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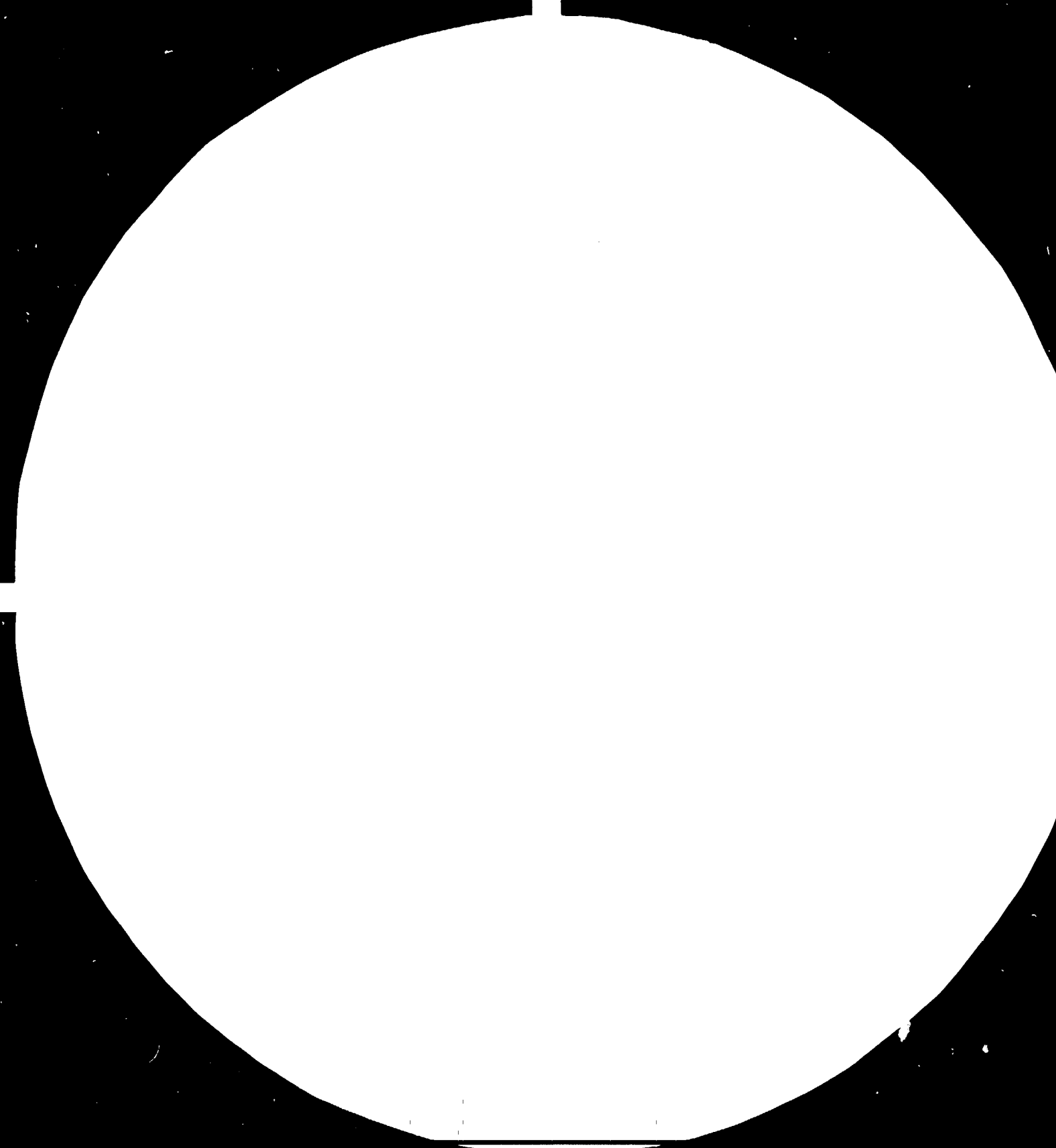

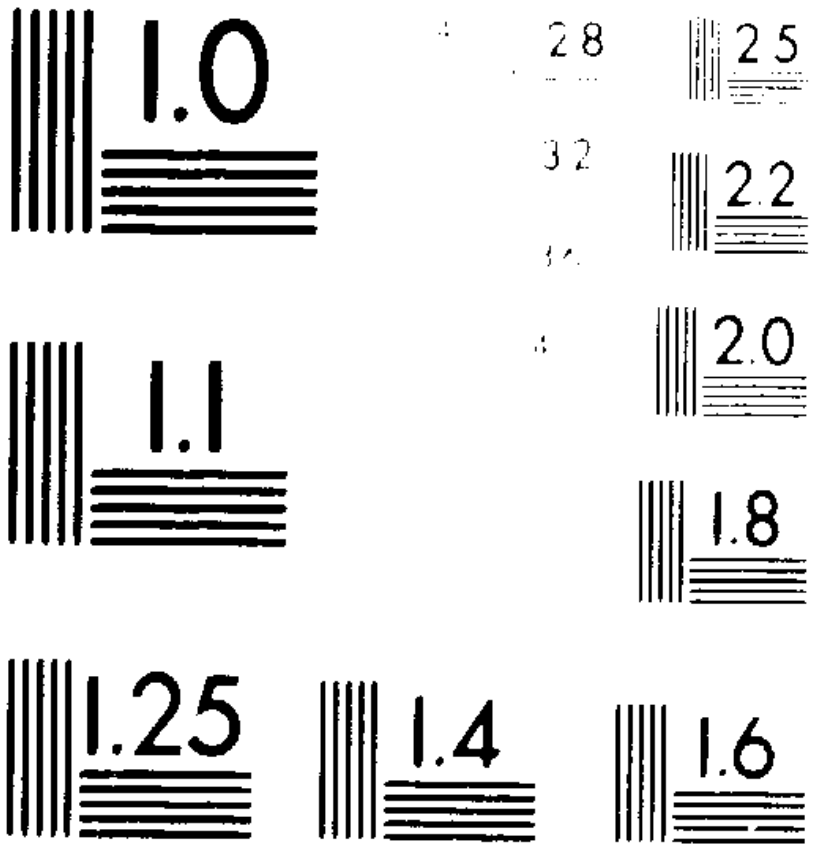

→ M. Diedrich

RESTRICTED

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2 January 1985
ENGLISH

Sri Lanka.

ESTABLISHMENT OF A CERAMIC RESEARCH AND DEVELOPMENT LABORATORY

DP/SRL/78/207

Technical Report* .

Prepared for the Government of Sri Lanka
by the United Nations Industrial Development Organization
acting as Executing Agency for the United Nations Development Programme

Based on the work of Y. Kato,
Expert in Ceramic Research and Development

United Nations Industrial Development Organization
Vienna

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CONTENTS

(1) GENERAL INFORMATION

The Ceylon Ceramics Corporation was initiated in 1955 and started operation at the Negombo Factory. Also, the second plant was established at Piliyandala and operated since 1967. Both these factories are producing mainly earthenware. However, the Piliyandala Factory is making a small quantity of Sanitary-ware and Mosaic Tiles for the domestic market. Additionally, other plants for raw materials such as kaolin, ball clay, feldspar, quartz and limestone, also belong to the Corporation. The Corporation owns factories that manufacture bricks and roofing tiles. Products from these factories are distributed to different parts of the country. Altogether, the Corporation employs 5358 people for the production of all products mentioned above.

Although, the Corporation has long and enough experience in the production of ceramic ware with locally available raw materials and labour, still there are many technical problems of a very intricate nature which the technical personal have found difficult to solve easily. Therefore, the final quality of the products is still poor and needs correction.

It is my point of view that the staff employed in the Corporation has not been trained sufficiently and fundamental studies were not organised since the beginning of the operation. Therefore, even now, I observe that there are shortages in the facilities available and qualified staff who are able to carry out quality control work, for future improvement.

In order to make a proper solution of such problems, the Ceramic Research and Development Project has been organised, with the

collaboration of UNIDO and the Ceylon Ceramics Corporation. The project was approved in 1983 for a two year duration. The UNIDO input was US $ 1,005,800 and the input of the Government of Sri Lanka was Rs. 1,848,850 of which the budget for the equipment was contributed by the Government of West Germany.

However, since January 1984, I have been working in Sri Lanka to assist with the " Establishment of a Ceramic Research and Development Laboratory", including utilisation of various equipment and facilities. In addition, the Staff Training & Consultancy work were organised as part of my obligation.

(2) PROJECT ACTIVITIES

According to the project document, the following activities will be carried out during the period of operation.

a) Surveying the available Ceramic Raw Material resources and testing the materials to determine their suitability for use in the production of Ceramic Ware.

b) Purification, processing and further treatment methods to be created, to improve quality of material.

c) Development of new ceramic products.

d) Introduction of better manufacturing methods.

e) Tools and machinery to be improved.

f) Organisation of a technical training scheme for personnel

g) Render technical assistance to the local Ceramic Industry.

h) To assist in the preparation of glazes, colours, fritts etc.

i) Study of proper utlisation of energy.

j) Investigation of the possibility of developing alternate sources of energy.

k) Technical feasibility studies of new Ceramic Industries, to be established.

(3) WORK PLAN

Although, the initial work plan had been submitted on 20th January, the details are given in Annex (I)..

Many of the project activities could not proceed according to schedule,which was always delayed due to the following problems, viz:-

a) Late arrival of experts.

b) Change of post of Experts.

c) Delayed arrangements of building with electric power and water supply.

d) Late delivery of equipment.

e) Delayed installation of equipment and machinery.

f) Delayed recruitment of personnel.

(4) IMPLEMENTATION OF ACTIVITIES

During the past one year, I have provided assistance in the following areas :-

a) The establishment of the Ceramic Research Laboratory at Piliyandala.

b) The appointment of Project Staff.

c) Training of Project and Factory Staff.

d) I have also undertaken consultancy work.

The implementation of activities is shown in annex (2). A brief explanation of these activities is given in paragraph 5 -i)

(5) SITING OF THE RESEARCH LABORATORY

In order to proceed with the project activities the siting of the laboratory was decided on, taking into consideration the following essential aspects:-

a) Availability of easy transportation and communication with a view to make easy contact with the client and user.

b) For easy purchases of materials and hardware.

c) For obtaining general information and personnel.

d) For obtaining a constant and stable supply of electricity and water.

Having taken the above into consideration I arrived at a final decision to select the existing building and other facilities already available within the premises of the Ceylon Ceramics Corporation at Piliyandala. This decision, made possible the elimination of expenditure for the purchase of land and construction of buildings. In the selection of this site , I made certain, that there would be no interference with the day to day adminstration and work of the laboratory.

(6) ORGANISATION CHART OF PERSONNEL

The following chart was approved and most of the Research Staff were interviewed and appointed to the project in May, 1984. Fifteen personnel were required, of which thirteen posts have been have filled and two more have to be filled soon.. This will be done as soon as qualified people are found. Most probably, the two posts, one for the Mineralogical Laboratory and the other for the Physical Laboratory, will be filled before the end of this month. A chart is shown in Annex (3).

Names of the staff are as follows:-

Romm No. (1) ..... Mr C.L. Ranatunga
Mr. H.W.S. Siritunga

Room No. (2)..... Mr. N. Karunasinghe
and one vacancy

Room Nos. (5 & 6)..... Mr. E.C. Alles and
Mr. K.P.A. Jayakody

Room No. (7)..... Mr. P. Mithrarathna and
Mr. N. Dharmasiri

Room No. (8)..... Mr. A.S. Pannila
and one vacancy

Room No. (8a) ..... Mr. Sarath Silva (Chief)
Mrs. R.D. Hemalatha (Designer)

Room Nos. (9 & 10)..... Miss L. Pigera
Mr. K.A.N. Dharmasiri

Room No. (12)..... Mrs. C.M.N. Perera (Secretary)

(7) LAY OUT

I. Building

Present - total area is 540 m^2 as shown in annex 5 & 6

Ground Floor	320 m^2
First Floor	220 m^2
Total	540 m^2

The area alloted for extension is 36 m^2.. This extension is for the installation of a gas kiln, jigger, a hand throwing wheel and an autoclave.

a) Ground Floor

Room No. (1) X-ray & D.T.A.Laboratory

Room No. (2) Mineralogical Laboratory

Room No. (3) Sample Preparation & Workshop

Room No. (4) Storeroom

Room No. (5) Pilot Plant for body preparation

Room No. (6) Pilot Plant for body forming

Room No. (7) Kilns & Firing Laboratory

b) First Floor

Room No. (8) Physical Laboratory

Room No. (8a) Design

Room No. (9) Balance & Chemical Laboratory

Room No. (10) Chemical Analysis Laboratory

Room No. (12) Lecture & Conference Room

Room No. (12) Office

2. Equipment

The Installation Expert - Dr. F.A. von Metzsch has submitted the list of machinery in detail. However, I inform that 148 items of

equipment had been purchased and supplied by the U.N. Sixteen items were purchased locally. Four items have not been received as yet.All items received and purchased have been installed.

Details of the above are given in annex 6, 6a, 6b.

(8) LABORATORY OPERATION & EXPENSES

The formal opening of the Ceramic Research Laboratory was held on 18th September, 1984 and the laboratory operations commenced after this date.Before the actual research operations started, much time was spent in making the necessary arrangements for the functioning of the laboratory. Arrangements included the supply of electricity, wiring of the premises, electrical transformer correction, rendering water supply, installing air-conditioner and humidity apparatus, painting of walls, windows, doors etc., rendering the floor drainage and supply of furnitire. A major portion of time, was spent in doing the necessary foundation work and installing the machinery. Collection of vehicles, raw materials and equipment for work in the research division was also done.The training of personnel commenced from the very start of the operations.

After the opening, several clients made requests for testing of materials, in order to assist them with their problems and difficulties. We have on record, orders for requests amounting to 70-80 per month. These have been in the form of chemical analysis, determination of physical property and suitability of raw materials for the production od ceramic ware.Several of these requests have not been complied with for want of time. The monthly expenditure of the laboratory , including salaries, wages, cost of eletricity and value of local purchases is approximately Rs.55,000/- to Rs. 60,000/- per month.

(9) RESEARCH WORK

The topics of research and tests are given below:-

1. Chemical Laboratory

   a. Chemical Analysis

   b. Determination of soluble salt content

   c. Lead content in glazes and decorating materials

   d. Colloidal properties of clay and casting slip

   e. pH value

   f. Ion exchange

2. Physical Laboratory

   a. Examination of physical properties of raw materials and products.

   b. Measurements of colour, whiteness, density, specific gravity, porosity, particle size, shrinkage bending strength and permeability.

3. X-ray Laboratory

   a. Determination of minerals by X-ray Diffractometer

   b. Quantitative determination by X-ray Fluorescent Spectrometer

   c. Differential Thermal Analysis (D.T.A.)

   d. Thermogravimetric Analyisi (T.G.A.)

   e. Thermal Expansion

4. Mineralogical Laboratory

   a. Observation by Scanning Electron Microscope

   b. Observation by Polarizing Microscope

   c. Sample preparation

5. Pilot Plant

a. Body & Glaze Preparation

b. Prototype Production

c. Mould Preparation

d. Practical Work of Forming & Finishing

e. New Designs and their Applications

6. Kiln Section

a. Glaze Application

b. Firing Tests with Temperature and Atmosphere Control

c. Gas Analysis & Calorimetry

d. P.C.E. Test

e. Autoclave Test

Beside the above, the following topics of research will also be carried out:-

Study of body and glaze for earthenware, sanitaryware, mosaic tiles, porcelain and new type of products.

(10) STAFF TRAINING

There are three groups of officers for training, depending on the work performed.

a) Internal Training- Laboratory Staff

The first group of officers are those involved in the day to day work of the Research Laboratory. The training commenced on the 25th of May,1984. The lectures dealt with the general aspects of manufacture of various types of ceramic ware - and in particular the quality control of raw materials,used in the manufacture of different ceramic bodies and glazes, shaping of different types of ceramic ware, application of decorating materials and glazes and the firing of all types of products. The officers involved in the work of the research laboratory, have also to learn and know very well the manner in which to operate the equipment within the laboratory.Almost all the equipment are very expensive and very intricate, so that each officer operating this equipment, must be taught the finer details of working each equipment. Lectures were held twice a week for the first group. Three officers from the Quality Control Department of the factory, joined in following the lectures, as they were using similiar but smaller equipment in their own department. Dr. F.A. von Metzsch the U.N. Installation Expert, very ably assisted in the rendering of lectures and demonstrations of operating the equipment.

b) Internal Training - Factory Staff

The second group of officers (21 in number) were selected from within the technical staff of the Corporation Factories. These lectures commenced on 23rd July, 1984 and ended on 30th October, 1984.

The lectures were as follows:-

a. Slip-House arrangement and operation

b. Jiggering and jollying & other production methods

c. Casting and greenware handling

d. Mould-making with Plaster of Paris

e. Preparation of fritts, glazes and pigments

f. Production of sanitaryware

g. Powder making and friction pressing of bricks, tiles and other ware

h. Mosiac Tile manufacture

c) External Training - Laboratory Staff

This scheme of training was decided on at the commencement of the project operation. However, as the necessary procedures and schedules of training had to be approved and organised by UNIDO Headquarters, proposals are being prepared for submission. It is proposed to have fourteen officers trained abroad, over a period of two to three months, in two groups, alternatively.

(11) CONSULTANCY WORK

Assistance and technical advice has been provided to various factories of the Corporation, private manufacturers and Government Agencies, since my arrival. The factories of the Ceramic Corporation are situated at Piliyandala, Negombo, Dankotuwa, Meepe, Borelesgamuwa and Meetiyagoda. I have directed the above factories in the preparation of body mixtures, glazes, material testing, correction of forming and finishing methods, reduction of damages in each process of manufacture, solving of loading and firing problems. I have also given directions in the correct methods of designing and decorating.

The Director, Department of Small Industries, requested me to visit the Central Training and Designing Centre, of the above department at Waragoda, Kelaniya. I have given advice in whatever way I could, within the short time at my disposal, to correct methods of production, at this centre.

I also visited M/s. Midaya Ceramic Co., at Kottawa.This company produces ornamental ware, for export.

(12) RECOMMENDATIONS

A. I would like to submit the following suggestions to the Ceramic Research & Development Project:-

1) Arrange to have a "self-supporting system" in the near future. This means, that the cost of operation of the Research Laboratory, should be covered by the fees, that will be charged for the advice and experiment carried out within the Research Laboratory in solving the technical problems of other factories within the Corporation or of factories outside the Corporation. According to the present arrangement, the Corporation spends at least Rs.60,000/- per month, during the trial period. After the trial period, I recommend that a reasonable fee be charged to the customer, for advice and tests carried out by the laboratory, and the moneys recovered be utilised to meet the cost of maintaining the Research laboratory.

2) Long -Term Staff Training:

I recommend that the training be of a theoretical and practical nature. I believe, it will not be too difficult to proceed in this training immediately, as some members of the staff, are already available to impart this training, together with the facilities of equipment.

3) Request to UNIDO for continued assistance

To achieve success in this project, assistance is necessary from external sources for the next two or three years.This assistance should be in the way of finances and personnel. Large sums of money have been donated to set up this project

a grand success. For the young research officers to gain more experience assistance should be forthcoming.

4) A Management System to be considered

For the present, the General Manager of the Corporation is over-looking the day to day management of the Research Laboratory. He is capable. Unfortunately, he is burdened with the administrative work of the whole Corporation and thus is unable to devote more time for the constructive work in the research area.. I hope some arrangement could be made, in the near future, for the General Manager to devote more time for research in the research division.At present, there are young research workers, who could be trained to take on the adminstration of this project - however, this will take time.

5) Establsihment of a Ceramic Association

Ceramic Associations have been formed all over the world with a view to exchanging modern technical know-how, in the field of ceramic research and ceramic manufacture. An association of this nature, if established in Sri Lanka, through the Ceramic Research Division, will be of great assistance to further the knowledge of the young research officers and manufacturers The Technical Institutes and Universities of the Government and Private manufacturers should unite, to make such a assosciation possible.

B) Recommendations for the Ceramic Corporation:

I would like to submit the following recommendations for the benefit of the Ceylon Ceramics Corporation.

1. Indirect staff for production is excessive:

Figures are given below:-

Total number of employees		5358
Direct labour		3714 ....69%
Indirect staff		1644.....31%
Executives	282	
Adminstration	1362	

In order to make the operation normal, 31% of indirect staff is too excessive and should be reduced to at least 10-15%, at this stage. If the numbers could be reduced to 5%, it would be very beneficial to the Corporation.

2) I recommend better co-operation between the staff and the workers. This would help the future of the Corporation both in production and otherwise. Each employee should realise the responsibility of the work he has to do.

3) Decisions must be carefully made to appoint the correct person to a particular job within the factory.This must done, with due consideration to the knowledge, qualifications and capability of each person.

4) The technical staff should have a knowledge of market trends. Products must be made to suit the market. The knowledge of the suitability of the product to the market, should be acquired through the marketing personnel.

5) The Planning & Development Division of the Corporation, is,as far as I an aware, working to produce daily production statistics. I am of the opinion that the staff of the Planning Division should collaborate more with the officers of the technical and marketing divisions, to produce more worth while items.

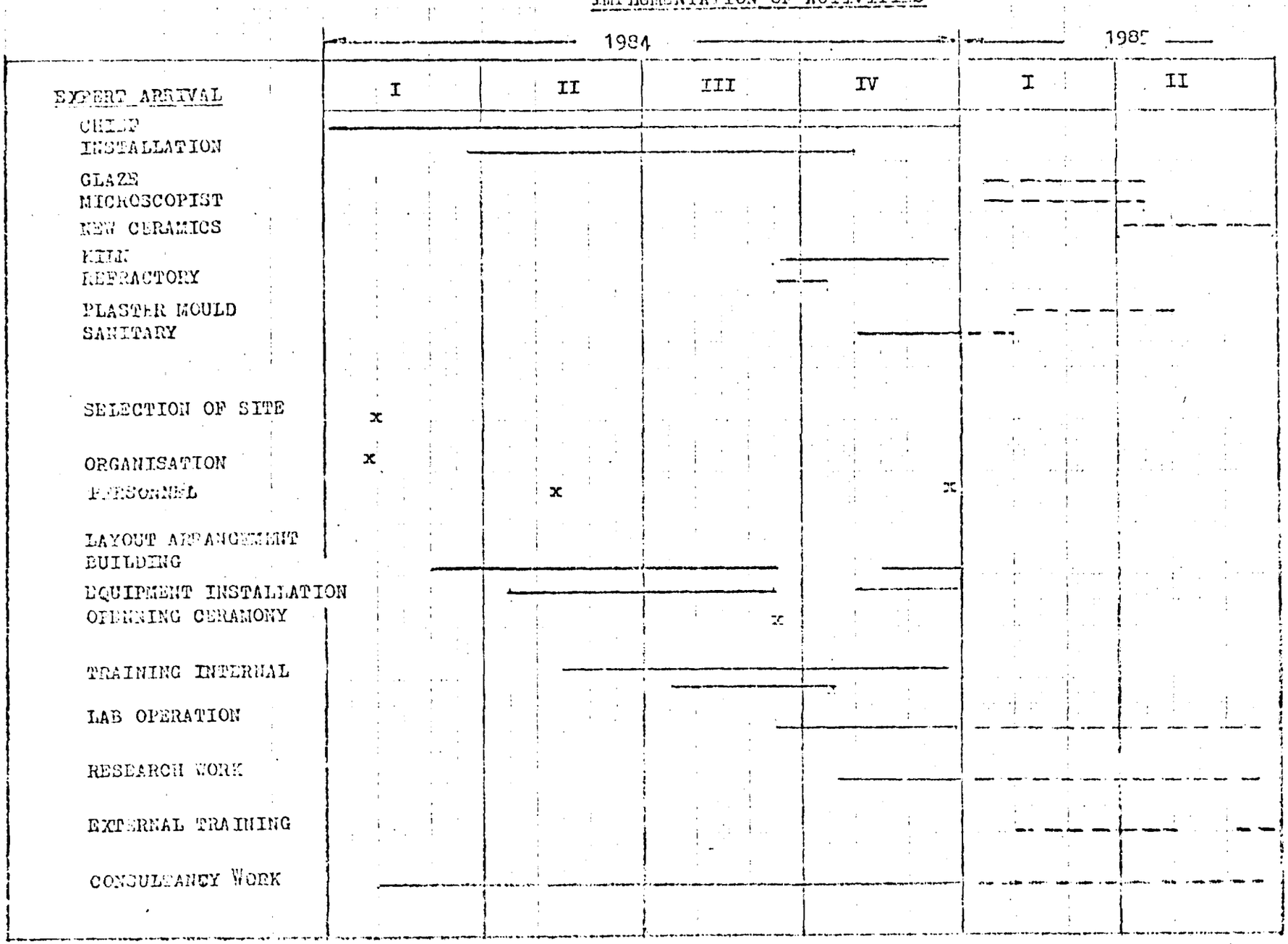
Finally, I would like to express my very sincere thanks to the Chairman & Board of Directors and the Staff of the Ceylon Ceramics Corporation and my colleagues of the U.N. for their great hospitality, kindness and co-operation during my assignment in Colombo. If there is anything more that I could do, please let me know and I will be ready to assist,

WORK PLAN

	1984 I	1984 II	1984 III	1984 IV	1985 I	1985 II
CHIEF EXPERT ARRIVAL	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx	xxxxxxxxxx		
INSTALLATION REPORT	xxxxx	xxxxxxxxxx	xxxxxx			
GLASS CONSULTANT "		xxxxxx	xxxxxx			
STRUCTURAL BRICK "	POST CHANGED AS MICROSCOPIST UNDER RECRUITMENT					
INSULATORS "	POST CHANGED AS NEW CERAMICS UNDER RECRUITMENT					
KILN DESIGN "		xxxxxx	xxxxxx			
REFRACTORY "			xxxx	xxxxxxxx		
PLASTER MOULD "		xxxxxxxxxxxx				
SANITARY "				xxxxxxxxxxx		
BUILDING ARRANGEMENET	xxxxxxxx	xxxx				
MACHINERIES INSTALLATION		xxxxxxxxxxx				
STAFFS TRAINING		xxxxxxxxxxx	xxxx	xxxxxxxx		
RESEARCH WORK		xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	CONTINUOUS	
TRAINING COURSE	xx		xx	xx		
SEMINAR				x		
CONSULTANCY WORK	xxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	xxxxxxxxxxx	CONTINUOUS	

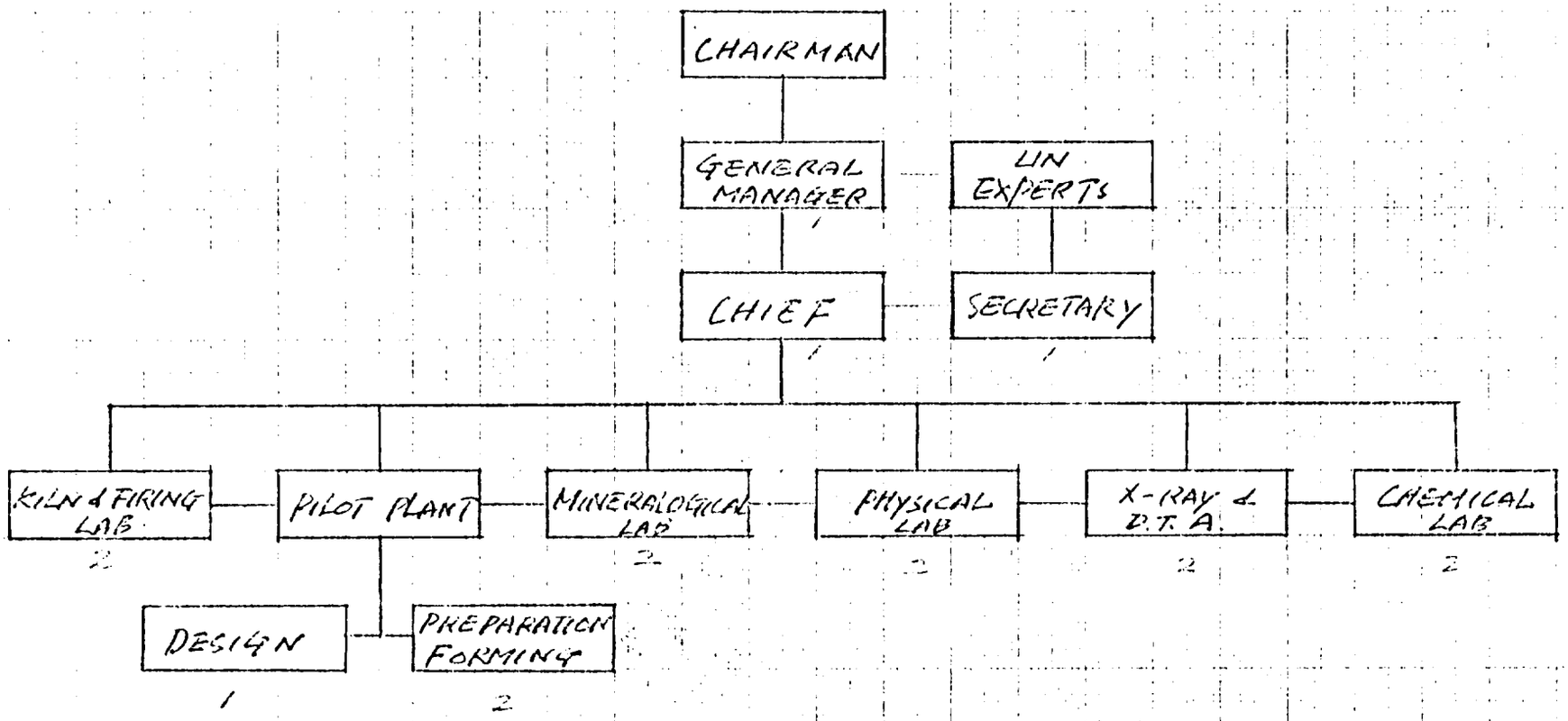
ANNEX -----I

IMPLEMENTATION OF ACTIVITIES



ANNEX 2

ORGANIZATION CHART FOR CERAMIC RESEACH PROJECT



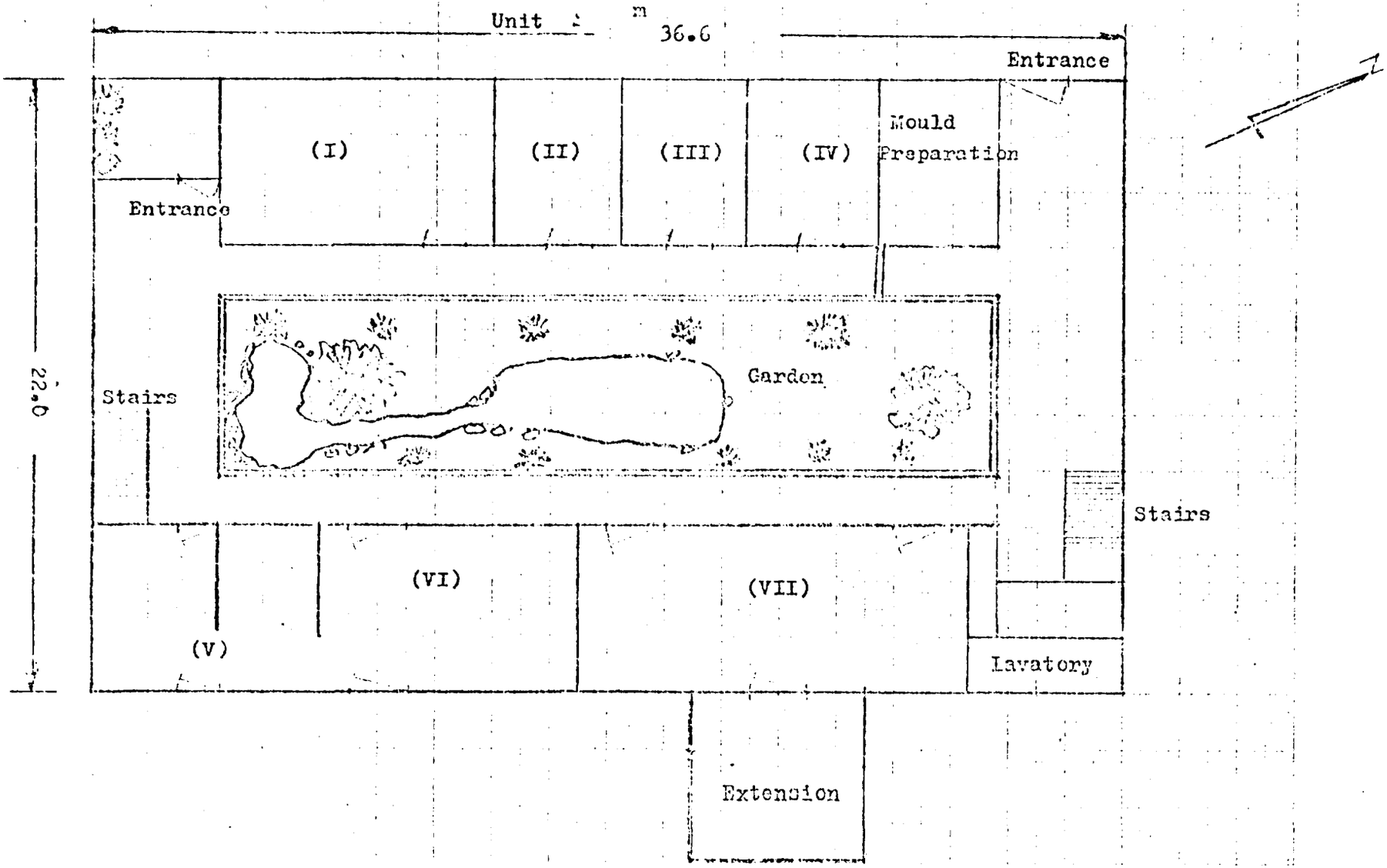
Required No's of Staff.

ANNEX---3

LAY OUT

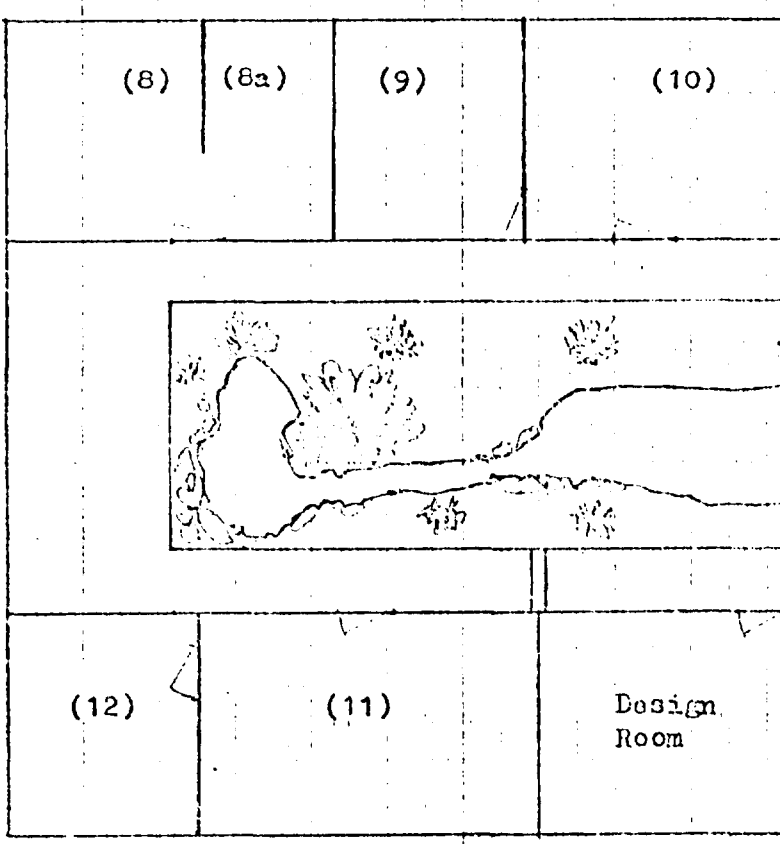
Scale : 1/200

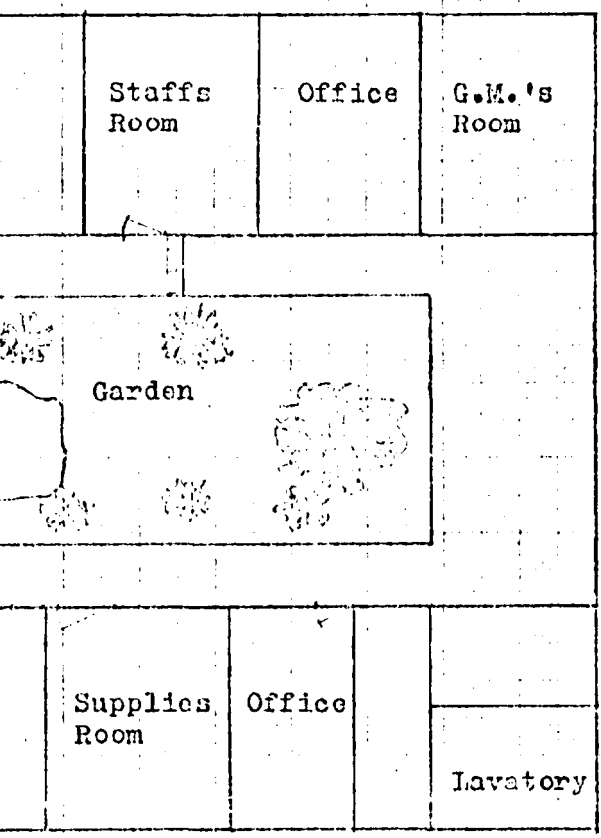
Unit : m



ANNEX 4

UPSTAIRS




Staffs Room
Office
G.M.'s Room
Garden
Supplies Room
Office
Lavatory

ANNEX 5

Inventory of Equipment

Room	Inv. No	Item
1	P 1	Zephir - Cooler
	P 2	X-Ray Diffractometer PW 1710
	P 3	X-Ray Spectrometer PW 1410/50
	P 4	Hewlett Packard Computer HP 85
	P 5	On-Line Recorder for Diffractometer
	P 6	Argon-Methane Cylinder 1 - Local
	P 7	Argon-Methane Cylinder 2 - Local
	P 8	Helium Gas Cylinder - Local
	S 11	Vibratom Mill
	M 1	STA Unit
	N 2	Measuring Unit
	N 3	Differential Dilatometer
	N 4	Thermostat for STA
	N 5	Thermostat for Dilatometer
	M 3	Test Piece Extruder
	O 3	Drying Oven
	U 1	Air Conditioner, Window Type Local
	o	Desiccator
	o	Humidity Control (brit.)
	o	Humidity Control (Japan)
	o	Thermometer with wet & dry bulb
2	J 4	Electron Microscope * I *) = not yet arrived.
	J 5	Photo Equipment *
	S 4	Stereo Microscope
	F 3	Polarizing Microscope
	F 4	Refractive Index Liquid Set
	K 2	Micrometer Dispensing Device
	M 18	Mohs Hardness Set (6-9)
	U 2	Air Conditioner, Window Type - Local
	o	Desiccator
	o	Microscopic Slides
	o	Mineral Collection
3	J 3	Microtome
	S 12	Grinding and Polishing Machine
	B 10	Lathe
	N 6	Stone Sawing Machine with 2 Diamond Wheels
4	U 5	Air Conditioner, Split Type
	M 8	Green Bending Strength Tester Acc. to BCRA
	B 3	Muller Mixer
5	A 1	Sliding Scale Platform Balance 150 kg - Local
	N 13	Ball Mill 100 ltr (Netzsch)
	o	Ball Mill 100 ltr (Negombo)
	I 1	Jaw Crusher
	I 2	High Speed Sample Grinder
	B 8	Jar Mill 9" with 6 jars
	B 9	Jar Mill 11" with 6 jars
	B 2	Muller Mixer
	O 5	OSK Pot Mill With 15 cm Jar
	F 1	Norton Jar Mill
	F 2	Norton Jar Mill
	N 7	High Speed Stirrer
	N 8	Filter Press with 14 Filterplates
	S 13	Hydrometer (0-60 g/ltr)
	o	3 Aluminium Tubes

Room	Inv. No	Items
	o	3 Plastic Tubs *
	o	2 kg Spring Balance - Purchased by Prof. Kato
6	M 1	Large Drying Box with Fan
	M 2	Small Drying Oven
	H 1	De-airing Extrusion Machine
	C 1	Handoperated Hydraulic Press
	I 3	Handthrowing Machine
	I 4	Handthrowing Machine I Not yet delivered
	I 5	Jigger Machine
	I 6	Jigger Machine
	S 5 +5a	IR Quick Drier with Balance 480 g
	S 8	Platform Balance 11000 g
	M 9	Pentrometer for Testing non-plastic Surface
	B 4	Clay Hardness Tester
	M 4	Test Piece Extruder
	M 6	Green Bending Strength Tester
	o	Pfefferkorn Apparatus
	G 1	Gallenkamp Universal Torsion Viscosimeter
	o	Meat Mincer - Local
7	S 9	Platform Balance 11000 g
	G 3	Stirrer Handilab Minor
	S 14	Hydrometer (0-60 g/ltr)
	M 9	Spraying Box
	A 2	Compressor and Spraying Gun
	O 4	OSK Drying Oven
	M 13	Glaze Thickness Tester
	K 1	Gardient Kiln
	N 10	Naber Super Kanthal Kiln
	N 11	Large Naber Kiln
	B 11	Bickley PCE Furnace
	I 7	Gas Kiln
	I 8	Gas Kiln
	W 1	Sager Cones
	O 9	Oxygen Cylinder with Valve - Local
	B 6	Bullers Ring Gauge
	B 7	Bullers Ring Gauge
	C 2	Filament Pyrometer
	J 1	6 - Channel Printing Recorder
	O 6	Calibrator for Thermocouples
	O 7	Potentiometer with Temperatur Display
	O 8	Potentiometer with Temperatur Display
	R 3	DC Microvoltmeter
	R 4	System Voltmeter UDS 6
	R 5	High Voltage Tester UHP
	B 1	Autoclave
	o	Chain Block *
	K 3	Adiabatic Calorimeter JPB
8	C 2	OSK Drying Oven
	R 1	Retsch Agate Mortar Grinder
	R 2	Sieving Machine Retsch Vibro
	O 4	Stirrer Handilab Minor with 3 Rotors
	S 15	Hydrometer (0-60 g/ltr)
	K 4	Thermostat (8 ltr/min)
	K 5	Permeability Meter
	K 6	Andreasen Sedimentation Apparatus
	K 7	Andreasen Sedimentation Apparatus

Room	Inv.No.		Items
	S	16	Sedimentograph
	S	17	Sedimentograph
8			
cont.	K	8	Vernier Caliper
	M	5	Test Piece Extruder
	M	7	Green Bending Strength Tester acc. to BCRA
	N	12	Bending Strength Tester Netzsch
	T	1	Bending Strength Tester TONI
	C	6	Sample Splitter
	B	14	Brockfield Viscosimeter
	G	6	Redwood Viscosimeter
	G	2	Gallenkamp Universal Torsion Viscometer
	M	14	Moisture Expansion Measuring Device
	S	6+6a	IR Quick Drier with Balance 480 g
	S	10	Platform Balance 14000 g
	L	1	Colorimeter LF 90 with Measuring Head
	M	16	Cannon Statistic Calculator
	M	10	Needle Penetrometer for Testing non-plastic surfaces
	M	11	Needle Penetrometer for Testing non-plastic surfaces
	M	12	Thickness Tester
	M	13	Thickness Tester
	G	8	Multi Test Tube Drier
9	S	16	Analytical Balance 2024 MP 6
	S	17	Platform Balance 12000 g
	S	7+7a	IR Quick Drier with Balance 480 g
	C	5	Centriguge Rotanta
	T	2	pH-Meter TPS
	M	14	Ion Sensitive Electrodes pb & F with Ag/AgCl-Electrode
	B	12	Magnetic Stirrer - Local
	H	2	6 Platinum Crucibles g
			2 Pt/Au Moulds g
			3 Platinum Dishes g
			6 Nickel Crucibles
	K	12	Orsat Apparatus
10	C	3	Crucible Furnace Simon Muller
	C	4	Crucible Furnace Simon Muller
	O	1	OSK Drying Oven
	G	5	Stirrer Handilab Minor with 3 rotors
	F	5	Vaccum Pump
	B	13	Digital Vaccum Meter * I * = not yet delivered
	B	14	Mercuri Vaccum Meter *
	L	2	Water Distillation Plant
	G	9	Multi Test Tube Drier
	G	10	Multi Test Tube Drier
	O		Glassware
	o		Chemicals
11	U	3	Air Conditioner Split Type - Local
	L	4	Magic Board - Local
	M	15	Overhead Projector - Local

Room	Inv.No	Items
12	E 1	Electrical Typewriter Olympia - Local
	U 5	U - BIX Copier - Local
	H 3	Vaccum Cleaner Hoover - Local
Library	L 5	Mackenzie : Thermoanalysis
	L 6	Singer : Industrial Ceramics
Carpark	N 13	Nissan Jeep

(ANNEX ----6b')