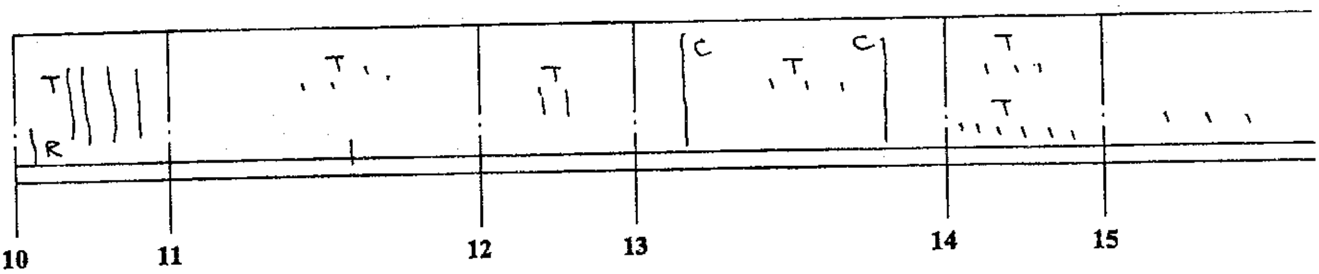
C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

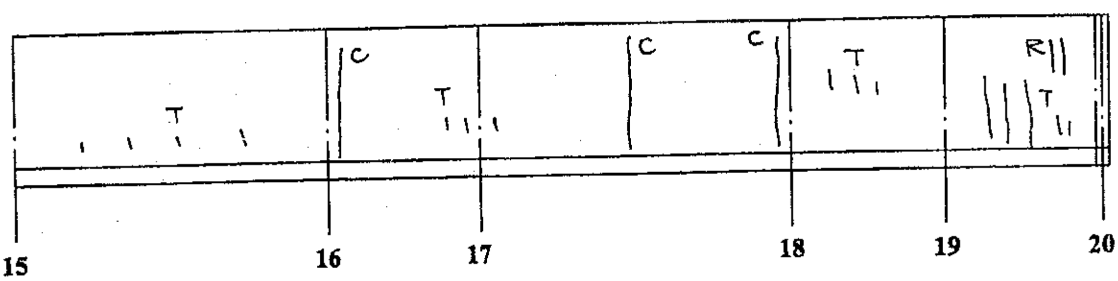
STRUCTURE N°5 - WALL IN AXIS M

INSIDE VIEW







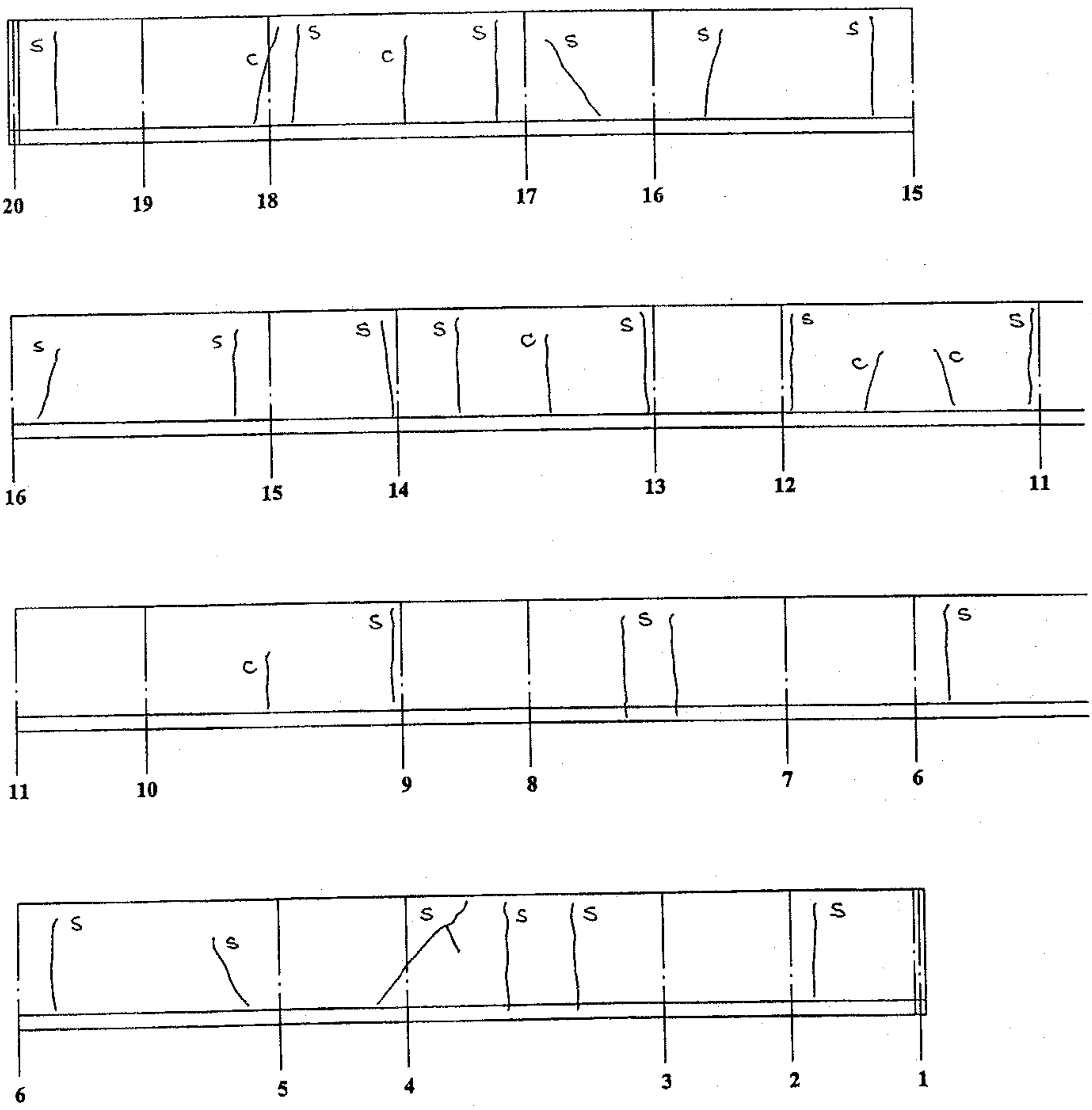


T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N°5 - WALL IN AXIS M

OUTSIDE VIEW



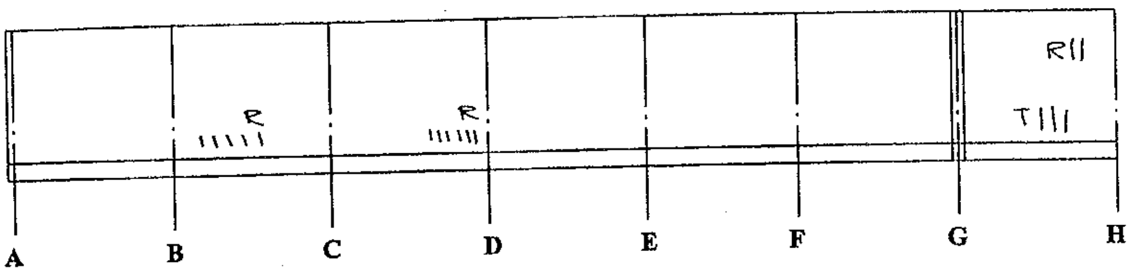
T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

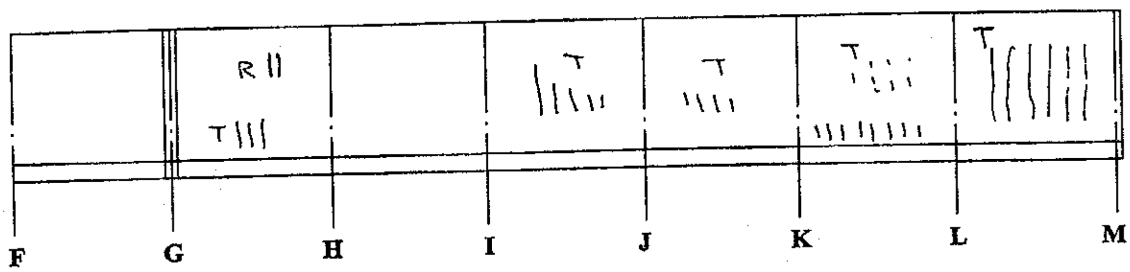
F - 20

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

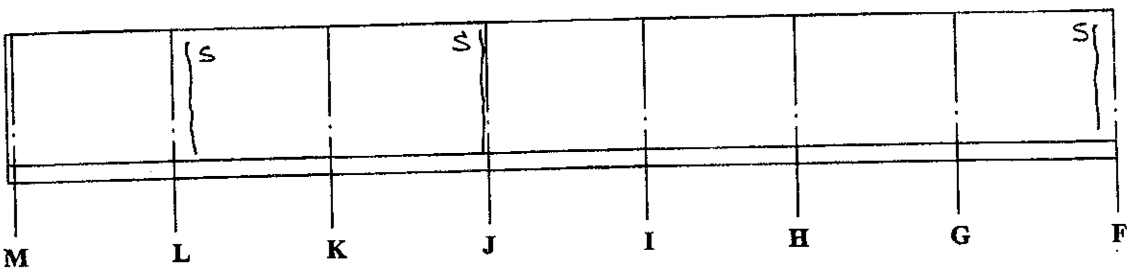
STRUCTURE N°5 - WALL IN AXIS 1

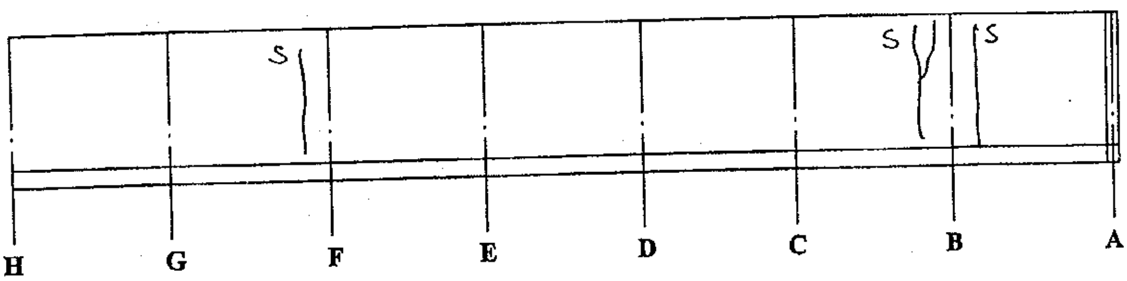
INSIDE VIEW





OUTSIDE VIEW



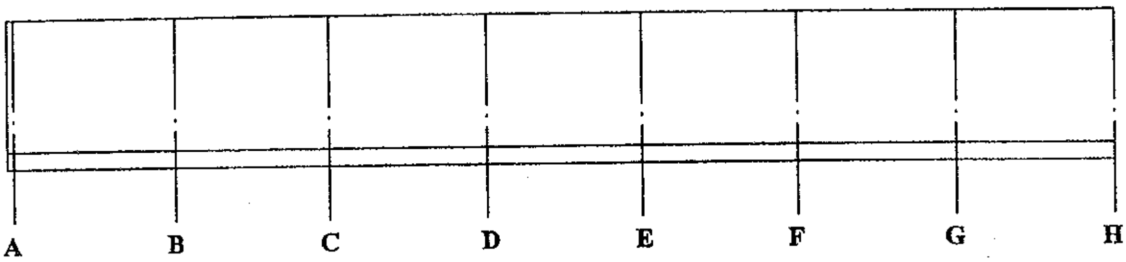


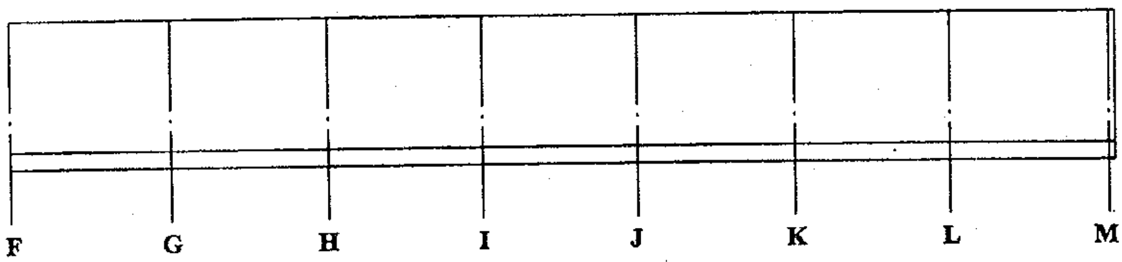
T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

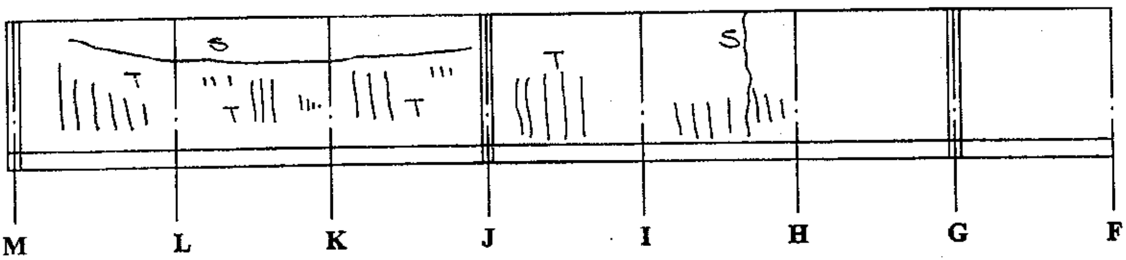
STRUCTURE N°5 - WALL IN AXIS 20

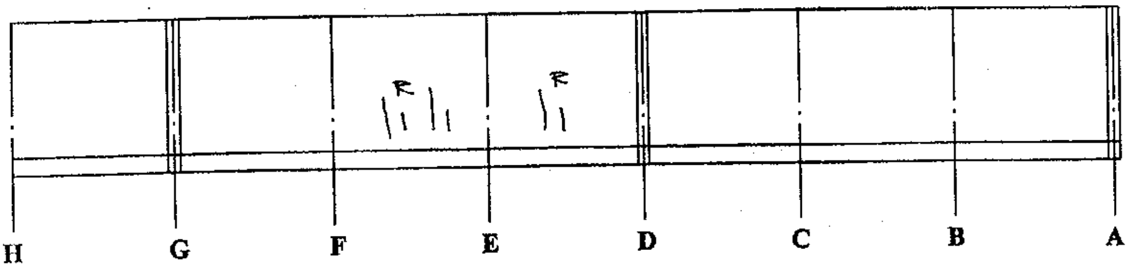
OUTSIDE VIEW





INSIDE VIEW



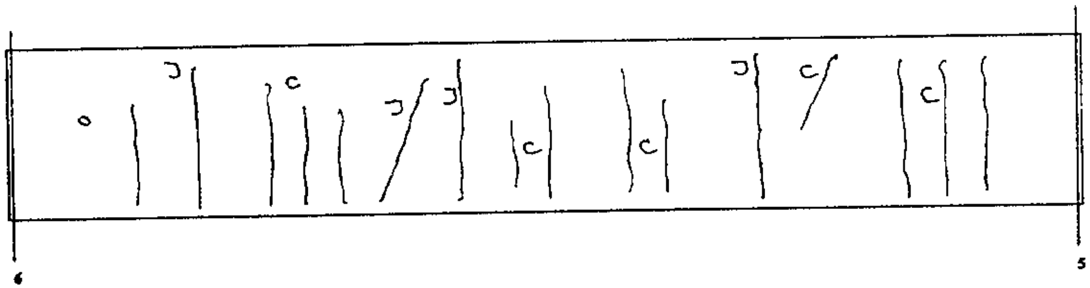


T – traces of the corosion of the reinforcement
S – cracks sanified
J – joints sanified

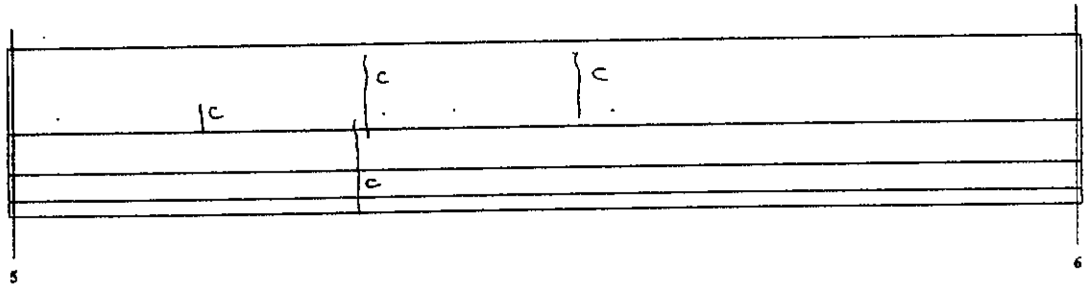
C – cracks in the wall
R – reiforcement visible
J-W – leaking joints

STRUCTURE N° 3 - WALL IN AXIS 1

OUTSIDE VIEW



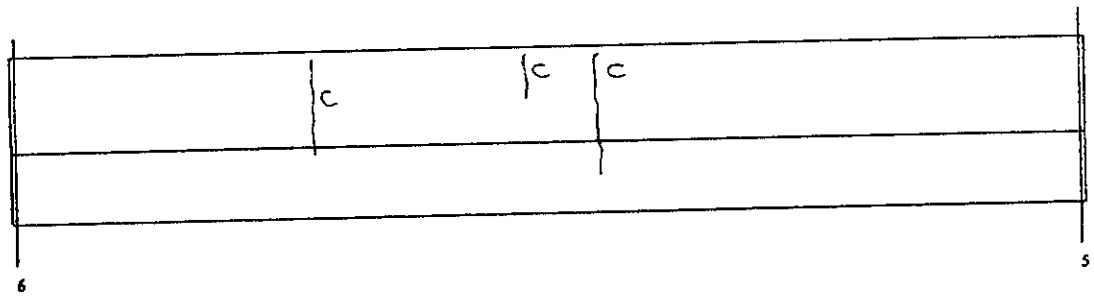
INSIDE VIEW



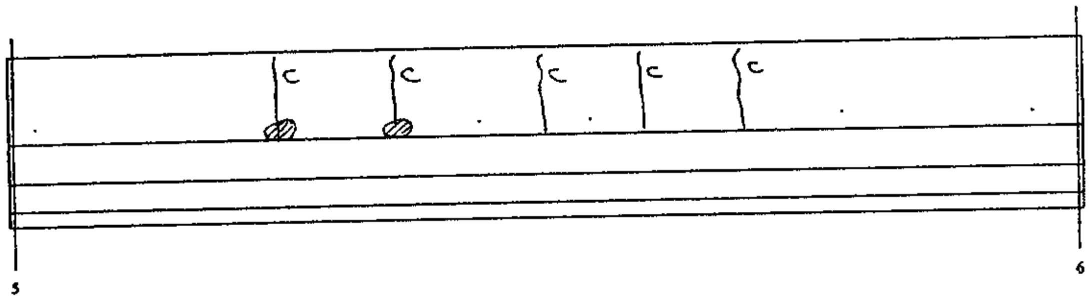
C – cracks in the wall J – joints sanified J-W – leaking joints

STRUCTURE N° 3 - WALL IN AXIS 2

VIEW FROM THE SIDE OF AXIS 1



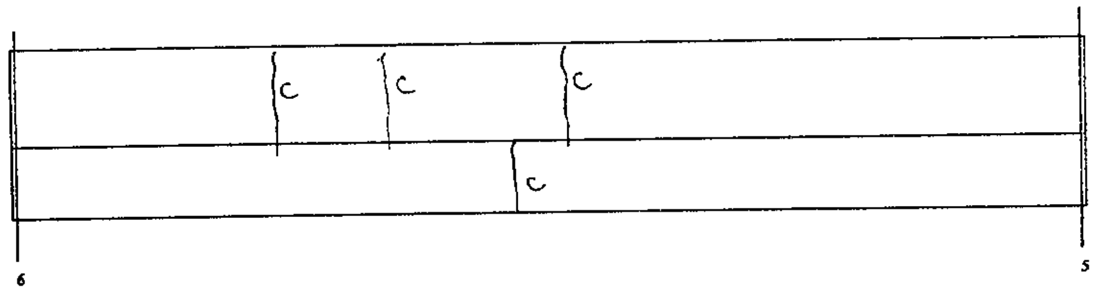
VIEW FROM THE SIDE OF AXIS 3



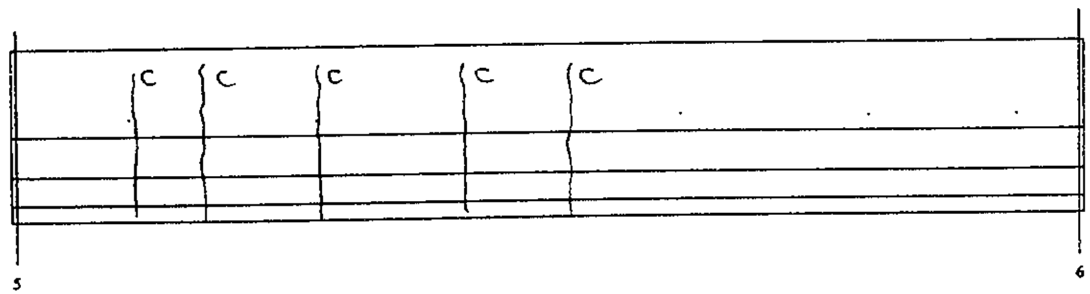
C – cracks in the wall   J – joints sanified   J-W – leaking joints

STRUCTURE N° 3 - WALL IN AXIS 3

VIEW FROM THE SIDE OF AXIS 2



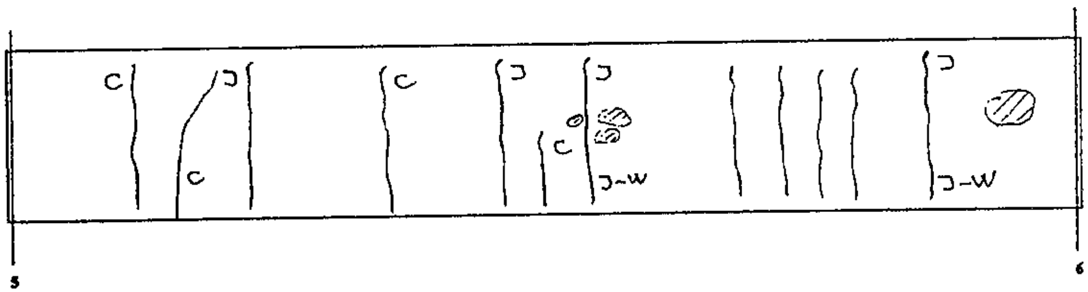
VIEW FROM THE SIDE OF AXIS 4



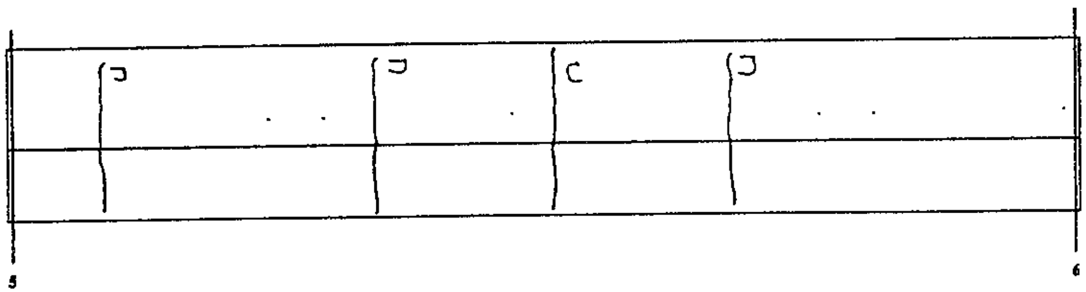
C – cracks in the wall   J – joints sanified   J-W – leaking joints

STRUCTURE N° 3 - WALL IN AXIS 4

OUTSIDE VIEW

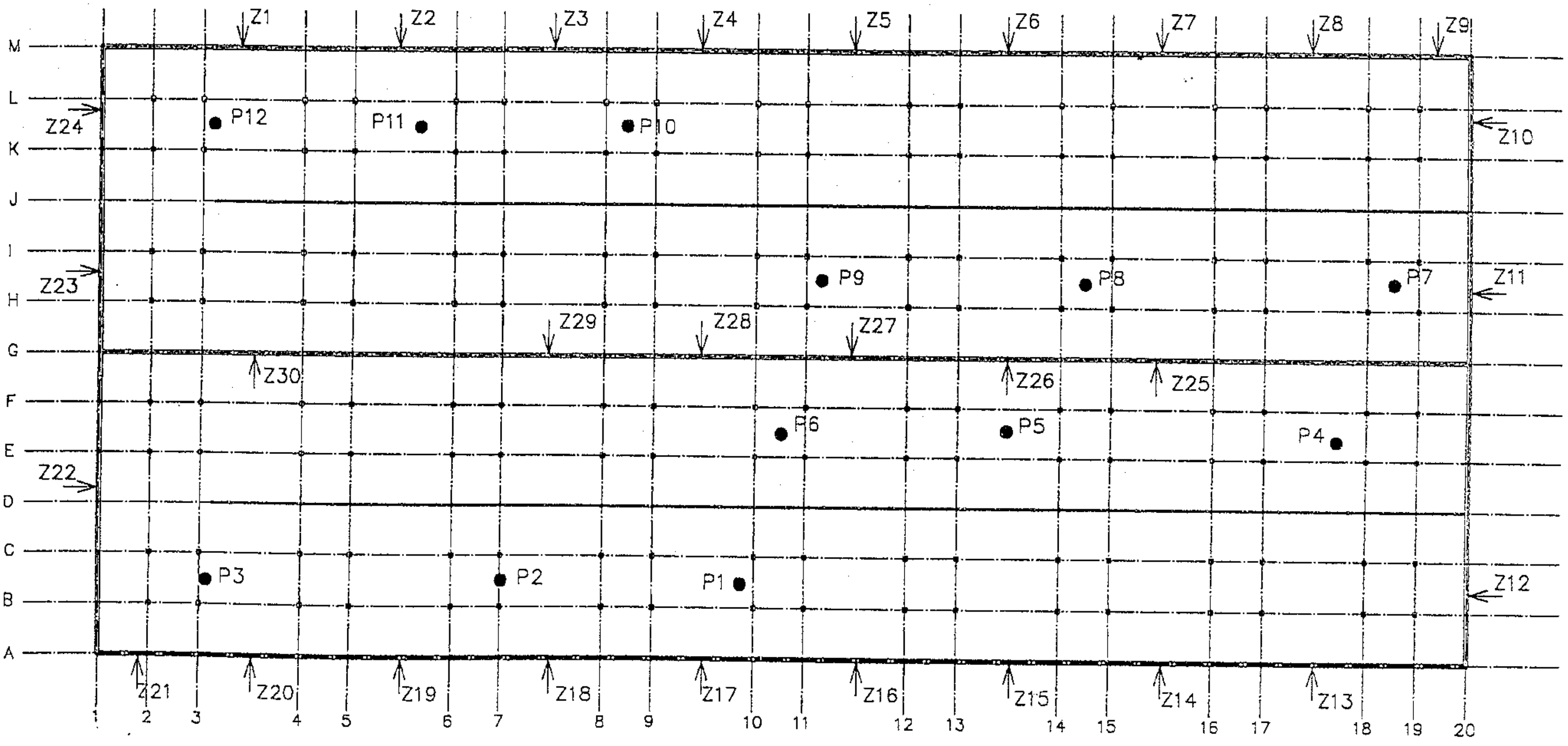


INSIDE VIEW



C – cracks in the wall J – joints sanified J-W – leaking joints

LOCATION OF EXTRACTION OF CONCRETE SPECIMEN FROM STRUCTURE AERATION TANK

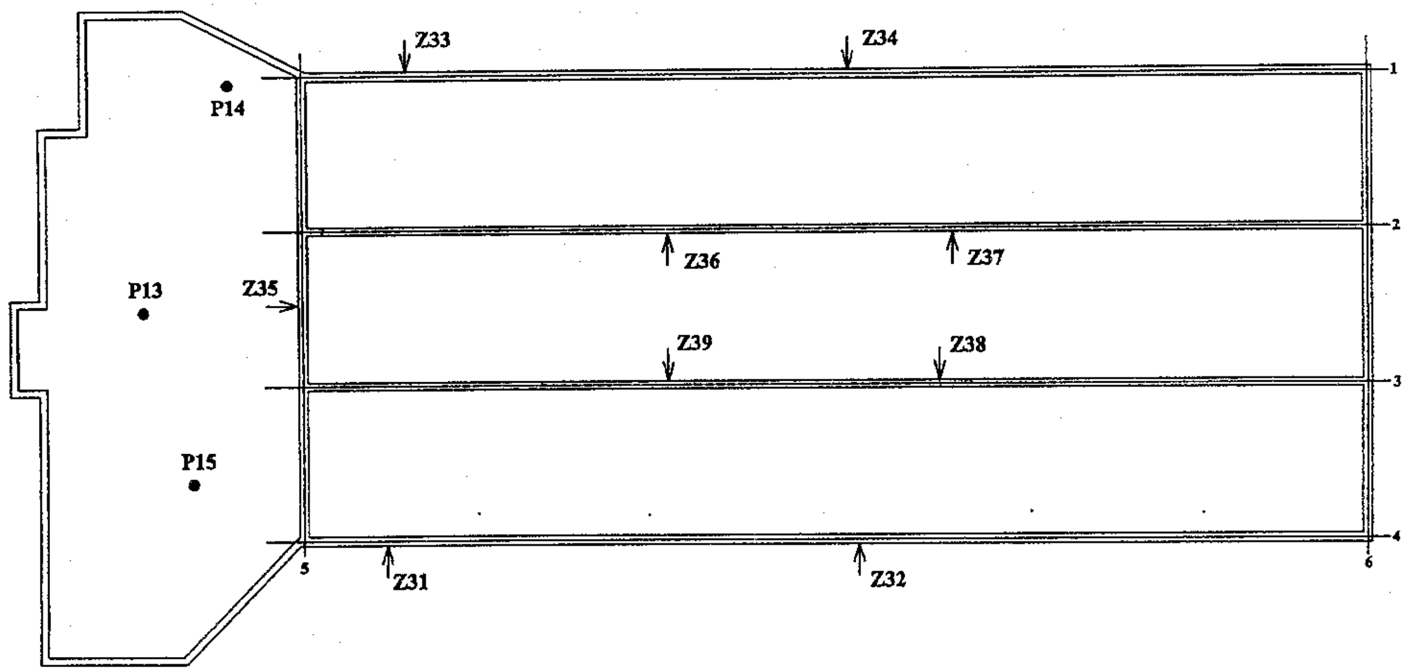


RESULT OF STRENGTH TEST ON PRESSURE AND MASS DENSITY OF CYLINDER CONCRETE SPECIMENS EXTRACTED FROM STRUCTURE OBJECT N^{O} 5 AND 3 AS PART OF WASTE WATERS FILTER COMPLEX- SARAJEVO

APPENDIX 2

Sarajevo, July 1999

LOCATION OF EXTRACTION OF CONCRETE SPECIMEN FROM STRUCTURE AERATED GRIT CHAMBER



In order to establish the quality of built in concrete in structure elements of Objects Aeration Tank (Structure No. 5) and Aerated Grit Chamber (Structure No. 3), the extraction, elaboration and testing were performed on cylinder concrete specimens 100 mm diameter.

Extraction of specimens from Structure No. 5 was performed between June 7 and June 21, and from Structures No. 3 on June 16 and 17, 1999.

Specimens of concrete were extracted mechanically with tubes with diamond crowns and elaborated in shape of cylinder 100 mm diameter and approximate height of 100 mm.

Extraction and examination of cylinder specimens were performed in accordance with the regulations of Standard JUS U.M.1.048 (concrete - additional proving of built in concrete quality).

In sum, 54 concrete specimens were extracted. From the Aeration Tank Structure 42 specimens were extracted, 9 specimens from outer longitudinal walls (walls in axes A and M), 3 specimens from outer transversal walls (walls in axes 1 and 20) and 6 specimens from middle longitudinal wall (wall in axis G) and 12 specimens from bottom plate. From Aerated Grit Chamber structure 12 specimens in sum were extracted, 2 specimens from longitudinal walls (walls in axes A, B, C, D) and 1 specimen from transversal wall in axis 2, and 3 specimens from bottom plate.

The sites of concrete extraction are mutually decided by the representatives both from the Institute and the investor. Location of specimen extraction is shown on drafts that are included in this Annex.

Testing of the specimens were performed at Institute on June 24, 1999.

Results of the testing are shown in Tables 1 and 2.

Determining of characteristic concrete strength on pressure and appraisal of MOMENT brand of concrete was performed according to article 46, Regulations of Technical Normative for Concrete and Reinforcement from 1987. Criterion No. 1 was used for those elements where the number of specimens was less than 10, i.e.

$$\mathbf{MB \leq m_3 - k_1 = m_3 - 3{,}00} \quad [\mathrm{N/mm^2}]$$

$$\mathbf{MB \leq x_1 + k_2 = x_1 + 3{,}00} \quad [\mathrm{N/mm^2}]$$

where:

- m_3 - arithmetic mean of three consecutive test results
- x_1 - the smallest value of three consecutive test results
- k_1 = 3 - for established production
- k_2 = 3 - for established production

Determination of characteristic strength of concrete on pressure and appraisal of MOMENT brand of concrete for walls of object No. 5 was also performed in accordance with Article 46, PBAB, using Criterion 3 ie.

$$\mathbf{MB \leq m_n - 1.3 \cdot S_n}$$

$$\mathbf{MB \leq x_1 + 4{,}00} \quad [\mathrm{N/mm^2}]$$

$$S_n = \sqrt{\frac{\Sigma(m_n - x_i)^2}{n-1}}$$

Determination of characteristic strength of concrete on pressure and appraisal of MOMENT brand of concrete for bottom plate of object No. 5 was performed according to the Article 46. PBAB, but applying the Criterion 2 i.e.

$$\mathbf{MB \leq m_n - 1.2 \cdot \sigma}$$

$$\mathbf{MB \leq x_1 + 4{,}00} \quad [N/mm^2]$$

In above words:

- n - number of test results in one party
- m_n - arithmetic mean of test results
- x_1 - the smallest value of tested strength from n test results
- x_i - value of each strength of n test results
- S_n - estimated standard deviation of n test results
- σ - standard deviation based on great number of previous tests of the same kind of concrete (standard deviation will be taken into consideration on specimen taken from the walls)

Test results of strength on pressure and density of cylinder concrete specimen taken from the Object Structure Aeration Tank (structure No. 5) as part of Filter of Waste Waters complex - Sarajevo

Table 1.

N°	STRUCTURE ELEMENT	MARK ON THE SPECIMEN	SPECIMEN DIMENSIONS		CONCRETE DENSITY [kg/m³]	FORCE OF SPECIMEN BREAKING [N]	STRENGHT ON PRESSURE	
			DIAMETER [mm]	HEIGHT [mm]			ESTABLISH. ON SPECIMEN [N/mm²]	REDUCED ON CUBE a=200 mm [N/mm²]
1.	WALL IN AXIS M	Z1	99,3	100,9	2406	304000	39,3	**40,0**
2.		Z2	99,2	100,8	2384	328000	42,4	**43,3**
3.		Z3	98,7	100,3	2471	257000	33,6	**34,3**
4.		Z4	99,2	99,4	2356	293000	37,9	**38,7**
5.		Z5	99,0	101,1	2431	346000	44,9	**45,8**
6.		Z6	99,0	100,3	2386	292000	37,9	**38,7**
7.		Z7	99,0	100,3	2438	315000	40,9	**41,7**
8.		Z8	98,7	100,0	2397	307000	40,1	**40,9**
9.		Z9	99,3	100,8	2408	324000	41,8	**42,7**
10.	WALL IN AXIS 10	Z10	98,8	100,4	2380	238000	31,0	**31,7**
11.		Z11	98,8	100,8	2479	340000	44,3	**45,2**
12.		Z12	98,9	100,3	2317	252000	32,8	**33,5**
13.	WALL IN AXIS A	Z13	99,7	100,8	2409	334000	43,7	**44,5**
14.		Z14	98,9	101,7	2401	305000	39,7	**40,5**
15.		Z15	98,9	100,4	2445	330000	43,0	**43,8**

Table 1. – cont.

Nº	STRUCTURE ELEMENT	MARK ON THE SPECIMEN	SPECIMEN DIMENSIONS		CONCRETE DENSITY [kg/m³]	FORCE OF SPECIMEN BREAKING [N]	STRENGHT ON PRESSURE	
			DIAMETER [mm]	HEIGHT [mm]			ESTABLISH. ON SPECIMEN [N/mm²]	REDUCED ON CUBE a=200 mm [N/mm²]
16.	WALL IN AXIS A	Z16	98,7	99,9	2390	317000	41,4	**42,3**
17.		Z17	99,0	100,5	2415	341000	44,3	**45,2**
18.		Z18	99,2	100,4	2406	339000	43,9	**44,7**
19.		Z19	99,1	100,4	2438	308000	39,9	**40,7**
20.		Z20	99,2	101,1	2386	287000	37,1	**37,9**
21.		Z21	99,0	100,2	2463	310000	40,3	**41,1**
22.	WALL IN AXIS 1	Z22	98,9	100,2	2344	226000	29,4	**30,0**
23.		Z23	98,9	100,7	2342	226000	29,4	**30,0**
24.		Z24	99,0	100,1	2441	284000	36,9	**37,6**
25.	WALL IN AXIS G	Z25	98,9	100,3	2875	435000	56,5	**57,8**
26.		Z26	99,0	99,9	3060	426000	55,3	**56,4**
27.		Z27	99,0	99,6	3034	450000	58,5	**59,6**
28.		Z28	99,4	101,2	2398	296000	38,1	**38,9**
29.		Z29	99,2	100,8	2343	322000	41,7	**42,5**
30.		Z30	99,7	100,1	2709	332000	42,5	**43,4**
31.	BOTTOM PLATE	P1	98,8	100,0	2413	268000	35,0	**35,7**
32.		P2	99,0	99,8	2417	298000	38,7	**39,5**
33.		P3	99,1	100,2	2346	257000	33,3	**34,0**
34.		P4	98,5	100,0	2384	230000	30,2	**30,8**
35.		P5	98,6	100,0	2480	308000	40,3	**41,1**
36.		P6	98,9	100,3	2302	187000	24,3	**24,8**
37.		P7	99,2	100,4	2522	280000	36,2	**37,0**
38.		P8	98,9	100,1	2498	337000	43,9	**44,7**
39.		P9	99,0	99,8	2484	238000	30,9	**31,5**
40.		P10	99,0	100,4	2478	272000	35,3	**36,0**
41.		P11	99,1	99,8	2429	252000	32,7	**33,3**
42.		P12	98,9	101,0	2432	284000	37,0	**37,7**

As abovementioned, determination of the characteristic strength of concrete on pressure and appraisal of MOMENT brand of concrete for walls of the Object No. 5 will be performed according to the Article 46. PBAB, applying the Criterion 3, as follows:

- number of tested specimen of concrete.................. n = 30
- average value of strength on pressure.................... m_n = 41.8 N/mm²
- the smallest individual strength on pressure........... x_1 = 30.0 N/mm²
- estimated standard deviation.............................. σ_{n-1} = 7.01 N/mm²
- standard deviation.. σ = 6.89 N/mm²

- characteristic strength of concrete on pressure:

$MB \leq m_n - 1{,}3 \cdot S_n = 41{,}8 - 1{,}3 \cdot 7{,}01 = \mathbf{32{,}69}\ N/mm^2$
$MB \leq x_1 + 4{,}00 = 30{,}0 + 4{,}00 = 34{,}0\ N/mm^2$...............

concrete corresponds to the class MB 30.

Determination of the characteristic strength of concrete and appraisal of MOMENT brand of concrete for the bottom plate of Object No.5 will be performed in accordance with the Article 46. PBAB, applying the Criterion 2, as follows:

- number of tested specimen of concrete................. n = 12
- average value of strength on pressure.................. m_n = 35.45 N/mm^2
- the smallest individual strength on pressure........... x_1 = 24.80 N/mm^2
- standard deviation.. σ = 6.89 N/mm^2

- characteristic strength of concrete on pressure:

$MB \leq m_n - 1{,}2 \cdot \sigma = 35{,}45 - 1{,}2 \cdot 6{,}89 = \mathbf{27{,}18}\ N/mm^2$
$MB \leq x_1 + 4{,}00 = 24{,}8 + 4{,}00 = 28{,}8\ N/mm^2$.............

concrete corresponds to the class MB 25.

Test results of strength on pressure and density of cylinder concrete specimen taken out of Object Structure Aerated Grit Chamber (Structure No.3) as part of Filter of Waste Waters complex – Sarajevo

Table 2.

N°	STRUCTURE ELEMENT	MARK ON THE SPECIMEN	SPECIMEN DIMENSIONS		CONCRETE DENSITY [kg/m³]	FORCE OF SPECIMEN BREAKING [N]	STRENGHT ON PRESSURE	
			DIAMETER [mm]	HEIGHT [mm]			ESTABLISH. ON SPECIMEN [N/mm²]	REDUCED ON CUBE a=200 mm [N/mm²]
1	WALL IN AXIS 4	Z31	99,4	100,8	2397	307000	39,6	**40,4**
2.		Z32	99,4	100,2	2408	321000	41,4	**42,2**
3.	WALL IN AXIS 1	Z33	99,1	100,5	2396	317000	41,1	**41,9**
4.		Z34	99,3	99,2	2506	362000	46,7	**47,7**
5	WALL IN AXIS 5	Z35	99,5	98,8	2398	314000	40,4	**41,2**
6	WALL IN AXIS 2	Z36	99,1	100,3	2514	382000	49,5	**50,5**
7.		Z37	99,4	99,7	2412	218000	28,1	**28,7**
8.	WALL IN AXIS 3	Z38	99,2	100,5	2416	320000	41,4	**42,2**
9.		Z39	99,6	99,7	2401	331000	42,5	**43,3**
10.	BOTTOM PLATE	P13	99,3	100,5	2473	290000	37,4	**38,2**
11.		P14	99,2	100,4	2455	308000	39,9	**40,6**
12.		P15	99,3	100,6	2457	286000	36,9	**37,7**

According the Criterion 1, follows:

Party of concrete 1. (Specimen 1 - 3)

MB ≤ 41,5 – 3 ≤ **38,5** N/mm^2
MB ≤ 40,4 + 3 ≤ 43,4 N/mm^2 ....**concrete corresponds to the class MB 35.**

Party of concrete 2. (Specimen 4 - 6)

MB ≤ 46,5 – 3 ≤ **43,5** N/mm^2
MB ≤ 41,2 + 3 ≤ 44,2 N/mm^2 ....**concrete corresponds to the class MB 40.**

Party of concrete 3. (Specimen 7 - 9)

MB ≤ 38,1 – 3 ≤ 35,1 N/mm^2
MB ≤ 28,7 + 3 ≤ **31,7** N/mm^2 ....**concrete corresponds to the class MB 30.**

Party of concrete 4. (Specimen 10 - 12)

MB ≤ 38,8 – 3 ≤ **35,8** N/mm^2
MB ≤ 37,7 + 3 ≤ 40,7 N/mm^2 ....**concrete corresponds to the class MB 35.**

Sarajevo, July 2, 1999.

Analyzed by:

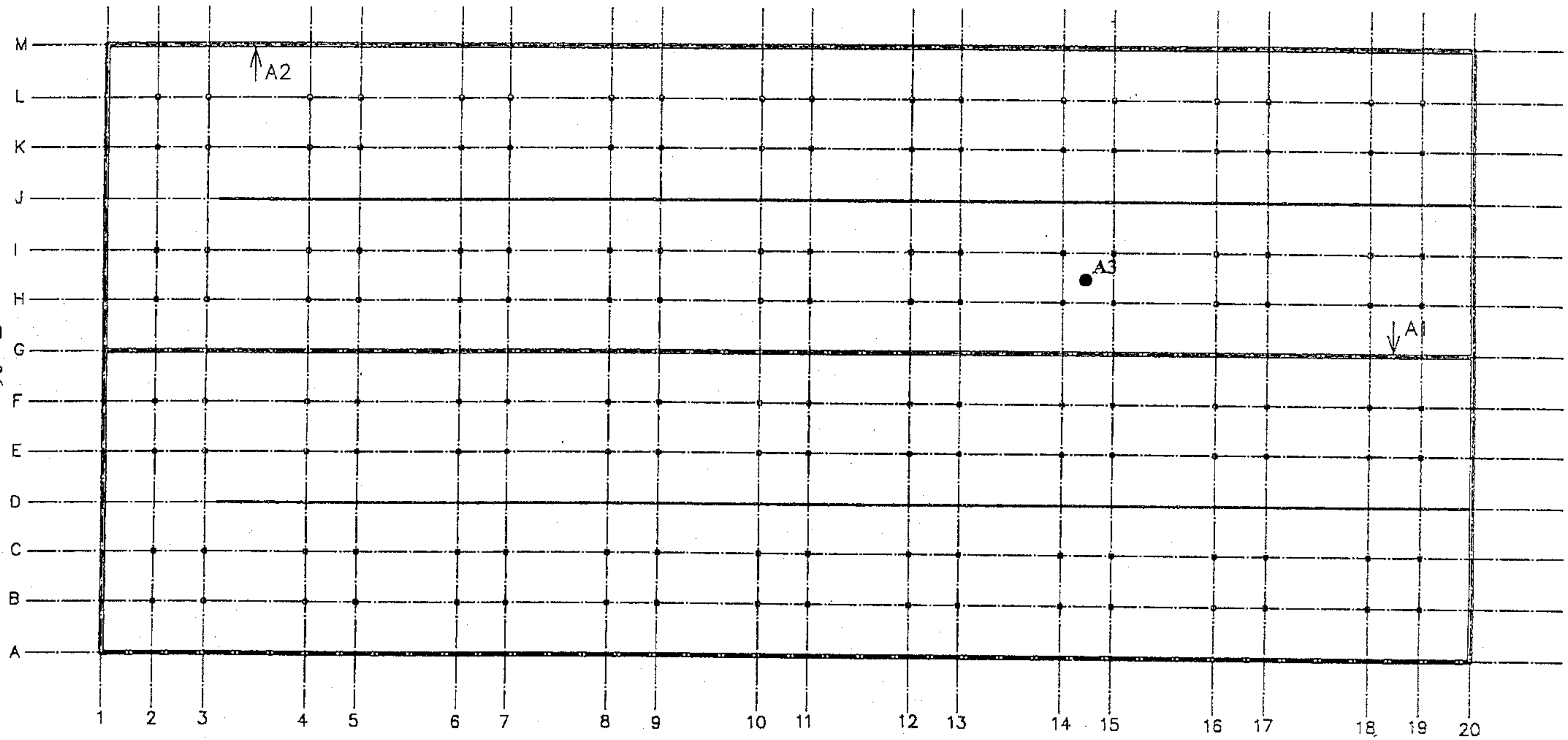
M.Sc. Muhamed Madžarević, Civ. Eng.

TEST RESULTS OF MECHANICAL CHARACTERISTICS OF REINFORCEMENT TAKEN OUT OF STRUCTURE OBJECT N° 5 AND 3 AS PART OF WASTE WATERS FILTER COMPLEX - SARAJEVO

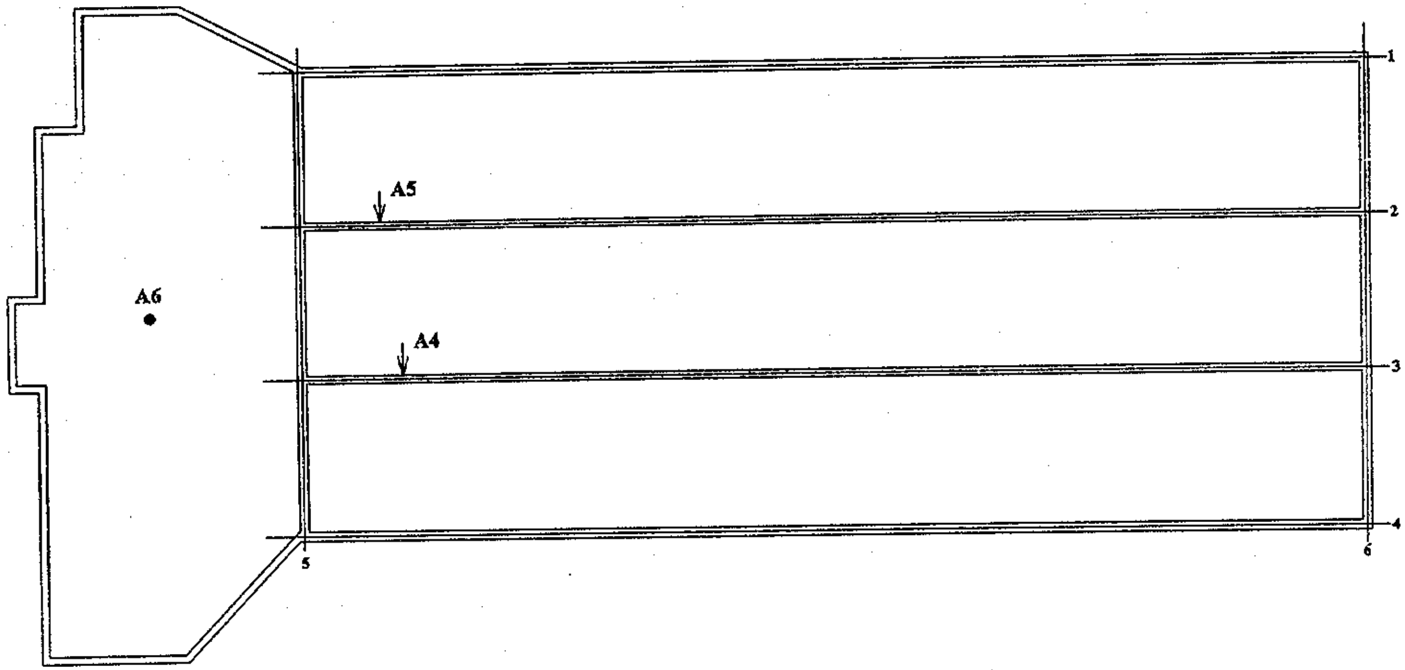
APPENDIX 3

Sarajevo, July 1999

LOCATION OF EXTRACTION OF REINFORCEMENT SPECIMEN FROM STRUCTURE AERATION TANK



LOCATION OF EXTRACTION OF REINFORCEMENT SPECIMEN FROM STRUCTURE AERATED GRIT CHAMBER



In order to determine mechanical characteristic of placed in reinforced concrete in elements of Object Structure Aeration Tank (Structure No. 5) and Aeration Grit Chamber (Structure No. 3), extraction, processing and testing was performed using destruction method of specimen of reinforcement from the walls, as well as from the bottom plate of both Objects.

Taking of reinforcement specimen was performed on June 17 and June 21, 1999.

Because it was impossible to take the reinforcement specimen directly from the bottom plate from either of 2 Objects, specimen of reinforcement that were in the concrete specimen were tested.

Therefore, in sum, 6 series of 3 specimen were tested. Specimen A1 and A2 were from the wall of Object Structure No. 5. From the parts of the reinforcement from the concrete specimen from the bottom plate mini test glasses were taken and marked as specimen A3. Specimen of the reinforcement A4 and A5 were taken from walls of the Object Structure No. 3, and from the specimen of the concrete taken out of the bottom plate specimen A6 was made. From this specimen the test glasses could have not been taken out, therefore, the test was performed by **"Brinell"** method. Control was performed on ward **"Brinell"** equipment at Institute. For appropriate balls ∅ 2,5 mm and force of impression F=1876 N stiffness was achieved, and intermediately the strength of basic material.

Specimen A1 and A2 were taken at location without the protecting layer of concrete i.e. reinforced bars were on surface, while the specimen A4 and A5 were taken at location with protecting layer of concrete at least 1 mm. By visual examination of reinforcement specimen immediately after extraction, as well as after their processing, it can be concluded that the degree of corrosion is insignificant i.e. did not have impact on reducing of cross-section i.e. on bearing capacity of bars.
The rest of specimen (A1 - A5) were processed and afterwards, the tests were performed on universal device (**Amsler** device), that gave values of basic stress $\mathbf{R_e}$ and $\mathbf{R_m}$, as well as deformation λ (ε).

The representatives of Institute and Investor mutually decided the sites of extractions of reinforcement specimen, and locations of extraction of reinforcement specimen are shown on drafts that are included in this Annex.

Specimen tests were performed at Institute on June 24, 1999.

Test results are shown in tables 1 - 6, as well as on diagrams that are also included in this Annex.

Table 1. Test results of mechanical characteristic of reinforcement - Specimen **A1**
nominal diameter: ∅ 25 mm (GA)

N°	Φ [mm]	F [mm²]	P_{vi} [N]	P_{max} [N]	R_e [N/mm²]	R_m [N/mm²]	l_0 [mm]	l_1 [mm]	Δl [mm]	$\varepsilon = \Delta l/l_0$	$\lambda = \varepsilon x100$	REMA-RKS
1.	13,8	149,6	42900	59800	286,8	399,8	138,5	170,5	32,0	0,2310	23,10	
2.	13,5	143,1	39100	58150	273,2	406,3	138,5	176,5	38,0	0,2744	27,44	
3.	13,6	145,3	42000	59550	289,1	409,9	138,5	170,4	31,9	0,2303	23,03	
			AVERAGE:		**283,03**	**405,33**			AVERAGE:		**24,52**	

Table 2. Test results of mechanical characteristic of reinforcement - Specimen **A2**
nominal diameter ∅ 18 mm (GA)

N°	Φ [mm]	F [mm²]	P_{vi} [N]	P_{max} [N]	R_e [N/mm²]	R_m [N/mm²]	l_0 [mm]	l_1 [mm]	Δl [mm]	$\varepsilon = \Delta l / l_0$	$\lambda = \varepsilon x100$	REMARKS
1.	18,0	254,5	73800	109800	290,0	431,4	180	235	55,0	0,3060	30,60	
2.	17,9	251,6	66000	104500	262,3	415,3	180	235	45,0	0,2500	25,00	
3.	18,0	254,5	73000	109100	286,8	428,7	180	235	55,0	0,3060	30,60	
			AVERAGE:		**279,70**	**425,13**			AVERAGE:		**28,73**	

Table 3. Test results of mechanical characteristic of reinforcement - Specimen **A3**
nominal diameter: ∅ 9 mm (MAG)

N°	Φ [mm]	F [mm²]	P_{vi} [N]	P_{max} [N]	R_e [N/mm²]	R_m [N/mm²]	l_0 [mm]	l_1 [mm]	Δl [mm]	$\varepsilon = \Delta l / l_0$	$\lambda = \varepsilon x100$	REMARKS
1.	4,90	18,85		12700		673,7	25	27,5	2,50	0,1000	10,00	
2.	5,15	20,82		13480		647,5	25	27,5	2,5	0,1000	10,00	
3.	5,00	19,62		14600		744,1	25	27,5	2,5	0,1000	10,00	
			AVERAGE:			**688,43**			AVERAGE:		**10,00**	

Table 4. Test results of mechanical characteristic of reinforcement - Specimen **A4**
nominal diameter: ∅ 12 mm (GA)

N°	Φ [mm]	F [mm²]	P_{vi} [N]	P_{max} [N]	R_e [N/mm²]	R_m [N/mm²]	l_0 [mm]	l_1 [mm]	Δl [mm]	$\varepsilon = \Delta l / l_0$	$\lambda = \varepsilon x100$	REMARKS
1.	12,0	113,04	37000	48500	372,2	428,8	120	142,5	22,5	0,1875	18,25	
2.	12,0	113,04	35800	48500	316,5	428,8	120	133,5	13,5	0,1125	11,25	
3.	12,0	113,04	34250	48750	302,8	431,0	120	-	-	-	-	BREAKING OUT OF MEASURING LENGHT
			AVERAGE:		**330,50**	**429,53**			AVERAGE:		**14,75**	

Table 5. Test results of mechanical characteristic of reinforcement - Specimen **A5**
nominal diameter: ∅ 12 mm (GA)

N°	Φ [mm]	F [mm²]	P_{vi} [N]	P_{max} [N]	R_e [N/mm²]	R_m [N/mm²]	l_0 [mm]	l_1 [mm]	Δl [mm]	$\varepsilon = \Delta l / l_0$	$\lambda = \varepsilon x100$	REMARKS
1.	12,0	113,04	39700	50250	351,0	444,3	120	148,5	28,5	0,2375	23,75	
2.	12,0	113,04	39100	50250	345,7	444,3	120	142,5	22,5	0,1875	18,75	
3.	12,0	113,04	39900	49300	352,8	435,9	120	-	-	-	-	BREAKING OUT OF MEASURING LENGHT
			AVERAGE:		**349,83**	**441,51**			AVERAGE:		**21,25**	

Table 6. Test results of reinforcement by "**Brinell**" method - Specimen **A6**

POSITION	MEASURING SITE	DIAMETER d_1 [mm]	DIAMETER d_2 [mm]	AVERAGE $d_{pr.}$ [mm]	STIFFNESS HB [N/mm²]	STRENGTH OF TENSION R_m [N/mm²]
Ø 12 mm (GA)	1.	1,18	1,22	1,20	1530	523
	2.	1,20	1,20	1,20	1530	523
	3.	1,20	1,18	1,19	1549	530
	4.	1,18	1,18	1,18	1579	540
				Average:	1547	529
Ø 8 mm (GA)	1.	1,23	1,21	1,22	1471	503
	2.	1,21	1,23	1,22	1471	503
	3.	1,22	1,22	1,22	1471	503
				Average:	1471	503

According to test results of mechanical characteristics of built in reinforcement in elements of Structure Object Aeration Tank (Structure No. 5) and Aeration Grit Chamber (Structure No. 3) it can be concluded that the built in reinforcement has mechanical characteristics, that by Article 71. Regulation of Technical Normative for Concrete and Reinforcement, has the following nominal values:

- REINFORCING STEEL **GA 240/360**

- stress on limits of big elongation........................ f_{av} = **240** N/mm²
- strength on spanning.. f_{az} = **360** N/mm²
- percentage of elongation in breaking.................... ε_{10} = **18** %

- REINFORCEMENT **MAG 500/560**

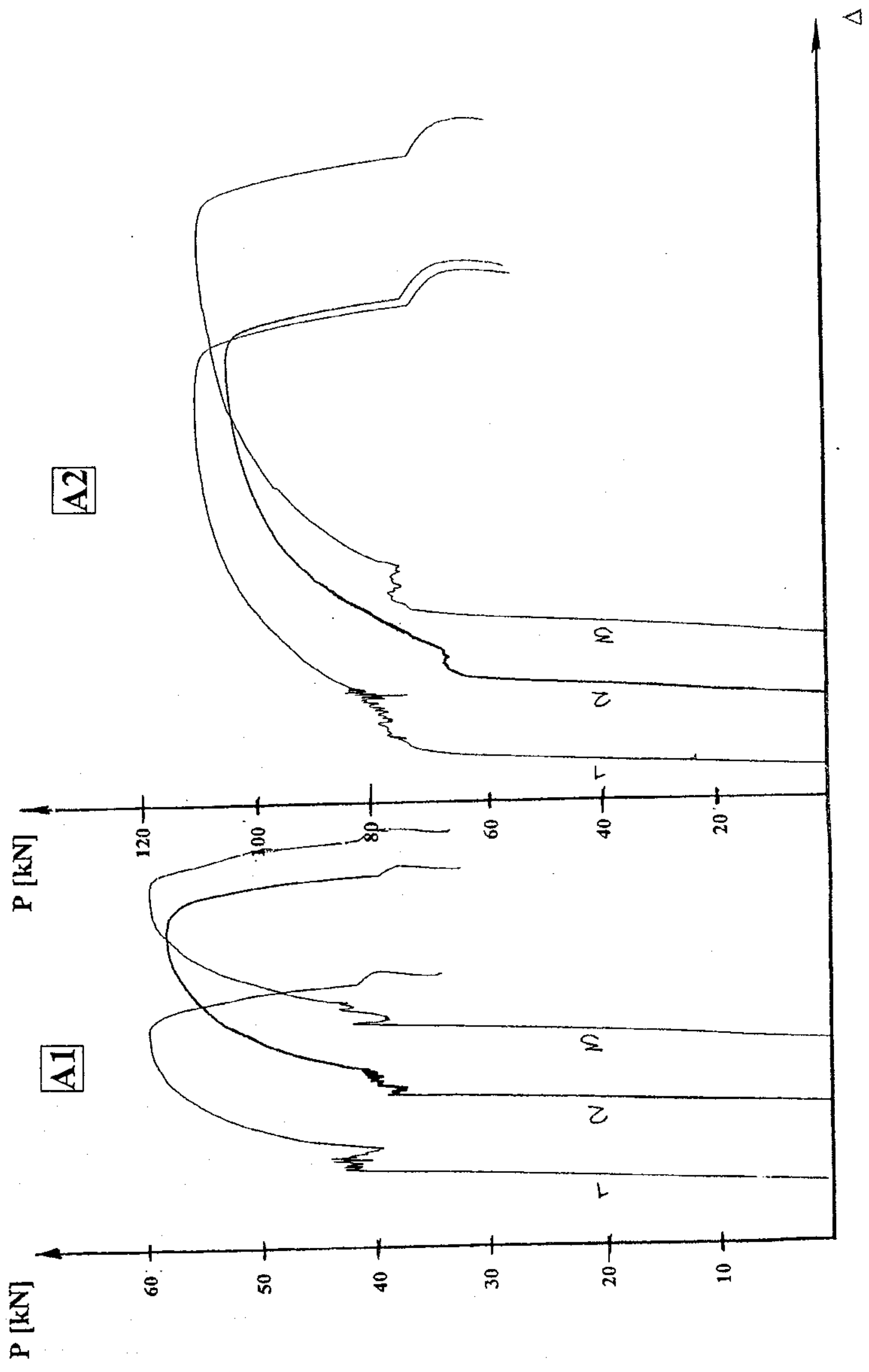
- stress on limits of big elongation........................ f_{av} = **500** N/mm²
- strength on spanning.. f_{az} = **560** N/mm²
- percentage of elongation in breaking.................... ε_{10} = **6** %

Sarajevo, July 2, 1999.

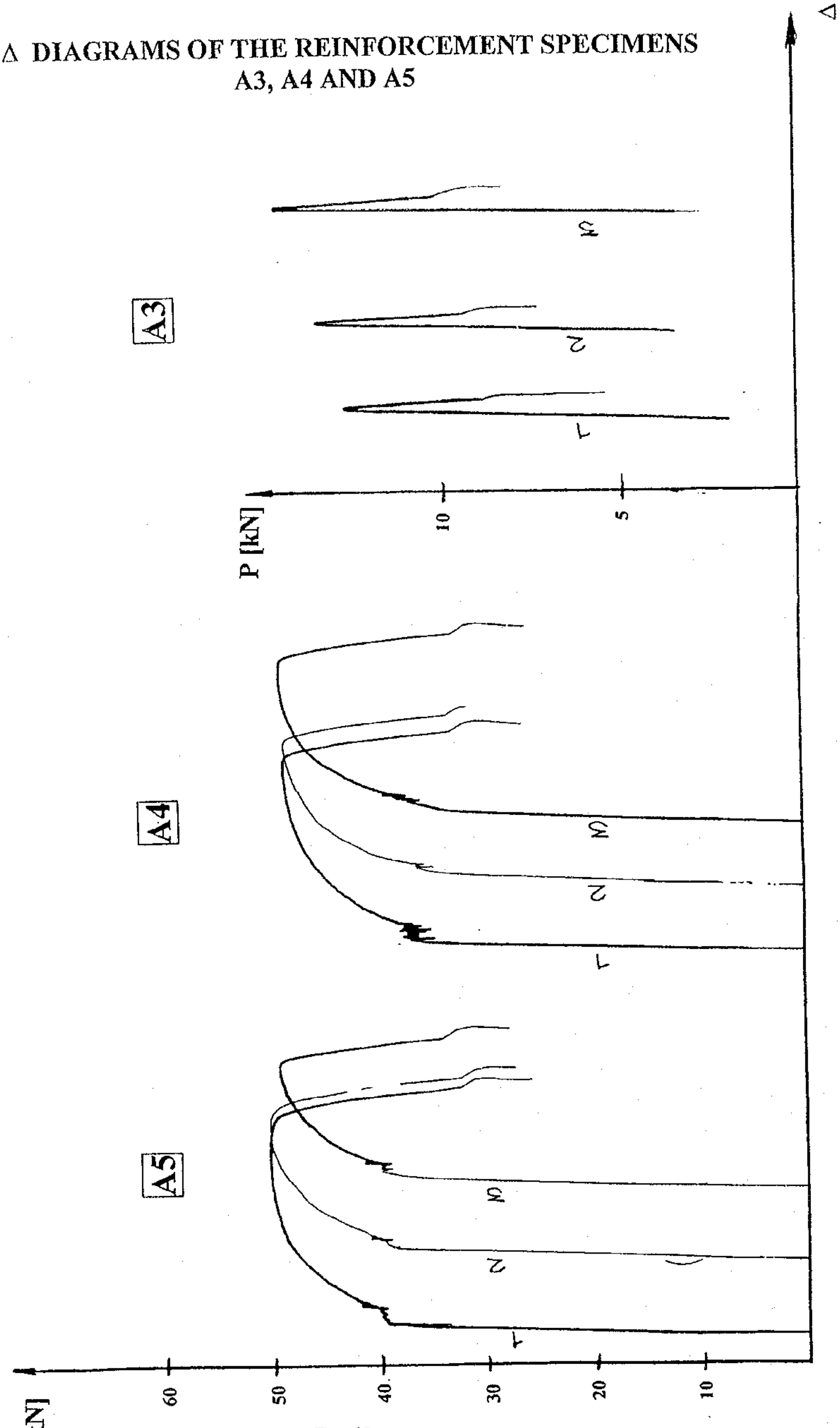
Analyzed by:

M.Sc. Muhamed Madžarević, Civ. Eng.

P – Δ DIAGRAMS OF THE REINFORCEMENT SPECIMENS
A1 AND A2



P – Δ DIAGRAMS OF THE REINFORCEMENT SPECIMENS A3, A4 AND A5

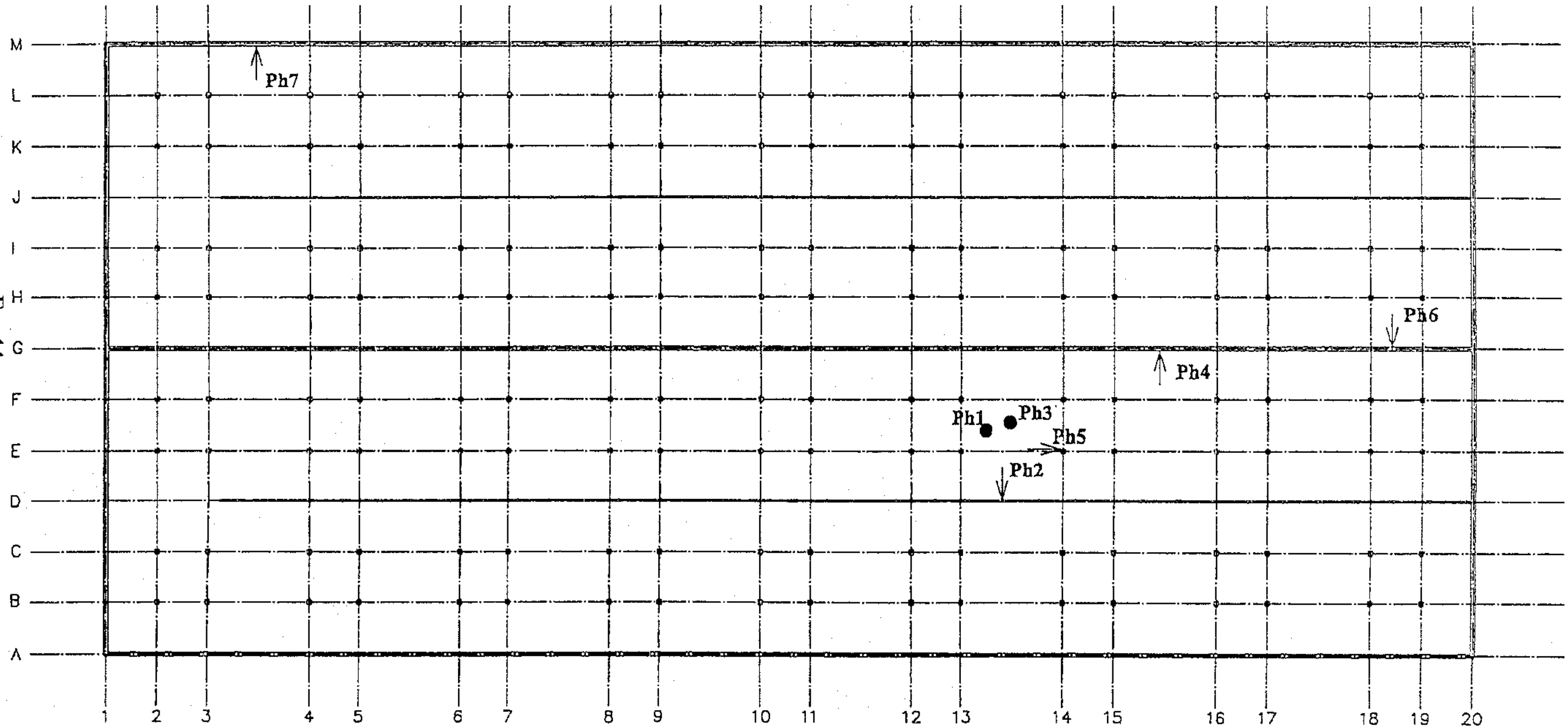


TEST RESULTS OF Ph VALUE OF THE CONCRETE BUILT IN THE OBJECT STRUCTURE N° 5 AND 3 AS PART OF THE WASTE WATERS FILTER COMPLEX SARAJEVO

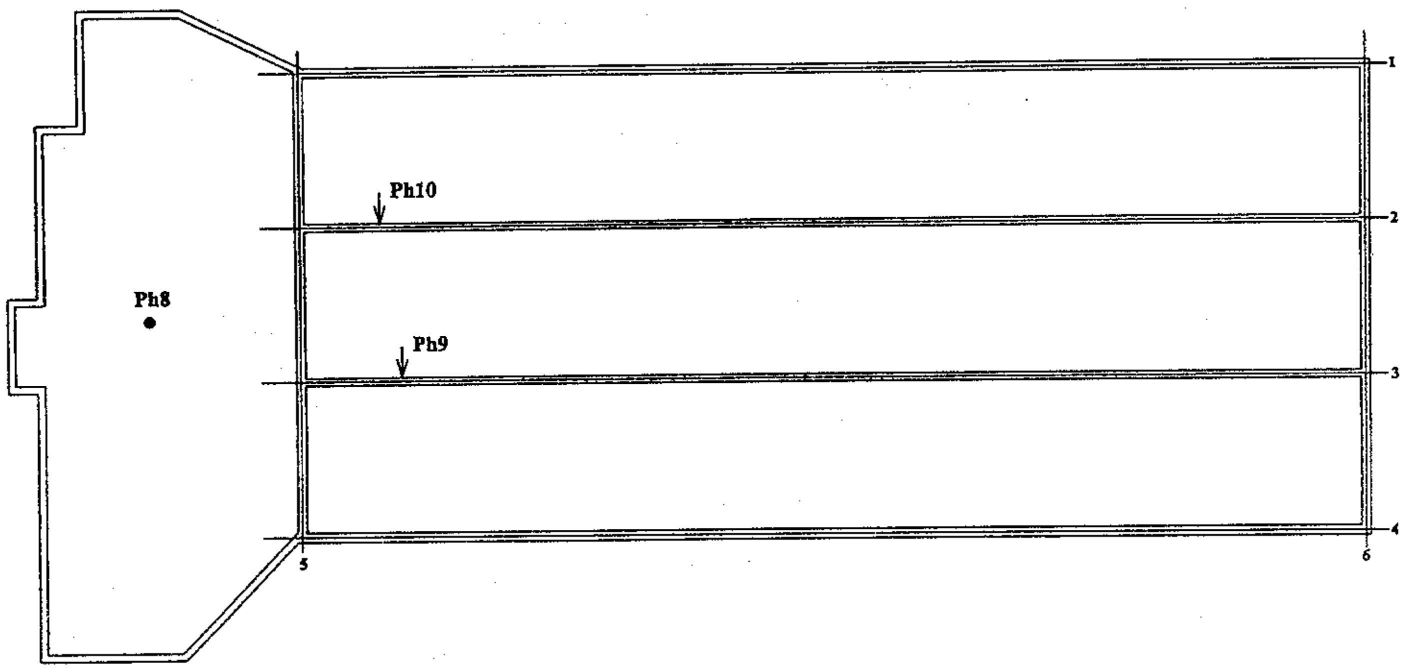
APPENDIX 4

Sarajevo, July 1999

LOCATION OF TESTING Ph VALUE OF CONCRETE OF THE STRUCTURE AERATION TANK



LOCATION OF TESTING Ph VALUE OF CONCRETE OF THE STRUCTURE AERATED GRIT CHAMBER



In order to determine Ph value of the concrete built in the elements of the Objects Structure Aeration Tank (Structure No. 5) and Aeration Grit Chamber (Structure No. 3), test were perfomed in total at seven locations of the Object Structure No.5 and at three locations of the Structure Object No.3.

For the testung liquid phenolphtanol was used which with the acid environment does not give any reaction, but with enlarged basic of environment reaction becomes pink. Basic environment gives bright pink reaction.

Tests were performed on June 15 and June 21, 1999.

The representatives of the Institute and Investor mutually decided sites of tests. Localities of tests are shown in draft that is included in this Appendix.

Based on the performed test following is concluded:

- OBJECT AERATION TANK

- Locality Ph1 (bottom plate) - acid environment was established on depth of app. 1 cm from the concrete surface, deeper the reaction was becoming bright pink
- Locality Ph2 (wall in Axis D) - acid environment was established on depth of app. 1,5 cm from the concrete surface, deeper the reaction was becoming bright pink.
- Locality Ph3 (bottom plate, on site of taking the P5 specimen) - acid environment was establish on depth of app. 1 cm from the concrete surface, deeper the reaction was becoming bright pink.
- Locality Ph4 (Specimen Z25) - acid environment was established of depth of app. 1,5 cm from the concrete surface, deeper the reaction was becoming bright pink.
- Locality Ph5 (Column E14) - on this column two characteristic places were tested. In one corner the protecting layer was damaged that the longitudinal reinforcement that corroded was visible. On this locality the acid environment was established on surrounding concrete in relation to the longitudinal bar of reinforcement. After this, adjoining corner was treated where the damage of protecting layer of concrete was not concluded. Acid environment was established on depth of app. 2 cm from the concrete surface and deeper the reaction was becoming bright pink.
- Locality Ph6 (wall in axis G, locality of reinforcement specimen A1) - acid environment was established on depth of app. 1 cm from the concrete surface and deeper the reaction was becoming bright pink.
- Locality Ph7 (wall in axis M, locality of the reinforcement specimen A2) - on this locality reinforcement was almost on the concrete surface without the protecting layer. Acid environment was established on depth deeper than the profile of the longitudinal reinforcement.

- OBJECT AERATION GRIT CHAMBER

- Locality Ph8 (bottom plate) - acid environment was established on depth of app. 0,5 cm from the concrete surface and deeper the reaction was becoming bright pink.
- Locality Ph9 (wall in axis 3, locality of the reinforcement specimen A4) - acid environment was established on depth of app. 0,5 cm from the concrete surface that was

less than the thickness of the protecting layer and deeper the reaction was becoming bright pink.

- Locality Ph10 (wall in axis 2, locality of reinforcement specimen A5) - acid environment was established on depth of app. 0,5 cm from the concrete surface that was less than the thickness of the protecting layer and deeper the reaction was becoming bright pink.

Sarajevo, July 2, 1999.

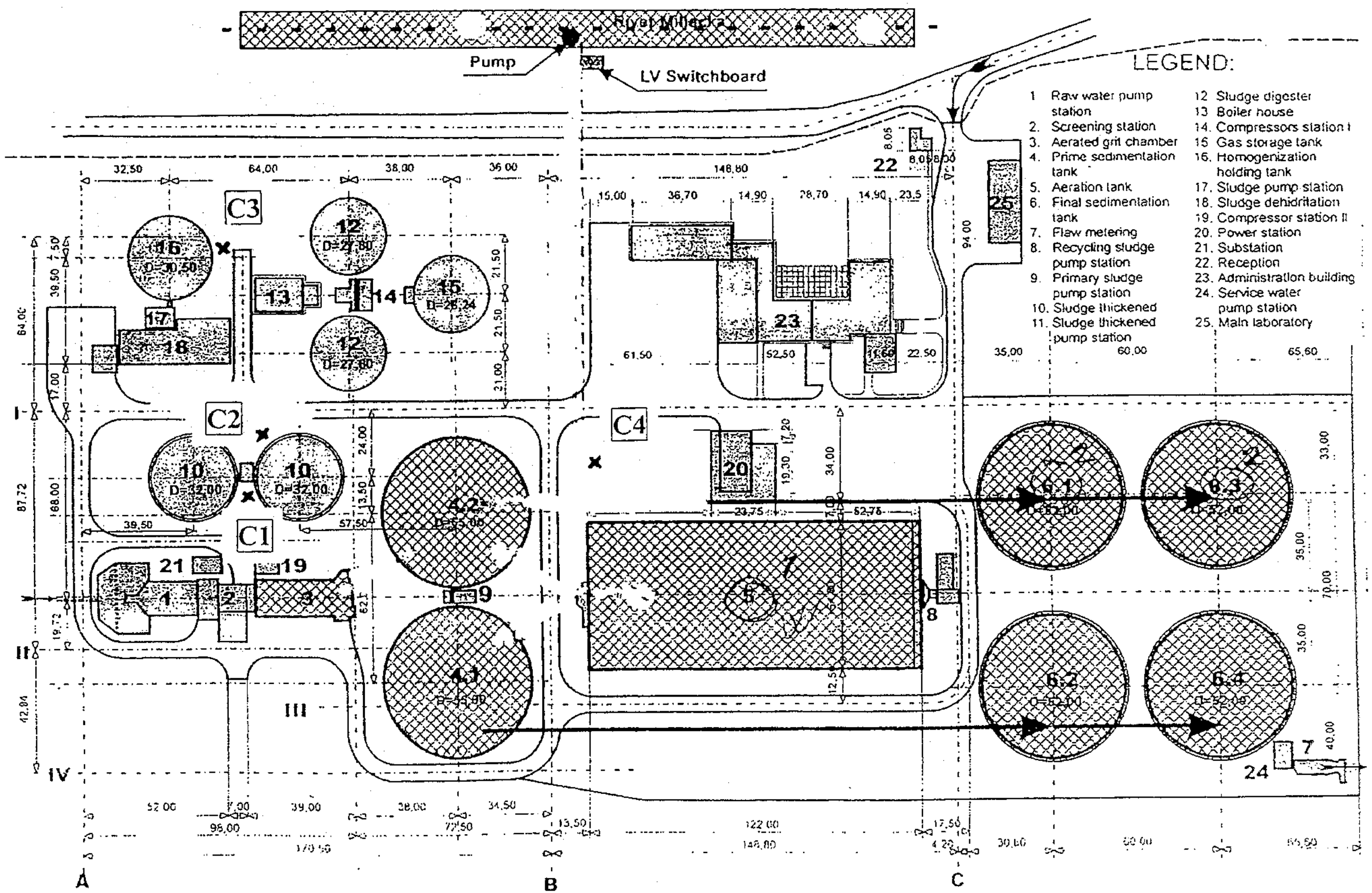
Analyzed by:

M.Sc. Muhamed Madžarević, Civ. Eng.

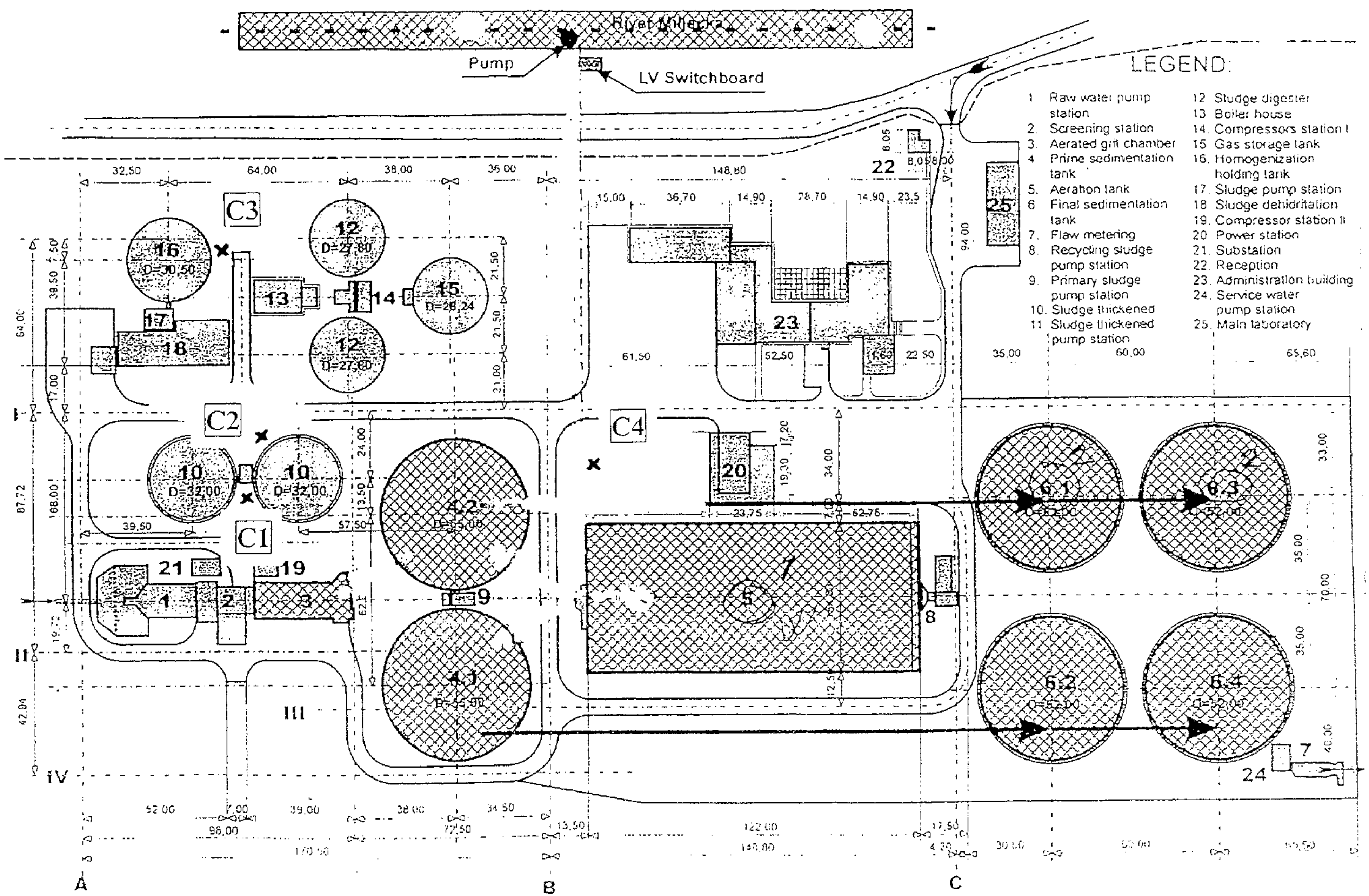
TEST RESULTS OF MECHANICAL AND GEOMETRICAL CHARACTERISTICS OF THE STEEL BUILT IN THE PIPELINE AS PART OF THE WASTE WATERS FILTER COMPLEX SARAJEVO

APPENDIX 5

Sarajevo, July 1999



LOCATION OF EXTRACTION OF PIPELINE SPECIMEN



LOCATION OF EXTRACTION OF PIPELINE SPECIMEN

In order to determine the mechanical characteristics as well as the geometrical dimension of materials of which the underground pipeline is made of, extraction, processing and testing of four specimens from the different location were performed with method of destroying.

Taking of the specimens was performed on June 29, 1999.

Testing was performed on June 30, 1999 with "BRINELL" method. Control was performed on stationary Brinell device at the Institute. For appropriate ball Ø 2,5 mm and force of impression F= 1876 N, appropriate stiffness was obtained, and intermediately the strength of the basic material.

By visual testing of specimens immediately after the extraction, as well as after their processing it can be concluded that on the locations that were treated by this testing the degree of corrosion of the basic material is insignificant i.e. it did not have impact on the reduction of the thickness of the pipeline, on the functionality nor on the pipeline capacity.

Representatives of the investor decided the sites of extraction of the specimen of the basic material of the pipeline. Localities of the extraction were shown on the draft that is enclosed in this Appendix.

Test results are shown in the Table 1.

Table 1. "Brinell" method test results the steel pipe of the pipeline as part of the Filter of Waste Water Complex - Sarajevo

POSITION AND DIMENSION OF THE PIPE	MEASURING SITE	DIAMETER d_1 [mm]	DIAMETER d_2 [mm]	AVERAGE $d_{pr.}$ [mm]	STIFFNESS HB [N/mm^2]	STRENGTH OF TENSION R_m [N/mm^2]
C1 Ø 230×5.5 mm	1	1,22	1,22	1,22	1471	499
	2	1,16	1,16	1,16	1638	555
	3	1,14	1,15	1,145	1687	572
	4	1,14	1,14	1,14	1706	578
	5	1,21	1,22	1,215	1491	505
	6	1,14	1,13	1,135	1716	582
				Average:	1618	549
C2 Ø 160×3.5 mm	1	1,16	1,17	1,165	1628	550
	2	1,16	1,18	1,17	1608	543
	3	1,15	1,15	1,15	1667	563
	4	1,17	1,17	1,17	1608	543
	5	1,17	1,17	1,17	1608	543
	6	1,17	1,16	1,165	1628	550
				Average:	1625	549

Table 1. – cont.

POSITION AND DIMENSION OF THE PIPE	MEASURING SITE	DIAMETER d_1 [mm]	DIAMETER d_2 [mm]	AVERAGE $d_{pr.}$ [mm]	STIFFNESS HB [N/mm²]	STRENGTH OF TENSION R_m [N/mm²]
C3 Ø 220×7 mm	1	1,17	1,17	1,17	1608	548
	2	1,2	1,19	1,195	1540	525
	3	1,18	1,17	1,175	1598	545
	4	1,23	1,23	1,23	1451	495
	5	1,1	1,1	1,1	1834	625
	6	1,23	1,23	1,23	1451	495
				Average:	1580	539
C4 Ø 230×5.5 mm	1	1,19	1,19	1,19	1549	531
	2	1,18	1,17	1,175	1598	548
	3	1,18	1,17	1,175	1598	548
	4	1,19	1,19	1,19	1549	531
	5	1,22	1,22	1,22	1471	504
	6	1,2	1,21	1,205	1510	518
				Average:	1546	530

Based on the performed tests, in accordance with the Standard JUȘ C.B0.500, the basic material that the pipeline is made of as part of the Filter of Waste Waters Complex - Sarajevo can be classified as class of the steel: C.0561; i.e. technical mark **ČN 36-B₂** - general structure steel middle stiffness.

Sarajevo, July 5, 1999.

Analyzed by:

[signature]

Emir Muhlisić, Civ. Eng.